Test Report

Report Number: 3188750MPK-001
Project Number: 3188750
October 20, 2009

Testing performed on the
UHF Radio
Model Numbers: HPT435, AW435, HPT435BT and AW435BT
FCC ID: WJ4HPT435
IC ID: 3504A-HPT435
to

FCC Part 90, RSS-119
For

Javad GNSS, Inc.

Test Performed by:	**Test Authorized by:**
Intertek Testing Services NA, Inc	Javad GNSS, Inc.
1365 Adams Court	1731 Technology Drive
Menlo Park, CA 94025	San Jose, CA 95110, USA

Prepared by: Krishna K Vemuri **Date:** October 20, 2009

Reviewed by: Ollie Moyrong **Date:** October 20, 2009

Report No. 3188750MPK-001

Equipment Under Test:	UHF Radio
Trade Name:	Javad GNSS, Inc.
Model No.:	HPT435, AW435, HPT435BT and AW435BT
Serial No.:	10001
FCC ID:	WJ4HPT435
IC ID:	3504A-HPT435
Applicant:	Javad GNSS, Inc.
Contact:	Mr. Vladimir Zhukov
Address:	1731 Technology Drive San Jose, CA 95110
Country	USA
Tel. number:	408-573-8100
Fax number:	408-573-9100
Applicable Regulation:	FCC Part 90, RSS-119
Test Site Location:	ITS - Site 1 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	September 09 to October 2, 2009

We attest to the accuracy of this report:

Krishna K Vemuri
Test Engineer

Ollie Moyrong
Engineering Manager

TABLE OF CONTENTS

1.0 Introduction

1.1 Product Description

Equipment under Test – EUT is the model HPT435. As declared by the Applicant, the models HPT435 and AW435 are identical except for their housing color and brand name (HPT for Javad; AW for ArWest). HPT435 is also known as the model HPT435BT, for marketing purposes only. AW435 is also known as the model AW435BT, for marketing purposes only. HPT435, HPT435BT, AW435 and AW435BT consist of identical hardware with the only difference being the color of the units.

HPT435 is an external UHF radio transceivers used for commercial, indoor and outdoor use.

The HPT435 provides real-time data transmission using spectrum efficient GMSK/BPSK/QPSK/8PSK/16QAM modulations.

The HPT435 provides half-duplex communication with transmitter output power of 35 W (+45.4 dBm) in the frequency bands 406.1-470 MHz for USA; 406.1-430 MHz and 450-470MHz for Canada with channel spacing 25 / 12.5 / 6.25 kHz.

For more information about the radios, refer to the attached product description.

Specification of the radio module	
Type	UHF radio
Rated RF Output Power	35 W
Frequency Ranges, MHz	406.1 – 470
Type of modulation	BPSK, QPSK, 8PSK, 16QAM, GMSK
Channel bandwidth and maximum data rate	25 kHz at 38.4 kbps 12.5 kHz at 19.2 kbps 6.25 kHz at 9.6 kbps
Antenna & Gain	Whip, 2.4 dBi
Detachable antenna	Yes
External input	data
Operating temperature	From -30^0C to $+50^0$C

EUT receive date: September 08, 2009
EUT receive condition: The prototype version of the EUT was received in good condition with no apparent damage. As declared by the Applicant it is identical to the production units.
Test start date: September 09, 2009
Test completion date: October 02, 2009

1.2 Summary of Test Results

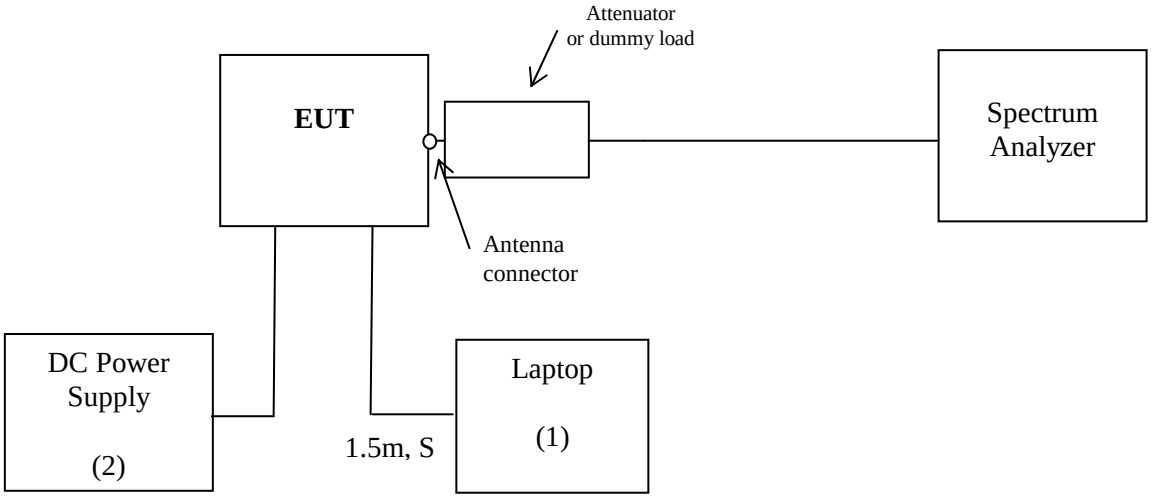
FCC Rule	RSS-119 Rule	Description of Test	Result
2.1046	4.1	RF Power Output	Complies
90.205(h)	-	ERP	Complies
2.1047	-	Modulation characteristics	Not Applicable
2.1049, 90.209	RSS-GEN	Occupied Bandwidth	Complies
90.210	5.8	Emission masks	Complies
2.1051, 90.210	5.8	Out of Band Emissions at Antenna Terminals	Complies
2.1053, 90.210	5.8	Spurious Radiation	Complies
2.1055, 90.213	5.3	Frequency Stability vs. Temperature and Voltage	Complies
90.214	5.9	Transient frequency behavior	Complies
2.1091	RSS-102	RF Exposure evaluation	Complies
15.109, 15.111	RSS-GEN	Emission from digital part and receiver	Complies

1.3 Test Configuration

1.3.1 Support Equipment

Item #	Description	Model No.	S/N
1	Compaq Laptop	Armada 7400	7933CY570119
2	DC Power Supply	6030A	US38320722

1.3.2 Block diagram of Test Setup



S = Shielded **U** = Unshielded	**F** = With Ferrite **m** = Length in Meters

1.4 Related Submittal(s) Grants

None

2.0 RF Power Output
FCC 2.1046

2.1 Test Procedure

The EUT RF output was connected as shown on the diagram in sec.1.3.2. The EUT was setup to transmit continuously the maximum power.

The spectrum analyzed was setup to measure the Average power. The attenuation and cable loss were added to the spectrum analyzed reading by using OFFSET function.

Measurements were performed at three frequencies (low, middle, and high channels).

2.2 Test Equipment

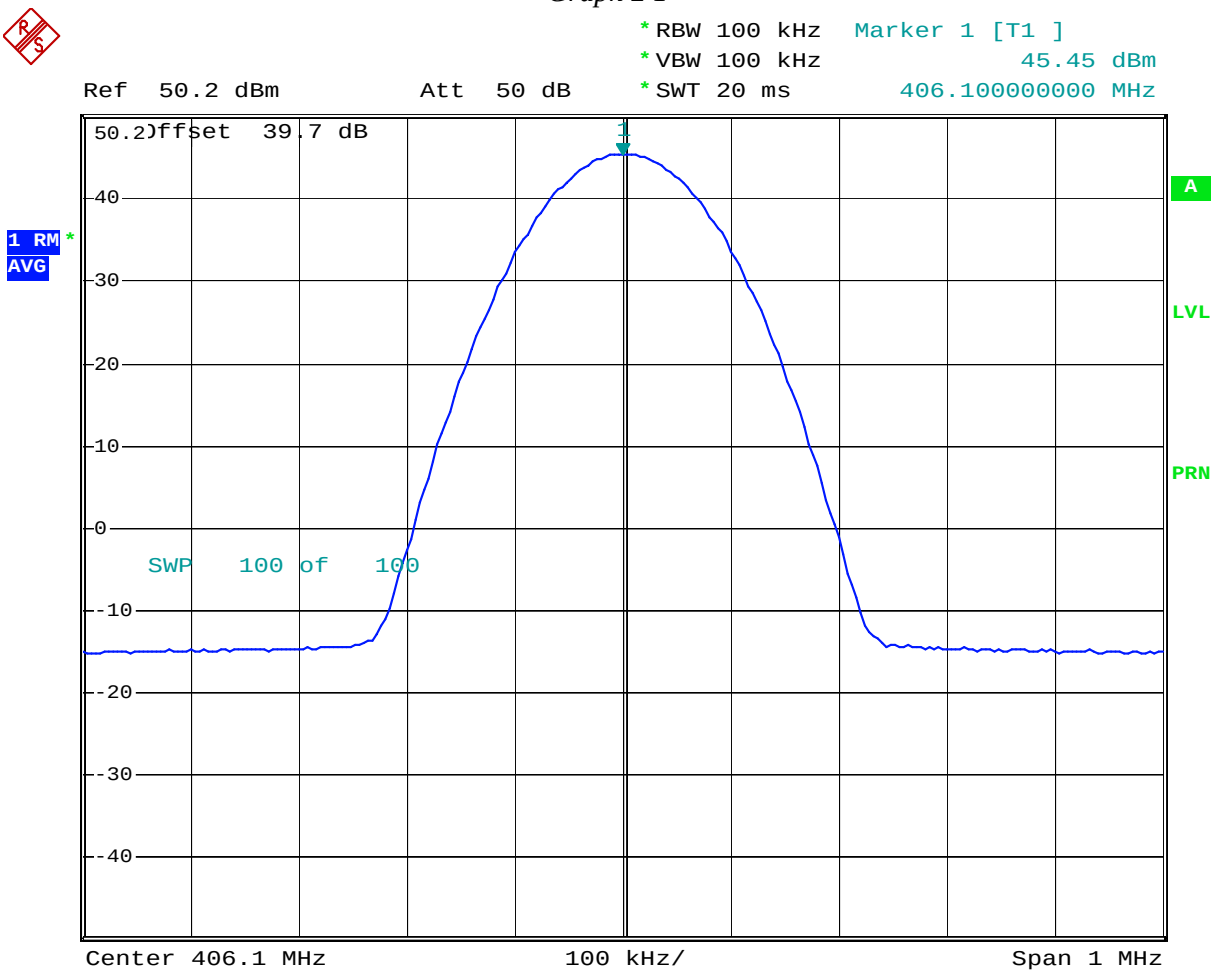
Rohde & Schwarz FSP40 Spectrum Analyzer

2.3 Test Results

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (Watt)	Graph
406.1	45.5	35.48	2.1
430.0	45.5	35.48	2.2
450.0	45.5	35.48	2.3
470.0	45.4	34.67	2.4

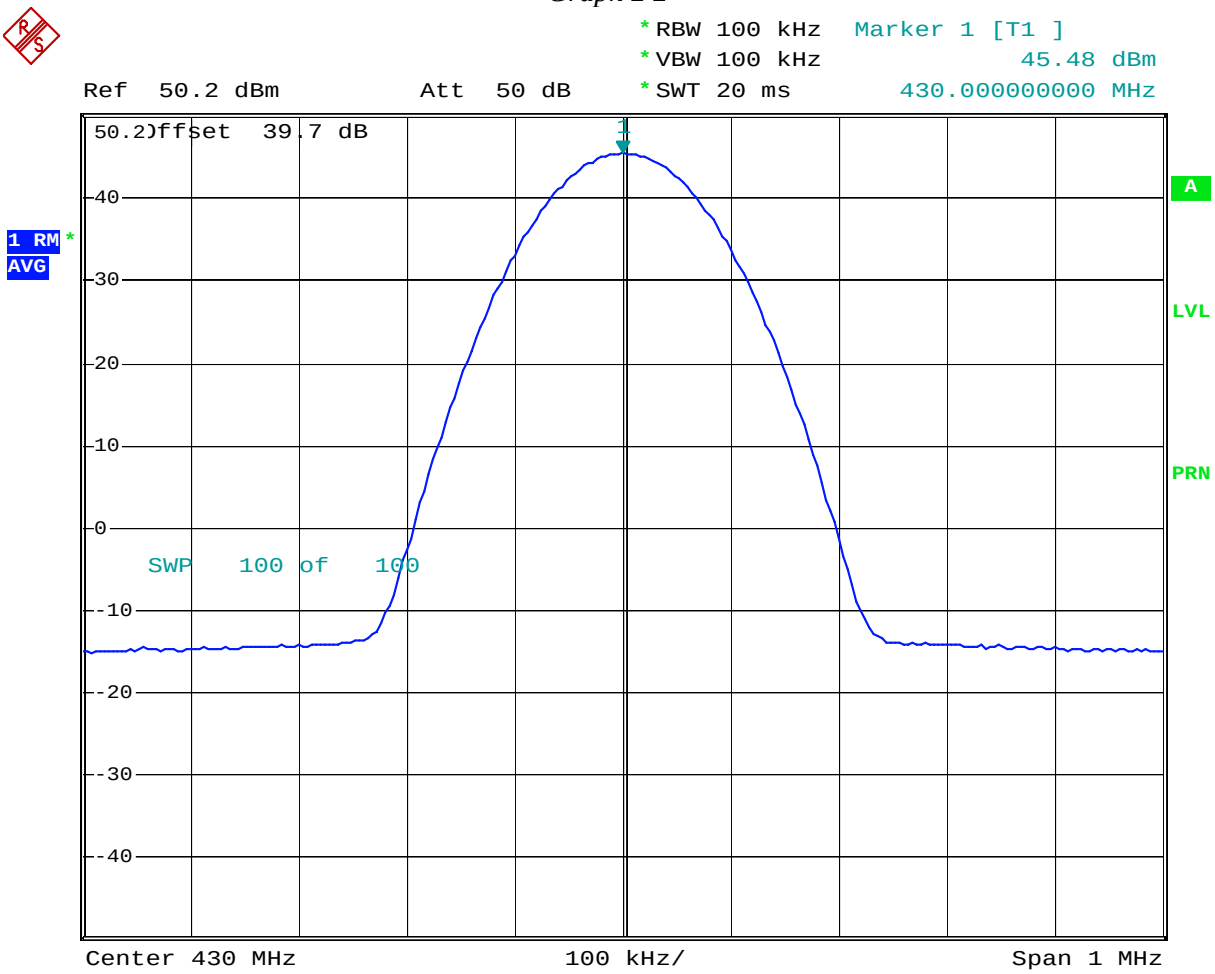
For more details refer to the attached Graphs.

Graph 2 1



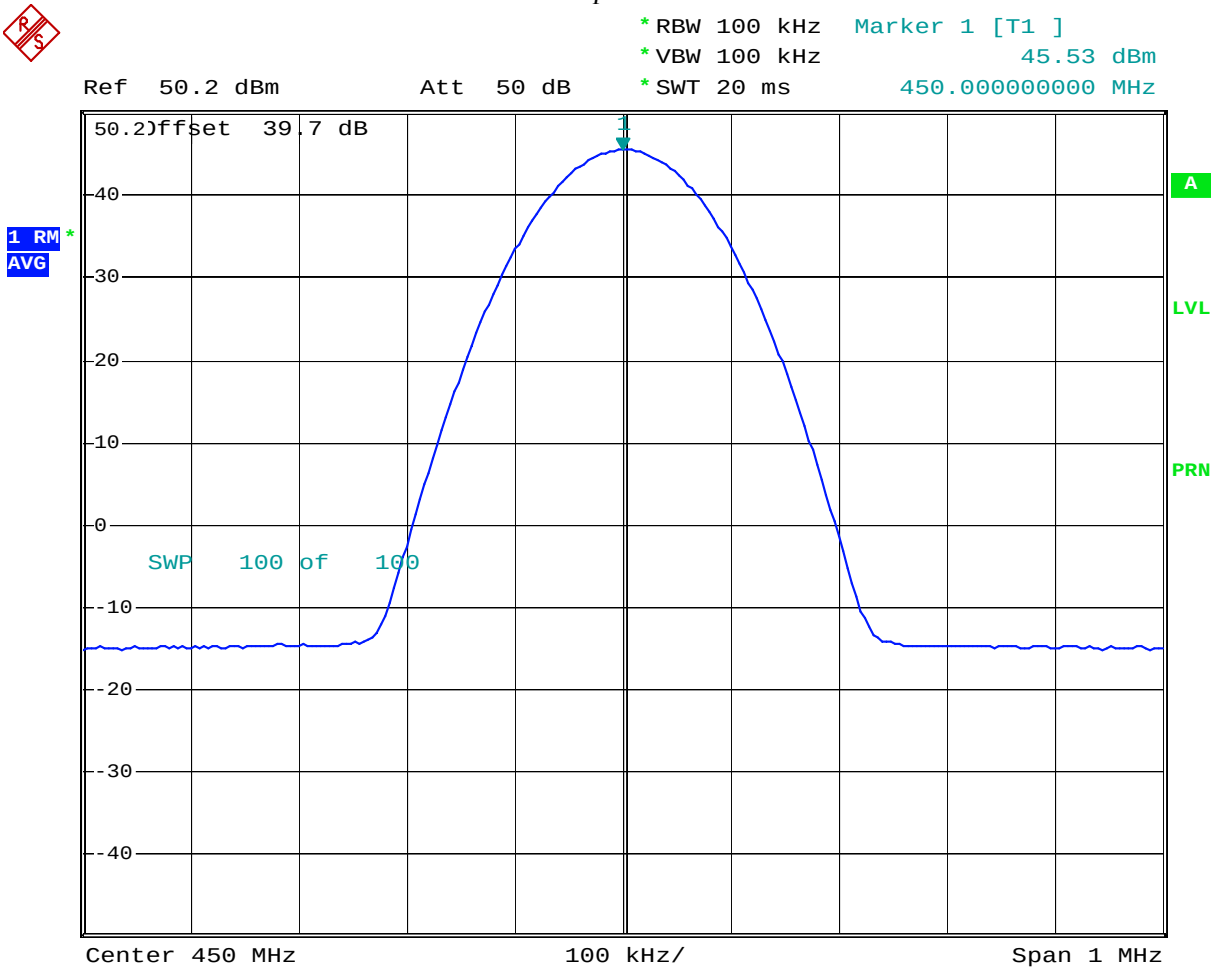
Comment: Power output
Date: 9.SEP.2009 12:40:58

Graph 2 2



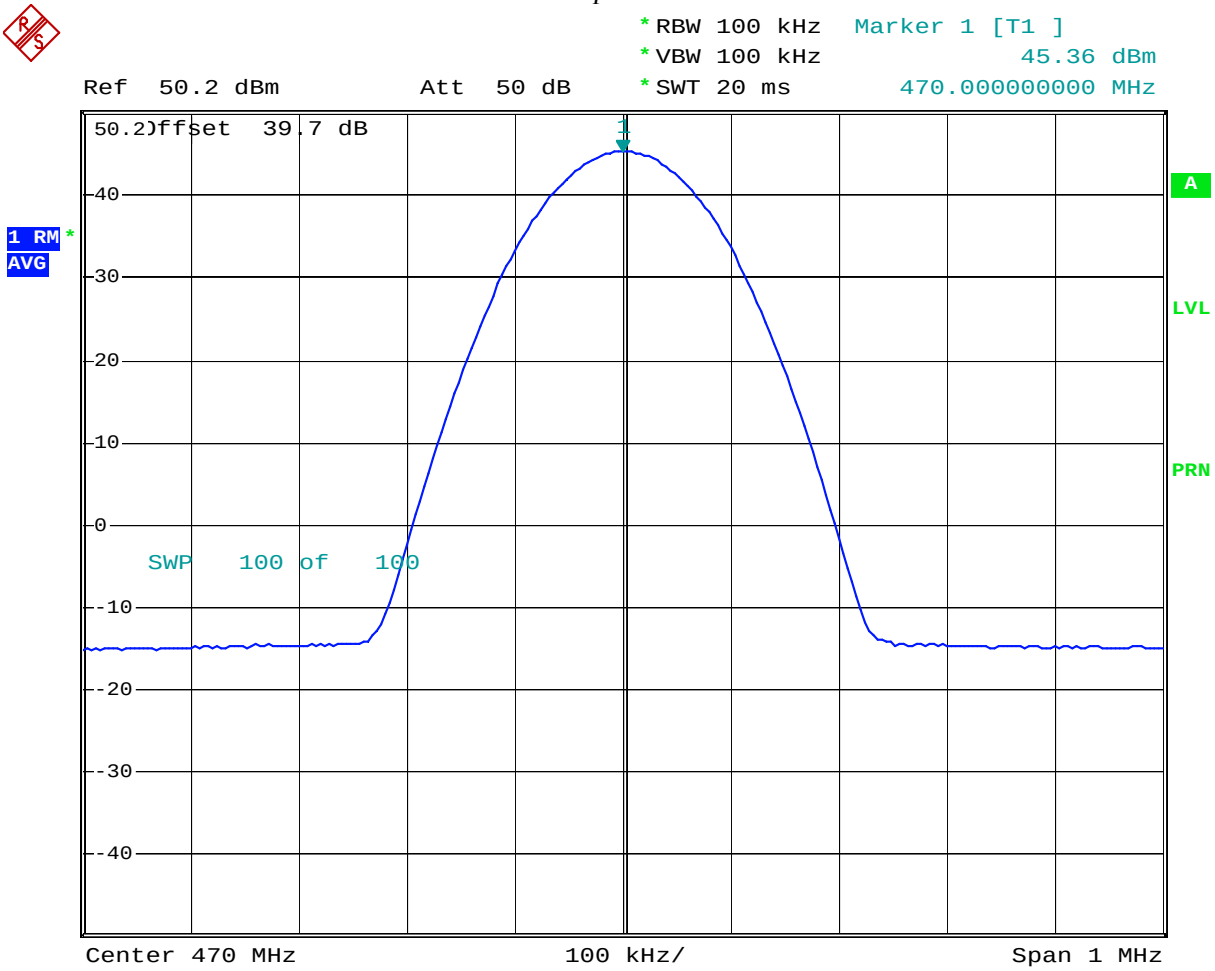
Comment: Power output
Date: 9.SEP.2009 12:41:43

Graph 2 3



Comment: Power output
Date: 9.SEP.2009 12:42:22

Graph 2 4



Comment: Power output
Date: 9.SEP.2009 12:43:19

3.0 Radiated Power

3.1 Requirement

FCC 90.205(h)

The maximum Effective Radiated Power (ERP) is 500 Watts.

3.2 Test Procedure

The ERP was calculated by adding the antenna gain to the output power in dBm.

$ERP = P_{max} + G_{dBd}$

3.3 Test Equipment

None

3.4 Test Results

According to the Installation Guide, a typical 2.4 dBi (0.3 dBd) gain antenna is used with the EUT. Therefore, the calculated peak radiated power is:

ERP = 45.5 + 0.3 = 45.8 dBm (or 38.02 W);
EIRP= 45.5 + 2.4 = 47.9 dBm (or 61.66 W).

Result	**Complies**

4.0 Occupied Bandwidth

FCC 2.1049, 90.209(b)(5)

4.1 Test Procedure

The EUT RF output was connected as shown on the diagram in sec.1.3.2. The EUT was setup to transmit the maximum power.

The spectrum analyzed was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth). The Occupied Bandwidth was measured at 430 MHz and 450 MHz for all types of modulation and authorized bandwidths.

4.2 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

4.3 Test Results

The test results are summarized in the following tables and presented on the Graphs 4.1 – 4.30.

The following Emission Designators are described the emission type:

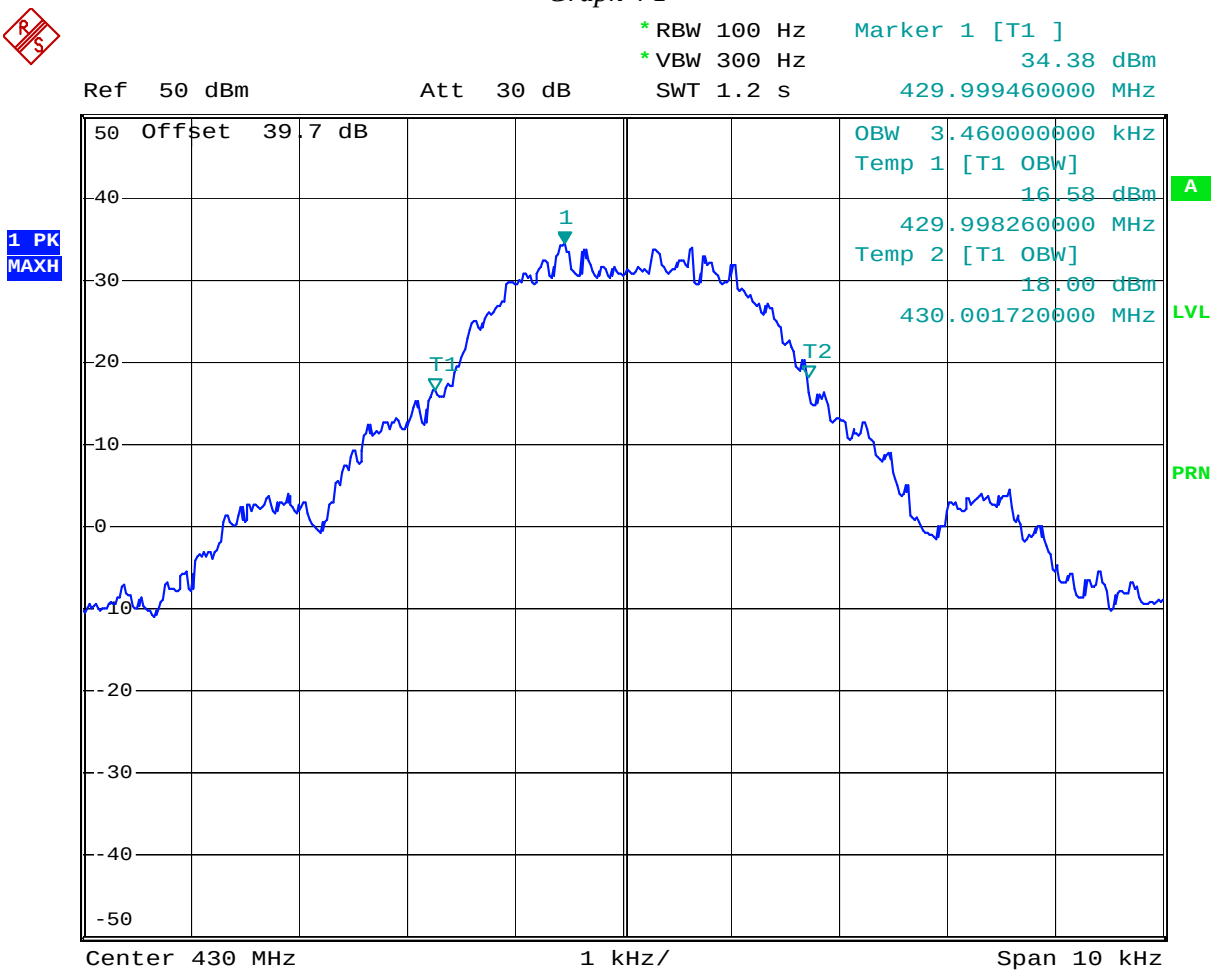
3K46G1D
2K36F1D
7K40G1D
5K64F1D
12K06G1D
9K84F1D

Frequency (MHz)	Modulation	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Measured Occupied Bandwidth (kHz)	Graph
430	BPSK	6.25	6.0	3.46	4.1
	QPSK			3.16	4.2
	8PSK			3.20	4.3
	16QAM			3.10	4.4
	GMSK			2.36	4.5
430	BPSK	12.5	11.25	7.40	4.6
	QPSK			6.36	4.7
	8PSK			5.88	4.8
	16QAM			6.16	4.9
	GMSK			5.64	4.10
430	BPSK	25.0	20.0	12.06	4.11
	QPSK			11.46	4.12
	8PSK			11.28	4.13
	16QAM			11.28	4.14
	GMSK			9.84	4.15

Frequency (MHz)	Modulation	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Measured Occupied Bandwidth (kHz)	Graph
450	BPSK	6.25	6.0	3.44	4.16
	QPSK			3.12	4.17
	8PSK			3.26	4.18
	16QAM			3.06	4.19
	GMSK			2.68	4.20
450	BPSK	12.5	11.25	6.96	4.21
	QPSK			6.20	4.22
	8PSK			5.76	4.23
	16QAM			6.08	4.24
	GMSK			5.48	4.25
450	BPSK	25.0	20.0	11.70	4.26
	QPSK			11.28	4.27
	8PSK			11.46	4.28
	16QAM			11.28	4.29
	GMSK			9.36	4.30

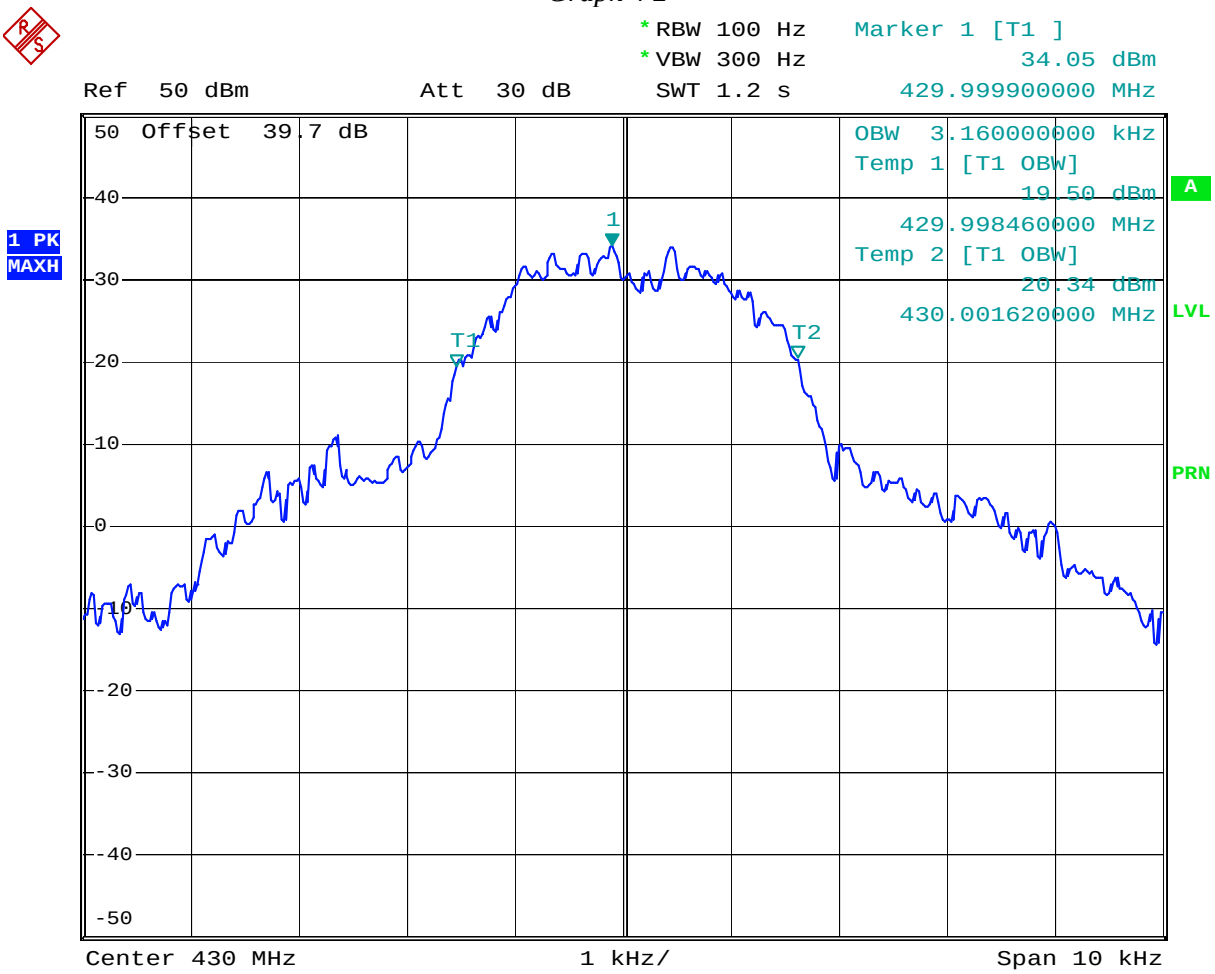
For more details refer to the attached Graphs.

Graph 4 1



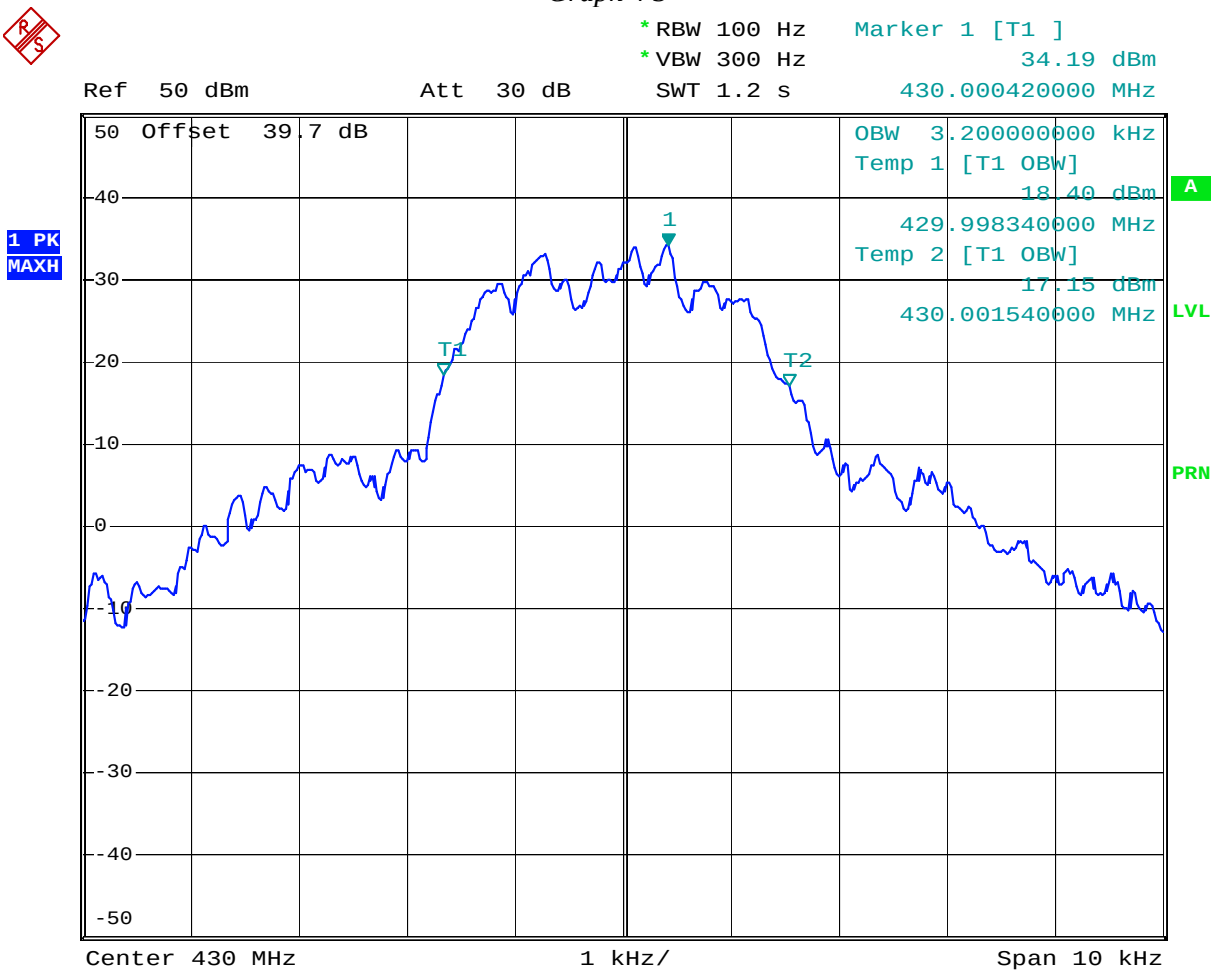
Comment: Occupied bandwidth, 6kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 12:59:15

Graph 4 2



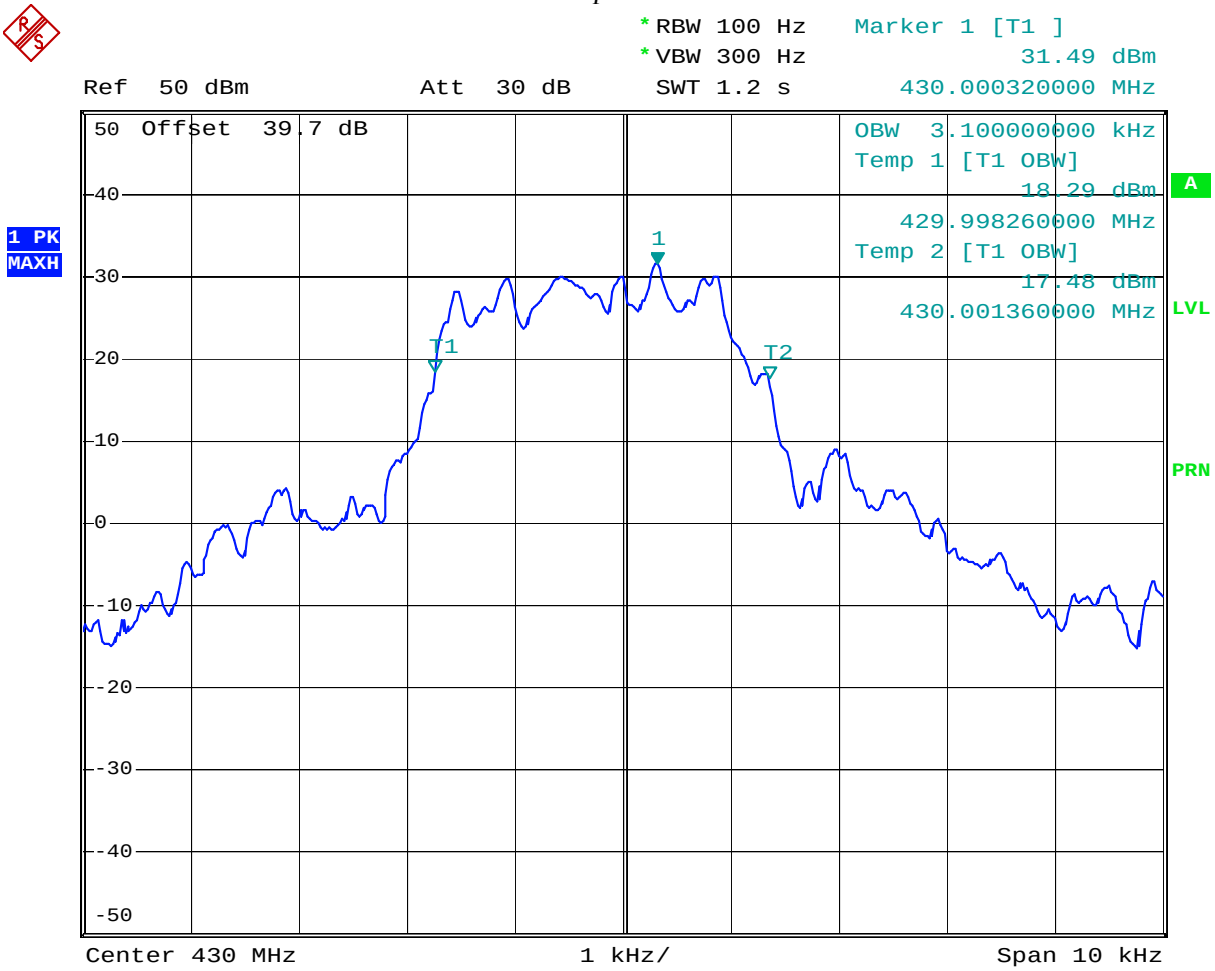
Comment: Occupied bandwidth, 6kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:00:33

Graph 4 3



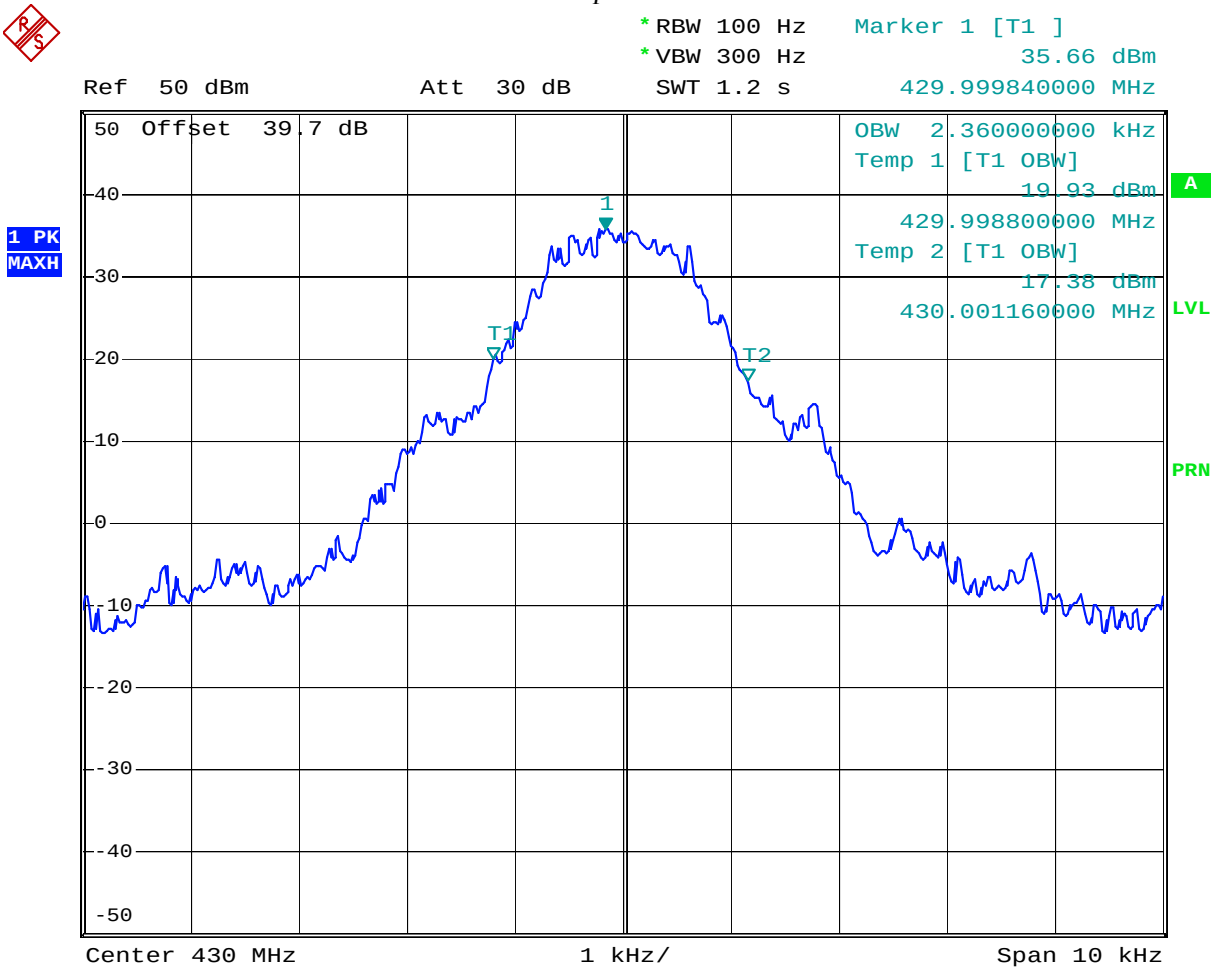
Comment: Occupied bandwidth, 6kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:01:55

Graph 4 4



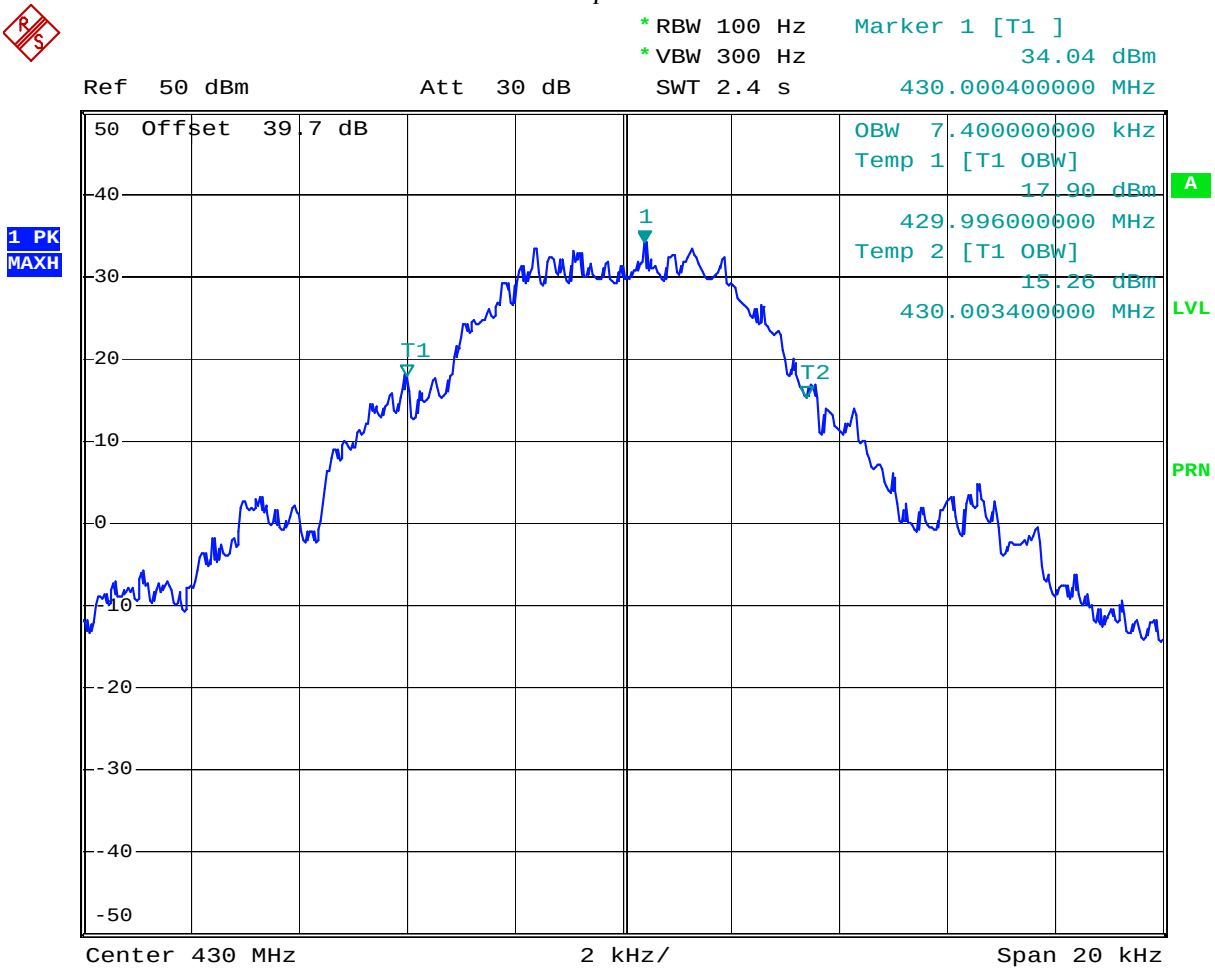
Comment: Occupied bandwidth, 6kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:03:03

Graph 4 5



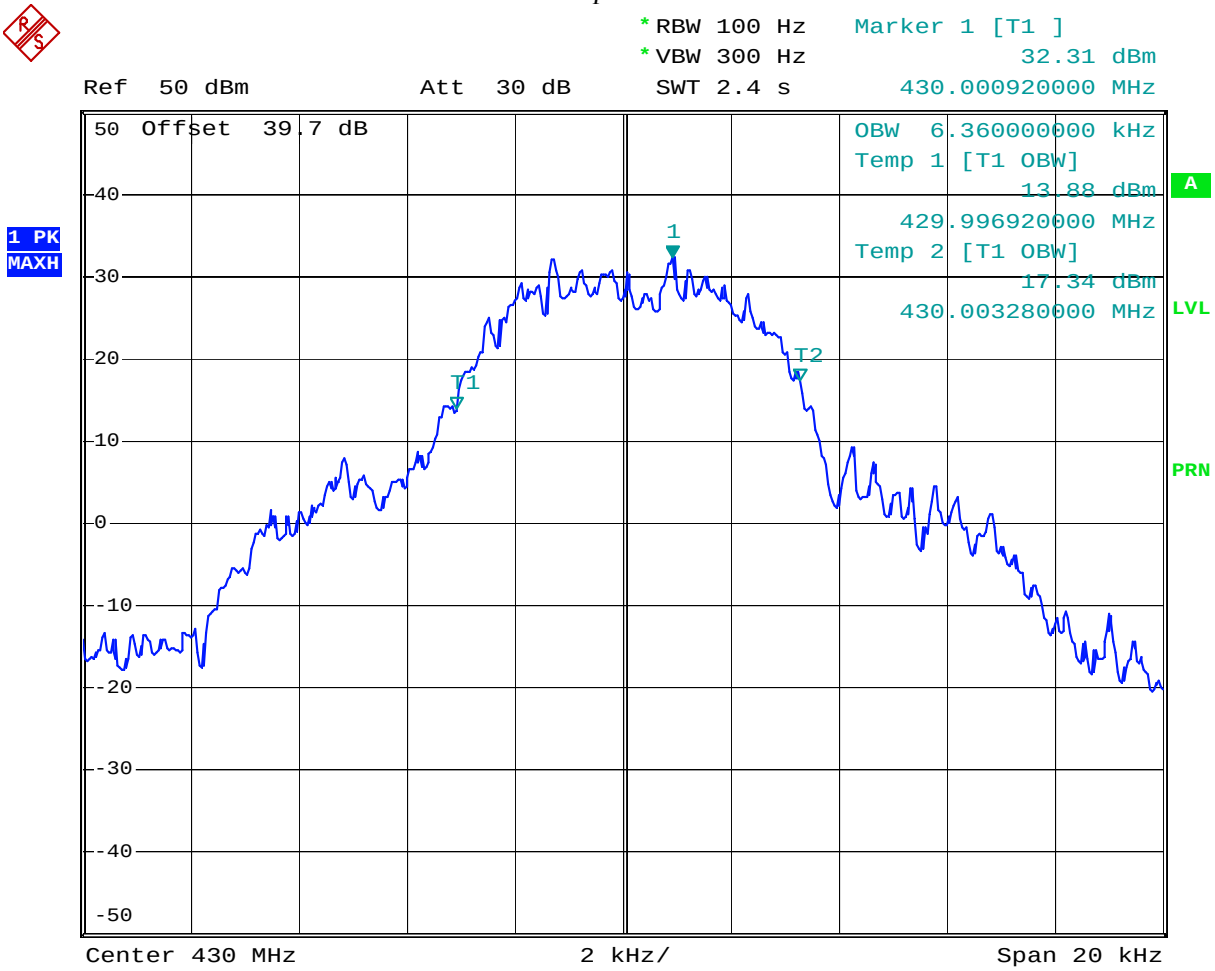
Comment: Occupied bandwidth, 6kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:04:40

Graph 4 6



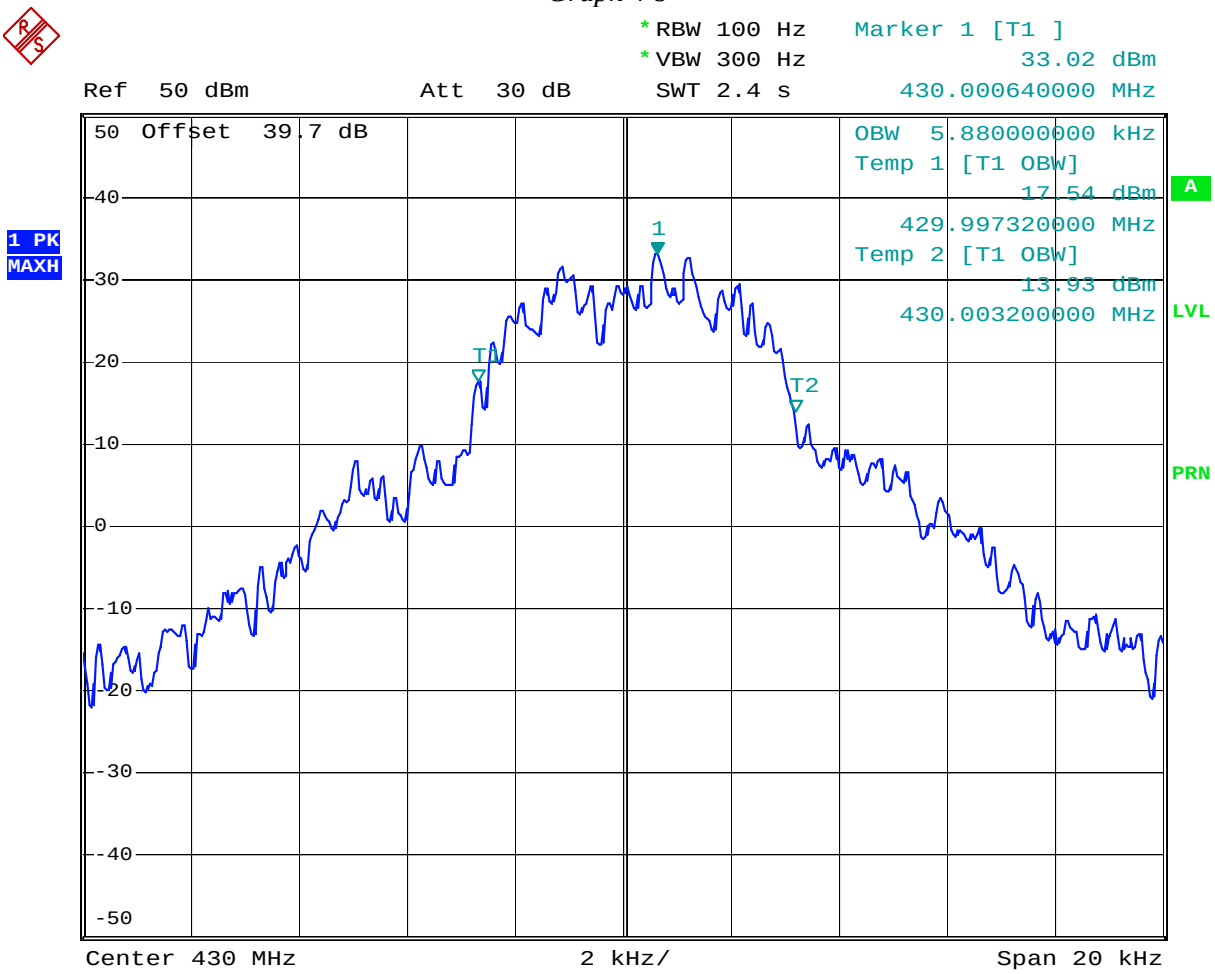
Comment: Occupied bandwidth, 11.25kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 13:08:14

Graph 4 7



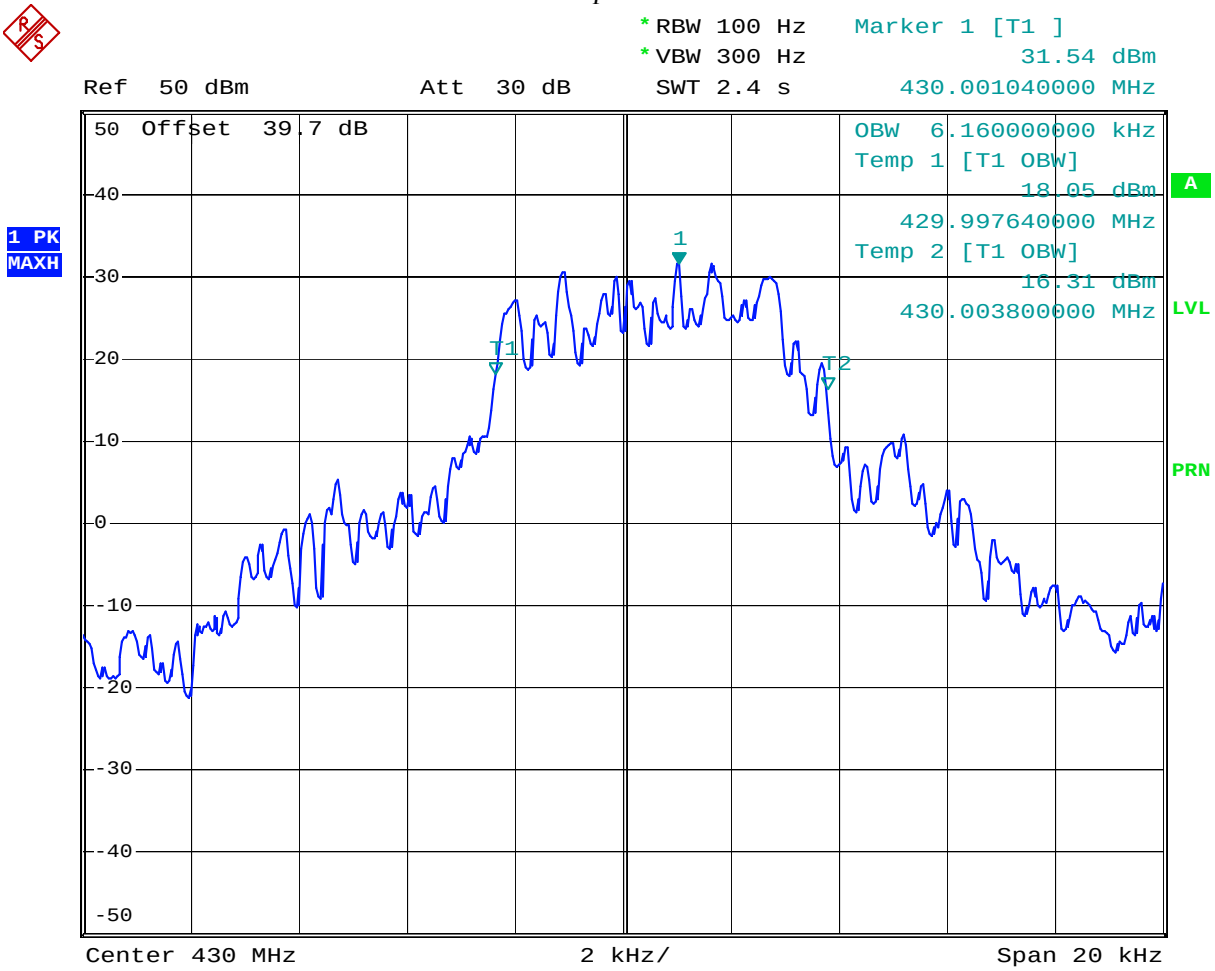
Comment: Occupied bandwidth, 11.25kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:09:41

Graph 4 8



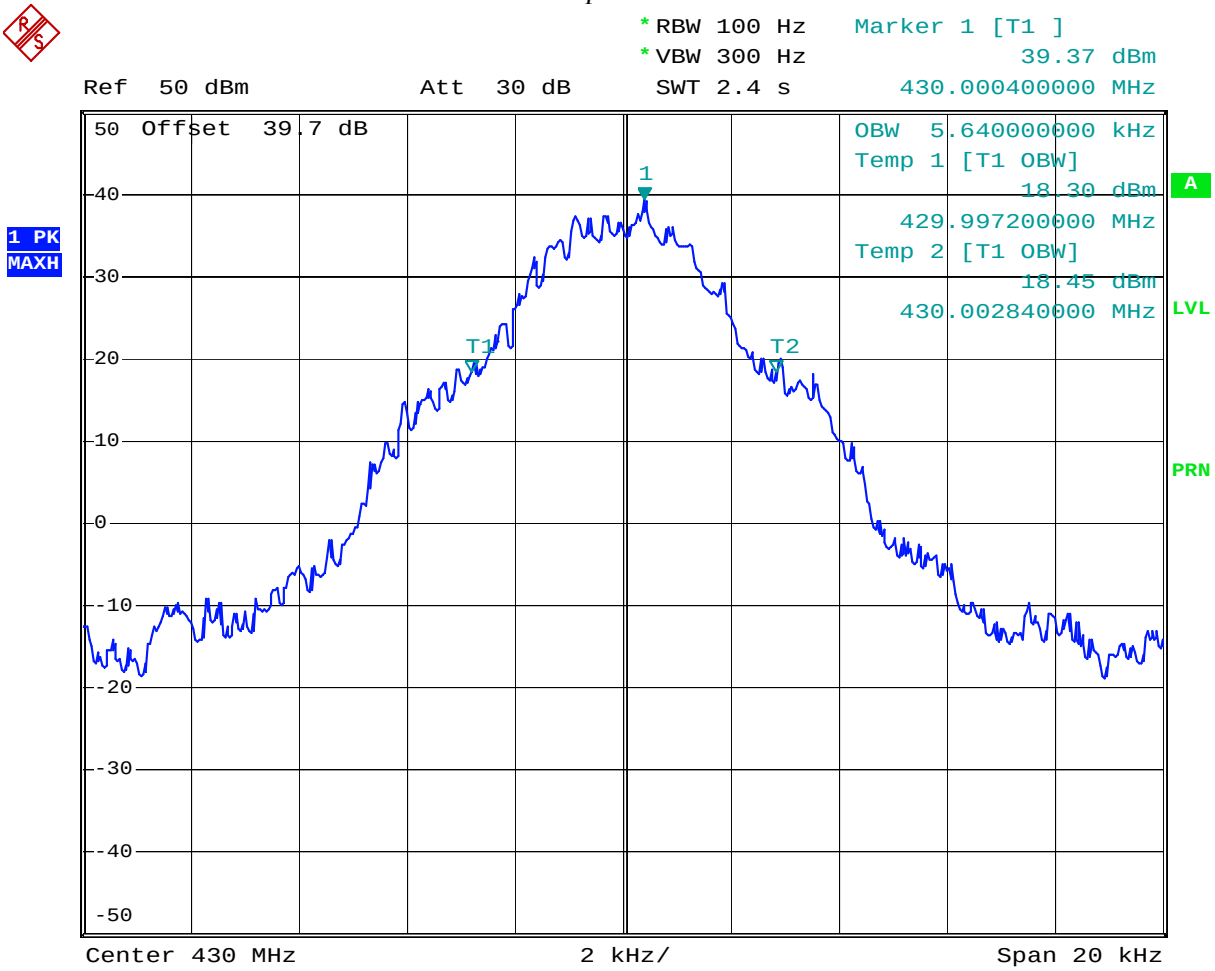
Comment: Occupied bandwidth, 11.25kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:11:05

Graph 4 9



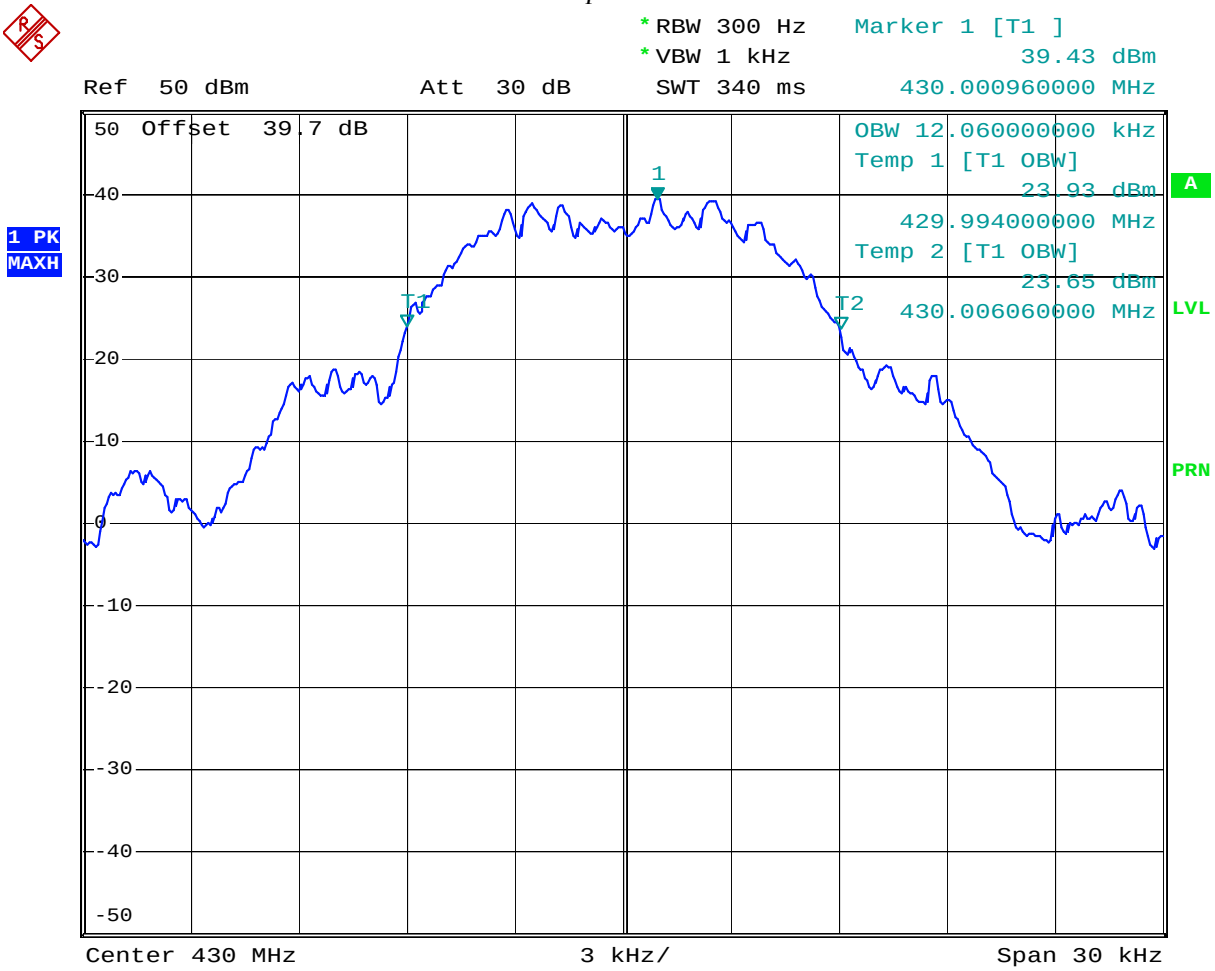
Comment: Occupied bandwidth, 11.25kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:12:24

Graph 4 10



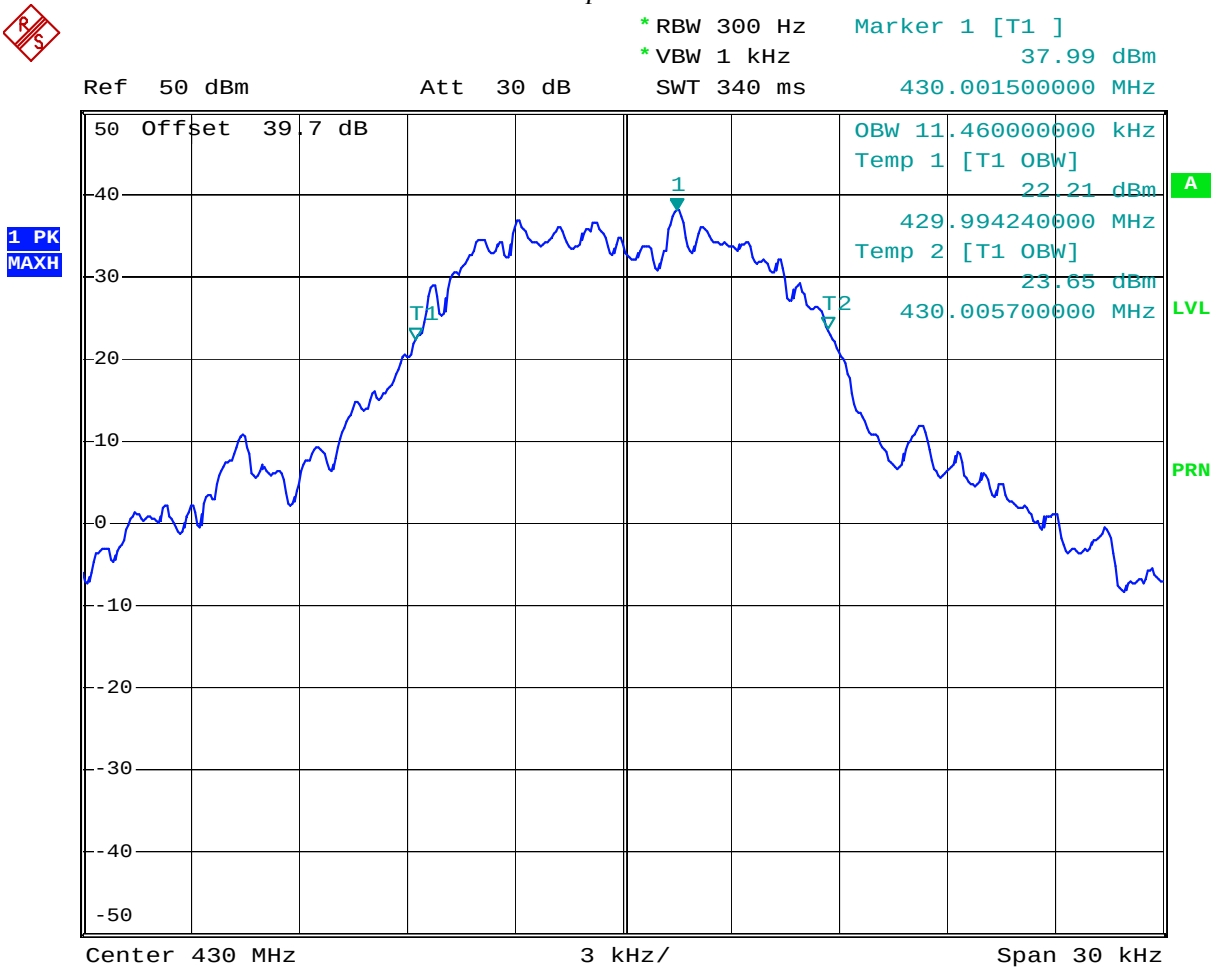
Comment: Occupied bandwidth, 11.25kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:13:43

Graph 4 11



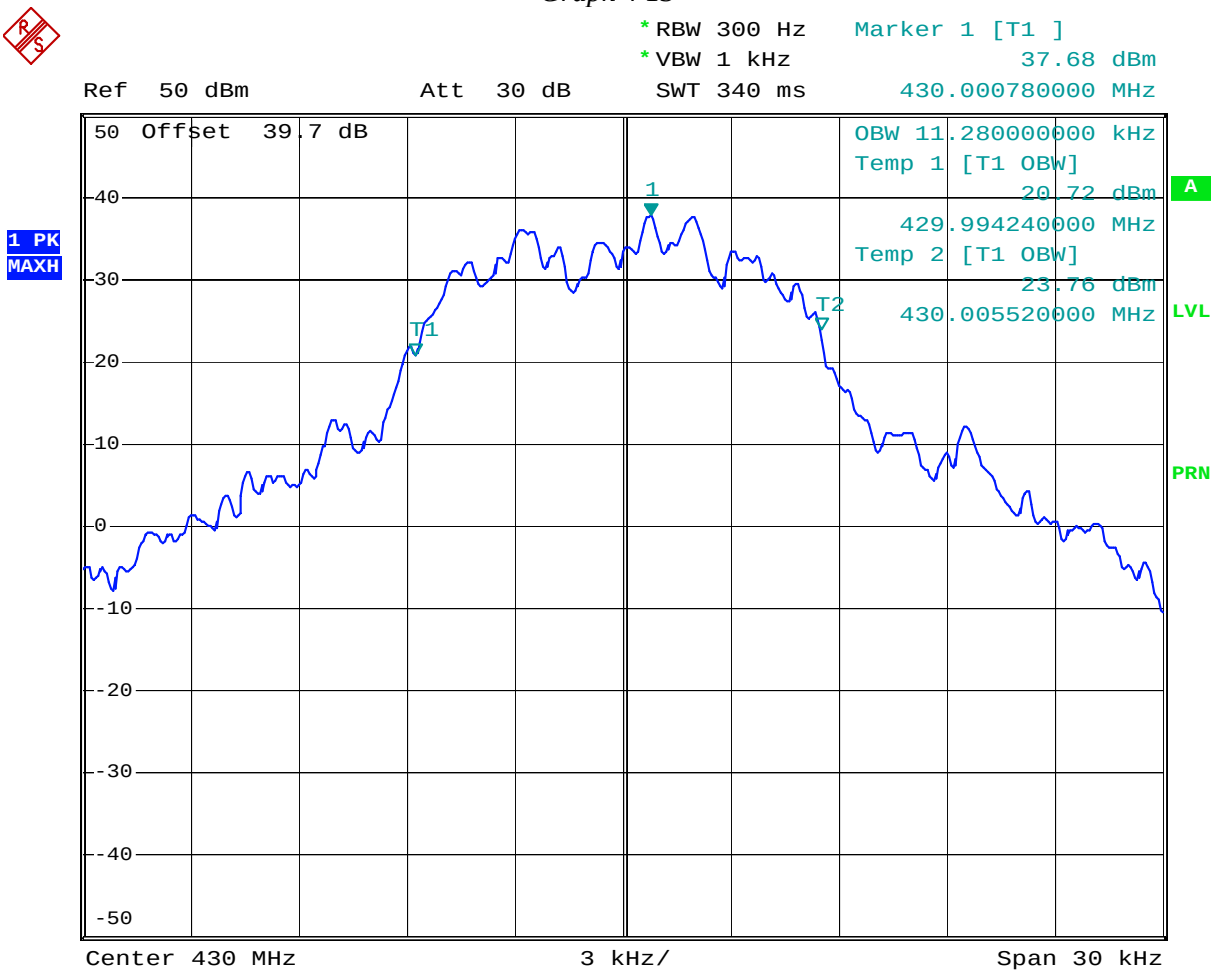
Comment: Occupied bandwidth, 20kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 13:18:03

Graph 4 12



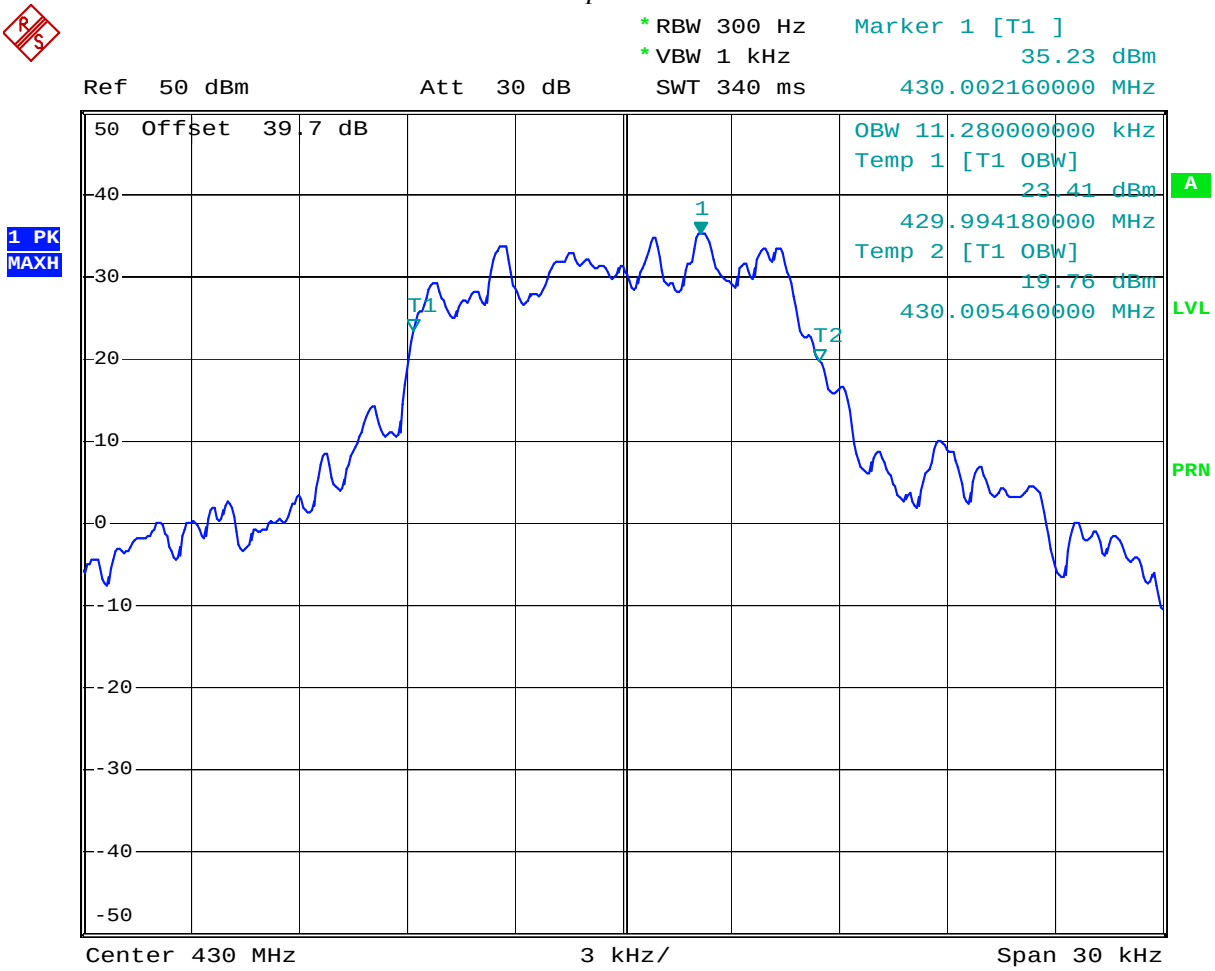
Comment: Occupied bandwidth, 20kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:19:00

Graph 4 13



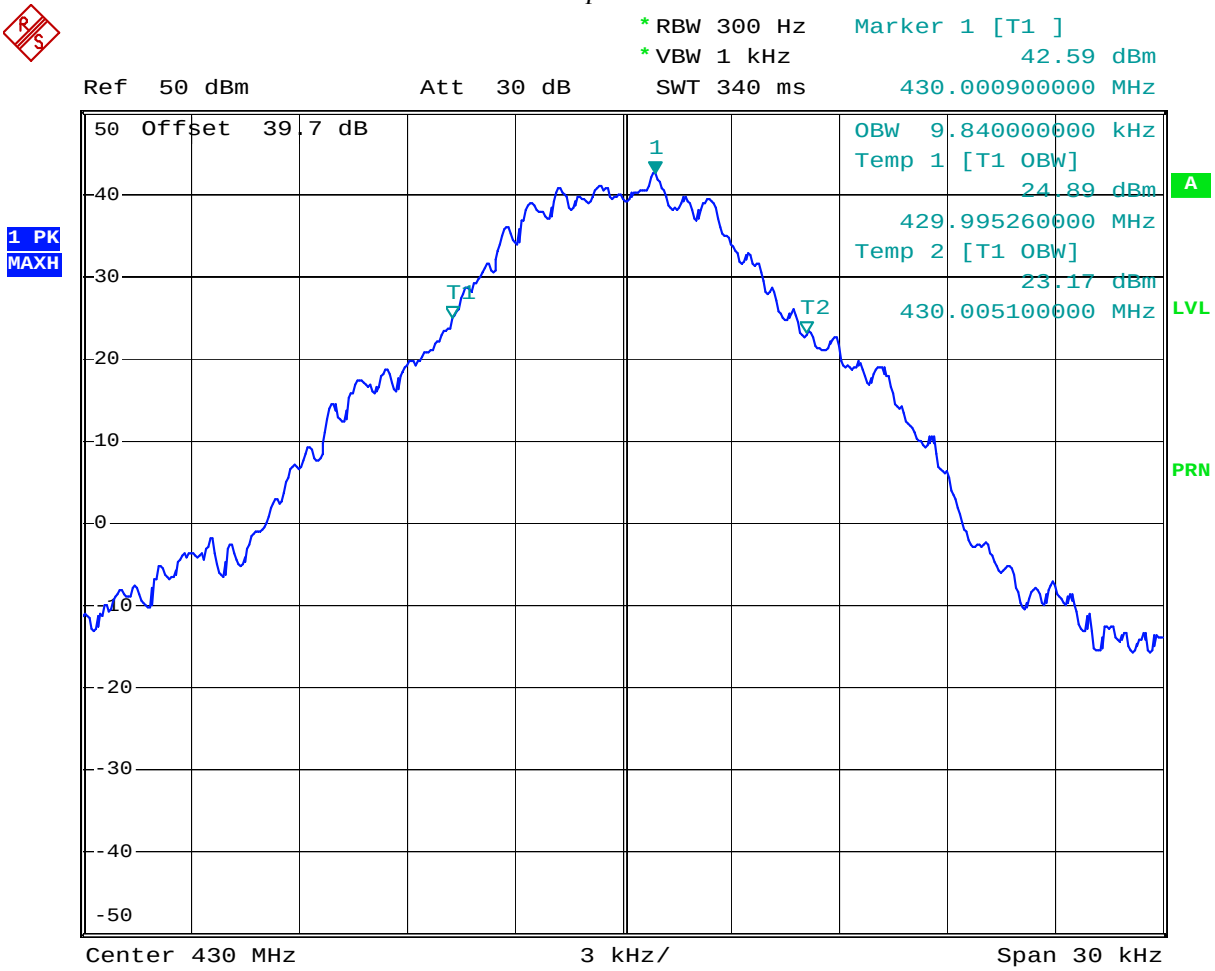
Comment: Occupied bandwidth, 20kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:20:03

Graph 4 14



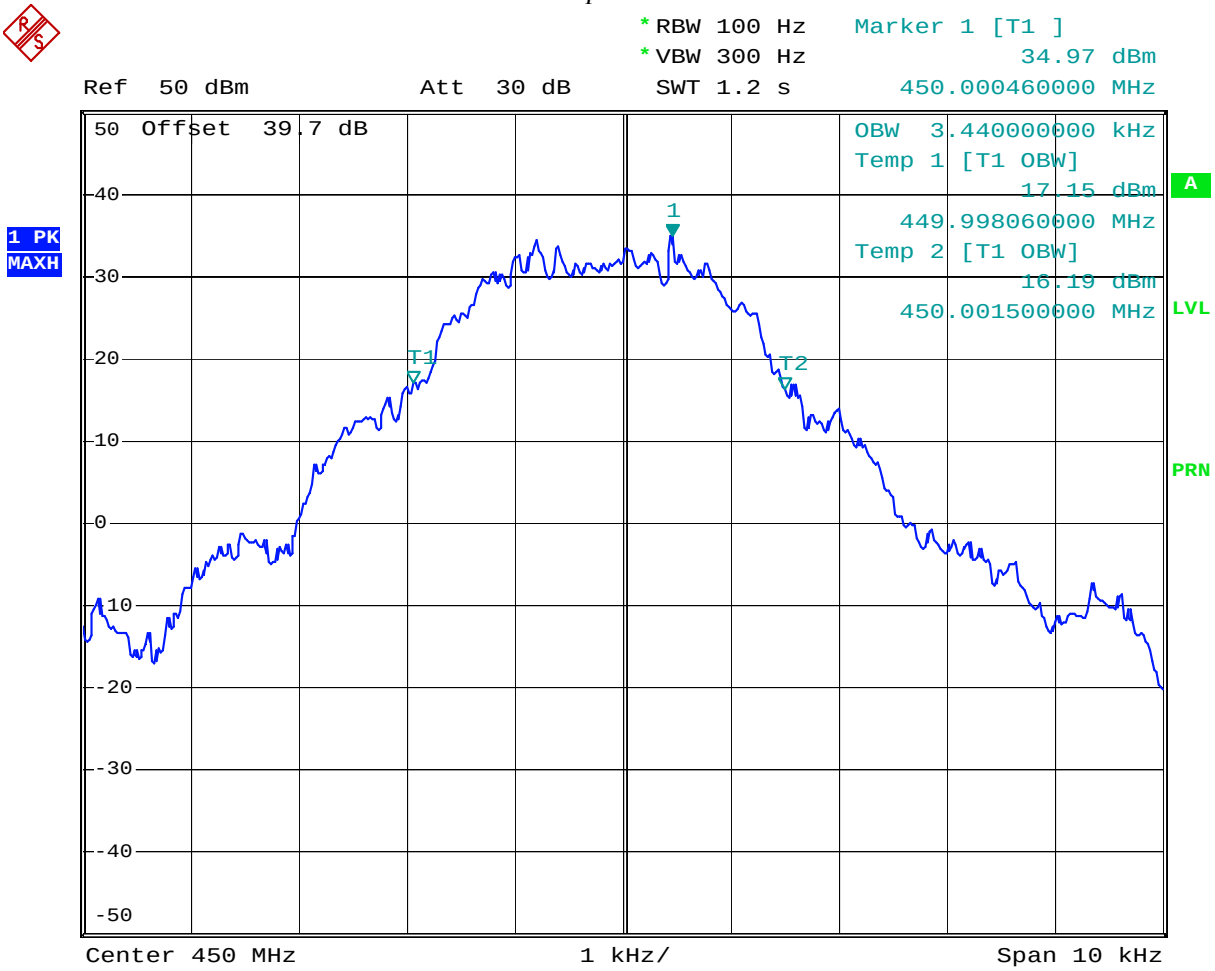
Comment: Occupied bandwidth, 20kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:21:02

Graph 4 15



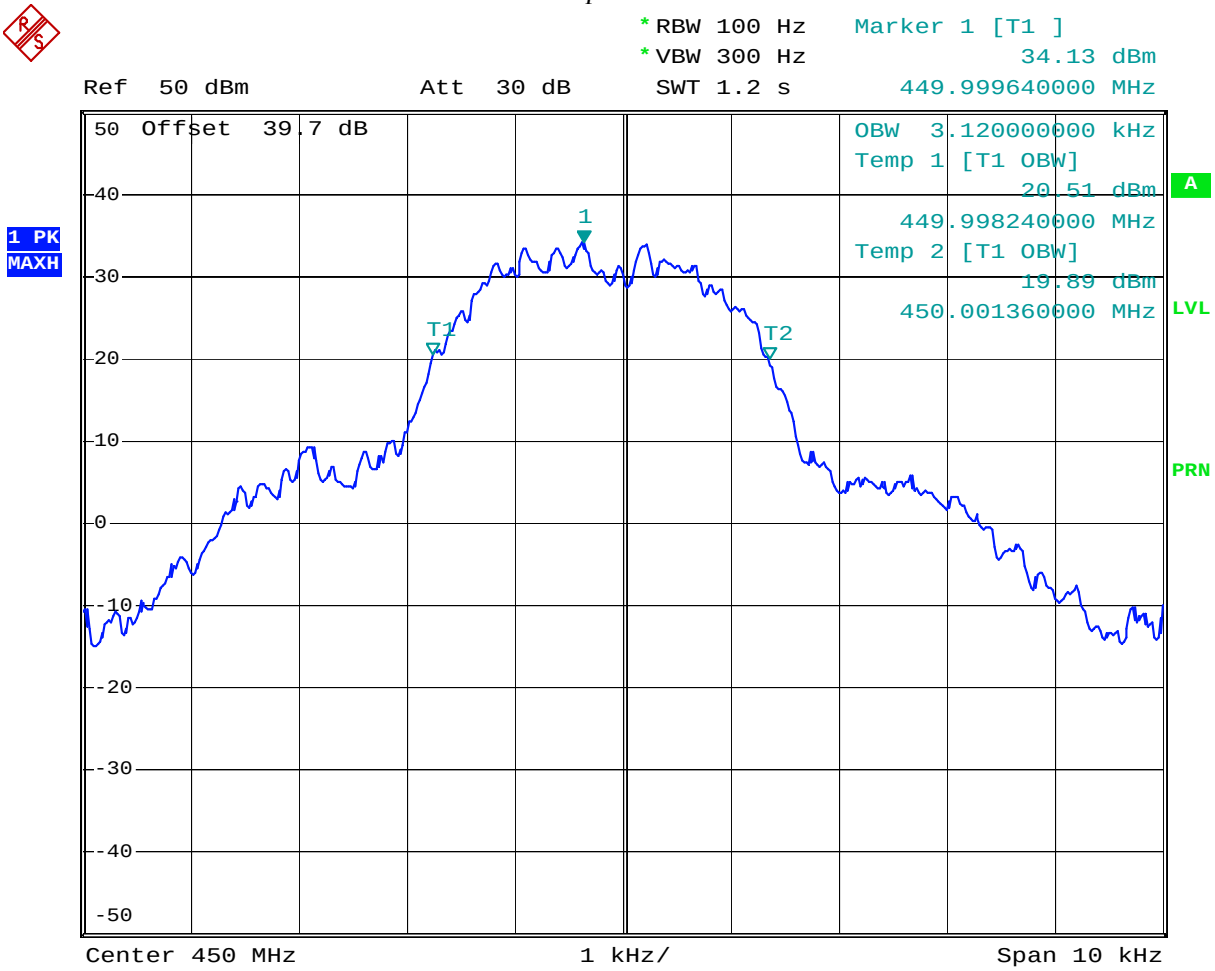
Comment: Occupied bandwidth, 20kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:22:07

Graph 4 16



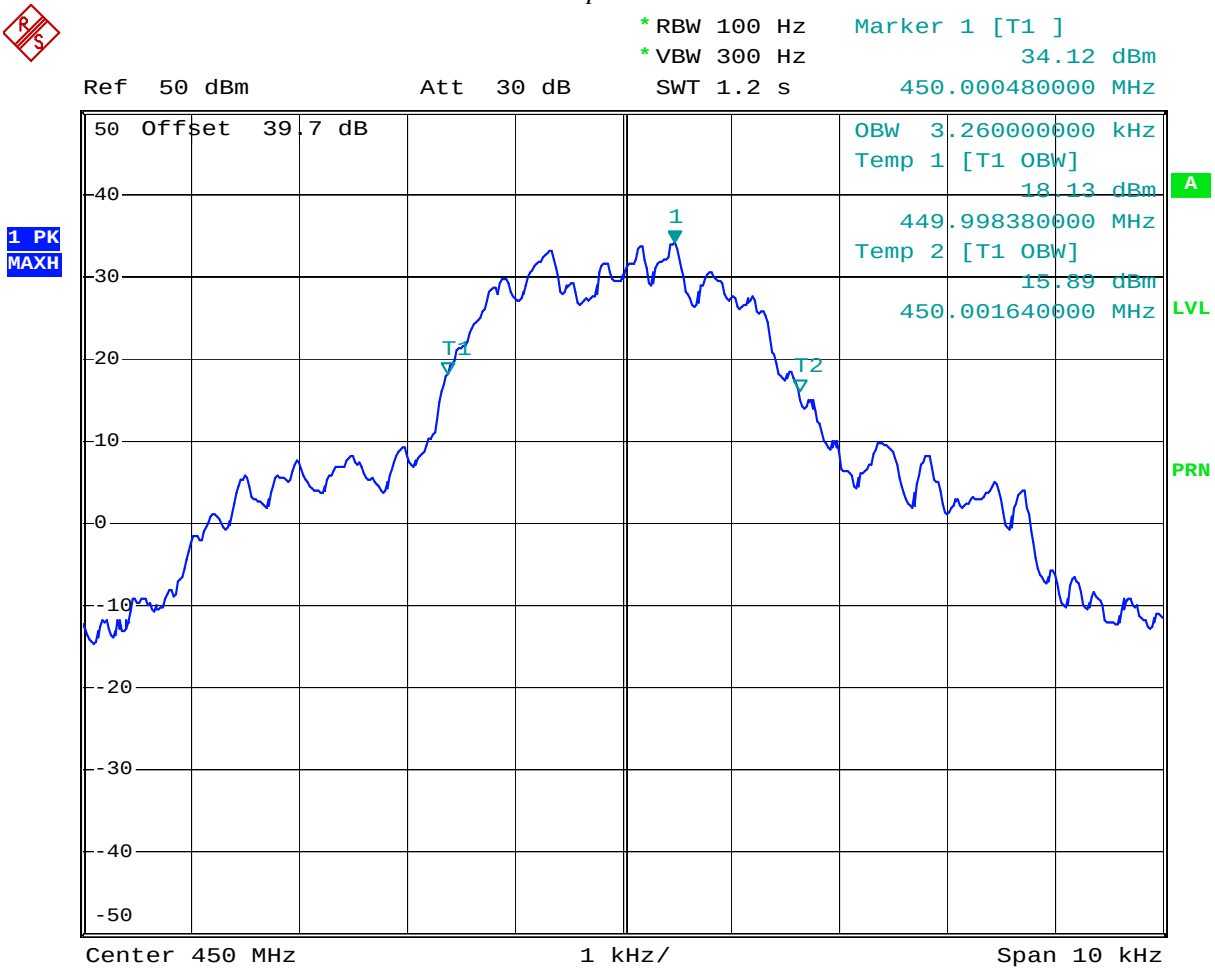
Comment: Occupied bandwidth, 6 kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 13:26:00

Graph 4 17



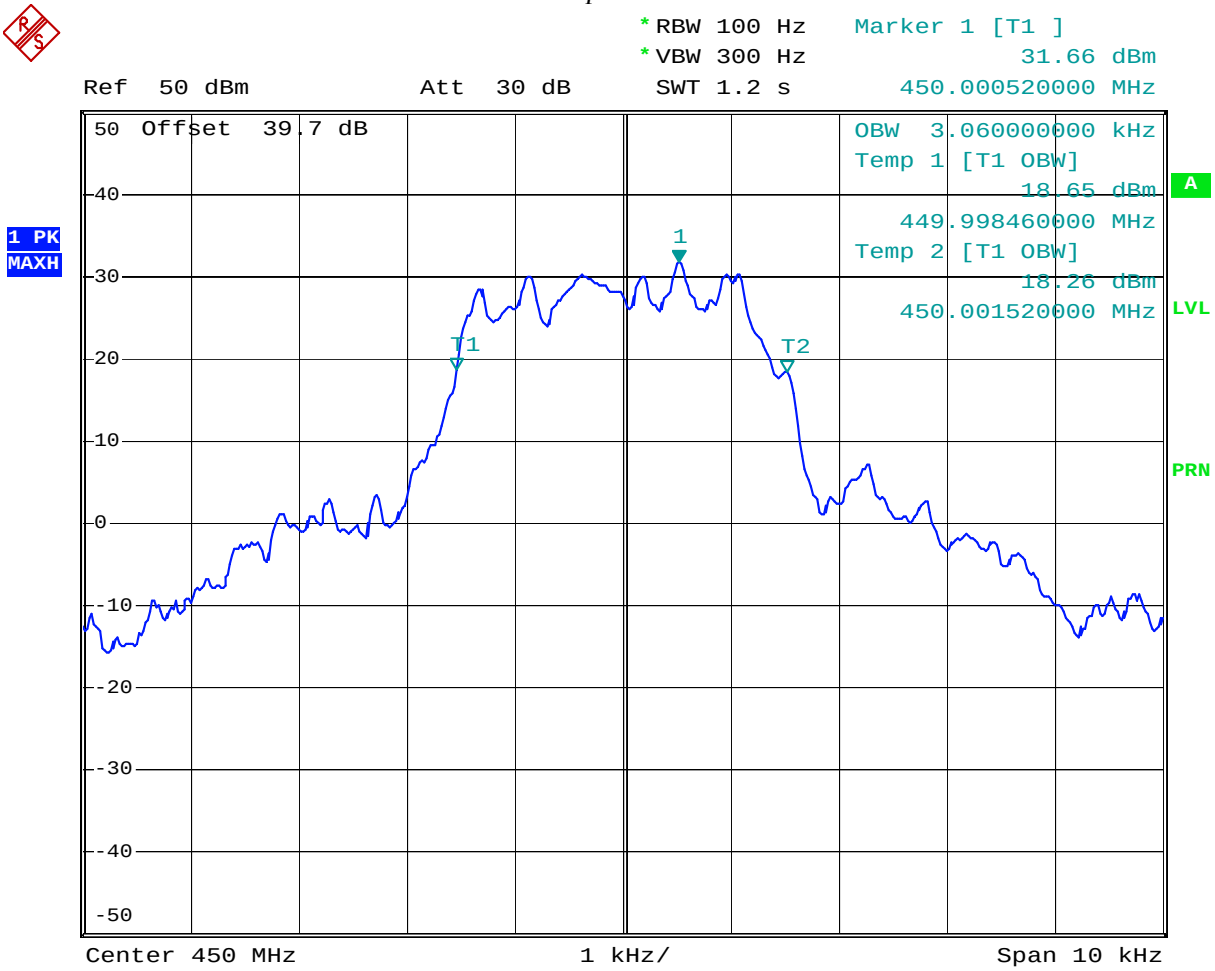
Comment: Occupied bandwidth, 6 kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:27:18

Graph 4 18



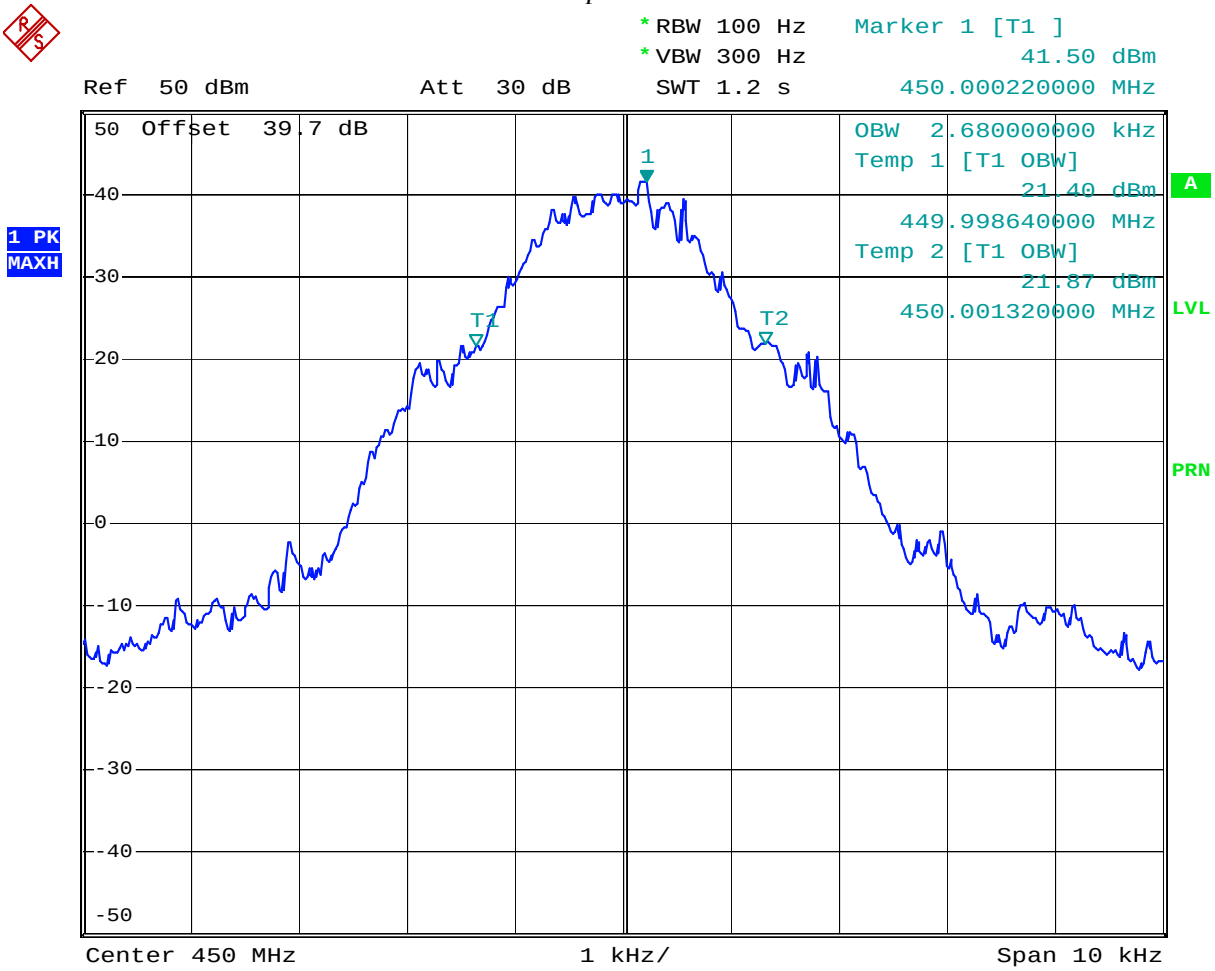
Comment: Occupied bandwidth, 6 kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:28:39

Graph 4 19



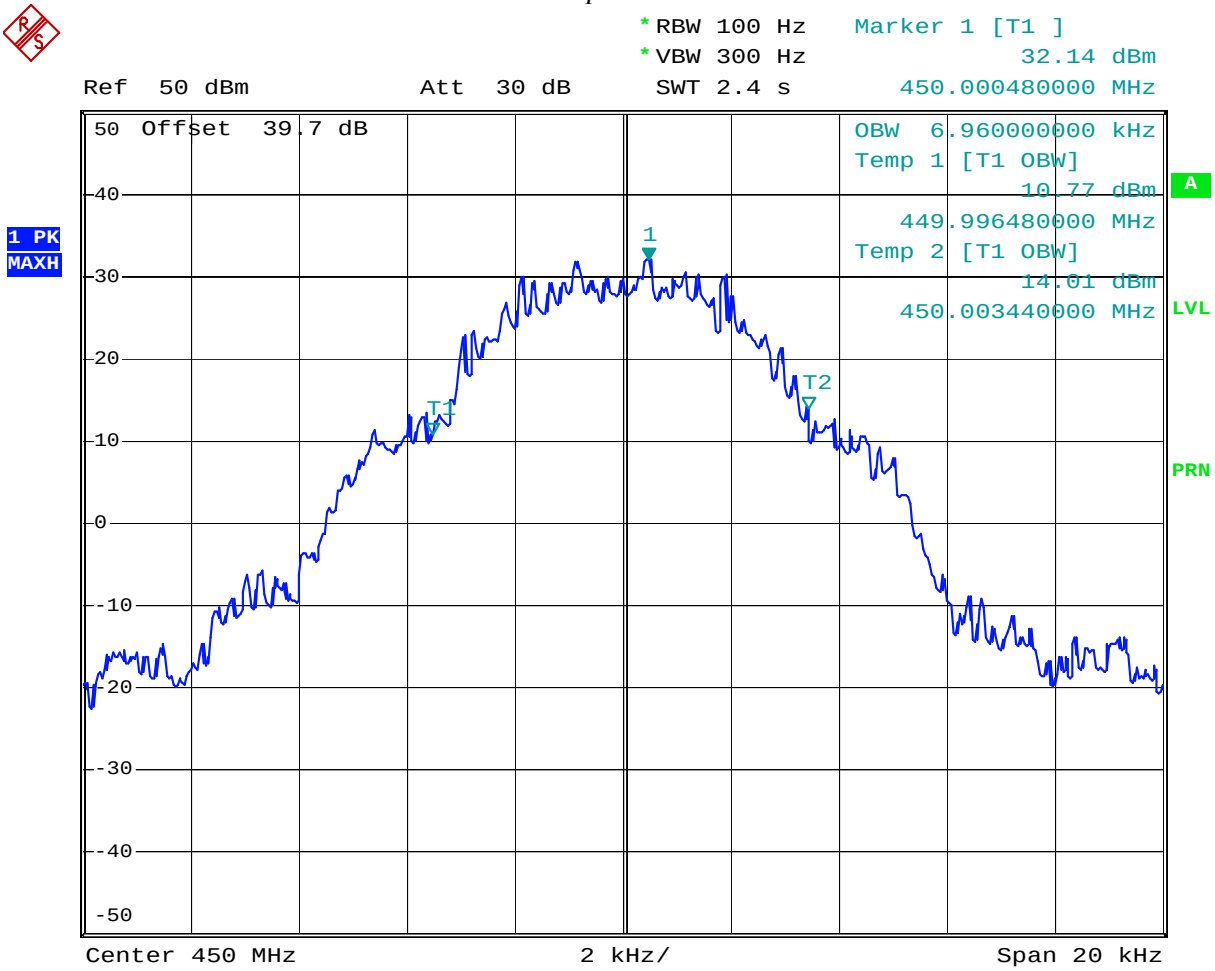
Comment: Occupied bandwidth, 6 kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:29:57

Graph 4 20



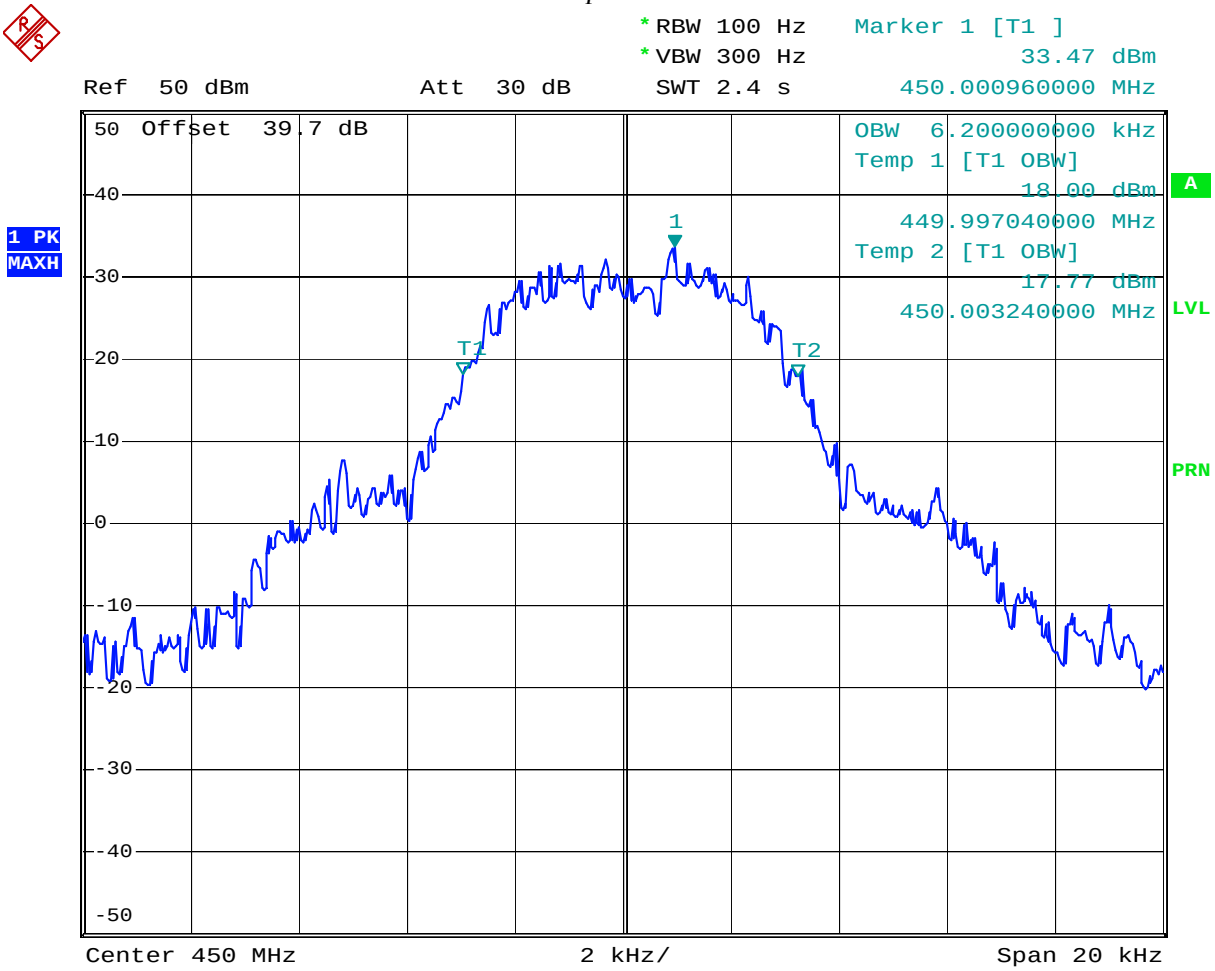
Comment: Occupied bandwidth, 6 kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:31:07

Graph 4 21



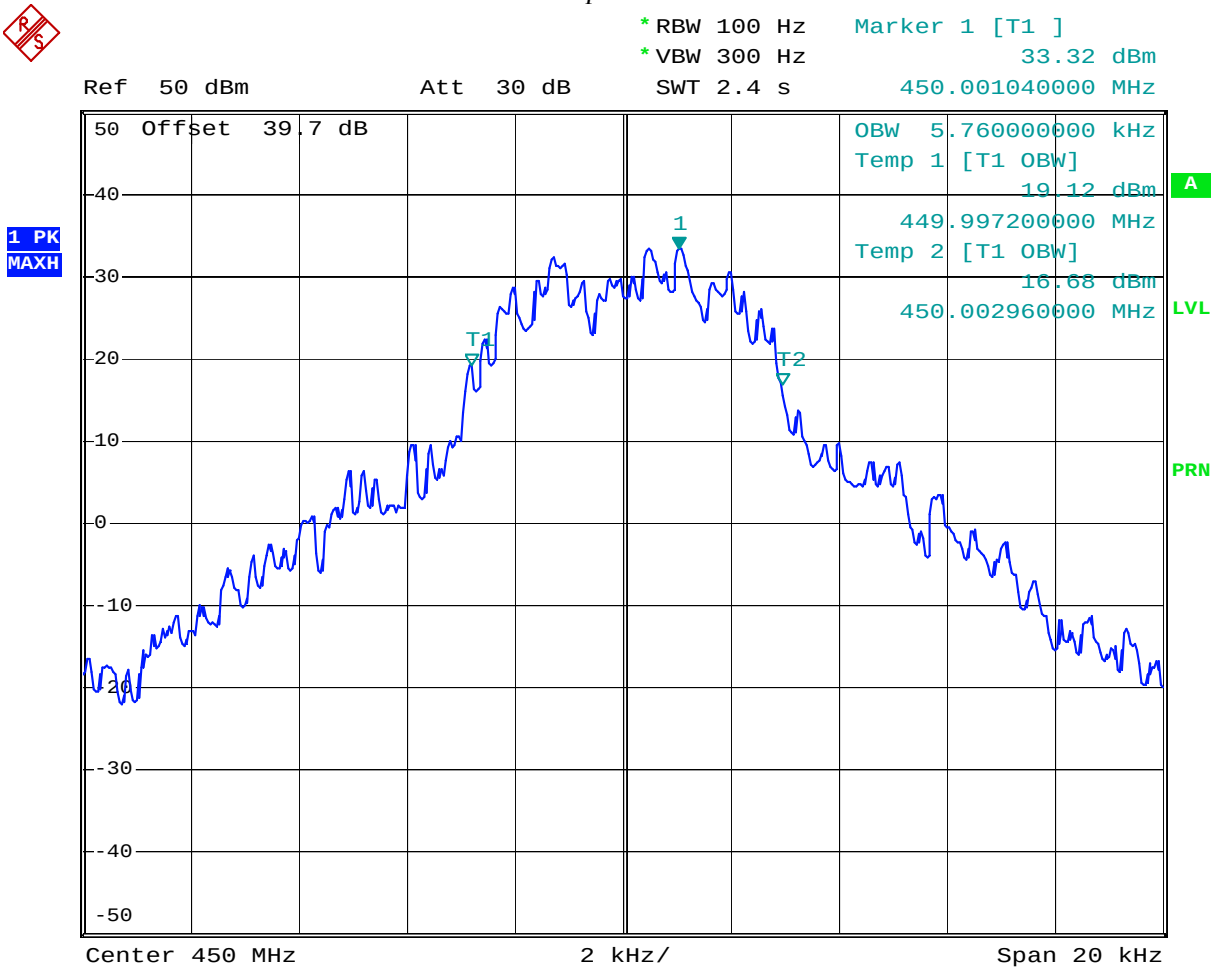
Comment: Occupied bandwidth, 11.25 kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 13:34:05

Graph 4 22



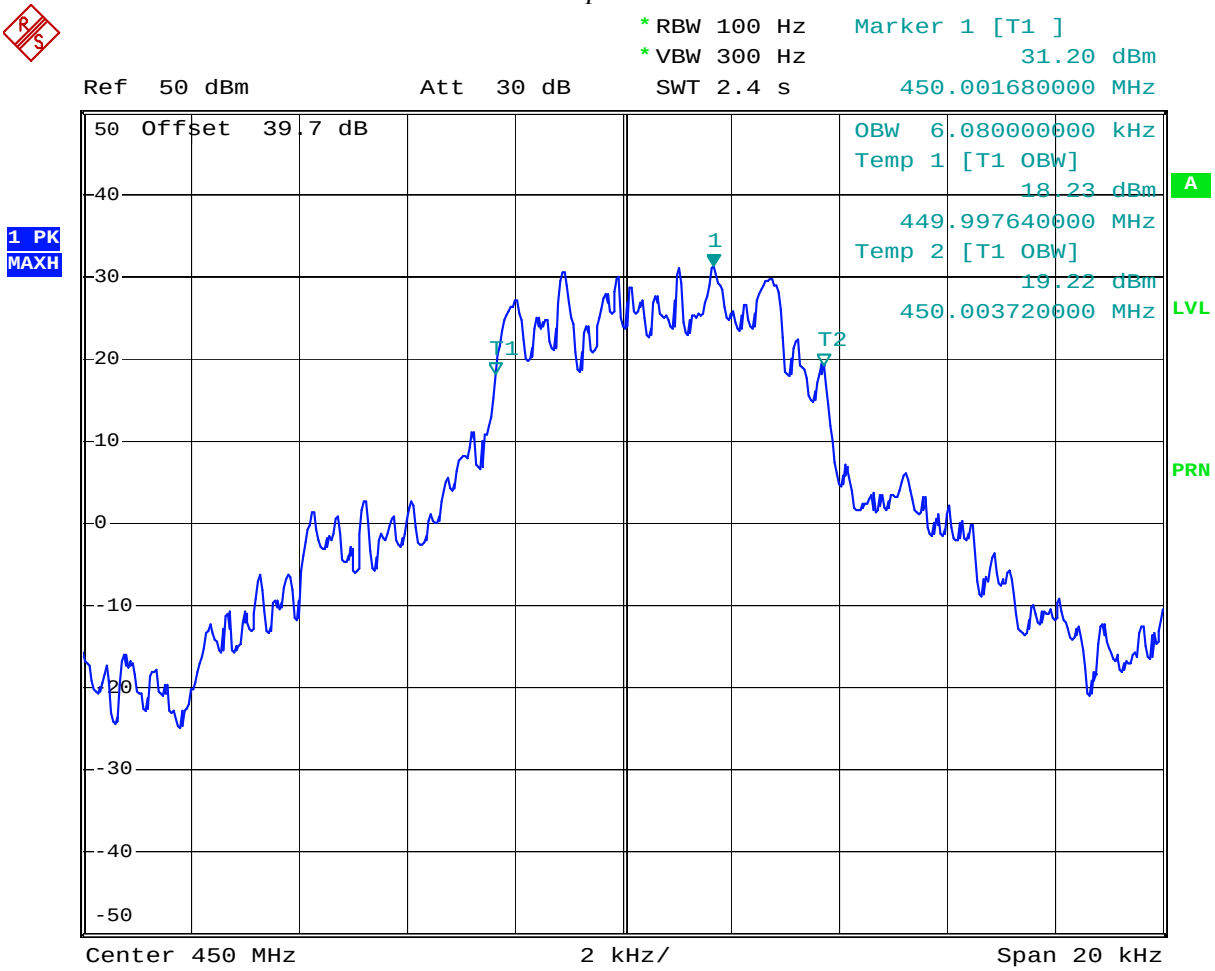
Comment: Occupied bandwidth, 11.25 kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:34:59

Graph 4 23



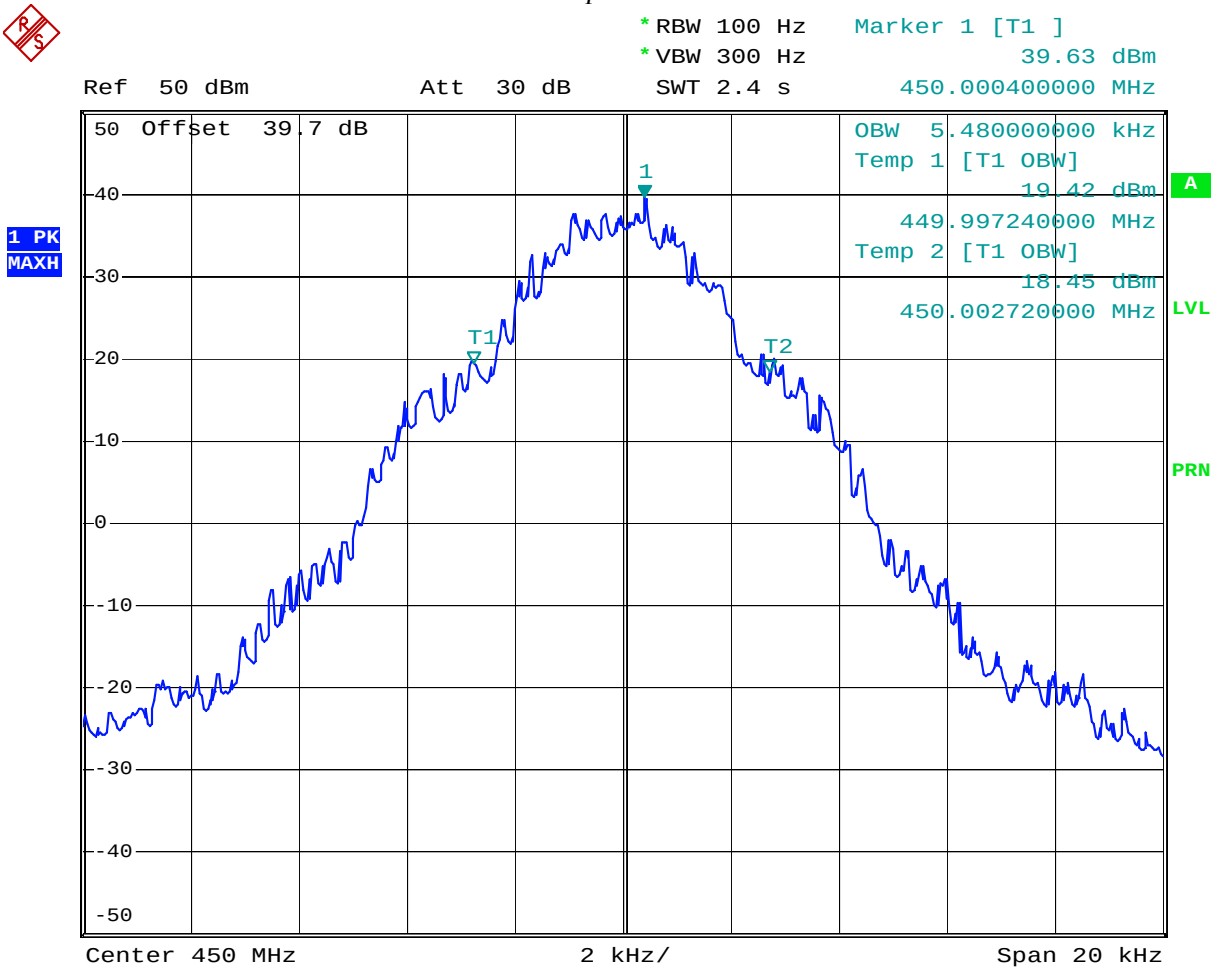
Comment: Occupied bandwidth, 11.25 kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:37:03

Graph 4 24



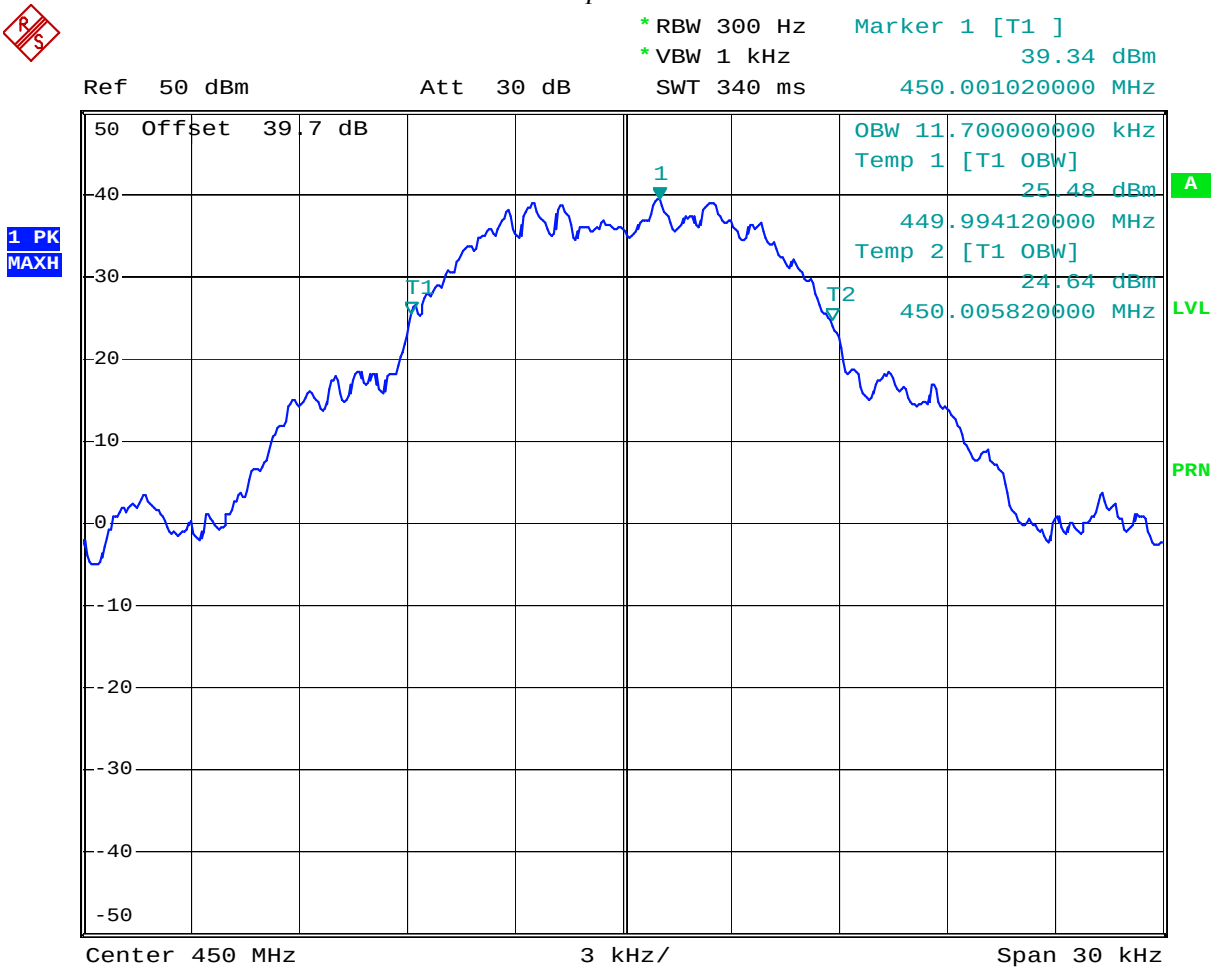
Comment: Occupied bandwidth, 11.25 kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:38:02

Graph 4 25



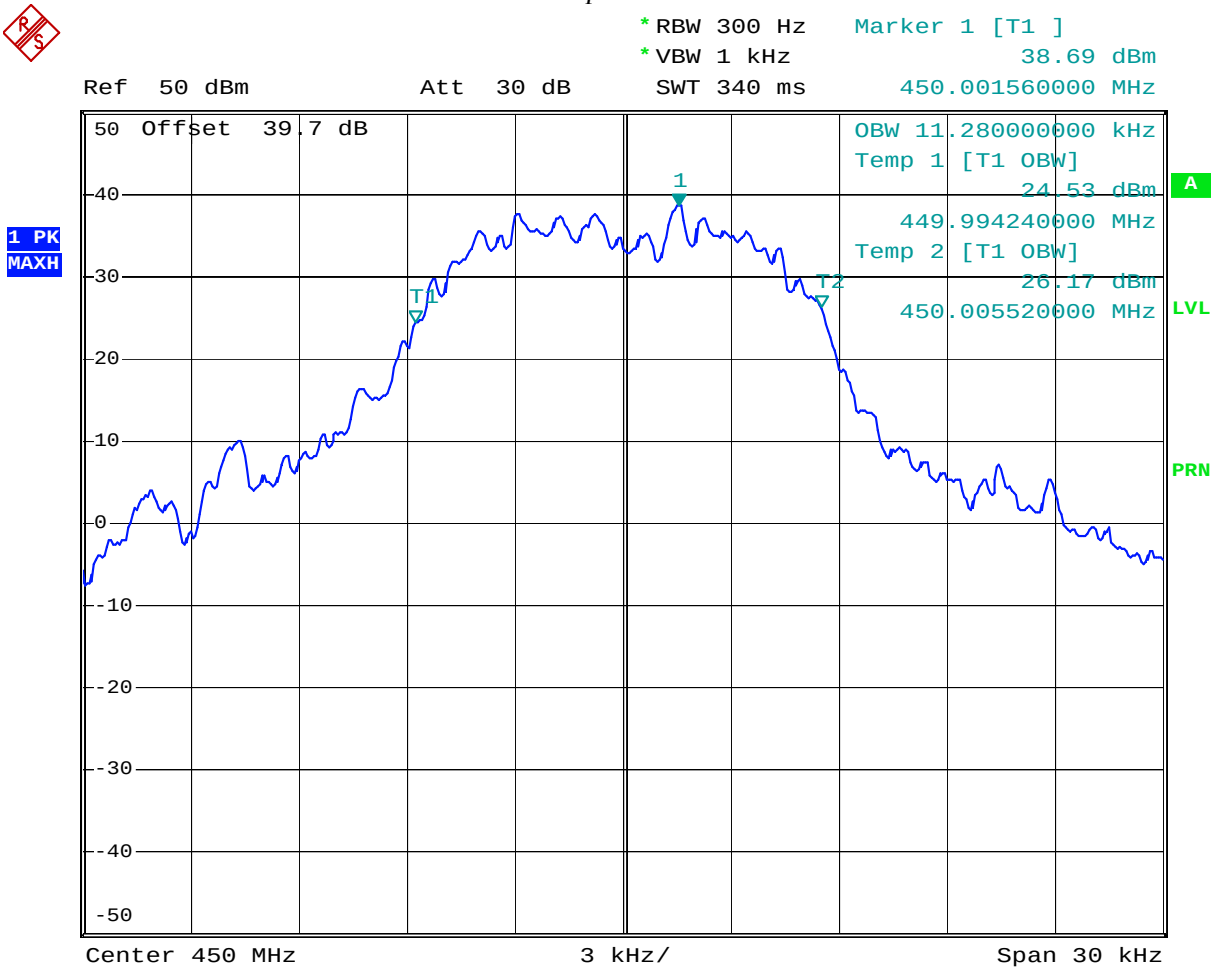
Comment: Occupied bandwidth, 11.25 kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:39:28

Graph 4 26



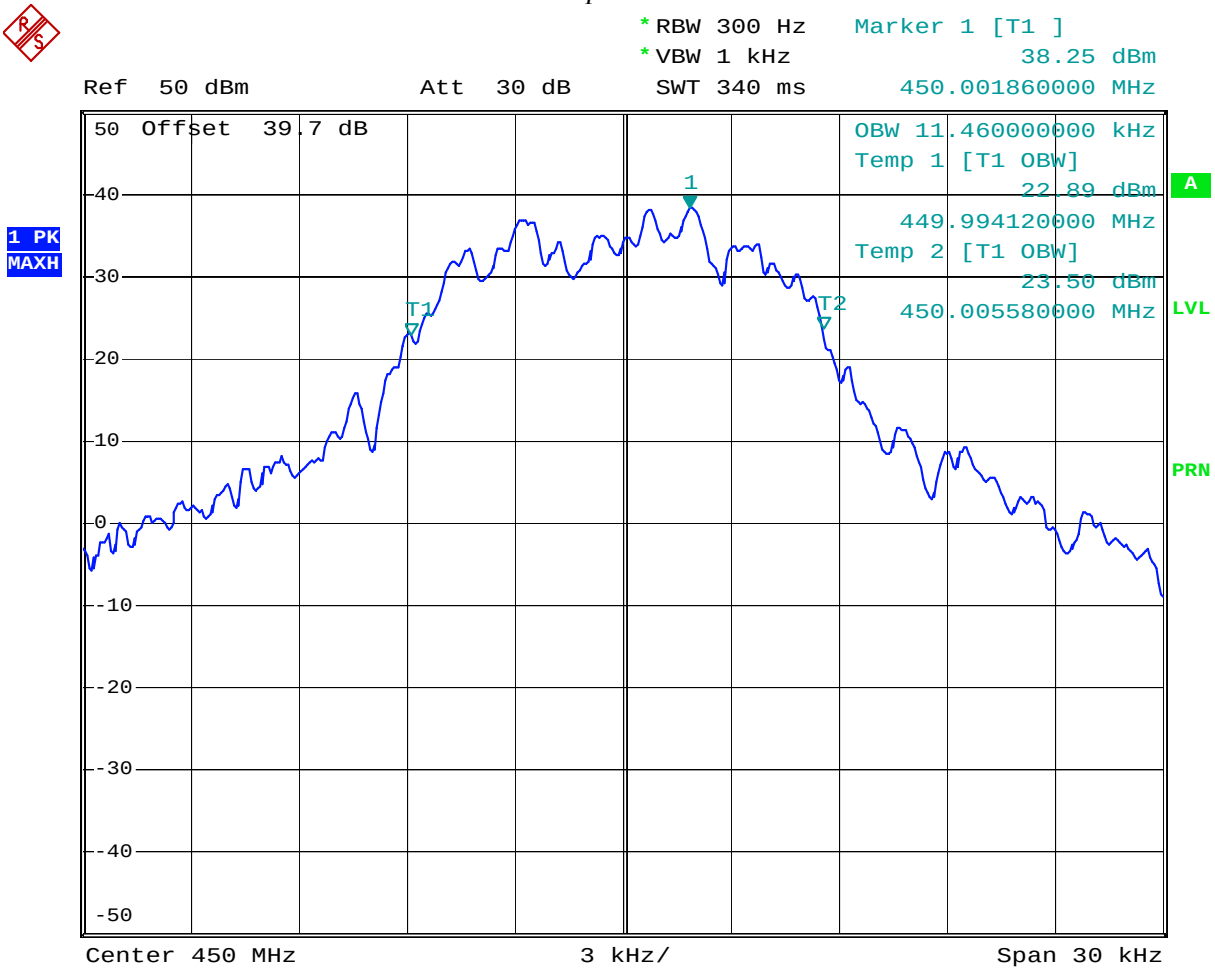
Comment: Occupied bandwidth, 20 kHz authorized bandwidth, BPSK
Date: 9.SEP.2009 13:44:28

Graph 4 27



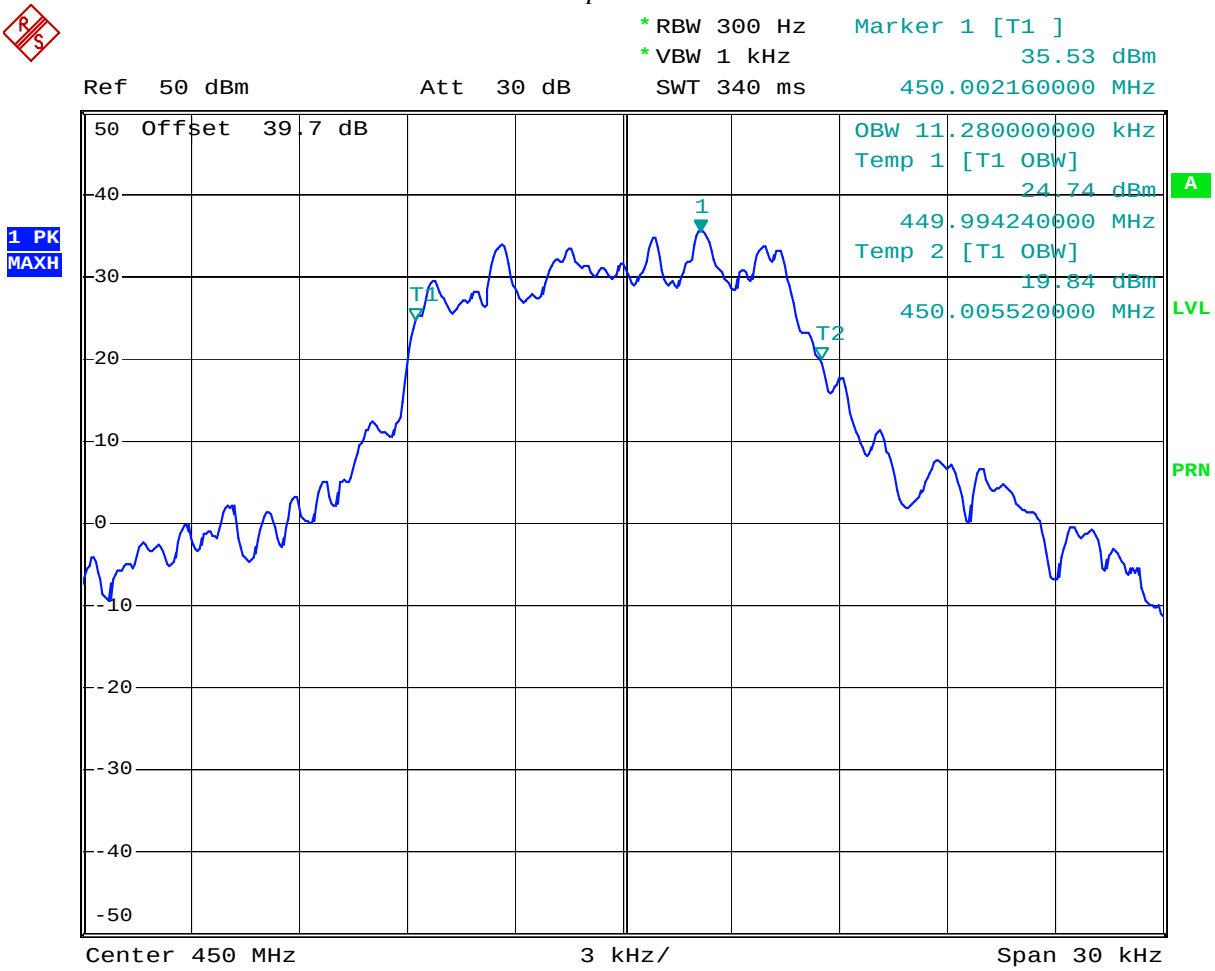
Comment: Occupied bandwidth, 20 kHz authorized bandwidth, QPSK
Date: 9.SEP.2009 13:45:32

Graph 4 28



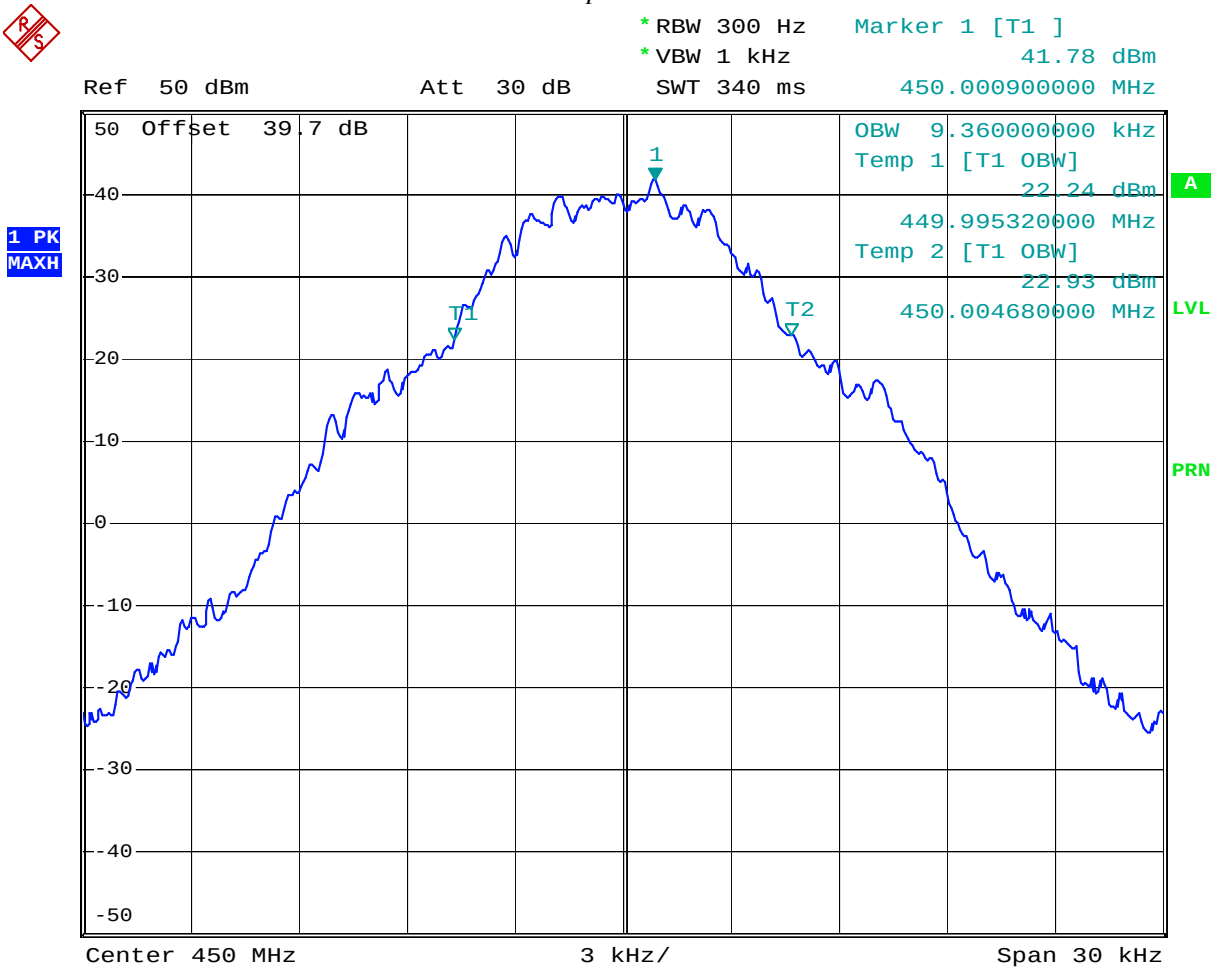
Comment: Occupied bandwidth, 20 kHz authorized bandwidth, 8PSK
Date: 9.SEP.2009 13:46:37

Graph 4 29



Comment: Occupied bandwidth, 20 kHz authorized bandwidth, 16QAM
Date: 9.SEP.2009 13:47:21

Graph 4 30



Comment: Occupied bandwidth, 20 kHz authorized bandwidth, GMSK
Date: 9.SEP.2009 13:48:28

5.0 Emission Mask

FCC 90.210

5.1 Requirement

Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask C (for equipment without audio low pass filter).

Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D.

Equipment designed to operate with a 6.25 channel bandwidth must meet the requirements of Emission Mask E

5.2 Test Procedure

The EUT RF output was connected as shown on the diagram in sec.1.3.2. The EUT was setup to transmit the maximum power.

The spectrum analyzed was setup to measure the Emission at frequencies ± 100 kHz from the fundamental frequency – for Mask C, ± 31.25 kHz – for Mask D, ± 22.5 kHz – for Mask E. The peak detector is used for these measurements.

The Emission Mask was measured at 406.1 MHz, 430 MHz, 450 MHz and 470 MHz for all five types of modulation.

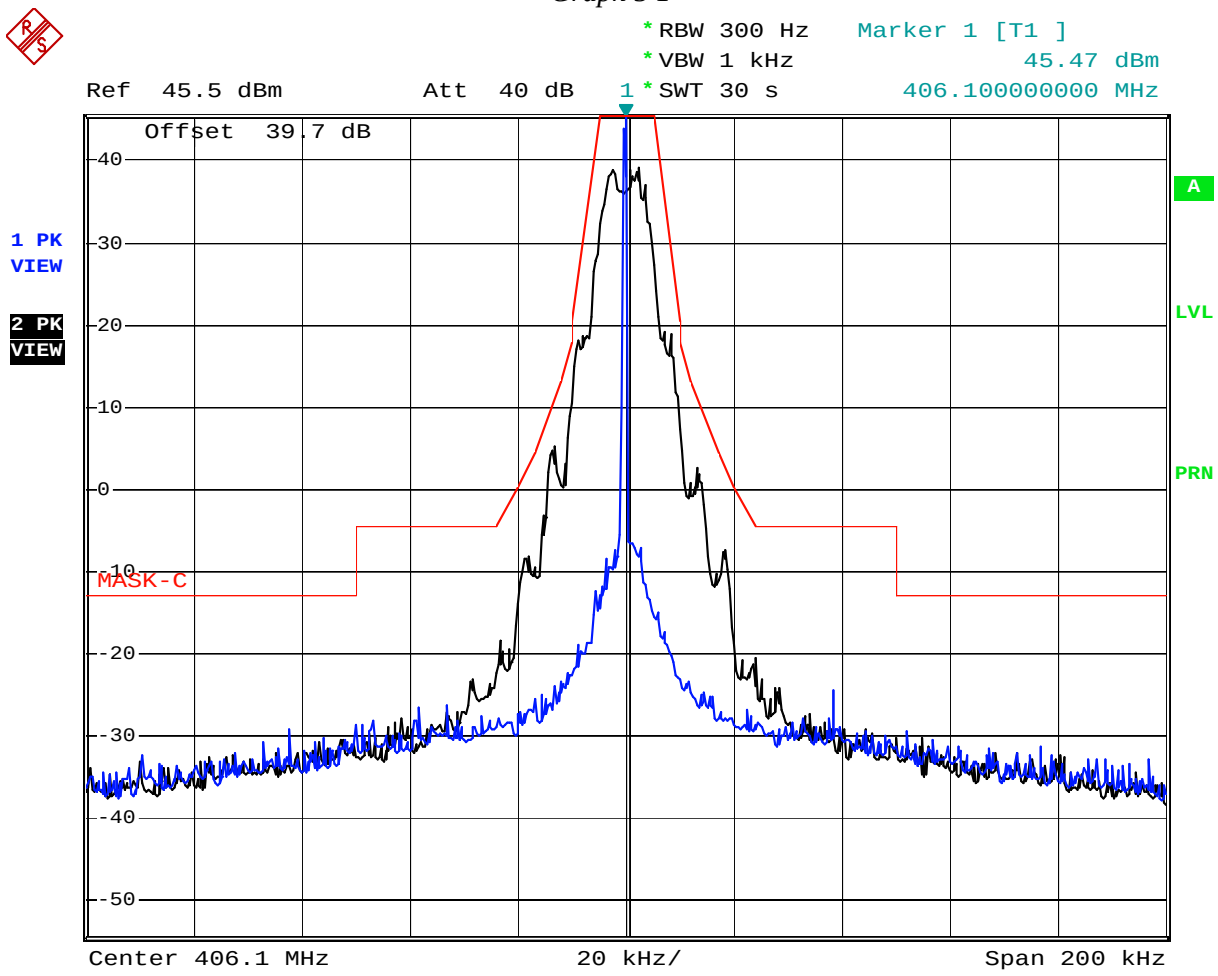
5.3 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

5.4 Test Results

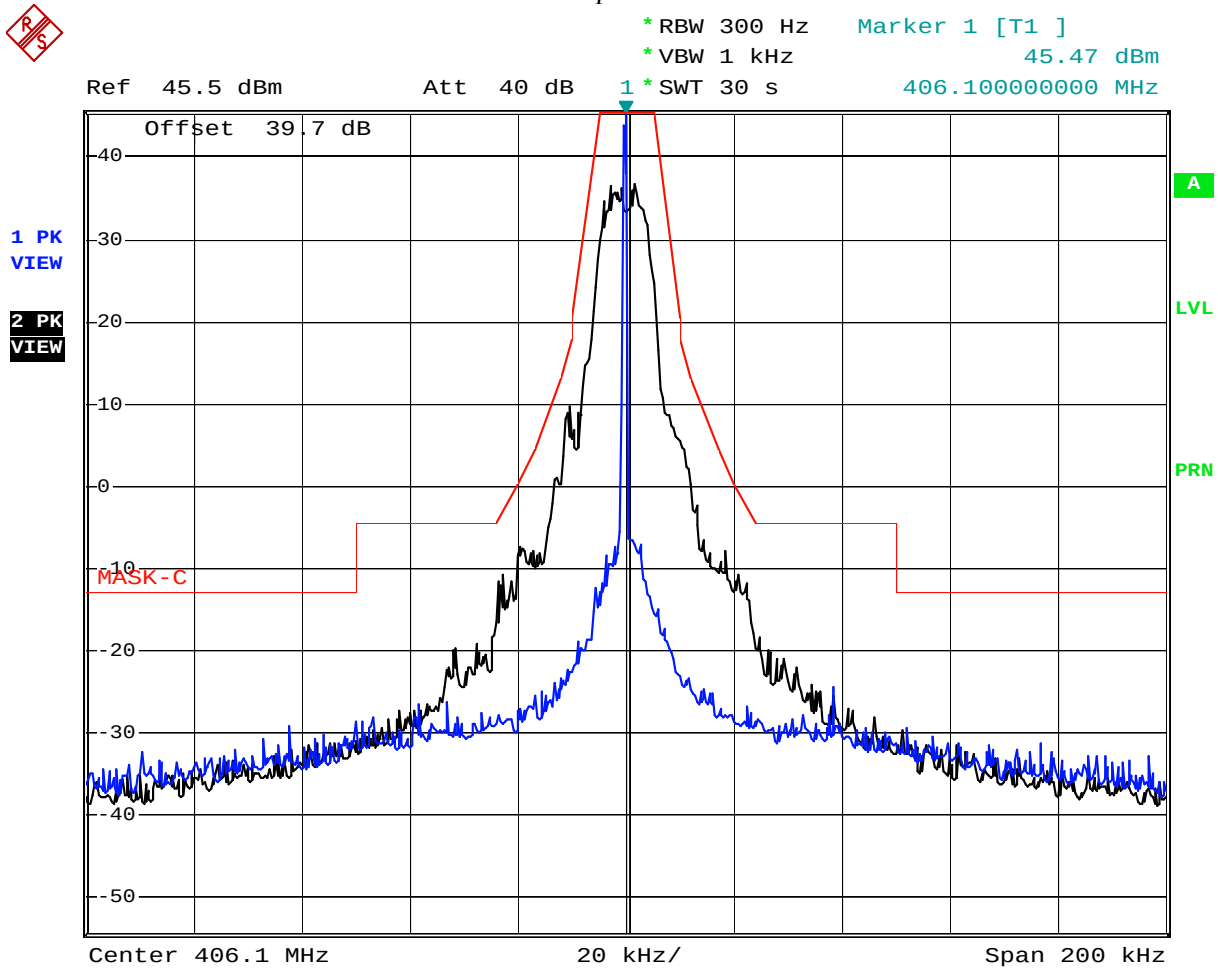
Complies with Emission Mask Requirements. For more details refer to the attached Graphs: 5.1 – 5.60.

Graph 5 1



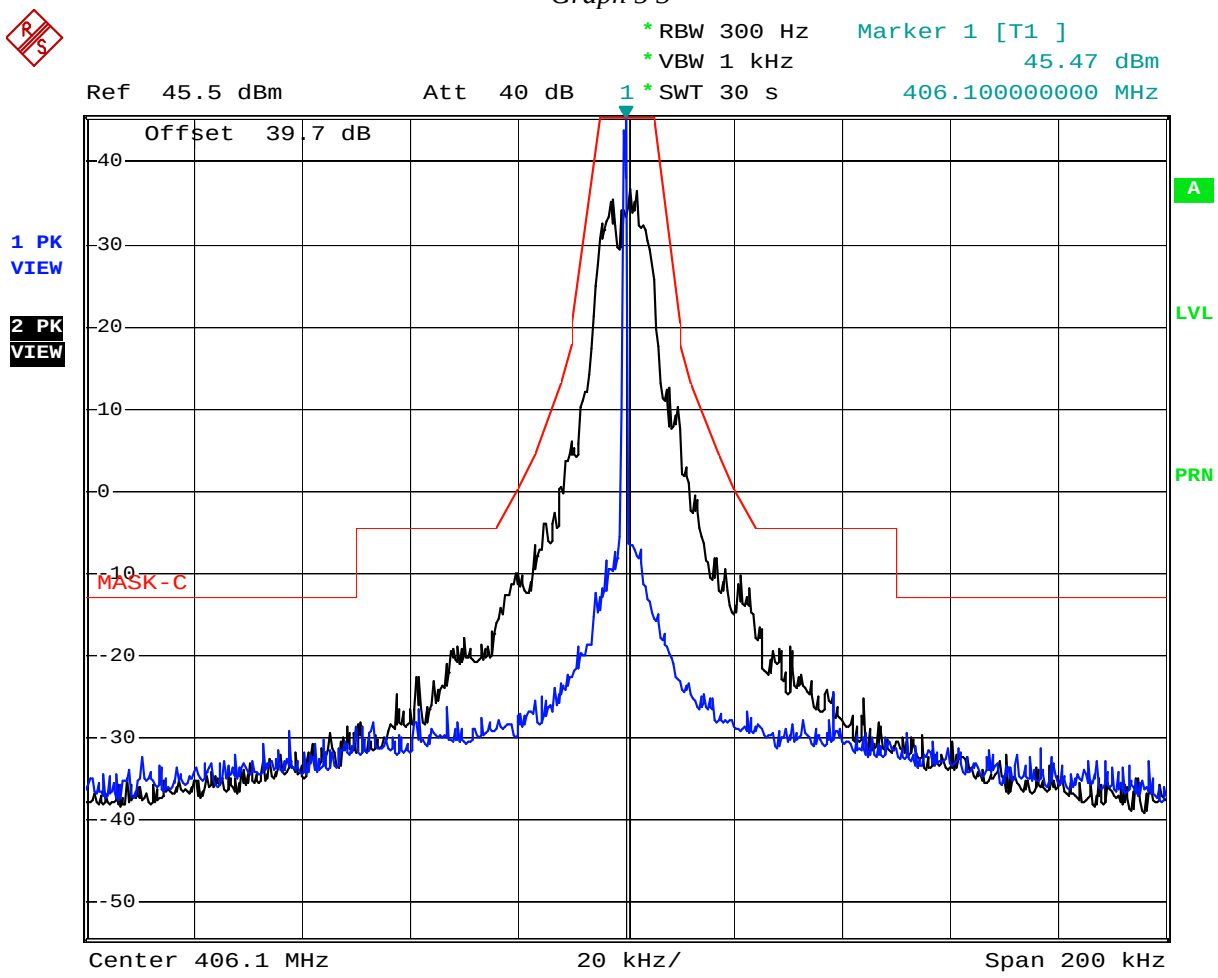
Comment: Emission Mask, 25 kHz ch. spacing, BPSK
Date: 9.SEP.2009 17:55:41

Graph 5 2



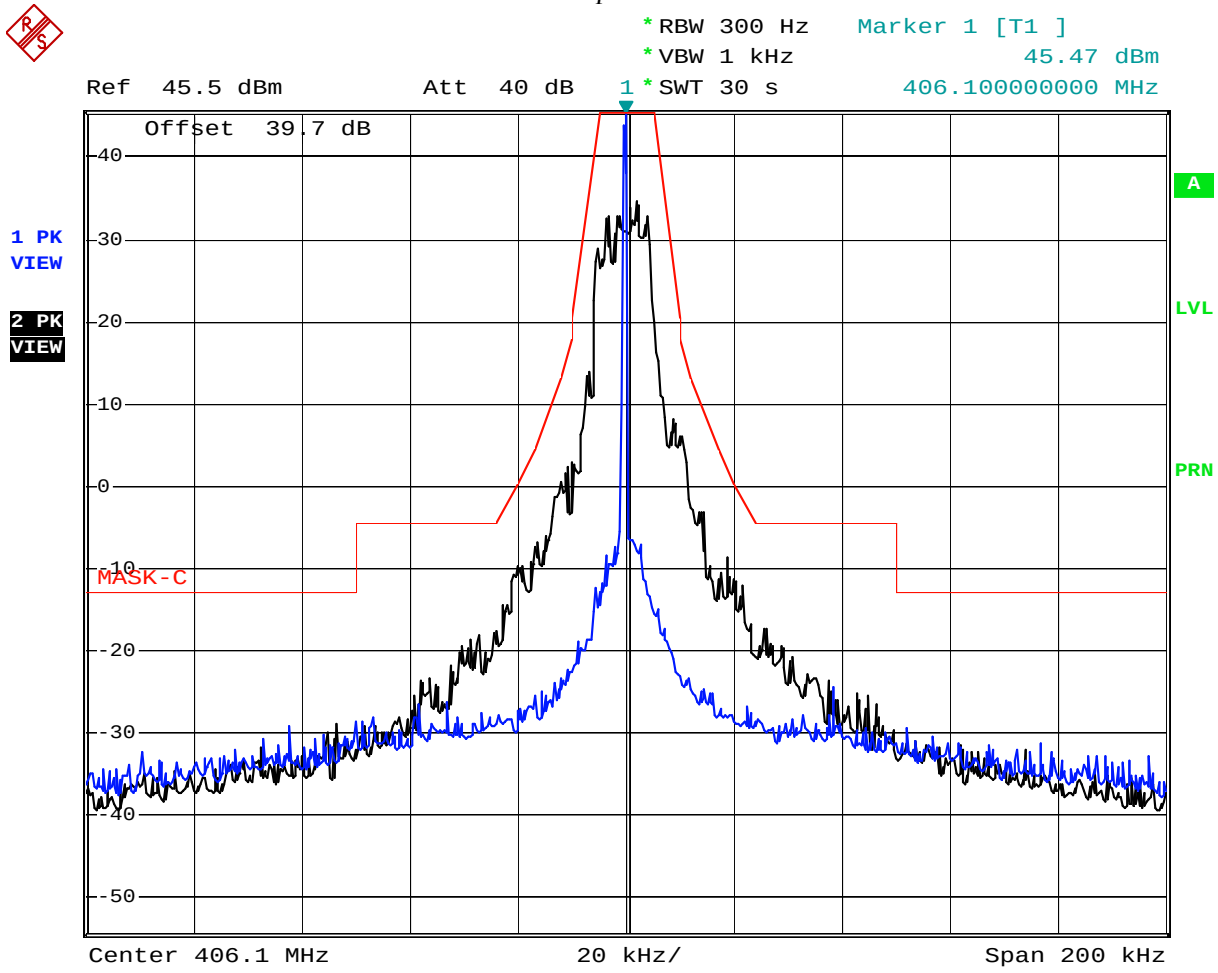
Comment: Emission Mask, 25 kHz ch. spacing, QPSK
Date: 9.SEP.2009 17:59:17

Graph 5 3



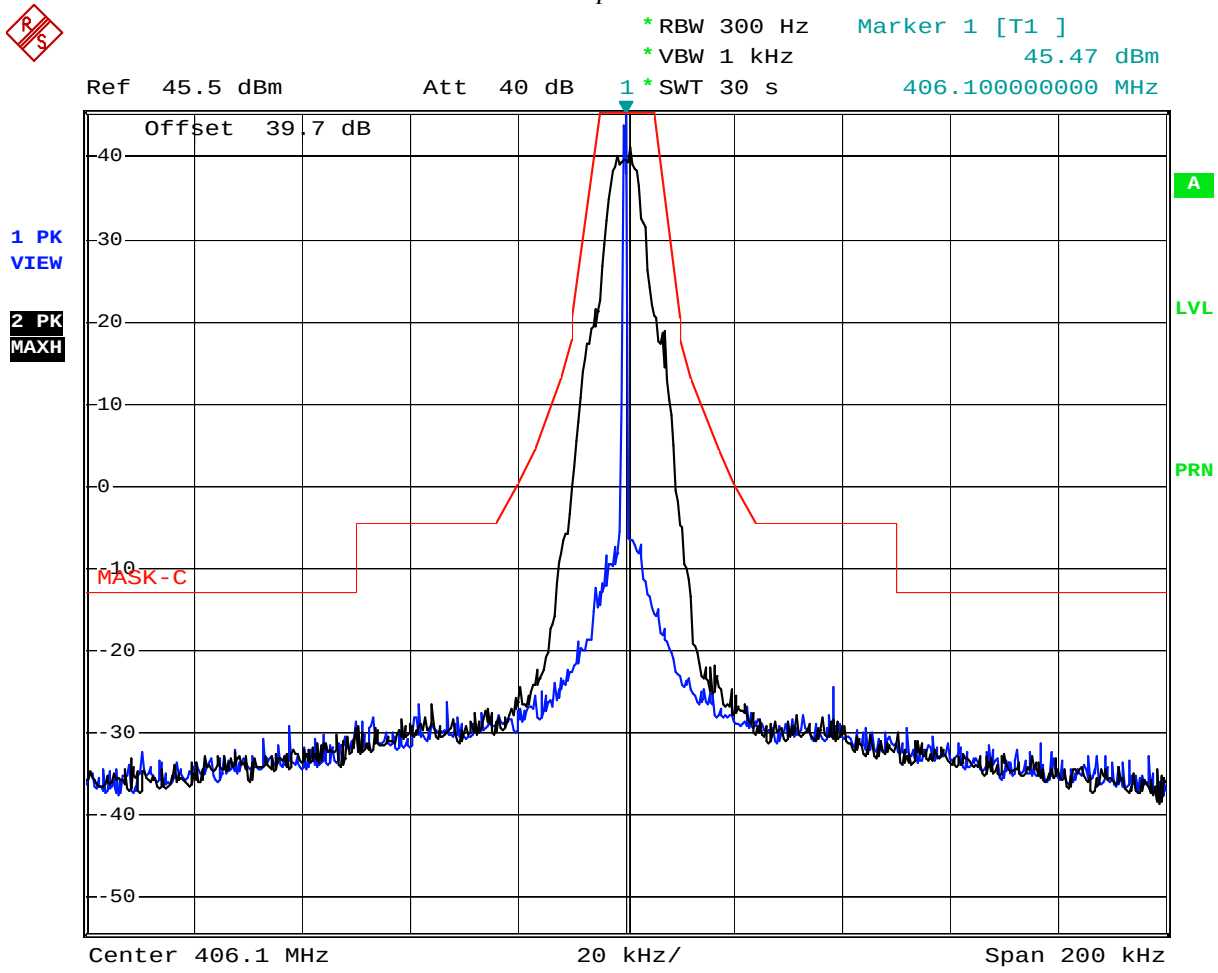
Comment: Emission Mask, 25 kHz ch. spacing, 8PSK
Date: 9.SEP.2009 18:01:34

Graph 5 4



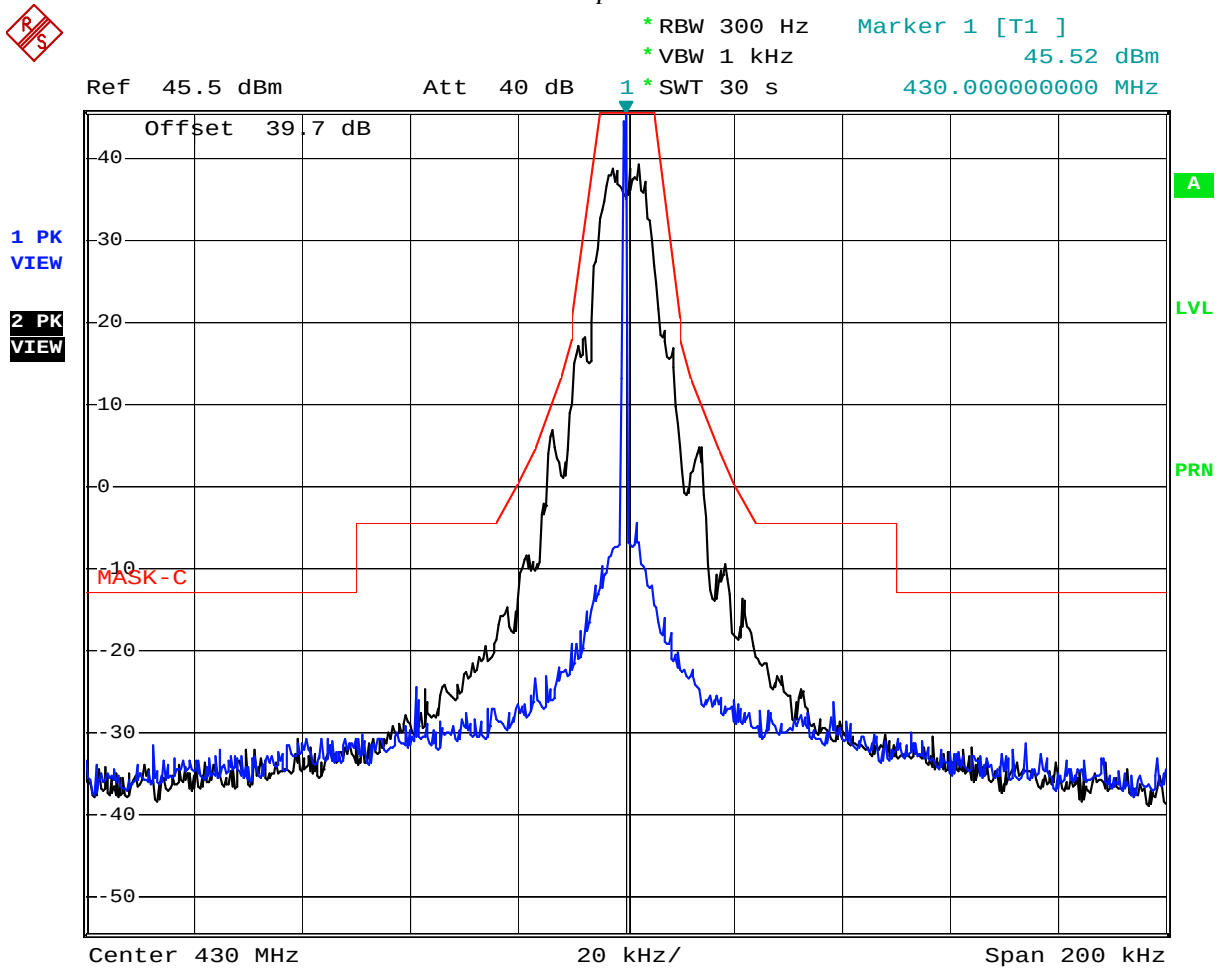
Comment: Emission Mask, 25 kHz ch. spacing, 16QAM
Date: 9.SEP.2009 18:04:21

Graph 5 5



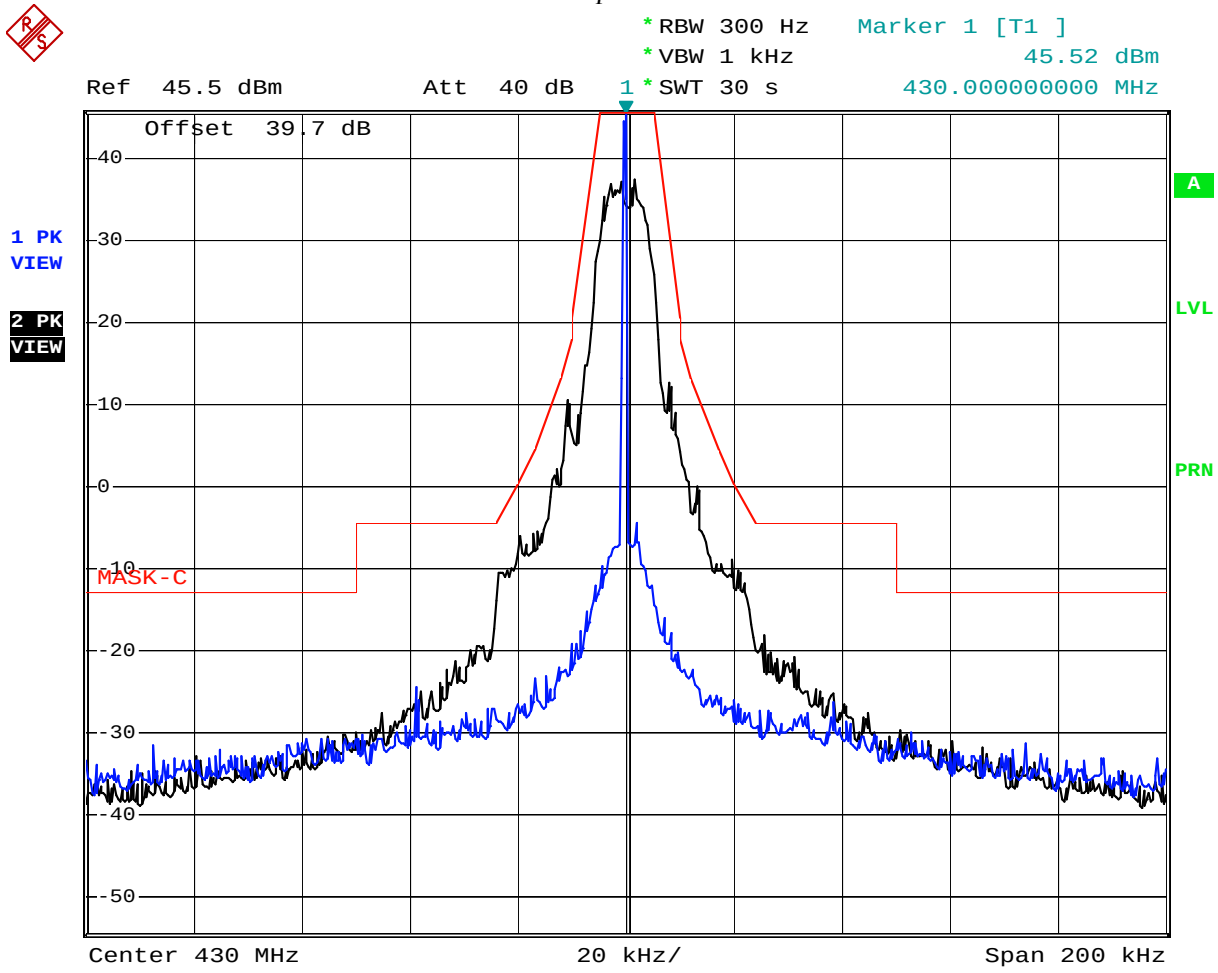
Comment: Emission Mask, 25 kHz ch. spacing, GMSK
Date: 9.SEP.2009 18:06:33

Graph 5 6



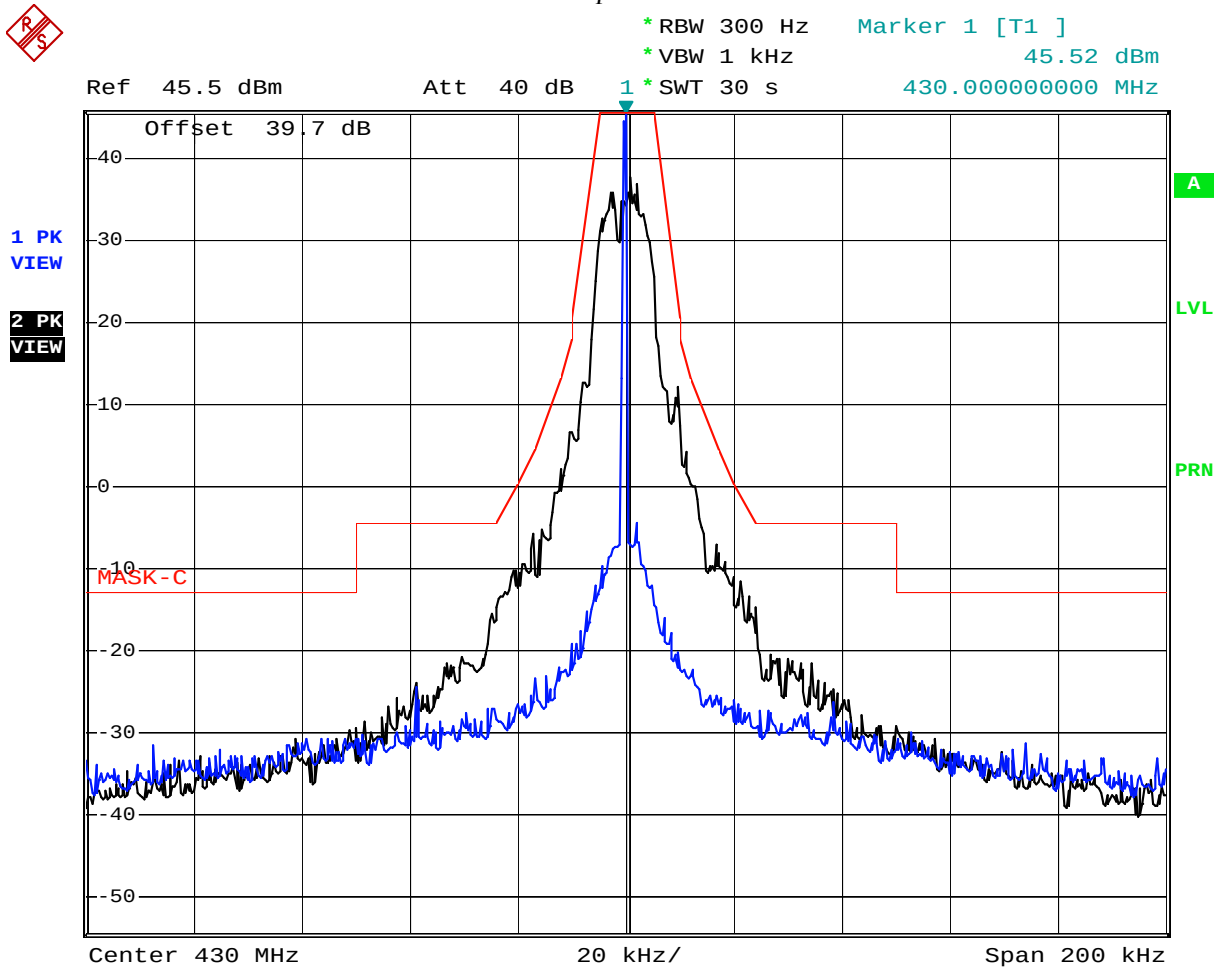
Comment: Emission Mask, 25 kHz ch. spacing, BPSK
Date: 9.SEP.2009 18:11:55

Graph 5 7



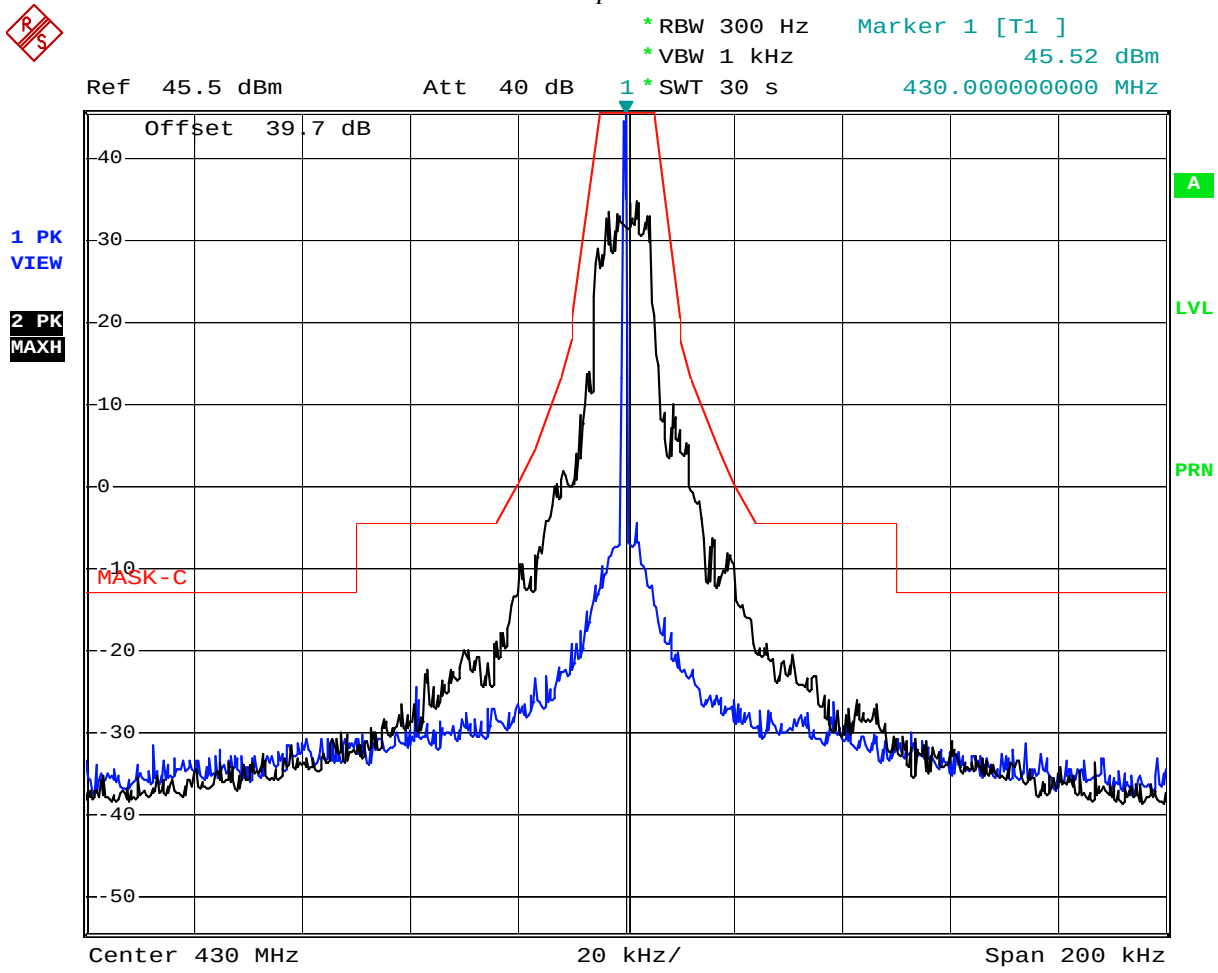
Comment: Emission Mask, 25 kHz ch. spacing, QPSK
Date: 9.SEP.2009 18:14:11

Graph 5 8



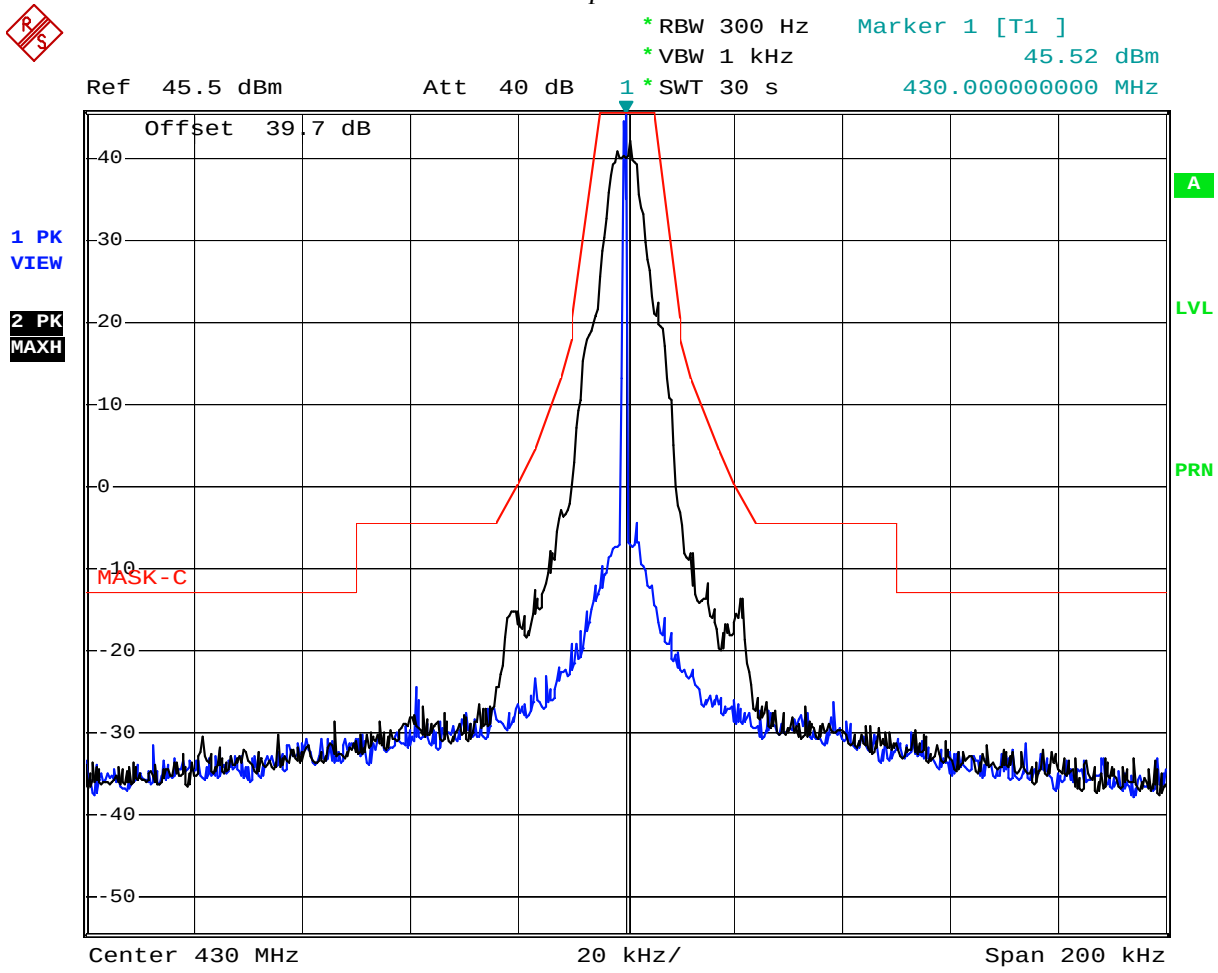
Comment: Emission Mask, 25 kHz ch. spacing, 8PSK
Date: 9.SEP.2009 18:16:41

Graph 5 9



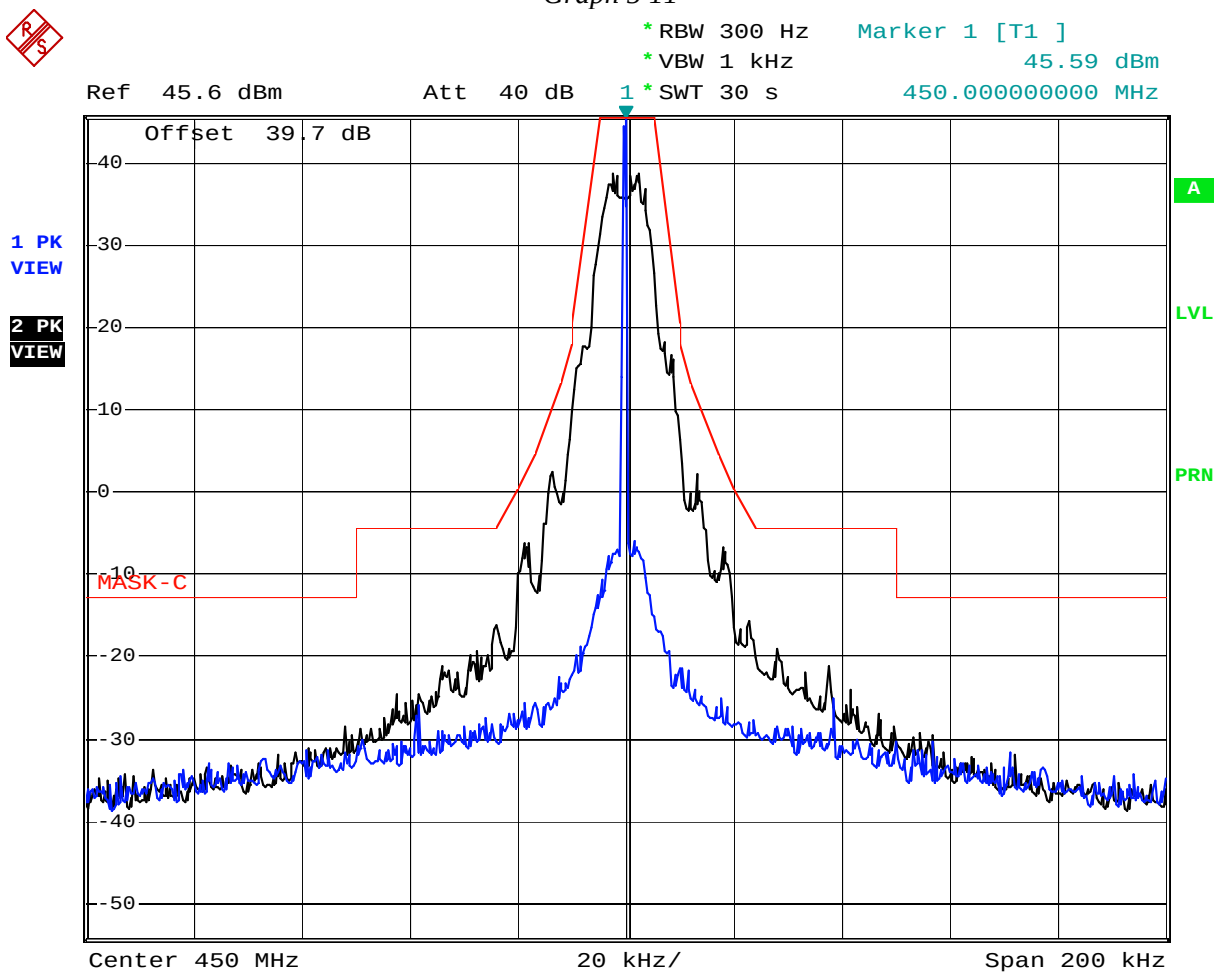
Comment: Emission Mask, 25 kHz ch. spacing, 16QAM
Date: 9.SEP.2009 18:18:50

Graph 5 10



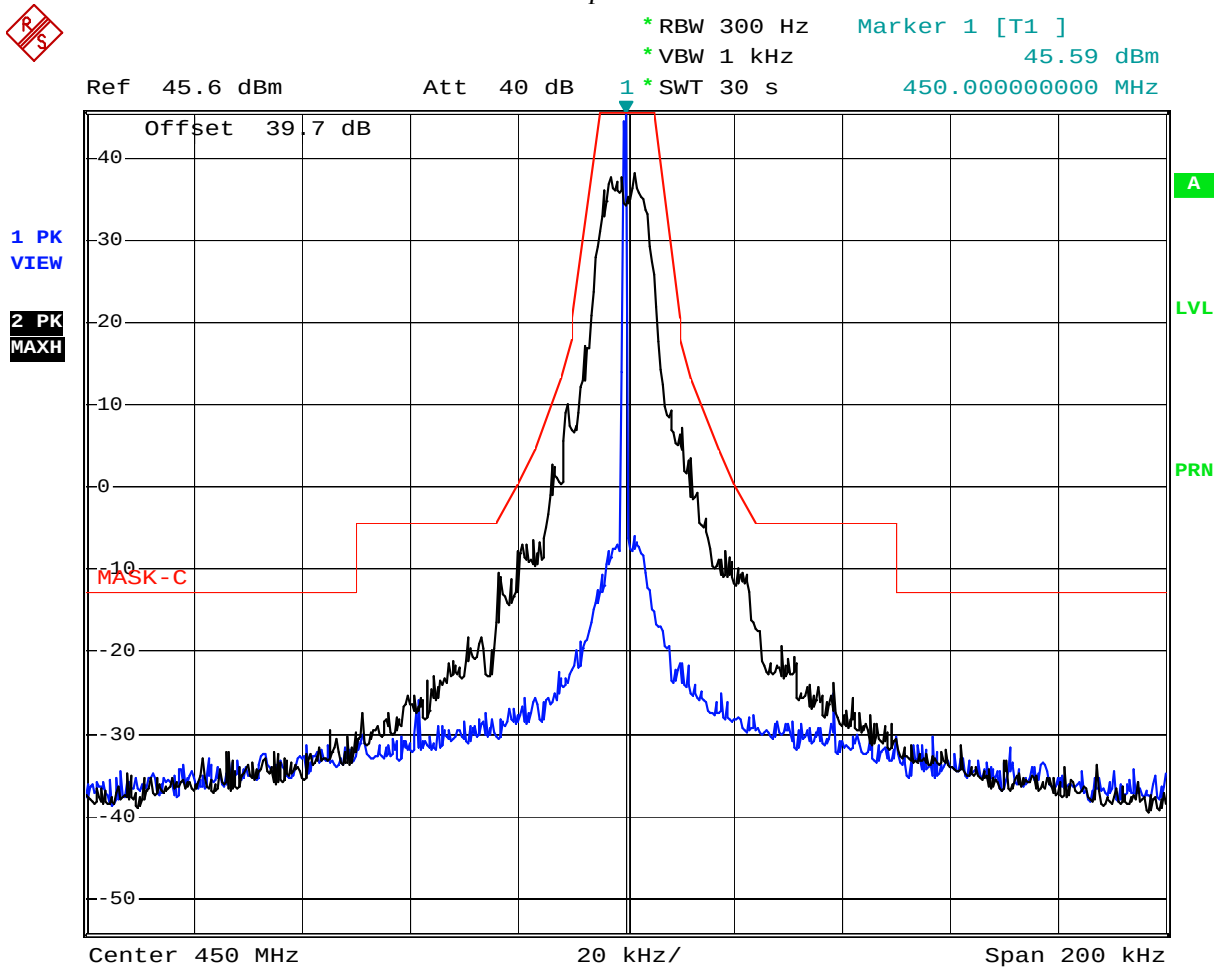
Comment: Emission Mask, 25 kHz ch. spacing, GMSK
Date: 9.SEP.2009 18:21:30

Graph 5 11



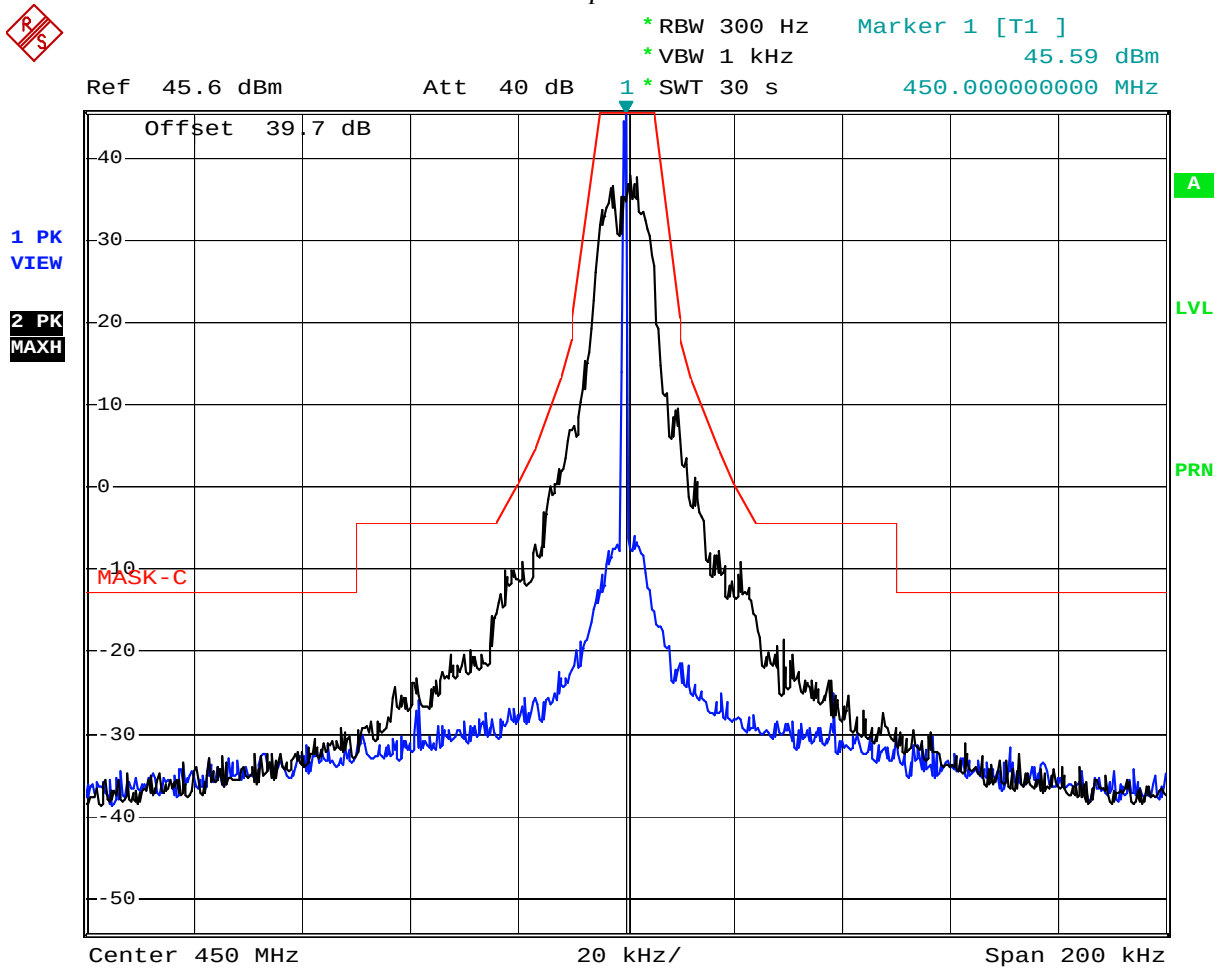
Comment: Emission Mask, 25 kHz ch. spacing, BPSK
Date: 9.SEP.2009 18:30:41

Graph 5 12



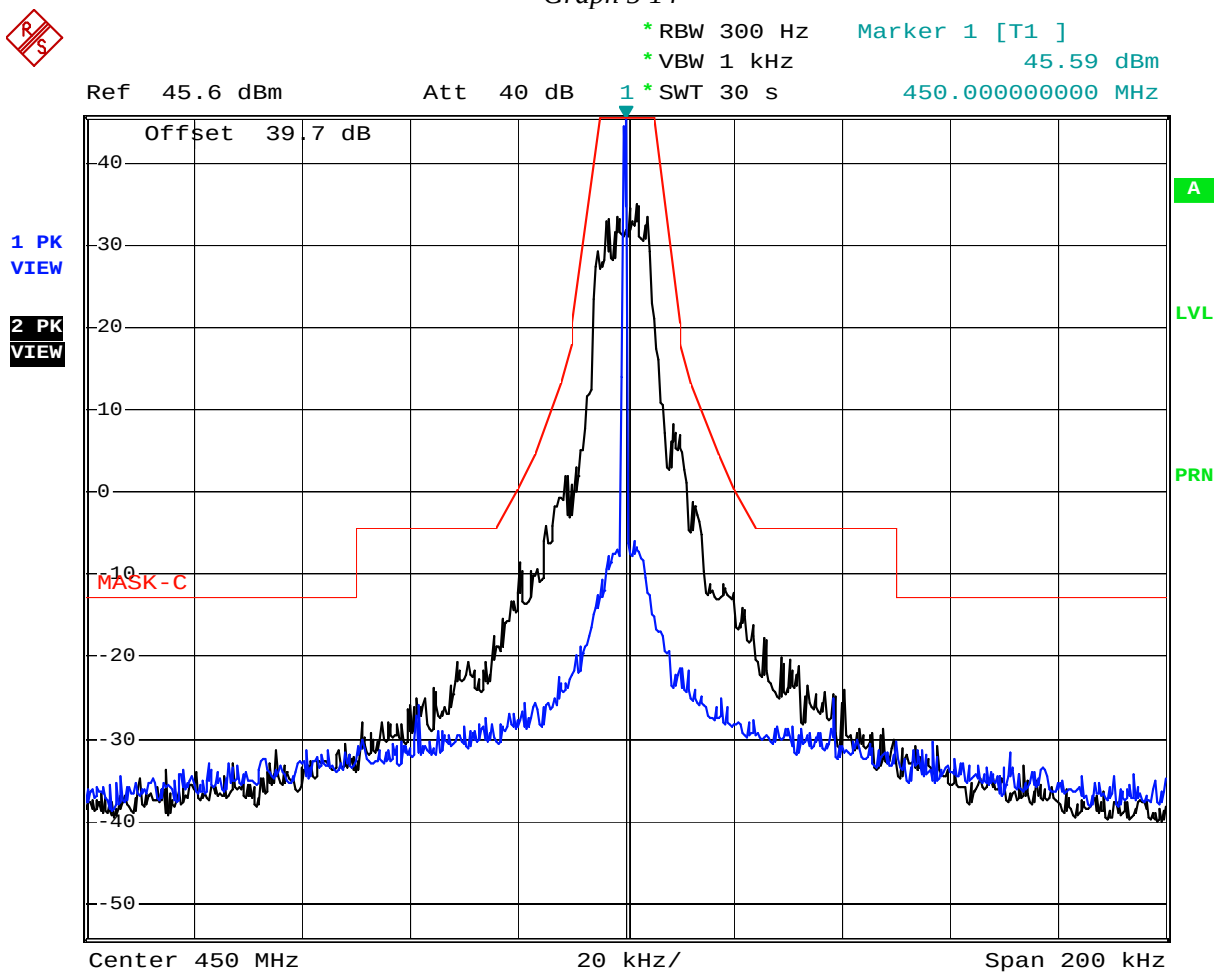
Comment: Emission Mask, 25 kHz ch. spacing, QPSK
Date: 9.SEP.2009 18:32:46

Graph 5 13



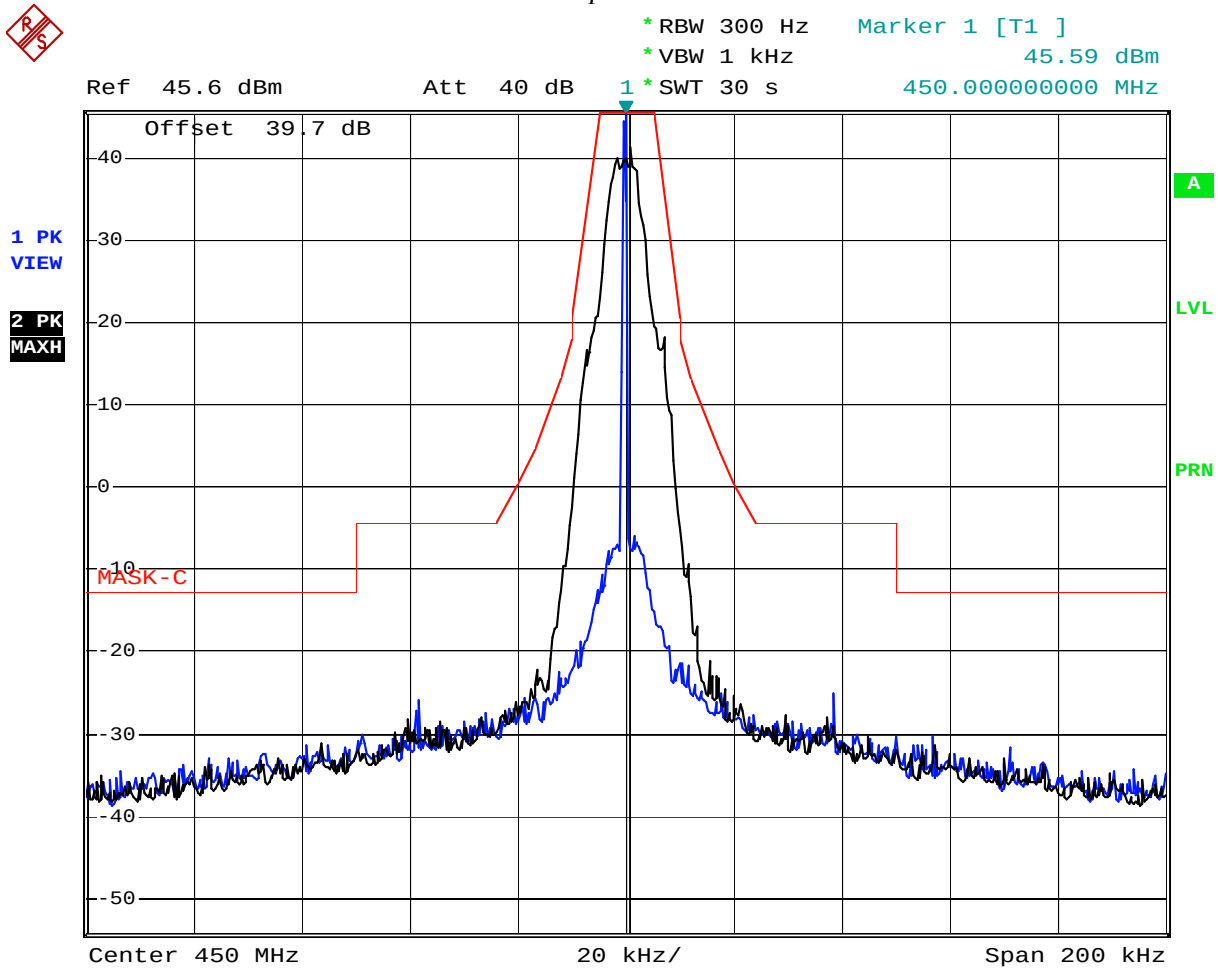
Comment: Emission Mask, 25 kHz ch. spacing, 8PSK
Date: 9.SEP.2009 18:34:49

Graph 5 14



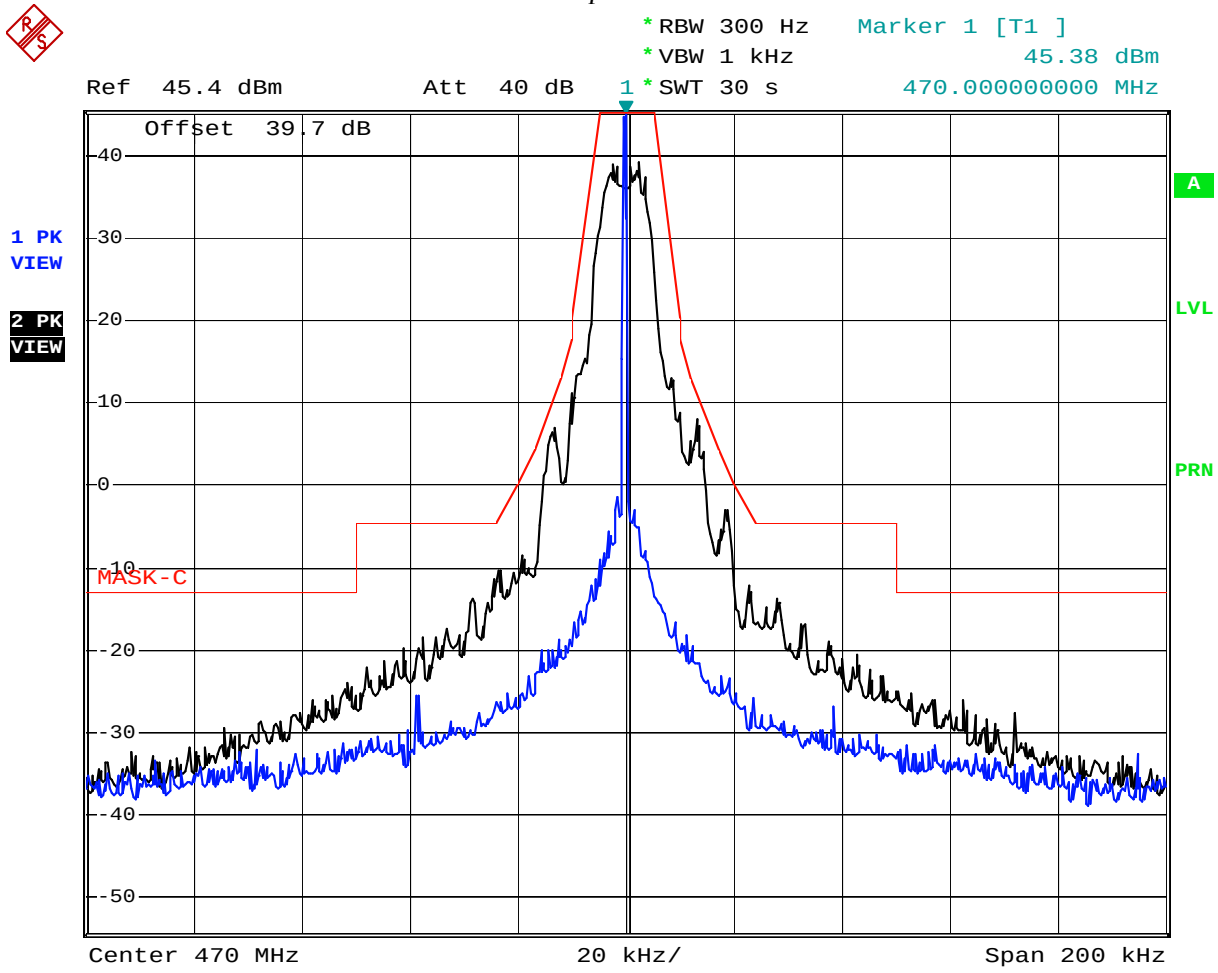
Comment: Emission Mask, 25 kHz ch. spacing, 16QAM
Date: 9.SEP.2009 18:37:58

Graph 5 15



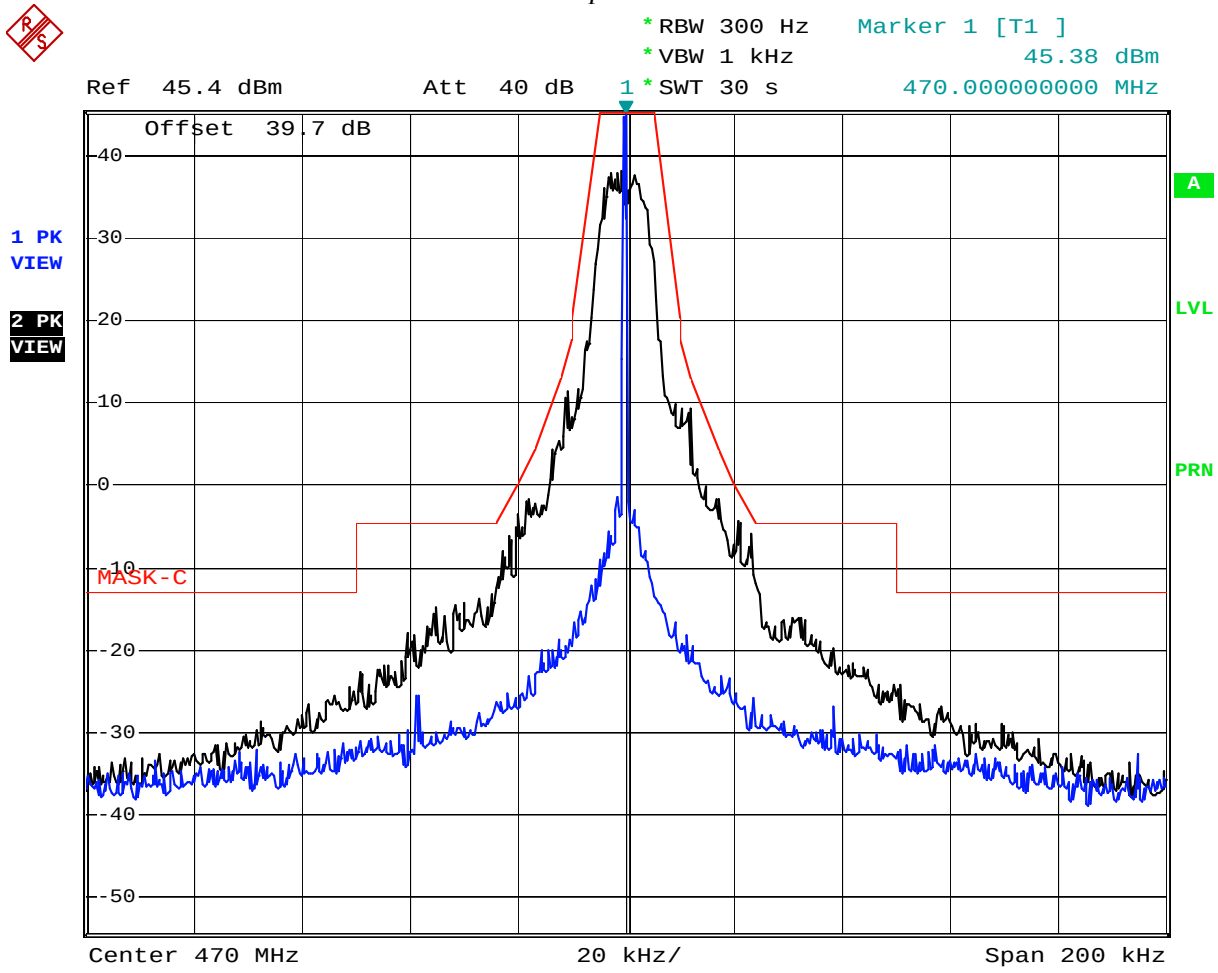
Comment: Emission Mask, 25 kHz ch. spacing, GMSK
Date: 9.SEP.2009 18:40:09

Graph 5 16



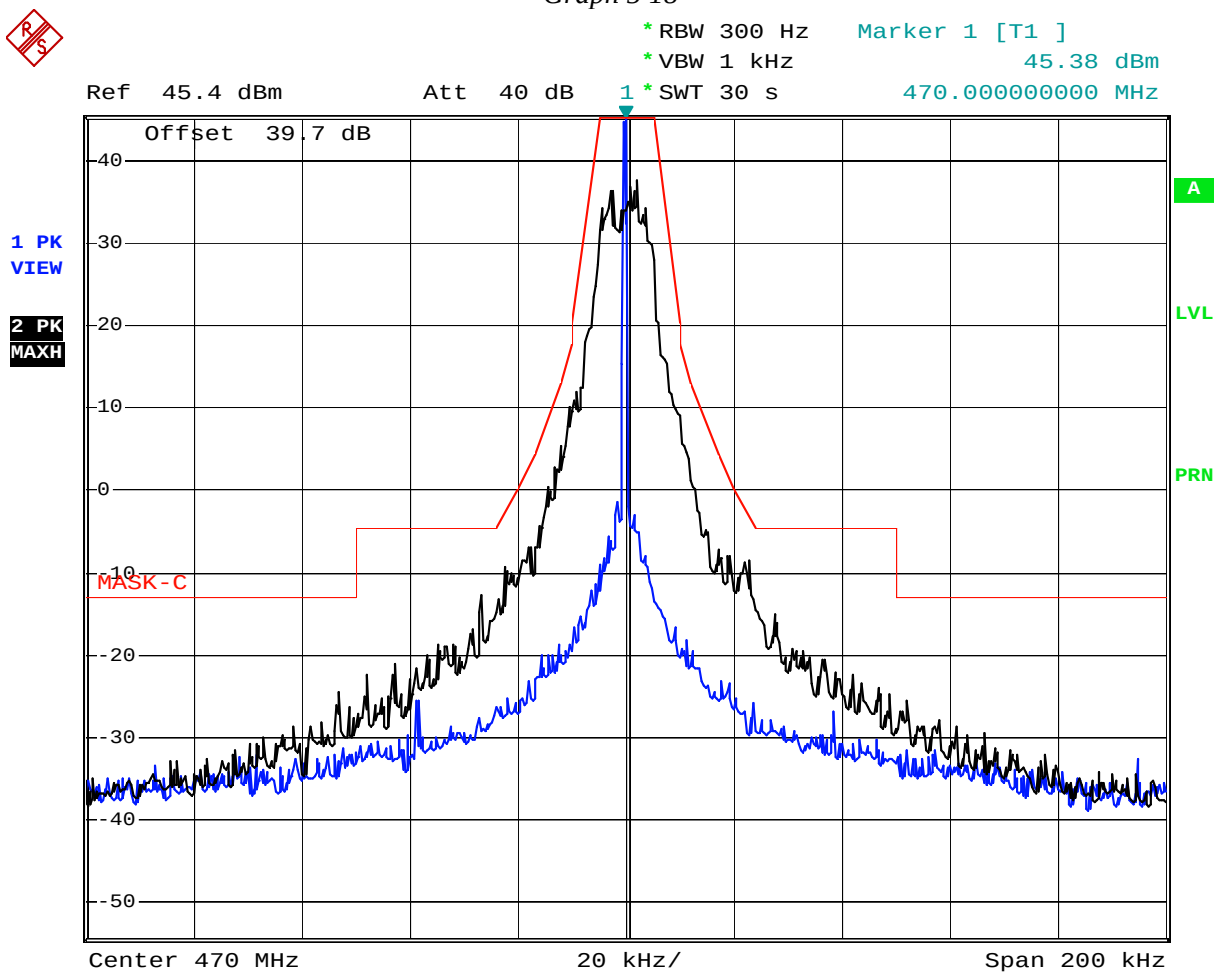
Comment: Emission Mask, 25 kHz ch. spacing, BPSK
Date: 9.SEP.2009 18:48:45

Graph 5 17



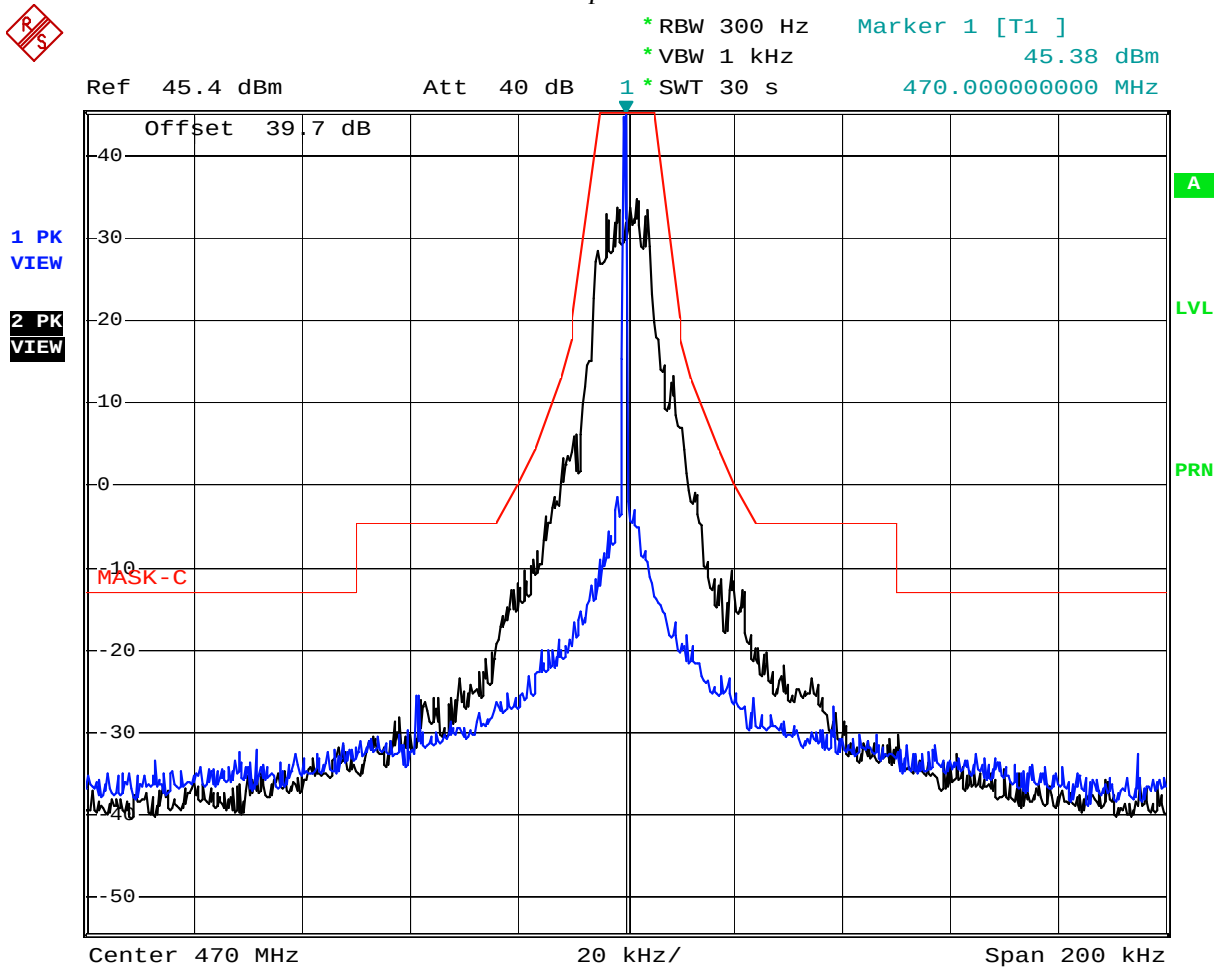
Comment: Emission Mask, 25 kHz ch. spacing, QPSK
Date: 9.SEP.2009 18:50:57

Graph 5 18



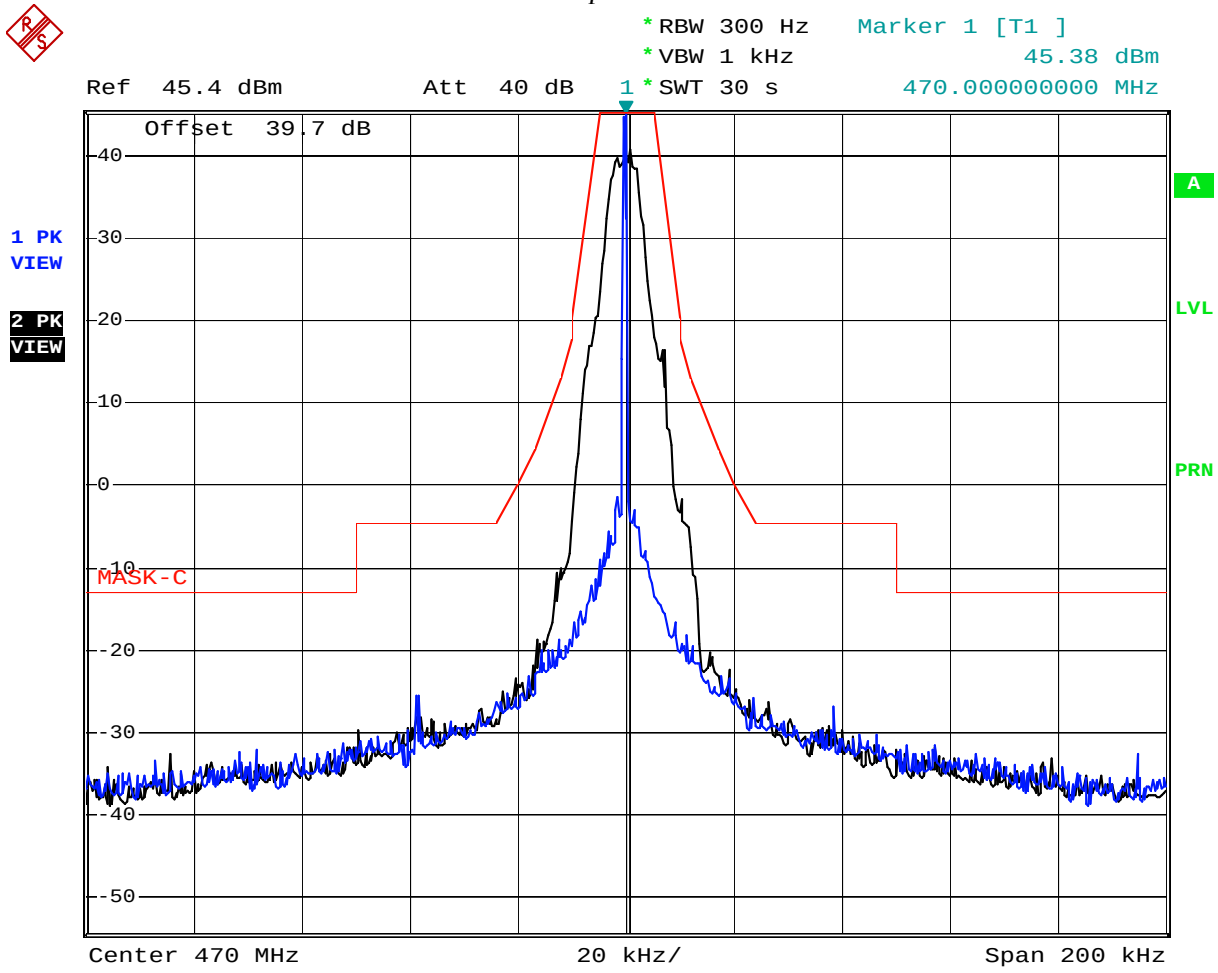
Comment: Emission Mask, 25 kHz ch. spacing, 8PSK
Date: 9.SEP.2009 18:52:54

Graph 5 19



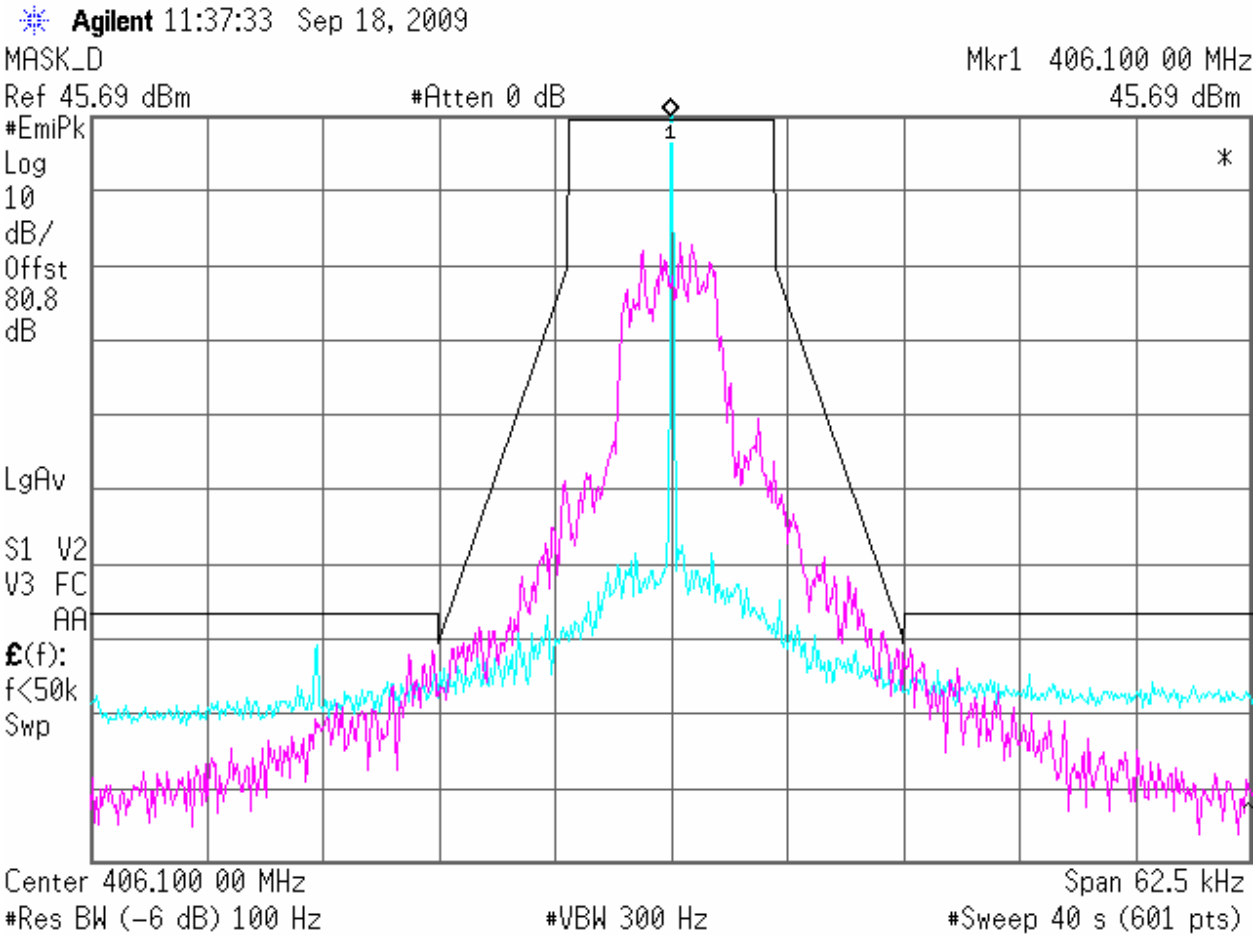
Comment: Emission Mask, 25 kHz ch. spacing, 16QAM
Date: 9.SEP.2009 18:55:12

Graph 5 20



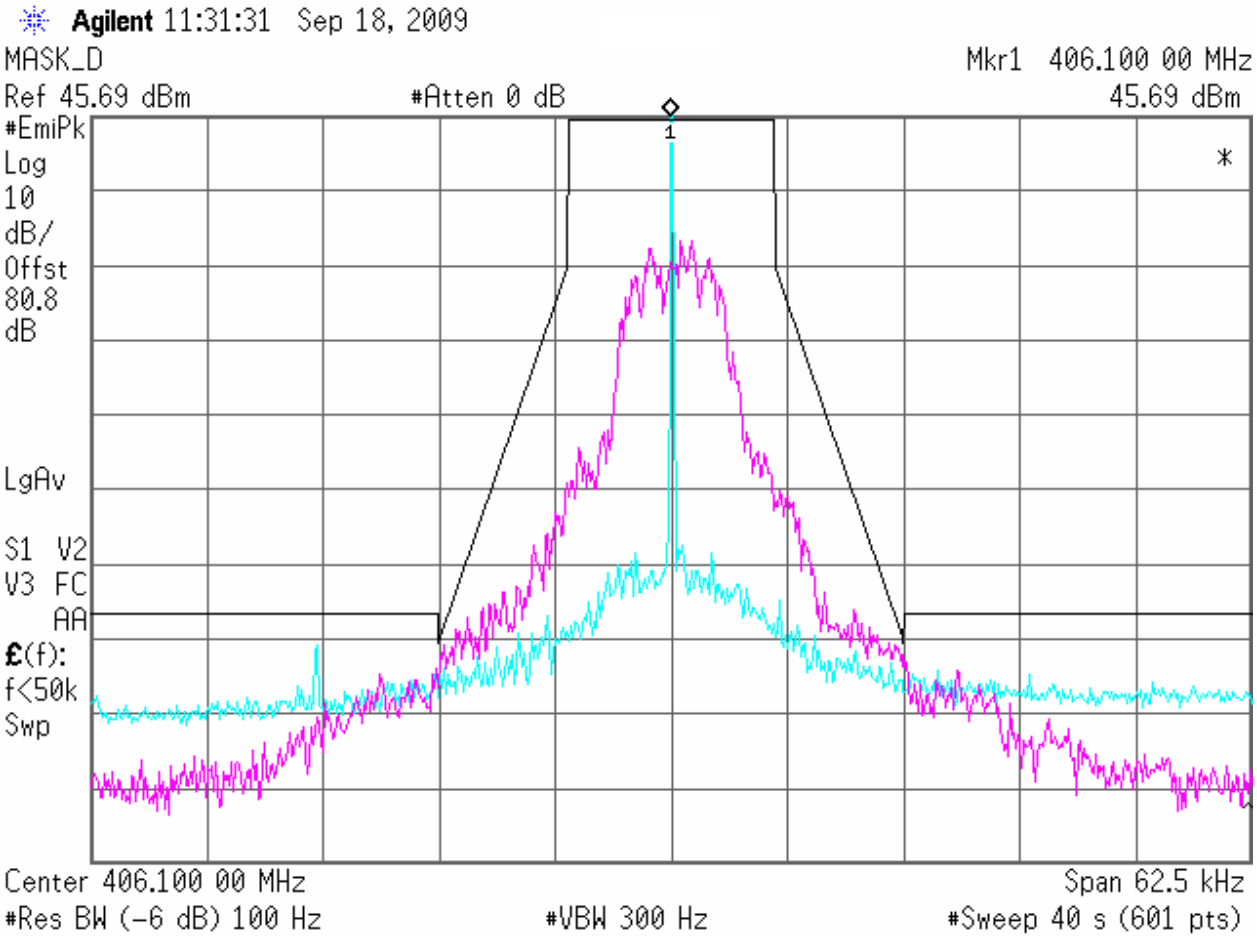
Comment: Emission Mask, 25 kHz ch. spacing, GMSK
Date: 9.SEP.2009 18:57:33

Graph 5 21



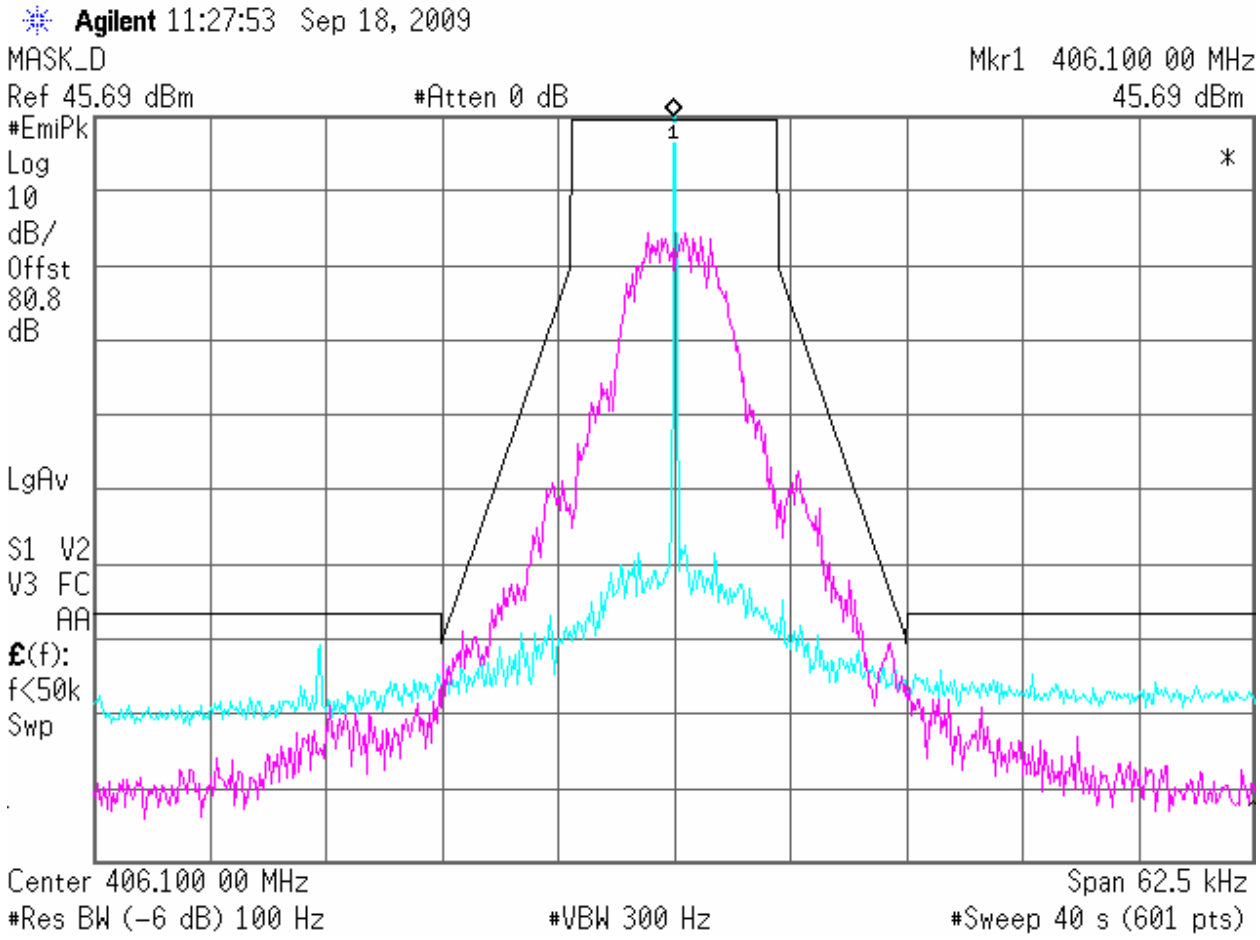
Emission Mask, 12.5kHz ch spacing, 16QAM

Graph 5 22



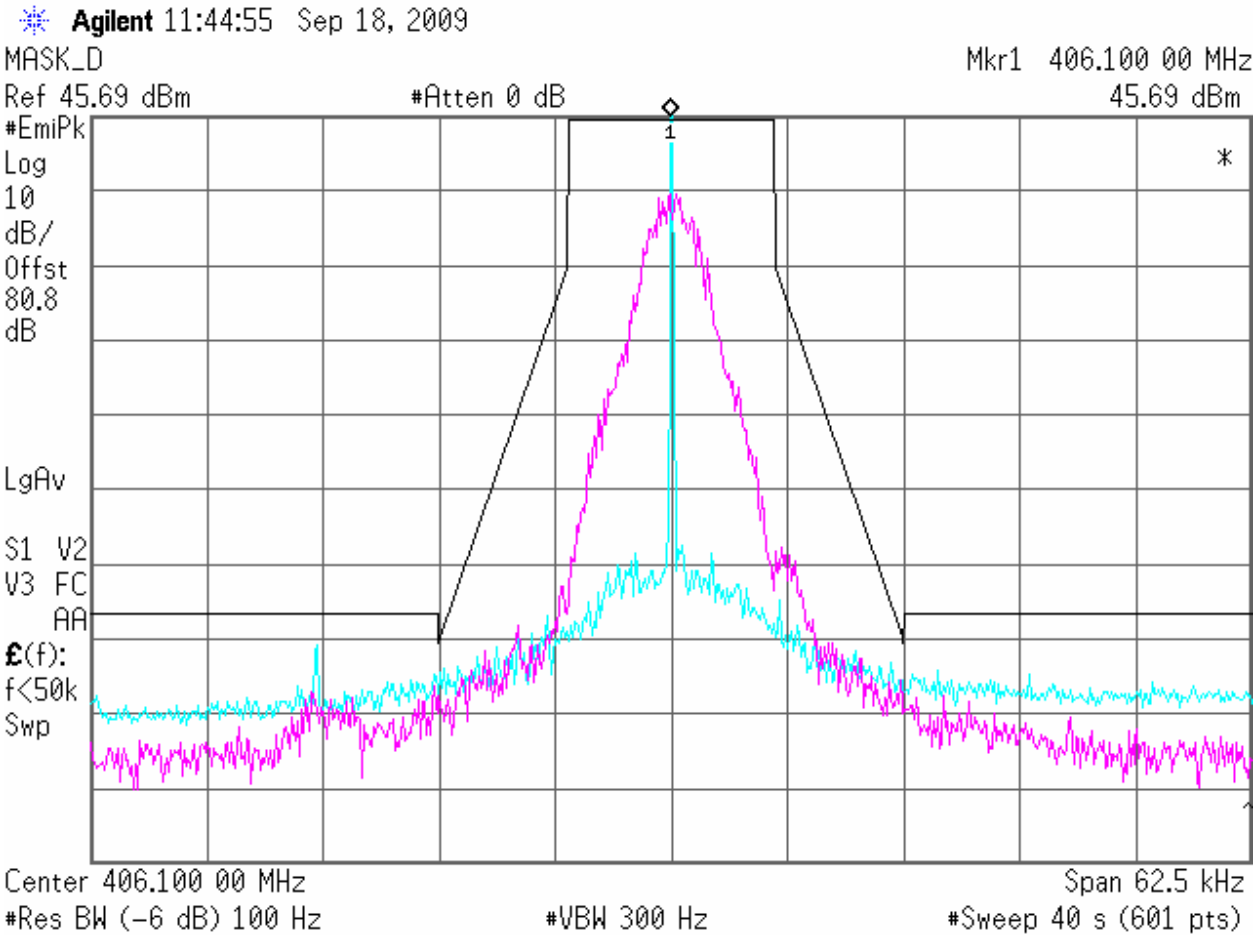
Emission Mask, 12.5kHz ch spacing, 8PSK

Graph 5 23



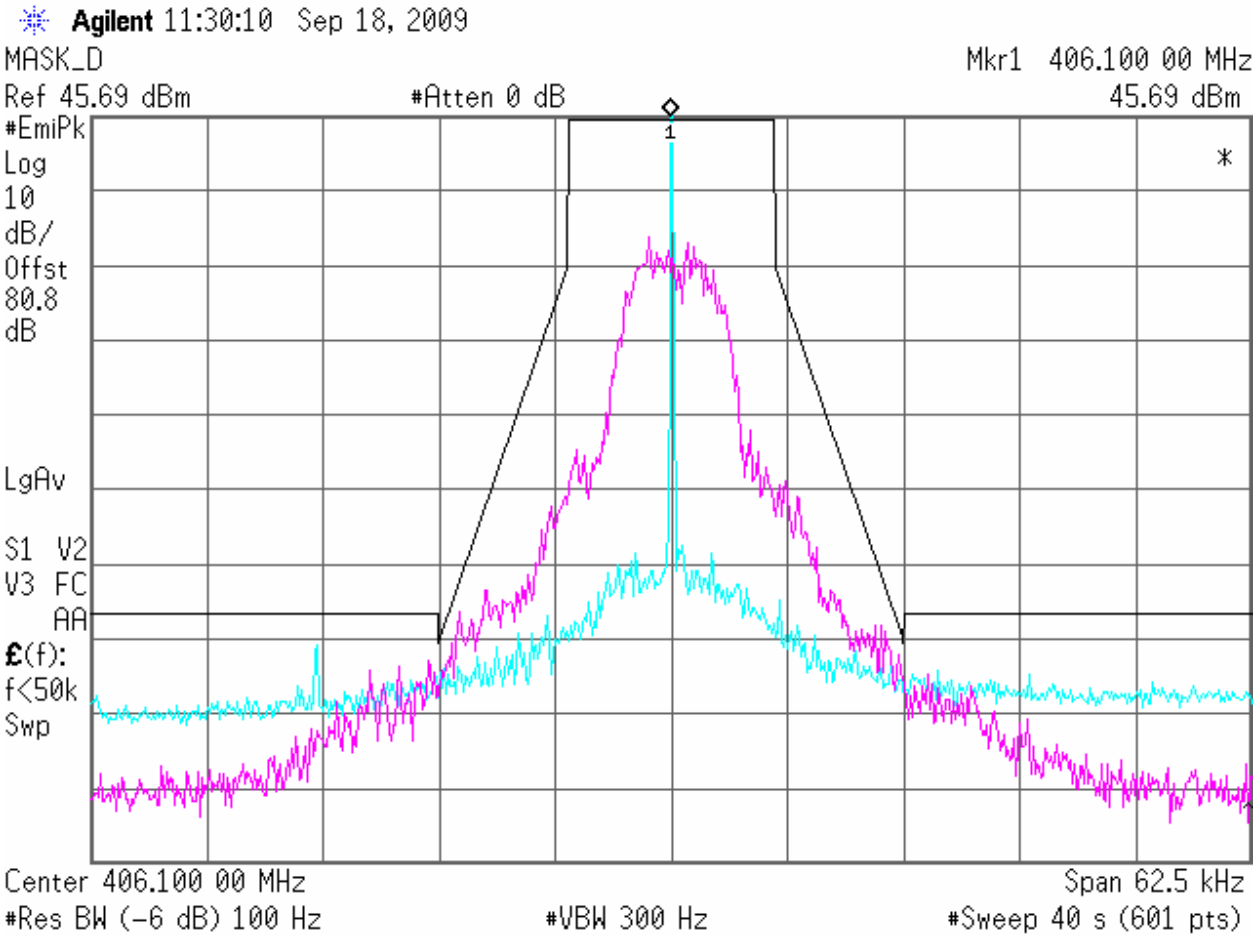
Emission Mask, 12.5kHz ch spacing, BPSK

Graph 5 24



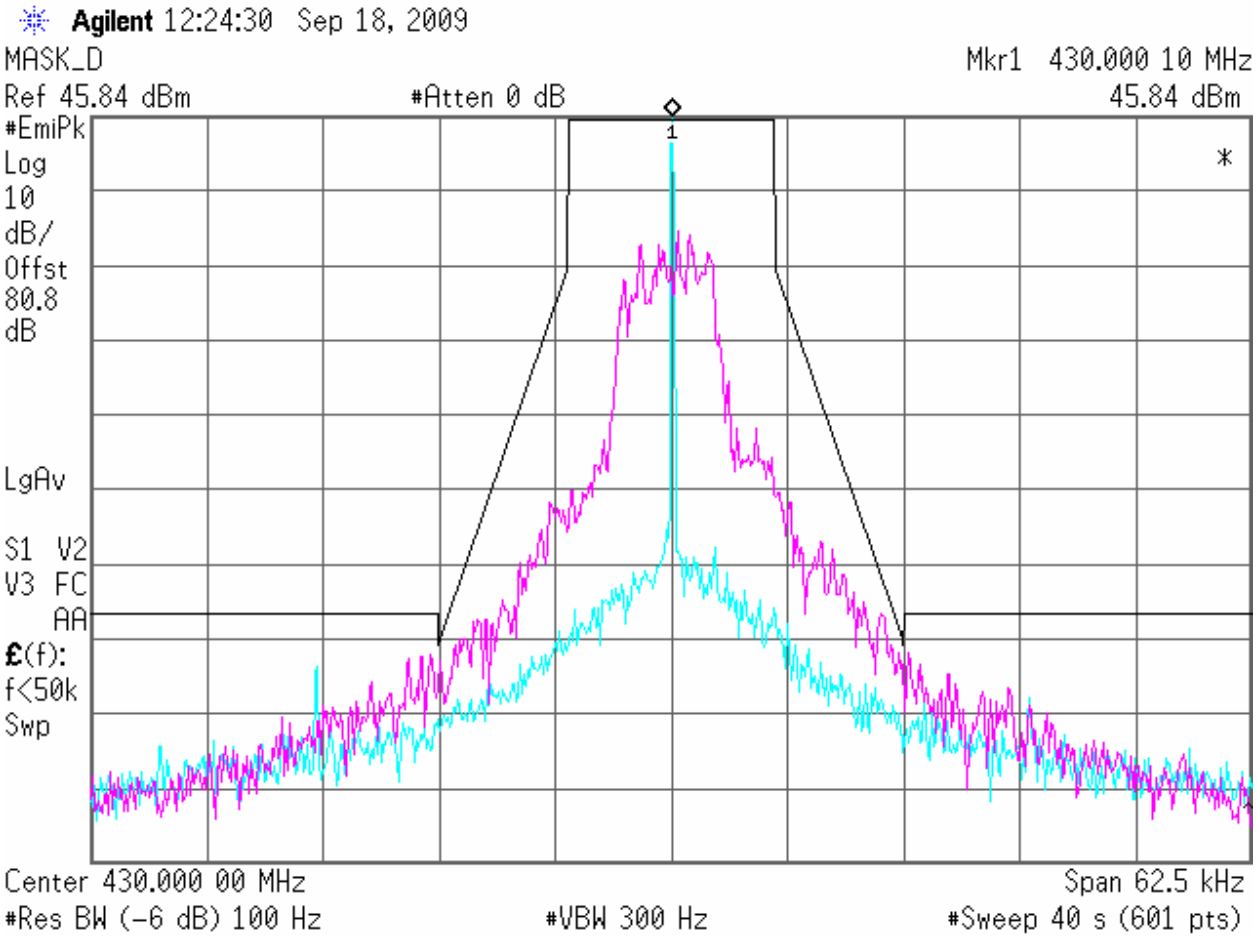
Emission Mask, 12.5kHz ch spacing, GMSK

Graph 5 25



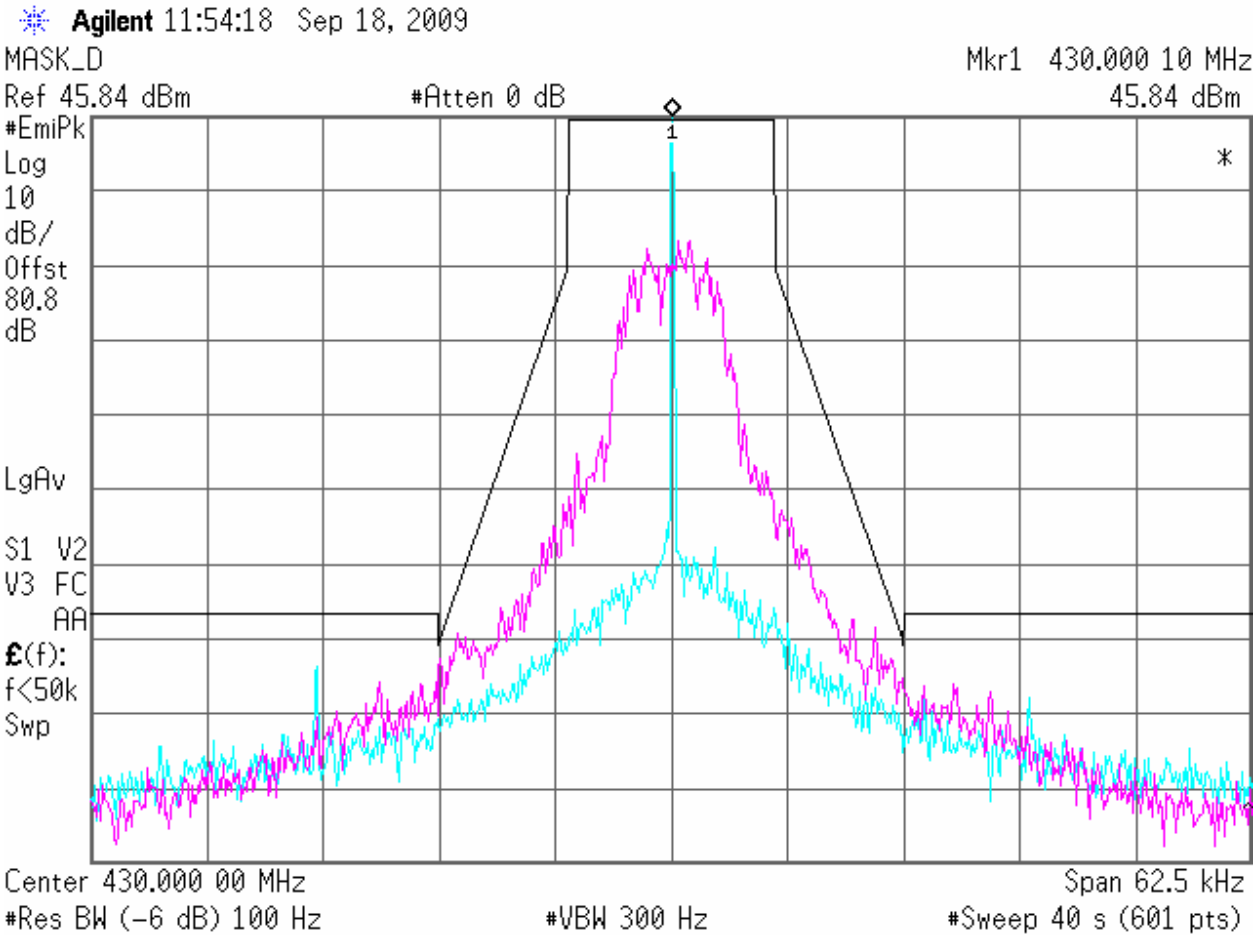
Emission Mask, 12.5kHz ch spacing, QPSK

Graph 5 26



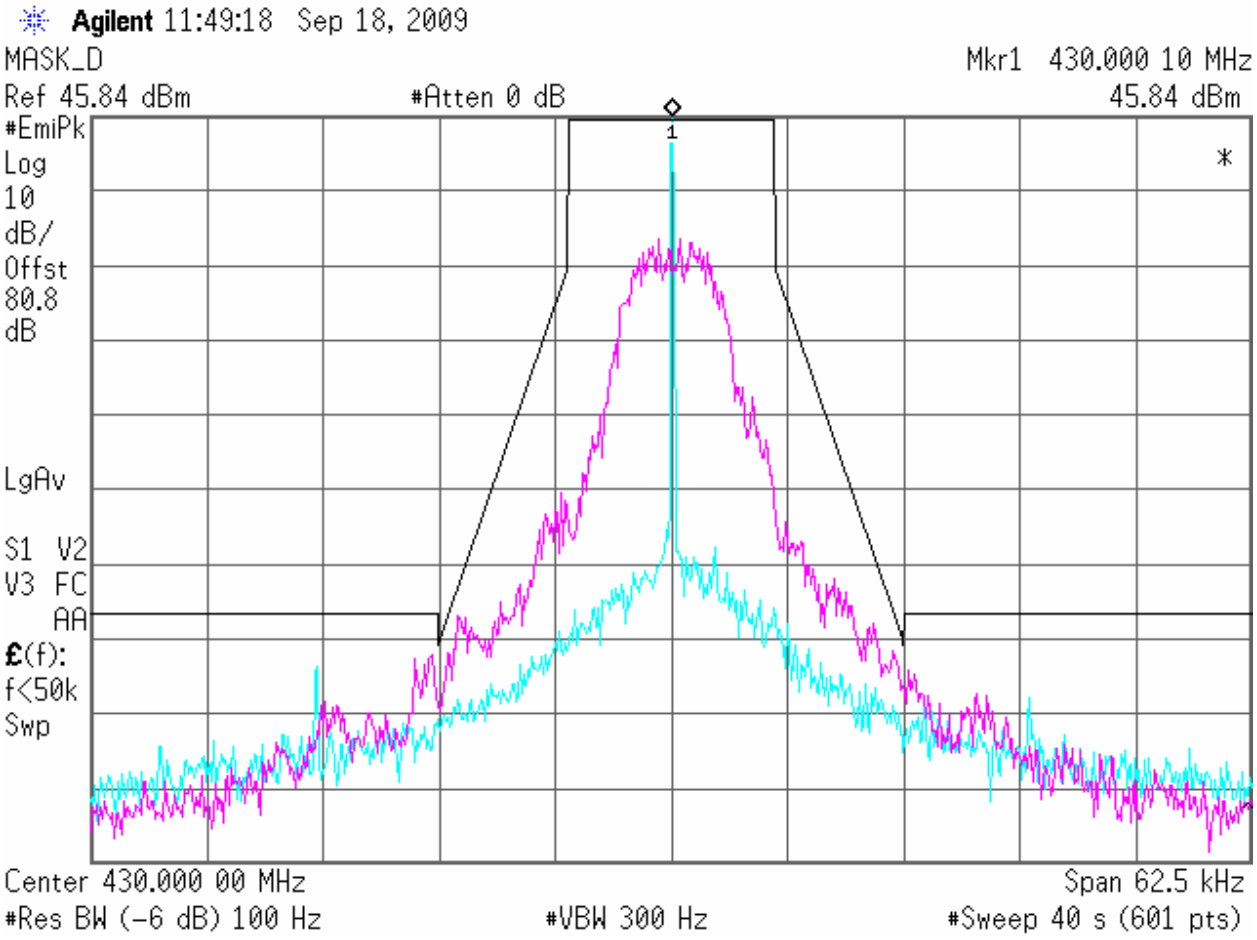
Emission Mask, 12.5kHz ch spacing, 16QAM

Graph 5 27



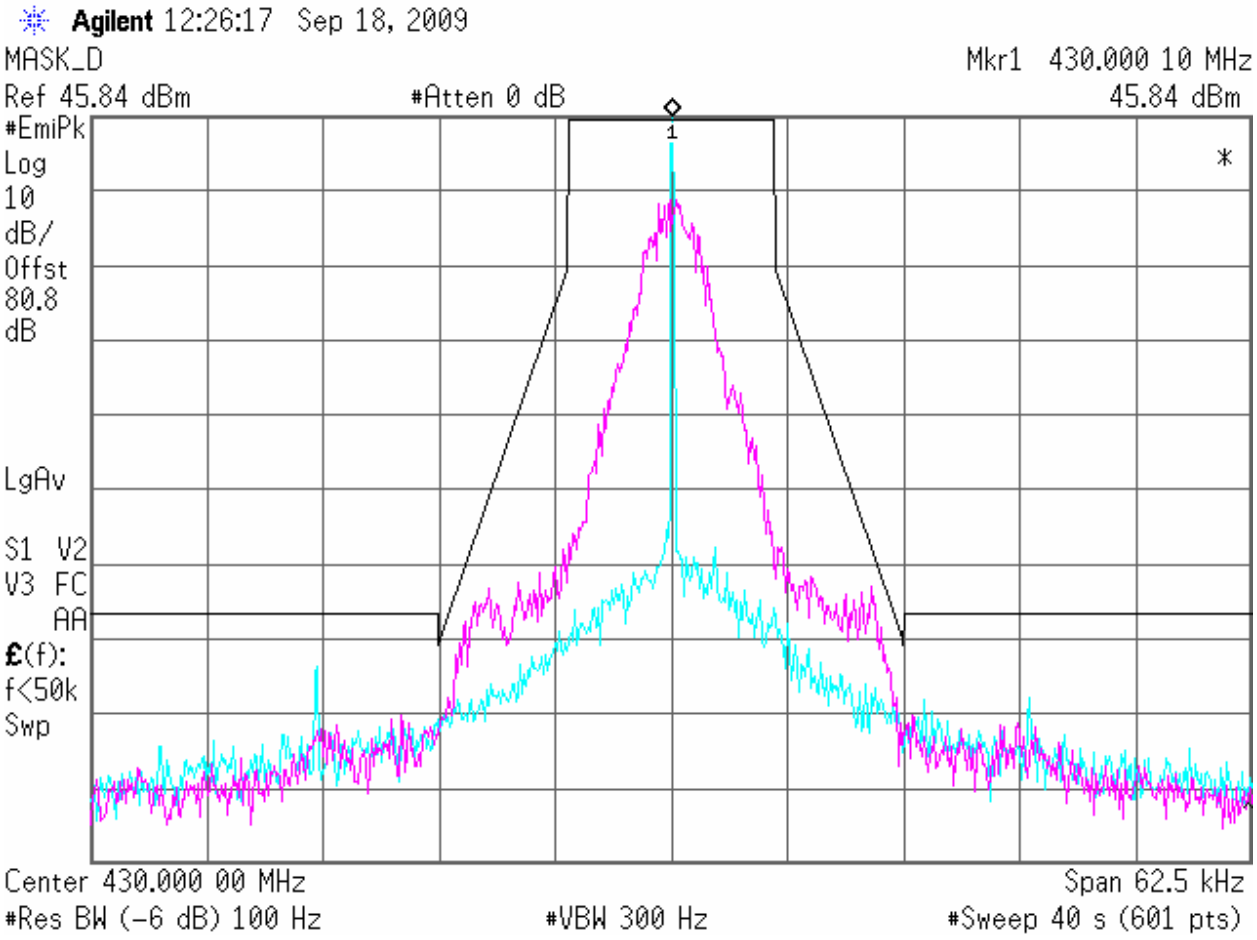
Emission Mask, 12.5kHz ch spacing, 8PSK

Graph 5 28



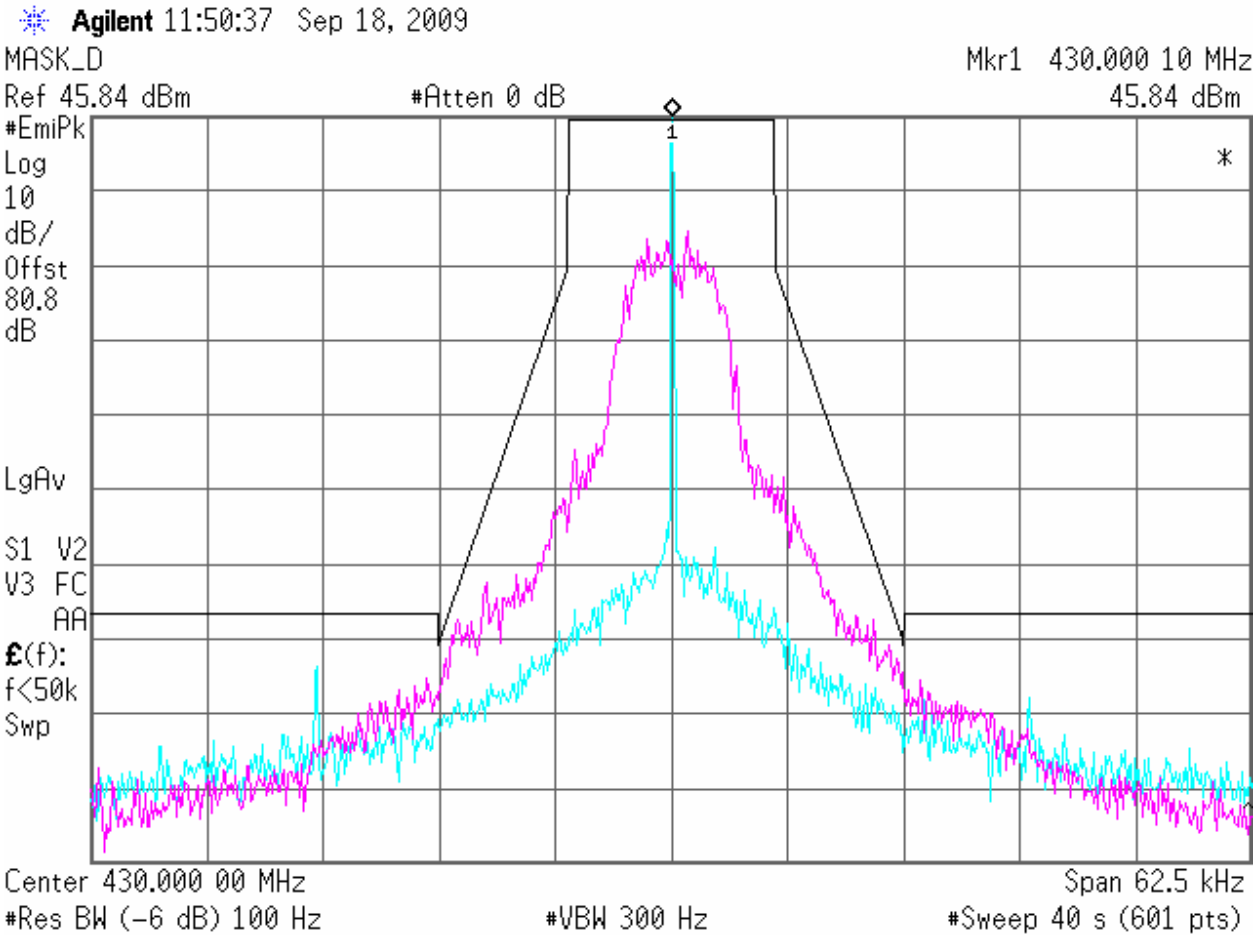
Emission Mask, 12.5kHz ch spacing, BPSK

Graph 5 29



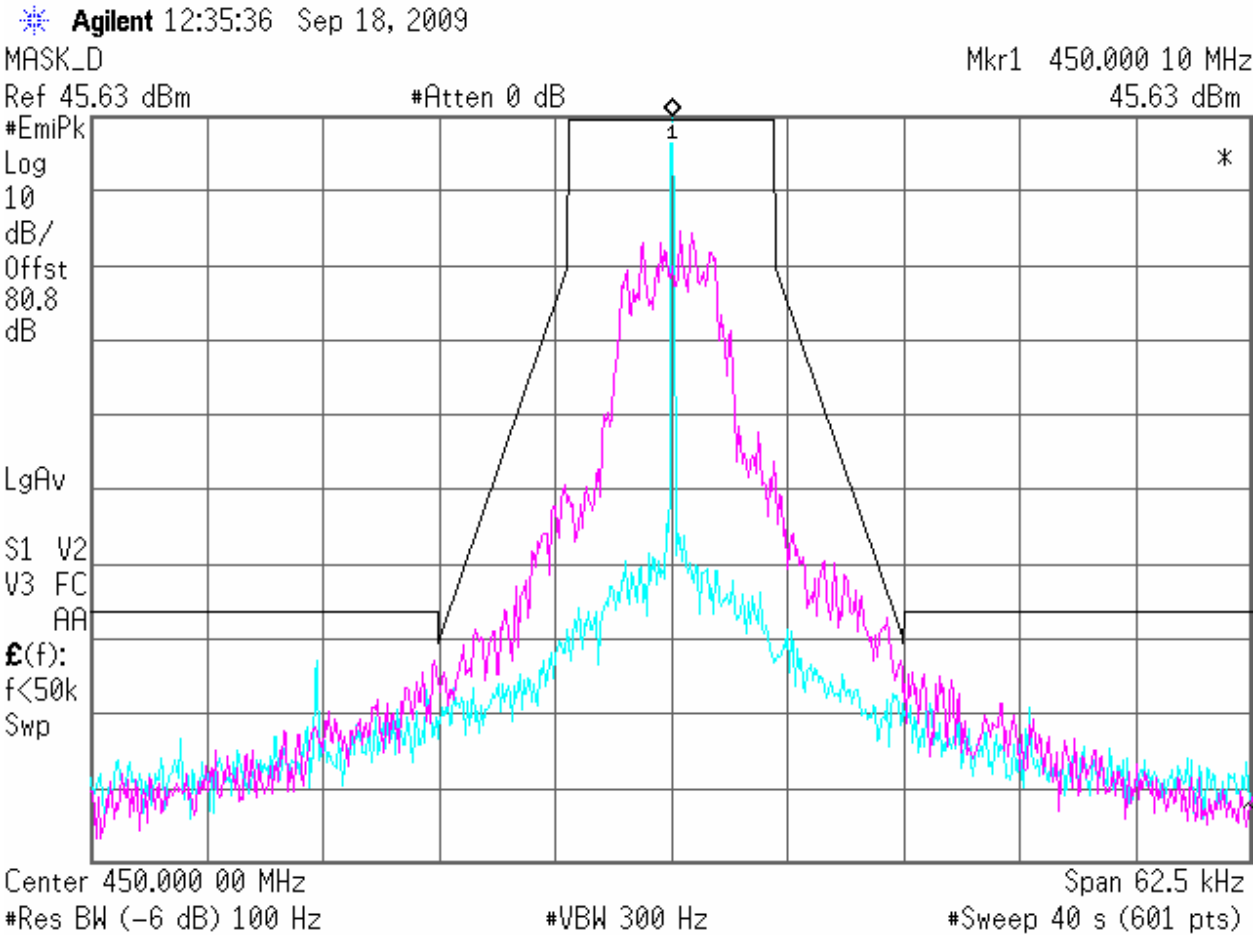
Emission Mask, 12.5kHz ch spacing, GMSK

Graph 5 30



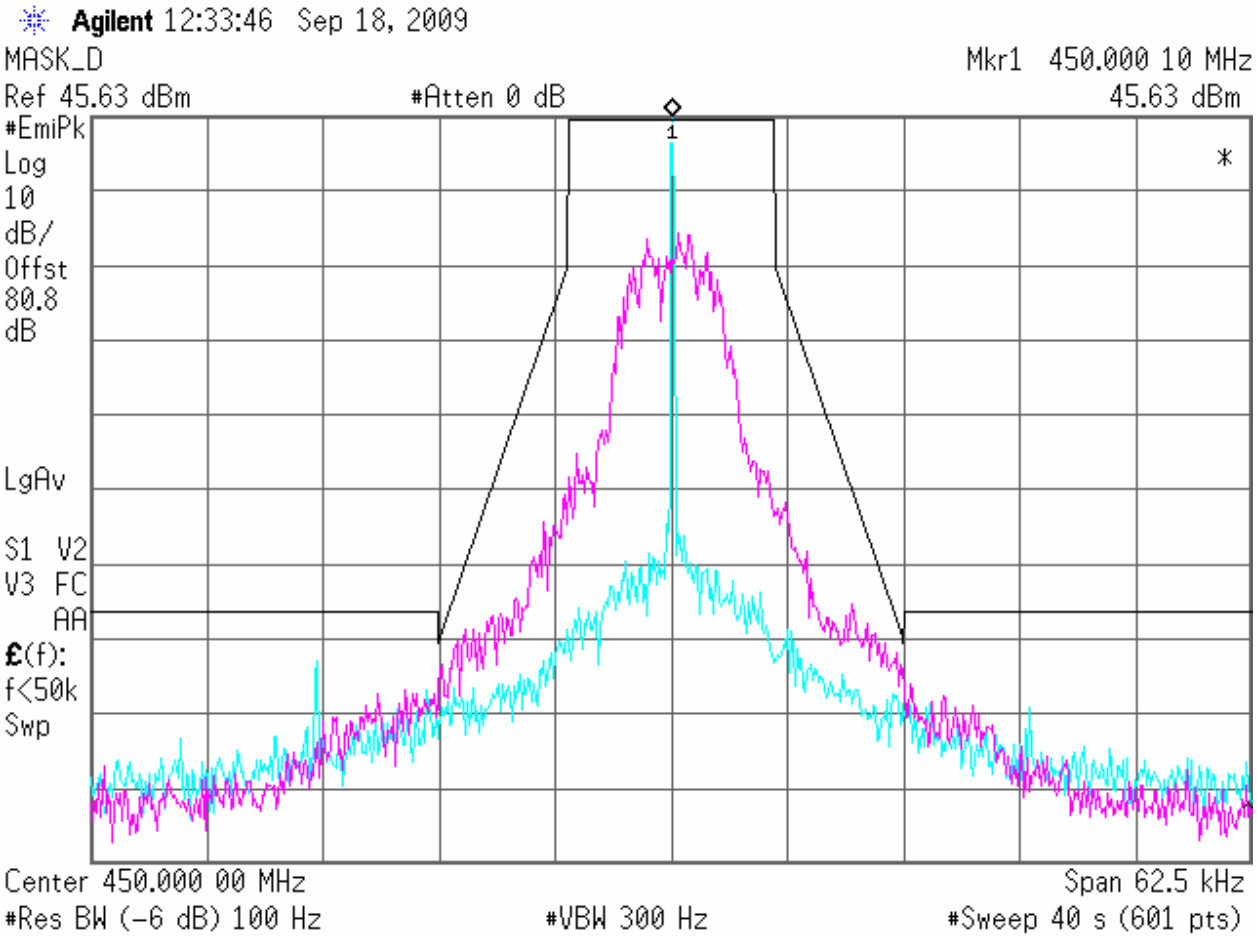
Emission Mask, 12.5kHz ch spacing, QPSK

Graph 5 31



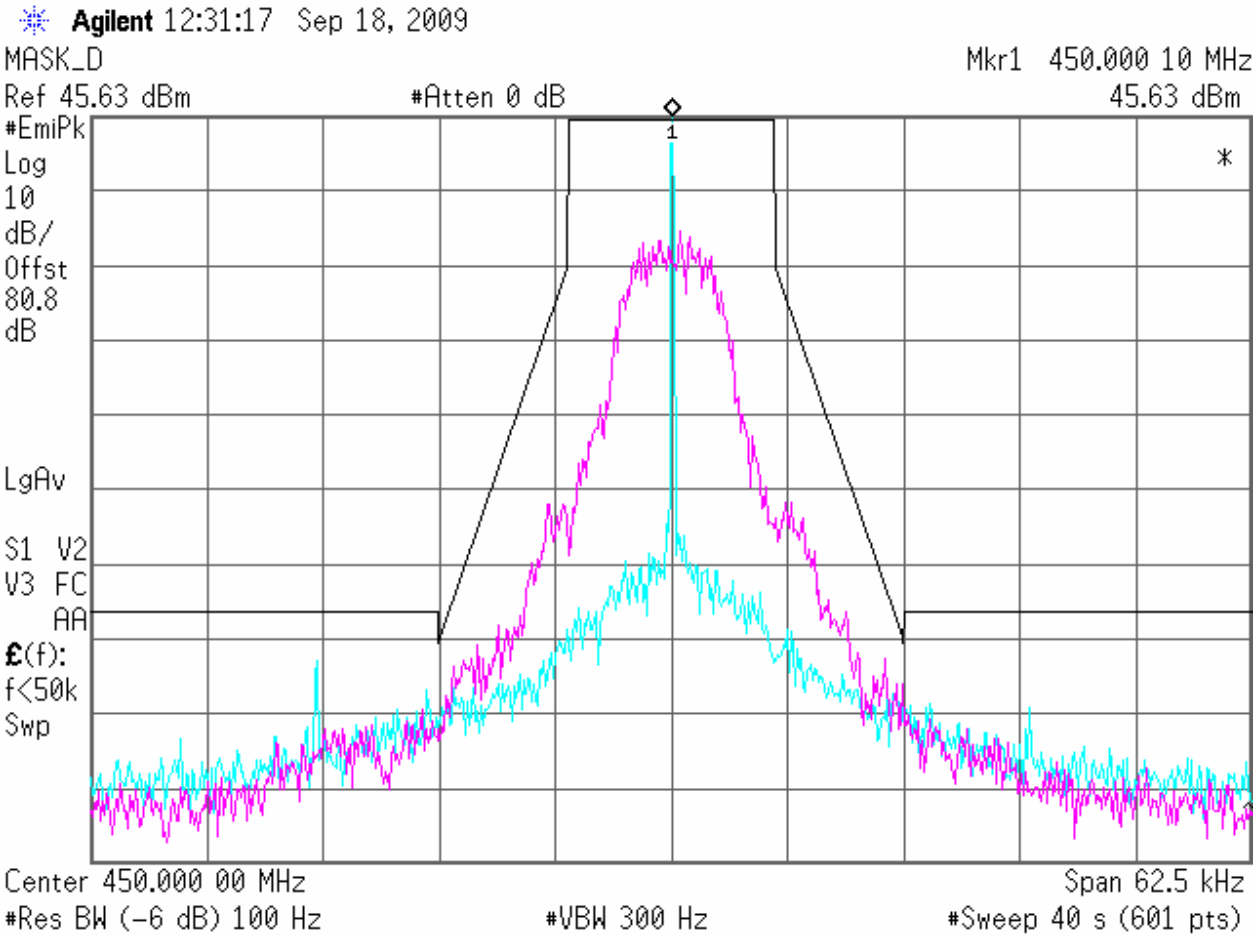
Emission Mask, 12.5kHz ch spacing, 16QAM

Graph 5 32



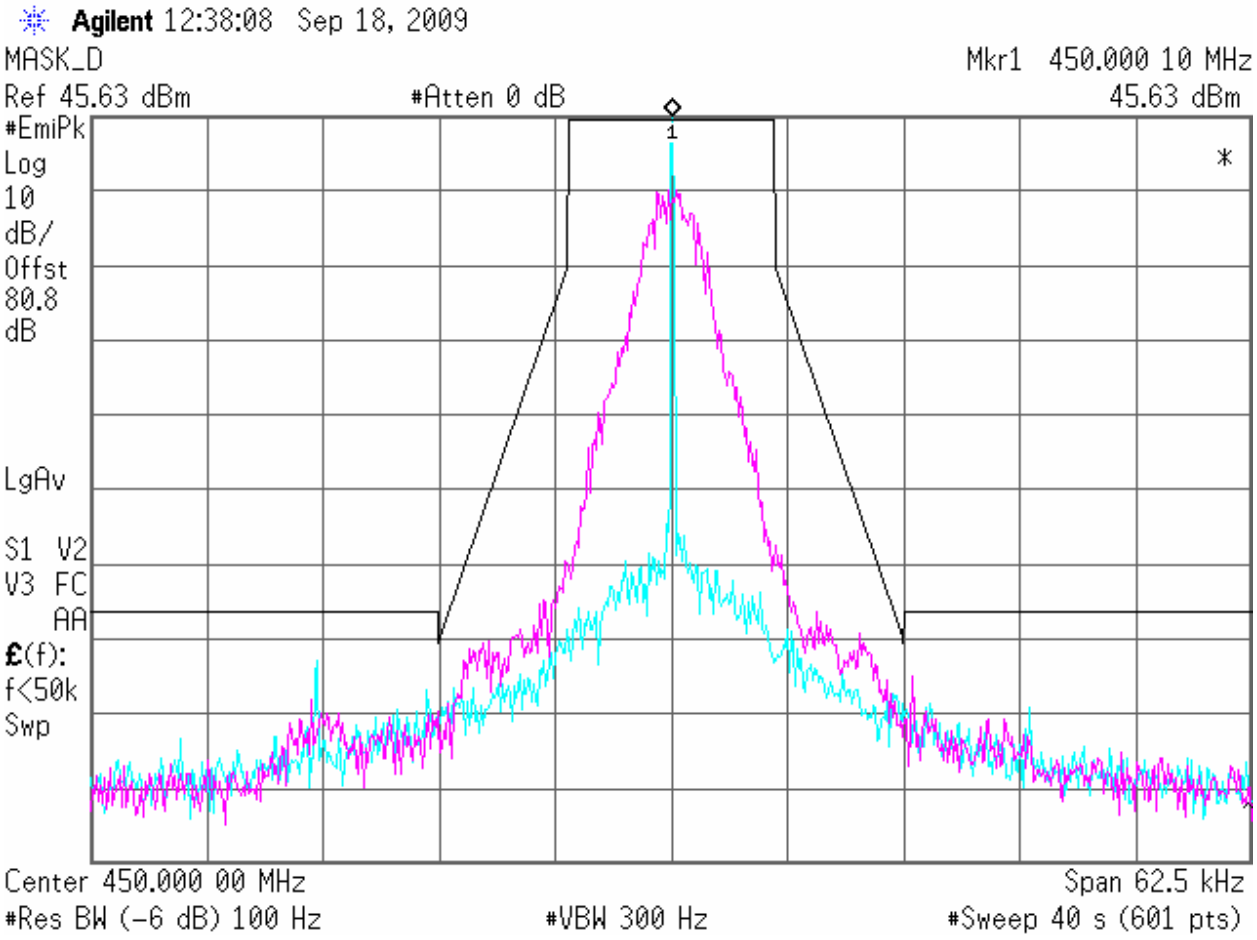
Emission Mask, 12.5kHz ch spacing, 8PSK

Graph 5 33



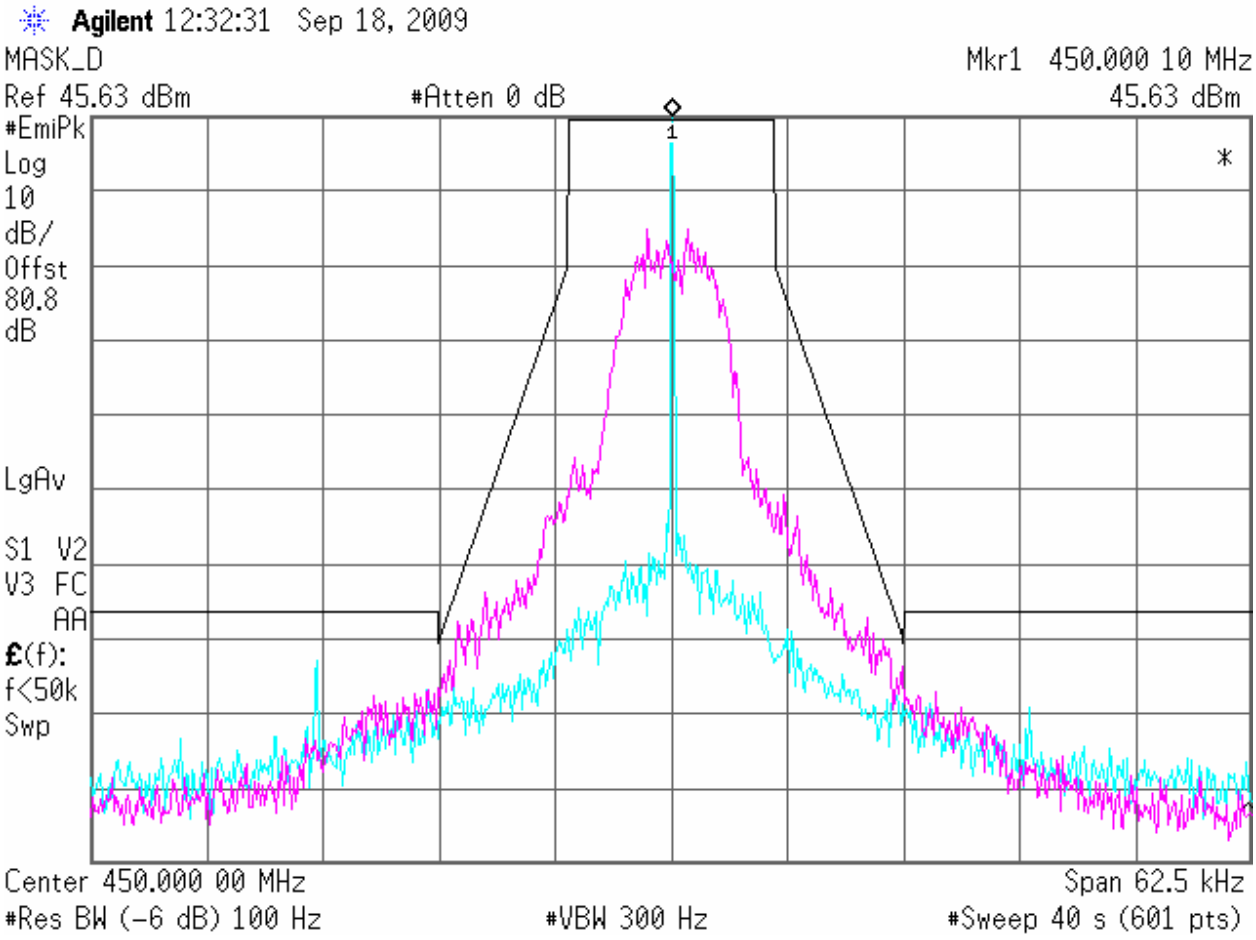
Emission Mask, 12.5kHz ch spacing, BPSK

Graph 5 34



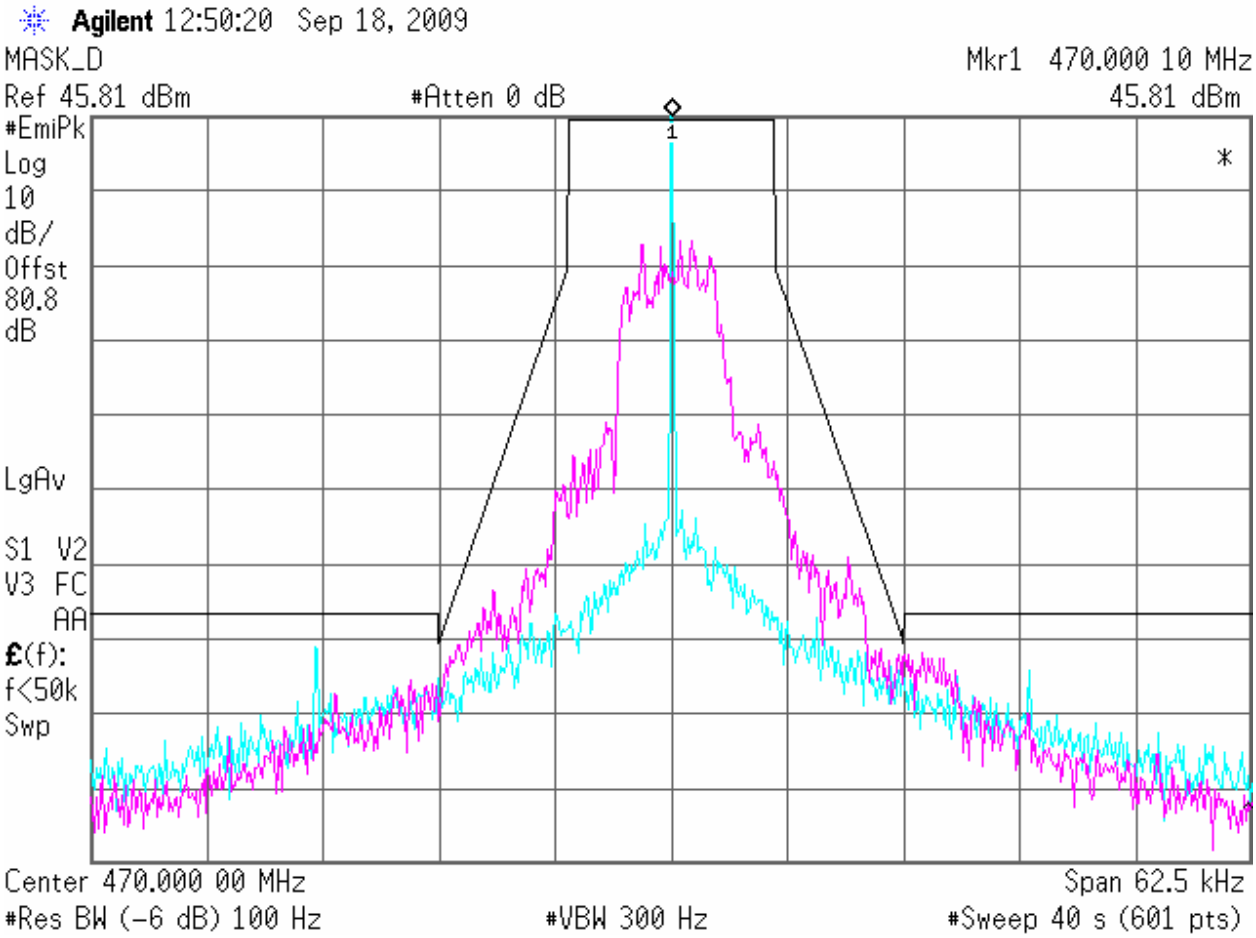
Emission Mask, 12.5kHz ch spacing, GMSK

Graph 5 35



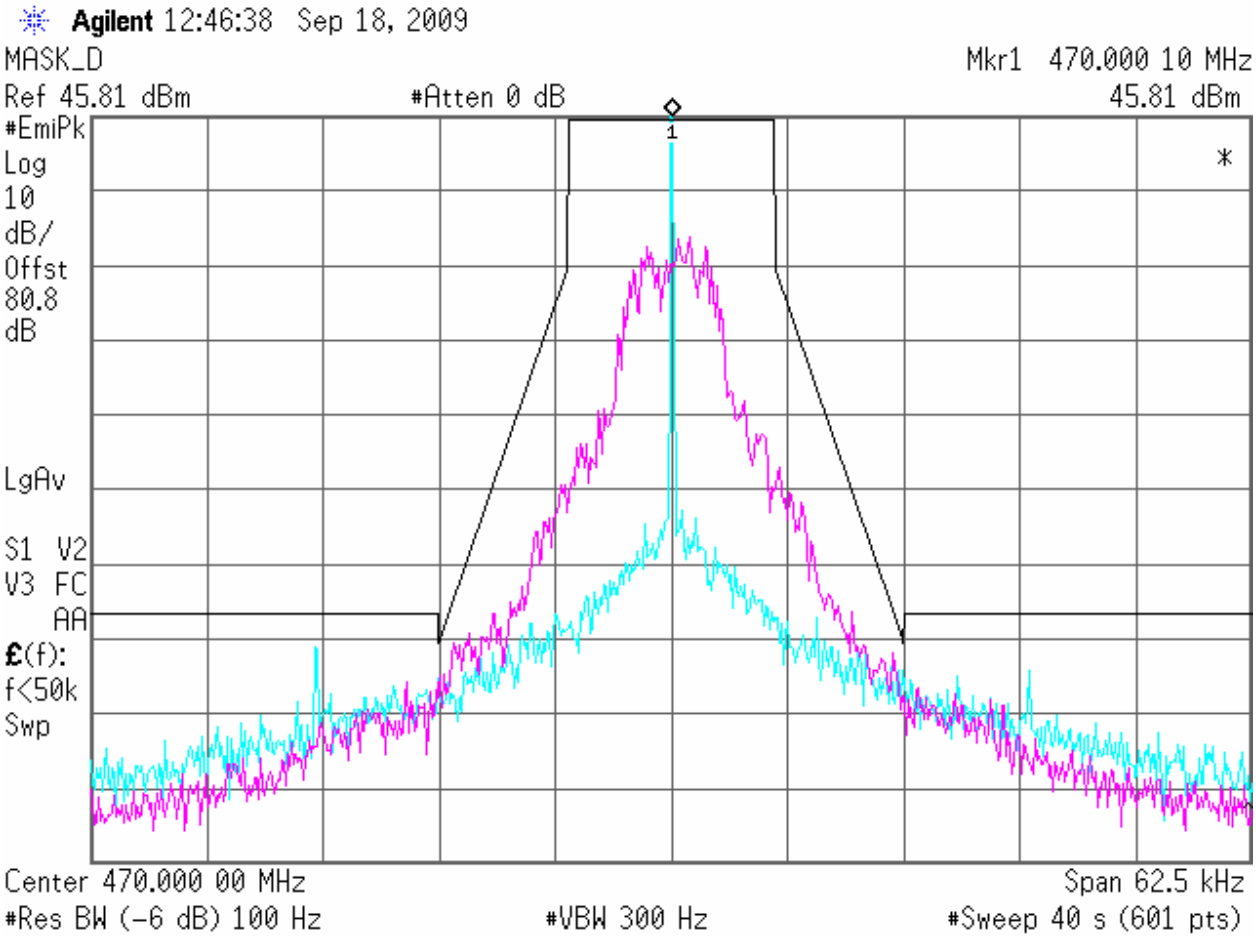
Emission Mask, 12.5kHz ch spacing, QPSK

Graph 5 36



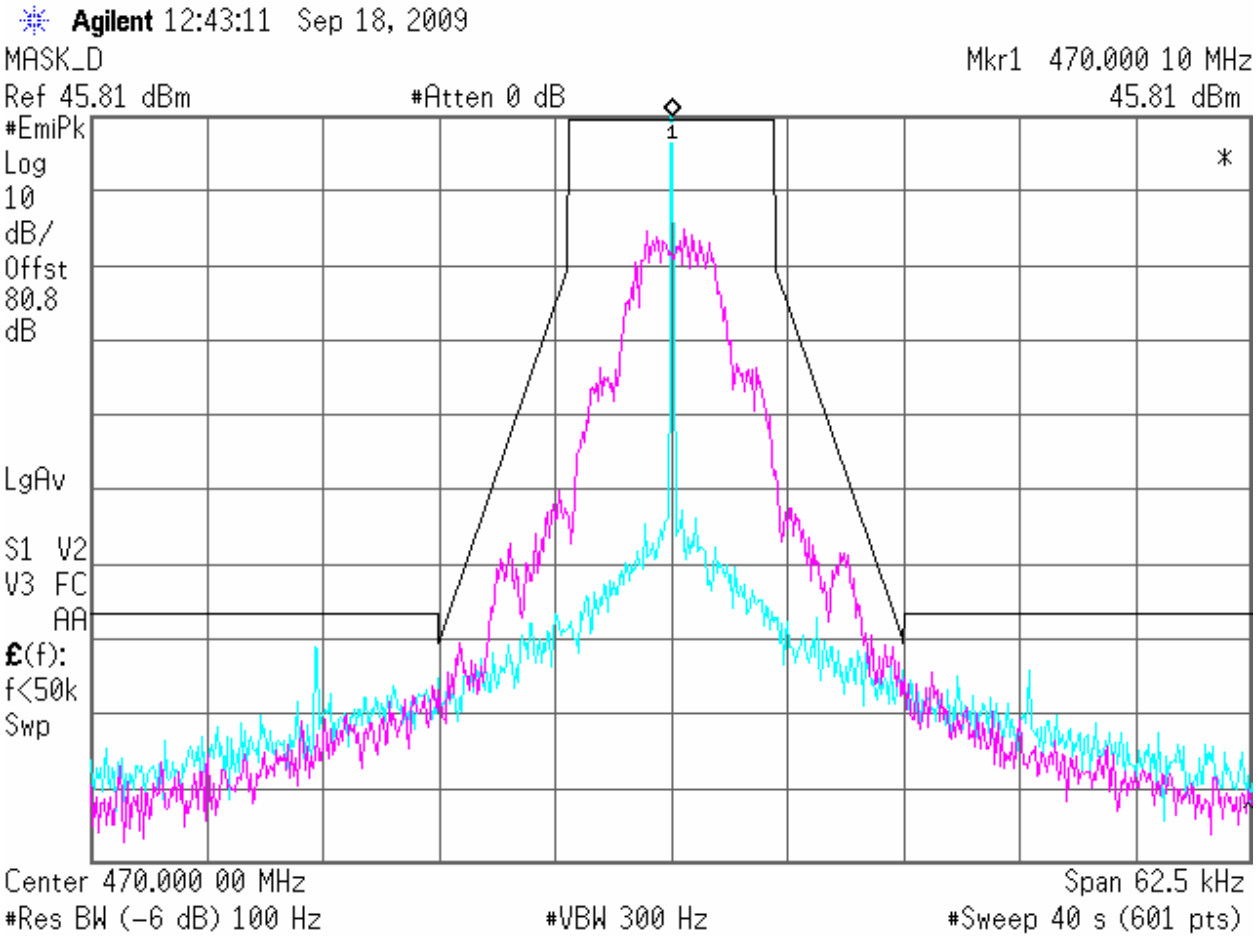
Emission Mask, 12.5kHz ch spacing, 16QAM

Graph 5 37



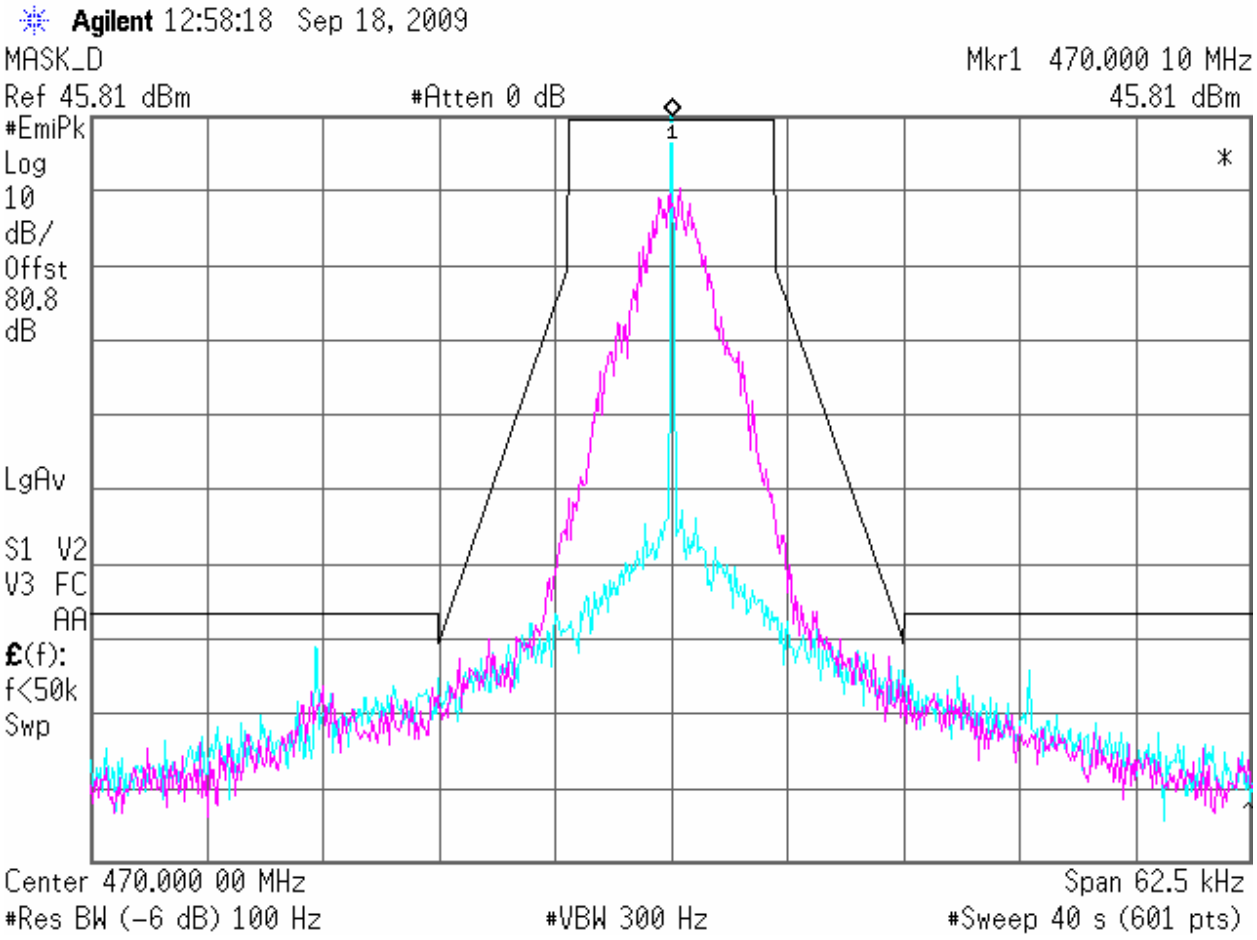
Emission Mask, 12.5kHz ch spacing, 8PSK

Graph 5 38



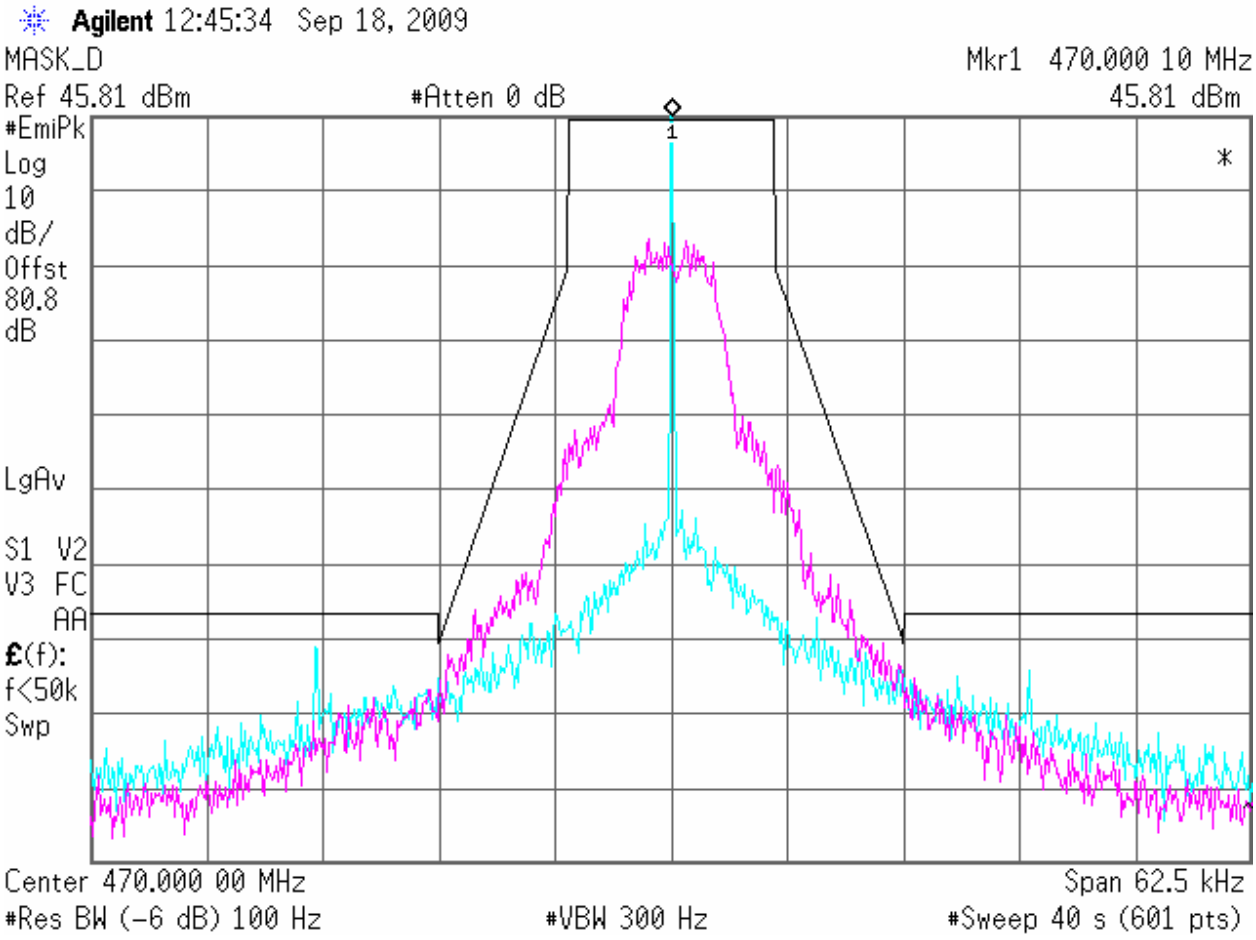
Emission Mask, 12.5kHz ch spacing, BPSK

Graph 5 39



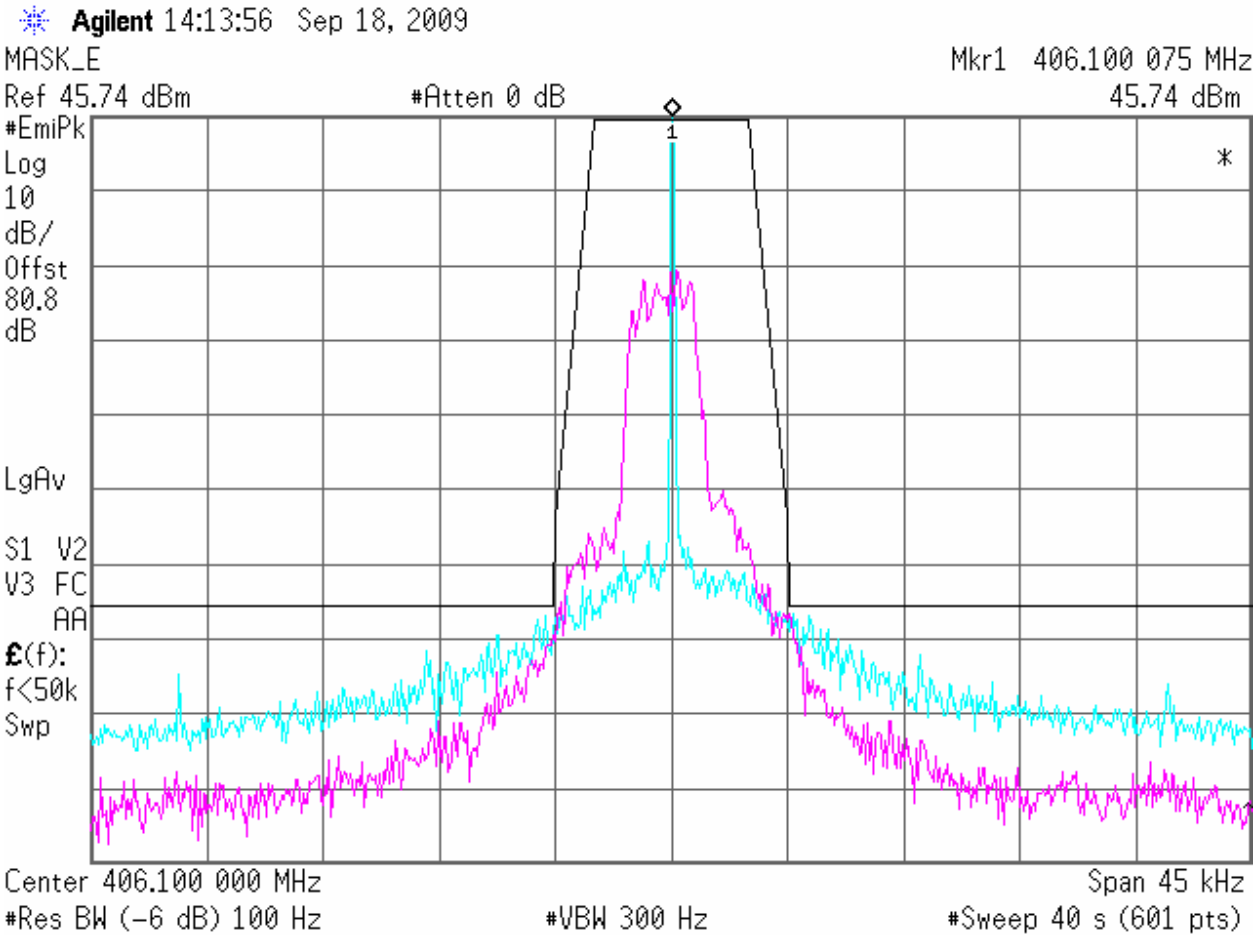
Emission Mask, 12.5kHz ch spacing, GMSK

Graph 5 40



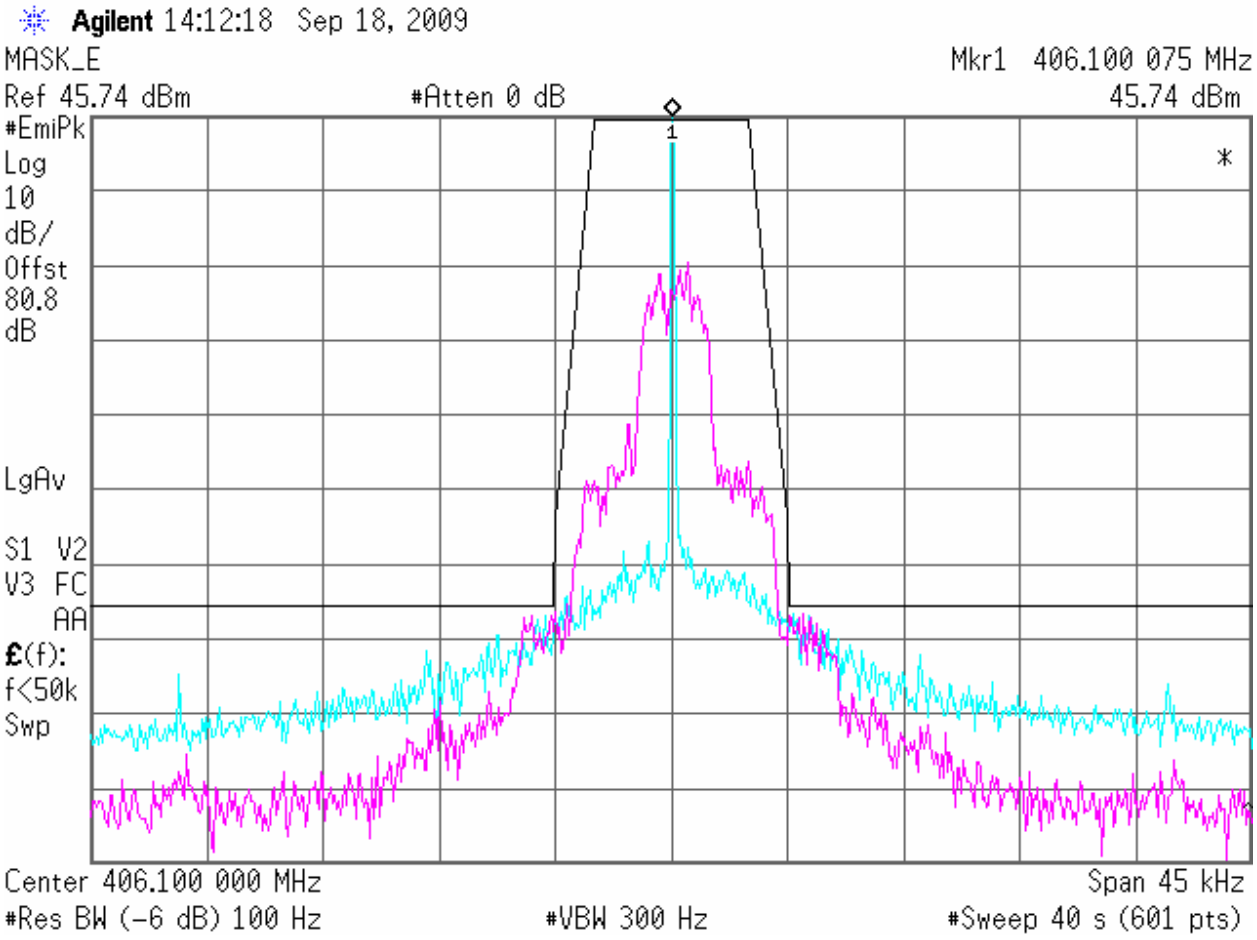
Emission Mask, 12.5kHz ch spacing, QPSK

Graph 5 41



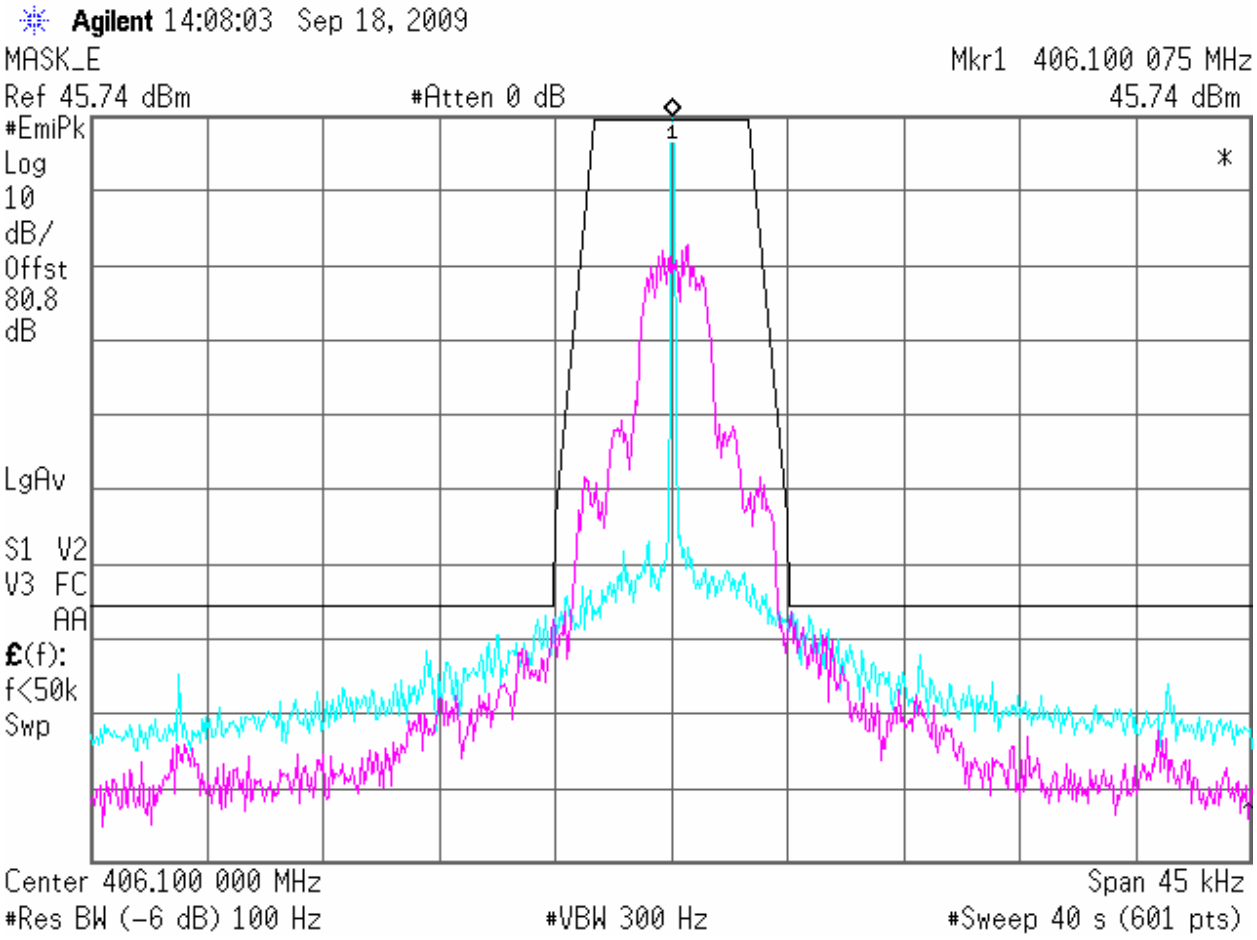
Emission Mask, 6.25kHz ch spacing, 16QAM

Graph 5 42



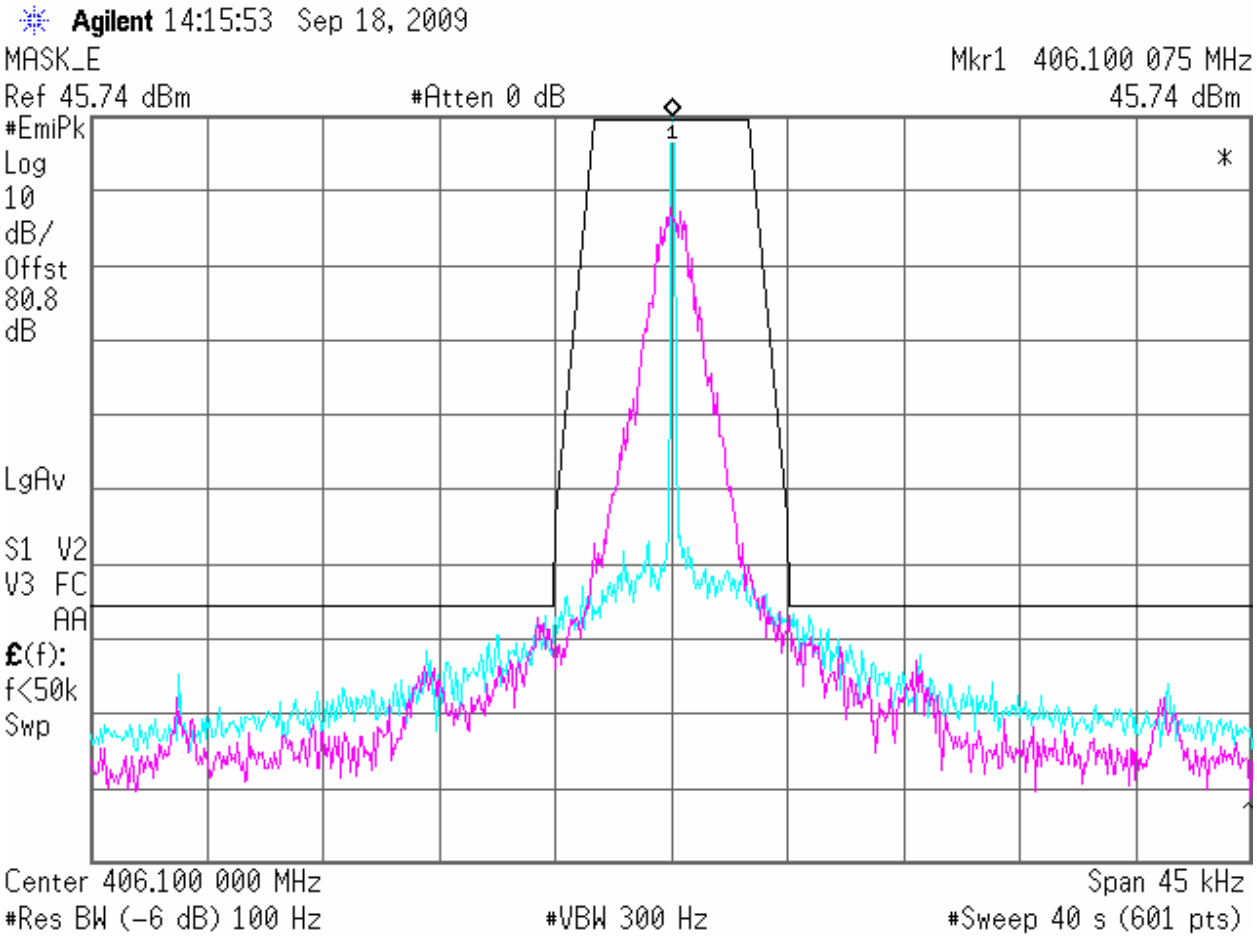
Emission Mask, 6.25kHz ch spacing, 8PSK

Graph 5 43



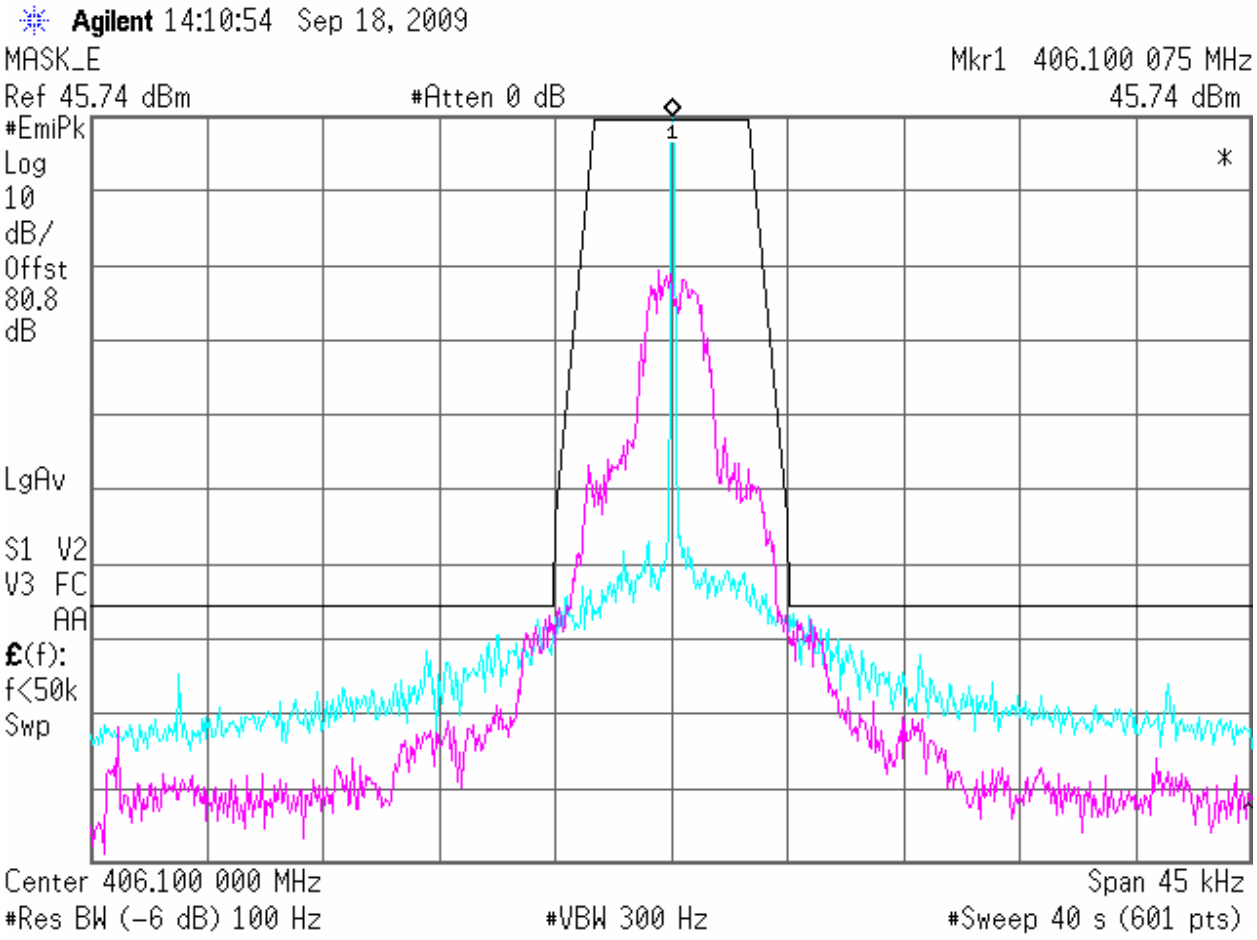
Emission Mask, 6.25kHz ch spacing, BPSK

Graph 5 44



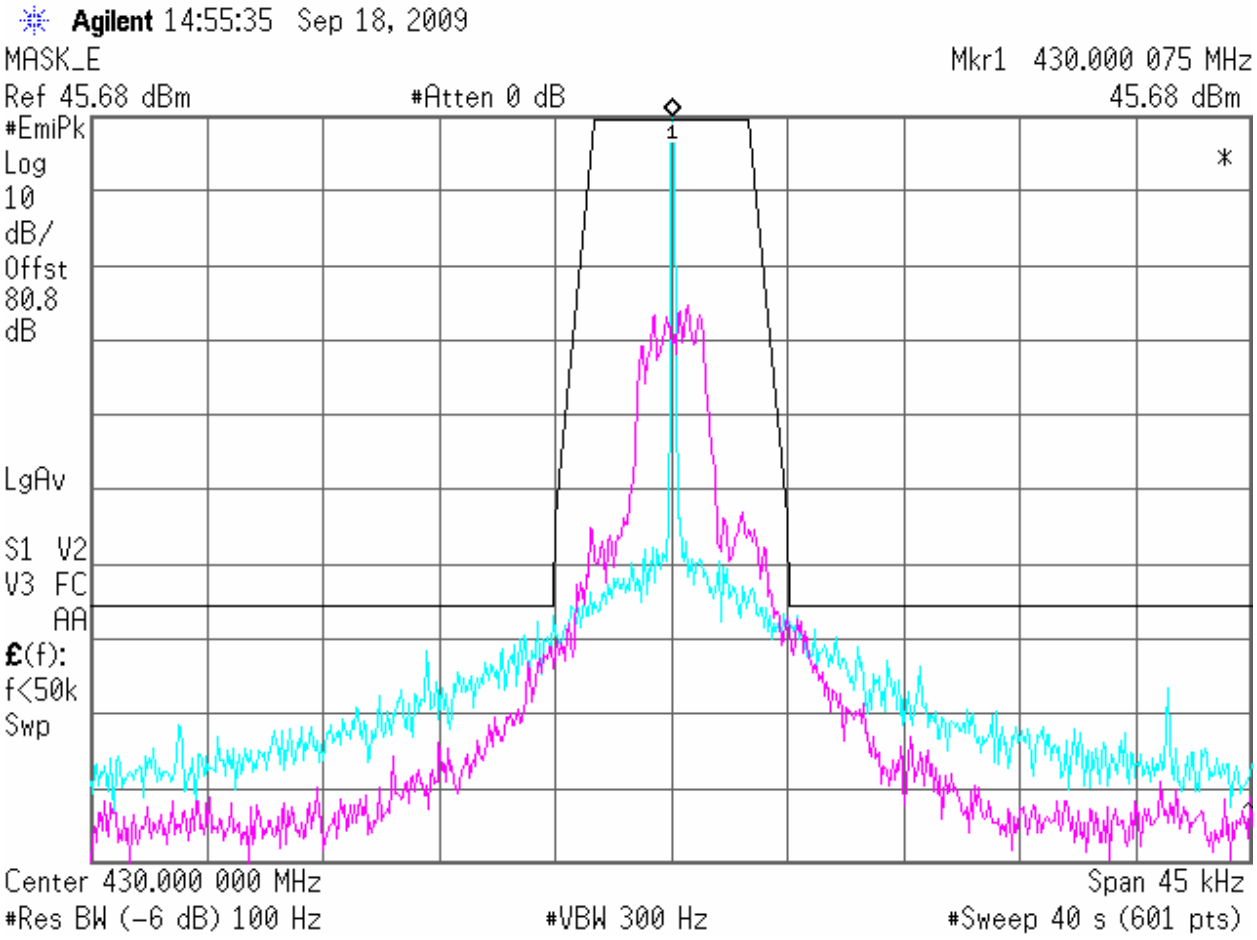
Emission Mask, 6.25kHz ch spacing, GMSK

Graph 5 45



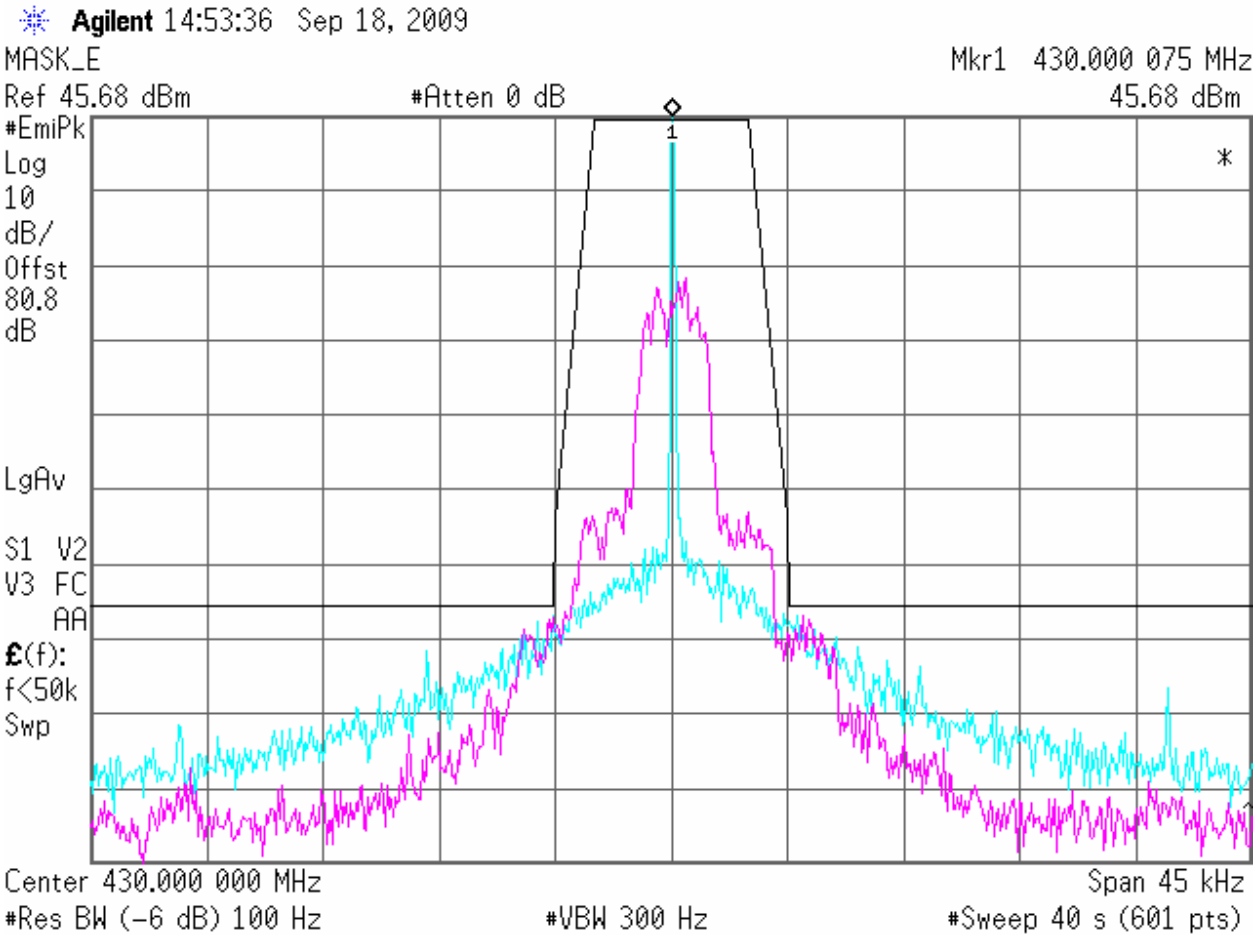
Emission Mask, 6.25kHz ch spacing, QPSK

Graph 5 46



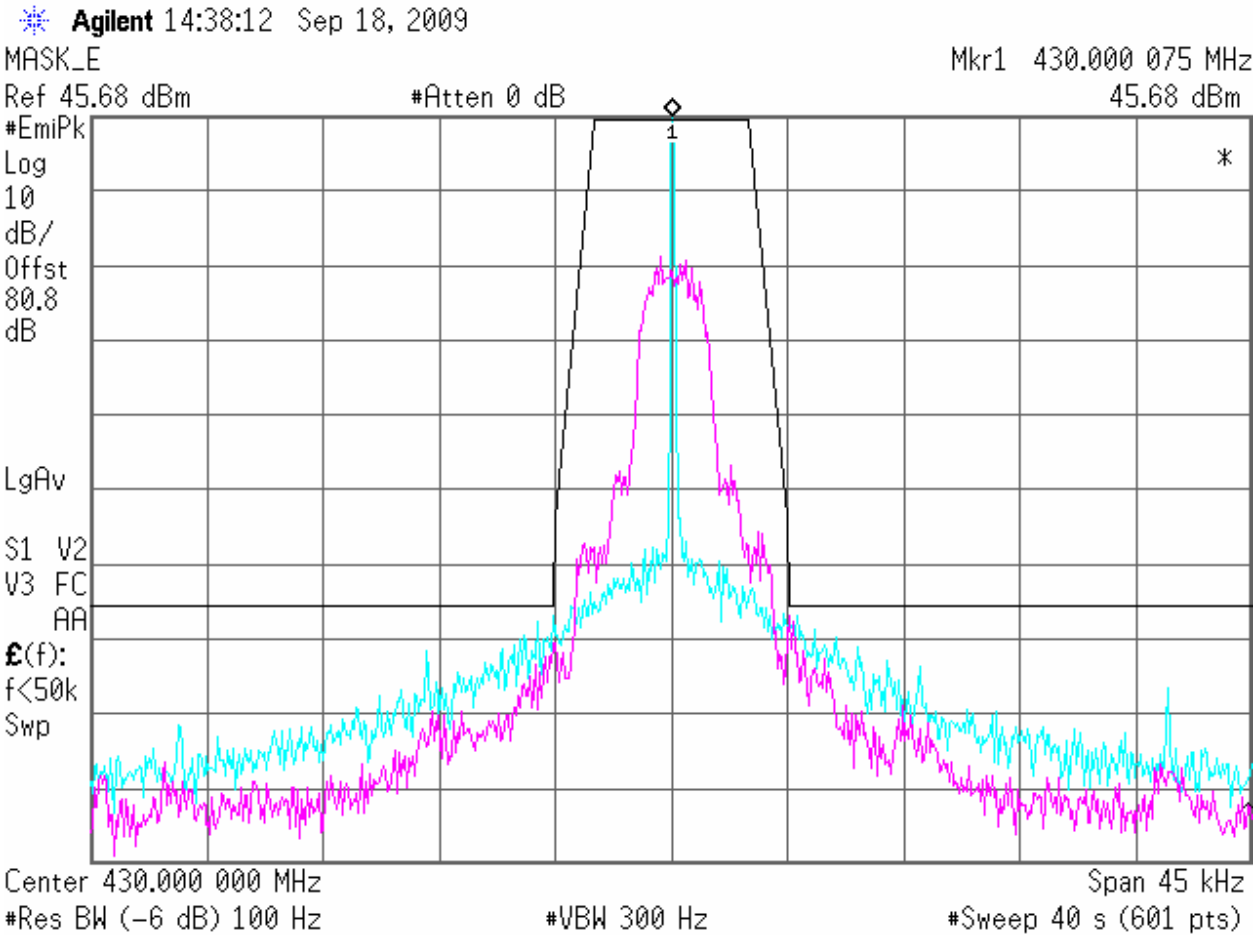
Emission Mask, 6.25kHz ch spacing, 16QAM

Graph 5 47



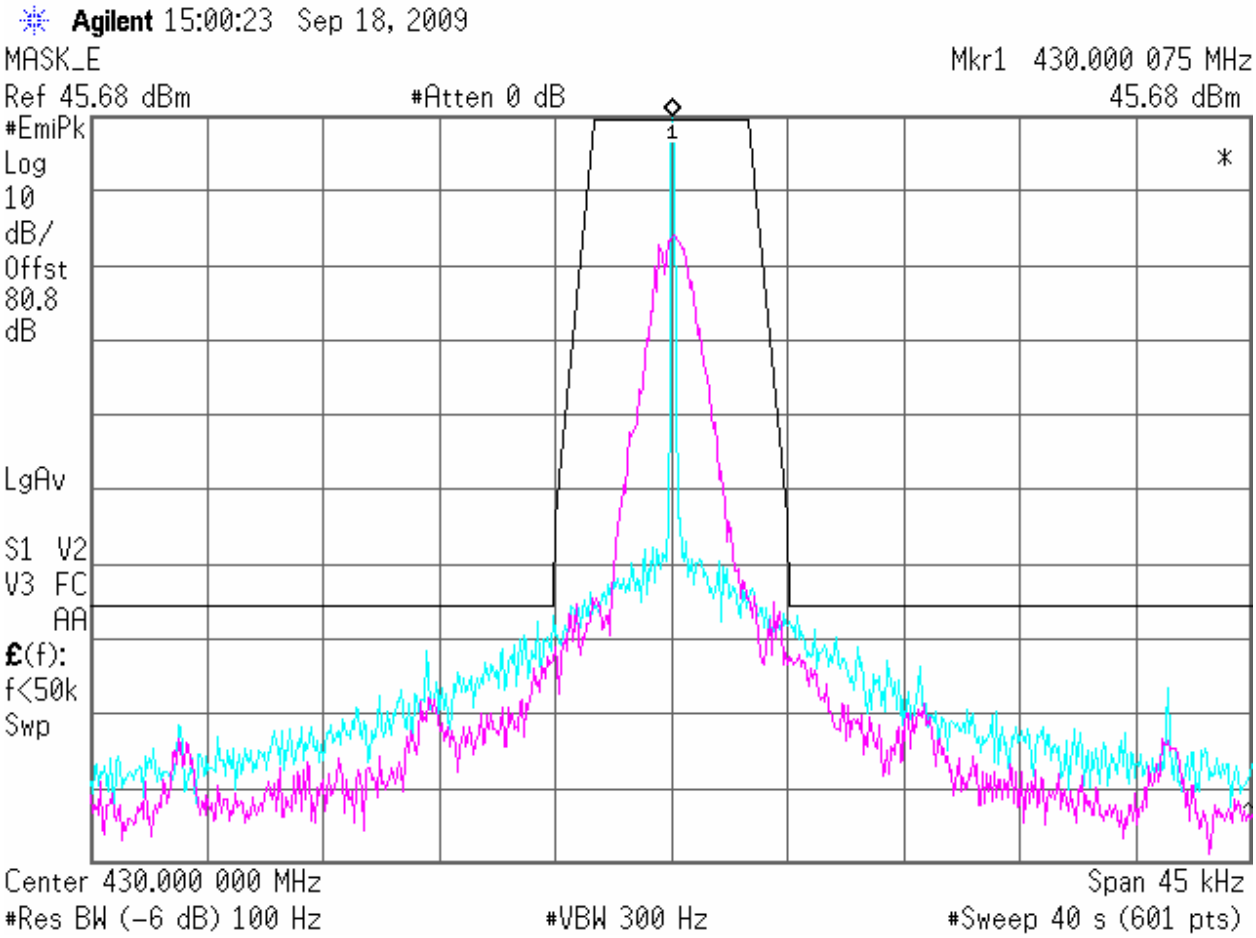
Emission Mask, 6.25kHz ch spacing, 8PSK

Graph 5 48



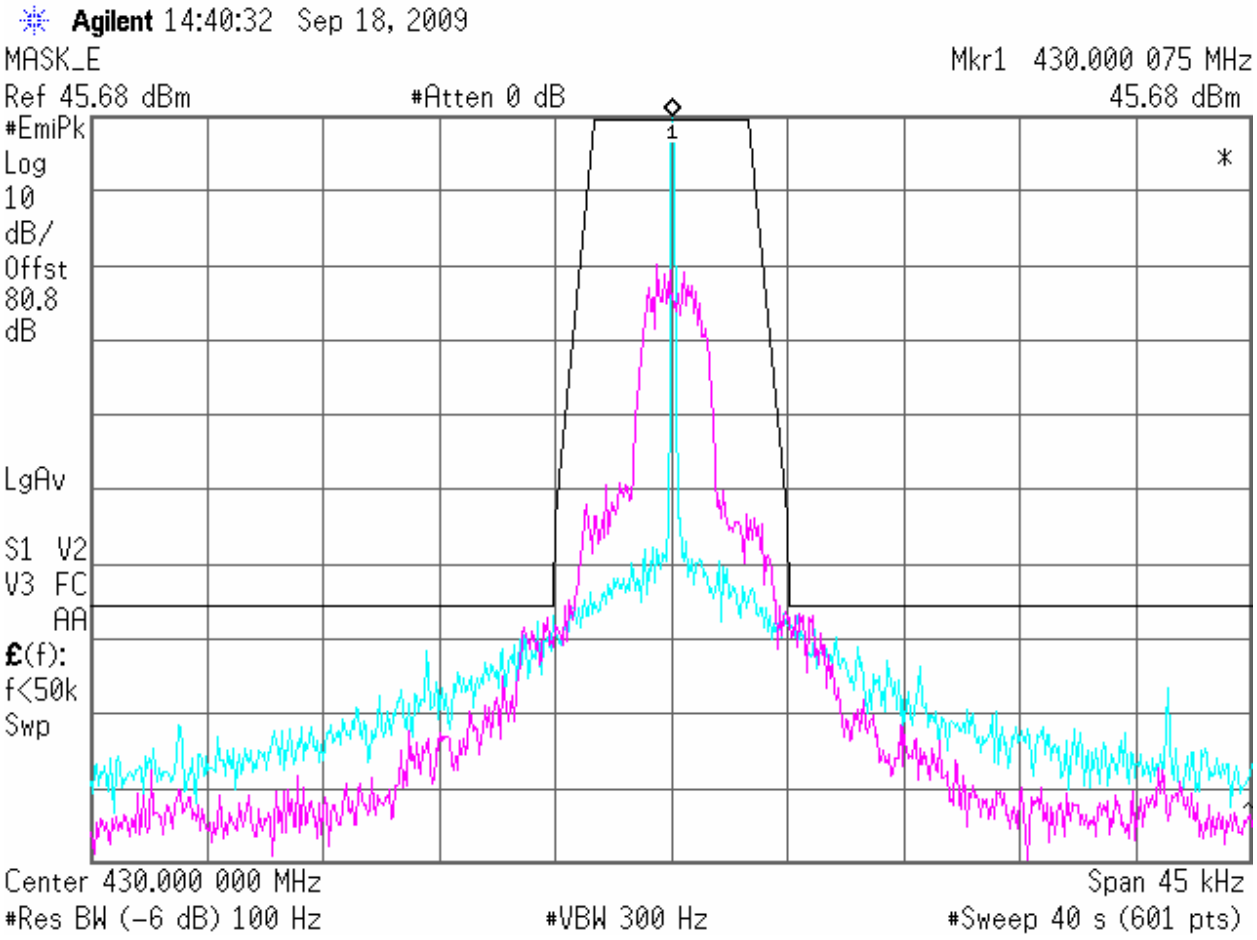
Emission Mask, 6.25kHz ch spacing, BPSK

Graph 5 49



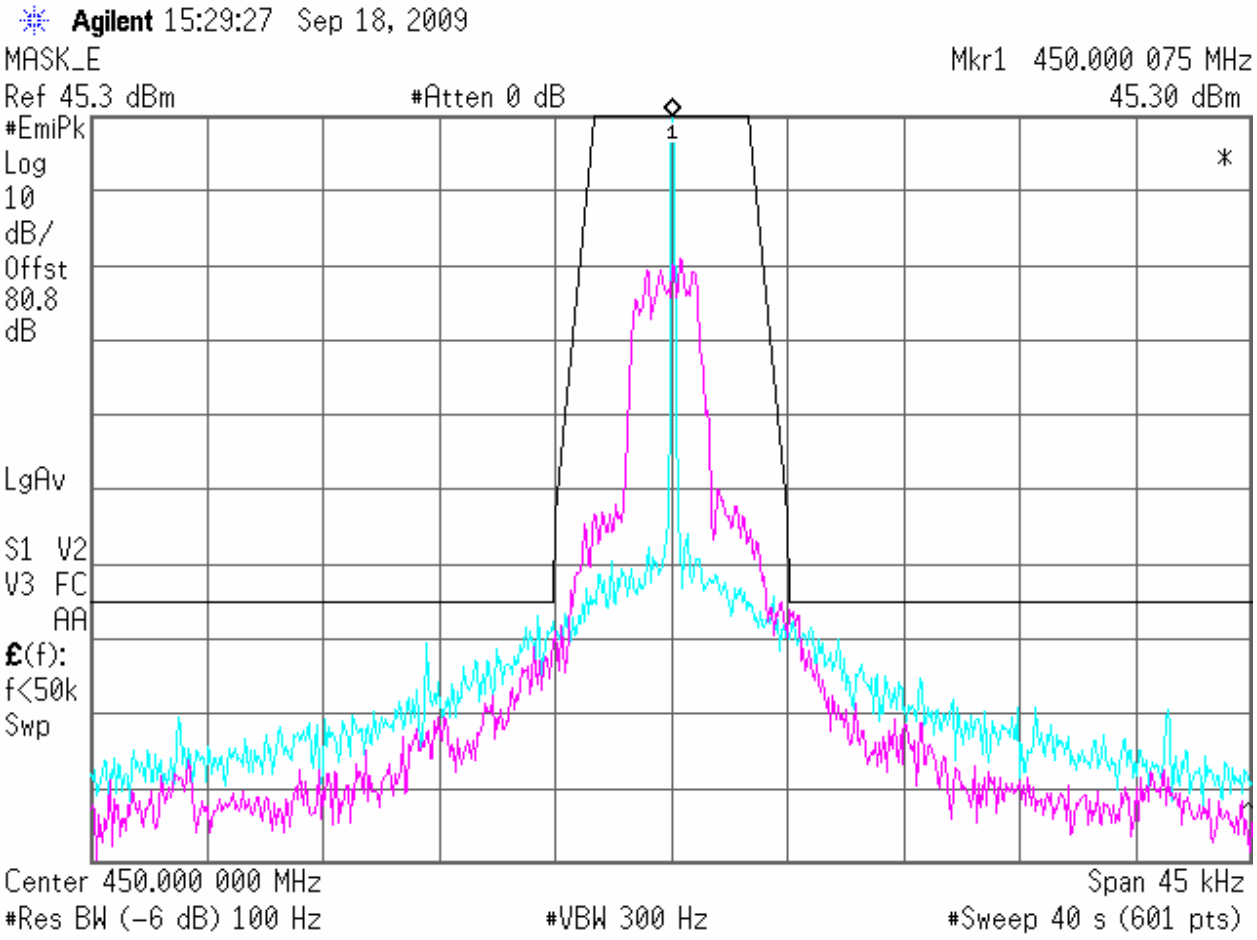
Emission Mask, 6.25kHz ch spacing, GMSK

Graph 5 50



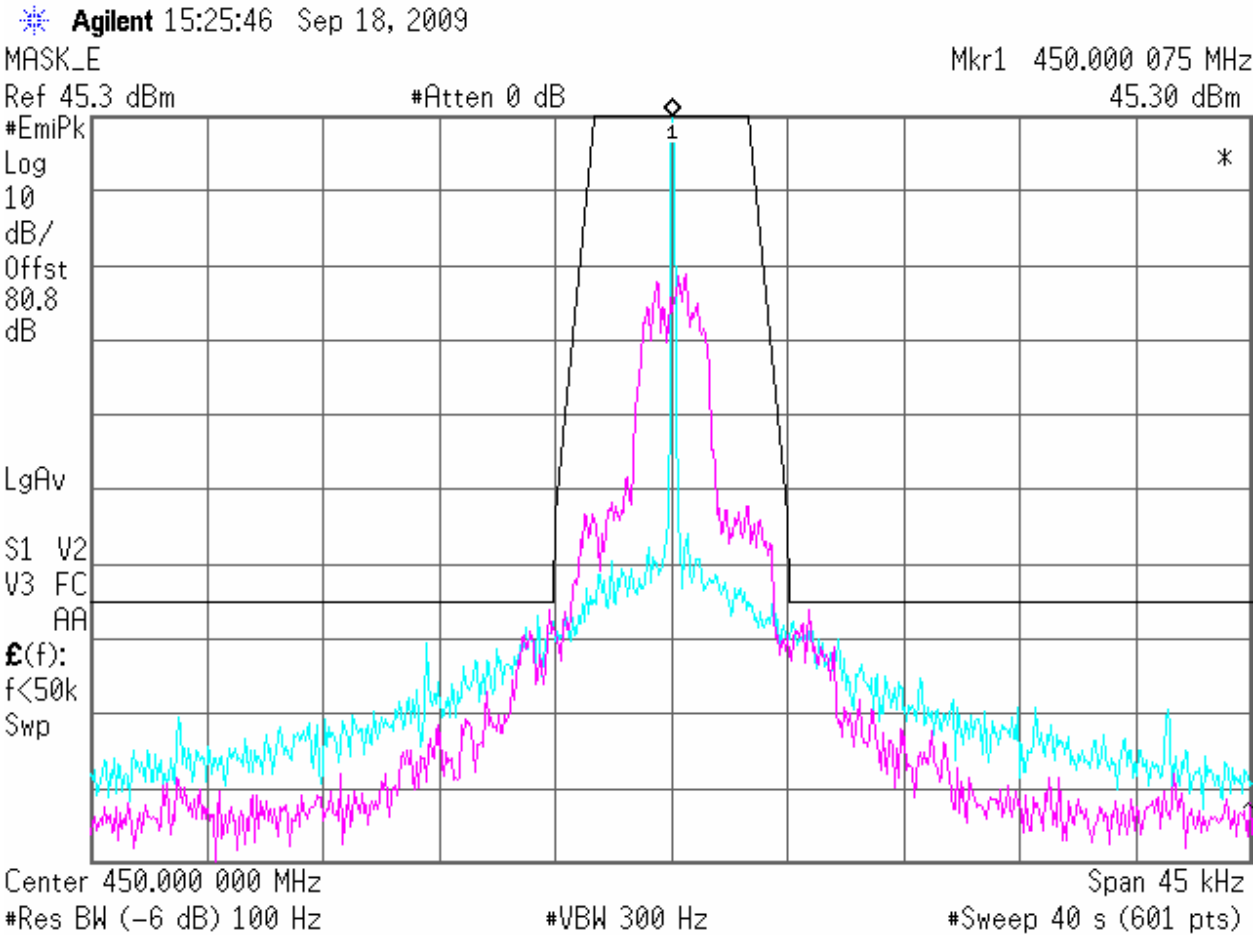
Emission Mask, 6.25kHz ch spacing, QPSK

Graph 5 51



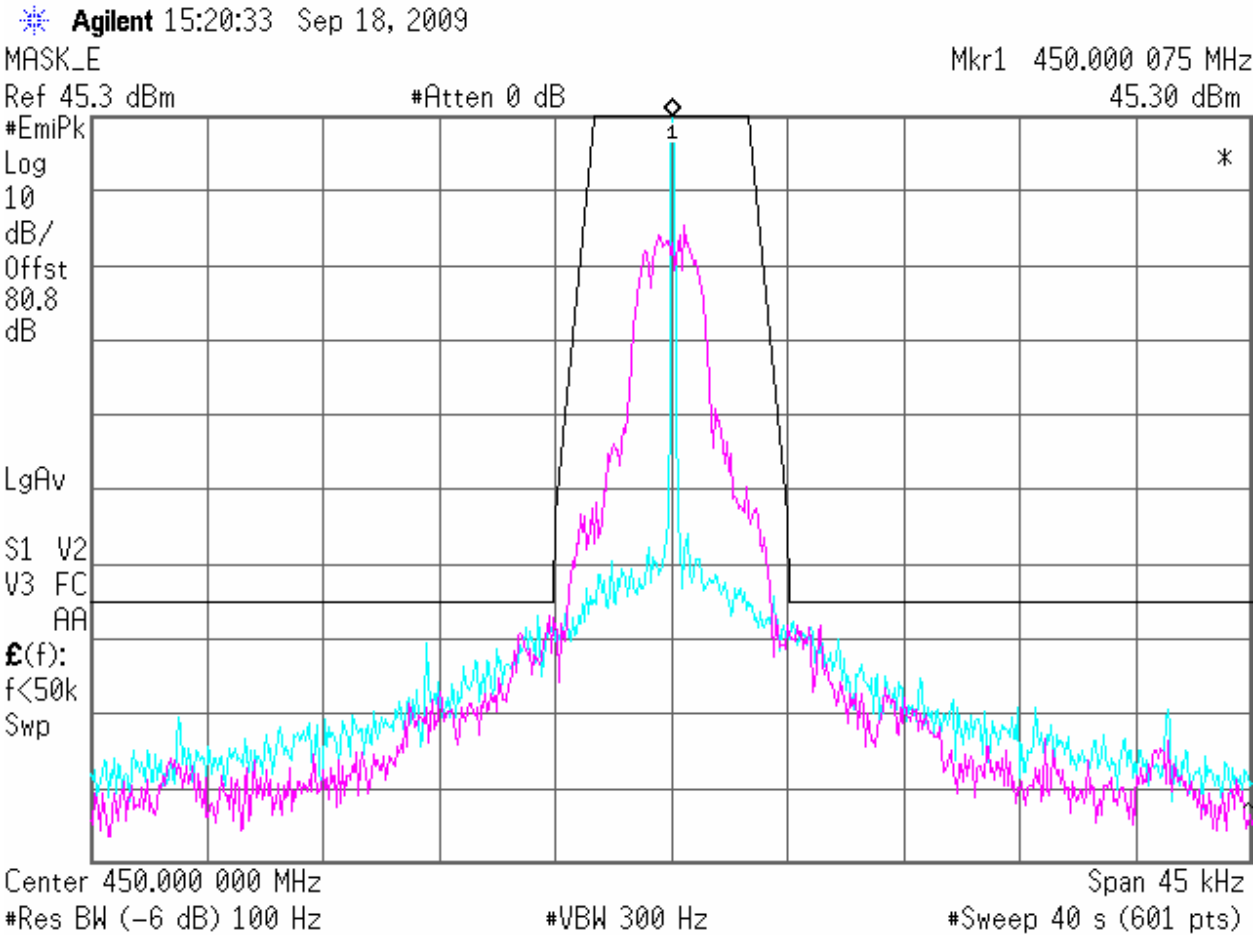
Emission Mask, 6.25kHz ch spacing, 16QAM

Graph 5 52



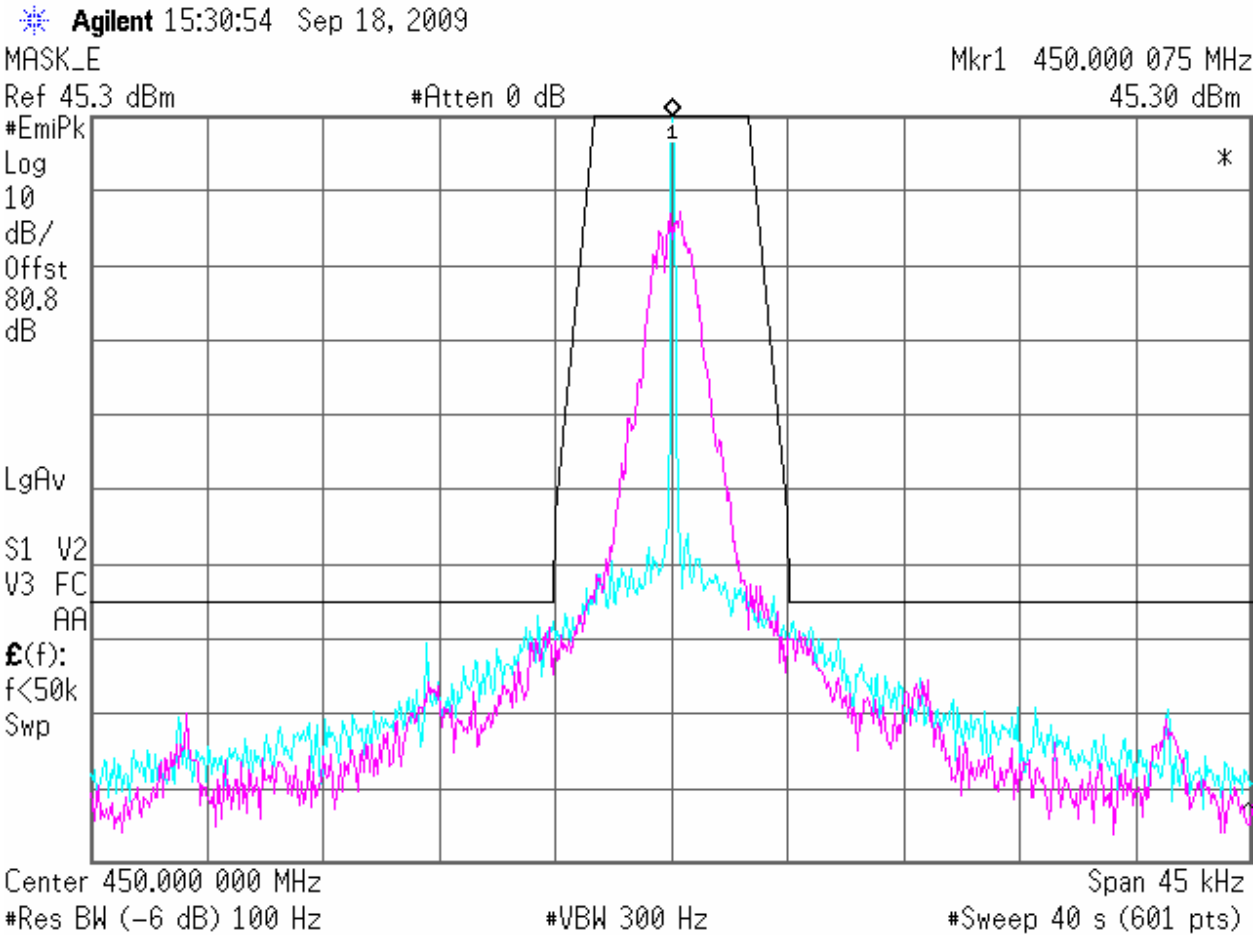
Emission Mask, 6.25kHz ch spacing, 8PSK

Graph 5 53



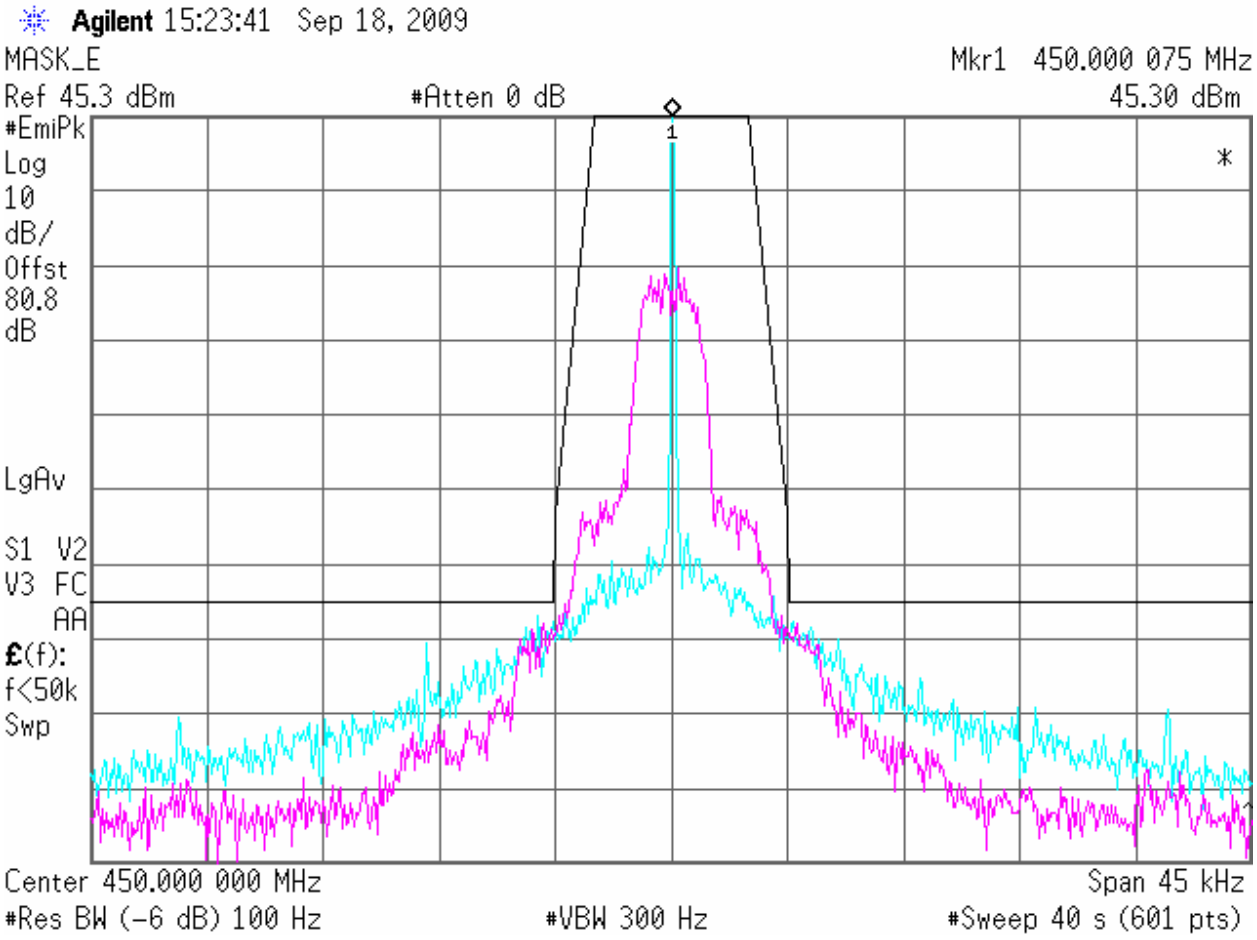
Emission Mask, 6.25kHz ch spacing, BPSK

Graph 5 54



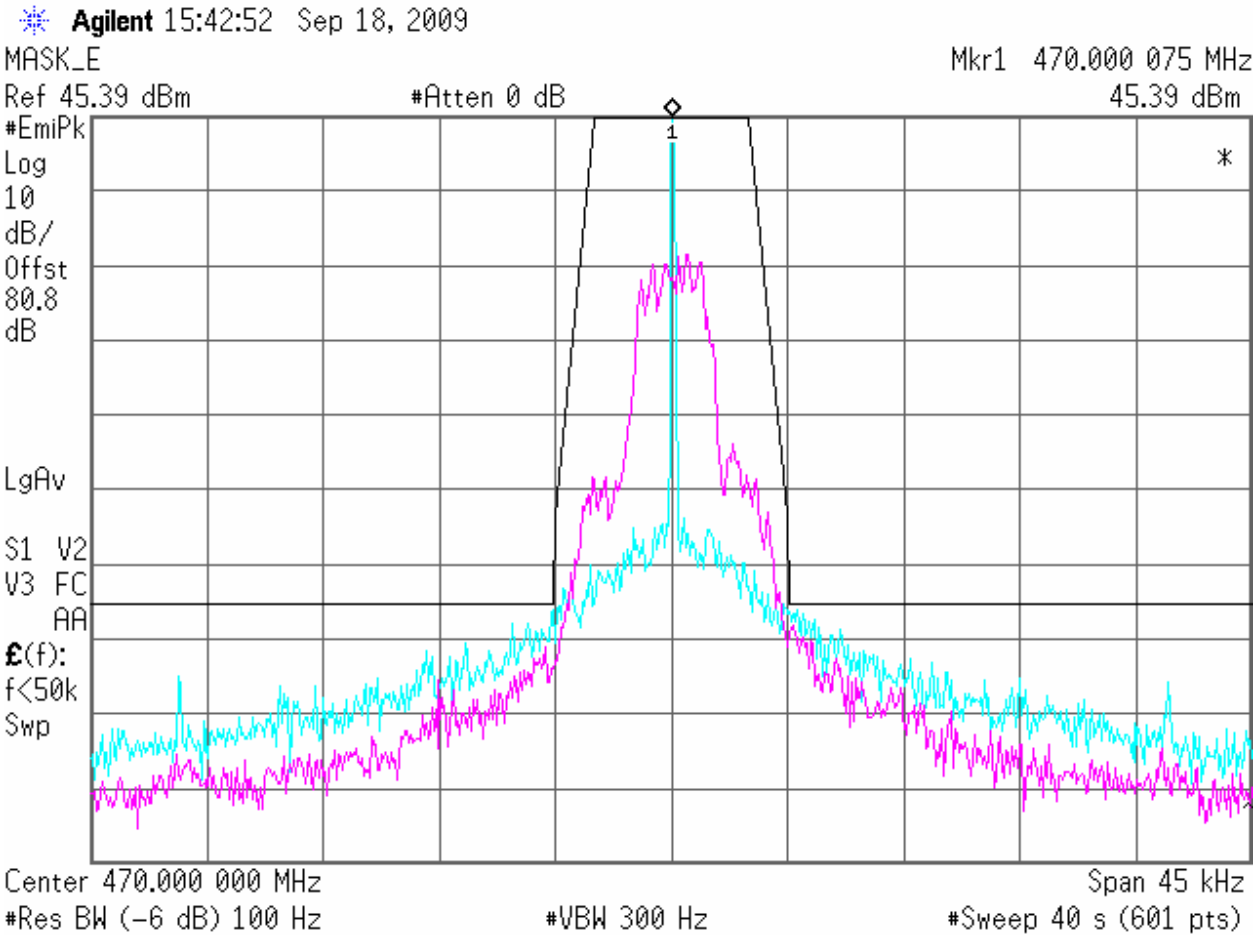
Emission Mask, 6.25kHz ch spacing, GMSK

Graph 5 55



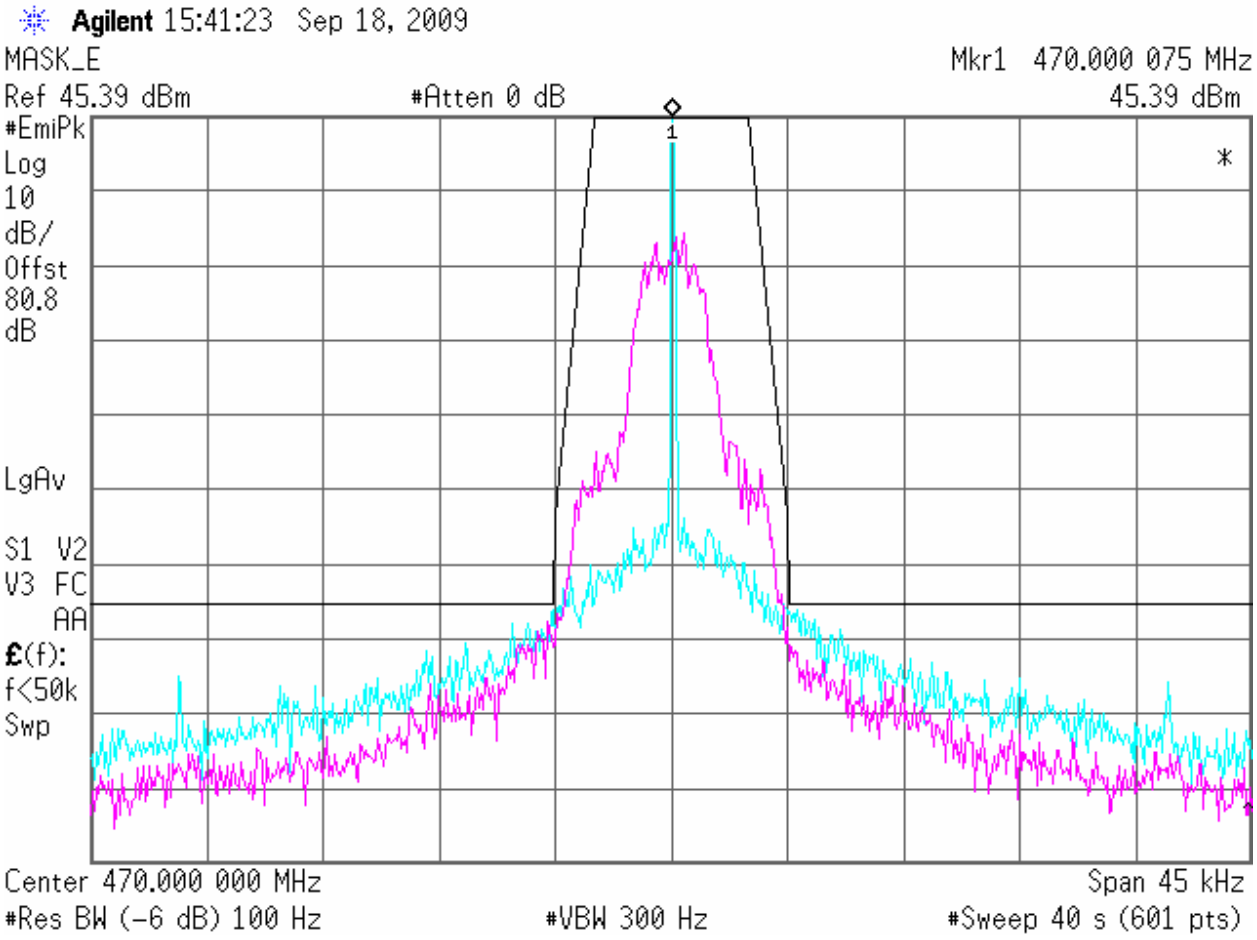
Emission Mask, 6.25kHz ch spacing, QPSK

Graph 5 56



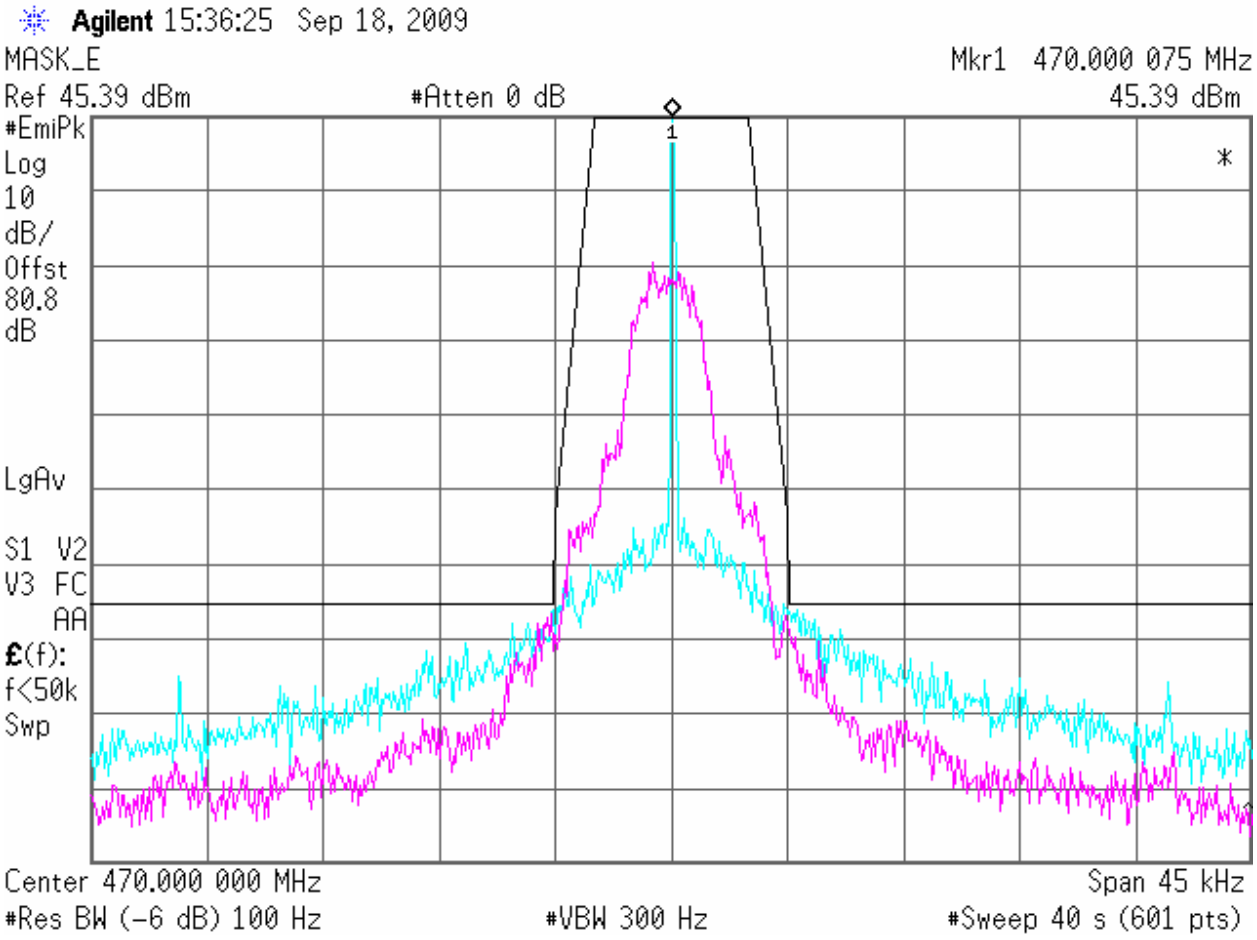
Emission Mask, 6.25kHz ch spacing, 16QAM

Graph 5 57



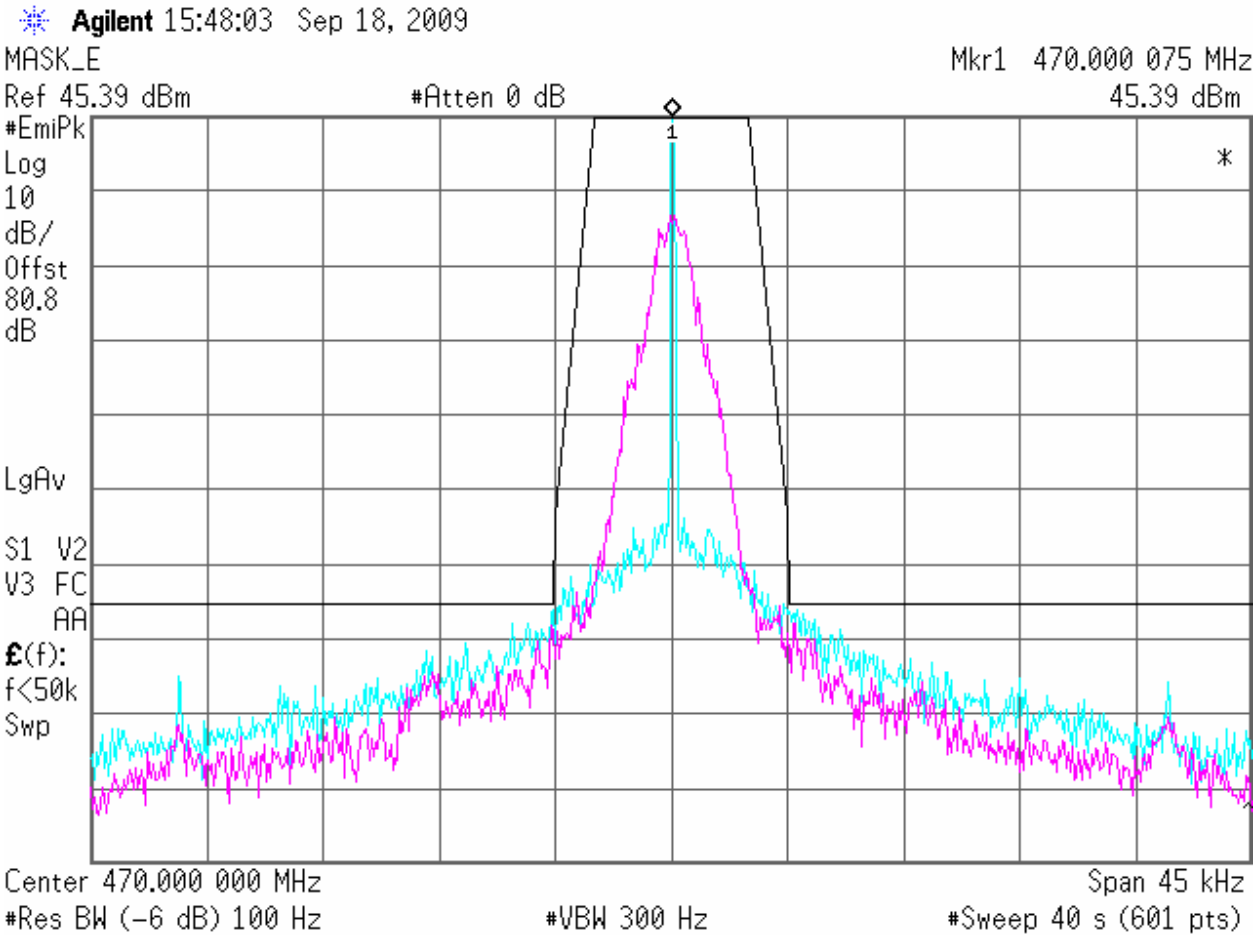
Emission Mask, 6.25kHz ch spacing, 8PSK

Graph 5 58



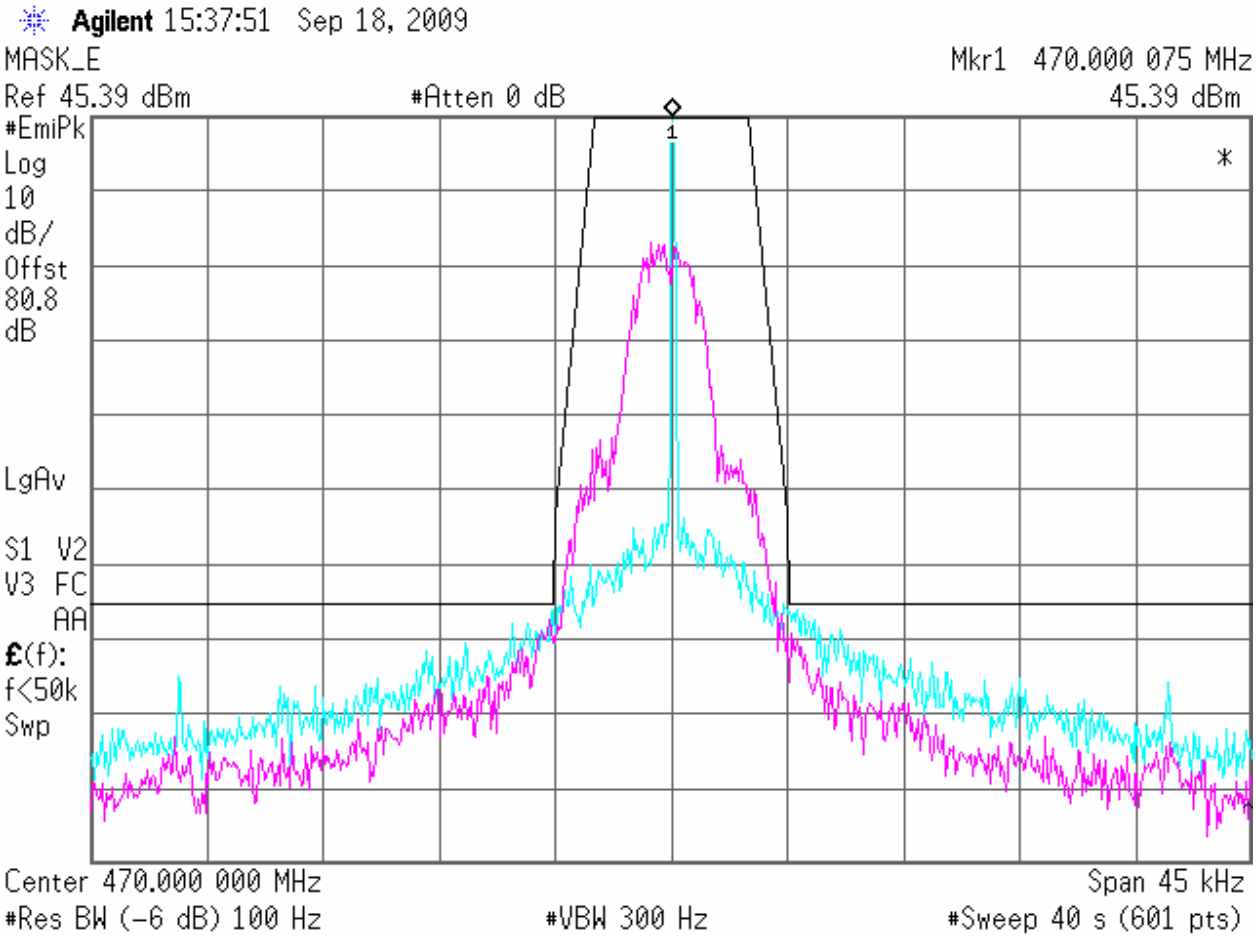
Emission Mask, 6.25kHz ch spacing, BPSK

Graph 5 59



Emission Mask, 6.25kHz ch spacing, GMSK

Graph 5 60



Emission Mask, 6.25kHz ch spacing, QPSK

6.0 Spurious Emissions at Antenna Terminals

FCC 2.1051, 90.210

6.1 Requirement

Emission Mask C

The power of any emissions must be attenuated below the unmodulated carrier output power (P) on any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: at least (43 + 10 log P) dB.

Note: That corresponds to the level of -13 dBm for any out-of-band and spurious emissions.

Emission Mask D

The power of any emissions must be attenuated below the unmodulated carrier output power (P) on any frequency removed from the center of the authorized bandwidth by more than 12.5 kHz:
at least (50 + 10 log P) dB or 70 dB, whichever is lesser attenuation.

Note: Attenuation of (50 + 10 log P) dB corresponds to the level of -20 dBm for any out-of-band and spurious emissions.

Emission Mask E

The power of any emissions must be attenuated below the unmodulated carrier output power (P) on any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz:
at least (55 + 10 log P) dB or 65 dB, whichever is lesser attenuation.

Note: Attenuation of 65dB corresponds to the level of -19.6 dBm for any out-of-band and spurious emissions.

6.2 Test Procedure

The EUT RF output was connected as shown on the diagram in sec.1.3.2. The EUT was setup to transmit the maximum power.

For measurements at frequencies below 1 GHz, the spectrum analyzed resolution bandwidth was set to 10 kHz. For measurements at frequencies above 1 GHz, the spectrum analyzed resolution bandwidth was set to 1 MHz. Average detector is used for these measurements.

Sufficient scans were taken to show the spurious emissions up to 10th harmonic.

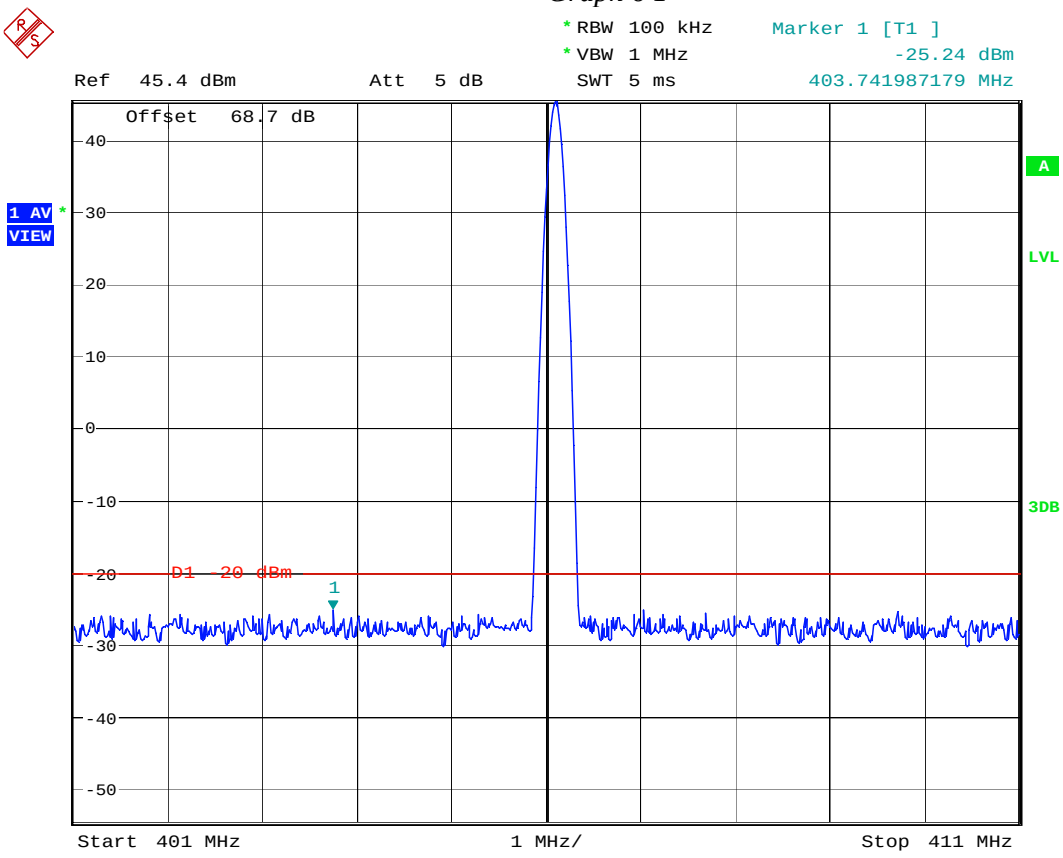
6.3 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

6.4 Test Results

Complies	Refer to the following Graphs

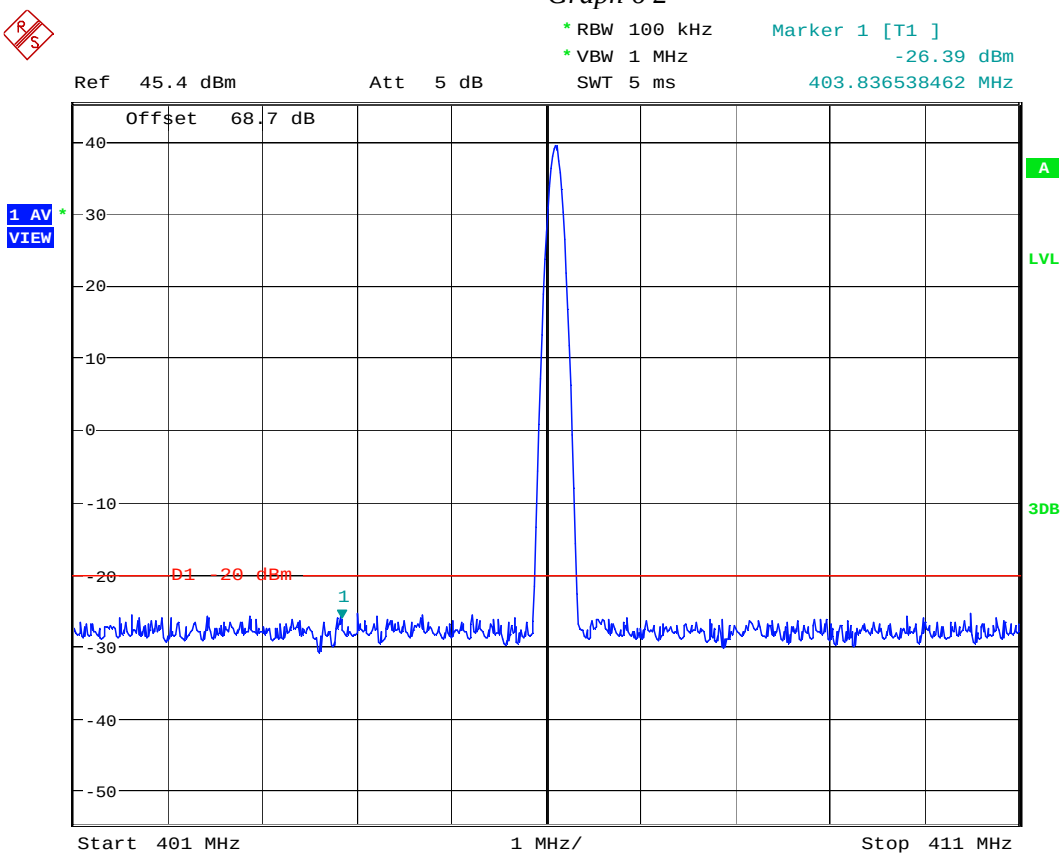
Graph 6 1



Conducted spurious, 406.1 MHz, Unmodulated

Date: 14.SEP.2009 18:02:53

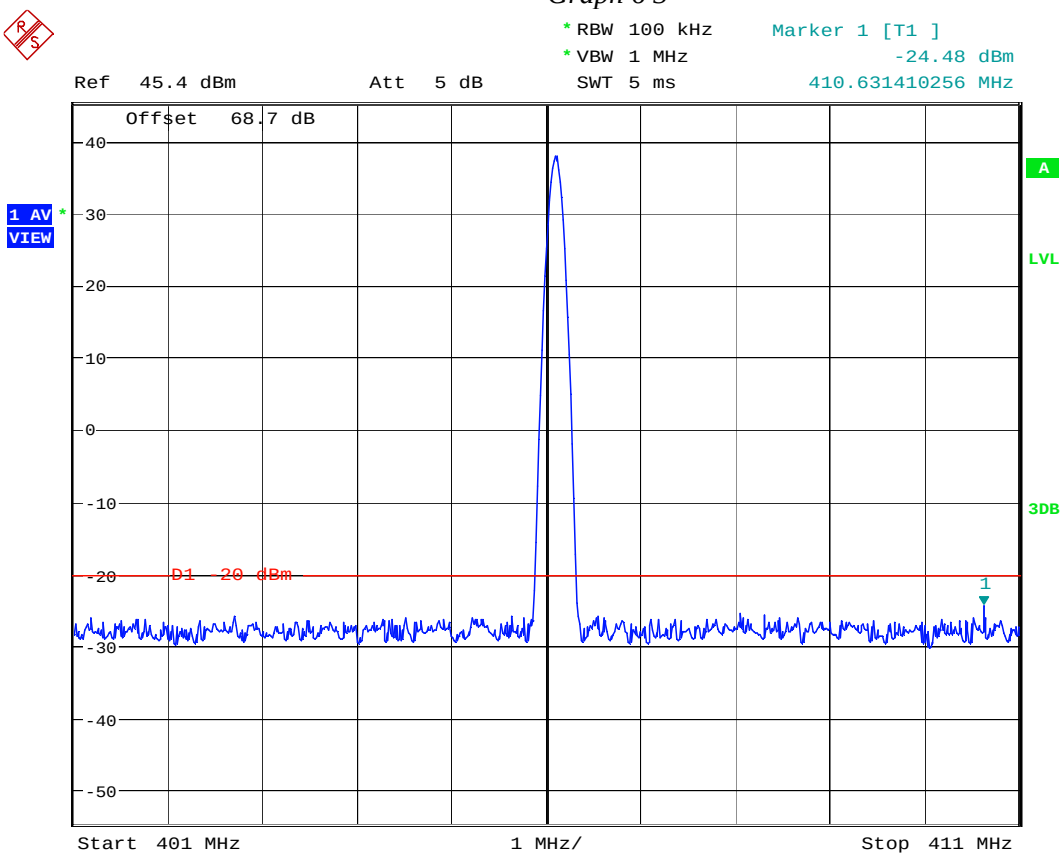
Graph 6 2



Conducted spurious, 406.1 MHz, BPSK

Date: 14.SEP.2009 18:05:54

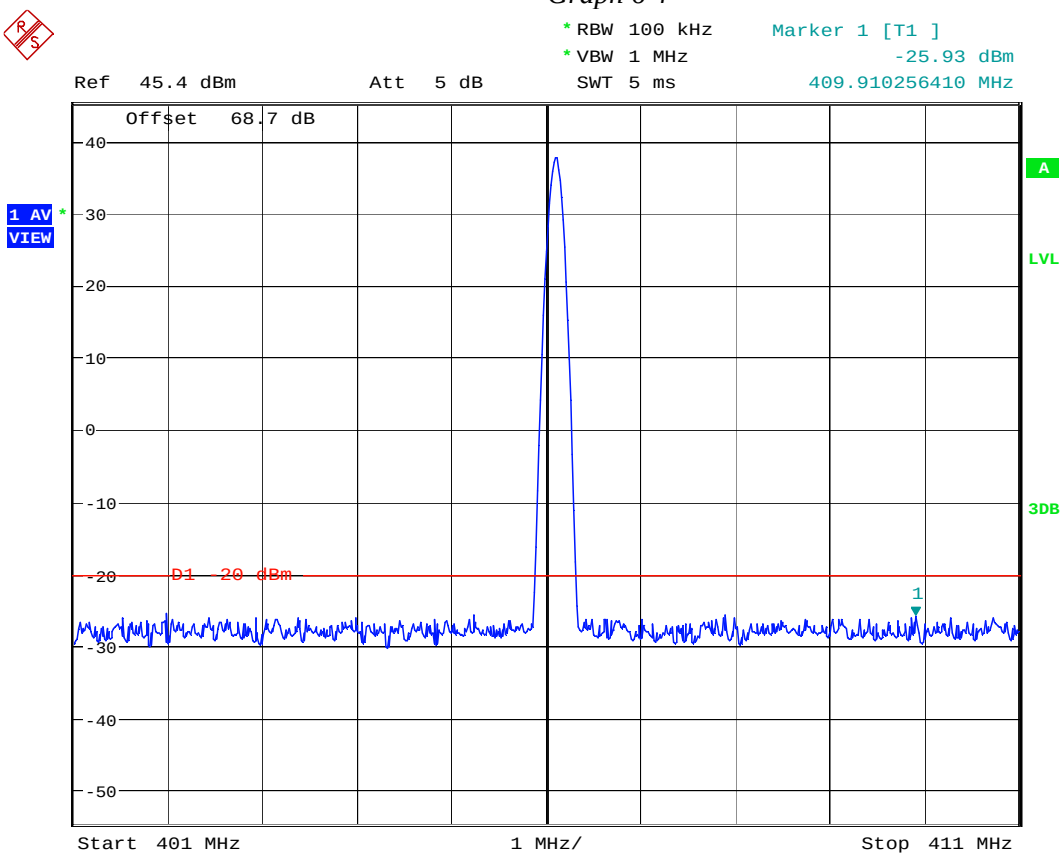
Graph 6 3



Conducted spurious, 406.1 MHz, QPSK

Date: 14.SEP.2009 18:06:50

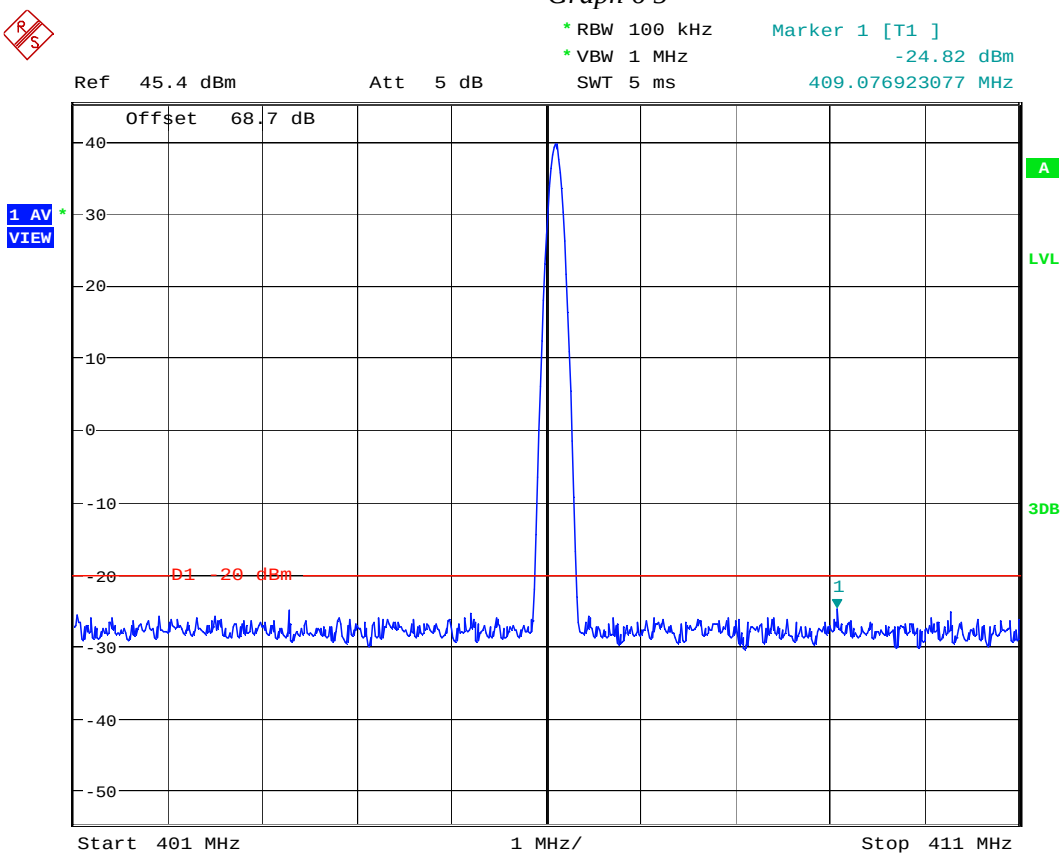
Graph 6 4



Conducted spurious, 406.1 MHz, 8PSK

Date: 14.SEP.2009 18:07:56

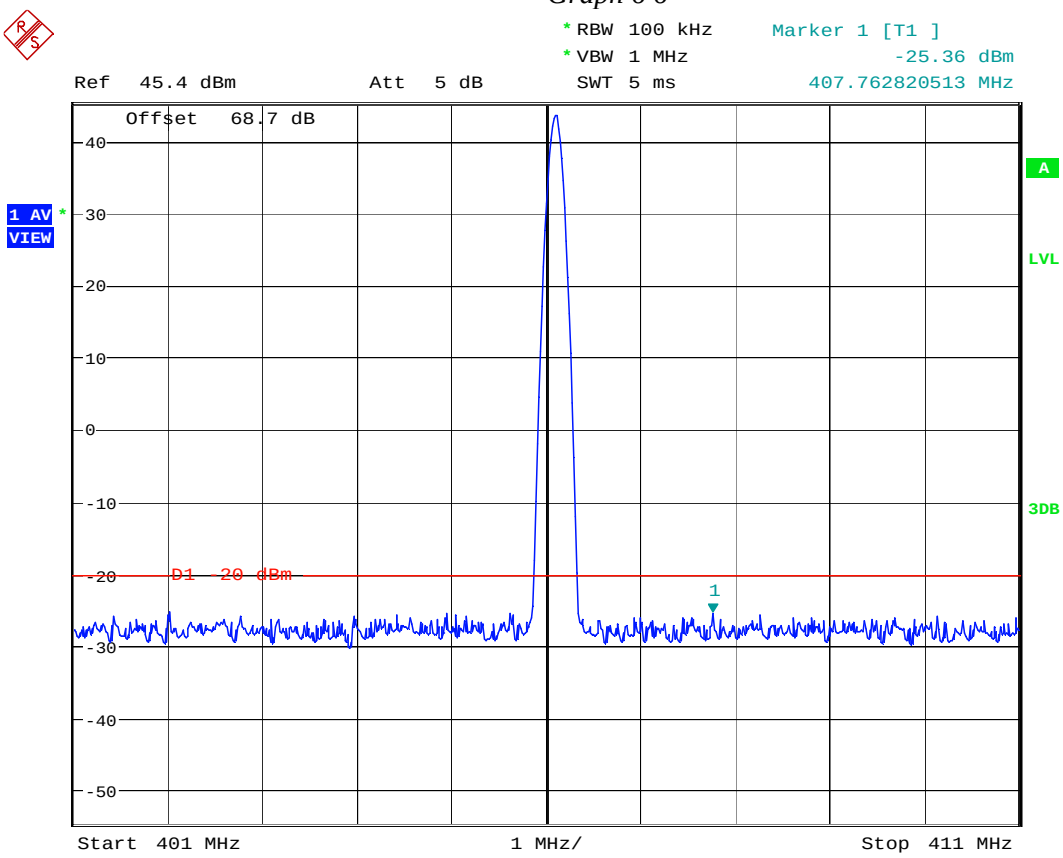
Graph 6 5



Conducted spurious, 406.1 MHz, 16QAM

Date: 14.SEP.2009 18:08:51

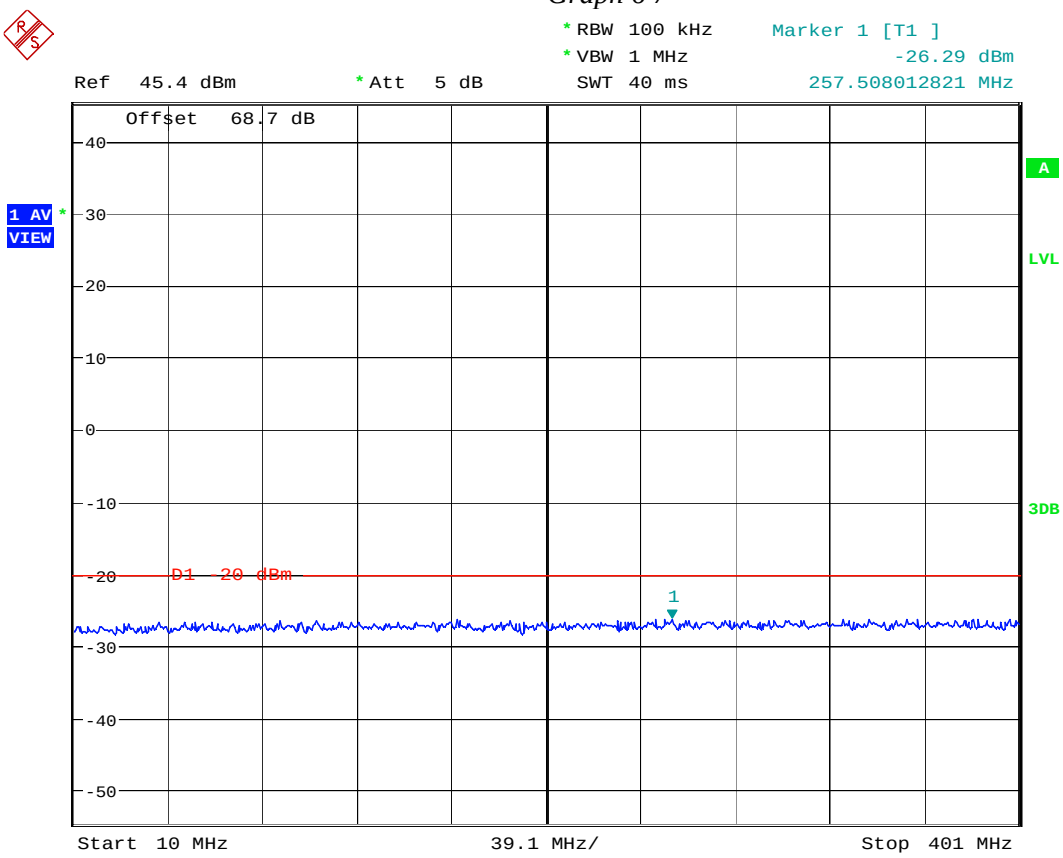
Graph 6 6



Conducted spurious, 406.1 MHz, GMSK

Date: 14.SEP.2009 18:09:58

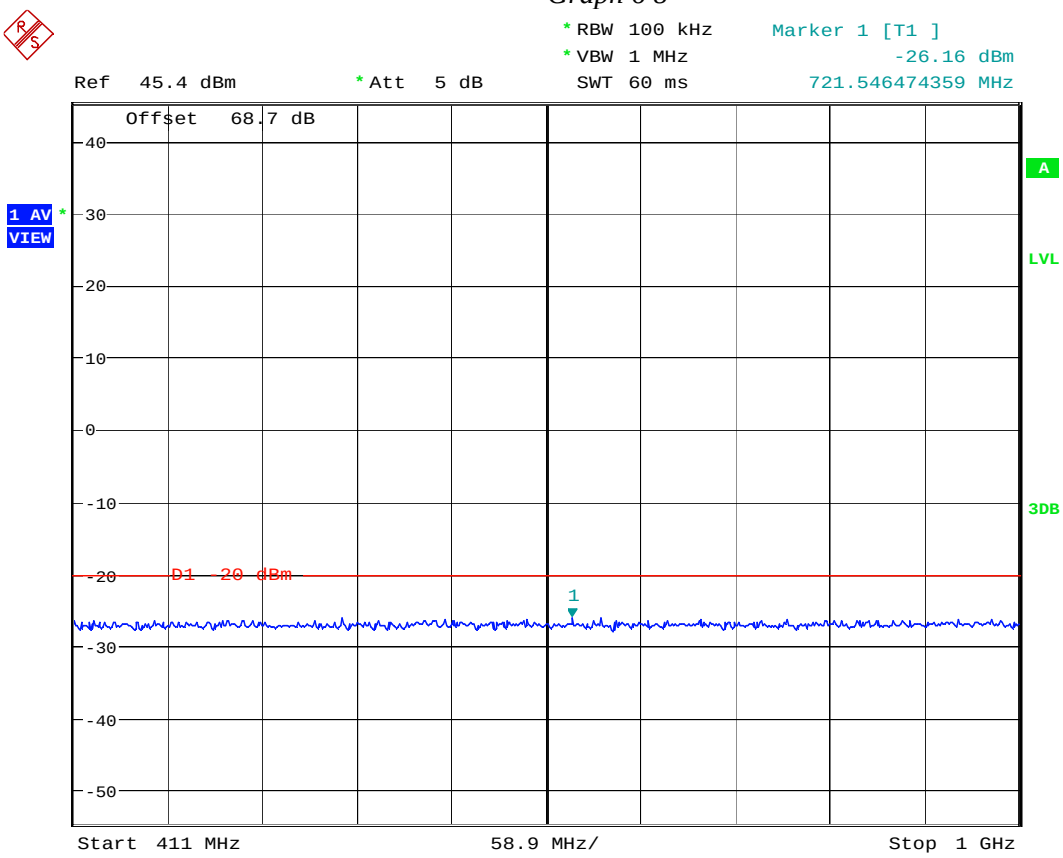
Graph 6 7



Conducted spurious, 406.1 MHz, GMSK

Date: 14.SEP.2009 18:13:35

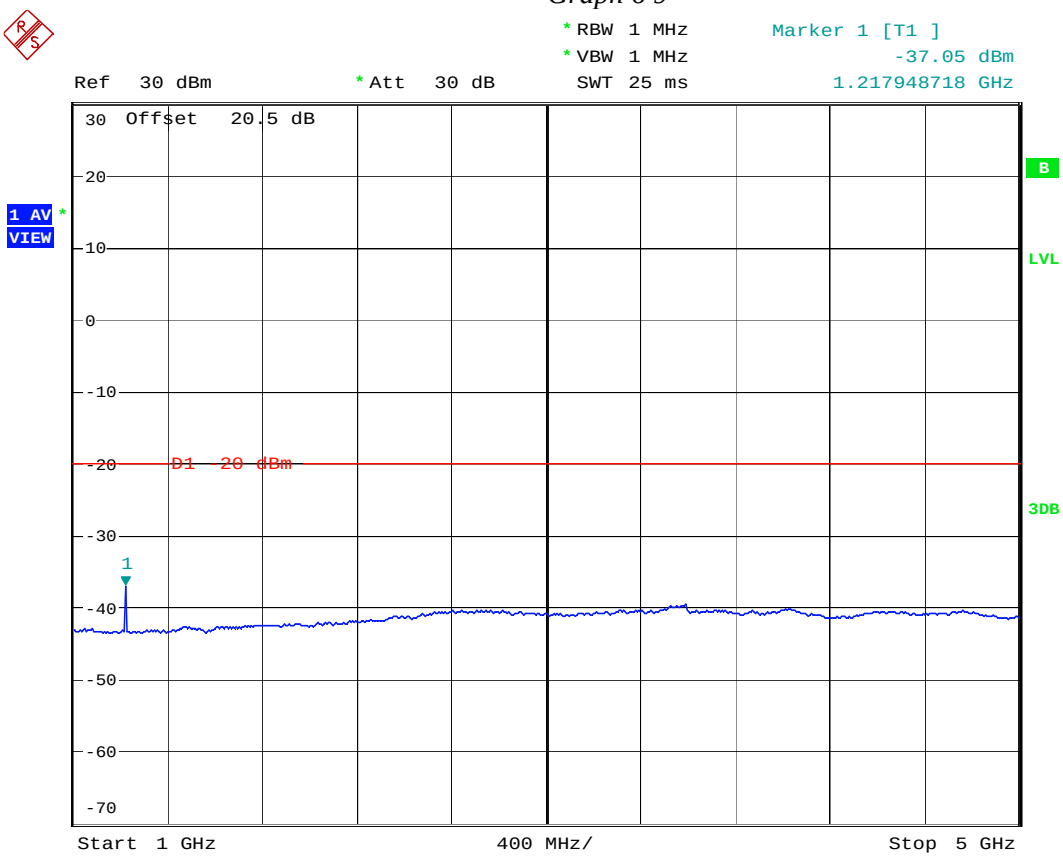
Graph 6 8



Conducted spurious, 406.1 MHz, GMSK

Date: 14.SEP.2009 18:14:19

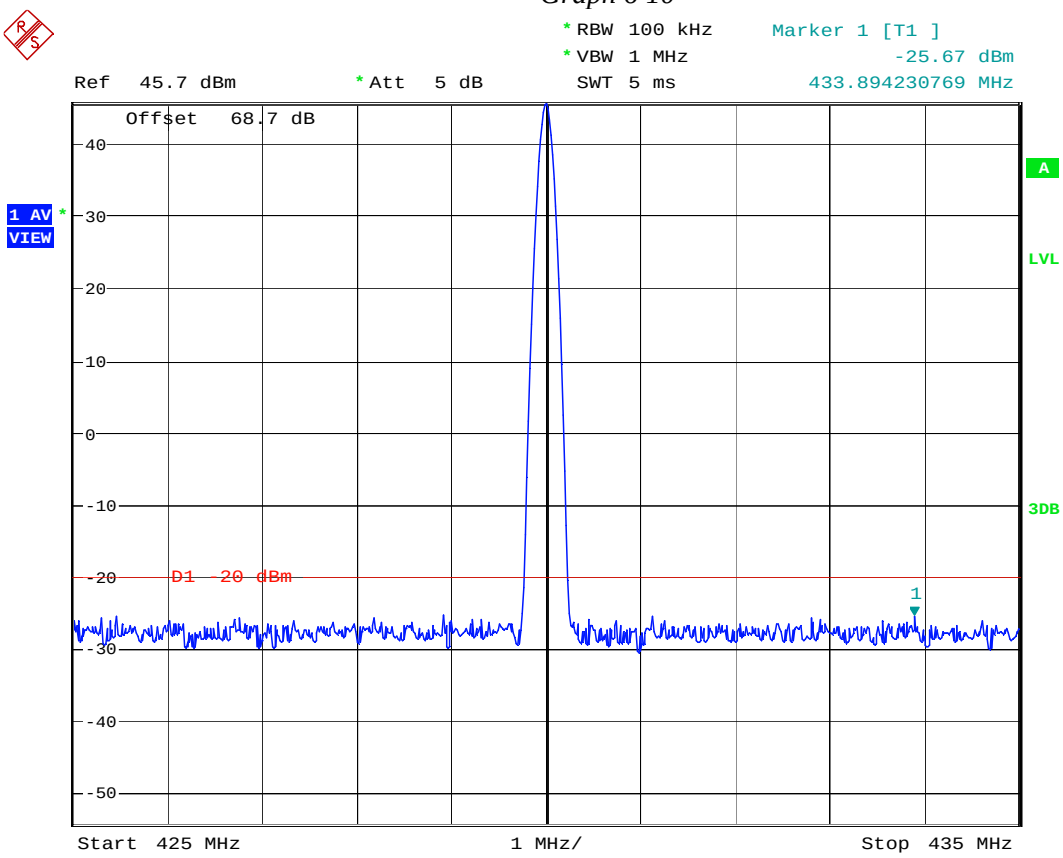
Graph 6 9



Conducted spurious, 406.1 MHz, GMSK

Date: 16.SEP.2009 02:09:56

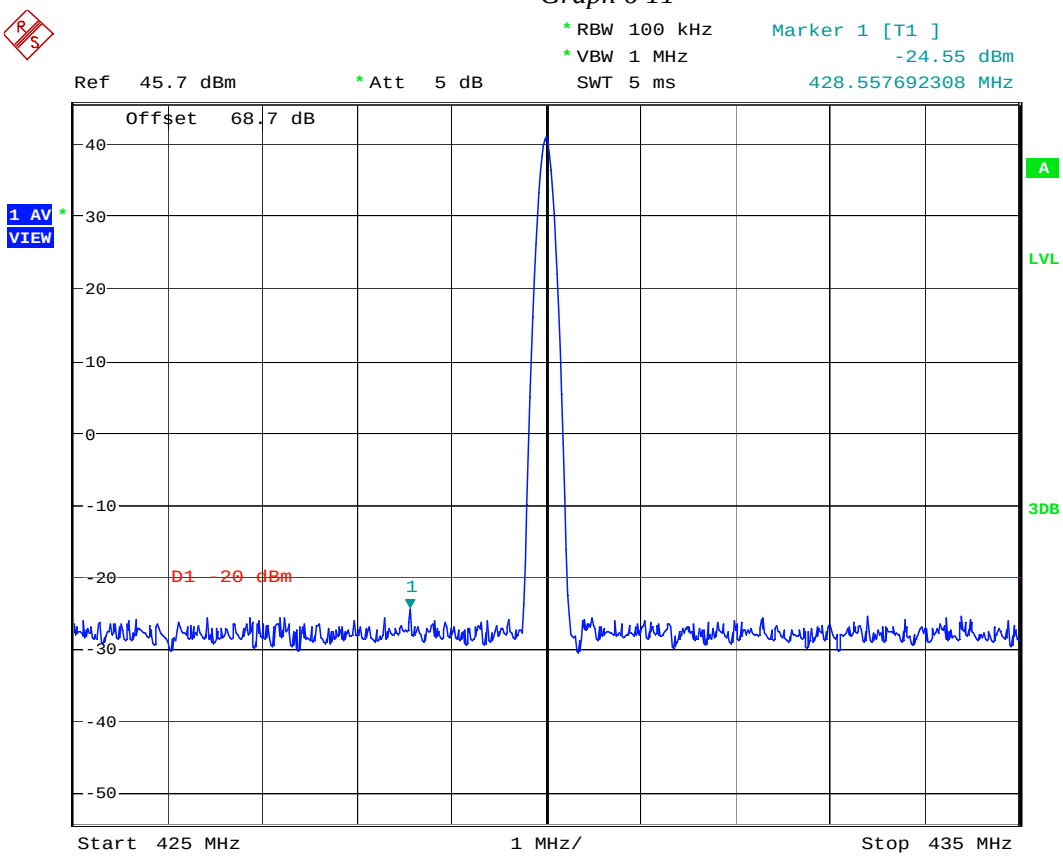
Graph 6 10



Conducted spurious, 430 MHz, Unmodulated

Date: 14.SEP.2009 18:30:58

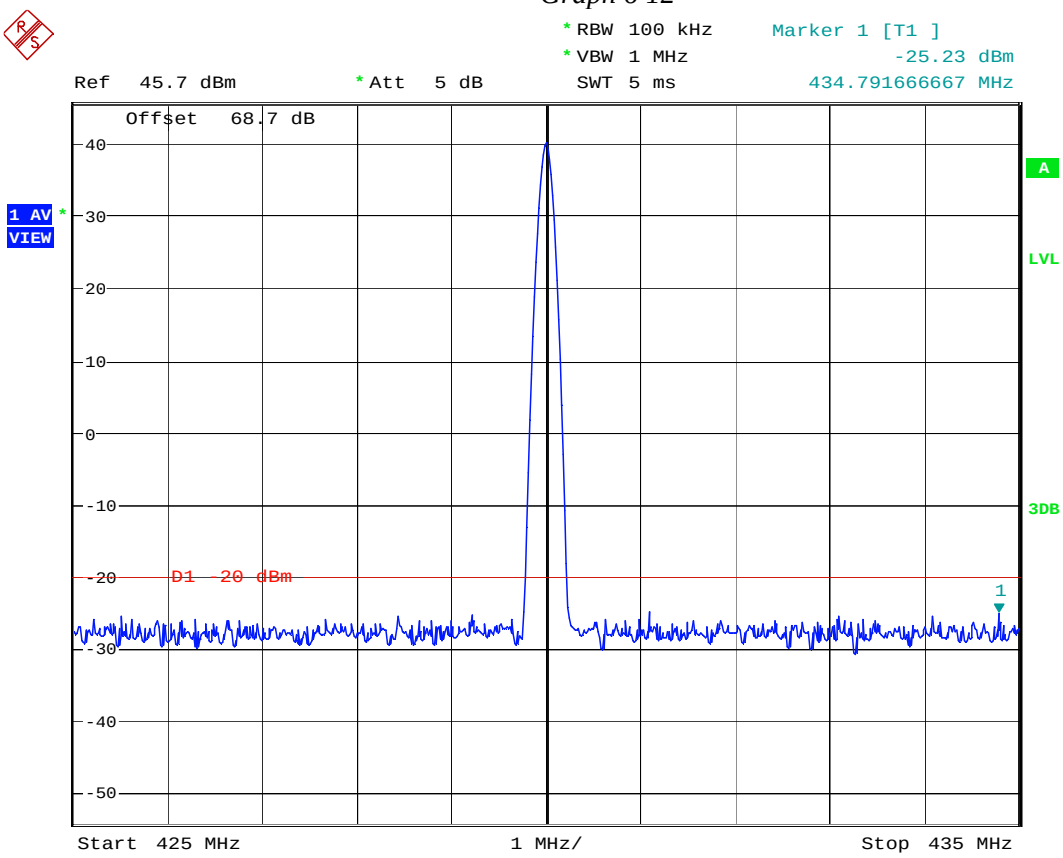
Graph 6 11



Conducted spurious, 430 MHz, BPSK

Date: 14.SEP.2009 18:31:51

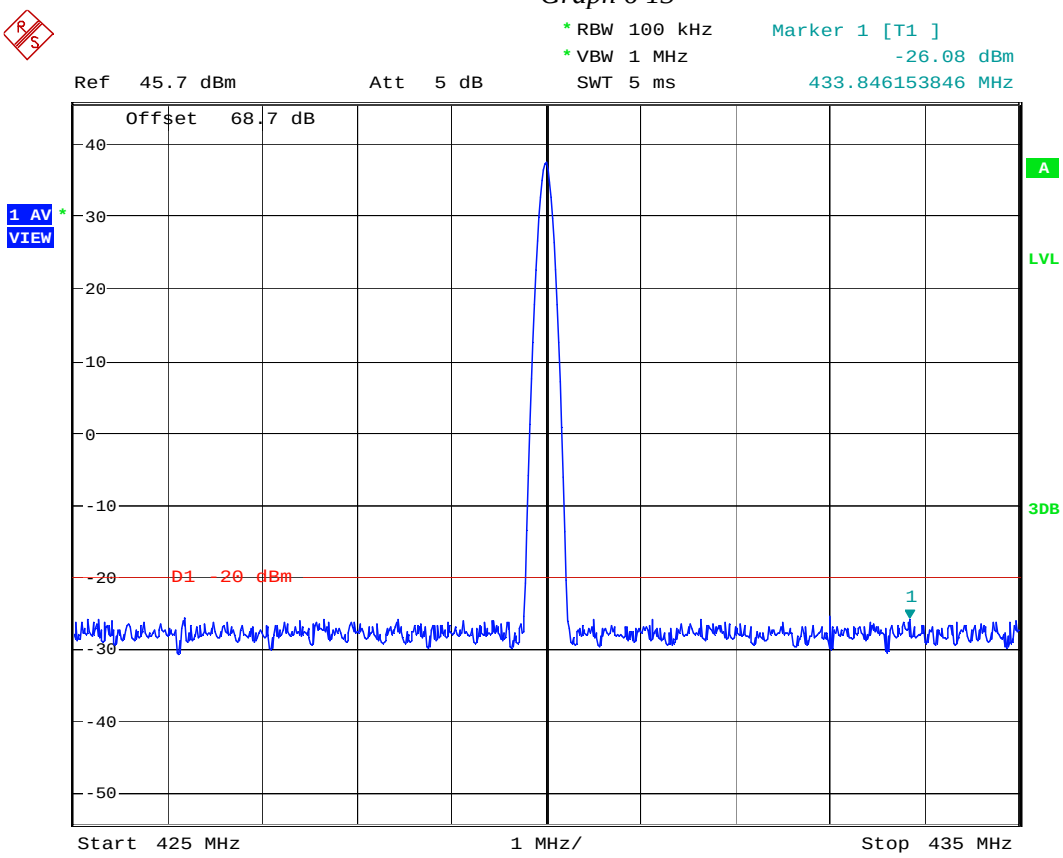
Graph 6 12



Conducted spurious, 430 MHz, QPSK

Date: 14.SEP.2009 18:32:56

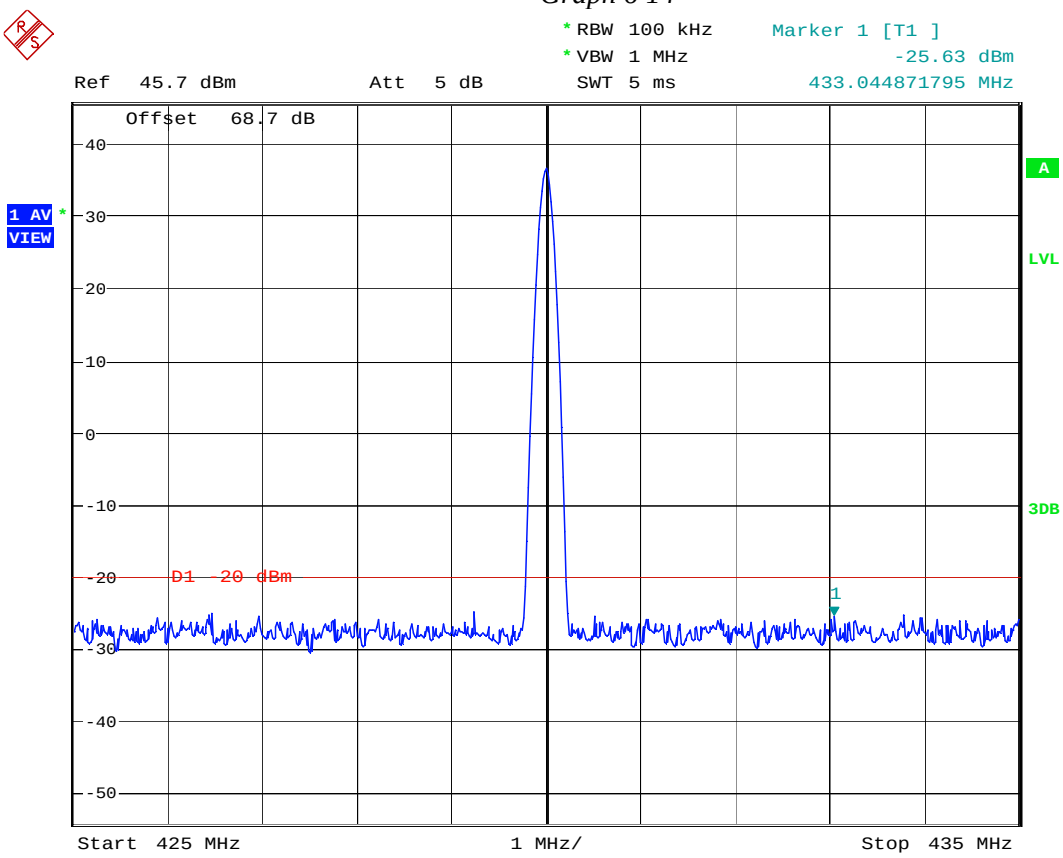
Graph 6 13



Conducted spurious, 430 MHz, 8PSK

Date: 14.SEP.2009 19:25:46

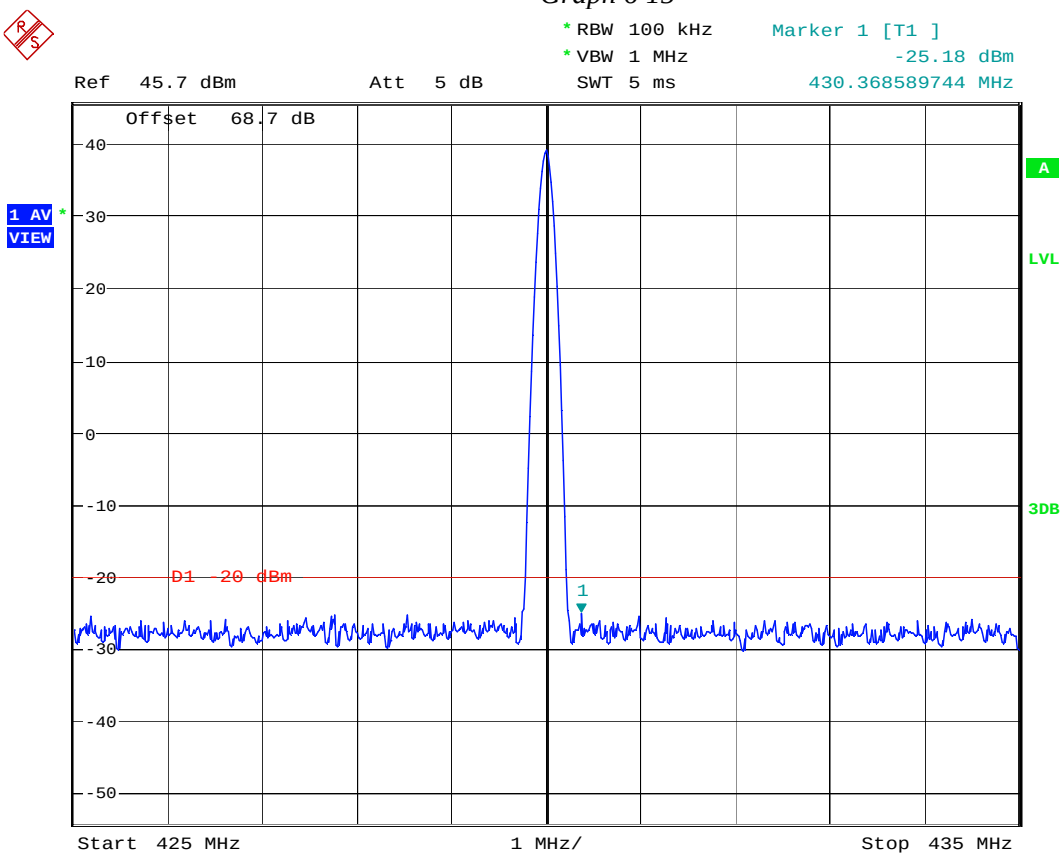
Graph 6 14



Conducted spurious, 430 MHz, 16QAM

Date: 14.SEP.2009 19:26:52

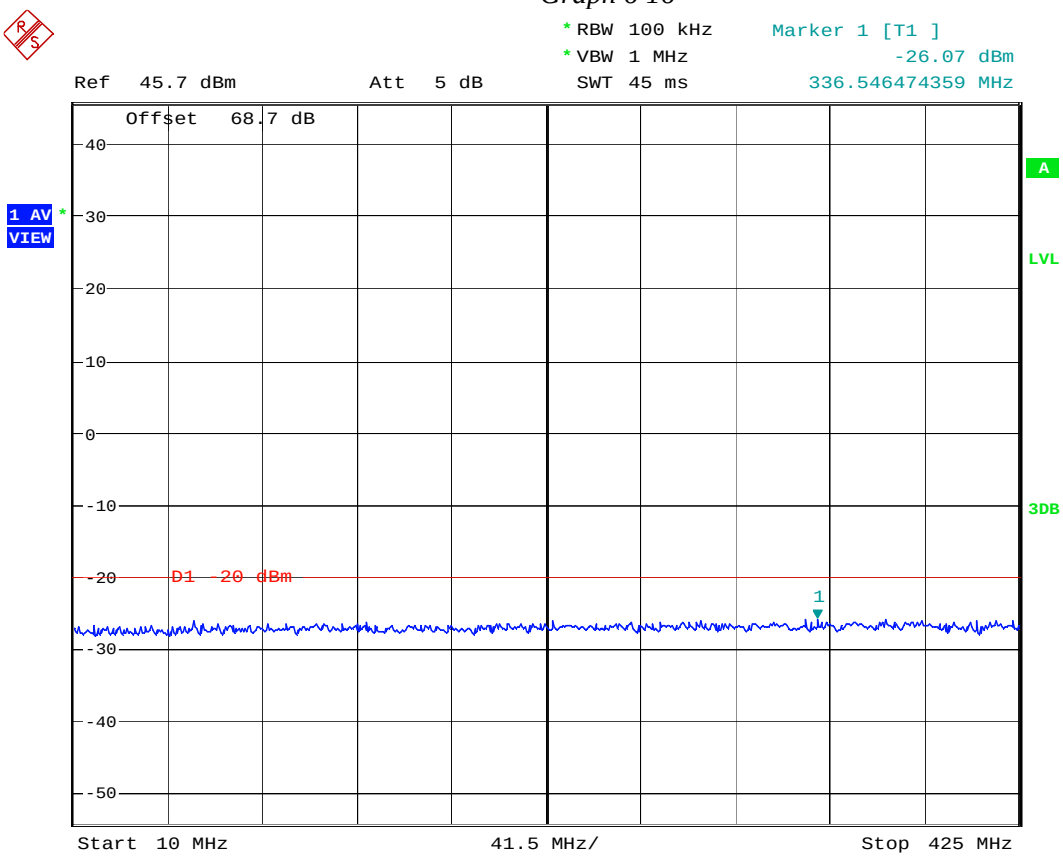
Graph 6 15



Conducted spurious, 430 MHz, GMSK

Date: 14.SEP.2009 19:27:50

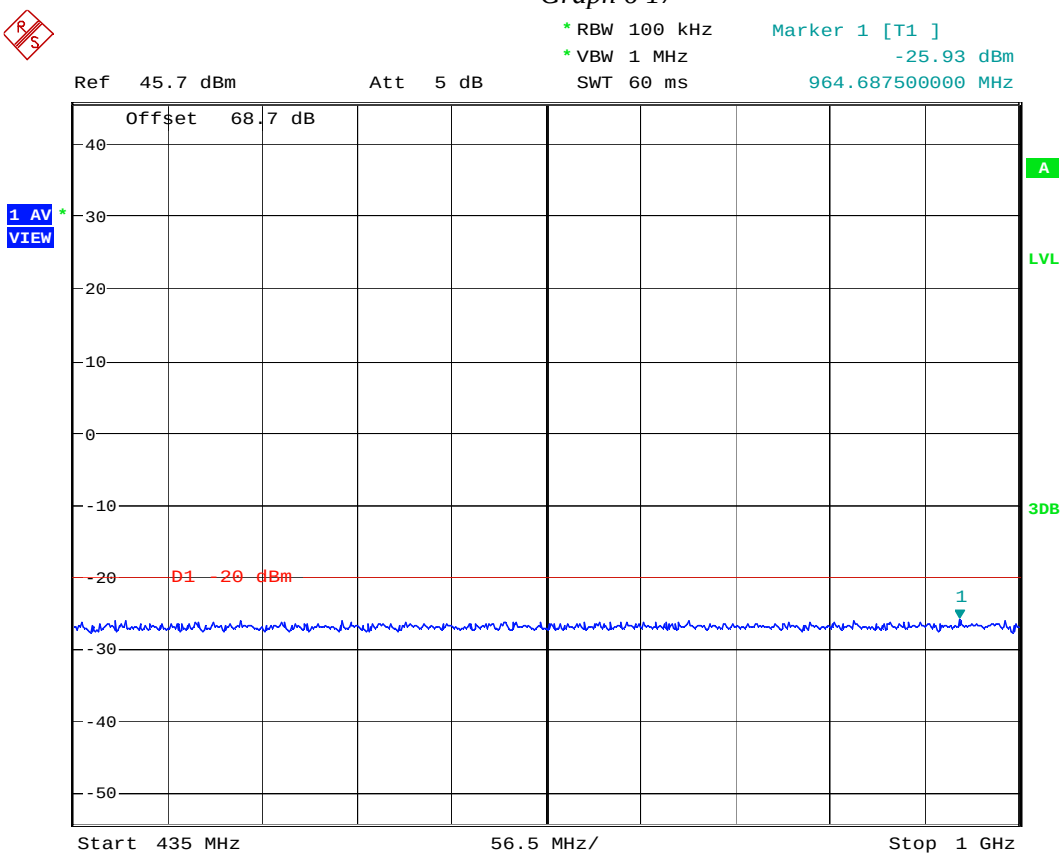
Graph 6 16



Conducted spurious, 430 MHz, GMSK

Date: 14.SEP.2009 19:29:55

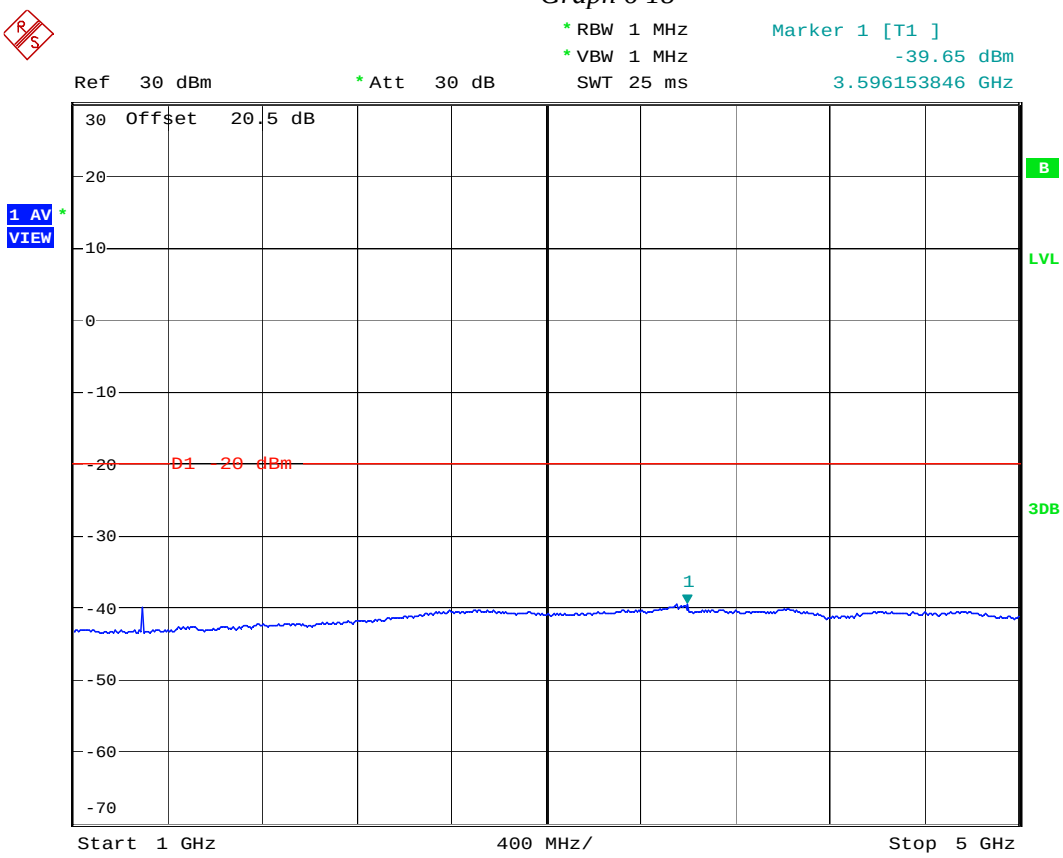
Graph 6 17



Conducted spurious, 430 MHz, GMSK

Date: 14.SEP.2009 19:30:42

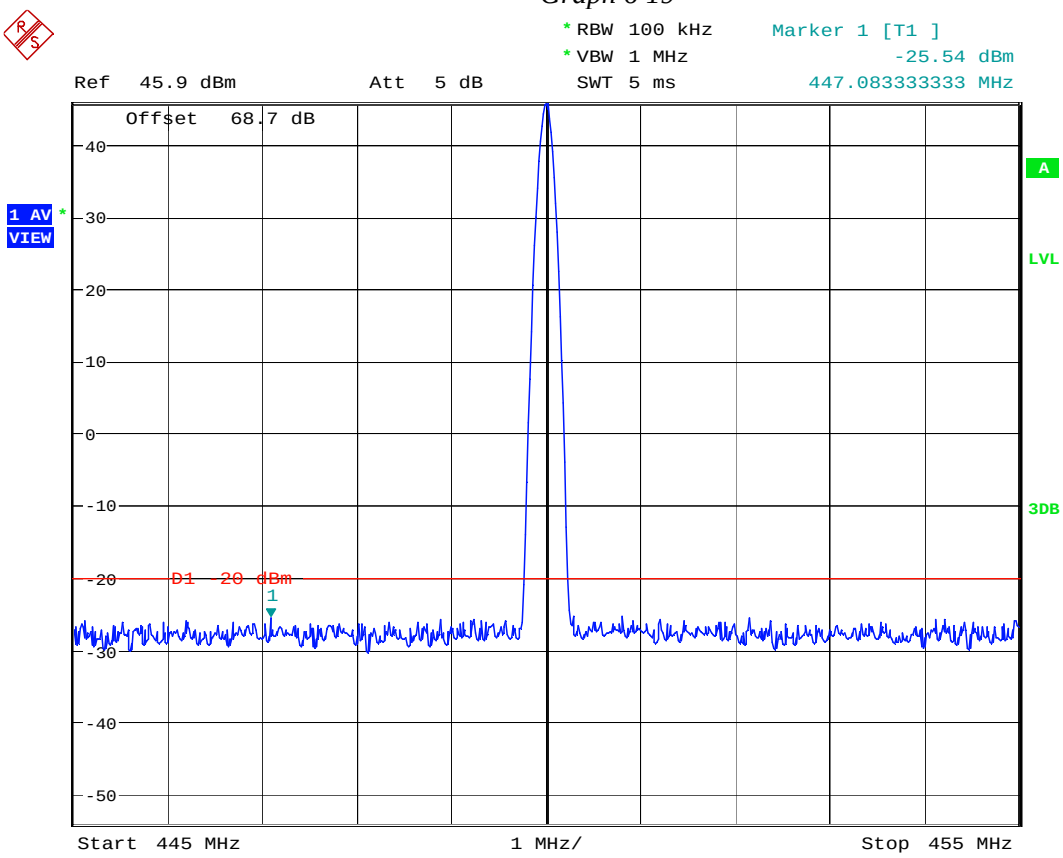
Graph 6 18



Conducted spurious, 430 MHz, GMSK

Date: 16.SEP.2009 02:10:43

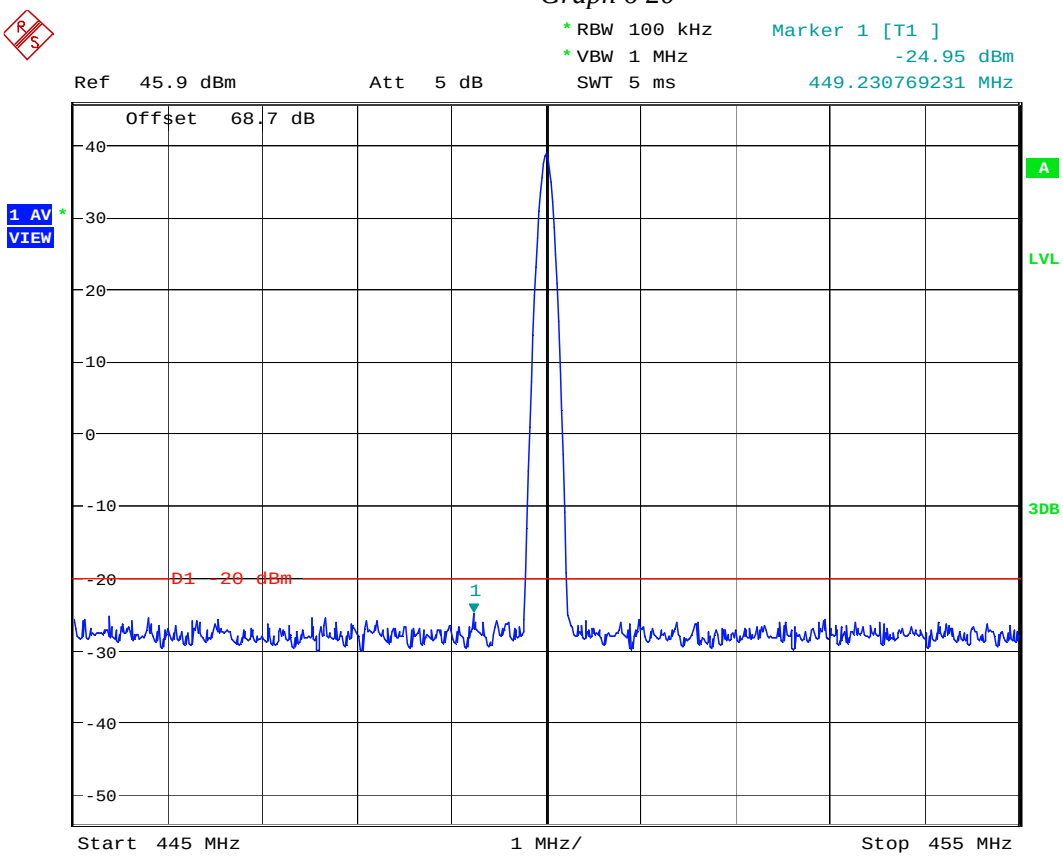
Graph 6 19



Conducted spurious, 450 MHz, Unmodulated

Date: 14.SEP.2009 19:39:04

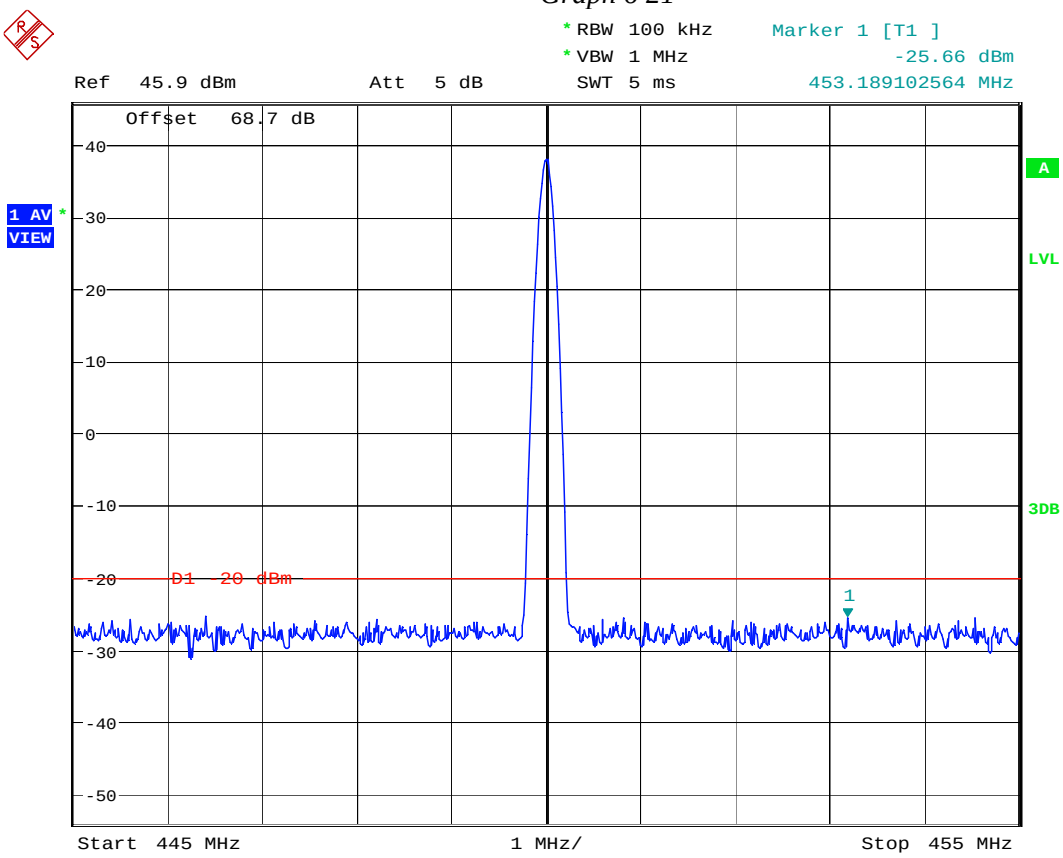
Graph 6 20



Conducted spurious, 450 MHz, BPSK

Date: 14.SEP.2009 19:40:07

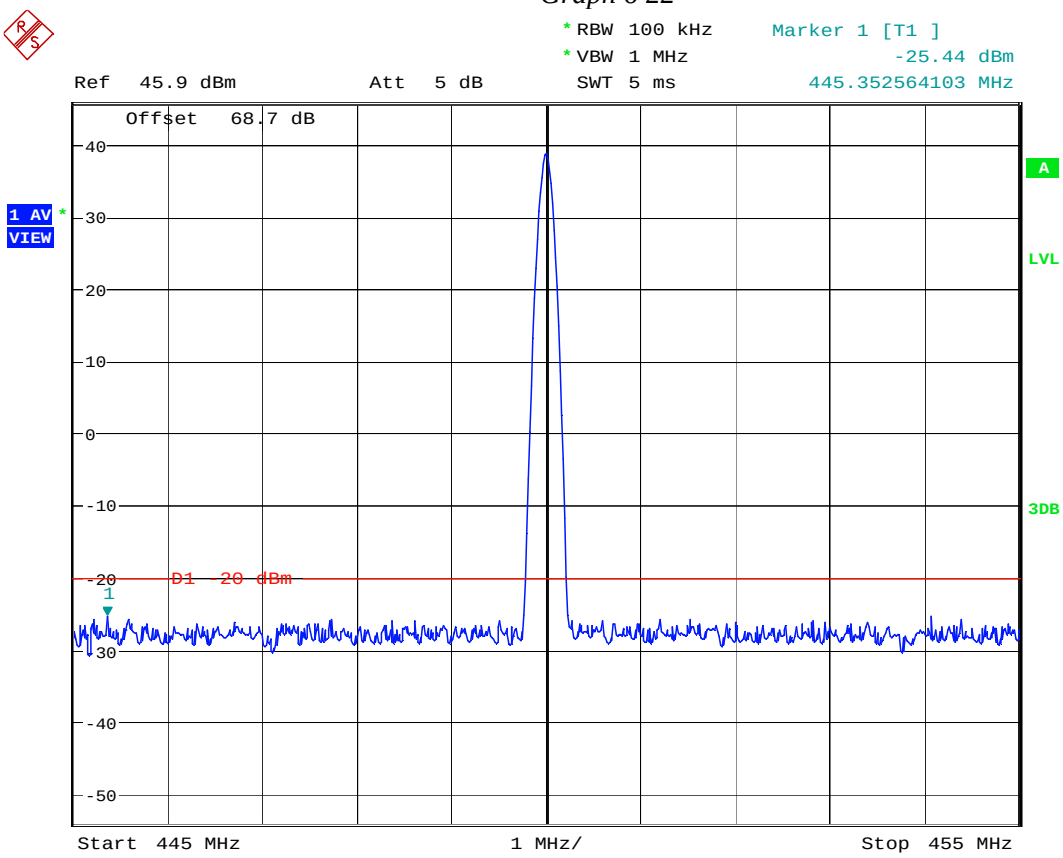
Graph 6 21



Conducted spurious, 450 MHz, QPSK

Date: 14.SEP.2009 19:41:01

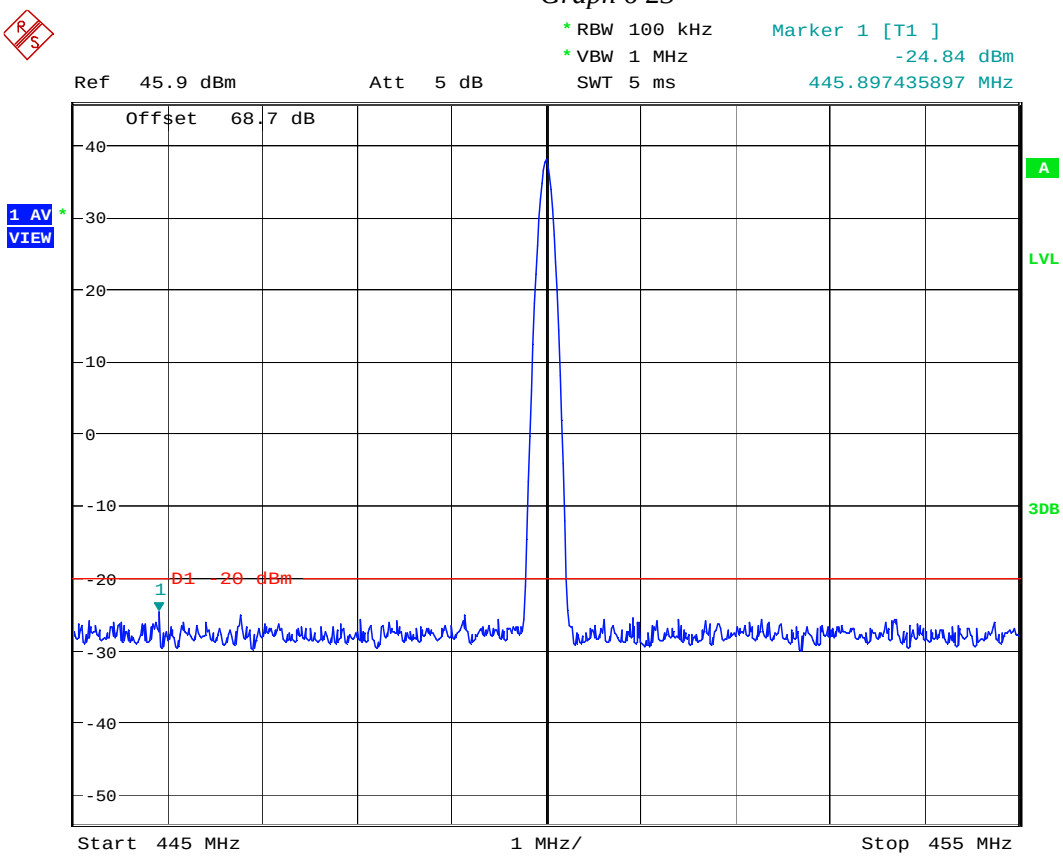
Graph 6 22



Conducted spurious, 450 MHz, 8PSK

Date: 14.SEP.2009 19:41:57

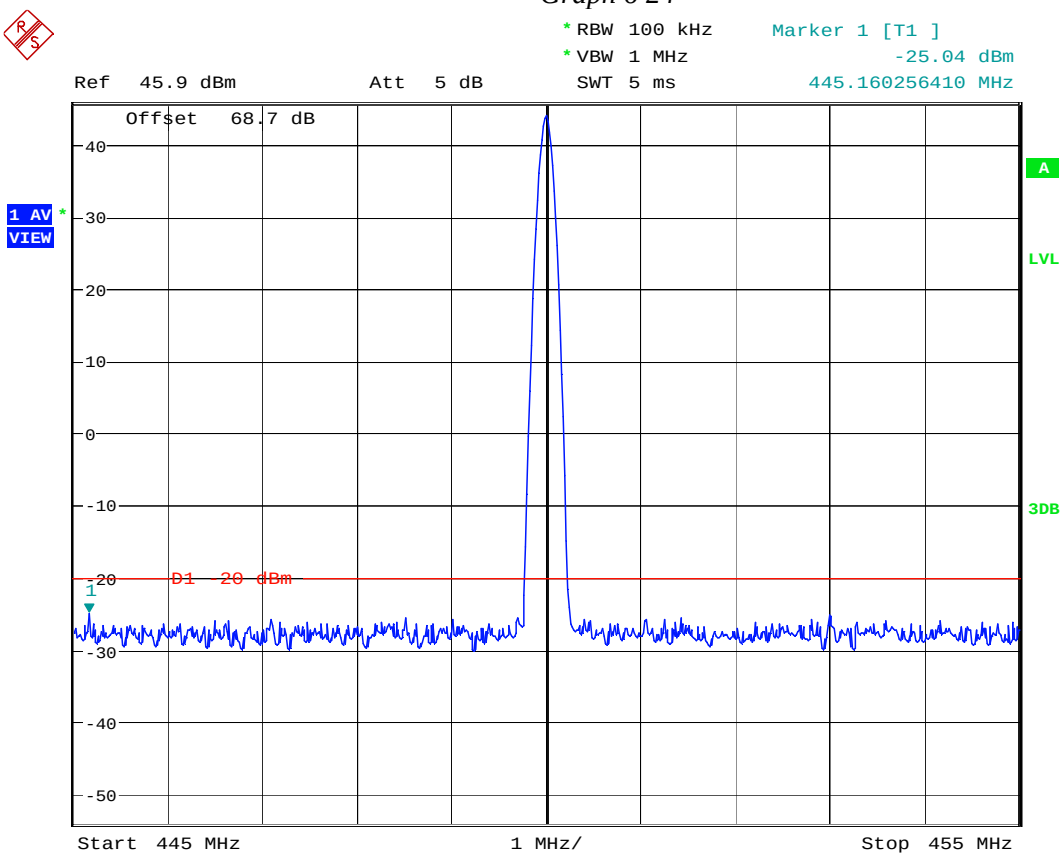
Graph 6 23



Conducted spurious, 450 MHz, 16QAM

Date: 14.SEP.2009 19:43:07

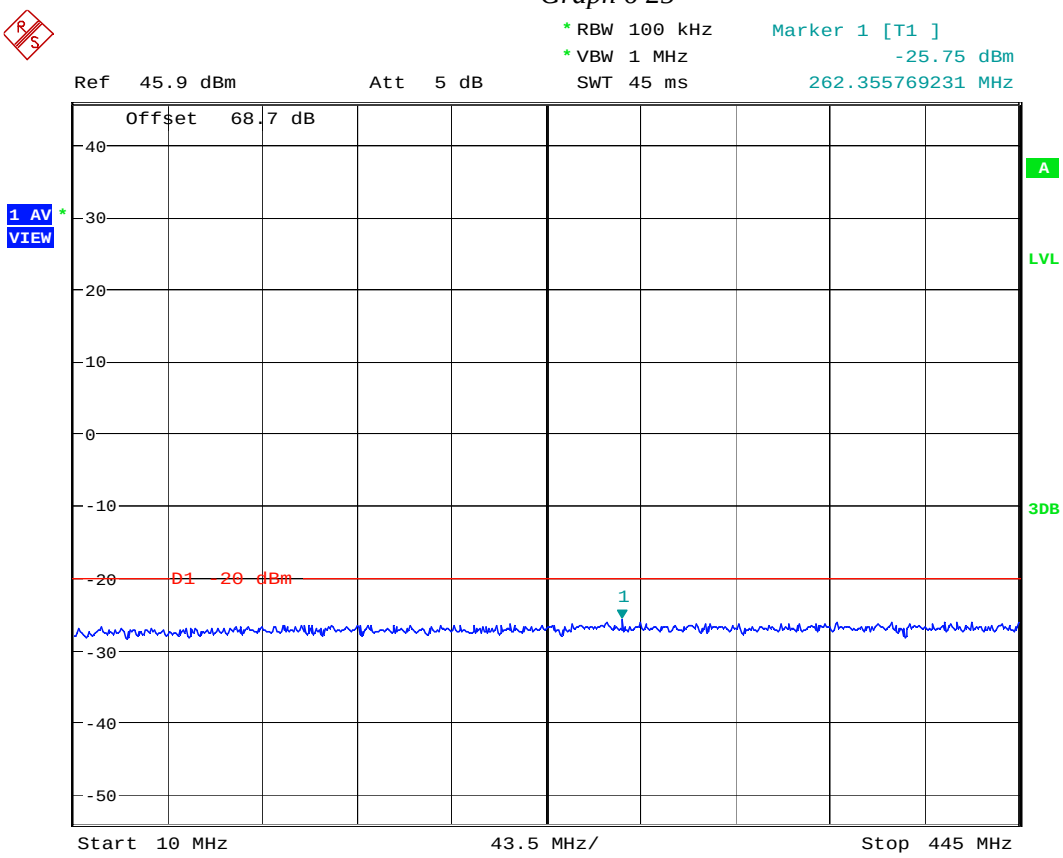
Graph 6 24



Conducted spurious, 450 MHz, GMSK

Date: 14.SEP.2009 19:43:59

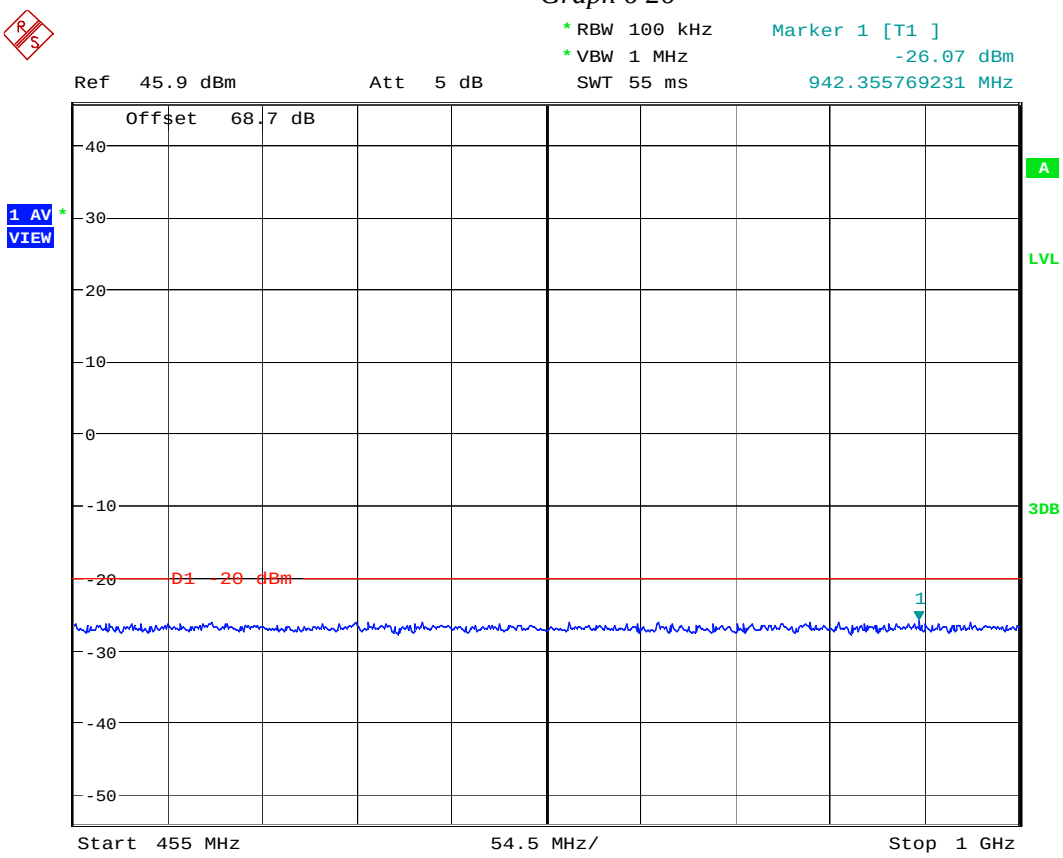
Graph 6 25



Conducted spurious, 450 MHz, GMSK

Date: 14.SEP.2009 19:44:37

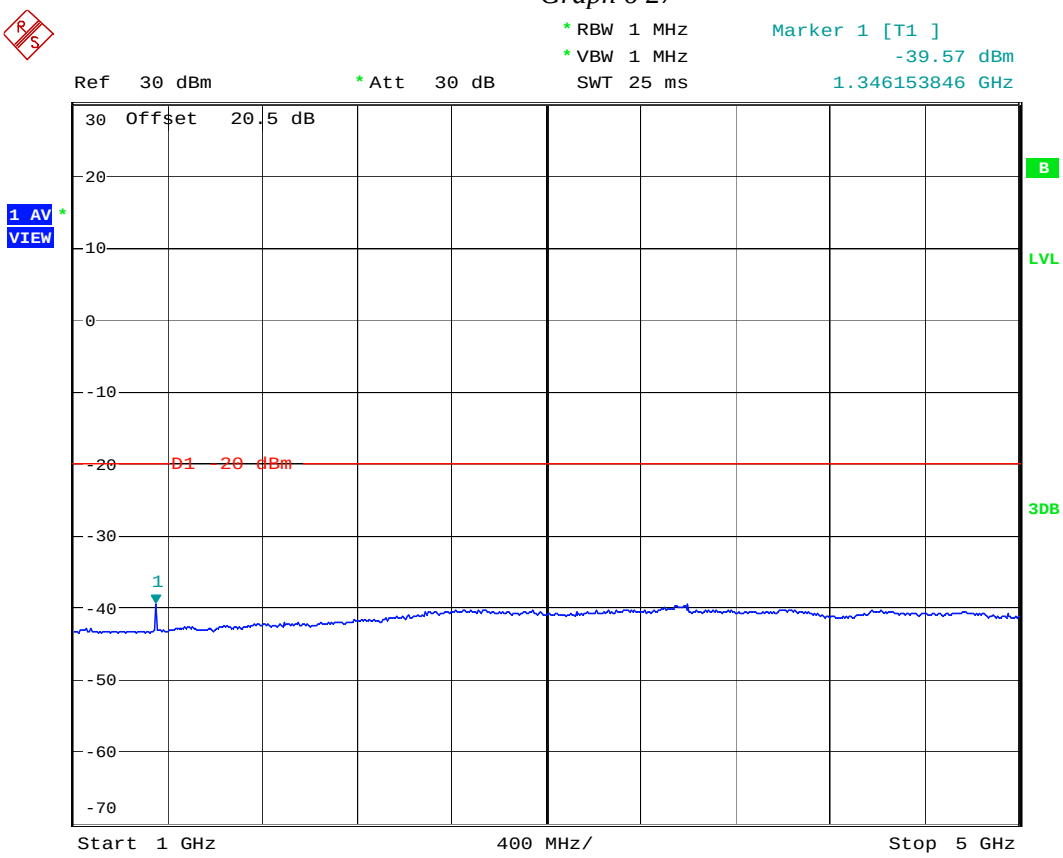
Graph 6 26



Conducted spurious, 450 MHz, GMSK

Date: 14.SEP.2009 19:45:07

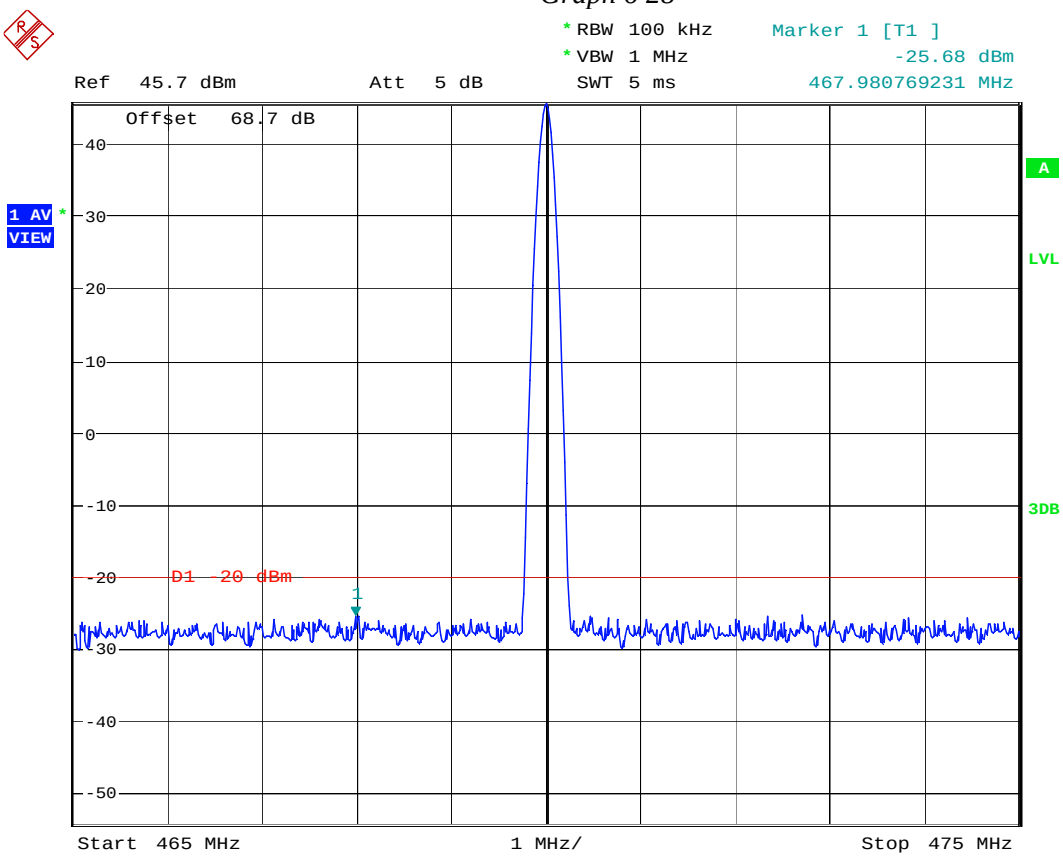
Graph 6 27



Conducted spurious, 450 MHz, GMSK

Date: 16.SEP.2009 02:11:29

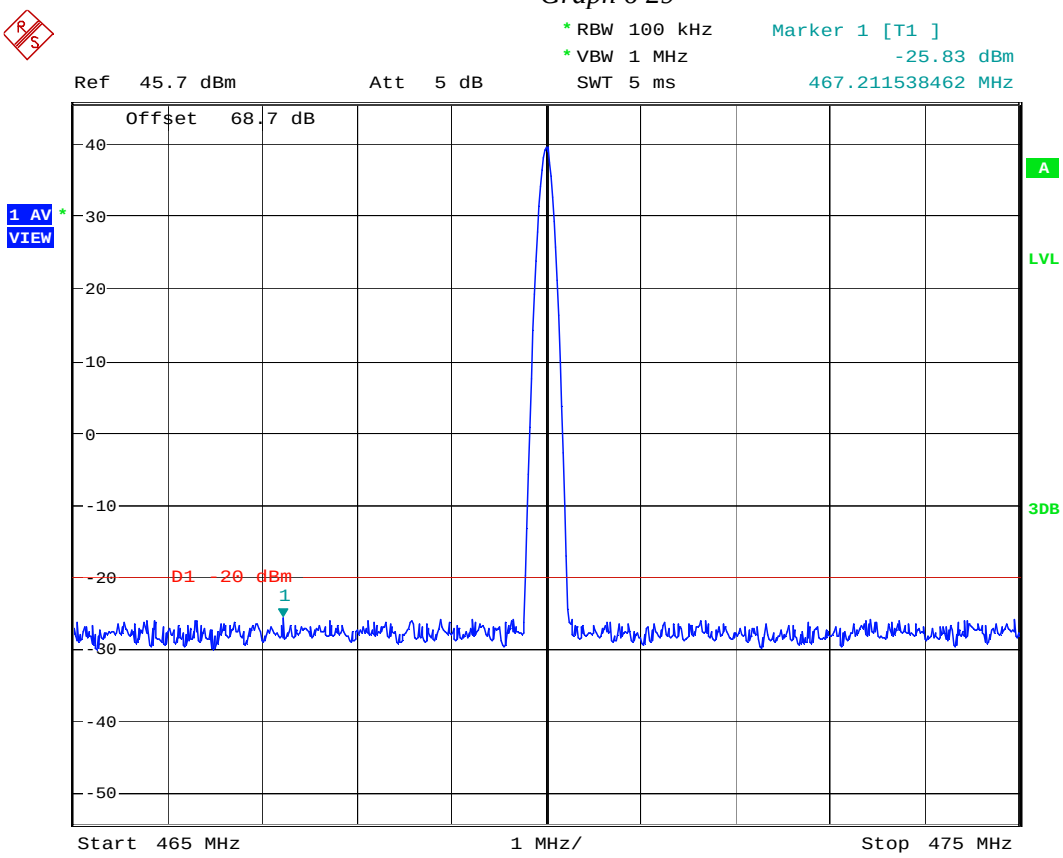
Graph 6 28



Conducted spurious, 470 MHz, Unmodulated

Date: 14.SEP.2009 19:47:28

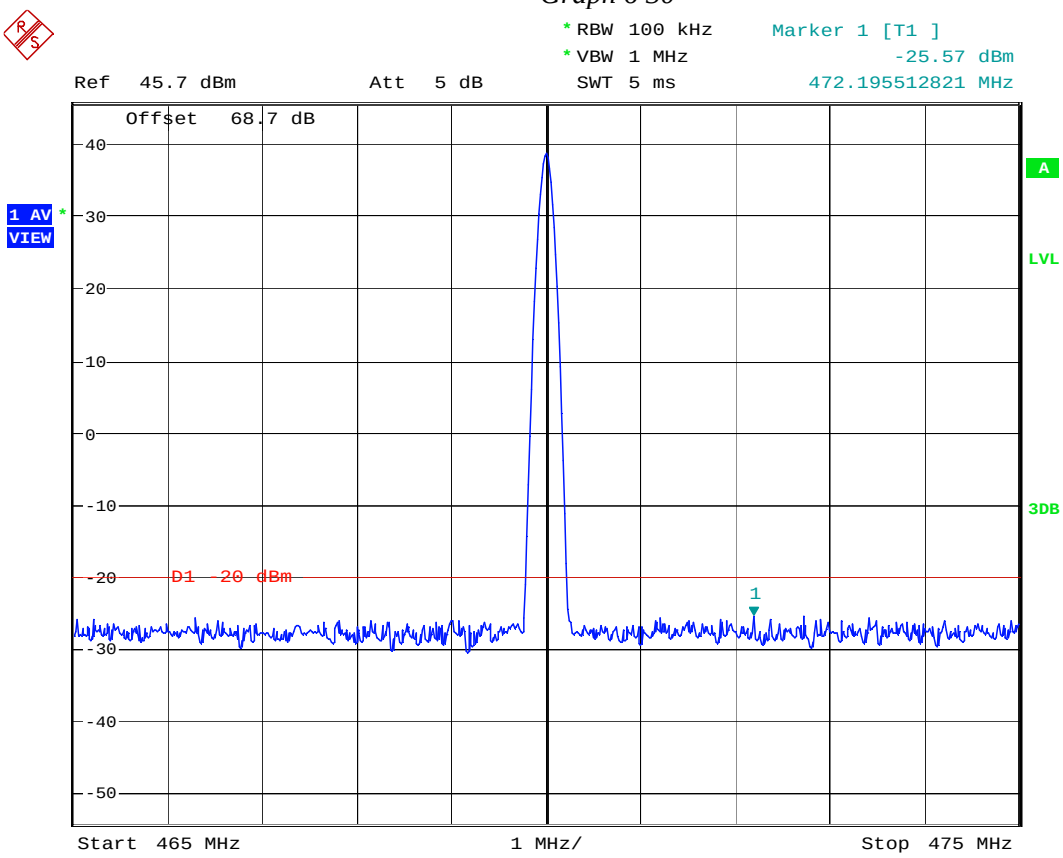
Graph 6 29



Conducted spurious, 470 MHz, BPSK

Date: 14.SEP.2009 19:48:11

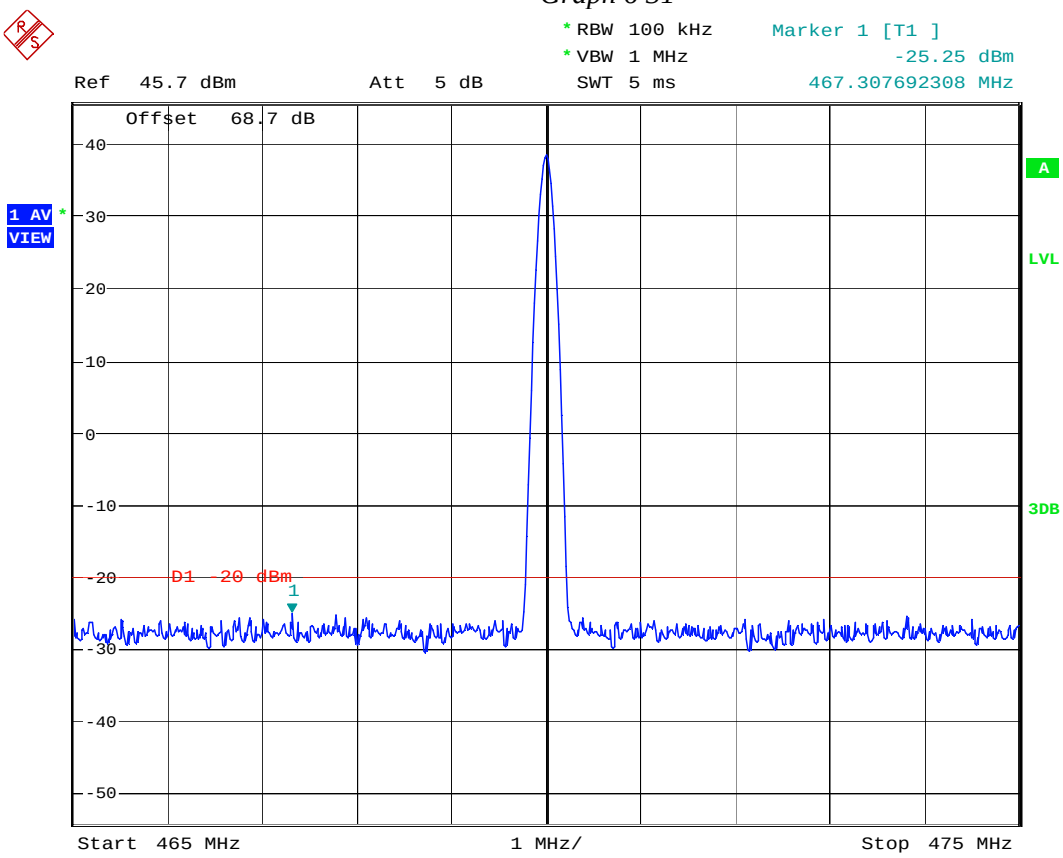
Graph 6 30



Conducted spurious, 470 MHz, QPSK

Date: 14.SEP.2009 19:49:13

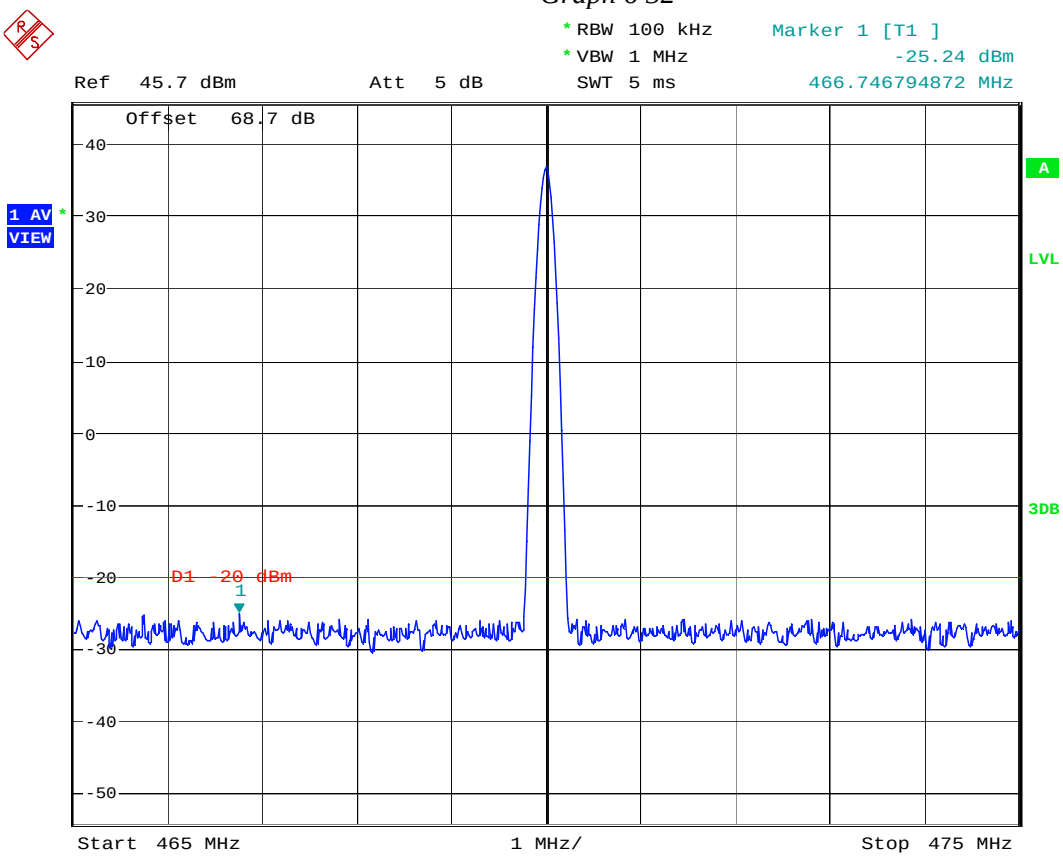
Graph 6 31



Conducted spurious, 470 MHz, 8PSK

Date: 14.SEP.2009 19:49:57

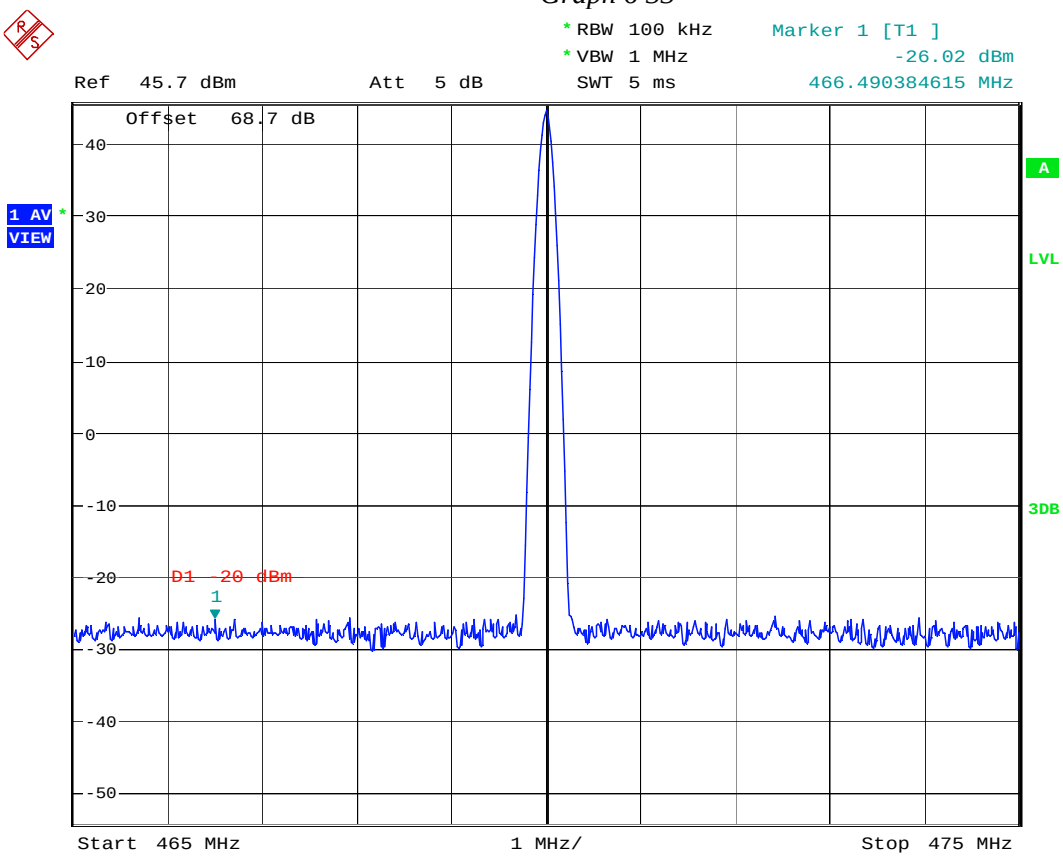
Graph 6 32



Conducted spurious, 470 MHz, 16QAM

Date: 14.SEP.2009 19:50:44

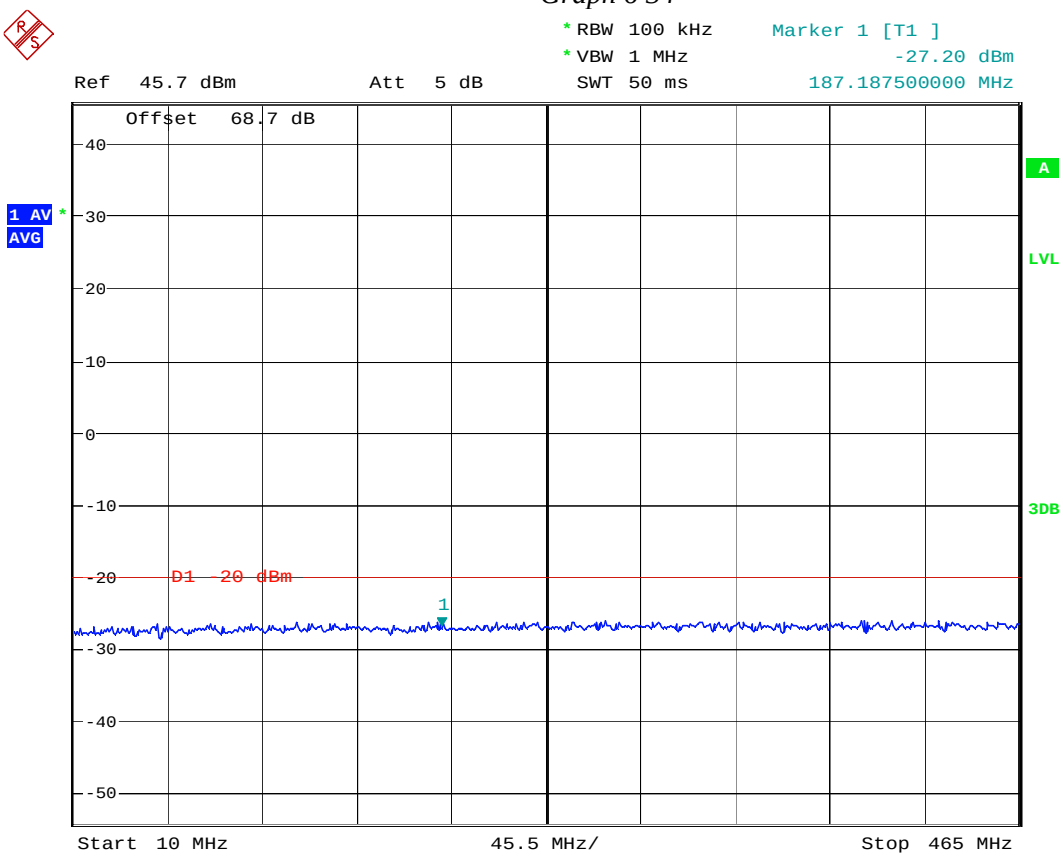
Graph 6 33



Conducted spurious, 470 MHz, GMSK

Date: 14.SEP.2009 19:51:44

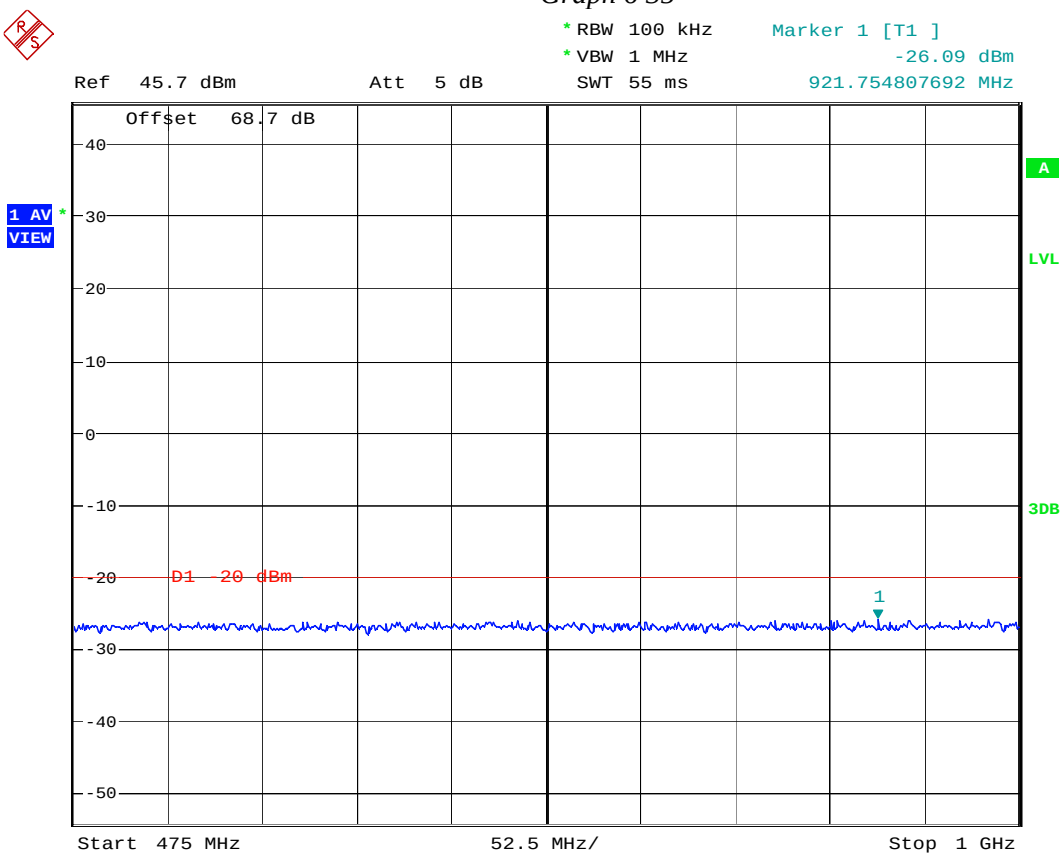
Graph 6 34



Conducted spurious, 470 MHz, GMSK

Date: 14.SEP.2009 19:52:40

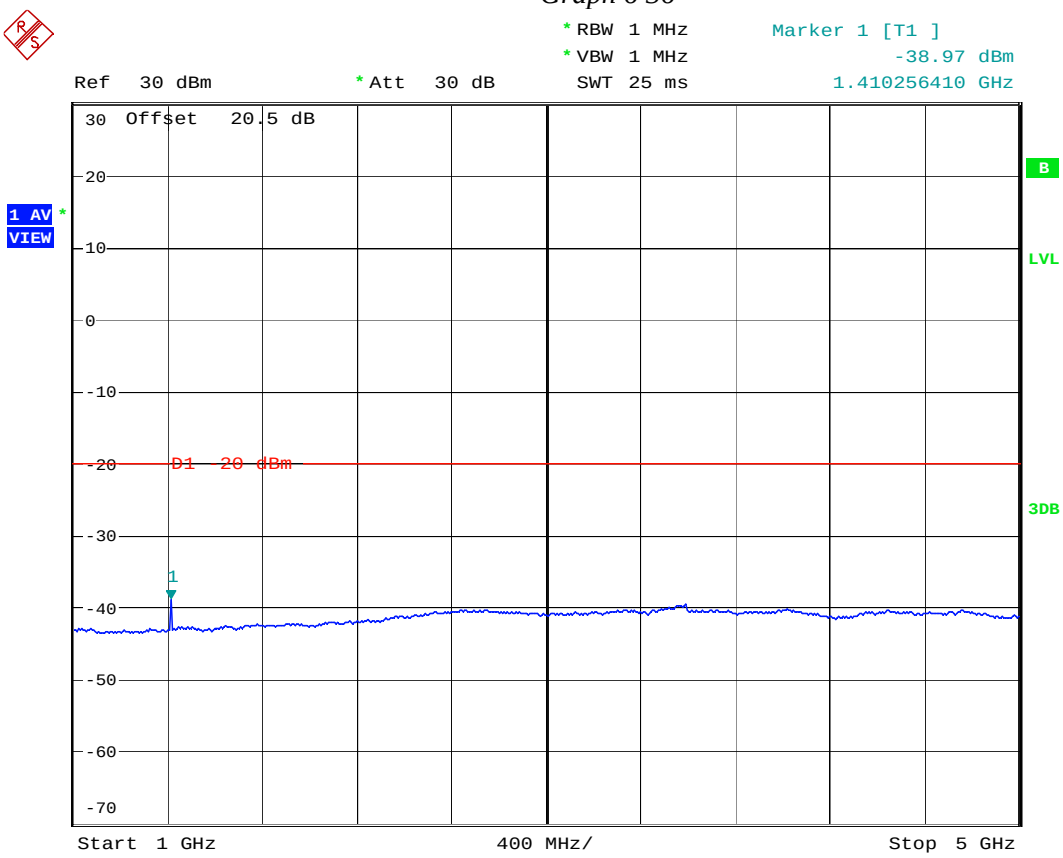
Graph 6 35



Conducted spurious, 470 MHz, GMSK

Date: 14.SEP.2009 19:53:19

Graph 6 36



Conducted spurious, 470 MHz, GMSK

Date: 16.SEP.2009 02:12:18

7.0 Spurious Radiation

FCC 2.1053, 90.210

7.1 Requirement

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by at least (50 + 10 log P) dB or 70 dB, whichever is lesser attenuation.

Note: Attenuation of (50 + 10 log P) dB corresponds to the level of -20 dBm for any out-of-band and spurious emissions.

7.2 Test Procedure

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to 10th harmonic was investigated. The worst case of emissions was reported.

For spurious emissions attenuation, the substitution method was used. The EUT was substituted by a reference antenna (half-wave dipole - below 1 GHz, or Horn antenna - above 1GHz), connected to a signal generator. The signal generator output level ($\mathbf{V_g}$ in dBm) was adjusted to obtain the same reading as from EUT. The ERP at the spurious emissions frequency was calculated as follows.

$$ERP_{(dBm)} = \mathbf{V_g + G_{(dBd)}}$$

The spurious emissions attenuation is the difference between ERP at the fundamental frequency (see section 3) and at the spurious emissions frequency.

7.3 Test Equipment

Roberts Antenna
EMCO 3115 Horn Antennas
Rohde & Schwarz FSP40 Spectrum Analyzer
Low Pass Filter
Preamplifiers

7.4 Test Results

Spurious Radiated Emissions

Frequency	SA Reading (from EUT)	Signal Generator Output required to have the same SA Reading as from EUT	ERP*	ERP Limit	ERP Margin
MHz	**dB(µV)**	**V_g dBm**	**dBm**	**dBm**	**dB**
Tx 406.1 MHz					
812.2	31.7	-61.4	-61.4	-20.0	-41.4
1218.3	38.2	-69.6	-64.4	-20.0	-44.4
1624.4	30.5	-74.7	-68.3	-20.0	-48.3
2030.5	29.9	-73.5	-67.0	-20.0	-47.0
2436.6	30.9	-72.5	-65.2	-20.0	-45.2
2842.7	29.5	-72.8	-65.3	-20.0	-45.3
3248.8	31.2	-68.7	-61.1	-20.0	-41.1
3654.9	36.8	-62.5	-54.9	-20.0	-34.9
4061.0	33.1	-64.7	-57.0	-20.0	-37.0
Tx 430.0 MHz					
860.0	39.5	-53.2	-53.2	-20.0	-33.2
1290.0	35.0	-72.7	-67.2	-20.0	-47.2
1720.0	36.1	-69.9	-63.5	-20.0	-43.5
2150.0	30.1	-72.9	-66.1	-20.0	-46.1
2580.0	29.4	-73.1	-65.7	-20.0	-45.7
3010.0	29.9	-72.3	-64.7	-20.0	-44.7
3440.0	43.2	-56.2	-48.6	-20.0	-28.6
3870.0	30.3	-67.6	-59.9	-20.0	-39.9
4300.0	30.1	-65.8	-57.4	-20.0	-37.4

* ERP is calculated as: $ERP_{(dBm)} = \mathbf{V_{g(dBm)} + G_{(dBd)}}$

All other emissions not reported are more than 20 dB below the limit.

Spurious Radiated Emissions

Frequency	SA Reading (from EUT)	Signal Generator Output required to have the same SA Reading as from EUT	ERP*	ERP Limit	ERP Margin
MHz	**dB(µV)**	**V_g dBm**	**dBm**	**dBm**	**dB**
Tx 450.0 MHz					
900.0	40.1	-51.4	-51.4	-20.0	-31.4
1350.0	34.3	-73.0	-67.2	-20.0	-47.2
1800.0	31.0	-74.6	-68.1	-20.0	-48.1
2250.0	29.1	-73.4	-66.4	-20.0	-46.4
2700.0	31.2	-71.5	-64.0	-20.0	-44.0
3150.0	36.6	-64.9	-57.3	-20.0	-37.3
3600.0	36.0	-63.4	-55.8	-20.0	-35.8
4050.0	37.5	-60.3	-52.6	-20.0	-32.6
4500.0	30.8	-67.1	-58.2	-20.0	-38.2
Tx 470.0 MHz					
940.0	33.7	-57.7	-57.7	-20.0	-37.7
1410.0	32.6	-74.9	-68.9	-20.0	-48.9
1880.0	31.7	-73.6	-67.1	-20.0	-47.1
2350.0	31.5	-72.2	-65.1	-20.0	-45.1
2820.0	29.1	-72.7	-65.2	-20.0	-45.2
3290.0	37.5	-62.9	-55.3	-20.0	-35.3
3760.0	34.4	-64.6	-56.9	-20.0	-36.9
4230.0	36.3	-62.1	-53.8	-20.0	-33.8
4700.0	40.8	-55.8	-46.9	-20.0	-26.9

* ERP is calculated as: $ERP_{(dBm)} = \mathbf{V_{g(dBm)} + G_{(dBd)}}$

All other emissions not reported are more than 10 dB below the limit.

Result	Complies

8.0 Transient Frequency behavior

FCC 90.214

8.1 Requirement

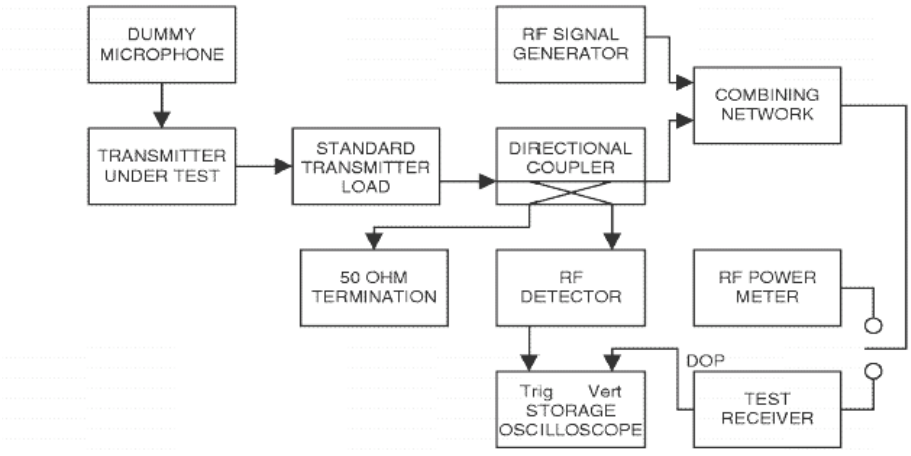
Time interval	Maximum frequency difference	Time
Transient Frequency Behavior for equipment designed to operate on 25 kHz channels		
t1 *	±25 kHz	10 ms
t2	±12.5 kHz	25 ms
t3 *	±25 kHz	10 ms
Transient Frequency Behavior for equipment designed to operate on 12.5 kHz channels		
t1 *	±12.5 kHz	10 ms
t2	±6.25 kHz	25 ms
t3 *	±12.5 kHz	10 ms

ton is the instant when a 1 kHz test signal is completely suppressed
t1 is time period immediately following **t**on
t2 is time period immediately following **t**1
t3 is time period from the instant when the transmitter is turned off until **t**off
toff is the instant when the 1 kHz test signal start to rise

* If the transmitter carrier output power rating is 6 Watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

8.2 Test Procedure

Test was performed according to the block diagram below.

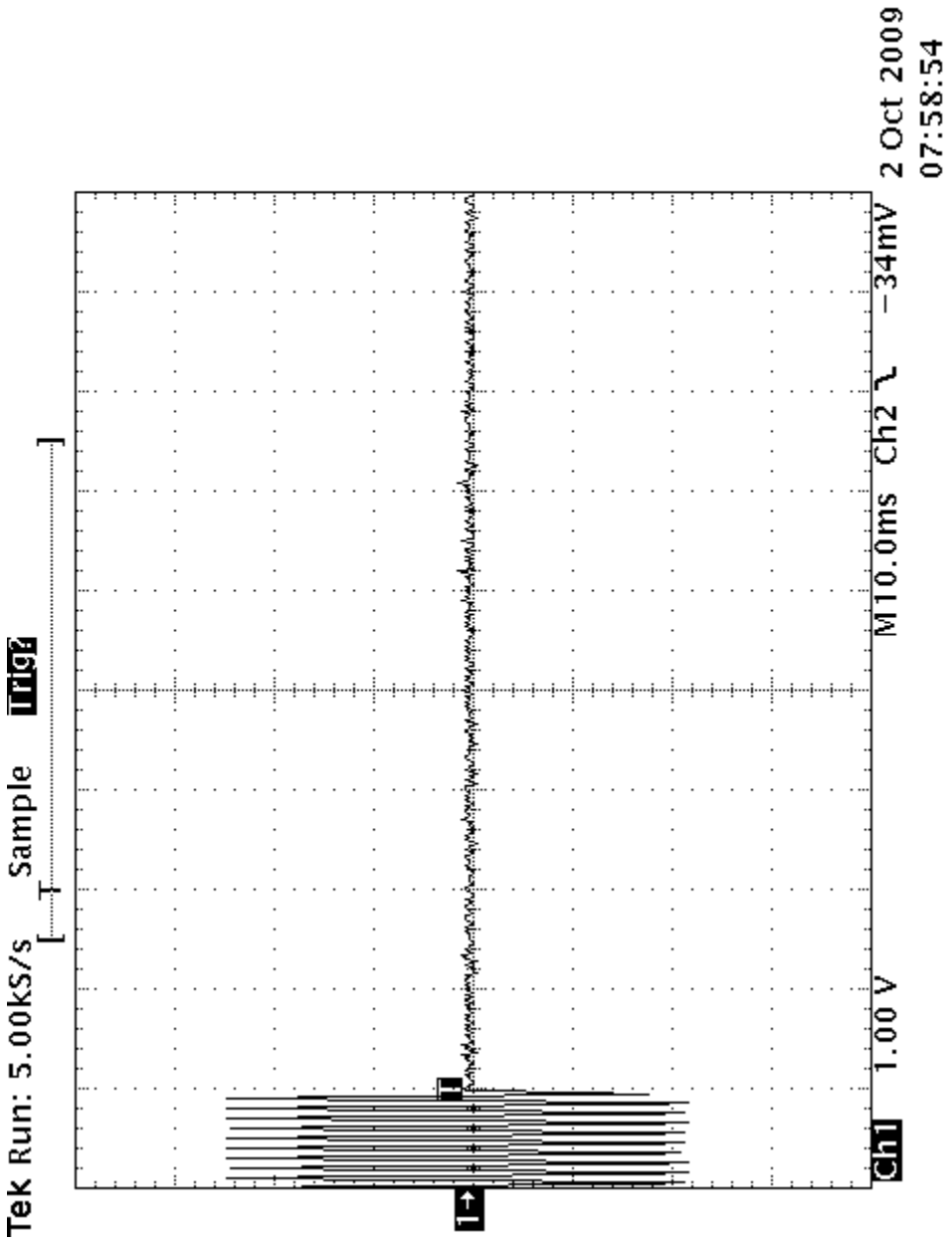


8.3 Test results

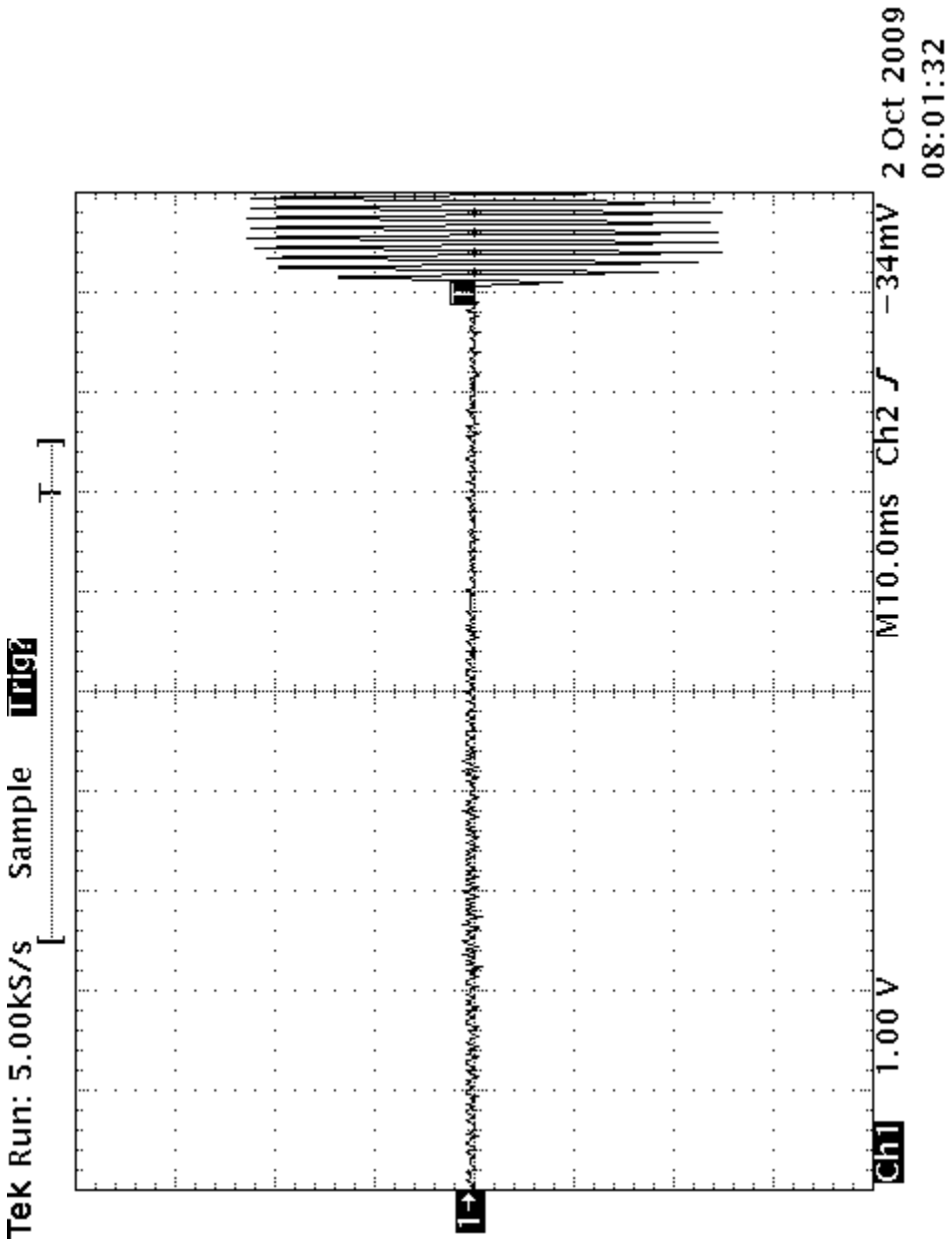
For more details refer to the attached Graphs

Result	Complies

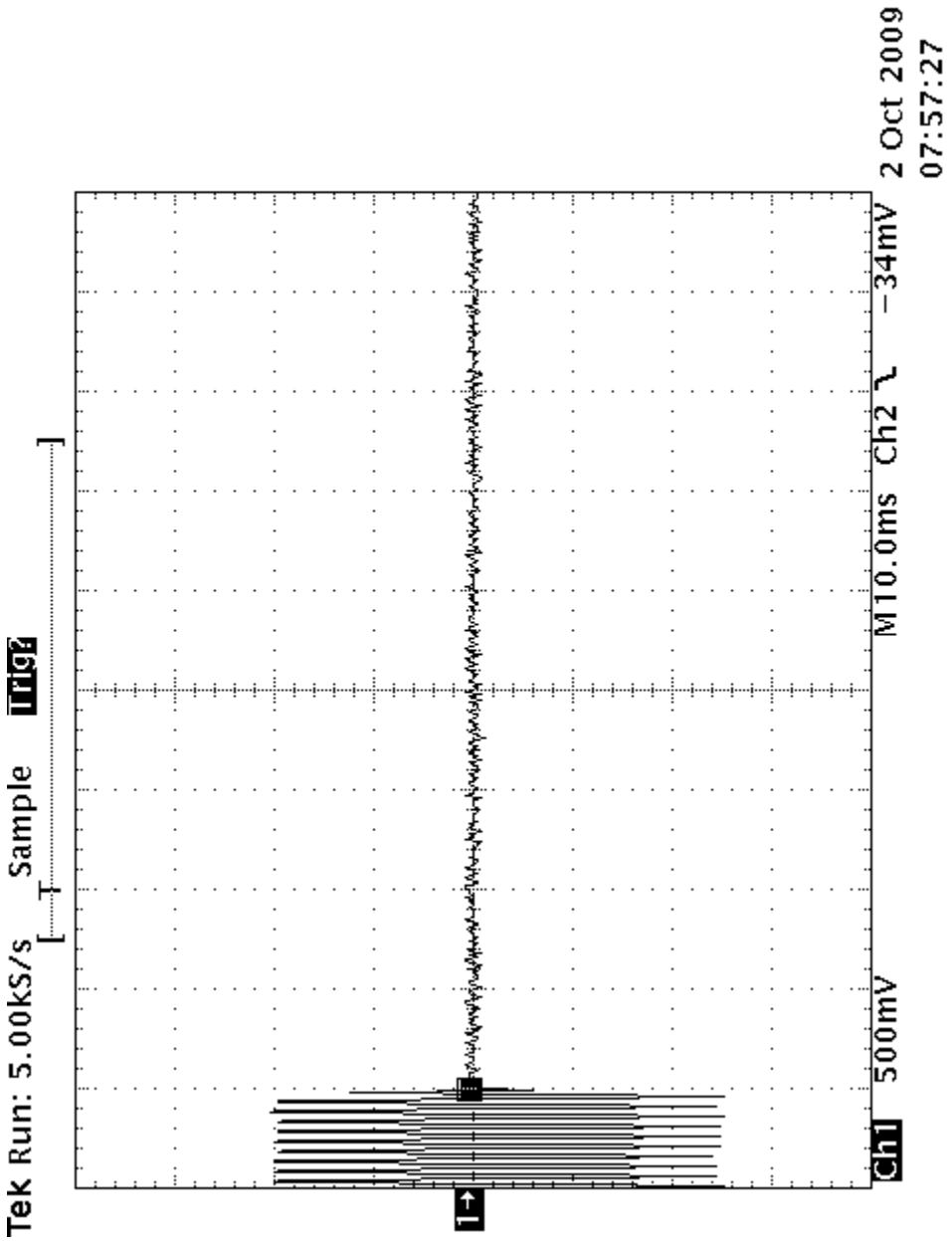
430 MHz, 25 kHz spacing



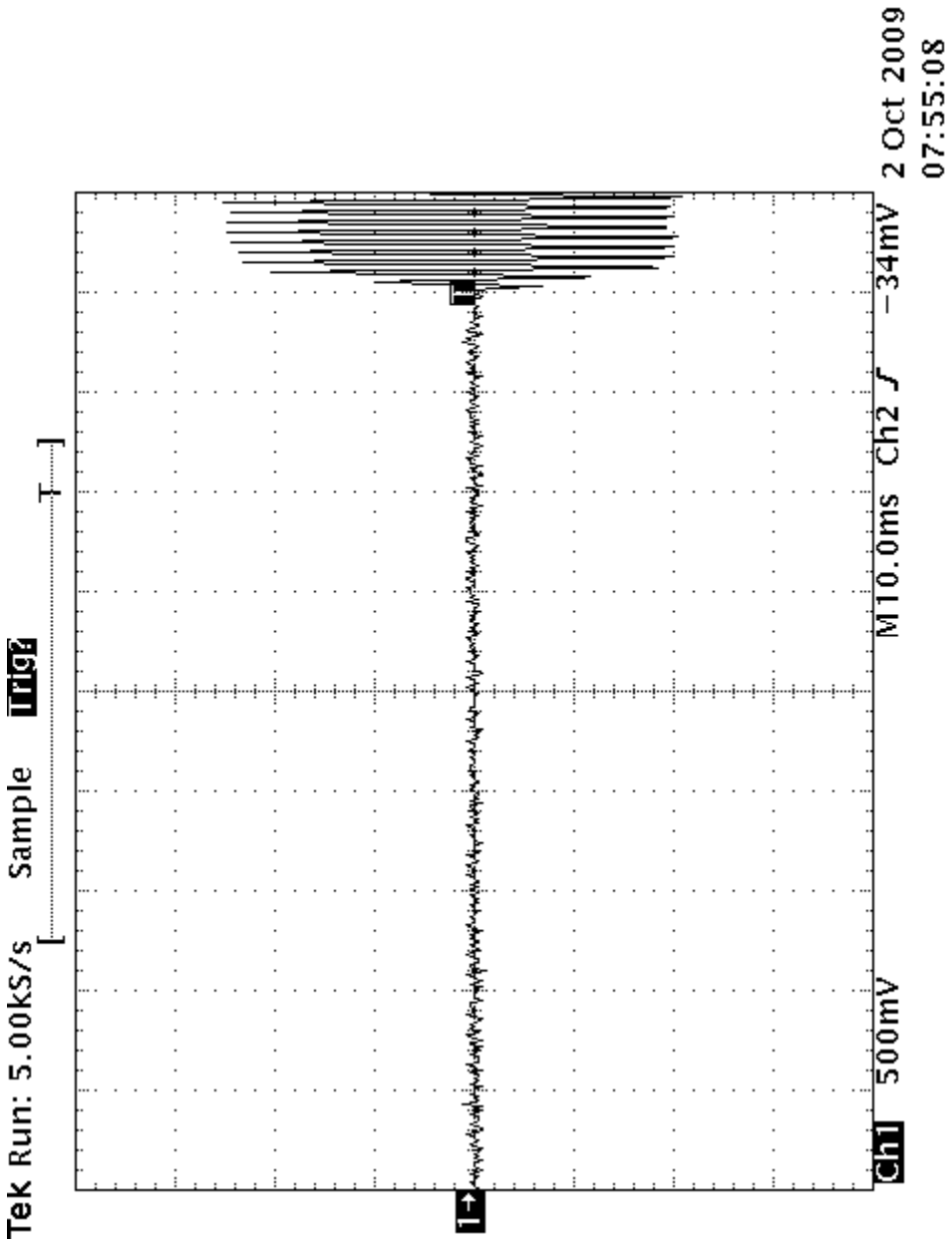
430 MHz, 25 kHz spacing



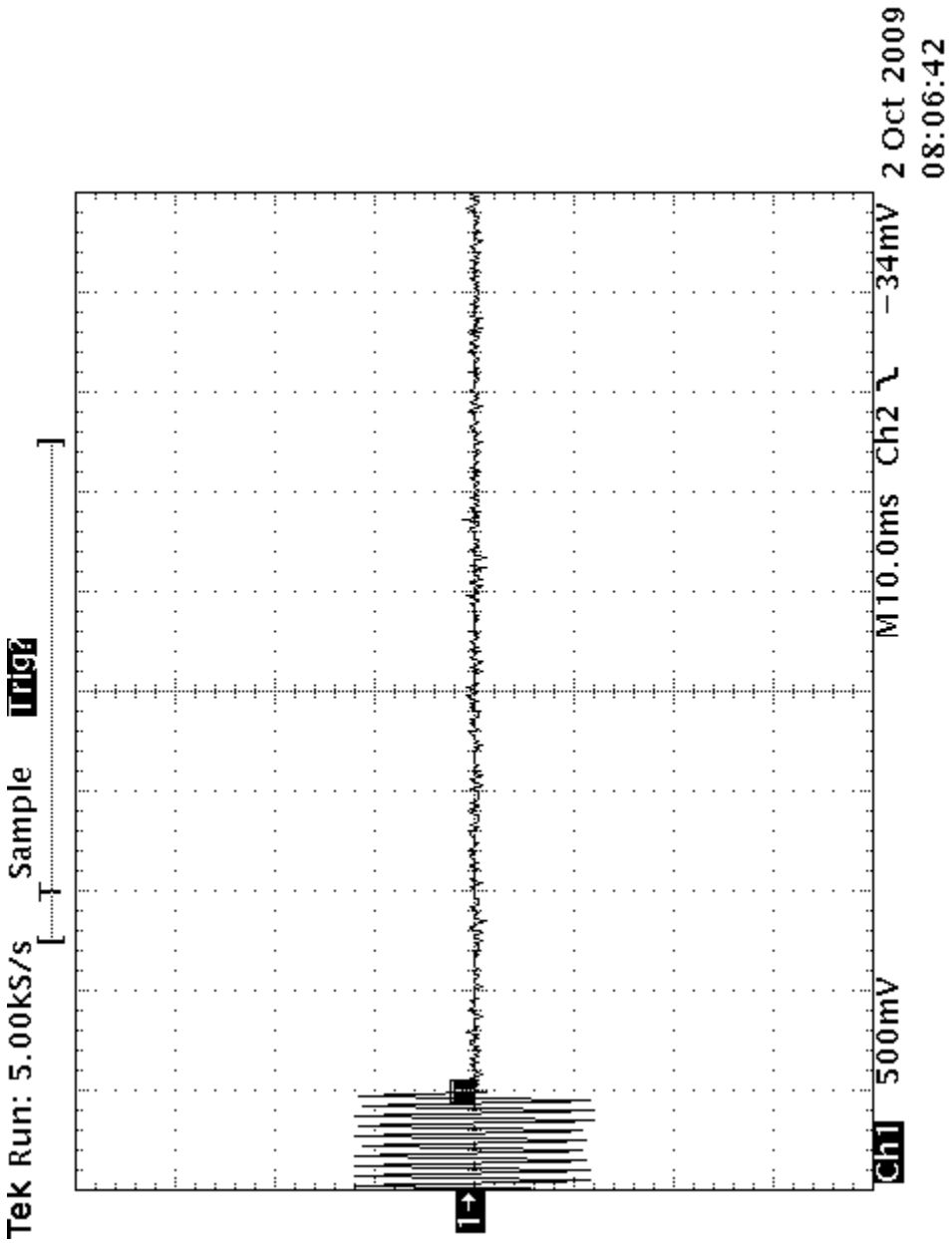
430 MHz, 12.5 kHz spacing



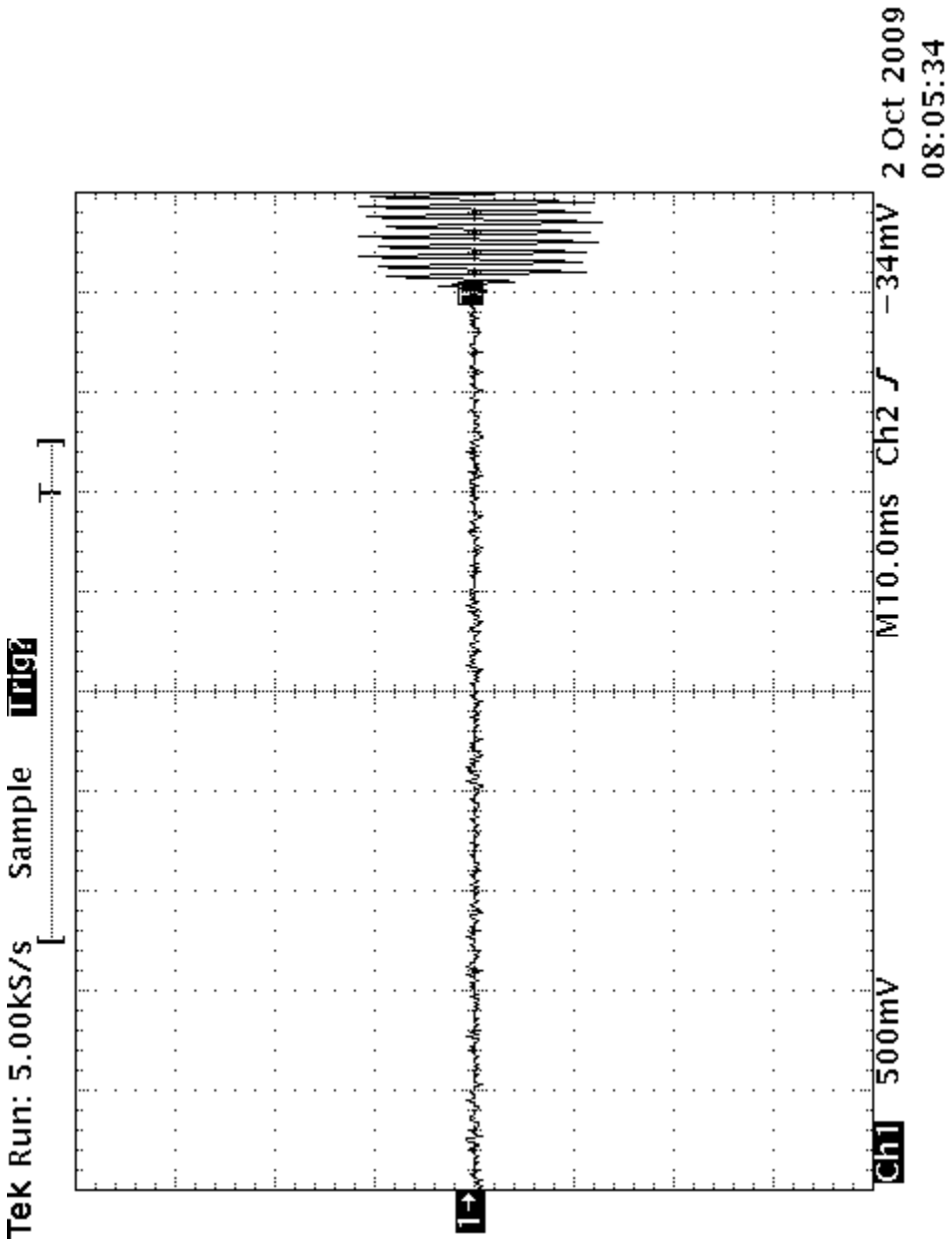
430 MHz, 12.5 kHz spacing



430 MHz, 6.25 kHz spacing



430 MHz, 6.25 kHz spacing



9.0 Frequency Stability vs Temperature and Voltage

FCC 2.1055, 90.213

9.1 Requirement

In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

Note: according to RSS-119, the frequency stability for mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

9.2 Test Procedure

The EUT was placed inside the temperature chamber. The RF power output was connected to frequency counter. The EUT was setup to transmit the maximum power.

After the temperature stabilized for approximately 20 minutes, the transmitting frequency was measured by the frequency counter and recorded.

At the room temperature, the frequency was measured when the EUT was powered with the nominal voltage and with 85% and 115% of the nominal voltage.

9.3 Test Equipment

Temperature Chamber
Frequency counter

9.4 Test Results

Nominal frequency: 430 MHz

Temperature (°C)	**Maximum deviation from nominal,** Hz	**Maximum deviation from nominal,** ppm	**Maximum deviation from frequency at 20°C,** ppm
-30	-160	0.37	0.34
-20	-140	0.33	0.30
-10	-67	0.16	0.13
0	-32	0.07	0.04
10	48	0.11	0.14
20	-13	0.07	0.0
30	-53	0.12	0.09
40	-77	0.18	0.15
50	-150	0.35	0.32

DC Voltage, V	**Maximum deviation from nominal,** Hz	**Maximum deviation from nominal,** ppm
11.2	19	0.04
13.2	-13	0.02
15.2	-33	0.08

Result	Complies

10.0 RF Exposure evaluation

FCC 2.1091

The EUT is a wireless device used in a mobile application, at least 100 cm from any body part of the user or nearby persons.

The maximum calculated EIRP is 61.66 W, and ERP is 38.02 W.

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 50% - see the document “HPT435 UHF OEM Module Duty Cycle evaluation”.
Therefore, the average EIRP is 30.83 W

Using the formula for the Power Density $S = EIRP/ 4\pi D^2$, the distance D, where the Maximum Permissible Exposure (MPE) satisfies the FCC 1.1310 limit for General Population/Uncontrolled Exposure, can be calculated as:

$$D \geq \sqrt{(EIRP/ 4\pi S)}$$

According to FCC 1.1310, the MPE Limit at 406 MHz is 2.7 W/m^2, therefore $D \geq 0.95$ m.

The Statement that a minimum separation distance of 100 cm between the antenna and persons must be maintained is included in the User’s manual.

11.0 Emission from digital part and receiver

11.1 Radiated emissions
FCC 15.109

11.1.1 Test Limit

Radiated Emission Limit for FCC Part 15 Subpart B and ICES 003

Radiated Emission Limits for Class A at 10 meters	
Frequency (MHz)	**Quasi-Peak limits, dB (μV/m)**
30 to 88	39.1
88 to 216	43.5
216 to 960	46.4
960 and up	49.5
Radiated Emission Limits for Class B at 3 meters	
Frequency (MHz)	**Quasi-Peak limits, dB (μV/m)**
30 to 88	40.0
88 to 216	43.5
216 to 960	46.0
960 and up	54.0

11.1.2 Test Procedure

Measurements are conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1000 MHz and with the average detector instrument in the frequency range above 1000 MHz. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole.

Measurements of the radiated field are made with the antenna located at a distance of 10 meters from the EUT. If the field-strength measurements at 10m cannot be made because of high ambient noise level or for other reasons, measurements of Class B equipment may be made at a closer distance, for example 3m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for a larger EUT.

Floor standing EUTs are placed on a horizontal metal ground plane and isolated from the ground plane by 3 to 12 mm of insulating material.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4 (2003).

Example Field Strength Calculation
The field strength is calculated by adding the Antenna Factor and Cable Factor. Then by subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

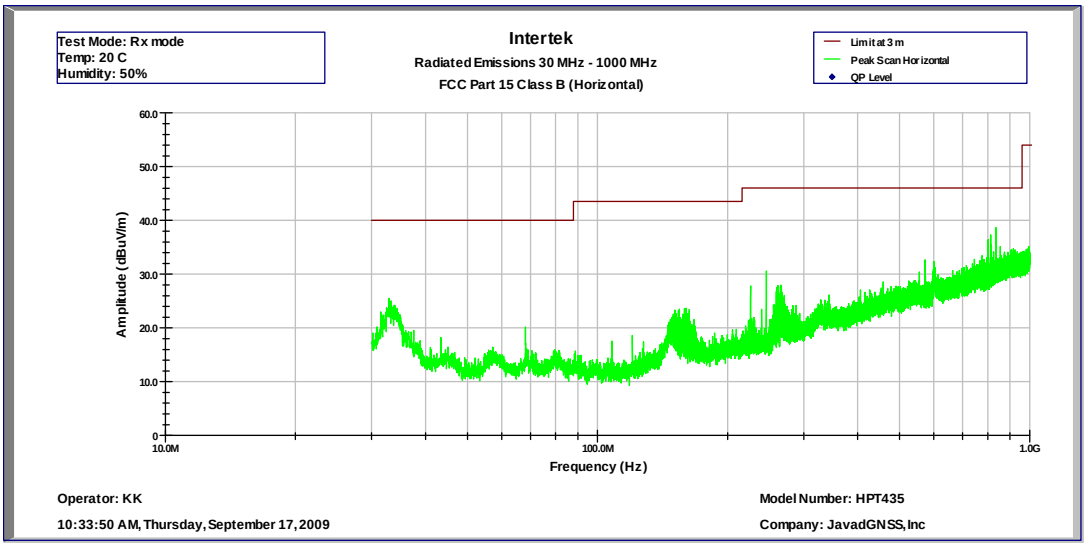
FS = RA + AF + CF – PA
Where FS = Field Strength in dB (µV/m)
RA = Receiver Amplitude (including preamplifier) in dB (µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
PA= Preamplifier Factor in dB

Assume a receiver reading of 52.0 dB (µV) is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB (µV/m).

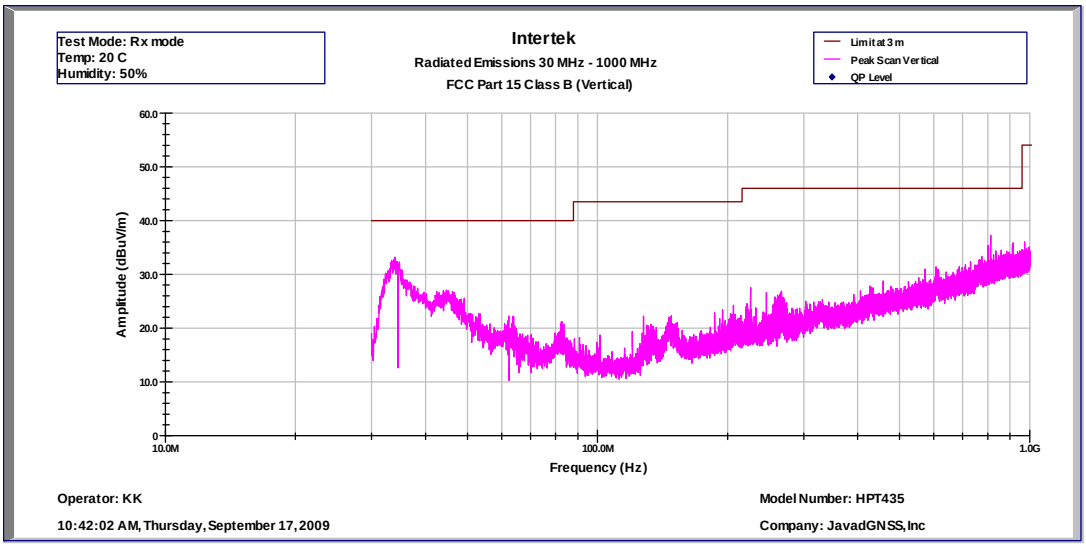
RA = 52.0 dB (µV)
AF = 7.4 dB (1/m)
CF = 1.6 dB
PA = 29.0 dB
FS = RF + AF + CF – PA
FS = 52.0 + 7.4 + 1.6 – 29.0
FS = 32 dB (µV/m)

11.1.3 Test Results

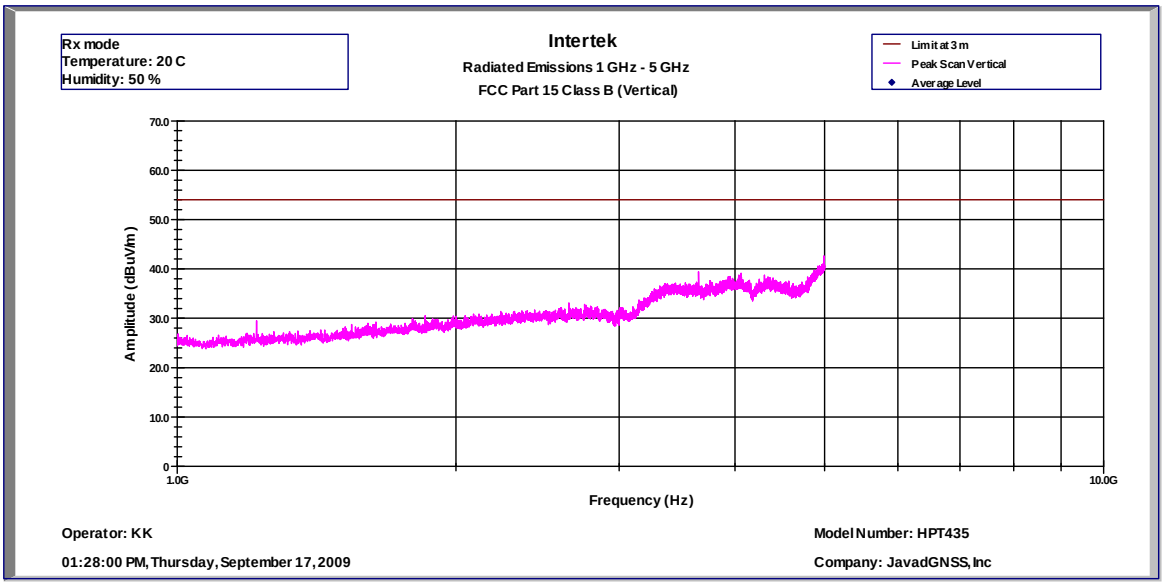
Result	Complies by 6.8 dB

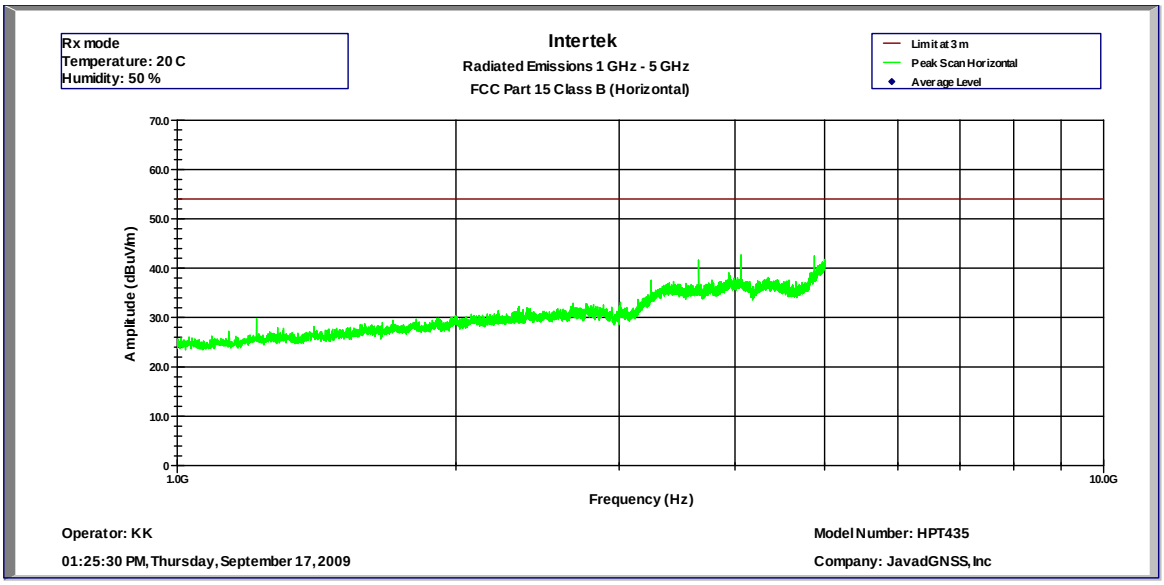


Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (Pk-Horizontal)								
Operator: KK			Model Number: HPT435					
September 17, 2009			Company: Javad GNSS, Inc.					
Frequency (Hz)	**Peak FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
2.26E+08	27.8	46.0	-18.2	37.2	1.6	31.9	10.5	10.4
2.46E+08	30.5	46.0	-15.5	39.3	1.6	31.9	10.5	11.0
2.60E+08	27.5	46.0	-18.5	35.5	1.7	31.9	10.5	11.7
2.62E+08	27.9	46.0	-18.1	35.7	1.7	31.9	10.5	11.9
2.65E+08	27.7	46.0	-18.3	35.2	1.7	31.9	10.5	12.2
2.65E+08	27.9	46.0	-18.1	35.4	1.7	31.9	10.5	12.2
2.66E+08	27.9	46.0	-18.1	35.4	1.7	31.9	10.5	12.2
4.58E+08	28.5	46.0	-17.5	30.2	2.3	32.1	10.5	17.7
5.55E+08	30.3	46.0	-15.7	30.2	2.5	32.2	10.5	19.4
5.73E+08	32.6	46.0	-13.4	33.0	2.5	32.2	10.5	18.8
6.01E+08	32.3	46.0	-13.7	29.0	2.6	32.3	10.5	22.5
7.45E+08	32.7	46.0	-13.3	29.9	2.9	32.2	10.5	21.7
7.77E+08	33.4	46.0	-12.6	30.3	3.0	32.1	10.5	21.8
8.02E+08	36.4	46.0	-9.6	33.2	3.0	32.0	10.5	21.7
8.12E+08	37.3	46.0	-8.7	33.8	3.0	32.0	10.5	21.9
8.16E+08	35.4	46.0	-10.6	31.9	3.1	32.0	10.5	21.9
8.26E+08	34.1	46.0	-11.9	30.4	3.1	31.9	10.5	22.1
8.36E+08	38.6	46.0	-7.4	34.6	3.1	31.9	10.5	22.3
8.55E+08	35.2	46.0	-10.8	30.7	3.1	31.8	10.5	22.7
9.96E+08	35.1	54.0	-18.9	28.1	3.4	30.6	10.5	23.7
Mode: Rx mode Temp: 20 C, Humidity: 50%								



Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (Pk-Vertical)								
Operator: KK			Model Number: HPT435					
September 17, 2009			Company: Javad GNSS, Inc.					
Frequency (Hz)	**Peak FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
3.40E+07	33.2	40.0	-6.8	47.9	0.6	32.0	10.5	6.2
3.48E+07	32.3	40.0	-7.7	46.9	0.6	32.0	10.5	6.3
2.26E+08	27.5	46.0	-18.5	35.2	1.6	31.9	10.5	12.2
2.46E+08	26.5	46.0	-19.5	33.4	1.6	31.9	10.5	12.9
2.57E+08	25.7	46.0	-20.3	32.8	1.7	31.9	10.5	12.7
2.61E+08	26.1	46.0	-19.9	32.9	1.7	31.9	10.5	12.9
2.62E+08	25.9	46.0	-20.1	32.6	1.7	31.9	10.5	13.0
2.65E+08	26.4	46.0	-19.6	33.0	1.7	31.9	10.5	13.1
2.67E+08	26.9	46.0	-19.1	33.3	1.7	31.9	10.5	13.2
2.68E+08	25.6	46.0	-20.4	32.0	1.7	31.9	10.5	13.3
2.69E+08	25.7	46.0	-20.3	31.9	1.7	31.9	10.5	13.4
4.06E+08	26.9	46.0	-19.1	29.4	2.1	32.0	10.5	16.8
4.28E+08	27.8	46.0	-18.2	29.3	2.2	32.0	10.5	17.8
4.58E+08	28.8	46.0	-17.2	30.2	2.3	32.1	10.5	17.8
5.73E+08	30.9	46.0	-15.1	30.8	2.5	32.2	10.5	19.3
6.07E+08	31.3	46.0	-14.7	28.3	2.6	32.3	10.5	22.2
8.02E+08	35.3	46.0	-10.7	31.3	3.0	32.0	10.5	22.6
8.12E+08	37.2	46.0	-8.8	32.9	3.0	32.0	10.5	22.7
9.16E+08	35.8	46.0	-10.2	30.0	3.2	31.3	10.5	23.4
9.74E+08	36.0	54.0	-18.0	29.3	3.3	30.8	10.5	23.7
Mode: Rx mode Temp: 20 C, Humidity: 50%								


Rx mode
Temperature: 20 C
Humidity: 50 %
Intertek
Radiated Emissions 1 GHz - 5 GHz
FCC Part 15 Class B (Vertical)
Limit at 3 m
Peak Scan Vertical
Average Level
Amplitude (dBuV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Operator: KK
01:28:00 PM, Thursday, September 17, 2009
Model Number: HPT435
Company: JavadGNSS, Inc


Rx mode
Temperature: 20 C
Humidity: 50 %
Intertek
Radiated Emissions 1 GHz - 5 GHz
FCC Part 15 Class B (Horizontal)
Limit at 3 m
Peak Scan Horizontal
Average Level
Amplitude (dBuV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Operator: KK
01:25:30 PM, Thursday, September 17, 2009
Model Number: HPT435
Company: JavadGNSS, Inc

11.2 Receiver antenna conducted emissions
FCC 15.111(a)

11.2.1 Limit

The power at the antenna terminal shall not exceed 2.0 nanowatts (-57 dBm).

11.2.2 Test Procedure

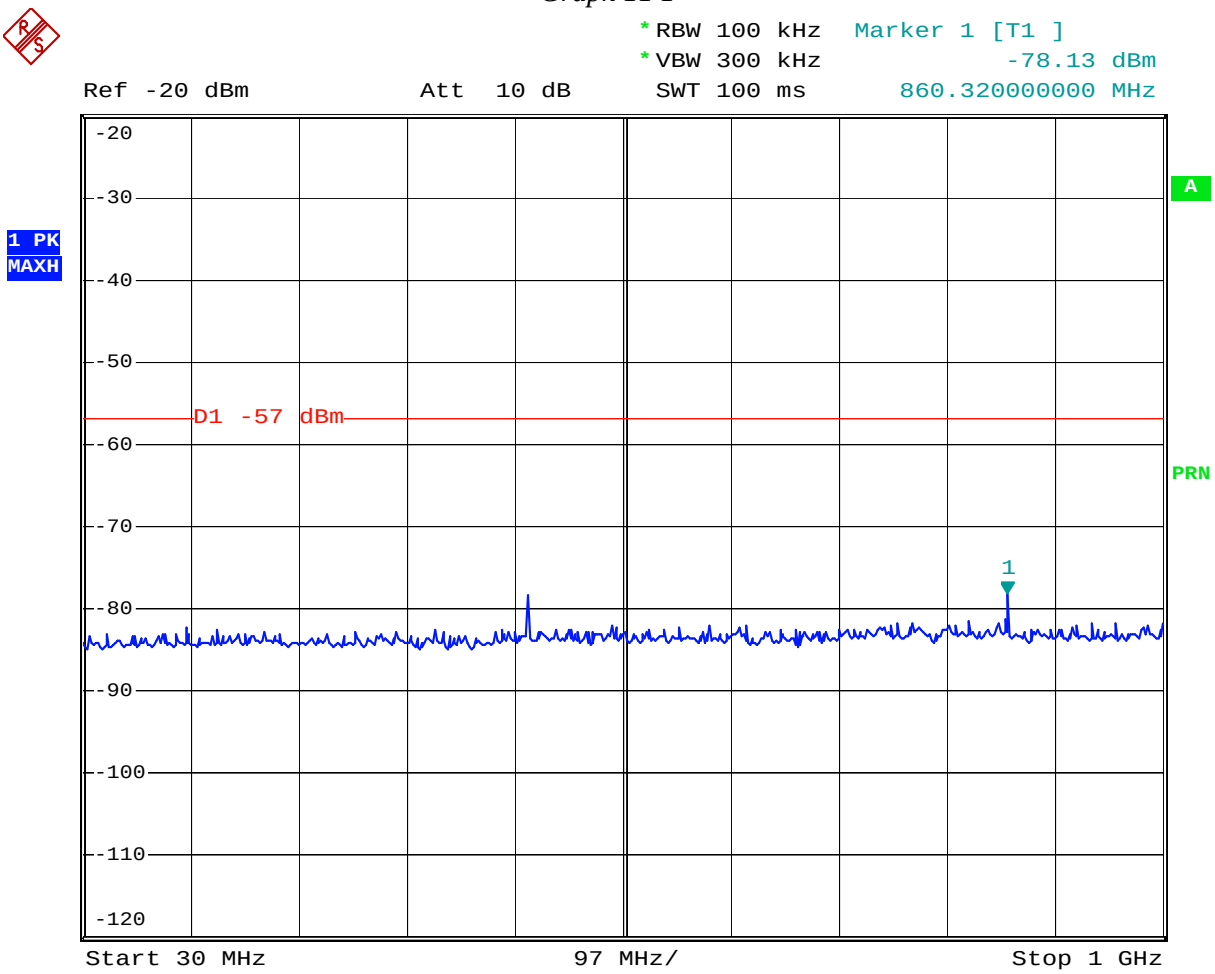
The spectrum analyzer was connected to the RF output of the EUT. The EUT was setup in receiving mode. Test was performed at tuned frequencies of 430 MHz and 450 MHz.

11.2.3 Test Results

The test results are presented on the following graphs.

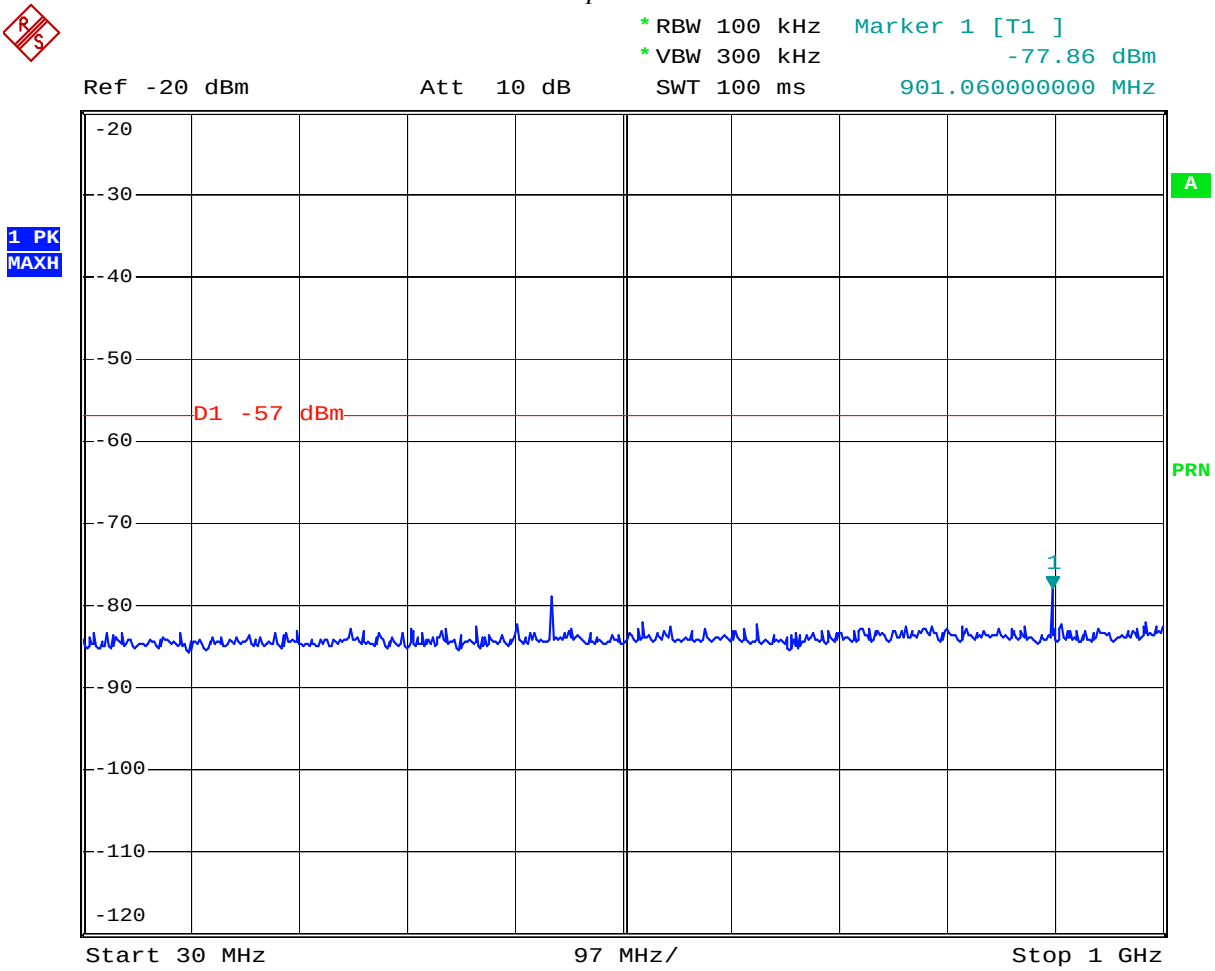
Result	Complies by 6.7 dB

Graph 11 1



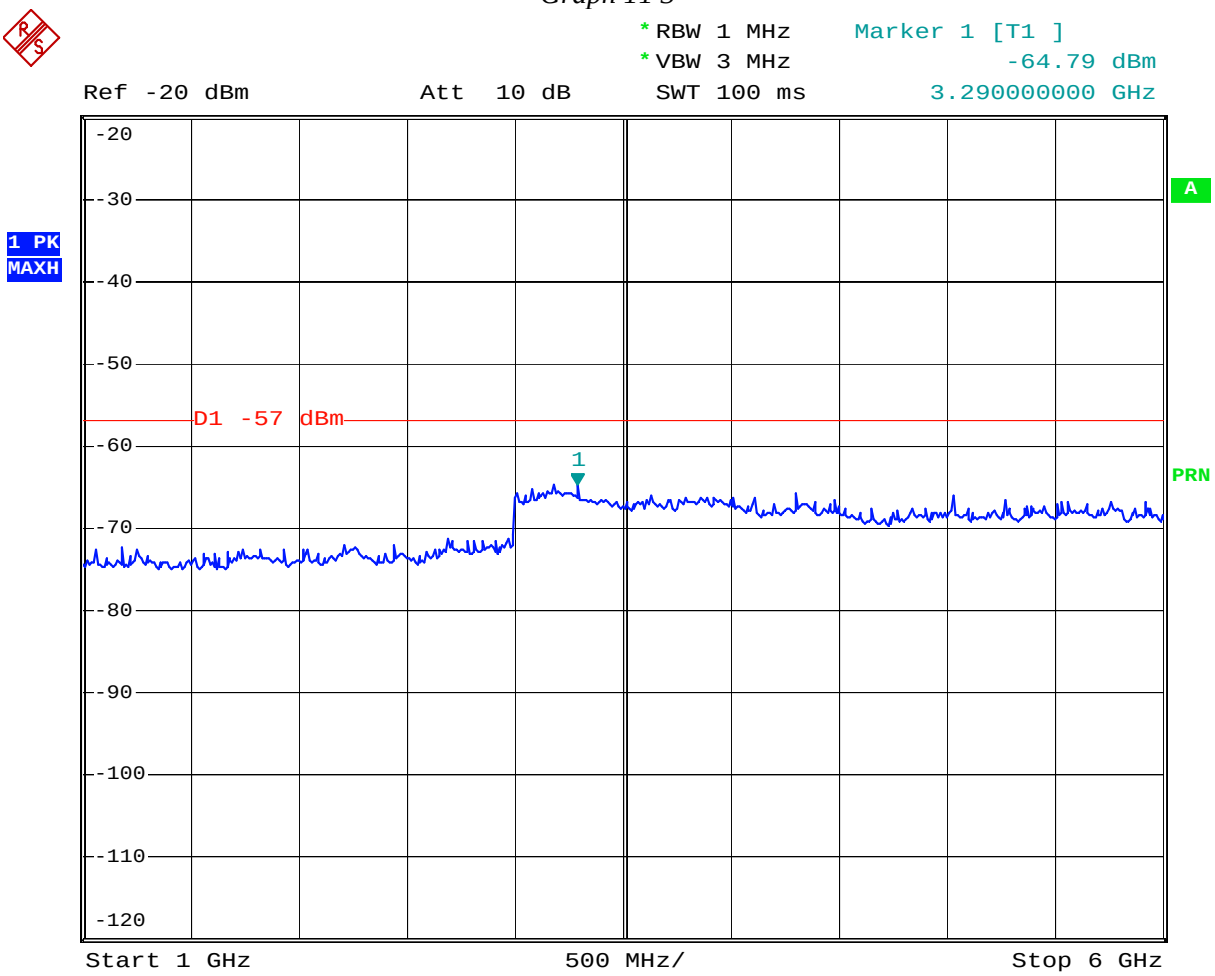
Comment: Receiver spurious conducted, f=430MHz
Date: 10.SEP.2009 10:42:08

Graph 11 2



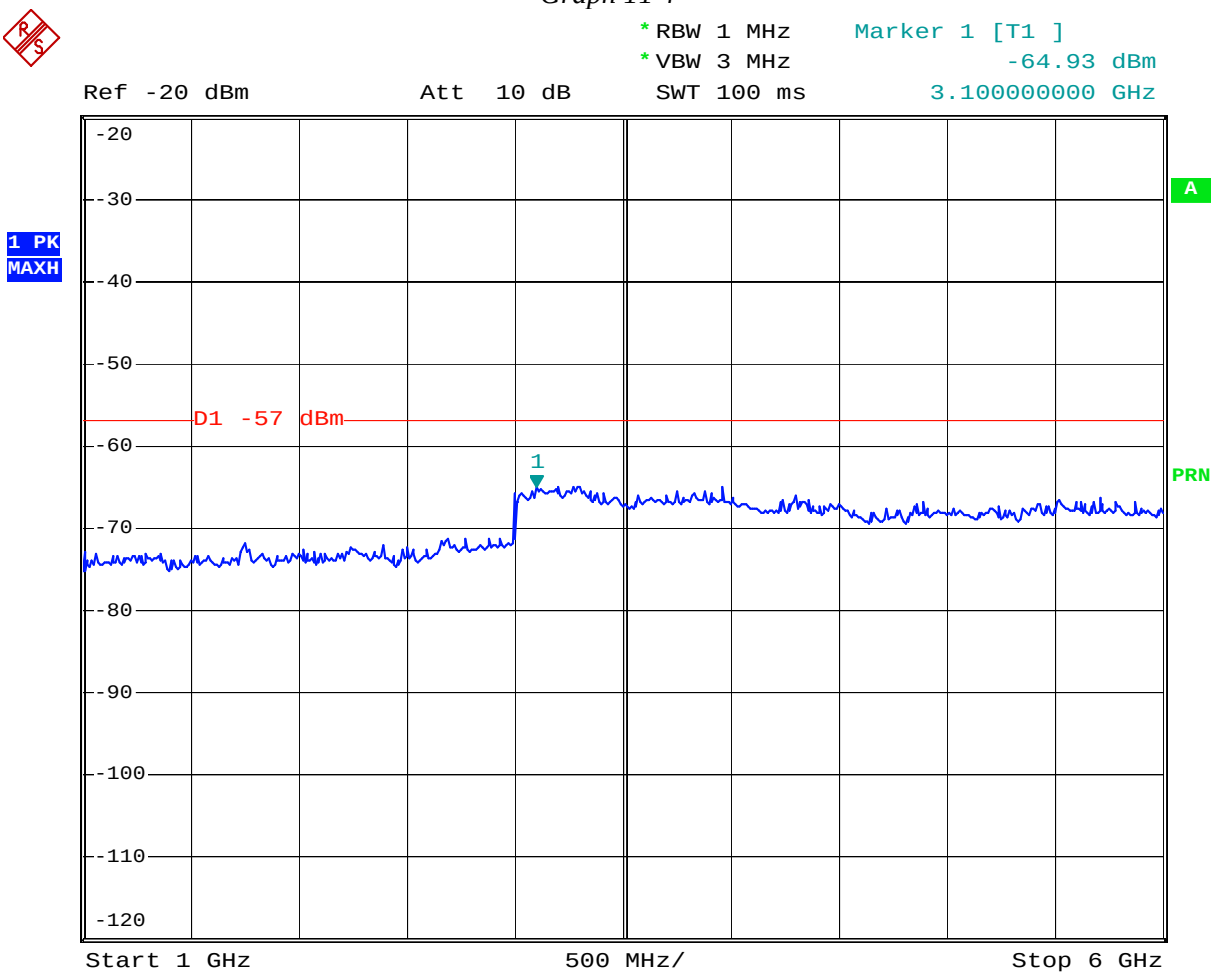
Comment: Receiver spurious conducted, f=450MHz
Date: 10.SEP.2009 10:43:25

Graph 11 3



Comment: Receiver spurious conducted, f=430MHz
Date: 10.SEP.2009 10:46:51

Graph 11 4



Comment: Receiver spurious conducted, f=450MHz
Date: 10.SEP.2009 10:47:50

12.0 List of Test Equipment

Measurement equipment used for compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	07/01/10
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	07/01/10
Spectrum Analyzer	Rohde&Schwarz	FSP40	036612004	12	10/13/09
Spectrum Analyzer	Agilent Technologies	E4440A	MY44303944	12	04/27/10
BI-Log Antenna	EMCO	3143	9509-1160	12	11/07/09
Pre-Amplifier	Sonoma	310N	185634	12	11/10/09
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	07/28/10
Vector Signal Generator	Rohde&Schwarz	SMU200A	102499	12	04/01/10
Spectrum Analyzer	Rohde&Schwarz	FSU	200482	12	04/27/10
Double-ridged Horn Antenna	EMCO	3115	9170-3712	12	10/22/09
Double-ridged Horn Antenna	EMCO	3115	31626	12	04/23/10
Oscilloscope	Tektronix	TDS 380	BI05549	12	09/24/10
Power Meter	Agilent	E4416A	GB41292577	12	05/05/10
Signal Generator	Hewlett Packard	8663A	2537A00214	12	04/24/10

13.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 3188750	KK	October 20, 2009	Original document