TEST REPORT

Report Number: 100328280MPK-002
Project Number: G100328280
April 26, 2011

Testing performed on the
UHF Radio
Model Numbers: HPT404BT, HPT404, AW400BT, AW400 and AW400AF
FCC ID: WJ4HPT404
IC ID: 3504A-HPT404
to

FCC Part 90, RSS-119 Issue 10

for

Javad GNSS, Inc.

Test Performed by:	**Test Authorized by:**
Intertek Testing Services NA, Inc	Javad GNSS, Inc.
1365 Adams Court	900 Rock Avenue
Menlo Park, CA 94025	San Jose, CA 95131, USA

Prepared by: Krishna K Vemuri **Date:** April 26, 2011

Reviewed by: Ollie Moyrong **Date:** April 26, 2011

Report No. 100328280MPK-002

Equipment Under Test:	UHF Radio
Trade Name:	Javad GNSS, Inc.
Model No.:	HPT404BT, HPT404, AW400BT, AW400 and AW400AF
Serial No.:	EMCProto1
FCC ID:	WJ4HPT404
IC ID:	3504A-HPT404
Applicant:	Javad GNSS, Inc.
Contact:	Mr. Vladimir Zhukov
Address:	900 Rock Avenue San Jose, CA 95131
Country	USA
Tel. number:	(408) 770-1770
Fax number:	(408) 770-1799
Email:	v.zhukov@javad.com
Applicable Regulation:	FCC Part 90, RSS-119 Issue 10
Test Site Location:	ITS - Site 1 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	April 01 to April 25, 2011

We attest to the accuracy of this report:

Krishna K Vemuri
EMC Senior Staff Engineer

Ollie Moyrong
Engineering Manager

TABLE OF CONTENTS

1.0 Introduction

1.1 Product Description

The Equipment Under Test (EUT) is the model HPT404BT. As declared by the Applicant, the models HPT404BT and AW400BT are identical except for their housing color and brand name (HPT for Javad; AW for ArWest). Models HPT404, AW400, AW400AF are exactly the same as models HPT404BT and AW400BT consist of identical hardware without having modular approved Bluetooth Module with FCC ID: WJ4BT4EX8M, IC: 3504A-BT4EX8M.

HPT404BT is an external UHF radio transceiver used for commercial, indoor and outdoor use.

The HPT404BT provides real-time data transmission using spectrum efficient GMSK/BPSK/QPSK/8PSK/16QAM modulations.

The HPT404BT provides half-duplex communication with transmitter output power of 4 W (+36 dBm) in the frequency bands 406.1-470 MHz for USA; 406.1-430 MHz and 450-470MHz for Canada with channel spacing of 25 / 12.5 / 6.25 kHz.

For more information about the radio, refer to the users manual.

Specification of the radio module	
Type	UHF radio
Rated RF Output Power	4 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, 2.5 dBi
Detachable antenna	Yes
External input	data
Operating temperature	From -30^0C to $+50^0$C

EUT receive date: April 01, 2011
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: April 01, 2011
Test completion date: April 25, 2011

1.2 Summary of Test Results

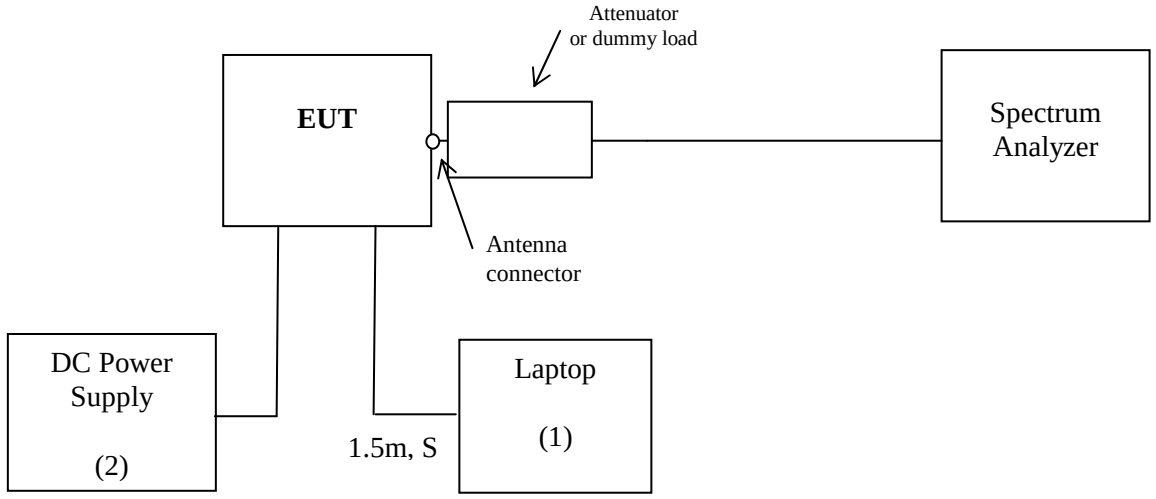
FCC Rule	RSS-119 Rule	Description of Test	Result
2.1046	4.1	RF Power Output	Complies
90.205(h)	-	ERP	Complies
2.1047	-	Modulation characteristics	Not Applicable
2.1049, 90.209	RSS-GEN	Occupied Bandwidth	Complies
90.210	5.8	Emission masks	Complies
2.1051, 90.210	5.8	Out of Band Emissions at Antenna Terminals	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	Toshiba Laptop	A15-S129	Z3042027P
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 section 1.3.2. The EUT was setup to transmit continuously the maximum power.

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

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

2.2 Test Equipment

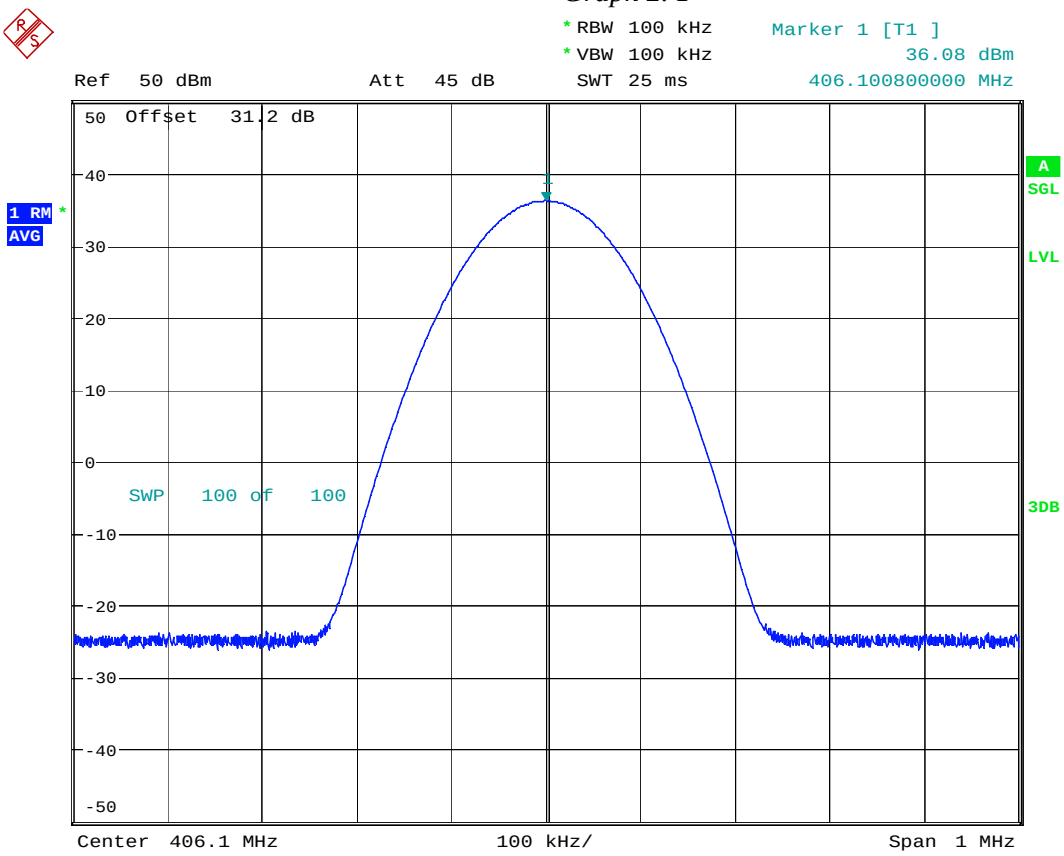
Rohde & Schwarz FSP40 Spectrum Analyzer.

2.3 Test Results

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (Watt)	Graph
406.1	36.08	4.0	2.1
430.0	35.83	3.8	2.2
450.0	35.46	3.5	2.3
470.0	35.91	3.9	2.4

For more details refer to the attached Graphs.

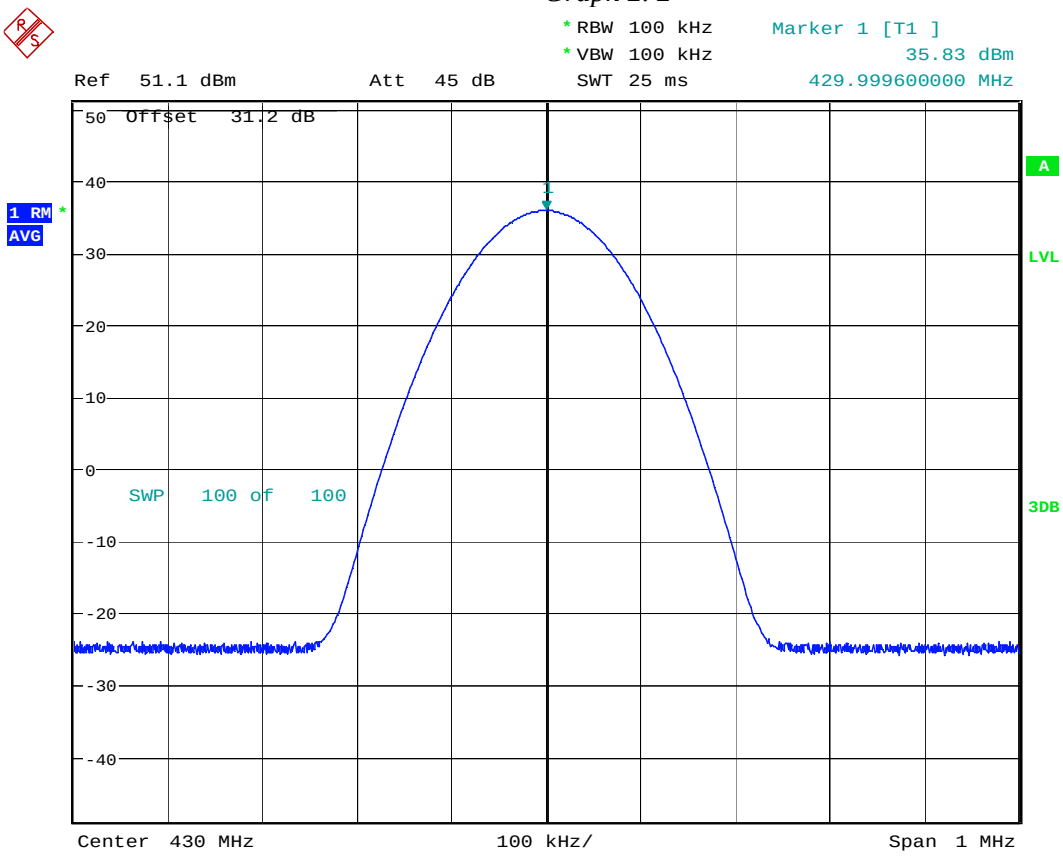
Graph 2. 1



Power output

Date: 11.APR.2011 17:41:24

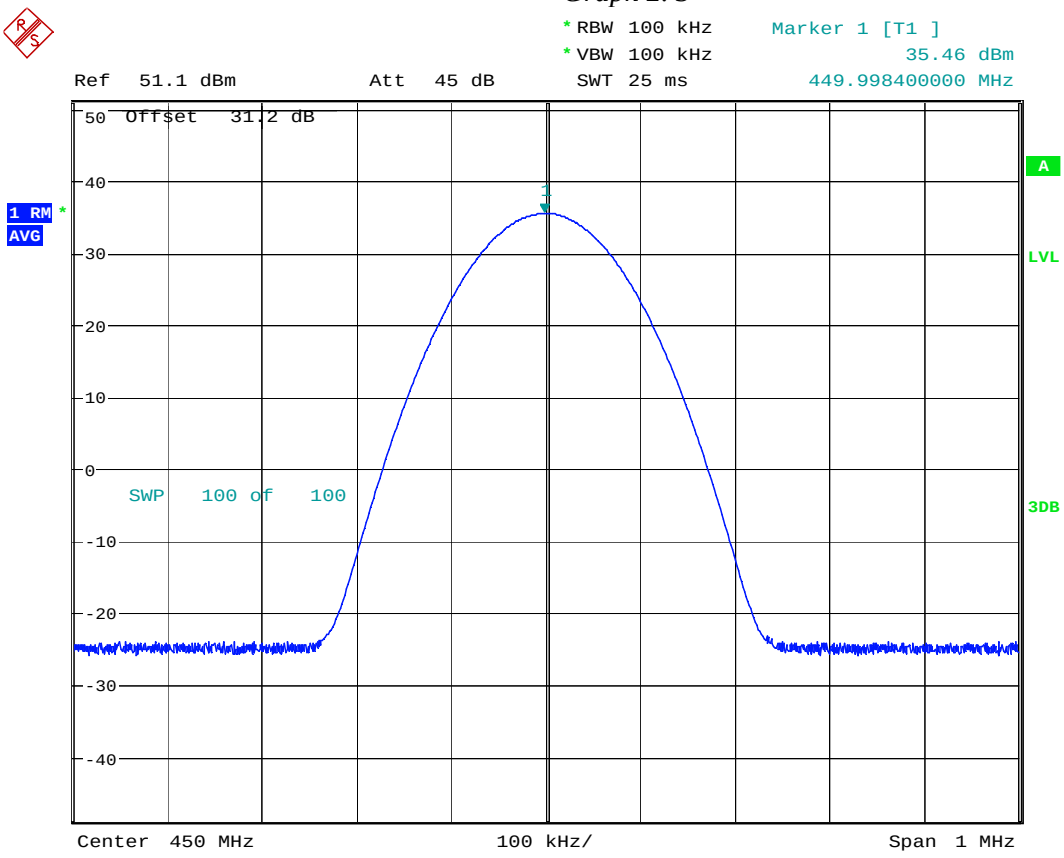
Graph 2. 2



Power output

Date: 11.APR.2011 17:18:25

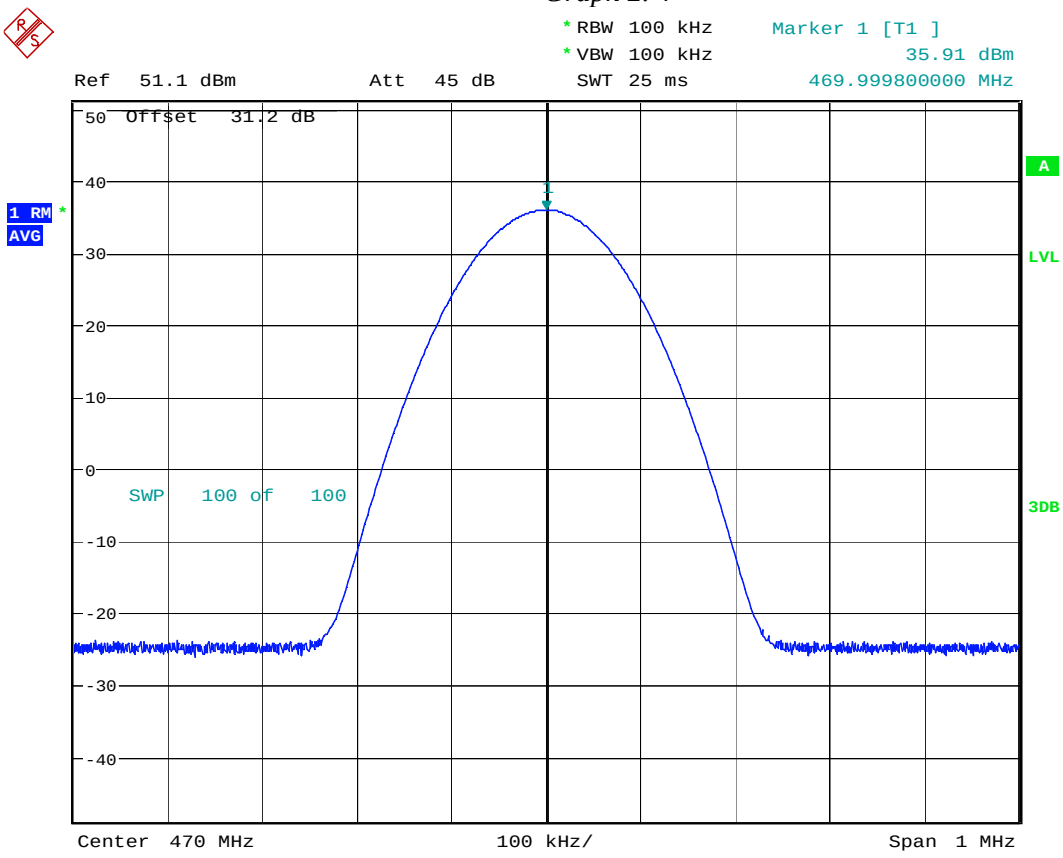
Graph 2. 3



Power output

Date: 11.APR.2011 17:19:12

Graph 2. 4



Power output

Date: 11.APR.2011 17:19:54

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 2.5 dBi (0.4 dBd) gain antenna is used with the EUT. Therefore, the calculated peak radiated power is:

ERP = 36.08 + 0.4 = 36.48dBm (or 4.45 W).
EIRP= 36.08 + 2.5 = 38.58 dBm (or 7.21 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 section 1.3.2. The EUT was setup to transmit the maximum power.

The spectrum analyzer was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth). The Occupied Bandwidth was measured at 406.1 MHz and 470 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:

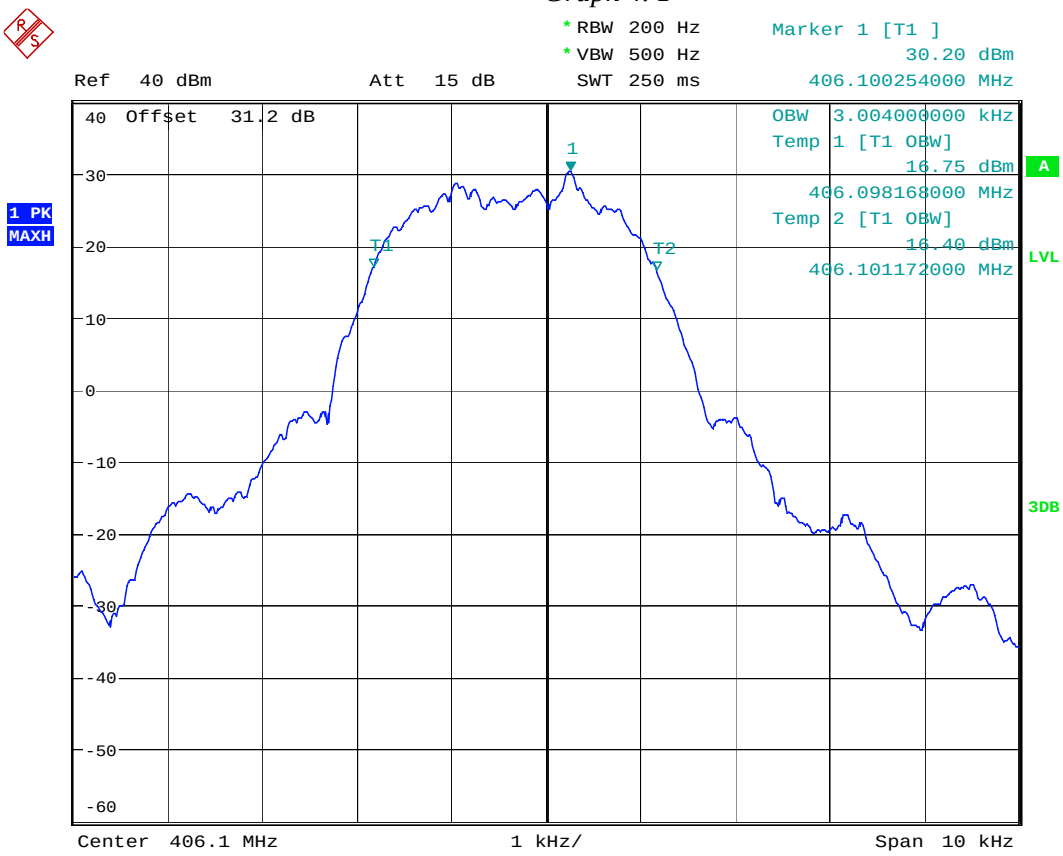
3K05G1D
3K09F1D
6K05G1D
6K00F1D
11K97G1D
11K92F1D

Frequency (MHz)	Modulation	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Measured Occupied Bandwidth (kHz)	Graph
406.1	BPSK	6.25	6.0	3.00	4.1
	QPSK			3.05	4.2
	8PSK			3.04	4.3
	16QAM			3.01	4.4
	GMSK			3.00	4.5
406.1	BPSK	12.5	11.25	5.96	4.6
	QPSK			6.04	4.7
	8PSK			6.05	4.8
	16QAM			5.98	4.9
	GMSK			5.95	4.10
406.1	BPSK	25.0	20.0	11.85	4.11
	QPSK			11.95	4.12
	8PSK			11.97	4.13
	16QAM			11.90	4.14
	GMSK			11.68	4.15

Frequency (MHz)	Modulation	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Measured Occupied Bandwidth (kHz)	Graph
470	BPSK	6.25	6.0	3.01	4.16
	QPSK			3.05	4.17
	8PSK			3.05	4.18
	16QAM			3.00	4.19
	GMSK			3.09	4.20
470	BPSK	12.5	11.25	5.96	4.21
	QPSK			6.00	4.22
	8PSK			5.98	4.23
	16QAM			5.96	4.24
	GMSK			6.00	4.25
470	BPSK	25.0	20.0	11.87	4.26
	QPSK			11.87	4.27
	8PSK			11.83	4.28
	16QAM			11.89	4.29
	GMSK			11.92	4.30

For more details refer to the attached Graphs.

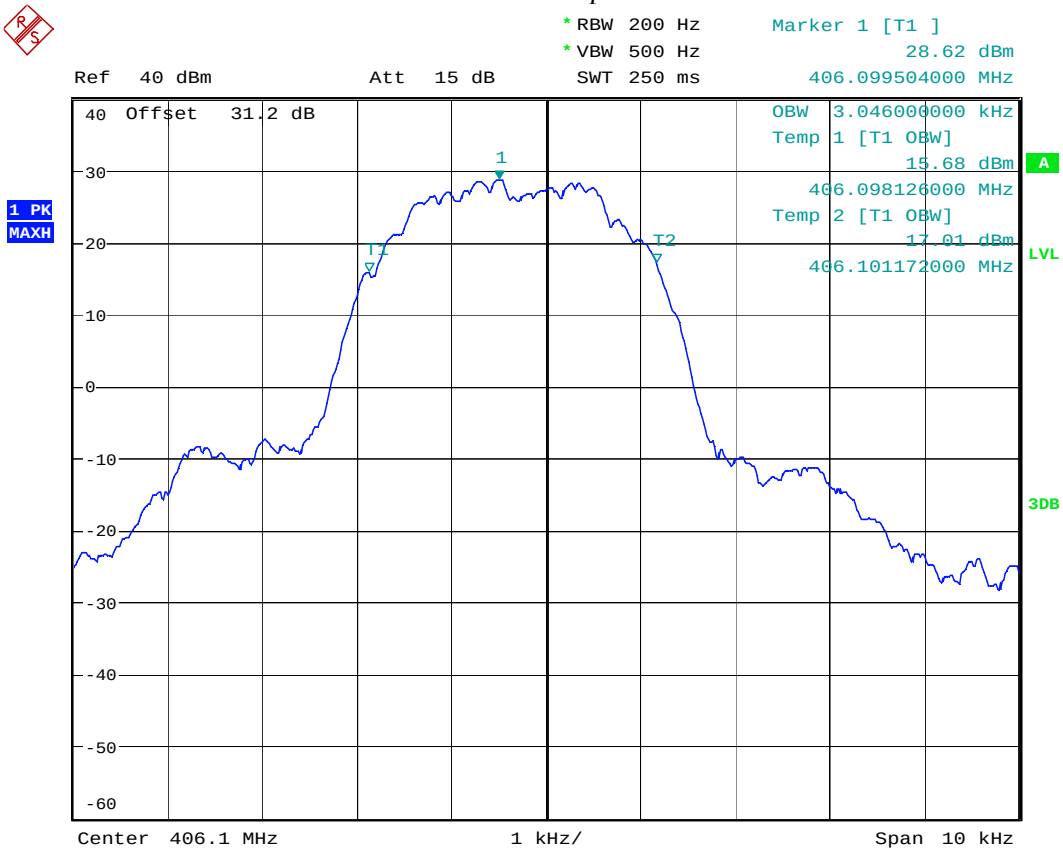
Graph 4. 1



Occupied bandwidth, 6kHz authorized bandwidth, BPSK

Date: 12.APR.2011 11:52:07

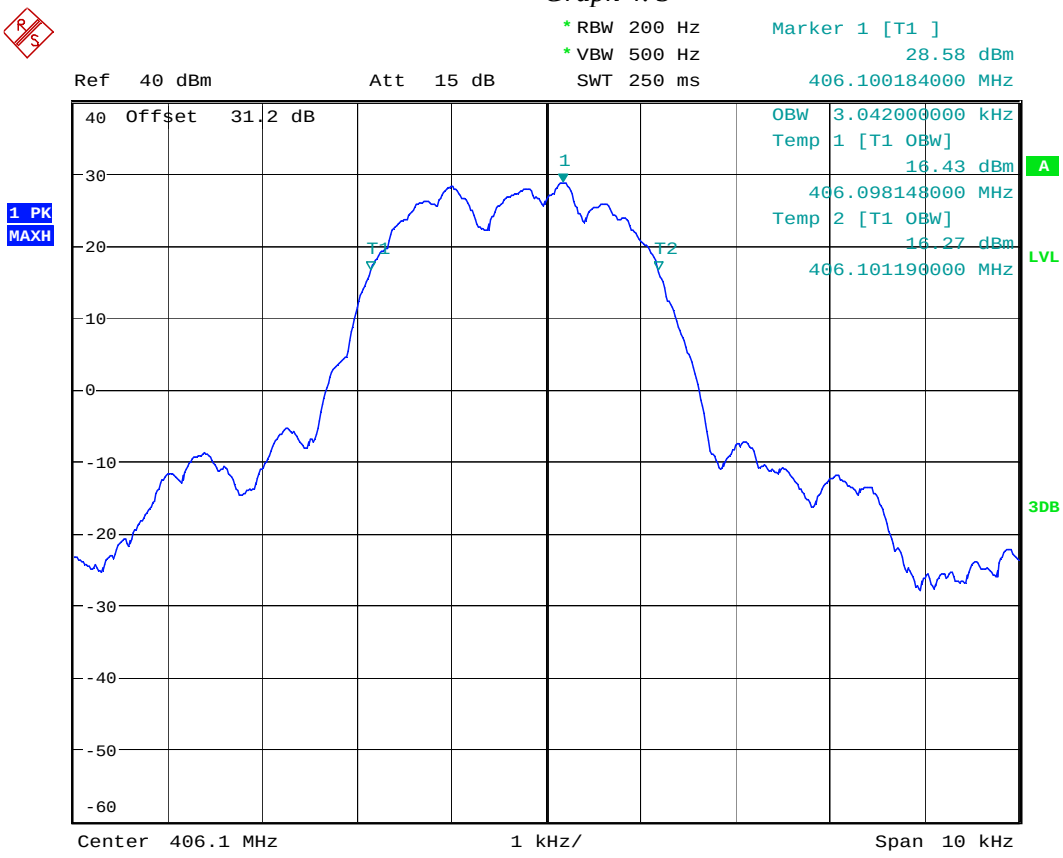
Graph 4. 2



Occupied bandwidth, 6kHz authorized bandwidth, QPSK

Date: 12.APR.2011 11:53:32

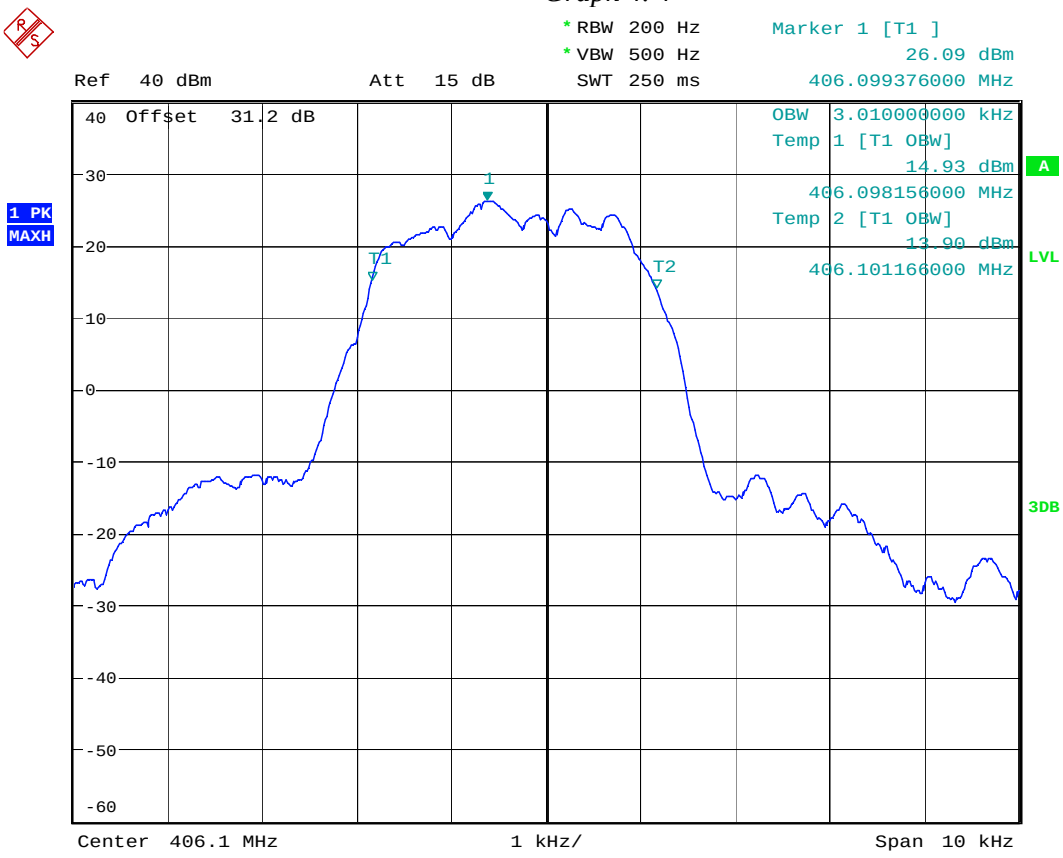
Graph 4. 3



Occupied bandwidth, 6kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 11:54:46

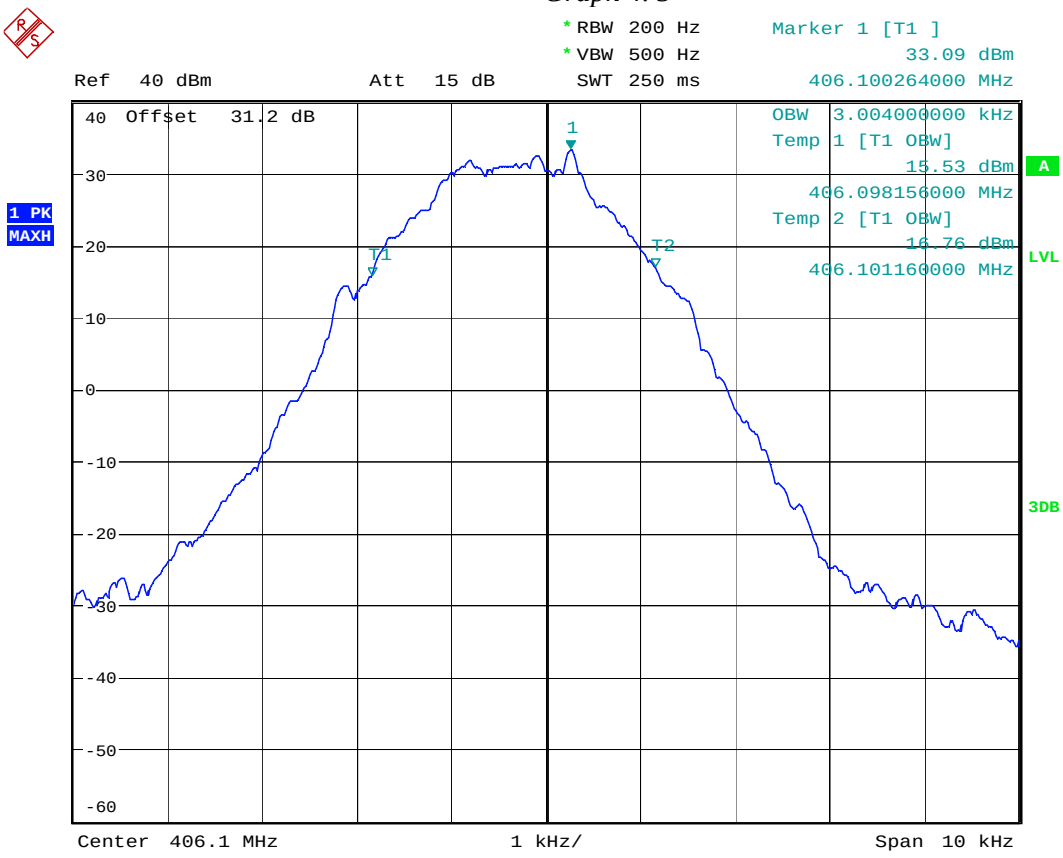
Graph 4. 4



Occupied bandwidth, 6kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 11:55:36

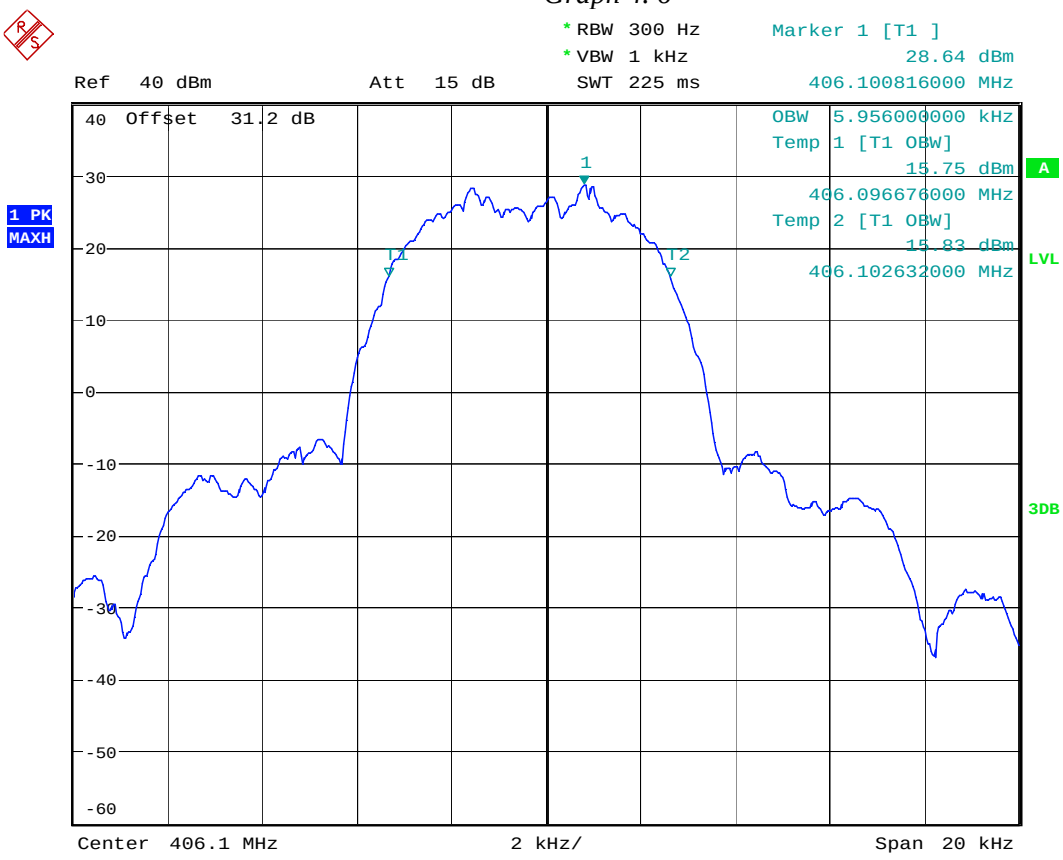
Graph 4. 5



Occupied bandwidth, 6kHz authorized bandwidth, GMSK

Date: 12.APR.2011 11:56:36

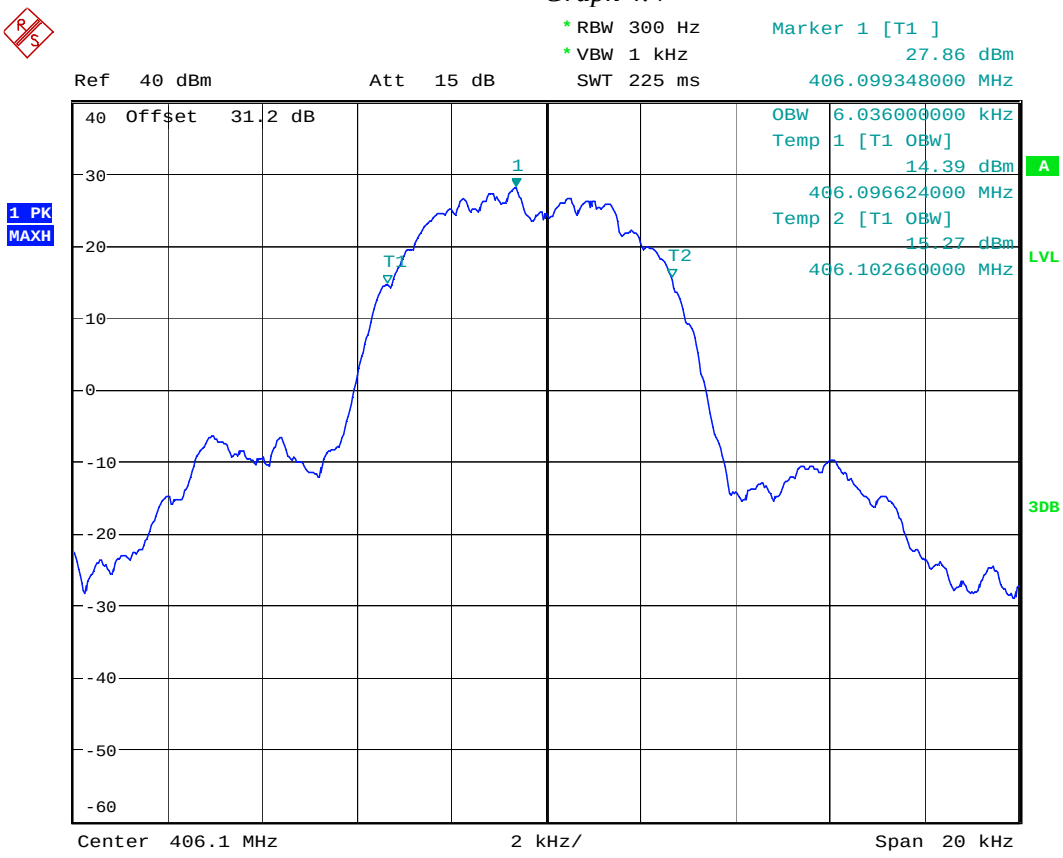
Graph 4. 6



Occupied bandwidth, 11.25kHz authorized bandwidth, BPSK

Date: 12.APR.2011 12:01:51

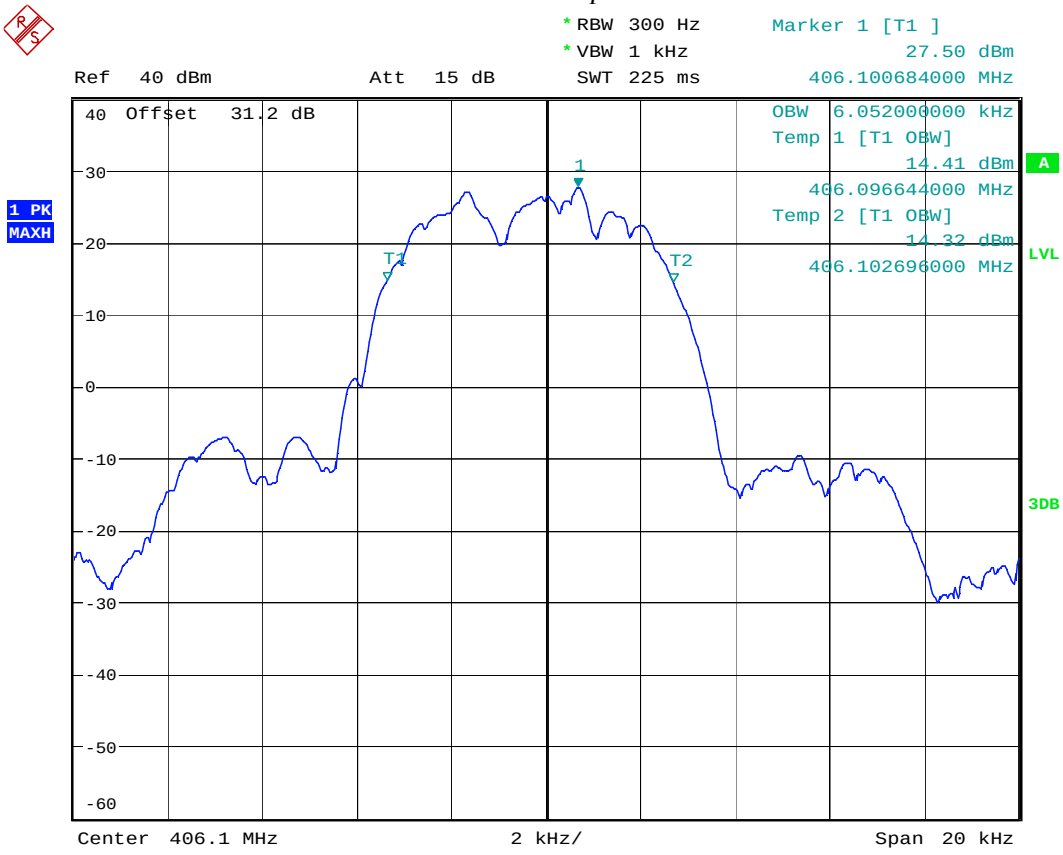
Graph 4. 7



Occupied bandwidth, 11.25kHz authorized bandwidth, QPSK

Date: 12.APR.2011 12:03:34

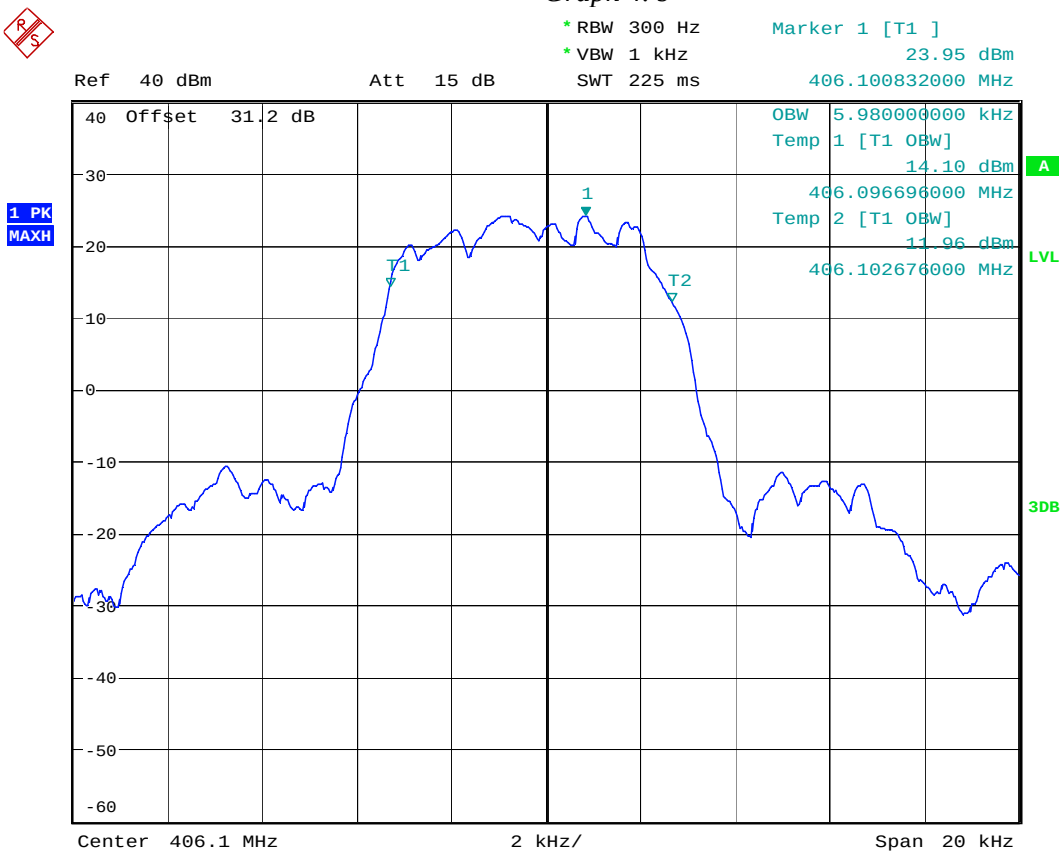
Graph 4. 8



Occupied bandwidth, 11.25kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 12:04:52

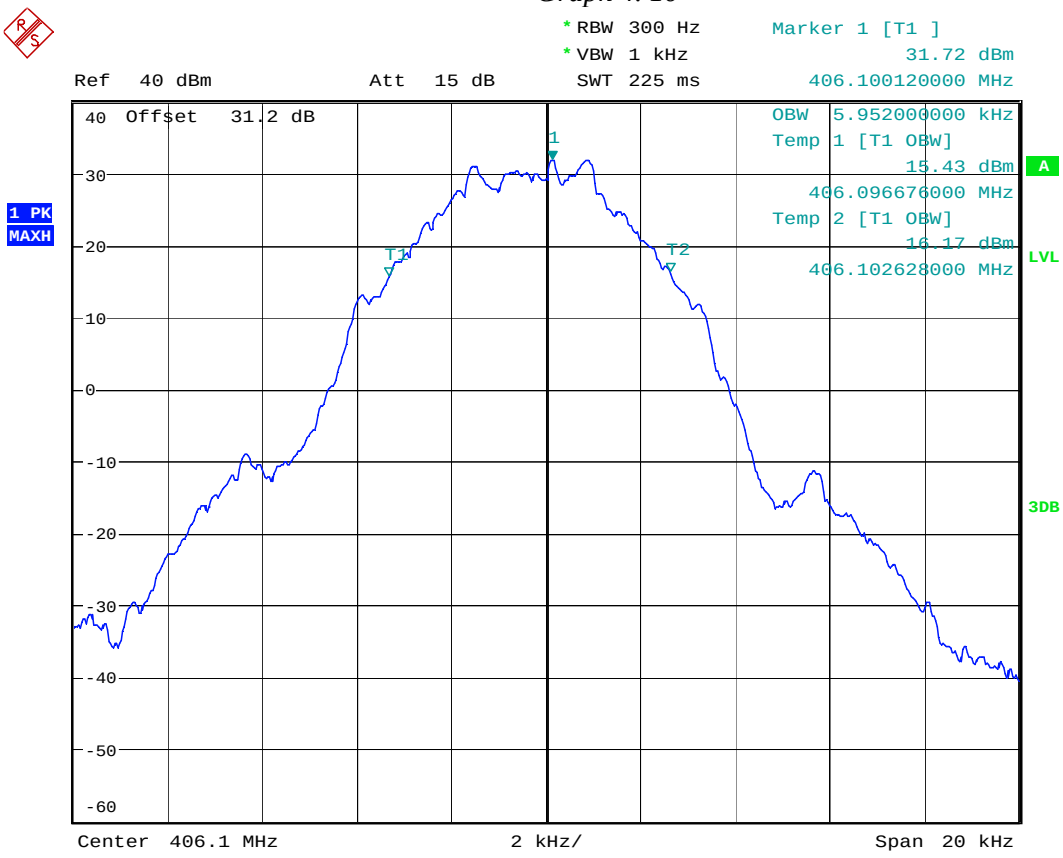
Graph 4. 9



Occupied bandwidth, 11.25kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 12:06:05

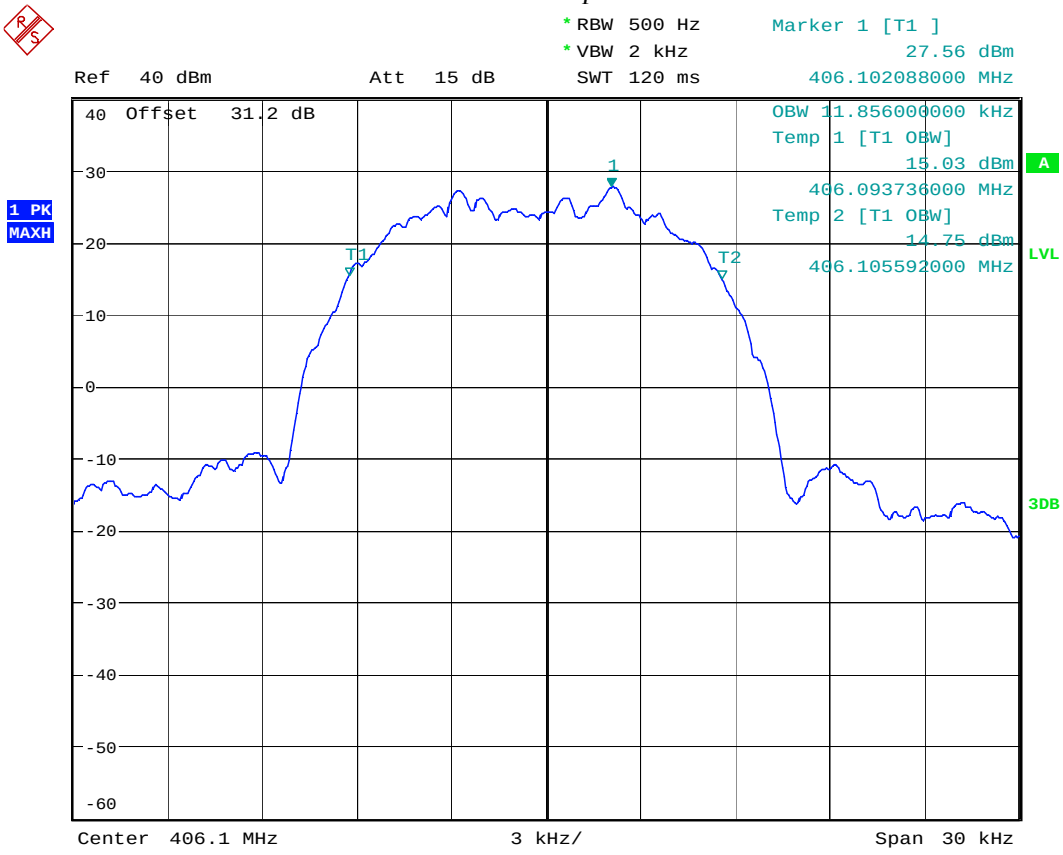
Graph 4. 10



Occupied bandwidth, 11.25kHz authorized bandwidth, GMSK

Date: 12.APR.2011 12:07:41

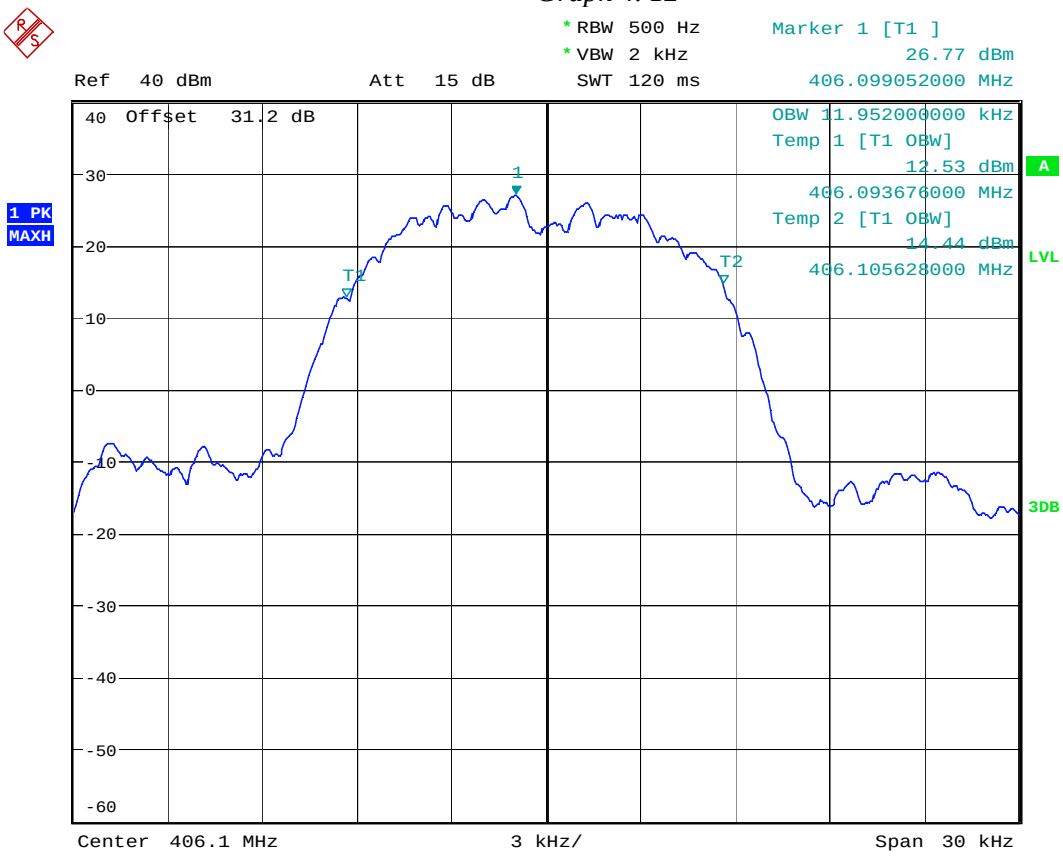
Graph 4. 11



Occupied bandwidth, 20kHz authorized bandwidth, BPSK

Date: 12.APR.2011 12:48:52

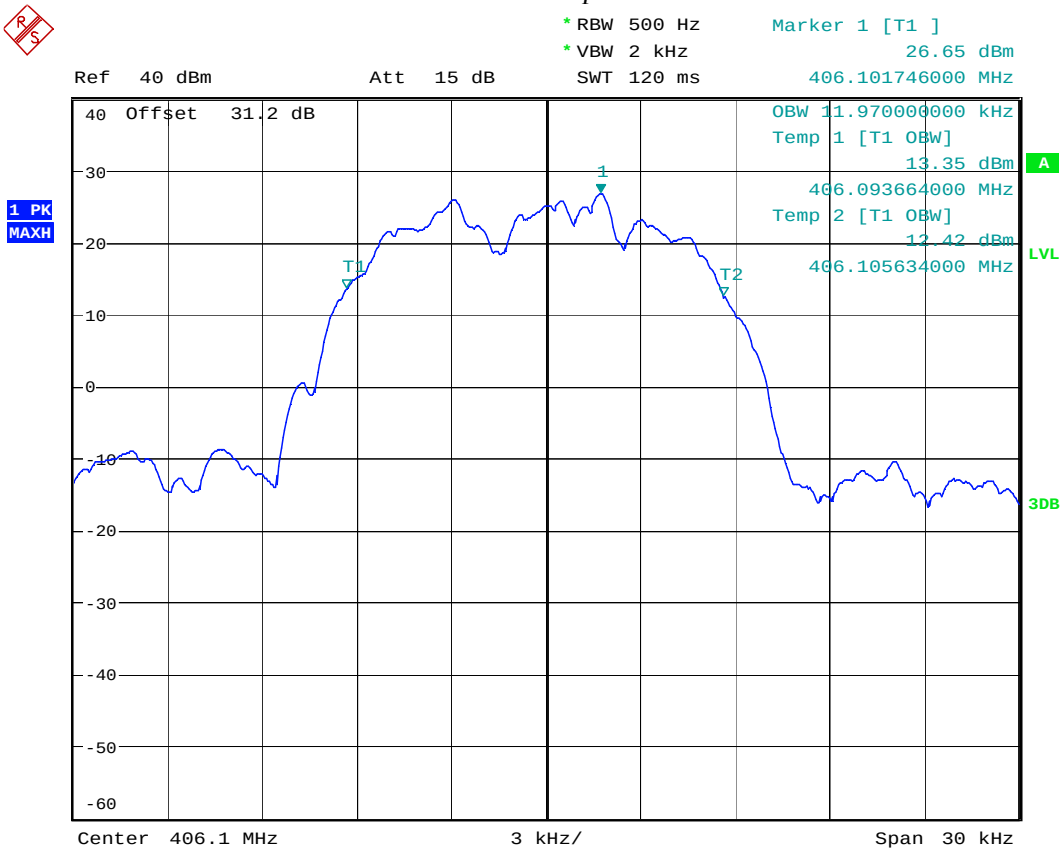
Graph 4. 12



Occupied bandwidth, 20kHz authorized bandwidth, QPSK

Date: 12.APR.2011 12:50:06

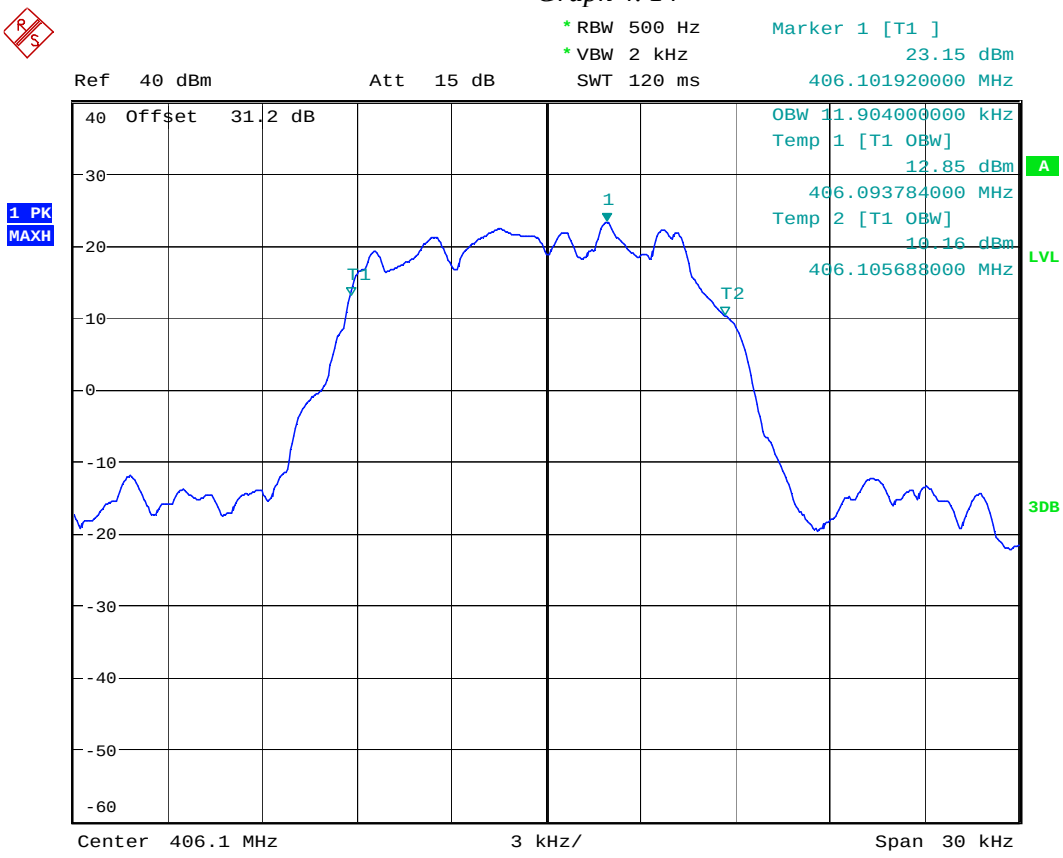
Graph 4. 13



Occupied bandwidth, 20kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 12:51:02

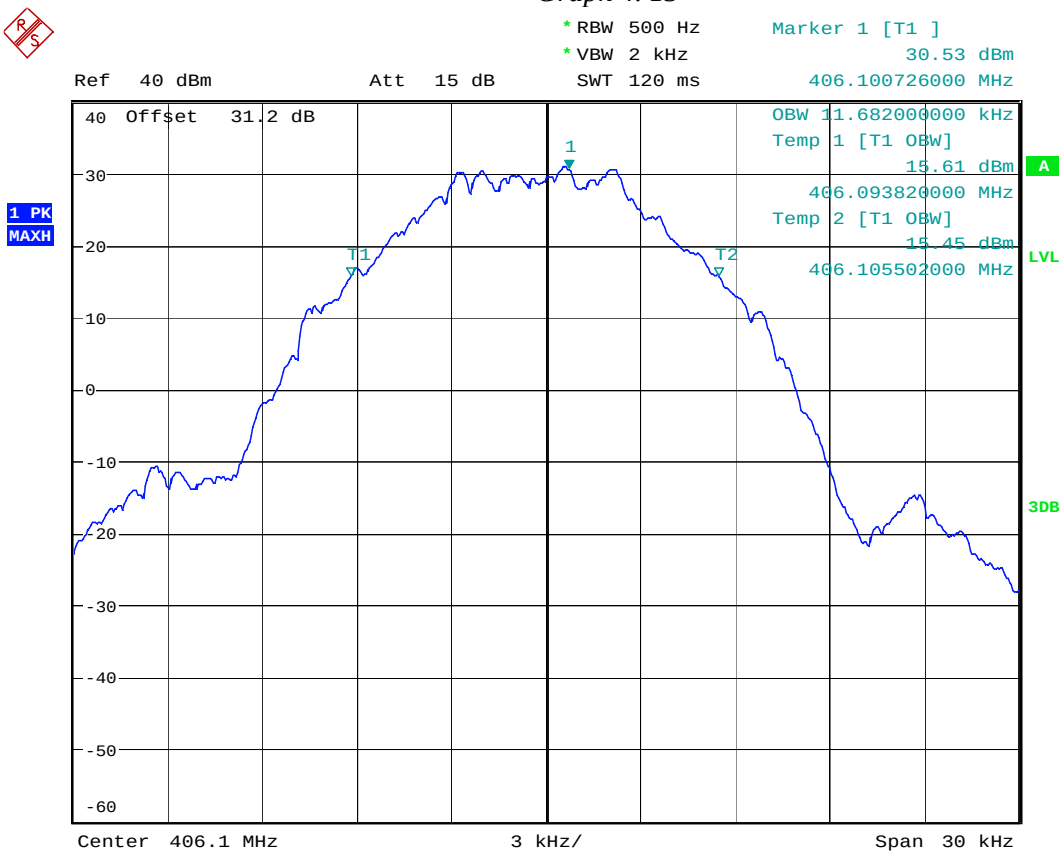
Graph 4. 14



Occupied bandwidth, 20kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 12:52:07

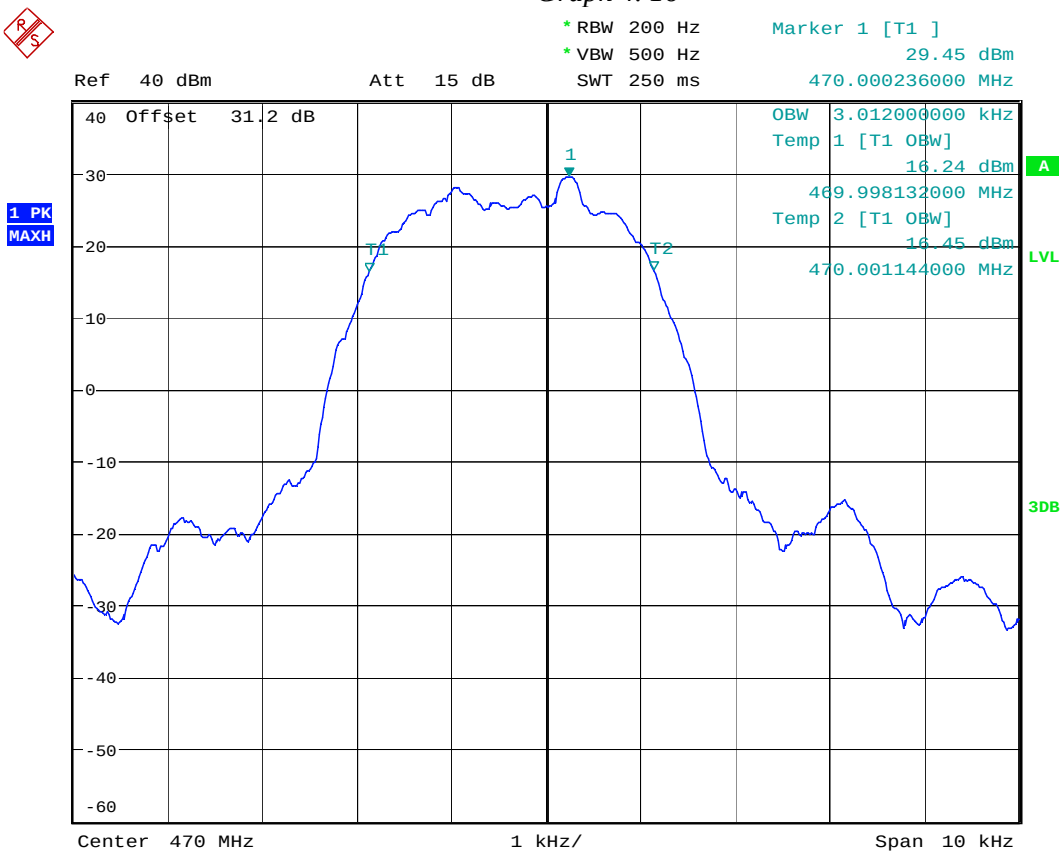
Graph 4. 15



Occupied bandwidth, 20kHz authorized bandwidth, GMSK

Date: 12.APR.2011 12:54:34

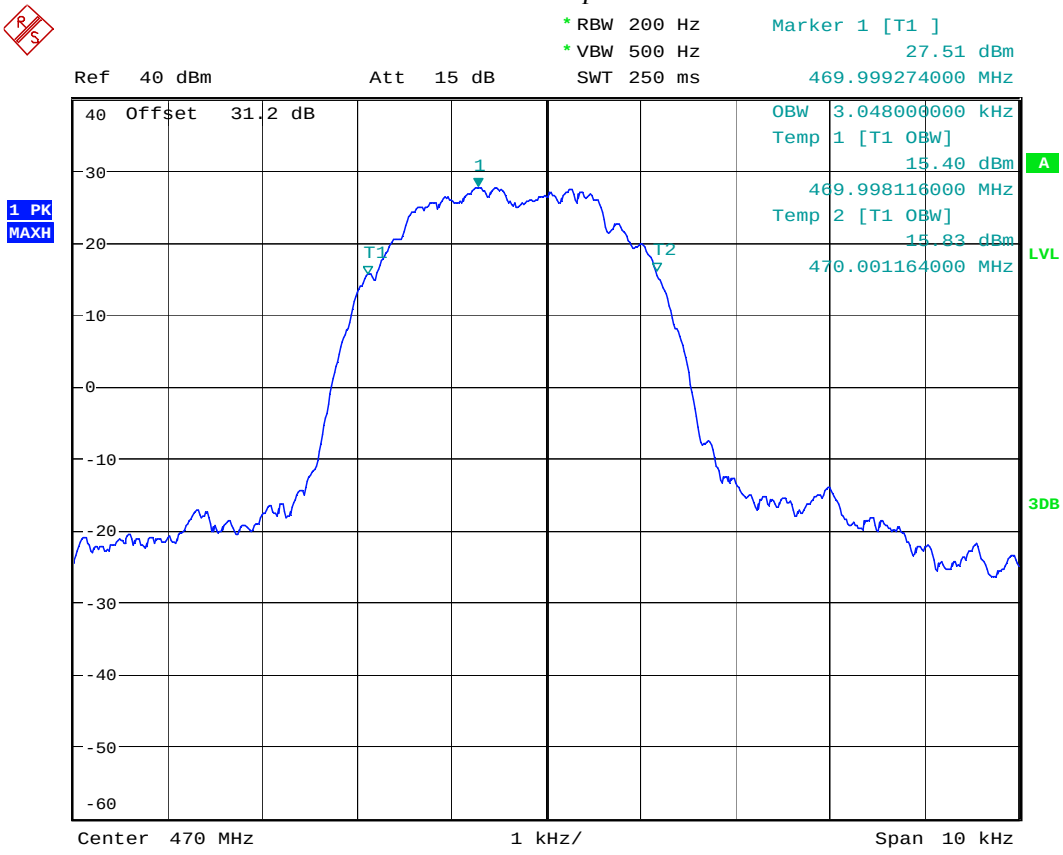
Graph 4. 16



Occupied bandwidth, 6kHz authorized bandwidth, BPSK

Date: 12.APR.2011 11:43:10

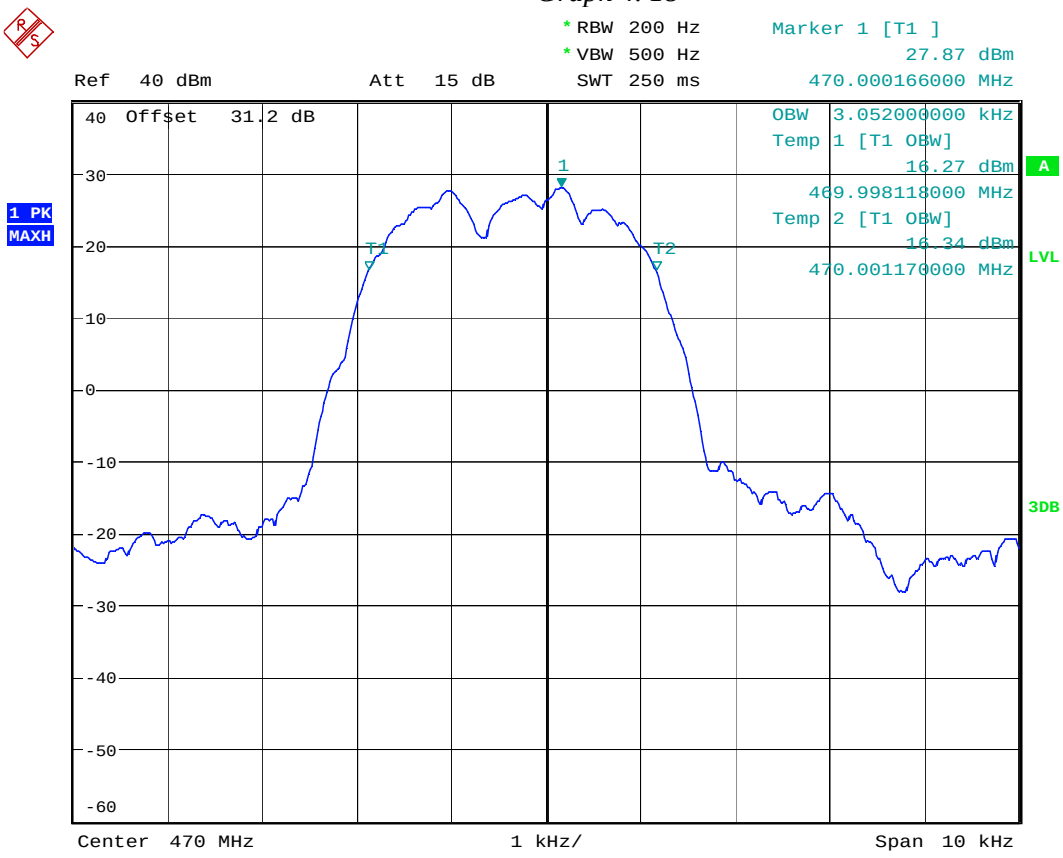
Graph 4. 17



Occupied bandwidth, 6kHz authorized bandwidth, QPSK

Date: 12.APR.2011 11:44:20

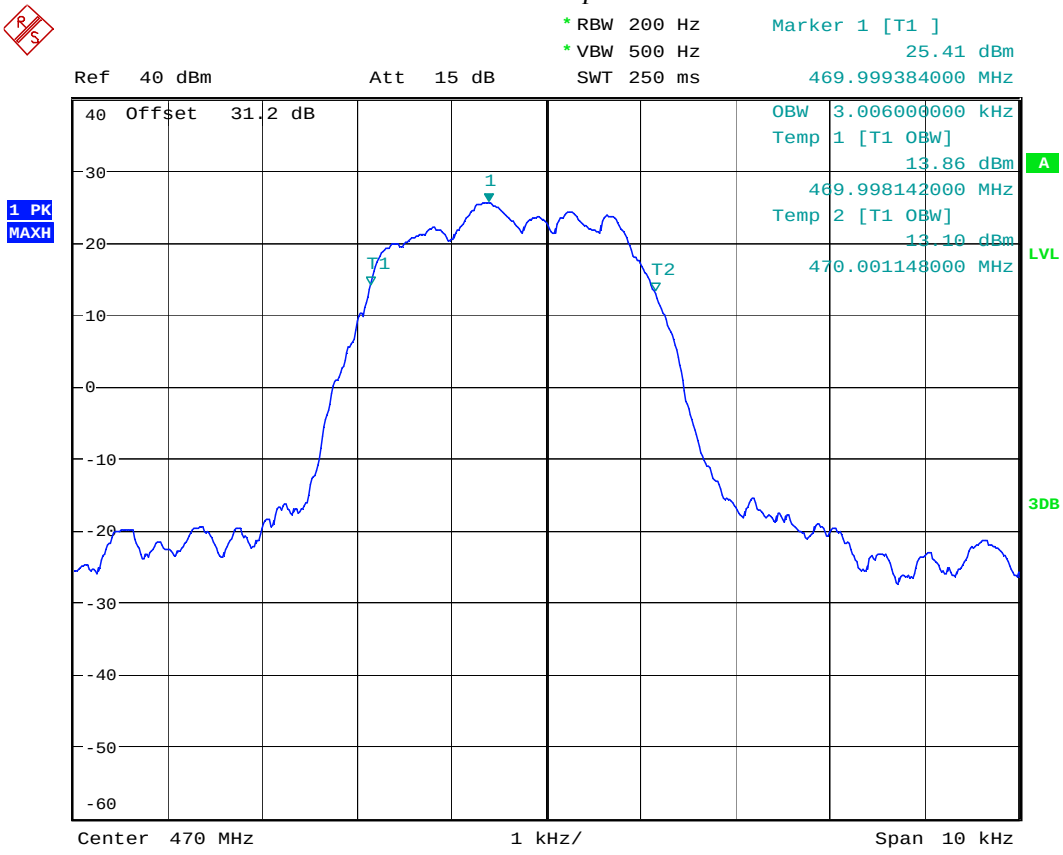
Graph 4. 18



Occupied bandwidth, 6kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 11:49:02

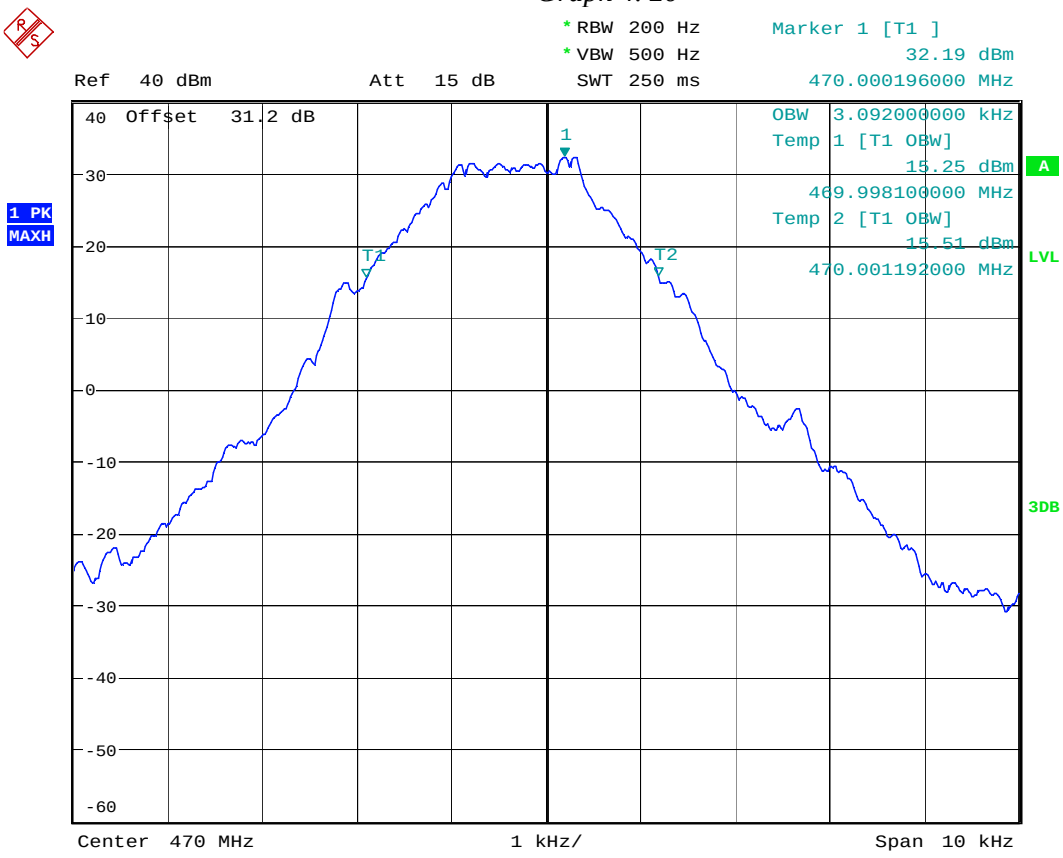
Graph 4. 19



Occupied bandwidth, 6kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 11:49:55

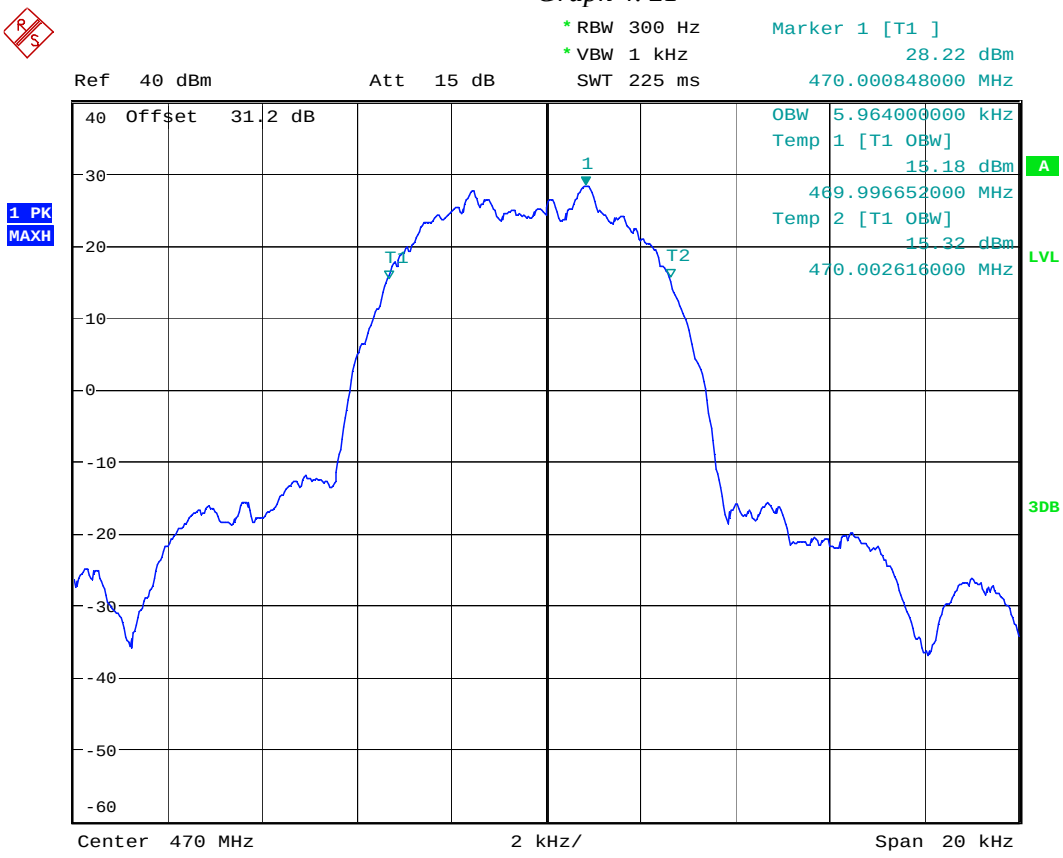
Graph 4. 20



Occupied bandwidth, 6kHz authorized bandwidth, GMSK

Date: 12.APR.2011 11:50:53

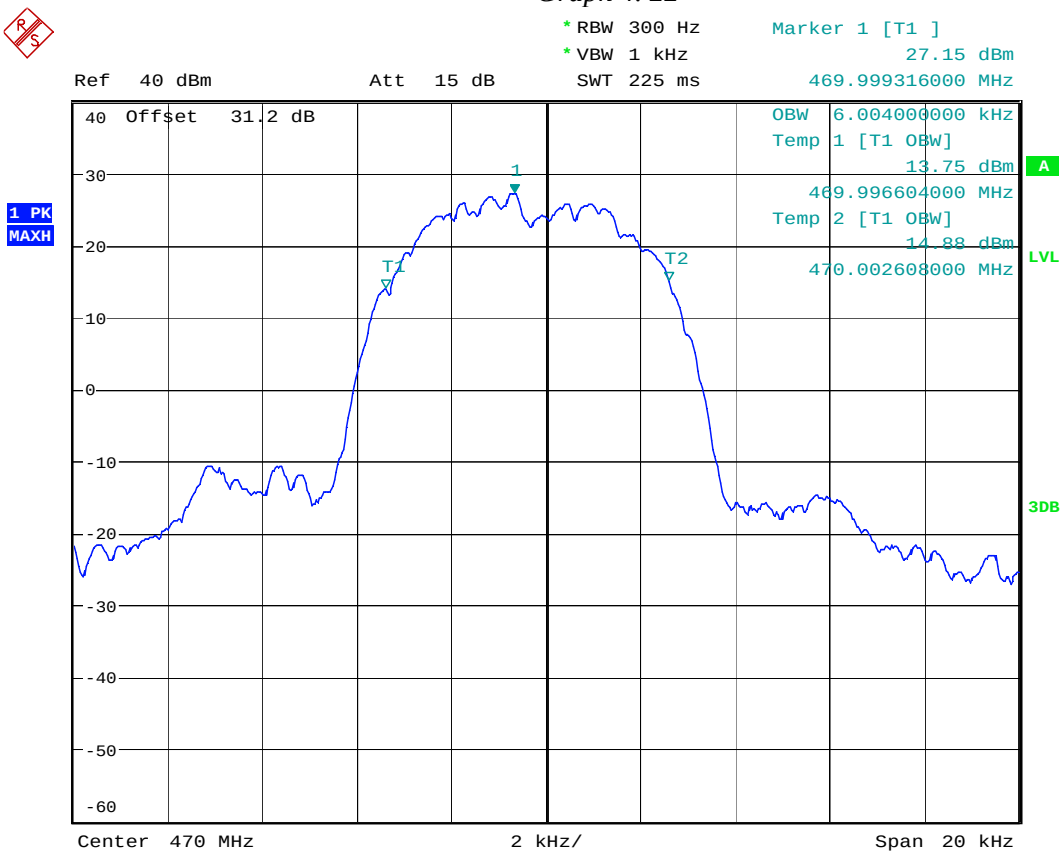
Graph 4. 21



Occupied bandwidth, 11.25kHz authorized bandwidth, BPSK

Date: 12.APR.2011 12:09:41

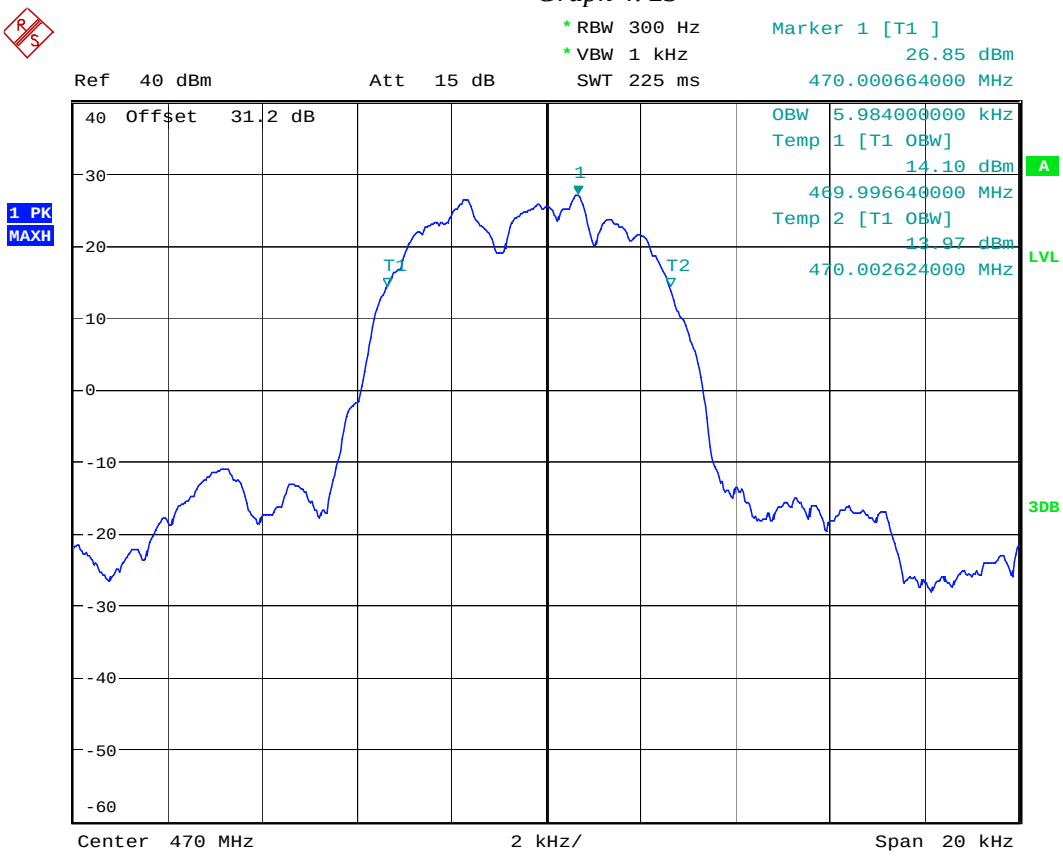
Graph 4. 22



Occupied bandwidth, 11.25kHz authorized bandwidth, QPSK

Date: 12.APR.2011 12:11:11

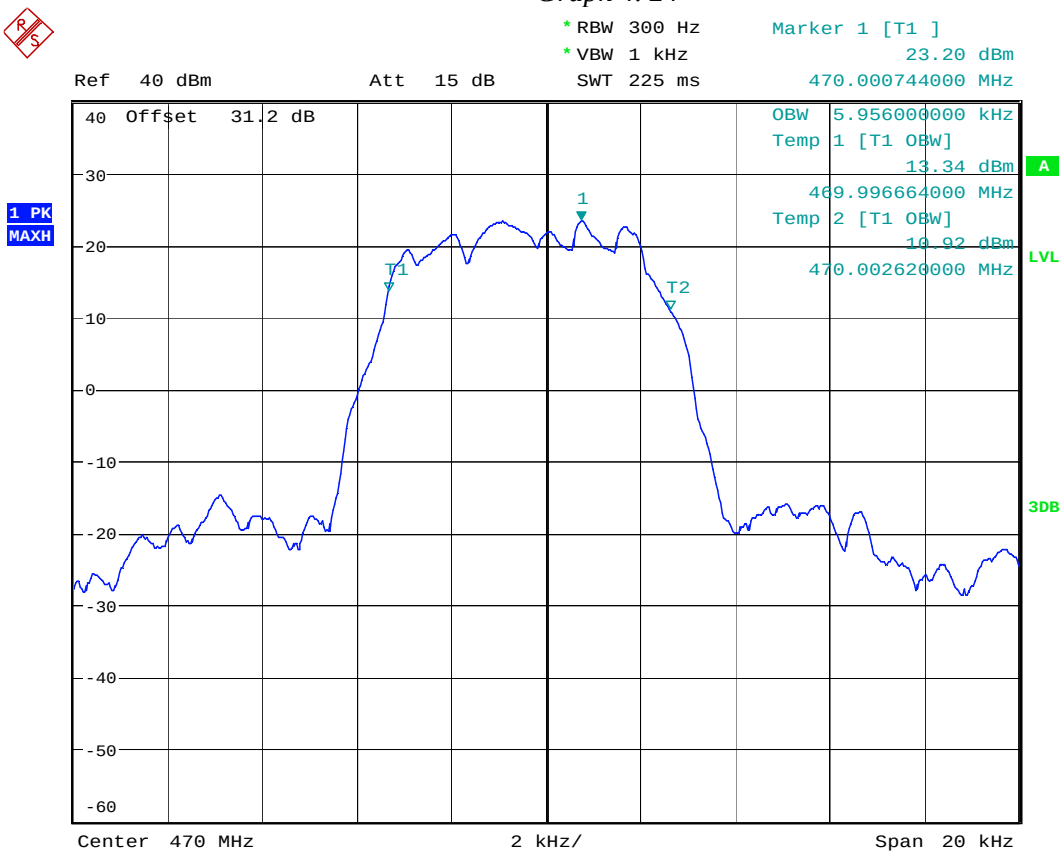
Graph 4. 23



Occupied bandwidth, 11.25kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 12:12:32

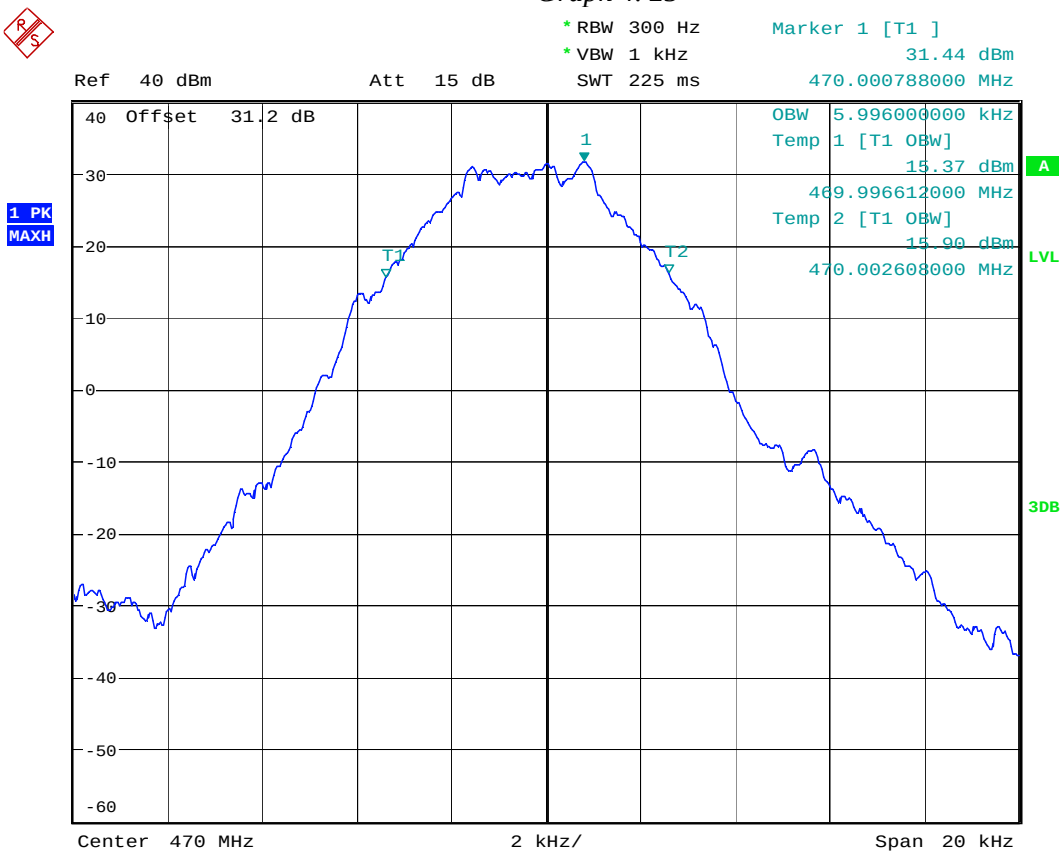
Graph 4. 24



Occupied bandwidth, 11.25kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 12:13:33

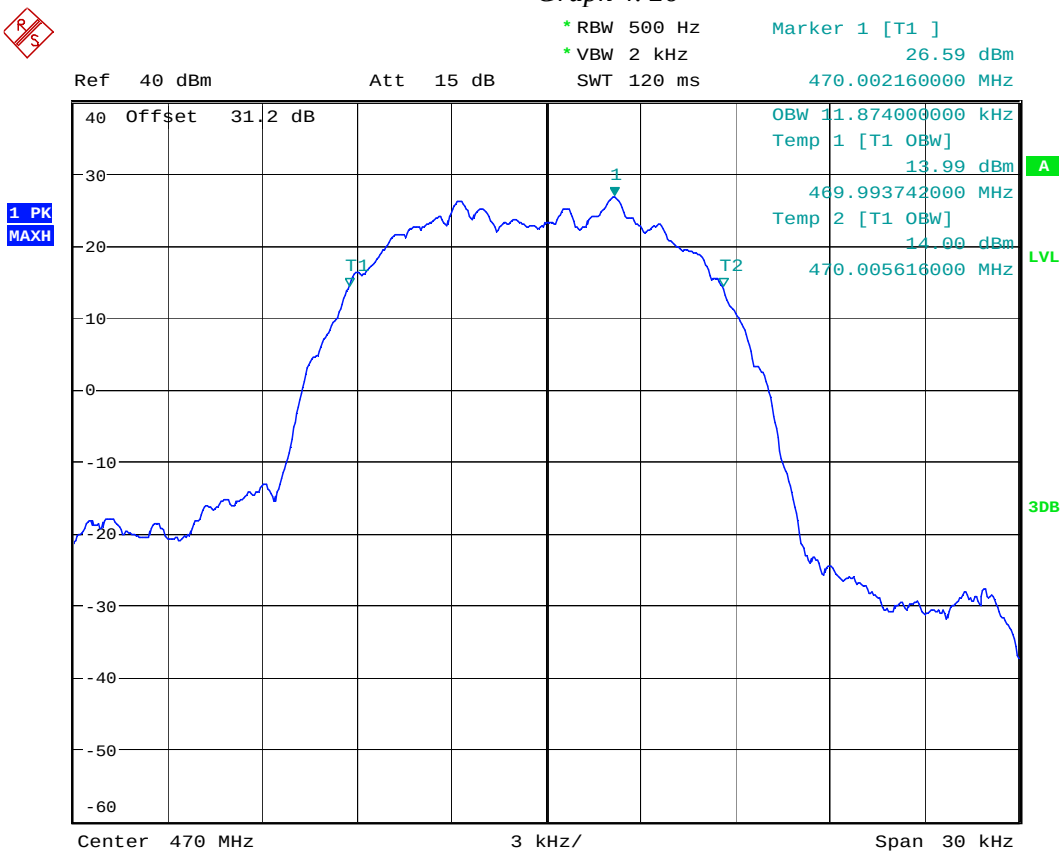
Graph 4. 25



Occupied bandwidth, 11.25kHz authorized bandwidth, GMSK

Date: 12.APR.2011 12:15:03

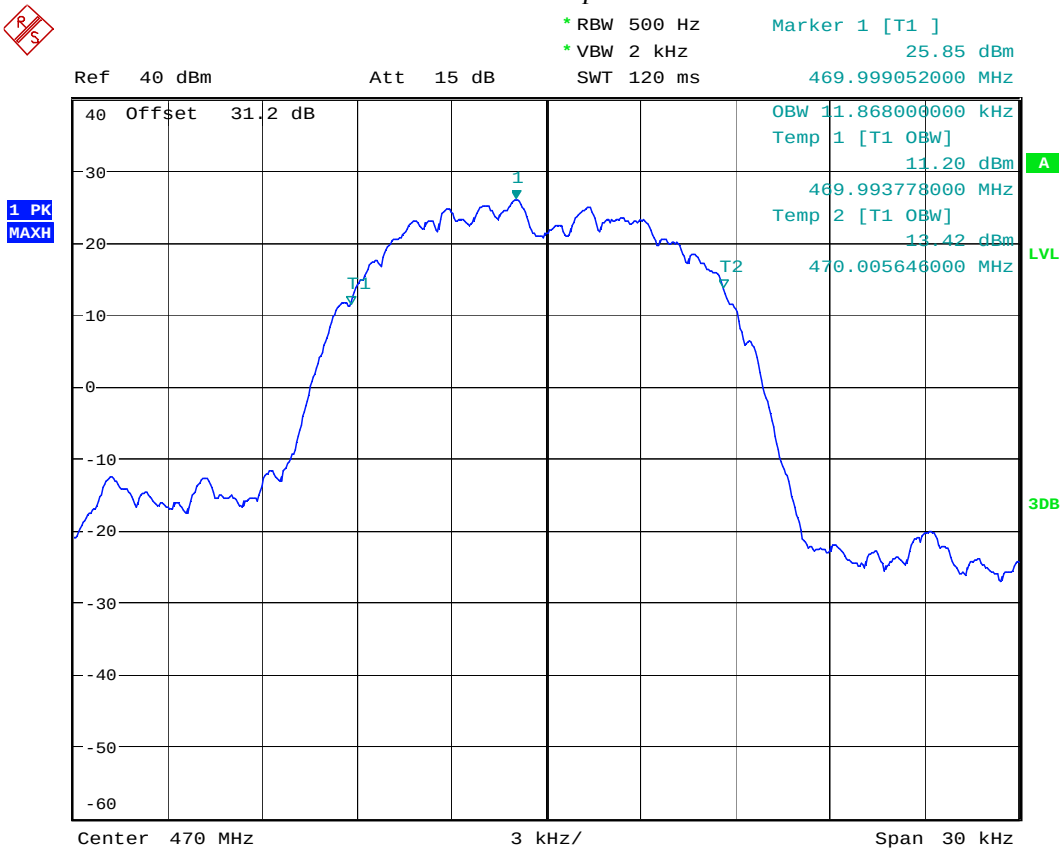
Graph 4. 26



Occupied bandwidth, 20kHz authorized bandwidth, BPSK

Date: 12.APR.2011 12:42:47

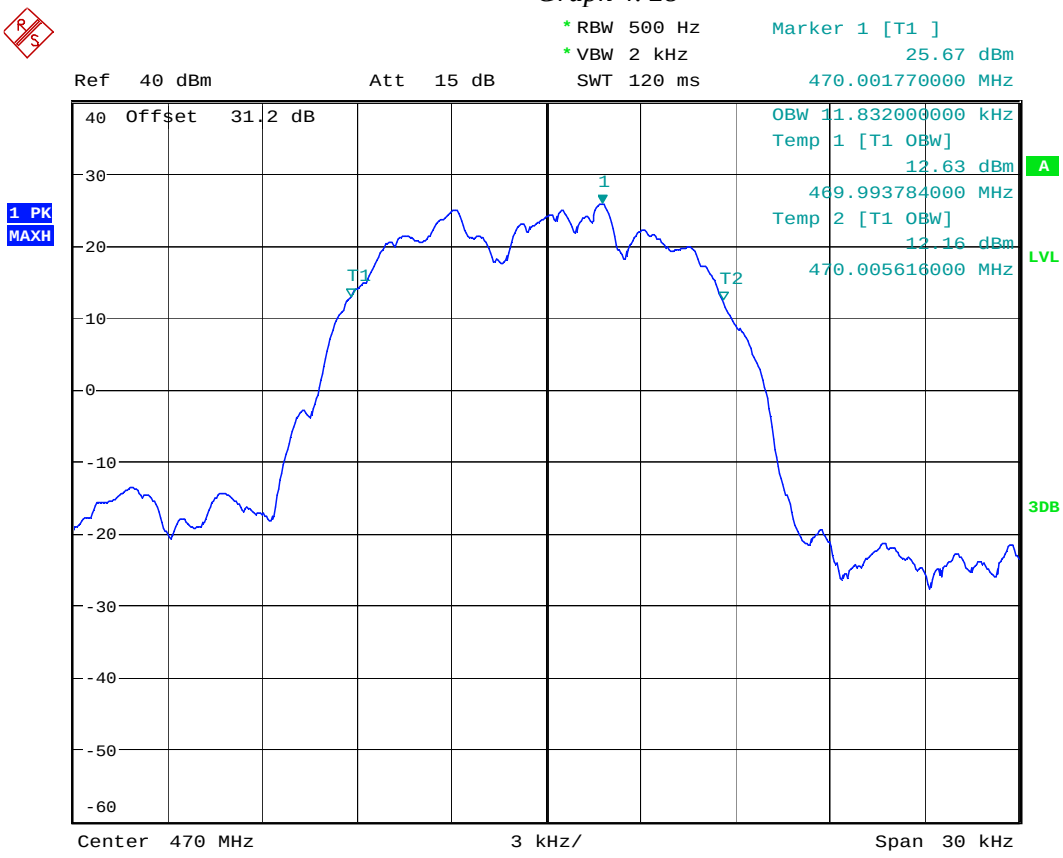
Graph 4. 27



Occupied bandwidth, 20kHz authorized bandwidth, QPSK

Date: 12.APR.2011 12:43:53

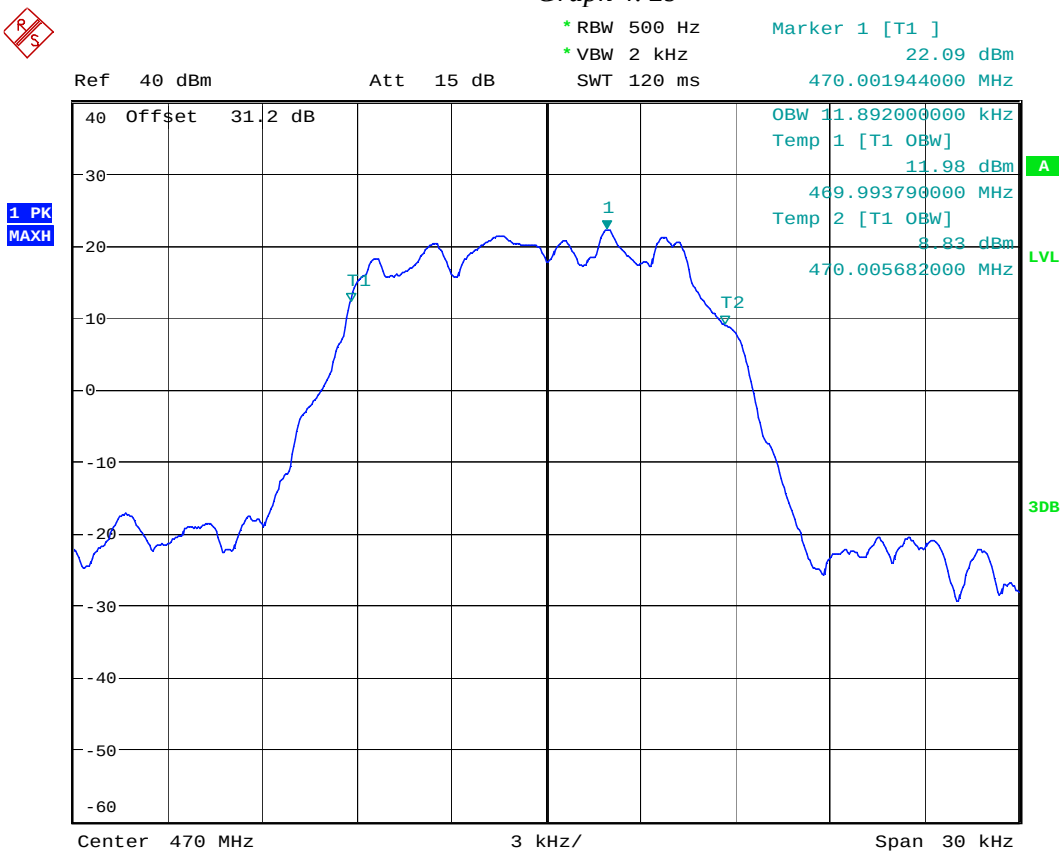
Graph 4. 28



Occupied bandwidth, 20kHz authorized bandwidth, 8PSK

Date: 12.APR.2011 12:44:54

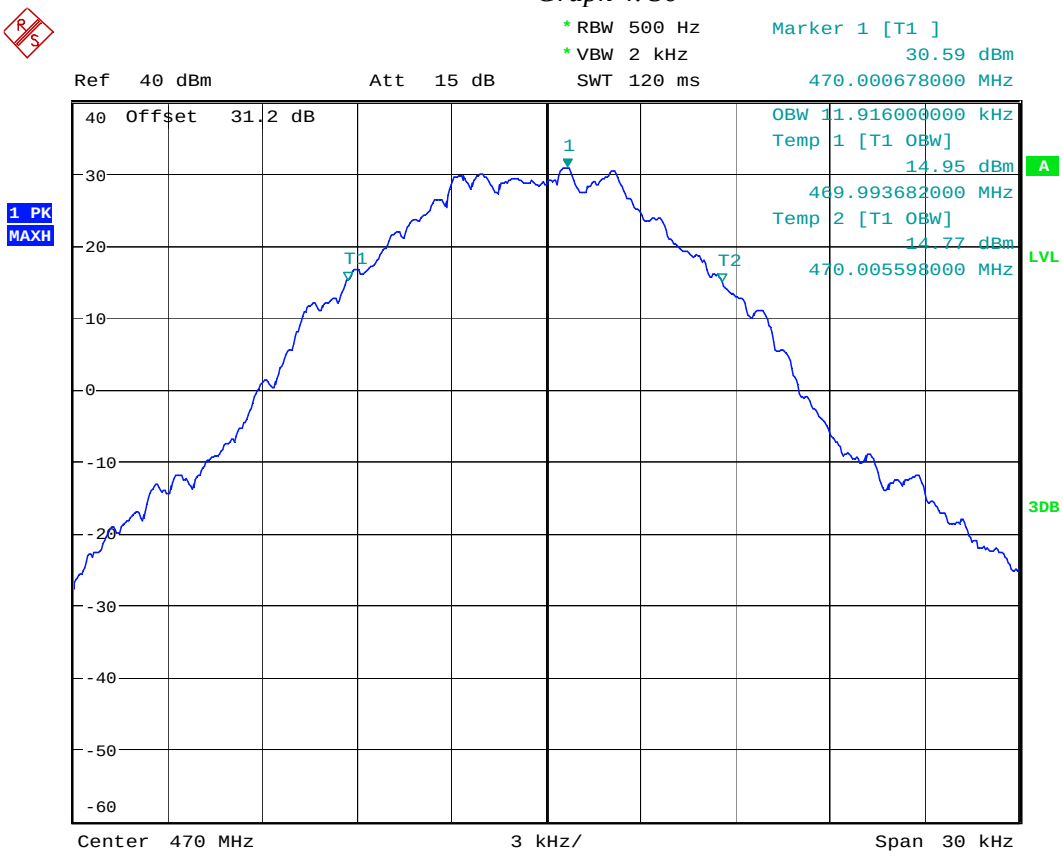
Graph 4. 29



Occupied bandwidth, 20kHz authorized bandwidth, 16QAM

Date: 12.APR.2011 12:45:30

Graph 4. 30



Occupied bandwidth, 20kHz authorized bandwidth, GMSK

Date: 12.APR.2011 12:46:45

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 section 1.3.2. The EUT was setup to transmit the maximum power.

The spectrum analyzer 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 and 470 MHz for all five types of modulation.

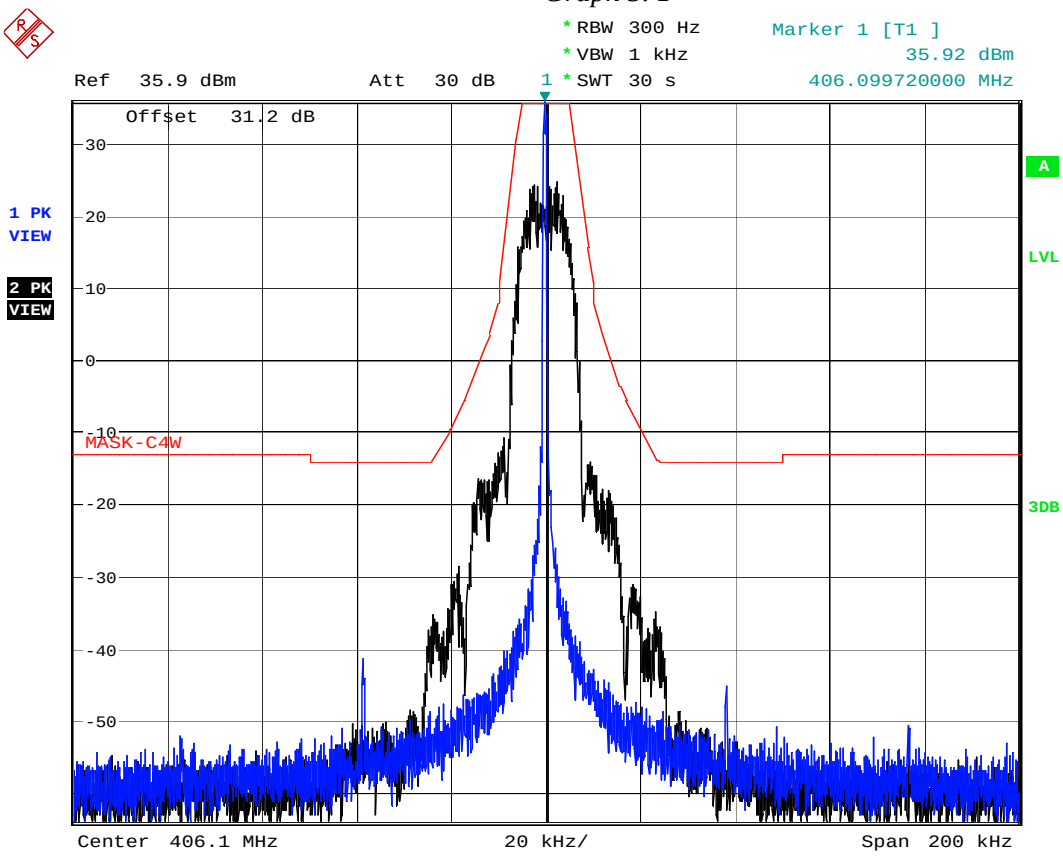
5.3 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

5.4 Test Results

Complies with Emission Mask Requirements. For more details refer to the attached Graphs: 5.1 – 5.30.

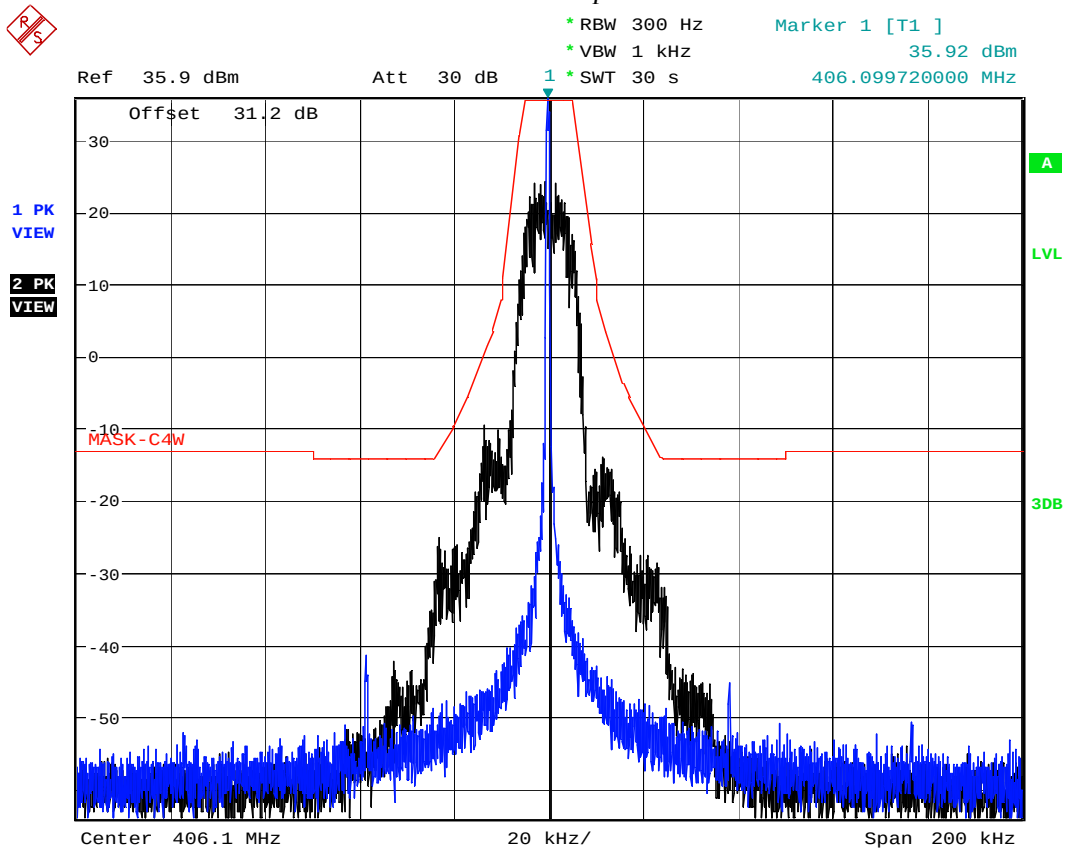
Graph 5. 1



Emission Mask, 25kHz ch. spacing, BPSK

Date: 11.APR.2011 21:19:08

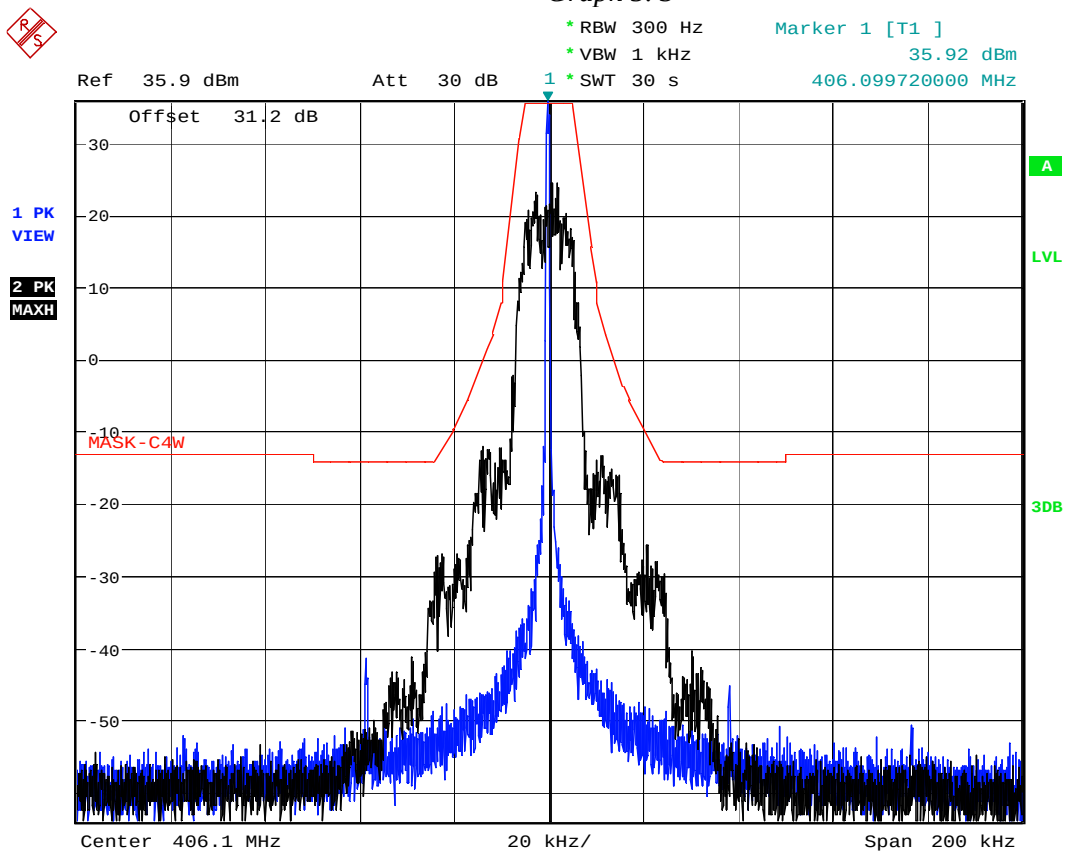
Graph 5. 2



Emission Mask, 25kHz ch. spacing, QPSK

Date: 11.APR.2011 21:20:37

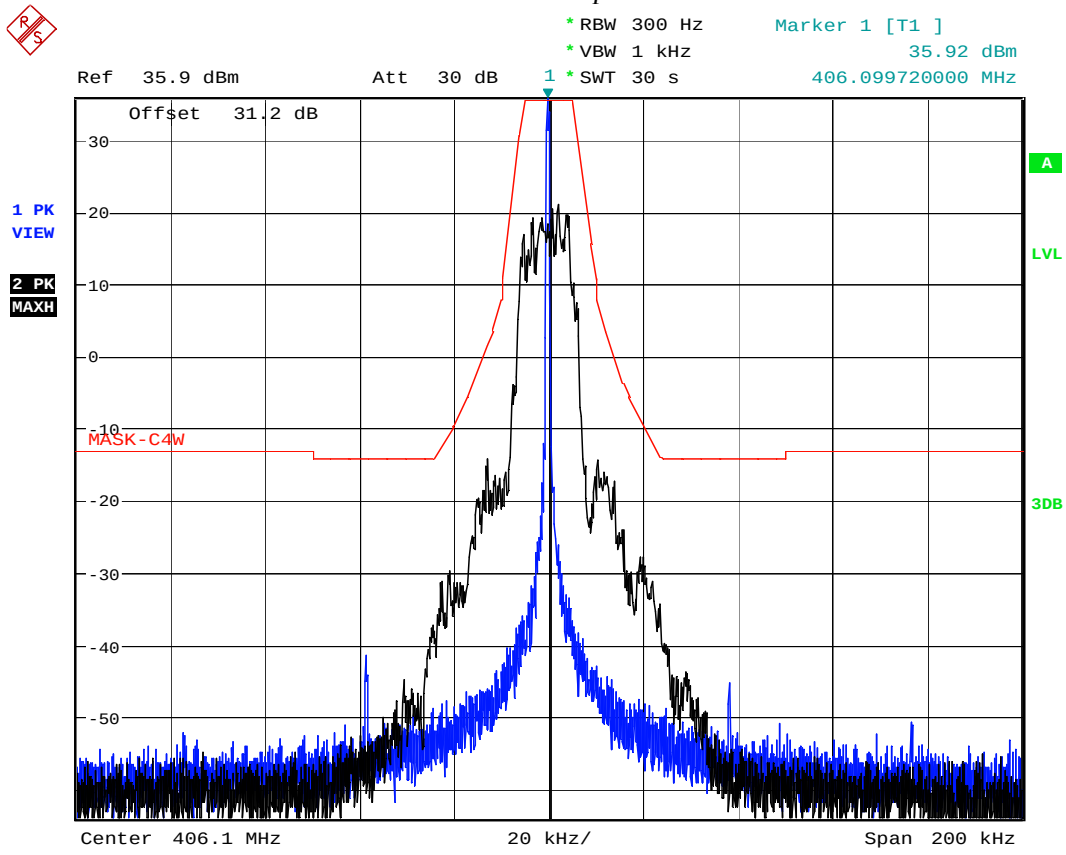
Graph 5. 3



Emission Mask, 25kHz ch. spacing, 8PSK

Date: 11.APR.2011 21:22:06

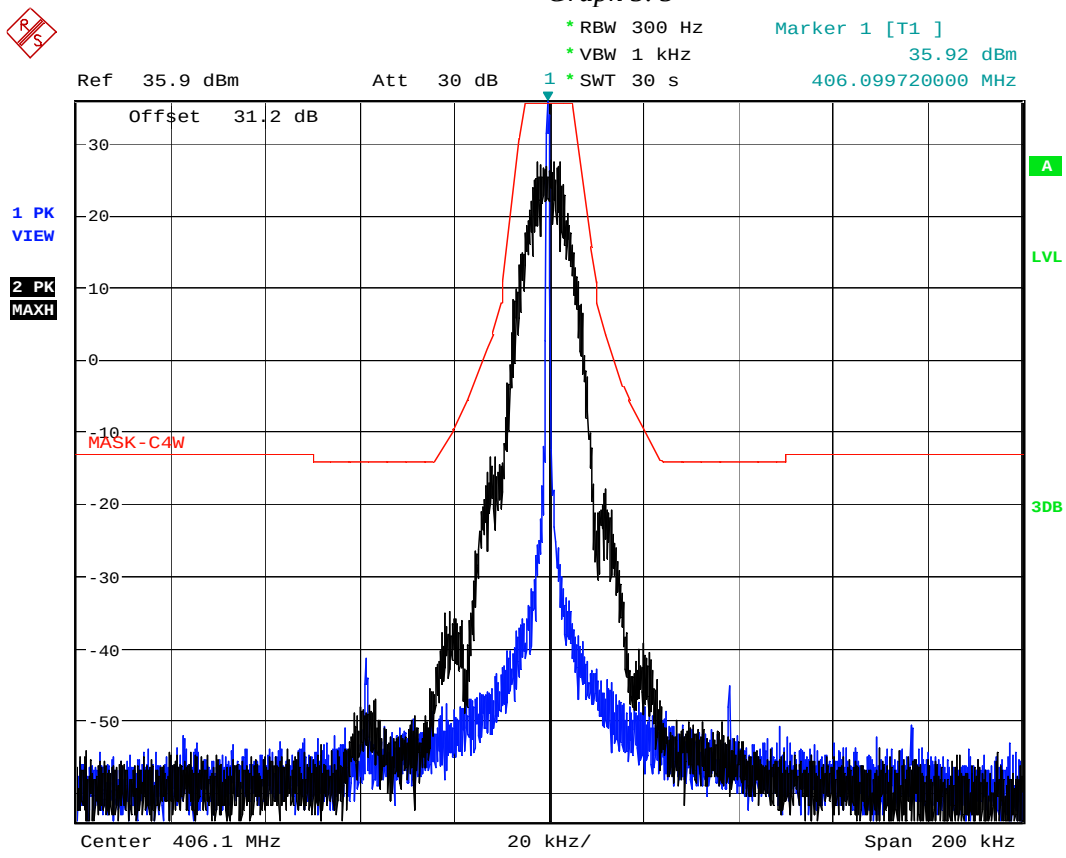
Graph 5. 4



Emission Mask, 25kHz ch. spacing, 16QAM

Date: 11.APR.2011 21:23:18

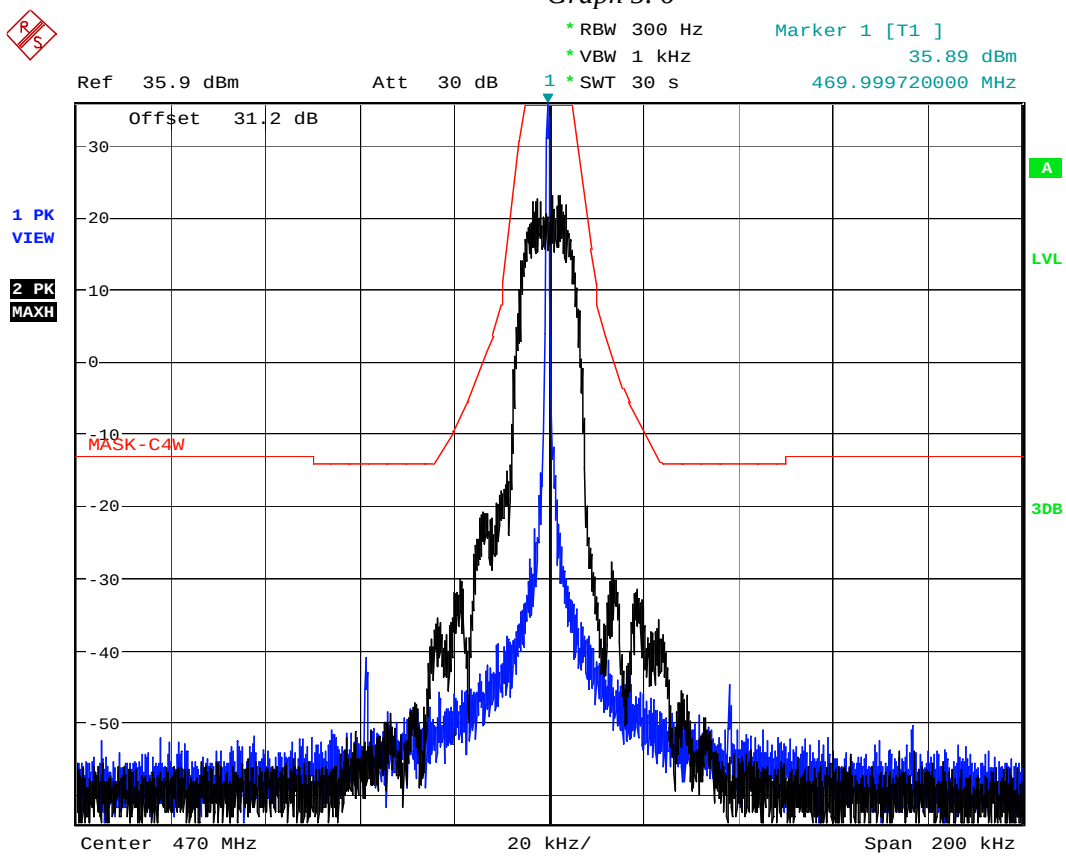
Graph 5. 5



Emission Mask, 25kHz ch. spacing, GMSK

Date: 11.APR.2011 21:24:28

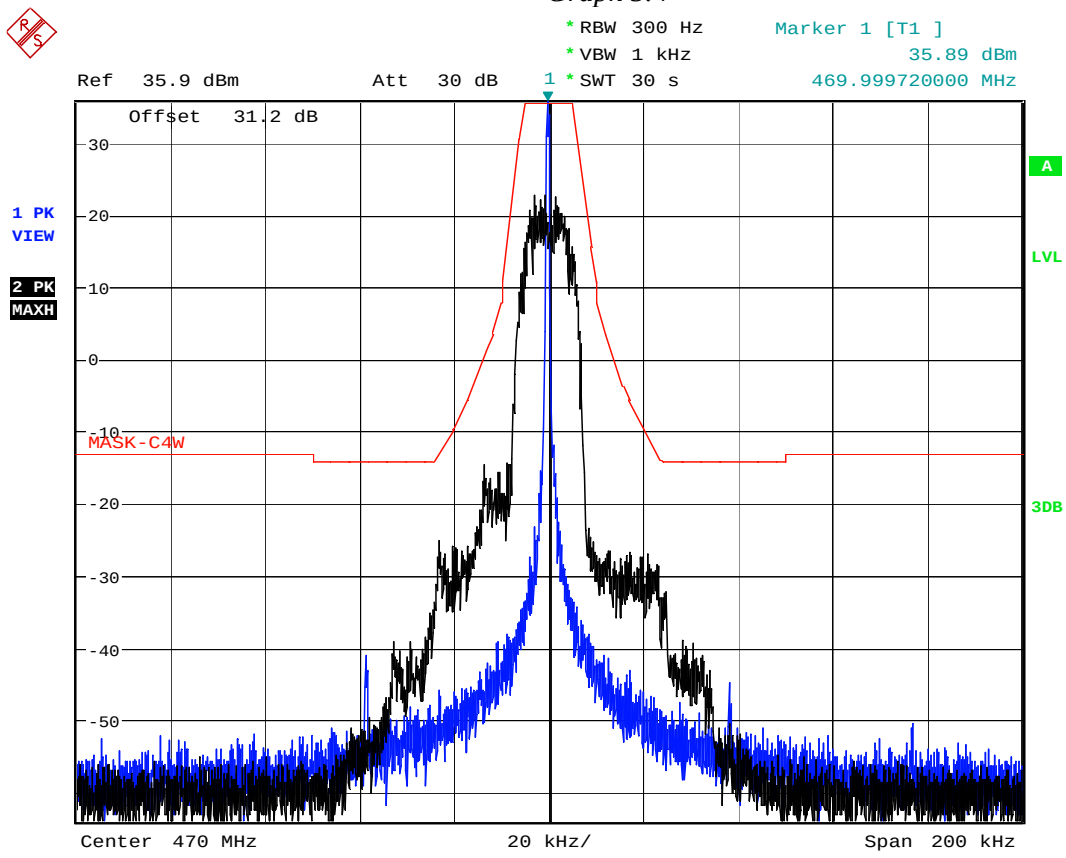
Graph 5. 6



Emission Mask, 25kHz ch. spacing, BPSK

Date: 12.APR.2011 08:33:31

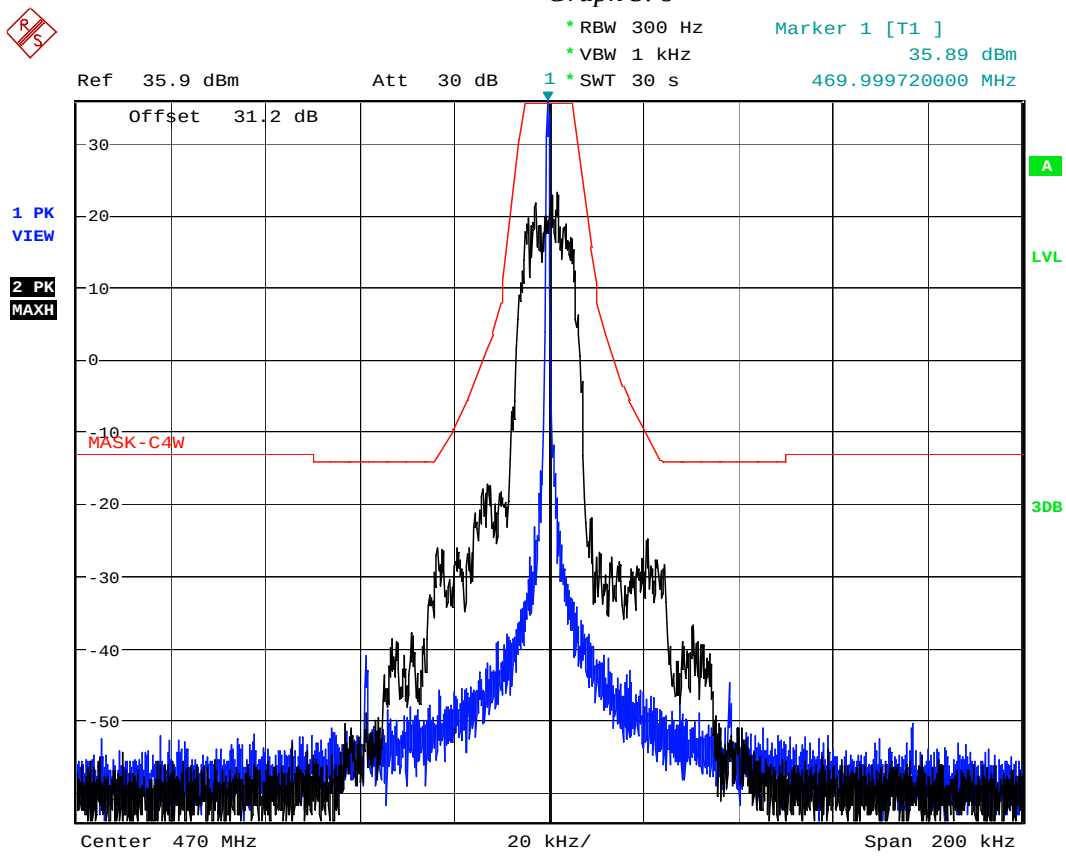
Graph 5. 7



Emission Mask, 25kHz ch. spacing, QPSK

Date: 12.APR.2011 08:34:44

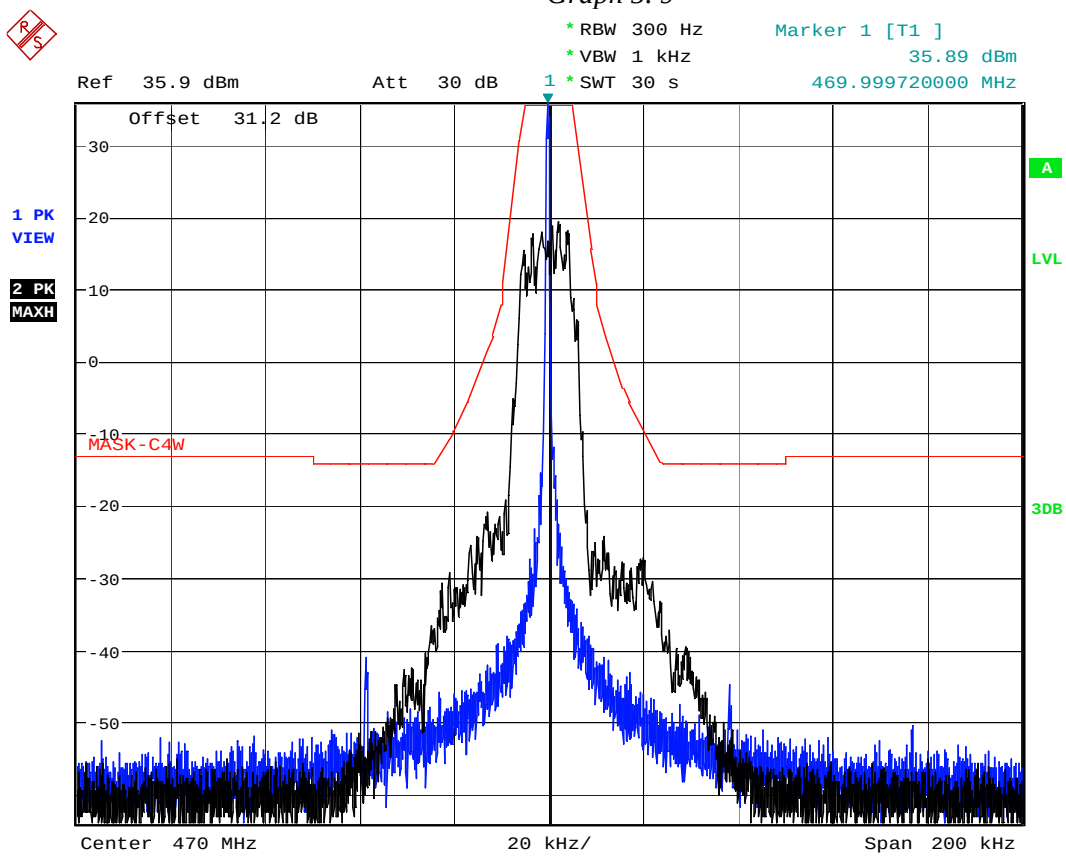
Graph 5. 8



Emission Mask, 25kHz ch. spacing, 8PSK

Date: 12.APR.2011 08:36:33

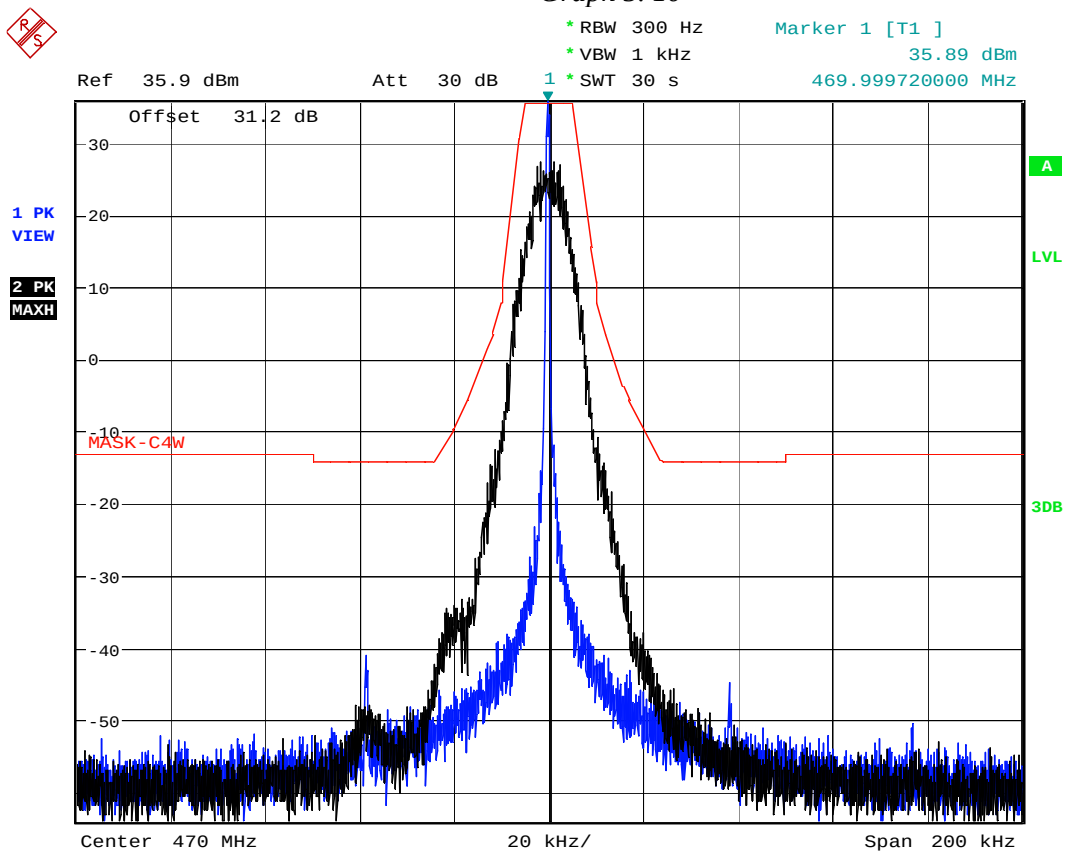
Graph 5. 9



Emission Mask, 25kHz ch. spacing, 16QAM

Date: 12.APR.2011 08:37:47

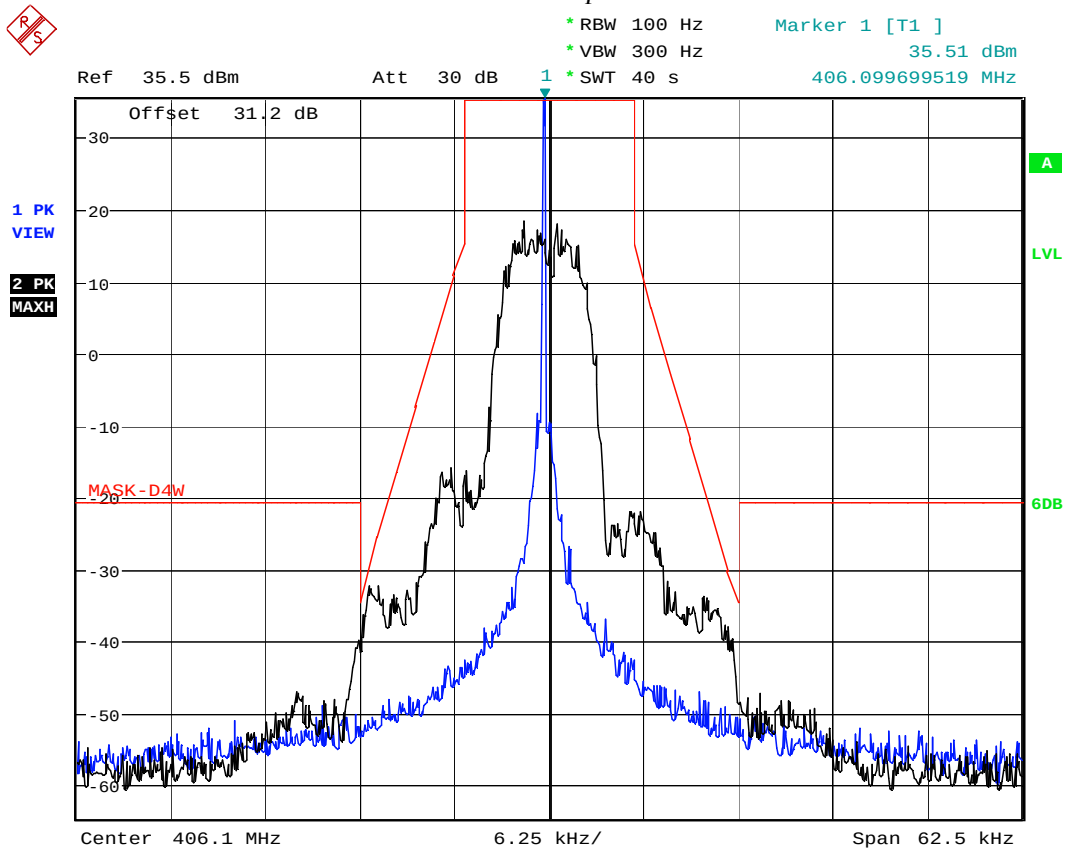
Graph 5. 10



Emission Mask, 25kHz ch. spacing, GMSK

Date: 12.APR.2011 08:41:40

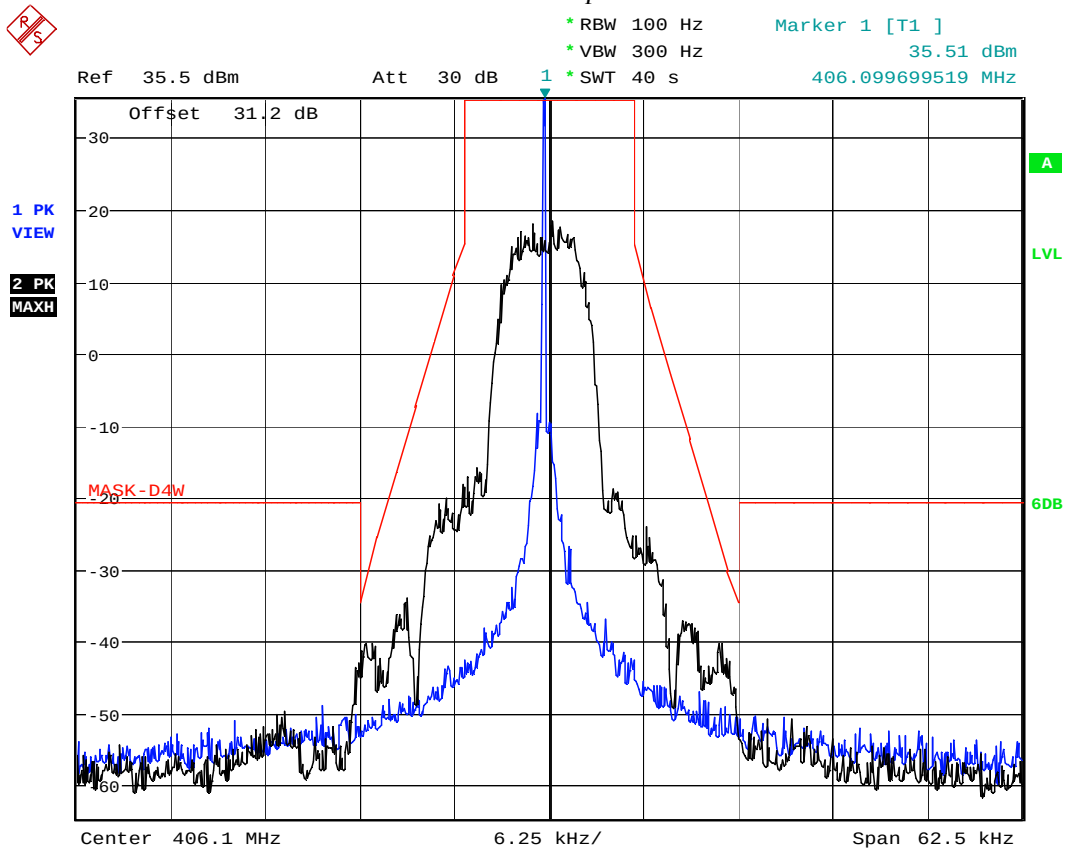
Graph 5. 11



Emission Mask, 12.5kHz ch. spacing, QPSK

Date: 14.APR.2011 16:13:49

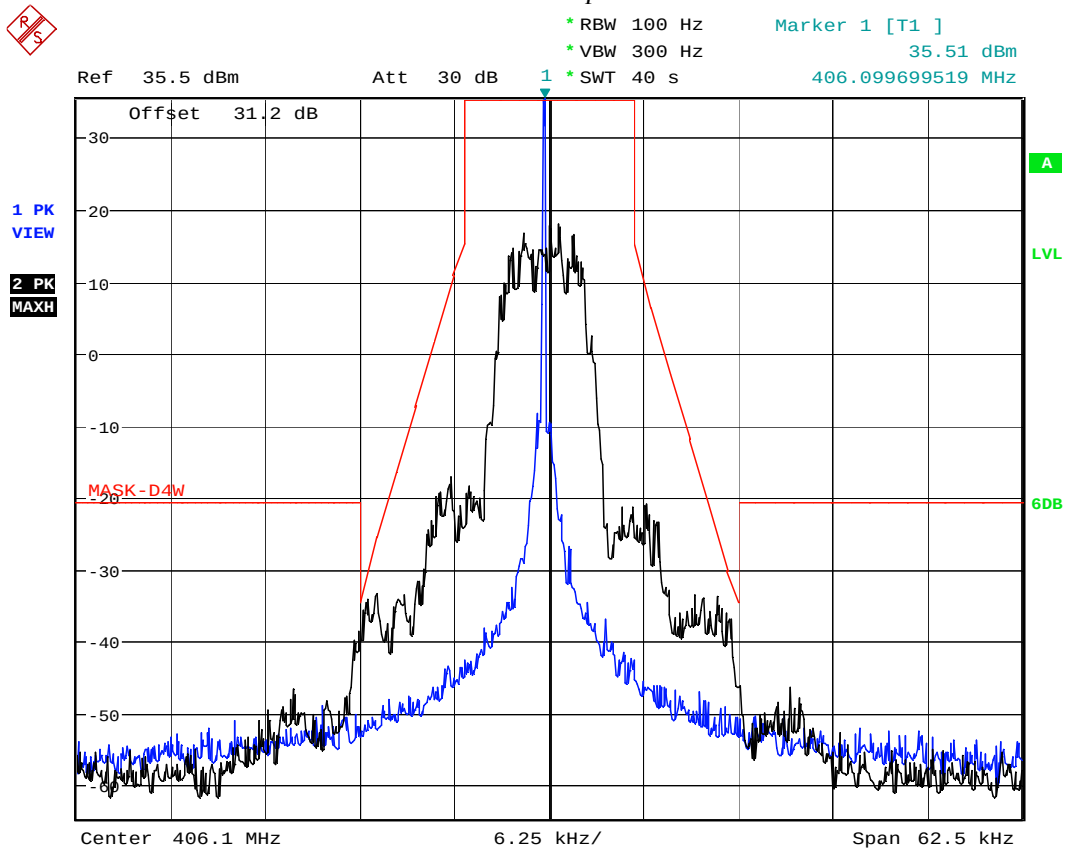
Graph 5. 12



Emission Mask, 12.5kHz ch. spacing, BPSK

Date: 14.APR.2011 16:16:17

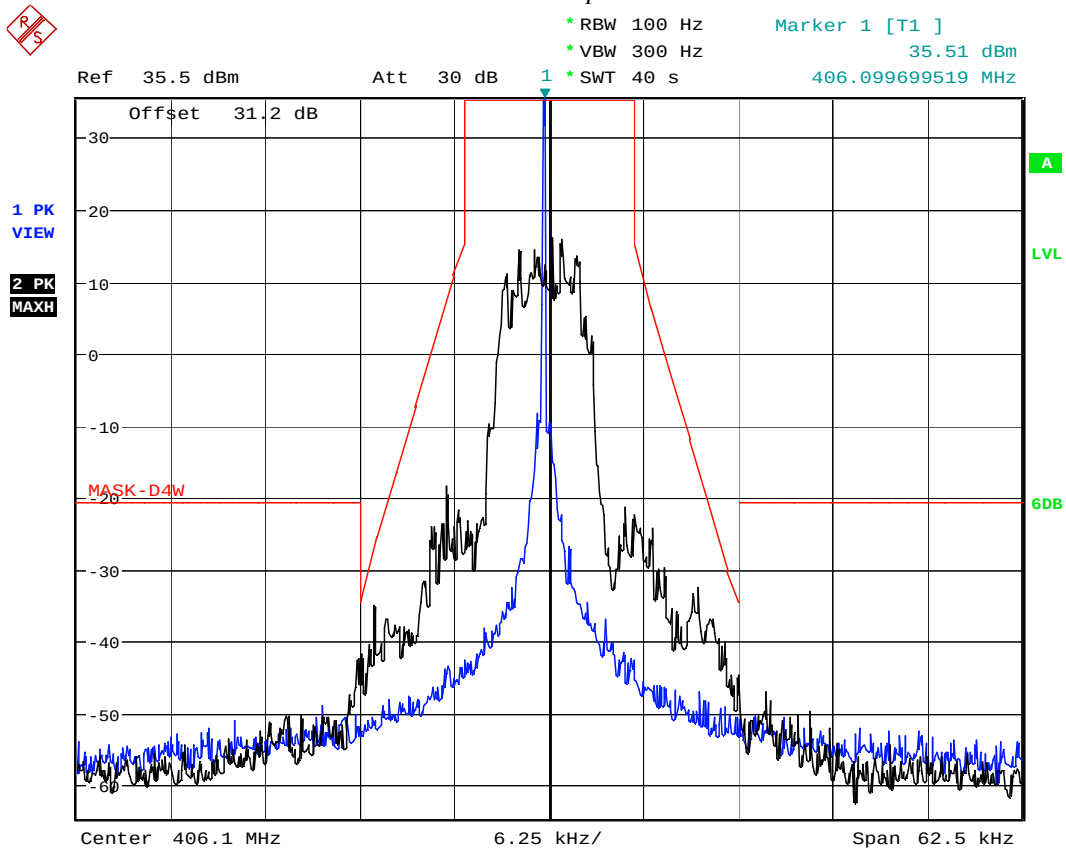
Graph 5. 13



Emission Mask, 12.5kHz ch. spacing, 8PSK

Date: 14.APR.2011 16:18:48

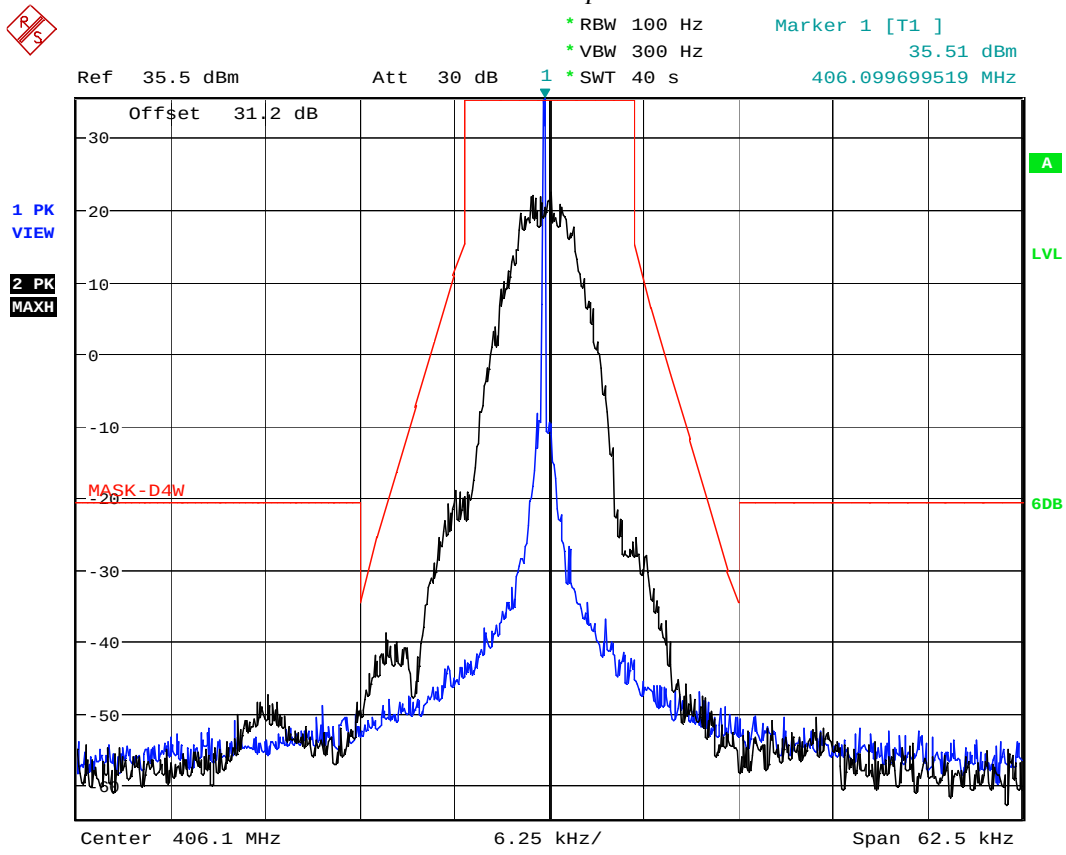
Graph 5. 14



Emission Mask, 12.5kHz ch. spacing, 16QAM

Date: 14.APR.2011 16:21:10

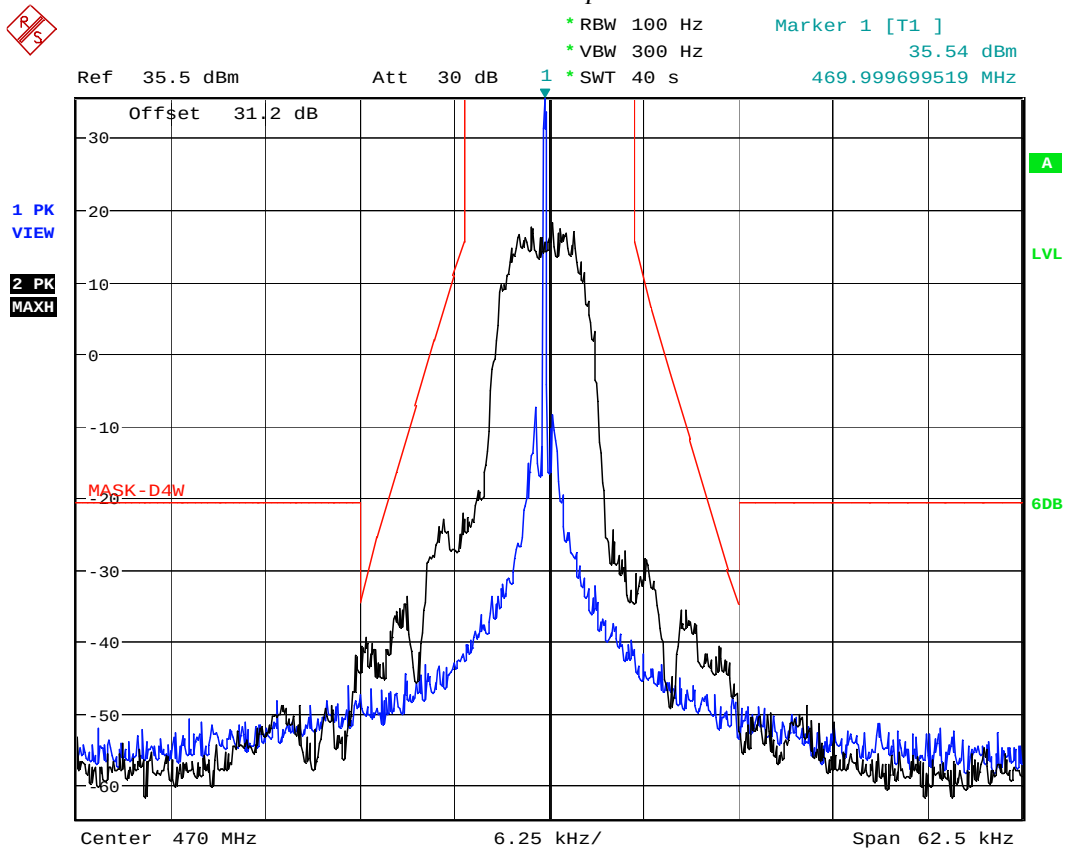
Graph 5. 15



Emission Mask, 12.5kHz ch. spacing, GMSK

Date: 14.APR.2011 16:22:58

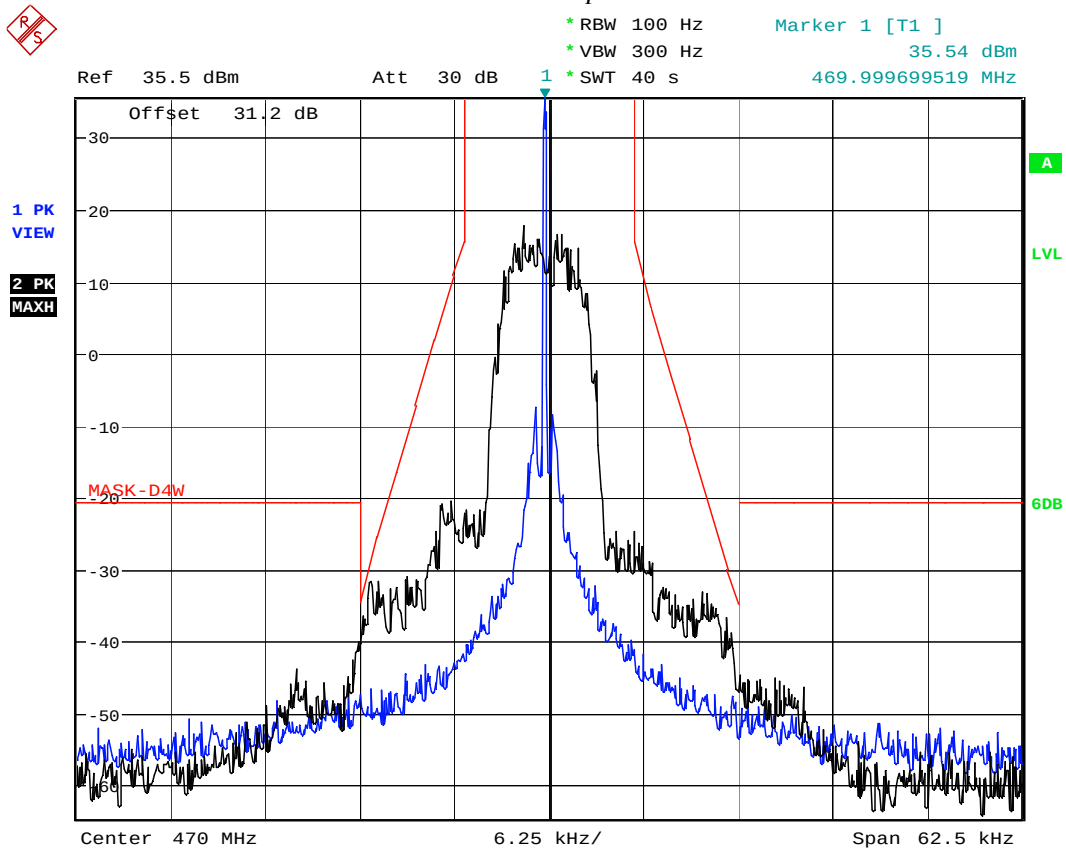
Graph 5. 16



Emission Mask, 12.5kHz ch. spacing, BPSK

Date: 14.APR.2011 17:14:28

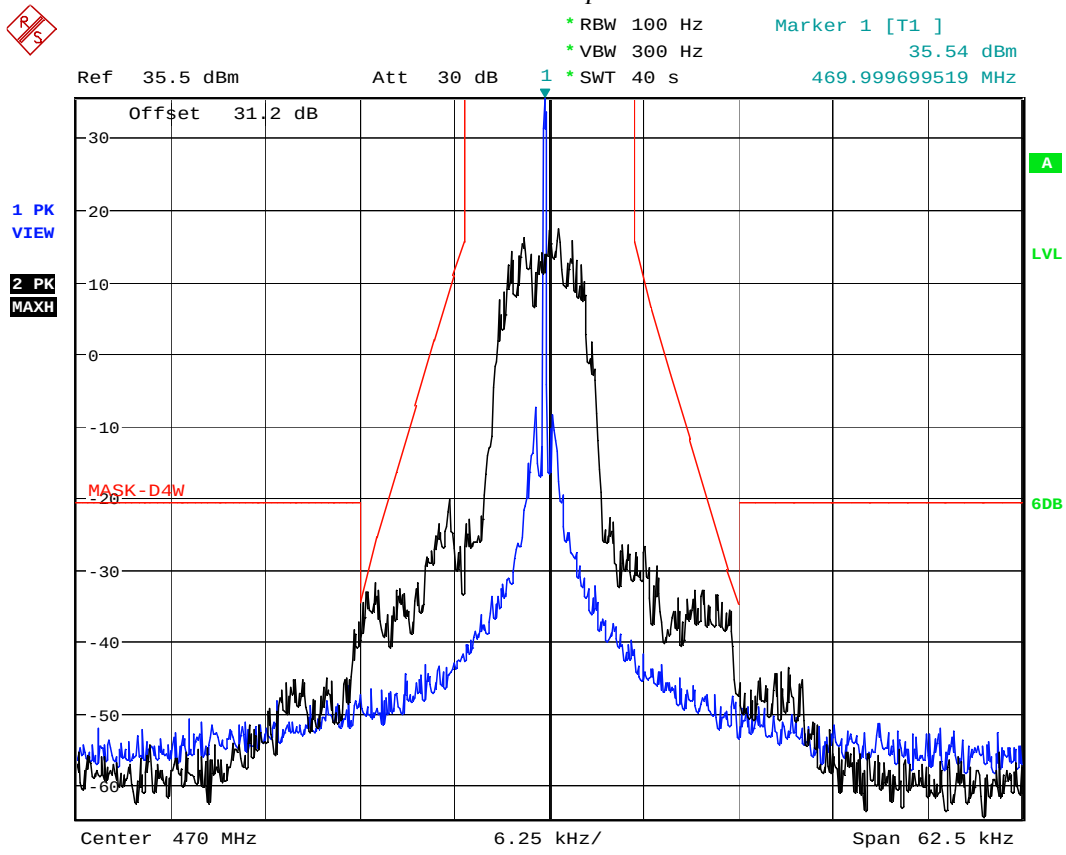
Graph 5. 17



Emission Mask, 12.5kHz ch. spacing, QPSK

Date: 14.APR.2011 17:20:56

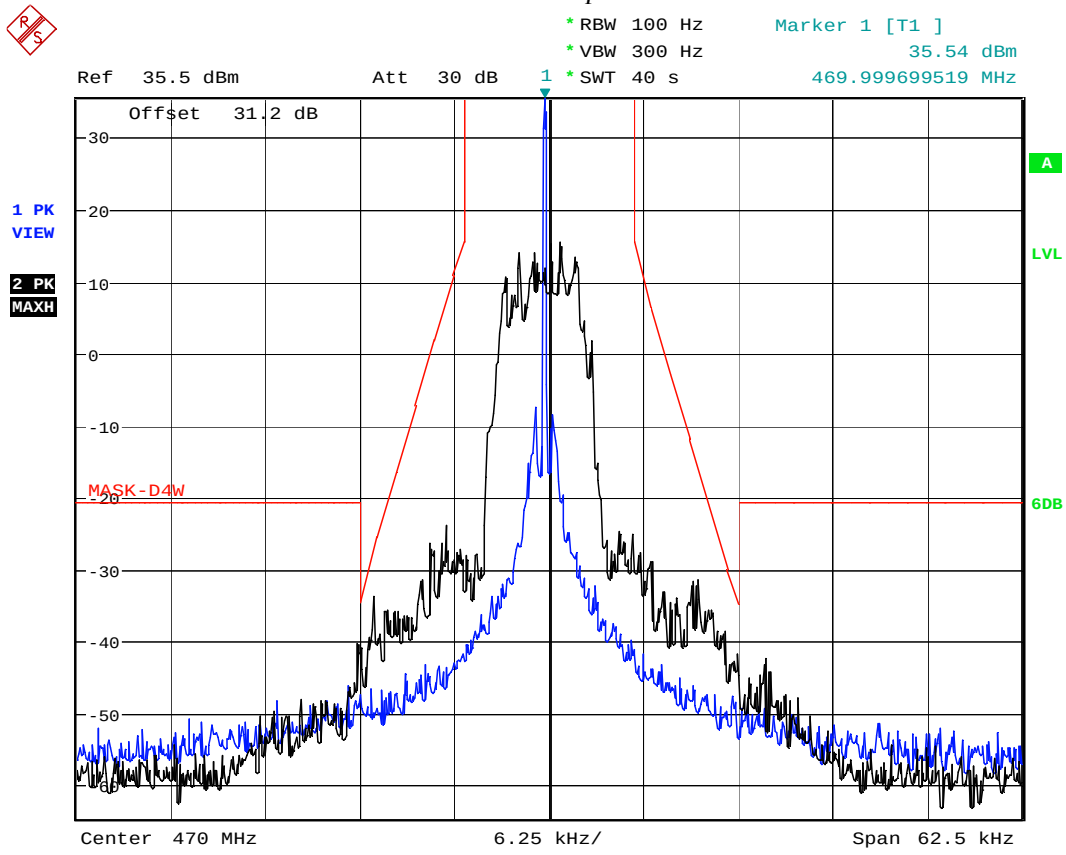
Graph 5. 18



Emission Mask, 12.5kHz ch. spacing, 8PSK

Date: 14.APR.2011 17:23:33

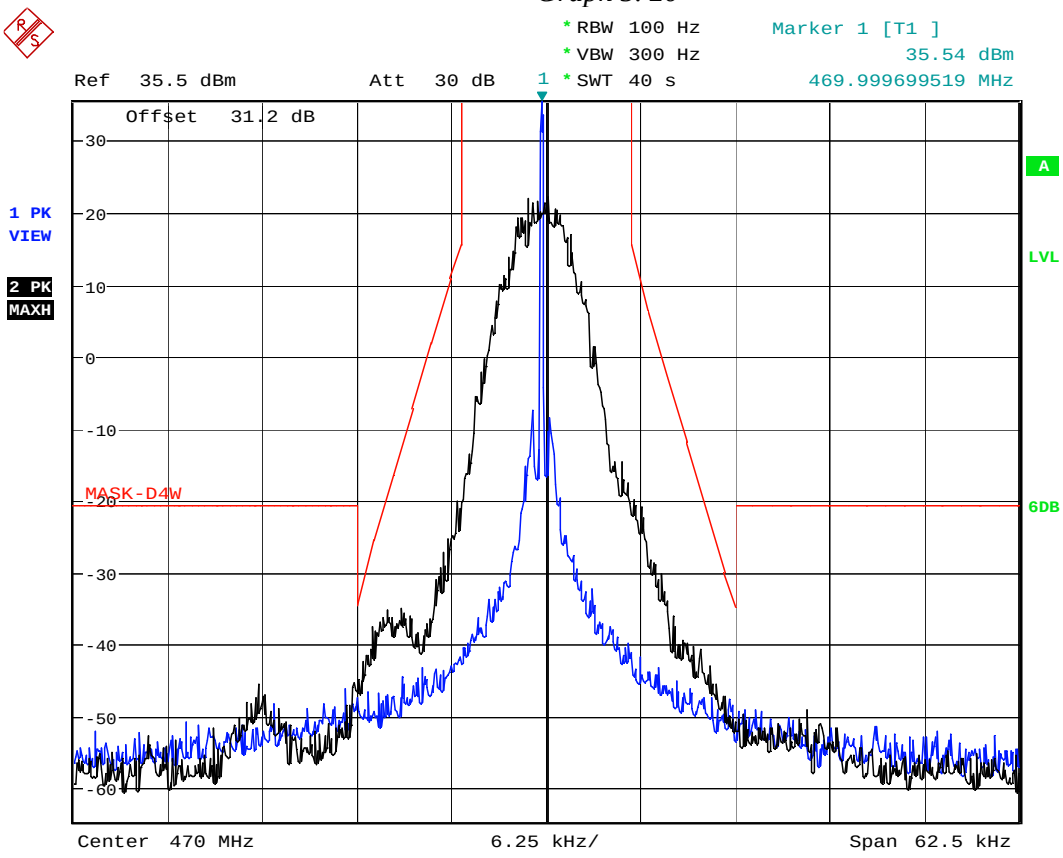
Graph 5. 19



Emission Mask, 12.5kHz ch. spacing, 16QAM

Date: 14.APR.2011 17:28:40

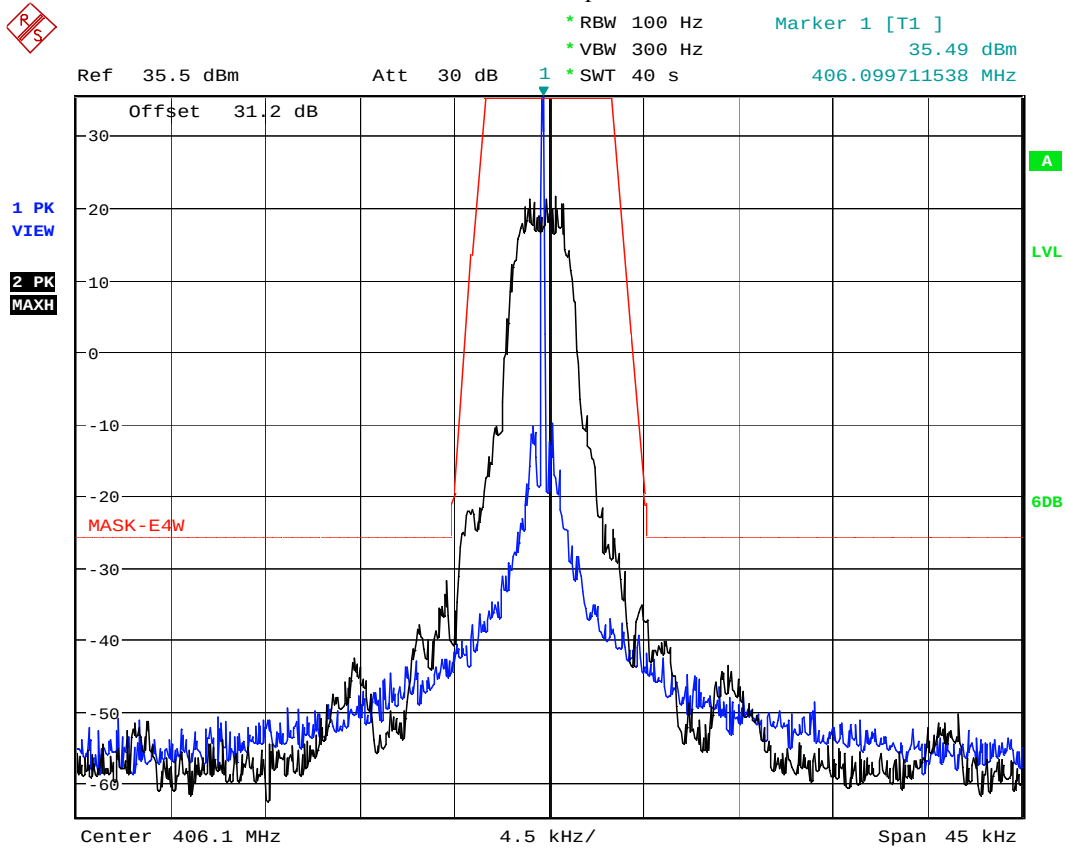
Graph 5. 20



Emission Mask, 12.5kHz ch. spacing, GMSK

Date: 14.APR.2011 17:30:19

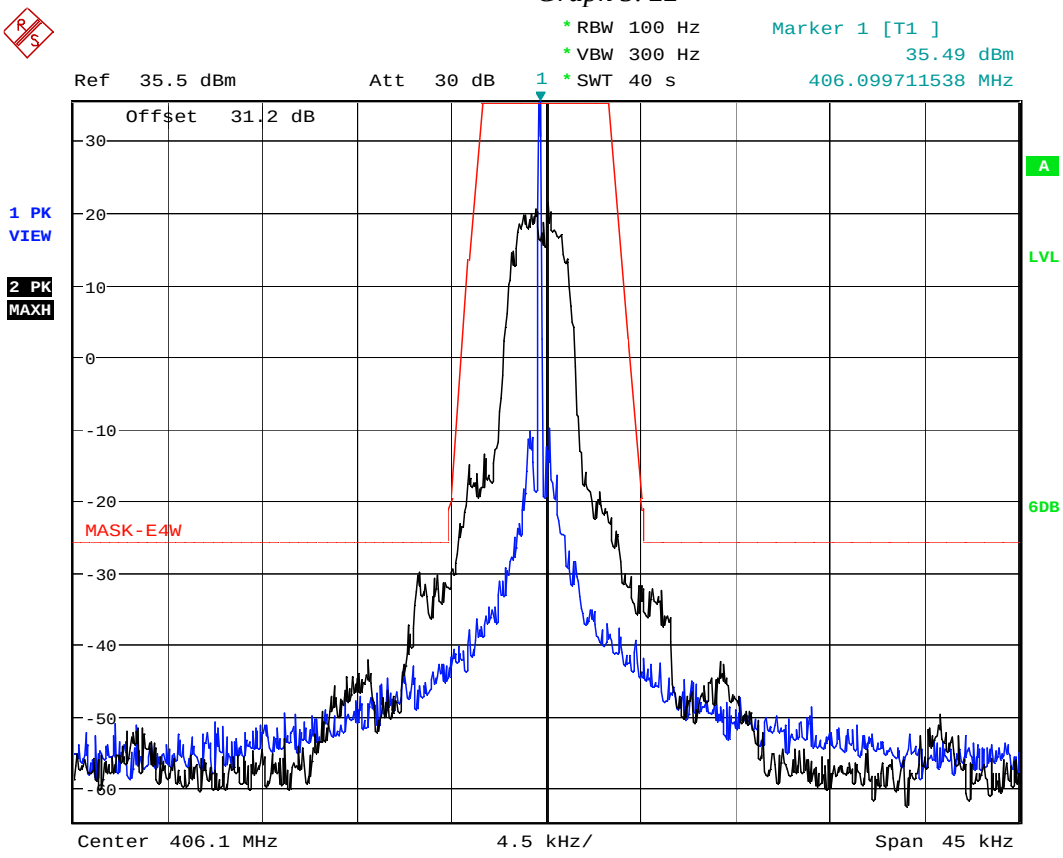
Graph 5. 21



Emission Mask, 6.25kHz ch. spacing, BPSK

Date: 15.APR.2011 09:24:39

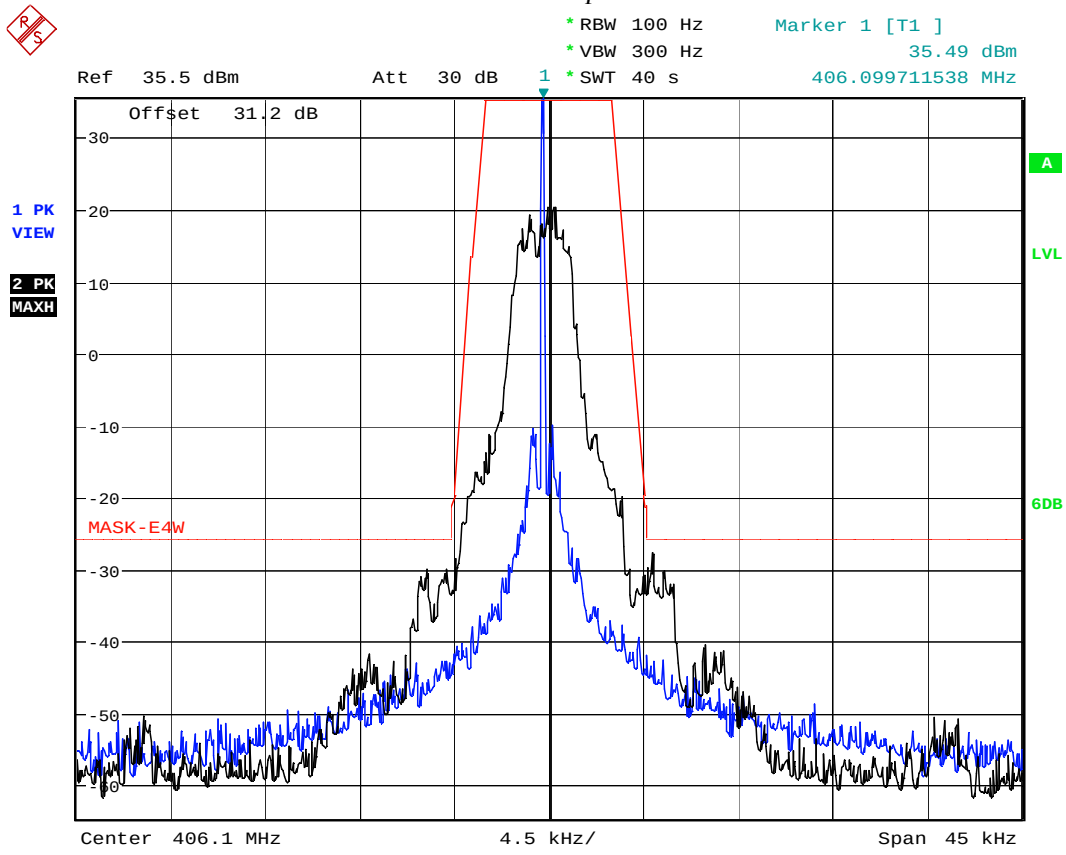
Graph 5. 22



Emission Mask, 6.25kHz ch. spacing, QPSK

Date: 15.APR.2011 09:23:05

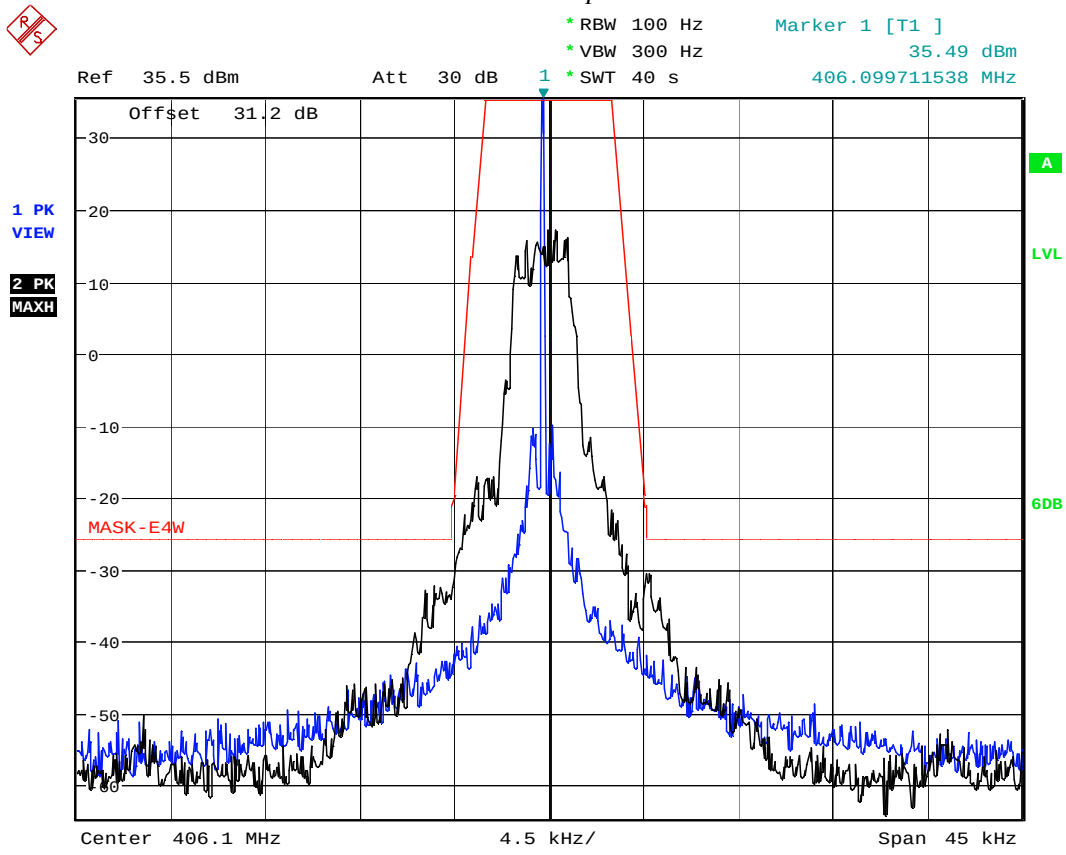
Graph 5. 23



Emission Mask, 6.25kHz ch. spacing, 8PSK

Date: 15.APR.2011 09:32:26

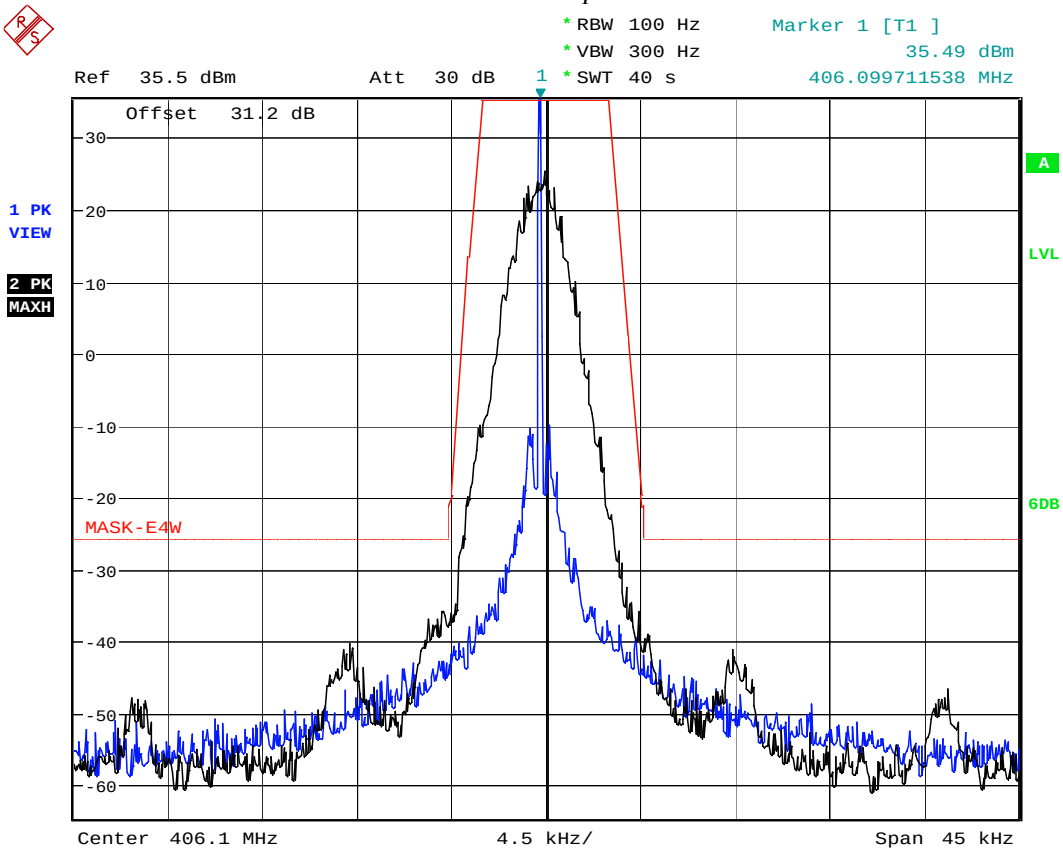
Graph 5. 24



Emission Mask, 6.25kHz ch. spacing, 16QAM

Date: 15.APR.2011 09:33:59

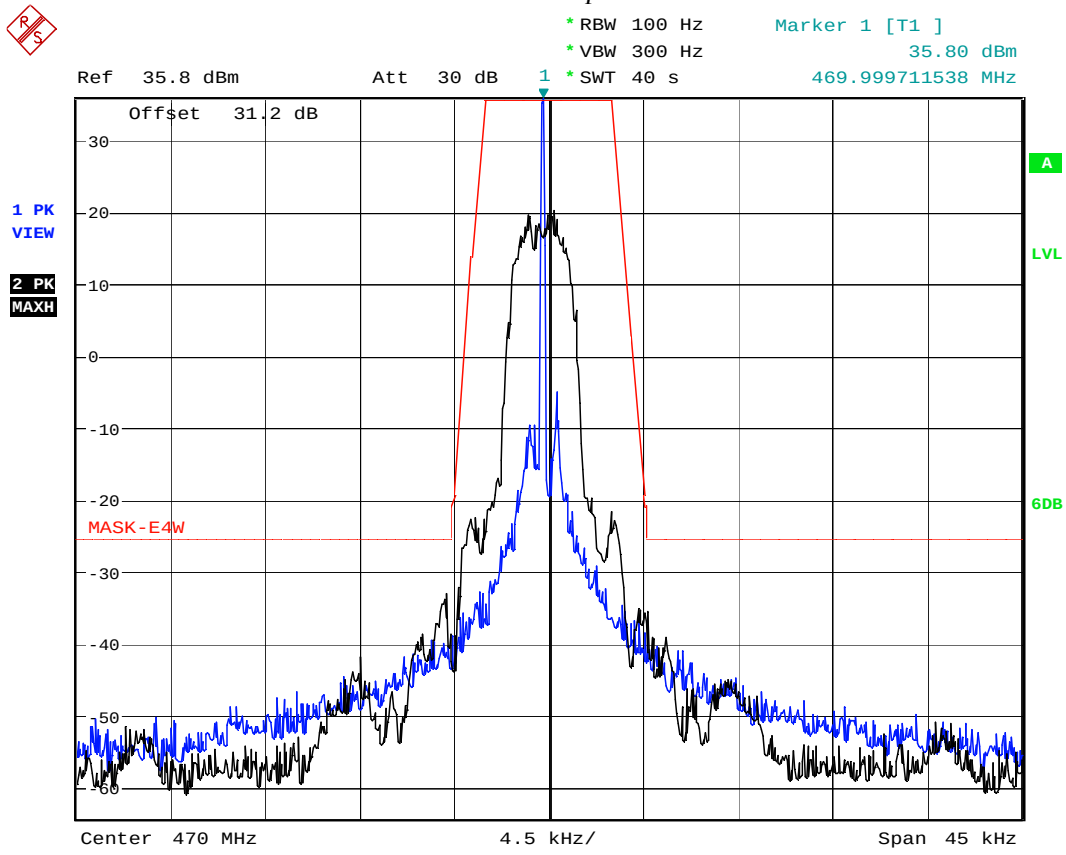
Graph 5. 25



Emission Mask, 6.25kHz ch. spacing, GMSK

Date: 15.APR.2011 09:35:34

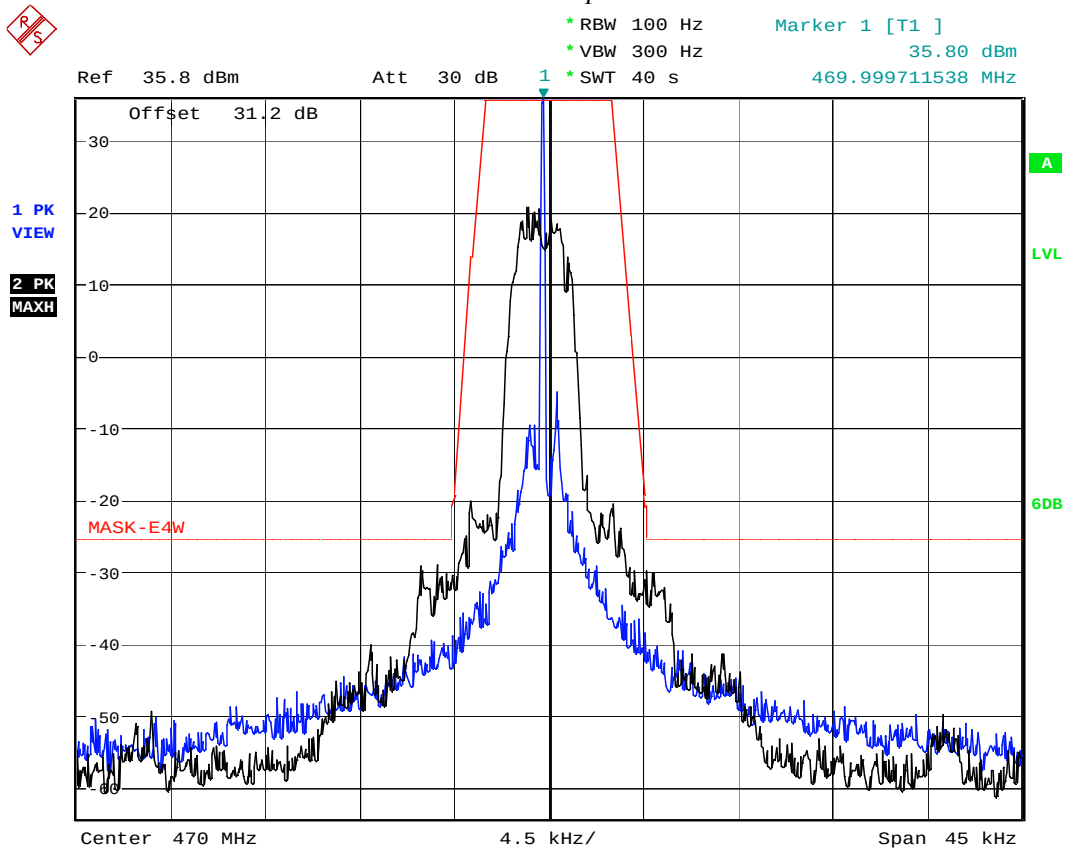
Graph 5. 26



Emission Mask, 6.25kHz ch. spacing, BPSK

Date: 15.APR.2011 09:03:56

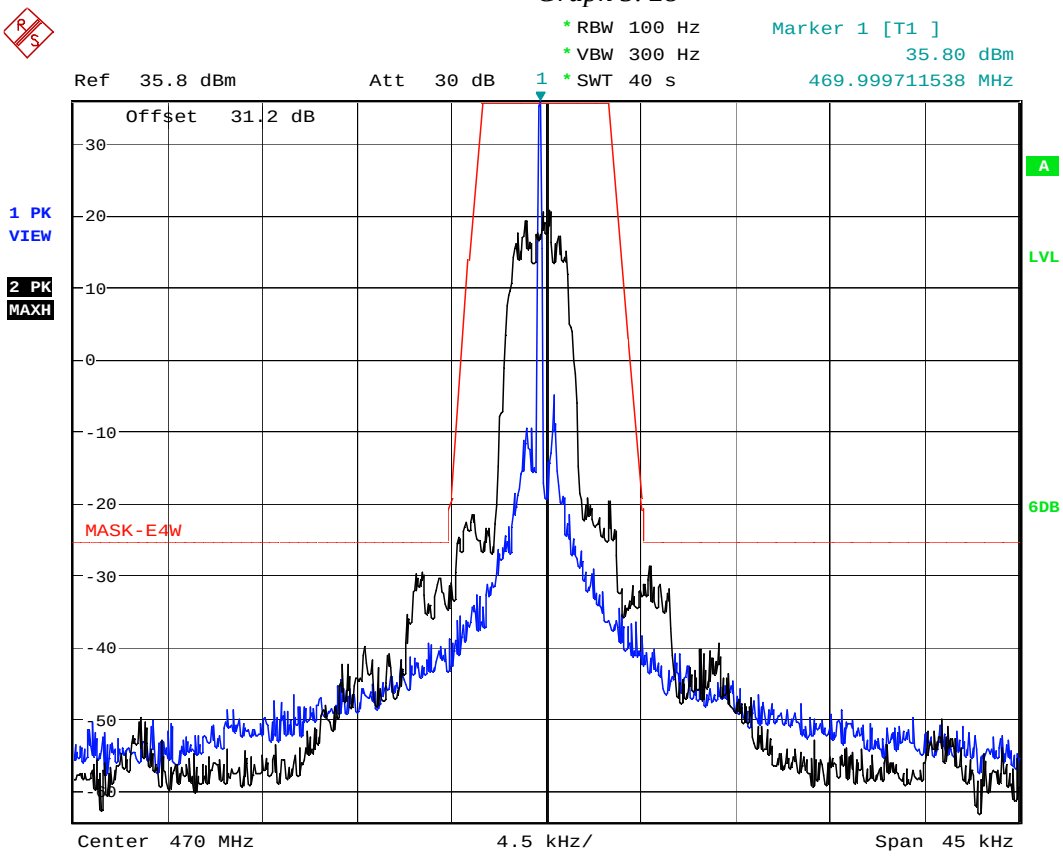
Graph 5. 27



Emission Mask, 6.25kHz ch. spacing, QPSK

Date: 15.APR.2011 09:05:31

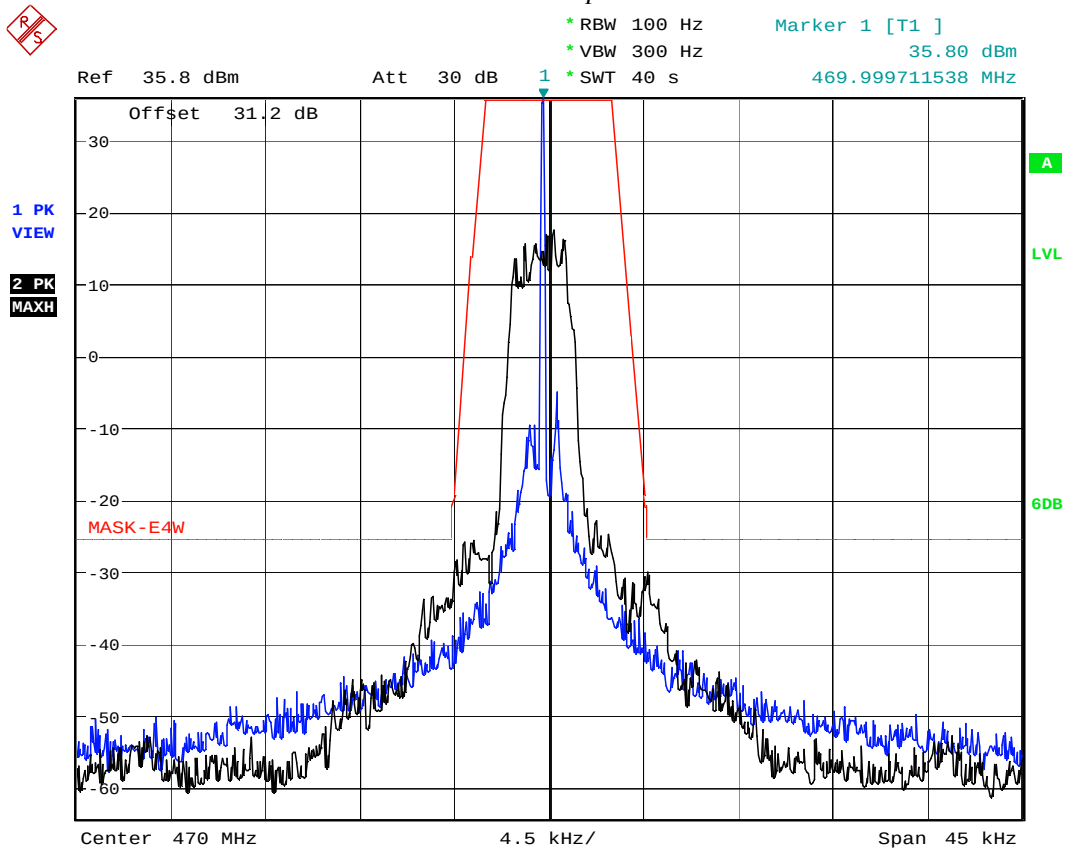
Graph 5. 28



Emission Mask, 6.25kHz ch. spacing, 8PSK

Date: 15.APR.2011 09:07:04

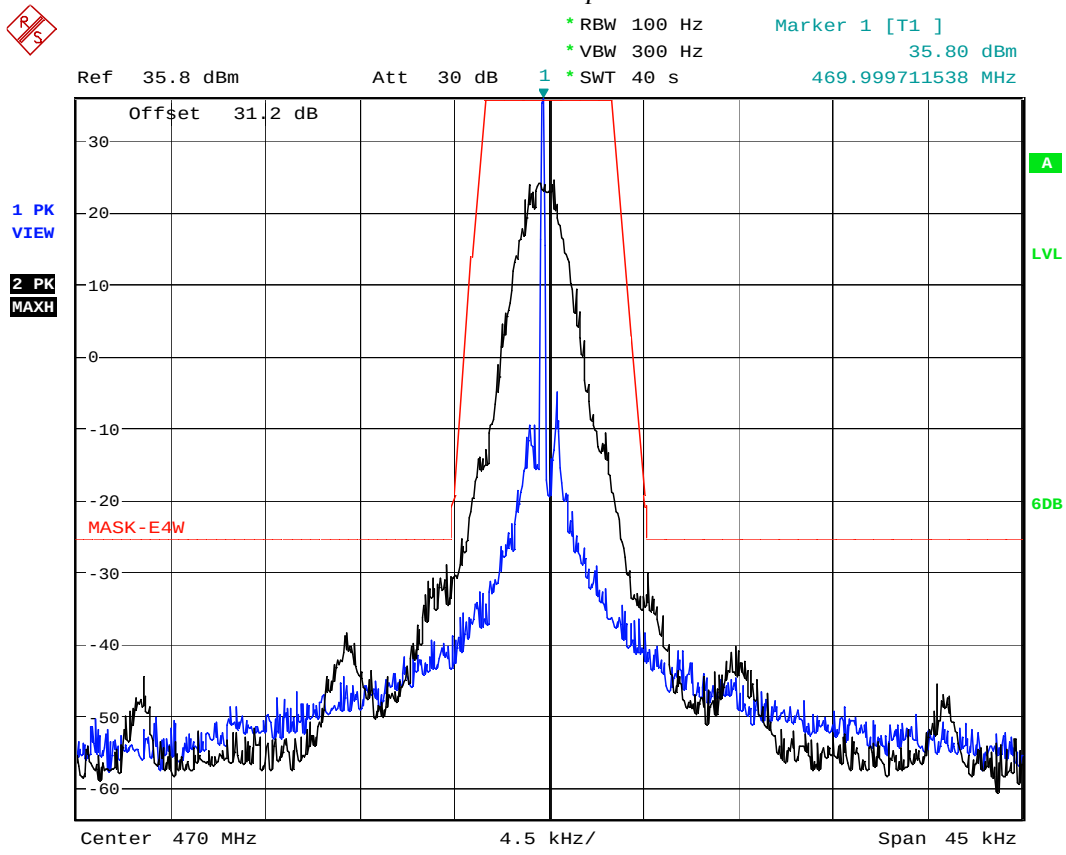
Graph 5. 29



Emission Mask, 6.25kHz ch. spacing, 16QAM

Date: 15.APR.2011 09:08:44

Graph 5. 30



Emission Mask, 6.25kHz ch. spacing, GMSK

Date: 15.APR.2011 09:10:17

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 (55 + 10 log P) dB corresponds to the level of -25 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 section 1.3.2. The EUT was setup to transmit the maximum power.

For measurements at frequencies below 1 GHz, the spectrum analyzer resolution bandwidth was set to 10 kHz. For measurements at frequencies above 1 GHz, the spectrum analyzer 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.

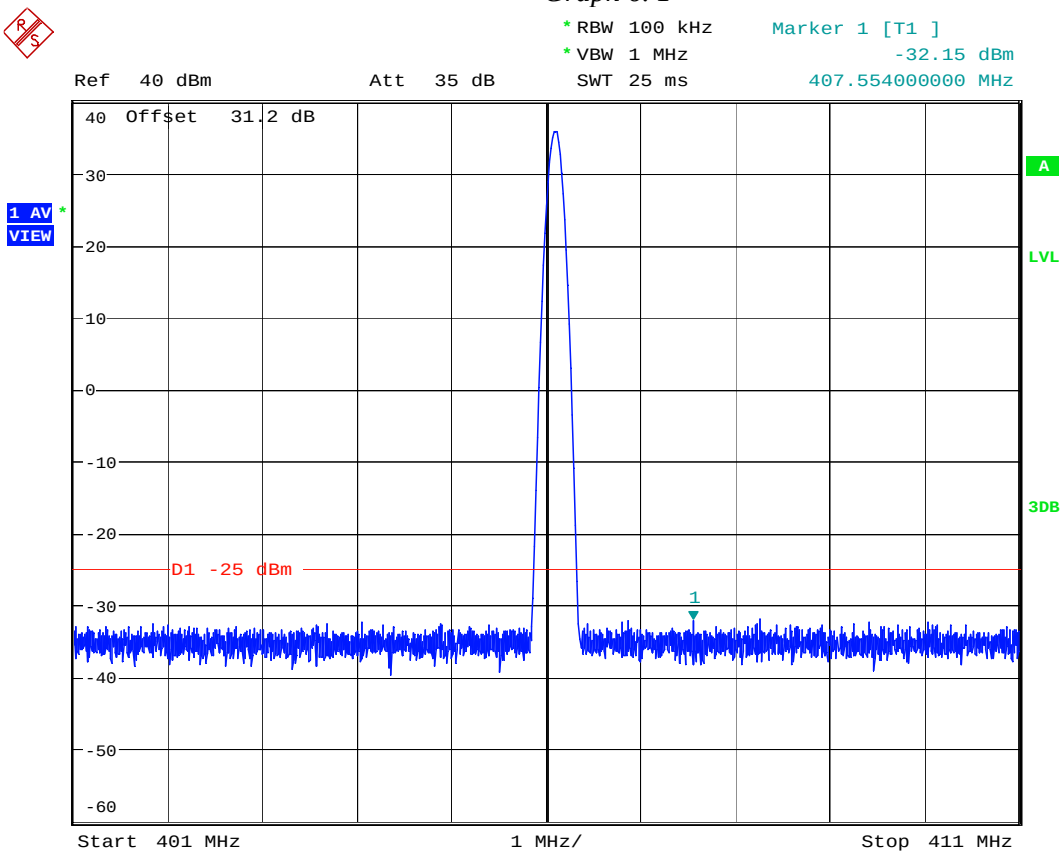
6.3 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

6.4 Test Results

Complies	Refer to the following Graphs

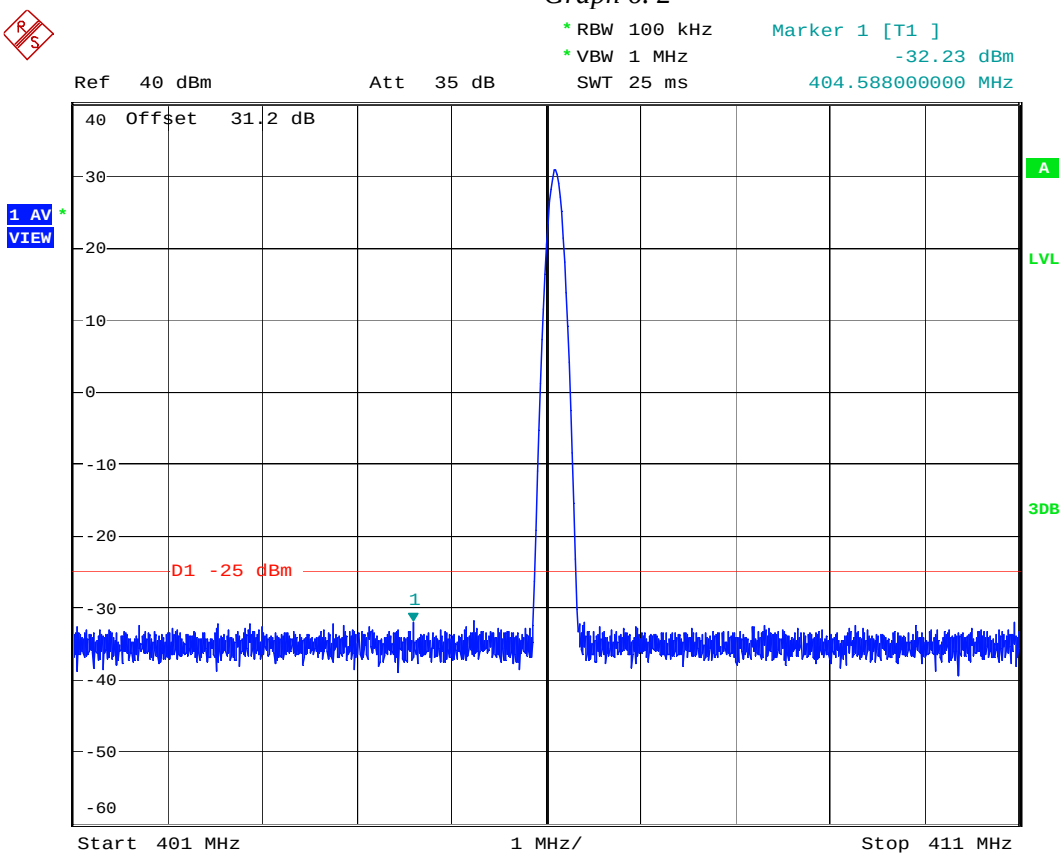
Graph 6. 1



Conducted spurious, 406.1MHz, Unmodulated

Date: 12.APR.2011 13:09:04

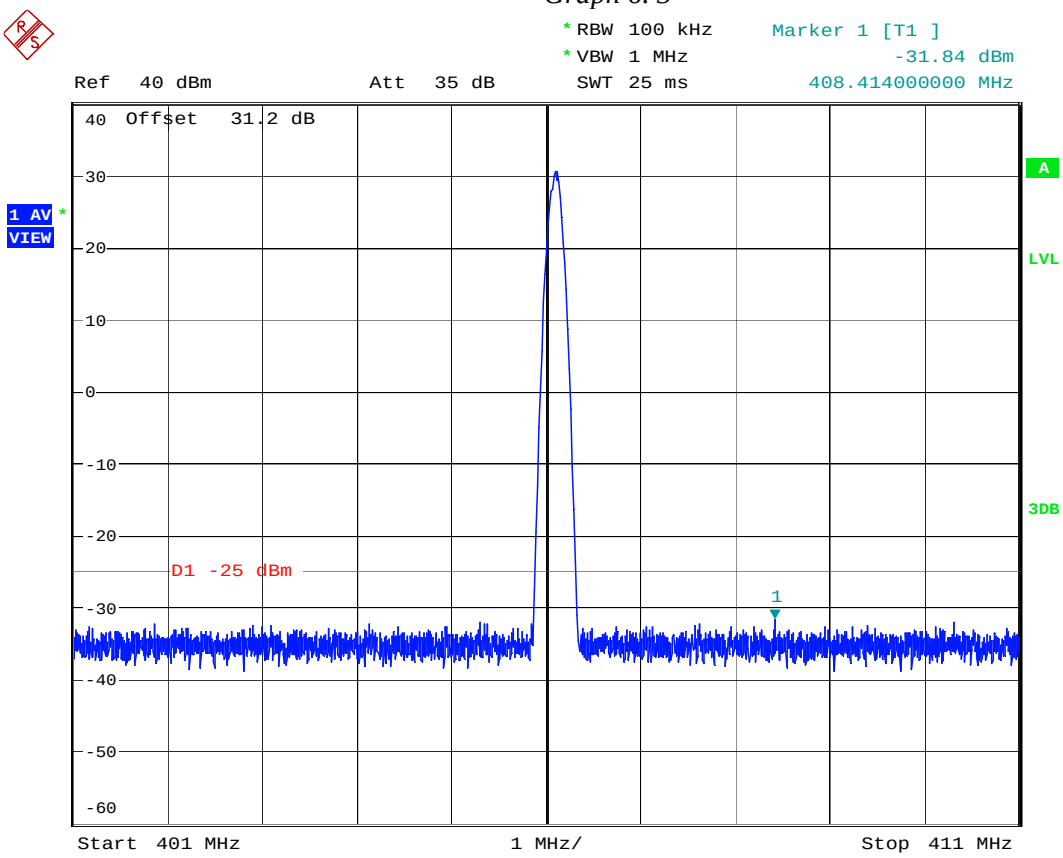
Graph 6. 2



Conducted spurious, 406.1MHz, BPSK

Date: 12.APR.2011 13:10:10

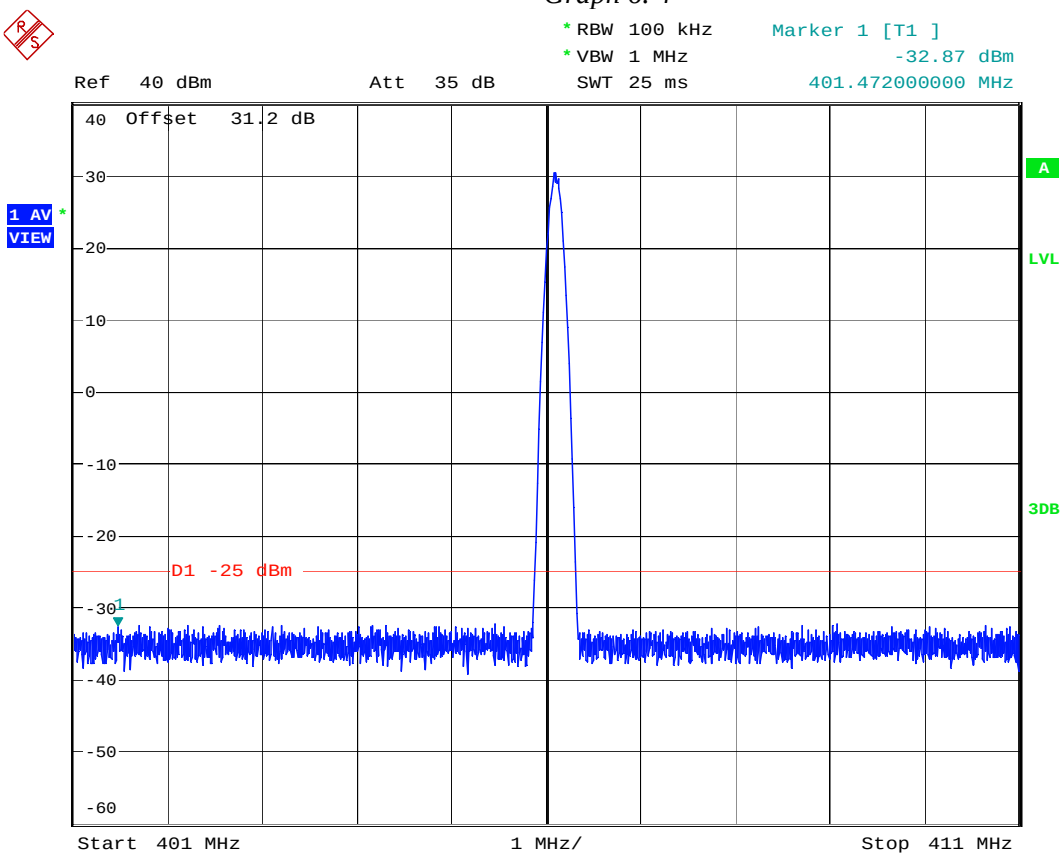
Graph 6. 3



Conducted spurious, 406.1MHz, QPSK

Date: 12.APR.2011 13:11:20

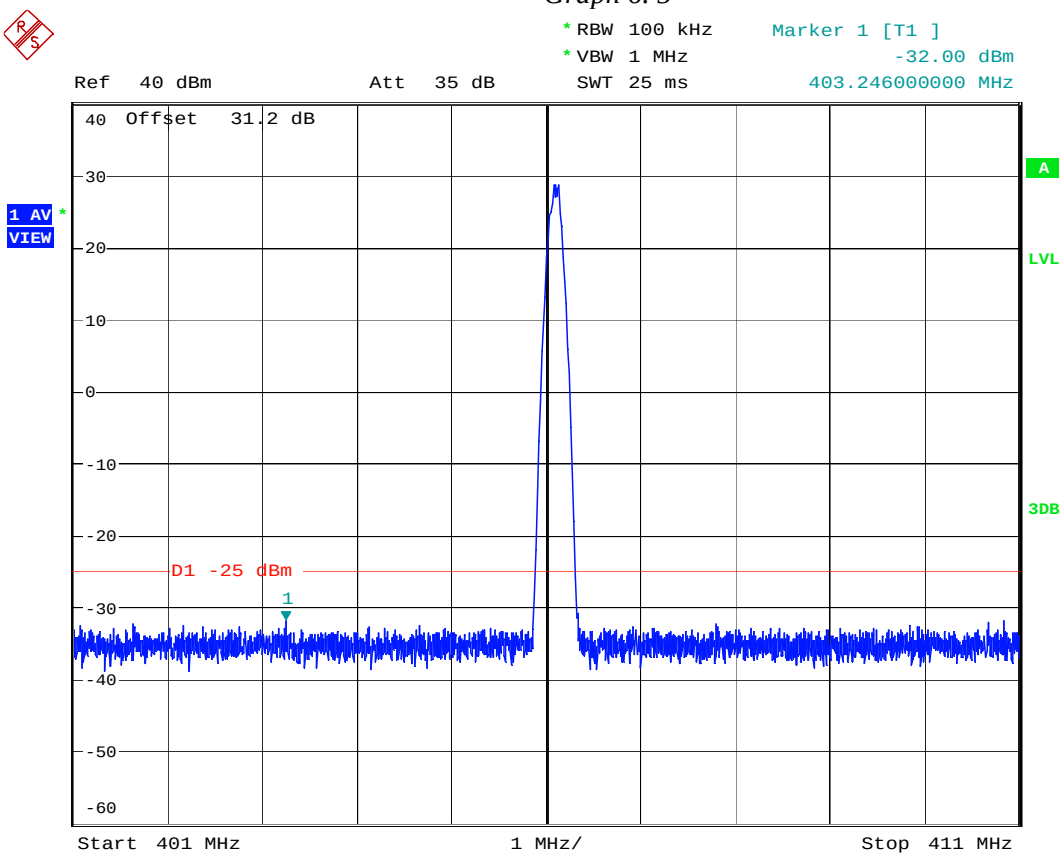
Graph 6. 4



Conducted spurious, 406.1MHz, 8PSK

Date: 12.APR.2011 13:12:46

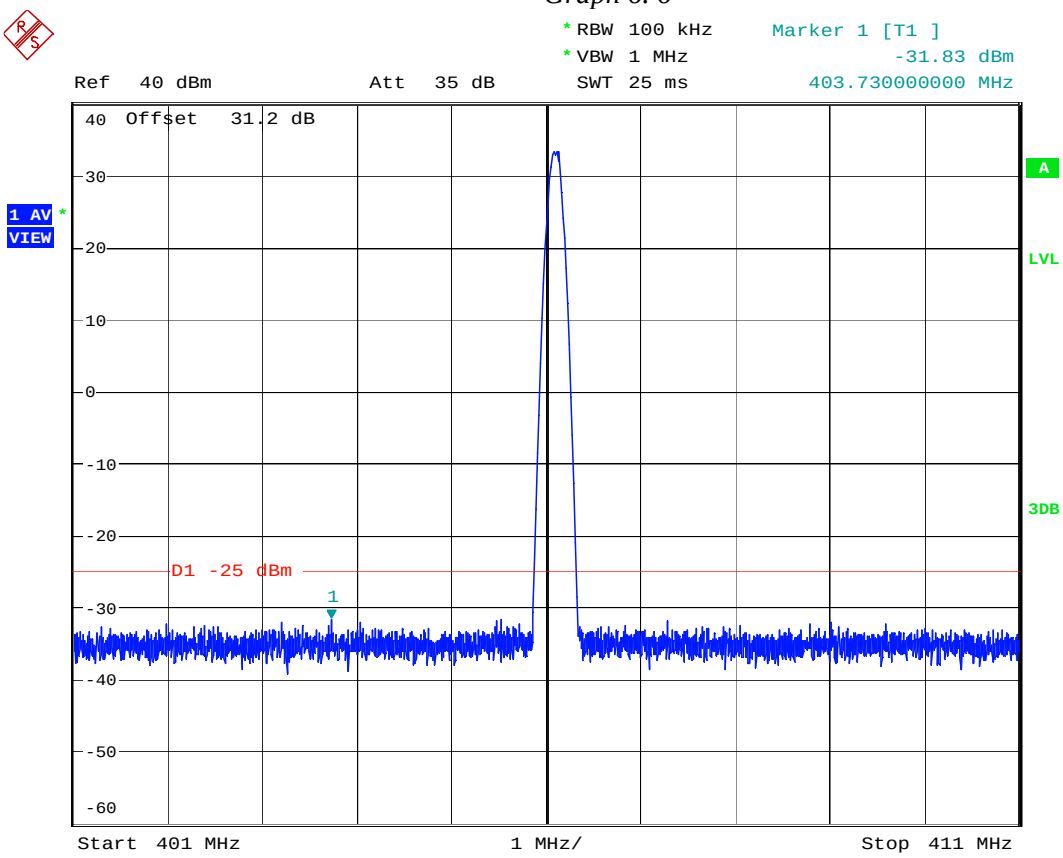
Graph 6. 5



Conducted spurious, 406.1MHz, 16QAM

Date: 12.APR.2011 13:13:37

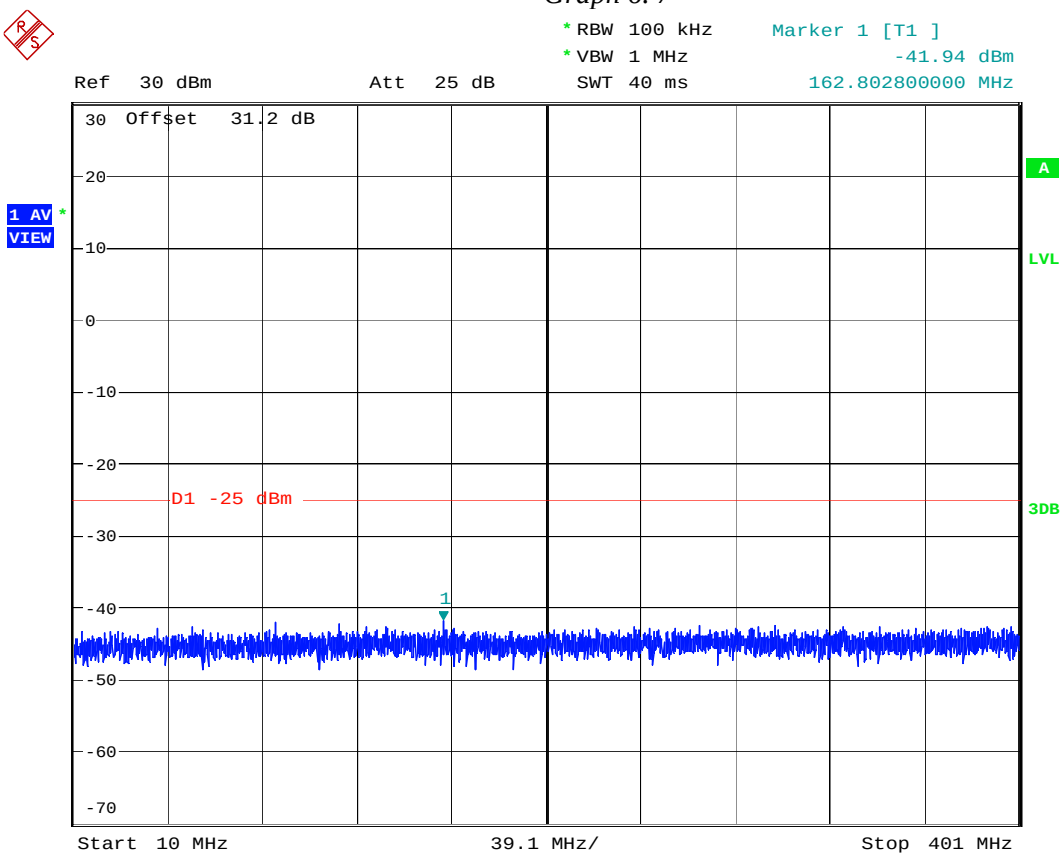
Graph 6. 6



Conducted spurious, 406.1MHz, GMSK

Date: 12.APR.2011 13:14:30

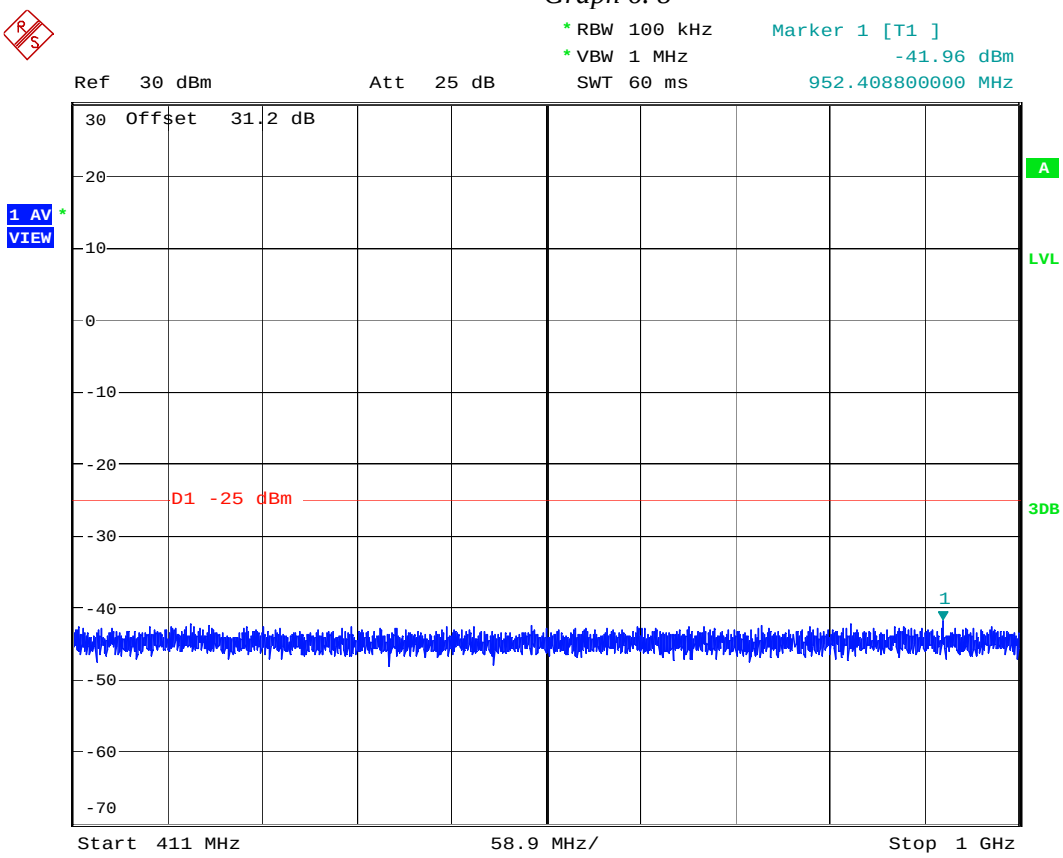
Graph 6. 7



Conducted spurious, 406.1MHz, GMSK

Date: 12.APR.2011 13:20:40

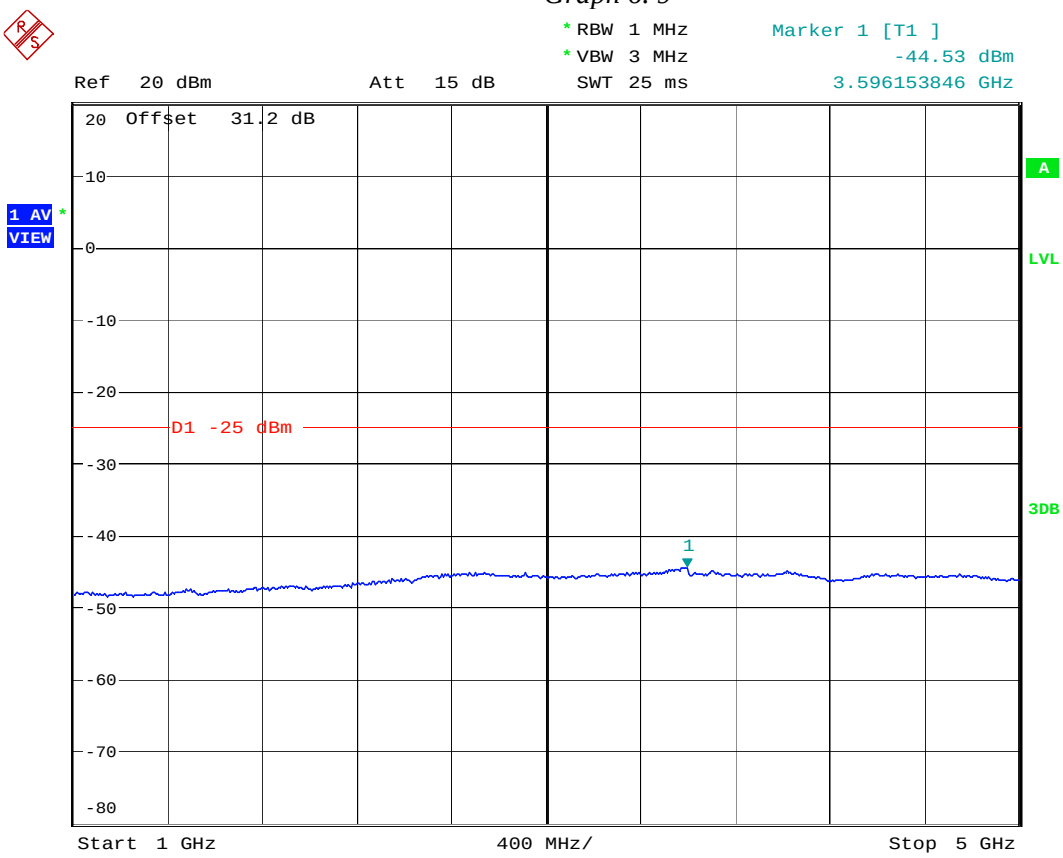
Graph 6. 8



Conducted spurious, 406.1MHz, GMSK

Date: 12.APR.2011 13:21:25

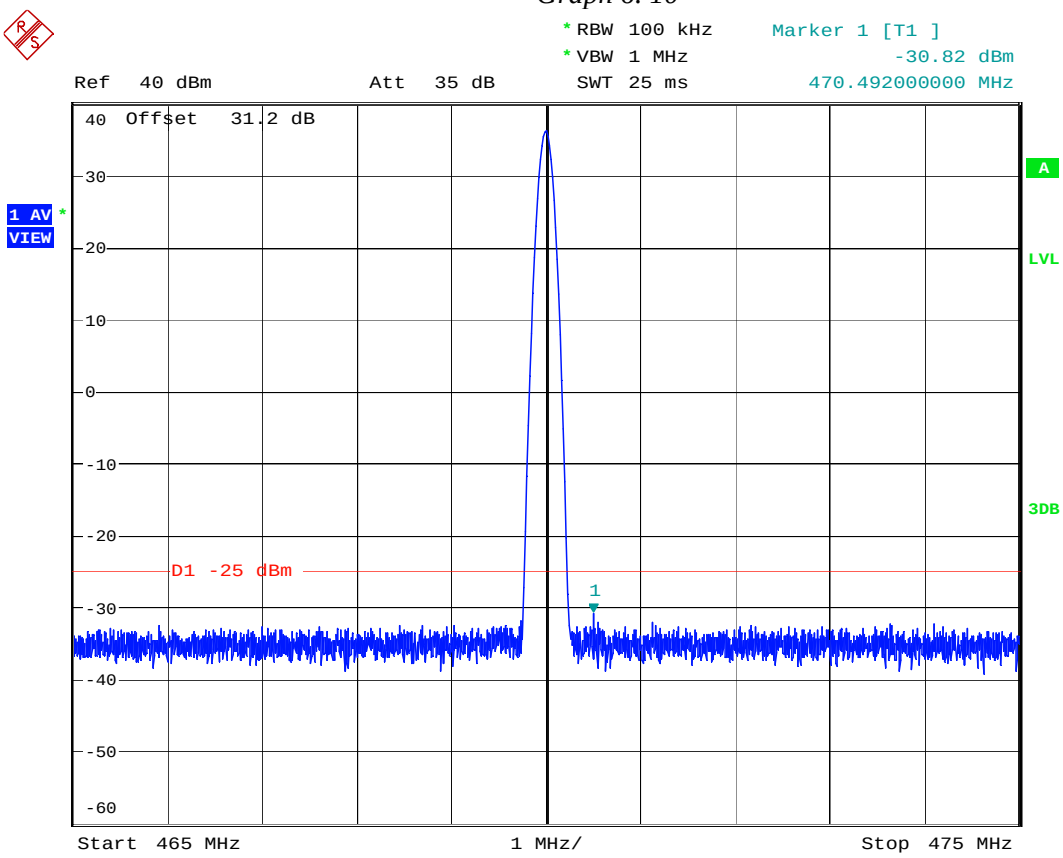
Graph 6. 9



Conducted spurious, 406.1MHz, GMSK

Date: 14.APR.2011 13:37:33

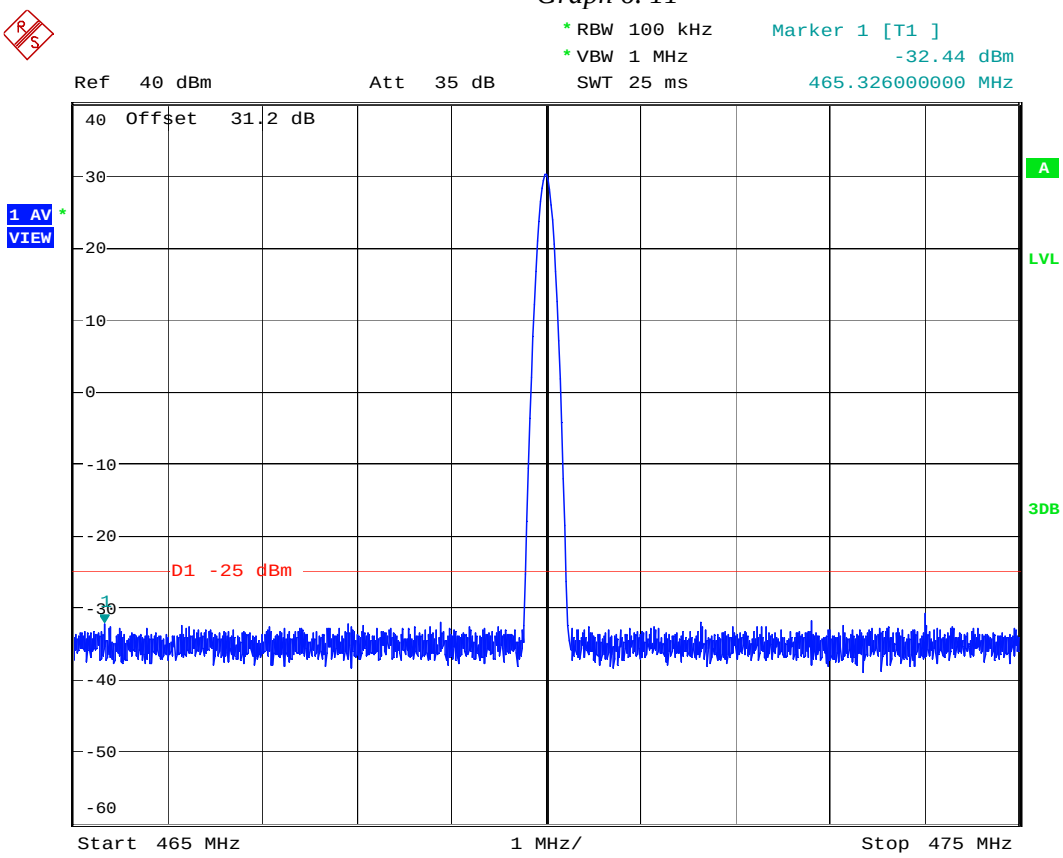
Graph 6. 10



Conducted spurious, 470MHz, Unmodulated

Date: 12.APR.2011 13:36:46

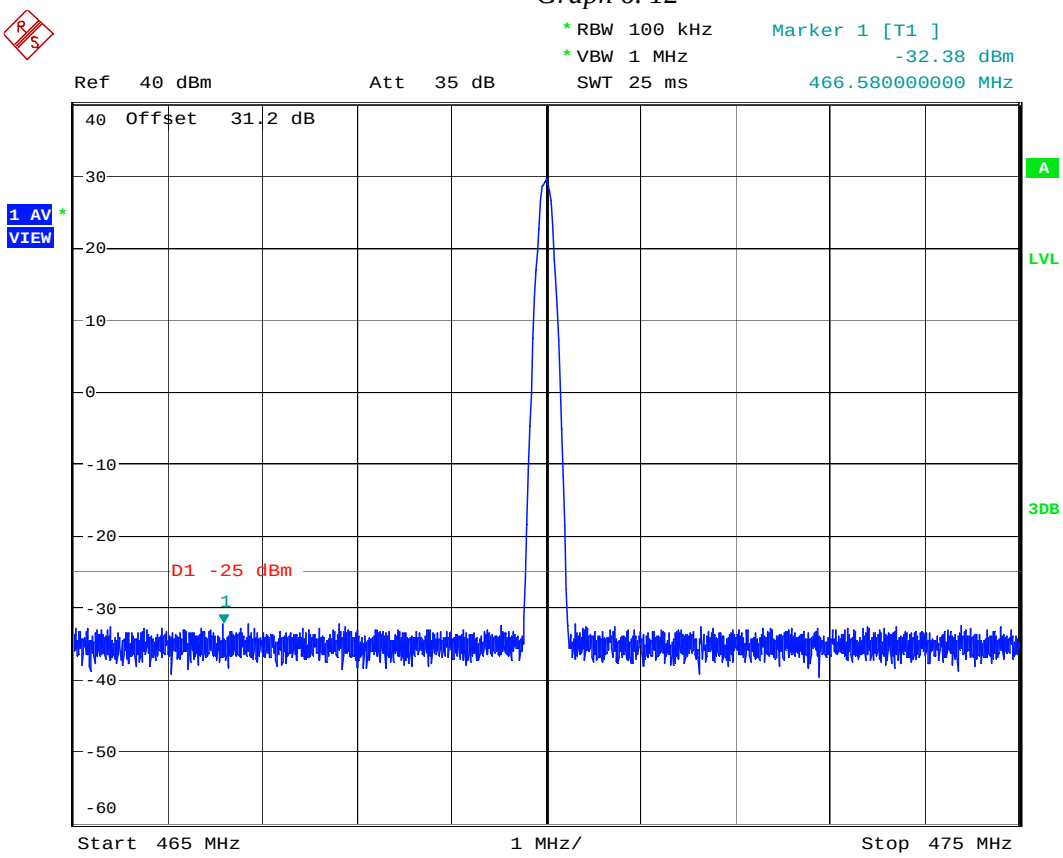
Graph 6. 11



Conducted spurious, 470MHz, BPSK

Date: 12.APR.2011 13:37:37

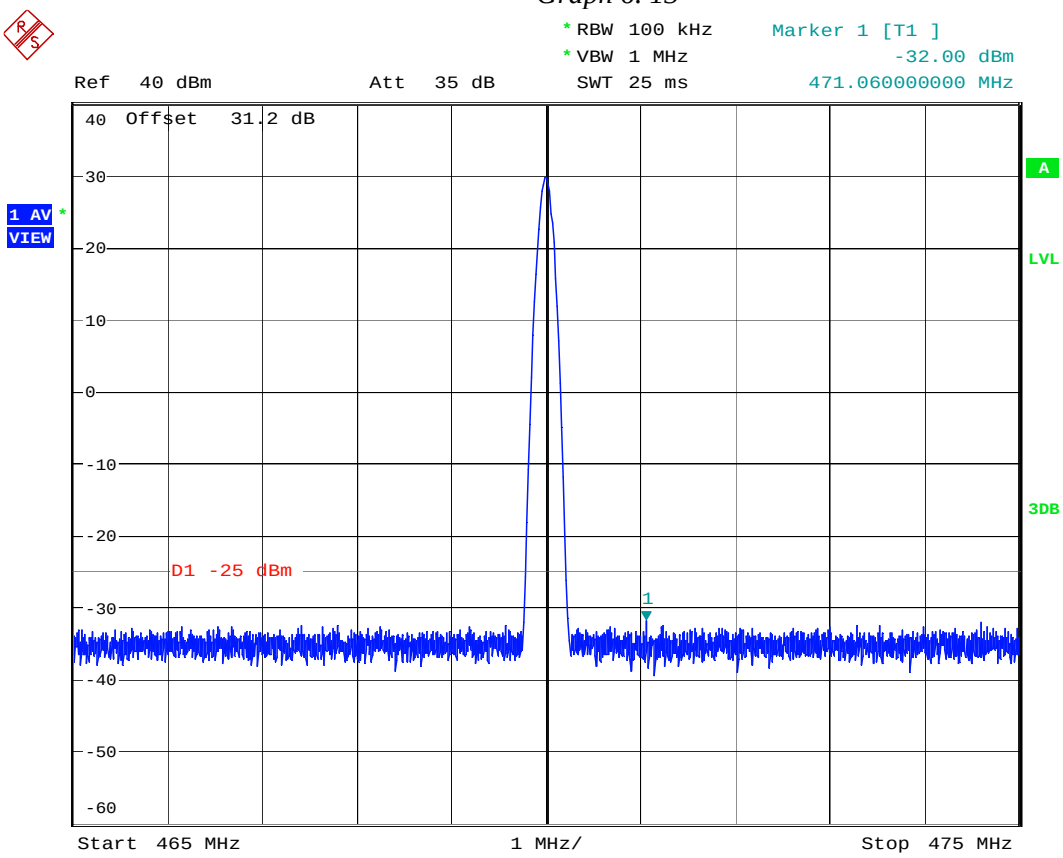
Graph 6. 12



Conducted spurious, 470MHz, QPSK

Date: 12.APR.2011 13:38:24

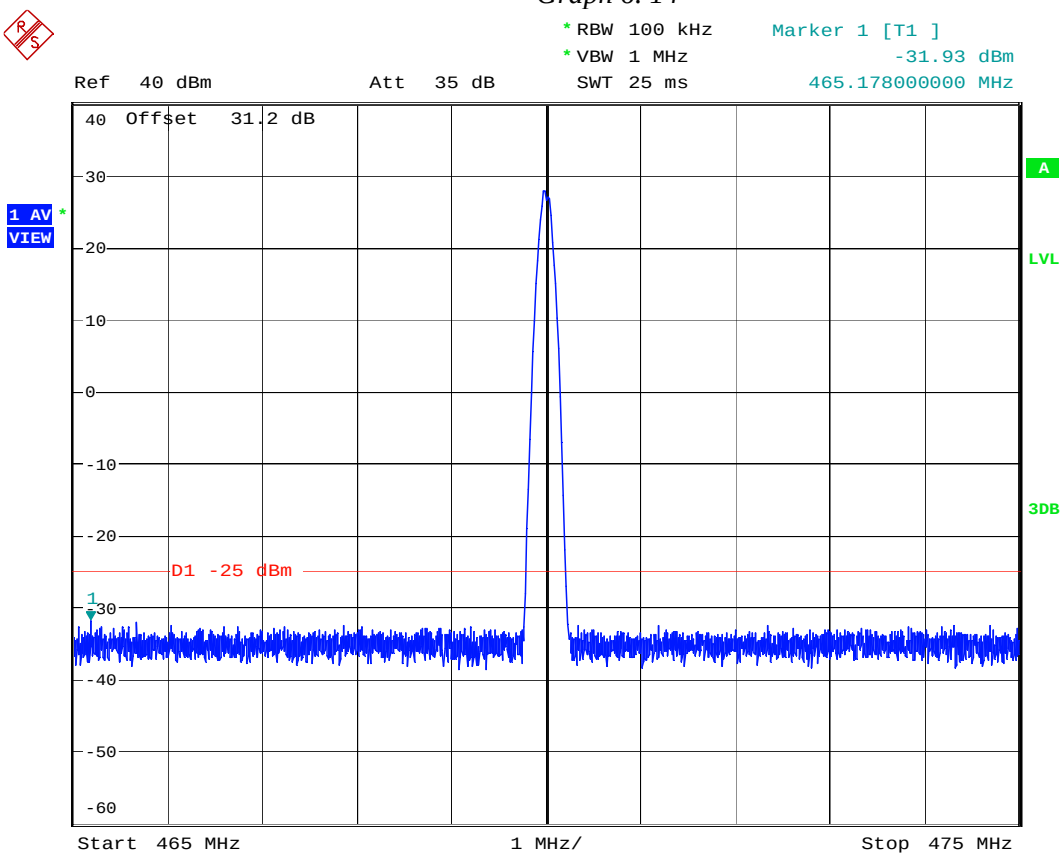
Graph 6. 13



Conducted spurious, 470MHz, 8PSK

Date: 12.APR.2011 13:39:08

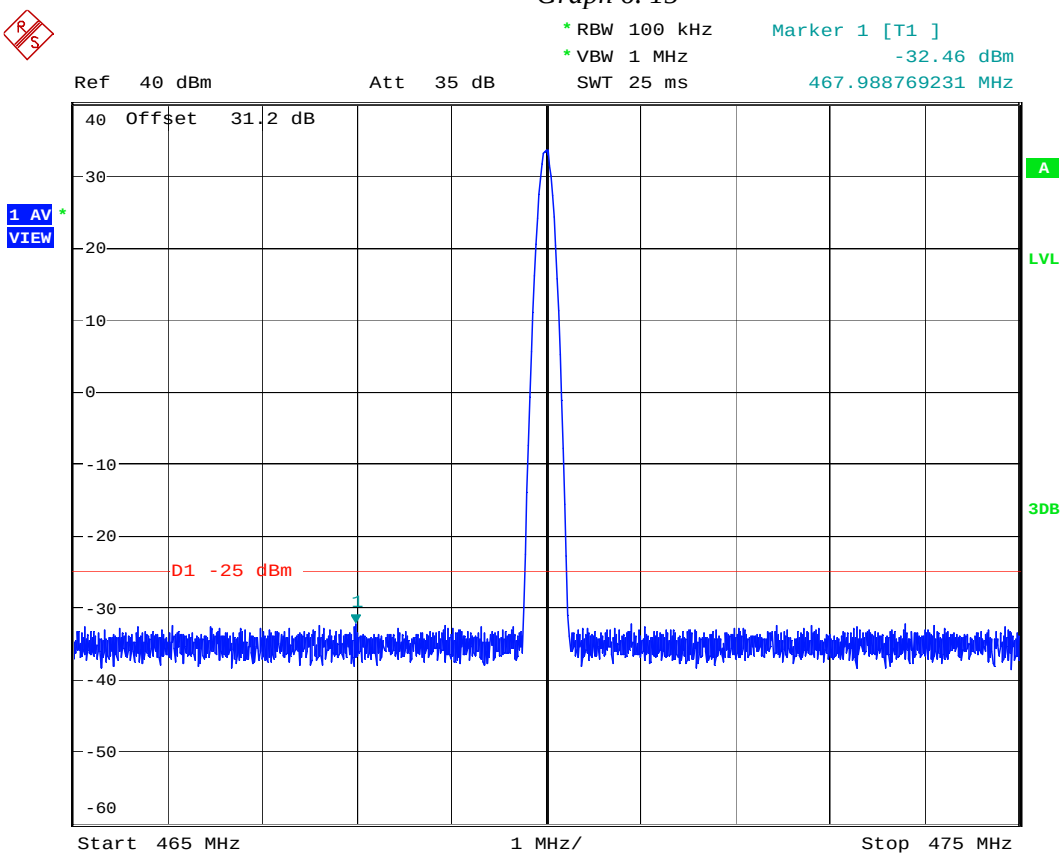
Graph 6. 14



Conducted spurious, 470MHz, 16QAM

Date: 12.APR.2011 13:39:59

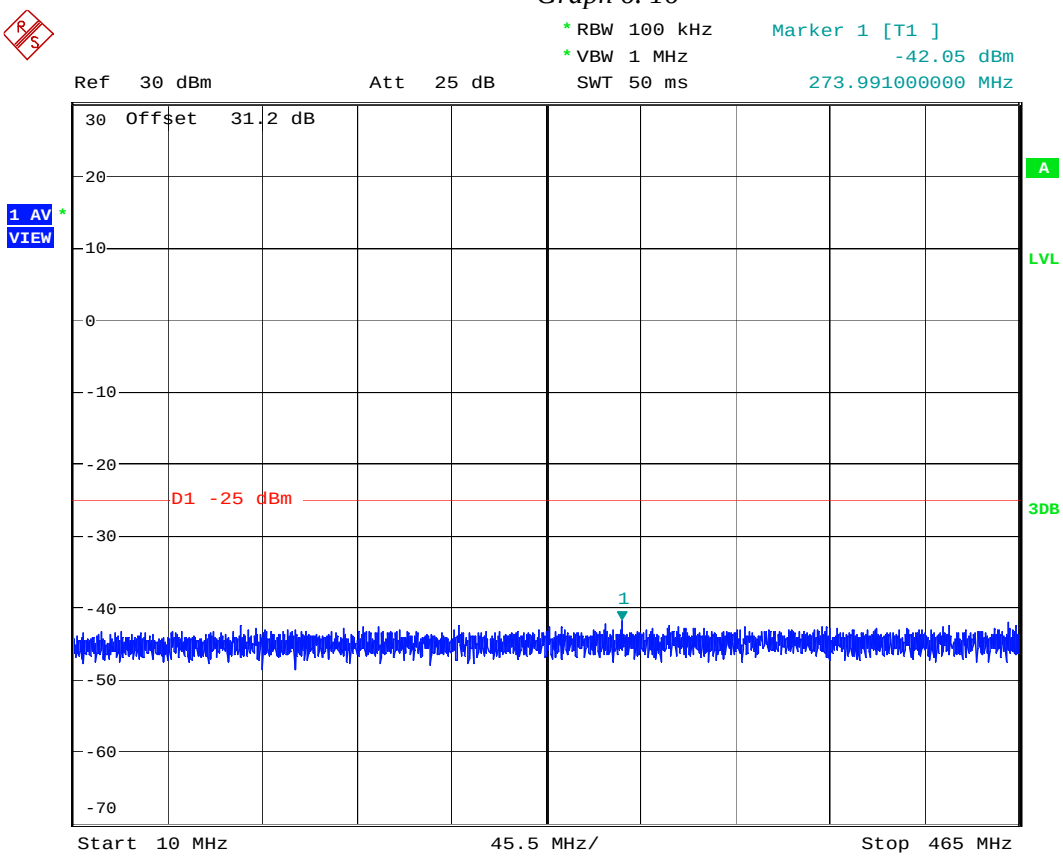
Graph 6. 15



Conducted spurious, 470MHz, GMSK

Date: 12.APR.2011 13:40:52

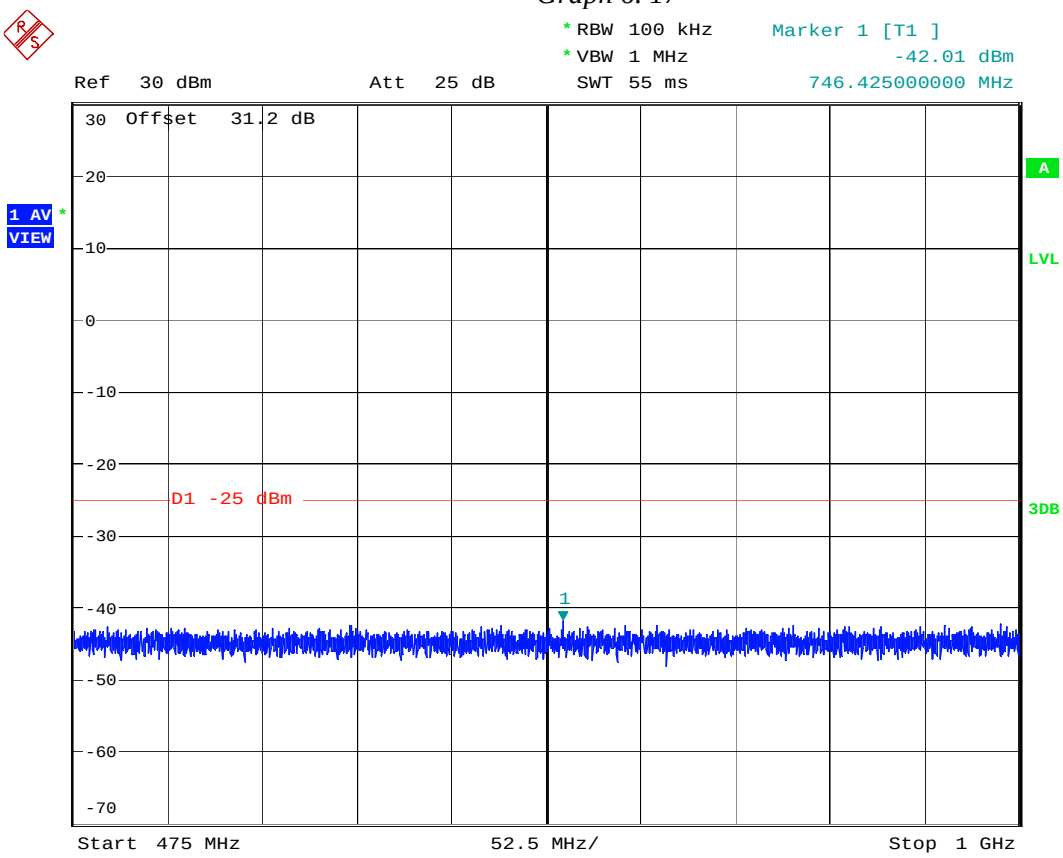
Graph 6. 16



Conducted spurious, 470MHz, GMSK

Date: 12.APR.2011 13:41:43

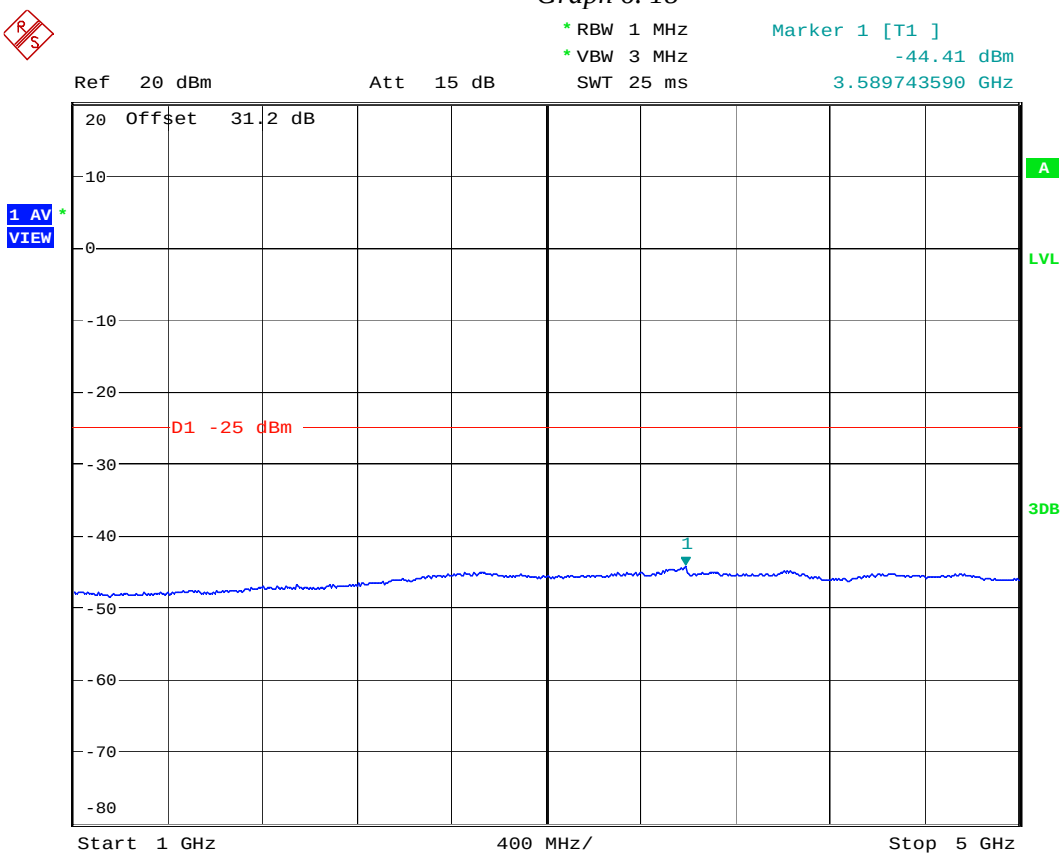
Graph 6. 17



Conducted spurious, 470MHz, GMSK

Date: 12.APR.2011 13:43:37

Graph 6. 18



Conducted spurious, 470MHz, GMSK

Date: 14.APR.2011 13:38:42

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 (55 + 10 log P) dB or 65 dB, whichever is lesser attenuation.

Note: Attenuation of (55 + 10 log P) dB corresponds to the level of -25 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	18.9	-44.0	-44.0	-25.0	-19.0
1218.3	45.8	-64.3	-59.1	-25.0	-34.1
1624.4	37.4	-74.0	-66.8	-25.0	-41.8
2030.5	42.7	-63.4	-57.6	-25.0	-32.6
2436.6	36.2	-73.1	-64.8	-25.0	-39.8
2842.7	36.5	-71.9	-63.4	-25.0	-38.4
3248.8	37.0	-69.1	-60.8	-25.0	-35.8
3654.9	36.8	-66.9	-58.5	-25.0	-33.5
4061.0	41.1	-61.5	-53.3	-25.0	-28.3
Tx 430.0 MHz					
860.0	12.5	-49.4	-49.4	-25.0	-24.4
1290.0	43.1	-66.4	-61.4	-25.0	-36.4
1720.0	35.8	-75.1	-67.7	-25.0	-42.7
2150.0	38.5	-68.3	-61.9	-25.0	-36.9
2580.0	36.3	-71.9	-63.8	-25.0	-38.8
3010.0	37.6	-69.3	-61.1	-25.0	-36.1
3440.0	37.1	-67.9	-59.7	-25.0	-34.7
3870.0	36.1	-66.7	-58.5	-25.0	-33.5
4300.0	36.4	-66.9	-57.9	-25.0	-32.9

* 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	14.3	-47.5	-47.5	-25.0	-22.5
1350.0	40.4	-69.2	-63.9	-25.0	-38.9
1800.0	36.6	-74.6	-66.9	-25.0	-41.9
2250.0	38.7	-69.8	-62.3	-25.0	-37.3
2700.0	36.4	-71.4	-63.3	-25.0	-38.3
3150.0	37.0	-69.8	-61.4	-25.0	-36.4
3600.0	37.4	-67.5	-59.0	-25.0	-34.0
4050.0	37.1	-65.5	-57.3	-25.0	-32.3
4500.0	36.0	-66.5	-57.3	-25.0	-32.3
Tx 470.0 MHz					
940.0	16.0	-45.5	-45.5	-25.0	-20.5
1410.0	42.2	-66.3	-60.8	-25.0	-35.8
1880.0	37.1	-73.0	-65.7	-25.0	-40.7
2350.0	36.6	-72.7	-64.7	-25.0	-39.7
2820.0	37.0	-71.2	-62.7	-25.0	-37.7
3290.0	37.9	-68.1	-59.8	-25.0	-34.8
3760.0	37.0	-66.5	-58.3	-25.0	-33.3
4230.0	37.2	-66.2	-57.5	-25.0	-32.5
4700.0	36.9	-64.4	-55.5	-25.0	-30.5

* 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

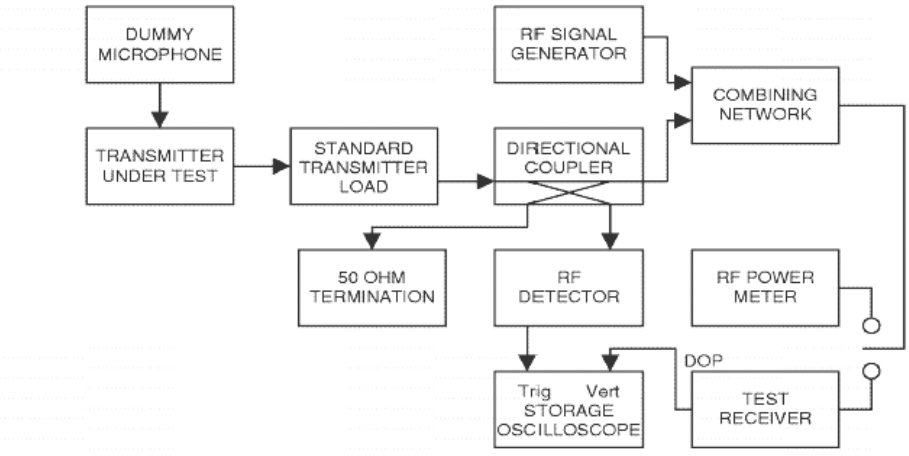
Time Interval	Maximum Frequency Difference	Time
Transient Frequency Behavior for equipment designed to operate on 25 kHz channels		
t1 *	±25 kHz	10 ms
t2	±12.5 kHz	25 ms
t3 *	±25 kHz	10 ms
Transient Frequency Behavior for equipment designed to operate on 12.5 kHz channels		
t1 *	±12.5 kHz	10 ms
t2	±6.25 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.

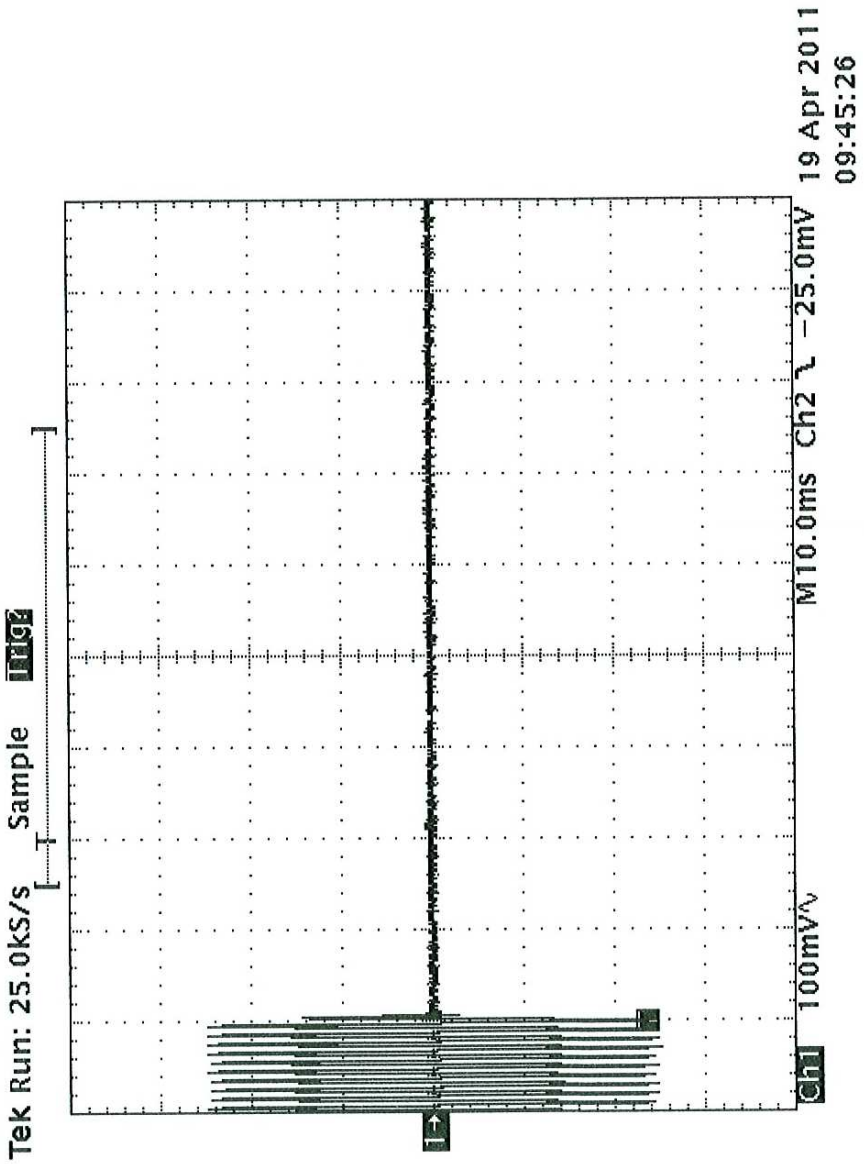


8.3 Test Results

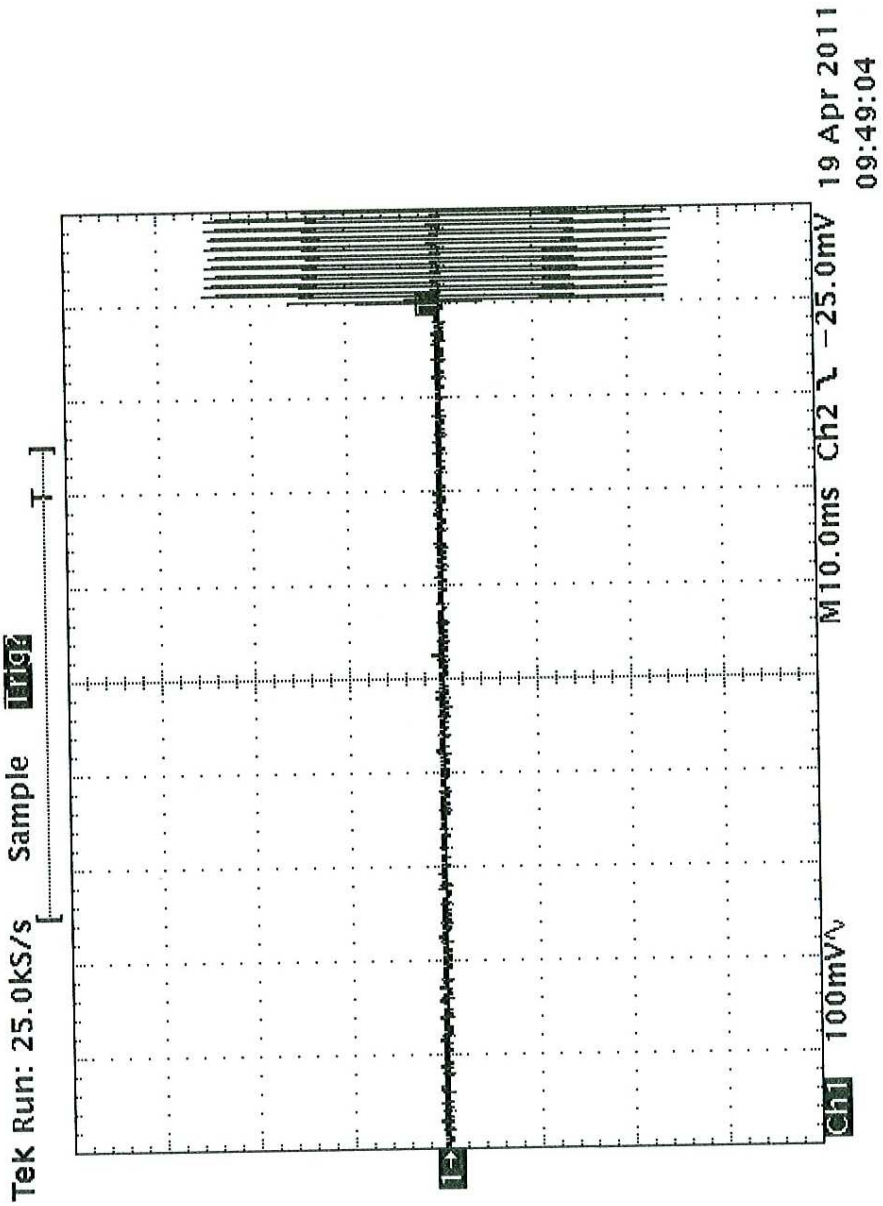
For more details refer to the attached Graphs

Result	Complies

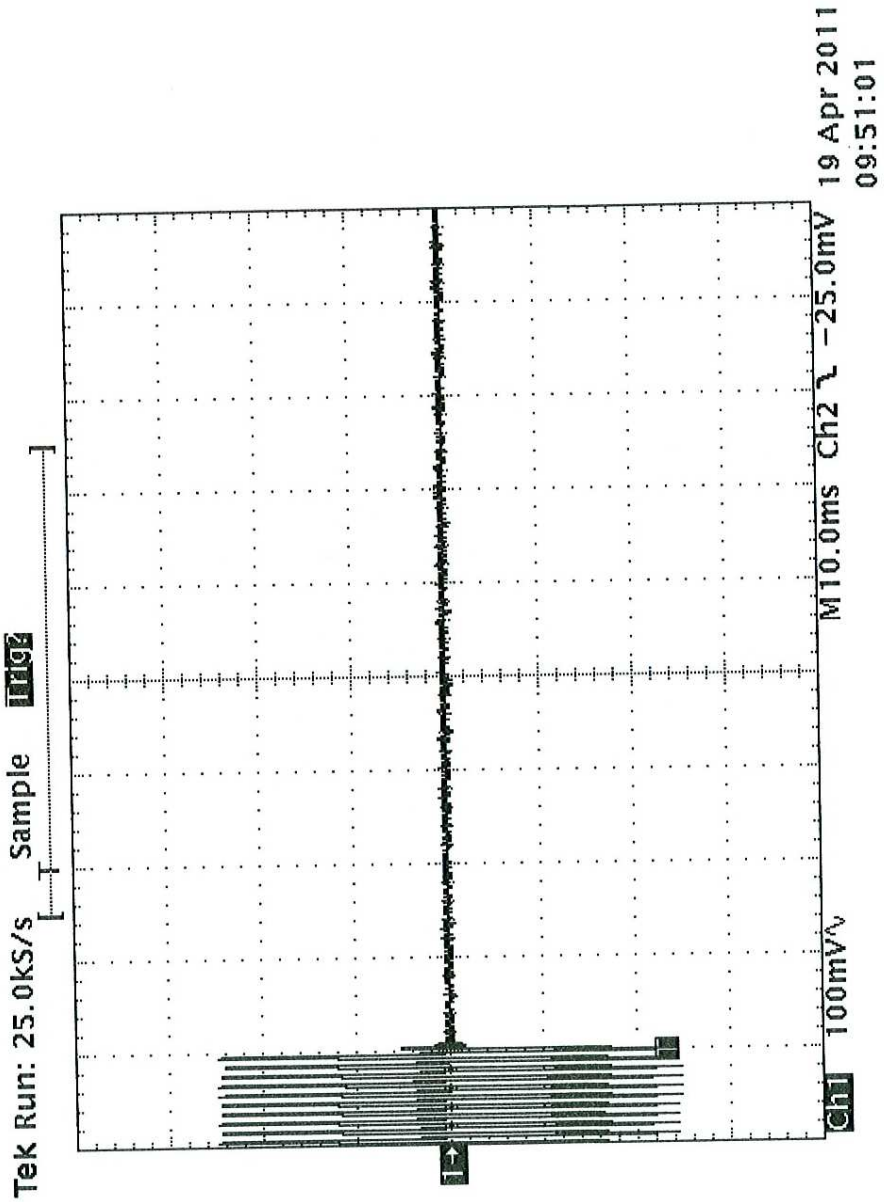
406.1 MHz, 25 kHz spacing



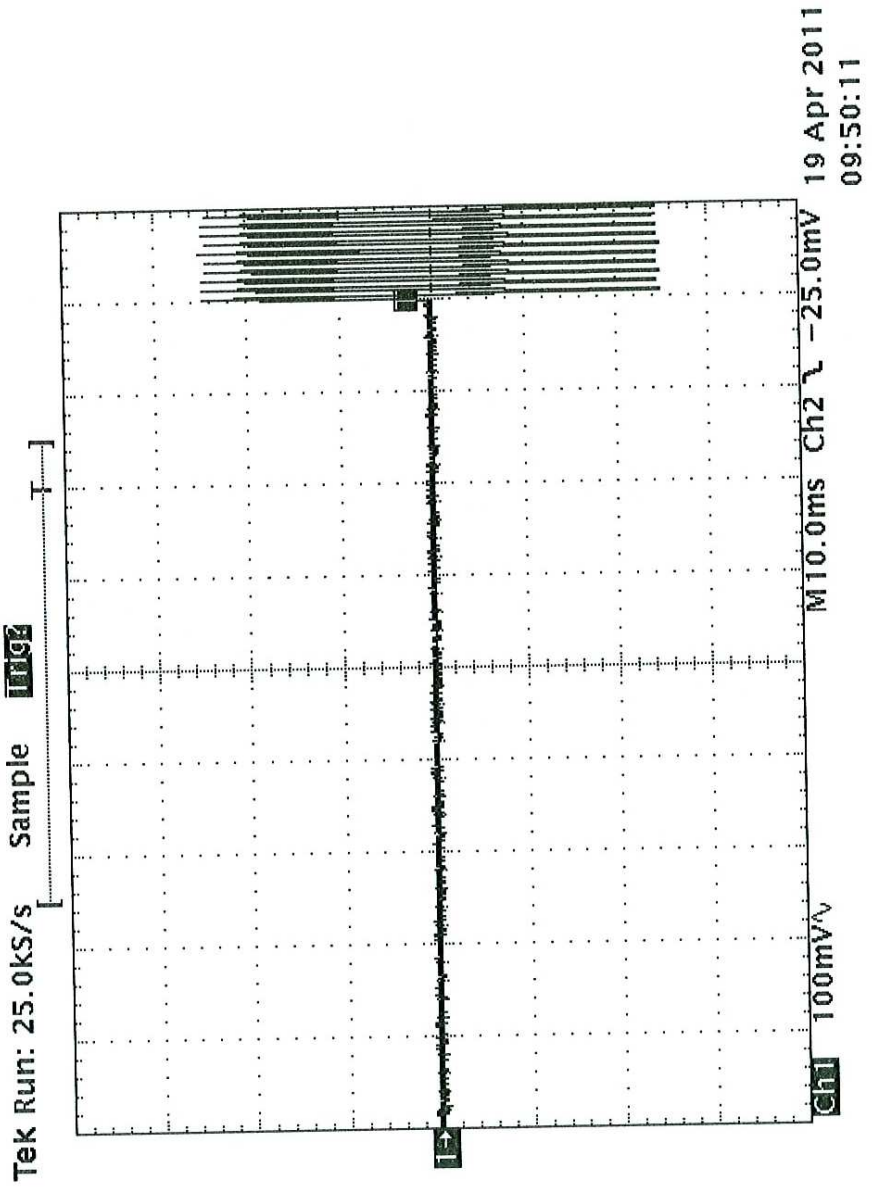
406.1 MHz, 25 kHz spacing



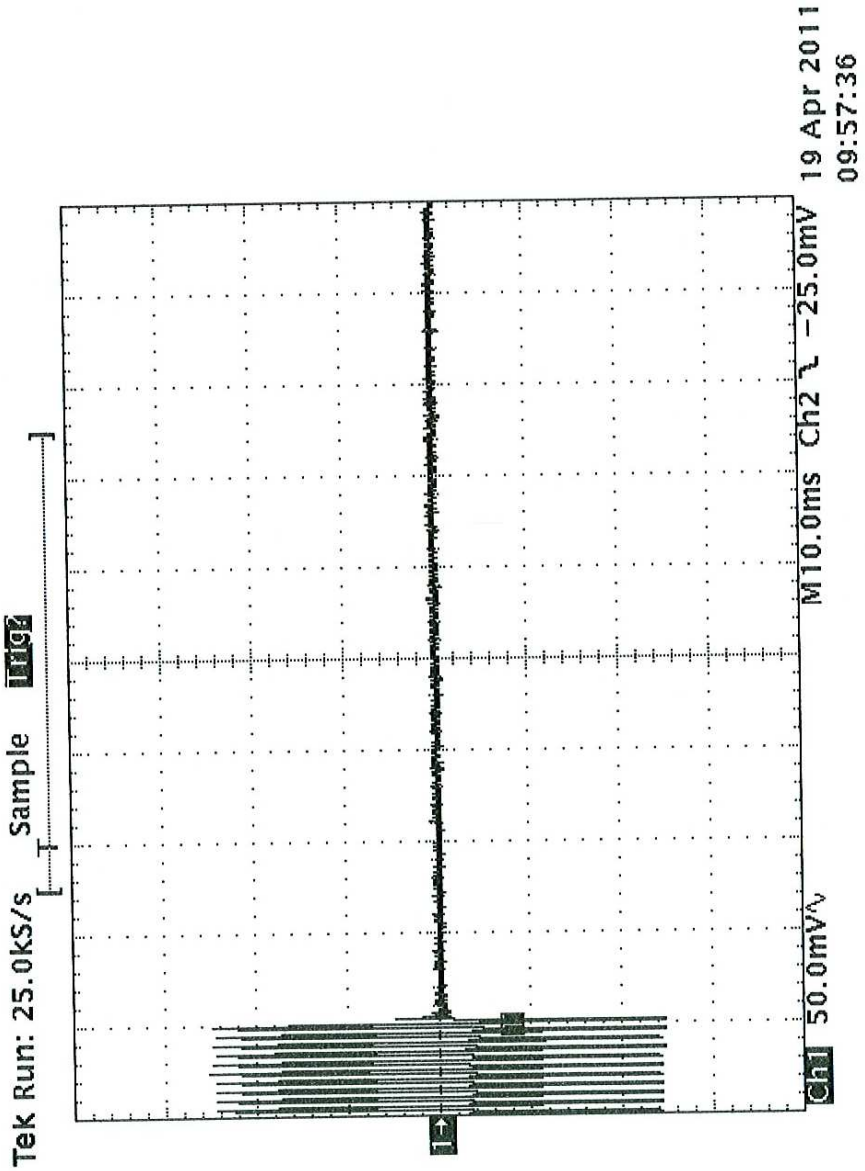
470MHz, 25 kHz spacing



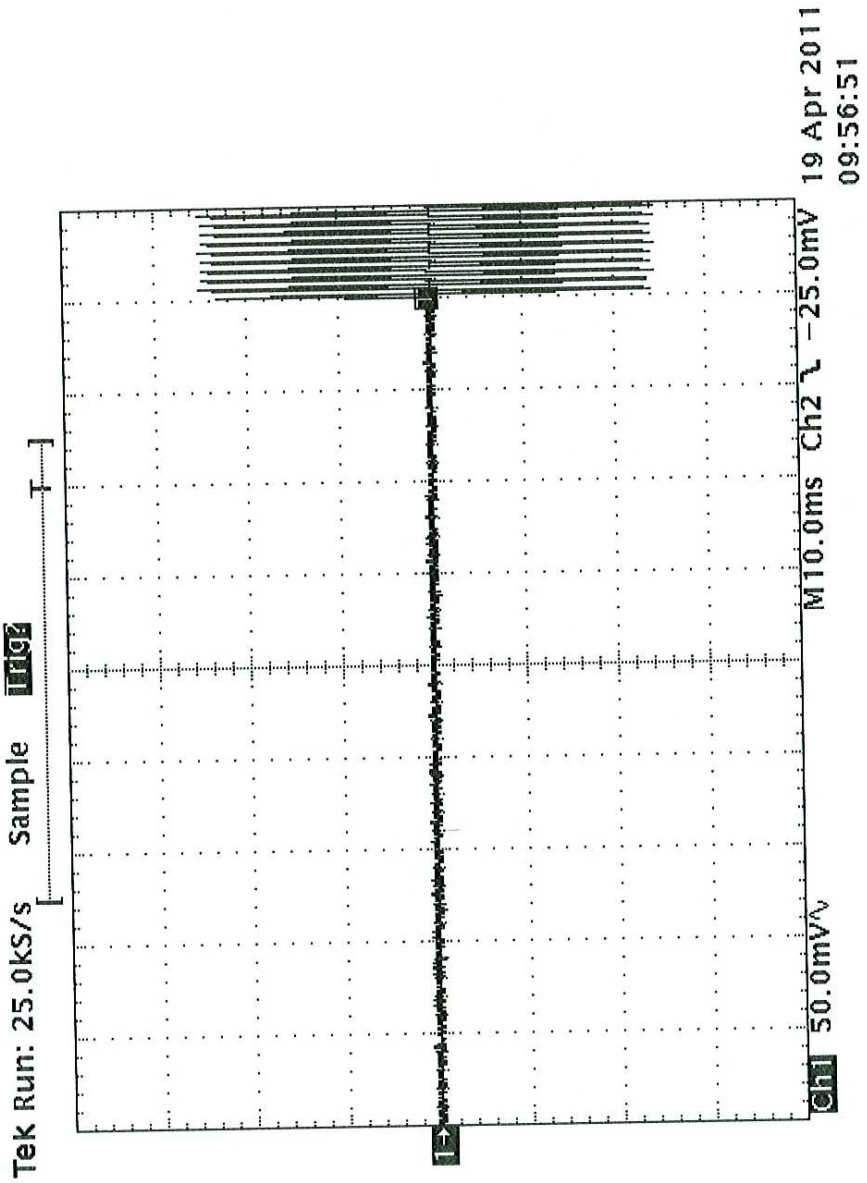
470MHz, 25 kHz spacing



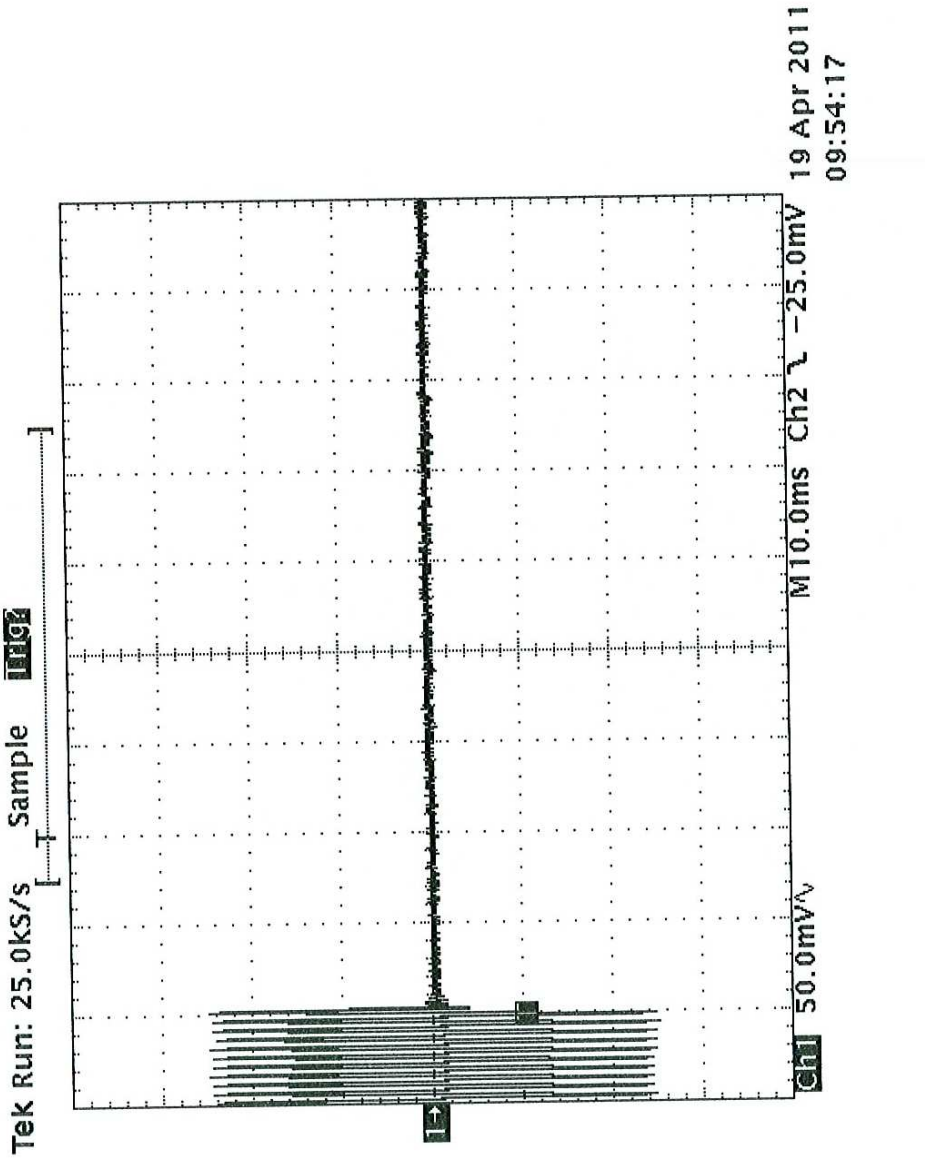
406.1 MHz, 12.5 kHz spacing



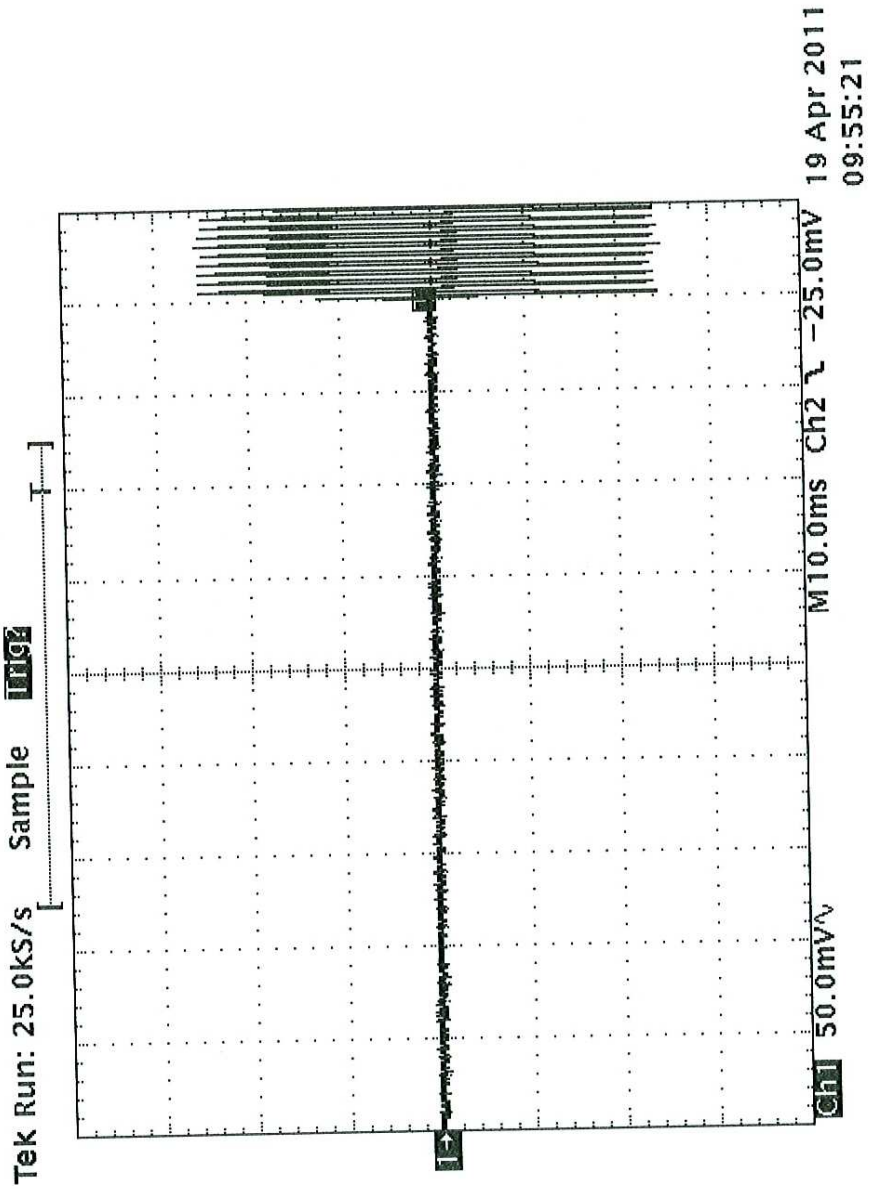
406.1 MHz, 12.5 kHz spacing



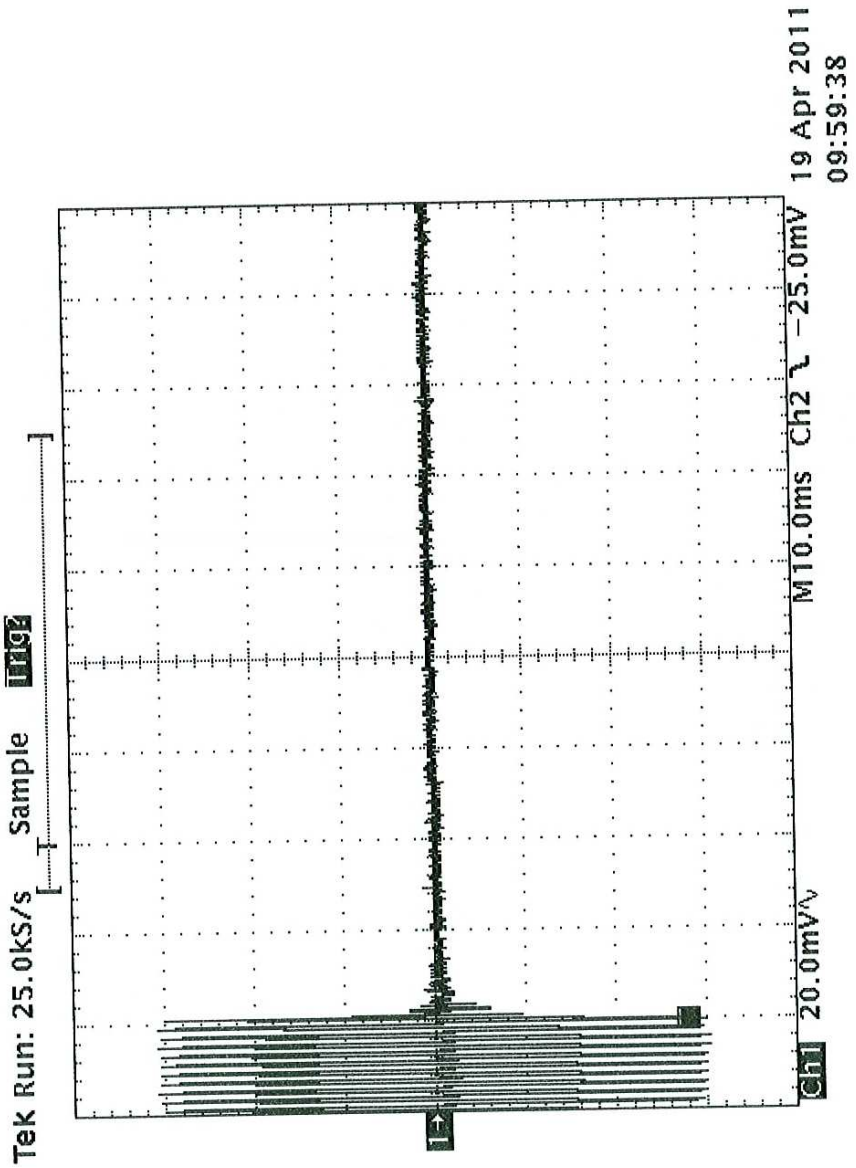
470 MHz, 12.5 kHz spacing



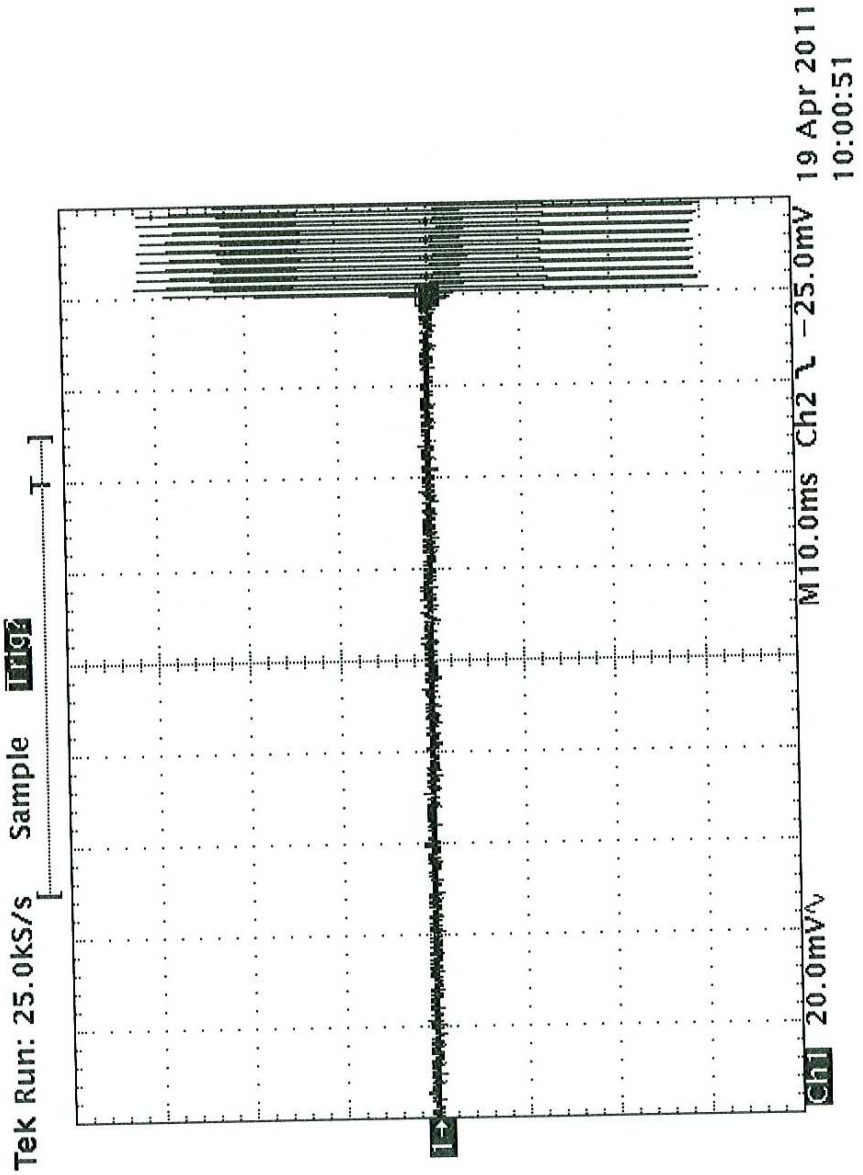
470 MHz, 12.5 kHz spacing



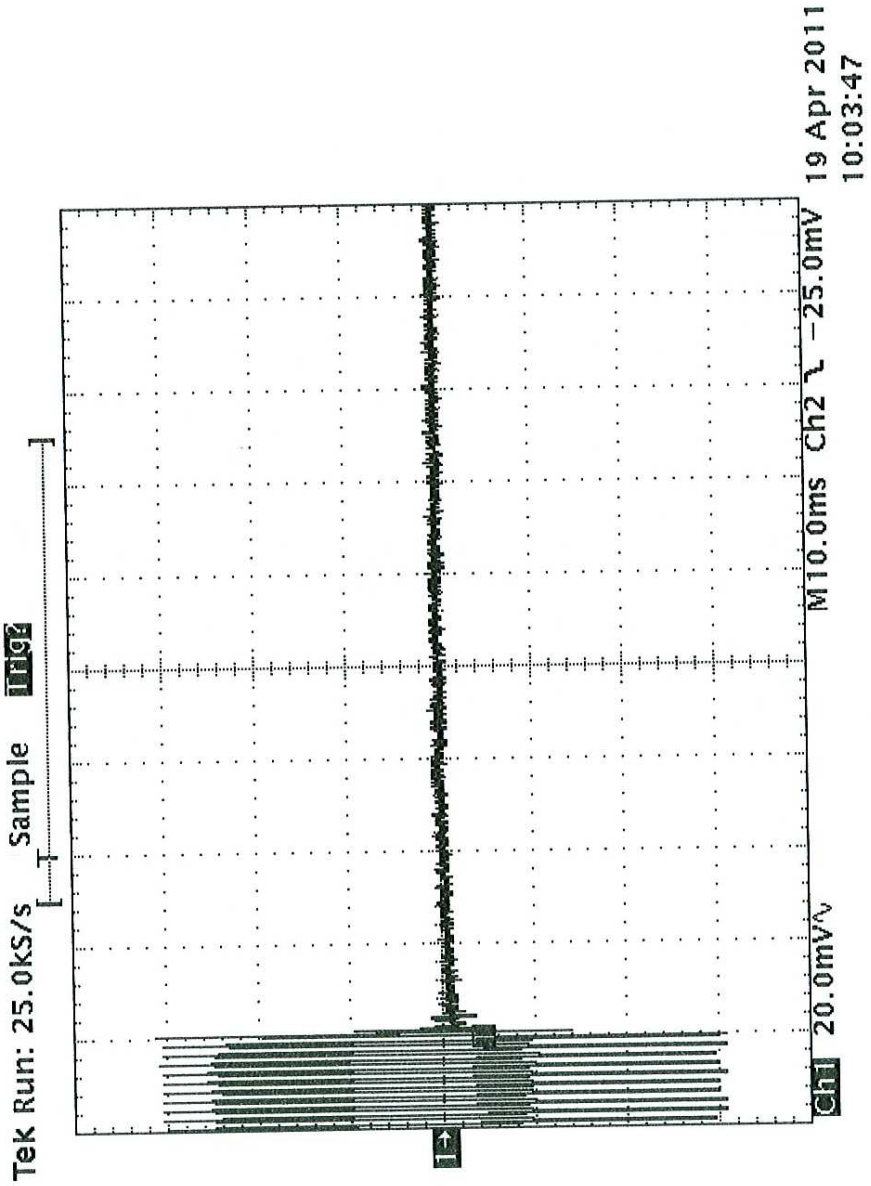
406.1 MHz, 6.25 kHz spacing



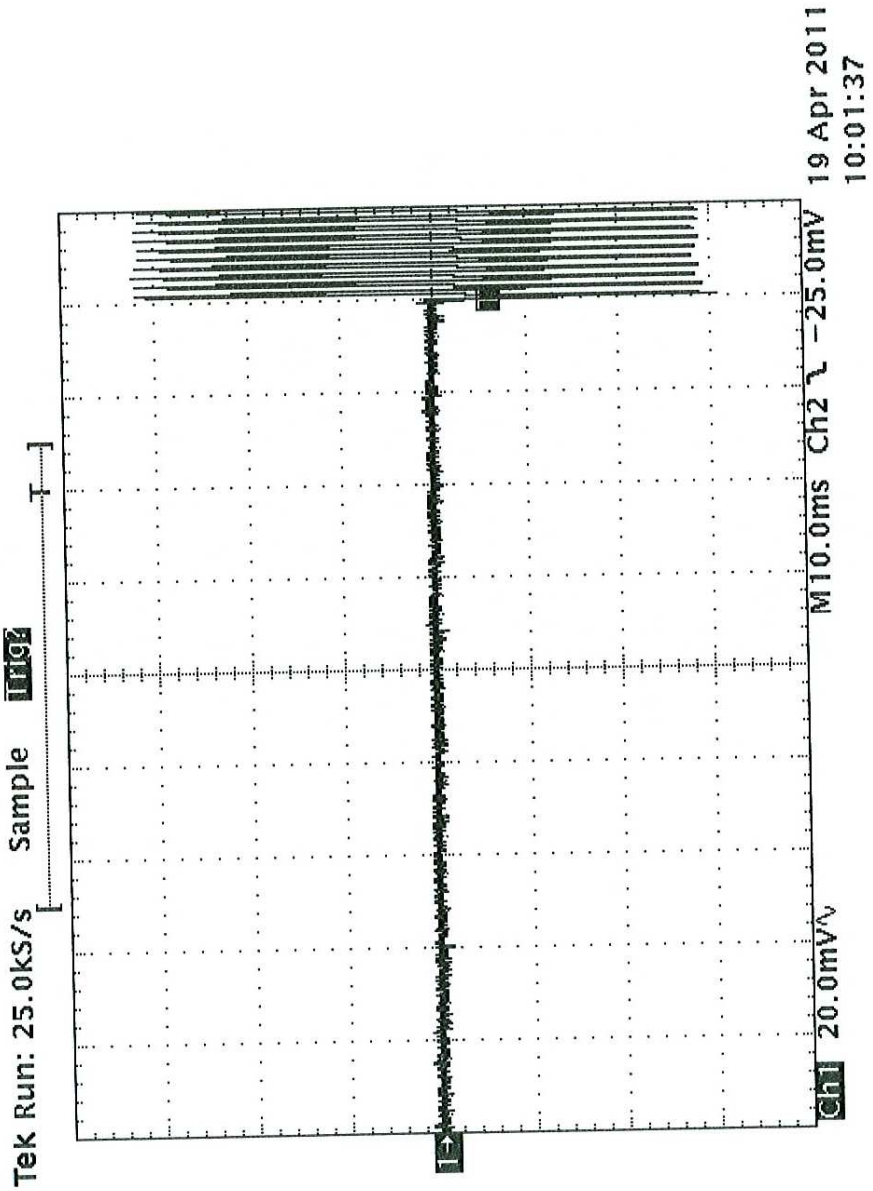
406.1 MHz, 6.25 kHz spacing



470 MHz, 6.25 kHz spacing



470 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: 406.1 MHz

Temperature (°C)	**Maximum Deviation from Frequency at 20°C** Hz	**Maximum Deviation from Frequency at 20°C** ppm
-30	-164	0.41
-20	-114	0.28
-10	-70	0.17
0	-6	0.02
10	144	0.35
20	0	0.00
30	-34	0.08
40	-94	0.23
50	-144	0.35

Nominal Frequency: 470 MHz

Temperature (°C)	**Maximum Deviation from Frequency at 20°C** Hz	**Maximum Deviation from Frequency at 20°C** ppm
-30	-199	0.42
-20	-168	0.36
-10	-120	0.26
0	-112	0.24
10	192	0.41
20	0	0.00
30	-10	0.02
40	-128	0.27
50	-97	0.21

Nominal Frequency: 406.1 MHz

DC Voltage V	Maximum Deviation from Nominal Hz	Maximum Deviation from Nominal ppm
9.0	164	0.40
12.0	166	0.41
24.0	167	0.41
36.0	169	0.42

Nominal Frequency: 470 MHz

DC Voltage V	Maximum Deviation from Nominal Hz	Maximum Deviation from Nominal, ppm
9.0	194	0.41
12.0	192	0.41
24.0	195	0.42
36.0	197	0.42

Result	Complies

10.0 RF Exposure Evaluation

FCC 2.1091

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

The maximum calculated EIRP is 38.58 dBm (or 7.21 W), and ERP is 36.48dBm (or 4.45 W).

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 50%, refer to the document, "HPT404BT UHF OEM Module Duty Cycle evaluation".
Therefore, the average EIRP is 3.61 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 $D \geq 0.33$ m.

A statement that a minimum separation distance of 100 cm between the antenna and persons is included in the User's Manual.

11.0 Emissions from Digital Parts 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 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:

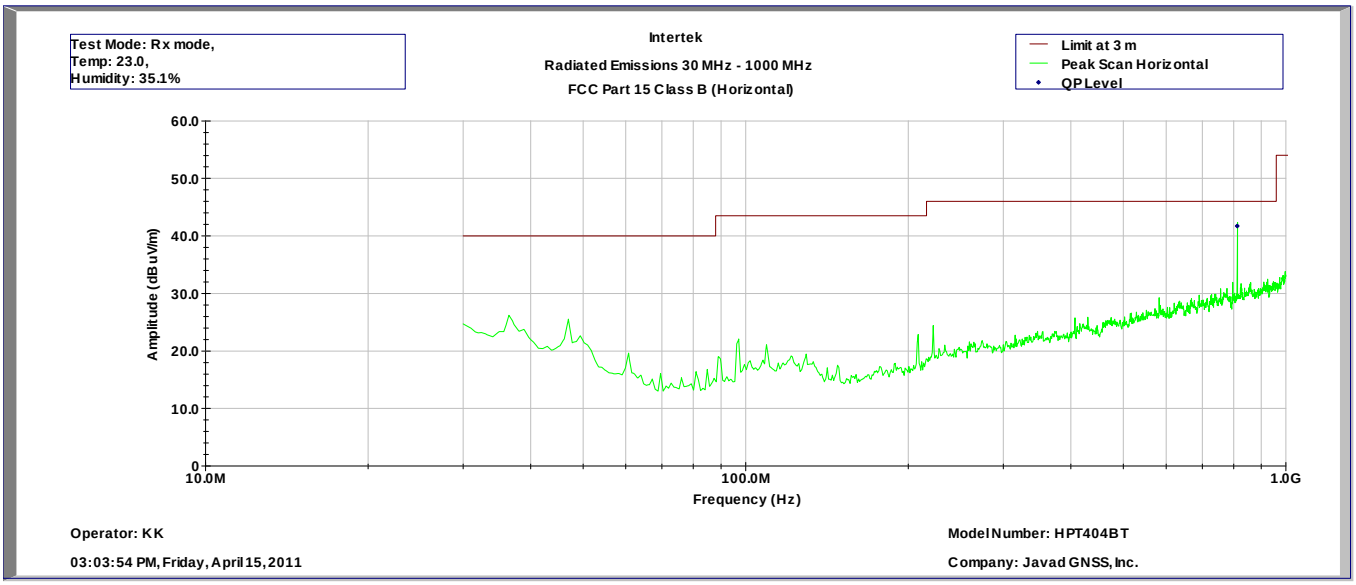
FS = RA + AF + CF – PA
Where FS = Field Strength in dB (µV/m)
RA = Receiver Amplitude (including preamplifier) in dB (µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
PA= Preamplifier Factor in dB

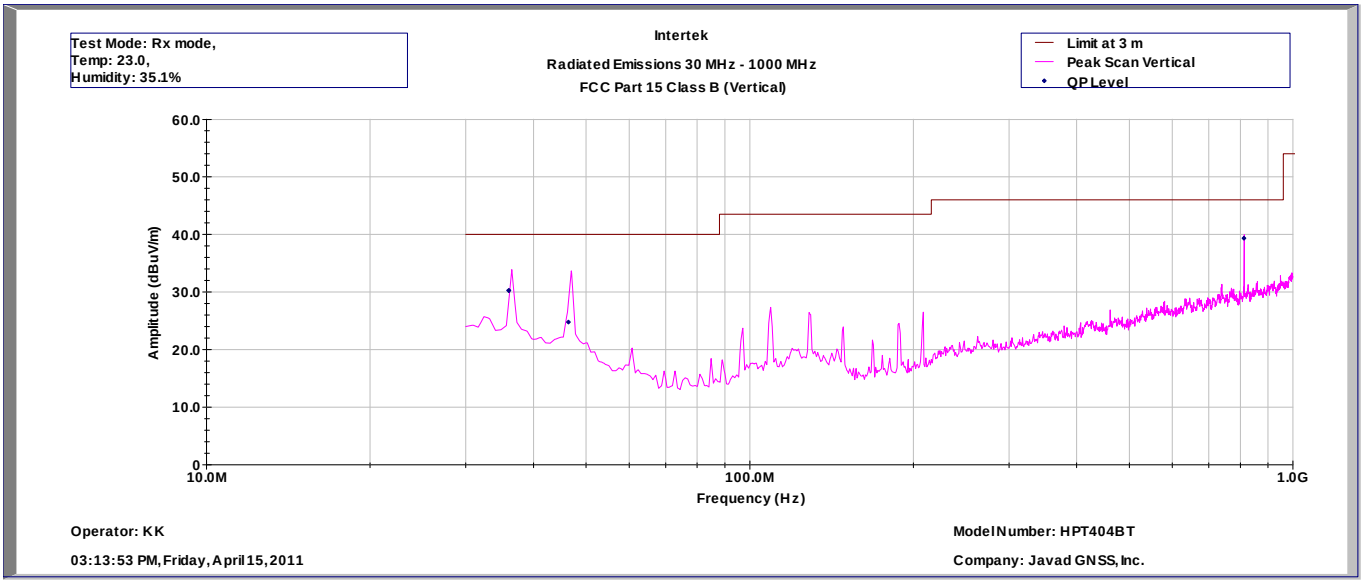
Assume a receiver reading of 52.0 dB (µV) is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB (µV/m).

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

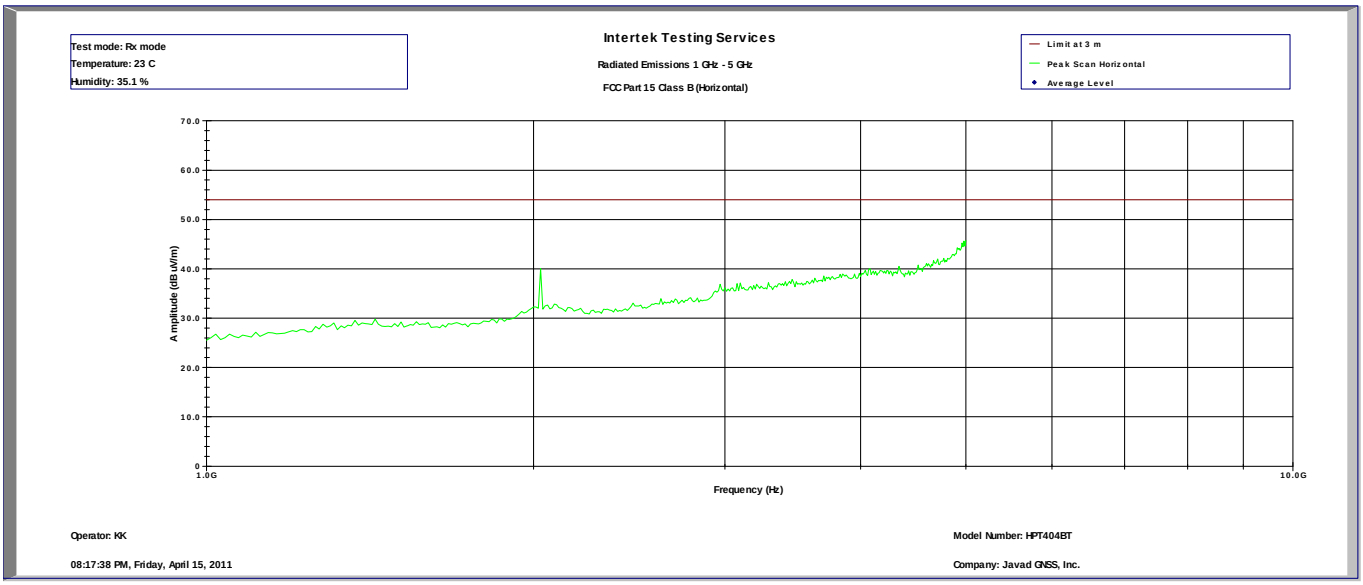
Result	Complies by 4.3 dB

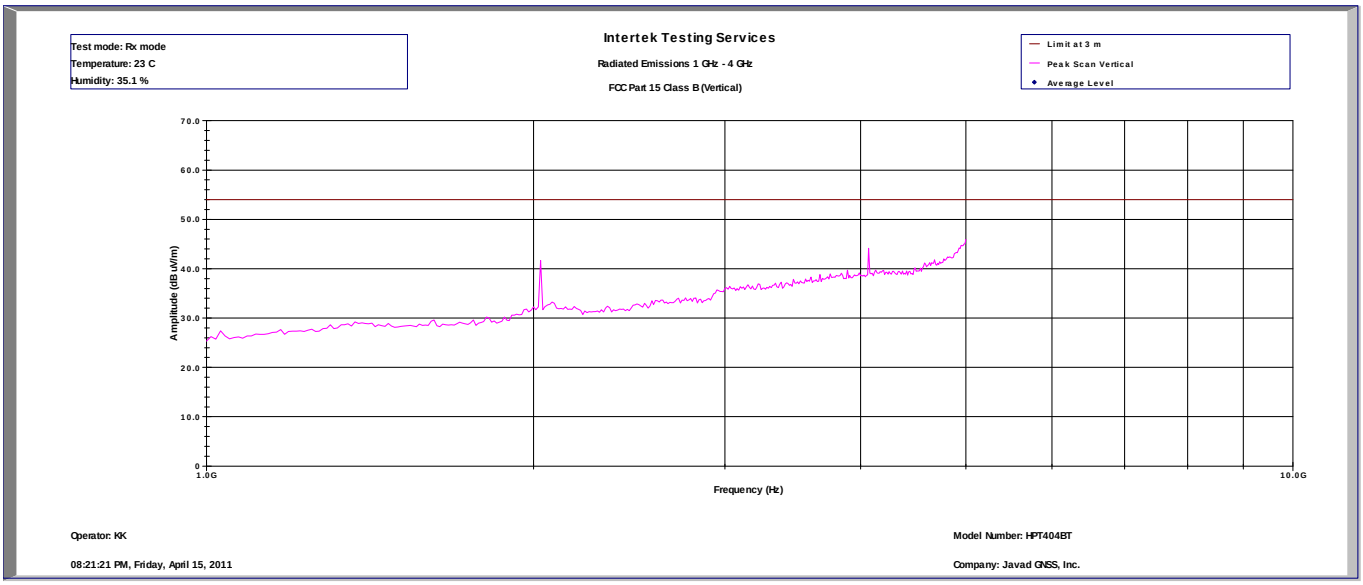

Test Mode: Rx mode,
Temp: 23.0,
Humidity: 35.1%
Intertek
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (Horizontal)
Limit at 3 m
Peak Scan Horizontal
QP Level
Amplitude (dBuV/m)
60.0
50.0
40.0
30.0
20.0
10.0
0
10.0M
100.0M
1.0G
Frequency (Hz)
Operator: KK
03:03:54 PM, Friday, April 15, 2011
Model Number: HPT404BT
Company: Javad GNSS, Inc.


Test Mode: Rx mode,
Temp: 23.0,
Humidity: 35.1%
Intertek
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (Vertical)
Limit at 3 m
Peak Scan Vertical
QP Level
Amplitude (dBuV/m)
60.0
50.0
40.0
30.0
20.0
10.0
0
10.0M
100.0M
1.0G
Frequency (Hz)
Operator: KK
03:13:53 PM, Friday, April 15, 2011
Model Number: HPT404BT
Company: Javad GNSS, Inc.

Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (Horizontal)								
Operator: KK				Model Number: HPT404BT				
September 17, 2009				Company: Javad GNSS, Inc.				
Frequency	**Peak FS**	**Limit@3m**	**Margin**	**RA**	**CF**	**AG**	**DCF**	**AF**
(Hz)	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**
8.12E+08	41.7	46.0	-4.3	39.1	3.4	31.9	10.5	20.7
Mode: Rx mode Temp: 23 C, Humidity: 35.1%								

Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (Vertical)								
Operator: KK				Model Number: HPT404BT				
September 17, 2009				Company: Javad GNSS, Inc.				
Frequency	**Peak FS**	**Limit@3m**	**Margin**	**RA**	**CF**	**AG**	**DCF**	**AF**
(Hz)	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**
3.60E+07	30.2	40.0	-9.8	34.0	0.7	31.9	10.5	16.9
4.64E+07	24.8	40.0	-15.2	30.0	0.8	31.9	10.5	15.4
1.09E+08	27.3	43.5	-16.2	36.8	1.2	32.0	10.5	10.8
1.29E+08	26.4	43.5	-17.1	35.4	1.3	31.9	10.5	11.2
2.09E+08	26.5	43.5	-17.0	35.9	1.7	31.9	10.5	10.3
8.12E+08	39.3	46.0	-6.7	36.7	3.4	31.9	10.5	20.7
Mode: Rx mode Temp: 23 C, Humidity: 35.1%								


Test mode: Rx mode
Temperature: 23 C
Humidity: 35.1 %
Intertek Testing Services
Radiated Emissions 1 GHz - 5 GHz
FCC Part 15 Class B (Horizontal)
Limit at 3 m
Peak Scan Horizontal
Average Level
Amplitude (dB uV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Operator: KK
08:17:38 PM, Friday, April 15, 2011
Model Number: HPT404BT
Company: Javad GNSS, Inc.


Test mode: Rx mode
Temperature: 23 C
Humidity: 35.1 %
Intertek Testing Services
Radiated Emissions 1 GHz - 4 GHz
FCC Part 15 Class B (Vertical)
Limit at 3 m
Peak Scan Vertical
Average Level
Amplitude (dB uV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Operator: KK
08:21:21 PM, Friday, April 15, 2011
Model Number: HPT404BT
Company: Javad GNSS, 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

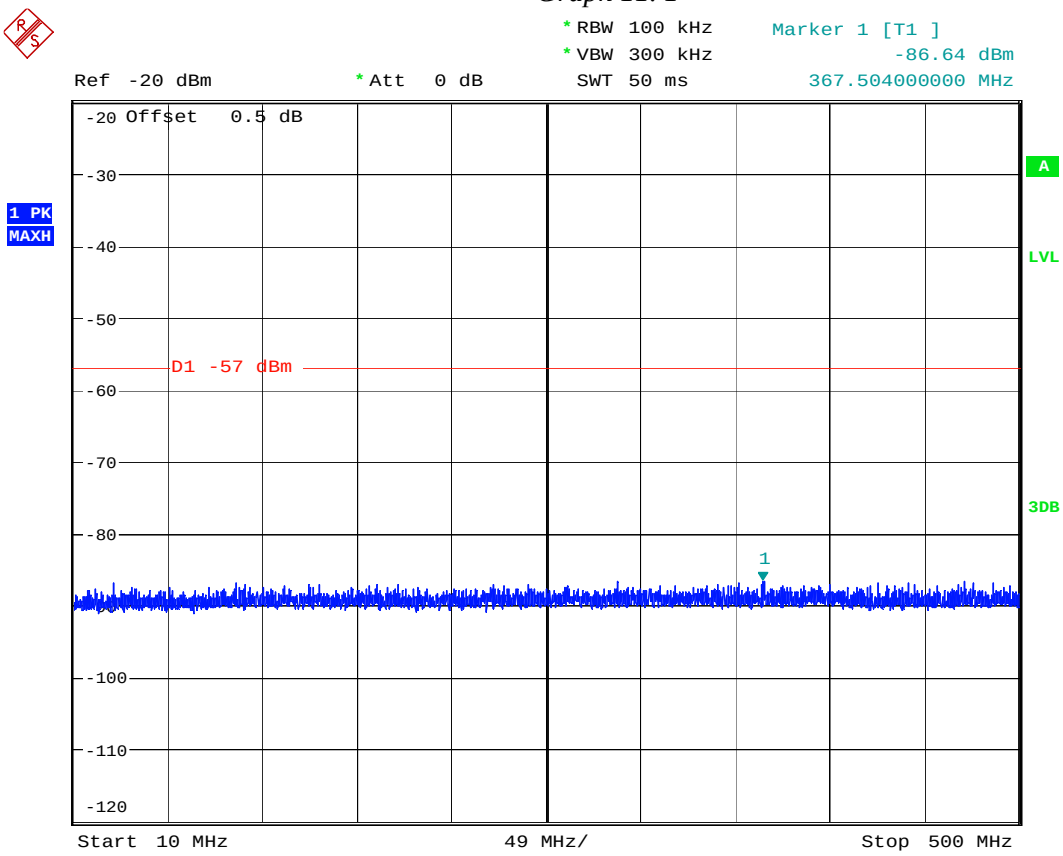
The spectrum analyzer was connected to the RF output of the EUT. The EUT was setup in receiving mode. Test was performed at tuned frequencies of 406.1 MHz and 470 MHz.

11.2.3 Test Results

The test results are presented on the following graphs.

Result	Complies

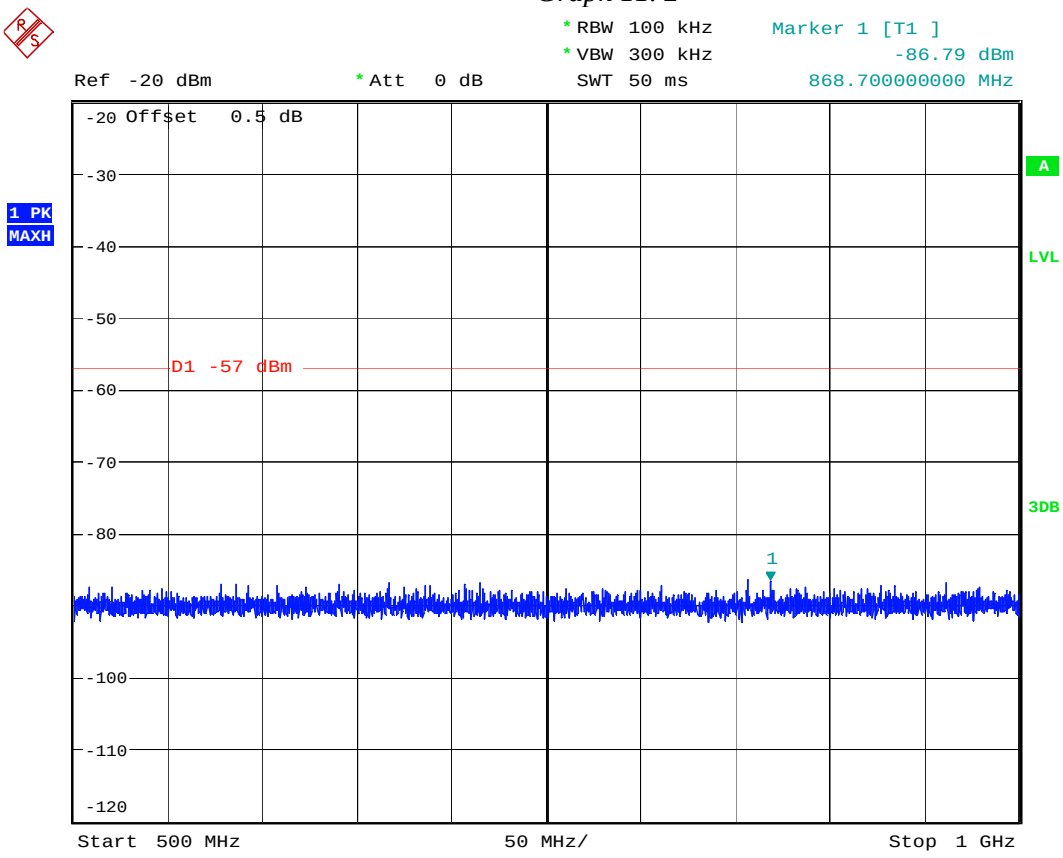
Graph 11. 1



Receiver conducted spurious, 470MHz

Date: 12.APR.2011 13:58:18

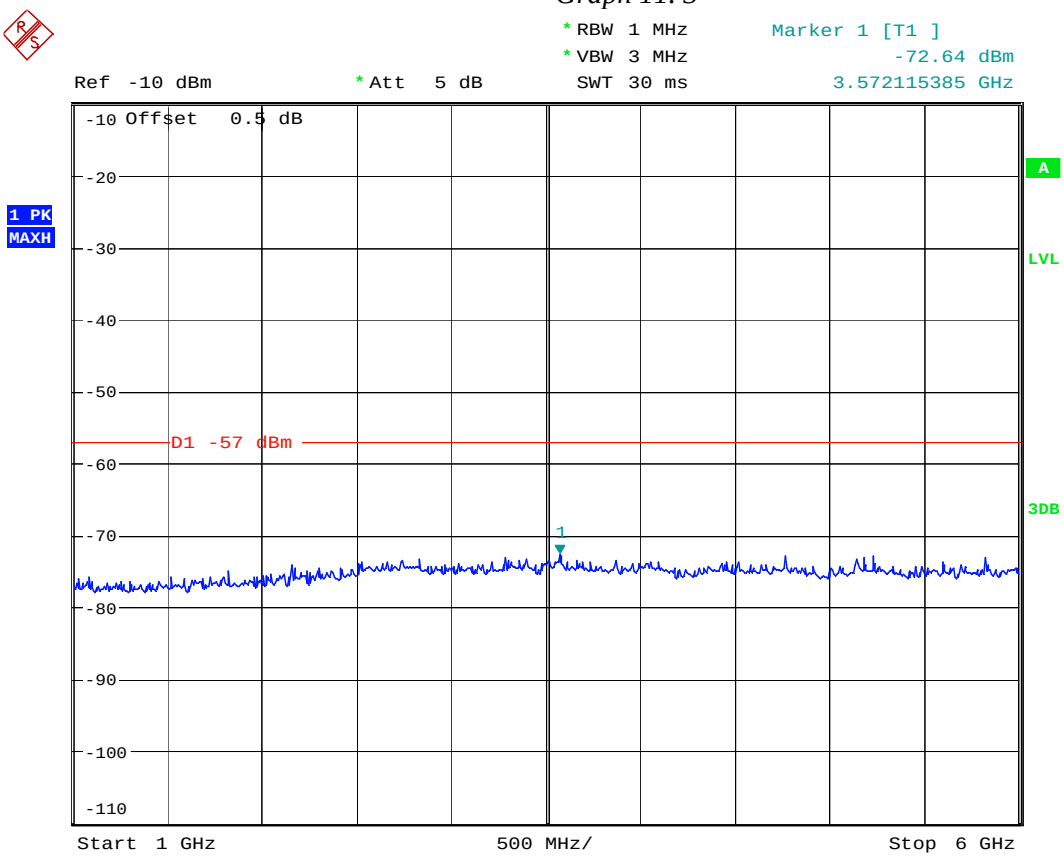
Graph 11. 2



Receiver conducted spurious, 470MHz

Date: 12.APR.2011 13:59:05

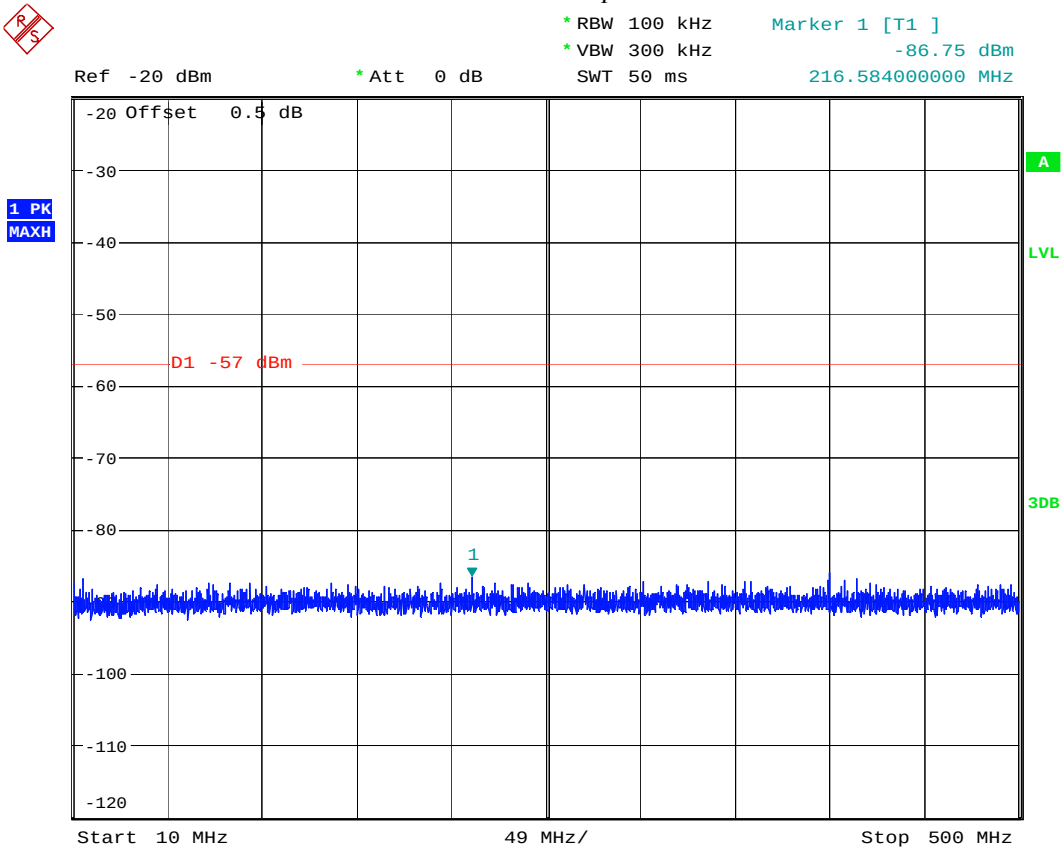
Graph 11. 3



Receiver spurious conducted, f=470MHz

Date: 14.APR.2011 14:00:11

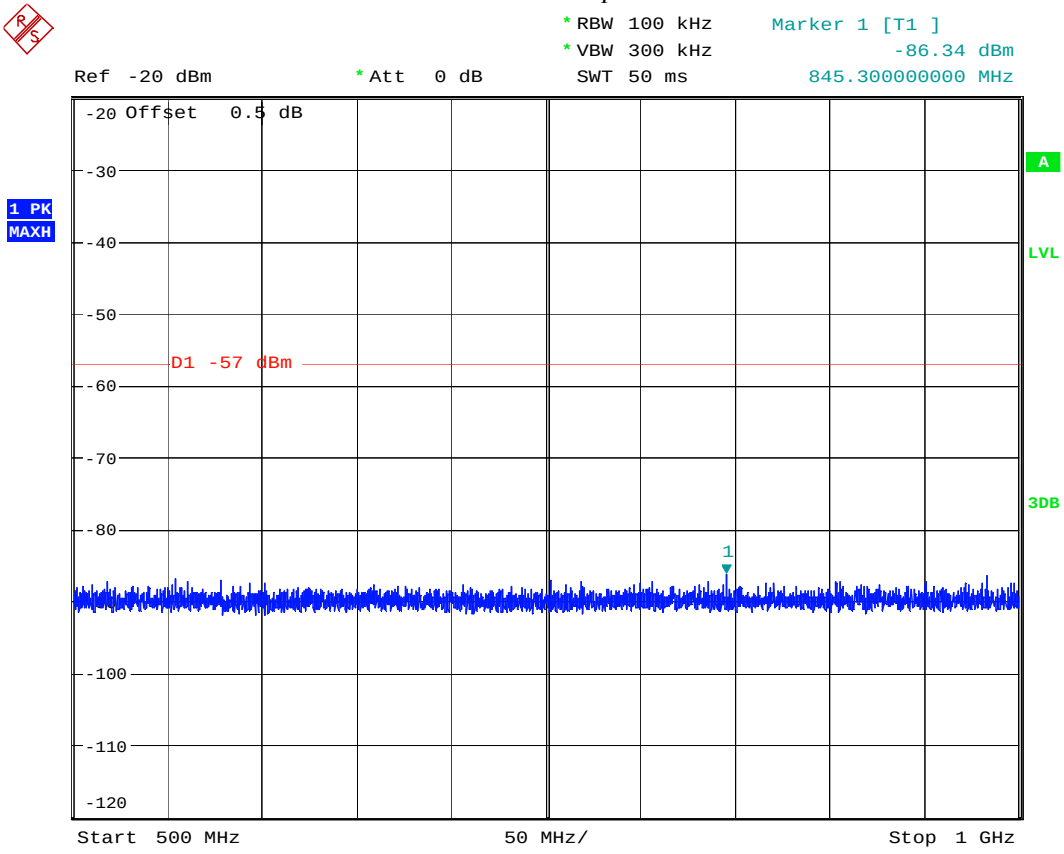
Graph 11. 4



Receiver conducted spurious, 406.1MHz

Date: 12.APR.2011 14:00:49

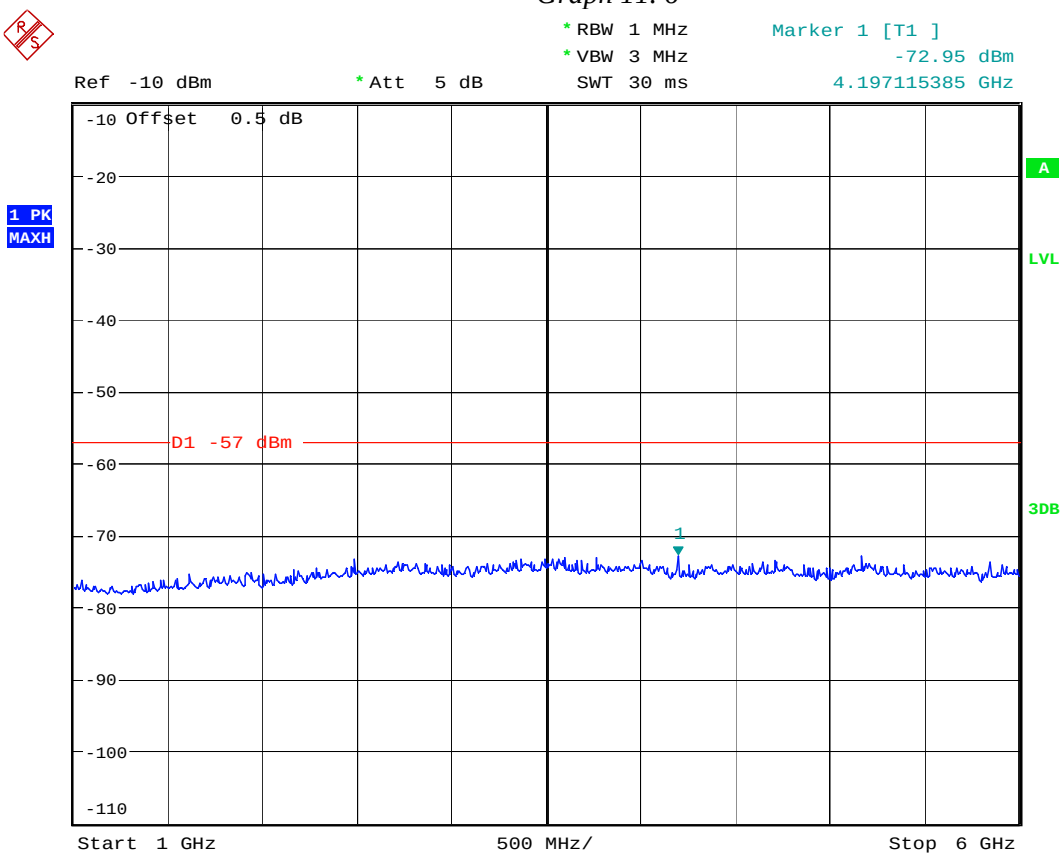
Graph 11. 5



Receiver conducted spurious, 406.1MHz

Date: 12.APR.2011 14:00:04

Graph 11. 6



Receiver spurious conducted, f=406.1MHz

Date: 14.APR.2011 13:59:17

12.0 List of Test Equipment

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	12/08/11
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	12/08/11
Spectrum Analyzer	Rohde&Schwarz	FSP40	036612004	12	11/04/11
BI-Log Antenna	ARA	LPB-2513/A	1154	12	06/29/11
Pre-Amplifier	Sonoma	310N	185634	12	12/01/11
Pre-Amplifier	Sonoma	310N	293620	12	11/02/11
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	08/05/11
Vector Signal Generator	Rohde&Schwarz	SMU200A	102499	12	04/28/11
Spectrum Analyzer	Rohde&Schwarz	FSU	200482	12	03/23/12
Horn Antenna	EMCO	3115	9170-3712	12	11/09/11
Horn Antenna	EMCO	3115	00126795	12	10/28/11
Oscilloscope	Tektronix	TDS 680C		12	09/20/11
Power Meter	Hewlett Packard	EPM-442A	US37480416	12	06/03/11
Signal Generator	Hewlett Packard	8663A	2537A00214	12	04/29/11
Signal Generator	Hewlett Packard	SMR40	100445	12	08/27/11

13.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / G100328280	KK	April 26, 2011	Original document