TEST REPORT

Report Number: 100359040MPK-002
Project Number: G100359040
June 20, 2011

Testing performed on the
VHF Radio
Model Numbers: HPT104BT, HPT104, AW100BT, AW100 and AW100AF
FCC ID: WJ4HPT104
IC ID: 3504A-HPT104

to

FCC Part 90, RSS-119 Issue 11

for

Javad GNSS, Inc.

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

Prepared by: Krishna K Vemuri **Date:** June 20, 2011

Reviewed by: Ollie Moyrong **Date:** June 20, 2011

Report No. 100359040MPK-002

Equipment Under Test:	VHF Radio
Trade Name:	Javad GNSS, Inc.
Model No.:	HPT104BT, HPT104, AW100BT, AW100 and AW100AF
Serial No.:	EMCProto1
FCC ID:	WJ4HPT104
IC ID:	3504A-HPT104
Applicant:	Javad GNSS, Inc.
Contact:	Mr. Vladimir Zhukov
Address:	900 Rock Avenue San Jose, CA 95131
Country	USA
Tel. Number:	(408) 770-1770
Fax:	(408) 770-1799
Email:	v.zhukov@javad.com
Applicable Regulation:	FCC Part 90, RSS-119 Issue 11
Test Site Location:	ITS - Site 1 1365 Adams Drive Menlo Park, CA 94025
Date of Test:	June 08 to June 16, 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 HPT104BT. As declared by the Applicant, the models HPT104BT and AW100BT are identical except for their housing color and brand name (HPT for Javad; AW for ArWest). The models HPT104, AW100, AW100AF are similar to the models HPT104BT and AW100BT with the exception of not having a modular approved Bluetooth Module installed. For Bluetooth Module compliance, reference Intertek reports: 3190052MPK-002 issued on October 31, 2009 and 3190052MPK-003 issued on October 31, 2009, FCC ID: WJ4BT4EX8M, IC: 3504A-BT4EX8M.

HPT104BT is an external VHF Radio transceiver used for commercial, indoor and outdoor use.

The HPT104BT provides real-time data transmission using spectrum efficient GMSK/BPSK/QPSK/8PSK/16QAM modulations.

The HPT104BT provides half-duplex communication with transmitter output power of 4 W (+36 dBm) in the frequency bands 150-174MHz for USA with channel spacing 12.5/6.25 kHz; 138-144MHz, 148-149.9MHz and 150.05-174MHz for Canada with channel spacing 25/12.5/6.25 kHz.

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

Radio Specifications	
Type	VHF Radio
Rated RF Output Power	4W
Frequency Ranges	150-174MHz for USA, 138-144MHz, 148-149.9MHz and 150.05-174MHz for Canada
Type of Modulation	BPSK, QPSK, 8PSK, 16QAM, GMSK
Channel Bandwidth and Maximum Data Rate	25 kHz at 38.4 kbps for Canada 12.5 kHz at 19.2 kbps for USA and Canada 6.25 kHz at 9.6 kbps for USA and Canada
Antenna & Gain	Whip, 2.4 dBi
Detachable Antenna	Yes
External Input	Data
Operating Temperature	From -30^0C to $+50^0$C

EUT receive date: June 07, 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: June 08, 2011
Test completion date: June 16, 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(d)	-	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	Emissions from Digital Parts and Receiver	Complies

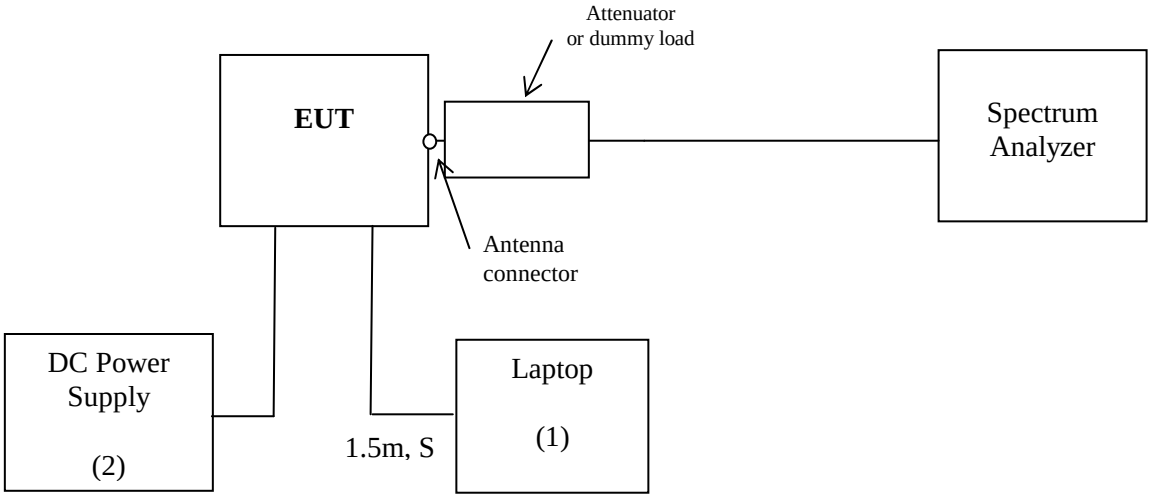
*Radio transmission is for data only.

1.3 Test Configuration

1.3.1 Support Equipment

Item #	Description	Model No.	S/N
1	Toshiba Laptop	A15-S129	Z3042027P
2	Topward Electronic Instruments, DC Power Supply	TPS-4000	974513

1.3.2 Block Diagram of Test Setup



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

During testing, the EUT was connected to a computer through a serial cable. Test software loaded on the computer was adjusted to exercise the receiver at different channel spacings/data rates.

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 report 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

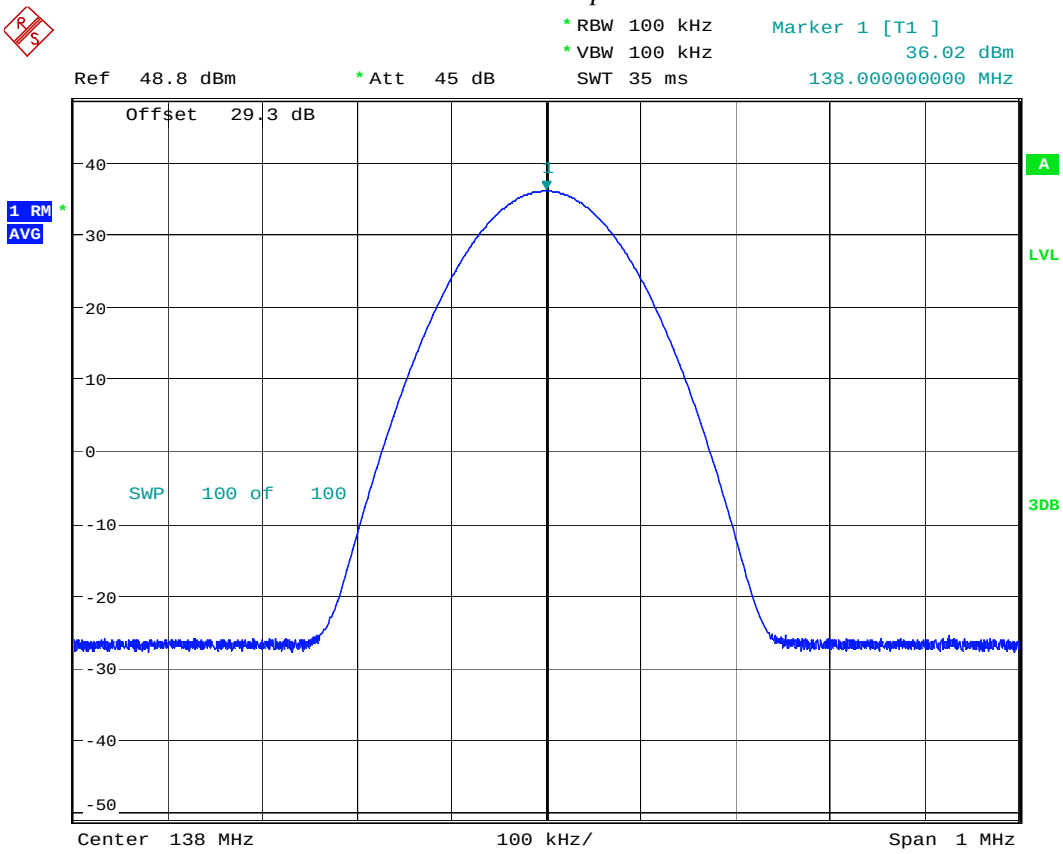
Rohde & Schwarz FSU26 Spectrum Analyzer.

2.3 Test Results

Frequency (MHz)	Measured Output Power (dBm)	Measured Output Power (Watt)	Graph
138.0	36.02	4.0	2.1
150.0	36.04	4.02	2.2
150.5	36.00	3.98	2.3
174.0	36.02	4.0	2.4

Refer to the attached graphs.

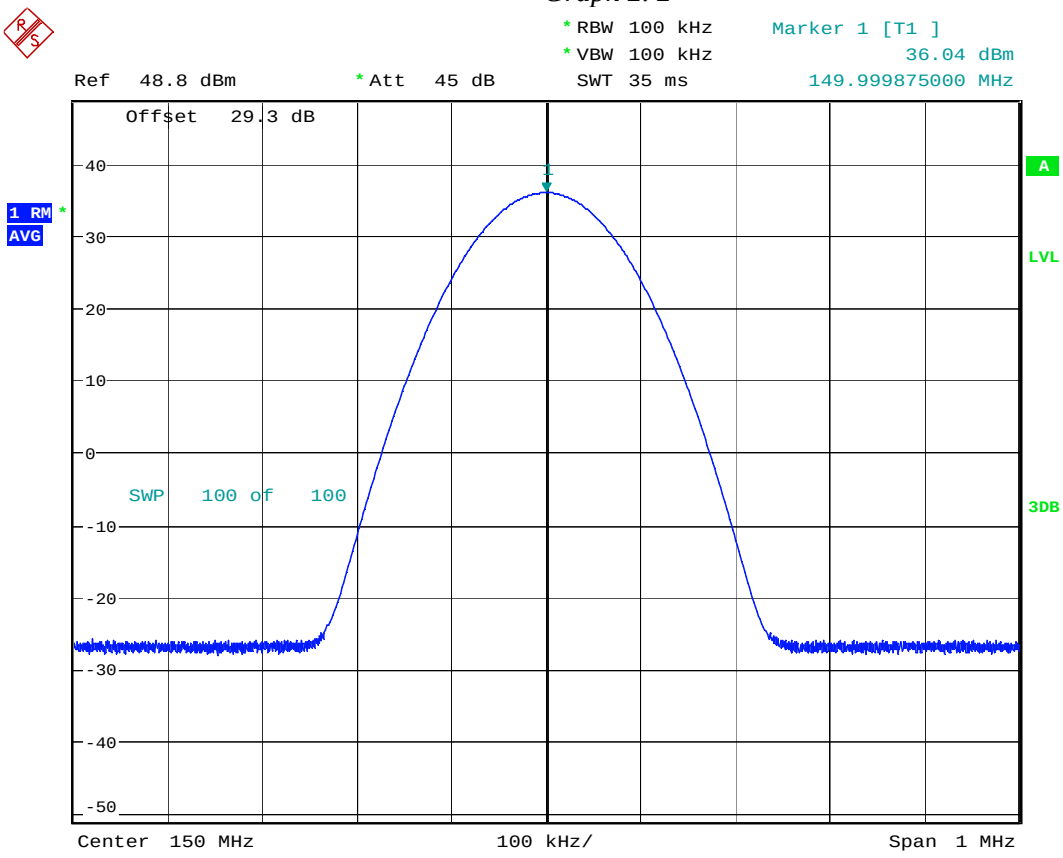
Graph 2. 1



Power output

Date: 9.JUN.2011 12:59:24

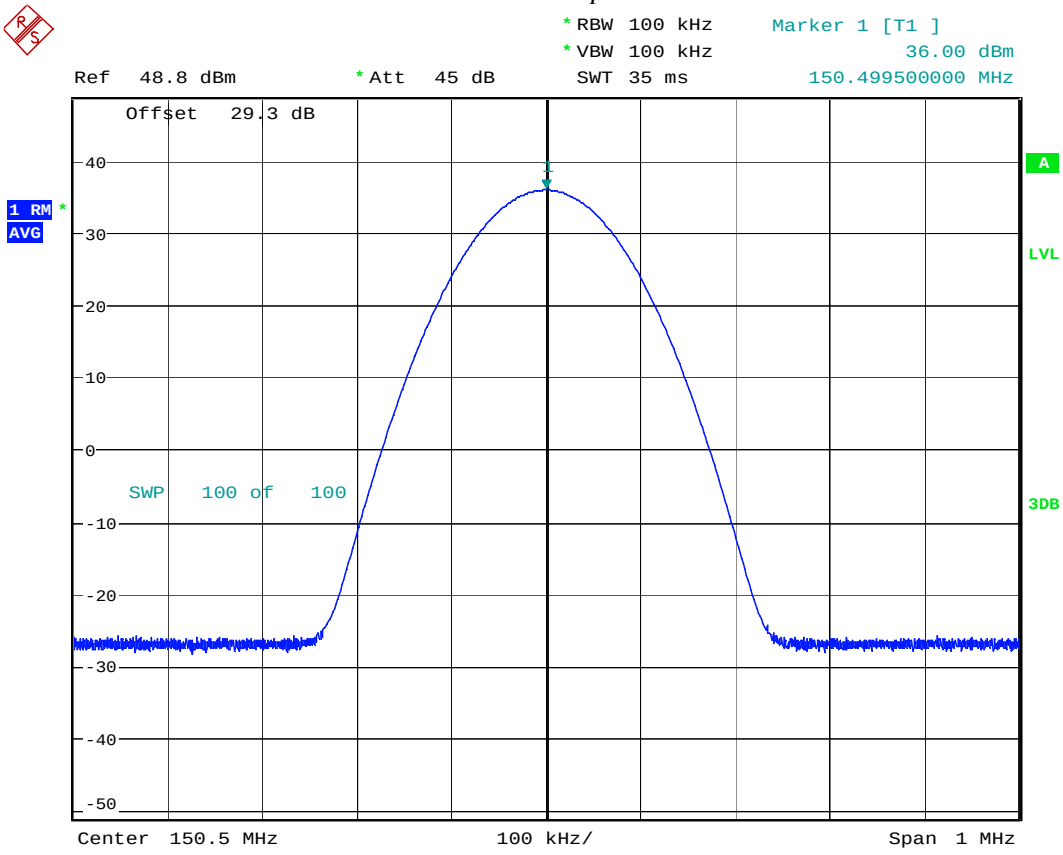
Graph 2. 2



Power output

Date: 9.JUN.2011 09:13:42

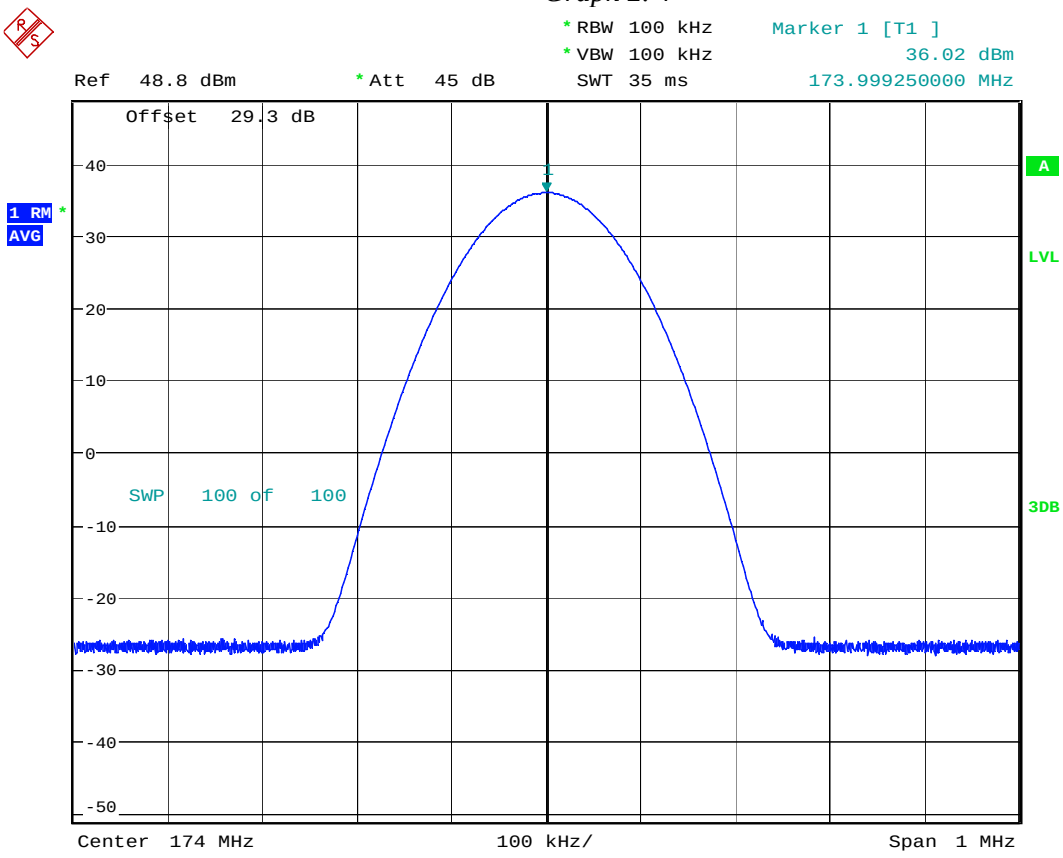
Graph 2. 3



Power output

Date: 9.JUN.2011 09:10:23

Graph 2. 4



Power output

Date: 9.JUN.2011 13:02:32

3.0 Radiated Power

3.1 Requirement

FCC 90.205(d)

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 = 36.04 + 0.3 = 36.34dBm (or 4.305 W).
EIRP= 36.04 + 2.4 = 38.44 dBm (or 6.982 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 report 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 174 MHz for all types of modulation and authorized bandwidths.

4.2 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer

4.3 Test Results

Complies	Refer to the following Graphs

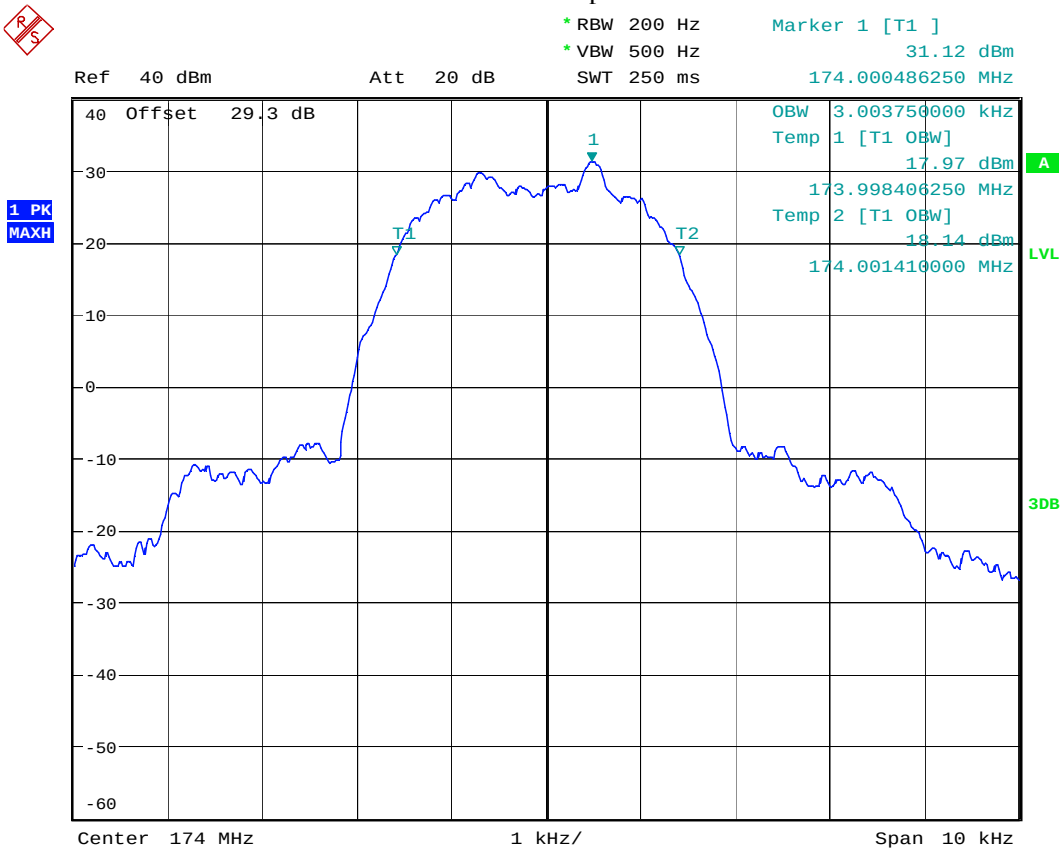
The following Emission Designators were determined:

3K04G1D
2K94F1D
6K03G1D
5K83F1D
12K00G1D
11K56F1D

Frequency (MHz)	Modulation	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Measured Occupied Bandwidth (kHz)	Graph
174	BPSK	6.25	6.0	3.00	4.1
	QPSK			3.04	4.2
	8PSK			3.04	4.3
	16QAM			3.00	4.4
	GMSK			2.94	4.5
174	BPSK	12.5	11.25	5.95	4.6
	QPSK			6.03	4.7
	8PSK			6.02	4.8
	16QAM			6.01	4.9
	GMSK			5.83	4.10
174	BPSK	25.0	20.0	11.87	4.11
	QPSK			11.99	4.12
	8PSK			11.94	4.13
	16QAM			12.00	4.14
	GMSK			11.56	4.15

Refer to the attached Graphs.

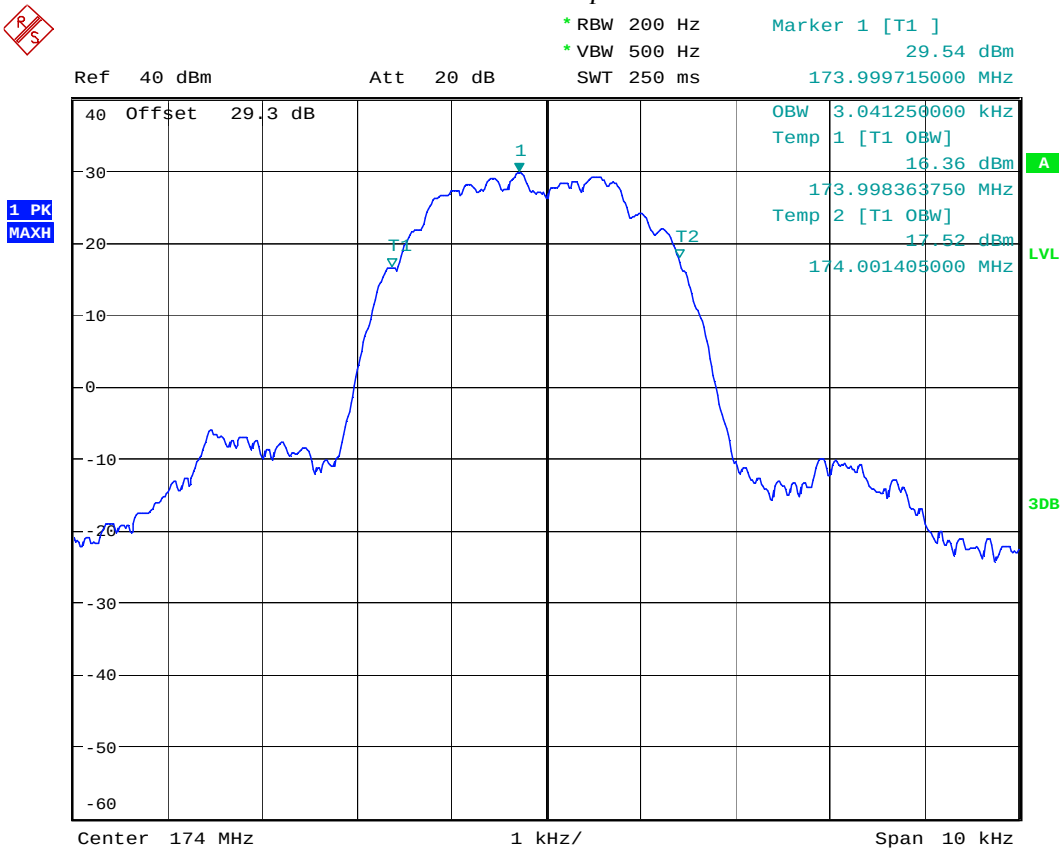
Graph 4. 1



Occupied bandwidth, 6kHz authorized bandwidth, BPSK

Date: 9.JUN.2011 09:30:26

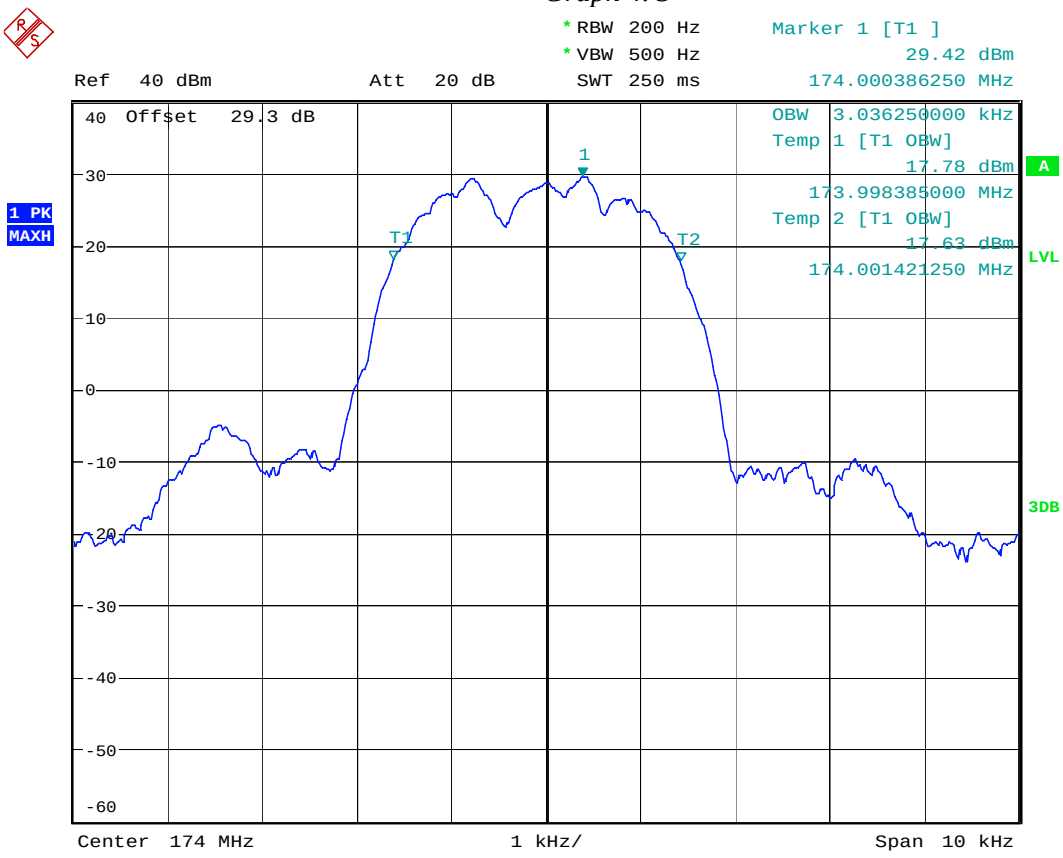
Graph 4. 2



Occupied bandwidth, 6kHz authorized bandwidth, QPSK

Date: 9.JUN.2011 09:31:36

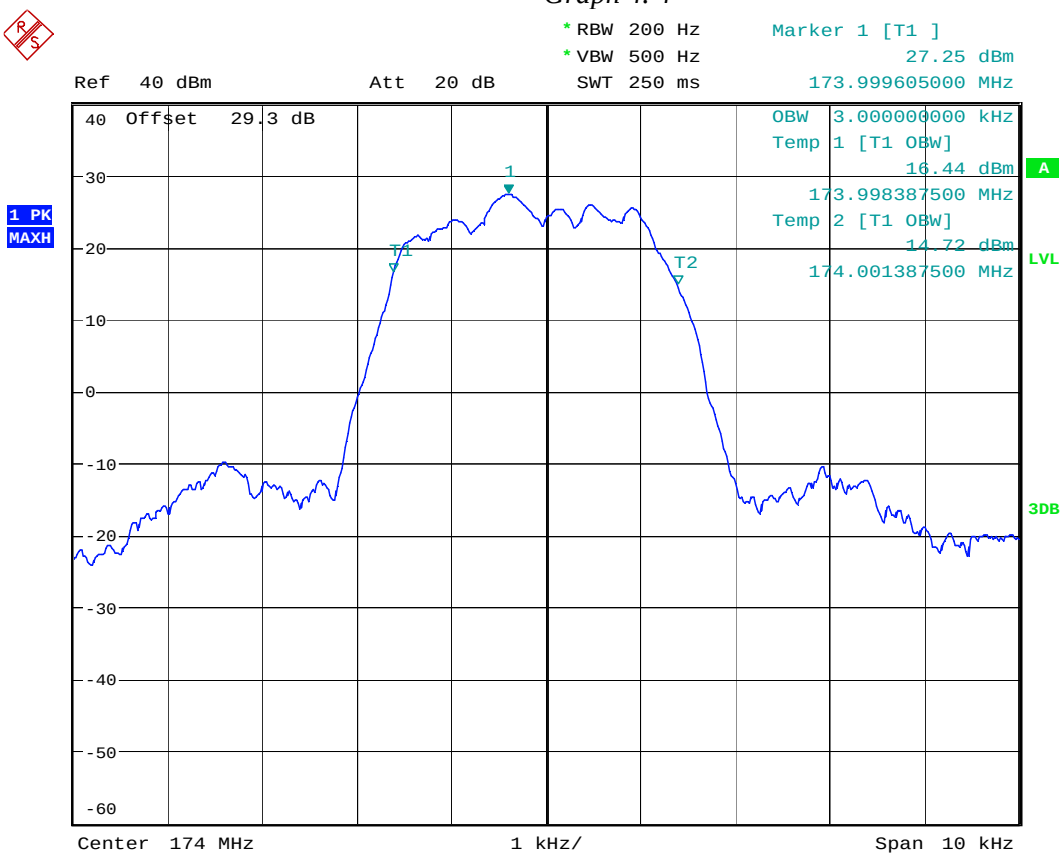
Graph 4. 3



Occupied bandwidth, 6kHz authorized bandwidth, 8PSK

Date: 9.JUN.2011 09:32:45

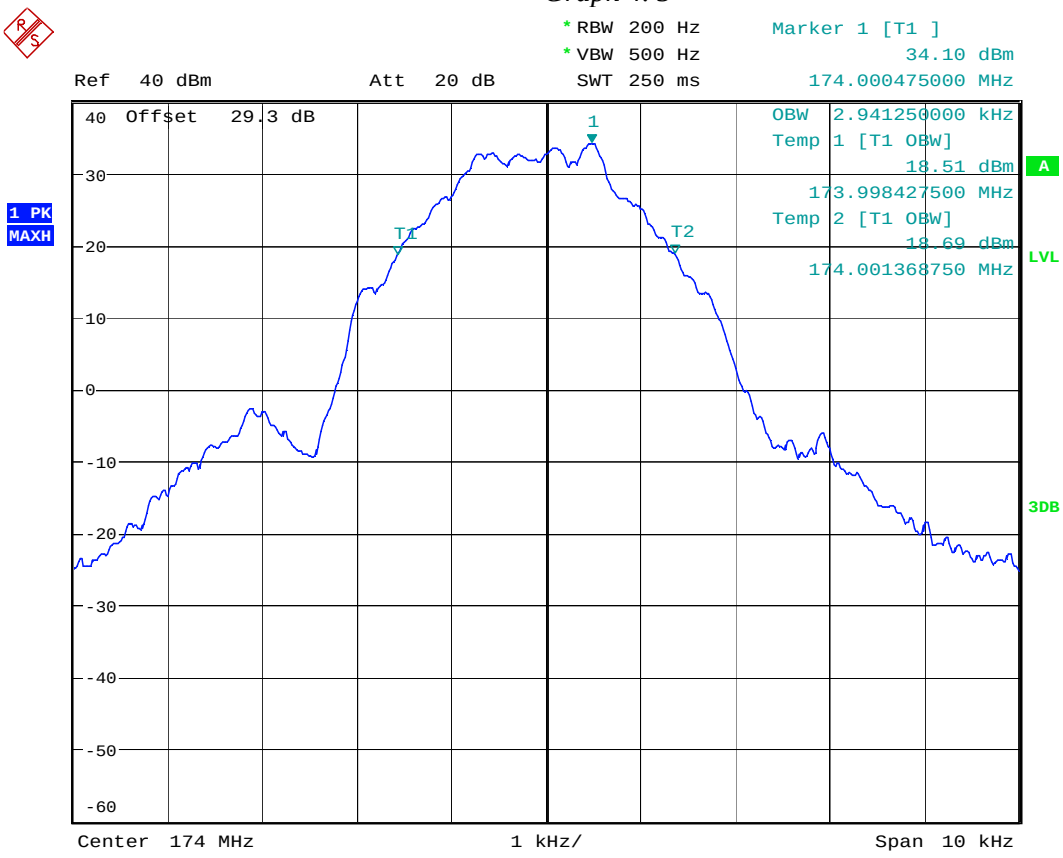
Graph 4. 4



Occupied bandwidth, 6kHz authorized bandwidth, 16QAM

Date: 9.JUN.2011 09:33:49

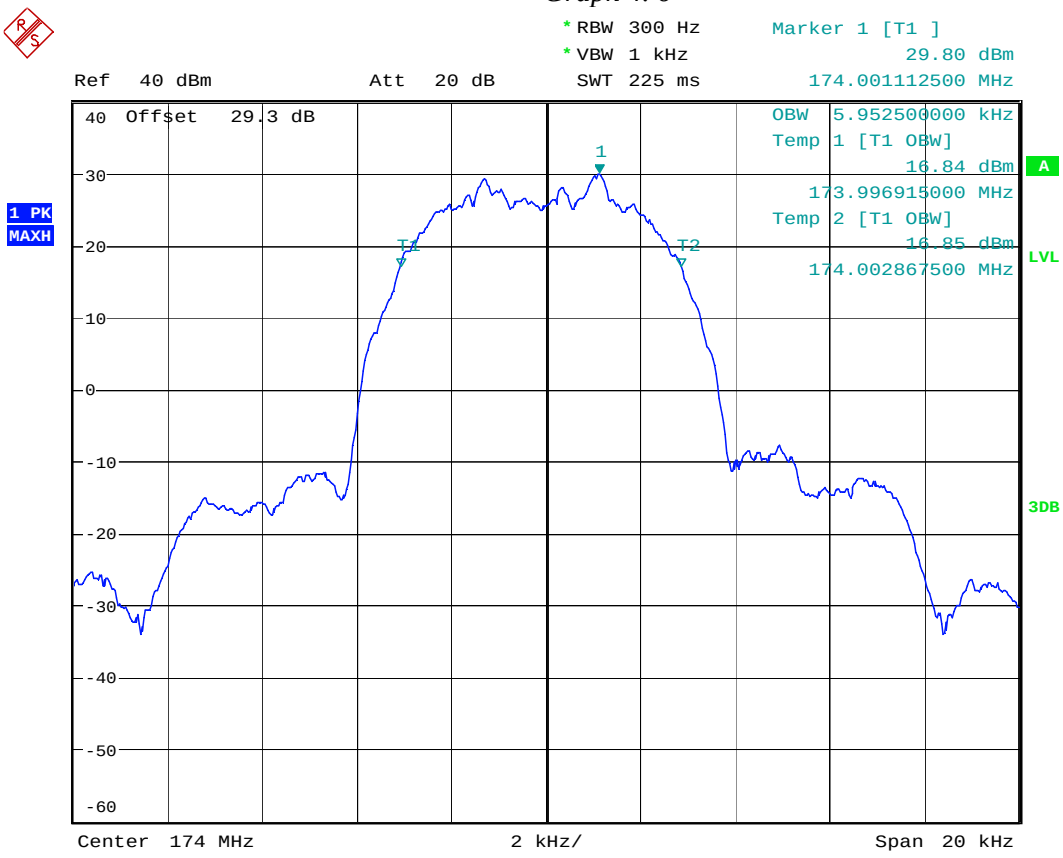
Graph 4. 5



Occupied bandwidth, 6kHz authorized bandwidth, GMSK

Date: 9.JUN.2011 09:36:40

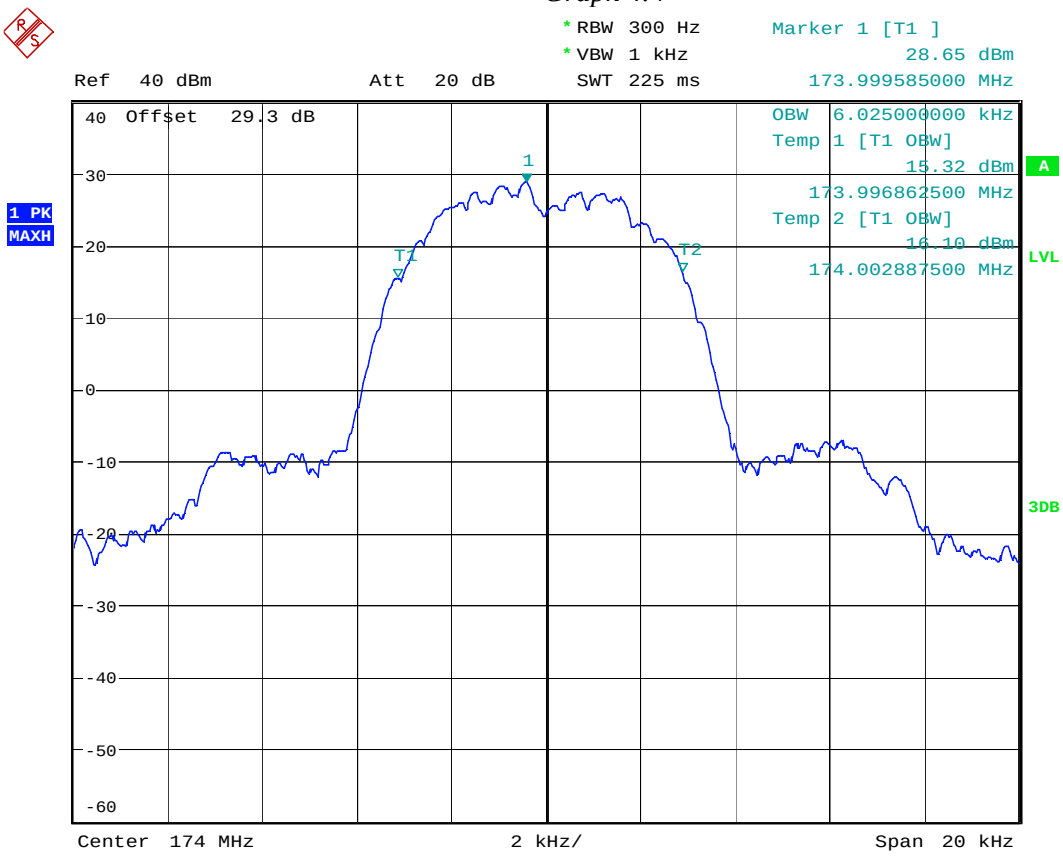
Graph 4. 6



Occupied bandwidth, 11.25kHz authorized bandwidth, BPSK

Date: 9.JUN.2011 09:39:19

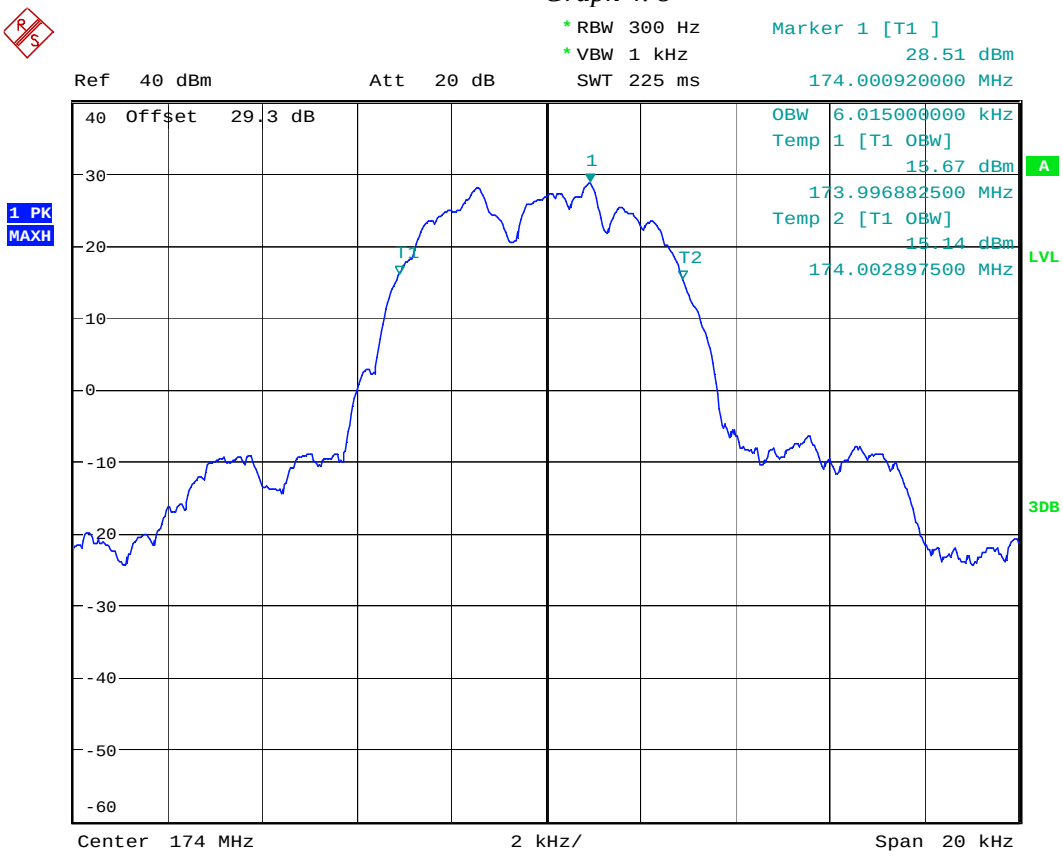
Graph 4. 7



Occupied bandwidth, 11.25kHz authorized bandwidth, QPSK

Date: 9.JUN.2011 09:40:31

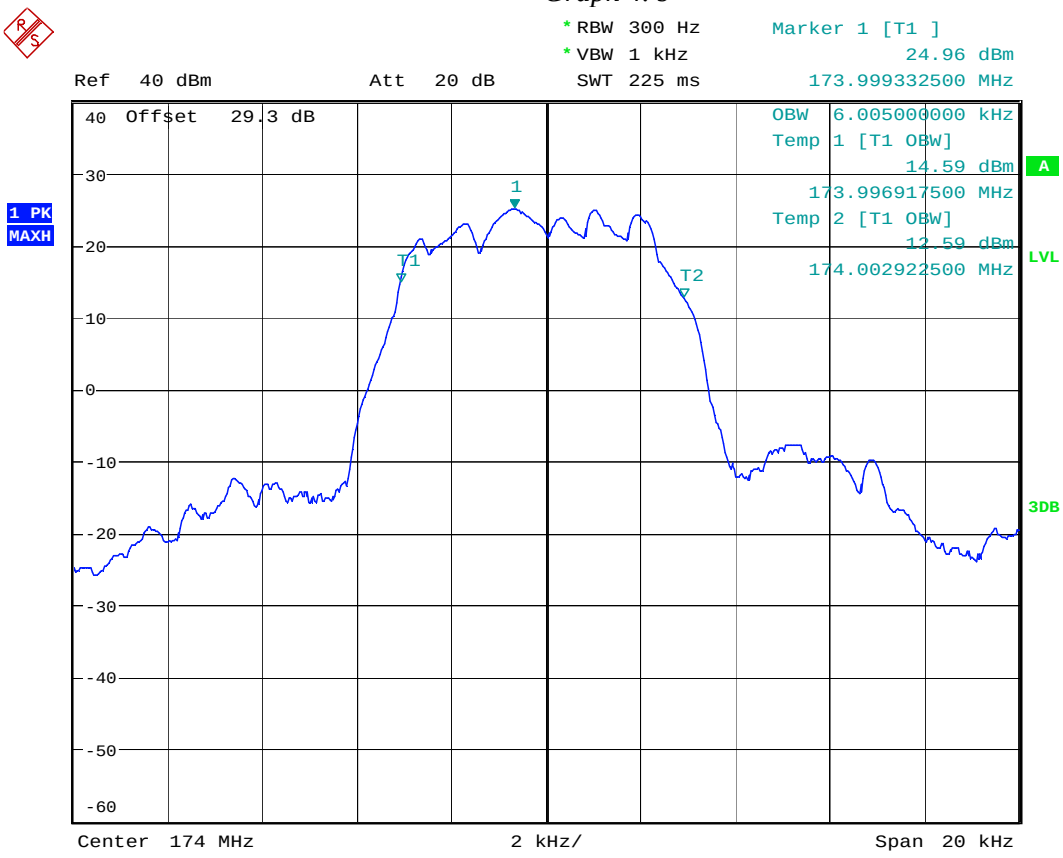
Graph 4. 8



Occupied bandwidth, 11.25kHz authorized bandwidth, 8PSK

Date: 9.JUN.2011 09:41:44

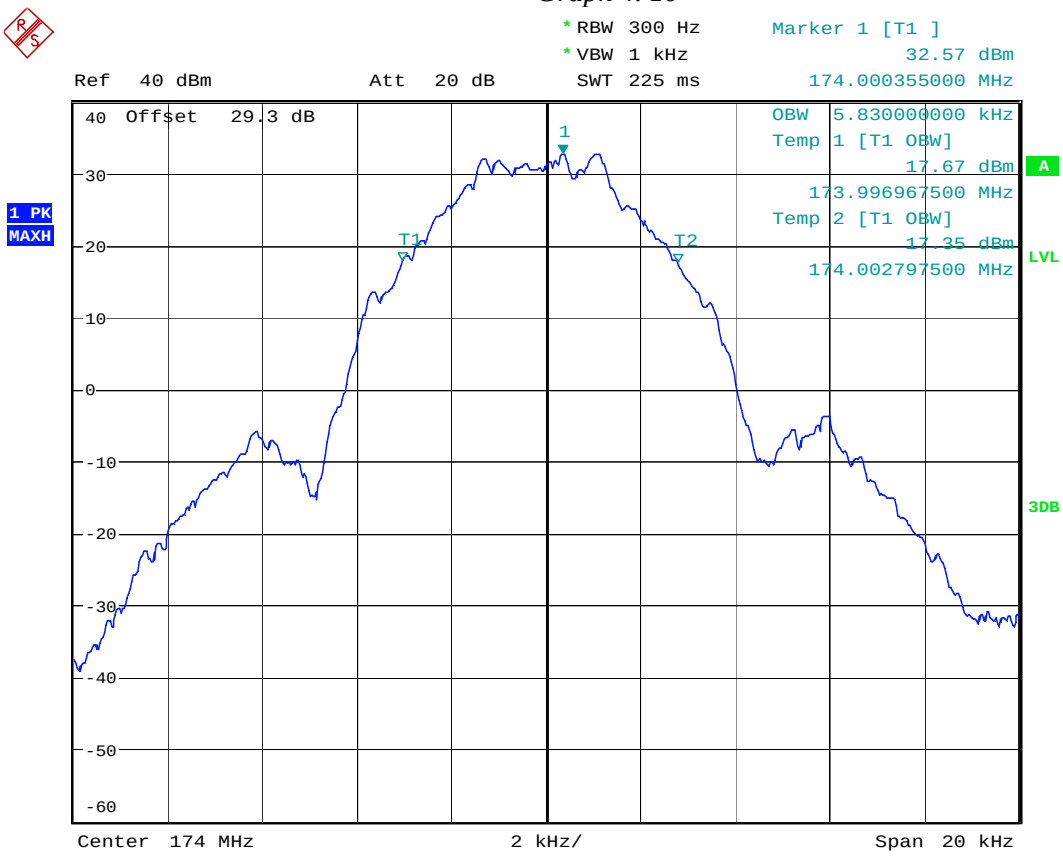
Graph 4. 9



Occupied bandwidth, 11.25kHz authorized bandwidth, 16QAM

Date: 9.JUN.2011 09:42:42

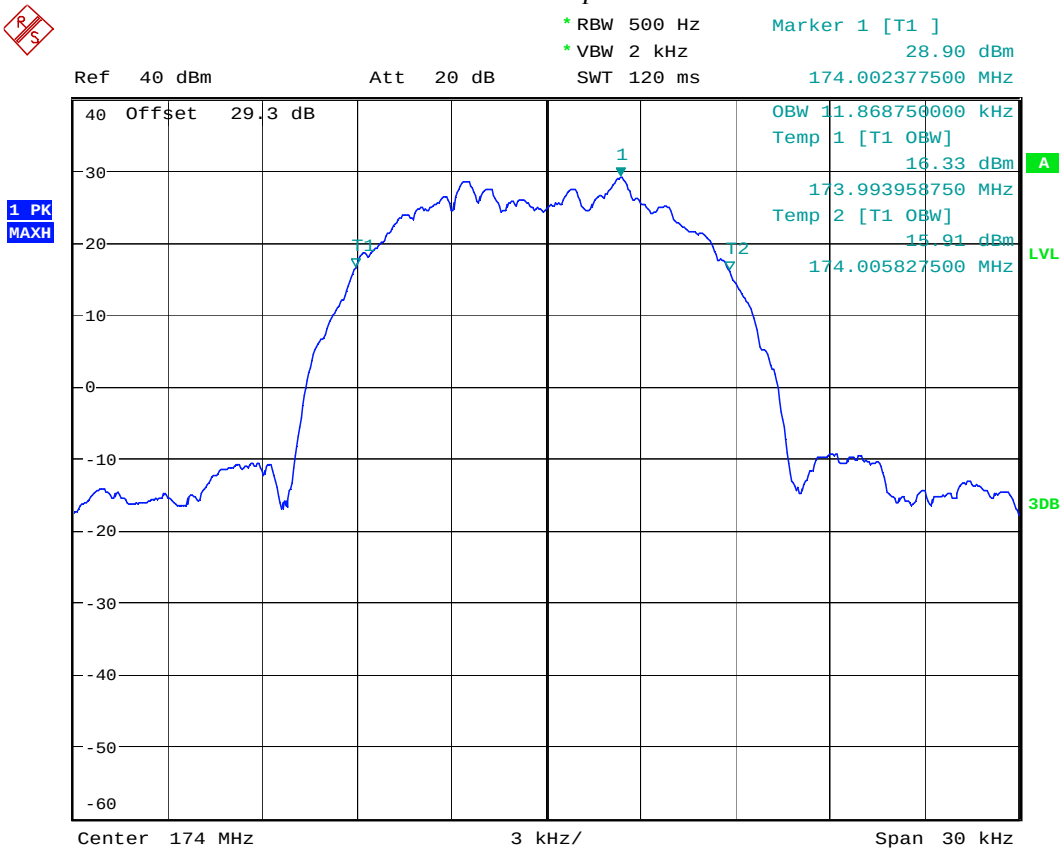
Graph 4. 10



Occupied bandwidth, 11.25kHz authorized bandwidth, GMSK

Date: 9.JUN.2011 09:44:08

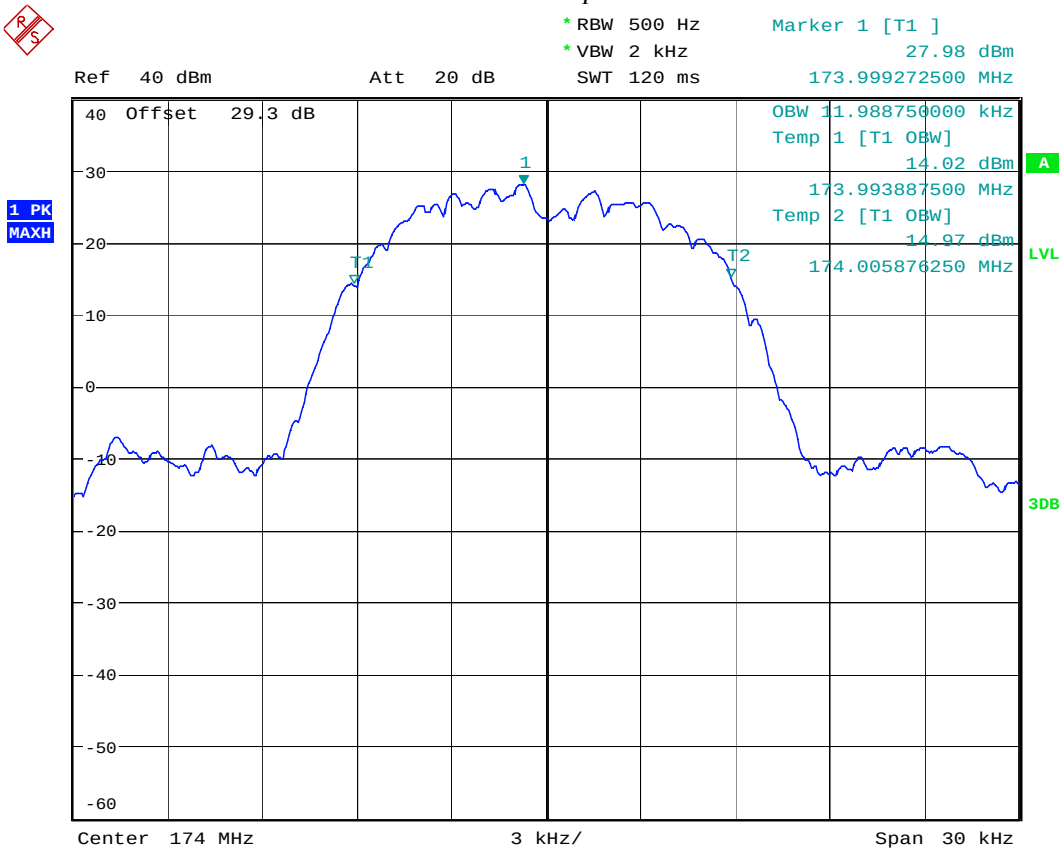
Graph 4. 11



Occupied bandwidth, 20kHz authorized bandwidth, BPSK

Date: 9.JUN.2011 09:46:27

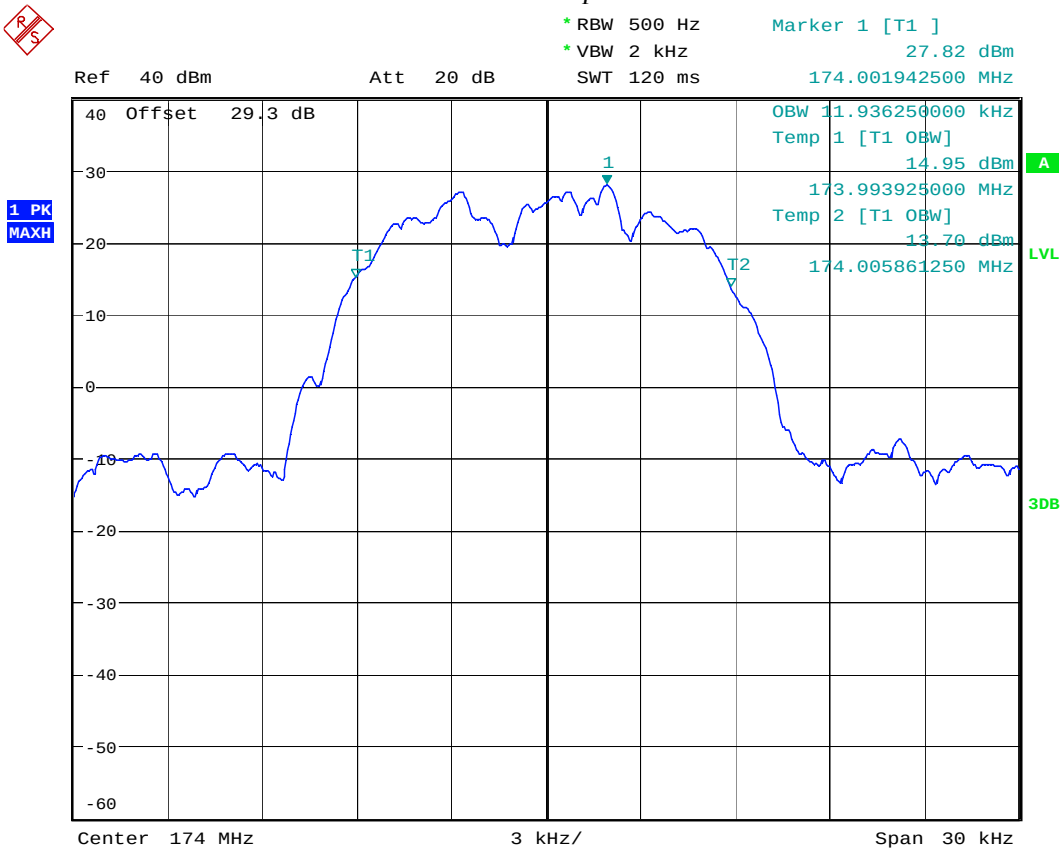
Graph 4. 12



Occupied bandwidth, 20kHz authorized bandwidth, QPSK

Date: 9.JUN.2011 09:48:07

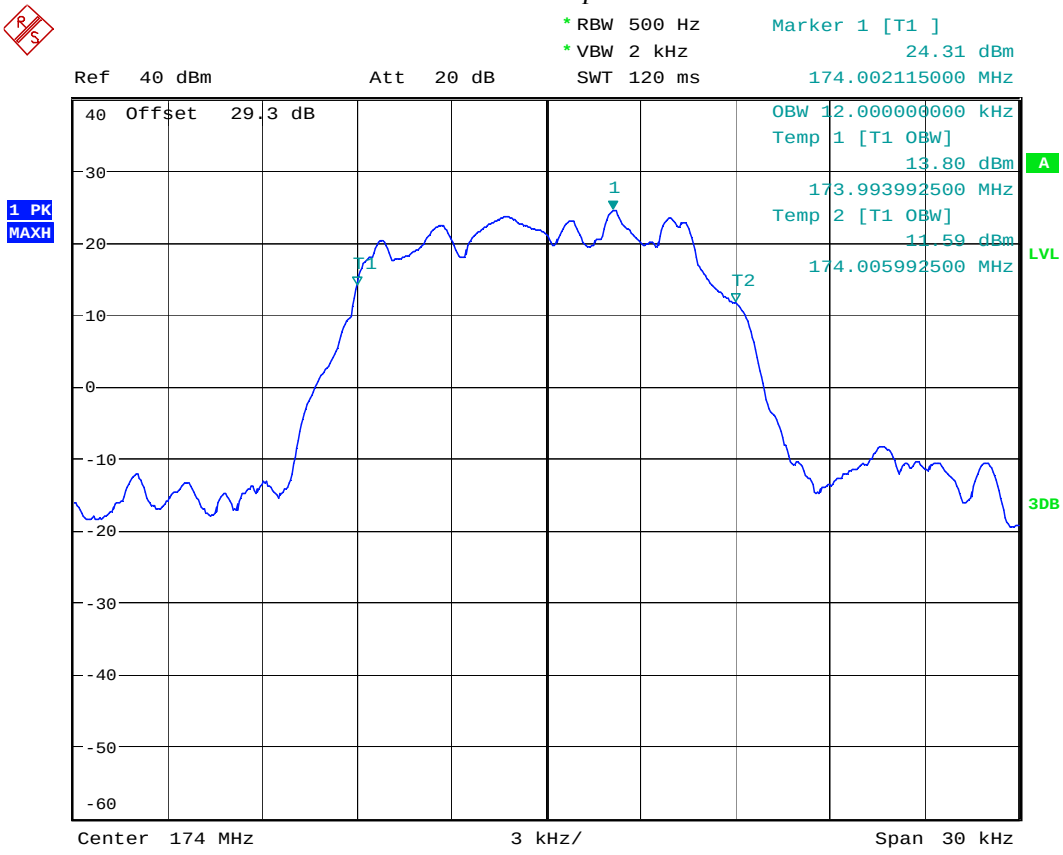
Graph 4. 13



Occupied bandwidth, 20kHz authorized bandwidth, 8PSK

Date: 9.JUN.2011 09:49:53

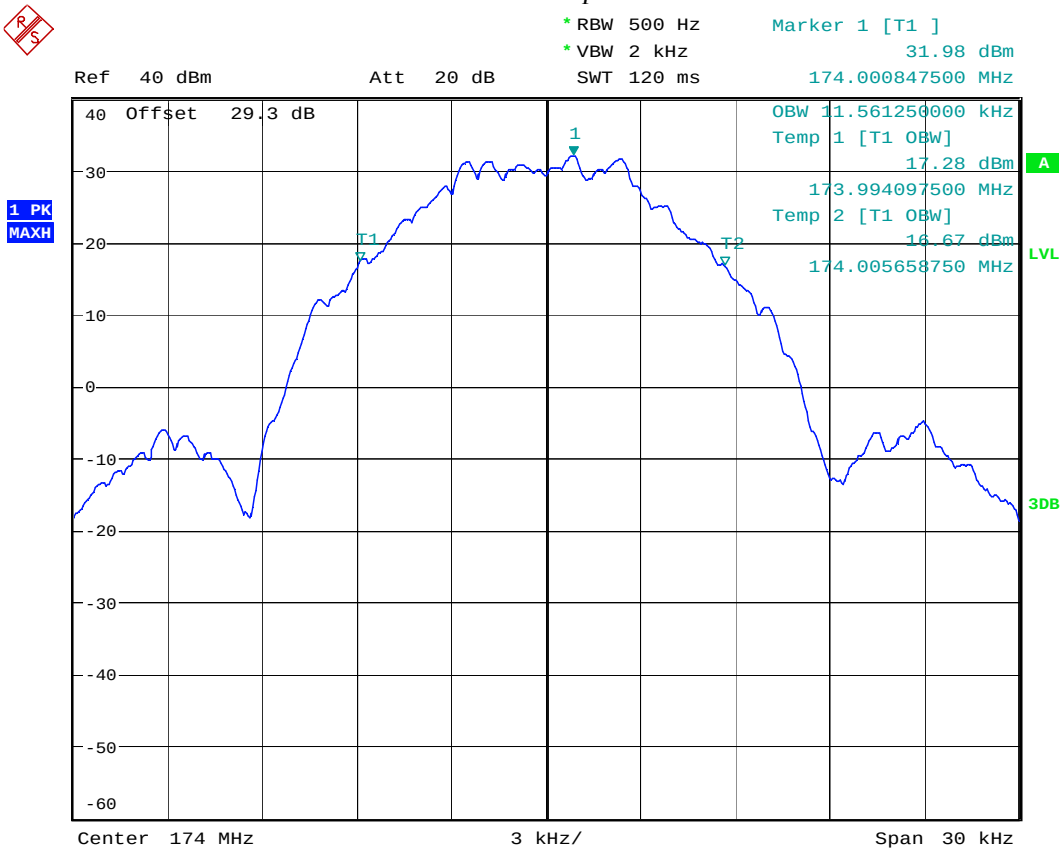
Graph 4. 14



Occupied bandwidth, 20kHz authorized bandwidth, 16QAM

Date: 9.JUN.2011 09:51:08

Graph 4. 15



Occupied bandwidth, 20kHz authorized bandwidth, GMSK

Date: 9.JUN.2011 09:53:22

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 6.25kHz 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 report 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 150.5 MHz and 174 MHz for all five types of modulation.

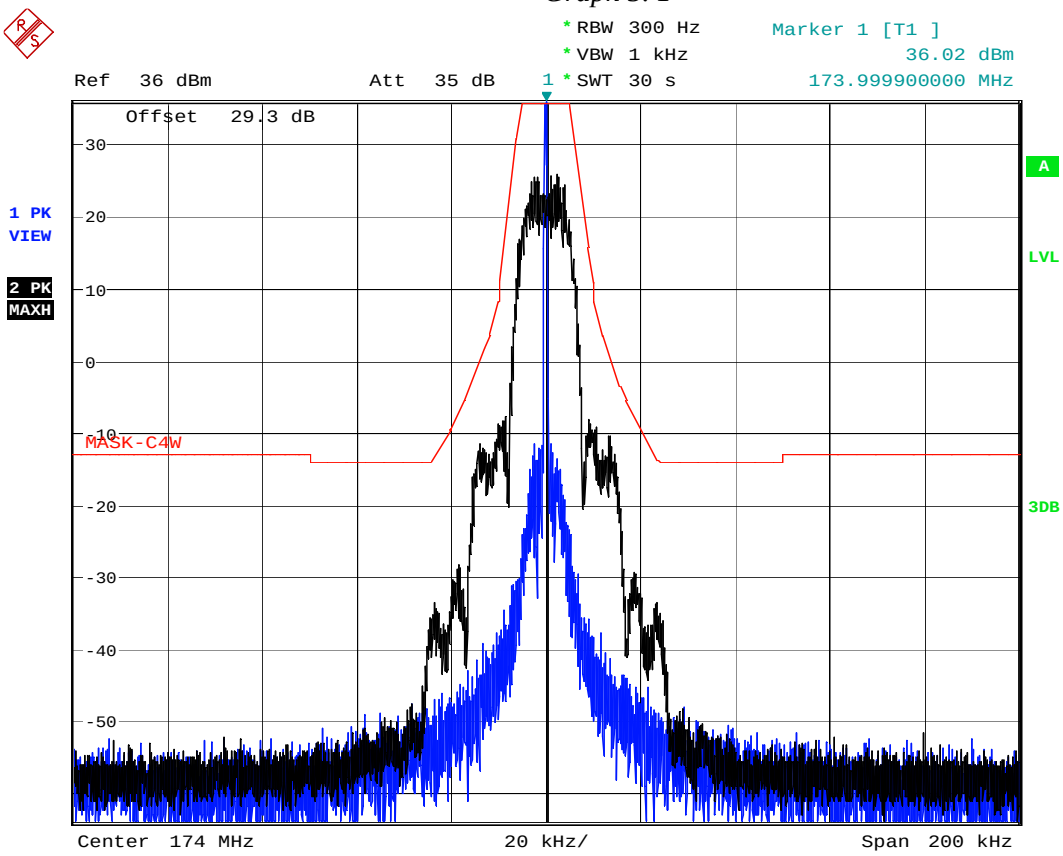
5.3 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer

5.4 Test Results

Complies	Refer to the following Graphs

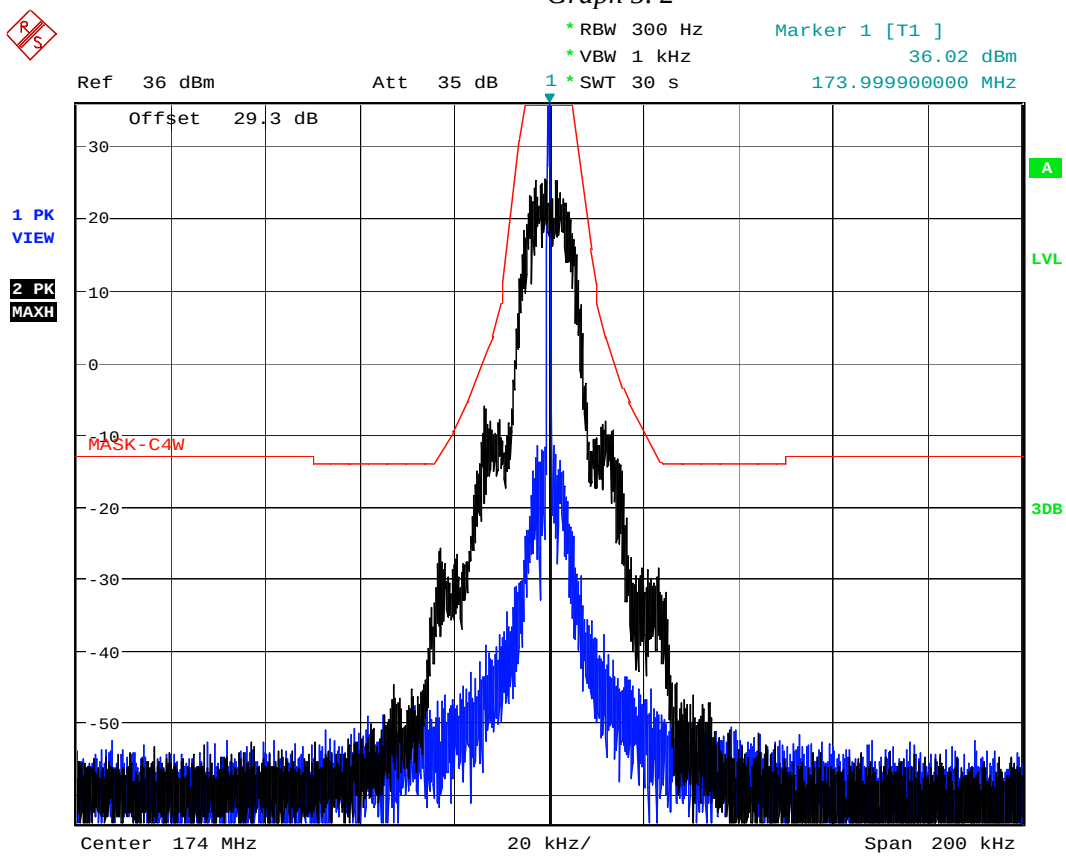
Graph 5. 1



Emission Mask, 25kHz ch. spacing, BPSK

Date: 15.JUN.2011 16:48:57

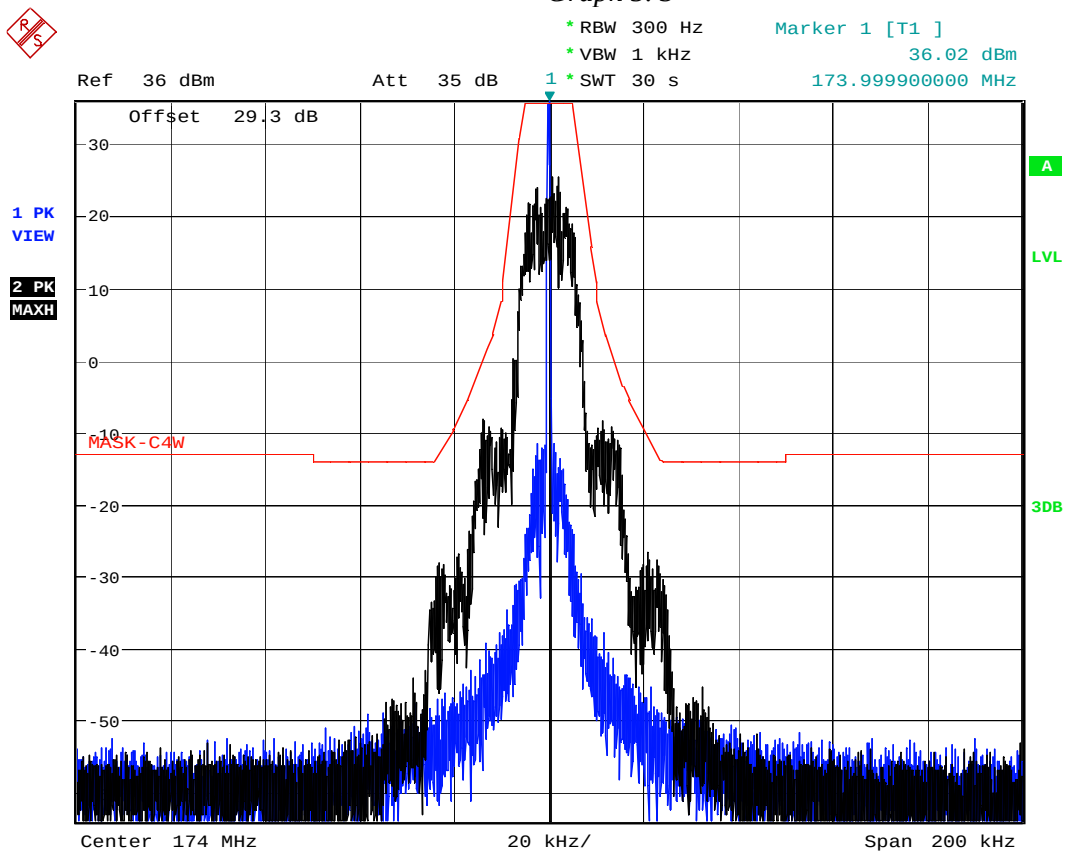
Graph 5. 2



Emission Mask, 25kHz ch. spacing, QPSK

Date: 15.JUN.2011 16:50:11

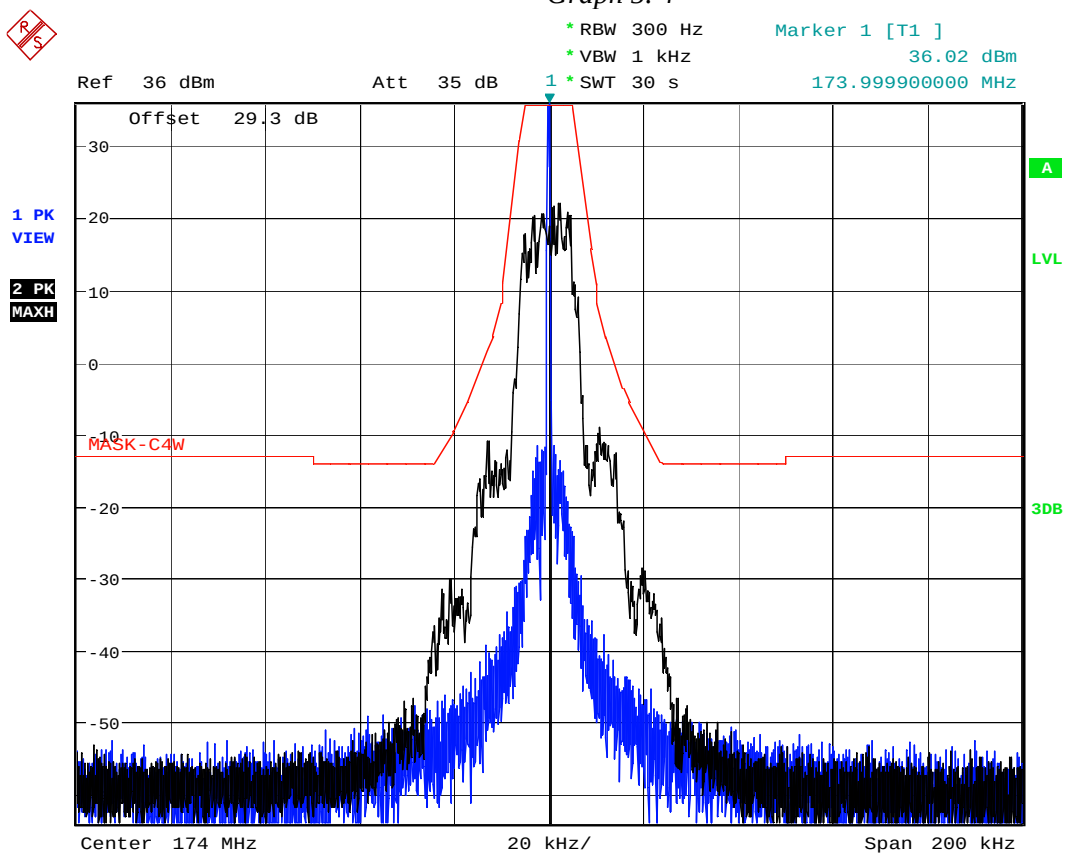
Graph 5. 3



Emission Mask, 25kHz ch. spacing, 8PSK

Date: 15.JUN.2011 16:51:06

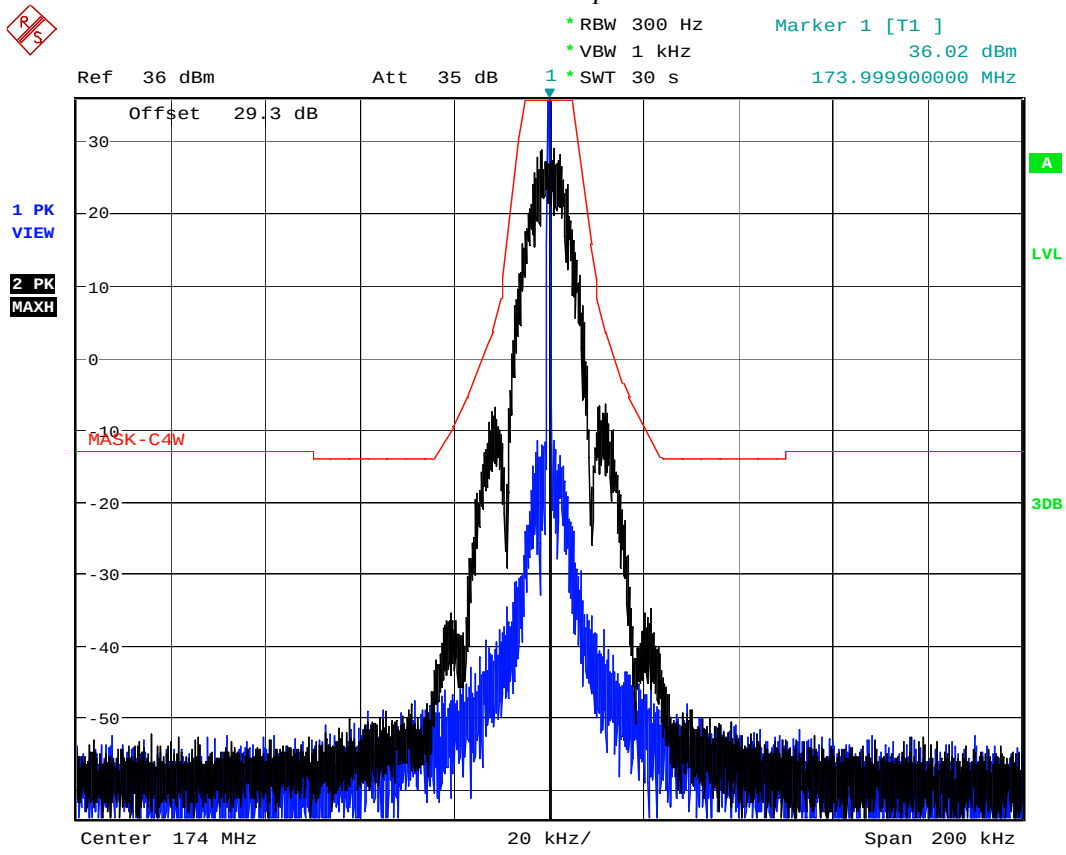
Graph 5. 4



Emission Mask, 25kHz ch. spacing, 16QAM

Date: 15.JUN.2011 16:52:40

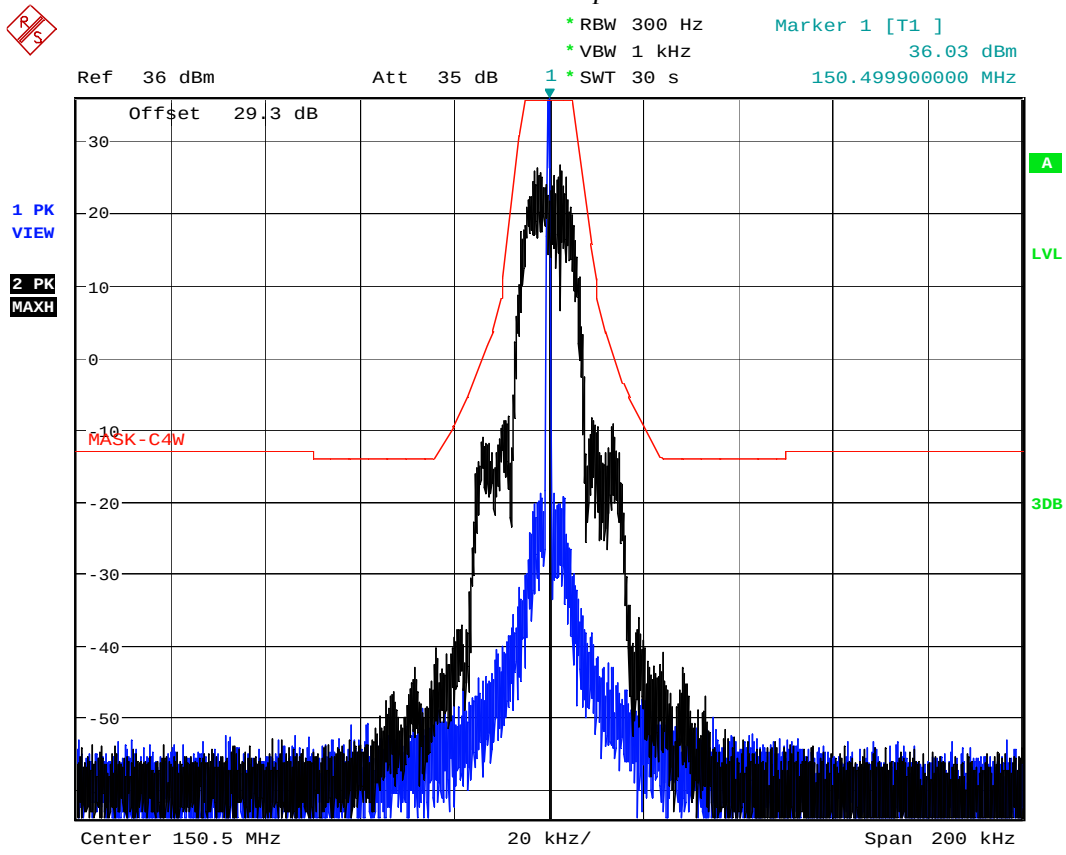
Graph 5. 5



Emission Mask, 25kHz ch. spacing, GMSK

Date: 15.JUN.2011 16:54:07

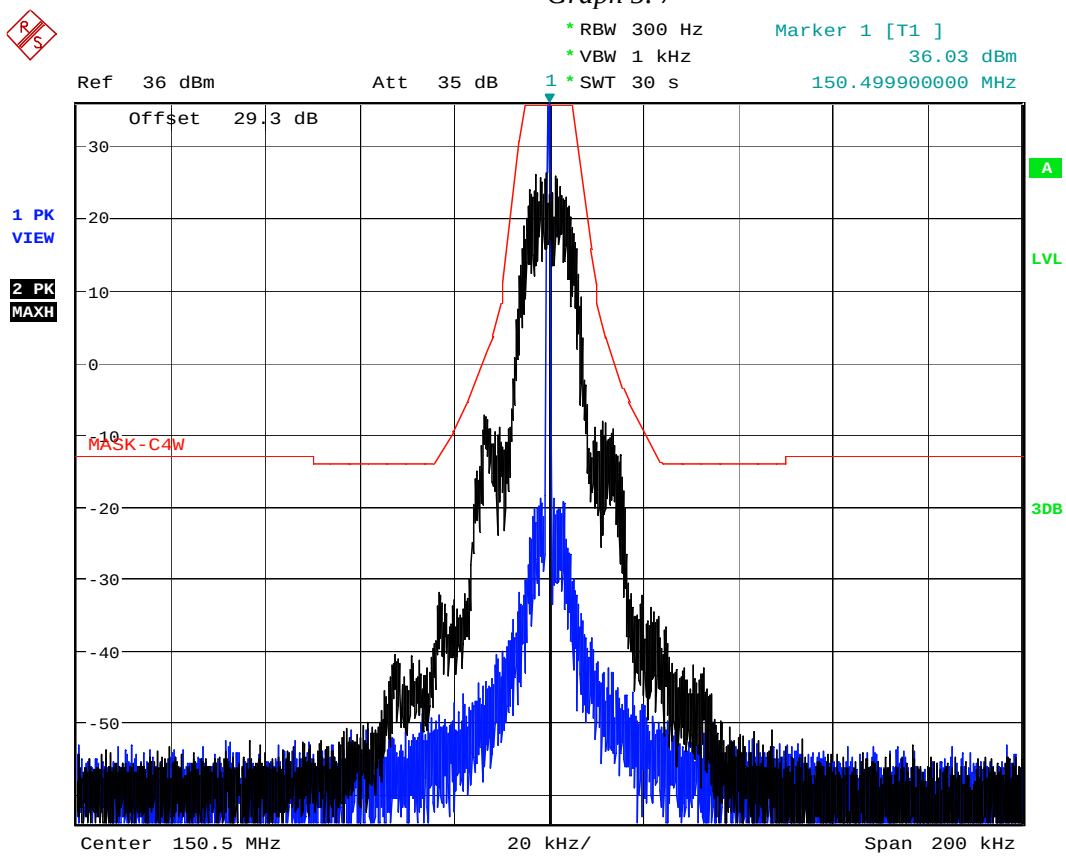
Graph 5. 6



Emission Mask, 25kHz ch. spacing, BPSK

Date: 15.JUN.2011 17:04:47

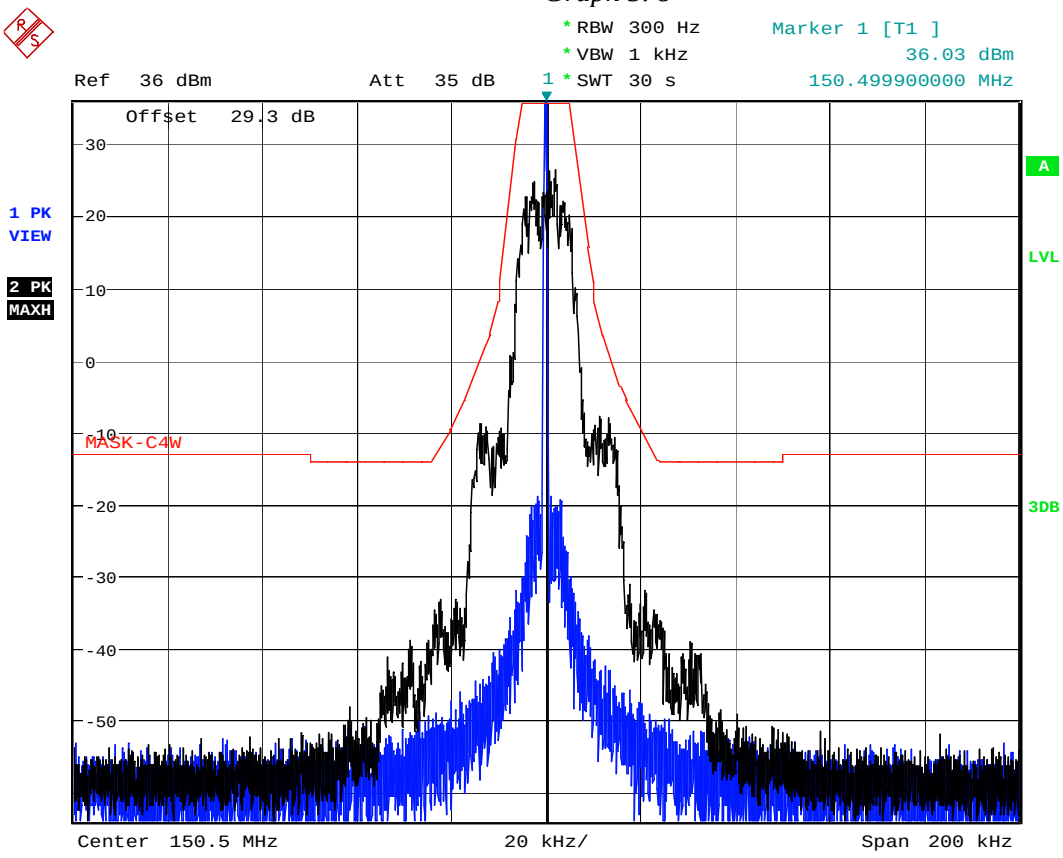
Graph 5. 7



Emission Mask, 25kHz ch. spacing, QPSK

Date: 15.JUN.2011 17:05:43

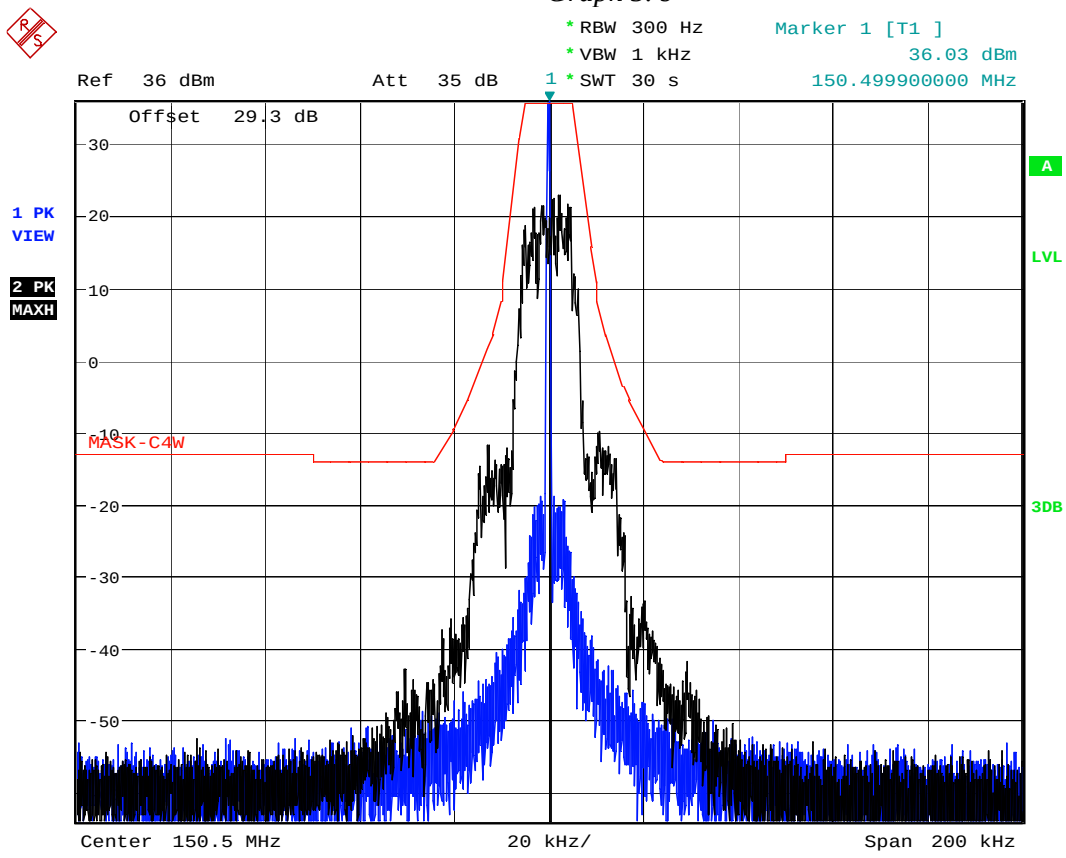
Graph 5. 8



Emission Mask, 25kHz ch. spacing, 8PSK

Date: 15.JUN.2011 17:07:33

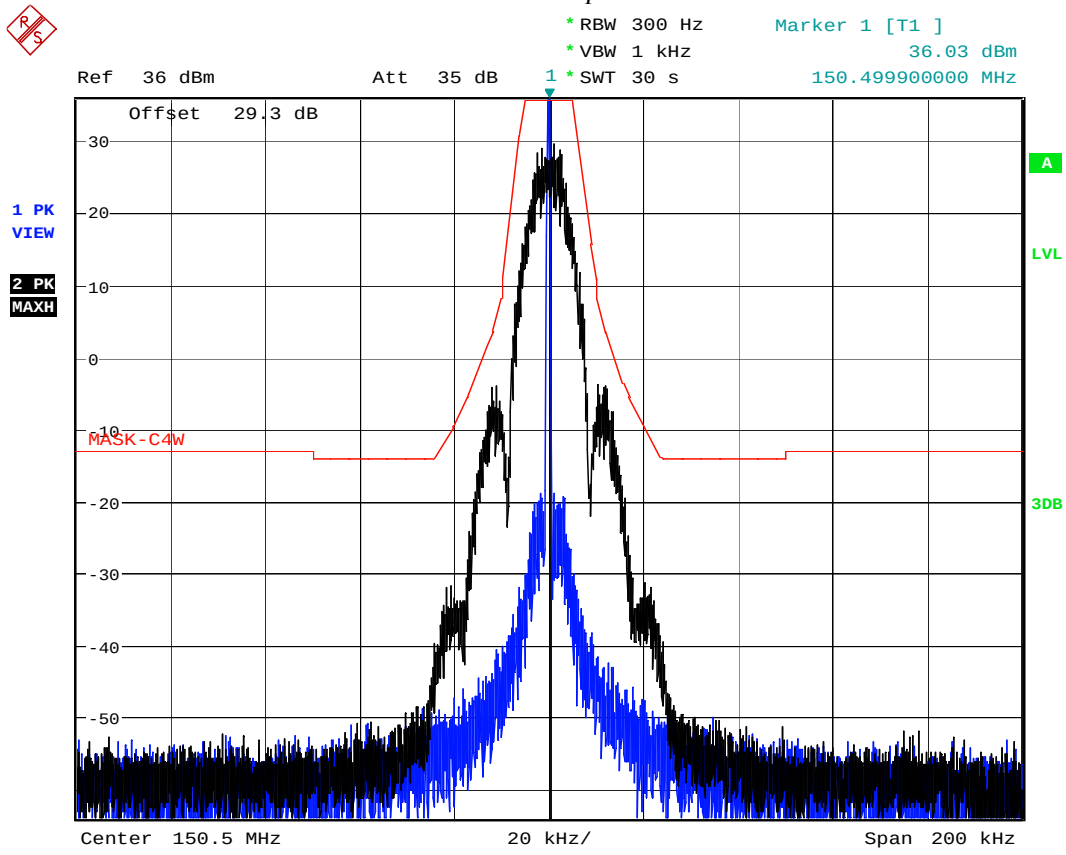
Graph 5. 9



Emission Mask, 25kHz ch. spacing, 16QAM

Date: 15.JUN.2011 17:08:26

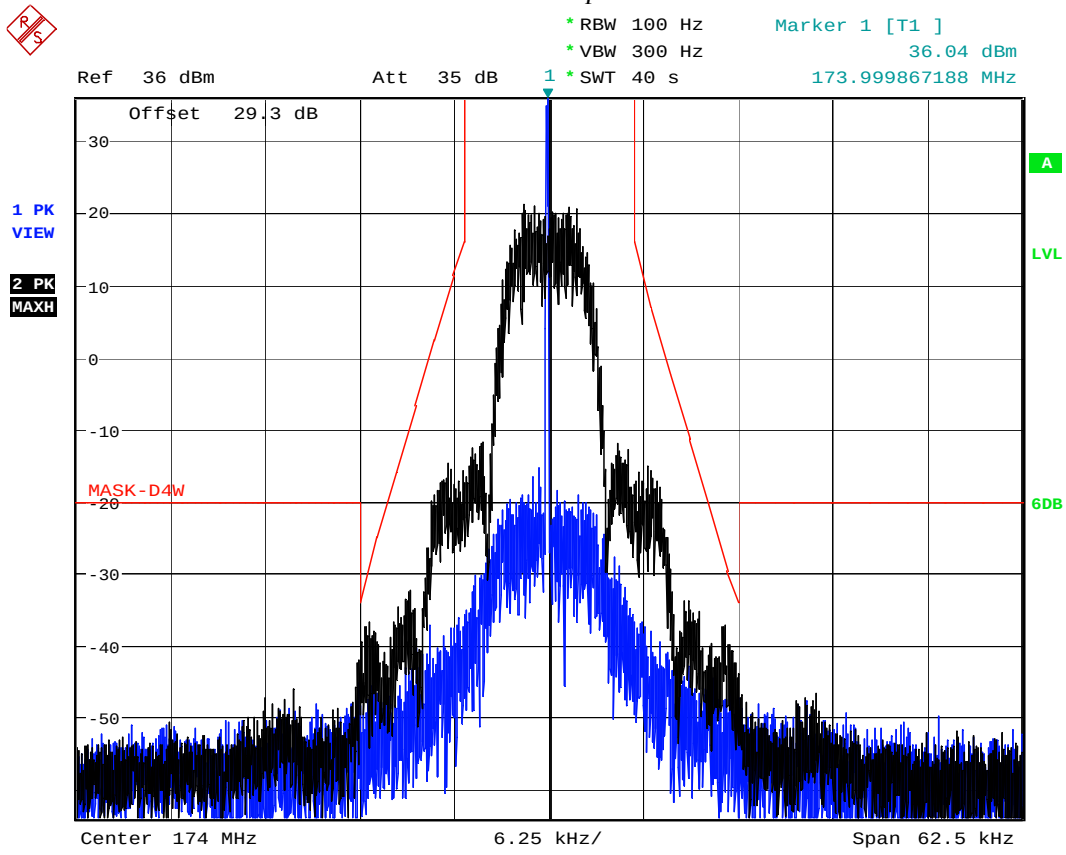
Graph 5. 10



Emission Mask, 25kHz ch. spacing, GMSK

Date: 15.JUN.2011 17:09:42

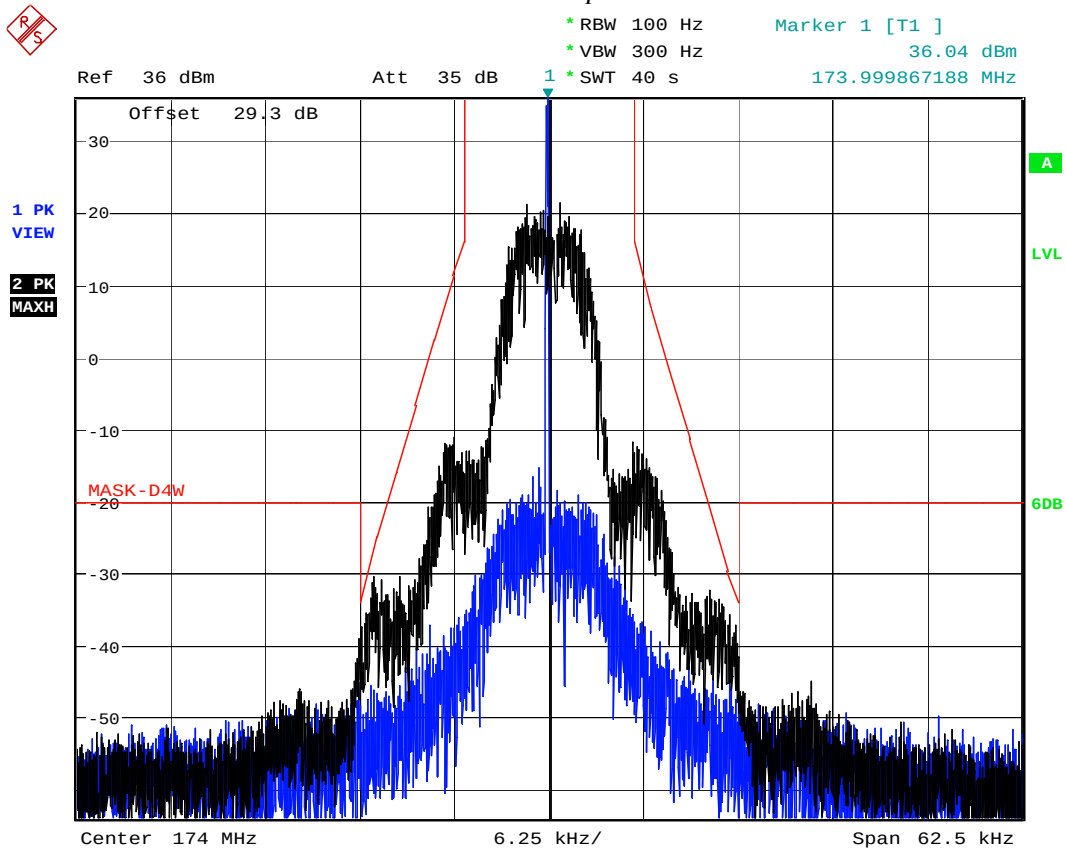
Graph 5. 11



Emission Mask, 12.5kHz ch. spacing, BPSK

Date: 10.JUN.2011 12:06:22

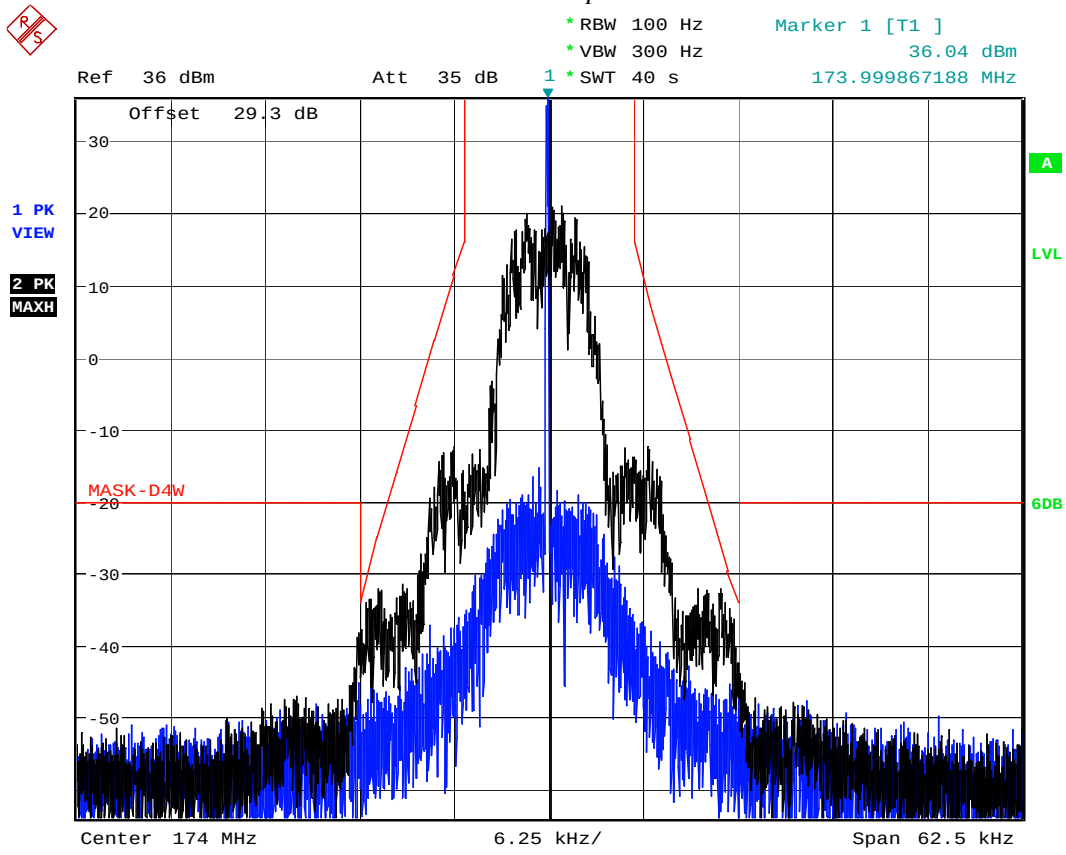
Graph 5. 12



Emission Mask, 12.5kHz ch. spacing, QPSK

Date: 10.JUN.2011 12:09:37

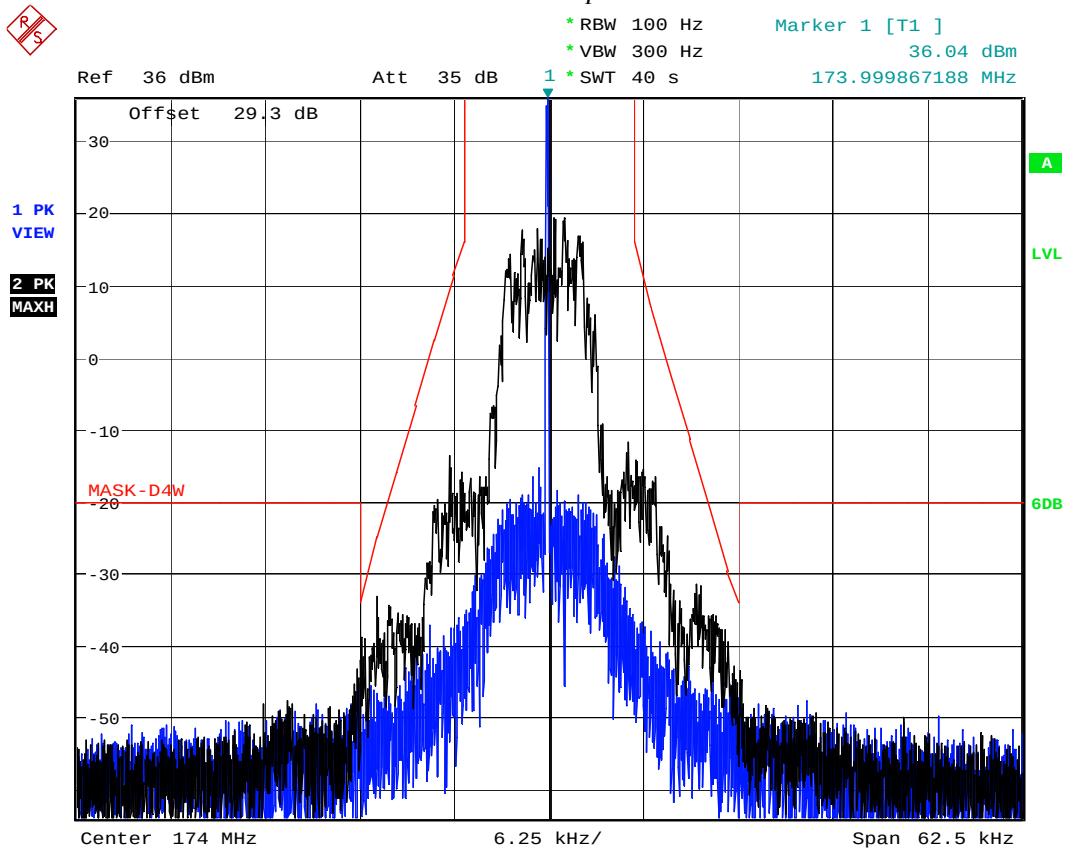
Graph 5. 13



Emission Mask, 12.5kHz ch. spacing, 8PSK

Date: 10.JUN.2011 12:11:12

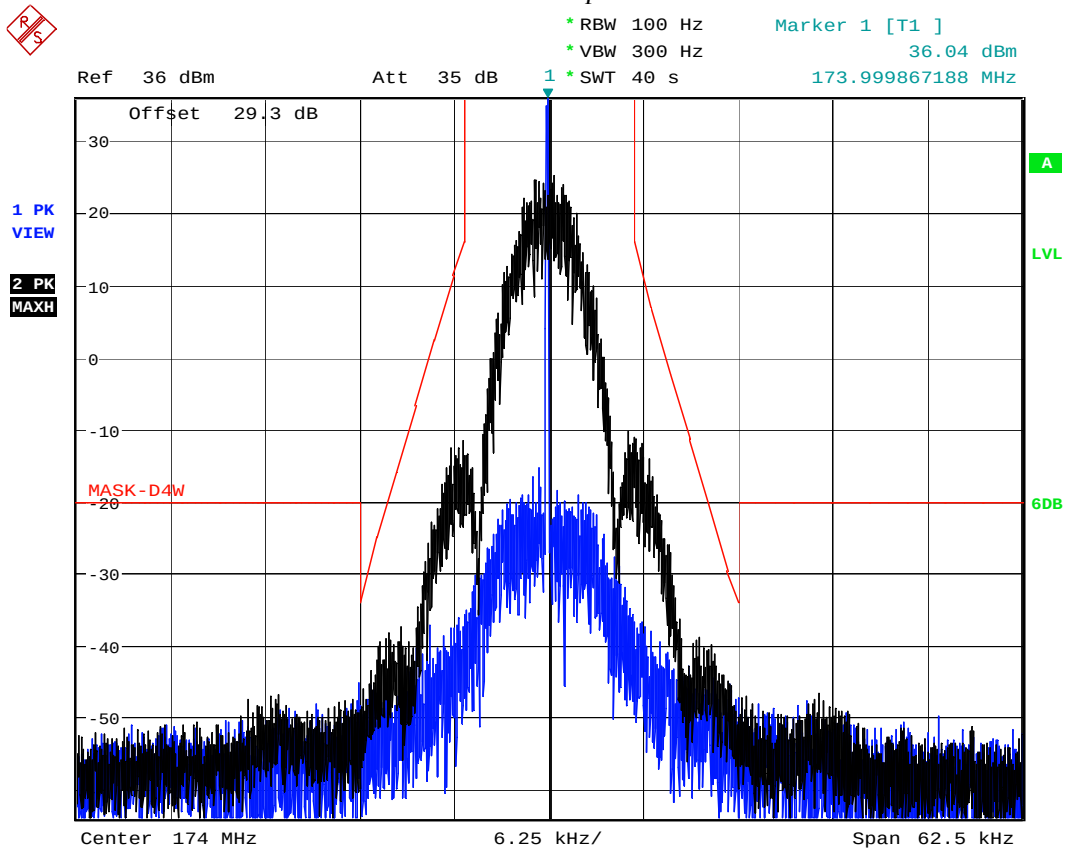
Graph 5. 14



Emission Mask, 12.5kHz ch. spacing, 16QAM

Date: 10.JUN.2011 12:12:44

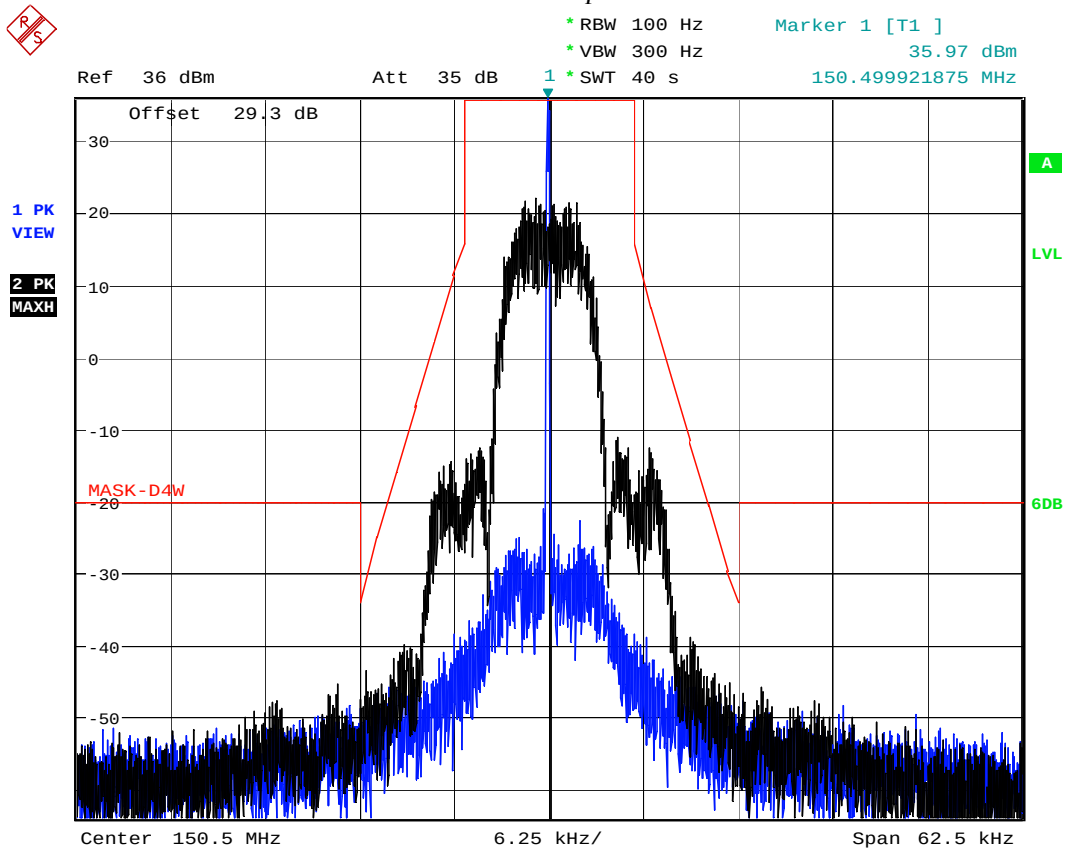
Graph 5. 15



Emission Mask, 12.5kHz ch. spacing, GMSK

Date: 10.JUN.2011 12:14:27

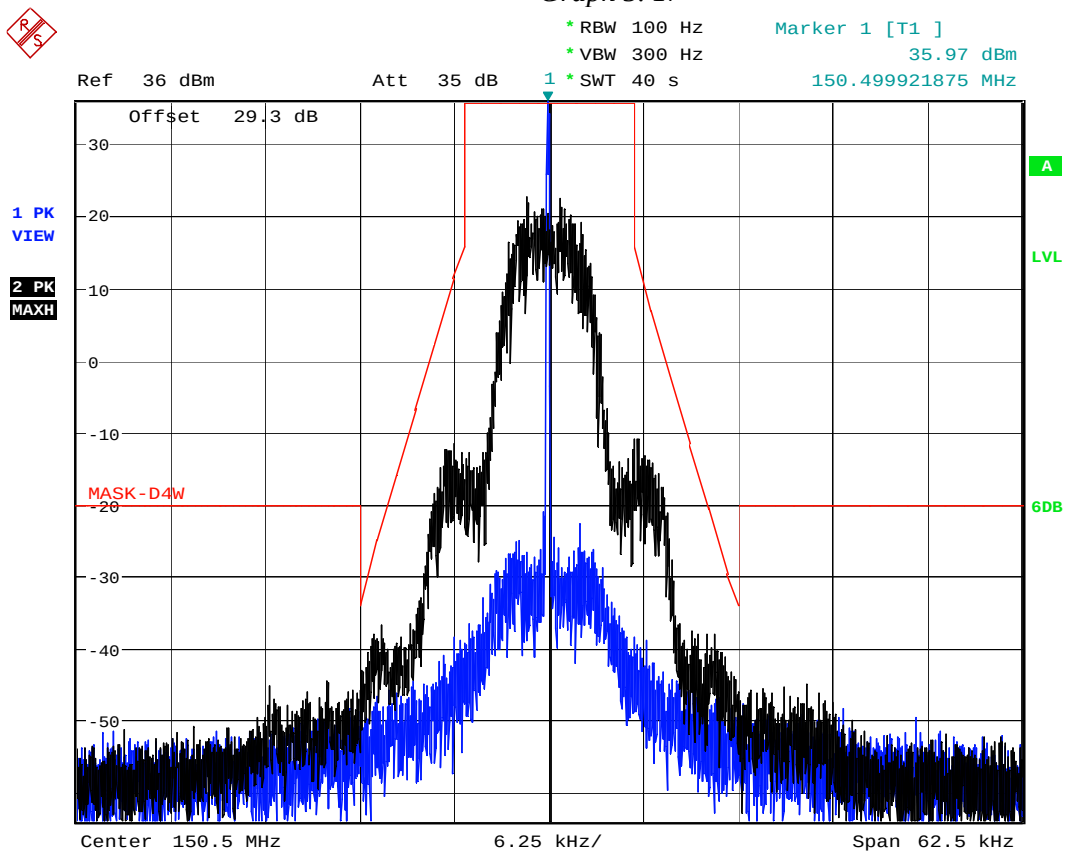
Graph 5. 16



Emission Mask, 12.5kHz ch. spacing, BPSK

Date: 10.JUN.2011 13:24:53

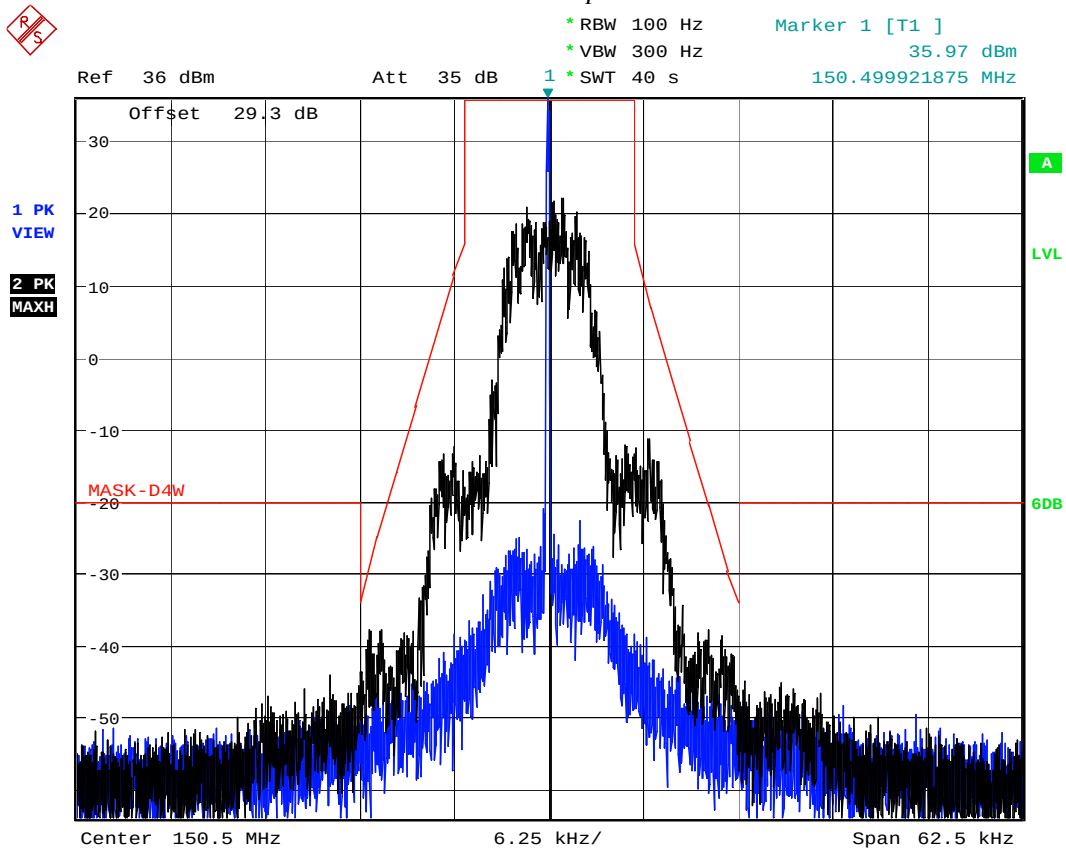
Graph 5. 17



Emission Mask, 12.5kHz ch. spacing, QPSK

Date: 10.JUN.2011 13:26:45

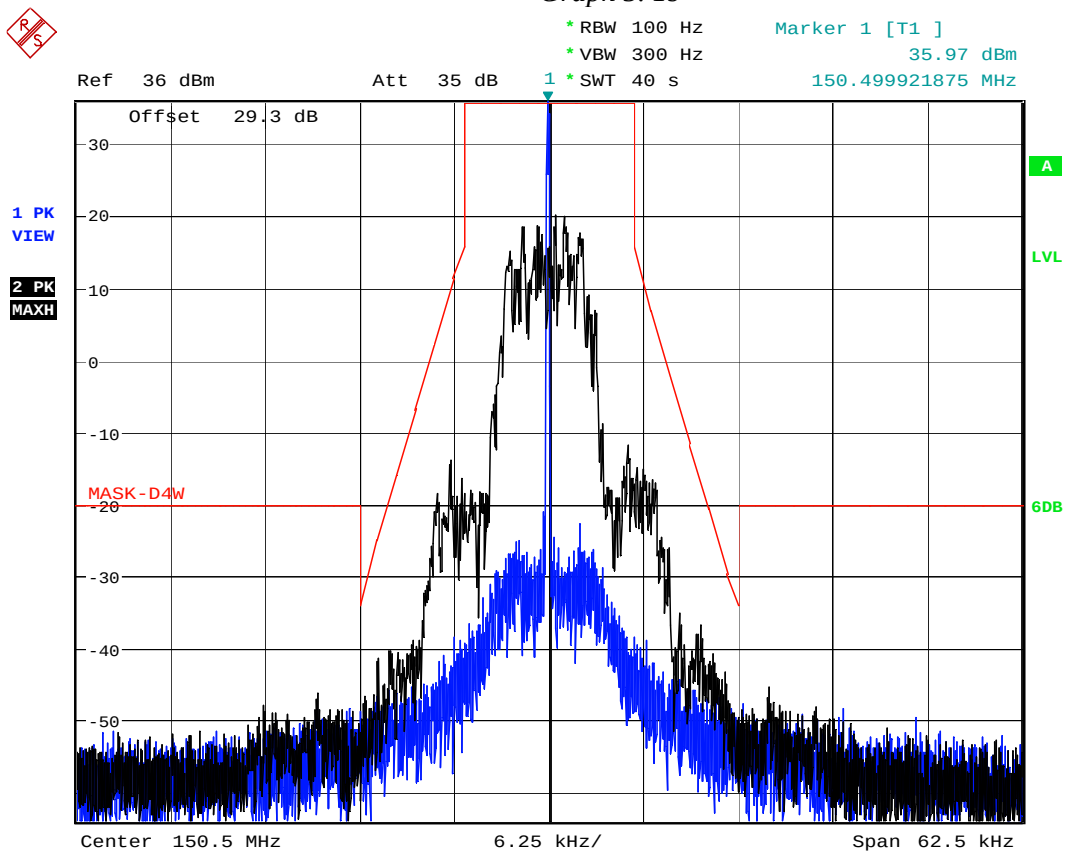
Graph 5. 18



Emission Mask, 12.5kHz ch. spacing, 8PSK

Date: 10.JUN.2011 13:28:20

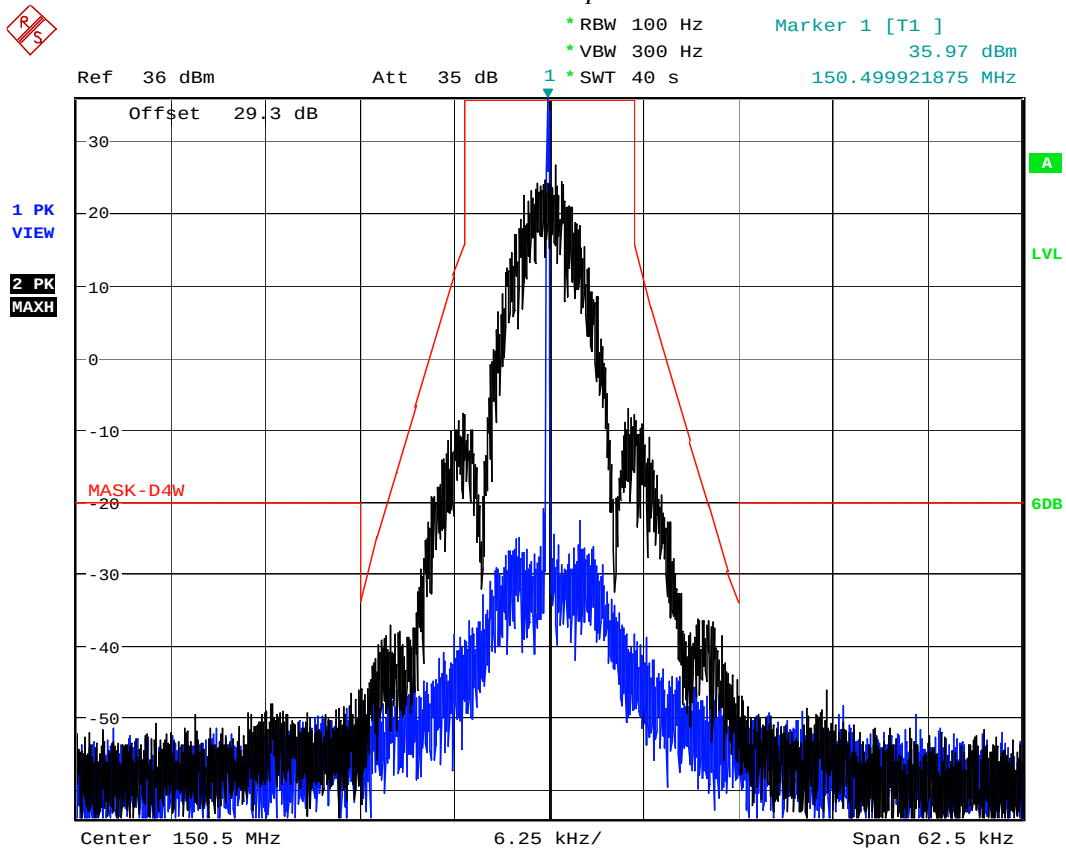
Graph 5. 19



Emission Mask, 12.5kHz ch. spacing, 16QAM

Date: 10.JUN.2011 13:30:02

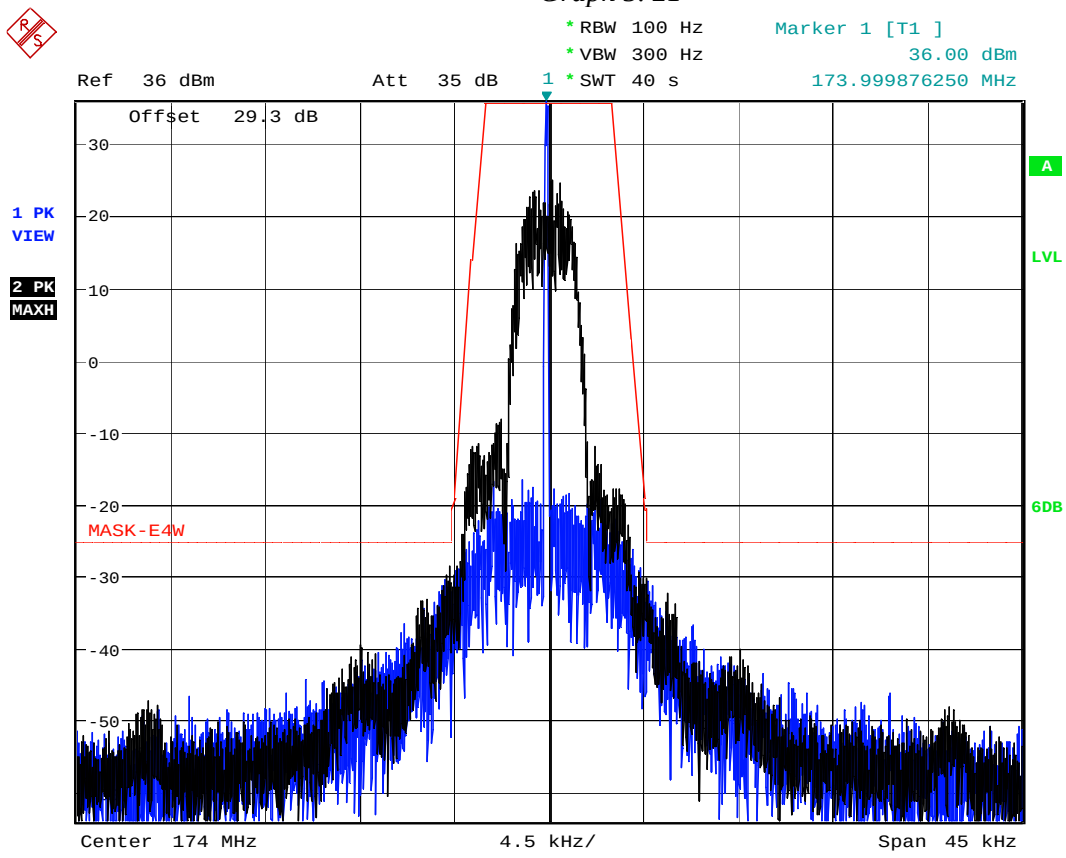
Graph 5. 20



Emission Mask, 12.5kHz ch. spacing, GMSK

Date: 10.JUN.2011 13:31:46

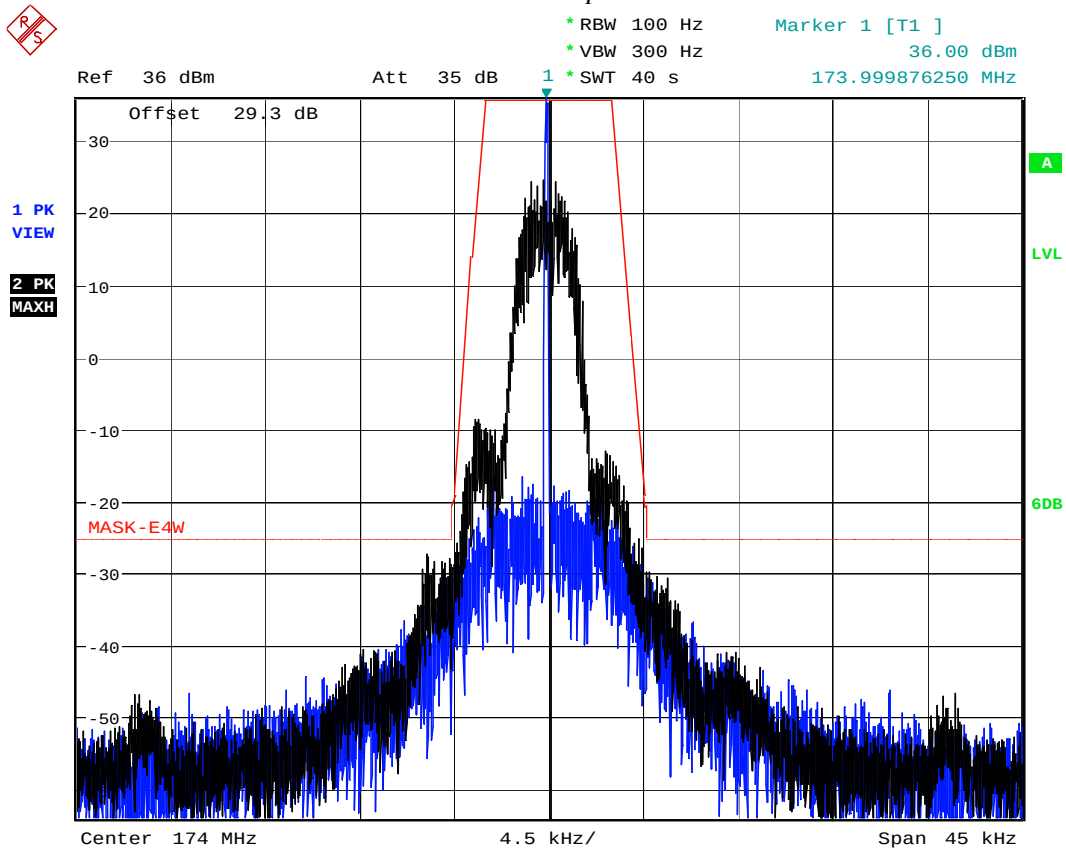
Graph 5. 21



Emission Mask, 6.25kHz ch. spacing, BPSK

Date: 10.JUN.2011 10:57:25

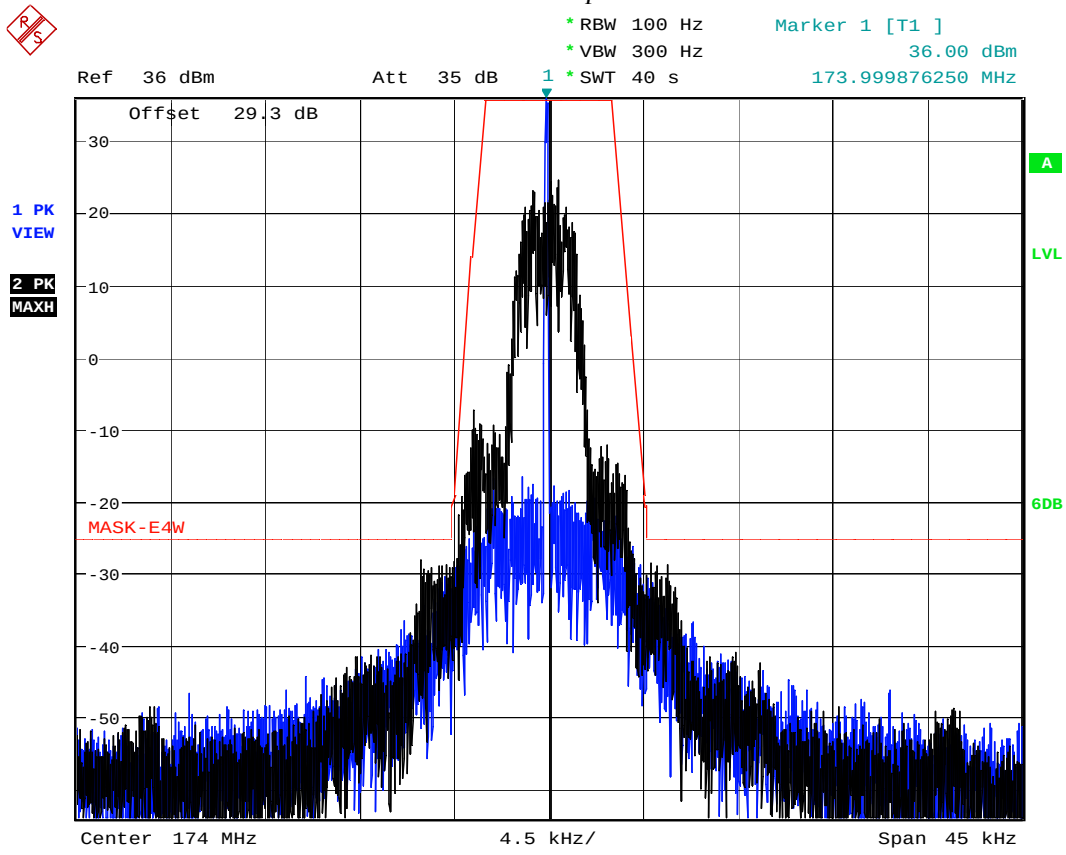
Graph 5. 22



Emission Mask, 6.25kHz ch. spacing, QPSK

Date: 10.JUN.2011 11:00:43

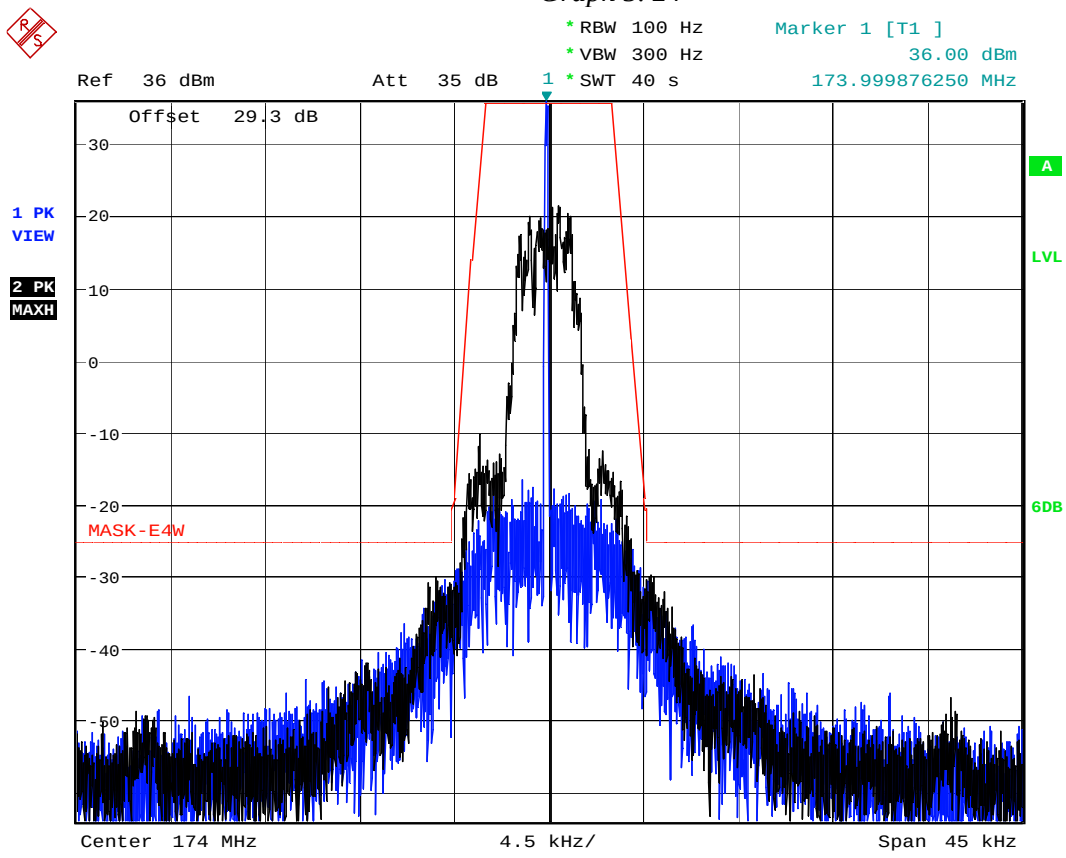
Graph 5. 23



Emission Mask, 6.25kHz ch. spacing, 8PSK

Date: 10.JUN.2011 11:02:17

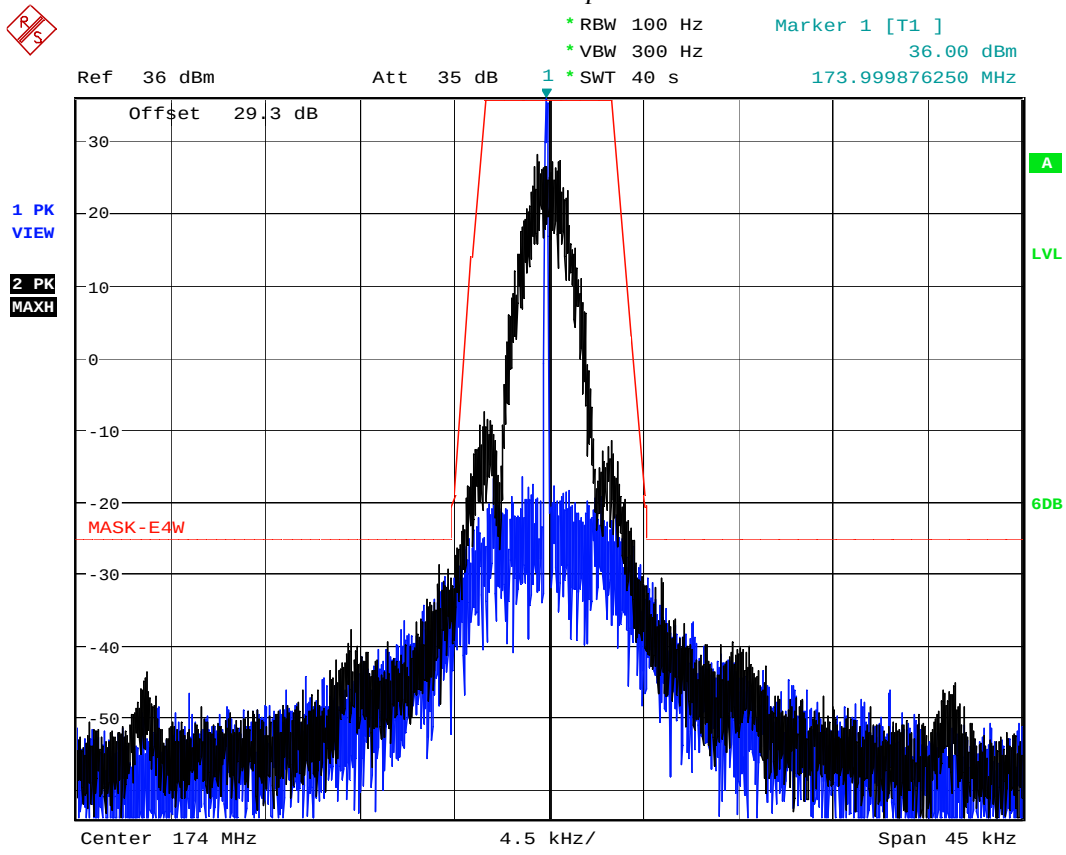
Graph 5. 24



Emission Mask, 6.25kHz ch. spacing, 16QAM

Date: 10.JUN.2011 11:04:30

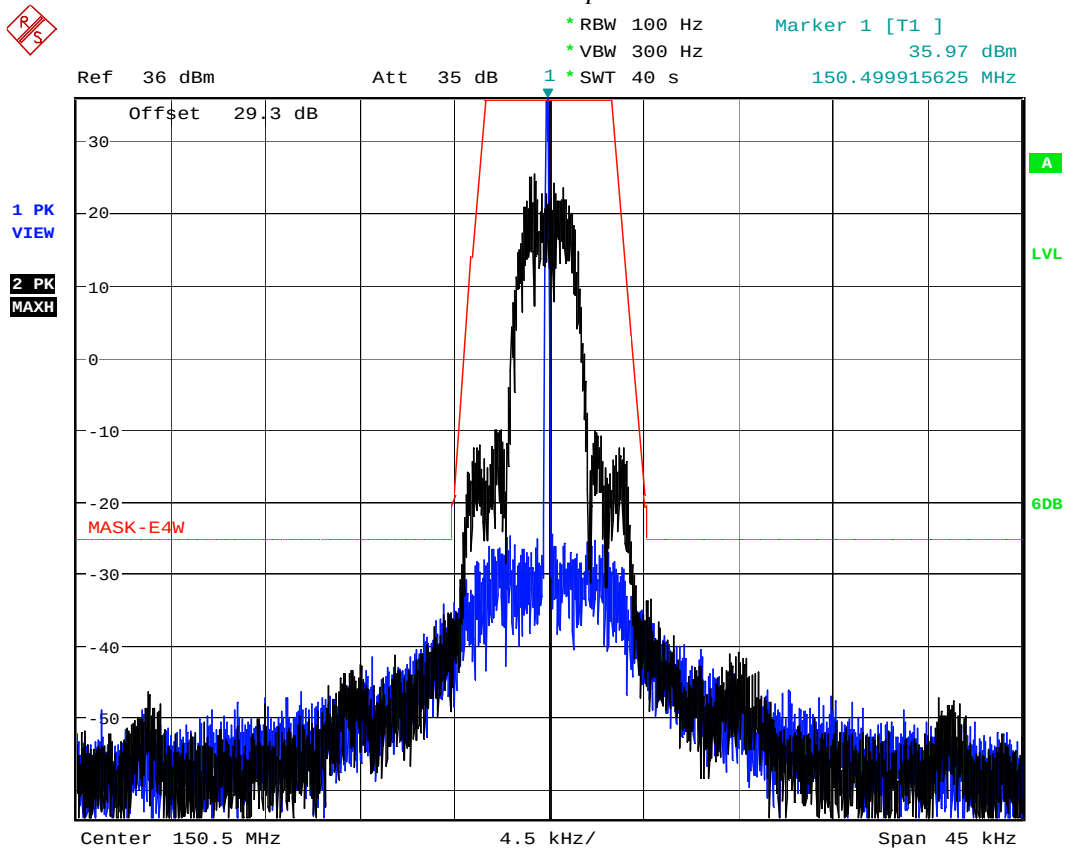
Graph 5. 25



Emission Mask, 6.25kHz ch. spacing, GMSK

Date: 10.JUN.2011 11:06:10

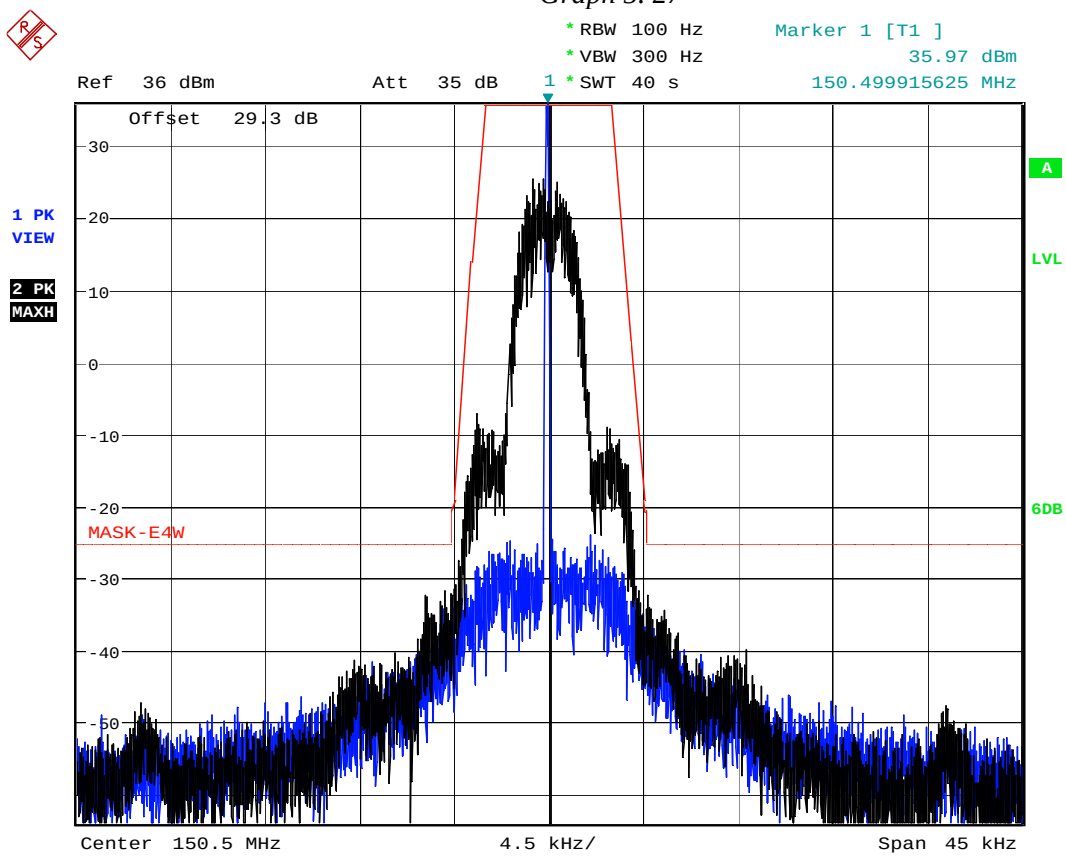
Graph 5. 26



Emission Mask, 6.25kHz ch. spacing, BPSK

Date: 10.JUN.2011 11:13:23

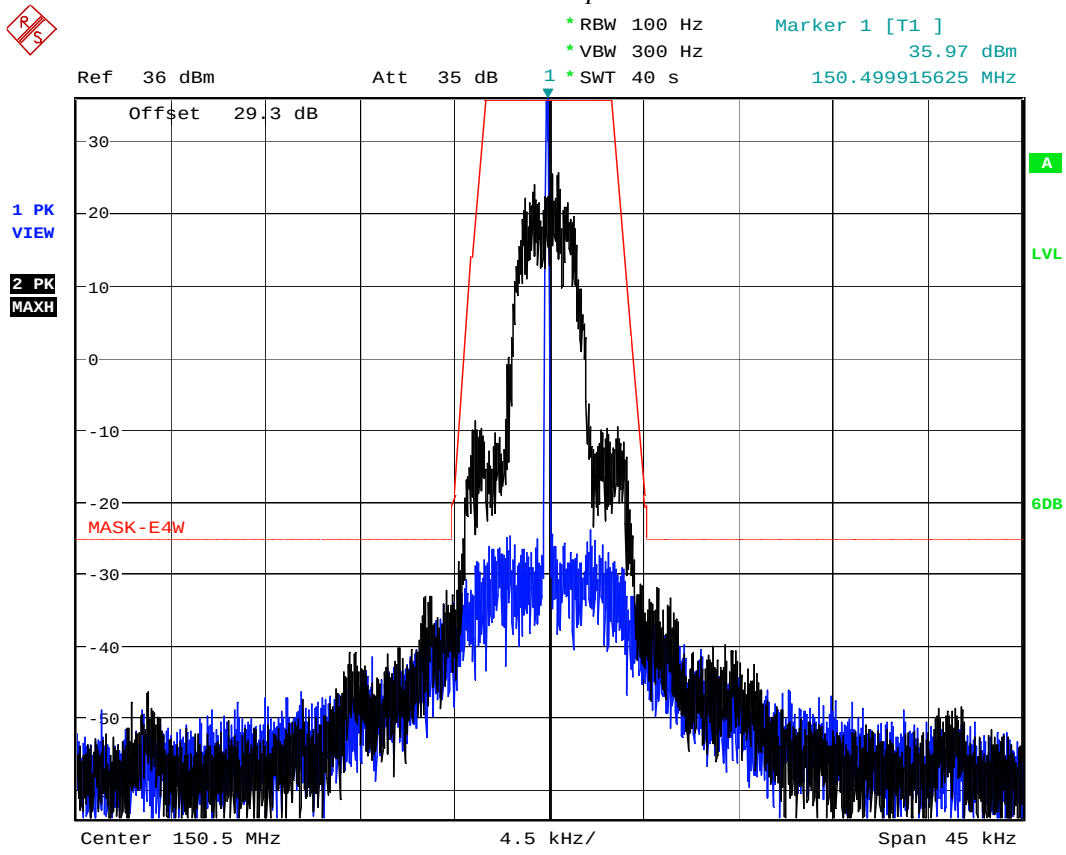
Graph 5. 27



Emission Mask, 6.25kHz ch. spacing, QPSK

Date: 10.JUN.2011 11:14:58

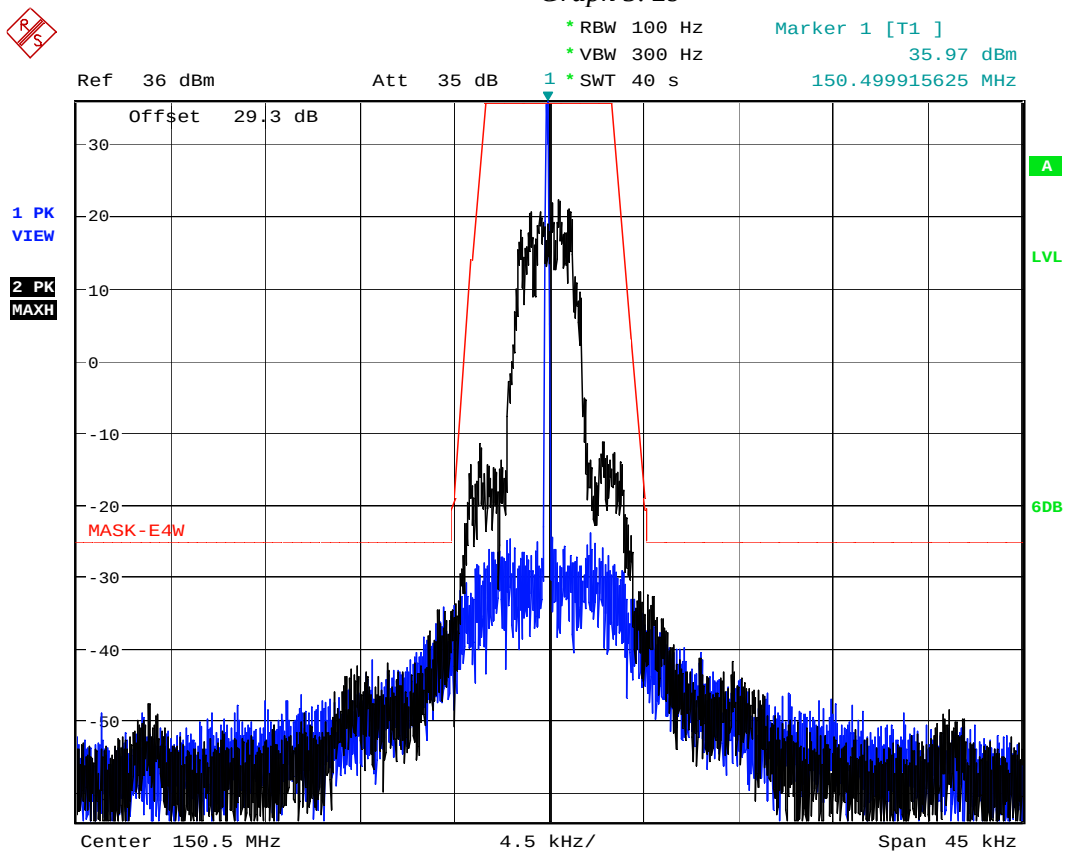
Graph 5. 28



Emission Mask, 6.25kHz ch. spacing, 8PSK

Date: 10.JUN.2011 11:16:50

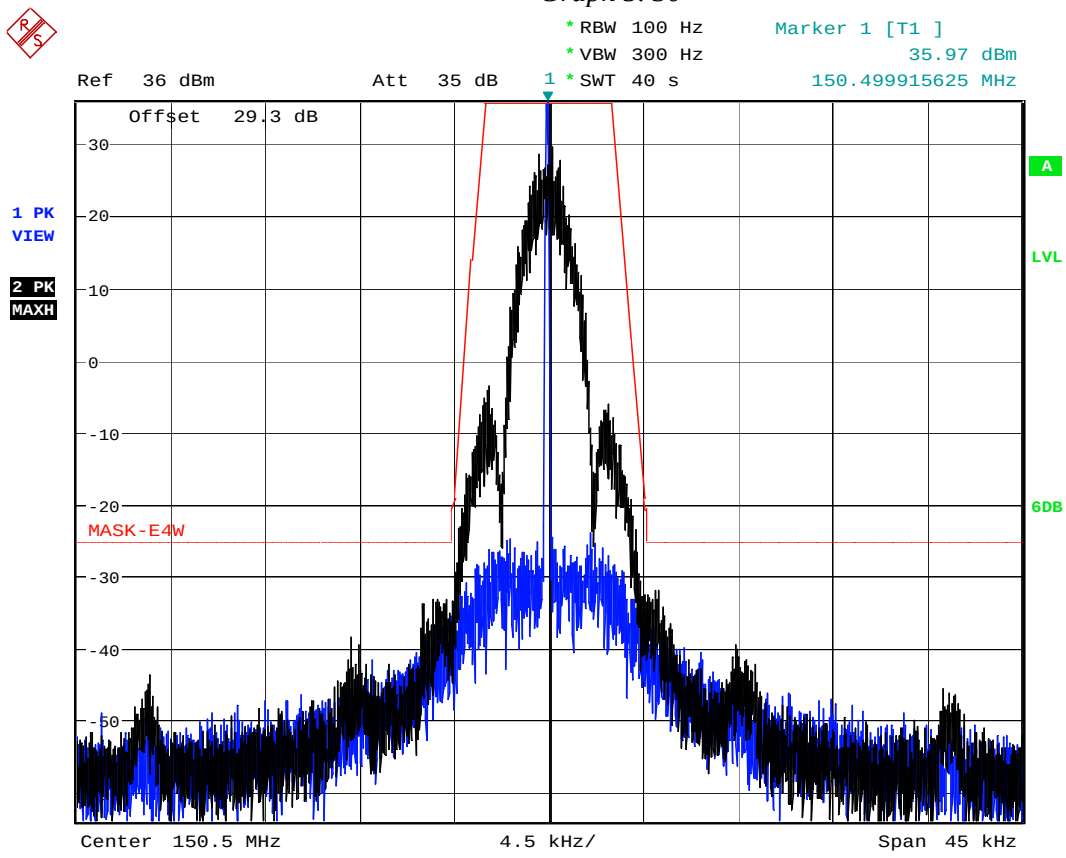
Graph 5. 29



Emission Mask, 6.25kHz ch. spacing, 16QAM

Date: 10.JUN.2011 11:18:30

Graph 5. 30



Emission Mask, 6.25kHz ch. spacing, GMSK

Date: 10.JUN.2011 11:20:12

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 report 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.

Measurements were performed at different modulations and channel bandwidths. The worst case data was reported.

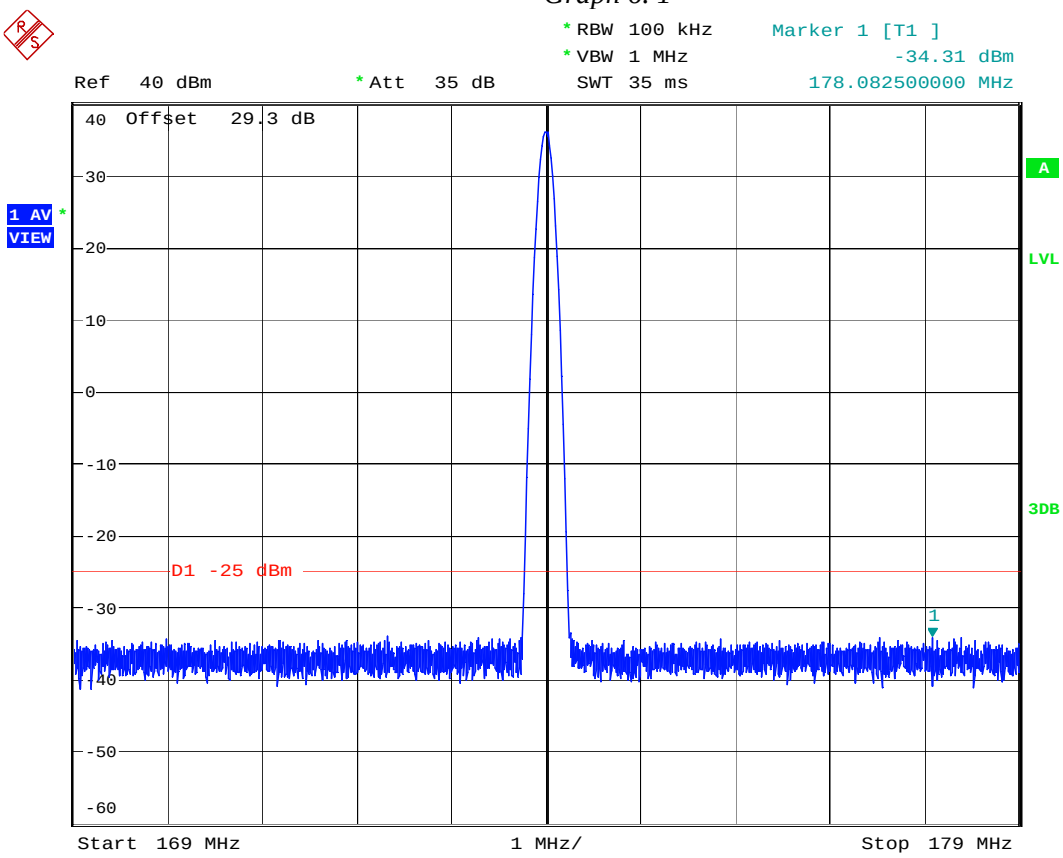
6.3 Test Equipment

Rohde & Schwarz FSU26 Spectrum Analyzer

6.4 Test Results

Complies	Refer to the following Graphs

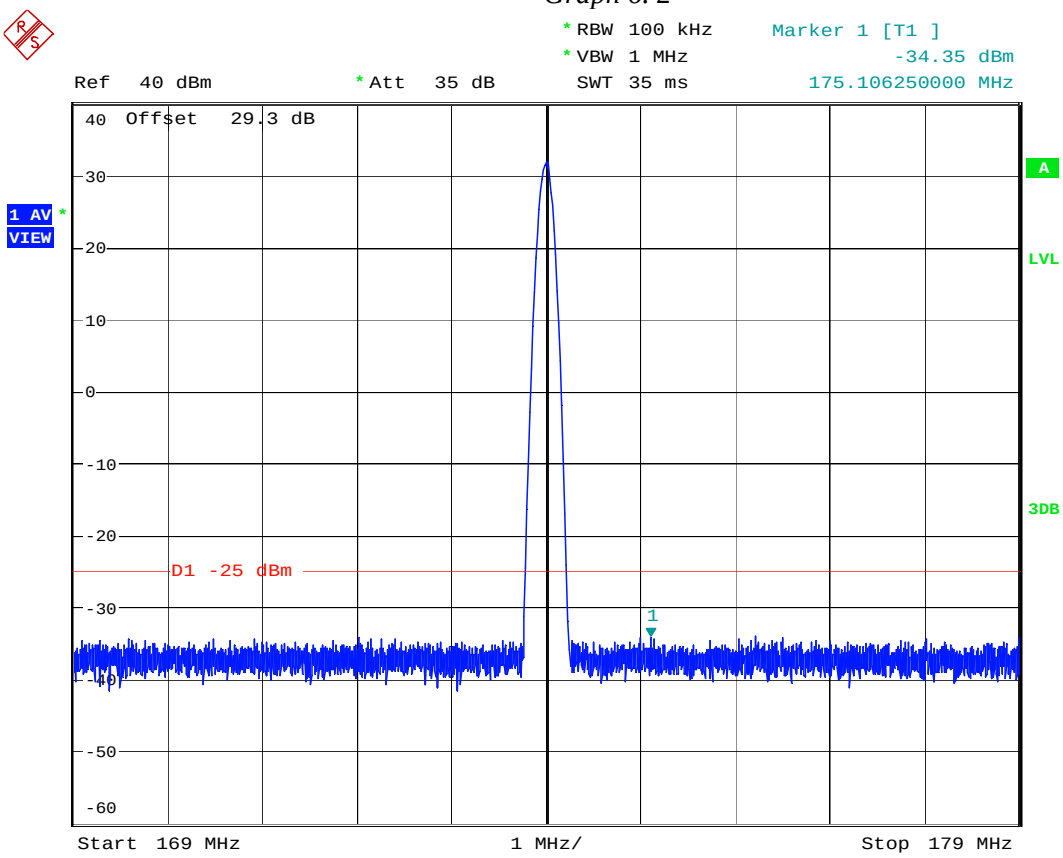
Graph 6. 1



Conducted spurious, 174MHz, Unmodulated

Date: 9.JUN.2011 13:21:06

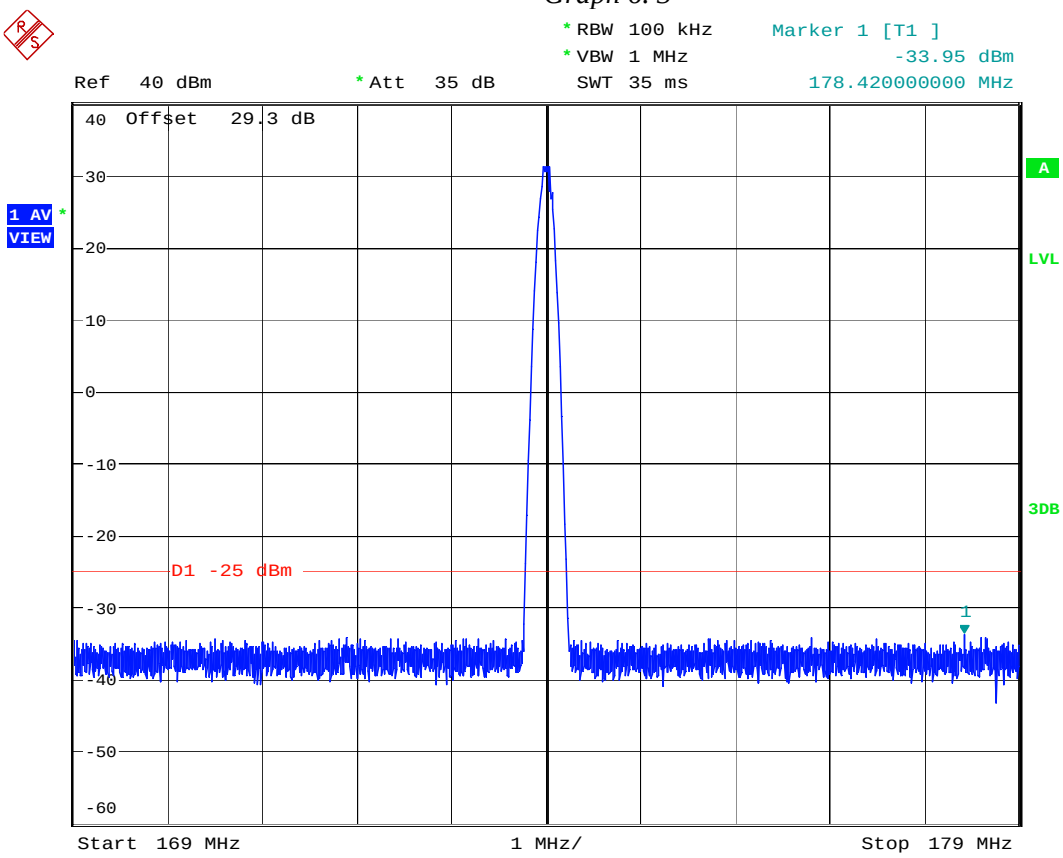
Graph 6. 2



Conducted spurious, 174MHz, BPSK

Date: 9.JUN.2011 13:22:07

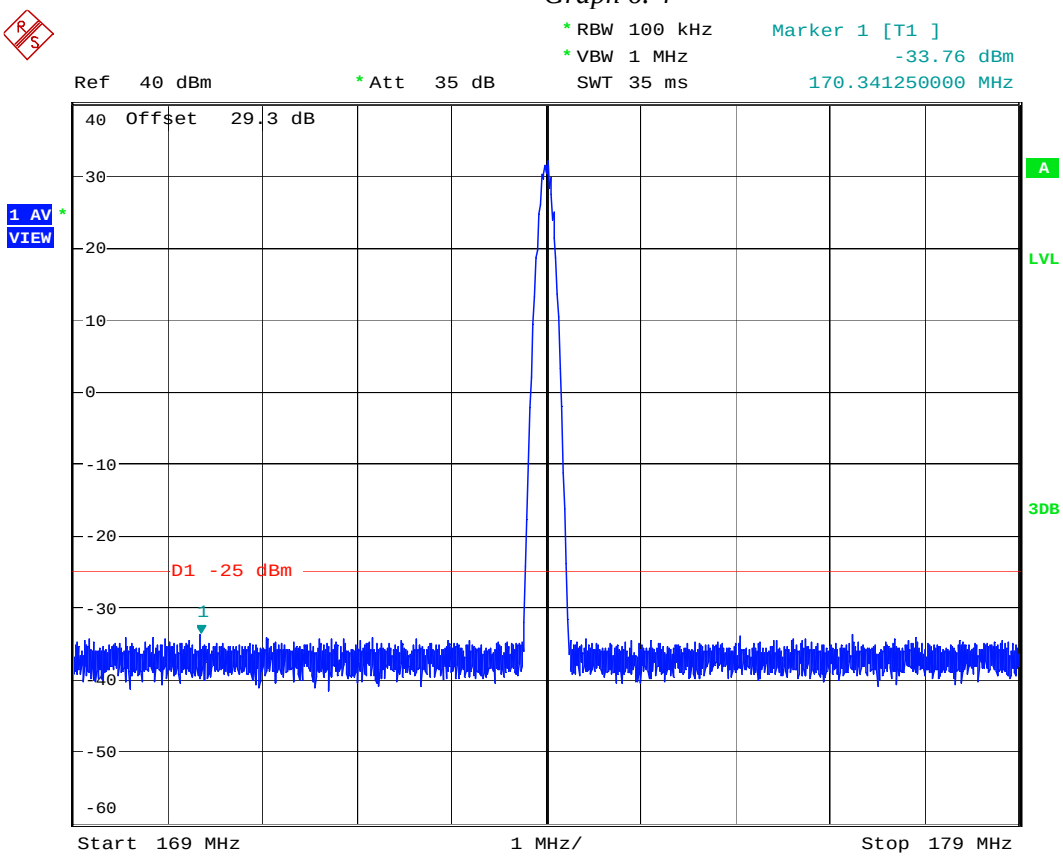
Graph 6. 3



Conducted spurious, 174MHz, QPSK

Date: 9.JUN.2011 13:23:06

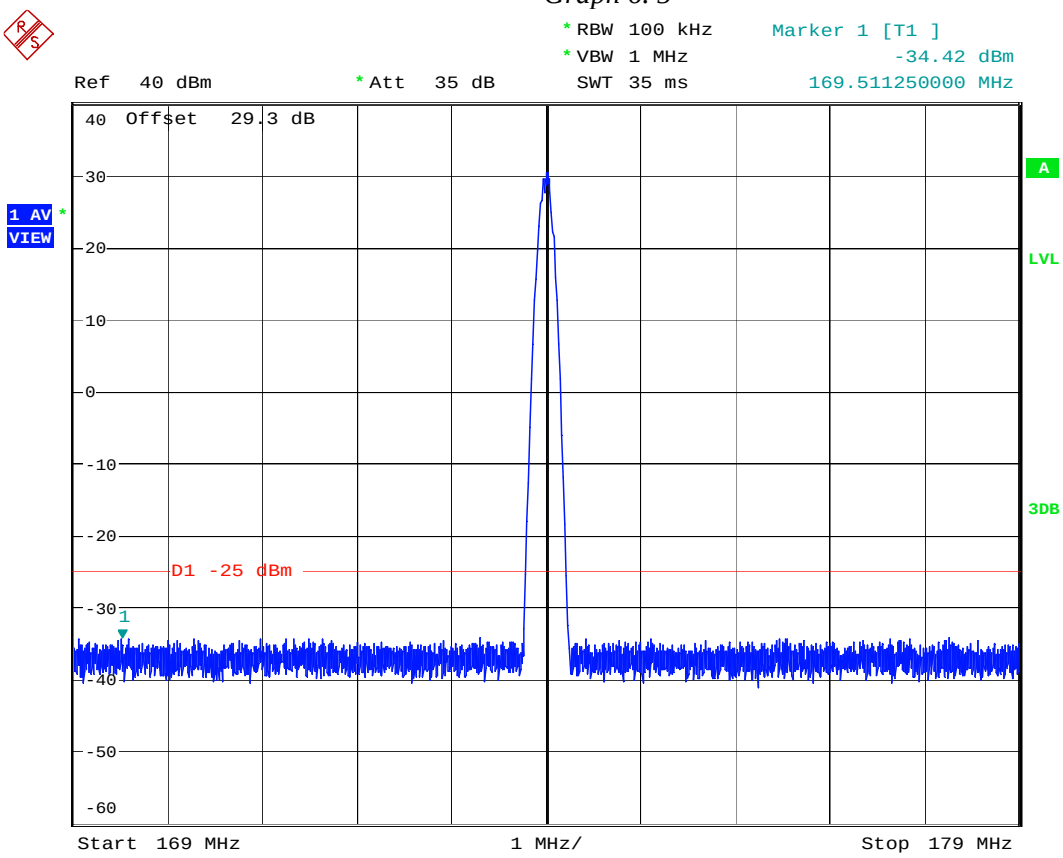
Graph 6. 4



Conducted spurious, 174MHz, 8PSK

Date: 9.JUN.2011 13:24:06

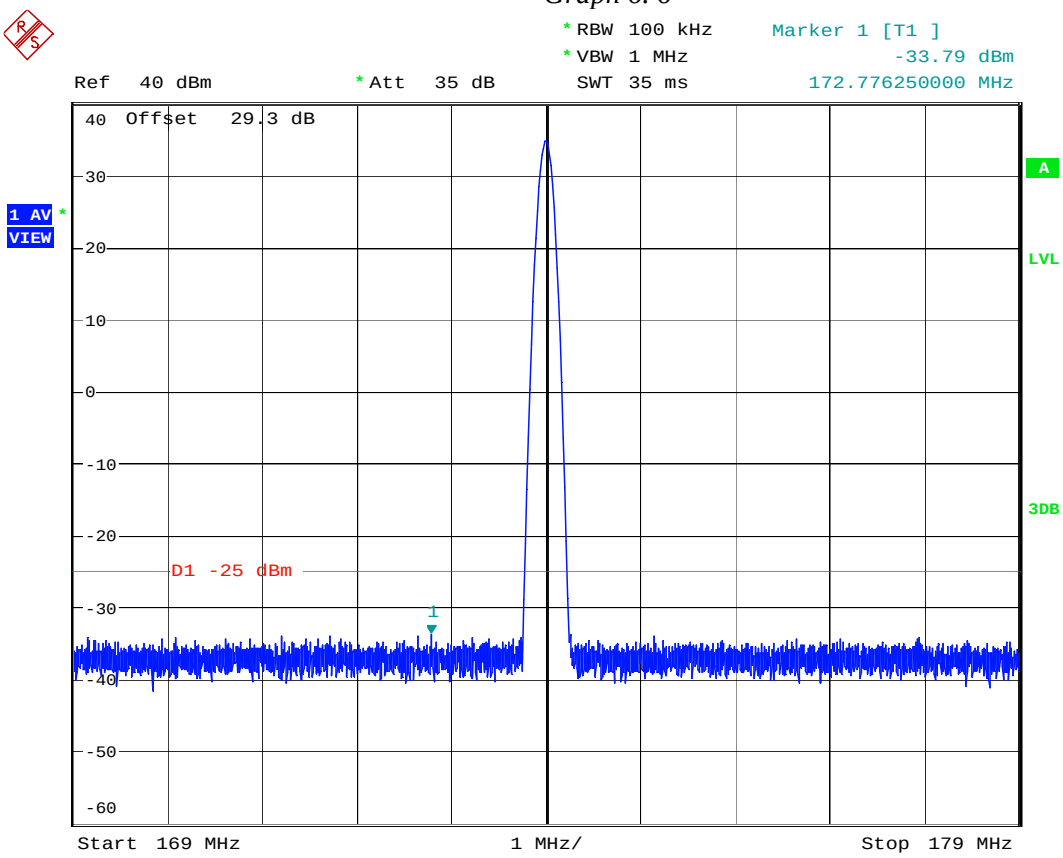
Graph 6. 5



Conducted spurious, 174MHz, 16QAM

Date: 9.JUN.2011 13:25:04

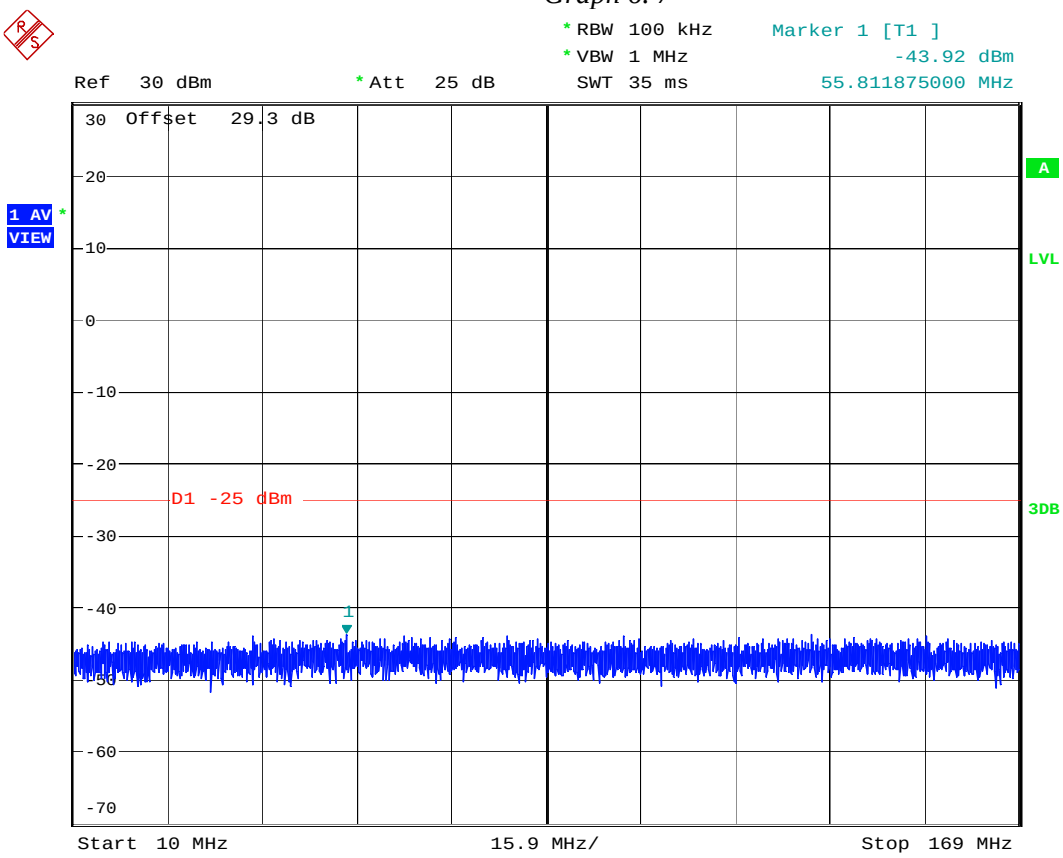
Graph 6. 6



Conducted spurious, 174MHz, GMSK

Date: 9.JUN.2011 13:25:59

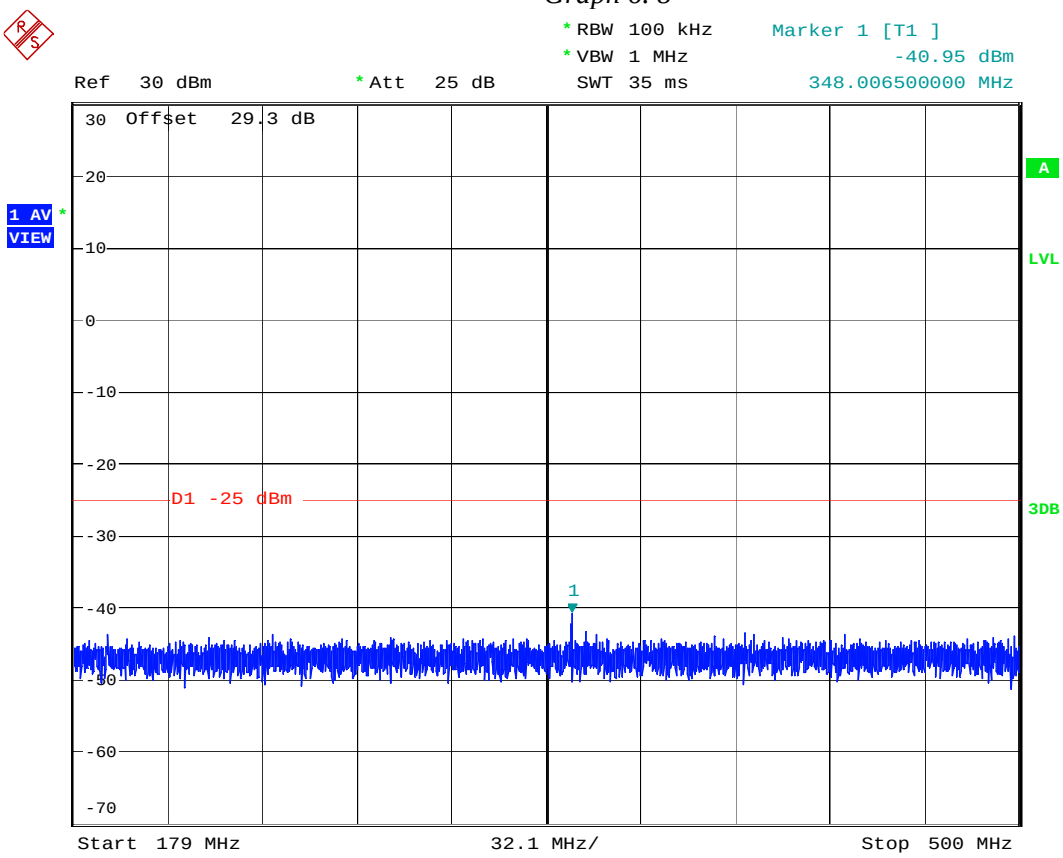
Graph 6. 7



Conducted spurious, 174MHz, GMSK

Date: 9.JUN.2011 13:28:20

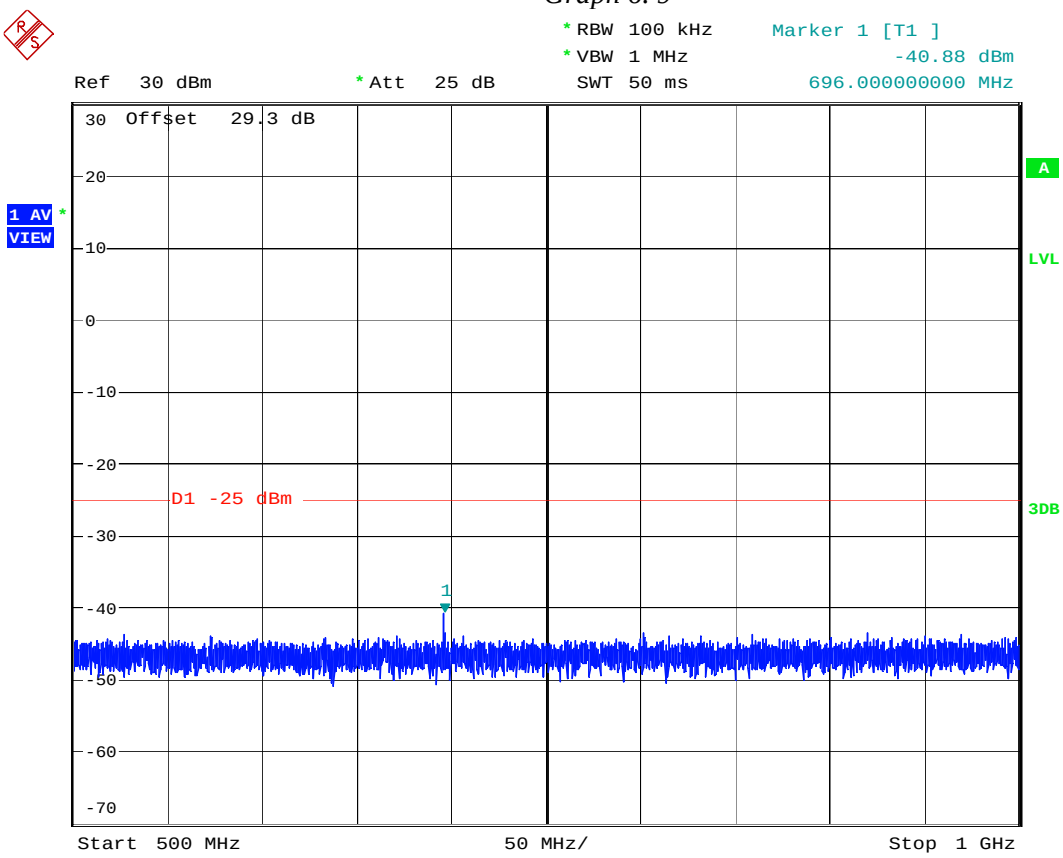
Graph 6. 8



Conducted spurious, 174MHz, GMSK

Date: 9.JUN.2011 13:30:02

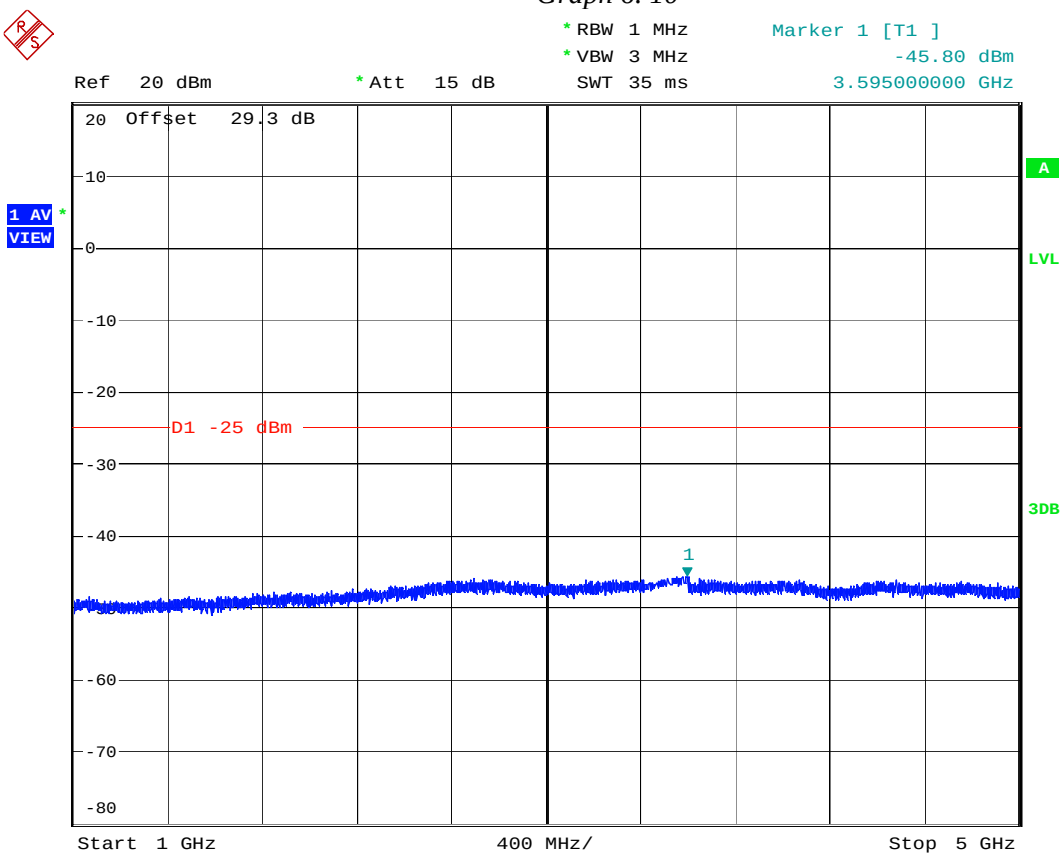
Graph 6. 9



Conducted spurious, 174MHz, GMSK

Date: 9.JUN.2011 13:30:40

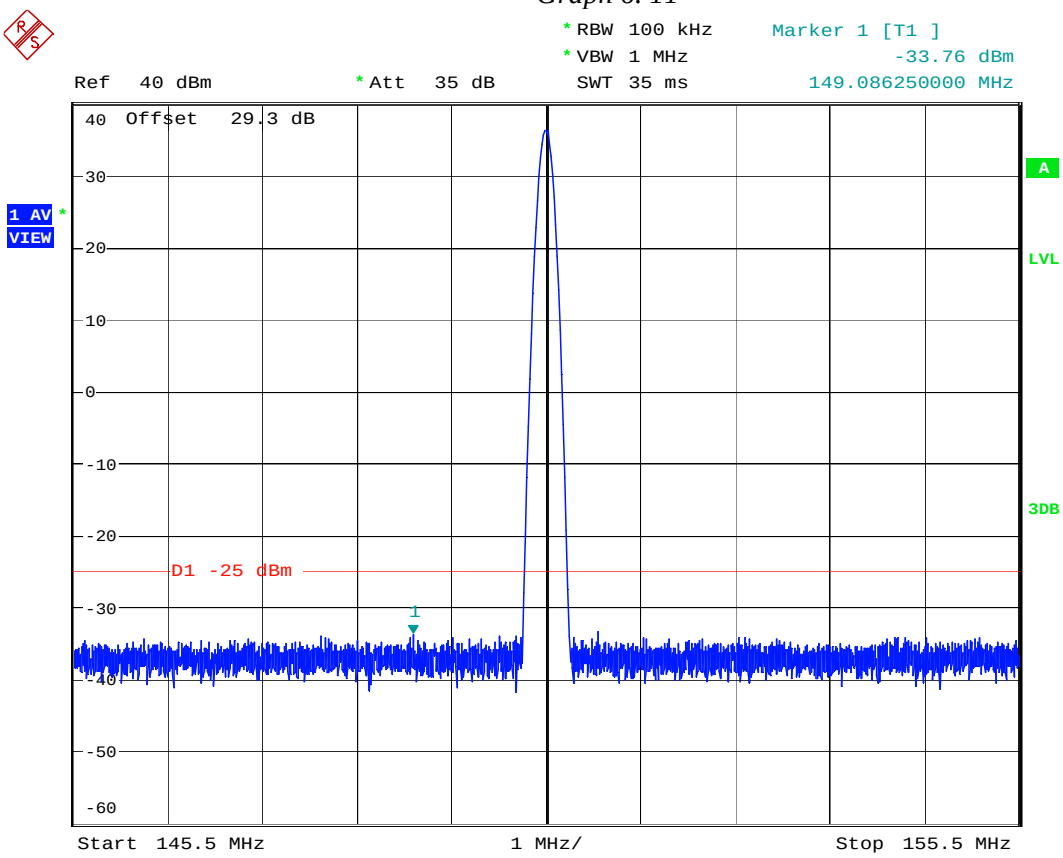
Graph 6. 10



Conducted spurious, 174MHz, GMSK

Date: 9.JUN.2011 13:31:55

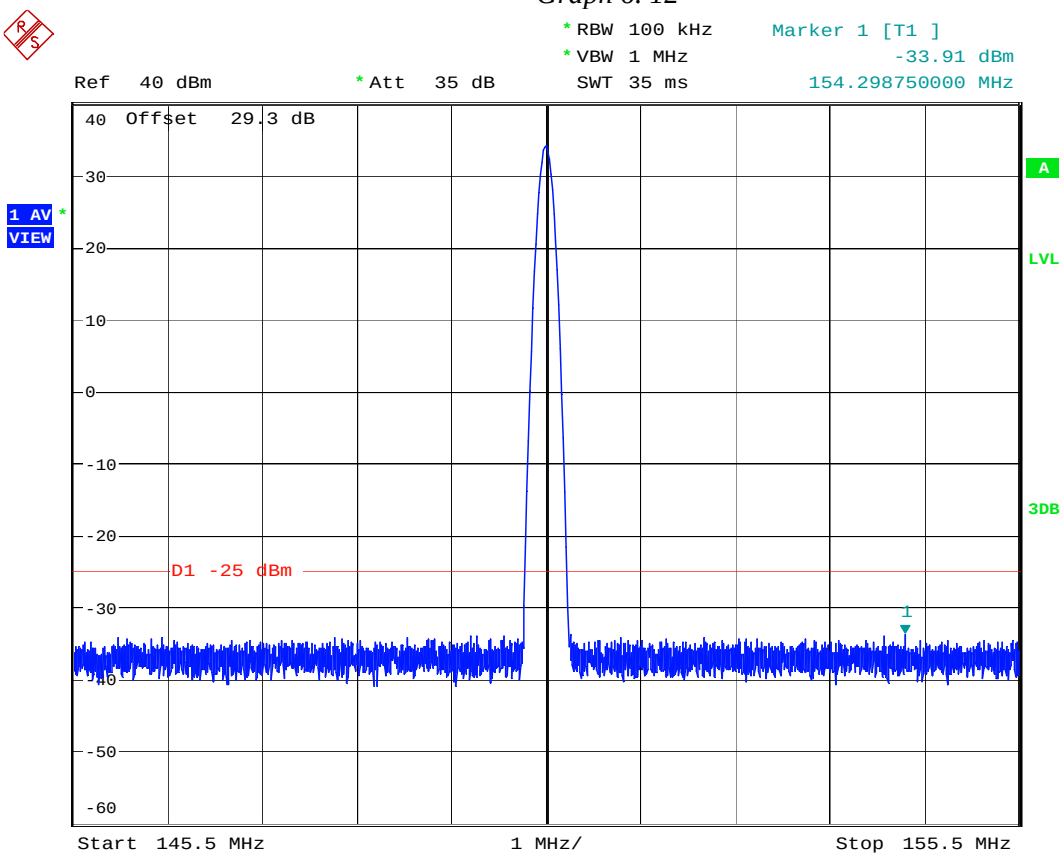
Graph 6. 11



Conducted spurious, 150.5MHz, Unmodulated

Date: 9.JUN.2011 13:37:06

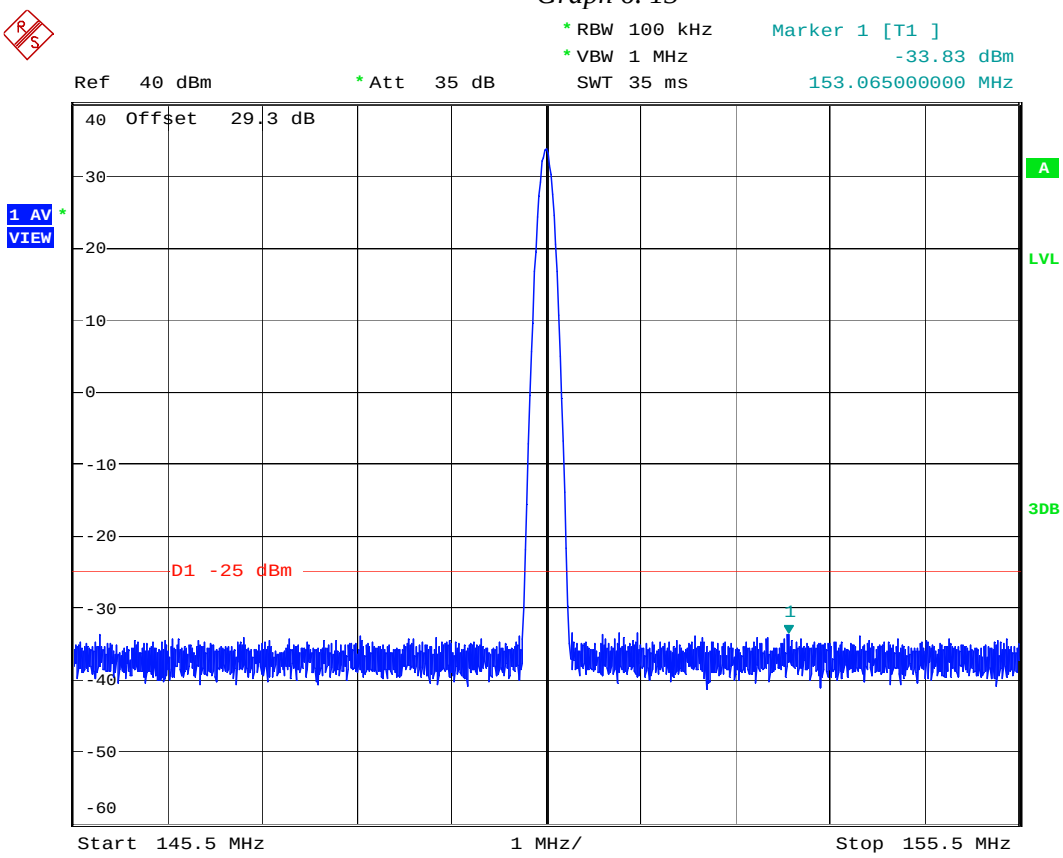
Graph 6. 12



Conducted spurious, 150.5MHz, BPSK

Date: 9.JUN.2011 13:38:25

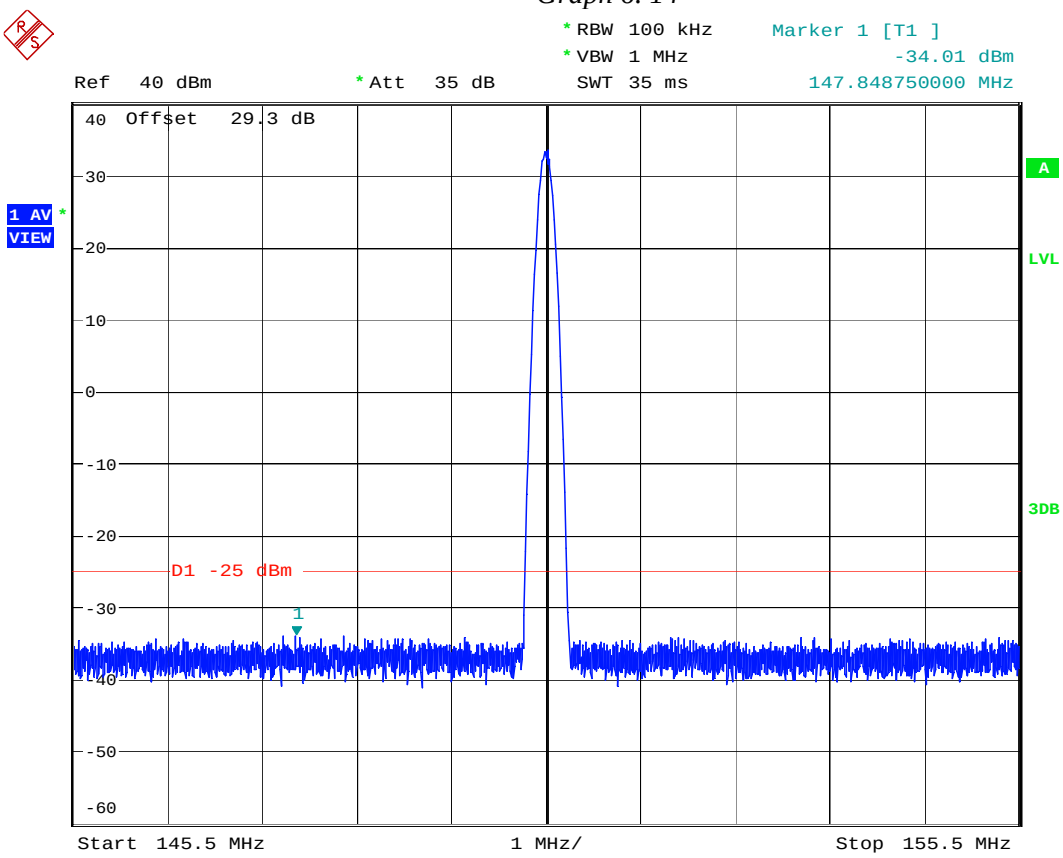
Graph 6. 13



Conducted spurious, 150.5MHz, QPSK

Date: 9.JUN.2011 13:39:19

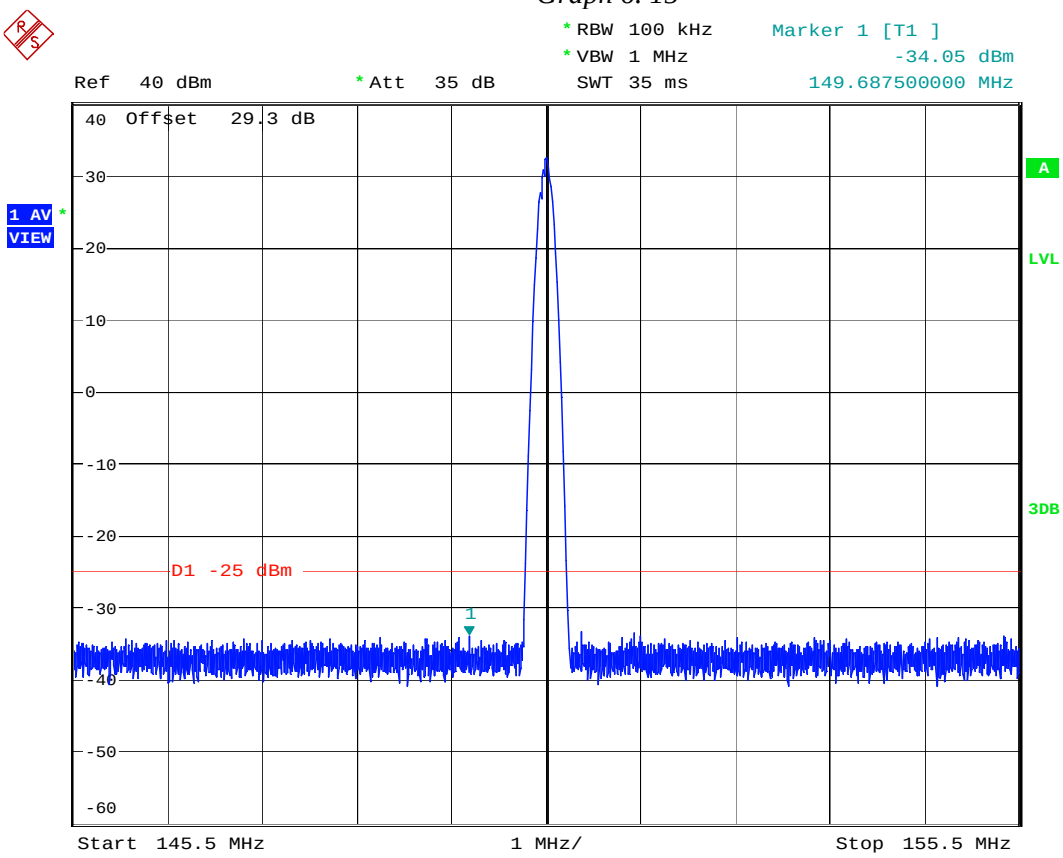
Graph 6. 14



Conducted spurious, 150.5MHz, 8PSK

Date: 9.JUN.2011 13:40:07

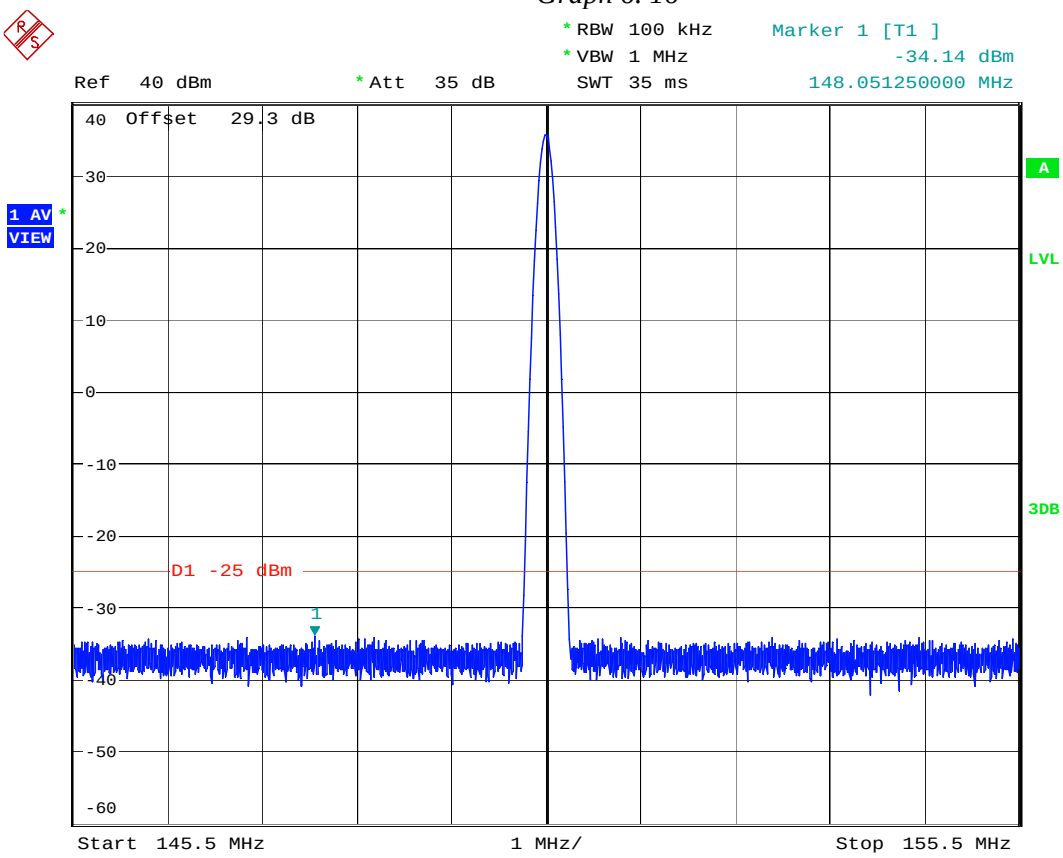
Graph 6. 15



Conducted spurious, 150.5MHz, 16QAM

Date: 9.JUN.2011 13:41:43

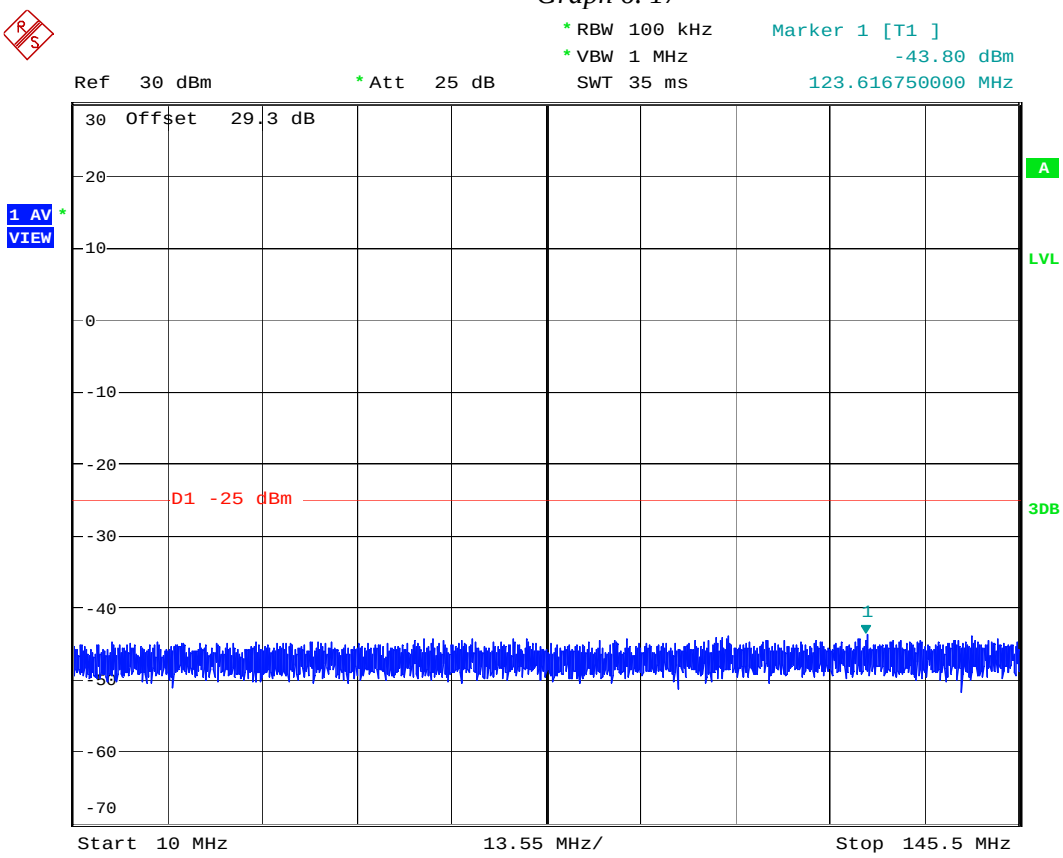
Graph 6. 16



Conducted spurious, 150.5MHz, GMSK

Date: 9.JUN.2011 13:42:41

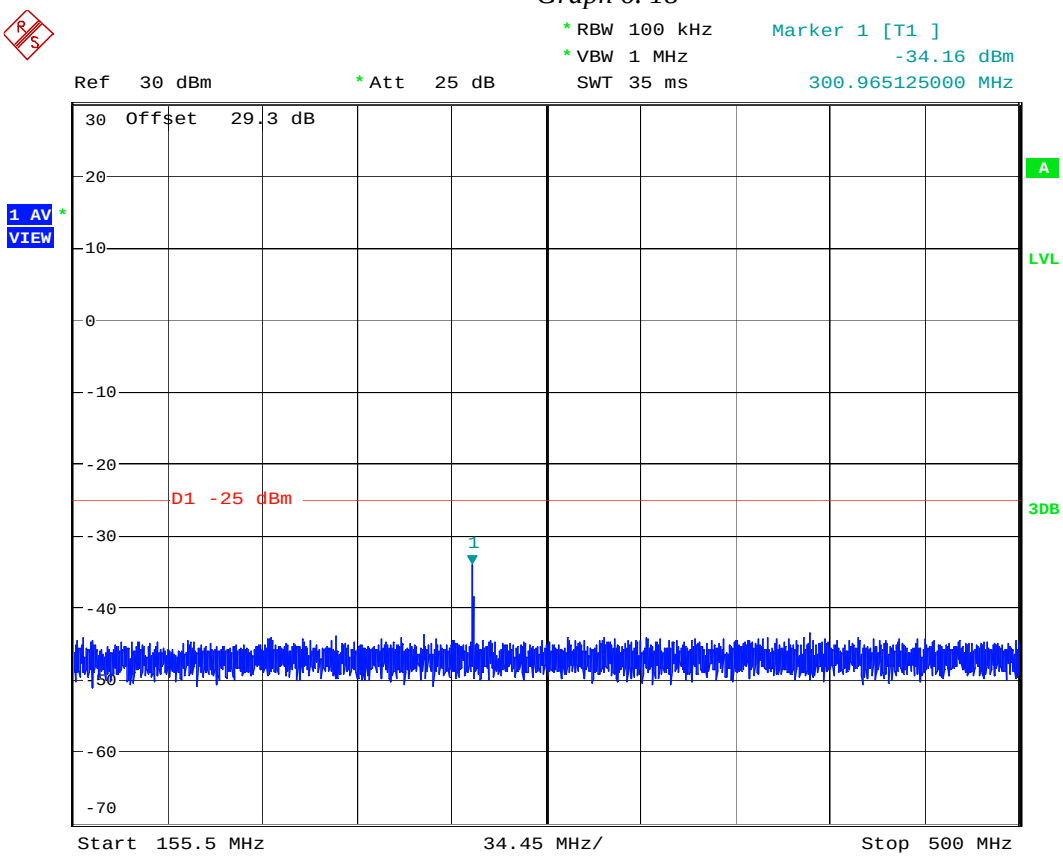
Graph 6. 17



Conducted spurious, 150.5MHz, GMSK

Date: 9.JUN.2011 13:46:46

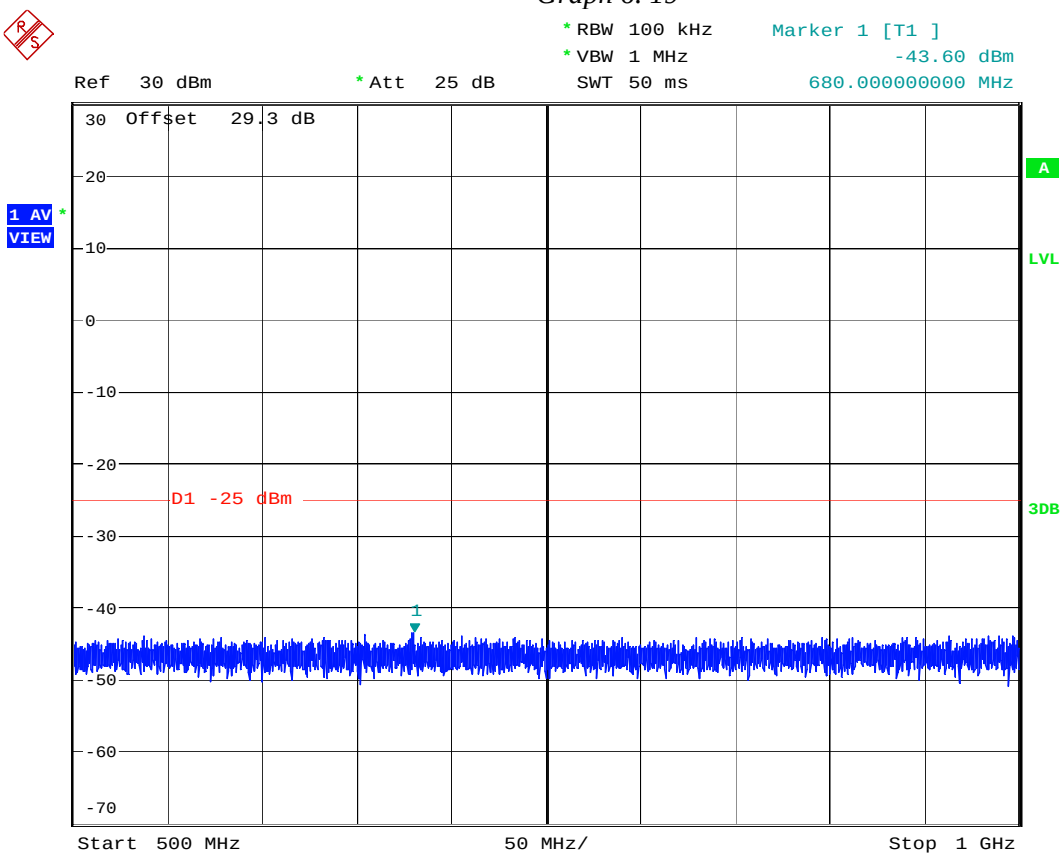
Graph 6. 18



Conducted spurious, 150.5MHz, GMSK

Date: 9.JUN.2011 13:47:16

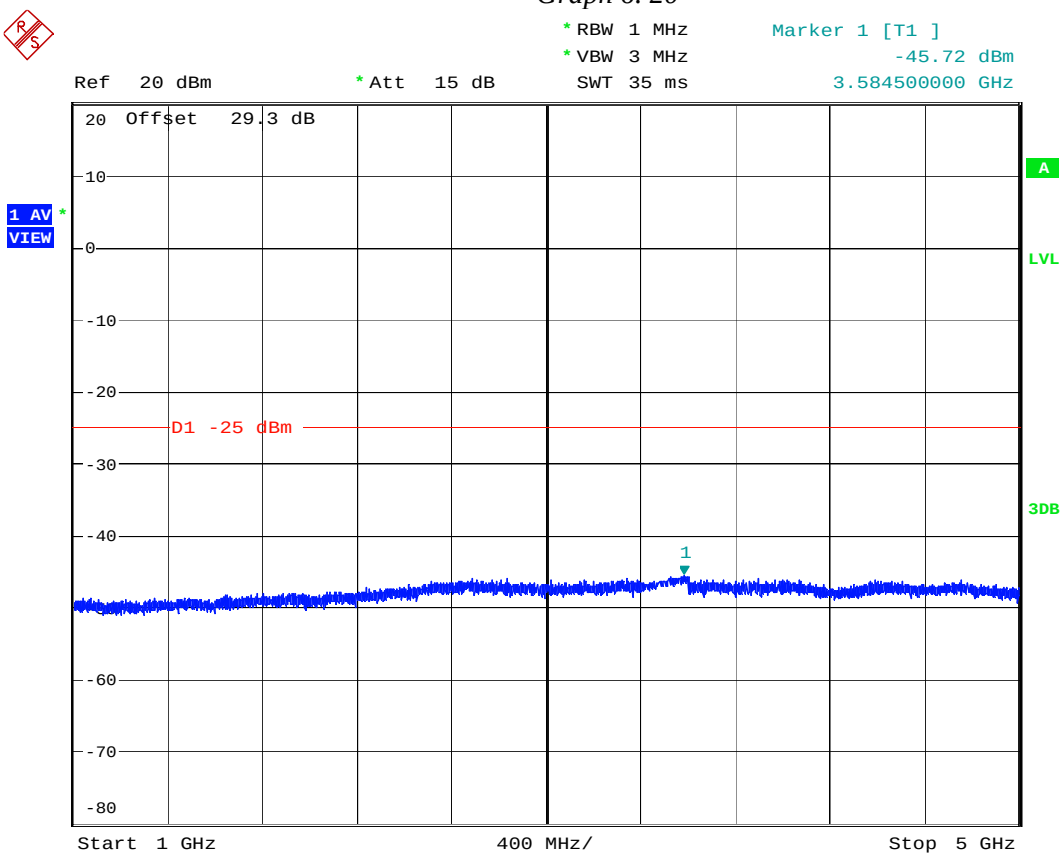
Graph 6. 19



Conducted spurious, 150.5MHz, GMSK

Date: 9.JUN.2011 13:47:51

Graph 6. 20



Conducted spurious, 150.5MHz, GMSK

Date: 9.JUN.2011 13:33:49

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 the 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 were 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.

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

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

7.3 Test Equipment

Roberts Antenna
EMCO 3115 Horn Antennas
Rohde & Schwarz FSU26 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 150.5 MHz					
36.47	38.1	-63.0	-63.0	-25.0	-38.0
39.70	34.6	-66.9	-66.9	-25.0	-41.9
62.33	36.3	-72.4	-72.4	-25.0	-47.4
93.86	53.8	-55.3	-55.3	-25.0	-30.3
169.03	41.8	-66.6	-66.6	-25.0	-41.6
205.41	50.3	-56.9	-56.9	-25.0	-31.9
301.00	44.4	-59.3	-59.3	-25.0	-34.3
451.50	29.5	-71.1	-71.1	-25.0	-46.1
987.88	25.1	-65.8	-65.8	-25.0	-40.8
1505.00	35.9	-73.4	-68.3	-25.0	-43.3
1914.00	39.7	-69.3	-62.7	-25.0	-37.7
4130.00	37.3	-66.1	-57.1	-25.0	-32.1

* 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 174 MHz					
36.47	39.3	-61.7	-61.7	-25.0	-36.7
39.70	35.8	-65.7	-65.7	-25.0	-40.7
62.33	37.1	-71.6	-71.6	-25.0	-46.6
93.86	53.6	-55.5	-55.5	-25.0	-30.5
204.60	50.4	-56.9	-56.9	-25.0	-31.9
230.00	32.0	-56.3	-56.3	-25.0	-31.3
230.10	31.8	-56.3	-56.3	-25.0	-31.3
348.00	48.2	-53.6	-53.6	-25.0	-28.6
522.00	32.6	-66.1	-66.1	-25.0	-41.1
870.00	26.9	-67.5	-67.5	-25.0	-42.5
984.64	25.8	-65.4	-65.4	-25.0	-40.4
1392.00	35.7	-71.9	-68.3	-25.0	-43.3
1914.00	34.8	-73.7	-67.1	-25.0	-42.1
3840.00	37.2	-66.7	-58.0	-25.0	-33.0

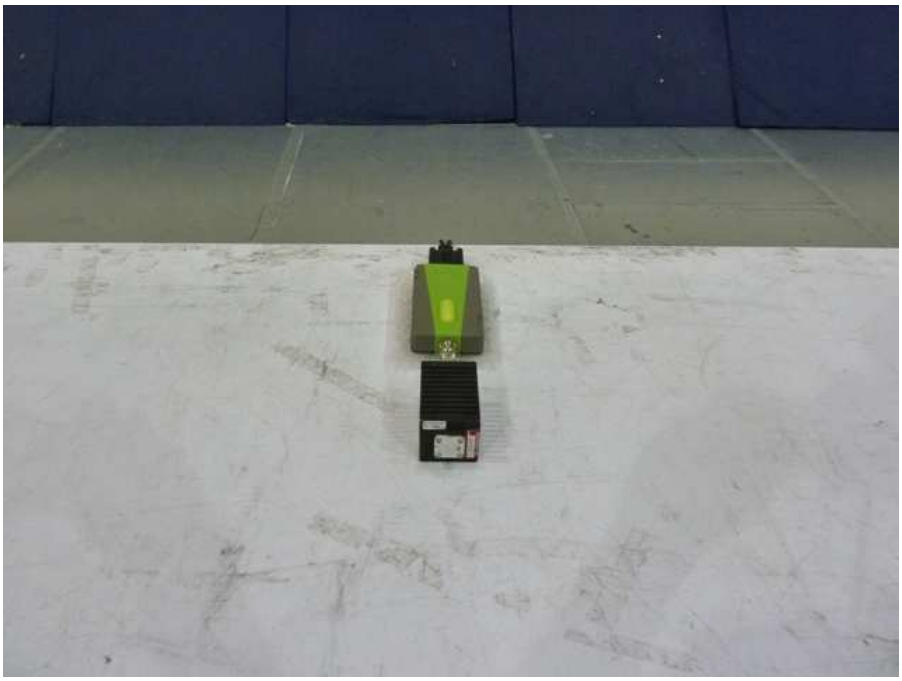
* ERP is calculated as: $ERP_{(dBm)} = \mathbf{V_{g(dBm)} + G_{(dBd)}}$

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

Result	Complies

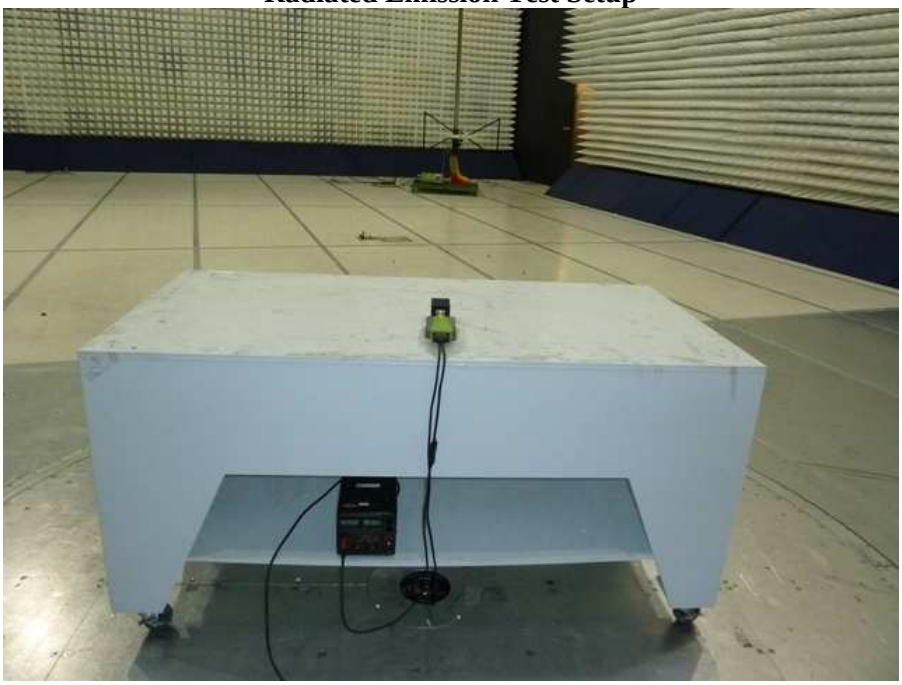
7.5 Test Setup Photographs

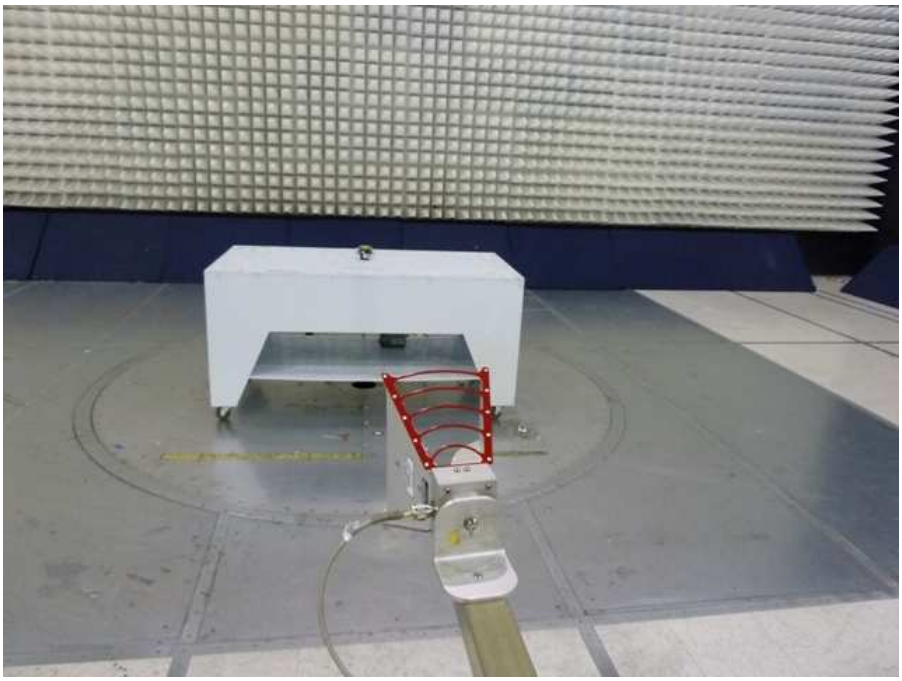
Radiated Emission Test Setup



7.5 Test setup photographs

Radiated Emission Test Setup





8.0 Transient Frequency Behavior

FCC 90.214

8.1 Requirement

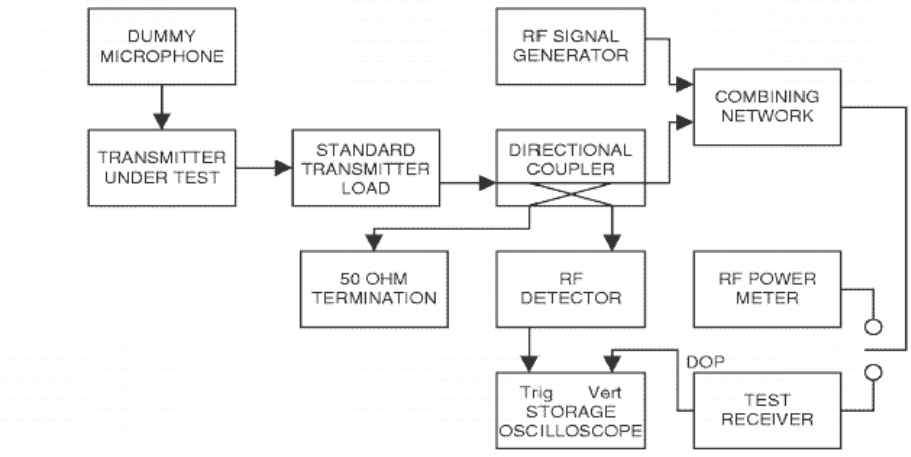
Time Interval	Maximum Frequency Difference	Time
Transient Frequency Behavior for equipment designed to operate on 25 kHz channels		
t1*	±25 kHz	10 ms
t2	±12.5 kHz	25 ms
t3*	±25 kHz	10 ms
Transient Frequency Behavior for equipment designed to operate on 12.5 kHz channels		
t1*	±12.5 kHz	10 ms
t2	±6.25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

The test was performed according to the block diagram below.

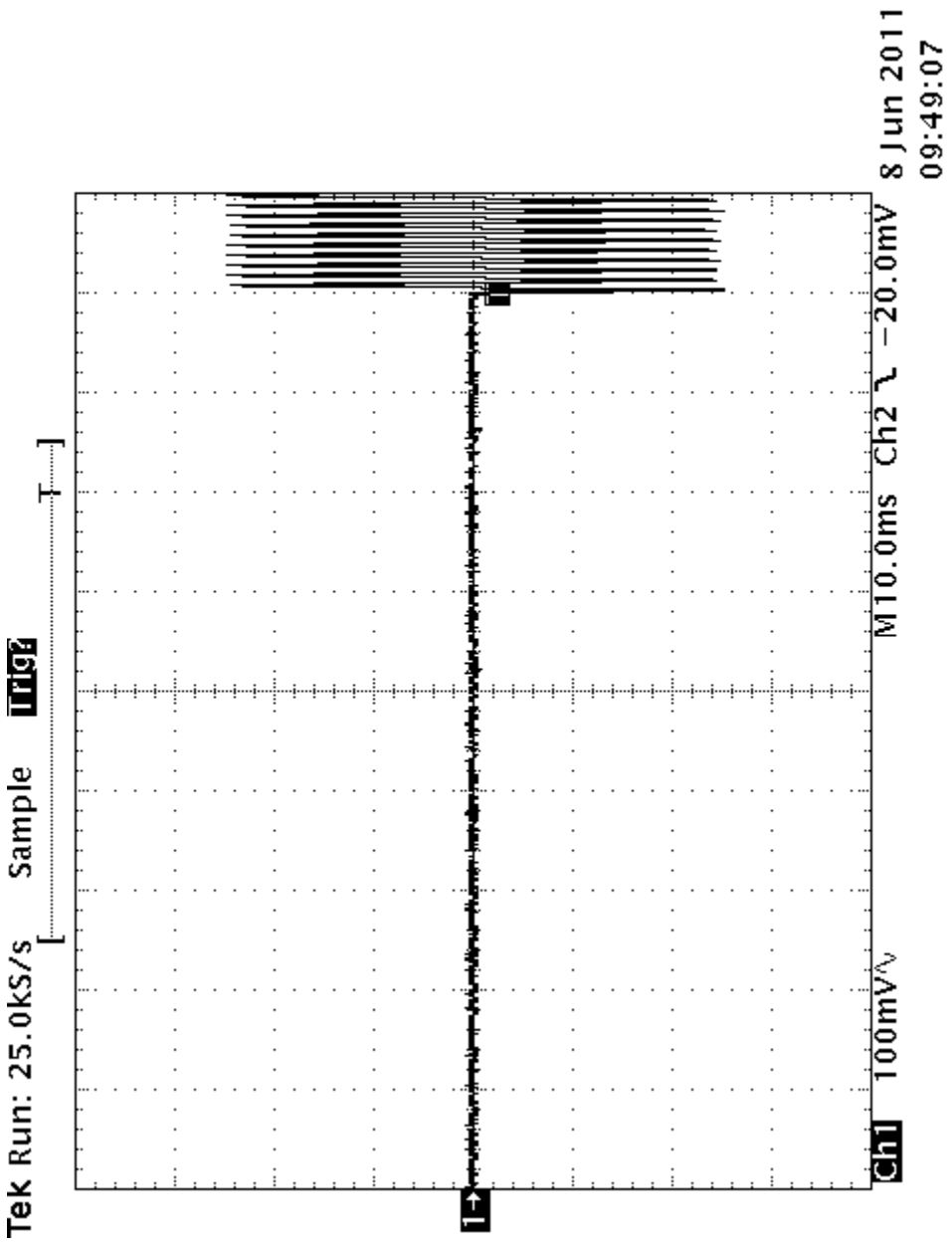


8.3 Test Results

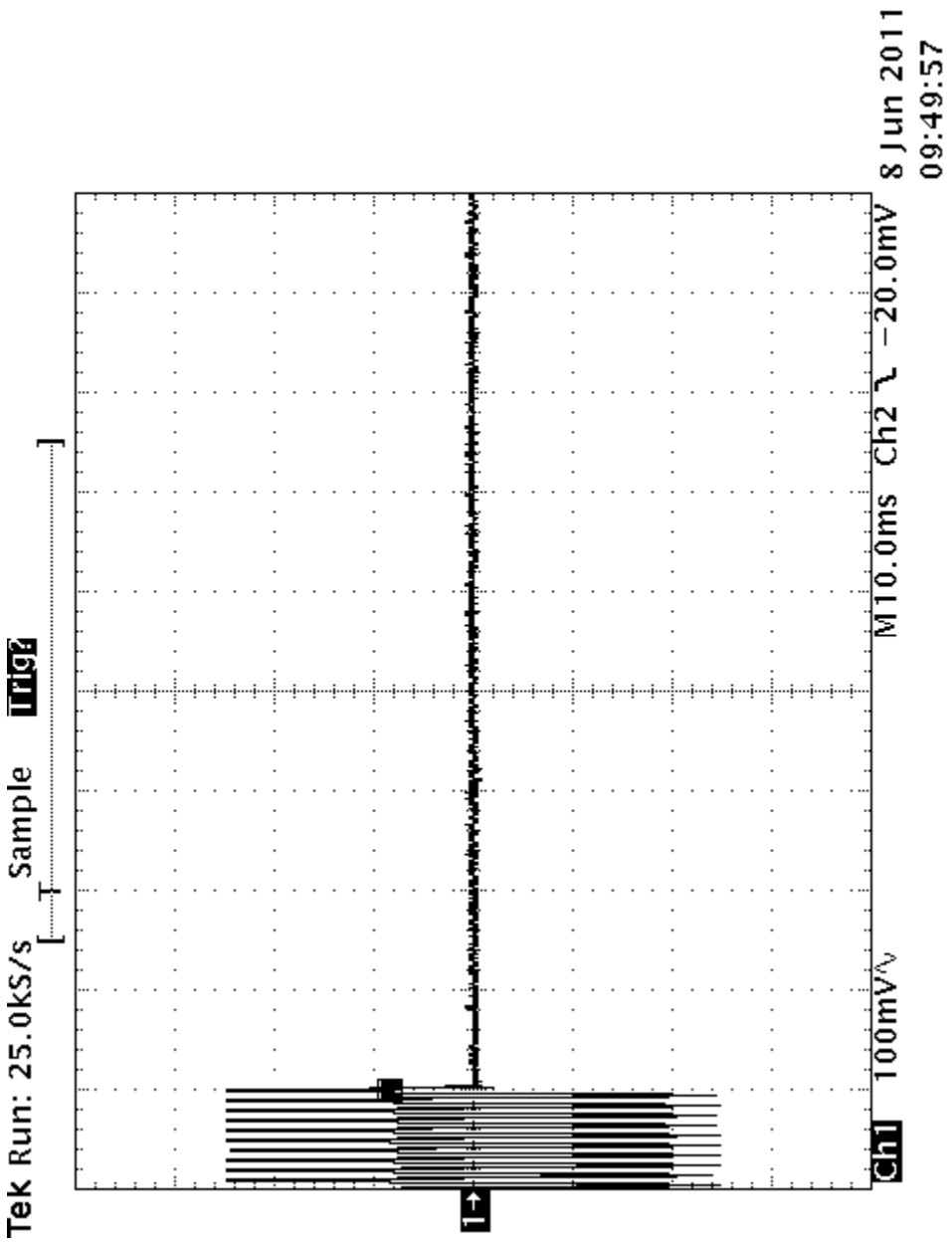
Result	Complies

Refer to the attached Graphs

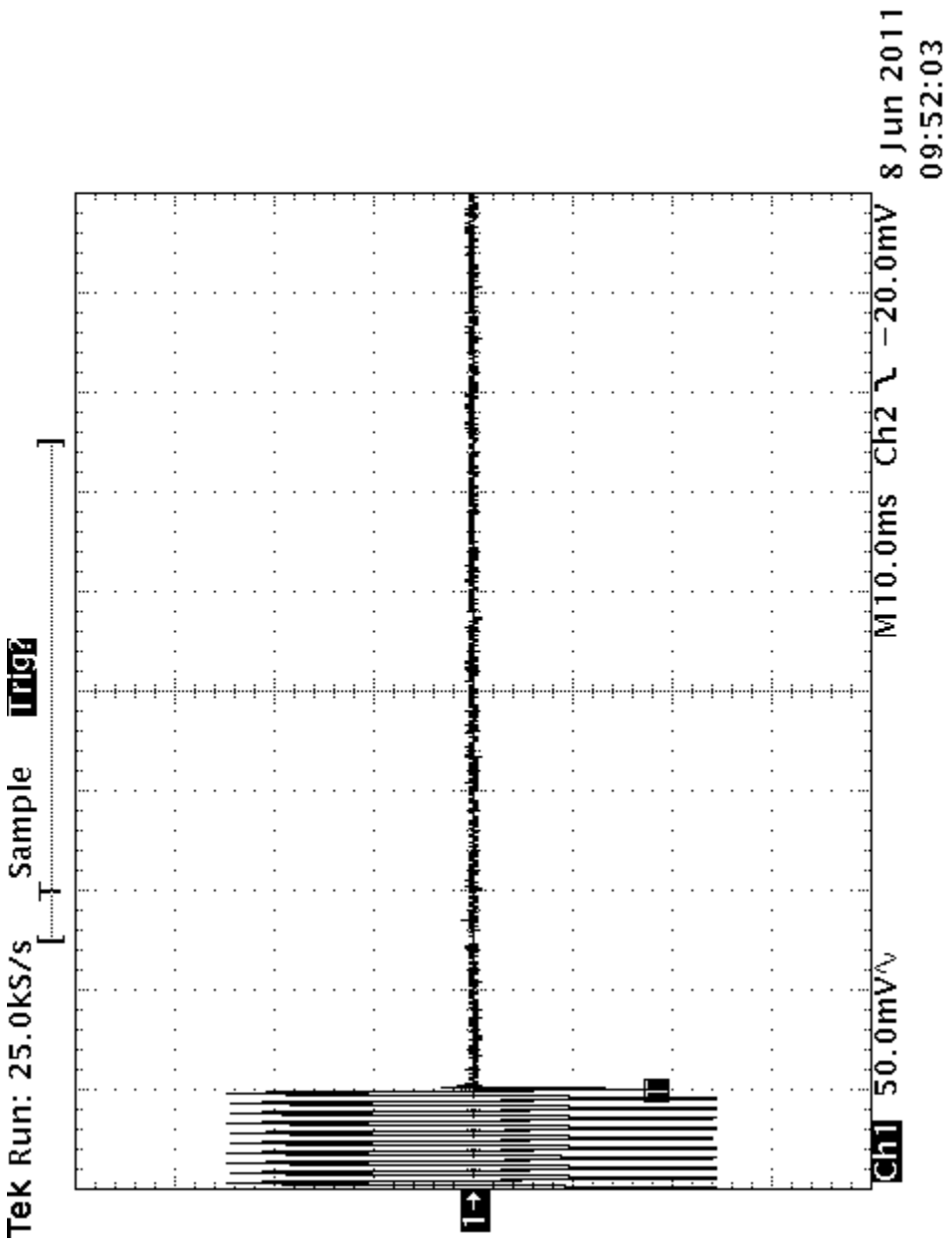
174 MHz, 25 kHz spacing



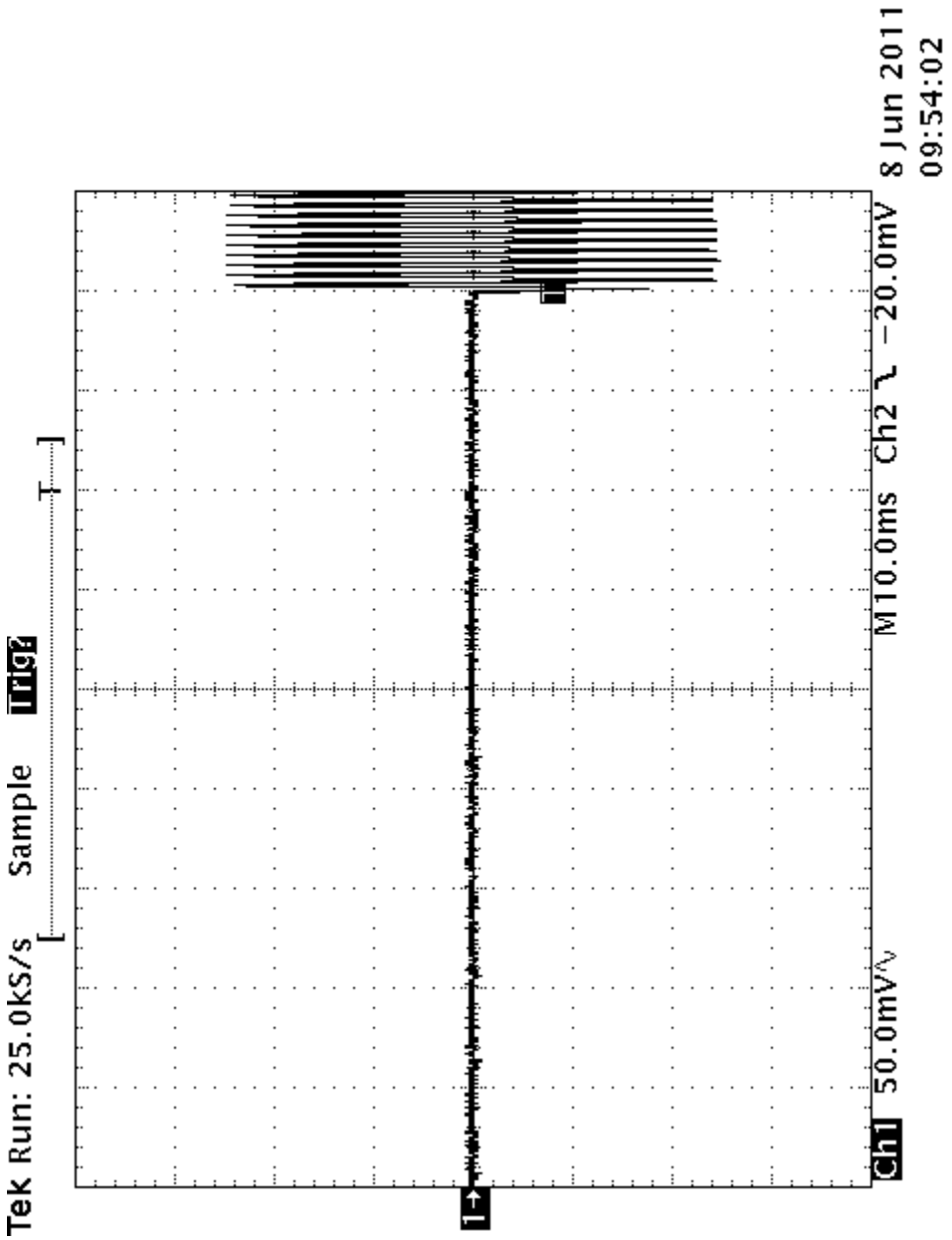
174 MHz, 25 kHz spacing



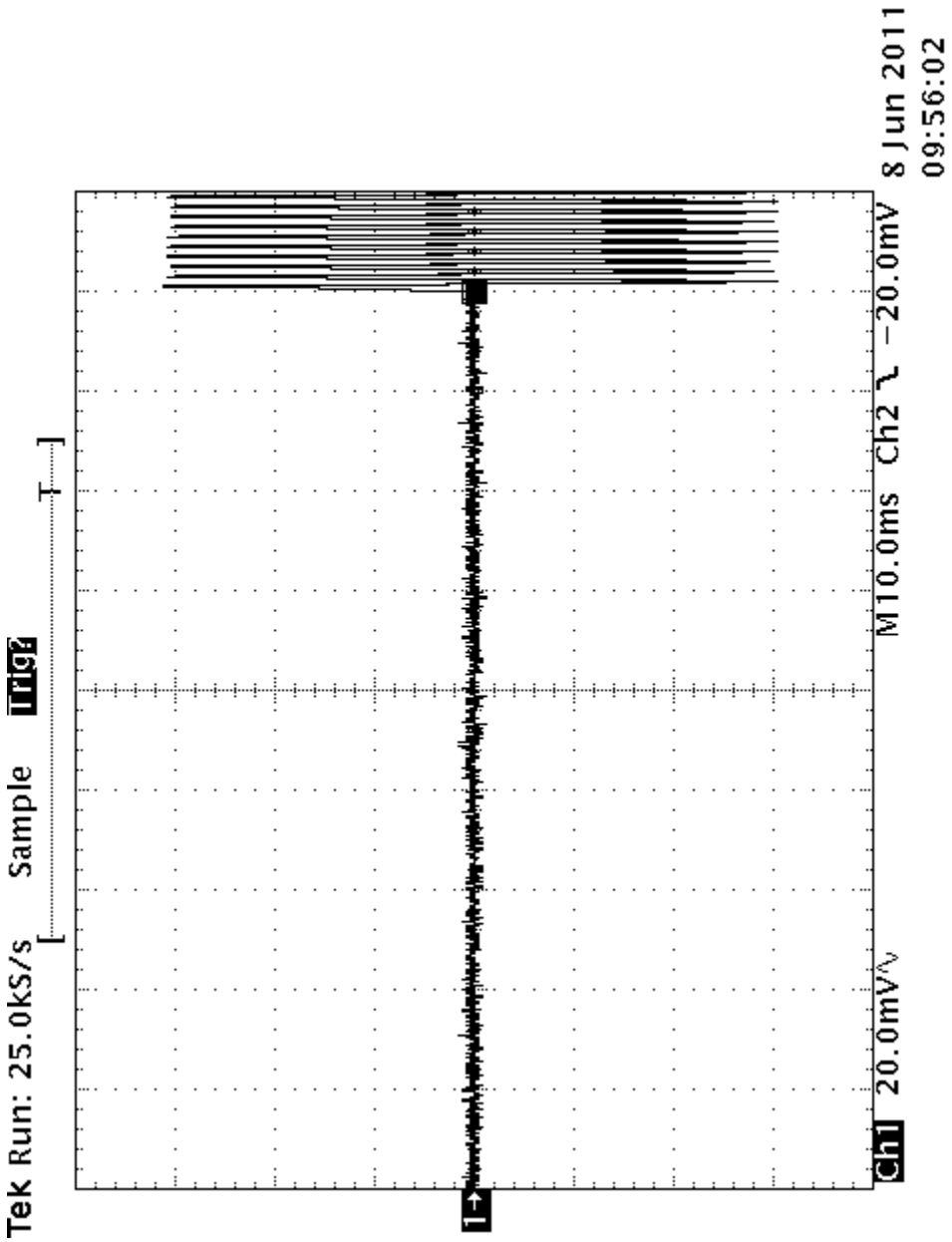
174 MHz, 12.5 kHz spacing



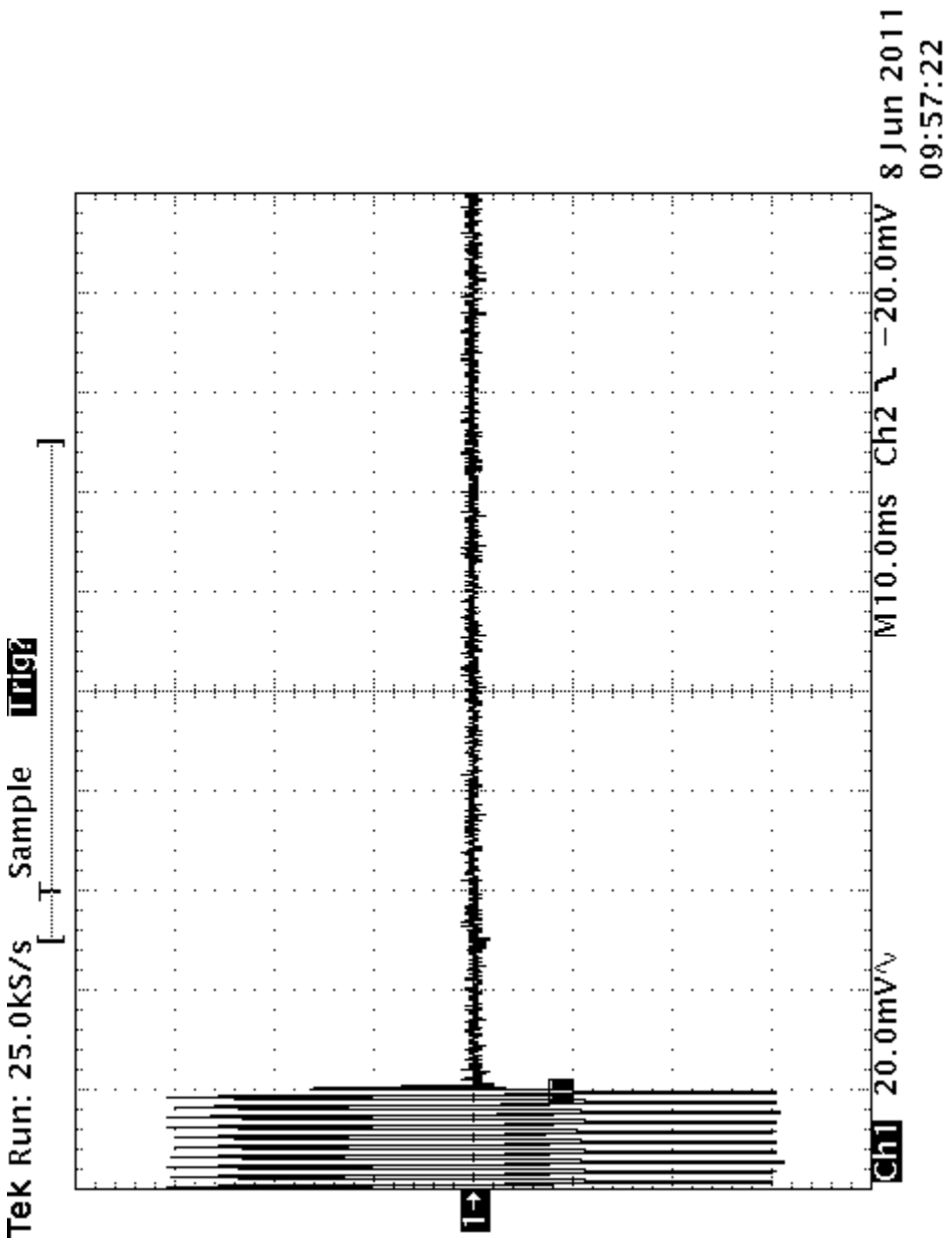
174 MHz, 12.5 kHz spacing



174 MHz, 6.25 kHz spacing



174 MHz, 6.25 kHz spacing



9.0 Frequency Stability vs Temperature and Voltage

FCC 2.1055, 90.213

9.1 Requirement

In the 150–174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

Note: according to RSS-119, the frequency stability for mobile stations designed to operate with a 6.25 kHz Authorized Bandwidth must have a frequency stability of 2.0 ppm. Mobile stations designed to operate with a 20 kHz and 11.25 kHz Authorized Bandwidth must have a frequency stability of 5.0 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: 150.5 MHz

Temperature (°C)	**Maximum deviation from frequency at 20°C,** Hz	**Maximum deviation from frequency at 20°C,** ppm
-30	-111	0.64
-20	-44	0.25
-10	-23	0.13
0	-28	0.16
10	3	0.02
20	0	0.0
30	-5	0.03
40	-62	0.36
50	-72	0.41

Nominal frequency: 174 MHz

Temperature (°C)	**Maximum deviation from frequency at 20°C,** Hz	**Maximum deviation from frequency at 20°C,** ppm
-30	-62	0.36
-20	0	0.0
-10	20	0.11
0	14	0.08
10	48	0.28
20	0	0.0
30	-1	0.01
40	-4	0.02
50	-29	0.17

Nominal frequency: 150.5 MHz

DC Voltage, V	Maximum deviation from nominal, Hz	Maximum deviation from nominal, ppm
9.0	-40	0.27
12.0	-40	0.27
24.0	-39	0.27
36.0	-40	0.27

Nominal frequency: 174 MHz

DC Voltage, V	Maximum deviation from nominal, Hz	Maximum deviation from nominal, ppm
9.0	-98	0.56
12.0	-98	0.56
24.0	-98	0.56
36.0	-97	0.56

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 6.982 W, and ERP is 4.305 W.

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 50% (refer to the document, "HPT104BT VHF OEM Module Duty Cycle evaluation"); therefore, the average EIRP is 3.491 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 in this band is 2.0 W/m^2, therefore $D \geq 0.37$ m.

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

11.0 Emission 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 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:

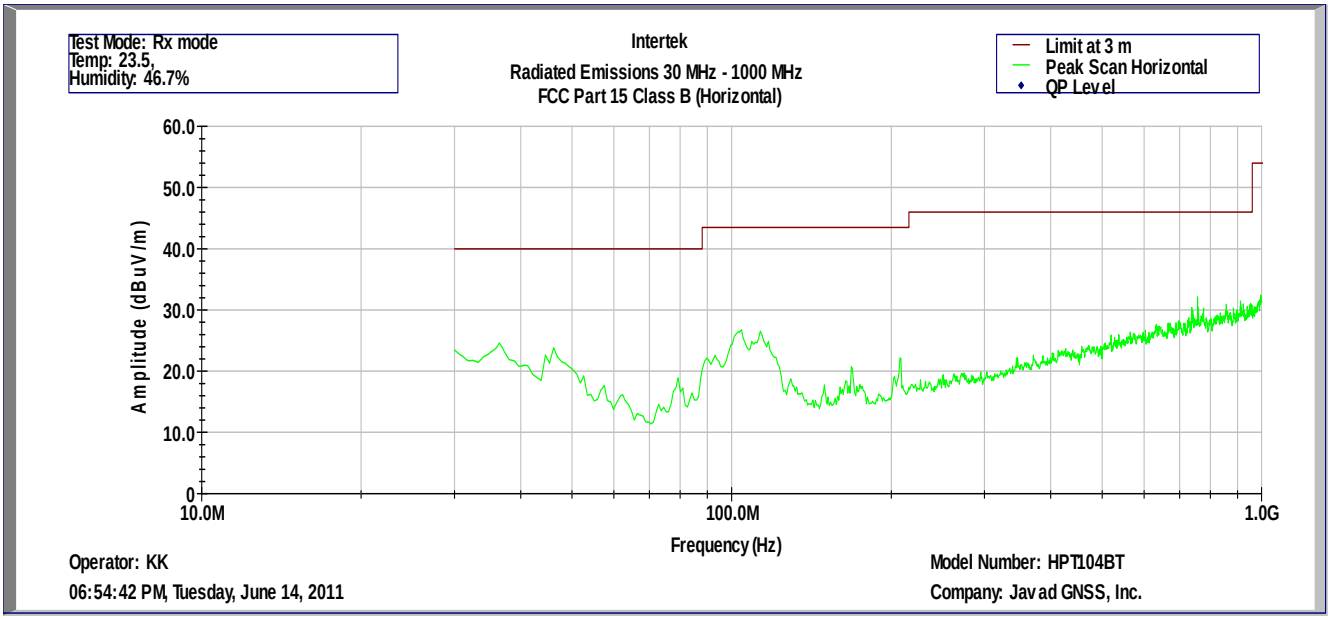
FS = RA + AF + CF – PA
Where FS = Field Strength in dB (µV/m)
RA = Receiver Amplitude (including preamplifier) in dB (µV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
PA= Preamplifier Factor in dB

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).

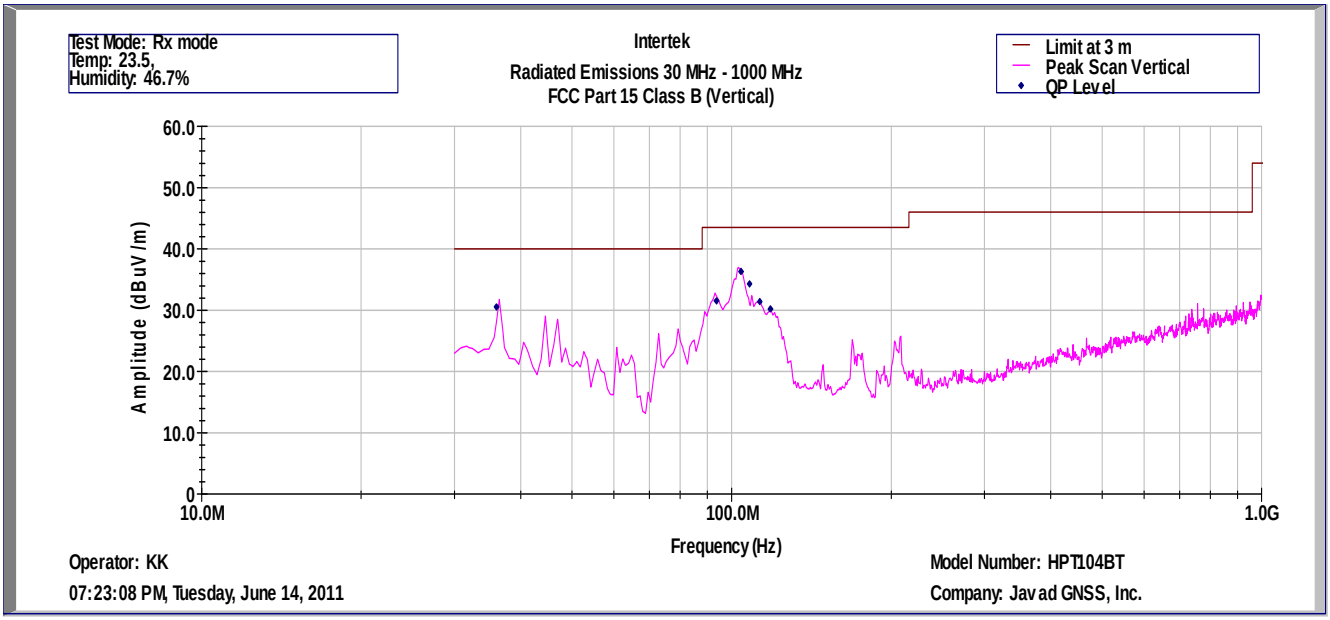
RA = 52.0 dB (µV)
AF = 7.4 dB (1/m)
CF = 1.6 dB
PA = 29.0 dB
FS = RF + AF + CF – PA
FS = 52.0 + 7.4 + 1.6 – 29.0
FS = 32 dB (µV/m)

11.1.3 Test Results

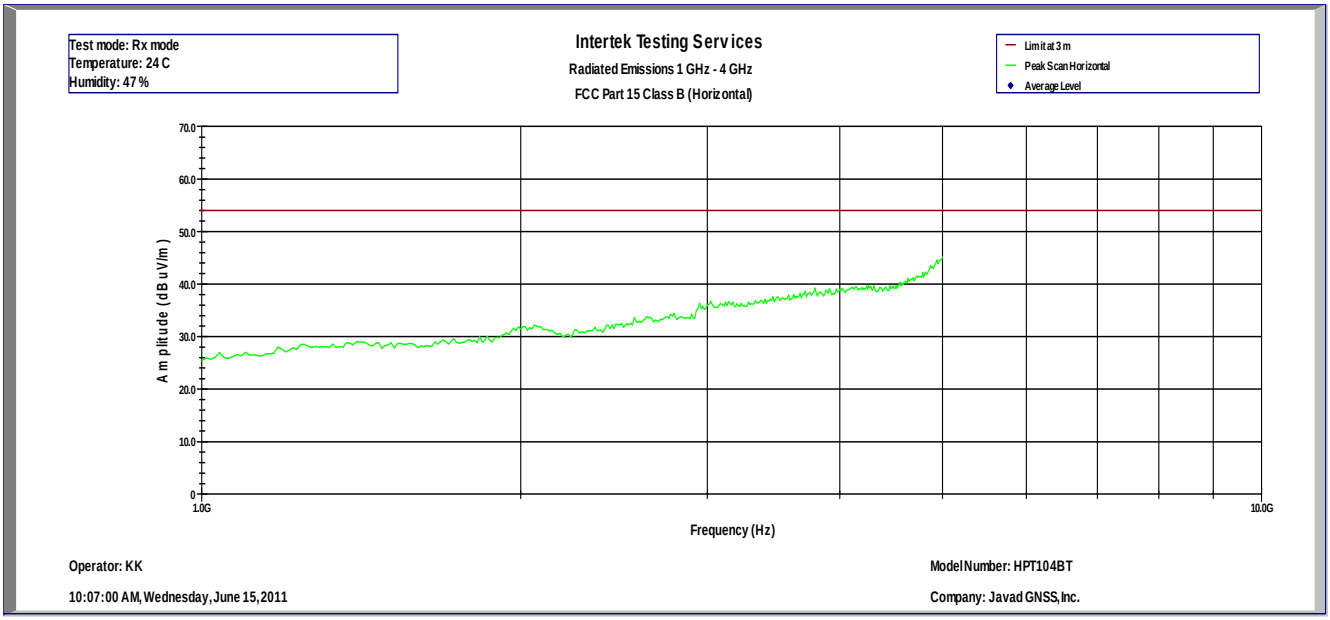
Result	Complies by 7.2 dB

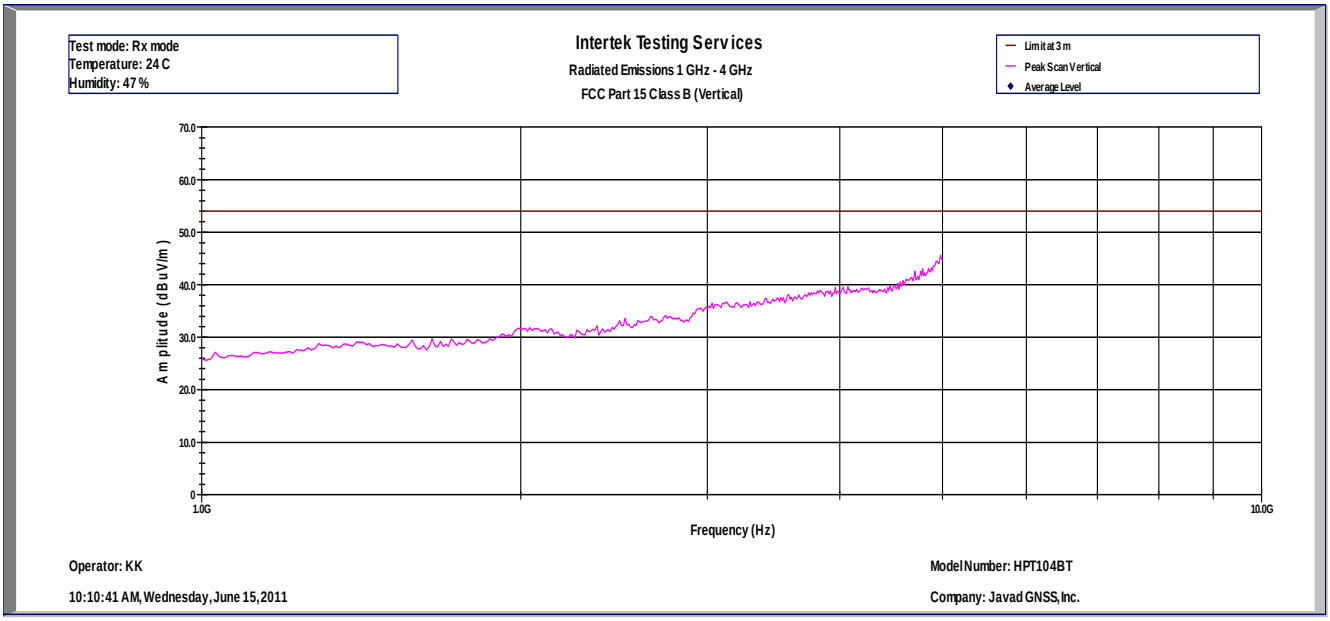


Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (Pk-Horizontal)								
Operator: KK				Model Number: HPT104BT				
June 14, 2011				Company: Javad GNSS, Inc.				
Frequency (Hz)	**Peak FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
36466700	24.6	40.0	-15.4	28.3	0.7	31.9	10.5	17.0
104367000	26.7	43.5	-16.8	36.2	1.2	32.0	10.5	10.9
168225000	20.8	43.5	-22.7	31.9	1.5	31.9	10.5	8.7
996767000	32.4	54.0	-21.6	25.7	3.8	30.9	10.5	23.4
Mode: Rx mode Temp: 23.5 C, Humidity: 46.7%								



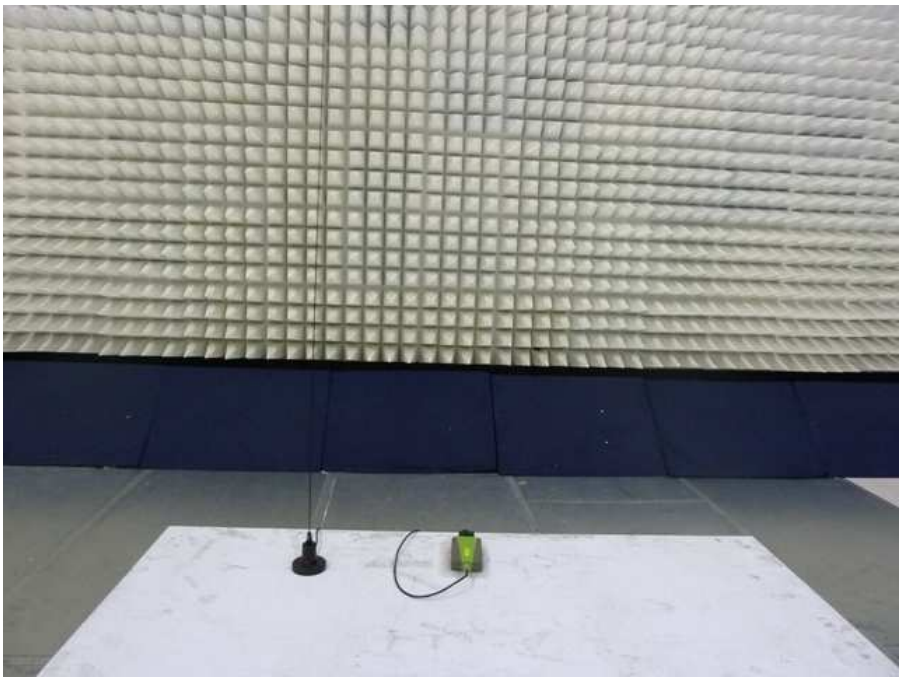
Intertek Testing Services								
Radiated Emissions 30 MHz - 1000 MHz								
FCC Part 15 Class B (QP-Vertical)								
Operator: KK				Model Number: HPT104BT				
June 14, 2011				Company: Javad GNSS, Inc.				
Frequency (Hz)	**QP FS dB(uV/m)**	**Limit@3m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**CF dB**	**AG dB**	**DCF dB**	**AF dB(1/m)**
36030000	30.5	40.0	-9.5	34.3	0.7	31.9	10.5	16.9
93625000	31.5	43.5	-12.0	43.3	1.1	32.1	10.5	8.7
104163000	36.3	43.5	-7.2	45.7	1.2	32.0	10.5	11.0
108130000	34.3	43.5	-9.2	44.0	1.2	32.0	10.5	10.6
113013000	31.4	43.5	-12.1	40.5	1.2	32.0	10.5	11.2
118415000	30.2	43.5	-13.3	39.0	1.3	32.0	10.5	11.4
Mode: Rx mode Temp: 23.5 C, Humidity: 46.7%								


Test mode: Rx mode
Temperature: 24 C
Humidity: 47 %
Intertek Testing Services
Radiated Emissions 1 GHz - 4 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
10:07:00 AM, Wednesday, June 15, 2011
Model Number: HPT104BT
Company: Javad GNSS, Inc.


Test mode: Rx mode
Temperature: 24 C
Humidity: 47 %
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 (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
10:10:41 AM, Wednesday, June 15, 2011
Model Number: HPT104BT
Company: Javad GNSS, Inc.

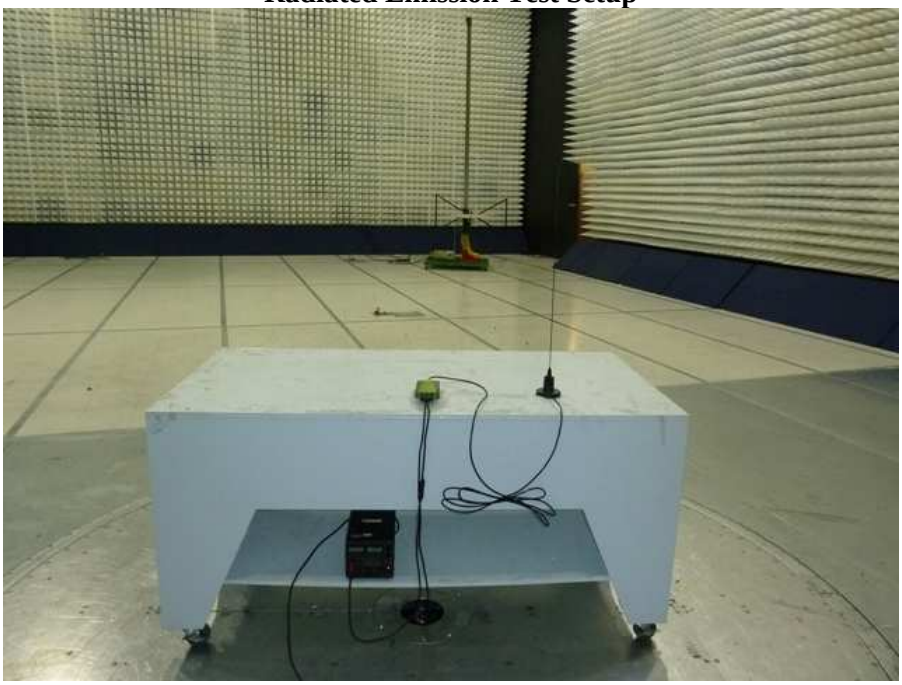
11.1.4 Test Setup Photographs

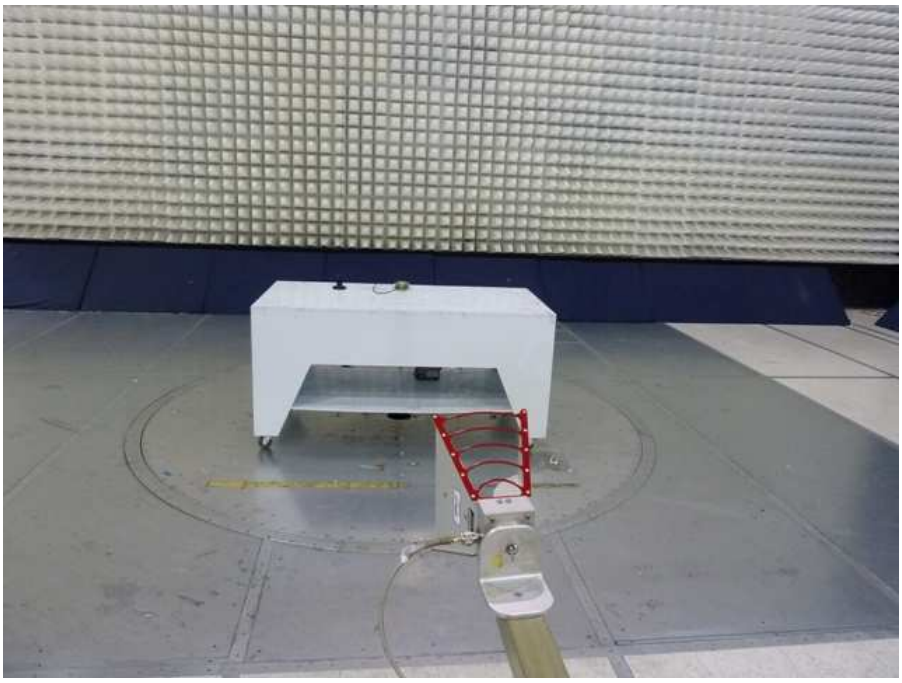
Radiated Emission Test Setup



11.1.4 Test Setup Photographs

Radiated Emission Test Setup





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

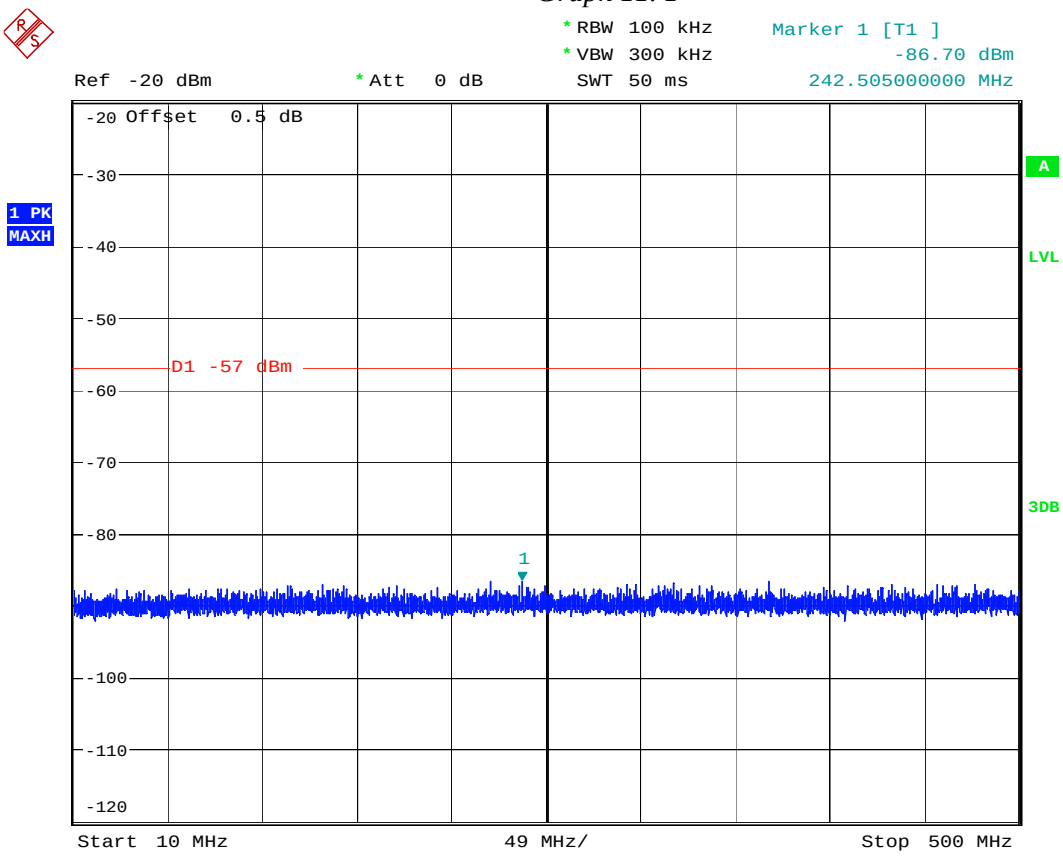
The spectrum analyzer was connected to the RF output of the EUT. The EUT was setup in receiving mode. Test was performed at tuned frequencies of 150 MHz.

11.2.3 Test Results

Result	Complies

Refer to the following graphs.

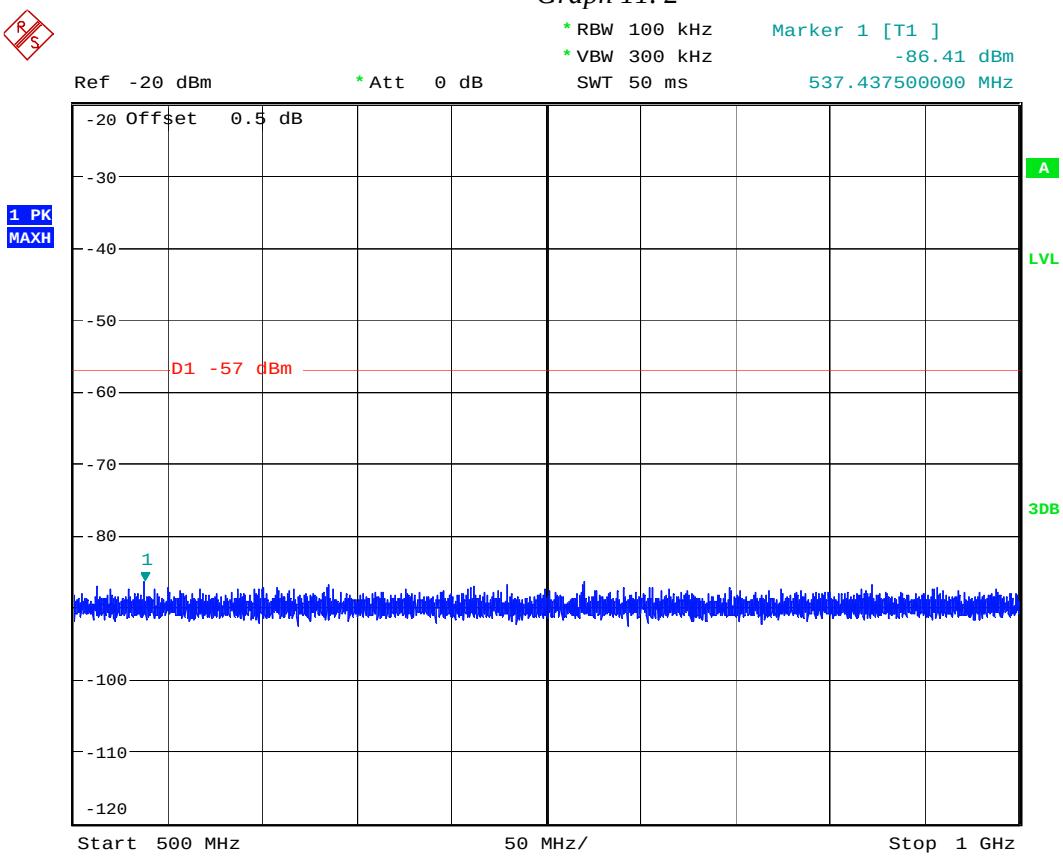
Graph 11. 1



Receiver conducted spurious, 174MHz

Date: 9.JUN.2011 14:07:20

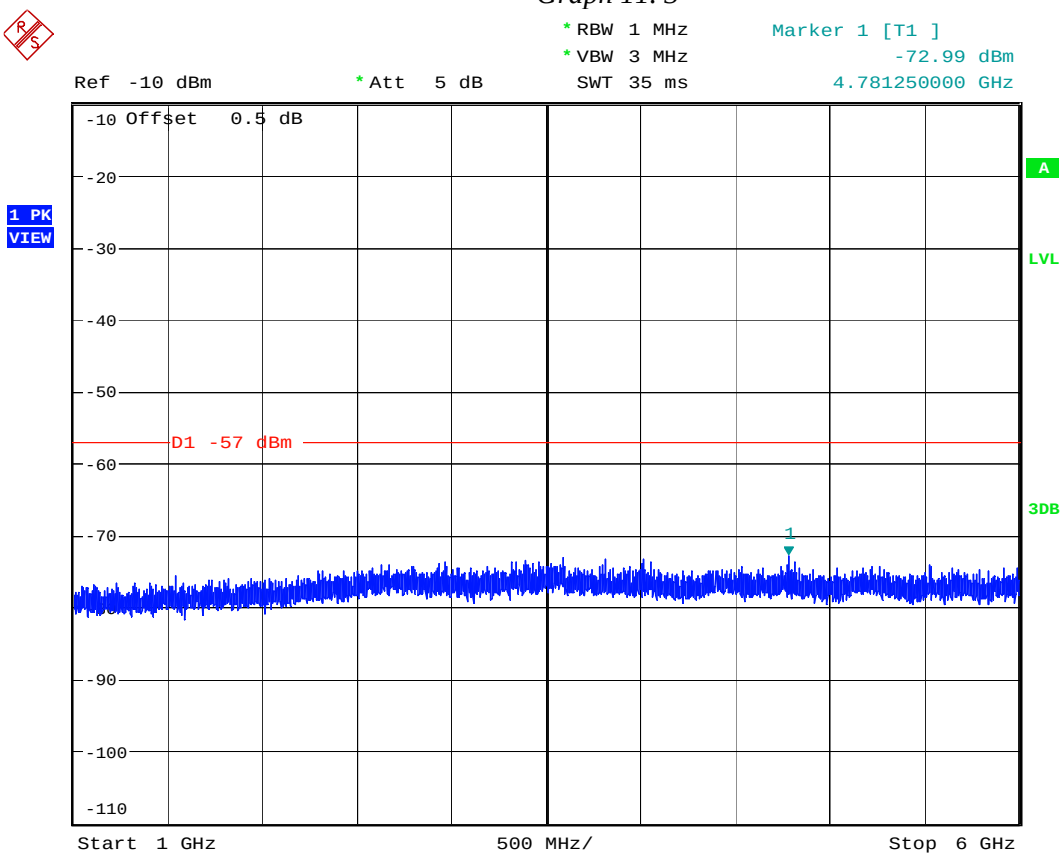
Graph 11. 2



Receiver conducted spurious, 174MHz

Date: 9.JUN.2011 14:11:00

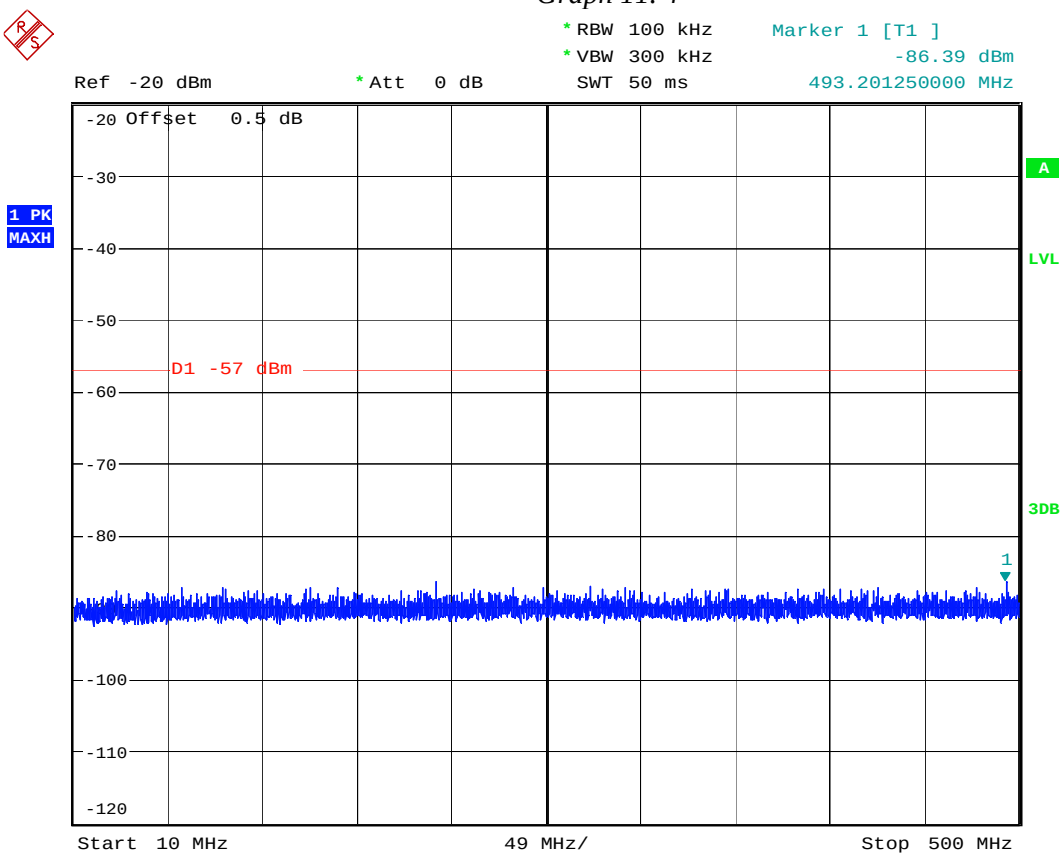
Graph 11. 3



Receiver conducted spurious, 174MHz

Date: 9.JUN.2011 14:12:42

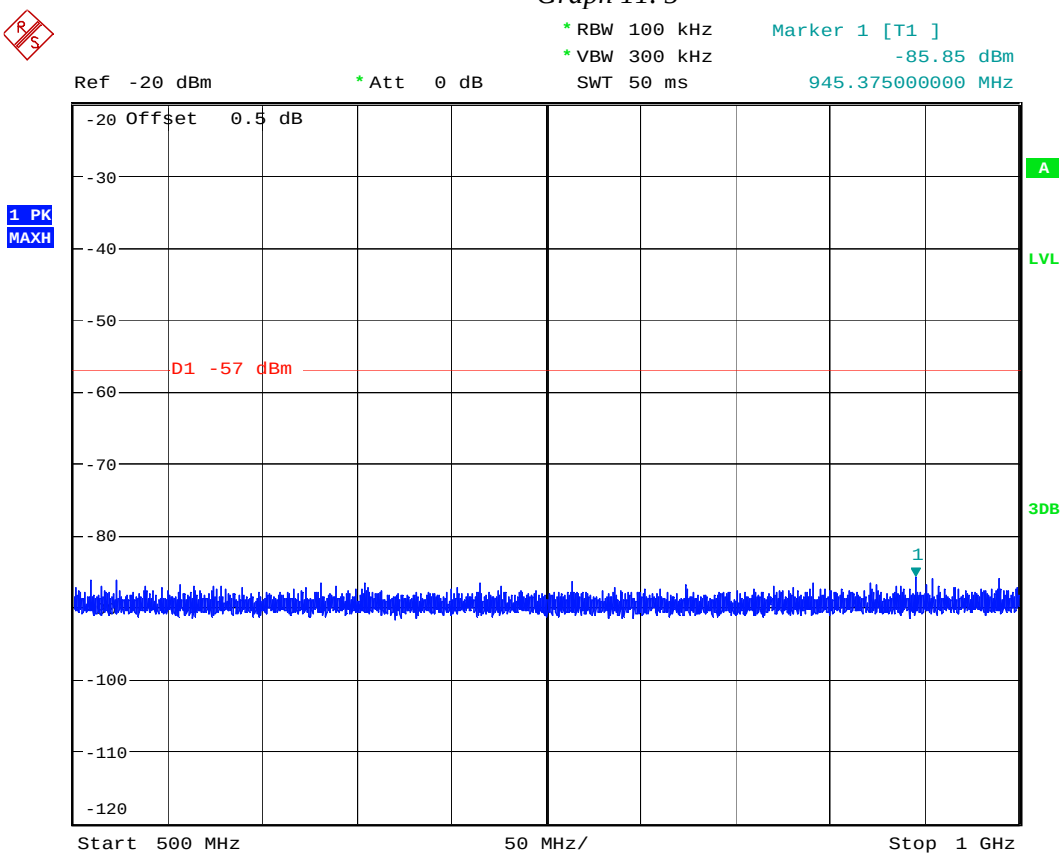
Graph 11. 4



Receiver conducted spurious, 150.5MHz

Date: 9.JUN.2011 14:08:24

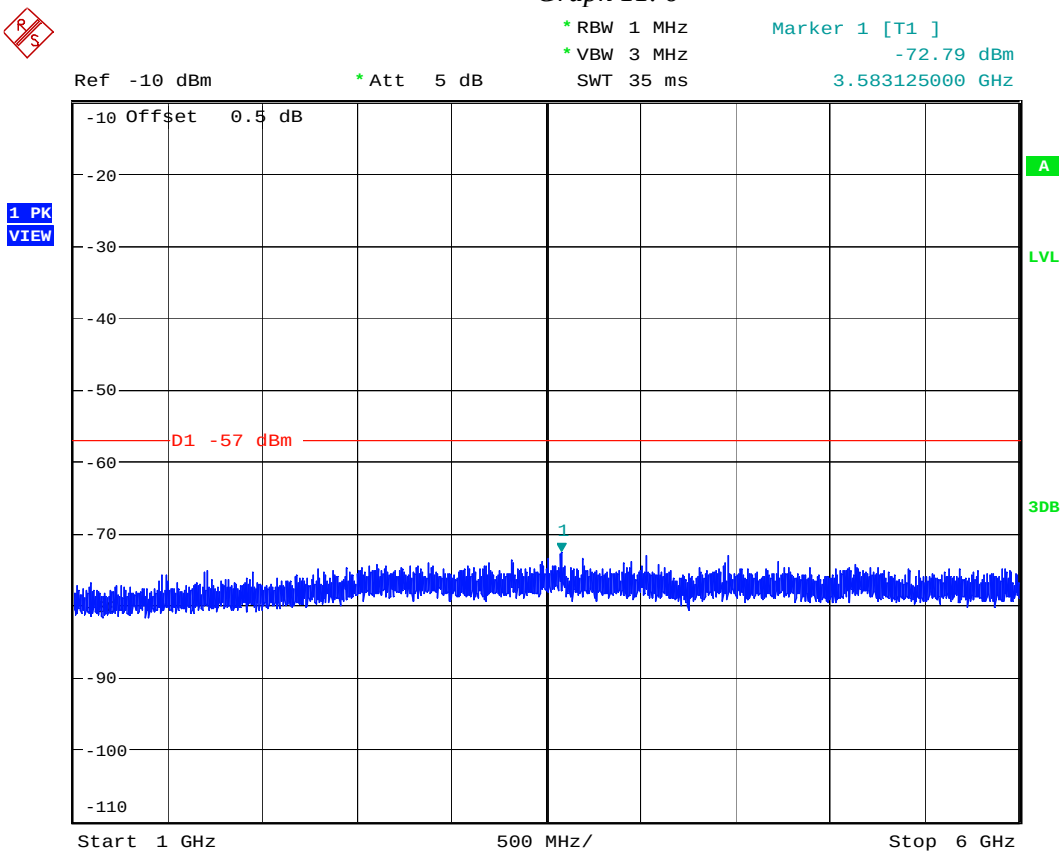
Graph 11. 5



Receiver conducted spurious, 150.5MHz

Date: 9.JUN.2011 14:10:04

Graph 11. 6



Receiver conducted spurious, 150.5MHz

Date: 9.JUN.2011 14:13:30

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	12/04/11
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	12/04/11
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	04/28/12
Spectrum Analyzer	Rohde&Schwarz	FSU26	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	01/25/12
Signal Generator	Hewlett Packard	SMR40	100445	12	08/27/11

No Calibration required

13.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / G100359040	KK	June 20, 2011	Original document