3.0 Occupied Bandwidth

FCC 2.1049, 90.209(b)(5)

3.1 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 analyzed was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth). The Occupied Bandwidth was measured at the low, middle and high channels for all types of modulation and authorized bandwidths.

3.2 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

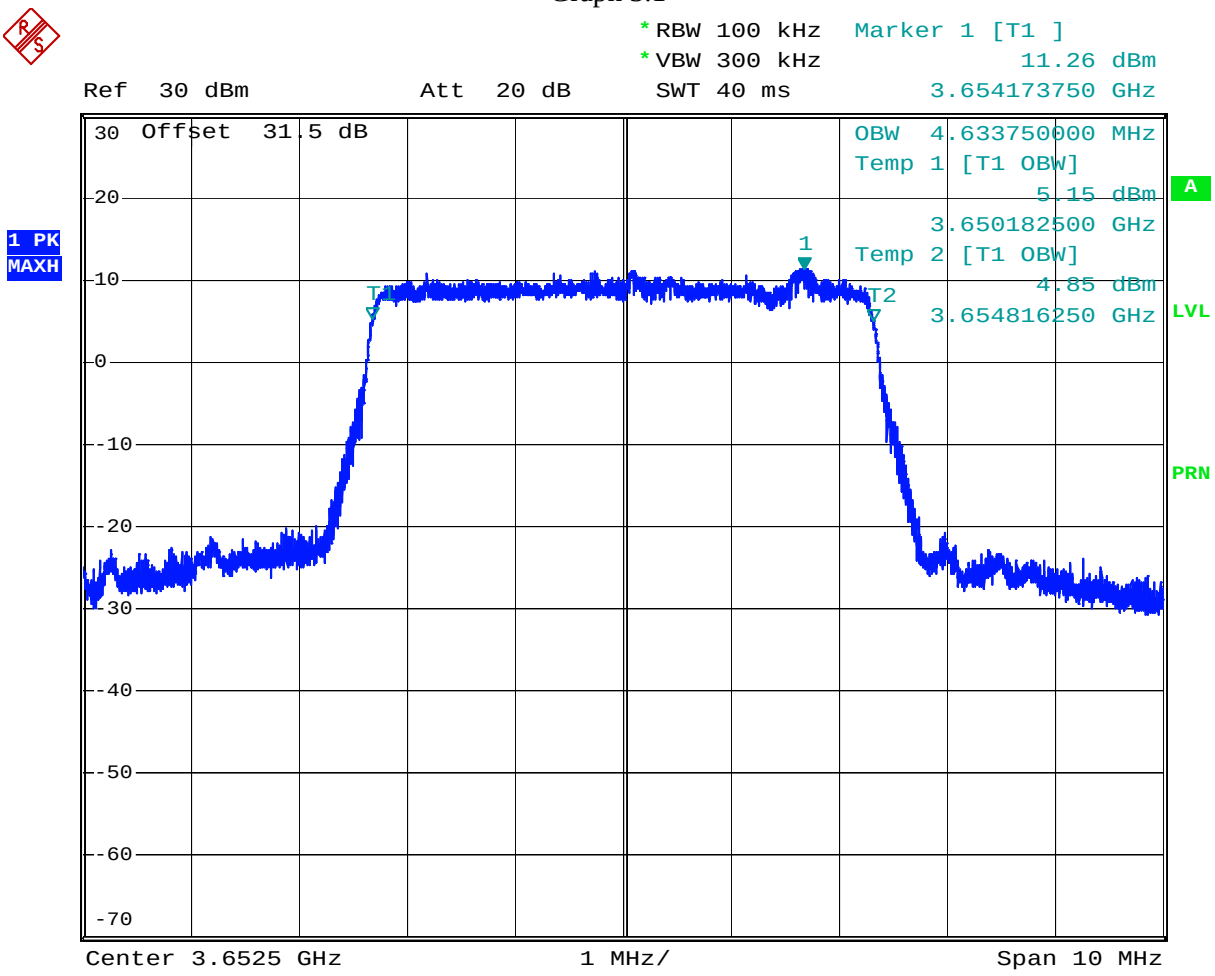
3.3 Test Results

Frequency (GHz)	Modulation	Channel Bandwidth (MHz)	Measured Occupied Bandwidth (MHz)	Graph
3.6525	QPSK	5	4.63	3.1
	16 QAM		4.63	3.2
	64 QAM		4.63	3.3
3.6625	QPSK	5	4.63	3.4
	16 QAM		4.63	3.5
	64 QAM		4.63	3.6
3.6725	QPSK	5	4.63	3.7
	16 QAM		4.63	3.8
	64 QAM		4.63	3.9

Frequency (GHz)	Modulation	Channel Bandwidth (MHz)	Measured Occupied Bandwidth (MHz)	Graph
3.655	QPSK	10	9.26	3.10
	16 QAM		9.24	3.11
	64 QAM		9.26	3.12
3.6625	QPSK	10	9.26	3.13
	16 QAM		9.26	3.14
	64 QAM		9.26	3.15
3.67	QPSK	10	9.24	3.16
	16 QAM		9.24	3.17
	64 QAM		9.26	3.18

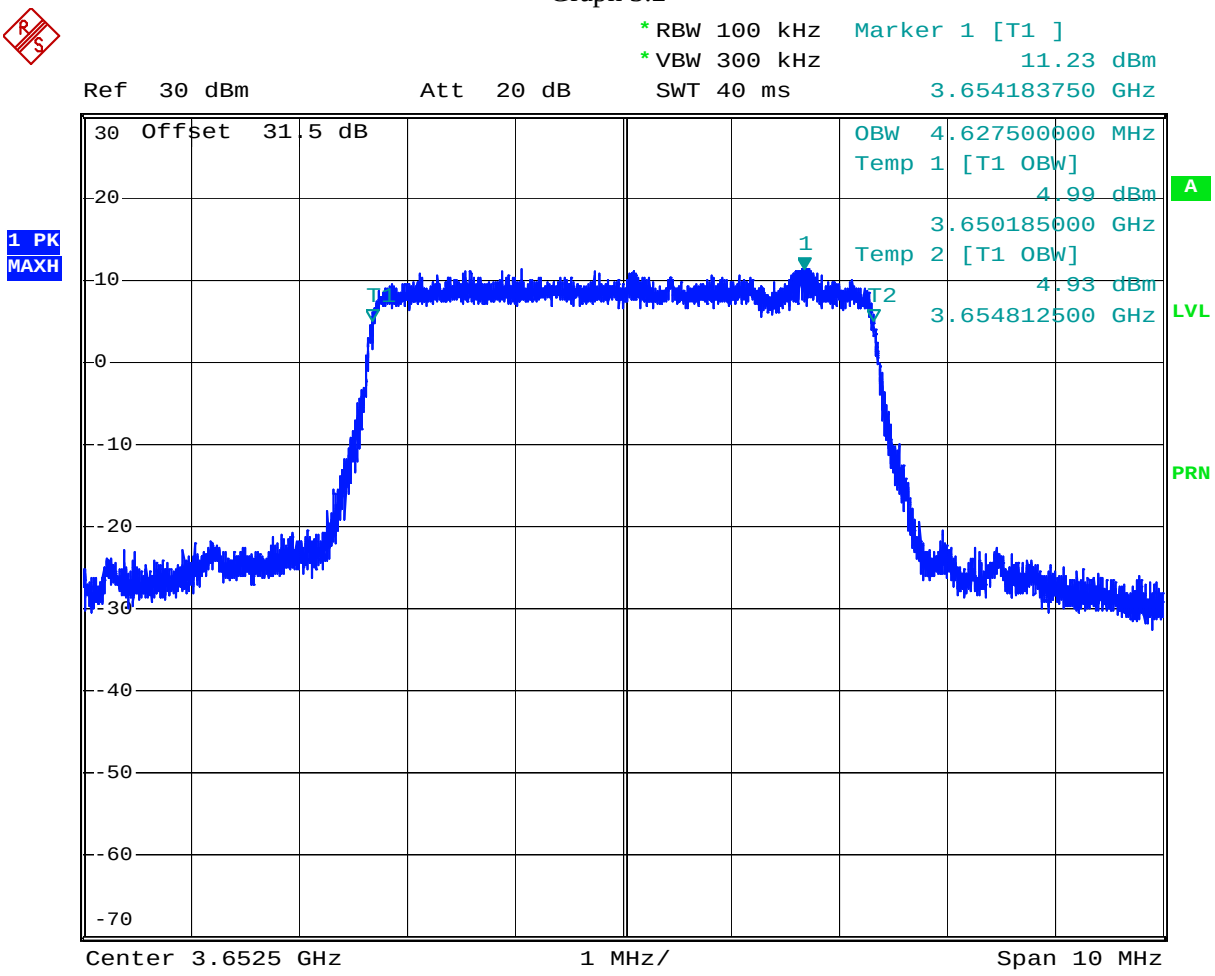
For more details refer to the attached Graphs.

Graph 3.1



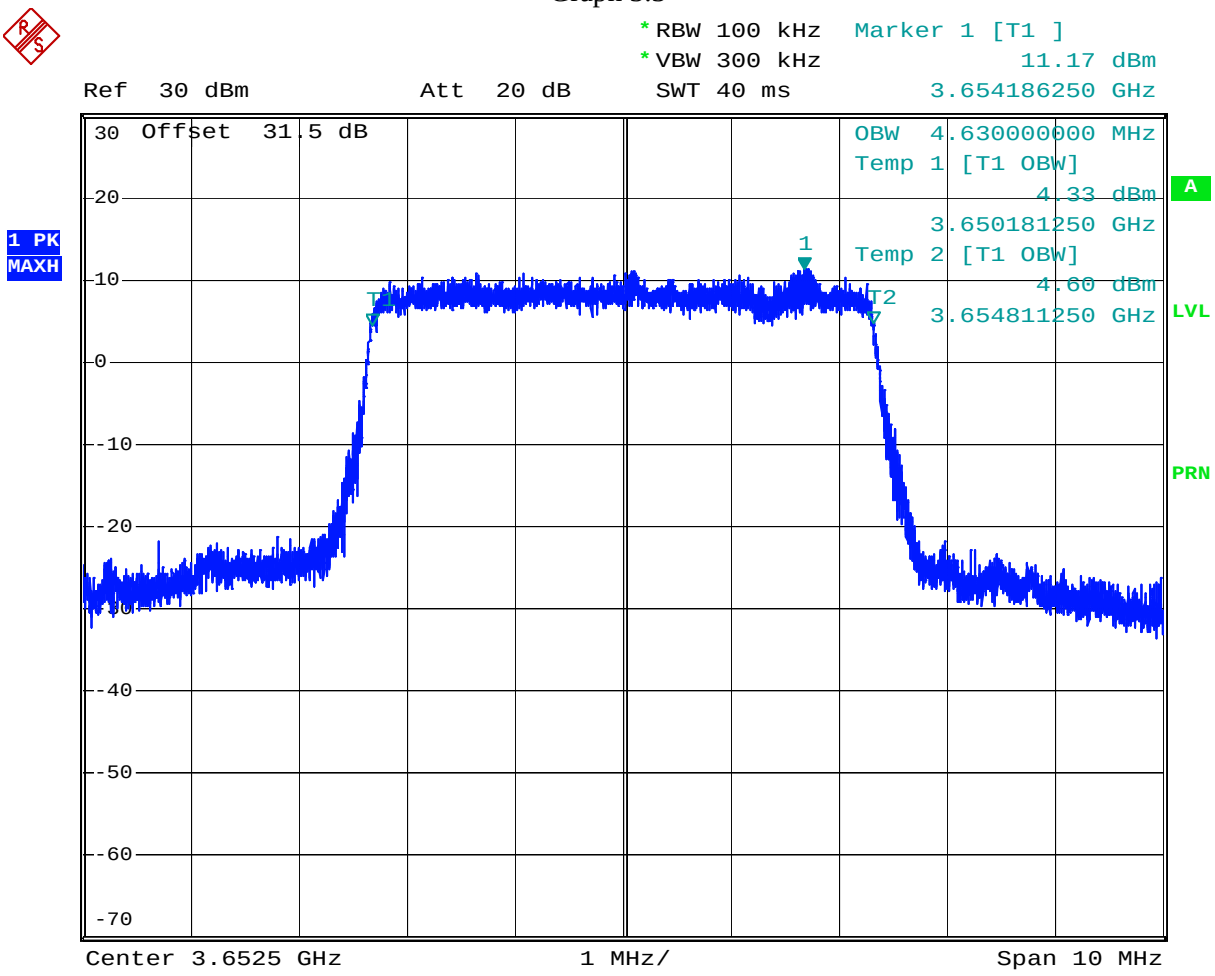
Comment: QPSK, LOW CHANNEL
Date: 23.FEB.2010 12:01:36

Graph 3.2



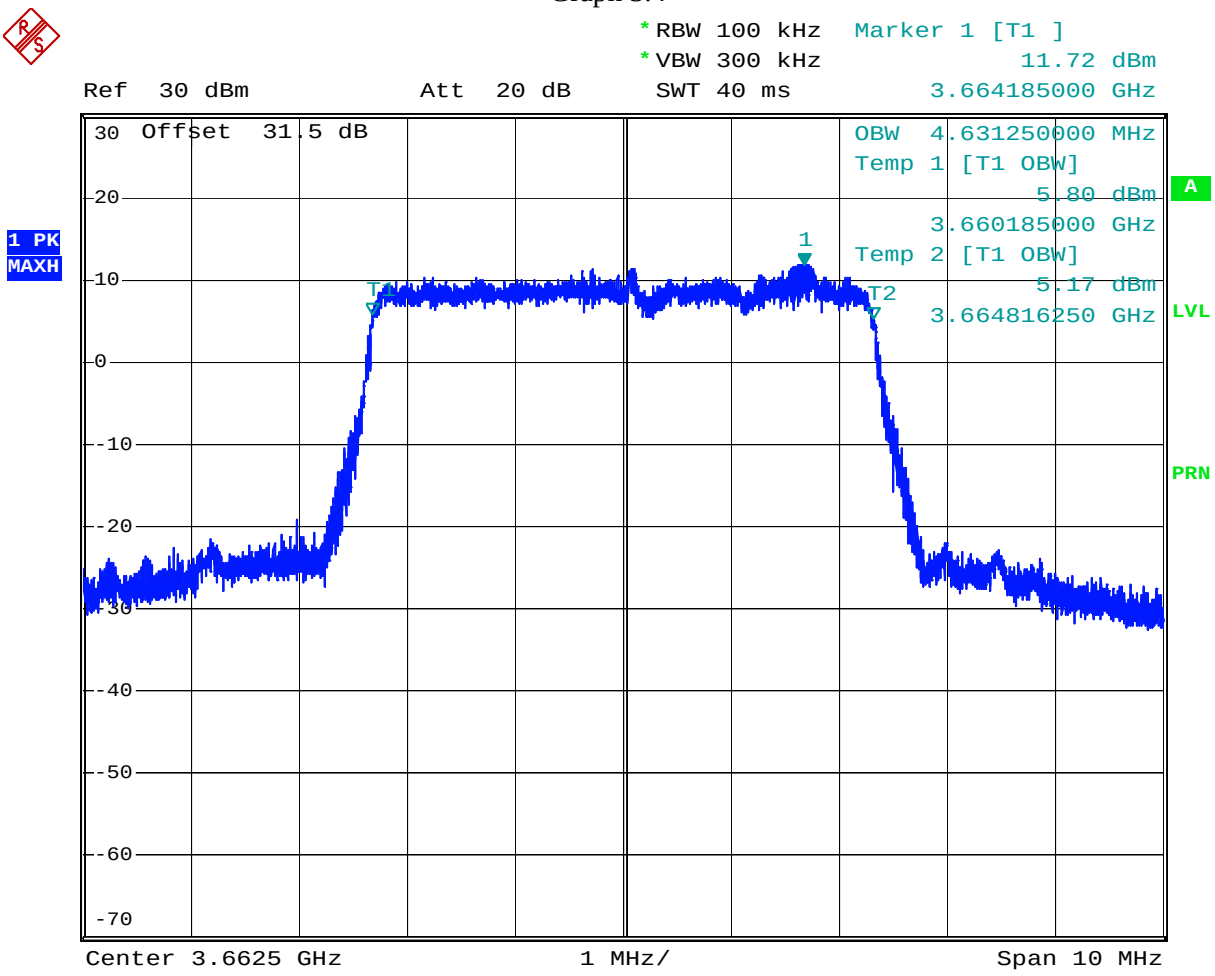
Comment: 16QAM, LOW CHANNEL
Date: 23.FEB.2010 12:16:07

Graph 3.3



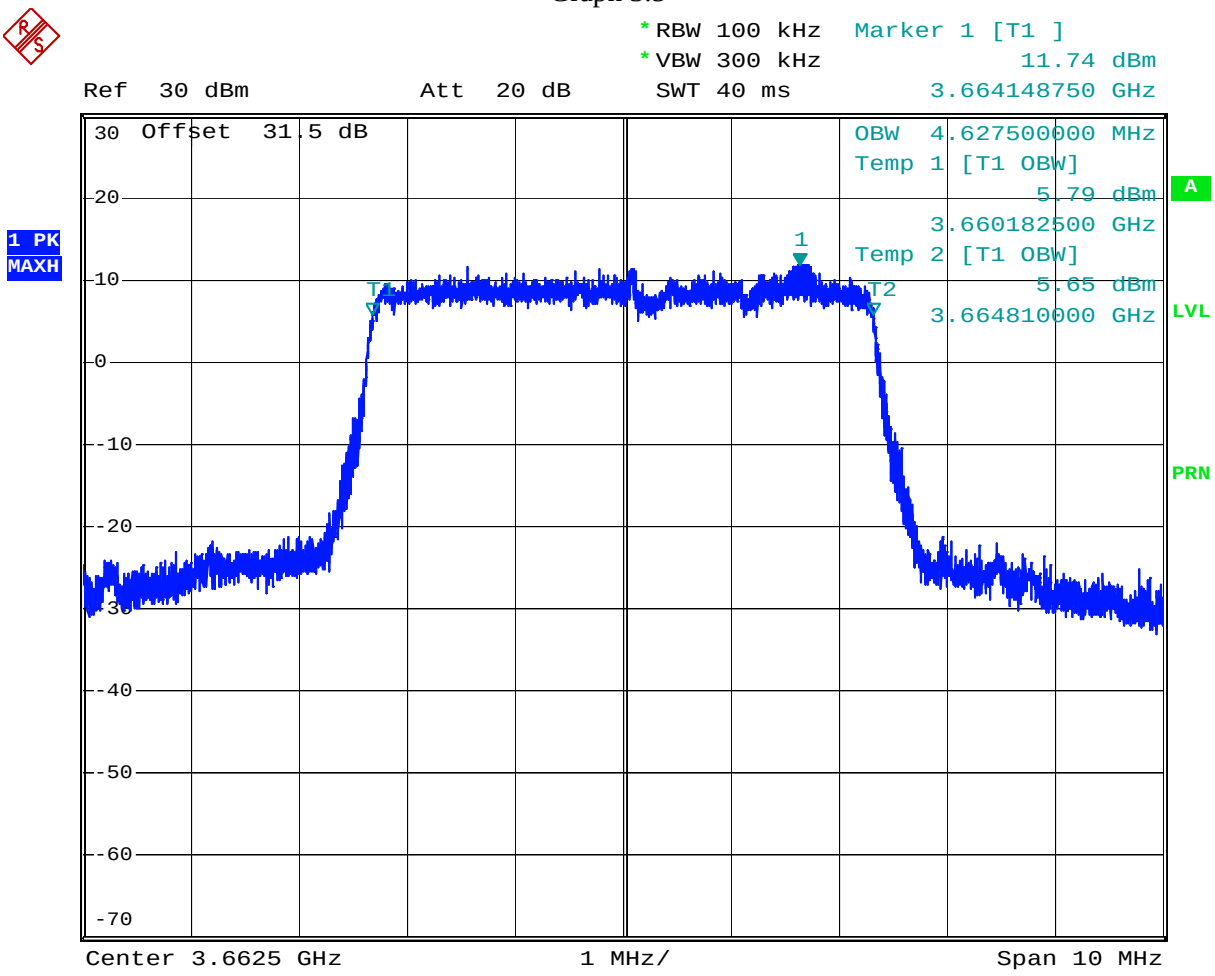
Comment: 64QAM, LOW CHANNEL
Date: 23.FEB.2010 12:19:48

Graph 3.4



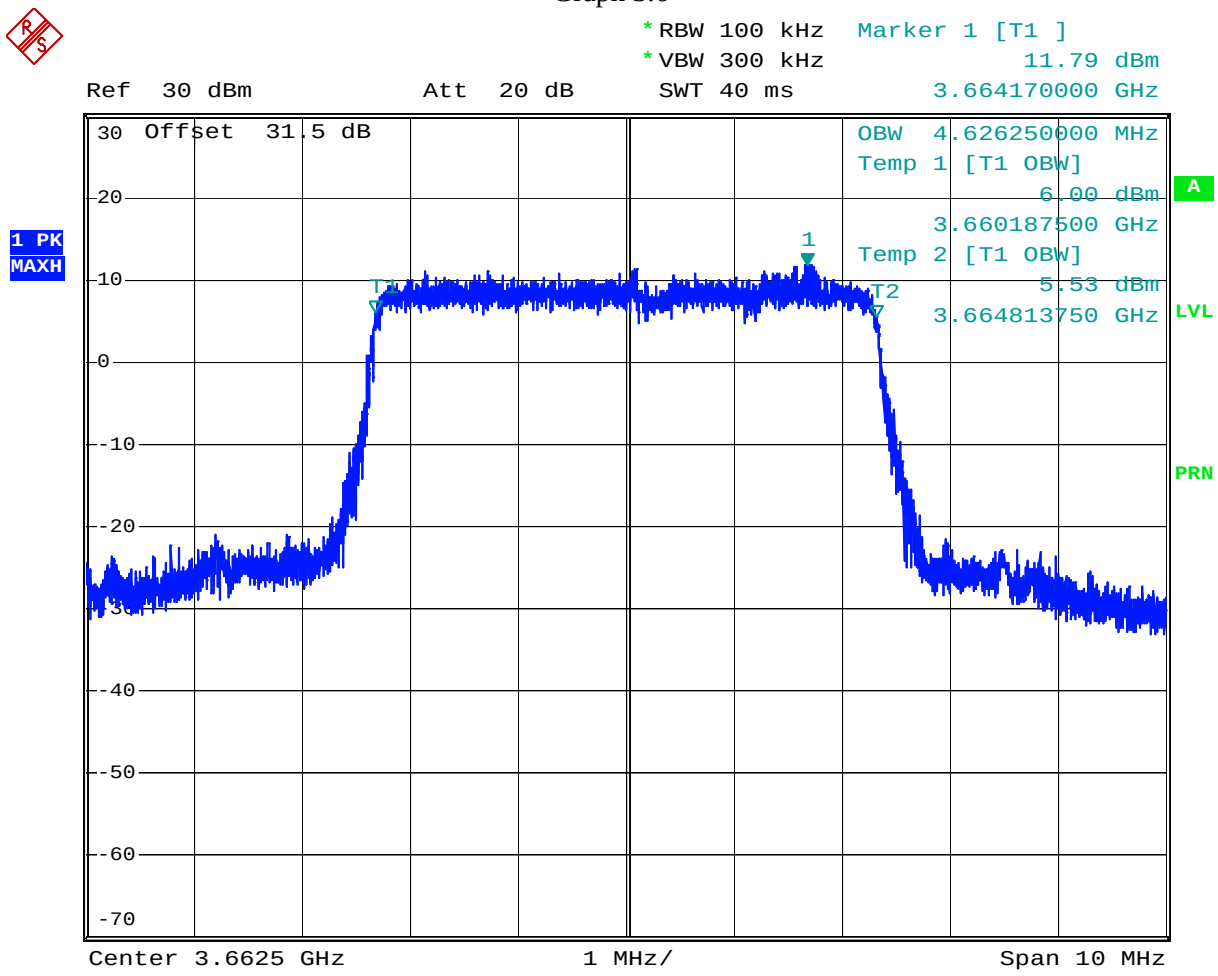
Comment: QPSK, MID CHANNEL
Date: 23.FEB.2010 12:05:36

Graph 3.5



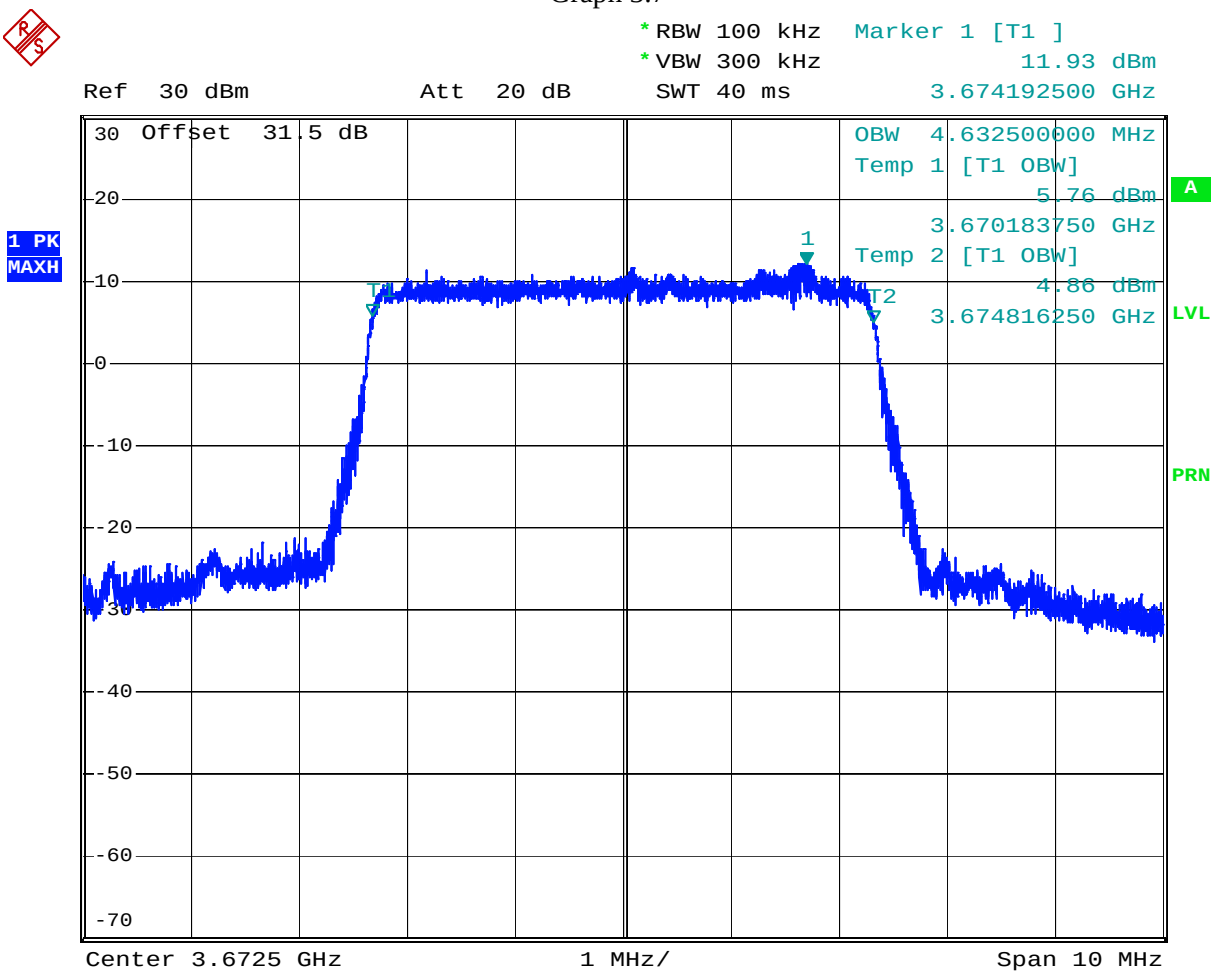
Comment: 16QAM, MID CHANNEL
Date: 23.FEB.2010 12:13:41

Graph 3.6



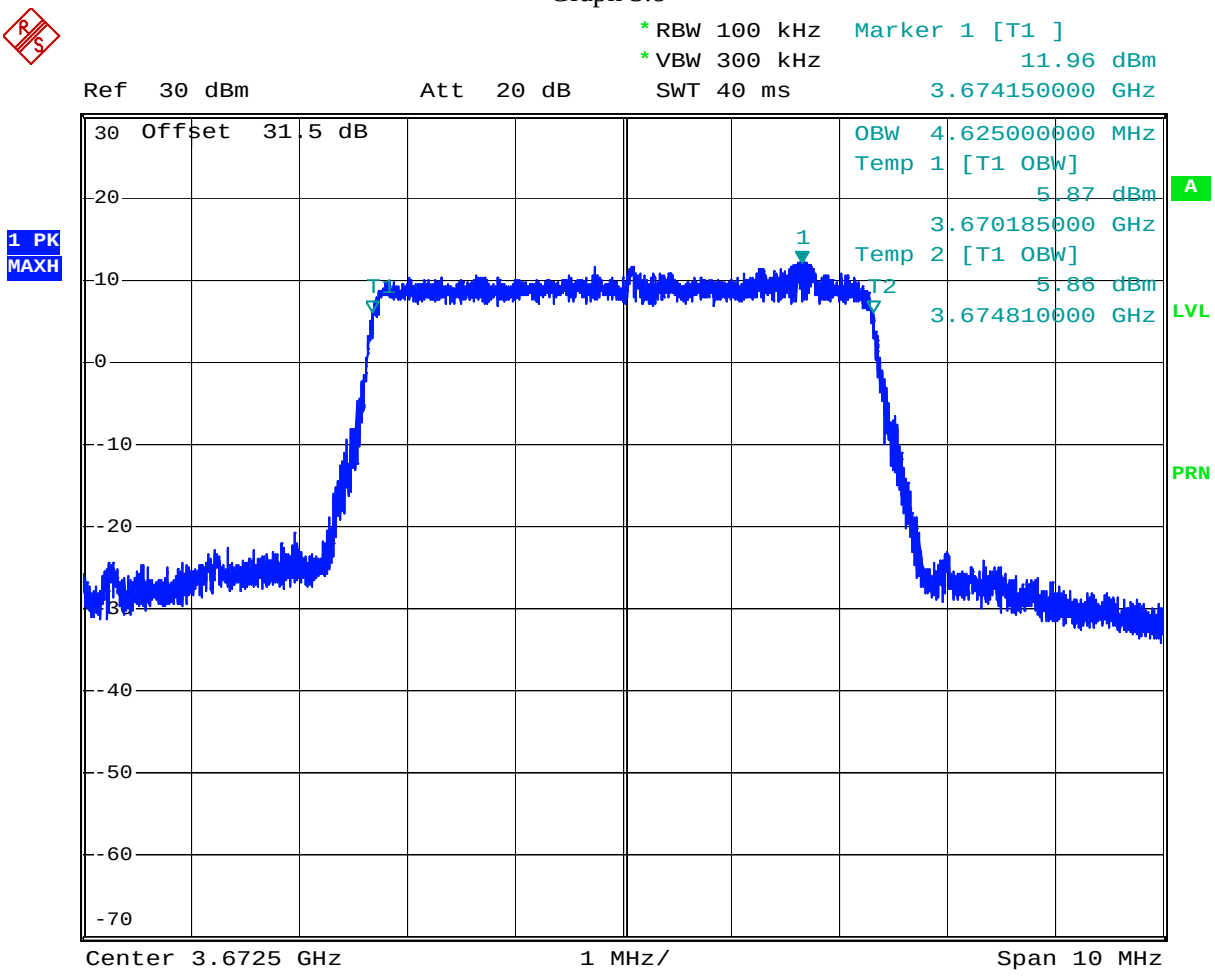
Comment: 64QAM, MID CHANNEL
Date: 23.FEB.2010 12:21:22

Graph 3.7



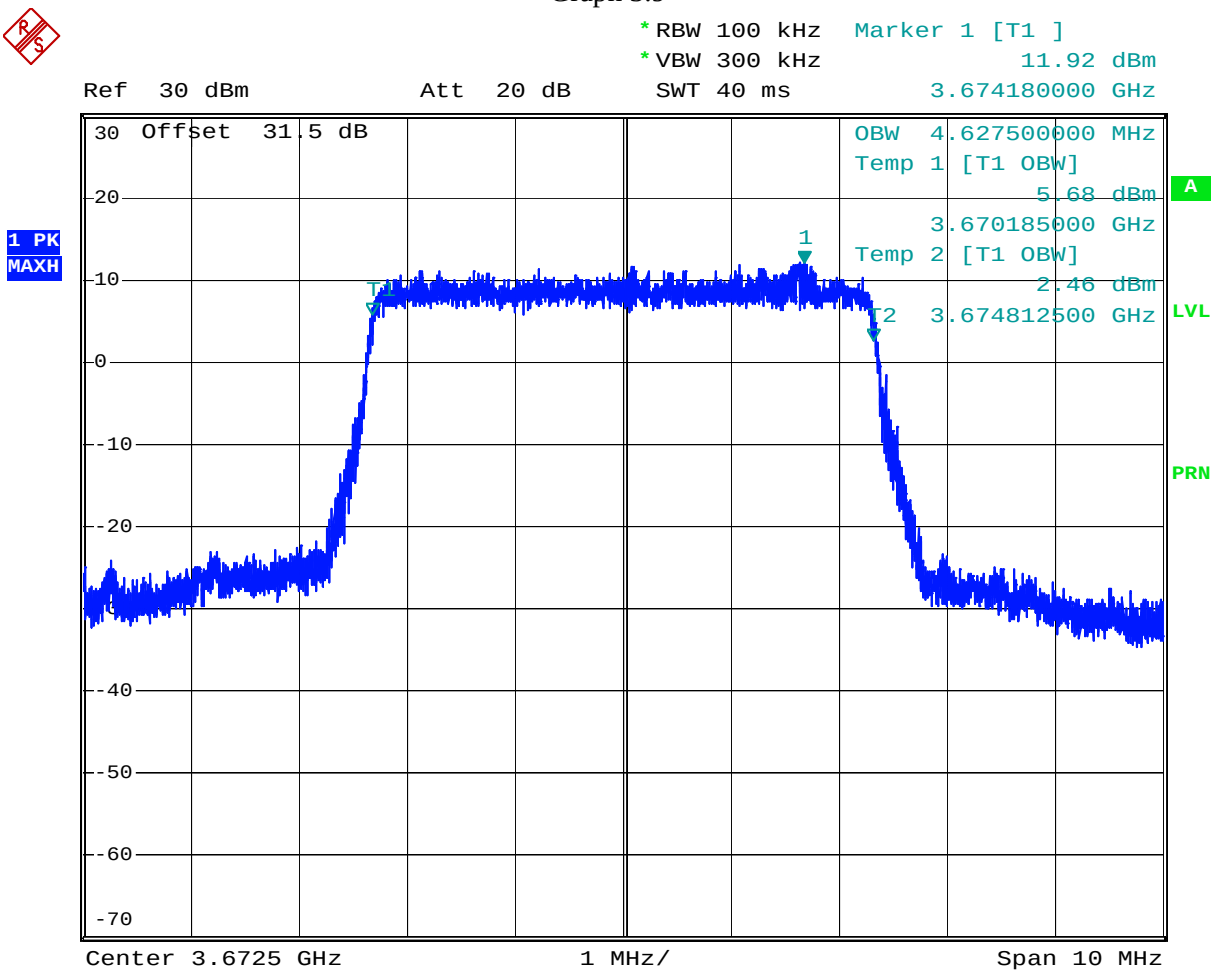
Comment: QPSK, HIGH CHANNEL
Date: 23.FEB.2010 12:08:03

Graph 3.8



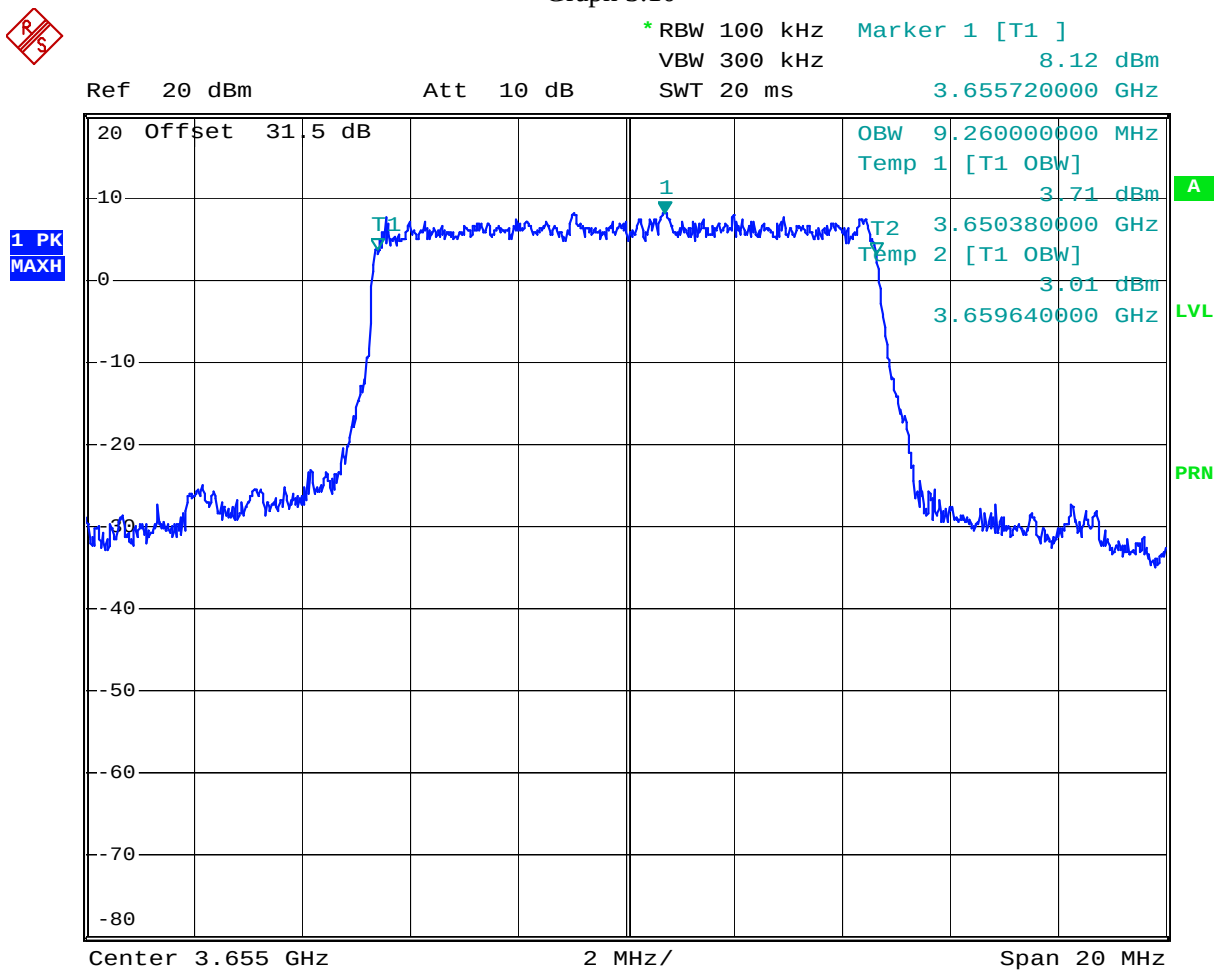
Comment: 16QAM, HIGH CHANNEL
Date: 23.FEB.2010 12:09:57

Graph 3.9



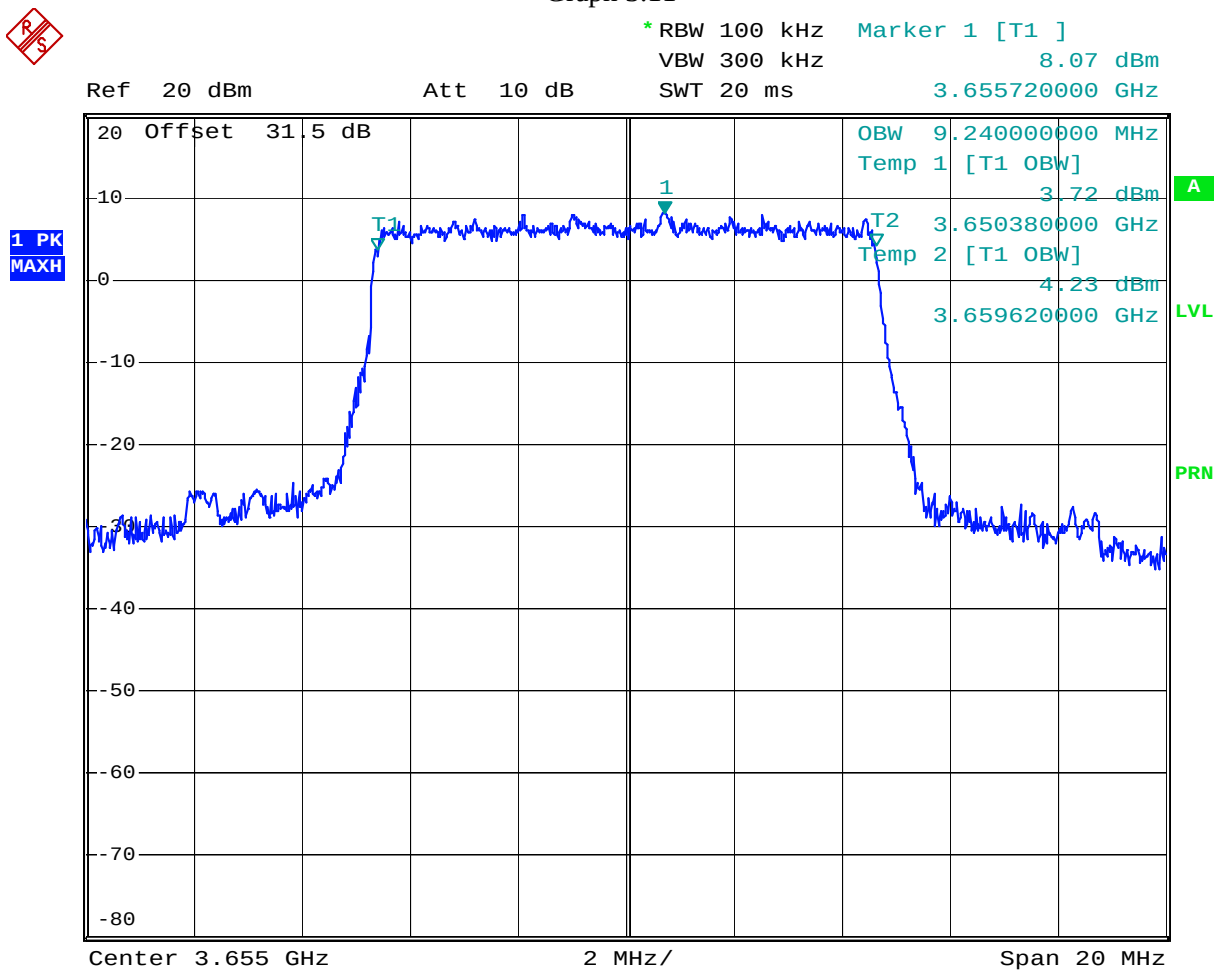
Comment: 64QAM, HIGH CHANNEL
Date: 23.FEB.2010 12:22:41

Graph 3.10



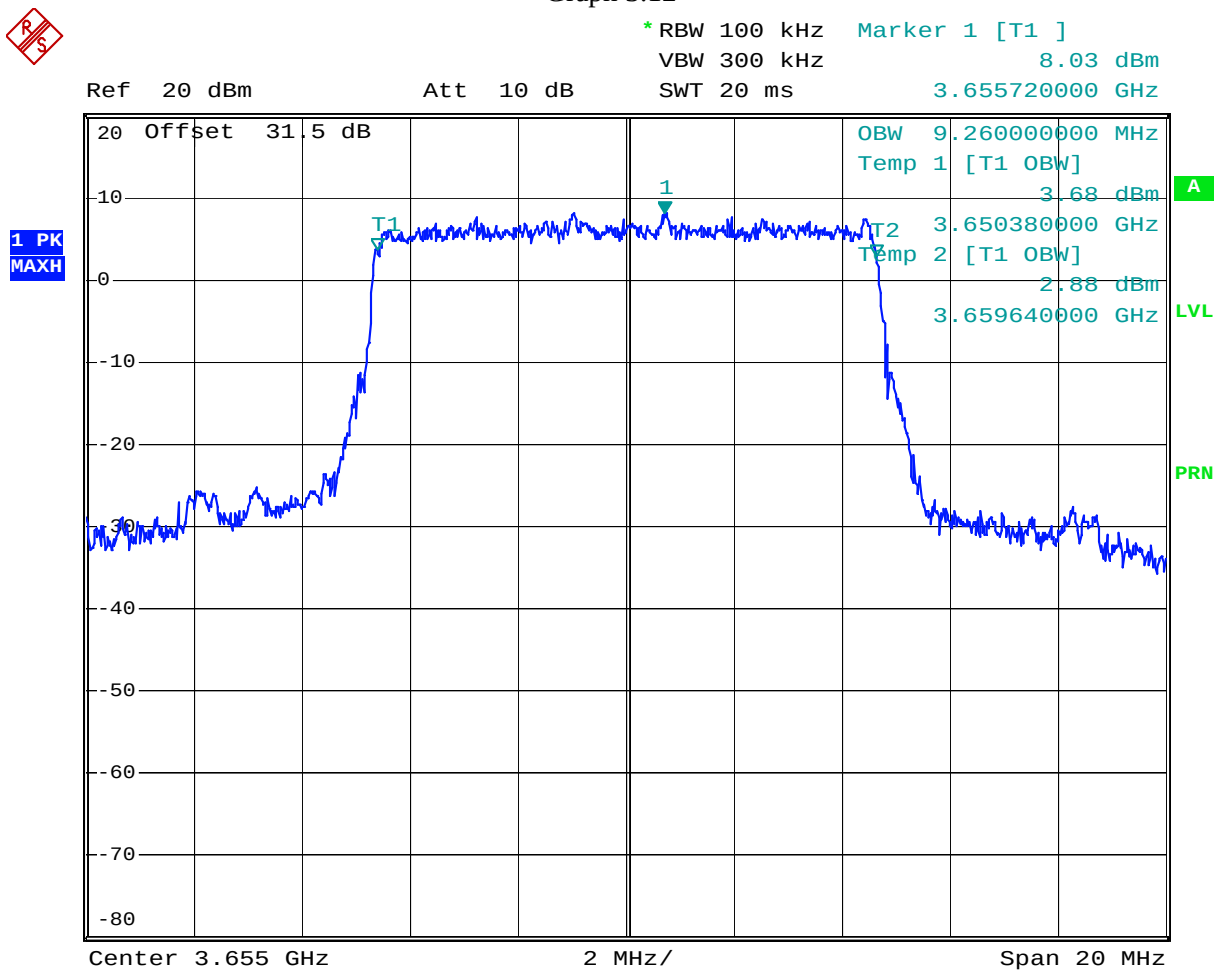
Comment: QPSK, LOW CHANNEL
Date: 23.FEB.2010 16:42:26

Graph 3.11



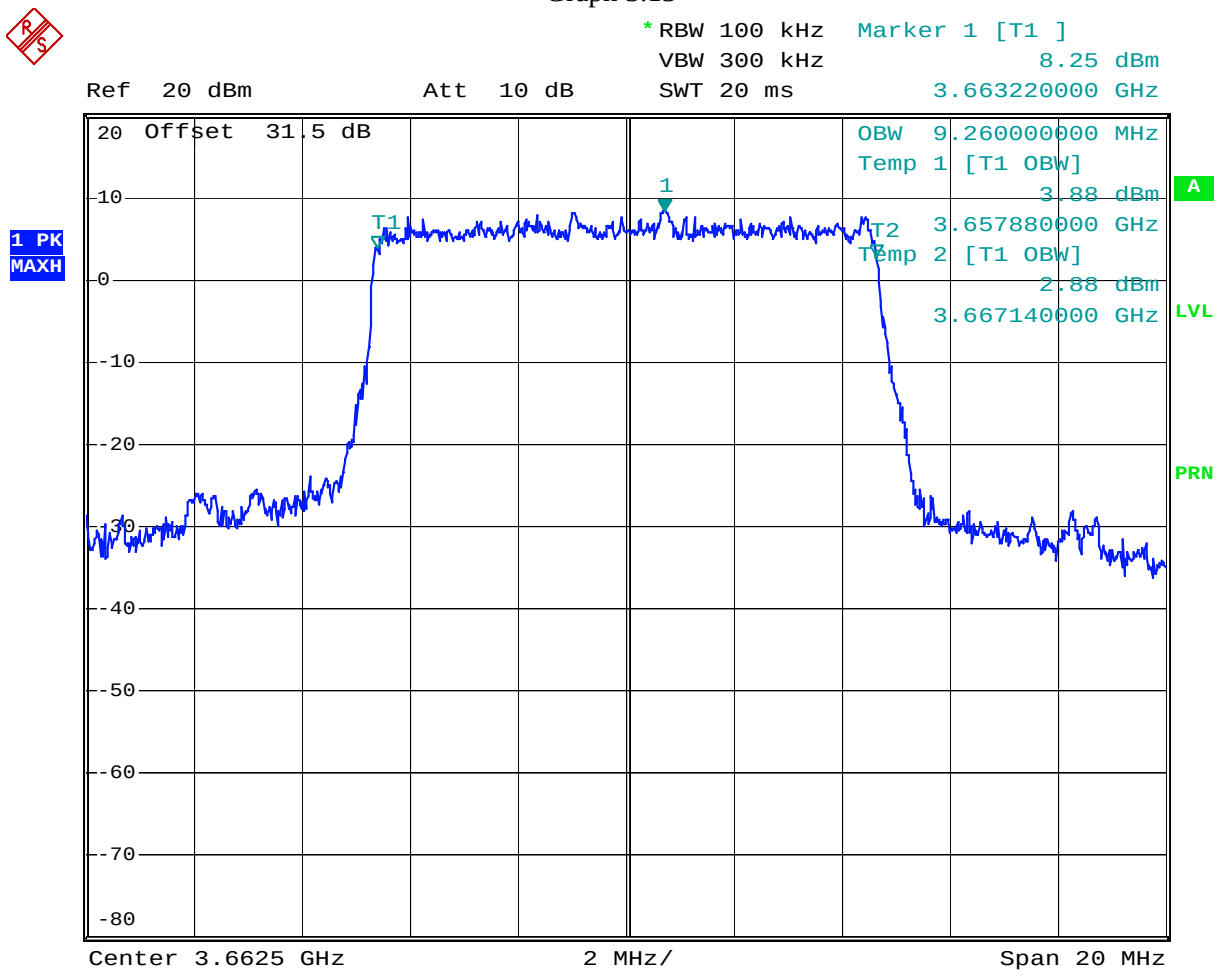
Comment: 16QAM, LOW CHANNEL
Date: 23.FEB.2010 16:49:13

Graph 3.12



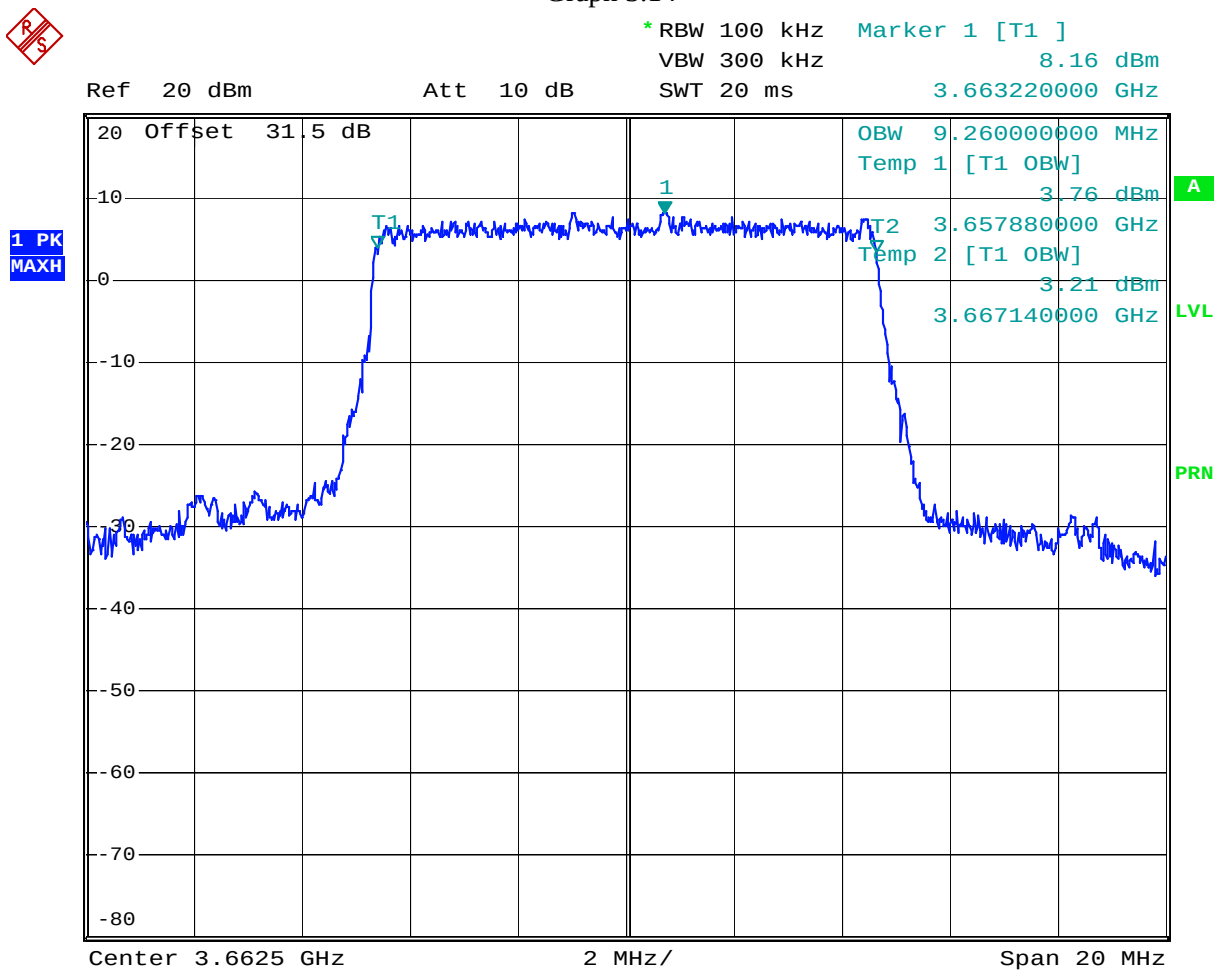
Comment: 64QAM, LOW CHANNEL
Date: 23.FEB.2010 16:50:25

Graph 3.13



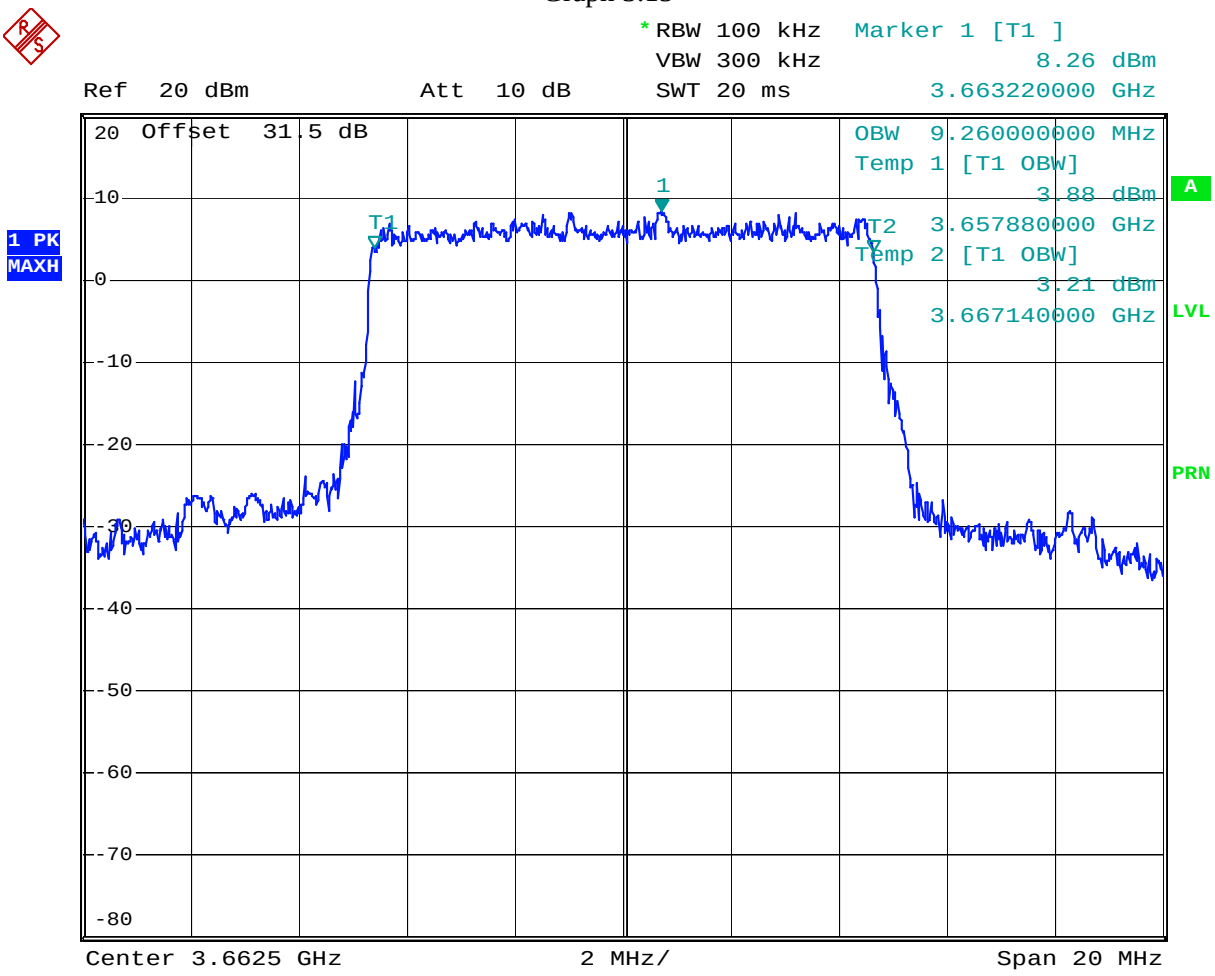
Comment: QPSK, MID CHANNEL
Date: 23.FEB.2010 16:45:03

Graph 3.14



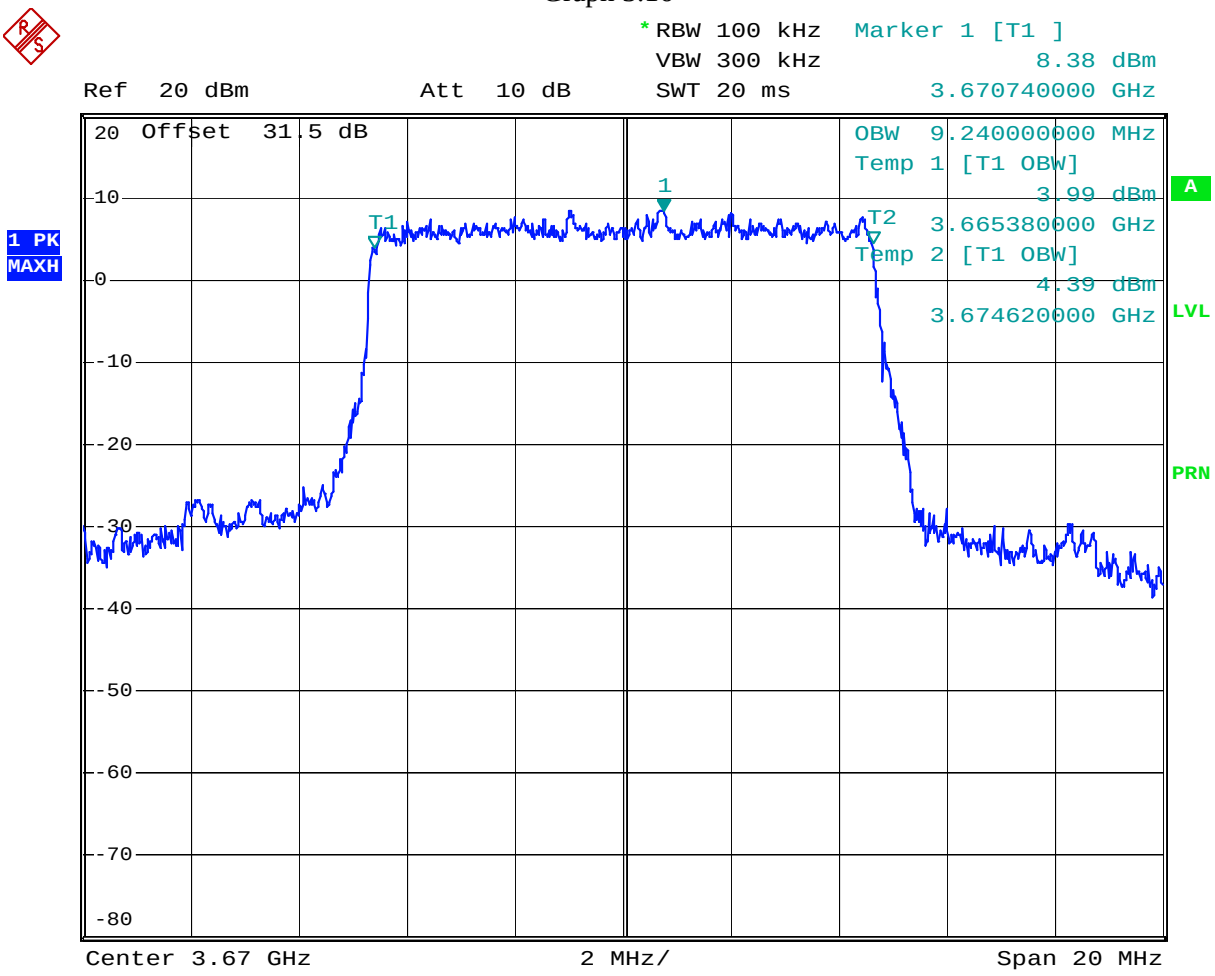
Comment: 16QAM, MID CHANNEL
Date: 23.FEB.2010 16:48:12

Graph 3.15



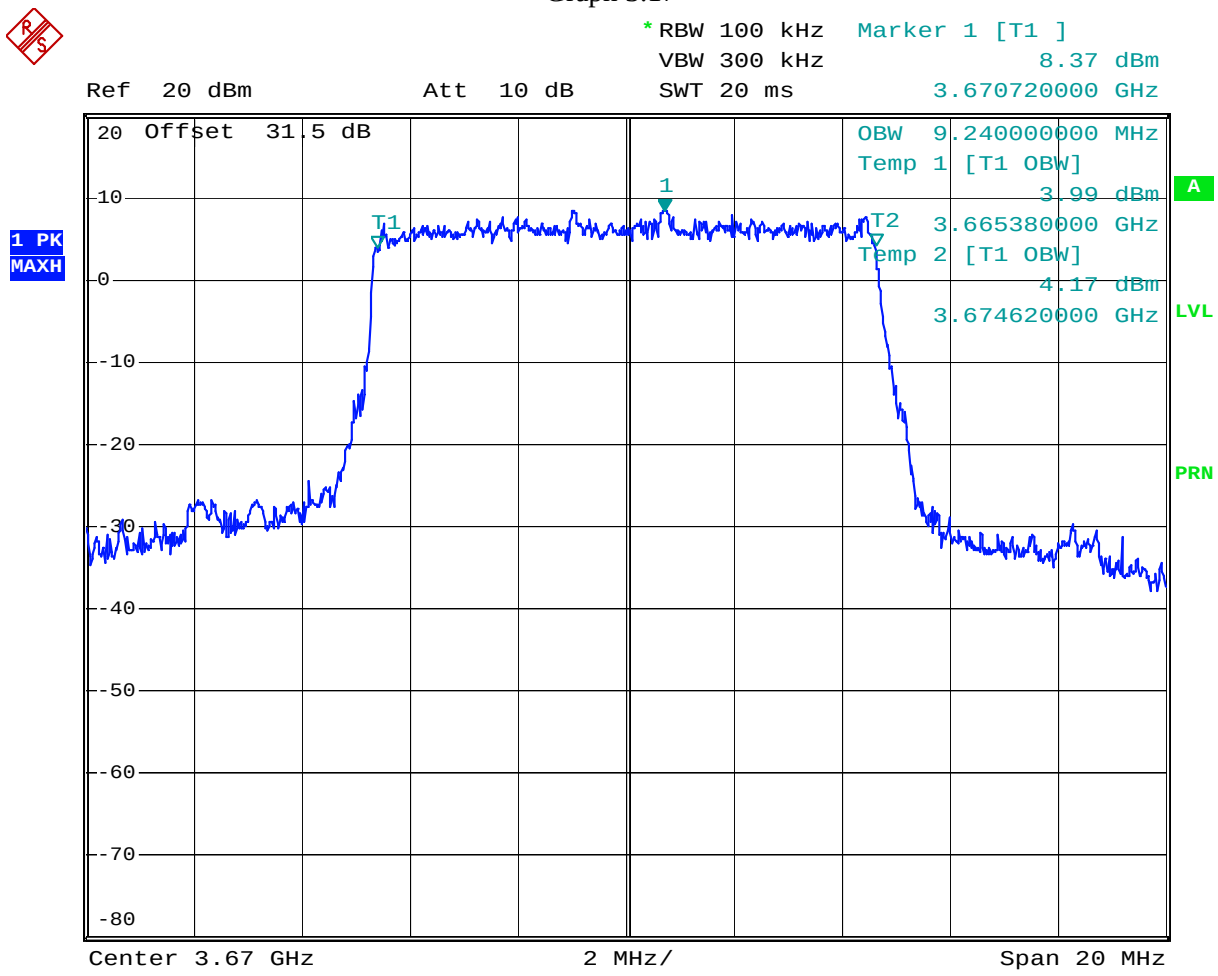
Comment: 64QAM, MID CHANNEL
Date: 23.FEB.2010 16:51:55

Graph 3.16



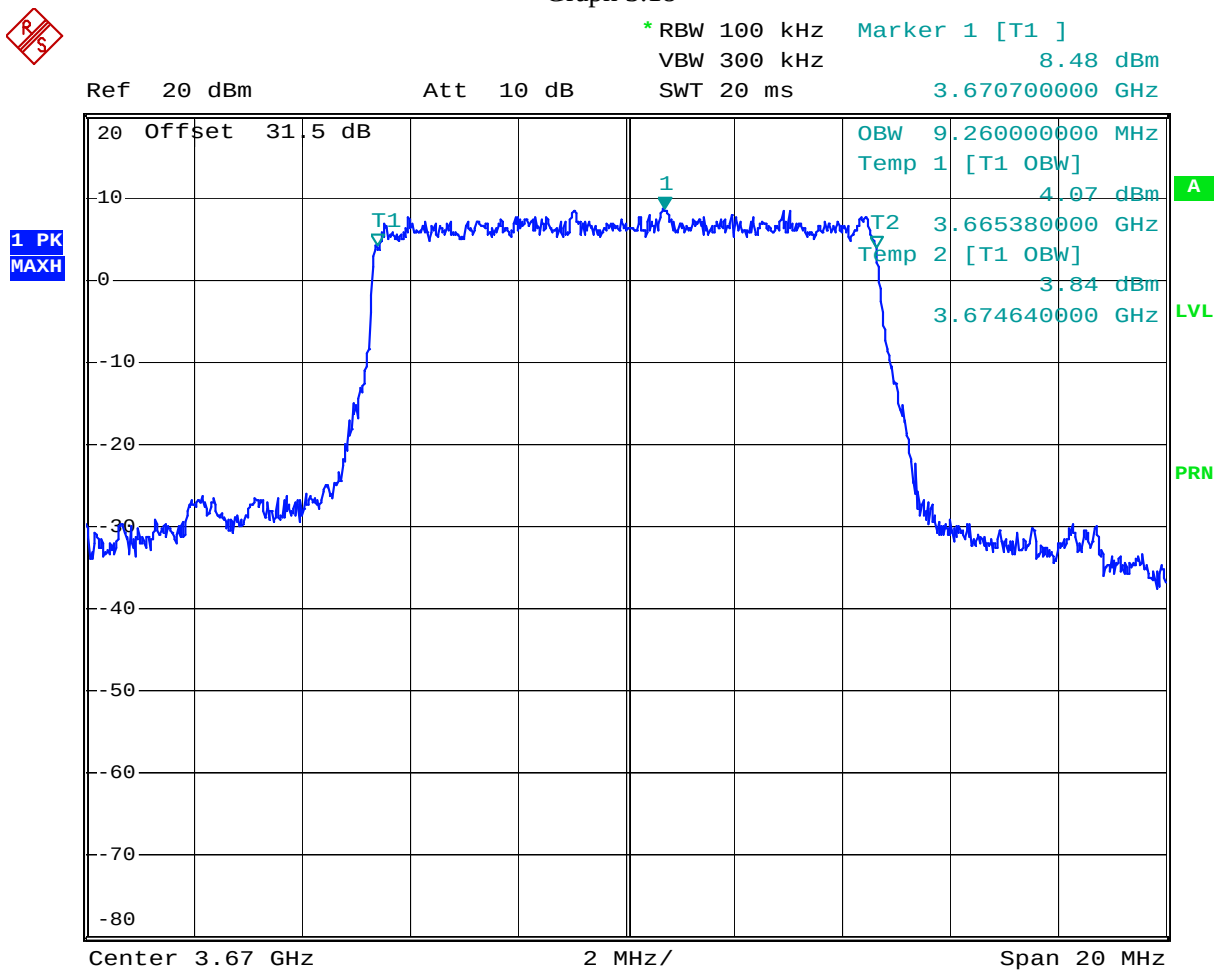
Comment: QPSK, HIGH CHANNEL
Date: 23.FEB.2010 16:46:12

Graph 3.17



Comment: 16QAM, HIGH CHANNEL
Date: 23.FEB.2010 16:47:03

Graph 3.18



Comment: 64QAM, HIGH CHANNEL
Date: 23.FEB.2010 16:53:42

4.0 Spurious Emissions at Antenna Terminals

FCC 2.1051, 90.1323

4.1 Requirement

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

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

4.3 Test Equipment

Rohde & Schwarz FSP40 Spectrum Analyzer

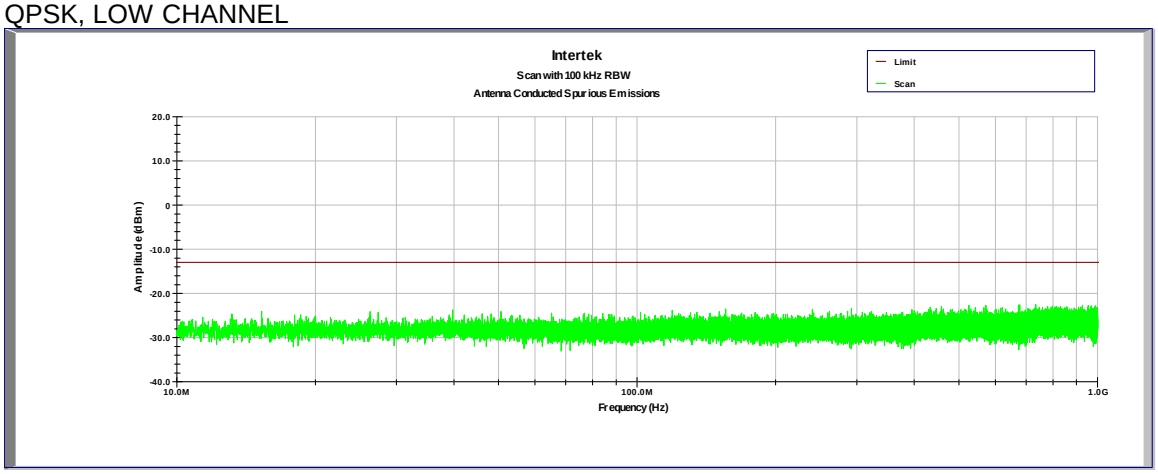
4.4 Test Results

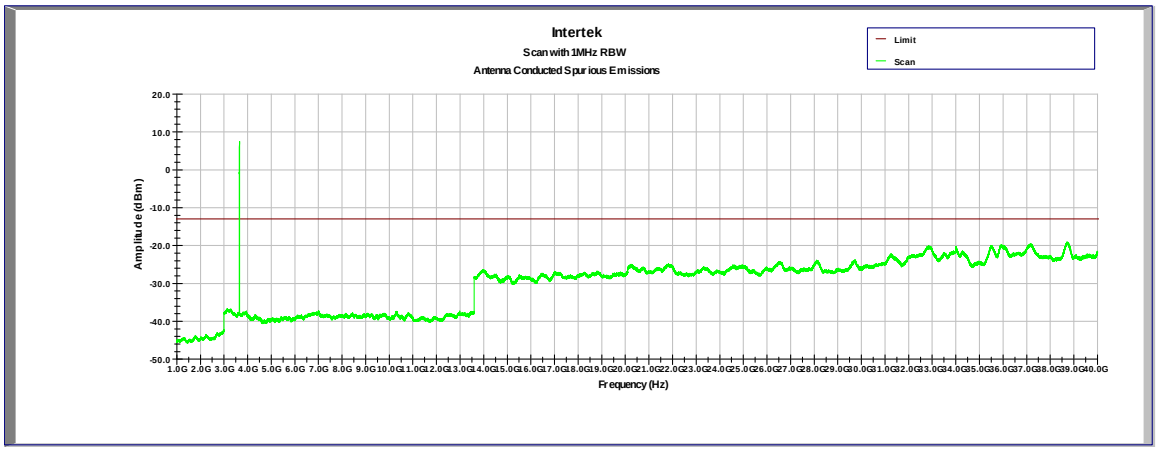
Complies	Refer to the following Graphs

Measurements were made on the low, middle and high channels for all modulations.

Graph 4.1
5 MHz

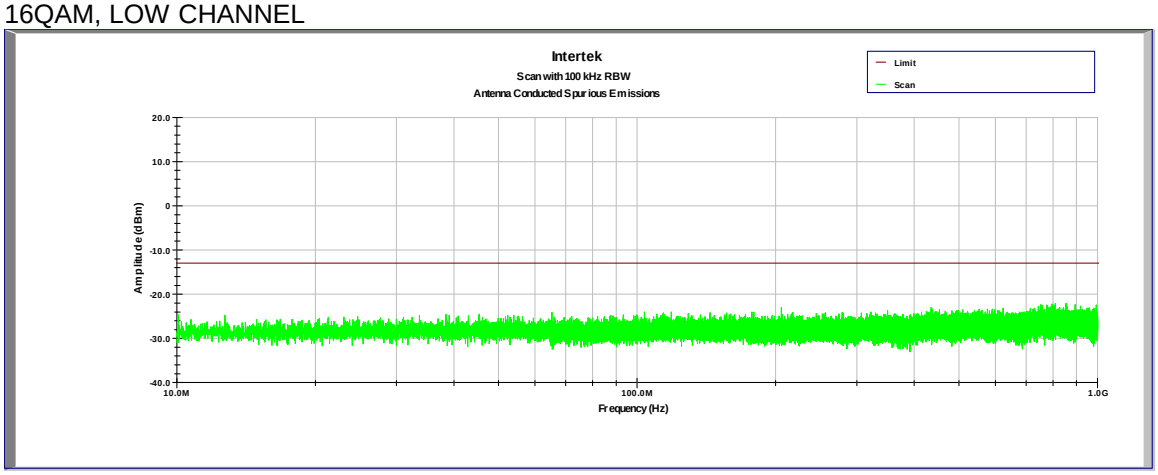
QPSK, LOW CHANNEL

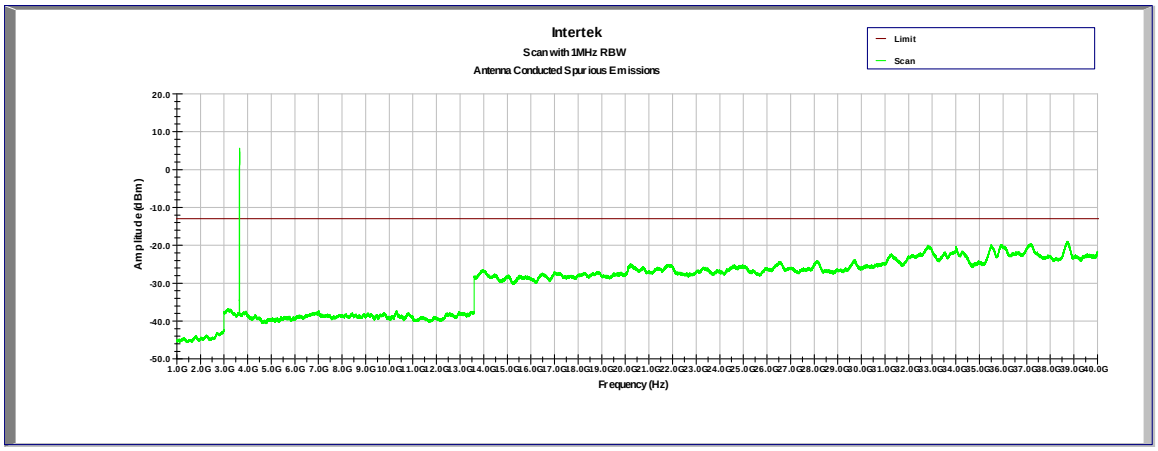




Graph 4.2
5 MHz

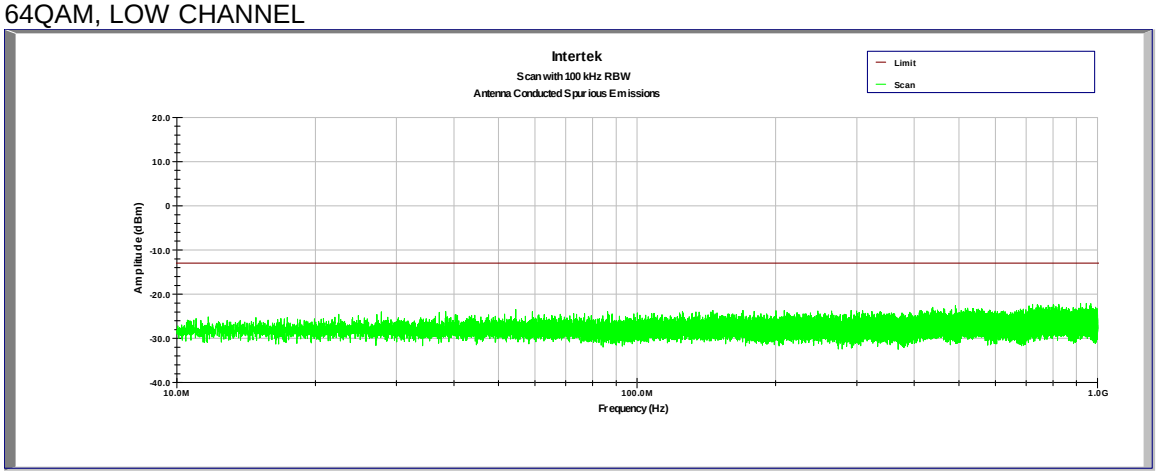
16QAM, LOW CHANNEL

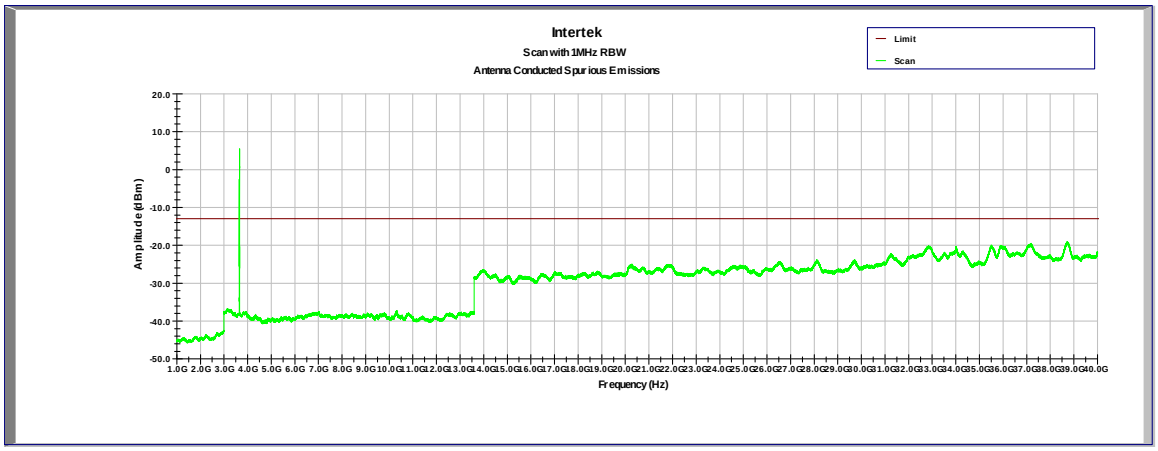




Graph 4.3
5 MHz

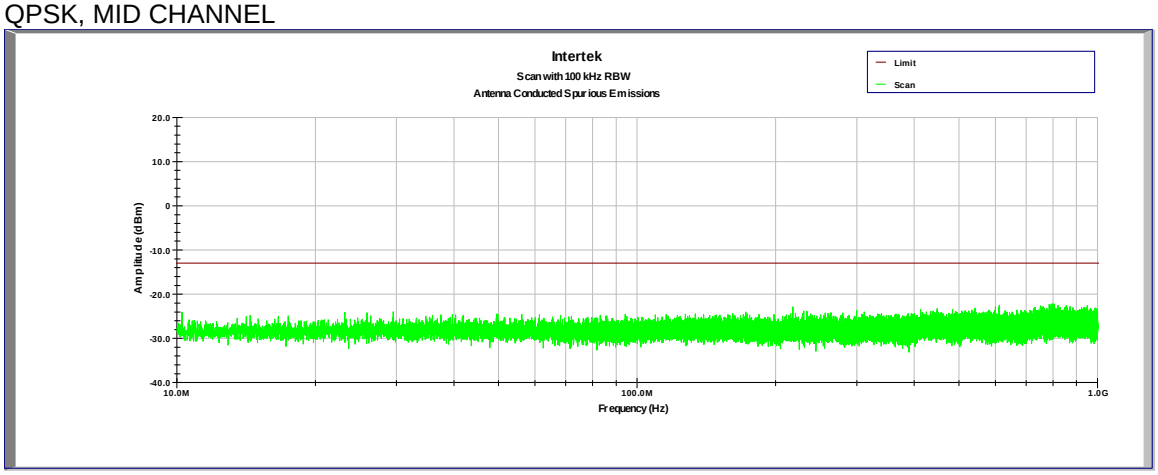
64QAM, LOW CHANNEL

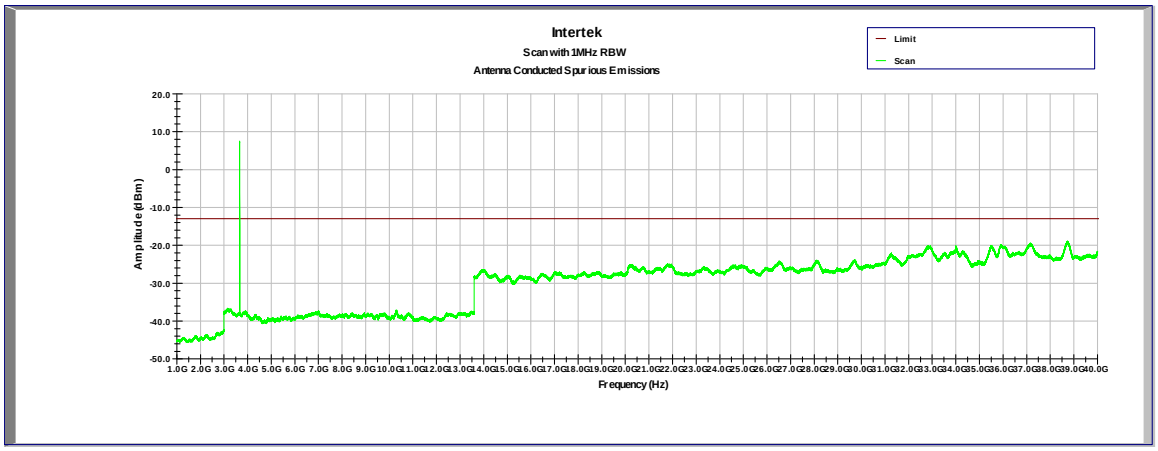




Graph 4.4
5 MHz

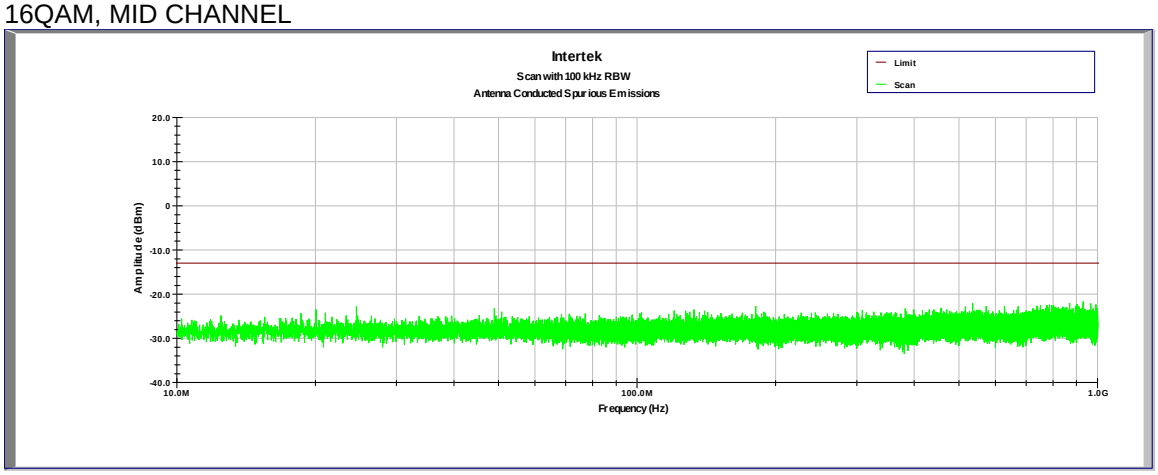
QPSK, MID CHANNEL

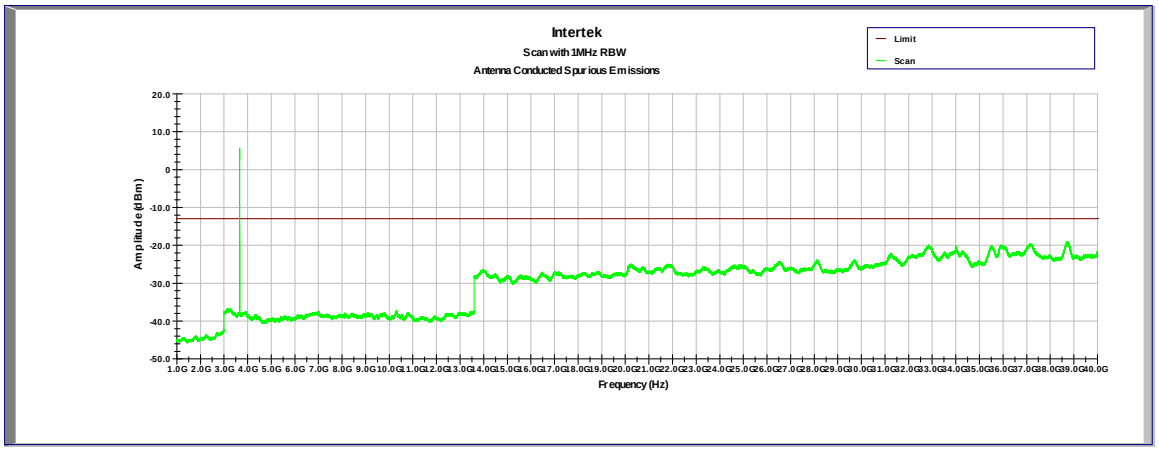




Graph 4.5
5 MHz

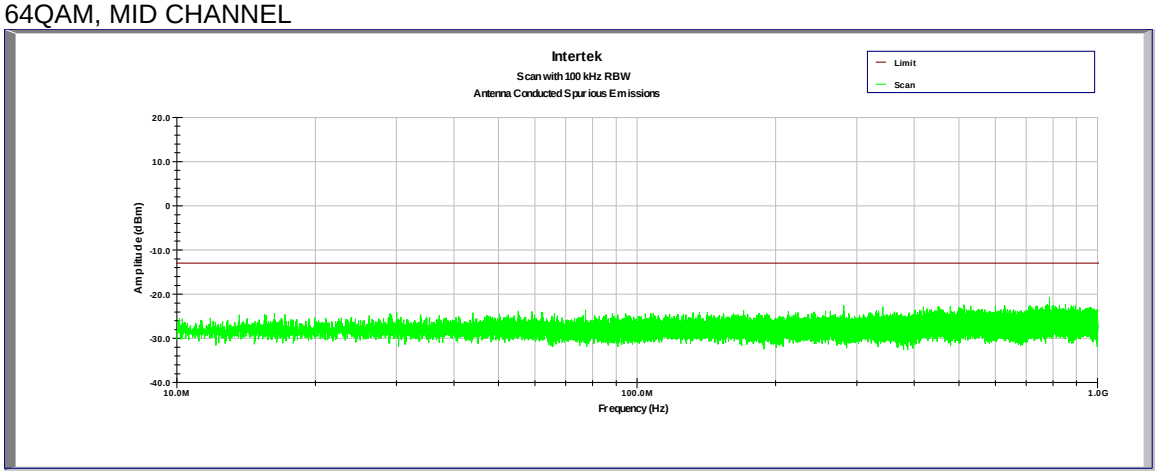
16QAM, MID CHANNEL

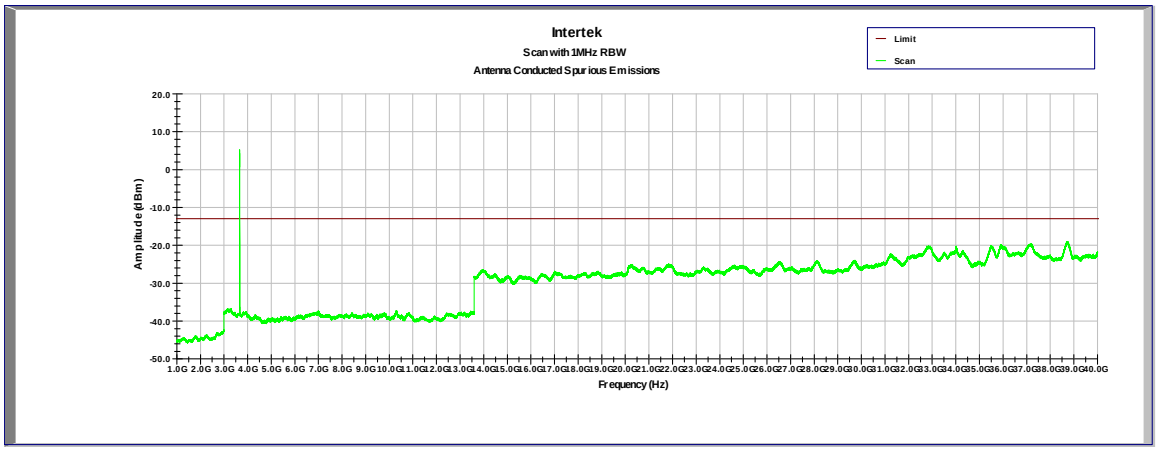




Graph 4.6
5 MHz

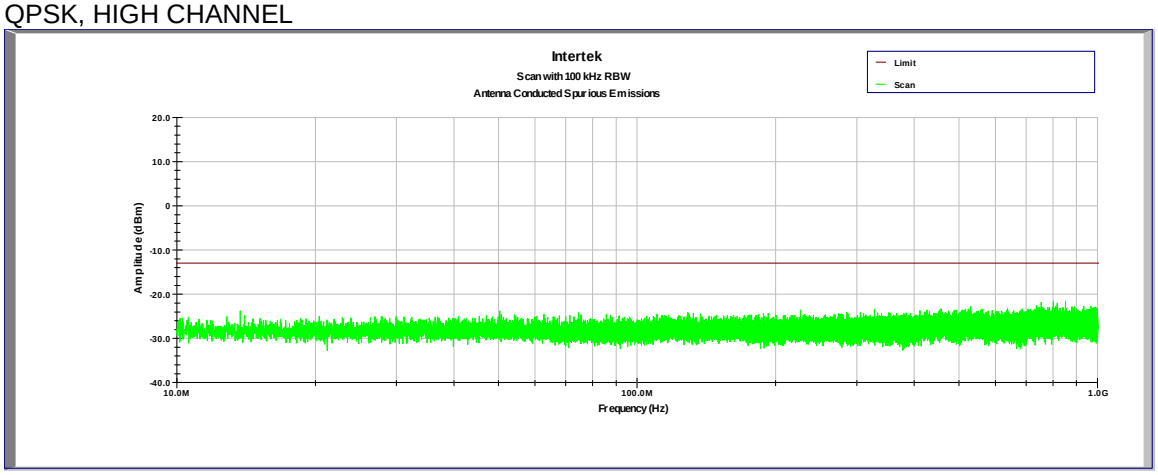
64QAM, MID CHANNEL

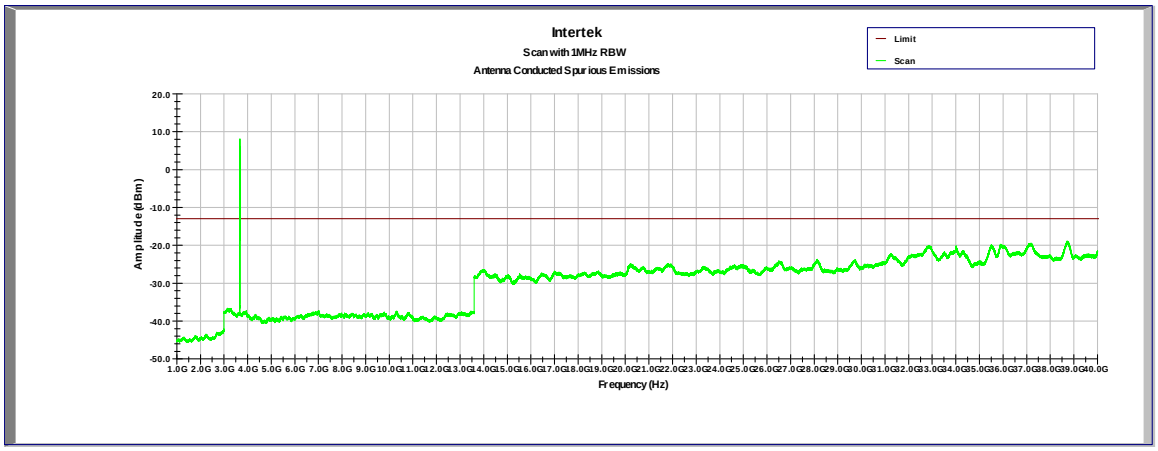




Graph 4.7
5 MHz

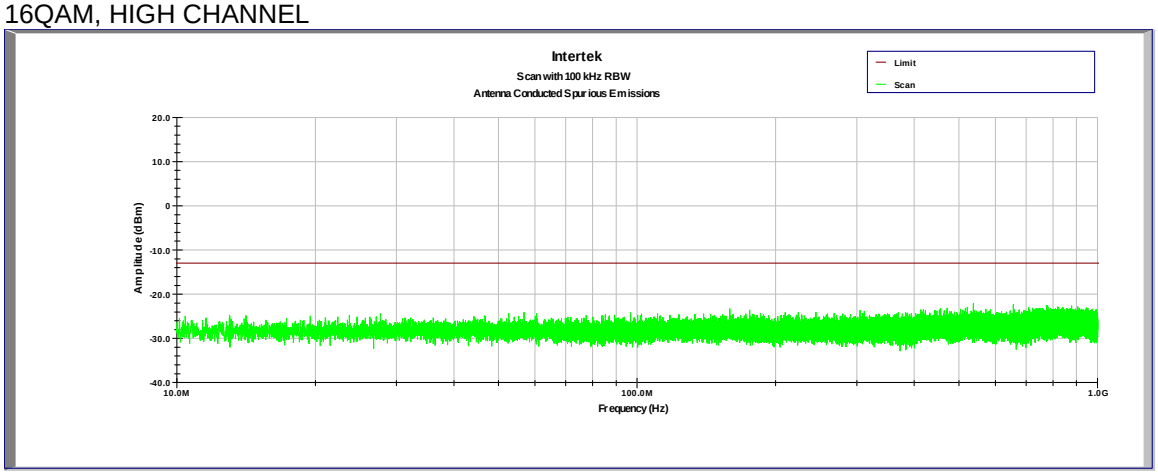
QPSK, HIGH CHANNEL

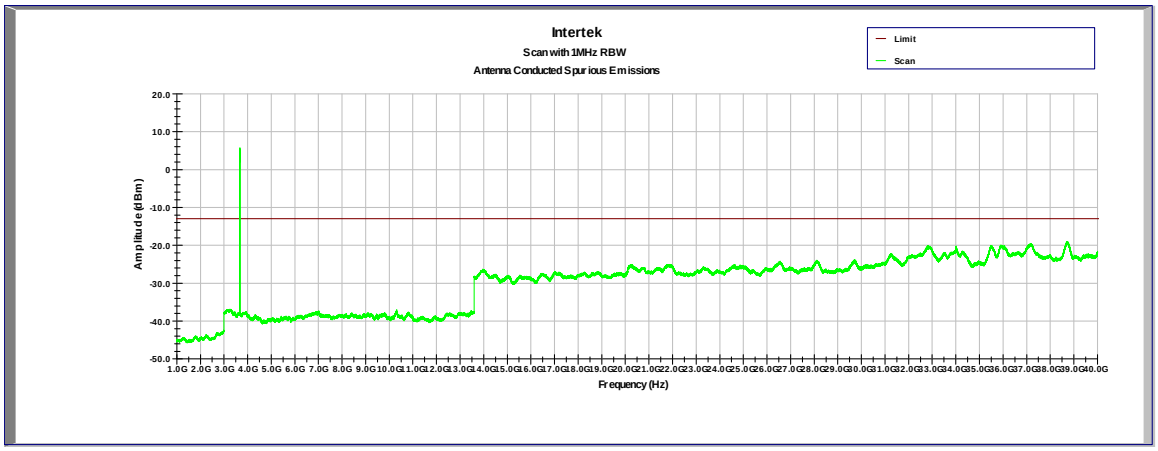




Graph 4.8
5 MHz

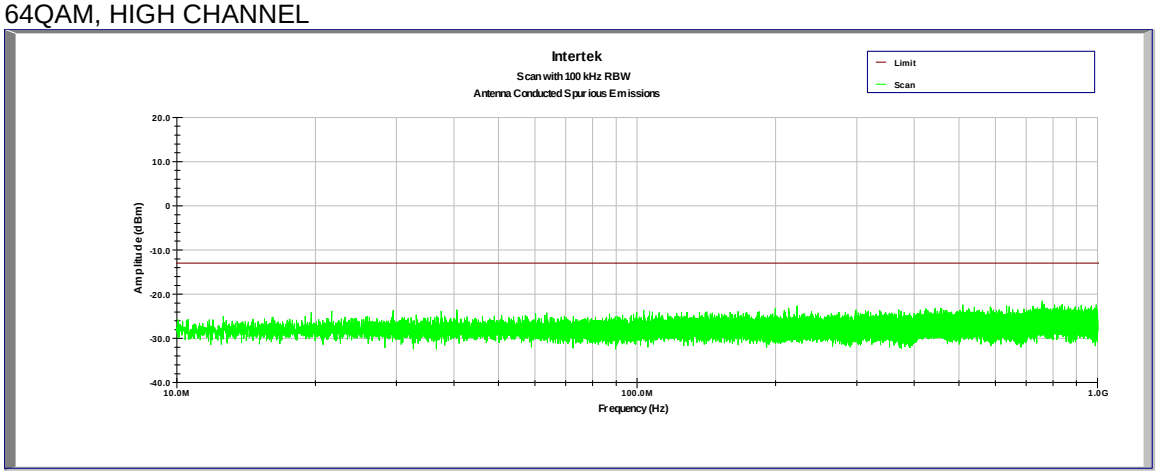
16QAM, HIGH CHANNEL

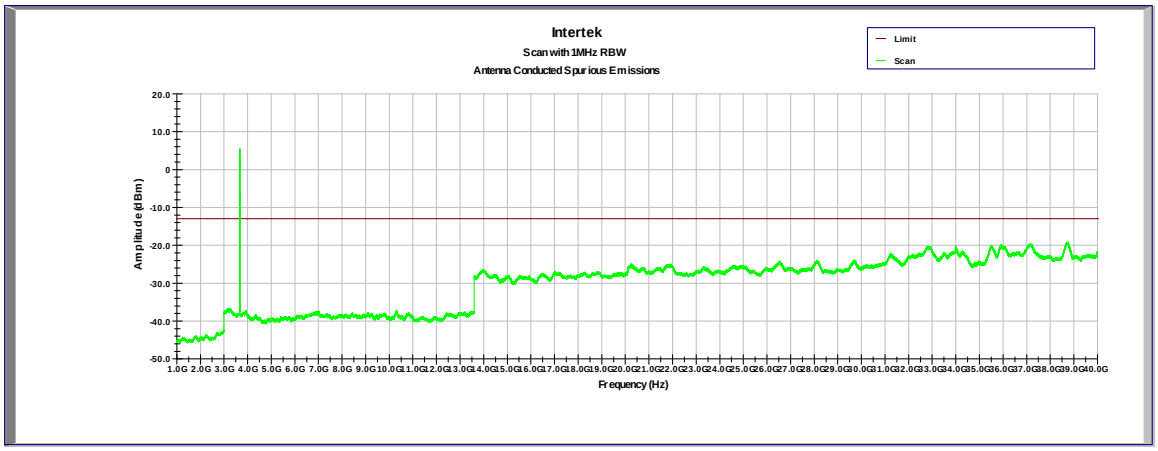




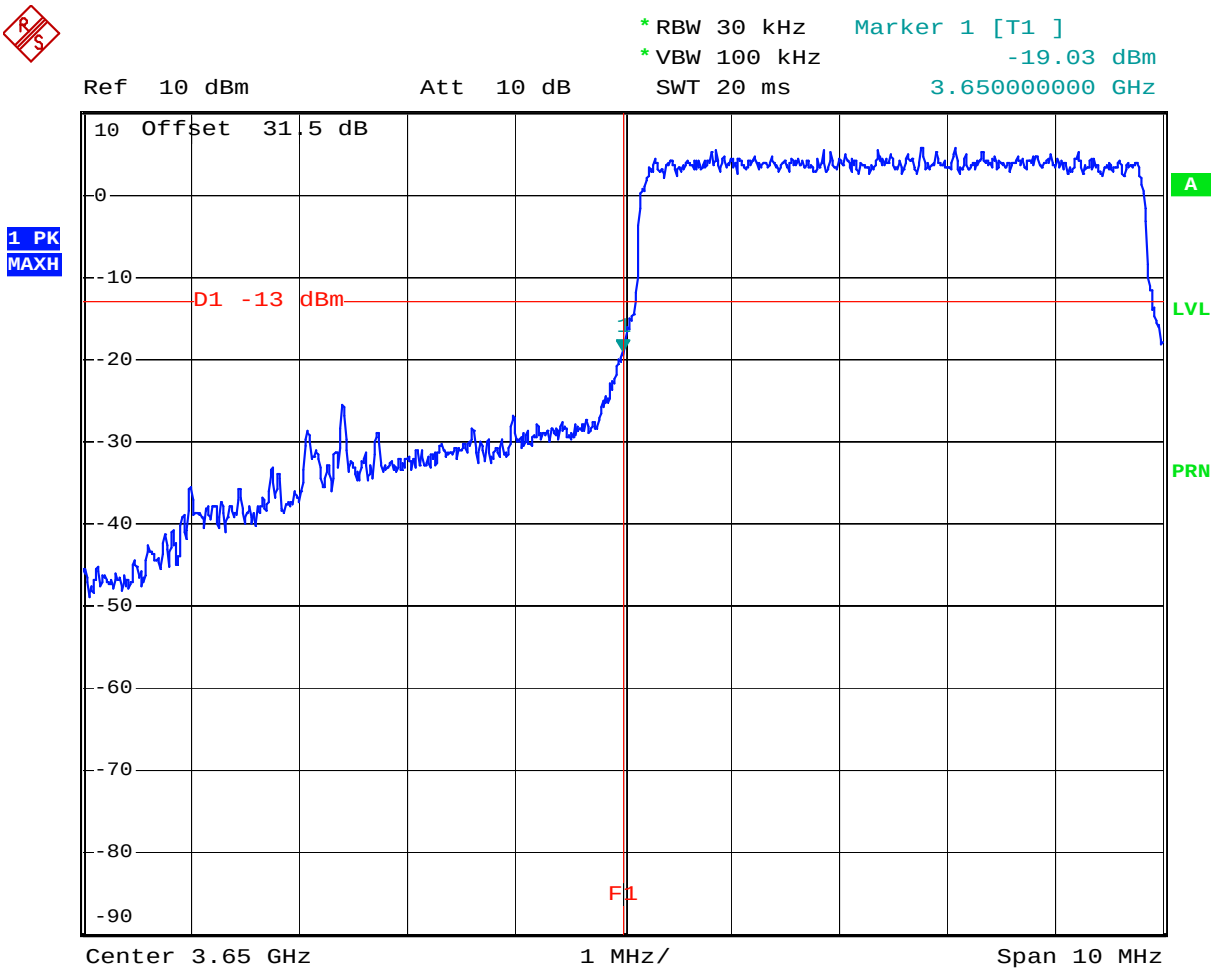
Graph 4.9
5 MHz

64QAM, HIGH CHANNEL



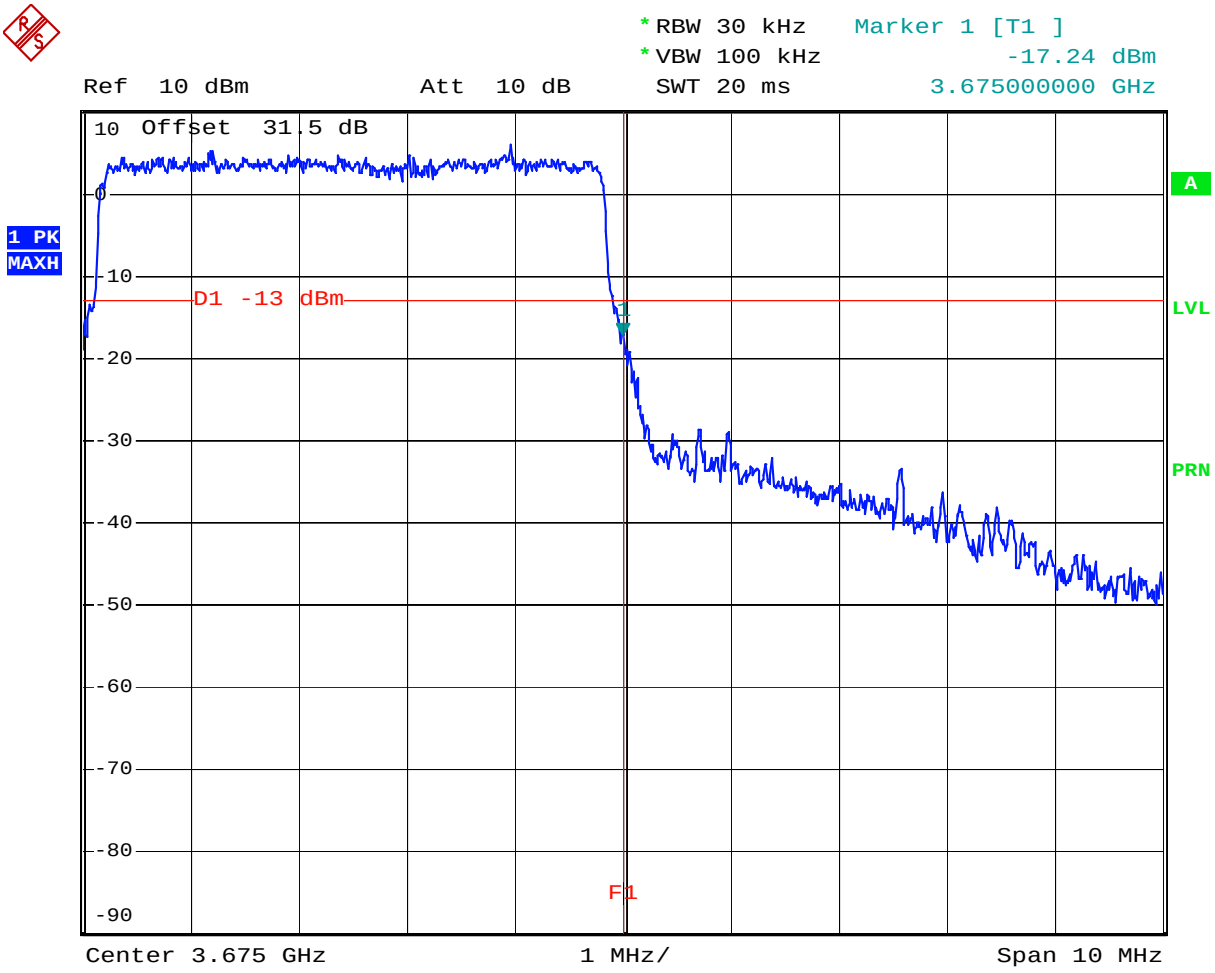


Lower Bandedge
Graph 4.10
5 MHz



Comment: QPSK, LOW CHANNEL
Date: 23.FEB.2010 13:33:11

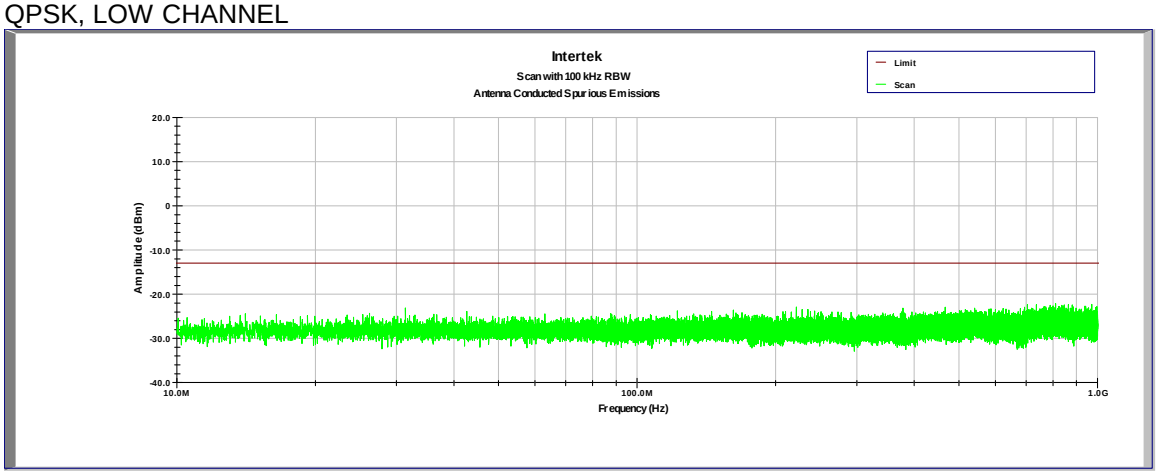
Upper Bandedge
Graph 4.11
5 MHz

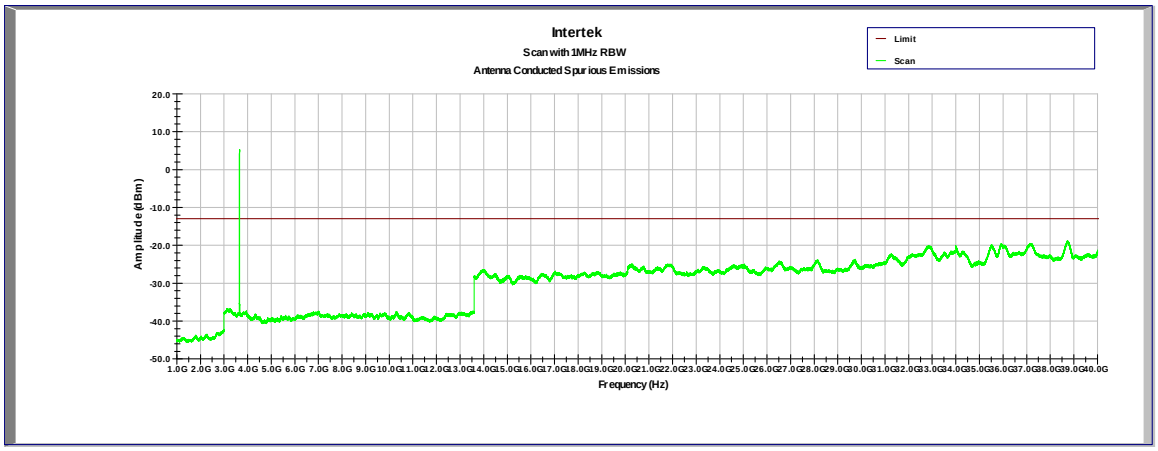


Comment: QPSK, HIGH CHANNEL
Date: 23.FEB.2010 13:35:05

Graph 4.12
10 MHz

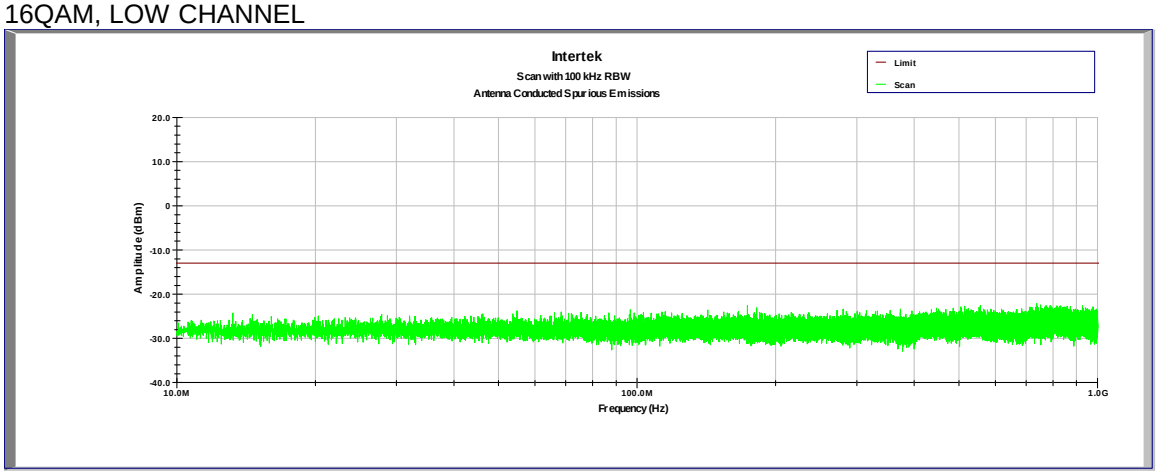
QPSK, LOW CHANNEL

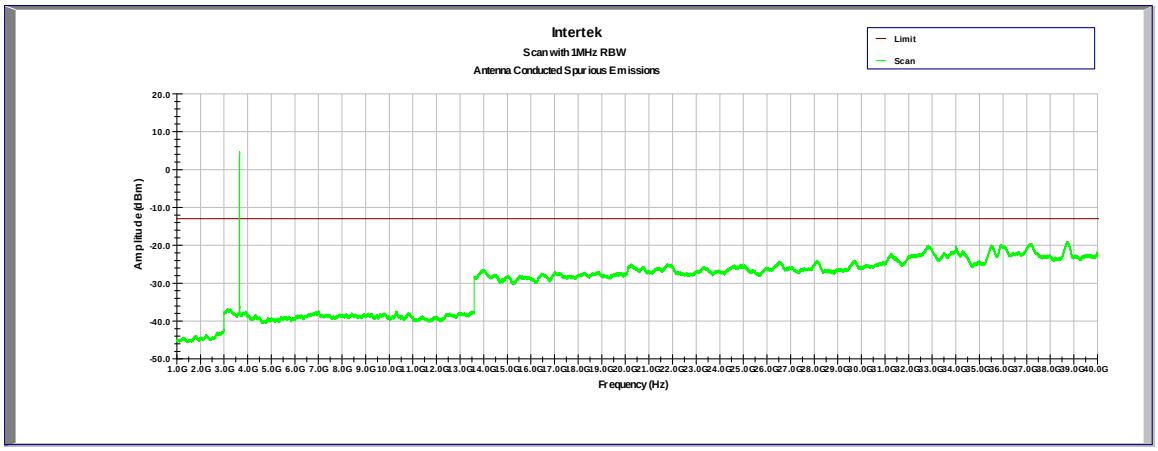




Graph 4.13
10 MHz

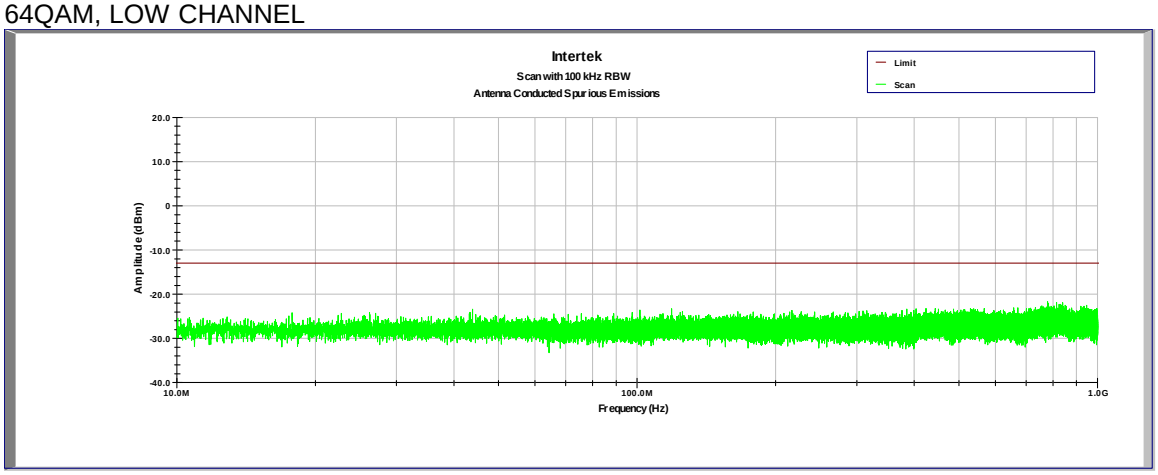
16QAM, LOW CHANNEL

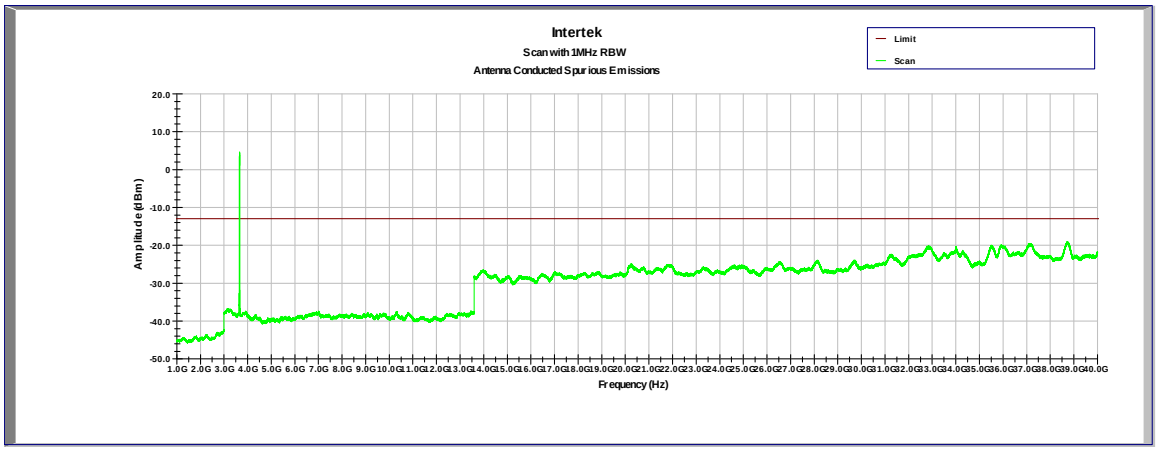




Graph 4.14
10 MHz

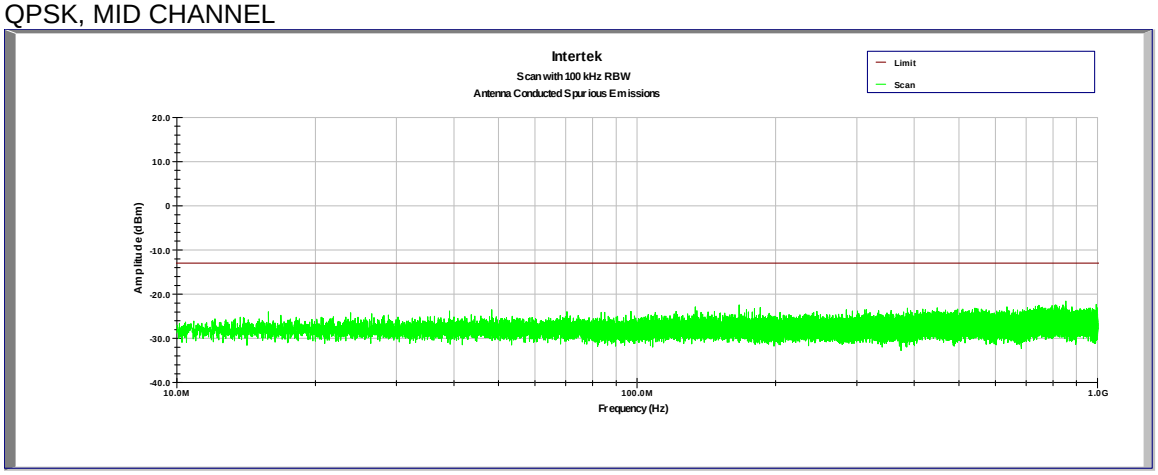
64QAM, LOW CHANNEL

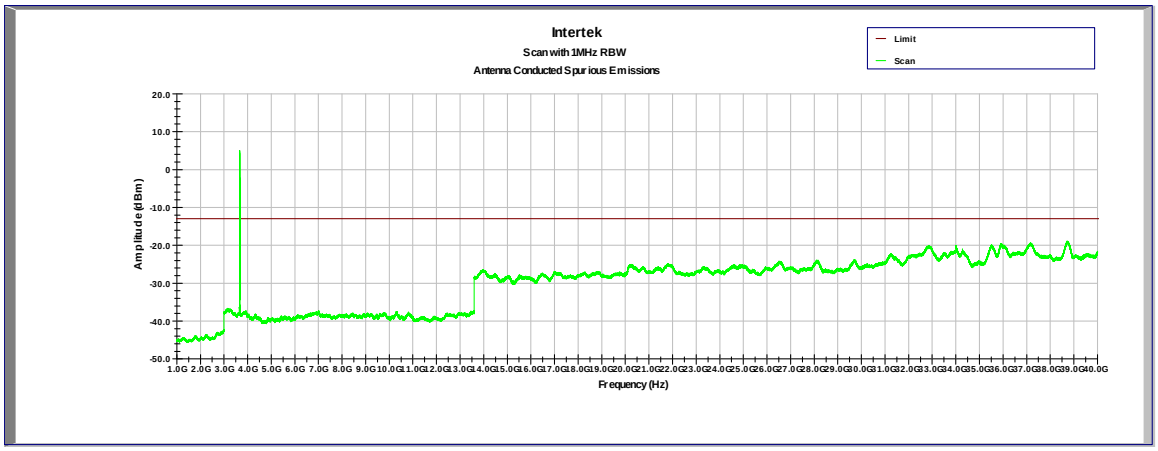




Graph 4.15
10 MHz

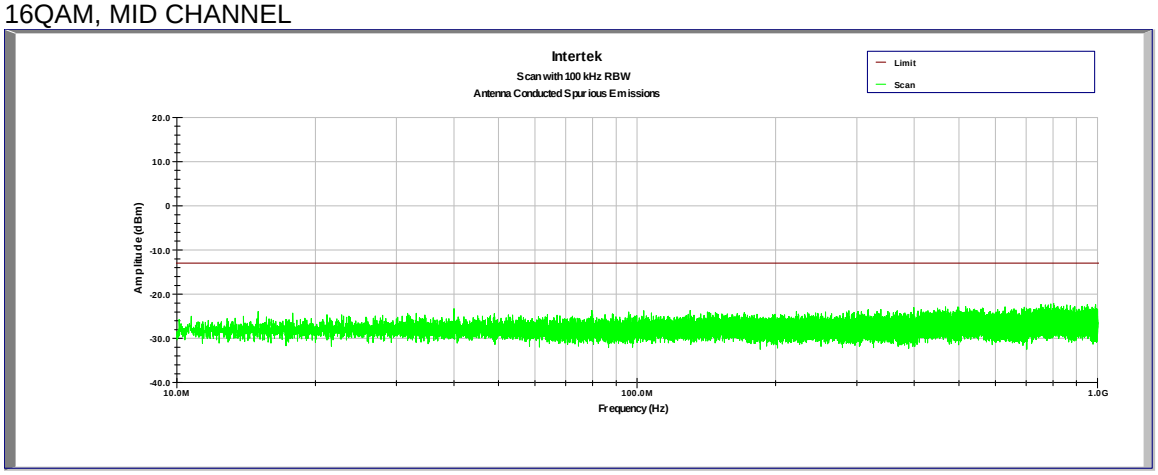
QPSK, MID CHANNEL

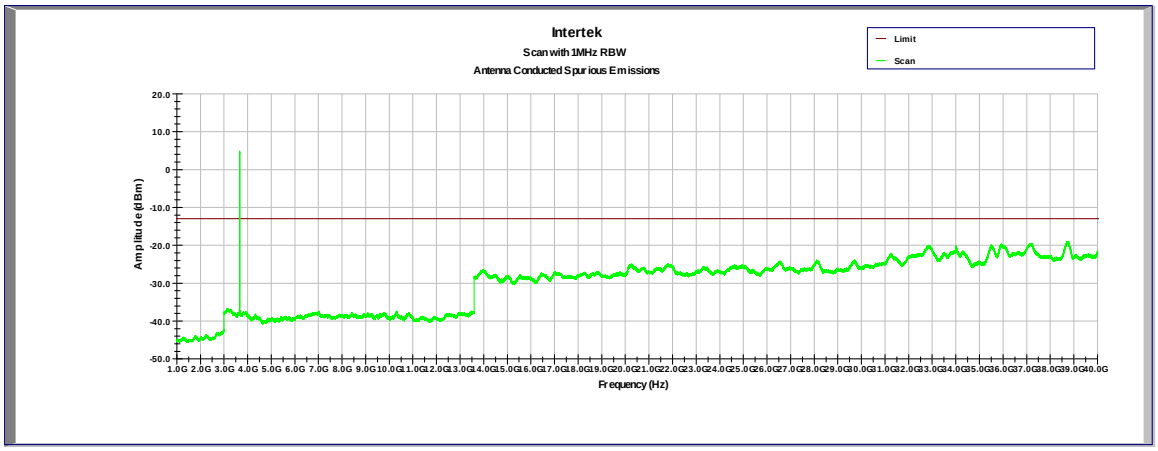




Graph 4.16
10 MHz

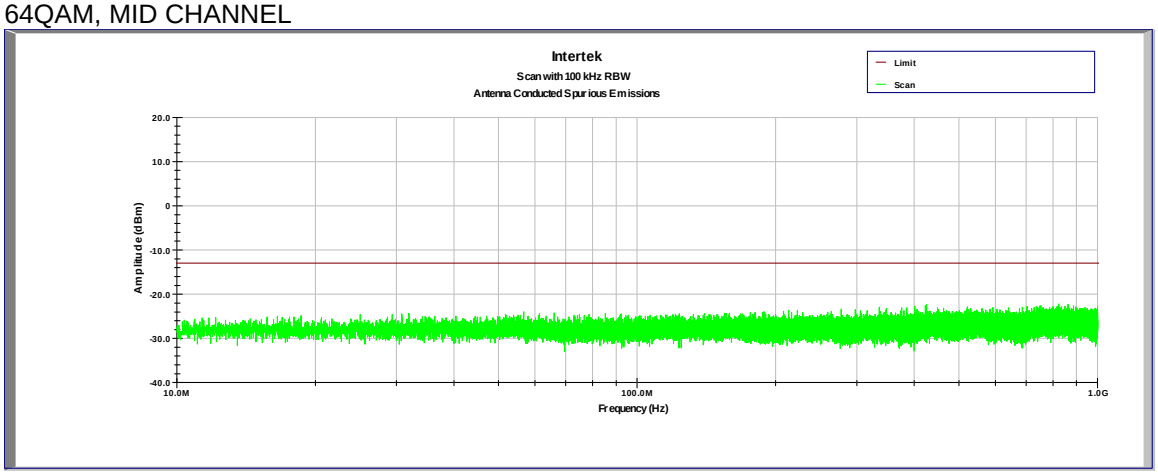
16QAM, MID CHANNEL

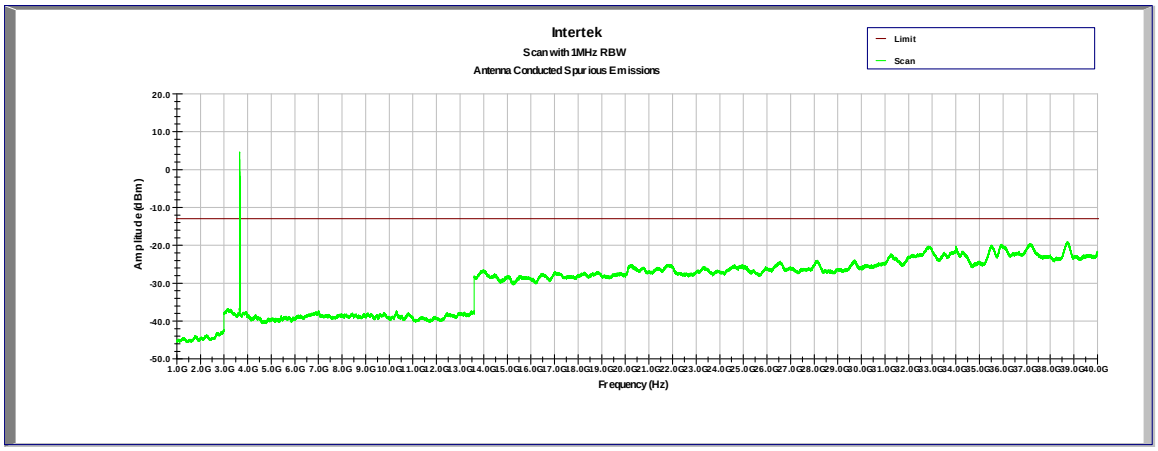




Graph 4.17
10 MHz

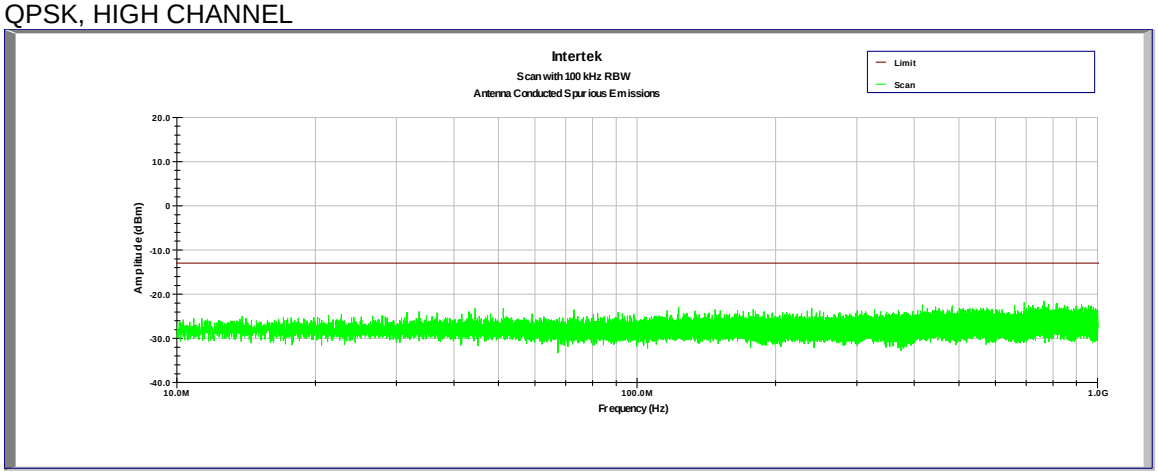
64QAM, MID CHANNEL

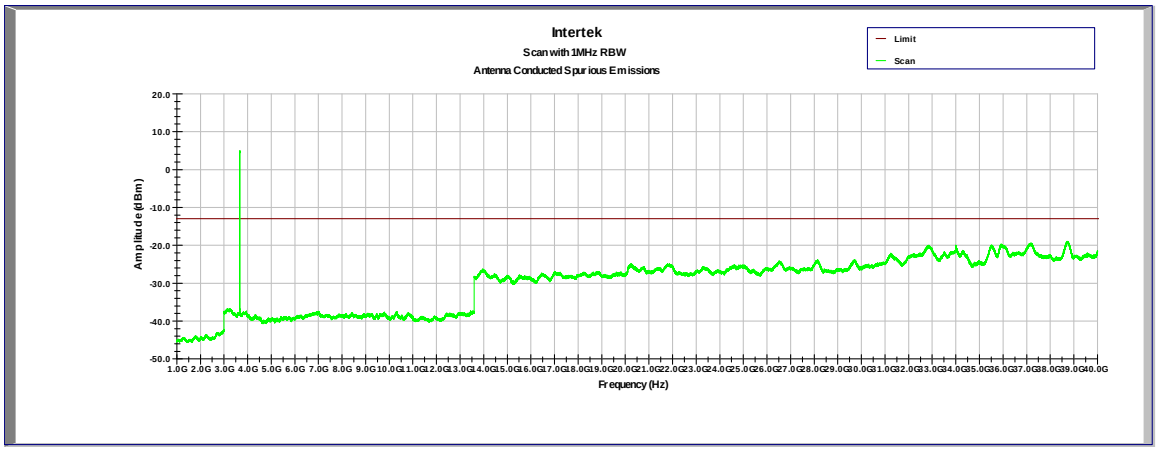




Graph 4.18
10 MHz

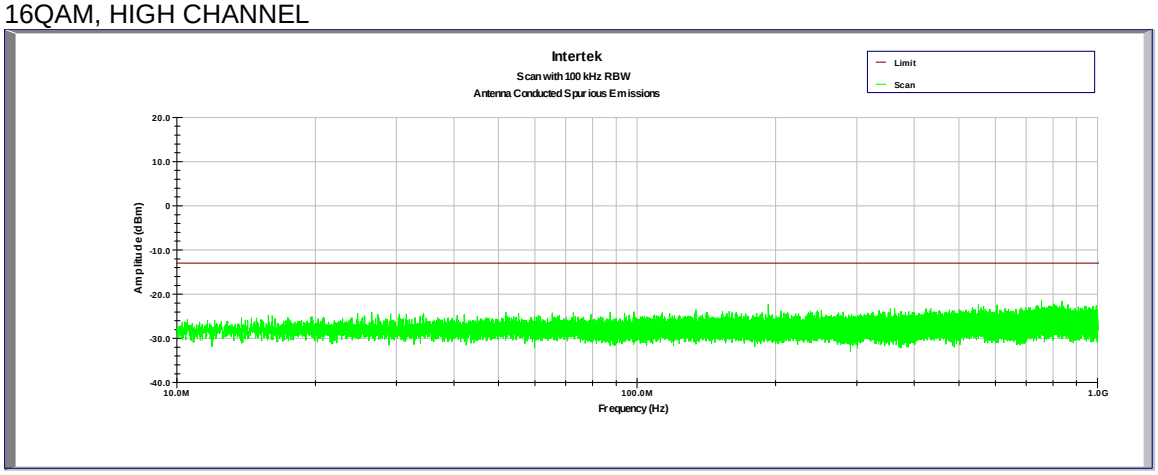
QPSK, HIGH CHANNEL

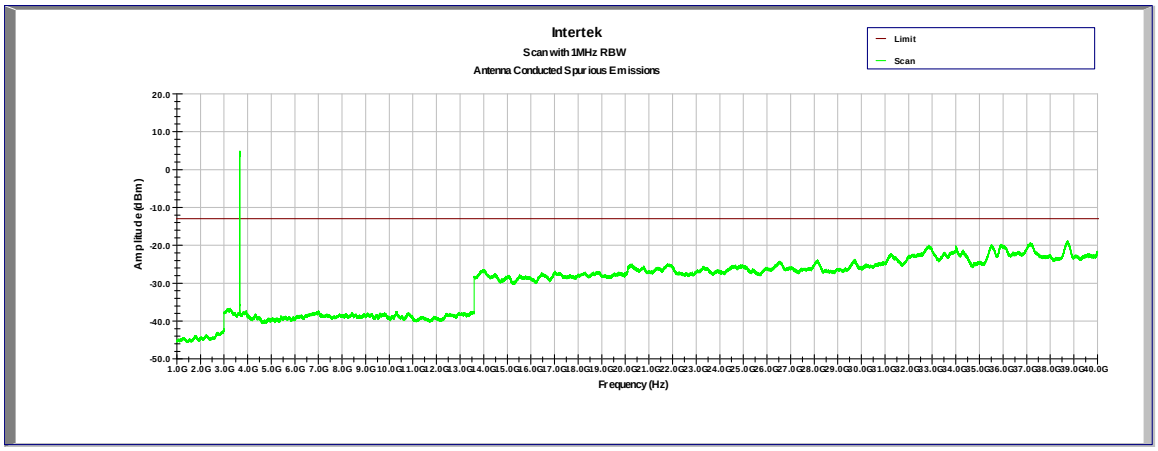




Graph 4.19
10 MHz

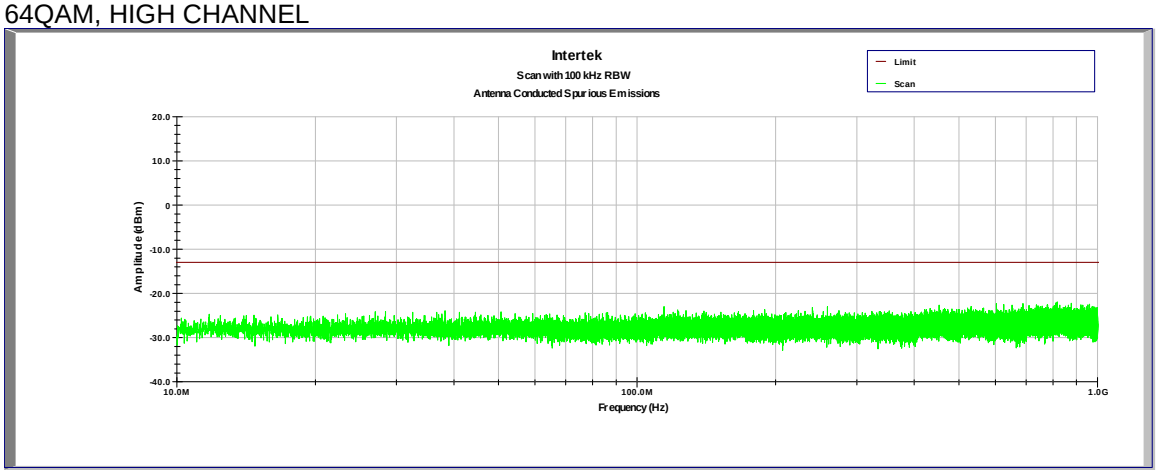
16QAM, HIGH CHANNEL

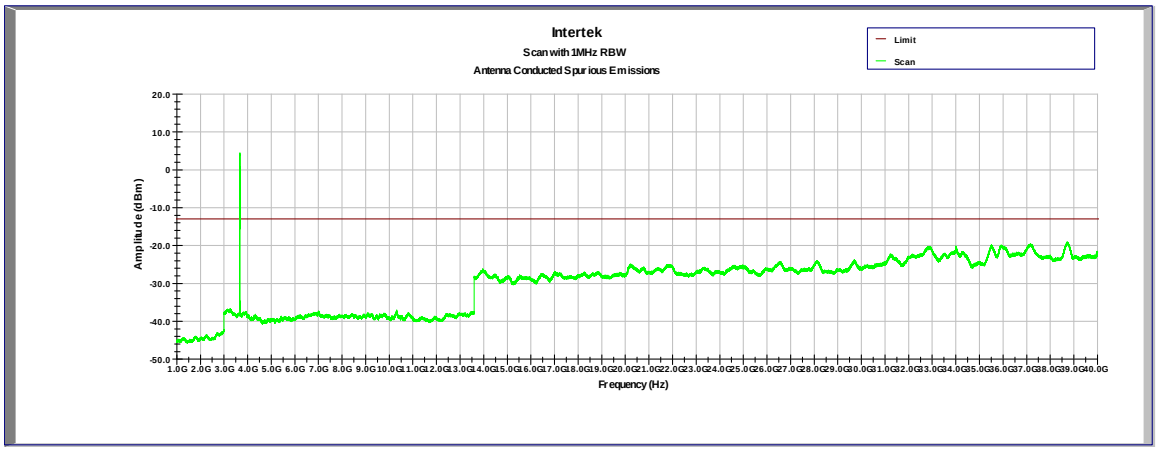




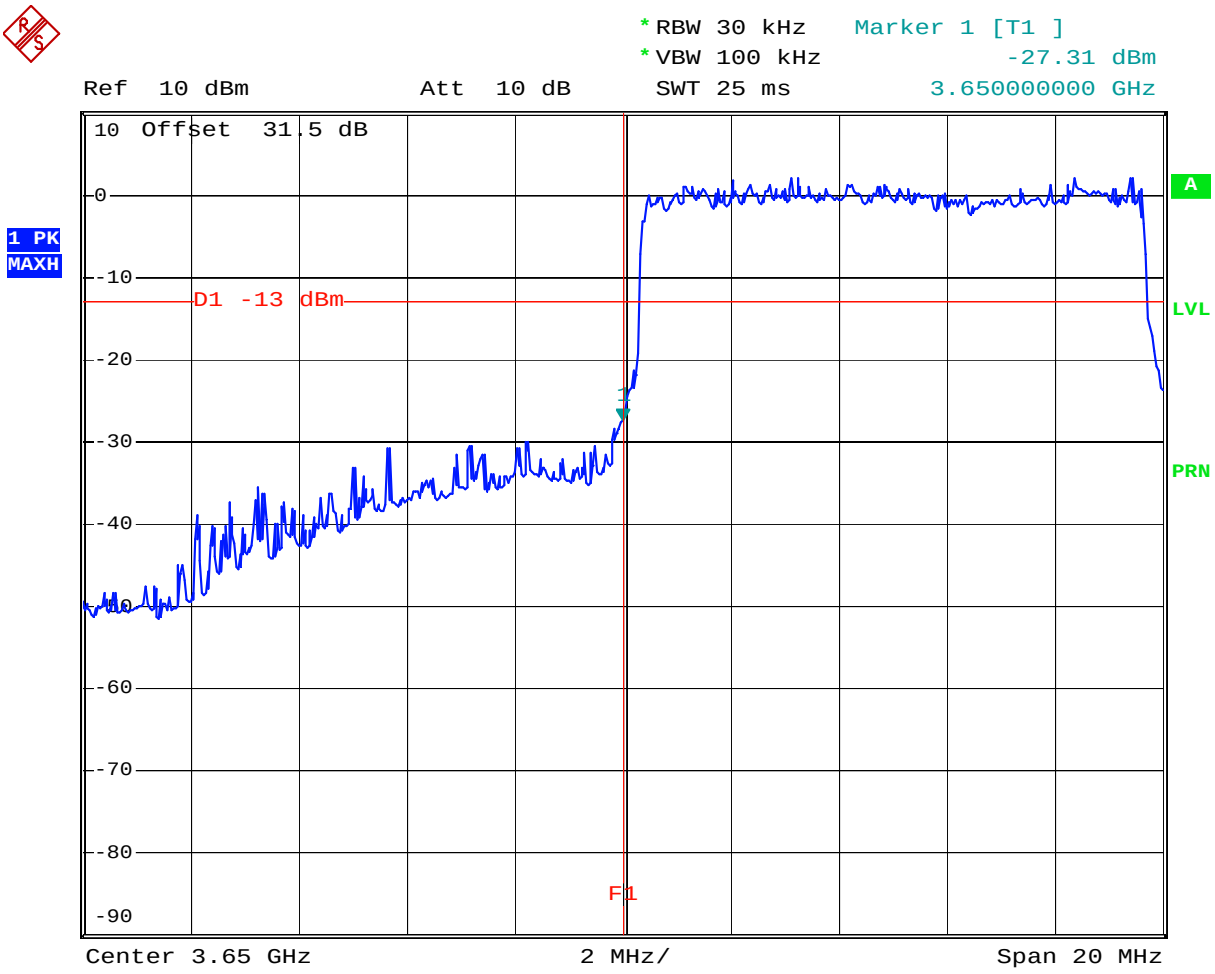
Graph 4.20
10 MHz

64QAM, HIGH CHANNEL



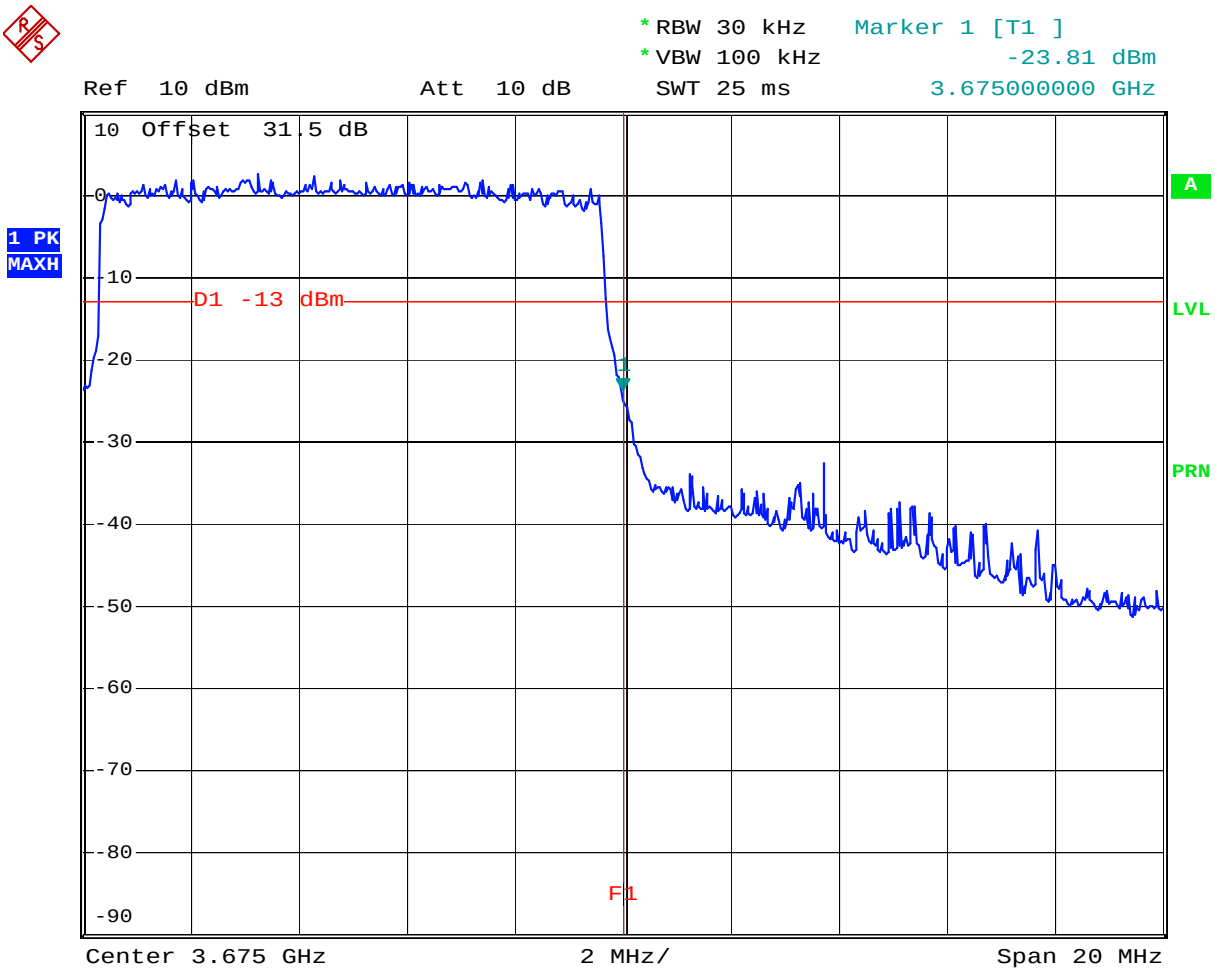


Lower Bandedge
Graph 4.21
10 MHz



Comment: QPSK, LOW CHANNEL
Date: 23.FEB.2010 16:34:08

Upper Bandedge
Graph 4.22
10 MHz



Comment: QPSK, HIGH CHANNEL
Date: 23.FEB.2010 16:30:09

5.0 Spurious Radiation

FCC 2.1053, 90.1323

5.1 Requirement

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

5.2 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.

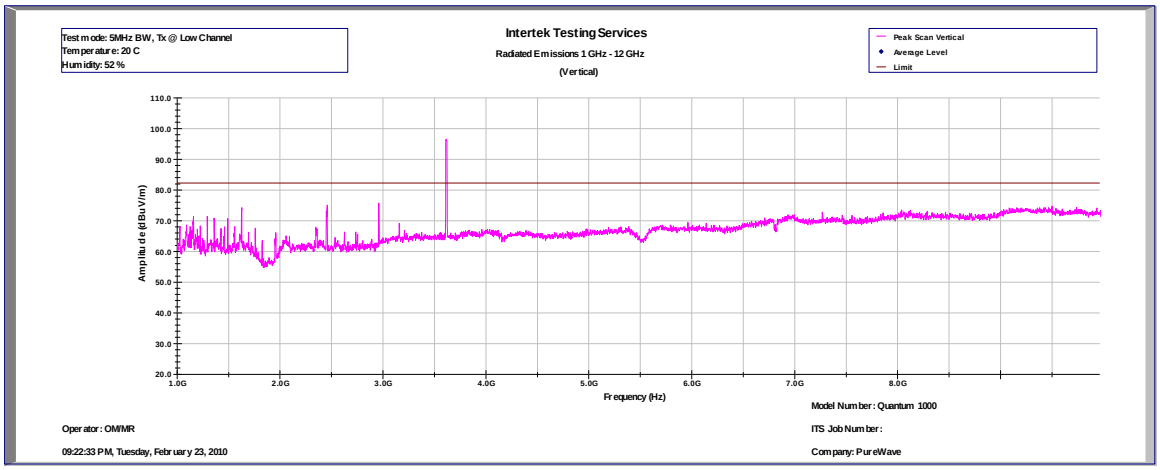
The frequency range up to 10th harmonic of each of the three fundamental frequency (low, middle, and high channels) was investigated. The worst case of emissions was reported.

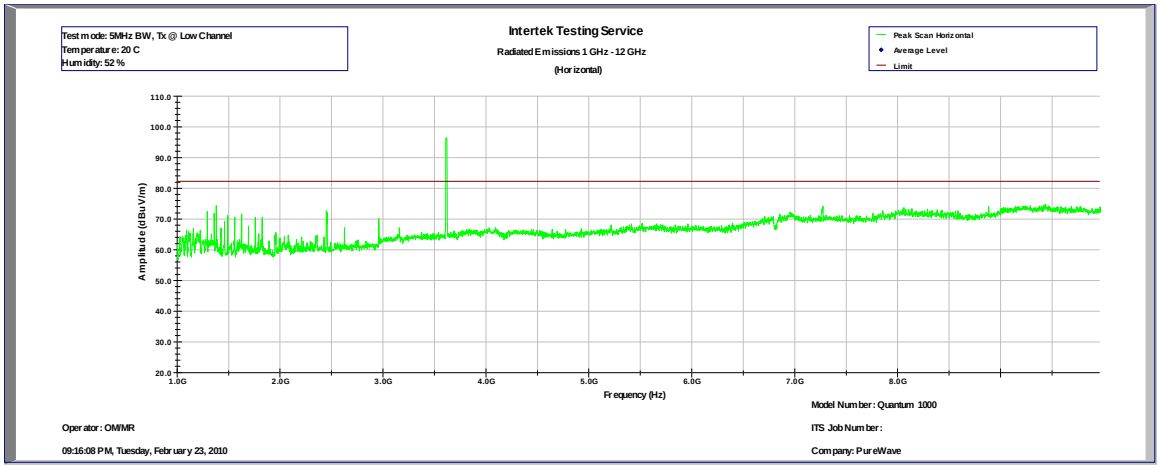
5.3 Test Equipment

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

5.4 Test Results

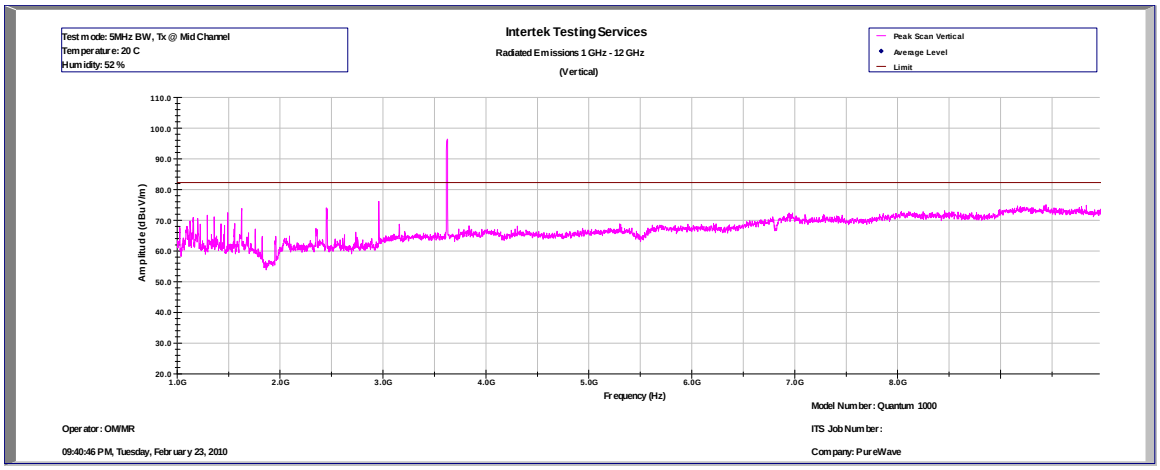
Spurious Radiated Emissions

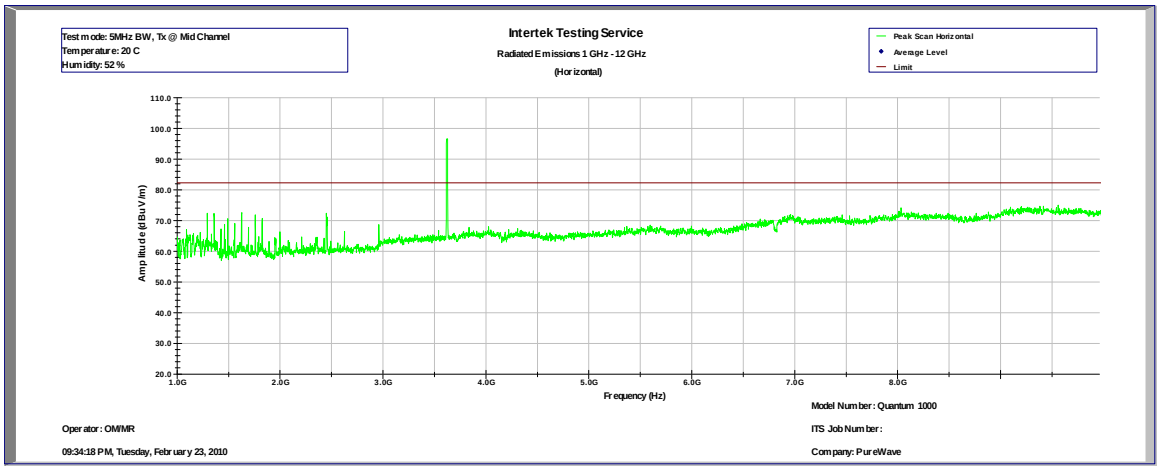




All other emission are at least 10dB below the limit.

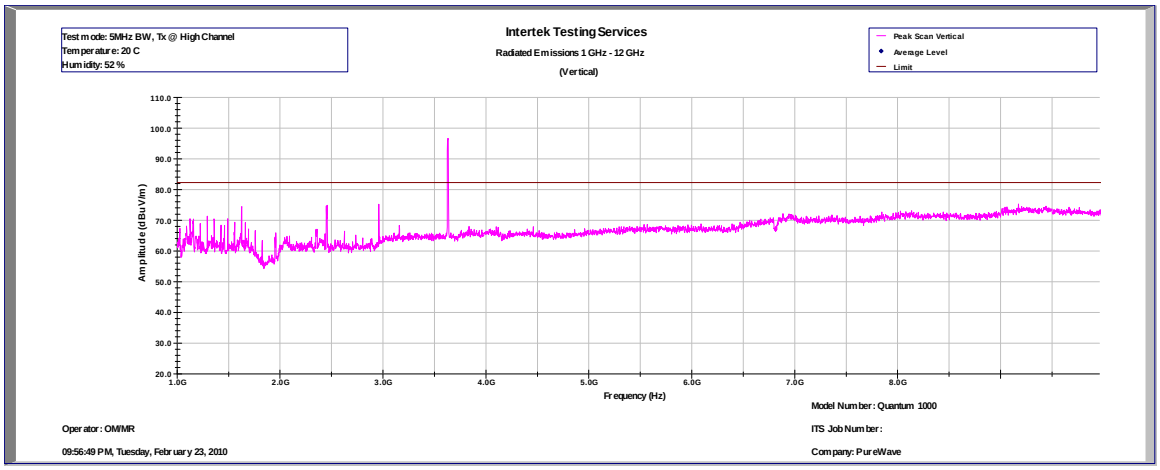
Spurious Radiated Emissions

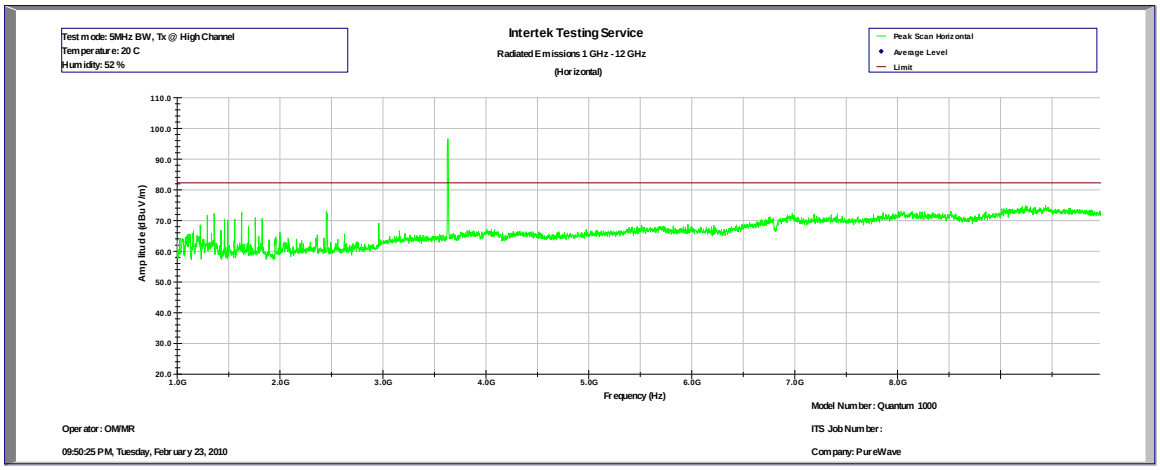




All other emission are at least 10dB below the limit.

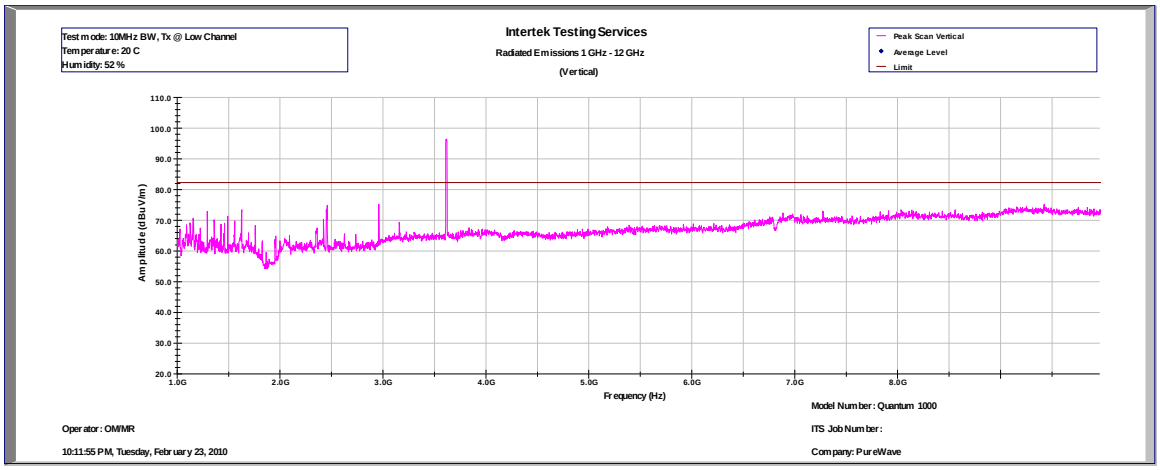
Spurious Radiated Emissions

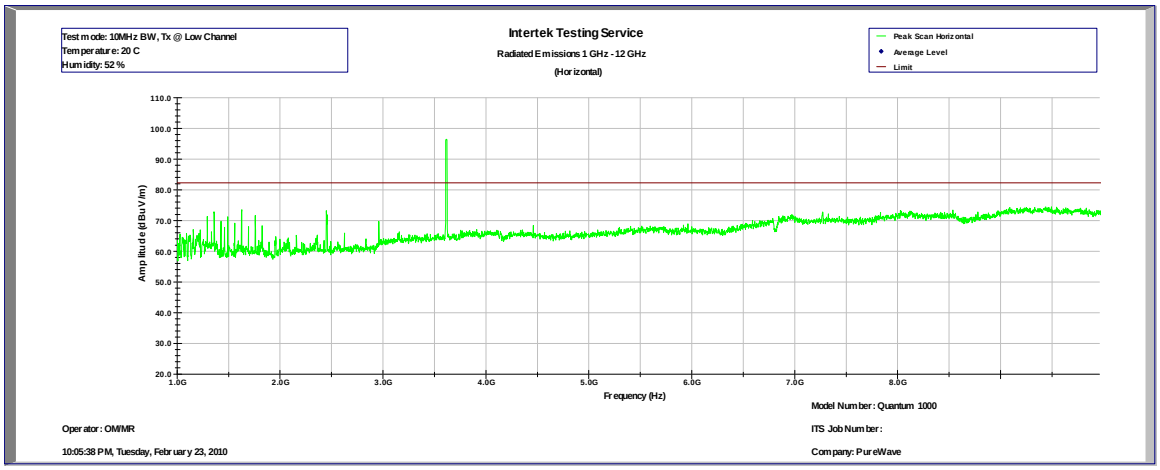




All other emission are at least 10dB below the limit.

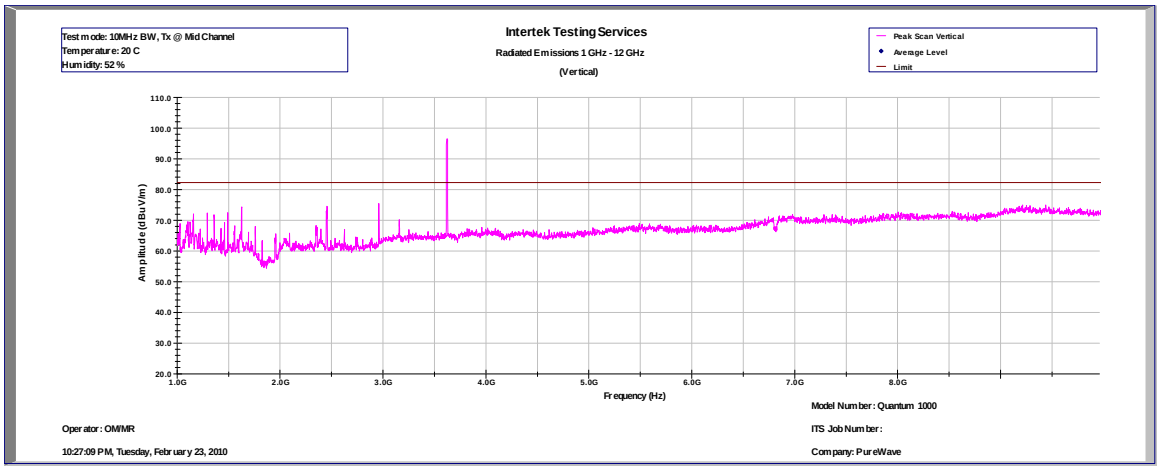
Spurious Radiated Emissions

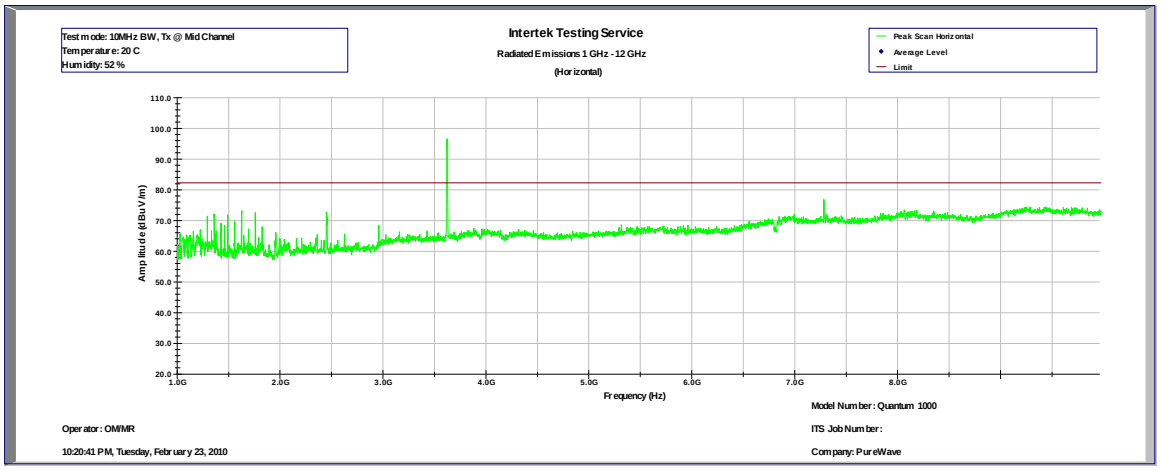




All other emission are at least 10dB below the limit.

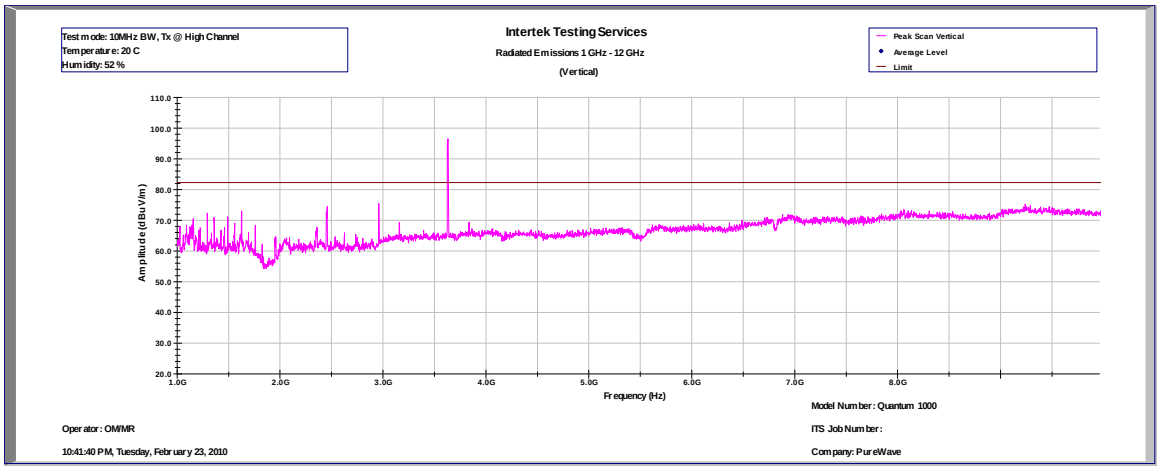
Spurious Radiated Emissions

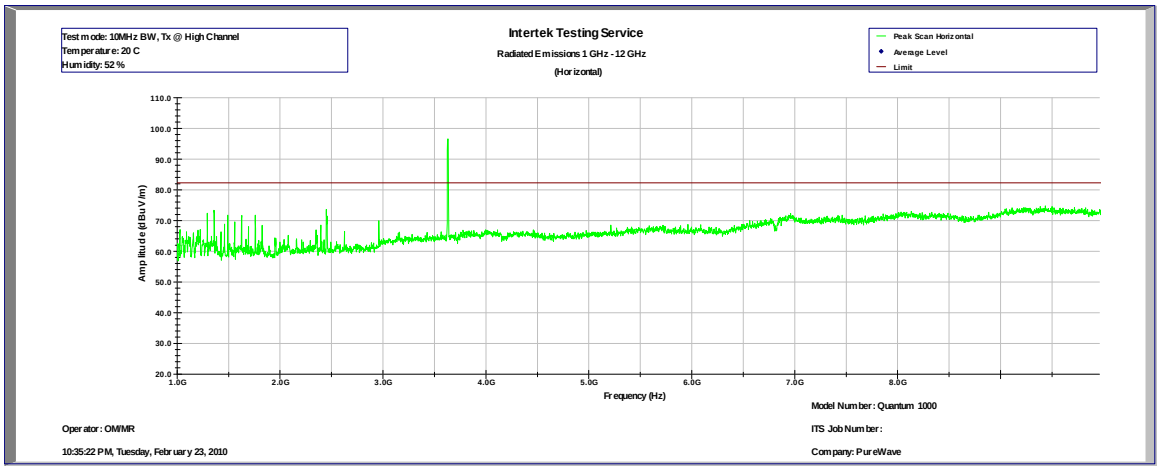




All other emission are at least 10dB below the limit.

Spurious Radiated Emissions





All other emission are at least 10dB below the limit.

Result	Complies

6.0 Frequency Stability vs Temperature and Voltage

FCC 2.1055, 90.213

6.1 Requirement

The frequency stability shall be measured with variation of ambient temperature as follows:

From −30° to +50° centigrade. Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.

The frequency stability shall be measured with variation of primary supply voltage as follows:

Vary primary supply voltage from 85 to 115 percent of the nominal value.

6.2 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.

6.3 Test Equipment

Temperature Chamber
Frequency counter

6.4 Test Results

Nominal frequency: 3,662,500,240 Hz

Temperature (°C)	**Measured Frequency** Hz	**Maximum deviation from nominal at 20°C Hz**
-30	3,662,500,280	+40
-20	3,662,500,318	+78
-10	3,662,500,484	+244
0	3,662,500,051	-189
10	3,662,500,802	+562
20	**3,662,500,240**	**0**
30	3,662,500,670	+430
40	3,662,500,339	+99
50	3,662,500,446	+206

DC Voltage	**Measured Frequency Hz**	**Maximum deviation from nominal at 20°C Hz**
-48V Nominal	**3,662,500,650**	**-**
85%	3,662,500,242	+2
115%	3,662,500,243	+3

Result	Complies

7.0 RF Exposure evaluation

FCC 2.1091

The maximum calculated EIRP is 10W.

Using the formula for the Power Density

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

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

The MPE Limit for General Population/Uncontrolled Exposure is 1 mW/cm^2, therefore $D \geq 28$ cm

The Statement that a minimum separation distance of 28 cm between the antenna and persons must be maintained is included in the User's manual.

8.0 Emissions from Digital Parts, Receiver and Transmitter spurious from 30 MHz - 1GHz

8.1 Radiated emissions
FCC 15.109, FCC 15.209

8.1.1 Test Limit

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

8.1.2 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.

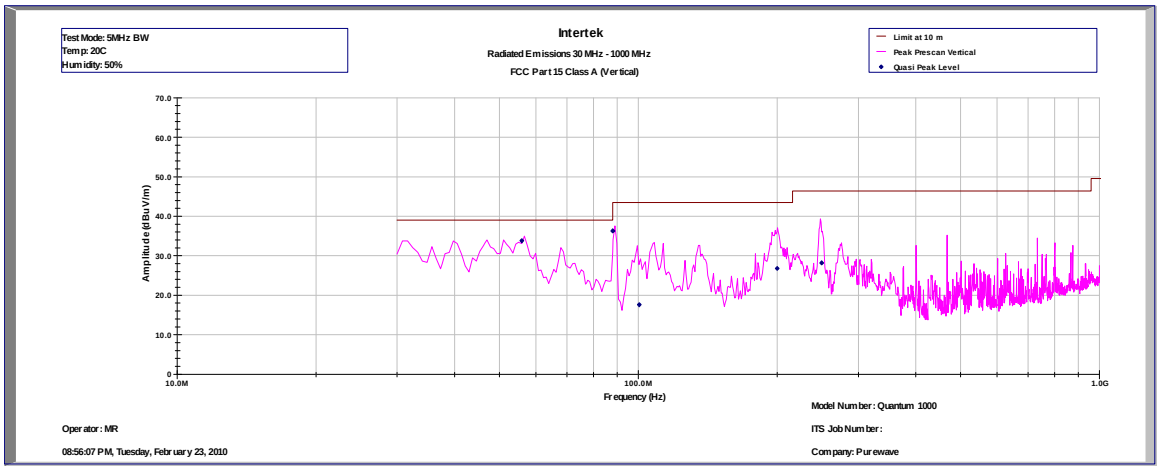
Equipment setup for radiated emission tests followed the guidelines of ANSI C63.4 (2003).

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

FS = RA + AF + CF - AG + DF

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)
AG = Amplifier Gain in dB

8.1.3 Test Results



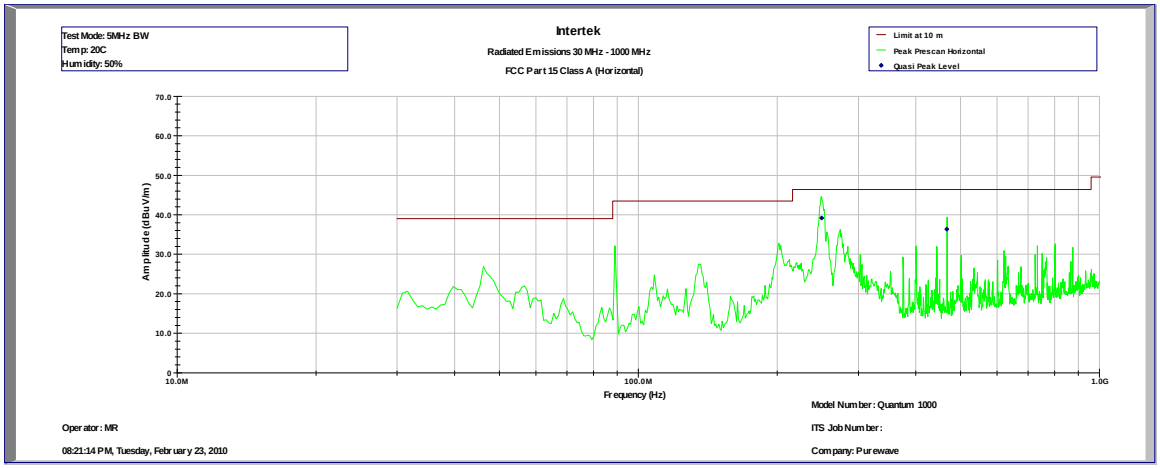
Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class A (QP-Vertical)

Operator: MR — Model Number: Quantum 1000

08:56:05 PM, Tuesday, February 23, 2010 — Company: Purewave

Frequency	Quasi Pk FS	Limit@10m	Margin	RA	CF	AG	AF
Hz	dB(uV/m)	dB(uV/m)	dB	dB	dB	dB	dB(1/m)
5.589E+07	33.8	39	-5.2	53.2	0.9	32.1	11.8
8.809E+07	36.3	43.5	-7.2	58.1	1.1	32	9.1
1.005E+08	17.6	43.5	-25.9	37.8	1.2	32	10.7
2.002E+08	26.8	43.5	-16.7	47	1.7	32	10.2
2.500E+08	28.2	46.4	-18.2	45.8	1.9	32	12.5

Test Mode: 5MHz BW
Temp: 20C
Humidity: 50%



Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class A (QP-Horizontal)

Operator: MR

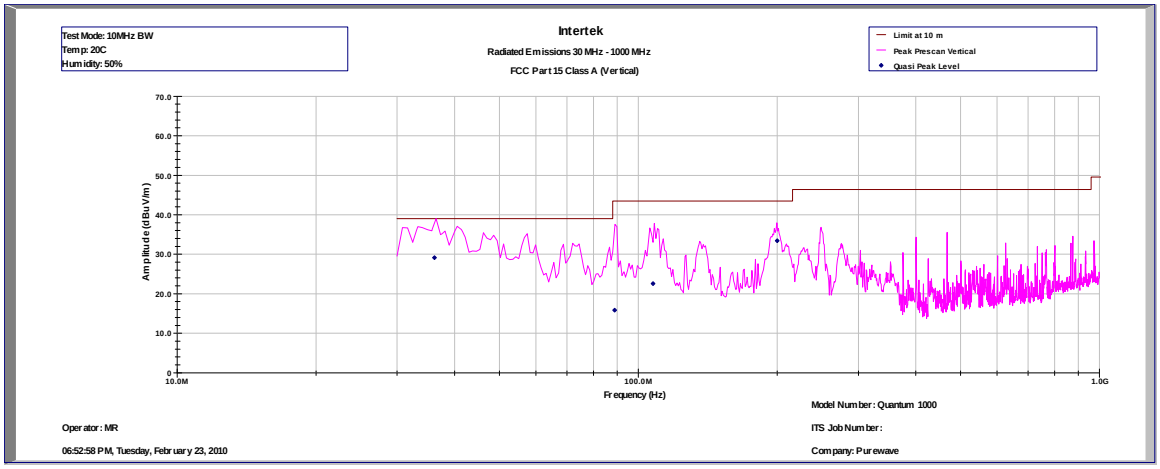
Model Number: Quantum 1000

08:21:12 PM, Tuesday, February 23, 2010

Company: Purewave

Frequency	Quasi Pk FS	Limit@10m	Margin	RA	CF	AG	AF
Hz	dB(uV/m)	dB(uV/m)	dB	dB(uV)	dB	dB	dB(1/m)
2.500E+08	39.1	46.4	-7.3	56.7	1.9	32	12.6
4.667E+08	36.3	46.4	-10.1	48.8	2.6	32.1	17

Test Mode: 5MHz BW
Temp: 20C
Humidity: 50%



Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class A (QP-Vertical)

Operator: MR

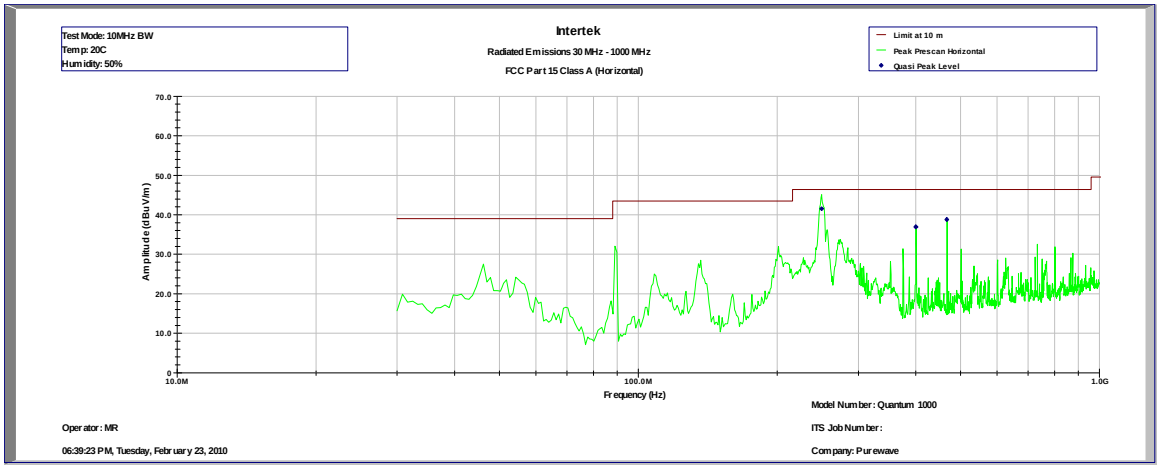
Model Number: Quantum 1000

06:52:58 PM, Tuesday, February 23, 2010

Company: Purewave

Frequency	Quasi Pk FS	Limit@10m	Margin	RA	CF	AG	AF
Hz	dB(uV/m)	dB(uV/m)	dB	dB	dB	dB	dB(1/m)
3.614E+07	29.1	39.0	-9.9	43.3	0.7	32.1	17.2
8.887E+07	15.8	43.5	-27.7	37.6	1.1	32.0	9.2
1.076E+08	22.5	43.5	-21.0	42.8	1.2	32.0	10.5
2.000E+08	33.4	43.5	-10.1	53.6	1.7	32.0	10.2

Test Mode: 10MHz BW
Temp: 20C
Humidity: 50%



Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class A (QP-Horizontal)

Operator: MR Model Number: Quantum 1000

06:39:23 PM, Tuesday, February 23, 2010 Company: Purewave

Frequency	Quasi Pk FS	Limit@10m	Margin	RA	CF	AG	AF
Hz	dB(uV/m)	dB(uV/m)	dB	dB(uV)	dB	dB	dB(1/m)
2.500E+08	41.5	46.4	-4.9	59.1	1.9	32.0	12.6
4.000E+08	36.9	46.4	-9.5	50.9	2.4	32.0	15.7
4.667E+08	38.8	46.4	-7.6	51.3	2.6	32.1	17.0

Test Mode: 10MHz BW
Temp: 20C
Humidity: 50%

Result	Complies

9.0 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	12/04/10
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	12/04/10
Spectrum Analyzer	Rohde&Schwarz	FSP40	036612004	12	10/16/10
BI-Log Antenna	Antenna Research	LPB-2513/A	1154	12	06/23/10
Pre-Amplifier	Sonoma	310N	185634	12	11/19/10
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	07/28/10
Horn Antenna	EMCO	3115	9107-3712	12	11/03/10

10.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 3183595	OM	February 25, 2010	Original document