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Project 10003-10

Prepared for:

Motorola  
6500 River Place Blvd. Building 7  
Austin, Texas 78730

By

Professional Testing (EMI), Inc.  
1601 N. A.W. Grimes Blvd., Suite B  
Round Rock, Texas 78665

June 26, 2009

Revised August 3, 2009

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**CERTIFICATION**  
**Wireless Test Report**  
**Motorola**  
**WTM1100**

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*THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF PROFESSIONAL TESTING (EMI), INC.*



Applicant: Motorola  
Applicant's Address: 6500 River Place Blvd. Building 7  
Austin, Texas 78730  
FCC ID: IHDP56KM4  
IC Number: 109O-KM4  
Project Number: 10003-10  
Test Dates: June 8 – June 19 2009; July 17, 2009; July 20 – July 21, 2009  
The **Motorola WTM1100** was tested to and found to be in compliance with FCC 47 CFR Part 27.

I, Jason Anderson, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

A handwritten signature in black ink, appearing to read "JA", with a long horizontal stroke extending to the right.

Jason Anderson  
Director of Testing Services

This report has been reviewed and accepted by Motorola. The undersigned is responsible for ensuring that this device will continue to comply with the FCC and IC rules.

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## 1.0 Introduction

### 1.1 Scope

This report describes the extent of the Equipment Under Test (EUT) conformance to the Intentional Radiator requirements of the USA and Canada.

### 1.2 EUT Description

The WTM1100 is an IEEE 802.16e Wave 2 compliant, single-band Half Mini-PCIE wireless network adapter that operates in the 2.5 GHz or 3.5 GHz spectrum for WiMax connectivity. The WTM1100 is capable of delivering up to 4Mbps UL/ 16 Mbps DL over WiMax.

Note 1: For a more detailed description, please refer to the manufacturer's specifications or User's Manual.

### 1.3 EUT Operation

The EUT was configured as a peripheral device with the host being a laptop computer. The host device was populated with at least two types of I/O per ANSI C63.4. The EUT was tested while in a continuous transmit mode. The EUT was tuned to a low, middle, and high channel to perform power, occupied bandwidth, conducted emissions, and spurious/harmonic tests. The EUT was placed in continuous transmit mode at maximum power by a program provided by the manufacturer (RTT software test tool). The system tested consisted of the following:

Manufacturer	Model	FCC ID Number	IC Identifier
Motorola	WTM1100	IHDP56KM4	109O-KM4

The following rules apply to the operation of the EUT:

Guidelines	FCC Rules
	Part 27 & Part 2
Power and Antenna Height Limits	27.50
Emission Limits	27.53
Frequency Stability	27.54
Occupied Emissions Bandwidth	27.53
Measurements Required: RF Power Output	2.1046
Measurements Required: Occupied Bandwidth	2.1049
Measurements Required: Spurious Emissions at Antenna Terminals	2.1051
Measurements Required: Field Strength of Spurious Radiation	2.1053
Measurements Required: Frequency Stability	2.1055

#### **1.4 Test Site**

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. This site is registered with the FCC under Section 2.948 and Industry Canada per RS-212 and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Rd., Austin, Texas, 78758 while the main office is located at 1601 N. A.W. Grimes Blvd., Suite B, Round Rock, Texas, 78665. Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing. The procedure of ANSI C63.4:2003 were utilized for making all emissions measurements.

## 1.5 Applicable Documents

The data collected for this report are presented entirely in Appendix B.

<b>Document</b>	<b>Title</b>	<b>Release</b>
ANSI/TIA 603-C	Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards	2004
47 CFR	Part 2 – Frequency Allocations And Radio Treaty Matters; General Rules And Regulations	
47 CFR	Part 27 – Miscellaneous Wireless Communications Services	
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment.	2003

## 2.0 Power Line Conducted Emissions

### 2.1 Test Procedure

The EUT was configured and operated in a manner consistent with typical applications. The EUT power cord in excess of one meter was folded back and forth forming a bundle 30 to 40 cm long in the approximate center of the cable. Power supply cords for the peripheral equipment were powered from an auxiliary LISN. Excess interface cable lengths were separately bundled in a non-inductive arrangement at the approximate center of the cable with the bundle 30 to 40 centimeters in length. The conducted emissions were maximized, by varying the operating states and configuration of the EUT.

The tests were performed in a 8' x 8' RayProof modular shielded room. The EUT was placed on a non-metallic table 0.4 meters from a vertical metal reference plane and 0.8 meters from a horizontal metal reference plane. A drawing showing the test setup is given as Figure 1.

### 2.2 Test Criteria

The FCC Power line Conducted Emission limits are given below.

Frequency (MHz)	Conducted Limits (dBuV)	
	Average	Quasi-Peak
0.15 – .50	66-56*	56 – 46*
.50 - 5	56	46
5 – 30	60	50

The tighter limit shall apply at the edge between two frequency bands.

\*Decreases with the logarithm of the frequency.

## 3.0 Peak Output Power

Peak power measurements were made on selected fundamental transmit frequencies of the EUT for the lowest, most center, and highest transmit frequency.

### 3.1 Test Procedure

The EUT was directly connected to a spectrum analyzer with a calibrated measurement cable. The RBW of the Spectrum analyzer was 1 MHz and the peak detector was employed.

### 3.2 Test Criteria

The maximum peak output power is 2 W for devices operating in the frequency range 2496 - 2690 MHz according to FCC 27.50.

## **4.0 Occupied Bandwidth**

Occupied bandwidth measurements were performed on the EUT to determine compliance with FCC 27.53 and FCC 2.1049. Occupied Bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

### **4.1 Test Procedure**

The occupied bandwidth was measured with a spectrum analyzer connected directly to the EUT's Main Antenna with a calibrated measurement cable while the EUT was operating in continuous transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency. Display line and marker delta functions were used to measure the occupied bandwidth of the EUT. Measurements were made at the Low (2501 MHz), Mid (2593 MHz), and High (2685 MHz) frequencies for 16QAM and QPSK 10 MHz channels. And at the Low (2501 MHz), Mid (2593 MHz), and High (2687.5 MHz) frequencies for 16QAM and QPSK 5 MHz channels

### **4.2 Test Criteria**

The 26 dB bandwidth must be measured and reported for the FCC and IC.

## **5.0 Band Edge Spurious Emissions Measurements**

Band Edge Spurious Emissions Measurements were performed on the EUT to determine compliance to FCC 27.53(m)(4)(6), and FCC 2.1051. Power of any emission outside of the channel edge must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB at the channel edge and  $55 + 10 \log(P)$  dB at 5.5 MHz from the channel edges. The limit of emission equal to  $-25$ dBm. In the 1MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

### **5.1 Test Procedure**

The Band Edge Spurious Emissions were measured with a spectrum analyzer connected directly to the EUT's Main Antenna with a calibrated measurement cable while the EUT was operating in continuous transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency. Measurements were made at the Low (2501 MHz), Mid (2593 MHz), and High (2685 MHz) frequencies for 16QAM and QPSK 10 MHz channels. And at the Low (2501 MHz), Mid (2593 MHz), and High (2687.5 MHz) frequencies for 16QAM and QPSK 5 MHz channels.

### **5.2 Test Criteria**

The Band Edge Spurious Emissions will meet criteria if they are attenuated below the limits specified in FCC 27.53(m)(4)(6) , FCC 2.1051. For this test the adjacent restricted band measurement included measurements of the band edge emissions and compared to 27.53.

## **6.0 Frequency Stability**

Frequency Stability measurements were performed on the EUT to determine compliance to FCC 27.54 , FCC 2.1055. The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### **6.1 Test Procedure**

Frequency Stability vs. Temperature: The Frequency Stability was measured with a spectrum analyzer connected directly to the EUT's Main Antenna with a calibrated measurement cable while the EUT was operating in continuous CW output mode with modulation turned off and operating at a 50% duty cycle at the appropriate center frequency. This was accomplished using the RTT test software. The EUT was placed inside the temperature chamber. The RF output cable exited the chamber through an opening made for the purpose. After the temperature stabilized for the required period of time, the frequency output was recorded from the spectrum analyzer.

### **6.2 Test Criteria**

The Frequency Stability will meet criteria if the fundamental emissions stay within the authorized bands of operation.

## **7.0 Radiated Spurious Emissions**

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to FCC sections 27.53, 2.1053.

### **7.1 Test Procedure**

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 10 meters from the measurement antenna.

For spurious emissions below 1 GHz quasi-peak detection is used with a resolution bandwidth of 120 kHz. The emissions were maximized by rotating the EUT and raising and lowering the measurement antenna from 1-4 meters. The test setup is included in Appendix A.

Spurious/harmonic emissions above 1 GHz peak are measured with average and peak detection with a resolution bandwidth of 1 MHz and measured at a distance of 1 meter. Average detection is used to determine compliance of the EUT if the peak does not meet the average limit. Non-harmonic emissions must satisfy the average limit and the peak limit (20 dB above average). The test setup is included in Appendix A. Above 1 GHz testing was completed at 3 transmit frequencies to determine compliance.

**Note:** We derived an approximate field strength limit using the simplified Friis Transmission formula in order to make a preliminary comparison to the spurious radiated power limit of -13 dBm and -25 dBm. The associated formula and calculated limits are shown below. In order to demonstrate compliance with the radiated power limit antenna substitution was performed. Antenna substitution was performed on the 6 worst case spurious emissions summed across all operating modes.

## 7.2 Test Criteria

The radiated limits of FCC 27.53 are shown below. The limits specified are at 3 meters and 10 meters. The limits are quasi-peak for emissions below 1 GHz and average for emissions above 1 GHz. Also above 1 GHz the peak limit is 20 dB above the average limit.

Frequency MHz	Test Distance (Meters)	Radiated Power (dBm)	Field Strength (dB $\mu$ V/m)
30 to 1000	10	-13	73.9
Above 1000	3	-13	84.3

## 8.0 Modifications

No hardware modifications were made. The software settings for the output power were limited to 22.74 dBm at a minimum during the Channel Edge measurements. Motorola is responsible for limiting the maximum power output from the device to 22.74 dBm for production units in order to maintain compliance with the FCC rules.

## 9.0 Test Equipment

A list of the test equipment utilized to perform the testing is given below. The date of calibration is given for each.

### Conducted Test Equipment

Asset #	Manufacturer	Model #	Description	Calibration Due
1281	HP	85650A	Quasi-peak Adapter	January 05, 2010
0045	HP	85662A	Spectrum Analyzer Display	NCR
1284	HP	8568B	Spectrum Analyzer	January 05, 2010
1087	PTI	PTI-ALF3	Attenuator, Limiter, Filter	June 7, 2009
1185	Emco	3825/2	Line Impedance Stabilization Network	September 13, 2009
0081	ELGAR	1751SL	AC Power Supply	NCR
1173	PTI	100KHz HPF	High Pass Filter	January 26, 2010

### Radiated Test Equipment

Asset #	Manufacturer	Model #	Description	Calibration Due
1277	HP	85650A	Quasi-peak Adapter (high band)	October 21, 2009
1273	HP	85662A	Spectrum Analyzer Display (high band)	NCR
0084	HP	8566B	Spectrum Analyzer (high band)	February 23, 2010
1035	HP	85685A	RF Preselector (high band)	January 29, 2010
0085	HP	85650A	Quasi-peak Adapter (low band)	July 7, 2009
1629	HP	85662A	Spectrum Analyzer Display (low band)	NCR
1145	HP	8568B	Spectrum Analyzer (low band)	July 7, 2009
0238	HP	85685A	RF Preselector (low band)	July 30, 2009
1454	HP	8447D	RF Preamplifier	June 17, 2009
1497	Emco	3108	Biconical Antenna	April 16, 2009
1486	Emco	3147	Log Periodic Dipole Array Antenna	April 16, 2009
C026	none	none	Coaxial Cable (low band)	July 02, 2009
C027	none	none	Coaxial Cable (high band)	July 02, 2009

Radiated Test Equipment (retest)

Asset #	Manufacturer	Model #	Description	Calibration Due
1277	HP	85650A	Quasi-peak Adapter (high band)	October 21, 2009
1273	HP	85662A	Spectrum Analyzer Display (high band)	NCR
0084	HP	8566B	Spectrum Analyzer (high band)	February 23, 2010
1035	HP	85685A	RF Preselector (high band)	January 29, 2010
0085	HP	85650A	Quasi-peak Adapter (low band)	July 7, 2009
1629	HP	85662A	Spectrum Analyzer Display (low band)	NCR
1145	HP	8568B	Spectrum Analyzer (low band)	July 7, 2009
0238	HP	85685A	RF Preselector (low band)	July 30, 2009
1454	HP	8447D	RF Preamplifier	June 17, 2009
1497	Emco	3108	Biconical Antenna	April 16, 2010
1486	Emco	3147	Log Periodic Dipole Array Antenna	April 16, 2010
C026	none	none	Coaxial Cable (low band)	July 02, 2009
C027	none	none	Coaxial Cable (high band)	July 02, 2009

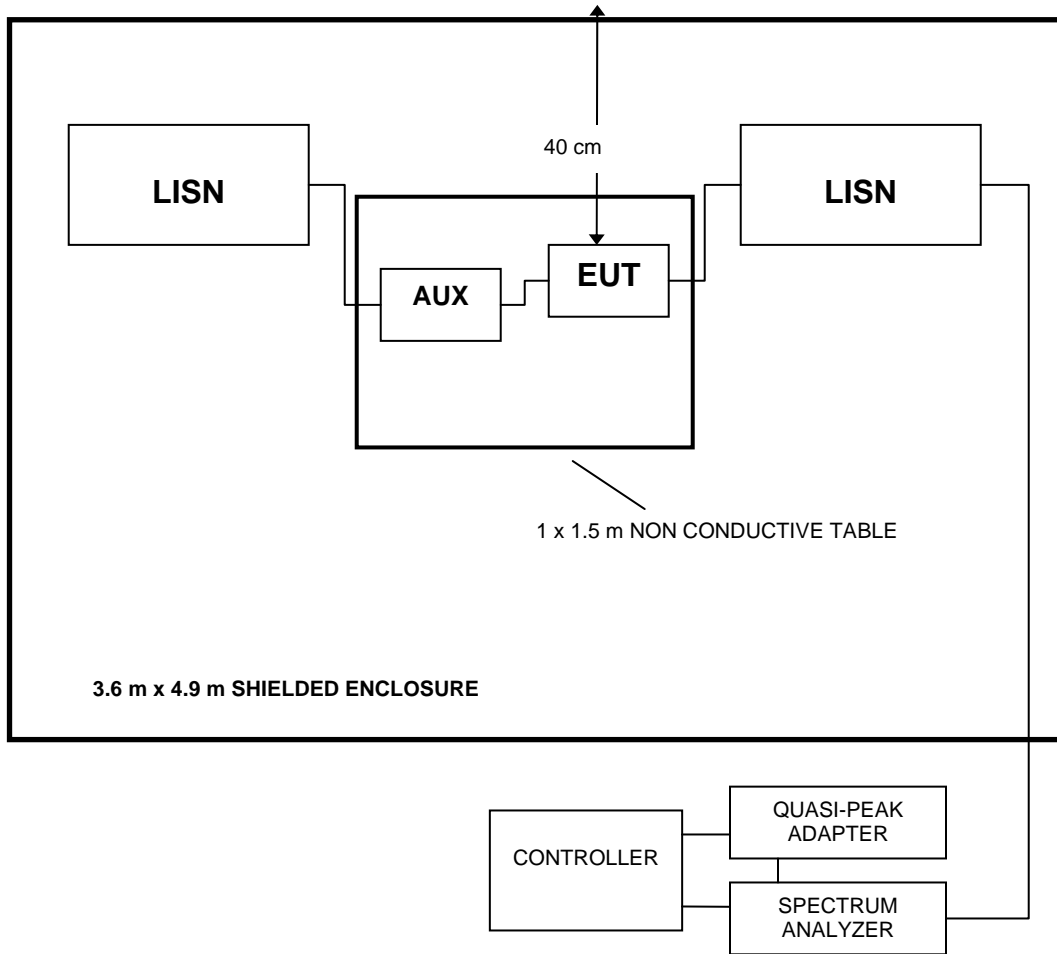
Microwave Radiated Test Equipment

Asset #	Manufacturer	Model #	Description	Calibration Due
0582	EMCO	3115	Ridge Guide Antenna	September 30, 2009
1529	Miteq	Antenna Mounted	Microwave Preamplifier (preamp 1)	June 30, 2009
0084	HP	8566B	Spectrum Analyzer	February 23, 2010
1273	HP	85662A	Spectrum Analyzer Display	NCR
1530	Miteq	None	Microwave Preamplifier (preamp 2)	June 30, 2009
C030	None	None	Coaxial Cable (MRE band)	June 30, 2009

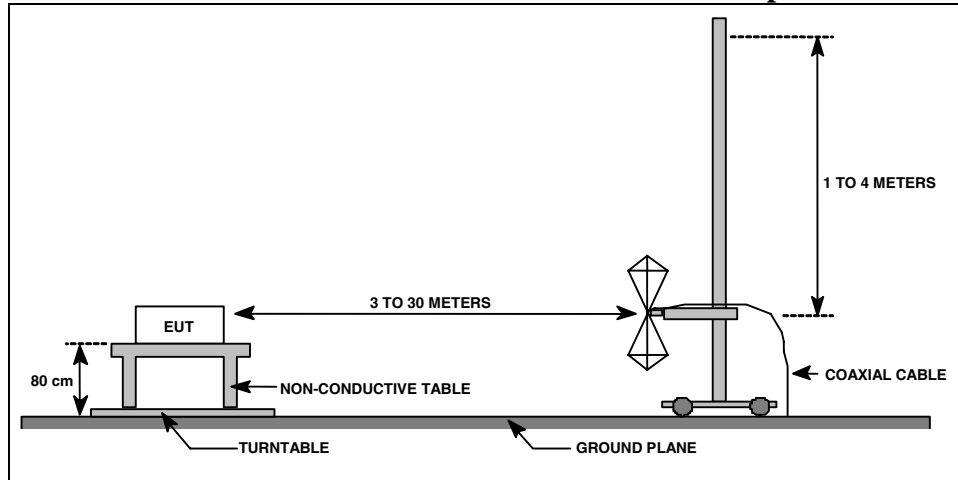
Asset #	Manufacturer	Model #	Description	Calibration Due
XXXX	Pasternack	LLS	2 sections, total 12ft	January 21, 2010
0582	EMCO	3115	Ridge Guide Antenna	September 30, 2009
1594	Miteq	AFS44-00102650	Microwave Preamplifier (preamp 1)	February 25, 2010
1342	Rohde & Schwarz	ESMI	EMI Test Receiver	December 4, 2010
1343	Rohde & Schwarz	ESMI	EMI Test Receiver Display	December 4, 2010
(Motorola)	Rohde & Schwarz	FSQ26	Vector and Scaler Signal Analyzer	June 19, 2010



**FIGURE 1: Conducted Emissions Test Setup**



**FIGURE 2: Radiated Emissions Test Setup**





**Conducted Power Measurements**

PROJECT #	DATE	CLASS	DISTANCE	COUPLING	RBW	VBW	DETECTOR
10003-10	June 18, 2009	N/A	N/A	Direct	1 MHz	1 MHz	Average Channel Power

Channel	Frequency (MHz)	Modulation	Channel Bandwidth	Power (dBm)	Power (mW)
Low	2501	16QAM	10 MHz	22.93	196.34
Mid	2593	16QAM	10 MHz	22.86	193.20
High	2685	16QAM	10 MHz	22.74	187.93
Low	2501	QPSK	10 MHz	22.87	193.64
Mid	2593	QPSK	10 MHz	22.87	193.64
High	2685	QPSK	10 MHz	22.74	187.93
Low	2501	16QAM	5 MHz	22.90	194.98
Mid	2593	16QAM	5 MHz	22.87	193.64
High	2687.5	16QAM	5 MHz	22.81	190.99
Low	2501	QPSK	5 MHz	22.85	192.75
Mid	2593	QPSK	5 MHz	22.89	194.54
High	2687.5	QPSK	5 MHz	22.90	194.98

(The RF output of the transmitter was connected to the input of the PSA spectrum analyzer through sufficient attenuation)

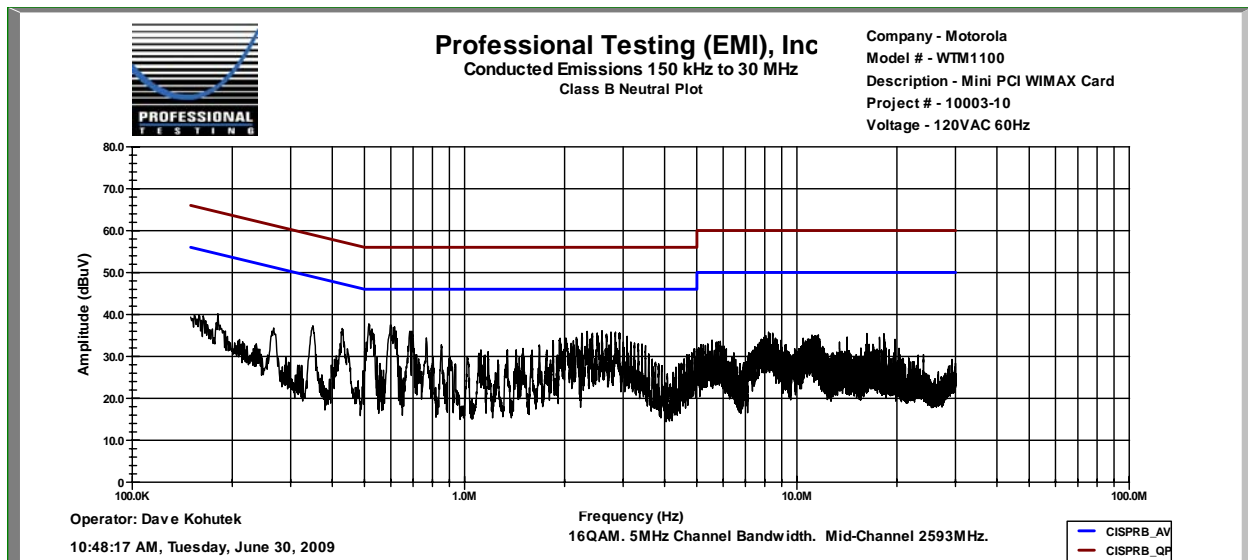
Power Line Conducted Emissions

**Power Line Conducted Emissions Data Sheet**

PROJECT #	DATE	CLASS	DISTANCE	COUPLING	RBW	VBW	DETECTOR
10003-10	June 30, 2009	FCC B	N/A	LISN	9 kHz	100 kHz/ 10 Hz	QP/Average

**16QAM 5 MHz Channel Bandwidth Mid Channel 2593 MHz (Neutral)**

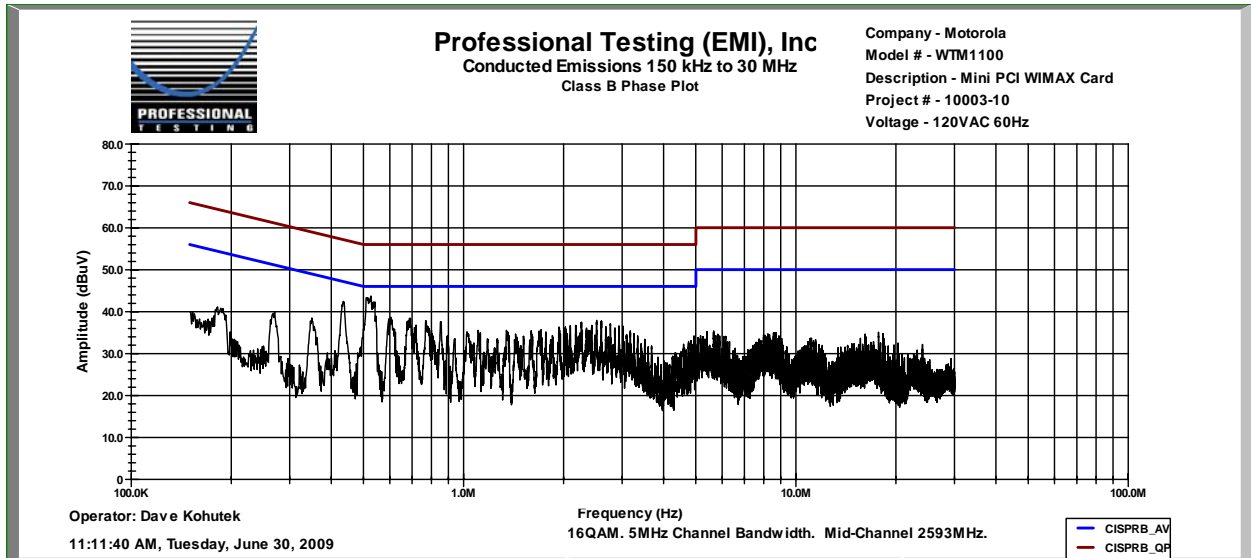
Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.18429	36.0	31.9	65.0	-29.0	55.0	-23.1
0.35072	36.0	32.1	60.3	-24.3	50.3	-18.2
0.42974	39.0	33.6	58.0	-19.1	48.0	-14.4
0.51944	39.8	34.4	56.0	-16.2	46.0	-11.6
0.60039	36.9	35.3	56.0	-19.1	46.0	-10.7
8.23042	33.6	27.5	60.0	-26.4	50.0	-22.5
8.31003	33.4	27.9	60.0	-26.6	50.0	-22.1
8.48102	32.6	27.6	60.0	-27.4	50.0	-22.4
16.2428	32.9	29.2	60.0	-27.1	50.0	-20.8
18.2596	34.2	30.2	60.0	-25.8	50.0	-19.8



**RESULT = PASS**

**16QAM 5 MHz Channel Bandwidth Mid Channel 2593 MHz (Phase)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.26508	38.1	35.0	62.7	-24.6	52.7	-17.8
0.43241	41.6	38.0	57.9	-16.4	47.9	-9.9
0.51086	41.2	34.6	56.0	-14.8	46.0	-11.4
0.59721	39.4	36.8	56.0	-16.6	46.0	-9.2
0.67758	36.9	34.8	56.0	-19.1	46.0	-11.2
5.4161	33.4	29.4	60.0	-26.6	50.0	-20.6
5.67147	33.2	28.7	60.0	-26.8	50.0	-21.3
8.57867	32.4	26.9	60.0	-27.6	50.0	-23.1
8.6622	32.4	26.8	60.0	-27.6	50.0	-23.2
8.74725	31.9	26.1	60.0	-28.1	50.0	-23.9

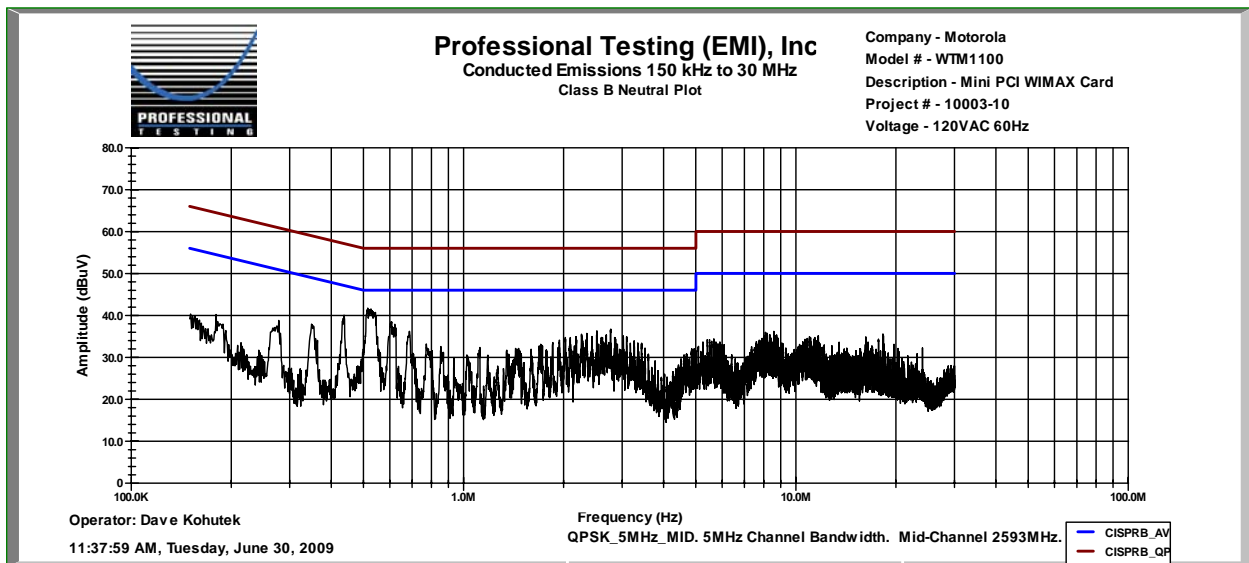


**RESULT = PASS**

Power Line Conducted Emissions

**QPSK 5 MHz Channel Bandwidth Mid Channel 2593 MHz (Neutral)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.27184	35.5	31.8	62.5	-27.0	52.5	-20.7
0.3484	36.2	32.7	60.3	-24.1	50.3	-17.6
0.43007	39.1	34.8	58.0	-18.9	48.0	-13.2
0.51442	40.0	34.2	56.0	-16.0	46.0	-11.8
0.60983	37.0	35.2	56.0	-19.0	46.0	-10.8
8.08942	33.3	27.9	60.0	-26.7	50.0	-22.1
8.17442	33.5	28.1	60.0	-26.5	50.0	-21.9
8.3374	33.7	27.9	60.0	-26.3	50.0	-22.1
8.5865	33.3	26.9	60.0	-26.7	50.0	-23.1
8.75353	32.8	27.1	60.0	-27.2	50.0	-22.9

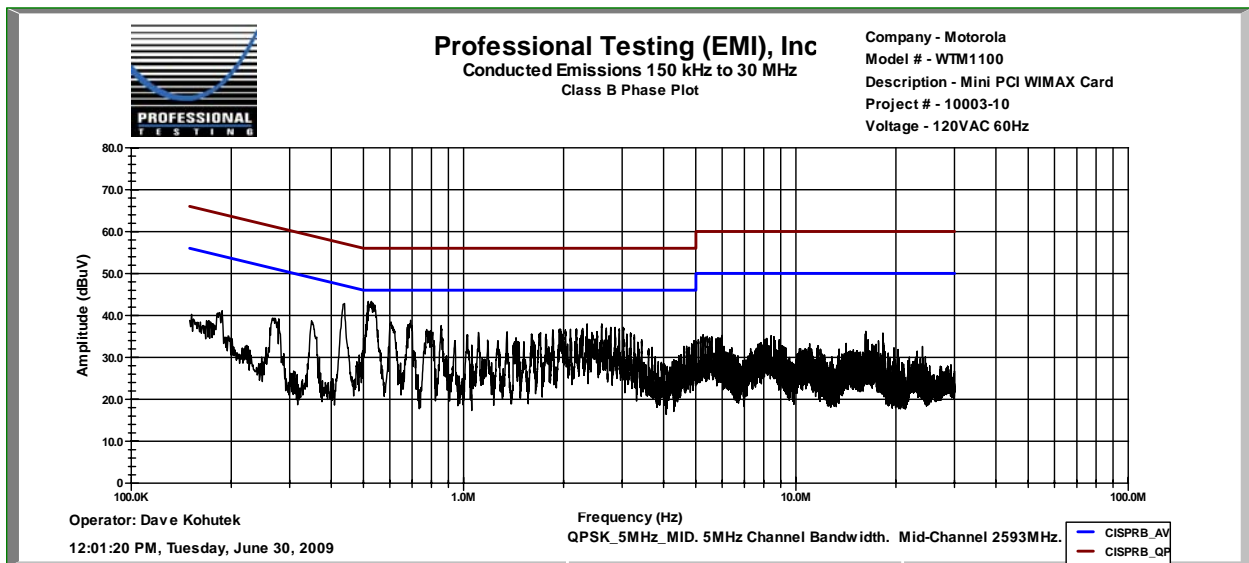


**RESULT = PASS**

Power Line Conducted Emissions

**QPSK 5 MHz Channel Bandwidth Mid Channel 2593 MHz (Phase)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.36025	36.9	34.6	60.0	-23.1	50.0	-15.4
0.43244	41.8	36.4	57.9	-16.2	47.9	-11.6
0.51751	41.0	35.6	56.0	-15.0	46.0	-10.4
0.59953	39.5	37.3	56.0	-16.5	46.0	-8.7
0.6832	37.0	33.0	56.0	-19.0	46.0	-13.0
5.2584	33.1	27.8	60.0	-26.9	50.0	-22.2
6.00722	32.4	27.1	60.0	-27.6	50.0	-22.9
16.1832	32.2	27.5	60.0	-27.8	50.0	-22.5
16.2435	33.6	29.1	60.0	-26.4	50.0	-20.9
18.2601	33.7	29.8	60.0	-26.3	50.0	-20.2

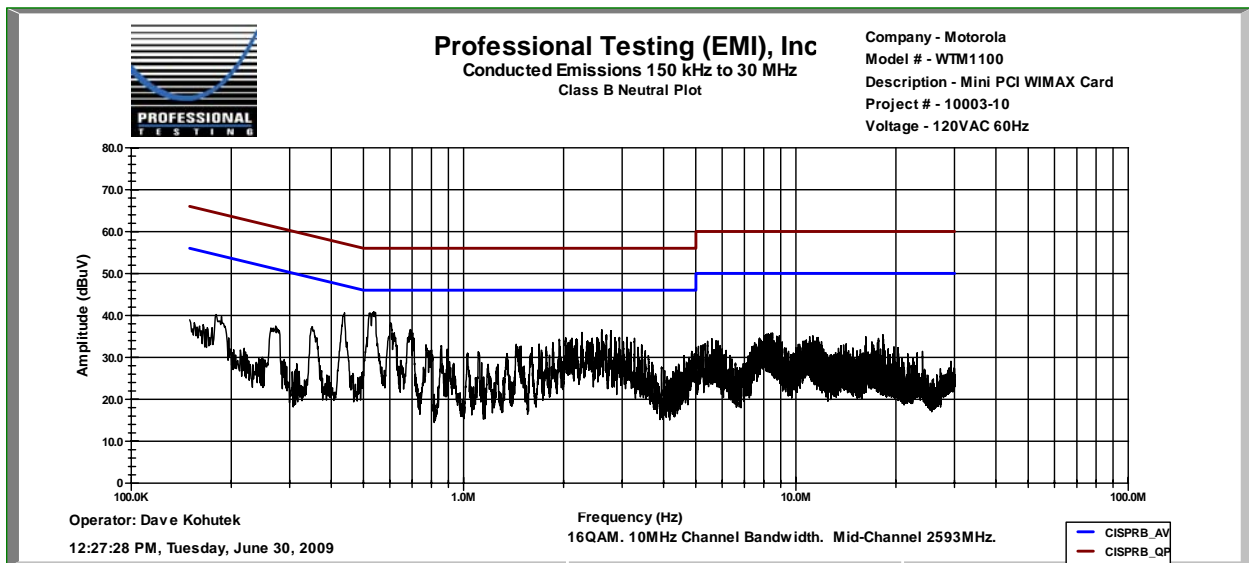


**RESULT = PASS**

Power Line Conducted Emissions

**16QAM 10 MHz Channel Bandwidth Mid Channel 2593 MHz (Neutral)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.18429	36.0	31.9	65.0	-29.0	55.0	-23.1
0.35072	36.0	32.1	60.3	-24.3	50.3	-18.2
0.42974	39.0	33.6	58.0	-19.1	48.0	-14.4
0.51944	39.8	34.4	56.0	-16.2	46.0	-11.6
0.60039	36.9	35.3	56.0	-19.1	46.0	-10.7
8.23042	33.6	27.5	60.0	-26.4	50.0	-22.5
8.31003	33.4	27.9	60.0	-26.6	50.0	-22.1
8.48102	32.6	27.6	60.0	-27.4	50.0	-22.4
16.2428	32.9	29.2	60.0	-27.1	50.0	-20.8
18.2596	34.2	30.2	60.0	-25.8	50.0	-19.8

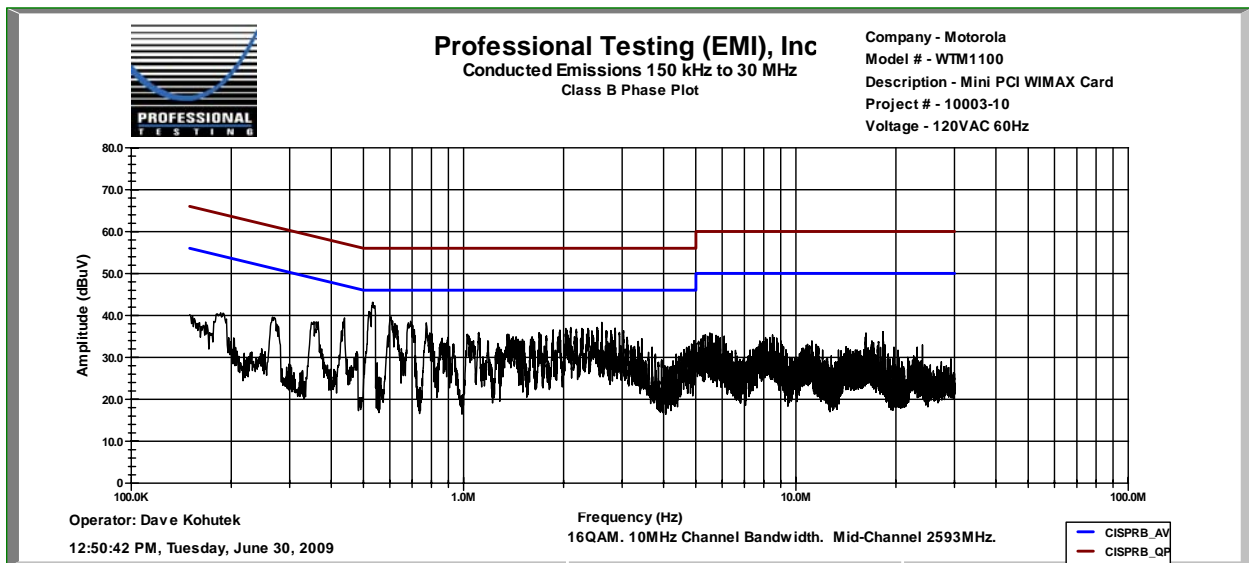


**RESULT = PASS**

Power Line Conducted Emissions

16QAM 10 MHz Channel Bandwidth Mid Channel 2593 MHz (Phase)

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.43209	41.6	37.6	57.9	-16.4	47.9	-10.3
0.51413	42.1	35.4	56.0	-13.9	46.0	-10.6
0.59953	39.5	36.5	56.0	-16.5	46.0	-9.5
0.6844	36.8	34.5	56.0	-19.2	46.0	-11.5
2.59829	35.7	32.5	56.0	-20.3	46.0	-13.5
5.35122	33.4	28.7	60.0	-26.6	50.0	-21.3
5.51625	33.6	28.4	60.0	-26.4	50.0	-21.6
5.59882	32.4	28.4	60.0	-27.6	50.0	-21.6
16.247	33.0	29.1	60.0	-27.0	50.0	-20.9
18.2616	34.2	29.8	60.0	-25.8	50.0	-20.2

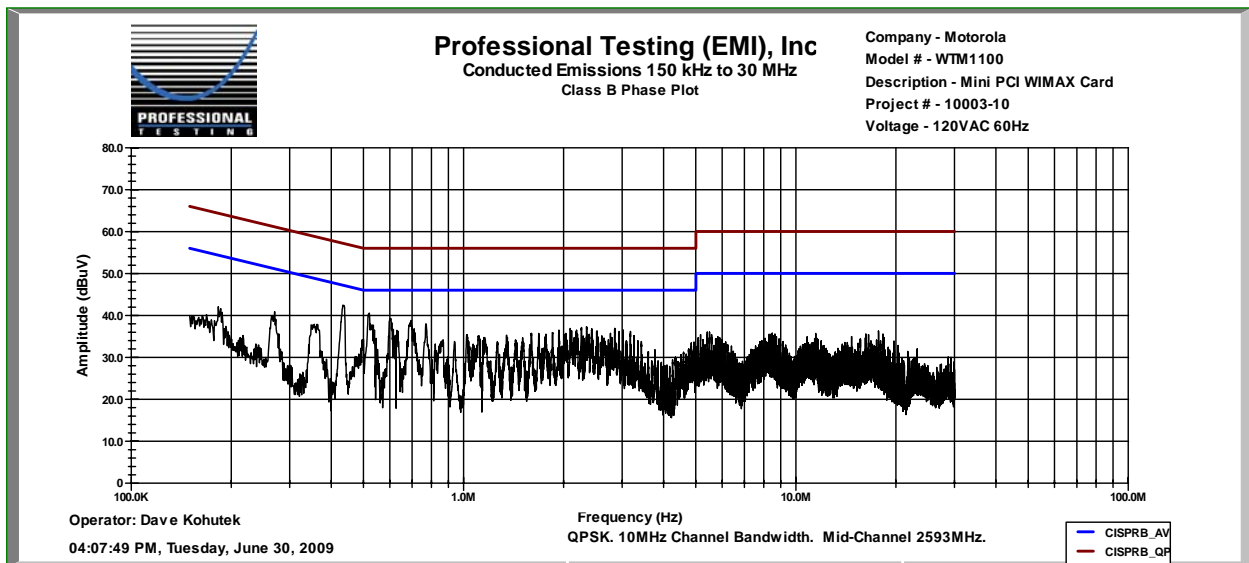


**RESULT = PASS**

Power Line Conducted Emissions

**QPSK 10 MHz Channel Bandwidth Mid Channel 2593 MHz (Neutral)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.18429	36.0	31.9	65.0	-29.0	55.0	-23.1
0.35072	36.0	32.1	60.3	-24.3	50.3	-18.2
0.42974	39.0	33.6	58.0	-19.1	48.0	-14.4
0.51944	39.8	34.4	56.0	-16.2	46.0	-11.6
0.60039	36.9	35.3	56.0	-19.1	46.0	-10.7
8.23042	33.6	27.5	60.0	-26.4	50.0	-22.5
8.31003	33.4	27.9	60.0	-26.6	50.0	-22.1
8.48102	32.6	27.6	60.0	-27.4	50.0	-22.4
16.2428	32.9	29.2	60.0	-27.1	50.0	-20.8
18.2596	34.2	30.2	60.0	-25.8	50.0	-19.8

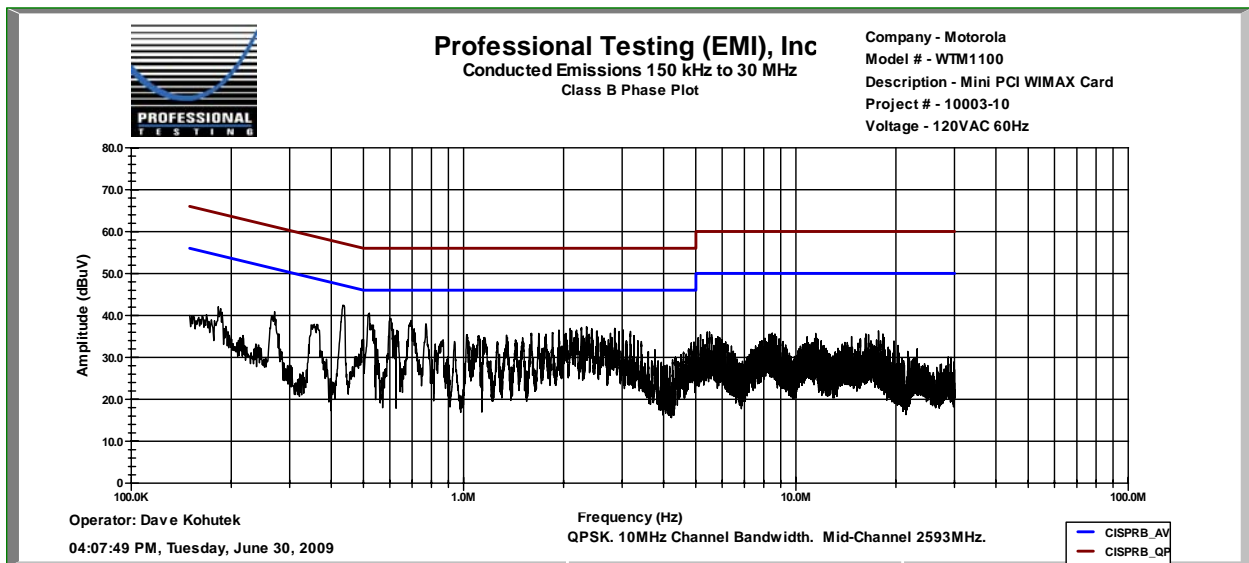


**RESULT = PASS**

Power Line Conducted Emissions

**QPSK 10 MHz Channel Bandwidth Mid Channel 2593 MHz (Phase)**

Frequency Reading (MHz)	Quasi-peak Reading (dBuV)	Average Reading (dBuV)	Quasi-peak Limit (dBuV)	Quasi-peak Margin (dB)	Average Limit (dBuV)	Average Margin (dB)
0.18258	38.5	34.4	65.1	-26.6	55.1	-20.7
0.26473	37.9	34.7	62.7	-24.8	52.7	-18.0
0.43319	41.4	37.4	57.9	-16.5	47.9	-10.5
0.51099	40.4	35.3	56.0	-15.6	46.0	-10.7
0.59598	39.6	36.8	56.0	-16.4	46.0	-9.2
5.17163	33.1	28.1	60.0	-26.9	50.0	-21.9
5.4215	32.9	28.3	60.0	-27.1	50.0	-21.7
5.50232	33.9	29.1	60.0	-26.1	50.0	-20.9
8.49942	32.7	26.9	60.0	-27.3	50.0	-23.1
17.7096	34.1	30.1	60.0	-25.9	50.0	-19.9



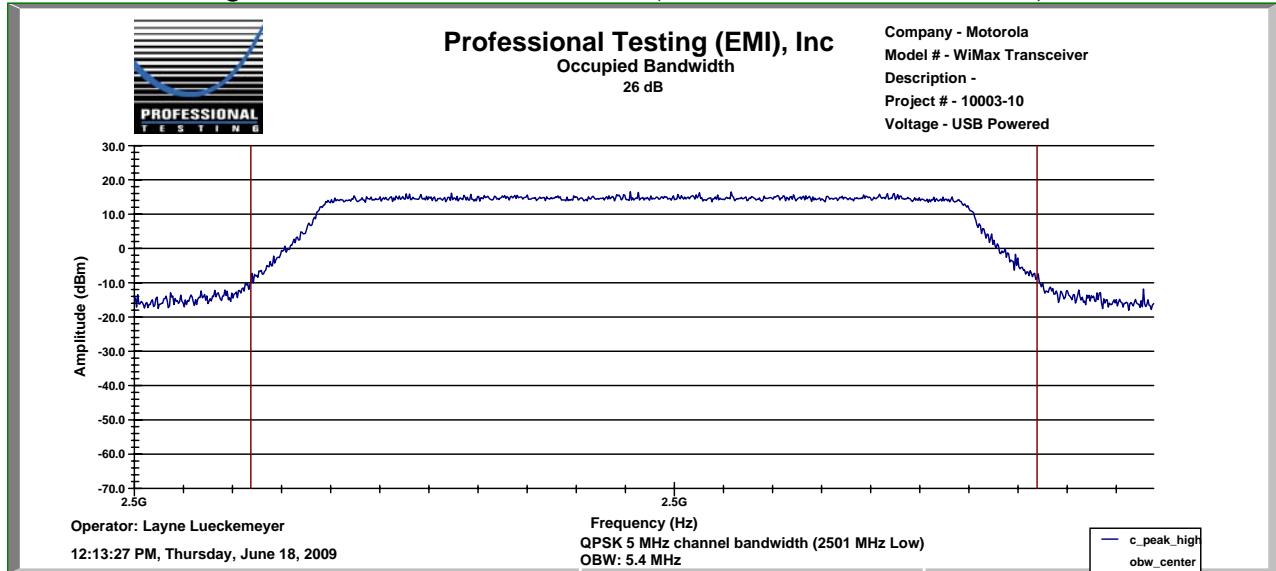
**RESULT = PASS**

# Occupied Bandwidth

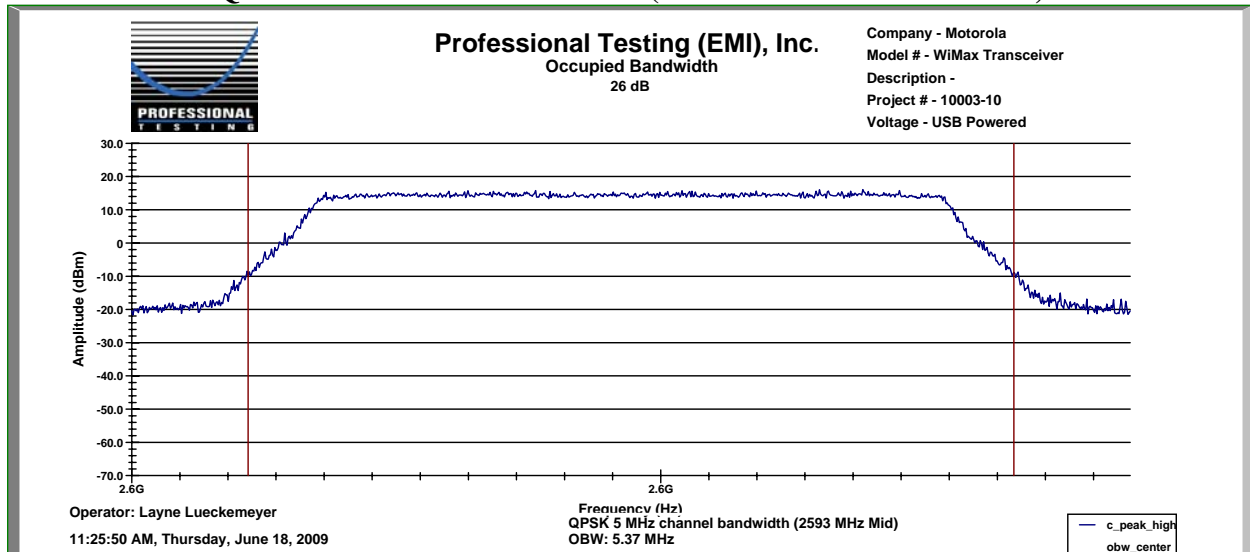
## Occupied Bandwidth

PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 18, 2009	27.53	N/A	Direct	100 kHz	300 kHz	Peak
COMMENT	Transmitting 26 dB Bandwidth – 2501 MHz						

### QPSK Low Channel 2501 MHz (5 MHz Channel Bandwidth)



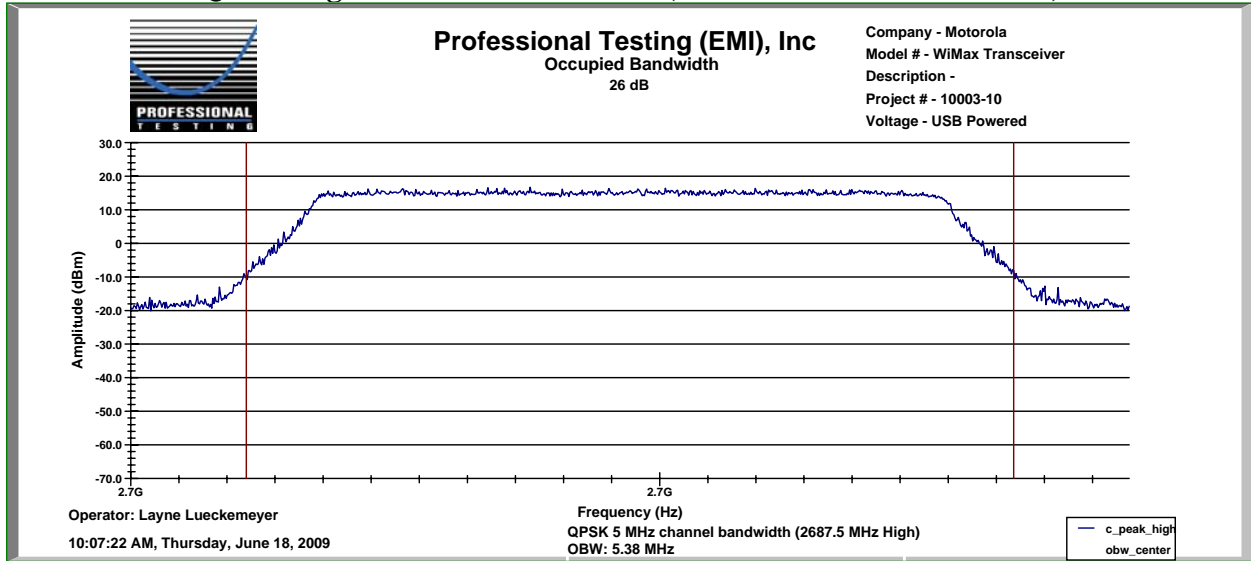
### QPSK Mid Channel 2593 MHz (5 MHz Channel Bandwidth)



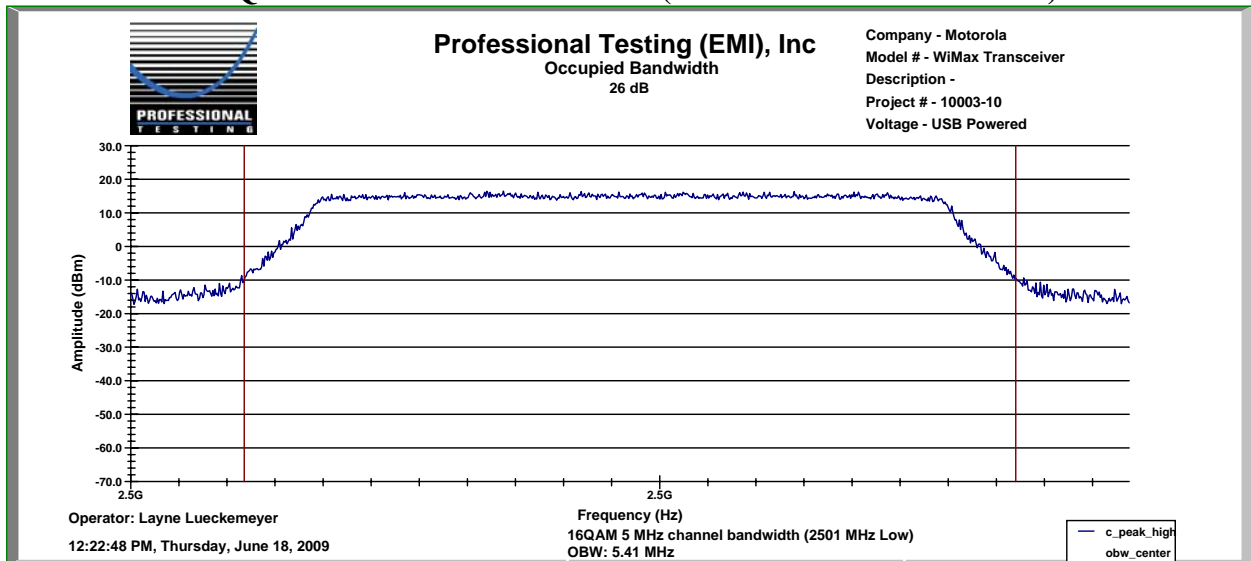
**RESULT = PASS**

# Occupied Bandwidth

## QPSK High Channel 2687.5 MHz (5 MHz Channel Bandwidth)



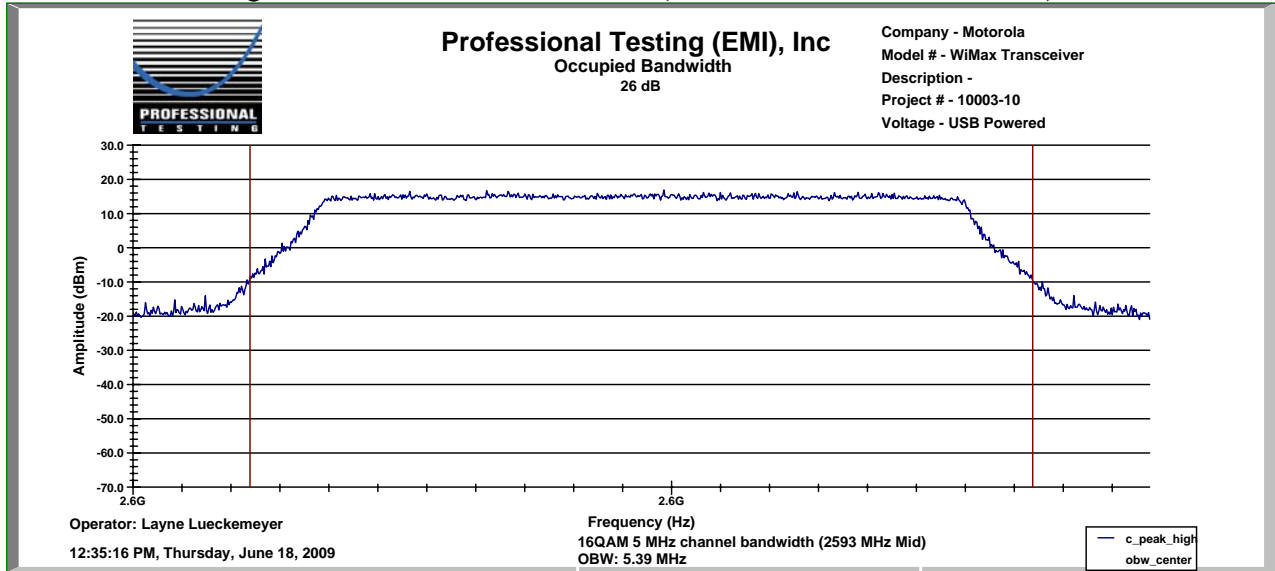
## 16QAM Low Channel 2501 MHz (5 MHz Channel Bandwidth)



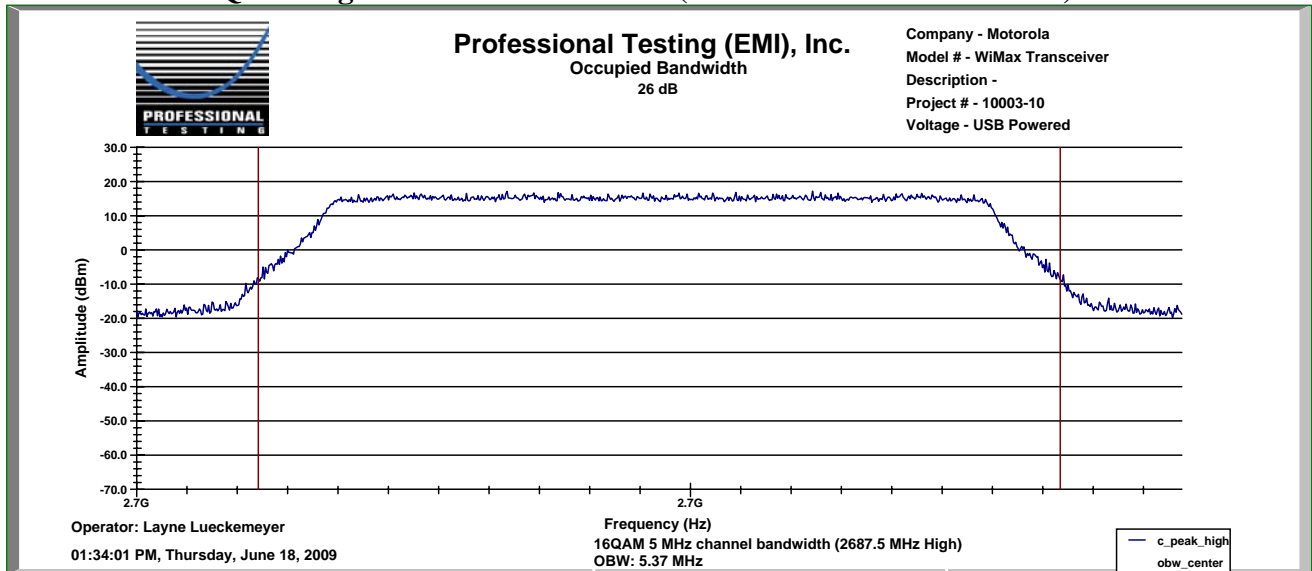
**RESULT = PASS**

# Occupied Bandwidth

## 16QAM Mid Channel 2593 MHz (5 MHz Channel Bandwidth)



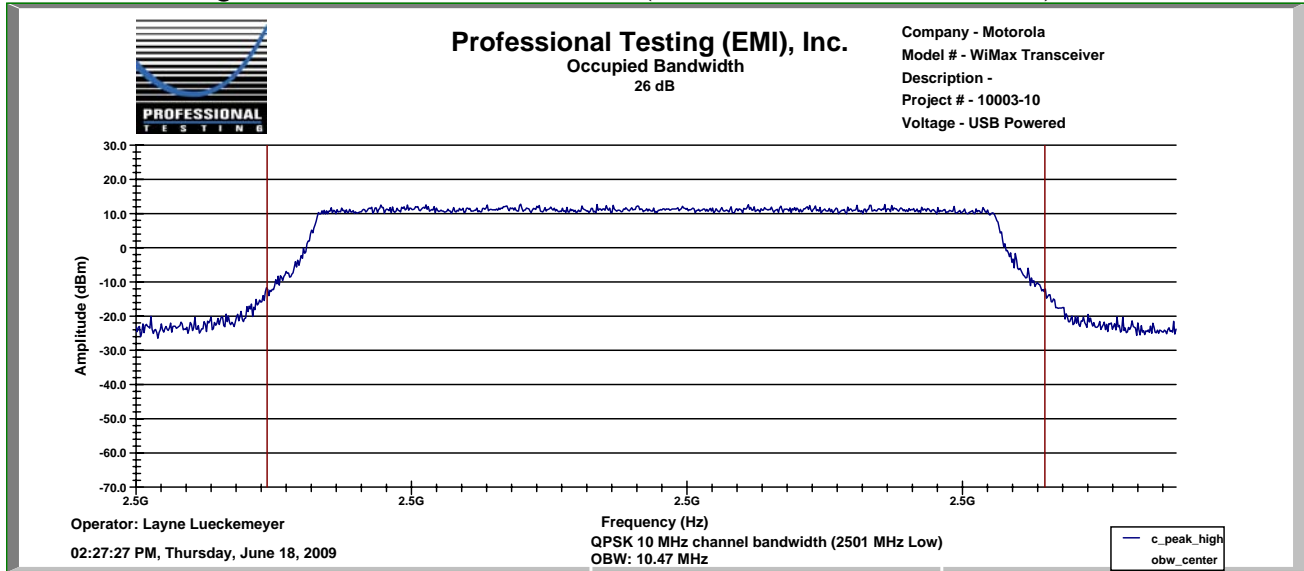
## 16QAM High Channel 2687.5 MHz (5 MHz Channel Bandwidth)



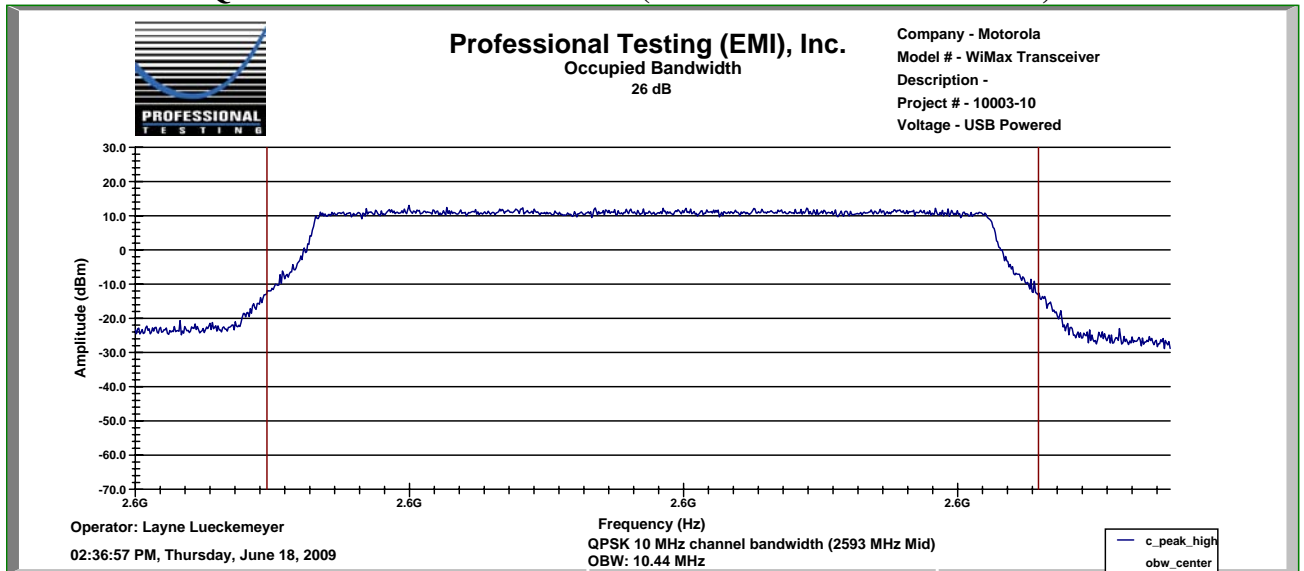
**RESULT = PASS**

# Occupied Bandwidth

## QPSK Low Channel 2501 MHz (10 MHz Channel Bandwidth)



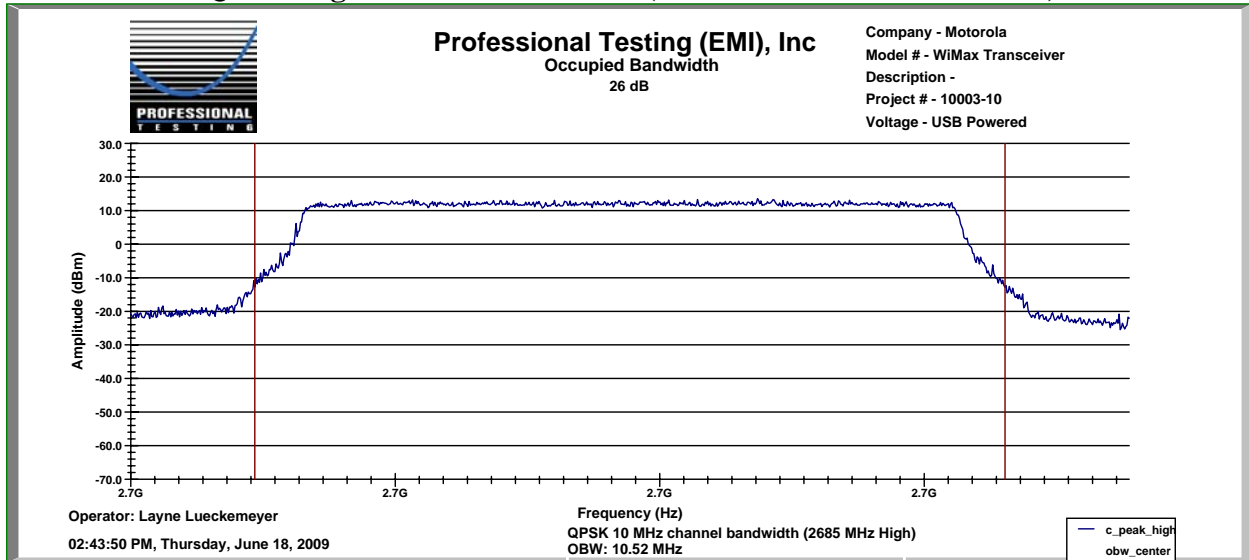
## QPSK Mid Channel 2593 MHz (10 MHz Channel Bandwidth)



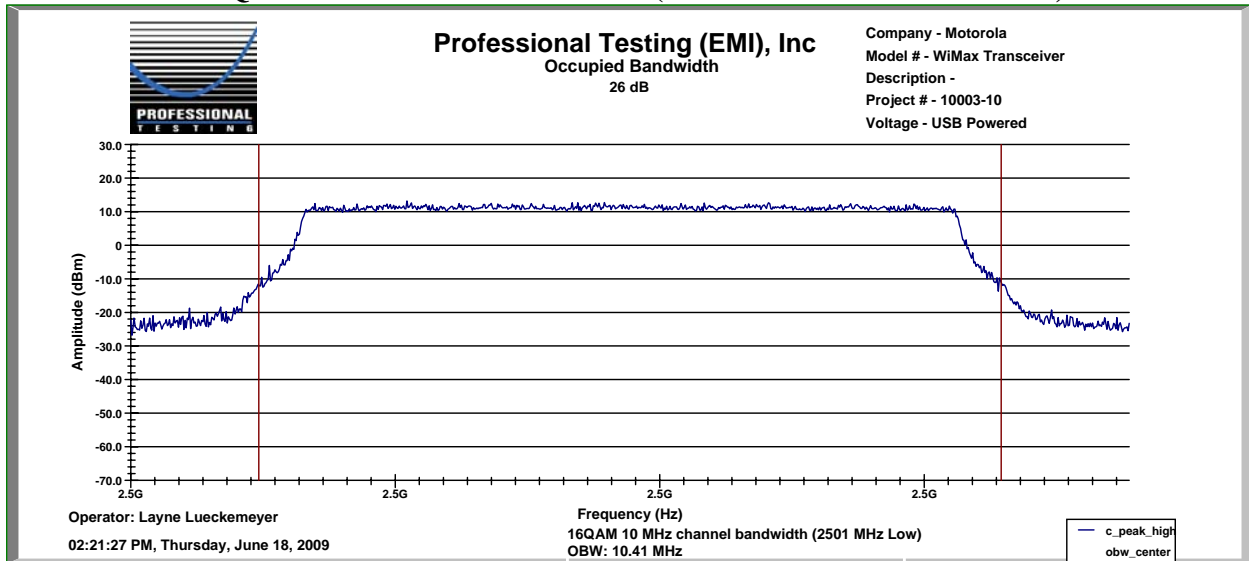
**RESULT = PASS**

# Occupied Bandwidth

## QPSK High Channel 2685 MHz (10 MHz Channel Bandwidth)



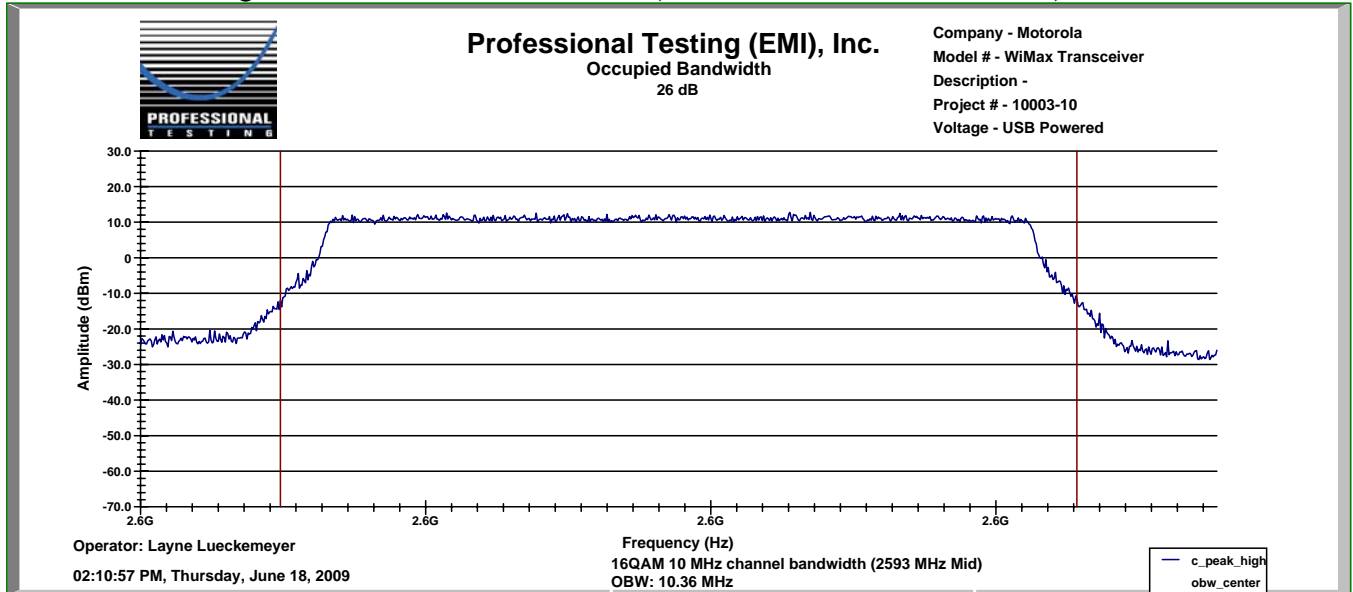
## 16QAM Low Channel 2501 MHz (10 MHz Channel Bandwidth)



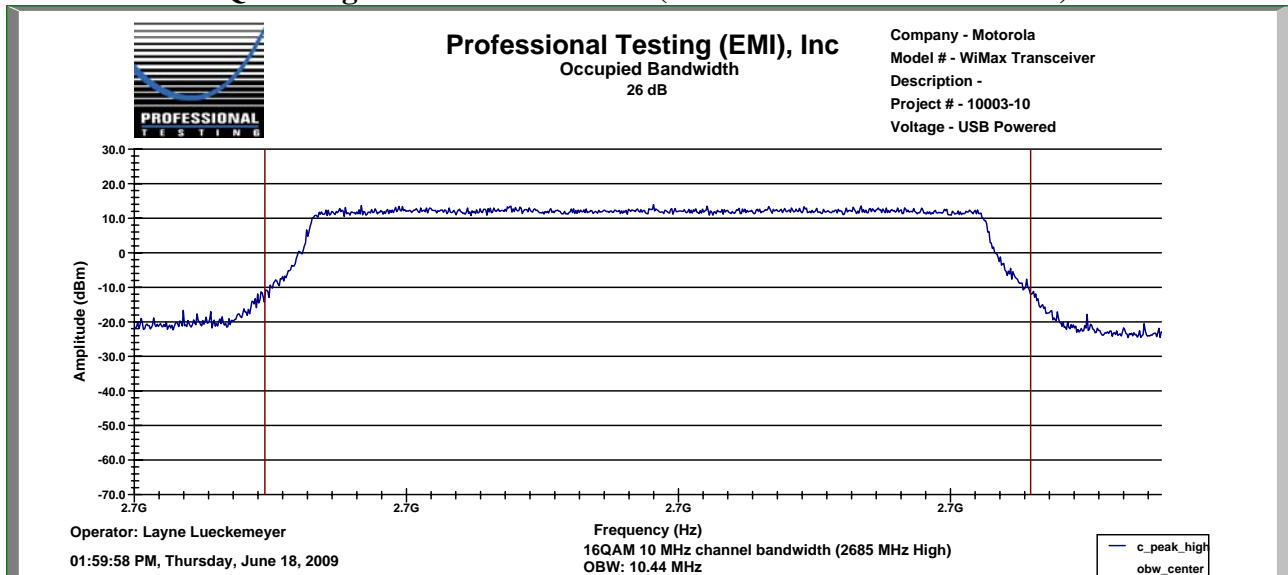
**RESULT = PASS**

# Occupied Bandwidth

## 16QAM Mid Channel 2593 MHz (10 MHz Channel Bandwidth)



## 16QAM High Channel 2685 MHz (10 MHz Channel Bandwidth)



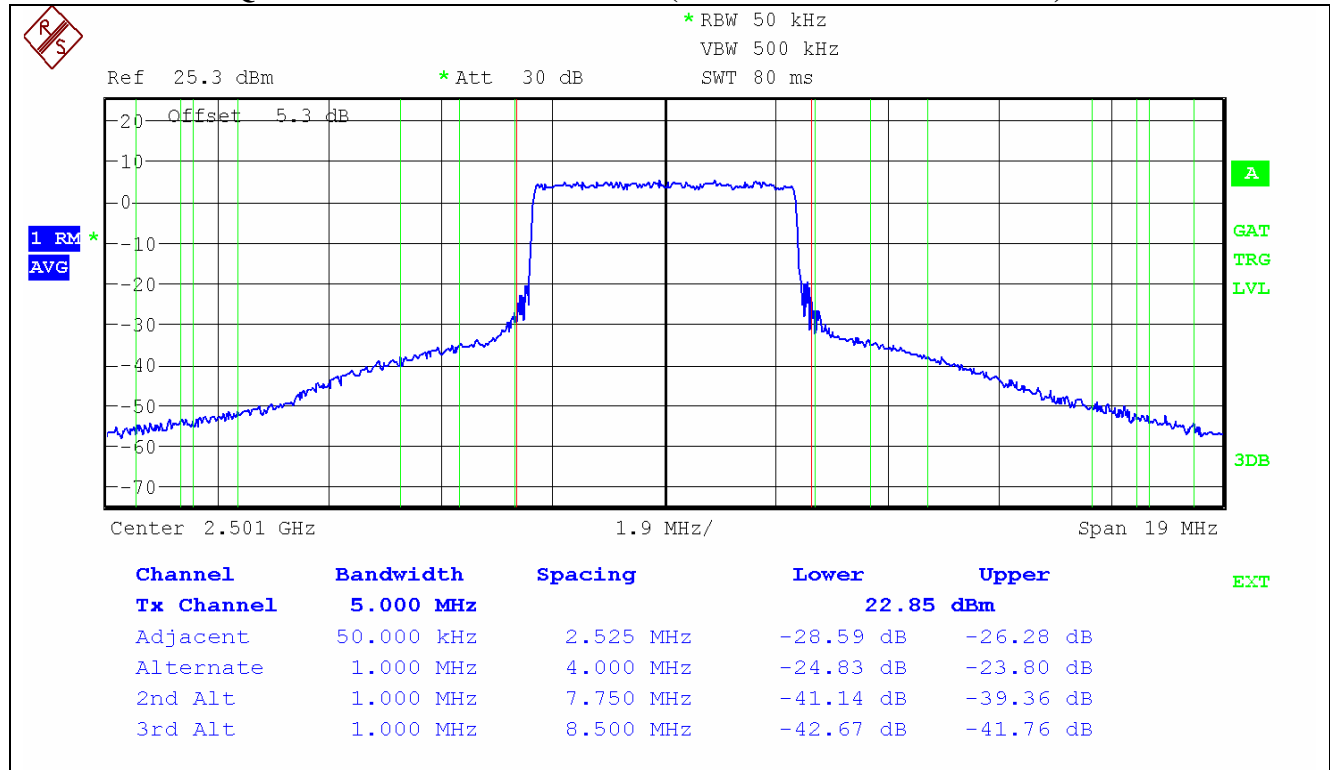
**RESULT = PASS**

# Band Edge

## Band Edge Measurement Data Sheet

PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 18, 2009	27.53(m)(4)(6)	N/A	Direct	50 kHz	500 kHz	Average

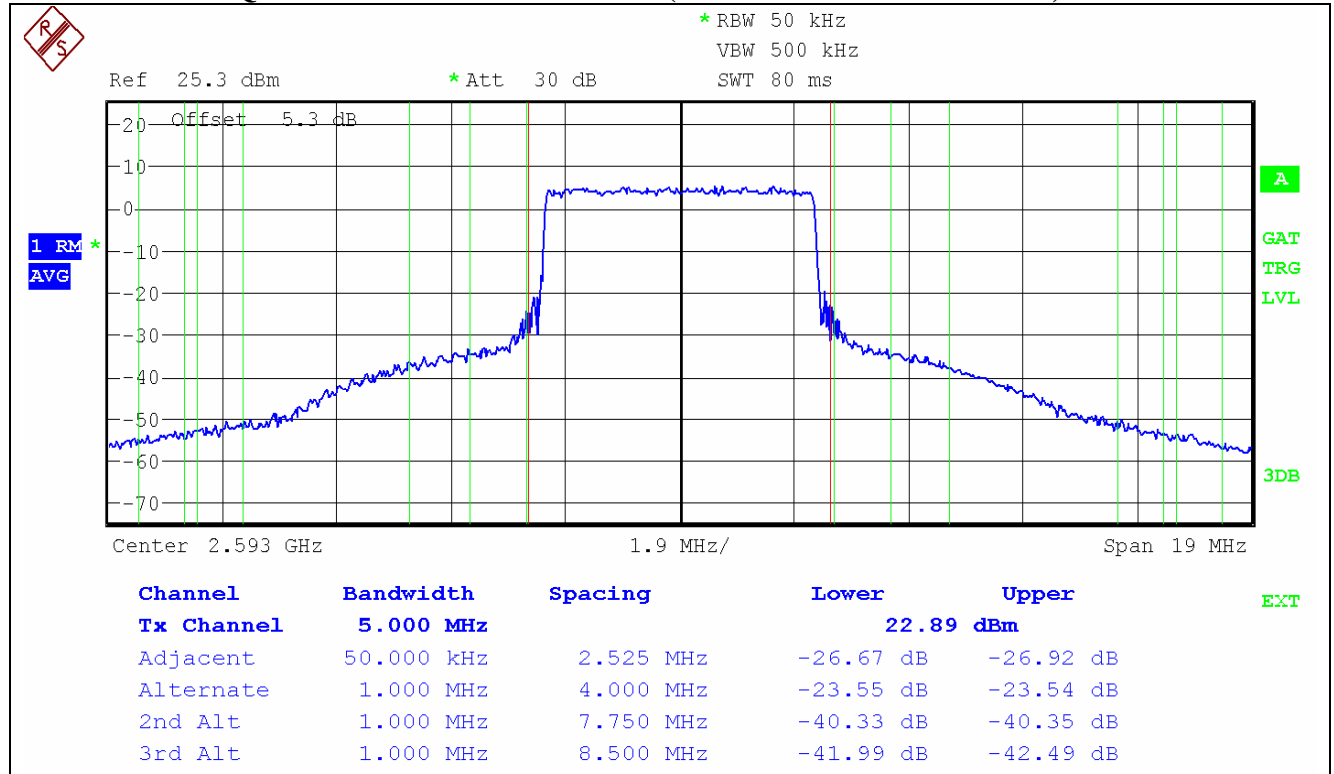
### QPSK Low Channel 2501 MHz (5 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

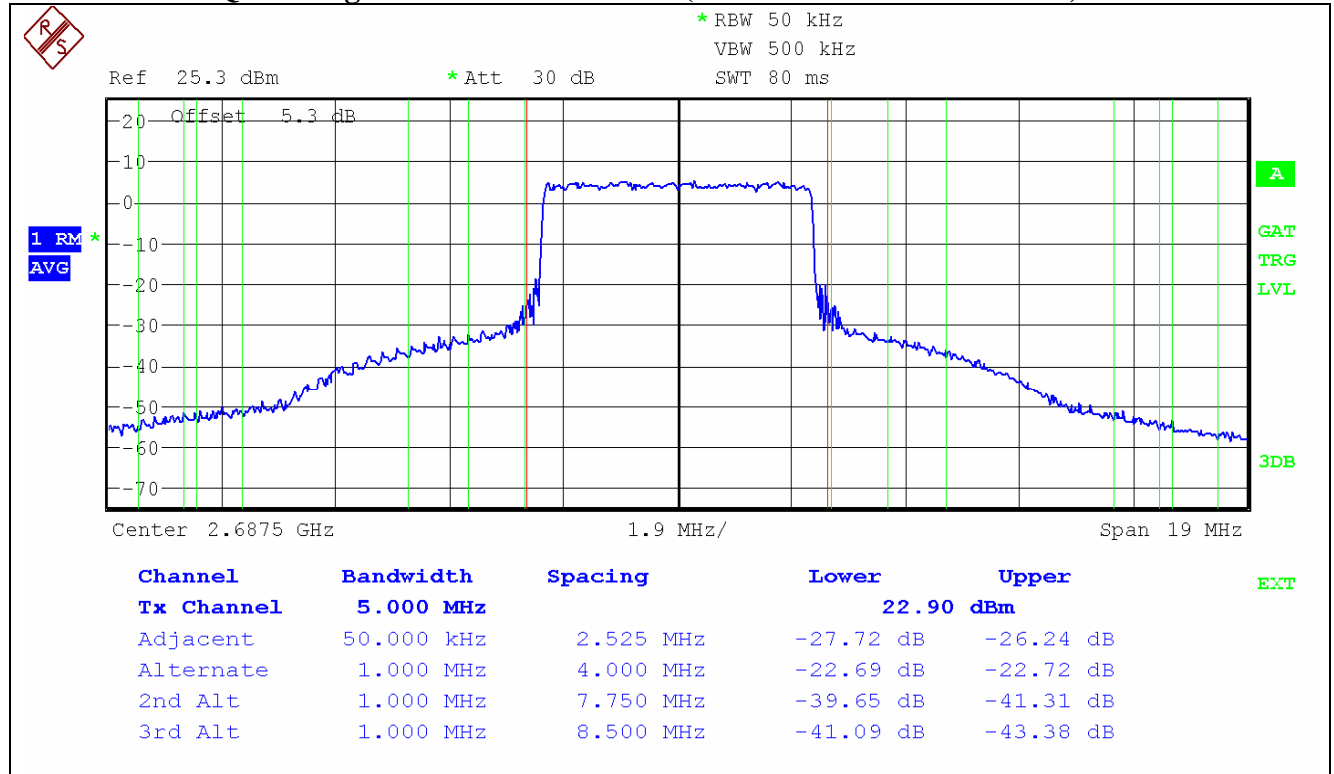
## QPSK Mid Channel 2593 MHz (5 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

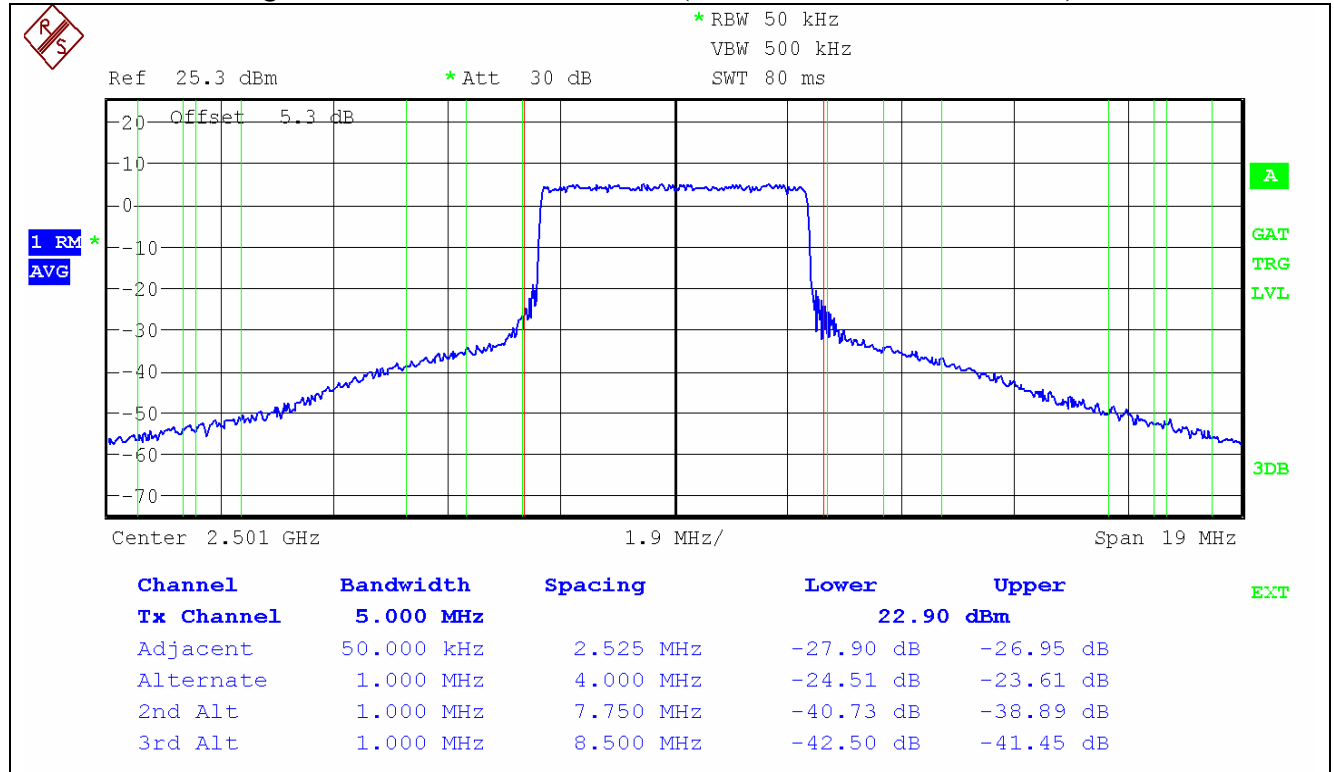
## QPSK High Channel 2687.5 MHz (5 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

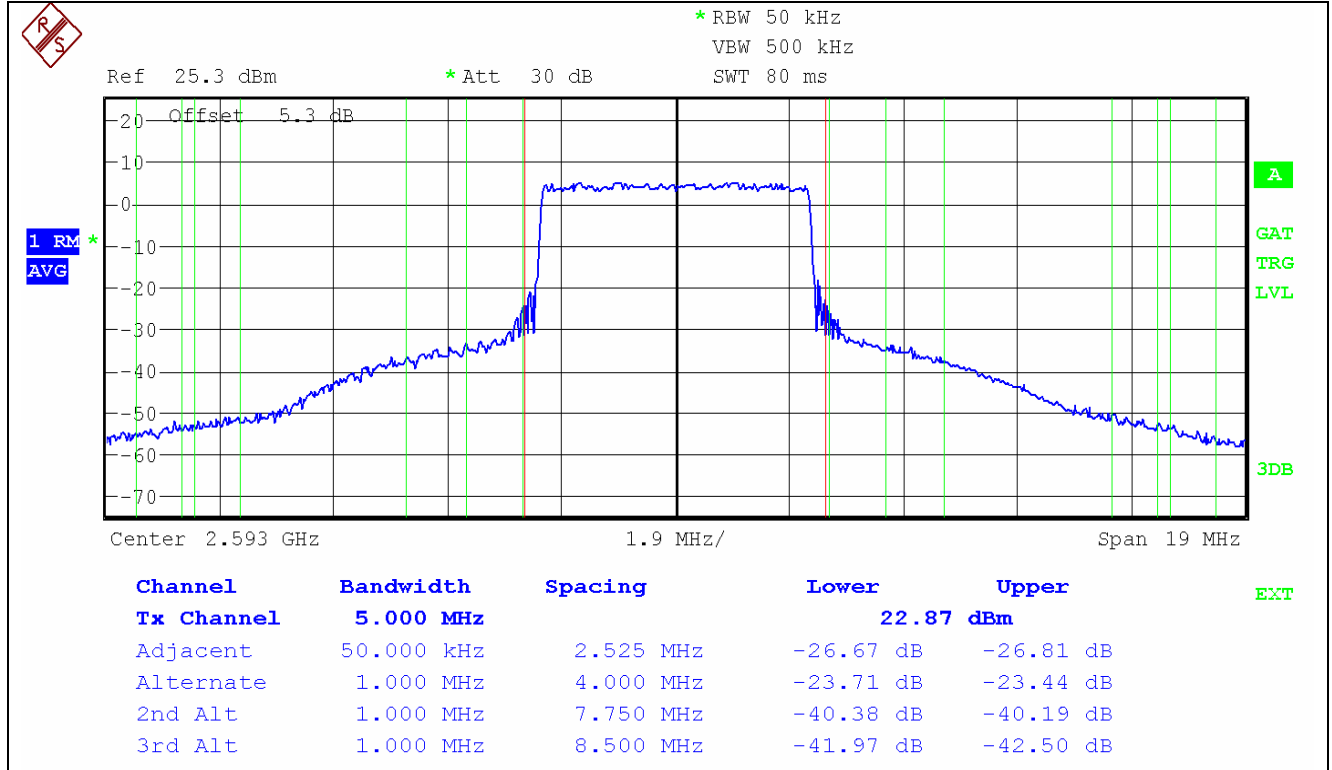
## 16QAM Low Channel 2501 MHz (5 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

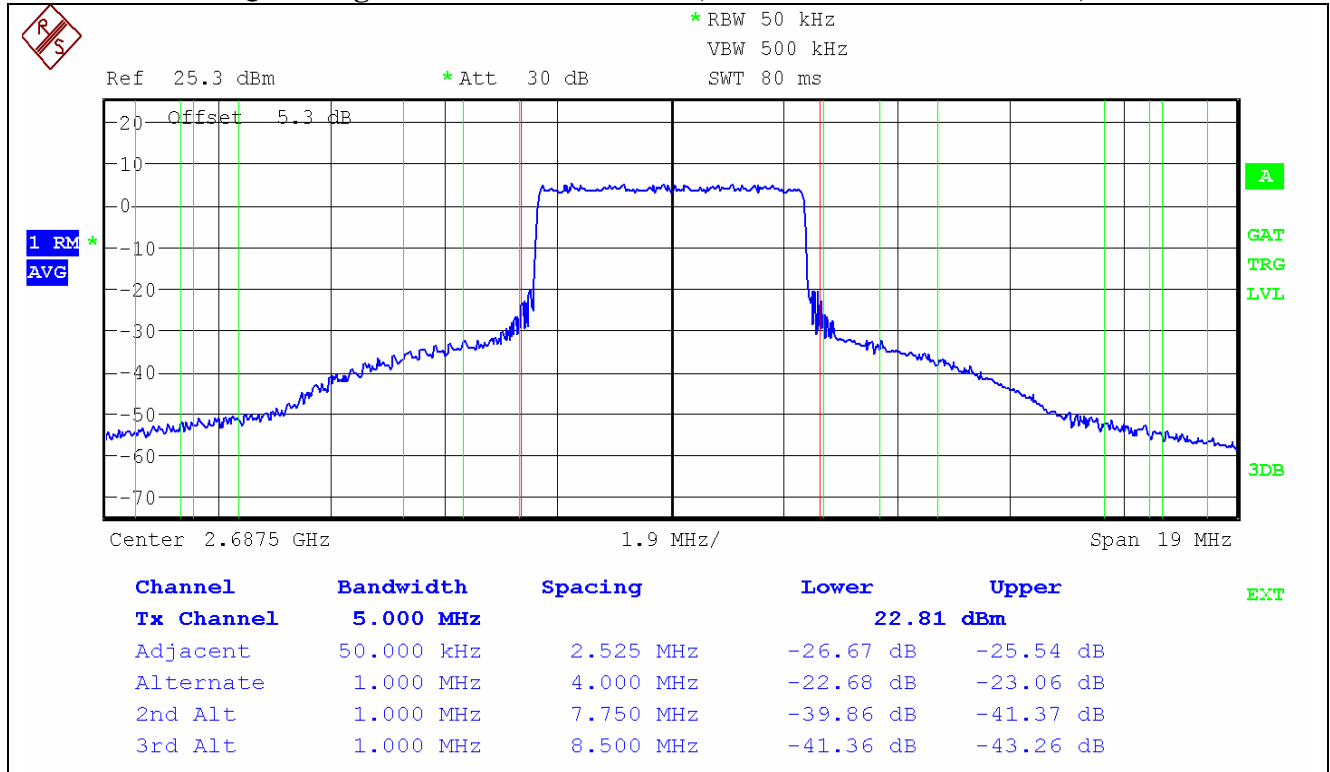
## 16QAM Mid Channel 2593 MHz (5 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

## 16QAM High Channel 2687.5 MHz (5 MHz Channel Bandwidth)



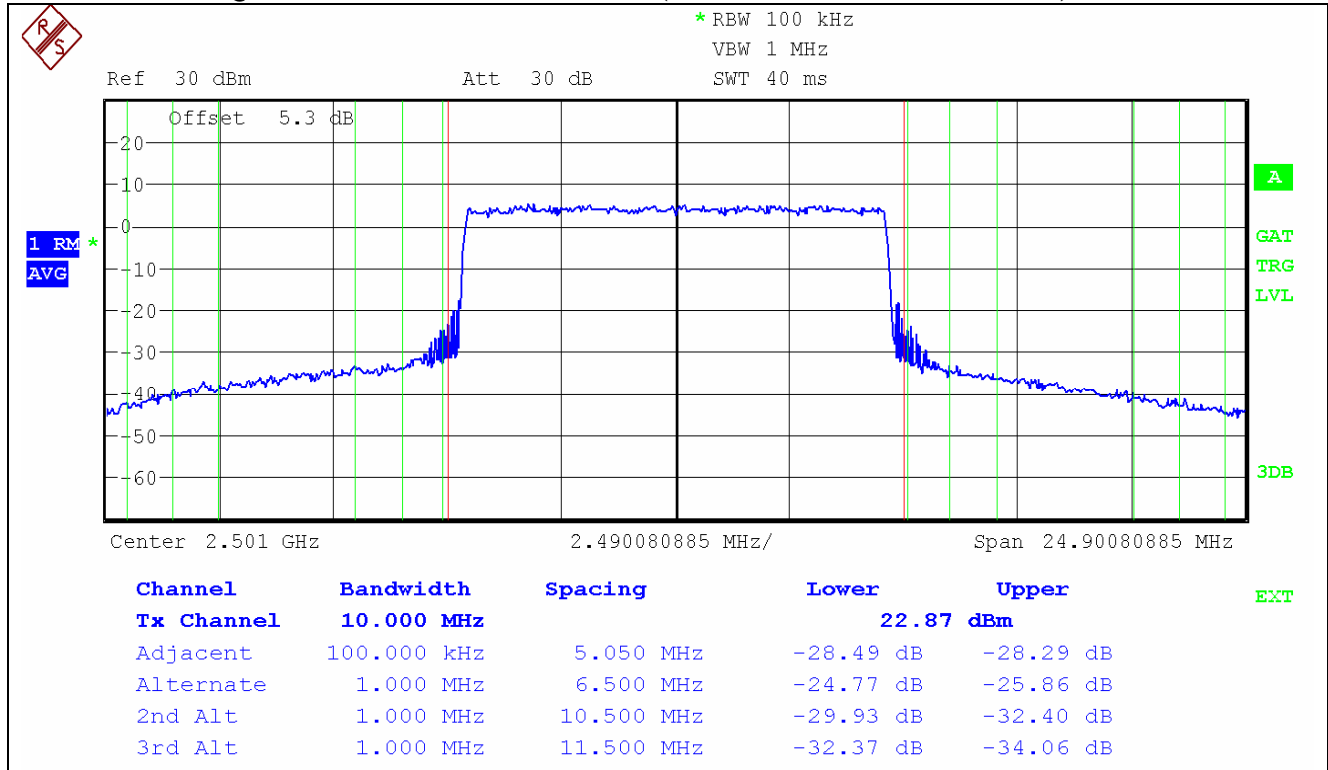
**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

## Band Edge Measurement Data Sheet

PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 18, 2009	27.53(m)(4)(6)	N/A	Direct	100 kHz	1MHz	Average

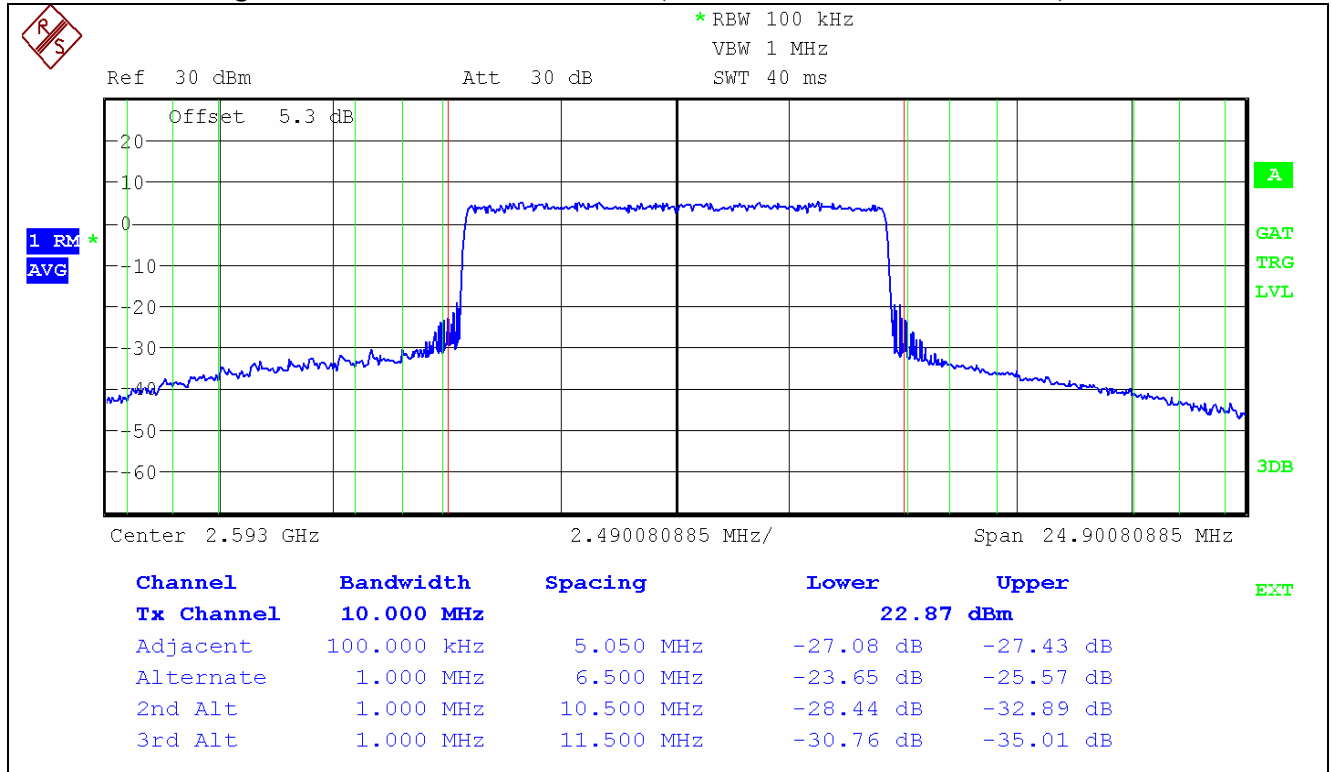
### QPSK Low Channel 2501 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

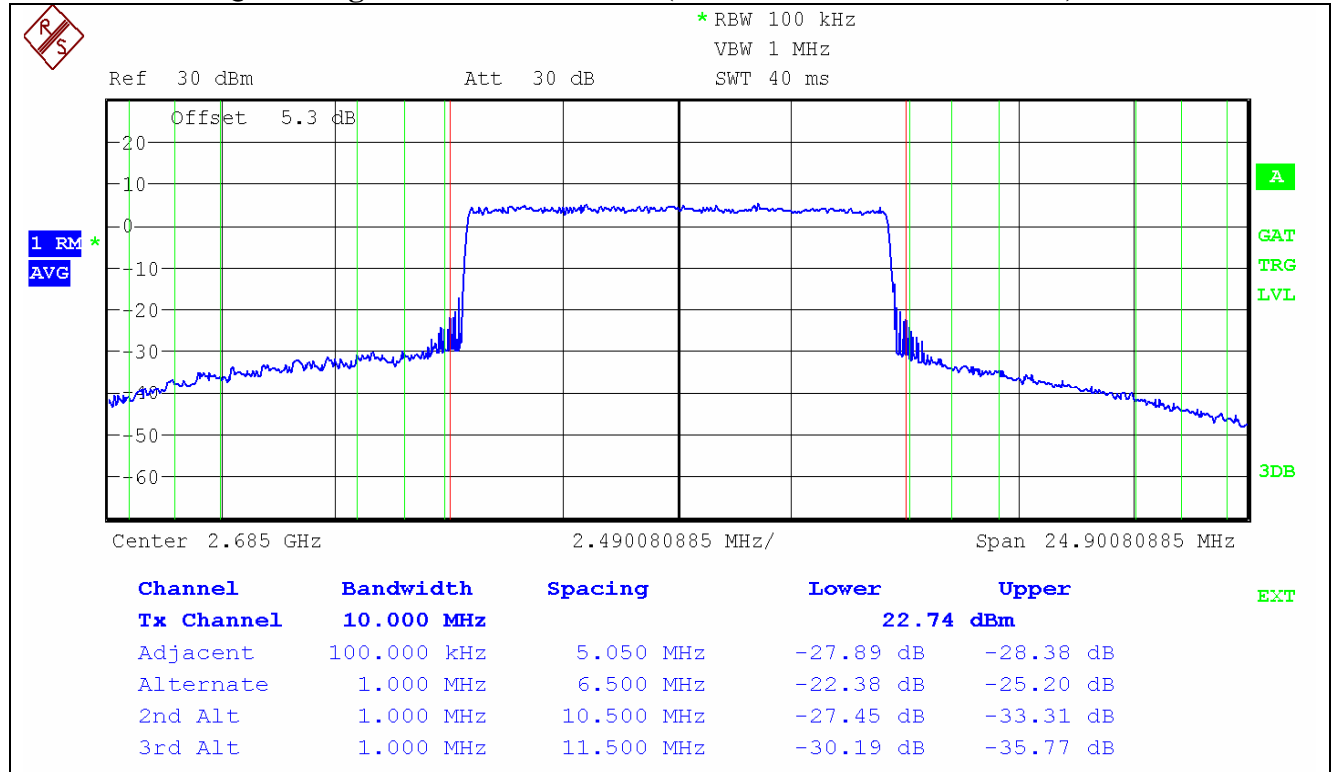
## QPSK Mid Channel 2593 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute  
 RESULTS = PASS**

# Band Edge

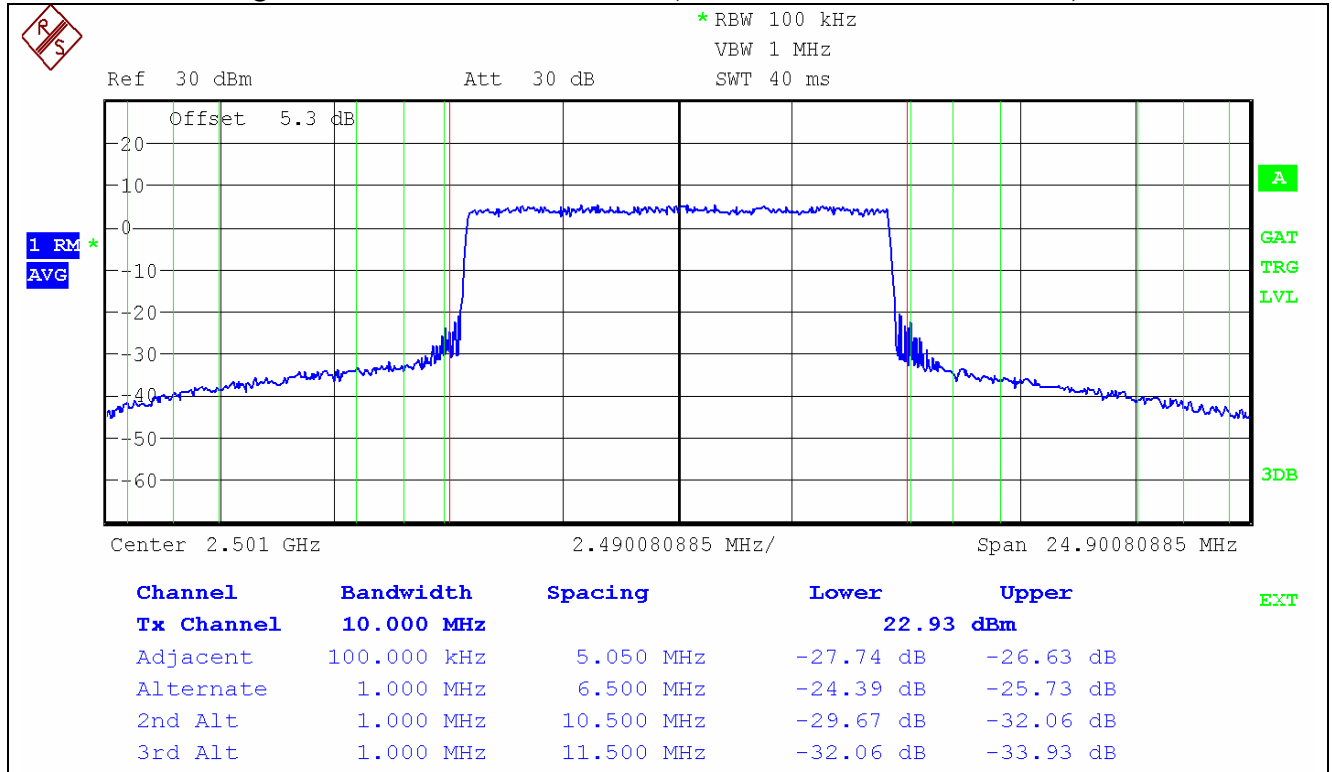
## QPSK High Channel 2685 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

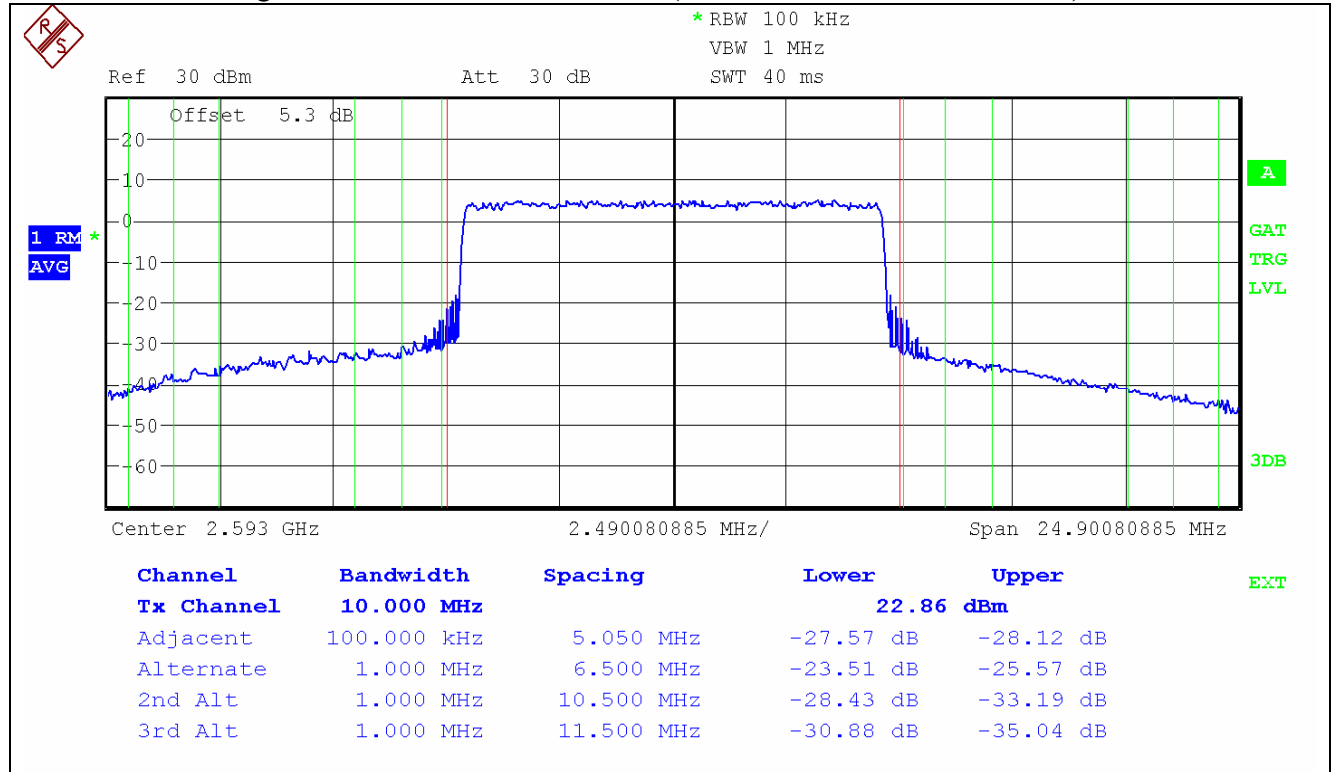
## 16QAM Low Channel 2501 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

# Band Edge

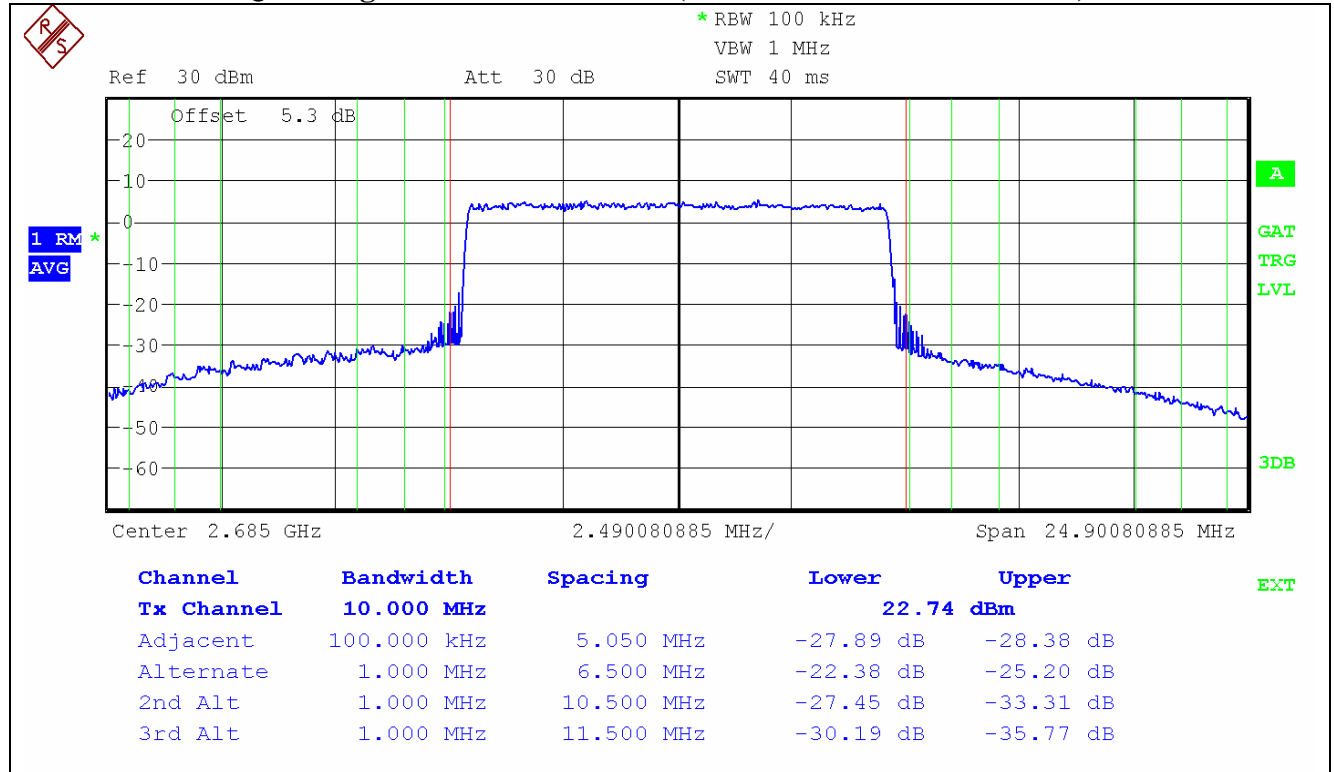
## 16QAM Mid Channel 2593 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute  
 RESULTS = PASS**

# Band Edge

## 16QAM High Channel 2685 MHz (10 MHz Channel Bandwidth)



**Note: Adjacent channel power measured in Absolute RESULTS = PASS**

Frequency Stability

**Frequency Stability Measurement Data Sheet**

PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 19, 2009	27.54	N/A	Direct	500 Hz	100 kHz	Peak
<b>COMMENT</b>		Continuous transmit on the Mid channel frequency with modulation turned off					

Temp (Celsius)	Reference Freq (MHz)	Measured Freq (MHz)	Difference (MHz)
-20	2593.0041	2593.003	-0.0011
-10	2593.0041	2593.0031	-0.0010
0	2593.0041	2593.00325	-0.0008
10	2593.0041	2593.004	-0.0001
20	2593.0041	2593.0041	0.0000
30	2593.0041	2593.0042	0.0001
40	2593.0041	2593.0042	0.0001
50	2593.0041	2593.0044	0.0003
55	2593.0041	2593.0044	0.0003

**RESULT = PASS**

## Antenna Port Conducted Emissions

### Antenna Port Conducted Emissions Measurement Data Sheet

#### Measurement Parameters

##### 30 MHz to 1000 MHz

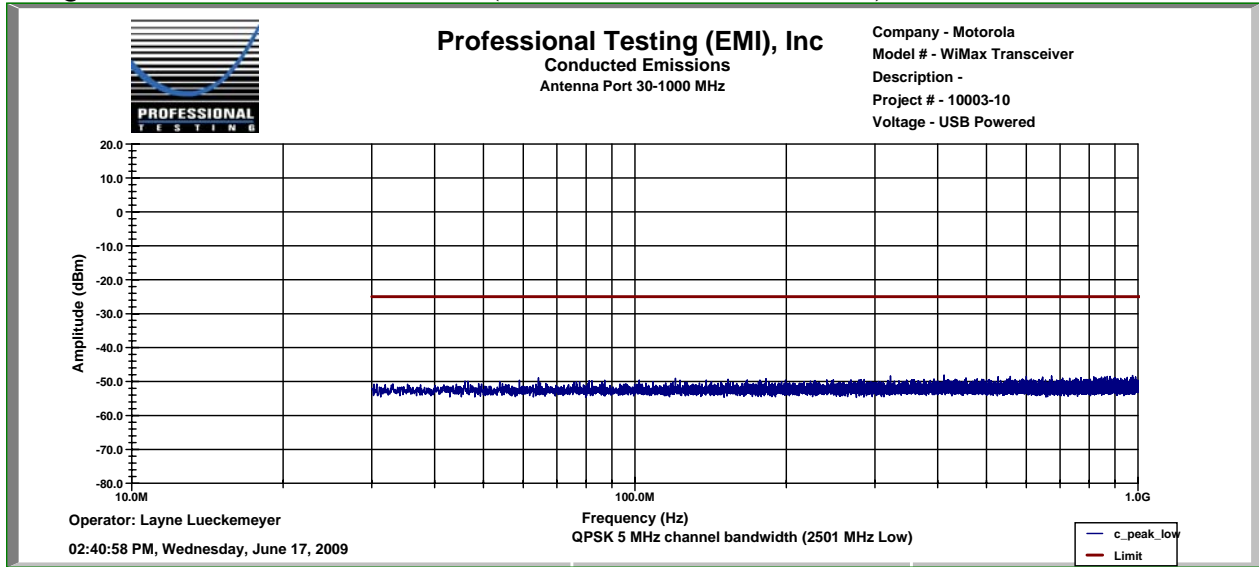
PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 17, 2009	27.53	N/A	Direct	120 kHz	300 kHz	Peak

##### 1 GHz to 26 GHz

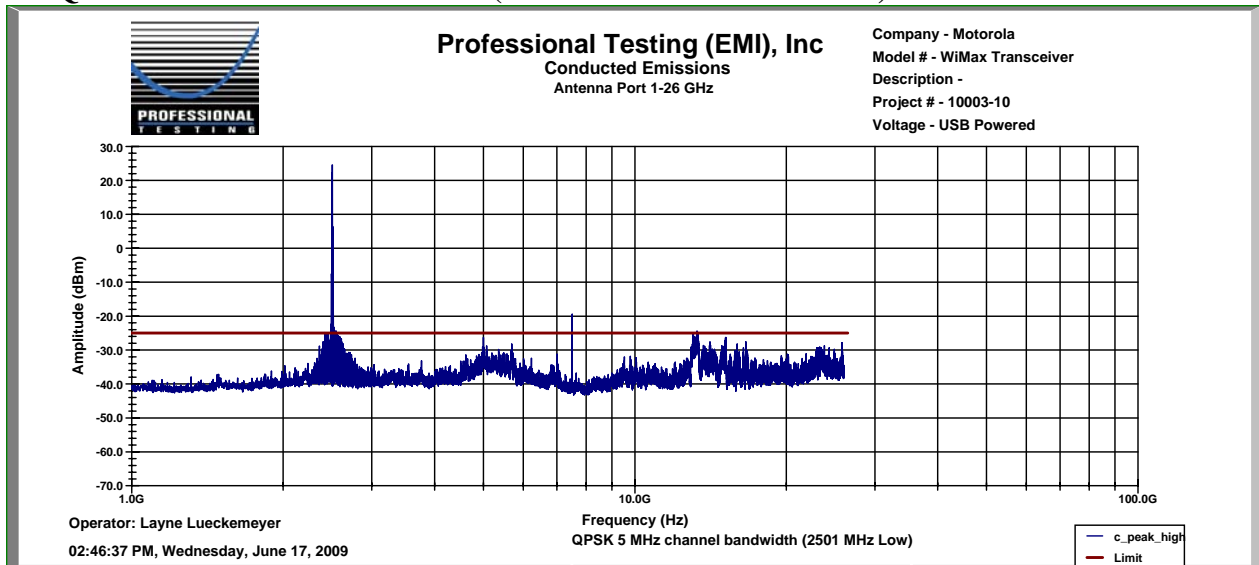
PROJECT #	DATE	RULE	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 17, 2009	27.53	N/A	Direct	1 MHz	1 MHz	Peak

# Antenna Port Conducted Emissions

## QPSK Low Channel 2501 MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## QPSK Low Channel 2501 MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

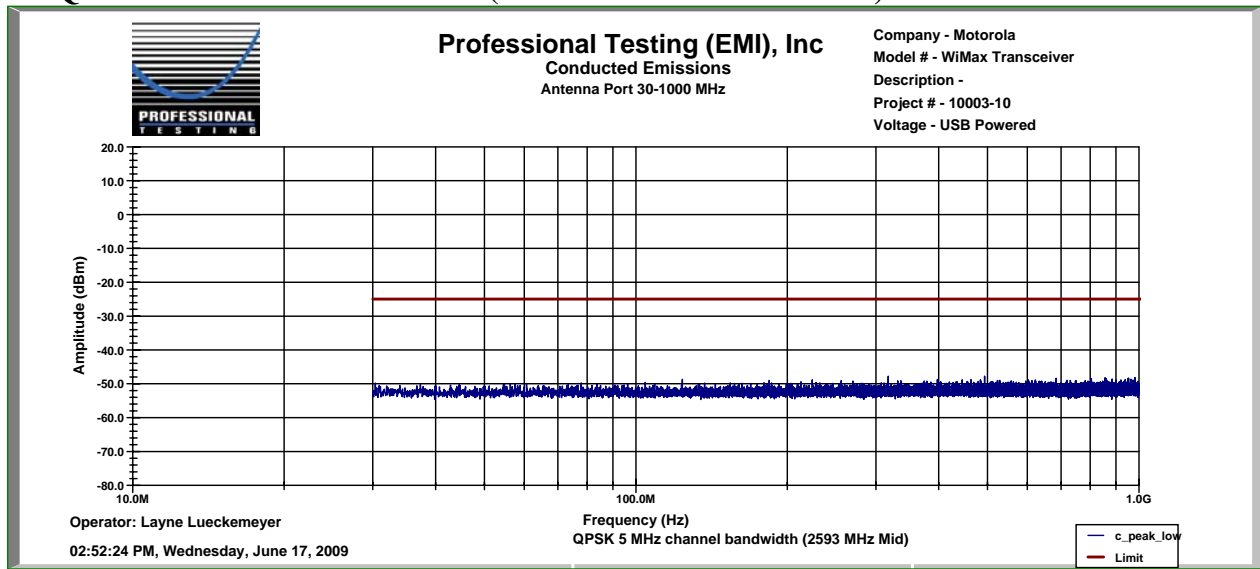


**RESULT = PASS**

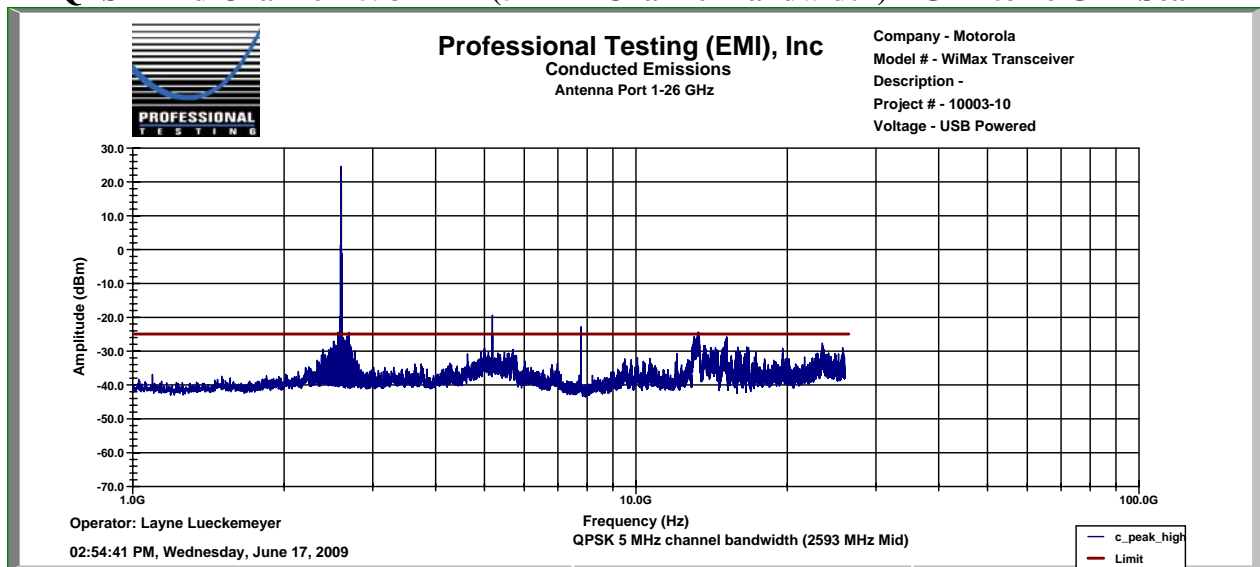
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## QPSK Mid Channel 2593 MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



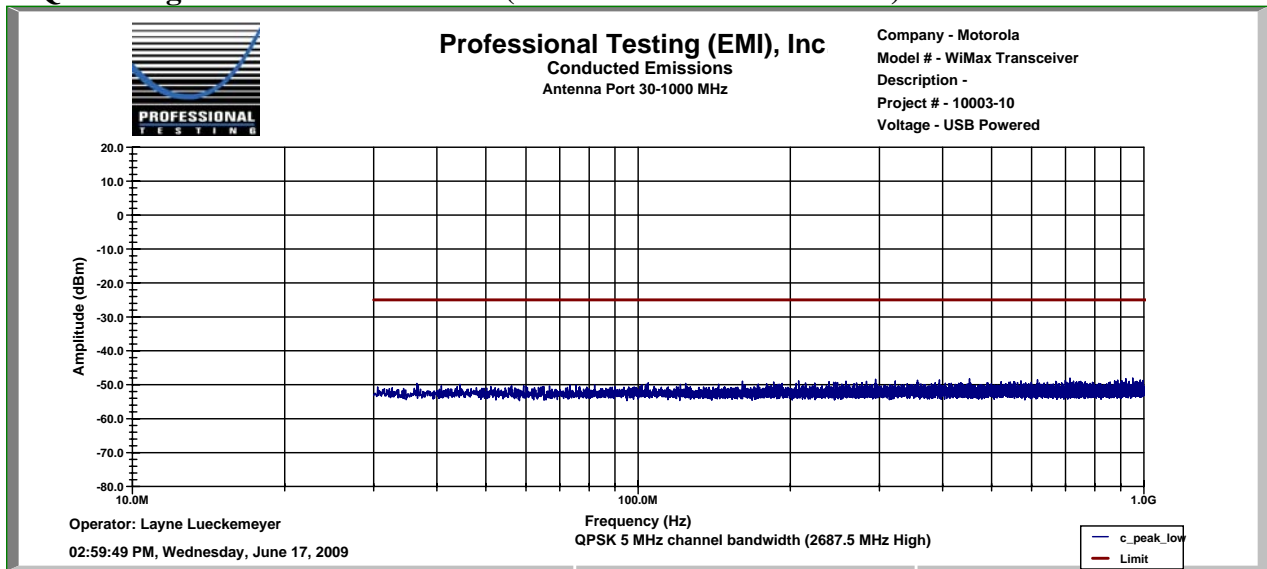
## QPSK Mid Channel 2593 MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan



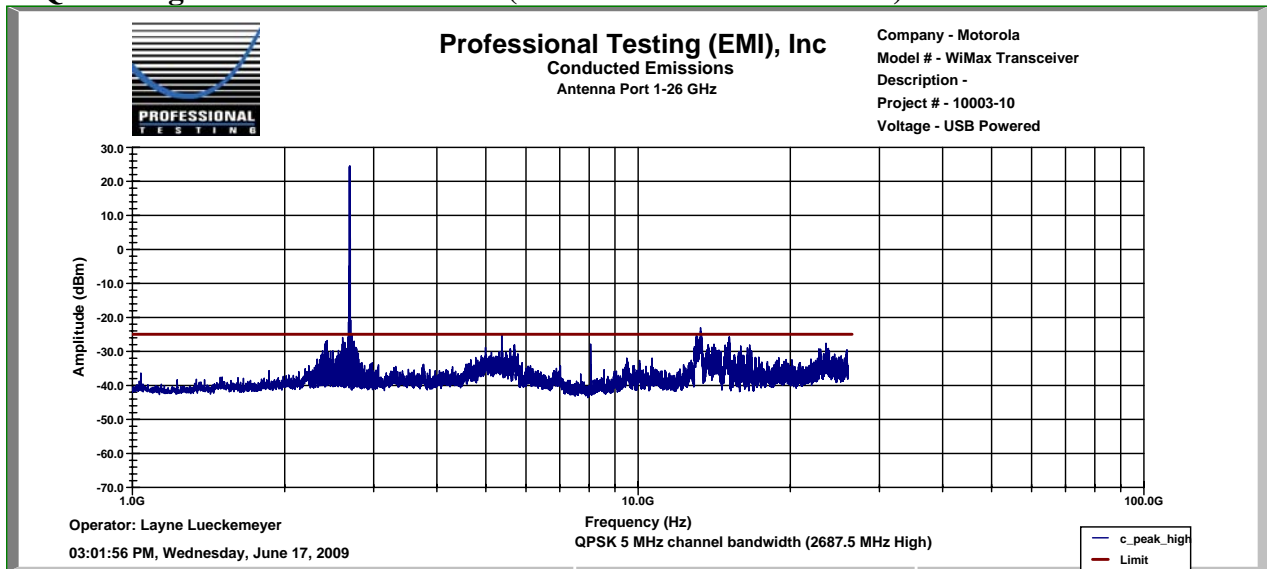
**RESULT = PASS**

**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

### QPSK High Channel 2687.5 MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



### QPSK High Channel 2687.5 MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

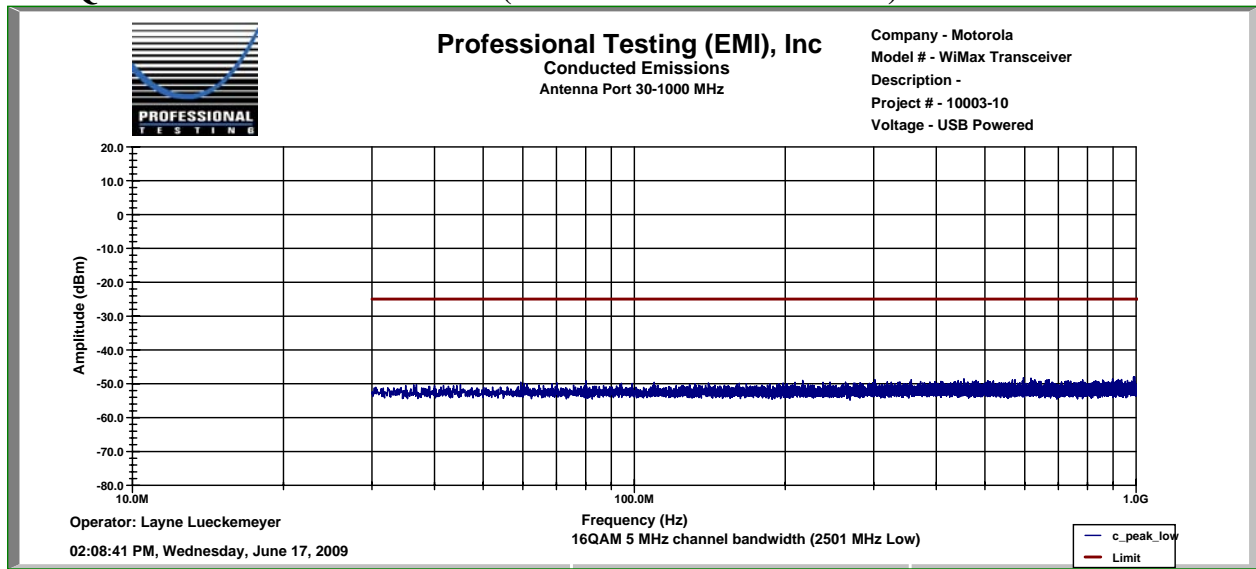


**RESULT = PASS**

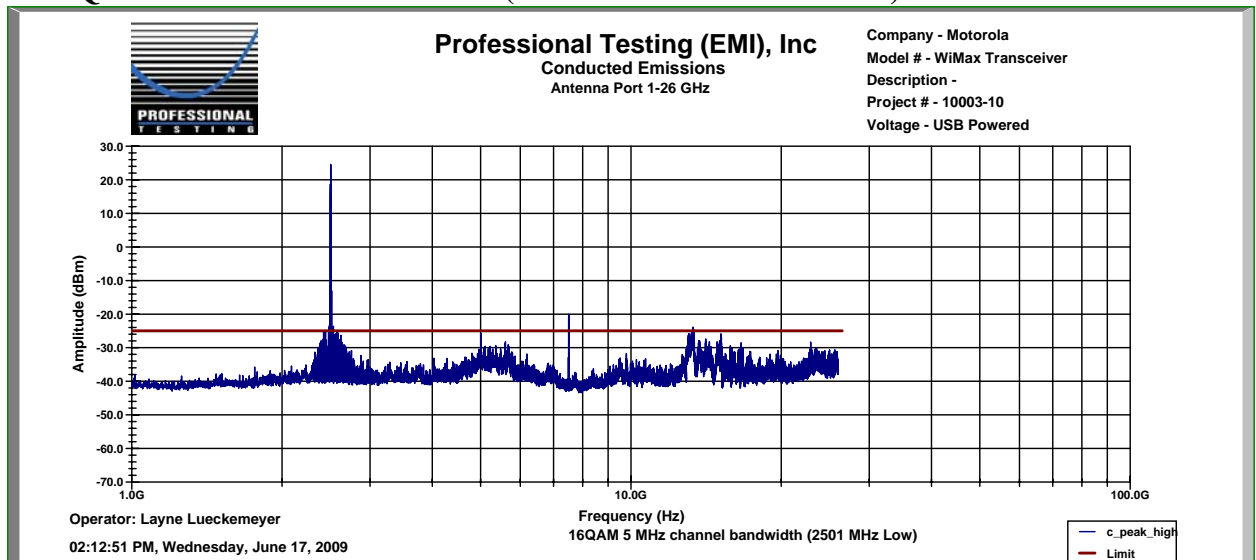
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## 16QAM Low Channel 2501 MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## 16QAM Low Channel 2501 MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

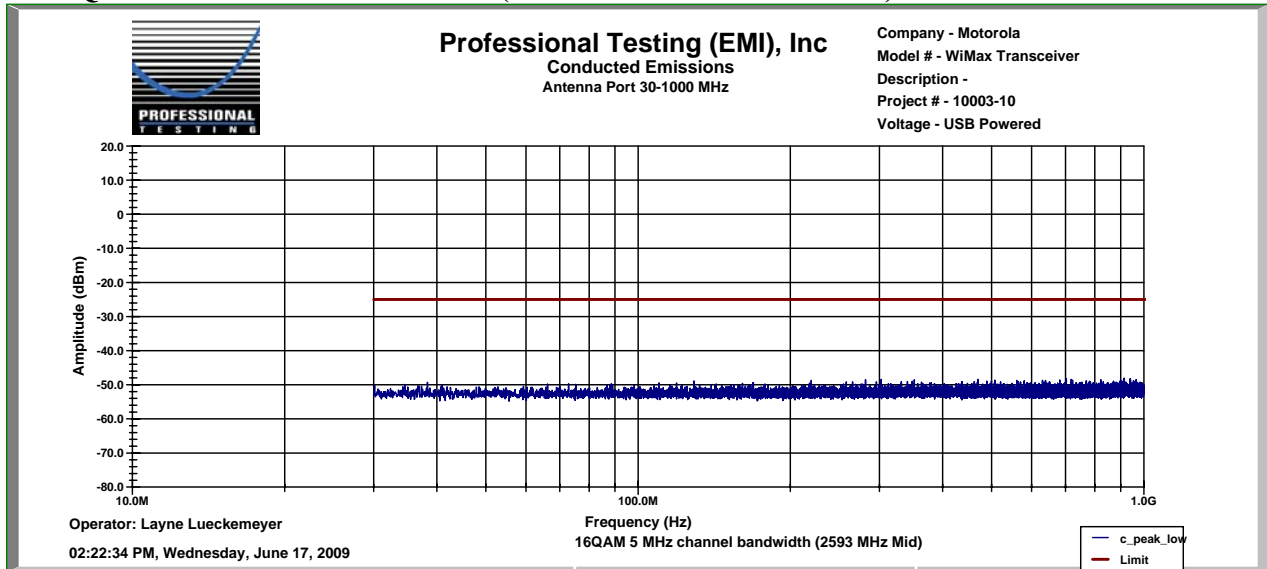


**RESULT = PASS**

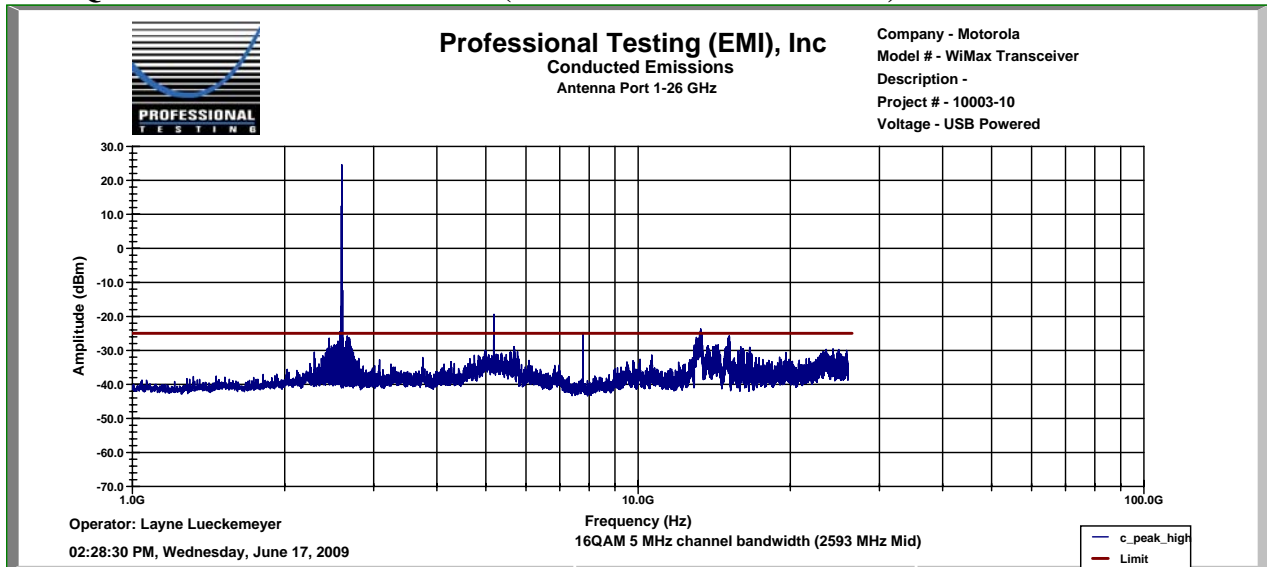
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## 16QAM Mid Channel 2593 MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## 16QAM Mid Channel 2593 MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

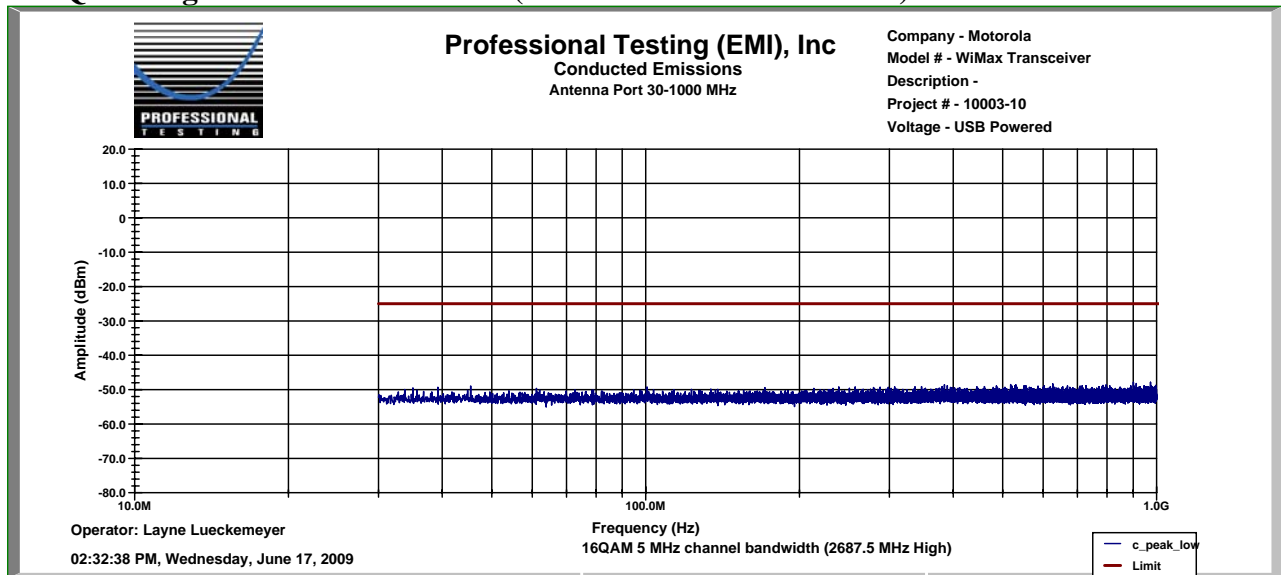


**RESULT = PASS**

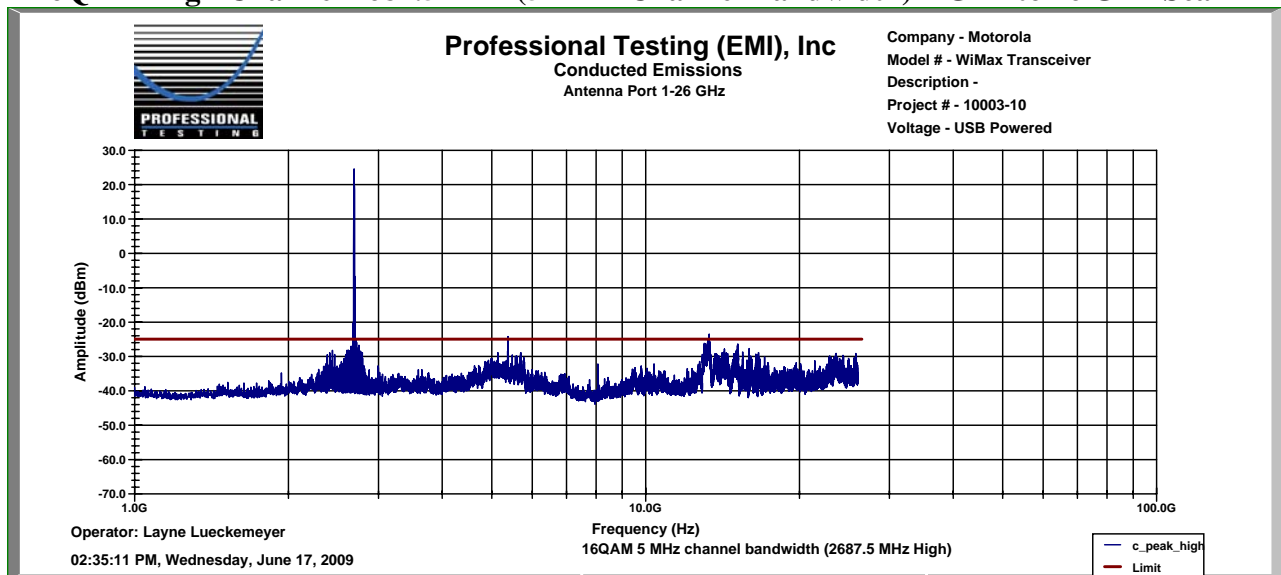
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 \cdot \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## 16QAM High Channel 2687.5MHz (5 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## 16QAM High Channel 2687.5MHz (5 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

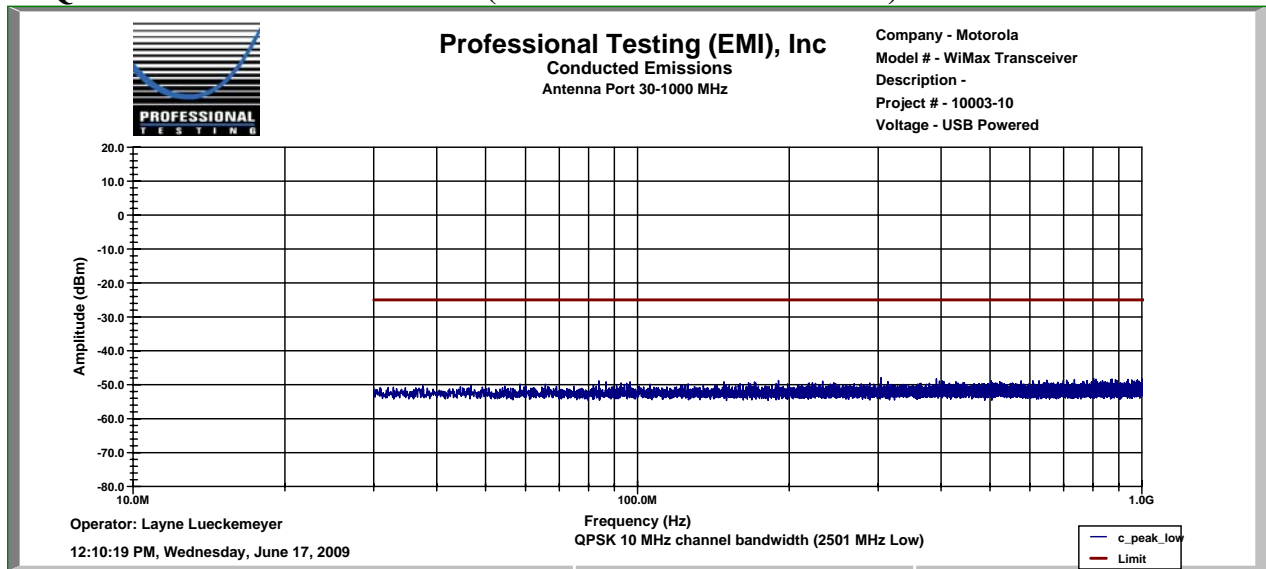


**RESULT = PASS**

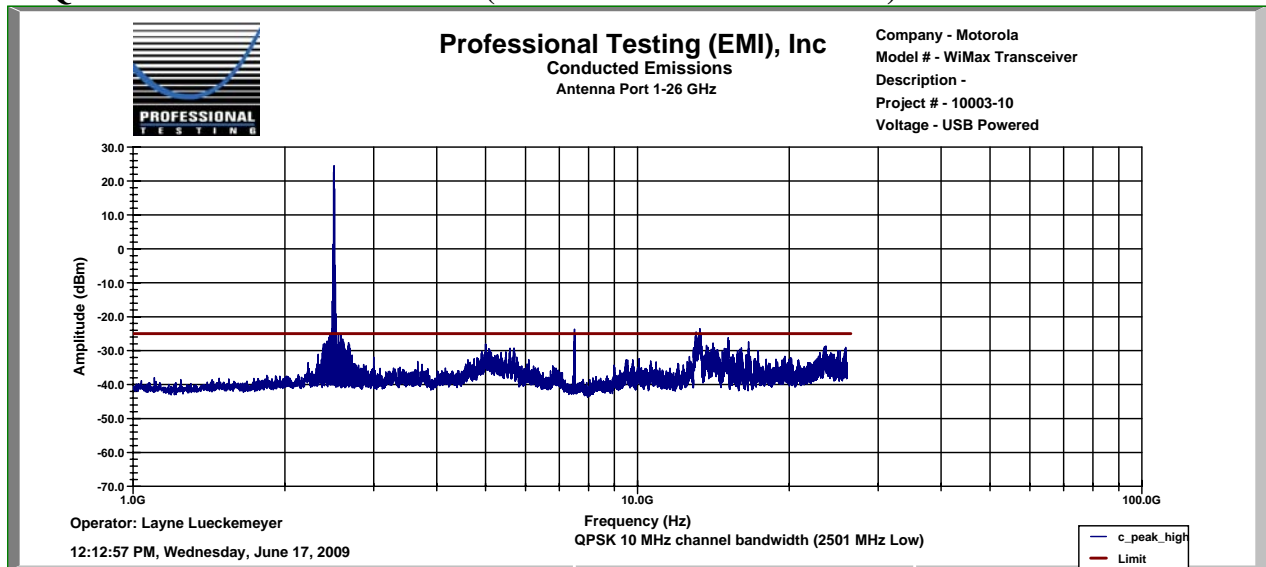
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## QPSK Low Channel 2501 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## QPSK Low Channel 2501 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

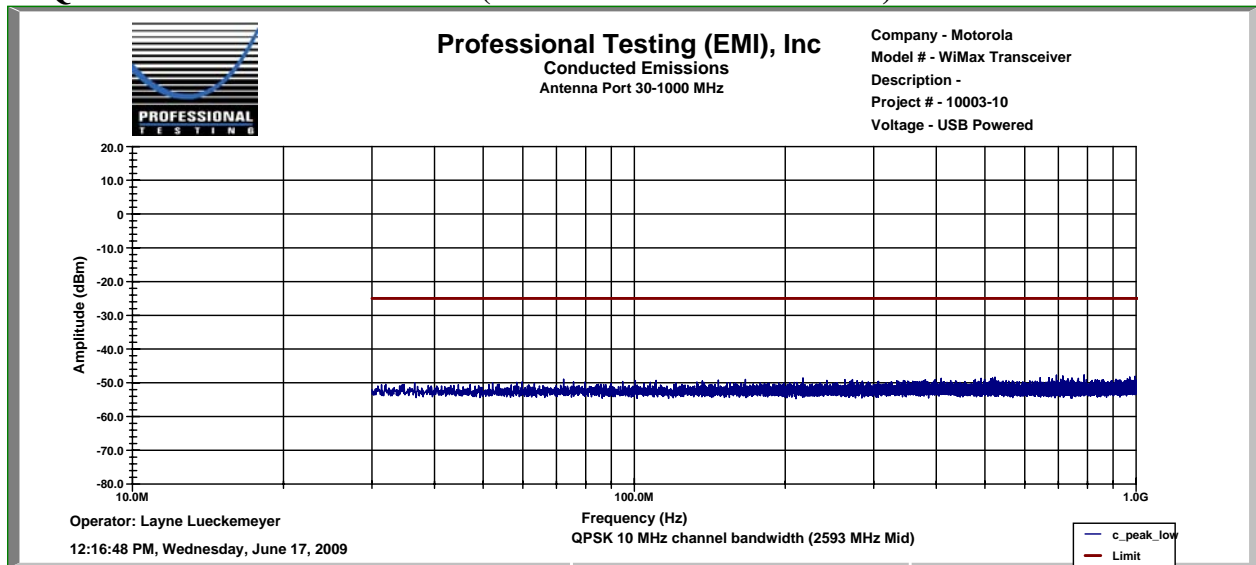


**RESULT = PASS**

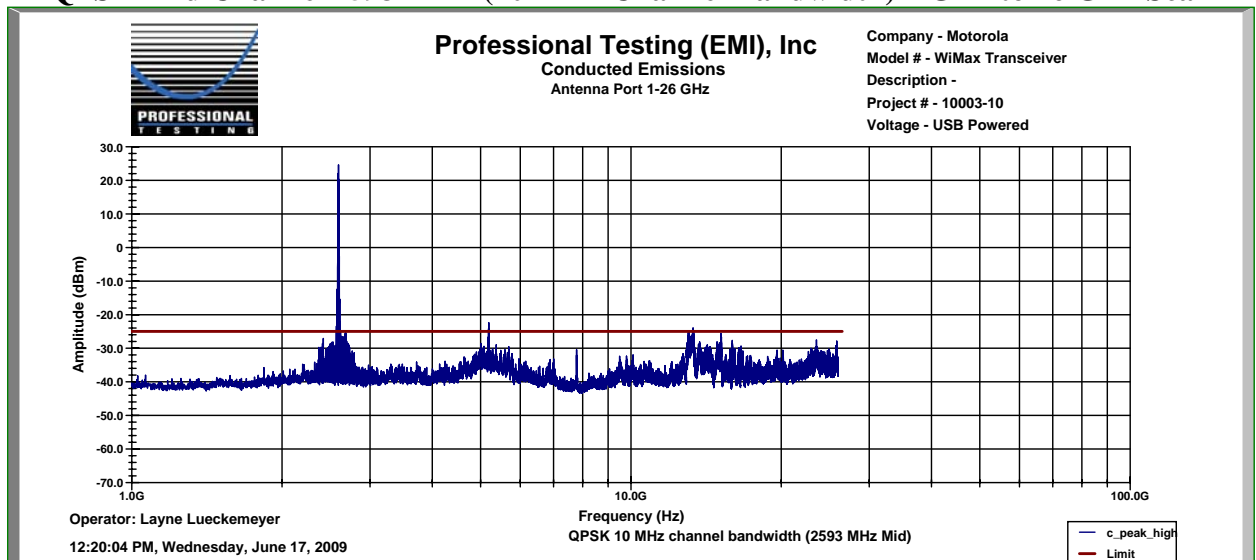
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## QPSK Mid Channel 2593 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## QPSK Mid Channel 2593 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

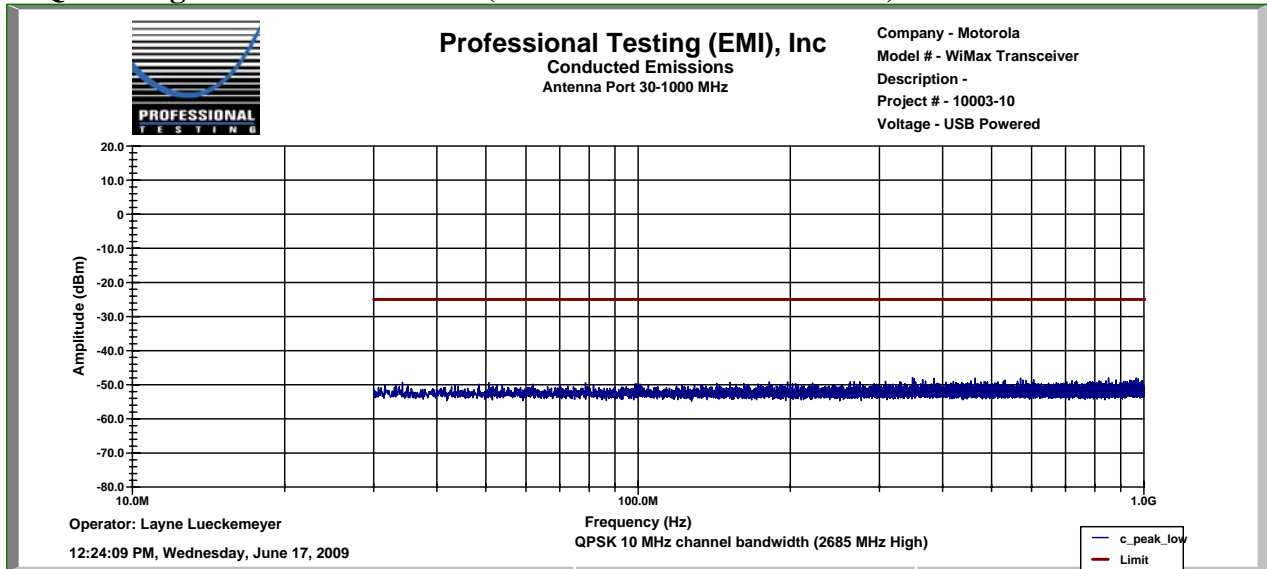


**RESULT = PASS**

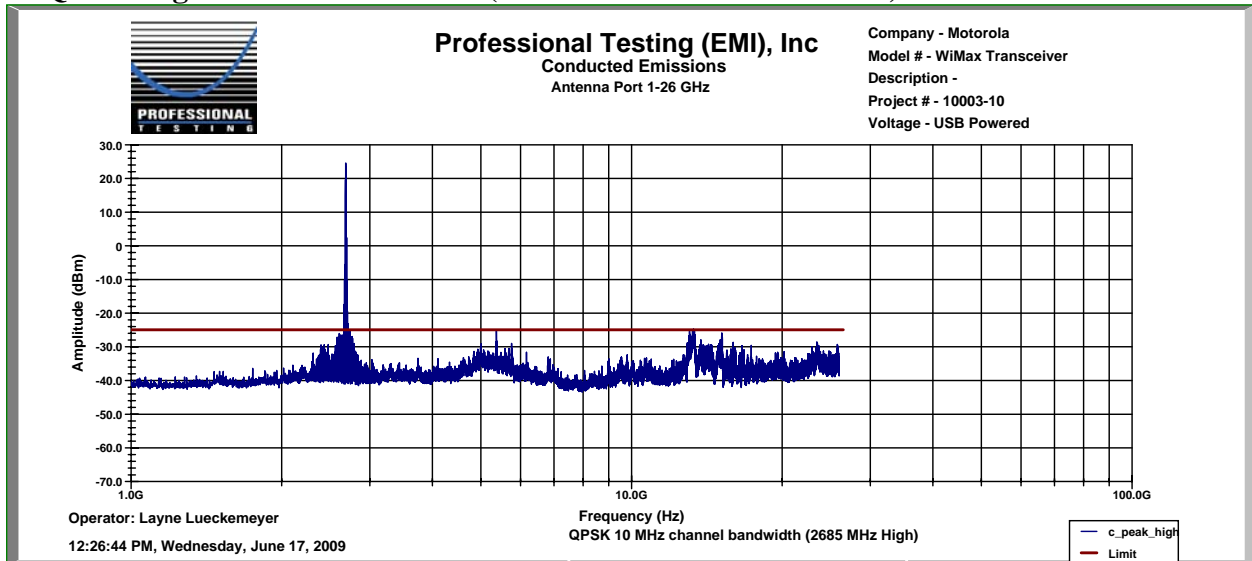
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 \cdot \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## QPSK High Channel 2685 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## QPSK High Channel 2685 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

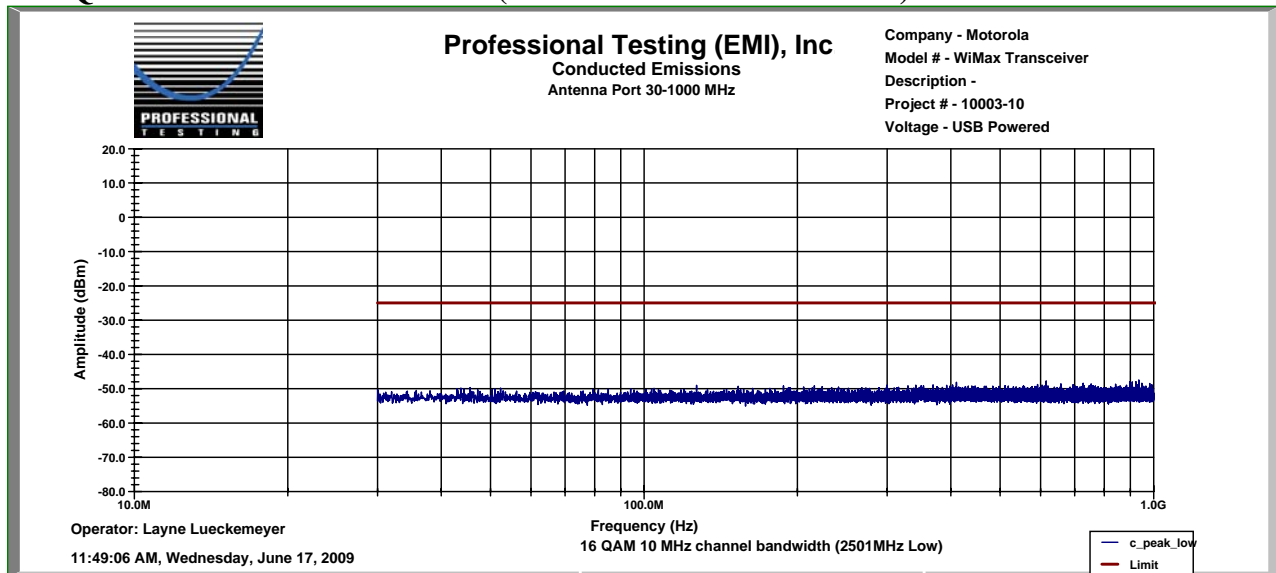


**RESULT = PASS**

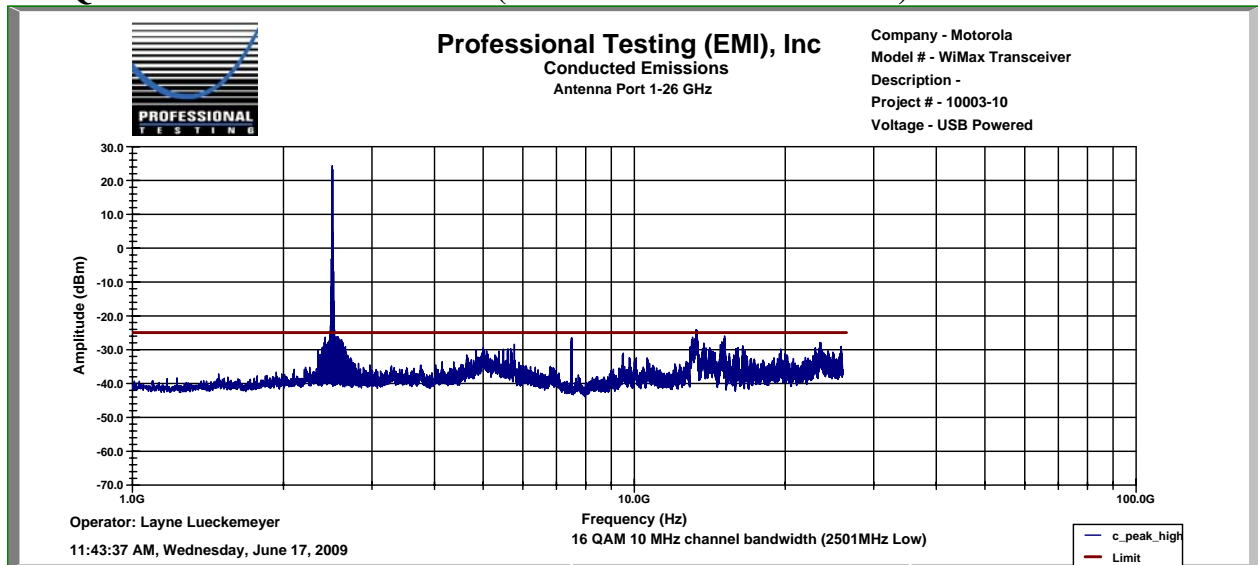
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 \cdot \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## 16QAM Low Channel 2501 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



## 16QAM Low Channel 2501 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan

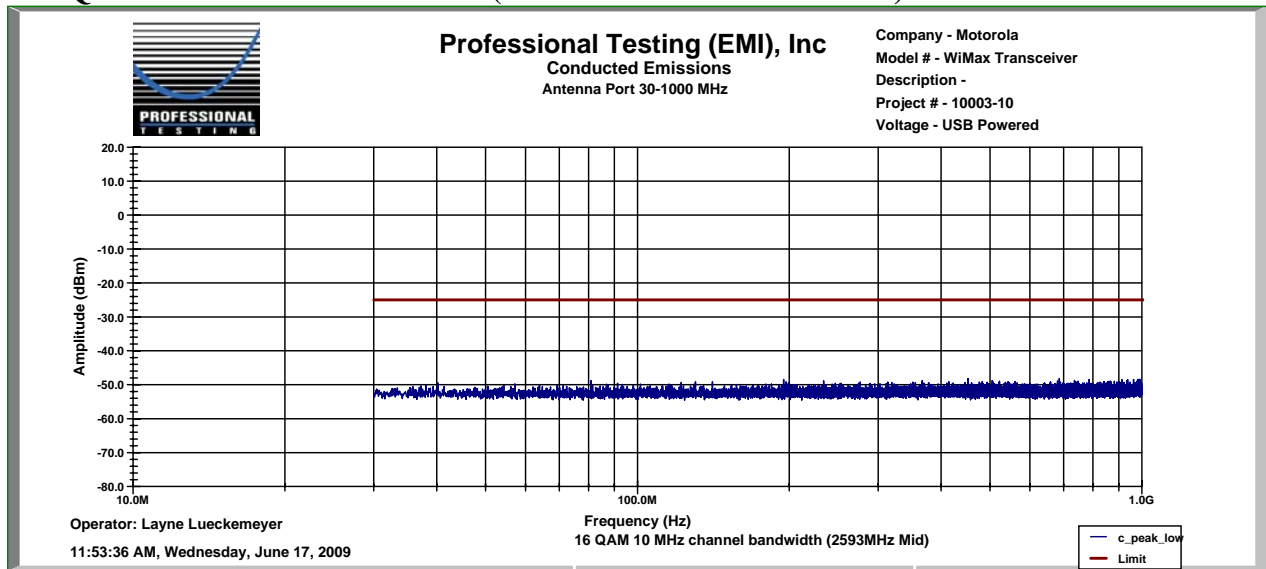


**RESULT = PASS**

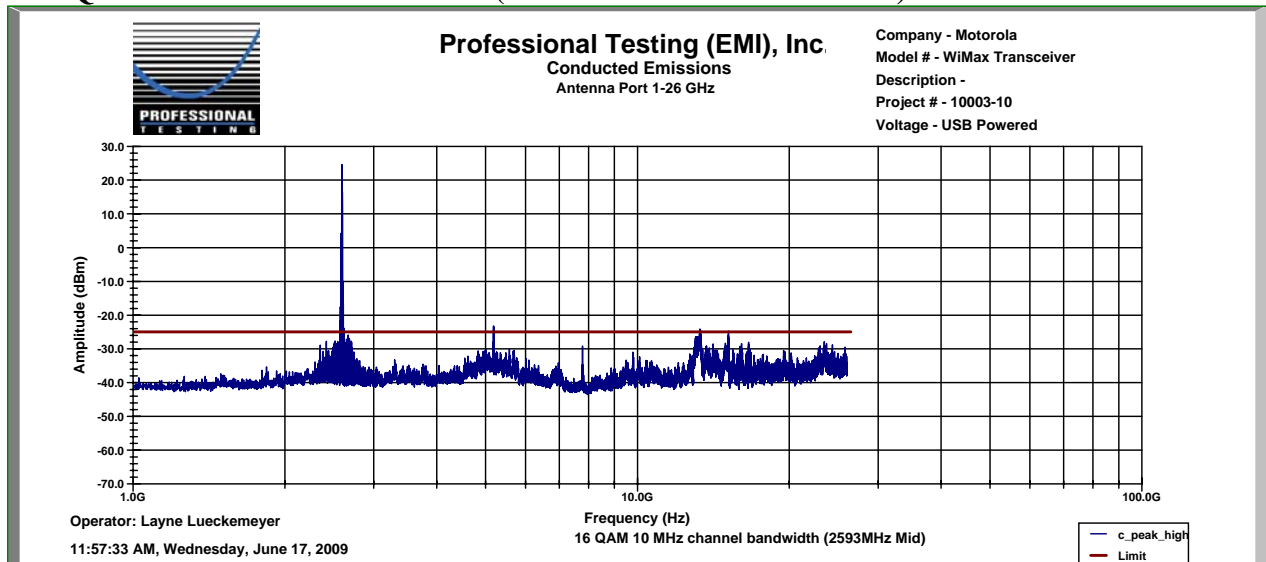
**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

# Antenna Port Conducted Emissions

## 16QAM Mid Channel 2593 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



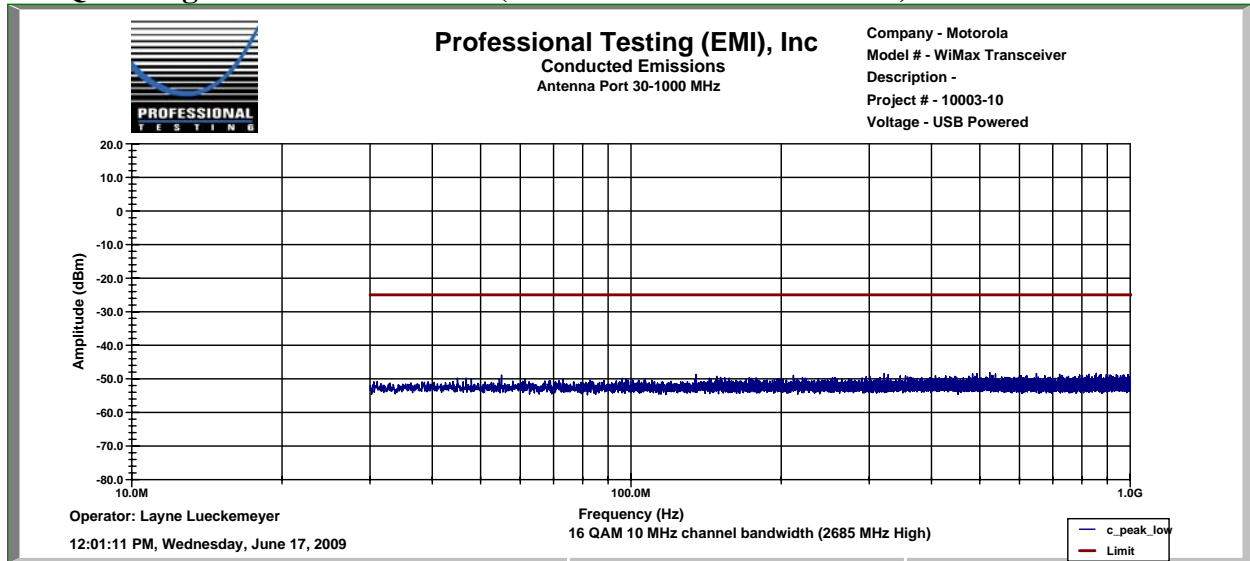
## 16QAM Mid Channel 2593 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan



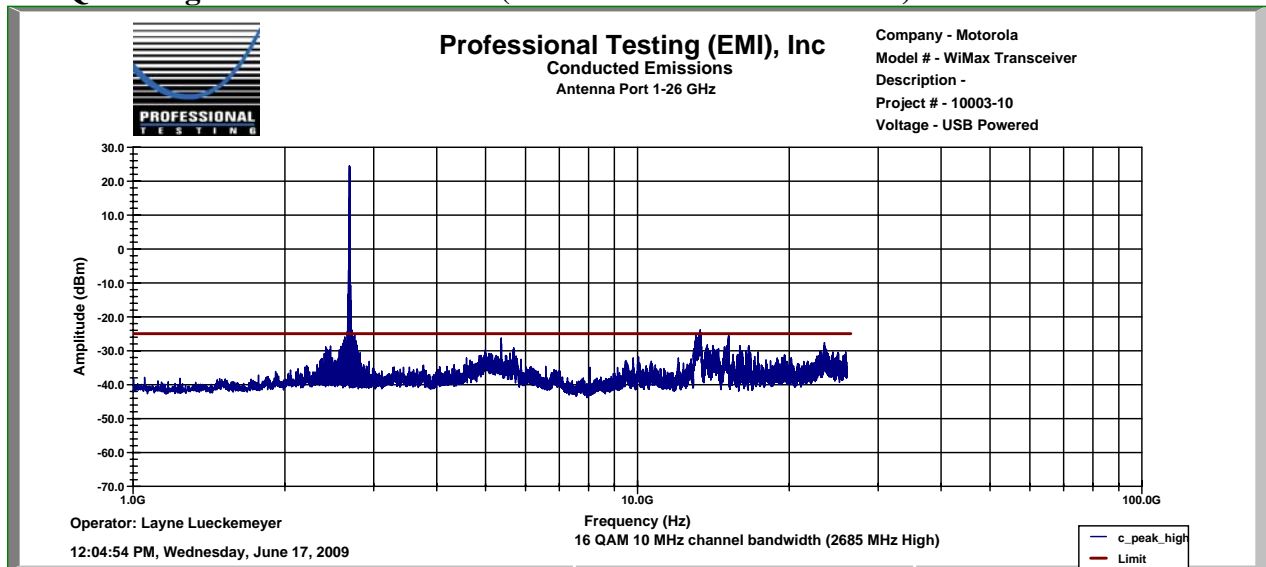
**RESULT = PASS**

**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

### 16QAM High Channel 2685 MHz (10 MHz Channel Bandwidth) 30 MHz to 1 GHz Scan



### 16QAM High Channel 2685 MHz (10 MHz Channel Bandwidth) 1 GHz to 26 GHz Scan



**RESULT = PASS**

**Note: Emission levels that exceeded acceptable levels were reduced by averaging the duty cycle of the WiMax transceiver utilizing the formula  $Avg = 10 * \log(\text{duty cycle})$  which produced a result that lowered the peak emissions by -6 dBm.**

### Spurious Radiated Emissions Data Sheet

#### Measurement Parameters

##### 30 MHz to 1000 MHz

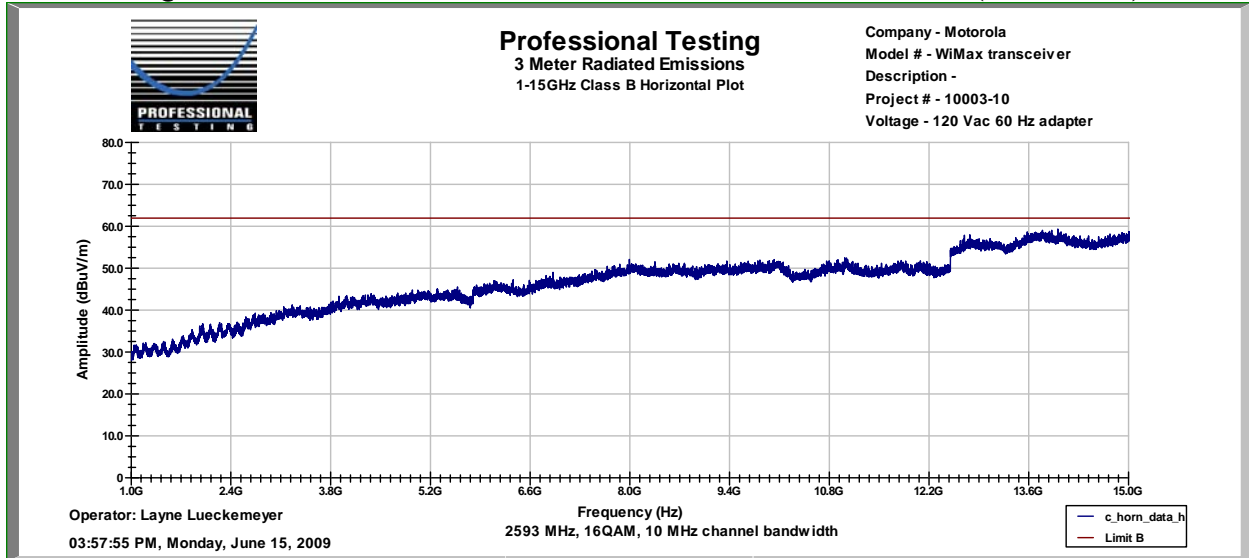
PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 15-16, 2009		10 m	Bicon   Log	120 kHz	300 kHz	Peak

##### 1 GHz to 15 GHz

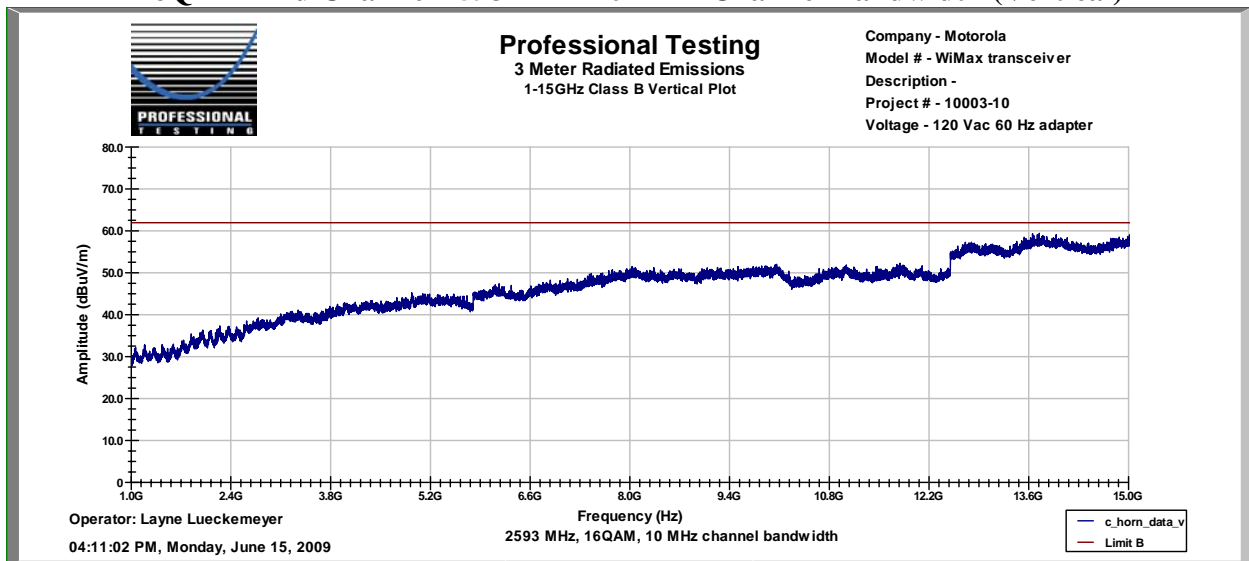
PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
10003-10	June 15-16, 2009		3 m	Horn	1 MHz	1 MHz	Peak

# Radiated Emissions

## 16QAM Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Horizontal)



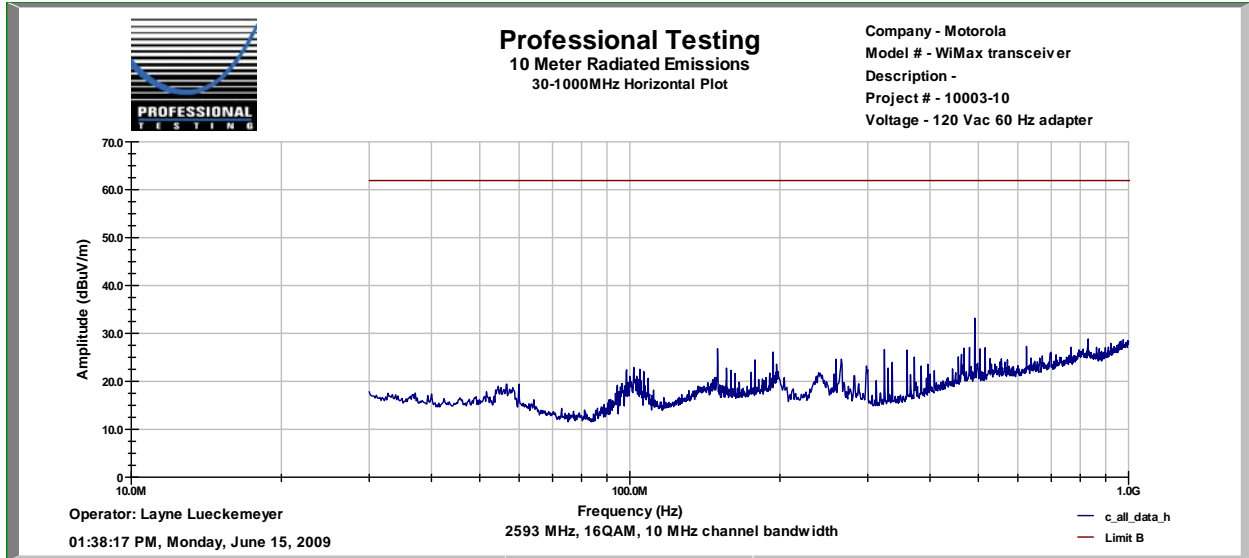
## 16QAM Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Vertical)



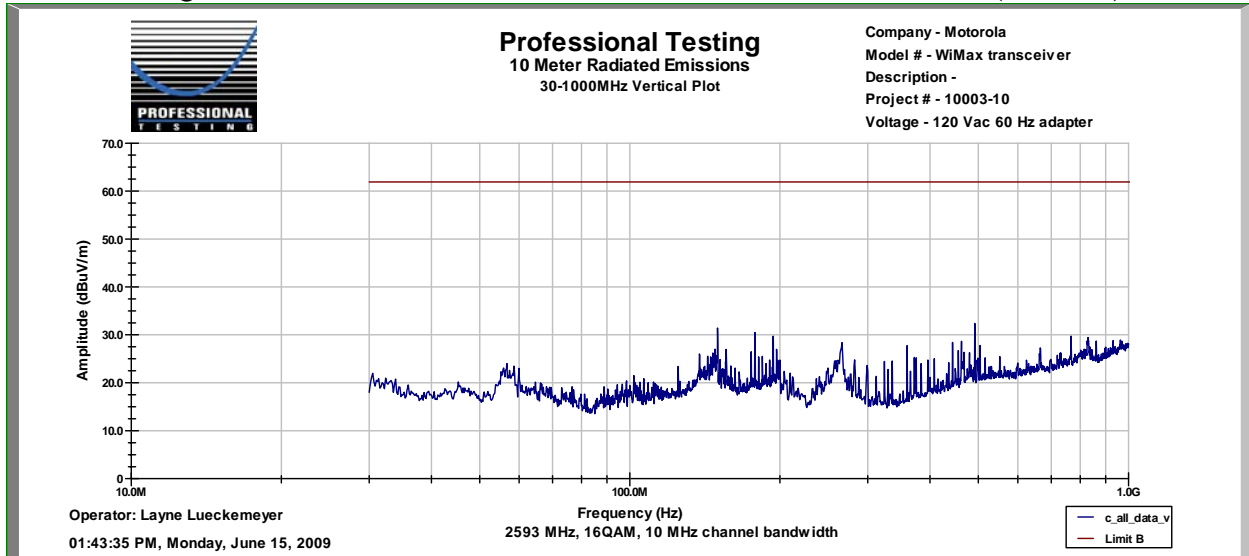
**RESULT = PASS**

## 16QAM Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Horizontal)

# Radiated Emissions



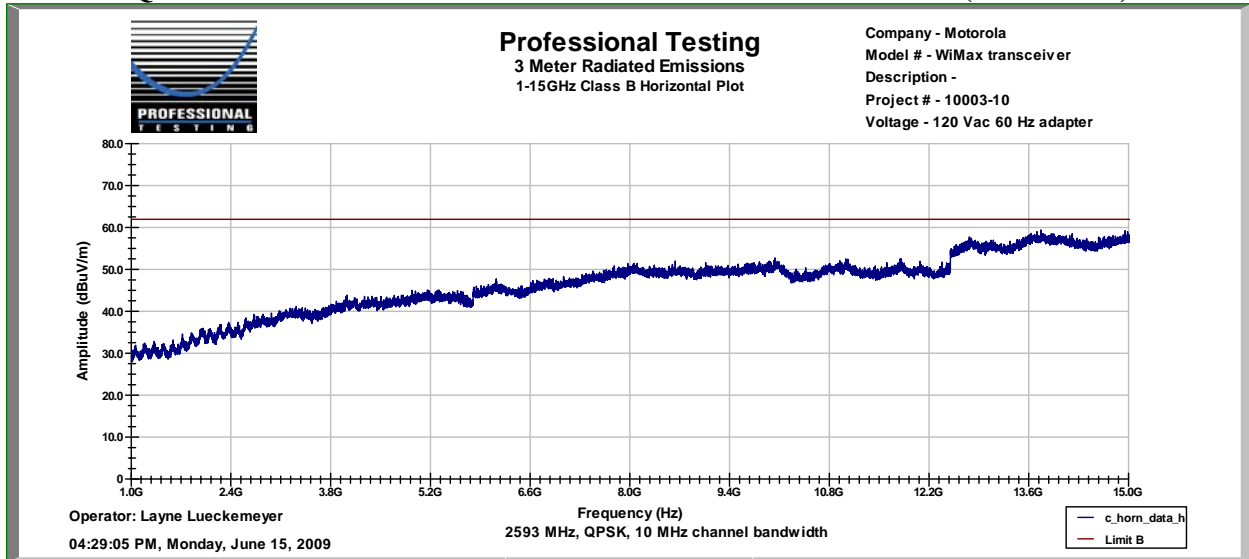
## 16QAM Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Vertical)



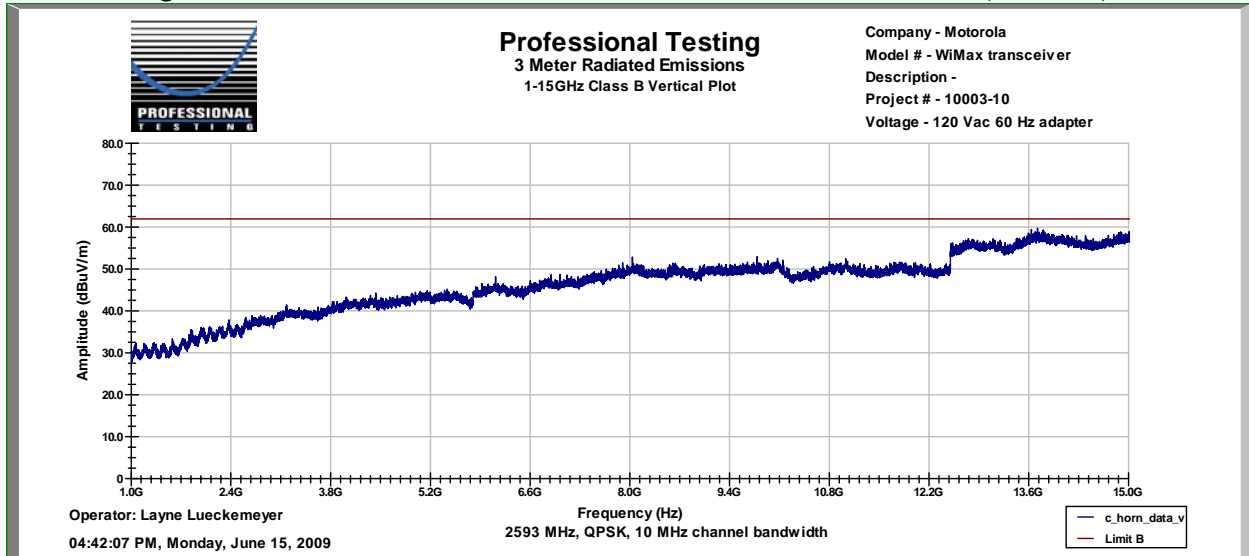
**RESULT = PASS**

# Radiated Emissions

## QPSK Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Horizontal)



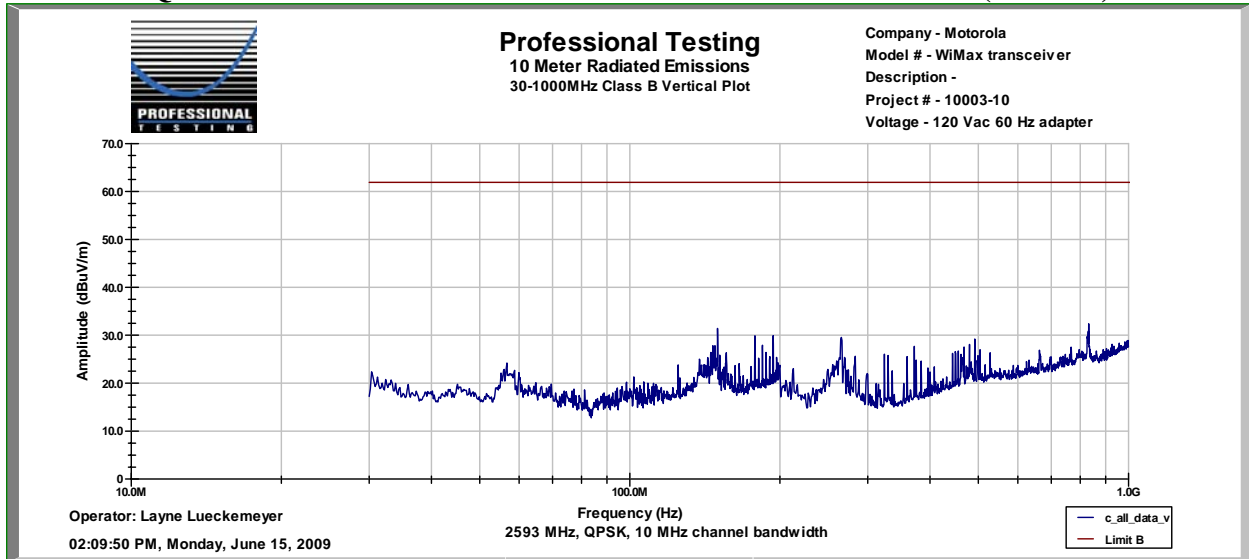
## QPSK Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Vertical)



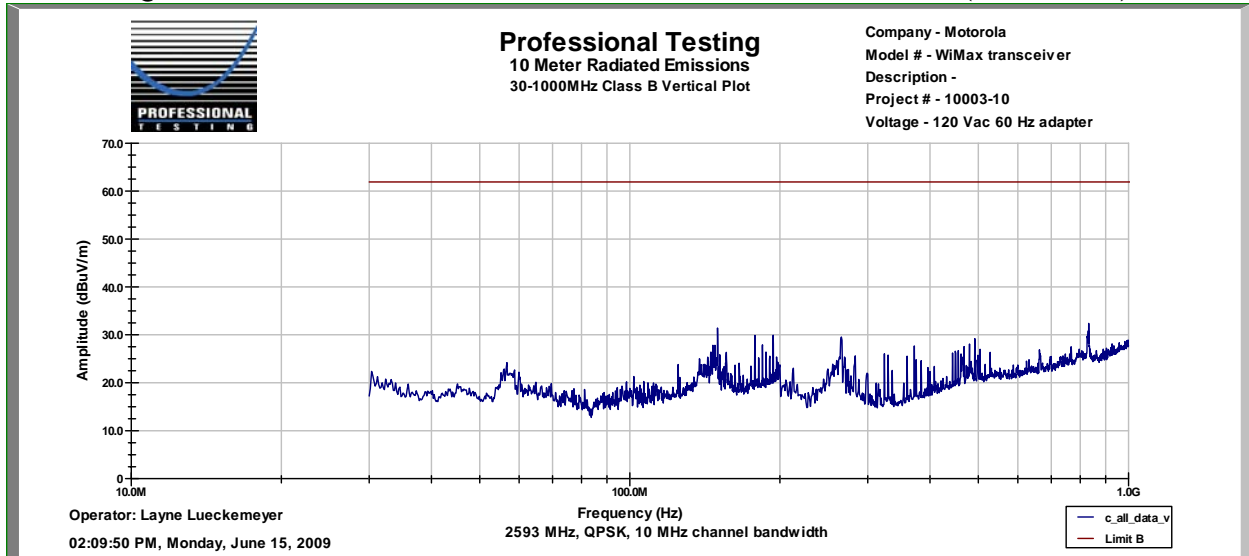
**RESULT = PASS**

# Radiated Emissions

## QPSK Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Vertical)



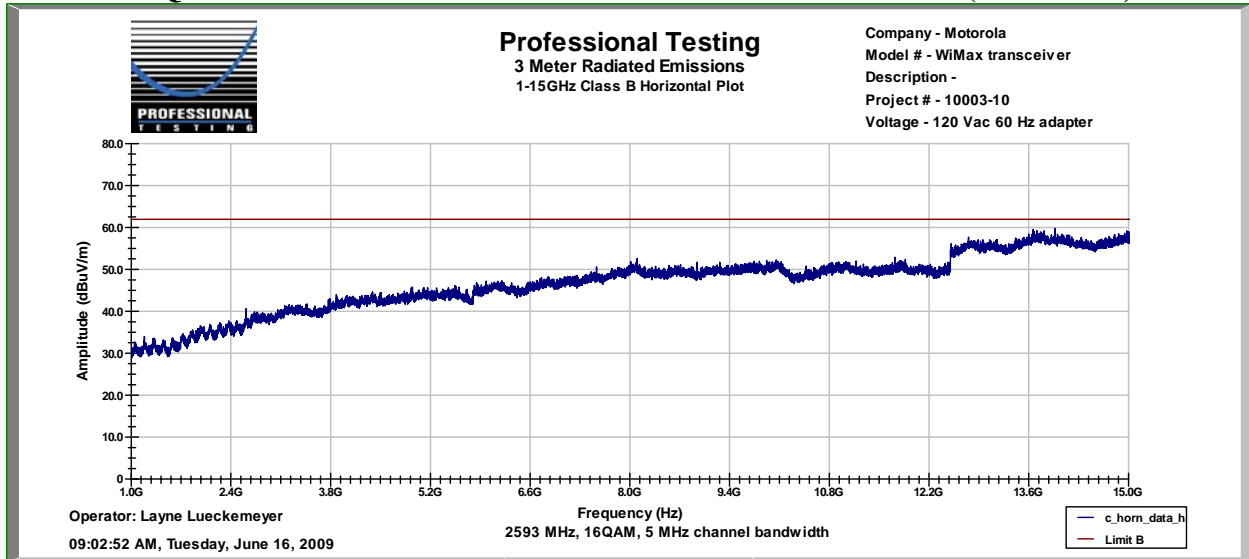
## QPSK Mid Channel 2593 MHz 10 MHz Channel Bandwidth (Horizontal)



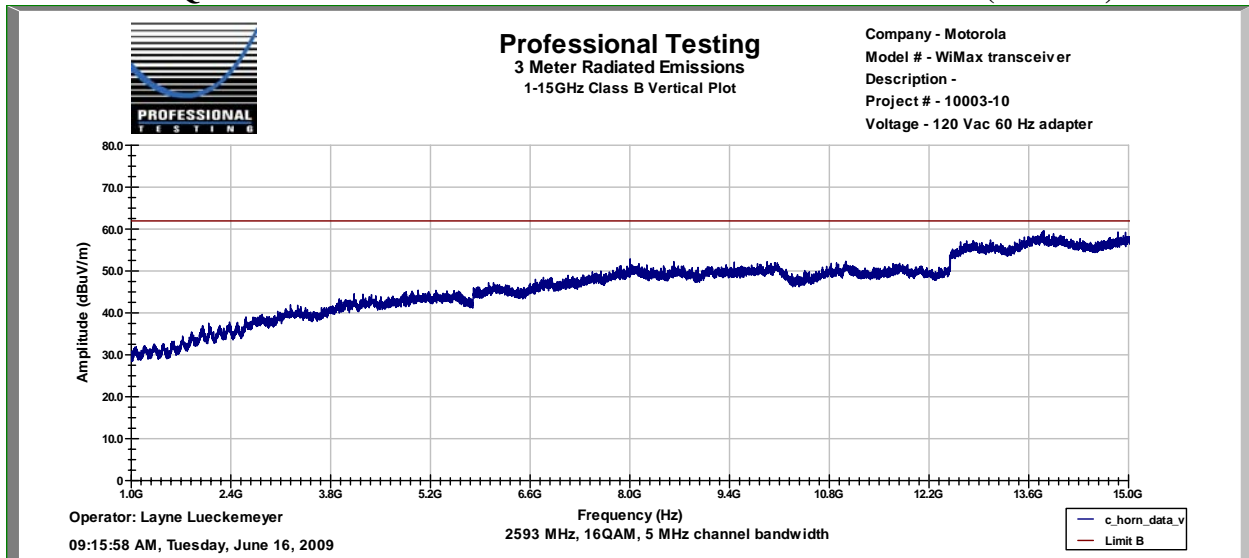
**RESULT = PASS**

# Radiated Emissions

## 16QAM Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Horizontal)



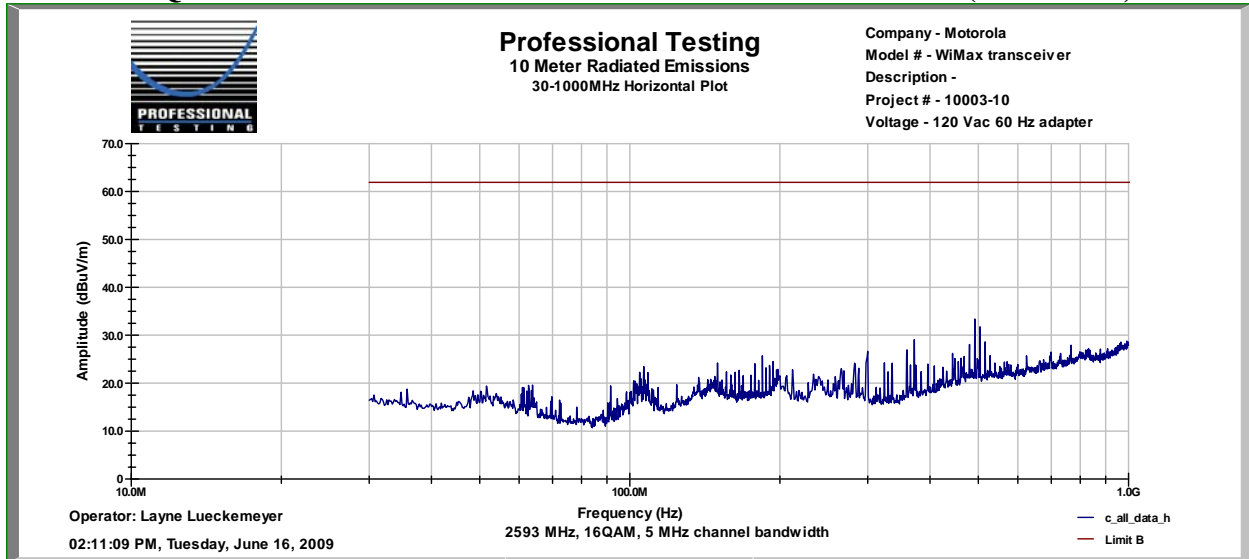
## 16QAM Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Vertical)



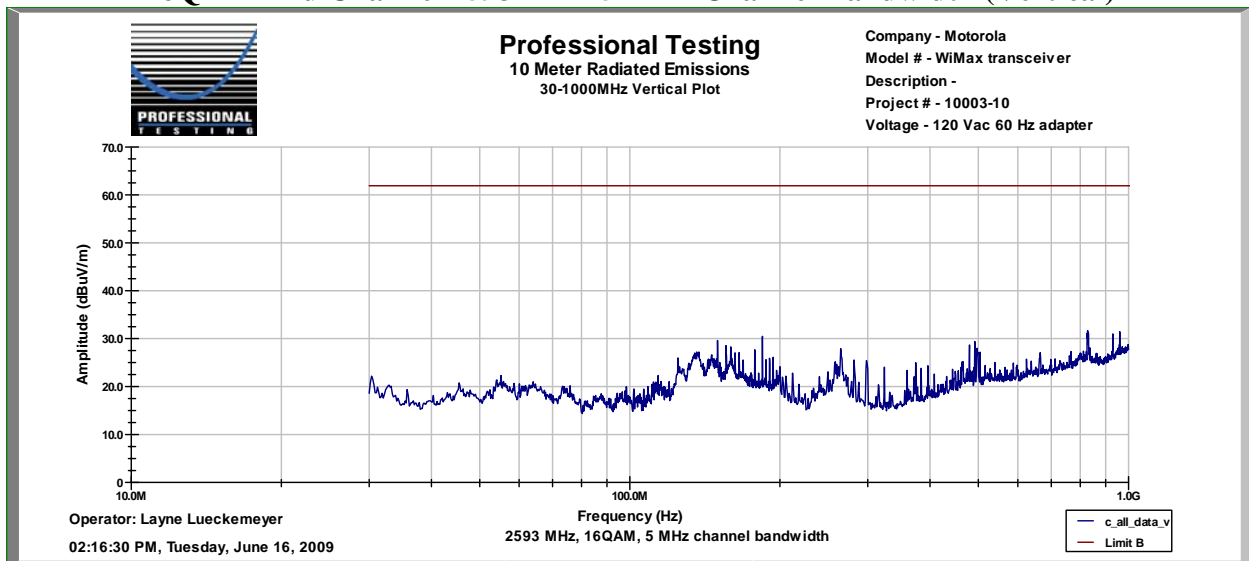
**RESULT = PASS**

# Radiated Emissions

## 16QAM Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Horizontal)



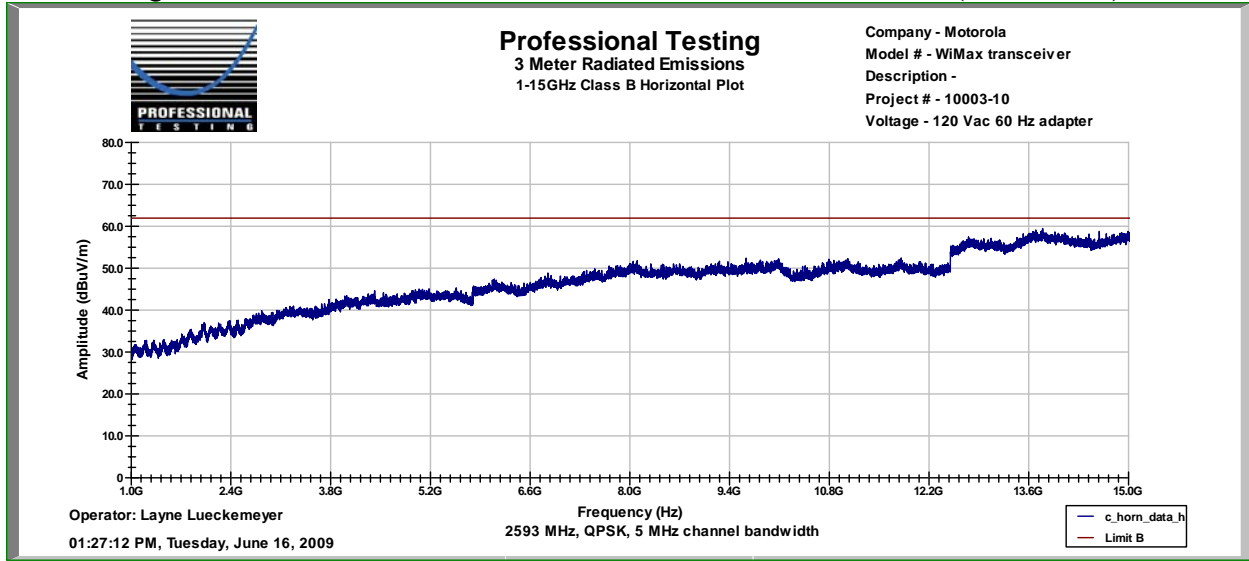
## 16QAM Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Vertical)



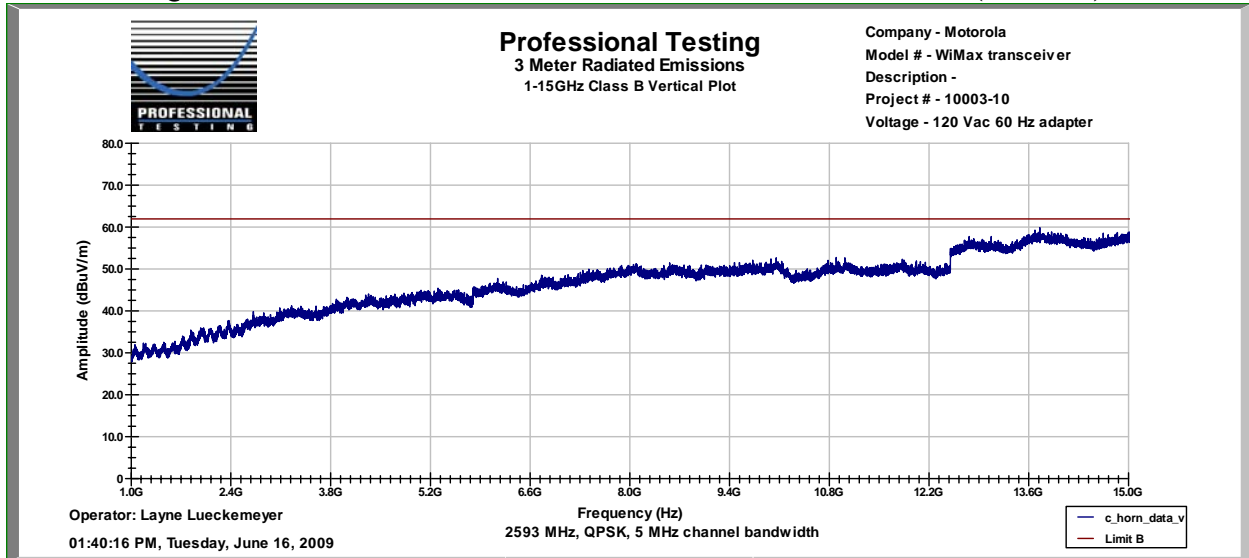
**RESULT = PASS**

# Radiated Emissions

## QPSK Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Horizontal)



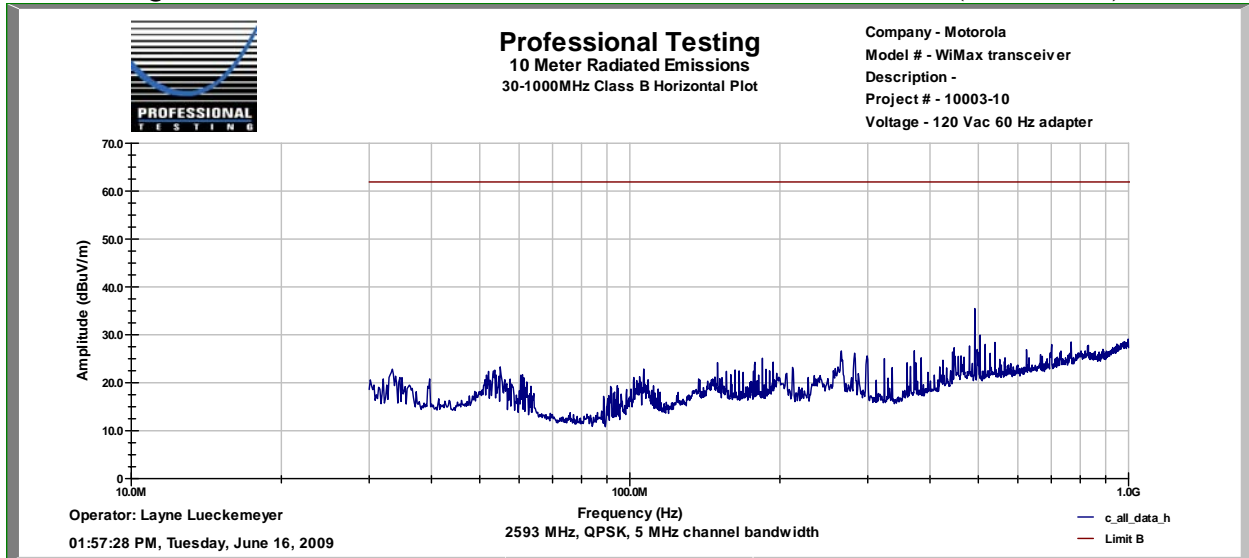
## QPSK Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Vertical)



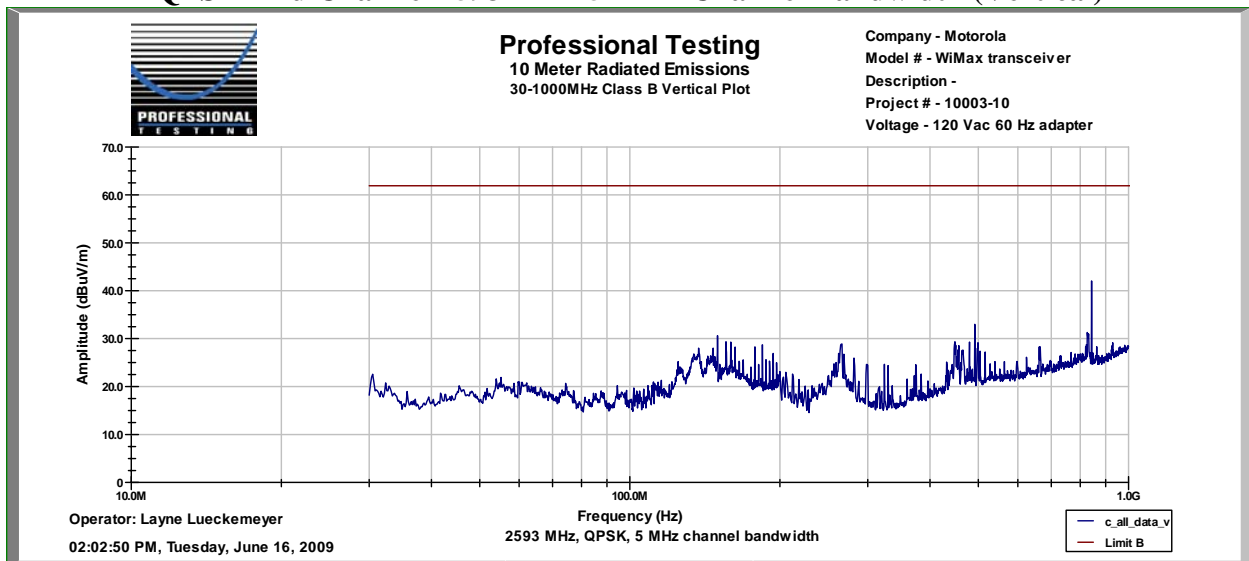
**RESULT = PASS**

# Radiated Emissions

## QPSK Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Horizontal)



## QPSK Mid Channel 2593 MHz 5 MHz Channel Bandwidth (Vertical)



**RESULT = PASS**

## Radiated Emissions

### Antenna Substitution

We derived an approximate field strength limit using the simplified Friis Transmission formula in order to make a preliminary comparison to the spurious radiated power limit of -13 dBm and -25 dBm. The associated formula and calculated limits are shown below. In order to demonstrate compliance with the radiated power limit antenna substitution was performed. Antenna substitution was performed on the 6 worst case spurious emissions summed across all operating modes.

#### Vertical

Frequency (MHz)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)
150.02	42.7	25.7	12.3	1.4	30.6
266.4	49.6	36.3	13.1	2.4	28.8
492	47.3	36.6	19.0	3.4	33.0
844	51	36.7	22.8	4.8	42.0

#### Horizontal

Frequency (MHz)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)
372	45	36.6	15.4	2.8	26.6
492	49.8	36.6	19.0	3.4	35.5

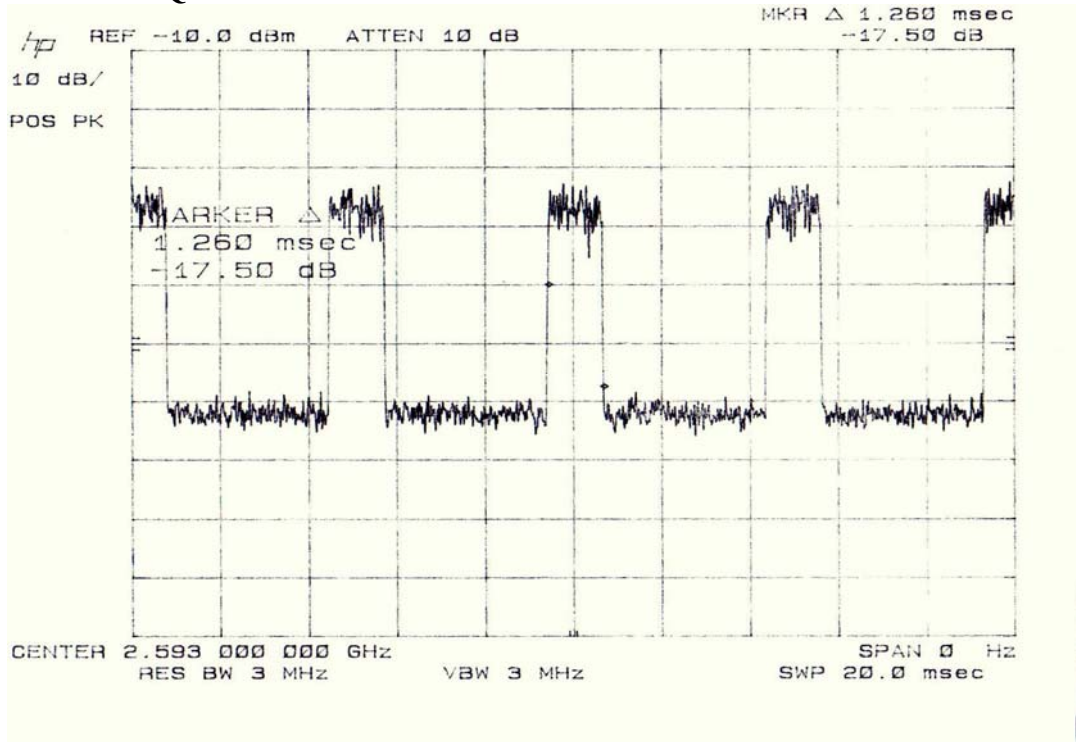
#### Substitution

Frequency (MHz)	Signal Generator (dBm)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
150.02	-55.1	5.2	-60.3	-25	-35.3
266.4	-57.5	6.8	-64.3	-25	-39.3
492	-47.3	9	-56.3	-25	-31.3
844	26.4	12.2	14.2	-25	39.2
372	-56.2	7.8	-64	-25	-39
492	-47	9	-56	-25	-31

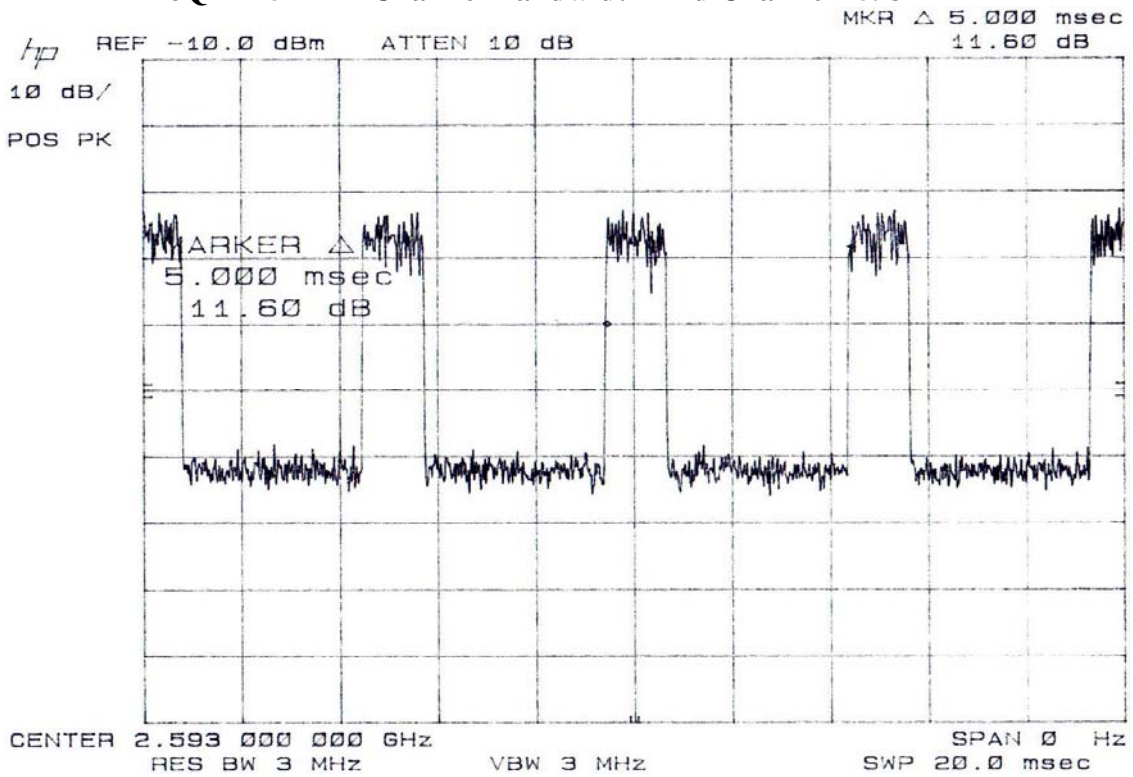
Timing

## Timing

### 16QAM 5 MHz Channel Bandwidth Mid Channel 2593 MHz



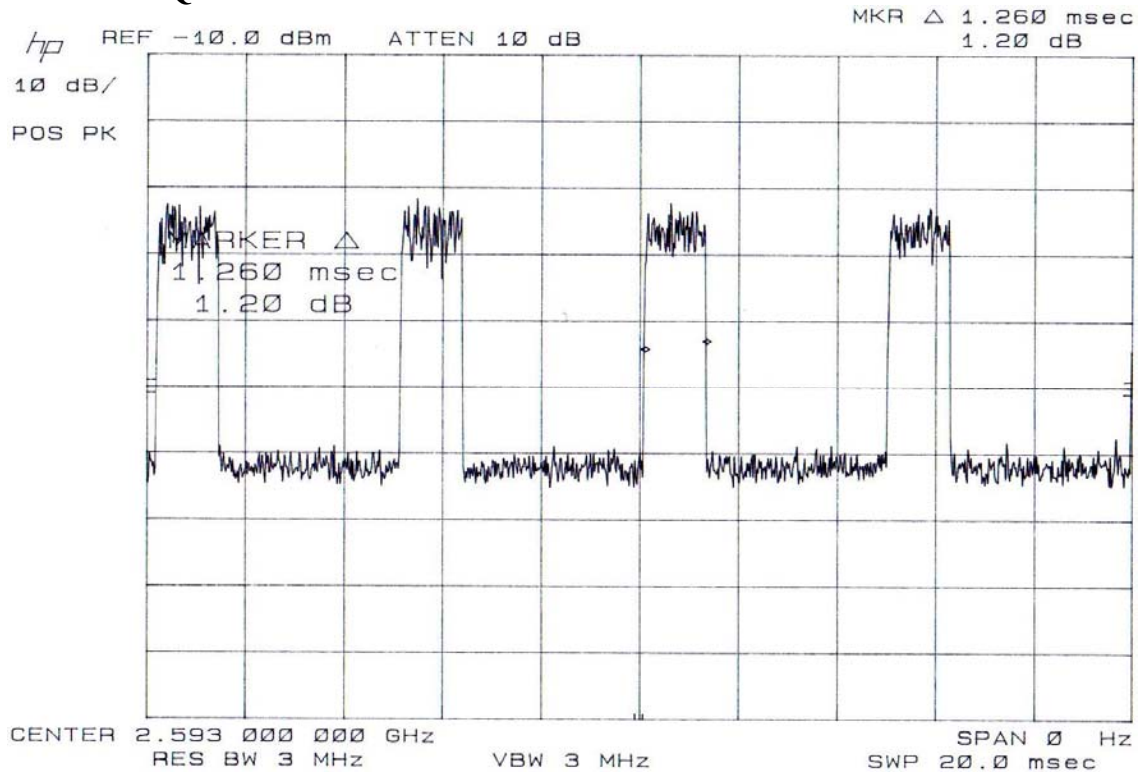
### 16QAM 5 MHz Channel Bandwidth Mid Channel 2593 MHz



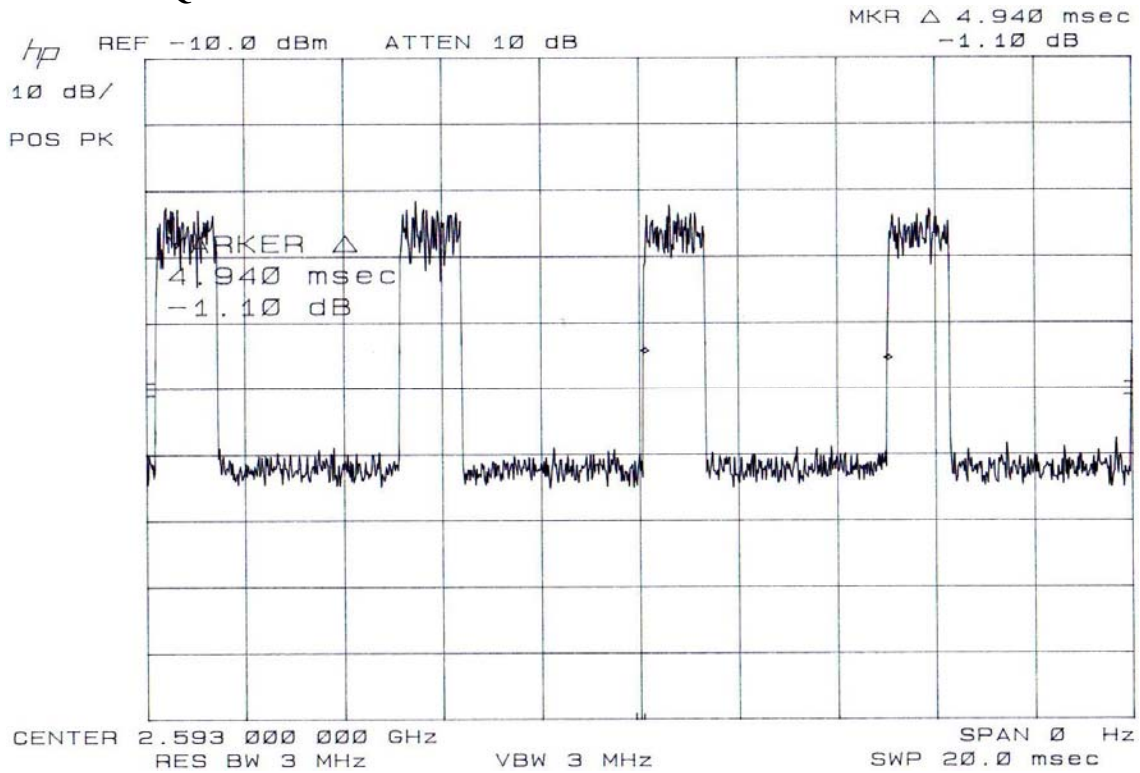
**Duty Cycle calculated at 25.2%**

Timing

**QPSK 5 MHz Channel Bandwidth Mid Channel 2593 MHz**



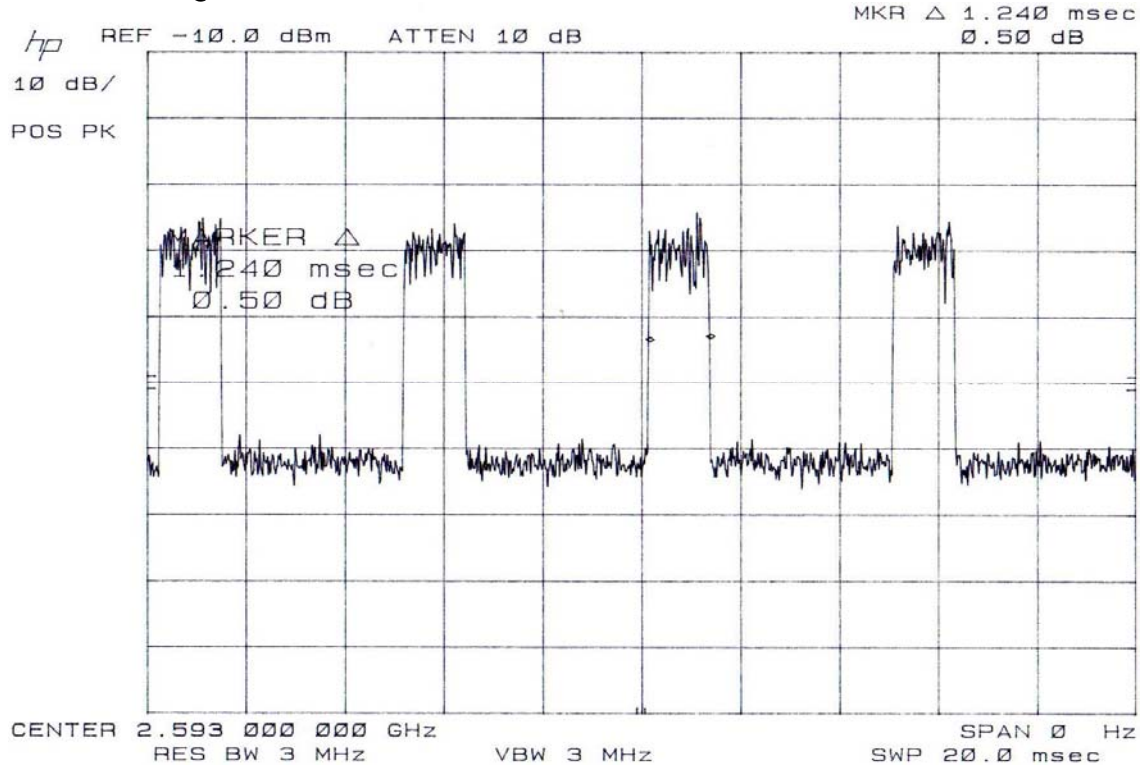
**QPSK 5 MHz Channel Bandwidth Mid Channel 2593 MHz**



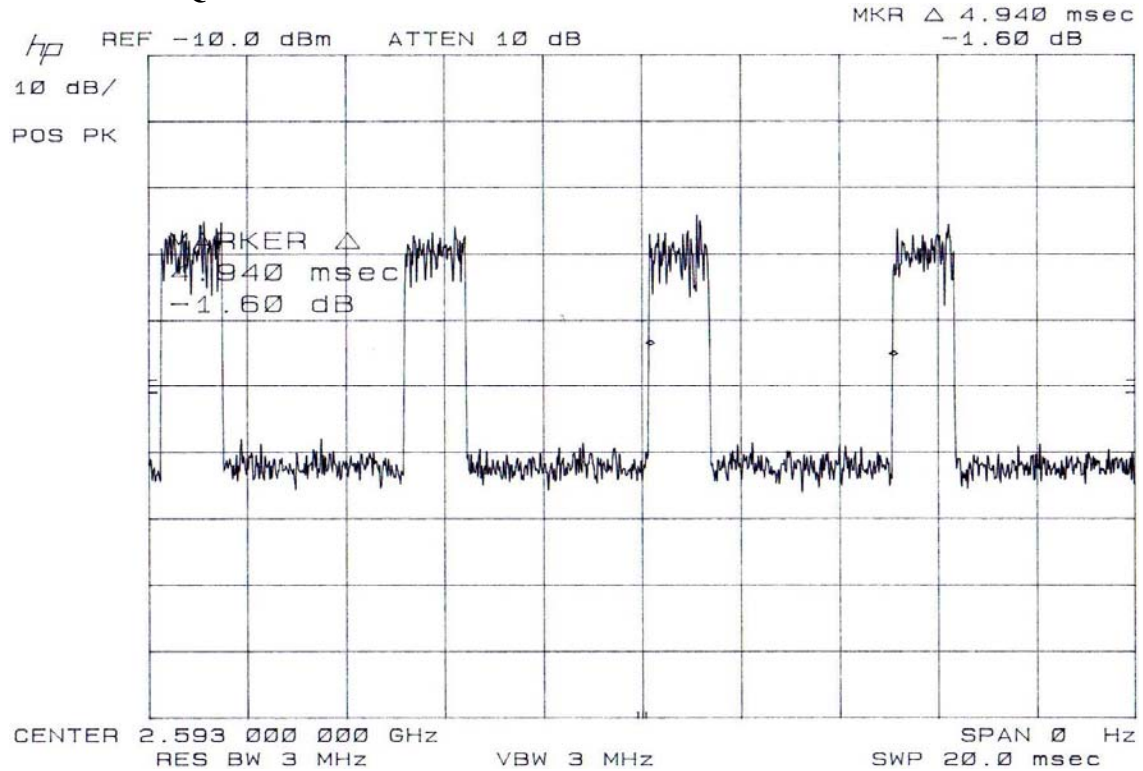
**Duty Cycle calculated at 25.5%**

# Timing

## 16QAM 10 MHz Channel Bandwidth Mid Channel 2593 MHz



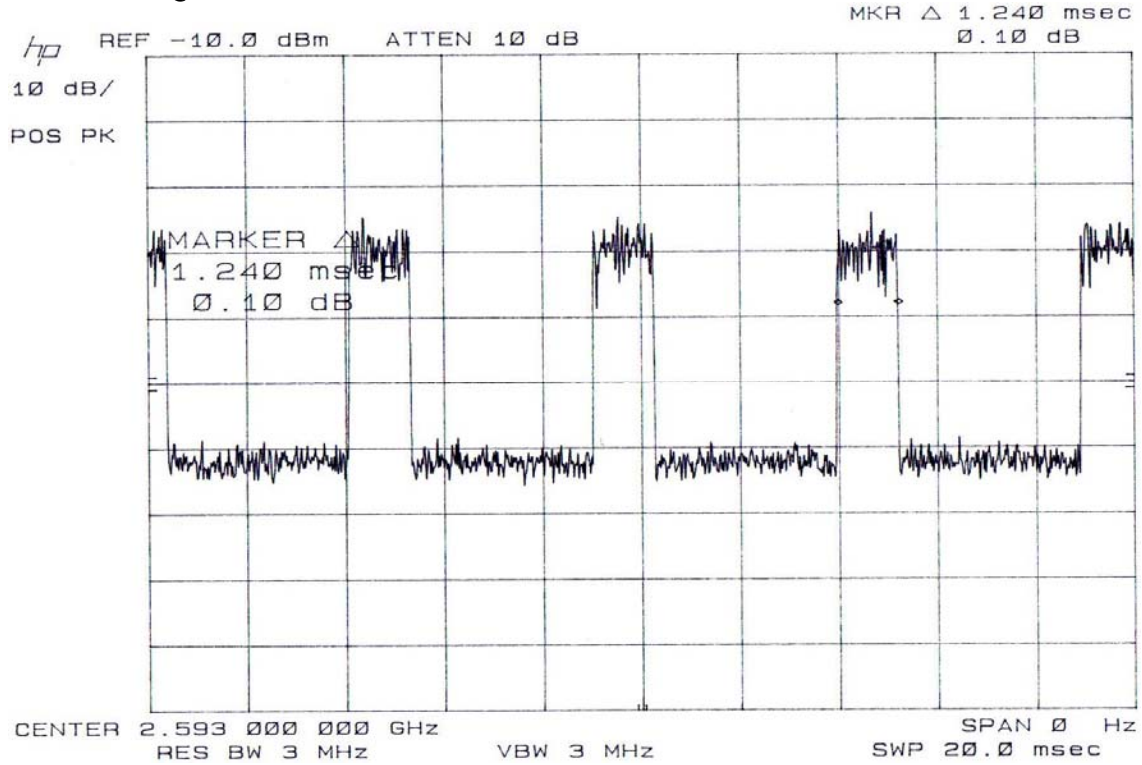
## 16QAM 10 MHz Channel Bandwidth Mid Channel 2593 MHz



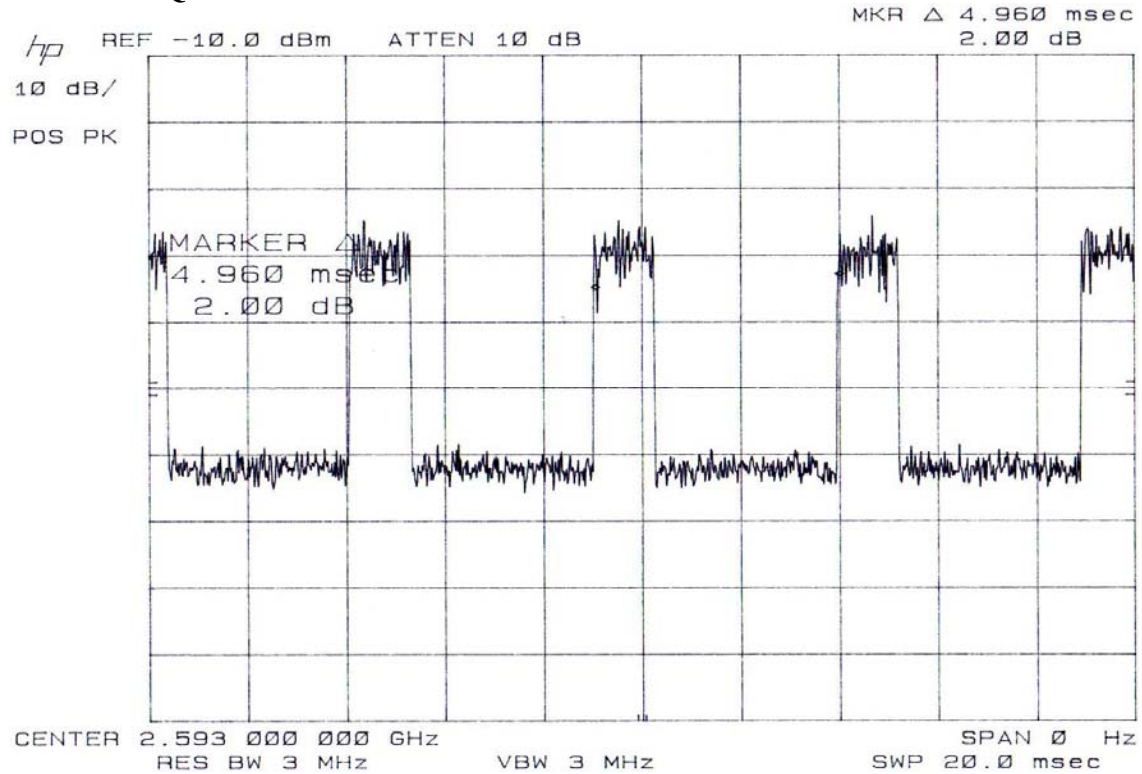
**Duty Cycle calculated at 25.1%**

Timing

**QPSK 10 MHz Channel Bandwidth Mid Channel 2593 MHz**



**QPSK 10 MHz Channel Bandwidth Mid Channel 2593 MHz**



**Duty Cycle calculated at 25.0%**

Timing

### Timing Calculation

**Duty Cycle = 25%**

**Peak to Average Factor =  $10 \cdot \log(\text{Duty Cycle})$**

**Peak to Average Factor =  $10 \cdot \log(0.25)$**

**Peak to Average Factor = -6 dB**