



**FCC CFR47 PART 15 SUBPART F
CERTIFICATION TEST REPORT**

FOR

MINI PCI UWB MODULE

MODEL NUMBER: TZM7201

FCC ID: UEZTZM7201

REPORT NUMBER: 08U11871-1

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Revision History

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TZERO TECHNOLOGIES
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SUNNYVALE, CA 94085

EUT DESCRIPTION: UWB Module (MINI PCI)

MODEL: TZM7201

SERIAL NUMBER: 0014EF002108

DATE TESTED: JUNE 09 TO 14, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart F	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:



MICHAEL HECKROTTE
DIRECTOR OF ENGINEERING
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Tested By:



THANH NGUYEN
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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a UWB module in a mini PCI form factor intended for hand-held applications.

Four configurations are available, differing in the number of receivers and the type of RF connector. The EUT may be equipped with one transmitter and one receiver, or with one transmitter and two receivers. The EUT may be equipped with either MMCX or UFL connectors.

5.2. OPERATING FREQUENCY RANGE

The UWB radio operates over a nominal frequency range of 3100 to 4800 MHz. The measured UWB bandwidths of all three channels lie within this range.

5.3. MAXIMUM OUTPUT POWER

The UWB transmitter has a maximum radiated output power as follows:

RMS Output Power (dBm/MHz EIRP)	RMS Output Power (uW/MHz EIRP)
-42.19	0.060

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT utilizes a Monopole antenna, with a nominal gain of 0 dBi over the 3100 to 4800 MHz frequency range of the UWB radio. Three antenna models are available: Omron WXA-S1FL, Omron WXA-N1SF, and Taiyo Yuden AH 086M555003-T.

5.5. SOFTWARE AND FIRMWARE

The board is run on core application software, release 3.0. A script is used to force the TX to continuous transmission.

5.6. OPERATING MODE

The EUT was tested in its normal (hopping) operating mode in accordance with the waiver documented in ET Docket 04-352. Test results demonstrate that the EUT does not operate within the 5030 to 5650 MHz band.

5.7. WORST-CASE CONFIGURATION

Preliminary tests were performed with all three antennas. The Omron WXA-S1FL showed the highest emissions, therefore was used for final tests.

Preliminary tests were performed with the single receiver version and the dual receiver version. The single receiver version showed the highest emissions, therefore was used for final tests.

MMCX connectors have a lower insertion loss than UFL connectors, therefore boards with MMCX connectors were used for all tests.

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	DVE	DSA_D101F_05A	2195	N/A

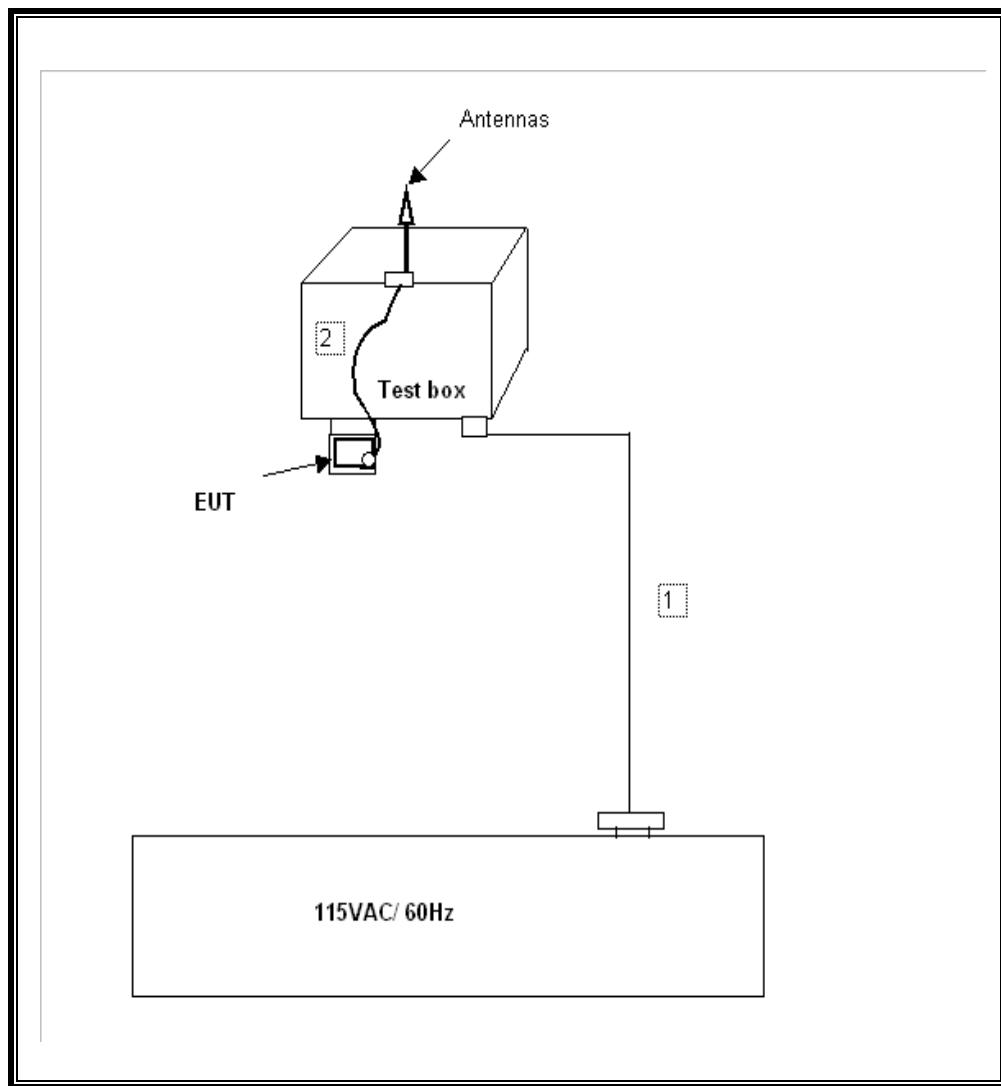
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	DC	1	Plug in	Unshielded	1.5m	No
2	Antenna	1	SMA	shielded	.2m	No

TEST SETUP

The EUT is connected to a test box. The script to force continuous transmission is run through a serial port / hyper-terminal session. After downloading the script, the laptop is disconnected from the board and removed from the chamber during tests.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A0022704	9/28/2008
Antenna, Microwave Horn	ARA	AT4002A	322899	12/20/2008
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	4/15/2009
Antenna, Horn 18 ~ 26 GHz	ARA	SWH-28	1007	9/26/2008
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	4/11/2009
Preamplifier, 1300 MHz	Agilent / HP	8447D	1937A02062	5/9/2009
Preamplifier, 1 ~ 2 GHz	Miteq	AFS3-01000200	1199462	8/14/2008
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	8/14/2008
Preamplifier, 26 ~ 40 GHz	Miteq	NSP4000-SP2	924343	8/14/2008
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	6/12/2008
RF Filter Section	Agilent / HP	85420E	3705A00256	6/12/2008
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42510266	10/26/2008
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	9/15/2008
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	9/15/2008
EMI Test Receiver	R & S	ESHS 20	827129/006	1/27/2008

7. LIMITS AND RESULTS

7.1. UWB BANDWIDTH, CENTER FREQUENCY, AND FRACTIONAL BANDWIDTH

DEFINITIONS AND LIMITS

§15.503 Definitions.

(a) UWB Bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L . The frequency at which the highest radiated emission occurs is designated f_M .

(b) Center frequency. The center frequency, f_C , equals $(f_H + f_L)/2$.

(c) Fractional bandwidth. The fractional bandwidth equals $2(f_H - f_L)/(f_H + f_L)$.

(d) Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

§15.519 (b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

TEST PROCEDURE

Radiated measurements are made using the procedures described above. The detection mode is set to peak detection, the sweep time is AUTO, and the Max Hold trace function is utilized. The frequency range from 3.1 to 10.6 GHz is measured, and corrected from raw values to Peak EIRP.

The frequency at which the maximum EIRP is measured is designated as f_M . A major graticule line of the plot is adjusted to exactly equal the peak EIRP at f_M . The spectral envelope at the major graticule line that is 10 dB below the reference graticule is examined to determine the frequency band bounded by the points that are 10 dB below the highest radiated emission. The upper boundary is designated f_H and the lower boundary is designated f_L .

The center frequency, f_C , is calculated as $(f_H + f_L)/2$.

The antenna polarization that yields the highest EIRP at f_M is used to calculate the above parameters.

Calculations are made independently for each of the three channels.

LOW CHANNEL RESULTS (VERTICAL POLARIZATION)

f Max (GHz)	Reference EIRP at f Max (dBm)	10 dB down from Reference EIRP (dBm)
3.624	-33.6	-43.6

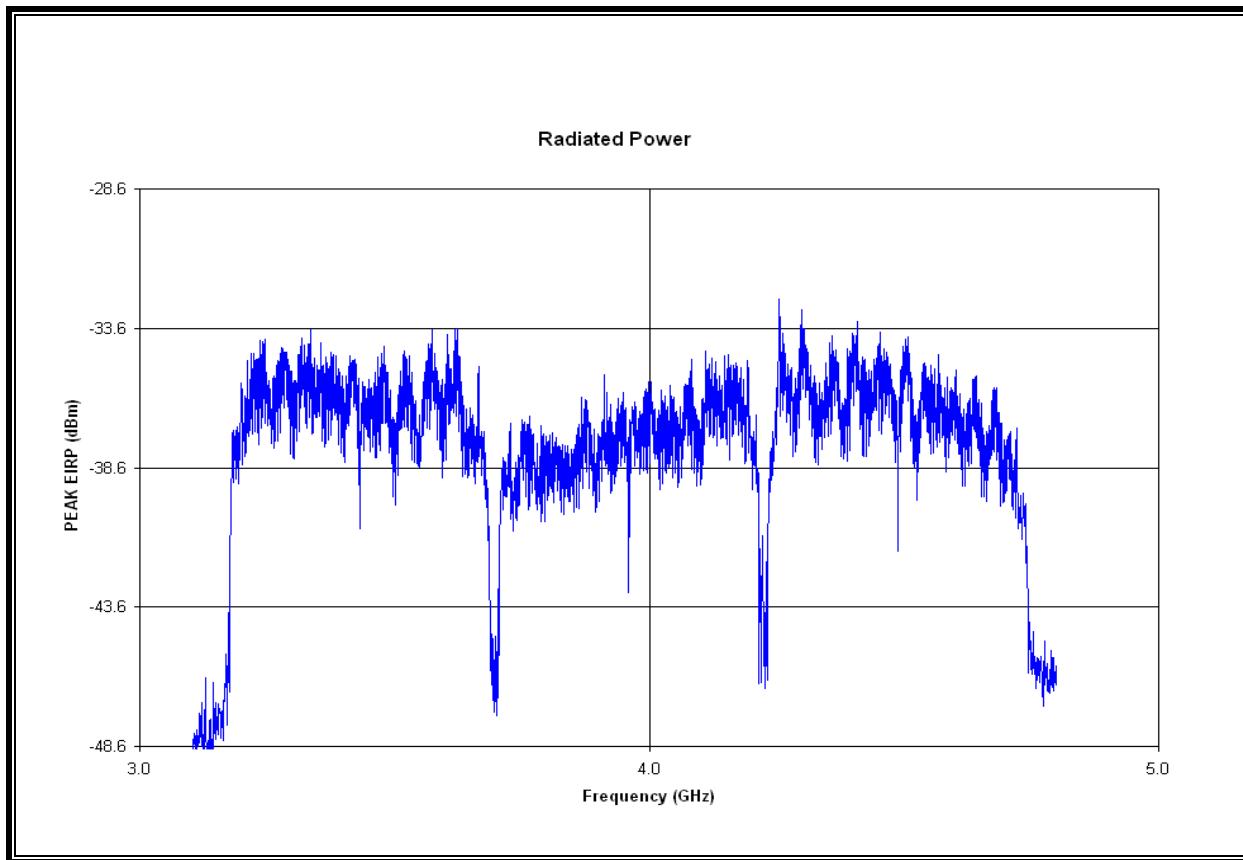
f Low (GHz)	Minimum f Low (GHz)
3.177	3.1

f High (GHz)	Maximum f High (GHz)
3.687	10.6

f Center (GHz)
3.432

UWB BW (GHz)	Minimum UWB BW (GHz)
0.510	0.500

PLOT OF PEAK EIRP WITH REFERENCE GRATICULE ADJUSTED FOR LOW CHANNEL F MAX



MID CHANNEL RESULTS (VERTICAL POLARIZATION)

f Max (GHz)	Reference EIRP at f Max (dBm)	10 dB down from Reference EIRP (dBm)
4.111	-34.4	-44.4

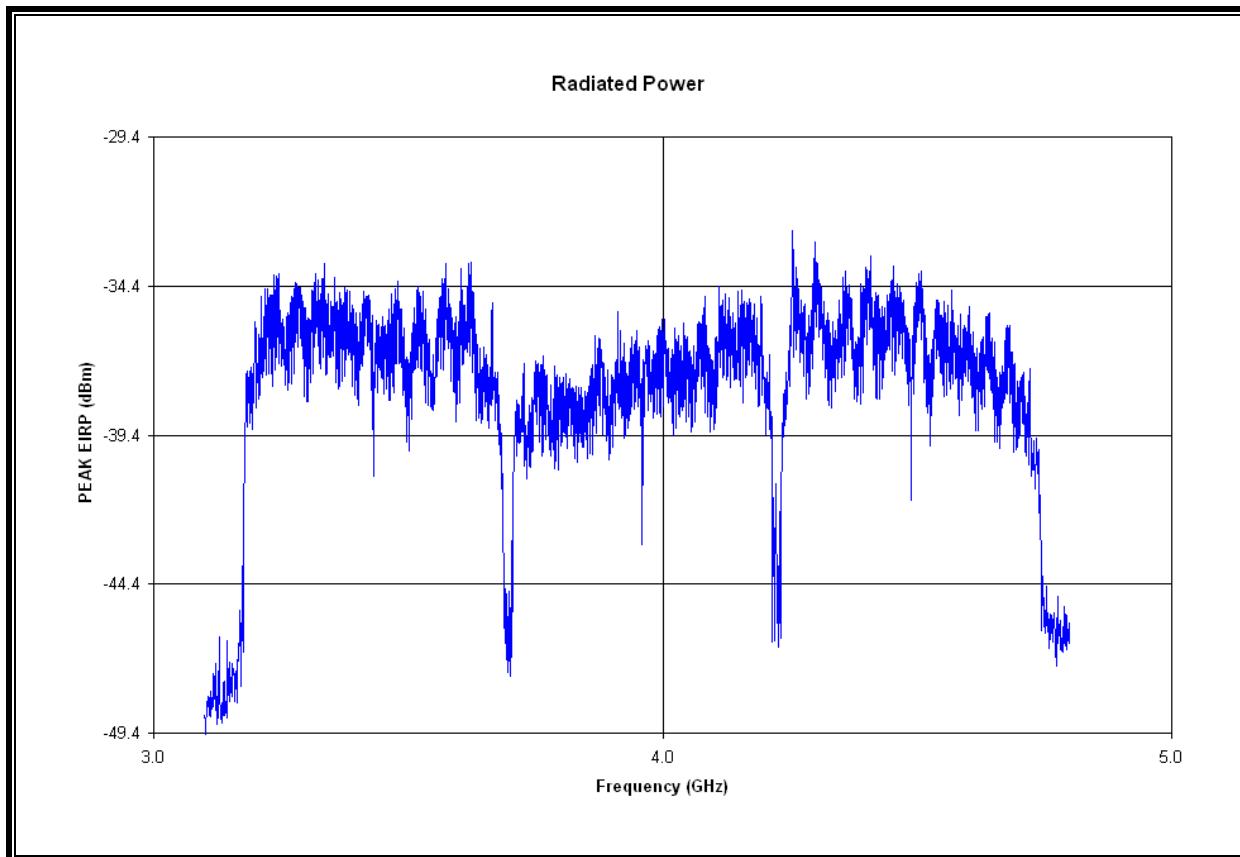
f Low (GHz)	Minimum f Low (GHz)
3.703	3.1

f High (GHz)	Maximum f High (GHz)
4.212	10.6

f Center (GHz)
3.958

UWB BW (GHz)	Minimum UWB BW (GHz)
0.509	0.500

PLOT OF PEAK EIRP WITH REFERENCE GRATICULE ADJUSTED FOR MID CHANNEL F MAX



HIGH CHANNEL RESULTS (VERTICAL POLARIZATION)

f Max (GHz)	Reference EIRP at f Max (dBm)	10 dB down from Reference EIRP (dBm)
4.255	-32.6	-42.6

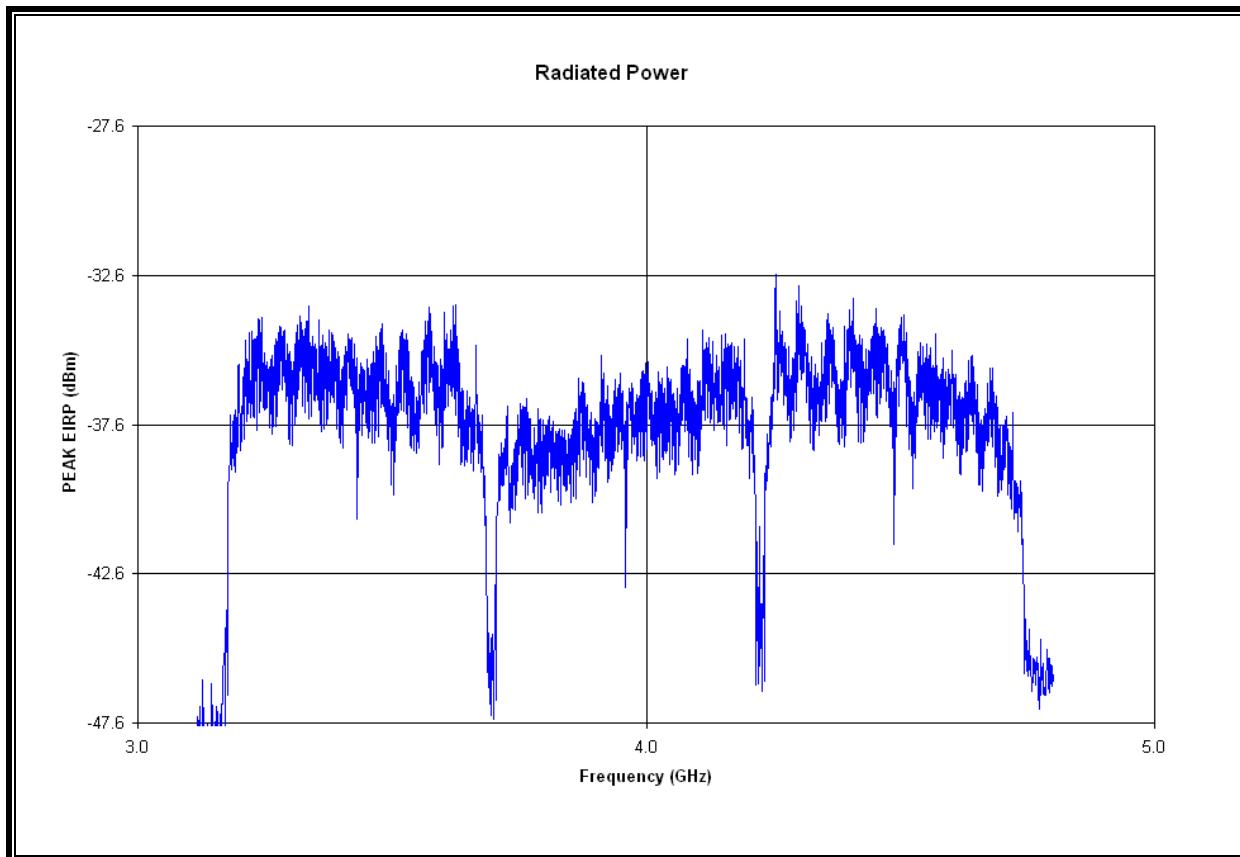
f Low (GHz)	Minimum f Low (GHz)
4.230	3.1

f High (GHz)	Maximum f High (GHz)
4.743	10.6

f Center (GHz)
4.487

UWB BW (GHz)	Minimum UWB BW (GHz)
0.513	0.500

PLOT OF PEAK EIRP WITH REFERENCE GRATICULE ADJUSTED FOR HIGH CHANNEL F MAX



7.2. PEAK POWER

LIMIT

§15.519 (e) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

§15.521 (g) When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, f_M . If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be $20 \log (RBW/50)$ dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using $E(\text{dBuV/m}) = P(\text{dBm EIRP}) + 95.2$. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

§15.521 (e) The frequency at which the highest radiated emission occurs, f_M , must be contained within the UWB bandwidth.

TEST PROCEDURE

Radiated measurements are made using the procedures described above.

RESULTS

RBW =	3	Limit =	-24.44	Distance =	3.0
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Low Channel					
f Max (GHz)	Reading (dBuV)	Antenna Factor (dB/m)	Cable (dB)	Preamp (dB)	Distance Factor (dB)
3.624	60.67	31.36	11.36	-34.90	0.00
Field Strength at 3 meters (dBuV/m)		EIRP Conversion Factor	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
68.49		-95.20	-26.71	-24.44	-2.27

Mid Channel					
f Max (GHz)	Reading (dBuV)	Antenna Factor (dB/m)	Cable (dB)	Preamp (dB)	Distance Factor (dB)
4.111	55.35	32.31	11.62	-34.59	0.00
Field Strength at 3 meters (dBuV/m)		EIRP Conversion Factor	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
64.69		-95.20	-30.51	-24.44	-6.07

High Channel					
f Max (GHz)	Reading (dBuV)	Antenna Factor (dB/m)	Cable (dB)	Preamp (dB)	Distance Factor (dB)
4.255	59.03	32.46	11.72	-34.71	0.00
Field Strength at 3 meters (dBuV/m)		EIRP Conversion Factor	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
68.50		-95.20	-26.70	-24.44	-2.26

7.3. RADIATED EMISSIONS ABOVE 960 MHz

LIMITS

§15.519 (c) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960–1610	- 75.3
1610–1990	- 63.3
1990–3100	- 61.3
3100–10600	- 41.3
Above 10600	- 61.3

§15.519 (d) In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164–1240	- 85.3
1559–1610	- 85.3

§15.521 (d) Within the tables in §§15.509, 15.511, 15.513, 15.515, 15.517, and 15.519, the tighter emission limit applies at the band edges. Radiated emission levels above 960 MHz are based on RMS average measurements over a 1 MHz resolution bandwidth. The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time.

§15.521 (e) The frequency at which the highest radiated emission occurs, f_M , must be contained within the UWB bandwidth.

TEST PROCEDURE

Radiated measurements are made using the procedures described above. The number of points on the horizontal axis of the spectrum analyzer is set to (frequency span in MHz + 1) and the sweep time is set to (frequency span in MHz) milliseconds, the RBW is set to 1 MHz and the detector function is set to RMS average.

For the requirements of §15.519 (d), an RBW of 10 kHz is utilized.

RESULTS

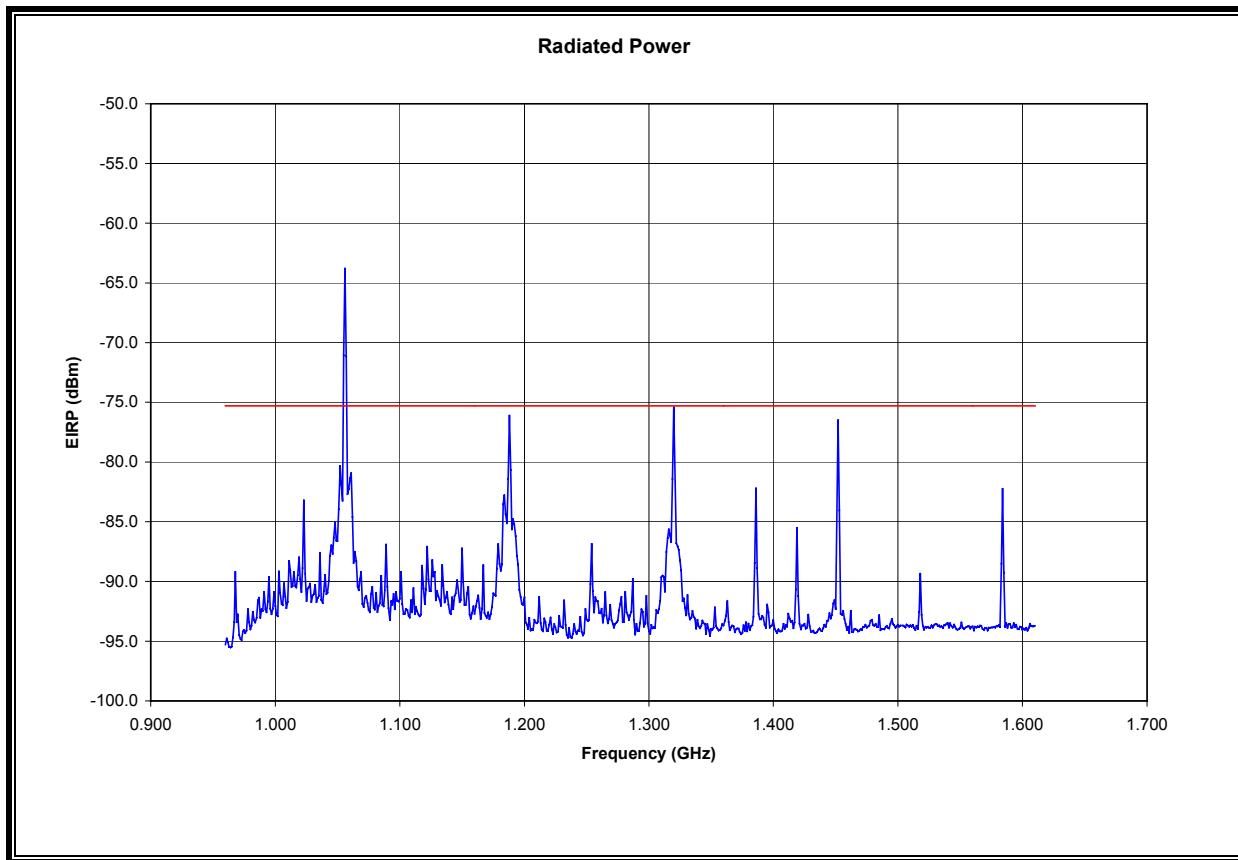
The highest radiated emission at f_M is as follows:

Polarization =	Vertical	Distance =	1.0
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f Max (GHz)	Reading (dBuV)	Antenna Factor (dB/m)	Cable (dB)	Preamp (dB)	Distance Factor (dB)
4.481	53.35	32.00	11.90	-34.70	-9.54

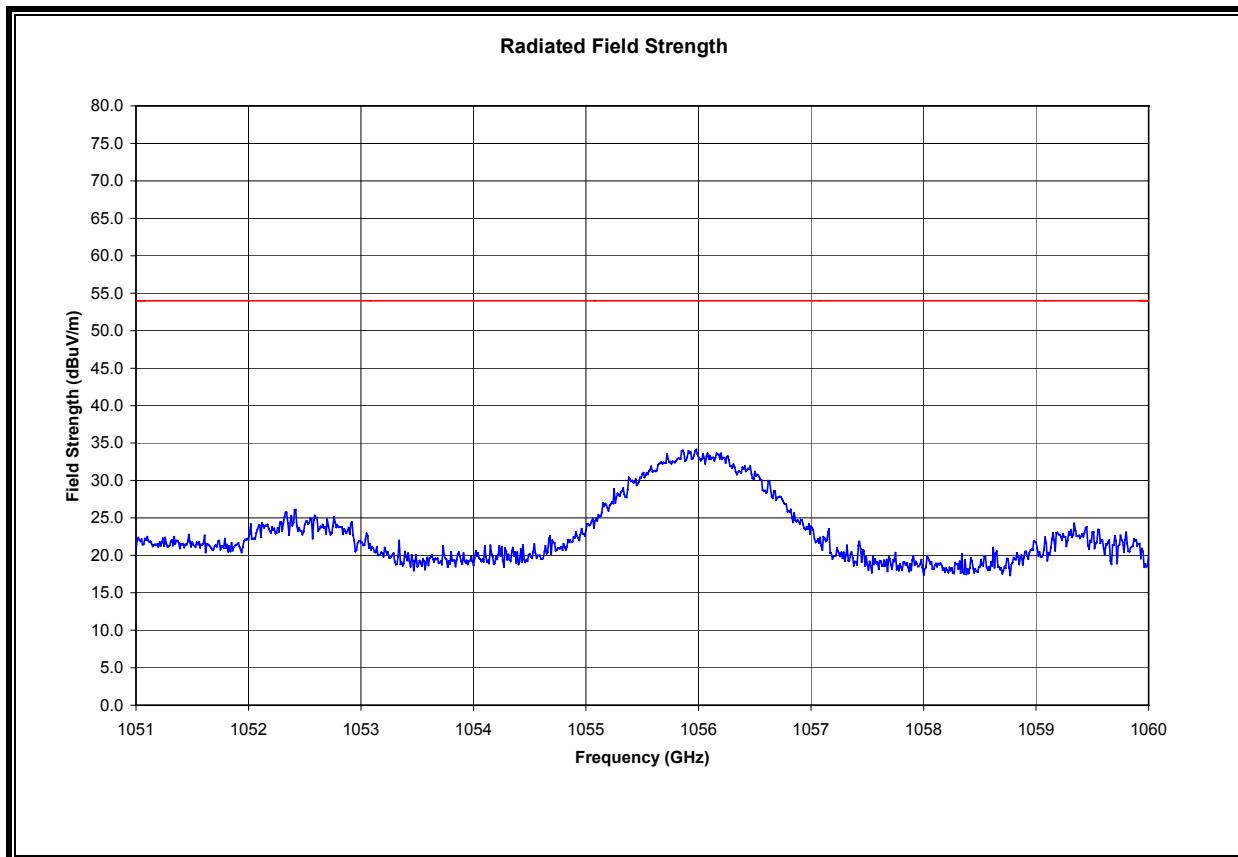
Field Strength at 3 meters (dBuV/m)	EIRP Conversion Factor	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
53.01	-95.20	-42.19	-41.30	-0.89

EIRP 0.960 TO 1.610 GHz, 1 MHz BW, HORIZONTAL



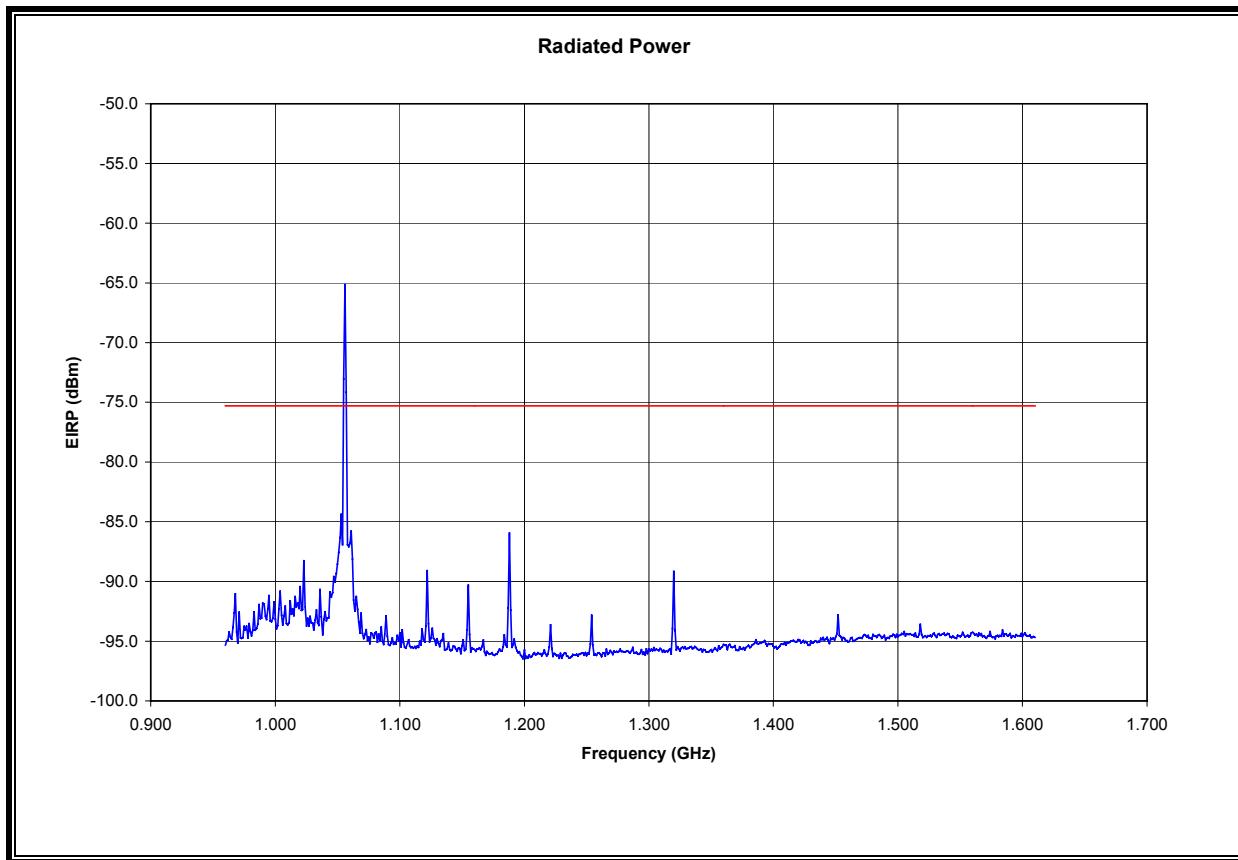
Note: The emission at 1.056 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 1.056 GHz, 1 MHz BW, HORIZONTAL, 15.209 LIMIT



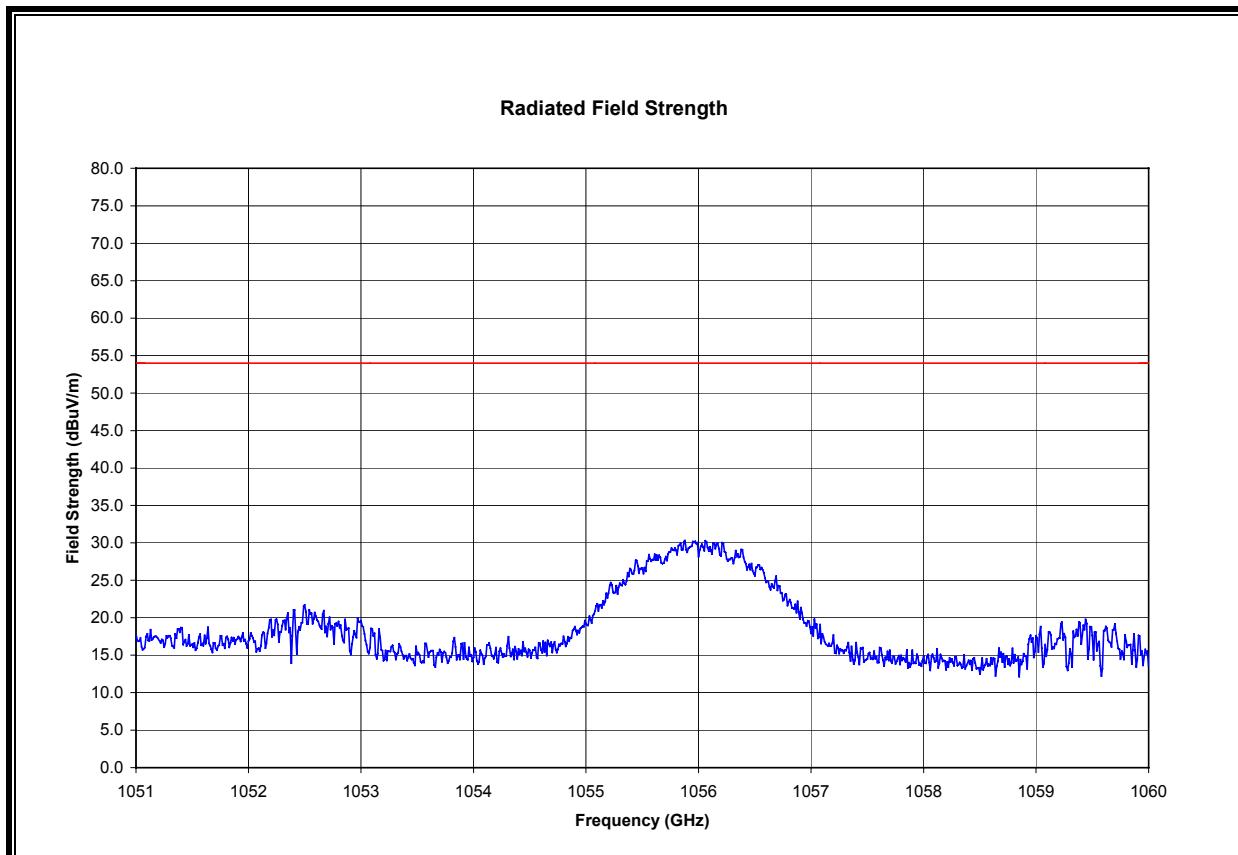
Note: The peak emission is measured above. It is less than the average limit.

EIRP 0.960 TO 1.610 GHz, 1 MHz BW, VERTICAL



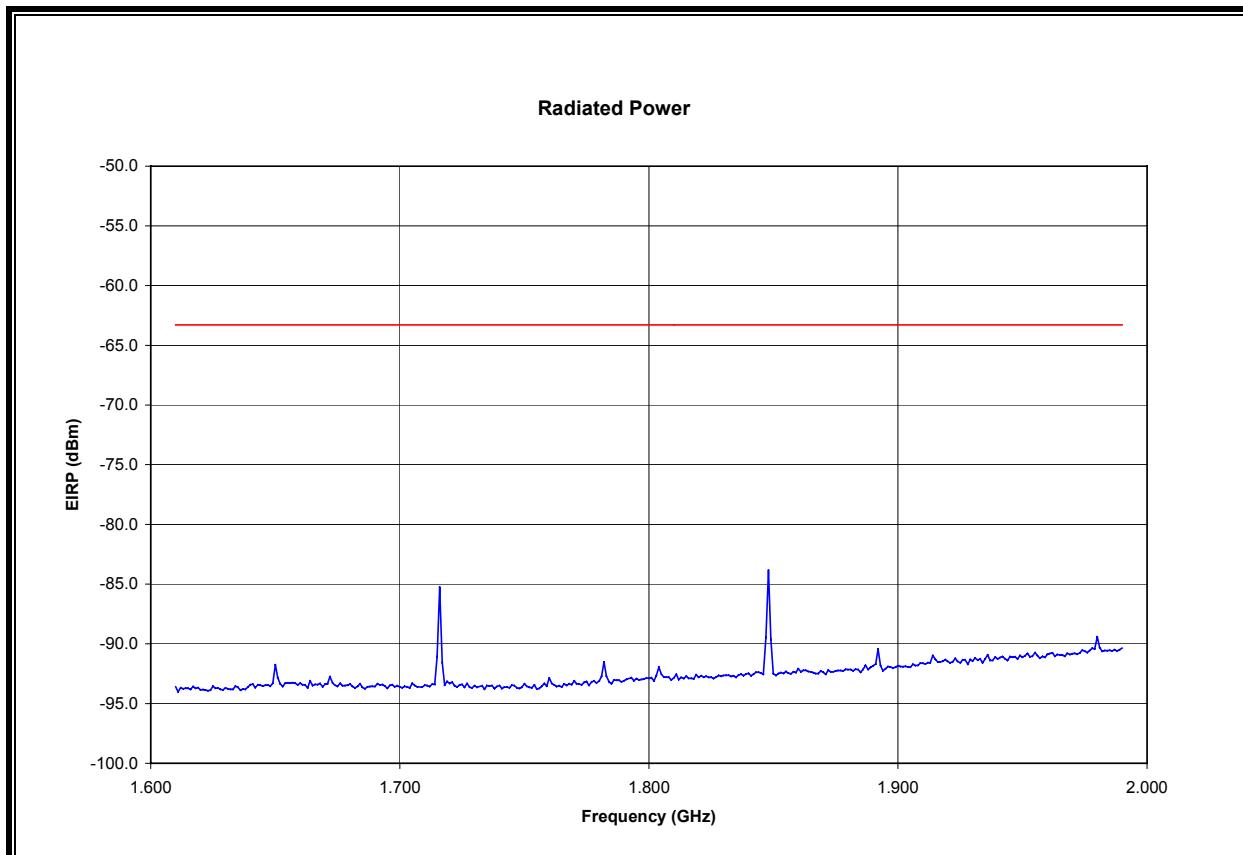
Note: The emission at 1.056 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 1.056 GHz, 1 MHz BW, VERTICAL, 15.209 LIMIT

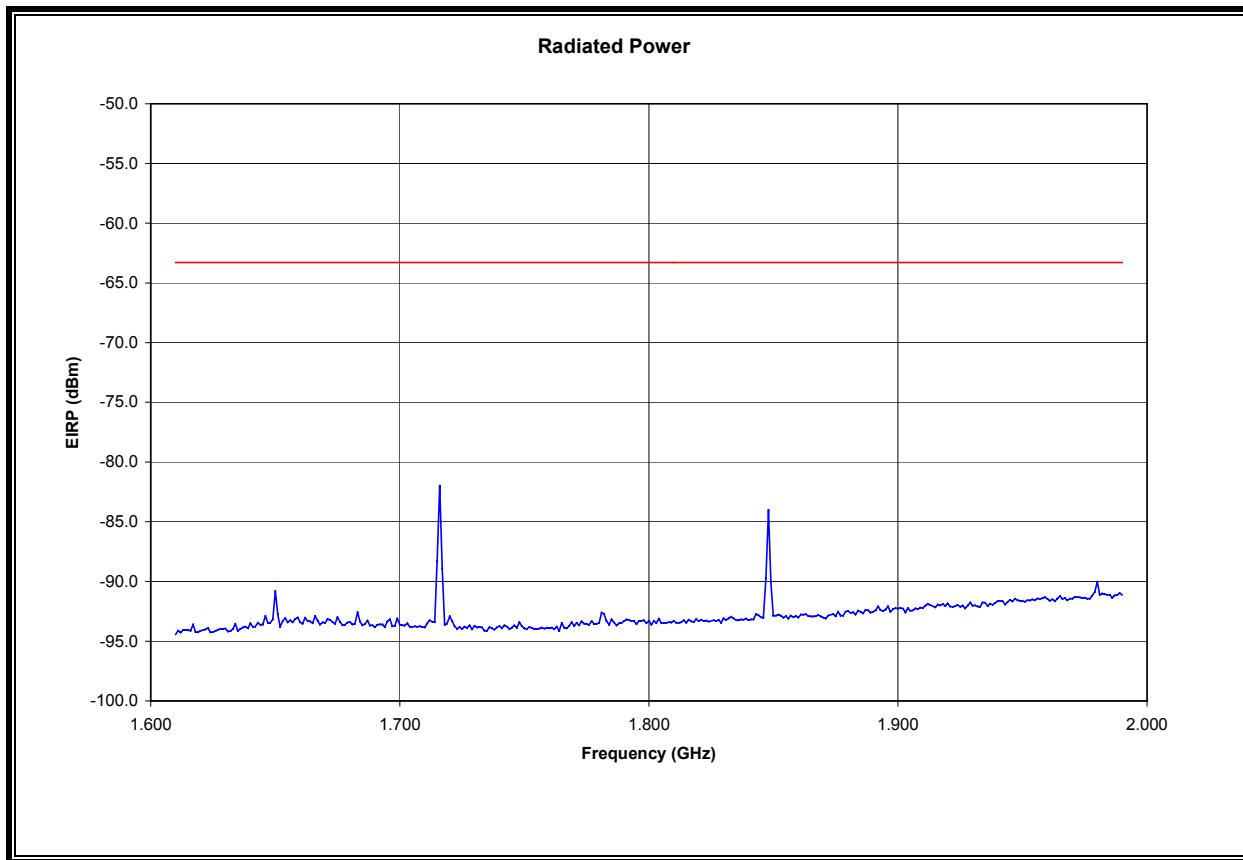


Note: The peak emission is measured above. It is less than the average limit.

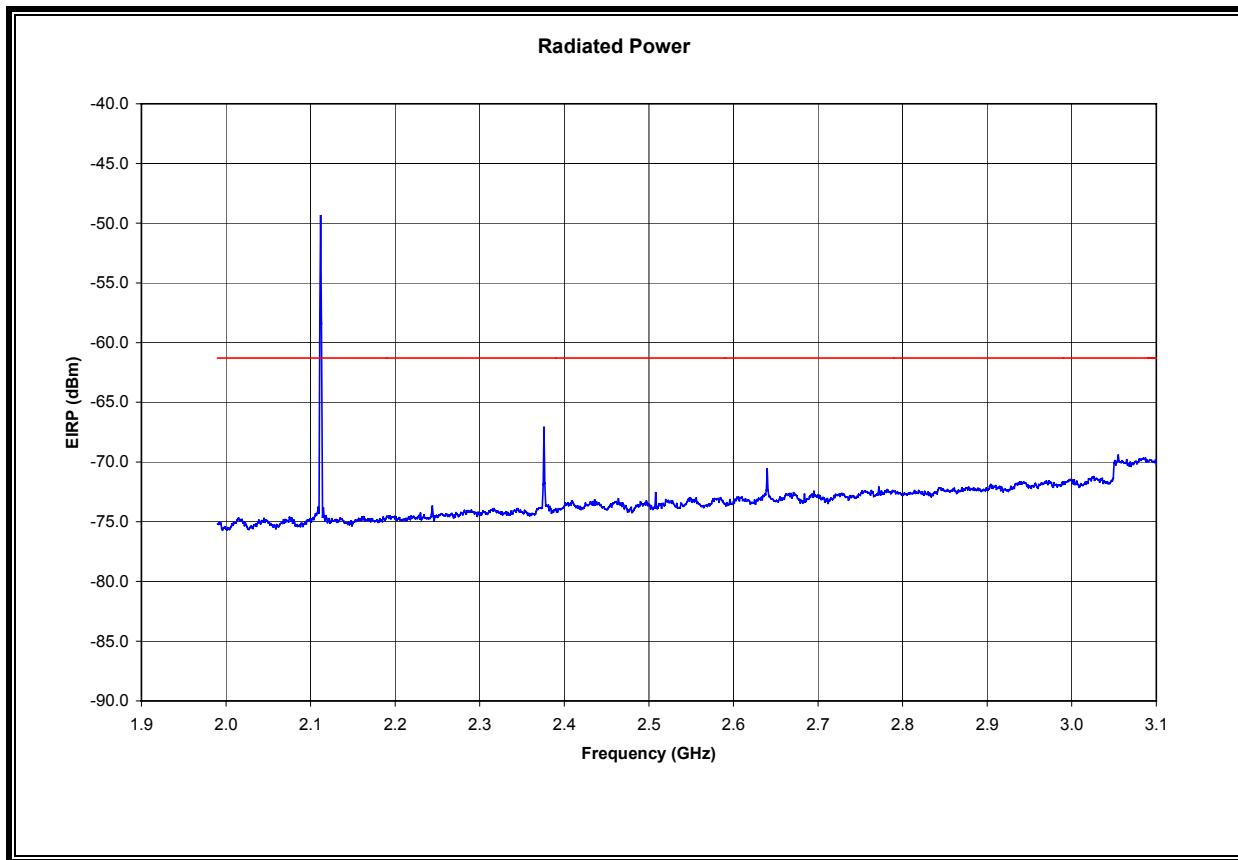
EIRP 1.610 TO 1.990 GHz, 1 MHz BW, HORIZONTAL



EIRP 1.610 TO 1.990 GHz, 1 MHz BW, VERTICAL

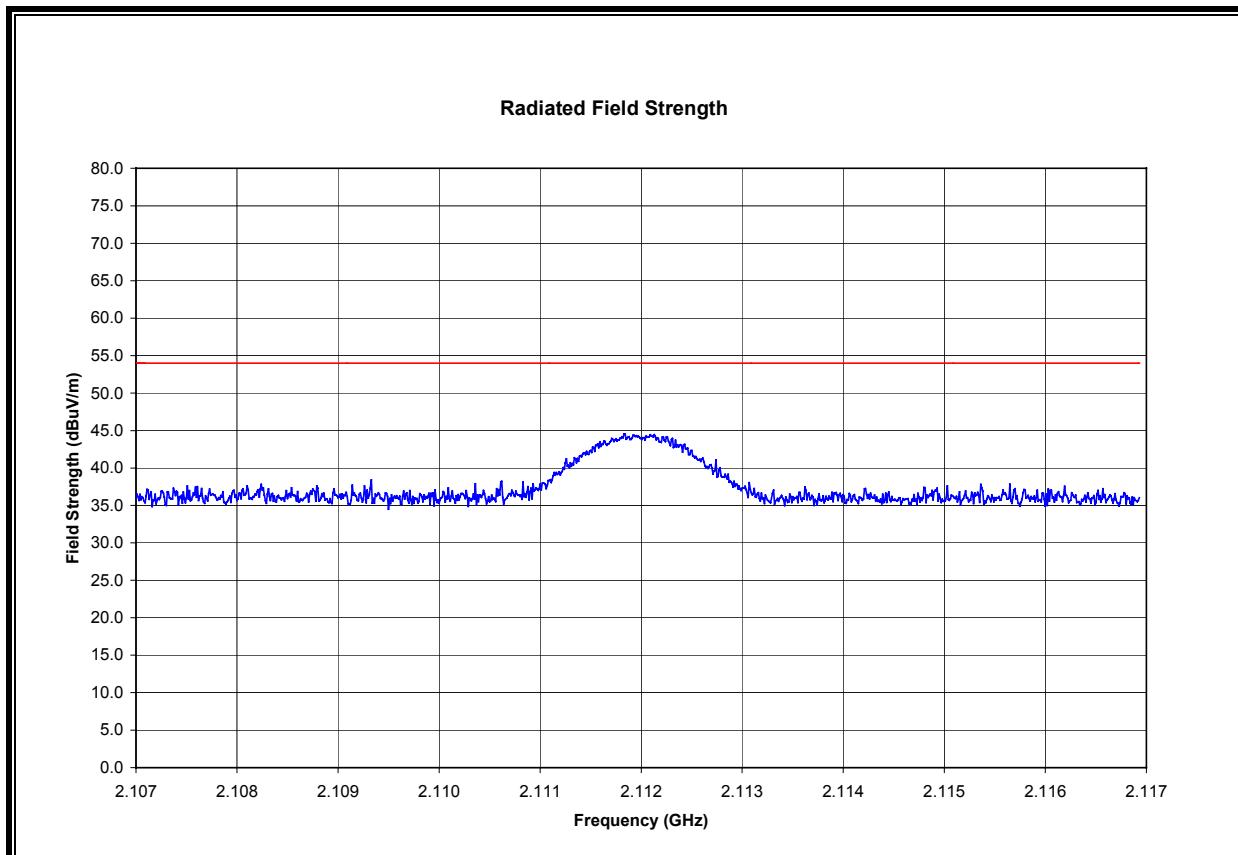


EIRP 1.990 TO 3.100 GHz, 1 MHz BW, HORIZONTAL



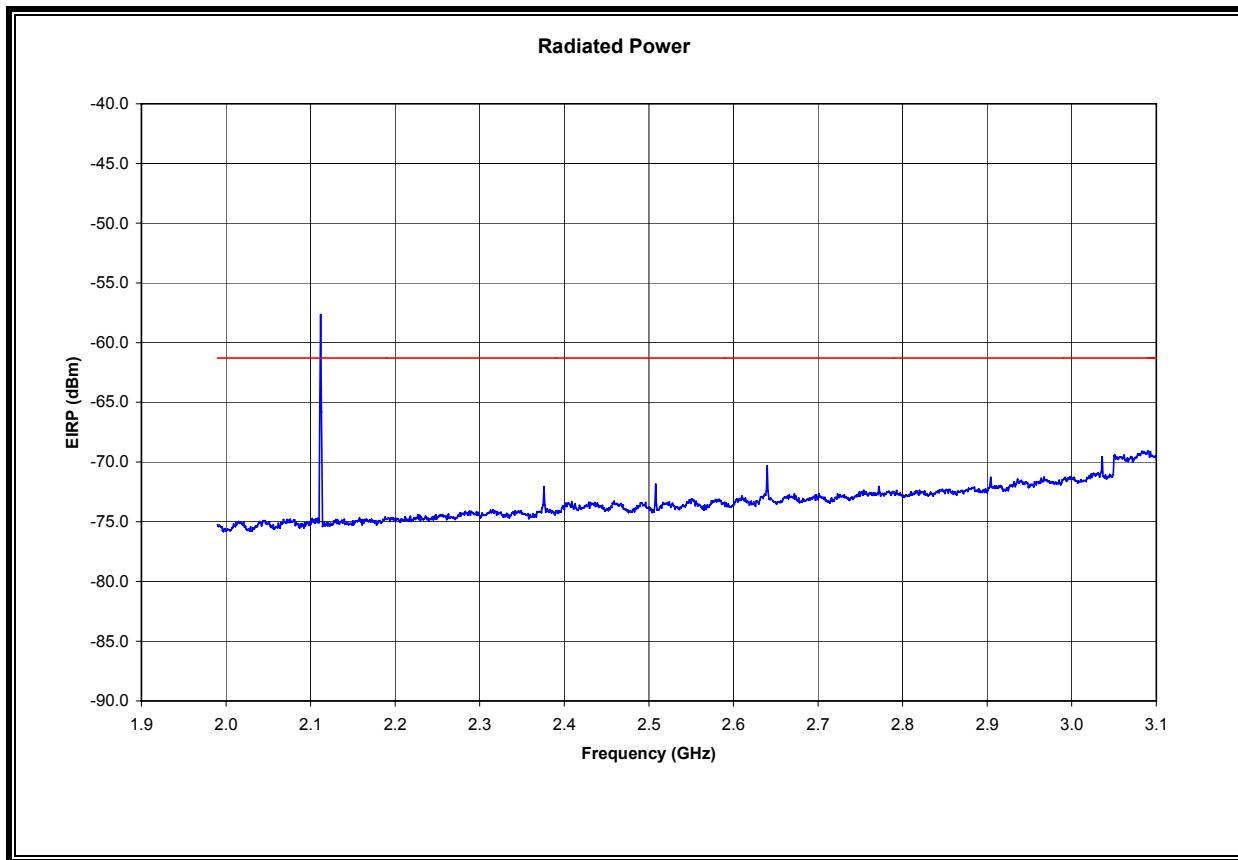
Note: The emission at 2.112 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 2.112 GHz, 1 MHz BW, HORIZONTAL, 15.209 LIMIT



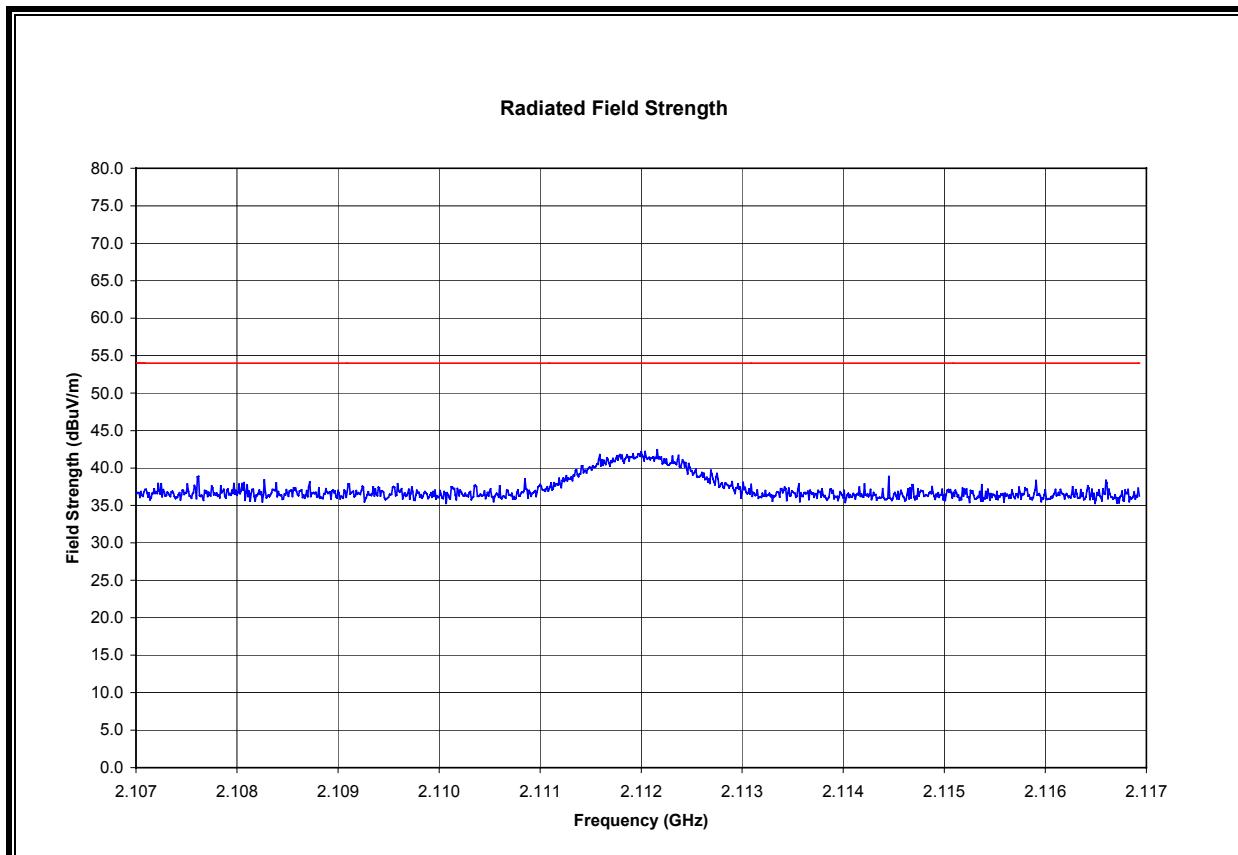
Note: The peak emission is measured above. It is less than the average limit.

EIRP 1.990 TO 3.100 GHz, 1 MHz BW, VERTICAL



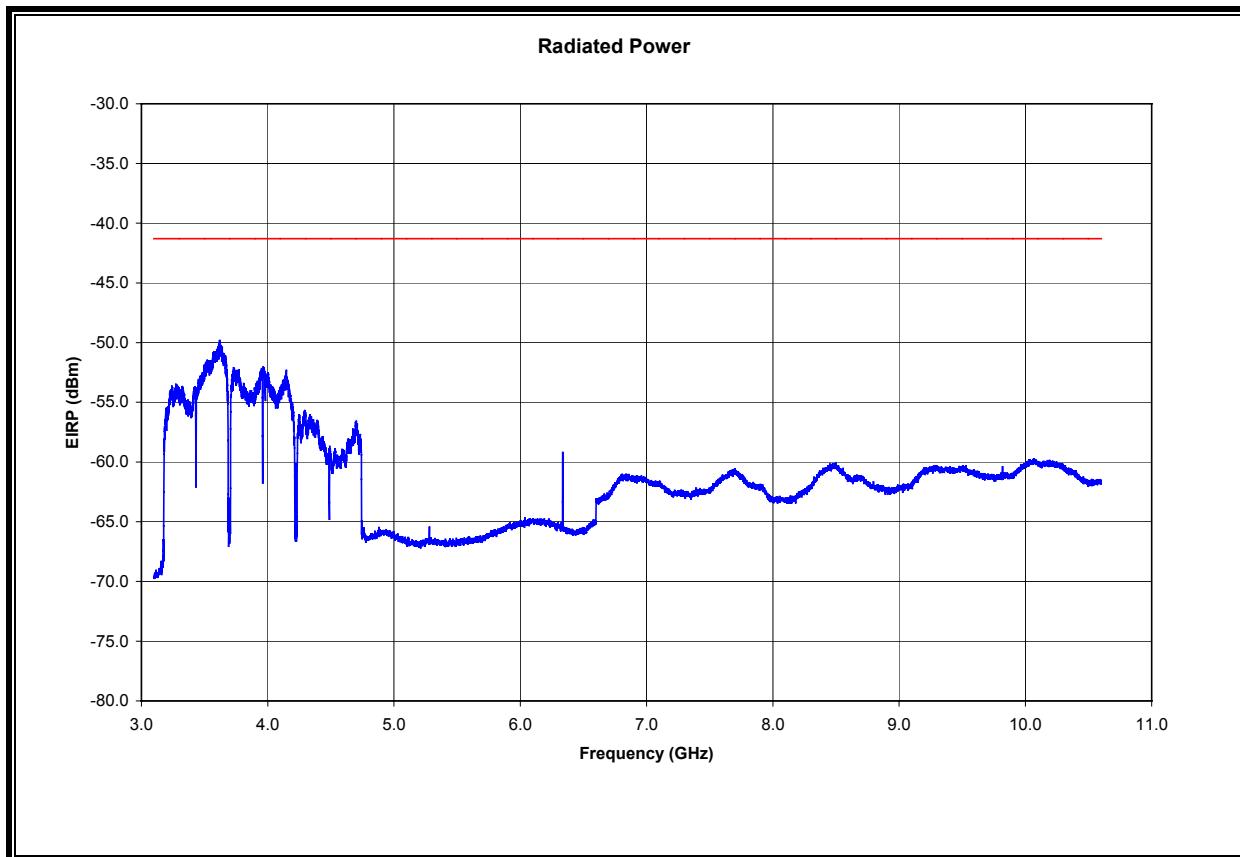
Note: The emission at 2.112 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 2.112 GHz, 1 MHz BW, VERTICAL, 15.209 LIMIT

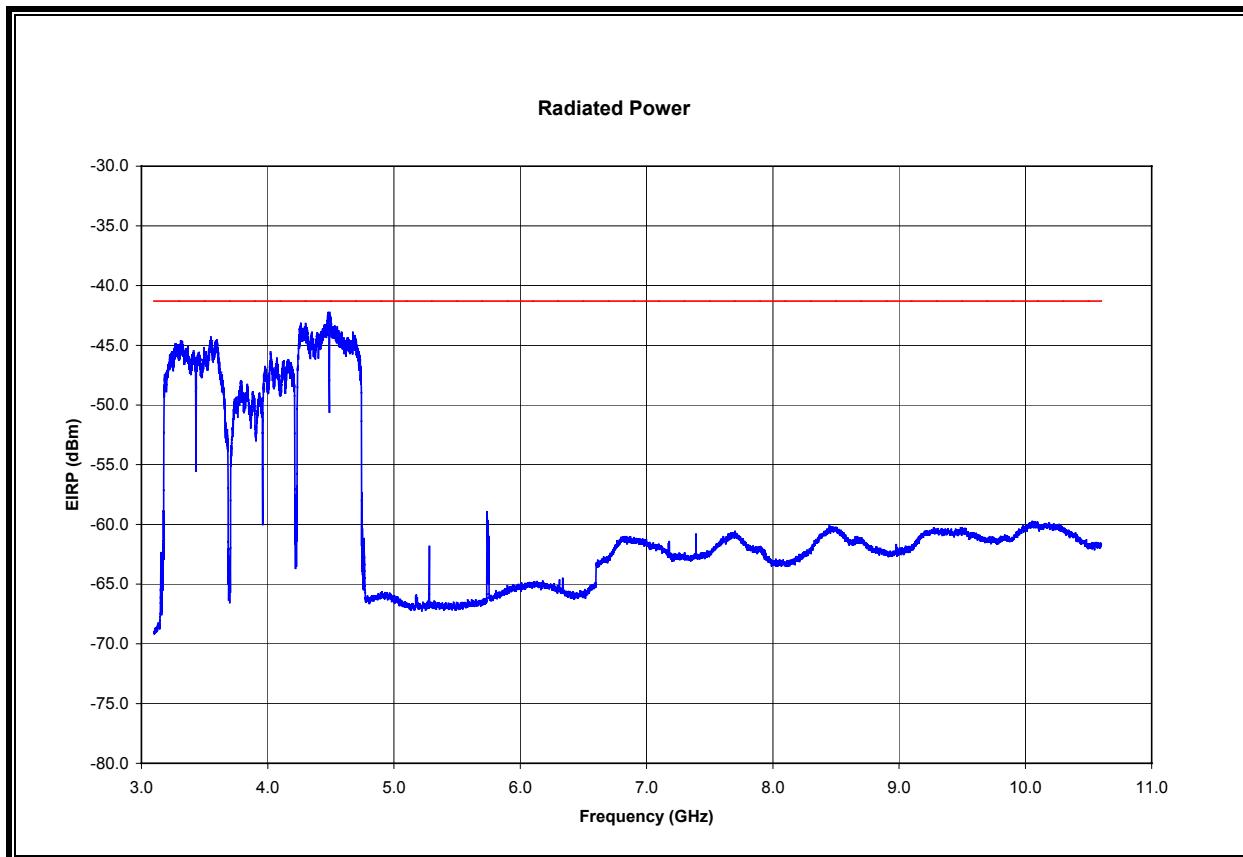


Note: The peak emission is measured above. It is less than the average limit.

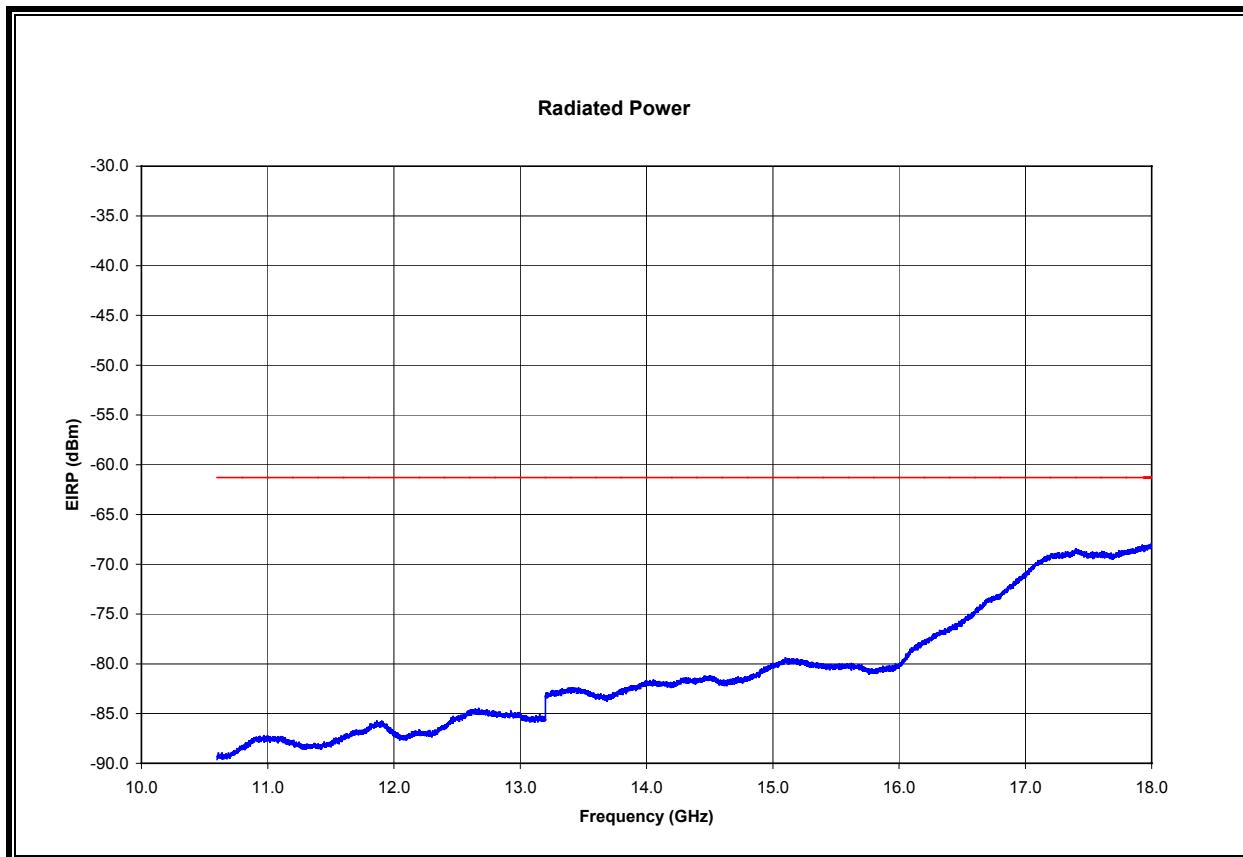
EIRP 3.1 TO 10.6 GHz, 1 MHz BW, HORIZONTAL



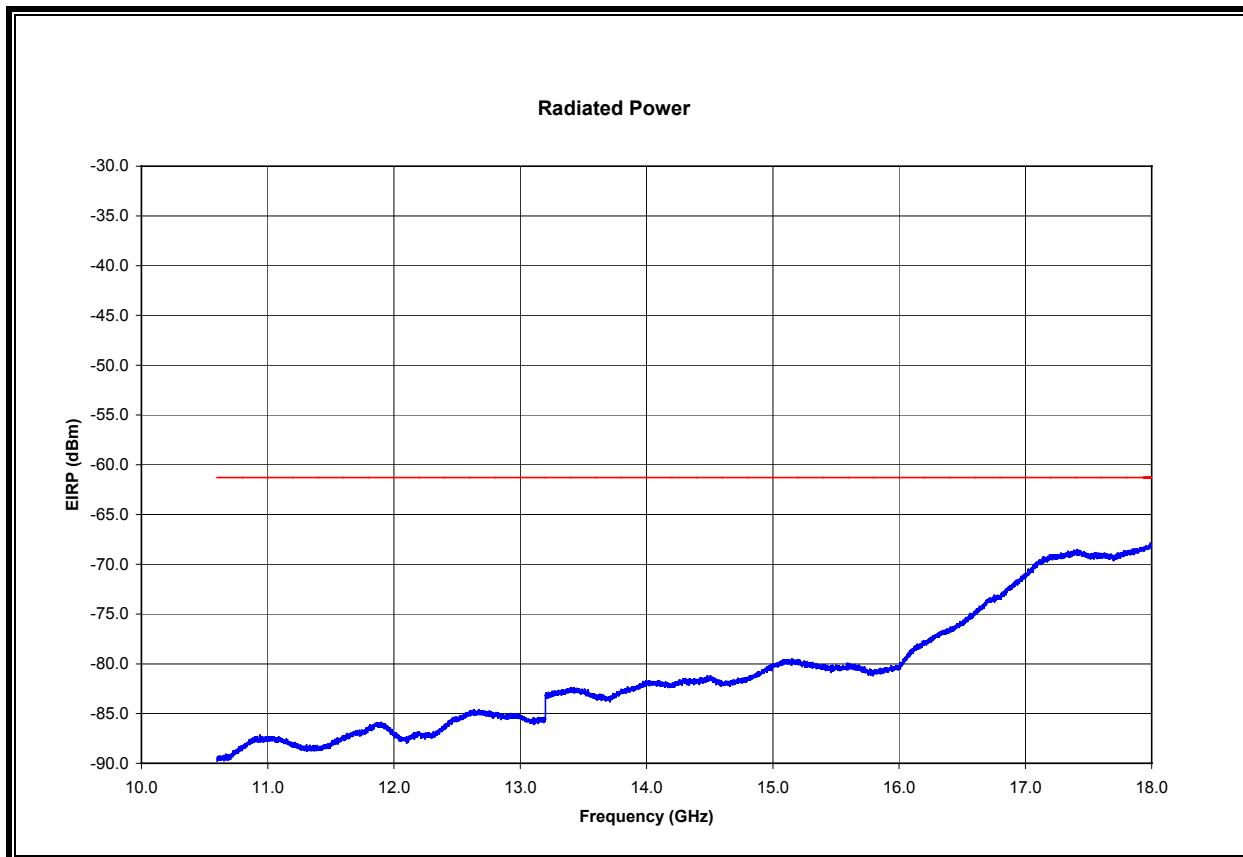
EIRP 3.1 TO 10.6 GHz, 1 MHz BW, VERTICAL



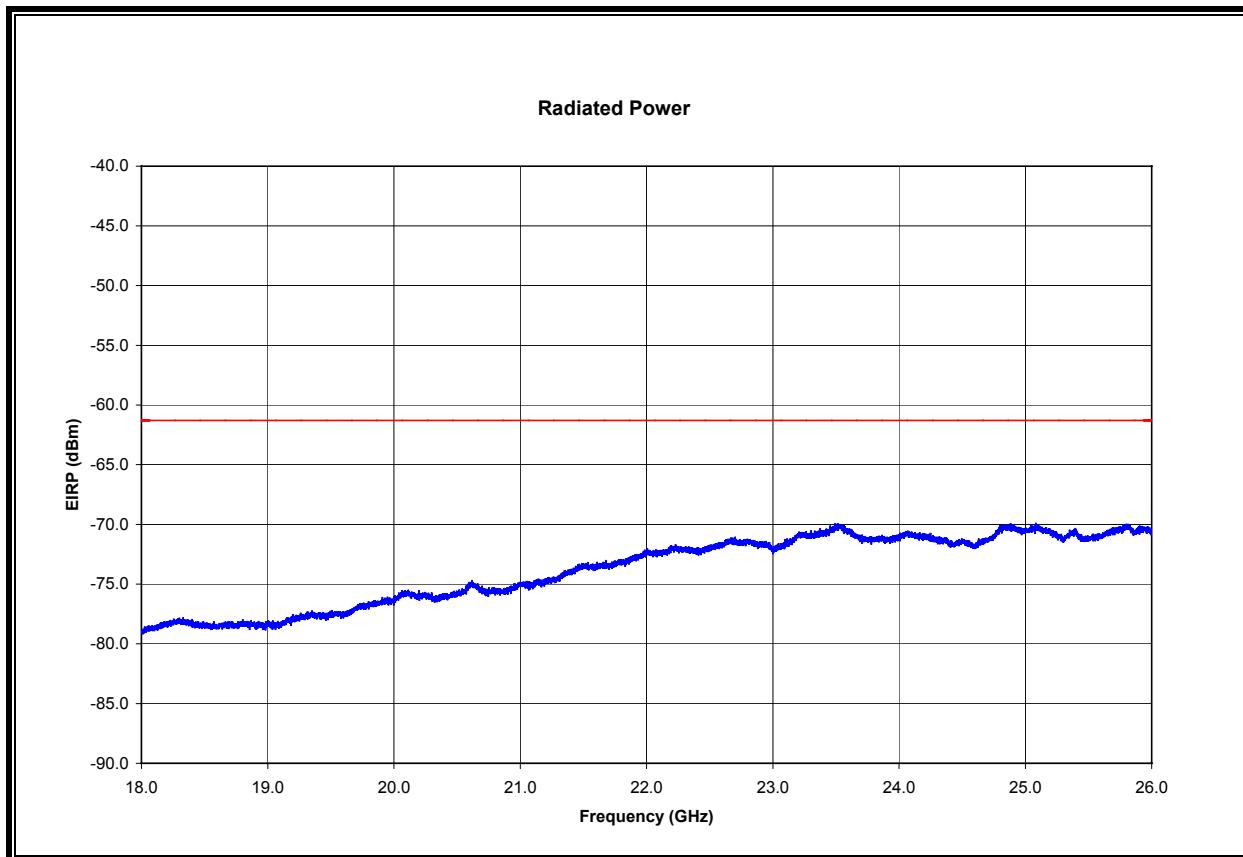
EIRP 10.6 TO 18 GHz, 1 MHz BW, HORIZONTAL



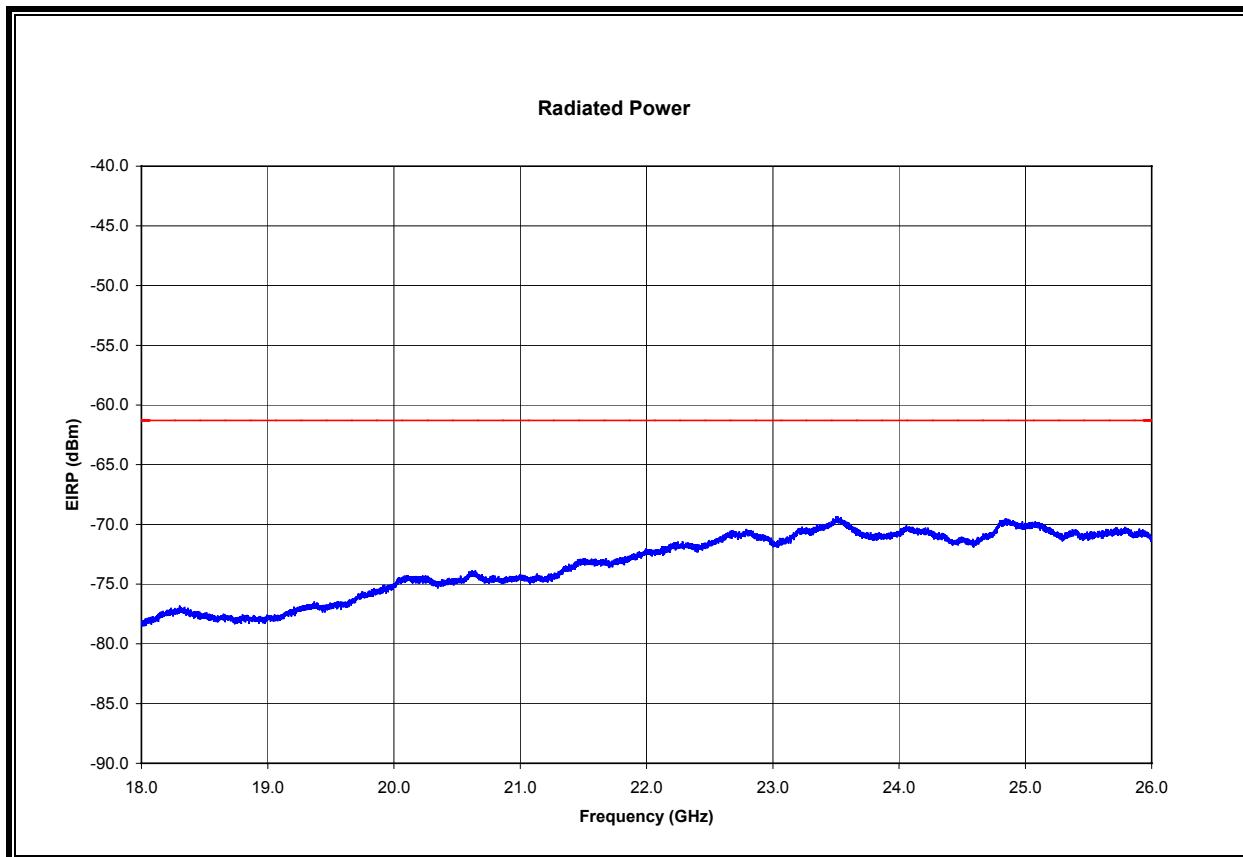
EIRP 10.6 TO 18 GHz, 1 MHz BW, VERTICAL



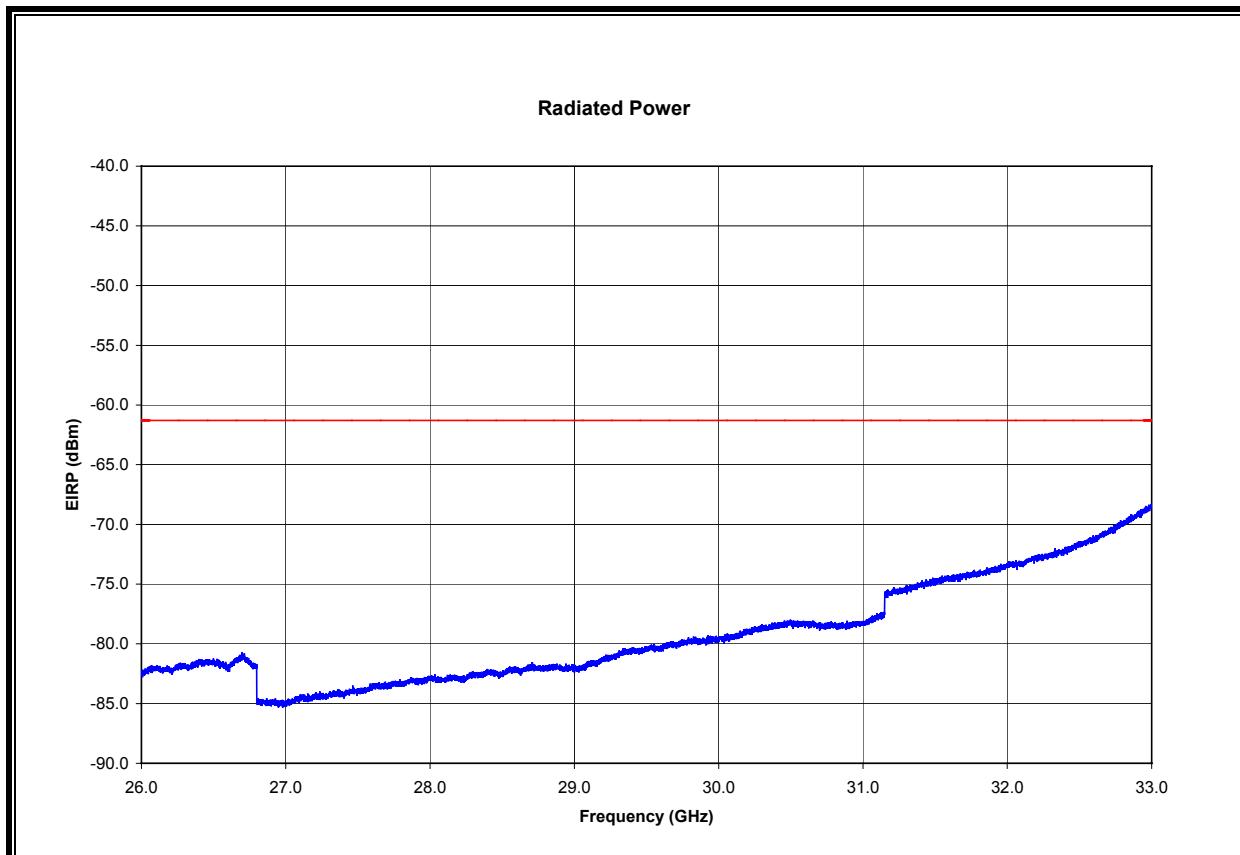
EIRP 18 TO 26 GHz, 1 MHz BW, HORIZONTAL



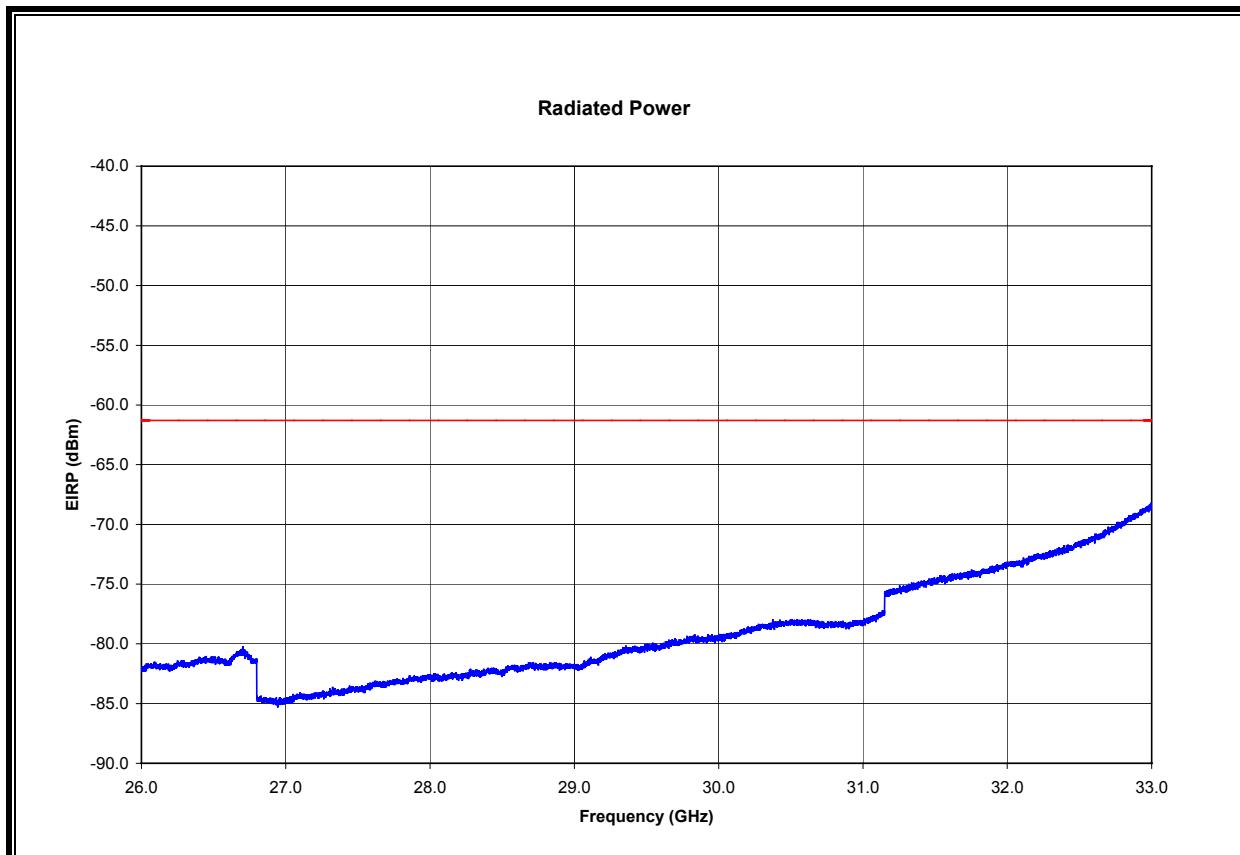
EIRP 18 TO 26 GHz, 1 MHz BW, VERTICAL



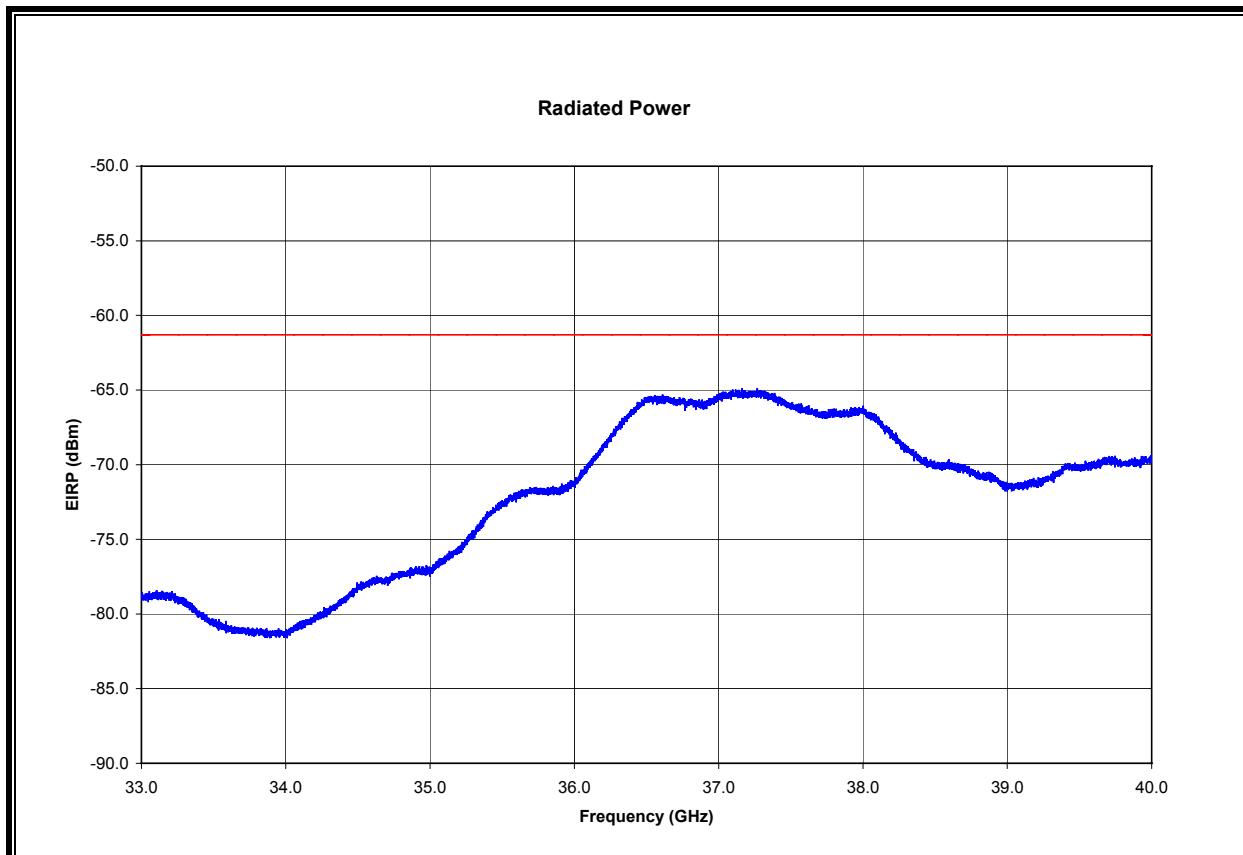
EIRP 26 TO 33 GHz, 1 MHz BW, HORIZONTAL



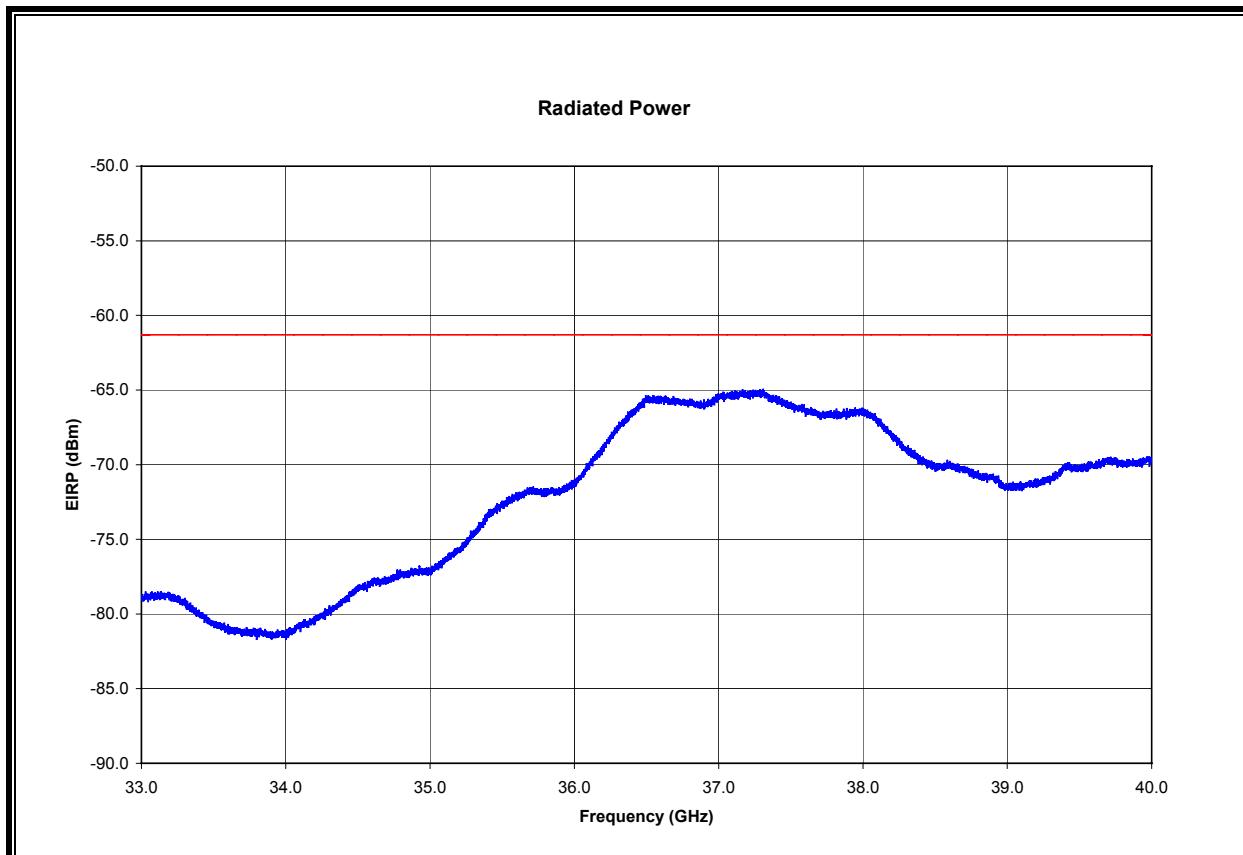
EIRP 26 TO 33 GHz, 1 MHz BW, VERTICAL



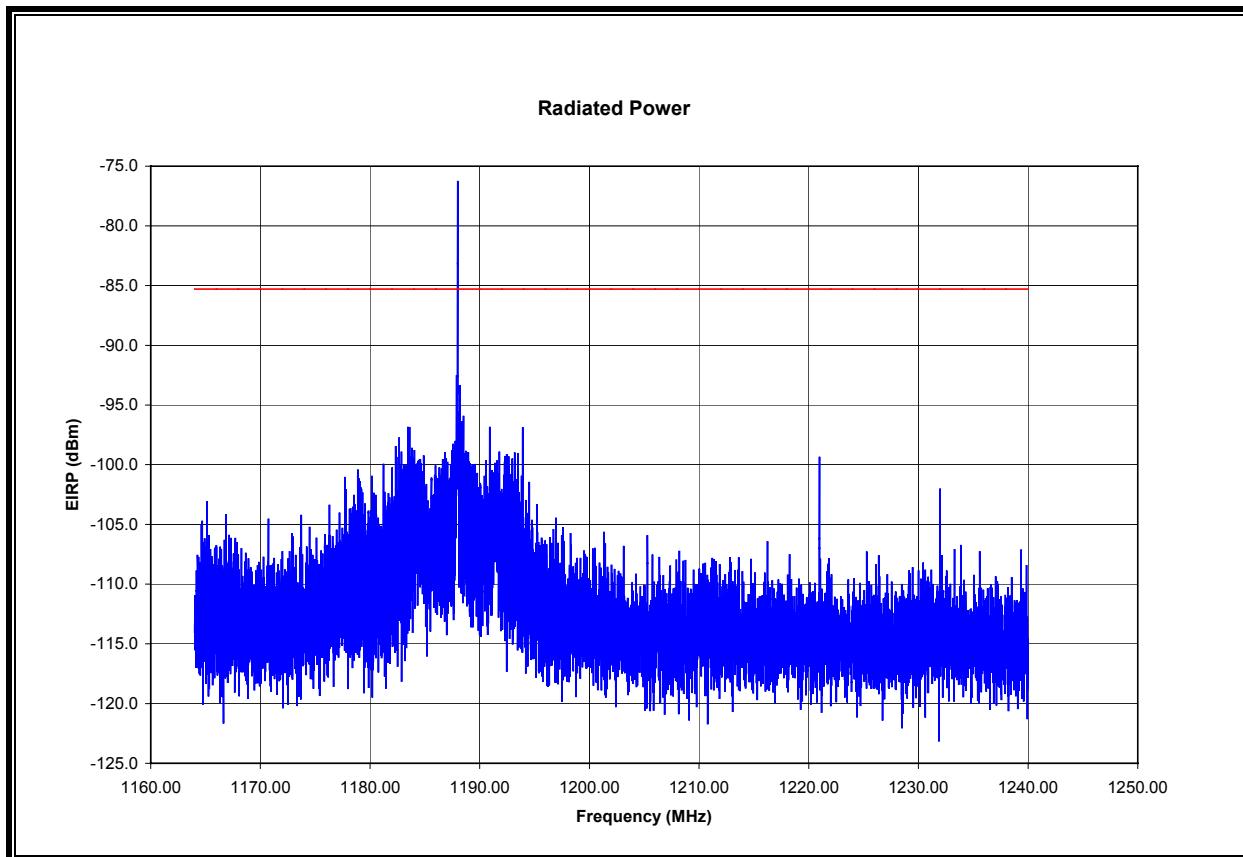
EIRP 33 TO 40 GHz, 1 MHz BW, HORIZONTAL



EIRP 33 TO 40 GHz, 1 MHz BW, VERTICAL

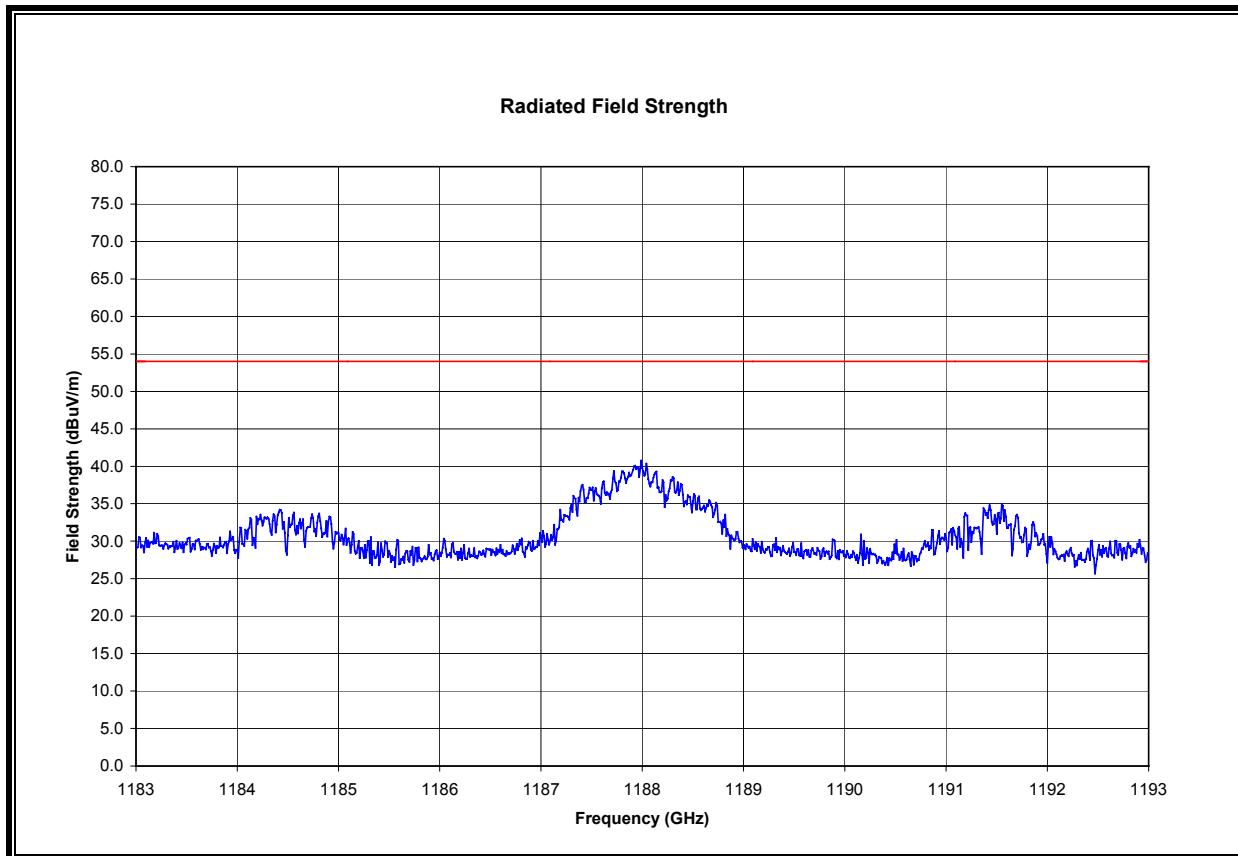


EIRP 1.164 TO 1.240 GHz, 1 kHz BW, HORIZONTAL



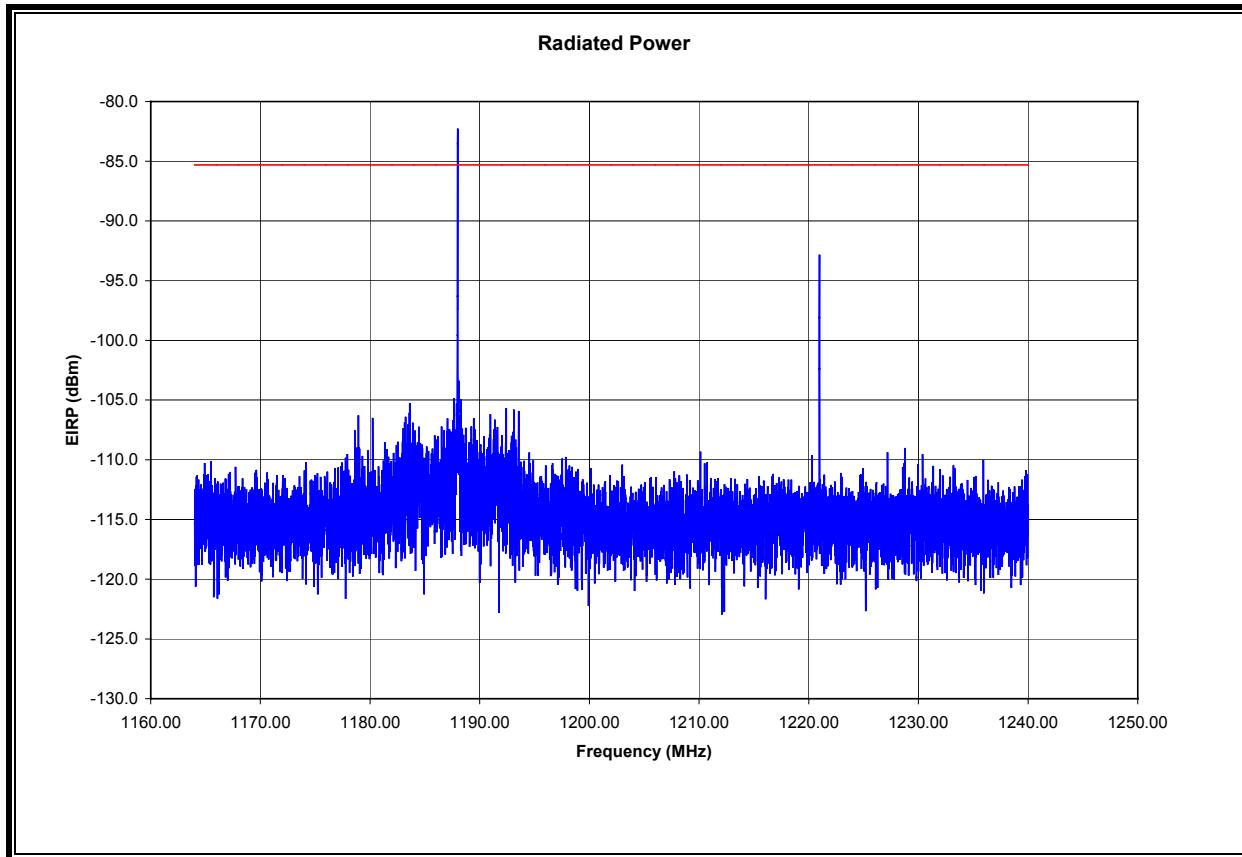
Note: The emission at 1.188 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 1.188 GHz, 1 MHz BW, HORIZONTAL, 15.209 LIMIT



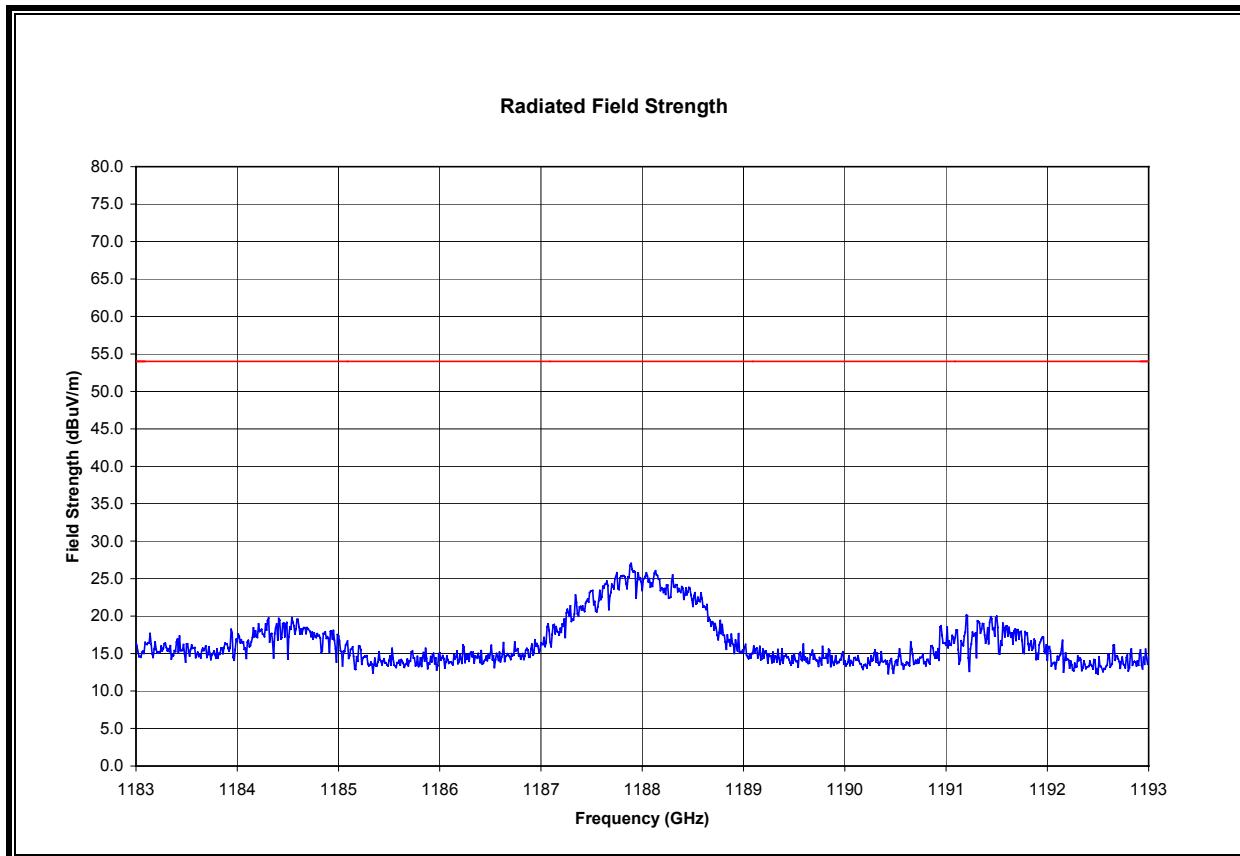
Note: The peak emission is measured above. It is less than the average limit.

EIRP 1.164 TO 1.240 GHz, 1 kHz BW, VERTICAL



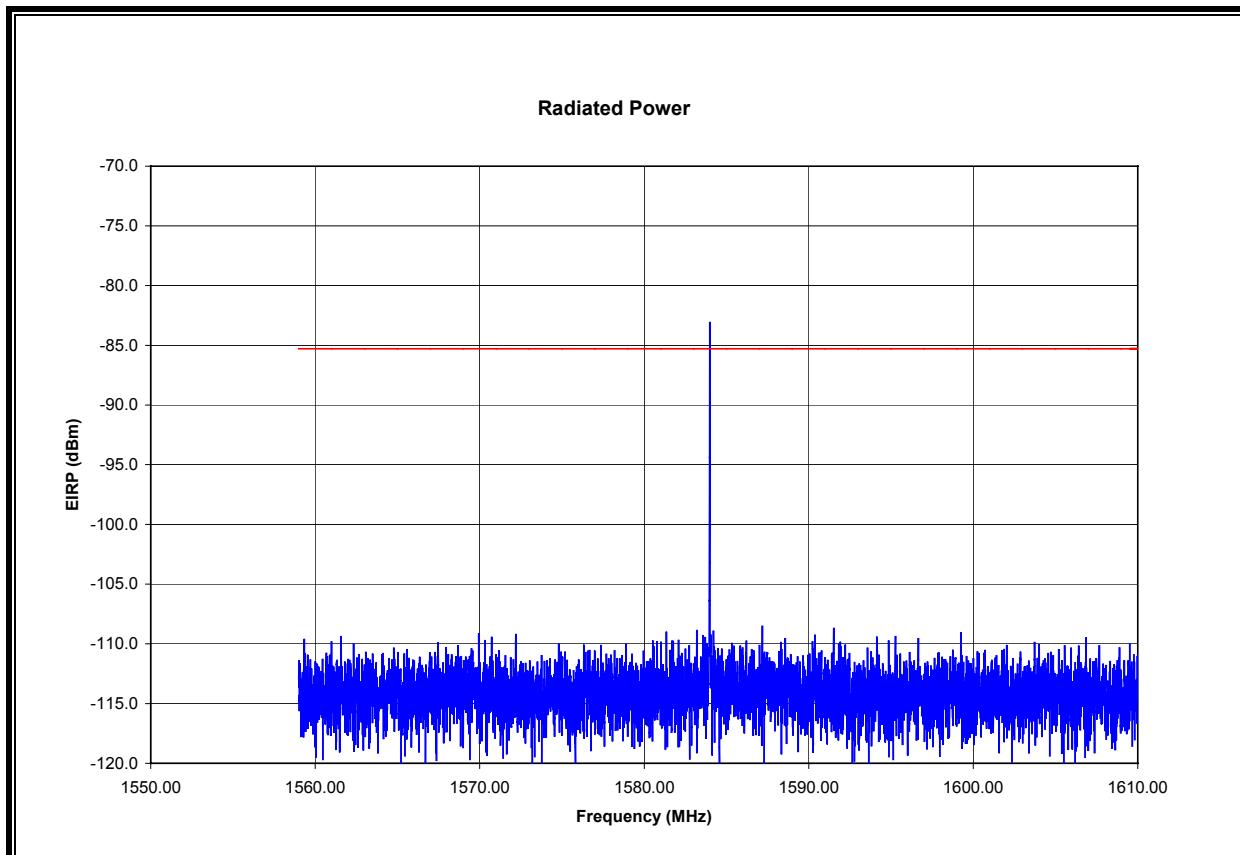
Note: The emission at 1.188 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 1.188 GHz, 1 MHz BW, VERTICAL, 15.209 LIMIT



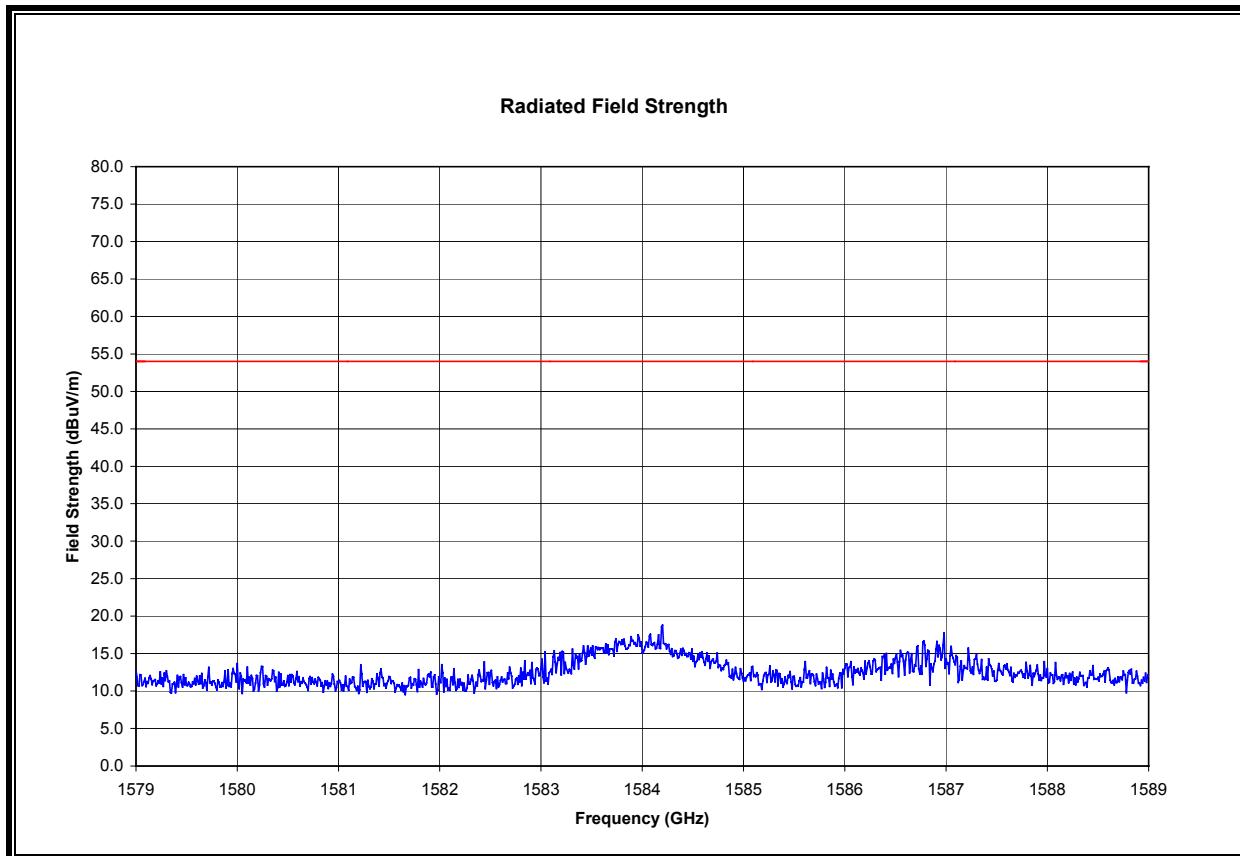
Note: The peak emission is measured above. It is less than the average limit.

EIRP 1.559 TO 1.610 GHz, 1 kHz BW, HORIZONTAL



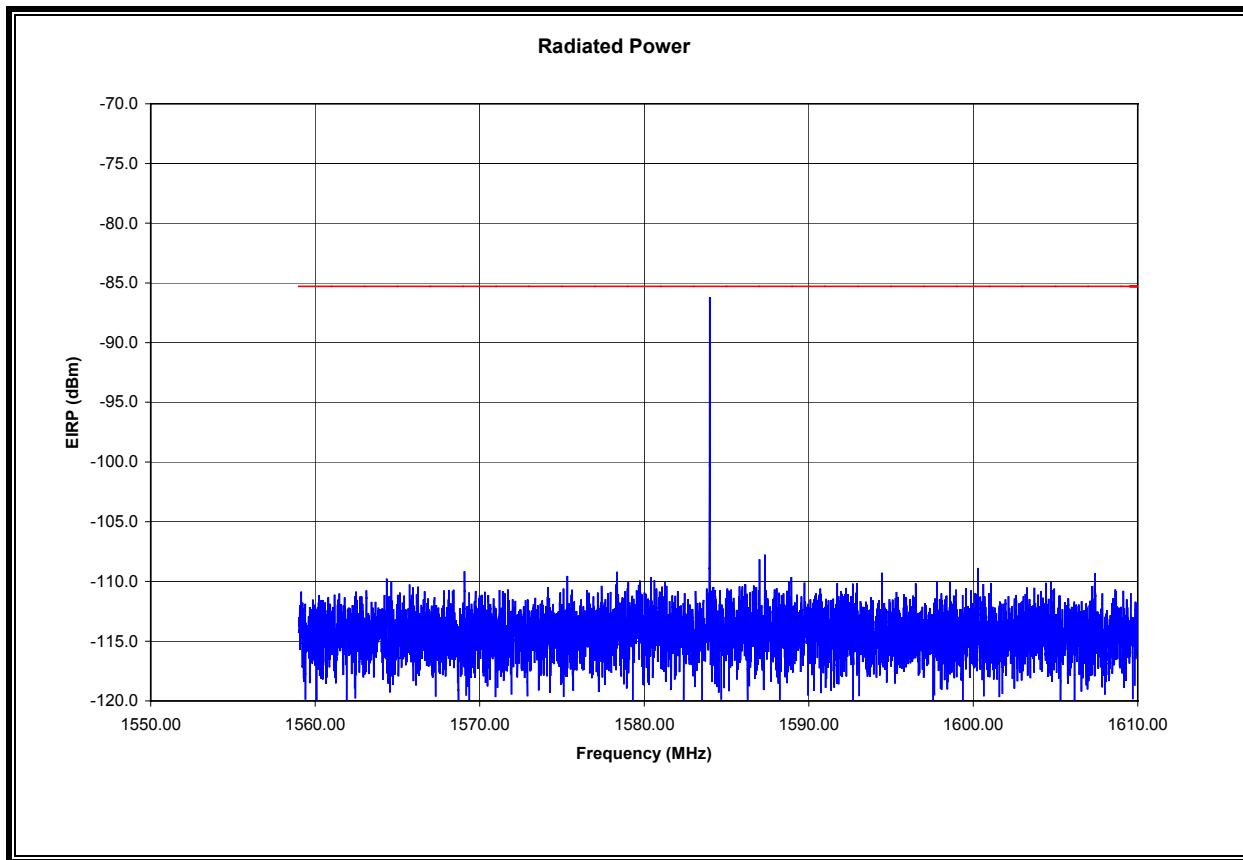
Note: The emission at 1.584 GHz was identified as an emission from digital circuitry used to enable the operation of the UWB transmitter, and is not intended to be radiated from the transmitter's antenna.

FIELD STRENGTH 1.584 GHz, 1 MHz BW, HORIZONTAL, 15.209 LIMIT



Note: The peak emission is measured above. It is less than the average limit.

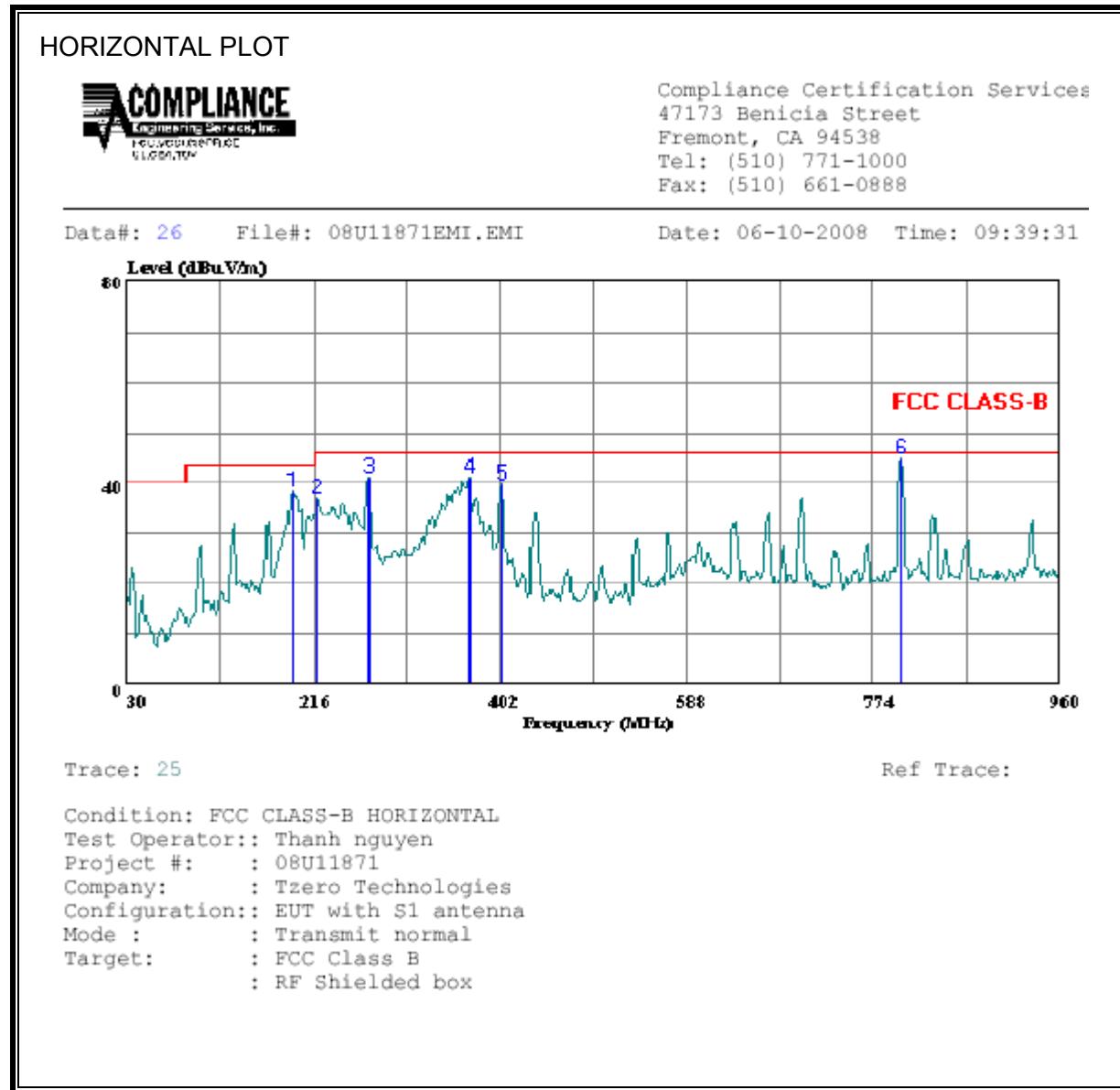
EIRP 1.559 TO 1.610 GHz, 1 kHz BW, VERTICAL



7.4. RADIATED EMISSIONS BELOW 960 MHz

§15.519 (c) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209.

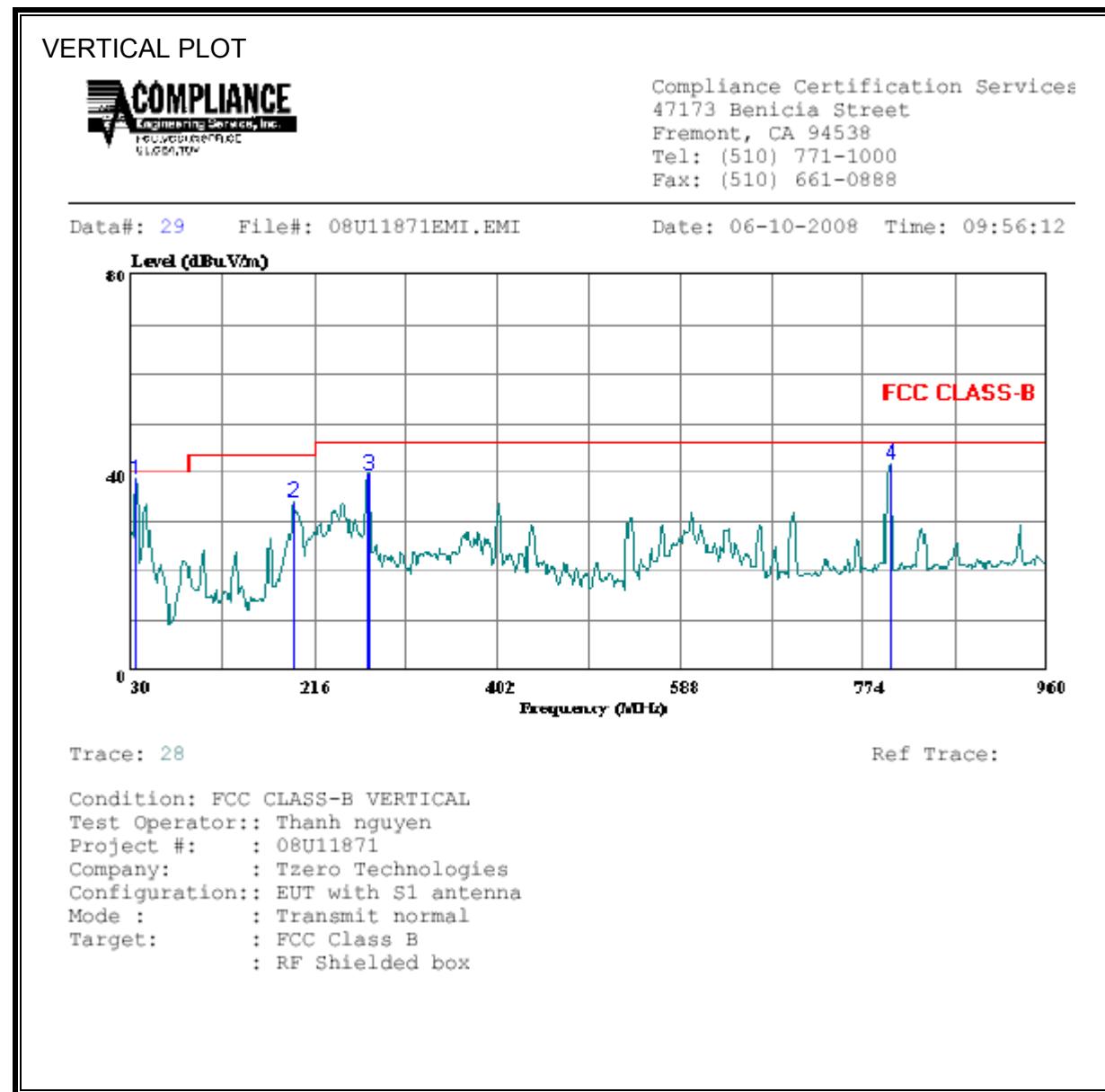
SPURIOUS EMISSIONS 30 TO 960 MHz (HORIZONTAL)



HORIZONTAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV		dB	dBuV/m	dBuV/m	dB
1	194.610	56.25	-17.84	38.41	43.50	-5.09	Peak
2	219.720	55.87	-18.86	37.01	46.00	-8.99	Peak
3	270.870	58.25	-17.01	41.24	46.00	-4.76	Peak
4	371.310	55.21	-14.10	41.11	46.00	-4.89	Peak
5	403.860	53.01	-13.30	39.71	46.00	-6.29	Peak
6	800.970	51.72	-6.86	44.86	46.00	-1.14	Peak

SPURIOUS EMISSIONS 30 TO 960 MHz (VERTICAL)



VERTICAL DATA

Freq	Read		Level	Limit	Over	Limit	Remark
	Level	Factor					
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	33.720	50.09	-11.32	38.77	40.00	-1.23	Peak
2	194.610	52.14	-17.84	34.30	43.50	-9.20	Peak
3	270.870	56.84	-17.01	39.83	46.00	-6.17	Peak
4	800.970	48.92	-6.86	42.06	46.00	-3.94	Peak

7.5. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 [*]	56 to 46 [*]
0.5-5	56	46
5-30	60	50

^{*} Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

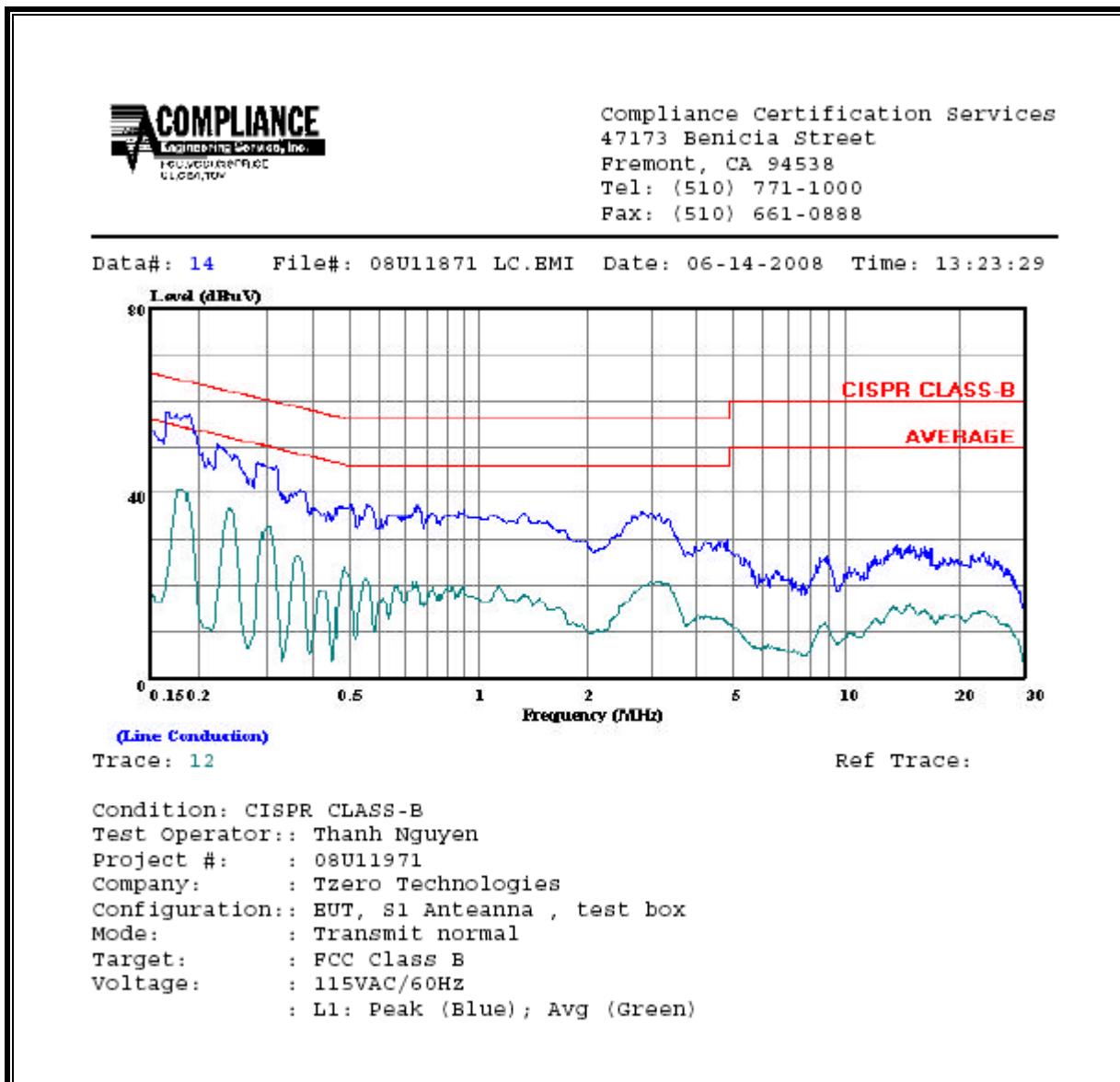
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq. (MHz)	Reading			Closs (dB)	Limit	EN_B	Margin		Remark
	PK (dBuV)	QP (dBuV)	AV (dBuV)				QP (dB)	AV (dB)	
0.19	56.98	--	40.92	0.00	64.08	54.08	-7.10	-13.16	L1
0.22	50.41	--	36.50	0.00	62.67	52.67	-12.26	-16.17	L1
0.29	46.55	--	33.03	0.00	60.67	50.67	-14.12	-17.64	L1
0.17	58.97	--	42.51	0.00	64.77	54.77	-5.80	-12.26	L2
0.25	51.60	--	35.23	0.00	61.89	51.89	-10.29	-16.66	L2
3.64	37.15	--	22.04	0.00	56.00	46.00	-18.85	-23.96	L2
6 Worst Data									

LINE 1 RESULTS



LINE 2 RESULTS

