



**FCC CFR47 PART 15 SUBPART C**

**CERTIFICATION TEST REPORT**

**FOR**

**2.4 GHz Wireless Temperature Sensor / Thermostat**

**MODEL NUMBER: WT-21**

**FCC ID: TF7WT-21-1000**

**REPORT NUMBER: 08U11843-1**

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**NVLAP LAB CODE 200065-0**

Revision History

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** EVEREX COMMUNICATIONS  
5020A BRANDIN CT.  
FREMONT, CA 94538, U.S.A.

**EUT DESCRIPTION:** 2.4 GHz Wireless Temperature Sensor / Thermostat

**MODEL:** WT-21

**SERIAL NUMBER:** 02172

**DATE TESTED:** MAY 27-29, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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:

Tested By:



FRANK IBRAHIM  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES



TOM CHEN  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, 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
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a battery powered or 24VAC powered, IEEE 802.15.4 wireless temperature sensor/thermostat, operating in 2.4Ghz ISM band.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2405 - 2480	802.15.4	3.74	2.37

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Dipole antenna, with a maximum gain of 2 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The test utility software used is WT-21-FCC-Test v1.0.0

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. The highest output was power was measured at low channel; therefore, radiated emissions 30-1000 MHz and power line conducted emissions were performed with EUT tuned to low channel (2405 MHz).

## 5.6. DESCRIPTION OF TEST SETUP

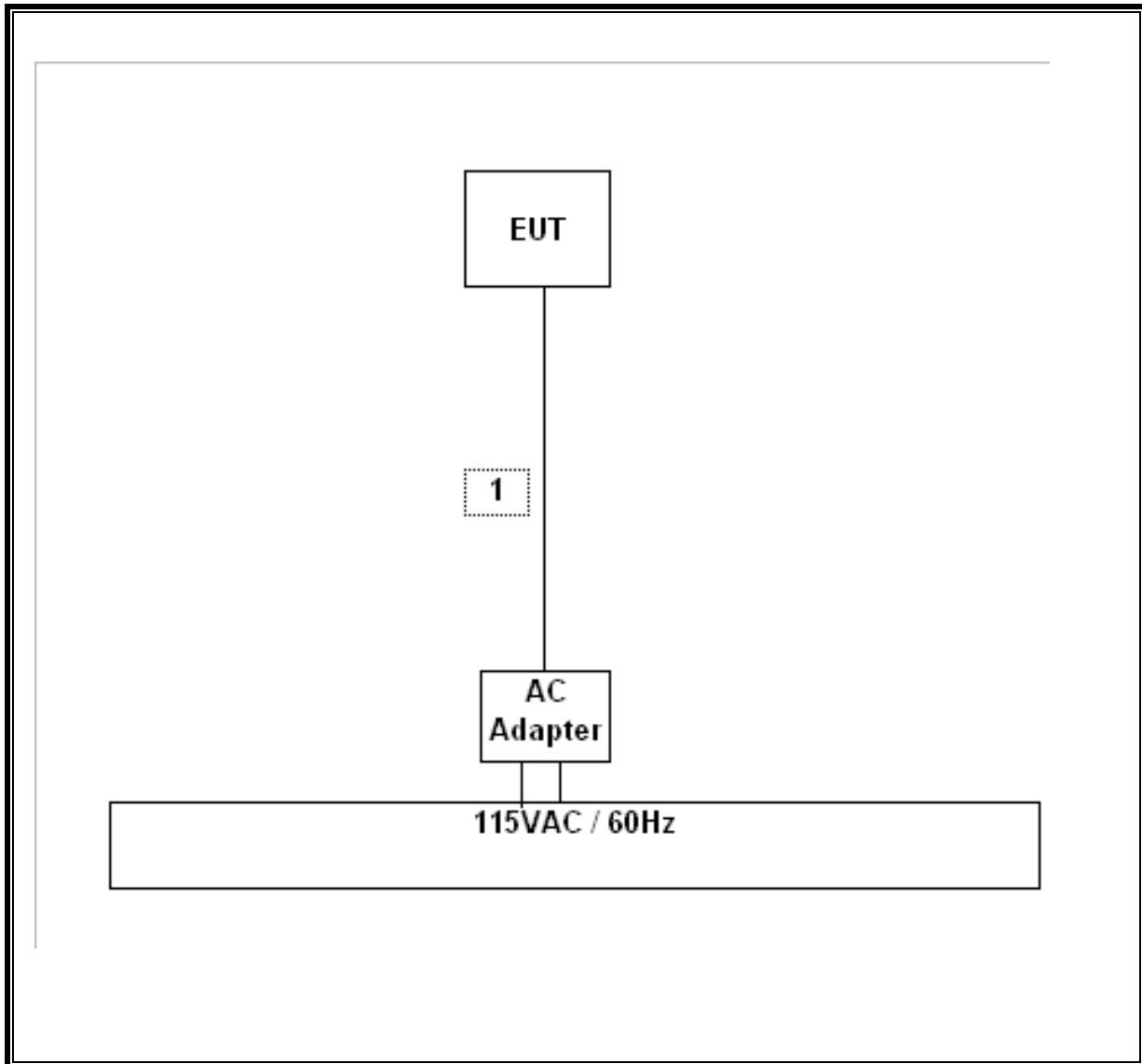
### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter	MG Electronics	MGT2420	N/A	Doc

### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	N/A	Un-shield	1.5m	N/A

**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	Asset	Cal Date	Cal Due
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	02/06/08	08/06/09
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/07	10/25/08
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	09/28/07	09/28/08
Power Sensor, 18 GHz	Agilent / HP	8481A	N02782	06/12/07	08/22/08
Power Meter	Agilent / HP	438A	C01068	03/20/07	06/20/08
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00872	04/22/08	04/22/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	08/03/07	09/27/08
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	10/11/07	10/11/08
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	02/06/07	06/12/08
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	02/06/07	06/12/08
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	09/29/07	09/28/08

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

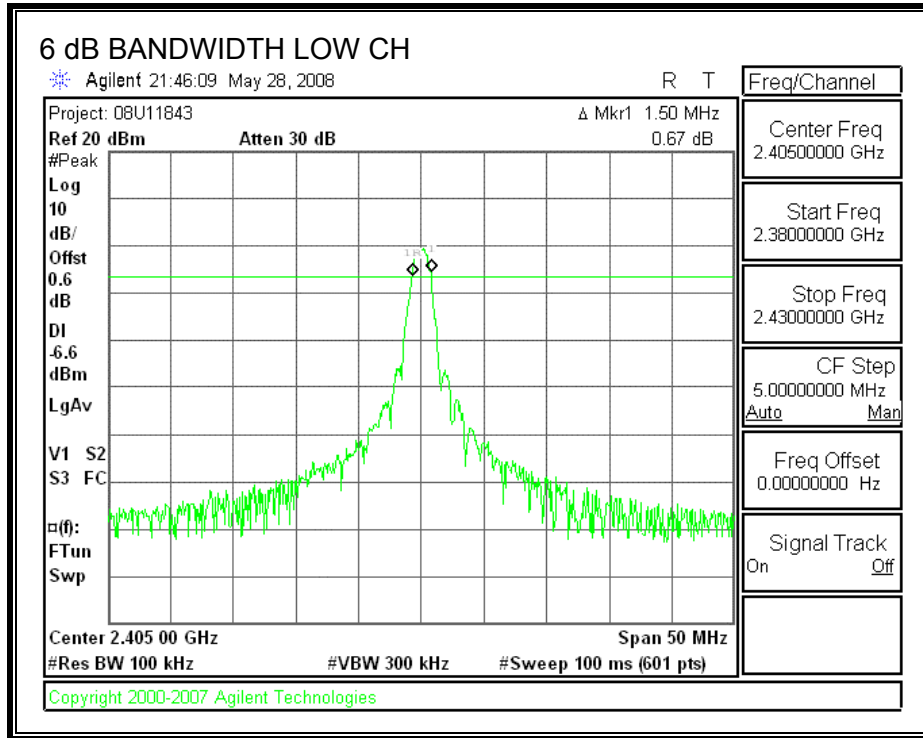
#### TEST PROCEDURE

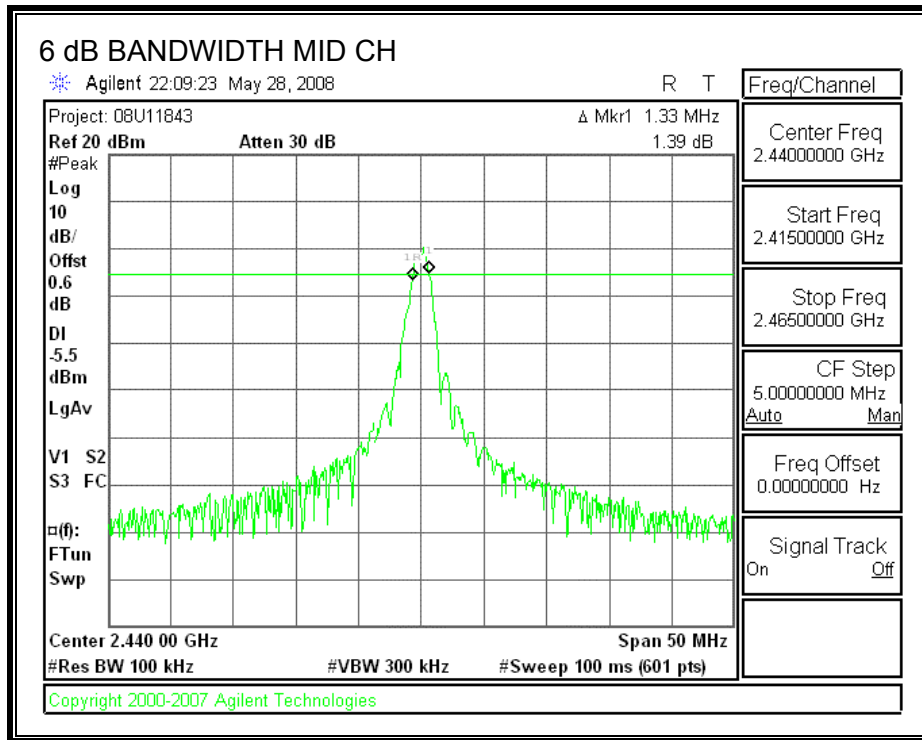
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

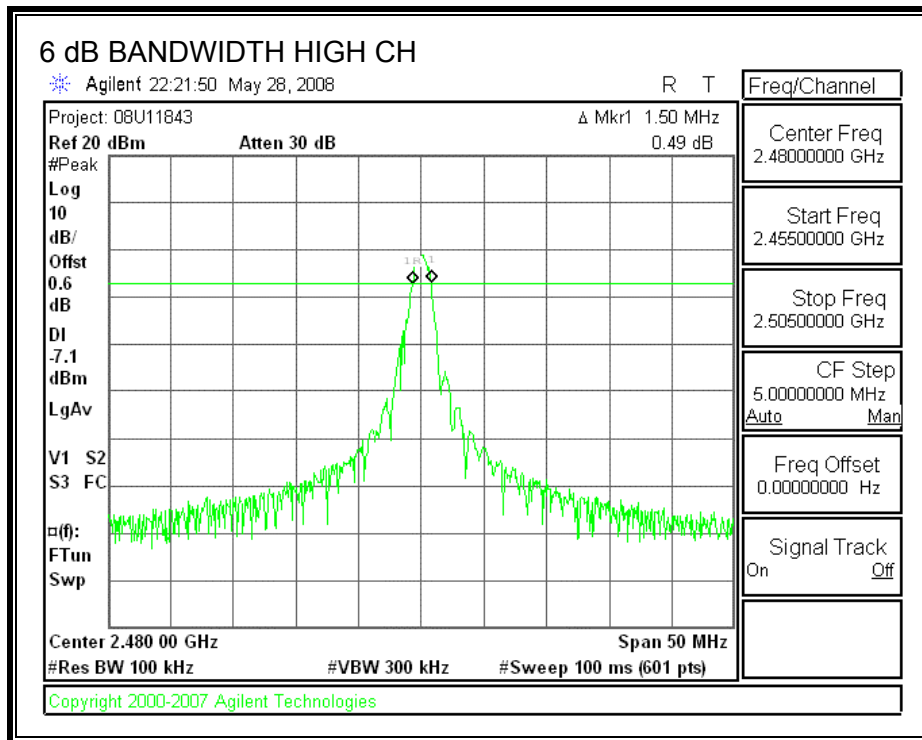
#### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.50	0.5
Middle	2440	1.33	0.5
High	2480	1.50	0.5

**6 dB BANDWIDTH**







## 7.2. OUTPUT POWER

### LIMITS

FCC §15.247 (b)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

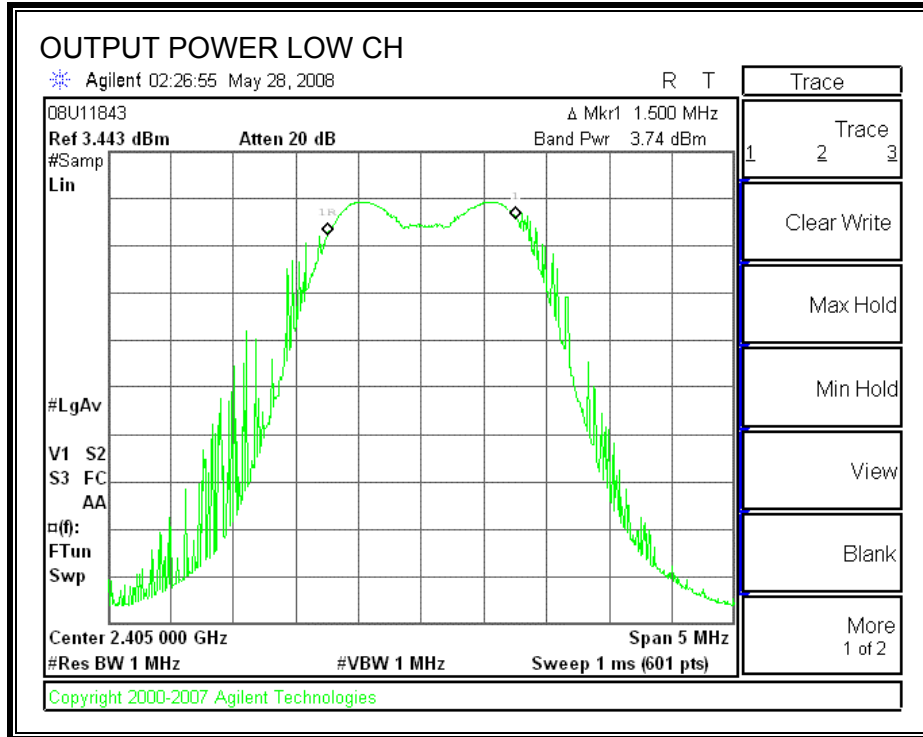
### TEST PROCEDURE

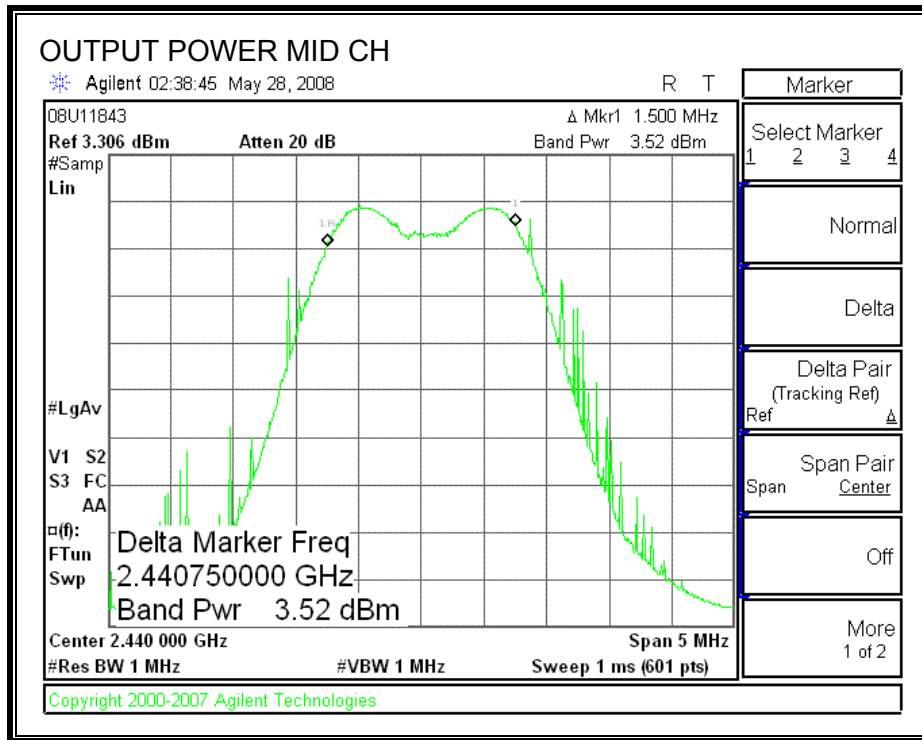
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

### RESULTS

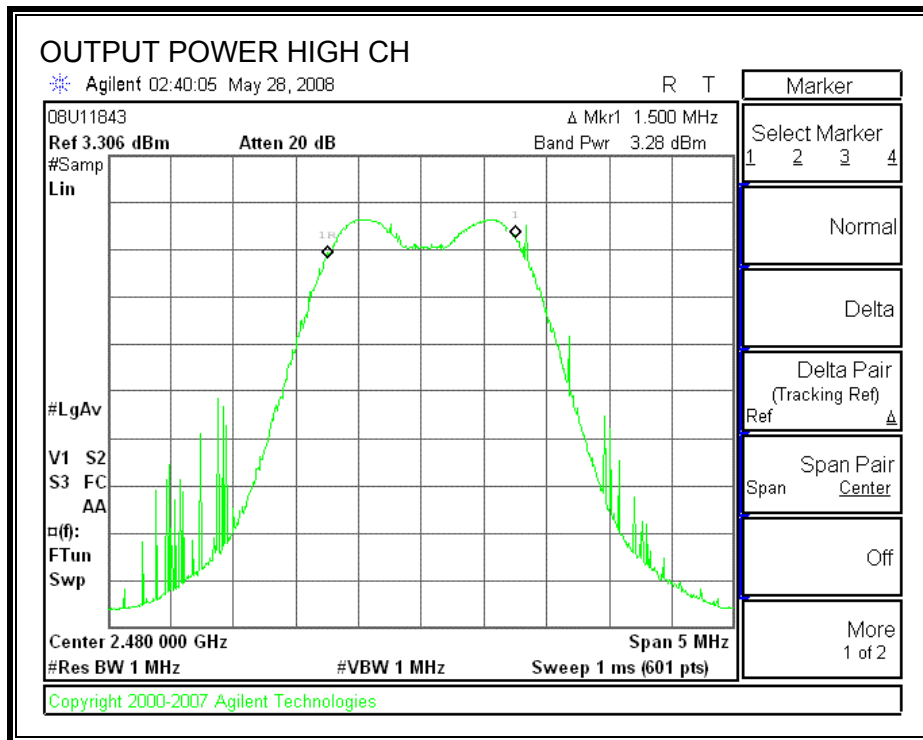
Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	3.74	0.6	4.34	30	-25.66
Middle	2440	3.52	0.6	4.12	30	-25.88
High	2480	3.28	0.6	3.88	30	-26.12

**OUTPUT POWER**









### 7.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

#### RESULTS

The cable assembly insertion loss of 0.6 dB (0.6 dB cable loss) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2405	0.64
Middle	2440	0.61
High	2480	0.52

## 7.4. POWER SPECTRAL DENSITY

### LIMITS

FCC §15.247 (e)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

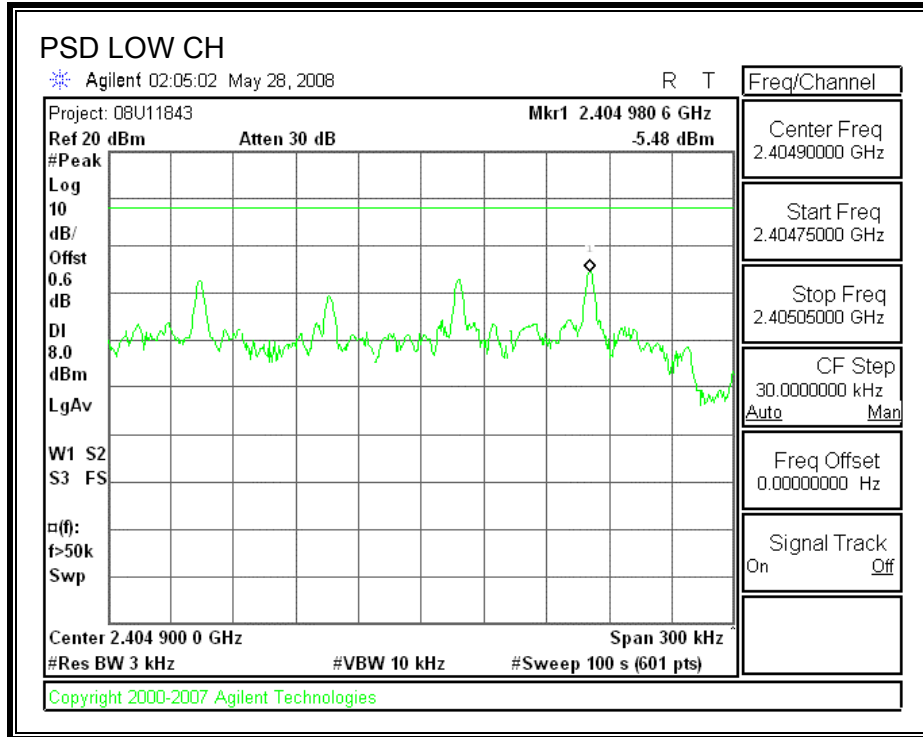
### TEST PROCEDURE

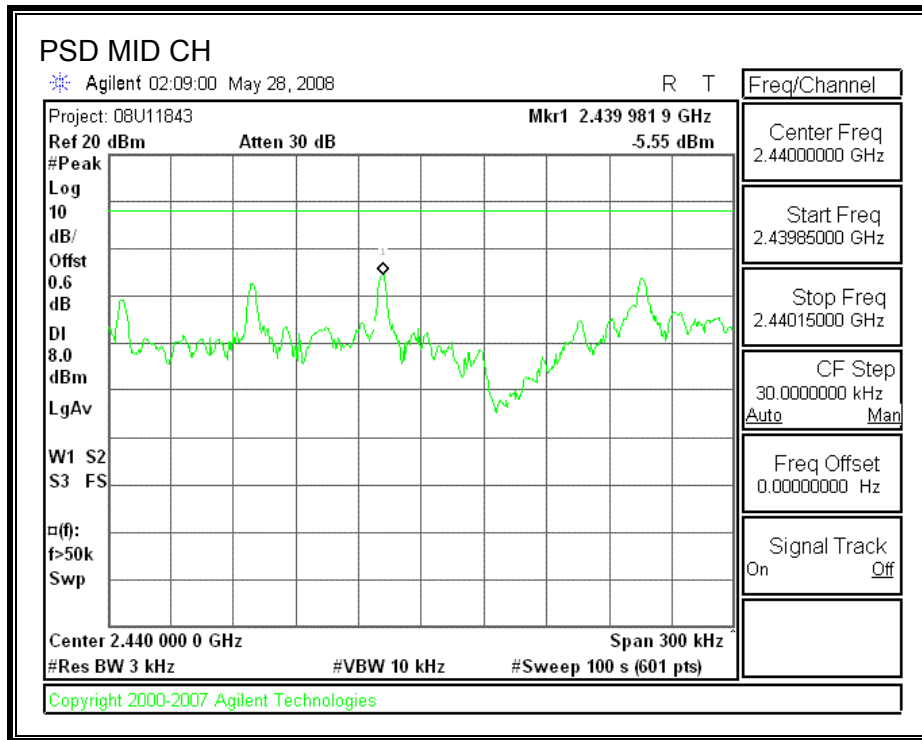
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

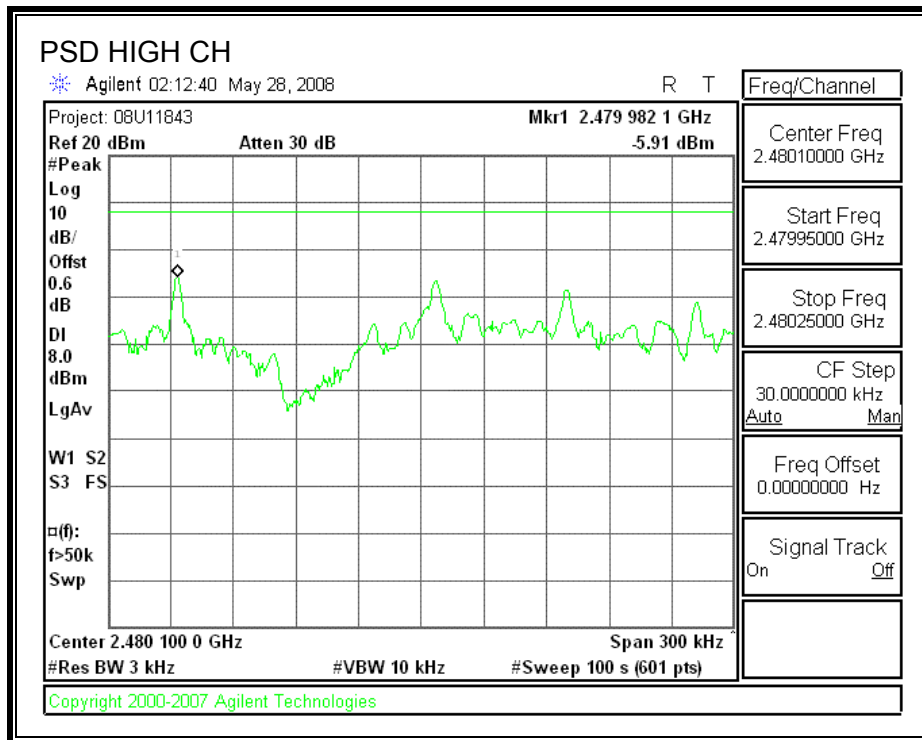
### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2405	-5.48	8	-13.48
Middle	2440	-5.55	8	-13.55
High	2480	-5.91	8	-13.91

**POWER SPECTRAL DENSITY**







## **7.5. CONDUCTED SPURIOUS EMISSIONS LIMITS**

FCC §15.247 (d)

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

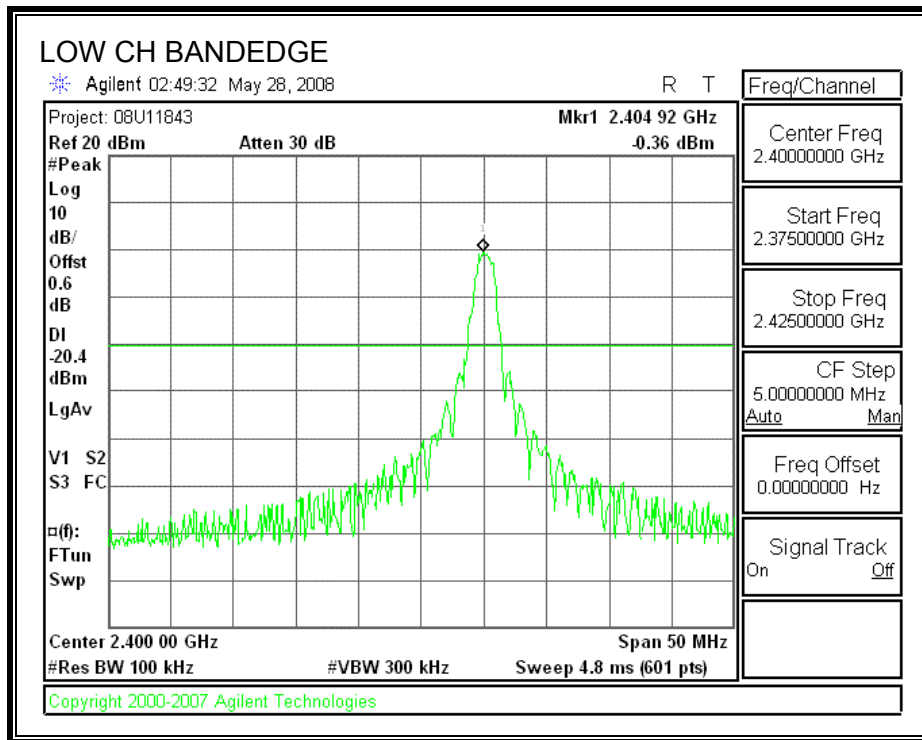
### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

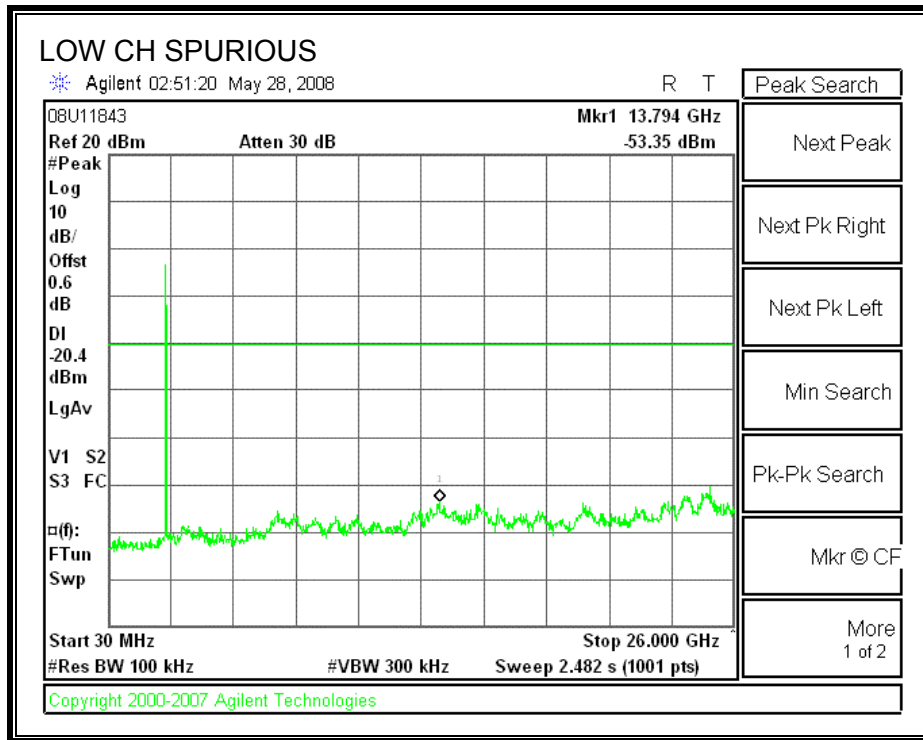
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

**RESULTS**

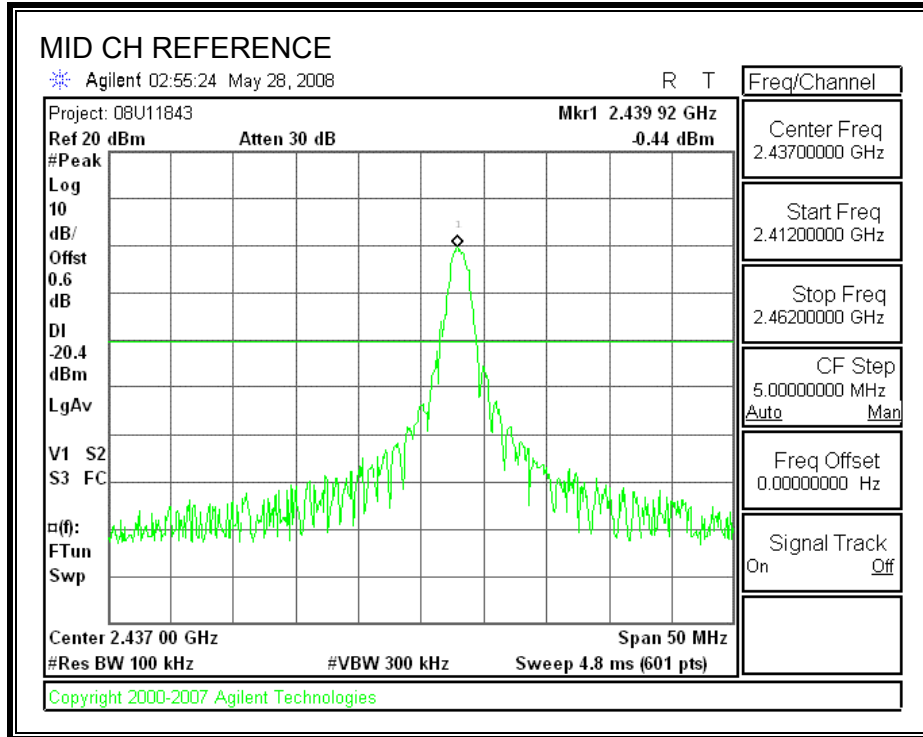
**SPURIOUS EMISSIONS, LOW CHANNEL**

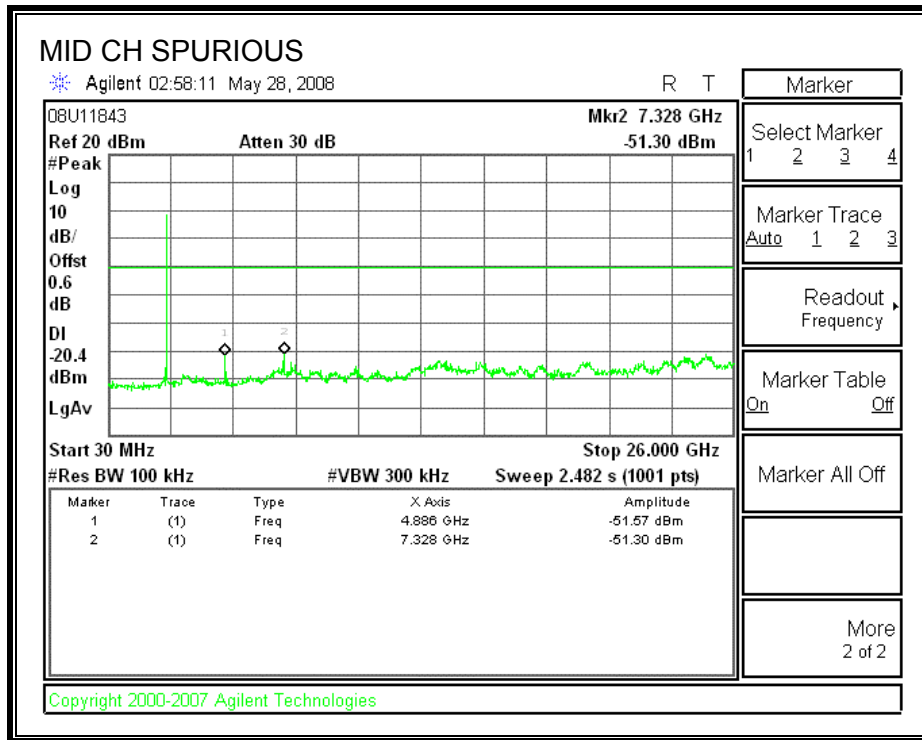




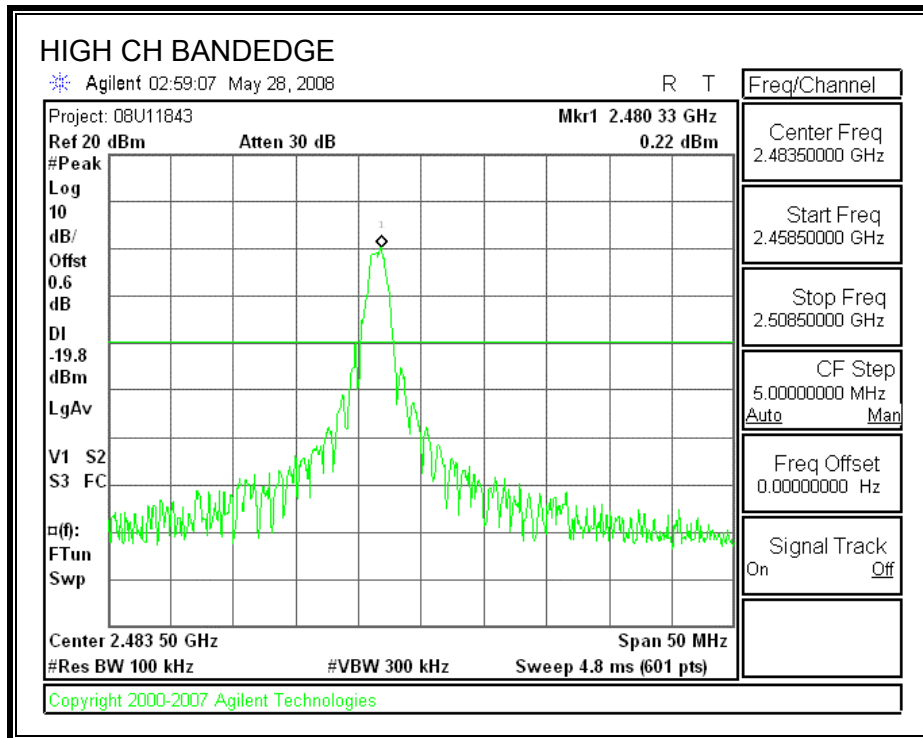


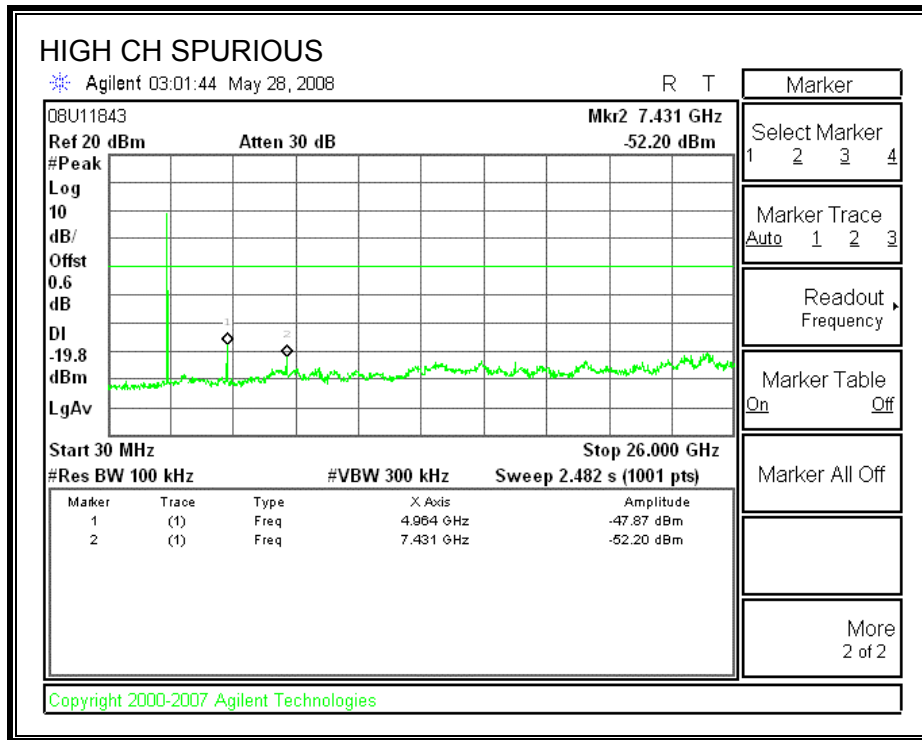
**SPURIOUS EMISSIONS, MID CHANNEL**





**SPURIOUS EMISSIONS, HIGH CHANNEL**





## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

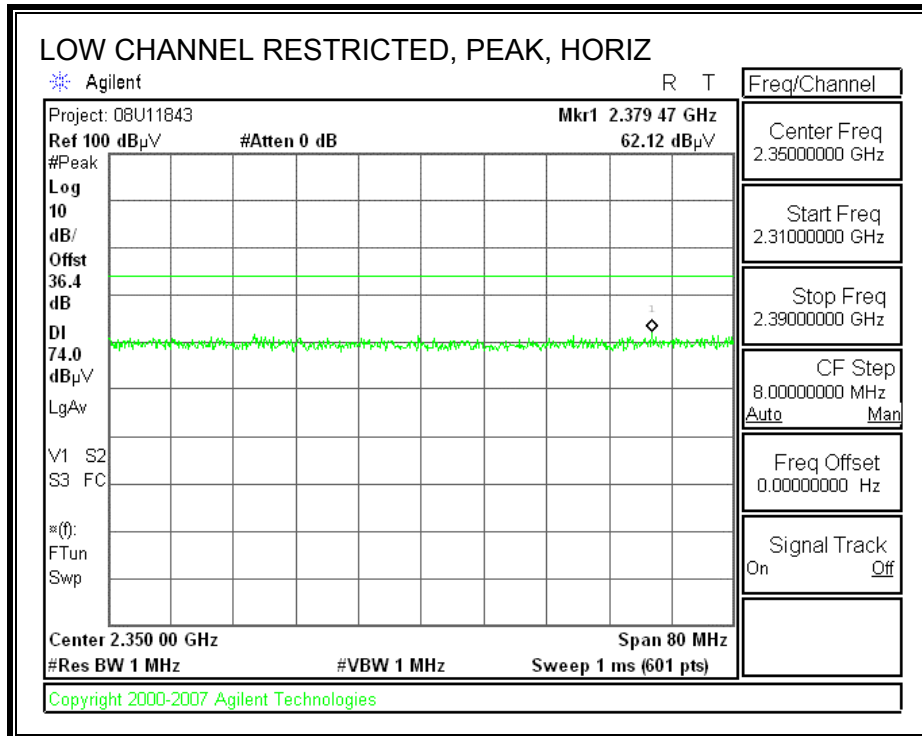
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

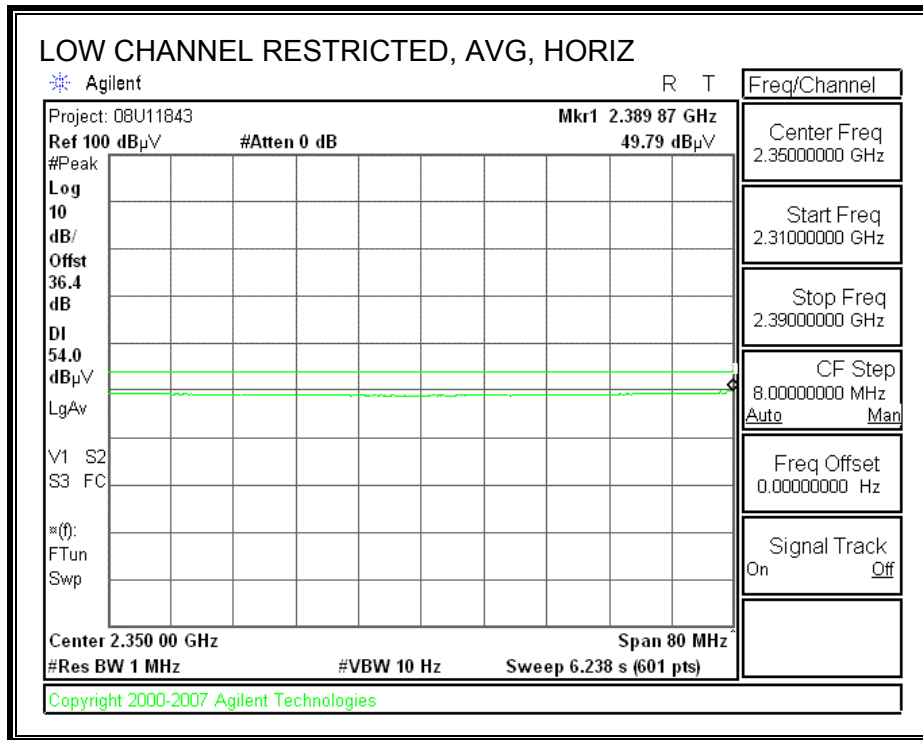
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

## 8.2. TRANSMITTER ABOVE 1 GHz

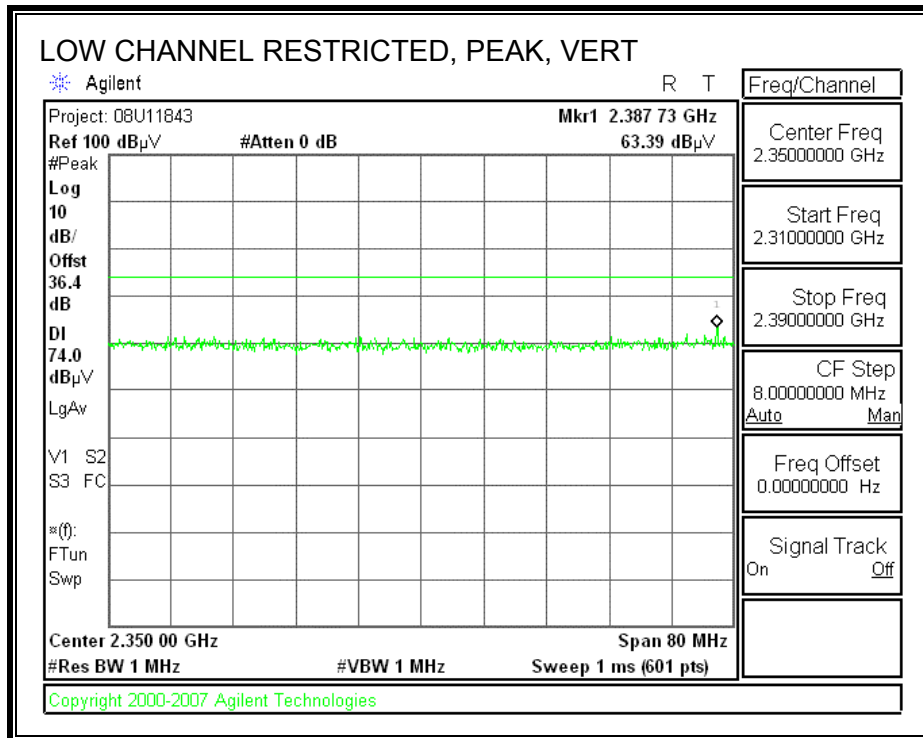
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

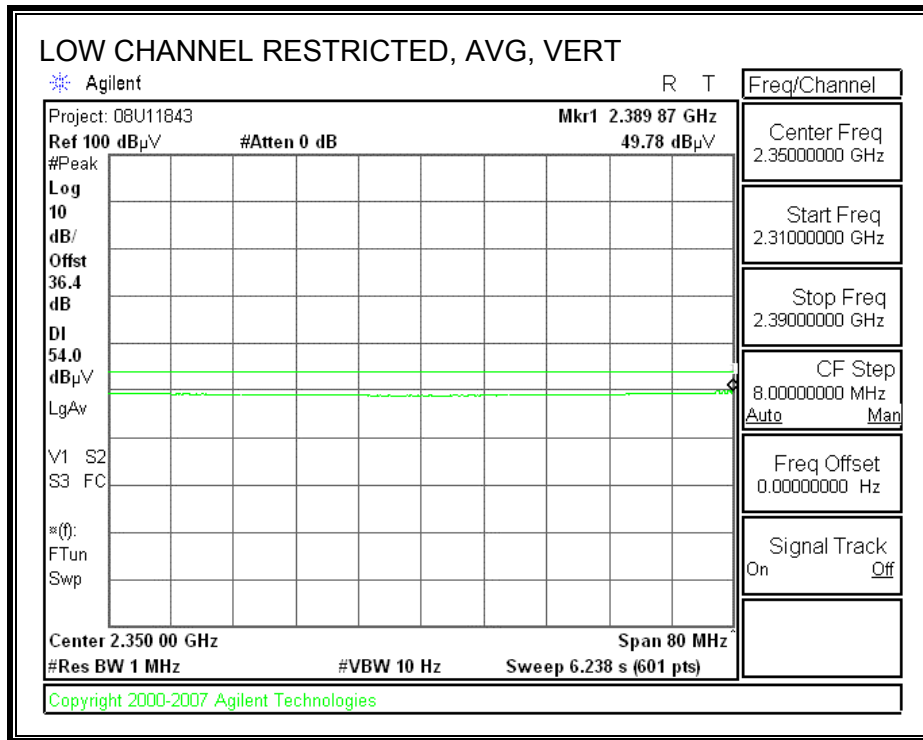




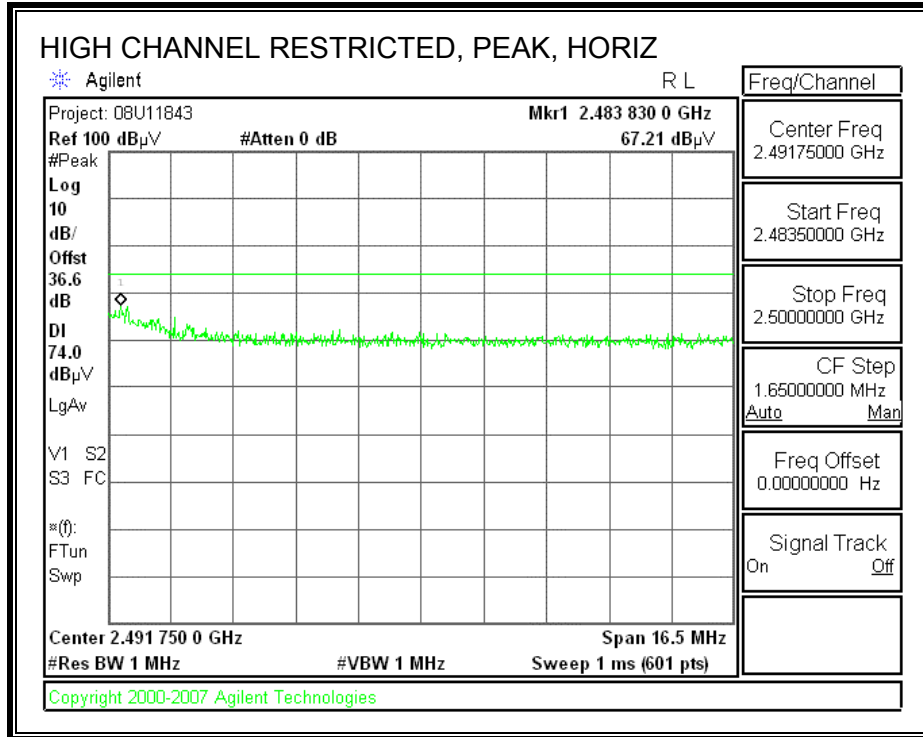


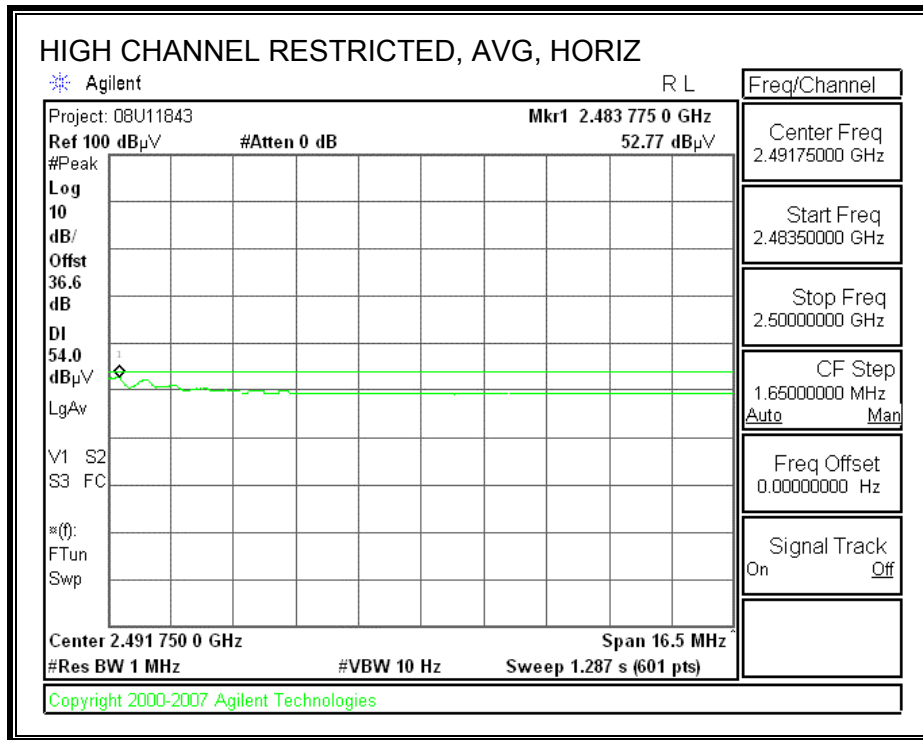
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



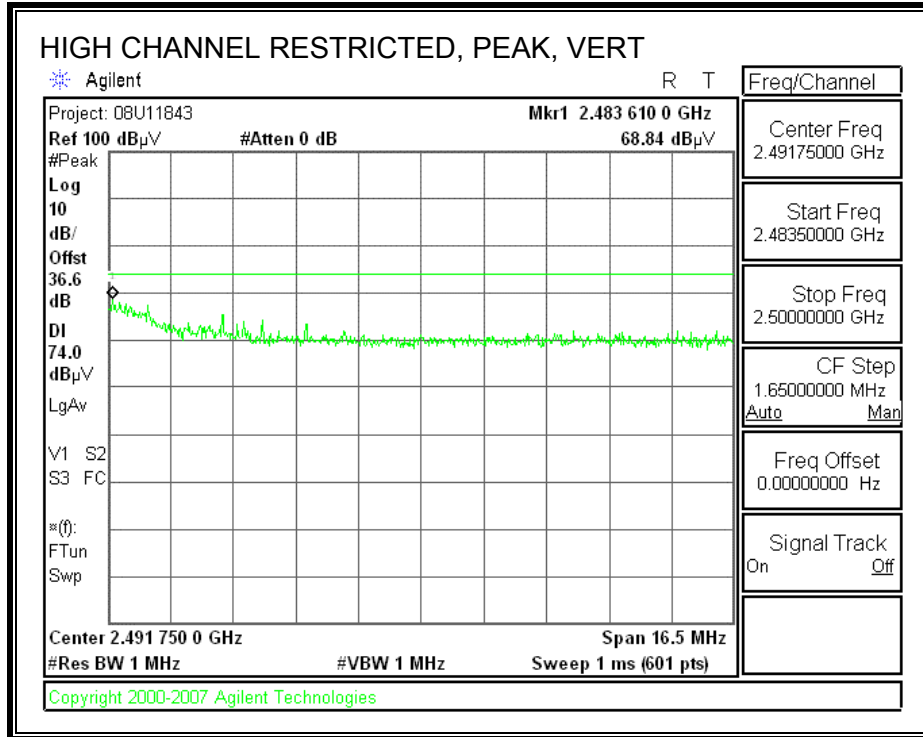


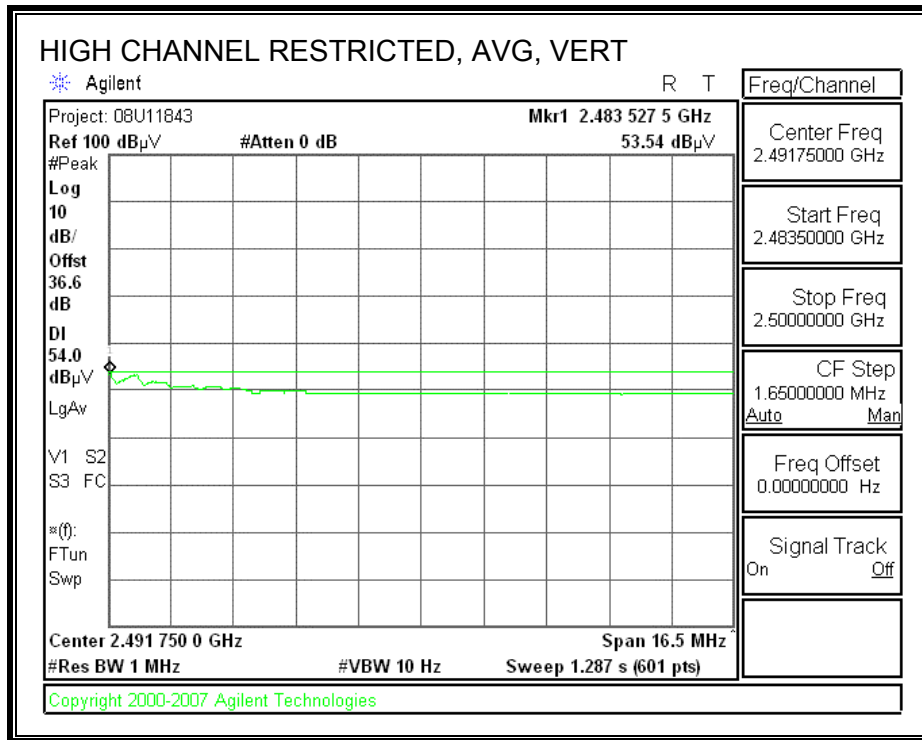
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**

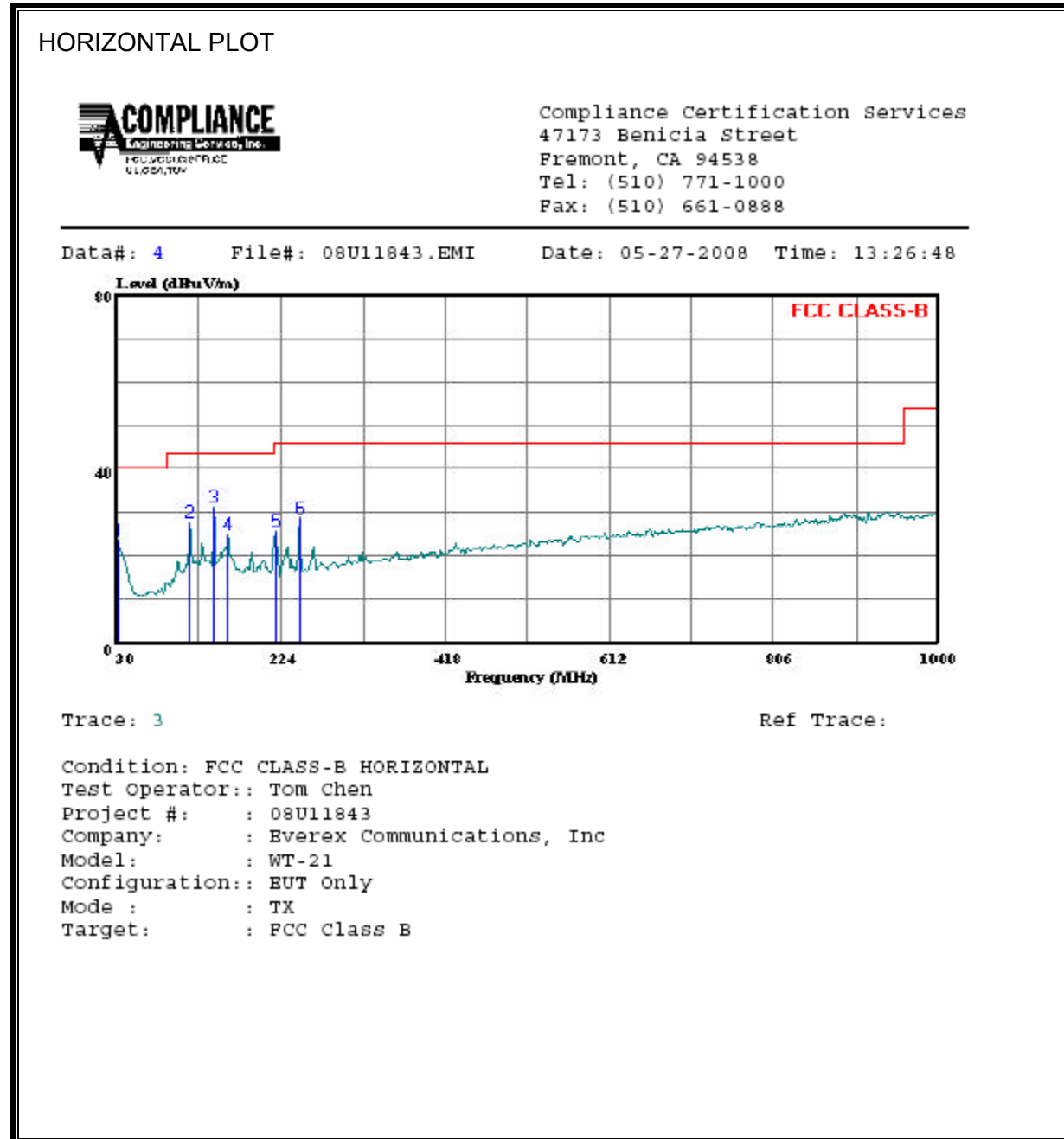






### 8.3. WORST-CASE BELOW 1 GHz

#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

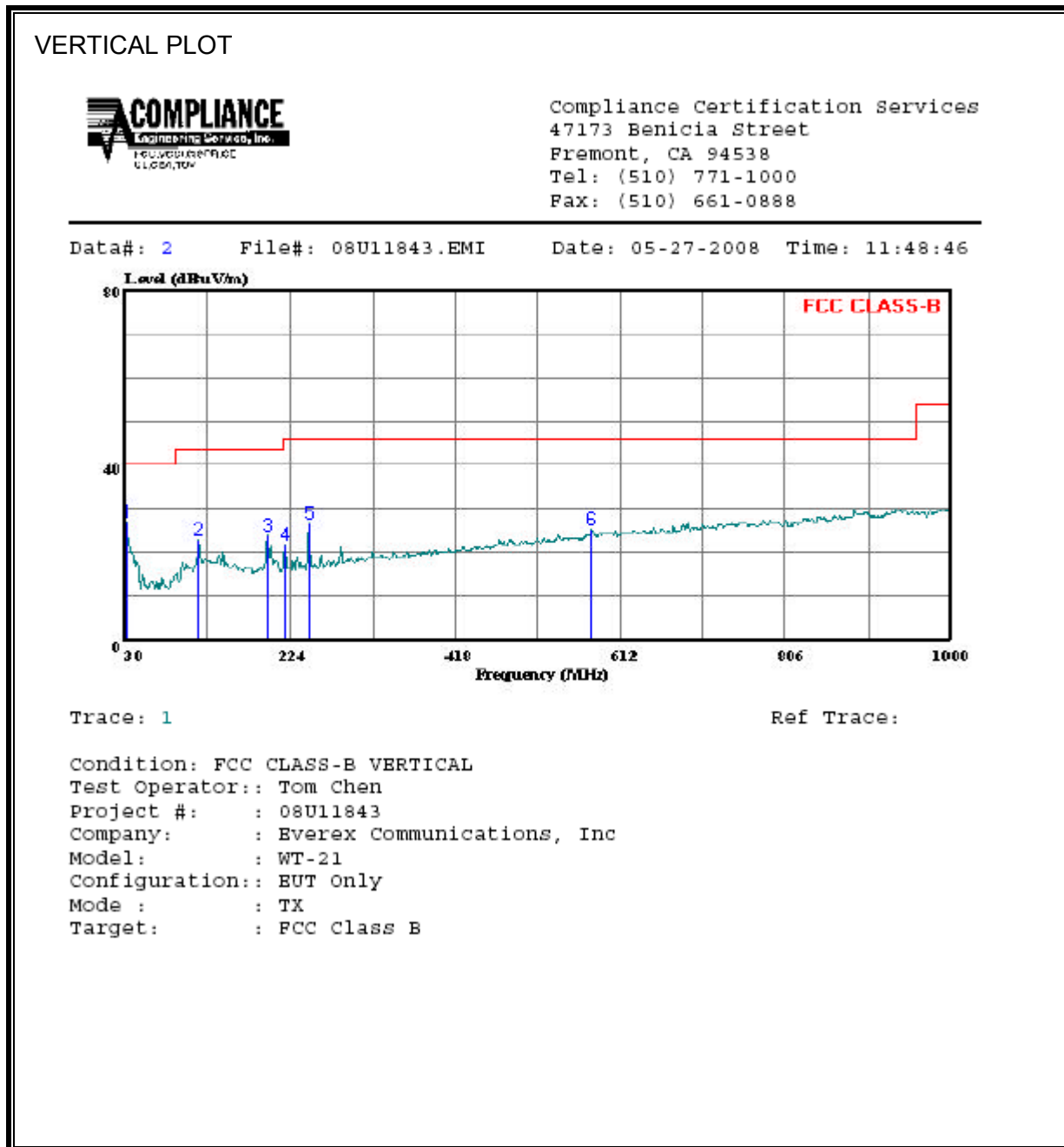




HORIZONTAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	31.940	29.99	-6.58	23.41	40.00	-16.59	Peak
2	116.330	41.60	-13.94	27.66	43.50	-15.84	Peak
3	145.430	44.61	-13.55	31.06	43.50	-12.44	Peak
4	159.980	39.04	-14.14	24.90	43.50	-18.60	Peak
5	218.180	40.79	-15.17	25.62	46.00	-20.38	Peak
6	245.340	43.07	-14.42	28.65	46.00	-17.35	Peak

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**



VERTICAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	31.940	33.63	-6.58	27.05	40.00	-12.95	Peak
2	116.330	36.90	-13.94	22.96	43.50	-20.54	Peak
3	196.840	37.98	-13.93	24.05	43.50	-19.45	Peak
4	218.180	37.08	-15.17	21.91	46.00	-24.09	Peak
5	245.340	40.97	-14.42	26.55	46.00	-19.45	Peak
6	577.080	31.03	-5.71	25.32	46.00	-20.68	Peak

## 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

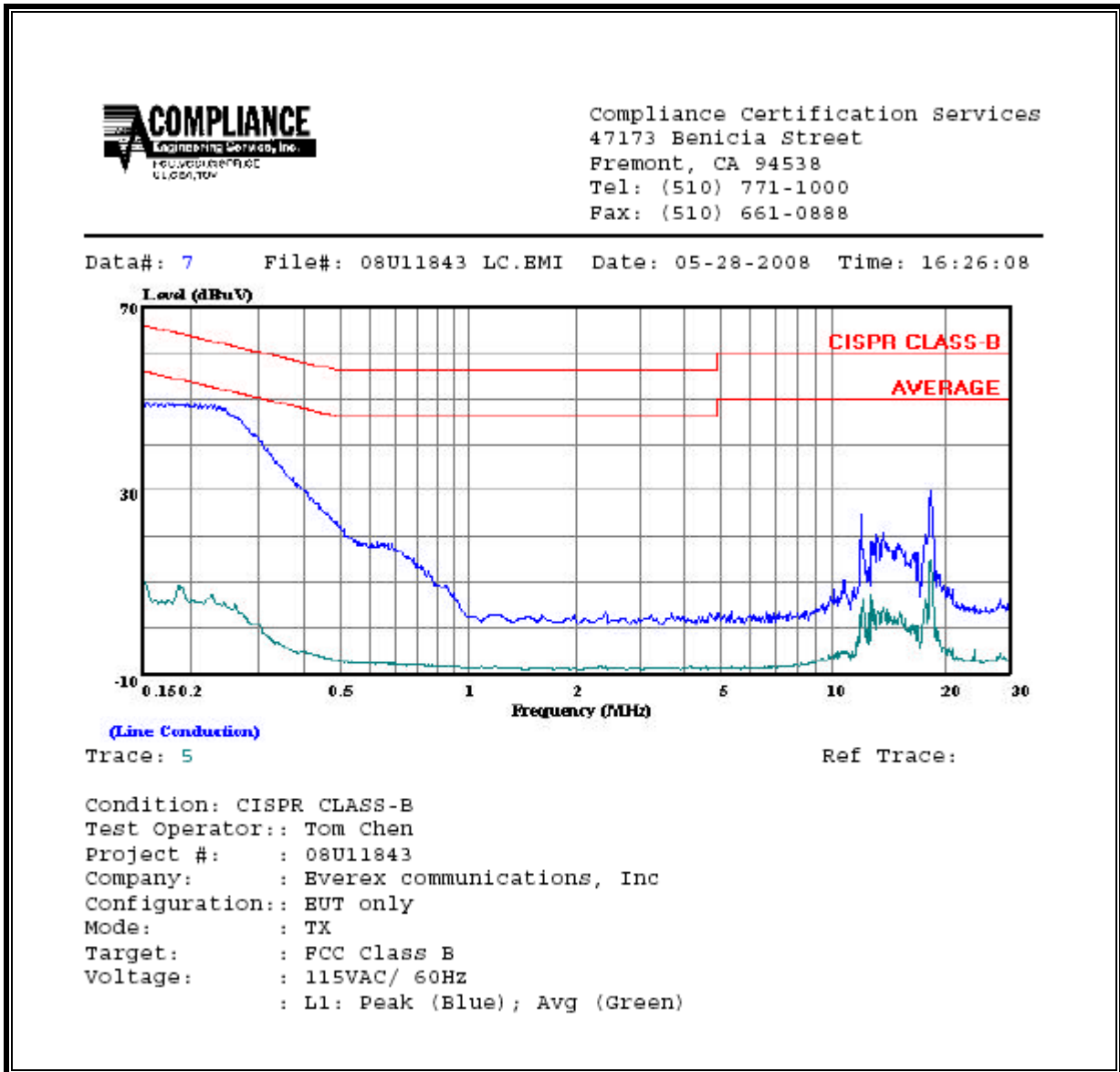
ANSI C63.4

**RESULTS**

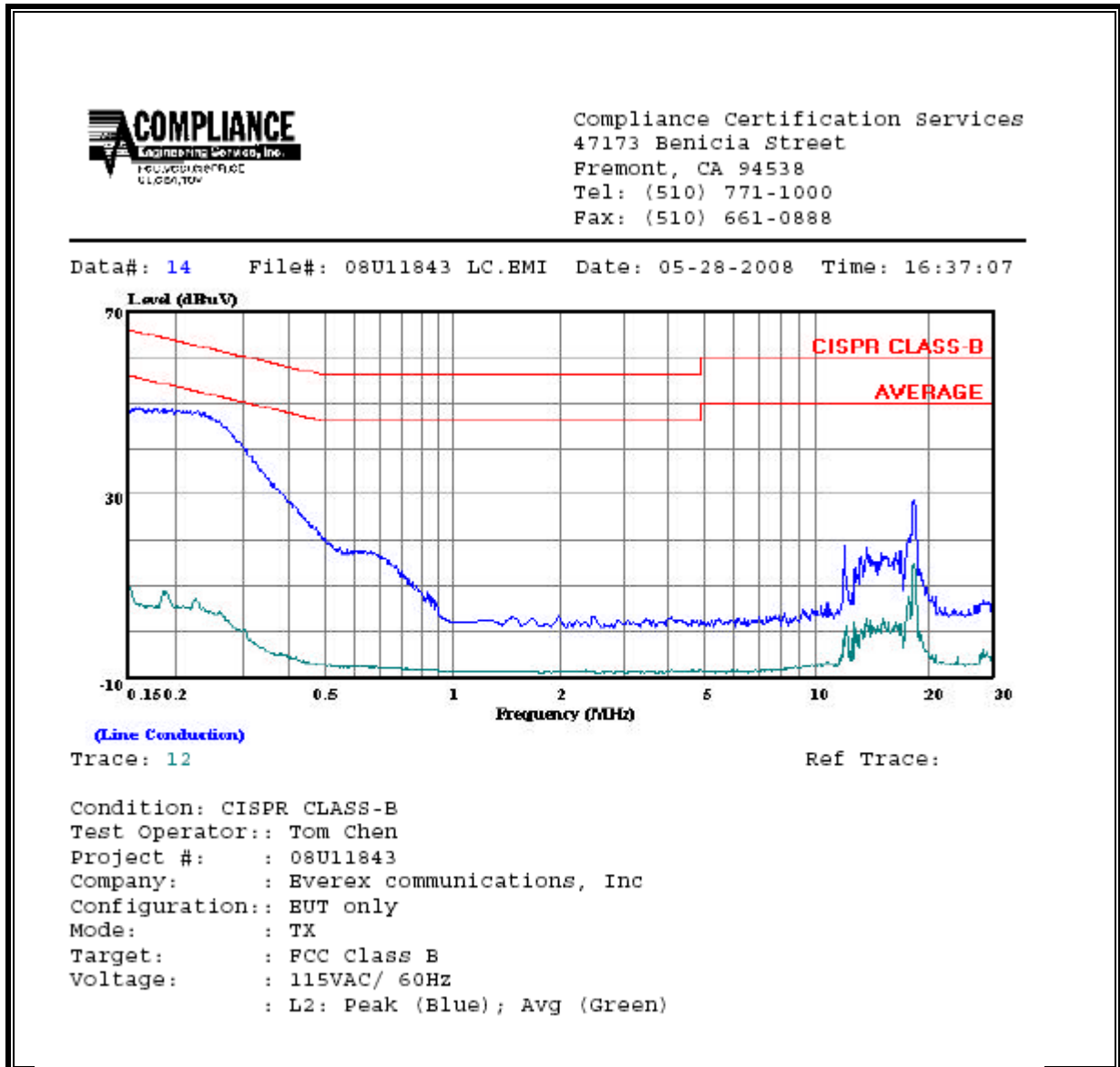
**6 WORST EMISSIONS**

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq. (MHz)	Reading			Class (dB)	Limit QP	FCC B AV	Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)				QP (dB)	AV (dB)	
0.16	48.59	--	5.67	0.00	65.26	55.26	-16.67	-49.59	L1
0.20	48.93	--	5.98	0.00	63.82	53.82	-14.89	-47.84	L1
0.23	48.38	--	6.05	0.00	62.38	52.38	-14.00	-46.33	L1
0.16	48.75	--	5.64	0.00	65.41	55.41	-16.66	-49.77	L2
0.19	48.28	--	6.24	0.00	63.91	53.91	-15.63	-47.67	L2
0.23	47.66	--	4.91	0.00	62.31	52.31	-14.65	-47.40	L2
6 Worst Data									

**LINE 1 RESULTS**

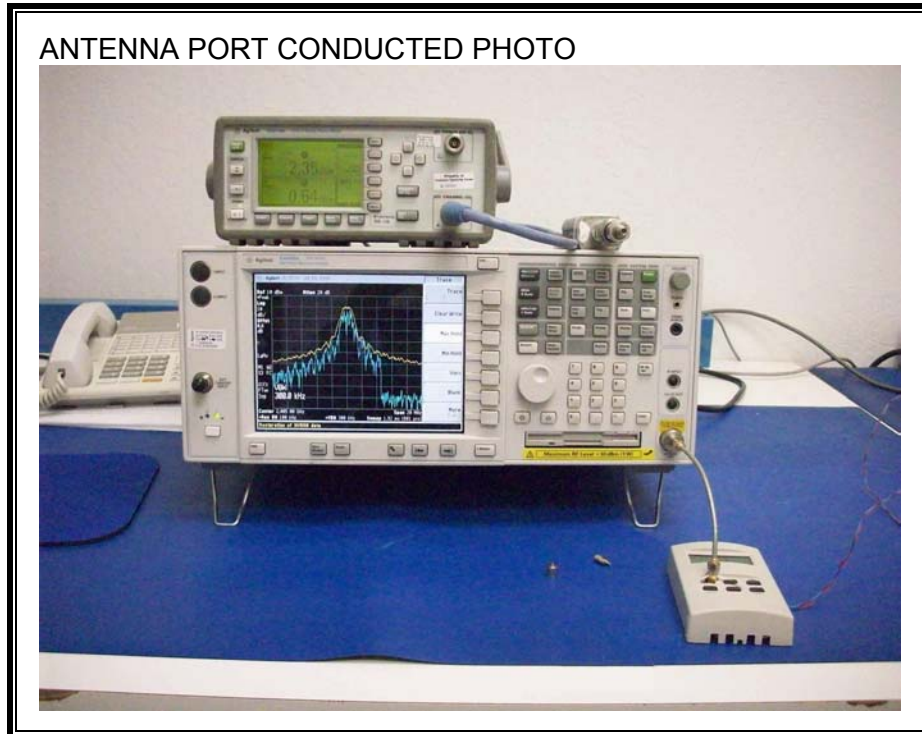


**LINE 2 RESULTS**



## 10. SETUP PHOTOS

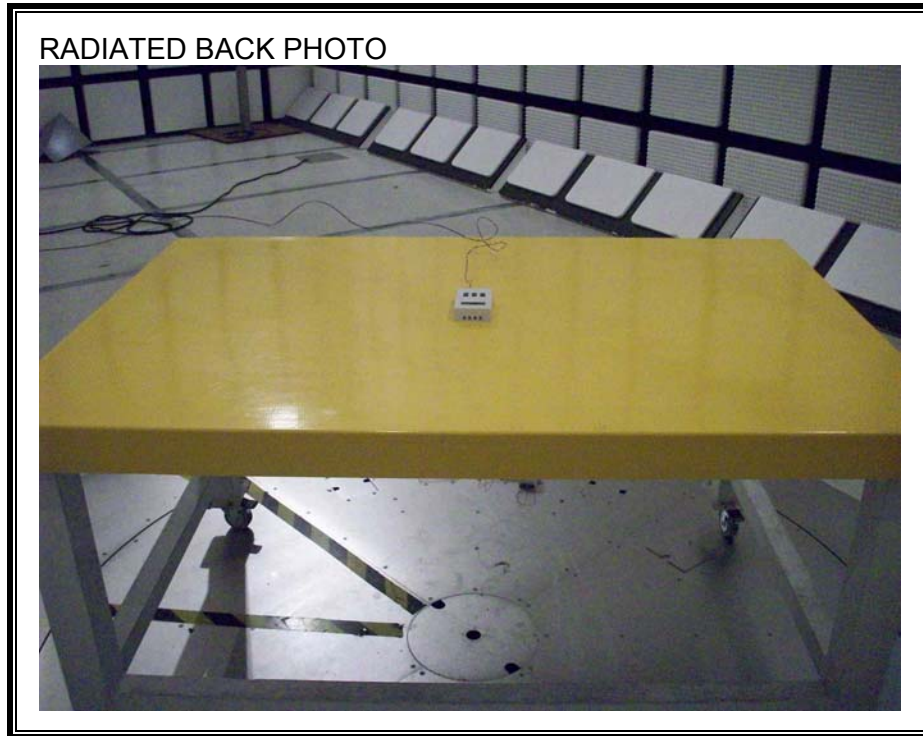
### ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP





**RADIATED RF MEASUREMENT SETUP**





**POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP**





**END OF REPORT**