



**FCC CFR47 PART 15 SUBPART C  
CLASS II PERMISSIVE CHANGE  
CERTIFICATION  
TEST REPORT**

**FOR**

**BLUETOOTH REMOTE**

**MODEL NUMBER: PWR-07-01**

**FCC ID: QYPPWR0701**

**REPORT NUMBER: 03U2382-1**

**ISSUE DATE: JANUARY 6, 2004**

*Prepared for*

**POLYMAP WIRELESS  
310 SOUTH WILLIAMS BLVD. SUITE 346  
TUSCON, ARIZONA 85711  
U.S.A**

*Prepared by*

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## 1. TEST RESULT CERTIFICATION

**COMPANY NAME:** POLYMAP WIRELESS  
310 SOUTH WILLIAMS BLVD. SUITE 346  
TUSCON, ARIZONA 85711  
U.S.A

**EUT DESCRIPTION:** BLUETOOTH REMOTE

**MODEL:** PWR-07-01

**DATE TESTED:** NOVEMBER 24 – DECEMBER 1, 2003

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

Tested By:



MIKE HECKROTTE  
CHIEF ENGINEER  
COMPLIANCE CERTIFICATION SERVICES



NEELESH RAJ  
EMC TECHNICIAN  
COMPLIANCE CERTIFICATION SERVICES

## 2. DESCRIPTION OF EUT AND CLASS II PERMISSIVE CHANGE

The EUT is a battery powered Bluetooth transceiver with a maximum output power of 0.0021 Watts (3.22 dBm) over the frequency range of 2402 to 2480 MHz.

### DESCRIPTION OF CHANGES

1. Switched from a chip antenna soldered to the PCB to a strip antenna connected via a coaxial cable. The peak gain of the antenna is 3.0 dBi.
2. Added a "WAKE-UP" feature to the voltage regulator, which feeds power (3.3VDC) to the circuit. This involved:
  - Switching regulators to one which has this new "SHUT DOWN" feature (same manufacturer and same line of LDO regulators)
  - Increased connector size to allow one more input signal called "WAKE UP" from host system.
  - Routed one more net from the micro-controller's GPIOs: "STAY AWAKE".
3. Reduced pull-up resistor size to enhance 2-wire bus stability (50K to 20K ohms).
4. Added filter to power input of RS232 driver (one series 10 ohm resistor).
5. Added capability to bypass RS232 driver (in case we want to drive a 3.3VDC serial interface instead of the current +/- 12VDC PC standard).

### 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/2001, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

### 4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

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



No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

## 5. CALIBRATION AND UNCERTAINTY

### 5.1. 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.

### 5.2. 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%.

### 5.3. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
Spectrum Analyzer 3Hz ~ 26.5 GHz	Agilent	E4440A	US41421507	5/8/2004
Spectrum Analyzer 3Hz ~ 44 GHz	Agilent	E4446A	US42510266	7/23/2004
RF Filter Section	HP	85420E	3705A00256	11/21/2004
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/21/2004
Antenna, Bicon/Log, 25 ~ 2000 MHz	ARA	LPB-2520/A	1185	3/6/2004
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	2/4/2004
Antenna, Horn, 18 ~ 26 GHz	ARA	MWH-1826/B	1013	2/2/2004
Amplifier 1-26GHz	MITEQ	NSP2600-SP	924342	4/25/2004
2.4-2.5 GHz Reject Filter	Micro-Tronics	BRM50702	1	N/A
10dB Attenuator	Weinschel	56-10	K16148	N/A

## 6. SETUP OF EQUIPMENT UNDER TEST

### SUPPORT EQUIPMENT

TEST PERIPHERALS				
Device Type	Manufacturer	Model Number	Serial Number	FCC ID
ADAPTER BOARD	POLYMAP	94U-0, 34-03	N/A	N/A
AC ADAPTER	CUI, INC.	35-6-200	N/A	N/A
REMOTE LAPTOP	FUJITSU	FPC03014A	841570	DoC
AC ADAPTER	SAMSUNG	PSCU480103A	980903122 REV.A	N/A

### I/O CABLES

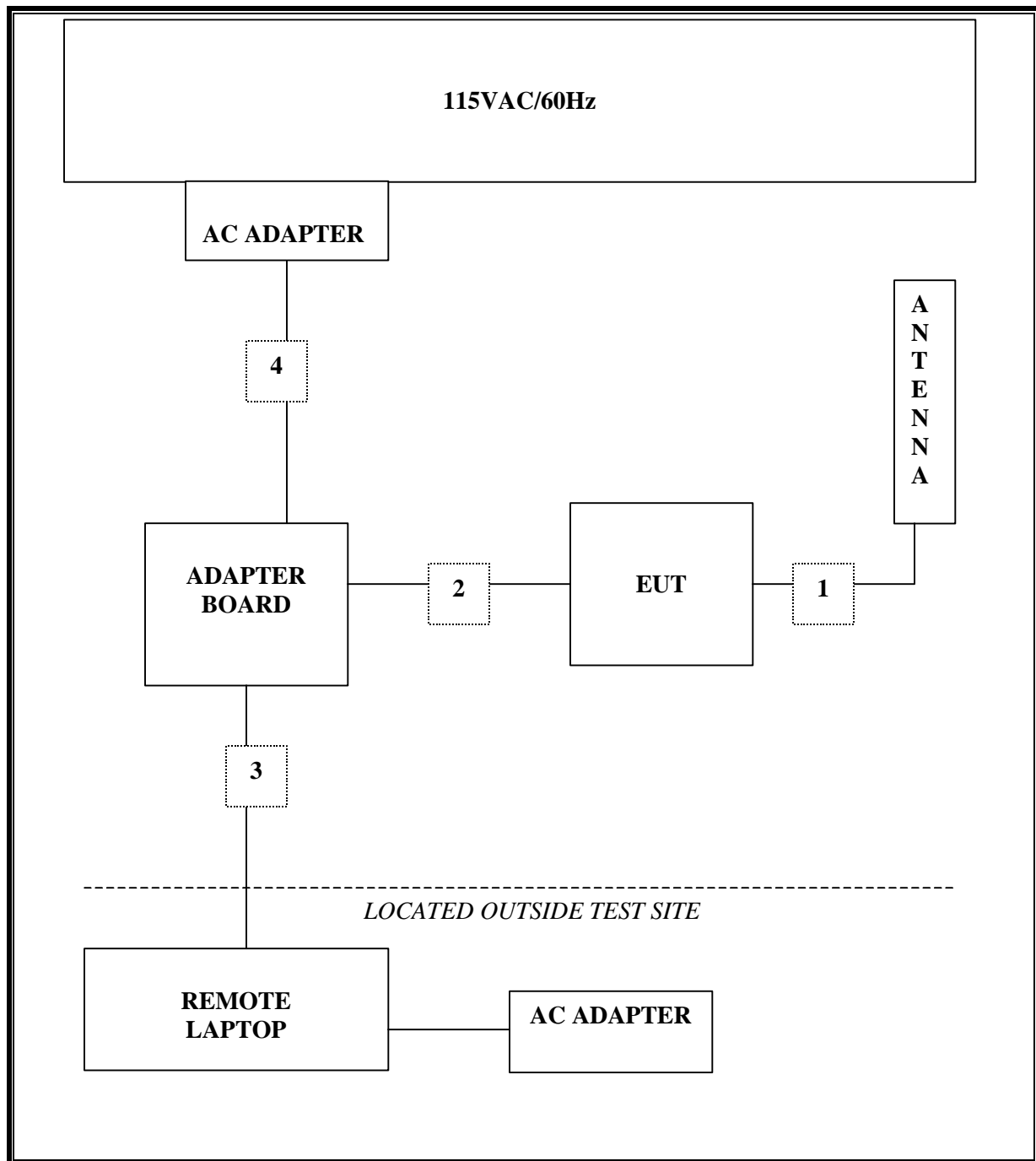
TEST I / O CABLES								
Cable No	I/O Port	# of I/O Port	Connector Type	Type of Cable	Cable Length	Data Traffic	Bundled	Remark
1	ANTENNA	1	UFL	SHIELDED	0.2M	YES	NO	N/A
2	CNTR/PWR	1	12 PIN	UNSHIELDED	0.15M	YES	NO	N/A
3	SERIAL	1	DB9	SHIELDED	2.74M	YES	NO	N/A
4	DC PWR	1	DC PWR	UNSHIELDED	1.86M	NO	NO	N/A

### TEST SETUP

The EUT was connected to the remote laptop (located outside the test site) via the adapter board (serial port). Both the module and antenna were tested in the X, Y, and Z positions, Y position was found to be worst case and all testing was done in the worst-case position. During the testing process the EUT was placed in a continuous transmit mode using a test utility program residing in the remote laptop.



**SETUP DIAGRAM FOR TESTS**



## 7. APPLICABLE LIMITS AND TEST RESULTS

### 7.1. MAXIMUM PERMISSIBLE EXPOSURE

#### LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....			f/300	6
1500–100,000 .....			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....			f/1500	30
1500–100,000 .....			1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## **CALCULATIONS**

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$$d = \sqrt{((30 * P * G) / (3770 * S))}$$

Changing to units of Power to mW and Distance to cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

yields

$$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$$

$$d = 0.282 * \sqrt{(P * G / S)}$$

where

d = distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power Density in mW/cm<sup>2</sup>

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$

$$G \text{ (numeric)} = 10^{(G \text{ (dBi)} / 10)}$$

yields

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S} \quad \text{Equation (1)}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

Equation (1) and the measured peak power is used to calculate the MPE distance.

## **LIMITS**

From §1.1310 Table 1 (B),  $S = 1.0 \text{ mW/cm}^2$

## **RESULTS**

No non-compliance noted:

<b>Power Density Limit (mW/cm<sup>2</sup>)</b>	<b>Output Power (dBm)</b>	<b>Antenna Gain (dBi)</b>	<b>MPE Distance (cm)</b>
1.0	3.22	3.00	0.58

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

## **7.2. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions, which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **TEST PROCEDURE**

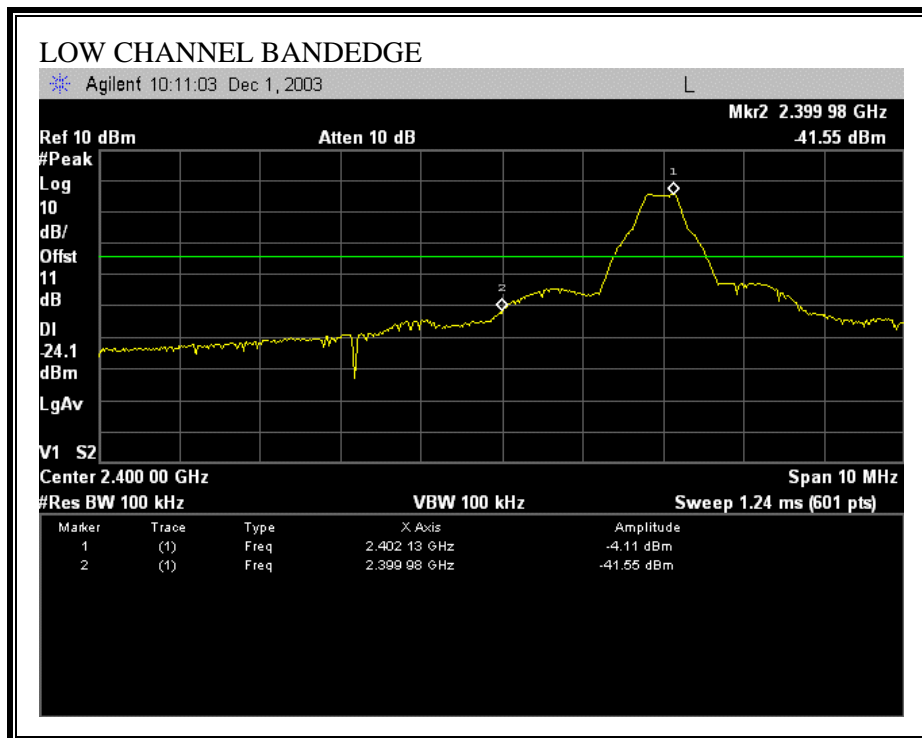
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

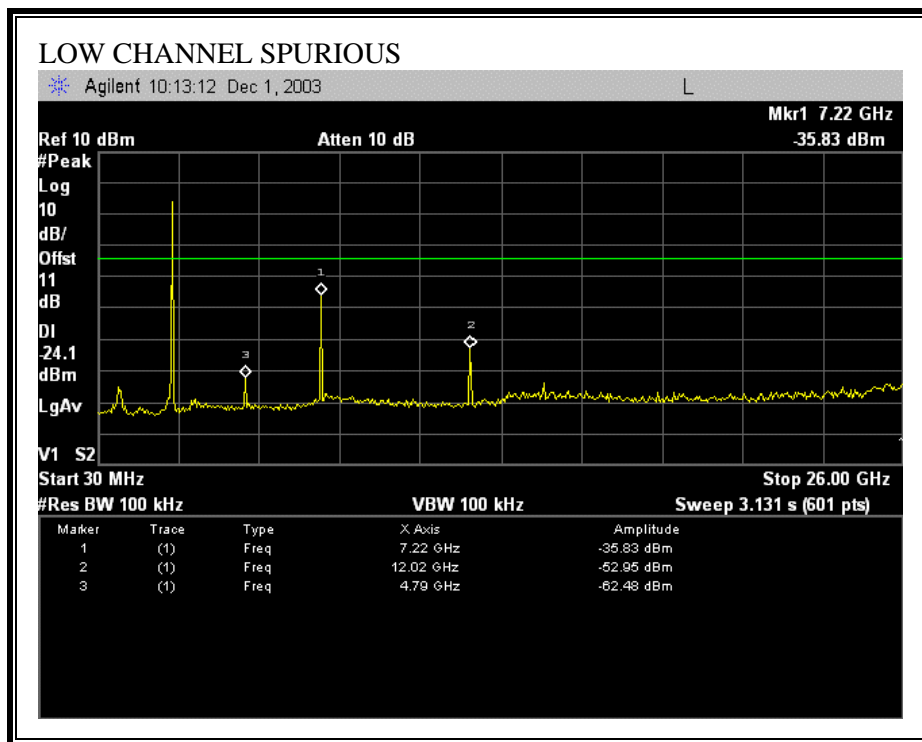
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

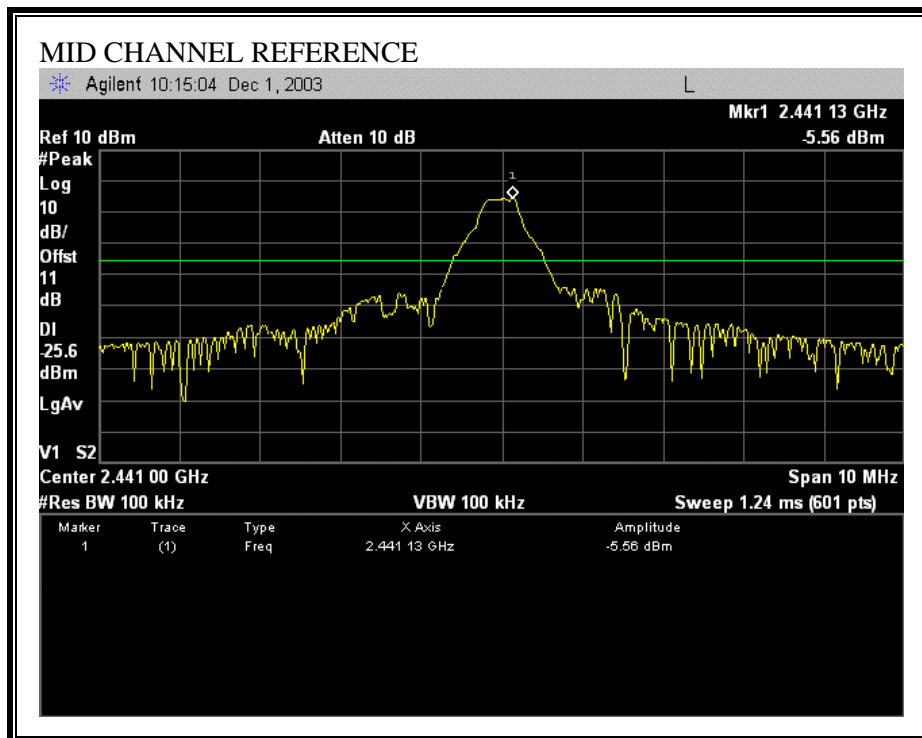
No non-compliance noted:

**SPURIOUS EMISSIONS, LOW CHANNEL**

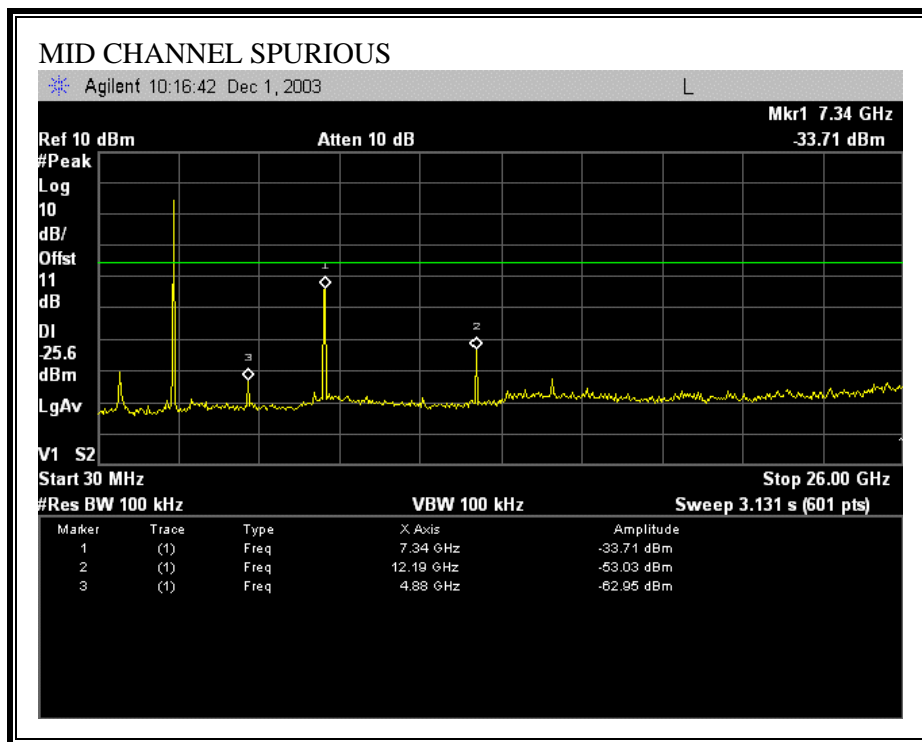




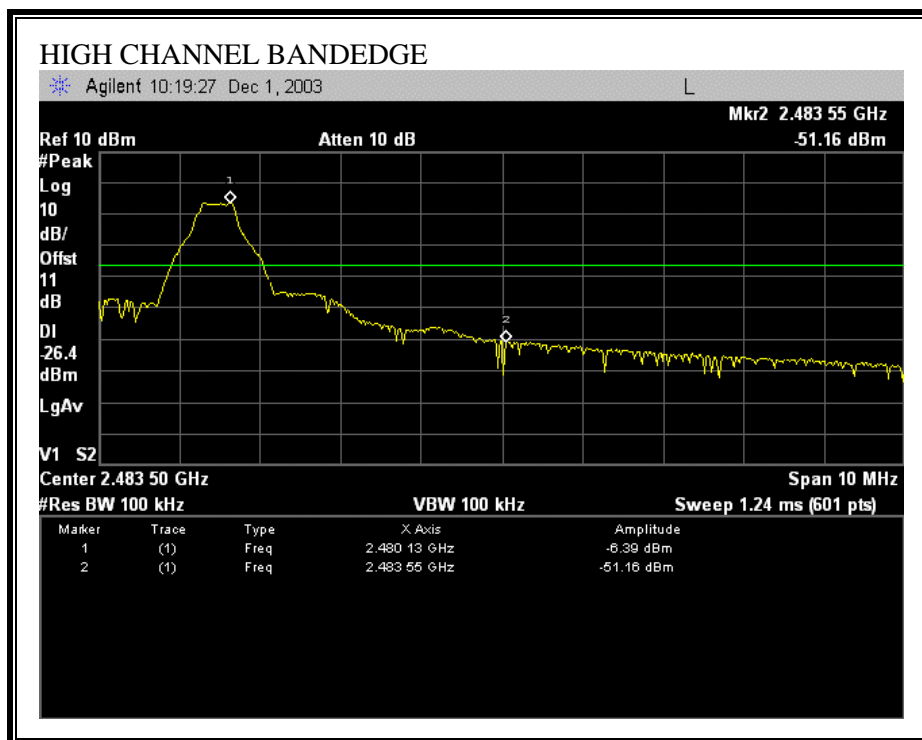
**SPURIOUS EMISSIONS, MID CHANNEL**

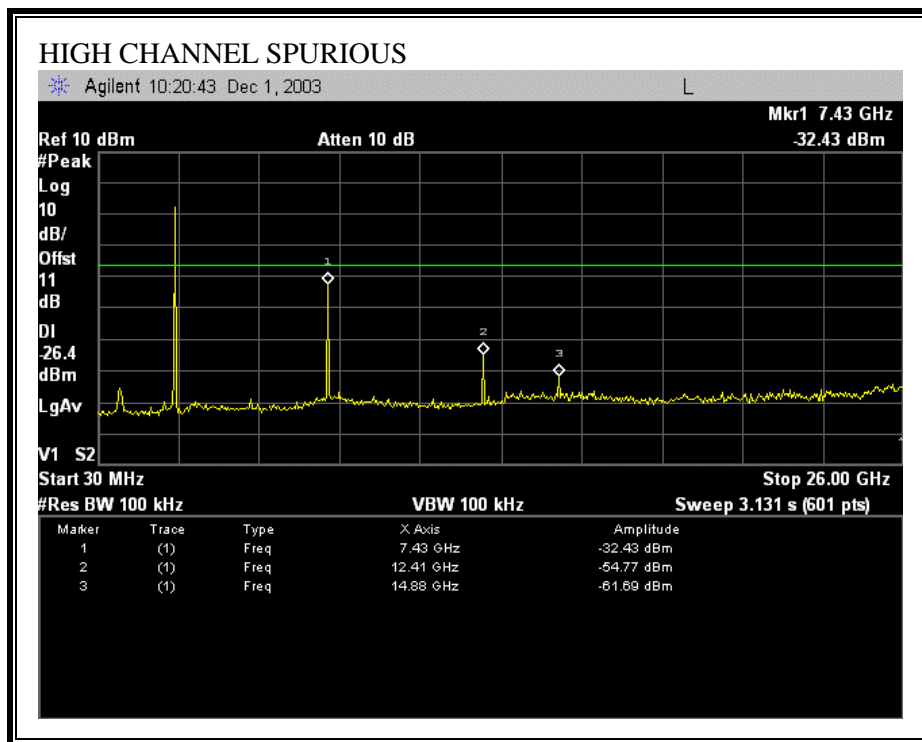




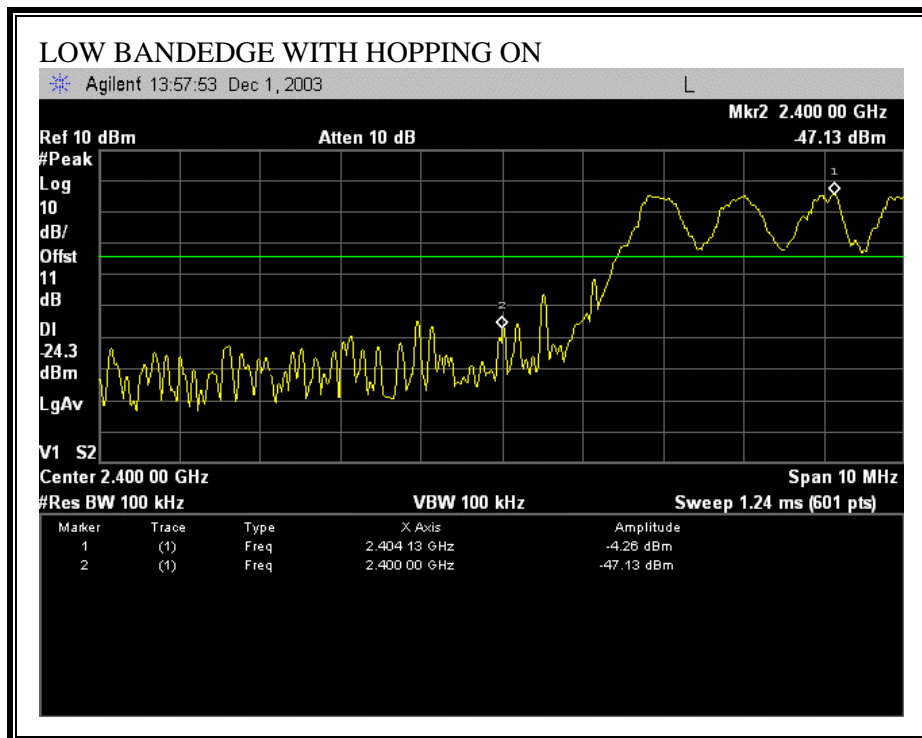


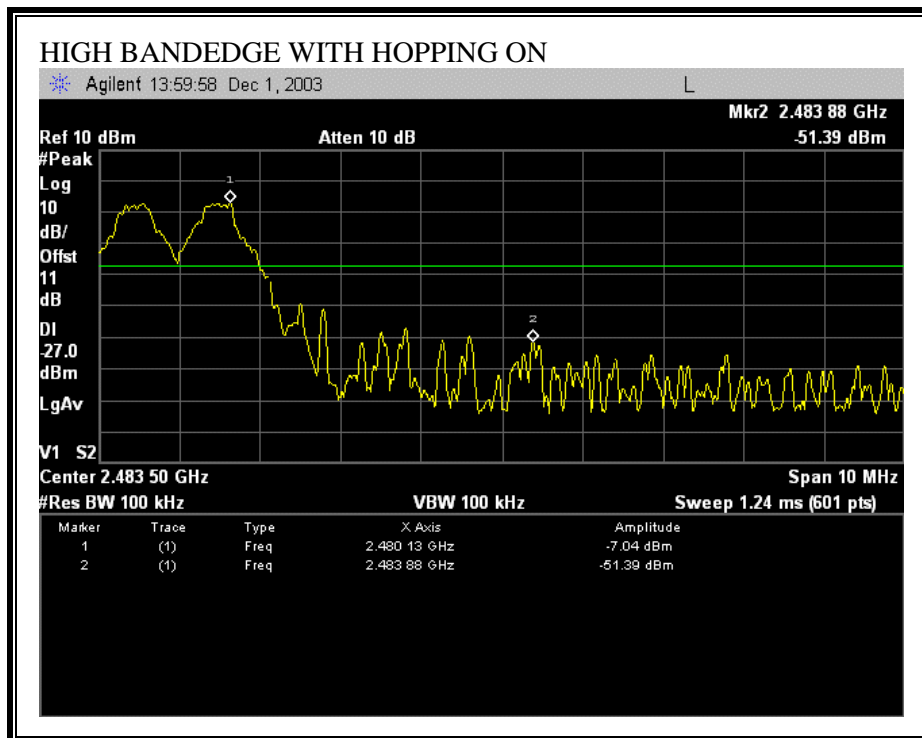
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





### 7.3. RADIATED EMISSIONS

#### 7.3.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

##### LIMITS

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

## **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.

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.

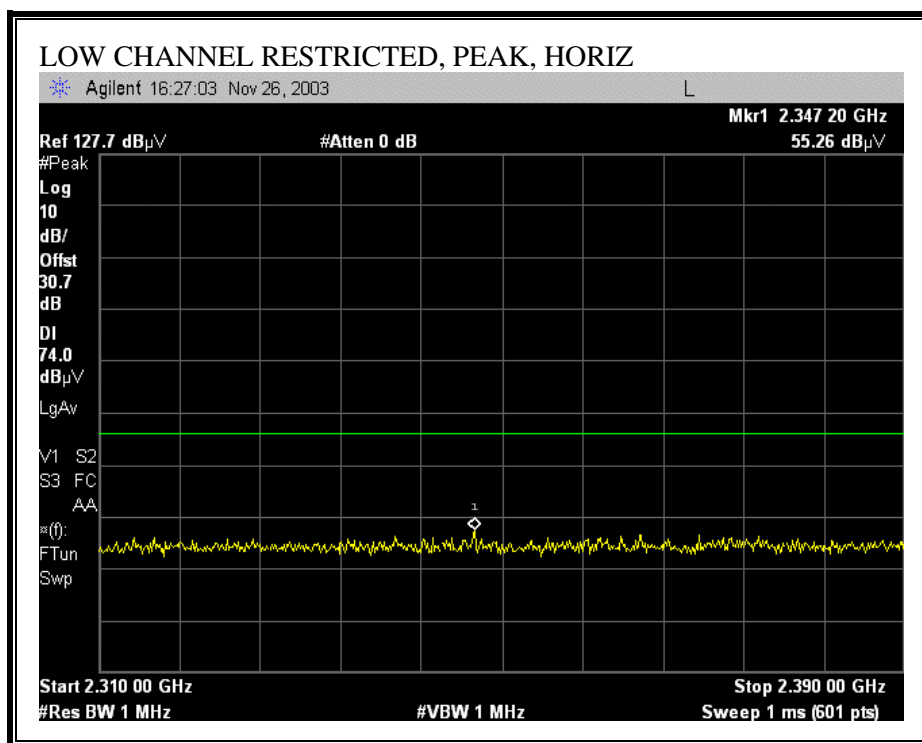
## **RESULTS**

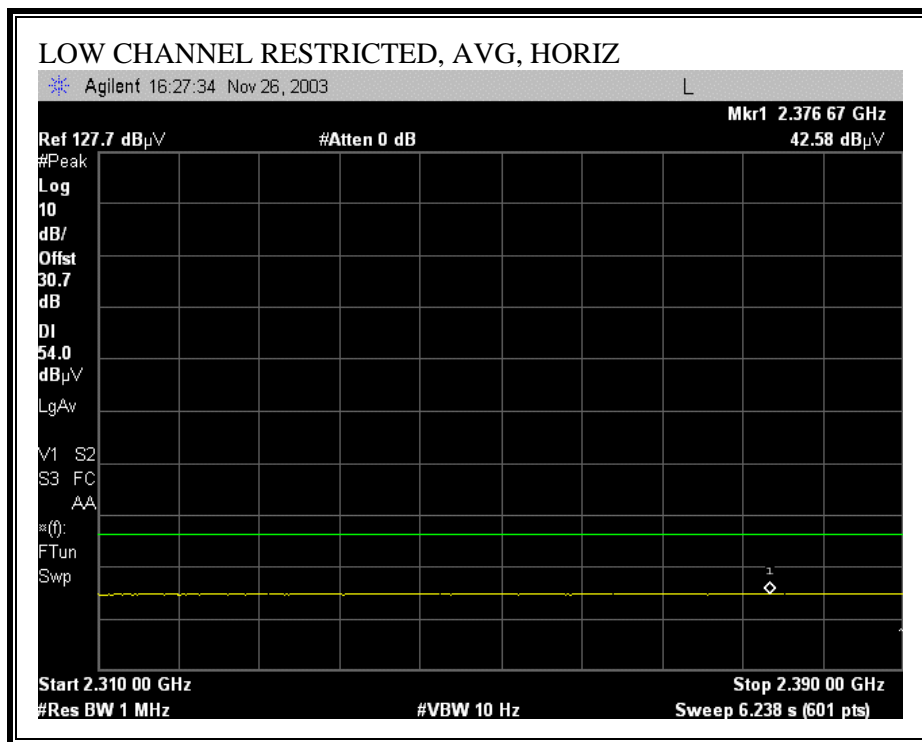
No non-compliance noted:



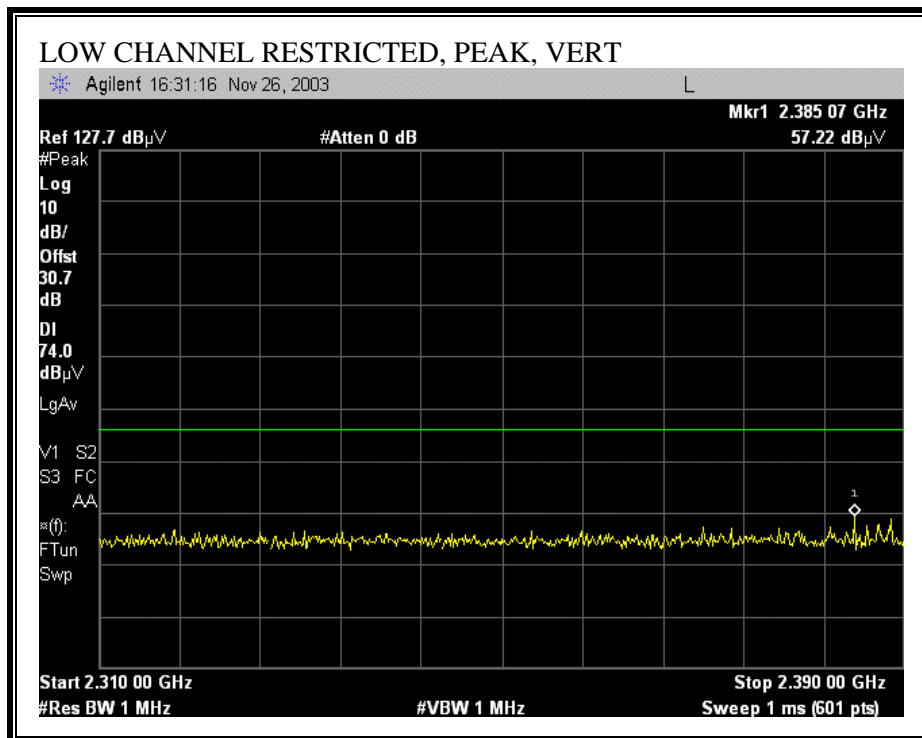
### 7.3.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ

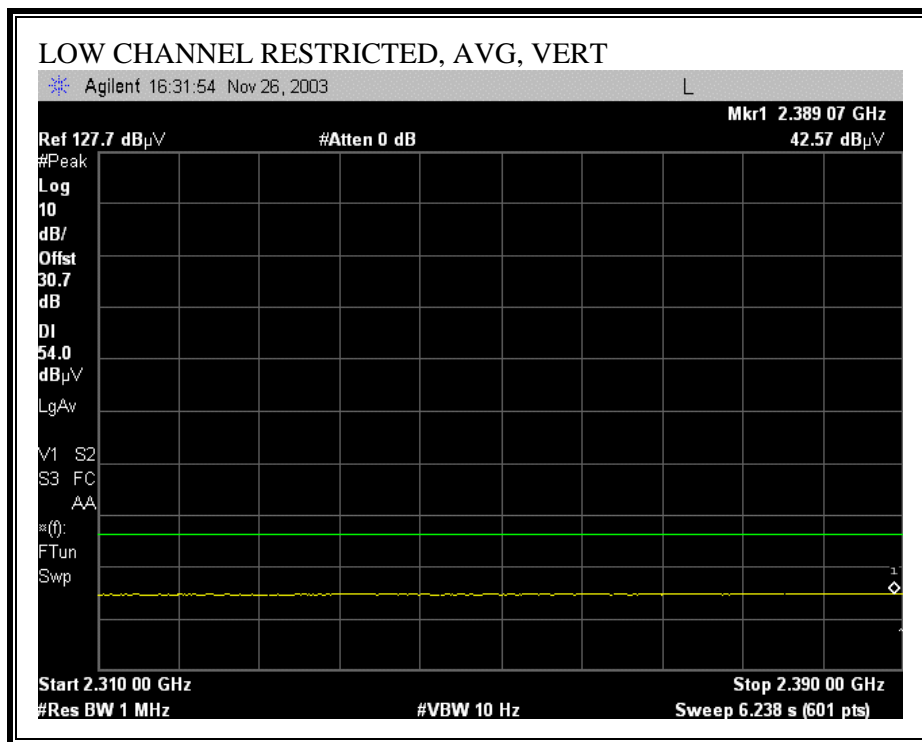
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



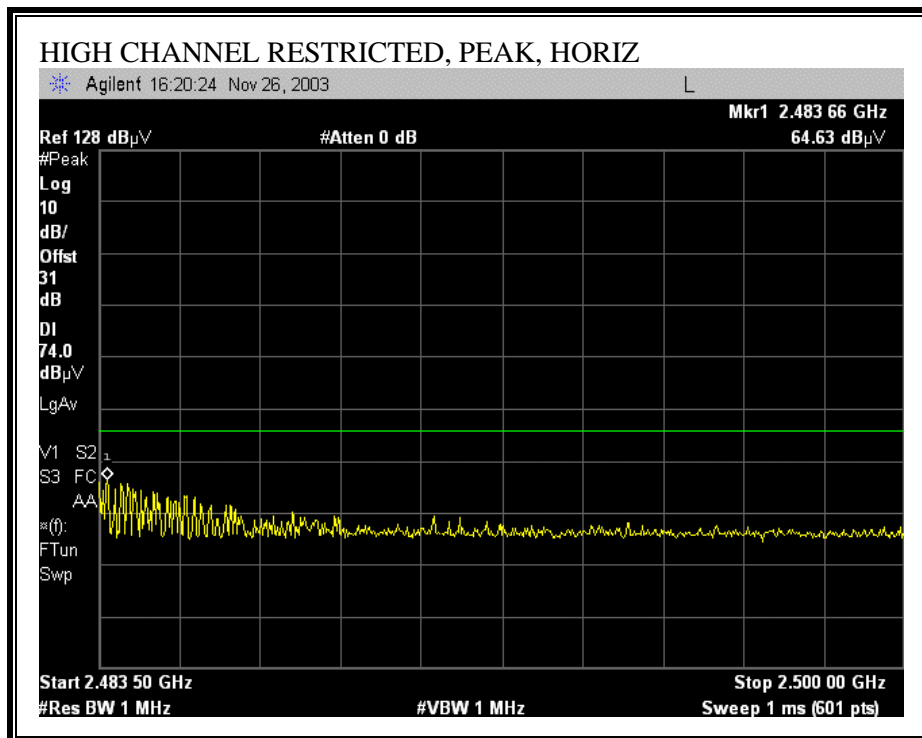


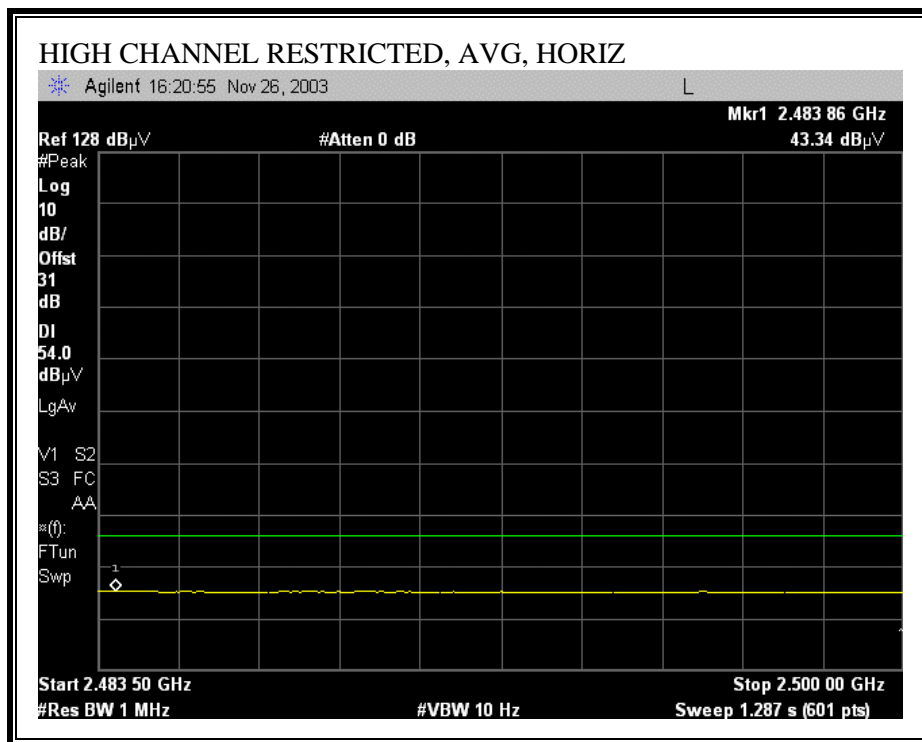
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



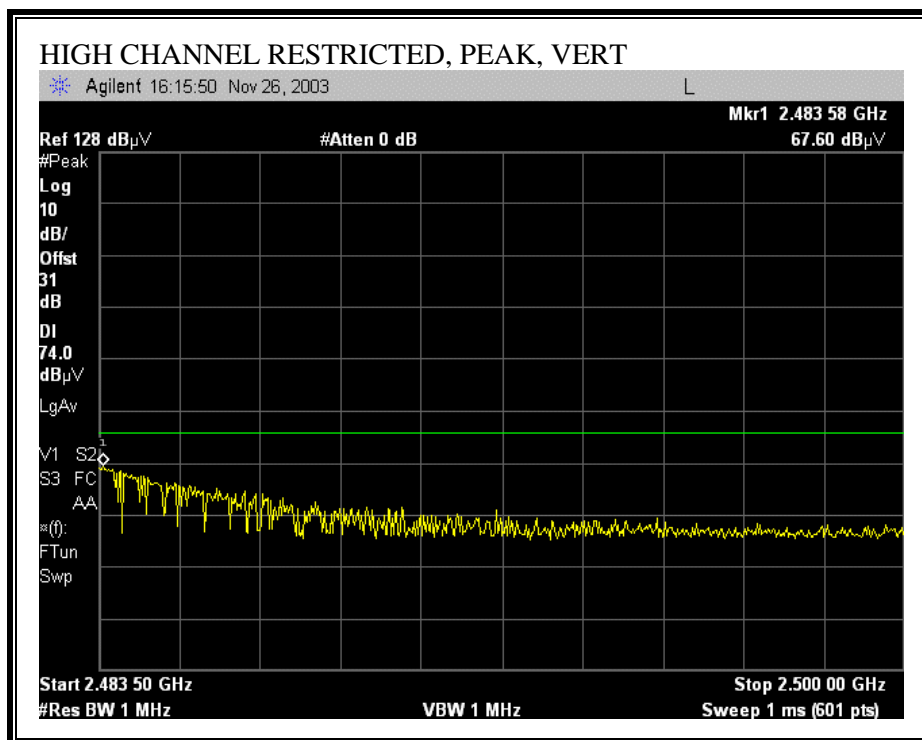


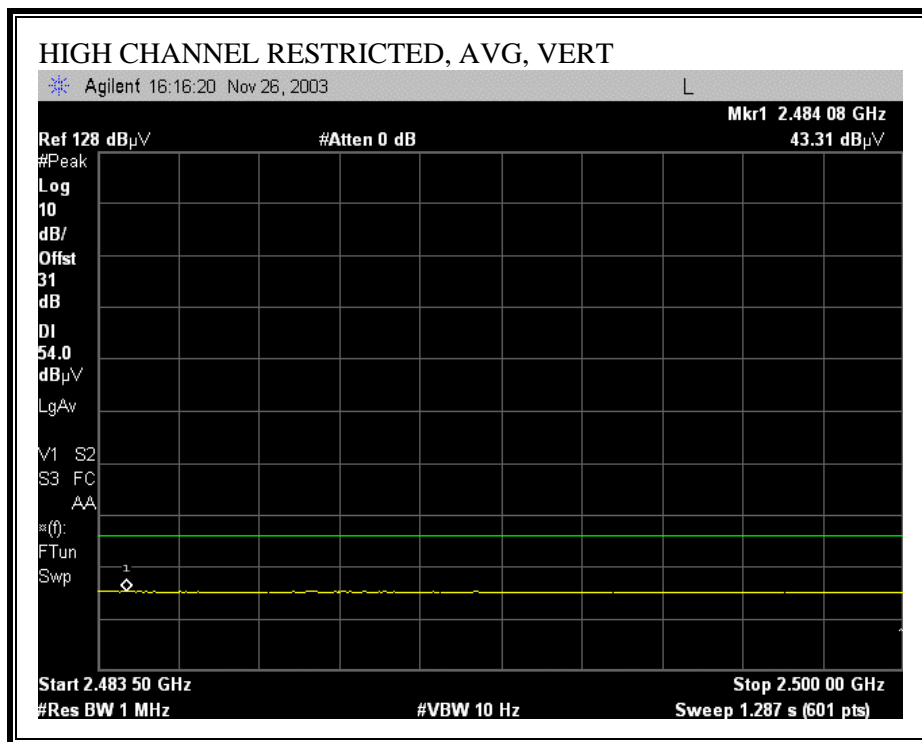
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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







## HARMONICS AND SPURIOUS EMISSIONS

11/28/03 High Frequency Measurement  
Compliance Certification Services, Morgan Hill Open Field Site

Test Eng: NEELISH RAO  
Project #: 03U2382  
Company: POLYMAP WIRELESS  
EUT Descr: BLUETOOTH REMOTE  
EUT M/N: PWR-07-01  
Test Target: FCC  
Mode Oper: TX

Test Equipment:

EMCO Horn 1-18GHz

Pre-amplifier 1-26GHz

Spectrum Analyzer

Horn > 18GHz

Limit

T13; S/N: 6717 @3m

T87 Miniq 924342

Agilent E4446A Analyzer

FCC 15.205

Hi Frequency Cables

☐ (2 ft) ☒ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☒ (12 ft)

Peak Measurements: 1 MHz Resolution Bandwidth  
10MHz Video Bandwidth

Average Measurements: 1 MHz Resolution Bandwidth  
10Hz Video Bandwidth

f	Dist	Read Pk	Read Avg	AF	CL	Amp	D Corr	HPF	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	feet	dBuV	dBuV	dB/m	dB	dB	dB		dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	
LOW CHANNEL 2402 MHZ															
4.804	9.8	49.5	39.4	33.4	2.9	-44.7	0.0	1.0	42.1	32.0	74.0	54.0	-31.9	-22.0	V(NOISE FLOOR)
12.010	9.8	49.2	38.3	39.2	5.1	-42.1	0.0	1.0	52.3	41.4	74.0	54.0	-21.7	-12.6	V(NOISE FLOOR)
4.804	9.8	50.0	39.1	33.4	2.9	-44.7	0.0	1.0	42.6	31.7	74.0	54.0	-31.4	-22.3	H(NOISE FLOOR)
12.010	9.8	48.3	36.1	39.2	5.1	-42.1	0.0	1.0	51.4	39.2	74.0	54.0	-22.6	-14.8	H(NOISE FLOOR)
MIDDLE CHANNEL 2441 MHZ															
4.882	9.8	49.4	39.4	33.4	3.0	-44.7	0.0	1.0	42.0	32.1	74.0	54.0	-32.0	-21.9	V
7.323	9.8	61.6	54.0	35.9	3.8	-44.5	0.0	1.0	57.7	50.1	74.0	54.0	-16.3	-3.9	V
12.205	9.8	46.3	36.0	39.2	5.2	-42.4	0.0	1.0	49.2	38.9	74.0	54.0	-24.8	-15.1	V(NOISE FLOOR)
4.882	9.8	47.6	37.9	33.4	3.0	-44.7	0.0	1.0	40.2	30.5	74.0	54.0	-33.8	-23.5	H(NOISE FLOOR)
7.323	9.8	65.8	57.5	35.9	3.8	-44.5	0.0	1.0	61.9	53.6	74.0	54.0	-12.1	-0.4	H
12.205	9.8	45.5	35.9	39.2	5.2	-42.4	0.0	1.0	48.4	38.5	74.0	54.0	-25.6	-15.2	H(NOISE FLOOR)
HIGH CHANNEL 2480 MHZ															
4.960	9.8	49.3	40.0	33.5	3.0	-44.8	0.0	1.0	42.0	32.7	74.0	54.0	-32.0	-21.3	V(NOISE FLOOR)
7.440	9.8	61.2	52.9	36.1	3.8	-44.4	0.0	1.0	57.6	49.3	74.0	54.0	-16.4	-4.7	V
12.400	9.8	47.9	37.1	39.2	5.2	-42.6	0.0	1.0	50.6	39.8	74.0	54.0	-23.4	-14.2	V(NOISE FLOOR)
4.960	9.8	49.1	39.4	33.5	3.0	-44.8	0.0	1.0	41.8	32.1	74.0	54.0	-32.2	-21.9	H(NOISE FLOOR)
7.440	9.8	62.3	54.4	36.1	3.8	-44.4	0.0	1.0	58.7	50.8	74.0	54.0	-15.3	-3.2	H
12.400	9.8	48.3	38.2	39.2	5.2	-42.6	0.0	1.0	51.0	40.9	74.0	54.0	-23.0	-13.1	H(NOISE FLOOR)
NO OTHER EMISSIONS DETECTED IN THE REST. BANDS ABOVE THE SYSTEM NOISE FLOOR															

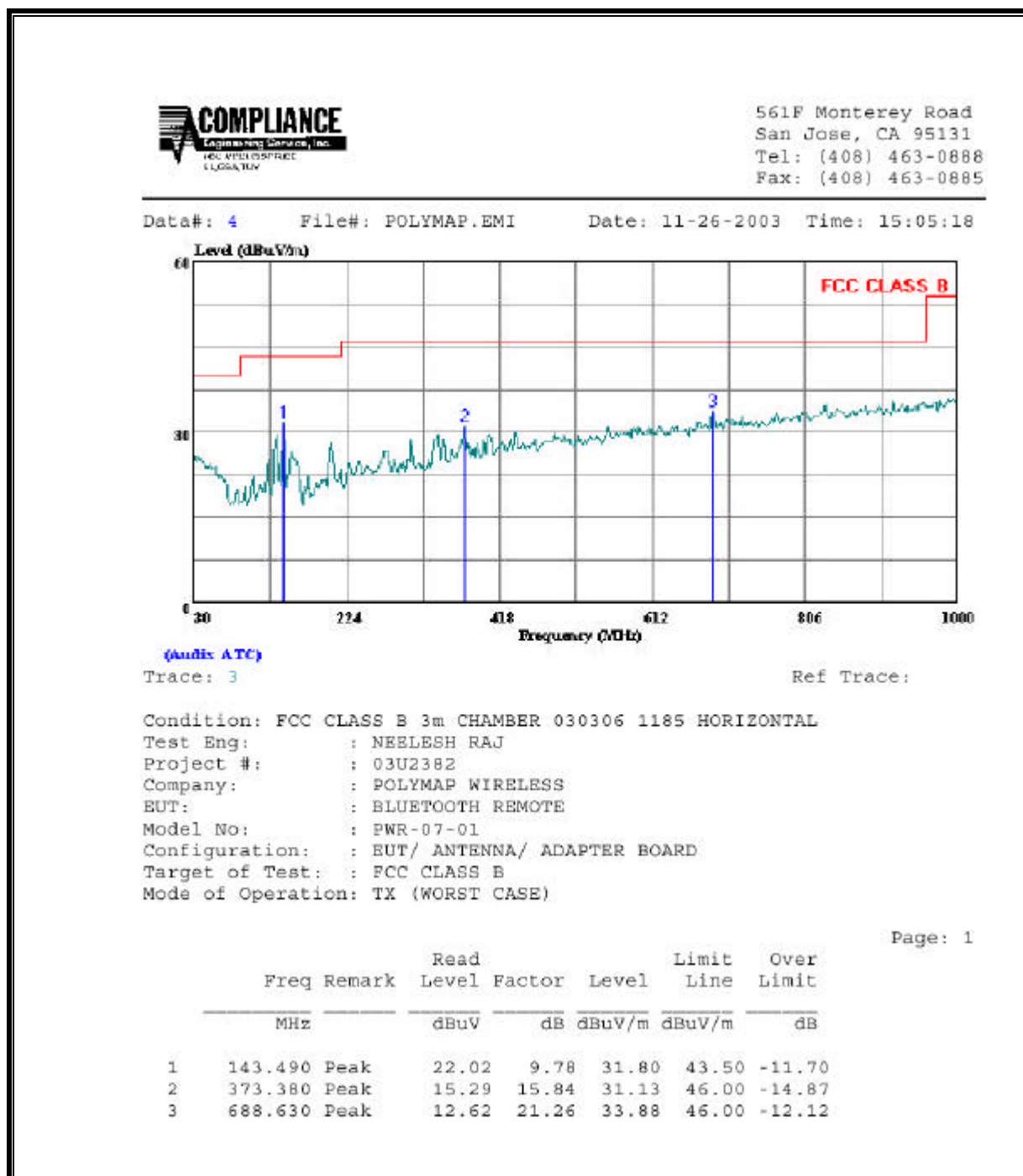
f Measurement Frequency  
Dist Distance to Antenna  
Read Analyzer Reading  
AF Antenna Factor  
CL Cable Loss

Amp Preamp Gain  
D Corr Distance Correct to 3 meters  
Avg Average Field Strength @ 3 m  
Peak Calculated Peak Field Strength  
HPF High Pass Filter

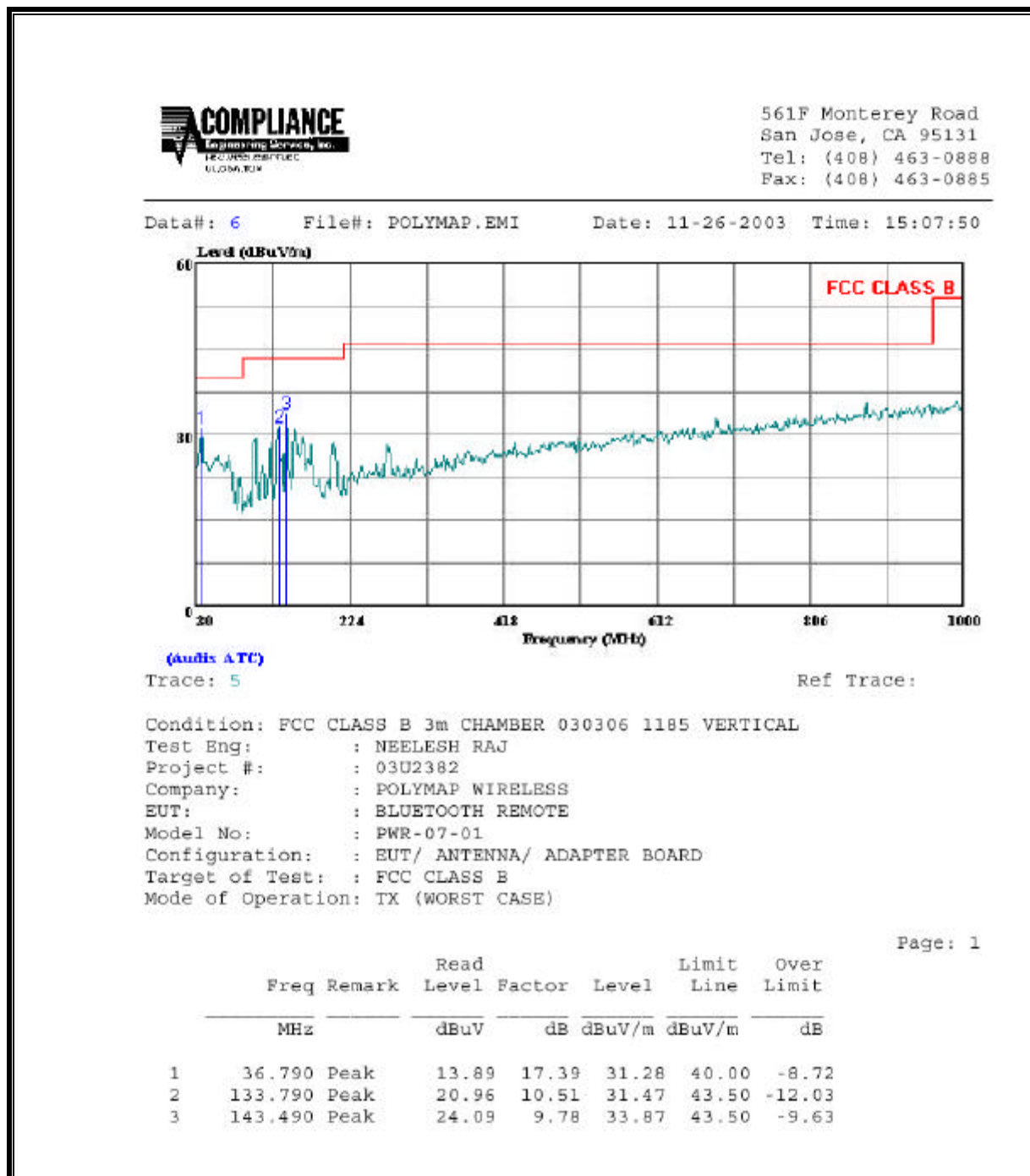
Avg Lim Average Field Strength Limit  
Pk Lim Peak Field Strength Limit  
Avg Mar Margin vs. Average Limit  
Pk Mar Margin vs. Peak Limit

### 7.3.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHZ

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

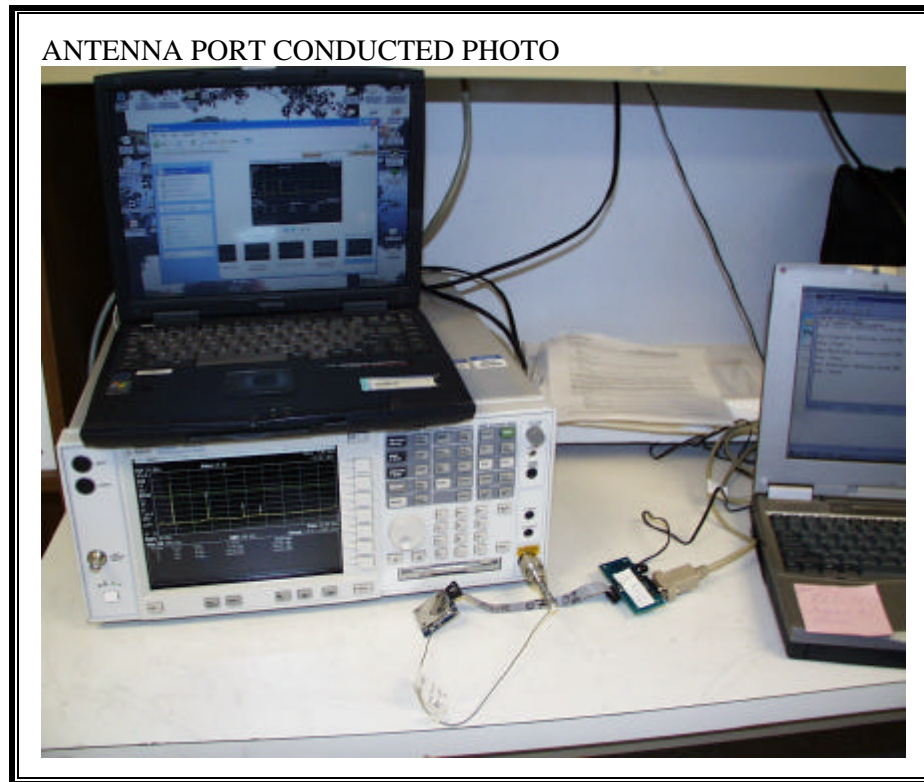


**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**



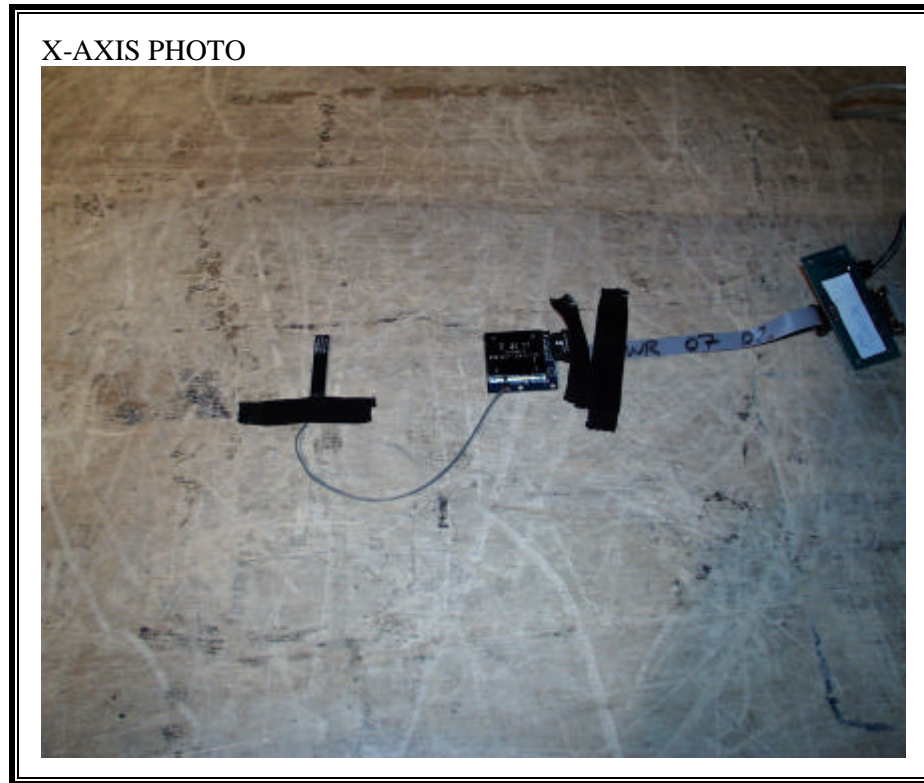
## 8. SETUP PHOTOS

### ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

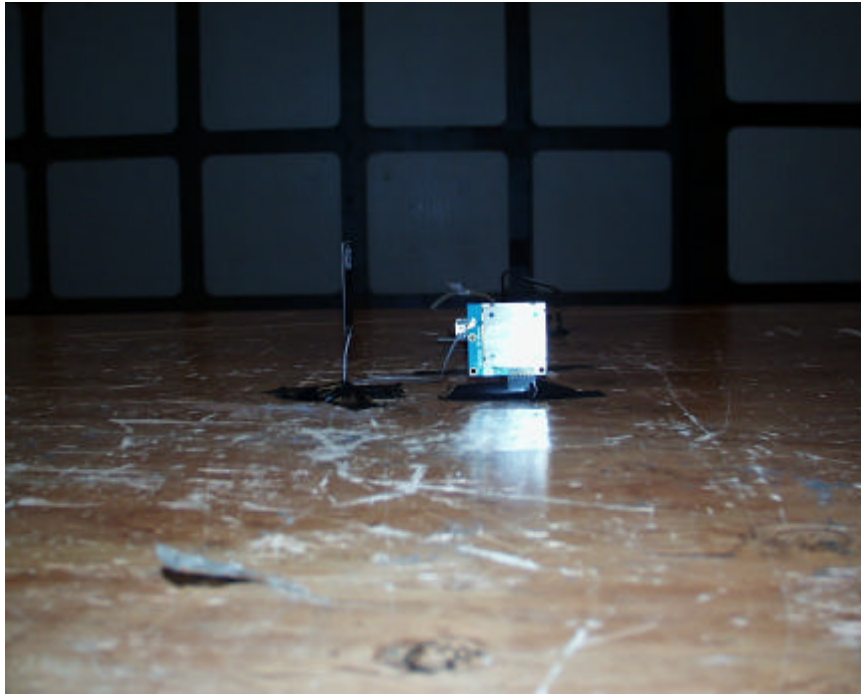




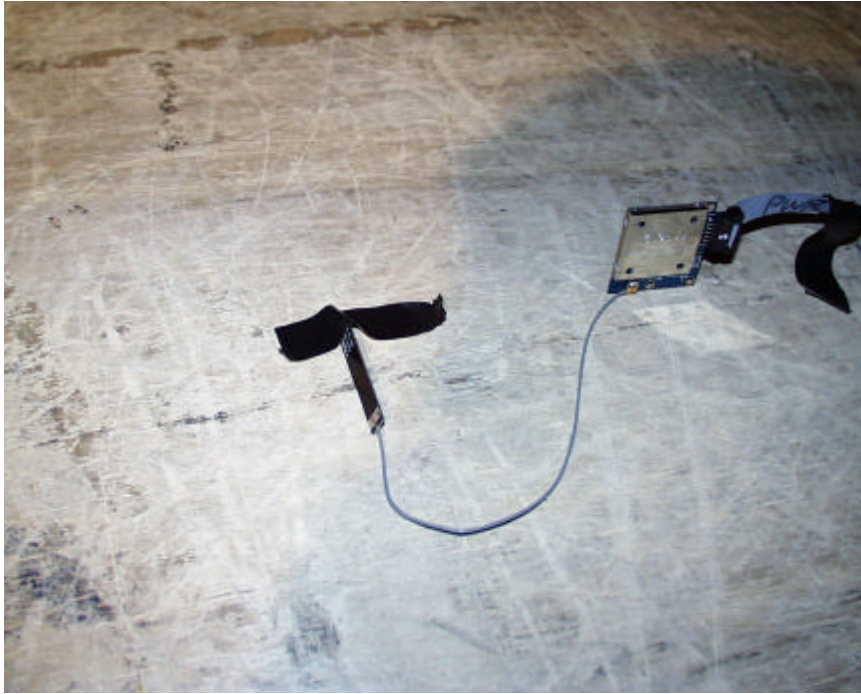
**RADIATED RF MEASUREMENT SETUP**



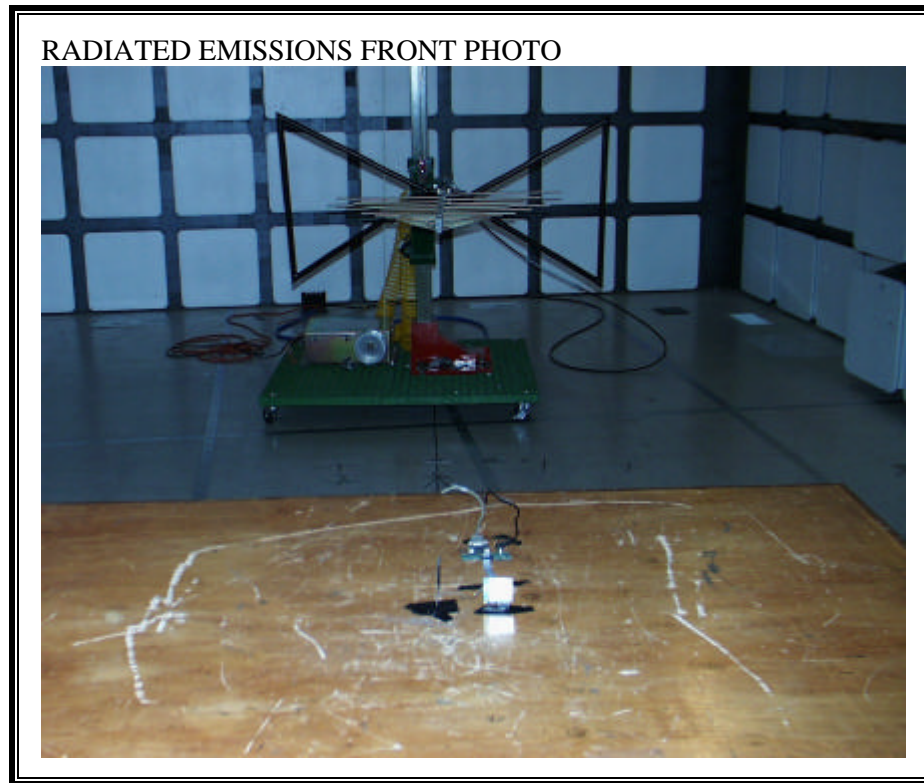
Y-AXIS PHOTO



Z-AXIS PHOTO



**RADIATED EMISSIONS SETUP**





RADIATED EMISSION BACK PHOTO



**END OF REPORT**