MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Digital Wireless Corporation**

MODEL: **WIT2410**

FCC ID: **HSW-2410M**

DATE: **July 12, 1999**

This report concerns (check one): Original grant_X_
Class II change_____

Equipment type: _____

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_X_

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.____
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

United States Technologies, Inc.
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

FIGURES

TABLES

SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is a Digital Wireless Corporation, Model WIT2410 modular 2.4 GHz spread spectrum transceiver. The EUT will be used with one of seven different antennas.

1.2 Related Submittal(s)/Grant(s)

The EUT will be used to send/receive data. The transceiver presented in this report will be used with other like transceivers:

The EUT is subject to the following authorizations:

a) Certification as a transceiver (modular approval)
b) Verification as a digital device

The information contained in this report is presented for the certification & verification authorization(s) for the EUT. The manufacturer desires to seek a modular approval on this device.

SECTION 2

TESTS AND MEASUREMENTS

TEST AND MEASUREMENTS

2.1 Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

The sample used for testing was received by U.S. Technologies on April 23 in good condition.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

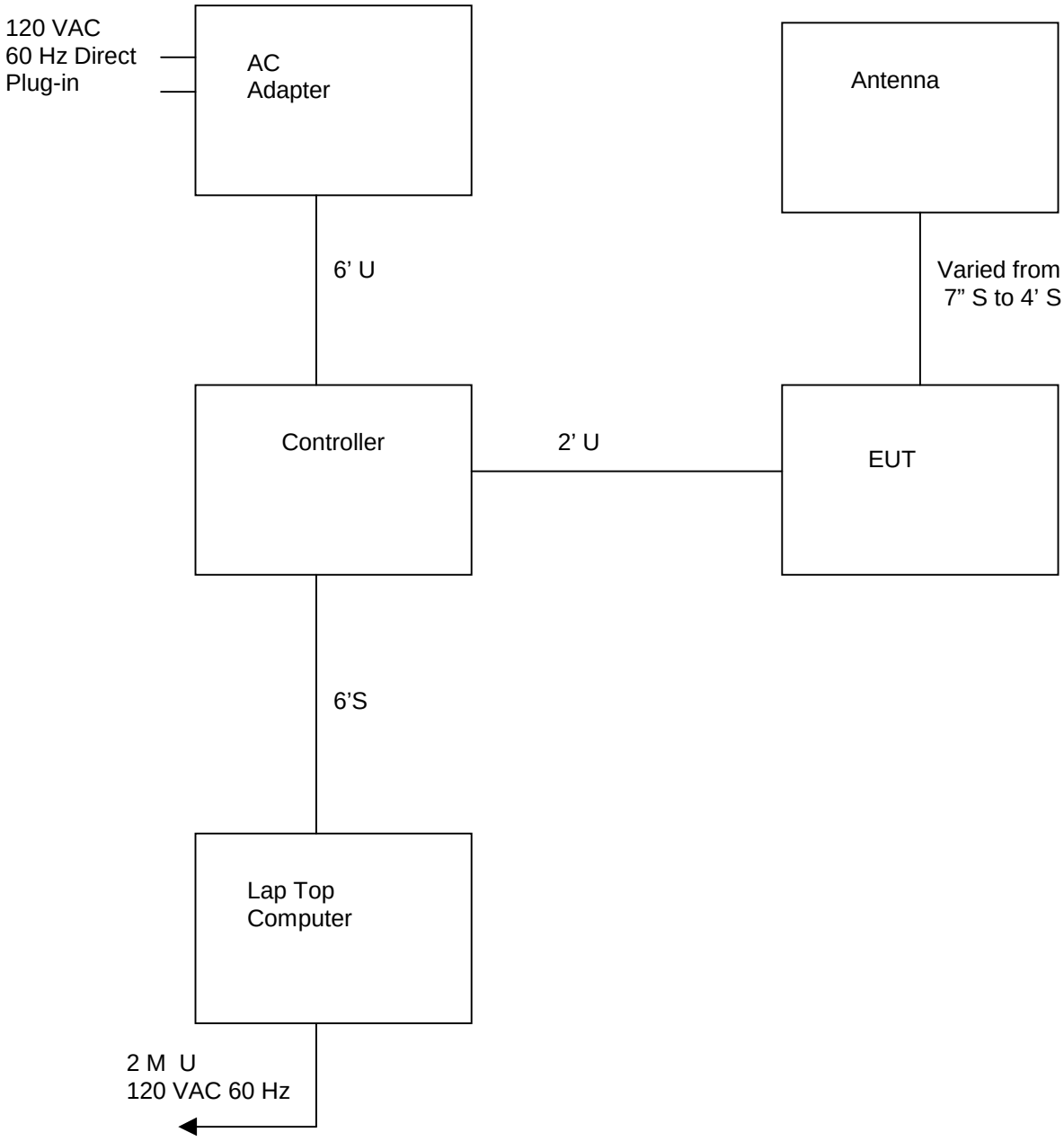
2.3 Test Equipment

Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

No modifications were made by US Tech, to bring the EUT into compliance with FCC Part 15, Class B Limits for the transmitter portion of the EUT or the Class B Digital Device Requirements.

FIGURE 1
TEST CONFIGURATION



Test Date: April 23, 1999
UST Project: 99-317
Customer: Digital Wireless Corporation
Model: WIT2410

FIGURE 2a – 2I

Photographs have been provided in separate files

TABLE 1

Test Date: **April 23, 1999-April 29, 1999**
UST Project: **99-317**
Customer: **Digital Wireless**
Model: **WIT 2410M**

EUT and Peripherals

PERIPHERAL MANU.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) Digital Wireless Corporation	WIT 2410M	00239	HSW-2410M	2'U
Antenna	Various, see antenna descriptions		None	Varied from 7" S to 4' S
AC Adapter CUI Stack	DV-1280	0695	None	120 VAC 60 Hz Direct Plug-in
Controller Digital Wireless Corporation	DWC	None	None	6' U
Lap Top Computer LTE Elite	4/75CX	6520HFJ6F406	CNT75MB1CB	2m U 120 VAC Hz Power Cord

TABLE 2
TEST INSTRUMENTS

TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
HORN ANTENNA	EMCO	3115	3723
HORN ANTENNA	EMCO	3116	9505-2255
BICONICAL ANTENNA	EMCO	3110	9307-1431
LOG PERIODIC ANTENNA	EMCO	3146	9110-3600
BILOG	CHASE	CBL6112A	2238
LISN	SOLAR ELE.	8012	865577
LISN	SOLAR ELE.	8028	910494
LISN	SOLAR ELE.	8028	910495
THERMOMETER	FLUKE	52	5215250
MULTIMETER	FLUKE	85	53710469
FUNCTION GENERATOR	TEKTRONIX	CFG250	CFG250TW15059
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394

2.6 Antenna Description (Paragraph 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Digital Wireless Corporation will sell the WIT2410 with one of the following antennas.

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB	Type of Connector
ACE	Dipole	ACE-2400NF	2 dBi	Reverse SMA to MMCX via adapter cable
Cushcraft	Yagi	PC2415-RTNF	15 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Omni-Directional	OD6-2400-RTNC	6 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Omni-Directional	OD12-2400PTA-RTNC	12 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Corner Reflector	SCR14-2400PTA-RTNC	14 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Patch	P7-2400RTNC	7 dBi	Reverse SMA to MMCX via adapter cable
Digital Wireless Corporation	Patch	PA2410	Appx. 3 dBi	Non-standard MMCX

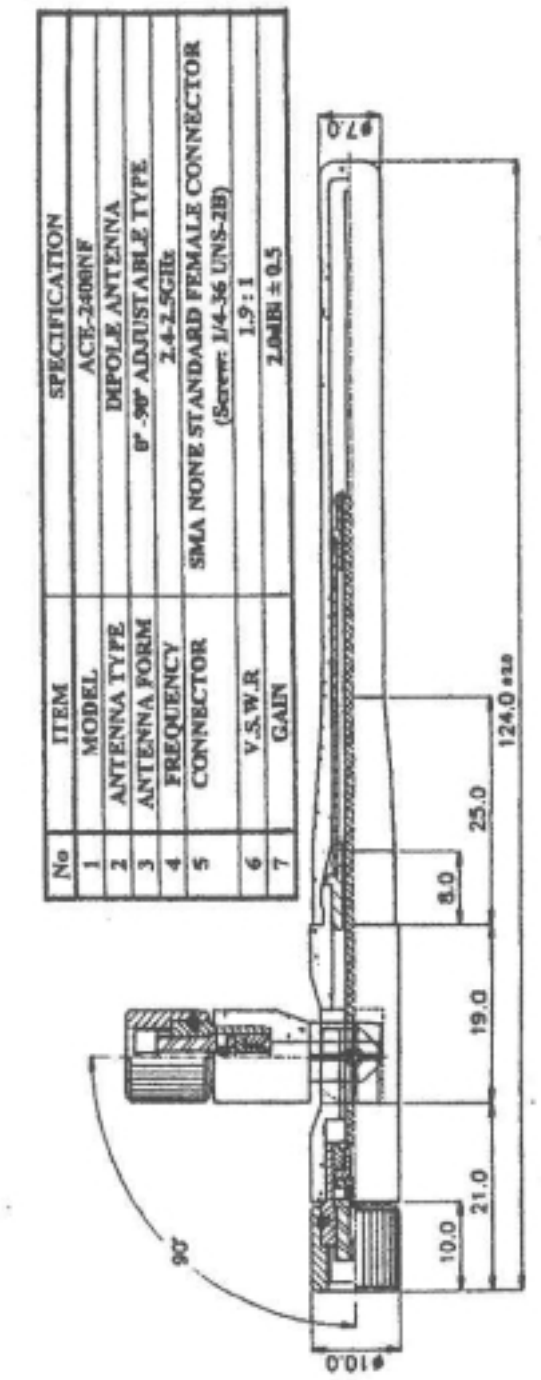
*For more specific antenna specifications, please see the following pages.

To ensure compliance with 15.203, Digital Wireless Corporation proposes to attach reverse-sex TNC connectors to the 15dBi Yagi, the 14dBi corner reflector, and the 9dBi and 12dBi omni-directional. The 2dBi dipole will be fitted with a reverse sex SMA as the TNC is too large to fit onto the antenna body.

Digital Wireless Corporation has arranged for the manufacturers of the 14 dBi corner reflector, the 15 dBi Yagi, the 6 dBi and 12 dBi omni-directional antennas to provide reverse-sex TNC connectors for these antennas. We have also arranged with the manufacturer of the 2dBi dipole to place a reverse sex SMA connector on that antenna. OEM customers wanting to use one of these antennas in their product will first need to obtain a special part number from Digital Wireless to give to the antenna manufacturer. The manufacturer, upon receipt of this number, will know to attach the reverse-sex TNC connector (or SMA in the case of the dipole) to the end of the antenna cable before shipping.

The customer then purchases an adapter cable from Digital Wireless that will connect the MMCX port on our module to the reverse-sex connector on the antenna. No other type of commercially available antenna will attach to this reverse-sex TNC (or SMA for the case of the dipole). Given the nonstandard nature of the interconnect between module and antenna and the difficulty involved in circumventing that connection, Digital Wireless Corporation believes that this procedure meets the requirements called out in 15.203.

The sixth antenna included in our application, the DWC patch, already has a nonstandard MMCX mating connector attached to it. It cannot be connected to anything else but a MMCX connector. No adapter cable is needed when using this antenna – the antenna snaps directly to the module. Digital Wireless has no official data sheet for this antenna. Lab measurements show an approximate antenna gain of 3dBi for the device.

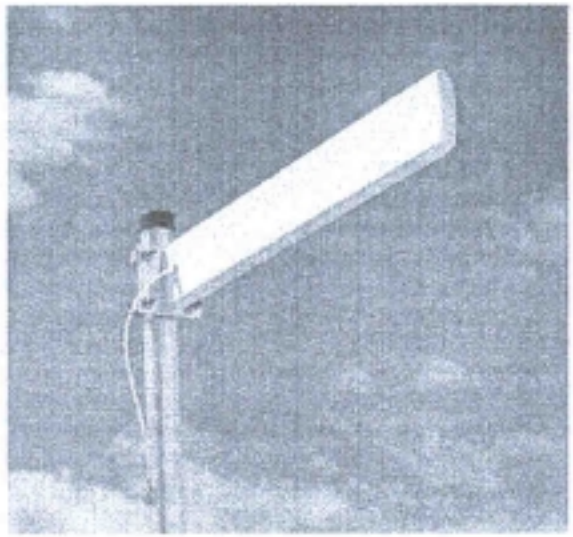


Radome Enclosed Yagis

PC2415N

Specifications

Minimum Gain (dBi/dBd)	15.0 / 13.0
Bandwidth (MHz)	2400-2500
Impedance (Ohms)	50
VSWR	1.5:1
Polarization	Linear
E Plane Beamwidth (@ -3 dB point)	30
H Plane Beamwidth (@ -3 dB point)	34
Front/Back Ratio (dB)	18
Maximum Power (watts)	50
Wind Rating (MPH)	125
L x W x D (inches)	26.0 x 4.0 x 1.5
Weight (pounds)	1.25
Mounting	1.5-2.2 OD

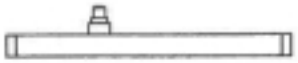


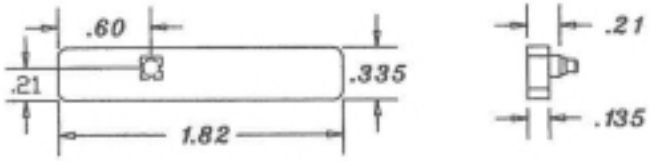
- *Directional*
- *Sealed, UV Stable Radome*
- *Easy Installation*
- *Also at 1.7 and 1.8GHz*

Cushcraft Corporation

FCC ID: HSW-2410M

REVISIONS					
REV	CC NO.	DESCRIPTION	DRN	ENGR. CHK.	DATE





1. CONNECTOR IS HUBER-SUHNER TYPE 81 MMCX-50-0-1 (PLUG) OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE: INCHES-------XXXXXX MM-------[XXXXXX] TOLERANCES .XX = ±.02 INCHES [.X] = ±.5 MM ANGULAR = ±.5° .XXX = ±.006 INCHES [.XX] = ±.15 MM	DIGITAL WIRELESS CORP. ONE MECA WAY, NORCROSS, GA 30093 USA TEL (770) 564-5540 FAX (770) 564-5541
THIRD ANGLE PROJECTION	TITLE DRAWING, ASSEMBLY 2.4 GHz PATCH ANTENNA WIT2410M
DRAWN: PM DATE 14MAY99	DESCRIPTION THIS PAGE
ENGR. PM DATE 14MAY99	SIZE A SCALE 1:1 DOC NUMBER 800262 REV. —
ENGR. MGR. MT DATE 14MAY99	PART NUMBER SHEET 1 OF 1

Product Specifications

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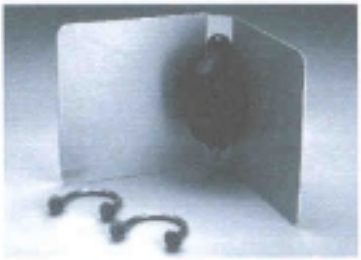
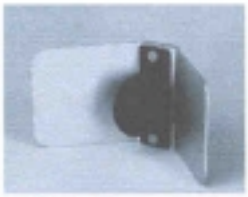


14 dBi Corner Reflector



9 dBi Mini Corner Reflector

Corner Reflector Antenna (Pat.Pend.)

For PCS, ISM & High Frequency Applications

- 14 dBi models for 1.7 - 2.6 GHz
- 9 dBi Mini model for 2.4 GHz applications
- Small aperture; minimizes windloading
- Split balun feed provides superior bandwidth & gain performance

Mobile Mark's high frequency Corner Reflector antennas are useful for many applications including surveillance work, PCS, LAN/WAN and other high frequency applications. Its unique design features allow the antenna to overcome many of the problems normally associated with higher frequency systems.

These corner reflectors utilize a half-wavelength element configuration. A unique balun fed design provides high efficiency radiation without skewing of the radiation pattern. The resultant performance provides excellent bandwidth, gain and match over the frequency range.

These antennas are very small in design and appearance. The connector mechanism exits at the rear of the antenna, allowing easy installation. The mounting bracket (supplied) allows both horizontal and vertical mounting of the antenna. Surface mount can also be accommodated. Each reflector panel on the 14 dBi models measure 7" x 7", providing very low aperture and windloading. The 9 dBi Mini-Corner Reflector has 3" x 3" panels, with total aperture of only 3" x 5.5".

The reflectors are made of aluminum, and irridited for weather protection. The radiating elements are weather protected within an ABS radome. This maintains integrity of the antenna without sacrificing looks or windloading.

Model Numbers

Frequency Range	Gain	Model
1700 -1900 MHz	14 dBi	SCR14-1800
1800 - 2000 MHz	14 dBi	SCR14-1900
2300 - 2600 MHz	14 dBi	SCR14-2400
2300 - 2600 MHz	9 dBi	SCR9-2400

Please confirm desired operating frequency at time of order. Other special configurations are available upon request. Operation subject to bandwidth restrictions.

Specifications

Frequency:	See above	**SCR14 Panel Size:**	7" x 7" each
Gain:	See above	**Max Wind Velocity:**	100+ mph
Bandwidth @2:1 SWR:	200 MHz or better	**Material:**	Irridited aluminum, ABS plastic radome material
Impedance:	50 Ohm nominal		
Maximum Power:	100 Watts	**Weight:**	
SCR9 Beamwidth:	65° vertical, 75° horizontal	SCR9	<1 lbs
SCR14 Beamwidth:	44° vertical, 35° horizontal	SCR14	<2 lbs
Front-to-Back ratio:	22 dB or better	**Mounting:**	Pole, surface, & corner mount, hardware included.
Lightning Protection:	DC grounded, external protection recommended	**Mounting Dimension:**	Mounts up to 2" outside diameter mast
SCR9 Aperture:	3" x 5.5" front face	**Connector:**	N female, attached at rear of antenna
SCR9 Panel Size:	3" x 3" each		
SCR14 Aperture:	7" x 10.5" front face		

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Visit our web page at www.mobilemark.com. Specifications subject to change without notice (11/98).

Product Specifications

MOBILE MARK®
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OD12 Series Antenna

OD9 Series with Reflector Option Kit

OD Series Omni Antenna

For WLAN, Video, PCS, and Data Systems

- 6 dBi, 9 dBi & 12 dBi antennas provide uniform omni coverage
- Unique design allows economical build out
- Mounting kit includes all hardware needed
- Reflector option provides directional beamshaping & increased performance

The OD Series Antennas are optimized for use in a wide variety of wireless systems. They are usable in point to point, multipoint and broadcast configurations. Typical uses include WLAN access points or bridge, PCS Microcell, and video surveillance transmitters.

These antennas consist of a collinear array with elements stacked vertically. Unique phasing cancels out-of-phase current distribution, improving system performance. This design maintains an omni pattern in the horizontal plane. The OD Series are free space antennas and can be mounted anywhere; no ground plane is required.

An option for the OD series is a reflector kit that beam shapes the omni pattern into a directional cardioid shape. This can result in improved performance for gain, and isolation for reduced interference.

The low profile black radome (1" diameter) makes the OD Series durable and rugged. They can withstand the harshest environments of snow, wind, rain and ice. The feed assembly is made of precision machined aluminum components and is irridited for weather protection. The OD Series comes with all the hardware needed to install it to a mast. Customized hardware is also available for unique mounting needs. For ISM, special connectors and models with cable are available including reverse polarized; please consult factory.

Model Numbers

Model	Freq.(MHz)	Gain	Applications
OD6-1800	1700-1900	6 dBi	PCN, Surveillance
OD9-1800	1700-1900	9 dBi	PCN, Surveillance
OD6-1900	1850-1990	6 dBi	PCS, CDMA/TDMA
OD9-1900	1850-1990	9 dBi	PCS, CDMA/TDMA
OD12-1900	1850-1990	12 dBi	PCS, CDMA/TDMA
OD6-2400	2400-2485	6 dBi	WLAN, ISM, Video
OD9-2400	2400-2485	9 dBi	WLAN, ISM, Video
OD12-2400	2400-2485	12 dBi	WLAN, ISM, Video

Frequencies subject to bandwidth constraints; confirm desired frequencies at time of order. Special frequencies are also available, please consult factory for information.

Reflector Options	Model
Add-on kit for 6 dBi models	ODR6-Kit
Add-on kit for 9 dBi models	ODR9-Kit
Add-on kit for 12 dBi models	ODR12-Kit

Specifications

Frequency & Gain:	See above	**Lightning Protection:**	External suggested
Bandwidth @2:1 SWR:	140 MHz, 85 MHz for OD12	**Material:**	ABS radome/aluminum feed
		Length/Weight:	
Nominal Impedance:	50 ohms	6 dBi Models	19 inches, 1.5 lbs
Max. Power (continuous):	100 watts	9 dBi Models	27 inches, 2.0 lbs
Vertical Beamwidth (-3 dB point):		12 dBi Models	43 inches, 2.5 lbs
6 dBi Models	25 degrees	**Antenna Diameter:**	1", main mast
9 dBi Models	14 degrees	**Connector:**	N female standard
12 dBi Models	9 degrees	**Mounting Kit:**	Mast mount kit included
Wind Loading (flat plate equiv.):	30-40 sq. inches	**Mounting Dimensions:**	Use mast up to 2" OD
Rated Wind Velocity:	100+ mph	**Accessory:**	Reflector Option Kit

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Product Specifications

MOBILE MARK®
COMMUNICATIONS ANTENNAS

P7-2400 shown wall mounted

Preliminary Info

Patch Antenna (Pat.Pend.)

WLAN & 2.4 GHz ISM Applications

- 4 1/2" weatherproof radome; perfect for in-building & outdoor coverage
- 7 dBi Gain model for 2.40 - 2.49 GHz
- Semi-hemisphere radiation pattern for easy installation
- Unique design provides high performance at an economical price

Mobile Mark's 2.4 GHz Patch Antenna is perfect for new Wireless LAN systems, as well as other applications in the ISM band. It has design features that make it invaluable, solving many of the problems normally associated with 2.4 GHz patch designs.

These antennas use a unique plate-air dielectric technology that provides significant improvements in efficiency while being very economical. VSWR performance is maintained across the operating bandwidth. The antenna design also provides near hemispherical energy radiation, resulting in broad area coverage, yet maintaining directivity and isolation. The antenna provides 7 dBi gain with vertical polarization.

This Patch antenna is small and provides an attractive design. It has a diameter of 4 1/2". The radome consists of a ergo-white polycarbonate, allowing aesthetic installation in all environments. It is durable and weatherproof. The antenna is mounted to a swivel that allows it to be angled left or right with a 30 degree angle. Flush surface mounting and pole mounting can also be accommodated.

The cable feed exits near the bottom of the antenna in a "scalloped" port. This allows the cable to be directed up, down or straight back. The antenna terminates with 6" of low loss RG-188 with a choice of a female TNC or a female SMA connector.

Model Number

Model	Description
P7-2400T	Patch Antenna with TNC
P7-2400S	Patch Antenna with SMA

Connectors provided are female. For other connectors or cable configurations, please consult factory.

Specifications

Frequency:	2400 - 2485 MHz	**Antenna Radome:**	White Polycarbonate
Gain:	7 dBi nominal	**Weight:**	0.5 lbs
Bandwidth @2.0:1 SWR:	85 MHz	**Mounting:**	Surface & pole mount, with articulating swivel bracket
Impedance:	50 Ohm nominal		
Maximum Power:	50 Watts	**Swivel Standoff:**	3" from wall to outer radome surface, centered
E Plane beamwidth:	45°		
H Plane beamwidth:	60°	**Mounting Dimension:**	Mounts up to 2" outside diameter mast
Front-to-Back ratio:	10 dB minimum		
Lightning Protection:	external recommended	**Connector:**	TNC or SMA female, others available upon request
Radome Size:	4 1/2" diameter x 3/4" high,		
Rated Wind Velocity:	100 mph+	**Cable:**	6 inches of RG-188

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2.7 Peak power within the band 2400 – 2483.5 GHz per FCC Section 15.247(b)

Peak power within the band 2400-2483.5 GHz has been measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. The spectrum analyzer was set for a 50 Ω impedance with the VBW ≥ RBW 6 dB bandwidth. The results of the measurements are given in Table 3 and Figure 3a through Figure 3c.

The EUT did not incorporate any antennas of directional gain greater than 6 dBi, therefore the output power has not been reduced as required by 15.247(b)(3).

TABLE 3
PEAK POWER OUTPUT

Test Date: **April 30, 1999**
UST Project: **99-317**
Customer: **Digital Wireless Corporation**
Model: **WIT2410**

Frequency of Fundamental (MHz)	Measurement (dBm)*	Measurement (Watt)*	FCC Limit* (Watt)
2401.9	16.2	41.7	1.0
2440.0	16.8	47.8	1.0
2483.5	16.8	47.8	1.0

*** Measurement includes 0.3 dB for cable loss**

Tester
Signature: _____ Name: Tim R. Johnson

Figure 3a.
Peak Power per FCC Section 15.247(b) (Low)

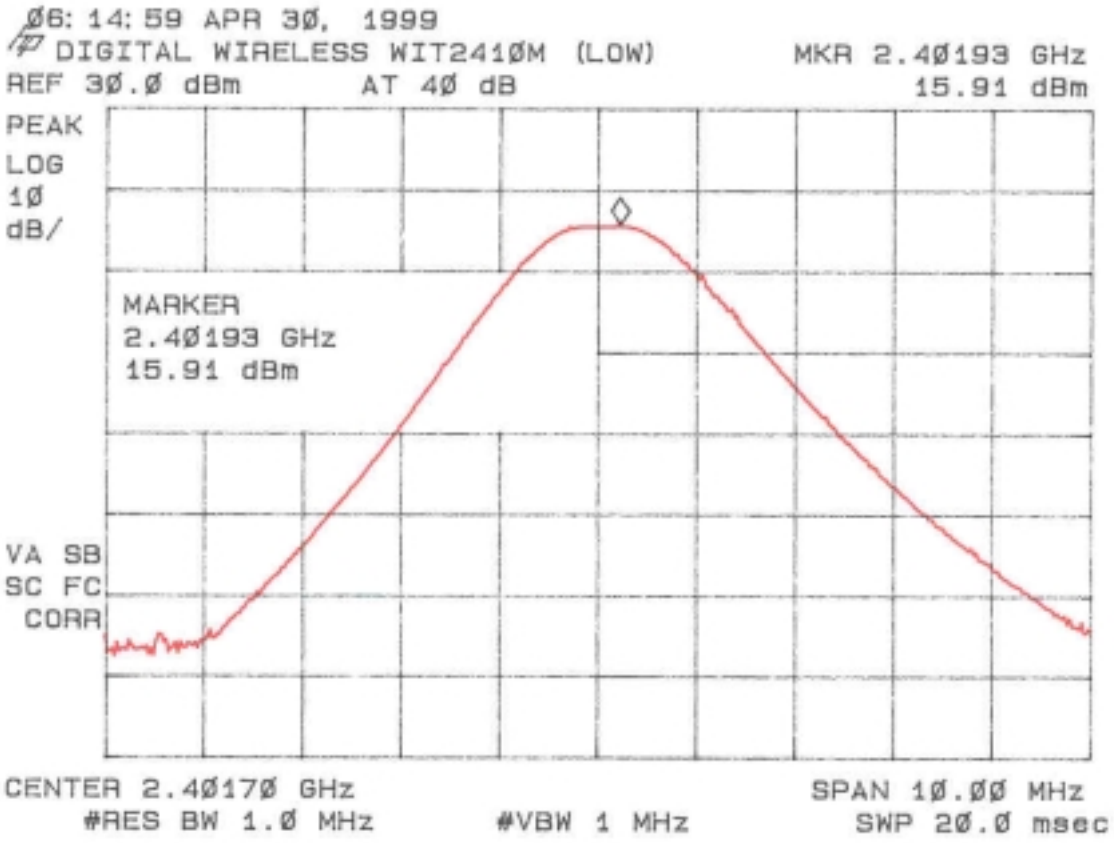


Figure 3b.
Peak Power per FCC Section 15.247(b) (Mid)

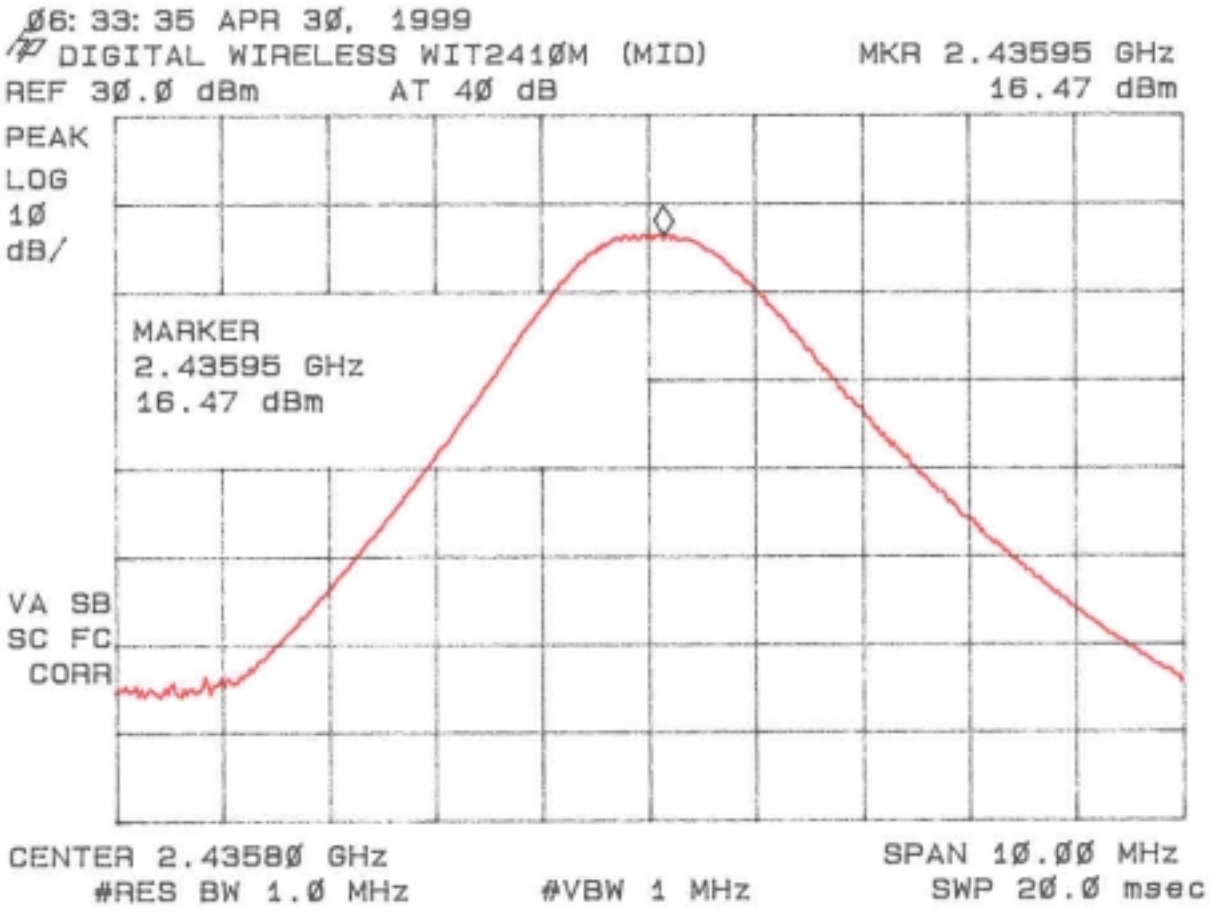
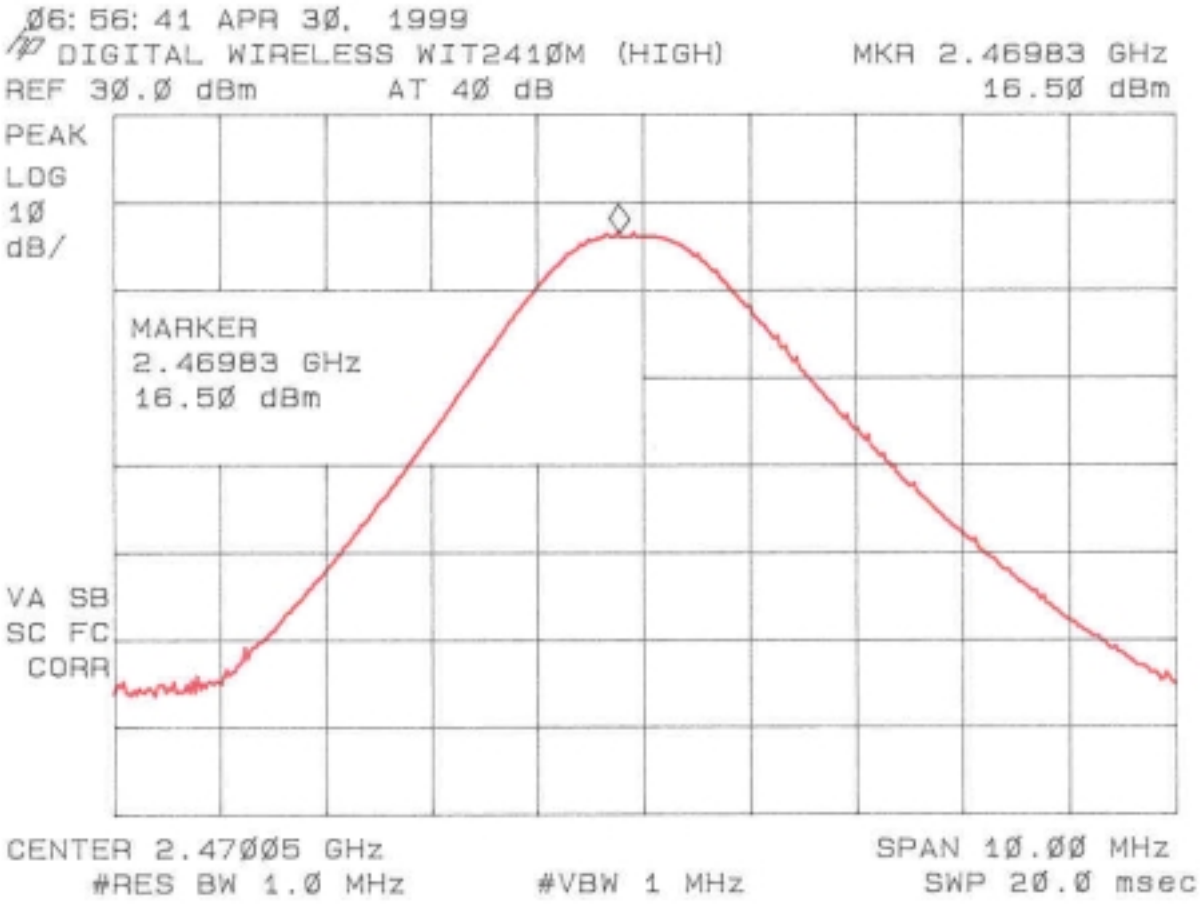


Figure 3c.
Peak Power per FCC Section 15.247(b) (High)



2.8 Antenna Conducted Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))

Spurious emissions in the frequency range 30 - 25000 have been measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. The spectrum analyzer was set for a 50 Ω impedance with the RBW = 100 kHz & VBW > RBW. All spurious emissions were measured to be greater than 20 dB down from the fundamental. The results of conducted spurious emissions are given in Figure 4a through Figure 4l.

Figure 4a
Antenna Conducted Spurious Emissions 15.247(c) Low

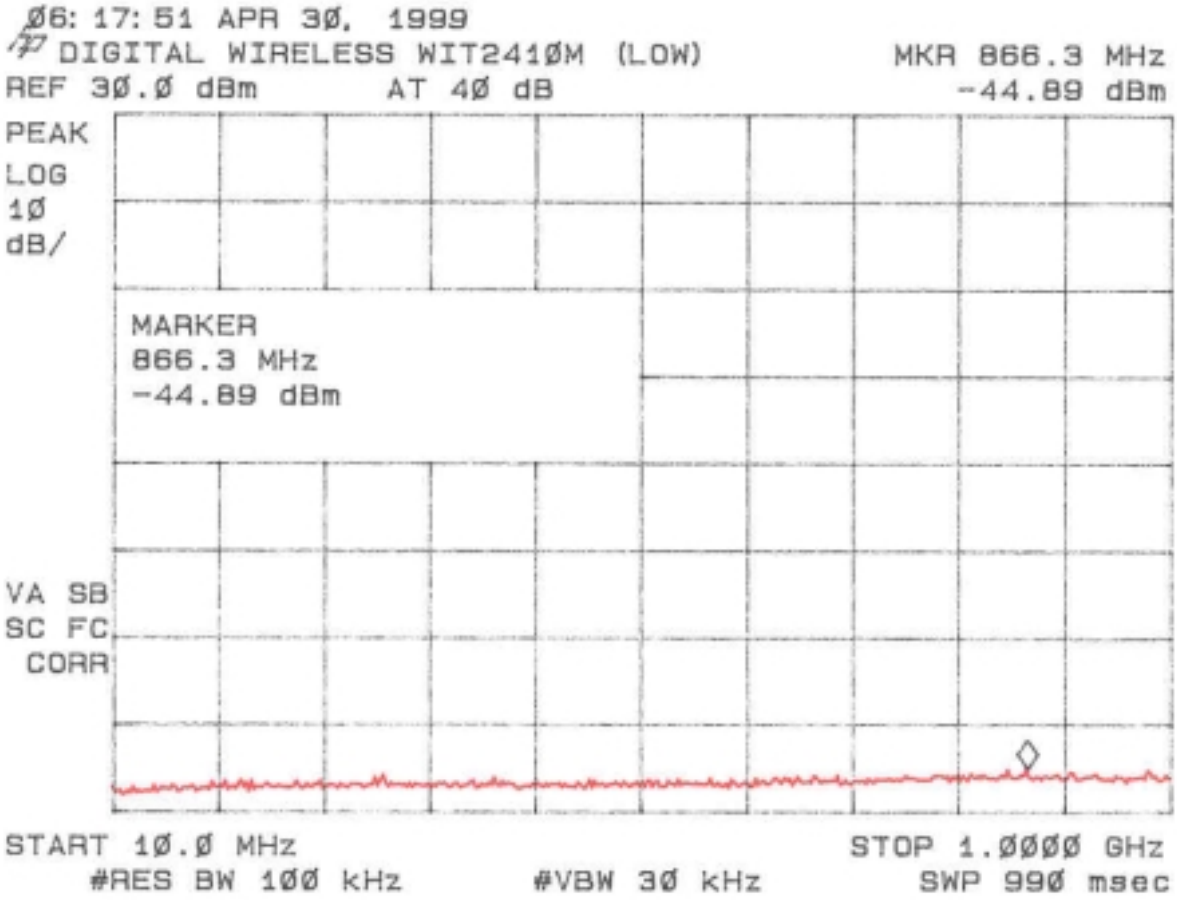


Figure 4b
Antenna Conducted Spurious Emissions 5.247(c) Low

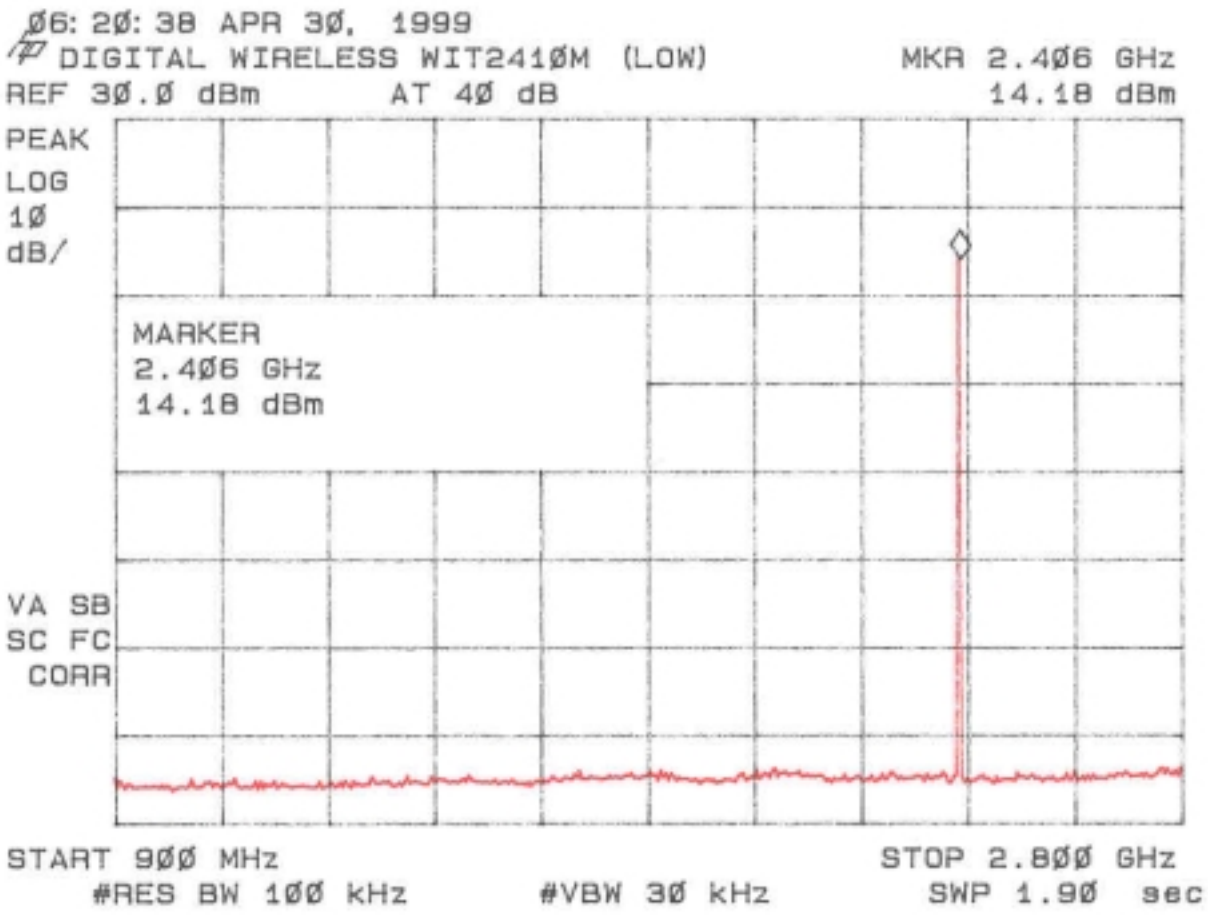


Figure 4c
Antenna Conducted Spurious Emissions 15.247(c) Low

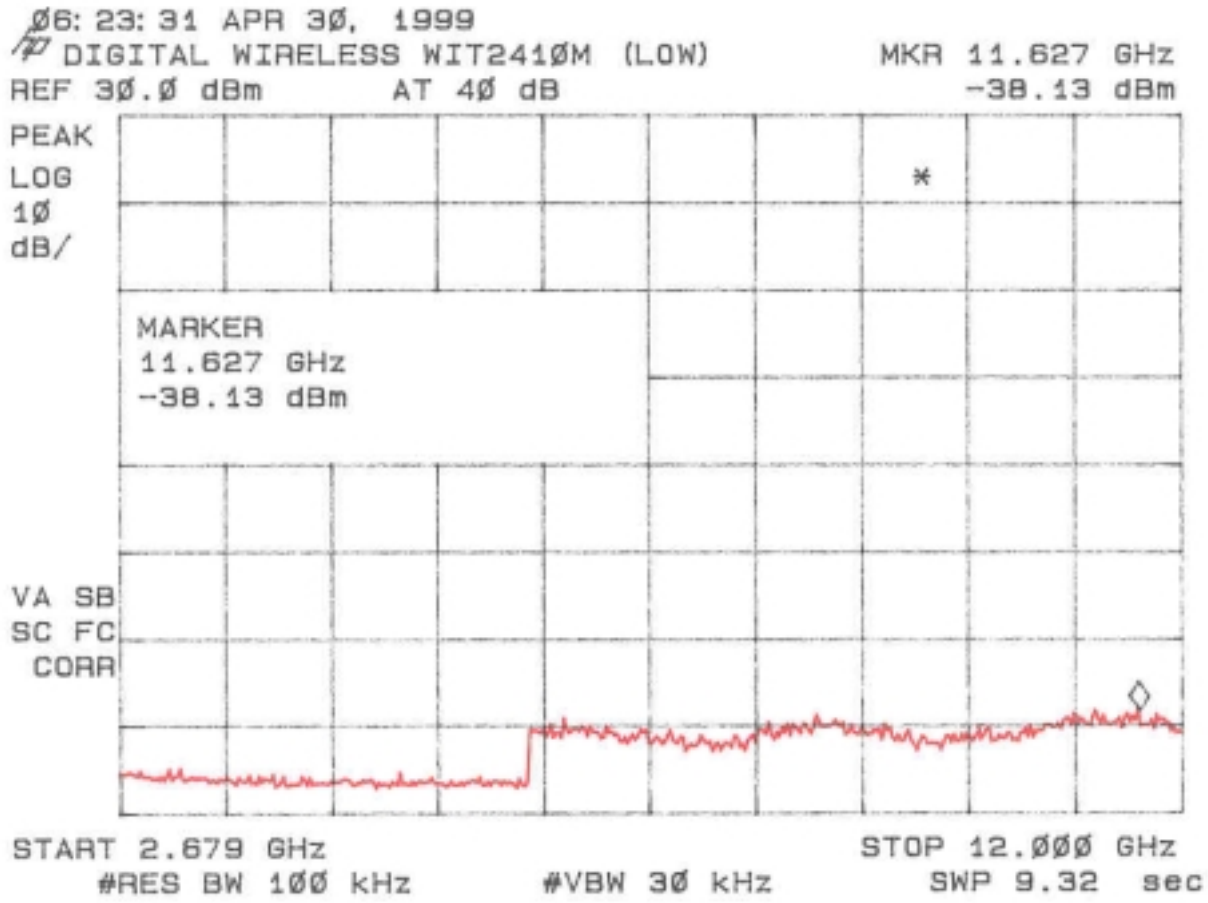


Figure 4d
Antenna Conducted Spurious Emissions 15.247(c) Low

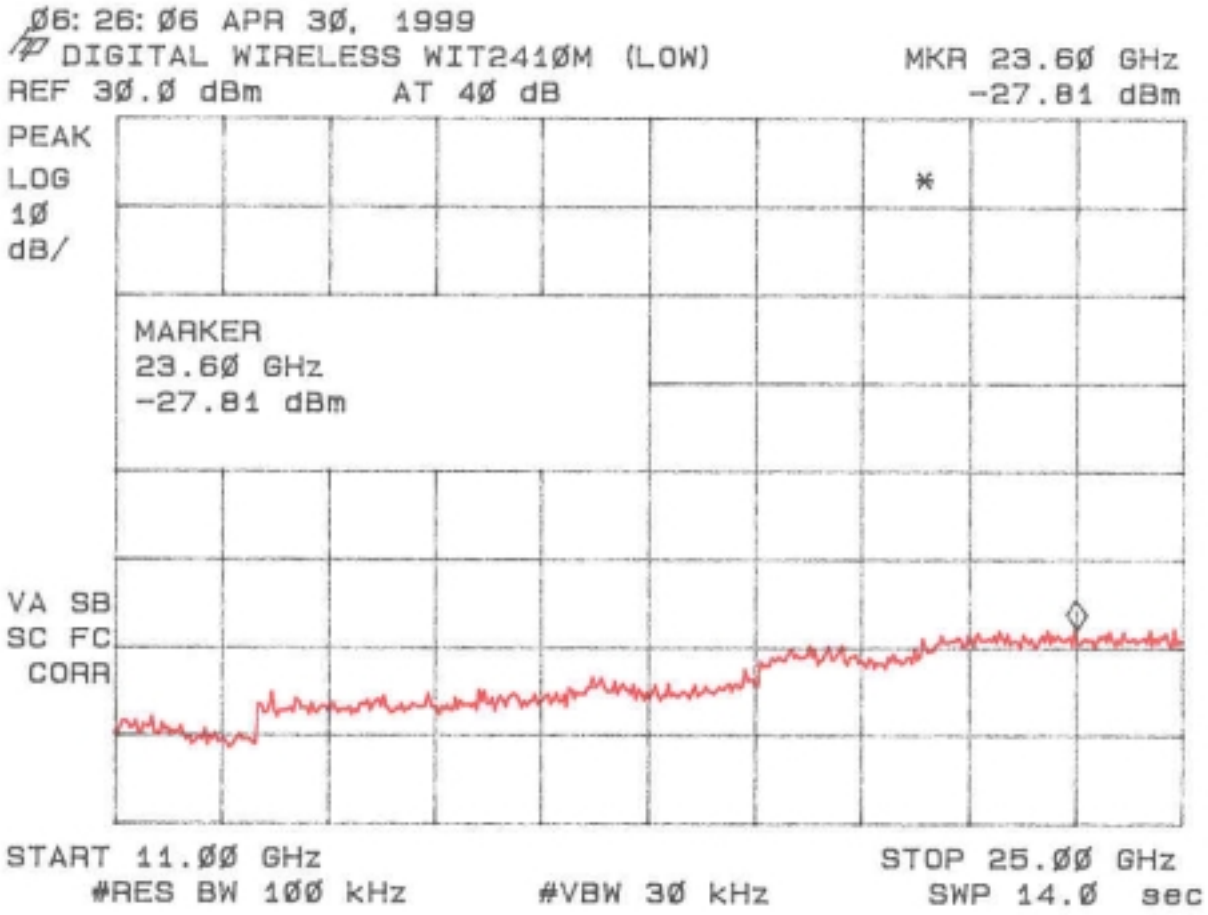


Figure 4e
Antenna Conducted Spurious Emissions 15.247(c) Mid

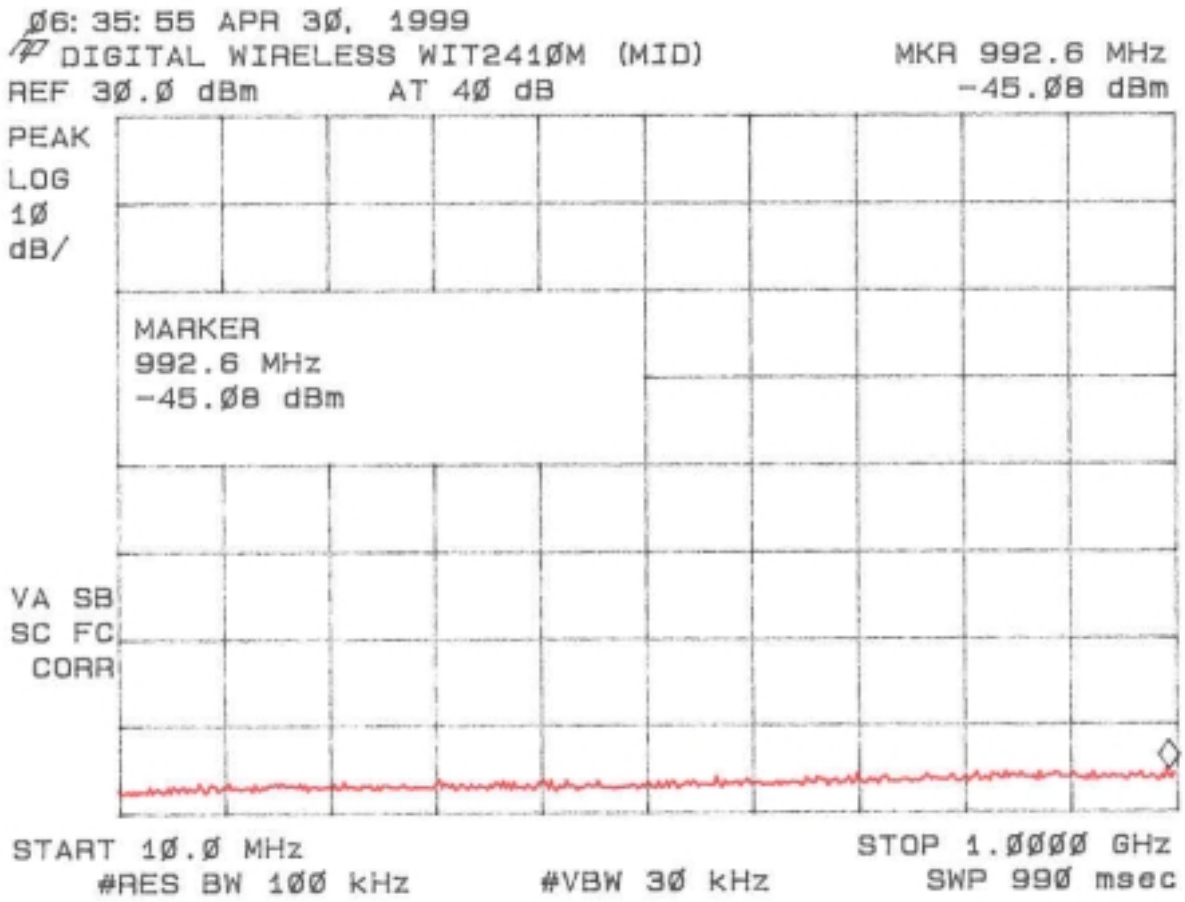


Figure 4f
Antenna Conducted Spurious Emissions 15.247(c) Mid

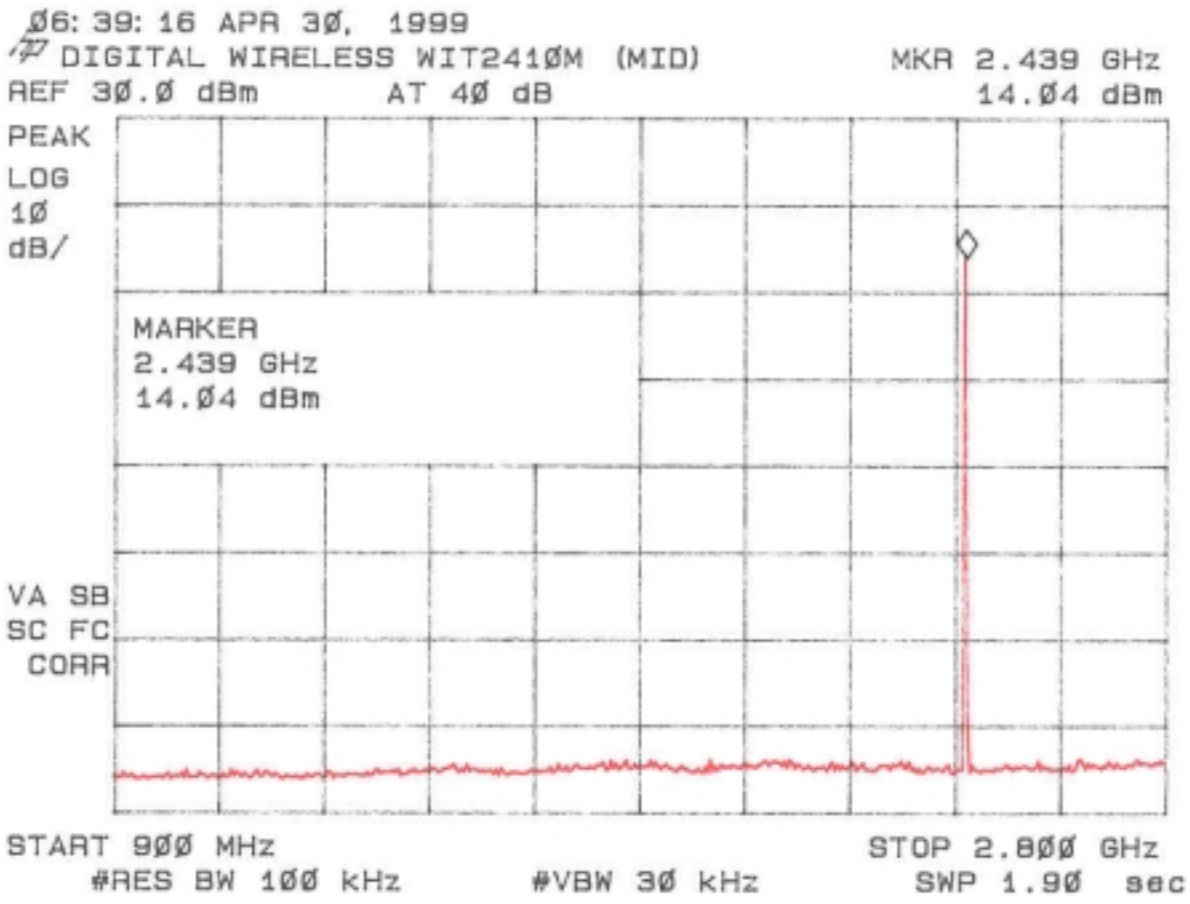


Figure 4g
Antenna Conducted Spurious Emissions 15.247(c) Mid

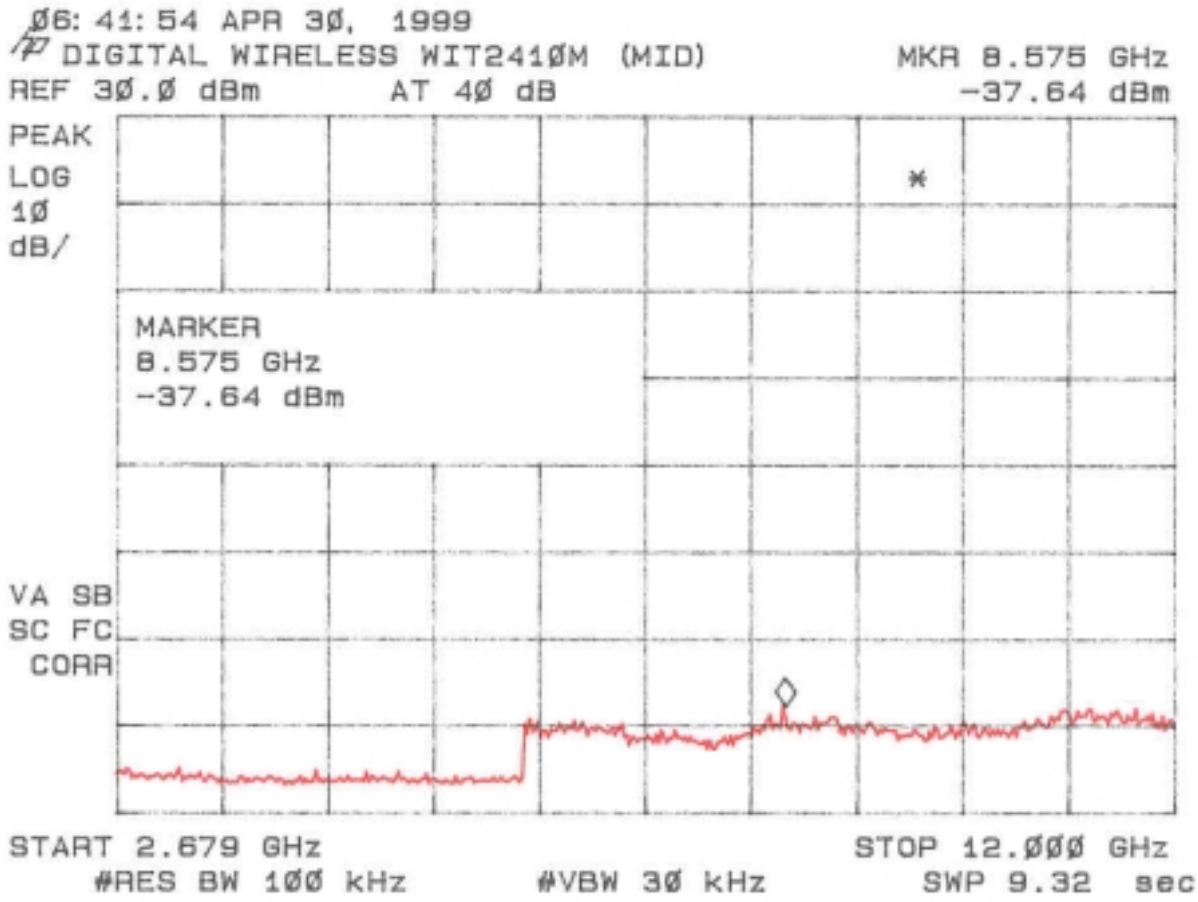


Figure 4h
Antenna Conducted Spurious Emissions 15.247(c) Mid

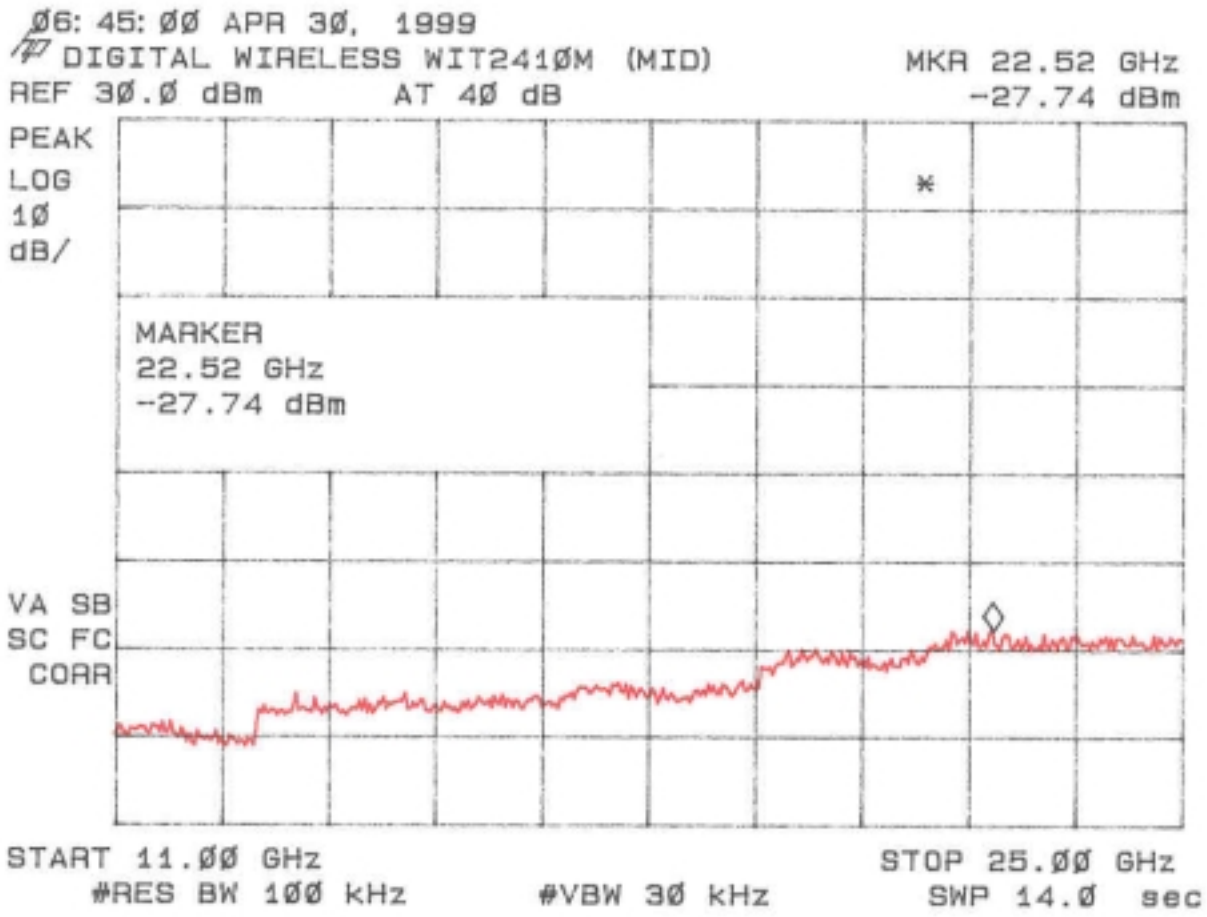


Figure 4i
Antenna Conducted Spurious Emissions 15.247(c) High

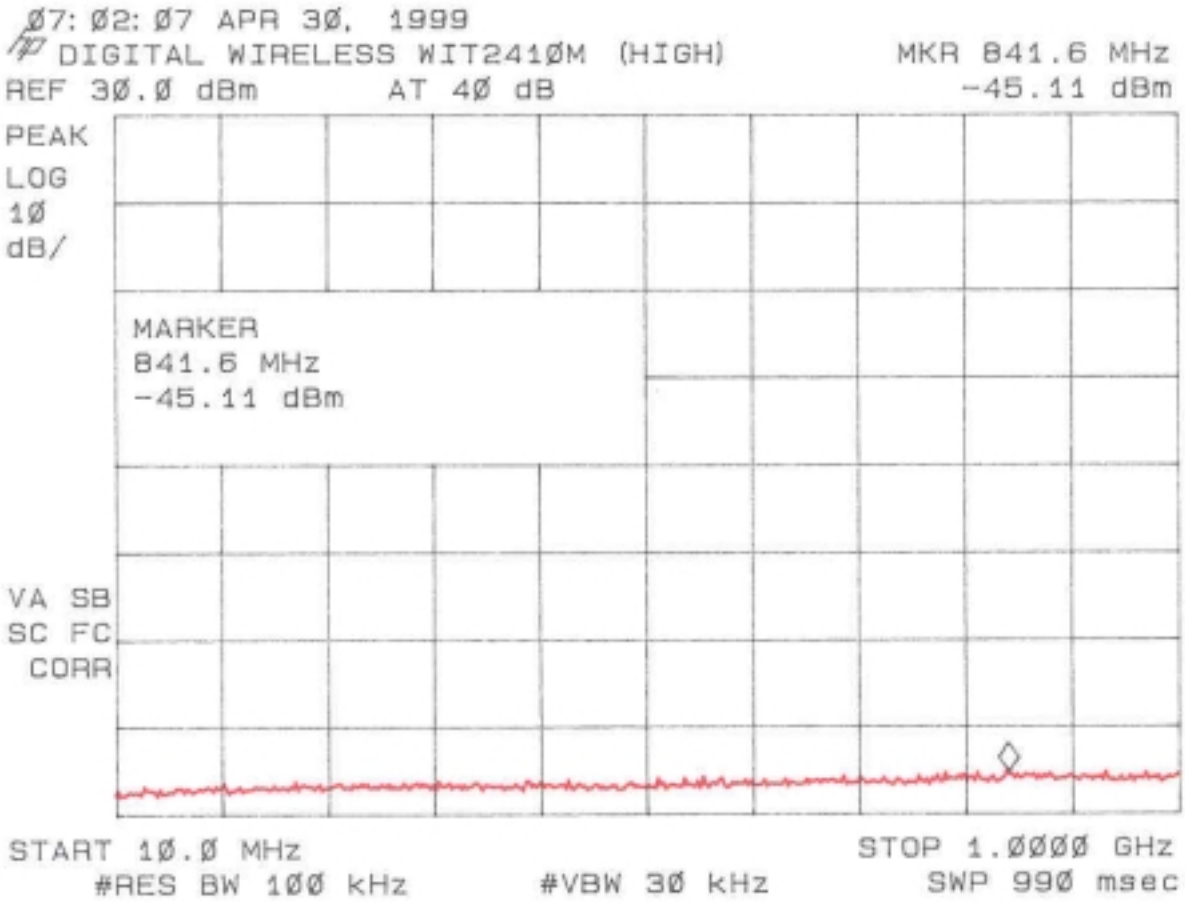


Figure 4j
Antenna Conducted Spurious Emissions 15.247(c) High

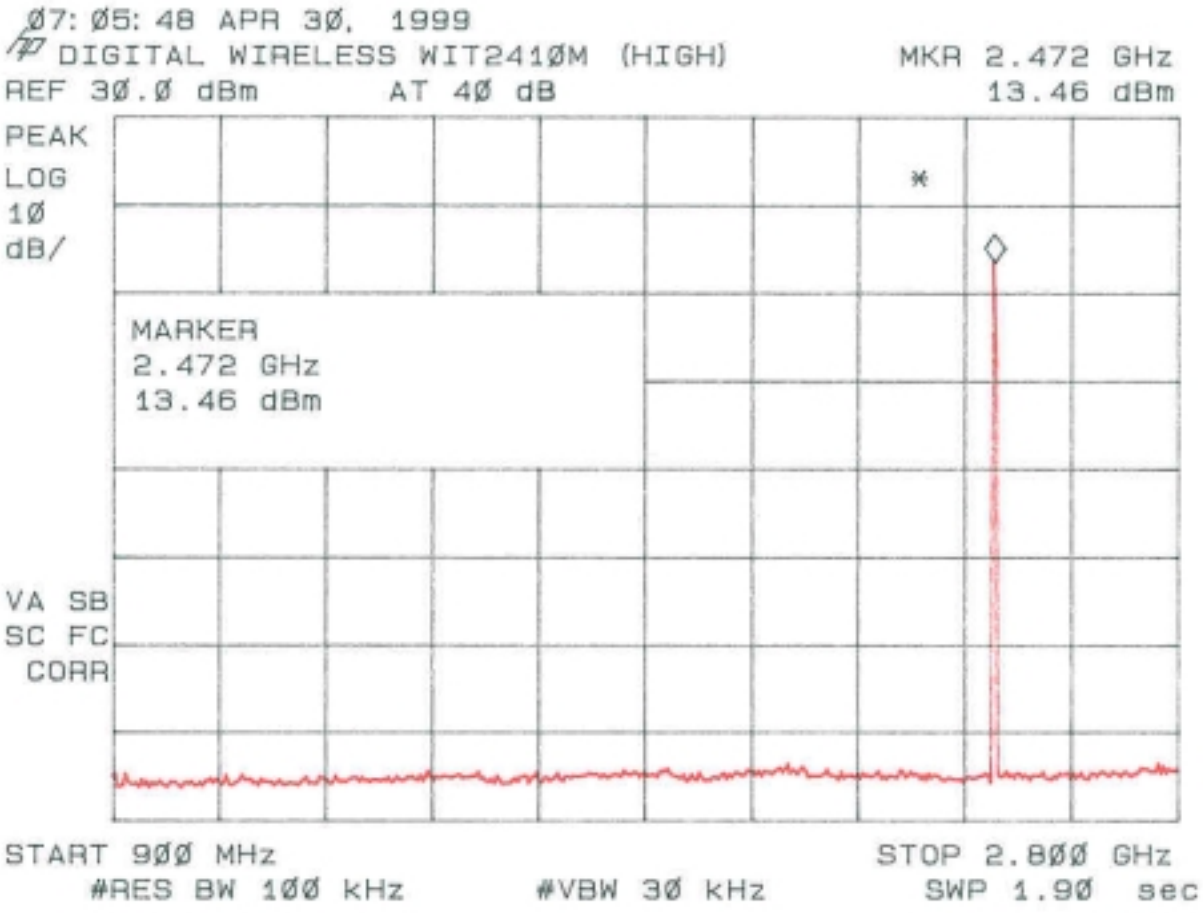


Figure 4k
Antenna Conducted Spurious Emissions 15.247(c) High

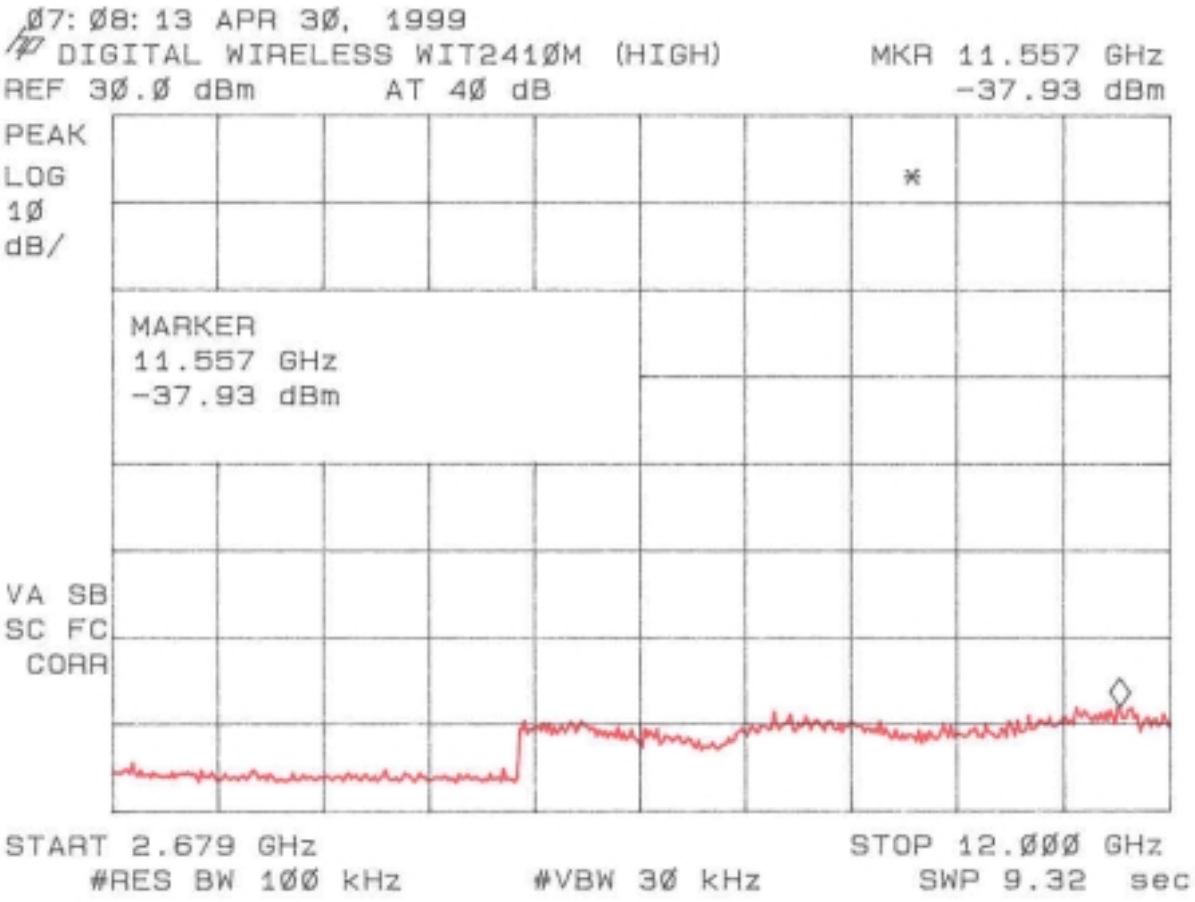


Figure 4l
Antenna Conducted Spurious Emissions 15.247(c) High