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Nivis, LLC
FCC Part 15, Certification Application
Amplified Radio Modem RF-P9-05-01-03

UST Project: 04-0282
Issue Date: January 21, 2005

I certify that I am authorized to sign for the manufacturer and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

UNITED STATES TECHNOLOGIES, INC. (AGENT RESPONSIBLE FOR TEST):

By: _______________

Name: **Louis A. Feudi**

Title: **Operations Manager**

Date: **January 21, 2005**

Nivis. LLC
900 Circle 75 Parkway, Suite 1700
Atlanta, GA 30339

By:

Name:

Title:

Date:

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Customer: Nivis, LLC
Model: Amplified Radio Modem RF-P9-05-01-03

MEASUREMENT/TECHNICAL REPORT

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

Equipment type:
Spread-Spectrum Frequency Hopping RF modem that operates in the 902-928 MHz ISM band

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

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GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is the Nivis Amplified Radio Modem RF-P9-05-01-03. The EUT is a Spread-Spectrum Frequency Hopping RF Modem operating in the 902-928 MHz ISM band. The radio modem is designed for remote data acquisition systems.

The RF-P9-05-01-03 radio modem exhibits the following features:

- Low power consumption achievable by employing the ultra-low power MSP430F149 microprocessor which powers the RF section down through a digital output pin of the processor. Power-down current draw as low as 5 µA is achievable.
- RF output of 23 dB achievable by employing the MAX2235 power amplifier
- Exceptional -117 dB sensitivity achieved with an external LNA used in conjunction with Chipcon's CC1020 RF transceiver
- No additional processing entities are required for data acquisition since the modem can read digital and analog data from the surrounding world through 8 digital I/O lines and 2 analog lines
- Communication with external processing entities is achieved serially either through a dedicated selectable baud-rate hardware UART at CMOS level or through a bit-banged I2C bus
- Operates over the extended temperature range of -40º to +85º and 80% non-condensing humidity
- Built in software protocol for error control and re-transmissions
- Frequency hopping algorithm which employs 50 frequency channels equally distributed over the 902-928 MHz band
- Compact size of 2" x 1.5" x 0.3" and weight of 0.8 oz (23 grams).
- Over-the-air re-programming of the firmware possible since an on-board 64 kByte EEPROM provides enough storage capability for code hot-swapping
- Integrated AFC (Automatic Frequency Correction) hardware and accompanying software algorithm excludes the need for a precise crystal operating over the extended temperature range
- Connectivity is provided through two 12-pin .100 singe row headers
- Two shields (one over the digital section and one over the RF section) greatly reduce radiated RF interfering emissions and improve RF immunity

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. Bock diagrams of the tested systems are shown in Figures 1a and 16. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2a -g.

The sample used for testing was received by U.S. Technologies on December 4, 2004 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

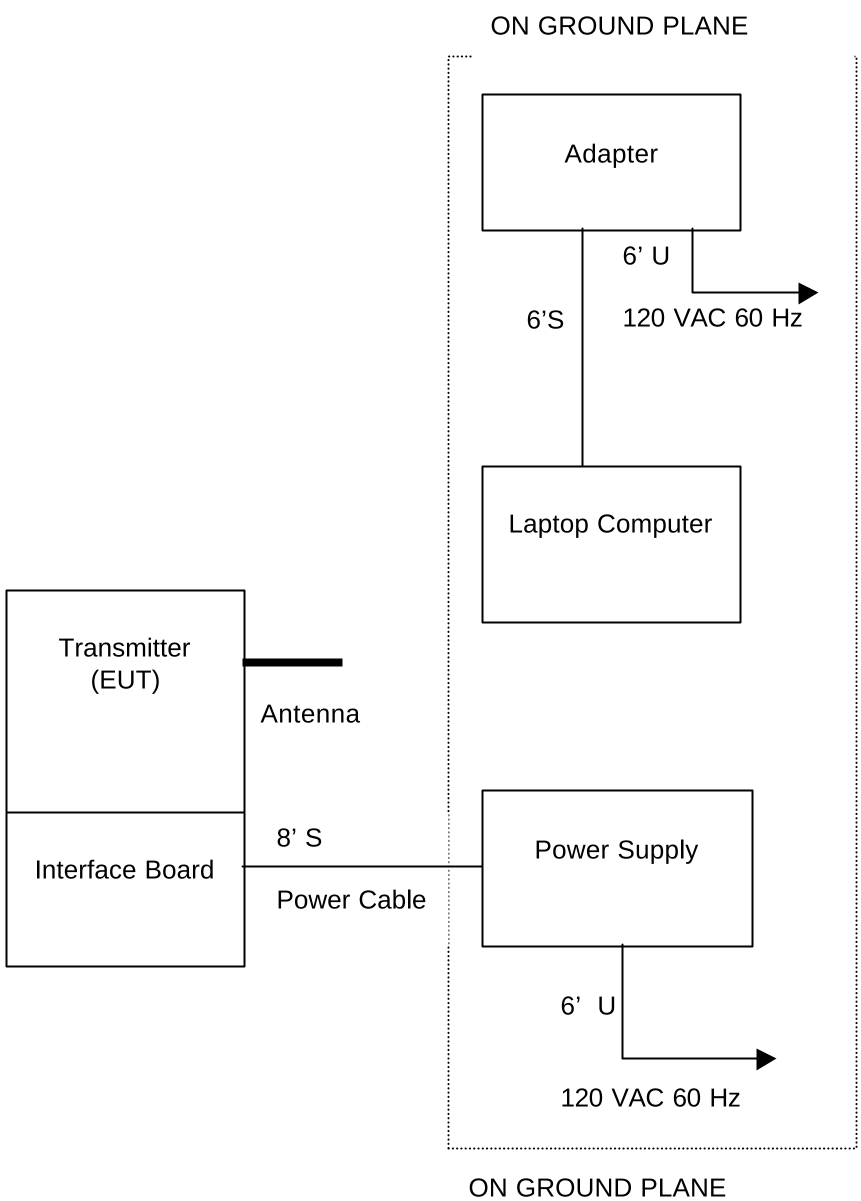

TABLE 1

EUT and Peripherals

PERIPHERAL MANU.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Transmitter (EUT) Nivis, LLC	RF-P9	1232	SQB-NIVISP9050103 (Pending)	Board Mount
Interface Board Landis & Gyr, Inc.	ASSY71217	None	None	Plugged Directly into Transmitter 8’ S Power Cable
Antenna			None	None
AC Adapter Total Micro Technologies	Notebook AC Adapter F1454A-TM	None	None	6’ U 120 VAC/ 60 Hz Power Cord
Laptop Computer Hewlett Packard	Omnibook XE2	TW02210231	None	6’ S
Power Supply BK Precision	1627A	D30310639	None	6’ U 120 VAC/ 60 Hz Power Cord

TABLE 2
TEST INSTRUMENTS

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8558B	HEWLETT-PACKARD	2332A10055	2/19/04
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	11/29/04
SIGNAL GENERATOR	8648B	HEWLETT-PACKARD	3642U01679	10/13/03
RF PREAMP	8447D	HEWLETT-PACKARD	2944A06291	4/29/04
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/18/04
LOG PERIODIC	3146	EMCO	3110-3236	6/30/04
LISN (x 2) 8028-50-TS24-BNC	8028	SOLAR ELE.	910494 & 910495	1/20/04
HORN ANTENNA	SAS-571	A. H. SYSTEMS	605	04/26/04
PREAMP	8449B	HEWLETT PACKARD	3008A00480	06/23/04
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

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. The Nivis modem uses both a permanently attached antenna for the Fractal Antenna and a reverse SMA connector for the Dual Band Antenna.

1. Fractal Nivis-Falcon Antenna

Type of antenna Fractal antenna which consists of a straight radiator fed in the center. Radiator is etched out of copper on a PCB in the shape determined by fractal lgorithms to be optimal for the desired band. Antenna is tuned to be resonant at 1.05 Ghz since the final enclosure load lowers the resonant frequency to 915 Mhz.

Model number: NIVIS-FALCON
US PAT #6452553 & Patent Pending

Manufacturer: Fractal Antenna Systems Inc.

Antenna gain: (Gain measurements obtained by comparing to gain of a dipole antenna)

Frequency	Dipole	Fractal (dBd)
902 Mhz	0 dBd	1.73 dBd
915 Mhz	0 dBd	-1.3 dBd
928 Mhz	0dBd	0

Type of connector: Antenna is soldered directly to the antenna pad J3.
Antennal pad is a SMA connector footprint in order to allow the possibility to mount an SMA connector for conducted RF output tests.

2. Comtelco Dual Band Mobile Antenna

Type of antenna: Dual band cellular PCS mobile antenna, ultra-wide band performance covering 806 – 928 and 1710-1970 Mhz.

Model number: A113182B
Part number: 438155
Manufacturer: Comtelco Industries
Antenna gain: Unity gain.
Type of connector: SMA connector

2.7 Peak power within the band 902 – 928 MHz per FCC Section 15.247(b)

Peak power within the band 902 – 928 MHz 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 3a1 through Figure 3b3.

Fundamental Frequencies were measured at Low Channel, Mid Channel, High Channel.

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TABLE 3a
PEAK POWER OUTPUT
Dual Band Antenna

Frequency of Fundamental (MHz)	Measurement (dBm)*	Measurement (mW)*	FCC Limit (Watt)
910.475	21.02	126.48	1.0
918.975	19.44	87.90	1.0
927.435	19.57	90.57	1.0

*** Measurement includes 0.1 dB for cable loss**

Test Date: January 13, 2005

Tester Signature: ________ **Name: David Blethen**

Figure 3a1.
Peak Power per FCC Section 15.247(b) (Low Channel)
Dual Band Antenna

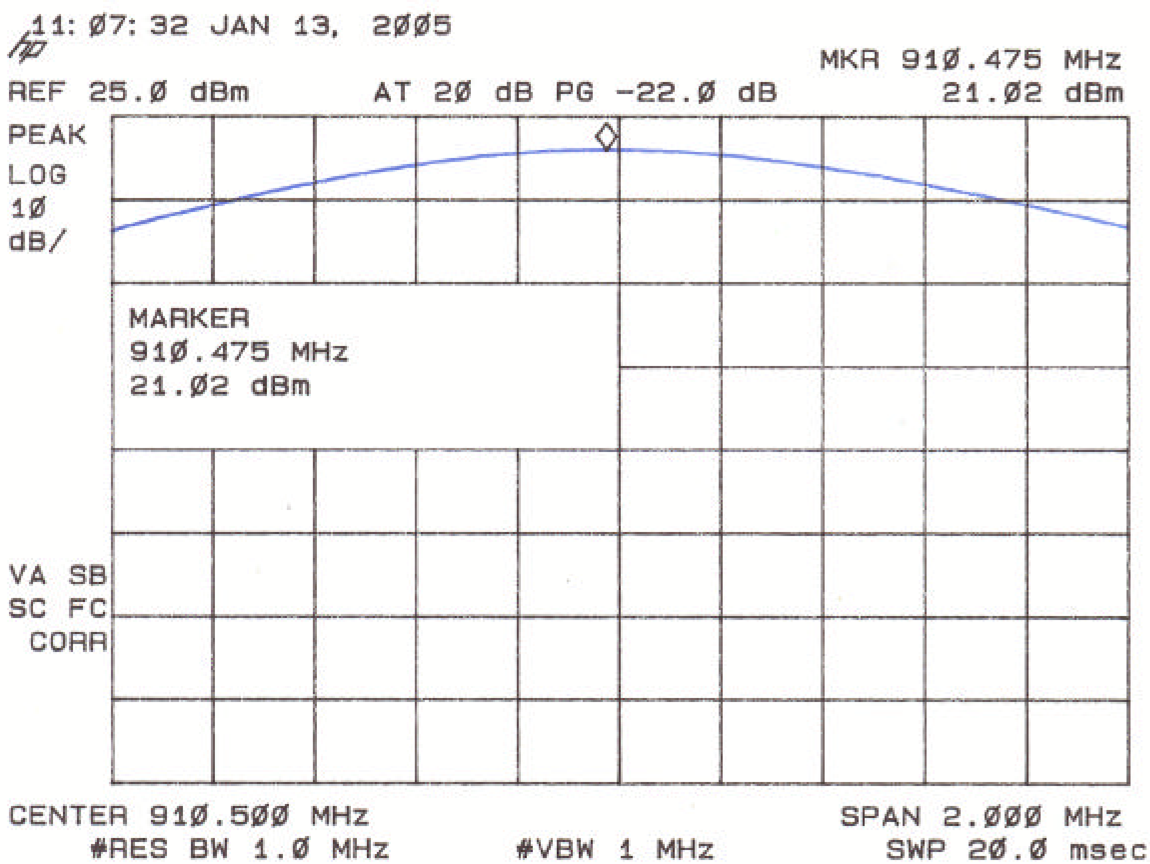

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Figure 3a2.
Peak Power per FCC Section 15.247(b) (Mid Channel)
Dual Band Antenna

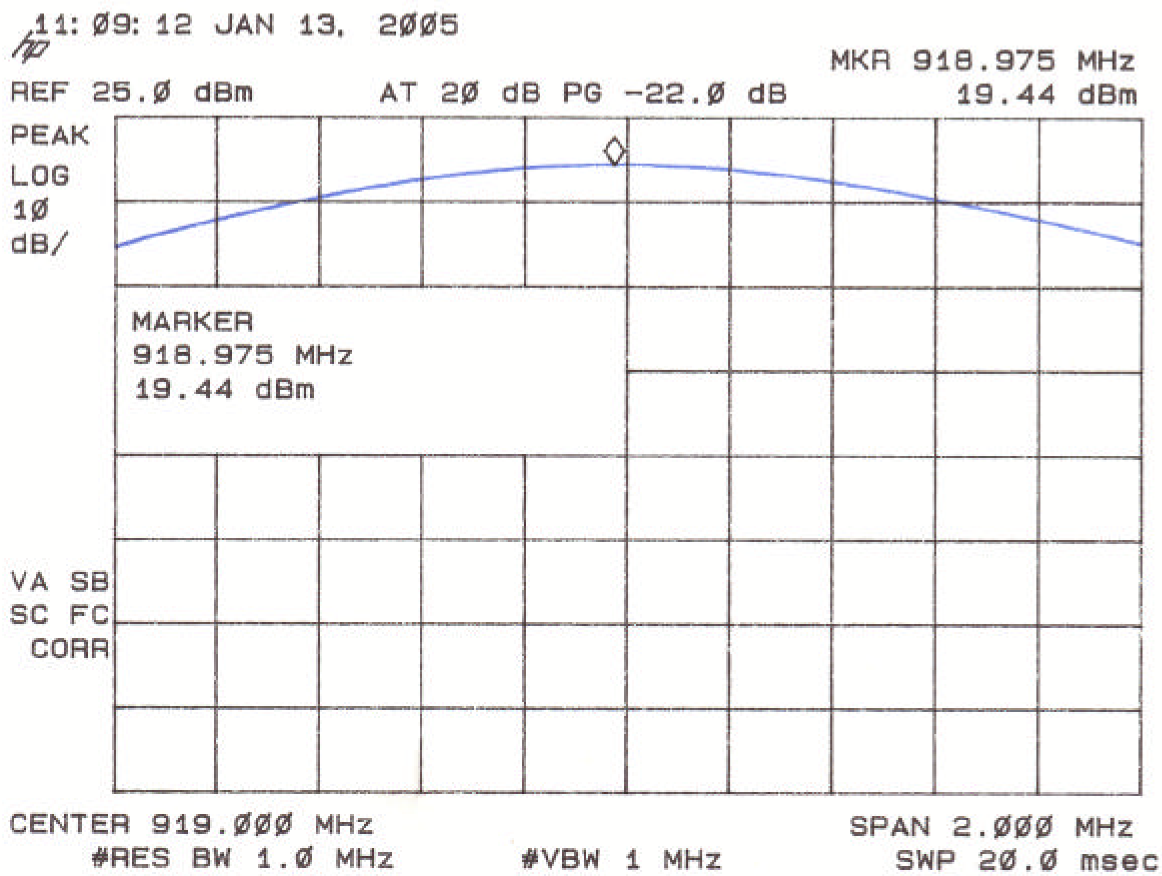

Figure 3a3.
Peak Power per FCC Section 15.247(b) (High Channel)
Dual Band Antenna

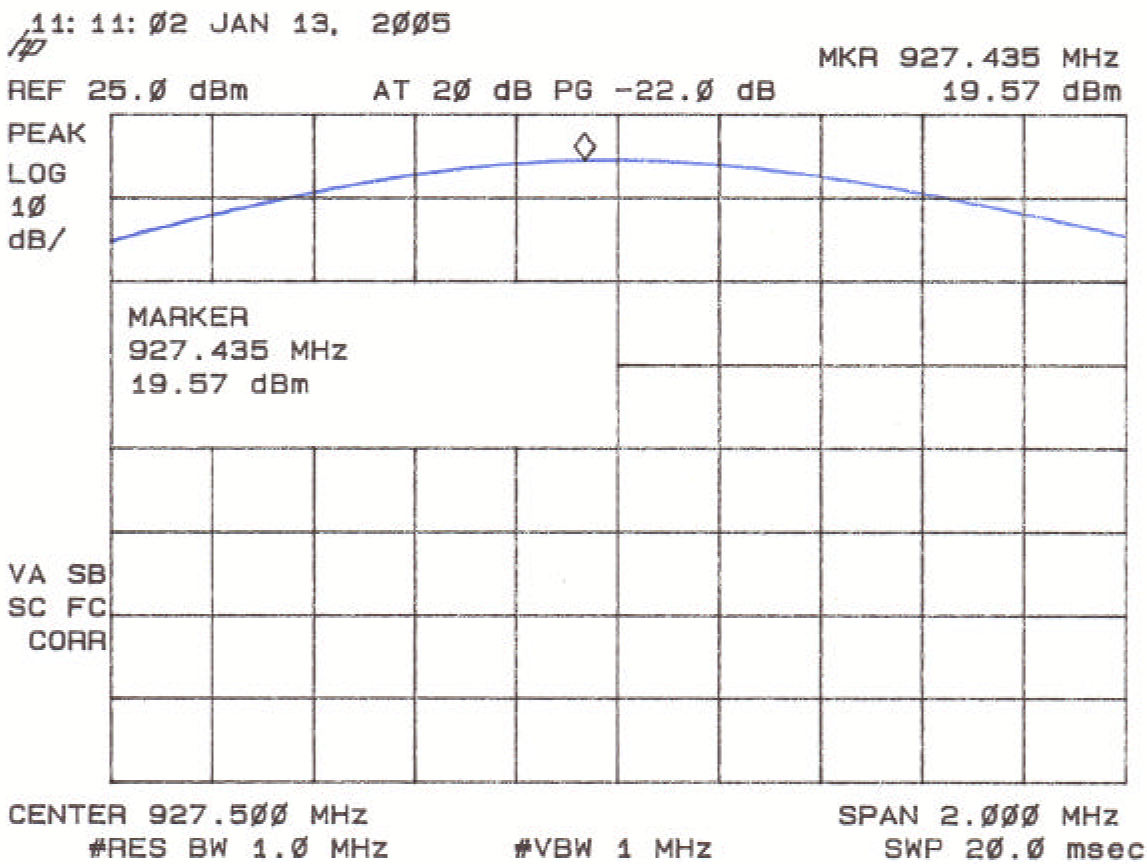

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TABLE 3b
PEAK POWER OUTPUT
Fractal Antenna

Frequency of Fundamental (MHz)	Measurement (dBm)*	Measurement (mW)*	FCC Limit (Watt)
910.447	20.86	121.90	1.0
918.937	21.11	129.12	1.0
927.440	20.88	122.46	1.0

*** Measurement includes 0.1 dB for cable loss**

Test Date: January 13, 2005

Tester Signature: ______ **Name: David Blethen**

Figure 3b1.
Peak Power per FCC Section 15.247(b) (Low Channel)
Fractal Antenna

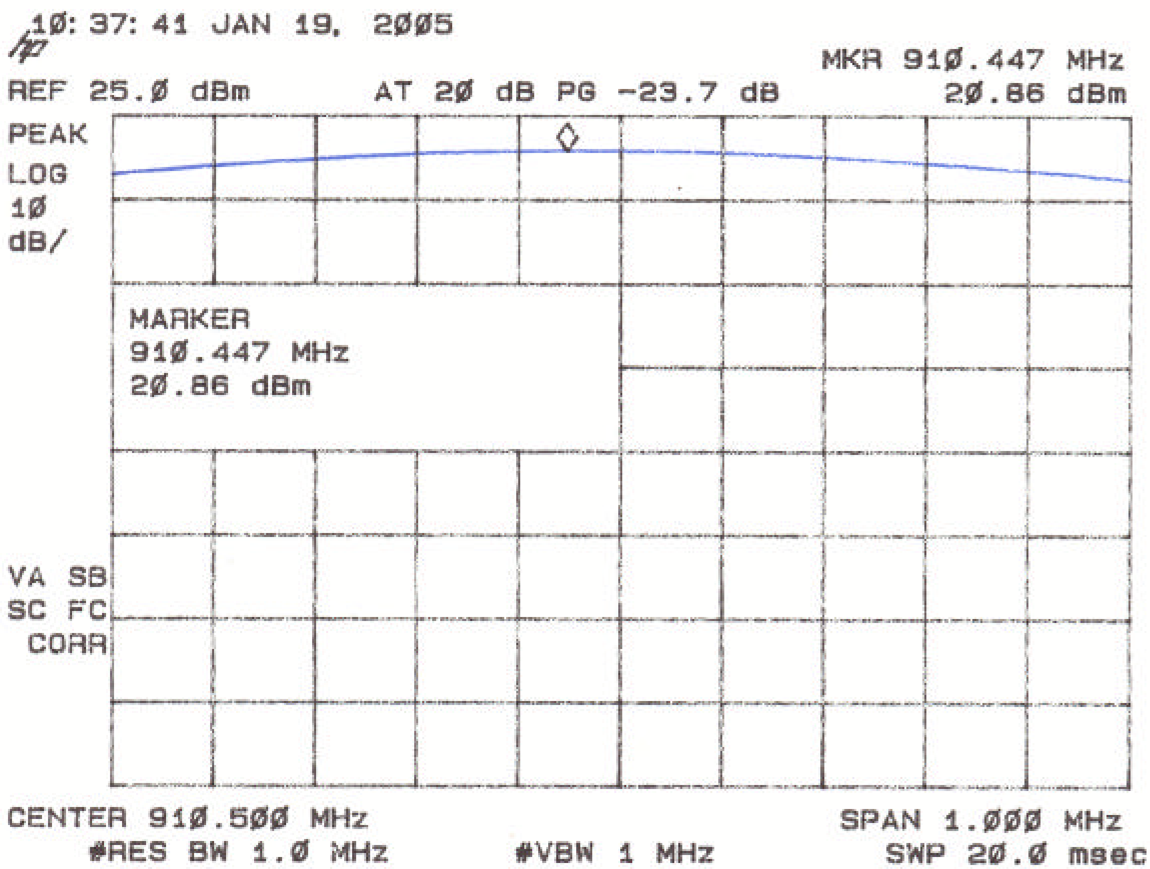

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Figure 3b2.
Peak Power per FCC Section 15.247(b) (Mid Channel)
Fractal Antenna

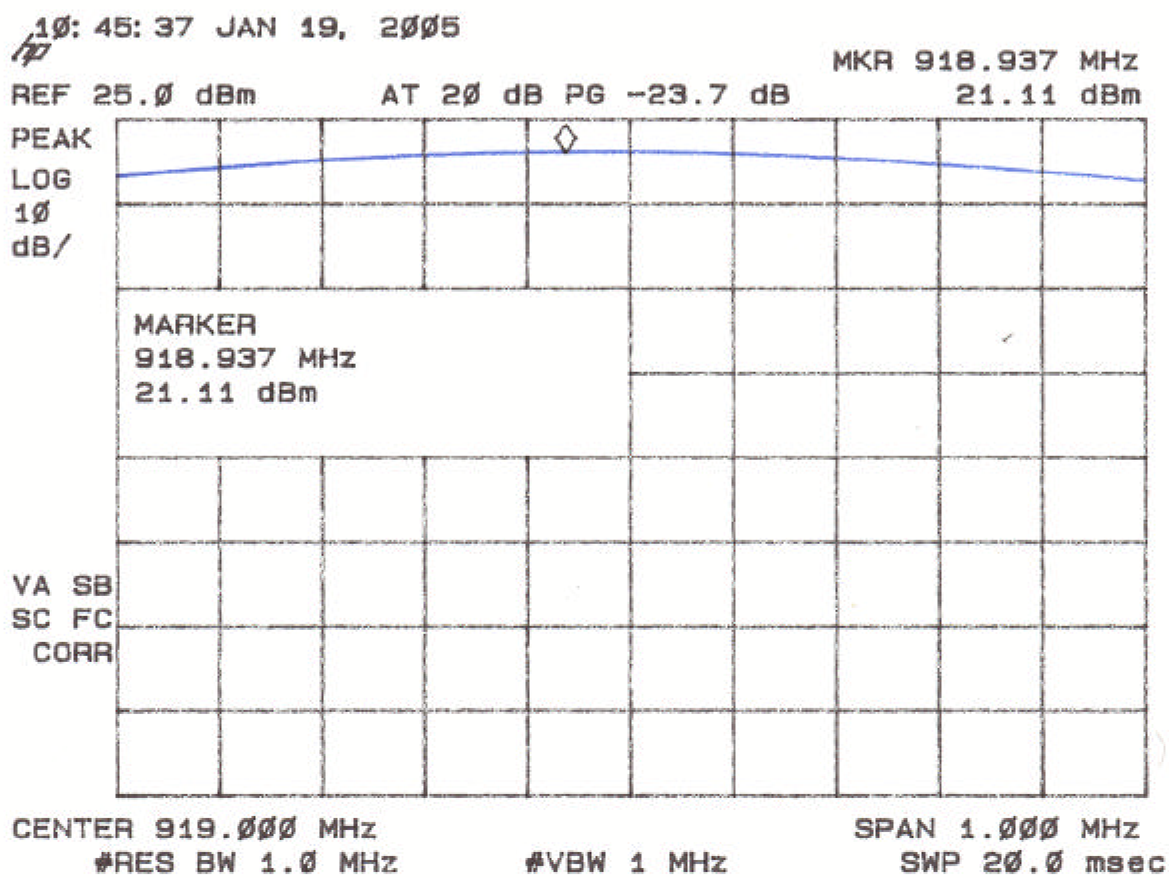
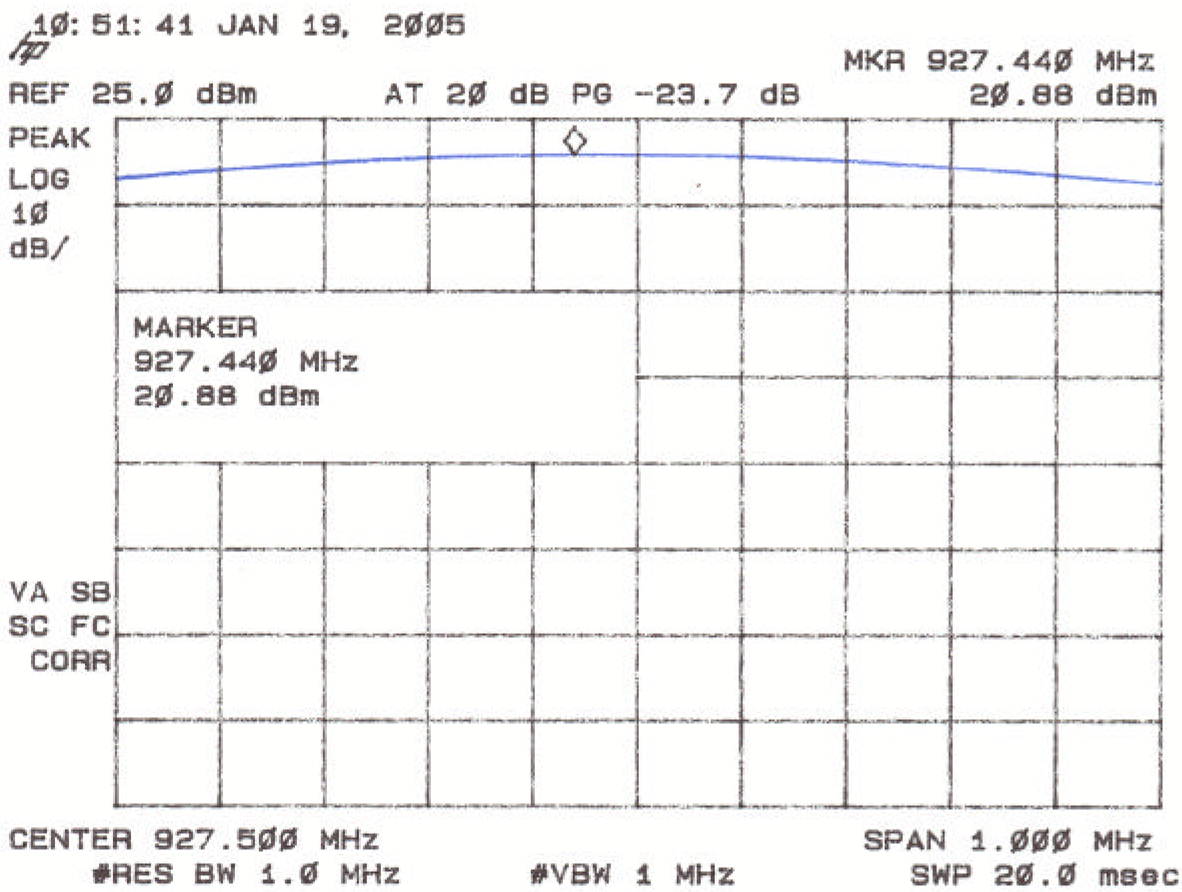


Figure 3b3.
Peak Power per FCC Section 15.247(b) (High Channel)
Fractal Antenna



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

Spurious emissions in the frequency range 30 – 25000 MHz 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 or conducted spurious emissions are given in Figure 4a through 4l.

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

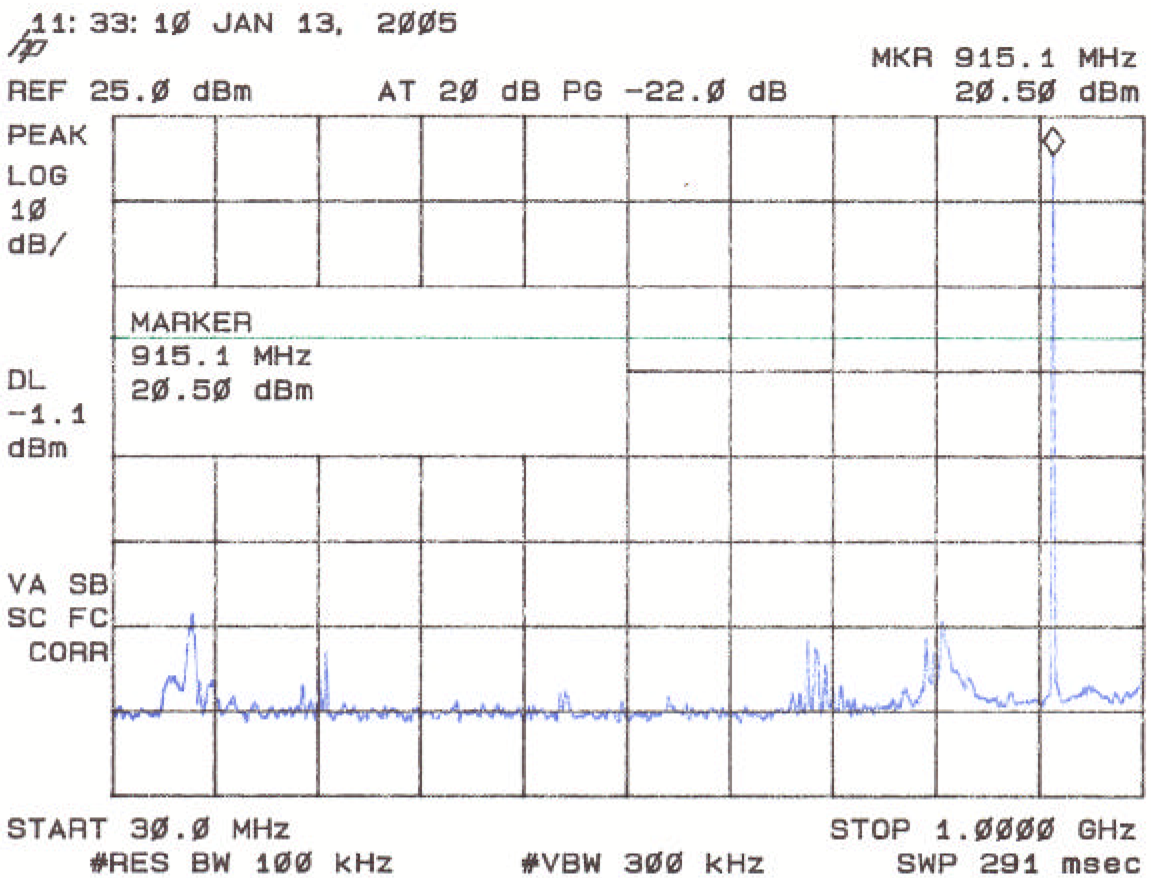


Figure 4b
Antenna Conducted Spurious Emissions 5.247(c) (Low Channel)
Dual Band Antenna

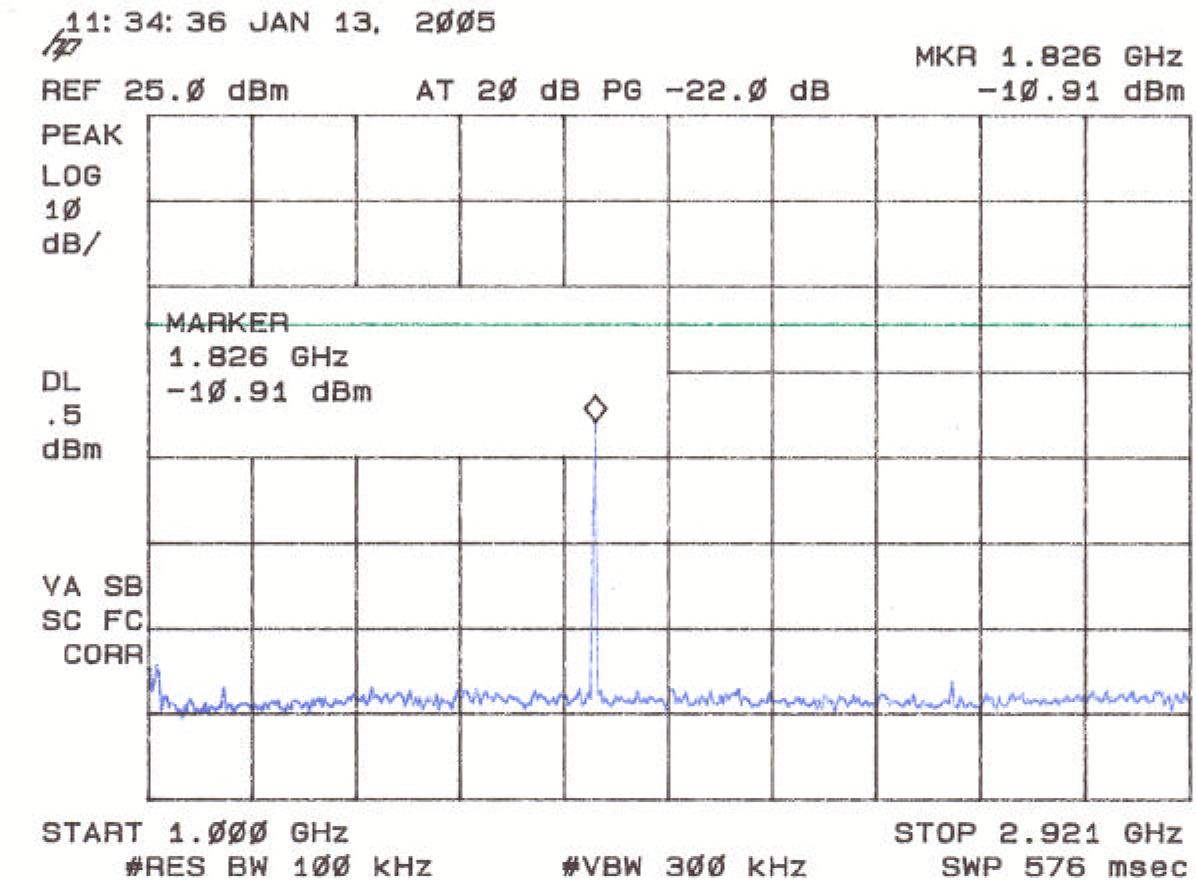


Figure 4c
Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Dual Band Antenna

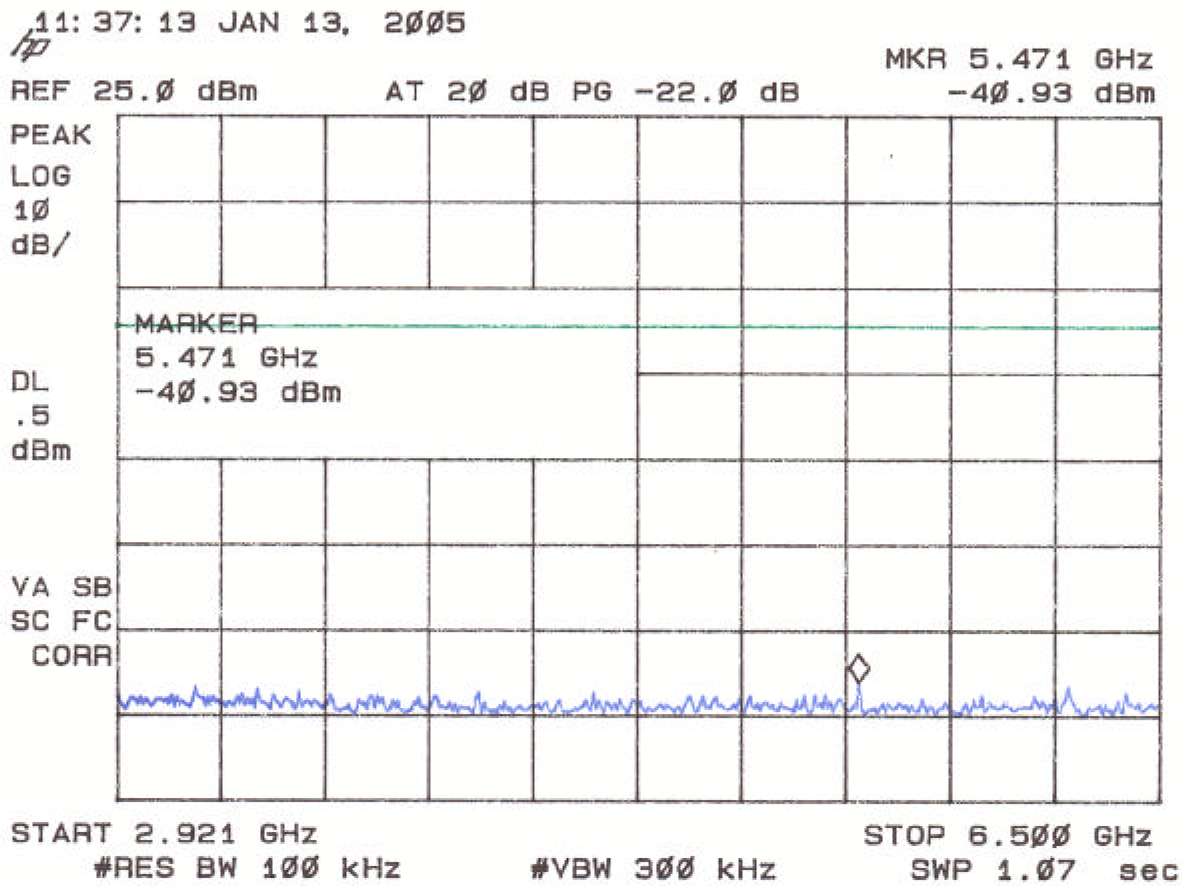


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Figure 4d
Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Dual Band Antenna

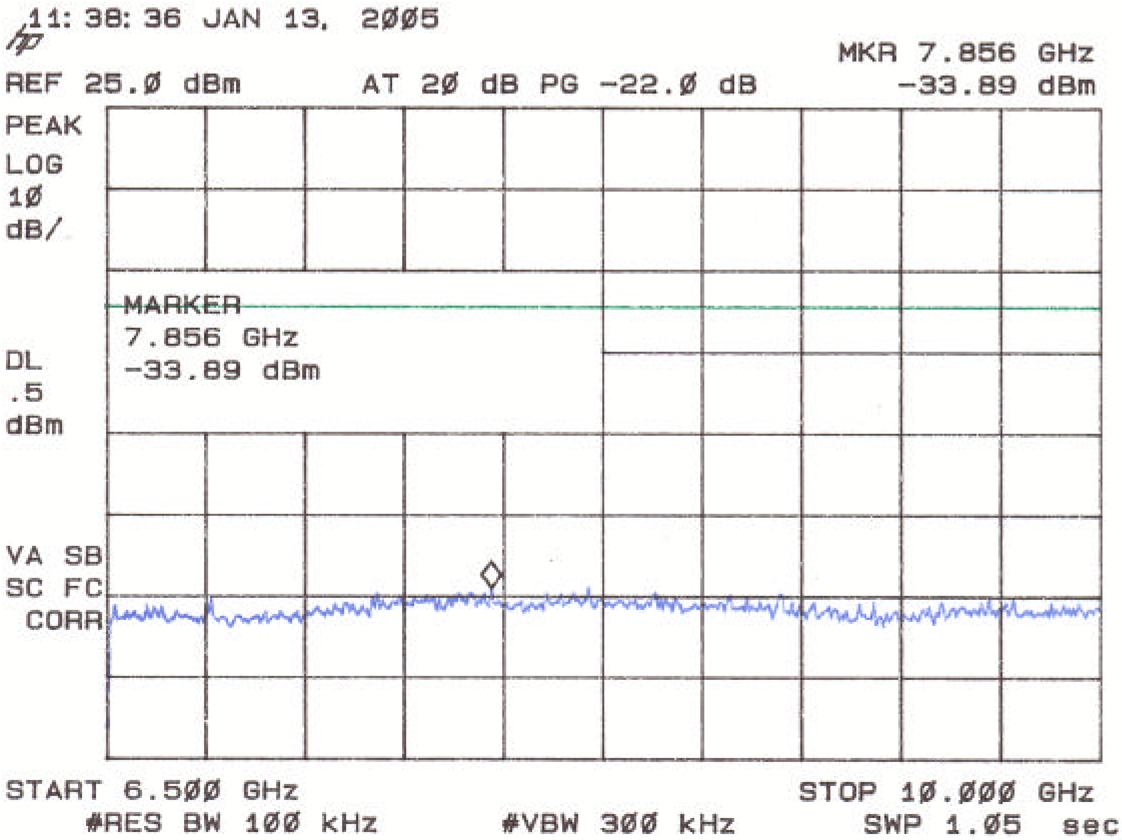

Figure 4e
Antenna Conducted Spurious Emissions 15.247(c)) (Mid Channel)
Dual Band Antenna

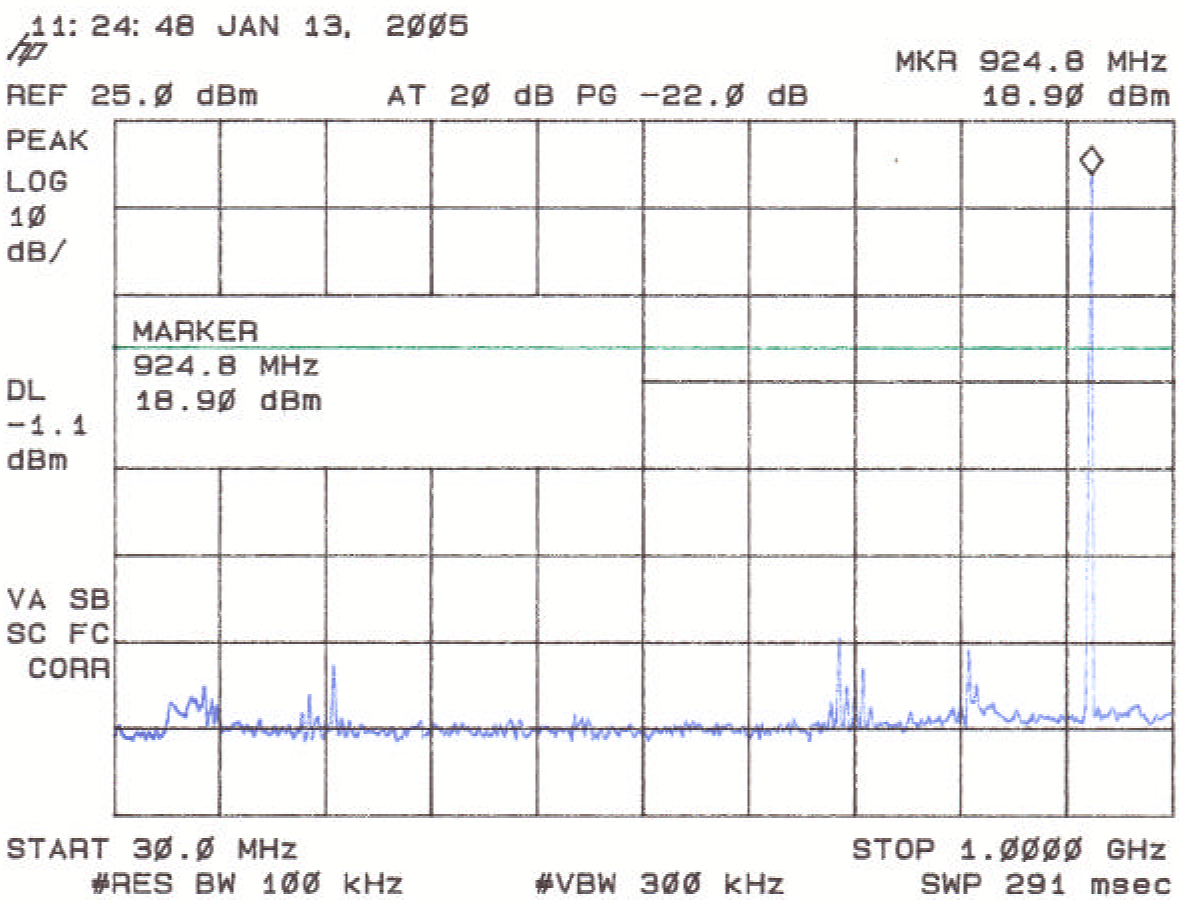

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Figure 4f
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Dual Band Antenna

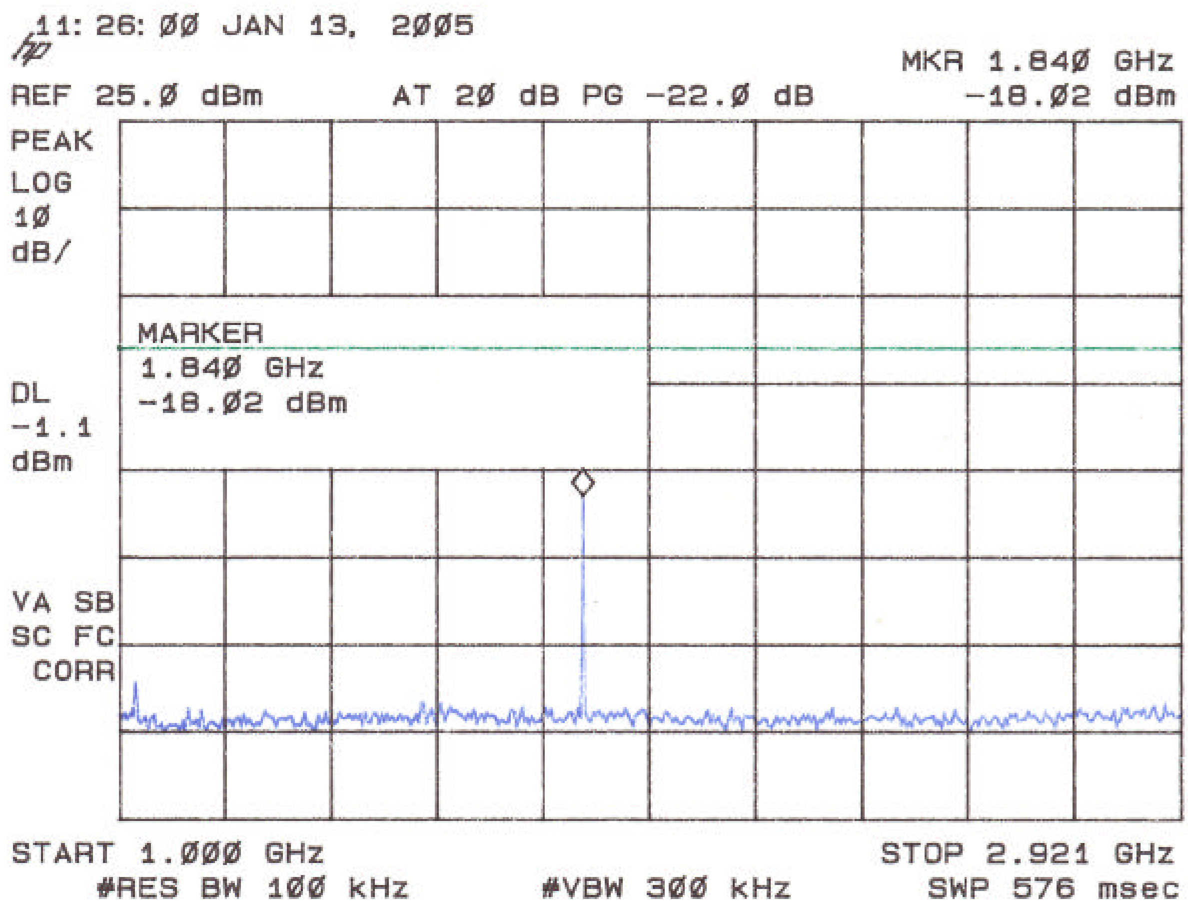

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Figure 4g
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Dual Band Antenna

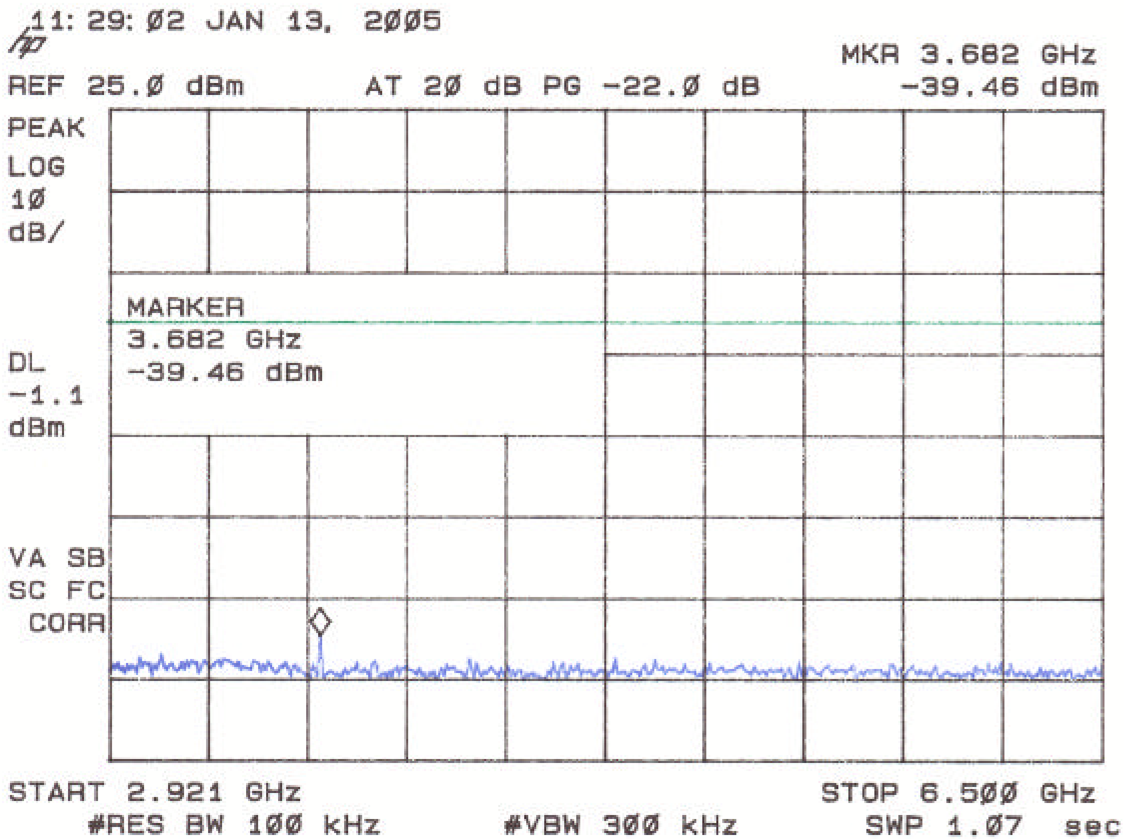

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Figure 4h
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Dual Band Antenna

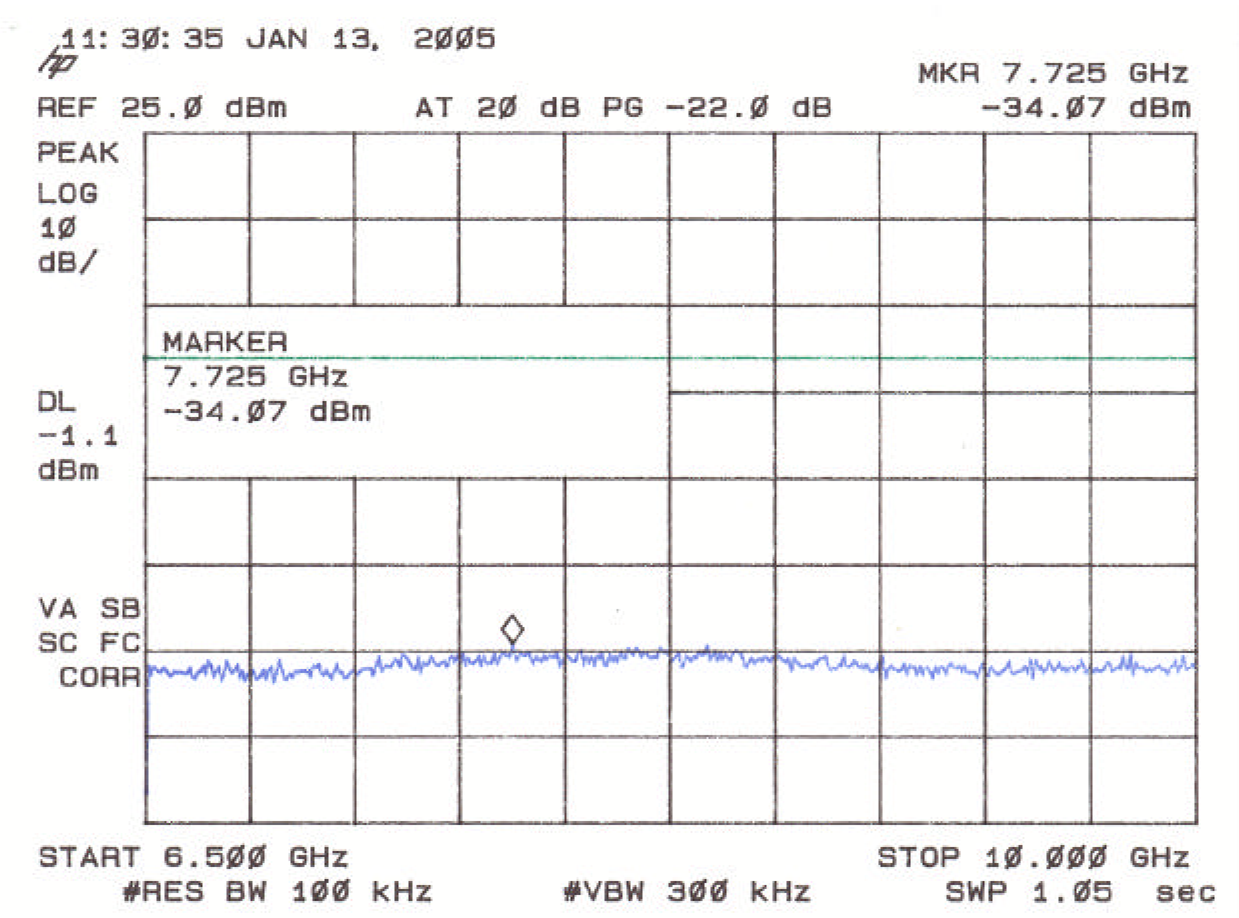

Figure 4i
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Dual Band Antenna

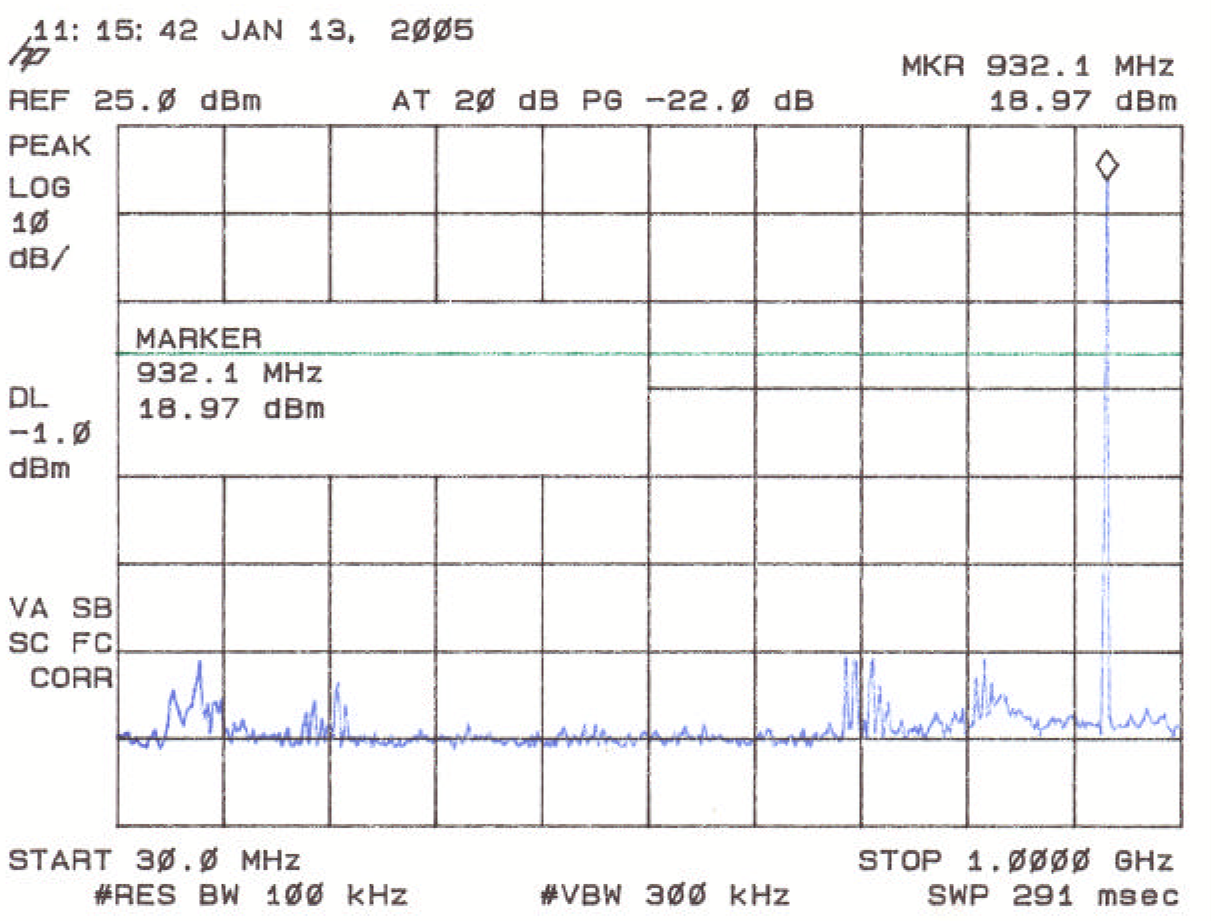

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Figure 4j
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Dual Band Antenna

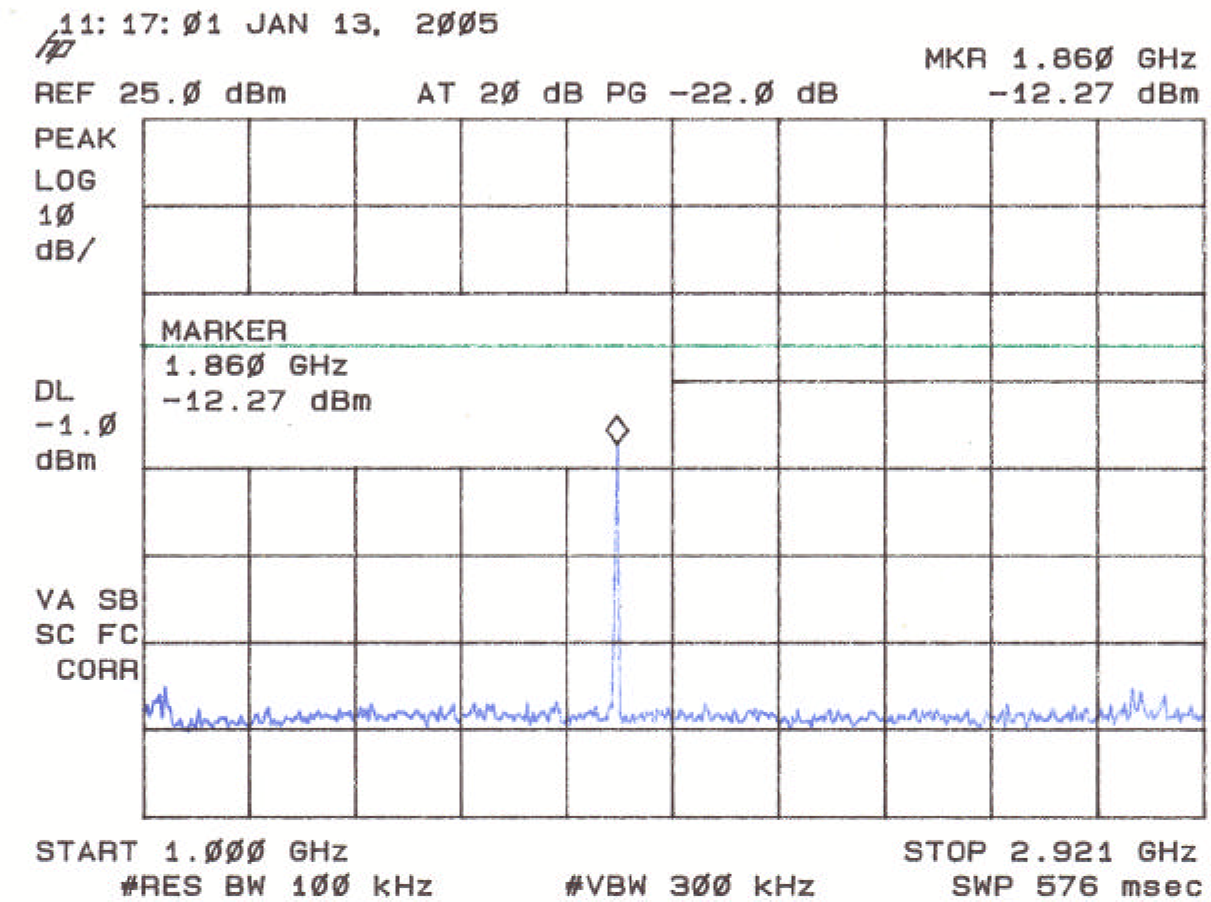

Figure 4k
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Dual Band Antenna

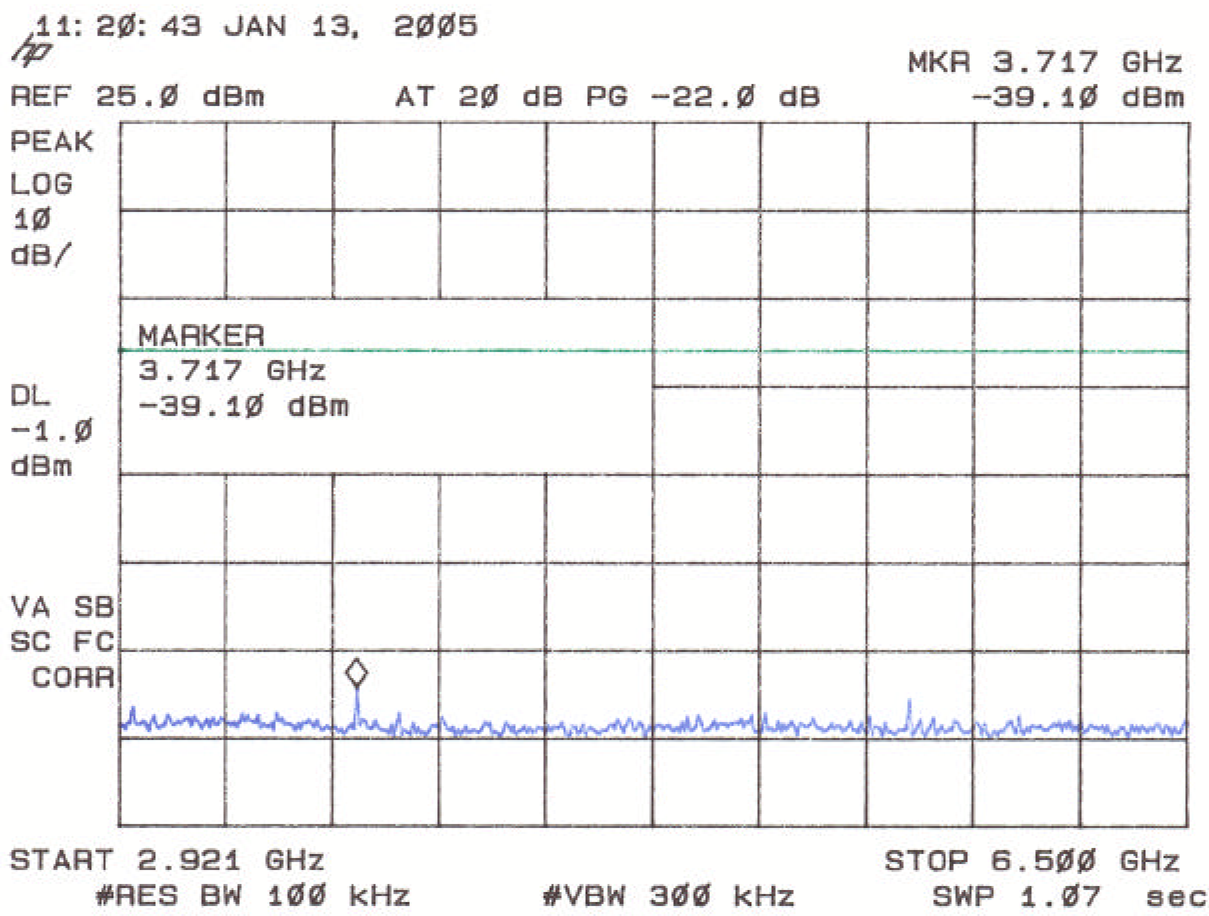

Figure 4l
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Dual Band Antenna

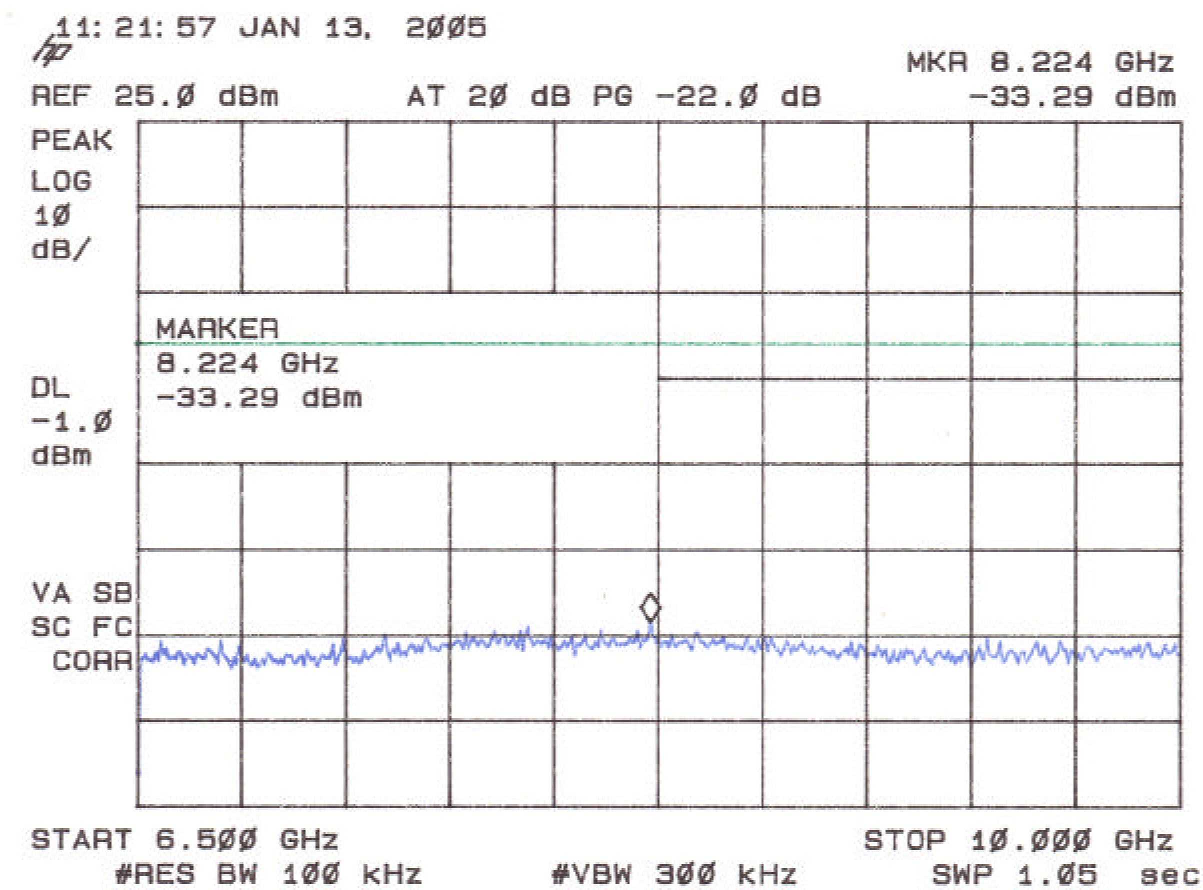

Figure 4m

Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Fractal Antenna

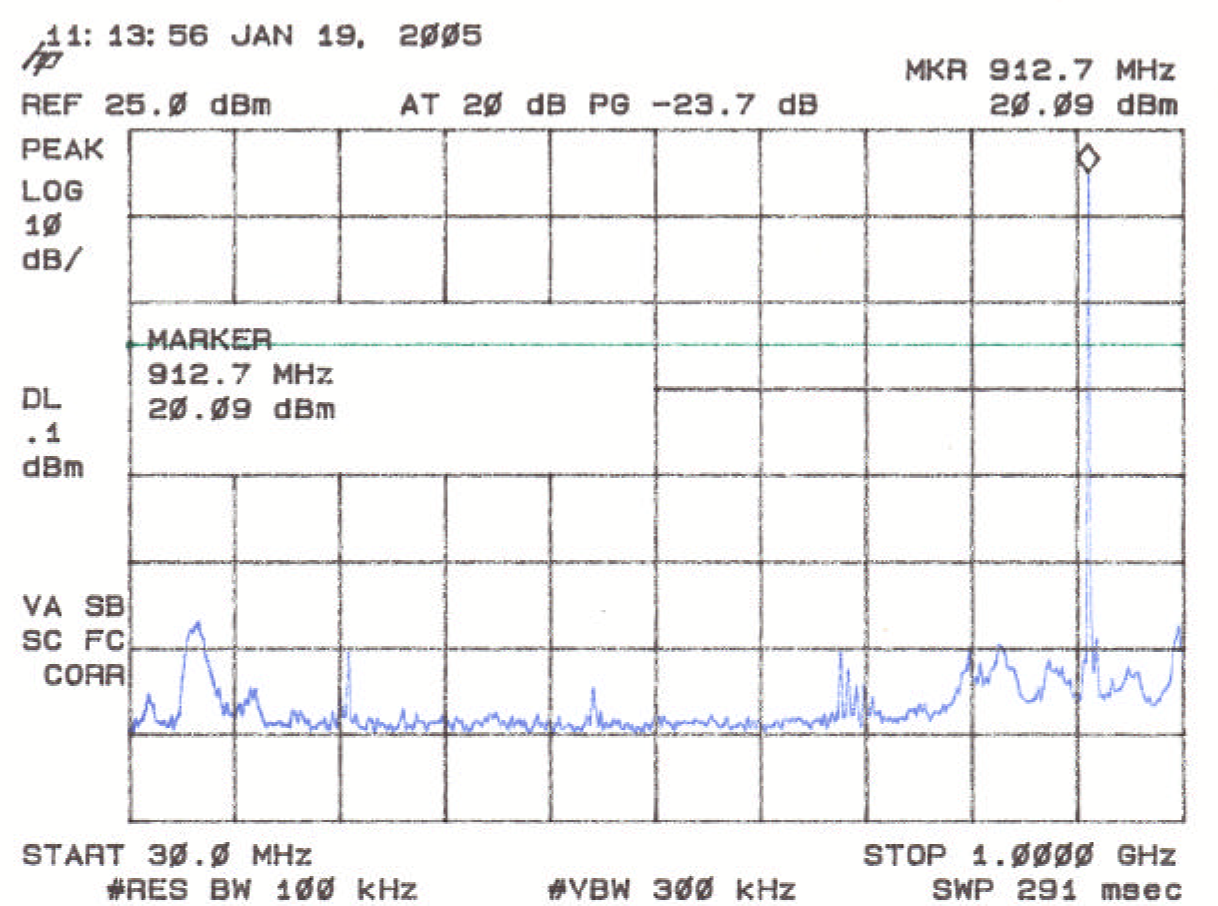

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Figure 4n
Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Fractal Antenna

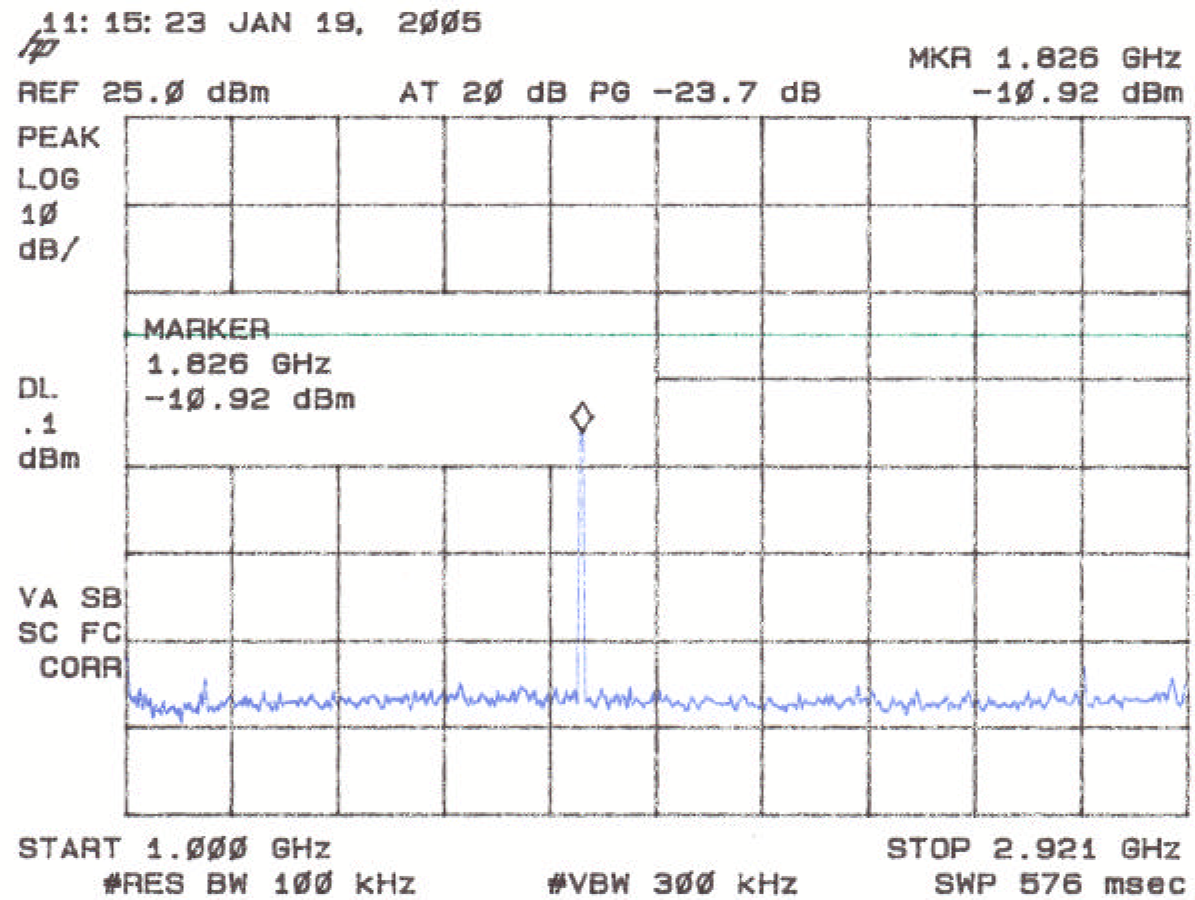

Figure 4o

Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Fractal Antenna

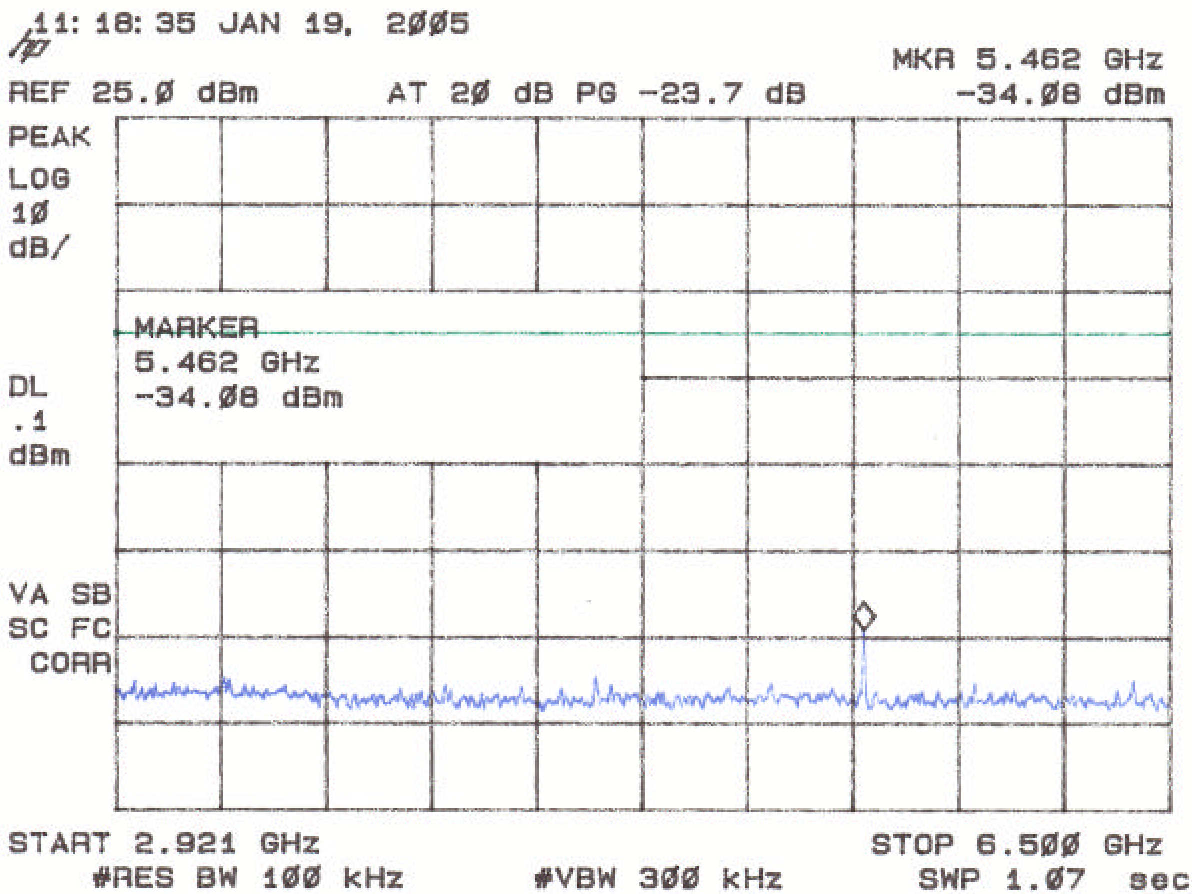

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Figure 4p

Antenna Conducted Spurious Emissions 15.247(c) (Low Channel)
Fractal Antenna

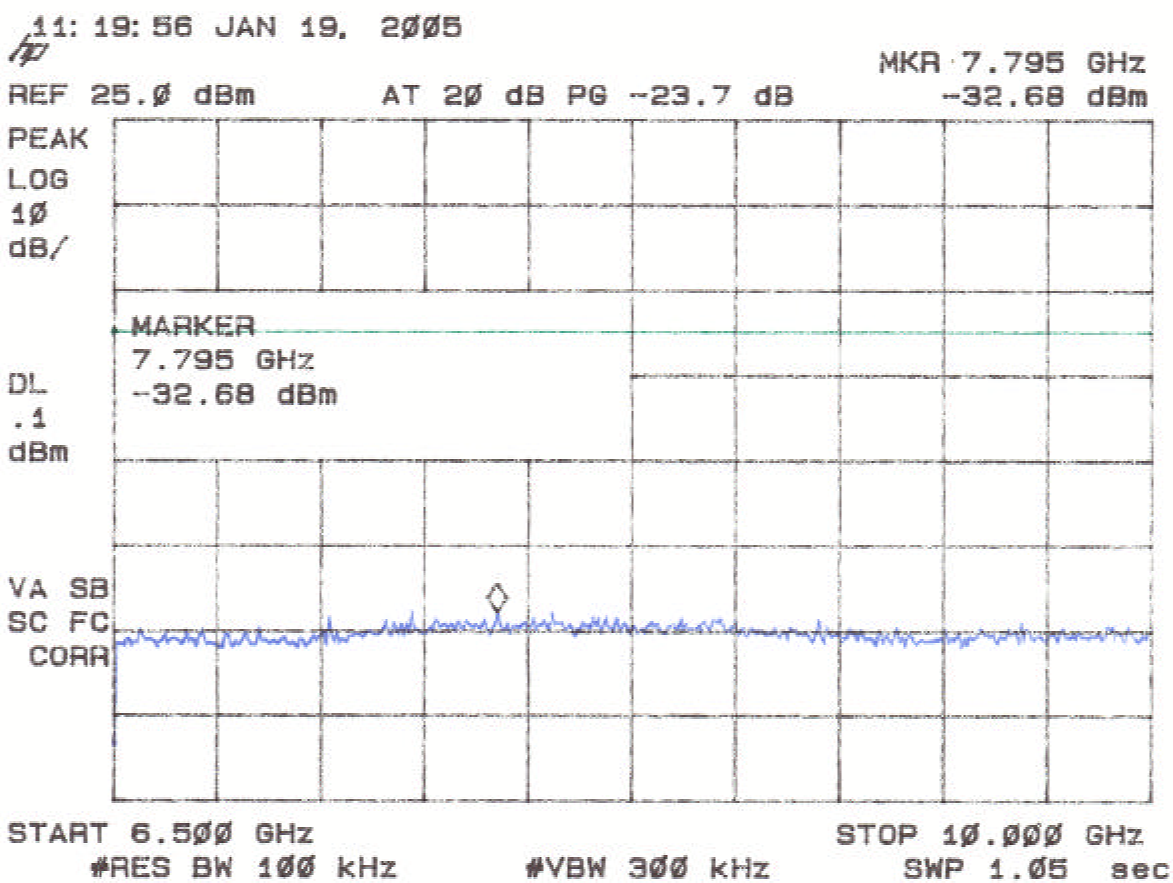

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Figure 4q
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Fractal Antenna

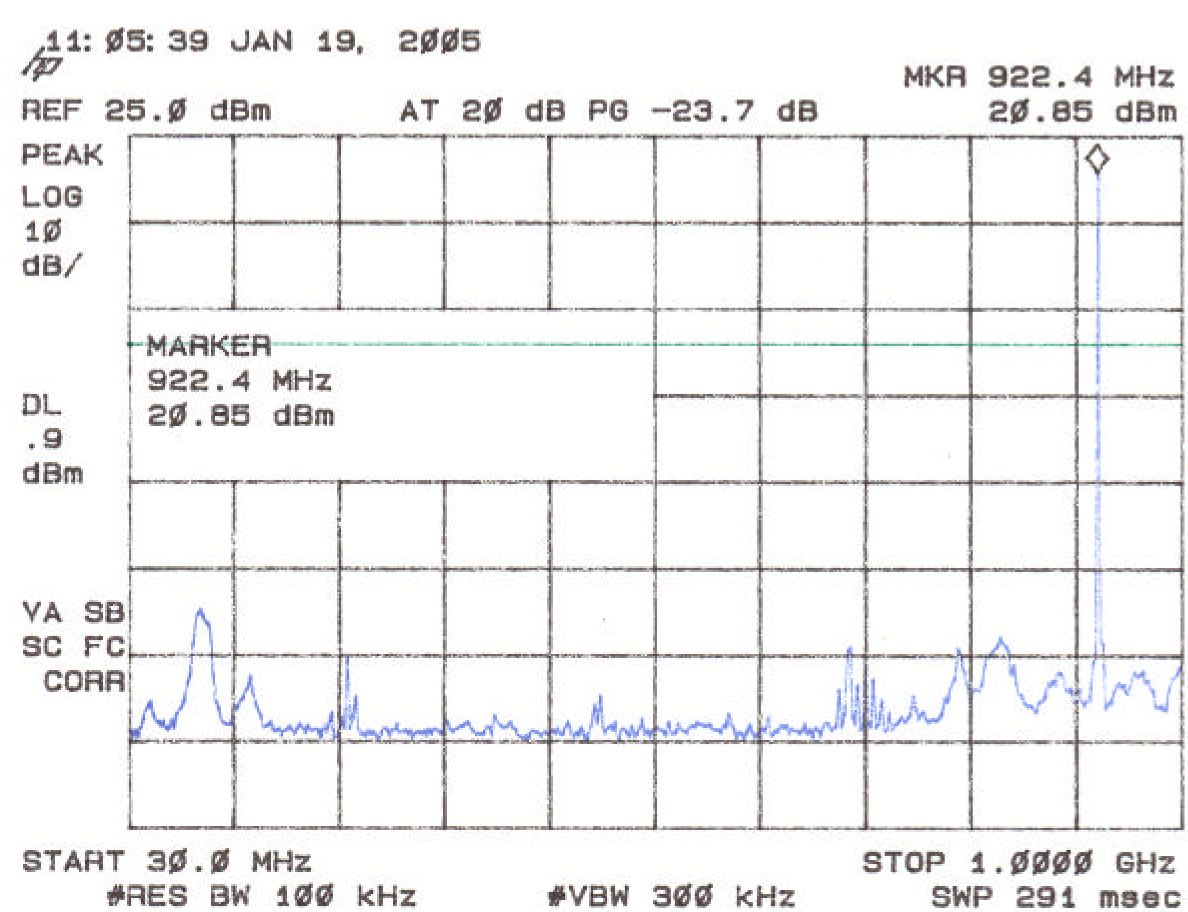

Figure 4r
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Fractal Antenna

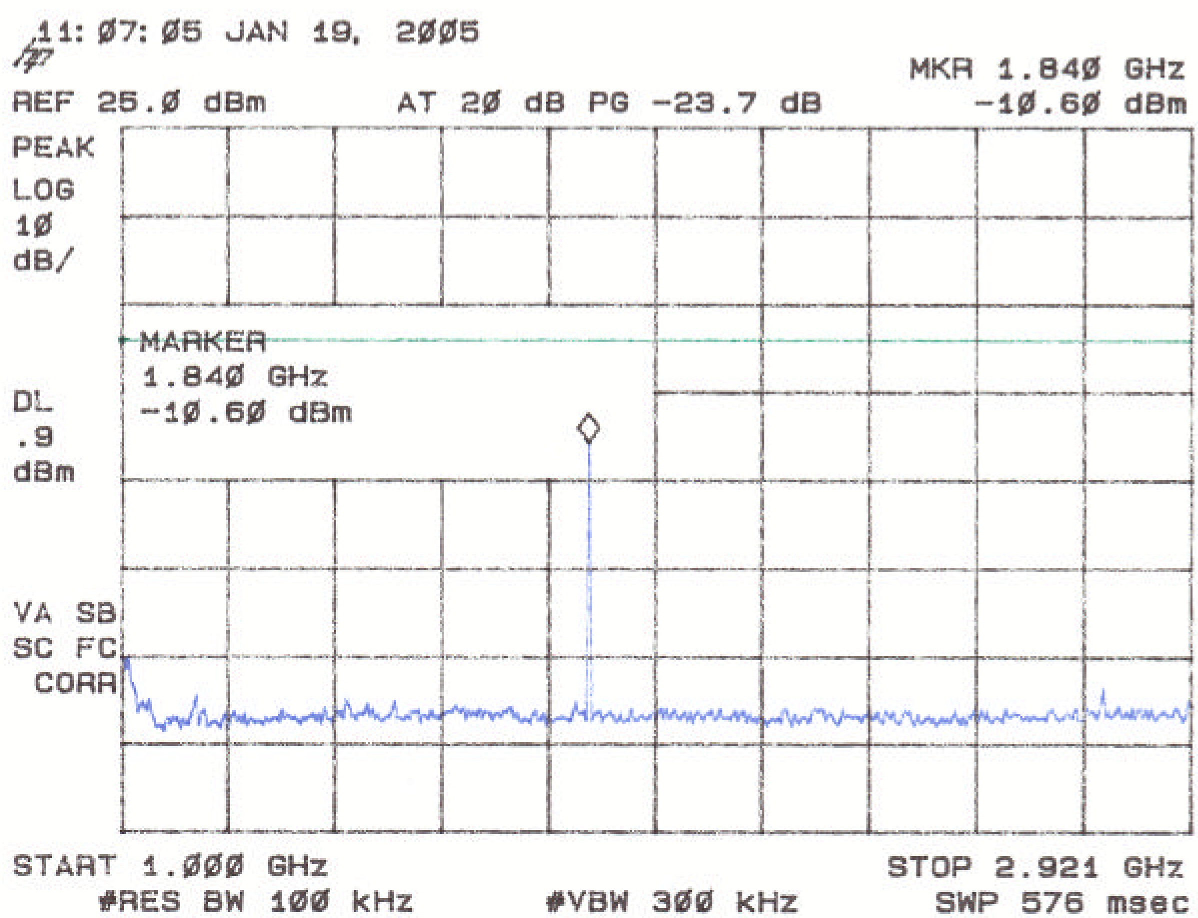

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Figure 4s
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Fractal Antenna

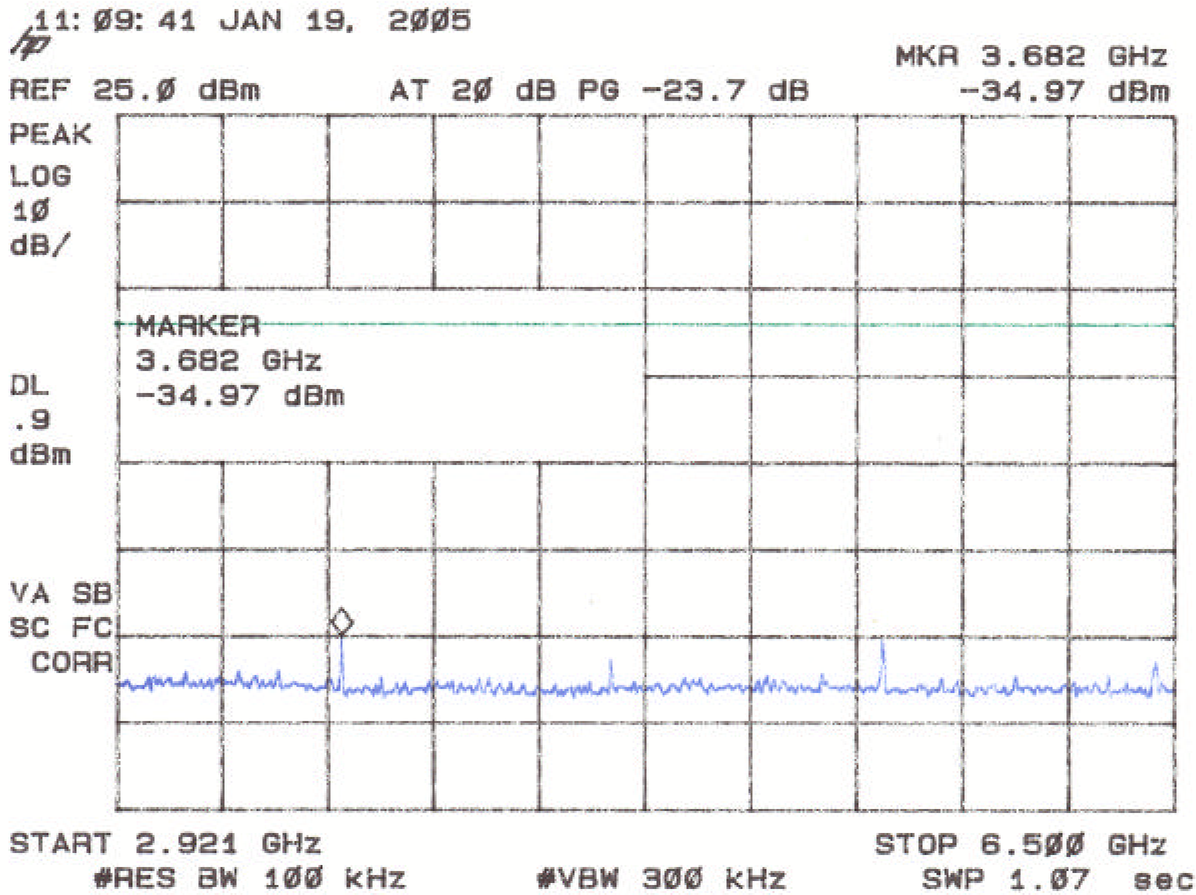

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Figure 4t
Antenna Conducted Spurious Emissions 15.247(c) (Mid Channel)
Fractal Antenna

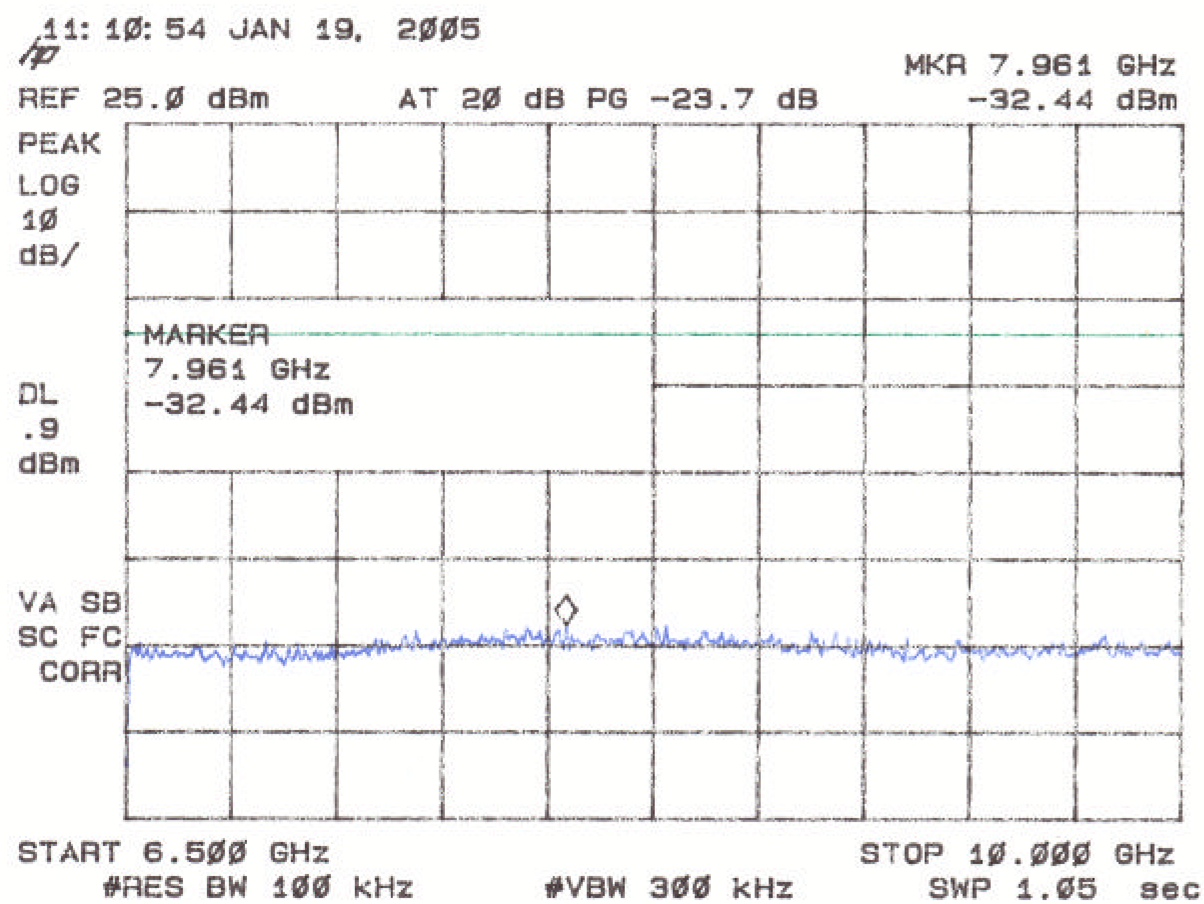

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Figure 4u
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Fractal Antenna

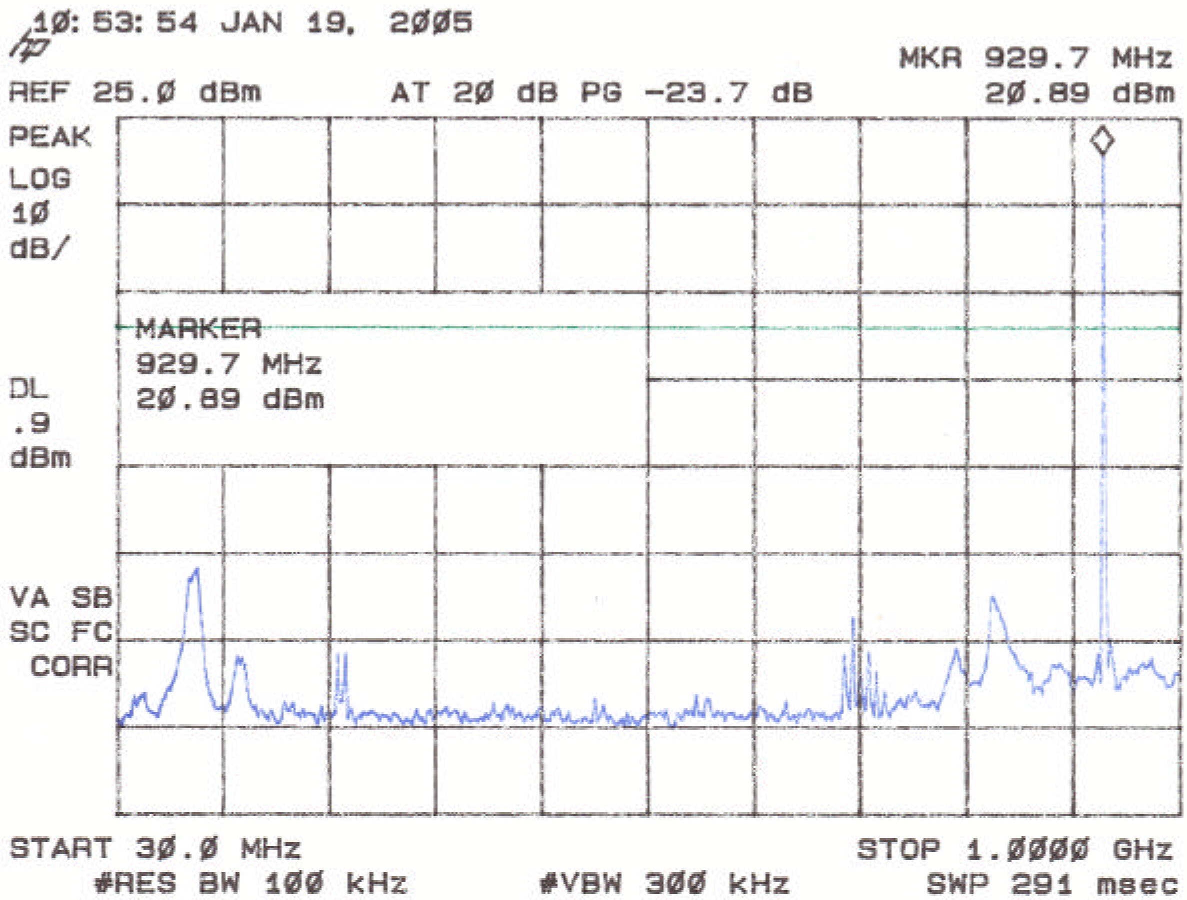

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Figure 4v
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Fractal Antenna

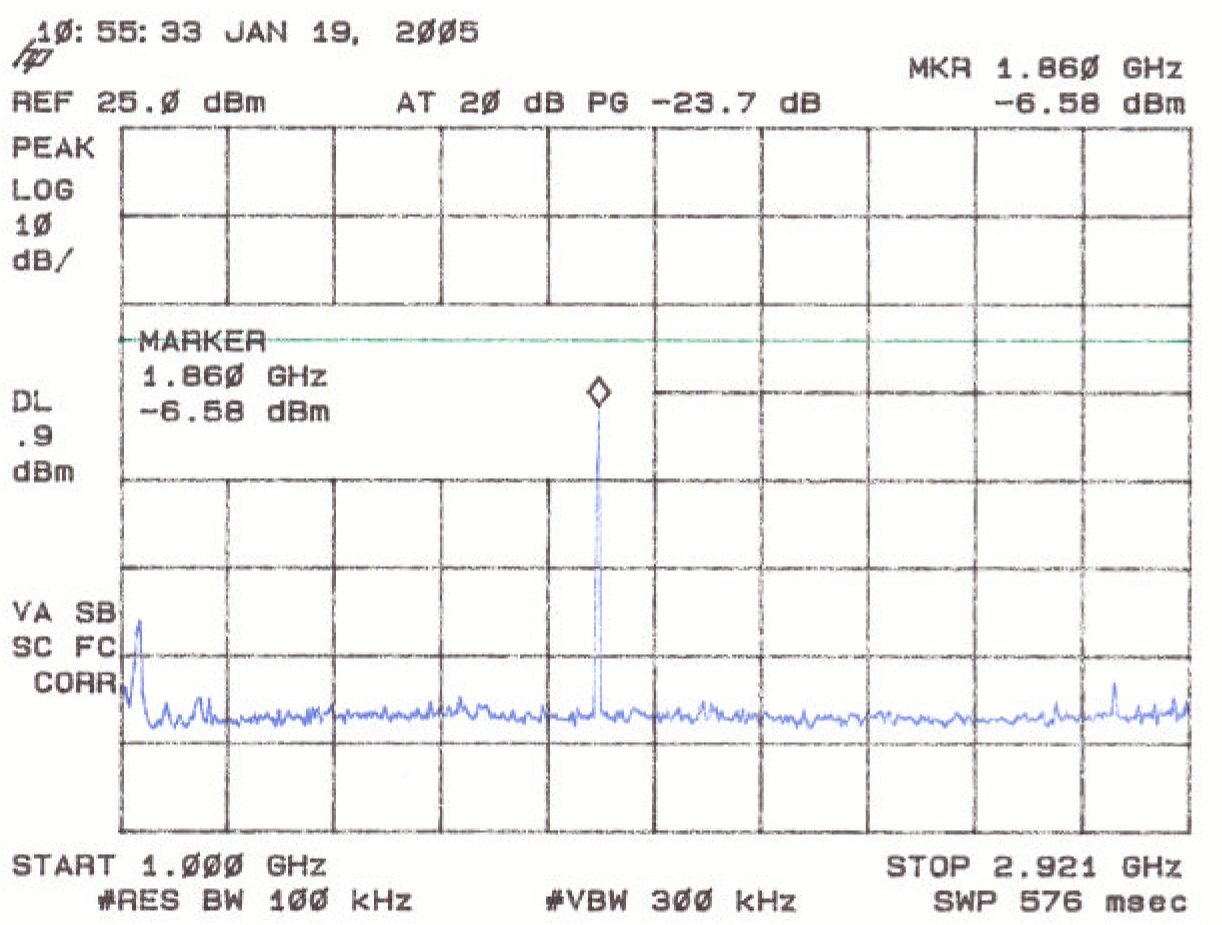

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Figure 4w

Antenna Conducted Spurious Emissions 15.247(c) (High Channel)

Fractal Antenna

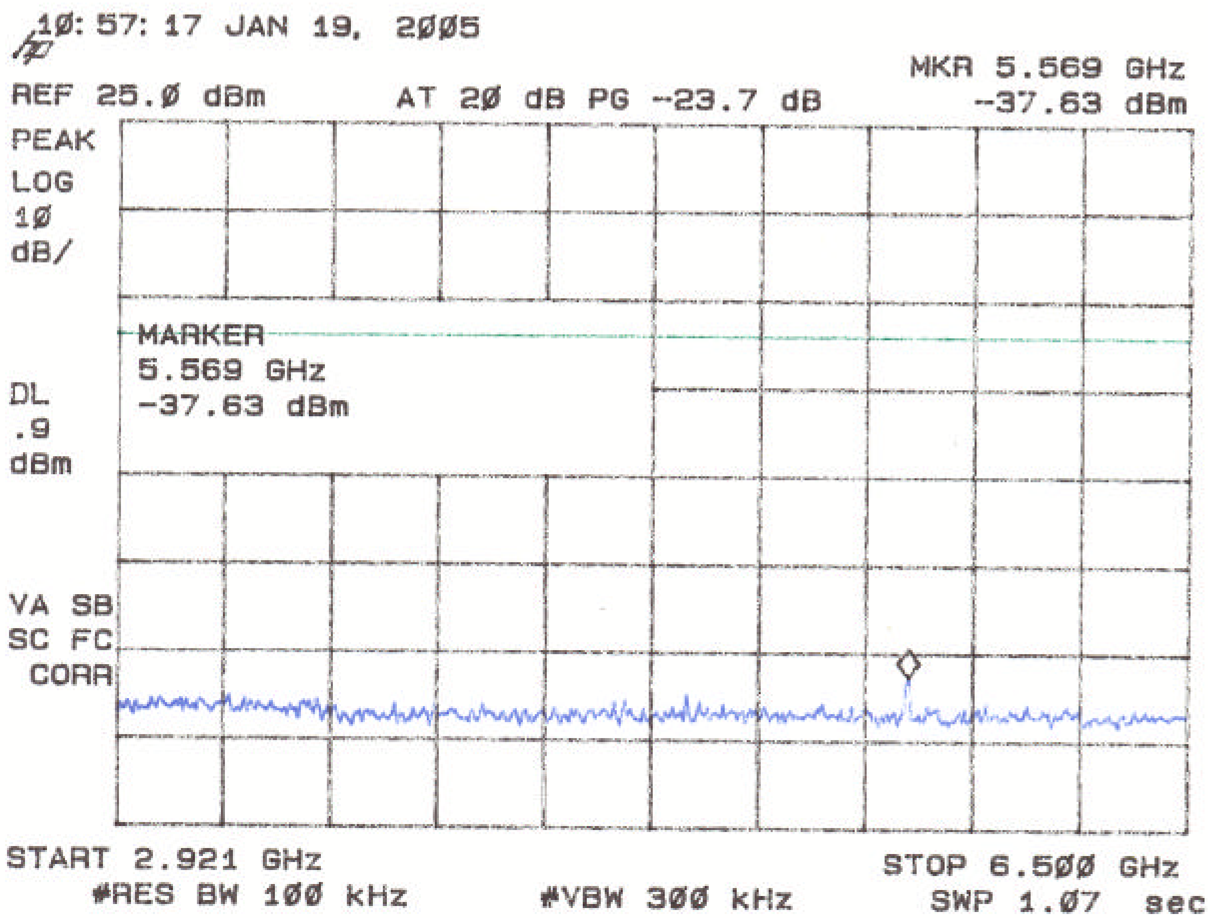

Figure 4x
Antenna Conducted Spurious Emissions 15.247(c) (High Channel)
Fractal Antenna