U.S. TECH

A TRADITION IN TESTING SERVICES

March 4, 2002

Mr. Steven Makk
Stephen Makk & Associates, Inc.
1015 Conyers Executive Park, Suite 200
Conyers, GA 30012

Dear Mr. Makk:

Enclosed please find Signal Golf International Pte. Ltd. file copy of the Part 15 Certification Application for the Yard Dog Transmitter.

Signal Golf International Pte. Ltd. should expect to receive a certification grant for this product within the next 1-2 weeks.

If you have any questions, please don't hesitate to call. Thank you for your business.

Sincerely,

Timothy R. Johnson
NARTE Certified EMC Engineer
No. EMC-002205-NE

U.S. TECH
A TRADITION IN TESTING SERVICES

Signal Golf International Pte. Ltd.
FCC Part 15, Certification Application
Yard Dog

March 4, 2002

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Signal Golf International Pte. Ltd.**

MODEL: **Yard Dog**

FCC ID: **P2T010407-0D**

DATE: **March 4, 2002**

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

Equipment type: **__DSS Spread Spectrum____**

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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TABLES

SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is a Signal Golf International Pte. Ltd., Model Yard Dog. The Yard Dog is the hand held portion of an advanced yardage measurement system for use on golf courses. The EUT is a DSS spread spectrum device designed to operate from 2421.6 MHz – 2461.6 MHz. The EUT is designed to transmit only when held away from the body and the appropriate button is pressed by the user.

The other portion of this system is the Smart Pin, which is a transceiver which is located as part of the Flag pole used on a golf course (one per hole). The purpose of the system is to determine the distance between the hand held unit (used by a golfer) to the flag pole on the green.

1.2 Related Submittal(s)/Grant(s)

The EUT will be used with part of a system to send/receive data. The transceiver presented in this report will be used with another transceiver which has been submitted under FCC ID: P2T010417-0D.

The EUT is subject to the following authorizations:

a) Certification as a transceiver
b) Verification as a digital device

The information contained in this report is presented for the certification & verification authorization(s) for the EUT.

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.

Since the EUT is a hand held device, it was rotated about all 3 axis in order to obtain worse case results.

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

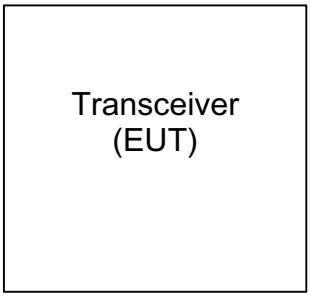
Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

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

FIGURE 1

TEST CONFIGURATION



Test Date: February 2, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Model: Yard Dog

FIGURE 2a

Photograph(s) for Digital Device and Spurious Emissions (Front)

Test Date: February 2, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Model: Yard Dog

FIGURE 2b

Photograph(s) for Digital Device & Spurious Emissions (Back)

Test Date: February 2, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Model: Yard Dog

FIGURE 2e

Photograph(s) for Digital Device Conducted Emissions

The EUT was battery powered, therefore Conducted Emissions were deemed not necessary.

TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Hand Held Transceiver Signal Golf International Pte. Ltd.	Yard Dog	None	P2T010407-0D (Pending)	N/A

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	2944A07436
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
MULTIMETER	FLUKE	85	53710469
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.

The Model Signal Golf International Pte. Ltd. Yard Dog incorporates an integrated antenna only. The antenna is a 1/3 wavelength antenna with a gain of 2 dBi. The antenna is made of RG-174 coax cable and soldered to the circuit board.

2.7 Peak Power Within the Band 2.4 – 2.4835 GHz per FCC Section 15.247(b)

Peak power within the band 2.4 – 2.4835 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 did not have a RBW greater than the 6 B bandwidth for the largest fundamental bandwidth, therefore this data was taken using the channel power function of the spectrum analyzer. 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: **February 8, 2002**
UST Project: **01-0732**
Customer: **Signal Golf International Pte. Ltd.**
Model: **Yard Dog**

Frequency of Fundamental (GHz)	Measurement (dBm)*	Measurement (Watt)*	FCC Limit (Watt)
2.4216	19.1	0.0813	1.0
2.4416	19.1	0.0813	1.0
2.4616	18.2	0.0662	1.0

*** Measurement includes 1.3 dB cable loss**

Tester Signature: _____ **Name:** **David Blethen**

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

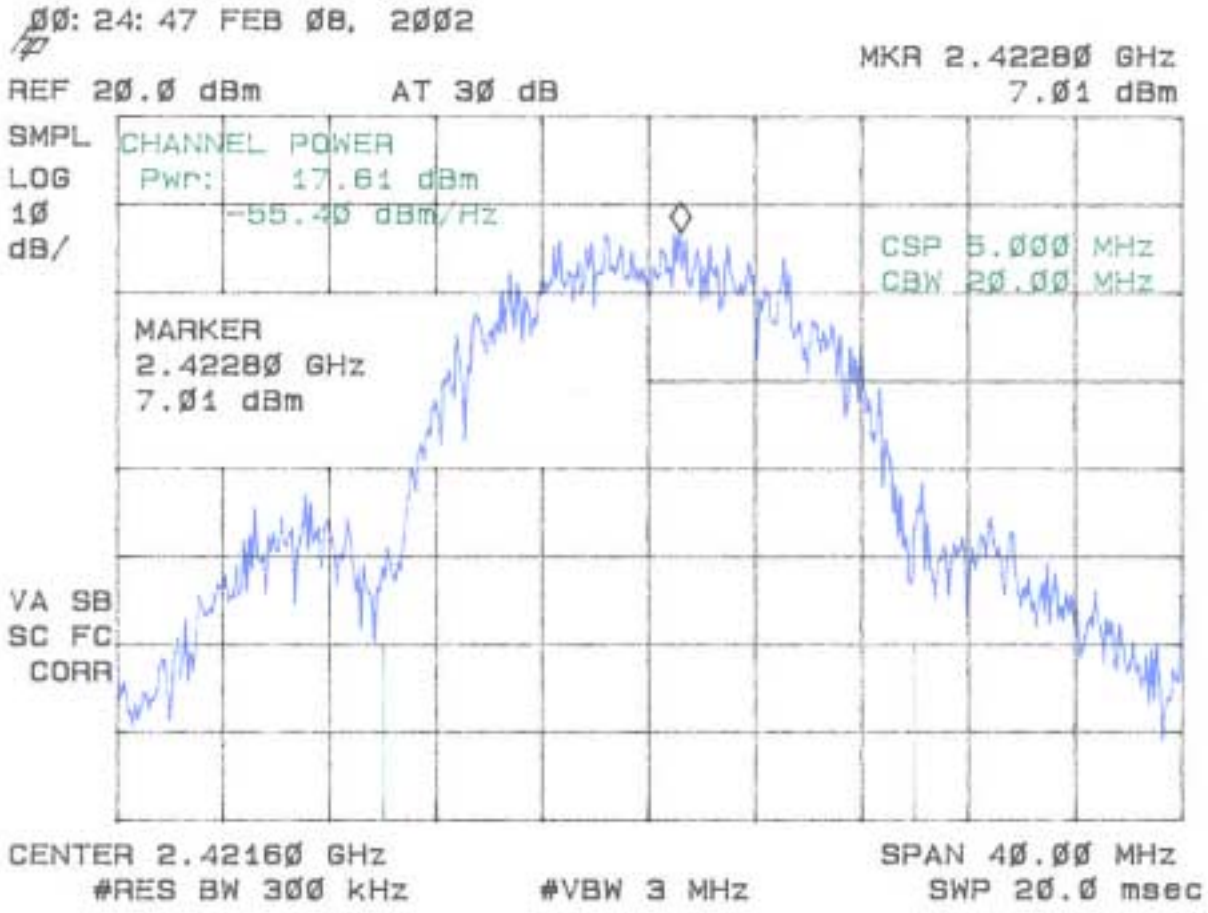


Figure 3b.
Peak Power per FCC Section 15.247(b) (Mid)

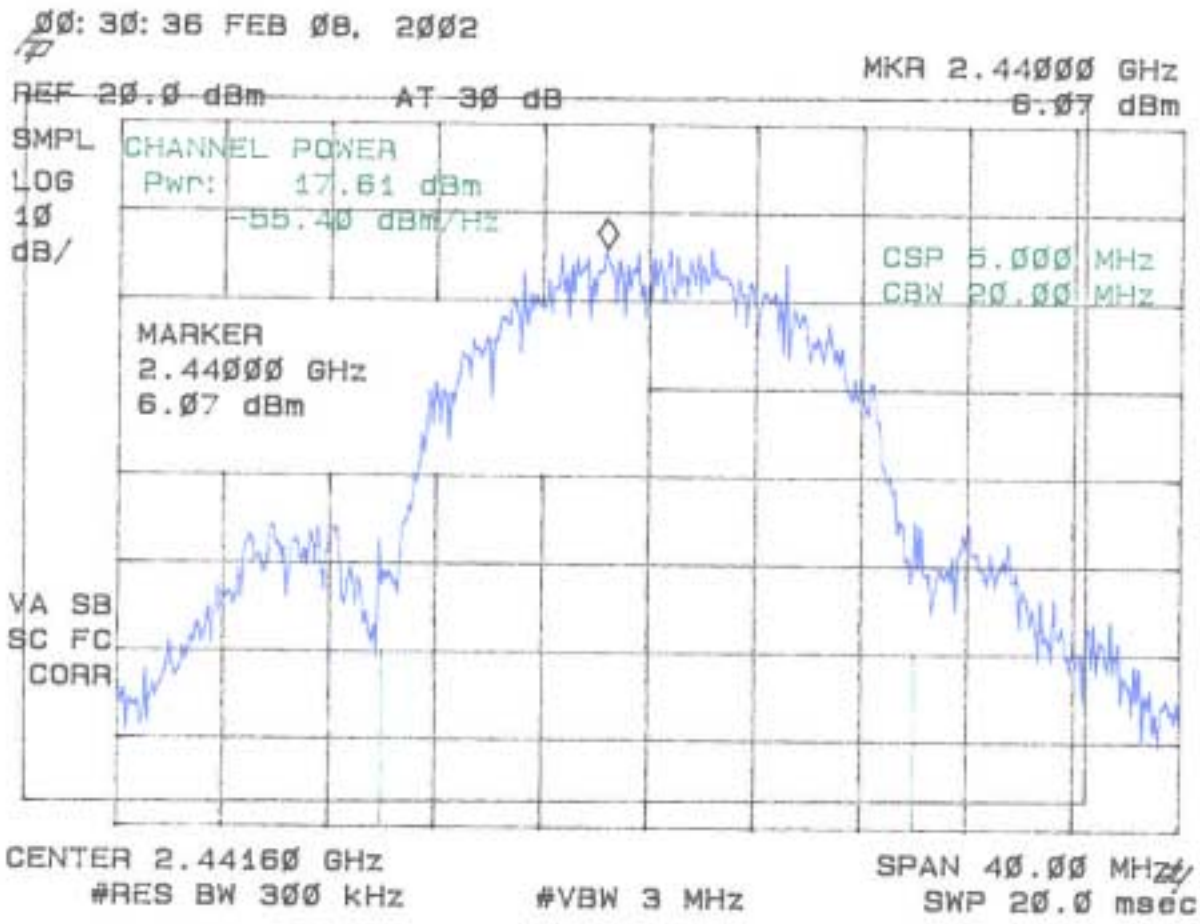
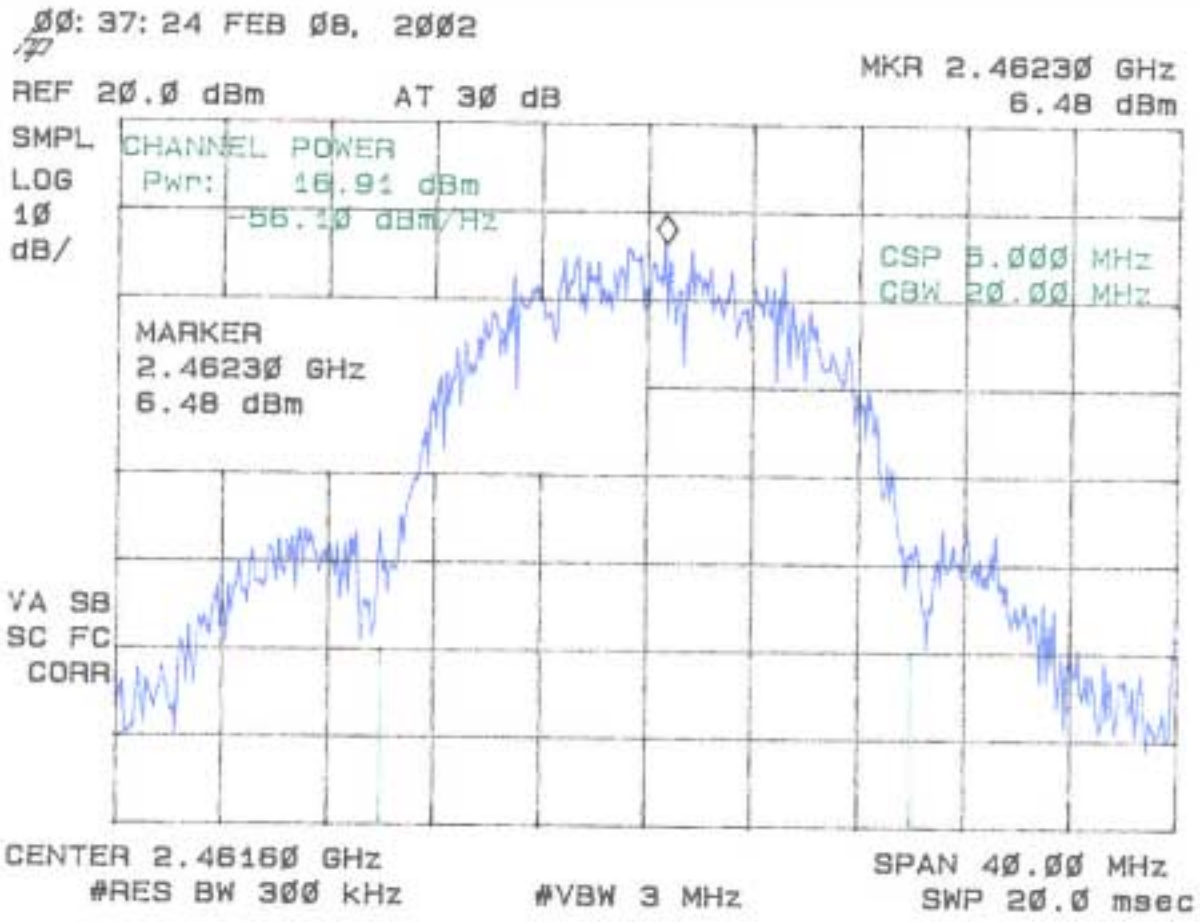


Figure 3c.
Peak Power per FCC Section 15.247(b) (High)



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

Antenna Conducted 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 of conducted spurious emissions are given in Figure 4a through Figure 4l.

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

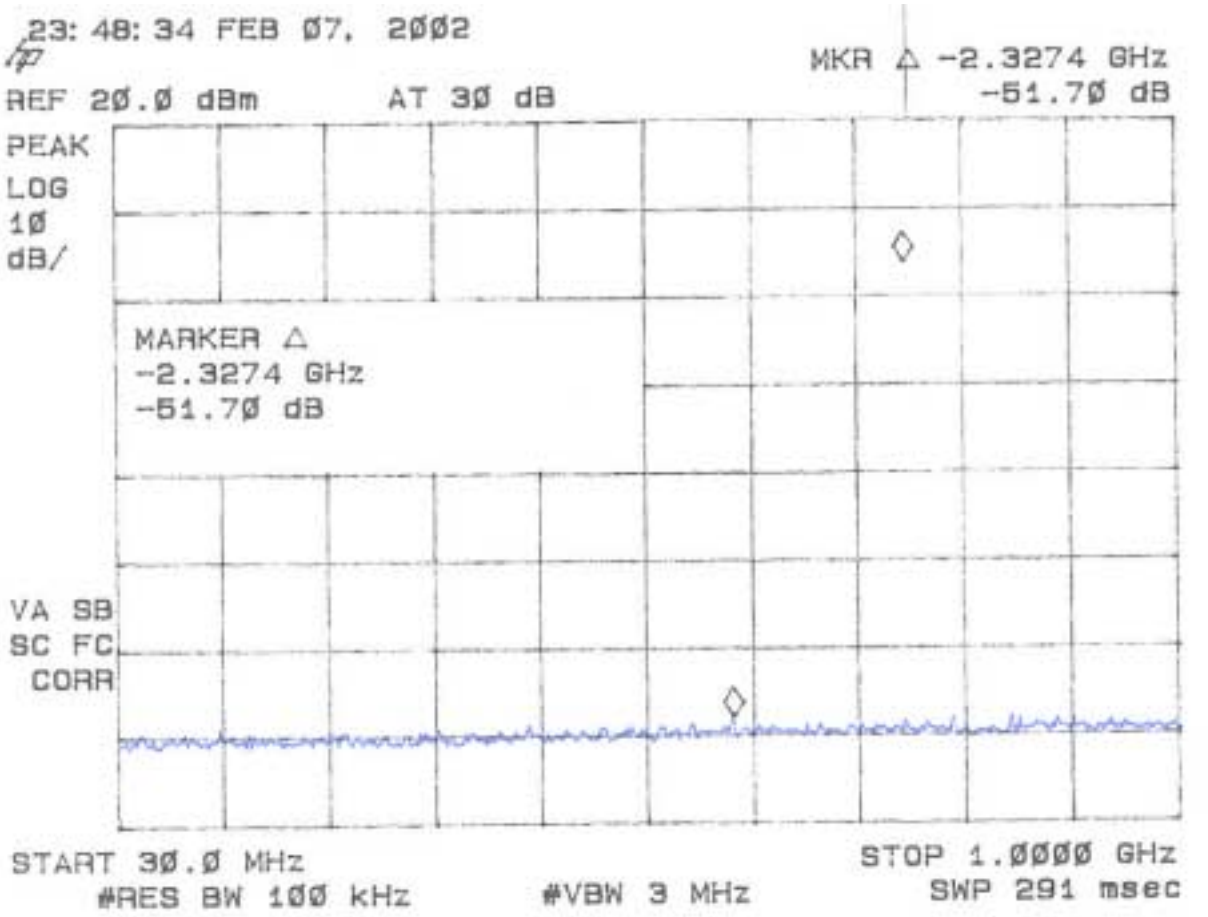


Figure 4b
Antenna Conducted Spurious Emissions 5.247(c) Low

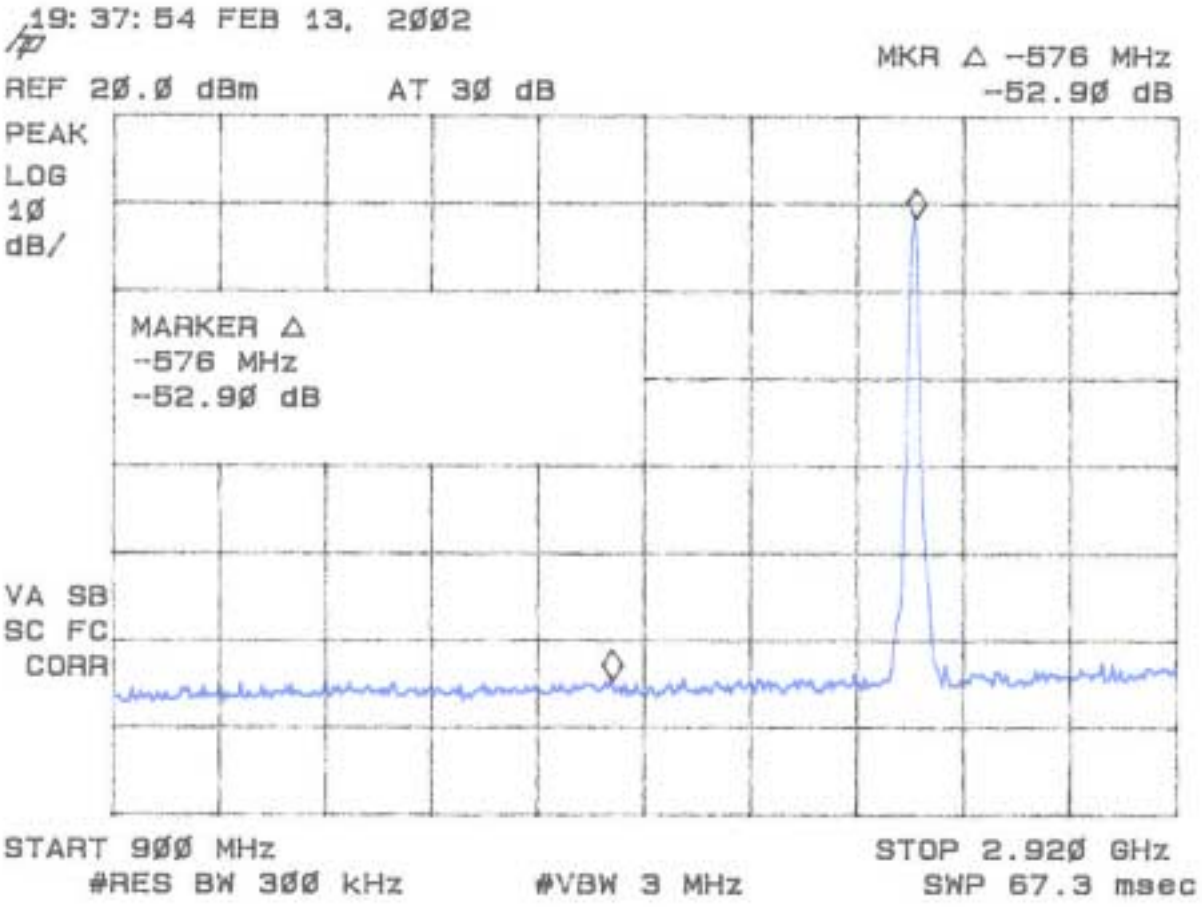


Figure 4c
Antenna Conducted Spurious Emissions 15.247(c) Low

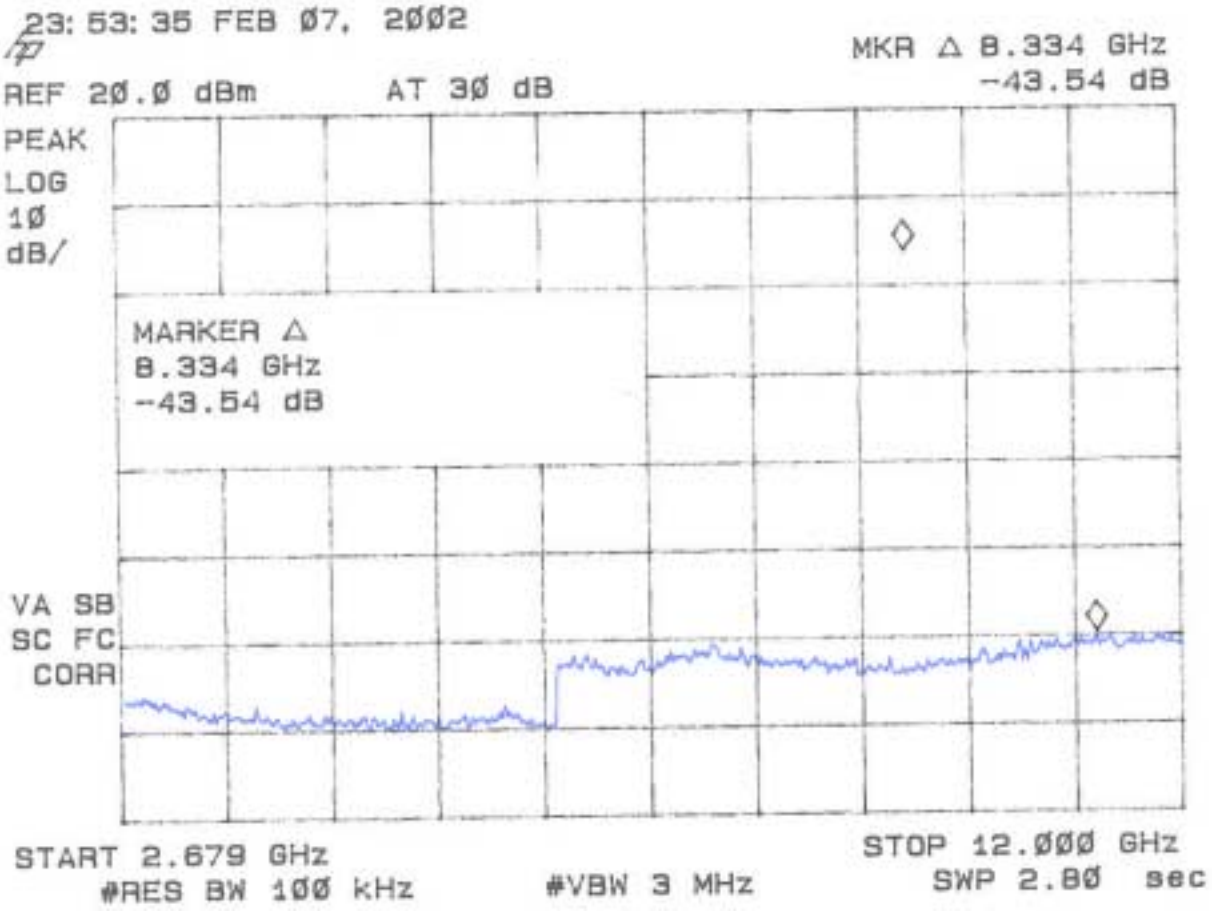


Figure 4d
Antenna Conducted Spurious Emissions 15.247(c) Low

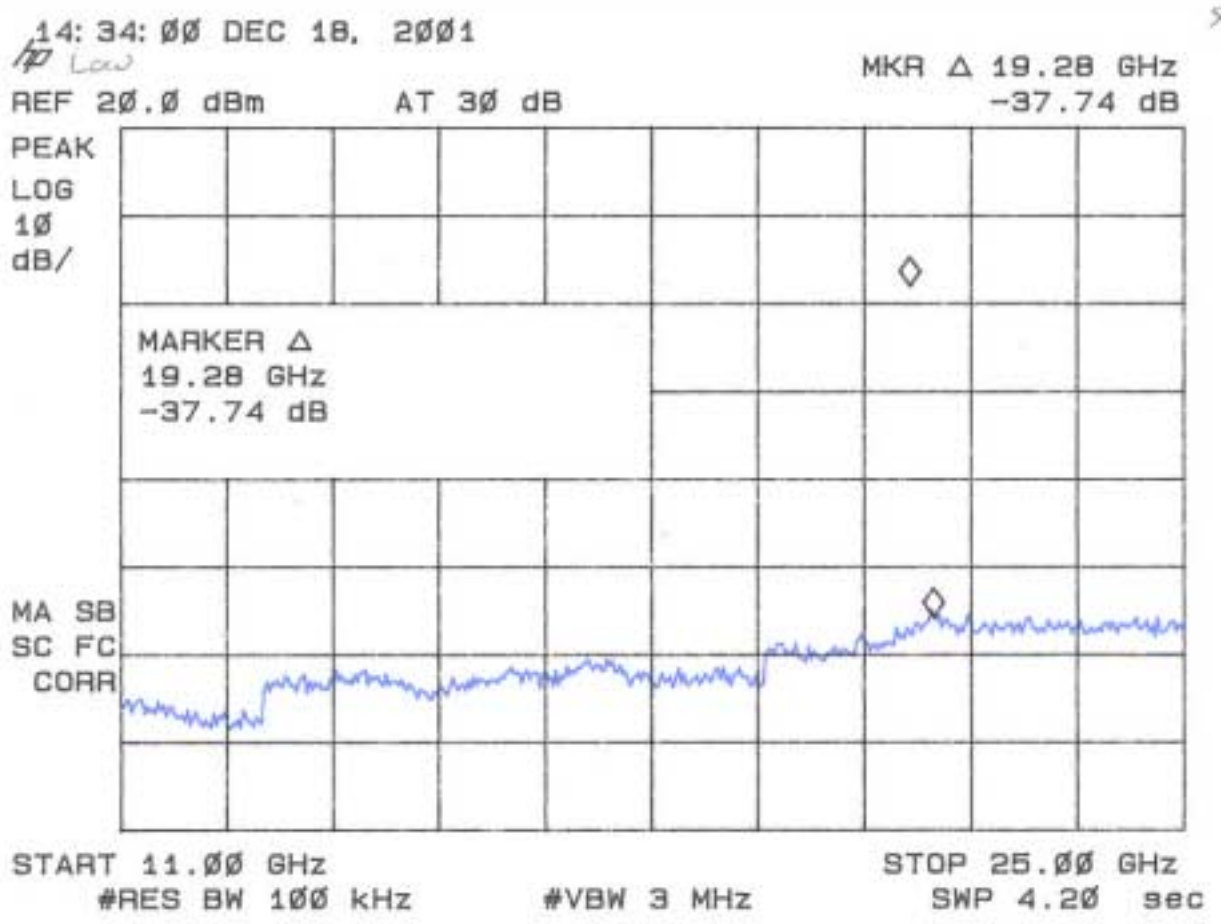


Figure 4e
Antenna Conducted Spurious Emissions 15.247(c) Mid

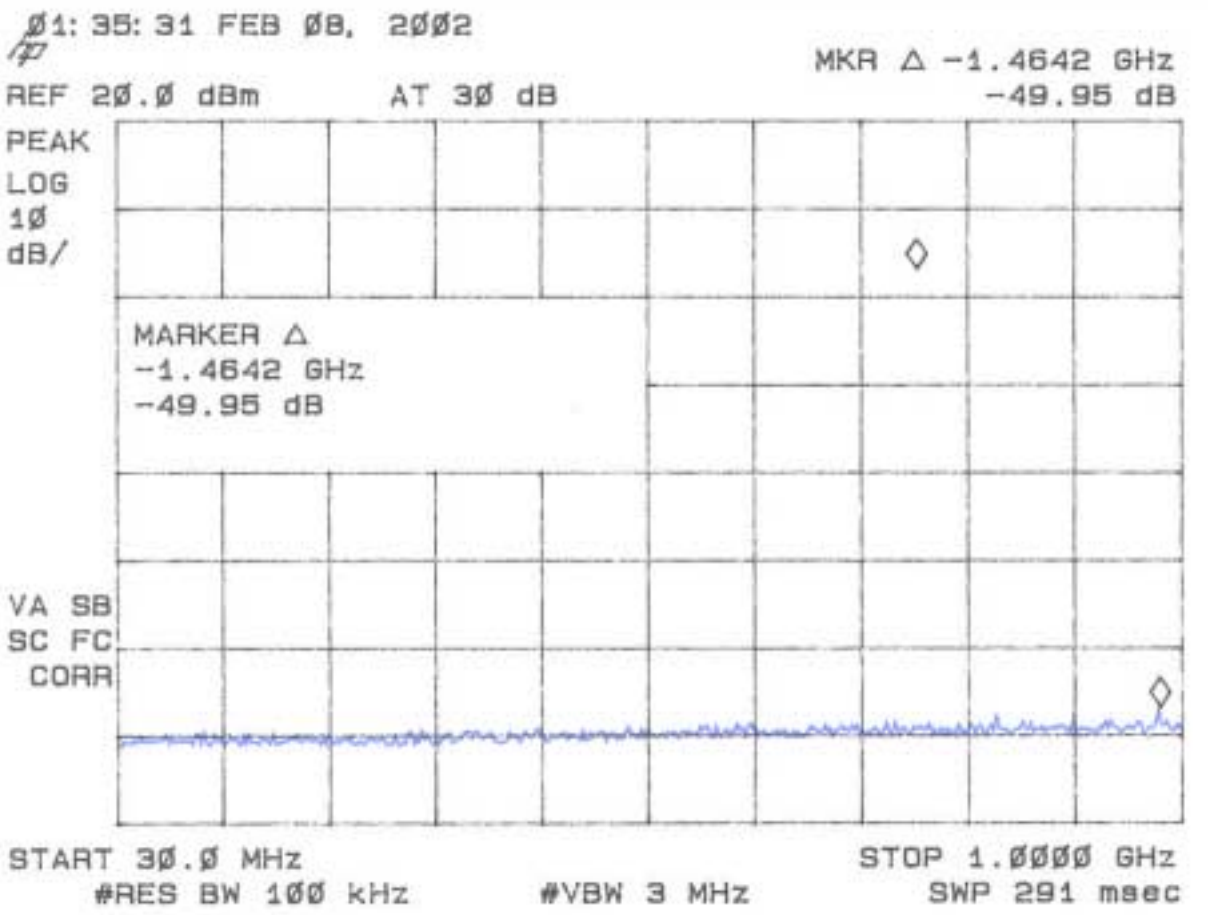


Figure 4f
Antenna Conducted Spurious Emissions 15.247(c) Mid

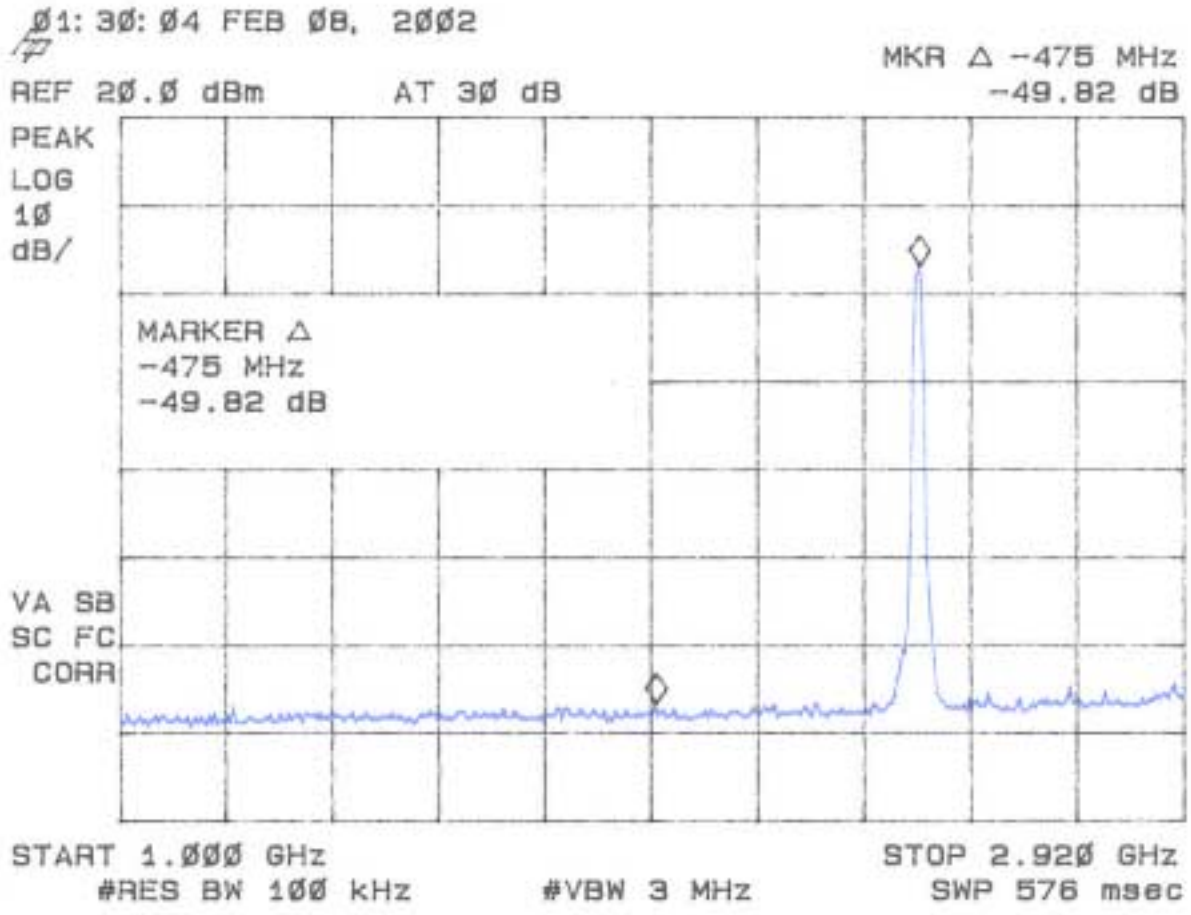


Figure 4g
Antenna Conducted Spurious Emissions 15.247(c) Mid

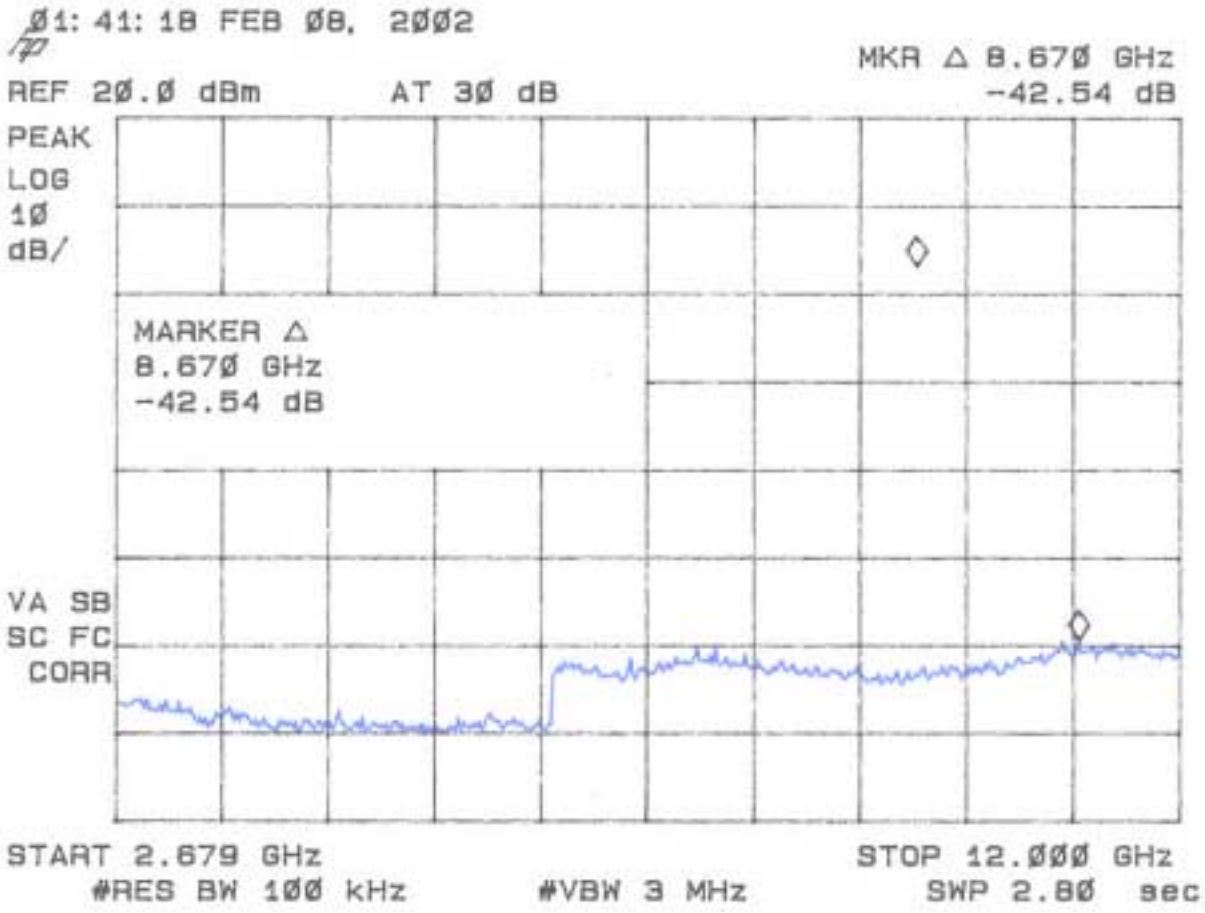


Figure 4h
Antenna Conducted Spurious Emissions 15.247(c) Mid

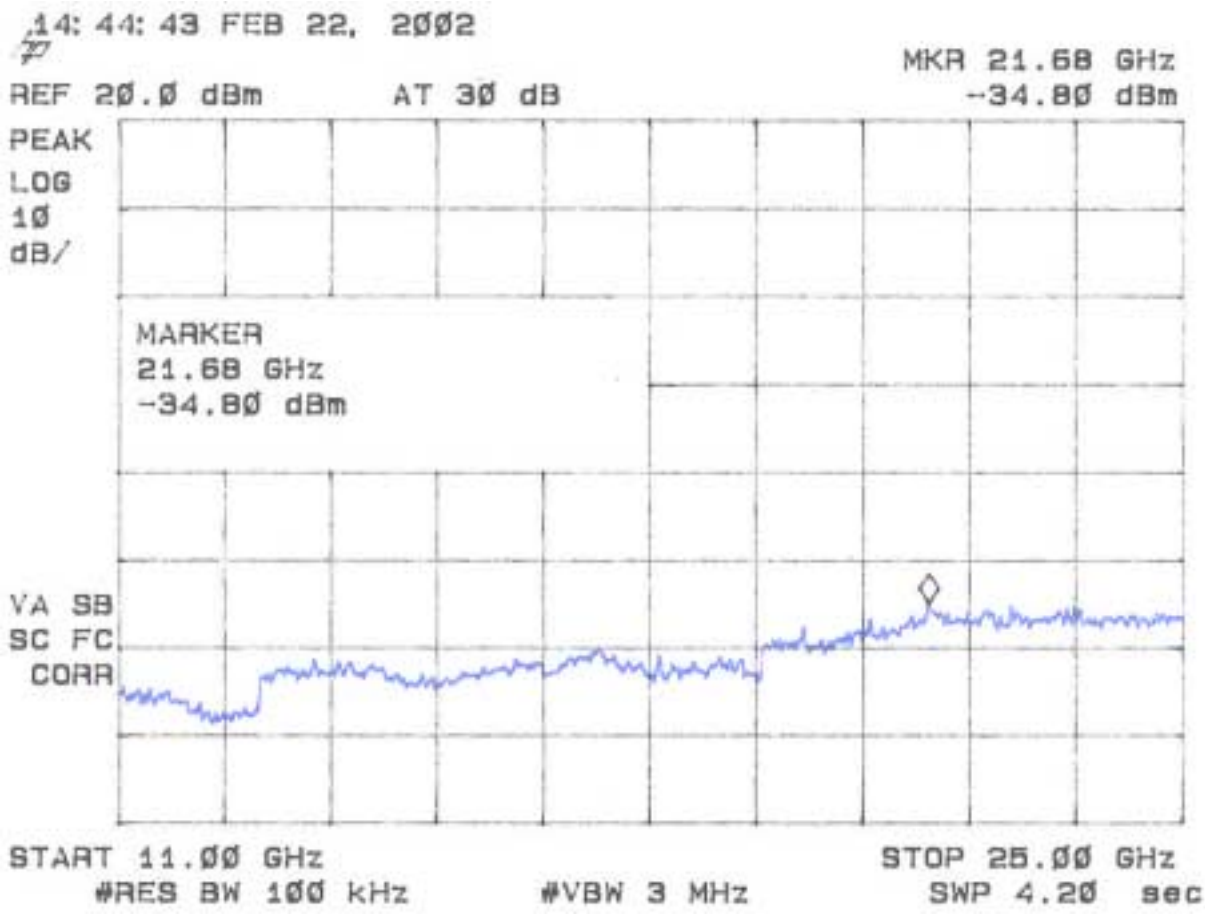


Figure 4i
Antenna Conducted Spurious Emissions 15.247(c) High

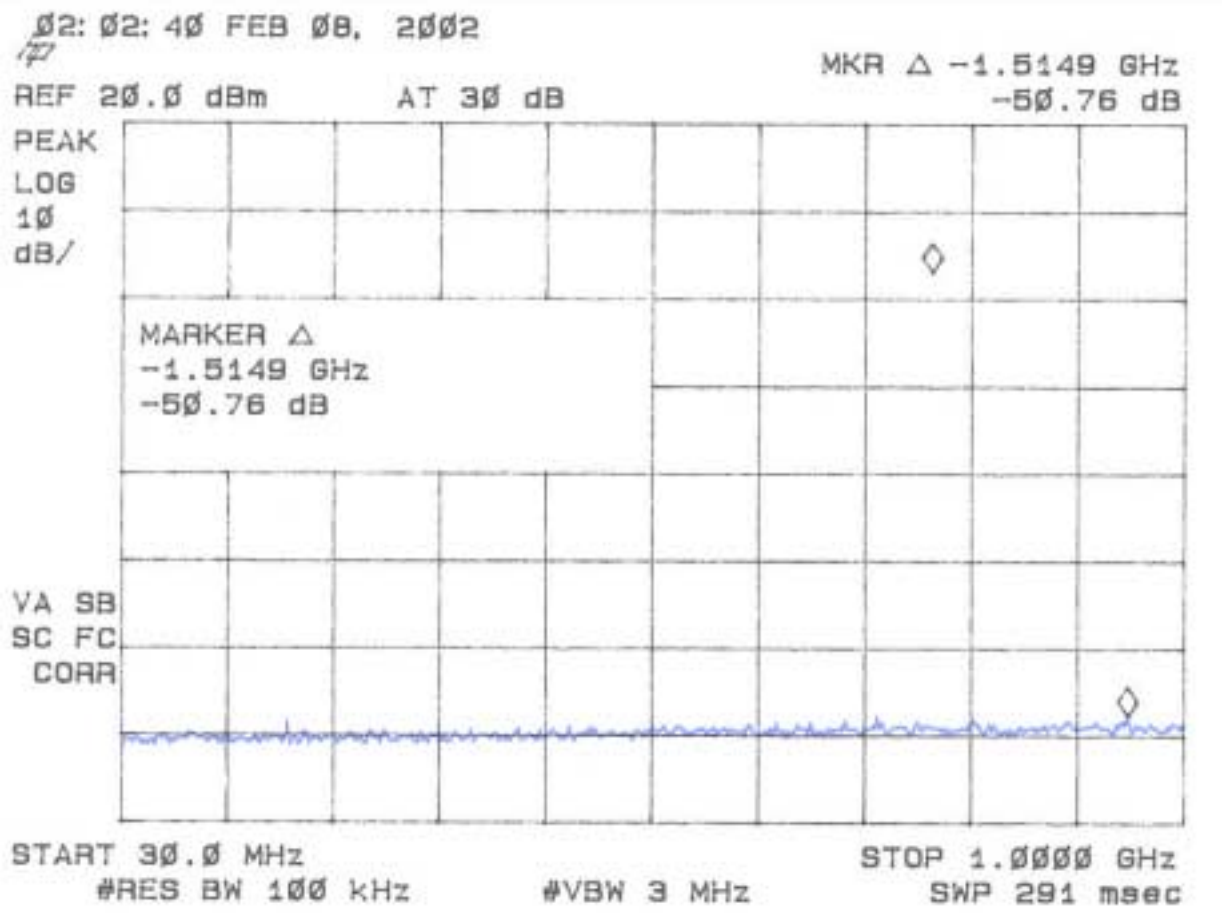


Figure 4j
Antenna Conducted Spurious Emissions 15.247(c) High

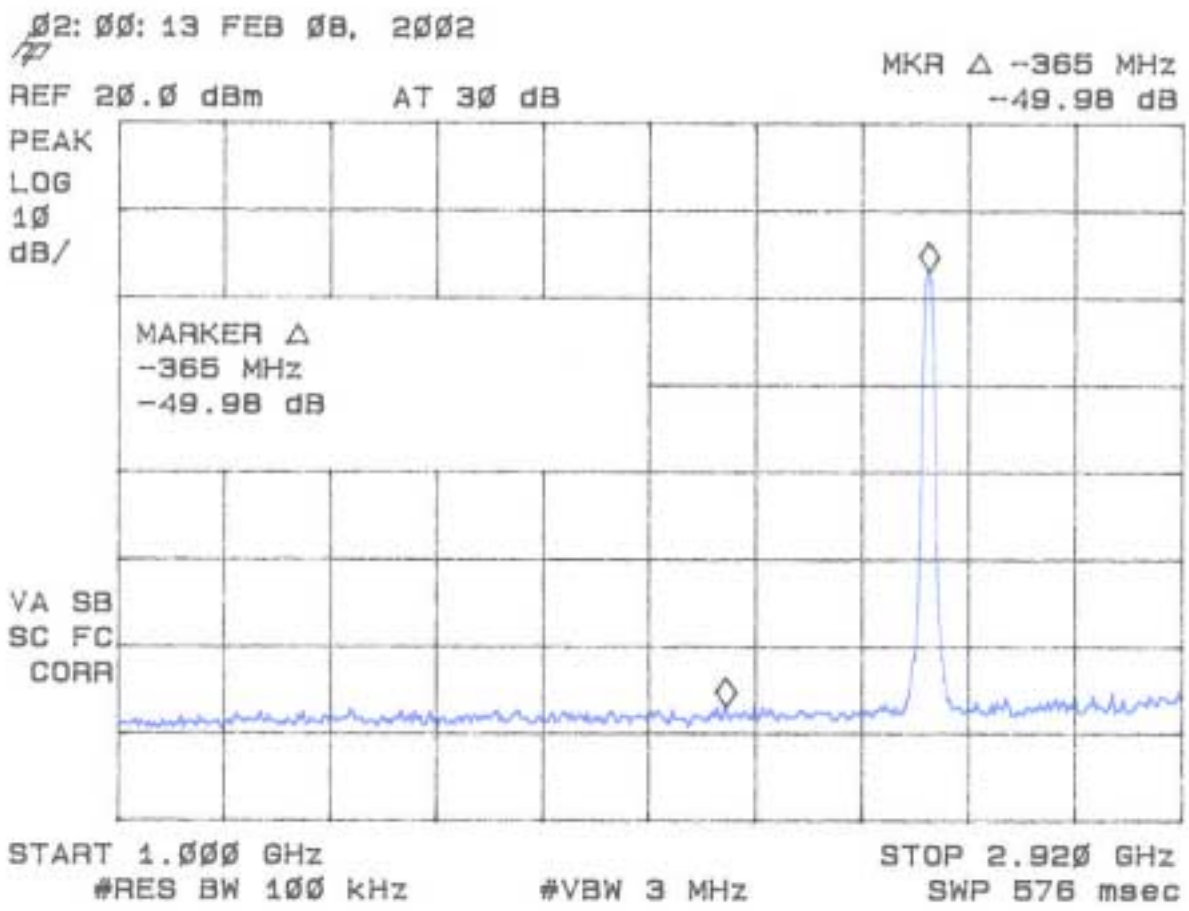


Figure 4k
Antenna Conducted Spurious Emissions 15.247(c) High

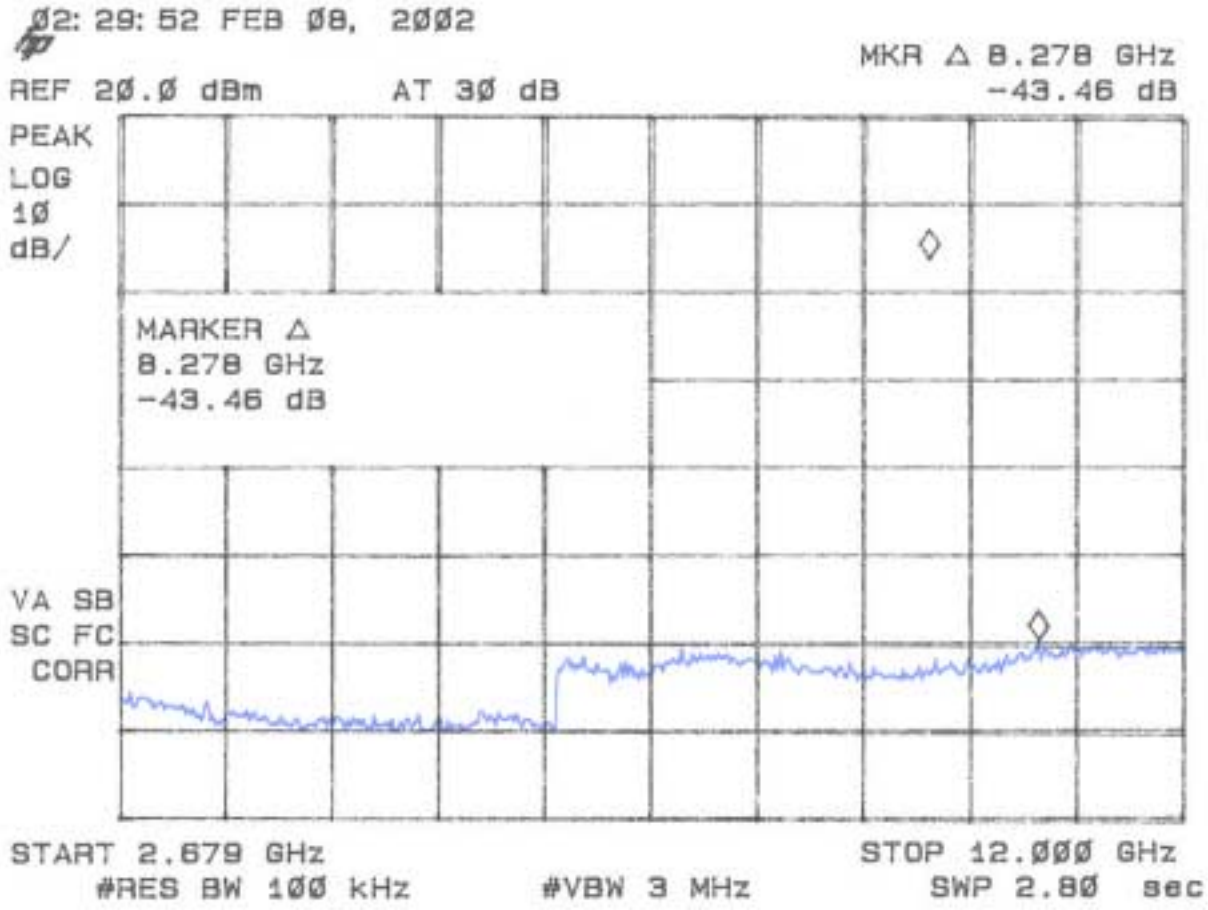
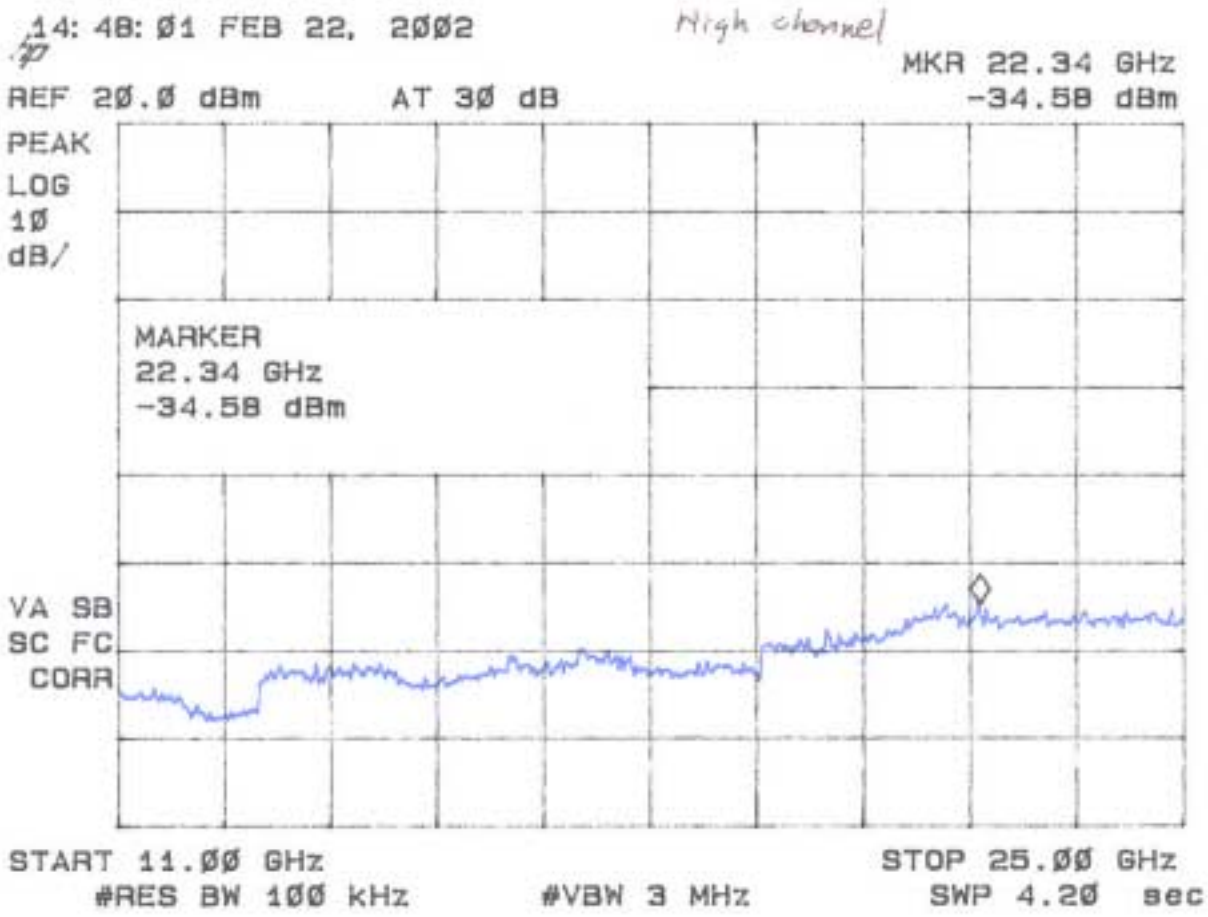


Figure 4l
Antenna Conducted Spurious Emissions 15.247(c) High



2.9 Peak Radiated Spurious Emission in the Frequency Range 30 -25000 MHz (FCC Section 15.247(c))

A preliminary scan was performed on the EUT to determine frequencies that were caused by the transmitter portion of the product. Significant emissions that fell within restricted bands were then measured on an OAT's site. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. The results of peak radiated spurious emissions falling within restricted bands are given in Table 4a (low), Table 4b, (mid), Table 4c (high) and Figure 5a-5b (low), Figure 5c-5d (mid) and Figure 5e-5f (high).

Figure 5a
Peak Radiated Spurious Emission 15.247(c) Low

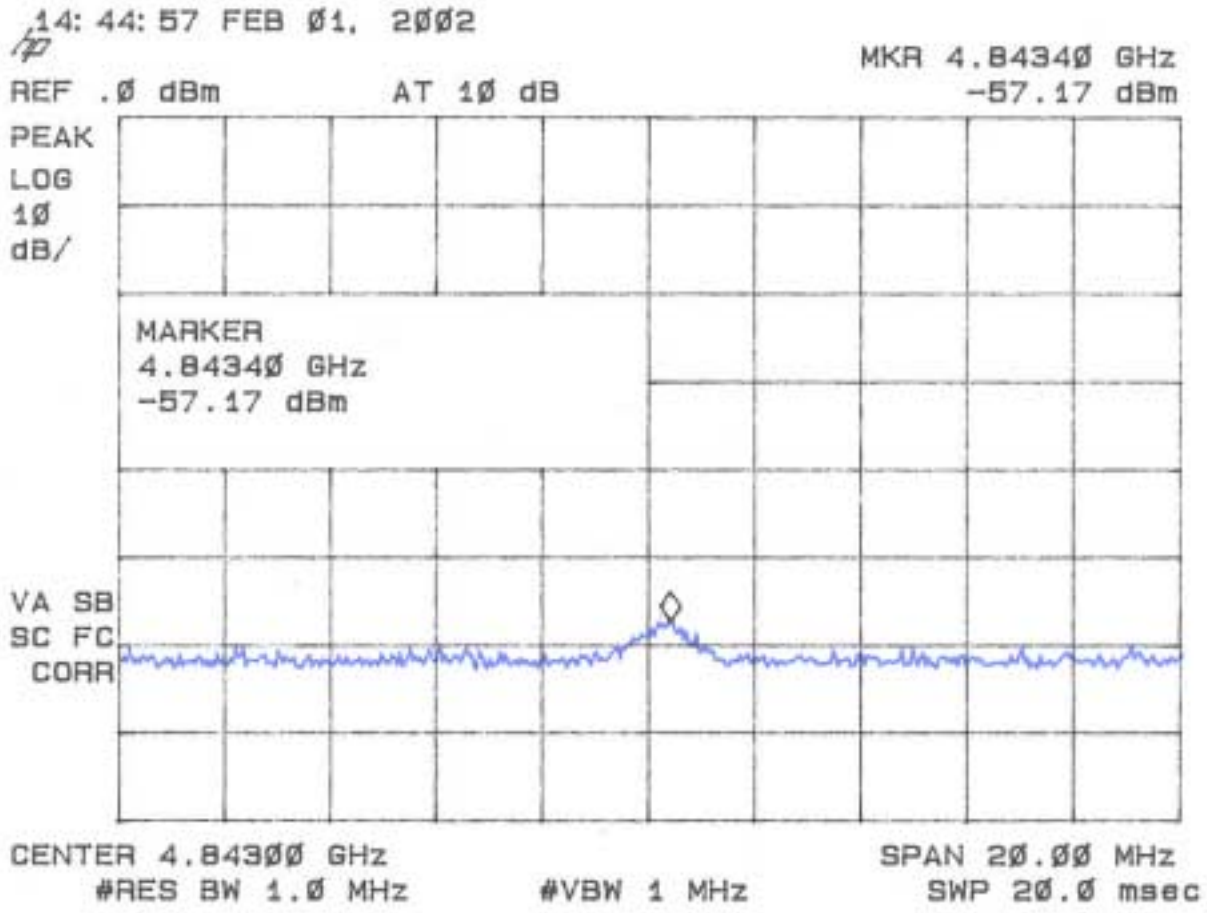


Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

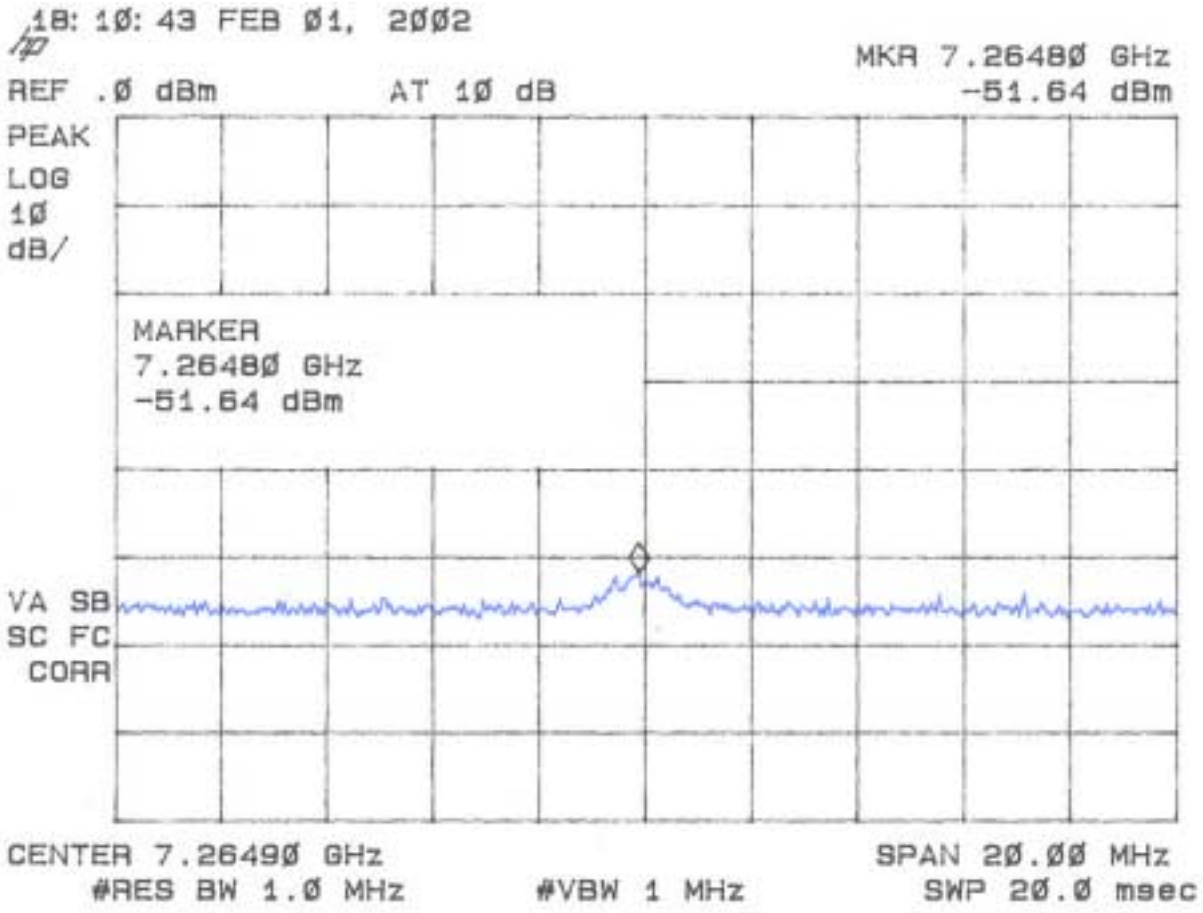


Figure 5c
Peak Radiated Spurious Emission 15.247(c) Mid

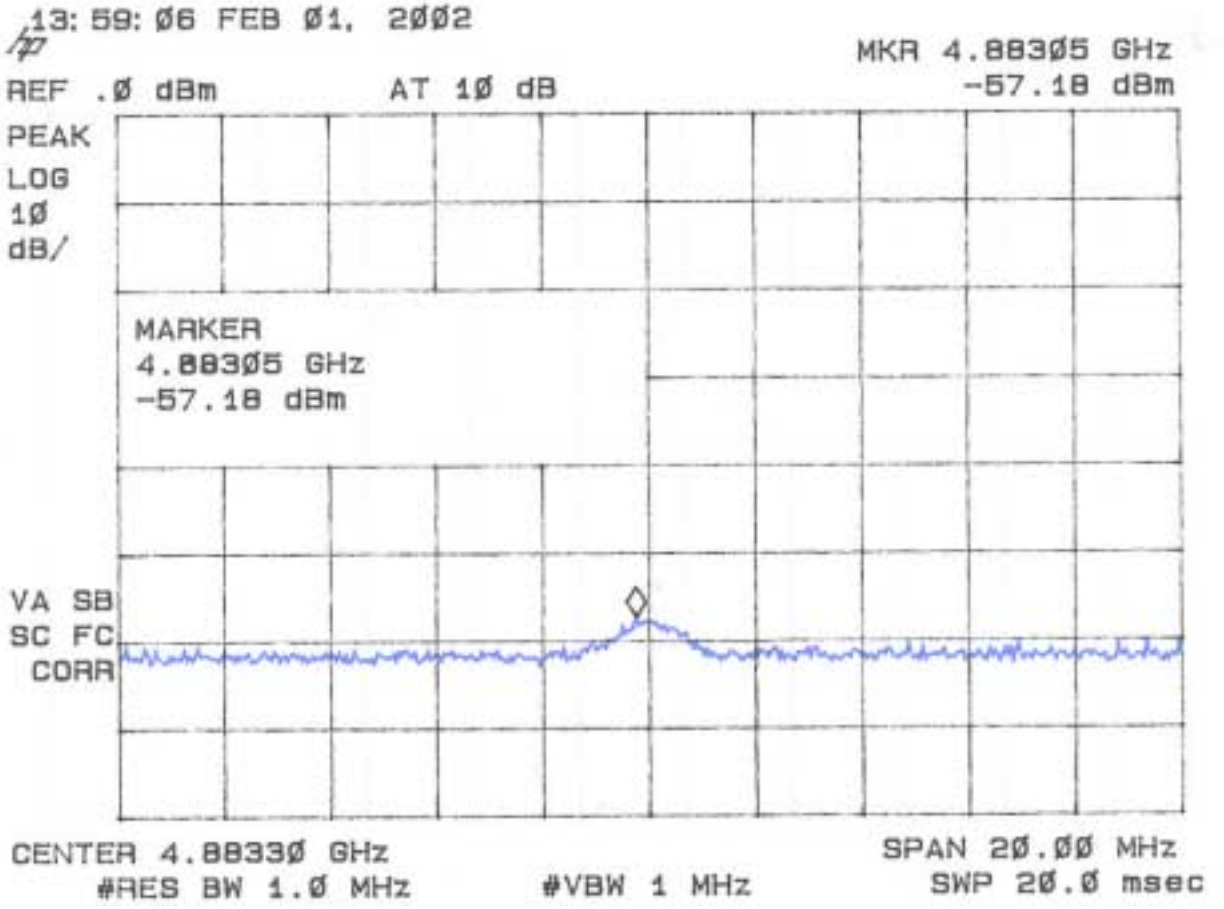


Figure 5d
Peak Radiated Spurious Emission 15.247(c) Mid

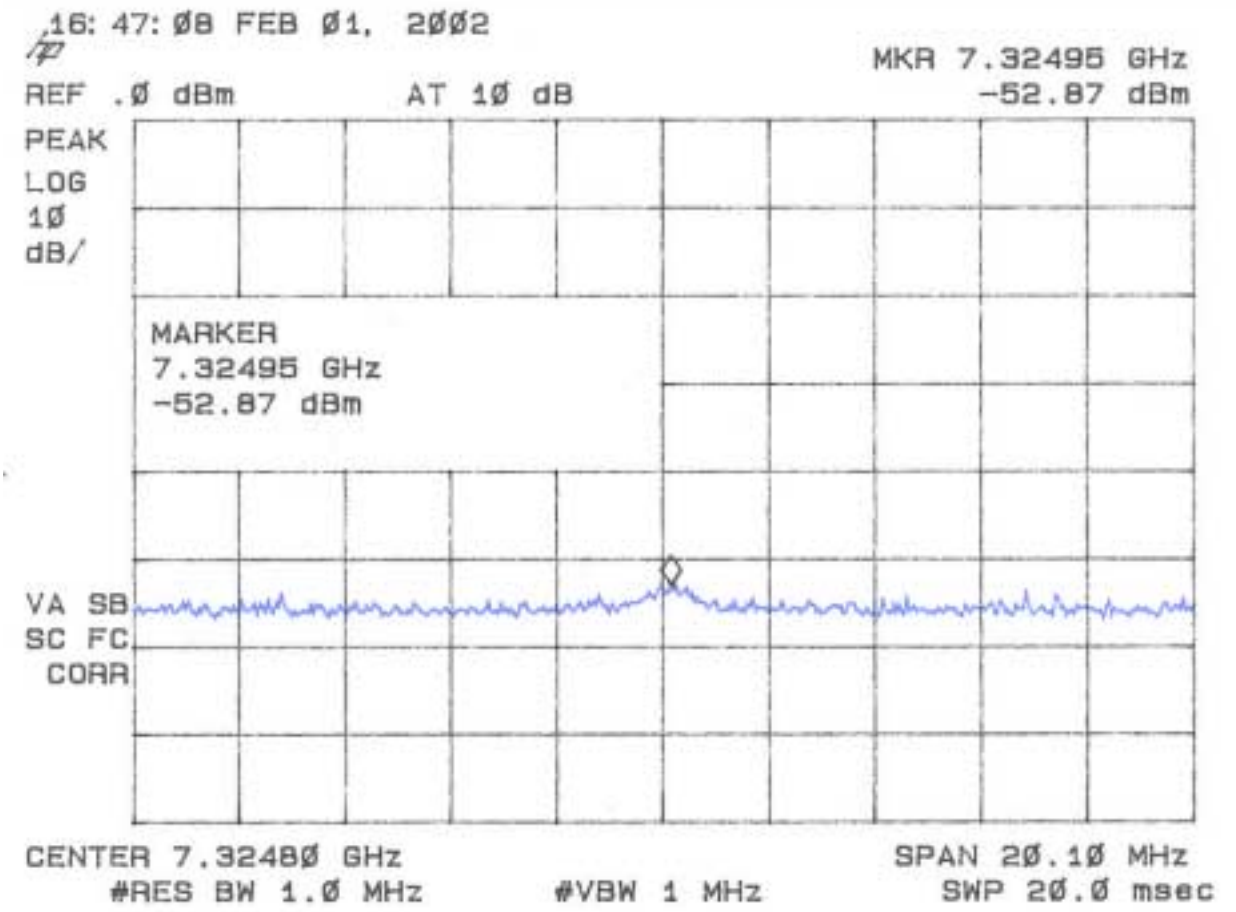


Figure 5e
Peak Radiated Spurious Emission 15.247(c) High

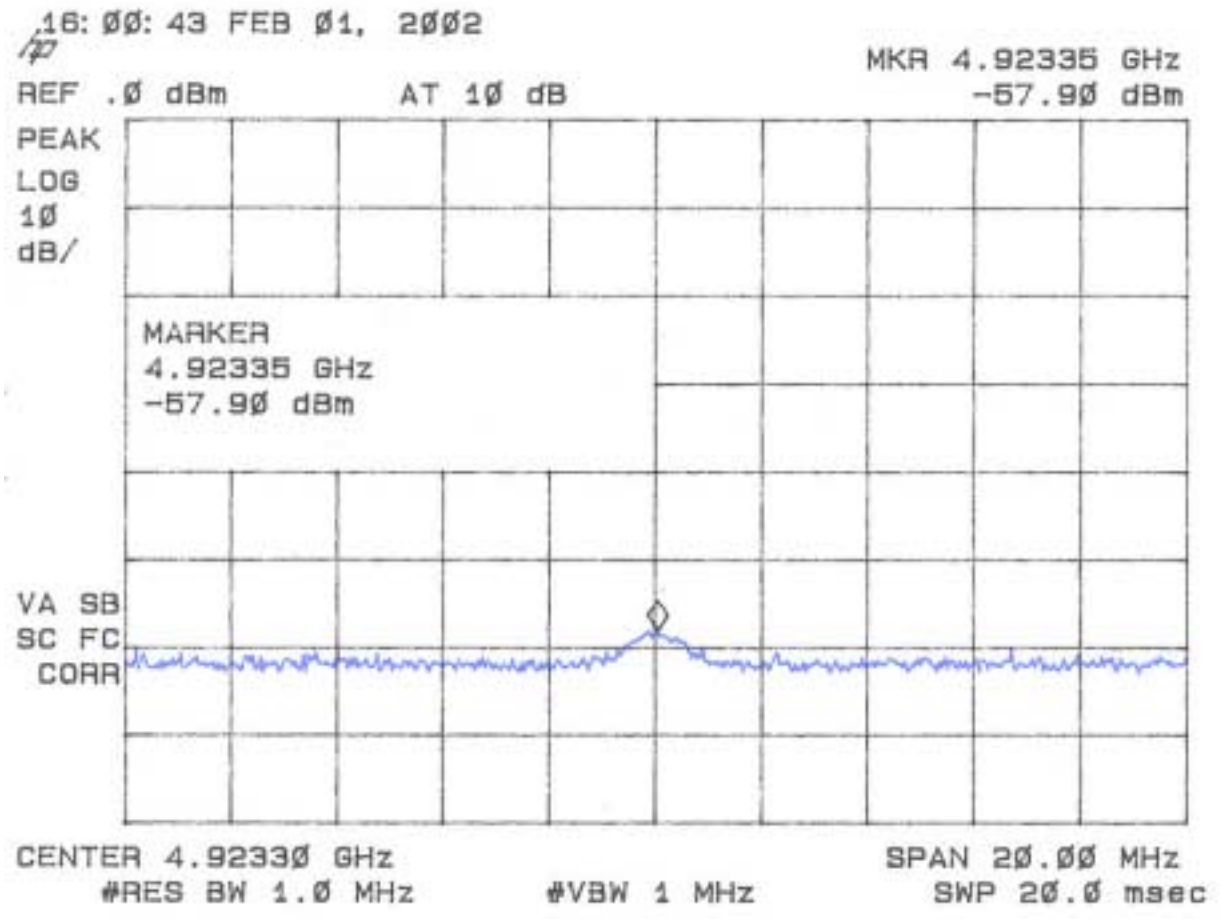


Figure 5f
Peak Radiated Spurious Emission 15.247(c) High

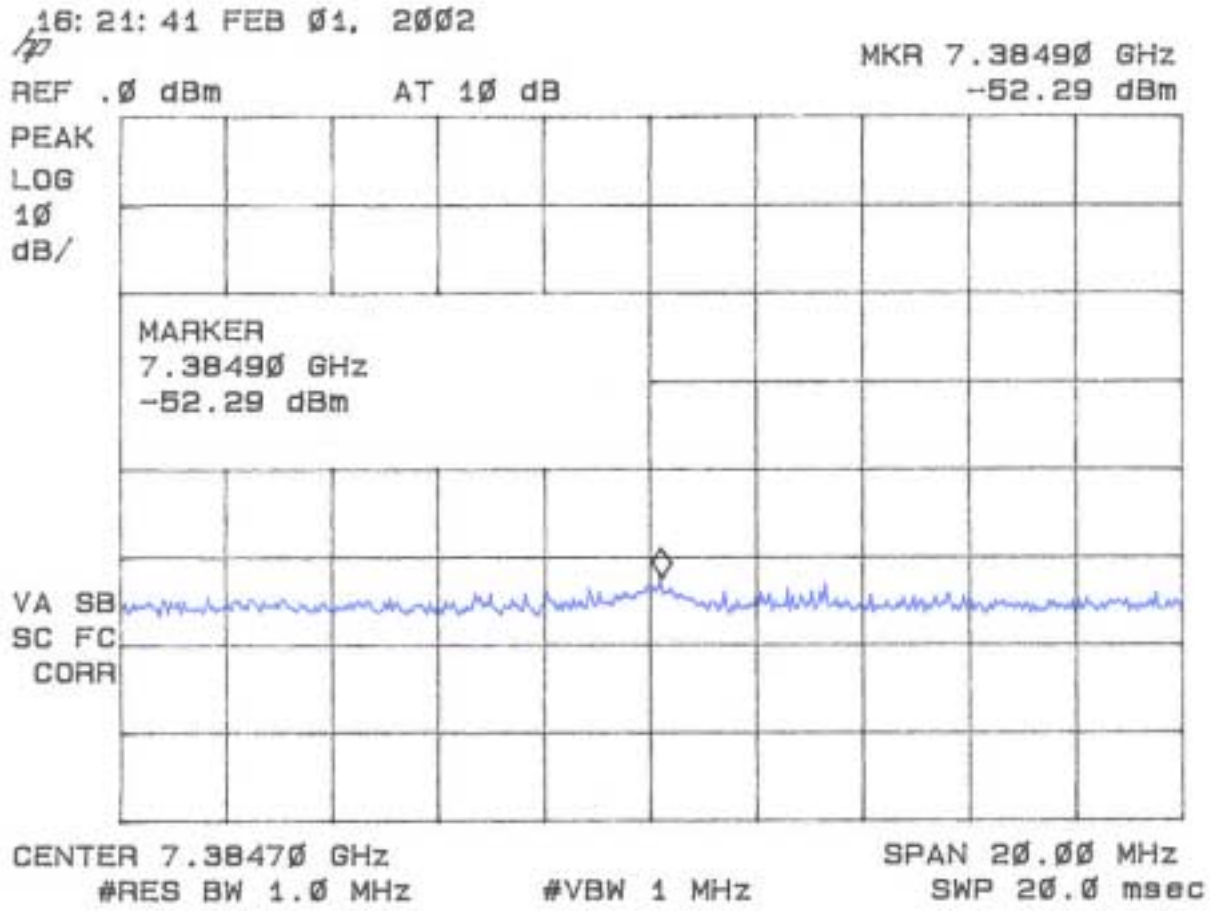


TABLE 4a PEAK RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.84	-56.17	33.9	34.7	6.7	830.6	5000
7.26	-60.28**	33.7	37.3	7.9	815.5	5000

TABLE 4b PEAK RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.88	-56.18	33.9	34.8	6.8	845.3	5000
7.32	-61.41**	33.7	37.3	7.9	720.2	5000

TABLE 4c PEAK RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.92	-56.90	33.9	34.9	6.9	793.0	5000
7.38	-60.83**	33.7	37.4	7.9	774.2	5000

*** = Data adjusted by + 1 dB for high pass filter.**
**** = In order to obtain better dynamic range, these measurements were made at 1 meter test distance and corrected by 20 log (1/3) = -9.54 dB**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-56.17 - 33.9 + 34.7 + 6.7 + 107)/20) = 830.6
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

2.10 Average Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))

The results of average radiated spurious emissions falling within restricted bands are given in Table 5a (low), Table 5b, (mid), Table 5c (high) and Figure 6a-6b (low), Figure 6c-6d (mid) and Table 6e-6f (high).

Compliance with the restricted bands at the bandedges has been shown in Table 5d and Figures 6g and 6h.

Figure 6a
Average Radiated Spurious Emission 15.247(c) Low

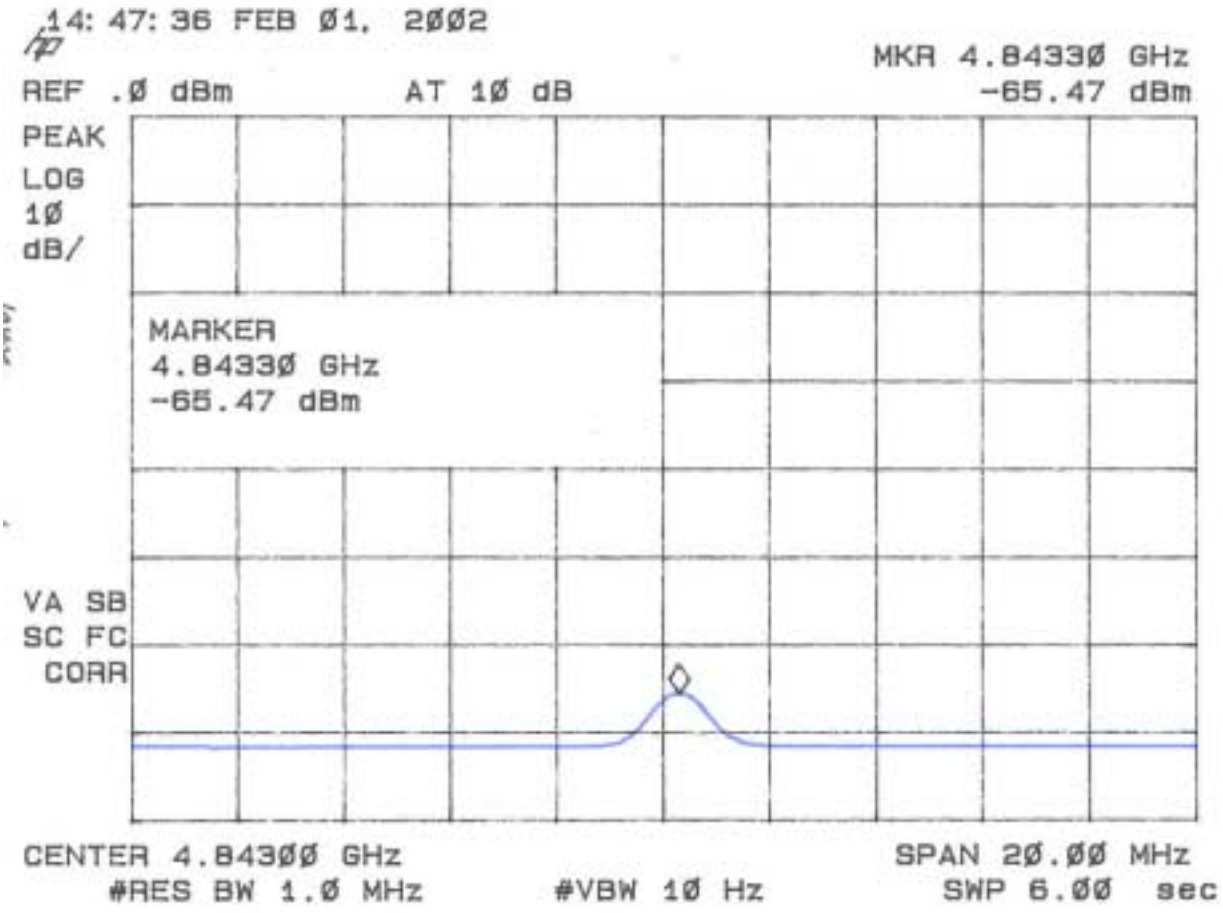


Figure 6b
Average Radiated Spurious Emission 15.247(c) Low

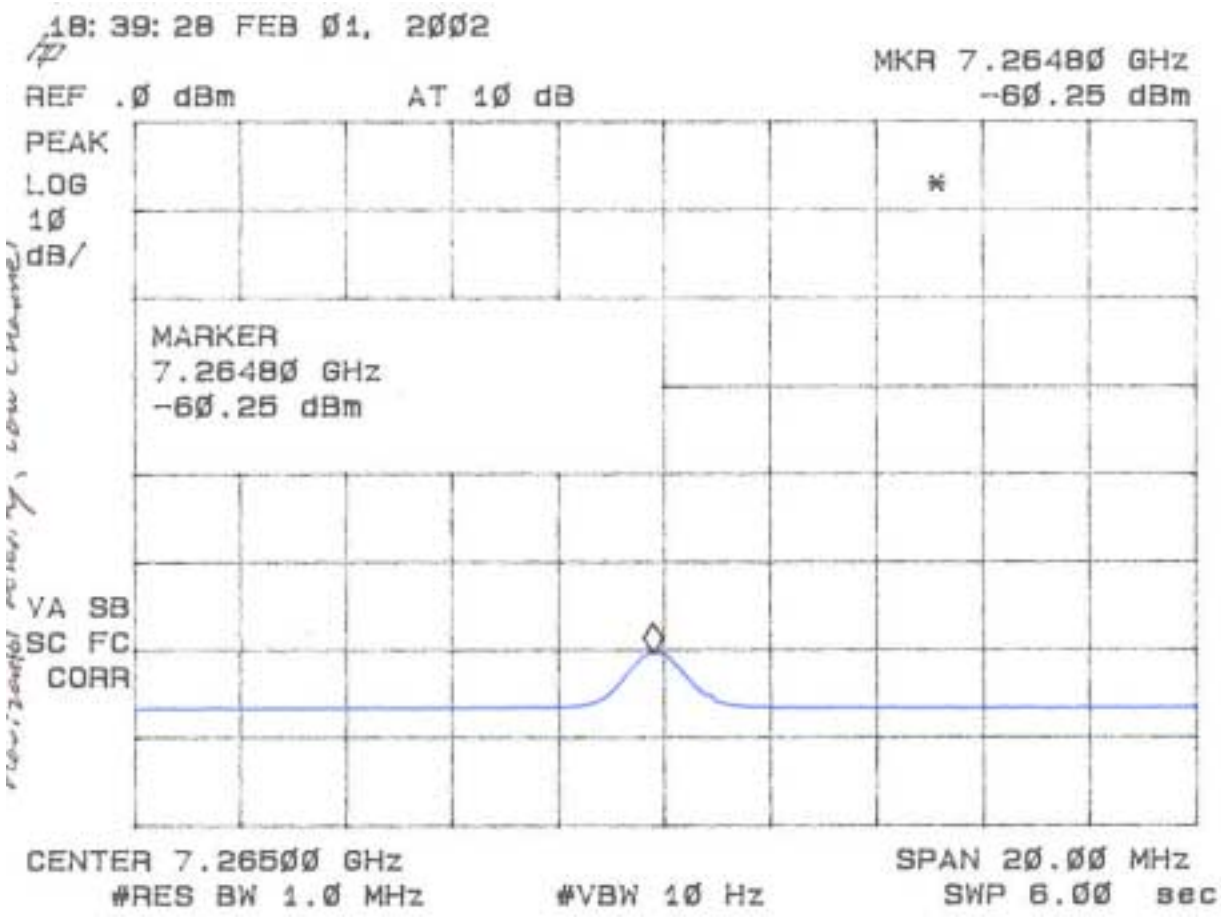


Figure 6c
Average Radiated Spurious Emission 15.247(c) Mid

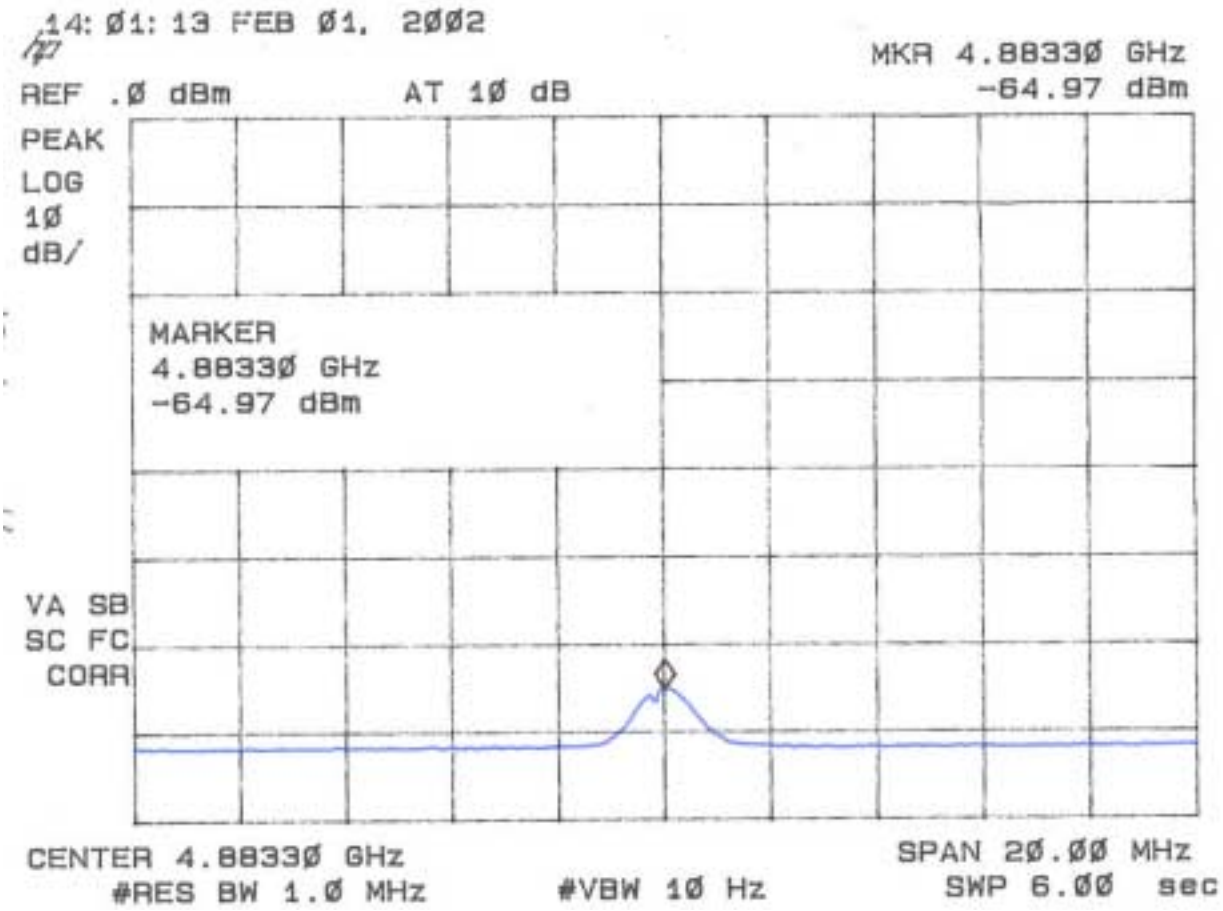


Figure 6d
Average Radiated Spurious Emission 15.247(c) Mid

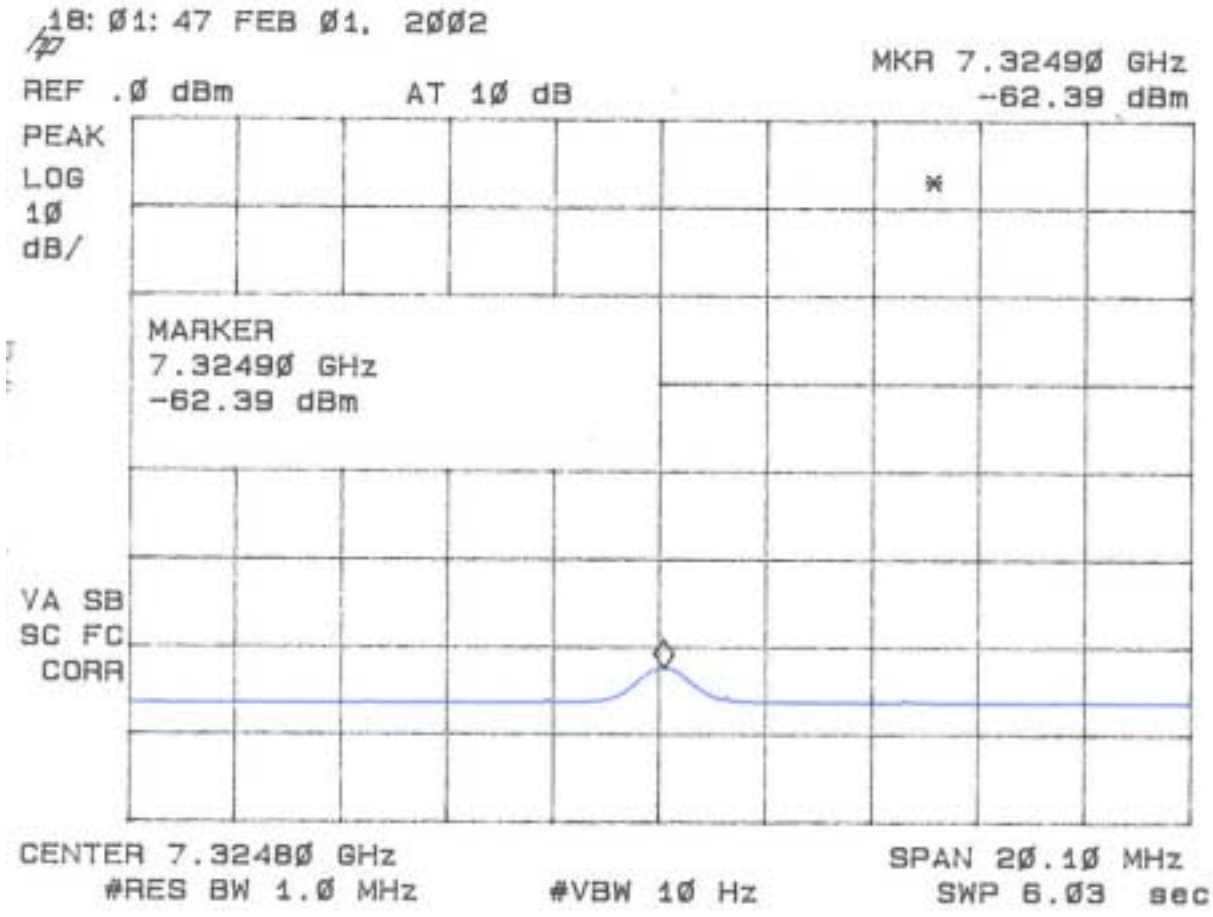


Figure 6e
Average Radiated Spurious Emission 15.247(c) High

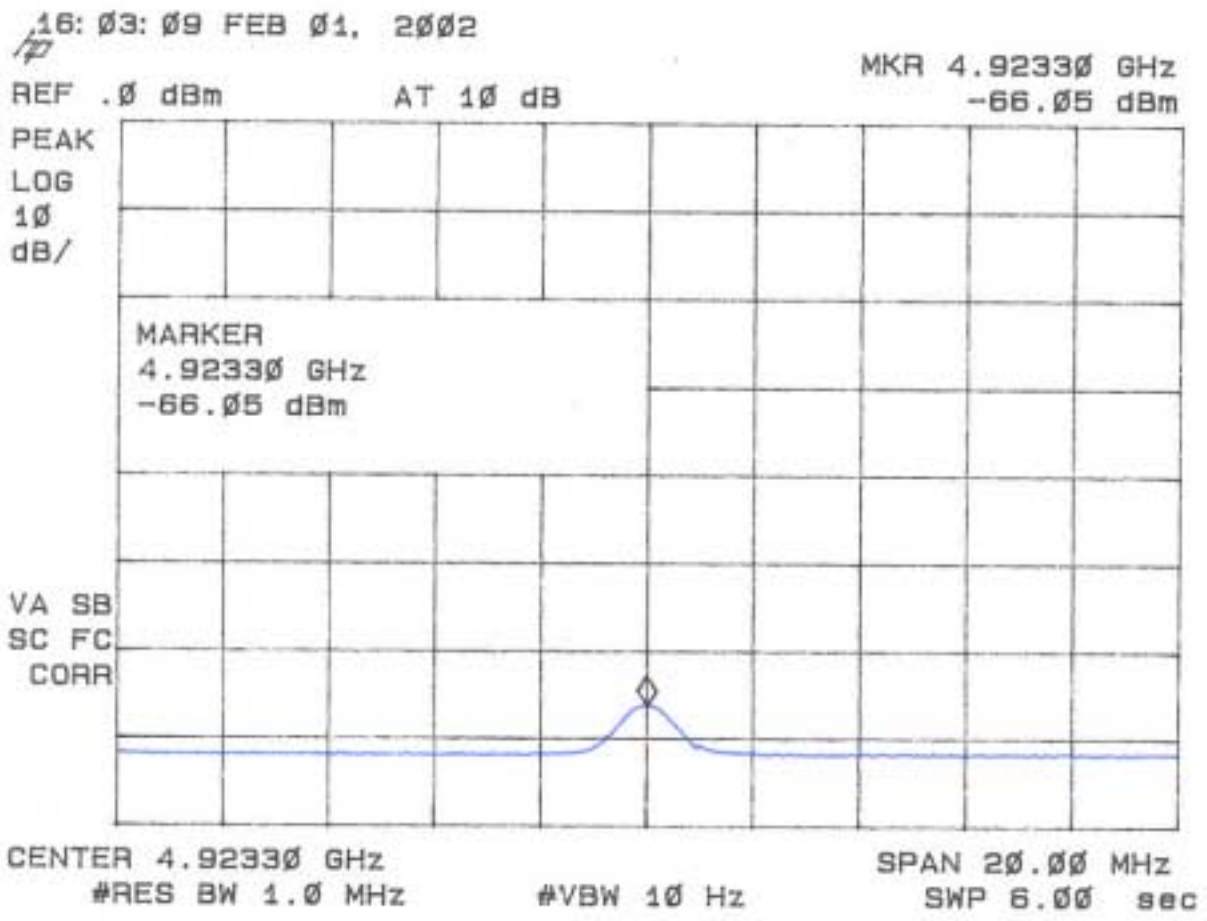


Figure 6f
Average Radiated Spurious Emission 15.247(c) High

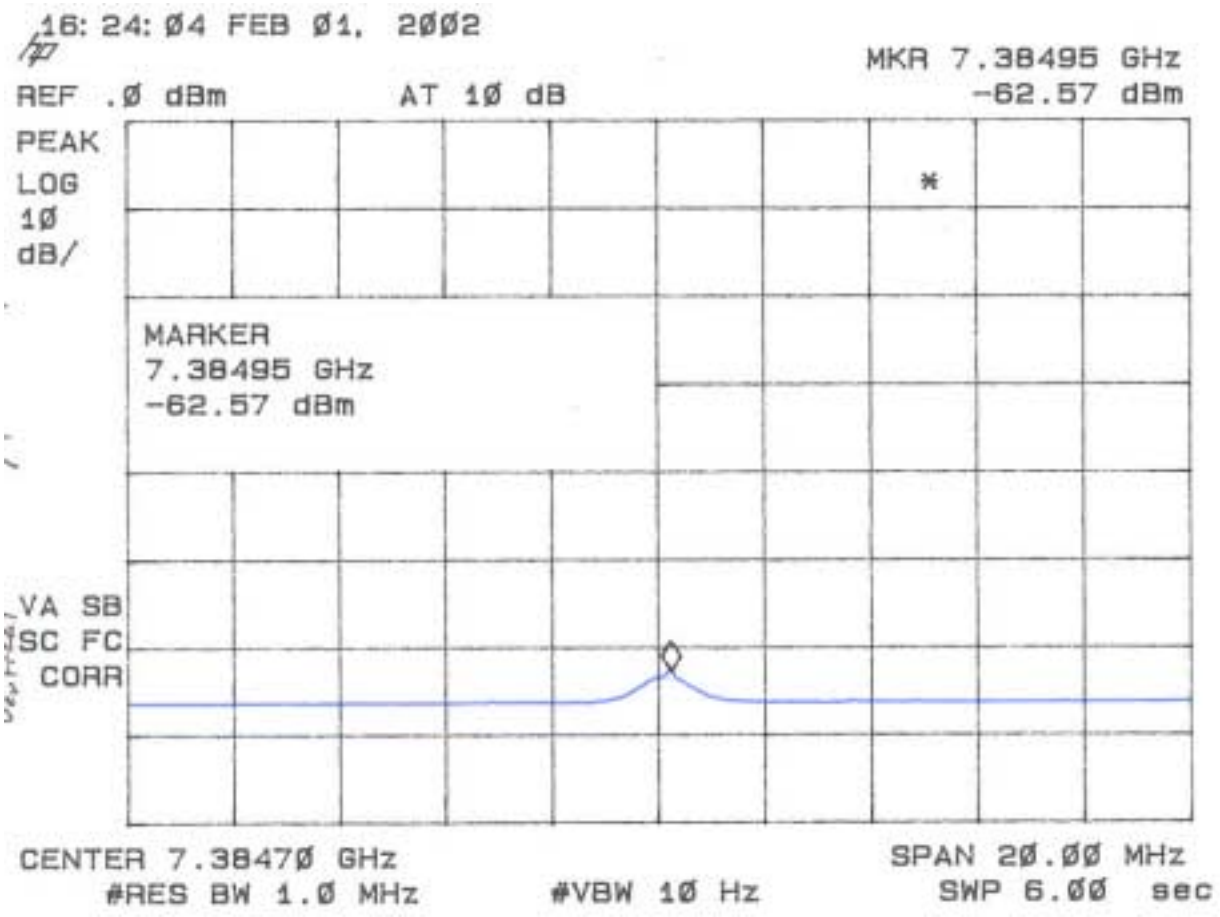


TABLE 5a AVERAGE RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.84	-64.47	33.9	34.7	6.7	319.4	500
7.26	-68.79**	33.7	37.3	7.9	306.1	500

TABLE 5b AVERAGE RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.88	-63.97	33.9	34.8	6.8	344.8	500
7.32	-70.93**	33.7	37.3	7.9	240.7	500

TABLE 5c AVERAGE RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.92	-65.05	33.9	34.9	6.9	310.3	500
7.38	-71.11**	33.7	37.4	7.9	237.1	500

*** = Data adjusted by + 1dB for high pass filter.**
**** = In order to obtain better dynamic range, these measurements were made at 1 meter test distance and corrected by 20 log (1/3) = -9.54 dB**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-64.47 - 33.9 + 34.7 + 6.7 + 107)/20) = 319.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

TABLE 5d BANDEDGE EMISSIONS

Freq. (GHz)	Test Data (dBm) @3m	Correction at bandedge	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
Restricted Band starting below 2.390 GHz						
2.422	-38.0	53.1	30.4	4.1	331.1	500
Restricted Band above 2.4835						
2.462	-37.5	56.4	30.5	4.2	231.7	500

Notes:

1) Radiated data taken with normal peak bandwidths (RBW = VBW = 1MHz)
2) Correction is for:
- **a) Delta between the 1 MHz RBW and 100 kHz RBW at the fundamental**
- **b) Delta between peak of fundamental and highest emission outside of band using 100 kHz RBW.**

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-38.0 – 53.1 + 30.4 + 4.1 + 107)/20) = 331.1
CONVERSION FROM dBm TO dBuV = 107 dB

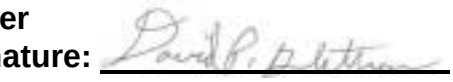
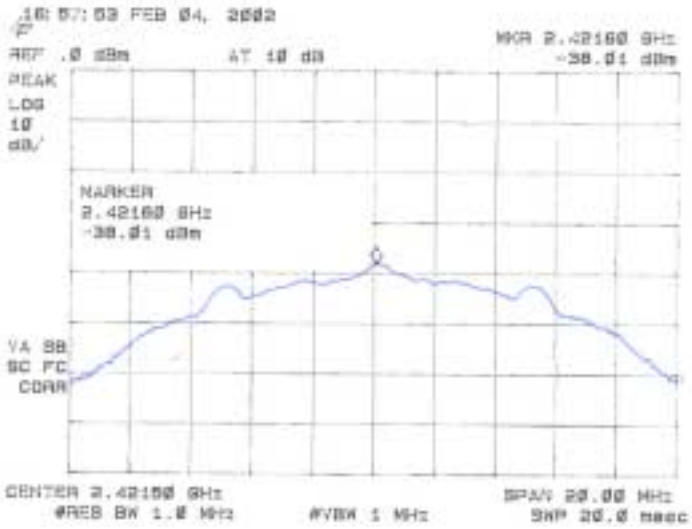
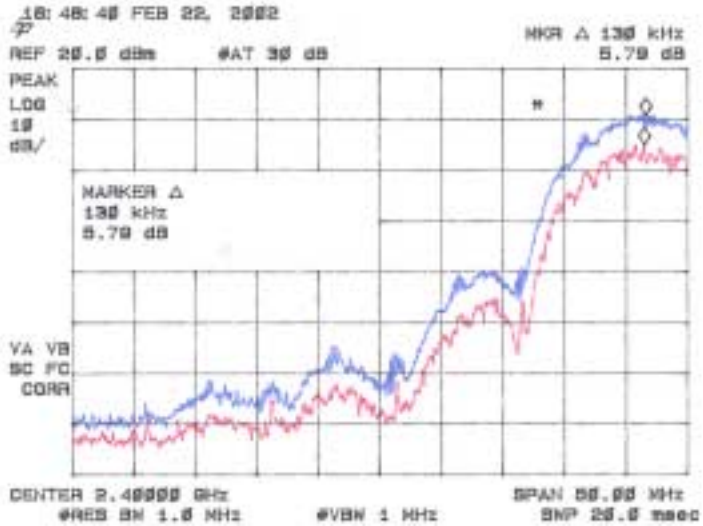
Tester Signature:  **Name: David Blethen**

Figure 6g
Bandedge Plots





RBW=1MHz

RBW= 100 kHz

NOTE: VBW wasn't adjusted for Averaging, therefore this deemed worse case

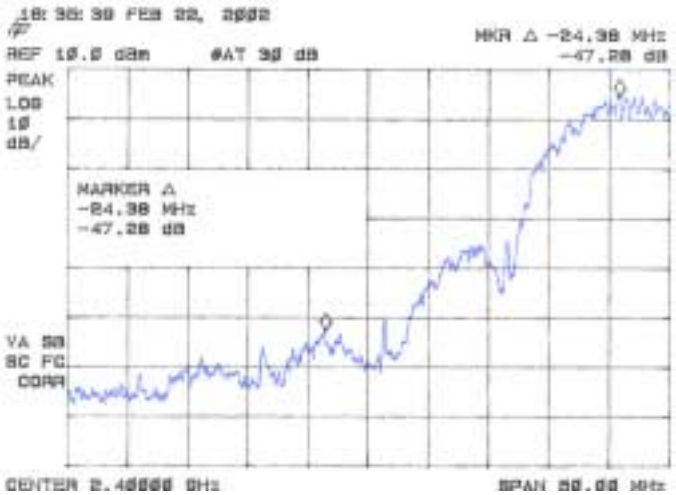
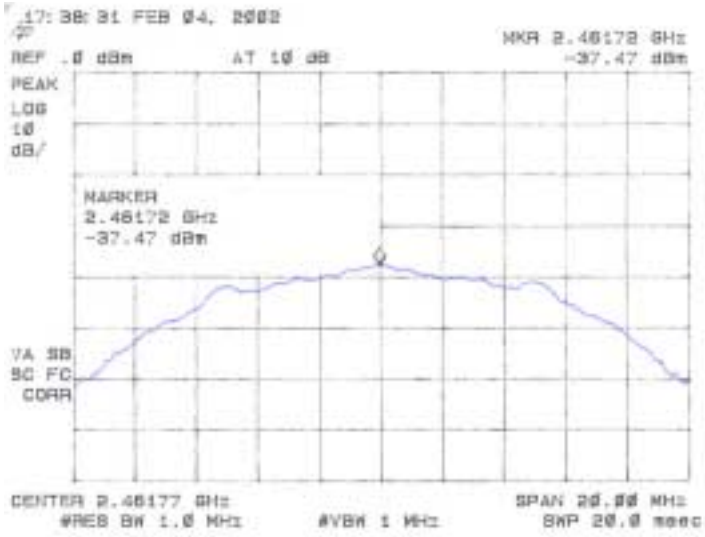
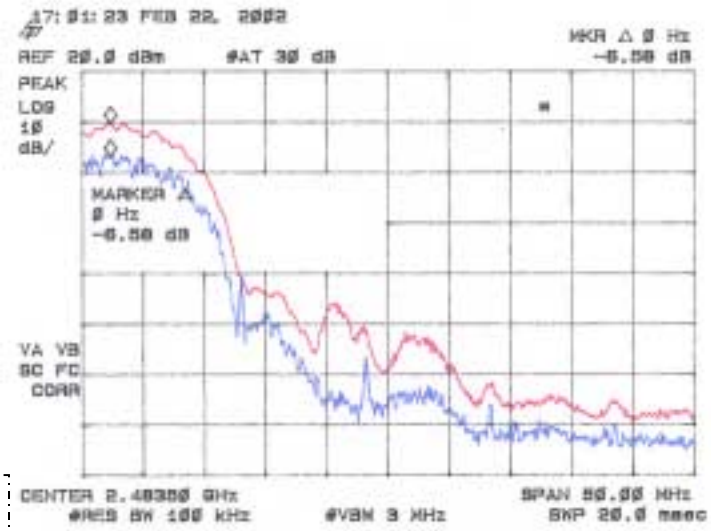


Figure 6h
Bandedge Plots

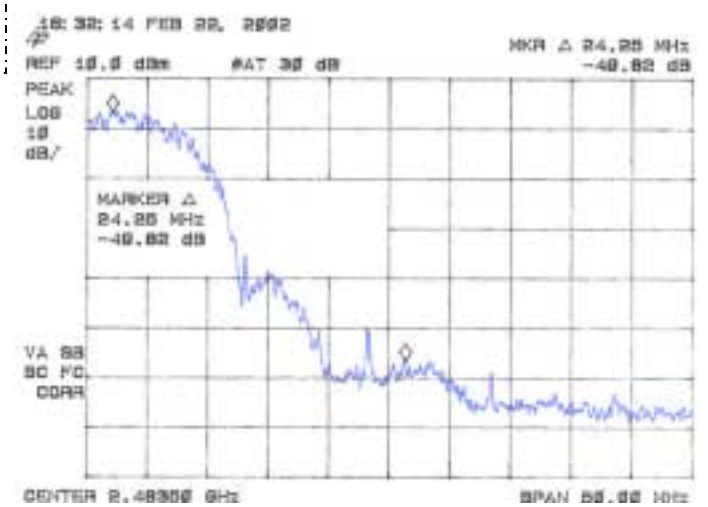




RBW=VBW=1MHz

RBW= 100 kHz

NOTE: VBW wasn't adjusted for Averaging, therefore this deemed worse case



2.11 Minimum 6 dB Bandwidth per FCC Section 15.247(a)(2)

The minimum requirement is given in Figure 7a through 7c. If the EUT incorporates different spreading codes or data rates these were each investigated and the one which produced the smallest 6 dB bandwidth was selected for test.

Figure 7a.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Low)

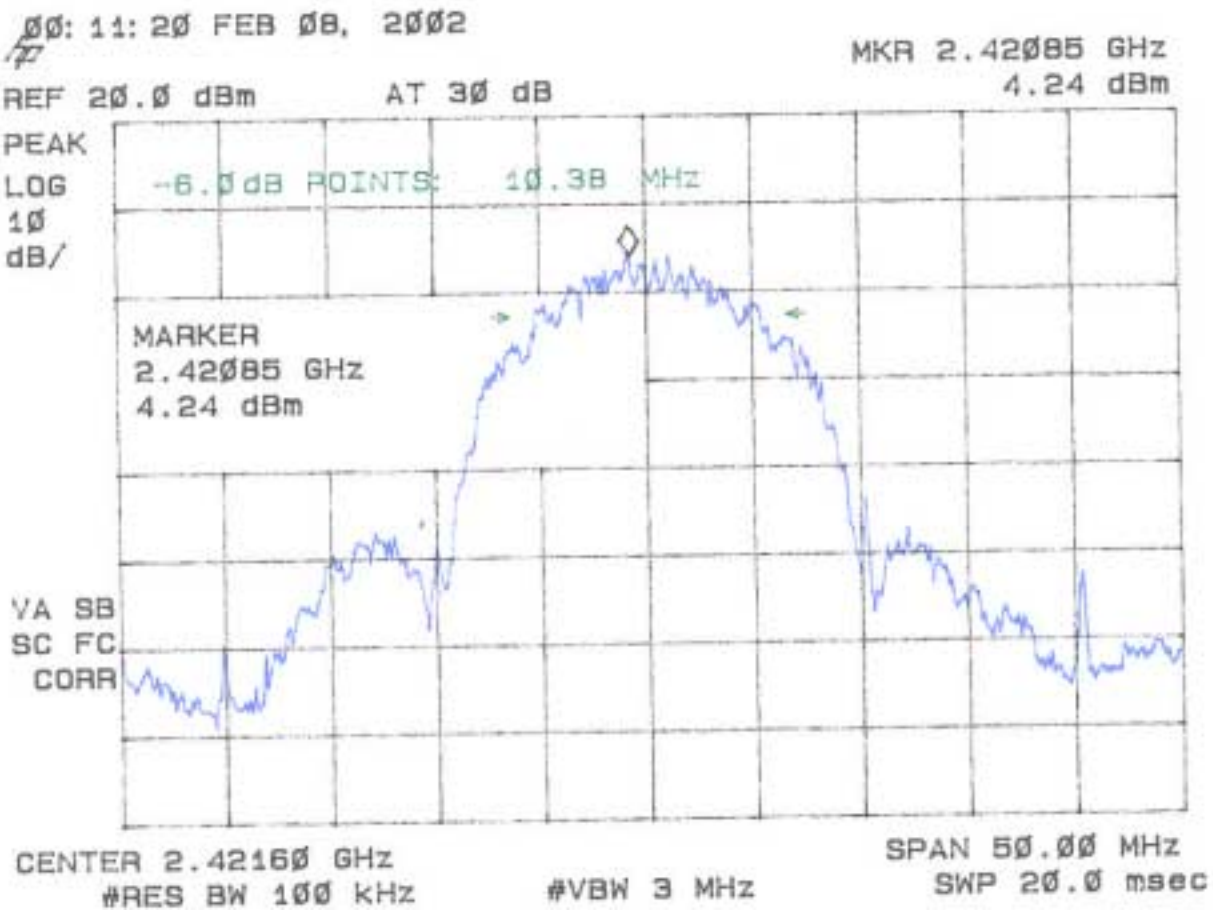


Figure 7b.
6 dB Bandwidth per FCC Section 15.247(a)(2) (Mid)

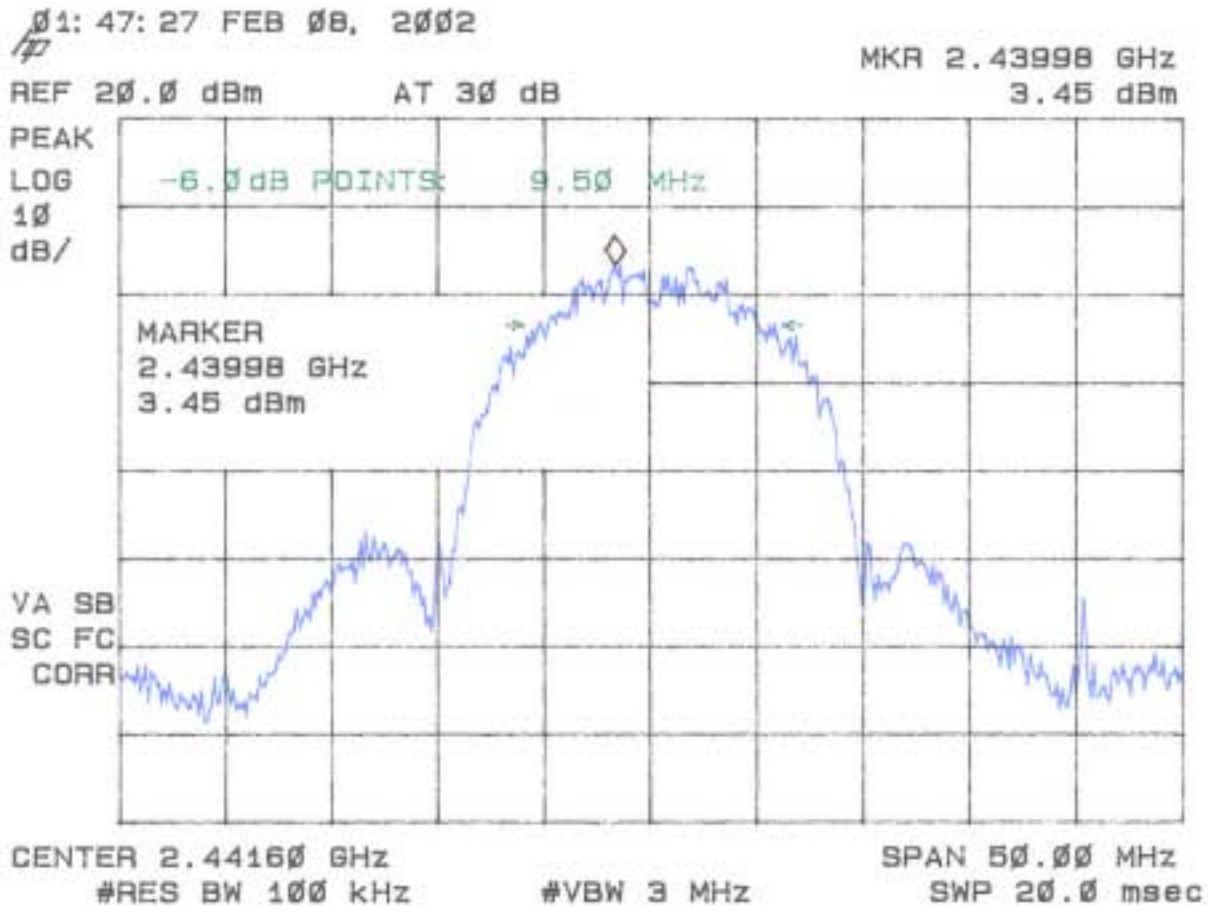
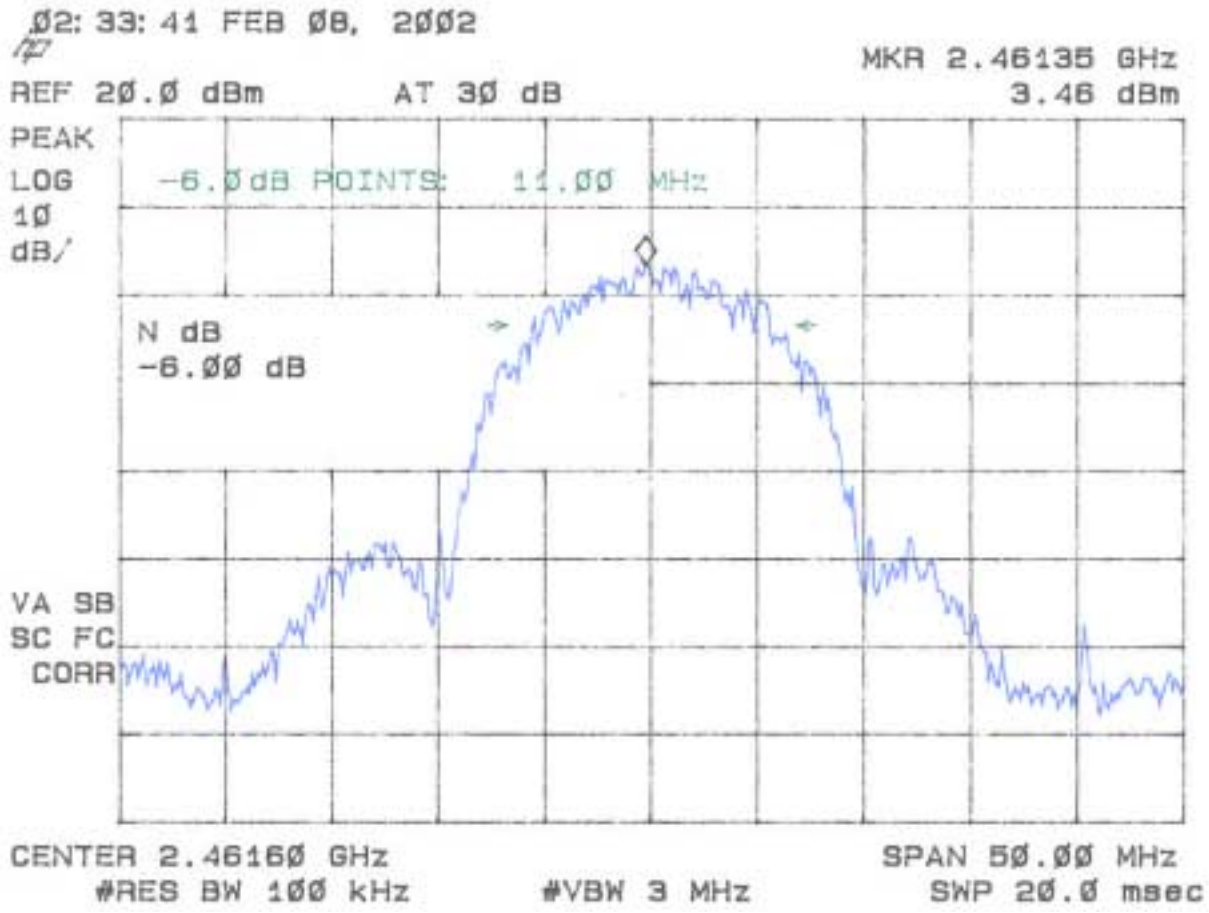


Figure 7c.
6 dB Bandwidth per FCC Section 15.247(a)(2) (High)



2.12 Power Spectral Density FCC Section 15.247(d)

The transmitter power spectral density averaged over any 1 second interval is given in Table 7 and Figure 8a through Figure 8c. If the EUT incorporates different spreading codes or data rates these were each investigated and the one which produced the smallest 6 dB bandwidth was selected for test.

The measurement was made using a spectrum analyzer utilizing noise marker mode. A 34.8 dBm adjustment has been added to the measurement to correct from 1 Hz to 3 kHz measurement.

TABLE 6
POWER SPECTRAL DENSITY

Test Date: **February 13, 2002**
UST Project: **01-0732**
Customer: **Signal Golf International Pte. Ltd.**
Model: **Yard Dog**

Frequency (GHz)	Test Data (dBm) Normalized to 1 Hz	Results (dBm)	FCC Limit (dBm)
2.4216	-49.65	-14.85	8.0
2.4416	-49.02	-14.22	8.0
2.4616	-49.72	-14.92	8.0

Note: 34.8 dBm has been added to correct from 1 Hz to 3 kHz

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

Figure 8a
Power Spectral Density 15.247(d) Low

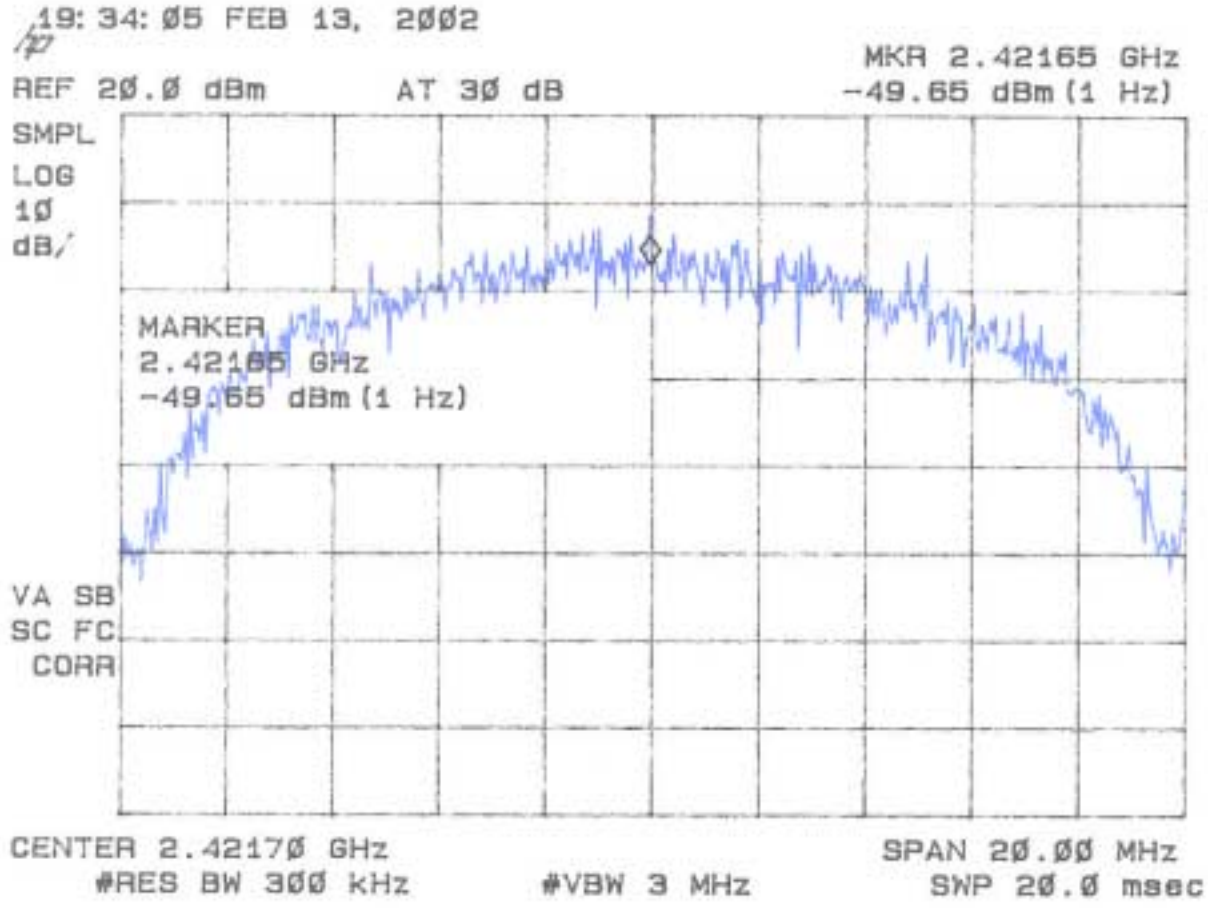


Figure 8b
Power Spectral Density 15.247(d) Mid

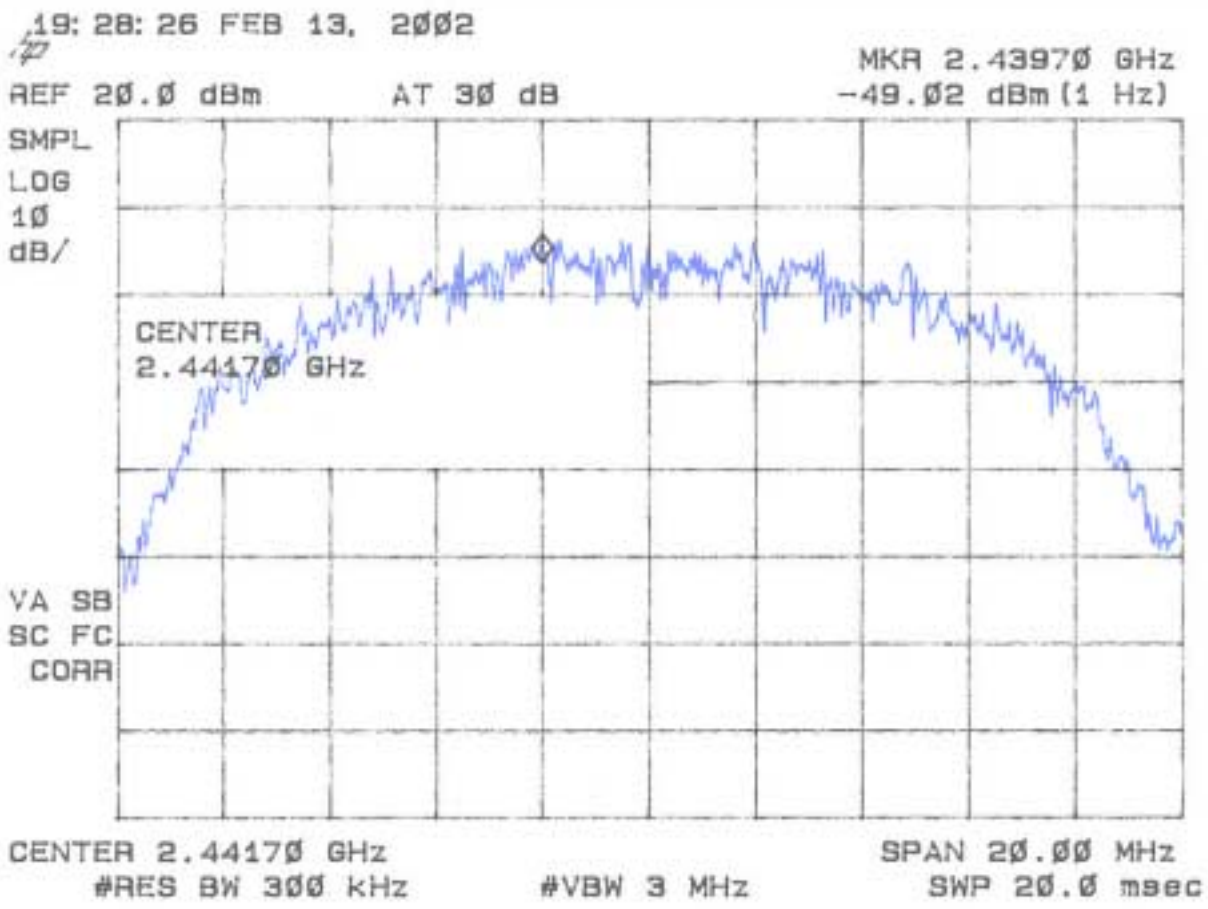
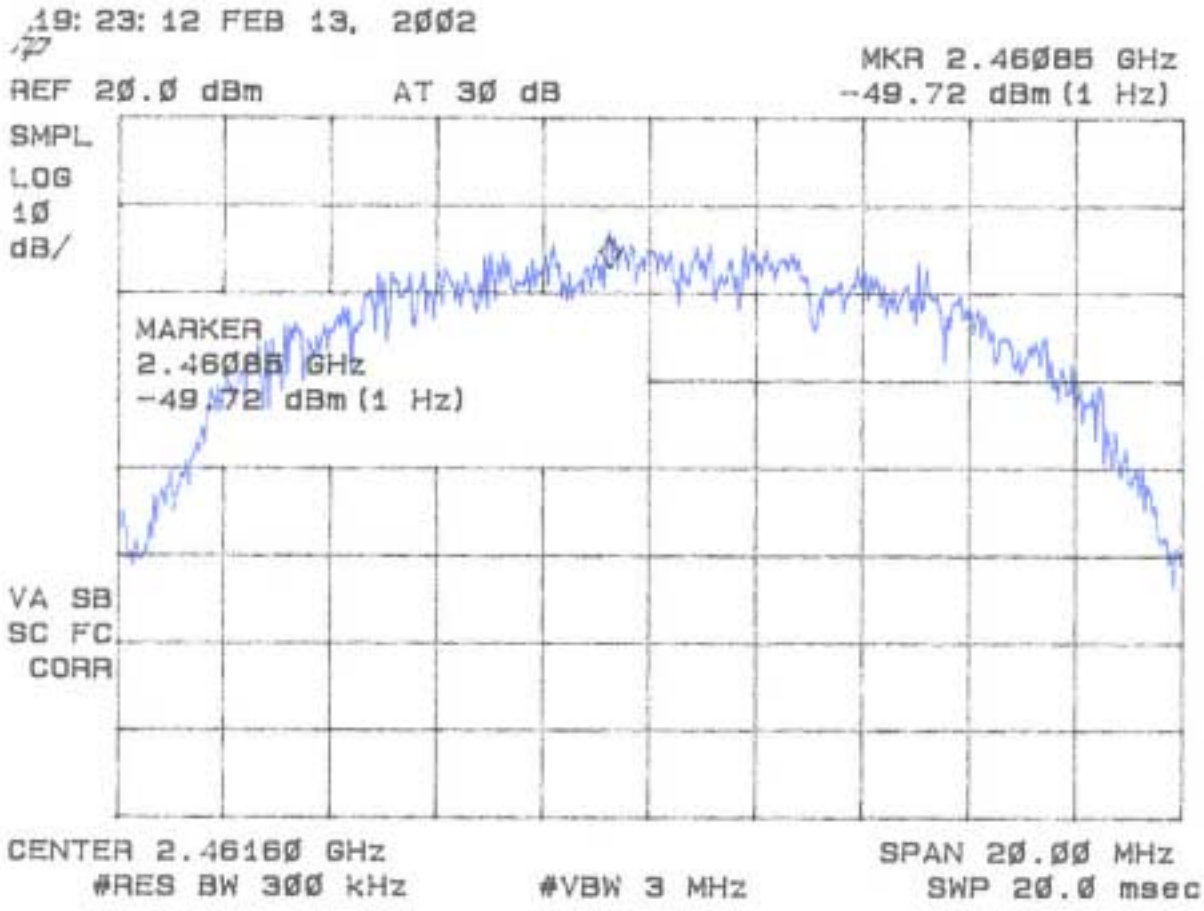


Figure 8c
Power Spectral Density 15.247(d) High



2.13 Processing Gain

Data regarding processing gain has been provided on the following page from Signal Golf International Pte. Ltd.

Provided in Separate File
(Processing Gain)

2.14 Power Line Conducted Emissions for Transmitter FCC Section 15.207

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 7.

TABLE 7. CONDUCTED EMISSIONS DATA
CLASS B

Test Date: February 8, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Product: Yard Dog

Frequency (MHz)	Test Data (dBm) Phase	Test Data (dBm) Neutral	RESULTS (uV) Phase	RESULTS (uV) Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.					

Tester Signature: _____ **Name:** David Blethen

2.15 Radiated Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 5000 MHz. Measurements were made with the analyzer's bandwidth set to 120 kHz measurements made less than 1 GHz and 1 MHz for measurements made 1 GHz and higher. Results are shown in Table 8.

TABLE 8. RADIATED EMISSIONS DATA

CLASS B

Test Date: January 8, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Product: Yard Dog

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m
352.0	-97.0	19.0	28.0	200.0
403.0	-96.0	20.5	37.8	200.0

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-97.0 + 19.0 + 107)/20) = 28.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature:  **Name: David Blethen**

2.16 Power Line Conducted Emissions for Digital Device FCC Section 15.107

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 9.

TABLE 9. CONDUCTED EMISSIONS DATA – DIGITAL DEVICE CLASS B

Test Date: February 8, 2002
UST Project: 01-0732
Customer: Signal Golf International Pte. Ltd.
Product: Yard Dog

Frequency (MHz)	Test Data (dBm) Phase Neutral	RESULTS (uV) Phase Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.			

Tester Signature:  **Name:** David Blethen