Application
For

Title 47 USC Part 15,

Subpart B, Equipment Authorization of Verification for an Unintentional Radiator
And
Subpart C, Equipment Authorization of Certification for an Intentional Radiator

for
Nivis, LLC

2.4 GHz Mod2 RF Module

FCC ID: SQB-NIVISMOD0001

UST Project: 08-0078
Issue Date: July 10, 2008

Total Pages: 85

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
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I certify that I am authorized to sign for the Test Agency 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:

US TECH (Agent Responsible For Test):

By: 

Name: John Livingston

Title: Laboratory Manager

Date: July 10, 2008

3505 Francis Circle Alpharetta, GA 30004
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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Nivis, LLC

MODEL: 2.4 GHz Mod2

FCC ID: SQB-NIVISMOD0001

DATE: July 10, 2008

This report concerns (check one): Original grant [X]
Class II change

Equipment type: 2.4 GHz RF Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: N/A
date
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:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

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

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NIVIS

enterprise to edge™

AGENCY AGREEMENT

Federal Communications Commission
P.O. Box 429
Columbia, MD 21045

Date: 10 / JUNE / 2008

Gentlemen:

By signature below, we hereby appoint US Tech employees Sandi McEnery, John Livisingston, and Stephen Sawyer to act as our agents with regard to all FCC equipment authorizations. This appointment will remain in effect until otherwise notified.

I further certify by signature below that no party (per 47 CFR 1.2002(b)) to the application is subject to a denial of Federal benefits, including FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

This appointment includes the authority to complete FCC Form 731 on our behalf and sign the application as an authorized agent.

Name: L.A. BAY

Signature: L A Bay

Title: VP - OPERATIONS

Date: 10 JUNE 2008

1000 CIRCLE 75 PARKWAY • SUITE 300 • ATLANTA, GA 30339 • 678.202.6800

Testing Tomorrow's Technology

Confidentiality Request

May 18, 2008

American TCB
6731 Whittier Ave.
McLean, VA 22101

FCC ID: SQB-NIVISMOD0001

With regards to the exhibits submitted in support of the application for FCC ID: SQB-NIVISAN0010, please classify the following as confidential under the provision of 47 CFR 0.459:

- Schematics
- Block diagram
- Theory of Operation

These exhibits contain technical information that NIVIS, LLC deems to be sensitive and proprietary. Therefore this information cannot be published. If this information were to be made public it could be used to the disadvantage of the applicant in the marketplace.

Sincerely,

Sandi McEnery
US Tech
(Authorized Agent for NIVIS, LLC)

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1 General Information

1.1 Characterization of Test Sample

The sample used for testing was received by US Tech on May 5, 2008 in good condition.

1.2 Product Description

The Equipment under Test (EUT) is a Nivis, LLC, Model 2.4 GHz Mod2, 2.4 GHz modular spread spectrum transceiver. The EUT will be used with both integral and removable antennae. The same RF Card has provision for both arrangements which are factory provided to the user.

1.3 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 (with limited modular approval)
b) Verification as a digital device

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

2 Tests and Measurements

2.1 Configuration of Tested System

The Test Sample was tested per ANSI C63.4, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003) for subpart B Digital Verification requirements and per FCC KDB Publication number 558074 for Digital Transmission Characteristics. Digital RF conducted and radiated emissions data (FCC 15.107 and 109) were taken with the measuring receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figures 2 through 7.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

2.3 Test Equipment

Table 2 describes test equipment used to evaluate this product.

2.4 Modifications to EUT Hardware

No modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2 Test and Measurements (Cont'd)

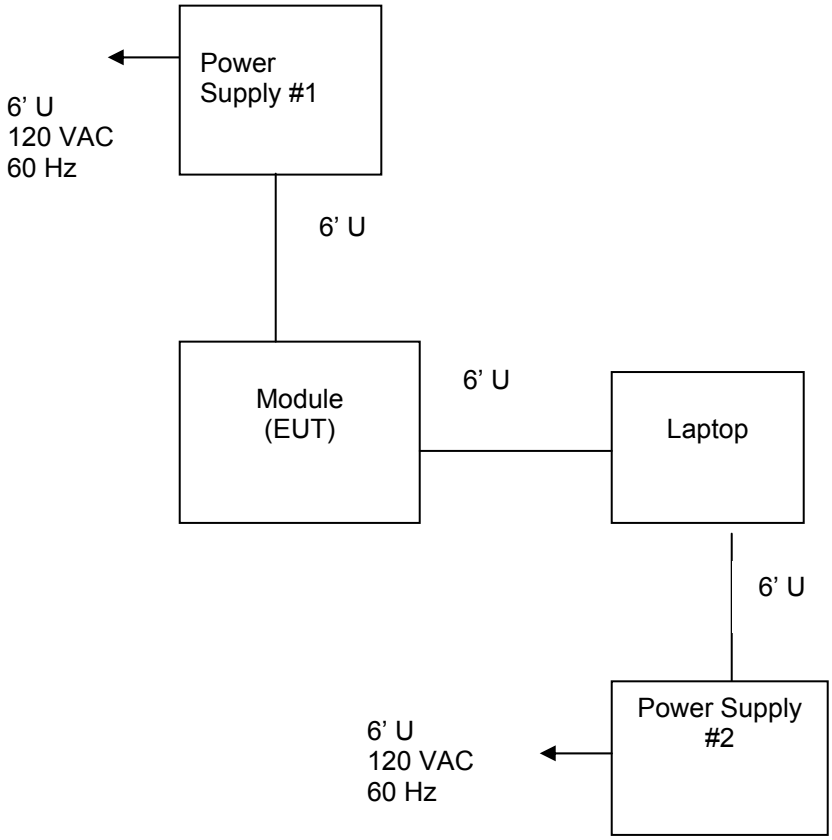


Figure 1- Test Configuration

2 Test and Measurements (Cont'd)

Test Date: May 2, 2008 – May 14, 2008
UST Project: 08-0078
Customer: Nivis, LLC
Model: 2.4 GHZ Mod2

Table 1 - EUT And Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) Nivis, LLC	2.4 GHz Mod2	None	Pending: SQB-NIVISMOD0001	6' U
Antenna, see antenna descriptions			None	30 cm Coax
Power Supply GlobTek Inc.	GT-410-52-1509	None	None	6' U 120 VAC/ 60 Hz
Laptop Computer Hewlett Packard	None	None	None	6' U
Power Supply Hewlett Packard	HPP181a	00629710	None	6' U 120 VAC/ 60 Hz

2 Test and Measurements (Cont'd)

Table 2 - Test Instruments

TEST EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2332A10055	3/28/07
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	1/15/08
SIGNAL GENERATOR	8648B	HEWLETT-PACKARD	3642U01679	10/30/07
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	6/14/07
BICONICAL ANTENNA 25 MHz to 200 MHz	3110B	EMCO	9307-1431	11/15/07
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	11/21/07
LISN (x 2) 9247-50-TS-50-N	9247	Solar Electronics	955824 & 955826	3/29/07
HORN ANTENNA 1 GHz to 18 GHz	3115	EMCO	9107-3723	10/16/06 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	8/21/07
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

2 Test and Measurements (Cont'd)

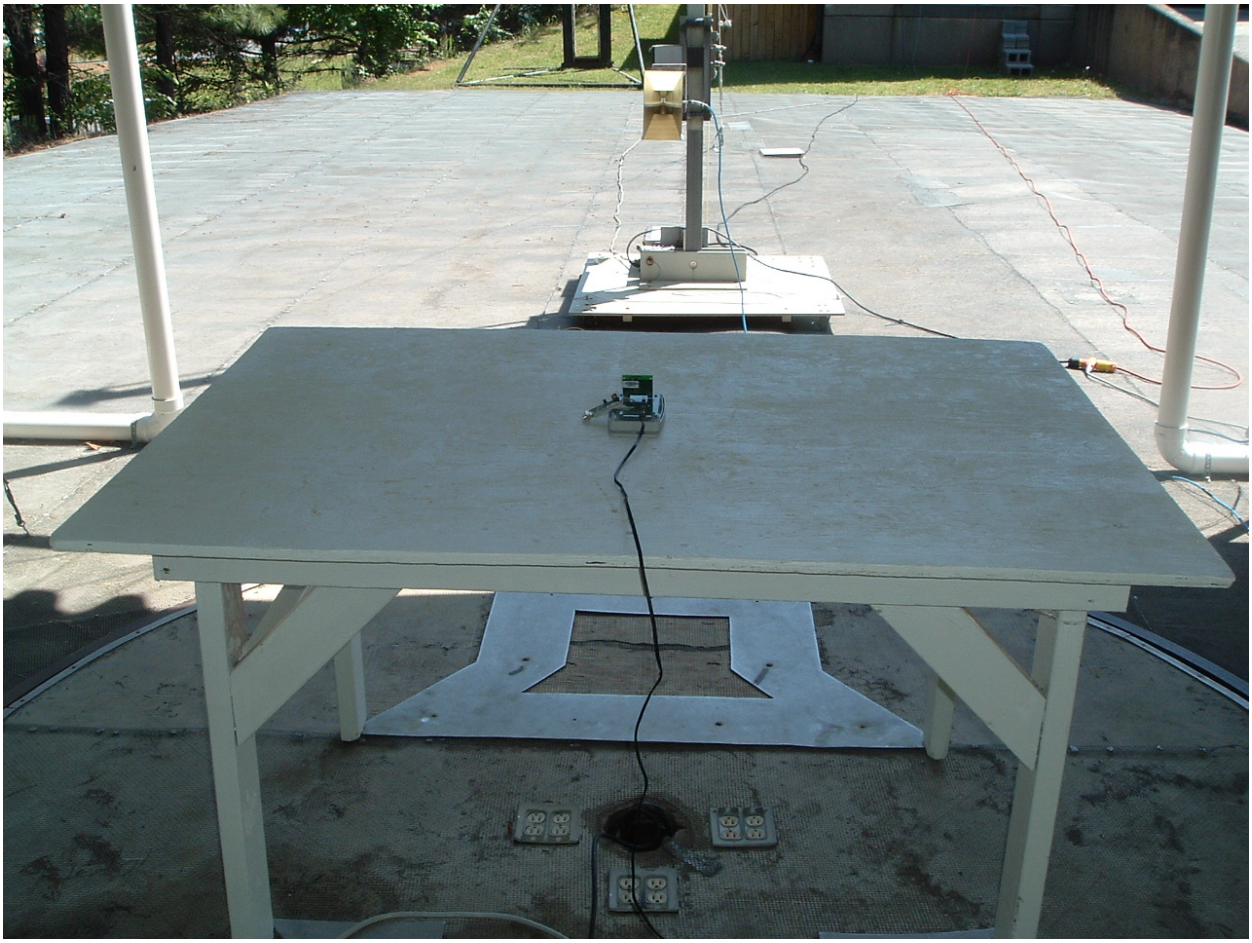


Figure 2 - Radiated Emissions Measurement Setup, Integral Antenna (Rear View)

2 Test and Measurements (Cont'd)

Figure 3 - Radiated Emissions Measurement Setup, Integral Antenna (Front View)

2 Test and Measurements (Cont'd)

Figure 4 - Digital Radiated Emissions Measurement Setup (Front View)

2 Test and Measurements (Cont'd)

Figure 5 - Digital Radiated Emissions Measurement Setup (Rear View)

2 Test and Measurements (Cont'd)

Figure 6 - Radiated Emissions Measurement Setup, External Antenna (Front View)

2 Test and Measurements (Cont'd)

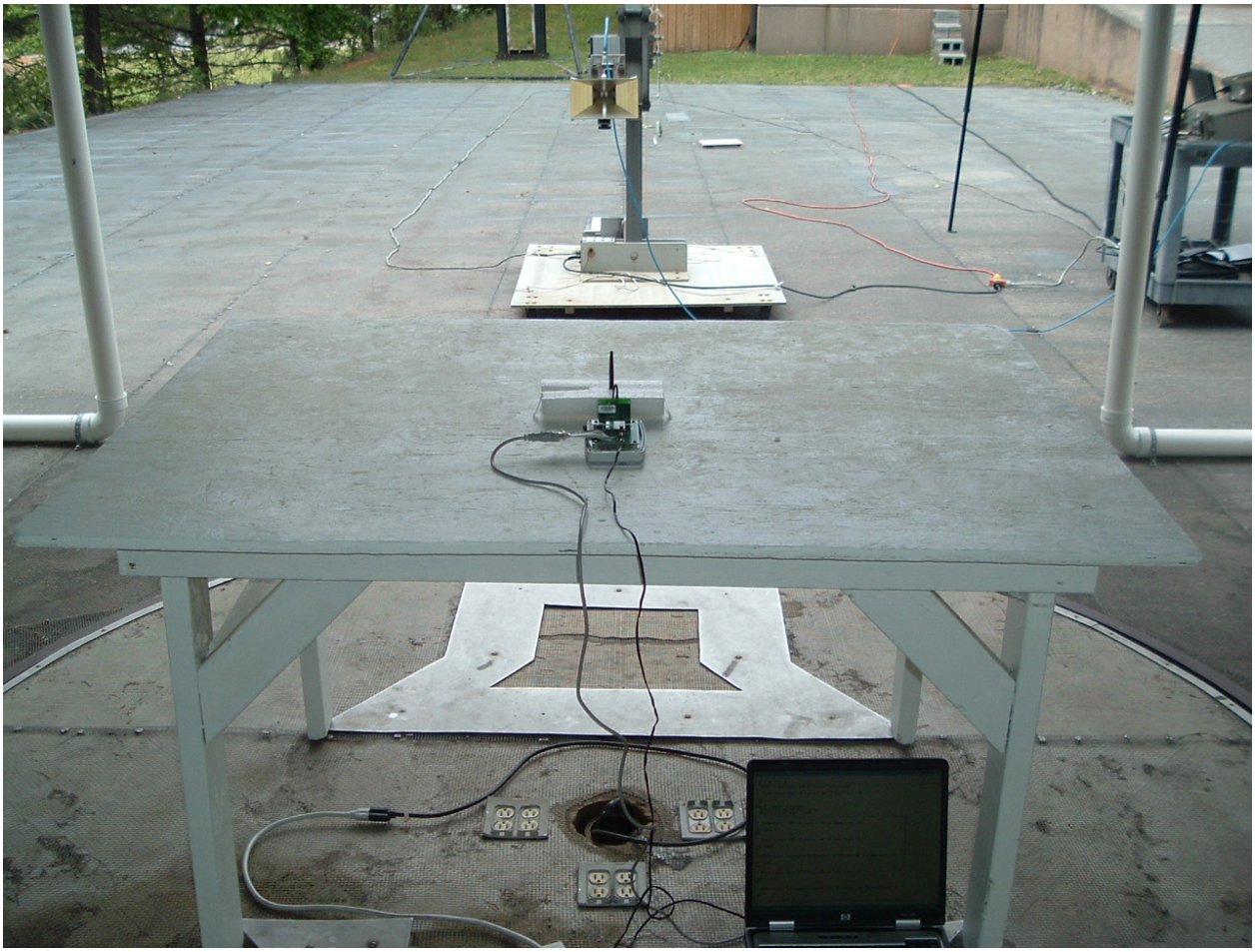


Figure 7 - Radiated Emissions Measurement Setup, External Antenna (Rear View)

2 Test and Measurements (Cont'd)

Figure 8 - Bench Measurements Setup

2 Test and Measurements (Cont'd)

Figure 9 - Conducted Emissions Measurement Setup

2 Test and Measurements (Cont'd)

2.5 Antenna Description (CFR 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.

Nivis, LLC will sell the model 2.4 GHz Mod2 RF Module with the following antennae.

Table 3 - Allowed Antennae

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Nivis	Ferrite		-1	Permanently Connected
Antenna Factor	RCT ½ Wave	RCT-RP	2.2	RP-SMA

To ensure compliance with 15.203, Nivis, LLC attaches RP-SMA connectors to all antennas except the integral antenna.

2.6 Worst Case Transmitter Duty Cycle (CFR 209)

The transmitter is capable of sending three types of transmissions. They are listed below, along with their pulse-width duration:

	Phy. overhead	Data length	TX len	Tx duration (µs)	Warm up (µs)	Sw delay (µs)	Total TX (µs)
Nack	8	15	23	736	144	20	900
ACK	8	24	32	1024	144	20	1188
Msg	8	125	133	4256	144	20	4420

The worst-case scenario in any 125 ms timelot, along with all transmission lengths, will be as follows:

2 Test and Measurements (Cont'd)

2.6 Worst Case Transmitter Duty Cycle (CFR 209) Cont'd

Transmitter Activity	Duration (µs)
Rcv message	
Send nack	736
Rcv message	
Send nack	736
Rcv message	
Send nack	736
Rcv message	
Send nack	736
Rcv message	
Send nack	736
Send message	4256
Rcv ACK	
Total:	7936

The duty cycle is computed as follows (in any 100 ms period):

Duty Cycle = (7936/100000) = 0.07936 = 7.94%

Correction Factor = $20\log_{10}(0.0794)$ = -22.0 dB

2 Test and Measurements (Cont'd)

2.7 Restricted Bands (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement.

2.8 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified as follows:

Table 4 - Number of Frequencies For Intentional Radiators

Freq Range over which The device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

2.9 Frequency Range of Radiated Measurements (Part 15.33)

a) The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

b) For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in a), whichever is the higher range of investigation.

2 Test and Measurements (Cont'd)

2.10 Peak Conducted Output Power (CFR 15.247 (b)(3))

For the model 2.4 GHz Mod2, the transmitter was programmed to operate at +19 to 22 dBm. Peak power within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 as a conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, to the antenna output terminals on the EUT. The spectrum analyzer was set for a 50 Ω impedance with the VBW = RBW = 3 MHz. The results of the measurements are given in Table 5 and Figures 10 through 12. The loss of the short cable is 0.5 dB, and the final values were determined by adding 0.5 dB to the measured values.

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

Table 5 - Peak (Antenna) Conducted Output Power Per Part 15.247 (b) (3)

Frequency of Fundamental (MHz)	Measurement (dBm)	Measurement (mW)	FCC Limit (mW)
Low - 2405	21.1	128.83	1000
Mid - 2440	22.0	158.49	1000
High - 2475	21.8	151.36	1000

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.10 Peak Conducted Output Power (CFR 15.247 (b)(3))

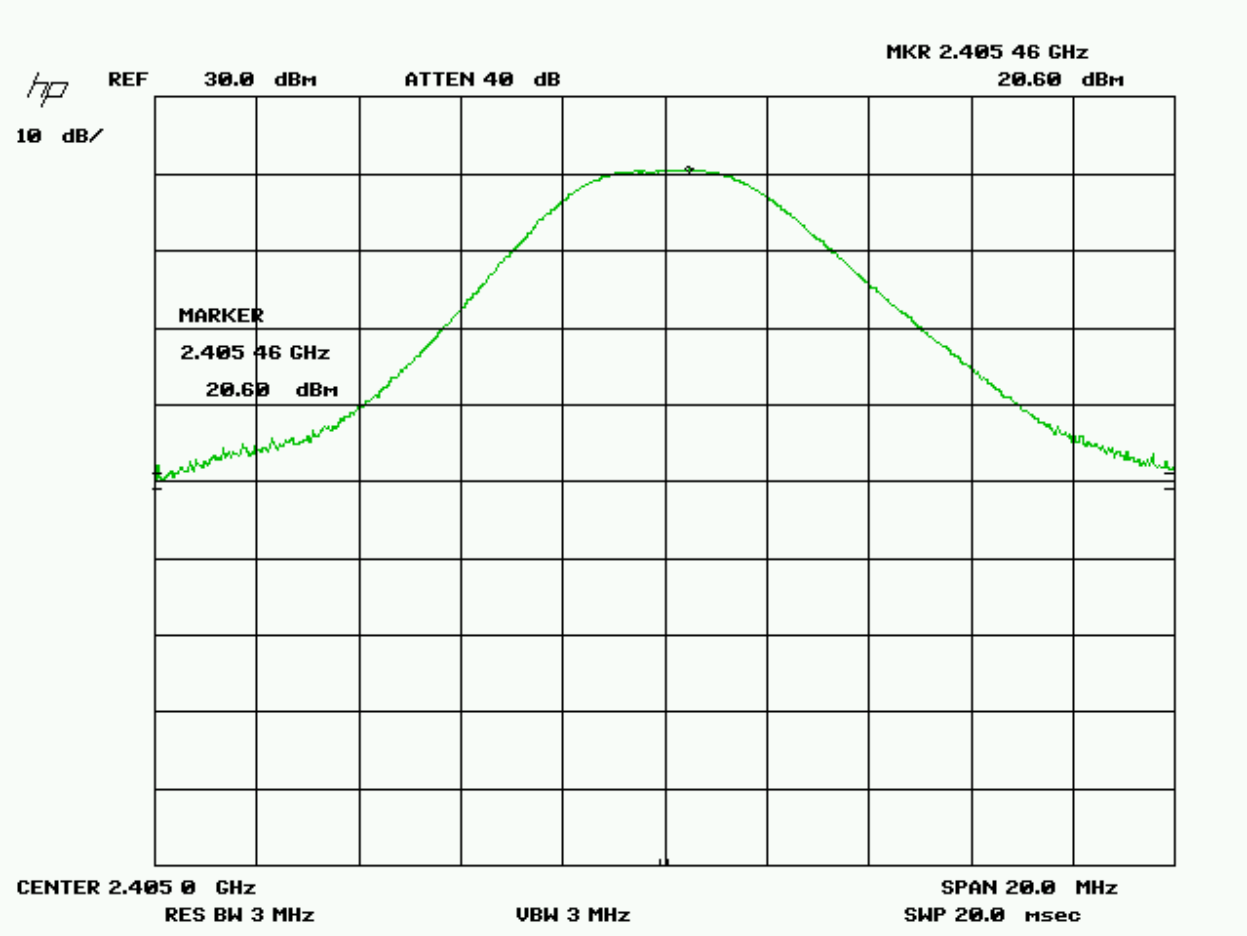


Figure 10 - Peak Conducted Output Power, Low Channel

Add 0.5 dB loss for cable assembly.

2 Test and Measurements (Cont'd)

2.10 Peak Conducted Output Power (CFR 15.247 (b)(3))

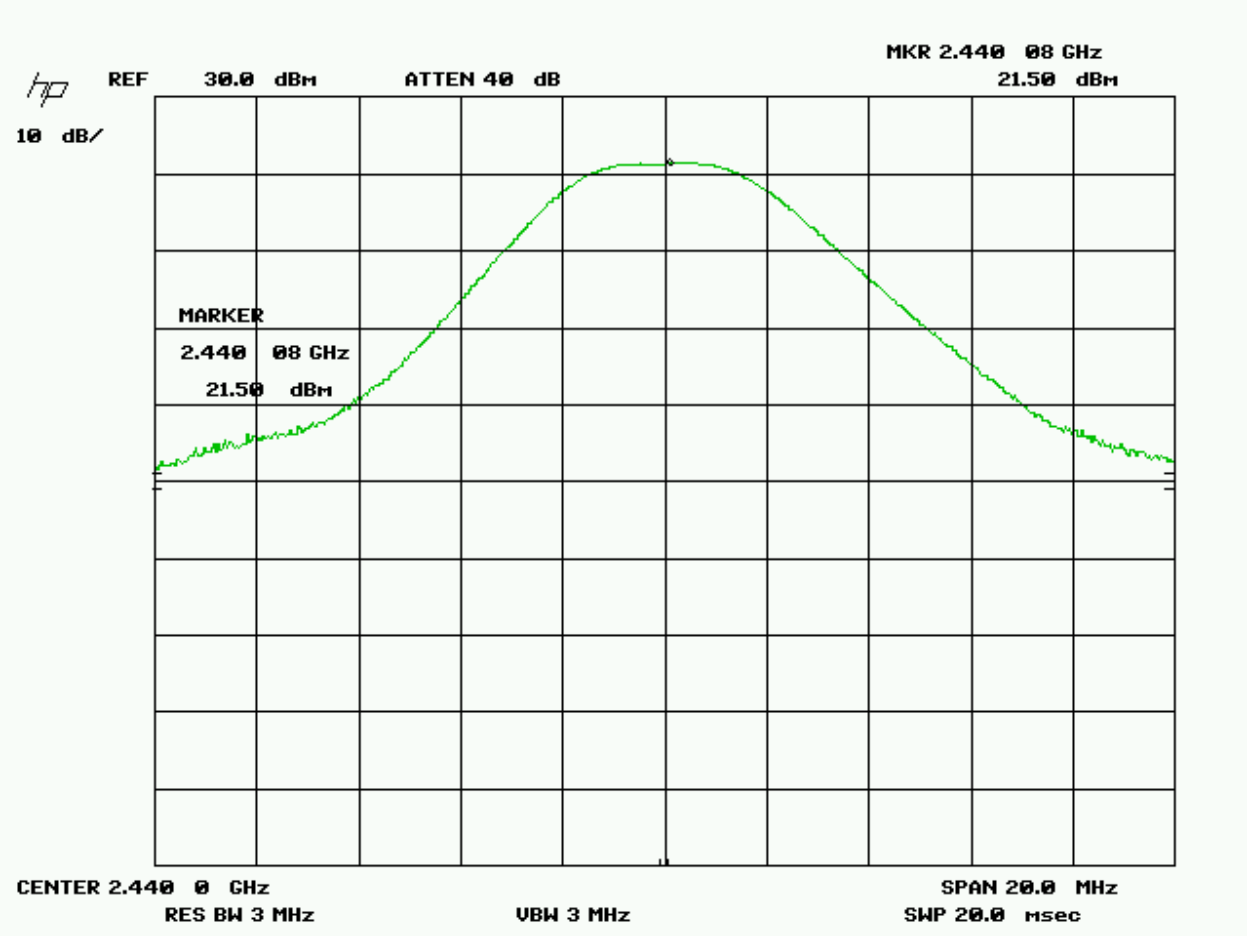


Figure 11 - Peak Conducted Output Power, Mid Channel

Add 0.5 dB loss for cable assembly.

2 Test and Measurements (Cont'd)

2.10 Peak Conducted Output Power (CFR 15.247 (b)(3))

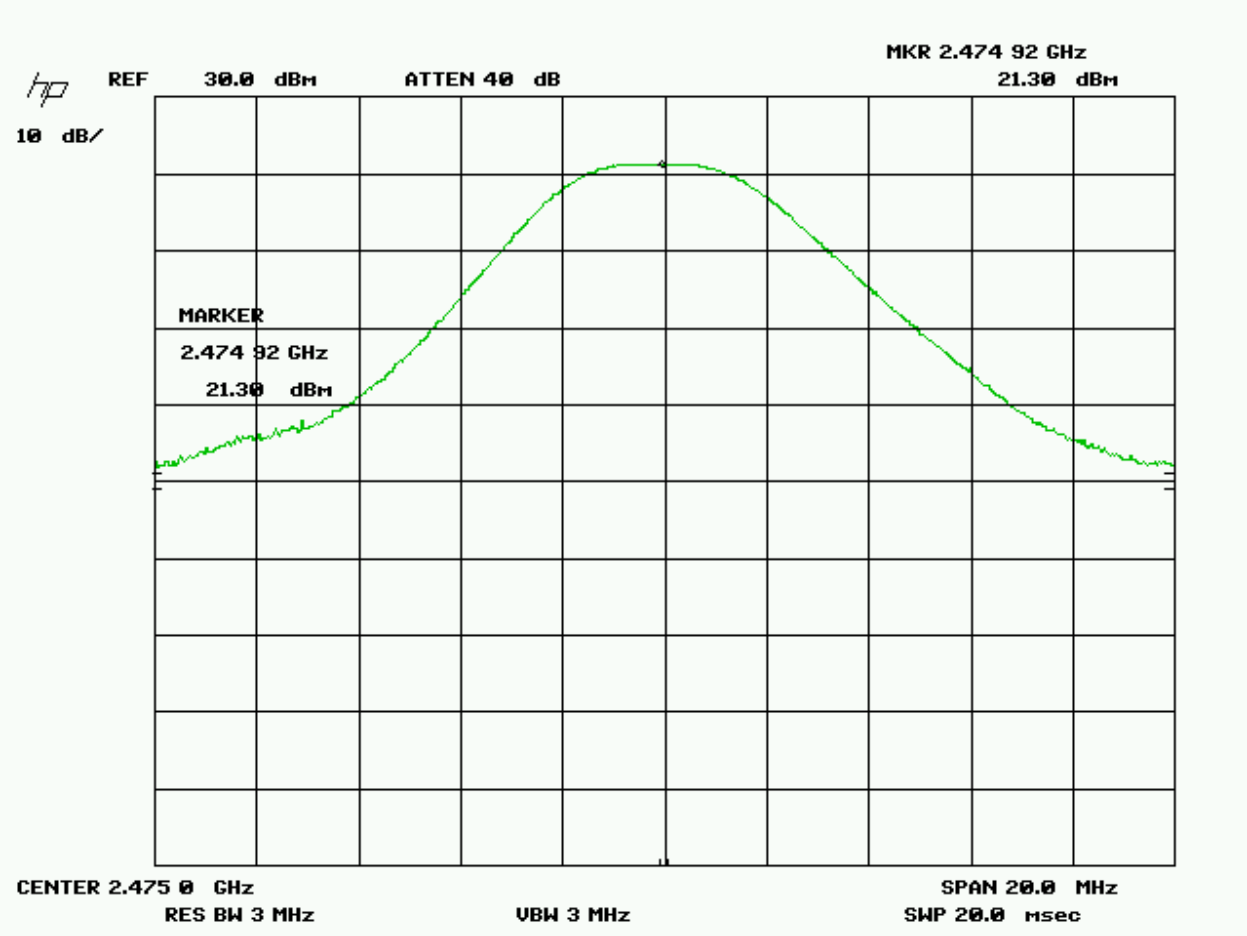


Figure 12 - Peak Conducted Output Power, High Channel

Add 0.5 dB loss for cable assembly.

2 Tests and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

The EUT, a Direct Sequence Spread Spectrum Transmitter, was placed into a continuous transmit mode of operation and tested per FCC KDB Publication 558074. A conducted scan was performed on the EUT (see Figures 13 through 18) to determine spurious signals that were caused by the transmitter. Significant emissions that fell within restricted bands were then measured on an OATS. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz.

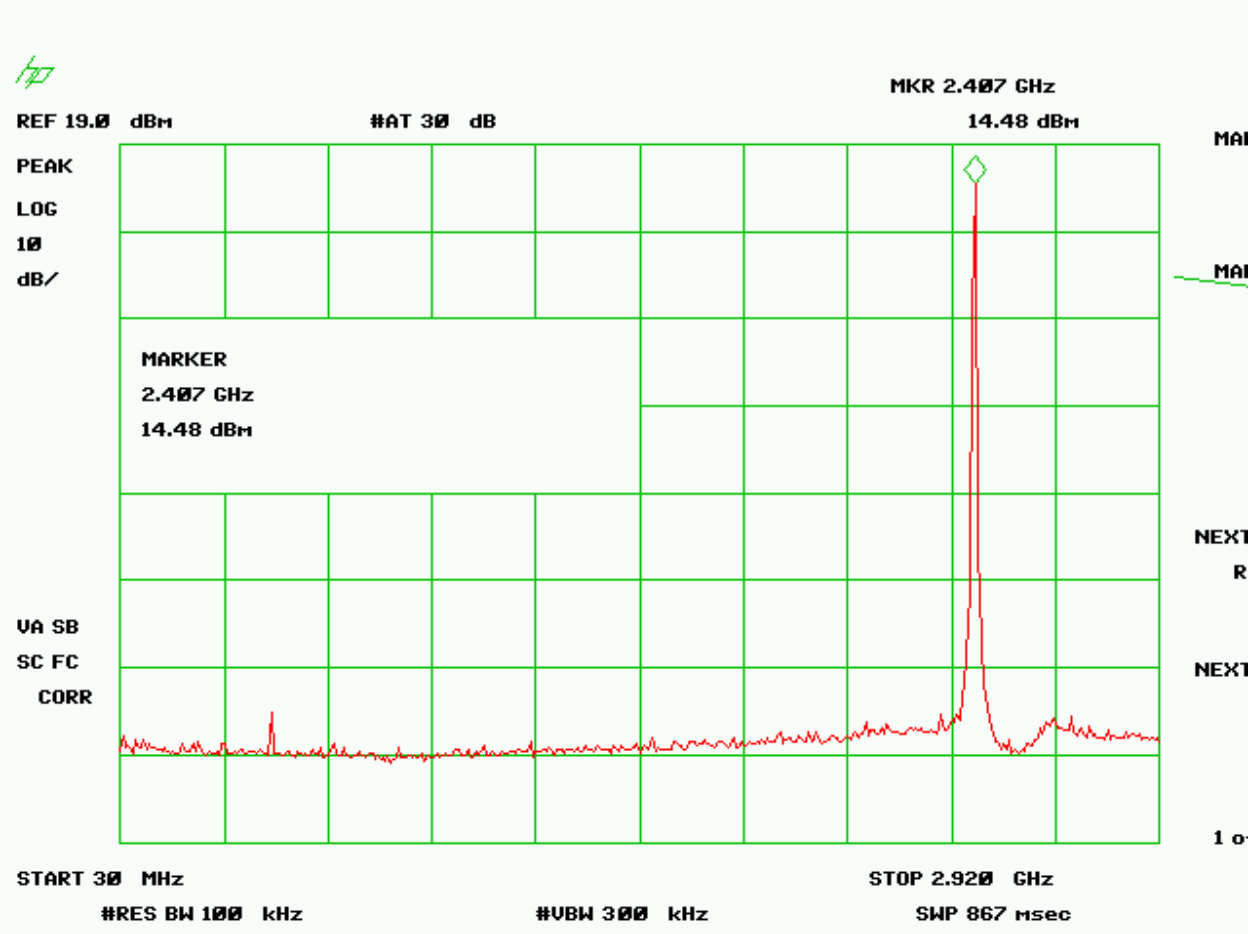
Radiated measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW set to 3 MHz. The results of peak radiated spurious emissions falling within restricted bands are given in Tables 5 and 6 and Figures 19 through 24. Each signal measured was maximized by raising and lowering the receive antenna between 1 meter and 4 meters in height while monitoring the spectrum analyzer display for the largest signal visible. Also, the EUT was rotated about its axis while monitoring the Spectrum Analyzer display for maxima. The EUT was measured when both maxima were maintained.

The integral antenna was removed and replaced by the external antenna and the peak radiated spurious emissions were re-measured. For test data, see Tables 5 and 6 and Figures 22 through 24. If radiated emissions above 1 GHz were measured at a distance of 1 meter, the measured value was extrapolated to a result at 3 meters using an inverse distance extrapolation factor of 20 dB/decade.

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

Figure 13 - Antenna Conducted Spurious Emissions – CFR 15.247 (b) - Low Channel



Note: Signal shown represents Fundamental Frequency

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

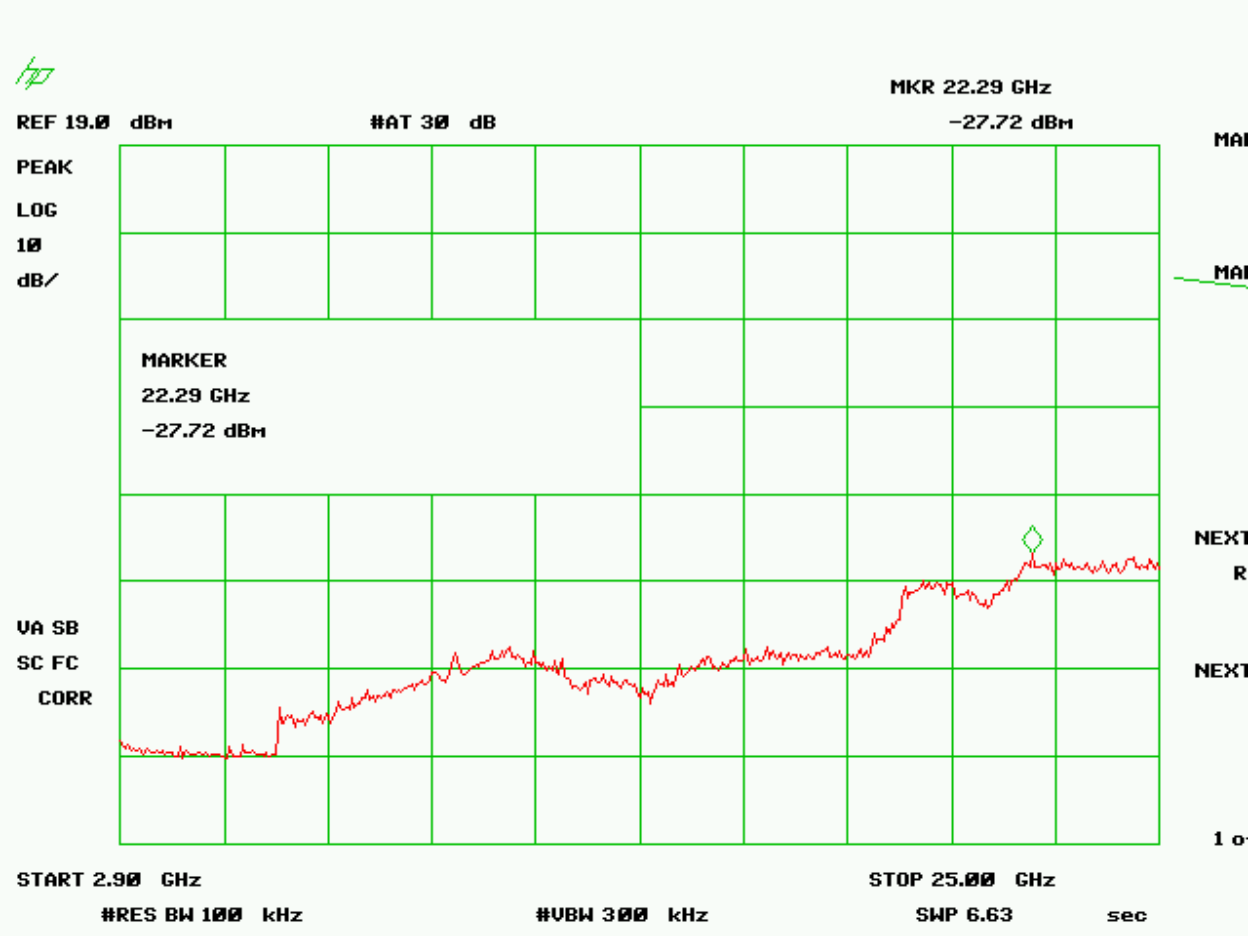


Figure 14 - Antenna Conducted Spurious Emissions– CFR 15.247 (b) - Low Channel Cont'd

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2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

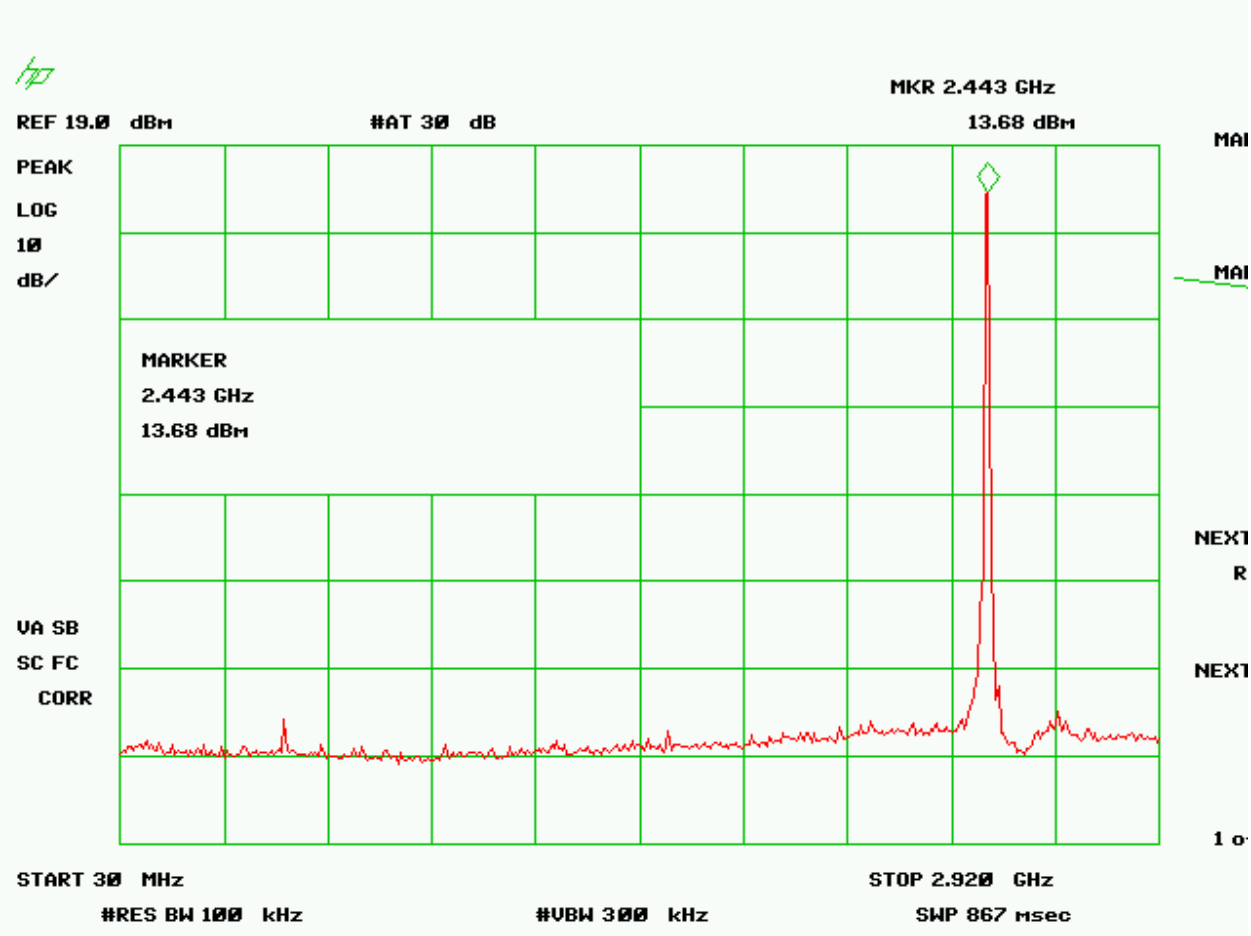

Figure 15 - Antenna Conducted Spurious Emissions – CFR 15.247 (b) - Mid Channel

Note: Signal shown represents Fundamental Frequency

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

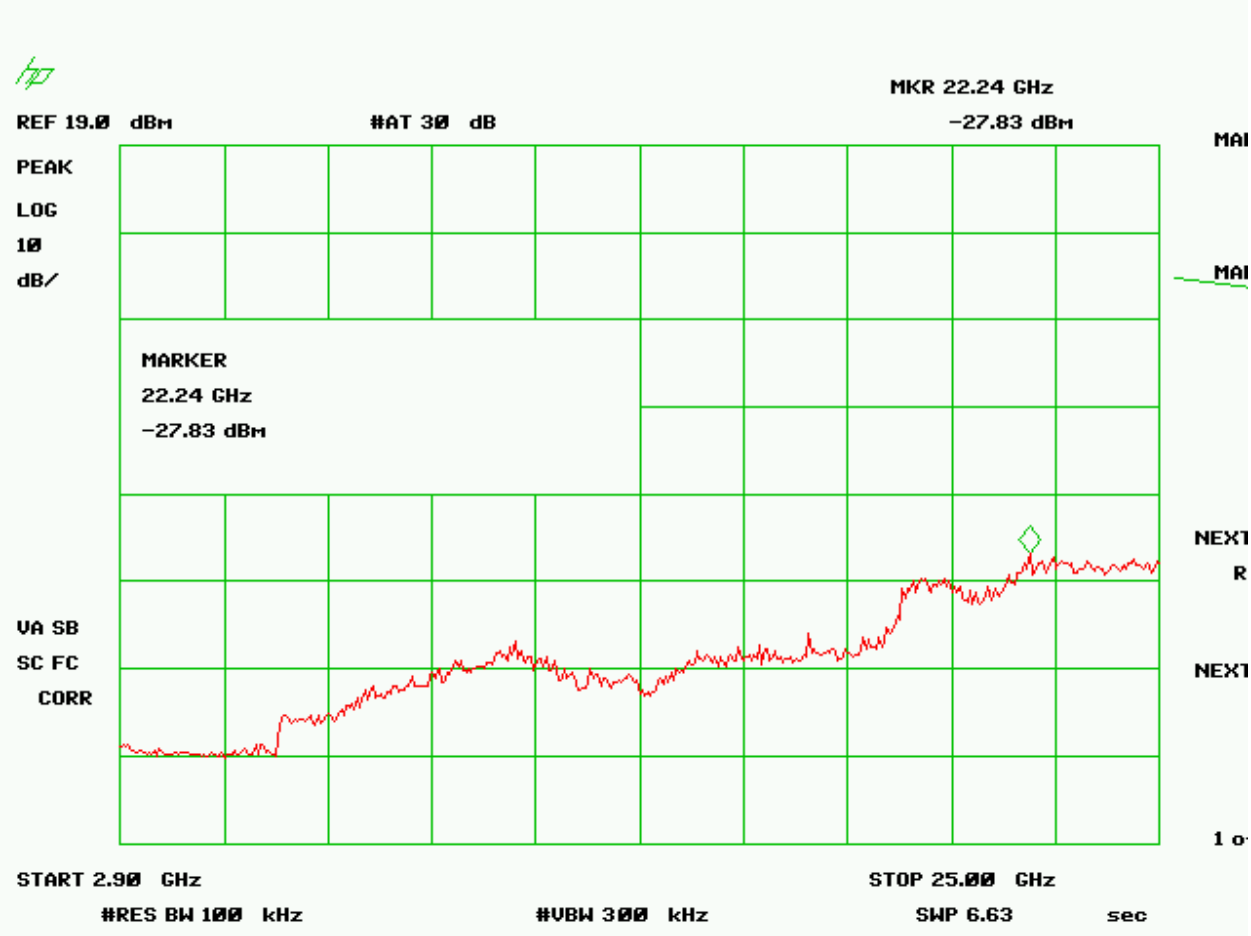

Figure 16 - Antenna Conducted Spurious Emissions – CFR 15.247 (b) - Mid Channel Cont'd

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

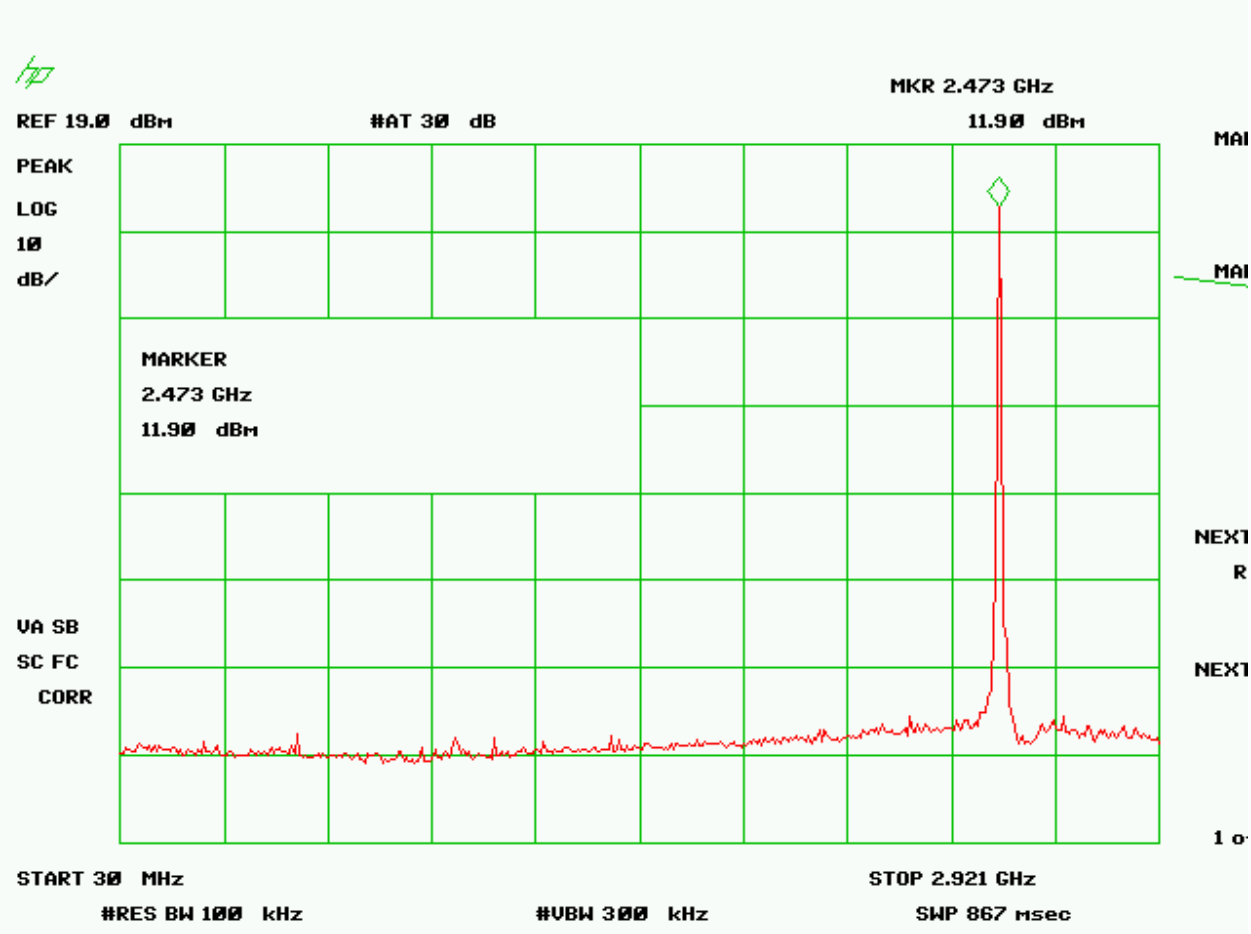

Figure 17 - Antenna Conducted Spurious Emissions – CFR 15.247 (b) - High Channel

Note: Signal shown represents Fundamental Frequency

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions (CFR 15.209) (IC RSS 210, A2.9 (a))

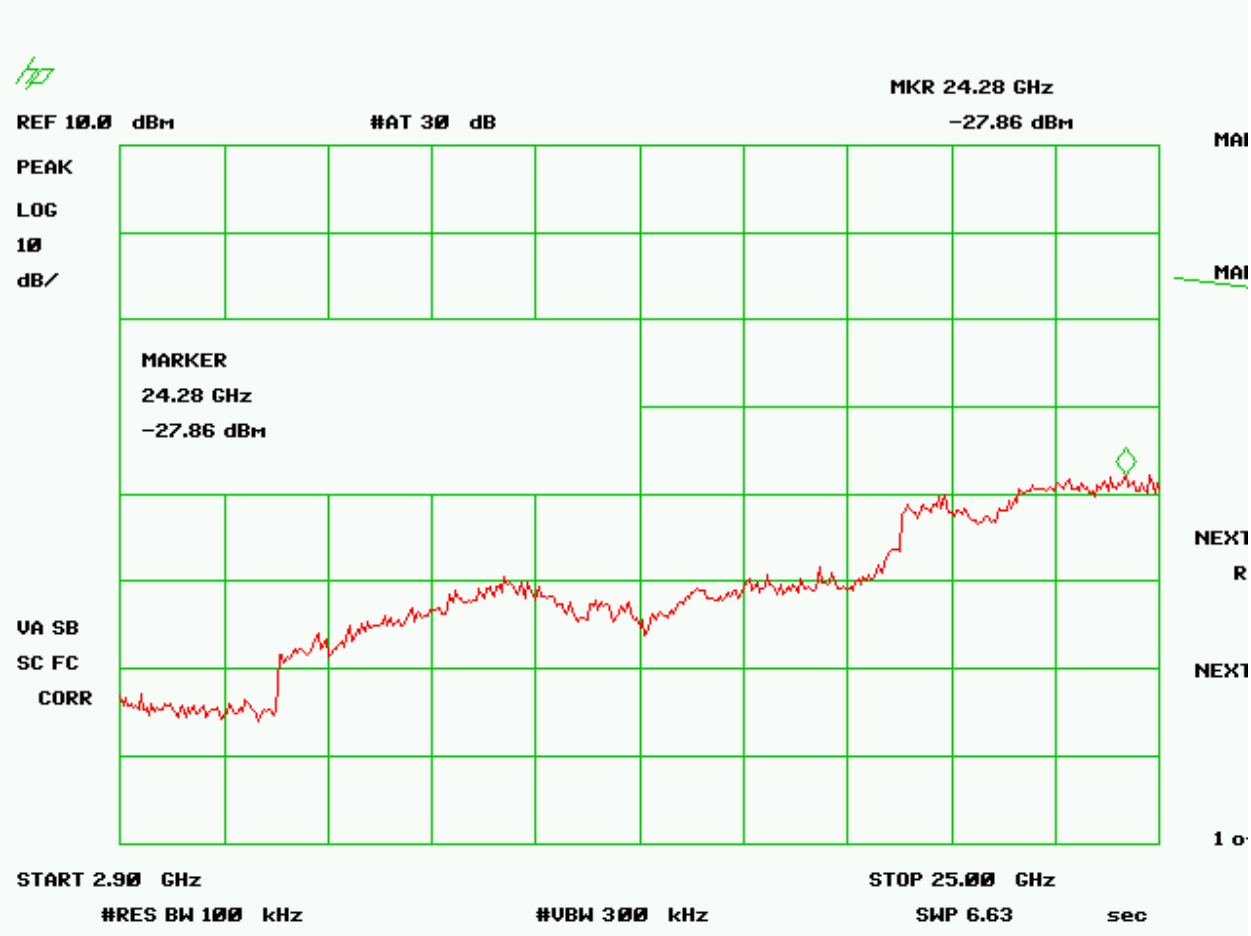

Figure 18 - Antenna Conducted Spurious Emissions - CFR 15.247 (b), High Channel Cont'd

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions - **Integral Antenna** (CFR 15.209) (IC RSS 210, A2.9(a))

Table 6 - Peak Radiated Spurious Emissions - Integral Antenna

Radiated Spurious Emissions w/Integral Antenna, Tested From 30 MHz – 25 GHz									
Test By: DA	Test: FCC Part 15.247 (d)					Client: Nivis, LLC			
	Project: 08-0078			Class:		Model: 2.4 GHz Mod2			
Frequency (MHz)	Spectrum Analyzer (dBm)	Transducer Table	Test Data (dBuV)	AF+CA-AM (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarity	Margin (dB)	DET PK / QP
LOW									
Fund 2404.95	-26.62	1HN3mV	80.38	31.8	112.1	--	3m./VERT	--	PK
2nd *4810	-57.18	1HN3mV	49.82	4.4	54.2	74.0	3m./HORZ	19.8	PK
3rd 7214.90	-57.18	1HN3mV	49.82	9.1	58.9	92.1	3m./VERT	33.2	PK
4th 9619.97	-39.87	1HN3mH	67.13	12.8	79.9	92.1	3m./HORZ	12.2	PK
5th *12025.1	-51.98	1HN3mV	55.02	17.7	72.7	74.0	3m./HORZ	1.3	PK
MID									
Fund 2439.98	-26.98	1HN3mV	80.02	31.8	111.8	--	3m./VERT	--	PK
2nd *4879.88	-51.66	1HN3mV	55.34	4.8	60.1	74.0	3m./VERT	13.9	PK
3rd *7319.90	-49.04	1HN3mH	57.96	9.4	67.4	74.0	3m./VERT	6.6	PK
4th 9760	-39.26	1HN3mH	67.74	13.0	80.8	91.8	3m./HORZ	11.1	PK
5th *12200.05	-56.68	1HN3mV	50.32	17.9	68.2	74.0	3m./HORZ	5.8	PK
HIGH									
Fund. 2475	-27.4	1hn3mv	79.6	31.5	111.1		3m./VERT	111.1	PK
2nd *4949	-49.2	1hn3mh	57.8	4.4	62.2	74.0	3m./HORZ	11.8	PK
3rd *7427	-48.5	1hn1mh	58.5	9.5	68.0	74.0	1m./HORZ	6.0	PK
4th 9902	-42.5	1hn1mh	64.5	13.0	77.6	91.1	1m./HORZ	13.5	PK
5th *12378	-50.5	1hn1mH	56.5	15.6	72.1	74.0	1m./HORZ	1.9	PK

* - Falls within restricted bands of CFR 15.205
Limits of 15.209 modified by 15.35
** Conversion from 1 meter to 3 meters = -9.54 dB

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious - Integral Antenna (Cont'd)

CL is cable loss. Preamplifier not used for the fundamentals.

SAMPLE CALCULATION:

RESULTS: At 9619.97 MHz: = (-39.87 + 12.8 + 107) = 79.93 dBuV/m @ 3m
Margin = (112.1-20) – 79.93 = 92.1 – 79.93 = 12.2 dB

The -20 dB is from 15.35 (b)

Conversion from dBm to dBuV = 107 dB

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions - **External antenna** (CFR 15.247(d)) (IC RSS 210, A2.9(a)) (Cont'd)

Table 7 - Peak Radiated Spurious Emissions - External Antenna

Radiated Spurious Emissions, Ext. Antenna, Tested from 30 MHz – 25 GHz									
Test By: DA	Test: FCC Part 15					Client: Nivis, LLC			
	Project: 08-0078		Class: B			Model: 2.4 GHz Mod2			
Frequency (MHz)	Spectrum Analyzer dBm	Test Data dBuV	Transducer Table	AF+CA-AM dB/m	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarity	Margin (dB)	Detector PK / QP
Low									
Fund 2405.00	- 22.2	84.8	1HN3mV	31.8	116.5	--	3m./VERT	--	PK
2nd *4810.13	-58	49.0	1HN3mV	4.4	53.4	74.0	3m./HOR	20.6	PK
3rd 7214.90	-59.9	47.1	1HN1mV	10.0	57.1	96.5	3m./HOR	39.4	PK
4th 9619.98	-37	36.9	1HN1mH	13.3	83.3	96.5	3m./HOR	13.2	PK
5th *12025.2	-55.6	51.4	1HN1mV	17.9	69.3	74.0	3m./HOR	4.7	PK
Mid									
Fund 2439.95	-26.4	80.6	1HN3mV	31.8	112.4	--	3m./VERT	--	PK
2nd *4880.00	-57.1	49.9	1HN3mV	4.6	54.5	74.0	3m./HOR	19.5	PK
3rd *7320.11	-55.5	51.5	1HN1mH	10.3	61.8	74.0	3m./HOR	12.2	PK
4th 9760.08	-39.00	68.00	1HN1mH	13.5	81.5	92.4	3m./HOR	10.9	PK
5th *12200.5	-57.2	49.8	1HN1mV	18.2	68.0	74.0	3m./HOR	6.0	PK
High									
Fund. 2475	-24.2	82.9	1hn3mv	31.5	114.4	--	3m./VERT	--	PK
2nd *4950.00	-53.7	53.3	1hn3mv	4.6	57.9	74.0	3m./VERT	16.1	PK
3rd *7425.00	-45.6	61.4	1hn1mH	9.5	70.9	74.0	1m./HOR	3.1	PK
4th 9900.00	-37.9	69.2	1hn1mH	13.0	82.2	94.4	1m./HOR	12.2	PK
5th *12375.00	-49.9	57.1	1hn1mH	15.6	72.7	74.0	1m./HOR	1.3	PK

* - Falls within the restricted bands of CFR 15.205.

(1) Limits from CFR 15.209

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious Emissions - External antenna (CFR 15.247(d)) (IC RSS 210, A2.9(a)) (Cont'd)

CL is cable loss. Preamplifier not used for the fundamentals.

Note: For the external antenna, all measurements above 5 GHz were measured from a distance of 1 meter and extrapolated to produce results at 3 meters by subtracting 9.54 dB from the raw measurement taken at 1 meter. Spectrum Analyzer readings shown in the second column already include this additional factor.

SAMPLE CALCULATION:

DISTANCE EXTRAPOLATION FACTOR = $20\log_{10}(3/1) = 9.54$ dB

RESULTS: At 4810.13 MHz, = (-58 + 4.4 + 107) = 53.4 dBuV/m at 3 m
MARGIN = 74 – 53.4 = 20.6 dB

CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious emissions (Cont'd)

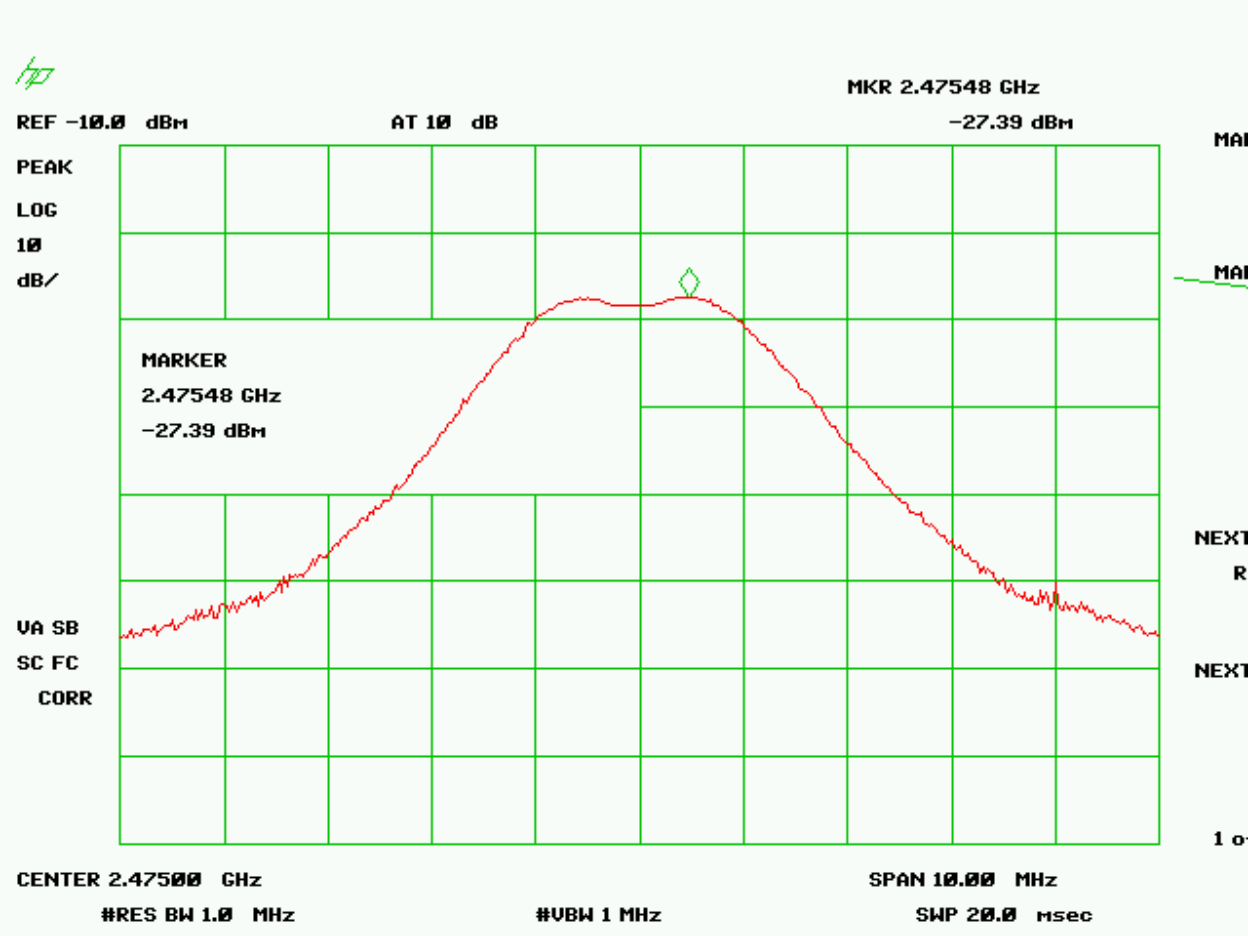

Figure 19 - Peak Radiated Spurious Emissions - 15.247 (d) - Fundamental, High Channel, Integral Antenna, Vertical

2 Test and Measurements (Cont'd)

2.11 Peak Radiated Spurious emissions (Cont'd)

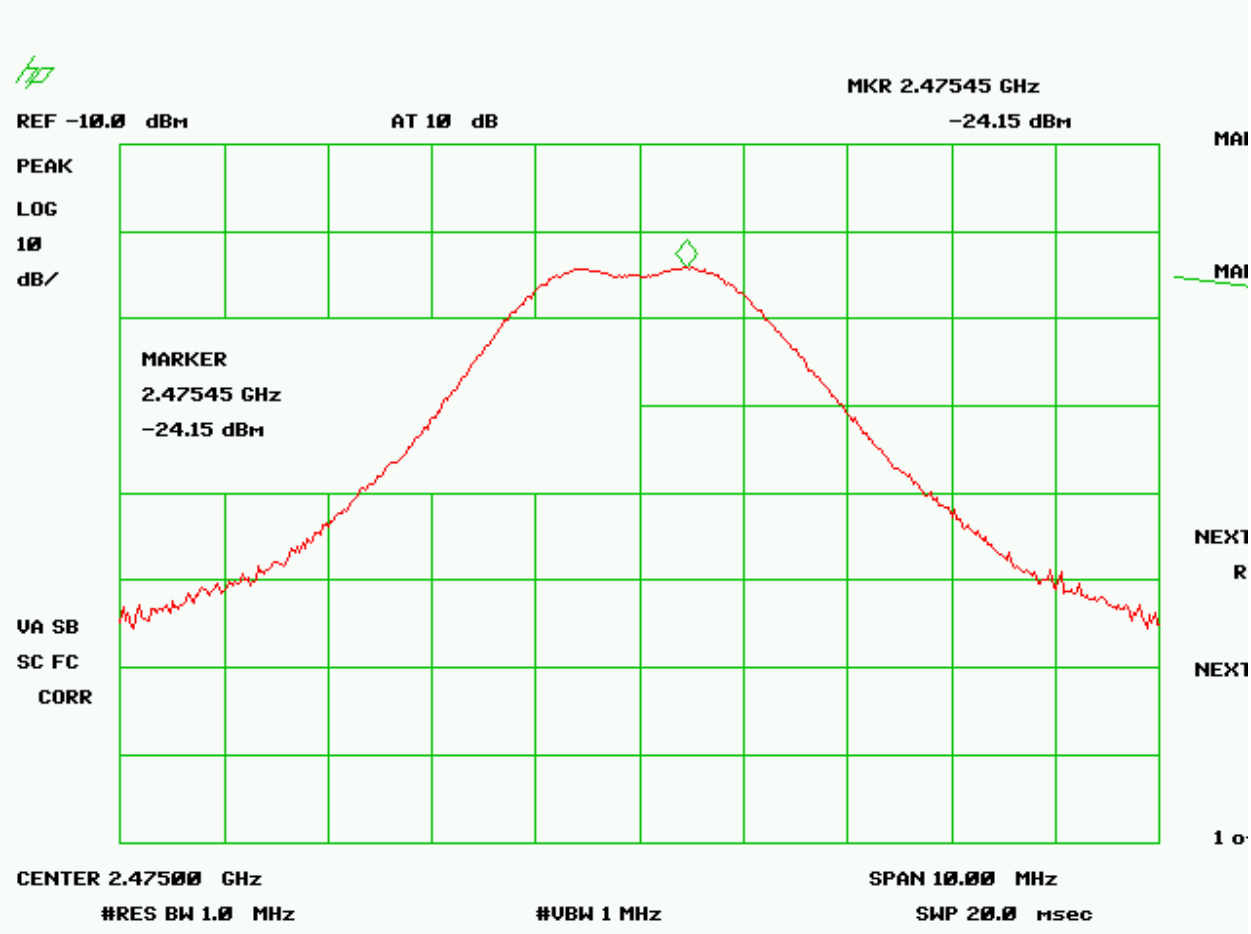

Figure 20 - Peak Radiated Spurious Emissions - 15.247 (d) - Fundamental, High Channel, External Antenna, Vertical

2 Test and Measurements (Cont'd)

2.12 Average Radiated Spurious emissions (CFR Part 15.209, 15.35)

The peak spurious emissions were corrected for duty cycle (-22.0 dB) and were compared to the average limits required by 15.209. Average radiated spurious emissions are found in Tables 8 and 9.

Table 8 - Average Radiated Emissions - Integral Antenna

Radiated Spurious Emissions Integral Antenna									
Test By: DA	Test: FCC Part 15.209					Client: Nivis, LLC			
	Project: 08-0078			Class:		Model: 2.4 GHz Mod2			
Frequency (MHz)	Spectrum Analyzer dBm	Transducer Table	Test Data dBuV	AF+CA-AM dB/m	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarity	Margin (dB)	Detector PK / AVG
LOW									
Fund 2404.95	-48.6	1HN3mV	58.5	31.8	90.2	--	3m./VERT	--	PK
2nd *4810	-79.1	1HN3mH	27.9	4.4	32.3	54.0	3m./HORZ	21.7	PK
3rd 7214.90	-79.1	1HN3mV	27.9	9.1	37.0	70.2	3m./VERT	32.7	PK
4th 9619.97	-61.8	1HN3mH	45.2	12.8	58.0	70.2	3m./HORZ	11.7	PK
5th *12025.1	-73.9	1HN3mH	33.1	17.7	50.7	54.0	3m./HORZ	3.3	PK
MID									
Fund 2439.98	-48.9	1HN3mV	58.1	31.8	89.9	--	3m./VERT	--	PK
2nd *4879.88	-73.6	1HN3mV	33.4	4.8	38.2	54.0	3m./VERT	15.8	PK
3rd *7319.90	-71.0	1HN3mV	36.0	9.4	45.4	54.0	3m./VERT	8.6	PK
4th 9760	-61.2	1HN3mH	45.8	13.0	58.8	69.9	3m./HORZ	10.6	PK
5th *12200.05	-78.6	1HN3mH	28.4	17.9	46.3	54.0	3m./HORZ	7.7	PK
HIGH									
Fund. 2475	-49.3	1hn3mv	57.7	31.5	89.2	--	3m./VERT	--	PK
2nd *4949	-71.1	1hn3mh	35.9	4.4	40.3	54.0	3m./HORZ	13.7	PK
3rd *7427	-70.4	1hn1mh	36.6	9.5	46.1	54.0	1m./HORZ	7.9	PK
4th 9902	-64.4	1hn1mh	42.6	13.0	55.7	69.2	1m./HORZ	13.5	PK
5th *12377	-72.4	1hn1mH	34.6	15.6	50.2	54.0	1m./HORZ	3.8	PK

Note: CL is cable loss. Preamplifier not used for fundamentals.

2 Test and Measurements (Cont'd)

2.12 Average Radiated Spurious emissions (Cont'd)

Table 9 - Average Radiated Emissions - External Antenna

Average Radiated Spurious Emissions External Antenna									
Test By: DA	Test: FCC Part 15.247					Client: Nivis, LLC			
	Project: 08-0078			Class:		Model: 2.4 GHz Mod2			
Frequency (MHz)	Spectrum Analyzer dBm	Transducer Table	Test Data dBuV	AF+CA-AM dB/m	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarity	Margin (dB)	Detector PK / AVG
Low									
Fund 2404.95	-44.1	1HN3mV	62.9	31.8	94.6	--	3m./VERT	--	PK
2nd *4810	-79.9	1HN3mH	27.2	4.4	31.5	54.0	3m./HORZ	22.5	PK
3rd 7214.90	-81.8	1HN1mH	25.2	10.0	35.2	74.6	3m./HORZ	39.4	PK
4th 9619.97	-58.9	1HN1mH	48.2	13.3	61.4	74.6	3m./HORZ	13.2	PK
5th *12025.1	-77.5	1HN1mH	29.5	17.9	47.4	54.0	3m./HORZ	6.6	PK
MID									
Fund 2439.98	-48.3	1HN3mV	58.7	31.8	90.5	--	3m./VERT	--	PK
2nd *4879.88	-79.0	1HN3mH	28.0	4.6	32.6	54.0	3m./HORZ	21.4	PK
3rd *7319.90	-77.4	1HN1mH	29.6	10.3	39.9	54.0	3m./HORZ	14.1	PK
4th 9760	-60.9	1HN1mH	46.2	13.5	59.6	70.5	3m./HORZ	10.9	PK
5th *12200.05	-79.1	1HN1mH	27.9	18.2	46.1	54.0	3m./HORZ	7.9	PK
HIGH									
Fund. 2475	-46.1	1hn3mv	61.0	31.5	92.5	--	3m./VERT	--	PK
2nd *4949	-75.6	1hn3mv	31.4	4.6	36.0	54.0	3m./VERT	18.0	PK
3rd *7427	-67.5	1hn1mH	39.5	9.5	49.0	54.0	1m./HORZ	5.0	PK
4th 9902	-59.8	1hn1mH	47.3	13.0	60.3	72.5	1m./HORZ	12.2	PK
5th *12375	-71.8	1hn1mH	35.2	15.6	50.8	54.0	1m./HORZ	3.2	PK

CL is cable loss. Preamplifier not used for the fundamentals.

2 Test and Measurements (Cont'd)

2 Test and Measurements (Cont'd)

2.13 Band - Edge Measurements – (CFR 15.247 (d))

Band Edge measurements were made with the EUT operating at the Low Channel and High Channel. Conducted measurements were performed to demonstrate compliance with the requirement of 15.247(d) that all emissions be attenuated by 20 dB outside the band. Radiated measurements were performed at the upper band edge to demonstrate compliance with the radiated emission limits of 15.209 that fall within restricted bands as defined in section 15.205.

For conducted measurements, the RBW was set to 100 kHz, and the VBW was set to 300 kHz.

2.13.1 Lower Band Edge

The transmitter was set to the lowest channel of operation, and a display line was set to 20 dB below the peak to demonstrate compliance at the band edge. Compliance is demonstrated in Figure 21.

2.13.2 Higher Band Edge

Compliance with the conducted band edge measurement is shown in Figure 22. Spurious components outside the band are attenuated by at least 20 dB.

The Marker-Delta method published by the FCC was followed for radiated band edge measurements. Using a RBW = 1% of the total span, the emission of greatest magnitude outside of the band (up to 2 standard bandwidths outside the band) was marked, and then a delta measurement between that emission and the peak fundamental emission was taken. That delta was subtracted from the value of the fundamental frequency of the highest operating channel to compute the field strength.

In all antenna configurations, the largest spurious component outside the band edge was attenuated by at least 20 dB from the fundamental, and both antenna configurations met the limits of radiated spurious emissions in Restricted Bands. Table 10 below summarizes the band-edge findings for both antennas.

2 Test and Measurements (Cont'd)

2.13.2 Higher Band Edge (Cont'd)

Table 10 - Upper Band Edge - Radiated Emissions

Peak Radiated Higher Band Edge Measurements									
Test By: DA	Test: FCC Part 15.247					Client: Nivis, LLC			
	Project: 08-0078			Class:		Model: 2.4 GHz Mod2			
Frequency (MHz)	Spectrum Analyzer dBm	Transducer Table	Test Data dBuV	AF+CA-AM dB/m	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarity	Margin (dB)	Detector PK / AVG
Integral Antenna									
Fund 2475	-27.4	1hn3mv	79.6	31.5	111.1	--	3m./VERT	--	PK
Band Edge 2484	-67.73	1hn3mv	39.3	31.8	71.1	74.0	3m./HORZ	2.9	PK
External Antenna									
Fund 2475	-24.2	1hn3mv	82.8	31.5	114.3	--	3m./VERT	--	PK
Band Edge 2484	-65.2	1hn3mv	41.8	31.8	73.3	74.0	3m./VERT	0.7	PK

The limit for the **average value** of radiated emissions in a Restricted Band is 54 dBuV/m. To compute the average values of the band edge emissions, the duty cycle correction factor of -22.0 dB is applied to the values in the Corrected Results column. After this correction, both antennas will also meet the restrictions placed on average radiated emissions in Restricted Bands. The worst-case average measurement is computed below.

SAMPLE CALCULATION OF WORST-CASE AVERAGE RADIATED UPPER BAND EDGE MEASUREMENT:

Results = Peak Corrected Results + Duty Cycle Correction Factor
Results(External Antenna) = 73.3 + (-22.0) = 51.3 dBuV/m
Margin = Limit – Results = 54 – 51.3 = 2.7 dB

Plots, in Figures 23 and 24, are shown of the worst-case radiated upper band edge delta measurements for the antennas.

2 Test and Measurements (Cont'd)

2.13 Band Edge Measurements (Cont'd)

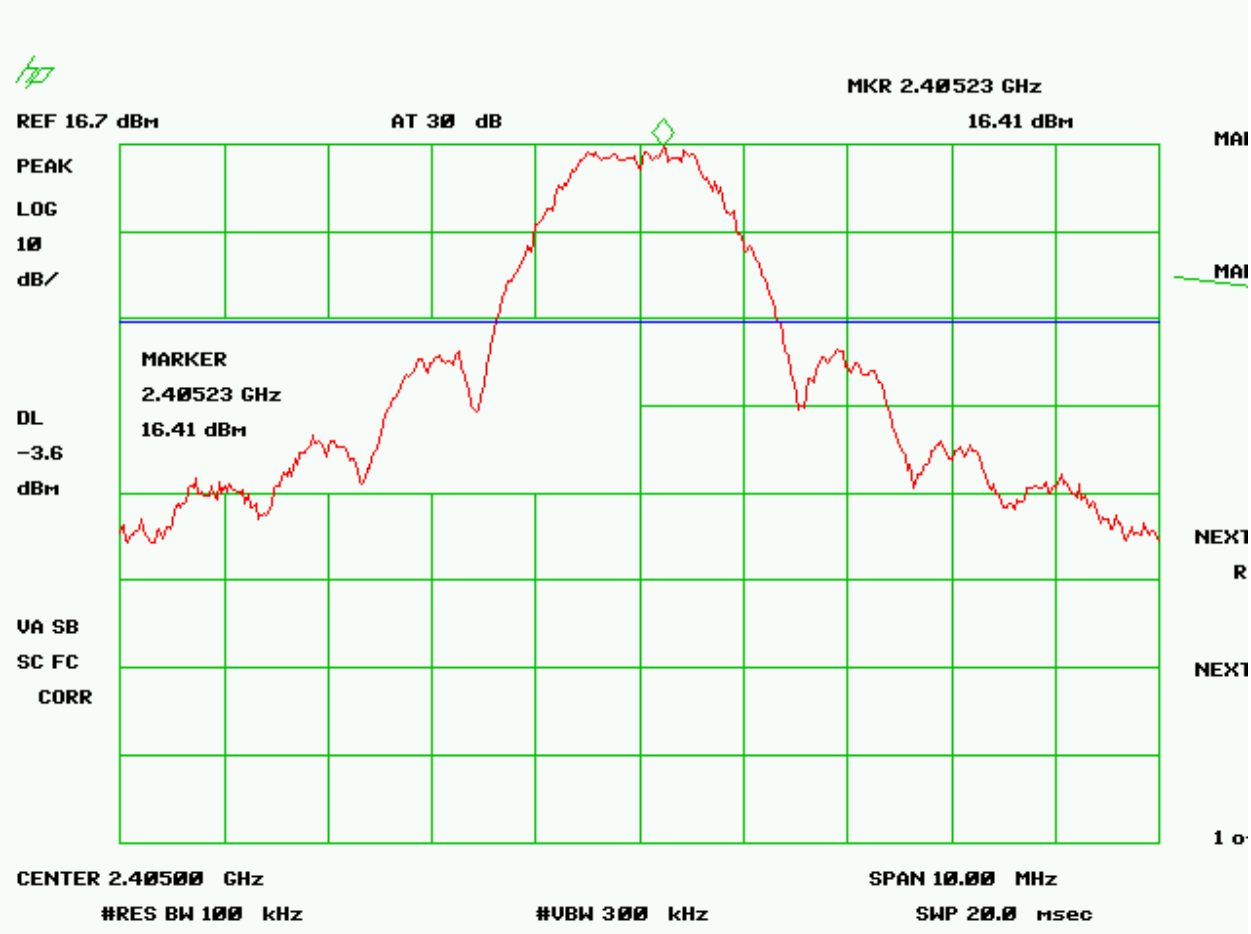

Figure 21 - Conducted Band Edge Compliance - Low Channel

2 Test and Measurements (Cont'd)

2.13 Band Edge Measurements, (Cont'd)

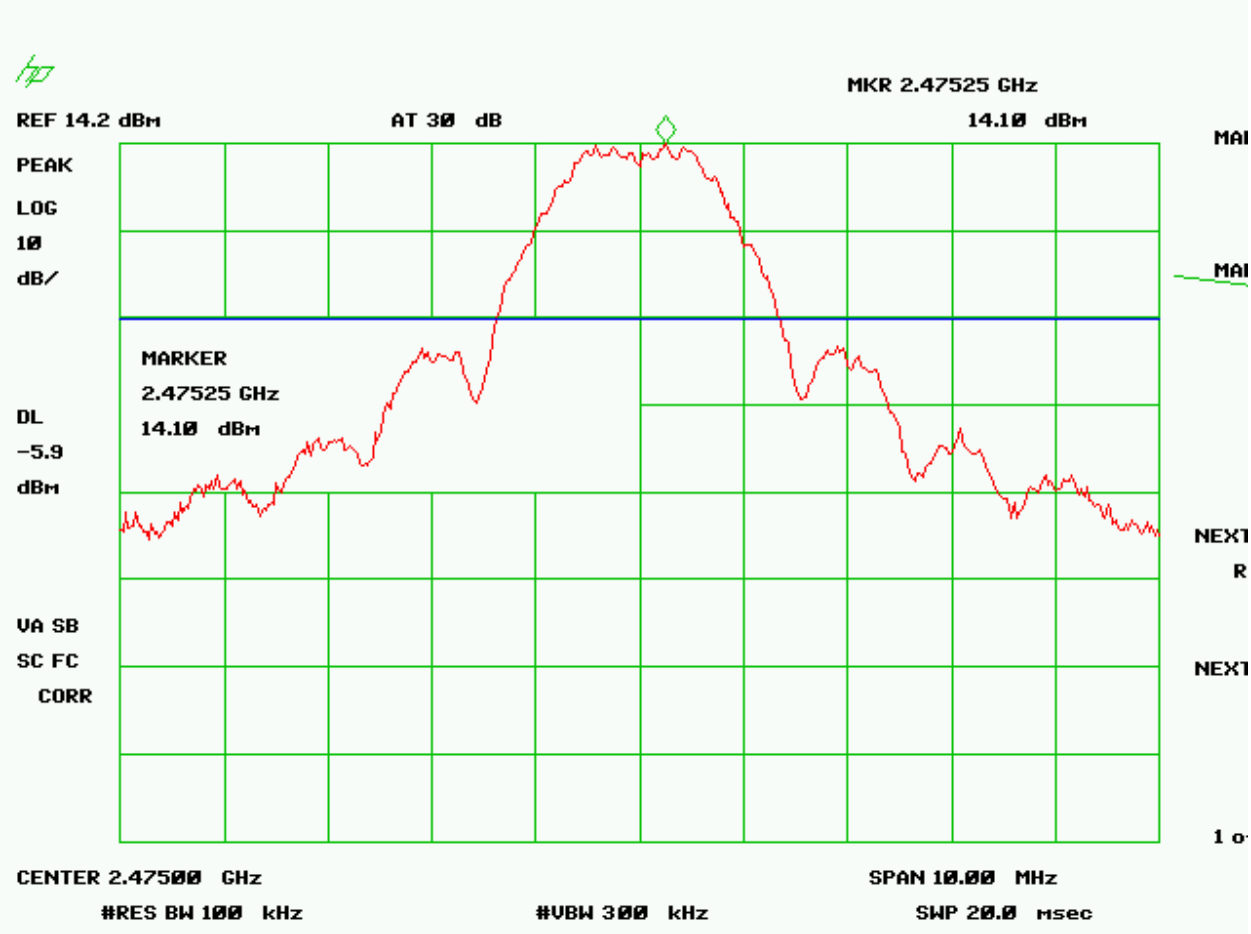

Figure 22 - Conducted Band Edge Compliance - High Channel

2 Test and Measurements (Cont'd)

2.13 Band Edge Measurements, (Cont'd)

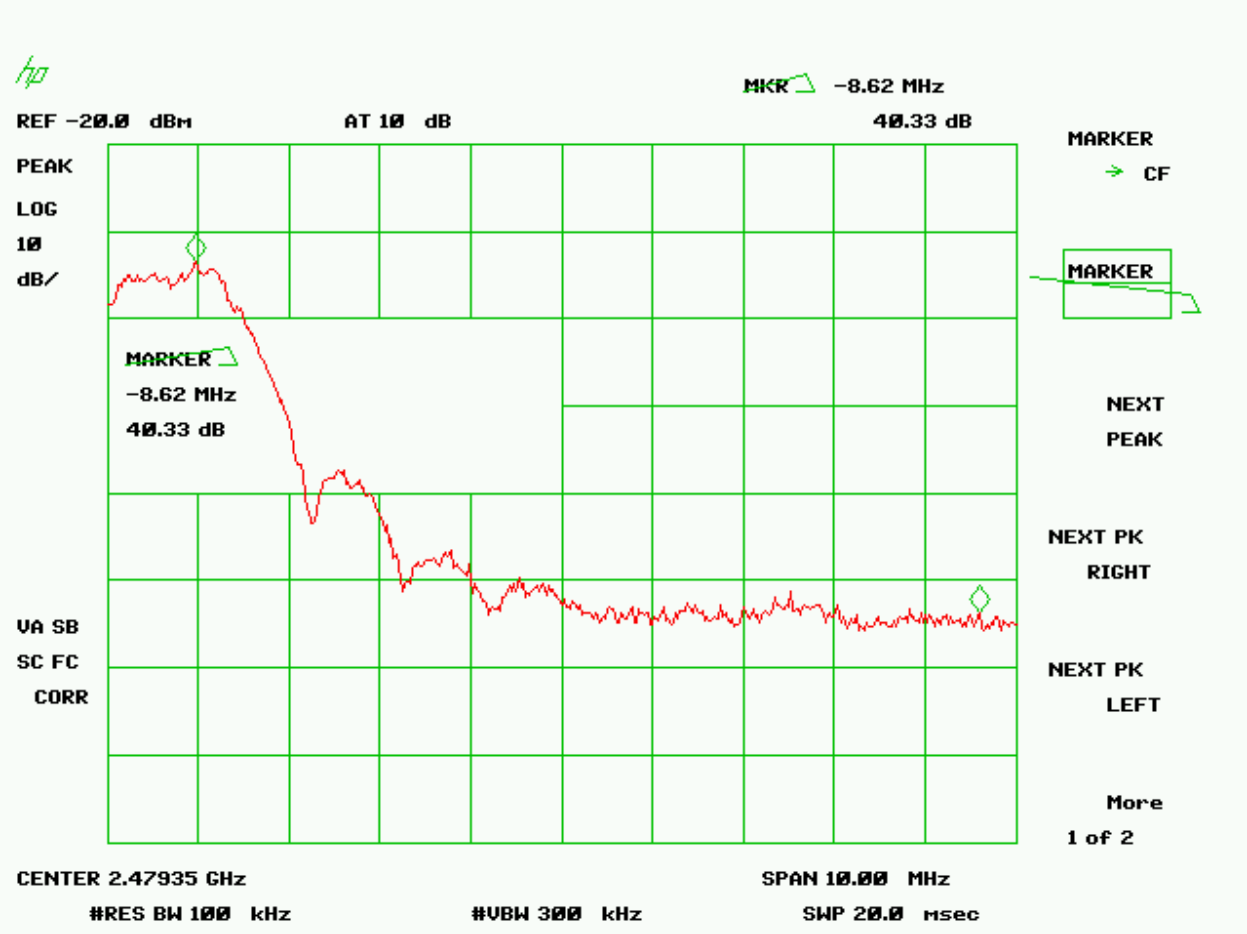

Figure 23 - Band Edge Compliance - High Channel Delta – Radiated – Integral Antenna

2 Test and Measurements (Cont'd)

2.13 Band Edge Measurements, (Cont'd)

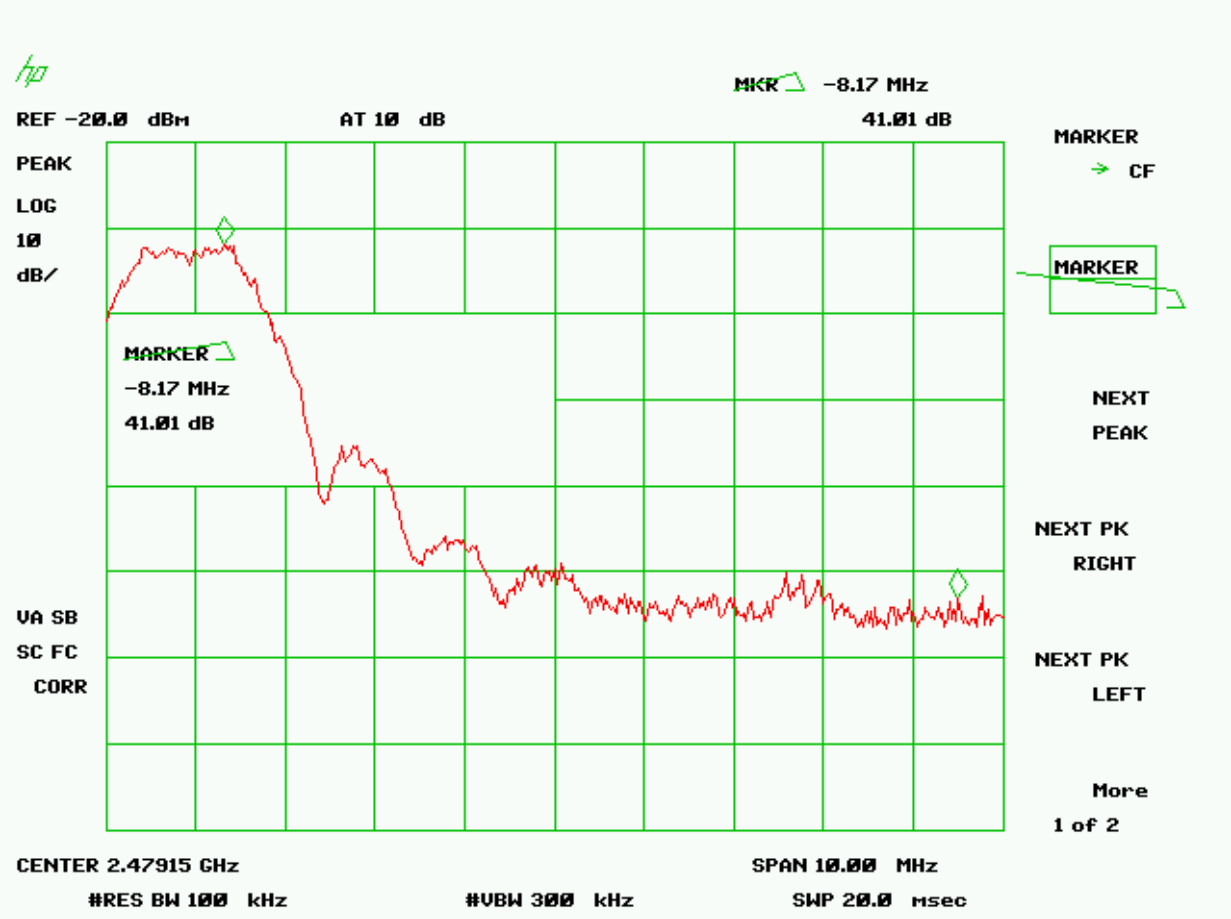

Figure 24 - Band Edge Compliance - High Channel Delta - Radiated - External Antenna

2 Test and Measurements (Cont'd)

2.14 Six dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

The EUT antenna port was connected to a spectrum analyzer that was set for a 50 Ω impedance. Measurements were performed similar to the method of FCC DA 00-7.5 except that the bandwidth is 6 dB, as opposed to 20 dB. The RBW was set to 100 kHz, and the VBW was set to 300 kHz. The results of this test are given in Table 11 and Figures 25 through 27

2.14 Six dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

Table 11 - 6 dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
2405	1.58	0.5
2440	1.58	0.5
2475	1.56	0.5

.

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.14 Six dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

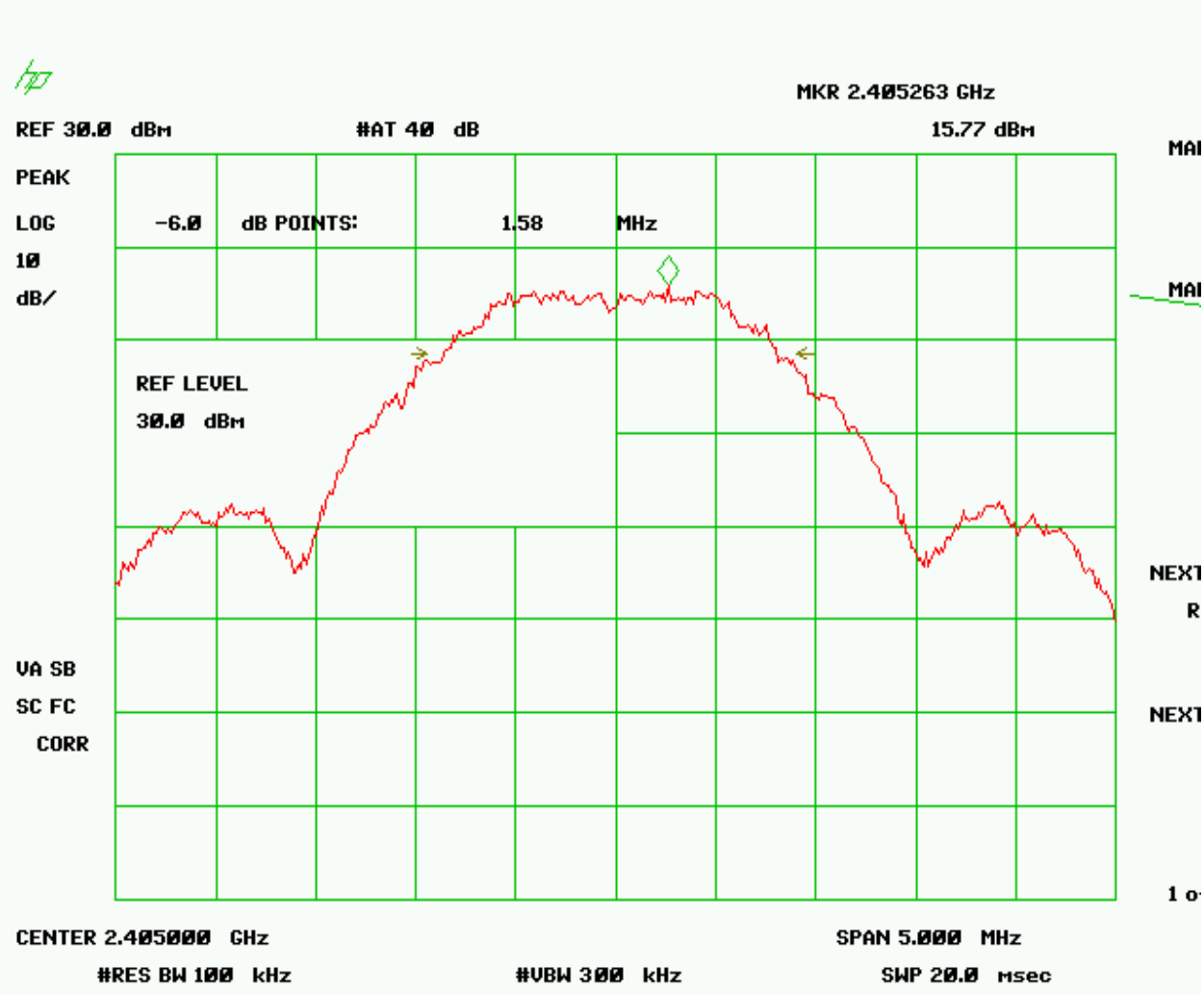

Figure 195 - 6 dB Bandwidth Per Part 15.247 (a) (2), Low Channel

2 Test and Measurements (Cont'd)

2.14 Six dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

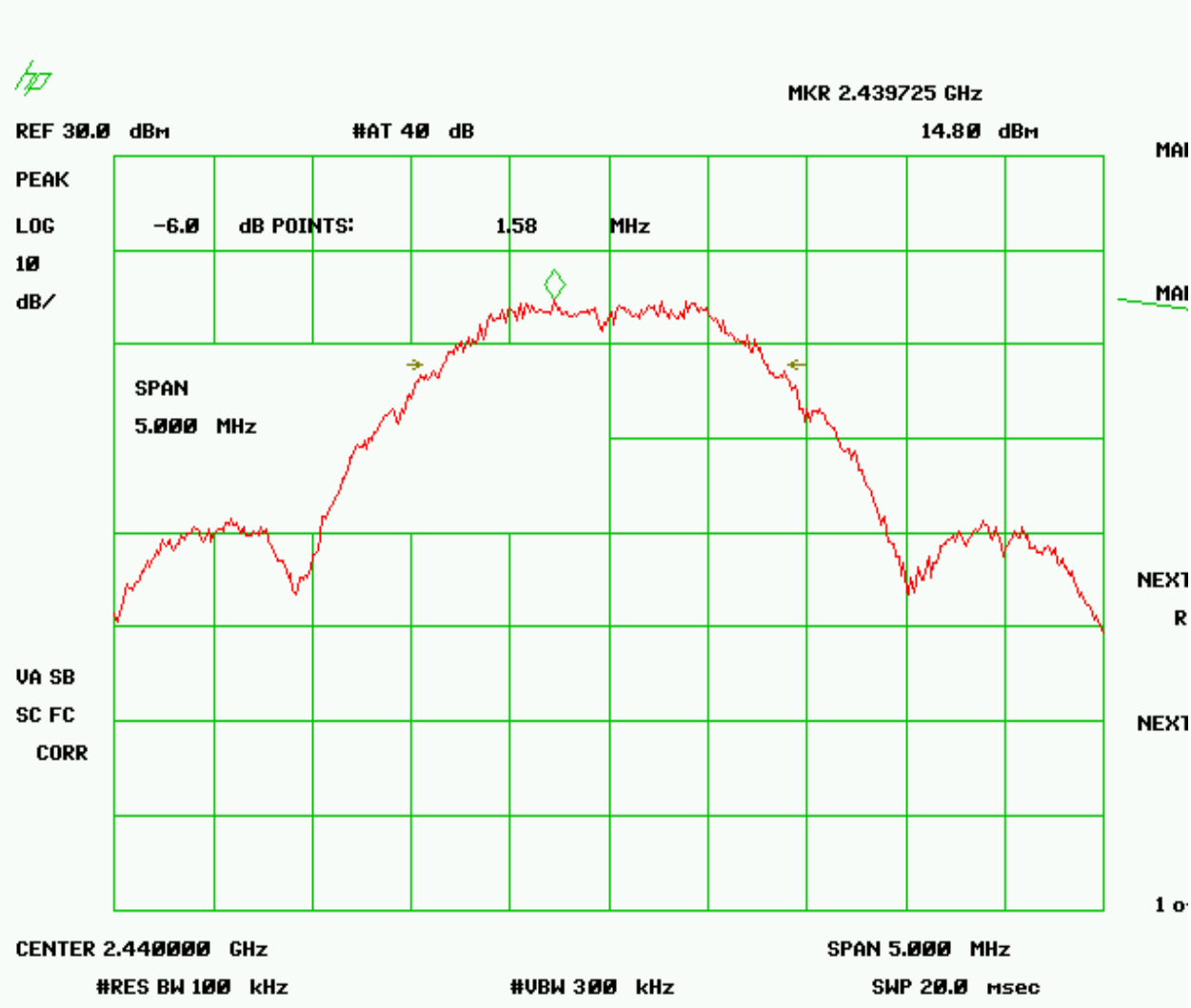

Figure 26 - 6 dB Bandwidth Per Part 15.247 (a) (2), Mid Channel

2 Test and Measurements (Cont'd)

2.14 Six dB Bandwidth per CFR 15.247(a)(2), (IC RSS 210, A8.2(a))

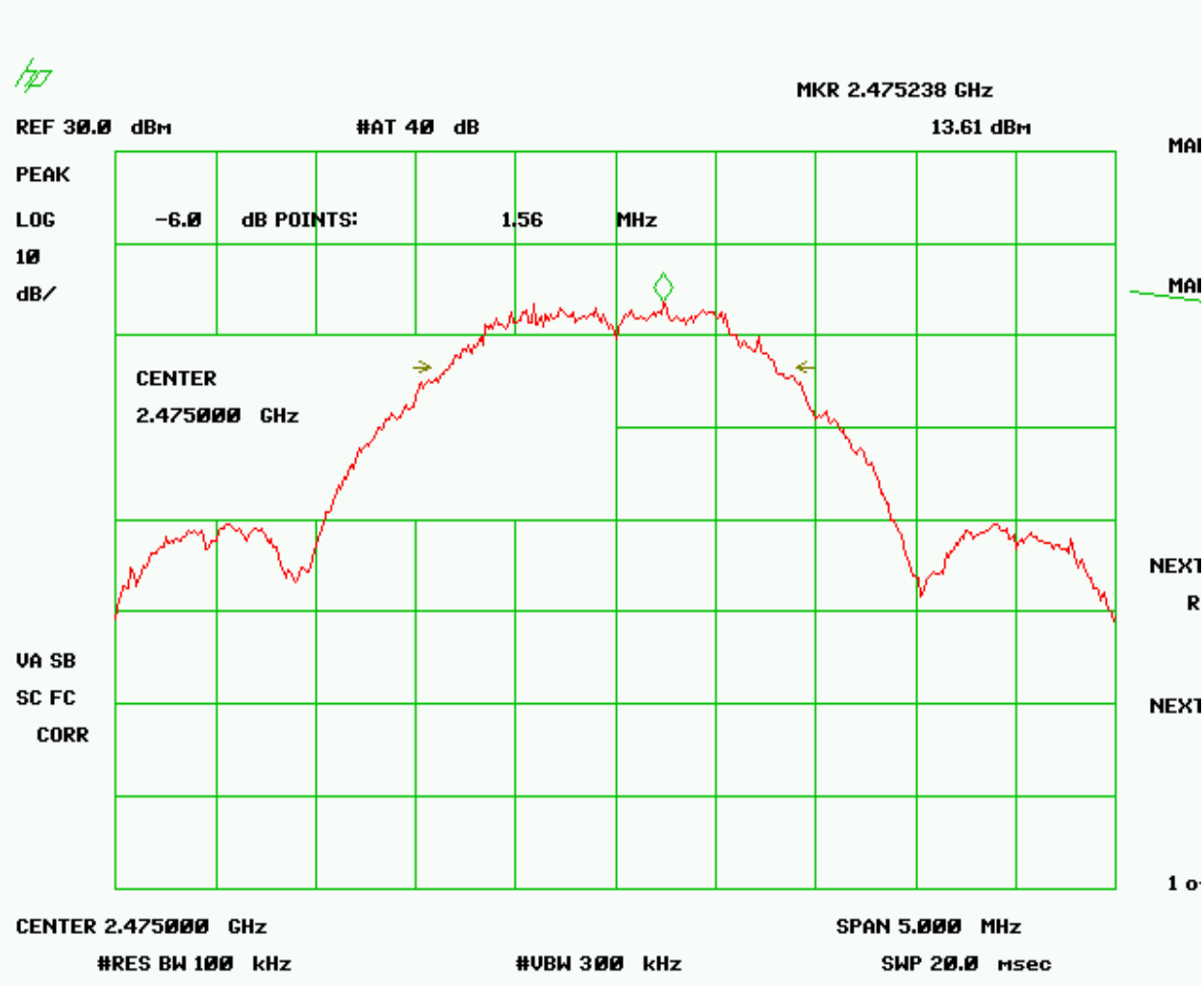

Figure 27 - 6 dB Bandwidth Per Part 15.247 (a) (2), High Channel

2 Test and Measurements (Cont'd)

2.15 Power Line Conducted Emissions for Digital Device - (CFR 15.107).

The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive. Please refer to the results as shown in Table 12.

2.16 Power Line Conducted Emissions for Transmitter CFR 15.207

The power line conducted voltage measurements have been carried out in accordance with CFR 15.207, per ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into a continuous mode of transmission.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission on the low channel. Those results are given in Table 12.

2 Test and Measurements (Cont'd)

2.15 / 2.16 Power Line Conducted Emissions for Digital Device - (CFR 15.107).

Table 12 - Power Line Conducted Emissions Data, Class B Part 15.107 and 15.207

Test By: DA		FCC Pt 15.107, 207			Client: NIVIS, LLC				
				Class: B	Model: 2.4 GHz Mod2				
Frequency (MHz)	Transducer Table	Test Data		CF+CL-AMP	Test Results	Test Limits	Location	Margin	Det. AVG
		dBm	dBuV	dB	dBuV	dBuV		dB	PK/QP
0.25	LISNP	-54.2	52.8	-0.2	52.6	61.8	Phase	9.2	QP
0.25	LISNP	-65.0	42	-0.2	41.8	51.8	Phase	9.9	AVG
1.12	LISNP	-82.4	24.6	0.0	24.6	46.0	Phase	21.4	PK
2.48	LISNP	-64.6	42.4	0.1	42.5	46.0	Phase	3.5	QP
5.08	LISNP	-72.4	34.6	0.2	34.8	50.0	Phase	15.2	PK
10.3	LISNP	-73.9	33.1	0.4	33.5	50.0	Phase	16.5	PK
20.3	LISNP	-85.0	22	0.5	22.5	50.0	Phase	27.5	PK
0.77	LISNN	-60.7	46.3	-0.1	46.2	56.0	Neutral	9.8	QP
0.77	LISNN	-76.9	30.1	-0.1	30.0	46.0	Neutral	16	AVG
0.257	LISNN	-63.5	43.5	-0.2	43.3	51.5	Neutral	8.2	PK
1.02	LISNN	-57.8	49.2	-0.1	49.2	56.0	Neutral	0.8	QP
1.02	LISNN	-74.8	32.2	-0.1	32.1	46.0	Neutral	13.9	AVG
5.1	LISNN	-74.1	32.9	0.2	33.2	50.0	Neutral	17.3	PK
12.23	LISNN	-77.1	29.9	0.3	30.2	50.0	Neutral	19.8	PK
28.88	LISNN	-87.0	20.0	0.4	20.4	50.0	Neutral	29.6	PK

Tested from 150 kHz to 30 MHz
SAMPLE CALCULATIONS: At 250 kHz, = 52.8 + (- 0.2) = 52.6 dBuV

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.17 Radiated Emissions for Digital Device (CFR 15.109 (a))

Radiated emissions were evaluated from 30 MHz to 25000 MHz per ANSI C63.4, Paragraph 8. Exploratory measurements showed that the EUT configured with the integral antenna under continuous transmission on the low channel produced the worst-case radiated emissions.

Measurements were made with the analyzer's bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made greater than or equal to 1 GHz. The video bandwidth was set to three times the resolution bandwidth. The test data were maximized as a part of the measurement procedure. The results are shown in Table 13.

Pre-scan plots were taken and are shown in Figures 28 and 29. The emissions recorded in the plots were determined to be from the laptop computer driving the module, and not from the module itself.

2 Test and Measurements (Cont'd)

2.17 Radiated Emissions for Digital Device (CFR 15.109 (a))

Measurements performed from 30 MHz – 25 GHz

Table 13 - Radiated Emissions Data (Digital Device) Class B

Radiated Emissions Receive Mode(CFR 15.209) and Digital Mode (CFR15.109)								
Test By: DA		Test: FCC Part 15.109		Client: NIVIS, LLC				
Project: 08-0078		Class: B		Model: 2.4 GHz Mod2				
Frequency (MHz)	Test Data (dBm)	AF Table Test Data (dBuV)	AF+CA -AMP (dB)	Results (uV/m)	Limits (uV/m)	Distance/ Polarity	Margin (dB)	DET PK / QP
No emissions detected within 20 dB of the FCC Part 15 B Limit.								

Tester Signature: Daniel Aparaschivei Name: Daniel Aparaschivei

2 Test and Measurements (Cont'd)

2.17 Radiated Emissions for Digital Device (CFR 15.109 (a))

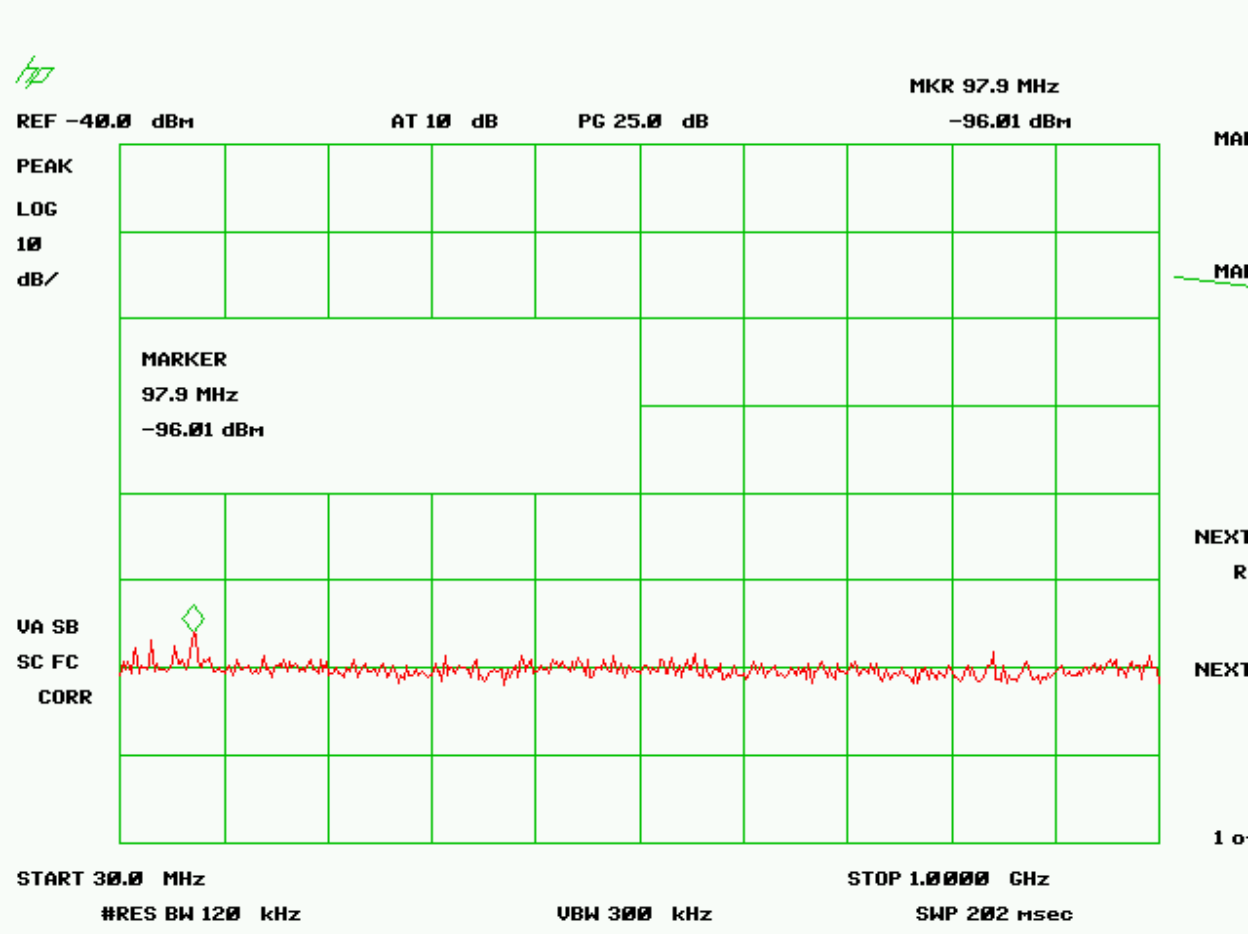

Figure 28 – Pre-Scan Plot - Radiated Emissions - Idle Mode - Vertical Polarity

2 Test and Measurements (Cont'd)

2.17 Radiated Emissions for Digital Device (CFR 15.109 (a))

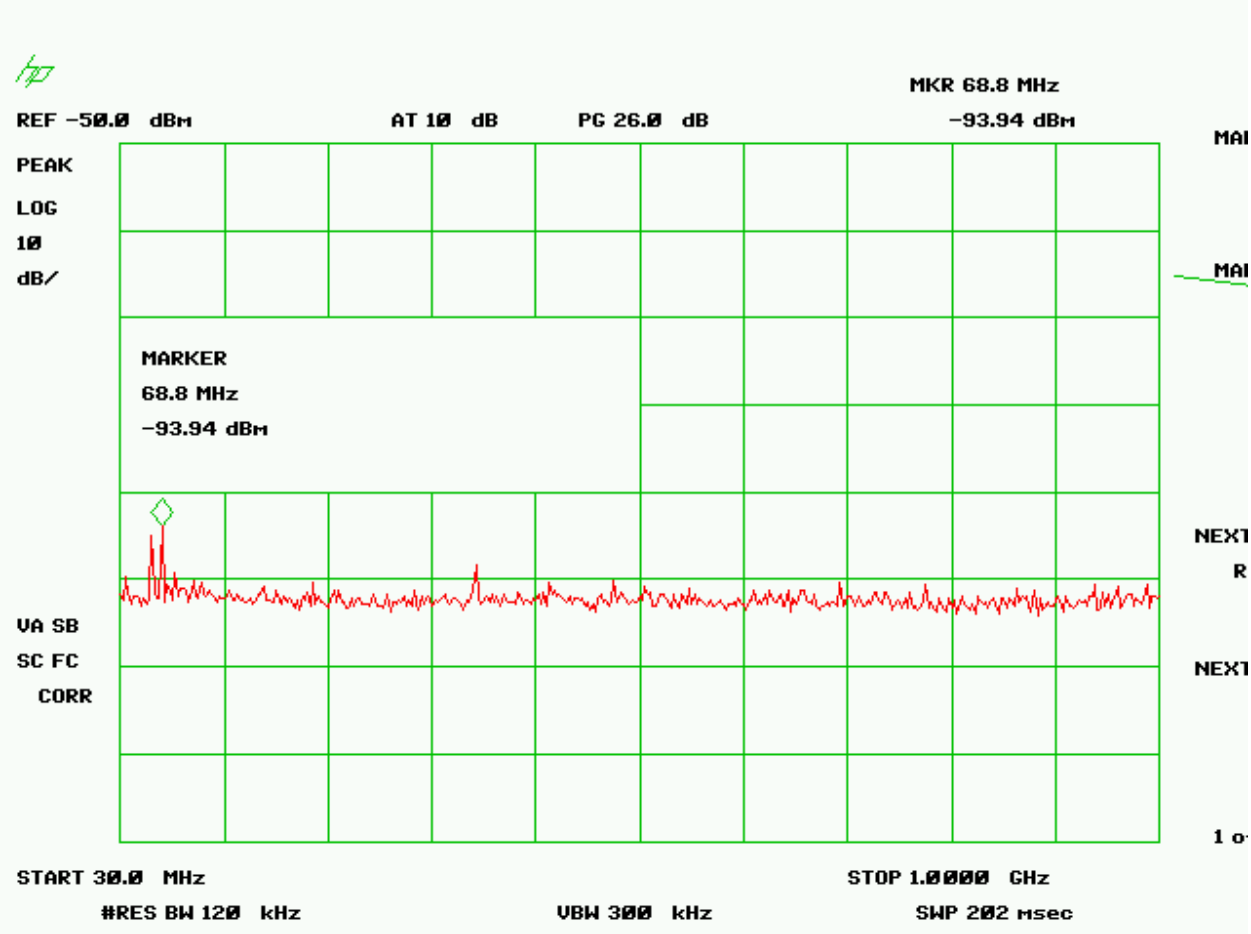

Figure 29 – Pre-Scan Plot - Radiated Emissions - Low Channel Transmission - Vertical Polarity

2 Test and Measurements (Cont'd)

2.18 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5)

The transmitter was placed into a continuous mode of operation. The center frequency was set to 2405.000 MHz for low channel and 2440.000 for mid channel and 2475.000 for high channel, all with a 1.5 MHz span. The measurements were performed per the procedures of FCC KDB Procedure 558074. The RBW was set to 3 kHz and the Video Bandwidth was set to 10 kHz. The trace capture time was set to (Span/3 kHz).

The power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in Figures 30 through 32. All are less than +8 dBm per 3 kHz band.

2 Test and Measurements (Cont'd)

2.18 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5)

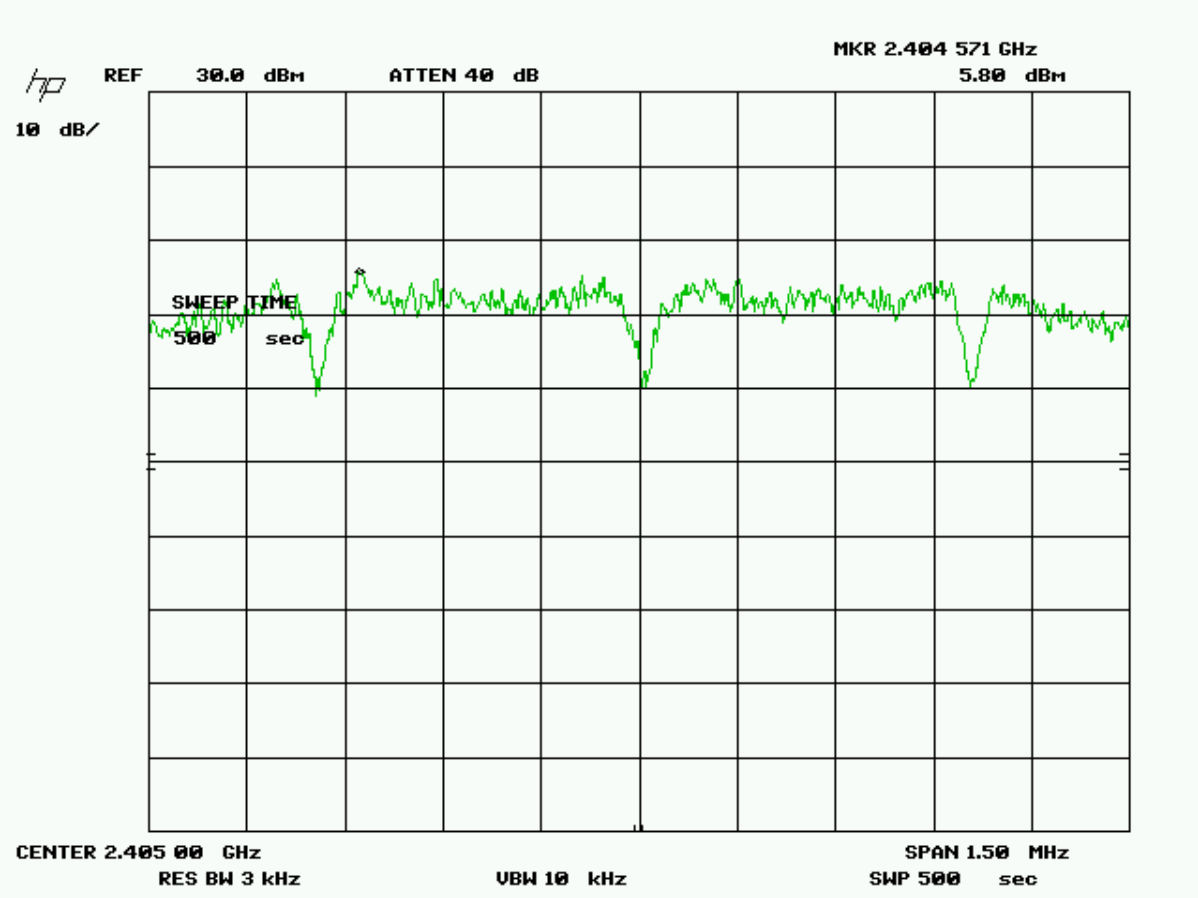

Figure 30 - Peak Power Spectral Density - Part 15.247 (e) - Low Channel

2 Test and Measurements (Cont'd)

2.18 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5)

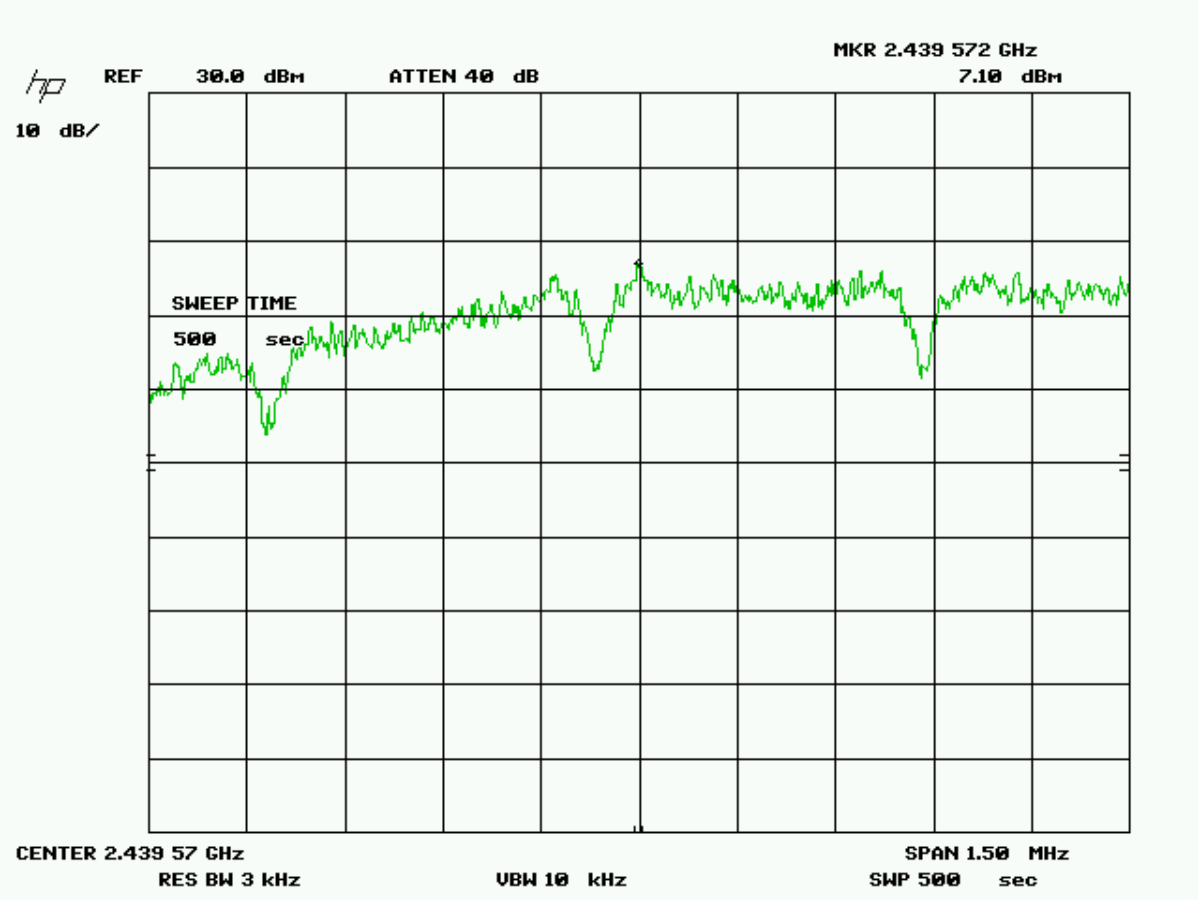

Figure 31 - Power Spectral Density - Part 15.247 (e) - Mid Channel

2 Test and Measurements (Cont'd)

2.18 Power Spectral Density (CFR 15.247(e)) (IC RSS 210 A8.5)

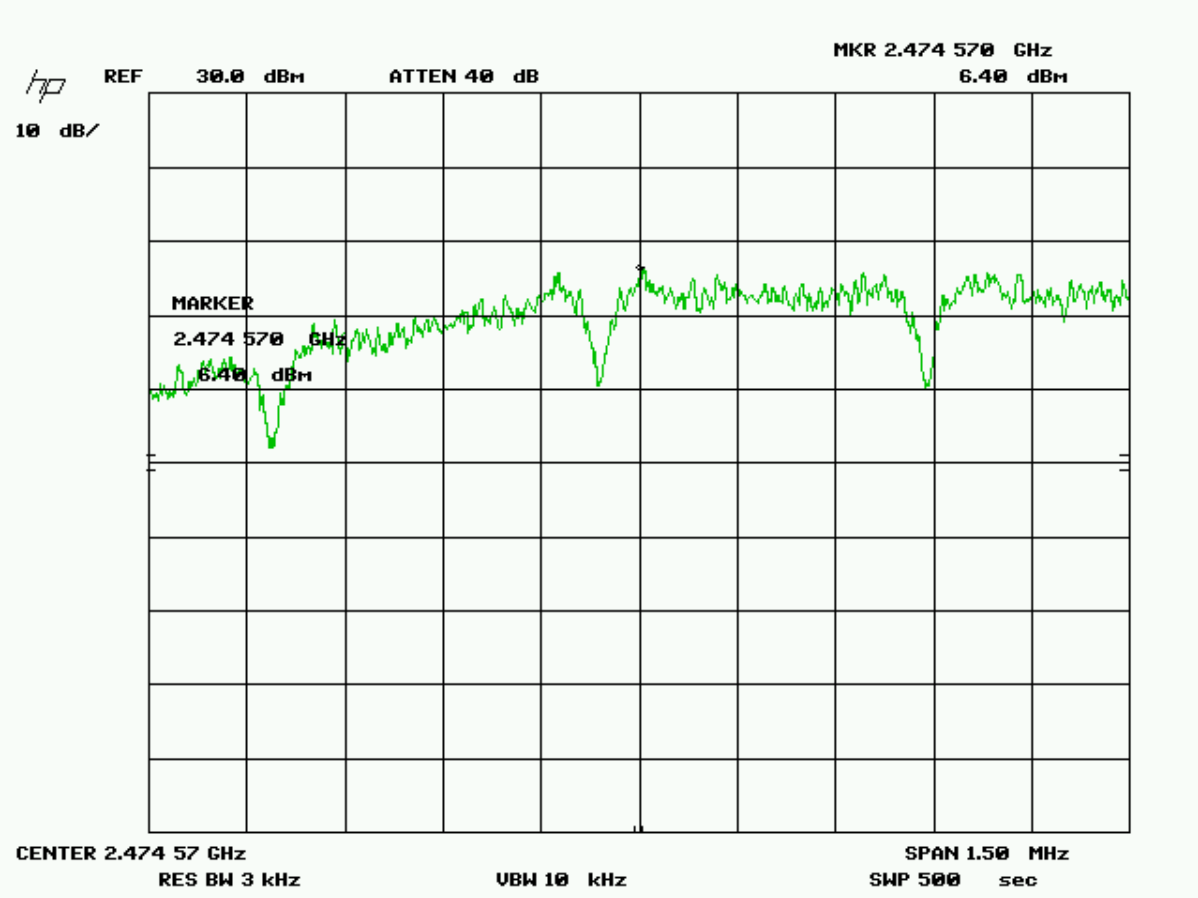

Figure 32 - Peak Power Spectral Density - Part 15.247 (e) - High Channel

2 Test and Measurements (Cont'd)

2.19 Maximum Public Exposure to RF (MPE) CFR 15.247 (i)

The maximum exposure level to the public from the RF power of the EUT shall not exceed a power density, **S**, of 1 mW/cm^2 at a distance, d, of 20 cm from the EUT.

Therefore, for :

Peak Power (Watts) = 0.15849 (from Table 5, herein)
Gain of Transmit Antenna = 2.2 dB_i = 1.66, numeric (from Table 3, herein)
d = Distance = 20 cm = 0.2 m

S = $(PG/ 4\pi d^2)$ = EIRP/4A = 0.15849(1.66)/4*Pi*0.2*0.2
=0.263/0.503 = 0.523 w/m^2
= (0.523W/m^2)(1m^2/W)(0.1 mW/cm^2)
= 0.0523 mW/cm^2

which is << less than 1 mW/cm^2