Testing Tomorrow's Technology

Application
For
Permissive Change

Title 47 Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraph 15.247
And
Certification under
RSS-210 Issue 8, December 2010

For the

Nivis, LLC.
VersaNode 310
Model: VN310R

FCC ID: SQB-VN3104034R5
IC: 6546A-NIVIS4042P3

UST Project: 13-0142
Issue Date: May 16, 2013

Total Pages: 44

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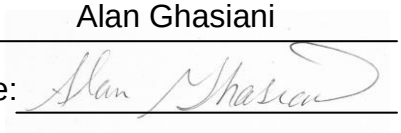
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date May 16, 2013

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Nivis, LLC.

MODEL: VN310R

FCC ID: SQB-VN3104034R5
IC ID: 6546A-NIVIS4042P3

DATE: May 16, 2013

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

Equipment type: 2.4 GHz Transmitter 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
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1 General Information

1.1 Purpose of this Report

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for a Class II Permissive Change to include the use of a new antenna. This evaluation is also required per FCC Docket # 178919 v05r03, section 1 Antenna Changes.

The following antennas are being added to be used with this radio module.

Antenna Type	Gain	Model	Manufacturer
Chip antenna	+0.5 dBi	ANT-2.4-CHP-X	Antenna Factor

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on May 1, 2013 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Nivis, LLC. VersaNode 310 model VN310R which is a 2.4 GHZ Transmitter Module. The VN310R consists of a baseband processor with integrated 2.4 GHz to 2.483 GHz ZigBee radio (SOC) plus peripheral components such as power amplifiers, switches, clocks, memory and linear regulators. There are no other variants to the VN310R. The EUT application is for indoor and outdoor environments and its main application is to serve as an industrial wireless network that supports ISA100.11a and Wireless HART industry standards.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2003, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)* for FCC subpart B Digital equipment Verification requirements and per FCC KDB Publication number 558074 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated verification emissions data (FCC 15.107 and 109) below 1 GHz 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 list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 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 site registration number is 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

1.6 Related Submittal(s)/Grant(s)

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

The EUT is subject to the following FCC Equipment Authorizations:

- The module has already been previously granted under the following FCC ID: SQB-VN3104034R5 and IC ID: 6546A-NIVIS4042P3.

The manufacturer desires to add the use of an additional antenna to this grant. No other changes have been implemented.

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
2.4 GHz radio Nivis, LLC. (EUT)	VN310R	Engineering Sample	Pending: SQB-VN3104034R5	1meter USB
Chip Antenna Antenna Factor	ANT-2.4-CHP-X	--	--	--
Laptop Computer IBM	Various	Various	Various	2 meter U -P
Power Supply IBM	Various	Various	None	2 meter U - P 120 VAC/ 60 Hz

2 Tests and Measurements

2.1 Test Equipment

Table 2 below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2 - Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	11/21/12
SPECTRUM ANALYZER	E4407B	Agilent	US41442935	10/29/12
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	11/29/12
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	8/09/11 2 yrs
BICONICAL ANTENNA 25 MHz to 200 MHz	BIA-25	Electro-Metrics	2451	7/02/12
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	6/15/12
HORN ANTENNA 1 GHz to 18 GHz	EMCO	3115	9107-3723	8/10/11 2 yrs
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	4/12/12

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 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.

2.3 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 in Table 3 as follows:

Table 3 - Number of Test Frequencies for Intentional Radiators

Frequency 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

Because the EUT operates over 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

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.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB. Please section 2.8 herein for details.

2.6 EUT Antenna Requirements (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. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4 - Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i	TYPE OF CONNECTOR
Antenna Factor	Chip	ANT-2.4-CHP-X	Antenna 1	+0.5	solder

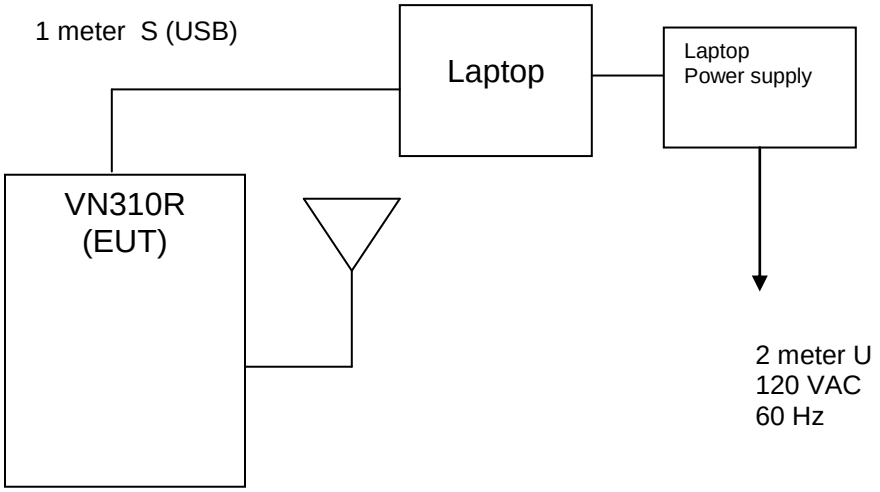


Figure 1- Test Configuration

2.7 Restricted Bands of Operation (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 see paragraph 2.10.

2.8 Transmitter Duty Cycle (CFR 35 (c))

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below. This factor was calculated by first determining the worst case scenario for system operation.

The worst-case scenario in any 100 ms timeslot, along with all transmission lengths, will be as follows:

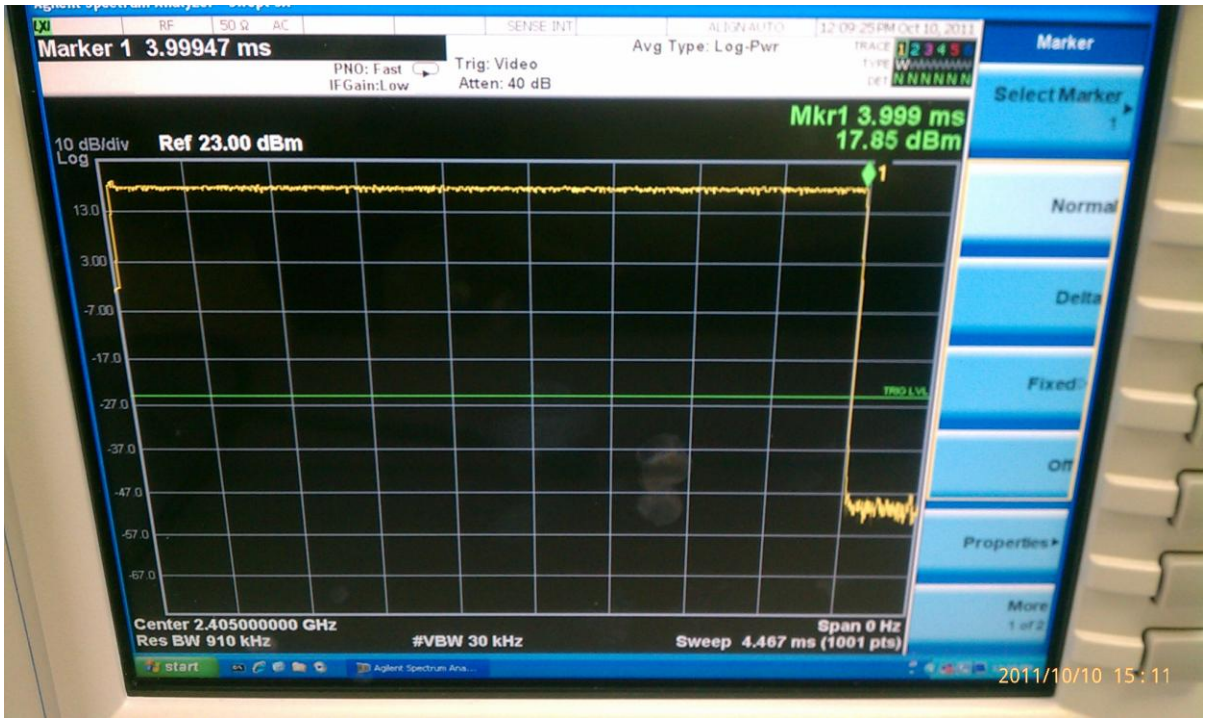


Figure 2 - Duty Cycle

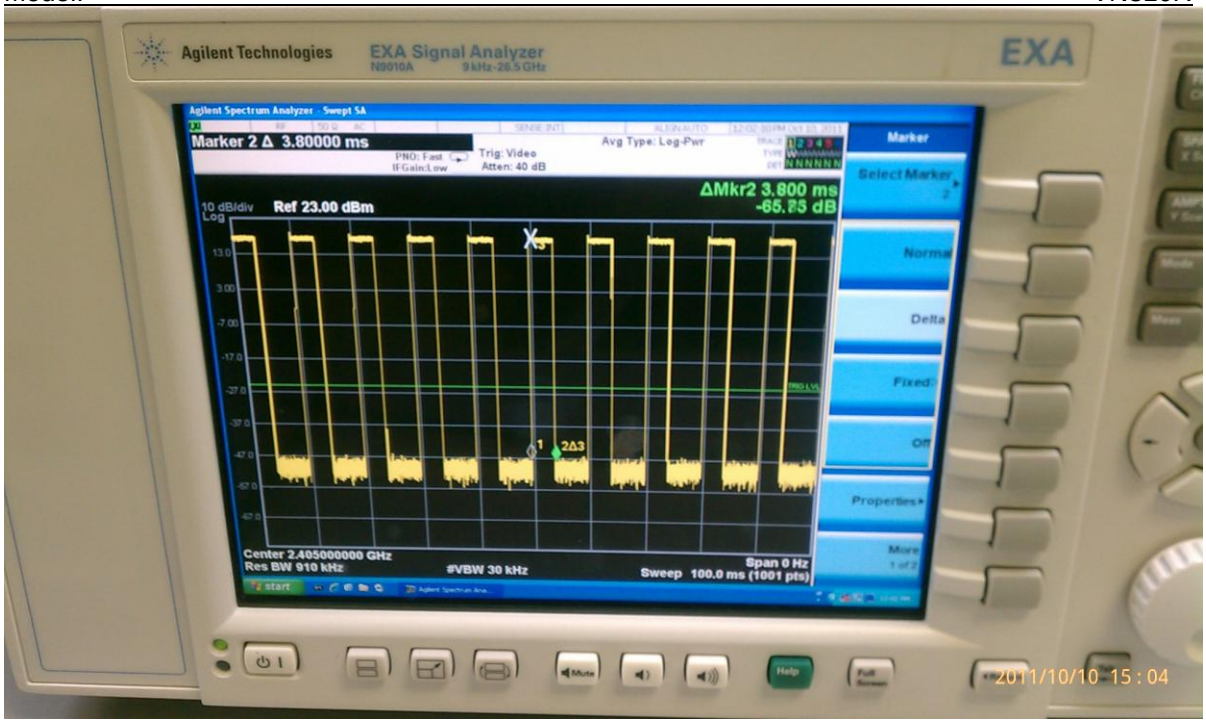


Figure 3 - Duty Cycle

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

Duty Cycle = (40 msec/100 msec) = 0.40 = 40 %

Correction Factor = $20\log_{10}(0.40)$ = **-7.96 dB**

2.9 Intentional Radiator, Radiated Emissions (Antenna Conducted) (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a))

The EUT was put into a continuous-transmit mode of operation and tested per FCC KDB Publication 558074 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to 12.5 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna Conducted Emissions of a significant magnitude that fell within restricted bands were then measured as radiated emissions on the OATS. The conducted emissions graphs are found in Figures 4 through 12 below. The limit for antenna conducted power is 1 Watt (30 dBm) per 15.247 (b)(3).

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 below.

For Average Voltage measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz. For a pulse-modulated transmitter, the EUT's average emissions are further modified by adding to them the worst-case duty cycle, determined by adding the EUT's total pulse widths (on time) over a 100 ms period and dividing by 100 ms.

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

On the OATS, the EUT was mounted on top of a non-conductive table, 80 cm above the floor, by placing it in the X-Z plane along the Z axis with its bottom cover in parallel with the ground. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

The test data is detailed below in for this section. Several radiated emissions above 1 GHz were measured at a distance of 1 meter. The measured value at 1 meter was then extrapolated to the resultant at 3 meters using an inverse distance extrapolation factor of -20 dB/decade. There were no test failures.

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

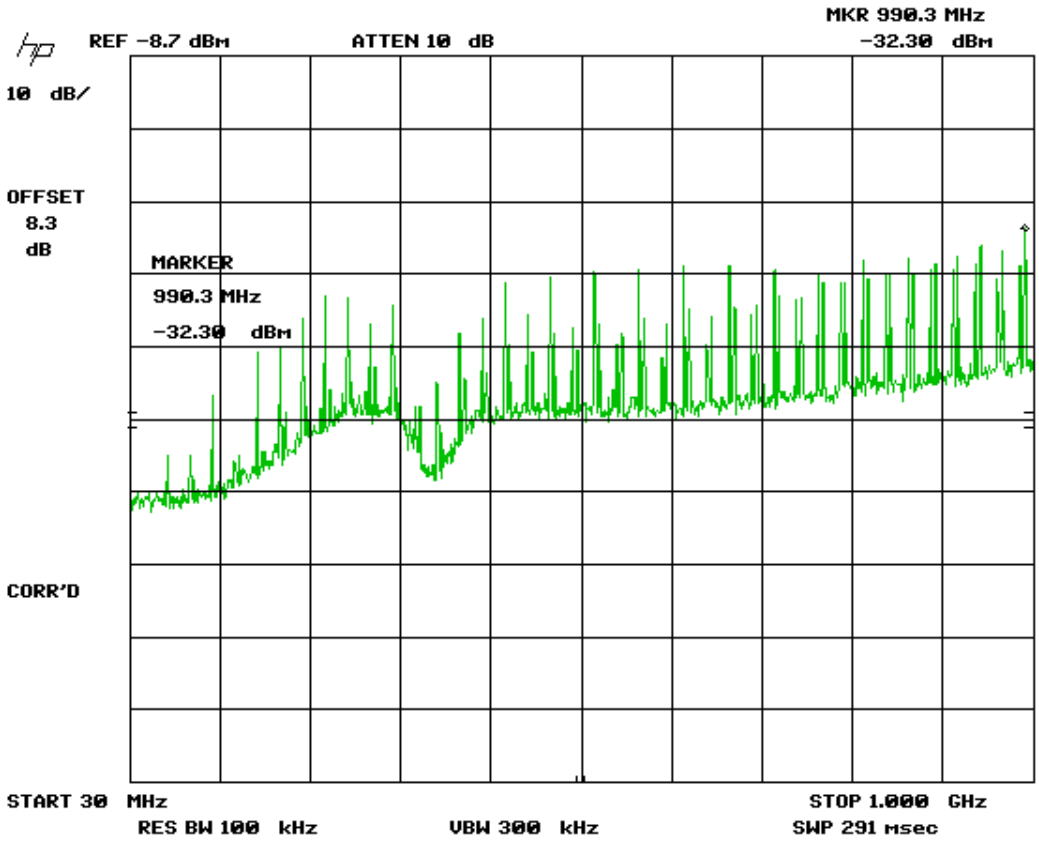


Figure 4 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Low Channel, Part 1

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

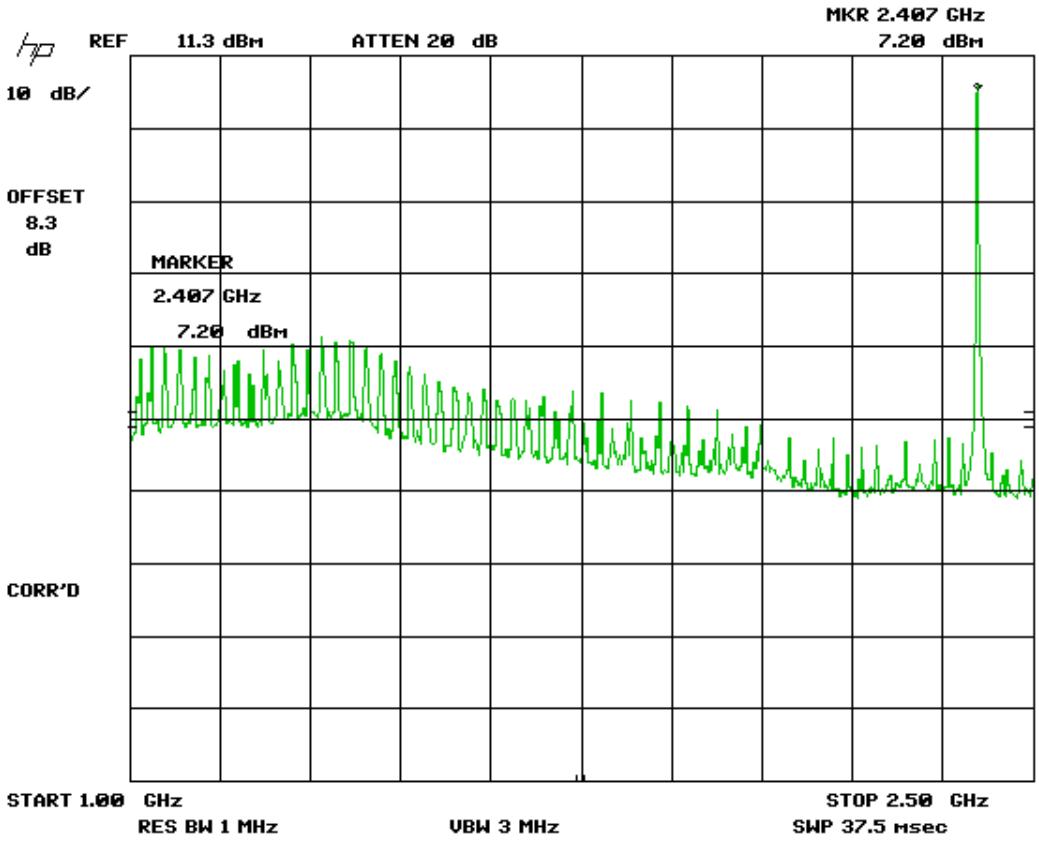


Figure 5 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Low Channel, Part 2

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

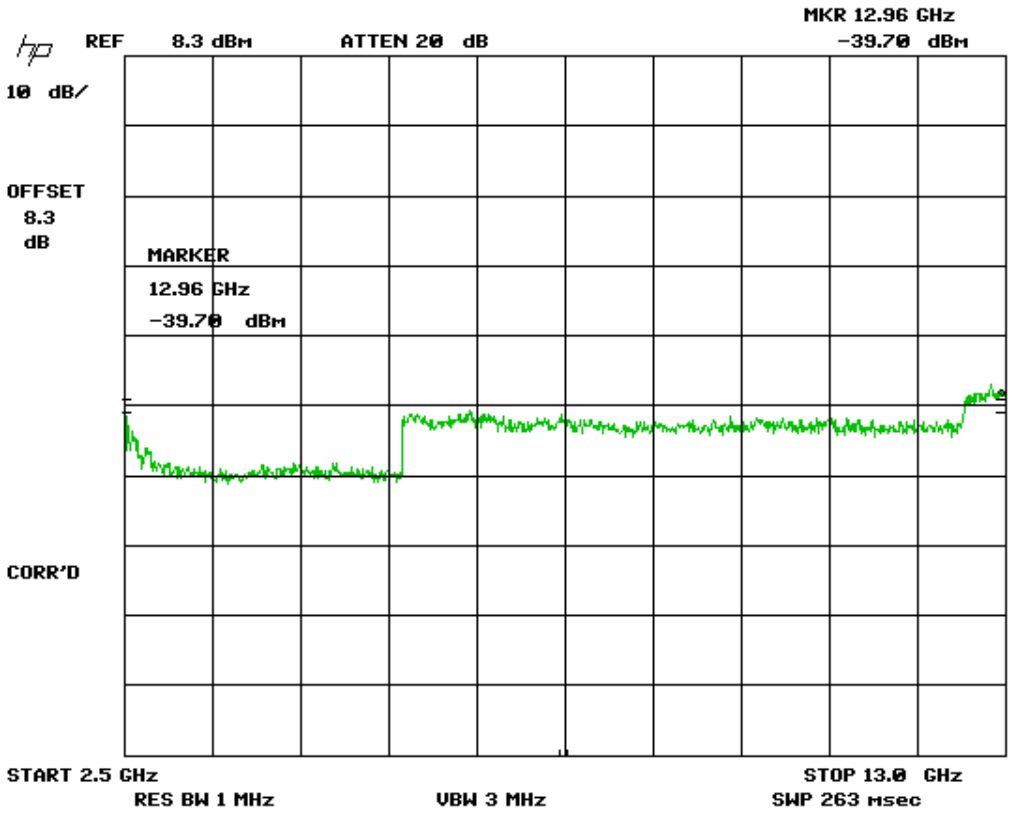


Figure 6 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Low Channel, Part 3

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

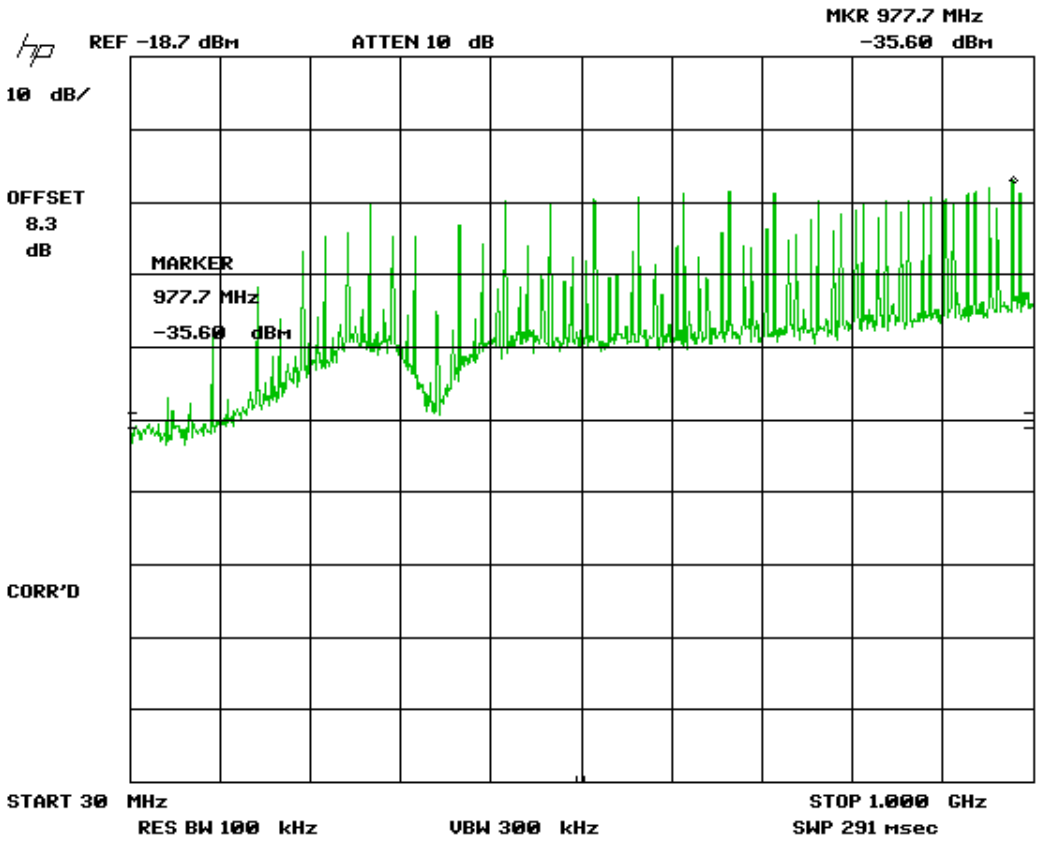


Figure 7 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Mid Channel, Part 1

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Signal shown represents Fundamental Frequency

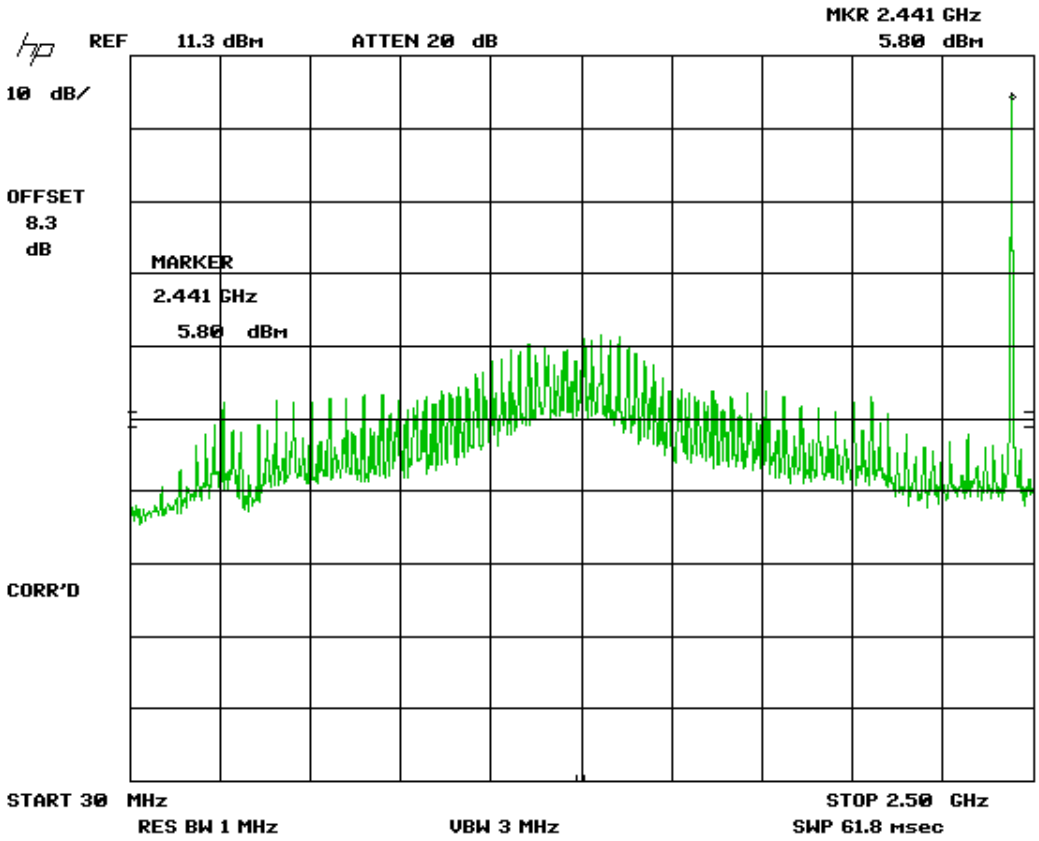


Figure 8 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Mid Channel, Part 2

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

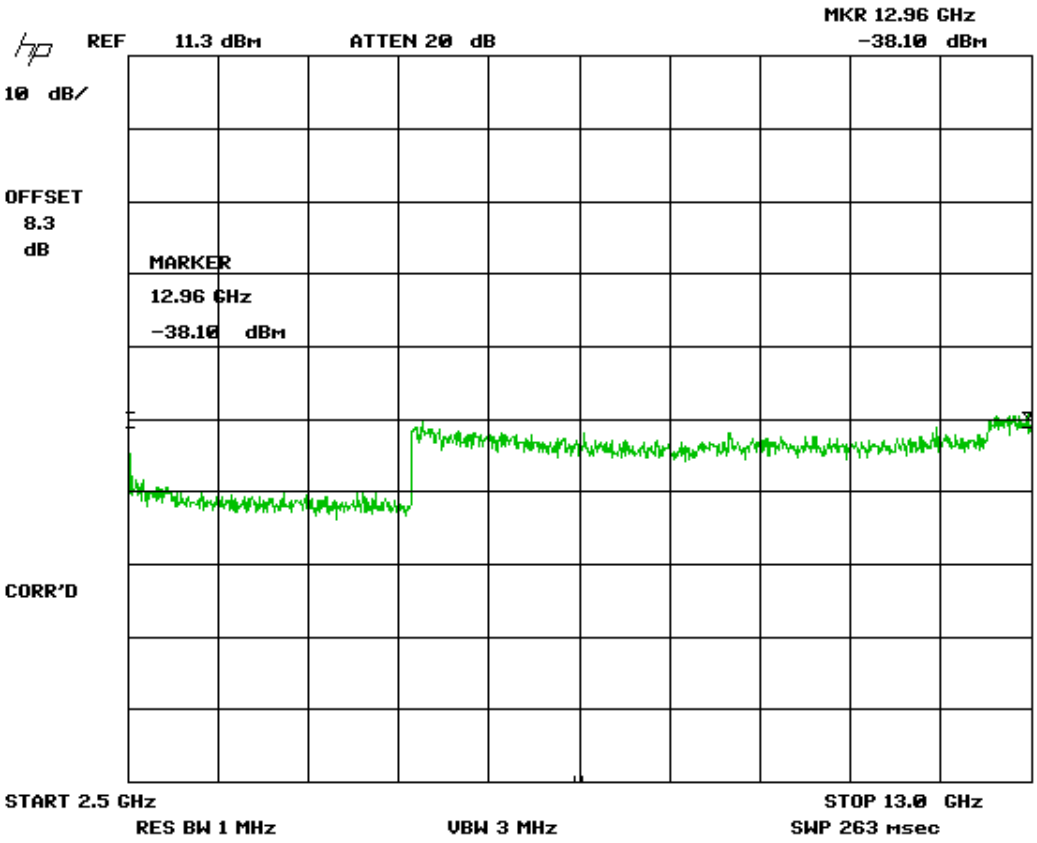


Figure 9 - Antenna Conducted Spurious Emissions – CFR 15.247 (d) Mid Channel, Part 3

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

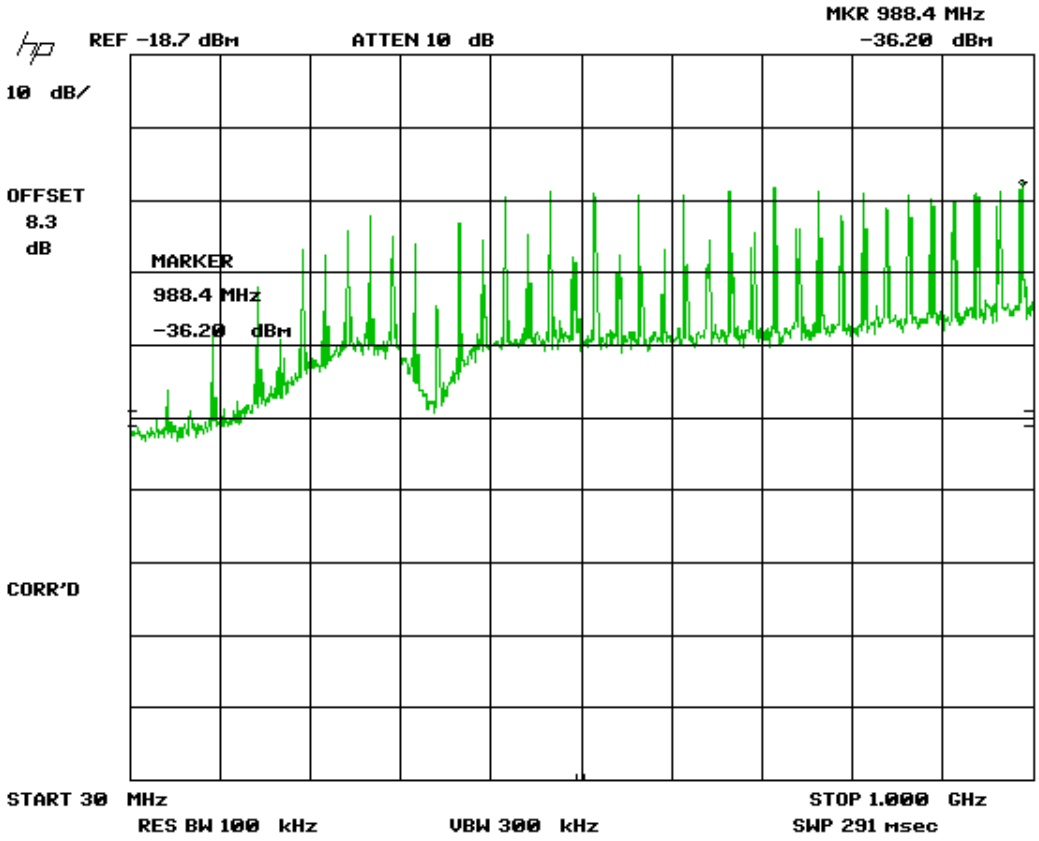


Figure 10 - Antenna Conducted Spurious Emissions – CFR 15.247 (b) High Channel, Part 1

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

Note: Large Signal shown is Fundamental Frequency

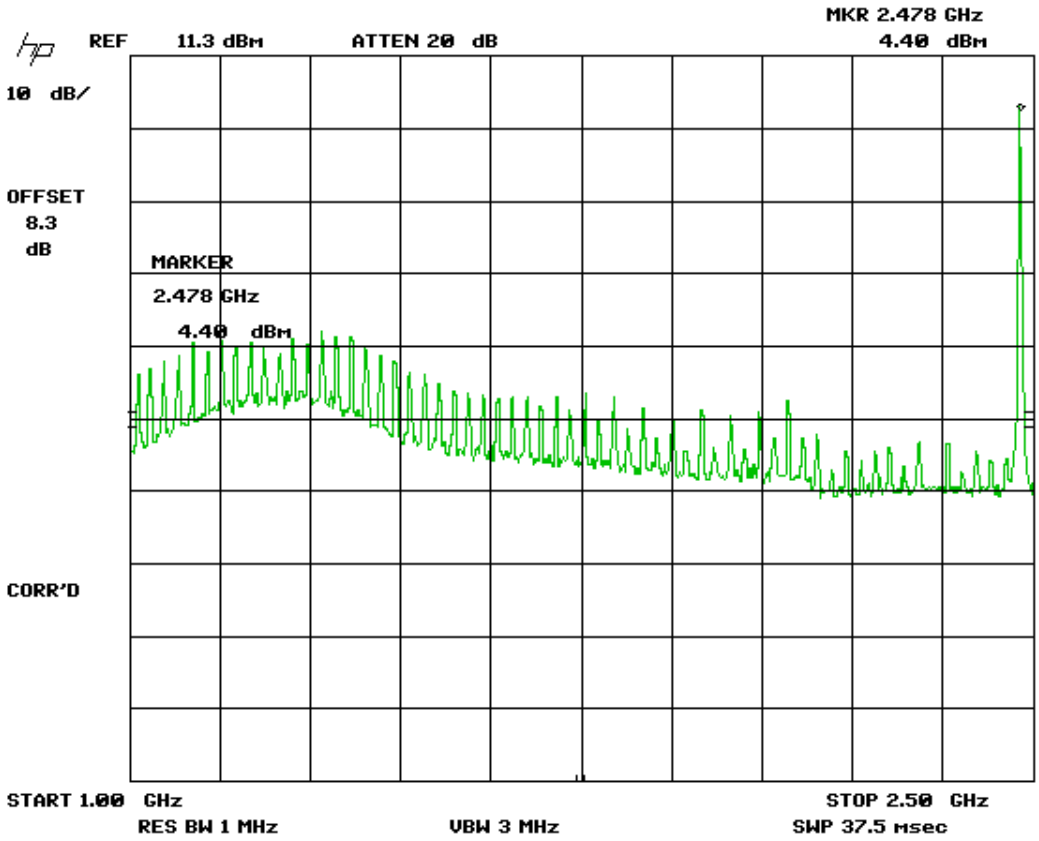


Figure 11 - Antenna Conducted Spurious Emissions - CFR 15.247 (d) High Channel, Part 2

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

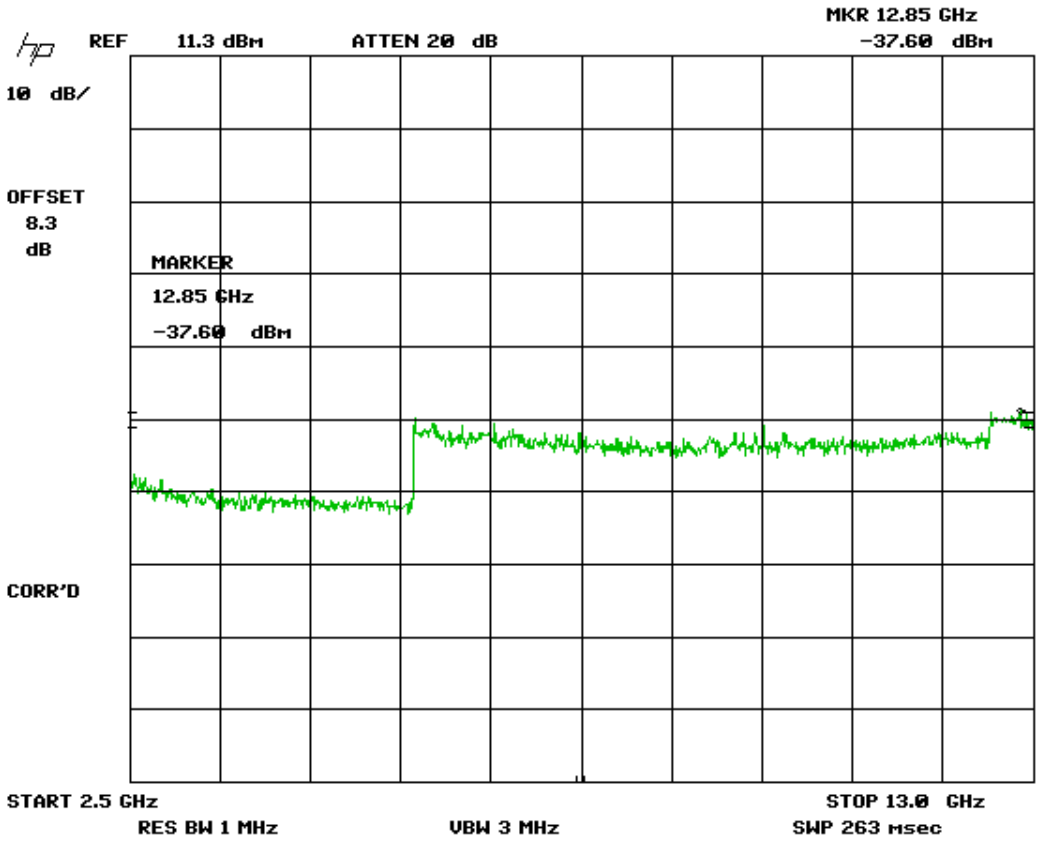


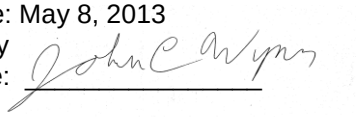
Figure 12 - Antenna Conducted Spurious Emissions - CFR 15.247 (d) High Channel, Part 3

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd)

Table 5 – Antenna 1- Peak Radiated Harmonic & Spurious Emissions

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By:	Test: FCC Part 15, Para 15.247(d)				Client: Nivis, LLC.		
JW	Project: 13-0142				Model: VN310R		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK							
2404.98	60.30	31.35	91.65		3.0m./		**PK**
4810.00	50.78	2.94	53.72	74	3.0m./	20.3	**PK**
7214.99	62.10	-2.88	59.22	74	3.0m./	14.8	**PK**
9619.97	61.10	-2.11	58.99	74	3.0m./	15.0	**PK**
MID BAND- PEAK							
2440.83	82.04	31.95	113.99		3.0m./		**PK**
4881.73*	47.99	3.82	52.81	74.0	3.0m./	21.2	**PK**
7322.48*	57.30	9.39	67.69	74.0	3.0m./	6.3	**PK**
9763.60	50.62	11.01	62.63	74.0	3.0m./	11.4	**PK**
HIGH BAND- PEAK							
2475.83	81.24	32.21	113.45		3.0m./		**PK**
4949.70*	47.38	3.95	52.33	74.0	3.0m./	21.7	**PK**
7427.50*	58.16	9.21	68.37	74.0	3.0m./	5.6	**PK**
9903.52	49.45	11.69	62.14	74.0	1.0m./	11.9	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
2. ND = No other signals detected within 20 dB of specification limit.
SAMPLE CALCULATION:
3. Measurements taken at 1 meter distance were extrapolated to 3 meter using a factor of (-9.5 dB).
4. 1.5 dB loss factor is added for all measurement using the high pass filter.
RESULTS: At 4810 MHz: = 50.78 dBuV+ (1.5 dB high pass filter loss) +1.44 dB/m = 53.72 dBuV/m @ 3m
Margin = (74.0 – 56.69) = 20.3 dB

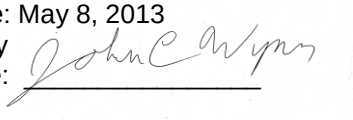
Test Date: May 8, 2013
Tested By
Signature:  Name: John Wynn

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Table 6 – Antenna 1- Average Radiated Spurious

Radiated Spurious Emissions, Tested from 30 MHz – 24 GHz							
Tested By: JW	Test: FCC Part 15, Para 15.247(d)			Client: Nivis, LLC.			
	Project: 13-0142			Model: VN310R			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA+DC (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - AVG							
2404.98	59.97	31.35	91.32		3.0m./		**AVG**
4810.00*	46.10	1.44	41.08	54.0	3.0m./	12.9	**AVG**
7214.99	62.35	6.30	52.69	71.3	1.0m./	18.6	**AVG**
MID BAND- AVG							
2440.00	57.10	31.35	85.45		3.0m./		**AVG**
4880.08*	47.96	1.27	42.77	54.0	1.0m./	11.2	**AVG**
7320.00*	61.53	5.40	50.97	54.0	1.0m./	3.0	**AVG**
HIGH BAND- AVG							
2475.00	54.65	31.60	86.25		3.0m./		**AVG**
4949.93*	46.69	1.57	41.80	54.0	3.0m./	12.2	**AVG**
7424.93*	60.51	5.33	49.88	54.0	1.0m./	4.1	**AVG**
9900.16	44.52	6.30	34.86	54.0	1.0m./	19.1	**AVG**

1. (*) Falls within the restricted bands of CFR 15.205.
2. ND = No other emissions detected within 20 dB of the Part 15.209 limits for spurious emissions within Restricted Bands.
3. Test data values measured at 1 meter include a factor of -9.54 dB for distance extrapolation from a test distance of 1 meter to 3 meters.
4. Additional factors already included are Duty Cycle, DC = -7.96 dB and filter factor of +1.0 dB.
SAMPLE CALCULATION:
RESULTS: At 4880.08 MHz: = (47.96+ (1.5 dB filter factor -7.96 DC)[(4)]) + (1.27 dB) = 42.77 dBuV/m @ 3m
Margin = (54.0 –42.77) = 11.2 dB

Test Date: May 8, 2013
Tested By
Signature:  Name: John Wynn

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

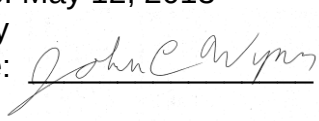
For the VN310R module, the transmitter was programmed to operate at a maximum of +12 dBm across the bandwidth.

Peak power within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 as an Antenna 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 an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW ≥ RBW. The loss of the short cable is 0.3 dB, and addition of an attenuator, 8.0 dB and the final corrected measurements were determined by adding 8.3 dB to the raw data measured values of Figures 13-15. Peak antenna conducted output power is tabulated in Table 7 below.

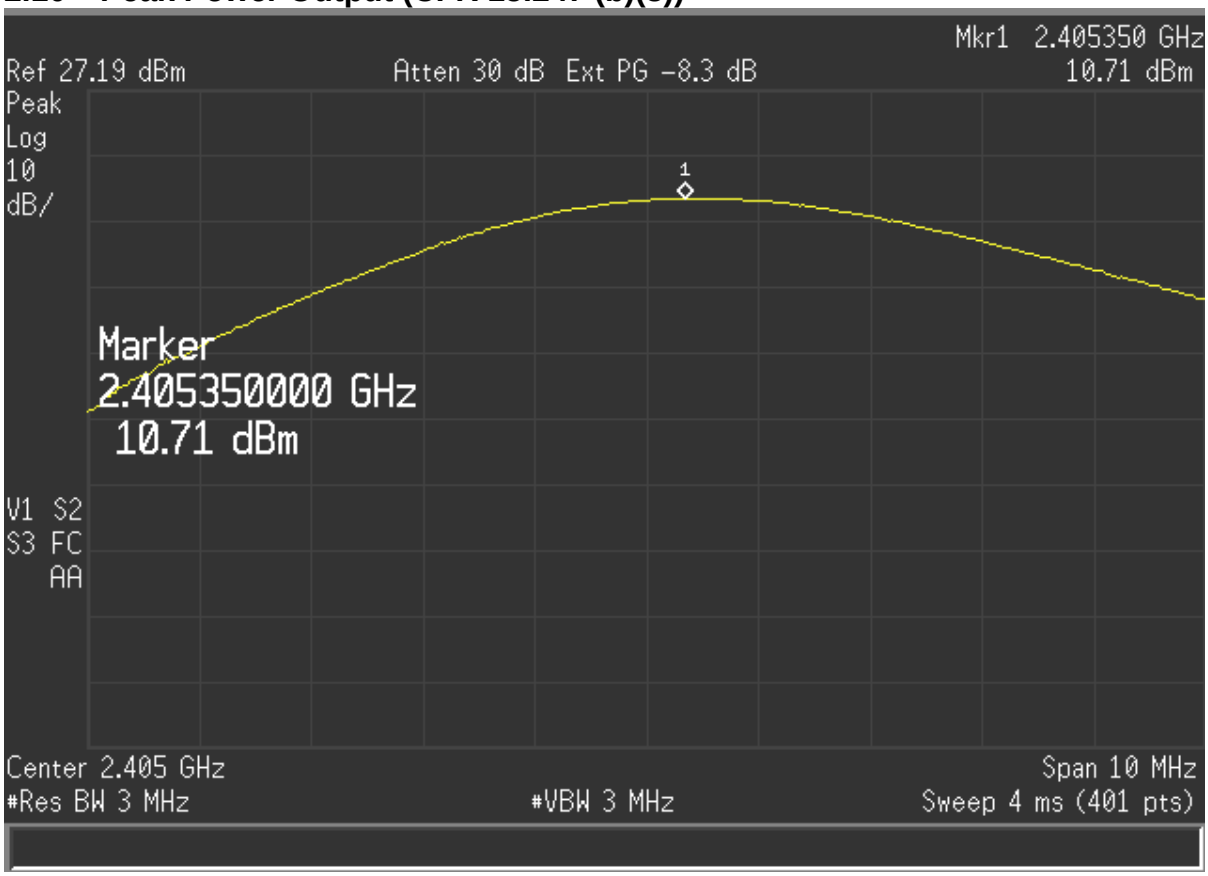
Table 7 - Peak Antenna Conducted Output Power per Part 15.247 (b) (3) (Same as EIRP)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Corrected Measurement (dBm)	(mW)	FCC Limit (mW Maximum)
Low Band 2405	10.71	10.71	11.78	1000
Mid Band 2442	9.42	9.42	8.75	1000
High Band 2475	8.00	8.00	6.31	1000

Note: reference adjusted for correction factor, 8.3 dB for attenuator and cable loss.
Note: The radio was set to a power level setting of “11”. This setting is not user adjustable.

Test Date: May 12, 2013
Tested By
Signature:  Name: John Wynn

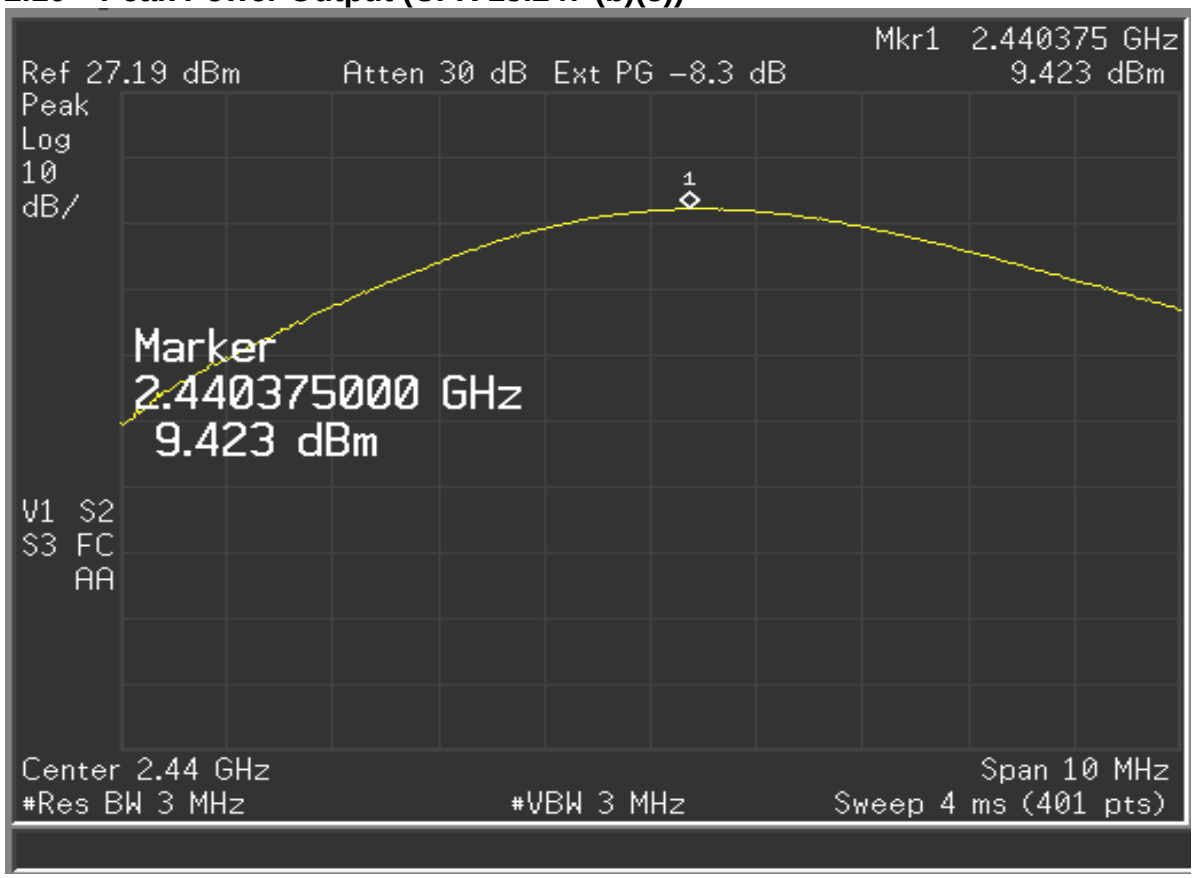
2.10 Peak Power Output (CFR 15.247 (b)(3))



Note: reference adjusted for correction factor.

Figure 13 - Peak Antenna Conducted Output Power, Low Channel

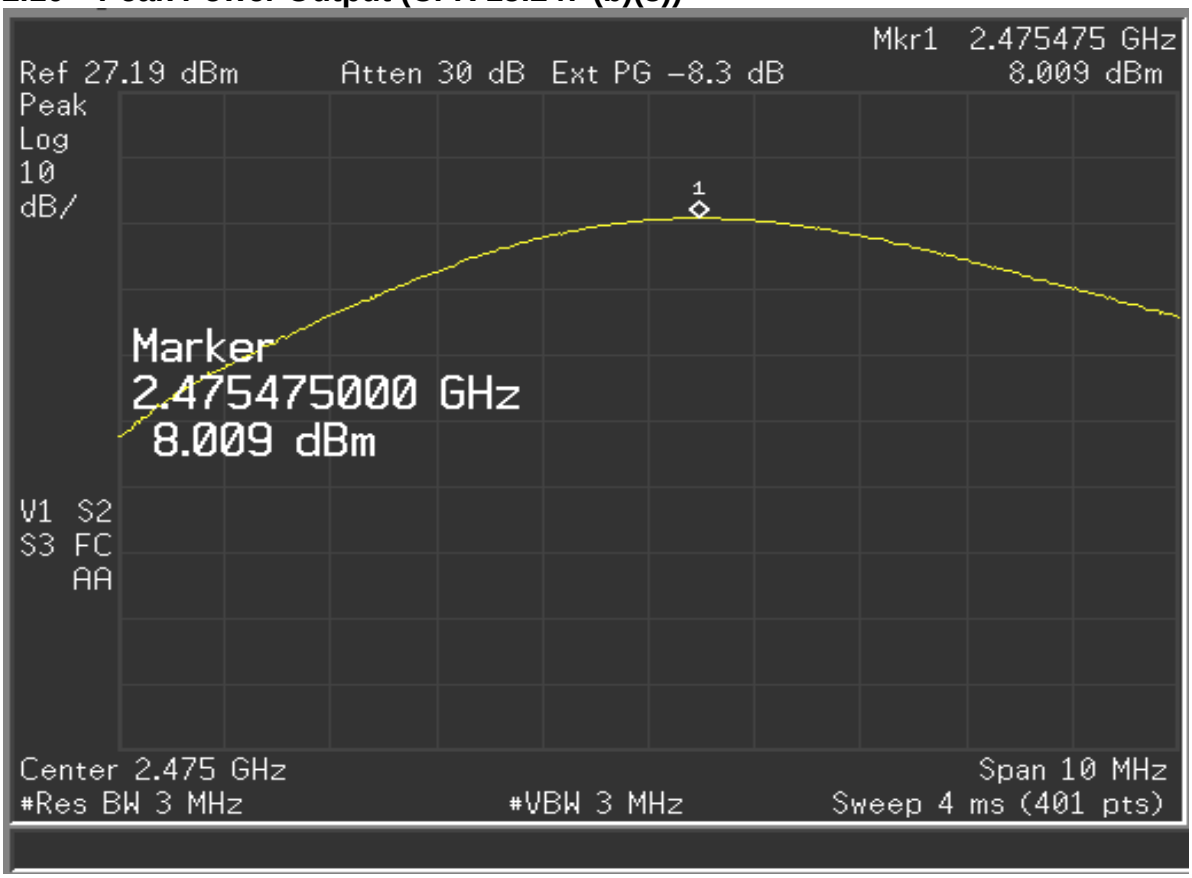
2.10 Peak Power Output (CFR 15.247 (b)(3))



Note: reference adjusted for correction factor.

Figure 14 - Peak Antenna Conducted Output Power, Mid Channel

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



Note: reference adjusted for correction factor.

Figure 15 - Peak Antenna Conducted Output Power, High Channel

2.11 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW ≥1% of the frequency span. In all cases, the VBW is set ≥ RBW. See figure 16 - 17 below.

2.11 Band Edge (Cont'd)

Table 8 - Upper Band Edge - Radiated Emissions

Peak Radiated Higher Band Edge Measurements								
Test By: JCW	Test: FCC Part 15.247					Client: Nivis, LLC.		
	Project: 13-0142		Class: A		Model: VN310R			
Frequency (MHz)	**AF table**	**Test data**	**AF+CA-AMP+DC dB/m**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarity**	**Margin (dB)**	**Detector PK / AVG**
Internal Antenna								
Fund. 2475.00	1HN3mV	54.65	31.6	86.25		3.0m./		**AVG**
Band Edge 2483.5	--	(86.25-38.19)	--	40.06	54.0	3m./	See calculation below	**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 -20.0 dB is applied to the values in the Corrected Results column. After this correction the EUT is found to have met the restrictions placed on average radiated emissions in Restricted Bands. The worst-case measurement is computed below.

CALCULATION OF WORST-CASE AVERAGE UPPER BAND EDGE MEASUREMENT:
Results = Peak Corrected Results + Duty Cycle Correction Factor
Results = 40.06 + (-7.96) = 32.1 dBuV/m
Margin = Limit – Results = 54 – 32.1 = 21.9 dB

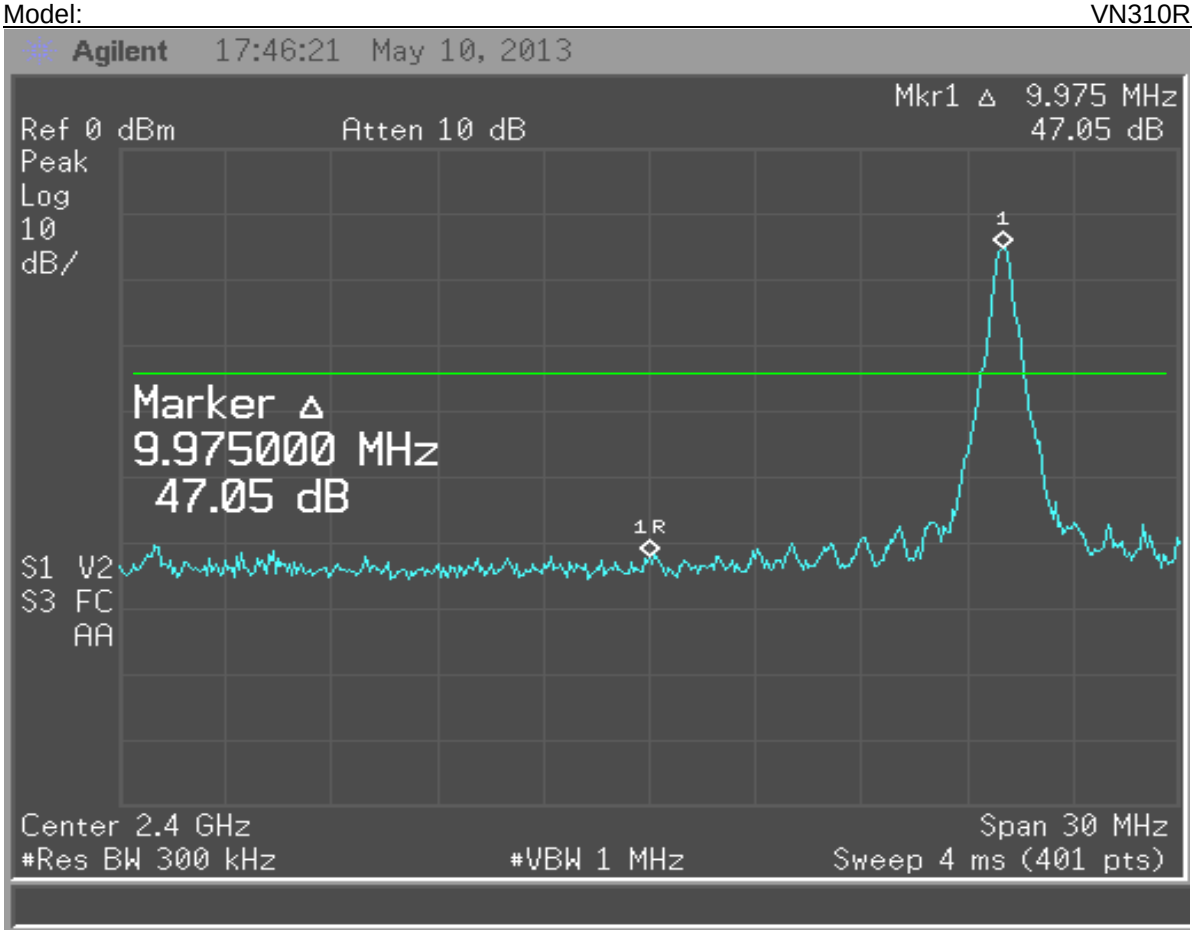


Figure 16. Band Edge Compliance – Low Channel Delta - Peak

Note: Radiated emission shown here as this is the worst case.

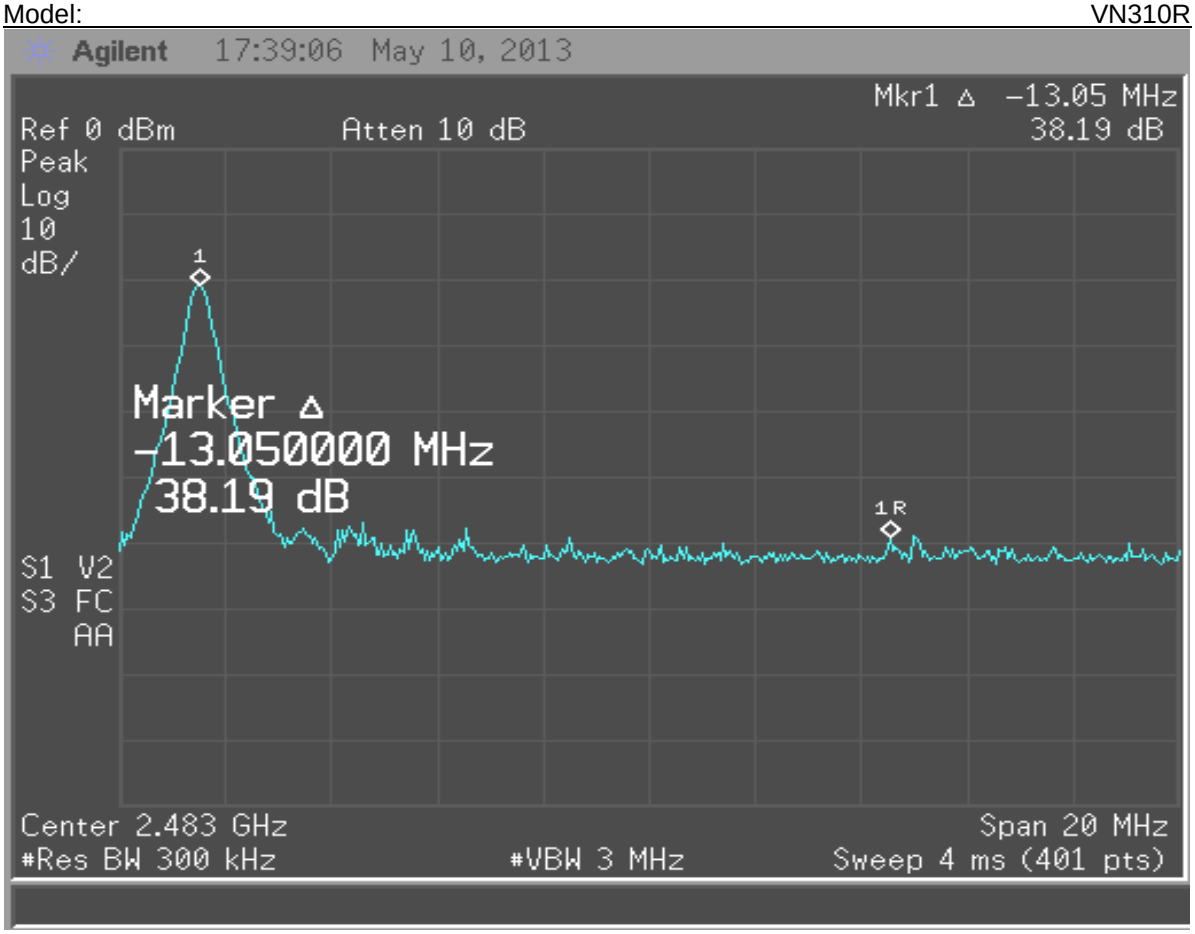


Figure 17. Band Edge Compliance – High Channel Delta - Peak
Note: Radiated emission shown here as this is the worst case.

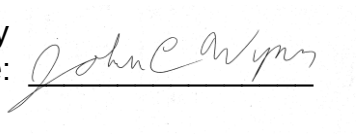
2.12 6 dB Bandwidth Measurement per CFR 15.247, 99% Occupied Bandwidth (IC RSS 210, A8.1)

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 for a bandwidth of 6 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 9 and Figures 18- 20.

Table 9 - 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	20dB/99% Occupied Bandwidth (MHz)
2405.0	1.325	2.575
2440.0	1.500	2.550
2475.0	1.500	2.575

Test Date: September 22, 2011

Tested By
Signature:  Name: John Wynn

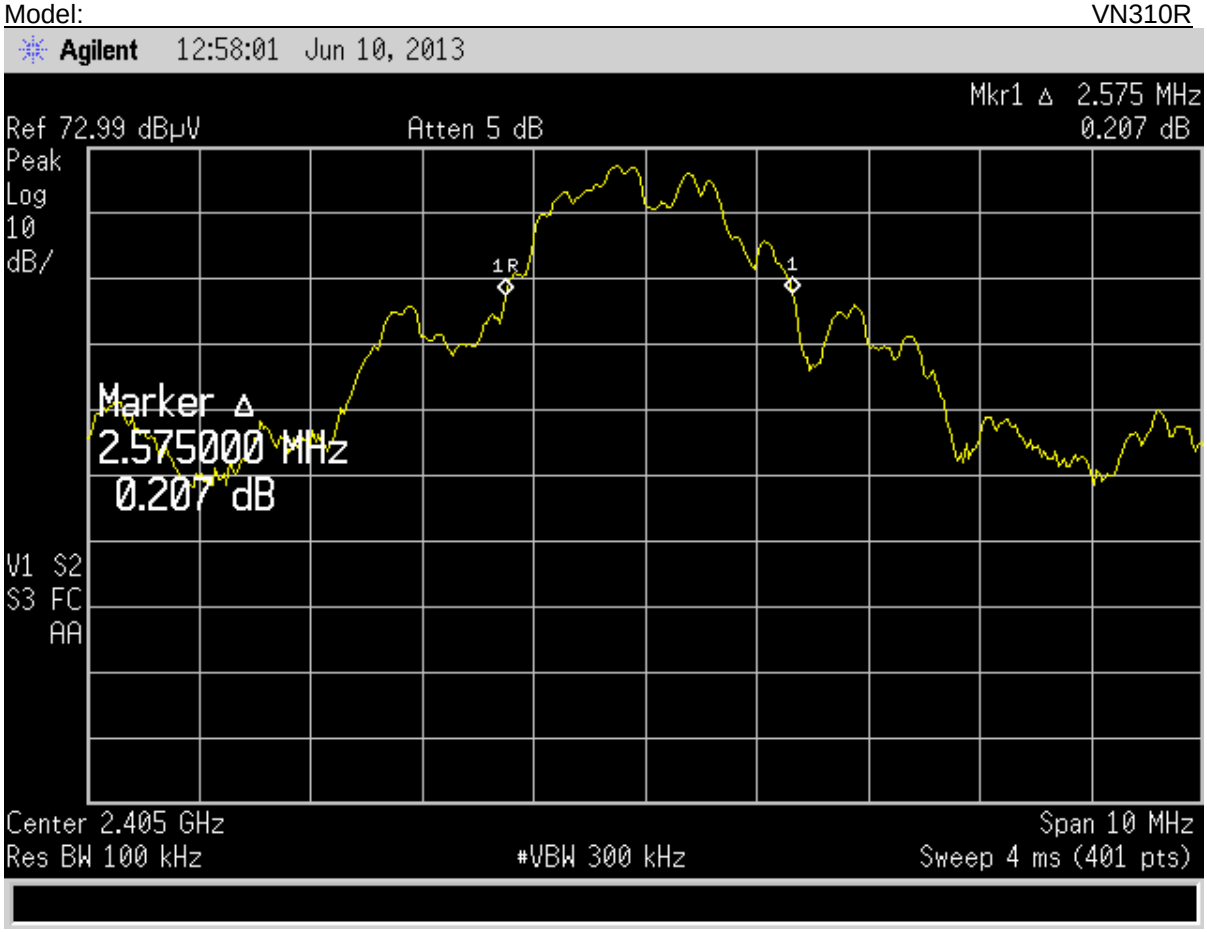


Figure 18. Low Channel 99% Bandwidth

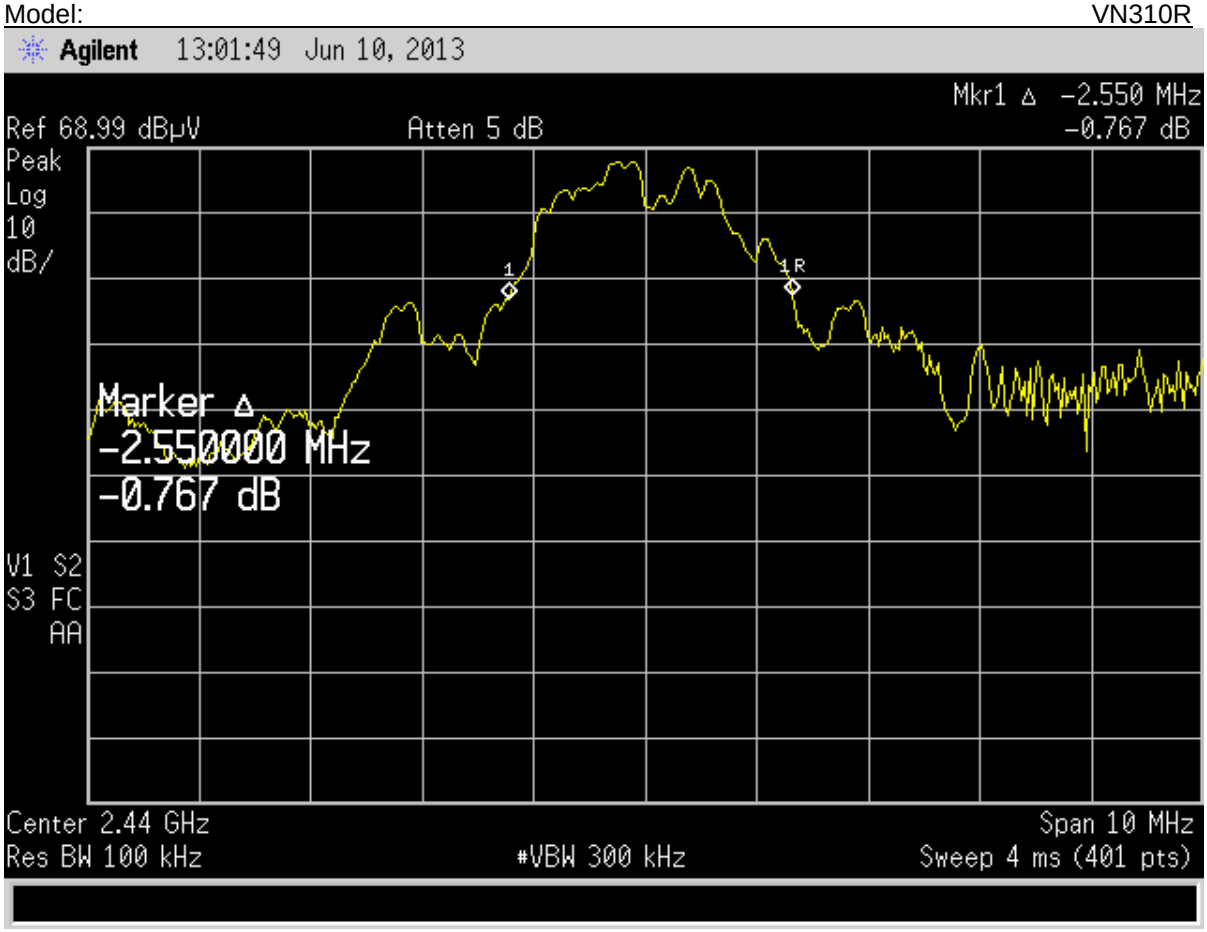


Figure 19. Mid Channel 99% Bandwidth

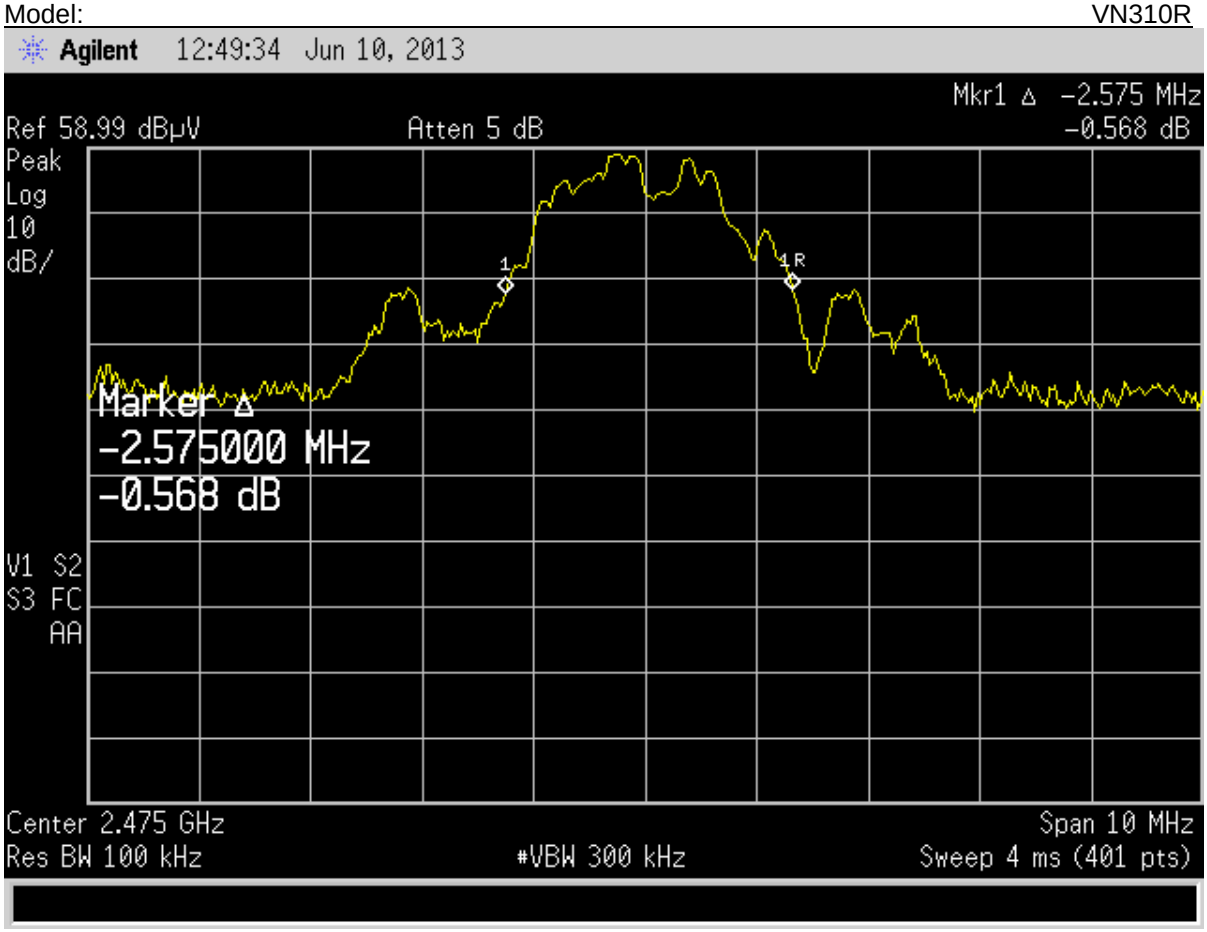


Figure 20. High Channel 99% Bandwidth

2.13 Intentional Radiator, Radiated Emissions (CFR 15.209)

The test data provided herein is to support the verification requirement for digital devices. The EUT was placed inside the host device which includes the co-located Bluetooth module. Both the EUT and the Bluetooth modules RF transmission was enable to allow them to transmit simultaneously. This allowed for testing the EUT in a transmitting state per 15.209. The EUT in this configuration was investigated from 9kHz or the lowest operating clock frequency to 12.5 GHz and tested as detailed in ANSI C63.4:2003, Paragraph 8. The worst case emissions are presented herein.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.4:2003.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The EUT was also evaluated as a co-located radio module during this evaluation. The EUT was programmed to simultaneously broadcast both transmitter radios. The emissions levels were no worst than previously found.

All measured signals were at least 3.9 dB below the specification limit. The results are shown in Table 10 below.

Table 10-Radiated Emissions, Below 1 GHz

Unintentional Radiator, Radiated Emissions							
Test By: JW	Test: FCC Part 15.209			Client: Nivis, LLC.			
	Project: 13-0142			Model: VN310R			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP**
Tested from 9 kHz to 1 GHz							
146.8500	53.30	-14.68	38.62	43.5	2BI3mH	4.9	**PK**
199.7400	47.60	-11.71	35.89	43.5	2BI3mH	7.6	**PK**
456.3000	46.90	-10.31	36.59	46.0	1LP3mV	9.4	**PK**
203.8500	44.50	-14.47	30.03	43.5	1LP3mH	13.5	**PK**
440.7100	41.00	-10.25	30.75	46.0	1LP3mH	15.2	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 limits
AF is antenna factor. CL is cable loss. PA is preamplifier gain

SAMPLE CALCULATION: At 199.74 MHz: = 47.6+ (-22.21) = 25.39 dBuV/m @ 3m
Margin = (43.5-25.39) = 18.1 dB

Test Date: M ay 13, 2013

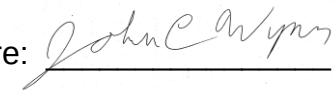
Tested By Signature:  Name: John Wynn

Table 11 - Radiated Emissions, Above 1 GHz

Unintentional Radiator, Radiated Emissions							
Test By: JW	Test: FCC Part 15.209			Client: Nivis, LLC.			
	Project: 13-0142			Model: VN310R			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP**
Tested from 1 GHz to 12.5 GHz							
1080.1100	49.32	-8.24	41.08	54.0	1HN3mH	12.9	**PK**
1084.7200	51.51	-8.23	43.28	54.0	1HN3mH	10.7	**PK**
1132.9100	53.90	-7.57	46.33	54.0	1HN3mH	7.7	**PK**
1175.9890	52.22	-7.25	44.97	54.0	1HN3mH	9.0	**PK**
1224.1200	55.30	-6.89	48.41	54.0	1HN3mH	5.6	**PK**
1319.9990	56.04	-6.77	49.27	54.0	1HN3mH	4.7	**AVG**
2357.0000	56.62	-3.92	52.70	54.0	1HN3mH	1.3	**PK**
3265.5000	45.63	-0.76	44.87	54.0	1HN3mH	9.1	**AVG**
3282.2750	48.55	-0.82	47.73	54.0	1HN3mH	6.3	**AVG**
3342.4710	50.36	-0.46	49.90	54.0	1HN3mH	4.1	**PK**
4347.6500	52.55	0.35	52.90	54.0	1HN3mH	1.1	**PK**
4398.7300	50.92	0.52	51.44	54.0	1HN3mH	2.6	**PK**
1085.3890	55.07	-8.45	46.62	54.0	1HN3mV	7.4	**PK**
1108.8100	54.64	-8.08	46.56	54.0	1HN3mV	7.4	**PK**
1223.9100	56.21	-7.27	48.94	54.0	1HN3mV	5.1	**PK**
1319.8500	58.48	-6.54	51.94	54.0	1HN3mV	2.1	**PK**
1656.5200	49.40	-5.97	43.43	54.0	1HN3mV	10.6	**AVG**
2357.0900	51.18	-3.82	47.36	54.0	1HN3mV	6.6	**PK**
3037.3600	50.34	-1.73	48.61	54.0	1HN3mV	5.4	**PK**
3156.5200	51.92	-1.28	50.64	54.0	1HN3mV	3.4	**AVG**
3281.9700	48.89	-0.83	48.06	54.0	1HN3mV	5.9	**AVG**
4347.7300	46.49	0.52	47.01	54.0	1HN3mV	7.0	**AVG**

Data measured at 1 meter was extrapolated to 10 meters by subtracting 20 dB.
No other emissions detected within 20 dB of the FCC Part 15.109 limits
AF is antenna factor. CL is cable loss. PA is preamplifier gain

SAMPLE CALCULATION: At 1085.81 MHz: = 54.64+ (-18.58) = 36.06 dBuV/m @ 3m
Margin = (49.5-36.06) = 13.4 dB

Test Date: M ay 13, 2013

Tested By Signature: John C Wynn Name: John Wynn