Testing Tomorrow's Technology

Application
For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraph 15.247

and

IC Radio Standards Specification: RSS-210

Permissive Change

For the

RFM / Cirronet Inc., WSN802GC, WSN802GP

FCC ID: HSW-WSN802G
IC: 4492A-WSN802G

UST Project: 10-0094
Issue Date: April 15, 2010

Total Pages: 25

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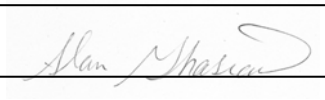
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Consulting Engineer President

Date: April 15, 2010

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: RFM / Cirronet Inc.

MODEL: WSN802GC, WSN802GP

FCC ID: HSW-WSN802G

DATE: April 15, 2010

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

Equipment type: 802.11b Transceiver 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:

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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 additional data rates on 5 Mbps and 11 Mbps.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on April 7, 2010 in good operating condition.

1.3 Product Description

The WSN802GC and WSN802GP transceiver module is used for IEEE 802.11b sensor networks. The module includes analog, digital and serial I/O, and is compatible with standard IEEE 802.11b access points.

1.4 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 FCC subpart B Digital equipment Verification requirements and per FCC KDB Publication number 558074 for Digital Transmission Systems Operating Under section 15.247. Also, Marker-Delta Method was followed to measure the upper band-edge.

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 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.

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) RFM / Cirronet Inc.	WSN802GC WSN802GP	None	HSW-WSN802G	1m U Ethernet 1m U USB
Switching Power Supply	--	None	None	6' 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 herewith.

Table 2 - Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2332A10055	06/22/09
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/7/09
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	09/08/09
HORN ANTENNA 1 GHz to 18 GHz	3115	EMCO	9107-3723	11/4/08 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	9/11/09
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

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:

2.6 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. RFM / Cirronet Inc. will sell the RF Module with the following antennas:

Table 4 - Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i
Fractus	Integrated	FR05-S1-N-0-102	Antenna 1	1.5
Mobile Mark Communication	Dipole Antenna	OD9-2400	Antenna 2	9
Cirronet	Patch Antenna	800484	Antenna 3	12

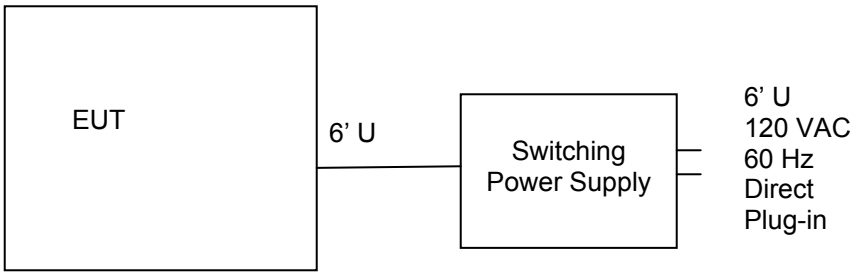


Figure 1 - Test Configuration

2.7 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 10 below. The limit for antenna conducted power is 251 mWatt (24 dBm) per 15.247 (b)(3) and b(4) due to the uses of antennas with 9 and 12 dBi.

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, 6 and 7 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.

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 new data rates (5 Mbps and 11 Mbps) were checked and the worse cases are shown in table 5~7.

For test data, see Tables 5 and 7. Radiated emissions above 3 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.

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

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz								
Tested By: K.M.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 10-0094				Model: WSN802GC, WSN802GP			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
2411.55	63.69		32.36	96.05		3m./		**PK**
4824.25	44.95	-8.54	4.53	40.94	54.0	1m./	13.1	**PK**
7237.60	45.90	-8.54	10.26	47.62	54.0	1m./	6.4	**PK**
MID BAND- PEAK								
2436.70	63.77		32.51	96.28		3m./		**PK**
4874.15	45.25	-8.54	4.68	41.39	54.0	1m./	12.6	**PK**
7392.90	46.93	-8.54	10.40	48.79	54.0	1m./	5.2	**PK**
HIGH BAND- PEAK								
2461.60	63.14		32.66	95.80		3m./		**PK**
4924.15	45.95	-8.54	4.52	42.23	54.0	1m./	11.8	**PK**
7392.90	47.19	-8.54	10.40	49.05	54.0	3m./	4.9	**PK**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- ND = No other signals detected within 20 dB of specification limit.

SAMPLE CALCULATION:

RESULTS: At 4824.25 MHz: = 44.95 dBuV + (-8.54) + 4.53 dB/m = 40.94 dBuV/m @ 3m
Margin = (54.0 – 40.94) = 13.1 dB

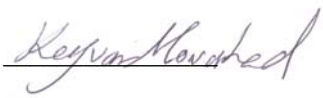
Test Date: April 7, 2010
Tested By
Signature:  Name: **Keyvan Muvahhid**

Table 6 - Peak Radiated Harmonic & Spurious Emissions-Antenna 2

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz								
Tested By: K.M.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 10-0094				Model: WSN802GC, WSN802GP			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
2411.50	72.55		32.36	104.91		3m./		**PK**
4824.40	41.86	1.00	3.83	46.69	54.0	3m./	7.3	**PK**
7237.50	46.14	-8.54	10.26	47.86	54.0	1m./	6.1	**PK**
MID BAND- PEAK								
2436.70	72.10		32.51	104.61		3m./		**PK**
4924.15	42.70	1.00	4.10	47.80	54.0	3m./	6.2	**PK**
7392.90	45.90	-8.54	10.40	47.76	54.0	1m./	6.2	**PK**
HIGH BAND- PEAK								
2461.60	72.69		32.66	105.35		3m./		**PK**
4924.15	41.87	1.00	4.10	46.97	54.0	3m./	7.0	**PK**
7392.90	46.65	-8.54	10.40	48.51	54.0	1m./	5.5	**PK**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- ND = No other signals detected within 20 dB of specification limit.

SAMPLE CALCULATION:

RESULTS: At 4824.40 MHz: = 41.86 dBuV+ (1.00) + 3.83 dB/m = 46.69 dBuV/m @ 3m
Margin = (54.0 – 46.69) = 7.3 dB

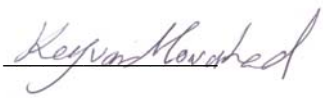
Test Date: April 7, 2009
Tested By
Signature:  Name: **Keyvan Muvahhid**

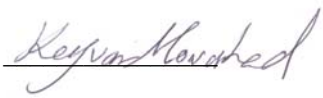
Table 7 - Peak Radiated Harmonic & Spurious Emissions-Antenna 3

Radiated Harmonic and Spurious Emissions, Tested from 30 MHz – 24 GHz								
Tested By: K.M.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 10-0094				Model: WSN802GC, WSN802GP			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
2411.55	75.03		32.46	107.49	--	3m./	--	**PK**
4824.25	46.28	-8.54	4.53	42.27	54.0	1m./	11.7	**PK**
7237.60	46.36	-8.54	10.26	48.08	54.0	1m./	5.9	**PK**
MID BAND- PEAK								
2436.70	74.91		32.61	107.52		3m./		**PK**
4874.15	46.04	-8.54	4.68	42.18	54.0	1m./	11.8	**PK**
7392.90	46.93	-8.54	10.40	48.79	54.0	1m./	5.2	**PK**
HIGH BAND- PEAK								
2461.60	75.10		32.76	107.86		3m./		**PK**
4924.15	46.23	-8.54	4.82	42.51	54.0	1m./	11.5	**PK**
7392.90	46.79	-8.54	10.40	48.65	54.0	1m./	5.3	**PK**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- ND = No other signals detected within 20 dB of specification limit.

SAMPLE CALCULATION:

RESULTS: At 4824.25 MHz: = 46.28 dBuV+ (-8.54)+ 4.53 dB/m = 42.27 dBuV/m @ 3m
Margin = (54.0 – 42.27) = 11.7 dB

Test Date: April 9, 2010
Tested By
Signature:  Name: **Keyvan Muvahhid**

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

Band Edge measurements are made 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.

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.

Additionally, because a restricted band per 15.205, begins at the upper band edge (2483.5 MHz), radiated emissions measurements are performed at the upper band edge to demonstrate compliance with the radiated emission limits of 15.209 (54 dBuV/m for average signals and 74 dBuV/m for peak signals) that fall within the restricted bands.

Using the “Marker-Delta” method for radiated band edge, the emission of greatest magnitude up to two standard bandwidths (~2 MHz) outside of the operating band is marked and then a delta level measurement between that emission peak and the peak of the fundamental emission is taken. That delta value is to be subtracted from the value of the fundamental signal of the highest operating channel to compute the field strength of the signal outside of the operating band.

2.8.1 Upper Restricted Band, Peak Radiated Measurement

Refer to Table 5,6,7, page 13~15. The peak electric field strength at 2475 MHz is 75.10 dBuV/m. Because the signal at 2483.5 MHz is 56.95 dB down, its peak Field Strength is 50.94 dBuV/m. This is less than the peak limit of 74 dBuV/m and 54 dBuv/m at that frequency. Therefore the EUT passes this requirement.

2.8.2 High Channel, Average Results:

As shown in Figure 2,3 below, the raw, measured field strength at 2461.6 MHz peak value is 75.10 dBuV. After correcting for cable loss, preamp gain, and the duty cycle, the result is as follows:

Result = V_{SA}(dBuV) + [Cable Loss(db) + Antenna Factor (dB/m)] + Duty Cycle(dB)

= 75.10 + [32.79] = 107.86 dBuV/m.
107.86 - 56.95 = 50.94

The limit is 54 dBuV/m. The unit passes the requirement.

High Channel Passing Margin = 54 dBuV/m – 50.94 dBuV/m = 3.1 dB

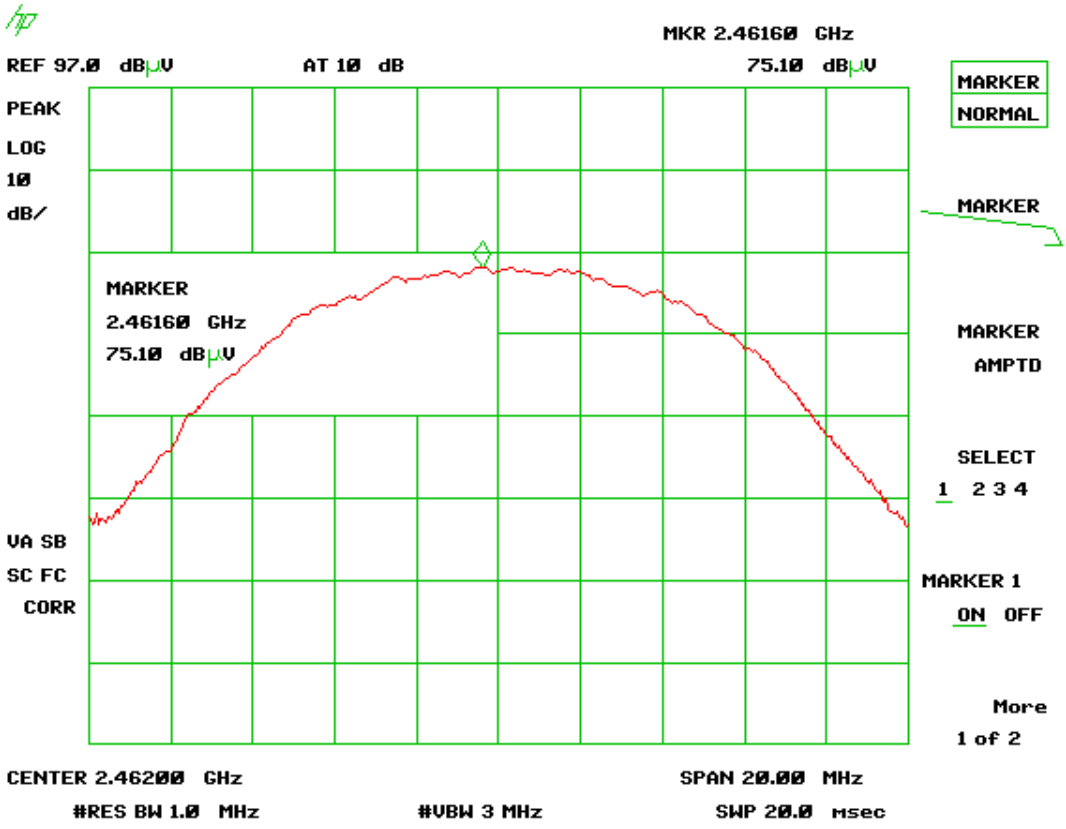


Figure 2 - Conducted Band Edge Compliance–High Channel-Peak Worse Case

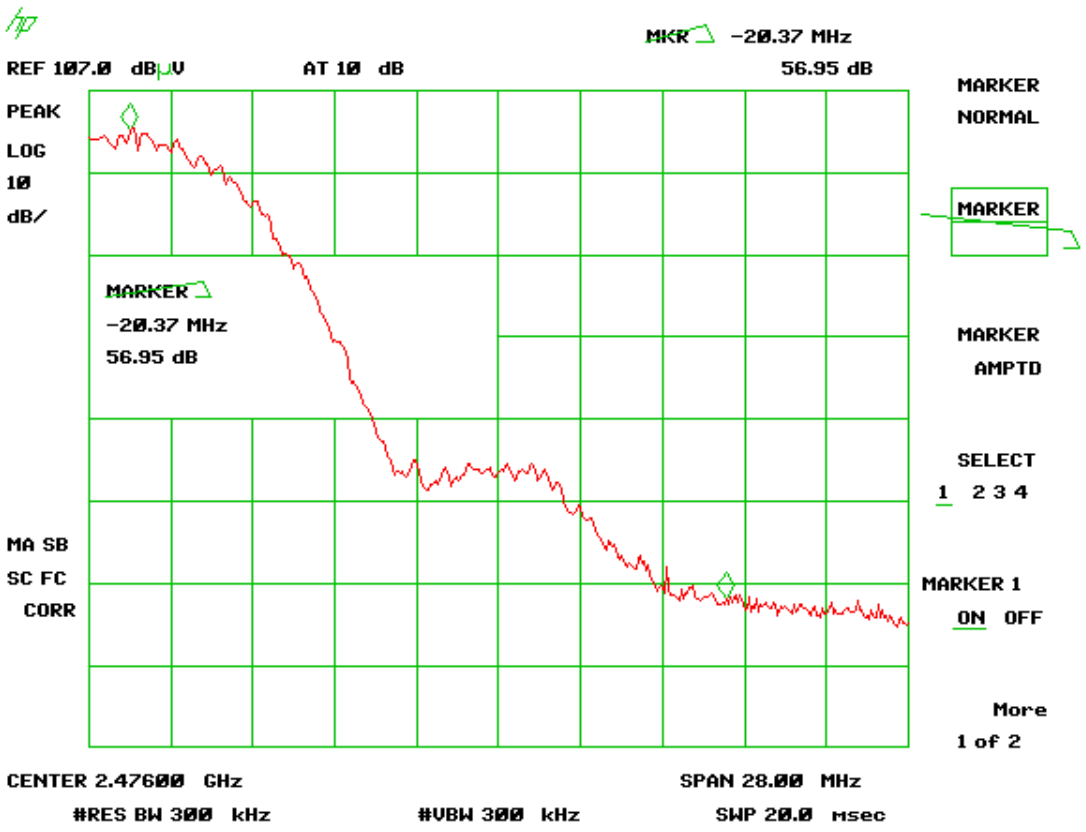


Figure 3 - Radiated Band Edge Compliance – High Channel

2.9 Measurement Uncertainty

2.9.1 Conducted Emissions Measurement Uncertainty:

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The data listed in this test report has sufficient margin to negate the effects of uncertainty. This measurement unconditionally passes.

2.9.2 Radiated Emissions Measurement Uncertainty:

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty, (more than the measurement uncertainty value at 902.82 and 914.82 MHz). Therefore, this test is conditionally acceptable.

Figure 4- Antenna 1 (Integrated) Front View

Figure 5– Antenna 1 (Integrated) Back View

Figure 6– Antenna 2 (Dipole) Front View

Figure 7– Antenna 2 (Dipole) Back View

Figure 8– Antenna 3 (Patch) Front View