Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15C, RSS-210 Issue 7

On

Wireless RF Control Module

BARBER2

Envisionnovation Inc.
1201-70 Dixfield Drive
Etobicoke, Ontario, Canada M9C 4J4

Prepared by:

TUV Rheinland of North America, Inc.

Client:	Envisionnovation Inc. 1201-70 Dixfield Drive Etobicoke, Ontario, Canada M9C 4J4	Bruce Douglas 416-275-1829 bdouglas@eininc.ca	
Identification:	Wireless RF Control Module	***Serial No.:***	NOT SERIALIZED
Test item:	BARBER2	***Date tested:***	08 April 2010
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542	
Test specification:	**Emissions:** FCC Part 15, Subpart C, RSS-210 Issue 7: FCC Part 15.207(a) and RSS-GEN 7.2.2 FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1 FCC Part 15.247(a)(2) and RSS-210 A1.1.3, FCC Part 15.247 and RSS-210 Annex 8, FCC Part 15.247(b)(3) and RSS-210 A8.4(4), FCC Part 15.247(d) and RSS-210 2.2, FCC Parts 15.109(a) and RSS-210 2.2, 2.6,A8.5, RSS-GEN 7.2.3.2 and FCC Part 15.107(a) and RSS-GEN 7.2.2		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		
tested by: Mark Ryan		***reviewed by:*** Michael Moranha	
23 April 2010 _____ ***Signature***		Michael Moranha 2010.05.17 11:39:33 -04'00' 17 May 2010 _____ ***Signature***	
Other Aspects:	**None**		

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

90552 and 100881	**NVLAP Lab Code (200094-0)**	**Industry Canada** **IC-2932H**

TABLE OF CONTENTS

1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Part 15C, RSS-210 Issue 7 based on the results of testing performed on 08 April 2010 on the Wireless RF Control Module, Model No. BARBER2, manufactured by Envisionnovation Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 *Summary of Test Results*

Applicant	Envisionnovation Inc. 1201-70 Dixfield Drive Etobicoke, Ontario, Canada M9C 4J4	**Tel**	416-275-1829	**Contact**	Bruce Douglas
		Fax	416-502-0707	**e-mail**	bdouglas@eininc.ca

Description	Wireless RF Control Module	**Model Number**	BARBER2
Serial Number	NOT SERIALIZED	**Test Voltage/Freq.**	3.3 VDC
Test Date Completed:	08 April 2010	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC Part 15, Subpart C Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out parts below	See Below	**Complies**
RSS-210 Issue 7 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out parts below	See Below	**Complies**
FCC Part 15.247 and RSS-210 Annex 8	Operation within the band 2400 to 2483.5 MHz	See called out parts below	Below Limit	Complies
FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1	Out-of-Band Spurious and Harmonic Emissions (EUT in Transmit Mode)	Below the applicable limits	Below Limit	Complies
FCC Part 15.207(a) and RSS-GEN 7.2.2	Conducted Emissions on Mains EUT in Transmit Mode	Below limit of section 15.207(a)	Below Limit	Complies
FCC Part 15.247(d) and RSS-210 2.2	Band Edge Radiated Emission	Per requirements of the standard	Below Limit	Complies
FCC Part 15.247(b)(3) and RSS-210 A8.4(4)	Conducted Output Power	Shall not exceed 1.0 Watts	Below Limit	Complies
FCC Part 15.247(a)(2) and RSS-210 A1.1.3	Occupied Bandwidth	6 dB ≥ 500 kHz 99% BW ≤ 0.5% of center freq.	Below Limit	Complies
FCC Part 15.247(e) and RSS-210, Section A8.2(b)	Peak Power Spectrial Denesity	≤ 8 dBm in any 3 kHz	Below Limit	Complies
FCC Part 15.31(e)	Voltage Requirements	Output at 0.85% and 1.15% of Nominal Voltage	Below Limit	Complies
FCC Parts 15.203, 15.204 and RSS-GEN 7.1.4	Antenna Requirements	Per requirements of the standard	Below Limit	Complies
FCC Parts 15.109(a) and RSS-210 2.2, 2.6,A8.5, RSS-GEN 7.2.3.2	Radiated Emissions while EUT in Receive Mode	Below limit of section 15.109(a) Class B	Below Limit	Complies
FCC Part 15.107(a) and RSS-GEN 7.2.2	Conducted Emissions EUT in Receive Mode	Below limit of section 15.107(a) Class B	Below Limit	Complies

2 Laboratory Information

2.1 Accreditations and Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Lab code: 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: IC-2932H The OATS has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174, R-1679, C-1790 and C-1791).

2.1.5 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.3 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.18 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated and Conducted RF Emissions (5 Meter Chamber)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	23-Jan-09	23-Jan-10
Antenna Horn 1-18GHz	EMCO	3115	5770	16-Jun-08	16-Jun-10
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	29-Jun-09	29-Jun-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	04-Dec-09	04-Dec-10
Cable, Coax	Andrew	FSJ1-50A	003	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	030	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	045	14-Dec-09	14-Dec-10
Cable, Coax	Andrew	FSJ1-50A	049	14-Dec-09	14-Dec-10
1.5 GHz High Pass Filter	Bonn Electronik	BHF 1500	025155	26-Jan-09	26-Jan-10
Conducted Emissions (AC/DC and Signal I/O)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	02-Feb-09	02-Feb-10
Transient Limiter	Schaffner	CFL-9206	1649	09-Dec-09	09-Dec-10
Transient Limiter	Schaffner	CFL-9206	1630	10-Dec-09	10-Dec-10
Receiver, EMI	Rohde & Schwarz	ESH3	860905/005	24-Aug-09	24-Aug-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	04-Dec-09	04-Dec-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440161	26-May-09	26-May-10
Cable, Coax	Pasternack	RG-223	051	09-Dec-09	09-Dec-10
General Laboratory Equipment					
Meter, Temp/Humid/Barom	Fisher	02-400	01	28--Dec-09	28--Dec-10
Meter, Temp/Humidity	Dickson Company	TH550	6215304	19-Mar-09	19-Mar-11
Attenuator	Pasternack	PE7015-20	NA	22-Jan-09	22-Jan-10

3 Product Information

3.1 Product Description

The Equipment Under Test (EUT) model BARBER2 802.15.4 transceiver module designed for use in OEM products, where the designers desire a pre-certified Zigbee wireless solution.

The radio module contains its own voltage regulation, and buffered I/O. The apparatus contains an integral microprocessor which can process base band data transmitted and received by the radio section. However, the radio section contains hardware buffers that limit data rate to 250 kBits/sec and limit transmitted signal bandwidth. No user data can cause over-modulation or over-deviation.

The transmitter RF power level is set to a fixed leveling a calibration step during manufacturing, and cannot be changed by the user.

The EUT module is mounted on a test gig that will supply power and a control circuit to allow the module to be set in all the required testing modes and frequencies.

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

4 Radiated Emissions

4.1 Spurious Emissions Outside the band - FCC 15.247(d), RSS-210 A8.5

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	19 March 2010	
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.247(d), RSS-210 A8.5, and RSS-GEN 7.2.1						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	3.3 VDC	**Temp**	74 ºF	**Humidity**	36%	**Pressure**	1000 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Final Test

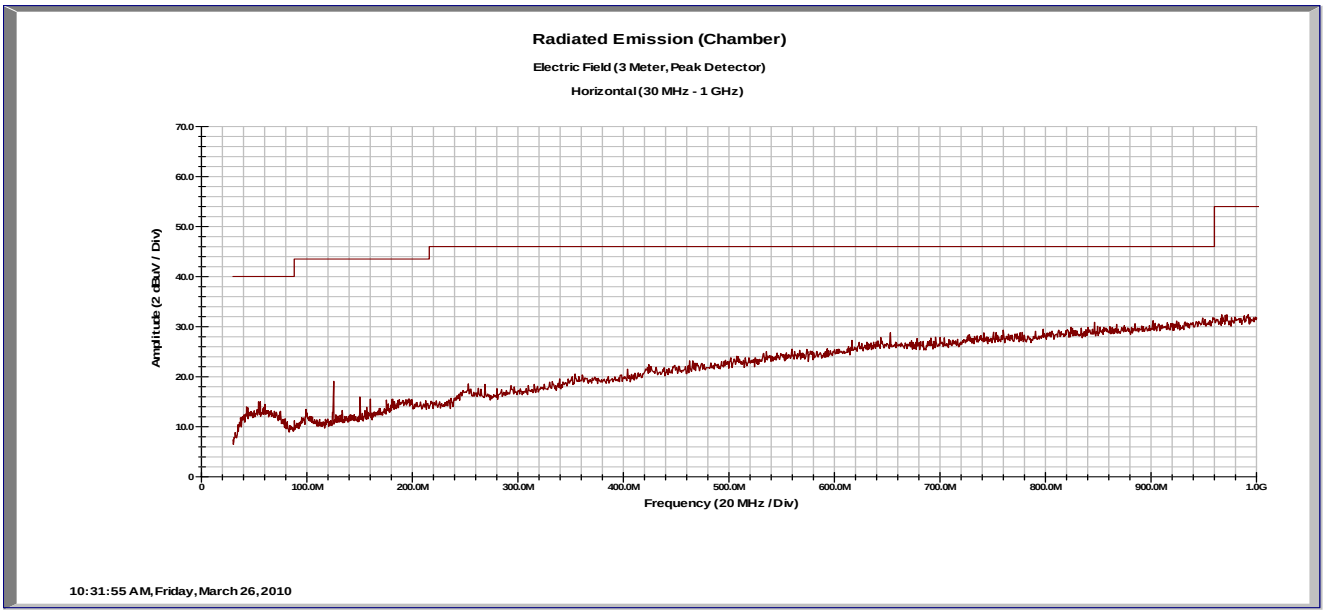
All final radiated spurious emissions measurements were below (in compliance) the limits.

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

4.1.4.1 Emissions Outside the Frequency Band

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

Worst-Case Radiated Emissions 30MHz to 1000MHz
Horizontal

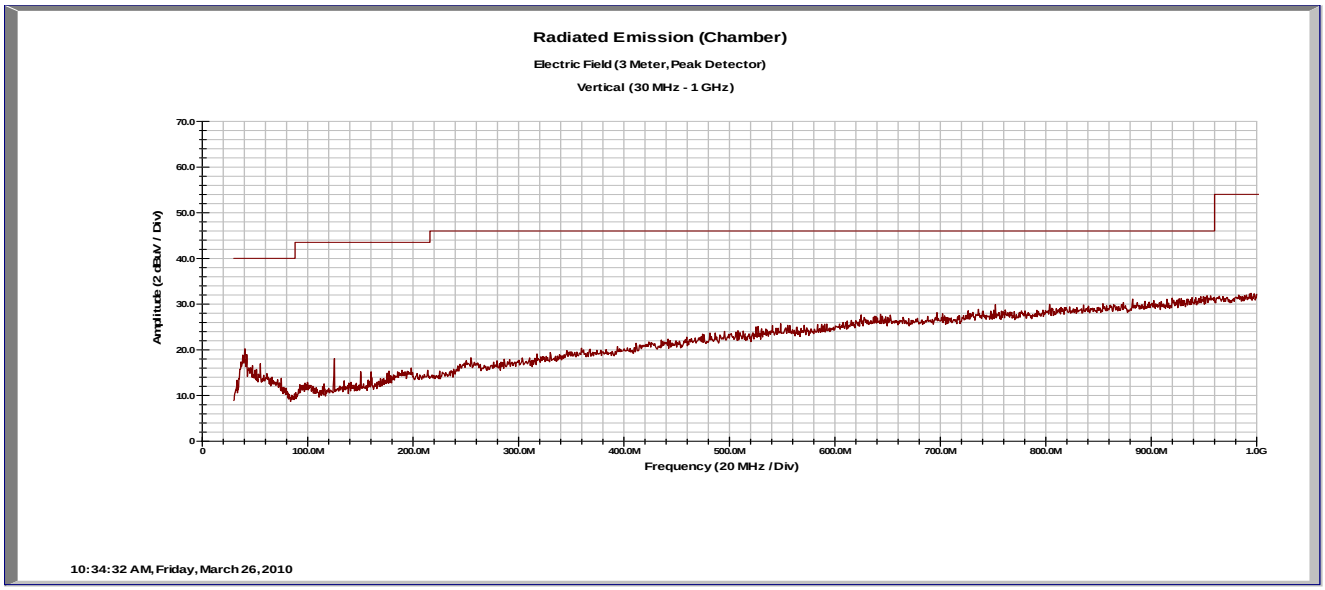


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All three frequencies and four antenna configurations had similar responses.
All emissions are more than 20 dB below the limit, or are below the noise floor of the receiver.
The emissions shown around 120MHz are anomalies of the receiver.

Worst-Case Radiated Emissions 30MHz to 1000MHz

Vertical

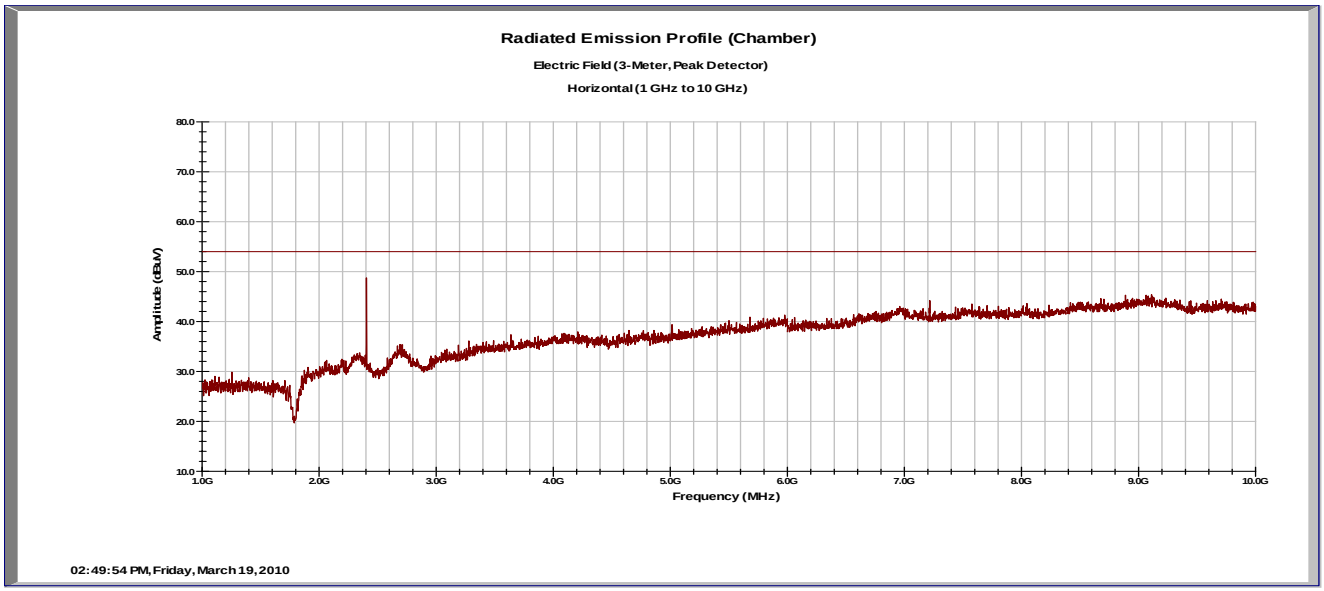


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All three frequencies and four antenna configurations had similar responses.
All emissions are more than 20 dB below the limit, or are below the noise floor of the receiver.
The emissions shown around 120MHz are anomalies of the receiver.

Worst-Case Radiated Emissions 1GHz to 10GHz

Horizontal

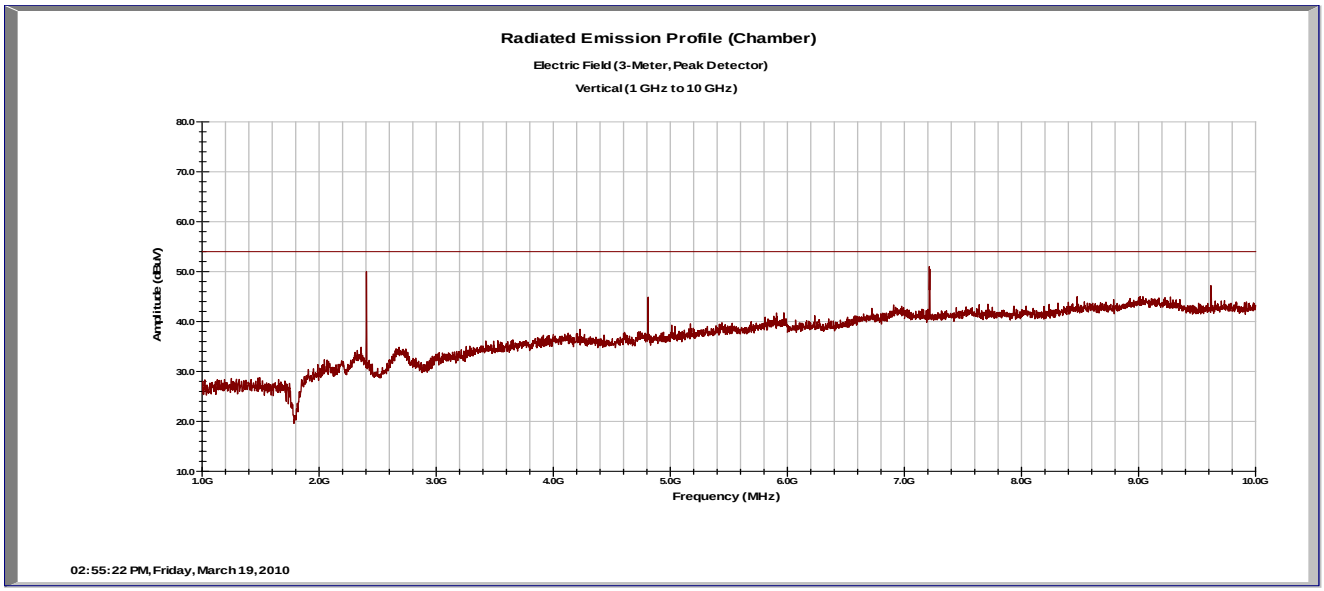


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: Worst Case Emissions shown was using the Monopole antenna in orientation 1, at low band.
ALL EMISSIONS including those outside Restricted Bands are below the limits of Part FCC 15.209.
The Fundamental Emissions at 2405MHz is attenuated by use of a notch filter.

Worst-Case Radiated Emissions 1GHz to 10GHz

Vertical

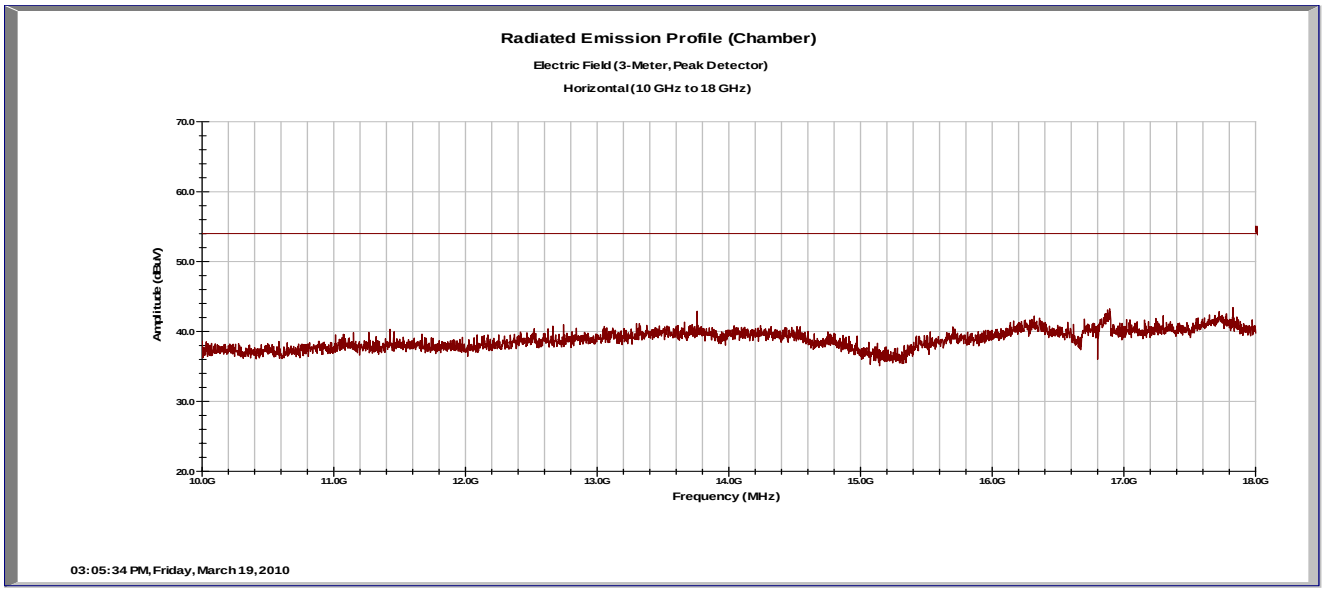


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
4810.00	V	1	3	29.83	35.52	6.79	32.82	33.92	54.00	-20.08
7221.00	V	1	130	31.80	35.32	8.95	36.03	41.45	54.00	-12.55
9620.80	V	1.7	169	32.88	36.07	10.22	37.92	44.95	54.00	-9.05
4810.00	V	1	3	41.56	35.52	6.79	32.82	45.65	74.00	-28.35
7221.00	V	1	130	43.01	35.32	8.95	36.03	52.66	74.00	-21.34
9620.80	V	1.7	169	44.12	36.07	10.22	37.92	56.19	74.00	-17.81

Notes:
Emissions shown in **Green** were measured using the Average detector.
The Emissions shown in **Blue** were measured using the Peak detector.
Worst Case Emissions shown was using the Monopole antenna in orientation 1, at low band.
ALL EMISSIONS including those outside Restricted Bands are below the limits of Part FCC 15.209.
The Fundamental Emissions at 2405MHz is attenuated by use of a notch filter.

Worst-Case Radiated Emissions 10GHz to 18GHz

Horizontal

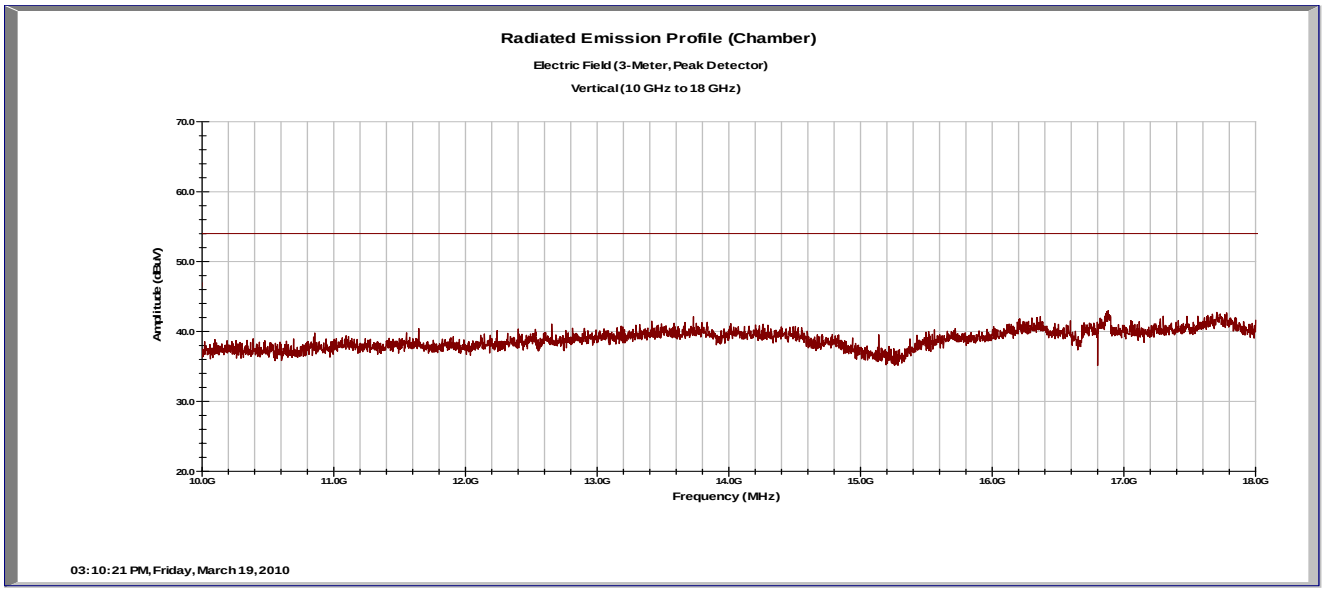


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: ALL EMISSIONS including those outside Restricted Bands are below the limits of Part FCC 15.209.
The Fundamental Emissions at 2405MHz is attenuated by use of a notch filter.

Worst-Case Radiated Emissions 10GHz to 18GHz

Vertical

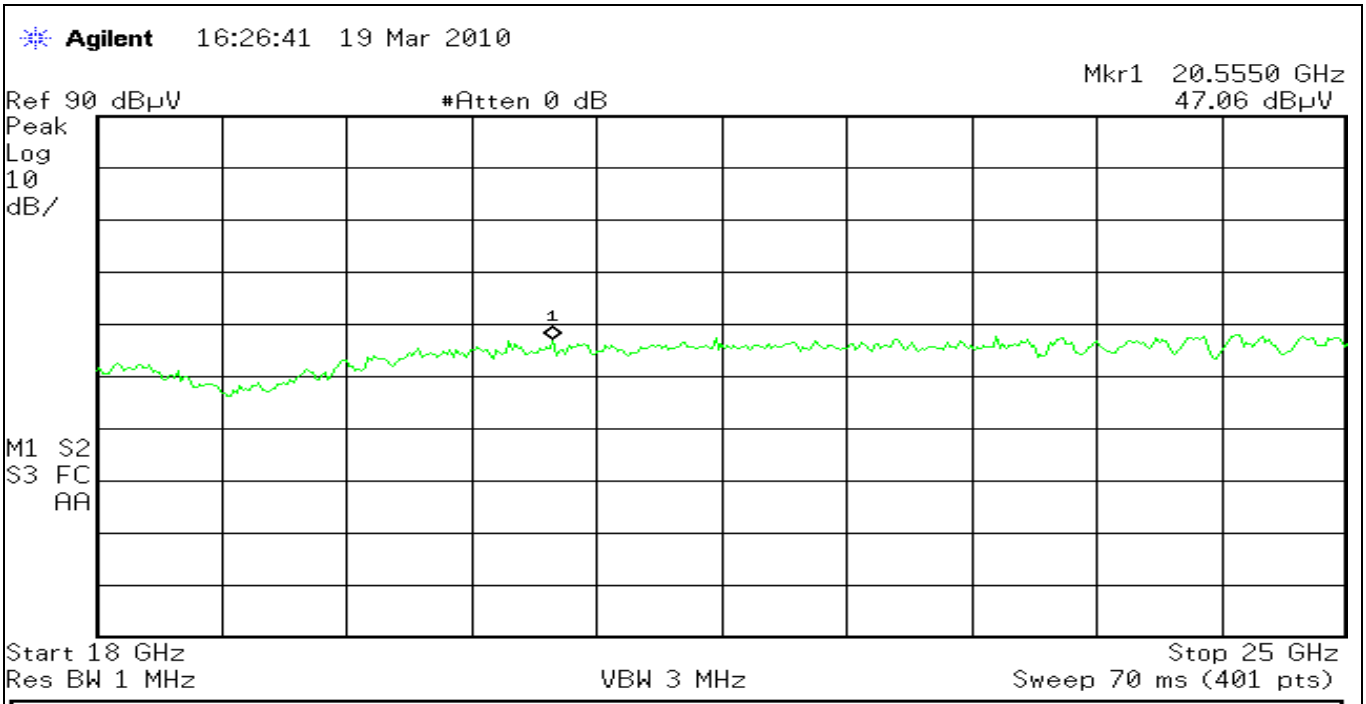


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
12026.00	V	1.1	88	23.46	35.34	11.82	39.03	38.96	54.00	-15.04
14431.2				Noise	Floor					
12026.00	V	1.1	88	35.44	35.34	11.82	39.03	50.94	74.00	-23.06
14431.2				Noise	Floor					

Notes: ALL EMISSIONS including those outside Restricted Bands are below the limits of Part FCC 15.209.
The Fundamental Emissions at 2405MHz is attenuated by use of a notch filter.

Worst-Case Radiated Emissions 18GHz to 25GHz

Horizontal

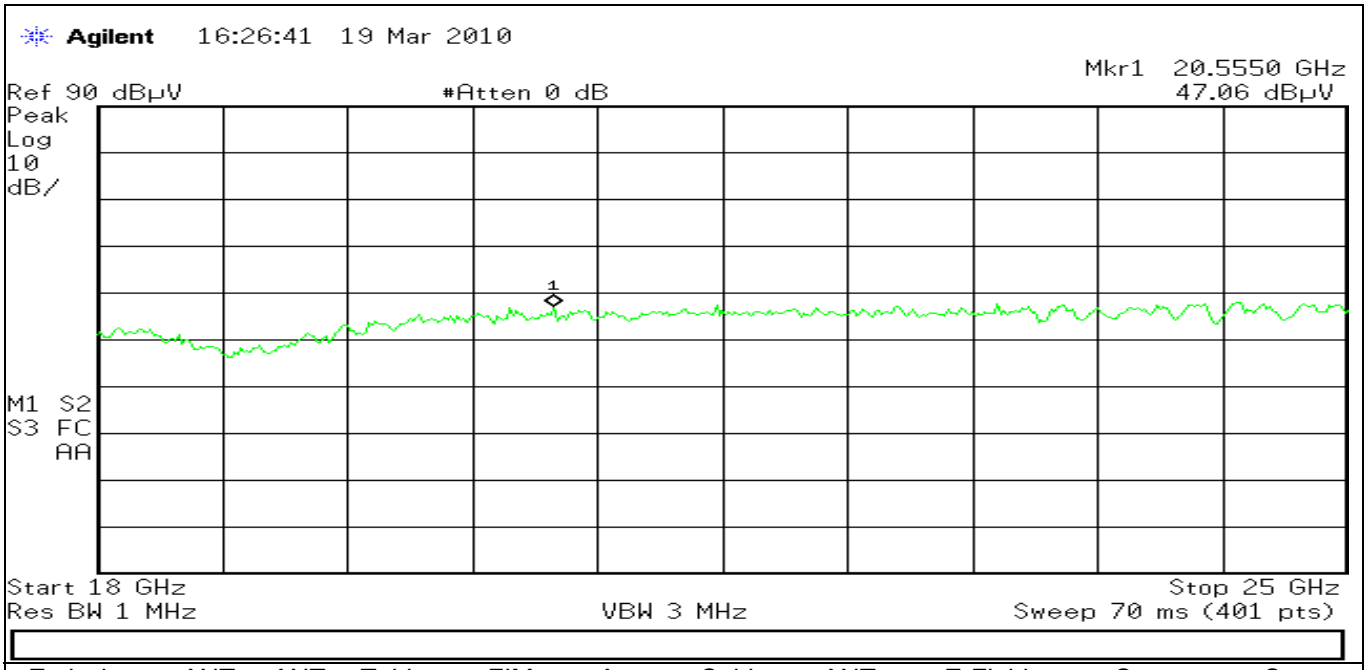


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All emissions were below the noise floor of the EMC Receiver.
The Trace shown above is raw data, without the application of correction factors.

Worst-Case Radiated Emissions 18GHz to 25GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All emissions were below the noise floor of the EMC Receiver.
The Trace shown above is raw data, without the application of correction factors.

4.2 Band Edge

4.2.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	29 March 2010	
Standard	FCC Part 15.247(d), RSS 210 2.2						
Product Model	BARBER2		**Serial#**	NOT SERIALIZED			
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.2.2 Test Procedure

Intentional radiators operating under the alternative provisions to the general emission limits must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

4.2.4 Final Test

The EUT met the performance criteria requirement as specified in this report and in the standards.

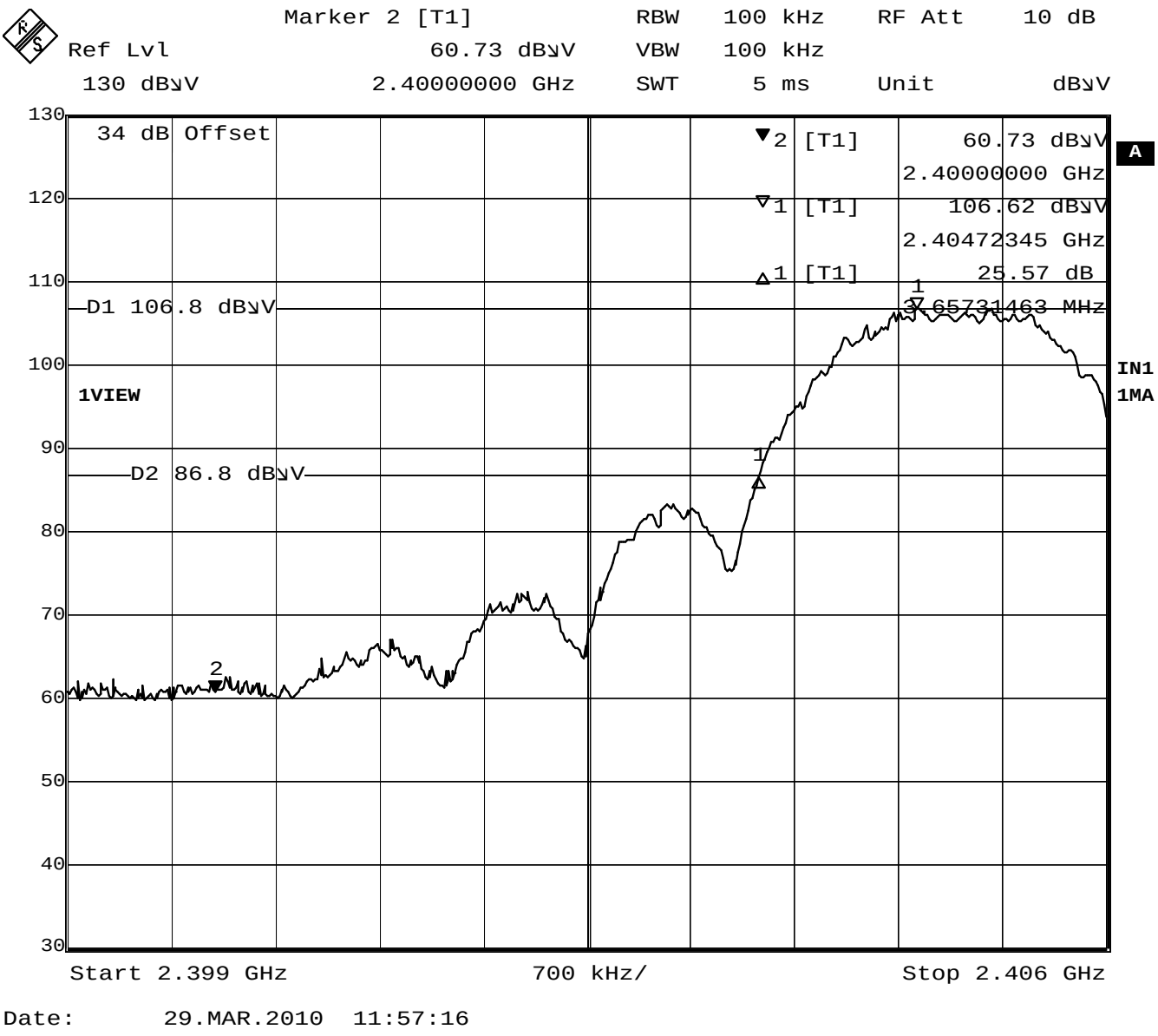


Figure 1: Lower Band Edge Measurement (Radiated Emission)

Note: Band Edge is at 2.4 GHz, and the nearest restricted band (2390MHz) is 10 MHz away

At the lowest channel, the 20dB down point is at 2401.066 MHz. The EUT is compliant with the rules.

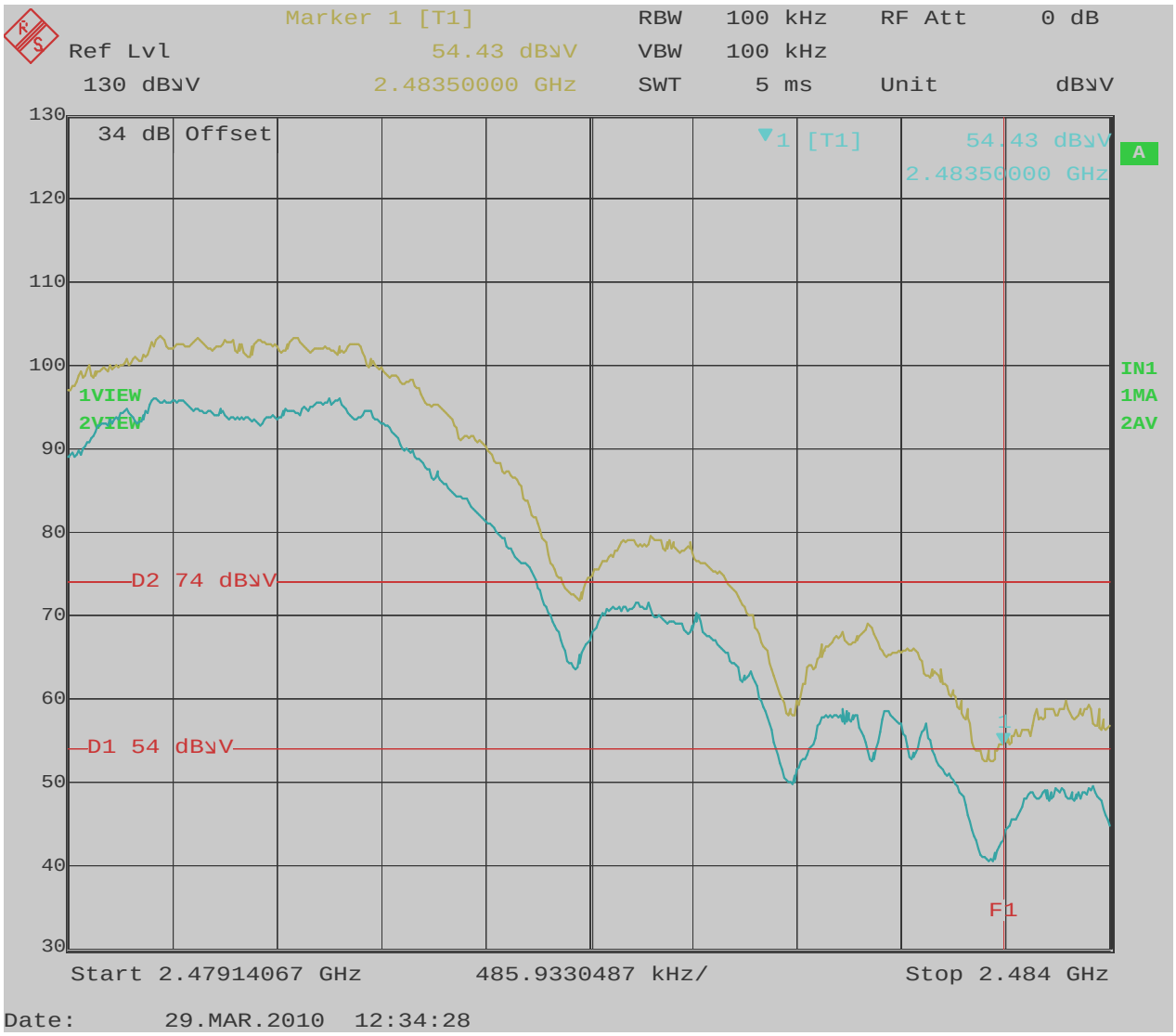


Figure 2: Upper Band Edge Measurement (Radiated Emission)

Note: Band edge (F1) at 2483.5 MHz is also the start of a restricted band, so the rules of 15.205 apply.

The highest channel frequency at 2.4835 GHz is 44.51 dBµV/m (average) which is 9.49dB below the 54 dB limit. And is 54.43 dBµV/m (peak) which is -19.57 dB below the 74 dB limit.

The EUT is compliant with the rules.

4.1 Conducted Emissions in Transmit mode

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

4.1.1 Over View of Test

Results	**NA** (as tested per this report)				**Date**	NA	
Standard	FCC Part 15.207(a) and RSS-GEN 7.2.2						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	120VAC / 60 Hz	**Temp**	73º F	**Humidity**	25%	**Pressure**	1011 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	**Test Performed By**	Mark Ryan				

4.1.2 Test Procedure

Since this device has many different applications, the company of the host device will be required to test for disturbances to the AC Mains.

4.1.3 Final Test

Since the EUT is powered by 3.3VDC provided by the host device, this test is not applicable.

5 Antenna Port Conducted Emissions

For conducted tests, the emissions were measured at the antenna port.

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSP-100 Issue 9. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1 Conducted Output Power, FCC 15.247(b)(3) and RSS-210 A8.4(4)

5.1.1 For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

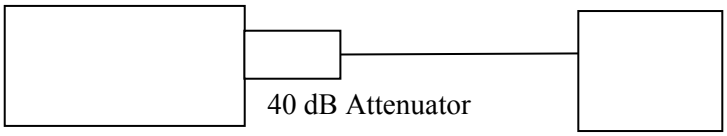
5.1.2 Test Over View

Results	**Complies** (as tested per this report)					**Date**	08 April 2010
Standard	FCC Part 15.247(b)(3) and RSS-210 A8.4(4)						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.1.3 Test Procedure

The peak output power was measured at the low, mid and high band frequencies. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The cable loss and the attenuator was measured and added in the reference level offset in the spectrum analyzer. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was equal to the resolution bandwidth.

Test Setup:



5.1.4 Deviations

There were no deviations from the test methodology listed in the test plan for the Surge Immunity test.

5.1.5 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

5.1.6 Peak Power Output

Peak Output Conducted Power Measurements

Emission Freq (MHz)	Corrected Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.60 (f_H)	**18.41**	**+30.00**	**-11.59**
2440.00 (f_M)	18.18	+30.00	-11.82
2480.00 (f_H)	17.92	+30.00	-12.04

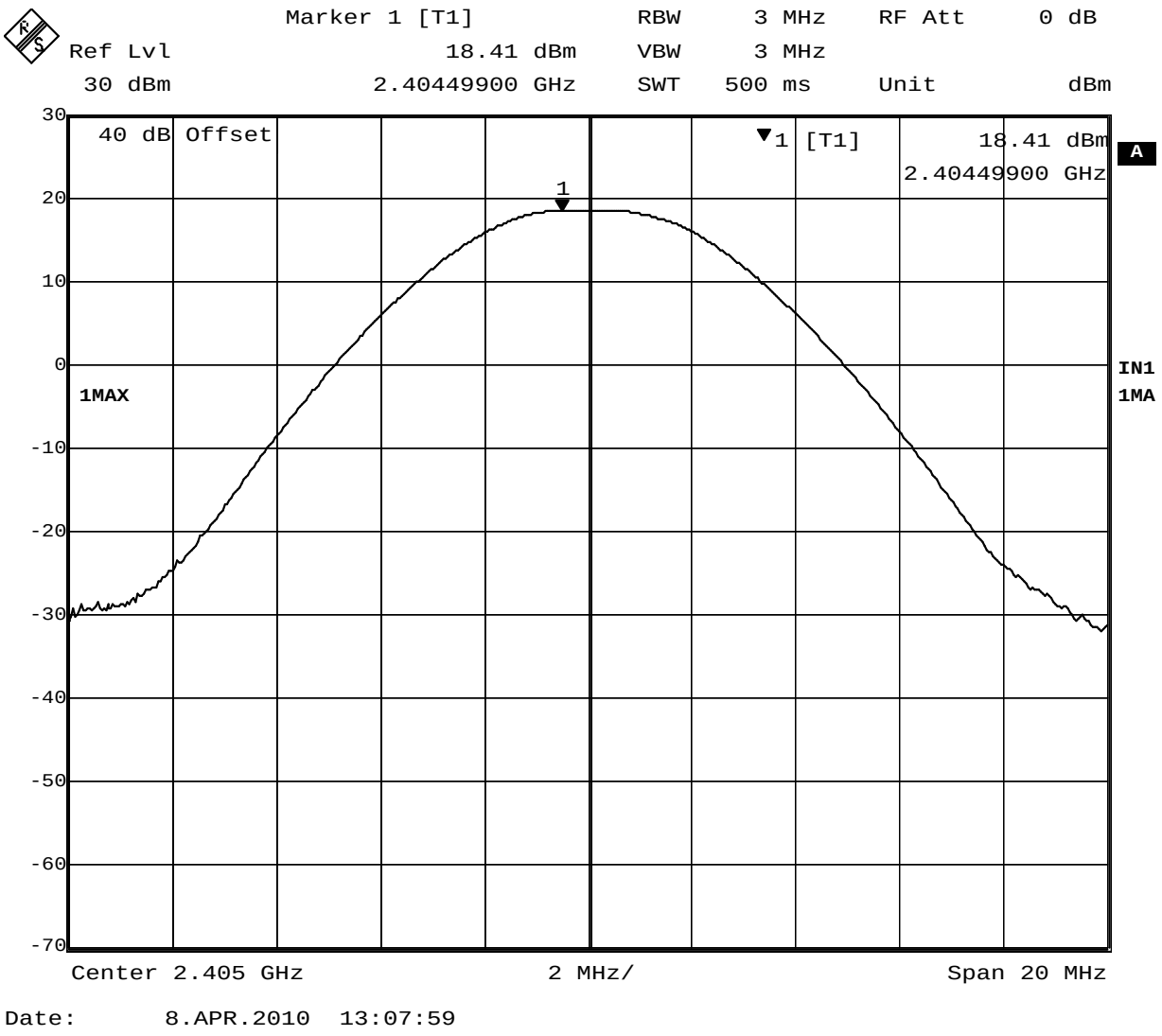


Figure 3 – Highest Peak Conducted Power Output for EUT highest frequency.

Graphs of the other frequencies are on file at the manufacturer and at TUV.

Antenna Gain

Refer to table in section error. All Antennas investigated are below 6dBi gain.

The EUT is also compliant to FCC Part 15.247(b)(4)

Results

As tested, the EUT was found to be compliant to the requirements of the test standard.

5.2 Peak Power Spectral Density

5.2.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	09 April 2010
Standard	FCC Part 15.247(e) and RSS 210 A8.2(b)						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	Below Limit (10dBm)			**Perf. Verification**	≤8 dBm in any 3 kHz		
Mod. to EUT	None			**Test Performed By**	Mark Ryan		

5.2.2 Test Procedure

Using the methods of ANSI C63.10:1999, section 6.11.2.3 were used.

5.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

5.2.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

Power Spectral Density Measurements

Emission Freq (MHz)	Corrected Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.60 (f_H)	**2.12**	**+8.00**	**-5.88**
2440.00 (f_M)	1.59	+8.00	-6.41
2480.00 (f_H)	0.53	+8.00	-7.47

Note: worst Case PSD measurement plots are shown below; the other plots are on file at TUV Rheinland.

5.2.5 Final Data

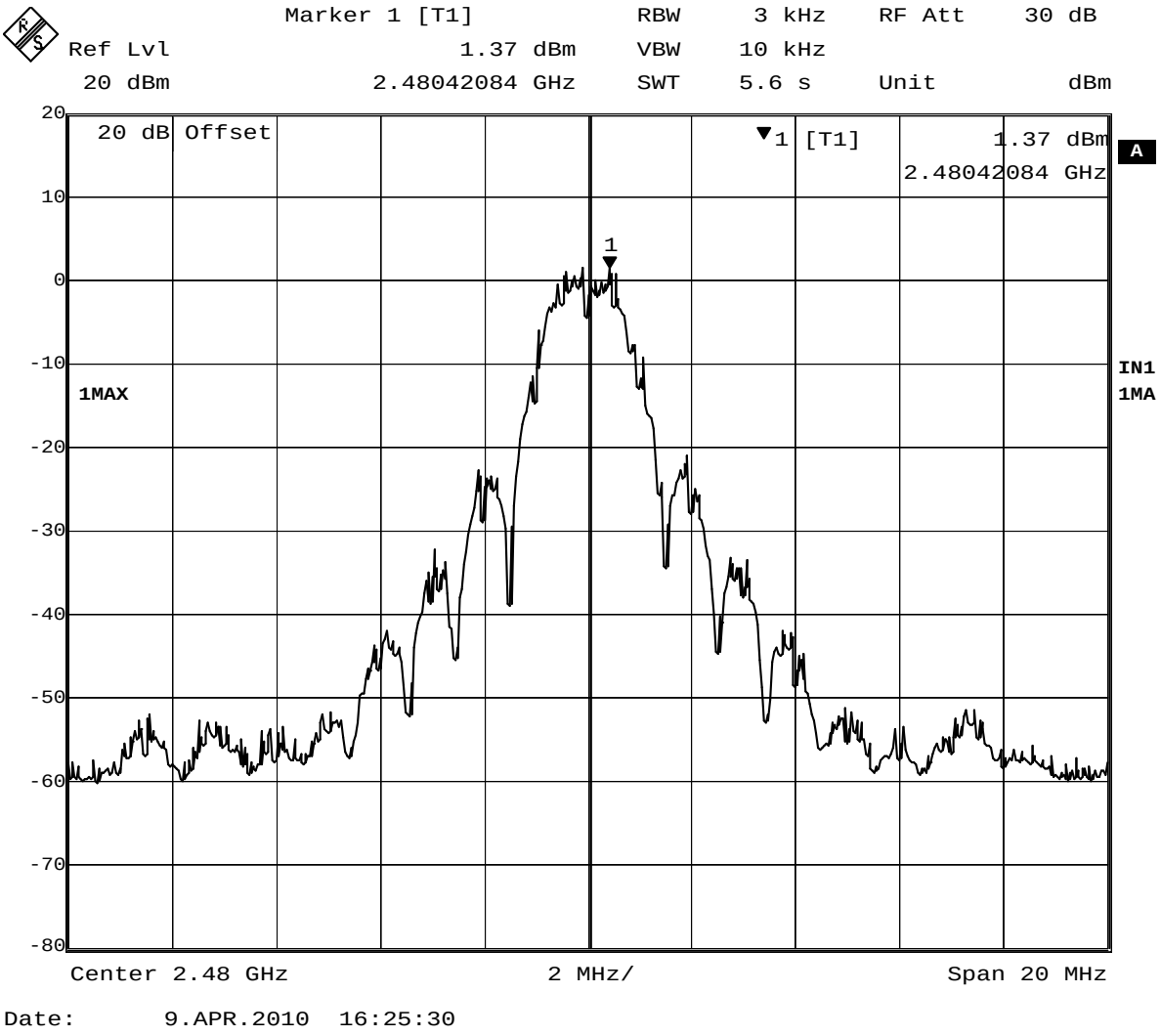


Figure 4: Peak Reference Frequency

Spectrum Analyzer Parameters:
RBW= 3kHz
Span= 20MHz
VBW= 10kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = sample detector, max hold

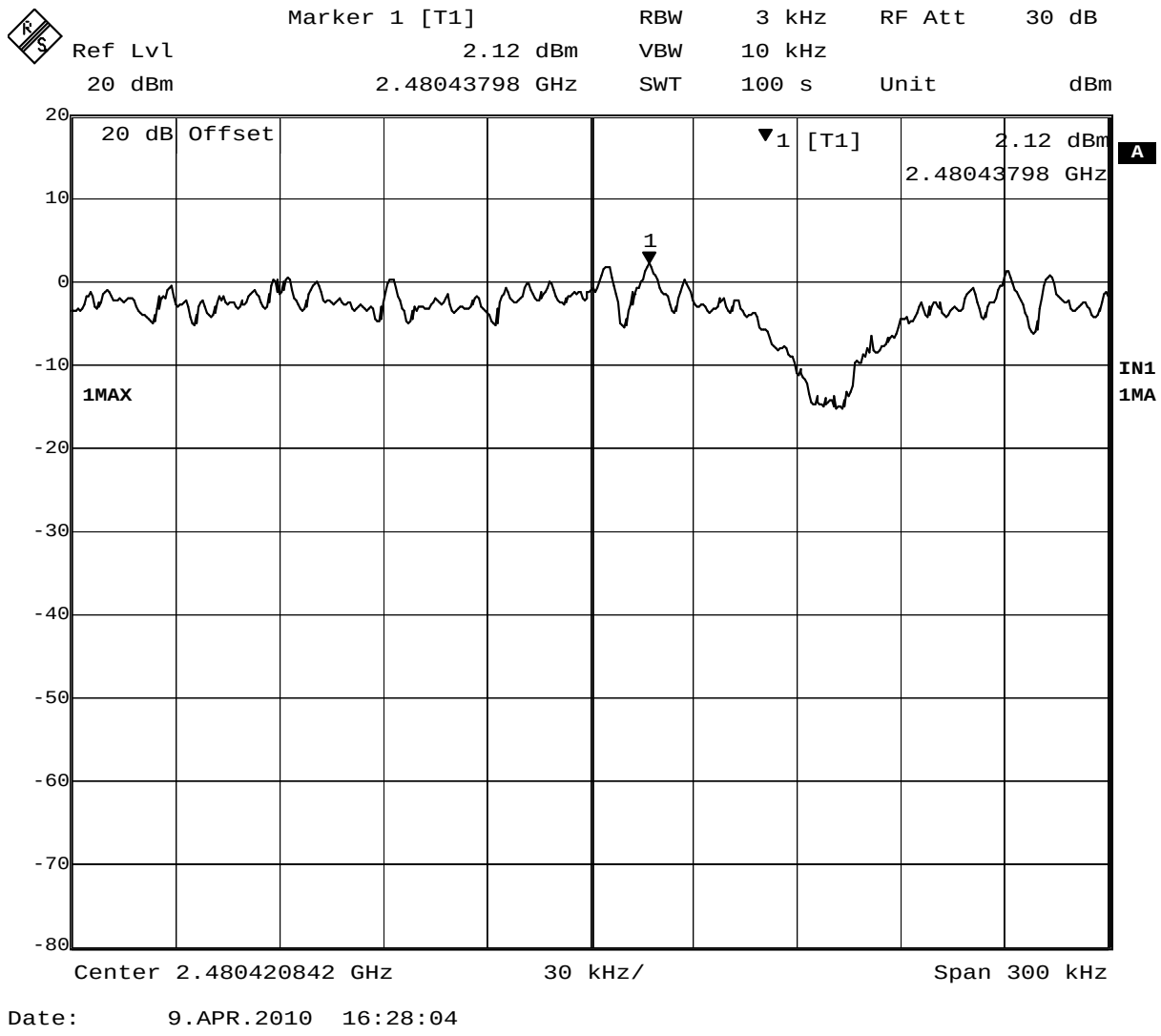


Figure 5: Power Spectral Density measurement

Spectrum Analyzer Parameters:
RBW= 3kHz
Span= 300kHz
VBW= 10kHz
LOG dB/div.= 10dB
Sweep = 100 Seconds
Detector = Sample detector, max hold

5.3 Occupied Bandwidth

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

5.3.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	22 January 2010
Standard	FCC Part 15.247(a)(2)						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.3.2 Test Procedure

Frequency hopping Systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Maximum allowed 20dB Bandwidth = 500 kHz

Channel Separation = 25 kHz Min. or the 20 dB bandwidth of the hopping channel, whichever is greater

The channel separation is greater than the measured maximum 20 dB bandwidth. Therefore the EUT is compliant with this section.

5.3.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

5.3.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

5.3.5 Final Data

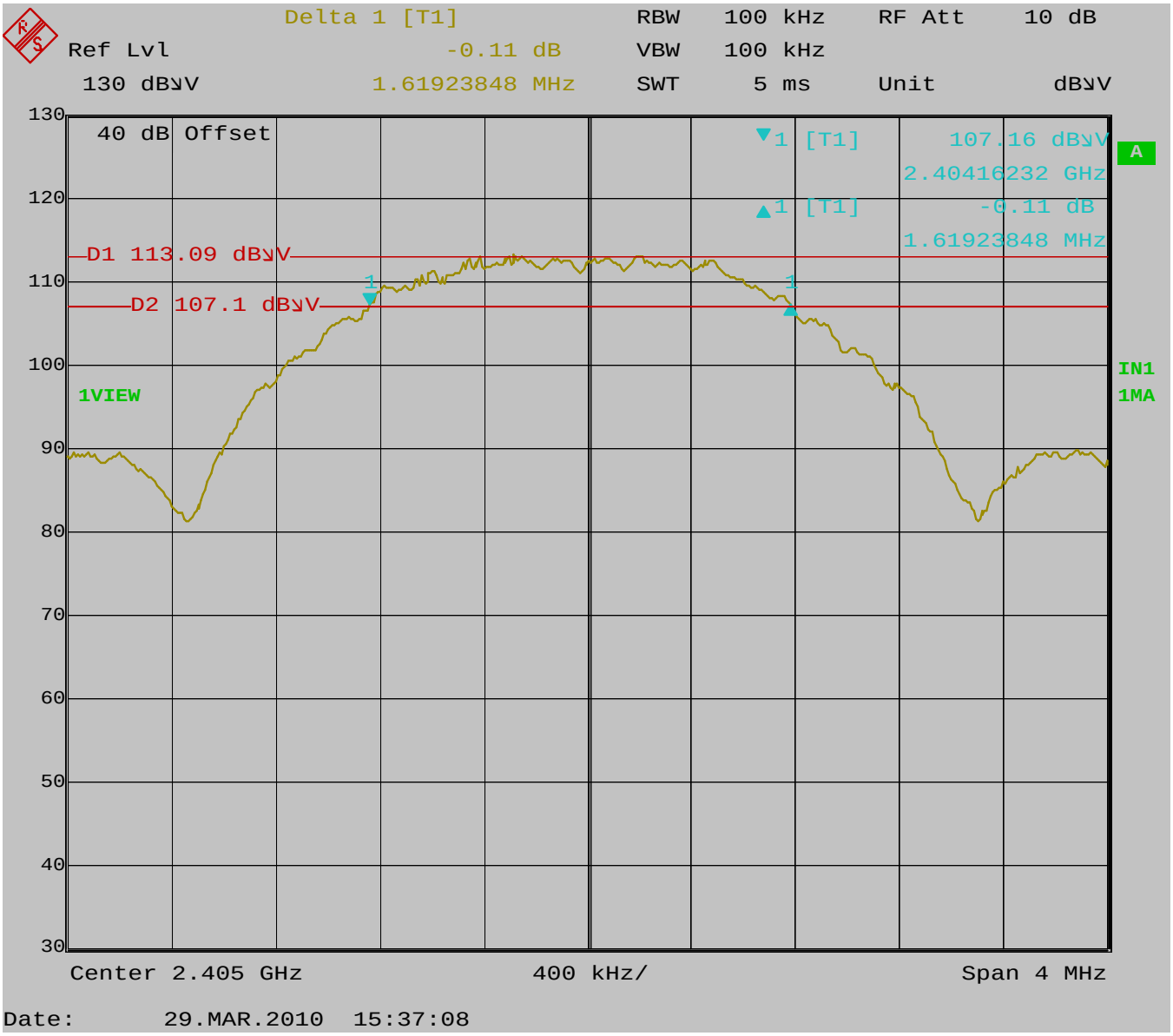


Figure 6: 6dB Occupied Bandwidth

Note: The above plot is the worst case.

6dB Band width is 1.62 MHz

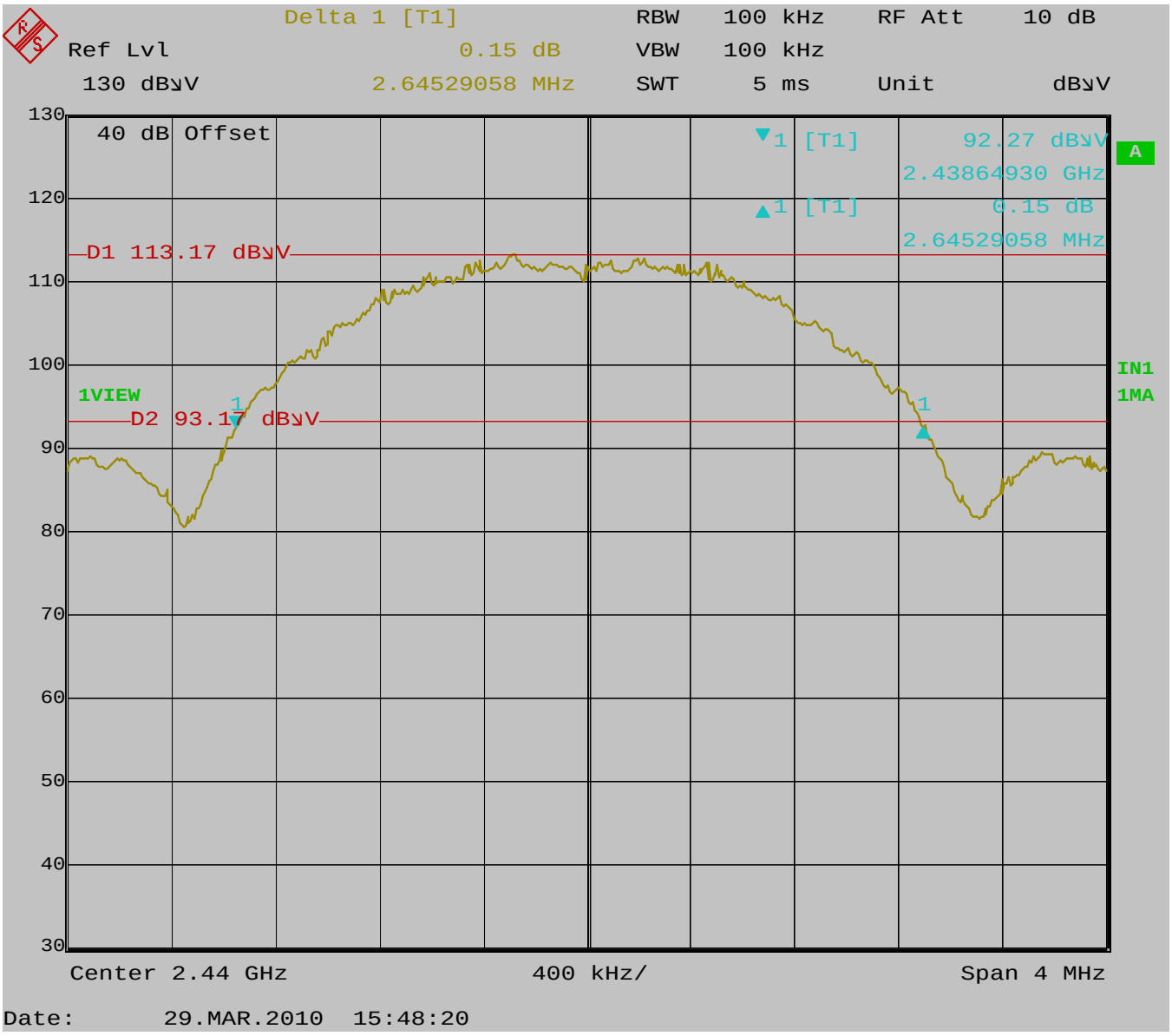


Figure 7: 20 dB Occupied Bandwidth

Note: The above plot is the worst case.

20dB Band width is 2.66 MHz

5.3.6 99% Power Bandwidth

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than .25% of the center frequency for devices operating between 70-900MHz. Foe devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

5.3.7 Test Over View

Results	**Complies** (as tested per this report)					**Date**	22 January 2010
Standard	RSS-210 Section A1.1.3						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

5.3.8 Test Procedure

Using the procedures of RSS-GEN section 4.6.1, the 1 kHz resolution bandwidth is 1% of the 1 MHz span. The Video bandwidth is 3 times that of the resolution bandwidth.

The limit of the bandwidth would be 0.25% of 902.8MHz is 1.08 MHz. The measured 99% bandwidth is 412.8 kHz.

5.3.9 Deviations

There were no deviations from the test methodology listed in the test plan for the Electrical Fast transients (EFT) Immunity test.

5.3.10 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

5.3.11 Final Data

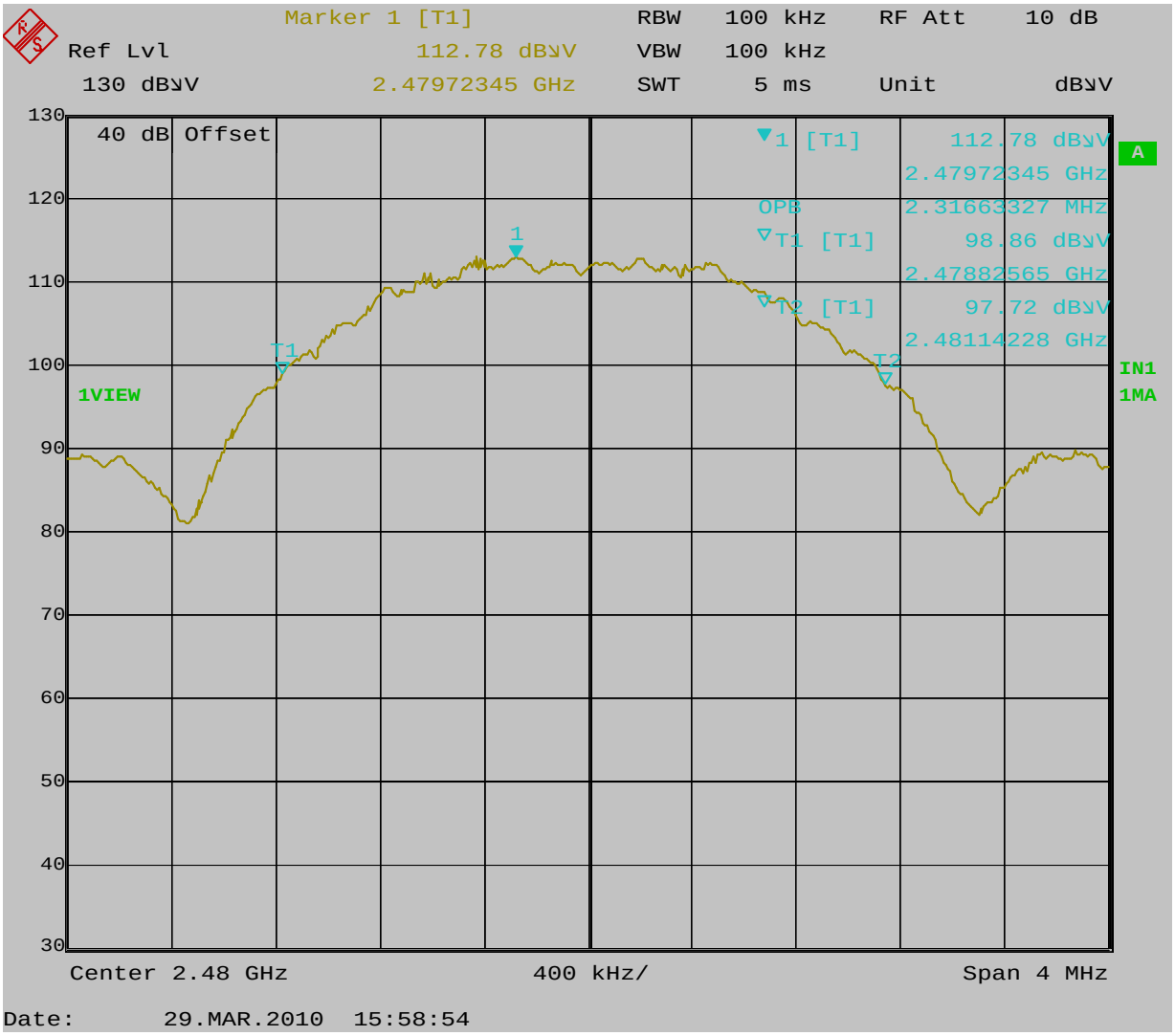


Figure 8 – 99% Power Bandwidth = 2.32 MHz

The EUT is compliant to the requirements of RSS-210 A1.1.3

5.4 Voltage Requirements FCC Part 15.31(e)

FCC Part 15.31 states that for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.4.1 Over View of Test

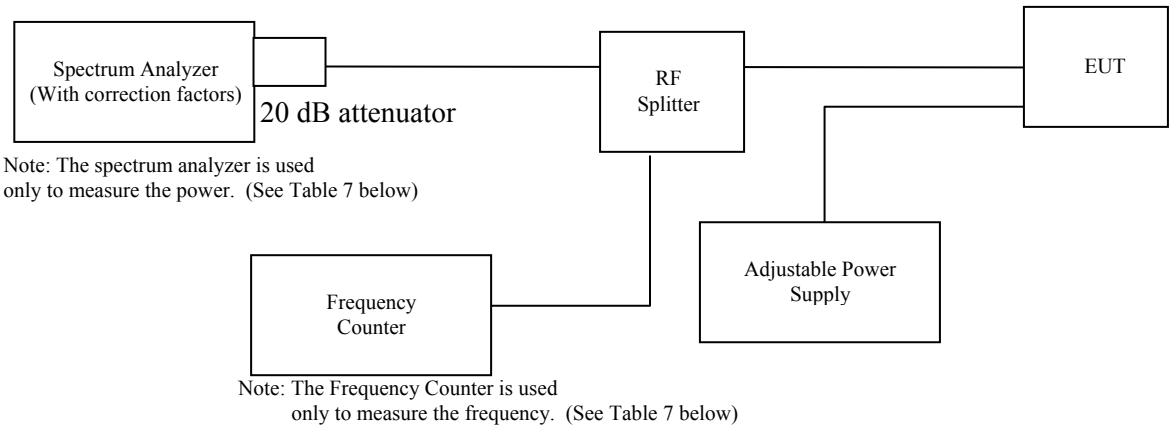
Results	**Complies** (as tested per this report)	**Date**	07 April 2010
Standard	FCC Part 15.31(e)		
Product Model	BARBER2	**Serial#**	NOT SERIALIZED
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details		
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit
Mod. to EUT	None	**Test Performed By**	Mark Ryan

5.4.2 Test Procedure

Since this module could be used in many different applications, including battery operation, the manufacturer selected that worst-case testing suite to be performed. The power source test was performed using the ±15% of rated voltage

Manufacturer Rated voltage: 3.3V, the test will be performed at ±15% of rated voltage.

Test Setup:



Note: The spectrum analyzer is used only to measure the power. (See Table 7 below)

Note: The Frequency Counter is used only to measure the frequency. (See Table 7 below)

Reference at nominal temperature; +24º C

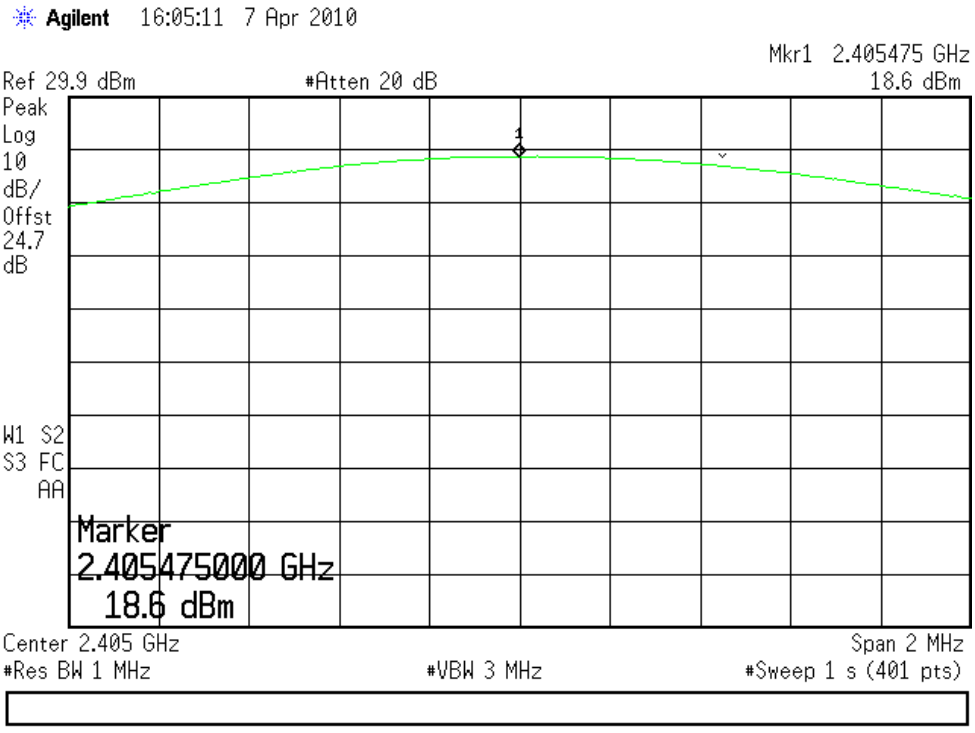
Volts	P(dBm)	Frequency in Hz	Δ to nominal Power (dB)	Δ to nominal Frequency (Hz)
3.3	18.11	2,405,493,787	0.00	0
2.8	17.32	2,405,493,785	-0.79	-2
3.8	18.60	2,405,493,786	0.49	-1

Note: Reading highlighted in Yellow is the reference frequency and power.

Nominal Rated Voltage (V_N): 3.3 Volts
+15% Max Voltage (V_+): 3.8 Volts
-15% Minimum Voltage (V_-): 2.8 Volts

5.4.3 Final Test

As tested, the EUT was found to be compliant to the requirements of the test standard.



Worst Case power shift at +3.8VDC from 18.1 dBm to 18.6 dBm.

Note: All other plots of the extreme voltage tests are on file at TUV Rheinland.
All Frequency measurements are recorded in the table above.

5.5 Antenna Requirements FCC Parts 15.203, 15.204 and RSS-GEN 7.1.4

FCC Part 15.31 states that for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.5.1 Over View of Test

Results	**Complies** (as tested per this report)	**Date**	19 March 2010
Standard	FCC Parts 15.203, 15.204 and RSS-GEN 7.1.4		
Product Model	BARBER2	**Serial#**	NOT SERIALIZED

5.5.2 Test Procedure

The EUT was investigated using four types of antennas. This test report presented the worst case values.

The four antennas that this device is certified to operate with are the following:

Approved External Antennas

Antenna	Mount (on host)	Gain
EAD Model Number BKR2400, Swivel Dipole Antenna (Referred in the test report as the "ROD" antenna)	External	2.0 dBi
EAD Model Number RHEA, PCB Antenna	Internal	2.0 dBi
Antenna Factor Model Number ANT-2.4-JJB-ST Quarter Wave Loaded Rod Antenna.	Internal	0 dBi
WURTH Model Number 7488930245 2.4 GHz Chip Antenna.	Internal	0.5 dBi (Max)

Note: Any other antenna will require retesting.

Antenna # 2 through 4 will be placed inside the host device, and will not be accessible to the end user, however antenna #1 may be mounted externally.

Antenna # 1 and 2 will was tested with a Model Number 0271113IPEX-102 cable assembly.

Manufacturer data sheets are available from the applicant.

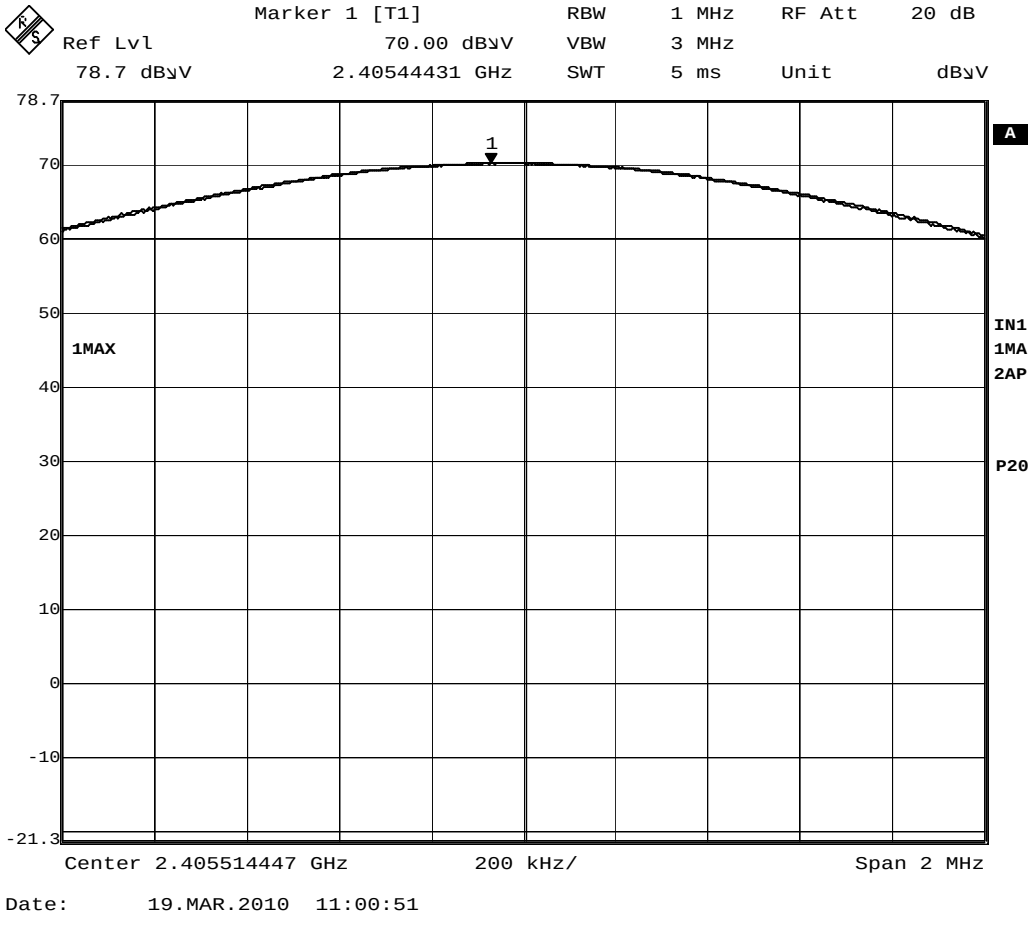
5.5.3 Final Test

The EUT was found to be compliant to the requirements of the test standard.

Radiated Emissions
Chip Antenna

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.60	H	1	124	66.05	0.00	5.84	28.31	100.20		
2405.60	V	1.2	193	69.50	0.00	5.84	28.21	103.54		
2405.60	**H**	**1.1**	**256**	**70.00**	**0.00**	**5.84**	**28.31**	**104.15**		
2405.60	V	1	228	65.52	0.00	5.84	28.21	99.56		
2405.60	H	1.6	292	69.03	0.00	5.84	28.31	103.18		
2405.60	V	1.2	86	66.76	0.00	5.84	28.21	100.80		

Notes: Orientation 1: RED, module w/ antenna flat on table, antenna facing toward RX antenna
Orientation 2: GREEN, module w/ antenna Vertical w/ long side on table, antenna facing toward RX antenna
Orientation 3: Blue, module w/ antenna Vertical w/ short side on table, antenna facing toward RX antenna

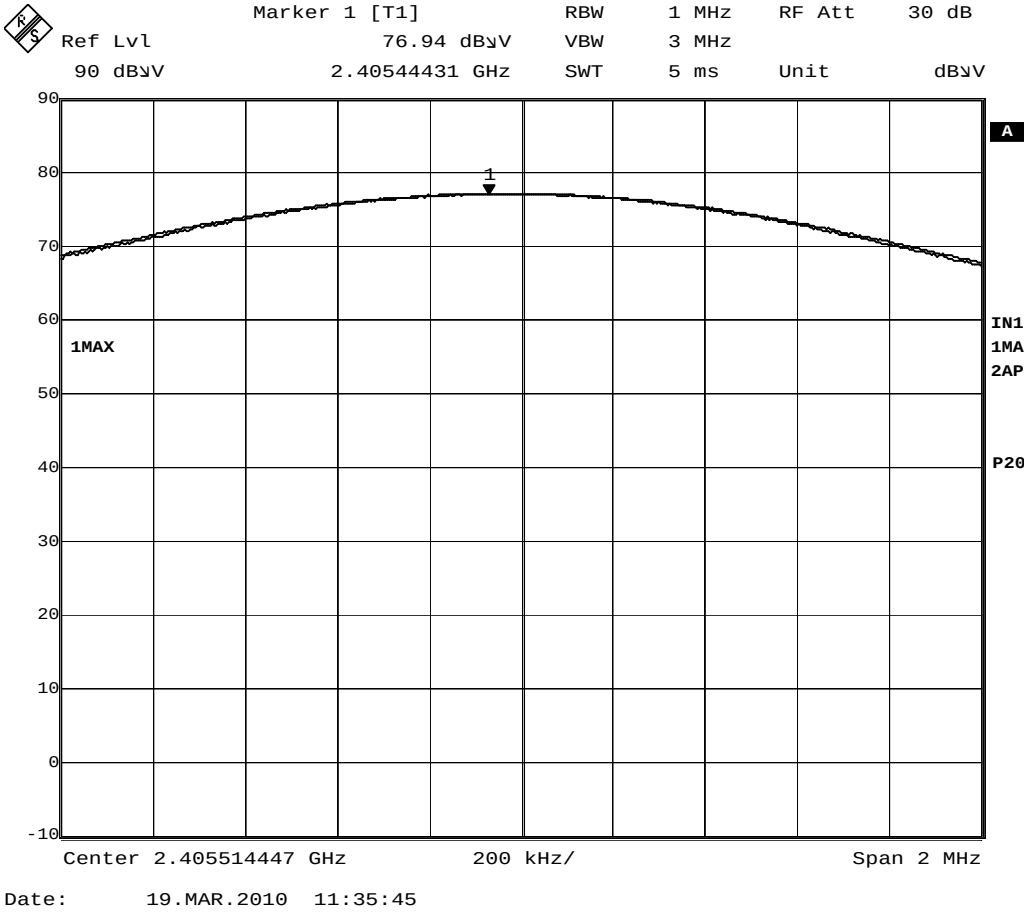


Chip Antenna

Radiated Emissions
Monopole Antenna

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.60	H	1.2	251	73.19	0.00	5.84	28.31	107.34		
2405.60	V	1.7	170	75.14	0.00	5.84	28.21	109.18		
2405.60	H	1.8	349	76.31	0.00	5.84	28.31	110.46		
2405.60	V	1.2	23	72.65	0.00	5.84	28.21	106.69		
2405.60	**H**	**1.7**	**11**	**76.94**	**0.00**	**5.84**	**28.31**	**111.09**		
2405.60	V	1.5	343	71.11	0.00	5.84	28.21	105.15		

Notes: Orientation 1: RED, module w/ antenna flat on table, antenna facing toward RX antenna
Orientation 2: GREEN, module w/ antenna Vertical w/ long side on table, antenna facing toward RX antenna
Orientation 3: Blue, module w/ antenna Vertical w/ short side on table, antenna facing toward RX antenna

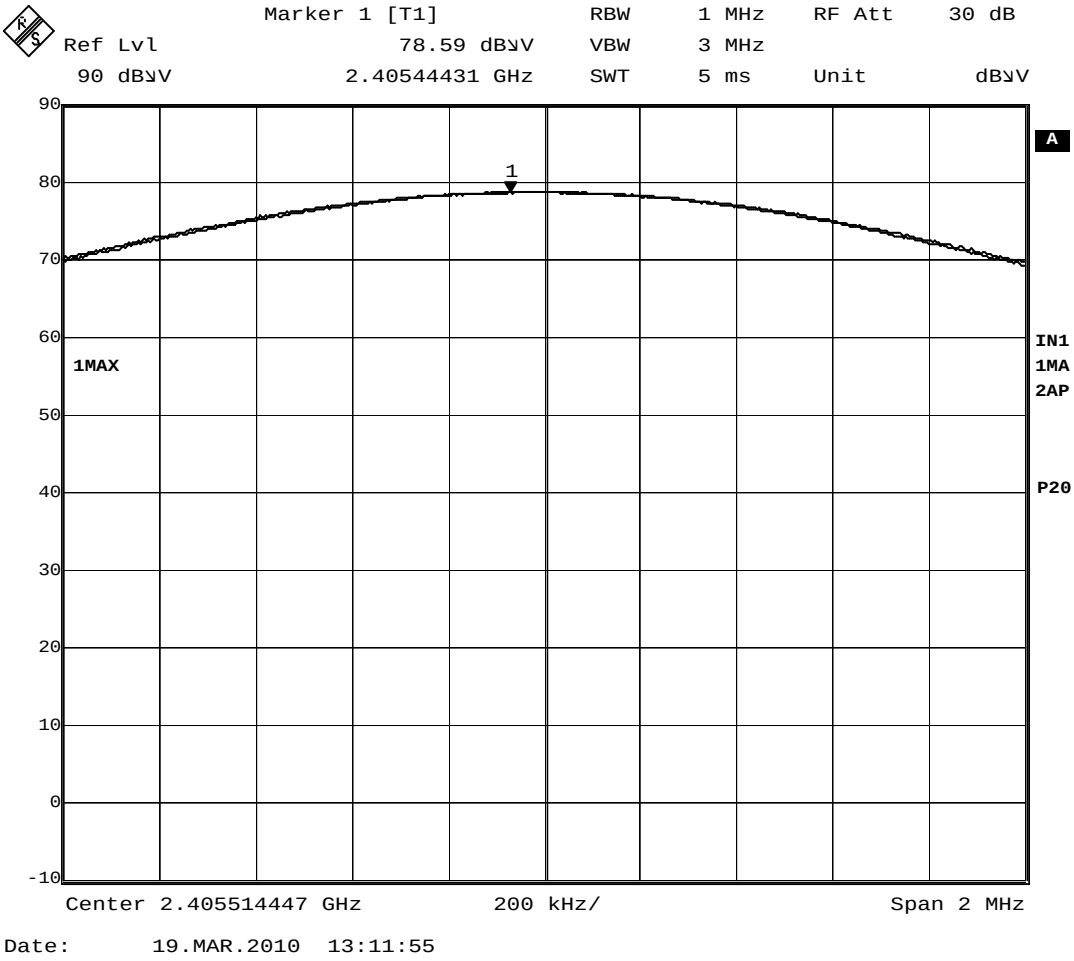


Monopole Antenna

Radiated Emissions
PCB Antenna

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.60	**H**	**1.2**	**71**	**78.59**	**0.00**	**5.84**	**28.31**	**112.74**		
2405.60	V	1.2	176	78.18	0.00	5.84	28.21	112.22		
2405.60	H	1.1	0	75.55	0.00	5.84	28.31	109.70		
2405.60	V	1.5	290	74.84	0.00	5.84	28.21	108.88		
2405.60	H	1	112	69.44	0.00	5.84	28.31	103.59		
2405.60	V	1	213	77.47	0.00	5.84	28.21	111.51		

Notes: Orientation 1: RED, module w/ antenna flat on table, antenna facing toward RX antenna
Orientation 2: GREEN, module w/ antenna Vertical w/ long side on table, antenna facing toward RX antenna
Orientation 3: Blue, module w/ antenna Vertical w/ short side on table, antenna facing toward RX antenna

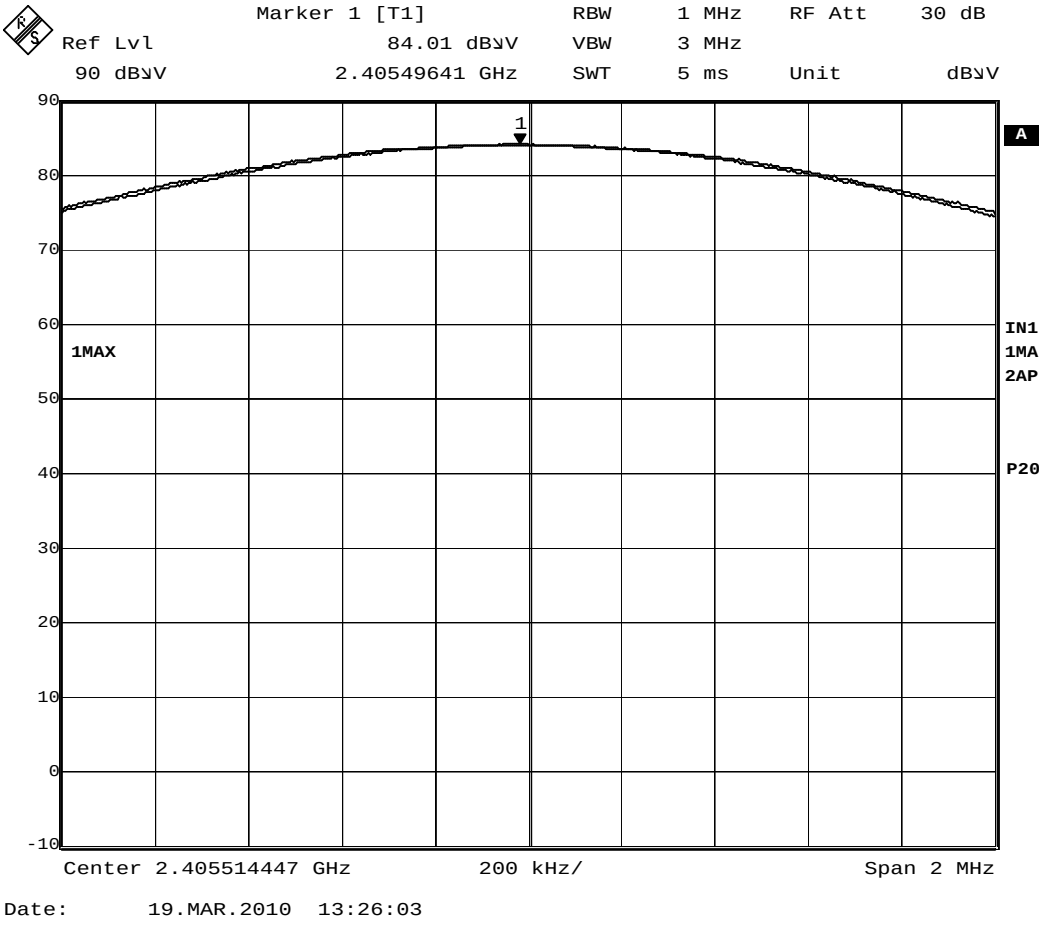


PCB Antenna

Radiated Emissions
Rod Antenna

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.60	H	1.2	76	78.59	0.00	5.84	28.31	112.74		
2405.60	V	1	166	76.31	0.00	5.84	28.21	110.35		
2405.60	H	2.5	284	70.58	0.00	5.84	28.31	104.73		
2405.60	**V**	**1.1**	**183**	**84.01**	**0.00**	**5.84**	**28.21**	**118.05**		

Notes: Orientation 1: RED, module w/ antenna flat on table, antenna facing toward RX antenna
Orientation 2: GREEN, module w/ antenna Vertical w/ long side on table, antenna facing toward RX antenna
Orientation 3: NA for rod antenna
Highest emissions of all orientations and polarities is shown in the yellow background.



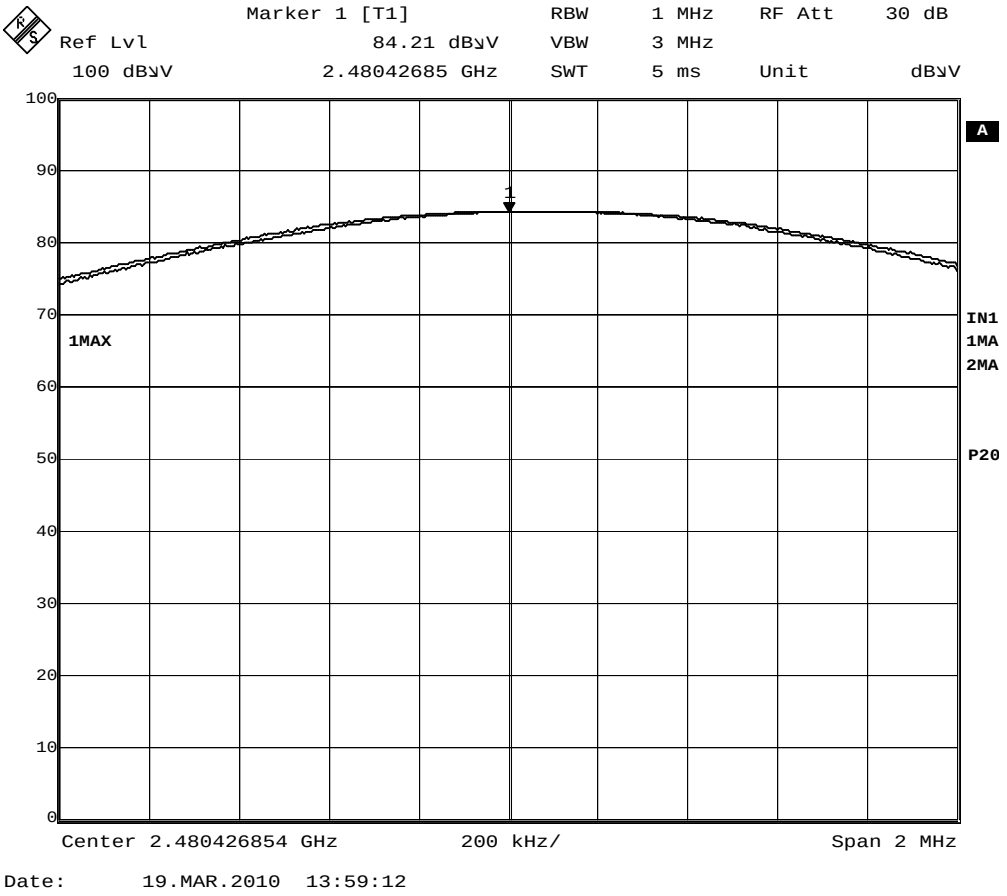
Rod Antenna

Radiated Emissions Worst-Case Channel

Rod Antenna

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.60	V	1.1	183	84.01	0.00	5.84	28.21	118.05		
2440.00	V	1.1	186	84.08	0.00	6.00	28.24	118.32		
2480.00	**V**	**2.5**	**284**	**84.21**	**0.00**	**6.19**	**28.28**	**118.68**		

Notes: Low Band (zigbee Channel 11): RED, module w/ antenna in orientation 2.
Mid Band (zigbee Channel 18): GREEN, module w/ antenna in orientation 2.
High Band (zigbee Channel 26): BLUE module w/ antenna in orientation 2.



Rod Antenna

6 Emissions in Receive Mode.

6.1 Radiated Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

6.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	26 March 2010	
Standard	FCC Parts 15.109(a) and RSS-210 2.2, 2.6,A8.5, RSS-GEN 7.2.3.2						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Configuration	See test plan for details						
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Frequency Range	30 MHz to 5 GHz @ 3m						
Perf. Criteria	(Below Limit)			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Mark Ryan		

6.1.2 Test Procedure

Radiated and FCC emissions tests were performed using the procedures of ANSI C63.4:2003 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 MHz to 5 GHz was investigated for radiated emissions.

Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber.

6.1.3 Deviations

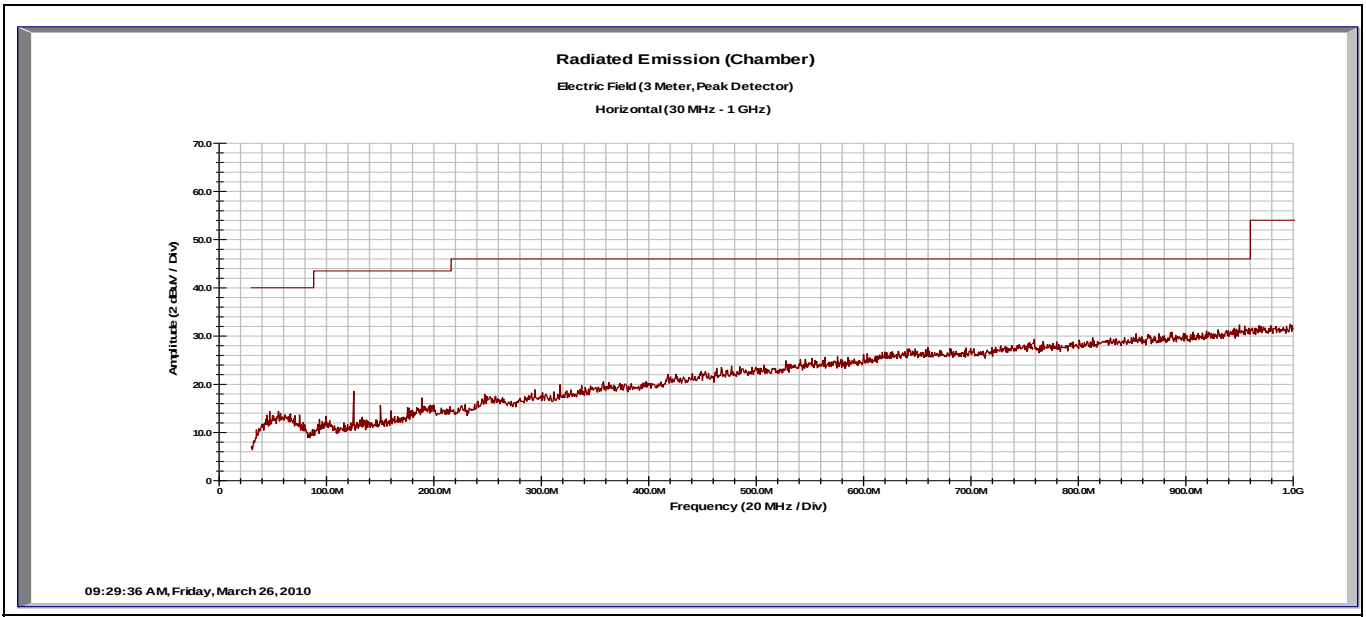
There were no deviations from the test methodology listed in the test plan for the radiated emission test.

6.1.4 Final Test

All final radiated emissions measurements were below (in compliance) the limits.

6.1.5 Final Graphs and Tabulated Data

Radiated Emissions – Monopole antenna – 30MHz to 1 GHz
Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

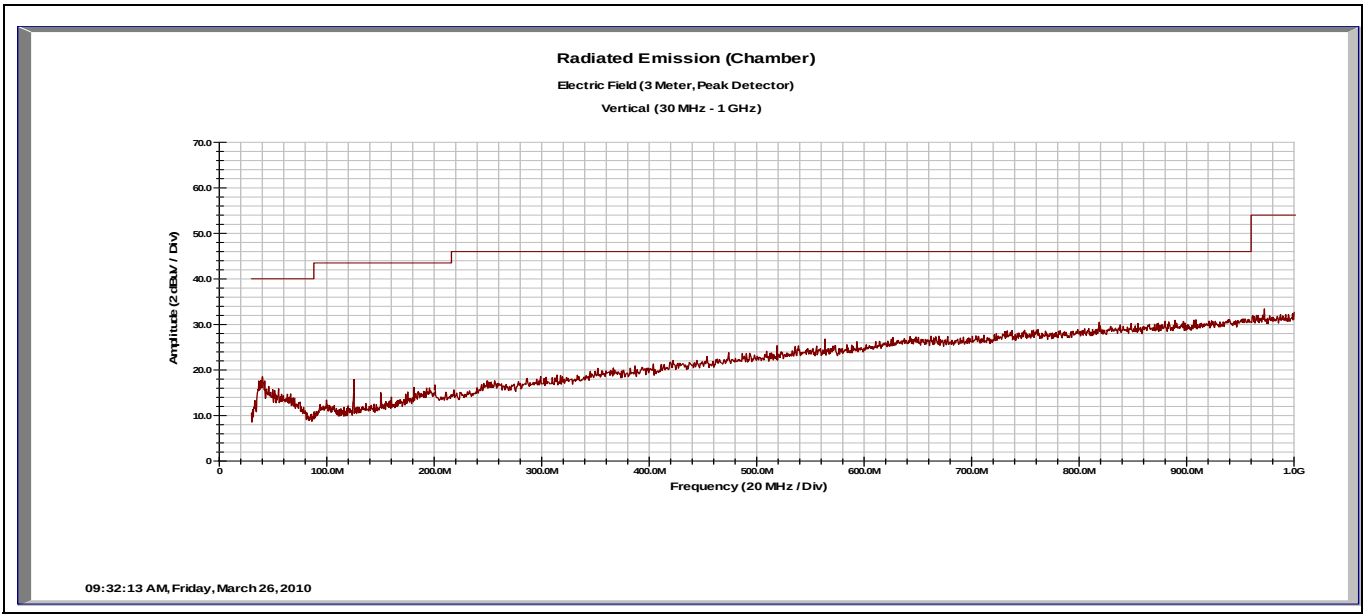
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.
The signals around 120MHz are anomalies in the receiver.

Radiated Emissions – Monopole antenna – 30MHz to 1 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

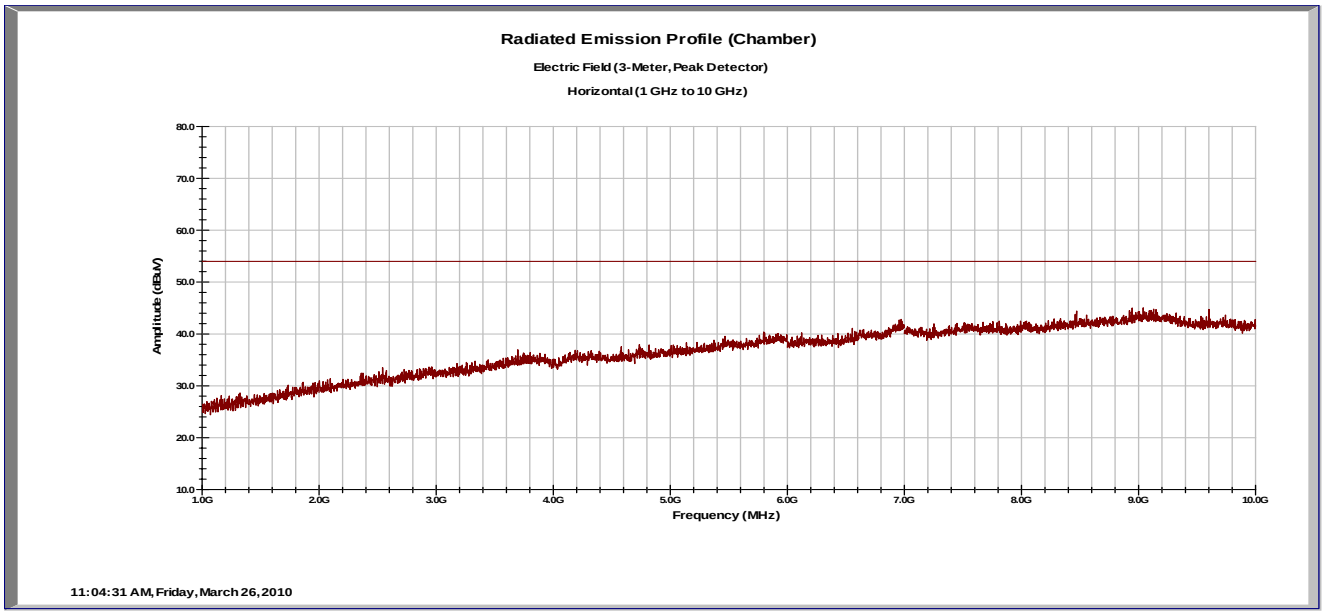
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.
The signals around 120MHz are anomalies in the receiver.

Radiated Emissions – Monopole antenna – 1 GHz to 10 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

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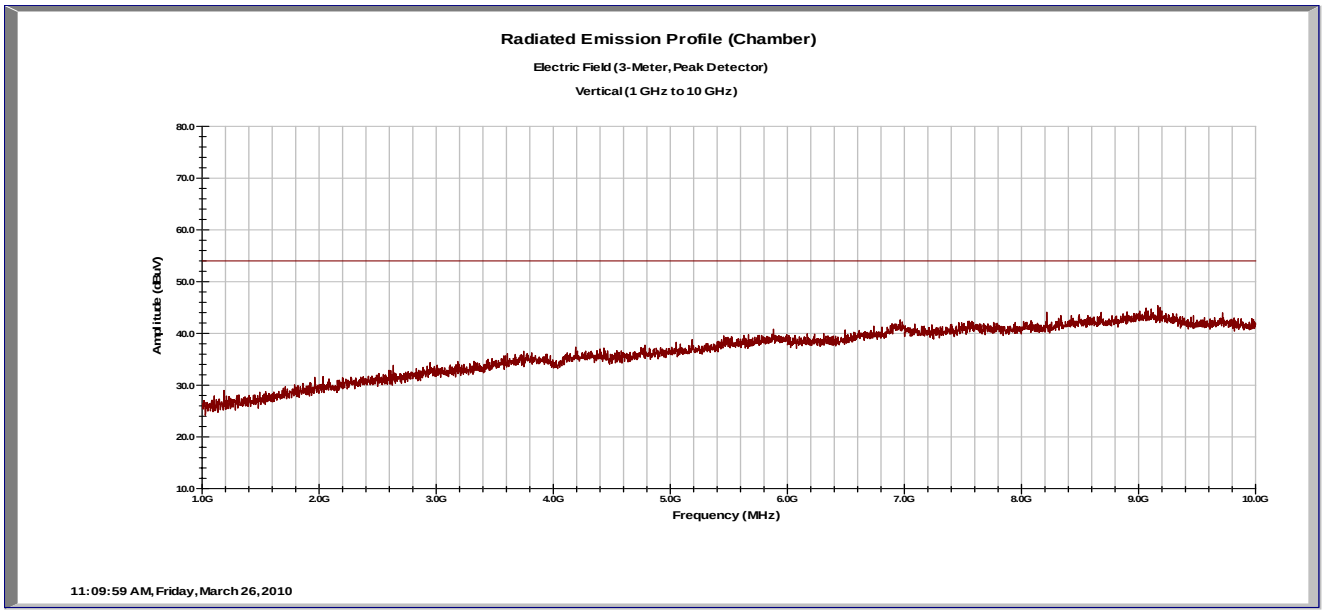
Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions – Monopole antenna – 1 GHz to 10 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

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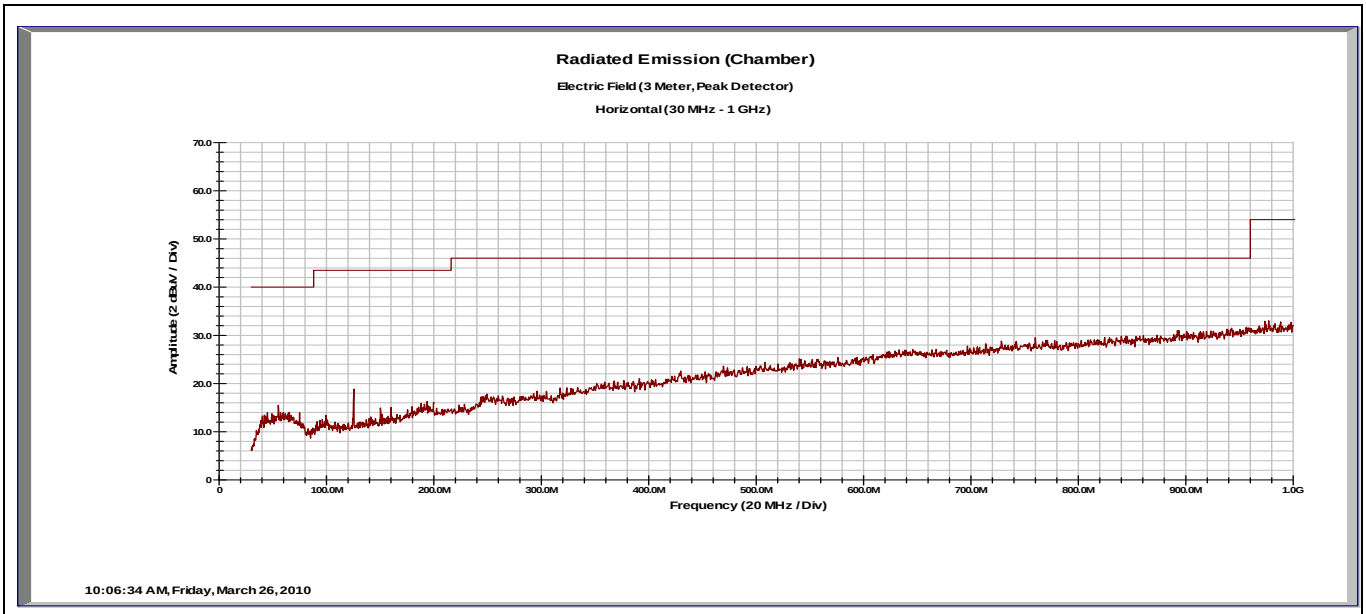
Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions – Rod antenna – 30MHz to 1 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

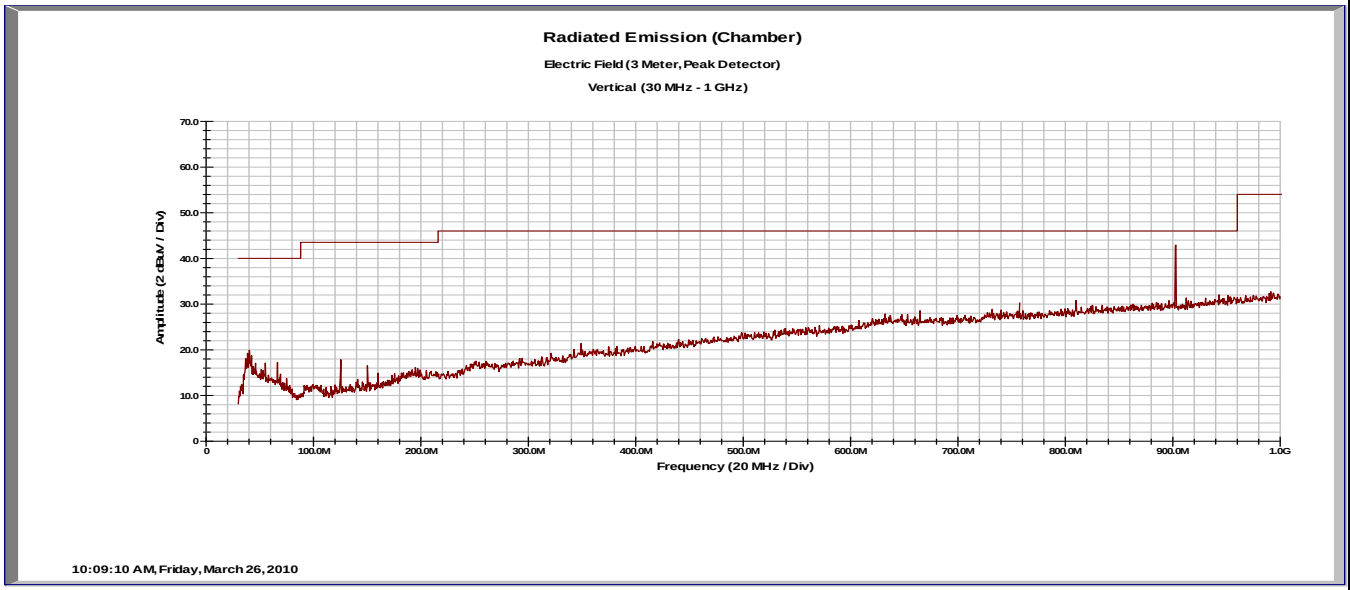
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.
The signals around 120MHz are anomalies in the receiver.

Radiated Emissions – Rod antenna – 30MHz to 1 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

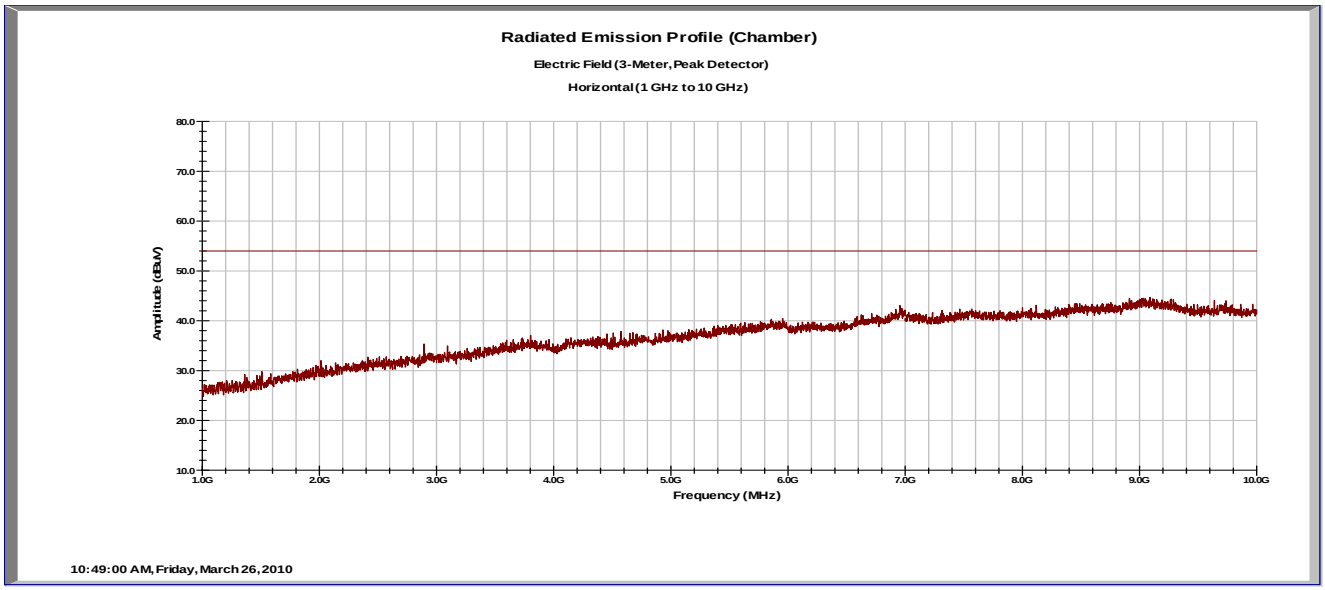
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.
The signals around 120MHz are anomalies in the receiver.

Radiated Emissions – Rod antenna – 1GHz to 10 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

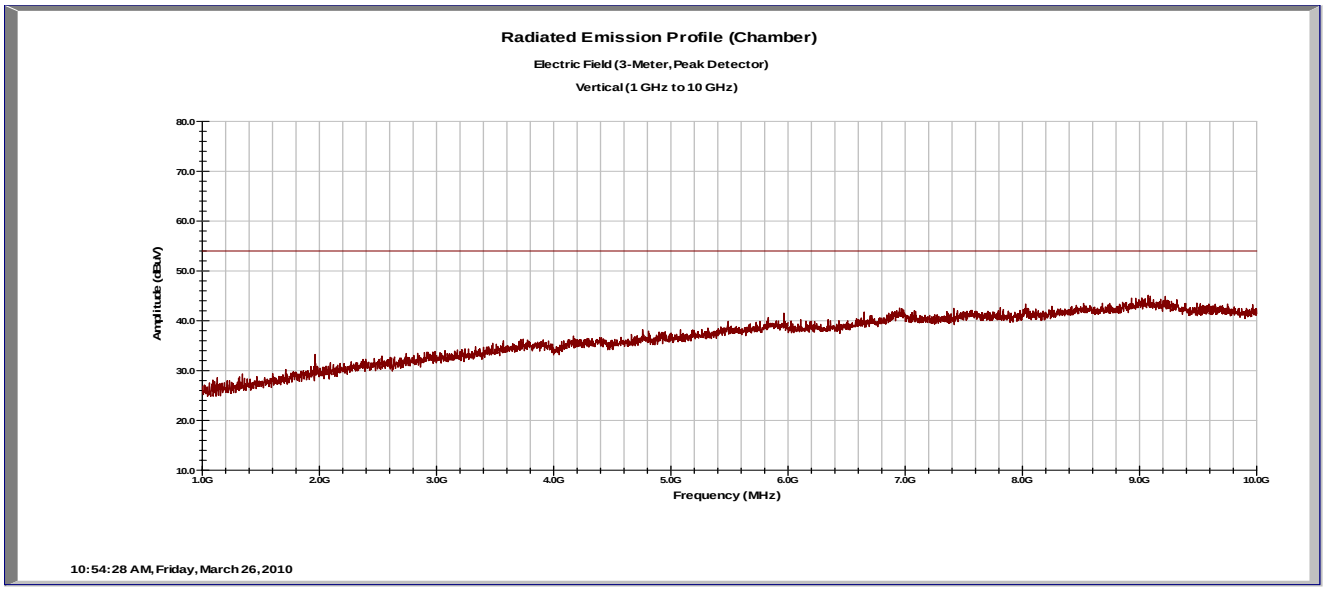
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

Radiated Emissions – Rod antenna – 1GHz to 10 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions are either more than 20dB below the limit, or below the noise floor of the receiver.

6.2 Conducted Emissions

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

6.2.1 Over View of Test

Results	**NA** (as tested per this report)					**Date**	
Standard	FCC Part 15.107(a) and RSS-GEN 7.2.2						
Product Model	BARBER2			**Serial#**	NOT SERIALIZED		
Configuration	See test plan for details						
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	3.3 VDC	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Frequency Range	150 kHz to 30 MHz						
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	**Test Performed By**	Mark Ryan				

6.2.2 Test Procedure

Since this device has many different applications, the company of the host device will be required to test for disturbances to the AC Mains.

6.2.3 Final Test

Since the EUT is powered by 3.3VDC provided by the host device, this test is not applicable.

Appendix A

Test Plan

This test report is intended to follow this test plan outlined here in unless other wise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

General Information

Client	Nichetronix, LLC
Address	656 Ashbrittle Dr.
Contact Person	Steven Bragg
Telephone	919-671-8359
Fax	N/A
e-mail	steve@nichetronix.com

Product Name

Green Quanta Zigbee Module

Model(s) Name

BARBER2

Equipment Under Test (EUT) Description

EUT is a small (38x21mm) 2.4 GHz Zigbee Radio Module, called Barber2 (see Figure 1 below). There are 4 different antennas, creating 4 different models:

– Chip antenna (on board)

– Monopole antenna (on board)

– Rod antenna (connectorized with U.FL connector)

– PCB patch antenna (connectorized with U.FL connector)

The Barber2 module is soldered to another small board (2.3”x1.1”) that we call a baseboard, which simulates a typical customer's PC board. The baseboard contains a pushbutton switch, which is used to change firmware test modes, and it contains a voltage regulator, so the board stack can be run from a source of greater than 3.6V. For emissions testing, the board can be conveniently powered with a 4-volt (nominal) rechargeable Li-Poly battery, as shown in the figure below.

The OEM who integrates the Barber2 into their product must perform mains EMI testing, but that testing is not required for the Barber2 itself.

Modifications

No modifications were required for EUT to pass testing.

Countries

☒	**USA**
☐	**Taiwan**
☐	**Japan**
☒	**Europe**
☒	**Other: Canada**

*Check all that apply

General Product Information

Size	**H**	12mm	**W**	37.5mm	**L**	20.5mm
Weight	10g		**Fork-Lift Needed**		No	
Notes	Size/weight does not include the small baseboard (2.3"x1.1") or the LiPoly rechargeable battery (about 2.0" x 0.8" x 0.2")					

Electrical Power Type

☐	**AC**	☒	**DC**	☒	**Batteries**	☐	**Host -**

Electrical Power Information

Name	**Type**	**Voltage**		**Frequency**	**Current**	**Notes**
		min	**max**			
Power	DC	2.7	3.6	--	150 mA max	
Notes	Power for testing should be provided from the LiPoly battery through the baseboard's 3.3V regulator. For power supply variation testing, the regulator on the baseboard can be easily disabled by de-soldering it and shorting pins 1 and 3 together.					

EUT Modes of Operation

Barber2 contains test firmware, which can be used in measurement of active and passive radiated emissions measurements, and performance measurements. The Barber2 module has an LED on it, which blinks to indicate the test mode number. The pushbutton switch on the base board cycles to the next test mode. There is a reset jumper provided on the baseboard to return to Mode 1, the default.

Below is a table of firmware test modes. An additional document is available detailing these test modes.

Mode #	Mode Name	Description / Use
1	IDLE	Powerup/RESET idle mode. Microcontroller is running, but radio transceiver is not transmitting or receiving. Can be used for non-intentional radiator tests.
2	CW LOW CHANNEL	Transmit continuous wave (CW) signal on lowest channel of 2.4 GHz band (channel 11, 2405 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for conducted power measurements and checking spurious emissions.
3	CW MID CHANNEL	Transmit continuous wave (CW) signal on middle of 2.4 GHz band (channel 18, 2445 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for conducted power measurements and checking spurious emissions.
4	CW HIGH CHANNEL	Transmit continuous wave (CW) signal on highest channel of 2.4 GHz band (channel 26, 2480 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for conducted power measurements and checking spurious emissions.
5	MODULATION LOW CHANNEL	Transmit pseudonoise (PN9) data using O-QPSK at 250kbits/sec with approx 2 MHz occupied BW on lowest channel of 2.4 GHz band (channel 11, 2405 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for occupied bandwidth and band-edge measurements and checking spurious emissions.
6	MODULATION MID CHANNEL	Transmit pseudonoise (PN9) data using O-QPSK at 250kbits/sec with approx 2 MHz occupied BW on middle of 2.4 GHz band (channel 18, 2445 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for occupied bandwidth measurements and checking spurious emissions.
7	MODULATION HIGH CHANNEL	Transmit pseudonoise (PN9) data using O-QPSK at 250kbits/sec with approx 2 MHz occupied BW on highest channel of 2.4 GHz band (channel 26, 2480 MHz). First time through this mode after RESET, power is +20 dBm; 2nd time and subsequent, power is +10 dBm. Useful for occupied bandwidth and band-edge measurements and checking spurious emissions.
8	RECEIVE ZIGBEE	Receiver is running continuously, and will blink the LED for 0.1 second for each packet with a good CRC that is received. Useful for unintentional radiator tests.

EUT Clock/Oscillator Frequencies

☒	**Less than 108MHz**	**FCC – scan up to 1GHz**
☐	**Less than 500MHz**	**FCC – scan up to 2GHz**
☐	**Less than 1000MHz**	**FCC – scan up to 5GHz**
☒	**Greater then 1000MHz**	**FCC – scan up to 5th Harmonic or 40GHz**

Electrical Support Equipment

Type	Manufacture	Model	Connected To
Battery Charger	Microchip Techologies	MCP7386XEV	LiPoly battery – DISCONNECT FROM BASEBOARD BEFORE CHARGING.

EUT Equipment/Cabling Information

EUT Port	Connected To	Location	Cable Type		
			Length	Shielded	Bead
U.FL (antenna)	Rod antenna or patch antenna (CABLES-PRE-ATTACHED)	On Barber2, next to shield	5”	Y	NA

EUT Test Program

The Emissions Test Firmware is controlled completely by two controls and one LED indicator, so no external computer is required (Refer to Figures 1 and 2, below). For emissions tests, typically the module/test board stack is powered by a rechargeable Li-ion or Li-Poly battery (shown in Fig. 1), so no external cables are required.

When the pushbutton is pushed for more than 0.5 seconds, then released, the Emissions Test Firmware changes to the next mode. After the pushbutton is released, the green LED indicator blinks a number of times, indicating the new mode number. For example, Mode 5 will flash the LED 5 times.

On power-up or reset, the board starts in Mode 1 (Idle), and one flash of the LED will be seen right after reset/power-up. When the Emissions Test Firmware is in the last mode, it cycles back to Mode 1 (Idle) when the pushbutton is pressed and released.

Upon the 2nd time entering Mode 2 after power-up / reset, the Firmware will transition from HIGH transmit power (approximately +20 dBm) to LOW transmit power (approximately +10 dBm) to facilitate ETSI testing. There is no visual indication of high / low power mode. To return to HIGH power, simply apply a reset to the board by shorting the two RESET pads together (Fig 2).

If the test operator is unsure of the mode or power level the Firmware is in, short the RESET pads together for a few hundred milliseconds or more (see Figure 2). The Emissions Test Firmware will enter Mode 1 High Power and blink the LED once.

Monitoring of EUT during Testing

No monitoring of the EUT during testing is required, except for the emissions test equipment.

EUT Configuration

Description

Configuration	Description
Rod Antenna	Connect Rod antenna cable to U.FL connector
PCB Patch Antenna	Connect PCB patch antenna to U.FL connector
Conducted Emissions Test	Connect U.FL to SMA adapter to U.FL connector
Chip Antenna	EUT is provided pre-configured with this antenna soldered to board
Monopole Antenna	EUT is provided pre-configured with this antenna soldered to board
Notes	All configurations are the same except as noted above