



## TEST REPORT

Report Number: 3175501MIN-001

Project Number: 3175501

Testing performed on the  
Hydra 2.4GHz Wireless RF Remote Control

FCC ID: W8G515-007400

Industry Canada ID: 8348A-515007400

to

47 CFR Part 15. 249:2008

RSS- 210, Issue 7, 2007

For

Cardinal Health Inc.

Test Performed by:  
Intertek Testing Services NA, Inc.  
7250 Hudson Blvd., Suite 100  
Oakdale, MN 55128

Test Authorized by:  
Cardinal Health Inc.  
5225-2 Verona Road P O Box 4451  
Madison, WI 53771

Prepared by: Richard Blonigen  
Richard Blonigen

Date: April 28, 2009

Reviewed by: Uri Spector  
Uri Spector

Date: April 28, 2009

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## 1.0 GENERAL DESCRIPTION

<b>Model:</b>	Hydra 2.4GHz Wireless RF Remote Control
<b>Type of EUT:</b>	Remote Control
<b>Serial Number:</b>	N/A
<b>FCC ID:</b>	W8G515-007400
<b>Industry Canada ID:</b>	8348A-515007400
<b>Related Submittal(s) Grants:</b>	None
<b>Company:</b>	Cardinal Health Inc.
<b>Customer:</b>	Mr. Ron Schulter
<b>Address:</b>	5225-2 Verona Road PO Box 4451 Madison, WI 53771
<b>Phone:</b>	(608) 441-2142
<b>Fax:</b>	(608) 441-2007
<b>Test Standards:</b>	<input checked="" type="checkbox"/> 47 CFR, Part 15:2008, §15.249 <input checked="" type="checkbox"/> RSS-210, Issue 7, 2007 <input checked="" type="checkbox"/> RSS-Gen, Issue 2, 2007 <input checked="" type="checkbox"/> 47 CFR, Part 15:2008, §15.109, Class B <input type="checkbox"/> Other
<b>Type of radio:</b>	<input checked="" type="checkbox"/> Stand -alone <input type="checkbox"/> Module <input type="checkbox"/> Hybrid
<b>Date Sample Submitted:</b>	March 25, 2009
<b>Test Work Started:</b>	March 26, 2009
<b>Test Work Completed:</b>	April 3, 2009
<b>Test Sample Conditions:</b>	<input type="checkbox"/> Damaged <input type="checkbox"/> Poor (Usable) <input checked="" type="checkbox"/> Good



## 1.1 Product Description; Test Facility

Product Description:	RF Remote Controller
Operating Frequency	2400-2483.5 MHz
Modulation:	GFSK
Emission Designator:	1M68F1D
Antenna(s) Info:	Integral antenna
Antenna Installation:	<input type="checkbox"/> User <input type="checkbox"/> Professional <input checked="" type="checkbox"/> Factory
Transmitter Power Configuration:	<input checked="" type="checkbox"/> Internal battery <input type="checkbox"/> External power source <input type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input type="checkbox"/> 400VAC <input checked="" type="checkbox"/> 3 VDC <input type="checkbox"/> Other: <input type="text"/> <input type="text"/> Amp. <input type="checkbox"/> 50Hz <input type="checkbox"/> 60Hz
Special Test Arrangement:	As a hand-held device the EUT was rotated through three orthogonal axes to determine and tested with the maximum emissions
Test Facility Accreditation:	A2LA (Certificate No. 1427.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003

## 1.2 EUT Configuration

The equipment under test was operated during the measurement under the following conditions:

- ☐ - Standby
- ☒ - Continuous
- ☐ - Continuous un-modulated
- ☐ - Test program (customer specific)
- ☐ -

### Operating modes of the EUT:

No.	Description
1	The device was pre-programmed to transmit continuously in three separate frequency channels, low, middle, and upper frequency channel, one channel being transmitted at a given time.

### Cables:

No.	Type	Length	Designation	Note
1	N/A			
2				

### Support equipment/Services:

No.	Item	Description
1	Hydra Dongle	Used to initiate transmission with remote control
2		

## 1.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

☐ Normal

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

## 1.4 Measurement uncertainty

The expanded uncertainty ( $k = 2$ ) for radiated emissions from 30 to 1000 MHz has been determined to be:  $\pm 4$  dB at 10m and  $\pm 5.4$  dB at 3m

The expanded uncertainty ( $k = 2$ ) for conducted emissions from 150 kHz to 30 MHz has been determined to be:  
 $\pm 2.6$  dB

## 1.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB( $\mu$ V/m)

RA = Receiver Amplitude in dB( $\mu$ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB( $m^{-1}$ )

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB( $\mu$ V) is obtained. The antenna factor of 7.4 dB( $m^{-1}$ ) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB( $\mu$ V/m).

$$RA = 48.1 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(m^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu\text{V}/\text{m})$$

**General notes:** None

## 2.0 TEST SUMMARY

Referring to the performance criteria and the operating mode during the tests specified in this report, the equipment complies with the requirements according to the following standards.

TEST SPECIFICATION	TEST PARAMETERS	RESULT
15.249(a) / RSS-210 A2.9(a)	Field strength of fundamental	Pass
15.249(a) / RSS-210 A2.9(a)	Field strength of harmonics	Pass
15.249(d) / RSS-210 A2.9(b)	Field strength of spurious emissions	Pass
15.215(c) / RSS- Gen 4.6.1	Bandwidth of the emission	Pass
15.207/RSS-Gen 7.2.2	Transmitter Power Line conducted emissions	N/A
15.109/ICES-003	Receiver/digital device radiated emissions	Pass
15.107/ ICES-003	Digital device conducted emissions	N/A



### 3.0 TEST CONDITIONS AND RESULTS

#### 3.1 Field strength of fundamental

**Test location:** ☐ OATS ☒ Anechoic Chamber ☐ Other

**Test distance:** ☐ 10 meters ☒ 3 meters

**Frequency range of measurements:** 2400MHz-2483.5MHz

**Test result:** **Pass**

**Max. Emissions margin at fundamental:** 9.4 dB below the limits

**Notes:** Test performed at low, middle and upper channel

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<b>Date:</b>	March 30, 2009	<b>Result: Pass</b>
<b>Standard:</b>	FCC 15.249(a) / RSS-210 A2.9	
<b>Tested by:</b>	Richard Blonigen	
<b>Test Point:</b>	Enclosure with antenna	
<b>Operation mode:</b>	See Page 5	
<b>Note:</b>		

**Table 3.1.1**

Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBμV	Total @ 3m dBμV/m	Average CF dB	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)									
Harmonics											
					Channel 2402MHz						
4804.00	V	129	33.0	6.3	39.8	42.9	42.4	0.0	54.0	-11.6	
4802.00	H	129	33.0	6.3	39.8	44.5	44.1	0.0	54.0	-9.9	
7206.00	V	157	35.8	7.7	40.1	43.6	47.0	0.0	54.0	-7.0	
7206.00	H	203	35.8	7.7	40.1	36.9	40.3	0.0	54.0	-13.7	
					Channel 2440MHz						
4880.00	V	142	33.1	6.4	39.8	41.7	41.4	0.0	54.0	-12.6	
4880.00	H	185	33.1	6.4	39.8	44.1	43.9	0.0	54.0	-10.1	
7320.00	V	151	36.1	7.7	39.9	47.7	51.5	0.0	54.0	-2.5	
7320.00	H	154	36.1	7.7	39.9	43.4	47.2	0.0	54.0	-6.8	
					Channel 2481MHz						
4962.00	V	189	33.2	6.5	39.7	38.9	38.9	0.0	54.0	-15.1	
4962.00	H	186	33.2	6.5	39.7	43.1	43.1	0.0	54.0	-10.9	
7443.00	V	133	36.4	7.7	39.8	48.4	52.7	0.0	54.0	-1.3	
7443.00	H	160	36.4	7.7	39.8	43.0	47.3	0.0	54.0	-6.7	



### 3.2 Field strength of harmonics and spurious emissions

**Test location:** ☐ OATS ☒ Anechoic Chamber ☐ Other

**Test distance:** ☐ 10 meters ☒ 3 meters

**Frequency range of measurements:** 30MHz-25GHz (10<sup>th</sup> Harmonic)

**Test result:** **Pass**

**Max. margin of harmonics and spurious emissions:** 1.3 dB below the limits

**Notes:** None

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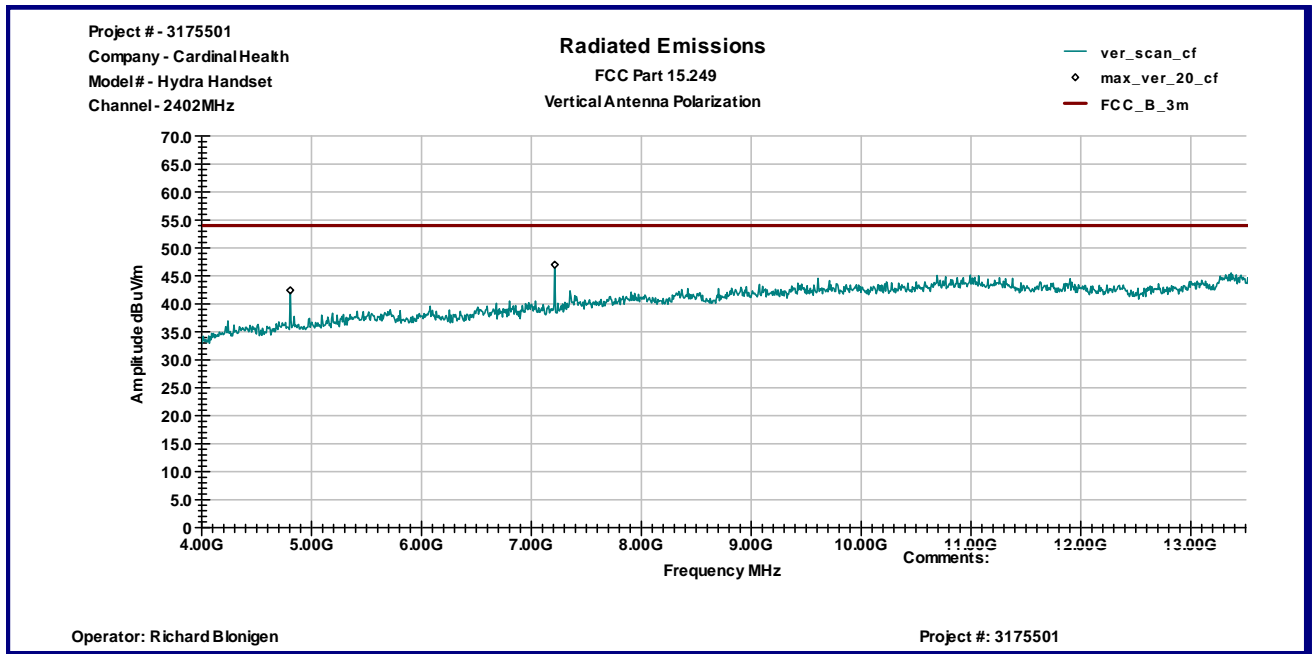
<b>Date:</b>	April 2, 2009	<b>Result: Pass</b>
<b>Standard:</b>	FCC 15.249(a) and (d) / RSS-210 A2.9	
<b>Tested by:</b>	Richard Blonigen	
<b>Test Point:</b>	Enclosure with antenna	
<b>Operation mode:</b>	See Page 5	
<b>Note:</b>	No emissions above ambient noise were detected above the 3 <sup>rd</sup> harmonics	

**Table 3.2.1**

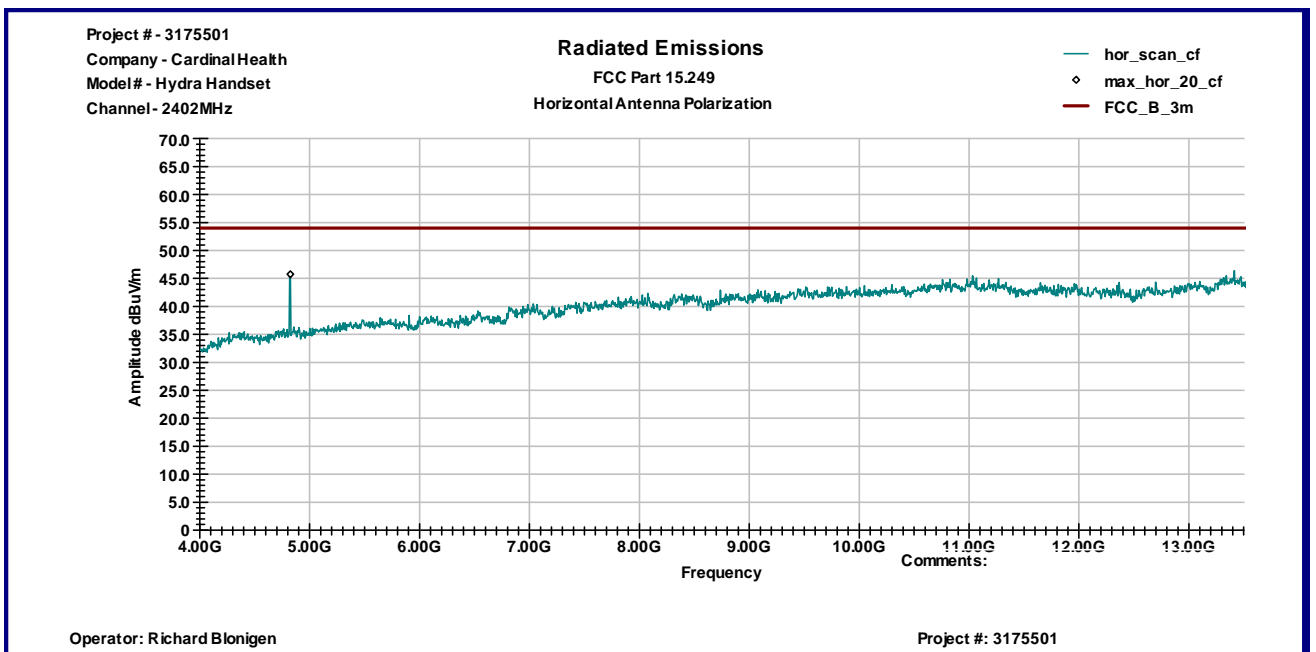
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBμV	Total @ 3m dBμV/m	Average CF dB	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)									
<b>Channel 2402MHz</b>											
4804.00	V	129	33.0	6.3	39.8	42.9	42.4	0.0	54.0	-11.6	
4802.00	H	129	33.0	6.3	39.8	44.5	44.1	0.0	54.0	-9.9	
7206.00	V	157	35.8	7.7	40.1	43.6	47.0	0.0	54.0	-7.0	
7206.00	H	203	35.8	7.7	40.1	36.9	40.3	0.0	54.0	-13.7	
<b>Channel 2440MHz</b>											
4880.00	V	142	33.1	6.4	39.8	41.7	41.4	0.0	54.0	-12.6	
4880.00	H	185	33.1	6.4	39.8	44.1	43.9	0.0	54.0	-10.1	
7320.00	V	151	36.1	7.7	39.9	47.7	51.5	0.0	54.0	-2.5	
7320.00	H	154	36.1	7.7	39.9	43.4	47.2	0.0	54.0	-6.8	
<b>Channel 2481MHz</b>											
4962.00	V	189	33.2	6.5	39.7	38.9	38.9	0.0	54.0	-15.1	
4962.00	H	186	33.2	6.5	39.7	43.1	43.1	0.0	54.0	-10.9	
7443.00	V	133	36.4	7.7	39.8	48.4	52.7	0.0	54.0	-1.3	
7443.00	H	160	36.4	7.7	39.8	43.0	47.3	0.0	54.0	-6.7	

Graph 3.2.1

## Vertical antenna polarization

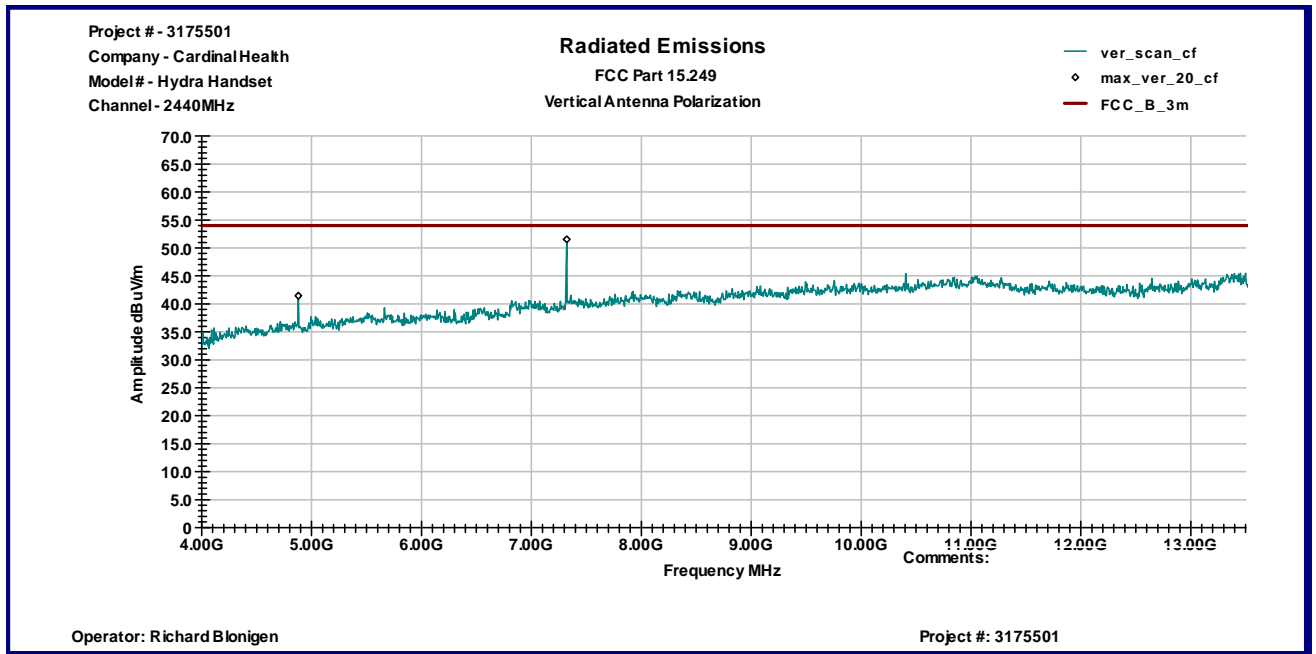


## Horizontal antenna polarization

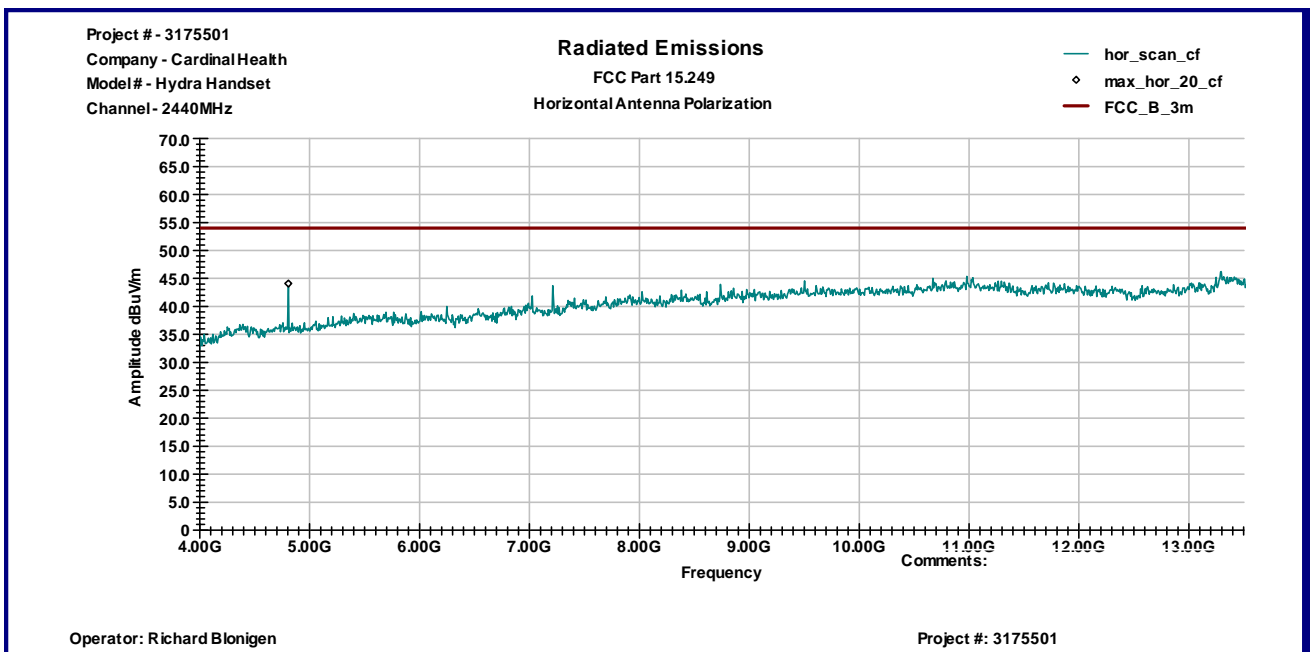


Graph 3.2.2

Vertical antenna polarization

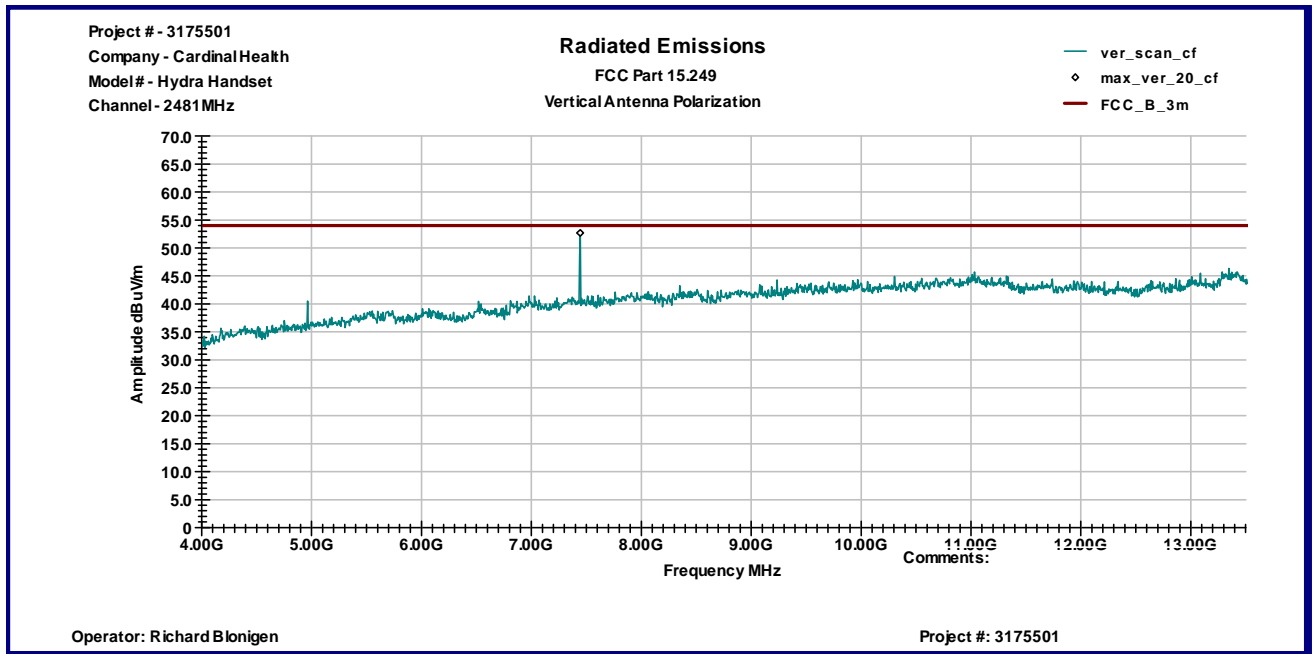


Horizontal antenna polarization

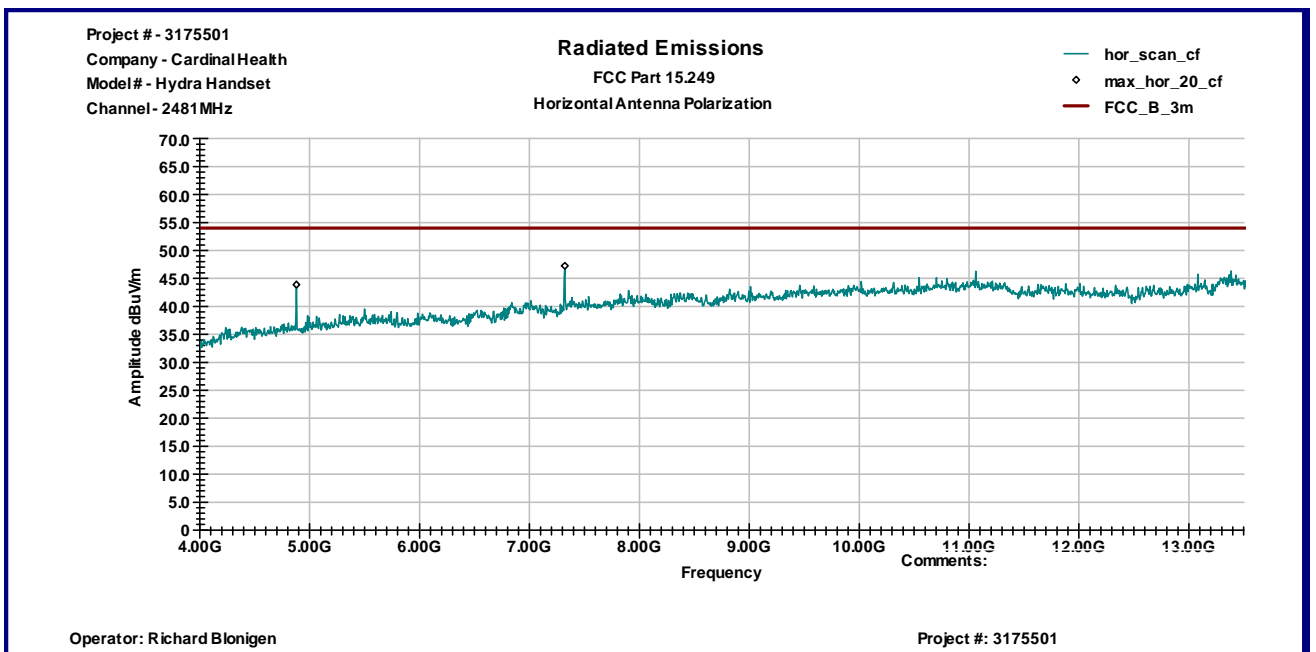


Graph 3.2.3

### Vertical antenna polarization

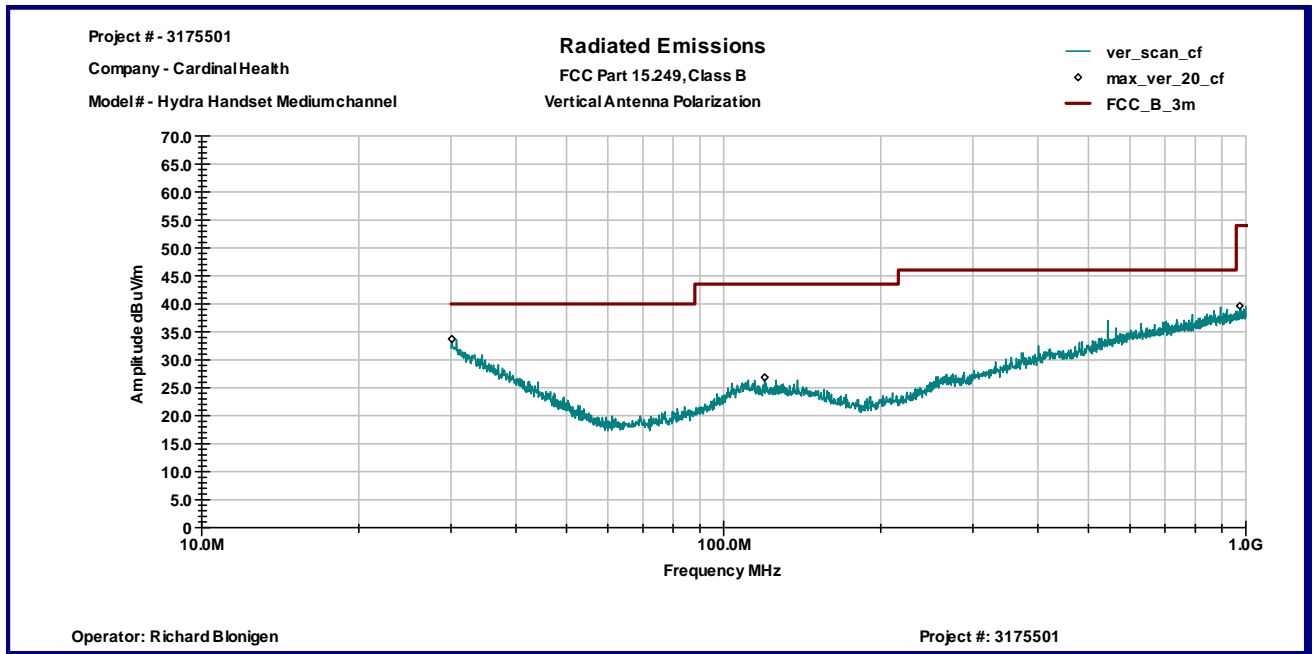


### Horizontal antenna polarization

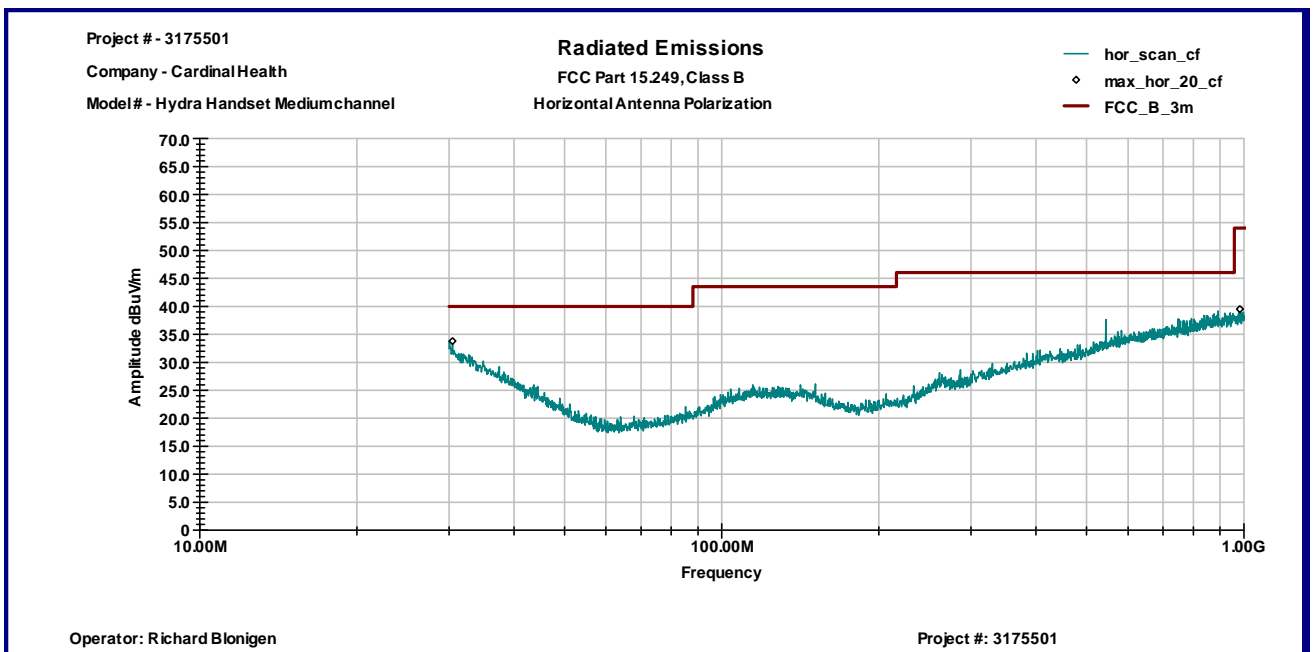


Graph 3.2.4

### Vertical antenna polarization



### Horizontal antenna polarization



### 3.2.1 Average correction factor calculation

An Average correction factor is calculated by averaging one complete pulse train.

One complete pulse train, including blanking intervals = 29.04 ms

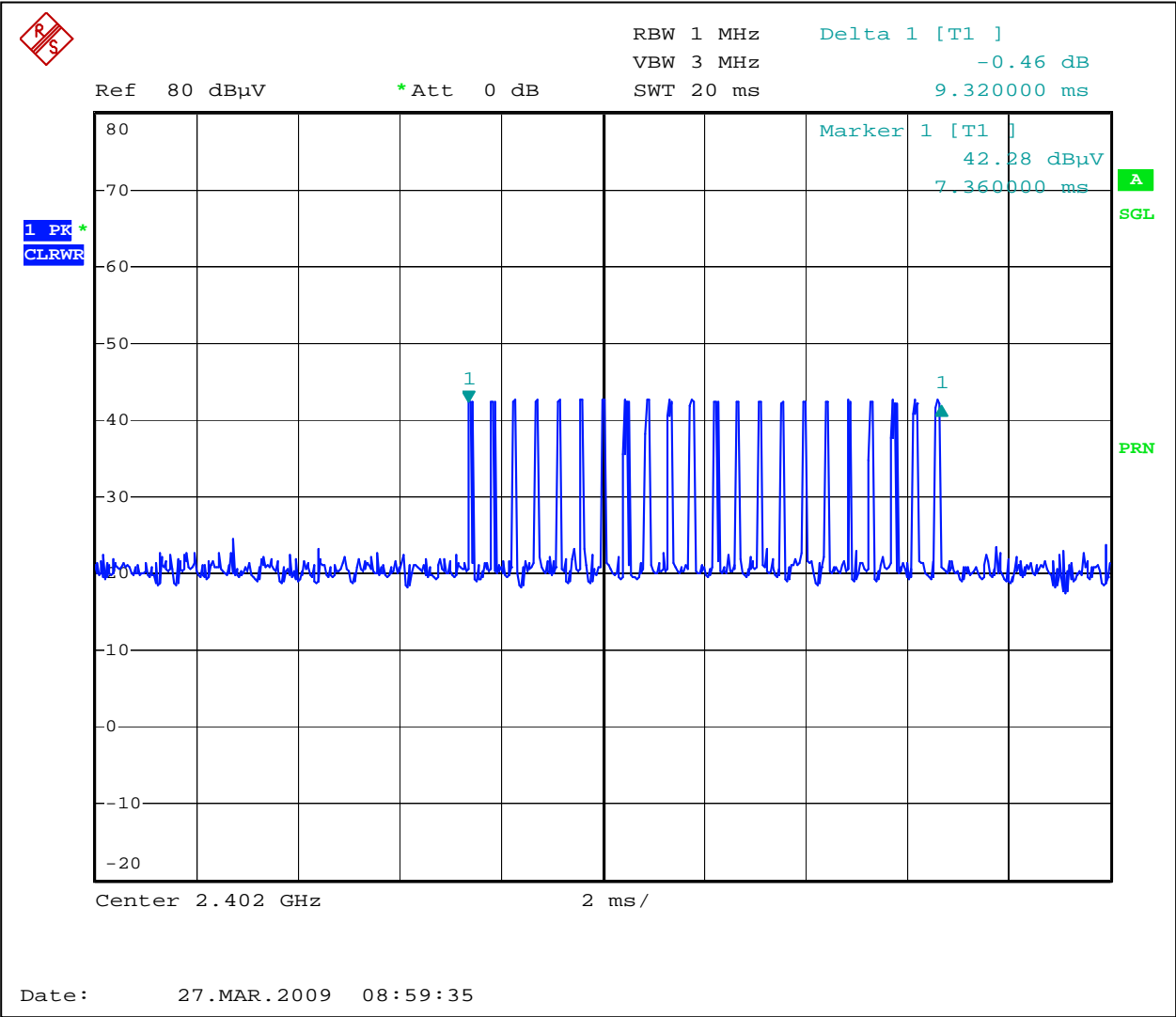
Time with field strength is in its maximum value (length of pulses) = 8.71 ms

Average Correction Factor =  $20\text{Log}(8.71 \text{ ms} / 29.04 \text{ ms}) = 10.46 \text{ dB}$

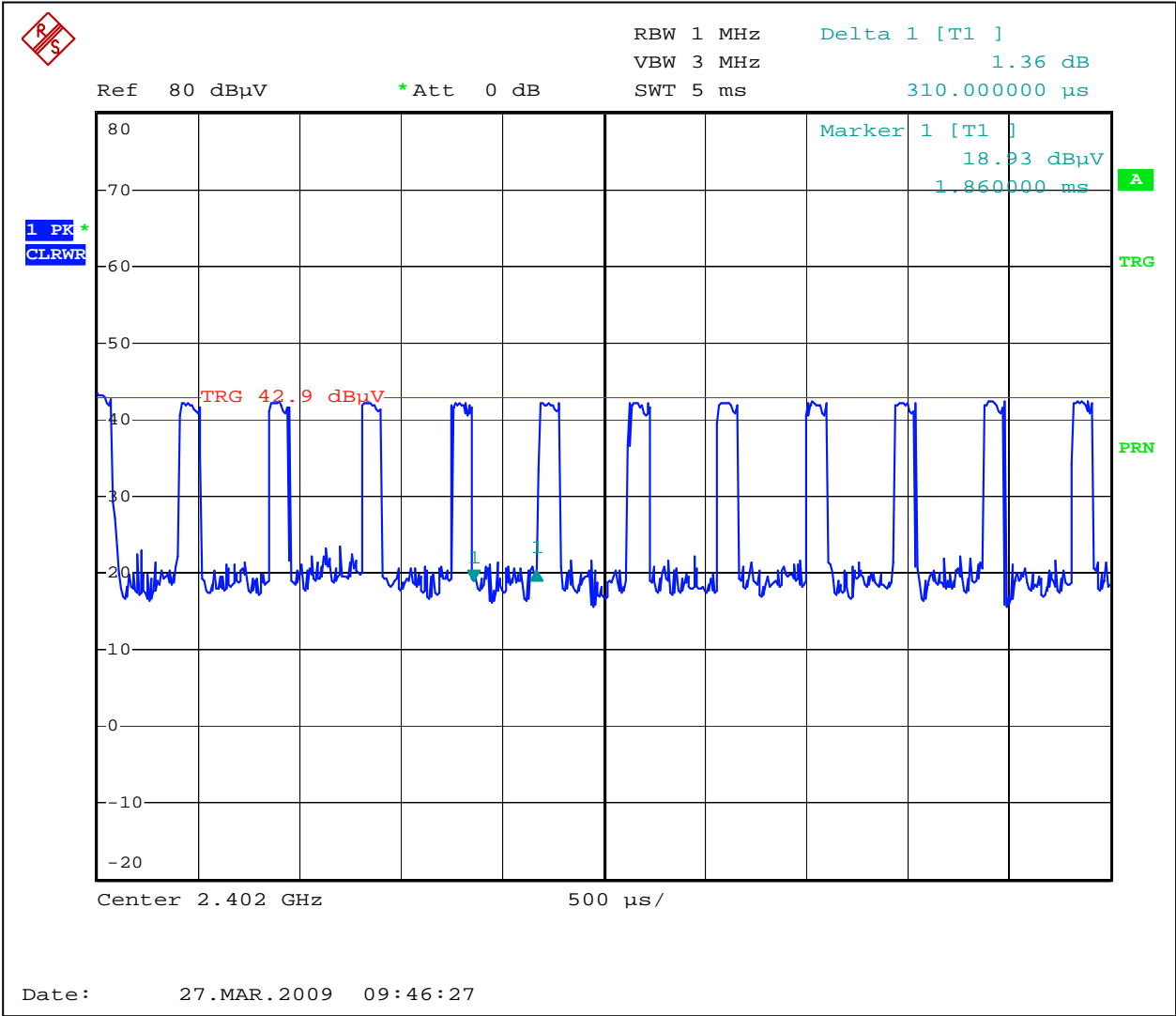
Graphs 3-2-5 to 3-2-8 are show pulse train timing.



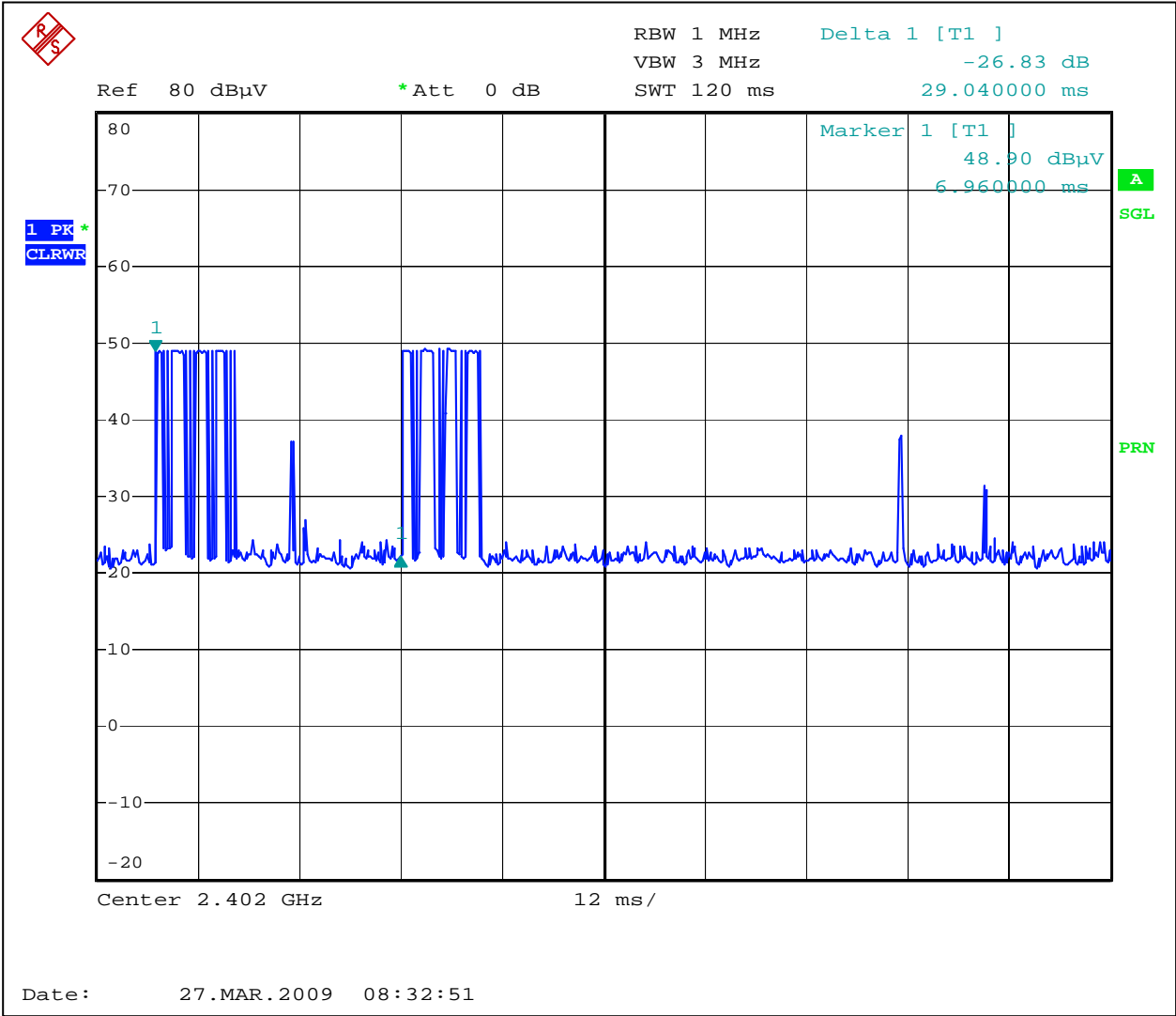
Graph 3.2.5



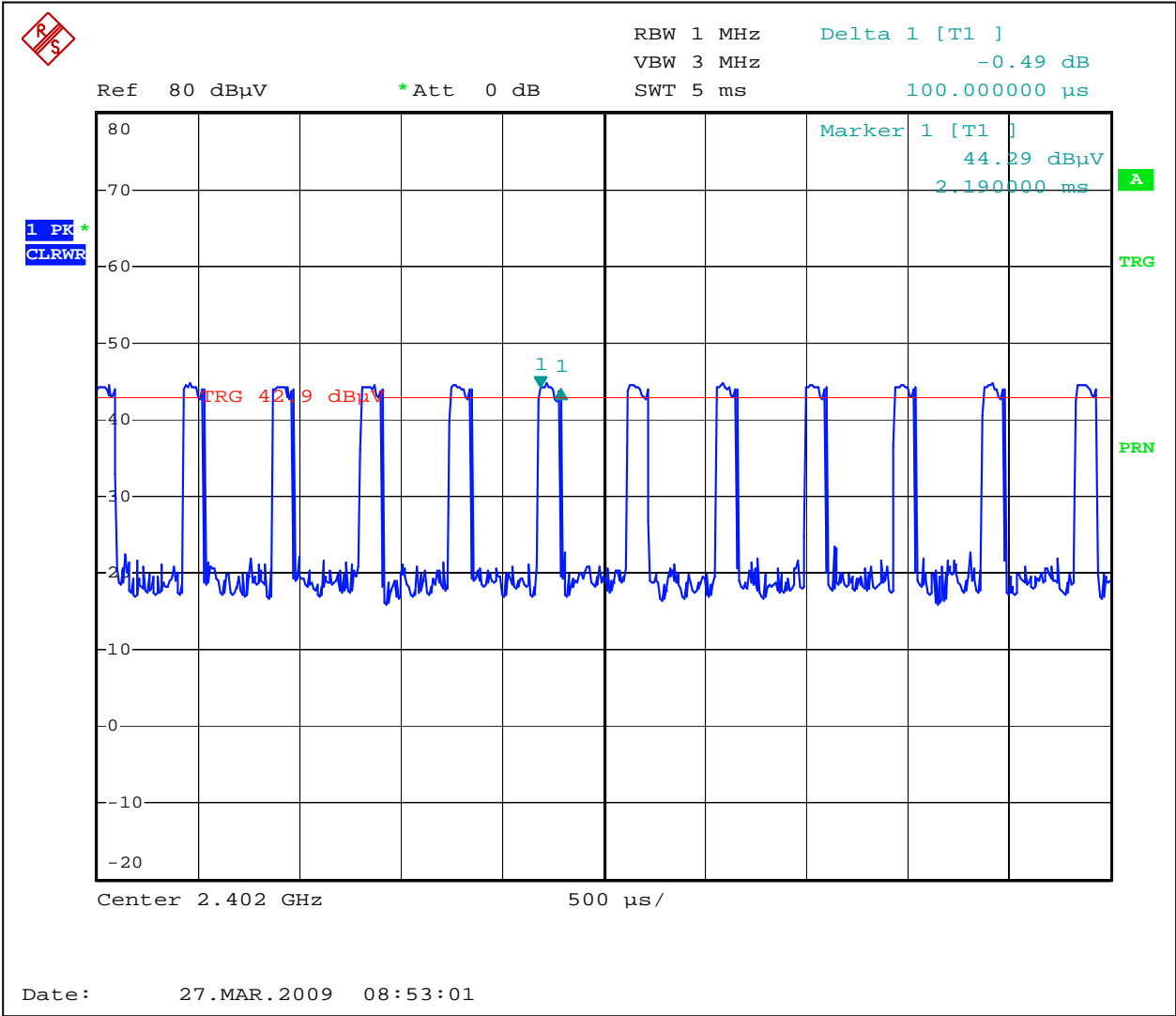
Graph 3.2.6



Graph 3.2.7



Graph 3.2.8



### 3.3 Bandwidth of Emissions

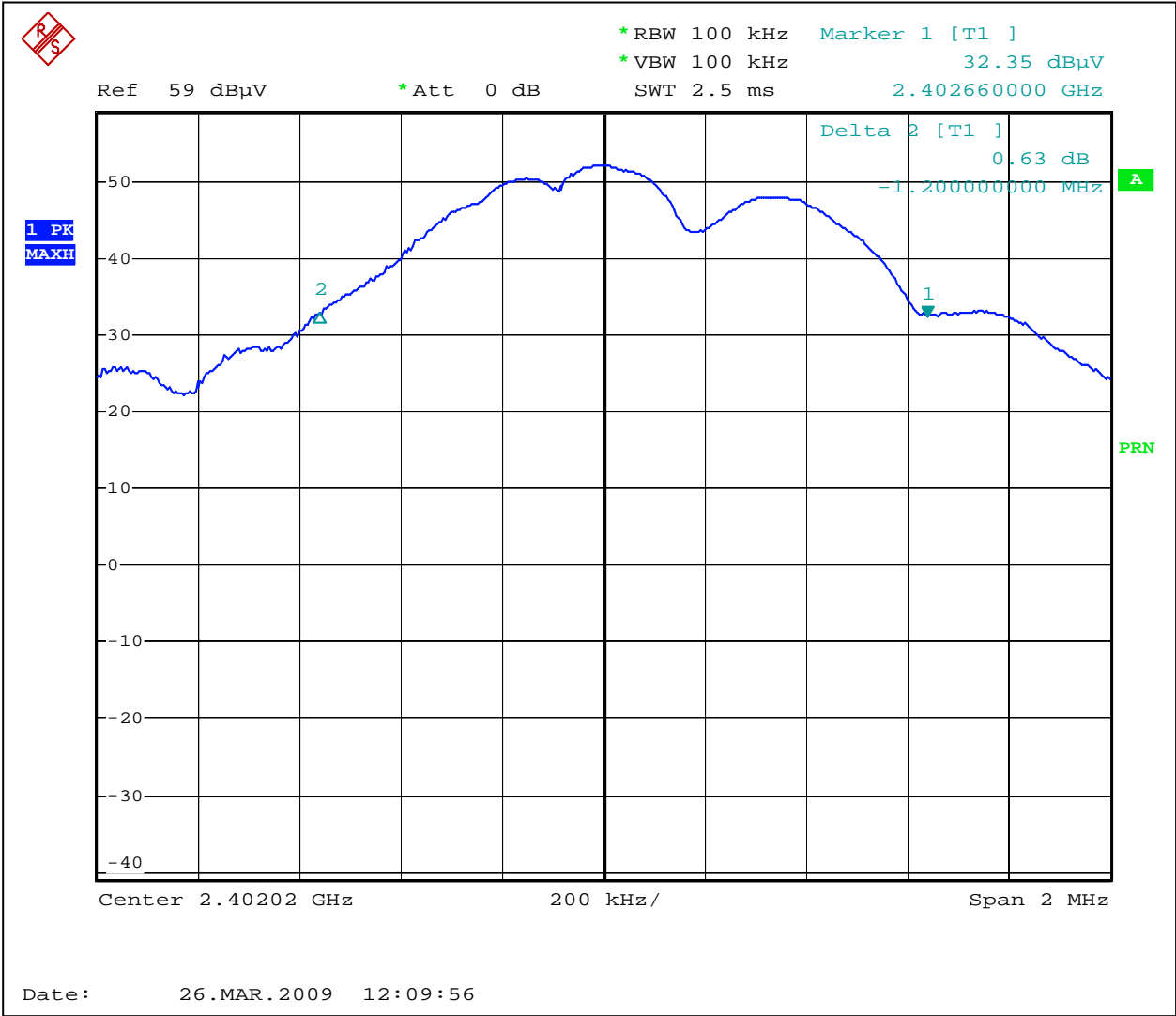
Measured 20dB bandwidth kHz	Measured 99% bandwidth kHz
1200	1240

Graphs 3-3-1 and 3-3-2 show bandwidth of emissions

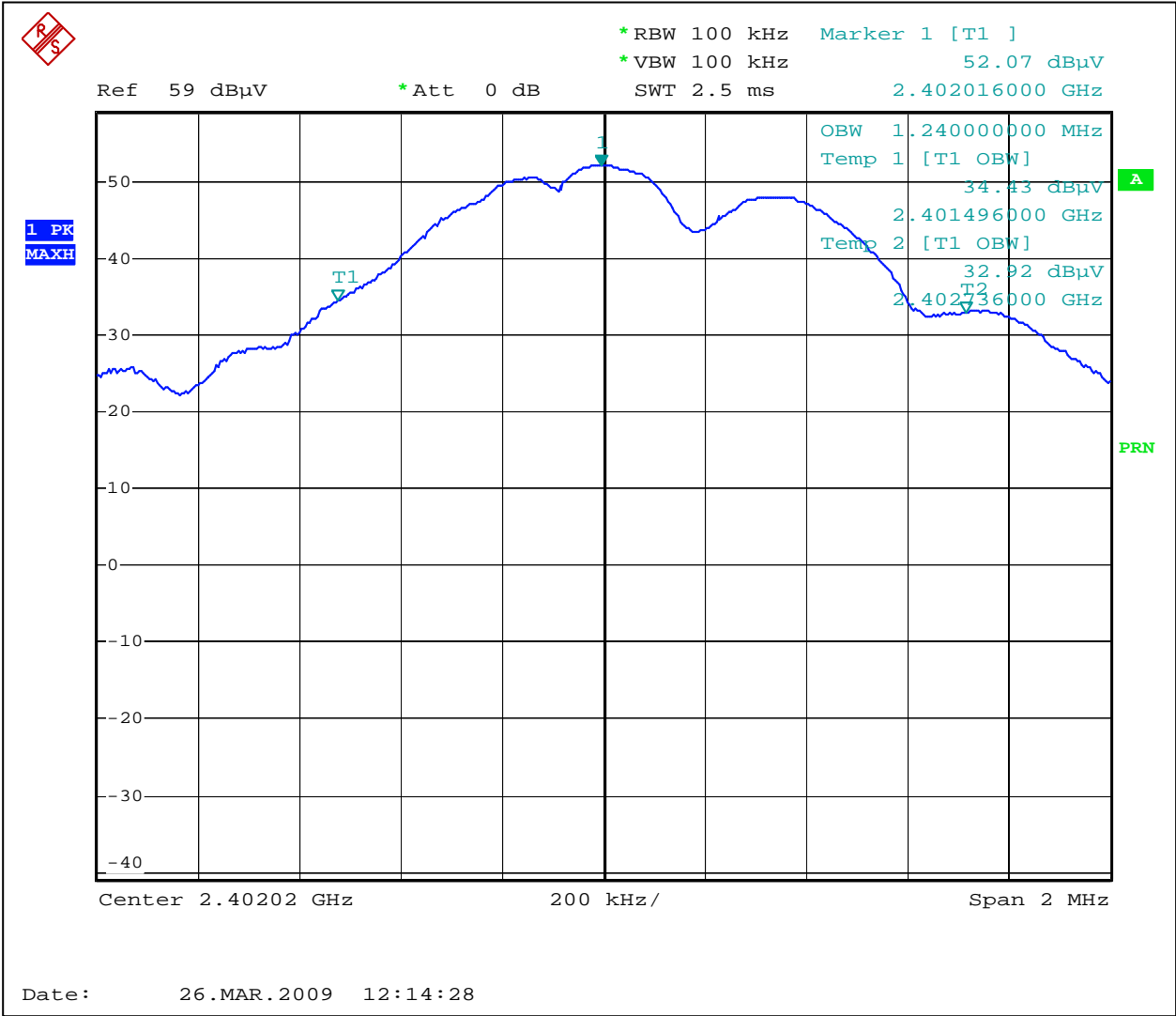
**Notes:** The bandwidth of emissions is contained within the frequency band of operation

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Graph 3.3.1



Graph 3.3.2





### 3.4 Transmitter power line conducted emissions

**Test location:** ☐ OATS ☐ Anechoic Chamber ☐ Other

**Test result:** N/A

**Frequency range:** 0.15MHz-30MHz

**Max. Emissions margin:**  dB below the limits

**Notes:** Testing is not applicable as battery operated device

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### 3.5 Receiver/digital device radiated emissions

**Test location:** ☐ OATS ☒ Anechoic Chamber

**Test distance:** ☐ 10 meters ☒ 3 meters

**Test result:** **Pass**

**Frequency range:** 30MHz-12.5GHz (5<sup>th</sup> Harmonic)

**Max. Emissions margin:** 6.1 dB below the limits

**Notes:** The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Table 3.5.1 and Graphs 3.5.1)

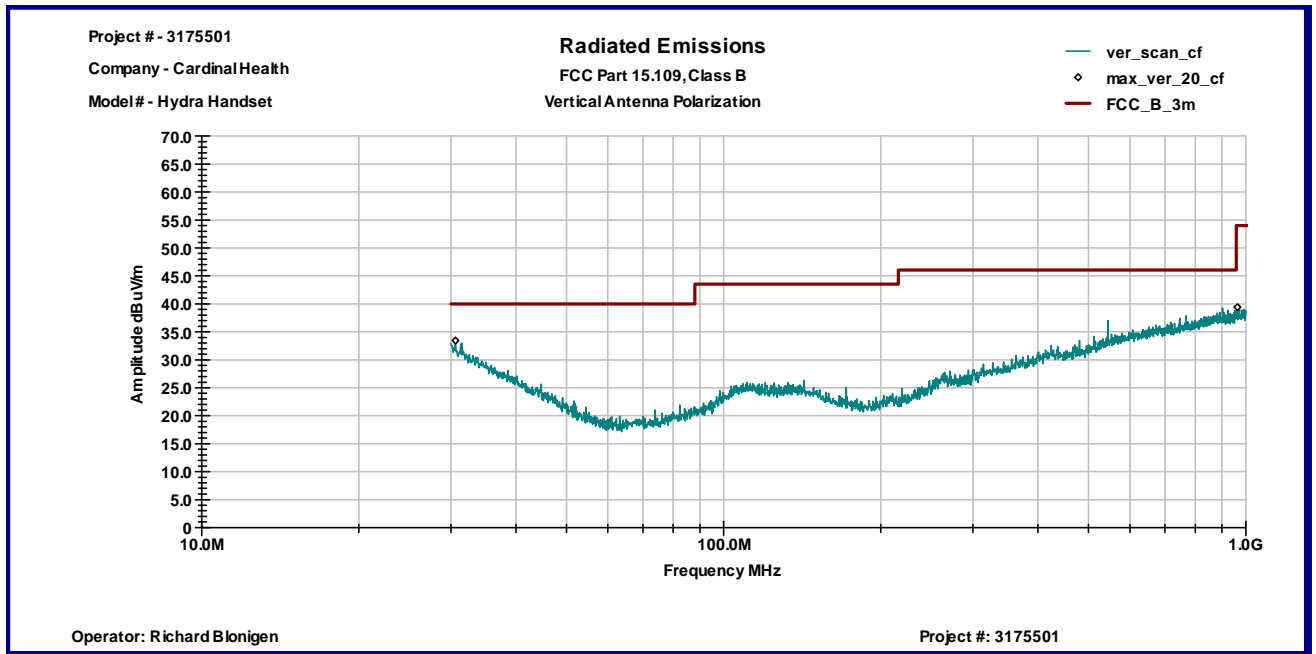
<b>Date:</b>	April 2, 2009	<b>Result: Pass</b>
<b>Standard:</b>	FCC Part 15.109, Class B	
<b>Tested by:</b>	Richard Blonigen	
<b>Test Point:</b>	Enclosure	
<b>Operation mode:</b>	Normal operation in receiving mode	
<b>Note:</b>	None	

**Table 3.5.1**

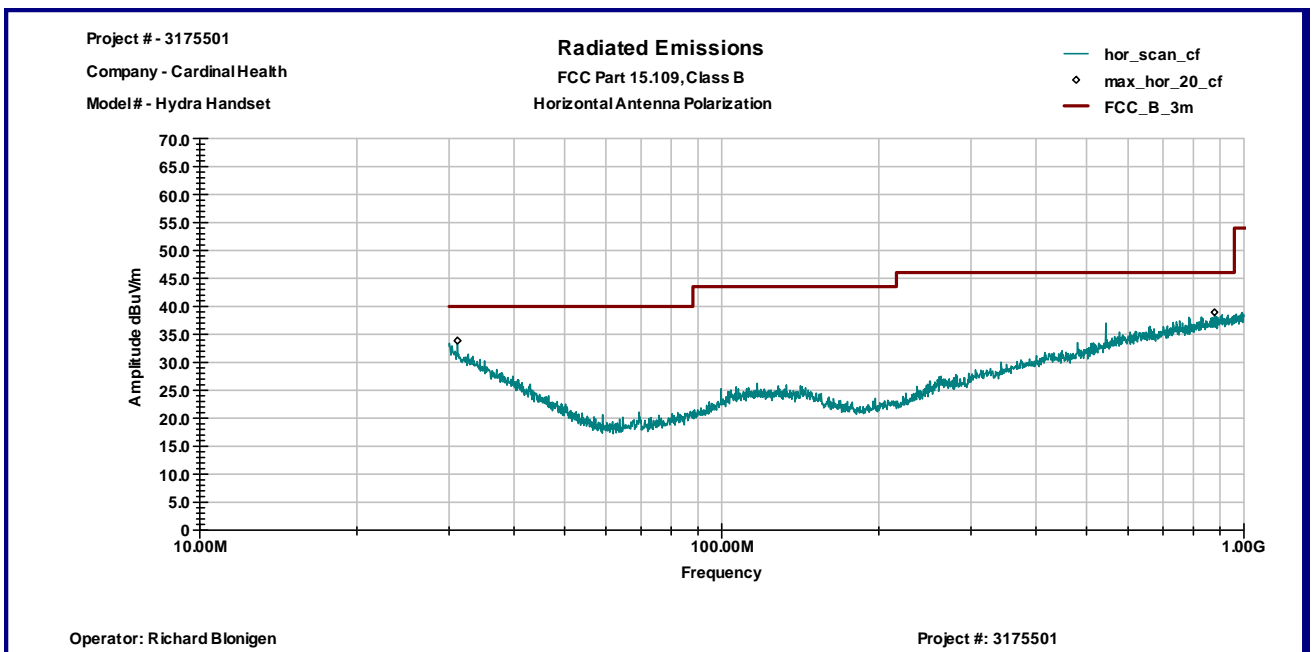
Frequency MHz	Antenna		Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBμV	Total @ 3m dBμV/m	Limit dBμV/m	Margin dB	Comments
	Polarity	Hts(cm)								
30.62	V	100	20.1	0.6	0.0	12.7	33.4	40.0	-6.6	
113.28	V	100	12.6	1.1	0.0	12.0	25.7	43.5	-17.8	
963.93	V	100	22.2	3.8	0.0	13.5	39.4	54.0	-14.6	
1034.00	V	100	22.7	4.0	0.0	6.6	33.3	54.0	-20.7	
1963.33	V	100	28.4	6.0	0.0	1.0	35.4	54.0	-18.5	
31.18	H	100	19.8	0.6	0.0	13.5	33.9	40.0	-6.1	
117.01	H	100	12.7	1.1	0.0	12.4	26.2	43.5	-17.3	
879.05	H	100	21.6	3.6	0.0	13.7	39.0	46.0	-7.1	

Graph 3.5.1

## Vertical antenna polarization

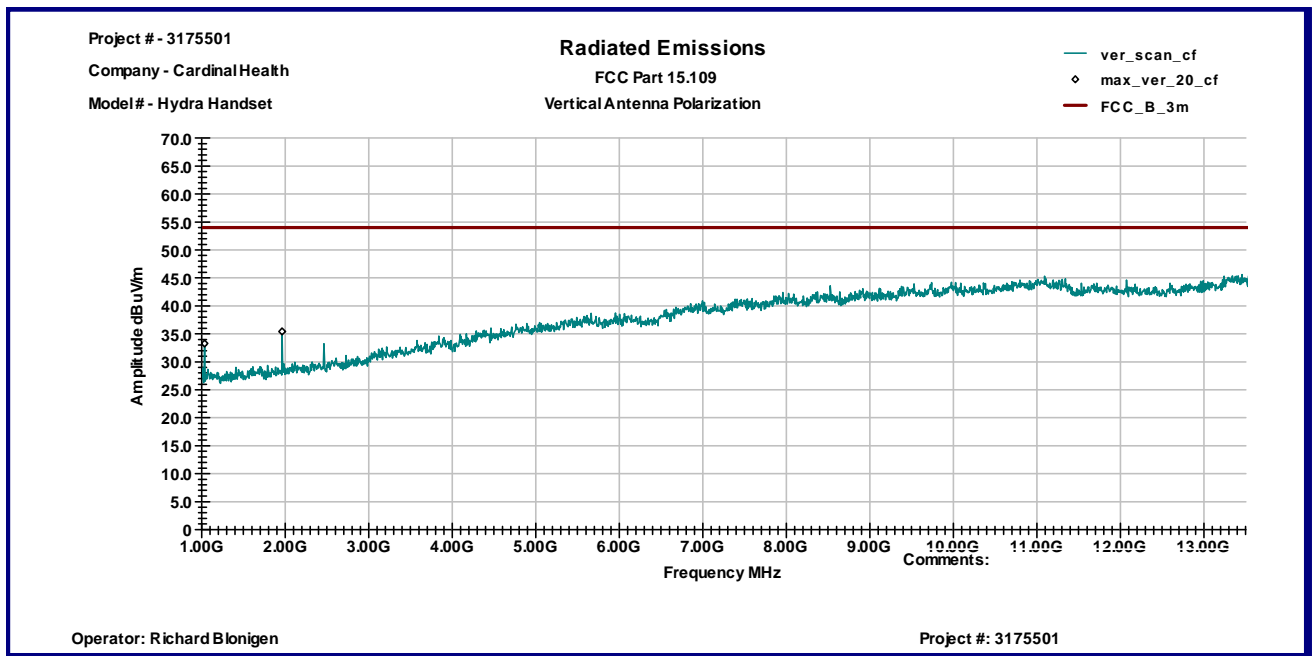


## Horizontal antenna polarization

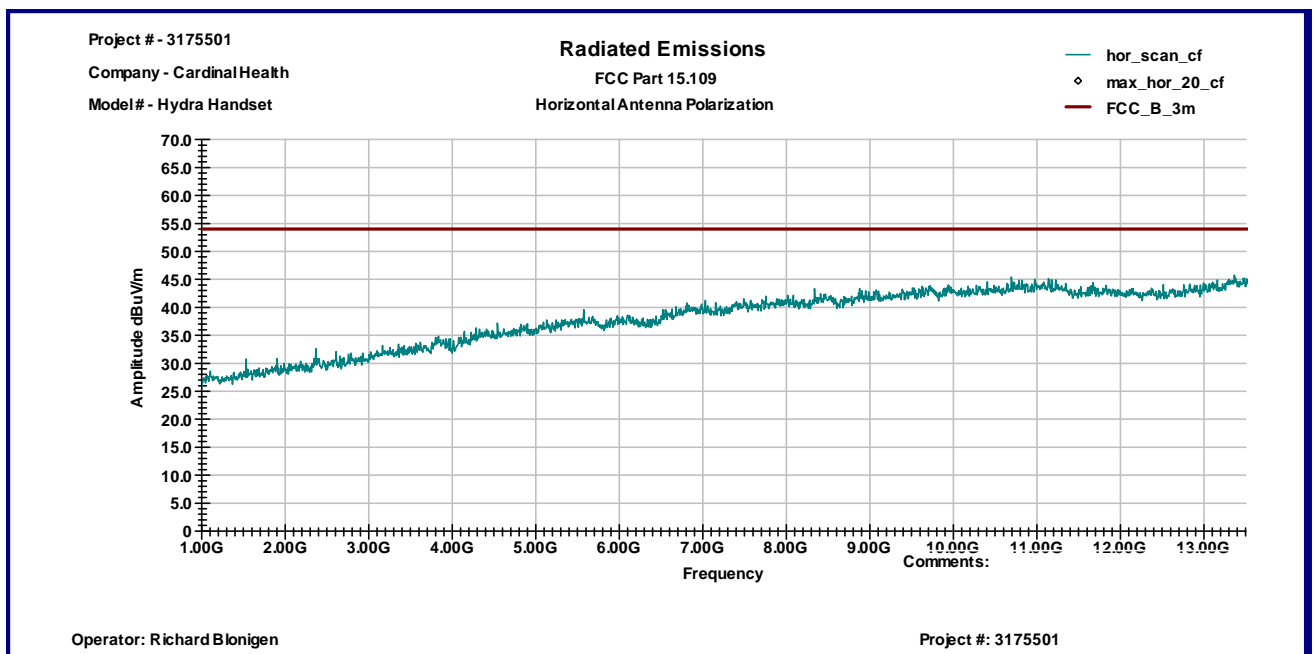


Graph 3.5.2

Vertical antenna polarization



Horizontal antenna polarization





### 3.6 Digital device conducted emissions

**Test location:** ☐ OATS ☐ Anechoic Chamber ☐ Other

**Test result:** N/A

**Frequency range:** 0.15MHz-30MHz

**Max. Emissions margin:**  dB below the limits

**Notes:** Testing is not applicable as battery operated device

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#### 4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	FSP 40	100024	12559	08/22/2009	<input checked="" type="checkbox"/>
Spectrum Analyzer	R & S	ESCI	100358	12909	05/07/2009	<input checked="" type="checkbox"/>
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	14459	08/27/2009	<input checked="" type="checkbox"/>
Horn Antenna	EMCO	3115	9507-4513	9936	03/04/2010	<input checked="" type="checkbox"/>
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	06/05/2009	<input checked="" type="checkbox"/>
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBV	<input checked="" type="checkbox"/>
High Pass Filter	Reactel	HS-4G-S12	0223	15274	VBV	<input checked="" type="checkbox"/>



## Test Setup Photos



