TEST REPORT

Report Number: 3175501MIN-008
Project Number: 3175501

Testing performed on the
Hydra 2.4GHz USB Dongle
FCC ID: W8G515-008900
Industry Canada ID: 8348A-515008900

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: _____ Date: April 24, 2009
Uri Spector

Reviewed by: _____ Date: April 24, 2009
Simon Khazon

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1.0 GENERAL DESCRIPTION

Model:	Hydra 2.4GHz USB Dongle
Type of EUT:	USB Dongle
Serial Number:	N/A
FCC ID:	W8G515-008900
Industry Canada ID:	8348A-515008900
Related Submittal(s) Grants:	None
Company:	Cardinal Health Inc.
Customer:	Mr. Ron Schulter
Address:	5225-2 Verona Road PO Box 4451 Madison, WI 53771
Phone:	(608) 441-2142
Fax:	
Test Standards:	☒ 47 CFR, Part 15:2008, §15.249 ☒ RSS–210, Issue 7, 2007 ☒ RSS-Gen, Issue 2, 2007 ☒ 47 CFR, Part 15:2008, §15.109, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	March 30, 2009
Test Work Started:	March 30, 2009
Test Work Completed:	April 24, 2009
Test Sample Conditions:	☐ Damaged ☐Poor (Usable) ☒ Good

1.1 Product Description; Test Facility

Product Description:	Hydra 2.4GHz USB Dongle
Operating Frequency	2400-2483.5 MHz
Modulation:	GFSK
Emission Designator:	1M68F1D
Antenna(s) Info:	Integral antenna
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter Power Configuration:	☐ Internal battery ☐ External power source ☐ 120VAC ☐ 230VAC ☐ 400VAC ☐ VDC ☒ Other: 5VDC via host PC Amp. ☐ 50Hz ☐ 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
☐ - 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. During testing the Dongle was connected to the host PC for power.

Cables:

No.	Type	Length	Designation	Note
1	None			
2				

Support equipment/Services:

No.	Item	Description
1	HP nc6000 laptop PC	Host computer
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: ±4 dB at 10m and ±5.4 dB at 3m

The expanded uncertainty (k = 2) for conducted emissions from 150 kHz to 30 MHz has been determined to be:
±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(µV/m)
RA = Receiver Amplitude in dB(µV)
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(µV) 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(µV/m).

RA = 48.1 dB(µV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(µV/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	Pass
15.109/ICES-003	Receiver/digital device radiated emissions	Pass
15.107/ ICES-003	Digital device conducted emissions	Pass

3.0 TEST CONDITIONS AND RESULTS

3.1 Field strength of fundamental

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Max. Emissions margin at fundamental: 0.5 dB below the limits

Notes: Test performed at low, middle and upper channel

Date:	April 22, 2009	**Result: Pass**
Standard:	FCC 15.249(a) / RSS-210 A2.9	
Tested by:	Uri Spector	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:		

Table 3.1.1

Frequency	Antenna		Ant. CF	Cable loss	Pre-amp	Reading	Total @ 3m	Average CF	Limit	Margin	Comments
MHz	Polarity	Hts(cm)	dB1/m	dB	Gain (dB)	dBµV	dBµV/m	dB	dBµV/m	dB	
					Peak Limits						
2401.64	V	108	28.3	4.1	0.0	61.8	94.2	0.0	114.0	-19.8	
2401.64	H	136	28.3	4.1	0.0	57.1	89.5	0.0	114.0	-24.5	
2439.66	V	110	28.4	4.1	0.0	64.2	96.7	0.0	114.0	-17.3	
2439.66	H	172	28.4	4.1	0.0	58.1	90.6	0.0	114.0	-23.4	
2481.00	V	111	28.5	4.1	0.0	64.9	97.6	0.0	114.0	-16.4	
2481.00	H	169	28.5	4.1	0.0	58.4	91.1	0.0	114.0	-22.9	
					Average Limits						
2401.64	V	108	28.3	4.1	0.0	59.3	91.7	0.0	94.0	-2.3	
2401.64	H	136	28.3	4.1	0.0	54.1	86.5	0.0	94.0	-7.5	
2439.66	V	110	28.4	4.1	0.0	61.0	93.5	0.0	94.0	-0.5	
2439.66	H	172	28.4	4.1	0.0	55.4	87.9	0.0	94.0	-6.1	
2480.62	V	111	28.5	4.1	0.0	60.1	92.8	0.0	94.0	-1.2	
2480.62	H	169	28.5	4.1	0.0	54.9	87.6	0.0	94.0	-6.4	

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^{th} Harmonic)

Test result: **Pass**

Max. margin of harmonics and spurious emissions: 4.8 dB below the limits

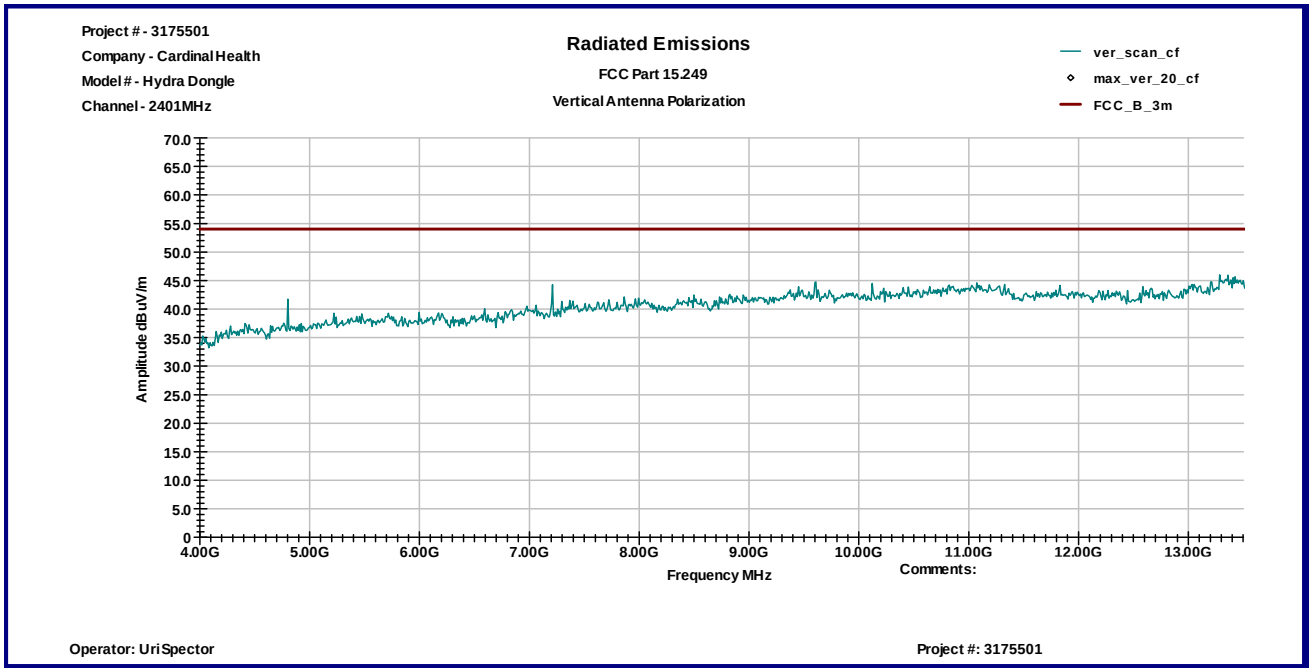
Notes: No Spurious Emissions related to transmitter were detected at the frequency range 30MHz-1000MHz. For Harmonics Emissions see Table 3.2.1 and Graphs 3.2.1-3.2.3. Test performed at low, middle and upper channel.

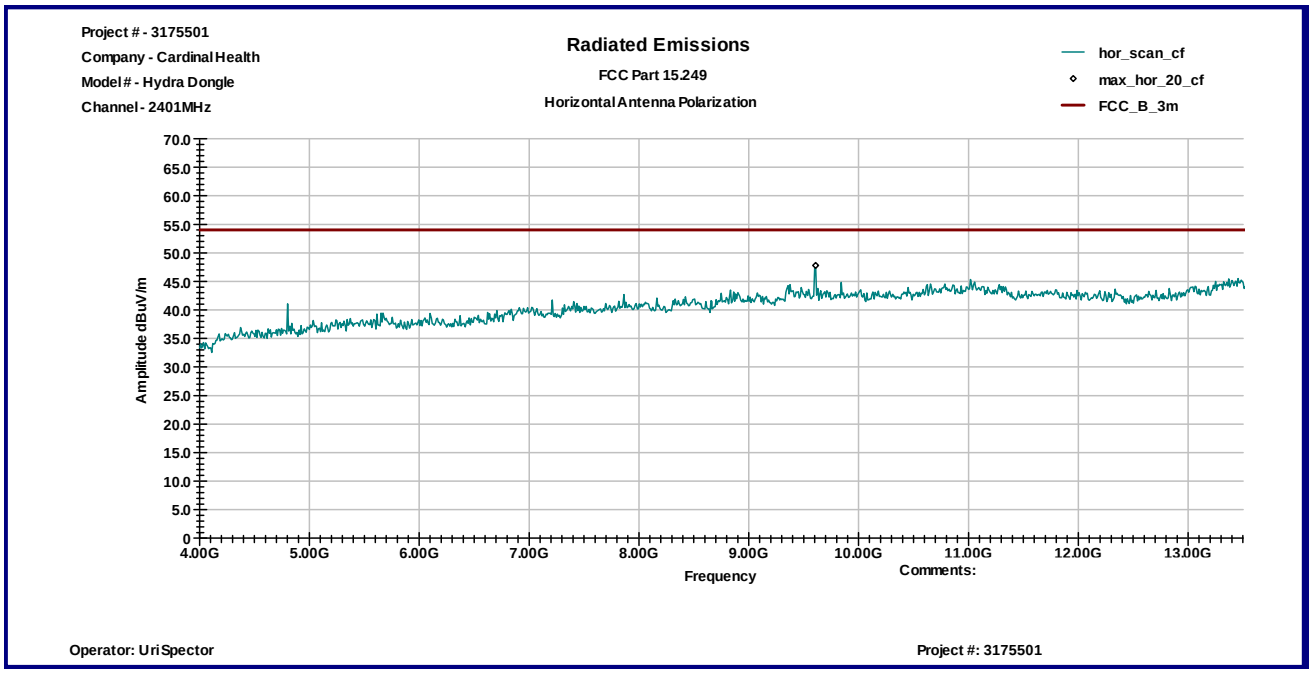
Date:	April 22, 2009	**Result: Pass**
Standard:	FCC 15.249(a) and (d) / RSS-210 A2.9	
Tested by:	Uri Spector	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:	No emissions above ambient noise were detected above the 3rd harmonics	

Table 3.2.1

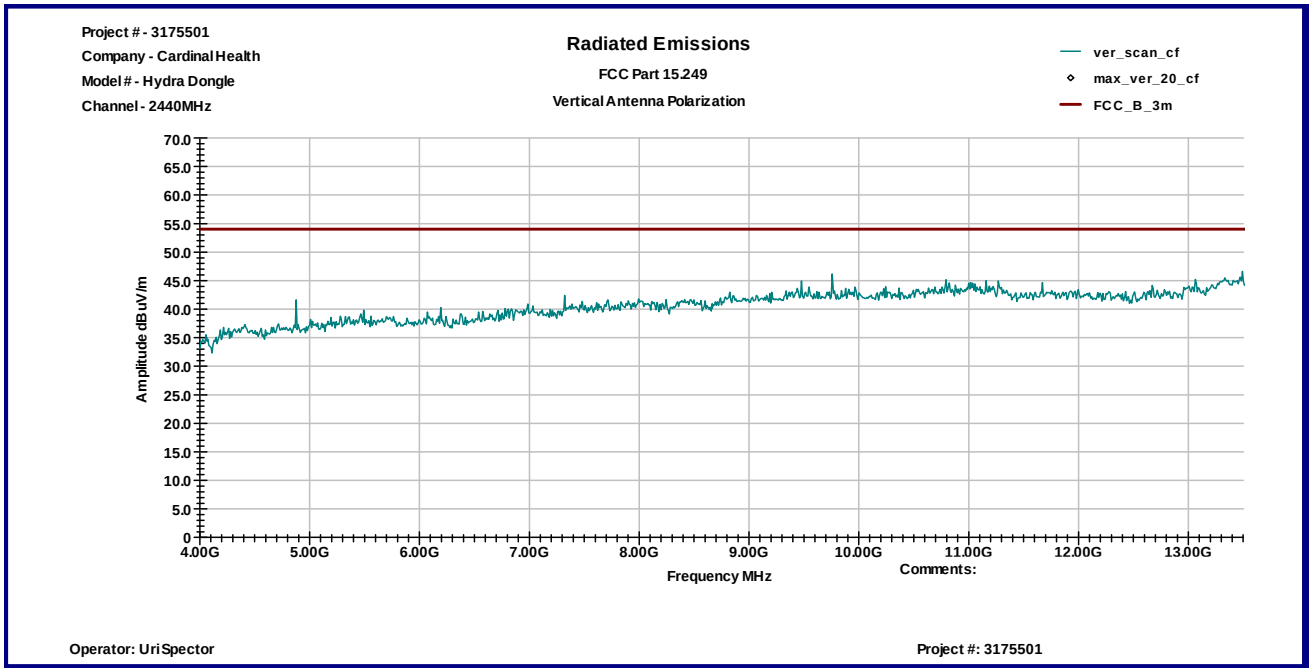
Frequency MHz	Antenna Polarity	Antenna Hts(cm)	Ant. CF dB1/m	Cable loss dB	Pre-amp Gain (dB)	Peak Reading dBµV	Total @ 3m dBµV/m	Average CF dB	Limit dBµV/m	Margin dB	Comments
			Harmonics Emissions								
					Channel 2401MHz						
4802.00	V	115	33.0	6.3	39.8	42.2	41.8	0.0	54.0	-12.2	
7210.66	V	100	35.8	7.7	40.0	40.8	44.2	0.0	54.0	-9.8	
					Channel 2440MHz						
4877.33	V	120	33.1	6.4	39.8	41.9	41.6	0.0	54.0	-12.4	
					Channel 2480MHz						
7444.00	V	100	36.4	7.7	39.8	44.9	49.2	0.0	54.0	-4.8	
7444.00	H	100	36.4	7.7	39.8	43.4	47.7	0.0	54.0	-6.3	
	Spurious Emissions-Bandedge Compliance, Peak Reading										
2400.00	V	110	28.3	4.1	39.8	44.0	36.6	0.0	54.0	-17.4	
2400.00	H	174	28.3	4.1	39.8	36.6	29.2	0.0	54.0	-24.8	
2483.50	V		28.6	4.1	39.7	37.9	30.9	0.0	54.0	-23.1	
2483.50	H	119	28.6	4.1	39.7	30.0	23.0	0.0	54.0	-31.0	

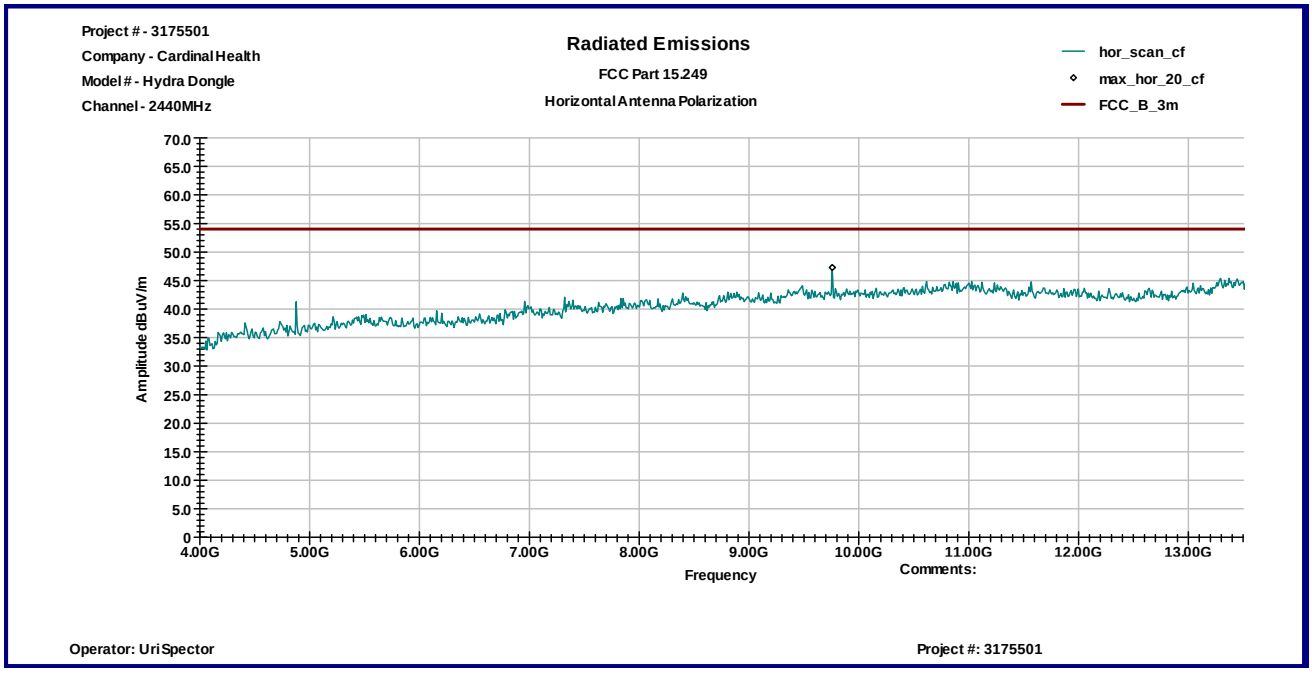
Graph 3.2.1


Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2401MHz
Radiated Emissions
FCC Part 15.249
Vertical Antenna Polarization
ver_scan_cf
max_ver_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency MHz
Comments:
Operator: UriSpector
Project #: 3175501

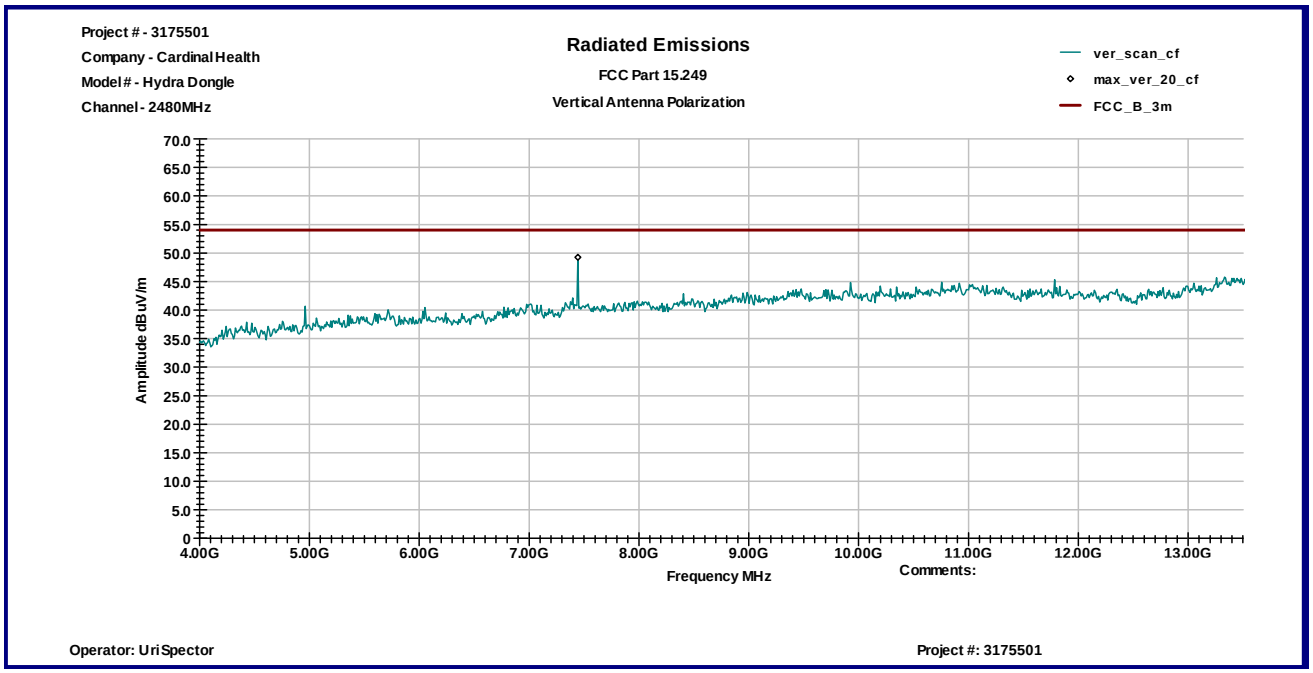

Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2401MHz
Radiated Emissions
FCC Part 15.249
Horizontal Antenna Polarization
hor_scan_cf
max_hor_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency
Comments:
Operator: UriSpector
Project #: 3175501

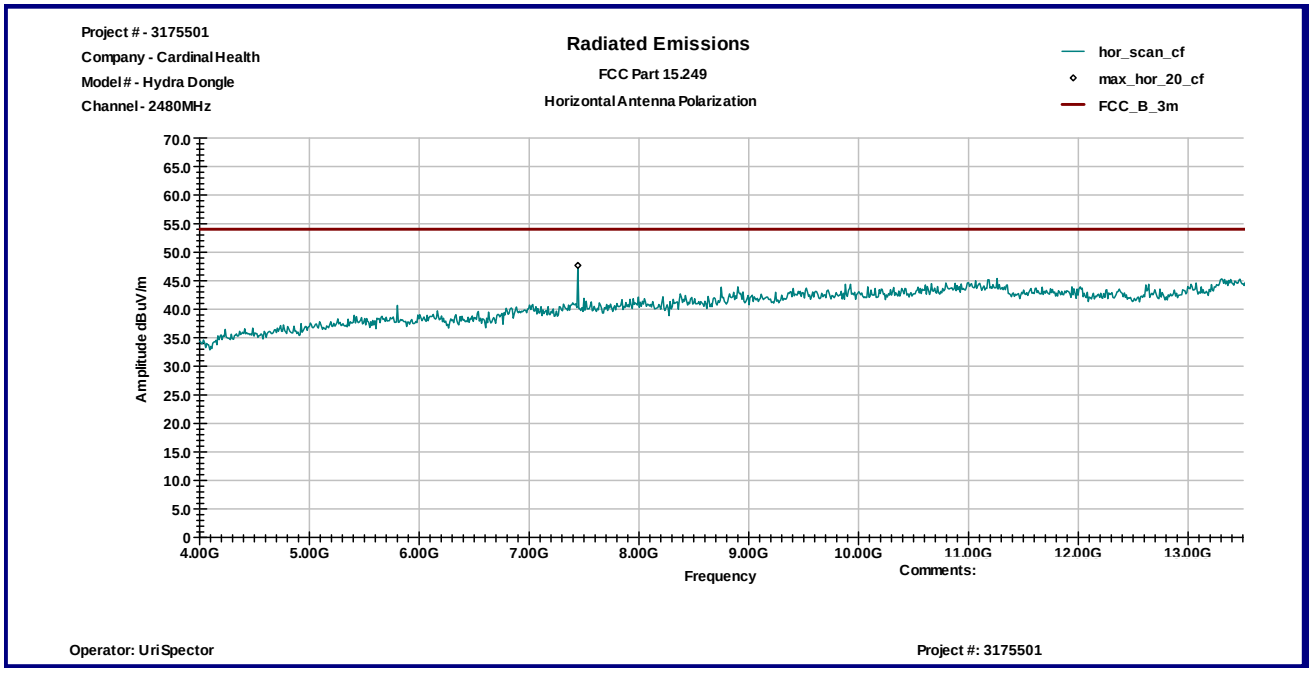
Graph 3.2.2


Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2440MHz
Radiated Emissions
FCC Part 15.249
Vertical Antenna Polarization
ver_scan_cf
max_ver_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency MHz
Comments:
Operator: Uri Spector
Project #: 3175501


Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2440MHz
Radiated Emissions
FCC Part 15.249
Horizontal Antenna Polarization
hor_scan_cf
max_hor_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency
Comments:
Operator: Uri Spector
Project #: 3175501

Graph 3.2.3


Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2480MHz
Radiated Emissions
FCC Part 15.249
Vertical Antenna Polarization
ver_scan_cf
max_ver_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency MHz
Comments:
Operator: UriSpector
Project #: 3175501


Project # - 3175501
Company - Cardinal Health
Model # - Hydra Dongle
Channel - 2480MHz
Radiated Emissions
FCC Part 15.249
Horizontal Antenna Polarization
hor_scan_cf
max_hor_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
4.00G
5.00G
6.00G
7.00G
8.00G
9.00G
10.00G
11.00G
12.00G
13.00G
Frequency
Comments:
Operator: UriSpector
Project #: 3175501

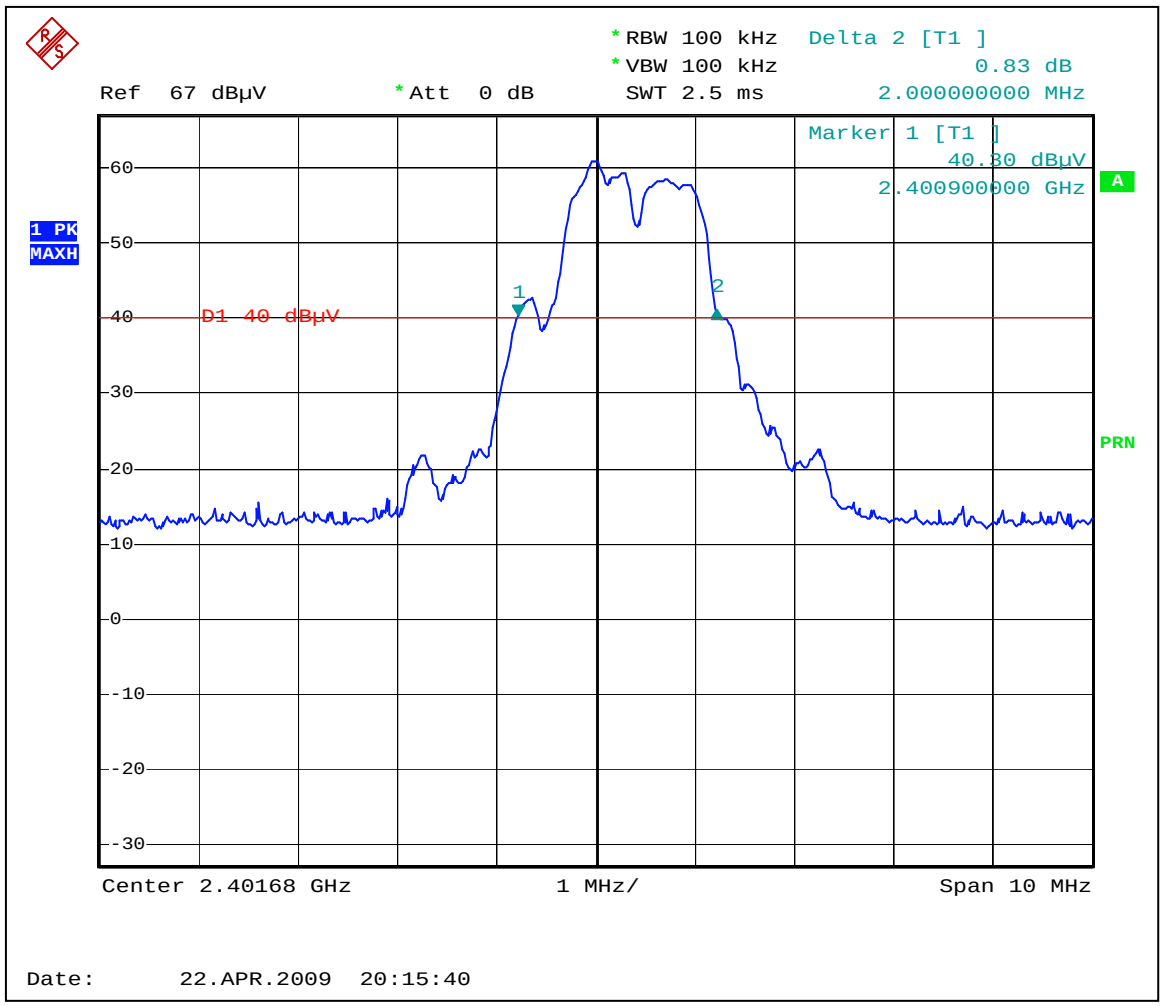
3.3 Bandwidth of Emissions

Measured 20dB bandwidth MHz	Measured 99% bandwidth MHz
2	1.68

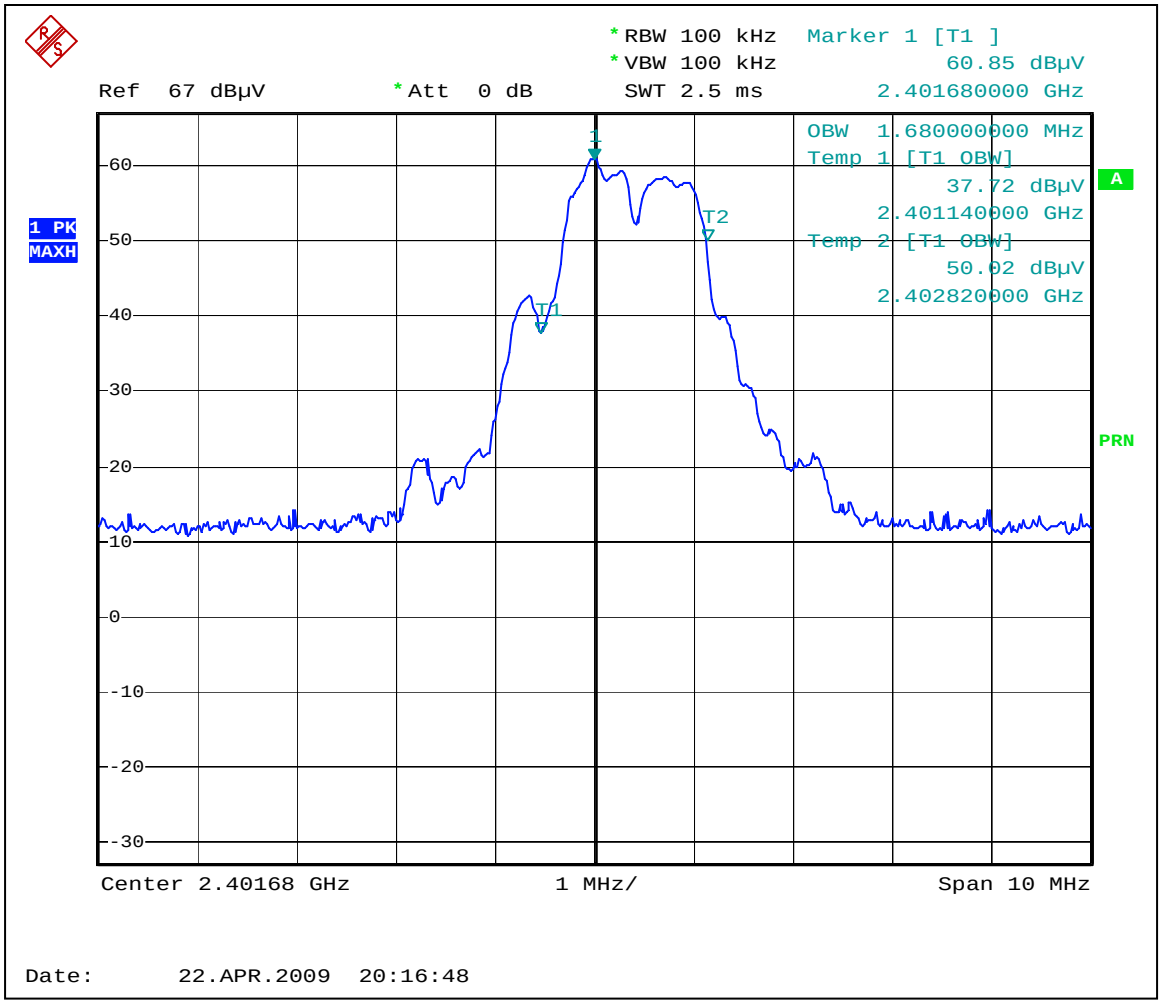
Graphs 3-3-1 and 3-3-2 are show bandwidth of emissions

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

Graph 3.3.1


*RBW 100 kHz
*VBW 100 kHz
Delta 2 [T1]
0.83 dB
Ref 67 dBµV
*Att 0 dB
SWT 2.5 ms
2.000000000 MHz
Marker 1 [T1]
40.30 dBµV
2.400900000 GHz
1 PK
MAXH
A
PRN
D1 40 dBµV
60
50
40
30
20
10
0
-10
-20
-30
Center 2.40168 GHz
1 MHz/
Span 10 MHz
Date: 22.APR.2009 20:15:40

Graph 3.3.2


*RBW 100 kHz
*VBW 100 kHz
Marker 1 [T1]
60.85 dBµV
2.401680000 GHz
Ref 67 dBµV
*Att 0 dB
SWT 2.5 ms
OBW 1.680000000 MHz
Temp 1 [T1 OBW]
37.72 dBµV
2.401140000 GHz
Temp 2 [T1 OBW]
50.02 dBµV
2.402820000 GHz
1 PK
MAXH
A
PRN
60
50
40
30
20
10
0
-10
-20
-30
T1
T2
Center 2.40168 GHz
1 MHz/
Span 10 MHz
Date: 22.APR.2009 20:16:48

3.4 Transmitter power line conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 8.5 dB below the limits

Notes: None

Date:	April 1, 2009	**Result:** **Pass**
Standard:	FCC 15.207	
Tested by:	Richard Blonigen	
Test Point:	Power Line L1 and L 2	
Operation mode:	See Page 5	
Note:		

Table 3.4.1

Line 1

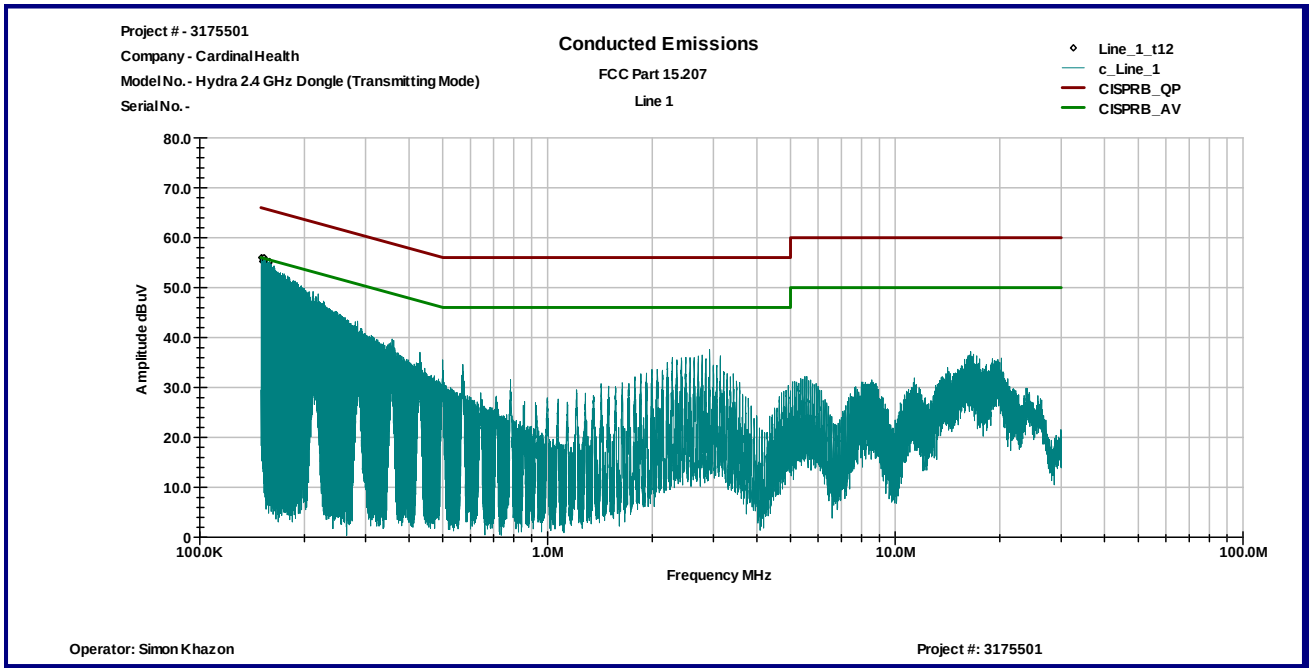
Frequency	Peak dBµV	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
150.01 kHz		47.4	25.5	66.0	56.0	-18.6	-30.5
571.37 kHz	34.6			56.0	46.0	-21.4	-11.4
2.923 MHz	37.5			56.0	46.0	-18.5	-8.5
5.563 MHz	32.2			60.0	50.0	-27.8	-17.8
8.561 MHz	31.5			60.0	50.0	-28.5	-18.5
16.47 MHz	37.1			60.0	50.0	-22.9	-12.9

Line 2

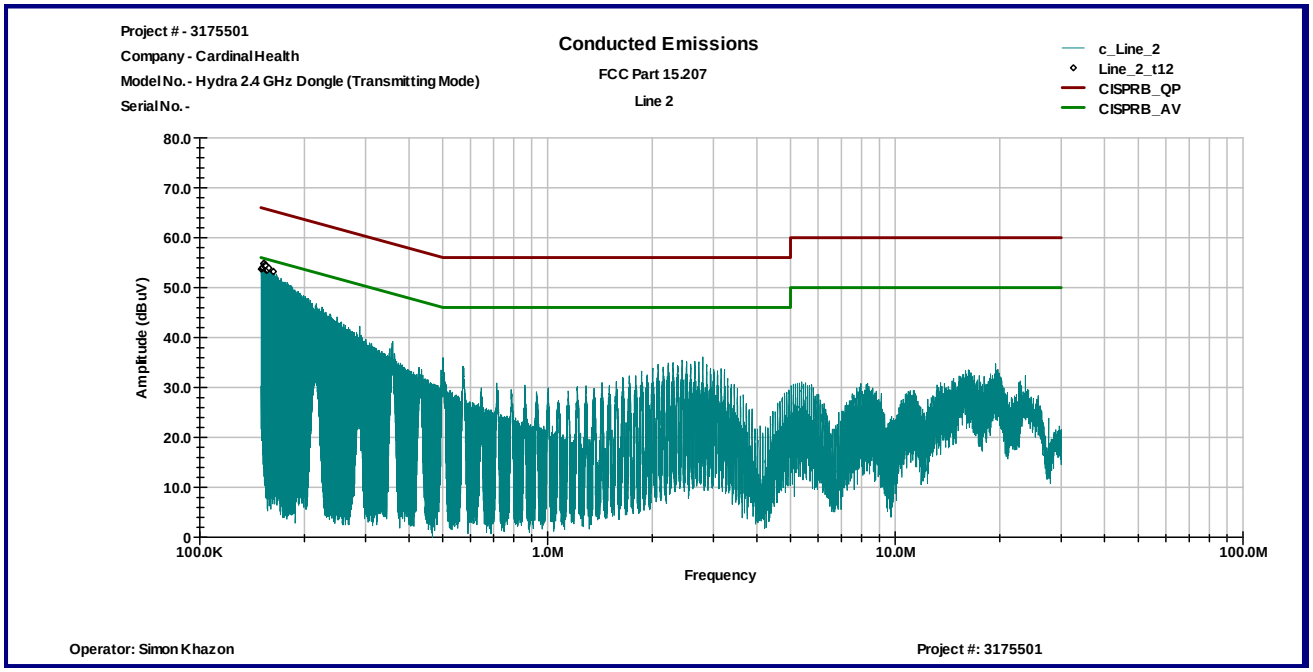
Frequency	Peak dBµV	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
150.15 kHz		47.5	25.0	66.0	56.0	-18.5	-30.5
861.17 kHz	30.4			56.0	46.0	-25.6	-15.6
2.794 MHz	36.1			56.0	46.0	-19.9	-9.9
7.957 MHz	30.8			60.0	50.0	-29.2	-19.2
19.421 MHz	34.7			60.0	50.0	-25.3	-13.3

Graph 3.4.1

Line 1



Line 2



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 (5th Harmonic)

Max. Emissions margin: 7.3 dB below the limits

Notes: The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Table 3.5.1, 3.5.2 and Graphs 3.5.1, 3.5.2)

Date:	April 7, 2009	**Result:** **Pass**
Standard:	FCC Part 15.109, Class B	
Tested by:	Richard Blonigen	
Test Point:	Enclosure	
Operation mode:	Digital Device Radiated Emissions	
Note:	None	

Table 3.5.1

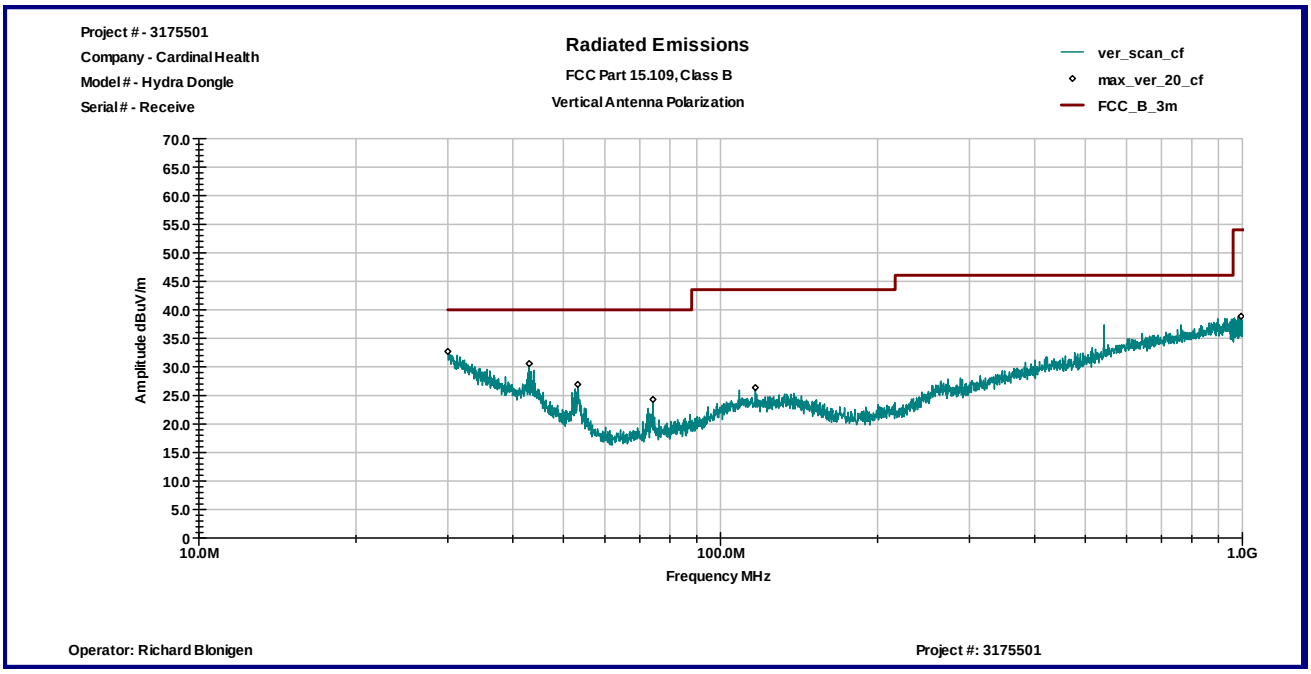
Frequency	Ant. Polarity	Peak Reading dBµV	Ant.Factor dB1/m	Total at 3m dBµV/m	QP Limit dBµV/m	Margin dB
30.0 MHz	V	11.6	21.1	32.7	40.0	-7.3
42.982 MHz	V	16.7	13.8	30.6	40.0	-9.4
53.255 MHz	V	17.8	9.1	26.9	40.0	-13.1
74.191 MHz	V	16.1	8.2	24.3	40.0	-15.7
116.58 MHz	V	12.4	14.0	26.4	43.5	-17.2

Table 3.5.2

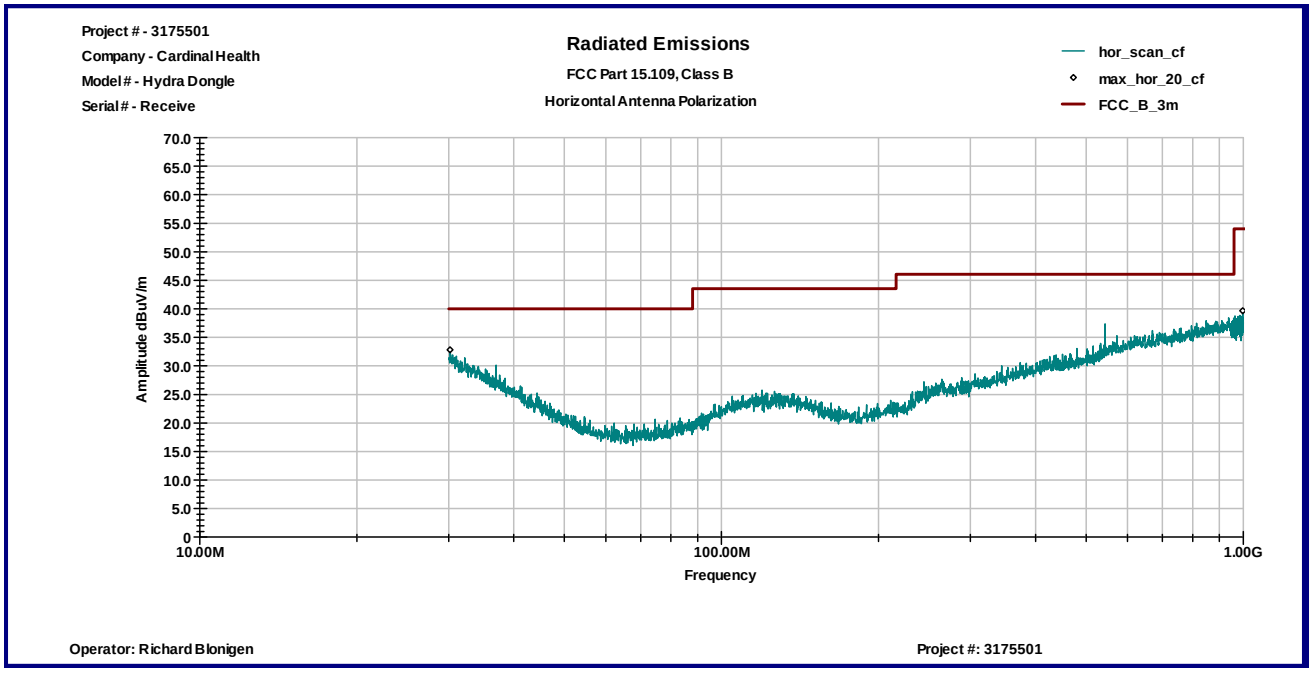
Frequency MHz	Antenna Polarity	Reading dBµV	Total C.F. dB1/m	Pre-Amp. Gain (dB)	Total at 3m dBµV/m	QP Limit dBµV/m	Margin dB
2.7952 GHz	V	44.7	33.5	40.0	38.2	54.0	-15.7
1.68 GHz	H	47.1	29.5	40.8	35.8	54.0	-18.2

Graph 3.5.1

Vertical antenna polarization

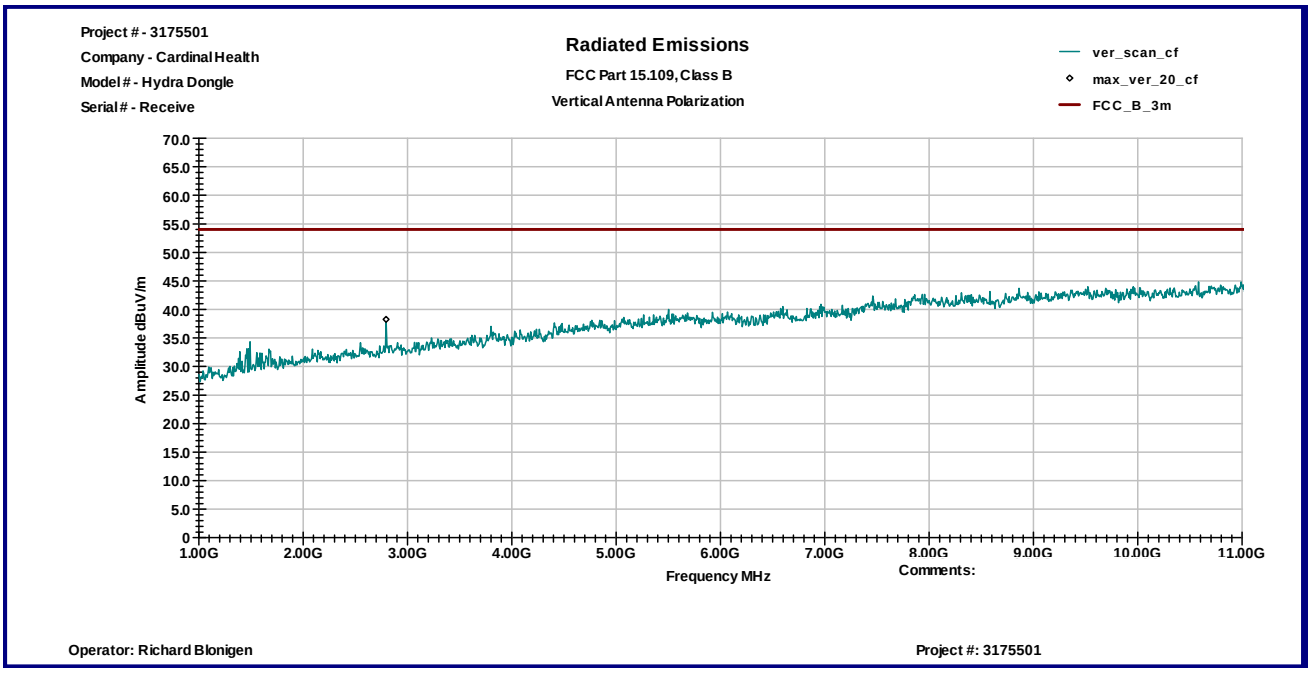


Horizontal antenna polarization

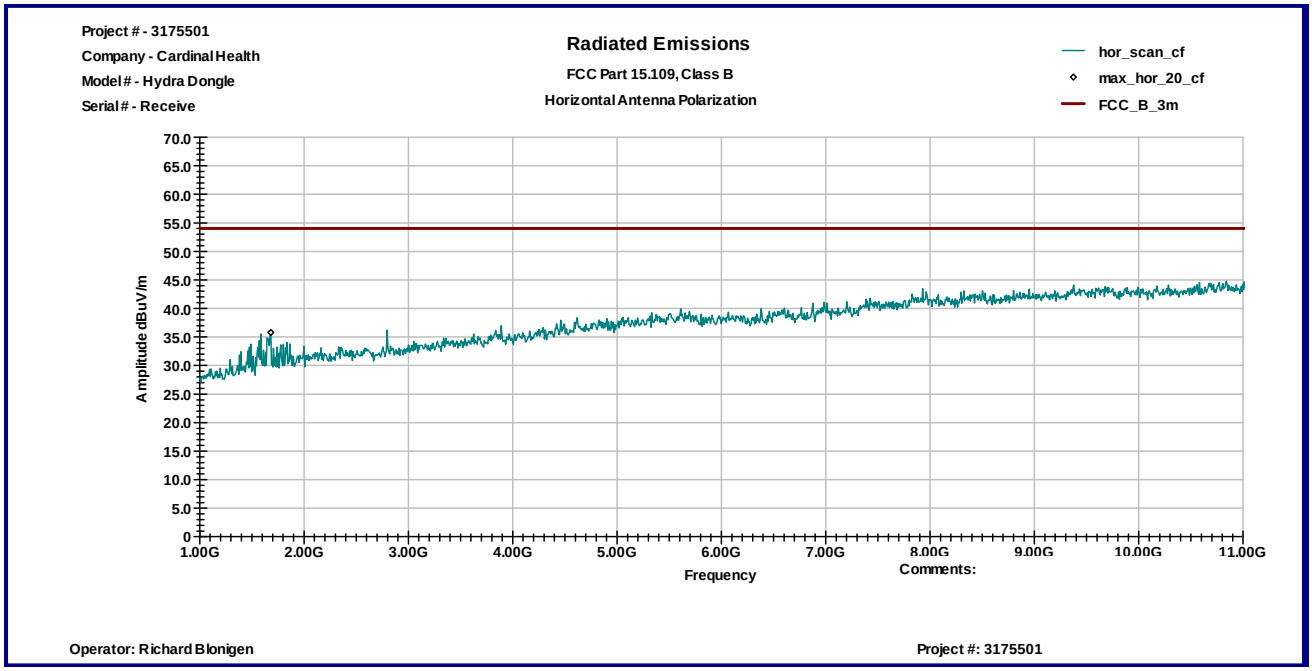


Graph 3.5.2

Vertical antenna polarization



Horizontal antenna polarization



3.6 Digital device conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 18.7 dB below the limits

Notes: None

Date:	April 1, 2009	**Result:** **Pass**
Standard:	FCC Part 15.107, Class B	
Tested by:	Richard Blonigen	
Test Point:	Line 1 and Line 2	
Operation mode:	Digital device conducted	
Note:		

Table 3.6.1

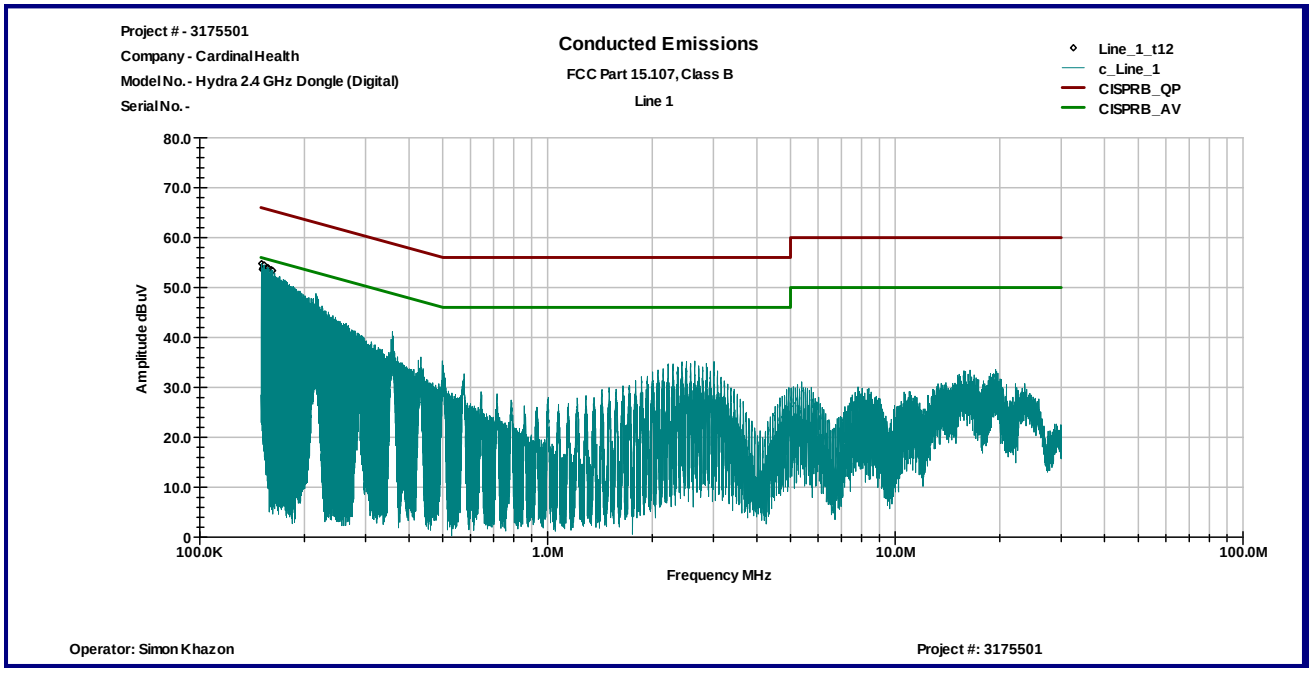
Line 1

Frequency	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
150.04 KHz	47.1	26.8	66.0	56.0	-18.9	-29.2
152.32 KHz	46.6	22.4	65.9	55.9	-19.3	-33.5
153.2 KHz	46.5	21.1	65.8	55.8	-19.3	-34.7
154.59 KHz	46.3	19.8	65.8	55.8	-19.5	-36.0
158.09 KHz	45.6	18.0	65.6	55.6	-19.9	-37.5
164.23 KHz	44.8	17.3	65.3	55.3	-20.4	-38.0

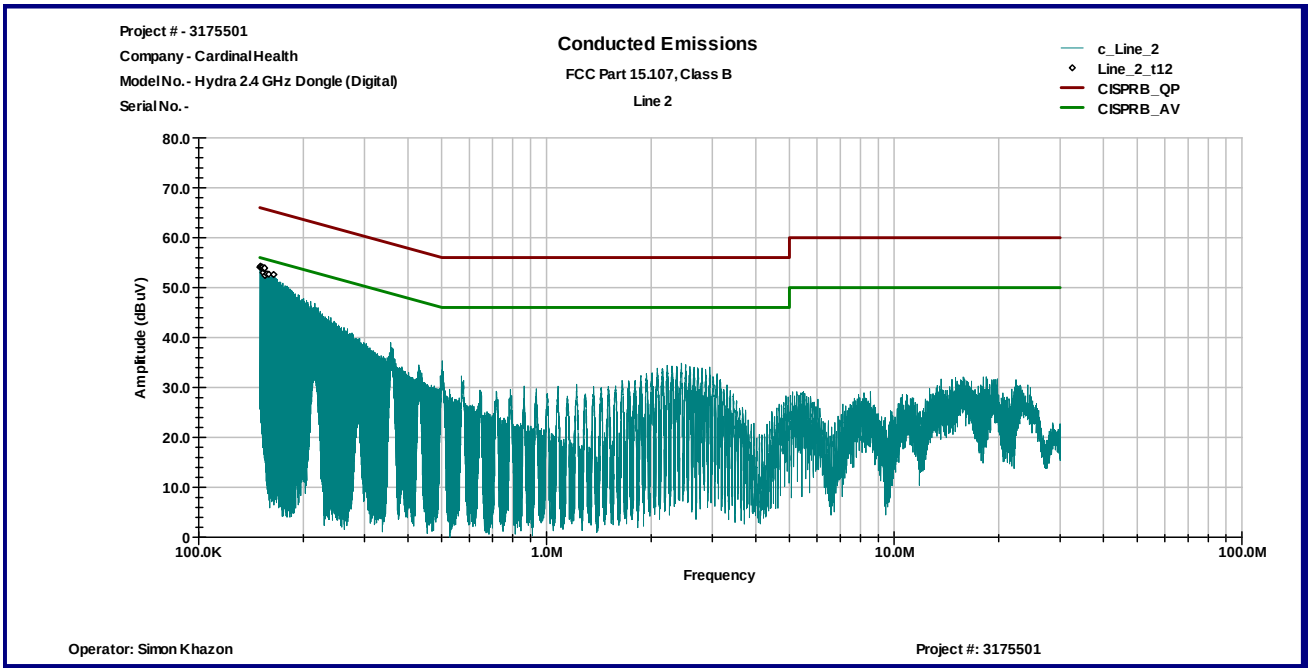
Line 2

Frequency	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
150.03 KHz	47.3	25.6	66.0	56.0	-18.7	-30.4
151.78 KHz	47.0	21.6	65.9	55.9	-18.9	-34.3
154.83 KHz	46.4	18.6	65.7	55.7	-19.3	-37.2
155.29 KHz	46.4	18.4	65.7	55.7	-19.3	-37.3
165.44 KHz	44.9	17.4	65.2	55.2	-20.3	-37.8

Graph 3.6.1



Graph 3.6.2



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	☒
Spectrum Analyzer	R & S	ESCI	100358	12909	05/07/2009	☒
Bicono-Log Antenna	Schaffner-Chase	CBL 6112 B	2468	14459	08/27/2009	☒
LISN	Fischer Custom Communications	FCC-LISN-2 MOD.SD	316	9945	10/28/2009	☒
Horn Antenna	EMCO	3115	9507-4513	9936	03/04/2010	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	06/05/2009	☒
System	TILE! Instrument Control		Ver. 3.4.K.29	15259	VBU	☒
High Pass Filter	Reactel	HS-4G-S12	0223	15274	VBU	☒