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FCC PART 15.249 TEST REPORT

UNLICENSED INTENTIONAL RADIATOR

Applicant	Invivo Corporation
Address	12601 Research Parkway Orlando Florida 32816 Usa
FCC ID	S6W453564100741A
Model Number	453564100741A
Product Description	MRI Compatible Equipment
Date Sample Received	11/25/2008
Date Tested	11/25/2008
Tested By	Richard Block
Approved By	Mario de Aranzeta
Report Number	2776UT8TestReport.pdf
Test Results	☒ PASS ☐ FAIL

ACCREDITED
Certificate # 0955-01

TABLE OF CONTENT

ATTESTATIONS

Summary

The device under test does:

☒ fulfill the requirements as identified in this test report
☐ not fulfill the requirements as identified in this test report

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

The test results apply only to the unit tested.

All Timco instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025:2005 requirements.

ACCREDITED
Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, Fl 32669

Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date:

REPORT SUMMARY

Disclaimer	The test results relate only to the items tested.
Purpose of Test	To demonstrate the DUT in compliance with FCC CFR 47, Part 15.249 requirements for low power intentional radios. To demonstrate the DUT in compliance with IC RSS-210 radiated spurious emissions requirements for low power intentional radios.
Test Standards	ANSI/TIA 603-C: 2004, FCC CFR 47 Part 15.249 ANSI C63.4: 2003, RSS-210, FCC Pt 15.109
Related Approval	Digital interface portion verified

TEST ENVIRONMENT

Test Facility	Timco Engineering, Inc. 849 NW State Road 45 Newberry, FL 32669 USA.
Test Condition in the laboratory	Temperature: 26ºC Relative humidity: 50%

TEST SETUP SUMMARY

Test Setup Diagram/ Description	The DUT was placed on the turntable per setup per ANSI C63.4: 2003 and. A test set up photo is provided for clarification.
Deviation from the standard/procedure	No deviation
Modification of DUT	No modification

TEST SUPPORTING EQUIPMENT

Supporting Device	Manufacturer	Model / FCC ID	Serial Number
N/A			

DUT SPECIFICATION

DUT Description	MRI Compatible Equipment		
FCC ID	S6W453564100741A		
Model Number			
Operating Frequency	TX: 2.402 – 2.481 GHz	RX: Same	
DUT Power Source	☒ 110–120Vac/50– 60Hz		
	☐ DC Power		
	☐ Battery Operated Exclusively		
Test Item	☐ Prototype	☒ Pre-Production	☐ Production
Type of Equipment	☒ Fixed	☐ Mobile	☐ Portable
Antenna Connector	FCC Rules require that the antenna connector be unique.		

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/07	12/7/09
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/07	12/7/09
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 12/8/07	12/8/09
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/07	12/8/09
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/07	4/29/09
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 12/29/08	12/29/10
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 7/16/07	7/16/09

TEST PROCEDURES

Radiation Interference: ANSI C63.4-2003 using a spectrum analyzer, a preselector, a quasi-peak adapter, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worse case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental.

Formula Of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBµV) to the antenna correction factor supplied by the antenna manufacturer. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:				
Freq (MHz)	Meter Reading	+ ACF	+ CL	= FS
33	20 dBµV	+ 10.36 dB	+ 0.5	= 30.86 dBµV/m @ 3m

Power Line Conducted Interference: The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

Occupied Bandwidth: A small sample of the transmitter output was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to -10 dBm per division.

ANSI C63.4-2003 10.1 Measurement Procedures: The DUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The DUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. Emissions attenuated more than 20 dB below the permissible value are not reported.

RADIATION INTERFERENCE

Rules Part No.: 15.249, 15.209

Requirements:

Frequency	Limits
Part 15.209	
9 to 490 kHz	2400/F (kHz) µV/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) µV/m @ 30 meters
1705 kHz to 30 MHz	29.54 dBµV/m @ 30 meters
30 – 88	40.0 dBµV/m @ 3 meters
80 – 216	43.5 dBµV/m @ 3 meters
216 – 960	46.0 dBµV/m @ 3 meters
Above 960	54.0 dBµV/m @ 3 meters
Part 15.249	
Fundamental 902 – 928 MHz	94.0 dBµV/m @ 3 meters
Fundamental 2.4 – 2.4835 MHz	94.0 dBµV/m @ 3 meters
Harmonics	54.0 dBµV/m @ 3 meters

Test Data:

Part 15.209

Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Margin dB
66.72	4.1	V	0.56	8.72	13.38	26.62
79.84	5.7	V	0.60	7.50	13.80	26.20
85.78	9.4	V	0.61	8.17	18.18	21.82
381.42	5.6	V	1.18	15.34	22.12	31.88
419.53	6.0	V	1.22	16.00	23.22	30.78

Part 15.249
Vertical Antenna

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,402.00	51.9	H	3.18	32.25	20.0	67.33	26.67
2,402.0	2,402.00	59.3	V	3.18	32.25	20.0	74.73	19.27
2,402.0	4,804.00	4.6	H	4.90	34.10	20.0	23.60	30.40
2,402.0	4,804.00	6.2	V	4.90	34.10	20.0	25.20	28.80
2,402.0	7,206.00	4.3	H	5.72	36.04	20.0	26.06	27.94
2,402.0	7,206.00	5.8	V	5.72	36.04	20.0	27.56	26.44
2,402.0	9,608.00	5.1	V	6.78	36.71	20.0	28.59	25.41
2,402.0	9,608.00	5.4	H	6.78	36.71	20.0	28.89	25.11
2,402.0	12,010.00	3.7	H	7.81	38.71	20.0	30.22	23.78
2,402.0	12,010.00	5.1	V	7.81	38.71	20.0	31.62	22.38
2,440.0	2,440.00	48.8	H	3.18	32.24	20.0	64.22	29.78
2,440.0	2,440.00	55.3	V	3.21	32.34	20.0	70.85	23.15
2,440.0	4,800.00	4.7	H	4.90	34.10	20.0	23.70	30.30
2,440.0	4,800.00	4.8	V	4.90	34.10	20.0	23.80	30.20
2,440.0	7,320.00	3.9	V	5.79	36.06	20.0	25.75	28.25
2,440.0	7,320.00	4.4	H	5.79	36.06	20.0	26.25	27.75
2,440.0	9,760.00	5.0	V	6.83	36.86	20.0	28.69	25.31
2,440.0	9,760.00	6.8	H	6.83	36.86	20.0	30.49	23.51
2,440.0	12,200.00	2.9	H	7.94	38.86	20.0	29.70	24.30
2,440.0	12,200.00	3.2	V	7.94	38.86	20.0	30.00	24.00
2,481.0	2,481.00	49.5	H	3.24	32.45	20.0	65.19	28.81
2,481.0	2,481.00	56.5	V	3.24	32.45	20.0	72.19	21.81
2,481.0	4,962.00	3.7	H	4.98	34.10	20.0	22.78	31.22
2,481.0	4,962.00	4.5	V	4.98	34.10	20.0	23.58	30.42
2,481.0	7,443.00	4.7	H	5.87	36.09	20.0	26.66	27.34
2,481.0	7,443.00	6.3	V	5.87	36.09	20.0	28.26	25.74
2,481.0	9,924.00	4.9	V	6.88	37.02	20.0	28.80	25.20
2,481.0	9,924.00	5.2	H	6.88	37.02	20.0	29.10	24.90
2,481.0	12,405.00	3.0	H	8.08	39.02	20.0	30.10	23.90
2,481.0	12,405.00	3.8	V	8.08	39.02	20.0	30.90	23.10

Part 15.249
Dipole Antenna

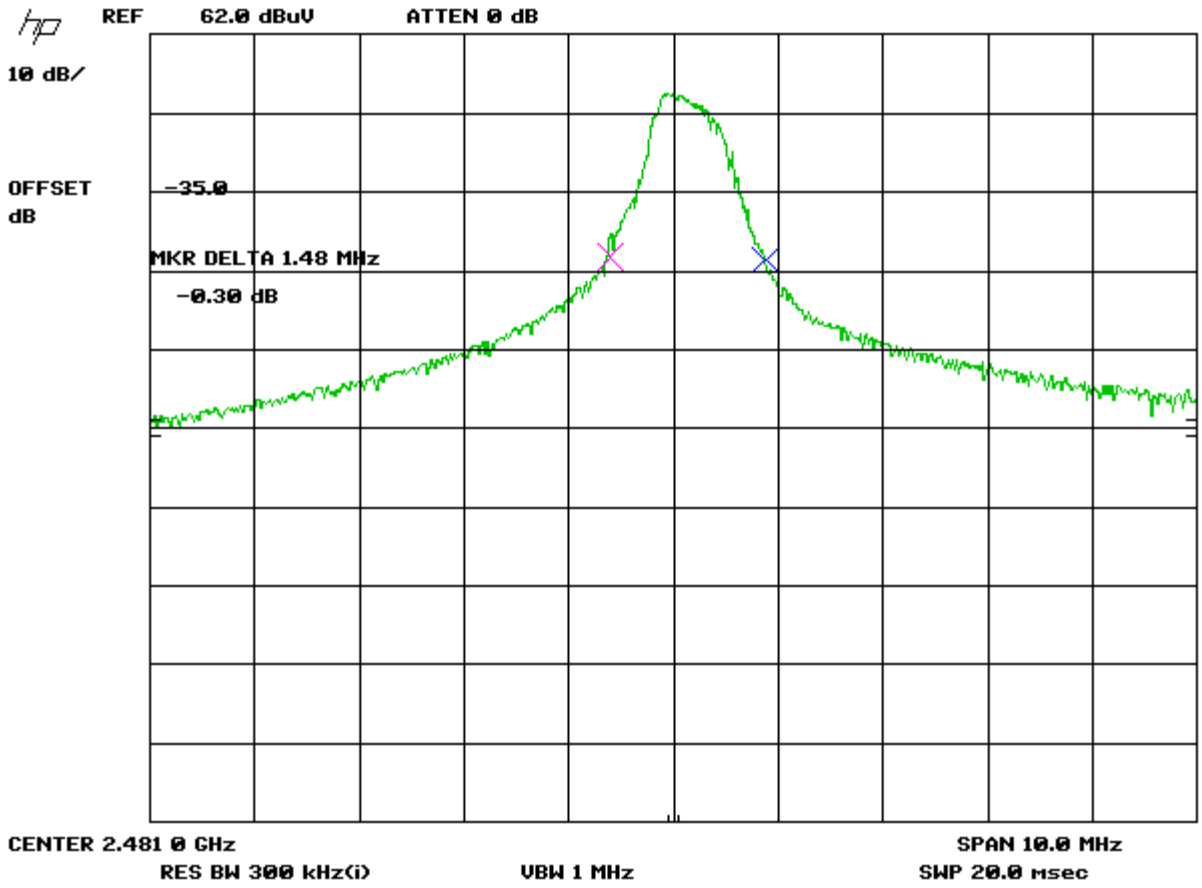
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,402.00	51.4	V	3.18	32.25	20.0	66.83	27.17
2,402.0	2,402.00	55.6	H	3.18	32.25	20.0	71.03	22.97
2,402.0	4,804.00	3.9	H	4.90	34.10	20.0	22.90	31.10
2,402.0	4,804.00	4.8	V	4.90	34.10	20.0	23.80	30.20
2,402.0	7,206.00	4.0	V	5.72	36.04	20.0	25.76	28.24
2,402.0	7,206.00	4.0	H	5.72	36.04	20.0	25.76	28.24
2,402.0	9,608.00	4.2	V	6.78	36.71	20.0	27.69	26.31
2,402.0	9,608.00	4.4	H	6.78	36.71	20.0	27.89	26.11
2,402.0	12,010.00	3.2	H	7.81	38.71	20.0	29.72	24.28
2,402.0	12,010.00	3.9	V	7.81	38.71	20.0	30.42	23.58
2,440.0	2,440.00	52.2	V	3.21	32.34	20.0	67.75	26.25
2,440.0	2,440.00	55.4	H	3.21	32.34	20.0	70.95	23.05
2,440.0	4,880.00	4.0	H	4.94	34.10	20.0	23.04	30.96
2,440.0	4,880.00	5.0	V	4.94	34.10	20.0	24.04	29.96
2,440.0	7,320.00	5.0	V	5.79	36.06	20.0	26.85	27.15
2,440.0	7,320.00	5.4	H	5.79	36.06	20.0	27.25	26.75
2,440.0	9,760.00	5.0	V	6.83	36.86	20.0	28.69	25.31
2,440.0	9,760.00	5.4	H	6.83	36.86	20.0	29.09	24.91
2,440.0	12,200.00	3.0	H	7.94	38.86	20.0	29.80	24.20
2,440.0	12,200.00	3.8	V	7.94	38.86	20.0	30.60	23.40
2,481.0	2,481.00	50.8	V	3.24	32.45	20.0	66.49	27.51
2,481.0	2,481.00	55.3	H	3.24	32.45	20.0	70.99	23.01
2,481.0	4,962.00	2.6	V	4.98	34.10	20.0	21.68	32.32
2,481.0	4,962.00	4.5	H	4.98	34.10	20.0	23.58	30.42
2,481.0	7,443.00	5.4	V	5.87	36.09	20.0	27.36	26.64
2,481.0	7,443.00	5.7	H	5.87	36.09	20.0	27.66	26.34
2,481.0	9,924.00	4.6	H	6.88	37.02	20.0	28.50	25.50
2,481.0	9,924.00	4.9	V	6.88	37.02	20.0	28.80	25.20
2,481.0	12,405.00	2.3	H	8.08	39.02	20.0	29.40	24.60
2,481.0	12,405.00	3.2	V	8.08	39.02	20.0	30.30	23.70

OCCUPIED BANDWIDTH

Rules Part No.: 15.249 (d)

Requirements: The field strength of any emissions appearing outside the bandedges and up to 10 kHz above and below the band edges shall be attenuated at least the general limits of 15.209.

Test Data: The bandwidth is 1.5 MHz



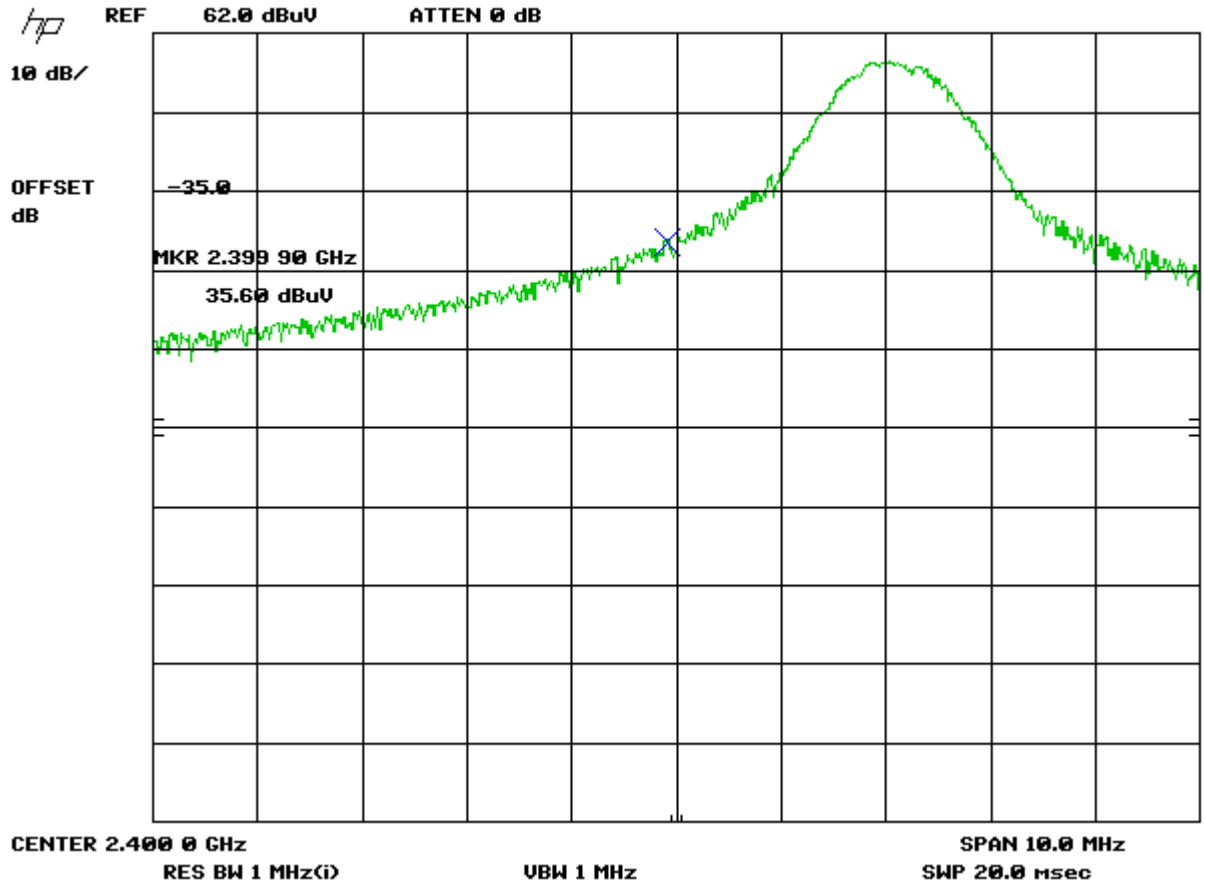
BAND EDGE COMPLIANCE

Rules Part No.: 15.249 (d)

Requirements: 40 dBc or in the case of restricted bands 54 dBµV/m.

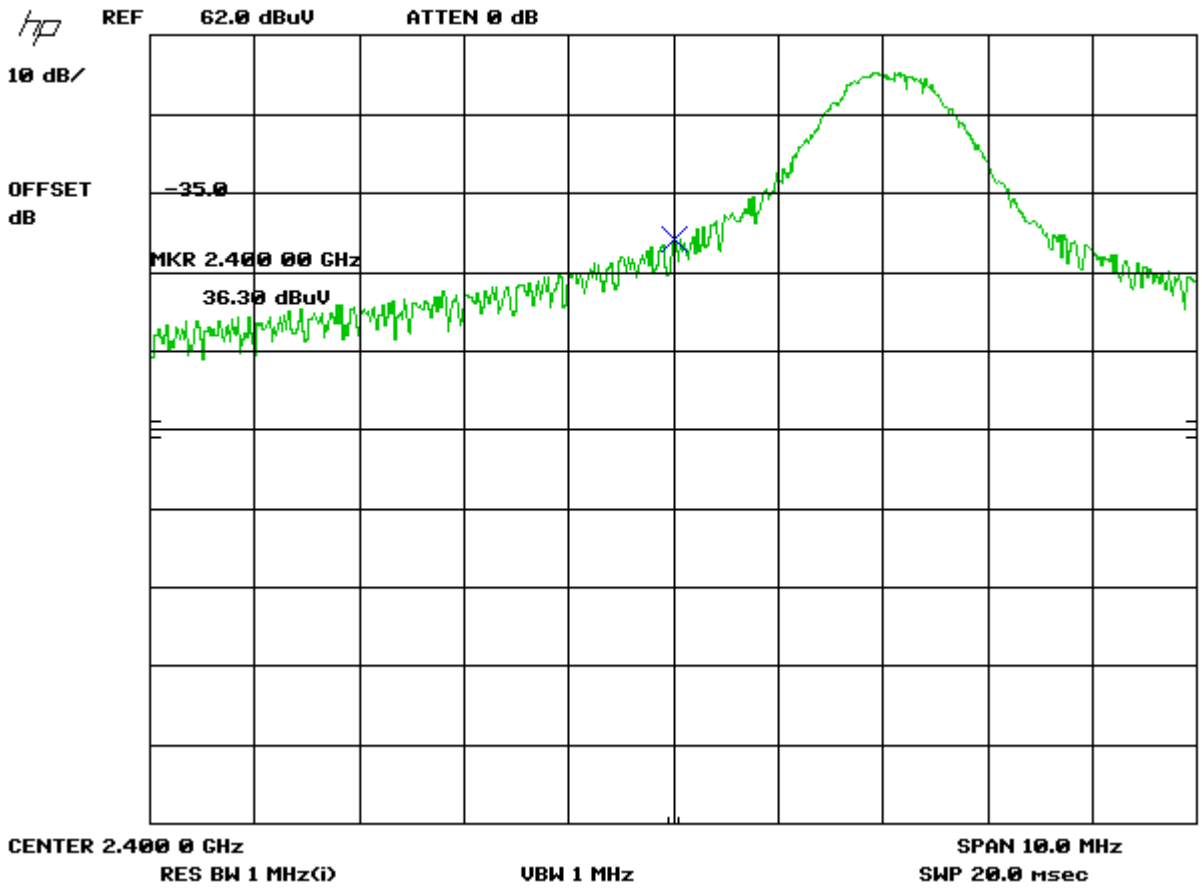
Test Data:

Vertical Antenna
Lower Band Edge



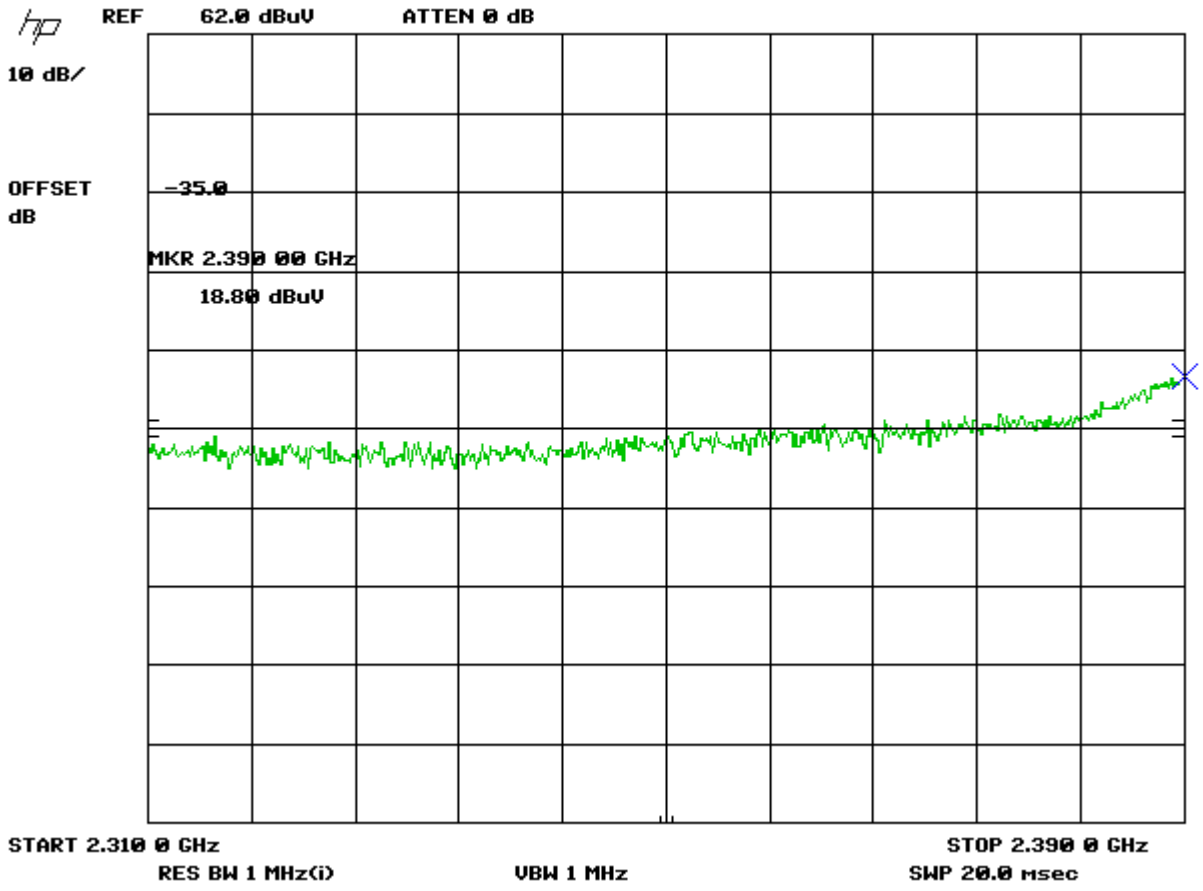
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,399.90	35.6	V	3.18	32.24	20.0	51.02	2.98

Dipole Antenna
Lower Band Edge



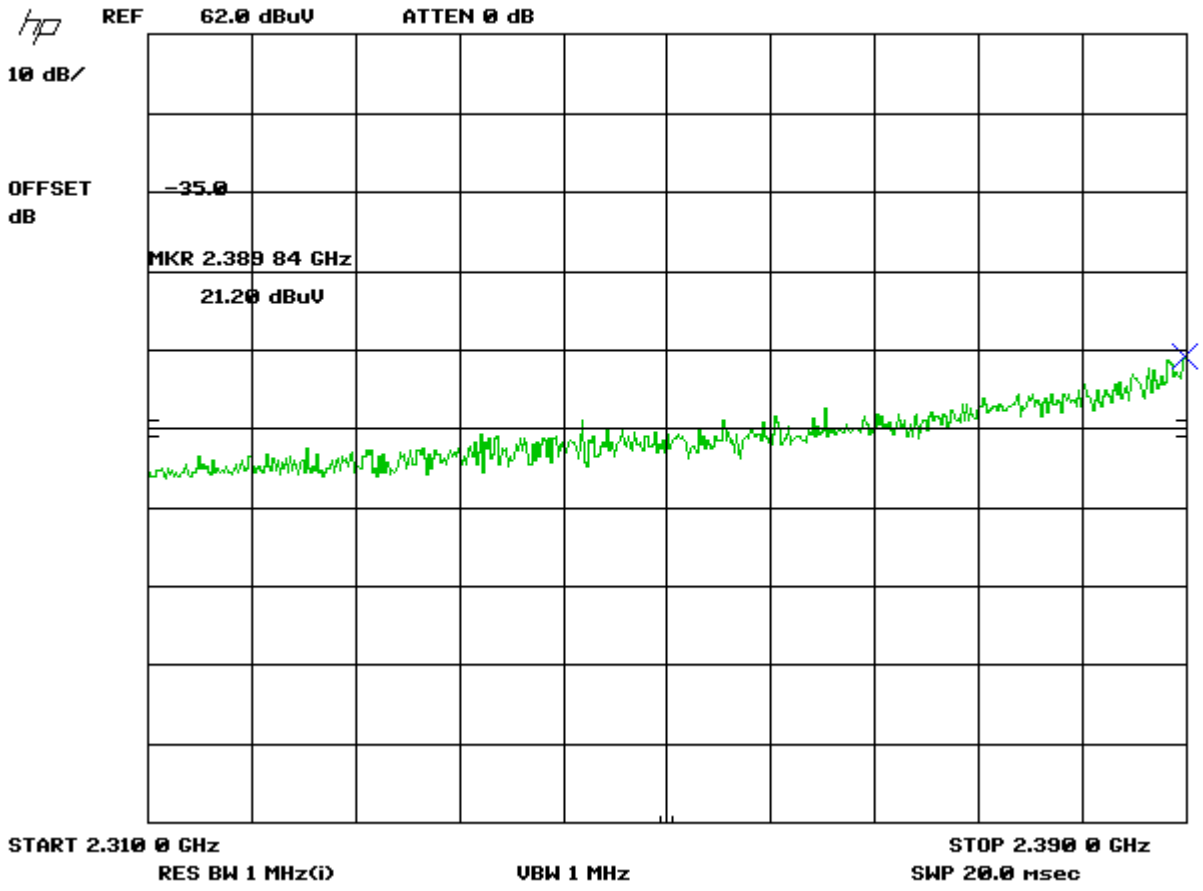
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,400.00	36.3	H	3.18	32.24	20.0	51.72	2.28

Vertical Antenna
Lower non-adjacent restricted band



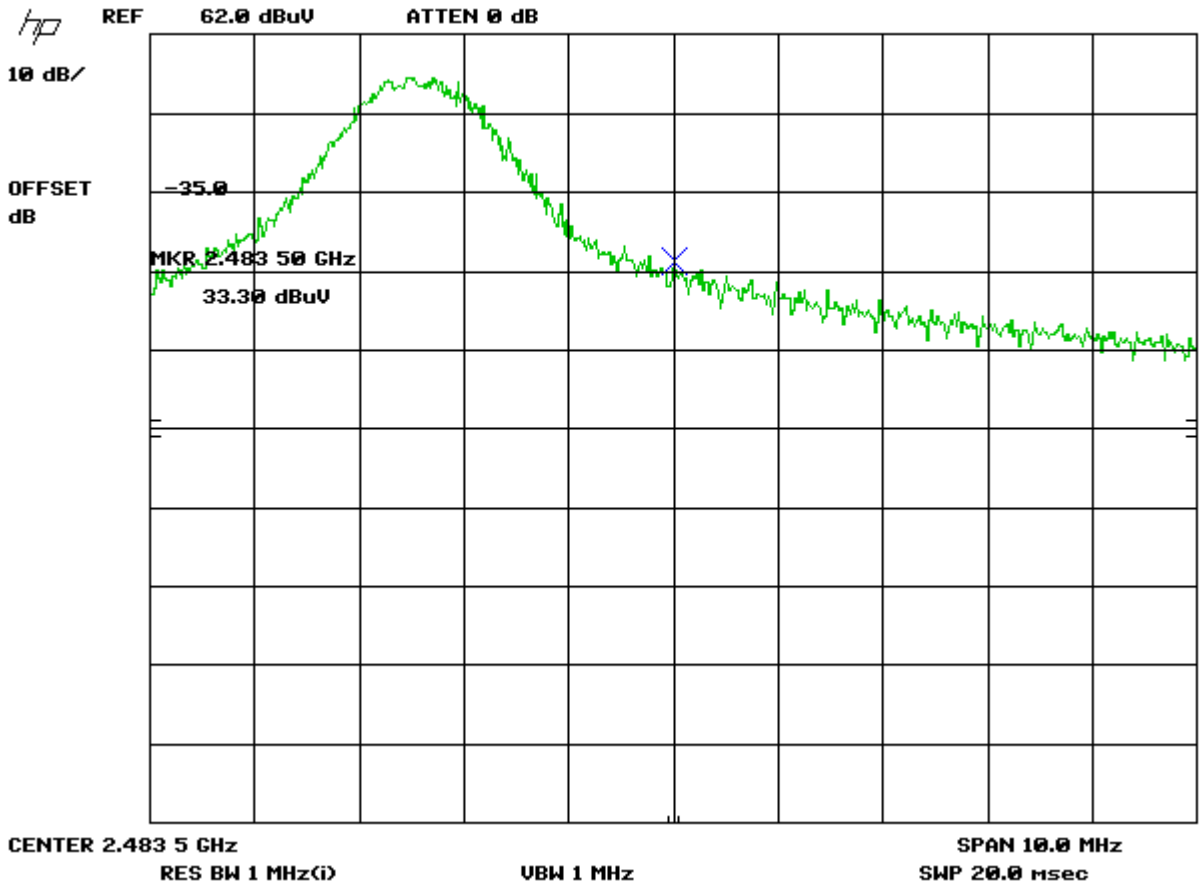
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,390.00	18.8	V	3.17	32.21	20.0	34.18	19.82

Dipole Antenna
Lower non-adjacent restricted band



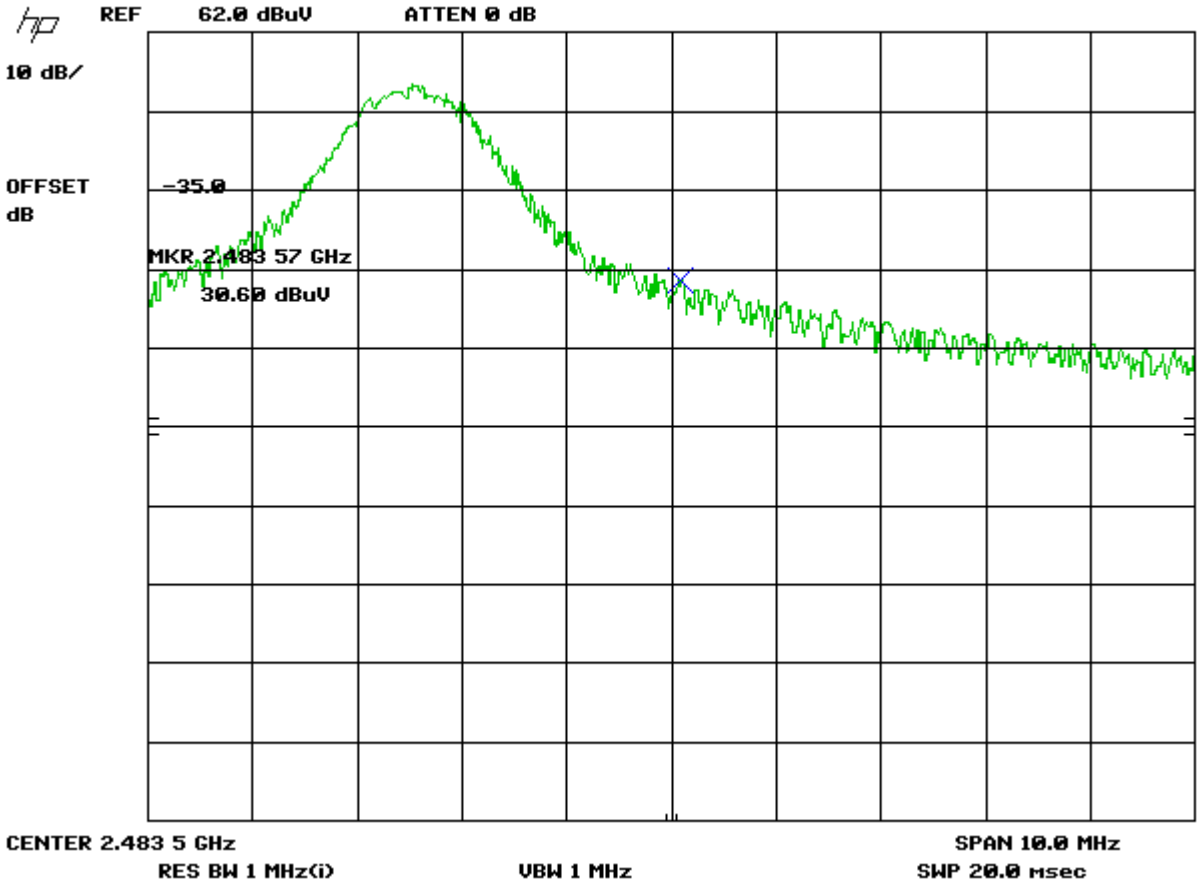
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,402.0	2,389.84	21.2	H	3.17	32.21	20.0	36.58	17.42

Vertical Antenna
Upper Band Edge



Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,481.0	2,483.50	33.3	V	3.24	32.46	20.0	49.00	5.00

Dipole Antenna
Upper Band Edge



Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Duty Cycle dB	Field Strength dBµV/m	Margin dB
2,481.0	2,483.57	30.6	H	3.24	32.46	20.0	46.30	7.70

DUTY CYCLE

The manufacturer declares and has prepared in a separate exhibit a calculation of duty cycle.

From the manufacturer:

We are sending an ECG packet out the wBTU every 4 msecs. Each packet is 224usec long.

We have two radio on the wBTU transmitting this data … It alternates between the two radios so each radio transmits at only 8 msec.
Each radio alternates between the base frequency and the base frequency + 8 Mhz

So I would say the duty cycle for any frequency or radio is 224 usec/8msec === 2.8%

In addition a backchannel command is sent out 4 times a second.
Backchannel commands are 128 usec long … therefore we are transmitting 512usec per second backchannel for an additional .05% duty cycle [Negligible]

Total duty cycle < 3%

Result: 20 dB

POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBµV)	Average Limits (dBµV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5.0 – 30	60	50

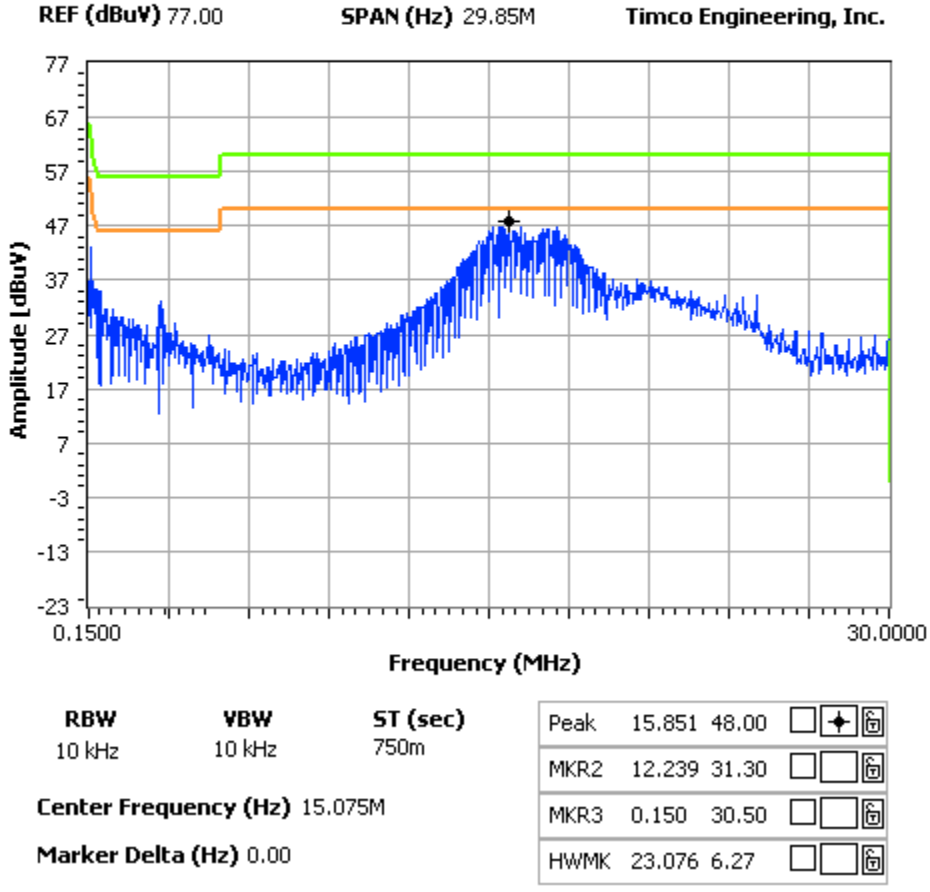
Test Data: The attached graphs represent the emissions read for power line conducted for this device. Both lines were observed.

Powerline
Line 1

NOTES:

POWERLINE CONDUCTED -- LINE 1
INVIVO CORPORATION

FCC 15.107 Mask Class B



Powerline
Line 2

NOTES:

POWERLINE CONDUCTED -- LINE 2
INVIVO CORPORATION

FCC 15.107 Mask Class B