TEST REPORT

Report Number: 101277992MIN-001D
Project Number: G101277992

Testing performed on the
Model 4200, Programmer Charger

FCC ID:
Industry Canada ID:

to
47 CFR Part 95 Subpart I: 2013
RSS- 243, Issue 3, November 2010
47 CFR, Part 15:2013, §15.109 and §15.107, Class B

Minnetronix

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

Test Authorized by:
Minnetronix
1635 Energy Park Drive
St. Paul, MN 55108 USA

Prepared by: _____ Date: November 19, 2013
Uri Spector

Reviewed by: _____ Date: November 19, 2013
Simon Khazon

TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION

Model:	4200
Type of EUT:	Programmer Charger, MedRadio
Serial Number:	DBR 1471
FCC ID:	
Industry Canada ID:	
Related Submittal(s) Grants:	N/A
Company:	Minnetronix
Customer:	Sue Sibilski
Address:	1635 Energy Park Drive St. Paul, MN 55108
Phone:	(651) 917-4060
Fax:	(651) 917-4066
e-mail:	ssibilski@minnetronix.com
Test Standards:	☒ 47 CFR, Part 95 Subpart I: 2013 ☒ RSS–243, Issue 3, November 2010 ☐ RSS-Gen, Issue 2, 2007 ☒ 47 CFR, Part 15:2013, §15.109 and §15.107, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	August 16, 2013
Test Work Started:	August 19, 2013
Test Work Completed:	November 15, 2013
Test Sample Conditions:	☐ Damaged ☐Poor (Usable) ☒ Good

1.1 Product Description; Test Facility

Product Description:	Programmer Charger
Operating Frequency	402-405MHz
Power Level Setting	8
Modulation:	FSK
Emission Designator:	252KF1D
Antenna(s) Info:	-9.1dBi chip antenna
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ External power source ☒ 100-240VAC ☐ 400VAC ☐ DC ☐ Other: ☒ 50-60Hz
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 C63.10-2009 / TIA 603-C

1.2 EUT Configuration

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

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

Operating modes of the EUT:

No.	Description
1	The EUT was powered 120VAC and was activated to transmit continuously modulated carrier except frequency error testing were a CW signal was transmitted. Channel 5 (403.65MHz) was utilized for testing.

Cables:

No.	Type	Length	Designation	Note
1	Not shielded USB Power cable	2m	Power Cable	
2	Model 4230 not shielded cable	1m	Charging Paddle	

Support equipment/Services:

No.	Item	Description
1	Avid Board	Implant Emulation board used during MedRadio Communication Sessions testing.

General notes: None

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

☒ **Extreme**

☐ **Temperature:**	+25 to +45 ° C
☒ **Temperature:**	-20 to +55 ° C
☐ **AC power:**	± 10%
☐ **Battery:**	0.85 -1.15 times

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)

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
FCC §2.1046 / FCC §95.639(f) / RSS-243 Section 5.4	Effective Radiated Power at Fundamental	Pass
FCC §2.1049 / FCC §95.633(e) / RSS-243 Section 5.1	Bandwidth of the emission	Pass
FCC §2.1053 / FCC §95.635 / RSS-243 Sections 5.5, 5.6	Radiated Spurious Emissions	Pass
FCC §2.1055 / FCC §95.627(e) / RSS-243 Sections 5.3	Frequency Error	Pass
FCC Part 15.109/ICES-003	Receiver/digital device radiated emissions	Pass
FCC Part 15.107/ICES-003	Receiver/digital device conducted emissions	Pass
FCC §95.627(a)(1-4) / RSS-243 Sections 5.7	The MedRadio Communication Sessions (Threshold Power Levels, Monitoring System Bandwidth, Scan Cycle Time, Channel Access, Discontinuation of a MedRadio Session, and Use of Pre-Scanned Alternate Channel)	Pass

3.0 TEST CONDITIONS AND RESULTS

3.1 Effective Radiated Power at Fundamental

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test distance: ☐ 10 meters ☒ 3 meters

Frequency range of measurements: 403.72MHz

Test result: **Pass**

Max. Emissions margin at fundamental: 4.9dB below the limits

Notes: Per FCC 95.627 (g)(3), the maximum effective radiated power measurement was determined by measuring radiated field from the equipment under test at 3m distance. The equivalent radiated field strength at 3 meters for 25µW is 18.2mV/meter at 3m test distance (85.2dBµV/m at 3m).

Date:	September 19, 2013	**Result:**	**Pass**
Standard:	FCC 95 Subpart I / RSS-243		
Tested by:	Uri Spector		
Test Point:	Enclosure with antenna		
Operation mode:	See Page 5		
Note:	None		

Table 3.1

Frequency	Antenna		Ant. CF	Cable loss	Pre-amp	Reading	Total @ 3m	Limit	Margin	Comments
MHz	Polarity	Hts(cm)	dB1/m	dB	Gain (dB)	dBµV	dBµV/m	dBµV/m	dB	
403.72	V	173	16.6	2.3	0.0	56.6	75.5	85.2	-9.7	EUT Ver
403.72	H	100	16.6	2.3	0.0	61.4	80.3	85.2	-4.9	EUT Hor

Comments: Measurements were taken using an Peak detector at RBW 300kHz, VBW 1MHz

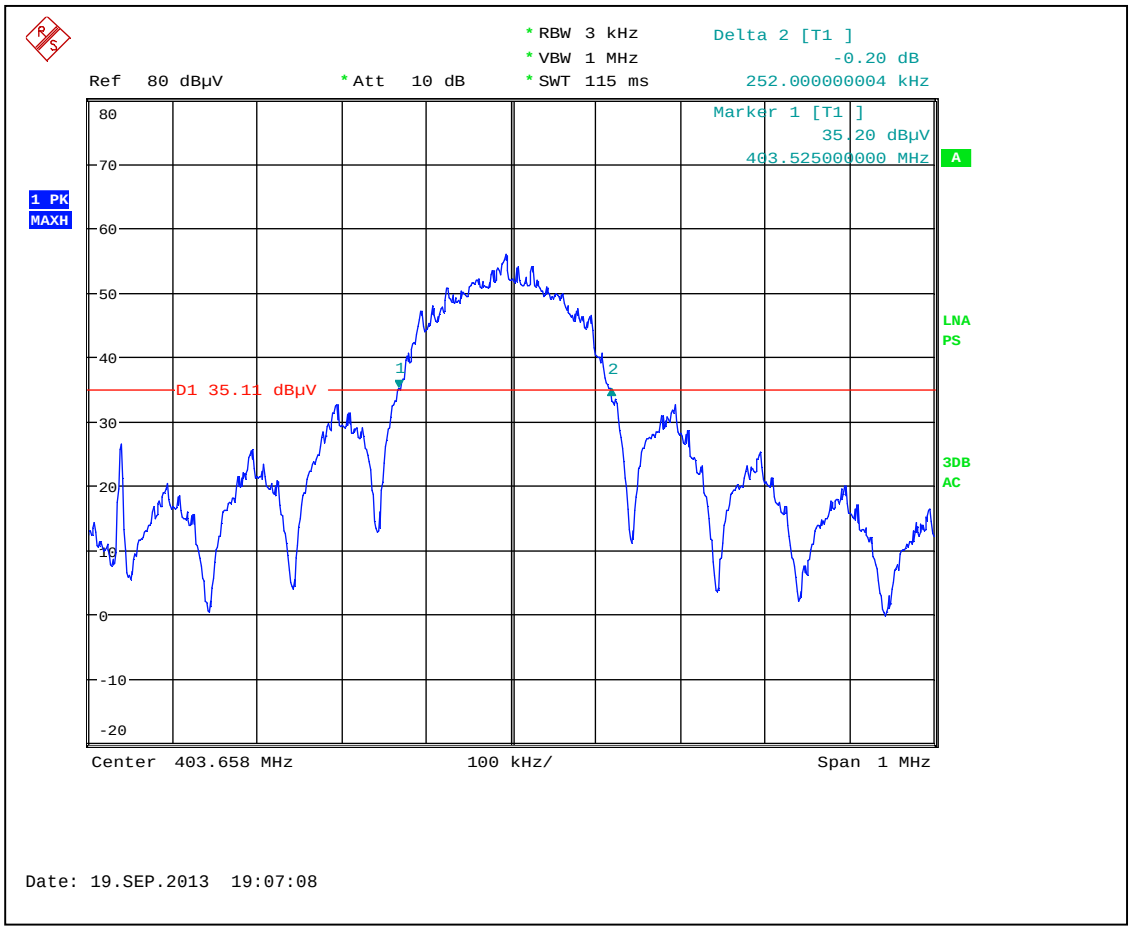
3.2 Bandwidth of Emissions

Center Frequency of operation MHz	Measured 20dB bandwidth kHz	Maximum bandwidth allowed kHz
403.65	252	300

Graph 3.2.1 shows bandwidth of emissions

Notes: None

Graph 3.2.1


RBW 3 kHz
VBW 1 MHz
SWT 115 ms
Delta 2 [T1]
-0.20 dB
252.000000004 kHz
Ref 80 dBµV
Att 10 dB
Marker 1 [T1]
35.20 dBµV
403.525000000 MHz
1 PK
MAXH
A
LNA
PS
3DB
AC
D1 35.11 dBµV
80
70
60
50
40
30
20
10
0
-10
-20
Center 403.658 MHz
100 kHz/
Span 1 MHz
Date: 19.SEP.2013 19:07:08

3.3 Radiated Spurious Emissions

Test location:	☐ OATS	☒ Anechoic Chamber
Test distance:	☐ 10 meters	☒ 3 meters
Test result:	**Pass**	
Frequency range:	30MHz-5000MHz	
Max. Emissions margin:	3.8dB below the limits	

Notes: The Radiated Spurious Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Table 3.3.1 and Graphs 3.3.1. 3.3.2).

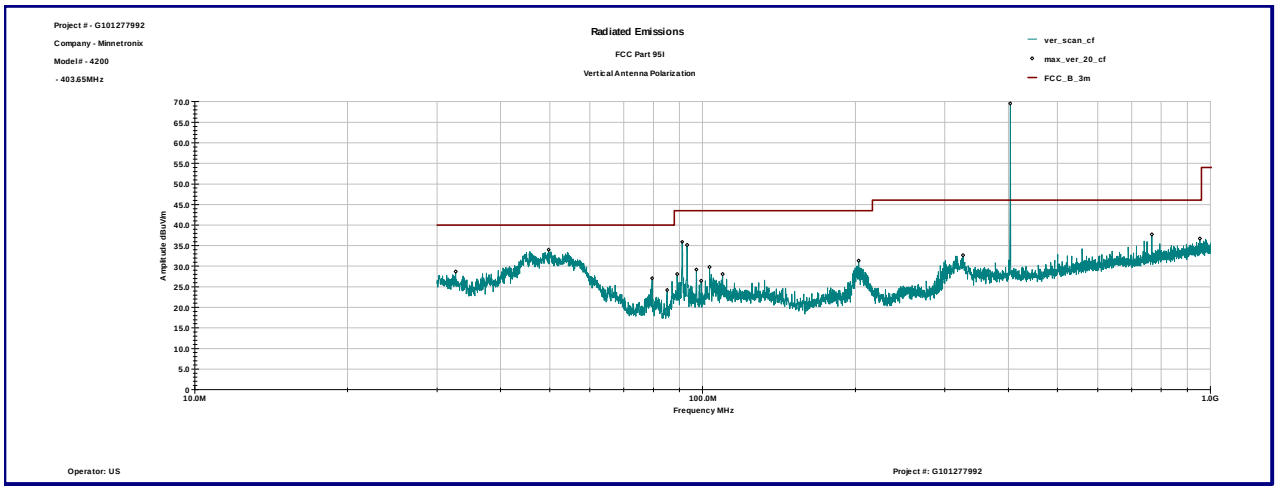
Date:	September 19, 2013	**Result:** **Pass**
Standard:	FCC Part 95 Subpart I / RSS-243	
Tested by:	Uri Spector	
Test Point:	Enclosure with antenna	
Operation mode:	See Page 5	
Note:	The fundamental frequency was removed from the table. No radiated spurious emissions were detected above 1GHz (see Graph 3.3.2).	

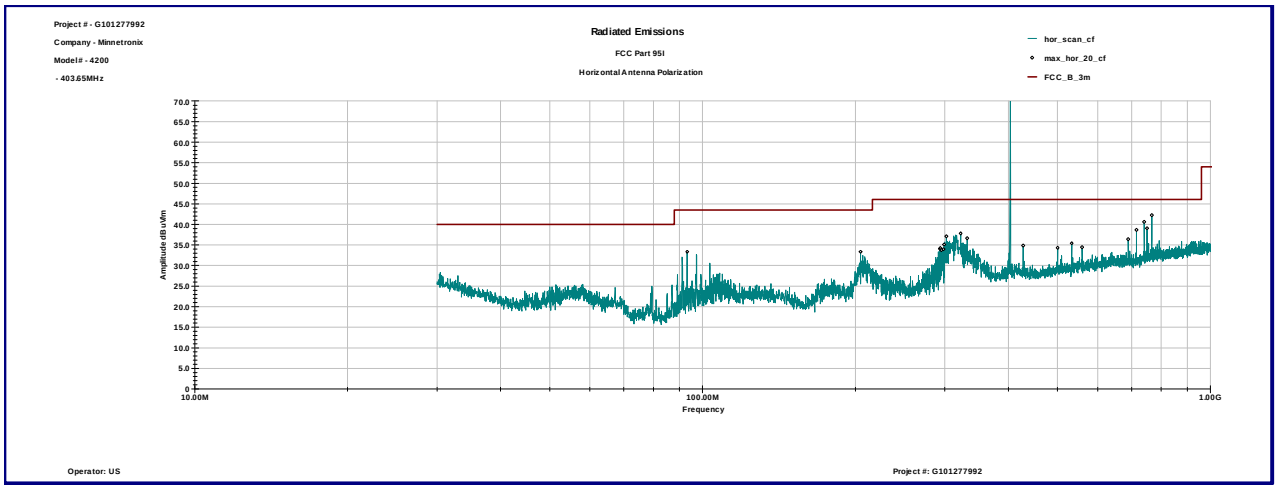
Spurious emissions more than 250 kHz removed from the MedRadio band (402-405MHz) at 3 meters test distance must not exceed 40dBµV/m in the range from 30-88 MHz, 43.5 from 88-216 MHz, 46dBµV/m from 216-960 MHz and 54dBµV/m above 960 MHz.
Emissions within 250kHz of the MedRadio band must be attenuated by at least 20dB below the maximum permitted output power, using an instrument resolution bandwidth approximately equal to 1% of the emissions bandwidth.
Emissions within the MedRadio band more than 150kHz away from the center frequency of the spectrum the transmission is intended to occupy, will be attenuated below the transmitter output power by at least 20dB, using an instrument resolution bandwidth approximately equal to 1% of the emissions bandwidth.

Table 3.3.1

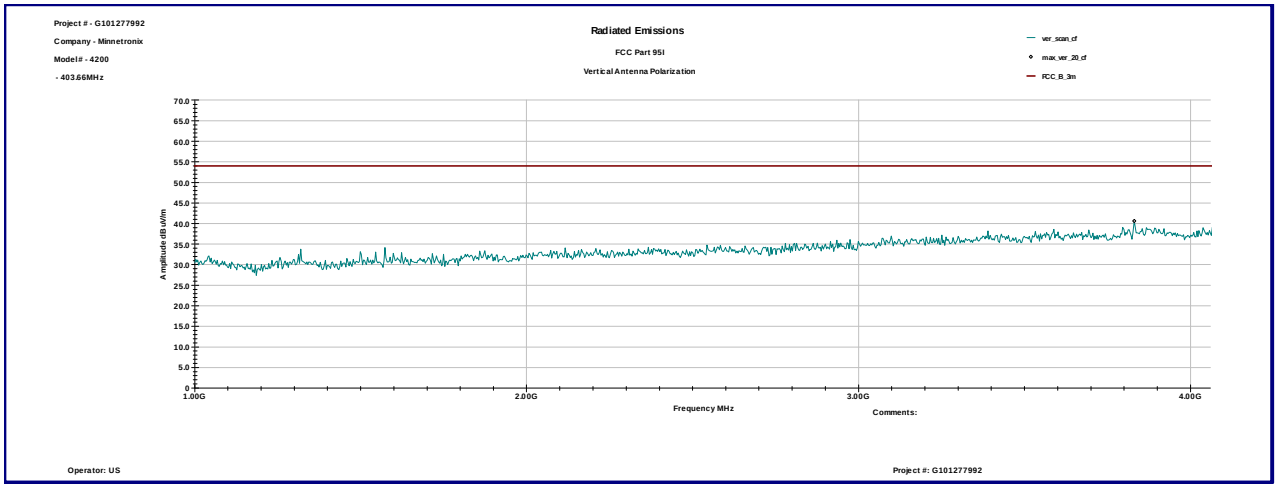
Frequency	Ant. Polarity	Peak Reading dBµV	Total C.F. dB1/m	Total at 3m dBµV/m	Limit dBµV/m	Margin dB
32.667 MHz	V	10.1	18.7	28.7	40.0	-11.3
49.775 MHz	V	24.2	9.8	34.0	40.0	-6.0
91.196 MHz	V	25.2	10.7	35.9	43.5	-7.6
93.21 MHz	V	23.9	11.2	35.1	43.5	-8.4
97.24 MHz	V	17.2	12.0	29.2	43.5	-14.3
203.07 MHz	V	19.1	12.3	31.3	43.5	-12.2
325.63 MHz	V	16.1	16.6	32.7	46.0	-13.3
766.93 MHz	V	14.0	23.7	37.7	46.0	-8.3
93.285 MHz	H	22.1	11.2	33.3	43.5	-10.2
204.67 MHz	H	21.0	12.3	33.3	43.5	-10.2
299.04 MHz	H	19.2	15.9	35.1	46.0	-10.9
322.17 MHz	H	21.2	16.6	37.8	46.0	-8.2
427.8 MHz	H	15.3	19.6	34.8	46.0	-11.2
533.08 MHz	H	14.5	20.9	35.4	46.0	-10.6
714.94 MHz	H	15.7	23.0	38.7	46.0	-7.4
740.76 MHz	H	17.1	23.5	40.6	46.0	-5.4
749.96 MHz	H	15.5	23.6	39.1	46.0	-6.9
766.93 MHz	H	18.5	23.7	42.2	46.0	-3.8

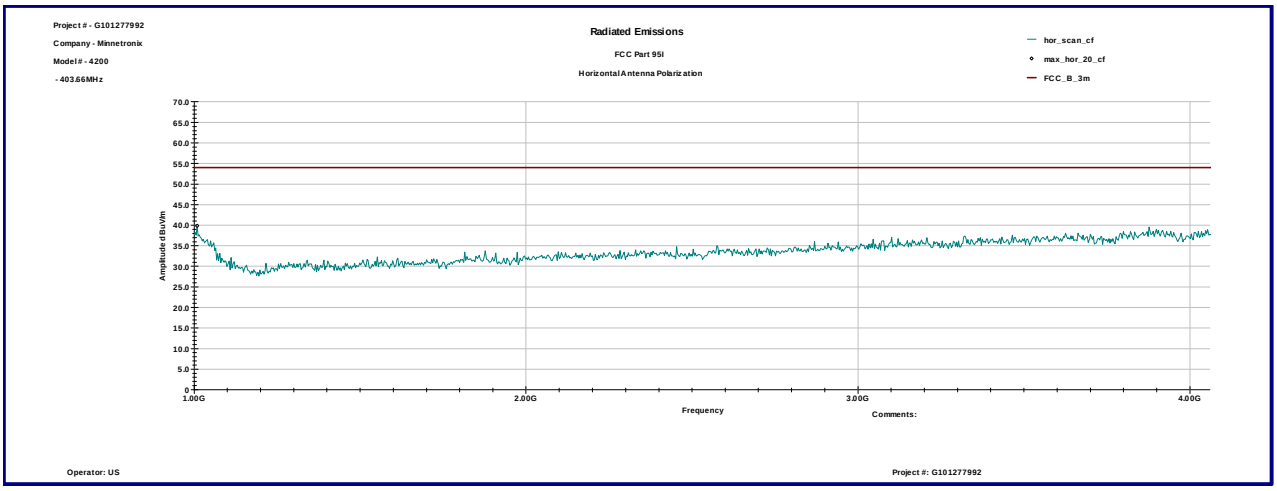
Graph 3.3.1


Project # - G101277992
Company - Minnetronix
Model# - 4200
- 403.65MHz
Radiated Emissions
FCC Part 95I
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
10.0M
100.0M
1.0G
Frequency MHz
Operator: US
Project #: G101277992

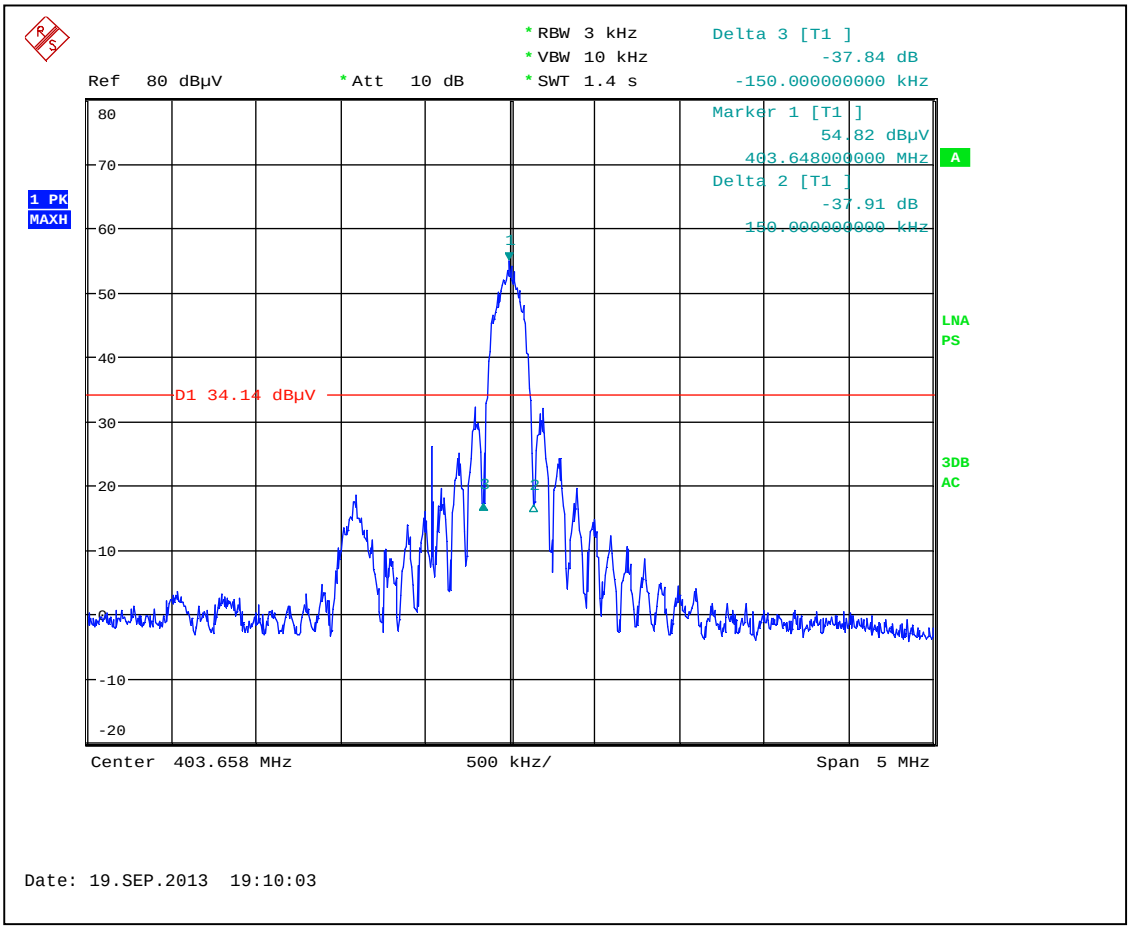

Project # - G101277992
Company - Minnetronix
Model# - 4200
- 403.65MHz
Radiated Emissions
FCC Part 95I
Horizontal Antenna Polarization
hor_scan_cf
max_hor_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
10.00M
100.00M
1.00G
Frequency
Operator: US
Project #: G101277992

Graph 3.3.2

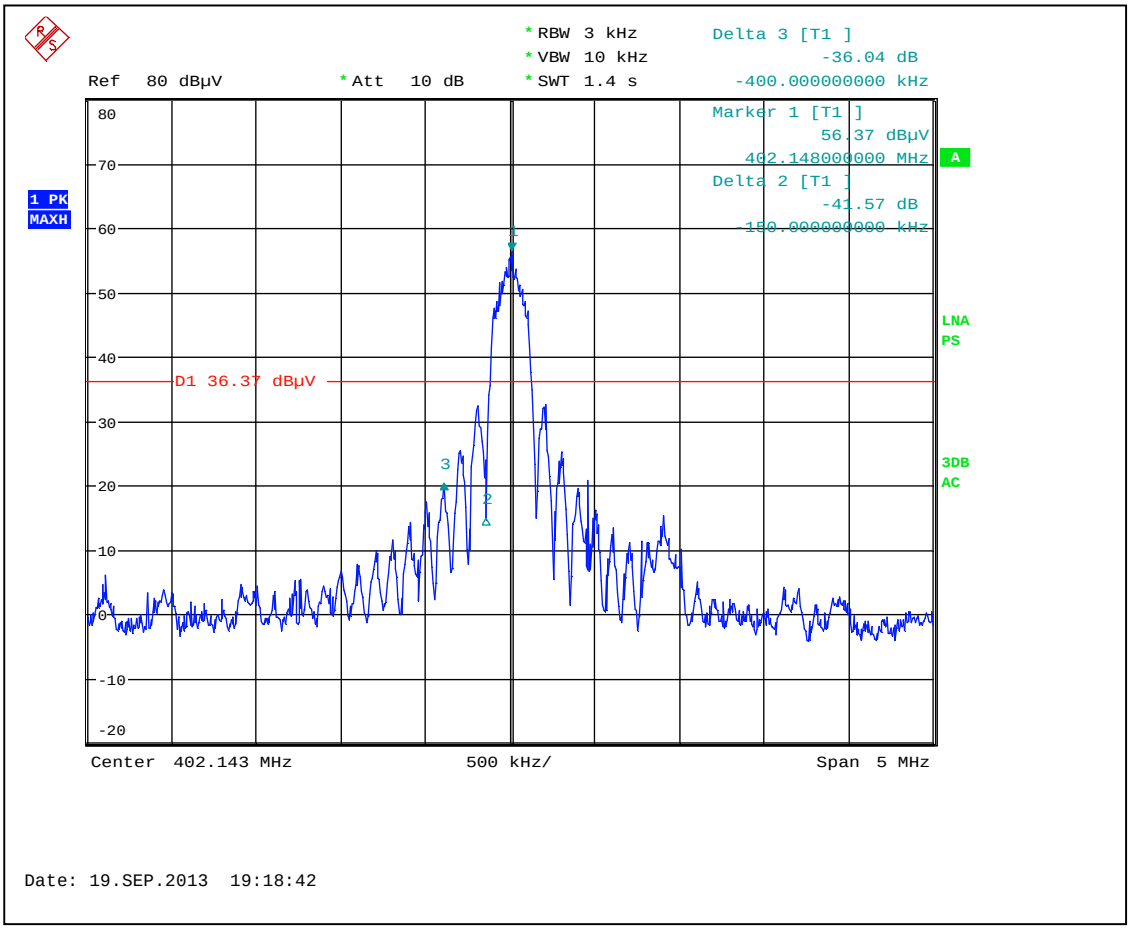

Project # - G101277992
Company - Minnetronix
Model # - 4200
- 403.66MHz
Radiated Emissions
FCC Part 95I
Vertical Antenna Polarization
ver_scan_cf
max_ver_20_cf
FCC_B_3m
Amplitude dBuV/m
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0
1.00G
2.00G
3.00G
4.00G
Frequency MHz
Comments:
Operator: US
Project #: G101277992


Project # - G101277992
Company - Minnetronix
Model # - 4200
- 403.66MHz
Radiated Emissions
FCC Part 95I
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
1.00G
2.00G
3.00G
4.00G
Frequency
Comments:
Operator: US
Project #: G101277992

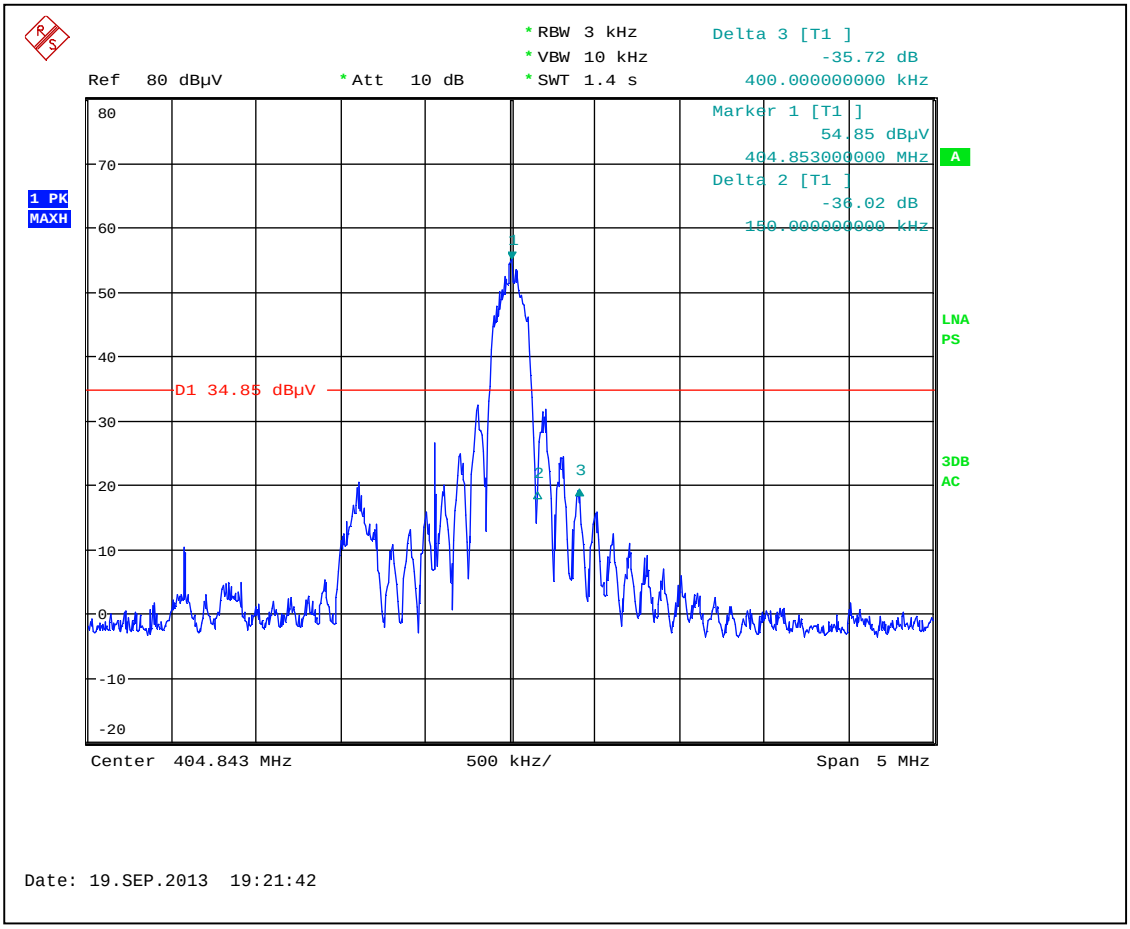
Graph 3.3.3
Emissions outside 150kHz offset from the intended frequency



Graph 3.3.4
Lower 250kHz band edge



Graph 3.3.5
Upper 250kHz band edge



Frequency Error

Table 3.4.1

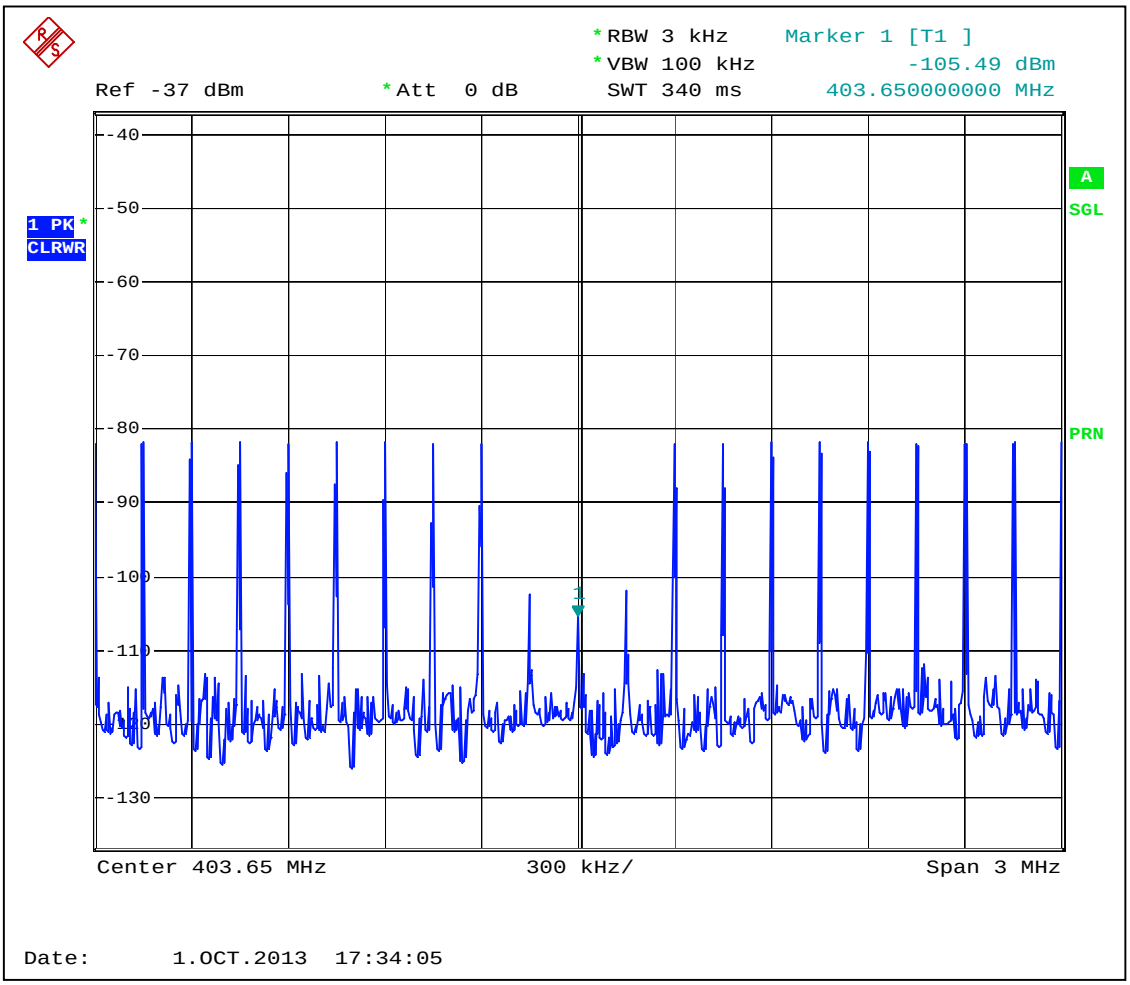
Temperature Degree C	Output Frequency MHz	Frequency Deviation kHz	Frequency Stability ppm	Frequency error limit ppm	Test Result
-20	403.6452	5.2	12.9	±100	Pass
0	403.6462	4.2	10.4	±100	Pass
15	403.6473	3.1	7.7	±100	Pass
25	403.6504	0.0	0.0	±100	Pass
35	403.6518	1.4	3.5	±100	Pass
55	403.6526	2.2	5.5	±100	Pass

3.5 MedRadio Operation

The MedRadio communication sessions must meet operating requirements for Threshold Power Levels, Monitoring System Bandwidth, Scan Cycle Time, Minimum Channel Monitoring Period, Channel Access, Discontinuation of a MedRadio Session, and Use of Pre-Scanned Alternate Channel.

For these tests, a blocking band was created using the vector signal generator. A notch was created in the blocking band by removing some of the tones, or by lowering the output power of some of the tones in relation to the other. A second signal generator was used to generate a tone on specific channel. Below is an example plot of the blocking band at the EUT, including a single notch in the center.

Graph 3.5.1



System Threshold Power Levels

The monitoring threshold power level shall not be greater the calculated level given by the equation, 10logB(Hz)-150(dBm/Hz)+G(dBi), where B is the emissions bandwidth of the MedRadio communication session transmitter having the widest emissions bandwidth and G is the antenna gain of the medical implant programmer transmitter monitoring system.

Calculated Threshold Power: 10 log(252kHz) -150+(-9.1)= -105.1dBm

The blocking band was set to -102.1dBm (3dB above the calculated threshold level), with a notch left open at 403.65MHz. A tone was introduces at the center of the notch at -111.1dBm, and was stepped up to the threshold level, -105.1dBm. At each step, MedRadio communications session was initiated and the selected channel was observed.

Measured Threshold Power: -107.1dBm

Monitoring System Bandwidth

The monitoring system bandwidth measured at its 20dB down points shall be equal to, or greater than the emissions bandwidth of the intended transmission.

The blocking band was set to -102.1dBm (3dB above the calculated threshold level), with a notch left open at 403.65MHz. A tone was introduced at the frequencies corresponding to the 20dB down points of the fundamental emission, and was increased until the EUT no longer transmitted on the central frequency. At each step, a MedRadio communication session was initiated and the selected channel was observed. The difference between the values at which the EUT detects the center channel emission and the channel edge emissions should be less than 20dB in order for the order for the monitoring system bandwidth to be wider than the emission bandwidth.

F_{low} = 403.524MHz
F_{high} = 403.776MHz

Pa= -104.1dBm
Pb= -95.1dBm
Pc= -97.1dBm

D1= Pa-Pb= -104.1-(-95.1)= -9.0dB
D2= Pa-Pc= -104.1-(-97.1)= -7.0dB

D1 and D2 are both less than 20dB

Test result: Pass

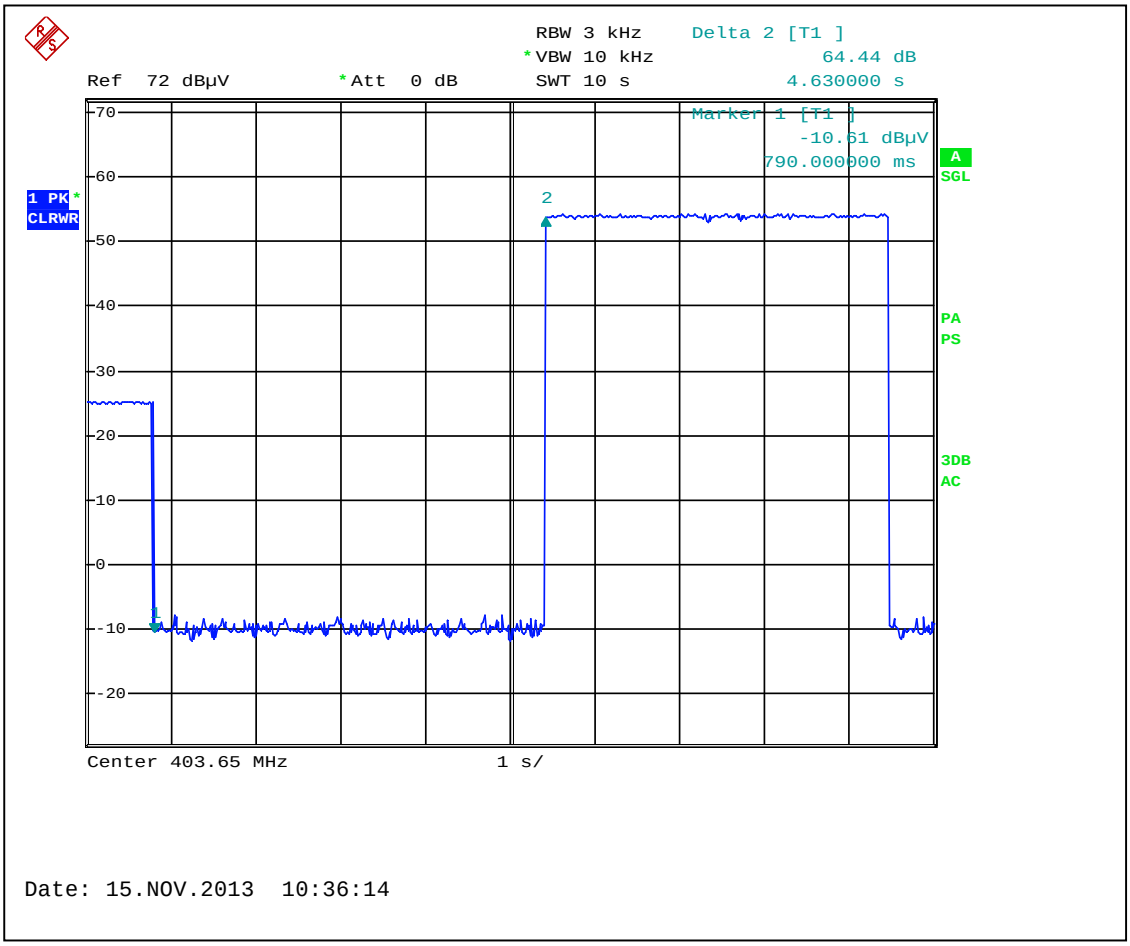
Scan Cycle Time

Within 5 seconds prior to initiating a communications session, circuitry associated with a medical implant programmer transmitter shall monitor all the channels in the 402-405MHz frequency band.

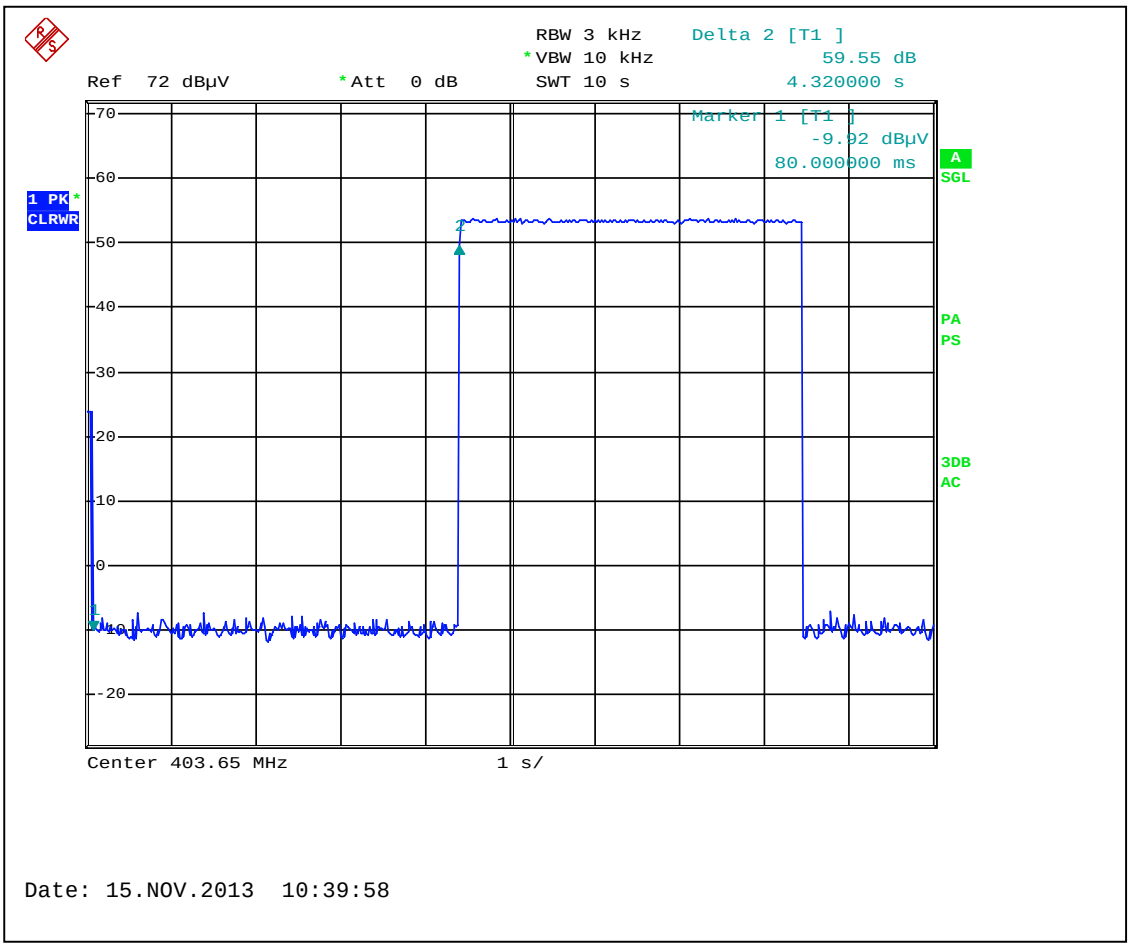
The blocking band was set to -102.1dBm (3dB above the calculated threshold level), with a notch left open at 403.65MHz. A tone was introduced at the center of the notch at -92.1dBm. The tone was removed and a MedRadio communications session was initiated. The time elapsed between removal of the CW tone and the start of the MedRadio session was recorded. The highest value was: **4.76sec**

Test result: Pass

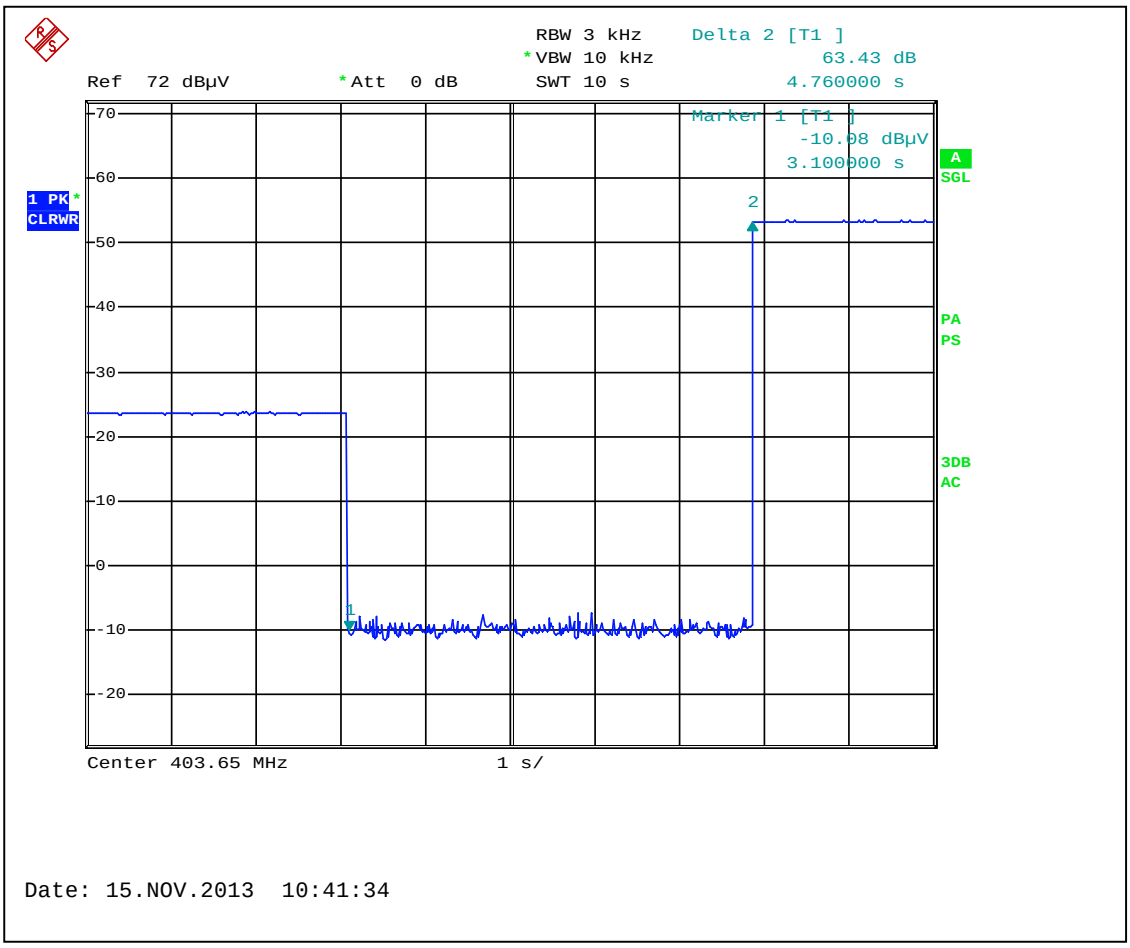
Graph 3.5.2 Scan Cycle Time 1 (4.63sec)



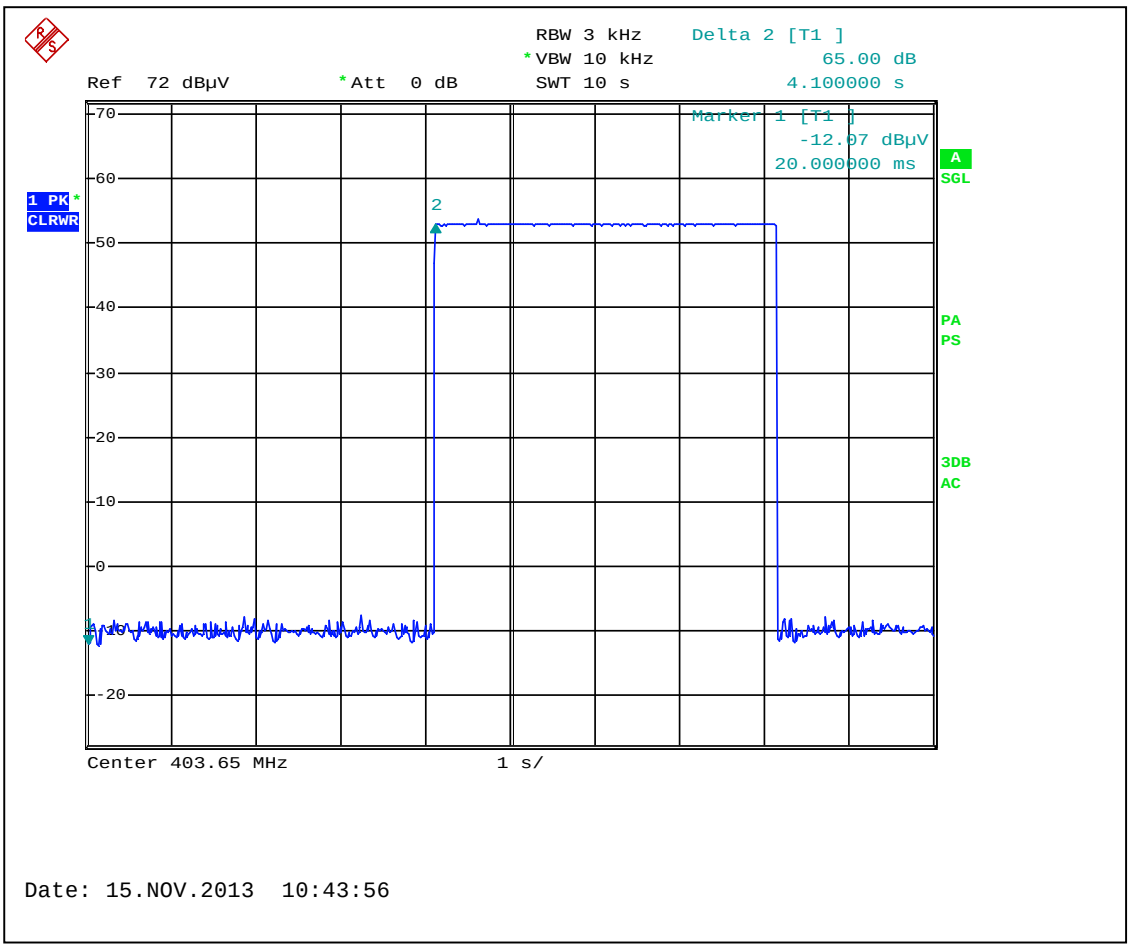
Graph 3.5.3 Scan Cycle Time 2 (4.32sec)



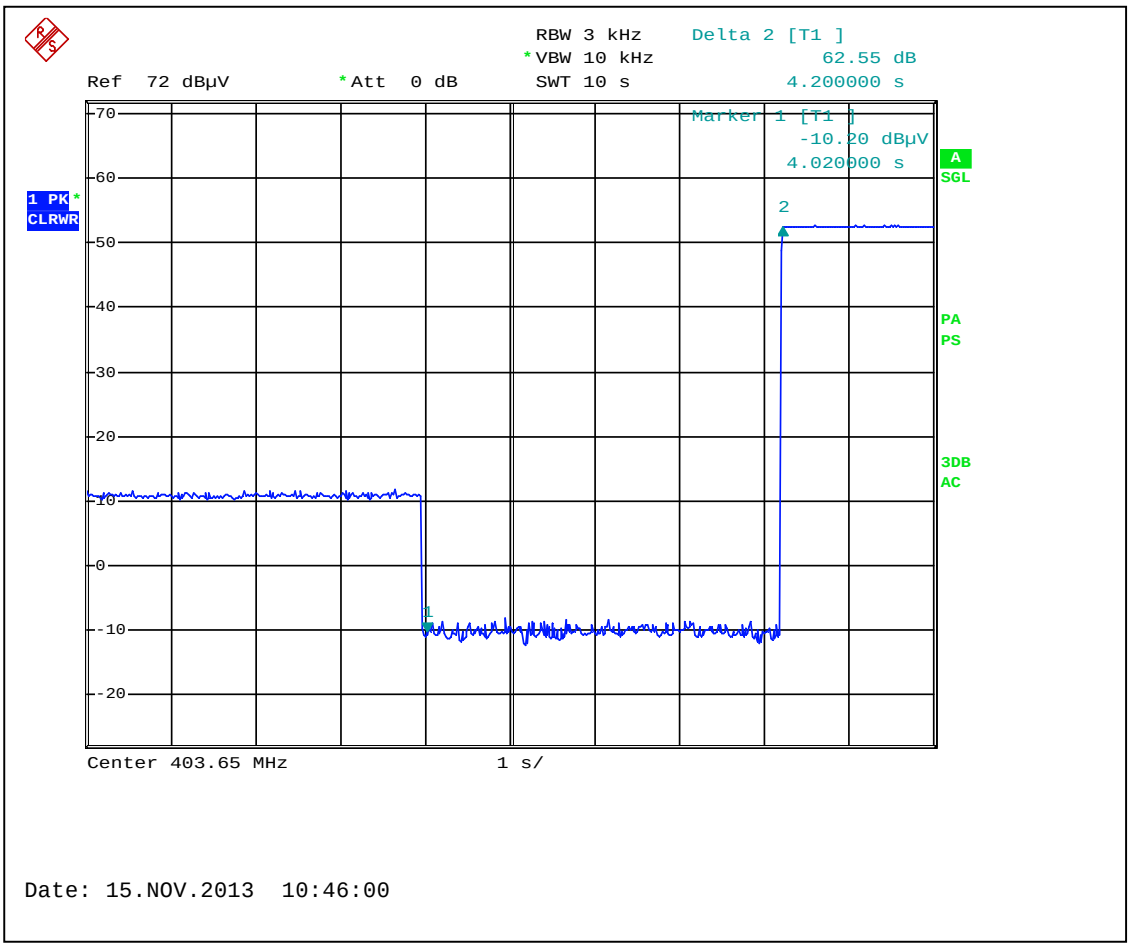
Graph 3.5.4 Scan Cycle Time 3 (4.76sec)



Graph 3.5.5 Scan Cycle Time 4 (4.10sec)



Graph 3.5.6 Scan Cycle Time 5 (4.20sec)



Channel Access

Immediate access is permitted on any channel having an ambient power level that is below the maximum threshold. If no channel having an ambient power below the maximum threshold is available, the equipment under test shall access and transmit on the least interfered channel.

The blocking band was set to -95.1dBm (10dB above the calculated threshold level), with a notch left open at 403.65MHz. A second notch was created at out-of operating-region by lowering the blocking tones by 7dB. A CW tone was introduced at the center of the channel at -108.1dB (3dB below the calculated threshold). A MedRadio communication session was then initiated and it was verified that the EUT transmitted only on the center frequency through several attempts. The CW tone at center frequency was then increased by 9dB to -99.1dBm, and it was verified that the EUT transmitted on the center frequency of the LIC channel over 10+ attempts.

Test result: Pass

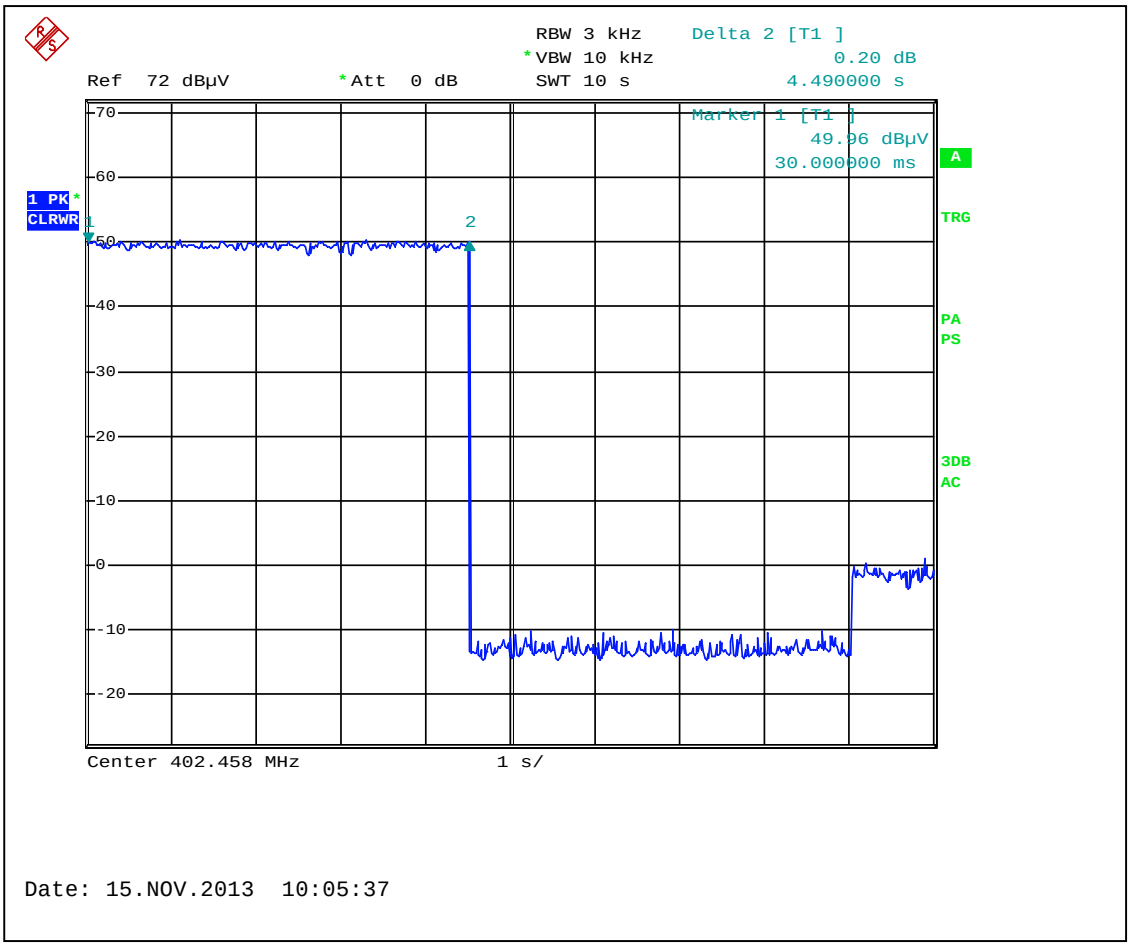
Discontinuation of a MedRadio session

MedRadio shall cease transmission in the event the communication session is interrupted for a period of 5 seconds or more.

A MedRadio communication session was initiated, and the MedRadio implant was caused to cease transmission during the session. The time from when the implant ceased transmission until the programmer ceased communication was 4.49 seconds, as shown in the plot below. Communication was set on channel 5 (403.65MHz). Power was turned off block the implant transmission.

Test result: Pass

Graph 3.5.7



Use of the Pre-scanned Alternate Channel

Pre-scanned alternate channel operation is not implemented

3.6 Receiver/digital device radiated emissions

Test location: ☐ OATS ☒ Anechoic Chamber

Test distance: ☐ 10 meters ☒ 3 meters

Test result: **Pass**

Frequency range: 30MHz-5000MHz

Max. Emissions margin: 7.1dB below the limits

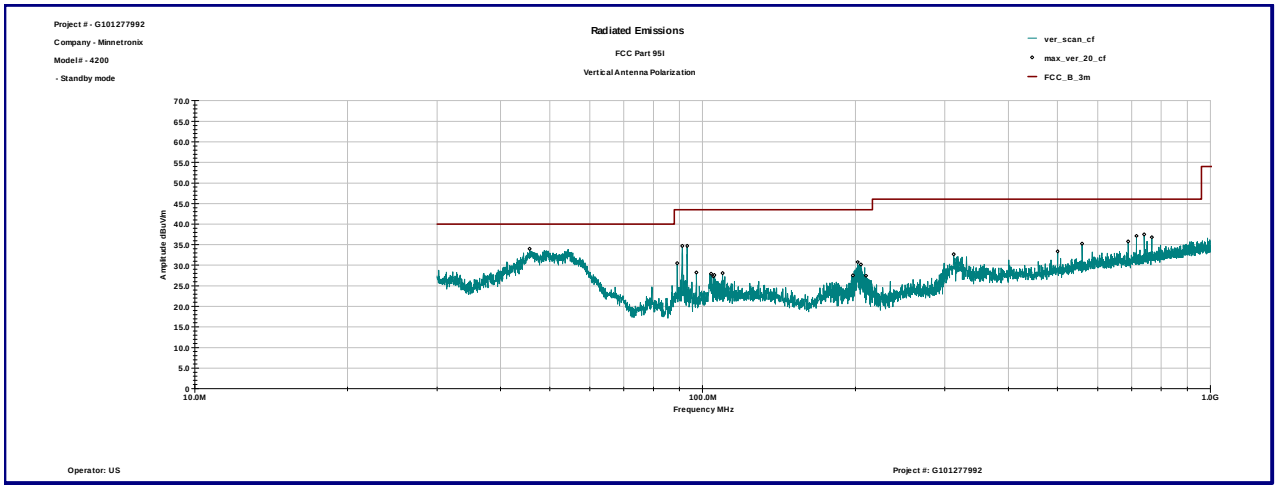
Notes: The Radiated Emissions test was performed in the Anechoic chamber at 3m measurement distance (see Tables 3.6.1 and Graphs 3.6.1 to 3.6.2).

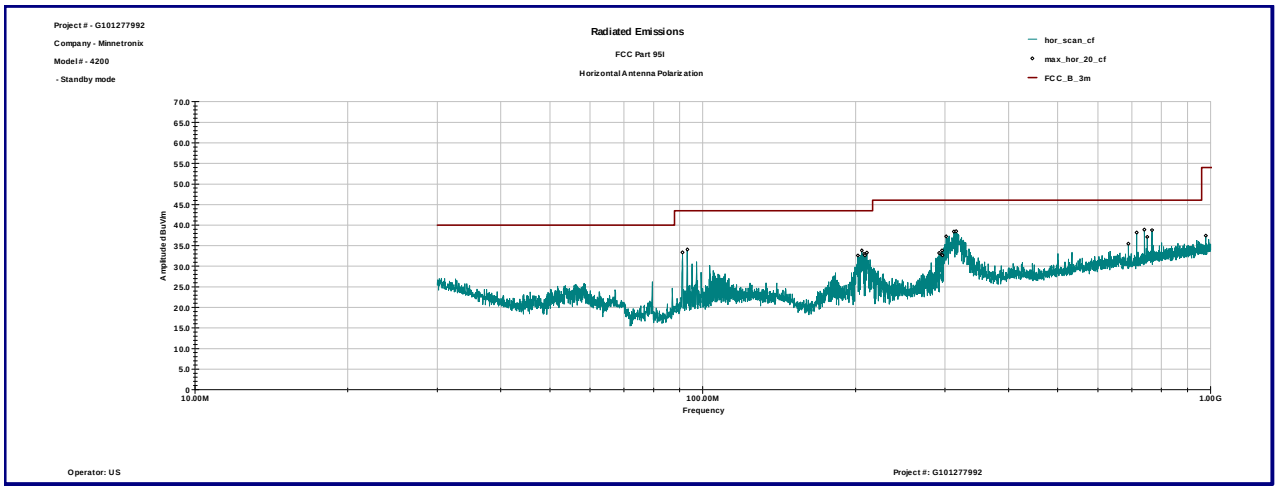
Date:	September 20, 2013	**Result:** **Pass**
Standard:	FCC Part 15.109, Class B	
Tested by:	Uri Spector	
Test Point:	Enclosure	
Operation mode:	Standby/Receiving mode	
Note:	No radiated spurious emissions were detected above 1GHz (see Graph 3.6.2).	

Table 3.6.1

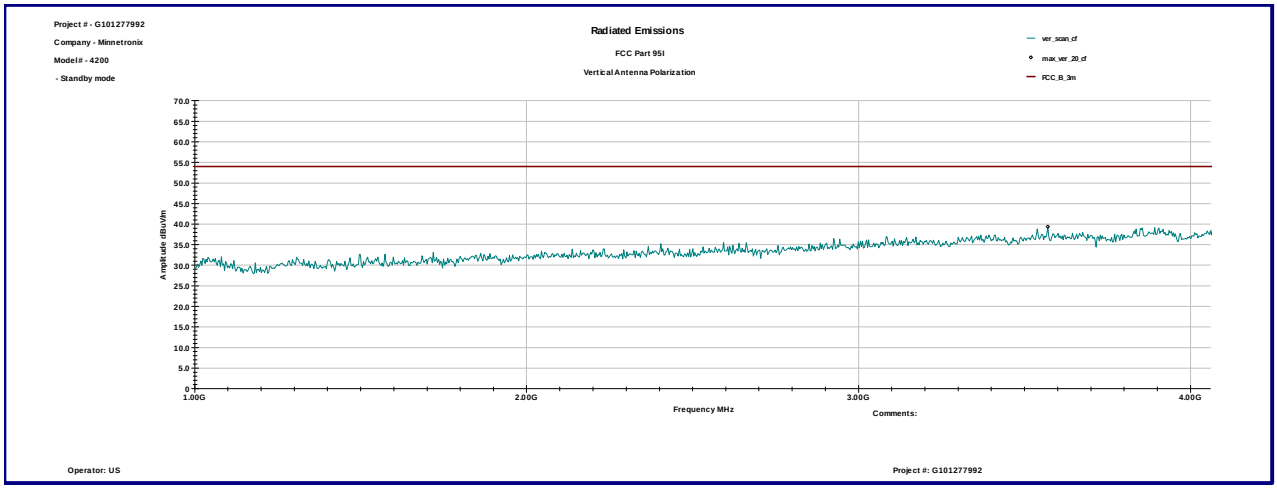
Frequency	Ant. Polarity	Peak Reading dBµV	Total C.F. dB1/m	Total at 3m dBµV/m	Limit dBµV/m	Margin dB
45.654 MHz	V	22.4	11.6	34.0	40.0	-6.0
91.27 MHz	V	24.0	10.7	34.7	43.5	-8.8
93.285 MHz	V	23.5	11.2	34.7	43.5	-8.8
109.48 MHz	V	14.6	13.5	28.1	43.5	-15.4
201.94 MHz	V	18.5	12.3	30.8	43.5	-12.8
559.06 MHz	V	13.6	21.7	35.2	46.0	-10.8
688.77 MHz	V	12.9	22.9	35.8	46.0	-10.2
714.94 MHz	V	14.2	23.0	37.1	46.0	-8.9
740.76 MHz	V	14.0	23.5	37.5	46.0	-8.5
766.93 MHz	V	13.1	23.7	36.8	46.0	-9.2
93.285 MHz	H	22.9	11.2	34.1	43.5	-9.5
205.8 MHz	H	21.5	12.3	33.8	43.5	-9.7
210.46 MHz	H	21.2	12.0	33.3	43.5	-10.3
301.39 MHz	H	21.3	16.0	37.3	46.0	-8.8
315.58 MHz	H	22.1	16.4	38.5	46.0	-7.5
714.94 MHz	H	15.3	23.0	38.2	46.0	-7.8
740.76 MHz	H	15.4	23.5	38.9	46.0	-7.1
749.96 MHz	H	13.6	23.6	37.1	46.0	-8.9
766.93 MHz	H	15.1	23.7	38.8	46.0	-7.2

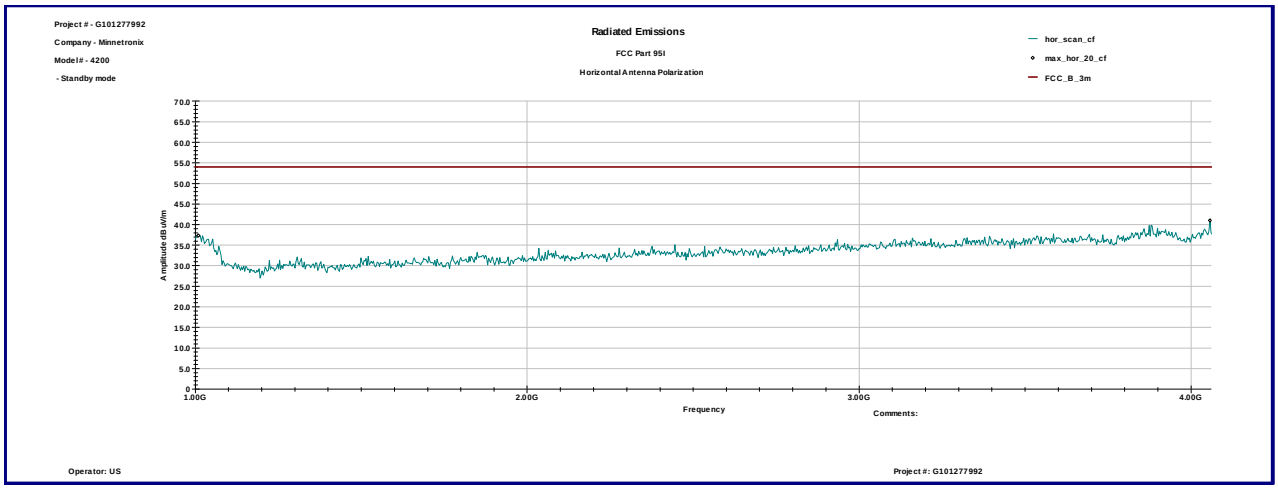
Graph 3.6.1


Project # - G101277992
Company - Minnetronix
Model # - 4200
- Standby mode
Radiated Emissions
FCC Part 95I
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
10.0M
100.0M
1.0G
Frequency MHz
Operator: US
Project #: G101277992


Project # - G101277992
Company - Minnetronix
Model # - 4200
- Standby mode
Radiated Emissions
FCC Part 95I
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
10.00M
100.00M
1.00G
Frequency
Operator: US
Project #: G101277992

Graph 3.6.2


Project # - G101277992
Company - Minnetronix
Model# - 4200
- Standby mode
Radiated Emissions
FCC Part 95I
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
1.00G
2.00G
3.00G
4.00G
Frequency MHz
Comments:
Operator: US
Project #: G101277992


Project # - G101277992
Company - Minnetronix
Model# - 4200
- Standby mode
Radiated Emissions
FCC Part 95I
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
1.00G
2.00G
3.00G
4.00G
Frequency
Comments:
Operator: US
Project #: G101277992

3.7 Digital device conducted emissions

Test location: ☐ OATS ☒ Anechoic Chamber ☐ Other

Test result: **Pass**

Frequency range: 0.15MHz-30MHz

Max. Emissions margin: 13.4dB below the limits

Notes: None

Date:	September 24, 2013	**Result:**	**Pass**
Standard:	FCC 15.107, Class B		
Tested by:	Uri Spector		
Test Point:	Power Line		
Operation mode:	Receiving mode		
Note:	None		

Table 3.7.1

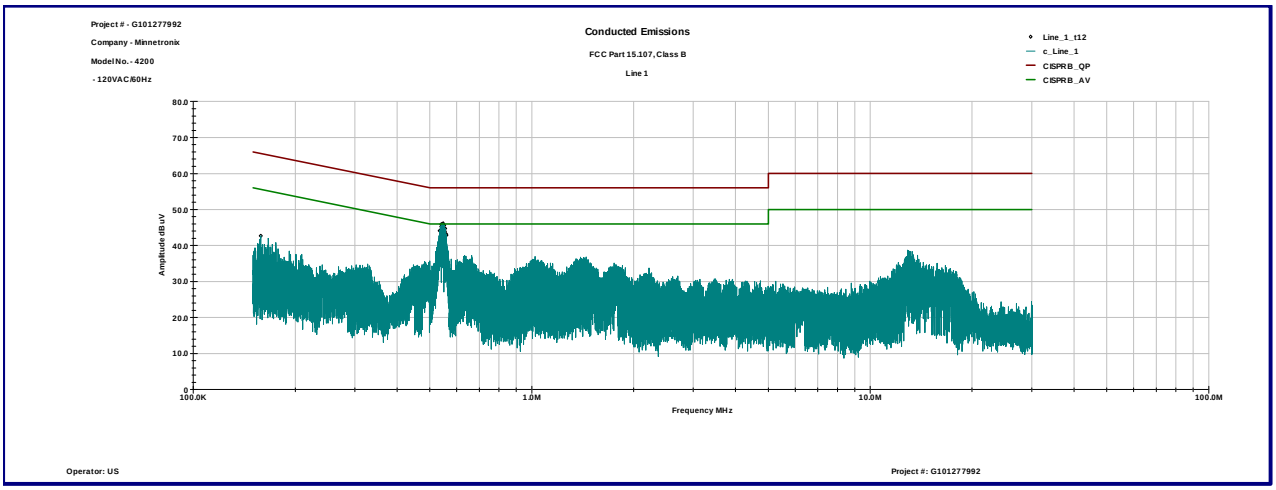
Line 1

Frequency MHz	QP dBµV	AVG dBµV	Cable Loss dB	QP Lim dBµV	AVG Lim dBµV	QP Margin dB	AVG Margin dB
0.150	33.3	17.2	0.1	66.0	56.0	-32.6	-38.7
0.310	30.6	18.5	0.1	60.0	50.0	-29.2	-31.3
0.547	42.4	31.0	0.2	56.0	46.0	-13.4	-14.8
1.022	32.1	22.1	0.2	56.0	46.0	-23.7	-23.7
1.422	32.3	21.9	0.3	56.0	46.0	-23.4	-23.8
13.160	31.9	20.8	0.9	60.0	50.0	-27.2	-28.3

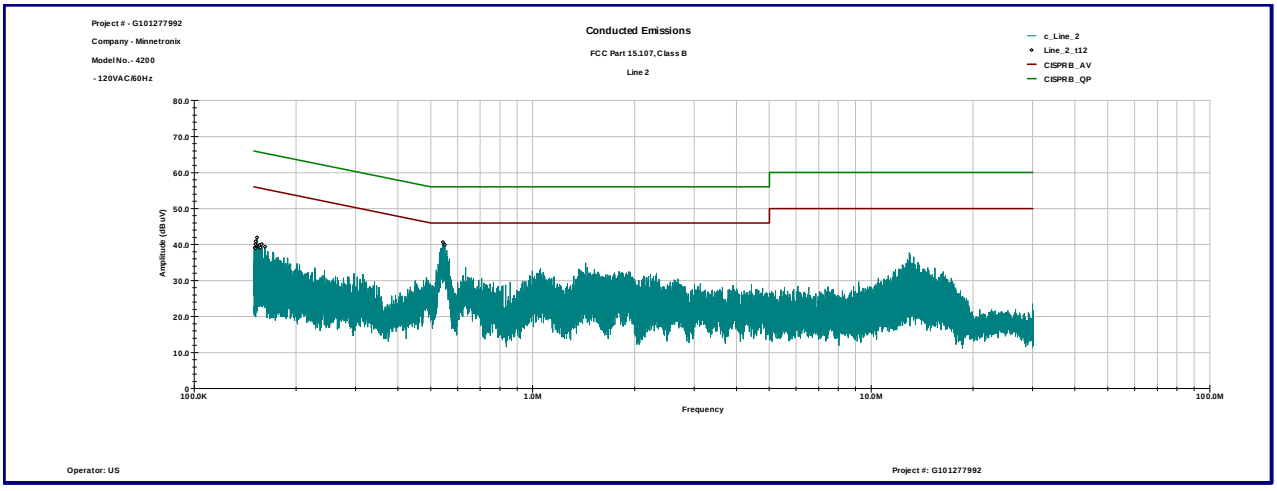
Line 2

Frequency MHz	QP dBµV	AVG dBµV	Cable Loss dB	QP Lim dBµV	AVG Lim dBµV	QP Margin dB	AVG Margin dB
0.150	33.9	17.5	0.1	66.0	56.0	-32.0	-38.4
0.550	17.1	10.3	0.2	56.0	46.0	-38.7	-35.5
1.049	25.0	17.3	0.2	56.0	46.0	-30.8	-28.5
1.433	26.7	19.4	0.3	56.0	46.0	-29.0	-26.3
2.323	25.3	15.4	0.4	56.0	46.0	-30.3	-30.2
12.945	29.6	17.6	0.9	60.0	50.0	-29.5	-31.5

Graph 3.7.1



Graph 3.7.2



4.0 TEST EQUIPMENT

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	INTERTEK ID	CAL DUE	USED
Spectrum Analyzer	R & S	ESU	100398	25283	12/19/2013	☒
Spectrum Analyzer	R & S	FSP 40	100024	12559	11/29/2013	☒
Bicono-Log Antenna	Schaffner-Teseq	CBL6112B	2468	9734	11/30/2013	☒
Horn Antenna	EMCO	3115	6579	15580	07/18/2014	☒
LISN	Fischer Custom Communications	FCC-LISN-50-25-2	2014	9665	04/23/2014	☒
System	Quantum Change	TILE! Instrument Control	Ver. 3.4.K.29	15259	VBU	☒
Pre-Amplifier	MITEQ	AMF-5D-00501800-28-13P	1122951	13475	11/01/2013	☒
Environmental Chamber	ESPEC	ESX-4CA	0111386	24300	04/11/2014	☒
Power Splitter	Mini-Circuits	ZSC-2-4	F221200749		VBU	☒
Signal Generator	R & S	SMT 03	DE12157	9950	11/30/2013	☒
Signal Generator	HP	E4433B ESG-D series	US38440484	Rented	09/24/2014	☒