EMISSIONS TEST REPORT

Report Number: 3094944BOX.001
Project Number: 3094944

Testing performed on the

SupraCor Console

Model: 0036-0010

To

FCC Part 15 Subpart C 15.225

For

Abiomed

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	Abiomed
70 Codman Hill Road	22 Cherry Hill Drive
Boxborough, MA 01719	Danvers, MA 01923

Prepared by: _____ Date: 3/31/06
Nicholas Abbondante

Reviewed by: _____ Date: 03-31-06
Jeff Goulet

1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company:	Abiomed 22 Cherry Hill Drive Danvers, MA 01923
Contact:	Ralph D'Ambrosio
Telephone:	978-646-1709
Fax:	978-777-5692
Email:	rdambrosio@abiomed.com

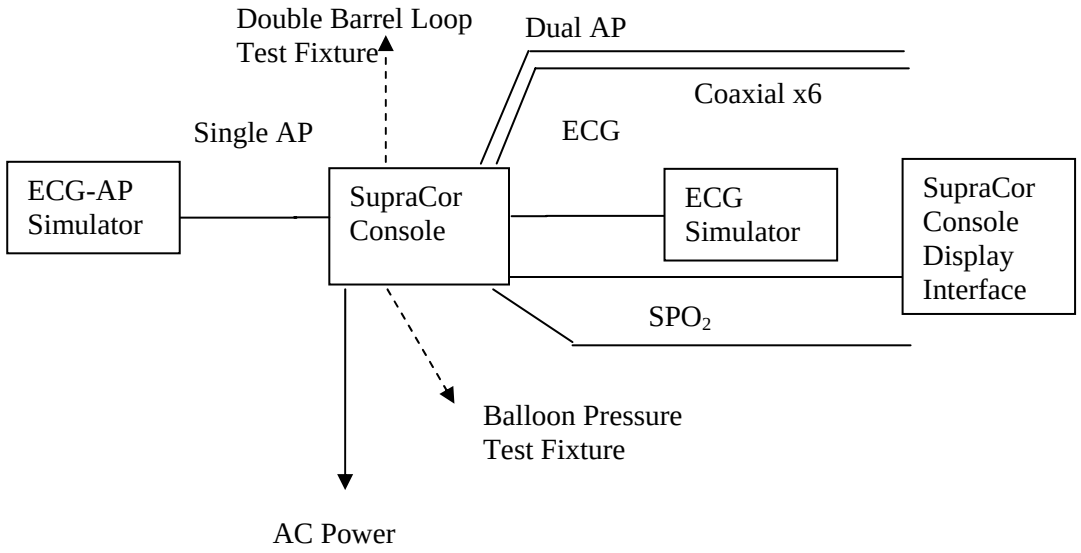
1.2 Equipment Under Test

Equipment Type:	SupraCor Console
Model Number(s):	0036-0010
Serial number(s):	SC0101
Manufacturer:	Abiomed
EUT receive date:	3/13/2006
EUT received condition:	Prototype in good condition
Test start date:	3/13/2006
Test end date:	3/20/2006

1.3 Test Plan Reference: Tested according to the standards listed and ANSI C63.4:2003.

1.4 Test Configuration

1.4.1 Block Diagram



1.4.2. Cables:

Cable	Shielding	Connector	Length (m)	Qty.
Coaxial Cables	Coaxial	Metal/BNC	1.5	6
SPO_2 Cable	None	Plastic	3	1
ECG Cable	None	Plastic	4.2	1
Dual AP Cable	None	Plastic	3.3	1
Single AP Cable	None	Plastic	3.3	1
AC Power Cable	None	Plastic	3	1

1.4.3. Support Equipment:

Name: Balloon Pressure Test Fixture
Model No.: N/L
Serial No.: N/L

Name: Double Barrel Loop Test Fixture
Model No.: N/L
Serial No.: N/L

Name: Netech ECG Patient Simulator
Model No.: MiniSim
Serial No.: 9413 & 9414

1.5 Mode(s) of Operation:

During testing, the RFID was transmitting repeatedly as it normally would during system operation. The EUT was tested as a floor-standing device. The SupraCor Console includes a display/interface which is hardwired as part of the console. Since the display/interface can be unclipped from the SupraCor Console main chassis and placed on a table with the interconnecting wiring extended, it was tested in this fashion. During the radiated emissions testing, only the transmitter was active in the EUT chassis. During the line-conducted emissions testing, the ECG, AP, Balloon Pump, and Ventricular Assist modes of the associated digital device were active.

1.6 Modifications Required for Compliance:

A Wurth Elektronik ferrite, part number 74271132, was placed in a double loop configuration on the power and data line to the RF module (at the RF module).

2.0 Test Summary

TEST STANDARD	RESULTS	
FCC Part 15 Subpart C 15.225		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
RF Output Power and Radiated Emissions FCC 15.205, 15.209, 15.225	RF Output Power is subject to the limits set forth in FCC Part 15.225, Spurious Emissions up to the tenth harmonic and in restricted bands are subject to the limits set forth in FCC Part 15.209. Spurious emissions must not exceed the fundamental field strength.	Pass
Frequency Stability FCC 15.225	The frequency drift of the carrier frequency must not exceed ±0.01% (100 PPM).	Pass
Line-Conducted Emissions FCC 15.207	Emissions must be below the 15.207 limits.	Pass

Notes: The RFID transmits at 13.56 MHz.

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	Description of Change

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m, ±3.8 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

The expanded uncertainty (k = 2) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

±3.2 for ISN and voltage probe measurements
±3.1 for current probe measurements

3.2 Site Description

Test Site(s): 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

The EMC Lab has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Test Results: Pass

Test Standard: FCC Part 15 Subpart C 15.205, 15.209, 15.225

Test: RF Output Power and Radiated Emissions

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	Yes		Equipment under Test:		SupraCor Console	

Maximum Test Disturbance Parameters: RF Output Power is subject to the limits set forth in FCC Part 15.225, Spurious Emissions up to the tenth harmonic and in restricted bands are subject to the limits set forth in FCC Part 15.209. Spurious emissions must not exceed the fundamental field strength.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	EMI Receiver Set W/RF Filter	Hewlett Packard	8542E	3520A00125	02/28/2007
3	RF FILTER	Hewlett Packard	85420E	3427A00126	02/28/2007
4	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	12/08/2006
5	ANTENNA	EMCO	3142	9701-1116	11/10/2006
6	Cable, BNC - BNC, 15' long	Belden	RG-58/U	CBL022	01/03/2007
7	LOOP ANTENNA	Empire	LP-105	905	08/15/2006
8	10 Meter in floor cable for site 2	ITS	RG214B/U	S2 10M FLR	09/02/2006

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	1/16/06 Revision

Test Results:

Notes: Limit has been extrapolated to 3 meters from the specified 30 meters. This has been done to facilitate comparison between the readings below 30 MHz to the readings above 30 MHz in order to demonstrate that the fundamental field strength is higher than the spurious emissions field strength.

Radiated Emissions

Company: Abiomed
Model #: 0036-0010
Serial #: SC0101
Engineers: Nicholas Abbondante
Project #: 3092038
Standard: FCC Part 15 Subpart C 15.225
Receiver: R&S ESCI (ROS002)
PreAmp: NONE.
Barometer: BAR2
Location: Site 2
Date(s): 03/16/06
Limit Distance (m): 3
Test Distance (m): 3
Temp/Humidity/Pressure: 19c 25% 999 mB
PreAmp Used? (Y or N): N
Voltage/Frequency: 120V/60Hz
Frequency Range: 150 kHz - 30 MHz

Antenna & Cables: LF
LF Antenna: LOOP2-E 8-15-06.txt
N Antenna: LOG1 11-10-06 V10.ant
HF Antenna: NONE.
SHF Antenna: NONE.
LF Cable(s): CBL022 1-03-07.cbl
N Cable(s): S2 10M FLR 9-2-2006.cbl
HF Cable(s): NONE.
SHF Cable(s): NONE.

Bands: N, LF, HF, SHF
LOOP2-H 8-15-06.txt
LOG1 11-10-06 H10.ant
NONE.
NONE.
NONE.
NONE.
NONE.
NONE.

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
PK	V	13.560	13.1	41.3	0.5	0.0	0.0	54.8	124.0	-69.2	9/30 kHz
PK	V	13.552	0.7	41.3	0.5	0.0	0.0	42.4	90.5	-48.1	9/30 kHz
PK	V	13.568	8.3	41.3	0.5	0.0	0.0	50.0	90.5	-40.5	9/30 kHz
PK	V	13.409	-10.2	41.3	0.5	0.0	0.0	31.6	80.5	-48.9	9/30 kHz
PK	V	13.723	-10.0	41.3	0.5	0.0	0.0	31.7	80.5	-48.8	9/30 kHz
PK	V	27.120	7.0	40.2	0.7	0.0	0.0	47.8	69.5	-21.7	9/30 kHz
QP	V	22.600	-1.1	40.4	0.6	0.0	0.0	39.9	69.5	-29.6	9/30 kHz
QP	V	23.470	0.6	40.4	0.6	0.0	0.0	41.7	69.5	-27.8	9/30 kHz
QP	V	25.640	2.6	40.4	0.7	0.0	0.0	43.7	69.5	-25.8	9/30 kHz
QP	V	27.380	-3.2	40.1	0.7	0.0	0.0	37.6	69.5	-31.9	9/30 kHz

Tx Only Radiated Emissions

Company: Abiomed
Model #: 0036-0010
Serial #: SC0101
Engineers: Nicholas Abbondante
Project #: 3092038
Standard: FCC Part 15 Subpart C 15.225
Receiver: R&S ESCI (ROS002)
PreAmp: NONE.
Barometer: BAR2
Location: Site 2
Date(s): 03/13/06
Limit Distance (m): 3
Test Distance (m): 10
Temp/Humidity/Pressure: 20c 24% 1004 mB
PreAmp Used? (Y or N): N
Voltage/Frequency: 120V/60Hz
Frequency Range: 30 - 135.6 MHz

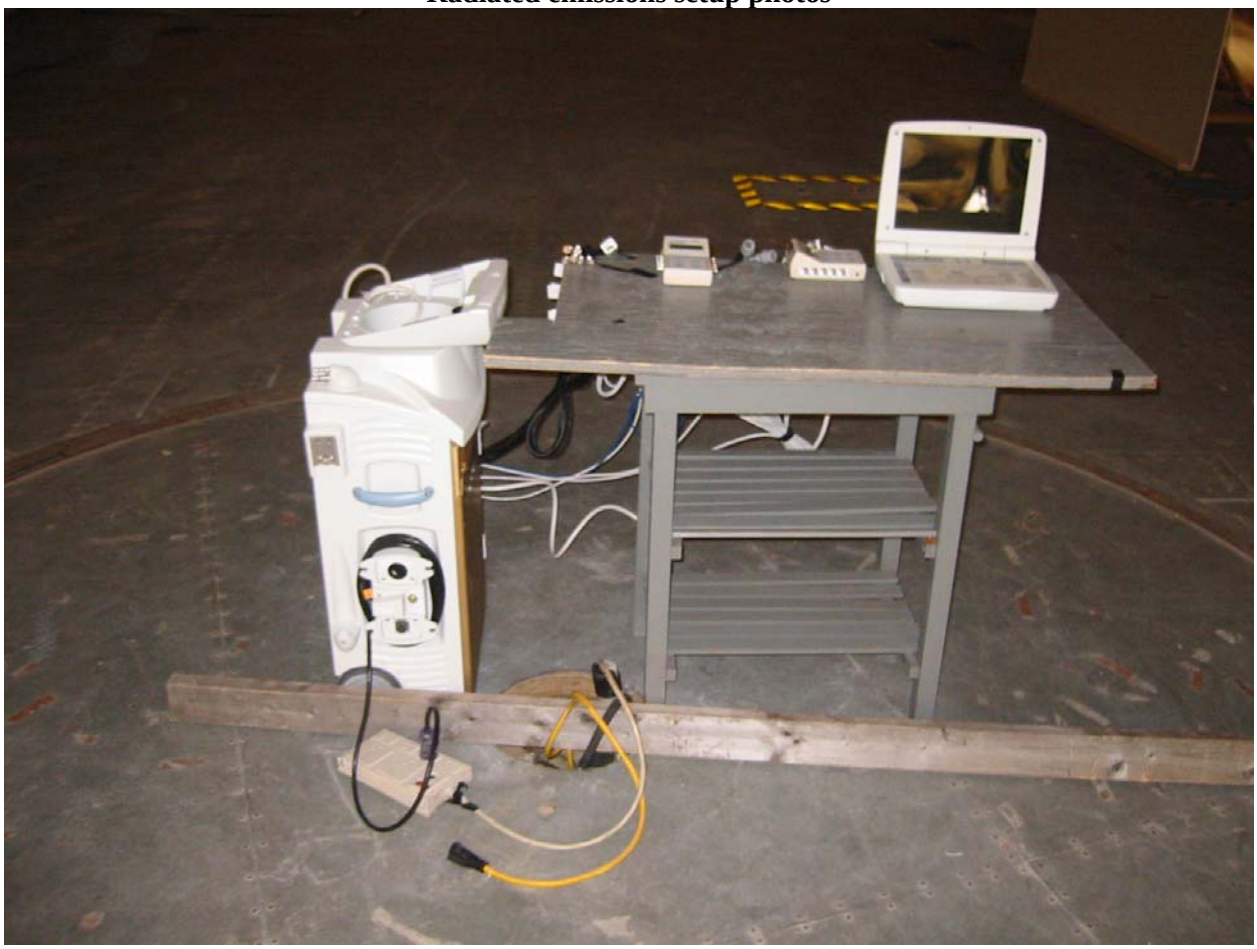
Antenna & Cables: N
LF Antenna: LOOP2-E 8-15-06.txt
N Antenna: LOG1 11-10-06 V10.ant
HF Antenna: NONE.
SHF Antenna: NONE.
LF Cable(s): CBL022 1-03-07.cbl
N Cable(s): S2 10M FLR 9-2-2006.cbl
HF Cable(s): NONE.
SHF Cable(s): NONE.

Bands: N, LF, HF, SHF
LOOP2-H 8-15-06.txt
LOG1 11-10-06 H10.ant
NONE.
NONE.
NONE.
NONE.
NONE.
NONE.

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	31.270	9.6	16.0	1.4	0.0	-10.5	37.5	40.0	-2.5	120/300 kHz
QP	V	40.700	14.1	10.7	1.5	0.0	-10.5	36.7	40.0	-3.3	120/300 kHz
QP	V	42.730	16.2	10.0	1.5	0.0	-10.5	38.1	40.0	-1.9	120/300 kHz
QP	V	53.160	19.6	6.8	1.5	0.0	-10.5	38.3	40.0	-1.7	120/300 kHz
QP	V	74.100	12.3	6.2	1.6	0.0	-10.5	30.6	40.0	-9.4	120/300 kHz
QP	V	108.500	16.6	7.8	1.8	0.0	-10.5	36.7	43.5	-6.8	120/300 kHz
QP	V	122.040	8.9	6.6	1.9	0.0	-10.5	27.9	43.5	-15.6	120/300 kHz
QP	V	135.600	13.1	6.6	2.0	0.0	-10.5	32.2	43.5	-11.3	120/300 kHz

Radiated emissions setup photos



Test Results: Pass

Test Standard: FCC Part 15 Subpart C 15.225

Test: Frequency Stability

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	N/A	Pressure (hPa):	N/A	Ambient (°C):	N/A
Pretest Verification Performed	N/A		Equipment under Test:		SupraCor Console	

Maximum Test Disturbance Parameters: The frequency drift of the carrier frequency must not exceed ±0.01% (100 PPM).

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Spectrum Analyzer	Agilent	E7405A	US40240205	08/09/2006
2	Digital Multimeter	Meterman	15XP	050407779	07/28/2006
3	Small Temperature/Humidity Chamber	Bryant Manufacturing	TH-5S	1207	04/06/2006
4	High Frequency Cable 40Ghz	Megaphase	TM40 K1K180	CBL029	12/20/2006
5	DC Power Supply, Programmable	Kepco	MBT 75-5M	F 81015	Verified

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	1/16/06 Revision

Test Details:

Frequency Stability

Company: Abiomed
Model #: 0036-0010
Serial #: SC0101
Engineer(s): Nicholas Abbondante
Project #: 3092038
Standard: FCC Part 15 Subpart C 15.225

Test Equipment Used:
AGL001 MET2 SAF187 CBL029 KEP2

Location: Safety
Date(s): 03/17/06

Limit: 100 PPM

Nominal f: 13.56 MHz

Voltage: 12 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	10.2	13.560050	0.01	1.36
+0%	12	13.560040	0	1.36
+15%	13.8	13.560045	0.005	1.36

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-20	13.559870	-0.17	1.36
-10	13.559955	-0.085	1.36
0	13.560005	-0.035	1.36
10	13.560030	-0.01	1.36
20	13.560040	0	1.36
30	13.560065	0.025	1.36
40	13.560095	0.055	1.36
50	13.560125	0.085	1.36

Test Results: Pass

Test Standard: FCC Part 15 Subpart C 15.207

Test: Line-conducted emissions

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	Yes		Equipment under Test:		SupraCor Console	

Maximum Test Disturbance Parameters: Spurious emissions on the AC line are subject to the requirements of FCC 15.207.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	LISN, 50uH, .01 - 50MHz, 24A	Solar Electronics	9252-50-R-24-BNC	941713	07/05/2007
3	EMI Receiver Set W/RF Filter	Hewlett Packard	8542E	3520A00125	02/28/2007
4	RF FILTER	Hewlett Packard	85420E	3427A00126	02/28/2007
5	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS24	08/12/2006
6	Cable, BNC - BNC, 15' long	Belden	RG-58/U	CBL022	01/03/2007

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	1/16/05 Revision

Test Results:

Conducted Emissions

Company: Abiomed
Model #: 0036-0010
Serial #: SC0101
Engineer(s): Nicholas Abbondante
Project #: 3092038 Date: 03/17/06
Standard: FCC Part 15 Subpart C 15.225
Barometer: BAR2 Temp/Humidity/Pressure: 19c 25% 1003 mB

Receiver: R&S ESCI (ROS002)
Cable: CBL022 1-03-07.cbl
LISN 1: LISN11 [1] 7-05-06.lsn
Location: Site 2 LISN 2: LISN11 [2] 7-05-06.lsn
LISN 3: NONE.
LISN 4: NONE.
Attenuator: DS24 8-12-06.txt

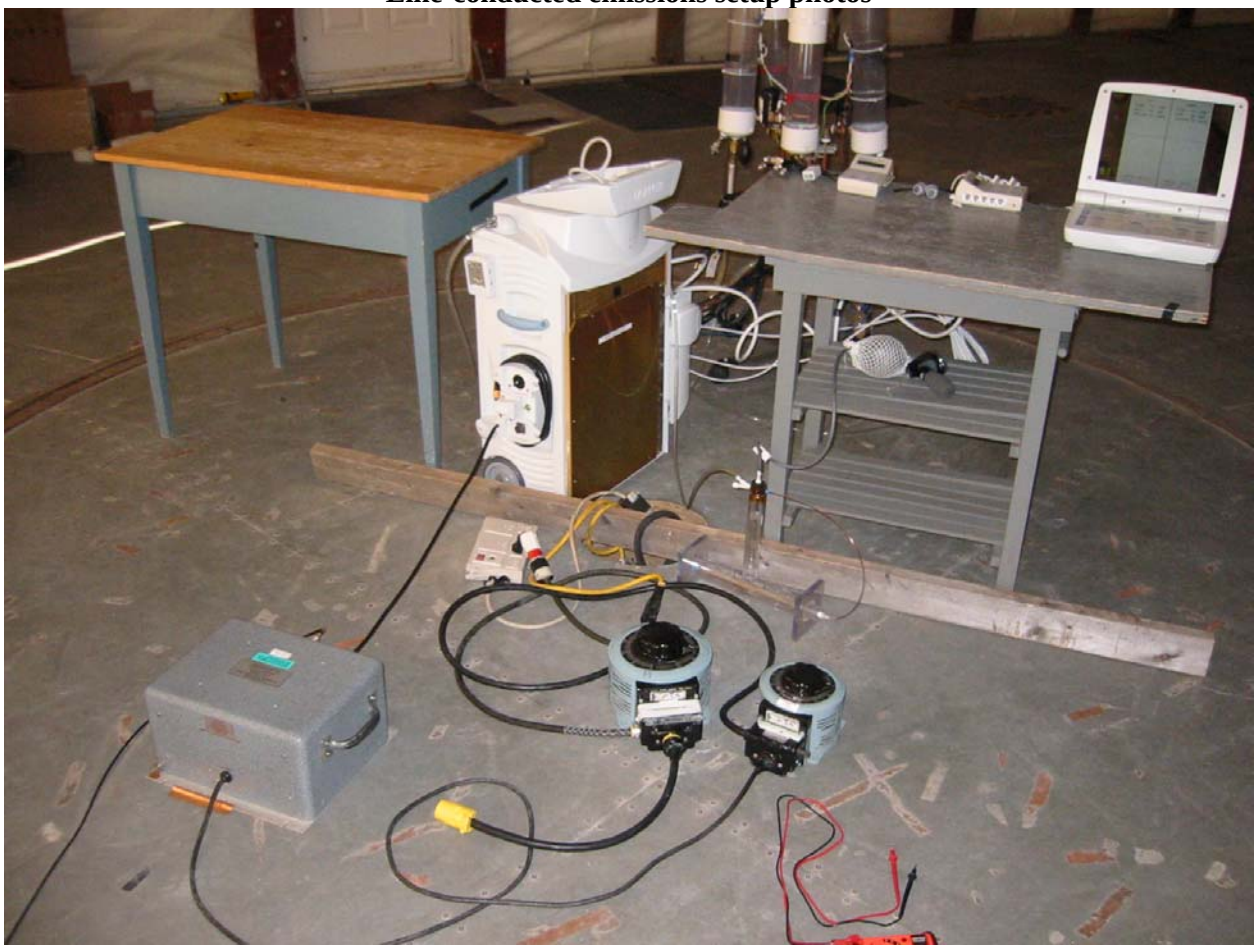
Voltage/Frequency: See Notes Frequency Range: 150 kHz - 30 MHz

Net is the sum of worst-case lisn, cable, & attenuator losses, and initial reading, factors are not shown
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
Note: Balloon Pump ECG-AP mode 100V/60Hz									
QP	0.156	28.0	28.6			49.4	65.7	-16.3	9/30 kHz
QP	0.197	23.8	24.2			45.0	63.7	-18.7	9/30 kHz
QP	0.547	-1.0	-1.3			19.9	56.0	-36.1	9/30 kHz
QP	4.133	16.0	15.3			37.0	56.0	-19.0	9/30 kHz
QP	9.840	15.4	14.0			36.7	60.0	-23.3	9/30 kHz
QP	13.560	27.1	27.0			48.4	60.0	-11.6	9/30 kHz
QP	29.850	-6.2	-8.1			15.9	60.0	-44.1	9/30 kHz
Note: Bi-vad mode 100V/60Hz									
QP	0.156	29.2	29.6			50.4	65.7	-15.3	9/30 kHz
QP	0.194	21.4	23.0			43.8	63.9	-20.1	9/30 kHz
QP	0.829	3.1	1.0			24.0	56.0	-32.0	9/30 kHz
QP	4.126	16.5	15.0			37.5	56.0	-18.5	9/30 kHz
QP	9.841	16.3	18.3			39.5	60.0	-20.5	9/30 kHz
QP	13.030	12.2	9.9			33.5	60.0	-26.5	9/30 kHz
QP	13.560	27.2	27.0			48.5	60.0	-11.5	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Line 4 dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
Note: Balloon Pump ECG-AP mode 100V/60Hz									
AVG	0.156	21.6	22.1			42.9	55.7	-12.8	9/30 kHz
AVG	0.197	19.2	18.9			40.0	53.7	-13.7	9/30 kHz
AVG	0.547	-7.2	-7.2			13.7	46.0	-32.3	9/30 kHz
AVG	4.133	14.8	14.0			35.8	46.0	-10.2	9/30 kHz
AVG	9.840	14.0	7.8			35.3	50.0	-14.7	9/30 kHz
AVG	13.560	11.2	11.1			32.5	50.0	-17.5	9/30 kHz
AVG	29.850	-13.4	-14.4			8.7	50.0	-41.3	9/30 kHz
Note: Bi-vad mode 100V/60Hz									
AVG	0.156	24.3	24.2			45.1	55.7	-10.6	9/30 kHz
AVG	0.194	17.2	17.2			38.0	53.9	-15.9	9/30 kHz
AVG	0.829	-1.7	-3.5			19.2	46.0	-26.8	9/30 kHz
AVG	4.126	14.3	14.0			35.3	46.0	-10.7	9/30 kHz
AVG	9.841	15.5	11.1			36.8	50.0	-13.2	9/30 kHz
AVG	13.030	2.2	-1.3			23.5	50.0	-26.5	9/30 kHz
AVG	13.560	11.7	11.3			33.0	50.0	-17.0	9/30 kHz

Line-conducted emissions setup photos



Line-Conducted Emissions, Front View, Ventricular Assist Mode

Line-Conducted Emissions, Back View, Ventricular Assist Mode

Line-Conducted Emissions, Front View, Balloon Pump Mode

Line-Conducted Emissions, Back View, Balloon Pump Mode