Intertek ETL SEMKO

August 10, 2004

Mr. Charles Kolifrath
Abiomed
22 Cherry Hill Drive
Danvers, MA 01923

Dear Mr. Kolifrath,

Enclosed you will find our emissions reports covering testing on the Hand Held Alarm Monitor, Model 0034-4590. Testing was performed from April 13, 2004.

If there are any questions regarding this report, please contact the undersigned or your account representative.

Sincerely,

Michael F. Murphy
Staff Engineer, EMC

Enclosure

Intertek ETL SEMKO

Emissions Testing
Performed
on the
Abiomed
Hand Held Alarm Monitor
Model No.: 0034-4590
Serial No.: EE072303129

To

FCC Part 15, Subpart C, Section 15.249

Date(s) of Test: April 13, 2004

Report Number: 3056512

Contact: Mr. Charles Kolifrath

Table of Contents

I – Introduction and Summary

TO: Mr. Charles Kolifrath
FROM: Kouma Sinn, Senior Project Engineer
DATE: August 6, 2004
Project #: 3056512

RE: Emissions Testing Performed on the Hand Held Alarm Monitor, Model: 0034-4590

On April 13, 2004, we tested the Hand Held Alarm Monitor, Model: 0034-4590 to determine if it was in compliance with the FCC Part 15, Subpart C, Section 15.249. A prototype version of the sample was received on April 13, 2004 in good condition. We found that the unit met the Part 15, Subpart C requirements when tested as received.

The following table summarizes the results of testing.

Test	Frequency (MHz)	Measurement	Requirement	Pass/Fail	Section of FCC Rules	Section of Test Report
Fundamental Field Strength	916.680	88.0 dBµV/m	94.0 dBµV/m	Pass	15.249	Table 1
Restricted Band & Spurious Emissions	6416.770	51.0 dBµV/m	54.0 dBµV/m	Pass	15.209	Table 1
Line-Conducted Emissions	0.831	38.9 dBµV	46.0 dBµV	Pass	15.107	Table 2

In summary, this report confirms that the Hand Held Alarm Monitor, Model: 0034-4590 is compliant with the FCC Part 15, Subpart C, Section 15.249 requirements when production units conform to the sample tested. Please address all questions and comments concerning this report to Jeff Goulet, EMC Team Leader.

II – Technical Requirements

15.1 Scope

The device is an intentional radiator intended to operate in accordance with 15. 249 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz. This device operates at 916.6 MHz.

15.15 General Technical Requirements

There are no controls accessible to the user that would cause the device to operate in violation of the FCC rules.

15.27 Special Accessories

No special accessories are necessary to meet compliance requirements.

15.31 Measurement Standards

The measurement procedures specified by ANSI C63.4:2001 were used to setup and test the device. See Section IV of this test report for detailed description of the test procedure.

The unit was tested as a standalone.

15.33 Frequency range of measurement

The device was scanned for spurious and harmonic emissions from 30 MHz to the 10^{th} harmonic of the fundamental frequency. The spurious emission scan from 30-1000MHz is addressed in a separate report.

15.35 Measurement detector functions and bandwidth

The following table illustrates the detector functions and bandwidth used to test the device.

After measuring the fundamental with a 120kHz RBW, the bandwidth was reduced to the lowest possible without desensitizing the analyzer (30kHz). All harmonics were investigated using this reduced RBW. If any harmonics were found, the RBW would have been increased to ensure that no desensitization of the analyzer was occurring. There were no harmonics detected, so all harmonic frequencies reflected in Table 1 are that of the measuring equipment noise floor; with 0dB Input Attenuation, and 30kHz RBW.

Frequency Range	Measurement Detector	Measurement Bandwidth
30 MHz - 1 GHz	Quasi-peak	120kHz
916.6 MHz	Peak	120kHz
1 GHz to 10th harmonic	Peak	30kHz (noise floor)

An averaging factor was not used for the device because peak measurements passed the specified limits.

15.37 Transition Provisions

Transition provisions were not applied to the device.

15.105 Information to the user

(b) For a Class B digital device peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

--Reorient or relocate the receiving antenna.
--Increase the separation between the equipment and receiver
--Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
--Consult the dealer or an experienced radio/TV technician for help.

15.107 Conducted limits.

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line shall not exceed the following. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

Frequency of Conducted Emission Limit – Class B

Frequency (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*Limits decrease linearly with the logarithm of the frequency.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 KHz to 30 MHz shall not exceed the limits in the following table. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency of Conducted Emission Limit – Class A

Frequency (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	79	66
0.5 to 30	73	60

The following option may be employed if the conducted emissions exceed the limits in paragraph (a) or (b) of this Section, as appropriate, when measured using instrumentation employing a quasi-peak detector function: if the level of the emission measured using the quasi-peak instrumentation is 6 dB, or more, higher than the level of the same emission measured with instrumentation having an average detector and a 9 kHz minimum bandwidth, that emission is considered broadband and the level obtained with the quasi-peak detector may be reduced by 13 dB for comparison to the limits. When employing this option, the following conditions shall be observed:

(1) The measuring instrumentation with the average detector shall employ a linear IF amplifier.

(2) Care must be taken not to exceed the dynamic range of the measuring instrument when measuring an emission with a low duty cycle.

(3) The test report required for verification or for an application for a grant of equipment authorization shall contain all details supporting the use of this option.

Summary of Test Results

Quasi-peak readings compare to quasi-peak limits					
Frequency (MHz)	**Reading Line (dBμV)**	**Reading Neutral (dBμV)**	**Net Reading (dBμV)**	**Limits (dBμV)**	**Margin (dB)**
0.209	20.1	14.0	42.5	63.2	-20.8
0.417	16.8	13	38.3	57.5	-19.2
0.831	21.0	20.0	41.9	56.0	-14.1
2.180	15.0	13.0	35.6	56.0	-20.4
5.400	12.0	9.0	32.6	60.0	-27.4
13.830	10.0	7.0	31.0	60.0	-29.0

Average readings compare to average limits					
Frequency (MHz)	**Reading Line (dBμV)**	**Reading Neutral (dBμV)**	**Net Reading (dBμV)**	**Limits (dBμV)**	**Margin (dB)**
0.209	15.1	10.0	37.5	53.2	-15.8
0.417	13.4	8.0	34.9	47.5	-12.6
0.831	18.0	17.0	38.9	46.0	-7.1
2.180	11.0	7.0	31.6	46.0	-14.4
5.400	8.0	4.0	28.6	50.0	-21.4
13.830	4.0	1.0	25.0	50.0	-25.0

Notes: Net readings include cable loss, insertion loss, and 20 dB attenuator.

15.109 Radiated emission limits.

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of Emission Radiated Limit – Class B

Frequency (MHz)	**Limit (μV/m)**	**Limit (dBμV/m)**
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

The field strength of radiated in the emission tables above, the tighter limit applies at the band edges. Sections 15.33 and 15.35 which specify the frequency range over which radiated emissions are to be measured and the detector functions and other measurement standards apply.

For a receiver which employs terminals for the connection of an external receiving antenna, the receiver shall be tested to demonstrate compliance with the provisions of this Section with an antenna connected to the antenna terminals unless the antenna conducted power is measured as specified in Section 15.111(a). If a permanently attached receiving antenna is used, the receiver shall be tested to demonstrate compliance with the provisions of this Section.

Summary of Test Results

Class	Configuration	Frequency (MHz)	Measurement (dBμV)	Measurement (μV)	Limit (μV)	Pass/ Fail
The device is not a receiver						

15.111 Antenna power conduction limits for receivers.

In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of Section 15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: with the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for
the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in Section 15.33 shall not exceed 2.0 nanowatts.

Summary of Test Results

Configuration	Frequency (MHz)	Measurement (dBμV)	Measurement (μV)	Limit (μV)	Pass/Fail
The device does not have the ability to connect to an external antenna. Measurements were not performed.					

15.201 Certification

The device is required to be certified in accordance with Part 2 of the FCC rules, Subpart J.

15.203 Antenna Requirements

The antennas are soldered to the PC board and cannot be readily removed from the device. The device itself is a closed plastic container that the user would not open to service.

15.204 External Radio Amplifier

The device is not an amplifier.

15.205 Restricted bands of operation

The attenuation required by 15.249 is greater than the general requirements of 15.209. All un-wanted emissions, from the transmitter, were compared to the general limits which are the requirement for restricted band emissions.

Below 1000 MHz a quasi peak detector was employed to measure all un-wanted emissions.

15.207 Conducted limits

All line-conducted emissions from the transmitter were compared to 15.107.

15.209 Radiated emission limits, general requirements

All un-wanted emissions from the transmitter were compared to the general requirements.

Detailed Description of Operation

The EUT was transmitting at 916.6 MHz during testing.

Test Method Justifications

For maximizing emissions, the system was rotated through 360 degrees, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed.

The EUT was mounted on a non-conductive box to allow the engineer to manipulate the EUT in the three orthogonal axes.

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C63.4 (2001).

The arrangement of the cables dangling from the rear of the table was varied to the extent possible to produce the maximum emissions.

15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875MHz, and 24.0-24.25 GHz

The field strength of emissions from this device shall comply with following:

Fundamental Frequency	Fundamental Field Strength		Harmonics Field Strength	
(MHz)	(mV)/m	(dBμV)/m	(μV)/m	(dBμV)/m
902-928	50	94	500	54

The emission requirement for harmonic emission is identical to the general requirement of 15.209. Spurious emission measurements were compared to the general requirement of 15.209.

The fundamental emission was measured with a peak detector. For above 1000 MHz, measurements were made with a peak detector.

III - Attestation

LABORATORY MEASUREMENTS

Pursuant To
Part 15, Subpart C
For
Intentional Radiators

Company Name: Abiomed
Address: 22 Cherry Hill Drive
Danvers, MA 01923

Model No.: 0034-4590

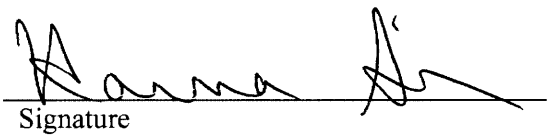
Serial No.: EE072303129

Date(s) of Test: April 13, 2004

Test Site Location: INTERTEK TESTING SERVICES NA INC.
70 Codman Hill Road
Boxborough, MA 01719

Site(s): 2C

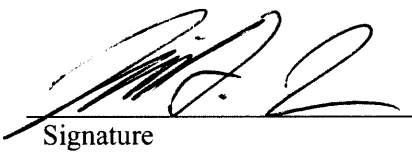
We attest to the accuracy of this report:



Signature

Kouma Sinn
Testing Performed By:

Senior Project Engineer
Title



Signature

Michael F. Murphy
Reviewer

Staff Engineer/EMC
Title

IV - Site Description

Introduction

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

A. **Test Set-Up**: The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (2001).

1. The test site is a Plastic/Fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (2001). Information on the site has been filed with the FCC as required by Rule 2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.

2. Power to the site is nominal line voltage of 117 V_{AC} and 230 V_{AC}, 60 Hz.

3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and 80 cm high above the groundplane. During the radiated emissions test, the turntable is rotated 360 degrees and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters. Body-worn, hand-held and small portable devices are mounted on a non-conductive box and emissions are investigated on three orthogonal axis.

4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

   Averaging Factor in dB = 20 LOG (duty cycle)

   The time period over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 465 Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

5. Antennas used below 1000 MHz was EMCO Model 3142 Biconolog Antennas. For measurements between 1000 MHz and 18000 MHz, an EMCO Model: 3115 Horn Antenna is used. The Antennas used are listed in the Test Equipment Summary in Section 5
6. The field strength measuring equipment used included:

V - Measurement Equipment

The following equipment was used to make measurements for emissions testing:

Description	Manufacturer	Model	Serial #	Cal Due
Spectrum Analyzer	Agilent	E7405A	US40240205	07/02/2004
Horn Antenna	EMCO	3115	9602-4675	09/03/2004
High Frequency cable	Megaphase	PM40 K1K1 197	CBL028	11/11/2004
30' BNC Cable	Alpha Wire (ITS)	RG 58A/U	CBL10MS3	07/15/2004
3M In Floor Cable	Alpha Wire (ITS)	RG 214/U	3M In Floor	09/22/2004
Antenna	EMCO	3142	9711-1223	11/05/2004
20 dB Attenuator	Mini-Circuit	CAT-20	DS25A	07/08/2004
LISN11	Solar Electronics	9252-50-R-24-BNC	941714	07/22/2004

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 150 kHz to 30 MHz.

8. The EUT is warmed up for 15 minutes prior to the test. If battery powered, a new battery is used.

9. Conducted measurements were made as described in ANSI C63.4 (2001). An IF bandwidth of 9 kHz is used, and peak or quasi-peak detection is employed.

10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report. Above 1000 MHz, a bandwidth of 1 MHz is used.

11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

VI - Configuration Information

Equipment Under Test: Hand Held Alarm Monitor

Model: 0034-4590

Serial No.: EE072303129

FCC Identifier: Not Labeled

Support Equipment:

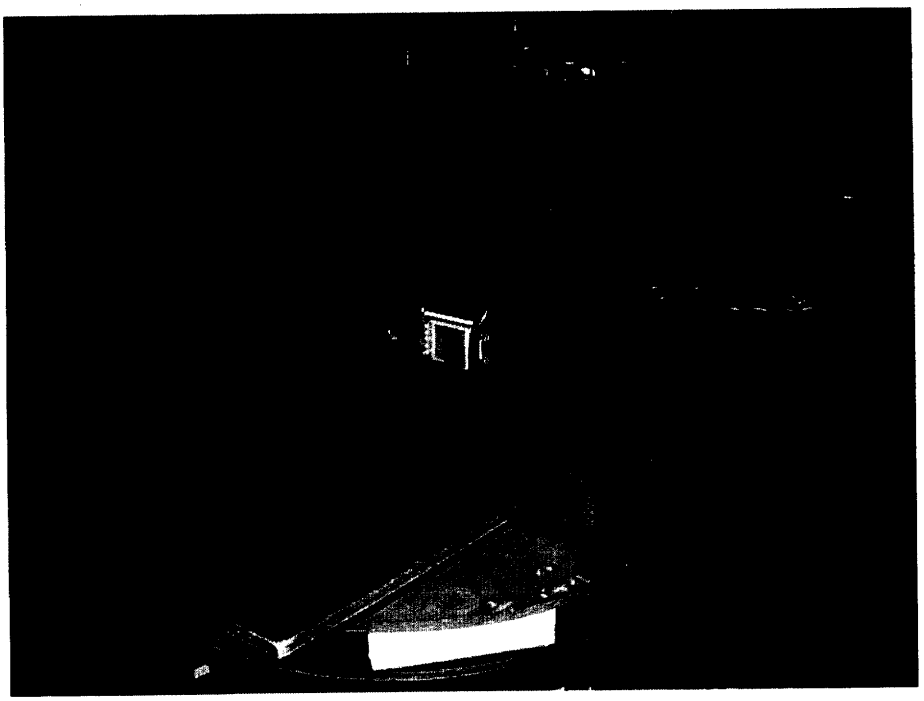
None

Cables:

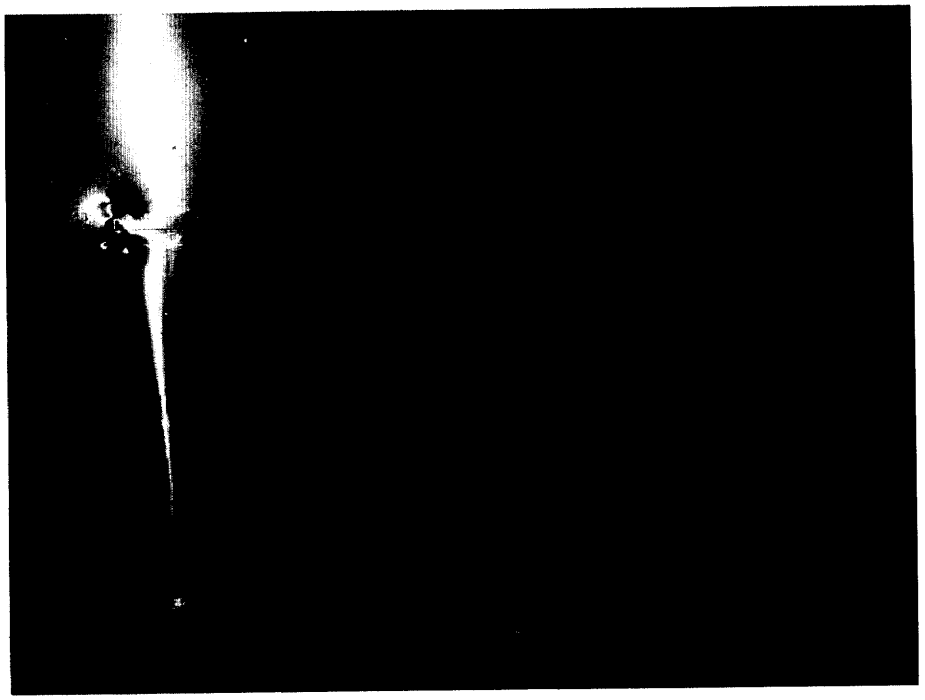
QTY	Description	Shield Description	Hood Description	Length (m)
1	Power Cable	Unshielded	Plastic	3.0

VII - Configuration Photographs

Worst-Case Radiated Emissions



Worst-Case Line-Conducted Emissions



VIII - Sample Calculation

The following is how net field strength readings were determined:

NF = RF + AF + CF + PF + DF

Where,

NF = Net Reading in dBμV/m
RF = Reading from receiver in dBμV/m
AF = Antenna Correction Factor in dB
CF = Cable Correction Factor in dB
PF = Preamplifier Correction Factor in dB
DF = Distance Factor in dB (using 20 dB/decade), from 3 to 1 meters 10.5 dB was added for measurements performed at 1 meter
AVF = Average Factor derived from the Duty Cycle

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

$UF = 10^{(NF / 20)}$

Where,

UF = Net Reading in μV/m

Example:

For the fundamental field strength measurement at 906.0 (distance = 3 meters) see table [1].

NF = RF + AF + CF + PF + DF = 57.5 + 24.0 + 4.0 + 0.0 + AVF = 81.3

$UF = 10^{(81.3 dB\mu V / 20)} =$ 11,614.5 μV/m

IX - Data Tables

Table 1

Date: 04/13/04 Temp: 20 C Antenna: HORN2 - 917MHz-9.17GHz and LOG2 - 916.680MHz
Standard: FCC Part 15.249 Humidity: 37% PreAmp: None
Class: None Group: None Cable(s): Site2, 3M Floor 3-22-04.cbl None
Limit Distance: 3 meters Test Distance: 3 meters
Voltage/Frequency: 120VAC 60Hz Frequency Range: 917MHz - 9.17GHz
Note: Mains Power and Battery Power resulted in the same emissions levels

	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)	Ave Limit dB(uV/m)	Margin dB
	H	916.680	62.7	24.0	1.2	0.0	0.0	88.0	94.0	-6.0
NF	H	1833.600	12.0	27.2	2.0	0.0	0.0	31.2	54.0	-22.8
NF	H	2750.040	12.0	29.7	2.9	0.0	0.0	44.5	54.0	-9.5
NF	H	3666.730	10.0	32.2	3.9	0.0	0.0	46.1	54.0	-7.9
NF	H	4583.400	9.0	33.0	4.8	0.0	0.0	46.8	54.0	-7.2
NF	H	5500.090	9.0	34.7	5.8	0.0	0.0	49.5	54.0	-4.5
NF	H	6416.770	9.0	35.2	6.7	0.0	0.0	51.0	54.0	-3.0
NF	H	7333.450	4.0	37.0	7.7	0.0	0.0	48.7	54.0	-5.3
NF	H	8250.130	3.0	37.7	8.7	0.0	0.0	49.3	54.0	-4.7
NF	H	9166.800	2.0	38.2	9.6	0.0	0.0	49.8	54.0	-4.2

NF = Noise Floor Reading, No Harmonics Detected

Table 2

Table 2

Conducted Emissions / Interference

Company: Abiomed
Engineer: MFM
Project #: 3056512
Date: 04/13/04
Standard: FCC Part 15.249
Class: None
Group: None
Preamp: None
Voltage/Frequency: 120VAC 60Hz

Location: Site 2
Pressure: 1011mbar
Temp: 20 C
Humidity: 36%

Model #: 0034-4590
Serial #: EE072303129
Receiver: Agilent E7405A
Cable: CBL10MS3 7-15-04.cbl
LISN 1, 2: LISN11 [1] 5-29-04.lsn None
LISN 3, N: None LISN11 [2] 5-29-04.lsn
Attenuator: DS25A 7-08-04.att
Frequency Range: 0.15 to 30MHz

Net is the sum of worst-case lisn, cable, & attenuator losses, preamp gain, and initial reading

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Quasi-Peak Net dB(uV)	Quasi-Peak Limit dB(uV)	Quasi-Peak Margin dB
0.209	20.1	N/A	N/A	14.0	42.5	63.2	-20.8
0.417	16.8	N/A	N/A	13.0	38.3	57.5	-19.2
0.831	21.0	N/A	N/A	20.0	41.9	56.0	-14.1
2.180	15.0	N/A	N/A	13.0	35.6	56.0	-20.4
5.400	12.0	N/A	N/A	9.0	32.6	60.0	-27.4
13.830	10.0	N/A	N/A	7.0	31.0	60.0	-29.0

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Average Net dB(uV)	Average Limit dB(uV)	Average Margin dB
0.209	15.1	N/A	N/A	10.0	37.5	53.2	-15.8
0.417	13.4	N/A	N/A	8.0	34.9	47.5	-12.6
0.831	18.0	N/A	N/A	17.0	38.9	46.0	-7.1
2.180	11.0	N/A	N/A	7.0	31.6	46.0	-14.4
5.400	8.0	N/A	N/A	4.0	28.6	50.0	-21.4
13.830	4.0	N/A	N/A	1.0	25.0	50.0	-25.0

X - Duty Cycle (Average Factor)

Average factor is subtracted from peak readings to compare emissions readings to average limits. The average factor is calculated from duty cycle measurements from the following plots.

N/A-Average factor was not used since peak measurements passed the specified limits.

XI - Bandwidth

The following plot(s) show bandwidth measurements made. The Bandwidth is the 99% power.

Not Applicable