

MEASUREMENT AND TECHNICAL REPORT

CARDIONET
 510 Market Street
 San Diego, CA 92101

DATE: 15 April 2002

This Report Concerns:	<input type="checkbox"/> Original Grant: X	<input type="checkbox"/> Class II Change:
Equipment Type:	Cardionet ECG Monitor with Arrhythmia Detection, Model 1001	
Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?	<input type="checkbox"/> Yes: Defer until:	<input type="checkbox"/> No: X
<i>Company Name</i> agrees to notify the Commission by: <input type="checkbox"/> N/A of the intended date of announcement of the product so that the grant can be issued on that date.		
Transition Rules Request per 15.37?	<input type="checkbox"/> Yes:	<input type="checkbox"/> *No: X
(*) FCC Part 2, Paragraph 2.1053(a); Part 22, Paragraph 22.917		
<i>Report Prepared by:</i> TÜV PRODUCT SERVICE 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 546 3999 Fax: 858 546 0364		

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1 GENERAL INFORMATION

1.1 Product Description (Ambulatory ECG Monitor)

Form**EMC Test Plan and Constructional Data Form**

EUT Description Ambulatory ECG Monitor with Arrhythmia Detection

EUT Name CardioNet ECG Monitor with Arrhythmia Detection

Model No.: 1001 Serial No.: _____

Product Options: None

Configurations to be tested: Standard Operational Mode

Power Requirements

Voltage: 15 VDC (If battery powered, make sure battery life is sufficient to complete testing.)

Current Current
(Amps/phase(max)): 1.1 (Amps/phase(nominal)): 0.5

Typical Installation and/or Operating Environment

For use at home by a heart patient.

EUT Power Cable

Permanent OR Removable Length (in meters): 3m wall adapter

EUT Interface Ports and Cables

Interface			Shielding							Length (in meters)	Removable	Permanent
Type	Analog	Digital	Qty	Yes	No	Type	Termination	Connector Type	Port Termination			
56kbs Analog Modem	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Twisted Pair			POTS	4	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RS-232	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Foil over twisted pairs		Moulded Insulated DB9	Standard RS-232 Termination	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>

EUT Software.

Revision Level: Rev. 76

Description: CardioNet embedded software load

EUT Operating Modes to be Tested

1. Typical Operating Mode
2. Monitor placed in continuous CW operation for radiated power tests.
3. Sensor placed in continuous CW operation for radiated power tests.

EMC Test Plan and Constructional Data Form

EUT System Components			
Description	Model #	Serial #	FCC ID #
Monitor Unit	1001		
Sensor Unit	None		
Base Unit	None		

Frequency	<i>Derived Frequency</i>	Component #/Location	Description of Use
26MHz	900MHz ISM Band	Monitor / Y2	Reference for ISM Transceiver
4MHz	4MHz	Monitor / Y1	uP Clk
3.6854MHz	133MHz	Monitor / Y3	uP Clk
32.768kHz	32.768kHz	Monitor / Y4	UP Timer
26MHz	900MHz ISM Band	Sensor / Y2	Reference for ISM Transceive
4MHz	4MHz	Sensor / Y1	uP Clk

Power Supply				
Manufacturer	Model #	Serial #	Type	
Friwo	7555M/15	N/A	X Switched-mode: (Frequency) 60Khz TO 120Khz <input type="checkbox"/> Linear <input type="checkbox"/> Other: at short circuit frequency can go down to 8kHz	

Critical EMI Components (Capacitors, ferrites, etc.)				
Description	Manufacturer	Part # or Value	Qty	Component #/Location
Ferrite Bead	Spectrum Control, Inc.	FCV-0805-A601P	3 on	Base Unit Ref designator L2 - L4

EMC Critical Detail				
Transient suppressors, filters, circuit layout with vias reduce RF noise. Voltage transients have been minimized by implementing good power-supply busing. To reduce voltage transients, the supply line's parasitic inductances as low as possible by reducing trace lengths, using wide traces, ground planes. Saw filters are used in our RF section to achieve low insertion loss and high stop band attenuation.				

1 GENERAL INFORMATION (continued)

1.2 Related Submittal/Grant

None

1.3 Tested System Details

The FCC IDs for all equipment, plus descriptions of all cables used in the tested system are:

None

1.4 Test Methodology

Purpose of Test: To demonstrate compliance with the ANSI C63.4 setup.

TEST	FCC CFR 47 #	PASS/FAIL
Radiated	15.249	Pass

Test Performed:

- 1. Conducted Emissions, FCC Part
- 2. Radiated Emissions EN55022: 1992 Class B limit, 30 - 1,000 MHz, 10 meters
- 3. Radiated Emission per FCC Part 2, Paragraph 2.1053, & Part 22, Paragraph 22.917
- 4. Engineering evaluations
- 5. Frequency Stability, Part 2, Paragraph 2.995, and Part 87, Paragraph 87.133
- RF Output Power, Part 2, Paragraph 2.985, Part 22, Paragraph 22.917

Both Conducted and radiated testing were performed according to the procedures in FCC/ANSI C63.4 and CSA 108.8 - M1983. Radiated testing was performed at an antenna-to-EUT distance of 3 meters (1 - 25 GHz).

1.5 Test Facility

The open area test site and conducted measurement data were tested by:

TÜV PRODUCT SERVICE
10040 Mesa Rim Road
San Diego, CA 92121-2912
Phone: 858 546 3999
Fax: 858 546 0364

The Test Site Data and performance comply with ANSI 63.4 and are registered with the FCC, 7435 Oakland Mills Rd, Columbia Maryland 21046. All Measurement Data is acquired according to the content of FCC Measurement Procedure and ANSI C63.4, unless supplemented with additional requirements as noted in the test report.

1.6 Part 2 Requirements

Tune-up procedure:

For our product there is no tune-up procedure over our operating frequencies and power level settings. Our communication link for our Monitor and Sensor which use the North American unlicensed ISM (industrial, scientific, and medical) band covers 902 MHz to 928 MHz (center frequency of 915 MHz), and is suitable for short range RF links at 1mW of power max. We have a total of 20 channels available at 500kHz of channel spacing. Once a channel (ISM frequency) has been selected we stay on channel to pass data.

Our CDPD wireless radio modem found in our Monitor is purchase from an OEM which shares the AMPS frequency of 824.04MHz – 848.97MHz. Since we are end users of this product we do not tune or adjust for power. This is not configurable and is set by the manufacturer.

For equipment employing digital modulation techniques

- a) Detailed description of the modulation system to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and
- b) Description of the modulating wavetrain for the maximum rated conditions under which the equipment will be operated.

Our ISM uses a Texas Instruments Transceiver which transmitter consists of an integrated VCO, and a small signal mW amplifier. The modulation itself is done in the direct digital synthesizer, hence no additional external components are necessary. The RF output power is approximately 4.5 dBm, no additional external RF power amplifier is necessary.

The CDPD wireless radio modem we purchase from an end manufacturer is a full-duplex wireless transceiver using the Cellular Digital Packet Data Specification. Has a data transfer rate up to 19,200 bits per second. The modem has built-in error correction which ensures data transmission. The CDPD network employs multiple security features includind frequency hopping, Reed-Solomon encoding and RC4 encryption.

If equipment is an AM broadcast stereophonic exciter-generator intended for interfacing with existing certified, or formerly type accepted or notified transmitters must include measurements made on a complete stereophonic transmitter.

Not Applicable

2. SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was initially tested for FCC emission in the following configuration:

See Block Diagram.

2.2 EUT Exercise Software

None

2.3 Special Accessories

None

2.4 Modification

None

2.5 Configuration of Tested System

See Block Diagram.

3 RADIATED EMISSION EQUIPMENT/DATA

The following data lists the significant emission frequencies, measured levels, correction factor (which includes cable and antenna corrections), the corrected reading, and the limit.

See following page(s).

See test setup photos for radiated emissions test setup.

REPORT No: SC201108 TESTER: Dave Bernardin SPEC: FCC Part 2.1053(a) /22.917
 CUSTOMER: CardioNet, Inc. TEST DIST: 3 Meters
 EUT: CardioNet ECG Monitor Model 1001 Arrhythmia Detection TEST SITE: Roof
 EUT MODE: CDPD Hi Power Transmit BICONICAL: N/A
 DATE: 25,March2001 ERP/EIRP Fact 7 LOG: 244
 NOTES: HORN: 251
 above 1GHz: RBW & VBW 1 MHz for PK; RBW 1MHz and VBW 10Hz for AVG
 below 1GHz: RBW & VBW 100 kHz for PK; RBW 100kHz and VBW 10Hz for AVG
 CF = Antenna Factor + Cable Loss - Preamplifier Gain + Preselector Loss

FREQ (MHz)	VERTICAL (dBuv)		HORIZONTAL (dBuv)		CF (dB/m)	MAX LEVEL (dBm(d))		SPEC LIMIT (dBm)		MARGIN (dB)		EUT Rotation	Antenna Height	Notes	dBuV/m	dBuV/m
	pk	av	pk	av		pk	av	pk	av	pk	av					
824.04	99.3	99	93	92.9	22.1	24.0	23.7			23.7	45	1.2		Fundamental (Low Band)	121.4	121.1
1648.08	55.6	53.6	56.9	55.1	-8.2	-46.6	-48.4	-13.0	-13.0	-33.6	-35.4	175	1.2		48.7	46.9
2472.12	47.8	37.2	42.5	33.6	-3.2	-50.7	-61.3	-13.0	-13.0	-37.7	-48.3	3	0.1		44.6	34.0
3296.16	42.8	30.7	43.1	31.4	-0.1	-52.3	-64.0	-13.0	-13.0	-39.3	-51	357	1	Noise Level	43.0	31.3
4120.2					2.0										2.0	2.0
4944.24					2.5										2.5	2.5
5768.28					7.3										7.3	7.3
6592.32					8.2										8.2	8.2
7416.36					10.9										10.9	10.9
8240.4					12.3										12.3	12.3
835.65	98	98	88.2	88.2	22.1	22.7	22.7			22.74	22.7	45	1.2	Fundamental (Mid Band)	120.1	120.1
1671.32	59.9	58.6	52.5	49.5	-8.0	-43.4	-46.8	-13.0	-13.0	-30.4	-33.8	359	1.2		51.9	50.6
2506.97	43.5	32.8	46.6	38.4	-3.1	-51.7	-62.0	-13.0	-13.0	-38.7	-49	3	1		43.5	35.3
3342.62	42.7	30.8	41.3	30.8	0.1	-52.5	-66.5	-13.0	-13.0	-39.5	-53.5	2	1	Noise Level	42.8	30.9
4178.27					1.9										1.9	1.9
5013.92					2.8										2.8	2.8
5849.57					7.5										7.5	7.5
6685.22					8.5										8.5	8.5
7520.87					11.1										11.1	11.1
8356.52					12.6										12.6	12.6
848.97	98.4	98.4	90.7	90.7	22.4	23.4	23.4			23.41	23.4	57	1	Fundamental (High Band)	120.8	120.8
1697.94	51.3	47.9	48.6	44.1	-7.8	-51.8	-57.3	-13.0	-13.0	-38.8	-44.3	306	1.2		43.5	40.1
2546.91	42.5	32.2	44.4	33.1	-2.9	-53.8	-67.2	-13.0	-13.0	-40.8	-54.2	306	1.2		41.5	30.2
3395.88	43.2	36.2	42.5	32.4	0.3	-51.8	-60.9	-13.0	-13.0	-38.8	-47.9	3	1.1	Noise level	43.5	38.5
4244.85					1.8										1.8	1.8
5093.82					3.4										3.4	3.4
5942.79					7.8										7.8	7.8
6791.76					9.0										9.0	9.0
7640.73					11.3										11.3	11.3
8489.7					12.9										12.9	12.9

REPORT No: SC201108 TESTER: Dave Bernardin SPEC: FCC Part 2.1053(a) / 22, 2/7
 CUSTOMER: CardioNet, Inc. *PAB* TEST DIST: 3 Meters
 EUT: CardioNet ECG Monitor Model 10001 with Arrhythmia Detection TEST SITE: Roof
 EUT MODE: CDPD Low Power Transmit BICONICAL: N/A
 DATE: 25 March 2001 ERP/EIRP Fact. 7 LOG: 244
 NOTES: HORN: 251
 above 1GHz: RBW & VEW 1 MHz for Pk; RBW 1MHz and VEW 10Hz for AVG
 below 1GHz: RBW & VEW 100 kHz for Pk; RBW 100kHz and VEW 10Hz for AVG
 CF = Antenna Factor + Cable Loss - Preamplifier Gain + Preselector Loss

FREQ (MHz)	VERTICAL (dBuv) pk av		HORIZONTAL (dBuv) pk av		CF (dB/m)	MAX LEVEL (dBm(d)) pk av	SPEC LIMIT (dBm) pk av		MARGIN (dB) pk av	EUT Rotation: v-beta	Antenna Height: m	Notes	dBuv/m	dBuV/m		
	75.1	75	73.7	73.8			22.1	-0.2	-0.3							
824.04	75.1	75	73.7	73.8	22.1	-0.2	-0.3					312	1.2	Fundamental (Low Band)	97.2	97.1
1648.08	47.8	36.9	46.4	36.5	-8.0	-55.7	-66.6	-13.0	-13.0	-42.7	-53.6	1	1	Noise Level	39.6	28.7
2472.12	47.8	37.2	47.5	37.1	-3.2	-50.7	-61.3	-13.0	-13.0	-37.7	-48.3	3	0.1	Noise Level	44.6	34.0
3296.16	43	36.8	43.1	36.8	-0.1	-52.3	-58.6	-13.0	-13.0	-39.3	-45.6	357	1	Noise Level	43.0	36.7
4120.2					2.0										2.0	2.0
4944.24					2.5										2.5	2.5
5768.28					7.3										7.3	7.3
6592.32					8.2										8.2	8.2
7416.36					10.9										10.9	10.9
8240.4					12.3										12.3	12.3
835.65	75.4	75	75.1	75.1	22.1	0.1	-0.2					306	1.2	Fundamental (Mid Band)	97.5	97.2
1671.32	47	36.4	46.3	36.5	-8.0	-56.3	-68.9	-13.0	-13.0	-43.3	-55.9	300	1.2	Noise Level	39.0	28.5
2506.97	43.5	32.3	43.6	32.5	-3.1	-64.7	-67.9	-13.0	-13.0	-41.7	-54.9	3	1	Noise Level	40.5	29.4
3342.62	43.1	31.2	41.5	31.2	0.1	-52.1	-66.1	-13.0	-13.0	-39.1	-53.1	2	1	Noise Level	43.2	31.3
4178.27					1.9										1.9	1.9
5013.92					2.8										2.8	2.8
5849.57					7.5										7.5	7.5
6685.22					8.5										8.5	8.5
7520.87					11.1										11.1	11.1
8356.52					12.6										12.6	12.6
848.97	74.4	73.8	71.9	71.9	22.4	-0.6	-1.2					309	1.2	Fundamental (High Band)	96.8	96.2
1697.94	46.2	36.6	46.6	36.6	-7.8	-56.6	-68.6	-13.0	-13.0	-43.6	-55.6	306	1.2	Noise level	38.7	28.8
2546.91	46.1	36.5	46.3	36.5	-2.9	-51.9	-63.8	-13.0	-13.0	-38.9	-50.8	306	1.2	Noise level	43.4	33.6
3395.88	43.2	36.2	42.6	33.4	0.3	-51.8	-60.9	-13.0	-13.0	-38.8	-47.9	3	1.1	Noise level	43.5	36.5
4244.85					1.8										1.8	1.8
5093.82					3.4										3.4	3.4
5942.79					7.8										7.8	7.8
6791.76					9.0										9.0	9.0
7640.73					11.3										11.3	11.3
8489.7					12.9										12.9	12.9

Emissions Test Conditions: RADIATED EMISSIONS, FCC Part 2, Paragraph 2.1053 and Part 22, Paragraph 22.917

The *RADIATED EMISSIONS* measurements were performed at the following test location :

- **Test not applicable**

- Roof, 3-meter open site, San Diego

Testing was performed at a test distance of:

- 1 meters
- 3 meters
- 10 meters

Test Equipment Used :

Model No.	Prop. No.	Description	Manufacturer	Serial No.	Cal Date
3115	251	Antenna, Double Ridge Guide	EMCO	2595	10/20/02
3146	244	Antenna, Log Periodic Dipole	EMCO	1063	02/21/03
8566B	823	Spectrum Analyzer	Hewlett Packard	211500842	07/24/02
8566B		Spectrum Analyzer Display	Hewlett Packard	2112A02185	07/24/02
Pre-Amp 2- 20 GHz	719	Pre-Amplifier	TÜV Product Service	--	N/A

Remarks: _____

Field Strength Calculation

If a preamplifier was used during the Radiated Emission Testing, it is required that the amplifier gain must be subtracted from the Spectrum Analyzer (Meter) Reading. In addition, a correction factor for the antenna , cable used and a distance factor, if any, must be applied to the Meter Reading before a true field strength reading can be obtained. In the automatic measurement, these considerations are automatically presented as a part of the print out. In the case of manual measurements and for greater efficiency and convenience, instead of using these correlation factors for each meter reading, the specification limit was modified to reflect these correlation factors at each frequency value so that the meter readings can be compared directly to the modified specification limit. This modified specification limit is referred to as the "Corrected Meter Reading Limit" or simply the CMRL, which is the actual field strength present at the antenna. The quantity can be derived in the following manner:

$$\text{Corrected Meter Reading Limit (CMRL)} = \text{SAR} + \text{AF} + \text{CL} - \text{AG} - \text{DC}$$

Where, SAR = Spectrum Analyzer Reading

AF = Antenna Factor

CL = Cable Loss

AG = Amplifier Gain (if any)

DC = Distance Correction (if any)

Assume the following situation: A meter reading of 29.4 dBuV was obtained from a Class A computing device measured at 83 MHz. Assume an antenna factor of 9.2 dB, a cable loss of 1.4 dB and amplifier gain of 20.0 dB at 83 MHz. The final field strength would be determined as follows:

$$\text{CMRL} = 29.4 \text{ dBuV} + 9.2 \text{ dB} = 1.4 \text{ dB} - 20 \text{ dB/M} - 0.0 \text{ dB}$$

$$\text{CMRL} = 20.0 \text{ dBuV/M}$$

This result is well below the FCC and CSA Class A limit of 29.5 dbuV/m at 83 MHz.

For the manual mode of measurement, a table of corrected meter reading limit was used to permit immediate comparison of the meter reading to determine if the measure emission amplitude exceeded the specification limit at that specific frequency.

ATTESTATION STATEMENT

GENERAL REMARKS:

SUMMARY:

All tests were performed per CFR 47, *Part 2, Paragraph 2.1053(a); Part 22, Paragraph 22.917.*

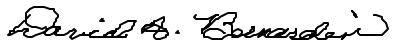
■ - Performed

The Equipment Under Test

■ - **Fulfills** the requirements of CFR 47, *Part 2, Paragraph 2.1053(a); Part 22, Paragraph 22.917.*

- TÜV PRODUCT SERVICE, INC. -

Responsible Engineer:



(EMC Engineer)