

MEASUREMENT AND TECHNICAL REPORT

CARDIONET
510 Market Street
San Diego, CA 92101

DATE: 15 April 2002

This Report Concerns:	Original Grant: ☒ X	Class II Change:
Equipment Type:	Cardionet ECG Monitor with Arrhythmia Detection, Model 1001	
Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?	Yes: ☐	No: ☒ X
	Defer until:	
Company Name agrees to notify the Commission by:	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?	Yes: ☐	*No: ☒ X
(*) FCC Part 15, Paragraph 15.107(a); 15.109(a); 15.249		
Report Prepared by: TÜV PRODUCT SERVICE 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 546 3999 Fax: 858 546 0364		

TABLE OF CONTENTS

	Pages
1 GENERAL INFORMATION	3
1.1 Product Description	3
1.2 Related Submittal Grant	5
1.3 Tested System Details	5
1.4 Test Methodology	5
1.5 Test Facility	5
2 SYSTEM TEST CONFIGURATION	6
2.1 Justification	6
2.2 EUT Exercise Software	6
2.3 Special Accessories	6
2.4 Equipment Modifications	6
2.5 Configuration of Tested System	6
3 RADIATED EMISSION EQUIPMENT/DATA	7
Field Strength Calculation	17
4 CONDUCTED EMISSION EQUIPMENT/DATA	18
5 Attestation Statement	24

EMC Test Plan and Constructional Data Form

EUT Description Ambulatory ECG Monitor with Arrhythmia DetectionEUT Name CardioNet ECG Monitor with Arrhythmia DetectionModel No.: 1001

Serial No.: _____

Product Options: NoneConfigurations to be tested: Standard Operational Mode**Power Requirements**Voltage: 15VDC (If battery powered, make sure battery life is sufficient to complete testing.)
 Current (Amps/phase(max)): 1.1 Current (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								
	Analog	Digital	Qty	Yes	No							
Type						Type	Termination	Connector Type	Port Termination	Length (in meters)	Removable	Permanent
56kbs Analog Modem	☒	☐	2	☐	☒	Twisted Pair			POTS	4	☒	☐
RS-232	☐	☒	1	☒	☐	Foil over twisted pairs		Molded Insulated DB9	Standard RS-232 Termination	1	☒	☐

EUT Software.Revision Level: Rev. 76Description: 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		

Oscillator Frequencies

Frequency	Derived Frequency	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 Transceiver
4MHz	4MHz	Sensor / Y1	uP Clk

Power Supply

Manufacturer	Model #	Serial #	Type
Friwo	7555M/15	N/A	☒ Switched-mode: (Frequency) 60kHz to 120kHz ☐ Linear ☐ 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:

- X 1. Conducted Emissions, FCC Part 15, Paragraph 15.107(a)
- X 2. Radiated Emissions, FCC Part 15, Paragraph 15.109(a); 15.249
- 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.

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).

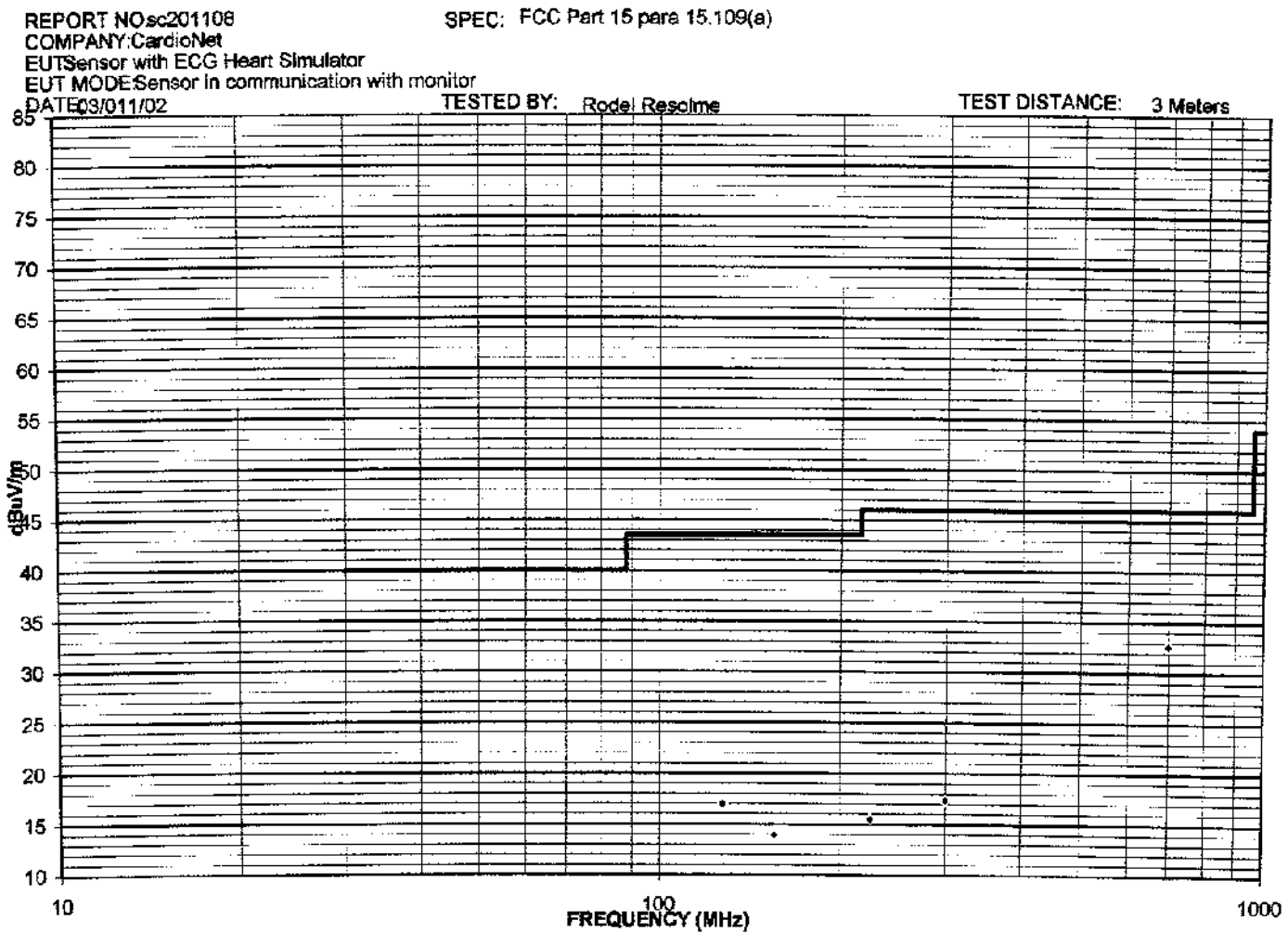
See test setup photos for radiated emissions test setup.

CF = Antenna Factor + Cable Loss - Preamplifier Gain + Preselector Loss

Page 8
Rev.No 1.0

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	52
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Page 9



ver 1.8a

Page 11
Rev.No 1.0

REPORT NO.sc201108

COMPANY:CardioNet

EUT:Monitor

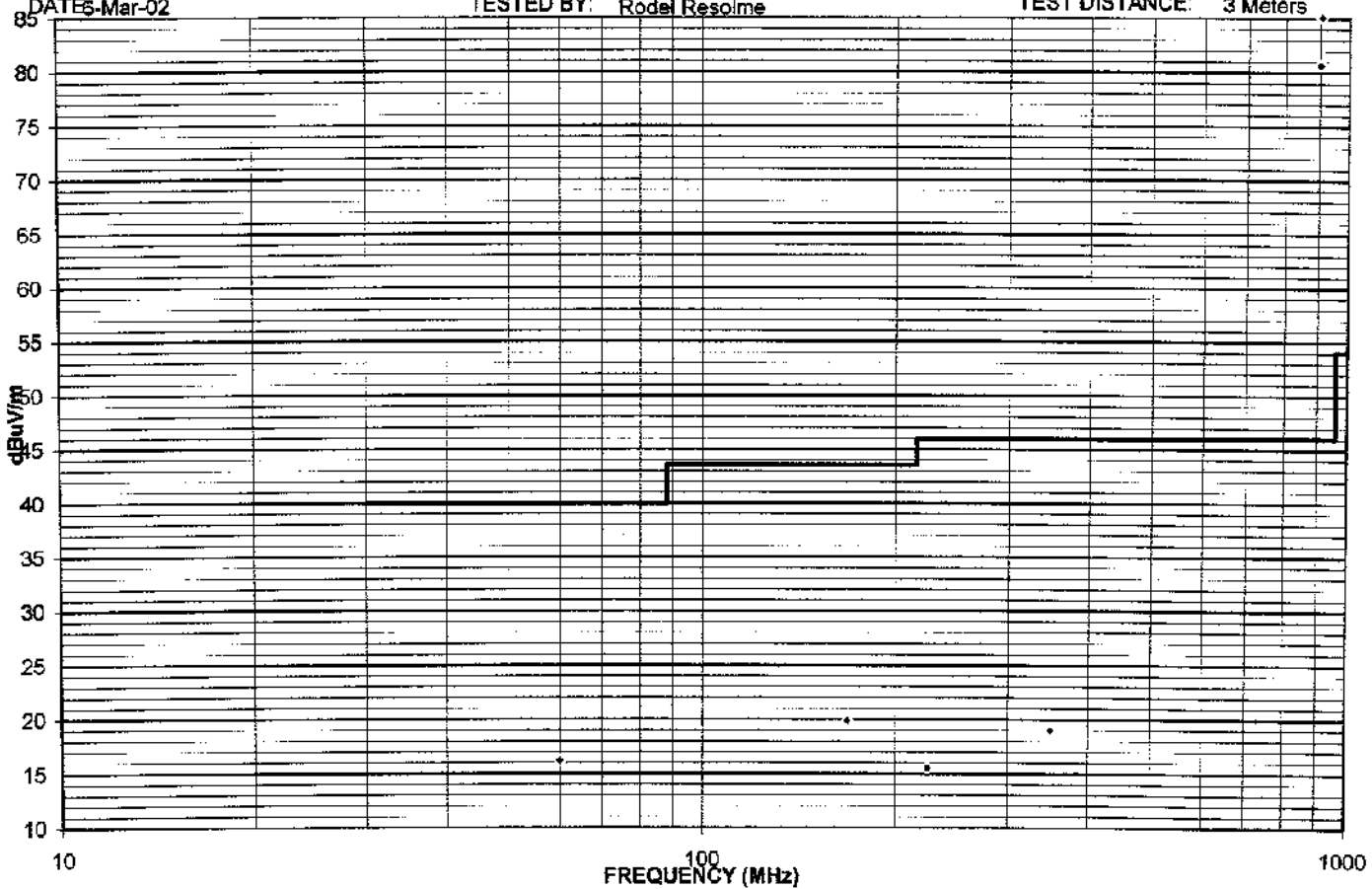
EUT MODE:Powered up operating mode

DATEs-Mar-02

SPEC: FCC Part 15 para 15.109(a)

TESTED BY: Rodol Resolme

TEST DISTANCE: 3 Meters



SPEC: FCC Part 15 para 15.109(a)

TEST DIST: 3 Meters

TEST SITE: 2

BICONICAL: 739

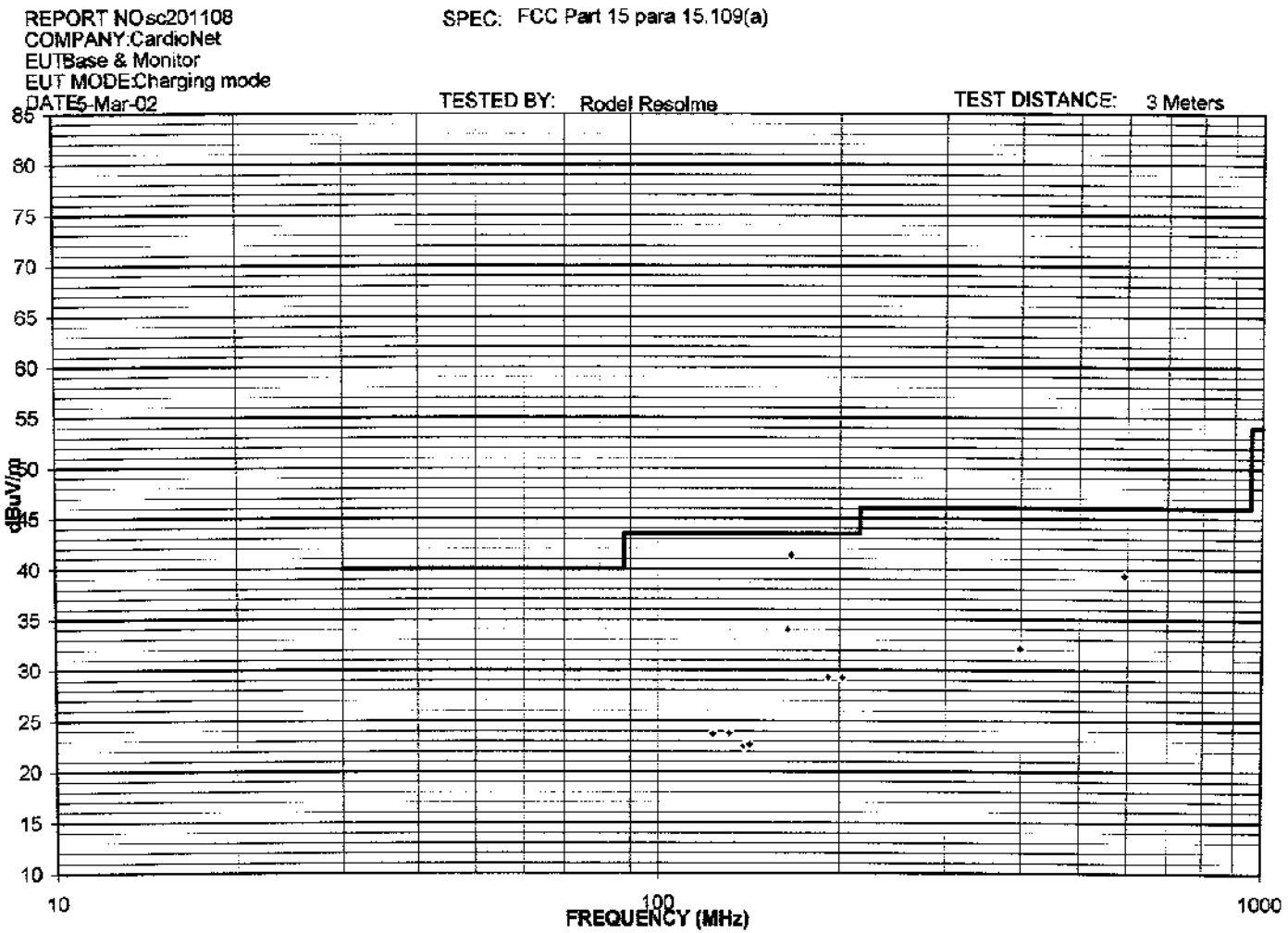
LOG PERIODIC: 739

RCVR: 427

Temperature: 15 Relative Humidity: 48

Ver 1.8a

[illegible]



Emissions Test Conditions: RADIATED EMISSIONS, FCC Part 15, Paragraph 15.109(a); 15.249

The <i>RADIATED EMISSIONS</i> 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	TUV Product Service --		N/A
ESVS30	427	Test Receiver	Rhode & Swartz	830350/996	12/08/02
LPB 2520/A	739	LPB Antenna	Antenna Research	1170	03/21/02

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.

4 CONDUCTED EMISSION EQUIPMENT/DATA

See following page(s).

TUV Product Service Conducted Emissions

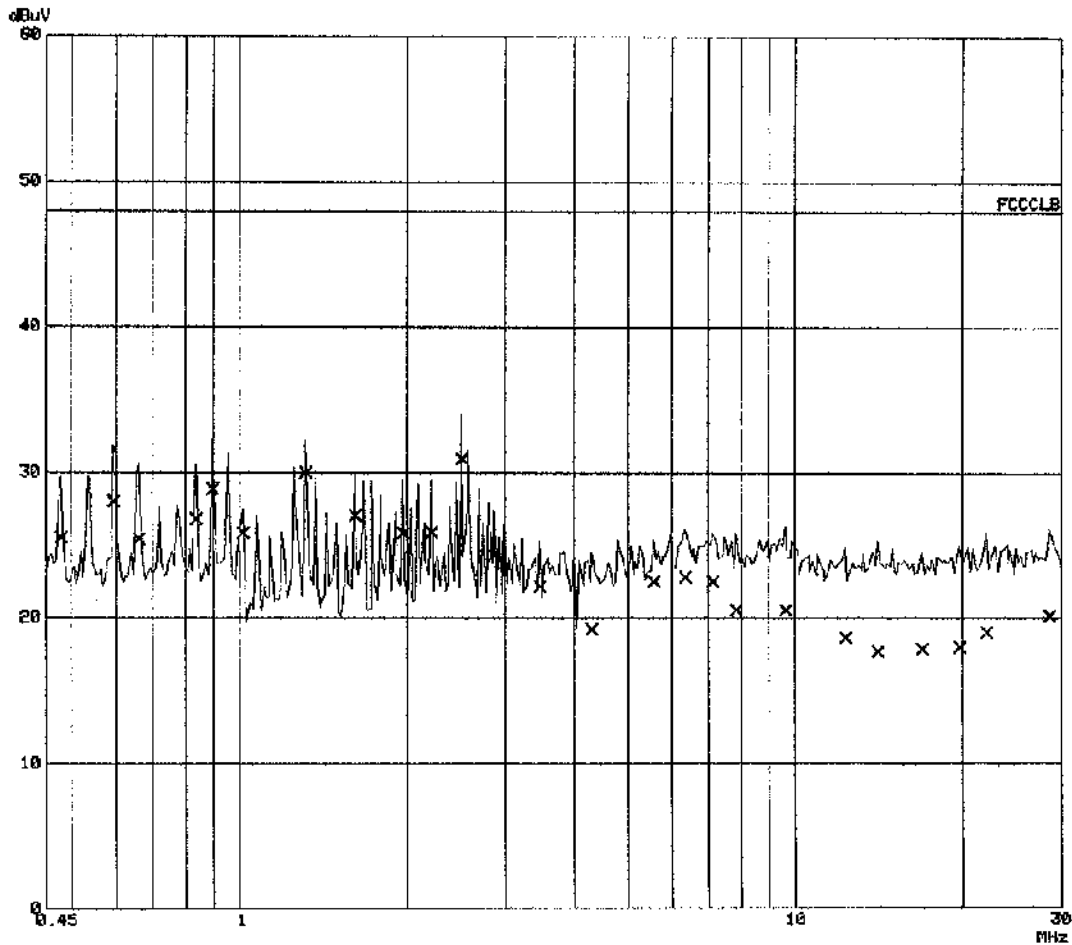
EUT: Base & Monitor
 Manuf: CardioNet
 Op Cond: Charging mode
 Operator: Rodel Resolme
 Test Spec: FCC Part 15 Class B
 Comment: 115 Vac 60 Hz Line 1
 SC201108
 Date: 05. Mar 02 10:48

Scan Settings (2 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
450k	1M	5k	10k	PK	100ms	AUTO	LN OFF
1M	30M	5k	10k	PK	2ms	AUTO	LN OFF

Transducer No.	Start	Stop	Name
5	9k	30M	20dBLISN

Final Measurement: x QP
 Meas Time: 1 s
 Subranges: 25
 Acc Margin: 40dB



**TUV Product Service
Conducted Emissions**

EUT: Base & Monitor
Manuf: CardioNet
Op Cond: Charging mode
Operator: Rodel Resolme
Test Spec: FCC Part 15 Class B
Comment: 115 Vac 60 Hz Line 1
SC201108
Date: 05. Mar 02 10:48

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.48000	25.6	48.0
0.59500	28.1	48.0
0.66000	25.5	48.0
0.83500	26.9	48.0
0.89500	28.9	48.0
1.01500	25.9	48.0
1.31500	30.0	48.0
1.61500	27.1	48.0
1.97000	25.9	48.0
2.21500	26.0	48.0
2.51500	31.0	48.0
2.87000	24.3	48.0
3.47000	22.2	48.0
4.31000	19.2	48.0
5.56500	22.5	48.0
6.34000	22.8	48.0
7.12000	22.6	48.0
7.84000	20.6	48.0
9.63500	20.6	48.0
12.32500	18.7	48.0
14.10000	17.7	48.0
16.89500	17.9	48.0
19.74500	18.0	48.0
22.03000	19.0	48.0
28.61500	20.1	48.0

* limit exceeded

TUV Product Service Conducted Emissions

EUT: Base & Monitor
 Manuf: CardioNet
 Op Cond: Charging mode
 Operator: Rodol Resolme
 Test Spec: FCC Part 15 Class B
 Comment: 115 Vac 60 Hz Line 2
 SC201108
 Date: 05. Mar 02 10:56

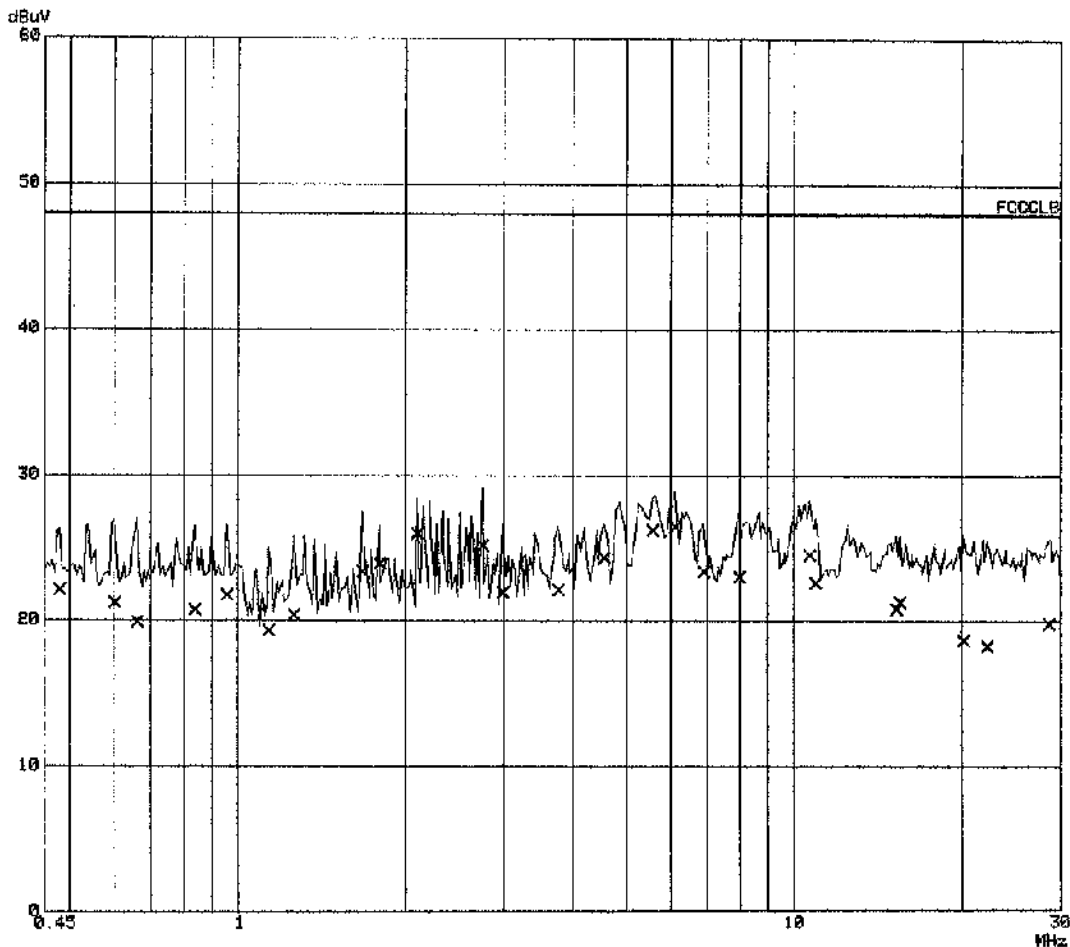
Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
450k	1M	5k	10k	PK	100ms	AUTO	LN OFF	60dB
1M	30M	5k	10k	PK	2ms	AUTO	LN OFF	60dB

Transducer No.	Start	Stop	Name
5	9k	30M	20dBLISN

Final Measurement: x QP

Meas Time: 1 s
 Subranges: 25
 Acc Margin: 40dB



**TUV Product Service
Conducted Emissions**

EUT: Base & Monitor
Manuf: CardioNet
Op Cond: Charging mode
Operator: Rodol Resolme
Test Spec: FCC Part 15 Class B
Comment: 115 Vac 60 Hz Line 2
SC201108
Date: 05. Mar 02 10:56

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.48000	22.1	48.0
0.60000	21.3	48.0
0.66000	19.9	48.0
0.83500	20.8	48.0
0.95500	21.8	48.0
1.13500	19.3	48.0
1.26000	20.4	48.0
1.67500	23.4	48.0
1.79500	23.9	48.0
2.09500	26.0	48.0
2.75500	25.2	48.0
2.99000	22.0	48.0
3.77000	22.1	48.0
4.55000	24.3	48.0
5.57000	26.3	48.0
6.11000	26.5	48.0
6.89000	23.4	48.0
7.97000	23.0	48.0
10.66500	24.5	48.0
10.96500	22.6	48.0
15.27500	20.8	48.0
15.52000	21.3	48.0
20.14000	18.7	48.0
22.24500	18.3	48.0
28.64500	19.8	48.0

* limit exceeded

Emissions Test Conditions: CONDUCTED EMISSIONS, FCC Part 15, Paragraph 15.107(a)

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

☐ - Test not applicable

■ - SR-3, Shielded Room, 12' x 20' x 8', Metal Chamber

Test Equipment Used :

MODEL #	PROP. #	DESCRIPTION	MANUFACTURER	SERIAL NO.	CAL DATE
ESHS30	459	Test Receiver	Rohde & Schwarz	837055/001	02/26/03
CAT-20	606	20 dB Attenuator	Mini-Circuits	832354/004	N/A
9242-50-4-24-BNC	458	LISN	Solar Electronics Co.	941720	03/11/02

Remarks: _____

ATTESTATION STATEMENT

GENERAL REMARKS:

SUMMARY:

All tests were performed per CFR 47, *FCC Part 15, Paragraph 15.107(a); 15.109(a); 15.249.*

■ - Performed

The Equipment Under Test

■ - **Fulfills** the requirements of CFR 47, *FCC Part 15, Paragraph 15.107(a); 15.109(a); 15.249.*

- TÜV PRODUCT SERVICE, INC. -

Responsible Engineer:



Engineer

Responsible Technician



Technician