Intertek Testing Services
ETL SEMKO

TEST REPORT

Report Number: 0232047W.doc
Project Number: 3032147
August 20, 2002

Evaluation of the
Dual Lead Telemetry Transmitter
Model Number: TM8B
to

FCC Part 95, Subpart H

Class
For
Life Sensing Instrument Company

Test Performed by:	Test Authorized by:
Intertek Testing Services 1950 Evergreen Blvd, Suite 100 Duluth, GA 30096	Life Sensing Instrument Company 329 West Lincoln Street Tullahoma, TN 37388

Prepared by: _____ Date: _____
Shawn McGuinness

Reviewed by: _____ Date: _____
David Schramm

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1 JOB DESCRIPTION

1.1 Client information

The Dual Lead Telemetry Transmitter has been tested at the request of

Company: Life Sensing Instrument Company
329 West Lincoln Street
Tullahoma, TN 37388

Name of contact: Gene Money
Telephone: (800) 624-2732
Fax: (931) 455-9093

1.2 Test plan reference:

Tests were performed to the following standards:

- FCC Part 95, Subpart H rules for an unintentional radiator

1.3 Equipment Under Test (EUT)

Equipment Under Test Technical Specifications	
Description	Dual Lead Telemetry Transmitter
Model Number	TM8B
Serial Number	tm8b4475611.00
Use of product:	Medical telemetry
Type of emission:	F3D
Maximum modulation frequency:	4.5 kHz
Maximum allowed deviation:	512 Hz
RF output power:	0.25 mW
Means for variation of operating power:	Fixed
Frequency range:	608 to 614 MHz
Maximum number of channels:	238
Channel separation:	25 kHz
Antenna:	Shield of patient leads
External input:	Patient's physiological information

EUT receive date: September 23, 2002

EUT receive condition: The EUT was received in good condition with no apparent damage.

Test start date: October 2, 2002

Test completion date: October 2, 2002

1.3.1 Test Summary

FCC Rule	Description of test	Result	Page
2.1046	RF power output	Pass	10
2.1047	Modulation characteristics	Not applicable	--
2.1049	Occupied Bandwidth	Pass	14
2.1053	Spurious emissions at antenna terminal	N/A[1]	--
95.1115 (a)	Field strength of fundamental	Pass	10
95.1115 (b)	Field strength of undesired emissions	Pass	10
15.107	AC Line conducted emissions	N/A[2]	--
2.1055	Frequency stability vs. Temperature vs. Voltage	Pass	16
2.1093	RF Exposure	N/A[3]	--

1.3.2 Brief Description

The test results in this report pertain only to the item tested.

The following description of the Dual Lead Telemetry Transmitter was supplied by Life Sensing Instrument Company:

The TM8B Dual Lead ECG Transmitter is a frequency synthesized transmitter operating in the UHF (606 – 614 MHz) range. The transmitter utilizes 5 independent patient lead wires with snap electrode adapters for disposable electrodes.

1.3.3 System Support Equipment

Table 1-1 contains the details of the support equipment associated with the Equipment Under Test.

Table 1-1: System Support Equipment

Description	Manufacturer	Model Number	Serial Number	FCC ID number
Patient Simulator	Dynatech	ECG110	0596	N/A

1.3.4 Cables associated with EUT

Table 1-2 contains the details of the cables associated with the EUT.

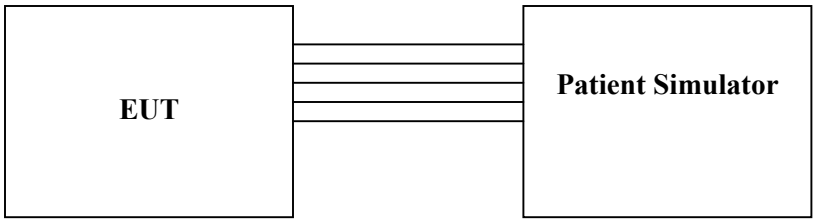
Table 1-2: Interconnecting cables between modules of EUT

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Patient Leads (x5)	1m	Yes, braid	None	EUT	Patient Simulator

[1] Not applicable because the EUT has only an integrated antenna.
[2] Not applicable because the EUT is only powered from 3Vdc batteries.
[3] Not applicable because the EUT is body worn and operates at 0.25 mW.

1.3.5 System Block Diagram

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.



1.3.6 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case results.

To insure maximum emissions were detected, the system was rotated 360 degrees, the antenna height was varied from 1 to 4 meters above the ground plane in both horizontal and vertical polarizations. These maximum emissions are represented in Section 3.0.

1.3.7 EUT exercising

The EUT exercise program used during radiated testing was designed to exercise the various system components in a manner similar to a typical use.

There was no special software to exercise the device. Once energized it operated normally.

1.3.8 Mode(s) of operation

The EUT was powered from a +3VDC battery.

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

1.4 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2 TEST ENVIRONMENT

2.1 Test Facility

The Duluth 10-meter chamber site is located at 1950 Evergreen Blvd., Suite 100, Duluth, Georgia. The test site is a 10-meter semi-anechoic chamber. The site meets the characteristics of CISPR 16-1: 1993 and ANSI C63.4: 1992. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

The A2LA accreditation code for this site is 121624 under certificate number 1455.01.

2.2 Test Equipment

Table 2-1 contains a list of the test equipment used during the testing.

Table 2-1 List of Test Equipment

Description	Make	Model	Serial #	Cal Date
EMI Receiver	HP	8546A	3410A00173	3/28/02
RF Filter Selector	HP	85460A	3448A00203	3/28/02
PreAmp	HP	8447D	2648A04296	8/06/02
BiLog Antenna	Chase	CBL6112A	2245	4/09/02
Cable	N/A	CableTW2	ITS#211411	6/11/02
Cable	N/A	CableTW3	ITS#211412	6/11/02
Cable	N/A	Cable N2	ITS# 211999a2	6/11/02

*** All calibrations are on 12-month cycles unless otherwise indicated**

2.3 Example 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 reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – PA

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(1/m)
PA= Preamplifier Factor in dB

Assume a receiver reading of 52.0 dB(μV) 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 dB(μV/m).

RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
PA = 29.0 dB
FS = RF + AF + CF – PA
FS = 52.0 + 7.4 + 1.6 – 29.0
FS = 32 dB(μV/m)

2.4 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

3 RADIATED EMISSIONS

3.1 Test Description

Paragraphs 2.1046 and 95.1115 are covered under this section.

Table 3-1 Radiated Disturbance Limit for FCC Part 95, Subpart H

Frequency (MHz)	3m limits, uV/m	3m limits, dB(uV/m)
608-614	200,000	106
below 960	200	46
960 and up	500	54

3.2 Test Procedure

Measurements were conducted according to Table 3-2 unless indicated otherwise in the measurement table.

Table 3-2 Measurement bandwidth settings

Measurement	Resolution bandwidth	Video Bandwidth	Detector
Fundamental	1 MHz	1 MHz	Peak
Unwanted emissions below 1 GHz	120 kHz	300 kHz	Quasi-peak
Unwanted emissions above 1 GHz	1 MHz	1 MHz	Peak

The measuring antenna correlates to a balanced dipole.

Measurements of the radiated field were made with the antenna located at a distance of 3 meters from the EUT.

The measuring antenna was adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth was varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) was varied during the measurements to find the maximum field-strength readings.

The EUT was placed on a table whose top is 0.8m above the ground plane. The table was constructed of non-conductive materials. Its dimensions were 1m by 1.5m.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4: 1992.

3.3 Test Results

The Dual Lead Telemetry Transmitter met the Fundamental, Spurious and Digital Device radiated disturbance requirements of FCC Part 95, Subpart H. The test results are located in Table 3-3 – 3.3-2.

The radiated power was calculated to be 0.25 mW using the following formula: $P_t * G_t = \frac{(E * d)^2}{30}$

Table 3-3 Fundamental Radiated Disturbance

Company: **Life Sensing instruments, Co.**
Model: **TM 8B**
Project No.: **3032147**
Date: 10/02/02
Standard: FCC95
Class: Subpart H Group: None
Notes: Fundamental Peak Reading

Tested by: Shawn K. McGuinness
Location: Duluth
Detector: HP8546
Antenna: CHAS2622
PreAmp: HP-1G
Cable(s): CABLEN2 Cable TW2
Distance: **3**

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
H	610.930	92.2	18.6	5.1	26.6	0.0	89.2	106.0	-16.8

Table 3.3-2 Spurious Radiated Disturbance

Company: **Life Sensing instruments, Co.**
Model: **TM 8B**
Project No.: **3032147**
Date: 10/02/02
Standard: FCC95
Class: Subpart H Group: None
Notes: Unwanted emissions

Tested by: Shawn K. McGuinness
Location: Duluth
Detector: HP8546
Antenna: CHAS2622
PreAmp: HP-1G
Cable(s): CABLEN2 Cable TW2
Distance: **3**

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
V	56.150	36.6	6.8	1.6	26.1	0.0	18.9	46.0	-27.1
V	109.450	35.4	11.7	2.1	26.0	0.0	23.2	46.0	-22.8
V	133.000	34.7	11.5	2.3	25.8	0.0	22.7	46.0	-23.3
H	288.600	31.2	13.0	3.6	25.2	0.0	22.5	46.0	-23.5
H	292.000	31.6	13.0	3.6	25.3	0.0	22.9	46.0	-23.1

Antenna: AH571 PreAmp: hp8449b

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
H	1222.110	41.5	25.2	6.6	38.1	0.0	35.1	54.0	-18.9
H	1833.110	38.2	28.8	8.3	37.2	0.0	38.0	54.0	-16.0
H	2444.110	36.8	30.4	9.7	37.0	0.0	39.9	54.0	-14.1

3.4 Test Configuration Photograph

Figure 3-1 and Figure 3-2 show the testing configurations used for Fundamental, Spurious and Digital Device radiated disturbances.

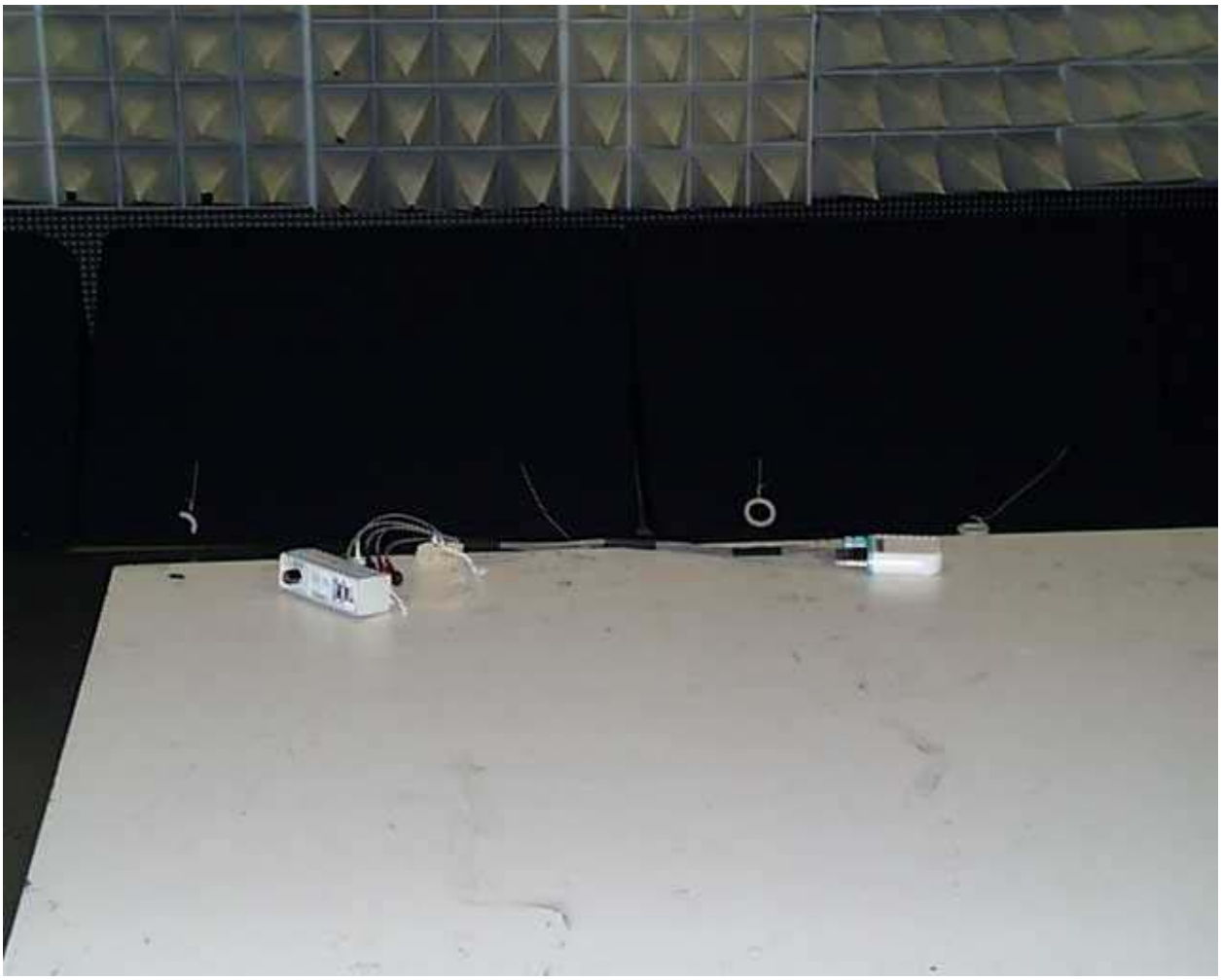


Figure 3-1: Configuration photograph, radiated disturbance, front view

Figure 3-2: Configuration photograph, radiated disturbance, rear view

4 OCCUPIED BANDWIDTH

4.1 Test description

Requirement:	FCC 2.1049
Emission Bandwidth:	<10.0 kHz

4.2 Test Procedure

The bandwidth measurement was performed using the radiated emissions setup because the EUT does not have an antenna port.

With the EUT in a position where the maximum emission was detected, the bandwidth was measured. The resolution bandwidth of the spectrum analyzer was setup at least 10 times higher than the necessary bandwidth of the transmitter. The peak level of the spectrum analyzer reading obtained was used as a reference level during the occupied bandwidth measurement.

The resolution bandwidth was setup to 300 Hz and the spectrum of the transmitting signal was recorded.

4.3 Test Results

The Necessary Bandwidth was calculated using the formula $B = 2 \times (M+D)$, where M is the highest modulation frequency, D is the deviation. As per TM8B specification, M=0.512kHz and D=4.5kHz. Therefore, B=10.0 kHz. The following figure shows the bandwidth to be 6.63 kHz.

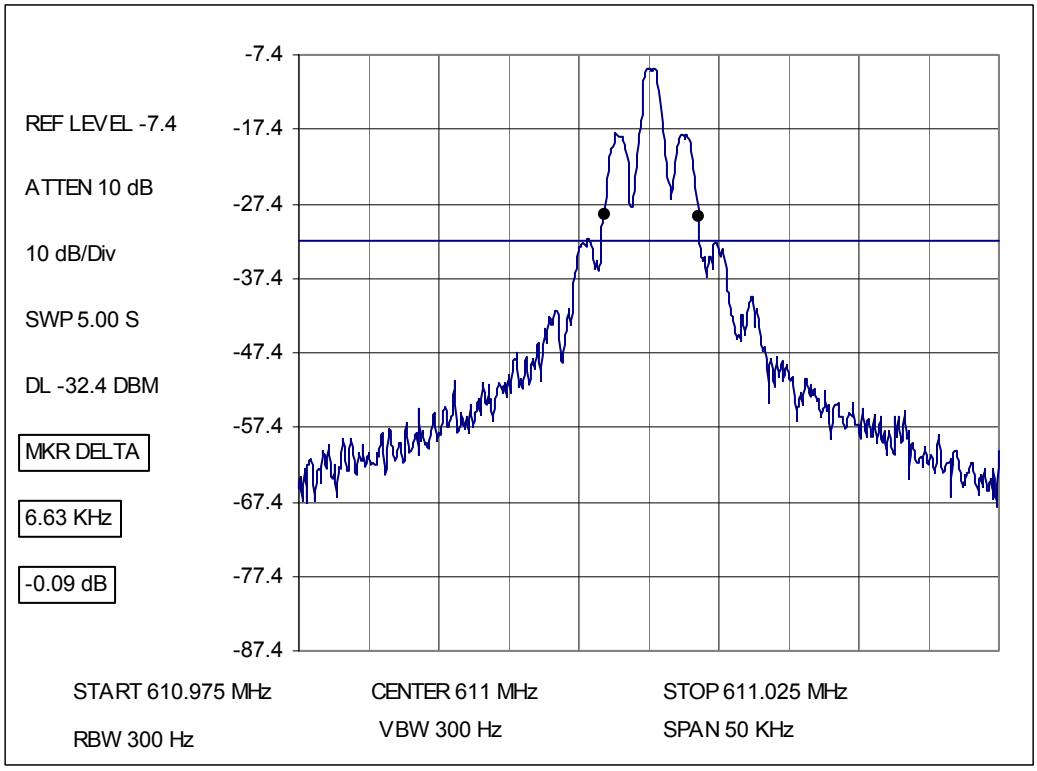


Figure 4-1 Occupied Bandwidth

5 SPURIOUS EMISSIONS AT ANTENNA TERMINAL

Test description

Parameter:	FCC 2.1051
Requirement:	20 dB below carrier

5.1 Test Procedure

This test was not applicable because the EUT does not have accessible antenna terminals.

6 FREQUENCY STABILITY

6.1 Test Description

Requirement:	FCC 2.1055
Frequency Tolerance	2 ppm

6.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm = \left(\frac{MCF}{ACF} - 1 \right) * 10^6$$

Where MCF is the measured carrier frequency in MHz
ACF is the assigned carrier frequency in MHz

6.2.1 Frequency stability vs. temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a spectrum analyzer through appropriate attenuation. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 30 minutes, the frequency of the output signal was measured.

6.2.2 Frequency stability vs. voltage

At room temperature (25 ±5 °C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

6.3 Test results

Table 6-1: Frequency stability vs. temperature

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50	611.001390	-10
40	611.001380	-20
30	611.001405	5
20	611.001415	15
10	611.001395	-5
0	611.001405	5
-10	611.001425	25
-20	611.001380	-20
-30	611.001370	-30

Table 6-2: Frequency stability vs. voltage

Supply (Battery) Volts	Frequency (MHz)	Difference (Hz)
2.4	611.001375	-25
2.6	611.001410	10
2.8	611.001405	5
3.0	611.001400	0
3.2	611.001370	-30
3.4	611.001395	-5
3.6	611.001400	0

7 RF EXPOSURE

This test is not applicable because the EUT is a body worn transmitter and operates at 0.25 mW.

8 AC MAINS LINE-CONDUCTED DISTURBANCE

This test not required as the EUT was powered only by batteries.