

## TEST REPORT

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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:

Intertek Testing Services  
1950 Evergreen Blvd, Suite 100  
Duluth, GA 30096

Test Authorized by:

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

Prepared by: \_\_\_\_\_  
Shawn McGuinness

Date: \_\_\_\_\_

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David Schramm

Date: \_\_\_\_\_

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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 <sup>1</sup> | --   |
| 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 <sup>2</sup> | --   |
| 2.1055      | Frequency stability<br>vs. Temperature<br>vs. Voltage | Pass             | 16   |
| 2.1093      | RF Exposure                                           | N/A <sup>3</sup> | --   |

## 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,<br>braid | None     | EUT        | Patient Simulator |

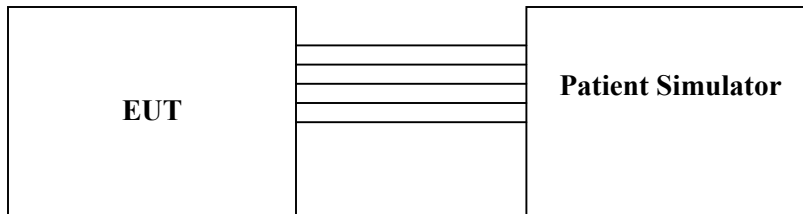
<sup>1</sup> Not applicable because the EUT has only an integrated antenna.

<sup>2</sup> Not applicable because the EUT is only powered from 3Vdc batteries.

<sup>3</sup> 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( $\mu$ V/m)
- RA = Receiver Amplitude (including preamplifier) in dB( $\mu$ V)
- 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( $\mu$ V) 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( $\mu$ V/m).

$$RA = 52.0 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(1/\text{m})$$

$$CF = 1.6 \text{ dB}$$

$$PA = 29.0 \text{ dB}$$

$$FS = RF + AF + CF - PA$$

$$FS = 52.0 + 7.4 + 1.6 - 29.0$$

$$FS = 32 \text{ dB}(\mu\text{V}/\text{m})$$

### 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:

$\pm 3.5$  dB at 10m,  $\pm 3.8$  dB at 3m

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

$\pm 2.6$  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<br>(MHz) | 3m limits,<br>uV/m | 3m limits,<br>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<br>bandwidth | Video<br>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.

# Intertek Testing Services

## 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:  $P_i * G_i = \frac{(E * d)^2}{30}$

*Table 3-3 Fundamental Radiated Disturbance*

Company: **Life Sensing instruments, Co.** Tested by: Shawn K. McGuinness  
 Model: **TM 8B** Location: Duluth  
 Project No.: **3032147** Detector: HP8546  
 Date: 10/02/02 Antenna: CHAS2622  
 Standard: FCC95 PreAmp: HP-1G  
 Class: Subpart H Group: None Cable(s): CABLEN2 Cable TW2  
 Notes: Fundamental Peak Reading 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.** Tested by: Shawn K. McGuinness  
 Model: **TM 8B** Location: Duluth  
 Project No.: **3032147** Detector: HP8546  
 Date: 10/02/02 Antenna: CHAS2622  
 Standard: FCC95 PreAmp: HP-1G  
 Class: Subpart H Group: None Cable(s): CABLEN2 Cable TW2  
 Notes: Unwanted emissions 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     |

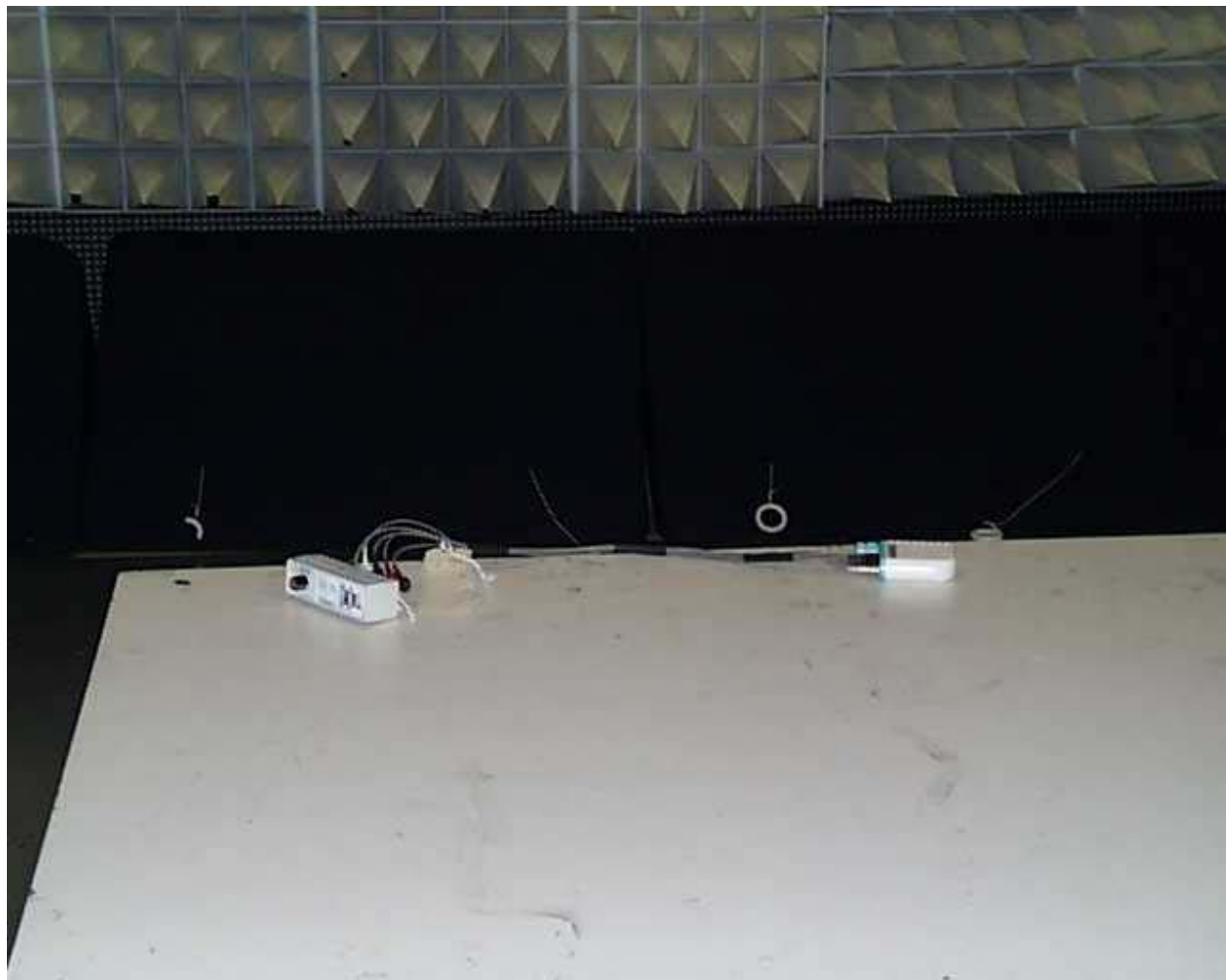
Antenna: AH571

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

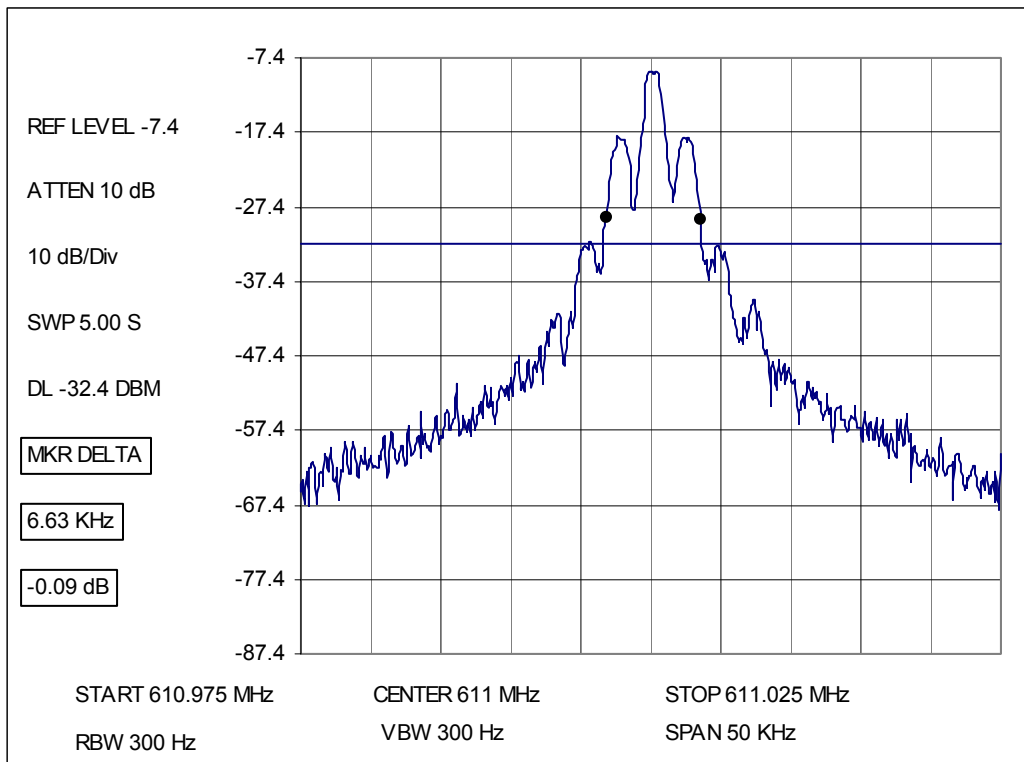
The bandwidth measurement was performed using the radiated emissions setup because the EUT does not have an antenna port.

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,  $M=0.512\text{kHz}$  and  $D=4.5\text{kHz}$ . Therefore,  $B=10.0\text{ kHz}$ . 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 | Frequency  | Difference |
|-------------|------------|------------|
| (°C)        | (MHz)      | (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<br>(Battery) | Frequency  | Difference |
|---------------------|------------|------------|
| Volts               | (MHz)      | (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.**