Resolution Products, Inc.

Wireless NAPS Sleep Sensor
FCC ID: U5X-RE627

Certification Test Report

15.249 Bluetooth LE

September 10, 2014

Contents

1. Introduction

The RE627 is a wireless sleep and heart rate detection pressure sensor for use in nursing homes. The unit is powered by a 6VDC power supply. The device measures 4 ¾" x 3 ¾" x 1".

The device communicates to a security system using Bluetooth LE in the 2.4GHz band.

Certification is requested under FCC Rules, Part 15, Subpart C, Paragraph 15.249. Equipment class for this transceiver is DXX, Low Power Communication Device Transmitter.

2. Statement of Compliance

Specific sections of FCC Rules Part 2 that require information or listing are given below.

2.1. FCC Part 2 §2.907

This is an application for certification of original equipment

2.2. FCC Part 2 §2.911

a) This application has been filed electronically using form 731.
b) All required information has been supplied in this application and its attachments.
c) This application has been electronically signed by an officer of Resolution Products, Inc.
d) The technical test data has been signed by the agency performing the testing.
e) Signature supplied in appropriate block on form 731.
f) Processing fee has been paid.
g) Signatures have been supplied electronically.

2.3. FCC Part 2 §2.913

a) This application has been filed electronically.
b) Appropriate fees have been filed electronically.
c) Equipment samples shall be supplied as requested.

2.4. FCC Part 2 §2.915

We are requesting a grant of certification. This application shows compliance with the technical standards.

2.5. FCC Part 2 §2.925

A label shall be affixed to each piece of equipment, showing the FCC identifier. The label shall read "FCC ID: U5X-RE627". See Exhibit B for a photograph showing the label and location on the device.

2.6. FCC Part 2 §2.943, 2.945

Sample production equipment shall be submitted to the FCC upon request.

2.7. FCC Part 2 §2.947

a) Measurement procedure follows ANSI C63.4: 2009.

b) A description of utilized test equipment is contained in the report.

2.8. FCC Part 2 §2.948

Radiated measurements were taken at the following FCC-approved facility:
Rhein Tech Laboratories, Inc.
360 Herndon Parkway, Suite 1400
Herndon, VA 20170 USA
Contact: Rick McMurray
703-689-0368

Photographs of the test site are shown in Exhibit J.

2.9. FCC Part 2 §2.1033

a) Form 731 has been filed electronically.
b) The technical report, along with its exhibits, contains the information as follows:
   (1) full name and mailing address of the manufacturer of the device and the applicant for certification:
   Resolution Products, Inc.
   1402 Heggen Street
   Hudson, WI 54016
   (2) FCC Identifier is U5X-RE627
   (3) Copy of the installation/user instructions is furnished as Exhibit E.
   (4) A brief description of the device and operation is furnished in Exhibit F. Schematic is furnished in Exhibit G.
   (5) Block diagram furnished in Exhibit H.
   (6) This document constitutes a technical test report.
   (7) Internal and external photographs have been furnished in Exhibits A and C.
   (8) Not applicable. There are no peripheral or accessory devices used with this device. It is a standalone device.
   (9) This application not pursuant to the transition rules of section 15.37
   (10) Not applicable. This device does not include a scanning receiver.
   (11) Not applicable.
   (12) Not applicable.
c) Not applicable. This device shall operate under Part 15 of the rules.
d) Not applicable.
e) Not applicable. This is not a composite system.

3. Discussion of Laboratory Measurements and Rules Compliance

3.1. FCC Part 15 §15.249(a) - Raw Field Strength Limits

For operation in the 2400-2483.5 MHz band, raw field strength limits are given as follows:
Fundamental: 50mV/m = 94dBuV/m
Spurious: 500uV/m = 54dBuV/m

Certain harmonics of the transmitted signal fall in the restricted bands of §15.205. These harmonics are all above 960MHz and have the following limit as given in §15.209:
Restricted band limit = 500uV/m = 54dBuV/m.

3.2. FCC Part 15 §15.249(e) - Duty Cycle Correction and Resulting Limits

There are two types of communication in Bluetooth LE, Advertising and Connection. The table below gives calculations of the maximum on-time for each type, in a 100ms window. In practice these conditions would likely never occur, but they are the worst case.

Advertising		
max duration of "advertising" packet	0.376	ms
number advertising packets per advertisement	3	#
min advertising interval per BTLE spec	20	ms
fcc window of time for averaging	100	ms
# advertisements in fcc window	5	#
# advertising packets in fcc window	15	#
advertising ontime in fcc window	5.64	ms
Connection		
max duration of "connection" packet	0.328	ms
number connection packets per connection event	2	#
min connection interval per BTLE spec	7.5	ms
fcc window of time for averaging	100	ms
# connection events in fcc window	13.33	#
# connection packets in fcc window	26.67	#
connection ontime in fcc window	8.75	ms

These calculations show that the worst case occupancy of a 100ms window is 8.75ms.

Calculating the allowed duty cycle correction factor as given in §15.35(c):

20log(8.75/100) = -21.16dB

However, §15.35(c) limits the allowed duty cycle correction factor to -20dB. Using the 20dB correction factor, the resulting **corrected radiated field strength limits** are as follows:

Fundamental:	**94 + 20 = 114dBuV/m**
Spurious and Restricted Bands:	**54 + 20 = 74dBuV/m**

3.3. Measured Radiated Field Strength Data

Radiated fundamental and spurious emissions were tested at three meters. The EUT was tested in the three orthogonal planes with the receive antenna in both polarities. The emissions were maximized per ANSI C63.4:2003 8.3.1.2; that is, the measurement antenna height was varied between 1 and 4m, and the EUT was rotated through 360 degrees on a rotating turntable until the maximum emissions were found. Both horizontal and vertical measurement antenna polarizations were used. A resolution bandwidth of 100kHz was used for frequencies less than 1000MHz, and a resolution bandwidth of 1MHz was used for frequencies greater than or equal to 1000MHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth.

The EUT was adapted to continuously transmit for testing purposes. All spurious emissions in the applicable frequency range were investigated.

Three channels (frequencies) are used for Bluetooth LE. For any given packet, one of two antennas is used to radiate the signal. Measured radiated field strength data for both antennas and all three channels is shown in Exhibit I.

The following gives a summary of the passing margins for each channel and its highest spurious signal.

3.3.1. 2402 MHz Channel Fundamental and Harmonics

The fundamental signal, at 94.1dBuV/m, passed by 19.9dB.
The highest spurious signal was the 9th harmonic, which passed by 5.8dB.
The next highest spurious signal was the 10th harmonic, which passed by 7.1dB.

3.3.2. 2440 MHz Channel Fundamental and Harmonics

The fundamental signal, at 96.5dBuV/m, passed by 17.5dB.
The highest spurious signal was the 9th harmonic, which passed by 7.3dB.
The next highest spurious signal was the 7nd harmonic, which passed by 10.3dB.

3.3.3. 2480 MHz Channel Fundamental and Harmonics

The fundamental signal, at 93.6dBuV/m, passed by 20.4dB.
The highest spurious signal was the 9th harmonic, which passed by 5.0dB.
The next highest spurious signal was the 10^{h} harmonic, which passed by 6.5dB.

3.4. FCC Part 15 §15.249(d) Non-harmonic Spurious Emissions

Other than harmonics, spurious emissions must be attenuated 50dB from the fundamental, or to the §15.209 limits, whichever is the lesser attenuation. In this case, the §15.209 limits are the lesser attenuation.

Detected non-harmonic spurious emissions are shown in Exhibit I. All emissions are passing.

The limit given in §15.209 for signals above 960Mhz is 500uV/m, or 54dBuV/m. With the 20dB allowed duty cycle averaging, the limit becomes **74dBuV/m.** At the band edges, close to the lower and upper fundamental signals, this limit applies. The band edges are at 2400MHz and 2483.5MHz.

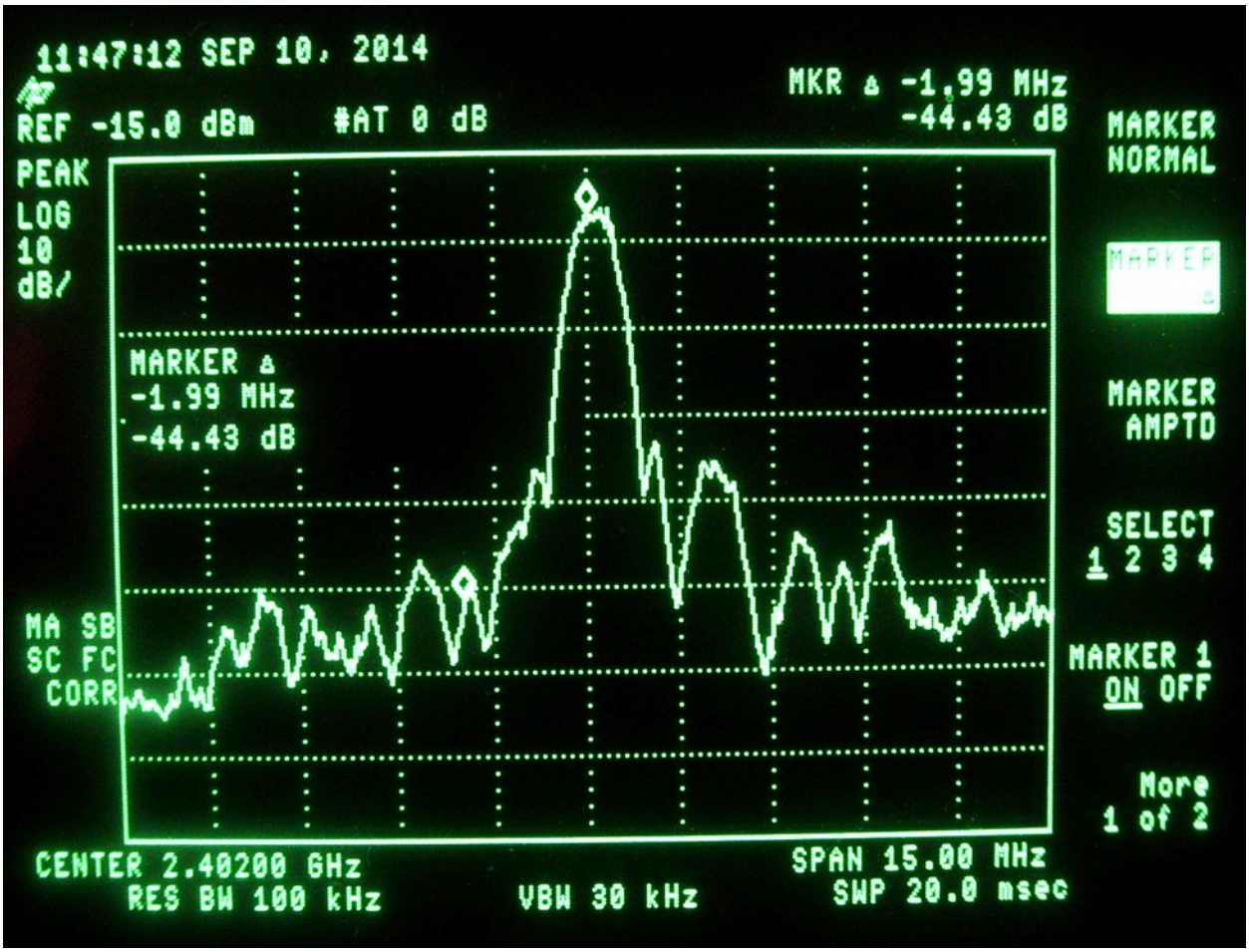
The following sections show conducted measurements taken on the upper and lower band edges. The measurements are then related to the radiated fundamental field strength for each channel in Exhibit I, to show compliance with the band edge spurious requirement.

Measurements are taken with a HP8594E Spectrum Analyzer, ID# 021814-1, Cal: 2/26/2014, Due: 2/26/2015.

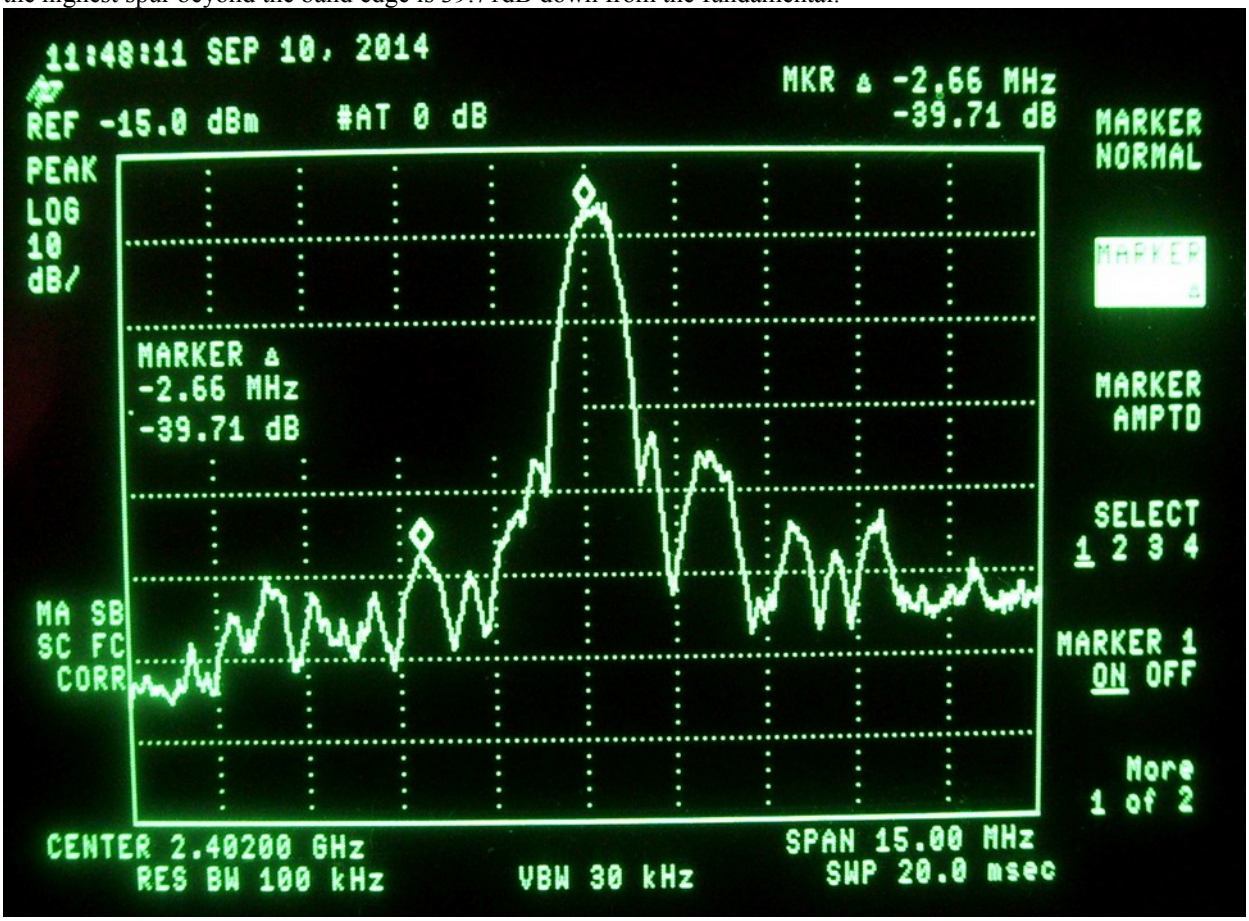
3.4.1. 2402 MHz Channel Band-Edge

The fundamental signal of the lower channel is 94.1dBuV/m. Because the limit at the band edge is 74dBuV/m, signals at the band edge must be 94.1 – 74 = **20.1dB down from the fundamental.**

The following plot shows the fundamental and the level at the band edge. The level at the band edge is 44.43dB down from the fundamental.



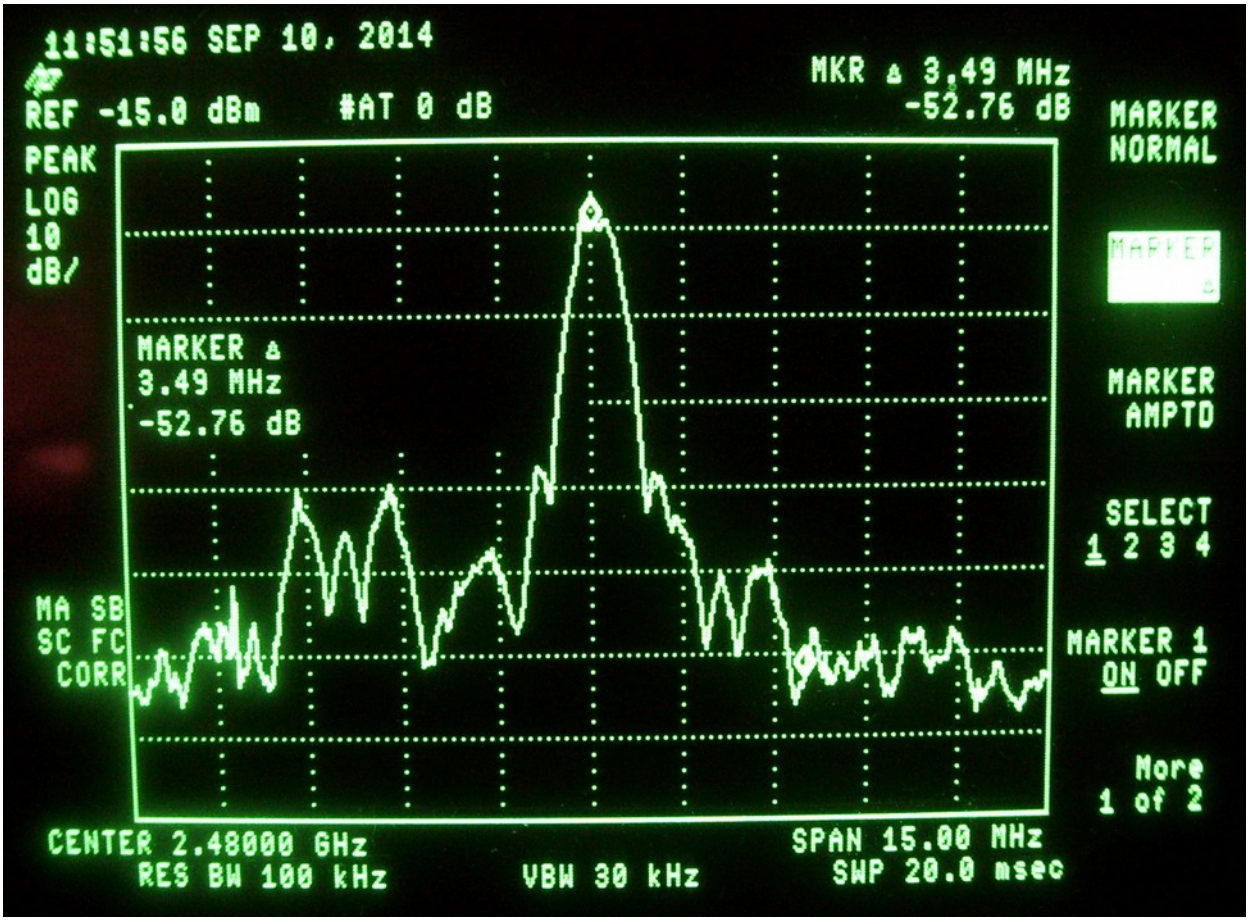
The following plot shows the fundamental and the level at the the highest spur beyond the band edge. The level at the highest spur beyond the band edge is 39.71dB down from the fundamental.



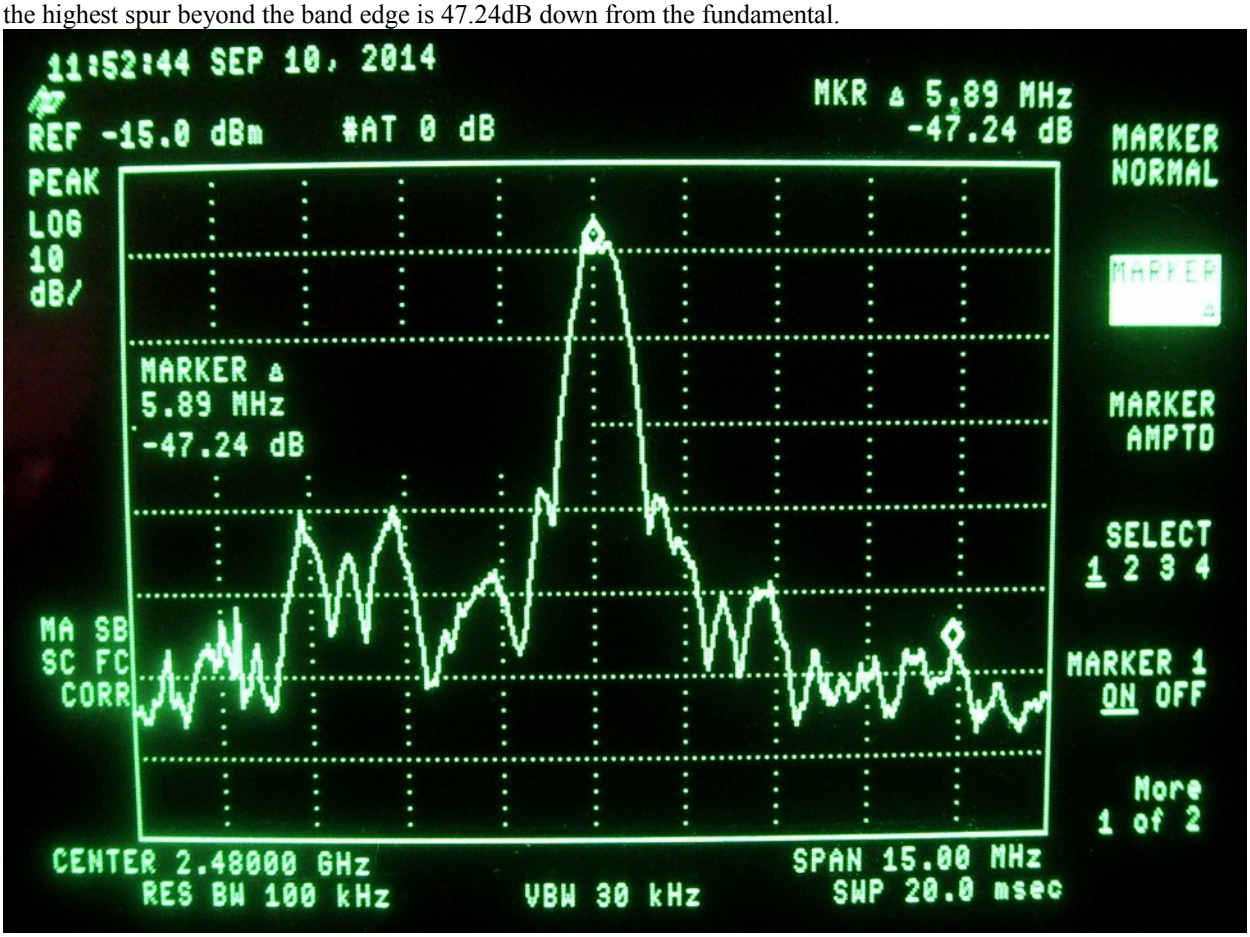
3.4.2. 2480 MHz Channel Band-Edge

The fundamental signal of the upper channel is 93.6dBuV/m. Because the limit at the band edge is 74dBuV/m, signals at the band edge must be 93.6 – 74 = **19.6dB down from the fundamental.**

The following plot shows the fundamental and the level at the band edge. The level at the band edge is 52.76dB down from the fundamental.



The following plot shows the fundamental and the level at the the highest spur beyond the band edge. The level at the highest spur beyond the band edge is 47.24dB down from the fundamental.



In summary, the spurious signals at the band edges pass the requirements.

3.5. FCC Part 15 §15.207

Conducted line emissions are shown in Exhibit I and show compliance with the limits.