



## Electromagnetic Compatibility Test Report

Tests Performed on a Delsys, Inc.

Wireless Sensor Transciever, Model SP-W06; System Model: DS-T03

Radiometrics Document RP-8506A1



*Product Detail:*

FCC ID: W4P-SP-W06  
ISED ID: 8138A-DST03  
Equipment type: DXX  
Low power transmitter 15.249

*Test Standards:*

US CFR Title 47, Chapter I, FCC Part 15 Subpart C  
FCC Part 15 CFR Title 47: 2016  
Industry Canada RSS-210, Issue 9

This report concerns: Original Grant for Certification

*Tests Performed For:*

**Delsys, Inc.**  
23 Strathmor Road  
Natick, Massachusetts 01760

*Test Facility:*

**Radiometrics Midwest Corporation**  
12 Devonwood Avenue  
Romeoville, IL 60446-1349  
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*Test Date(s): (Month-Day-Year)*

December 5 thru 13, 2016

Document RP-8506A1 Revisions:

| Rev. | Issue Date       | Affected Sections | Revised By        |
|------|------------------|-------------------|-------------------|
| 0    | October 13, 2017 |                   |                   |
| 1    | October 26, 2017 | 2.0, 11.2.1, 11.3 | Joseph Strzelecki |
|      |                  |                   |                   |

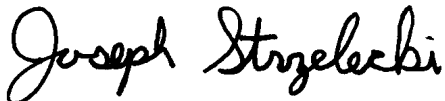
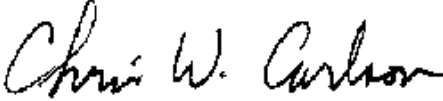
## Table of Contents

|                                                                 |    |
|-----------------------------------------------------------------|----|
| 1.0ADMINISTRATIVE DATA .....                                    | 3  |
| 2.0TEST SUMMARY AND RESULTS .....                               | 3  |
| 2.1 RF Exposure Compliance Requirements .....                   | 4  |
| 3.0EQUIPMENT UNDER TEST (EUT) DETAILS .....                     | 4  |
| 3.1 EUT Description .....                                       | 4  |
| 3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements .....   | 4  |
| 3.2 Related Submittals .....                                    | 4  |
| 4.0TESTED SYSTEM DETAILS .....                                  | 4  |
| 4.1 Tested System Configuration .....                           | 4  |
| 4.2 Special Accessories .....                                   | 4  |
| 4.3 Equipment Modifications .....                               | 5  |
| 5.0TEST SPECIFICATIONS .....                                    | 5  |
| 6.0TEST PROCEDURE DOCUMENTS .....                               | 5  |
| 7.0RADIOMETRICS' TEST FACILITIES .....                          | 5  |
| 8.0DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS ..... | 6  |
| 9.0CERTIFICATION .....                                          | 6  |
| 10.0TEST EQUIPMENT TABLE .....                                  | 6  |
| 11.0TEST SECTIONS .....                                         | 6  |
| 11.1 Radiated RF Emissions .....                                | 6  |
| 11.1.1 Field Strength Calculation .....                         | 7  |
| 11.1.2 Duty Cycle .....                                         | 7  |
| 11.2 Peak and Average Output Power .....                        | 8  |
| 11.2.1 Radiated Emissions Test Results .....                    | 10 |
| 11.3 Occupied Bandwidth Data .....                              | 12 |
| 11.4 Unintentional Emissions (Receive Mode) .....               | 14 |
| 11.4.1 Measurement Instrumentation Uncertainty .....            | 15 |

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Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03

**1.0 ADMINISTRATIVE DATA**

|                                                                                                                                                                                                                            |                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Equipment Under Test:</i><br>A Delsys, Inc., Trigno Avanti, Wireless Sensor<br>Sensor Model: SP-W06<br>System Model: DS-T03<br>Serial Number: none<br>This will be referred to as the EUT in this Report                |                                                                                                                                                                                                          |
| <i>Date EUT Received at Radiometrics: (Month-Day-Year)</i><br>December 5, 2016                                                                                                                                             | <i>Test Date(s): (Month-Day-Year)</i><br>December 5 thru 13, 2016                                                                                                                                        |
| <i>Test Report Written By:</i><br>Joseph Strzelecki<br>Senior EMC Engineer                                                                                                                                                 | <i>Test Witnessed By:</i><br>The tests were not witnessed by Delsys, Inc.<br>Delsys, Inc.                                                                                                                |
| <i>Radiometrics' Personnel Responsible for Test:</i><br><br>10/26/2017<br>Joseph Strzelecki<br>Senior EMC Engineer<br>NARTE EMC-000877-NE | <i>Test Report Approved By</i><br><br>10/26/2017<br>Chris W. Carlson<br>Director of Engineering<br>NARTE EMC-000921-NE |

**2.0 TEST SUMMARY AND RESULTS**

The EUT (Equipment Under Test) is an Wireless Sensor, Model SP-W06, manufactured by Delsys, Inc.. The detailed test results are presented in a separate section. The following is a summary of the test results.

**Emissions Tests Results**

| Environmental Phenomena | Frequency Range   | Basic Standard                       | Test Result |
|-------------------------|-------------------|--------------------------------------|-------------|
| RF Radiated Emissions   | 30-25,000 MHz     | FCC Part 15.249<br>RSS-210 & RSS-GEN | Pass        |
| Occupied Bandwidth Test | Fundamental Freq. | FCC Part 15<br>RSS-210 & RSS-GEN     | Pass        |

The model number of the Sensor is SP-W06. The system model number is DS-T03. This report has data for the Sensor only. The data for the base unit can be found in Radiometrics' report: "Delsys-6467-FCC-IC Rpt Rev3." The measurement results for the base station are shared from IC: 8138A-DST01 because the base station in system DST-01 and DST-03 are the same.

The Base station is FCC ID: W4P-SP-W02.

## 2.1 RF Exposure Compliance Requirements

Since the power output is less than 10 mW, the EUT meets the FCC requirement for RF exposure and it is exempt from RF exposure evaluations. There are no power level adjustments available to the end user. The antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

## 3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

### 3.1 EUT Description

The EUT is a wireless sensor, Model SP-W06, manufactured by Delsys, Inc. The EUT was in good working condition during the tests, with no known defects.

The EUT is an electronic dosimeter that measures the amount of radiation exposure that the wearer has encountered. It takes measurements periodically and sends the data to a base station via wireless transmission.

#### 3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the printed circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

### 3.2 Related Submittals

Delsys, Inc. is not submitting any other products simultaneously for equipment authorization related to the EUT.

## 4.0 TESTED SYSTEM DETAILS

### 4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm or 150cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

The EUT was tested as a stand-alone device. Power was supplied with a new battery.

The identification for all equipment used in the tested system, are:

**Tested System Configuration List**

| Item | Description                    | Type* | Manufacturer | Model Number | Serial Number |
|------|--------------------------------|-------|--------------|--------------|---------------|
| 1    | Trigno Avanti, Wireless Sensor | E     | Delsys, Inc. | SP-W06       | none          |

\* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

### 4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

### 4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

## 5.0 TEST SPECIFICATIONS

| Document              | Date | Title                                                                                                                 |
|-----------------------|------|-----------------------------------------------------------------------------------------------------------------------|
| FCC<br>CFR Title 47   | 2016 | Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices |
| IC RSS-210<br>Issue 9 | 2016 | Licence-Exempt Radio Apparatus: Category I Equipment                                                                  |
| IC RSS-Gen<br>Issue 4 | 2014 | General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)                  |

## 6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

| Document            | Date | Title                                                                                                                                |
|---------------------|------|--------------------------------------------------------------------------------------------------------------------------------------|
| ANSI<br>C63.4-2014  | 2014 | Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI<br>C63.10-2013 | 2013 | American National Standard for Testing Unlicensed Wireless Devices                                                                   |

## 7.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site ([www.radiomet.com](http://www.radiomet.com)). Radiometrics accreditation status can be verified at A2LA's web site ([www.a2la2.org](http://www.a2la2.org)).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6-inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry, Science and Economic Development Canada as site number IC 3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

## 8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

## 9.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

## 10.0 TEST EQUIPMENT TABLE

| RMC ID | Manufacturer    | Description       | Model No. | Serial No.               | Frequency Range | Cal Period | Cal Date |
|--------|-----------------|-------------------|-----------|--------------------------|-----------------|------------|----------|
| AMP-05 | RMC/Celeritek   | Pre-amplifier     | MW110G    | 1001                     | 1.0-12GHz       | 24 Mo.     | 10/06/15 |
| AMP-20 | Avantek         | Pre-amplifier     | SF8-0652  | 15221                    | 8-18GHz         | 12 Mo.     | 01/05/16 |
| AMP-22 | Anritsu         | Pre-amplifier     | MH648A    | M23969                   | 0.1-1200MHz     | 12 Mo.     | 01/05/16 |
| ANT-04 | Tensor          | Biconical Antenna | 4104      | 2246                     | 20-250MHz       | 24 Mo.     | 05/16/16 |
| ANT-06 | EMCO            | Log-Periodic Ant. | 3146      | 1248                     | 200-1000MHz     | 24 Mo.     | 11/25/15 |
| ANT-36 | EMCO            | Horn Antenna      | 3115      | 2502                     | 1.0-18GHz       | 24 Mo.     | 11/02/16 |
| ANT-48 | RMC             | Std. Gain Horn    | HW2020    | 1001                     | 18-26.5 GHz     | 24 Mo.     | 12/15/15 |
| MXR-02 | HP / Agilent    | Harmonic Mixer    | 11970K    | 2332A00489               | 18-26.5GHz      | 12 Mo.     | 01/08/16 |
| REC-08 | Hewlett Packard | Spectrum Analyzer | 8566B     | 2648A13481<br>2209A01436 | 30Hz-22GHz      | 24 Mo.     | 12/21/15 |
| REC-21 | Agilent         | Spectrum Analyzer | E7405A    | MY45118341               | 9Hz-26.5 GHz    | 24 Mo.     | 12/22/15 |
| THM-03 | Fluke           | Temp/Humid Meter  | 971       | 95850465                 | N/A             | 12 Mo.     | 01/11/16 |

Note: All calibrated equipment is subject to periodic checks.

| Software Company | Test Software Name | Version  | Applicable Tests                                  |
|------------------|--------------------|----------|---------------------------------------------------|
| Radiometrics     | RRECE11D           | 01.05.16 | RF Radiated Emissions (FCC Part 15 & EN 55011/22) |
| Agilent          | PSA/ESA-E/L/EMC    | 2.4.0.42 | Bandwidth and screen shots                        |

## 11.0 TEST SECTIONS

### 11.1 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

The EUT was rotated through three orthogonal axis as per 5.10.1 of ANSI C63.10 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 25,000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

### 11.1.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

$$FS = RA + AF + CF - AG + HPF + PKA$$

Where: FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

PKA = Peak to Average Factor (This is only used for average measurements above 1 GHz)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is  $20 \cdot \log(\text{Duty cycle mS}/100 \text{ mS})$ .

Note: The actual FCC limits are in  $\mu\text{V}/\text{m}$ . The data in the results table converted the limits to dBuV/m.

100  $\mu\text{V}/\text{m}$  = 40.0 dBuV/m

150  $\mu\text{V}/\text{m}$  = 43.5 dBuV/m

200  $\mu\text{V}/\text{m}$  = 46.0 dBuV/m

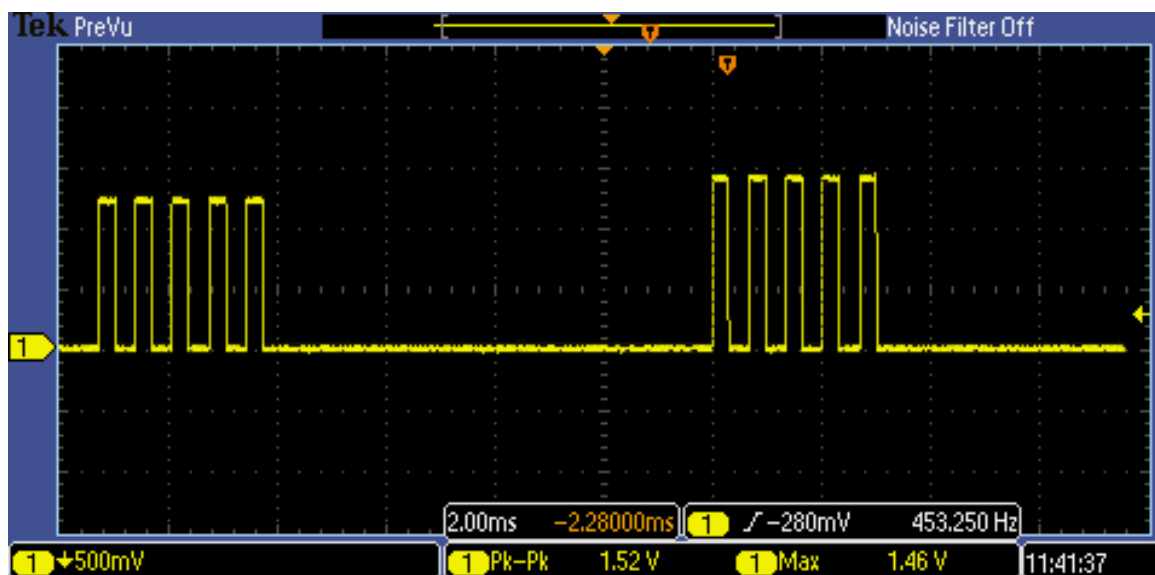
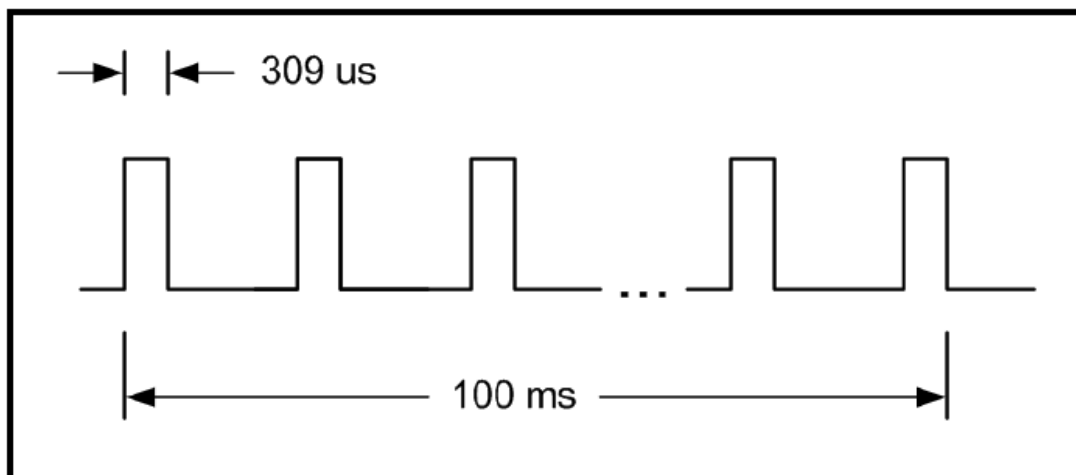
500  $\mu\text{V}/\text{m}$  = 54.0 dBuV/m

### 11.1.2 Duty Cycle

In accordance to 7.5 of ANSI C63.10 the following procedures were used. The average value of the pulsed emissions were measured as per section 7.5, formula (10) of ANSI C63.10-2013.

The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is  $20 \cdot \log(\text{Duty cycle}/100)$ . The transmitter operates for a maximum duration of 15.1 ms in any 100 ms interval for a 15.1% maximum duty cycle.  $20 \log(\text{mSec}/100\text{mSec}) = -16.4 \text{ dB}$  Peak to average Correction factor.

The EUT was set to the "worst-case" pulse ON time. The RF output connect to the input of an Oscilloscope via a Crystal detector. The 100 ms period that contains the maximum number of pulses was found to be 49. The duty cycle was determined by dividing the total maximum "ON time" by 100 ms ( $t_{\text{ON}}/100 \text{ ms}$ ).



This shows the duty cycle over

$$\text{Duty cycle} = ((49 \times 0.309) / 100) \text{ mSec} = 15.1\%$$

In its highest duty cycle mode, the transmitter sends the data in 0.309 mSec bursts. At most, there are 49 of these transmission in any 100 mSec, for a maximum transmitter duty cycle of 15.1%.

The duty cycle correction factor was used applying Equation (10) of ANSI C63.10 to the duty cycle determined in the preceding steps.

## 11.2 Peak and Average Output Power

The power output test method from ANSI C63.10-2013 section 11.9.1.1 was used for this test. The spectrum analyzer was set to peak channel power with a span of 20 MHz. The EUT antenna port was connected to the Spectrum analyzer Via a low loss coaxial cable. The trace was allowed to stabilize. The indicated level is the peak output power.

Span = 25 MHz; RBW = 1 MHz; VBW = 3 MHz

Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03

Tested by: Joseph Strzelecki/ Richard Tichgelaar

Test Date: December 13, 2016

**Peak Power**

| Frequency<br>(MHz) | Spec An<br>Reading<br>(dBm) | Attenuator<br>& cable<br>Loss (dB) | Peak Power (dBm) |        |
|--------------------|-----------------------------|------------------------------------|------------------|--------|
|                    |                             |                                    | dBm              | Watts  |
| 2402               | -7.29                       | 20.25                              | 12.96            | 0.0198 |
| 2440               | -7.23                       | 20.25                              | 13.02            | 0.0200 |
| 2480               | -7.25                       | 20.25                              | 13.00            | 0.0200 |

**Average Power**

| Frequency<br>MHz | Spec An<br>Reading<br>dBm | Attenuator &<br>cable Loss<br>dB | Peak<br>mW | Duty<br>Cycle<br>% | Average |         |
|------------------|---------------------------|----------------------------------|------------|--------------------|---------|---------|
|                  |                           |                                  |            |                    | mW      | W       |
| 2402             | -7.29                     | 20.25                            | 19.77      | 15.1               | 2.99    | 0.00299 |
| 2440             | -7.23                     | 20.25                            | 20.04      | 15.1               | 3.03    | 0.00303 |
| 2480             | -7.25                     | 20.25                            | 19.95      | 15.1               | 3.01    | 0.00301 |

This is used for RF exposure calculations, so there are no limits

Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03

**11.2.1 Radiated Emissions Test Results**

|               |                                                                            |
|---------------|----------------------------------------------------------------------------|
| Test Date     | 12/09 & 12/12/2016                                                         |
| Test Distance | 3 Meters                                                                   |
| Specification | FCC Part 15 Subpart C & RSS-GEN & RSS-210                                  |
| Abbreviations | Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP |

All emissions except Fundamental and harmonics; Emissions in Transmit Mode

| Freq. MHz | Meter Reading dBuV | Dect. | Ant. Pol. | Ant Factor | Cable & Amp Factors | Dist. Fact dB | EUT dBuV/m | Limit dBuV/m | Margin Under Limit dB | Note |
|-----------|--------------------|-------|-----------|------------|---------------------|---------------|------------|--------------|-----------------------|------|
| 33.3      | 40.7               | P     | H         | 11.4       | -28.3               | 0.0           | 23.8       | 40.0         | 16.2                  |      |
| 112.5     | 34.1               | P     | H         | 12.4       | -27.8               | 0.0           | 18.6       | 43.5         | 24.9                  |      |
| 126.8     | 35.2               | P     | H         | 12.0       | -27.8               | 0.0           | 19.5       | 43.5         | 24.0                  |      |
| 130.1     | 33.6               | P     | H         | 11.8       | -27.7               | 0.0           | 17.7       | 43.5         | 25.8                  |      |
| 193.4     | 32.0               | P     | H         | 16.9       | -27.5               | 0.0           | 21.4       | 43.5         | 22.1                  |      |
| 250.0     | 31.0               | P     | H         | 17.0       | -27.3               | 0.0           | 20.7       | 46.0         | 25.3                  |      |
| 443.8     | 30.6               | P     | H         | 16.0       | -27.1               | 0.0           | 19.5       | 46.0         | 26.5                  |      |
| 496.3     | 30.9               | P     | H         | 17.4       | -26.9               | 0.0           | 21.3       | 46.0         | 24.7                  |      |
| 691.3     | 29.9               | P     | H         | 21.2       | -26.2               | 0.0           | 24.9       | 46.0         | 21.1                  |      |
| 912.5     | 30.2               | P     | H         | 22.5       | -24.8               | 0.0           | 27.9       | 46.0         | 18.1                  |      |
| 2000.0    | 41.0               | P     | H         | 27.6       | -34.3               | 0.0           | 34.2       | 74.0         | 39.8                  | 1    |
| 2367.5    | 45.3               | P     | H         | 28.2       | -33.9               | 0.0           | 39.5       | 74.0         | 34.5                  | 1    |
| 2410.0    | 48.3               | P     | H         | 28.4       | -33.9               | 0.0           | 42.9       | 74.0         | 31.1                  | 1    |
| 2487.5    | 44.2               | P     | H         | 28.7       | -34.0               | 0.0           | 38.9       | 74.0         | 35.1                  | 1    |
| 2530.0    | 44.5               | P     | H         | 28.8       | -33.8               | 0.0           | 39.5       | 74.0         | 34.5                  | 1    |
| 2965.0    | 43.1               | P     | H         | 29.8       | -33.2               | 0.0           | 39.8       | 74.0         | 34.2                  | 1    |
| 3202.5    | 39.5               | P     | H         | 30.8       | -32.9               | 0.0           | 37.5       | 74.0         | 36.5                  | 1    |
| 32.8      | 46.3               | P     | V         | 11.3       | -28.3               | 0.0           | 29.3       | 40.0         | 10.7                  |      |
| 53.1      | 39.8               | P     | V         | 10.8       | -28.2               | 0.0           | 22.4       | 40.0         | 17.6                  |      |
| 75.7      | 38.9               | P     | V         | 6.3        | -28.0               | 0.0           | 17.2       | 40.0         | 22.8                  |      |
| 114.2     | 41.4               | P     | V         | 12.5       | -27.8               | 0.0           | 26.1       | 43.5         | 17.4                  |      |
| 120.8     | 42.0               | P     | V         | 12.4       | -27.8               | 0.0           | 26.6       | 43.5         | 16.9                  |      |
| 132.9     | 37.3               | P     | V         | 11.7       | -27.7               | 0.0           | 21.3       | 43.5         | 22.2                  |      |
| 193.4     | 40.4               | P     | V         | 16.9       | -27.5               | 0.0           | 29.8       | 43.5         | 13.7                  |      |
| 247.3     | 40.0               | P     | V         | 16.6       | -27.3               | 0.0           | 29.3       | 46.0         | 16.7                  |      |
| 383.1     | 31.2               | P     | V         | 15.2       | -27.2               | 0.0           | 19.2       | 46.0         | 26.8                  |      |
| 490.6     | 29.8               | P     | V         | 17.3       | -26.8               | 0.0           | 20.3       | 46.0         | 25.7                  |      |
| 536.3     | 31.2               | P     | V         | 16.9       | -26.4               | 0.0           | 21.7       | 46.0         | 24.3                  |      |
| 766.3     | 31.8               | P     | V         | 21.1       | -26.0               | 0.0           | 26.9       | 46.0         | 19.1                  |      |
| 922.5     | 29.8               | P     | V         | 22.8       | -24.8               | 0.0           | 27.8       | 46.0         | 18.2                  |      |
| 1132.5    | 43.2               | P     | V         | 24.8       | -34.5               | 0.0           | 33.4       | 74.0         | 40.6                  | 1    |
| 1550.0    | 42.5               | P     | V         | 25.6       | -34.5               | 0.0           | 33.7       | 74.0         | 40.3                  | 1    |
| 2367.5    | 51.7               | P     | V         | 28.2       | -33.9               | 0.0           | 46.0       | 74.0         | 28.0                  | 1    |
| 2407.5    | 49.7               | P     | V         | 28.4       | -33.9               | 0.0           | 44.2       | 74.0         | 29.8                  | 1    |
| 2490.0    | 46.2               | P     | V         | 28.7       | -33.9               | 0.0           | 40.9       | 74.0         | 33.1                  | 1    |
| 2530.0    | 46.4               | P     | V         | 28.8       | -33.8               | 0.0           | 41.5       | 74.0         | 32.5                  | 1    |
| 2567.5    | 48.7               | P     | V         | 28.8       | -33.7               | 0.0           | 43.9       | 74.0         | 30.1                  | 1    |
| 2577.5    | 44.6               | P     | V         | 28.9       | -33.6               | 0.0           | 39.9       | 74.0         | 34.1                  | 1    |
| 2597.5    | 43.4               | P     | V         | 28.9       | -33.6               | 0.0           | 38.7       | 74.0         | 35.3                  | 1    |
| 3285.0    | 40.4               | P     | V         | 31.0       | -32.8               | 0.0           | 38.6       | 74.0         | 35.4                  | 1    |

Note 1: Peak Reading under the Average limit

Judgment: Passed by at least 10.7 dB

No other emissions were detected within 10 dB of the limits.

Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03

## Fundamental and Harmonic Emissions FCC 15.249; Three axis tested

|                                             |      | Spectrum Analyzer Readings |       |       |      |                         |       |       |      |       | EUT      | Peak    | Ave    | Peak  | Ave | Margin |
|---------------------------------------------|------|----------------------------|-------|-------|------|-------------------------|-------|-------|------|-------|----------|---------|--------|-------|-----|--------|
| hrm                                         | Tx   | Peak                       |       | Ave   |      | Peak                    |       | Ave   |      | Corr. | Emission | Tot. FS |        | Limit |     | Under  |
| #                                           | Freq | Vertical Polarization      |       |       |      | Horizontal Polarization |       |       |      | Fact. | Freq MHz | dBuV/m  | dBuV/m | Limit |     |        |
|                                             |      | X                          | Y     | Z     | Max  | X                       | Y     | Z     | Max  |       |          |         |        |       |     |        |
| 1                                           | 2402 | 103.0                      | 104.9 | 112.6 | 96.2 | 108.3                   | 108.3 | 104.1 | 91.9 | -5.9  | 2402.0   | 106.7   | 90.3   | 114   | 94  | 3.7    |
| BE                                          | 2402 | 43.0                       | 44.9  | 52.6  | 36.2 | 48.3                    | 48.3  | 44.1  | 31.9 | 0.0   | 2400.0   | 52.6    | 36.2   | 74    | 54  | 17.8   |
| 2                                           | 2402 | 44.2                       | 53.9  | 46.0  | 37.5 | 45.1                    | 43.8  | 47.8  | 31.4 | 3.4   | 4804.0   | 57.3    | 40.9   | 74    | 54  | 13.1   |
| 3                                           | 2402 | 43.5                       | 41.4  | 38.5  | 27.1 | 37.9                    | 38.4  | 40.2  | 23.8 | 7.2   | 7206.0   | 50.7    | 34.3   | 74    | 54  | 19.7   |
| 4                                           | 2402 | 37.5                       | 39.8  | 35.7  | 23.4 | 38.7                    | 37.5  | 40.9  | 24.5 | 14.0  | 9608.0   | 54.9    | 38.5   | 74    | 54  | 15.5   |
| 1                                           | 2440 | 102.4                      | 101.0 | 111.6 | 95.2 | 103.9                   | 105.0 | 97.8  | 88.6 | -5.2  | 2440.0   | 106.4   | 90.0   | 114   | 94  | 4.0    |
| 2                                           | 2440 | 44.7                       | 54.2  | 45.1  | 37.8 | 46.8                    | 44.2  | 50.6  | 34.2 | 3.6   | 4880.0   | 57.8    | 41.4   | 74    | 54  | 12.6   |
| 3                                           | 2440 | 39.5                       | 42.2  | 38.6  | 25.8 | 37.8                    | 38.2  | 39.7  | 23.3 | 7.6   | 7320.0   | 49.8    | 33.4   | 74    | 54  | 20.6   |
| 4                                           | 2440 | 37.9                       | 39.9  | 41.9  | 25.5 | 36.8                    | 37.4  | 37.1  | 21.0 | 14.5  | 9760.0   | 56.4    | 40.0   | 74    | 54  | 14.0   |
| 1                                           | 2480 | 100.1                      | 99.6  | 110.1 | 93.7 | 103.9                   | 103.4 | 98.7  | 87.5 | -5.3  | 2480.0   | 104.8   | 88.4   | 114   | 94  | 5.6    |
| BE                                          | 2480 | 45.1                       | 44.6  | 55.1  | 38.7 | 48.9                    | 48.4  | 43.7  | 32.5 | 0.0   | 2483.5   | 55.1    | 38.7   | 74    | 54  | 15.3   |
| 2                                           | 2480 | 45.6                       | 53.2  | 52.2  | 36.8 | 47.8                    | 46.0  | 52.2  | 35.8 | 3.8   | 4960.0   | 57.0    | 40.6   | 74    | 54  | 13.4   |
| 3                                           | 2480 | 38.2                       | 41.4  | 39.7  | 25.0 | 38.6                    | 37.8  | 39.7  | 23.3 | 8.1   | 7440.0   | 49.5    | 33.1   | 74    | 54  | 20.9   |
| 4                                           | 2480 | 36.2                       | 35.1  | 37.0  | 20.6 | 37.4                    | 36.2  | 35.8  | 21.0 | 14.4  | 9920.0   | 51.8    | 35.4   | 74    | 54  | 18.6   |
| Column numbers (see below for explanations) |      |                            |       |       |      |                         |       |       |      |       |          |         |        |       |     |        |
| 1                                           | 2    | 3                          | 4     | 5     | 6    | 7                       | 8     | 9     | 10   | 11    | 12       | 13      | 14     | 15    | 16  | 17     |

Column #1. hrm = Harmonic; BE = Band Edge emissions

Column #2. Frequency of Transmitter.

Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #6. Average Reading based on peak reading reduced by the Duty cycle correction

Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #10. Average Reading based on peak reading reduced by the Duty cycle correction

Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor

Column #12. Frequency of Tested Emission

Column #13. Highest peak field strength at listed frequency.

Column #14. Highest Average field strength at listed frequency.

Column #15. Peak Limit. (Fundamental limit is 15.249, Harmonics are 15.209)

Column #16. Average Limit. (Fundamental limit is 15.249, Harmonics are 15.209)

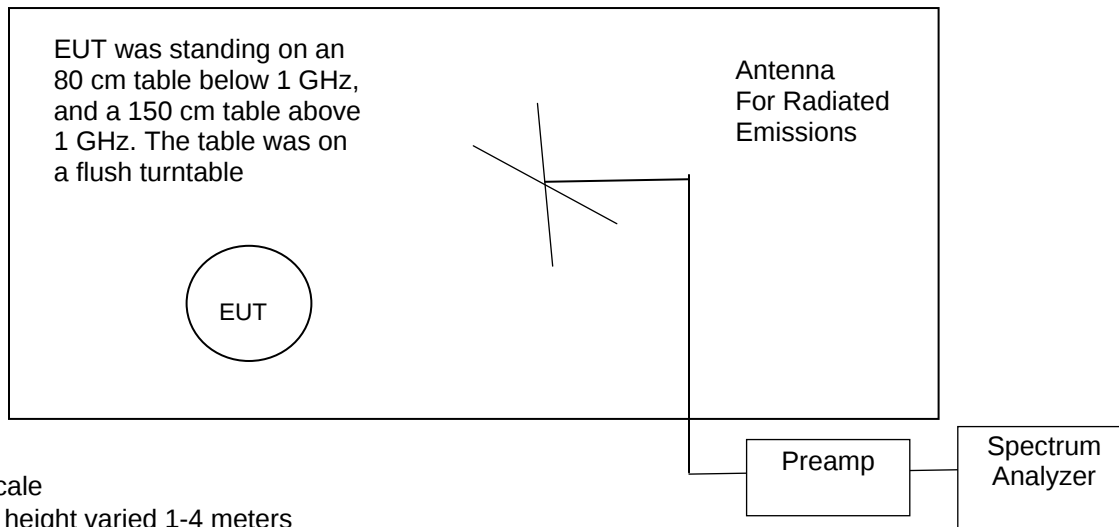
Column #17. The margin (last column) is the worst case margin under the peak or average limits for that row.

Overall Judgment: Passed by at least 3.7 dB

No other Emissions were detected from 30 to 25,000 MHz within 10 dB of the limits.

**Figure 1. Drawing of Radiated Emissions Setup**

Chamber E, anechoic

**Notes:**

- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

| Frequency Range | Receive Antenna | Pre-Amplifier | Spectrum Analyzer |
|-----------------|-----------------|---------------|-------------------|
| 30 to 200 MHz   | ANT-04          | AMP-22        | REC-11            |
| 200 to 1000 MHz | ANT-06          | AMP-22        | REC-11            |
| 1 to 10 GHz     | ANT-36          | AMP-05        | REC-11            |
| 10 to 18 GHz    | ANT-36          | AMP-20        | REC-11            |
| 18 to 25 GHz    | ANT-48          | AMP-29        | REC-08; MXR-01    |

**11.3 Occupied Bandwidth Data**

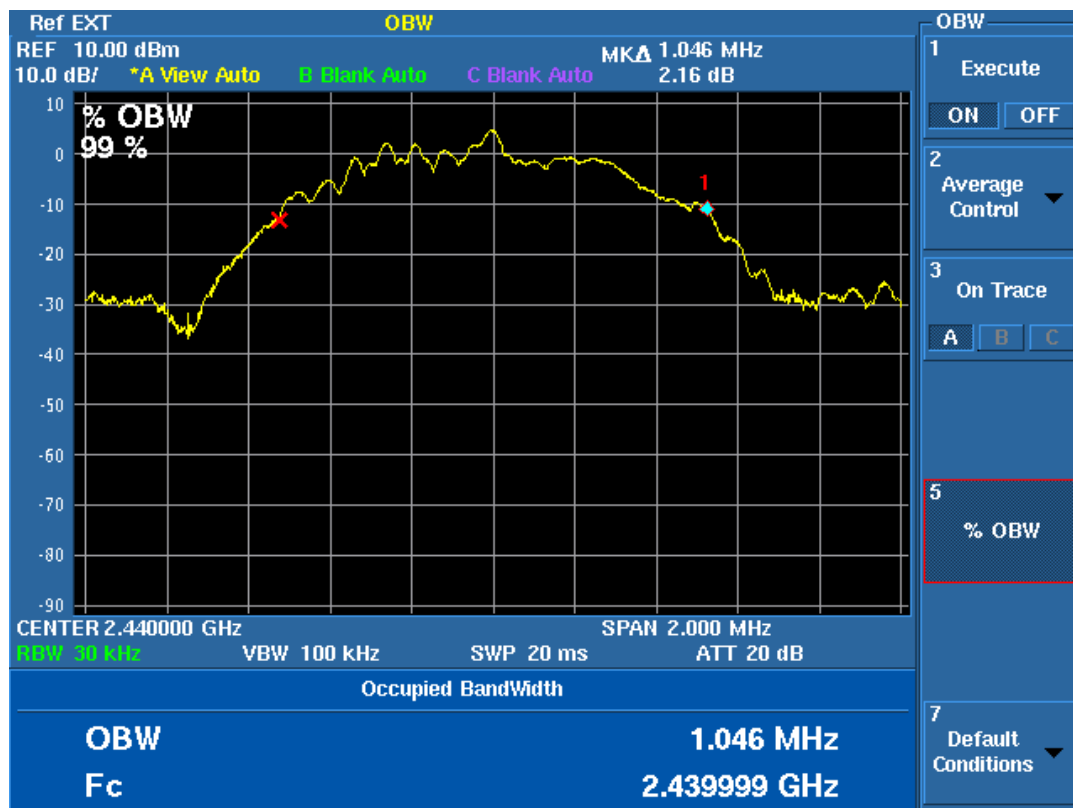
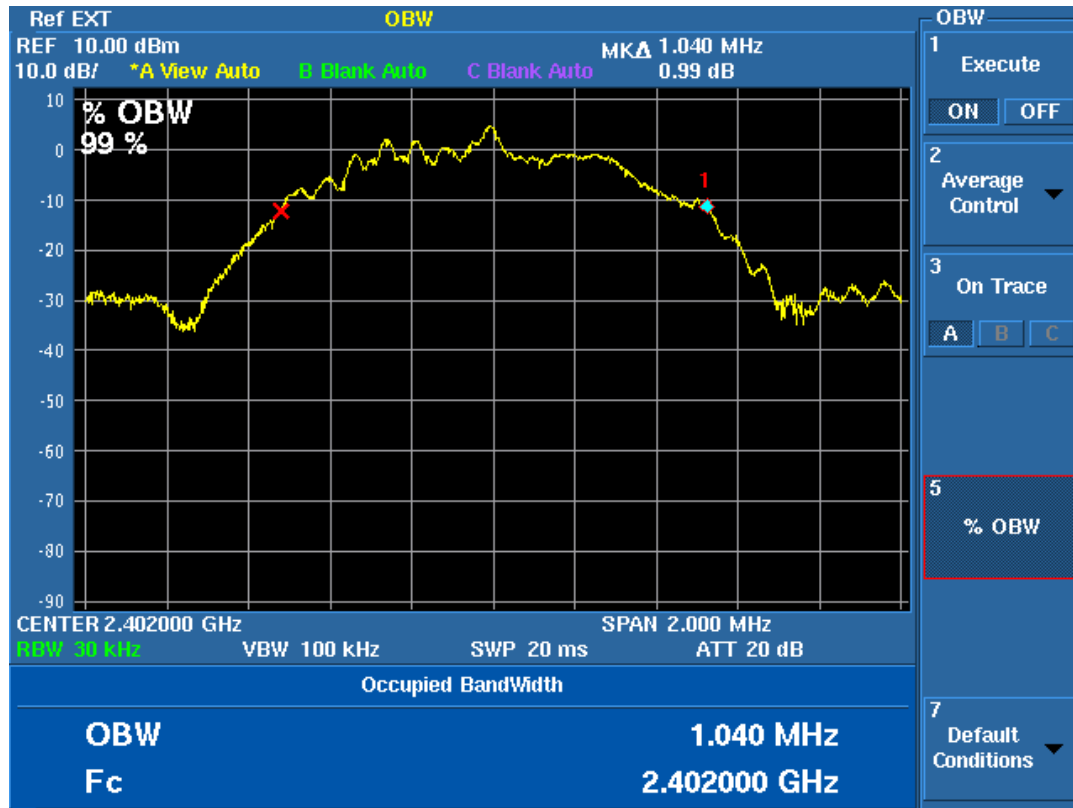
The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

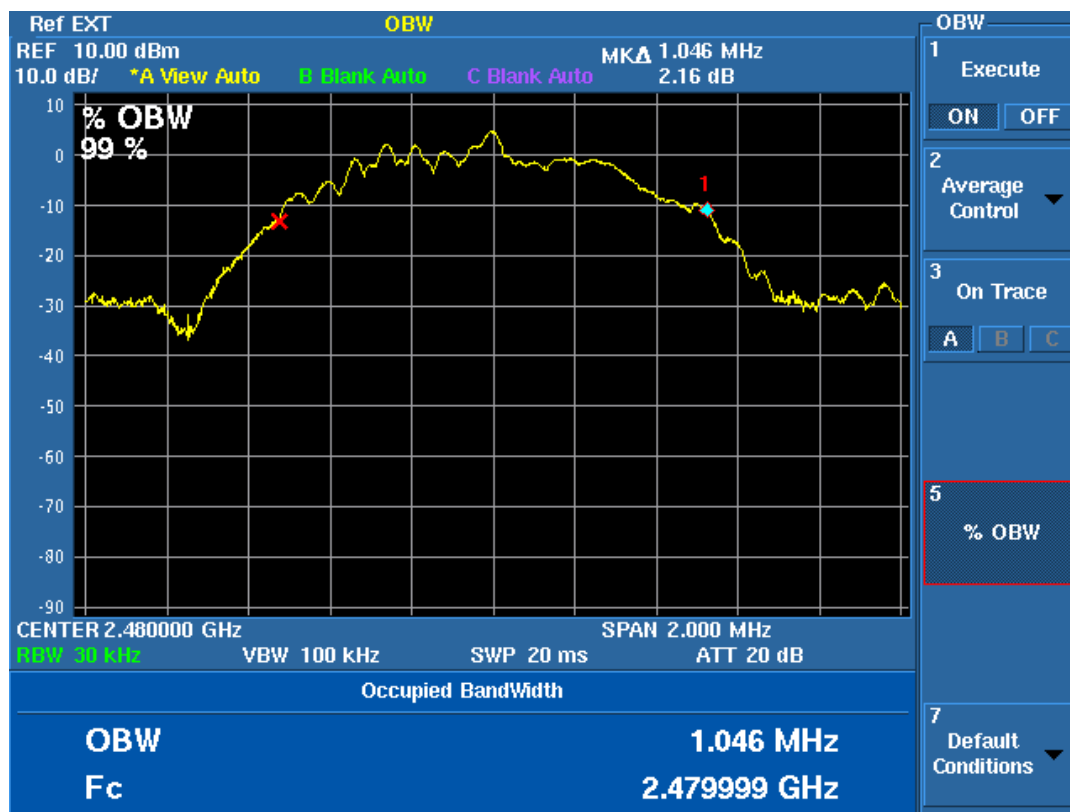
| Channel MHz | 99% EBW MHz |
|-------------|-------------|
| 2402        | 1.040       |
| 2440        | 1.046       |
| 2480        | 1.046       |

Judgement: Pass

Figure 2. Occupied Bandwidth Plots



Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03



#### 11.4 Unintentional Emissions (Receive Mode)

|               |                                                                            |               |                           |
|---------------|----------------------------------------------------------------------------|---------------|---------------------------|
| Manufacturer  | Delsys                                                                     | Specification | FCC Part 15.209 & RSS-GEN |
| Model         | SP-W06                                                                     | Test Date     | 12/12/2016                |
| Serial Number | None                                                                       | Test Distance | 3 Meters                  |
| Abbreviations | Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP |               |                           |
| Configuration | Receive mode                                                               |               |                           |

| Freq. MHz | Meter Reading dBuV | Dect. | Ant. Pol. | Ant Factor | Cable & Amp Factors | Dist. Fact dB | EUT dBuV/m | Limit dBuV/m | Margin Under Limit dB | Note |
|-----------|--------------------|-------|-----------|------------|---------------------|---------------|------------|--------------|-----------------------|------|
| 31.1      | 33.1               | P     | H         | 11.2       | -28.3               | 0.0           | 16.0       | 40.0         | 24.0                  |      |
| 32.2      | 40.8               | P     | H         | 11.3       | -28.3               | 0.0           | 23.8       | 40.0         | 16.2                  |      |
| 65.8      | 35.5               | P     | H         | 7.6        | -28.1               | 0.0           | 15.0       | 40.0         | 25.0                  |      |
| 93.8      | 35.4               | P     | H         | 10.6       | -27.9               | 0.0           | 18.1       | 43.5         | 25.4                  |      |
| 121.3     | 33.4               | P     | H         | 12.3       | -27.8               | 0.0           | 17.9       | 43.5         | 25.6                  |      |
| 187.9     | 35.6               | P     | H         | 17.1       | -27.5               | 0.0           | 25.2       | 43.5         | 18.3                  |      |
| 250.0     | 31.0               | P     | H         | 17.0       | -27.3               | 0.0           | 20.8       | 46.0         | 25.2                  |      |
| 376.9     | 30.9               | P     | H         | 14.7       | -27.1               | 0.0           | 18.5       | 46.0         | 27.5                  |      |
| 459.4     | 32.0               | P     | H         | 16.1       | -27.0               | 0.0           | 21.1       | 46.0         | 24.9                  |      |
| 505.0     | 30.8               | P     | H         | 17.7       | -27.0               | 0.0           | 21.5       | 46.0         | 24.5                  |      |
| 625.0     | 30.9               | P     | H         | 18.8       | -26.5               | 0.0           | 23.2       | 46.0         | 22.8                  |      |
| 841.3     | 30.3               | P     | H         | 21.8       | -25.4               | 0.0           | 26.7       | 46.0         | 19.3                  |      |
| 1165.0    | 46.4               | P     | H         | 25.1       | -34.6               | 0.0           | 36.9       | 74.0         | 37.1                  | 1    |
| 1177.5    | 46.6               | P     | H         | 25.2       | -34.6               | 0.0           | 37.2       | 74.0         | 36.8                  | 1    |
| 1402.5    | 44.0               | P     | H         | 25.6       | -34.6               | 0.0           | 35.0       | 74.0         | 39.0                  | 1    |
| 1777.5    | 45.6               | P     | H         | 26.8       | -34.4               | 0.0           | 38.0       | 74.0         | 36.0                  | 1    |
| 2027.5    | 41.6               | P     | H         | 27.6       | -34.2               | 0.0           | 35.0       | 74.0         | 39.0                  | 1    |

Testing of the Delsys, Inc., Model SP-W06, Wireless Sensor; System Model: DS-T03

| Freq. MHz | Meter Reading dBuV | Dect. | Ant. Pol. | Ant Factor | Cable & Amp Factors | Dist. Fact dB | EUT dBuV/m | Limit dBuV/m | Margin Under Limit dB | Note |
|-----------|--------------------|-------|-----------|------------|---------------------|---------------|------------|--------------|-----------------------|------|
| 2412.5    | 49.3               | P     | H         | 28.4       | -33.8               | 0.0           | 43.8       | 74.0         | 30.2                  | 1    |
| 2982.5    | 40.6               | P     | H         | 29.9       | -33.1               | 0.0           | 37.4       | 74.0         | 36.6                  | 1    |
| 3055.0    | 41.3               | P     | H         | 30.3       | -33.1               | 0.0           | 38.6       | 74.0         | 35.4                  | 1    |
| 30.5      | 30.6               | P     | V         | 11.1       | -28.4               | 0.0           | 13.4       | 40.0         | 26.6                  |      |
| 35.0      | 44.0               | P     | V         | 11.5       | -28.3               | 0.0           | 27.2       | 40.0         | 12.8                  |      |
| 44.3      | 35.1               | P     | V         | 12.0       | -28.3               | 0.0           | 18.8       | 40.0         | 21.2                  |      |
| 73.4      | 35.0               | P     | V         | 6.4        | -28.0               | 0.0           | 13.4       | 40.0         | 26.6                  |      |
| 105.3     | 42.1               | P     | V         | 12.2       | -27.8               | 0.0           | 26.4       | 43.5         | 17.1                  |      |
| 110.8     | 42.8               | P     | V         | 12.4       | -27.8               | 0.0           | 27.4       | 43.5         | 16.1                  |      |
| 162.6     | 33.4               | P     | V         | 15.3       | -27.6               | 0.0           | 21.1       | 43.5         | 22.4                  |      |
| 226.9     | 36.7               | P     | V         | 14.5       | -27.4               | 0.0           | 23.8       | 46.0         | 22.2                  |      |
| 233.5     | 36.4               | P     | V         | 14.9       | -27.4               | 0.0           | 23.9       | 46.0         | 22.1                  |      |
| 246.7     | 37.8               | P     | V         | 16.5       | -27.3               | 0.0           | 27.0       | 46.0         | 19.0                  |      |
| 274.4     | 34.7               | P     | V         | 13.0       | -27.3               | 0.0           | 20.4       | 46.0         | 25.6                  |      |
| 322.5     | 36.0               | P     | V         | 13.7       | -27.3               | 0.0           | 22.4       | 46.0         | 23.6                  |      |
| 379.4     | 34.1               | P     | V         | 14.9       | -27.2               | 0.0           | 21.9       | 46.0         | 24.1                  |      |
| 465.6     | 32.4               | P     | V         | 16.7       | -26.9               | 0.0           | 22.2       | 46.0         | 23.8                  |      |
| 491.9     | 30.4               | P     | V         | 17.3       | -26.8               | 0.0           | 20.8       | 46.0         | 25.2                  |      |
| 627.5     | 34.2               | P     | V         | 18.9       | -26.5               | 0.0           | 26.6       | 46.0         | 19.4                  |      |
| 863.8     | 32.4               | P     | V         | 23.0       | -25.3               | 0.0           | 30.2       | 46.0         | 15.8                  |      |
| 1067.5    | 52.5               | P     | V         | 24.2       | -34.5               | 0.0           | 42.3       | 74.0         | 31.7                  | 1    |
| 1082.5    | 52.3               | P     | V         | 24.3       | -34.6               | 0.0           | 42.1       | 74.0         | 31.9                  | 1    |
| 1120.0    | 51.5               | P     | V         | 24.6       | -34.5               | 0.0           | 41.5       | 74.0         | 32.5                  | 1    |
| 1242.5    | 49.2               | P     | V         | 25.5       | -34.7               | 0.0           | 40.0       | 74.0         | 34.0                  | 1    |
| 1275.0    | 49.4               | P     | V         | 25.5       | -34.7               | 0.0           | 40.3       | 74.0         | 33.7                  | 1    |
| 1285.0    | 48.8               | P     | V         | 25.6       | -34.7               | 0.0           | 39.7       | 74.0         | 34.3                  | 1    |
| 1462.5    | 45.7               | P     | V         | 25.5       | -34.6               | 0.0           | 36.6       | 74.0         | 37.4                  | 1    |
| 1582.5    | 44.7               | P     | V         | 25.8       | -34.4               | 0.0           | 36.1       | 74.0         | 37.9                  | 1    |
| 2410.0    | 49.6               | P     | V         | 28.4       | -33.9               | 0.0           | 44.1       | 74.0         | 29.9                  | 1    |
| 3617.5    | 41.0               | P     | V         | 31.5       | -32.6               | 0.0           | 39.9       | 74.0         | 34.1                  | 1    |

Judgment: Passed by 12.8 dB.

No other emissions were detected from 1 to 13 GHz within 10 dB of the limits.

**11.4.1 Measurement Instrumentation Uncertainty**

| Measurement                                            | Uncertainty |
|--------------------------------------------------------|-------------|
| Radiated Emissions, E-field, 3 meters, 30 to 200 MHz   | 3.3 dB      |
| Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz | 4.9 dB      |
| Radiated Emissions, E-field, 3 meters, 1 to 18 GHz     | 4.8 dB      |
| Radiated Emissions, E-field, 3 meters, 18 to 26 GHz    | 5.3 dB      |
| Bandwidth using marker delta method at a span of 4 MHz | 4 kHz       |
| Temperature THM-02                                     | 0.6 Deg C   |

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.