PSM Training ECHO

User Guide

Contacts

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Version	Description
2012-05-14	Initial Release
2012-06-15	Updates for OmniSense 3.3.11
2012-07-06	Move configuration and firmware upgrade details to OmniSense Live Help file
2012-11-06	Add GPS Support, move log format descriptions to separate document
2013-01-22	Add repeater description
2013-03-21	Update repeater battery life
2013-07-03	Add BioModule configuration for GPS
2014-FEB-11	Minor corrections and edits

Contents

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Glossary of Terms

AT	Anaerobic Threshold – closely associated with 2nd ventilatory threshold
BPM	Beats per minute (Heart rate) or Breaths per minute (Breathing rate)
BR	Breathing Rate
BT	Bluetooth®
ECG /EKG	Electro Cardio Gram
ECHO	2.4 GHz 802.15.4 Radio Network type used by this system
Gateway	Receiver device connected to PC
HR	Heart Rate
HR max	Maximum heart rate of an individual subject
LED	Light Emitting Diode
KML	Keyhole Markup Language – Google Earth File Format
PC	Personal Computer
PSM	Physiological Status Monitoring [system]
RH	Relative Humidity
RID	Zephyr™ Radio Interface Device
ROG	Red / Orange / Green[subject physiological status indication]
USB	Universal Serial Bus – PC hardware connection
VMU	Velocity Magnitude Unit – a measure of activity level (in g) over a fixed time interval

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1. Introduction

This document contains information required to operate the Zephyr™ PSM Training system incorporating OmniSense Application software, using Zephyr components which support the ECHO radio network type.

1.1 System Description

The PSM Training System is a remote physiological monitoring system that utilizes Zephyr's patented BioHarness™ product. The BioHarness™ allows the measurement of:

- Heart Rate
- Breathing Rate
- Activity level
- Subject orientation (posture)
- Estimated Core Temperature
- A variety of physiological parameters using automated fitness tests – details are in the *OmniSense Analysis Help file*

Data from the BioHarness™ is used to generate a color-coded Subject Status indication (ROG):

- Green
- Orange
- Red

Data is relayed over a radio network. This configuration will support a maximum of 50 subjects.

Individual subject data is updated every 2.5 seconds.

Specific BioHarness 3.0 hardware is required for a PSM Training system. This hardware is dual Bluetooth/ECHO.

The ECHO system does not support Bluetooth-only BioHarness modules.

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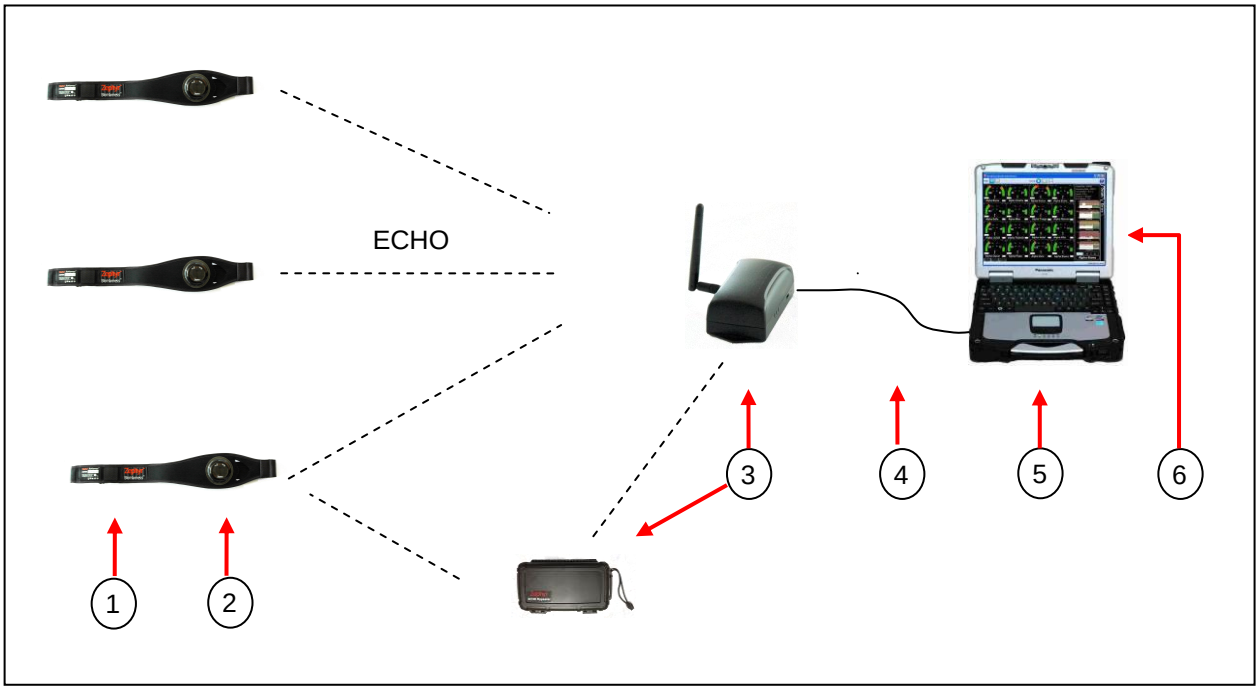
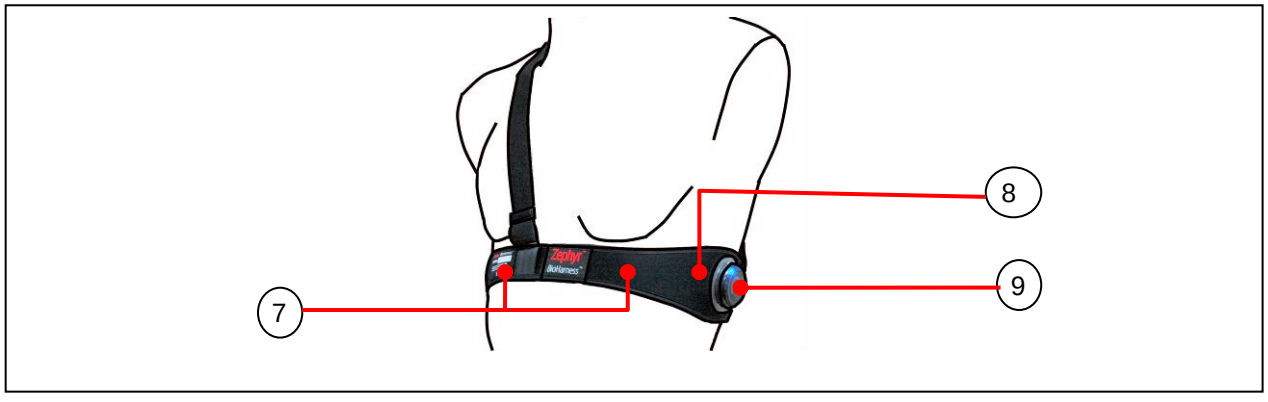
1.2 System Diagrams



1. BioHarness™ chest strap (up to 50)
2. BioHarness™ 3.0 ECHO module (up to 50)
3. ECHO gateway – additional repeaters can be used in the field to extend the network.
4. USB connector
5. PC platform
6. OmniSense Application software
7. Heart Rate (ECG) sensor locations
8. Breathing sensor location
9. Accelerometer in device



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1.3 Hardware Component Options

ZEPHYR Training SYSTEM CASE

- Main power supply or internal Li-on rechargeable batteries
- Charging / Configuration / Log Download of BioHarness modules

ZEPHYR ECHO GATEWAY

- Up to 300 yard range
- USB or battery powered
- Auxilliary field units can be added to extend network coverage (no additional configuration necessary)

Single Device Charge Cradle

- Mini-USB connectivity for device configuration & log download
- Connect to USB wall/car charger for charge only

Multi Device Charge Cradle

- Optional component
- Micro-USB connectivity for device configuration & log download
- Requires connection to PC and power outlet simultaneously for use

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Field Repeater

- Integrated rechargeable battery power supply
- 24 hr battery life (5200mAh)
- 3 hr charging
- Increase range or offer more effective coverage of an area

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1.4 Software Installation

Follow the instructions in the *OmniSense Software Installation Guide* to:

- Install OmniSense Live & Analysis modules including
  - Zephyr Cfg Tool
  - BioHarness Log Downloader
- Install drivers for all BioHarness devices

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2. Live Operations

For detailed information on how to set up and operate the OmniSense application to display data, refer to the *PSM Training OmniSense Live Help* accessed from the application toolbar.

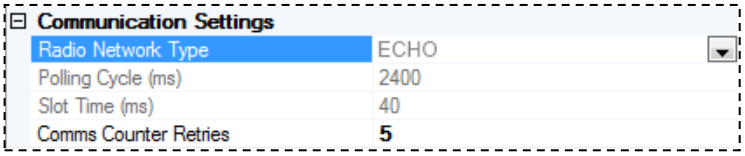
2.1 Radio Network Setup

Before adding any hardware components to the system database, radio network type must be set up or confirmed in the OmniSense Live module.

1. Start the Application

2. Select Preferences in toolbar

3. Set the *Network Type*



The *Radio Network Type* must be set to *ECHO*.

2.2 Database Setup

The system must be set up prior to going live. Details are in the *PSM Training OmniSense Live Help*:

1. All BioHarness modules added to system
2. All subject details added to system
3. BioHarness modules assigned to subjects
4. Subjects added to a Team
5. Team deployed to Live

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2.3 Issue BioHarness

1

Personnel			
First Name	Last Name	Garment	BioHarness
Brett	Nicholls	BH3 Side Strap	BHT507
John	Brown	BH3 Side Strap	BHT536

Confirm hardware allocation in OmniSense Setup > Hardware tab

2

Check components match those that are assigned to the subject

3

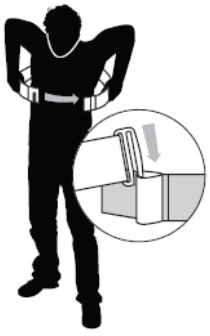
Power on components, check LEDs

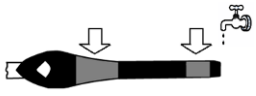
[To power OFF BioModule, *detach from strap*, press & hold center button]

4

Fit to Strap

5





Moisten grey sensor pads with water

Fasten at front, adjust tension for a snug fit, and rotate into position

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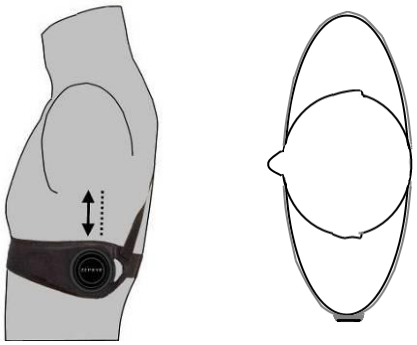
2.3.1 Strap Fitting

1

Tension indication loop at rear should be flush with strap (shown un-tensioned here) when subject inhales and chest is fully expanded

2



Centre line of the device should be directly under the armpit – for optimum breathing detection device should be at apex of rib curvature. The device can be moved slightly (~1") to the rear only (dotted line) if the optimum location is uncomfortable.

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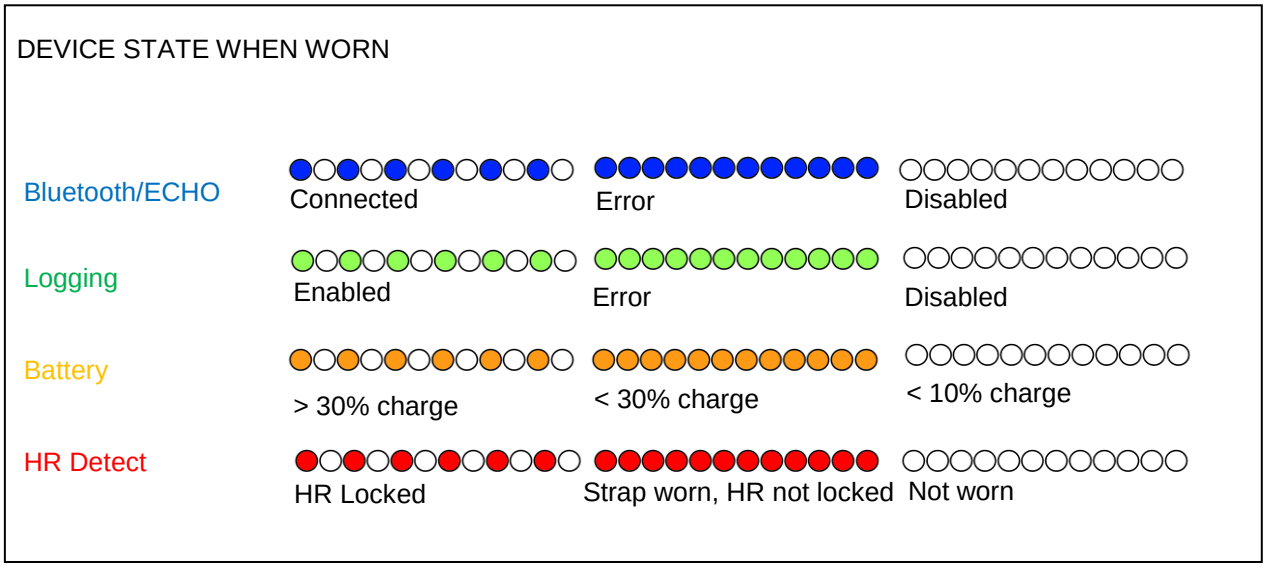
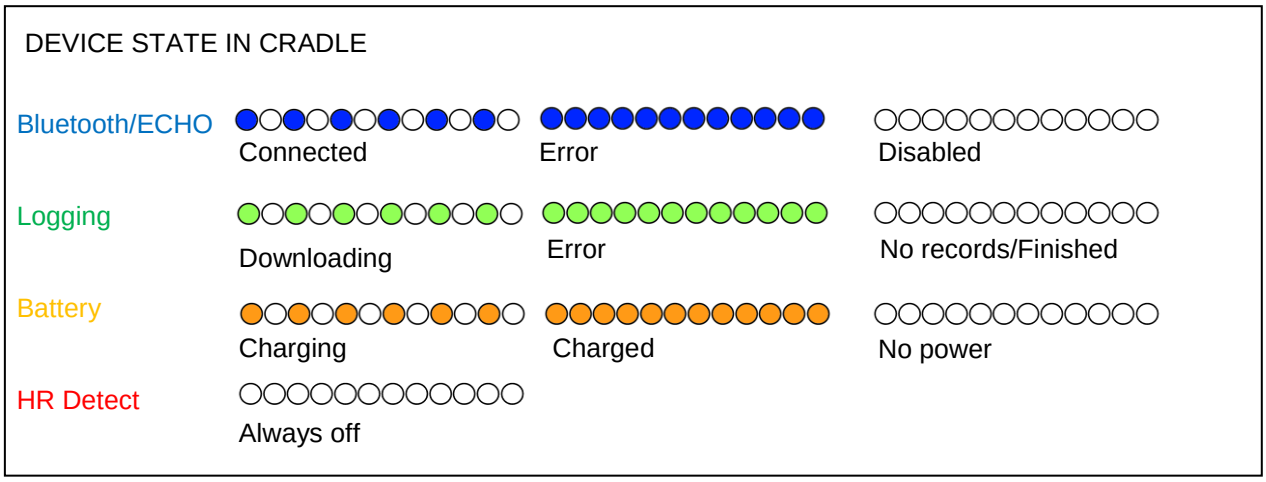
2.3.2 BioHarness LED Behaviour



If power cycling a BioHarness module does not cancel a Bluetooth or Logging error, then a hardware fault is likely – replace the device in the interim.



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2.3.3 Garment Type

It is necessary to set the garment type in OmniSense, as the orientation of the device varies, and accelerometer data must be interpreted correctly in order to display posture data.

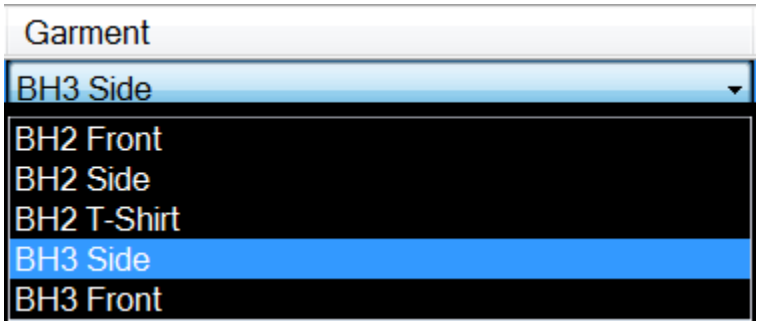
There are three variations of garment type:

'BH3 SIDE'

'BH3 SIDE'

BH3 FRONT

The garment/device type can be selected from a pull down in the ***Hardware*** tab of the ***Setup*** screen in the OmniSense Live Module.



Refer to the *OmniSense Live* help file on how to set garment type in the software. If the wrong type is set here, then posture data from the device will be invalid.

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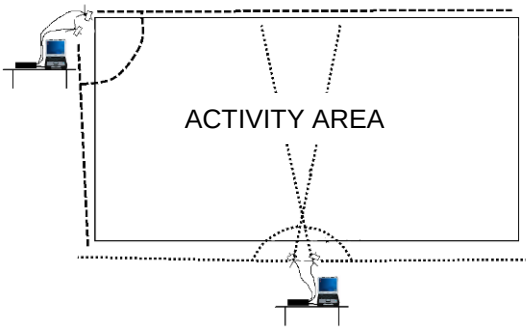
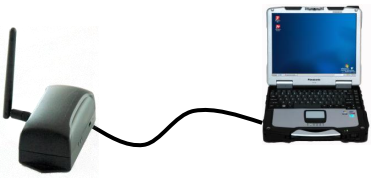
2.4 Operational Startup

1 Set up at preferred location



See also suggestions on optional field repeater units

2 Connect Gateway to PC



3 Power on BioHarness modules

4 Start OmniSense

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2.5 Live Screen Operation Checks

1 START APPLICATION

2 SELECT LIVE MODE

3 WAIT 1-2 minutes

It takes the Gateway 1-2 minutes for all network connections to establish and stabilize. During this time BioGauges may switch from black to blue to ROG colours intermittently

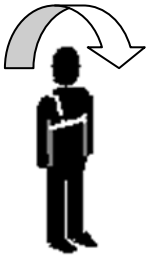
4 DATA STABILISATION TIMES FROM DEVICE POWER-ON

Heart Rate:	5 seconds
Breathing Rate:	30 – 45 seconds
Core Temperature;	1 second
Activity/Posture:	1 second

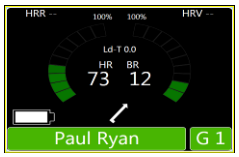
5 STATUS INDICATION ON START UP

Alpha Bravo	Alpha Bravo	Alpha Bravo	Alpha Bravo	Alpha Bravo	Alpha Bravo
SENDING REQUEST	ESTABLISHING CONNECTION	DEVICE NOT WORN (CHECK)	DATA STABILIZING	DATA STABILIZING	

6 FORWARD LEAN



7 POSTURE CHECK



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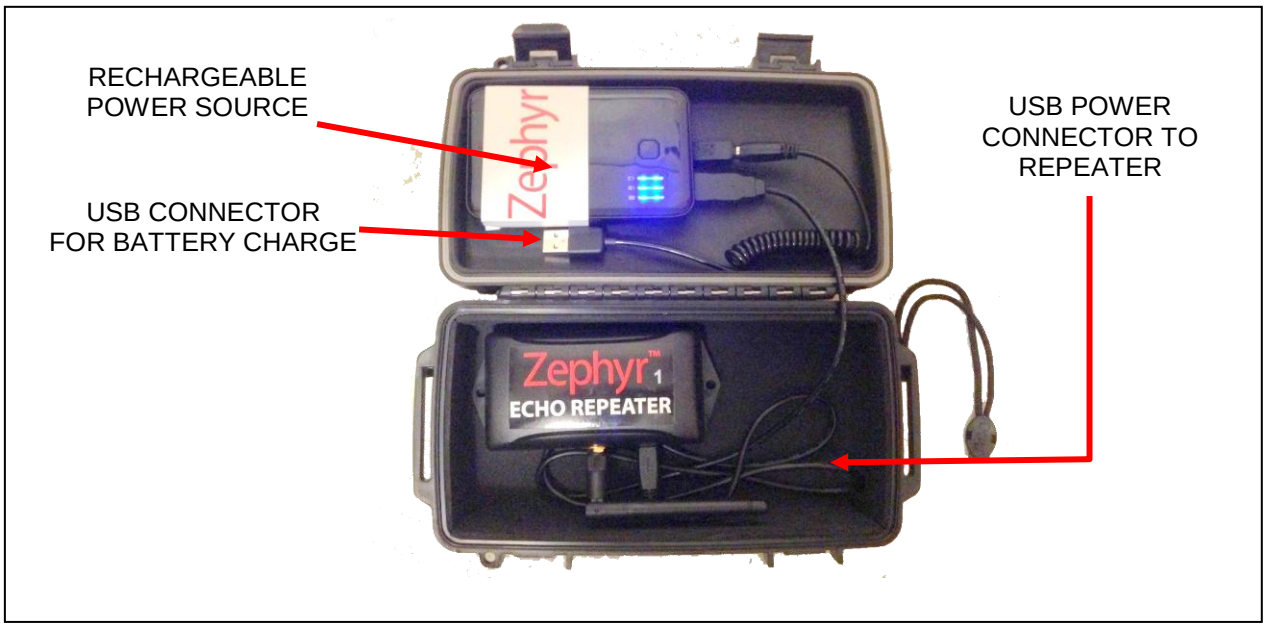
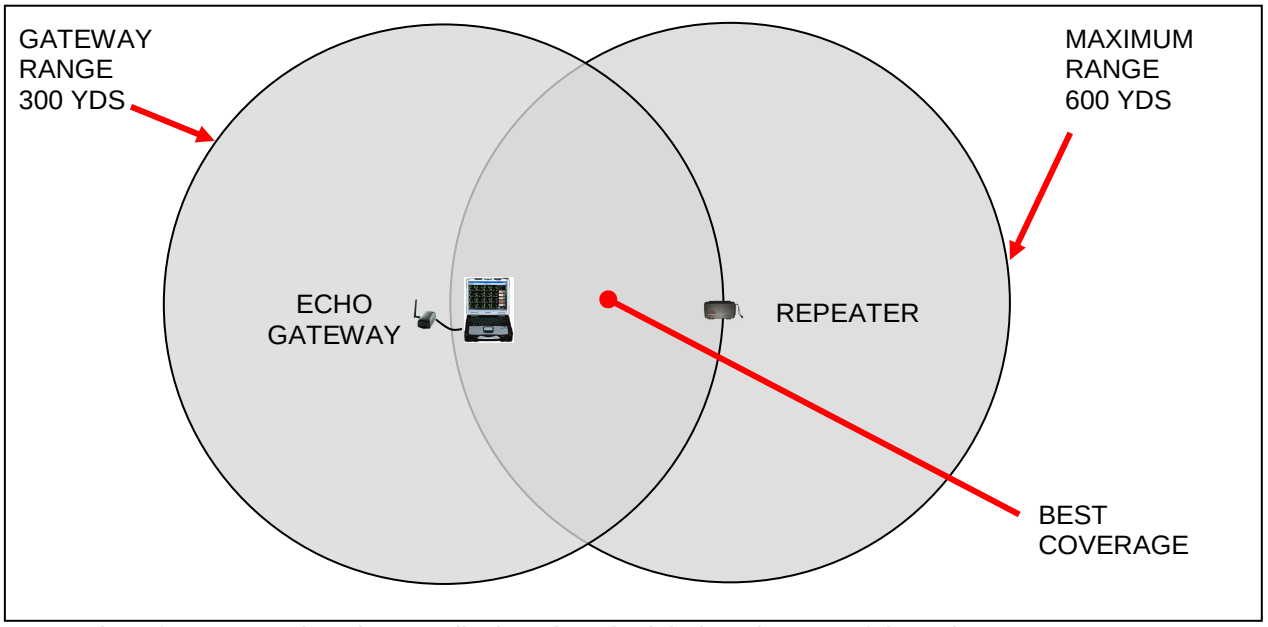
2.6 Field Repeater Units

Optional field repeater units, powered by an integrated rechargeable battery source, can be used to extend absolute range of the system, or provide better coverage of an area.

Field repeaters transmit directly to the base ECHO gateway, but NOT to each other. They cannot be used to extend the system range indefinitely.





Suggestions for repeater location are displayed on the label on the rear of the unit.

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2.7 GPS Support

OmniSense Live and Analysis now support GPS data.
Some criteria apply:

- A supported Bluetooth GPS unit must be used. This is currently a QStarz 818XT
- The BioHarness module must be configured using the Zephyr Cfg Tool – see the next section

LIVE MODULE
No GPS data can currently be displayed in the Live module. This function is supported by PSM Responder and some PSM Defense systems only.

ANALYSIS MODULE
GPS data, if it exists, will be imported into the OmniSense database using the Import Toolbar button and Zephyr Downloader tool.

GOOGLE EARTH
An external kml file of GPS data – for use in Google Earth – can be generated from Analysis by right-clicking the session in the Select Session Tree, and selecting the *Export KML* option for that session. This .kml file also contains summary physiological data:
Minimum/Maximum/Average for

- Heart Rate
- Breathing Rate
- Estimated Core Temperature
- Peak Acceleration
- Activity

See *Analysis Help* for details

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2.7.1 Configuring a BioHarness for use with a GPS

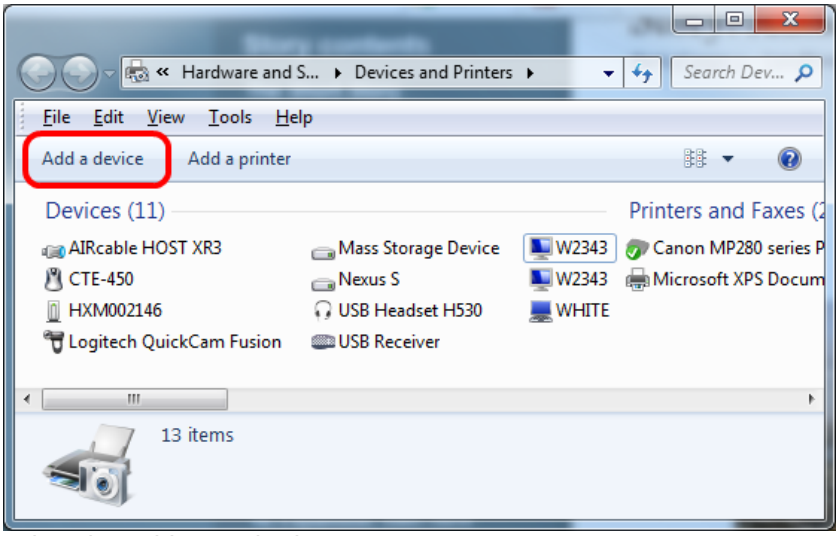
A BioModule can be configured to log GPS data for later download into OmniSense Analysis. Analysis can display summary speed and distance data, though not location.

However a kml file can be exported from a session containing GPS data, for import into Google Earth.

Streaming GPS data cannot be displayed on a BioGauge in OmniSense live using ECHO – this can only be done when using a PSM Responder System (Motorola digital radio network), or some PSM Defense variants.

First, determine the Bluetooth MAC address of the GPS. This can be done using a PC with Bluetooth capability.

1. Power on your GPS device – this can be done indoors – no satellite fix is needed for this task.
   Go to Windows > Start > Devices and Printers



   Select the *Add A Device* button

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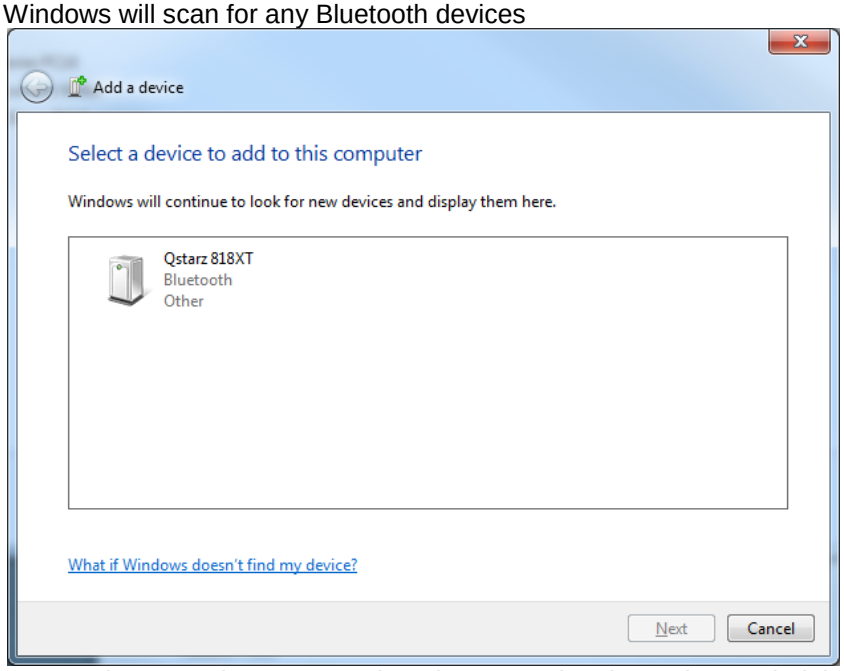
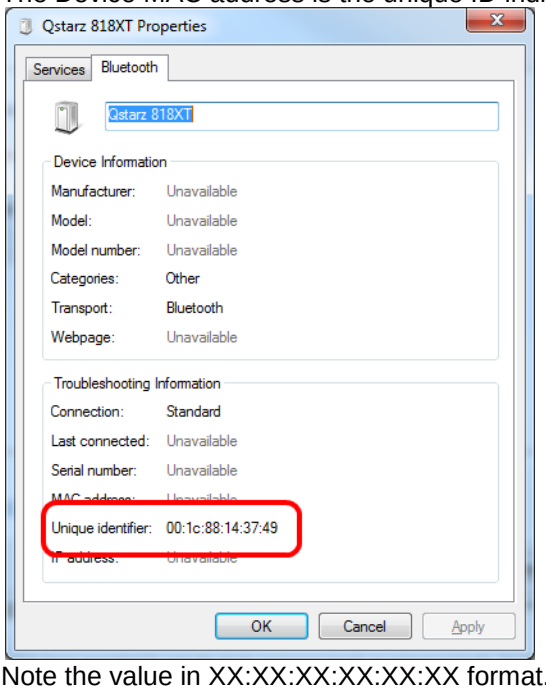
2. Windows will scan for any Bluetooth devices



It may take several attempts. When the Qstarz has been detected, right-click on the icon and select *Properties* from the context menu.

3. The Device MAC address is the unique ID indicated



Note the value in XX:XX:XX:XX:XX:XX format.

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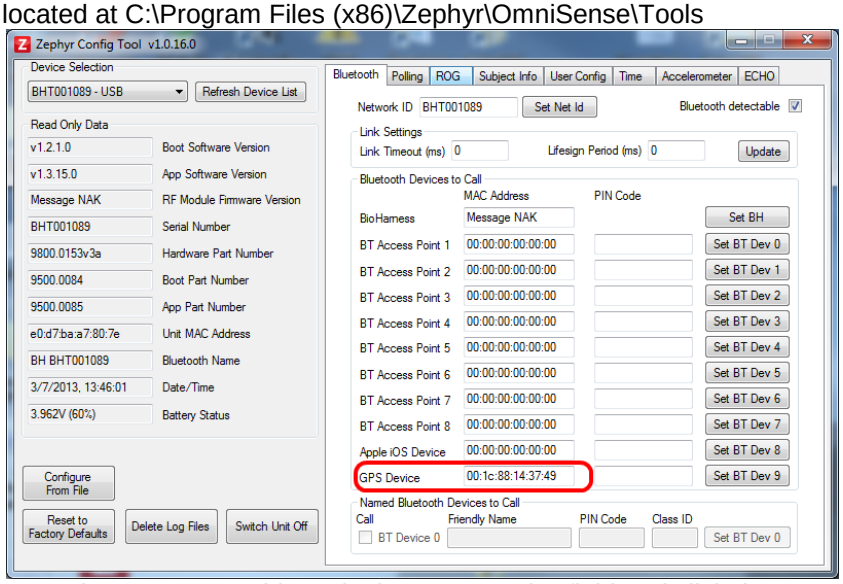
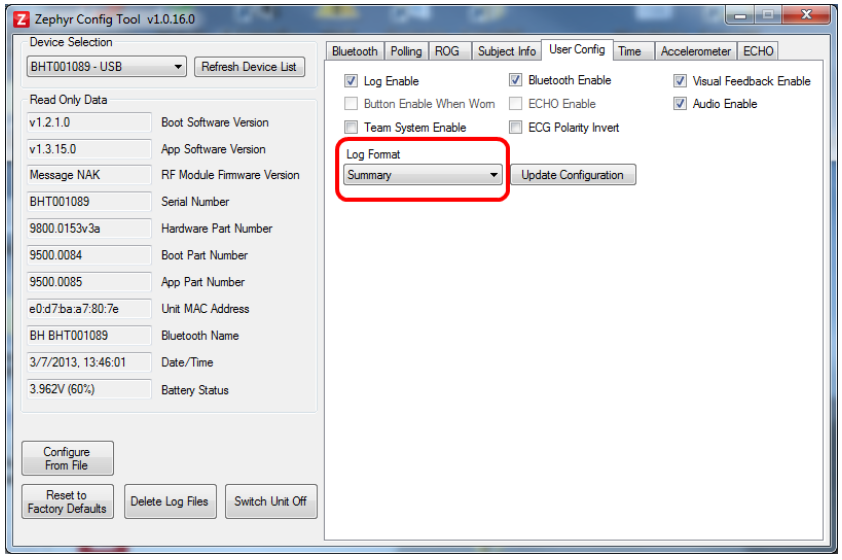
4. Now we must program the GPS MAC address into the BioModule using the Zephyr Config Tool located at C:\Program Files (x86)\Zephyr\OmniSense\Tools



Enter the GPS Mac address in the *GPS Device* field and click the *Set BT Dev 9* button.

5. In the *User Cfg* tab, confirm that the *Log Format* is set to *Summary* (the default) or *Summary and Waveform*



6. In operation, simply power on the GPS, then power on the configured BioHarness. The BioHarness will communicate with the GPS and add GPS data to the summary log format. Download the data directly into OmniSense Analysis when the session is finished. Instructions can be found in the OmniSense Analysis Help file.

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3. Logging

The default configuration of the BioHarness is to log and transmit simultaneously. Either of these modes can be turned on or off as required, using the Zephyr Cfg Tool located at
C:\Program Files(x86)\Zephyr\OmniSense\Tools.

Two utilities are provided for downloading logs from the device:

- Zephyr Downloader – accessed from the Analysis application toolbar download button
  - Download from a single device, or multiple devices simultaneously
  - Import data into OmniSense database and/or generate external csv files

- BioHarness Log Downloader – installed with OmniSense, found in location *C:\Program Files(x86)\Zephyr\OmniSense\Tools*
  - Legacy tool
  - Generate external csv file only

For both of the above utilities, the external csv files contain more detailed data than is imported to the OmniSense database. If the BioHarness module is configured appropriately, ECG and accelerometer waveform csv files, amongst others can be generated.

3.1 Download Device Logs

3.1.1 Download to OmniSense Database

A button on the OmniSense Analysis toolbar will allow direct downloading from a single device or devices into the OmniSense database. This process is described in detail in the *Analysis Help File* at the *Data Import & Export > Import Log Data from a BioHarness* node .

3.1.2 Download to External Files

This process is described in detail in the *Live Help File* at the *Software Utilities > BioHarness Log Downloader* node .

3.2 Logging Formats

The BioHarness can be configured to a number of different log formats. These are set using the Zephyr Cfg Tool. Briefly, the modes are:

General:	1 Hz general parameters + 18Hz breathing waveform & heart rate RR
General + ECG::	General + 250Hz raw ECG waveform
General + Acceleration	General + 100Hz Activity level (accelerometer magnitude)
BioHarness 3.0 only:	
Summary:	An extended General log containing additional parameters (Default)
Summary + Waveform:	Summary + 250Hz ECG + 100Hz accelerometer
Summary + Development	Summary + 1KHz ECG + 100Hz accelerometer

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4. Maintenance

4.1 BioHarness™ Module

- Clean with a damp cloth when needed
- Avoid prolonged immersion in water deeper than 1 meter. Do not use for swimming or related water-based activities.
- Avoid leaving the device in direct sunlight for prolonged periods

BATTERY

- Recharge each time after use - shallow charge cycles prolong battery life (see next section)
- Avoid storing in an uncharged state for prolonged periods
- A top-up charge of the battery is recommended once a month if the devices are not used regularly, to maintain optimum battery condition
- The device is sealed against moisture ingress; the internal lithium ion battery is not end-user replaceable. The device should be returned to an authorized agent for this procedure

REPLACEMENT

A replacement device must be added to the system — see the *OmniSense Live Help* — and re-assigned to the appropriate subject.

Erase all existing logs in a replacement device when assigning to a new subject, or they will be added to the subject's data in the database at the next download session.

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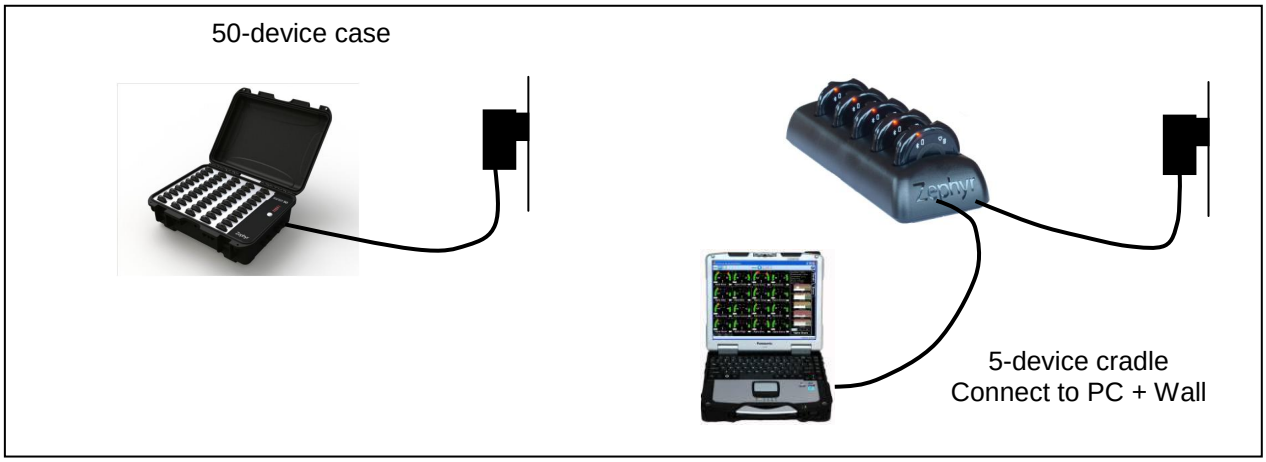
4.2 Charging BioHarness Modules



CHARGING TIMES: BioHarness

Fully discharged to 90% capacity:	1 hour
Fully discharged to 100% capacity:	3 hours

CHARGE NOTES

- Devices can be left in chargers. Protection circuitry in the device will prevent the BioHarness from being damaged.
- It is recommended that the BioHarness modules are charged after every use – shallow charge/discharge cycles prolong battery life
- Avoid storing the devices fully discharged for prolonged periods – it may damage/reduce battery life
- A top up charge is recommended once per month if the devices are not used regularly

LONG TERM STORAGE

Charge the device to full capacity, then use the Zephyr Cfg Tool to switch the device off completely. Turning off the device using the central button leaves the internal clock running.

The device clock will need to be reset using the Cfg Tool when it is next used. Full instructions can be found in the OmniSense Live Help File at the *Software Utilities > Zephyr Config Tool* node.

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4.3 Strap

WASH INSTRUCTIONS

- Detach the BioHarness™ module
- Rinse strap in fresh water after use to prevent salt buildup from perspiration
- Hand Wash, or
- Machine-wash on a Cold, Delicate setting after 30 days of use.
    - Firmly attach the Velcro® fastenings together and do not wash with other garments which may be damaged by these fastenings.
    - Use a washing pouch if possible.
    - Use soap or mild detergent, but NOT sterilizing tablets, as this may affect the conductive fibers on the sensor surfaces
    - Do Not spin or tumble dry
    - Hang to dry
    - Do not bleach.
    - Do not iron as the strap contains conductive fibers which may be adversely affected by excessive heat.

REPLACEMENT

BioHarness™ Straps have no unique characteristics or calibration procedures, and can be replaced at will.

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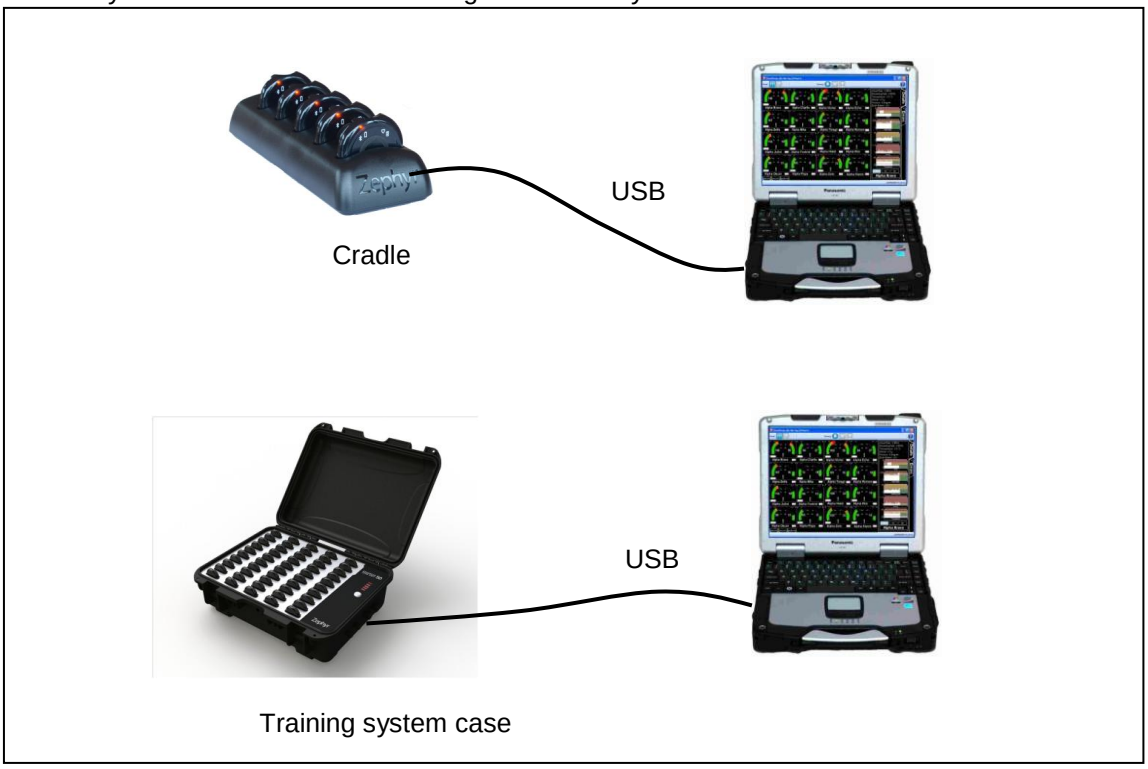
5. BioHarness Configuration

A large number of parameters can be configured within the BioHarness device, to tailor its function. The Zephyr Cfg Tool, located at C:/Program Files (x86)/Zephyr/OmniSense/Tools can be used to control settings.

> *Care should be taken when changing **any** parameters in the device. Record any settings before you change them, and seek advice from Zephyr if you are in doubt about a setting*

1. Connect your BioHarness Module a single cradle or system case to a PC.



2. Double-click the ***Zephyr Cfg Tool.exe*** executable file at ***C:\Program Files(x86)\Zephyr\OmniSense\Tools***.

3. A full description of the configurable settings can be found in the OmniSense Live Help File at the *Software Utilities* > *Zephyr Config Tool* node.

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6. Firmware Upgrades

Firmware upgrades for BioHarness devices become available as new functionality is added to the device. You must use the utility ZUSBUpdater.exe, in conjunction with a suitable .img firmware image file. Hardware compatibility is checked, so you should not be able to update a device with firmware intended for another type. Both are located in a *BioHarness Firmware Upgrade* directory on the software CD.

A full description of the update procedure can be found in the OmniSense Live Help File  at the *Software Utilities* > *Firmware Upgrades* node.

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7. Specifications

7.1 BioHarness Module

Parameter	Specification
Heart Rate:	25 – 240 Beats per Minute ± 1 BPM
Breathing Rate:	3 – 70 Breaths per Minute
Device Temperature:	10 – 60 °C ± 0.2°C in range 30 – 40°C
Battery Duration:	24 hrs Logging 16 hrs transmit
Charge Time:	3 hours to 100%, 1 hour to 90%
Battery Life:	Capacity 80% after 300 deep discharge cycles (4500hrs of use)
Storage Life:	6 months between charges (for optimal – recharge monthly)
Strap Sizes:	Small (XS – M; 27½ - 38 inches) Large (M- XL; 33½ - 43 inches)
Wash durability:	Typically 80 washes with BioHarness Module removed
Environmental – Operating:	
Humidity:	5 – 90 %RH
Temperature:	-10 – 50°C
Environmental – Storage:	
Humidity:	5 – 90 %RH
Temperature (< 1 month):	(Power off) -20°C – 45°C
Temperature (< 6 months):	(Power off) -20°C – 35°C
Water Resistance (Device):	IPX7 (immersion for up to 30minutes in 1 m of water)
Bluetooth Compliance:	Version 2.0 + EDR
Operating Frequency:	2.4 – 2.835 GHz Bluetooth 2.405 – 2.480 GHz ECHO
Output Power:	2 mW Bluetooth 100 mW ECHO

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8. Troubleshooting

Zephyr strives to develop products which are user-friendly and problem free. However, human, external system or environmental factors may result in issues which can be organised into the following types:

Software Installation problems:	Refer to the *OmniSense Software Installation Guide*
Operational Errors in Live Mode:	Refer to the *OmniSense Live User Guide*
Physiological Data Anomalies:	Section 8.2
Hardware:	Section 8.3
General Issues:	Section 8.4

See also the Troubleshooting Section in the *OmniSense Live Help* file.

8.1 Device Clock Synchronization

The default device configuration is that it both transmits and logs data internally, and can record up to 24 hours of data in a single session. All logged data is time-stamped using an internal clock in the BioHarness Module. The internal clock is not used to timestamp transmitted data.

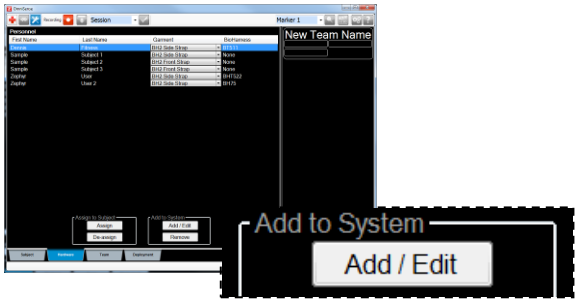
This clock will reset to 1/1/2000 12:00:00 a.m. in two cases:

- The Firmware has been upgraded
- The device has been left unused for a number of months

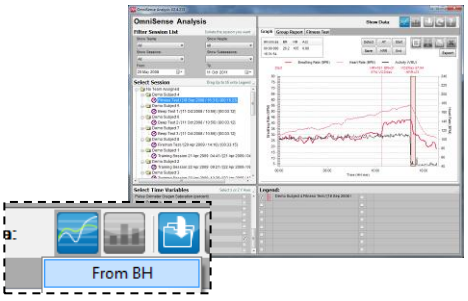
If either of these scenarios has happened, or there is any doubt that the device internal clock does not show current time, then the device clock should be re-synchronised, otherwise data sessions will be created, time stamped at the above date..

In addition, when the system is delivered to a customer, device clocks are likely to be synchronised to time zone at the point of manufacture, and should be resynchronised to local time.

Automatic BioHarness Clock/PC Synchronization



OmniSense Live:
When the device is added into the system at Setup



OmniSense Analysis:
Whenever data is imported from the device

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8.2 Physiological Data Anomalies

Parameter	Indication	Possible Cause	Check / Remedy
Heart Rate	Excessively high or erratic	• Movement of sensor surface against skin	• Check strap tension – has it loosened? • Is skin excessively dry
Heart Rate	Consistently 200+ bpm	• Damaged strap	• Replace strap to check
Breathing Rate	Abnormally low value	• Constant compression of breathing sensor by external force	• Check for / remove external agent • Check device at apex of rib curvature

8.3 General Issues

Parameter	Indication	Possible Cause	Check / Remedy
Communications	No data in BioGauges	• Radio network error	• Exit OmniSense, disconnect the Gateway receiver, wait & restart OmniSense • Check antenna connections • Confirm no duplication of device Short Addresses, especially if a new device has been added to the system. Use Zephyr Config Tool
Logged data time stamp	Dated 1/1/2000	• Device internal clock not resynchronized	• Connect device to PC and start log import utility in OmniSense Analysis to reset internal clock • Use Zephyr Cfg Tool to resync time

8.4 General Check Procedure

Carry out the following checks when in Live mode

Component	Indication	Check / Remedy
BioHarness Module	Constant LED	• Check LED behavior Section 2.3.2

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9. Warranty

Limited Warranty for the Zephyr PSM Training physiological monitoring system

Zephyr Technology Corporation warrants to the original end purchaser that

- the PSM TRAINING hardware shall be free from material defects in material and workmanship for a period of one (1) year from the original date of purchase (the "Hardware Warranty Period")
- the BioHarness Chest Strap shall be free from material defects in material and workmanship for a period of three (3) months or 50 hand washes, whichever comes first, from the date of purchase (the “Chest Strap Warranty Period”)
- the software shall be free from material defects or errors for a period of one (1) year from the original date of purchase (the “Software warranty period”).

If the product is determined to be materially defective during the Warranty Period, your sole remedy and Zephyr’s sole and exclusive liability shall be limited to the repair or replacement of this product with a new or refurbished product at Zephyr’s or its licensed distributor’s option. For purpose of this Limited Hardware Warranty and Liability, "refurbished" means a product that has been returned to its original specifications. Visit www.zephyr-technology.com for instructions on how to deliver the product to an authorized service facility.

This warranty shall not apply if this product

a) is used with products that are not compatible with this product
b) is modified, or tampered with
c) is damaged by acts of God, misuse, abuse, negligence, accident, wear and tear, unreasonable use, or by other causes unrelated to defective materials or workmanship
d) has had the serial number altered, defaced or removed
e) has, in the reasonable opinion of Zephyr or its licensed distributors, been opened, altered, or defaced. This warranty shall also be voidable by zephyr or its licensed distributors

If (1) Zephyr reasonably believes that the PSM TRAINING system has been used in a manner that would violate the terms and conditions of a separate end user license agreement for system software; or (2) the product is used with products not sold or licensed by Zephyr. You assume all risks and liabilities associated with use of third party products.

This warranty is provided to you in lieu of all other express or implied warranties including warranties of merchantability and fitness for a particular purpose for the PSM TRAINING system, which are disclaimed hereunder. However, if such warranties are required as a matter of law, then they are limited in duration to the warranty period.

Our sole and exclusive recourse in the event of any dissatisfaction with or damage arising from the use of the PSM TRAINING system and Zephyr's maximum liability shall be limited to repair or replacement of the PSM TRAINING system. Except as expressly stated above, Zephyr excludes all liability for any loss of data, loss of profit, or any other loss or damage suffered by you or any third party, whether such damages are direct, indirect, consequential, special, or incidental and however arising under any theory of law, as a result of using your PSM TRAINING system. Some countries, states or provinces do not allow limitation on how long an implied warranty lasts and some countries, states and provinces do not allow the exclusion or limitations of consequential or incidental damages, so the limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from country to country, state to state or province to province. This warranty is in all countries where Zephyr has an office or a licensed distributor. The warranty offered by Zephyr Technology Corporation on your PSM TRAINING hardware is the same whether or not you register your product.

Failure to register within one (1) week of receipt voids the warranty for the BioHarness Strap.

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