Zephyr Technology

OmniSense Live Help

OmniSense Help

This is the printed version of the OmniSense Help file.

Content has been optimised for screen display.

In the printed version, page breaks may interrupt continuity.

Printed: April 2016

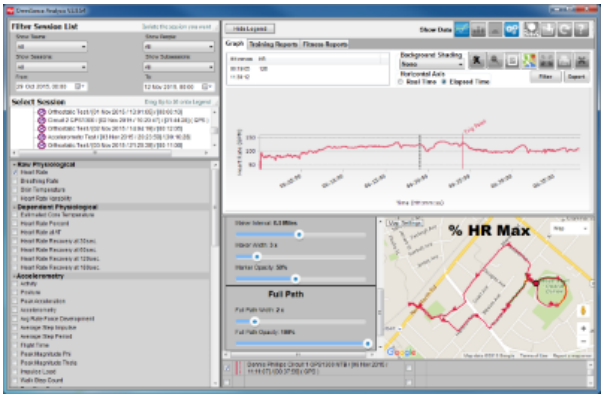
Table of Contents

Part 1

1 Getting Started

OmniSense Live User Guide

Live will display BioGauges for up to 100 subjects in a series of tabs.



Analysis will display data in a variety of graphs and reports, as well as import log data directly from BioModules

Click on the image that shows your system type, for a list of Quick Links

New Features - links to new features in this OmniSense release

Using this Guide - tips to using this guide

You are not connected to the internet - this is a local offline html document

1.1 PSM Direct Connect Quick Links

Follow the link for the relevant topic for your system
Troubleshooting
System Setup
Live Operations
Download External Log csv files

1.2 PSM Responder Quick Links

Follow the link for the relevant topic for your system
Troubleshooting

System Setup
Live Operations
Download External Log csv files

1.3 PSM Training Quick LInks

Follow the link for the relevant topic for your system
Troubleshooting
System Setup
Live Operations
Download External Log csv files

1.4 Contact Zephyr

Contacts

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Zephyr Technology is a Division of Medtronic.

1.5 New Features

OmniSense 4.1 April 2016

Miscellaneous	Miscellaneous minor bug fixes and improvements
Logging	Improvements to the BioModule firmware have greatly reduced log download times
BioHarness Module Firmware Version	BioModule 3.0 9800.0153 (BT only) BioHarness3_v1.5.0.0_1G BioModule 3.0 9800.0189v6-v9g (BT + ECHO) BioHarness3_v1.5.0.0_2G BioModule 3.0 9800.0189v9k (BT + ECHO + BLE) BioHarness3_v1.5.0.0_3G
OmniSense Analysis	• Downloader bug which did not import accelerometer data from

	BioModule fixed • New Demo data is now available, dated 2001 • An Android/iOS Readiness app is now available which will record Resting/Standing HR & HRV and Survey data from at-home orthostatic test and email to a recipient for manual entry to the OmniSense database via OmniSense Analysis

OmniSense 4.0 November 2015

ECHO Mode	ECHO now has 3 modes: 20x1: Up to 20 BioModules at 1 second refresh rate 50x2.5: Up to 50 BioModules at 2.5 second refresh rate 100x5: Up to 100 BioModules at 5 second refresh rate
Map Window	Maps or satellite views can be displayed if supported GPS devices are used. An internet connection is required for initial map download. Snail trails, location heat maps, distance markers, zoom/pan functions and a shuttle function
Improved HRV algorithm	The HRV algorithm is more reliable in the presence of movement artifacts
Accelerometer Data Analysis	Additional accelerometer data analysis is now performed in the BioModule, and a number of new parameters can now be displayed in the BioGauge
Readiness Testing	An orthostatic hypotension test is now described.
Audio Workout Support	Workout File Notes support audio text to speech
QStarz BT1300ST support	The smaller Qstarz GPS is now supported
End-of-life	Note that support is now removed for • ISM BioHarness module • Zephyr Z-Modem • Bluetooth Access Point 28-device Systems (but not Bluetooth Direct 7-device systems)
OmniSense Analysis	• Google Map display • Altitude Zone display • Additional Accelerometry Variables • Automated Readiness Test Analysis + Subject Survey • Data filter wizard • Marker support - markers can be added in Analysis • Merge Sessions • Change Session timestamps, shift by an offset • User-configurable scaling of bar graph vertical scales • Categorization of Variables • User-configurable default initial time period filter
BioHarness Module Firmware Version	BioModule 3.0 9800.0153 (BT only) BioHarness3_v1.4.12.0_1G BioModule 3.0 9800.0189v6-v9g (BT + ECHO) BioHarness3_v1.4.12.0_2G BioModule 3.0 9800.0189v9k (BT + ECHO + BLE) BioHarness3_v1.4.12.0_3G
BioHarness Module Log Format	New logging formats incorporating additional accelerometer data • Enhanced Summary • Enhanced Summary + Waveform • Enhanced Summary + Development

OmniSense 3.9.6 January 2015

Barcode Rapid Allocation Tool (BRAT)	The process of assigning BioModules and GPS units to subjects, and starting Live operations, can now be carried out by scanning pick lists of barcode or barcoded devices and user IDs
Add GPS	GPS devices can now be added to the system over Bluetooth®
Pebble Watch Support	Latest versions of the BioModule support a Zephyr application on the Pebble watch
Map Panel	GPS location data in a side panel and a static map location in a pop up window are now supported
OmniSense Analysis Analysis	• BioModule logs can be imported over Bluetooth® • Impact Angle now measured in degrees • Teams and subjects can now be deleted • Subjects can be moved to another team in the database • Sessions can be moved to another player in the database • Various minor bug fixes
BioHarness Module Firmware Version	BioModule 3.0 9800.0153 (BT only) BioHarness3_v1.4.5.0_1G BioModule 3.0 9800.0189v6-v9g (BT + ECHO) BioHarness3_v1.4.5.0_2G BioModule 3.0 9800.0189v9k (BT + ECHO + BLE) BioHarness3_v1.4.5.0_3G

OmniSense 3.8.0 September 2014

Clock Bug	In ECHO systems, device clocks are synchronized over-the-air before recording of data starts. This eliminates a bug which showed multiple subjects staring sessions at different times because their BioModule internal clocks were not synchronized
Marker Bug	The solution for the above bug also solves a problem where Markers set in OmniSense Live did not show up in OmniSense Analysis
Motorola APX Radio	This radio type is now supported, both in conventional and trunking mode. Specific firmware must be programmed into the BioModules - specified in the OmniSense release notes, and they must be Bluetooth paired to a specific radio. A specific firmware release must be used in each BioModule. Details in the Product Release Notes.
Intensity & Load	High and Low Limits for Physiological (%HR_{max}) and Mechanical (Peak G) intensity are now configurable, allowing for intensity and load calculations to be tailored for ranges typically seen in in a particular activity
Training Thresholds	Lower limits can be set for Physiological, Mechanical & Training Load values. If these limits are exceeded, the subject's name will flash in their Training BioGauge, giving an easily-seen indication that preset exertion levels have been achieved
OmniSense Analysis	See OmniSense Analysis Help for details: • sessions can now be archived to zsf files to reduce the size of the OmniSense database • the Pro Impact report offers more comprehensive analysis of Impact data processed from log files recorded on the BioModule. The BioModule must be configured to log in Summary and Waveform format, using the Zephyr Config Tool
BioHarness Module Firmware Version	BioModule 3.0 9800.0153 (BT only) BioHarness3_v1.3.27.0_1G BioModule 3.0 9800.0189 (BT + ECHO) BioHarness3_v1.3.27.0_2G

OmniSense 3.7.15 October 2013

Bug fixes	Various minor bug fixes as reported
Analysis Reports	Support for Chinese language
Impact Processor Tool	Now included in installer. Instructions added to Analysis Help file
Zephyr Config Tool	A new multi-device version of the Zephyr Config Tool now supplied. Users are required to enter their name to start, and a log file of any reconfigurations is created
Zephyr Firmware Updater	A new multi-device version of the Zephyr USBUpdater tool now supplied. Users are required to enter their name to start, and a log file of any firmware updates is created
BioHarness Module Firmware Version	BioModule 3.0 9800.0153 (BT only) BioHarness3_v1.3.23.0_1G BioModule 3.0 9800.0189 (BT + ECHO) BioHarness3_v1.3.23.0_2G

OmniSense 3.7.8 April 2013

Bug fixes	Various minor bug fixes as reported
Windows 8 Support	Support for Windows 8
GPS Support	BioHarness can now log GPS data from a supported device while configured to log Summary Data only - previously Summary and Waveform format was needed, which resulted in long data download times.
Windows Support	Security Certificates updated

OmniSense 3.6.1 November 2012

Log Download Support for more than 50 devices	For large ECHO systems, more than 50 devices can be added to the OmniSense database so that logs can be downloaded automatically. Only the first 50 devices will be assigned ECHO Short addresses for radio communication. Any further devices will have a null value for the short address. They cannot be used for streaming data communication by ECHO when thus configured, but can be used in logging mode.

OmniSense 3.6.0 October 2012

Bug Fixes	Various minor bug fixes
Help File	(This file). Updated screen captures, index & omissions.

OmniSense 3.5.1 October 2012 New Features

BioHarness Module Firmware Version	BioHarness 2.0: v2.3.10.0_9800.0151 BioHarness 3.0 (BT only): v1.3.14.0_9800.0153 BioHarness 3.0 (BT + ECHO): v1.3.14.0_9800.0189

Dropped Features

Heart Rate Recovery	This can no longer be configured to display in the subject BioGauge. It is not supported by PSM Training ECHO systems
HR@AT	This can no longer be configured to display in the subject BioGauge. It is not supported by PSM Training ECHO systems

OmniSense 3.4.21 September 2012 New Features

BioHarness Module Firmware Version	BioHarness 2.0: v2.3.10.0_9800.0151 BioHarness 3.0 (BT only): v1.3.13.0_9800.0153 BioHarness 3.0 (BT + ECHO): v1.3.13.0_9800.0189
Training Zones	Training Zone Intensities can be configured for display in the subject BioGauge
Speed Zones	Speed zones can be configured in Live module. They are displayed as a background color in the Analysis module. Supported GPS device required
Workout Tab	A side tab will now display the intensity target for your current workout zone, and the following target, with countdown timers.

OmniSense 3.4.18 September 2012 New Features

BioHarness Module Firmware Version	Required for this release of OmniSense: BioHarness 2.0: v2.3.10.0_9800.0151 BioHarness 3.0 (BT only): v1.3.13.0_9800.0153 BioHarness 3.0 (BT + ECHO): v1.3.13.0_9800.0189
Training Tab	An additional tab to display color coded subject tile indicating training zone by color, calories spent and physiological and training intensities. The tab color indicates a target effort if a training workout has been implemented
Training Workouts	A file containing a set of target efforts to be used in conjunction with the training tab
Astro Trunking	OmniSense now supports PSM Responder systems using Motorola digital radio configured to operate in Astro Trunking mode. Radios should be added to the system as for non-trunking systems.

Known Issues

ISM Limitations	OmniSense 3.x.x continues to support ISM devices, but users should be aware that some data is generated in the device itself, or relayed from an external Bluetooth sensor, and if the ISM device does not provide or support it, then the parameter will not be available in OmniSense. In Live, *unavailable* parameters include: Heart Rate Recovery, Heart Rate Variation, Estimated Core Temperature, Jump and Dash Test parameters, SpO2, Blood Pressure , Heart Rate Confidence & Streaming 3-axis accelerometer data.

OmniSense 3.4.5 July 2012 New Features

Subject BioGauge	Now displays BioHarness EID (Equipment Identifier) to the left of the subject name
GPS Support	The BioHarness can now GPS data, if it is configured to communicate with a supported Bluetooth GPS device, and logs Summary + Waveform format. The Zephyr Downloader accessed from the Analysis module toolbar can be used to save data into the OmniSense database, or to generate external .kml files. (Analysis cannot yet display location data).

OmniSense 3.4.4 July 2012 New Features

BioHarness Module Firmware Version	Required for this release of OmniSense: BioHarness 2.0: v2.3.10.0_9800.0151

	BioHarness 3.0 (BT only): v1.3.13.0_9800.0153 BioHarness 3.0 (BT + ECHO): v1.3.13.0_9800.0189
Configurable BioGauge	The sweep scales are now configurable
Z-Modem Support	Z-Modems used in previous PSM system are again supported. The Z-Modem does not support the Summary Packet however, so Estimated Core Temperature and some other communications parameters are not available
Metric/Imperial Units	The units setting in User Preferences in the Live module now changes units in the Analysis module as well.
ROG Defaults	These can now be reset for an individual subject in the Subject Setup screen. Default values them selves can be set in the User Preferences dialogue.
PSM Defense Support	Radio Network communications using various digital and tactical radios have been updated, along with firmware for the associated RID components
Over-the-Air device configuration	Changes made to subject parameters in OmniSense which affect ROG status algorithms are propagated over the air to the BioHarness module
GPS Support	The OmniSense database can now store GPS data from a supported Bluetooth GPS device which relays location data to a suitably-configured BioHarness 3. This data is not yet available for display. Location, speed & distance data will be available for display in subsequent OmniSense releases
Astro Trunking Support	PSM Responder now supports Motorola Radios configured to operate in Astro trunking mode.

Known Issues

Demo Mode	The configurable fields in the subject BioGauge are not populated with configurable data in Demo mode

OmniSense 3.3.5 May 2012 New Features

BioHarness Module Firmware Version	Required for this release of OmniSense: BioHarness 2.0: v2.3.8.0_9800.0151 BioHarness 3.0 (BT only): v1.3.5.0_9800.0153 BioHarness 3.0 (BT + ECHO): v1.3.5.0_9800.0189
License Key	As this software is already installed, you will already have encountered the license key. A full license key will be valid for any version of OmniSense 3.x.x. Another key must be acquired when OmniSense 4.x.x or later becomes available
Load & Intensity	New Physiological, Mechanical & Training Load & Intensity parameters are available. Cumulative Physiological Load is now displayed in the subject BioGauge. These are displayed in OmniSense Analysis and described in the Analysis Help file.
ECHO Radio Network Type	This supports a new type of expandable 2.4 GHz radio network type. A specific hardware version of the BioHarness 3.0 must be used.
Zephyr Compression Shirt	A new garment type is supported. As this garment does not feature a breathing sensor, the subject ROG algorithm is adjusted to take into account the lack of breathing data.
Configurable	The numeric values displayed at top left and right, and top center of

BioGauge	the subject BioGauge are now configurable
Simplified ROG algorithm configuration	Heart rate and breathing rate thresholds are again configurable
DownLoader Tool	The BioHarness MultiDownloader is now installed automatically. It can be accessed from the Analysis module toolbar

Dropped Features

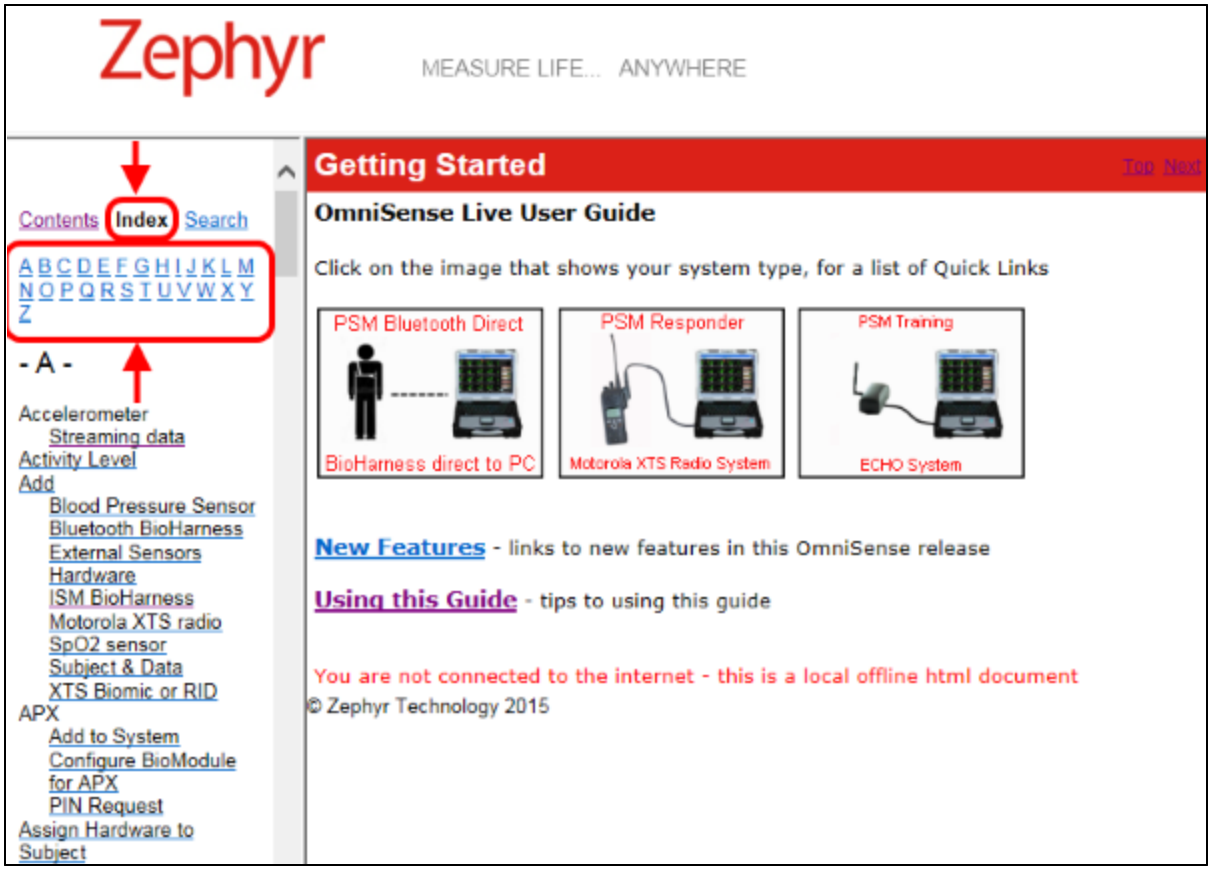
Effort	Effort was a cumulative heart rate derived indication based on heart rate zones, and has been replaced by Physiological Load
Exertion Score	Exertion Score was a cumulative activity level derived indication based on activity VMU averages, and has been replaced by Mechanical Load
Standing & Resting Heart Rate in BioGauge	The graticules indicating these values have been removed. They can still be entered in the Subject data screen

Known Issues

Demo Mode	The configurable fields in the subject BioGauge are not populated with configurable data in demo mode

1.6 Using This Guide

If using the Quick Links on the Getting Started page doesn't help, then the quickest way to find information is to use the Index:



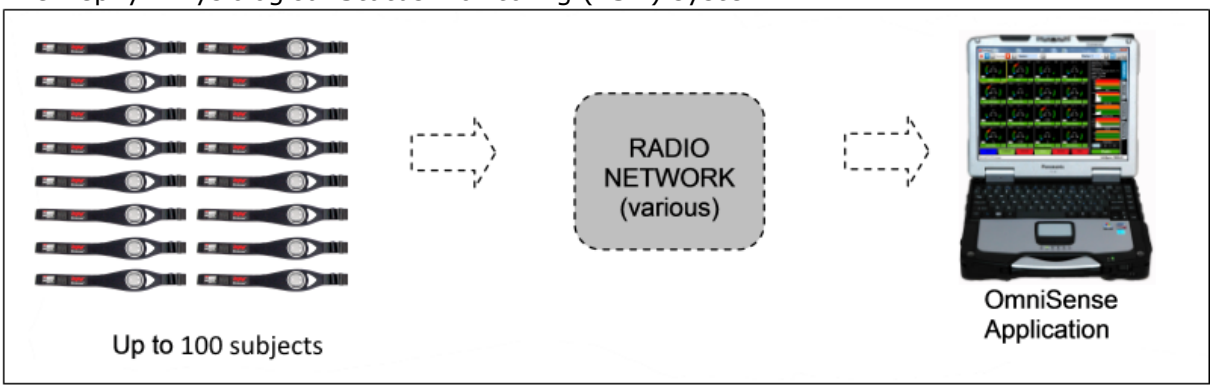
- Select the ***Index*** tab on the left-hand navigation panel. Use the Alphabet links to jump to a letter heading - it's quicker than scrolling through the list.
- Use the ***Search*** tab for a specific word search if the Index doesn't provide an appropriate reference
- Use the browser *Back*  button to retrace your path (Keyboard short cut  + )
- If you have a suggestion to add to the index, email support@zephyrtech.zendesk.com

Note that an HM2GO.exe web server application will run while you are viewing this file, to enable its viewing in Google Chrome browsers.
You are not connected to the internet.

Part 2

2 PSM System Description

The Zephyr Physiological Status Monitoring (PSM) system



Subject data

Each subject wears a Zephyr BioHarness™ module and chest strap or shirt which transmits

- Heart Rate
- Breathing Rate
- Activity level
- Subject orientation (posture)
- Accelerometer data (3-axis)
- Skin Temperature (BioHarness 2 only) or Estimated Core Temperature
- Subject status as Red/Orange/Green indication

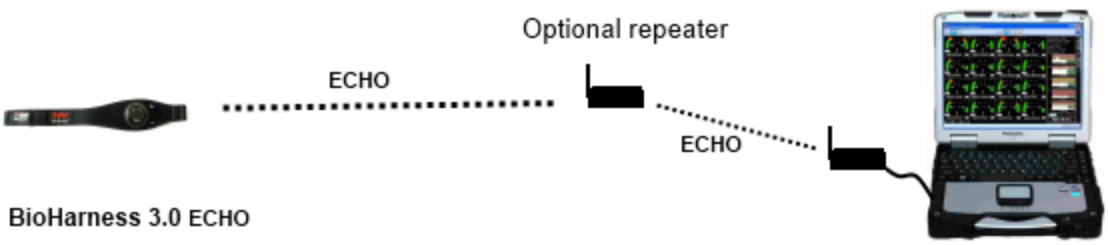
System Features

- Live module showing individual 'BioGauge' display
- Workout screens with preconfigured workouts and target training zones
- Optional GPS map window (internet connection required, & supported GPS)
- Trend graphs of live data
- Streaming accelerometer data
- External sensor data (Bluetooth systems only) for Blood Pressure or SpO_2
- Recording of session data to database
- Analysis module showing graphical comparison of parameters, and automatic fitness test analysis
- Live demo mode from a saved file

2.1 PSM Radio Network Options

This user guide is for *all* of the systems below. Variations in setup and use are described in the relevant sections.
You must set the correct Radio Network Type for the system to function.

PSM Training ECHO Max. subjects: 100



Transmission Frequency - once per 1,2.5 or 5 seconds (20, 50 or 100 BioModules)

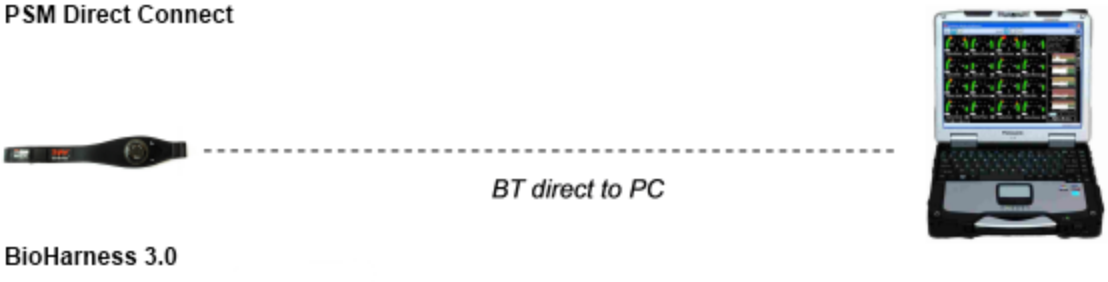
PSM Responder + Motorola APX digital radio Max. subjects: 64

Transmission Frequency - approximately two seconds per radio i.e. a maximum of 128 seconds with 64 radios operating

PSM Responder + Motorola XTS digital radio Max. subjects: 64

Transmission Frequency - approximately two seconds per radio i.e. a maximum of 128 seconds with 64 radios operating

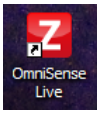
PSM Direct Connect Max. subjects: 7



Transmission Frequency - once per second

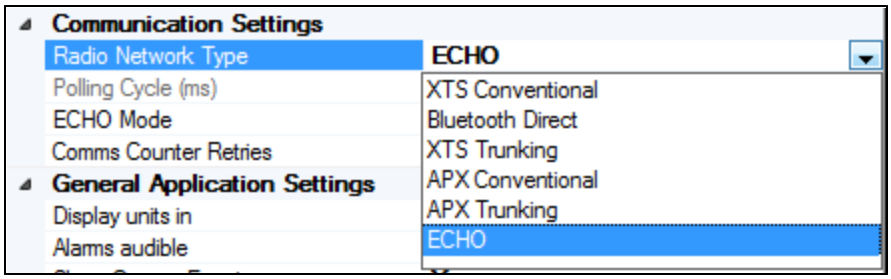
PSM Defense offers a variety of tactical radio network options. These are not included in this document.

2.1.1 Set Radio Network Type

1. Start the Live module 

2. Select the Preferences toolbar button 

3. Select the *Radio Network Type* pull-down and set according to your system type:



Radio Network Type	System
MotorolaXTS	PSM Responder using Motorola XPS radios
Bluetooth	PSM Bluetooth Direct - using a USB (Bluetooth, Classic, not Low Energy)dongle or native Bluetooth in a PC
ECHO	PSM Training ECHO - using an ECHO USB Gateway Settings: ECHO 20x1 - up to 20 devices with 1 sec update rate ECHO 50x2.5 - up to 50 devices with 2.5 sec update rate ECHO 100x5 - up to 100 devices with 5 sec update rate
ASTRO Trunking	PSM Responder, with Motorola radios configured to operate in trunking mode
APX Conventional	PSM Responder using Motorola APX Radios
APX Trunking	PSM Responder using Motorola APX radios in trunking mode

Other options are available for a variety of military tactical radio networks.

Part 3

3 System Setup

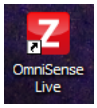
The next set of topics describe how to configure how a system before you use it.

You need to add the following to the OmniSense database before the Live module can operate:

- Subject data Name or ID, Birth Year, Gender and some physiological parameters
- Hardware components (BioHarness modules, radios if used, optional GPS units)
- Assign Hardware to subjects
- Teams Subjects must be allocated to a Team
- Deploy Teams Teams must be made active - 'deployed'

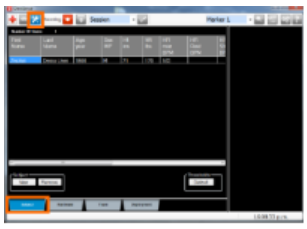
Overview of Setup screens

There are four major tasks necessary to set up the OmniSense internal database, prior to running the application in Live mode.

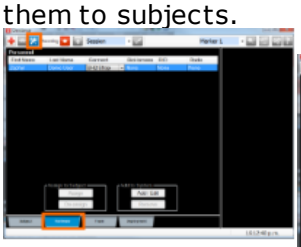
1. start the OmniSense Live module using the desktop shortcut. 

2. Select the Setup Mode toolbar button to access the setup tab pages shown below.


3. Add subjects and their physiological data to the database.

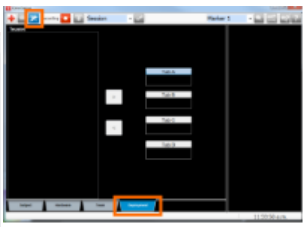


4. Add hardware components to the database, and assign them to subjects.



5. Organize the subjects into Teams

6. Deploy necessary teams for live operation



3.1 Add Subject Data

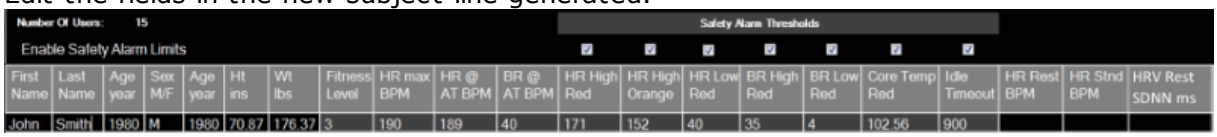
The OmniSense database needs some personal and physiological data in order to be able to configure individual BioGauges, and generate a Red/Orange/Green physiological status. Default values exist, and some other values are auto-calculated. Physiological thresholds can be updated by collecting fitness test data in the Live Module, and processing it in the Analysis module.
Fitness test protocols are described in the Analysis *Help* > *Fitness Testing* file topic.

1. Select the *Setup* button on the toolbar of OmniSense Live.

2. Select the *Subject* tab at the foot of the screen.

3. Select the New subject button.

4. Edit the fields in the new subject line generated.



If a checkbox above a column is *unchecked*, then that parameter value will *never cause any change in ROG status*. Within the ROG algorithm, a value will be assigned which never causes the threshold to be crossed. The actual streaming value will be displayed and saved to the OmniSense database as usual.

The next topic describes the parameters in detail.

Further tuning of the subject ROG status algorithm can be done manually using the Zephyr Config tool, though any manual settings should not conflict with those above, as OmniSense resends the above subject configuration to the device, each time it is used in a PSM Direct Connect or Training (ECHO) system. If a device has been re-configured using the Config Tool, OmniSense will overwrite with the above safety alarm thresholds.

3.1.1 Subject Physiological Parameters

This table describes the information contained in the subject setup screen.

Data	Min	Max	Default	Units	Defaults Set by Button	Description
First Name		40	New	Chars		Name of identifier (e.g.Call Sign)
Last Name		40	Subject	Chars		Name or identifier
Age Year	1900	Current year	1980	Year		YYYY format
Sex M/F			M	M/F		
Height	0	300cm or 168"	-	Cm or inches		Set Units in Preferences
Weight	0	300Kg or 660lbs	-	Kg or lbs		Set Units in Preferences
Fitness Level	1	10	3			1= Low fitness level 10= Elite athlete At present this value is only used in the algorithm to calculate Estimated Core Temperature

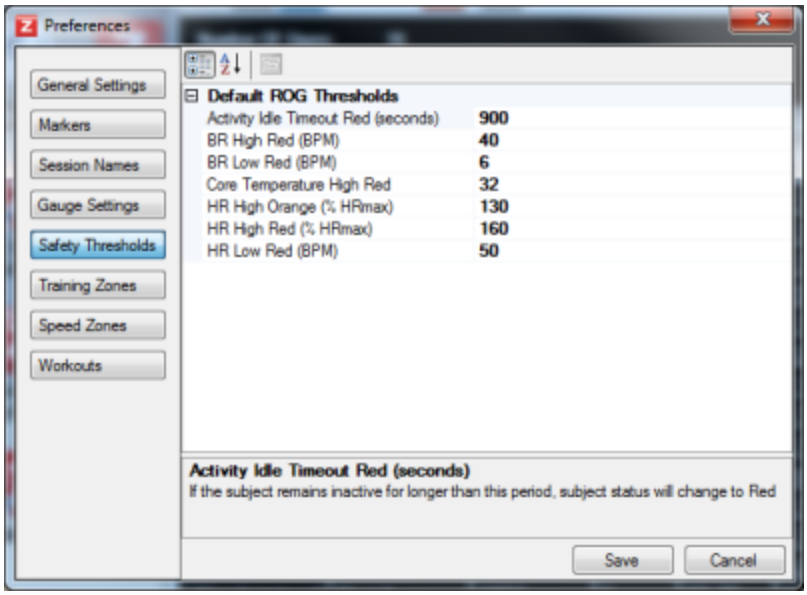
HR Max	40	240	Auto calculated	Beats/min		Auto-calculated from DOB & Gender using ACSM equation. Can be edited if exact value is known from a fitness test.
HR@AT	HR Low Red	HR Max	80% HRmax	Beats/min		Heart Rate at Anaerobic threshold. Saved from a Fitness Test Analysis. Used to establish Training Zones
BR@AT	4	70	40	Breaths/ min		Breathing rate at anaerobic threshold (AT). Can be established and saved from data recorded during a maximal fitness test
HR High Red	25	240	90% HRmax	Beats/min	Y	Above this value subject status is RED
HR High Orange	25	240	80% HRmax	Beats/min	Y	Above this value subject status is ORANGE
HR Low Red	4	240	40	Beats/min	Y	Below this value subject status is RED
BR High Red	70	70	35	Breaths/ min	Y	Above this value subject status is RED
BR Low Red	4	4	4	Breaths/ min	Y	Below this value subject status is RED
Core Temp Red	81 deg F	126 deg F	102.56	deg F/ deg C		Above this temperature subject status is RED
Idle Timeout	0		900	seconds		If a subject remains inactive for longer than this period, his subject status will be set to RED
HR Rest	HR Low	HR Max	-	Beats/min		Resting heart rate (after 1 min lying down)
HR Stand	HR Low	HR Max	-	Beats/min		Standing heart rate (after 1 min standing up)
HRV Rest SDNN				milliseconds		Resting Heart Rate Variability, obtained from an orthostatic hypotension test

Disabling Safety Alarm Thresholds

A number of thresholds can be disabled by un-checking the checkbox above their column. When this is done the parameter will be assigned a value internally which results in no data value for this parameter causing the relevant threshold state to be activated.

Setting Safety Alarm Threshold Defaults

The default button sets the safety alarm threshold defaults for those columns with check boxes only, for the selected subject. Th default values themselves can be set in the User Preferences dialogue



3.2 Add Hardware Components

Zephyr's BioHarness™ module is the common component for each PSM System. Other hardware components vary according to the radio network being used to send the data to the host PC platform. Then each component must be:

- Added to the OmniSense database when setting up the system - this saves the necessary communication parameters for each device
- Assign to a subject before going Live, so OmniSense can match the correct data with the correct subject

This table shows the various PSM Systems and their components, all of which use the OmniSense Application:

System	Max. Subjects	Per subject	Per Subject	Per Subject	Per System
PSM Bluetooth Direct	7	BT BioHarness module			Bluetooth Receiver*
PSM Responder	64	BT BioHarness module	Motorola XTS Digital Radio	Motorola XTS BioMic or RID	Motorola XTS PC Gateway radio *
PSM Training ECHO	50	BioHarness 3.0 ECHO	GPS (optional)		ECHO Gateway & optional Repeaters *

* this system component does not need to be added to the database

Before you can add any hardware components to your system, you must set the radio network type.

3.2.1 PSM Bluetooth Direct

The *Radio Network Type* should be set in *Preferences* to *Bluetooth.*

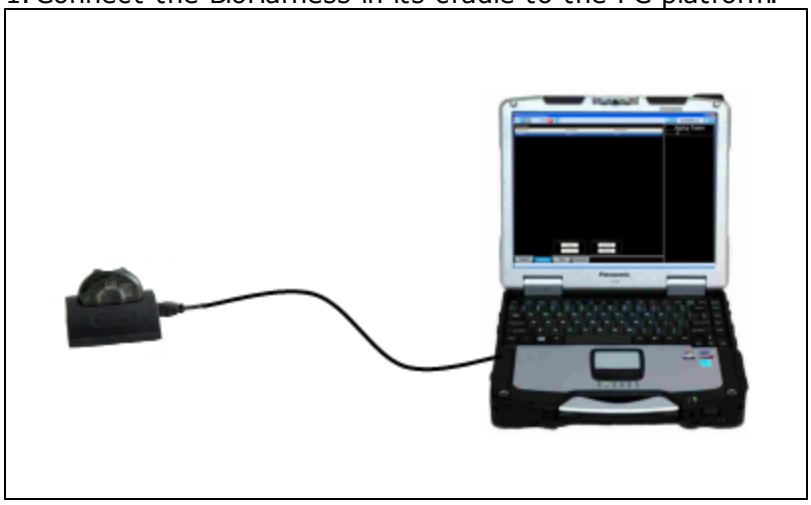
You must add a Bluetooth BioHarness for each subject to the OmniSense database, to a maximum of 7 subjects.

- it can be added by connecting it directly to a PC
- it must be labeled with an identifier so that it is issued to the correct user

3.2.1.1 Add Bluetooth BioHarness Module

Add by Connection to a PC

1. Connect the BioHarness in its cradle to the PC platform.



2. Start the OmniSense Live module
3. Select the *Setup* Toolbar button 
4. Select the *Hardware* tab 

5. Select the *Add/Edit* hardware button 

6. Follow the Wizard displayed

7. Select *Zephyr*

8. Select *Connection to PC*

9. OmniSense should detect your device automatically, and display its serial #

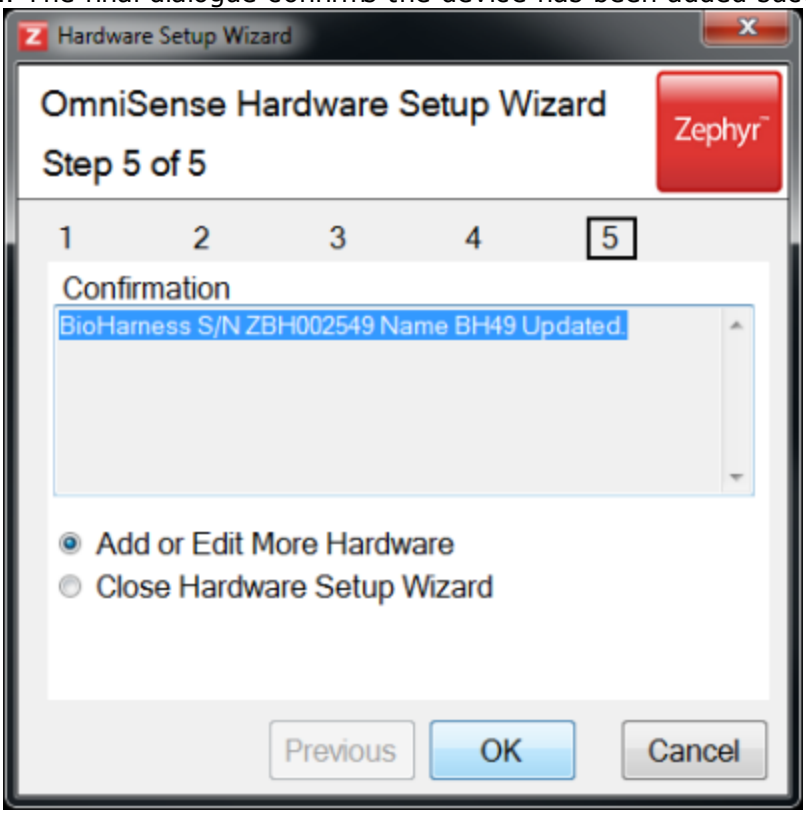
10. Choose a device name - BH49 is in the above example. You should clearly label the device with the same label,

so the correct device is issued to the subject when he is assigned BH49 in OmniSense

If this device is reconnected to the PC at a later date, the 'BH49' label will be redisplayed. It can be changed at any time,

but the module will need to be re-assigned to any subjects previously assigned to it using the original label.

11. The final dialogue confirms the device has been added successfully.



Click *OK* to add another device, or *Cancel* to exit the Wizard

3.2.2 PSM Responder

The *Radio Network Type* should be set in *Preferences* to *MotorolaXTS.*

You must add a Bluetooth BioHarness, a Motorola XTS Series Radio (appropriately configured - documentation is included on the system CD), plus a radio interface device (RID) for each subject to the OmniSense database, to a maximum of 64 subjects.

- Add Bluetooth BioHarness
- Add Motorola radio
- Add RID

- they can be added by connecting directly to a PC
- they must be labeled with an identifier so that they are issued to the correct user

Astro Trunking

If the Responder system is to use Motorola radios operating in Astro Trunking mode, radios and hardware are added as for non-trunking systems. Separate documents (not in this file) are provided by Zephyr to describe trunking server setup and configuration.

3.2.2.1 Add Bluetooth BioHarness Module

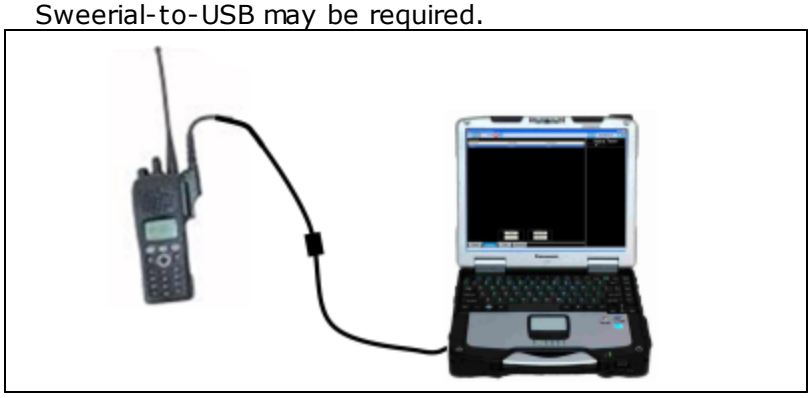
Adding a Bluetooth BioHarness module to a PSM Responder System is an identical to that for a Bluetooth Direct System.

3.2.2.2 Add Motorola XTS Radio

You can add a BioHarness module to the OmniSense database by two methods:
- Add by connection to the PC platform
- Add using a configuration file

Add by Connection to a PC

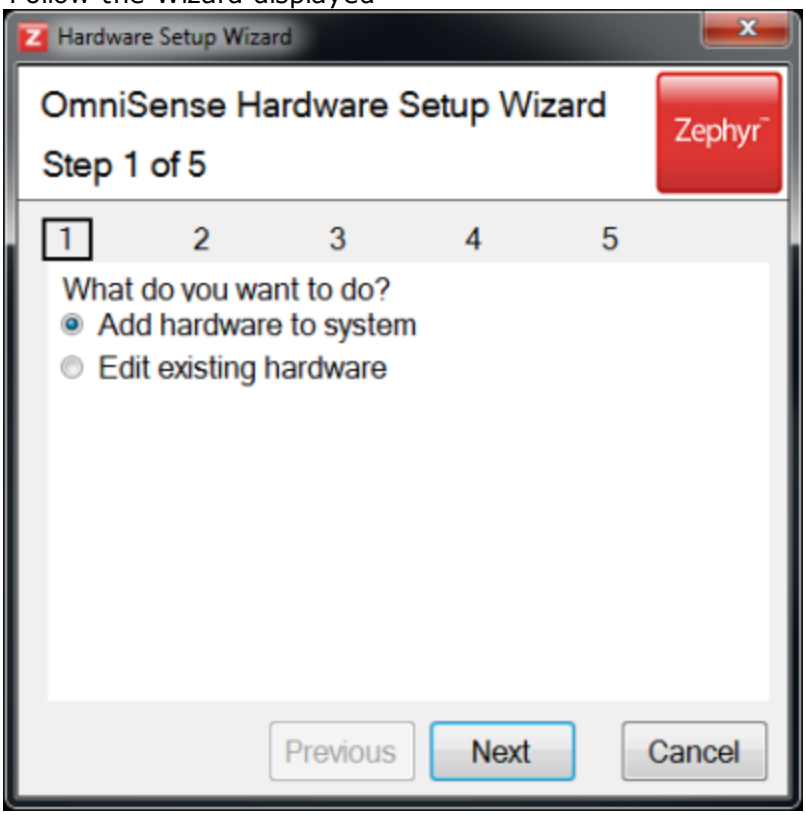
1. Connect the Radio to the PC using the supplied Serial adaptor cable. Use a Serial-to-USB adaptor connector if your PC has no serial socket. Driver installation for the Sweerial-to-USB may be required.



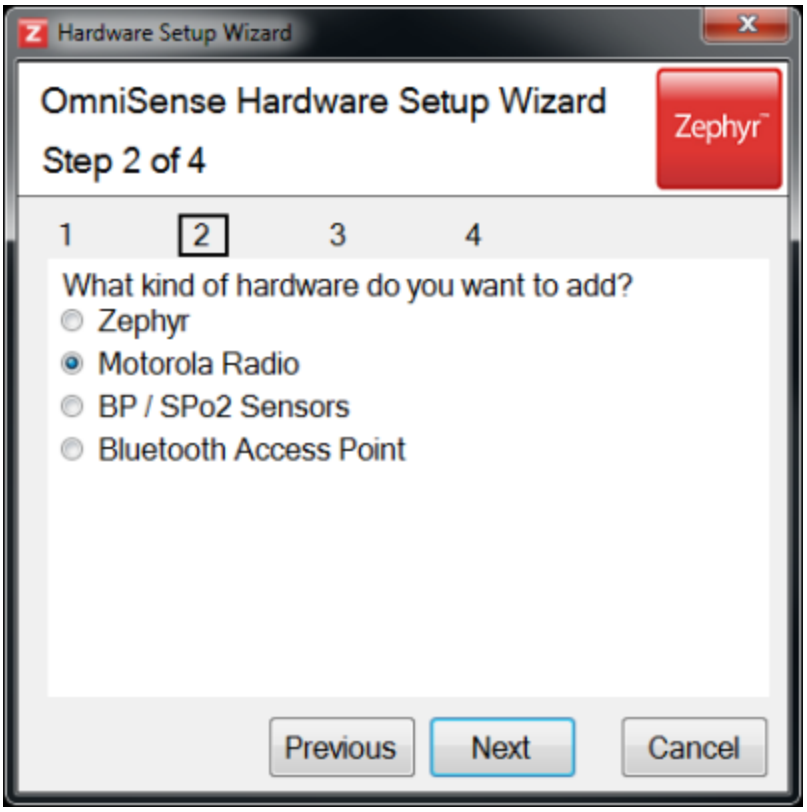
2. Start the OmniSense Live module
3. Select the *Setup* Toolbar button 
4. Select the *Hardware* tab 

5. Select the *Add/Edit* hardware button 

6. Follow the Wizard displayed



7. Select *Motorola Radio*

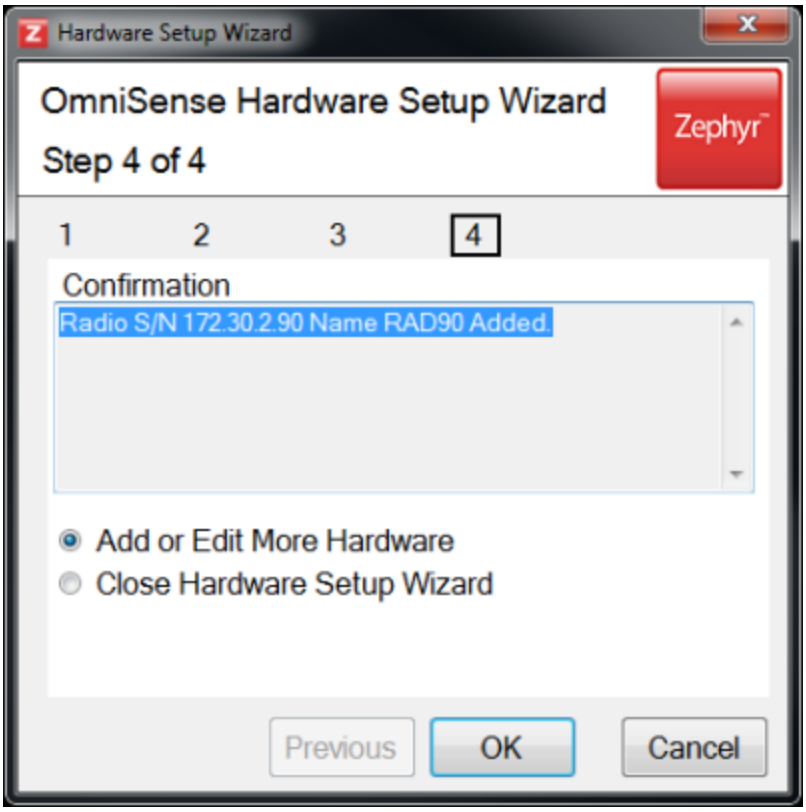


8. OmniSense should detect the radio automatically, and display a radio IP Address (172.30.2.90 in the capture below)

9. Choose a radio name - RAD90 is in the above example. You should clearly label the radio with the same label, so the correct radio is issued to the subject when he is assigned RAD90

If this radio is reconnected to the PC at a later date, the 'RAD90' label will be redisplayed. It can be changed at any time, but the radio will need to be re-assigned to any subjects previously assigned to it using the original label.

10. The final dialogue confirms the device has been added successfully.

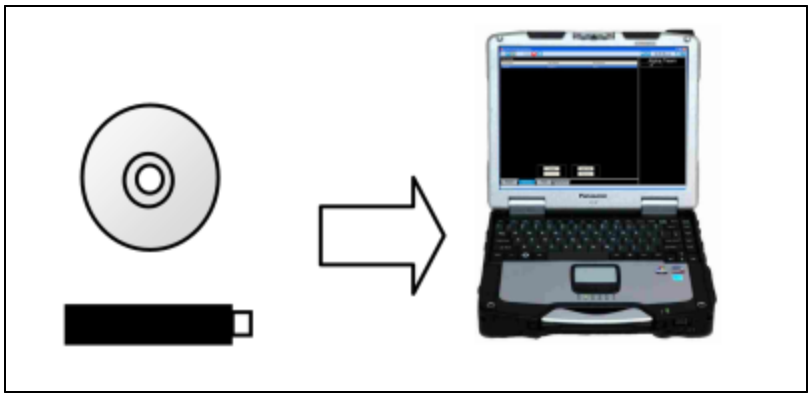


Click *OK* to add another device, or *Cancel* to exit the Wizard

Add by Configuration File **Back to top**

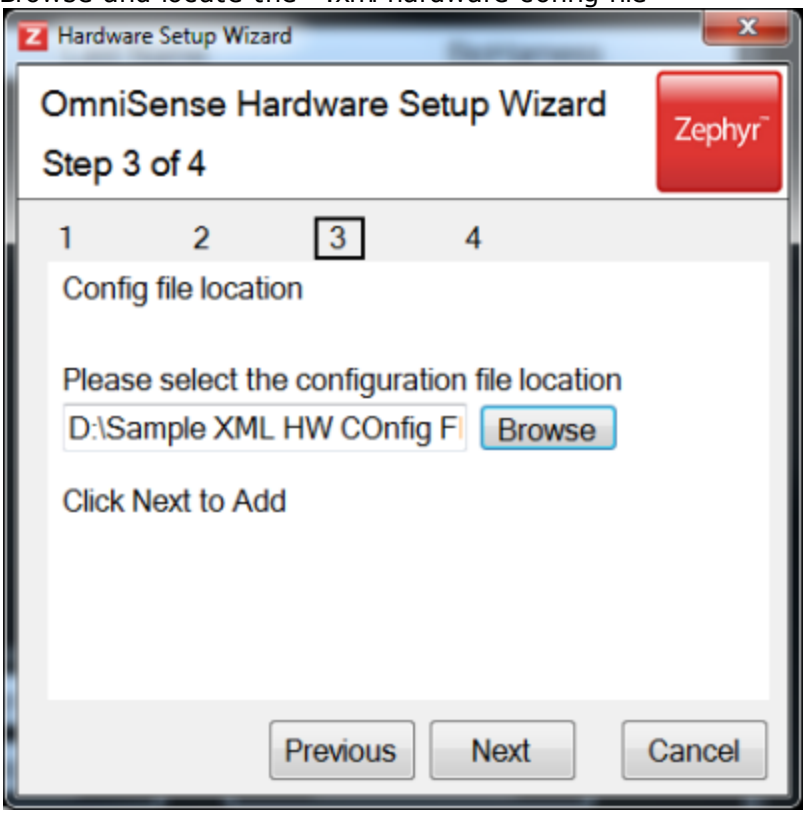
Large systems may be supplied with a Config file on a CD, which contains the details of a number of devices. If this is the case, each device will be pre-labeled. These labels will be used by the config file, so they should not be removed. If labels need to be changed, each device will have to be connected to the PC individually and the label edited using the same *Add/Edit* wizard.

1. Insert the CD or removable storage device into the PC platform, so that it can be browsed to

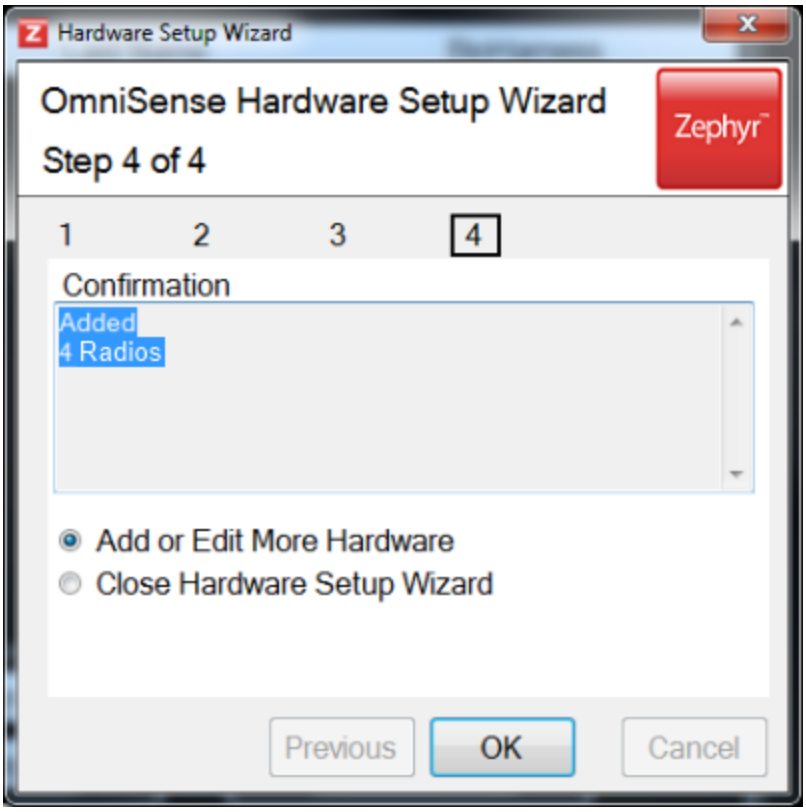


2. Select *Config file*

3. Browse and locate the *.xml hardware config file



4. The final dialogue confirms the devices have been added successfully



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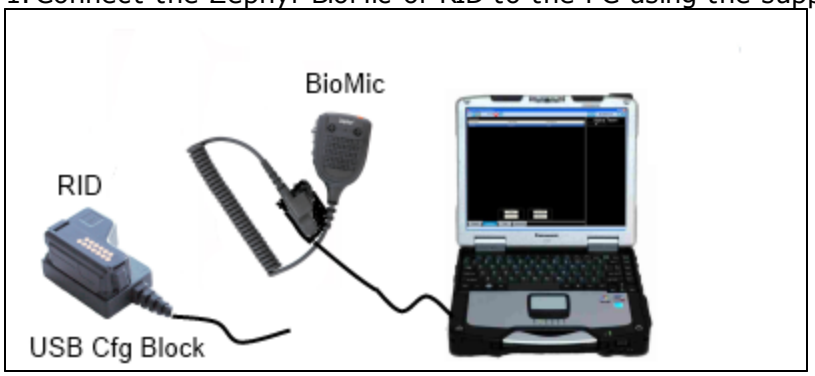
3.2.2.3 Add XTS BioMic or RID

You can add a BioHarness module to the OmniSense database by two methods:

- Add by connection to the PC platform
- Add using a configuration file

Add by Connection to a PC **Back to top**

1. Connect the Zephyr BioMic or RID to the PC using the supplied USB Config block.



2. Start the OmniSense Live module

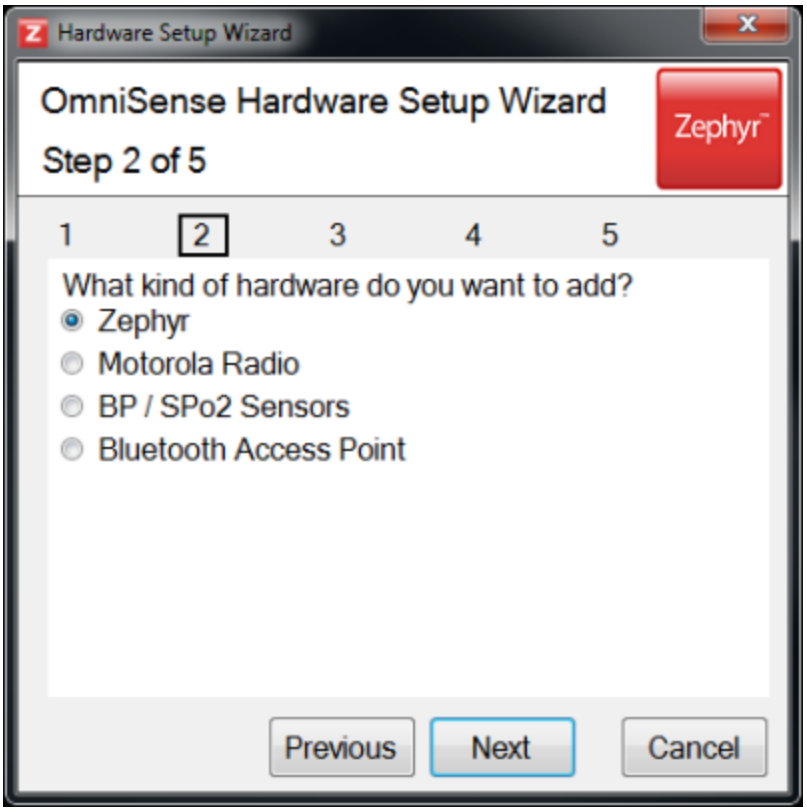
3. Select the *Setup* Toolbar button 

4. Select the *Hardware* tab 

5. Select the *Add/Edit* hardware button 

6. Follow the Wizard displayed

7. Select Zephyr



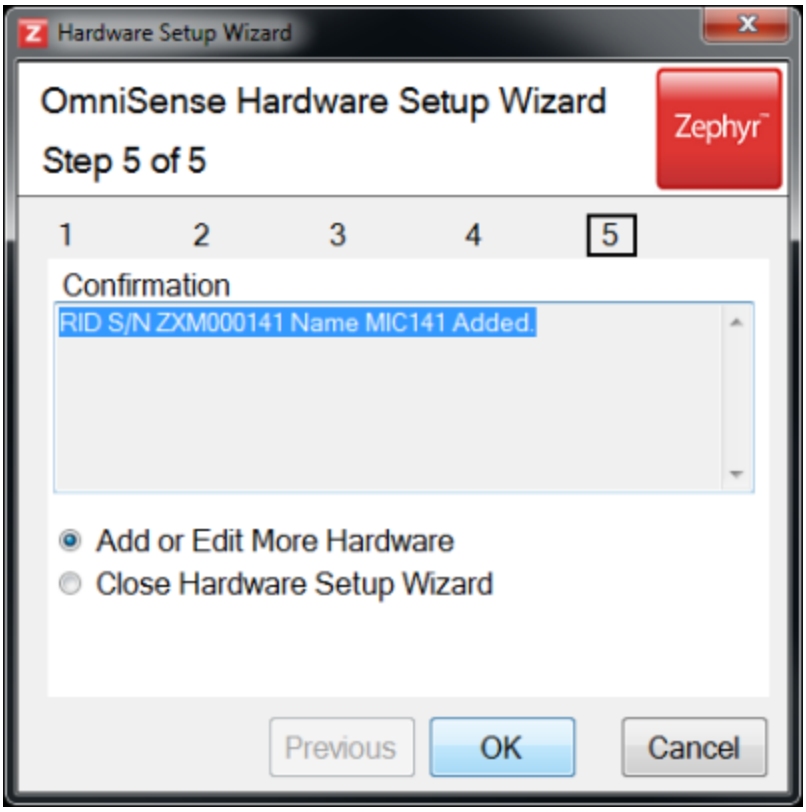
8. Select *Connection to PC*

9. OmniSense will detect the device and display its serial number. Choose a label for the

device (MIC141 in the example) and label the BioMic or RID so that the correct component can be can be issued to the subject.

If this BioMic is reconnected to the PC at a later date, the 'MIC141' label will be redisplayed. It can be changed at any time, but the BioMic will need to be re-assigned to any subjects previously assigned to it using the original label.

10. The final dialogue confirms the device has been added successfully.

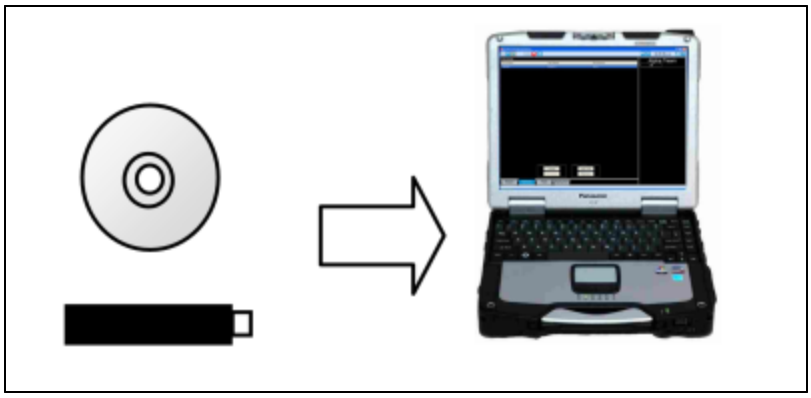


Click *OK* to add another device, or *Cancel* to exit the Wizard

Add by Configuration File **Back to top**

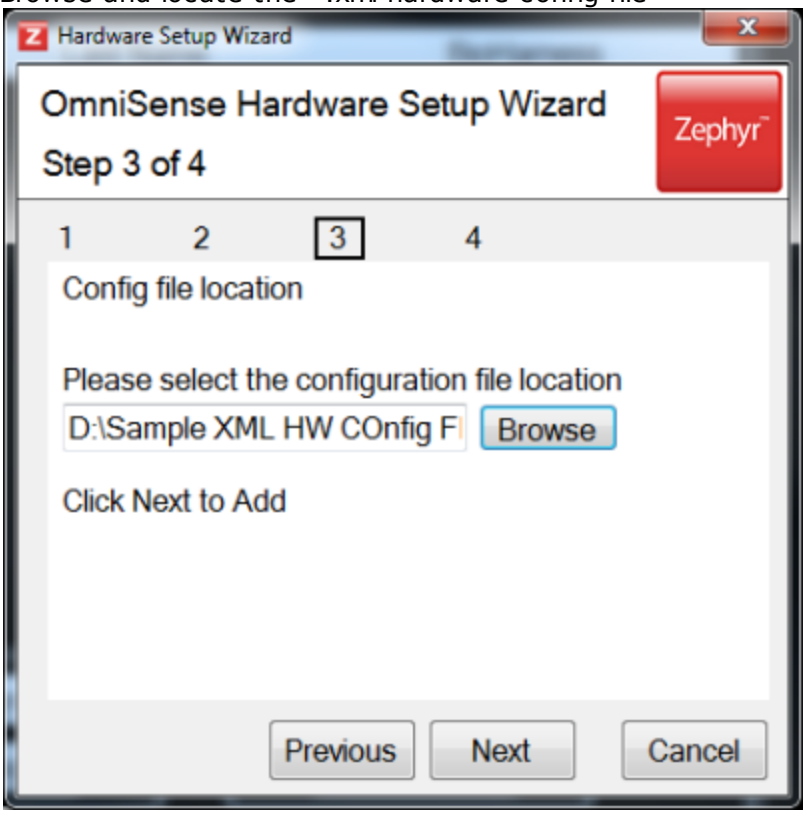
Large systems may be supplied with a Config file on a CD, which contains the details of a number of devices. If this is the case, each device will be pre-labeled. These labels will be used by the config file, so they should not be removed. If labels need to be changed, each device will have to be connected to the PC individually and the label edited using the same *Add/Edit* wizard.

1. Insert the CD or removable storage device into the PC platform, so that it can be browsed to

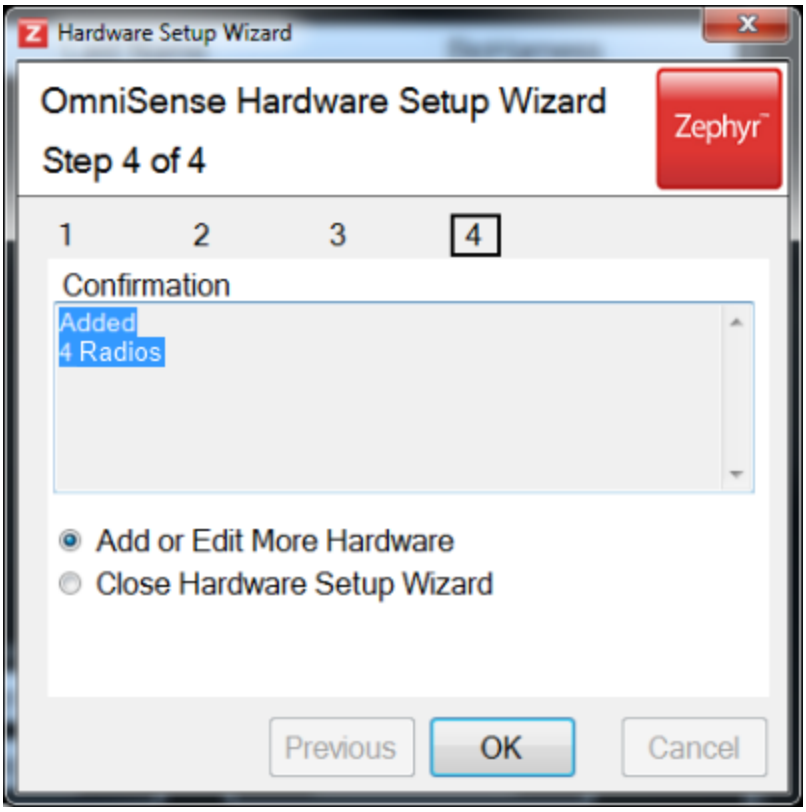


2. Select *Config file*

3. Browse and locate the *.xml hardware config file



4. The final dialogue confirms the devices have been added successfully



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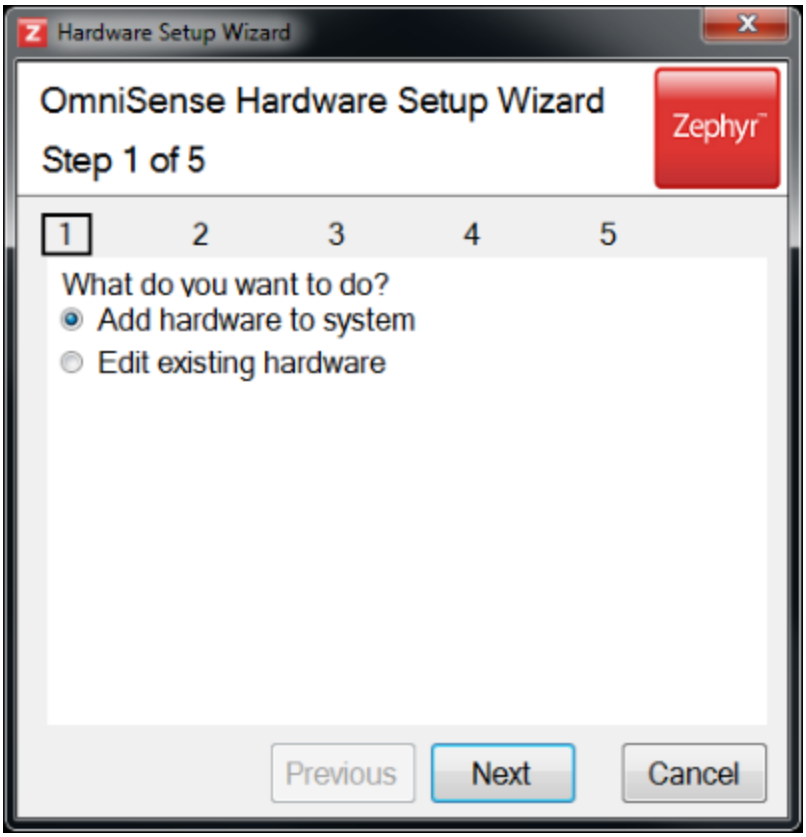
3.2.2.4 Add Motorola APX Radio

1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Hardware* tab 

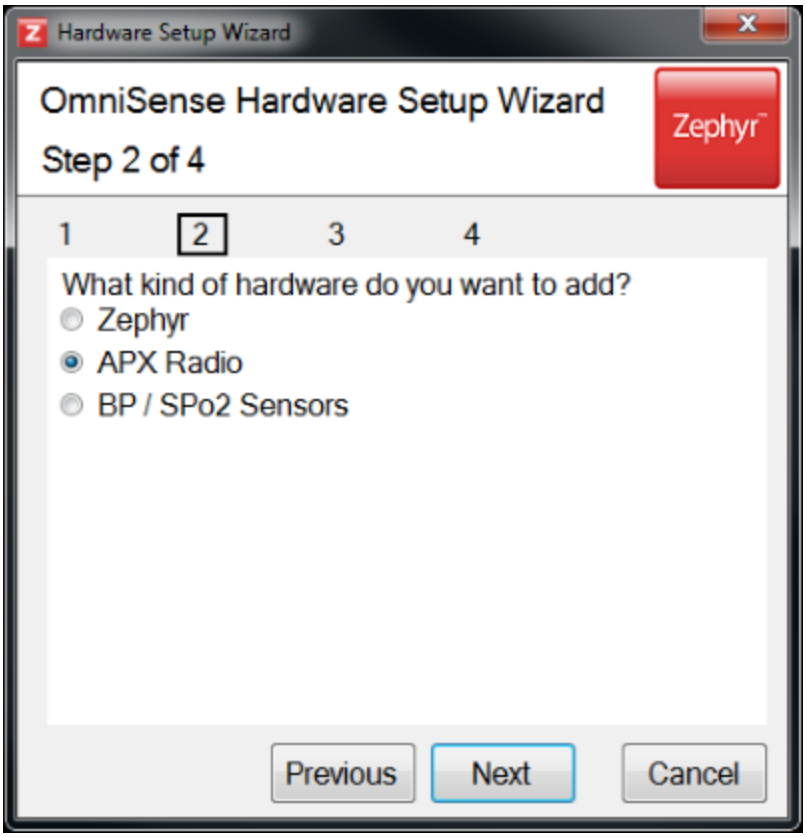
4. Select the *Add/Edit* hardware button 

5. Follow the Wizard displayed

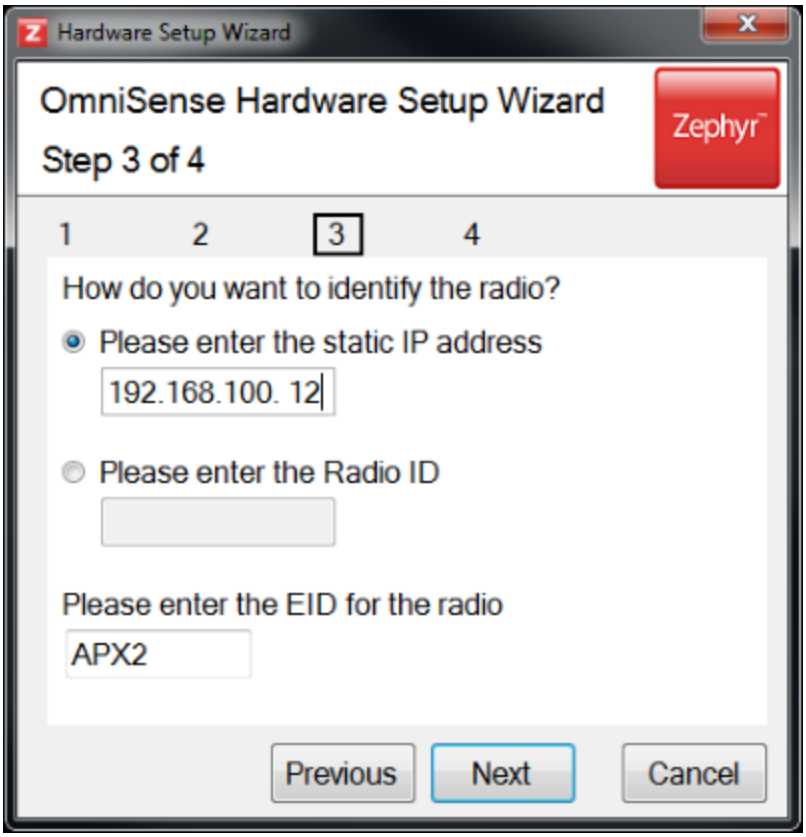


Select *Add Hardware*...

6. Select APX *Radio*

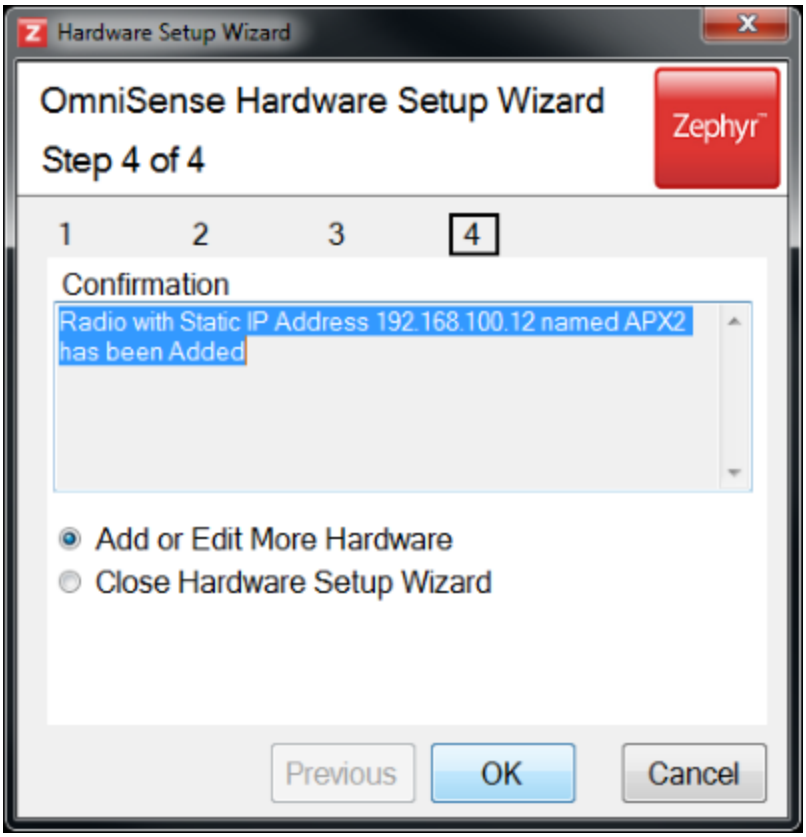


7. Manually enter the Bluetooth DUN Peer Address (192.168.100.12 in the capture below). This should be provided by a communications technician.



8. Choose an EID - Equipment ID - APX2 is in the above example. You should clearly label the radio with the same EID so the correct radio is issued to the subject when he is assigned APX2 in OmniSense Live

9. The final dialogue confirms the device has been added successfully.



Click *OK* to add another device, or *Cancel* to exit the Wizard

3.2.2.4.1 Configure BioModule for APX use

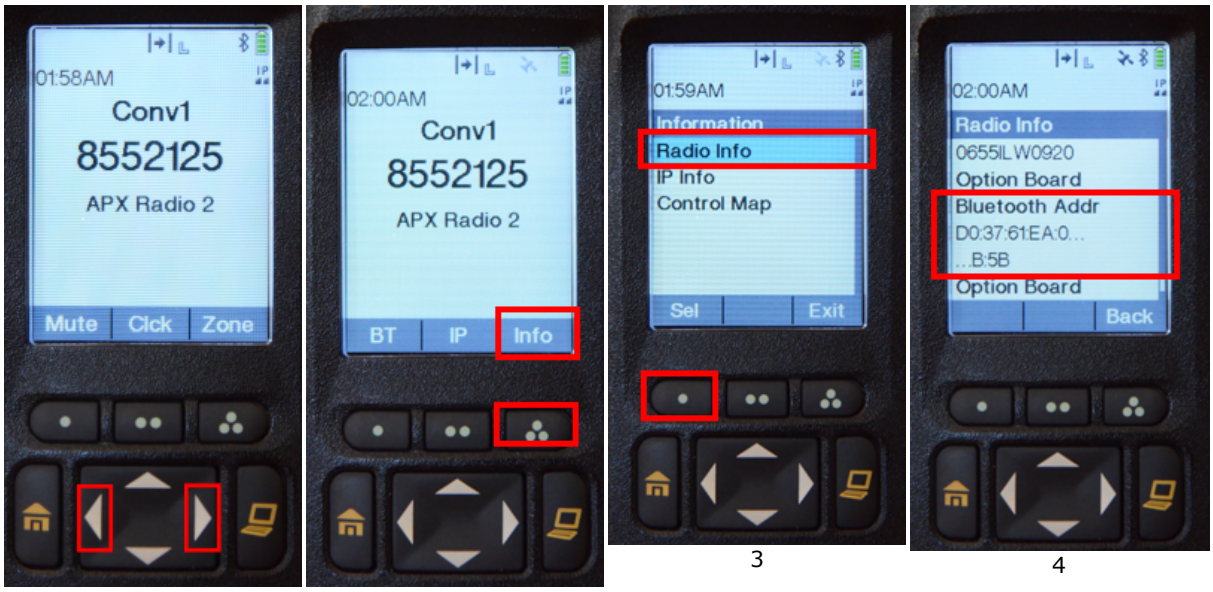
A BioModule used in an APX system must be programmed with the appropriate firmware, which will be supplied with the OmniSense release and specified in the product release notes.

Each BioModule must also be manually Bluetooth-paired with a specific APX radio. The Bluetooth MAC address of the radio must be determined using the radio menus, and this MAC addresses manually configured into the BioModule using the Zephyr Config Tool.

During operations, enter a PIN of 0 using the APX keypad when it receives a pairing request from the BioModule.

APX MAC Address

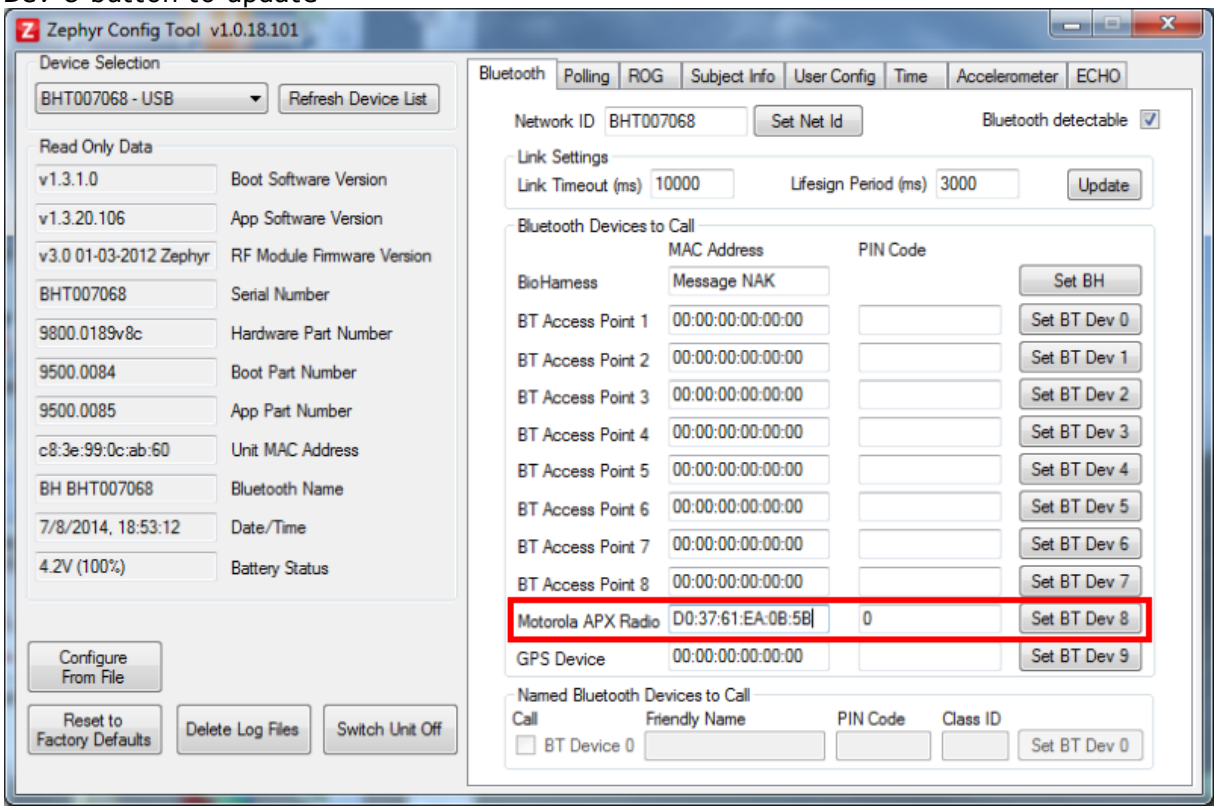
1. Turn on the radio and use the navigation button (left or right arrow) to display the BT/ IP/Info menu options
2. Select the *Info* option
3. Select the *Radio Info* option
4. Scroll down to find the Bluetooth (MAC) Addr. The example shows D0:37:61:EA:0B:5B
5. Note down the MAC address as it must be manually configured into a BioModule



1 2 3 4

Configure BioModule

1. Connect the Biomodule to a PC using a charge cradle or system case.
2. Open the Zephyr Config Tool
3. Enter the APX Bluetooth Address, and PIN 0 (zero) as shown below and click the *Set BT Dev 8* button to update



3.2.3 PSM Training ECHO

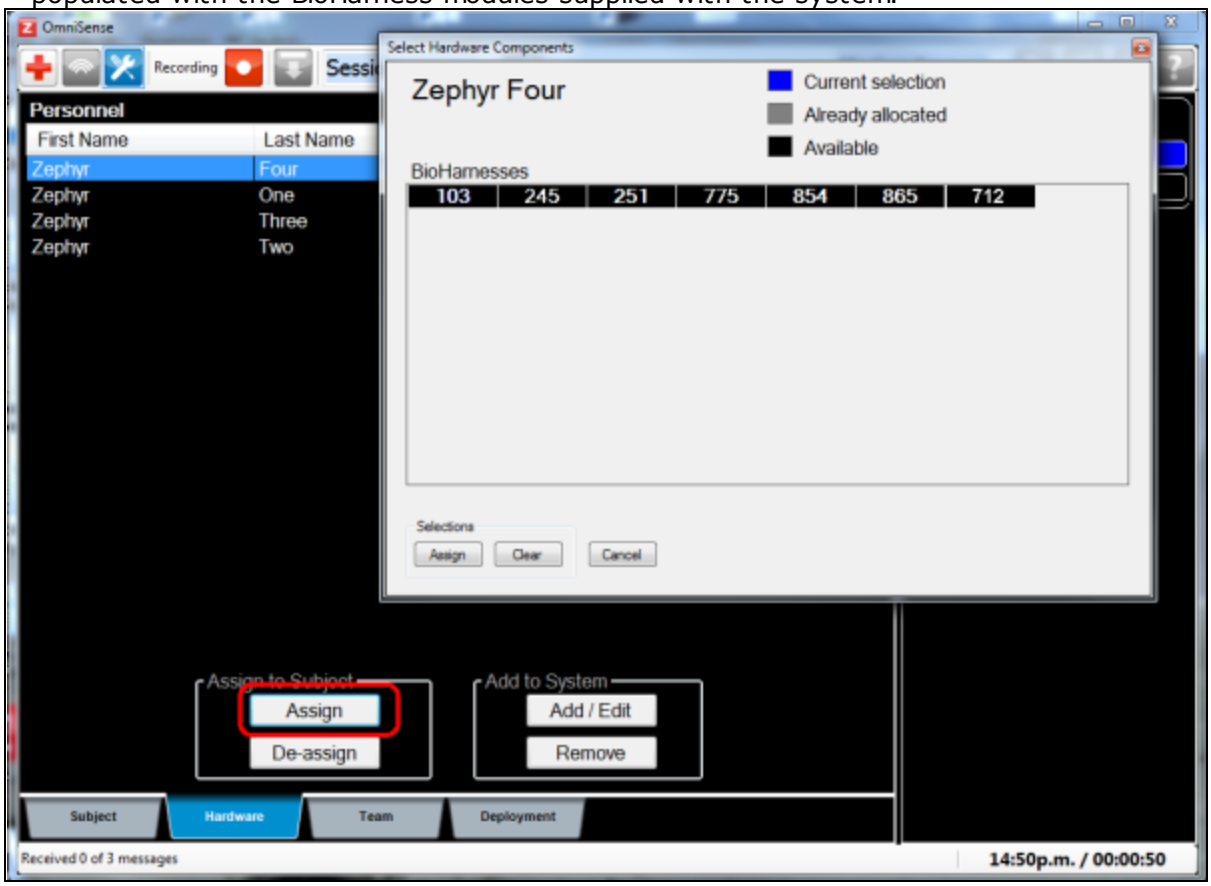
The *Radio Network Type* should be set in *Preferences* to ECHO 20x1, ECHO 50x2.5 or ECHO 100x5, according to the maximum number of BioModules to be used.

You must add a BioHarness 3.0 for each subject to the OmniSense database, to a maximum of 100 subjects. Systems shipped from Zephyr will have all BioHarness modules pre-loaded into the OmniSense database.

- BioHarness modules can also be added manually by connecting directly to a PC
- Each BioHarness will have an individual and unique *Short Transceiver Address* which is configured using the Zephyr Cfg Tool prior to shipping. A dialogue will display if two of these addresses conflict, when adding a device to the system. If a conflict is displayed, the short transceiver address should be changed manually, and the device added into the system again.
- they should be labeled with an identifier so they are issued to the correct user

3.2.3.1 Add BioHarness 3.0 ECHO

- Initial ECHO systems will be supplied with a version of OmniSense which has all hardware components already installed in the database. Adding the BioHarness modules to the database should not be needed. To confirm, go the *Setup* > *Hardware* page, select a subject and click the *Assign* button to display a dialogue, which should already be populated with the BioHarness modules supplied with the system.



- Manually adding a BioHarness ECHO module to a PSM Training system is an identical to that for a Bluetooth Direct System, which is described here

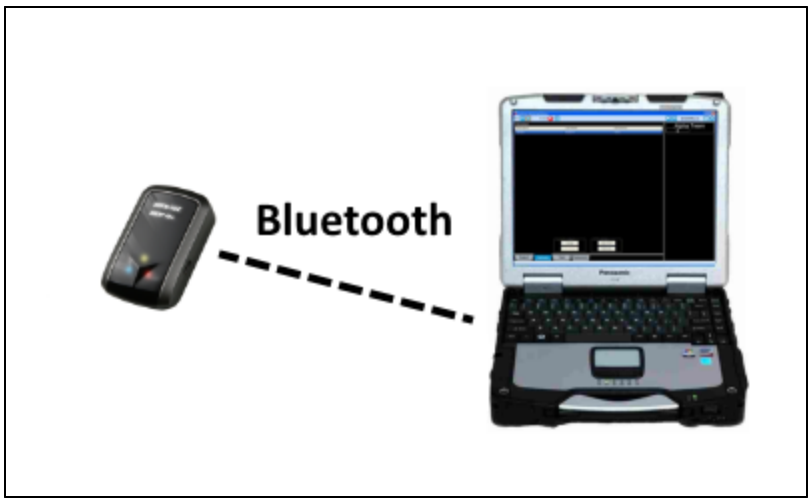
BioHarness Configuration for a PSM Training ECHO System

Should a BioHarness need to be added manually to a PSM Training ECHO system, it may need to be configured (say in the case of a damaged or faulty device being replaced). Each device in any given ECHO system has a unique Short Transceiver Address which must not conflict with other devices being operated at the time.

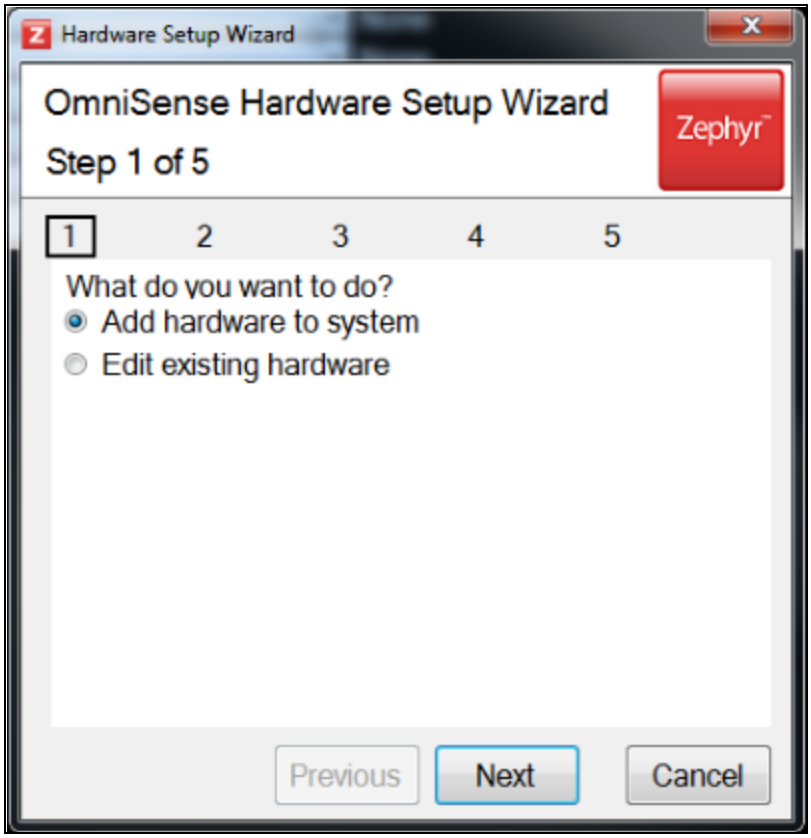
If a replacement device is being supplied by Zephyr, confirm that the value for the address on any replacement is already configured correctly with Zephyr (support@zephyrtech.zendesk.com) or the supplying agent.

3.2.3.2 Add GPS

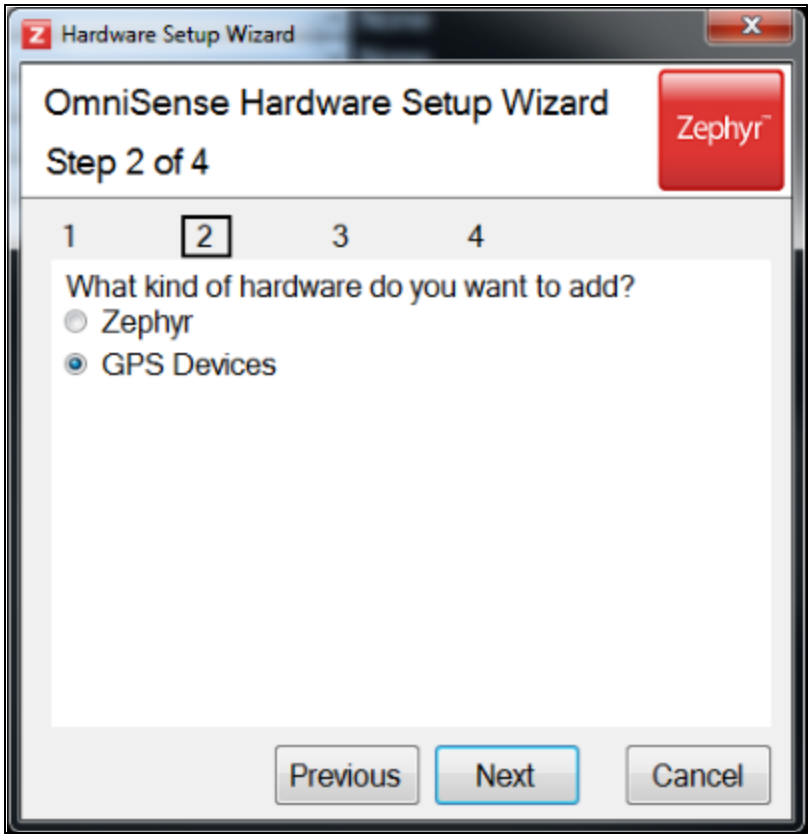
1. Power on the GPS



2. Start the Add Hardware Wizard

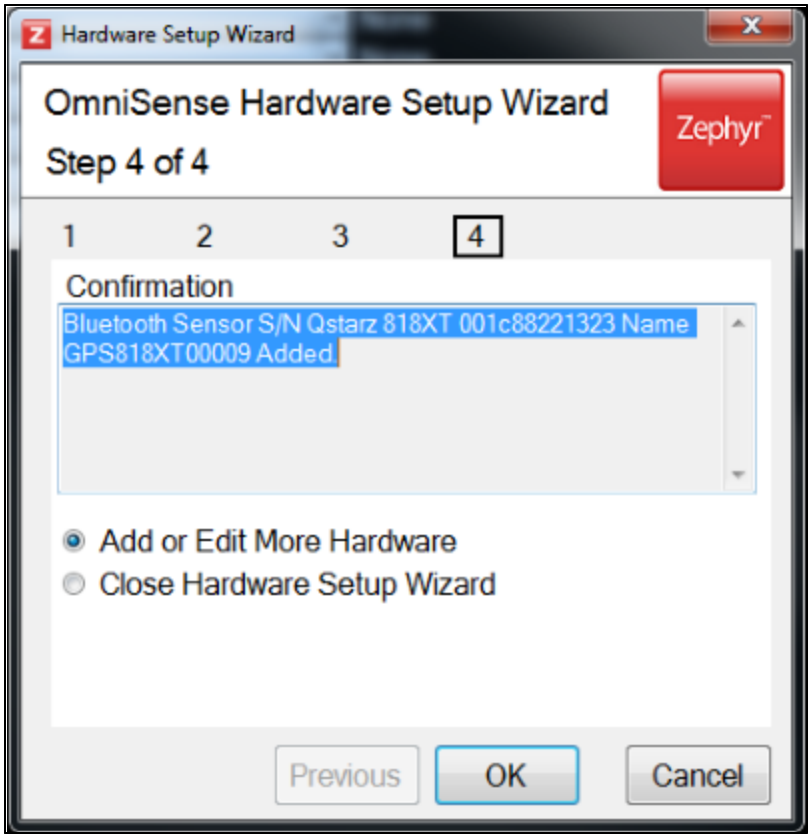


3. Select GPS Devices



4. Wait for the GPS to be detected. Use the Detect button for retries if necessary. When choosing a device name, it should match the label on any GPS shipped pre-labelled with a barcode. Incorporate the serial number on the barcode label into the device name e.g. 'QSTARZ818XT00009'. This label will be printed on device pick lists printed out when using barcode scanner rapid deployment

5. The device details will be entered into the OmniSense database, including the GPS Bluetooth MAC address, which will be sent to its companion BioModule over ECHO, when they are issued together using barcode scanner rapid deployment

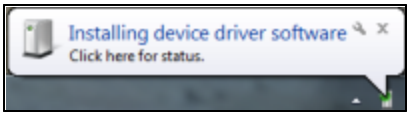


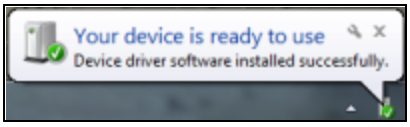
3.2.3.3 Add ECHO Gateway

To add an ECHO Gateway to your system, simply connect it to your PC using the USB-mini connector provided. Windows will automatically detect your device and install the required drivers.

No further configuration is necessary.

If ECHO receivers are used as repeaters in the system, they need never be connected to the host PC to be added to the system.





3.2.4 External Bluetooth Sensors

Not supported by the ECHO radio network type.

- Add SpO2 sensor to OmniSense
- Add Blood Pressure sensor to OmniSense

- Fingertip Pulse Oximeter - this measures % of dissolved oxygen (SpO_2) in the blood.
  Type: Nonin 9560BT

- Wrist cuff Blood Pressure sensor. Type: Zephyr OEM.

- These sensors send their readings to the subject BioHarness (not the PC), which relays the data as an additional data packet. These sensors are added to the host PC over a Bluetooth link, and not by physical connection to the PC.
- In operation, the host PC sends a request to the BioHarness for the sensor data. The BioHarness in turn sends a request to the sensor. Blood pressure or SpO_2 data is sent to the BioHarness, which in turn sends it back to the host PC.

3.2.4.1 Add SpO2 Sensor

Make sure the *Network Type* is set appropriately in *Preferences*
Note that OmniSense only supports Windows default Bluetooth drivers. If your PC uses drivers of any other type, a dialogue will display saying 'No Bluetooth Device detected'

1. If the PC does not have native Bluetooth, connect a Bluetooth USB dongle - you are

going to add this device over-the-air using Bluetooth.

2. Activate the sensor by fitting it to a finger, or holding the jaws open so that it powers on and illuminates the display

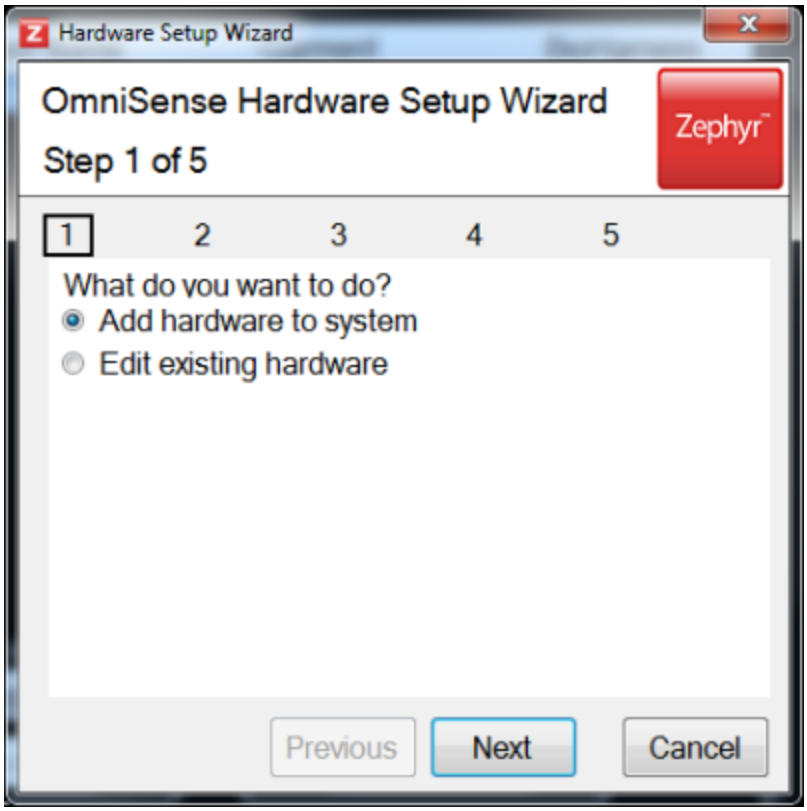
3. Start the OmniSense Live module

4. Select the *Setup* Toolbar button

5. Select the *Hardware* tab

6. Select the *Add/Edit* hardware button

7. Follow the hardware Wizard



8. Select *BP/SPo2 Sensors*

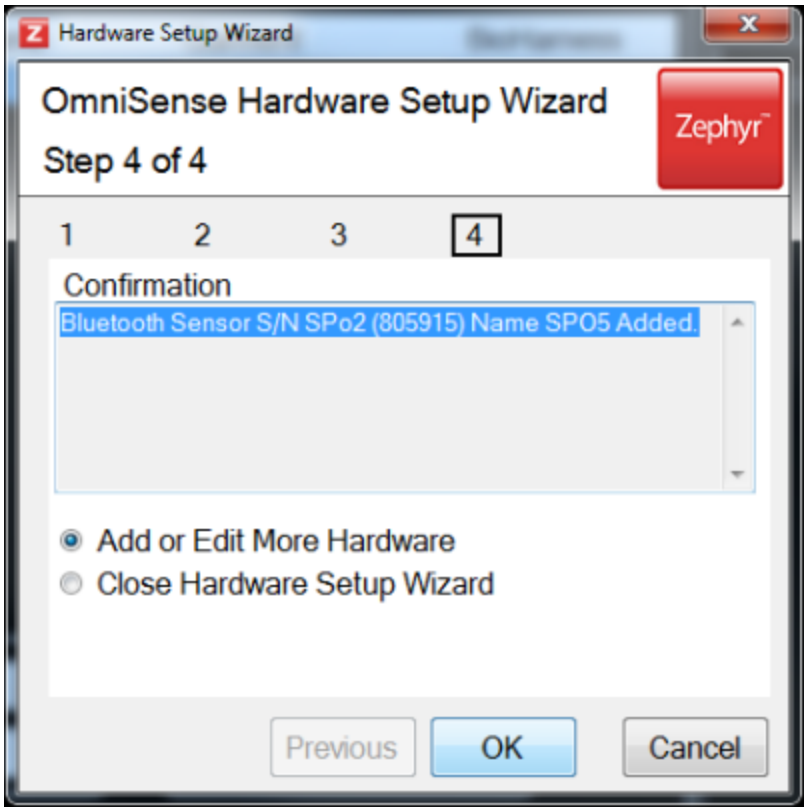
9. OmniSense will search for BT sensors which have been detected by the PC. This may take some tens of seconds - you may have to use the *Detect* button.

A weak battery in the sensor may have enough capacity to power the sensor on, but not to activate its Bluetooth. Insert a new battery if the device isn't detected by the PC.

OmniSense will populate the *passkey* field automatically. All Bluetooth devices have a passkey or PIN which is used when the device is 'paired' with a receiver. For the Nonin Pulse Oximeter, this passkey is the last six digits of the device serial number.

Enter a device label - 'SPO5' in the example above, and mark this on the device clearly, so that the correct device is assigned to a subject when in operational mode.

10. A dialogue will confirm the sensor has been added to the OmniSense database.



3.2.4.2 Add Blood Pressure Sensor

> Make sure the *Network Type* is set appropriately in *Preferences.*
> *Note that OmniSense only supports Windows default Bluetooth drivers. If your PC uses drivers of any other type, a dialogue will display saying 'No Bluetooth Device detected'*

1. If the PC does not have native Bluetooth, connect a Bluetooth USB dongle. You are going to add this device over-the-air using Bluetooth.

2. Power on the sensor using the power button - it need not be worn for the purpose of adding to the OmniSense database.

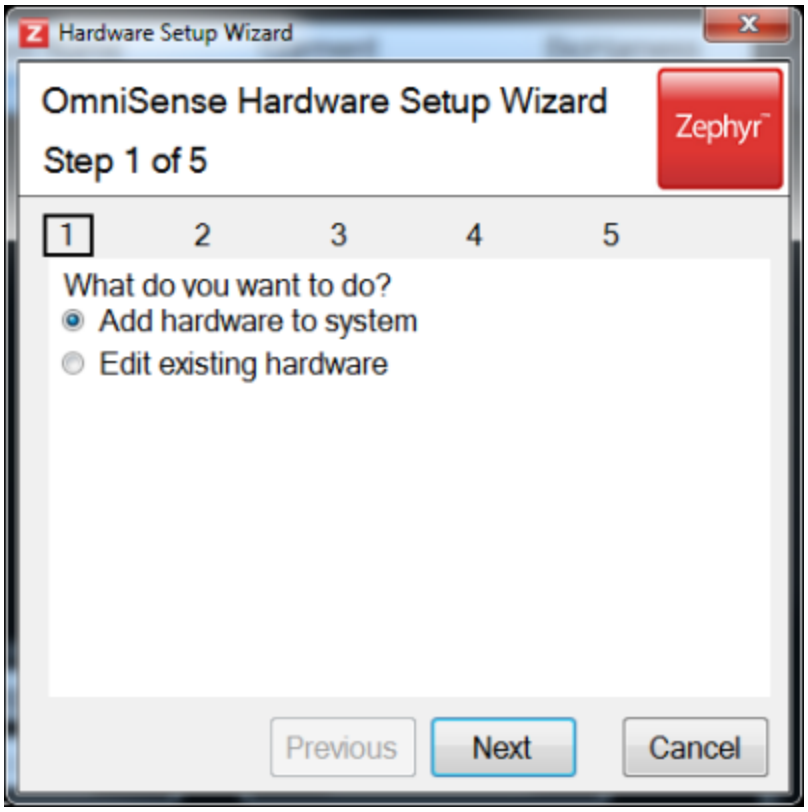
3. Start the OmniSense Live module

4. Select the *Setup* Toolbar button 

5. Select the *Hardware* tab 

6. Select the *Add/Edit* hardware button 

7. Follow the hardware Wizard



8. Select *BP/SPo2 Sensors*

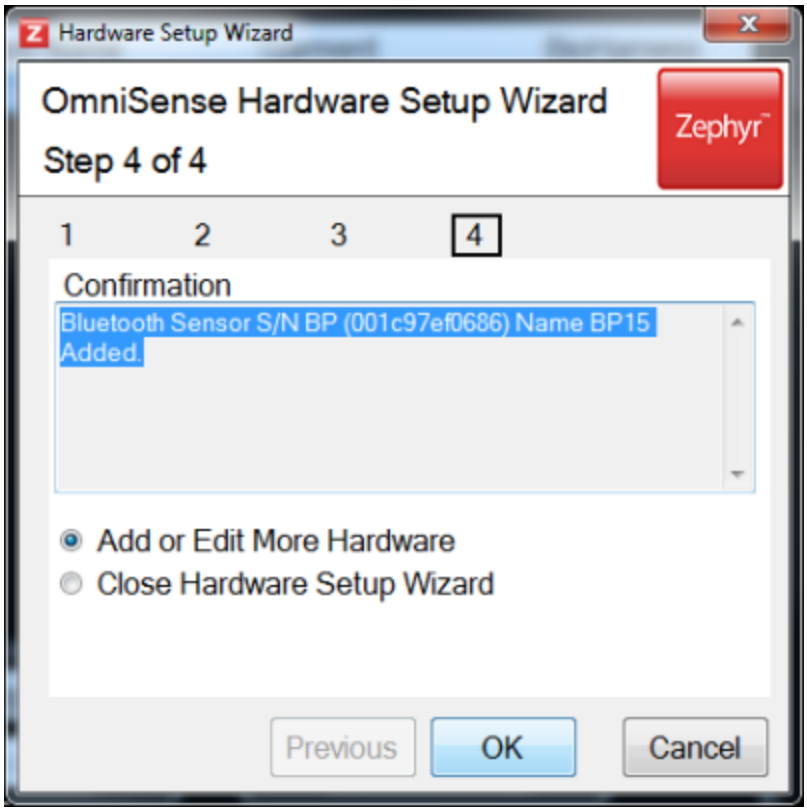
9. OmniSense will search for BT sensors which have been detected by the PC. This may take some tens of seconds - you may have to use the *Detect* button.

A weak battery in the sensor may have enough capacity to power the sensor on, but not to activate its Bluetooth. Insert a new battery if the device isn't detected by the PC.

OmniSense will populate the *passkey* field automatically. All Bluetooth devices have a passkey or PIN which is used when the device is 'paired' with a receiver. For the blood pressure cuff, this passkey is 1234.

Enter a device label - 'BP15' in the example above, and mark this on the device clearly, so that the correct device is assigned to a subject when in operational mode.

10. A dialogue will confirm the sensor has been added to the OmniSense database.



3.3 Edit / Remove Hardware Components

- Edit hardware components to change the identifying label on the front of the device. If a device is re-labeled, then the new label must be added to the OmniSense database.

- Remove a hardware component from the system if it has become faulty or needs to be replaced. This prevents possible re-assignment to a subject in error. The device can be added back into the system when the problem is rectified.

3.3.1 Edit Hardware Components

- To edit a hardware component, simply reconnect it to the PC by USB lead and cradle or system case as if you were adding a fresh device into the system.
- Proceed through the *Add Hardware* dialogues. When the dialogue to enter the device label is reached, it will already be populated with the existing label for the device

> *Remember to change the physical label on the device once you have edited it in OmniSense*

Example: For an ISM BioHarness module

1. Connect the BioHarness in its cradle to the PC platform.

2. Start the OmniSense Live module

3. Select the *Setup* Toolbar button 

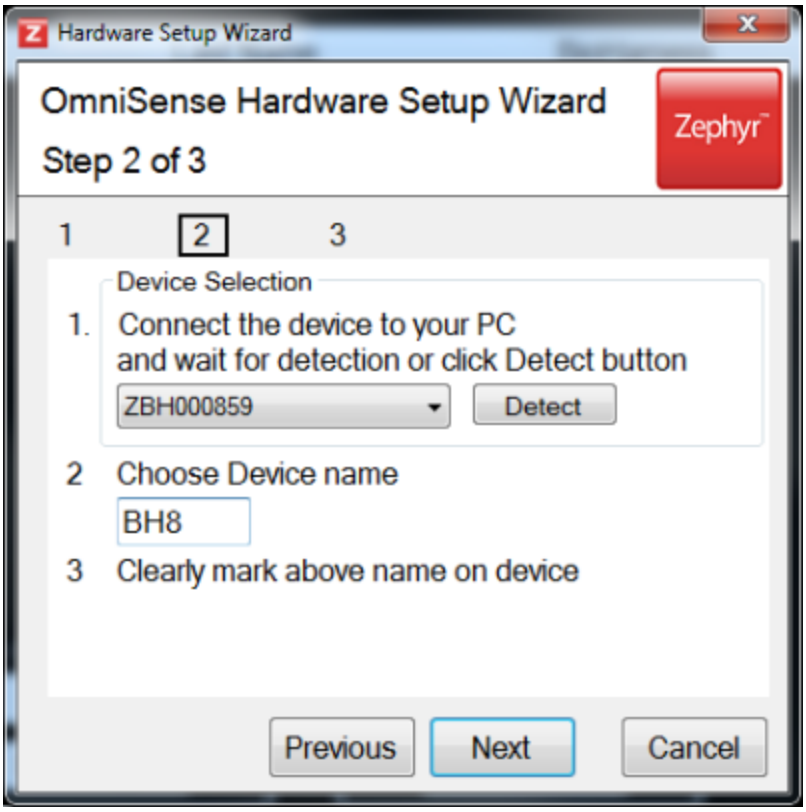
4. Select the *Hardware* tab 

5. Select the *Add/Edit* hardware button 

6. Follow the Wizard displayed

Select *Connection to PC*

7. The *Choose Device Name* field should already be populated - change to suit and continue.



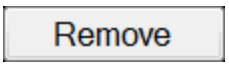
3.3.2 Remove Hardware

Remove hardware from the OmniSense database when you no longer want it to be available for assignment to subjects. It may be faulty, lost or damaged.
The device does *not* need to be connected tothe PC in order to remove it from the database:

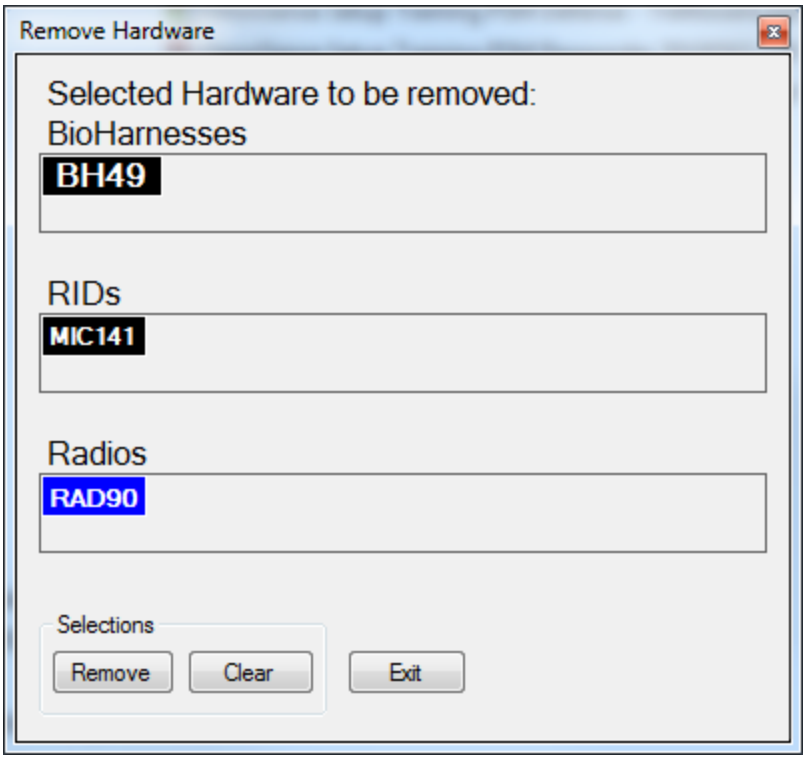
1. Start the OmniSense Live module

2. Select the *Setup* Toolbar button 

3. Select the *Hardware* tab 

4. Select the *Add/Edit* hardware button 

5. When the Remove dialogue displays



Select the component you wish to remove - the selected component(s) will display blue when clicked on, and click the Remove button in the dialogue. (Diagram shows dialogue for a PSM REsponder system. PSM Training will list different devices)

6. Components which have been removed can be added back into the database when they become available again, but you must follow the procedure for Adding New Hardware

3.4 Assign Hardware to Subjects

Hardware must be *assigned* to subjects within the OmniSense database. There is no way for the software to 'know' whose data is coming from which device in the system. Assigning a BioHarness module and optional GPS (and RID and radio if a PSM Responder system) to link it to a subject in the OmniSense database is a necessary setup task.

Hardware may be assigned automatically to subjects using a barcode scanner.

Confirm you have the correct Radio Network Type set - this affects which hardware components needed for each subject
The hardware should already have been added into the system.

You cannot assign the same hardware to:
- *two subjects in the same team*
- *Two subjects in different teams which are deployed at the same time*

A conflict dialogue will display in either situation

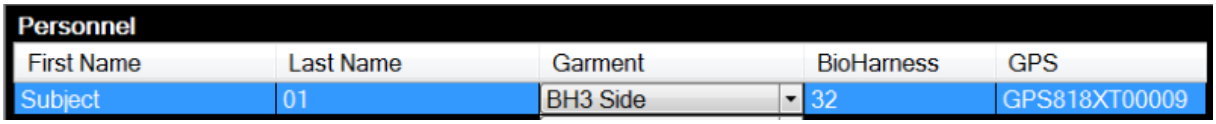
Subjects not assigned hardware can be deployed as part of a team. **NO HARDWARE** will be displayed on their BioGauge.

Hardware can be assigned during Live operations, or during setup, by following the steps

below:

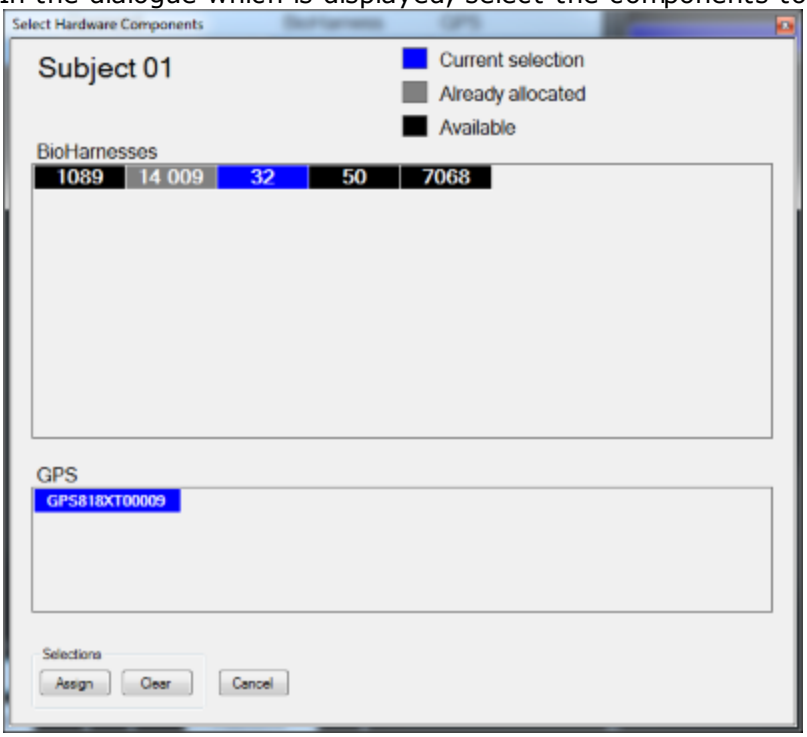
1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Hardware* tab 

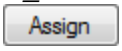
4. Select the subject you want to assign hardware to in the subject table

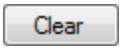


5. Click the *Assign* button 

6. In the dialogue which is displayed, select the components to be assigned.

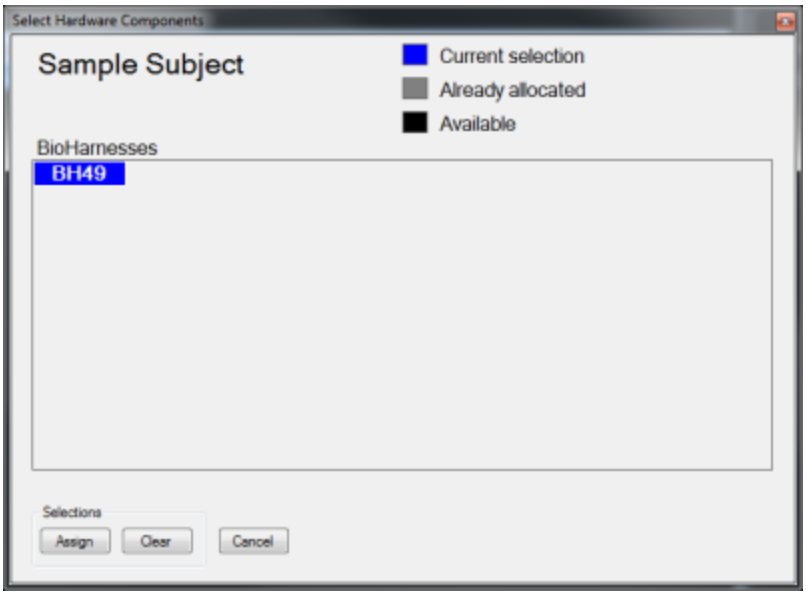


This dialogue is for a PSM Training system - Radio Network Type is set to *ECHO_##.* One of each component (BioHarness, optional GPS) must be selected before the 

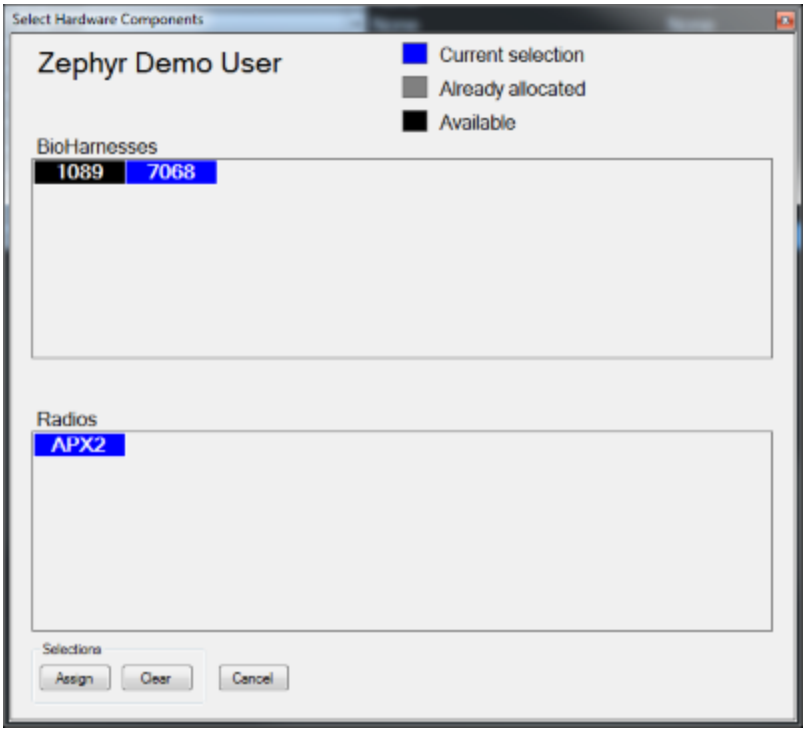
button in the dialogue will become active. To change selection, use the 

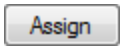
button.

7. If the Radio Network Type is set to *Bluetooth* or *ZephyrISM*, then there is only a BioHarness module to assign:



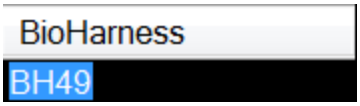
8. If the Radio Network Type is set to *APX Conventional* or *APX Trunking*, then one of each component (BioHarness, Radio) must be selected.



9. Click the 

button to assign the component(s).

10. You can also edit the subject hardware component fields directly in the *Personnel* table...



...but the component label must be exactly as it is stored in the OmniSense database.

3.4.1 Assign External Sensors

The two external Bluetooth sensors
- Blood Pressure wrist cuff
- Pulse Oximeter (SPO_2) finger sensor

are assigned to a subject during Live operations of OmniSense

3.5 Garment Type

Zephyr offer a variety of garment options:

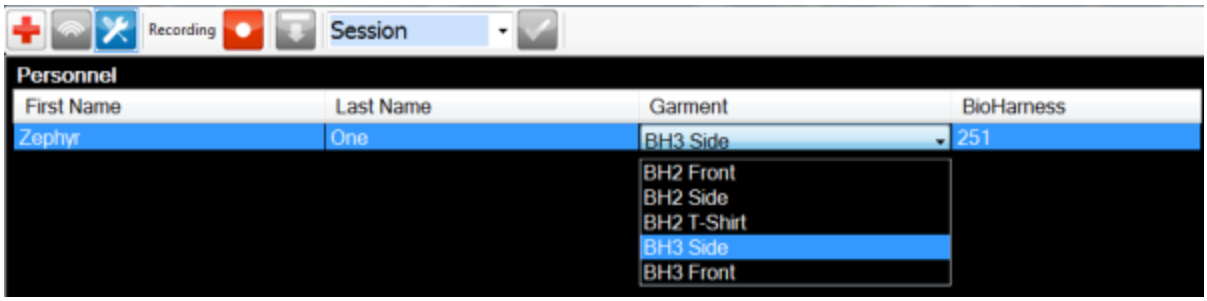
			
BH2 Front	BH2 Side, BH3 Side	BH2 T-Shirt	BH3 Front
BioHarness 2 [ISM & Bluetooth]	BioHarness 2 BioHarness 3	BioHarness 2	BioHarness 3
No longer manufactured	Manufactured 2010-	Manufactured 2011-	Manufactured 2012-

Garment type must be set up in OmniSense for each subject. If garment type is set wrongly, posture data may be invalid, as the device orientation varies.

Setting garment type in OmniSense

3.5.1 Setting Garment Type

1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Hardware* tab 
4. Use the *Garment* pull down selector to set the appropriate garment type for each subject.



3.5.2 Configure Device for Garment

BioHarness Bluetooth

- Bluetooth BioHarness modules are pre-configured in the factory to be used with a side strap option.
- The module can be re-configured for a different garment using the Zephyr Config Tool

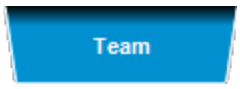
3.6 Manage Teams

Within the OmniSense database:
- No maximum team size*
- No maximum number of teams
- A subject cannot be in more than one team
- A maximum of four teams can be deployed concurrently

Add or edit a team
Remove a team

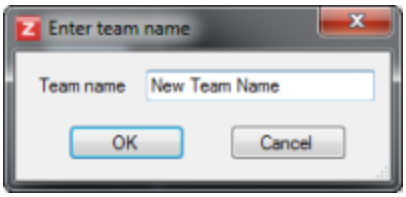
** as team size increases, the size of each BioGauge on screen is reduced. Beyond a team size of 16 or 25, detail on the BioGauges may become too small to read*

3.6.1 Add/Edit Team

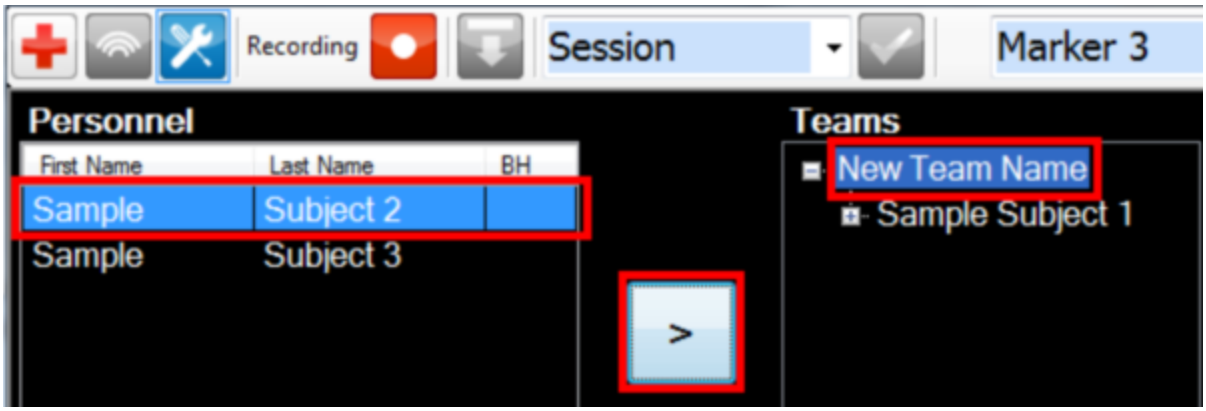
1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Team* tab 

4. Select the *New* button in the *Teams* frame 

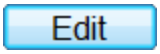
5. Enter team name in dialogue



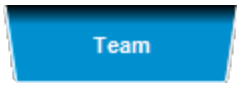
6. To populate the the team with subjects - these must already have been added to the database - select a team member in the *Personnel* panel, team from the *Teams* panel, and use the move right button 

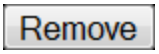


7. Repeat as necessary for each subsequent team member

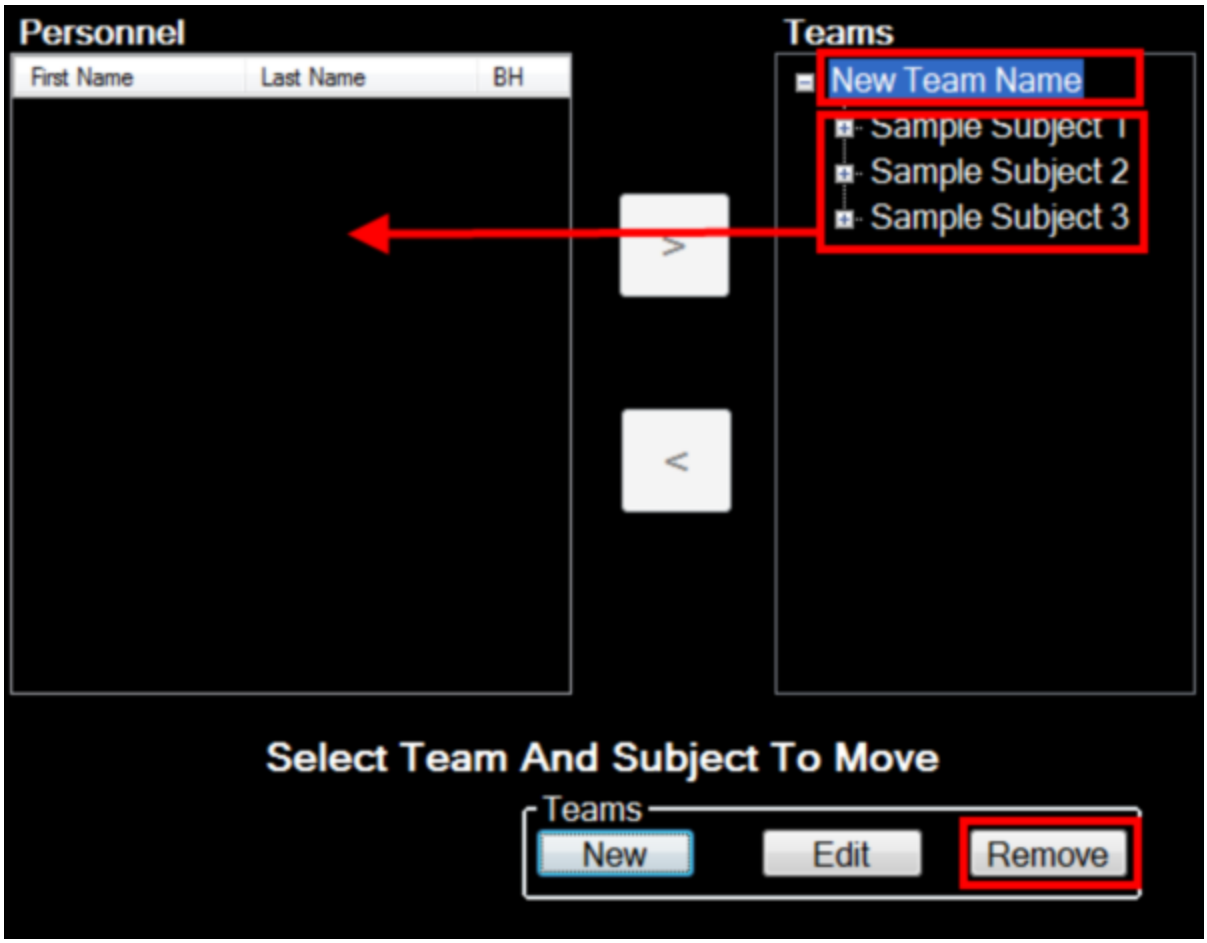
8. To edit a team name, select the team and use the *Edit* button 

3.6.2 Remove Team

1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Team* tab 

4. Select the Team you want to remove, click the *Remove* button 

5. Acknowledge the confirmation dialogue. The team will be removed, and all team members returned to the *Personnel* pane.



3.7 Deploy Teams

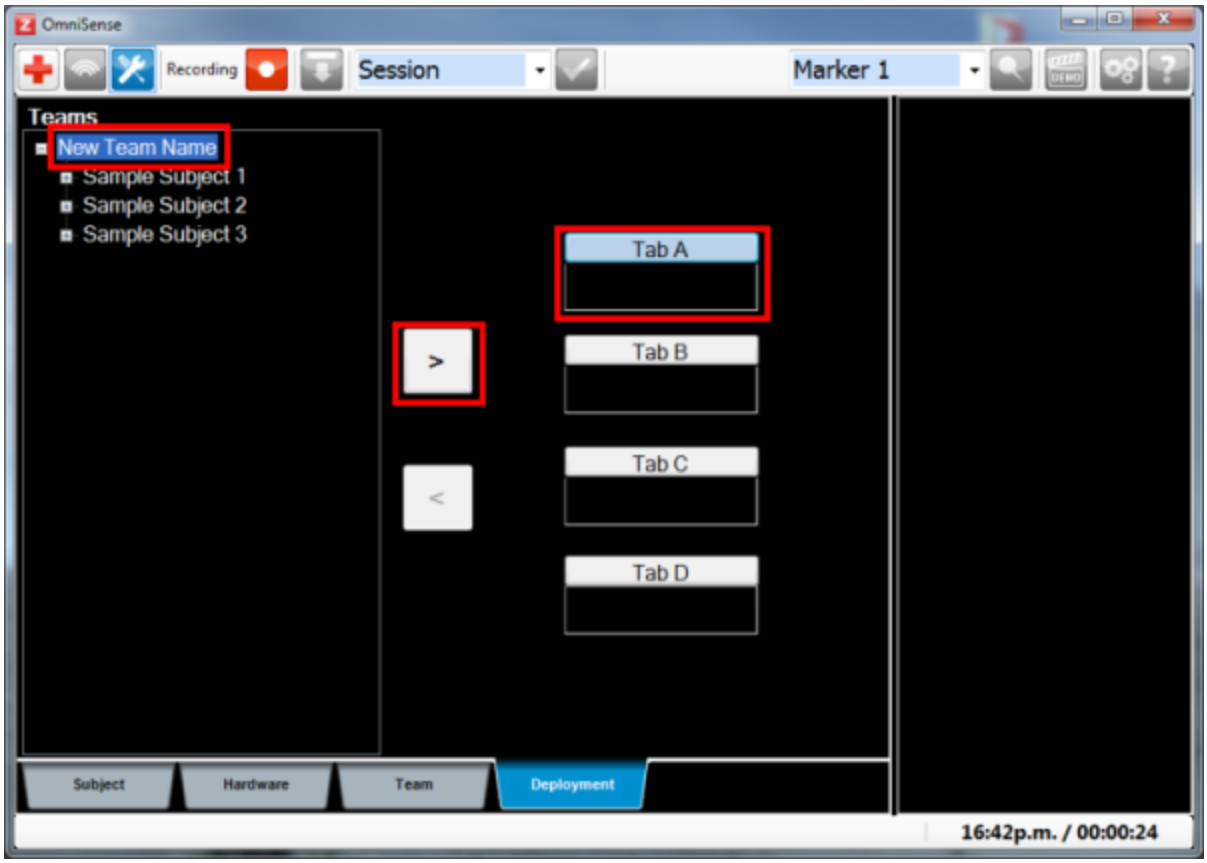
Deploying a team for live operations is a separate action to creating the team. This allows multiple team permutations to be stored in the database, for rapid deployment when they are needed.

- Four team tabs are available - select using the tabs below the BioGauge screens
- BioGauges will adjust in size (as above)
- Three extra tabs may display Safety and Medic and Training information

3.7.1 Deploy a Team

1. Start the OmniSense Live module
2. Select the *Setup* Toolbar button 
3. Select the *Deployment* tab 

4. Select the team and next available tab, and use the move right button to deploy 



3.8 Barcode Rapid Deployment

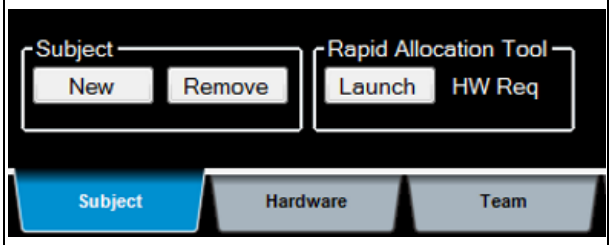
The barcode system has been developed so that BioModules and GPS units can be assigned to subjects, subjects assigned to teams, and teams deployed without using the screen interface. There are some prerequisites:

- BioModules must have been added into the system by connection to the PC over USB
- GPS Modules must have been added to the system by Bluetooth connection
- Subjects must exist in the system
- A supported barcode scanner or scanners must be used - these should be plug and play

if OmniSense 3.9 is installed

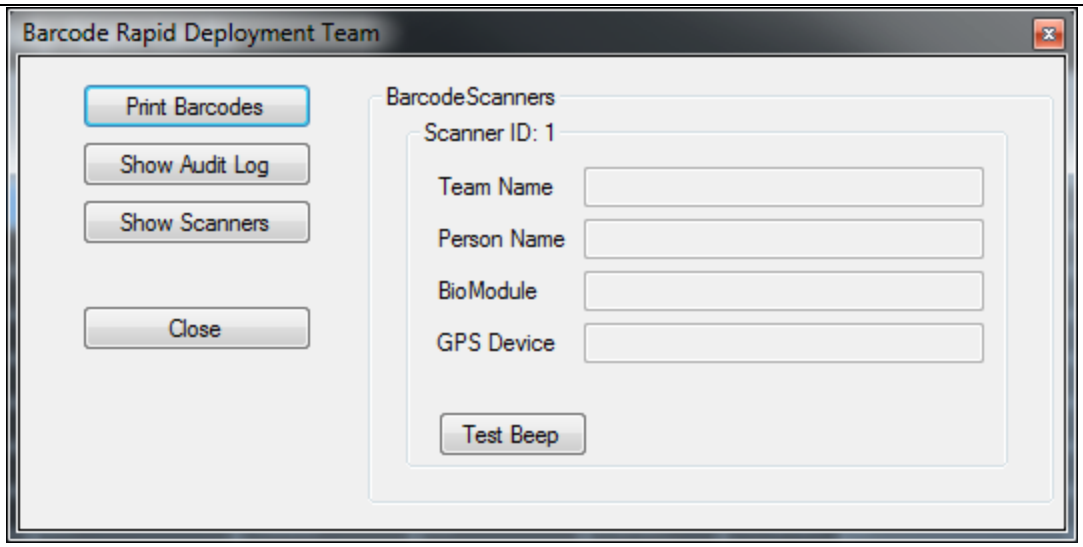
- Pick lists should be printed out for a Teams, BioModules, Subjects and GPS devices

Barcode Operation can be started in two ways:



From Setup > Subject tab, use the Launch button

Scan the Start barcode from any existing pick list
Scan from a few inches distance



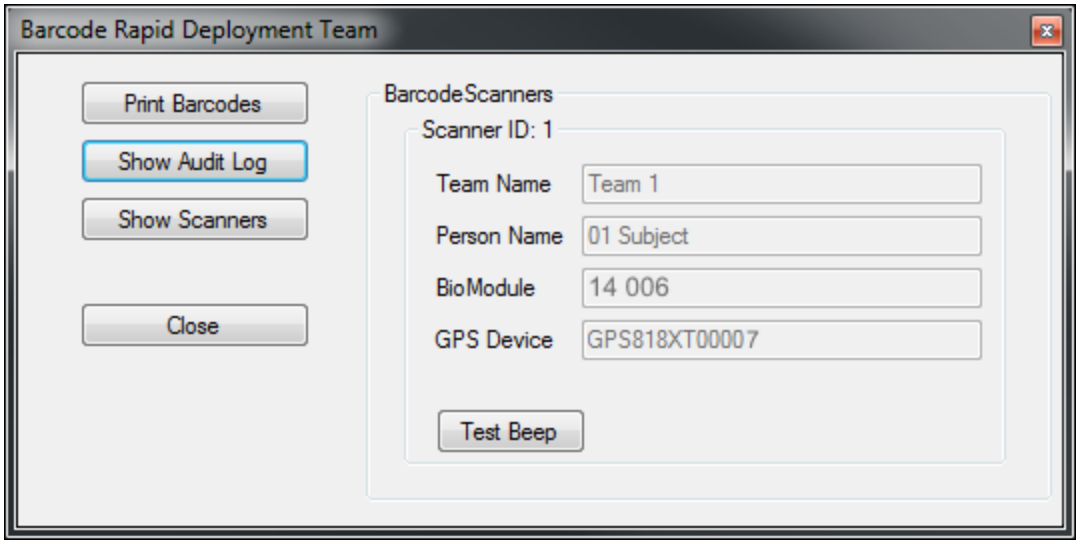
Barcode Deployment Dialogue
Start Scanning
or choose an option:
Print Barcodes
Show Audit Log
Show Scanners

3.8.1 Start Scanning

To allocate Team, BioModule and GPS to a subject, scan in the following order:

1	2	3	4

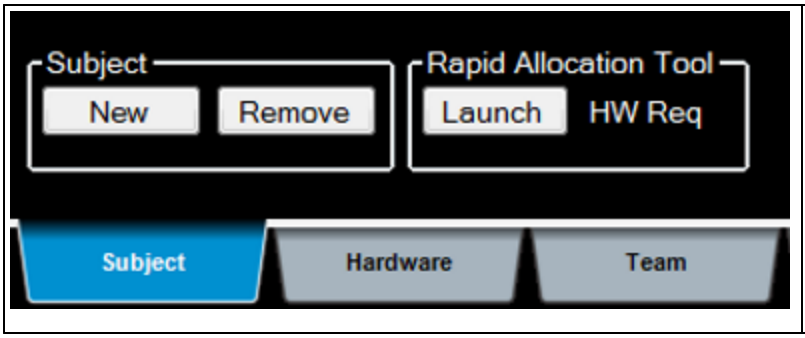
- the Barcode dialogue will automatically populate as components are scanned



- scan again to correct or change - the last scan for any component is the one retained

3.8.2 Print Barcodes

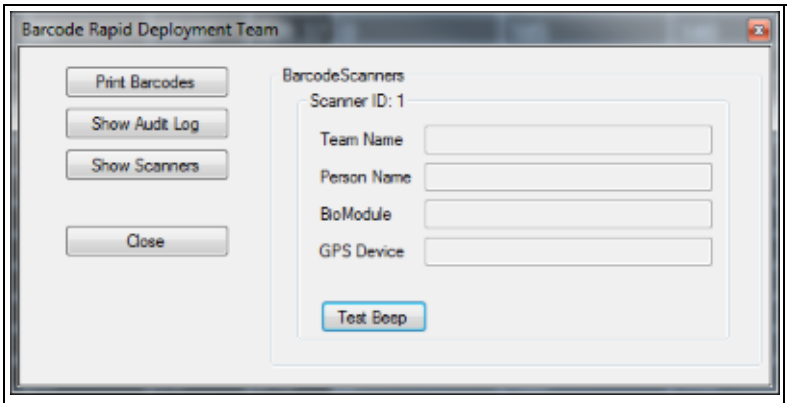
- Start the Barcode Rapid Allocation Tool by one of two means:



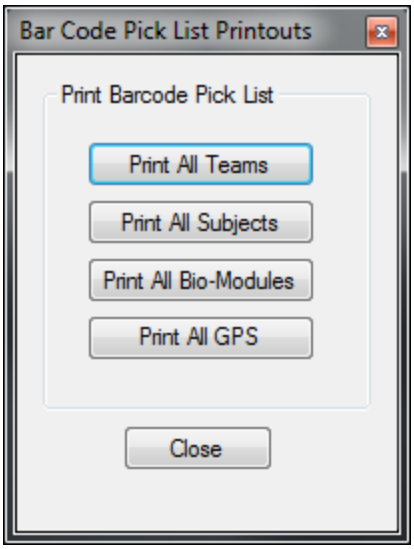
In an existing Picklist, scan

In Setup > Subject, use the *Launch* button	the barcode at top left

- When the Allocation Tool displays



Select *Print Barcodes*



Print the Pick Lists as required

- The Allocation Tool will generate PDF files, which can be printed off (Adobe Reader required)

Teams

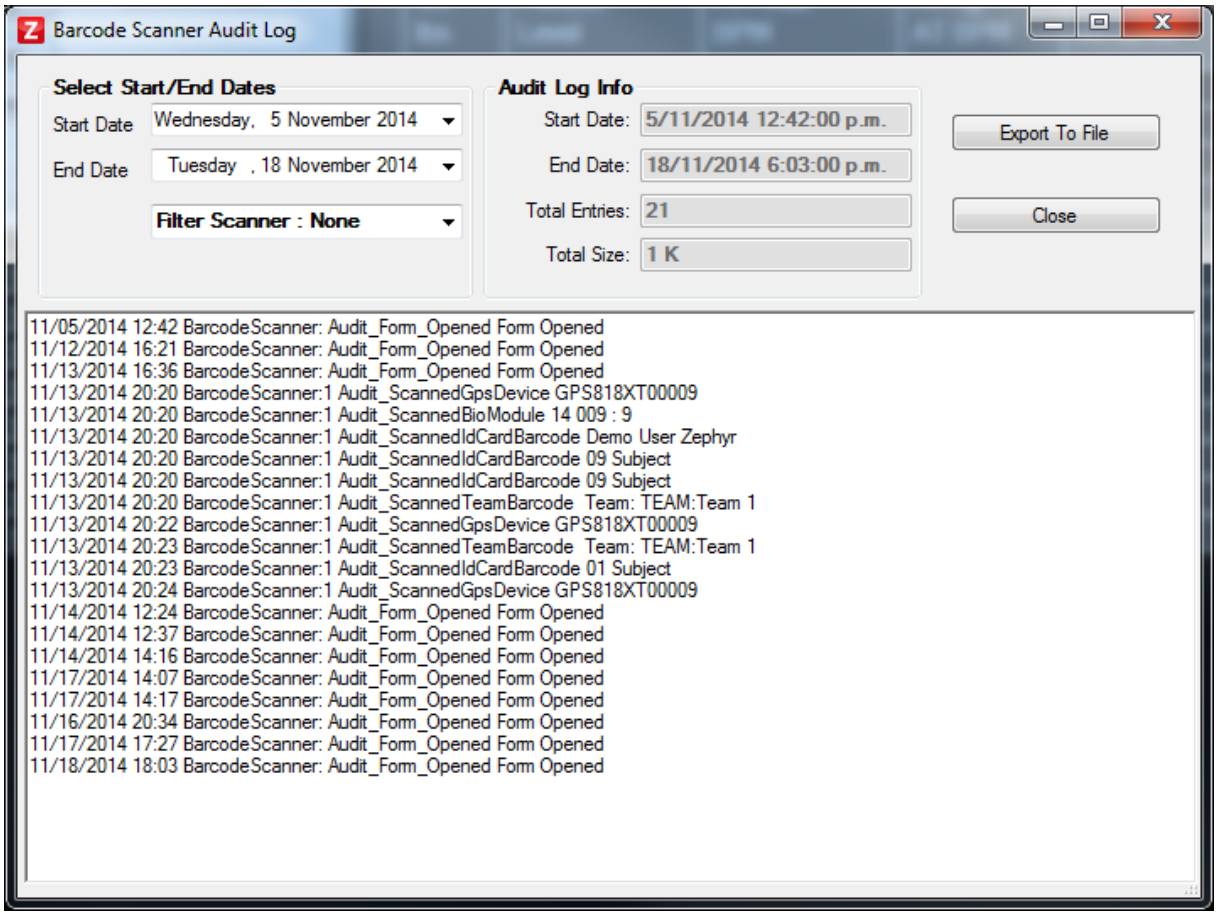
Subjects

BioModules

GPS modules

3.8.3 Show Audit Log

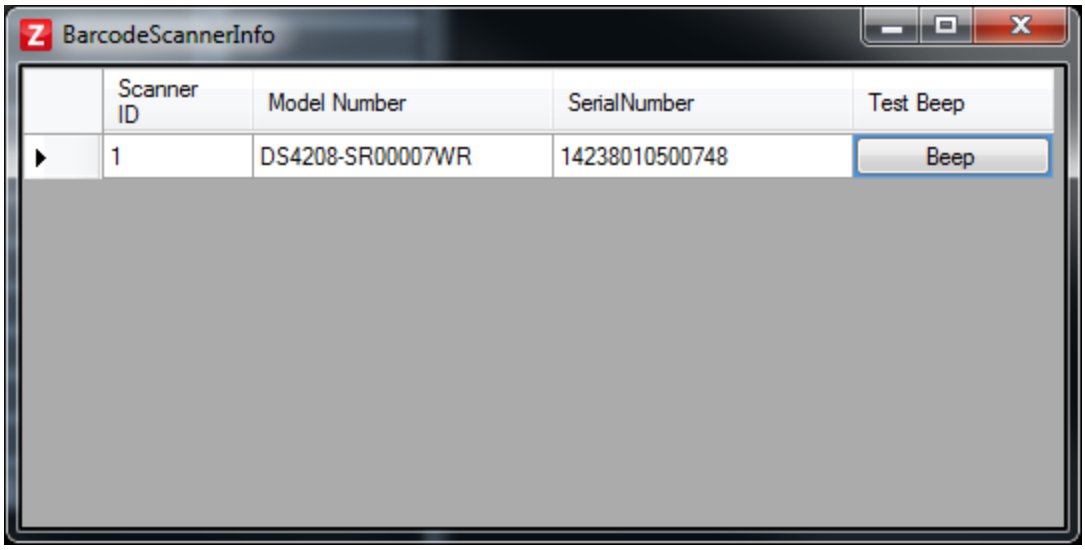
Accessed from the Barcode dialogue



- Display all scanner actions
- Set start and end dates to suit
- Filter messages by scanner ID
- Export to a file

3.8.4 Show Scanners

Accessed from the Barcode dialogue



- Display all connected (wired or wireless) scanners
- Beep Test to identify

3.8.5 Supported Bar Code Scanners

Motorola DS4208 (Wired)

Motorola DS3578 (Wireless/ Bluetooth)

Part 4

4 Live Operation

System Diagram

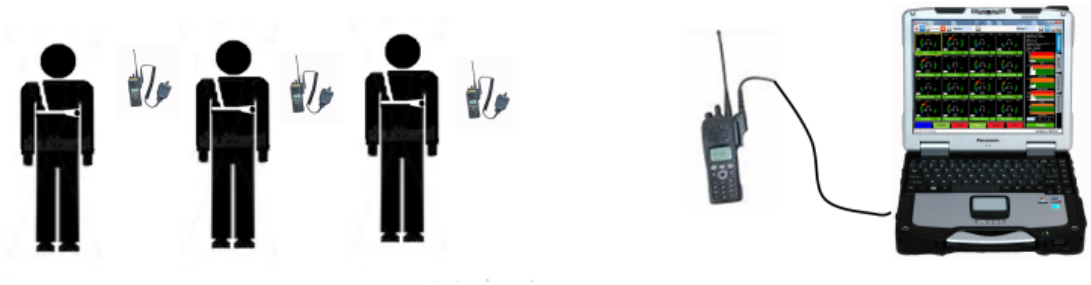


Diagram shows digital radio network - PSM Responder

Software Setup Checklist

A number of setup tasks must be performed prior to Live operations:

- All required hardware components added to the system
- Subject details added to the system
- Hardware components assigned to subjects
- Subjects added to a team
- Team deployed for Live operations

Live Operations Checklist

Check the following:

- BioHarness module batteries have sufficient charge
- All subjects wearing BioHarness strap/shirt and module, powered ON
- If subjects are wearing optional GPS units, they are powered ON
- All subject radio network components (if applicable) are powered on and indicate radio communication is activated
- For a PSM Responder/APX systems, each radio will request a Bluetooth PIN (value = 0) which should be entered via the radio keypad
- Any antenna or radio network component is connected to the host PC
- OmniSense Live is running

Communications Establishment / Data Stabilization

Switching to Live mode initiates three processes in sequence

- establishment of radio communications
- over-air configuration of BioModules with subject data and matched GPS addresses, and synchronization of device clocks
- reception and display of live data

Both of these steps may incur some delay, dependent on the type of radio network used, and the number of subjects which have been deployed.

4.1 Live Screen

Overview

1. Team Tabs - click to select a team
2. Toolbar
3. BioGauge - live subject data
4. Details side panel - vital signs including trend graphs, for the selected BioGauge
5. Accelerometer side panel - three-axis accelerometer trace for the selected BioGauge
6. Comms side panel - shows diagrammatic location of any communications error
7. Map side panel - (ECHO systems only) for display of GPS locations
   Sensors side panel - (Bluetooth systems only) for display and assignment of external Bluetooth sensors
8. Workout side panel - shows target training zone for current and next segment of workout
9. Medic Tab
10. Training tab - shows Training BioGauge for each subject
11. Safety Tab - shows a tile for each subject, with name and ROG status and duration only

4.2 Toolbar

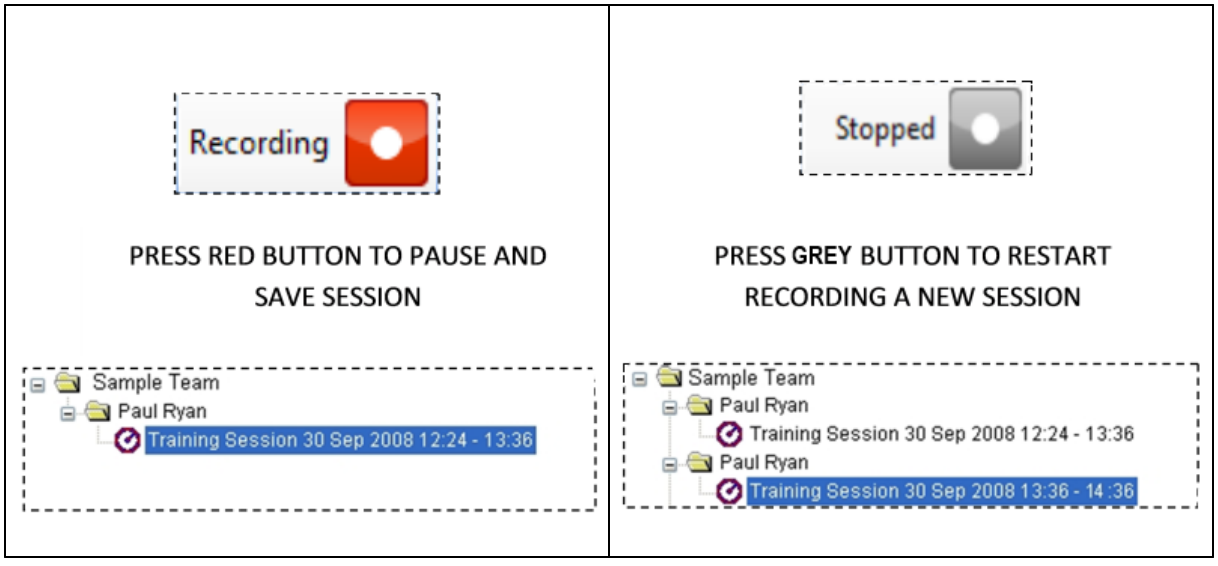
Toolbar Buttons

	Go to Live Mode		Recording (default) Press to Stop		Show/Hide Notification panel
	Go to Setup Mode		Paused recording Press to restart		Preferences
	Start Demo Mode		Help - local html help file		Insert Marker into recorded data
	Transfer selected subject to Medic tab		Transfer selected subject from Medic tab back to Team tab		Rename Session selected from pull down list
	Re-send device configurations		Display Map Window		

4.3 Recording Live Data

When a Live data session is started in OmniSense, data is automatically recorded into the application database. It can accessed at any point using the OmniSense Analysis Module – refer to the OmniSense Analysis Module Help for details.

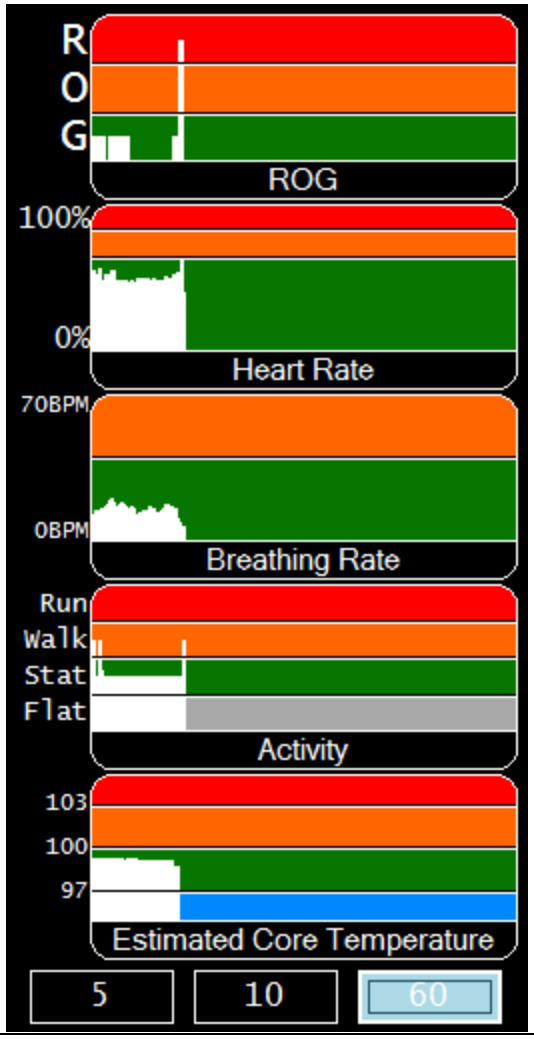
If some thought is put into creating a specific session name before recording, then sessions an be more easily retrieved in the Analysis module. This is particularly useful when creating training reports.



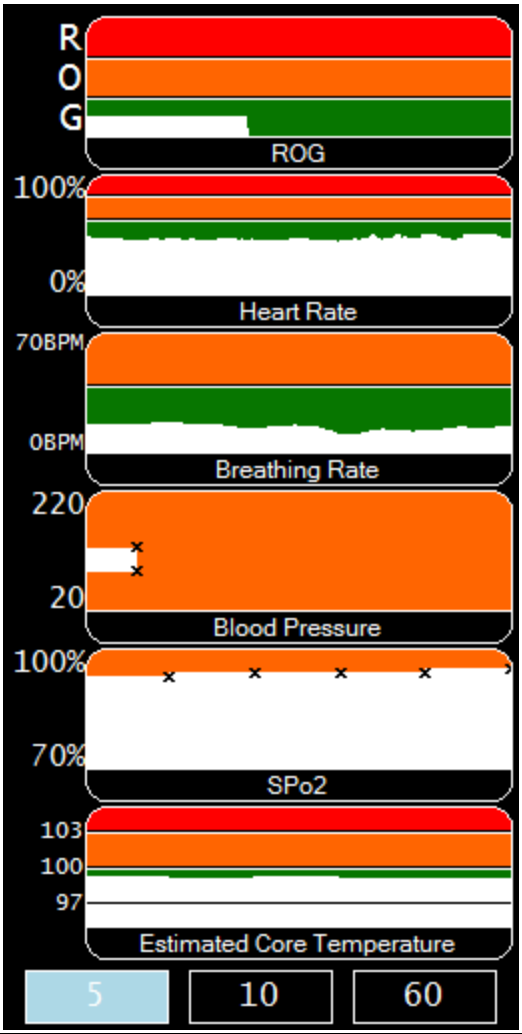
- Data will be saved for every subject deployed
- Sessions are saved automatically when Live is exited

Do not change the PC system clock time while recording – data may become corrupted or overwritten. An automatic daylight saving change during a recording session will have the same effect.

4.4 Trend Graphs



Default trend graphs

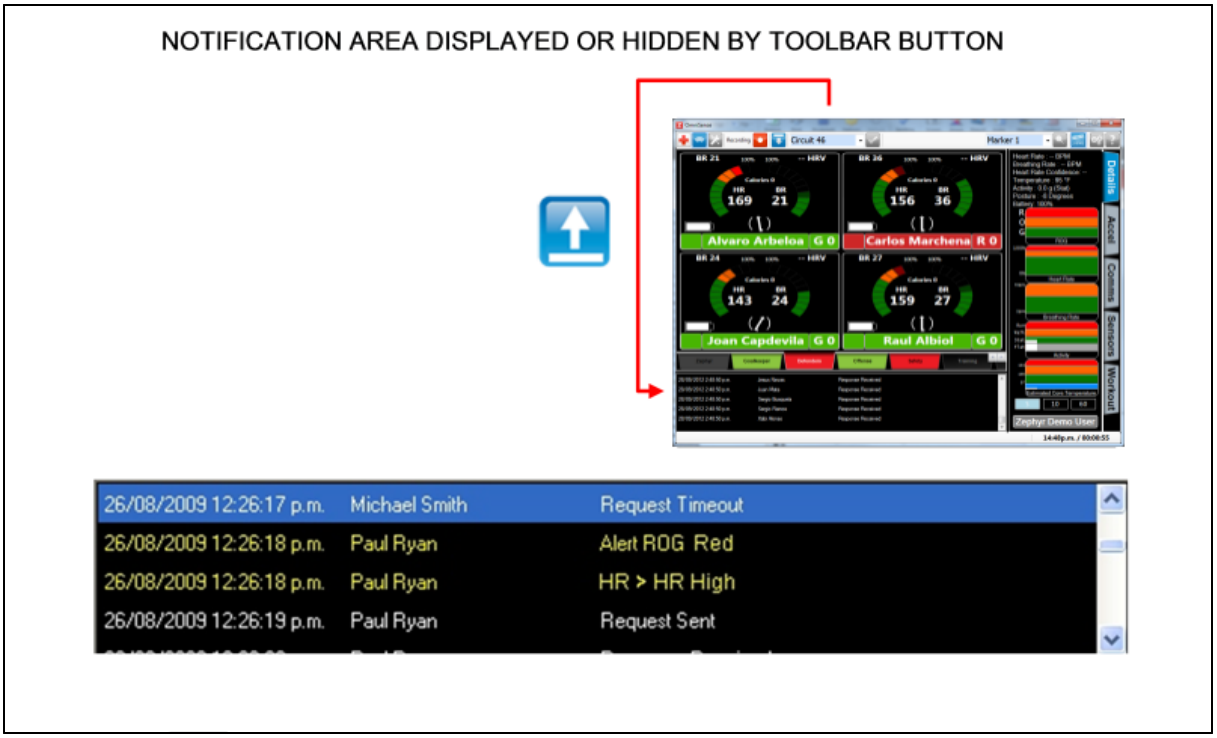


Trend graphs with external BP & SpO_2 sensor activated (Bluetooth Direct & PSM Responder systems only)

Subject Status (ROG)	
Red / Orange / Green	Refer Subject Status
Grey	Device error, low heart rate confidence
Blue	Comms error with BioHarness module or

	external sensor
Heart Rate	
Red	> 90% HR_{max}
Orange	> 80% HR_{max}
Green	< 80% HR_{max}
Breathing Rate	
Orange	> 42 breaths/minute
Green	< 42 breaths minute
Blood Pressure	
Systolic & diastolic pressure	mm Hg
SpO_2	
Dissolved blood oxygen saturation	%
Activity Level	
Run	> 0.8 VMU (g) ~ running equivalent
Walk	> 0.2 VMU (g) ~ walking equivalent
Stat	< 0.2 VMU (g) ~ static
Flat	0 VMU and horizontal posture
Estimate Core Temperature	
Blue	< 97 °F
Green	97 - 100 °F
Orange	100 - 102.5 °F
Red	> 102.5 °F

4.5 Notification Area



The notification area displays messages:

- Comms Messages — White text — Diagnose comms errors – see Troubleshooting
- Alert Messages — Yellow text — Displayed when ROG status changes, or subject physiological thresholds are crossed

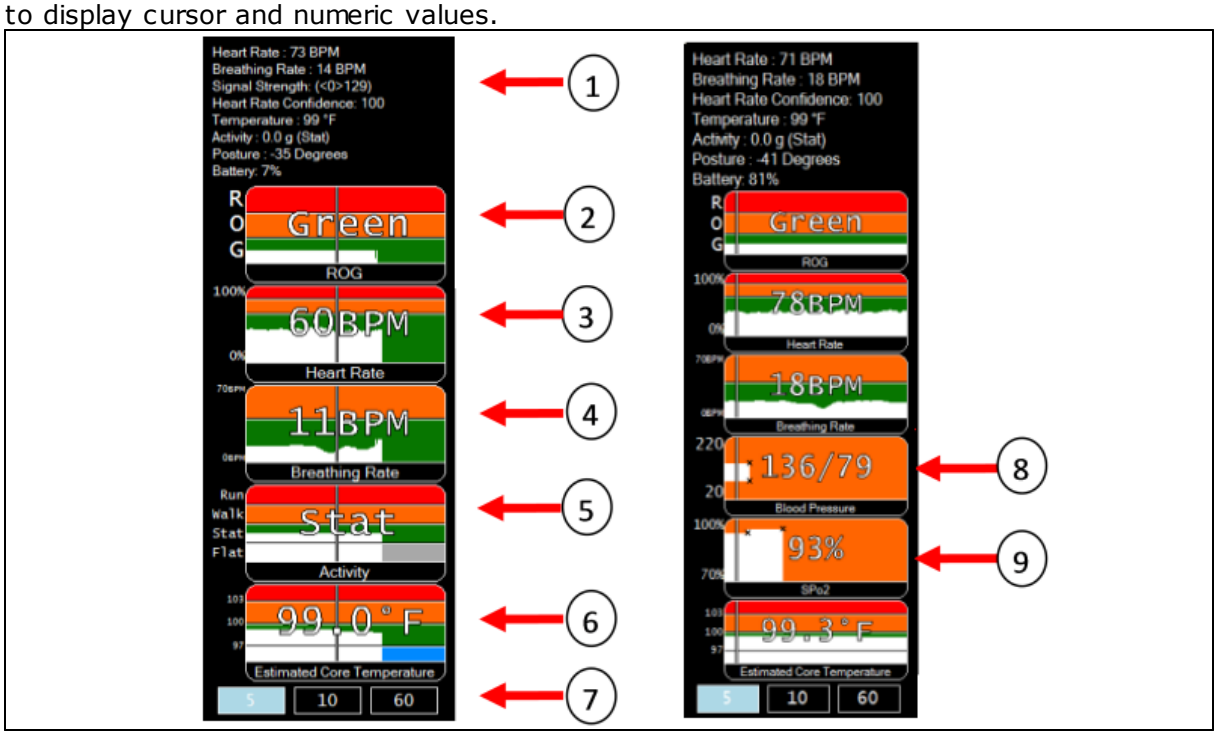
Message Text Example	**Type**	**Description**
Alert ROG Orange	Alert	All ROG status changes
HR > 65% Max	Alert	HR crossed 65% Max, 85% Max thresholds - either direction
BR > BR High	Alert	BR crossed subject's individual BR threshold - either direction
Temp > 40	Alert	Temp crossed 25/40°C (80/105°F) thresholds - either direction
Activity Flat	Alert	Change of activity state from: Flat = Horizontal/No movement Stat = VMU between 0 and 0.2g Walk = VMU between 0.2 and 0.8g Run = VMU greater than 0.8g
Request Sent	Comms	Data request sent to Bioharness
Response Received	Comms	Response received from subject BioHarness

An external file containing all the notification area messages is located at:

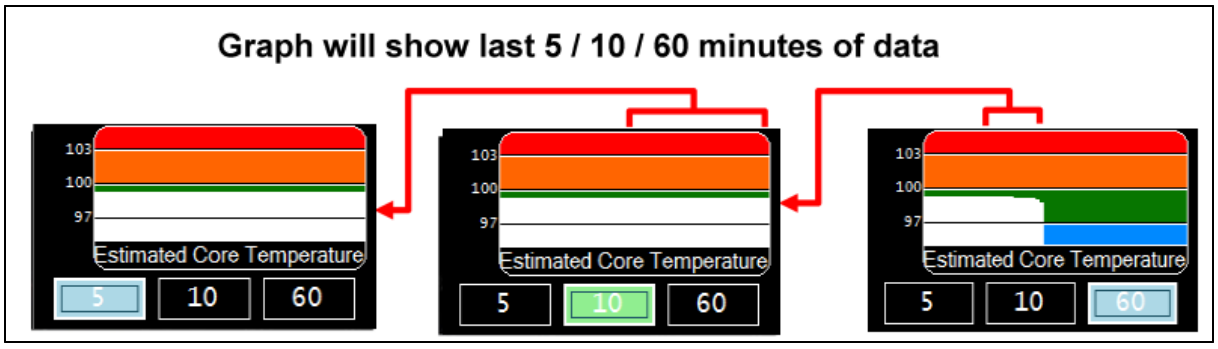
Windows® Vista & 7: C:\ProgramData\Zephyr\OmniSense Logs

4.6 Details Side Panel

Details are displayed for the subject whose BioGauge is selected. Float mouse over graphs to display cursor and numeric values.

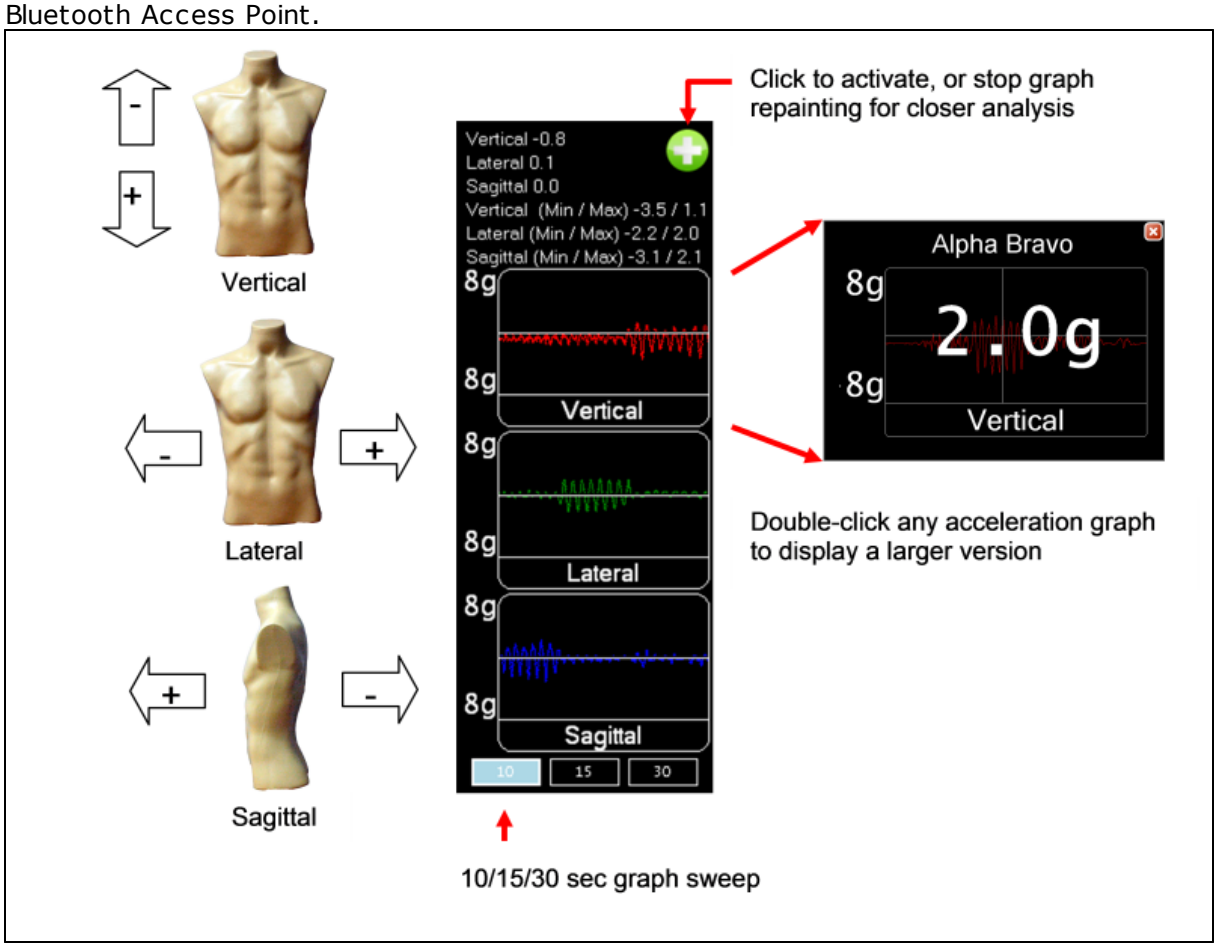


1. Subject ROG Physiological parameter details,
   battery & signal strengths
2. Subject ROG Status
3. Heart Rate
4. Breathing Rate
5. Activity Level
6. Estimated Core Temperature
7. 5/10/60 minute graph display options
8. Blood Pressure - activity removed
9. Blood Oxygen (%SPO2) - activity removed



4.7 Accelerometer Side Panel

This side panel is active only for PSM Bluetooth Direct, and PSM Training 3.0 using a Bluetooth Access Point.



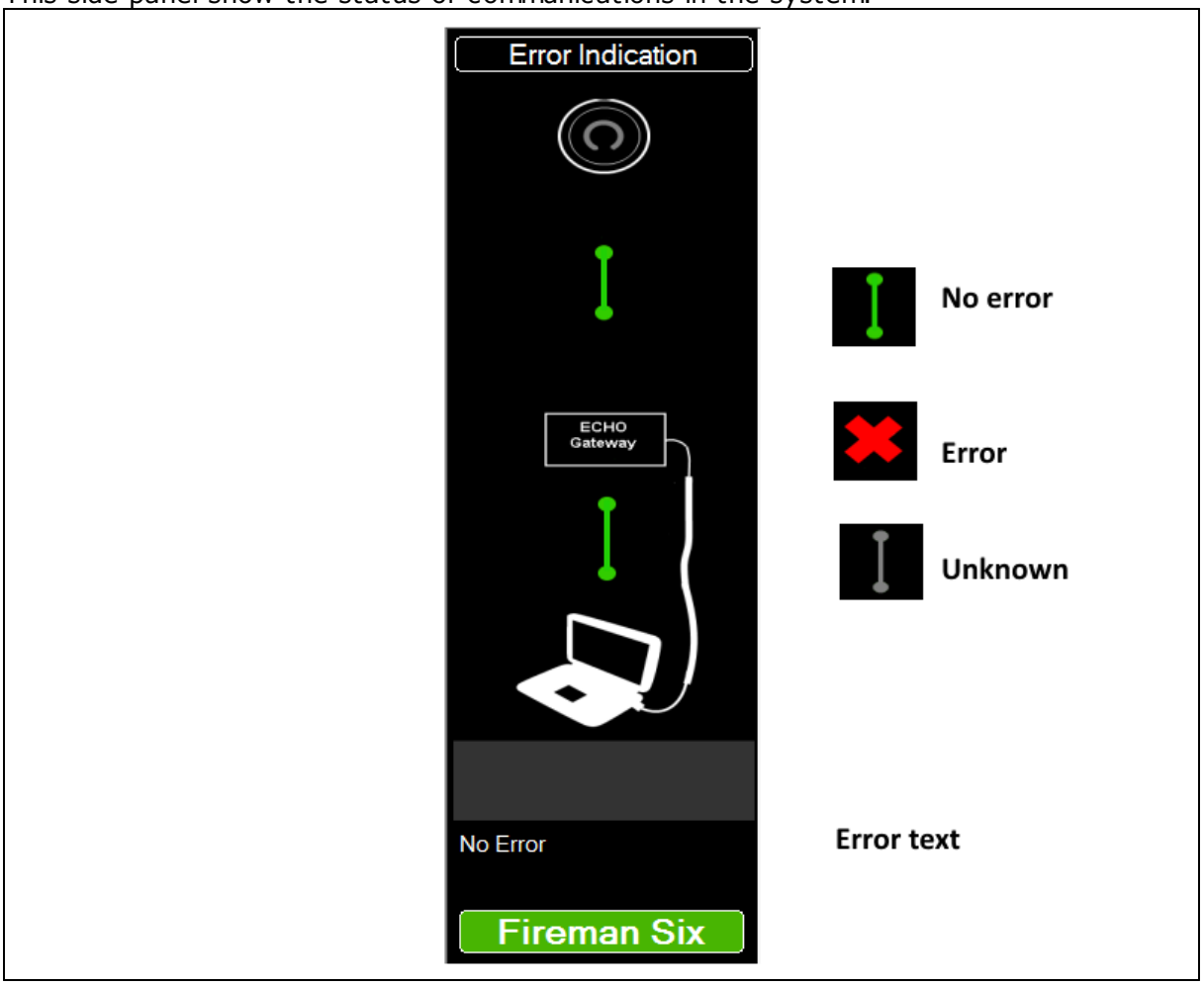
Clicking the start button at top right activates 50 Hz accelerometer data from the device associated with the selected BioGauge.

Bluetooth bandwidth will limit the number of devices that can be activated. If too many devices are selected, then some Bluetooth connections will be dropped, and reconnected without accelerometer data.

The correct garment type must be assigned in the Hardware setup tab, otherwise accelerometer axis mapping may be wrong – the device is oriented differently in front-mount and side-mount straps.

4.8 Comms Side Panel

This side panel show the status of communications in the system.



Details of all error indications are given in the Troubleshooting section.

4.9 Sensors Side Panel

Enter topic text here.

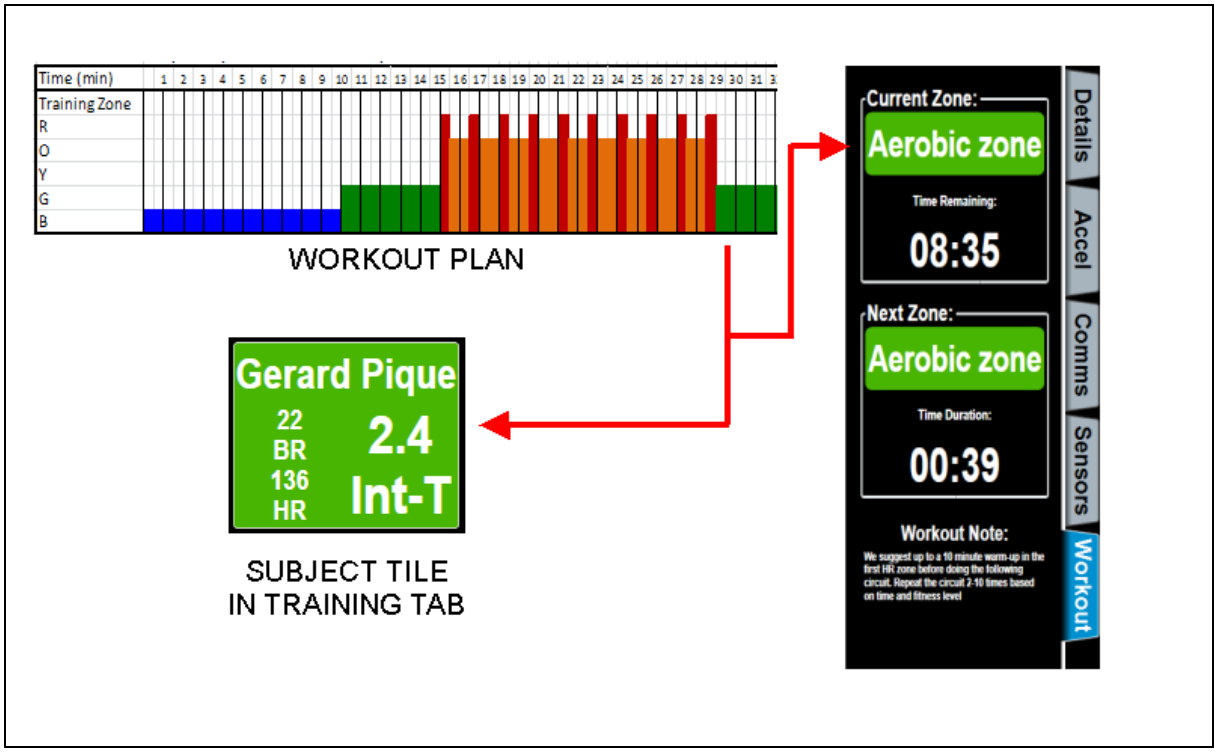
4.10 Map Side Panel

The Map panel shows GPS location coordinates.

A live Map Window with moving snail trails can be displayed using the Maps toolbar button (Google Earth Required)

4.11 Workout Side Panel

The workout side panel should be used in conjunction with the Training tab. Subjects should attempt to match their training zone with that of the current zone in the workout.

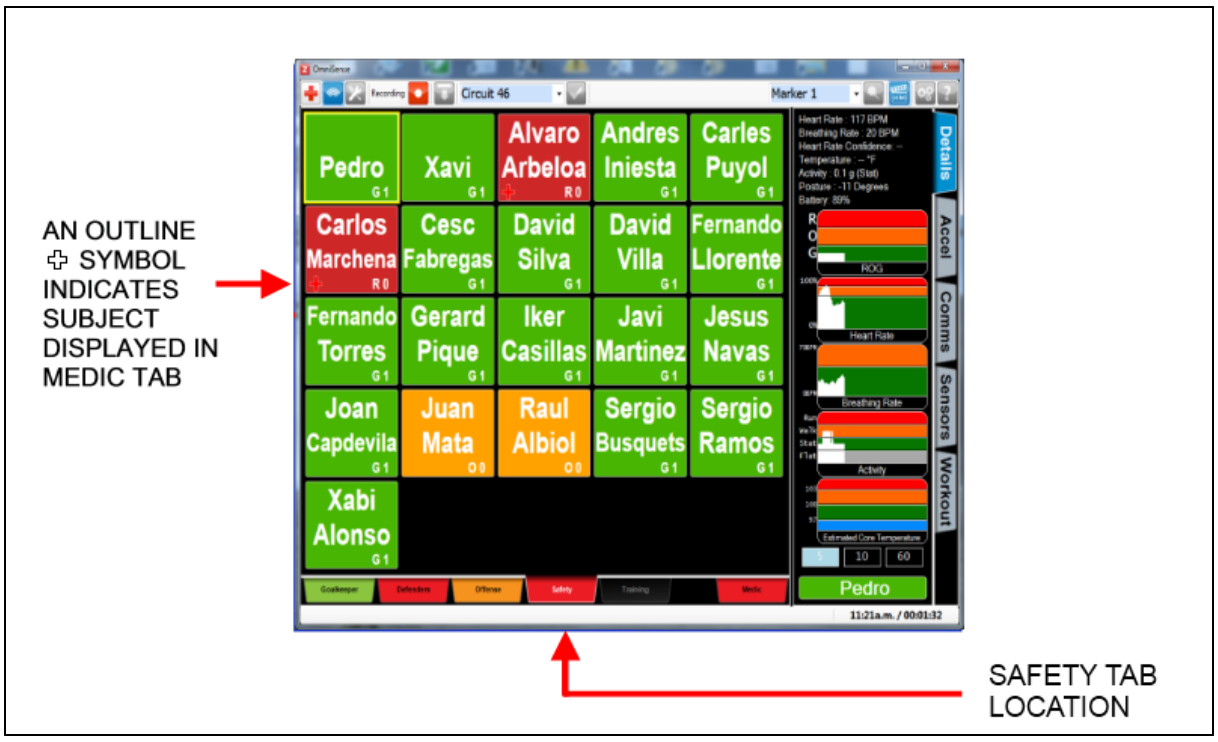


4.12 Medic Tab

- In addition to the Team tabs, which display Team subject BioGauges, a Medic tab is available. Subjects whose status has changed to Red for a specified duration (see User Preferences for configuring this) are automatically moved to this tab.
- Additionally, any other subject can be manually moved to this tab using the toolbar button + provided.
- This allows all those subjects who need to be monitored more closely to be visible on the same tab at the same time.
- Subjects must be manually moved back to their original Team tab using the toolbar button — if their condition changes back to Orange or Green.

4.13 Safety Tab

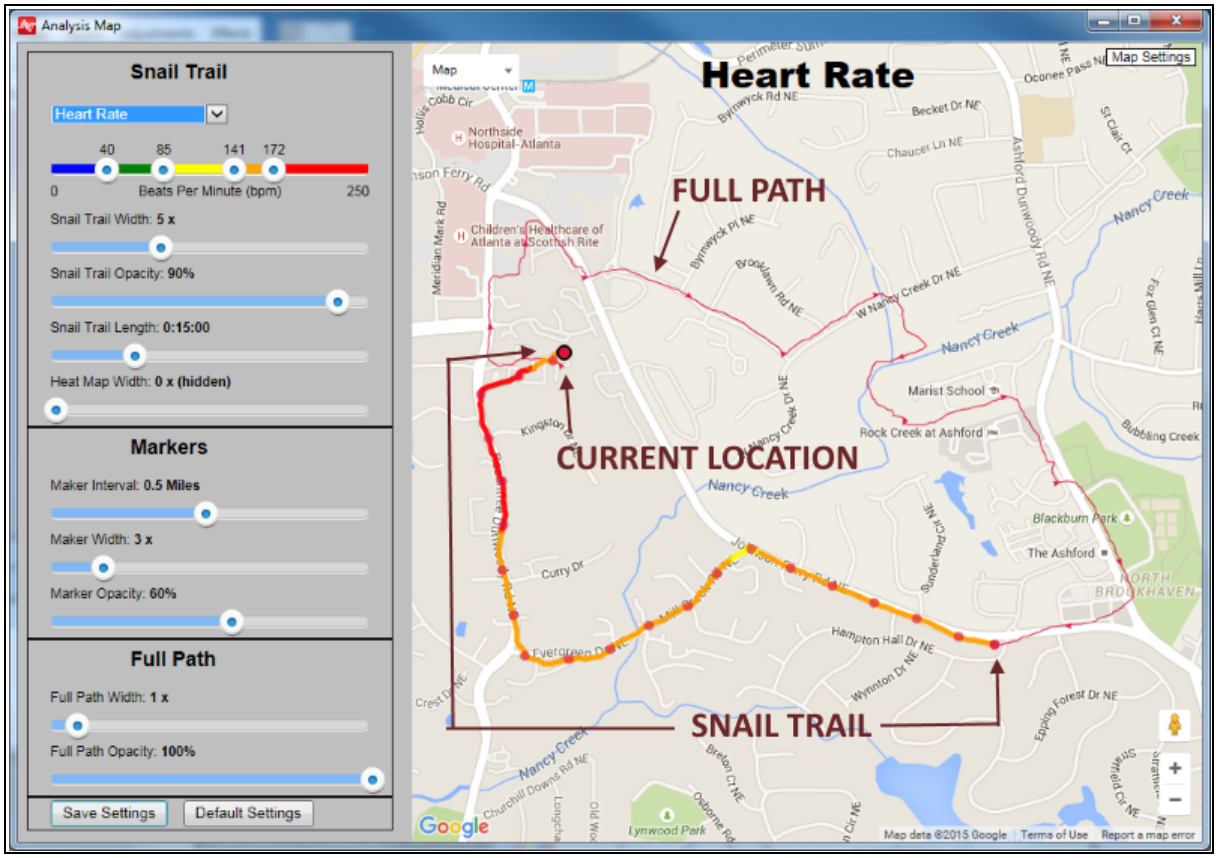
The safety tab displays no BioGauges, only a tile showing the name and subject status of all (up to 64 subjects) deployed across all Teams in the system, including those moved to the Medic tab.



Click on the summary tile of any subject to return to the team tab on which that subject is displayed.

4.14 Map Window

- An Internet connection is required.
- The Map  toolbar button will activate a separate Map window showing configurable snail trails for all subjects. A single subject is illustrated.
- The Map/Satellite view can be dragged by cursor to relocate.
- Use + / - buttons at bottom right, or mouse wheel, to zoom in / out on Map / Satellite view.



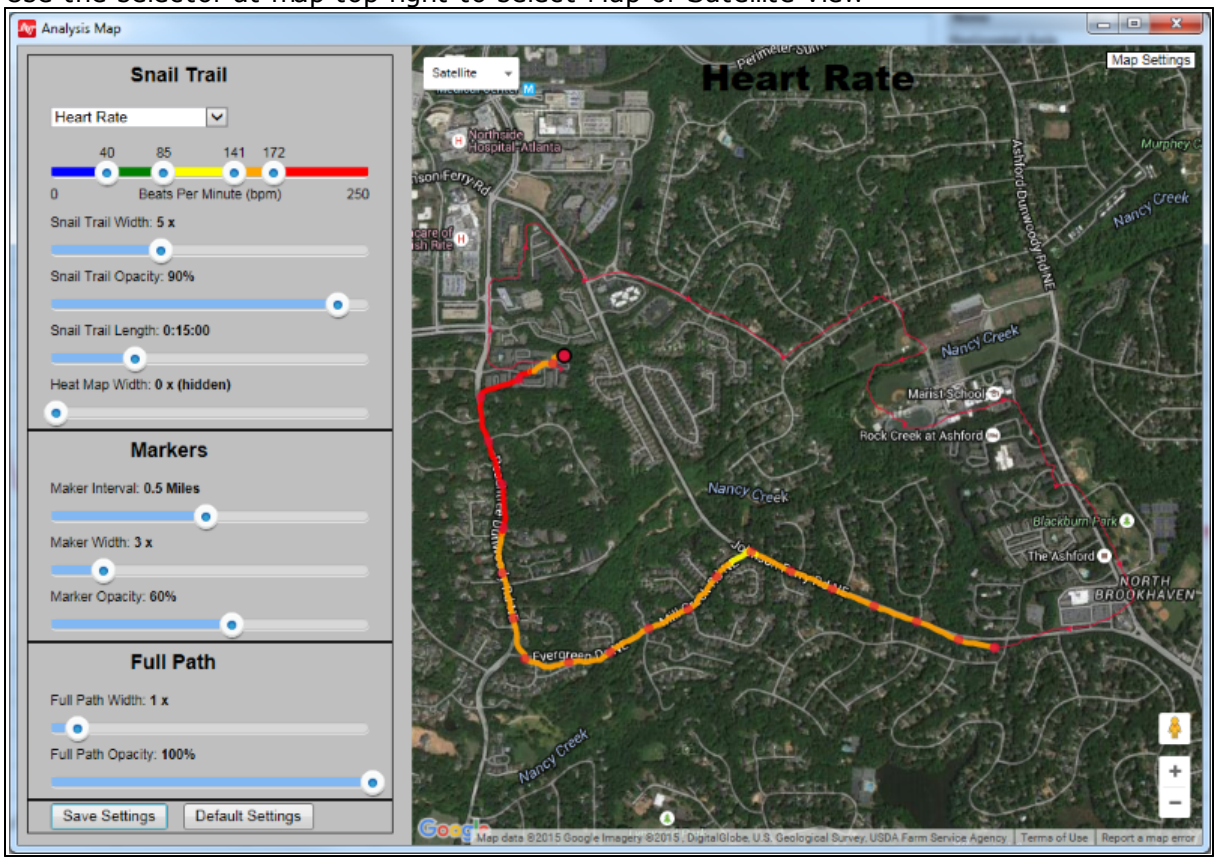
In the example above, non-default settings are used to emphasize trail features

Trail Configuration:

Parameter	Select from pull-down - Heart Rate (shown), %HRmax, %HR@AT, Physiological or Mechanical Intensity, Speed or Altitude Zone, ROG status or path only
Color Thresholds	Slide buttons to set coloring of snail trail
Width	Slide button for snail trail width. Extreme left = trail hidden
Opacity	Slide button for % opacity
Length	Slide button for time duration [hh:mm:ss] of snail trail, **preceding** current location
Location Heat Map Width	Slide button to set background color behind snail trail will turn from green to red as a location becomes prevalent. In a circuit run such as this, Heat Map is always green unless the runner stops and holds

	location.
Marker Interval	Slide button to add distance markers at fixed intervals
Marker Width	Slide button to set marker width. Extreme left = markers hidden
Marker Opacity	Slide button to set marker opacity
Full Path Width	Slide button to set width of path preceding snail trail. Extreme left = full path hidden.
Full Path Opacity	Slide button to set full path opacity
Save Settings	Save a preferred setting for repeated use.
Default Settings	Return to default settings

Use the selector at map top right to select Map or Satellite view



4.15 Training & Workout Tabs

Introduction

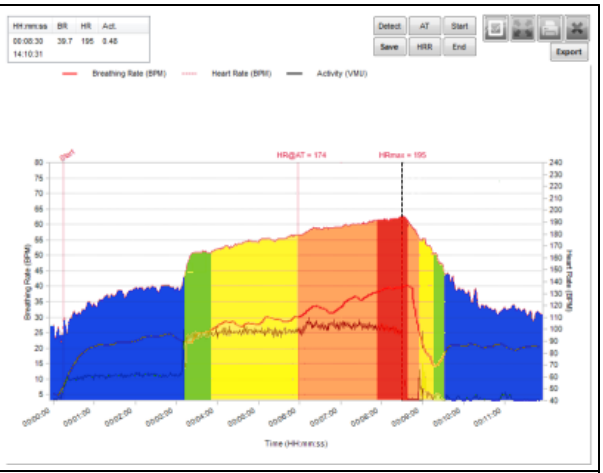
The Training tab displays a Training BioGuage tile for each subject, color-coded according to the intensity with which they are working out.

The configurable color zones depend on:

- heart rate at anaerobic threshold (usually 70 - 90% of maximum heart rate)
- maximum heart rate

In the Workout side panel as displayed below, subjects are given a Current Zone target intensity with duration timer. They should try and match their current intensity to the

target. The Next Zone is also displayed, with a countdown timer.

	
Live Training tab	A treadmill test displayed in OmniSense Analysis, from which the Training Zones are derived for each subject. In this example HR@AT = 174bpm, HRmax = 195bpm

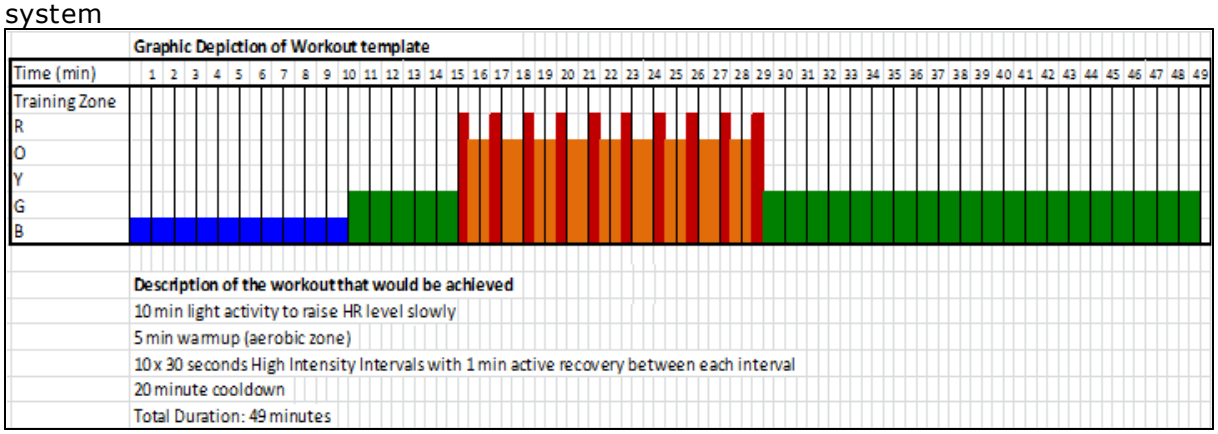
Training Zone Criteria

Training Zone Color	Description	Heart Rate Range [Default Settings]
Blue	Rest/Recovery	< 85% HR@AT
Green	Aerobic	85 - 95 % HR@AT
Yellow	Zone gap	95 - 100% HR@AT
Orange	Anaerobic	100 - 110% HR@AT
Red	High Intensity	110% HR@AT - HRmax

These limits are configurable in the Preferences dialogue

4.15.1 Training Workouts

OmniSense Live now incorporates a large number of training workout templates based on the Paul Robbins Periodization system. These workouts prescribe varying levels of training zone for varying amounts of time. The template names refer directly to the Robbins system



The color of the Training tab itself acts as a target color which subjects should aim to match their own tile color in the workout tab.

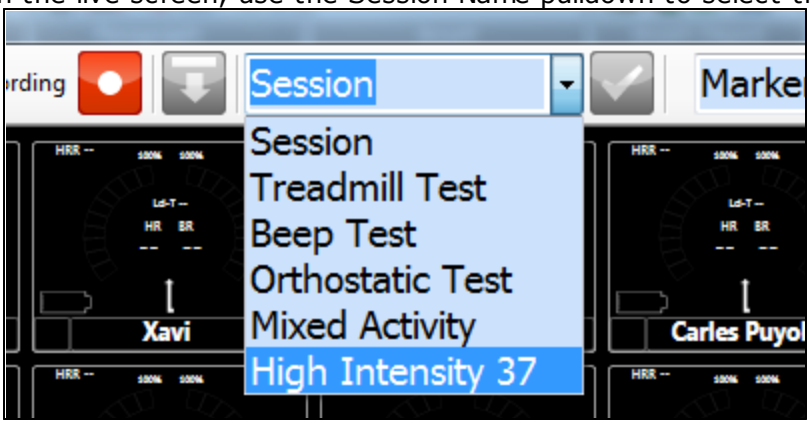
4.15.2 Selecting a Workout

OmniSense installs a large number (100+) of workouts as .csv files located at **..My Documents\OmniSense\WorkoutFiles**.
To select a file and implement it in OmniSense Live:

1. Select the User Preferences in the toolbar 

   Select the Workouts button, and check those you wish to access.

2. In the live screen, use the Session Name pulldown to select the desired workout



3. To activate the workout, click on the  button

4. The Training Tab itself will change color according to the template specification 

as will the target current zone indicator in the Workout Side Panel, if selected.

5. Subjects should attempt to tailor their efforts to make their own tile in the training tab match the color of the Current Zone indication itself.

4.15.3 Creating a Custom Workout

Workout templates are .csv (**c**omma **s**eparated **v**alues) files which, in Windows systems, open by default with Microsoft Excel®, or can be opened by any text editor such as Notepad.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Zone	Time	Notes									
2	G	5	After warm-up do the circuit 6-12 times before doing a 2 min active rest. Repeat 2-4 times before Recov									
3	R	0.17										
4	O	0.5										
5	O	0.25										
6	O	0.5										
7	R	0.17										
8	O	0.5										
9	O	0.25										
10	O	0.5										
11	R	0.17										
12	O	0.5										
13	O	0.25										
14	O	0.5										

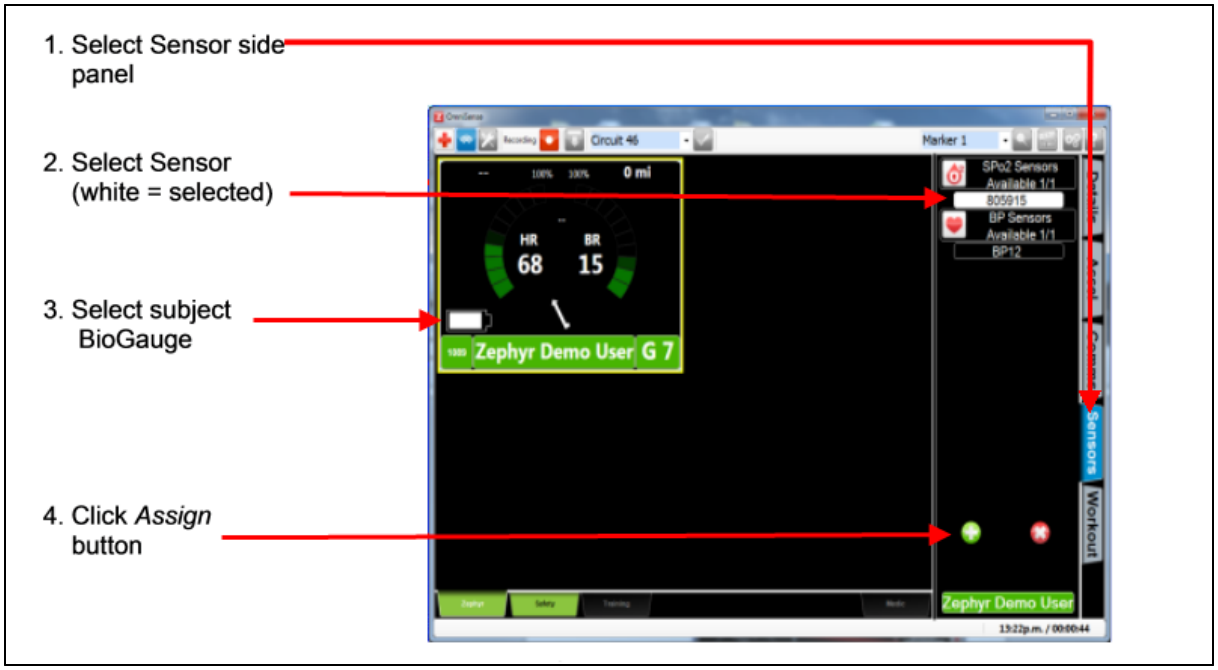
To create a customer template:

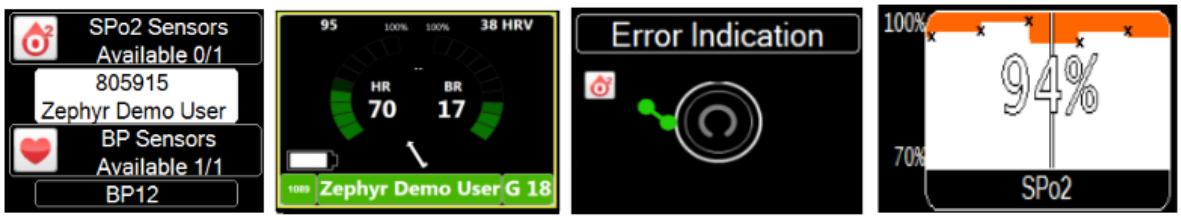
1. Copy any existing workout csv file
2. In column A, starting row 2, list the intended workout intensities using the criteria set in the Training Zones Preferences dialogue.
   e.g. Red: 110% to 100% HRmax
   Orange: 100% to 109% HR@AT
   Green: 50% to 99% HR@HT or as set by user.
   Use uppercase 'R','O' & 'G'
3. In column B, starting row 2, list the intended duration in decimal minutes of each component of the workout.
   e.g. 10 seconds: 0.17
   15 seconds: 0.25
   20 seconds: 0.33
   30 seconds: 0.50
   45 seconds: 0.75
   60 seconds: 1.0
   60 seconds: 1.5 etc
4. In cell C2 add in a text description - this will appear in the workout pane in the Preferences dialogue.
5. Save and rename the file to suit.

6. The new workout will appear automatically in the list in the workout pane in the preferences dialogue

4.16 Assign SpO2 Sensor

External SpO2 sensors must be added to the system as part of the Setup process. They can only be *assigned* to a subject during Live operations.





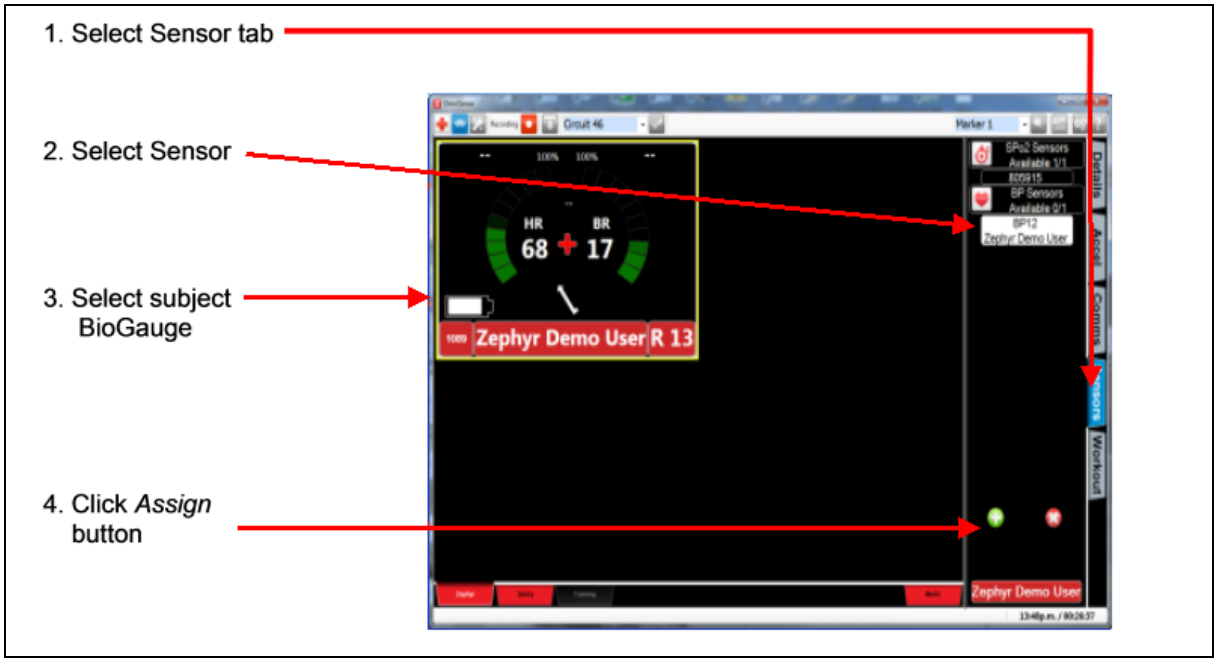
If the sensor is removed from a subject, it will power off automatically within a few seconds, and OmniSense will de-assign the sensor from the subject. The sensor must then be reassigned to the subject to continuer receiving data.

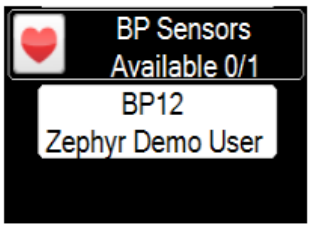
4.17 Assign Blood Pressure Sensor

Blood pressure is supported when using a supported sensor:

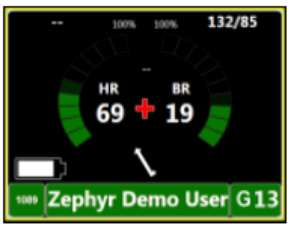
HPL-108 Bluetooth Blood pressure wrist cuff

Note that the default polling frequency for the BP sensor is every five minutes. If the sensor has powered off in this time, it must be reactivated within this time to take a fresh reading and update the data it sends.

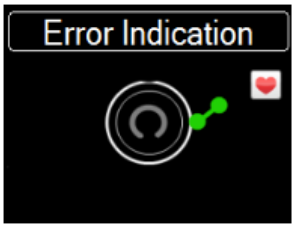




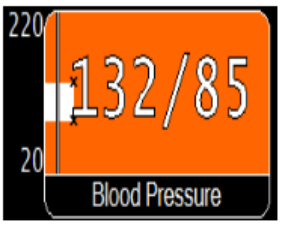
Assigned Name displayed



BP data displayed in BioGauge



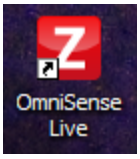
BT Link displayed in Comms tab



Trend Graph populated

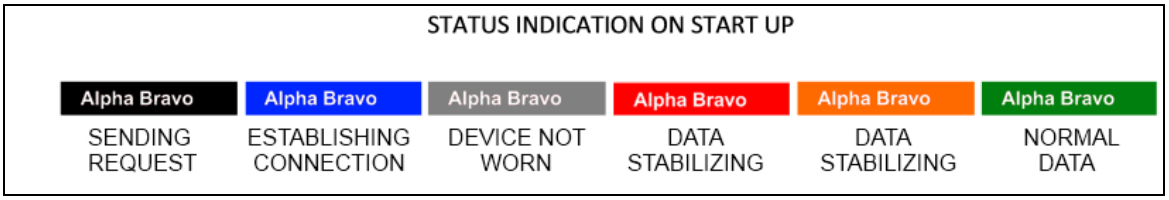
Readings which are manually initiated directly at the sensor are not sent to OmniSense – only those readings scheduled by the application (in Preferences) are displayed. If the cuff powers off between readings, it should be powered on again manually.

4.18 Operation Checks

1. Live checks can only be tested once the database has been fully set up, all components issued to subjects, and all hardware powered on.
2. Start OmniSense Live 

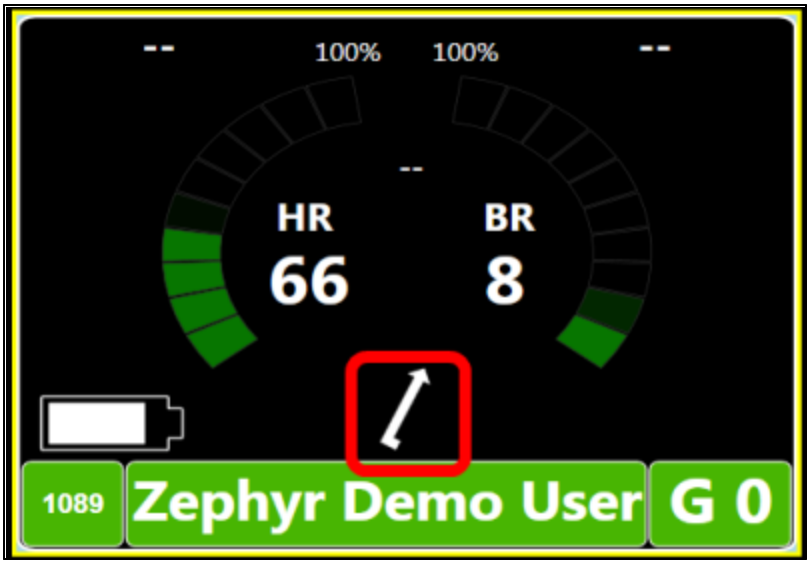
3. Select Live mode in the toolbar 
4. Wait
   ...wait a few moments for Bluetooth and other connections to establish. This may depend on the number of units deployed. The Blue LED on each device will flash once a connection is established.
5. Typical data stabilization times from device power on.

Heart Rate:	5 - 15 sec
Breathing Rate:	30 - 45 sec
Temperature:	1 sec
Activity/Posture:	1 sec

6. 

7. A convenient check is for the subject to lean forward:

8. Observe the response in the subject's BioGauge



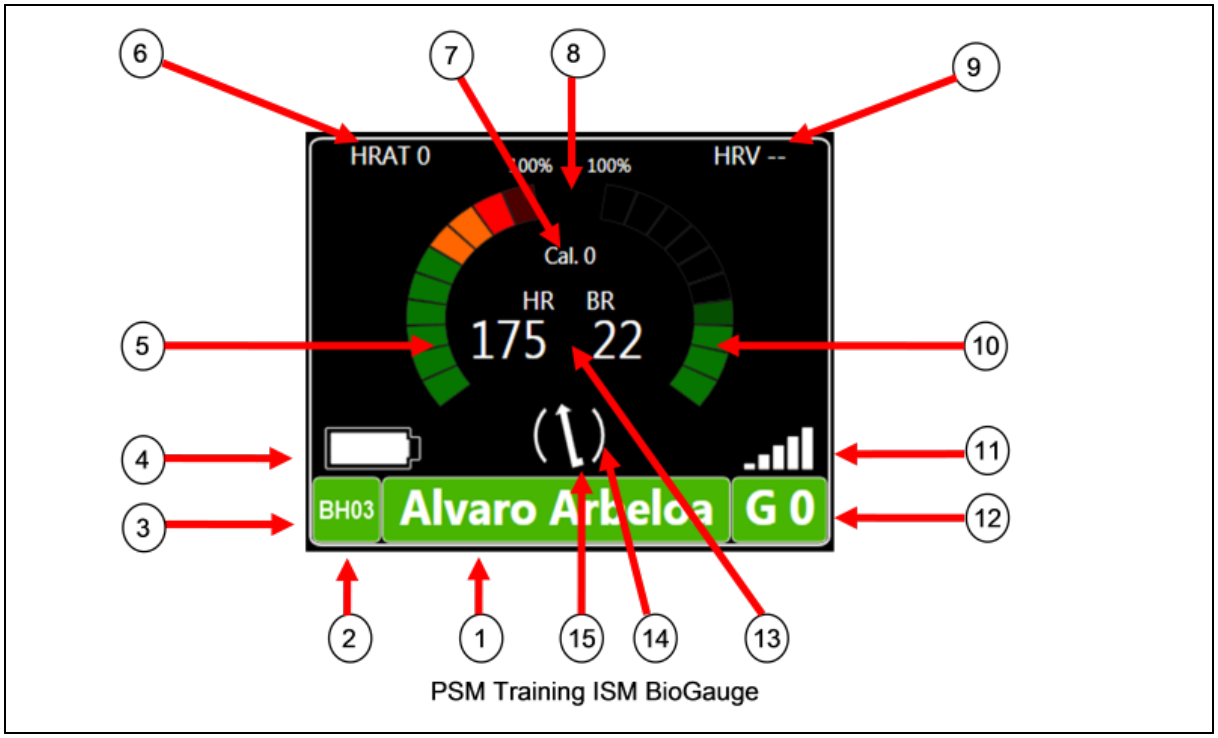
Part 5

5 Subject BioGauge

A configurable BioGauge showing physiological data is displayed for each subject deployed. There are three options:

- BioGauge for ISM Systems (PSM Training ISM)
- BioGauge for Bluetooth & ECHO Systems (PSM BT Direct, PSM Responder, PSM Training 3.0, PSM Training ECHO)
- Training BioGuage (used in conjunction with preconfigured workouts)

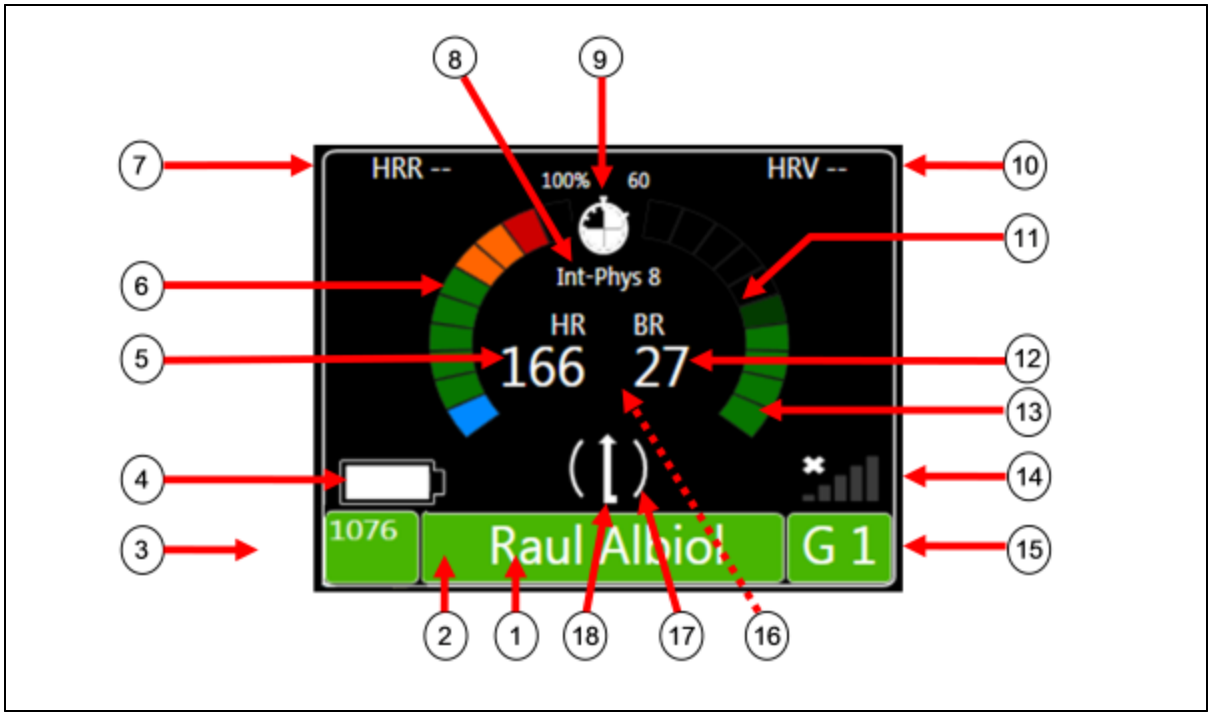
5.1 ISM BioGauge



PSM Training ISM BioGauge

1. Name or identifier
2. BioHarness Identifier
3. Physiological (Red/Orange/Green) or Comms (Blue/Grey) status indication - background color
4. BioHarness battery level
5. Configurable sweep scale & numeric value
6. Configurable value
7. Configurable value
8. No data indicator, 1 min per quadrant (not visible)
9. Data age indication (4 x 1min quadrants) if Status = Blue (Comms Error)
10. Configurable sweep scale & numeric value
11. Signal strength indication - based on ratio of lost data packets
12. 'R', 'O', 'G' indication of ROG status | Time in status (0 - 99 minutes)
13. Red cross means BioGauge also displayed on Medic Tab
14. Activity Level (↑) = walking equivalent ((↑)) = running equivalent
15. ↑ = posture indication

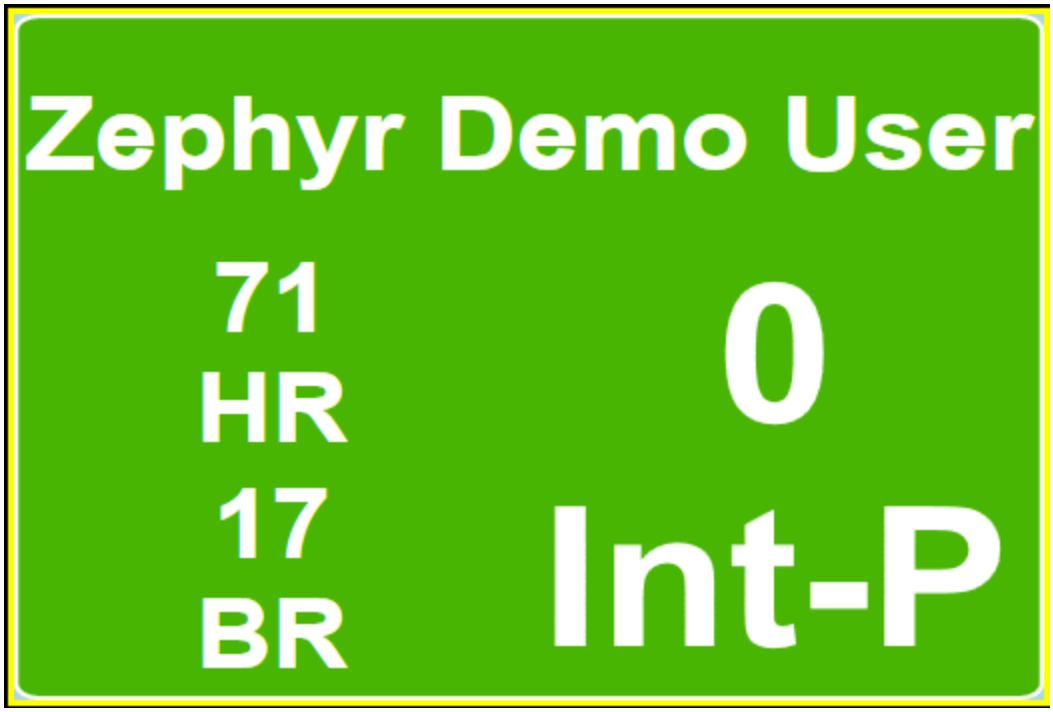
5.2 Bluetooth / ECHO BioGauge



1. Name or identifier
2. Physiological (Red/Orange/Green) or Comms (Blue/Grey) status indication - name background color
3. BioHarness Identifier
4. BioHarness battery level
5. Configurable field 1
6. Sweep scale reflecting configurable field 1
7. Configurable field 2
8. Configurable field 3
9. Data age indication (4 x 1min quadrants) if Status = Blue
10. Configurable field 4
11. HR at Anaerobic Threshold (AT) graticule
12. Configurable field 5
13. Sweep scale reflecting configurable field 5
14. Device signal strength indication (ISM and ECHO systems only)
15. 'R', 'O', 'G' indication of ROG status | Time in status (0 - 99 minutes)
16. Red cross means BioGauge also displayed on Medic Tab (not visible)
17. Activity Level (↑) = walking equivalent ((↑)) = running equivalent
18. ↑ = posture indication

5.3 Training BioGauge

A Training BioGuage is displayed in the Training Tab. The background color of the entire gauge changes according to the Training Zone configured in User Preferences. Training Zones reflect heart rate zones and indicate physiological workout level.

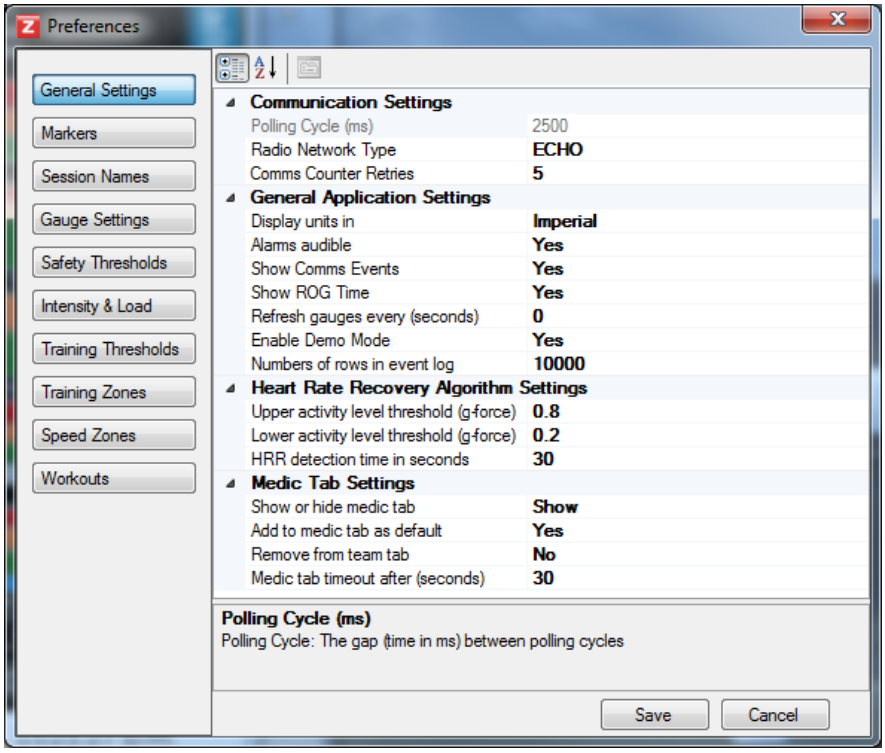


Only three configurable numeric fields are displayed. Its intended use is for subjects to match the background color of their gauge to a target color in the workout tab of Live.

Part 6

6 Settings

An OmniSense Settings/Preferences button is displayed on the toolbar: 



Preferences vary according to the radio network type used.

6.1 General Settings

Communication Settings	
Radio Network Type	Varies according to Radio Network Type
Comms Counter retries	How many data packets missed before Comms Error (Blue Subject Status) displayed
Polling Cycle (ms)	Leave at default 2400 - ECHO network only

Communication Settings	
	Leave at default 1000 - MotorolaXTS network only
ECHO Mode	20x 1 - 20 BioModules at 1 sec refresh rate 50x 2.5 - 50 BioModules at 2.5 sec refresh rate 100x 5 - 100 BioModules at 5 sec refresh rate
Slot Time (ms)	Leave at default 40 - ECHO network only Leave at default 1800 - MotorolaXTS network only
General Application Settings	
Display Units in	Imperial or metric (Height, weight, temperature throughout)
Alarms Audible	ROG Status change audible alerts
Show Comms Events	Comms events recorded in notification area
Show ROG Time	Time-in ROG-state displayed on subject status bar in BioGauge
Refresh gauges every (seconds)	How often default gauges are repainted. Default of 0 means after each cycle of device querying
Enable Demo Mode	Enables Demonstration Mode.
Numbers of rows in Event Log	Max. no. of lines displayed in notification area
Heart Rate Recovery Algorithm Settings (Bluetooth Direct systems only)	
Upper Activity threshold	The *maximum* activity level allowed during recovery phase (stationary approx) before the HRR algorithm can auto-detect HRR
Lower Activity Threshold	The *minimum* activity level needed (running approx) before HRR algorithm can auto-detect HR recovery
HRR detection time	Duration during which Upper activity threshold must *not* be exceeded e.g. sit or lie down during recovery, for auto-detection of HRR
Medic Tab Settings	
Show or hide Medic tab	Makes medic tab accessible during Live Mode
Add Medic Tab as default	Determines if subjects whose status changes to Red are automatically moved to the Medic tab.
Remove from Team Tab	Automatically move BioGauge to Medic tab after timeout. 'No' means BioGauge will be displayed in both Team and Medic tabs
Medic Tab timeout	Time delay in seconds of Red status before subjects are automatically transferred to Medic tab
Sensor Tab Settings (Bluetooth Direct Systems only)	

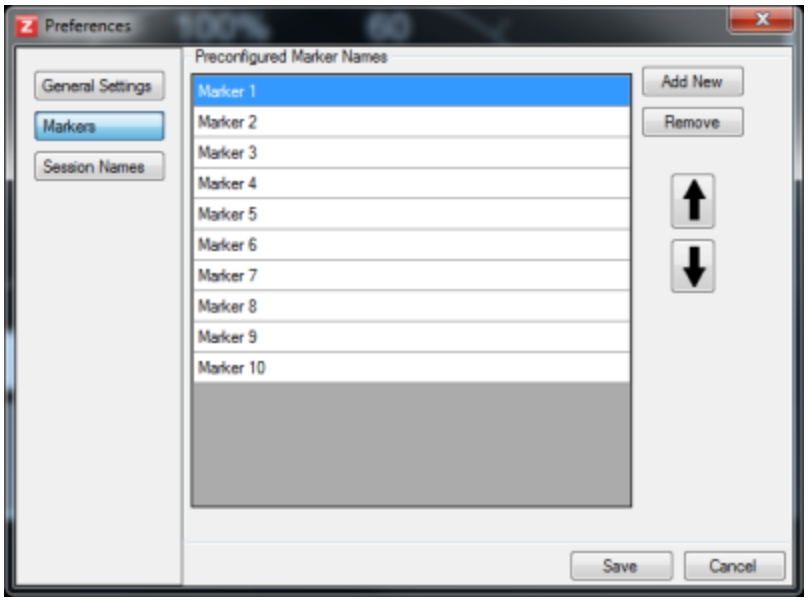
Communication Settings	
SpO2 sensor polling frequency (seconds)	How often a request is sent to update the subject SpO2 value (not ECHO systems)
BP Sensor polling frequency (minutes)	How often a request is sent to update blood pressure. Should be set to adhere to medical practice (not ECHO systems)

Additional parameters are configurable, dependent on the Radio Network Type set.

6.2 Markers

Markers can be seen when viewing recorded data in the Analysis module.

1. Create Markers - open the User Preferences dialogue
2. Select *Markers*



10 markers already exist. Edit the names of these, and add new markers as required.

3. To add a marker to a recording, mouse over the Marker button  . This button is only visible when data is being recorded. A pulldown will show three options:
- Individual - creates a marker in the session of the individual whose BioGauge is selected
- Team - creates a marker in the sessions of all members of the team whose tab is selected
- All - creates markers in all sessions being recorded, in all teams

4. The pull down list showing the markers will display. Select the Marker desired, and clicked the Marker button. A marker will be created in the recording. You can also edit field and add a custom Marker on the fly.
5. A Marker will be displayed as a vertical line in data displayed in the Analysis module.

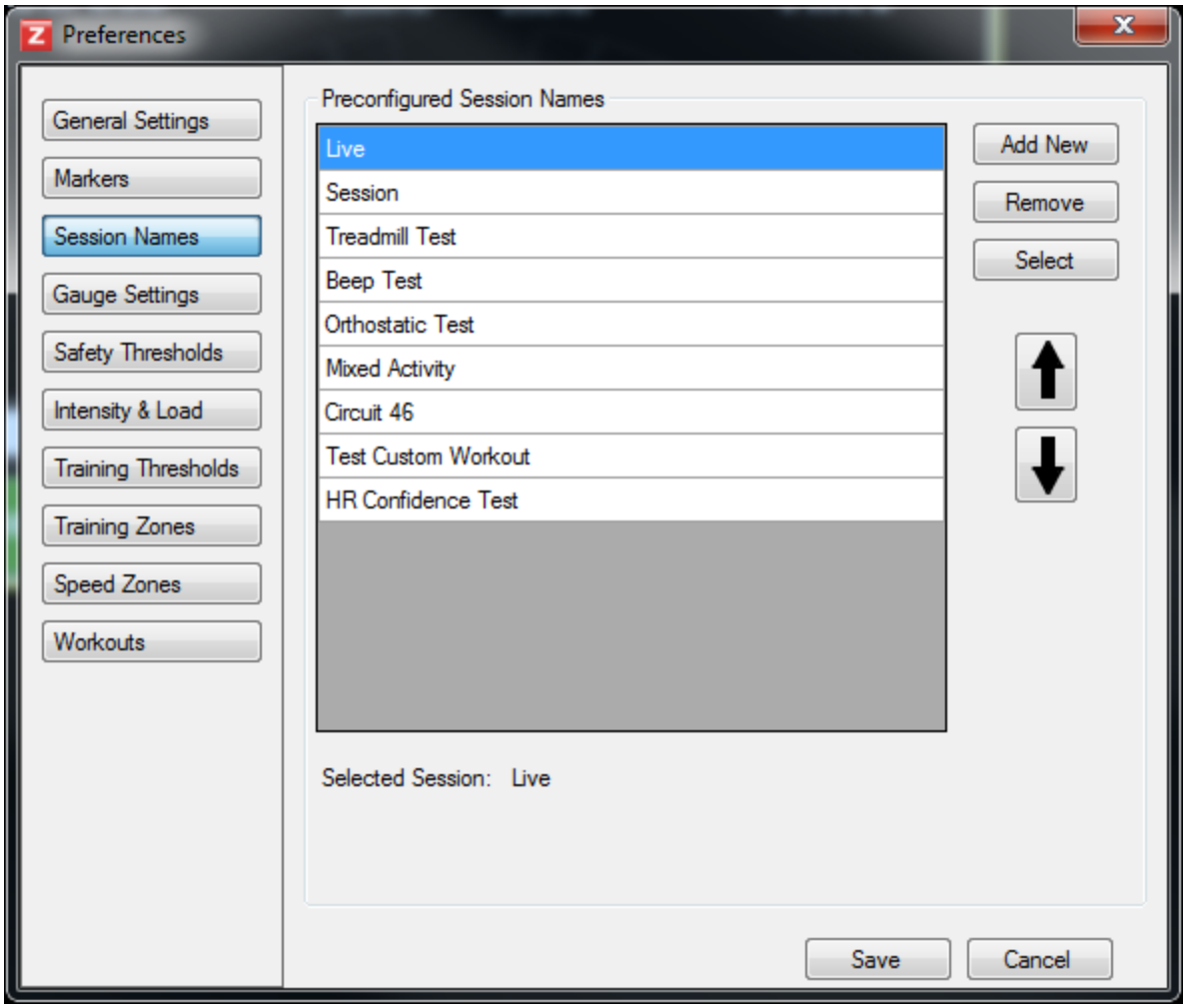
6. An additional elapsed time value is displayed beside the system time at bottom right of the window frame in the Live module

The clock is reset each time a new marker is placed.
7. Each time a Marker is placed, the next marker in the list is automatically selected.
8. All Markers are stored in an external file called *Markers.txt* which is located at: C:\ProgramData\Zephyr

6.3 Session Names

Session names are displayed in the Analysis module. They allow for easier filtering of data sessions.

You can also edit the session name displayed on the toolbar and create a new Session Name on the fly.

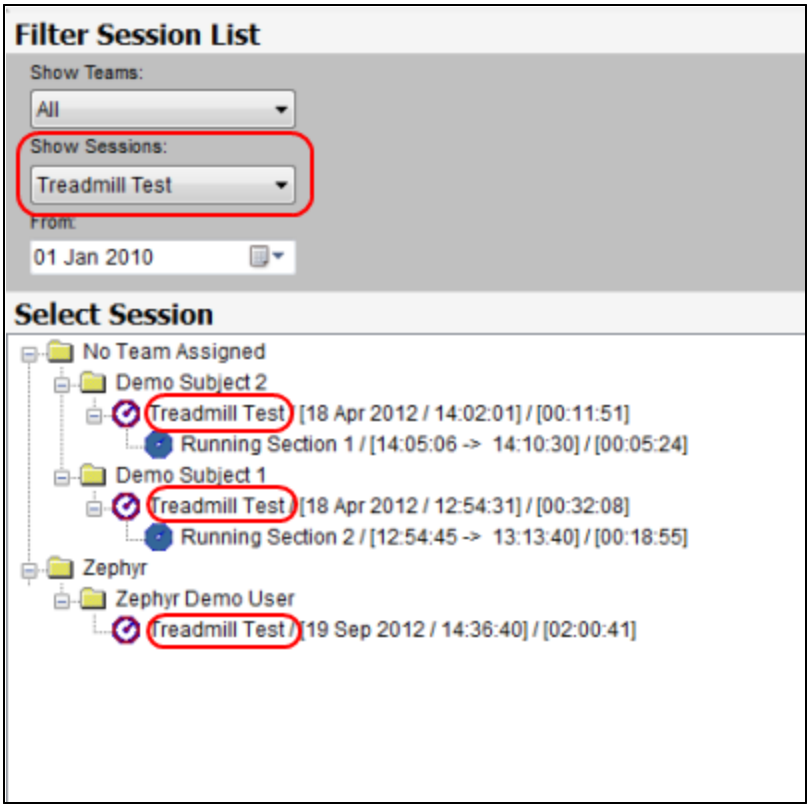


1. Create, edit and order Session Names using the Preferences dialogue

2. To name a session, select from the pulldown list in the Live module

and click the tick button to activate the new session name.

3. The session names can then be used to filter sessions in the Analysis module for faster data access.

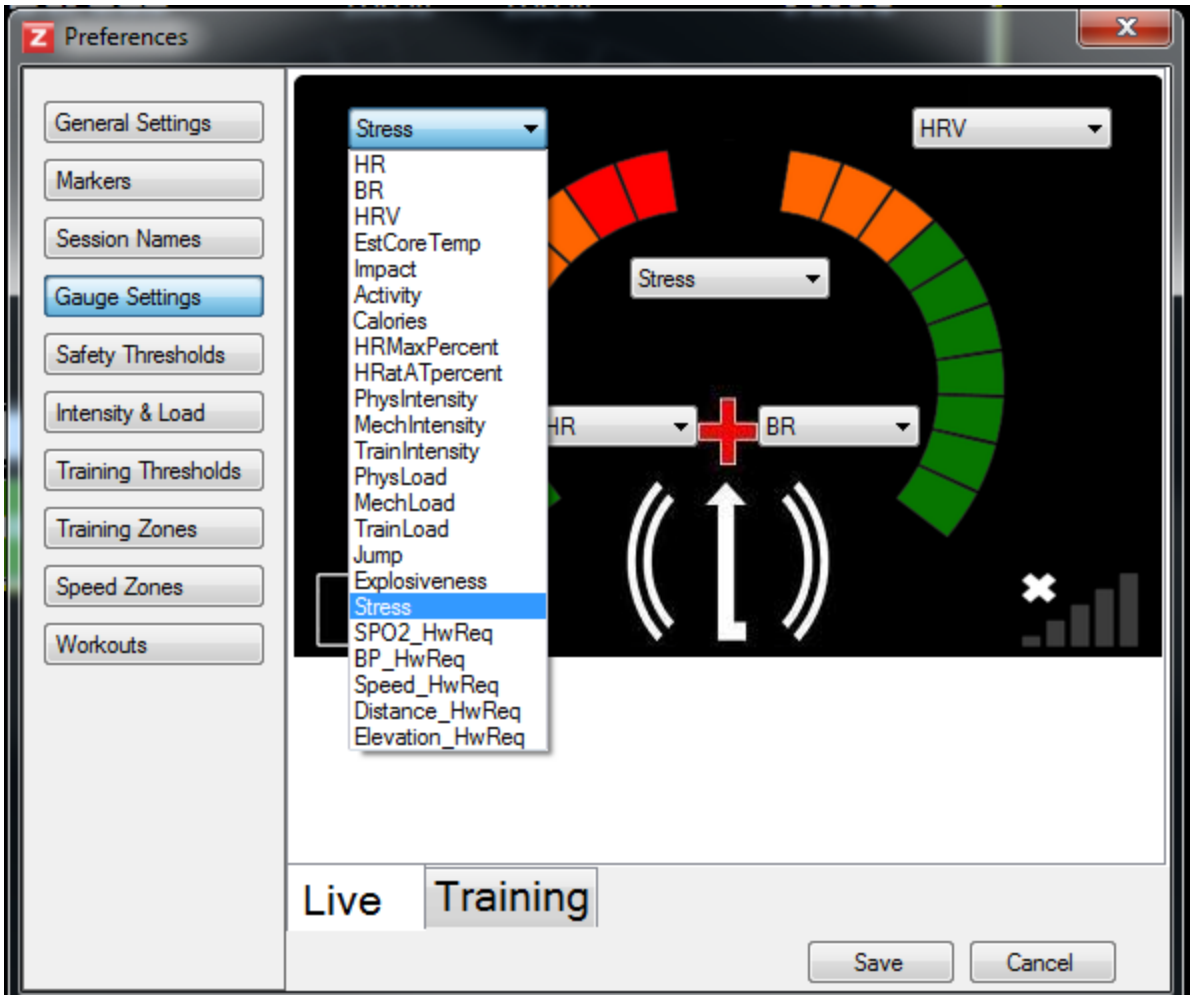


6.4 Gauge Settings

A subject BioGauge can be configured from the Preferences button on the application toolbar.

Training BioGuage

Live BioGuage



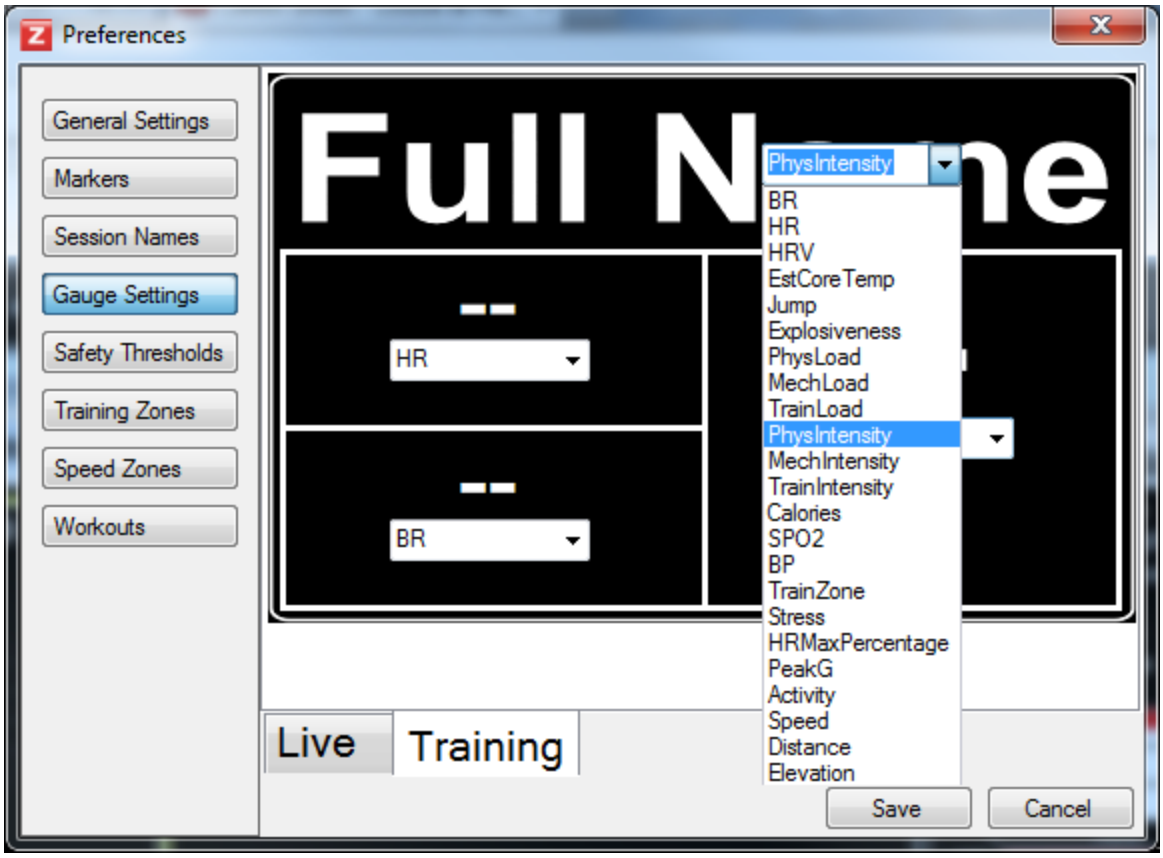
Select the *Gauge Settings* button, and use the pulldown lists to configure the values to be displayed for the three numeric fields and the two sweep scales

BR	Breathing Rate
HR	Heart Rate
HRV	5 minute SDNN Heart Rate Variability (not ISM systems)
EstCoreTemp	Estimated Core Temperature (not ISM systems)
Impact	Peak Acceleration - in previous 1 second for Bluetooth systems, in previous 2.5 seconds for ECHO
Activity	Activity Level in VMU
Calories	Calories burned - ACSM formula
HR_{Max} Percentage	% of subject's maximum heart rate
HRatATPercentage	% of subject HR@AT
PhysIntensity	Physiological Intensity
MechIntensity	Mechanical Intensity
TrainIntensity	Average of Physiological & Mechanical Intensities
PhysLoad	Physiological Load

MechLoad	Mechanical Load
TrainLoad	Average of Physiological & Mechanical Loads
Jump	Peak g value during Jump Event (not ISM systems)
Explosiveness	Peak g value during a 40 yard dash event (not ISM systems)
Stress	An HRV-derived metric of stress
SpO2	Dissolved blood oxygen % when a pulse oximeter is used (not ISM systems)
BP	MAP Blood pressure when a blood pressure cuff is used (not ISM systems)
Speed	Speed - BioHarness must have been configured to communicate with a supported GPS device. Available ONLY for PSM Responder and some PSM Defense variants
Distance	Distance traveled - BioHarness must have been configured to communicate with a supported GPS device. Available ONLY for PSM Responder and some PSM Defense variants
Elevation	Elevation - BioHarness must have been configured to communicate with a supported GPS device. Available ONLY for PSM Responder and some PSM Defense variants
Impulse Load	A cumulative measurement of mechanical load – the sum of the areas under the accelerometer magnitude curve for all impulses, measured in Newtons.
Walk Step Count	Cumulative walking step count. Steps, bounds and jumps are distinguished by analysis of the direction of impulse, magnitude of the impulse, and time interval from the previous impulse.
Run Step Count	Cumulative Running Step Count
Bound Count	Cumulative Bound Step Count
Jump Count	Cumulative detected Jump Count (crouch/pause/jump)
Minor Impact Count	Count of Minor Impacts (3g to 7g)
Major Impact Count	Count of Major Impacts (greater than 7g)
Avg Force Rate Development Rate	Measure of explosive power, averaged over previous 10 steps, measure in Newtons
Avg Step Impulse	A measure of the efficiency of steps, i.e. how much energy is expended during a step. Shorter (in duration) steps expend less energy. Measured in Newtons
Avg Step Period	Seconds - time duration of step
Flight Time	Jump flight time measured in milliseconds
Peak Magnitude Phi	Degrees from vertical of force or impact during an epoch
Peak Magnitude Theta	Degrees from horizontal of force or impact during an epoch

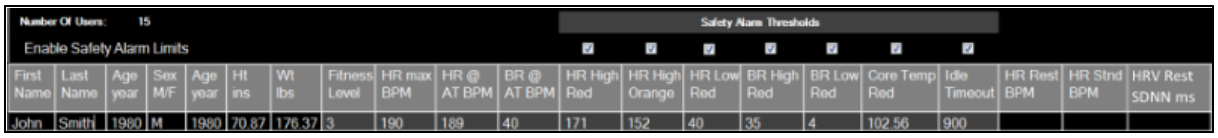
Training BioGauge

A Training BioGuage is displayed in the Training Tab. The background color of the entire gauge changes according to the Training Zone (dependent on HR) the subject is currently active in.



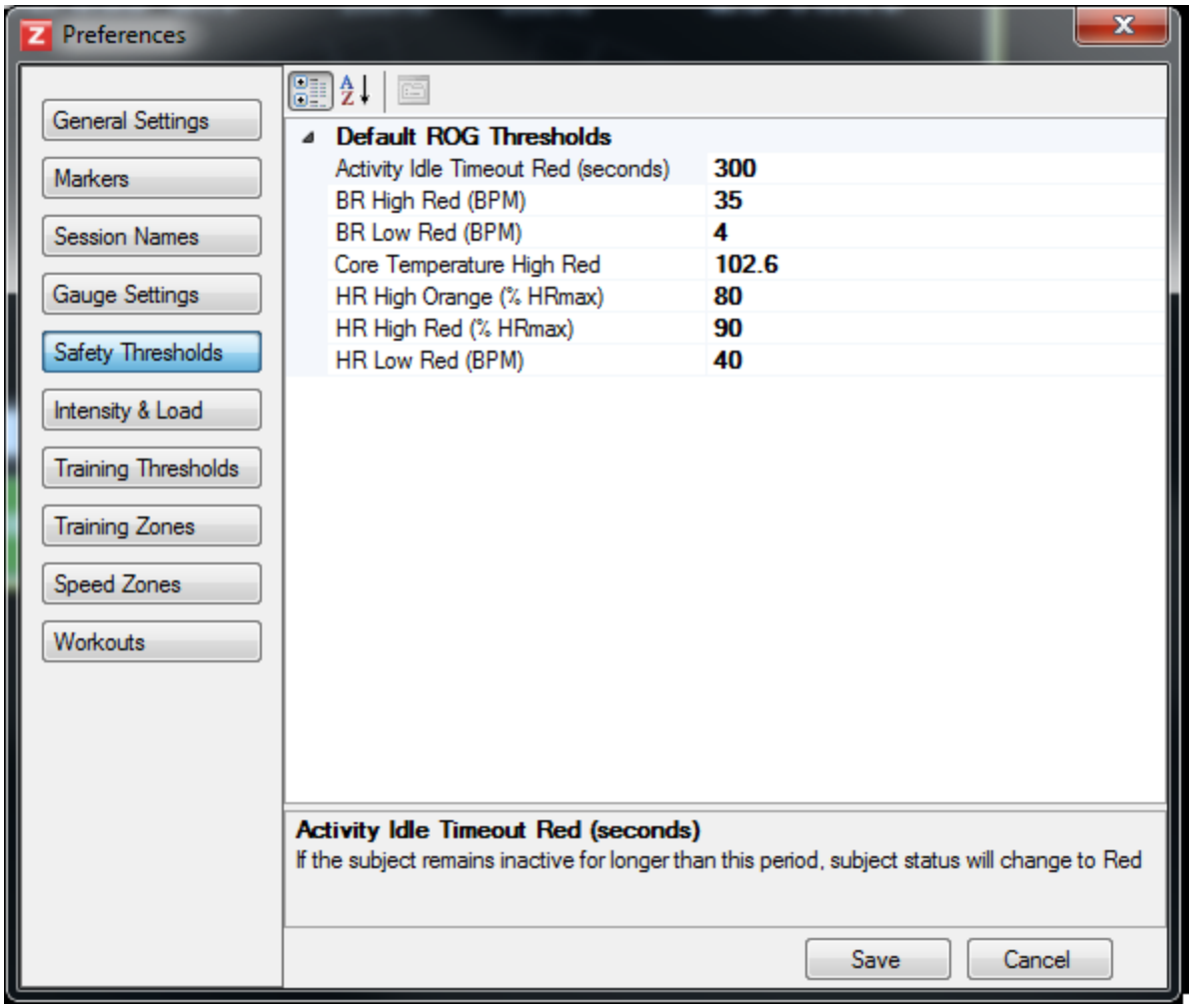
6.5 Safety Thresholds

In the subject setup screen, a number of ROG algorithm Safety Alarm Thresholds can be set manually, or set to default values using the Thresholds Default button in the lower right corner of the screen:



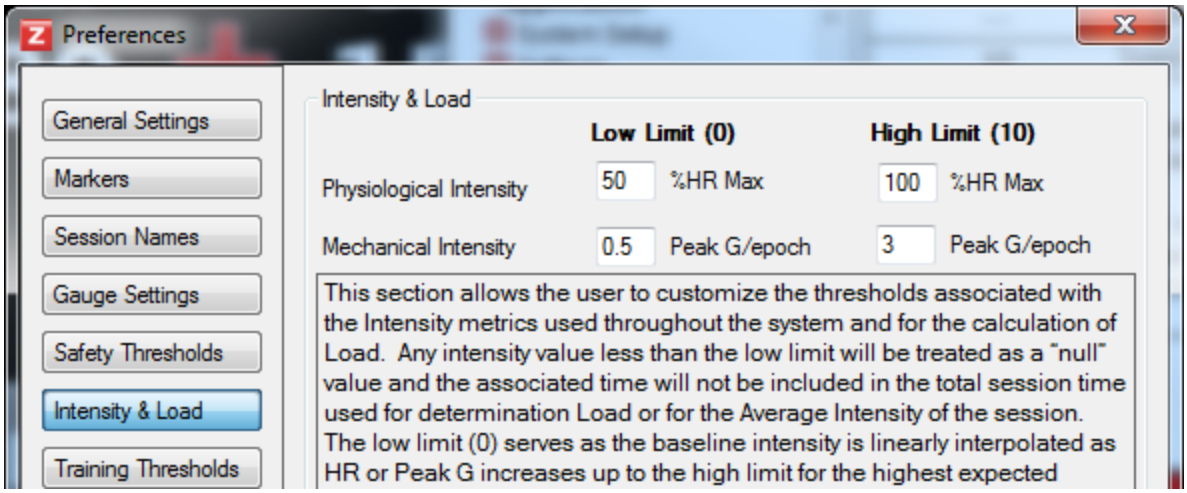
Number Of Users: 15											Safety Alarm Thresholds									
Enable Safety Alarm Limits											☑	☑	☑	☑	☑	☑	☑			
First Name	Last Name	Age year	Sex M/F	Age year	Ht ins	Wt lbs	Fitness Level	HR max BPM	HR @ AT BPM	BR @ AT BPM	HR High Red	HR High Orange	HR Low Red	BR High Red	BR Low Red	Core Temp Red	Idle Timeout	HR Rest BPM	HR Stnd BPM	HRV Rest SDNN ms
John	Smith	1980	M	1980	70.87	176.37	3	190	189	40	171	152	40	35	4	102.56	900			

The default values themselves can be set in the *Safety Thresholds* Preferences option



Activity Idle Timeout Red	Breathing Rate
BR High Red	
BR Low Red	
Core Temperature High Red	
HR High Orange (%HR_{max})	
HR High Red (%HR_{max})	
HR Low Red (BPM)	

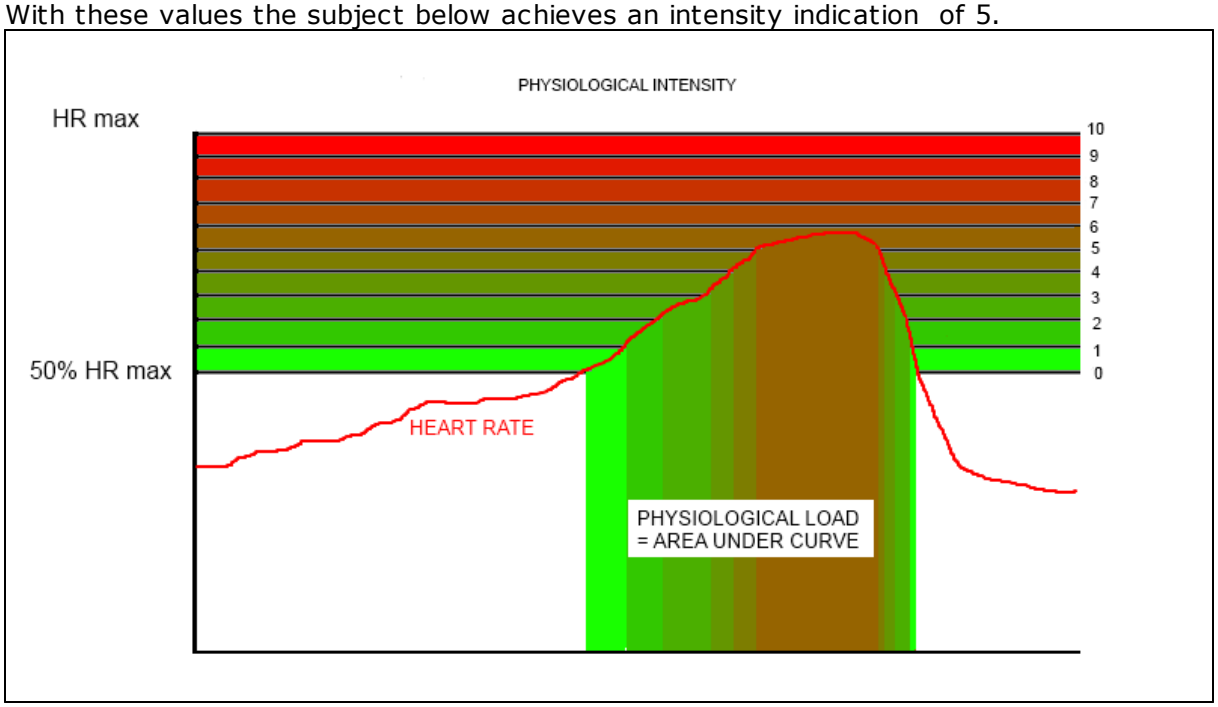
6.6 Intensity & Load



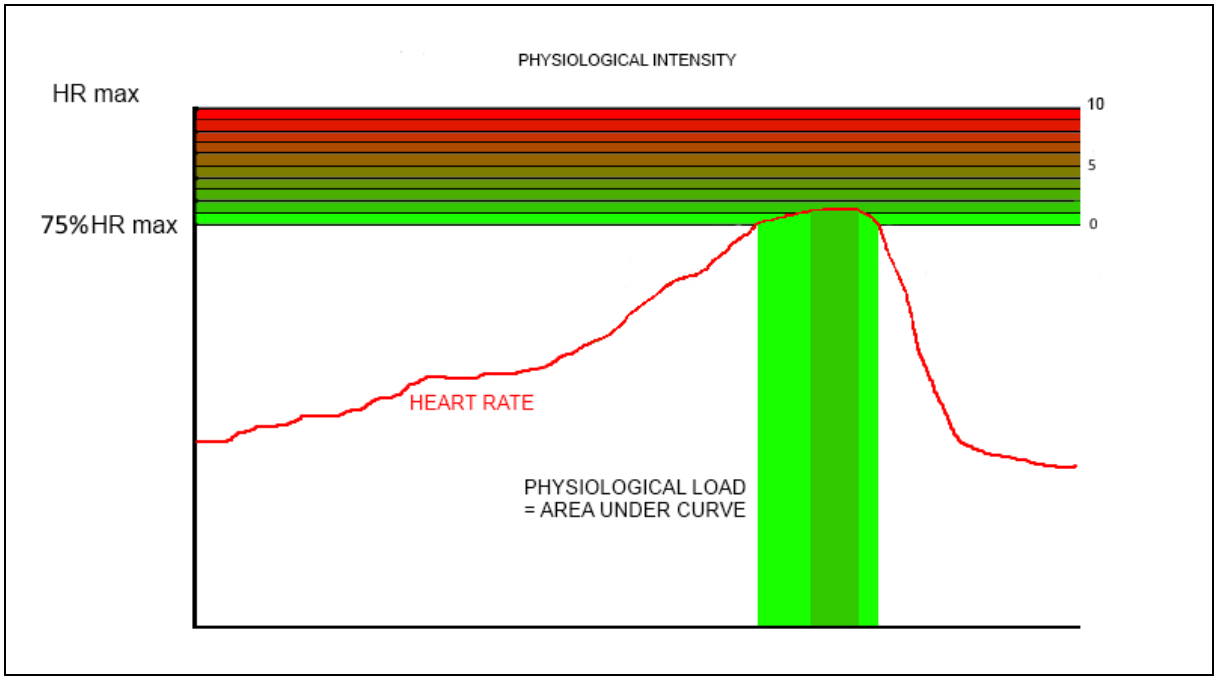
Physiological Intensity

Physiological Intensity is measured on a 0 - 10 scale, comparing current heart rate against a subject's maximum heart rate. The default settings are that 0 = 50% HR_{max}, and 10 = 100% HR_{max}.

With these values the subject below achieves an intensity indication of 5.



If the lower limit is increased up to 75% of HR_{max}, then the subject will only achieve an intensity indication of 2 for the same HR value. Their indicated physiological load is also reduced correspondingly.

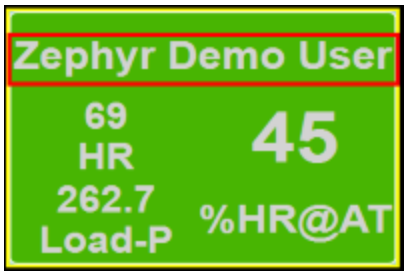


6.7 Training Thresholds

Training thresholds are configurable **lower** limits for Physiological Load, Mechanical Load and Training Load. If any one of these thresholds is crossed, then the subject name in the Training BioGuage in the Training tab will flash.

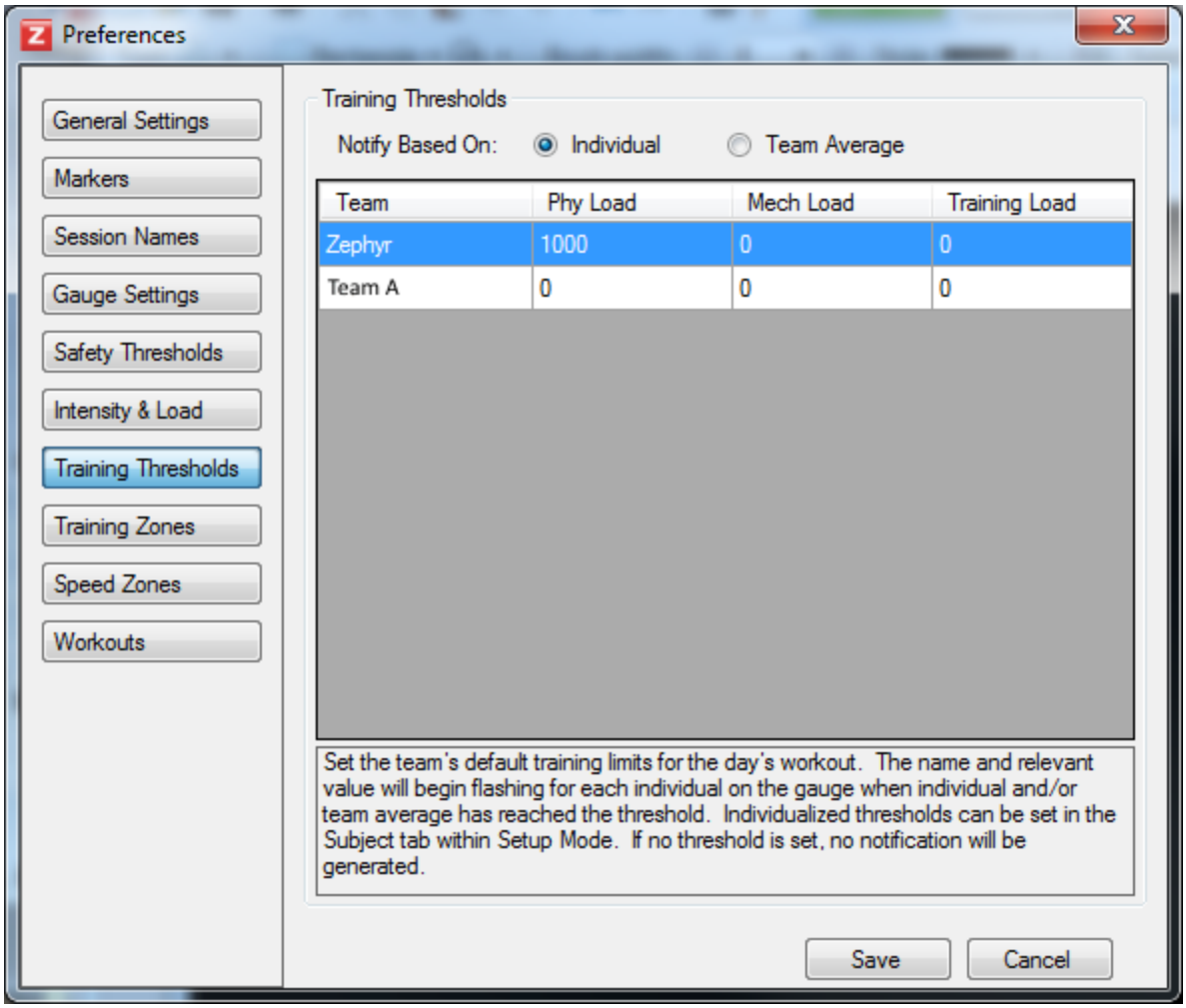
This gives an easily-seen indication that an individual subject has achieved a predetermined level.

Thresholds are set at Team level, but can apply to individual members.



The subject name will flash in a contrasting color.

Set Training Thresholds in the *Preferences* > *Training Thesholds* dialogue.

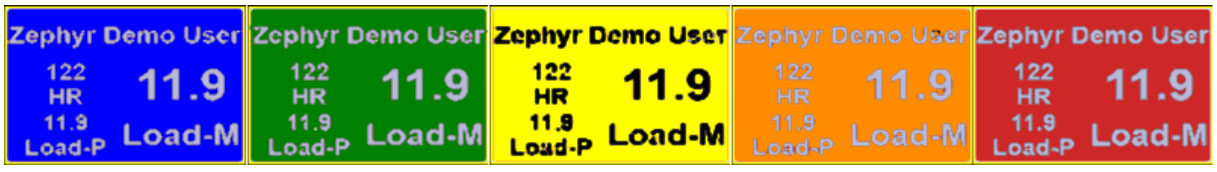


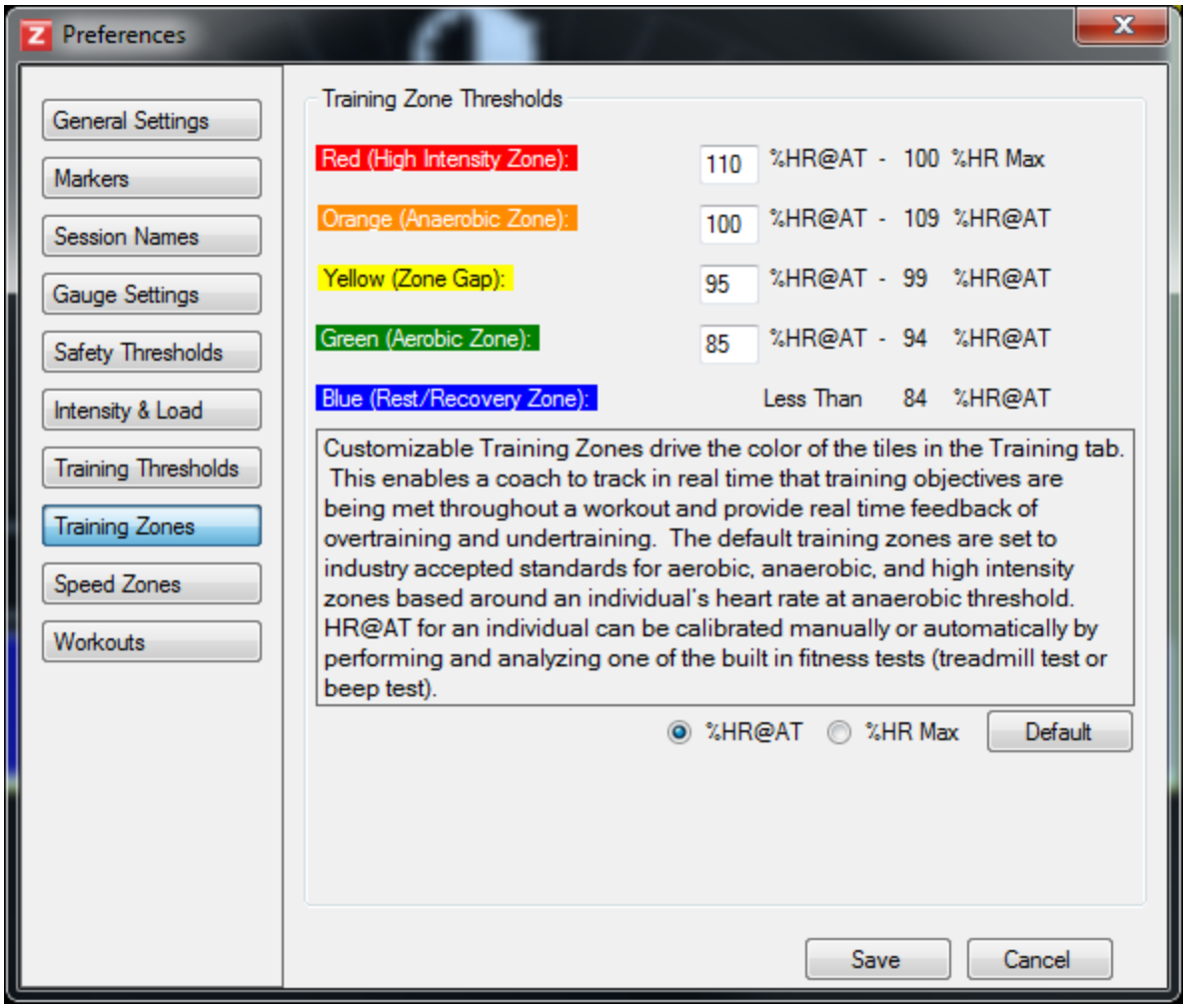
In this example:

- Members of Team Zephyr's names will flash when their Physiological Load exceeds 1000
- Mechanical Load and Training Load for Team Zephyr values will have no effect
- Members of Team A (if deployed at the same time) will have no effect

6.8 Training Zones

Training Zones colors are displayed as the background color of Training BioGauge displayed in the Training tab.

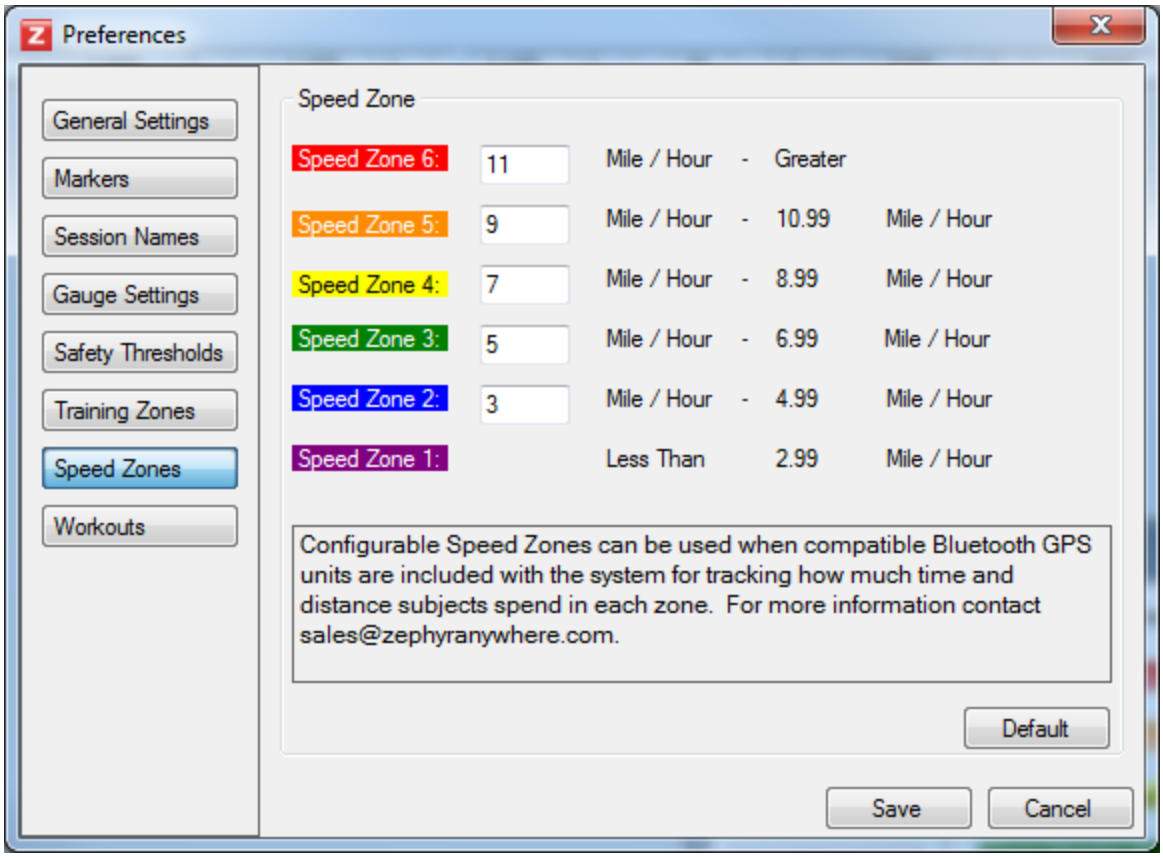




Set the lower limit for each zone - the upper limit for the adjacent zone will adjust automatically. The main reference for the zones is the subject's Heart Rate at Anaerobic Threshold (HR@AT):

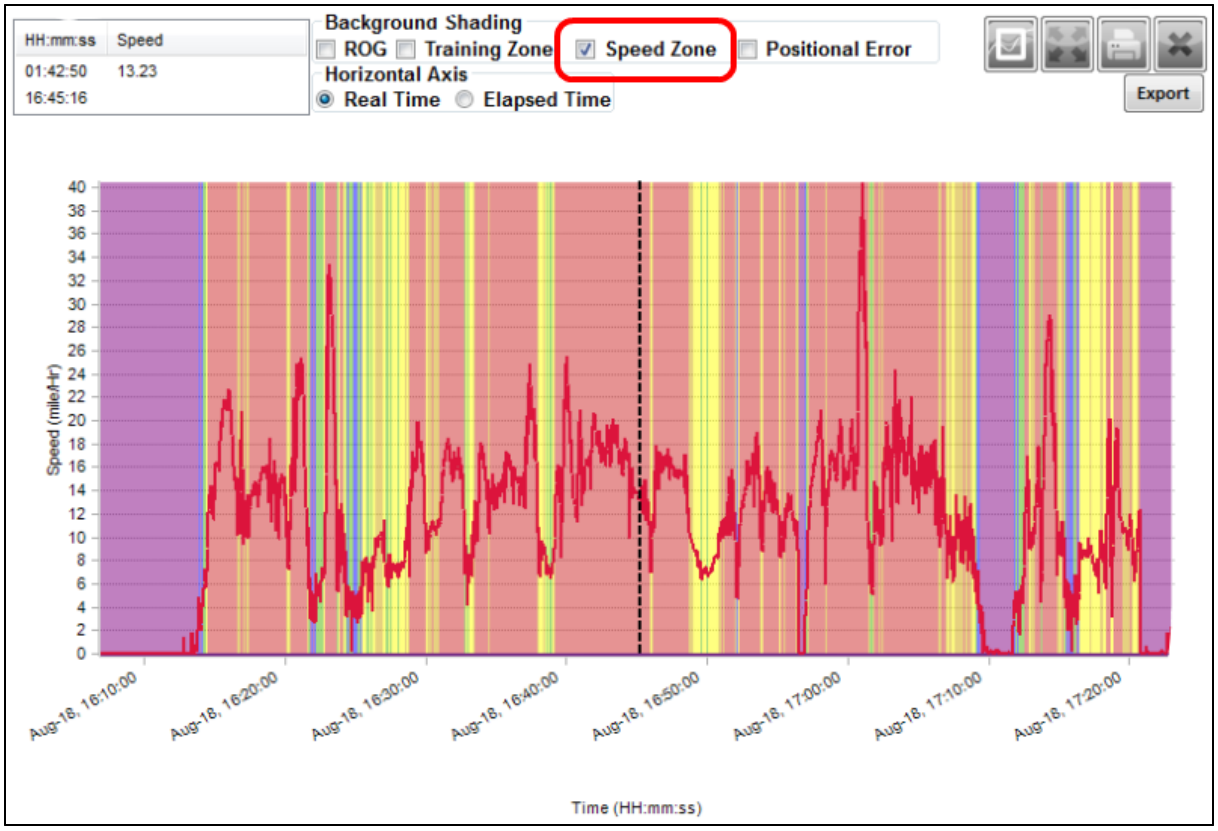
- is stored in the OmniSense database for each subject
- defaults to 80% of HR max when a new subject is created
- is normally in the range 70 - 90% HR max
- can be edited when creating a new subject
- can be updated automatically from the Analysis module after analyzing a maximum ramped-effort fitness test (treadmill or beep test)

6.9 Speed Zones



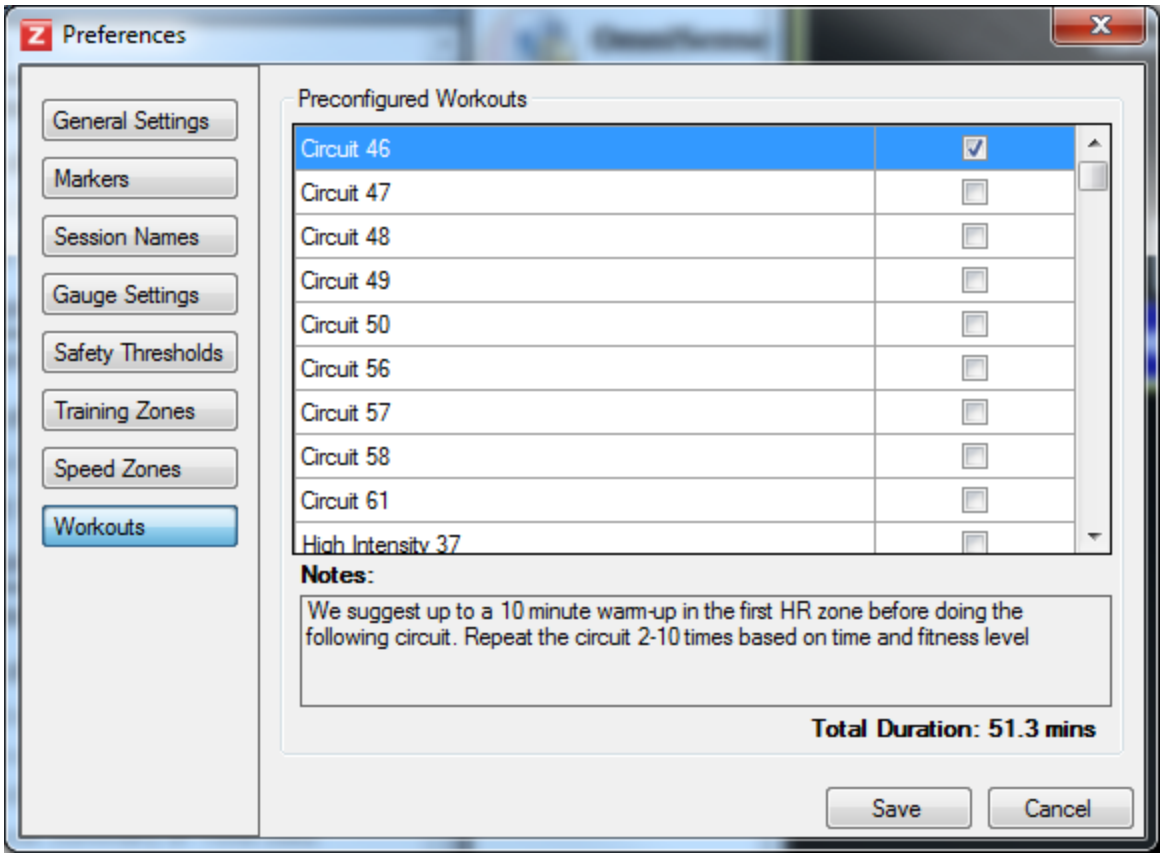
Speed zones can be configured for subjects who are using a supported GPS device in conjunction with their BioHarness.

The speed zone data is **not** viewed in OmniSense Live, but in Analysis:



Use the check box above the graph to show speed zones attained as background shading. Illustrated is speed over time in miles per hour over a cycle run tracked by GPS.

6.10 Workouts



Preconfigured workout templates are labeled to conform with the Paul Robbins Periodization system. Workouts are csv files stored at **..My Documents\OmniSense \WorkoutFiles**.

These files define a sequence of Training Intensities for specific periods of time. In the Workout Tab, a target intensity level is displayed by color - subjects should attempt to match the intensity level as it changes during the workout.

The files are based on the Paul Robbins Periodization system. The file names refer to this system directly. You can also create your own customer workout file by copying, renaming and modifying any existing file.

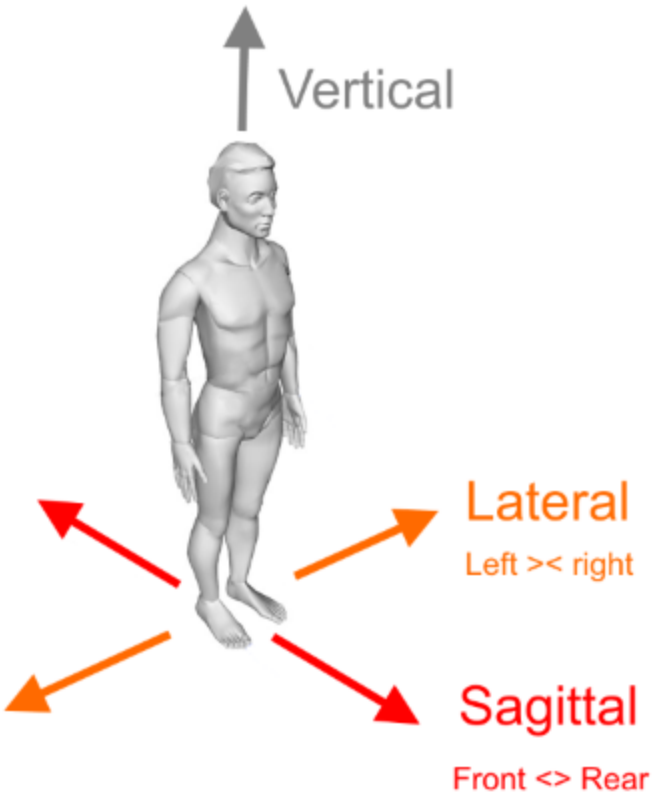
The notes support text to speech.

Part 7

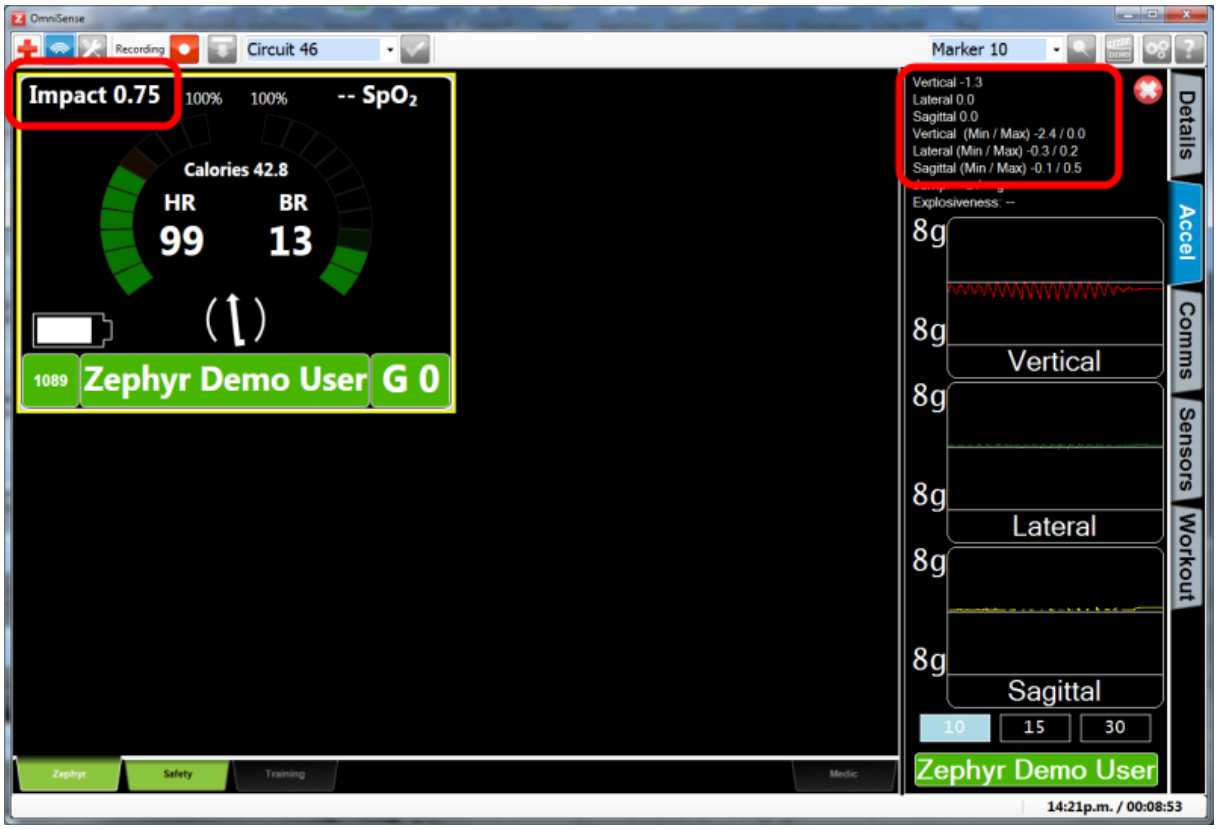
7 Parameters

Training Intensity
Training Load
Walk Step Count
Weight

7.1 Acceleration

Acceleration	Lateral, Sagittal & vertical acceleration
OmniSense Live	Accel Side Panel
OmniSense Analysis	Time & Summary graphs
Log Data	Summary & Waveform, Enhanced Summary & Waveform recorded as raw bits
Units	g
Range	-8g - +8g
Reporting Frequency	100 Hz
Notes	 • Axis orientation - automatic if BioModule is configured for the correct garment type

	• Vertical data will show 1g gravitational offset



7.2 Activity Level

Activity Level	Index of activity
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs, all Reports
Log Data	All Formats
Units	VMU (Velocity magnitude units, measured in g)
Range	0 - 16g
Reporting frequency	1Hz
Notes	 • Parentheses around posture arrow in BioGauge indicate activity level • Walking equivalent activity > 0.2 VMU, running equivalent

	activity > 0.8 VMU
Formula	VMU = SQRT(x^2 + y^2 + z^2) where x, y & z are the averages of the three axial acceleration magnitudes over the previous 1 second epoch, sampled at 100Hz

7.3 Average Force Development Rate

Average Force Development Rate	Measure of explosive power.
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs, Pro Impact Report
Log Data	Enhanced log formats
Units	Newtons per second
Range	0 - 16g
Reporting Frequency	1Hz
Notes	• The gradient of the accelerometer magnitude (the steepness of the curve) during initiation of an impulse. • Averaged for the previous 10 steps, and zero if no steps detected for 5 seconds • Available OmniSense 4.0 and later

7.4 Average Step Period

Average Step Period	Time duration of a step
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs, Pro Impact Report
Log Data	Enhanced log formats
Units	Seconds
Range	0 - 1023
Reporting Frequency	1Hz
Notes	• Averaged for the previous 10 steps, and zero if no steps detected for 5 seconds • Available OmniSense 4.0 and later

7.5 Average Step Impulse

Average Step Impulse	Area under the accelerometer magnitude curve for a detected step
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs, Pro Impact Report
Log Data	Enhanced log formats
Units	Newton Seconds
Range	0 - 1023
Reporting Frequency	1Hz
Notes	• A measure of the efficiency of steps i.e. how much energy is expended during a step. Shorter (in duration) steps expend

	less energy. • Averaged for the previous 10 steps, and zero if no steps detected for 5 seconds • Available OmniSense 4.0 and later

7.6 Battery Level

Battery Level	Subject BioModule battery level
OmniSense Live	Battery icon in subject BioGauge
OmniSense Analysis	Time graphs
Log Data	All log formats
Units	Volts
Range	3.5 - 4.5
Reporting Frequency	1Hz
Notes	• Fully charged battery voltage ~4.2V • Fully discharged battery voltage ~3.6V • The BioModule processor powers off the device at ~3.6V to prevent chemical degradation to the battery

7.7 Blood Pressure

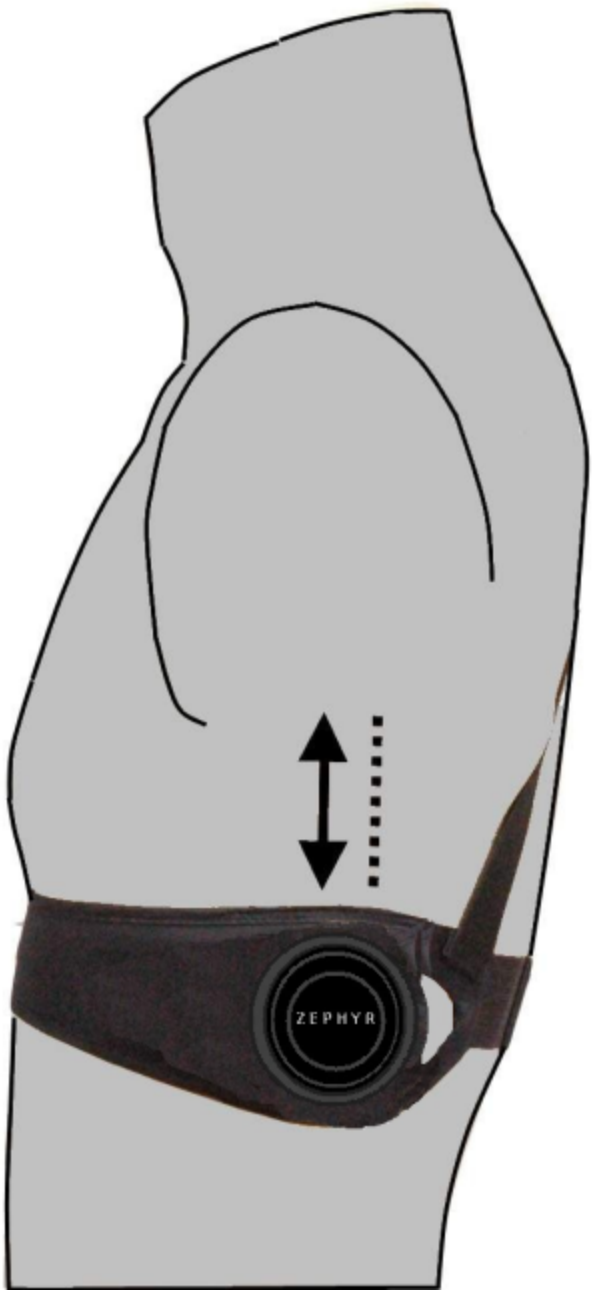
Blood Pressure	BP measured from a supported blood pressure cuff. Bluetooth Radio Network Type only
OmniSense Live	Subject BioGauge, Sensors side tab
OmniSense Analysis	Time graphs
Log Data	Not logged in BioModule
Units	mmHg
Range	20 -280
Reporting Frequency	Default 5 minutes. Set in Live Preferences
Notes	• Sensor must be added by Bluetooth to the system • Pressure readings are relayed direct to the host PC by Bluetooth • The Sensors side tab will only display when Radio Network type is set to Bluetooth (not ECHO)

7.8 Bound Count

Bound Count	Cumulative count of detected bounds
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, Pro Impact Report
Log Data	Enhanced log formats
Units	Count
Range	0 - 1023
Reporting Frequency	1Hz
Notes	• distinct from a step or a jump by the time in air between adjacent steps. • available from OmniSense 4.0 and later • reset when the BioModule is power cycled

7.9 Breathing Rate

Breathing Rate	Also respiration rate
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, reports
Log Data	All log formats
Units	Breaths per minute
Range	4 - 70
Reporting Frequency	1Hz
Notes	• breathing is detected by a pressure sensor in the strap which detects torso expansion and contraction due to breathing.  • Several breaths cycles are necessary for initial breathing rate to stabilize (15 - 45 seconds) • spontaneous adjustment of strap tension or location, or abrupt changes in posture, talking, coughing etc may cause changes in the range of pressure detected by the strap which produce temporary artefacts (peaks or troughs) in breathing rate indication which should be anticipated and potentially ignored when analyzing data • BioHarness side strap rear showing location of the breathing pressure sensor • The strap should be located with the BioHarness device located under or slightly to the rear of the left armpit • This places the pressure sensor at the apex of rib curvature on the torso, allowing for optimal pressure variation as the subject breathes.

	 • Regular manual palpitation of the breathing sensor can be used to check whether a sensor is functioning correctly. Use gentle pressure to simulate breathing cycles

7.10 Breathing B-B

Breathing BB	Detected breath to breath intervals

OmniSense Live	No
OmniSense Analysis	No
Log Data	Waveform and Development logs only
Units	Milliseconds
Range	
Reporting Frequency	Per breath detection event
Notes	• unfiltered breathing detections as interpreted by the breathing algorithm • false or missed detections, caused by movement, talking or movement of the strap will register in this data

7.11 Breathing Rate at Anaerobic Threshold

Breathing Rate at Anearobic Threshold (AT)	This is a fixed, saved value for any given subject
OmniSense Live	Saved in database, listed in Subject Details
OmniSense Analysis	Reports
Log Data	No
Units	Breaths per minute
Range	
Reporting Frequency	N/A
Notes	• Value can be manually entered in subject details screen • Value can be saved as a result of analysis of data from a Fitness Test

7.12 Calories Burned

Calories Burned	Cumulative estimation of calories burned during a session
OmniSense Live	Subject BioGauge
OmniSense Analysis	Summary Graphs, Reports
Log Data	No
Units	Calories
Range	
Reporting Frequency	1 Hz
Notes	• A heart rate based calculation $Calories = \sum_{e=1}^{n} Cal_e$ where Cal_e = Gender * (-55.0969 + (0.6309 * HR) + (0.1988 * wt) + (0.2017 * age)) + (1 - Gender) * (-20.4022 + (0.4472 * HR) - (0.1263 * wt) + (0.074 * age)) HR = average HR for epoch (1 second) wt = subject weight in Kg age = subject age in years Gender = 1 for male, 0 for female

7.13 Distance Travelled

Distance Traveled	GPS distance traveled since start of session
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, Reports
Log Data	Waveform or Development formats only
Units	Miles or Kilometers, configured in Preferences
Range	0 -
Reporting Frequency	1 Hz
Notes	• Data gathered by a supported GPS device, and relayed to BioModule • BioModule must be configured to log in standard or Enhanced Summary and Waveform or Summary and Development format using Zephyr Config Tool

7.14 Date of Birth

Subject Date of Birth	Birth year only
OmniSense Live	Subject details
OmniSense Analysis	No
Log Data	N/A
Units	Year
Range	0 -
Reporting Frequency	N/A
Notes	• Manually entered in subject details screen • Default for a new subject is 1980 • Used to automatically calculate HR_{max} for subject, until this is manually edited, or updated as a result of analysis of data from a Fitness Test • Used in formula to calculate Calories Burned

7.15 Elevation

Elevation	GPS elevation
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, Reports
Log Data	Waveform or Development formats only
Units	Feet or meters, configured in Preferences
Range	0 -
Reporting Frequency	1 Hz
Notes	• Data gathered by a supported GPS device, and relayed to BioModule • BioModule must be configured to log in standard or Enhanced Summary and Waveform or Summary and Development format using Zephyr Config Tool

7.16 Estimated Core Temperature

Estimated Core Temperature	Subject Core Temperature (estimation)

OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, Reports
Log Data	Summary or Enhanced Summary formats
Units	Degrees Fahrenheit or Celsius, configured in Preferences
Range	33 - 41 Degrees C
Reporting Frequency	1 Hz
Notes	• A heart rate based calculation • Search for 'Estimation of Human Internal Temperature from Wearable Physiological Sensors' by Buller, Tharion, Hoyt & Jenkins to see a paper describing this work.

7.17 Explosiveness

Explosiveness	Peak g detected during a dash event
OmniSense Live	Subject BioGauge (displayed as 'Dash')
OmniSense Analysis	Time and Summary graphs, Reports
Log Data	N/A
Units	g
Range	~ 6 - 11g
Reporting Frequency	Per dash event
Notes	• Calculated automatically if a Dash Event is detected

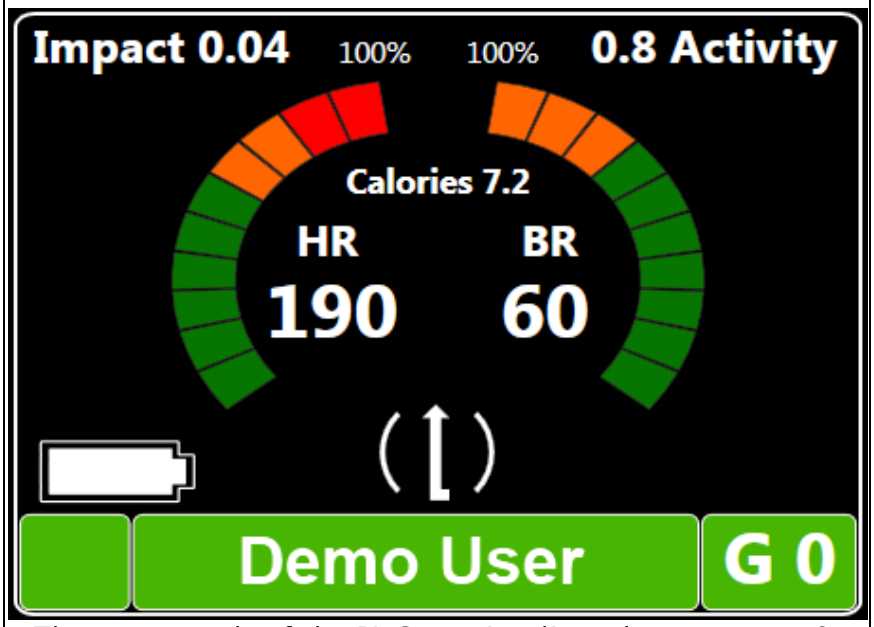
7.18 Fitness Level

Fitness Level	Metric of Fitness
OmniSense Live	Subject details (Default value of 3)
OmniSense Analysis	
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	N/A
Notes	• Zero is equivalent to an unfit subject; 10 is equivalent to an elite athlete • Can be edited manually in subject details

7.19 Gender

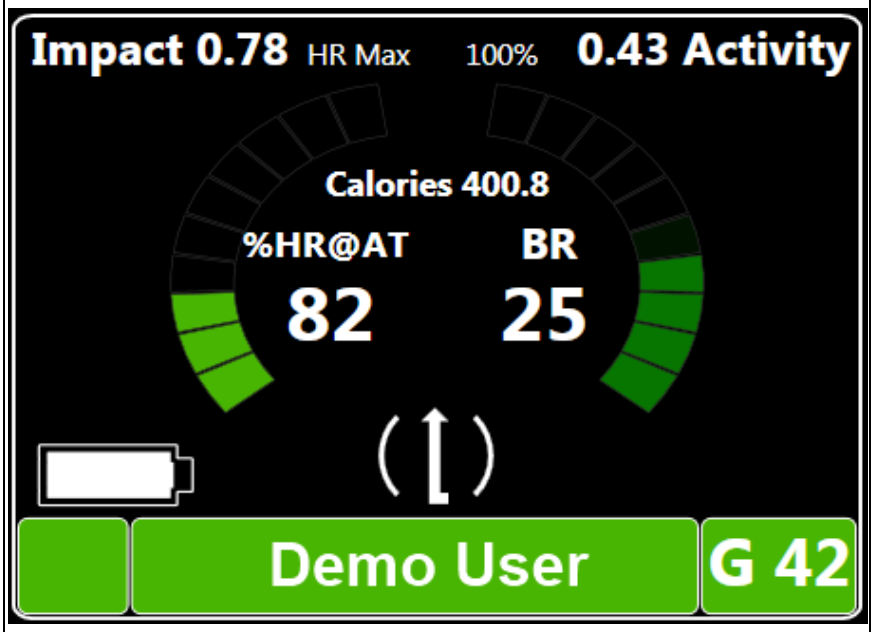
Gender	Subject Gender
OmniSense Live	Subject details
OmniSense Analysis	N/A
Log Data	N/A
Units	Male (M), Female (F)
Range	
Reporting Frequency	N/A
Notes	• Used in the formula to calculate Calories Burned

7.20 Heart Rate

Heart Rate	Heart Rate
OmniSense Live	Subject BioGauge, Details panel
OmniSense Analysis	Time and Summary graphs, reports
Log Data	All formats
Units	Beats per minute
Range	0 - 240
Reporting Frequency	1Hz
Notes	• Heart Rate is determined from analysis of 250Hz ECG data  • The sweep scale of the BioGauge is adjusted to represent 0 - 100% of the subject's maximum heart rate, as saved in the OmniSense database • The sweep scale is divided into 10 increments. Each represents 10% of the subject's HR_{max}.

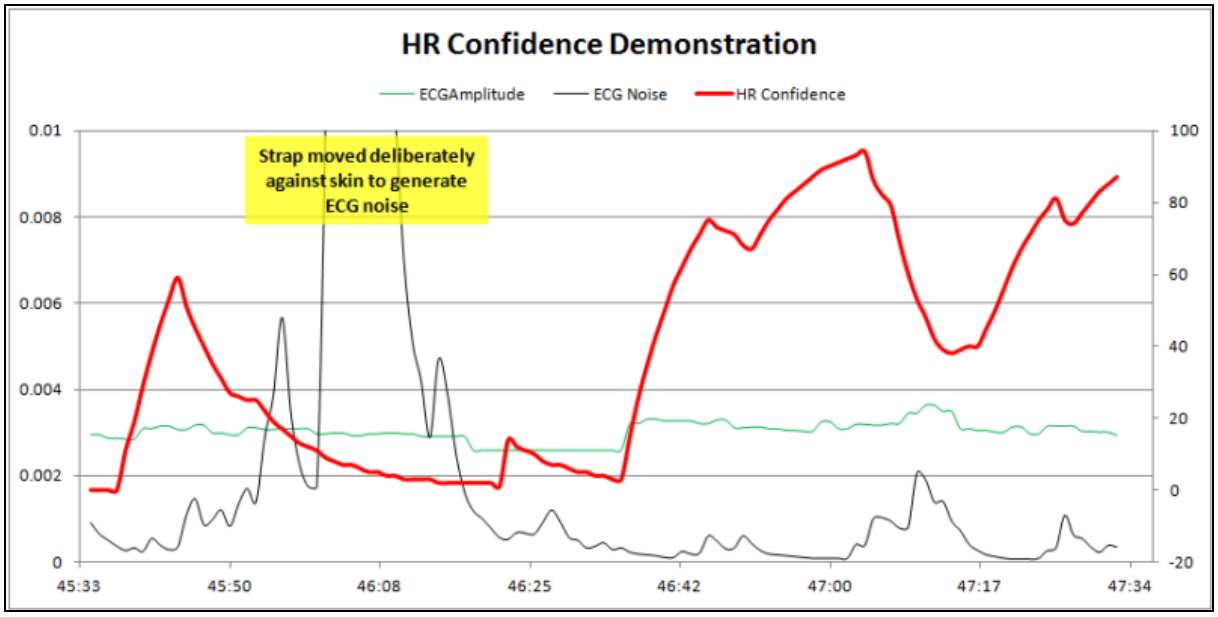
7.21 Heart Rate @ Anaerobic Threshold (AT) %

Heart Rate @ AT %	Heart Rate as percentage point of HR at anaerobic threshold
OmniSense Live	Subject BioGauge, Subject details
OmniSense Analysis	Time & Summary graphs, Reports
Log Data	N/A
Units	Beats per minute
Range	
Reporting Frequency	1Hz
Notes	• HR @ AT is a fixed saved value for each subject, in the

	OmniSense database • Can be entered manually is subject details screen • Can be saved automatically in OmniSense Analysis as a result of analysis of a Fitness Test  • HR@AT is typically 80 - 85% of HRmax, and is used as a reference point in some training strategies. • It is used to configure the Training Zones used in conjunction with workout schedules which can be set using the training and workout tabs in OmniSense Live.

7.22 Heart Rate Confidence

Heart Rate Confidence	A measure of the quality of the ECG signal
OmniSense Live	Details panel
OmniSense Analysis	Time & Summary graphs
Log Data	N/A
Units	%
Range	0 - 100
Reporting Frequency	1Hz
Notes	It is calculated by an algorithm which takes into account: • a wear detection flag (0 or 1 value) enabled by BioHarness firmware - if the garment is removed from the subject, then the impedance detected across the contacts in the device raises above a threshold, and the value is set to 0 and the subject ROG status turns to gray. • ECG signal strength • ECG noise level

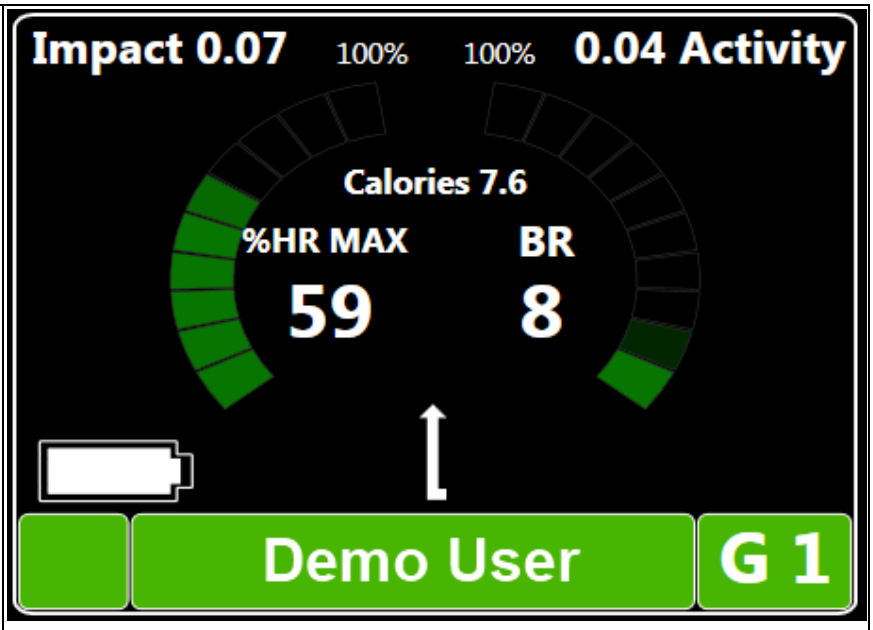


This graph shows a demonstration where a BioHarness strap is worn with dry sensor pads, and the strap moved against the surface of the skin, generating a peak of ECG noise. At this point:

- ECG amplitude is steady
- ECG noise is high
- HR confidence drops to below 50%
- Subject status on the BioGauge is indicated gray

7.23 Heart Rate Maximum (% of)

Heart Rate Maximum	Heart Rate displayed as a % of subject's maximum heart rate
OmniSense Live	Subject BioGauge, Details panel
OmniSense Analysis	Time and Summary graphs, reports
Log Data	N/A
Units	%
Range	0 - 100+
Reporting Frequency	1Hz
Notes	• Numeric value displayed on subject BioGauge is now a percentage, *not* beats per minute

	 • Sweep scale showing 59% of subject's maximum heart rate. • Maximum heart rate is stored in the OmniSense database by editing the subject physiological parameters, or as part of analysis of ramped fitness test data using the OmniSense Analysis module. • A value greater than 100 is possible if the stored HR_{max} for a subject is inaccurate.

7.24 Heart Rate Maximum

Heart Rate Maximum	Subject's heart rate maximum, saved in OmniSense database
OmniSense Live	Subject details
OmniSense Analysis	Reports
Log Data	N/A
Units	Beats per minute
Range	0 - 240
Reporting Frequency	N/A
Notes	A fixed value saved in the OmniSense database. • when a new subject is added it is auto-calculated but can be immediately edited • it is updated automatically when fitness test analysis data is saved in OmniSense Analysis • It governs the maximum value of the sweep scale in the subject BioGauge heart rate display • It is used to calculate HR as a percentage of maximum heart rate, when displayed in the subject BioGauge.

7.25 Heart Rate Resting

Heart Rate Resting	Subject's resting heart rate, saved in OmniSense database
OmniSense Live	Subject details
OmniSense Analysis	Readiness Report
Log Data	N/A
Units	Beats per minute
Range	0 - 240
Reporting Frequency	N/A
Notes	A fixed value saved in the OmniSense database. • when a new subject is added it can be entered manually • It will be calculated automatically in OmniSense Analysis from analysis of data from an Orthostatic Hypotension Test

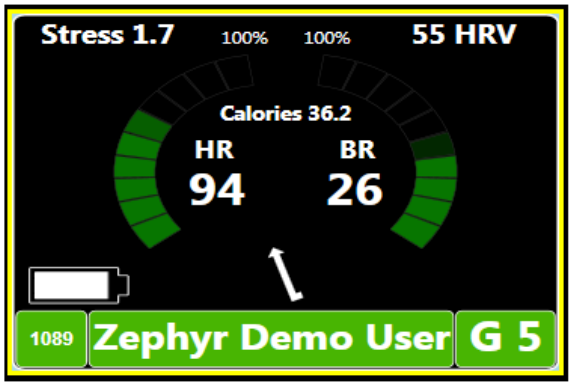
7.26 Heart Rate Standing

Heart Rate Standing	Subject's standing heart rate, saved in OmniSense database
OmniSense Live	Subject details
OmniSense Analysis	Readiness Report
Log Data	N/A
Units	Beats per minute
Range	0 - 240
Reporting Frequency	N/A
Notes	A fixed value saved in the OmniSense database. • when a new subject is added it can be entered manually • It will be calculated automatically in OmniSense Analysis from analysis of data from an Orthostatic Hypotension Test

7.27 Heart Rate Variability

Heart Rate Variability	A measure of the dynamic complexity of the ECG
OmniSense Live	Subject BioGauge
OmniSense Analysis	Reports
Log Data	Summary & Enhanced formats
Units	Milliseconds
Range	
Reporting Frequency	1Hz after first 300 beats (~5 minutes)
Notes	• A rolling 300 beat SDNN value (standard deviation of normal-normal intervals) • No data is displayed for ~ 5 minutes

Heart Rate Variability (HRV) is an SSDN (standard deviation of RR intervals) value calculated over a rolling 300 heart beat interval, and thus no value is displayed until approximately five minutes after device power-on. The displayed value is a standard deviation in milliseconds.



HRV
= 55 milliseconds
(300 beat SDNN)

Updated once per second

SDNN is the most representative parameter of HRV. Sometimes the term 'HRV' in medical papers indicates 'SDNN' among many papers of HRV analysis. Thus low SDNN is low HRV, which primarily indicates a reduction in dynamic complexity.

A healthy individual has a more irregular (higher) and complex HRV signal.

Age (Decade)	Mean SDNN	Notes
10s	55	> 50: High normal, Autonomic Nervous System's regulating function and stress coping ability good
20s	47	35-50: Low-mid normal. The ANS's regulating function and stress coping ability good
30s	41	20-35: Low. There's risk of developing stress induced disease. ANS function is weakened.
40s	37	< 20: Very low. There is a high risk of having chronic stress induced disease related to ANS dysfunction
50s	32	> 40: High normal 20-30: Low-mid normal 15-20: Low < 15: Very low
60s	27	

The clinical meaning of a decrease in SDNN is as follows:

- weakened autonomic nervous system's ability to keep homeostasis against the body's internal (e.g. core temperature) or external environmental changes
- lowered coping ability to various emotional or physical stressors
- general weakness of health

Diseases associated with lowered HRV

- Myocardial infarction
- Angina pectoralis
- Ventricular arrhythmia
- Diabetic autonomic neuropathy
- Brain injury
- Epilepsy
- Guillan-Barre syndrome
- Depression
- Anxiety disorder (Panic disorder)

- Sudden cardiac death
- Coronary artery disease
- Congestive heart failure
- Diabetes mellitus
- Multiple sclerosis
- Fibromyalgia
- Obesity
- Chronic Fatigue syndrome
- Autonomic dysrhythmias
- Stress induced diseases

7.28 Heart Rate Variability (Resting)

Heart Rate Variability Resting	Resting HRV
OmniSense Live	Subject details
OmniSense Analysis	Readiness Report
Log Data	N/A
Units	Milliseconds
Range	
Reporting Frequency	N/A
Notes	• Saved from analysis of an Orthostatic Hypotension Test data in OmniSense Analysis

7.29 Height

Height	Subject Height
OmniSense Live	Subject details
OmniSense Analysis	N/A
Log Data	N/A
Units	Meters or inches
Range	
Reporting Frequency	N/A
Notes	• Entered manually in Subject details. Used in BMI calculations

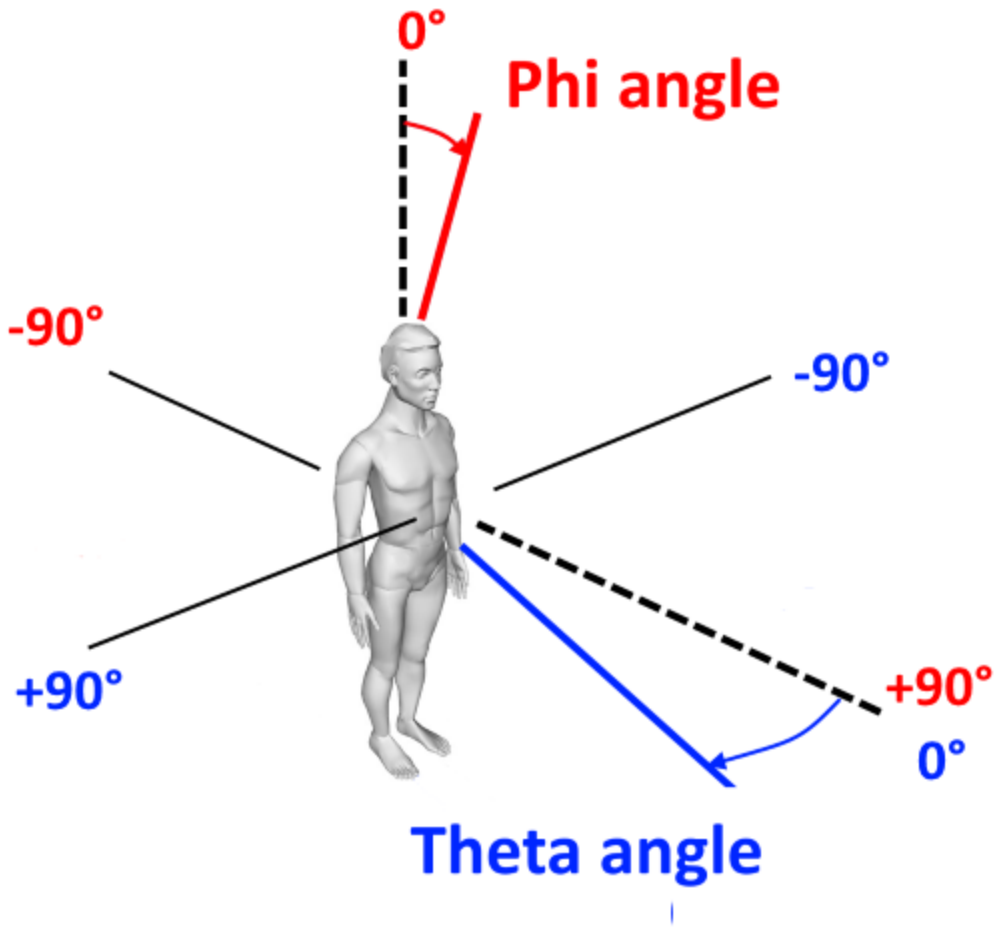
7.30 Impact

Impact	Peak Acceleration in previous reporting period
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	All formats
Units	g
Range	0 - 16
Reporting Frequency	1 - 5 sec, dependent on ECHO setting
Notes	• Peak Acceleration Magnitude in the previous reporting epoch, using SQRT($x^2 + y^2 + z^2$) where x,y & z are the axial acceleration values sampled at 100Hz

7.31 Impact Peak Magnitude Phi & Theta

Impact Peak Magnitude Phi & Theta	Direction of angle of peak impact in the previous epoch

OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	Enhanced Formats
Units	Degrees from vertical (phi), degrees from forward heading (theta)(see diagrams below)
Range	-180 - +180
Reporting Frequency	1 - 5 sec, dependent on ECHO setting
Notes	• direction of impact angle is determined by analysis of the three axial accelerometer streams



7.32 Impulse Load

Impulse Load	Accumulation of all impulses
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	Enhanced Formats
Units	Newtons
Range	0 -
Reporting Frequency	1 Hz

Notes	• the sum of the areas under the accelerometer magnitude curve for all impulses • reset when the BioModule is power cycled

7.33 Intensity and Load

In creating an exercise program it is important to ensure that mechanical load is gradually increased through the season as athletes become conditioned.

A high level repetitious mechanical load with unconditioned athletes can lead to stress fractures, shin splints, joint pain, or other "over use" injuries in short time. However, it is important to get enough mechanical load in your training plan to ensure good musculoskeletal development. The key is in the adaptation.

These parameters are provided to enable the coach to more effectively monitor these early warning signs and create adaptive training plans that optimize performance.

The balance of mechanical to physiological indicators measured for multiple individuals performing the same activity can give an indication of efficiency and even "heart".

A high mechanical combined with a low physiological score relative to the others would indicate an individual is more efficient. Conversely, a high physiological and comparable mechanical output relative to others would indicate that an individual may be less efficient but have more mental stamina to compensate.

These concepts should only be considered under controlled activity circumstances and when individual subject profiles have all been calibrated using the baseline ramped effort fitness testing method.

Physiological Intensity & Load - a measure of a subject's cardiovascular workout

Mechanical Intensity & Load - a measure of a subject's musculoskeletal workout

Training Intensity & Load - the arithmetic average of the above

7.34 Jump

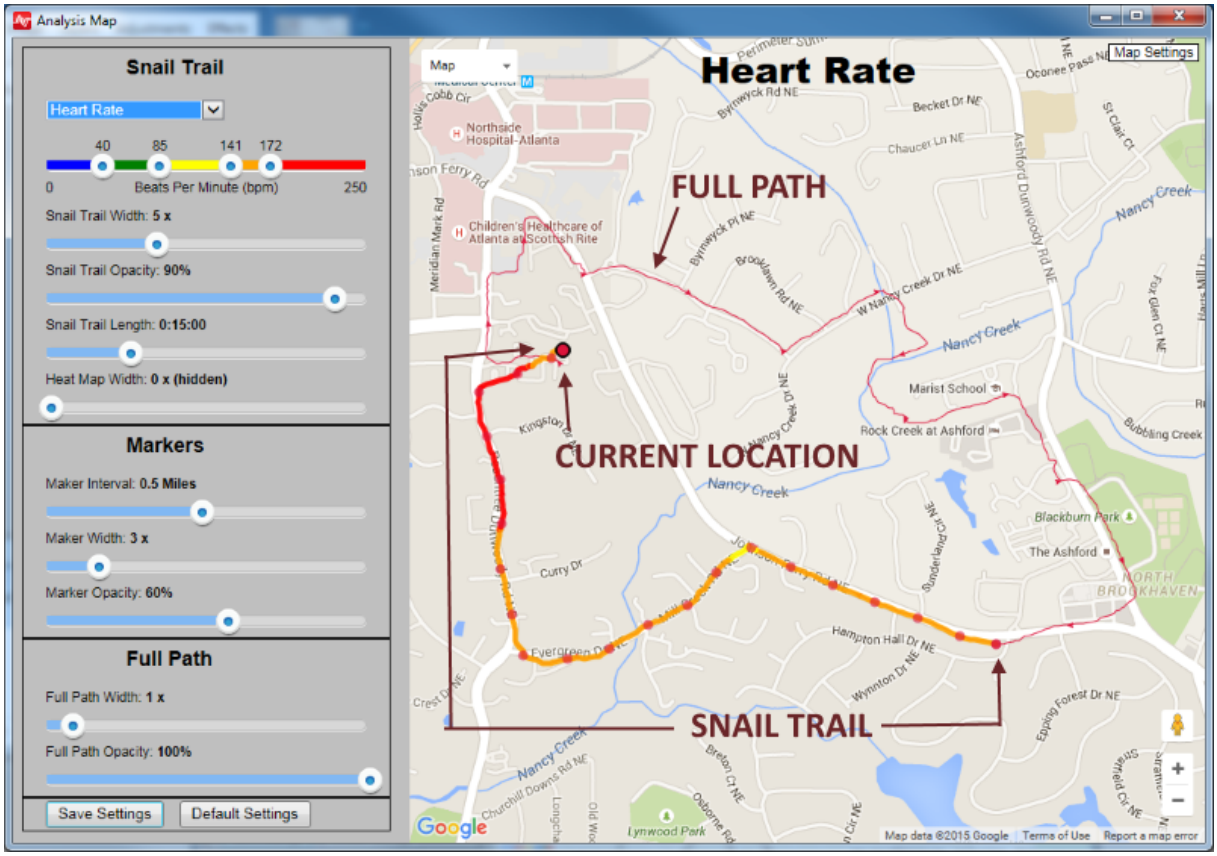
Jump	Peak g during a jump event
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	N/A
Units	g
Range	0 - 16
Reporting Frequency	Per event
Notes	• the peak (upward) g detected during a jump event • jump criteria must be satisfied (crouch, pause, upward acceleration and time in the air)

7.35 Jump Count

Jump Count	Count of detected jump events
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	Enhanced Formats
Units	Count
Range	0 -
Reporting Frequency	1 Hz
Notes	• distinguished from a bound or a step by the time in the air • available from OmniSense 4.0 and later • reset when the BioModule is power cycled

7.36 Location

Location	Geographic location (supported GPS required)
OmniSense Live	Map Side Panel, Map Window (shown below)
OmniSense Analysis	Map Panel/Window
Log Data	Summary and Enhanced formats
Units	Latitude & Longitude
Range	
Reporting Frequency	1 Hz
Notes	• a supported GPS is required



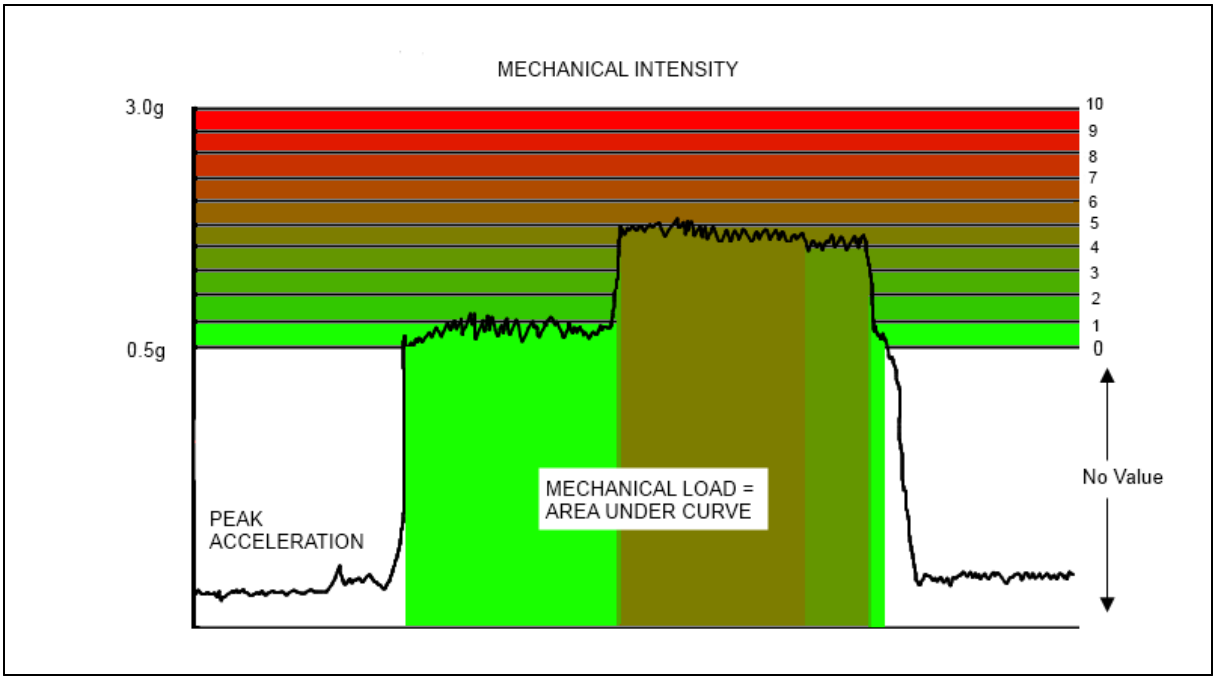
7.37 Major Impact Count

Major Impact Count	Count of Major Impacts
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs, Impact reports
Log Data	Enhanced formats
Units	Cumulative Count
Range	0 -
Reporting Frequency	1 Hz
Notes	• Major impact has peak accelerometer magnitude during the event greater than 7g • detected angle of impact distinguishes impact from a step

7.38 Mechanical Intensity

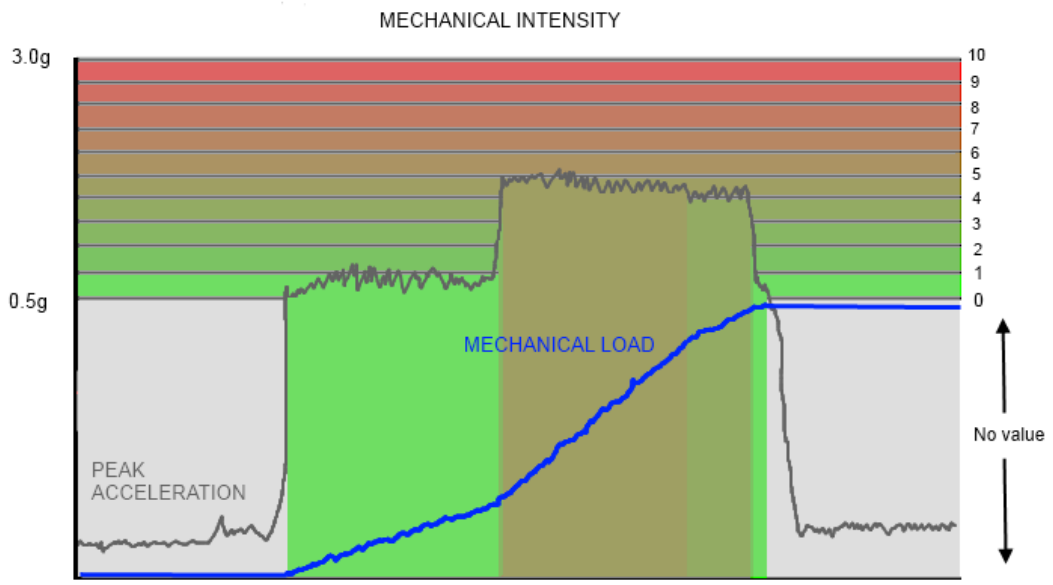
Mechanical Intensity	Index of kinetic output
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• Calculated within OmniSense • Peak Accelerometer Magnitude during epoch determines level of Intensity on 0 - 10 scale • Upper and lower peak g limits for the range are configurable in Live Preferences • An Intensity level of 10 is equivalent to a sprinting level of impact and movement • A subject whose peak acceleration values are less than 0.5g is considered to be resting. Mechanical Intensity = null. A null value will not bias any average intensity calculation if resting periods are included in a session. Walking will soon increase it above the 0.5g level. • Average mechanical intensity (per minute) = Mechanical load/ session duration in minutes

Intensity Level	Description
Null (no value)	Peak acceleration magnitude less than 0.5g (subject effectively resting)
...	Value scaled linearly between 0.5 (= 0) and 3.0g (= 10) e.g. 1.75g = Intensity of 5
10	Peak acceleration magnitude of 3.0g or greater



7.39 Mechanical Load

Mechanical Load	Cumulative index of kinetic output, based on Mechanical Intensity
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• Mechanical Intensity values are accumulated • Mechanical load is a measure of total kinematic output and will give a good indication of an individual's overall level of effort compared to their historic data, or to a group, for a given training session.



The blue line represents mechanical load. It increases only when mechanical intensity > 0 (peak g > 0.5g or configured value)

7.40 Minor Impact Count

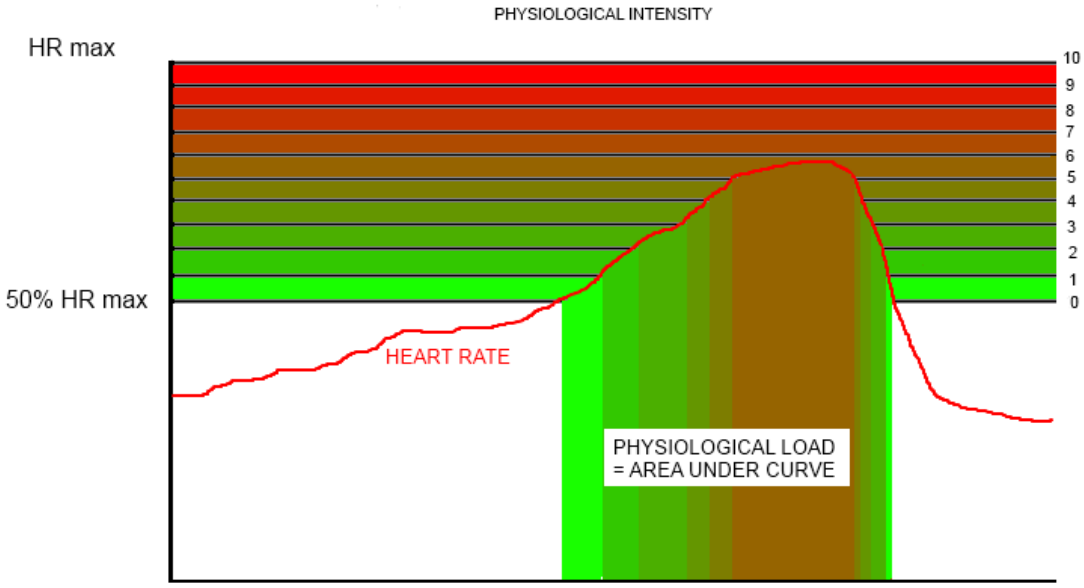
Major Impact Count	Count of Minor Impacts
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs, Impact reports
Log Data	Enhanced formats
Units	Cumulative Count
Range	0 -
Reporting Frequency	1 Hz
Notes	• Minor impact has peak accelerometer magnitude during the event between 3g and 7g • detected angle of impact distinguishes impact from a step

7.41 Physiological Intensity

Mechanical Intensity	Index of cardiac output
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• Calculated within OmniSense • Heart rate as a % of subject's stored HRmax determines Intensity on a 0 - 10 scale • Upper and lower $\%HR_{max}$ limits for the range are configurable in Live Preferences

	• An Intensity level of 10 is equivalent to 100% HR_{max} • A subject whose $\%HR_{max}$ value is less than 50% is considered to be resting. Physiological Intensity = null. A null value will not bias any average intensity calculation if resting periods are included in a session. Walking will soon increase it above the 50% level. • Maximum Heart Rate can be measured using a ramped maximal fitness test • Average physiological intensity (per minute) = Physiological load/session duration in minutes

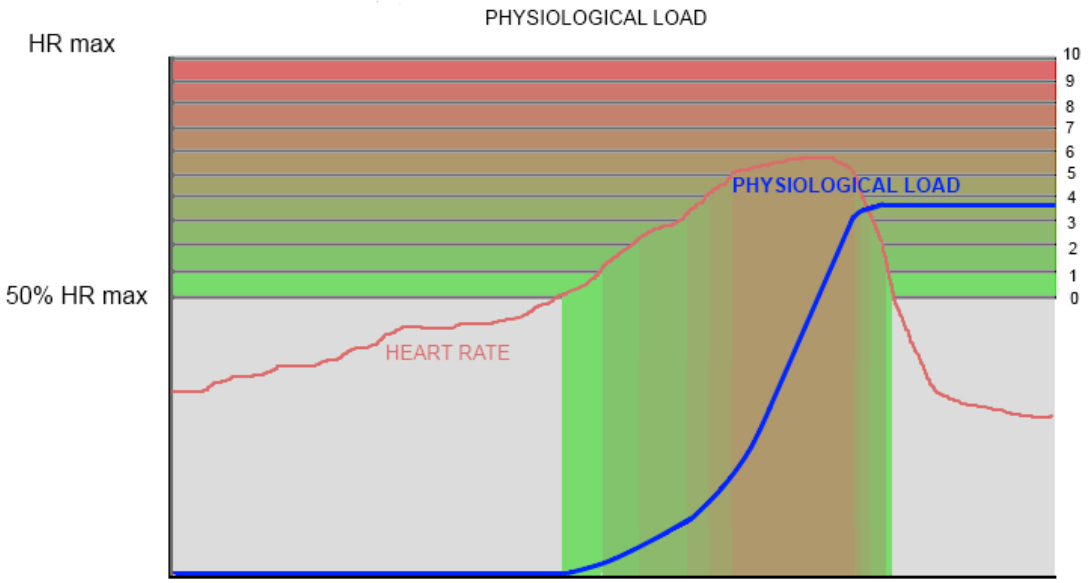
Intensity Level	Description
Null (no value)	Less than 50% of subject's maximum heart rate.
...	Value scaled linearly between 50% (= 0) and 100% (= 10) e.g. 75% HR_{max} = Intensity of 5
10	100% of maximum heart rate or greater



7.42 Physiological Load

Mechanical Load	Cumulative index of cardiac output, based on Physiological Intensity
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10

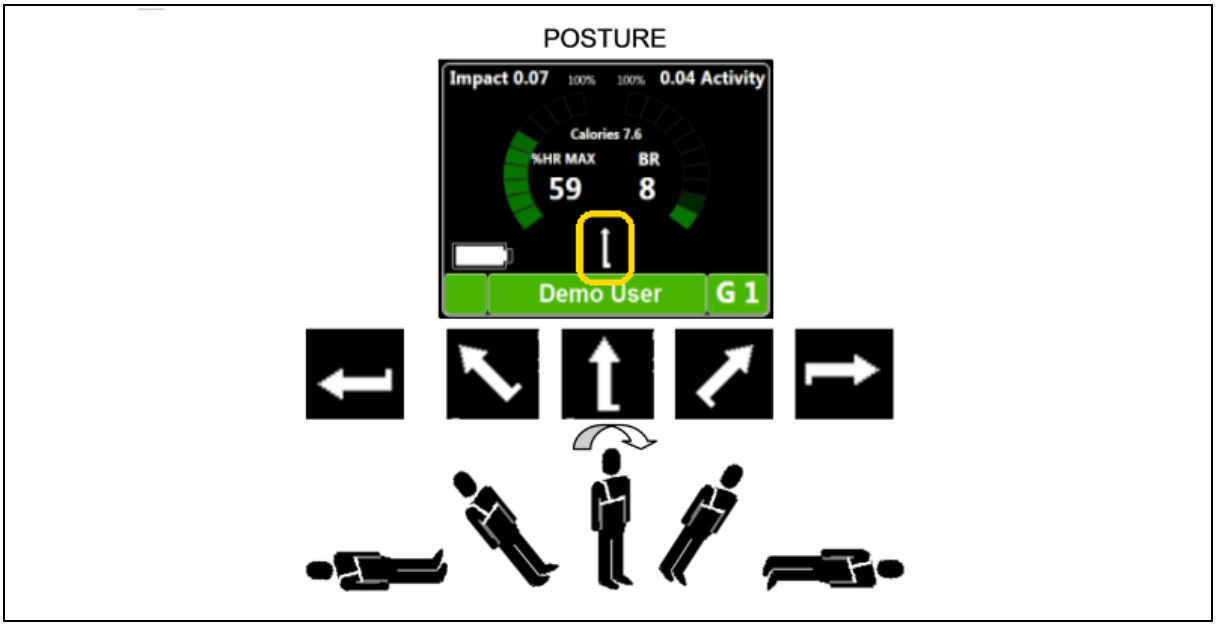
Reporting Frequency	1 Hz
Notes	• Physiological Intensity values are accumulated • Physiological load is a measure of total cardiovascular output and will give a good indication of an individual's overall level of effort compared to their historic data, or to a group, for a given training session.



The blue line represents physiological load. It increases only when physiological intensity > 0 (HR > 50%HR_{max} or configured value)

7.43 Posture

Posture	Orientation of subject
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	All formats
Units	Degrees from vertical
Range	-180 - +180
Reporting Frequency	1 Hz
Notes	• Subject vertical (sitting or standing) = 0 degrees • Subject inverted = ±180 degrees • Lateral (side to side) changes in posture are not detected - only lean forward/lean back. If posture indication is wrong, confirm that the garment type in subject setup is set correctly.



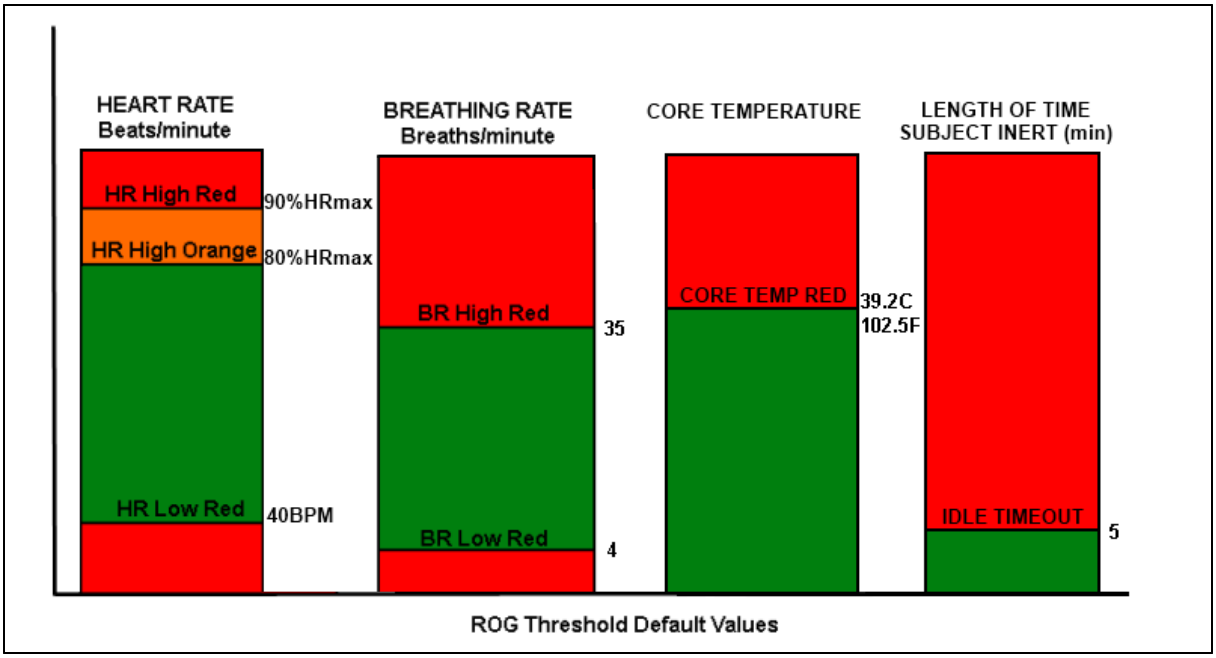
Posture will indicate from supine (subject lying on back) through prone (subject lying face down) to inverted if appropriate.

7.44 ROG Subject Status

ROG Subject Status	Color indication of subject physiological status in BioGauge
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time Graph
Log Data	Summary & Enhanced formats
Units	Red/Orange/Green
Range	N/A
Reporting Frequency	1 Hz
Notes	• The ROG algorithm combines activity level, heart rate and breathing rate, and raises subject status to Orange and then to Red if thresholds, such as those indicated below are crossed. The time in a particular state is also taken into account.

Green = values inside expected limits for activity level
Orange = values have crossed inner threshold, subject should be monitored accordingly
Red = values have crossed outer thresholds, subject should be monitored more closely
Grey = low heart rate confidence, or device not worn
Blue = communications error

The user can configure some heart rate and breathing rate thresholds (defaults shown):



- If either HR or BR move into the zones shown, the status will change accordingly.
- If an operator updates any subject thresholds in the subject setup screen, the new thresholds will be programmed into the subject's BioHarness live, over the air.

7.45 Run Step Count

Run Step Count	Count of detected run steps
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	Enhanced Formats
Units	Count
Range	0 -
Reporting Frequency	1 Hz
Notes	• distinguished from a bound or a walking step by activity level • available from OmniSense 4.0 and later • reset when the BioModule is power cycled

7.46 Saturated Blood Oxygen Level

Saturated Blood Oxygen Level	Percentage saturated blood oxygen (external sensor needed)
OmniSense Live	Sensors side panel, details panel
OmniSense Analysis	Time & Summary graphs
Log Data	None
Units	%
Range	90 - 100
Reporting Frequency	Set in Preferences
Notes	• Supported by Bluetooth Radio Network type only • SpO_2 sensor must be added to system

	• The PC sends a request to the BioModule, which requests data from the SpO_2 sensor. The BioModule receives the data and sends it back to the PC. No data is logged in the BioModule.

7.47 Signal Strength

Signal Strength	Received signal strength from BioModule
OmniSense Live	Subject BioGauge (bar indication)
OmniSense Analysis	Time graphs
Log Data	Summary & Enhanced formats (Bluetooth RSSI)
Units	Bar indication on BioGauge
Range	1-5
Reporting Frequency	1 Hz
Notes	

7.48 Speed

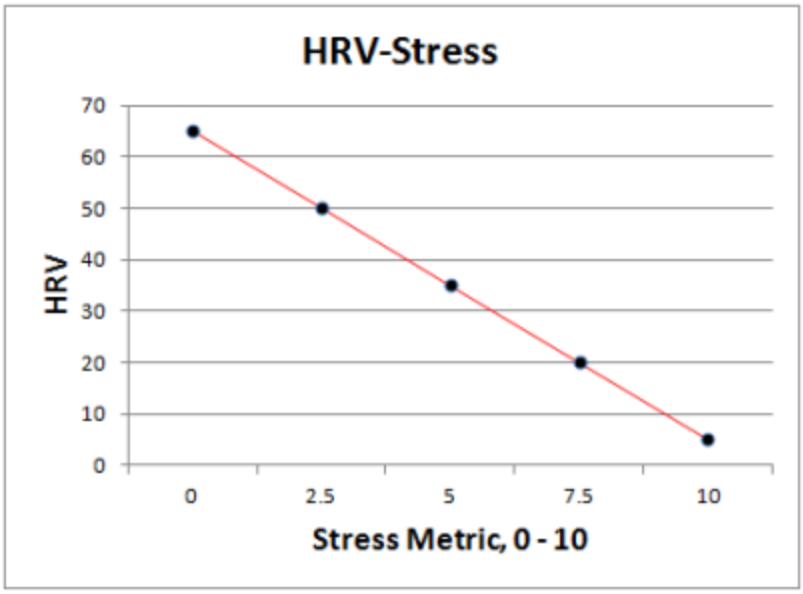
Distance Traveled	GPS speed
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary graphs, Reports
Log Data	Waveform or Development formats only
Units	Miles per hour or Kilometers per hour, configured in Preferences
Range	0 -
Reporting Frequency	1 Hz
Notes	• Data gathered by a supported GPS device, and relayed to BioModule • BioModule must be configured to log in standard or Enhanced Summary and Waveform or Summary and Development format using Zephyr Config Tool

7.49 Stress

Stress	Stress metric
OmniSense Live	Subject BioGauge
OmniSense Analysis	No
Log Data	None
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• Stress is a metric based on Heart Rate Variability

Stress Level	HRV Value	Description
0	> 65	Stress free
2.5	> 50	Low
5	> 35	Moderate
7.5	< 20	High

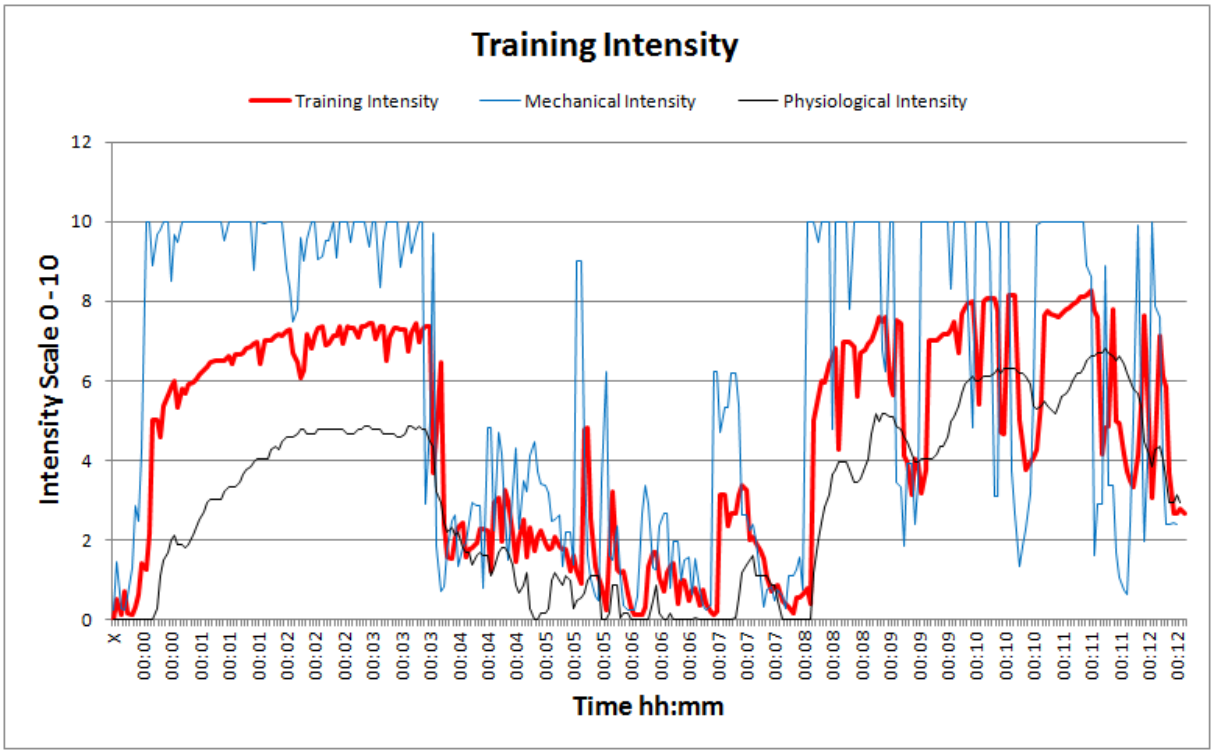
10	< 5	Very High



7.50 Training Intensity

Training Intensity	Index of total (cardiac + mechanical) output
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• The arithmetic average of Mechanical Intensity and Physiological Intensity

The relationship is shown by this export of the 3 intensity metrics for one of the soccer practice sessions from the Analysis module:

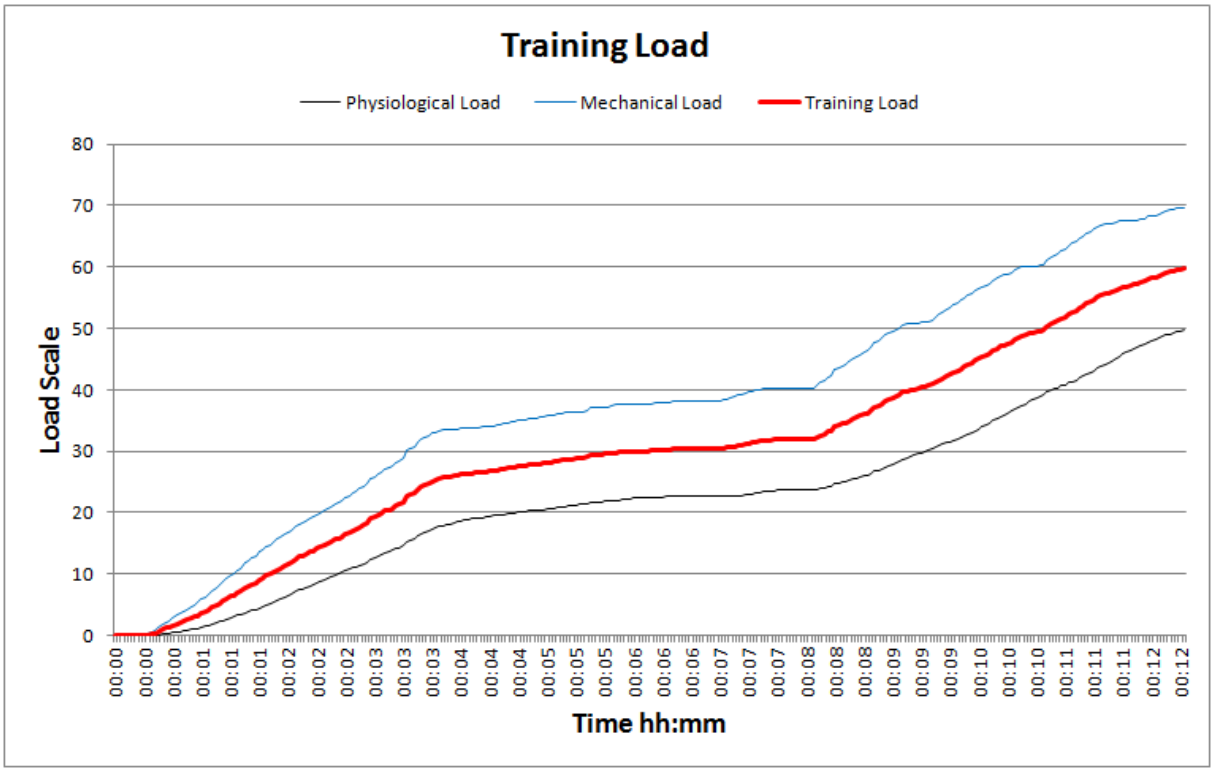


Note that any blue Mechanical Intensity peaks of greater than 3.0g register as the maximum 10 on the Intensity scale - hence the apparent 'clipping'. The maximum Physiological Intensity is 100% HR max. If this is exceeded then HR_{max} should be adjusted accordingly for that subject.

7.51 Training Load

Training Load	
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time and Summary Graphs
Log Data	N/A
Units	None
Range	0 - 10
Reporting Frequency	1 Hz
Notes	• Arithmetic average of Mechanical Load & Physiological Load

Likewise, Training Load is the average of physiological and mechanical loads. For the same session as above:



Care should be taken when interpreting Training Intensity & Load, if the activity involved involves much physiological effort but no mechanical effort which would be detected by the BioHarness, such as weight lifting, or erg workouts. Training Intensity and Load may not reflect the true level of workout involved, since mechanical intensity will be determined as low

7.52 Walk Step Count

Walk Step Count	Count of detected walking steps
OmniSense Live	Subject BioGauge
OmniSense Analysis	Time & Summary graphs
Log Data	Enhanced Formats
Units	Count
Range	0 -
Reporting Frequency	1 Hz
Notes	• distinguished from a bound or a jump by activity level, time in the air • available from OmniSense 4.0 and later • reset when the BioModule is power cycled

7.53 Weight

Weight	Subject Weight
OmniSense Live	Subject details
OmniSense Analysis	N/A

Log Data	N/A
Units	Kilograms or pounds
Range	
Reporting Frequency	N/A
Notes	• Entered manually in Subject details. Used in BMI calculations

Part 8

8 Logging

BioModules are configured to log data by default. Logging can be turned on or off, and the logging format set, by using the Zephyr Config Tool.

There are a number of logging formats. Use the links below to see the parameters contained in each format.

Format	Description
General	Legacy format originated for BioModule 1.0 and 2.0. Still supported in 3.0
General and ECG	250Hz ECG waveform logged in addition to all General log parameters
General and Accelerometer	100Hz Accelerometer magnitude data logged in addition to general log parameters
Summary	General + Additional 1 Hz parameters
Summary and Waveform	Summary + 250Hz ECG, 100 Hz Accelerometer, 25 Hz Breathing waveforms. Separate RR and BB external files
Summary and Development	ECG increased to 1000Hz, Accelerometry reduced to 50Hz
Enhanced Summary	Additional Impact parameters, from OmniSense 4.0 onwards
Enhanced Summary and Waveform	As above for Summary
Enhanced Summary and Development	As above For Summary

- When log data is imported into OmniSense analysis, not all parameters are added to the OmniSense database for view in the Analysis graphs.
- In addition, data can be saved as external csv files by the Zephyr Downloader in OmniSense Analysis.
- Some data (principally waveforms)can *only* be saved as external .csv files and viewed using external 3rd party applications.

The total logging capacity of a BioModule varies according to the log format:

Format	Total Logging Capacity (Hours)	Approximate Download Time per hour of data (Single BioModule)
General	500	
General and ECG	140	
General and Accelerometer	280	
Summary	450	10 sec
Summary and Waveform	60	30 sec
Summary and Development	30	1 min 30 sec
Enhanced Summary	450	12 sec
Enhanced Summary and Waveform	60	45 sec
Enhanced Summary and	30	2 min

Development		

8.1 General

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
General	1 Hz	Heart Rate Breathing Rate Skin Temperature Posture Activity Acceleration Battery BR Amplitude ECG Amplitude ECG Noise X Acc Min X Acc Peak Y Acc Min Y Acc Peak Z Acc Min Z Acc Peak	yyyy_mm_dd-hh_mm_ss_General	Yes
	18 Hz	Breathing Waveform Heart R-R	yyyy_mm_dd-hh_mm_ss_BR_RR	No
	Per Event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No

8.2 General and ECG

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
General and ECG	1 Hz	Heart Rate Breathing Rate Skin Temperature Posture Activity Acceleration Battery BR Amplitude ECG Amplitude ECG Noise X Acc Min X Acc Peak Y Acc Min Y Acc Peak	yyyy_mm_dd-hh_mm_ss_General	Yes

		Z Acc Min Z Acc Peak		
	18 Hz	Breathing Waveform Heart R-R	yyyy_mm_dd-hh_mm_ss_BR_RR	No
	Per Event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd- hh_mm_ss_Event_Data	No
	250 Hz	ECG waveform	yyyy_mm_dd-hh_mm_ss_ECG	No

8.3 General and Accelerometer

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
General and Accelerometer	1 Hz	Heart Rate Breathing Rate Skin Temperature Posture Activity Acceleration Battery BR Amplitude ECG Amplitude ECG Noise X Acc Min X Acc Peak Y Acc Min Y Acc Peak Z Acc Min Z Acc Peak	yyyy_mm_dd-hh_mm_ss_General	Yes
	18 Hz	Breathing Waveform Heart R-R	yyyy_mm_dd-hh_mm_ss_BR_RR	No
	Per Event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd- hh_mm_ss_Event_Data	No
	100 Hz	Acc Magnitude	yyyy_mm_dd- hh_mm_ss_Accelmag	No

8.4 Summary

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary	1 Hz	Heart Rate Breathing Rate Skin Temperature Posture	yyyy_mm_dd- hh_mm_ss_Summary	Yes

		Activity Peak Acceleration Battery Voltage Battery % BR Amplitude BR Noise BR Confidence ECG Amplitude ECG Noise HR Confidence HRV System Confidence GSR Status ROG Time ROG Vert Acc Min Vert Ac peak Lateral Acc Min Lateral Acc Peak Sagittal Acc Min Sagittal Acc Peak Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3		
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session Information	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No

8.5 Summary and Waveform

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary and Waveform	1 Hz	Heart Rate Breathing Rate Skin Temperature	yyyy_mm_dd-hh_mm_ss_Summary	Yes

		Posture Activity Peak Acceleration Battery Voltage Battery % BR Amplitude BR Noise BR Confidence ECG Amplitude ECG Noise HR Confidence HRV System Confidence GSR Status ROG Time ROG Vert Acc Min Vert Ac peak Lateral Acc Min Lateral Acc Peak Sagittal Acc Min Sagittal Acc Peak Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3		
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session Information	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No
	100 Hz	Vertical Accn Lateral Accn Sagittal Accn	yyyy_mm_dd-hh_mm_ss_Accel	No
	25 Hz	Breathing Waveform	yyyy_mm_dd-hh_mm_ss_Breathing	No
	250 Hz	ECG Waveform	yyyy_mm_dd-hh_mm_ss_ECG	No
	1 Hz	Location (Lat/ Long)	yyyy_mm_dd-hh_mm_ss_GPS	Yes (displayed on

		Altitude GPS fix Quality Speed Over Ground Track Angle HDOP	*supported GPS device required	Google Maps in OmniSense 4.0)

8.6 Summary and Development

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary and Development	1 Hz	Heart Rate Breathing Rate Skin Temperature Posture Activity Peak Acceleration Battery Voltage Battery % BR Amplitude BR Noise BR Confidence ECG Amplitude ECG Noise HR Confidence HRV System Confidence GSR Status ROG Time ROG Vert Acc Min Vert Ac peak Lateral Acc Min Lateral Acc Peak Sagittal Acc Min Sagittal Acc Peak Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3	yyyy_mm_dd-hh_mm_ss_Summary	Yes
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No

		Information		
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No
	50 Hz	Vertical Accn Lateral Accn Sagittal Accn	yyyy_mm_dd-hh_mm_ss_Accel	No
	25 Hz	Breathing Waveform	yyyy_mm_dd-hh_mm_ss_Breathing	No
	1000 Hz	ECG Waveform	yyyy_mm_dd-hh_mm_ss_ECG	No

8.7 Enhanced Summary

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary	1 Hz	Heart Rate Breathing Rate Posture Activity Peak Acceleration Battery % BR Amplitude BR Noise ECG Amplitude ECG Noise HR Confidence HRV ROG Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3 Impulse Load Walk Steps Run Steps Bounds Jumps Minor Impacts Major Impacts Average Rate Force Development Average Step Impulse	yyyy_mm_dd-hh_mm_ss_SummaryEnhanced	Yes

		Average Step Period Jump Flight Time Peak g Phi Angle Peak g Theta Angle		
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session Information	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No

8.8 Enhanced Summary and Waveform

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary	1 Hz	Heart Rate Breathing Rate Posture Activity Peak Acceleration Battery % BR Amplitude BR Noise ECG Amplitude ECG Noise HR Confidence HRV ROG Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3 Impulse Load Walk Steps Run Steps Bounds Jumps Minor Impacts	yyyy_mm_dd-hh_mm_ss_SummaryEnhanced	Yes

		Major Impacts Average Rate Force Development Average Step Impulse Average Step Period Jump Flight Time Peak g Phi Angle Peak g Theta Angle		
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session Information	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No
	100 Hz	Vertical Accn Lateral Accn Sagittal Accn	yyyy_mm_dd-hh_mm_ss_Accel	No
	25 Hz	Breathing Waveform	yyyy_mm_dd-hh_mm_ss_Breathing	No
	250 Hz	ECG Waveform	yyyy_mm_dd-hh_mm_ss_ECG	No
	1 Hz	Location (Lat/Long) Altitude GPS fix Quality Speed Over Ground Track Angle HDOP	yyyy_mm_dd-hh_mm_ss_GPS *supported GPS device required	Yes (displayed on Google Maps in OmniSense 4.0)

8.9 Enhanced Summary and Development

Format	Reporting Frequency	Parameter	External csv Filename	Imported Into OmniSense
Summary	1 Hz	Heart Rate Breathing Rate Posture Activity Peak Acceleration Battery % BR Amplitude	yyyy_mm_dd-hh_mm_ss_SummaryEnhanced	Yes

		BR Noise ECG Amplitude ECG Noise HR Confidence HRV ROG Device Temperature Status Info Link Quality RSSI Tx Power Core Temperature Aux ADC1/2/3 Impulse Load Walk Steps Run Steps Bounds Jumps Minor Impacts Major Impacts Average Rate Force - Development Average Step Impulse Average Step Period Jump Flight Time Peak g Phi Angle Peak g Theta Angle		
	Per Event	Heart R-R	yyyy_mm_dd-hh_mm_ss_RR	No
	Per Event	Breathing B-B	yyyy_mm_dd-hh_mm_ss_BB	No
	Per Download	Subject Information Device Information Session Information	yyyy_mm_dd-hh_mm_ss_SessionInfo.txt	No
	Per event	Event Code Event Type Source Event ID Event Specific Data	yyyy_mm_dd-hh_mm_ss_Event_Data	No
	50 Hz	Vertical Accn Lateral Accn Sagittal Accn	yyyy_mm_dd-hh_mm_ss_Accel	No
	25 Hz	Breathing Waveform	yyyy_mm_dd-hh_mm_ss_Breathing	No
	1000 Hz	ECG Waveform	yyyy_mm_dd-hh_mm_ss_ECG	No

Part 9

9 General Information

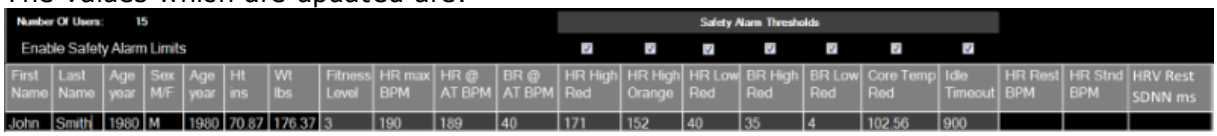
Over-the-Air BioHarness Configuration

9.1 Over-The-Air BioHarness Configuration

For selected Radio Network Types, subject safety thresholds are sent over-air to the device. These are updated in the device if they are updated in OmniSense Live in the Subject Setup screen. Supported Radio Network Types include:

- Bluetooth
- ECHO
- MotorolaXTS
- Defense networks (except MBITR)

The values which are updated are:



- HR High Red
- HR High Orange
- HR Low Red
- BR High Red
- BR Low Red
- Core Temperature Red
- Idle Timeout

If subject safety thresholds are changed manually using the Zephyr Config Tool, these changes will be overwritten the next time the device is connected to OmniSense, if the thresholds saved in the OmniSense database differ from those set manually in the device.

Part 10

10 Readiness

Readiness is a Zephyr metric measured on a scale of 1 to 10.

It is calculated using two sets of data:

From an Orthostatic Test
- Resting Heart Rate
- Standing Heart Rate
- Resting Heart Rate Variability

From Subject Survey scores, self-rated on a scale of 1 to 10
- Recent Training Load
- Recent Training Intensity
- Sleep Quality
- Overall Stress
- Current Stress
- Eating Habits
- Hydration State
- Injury Level

A Zephyr algorithm uses configurable weightings for each score to calculate a subject's Readiness Score, which is saved and dated in the OmniSense database.

The orthostatic test and survey can be carried out at home by using a Zephyr Readiness Android or iPhone application.
The application will email results to a coach or trainer who can use OmniSense Analysis to update the subject's Readiness history.

10.1 Readiness Phone Application

To use the Zephyr Readiness App, you will need:
- an email address to send to a coach or trainer who can update the subject's readiness details using OmniSense Analysis
- a Smart phone (Android or iPhone) with the readiness App, downloaded from Google Play Store or the Apple Store.

Part 11

11 Baseline Fitness Testing

OmniSense can be used to gather fitness testing data using a number of fitness test protocols. Data is gathered by recording from the Live module, or logged within the BioHarness module. For full descriptions of how to conduct tests and analyze data automatically, refer to the *OmniSense Analysis Help*.

In the Analysis module, protocols are described for:

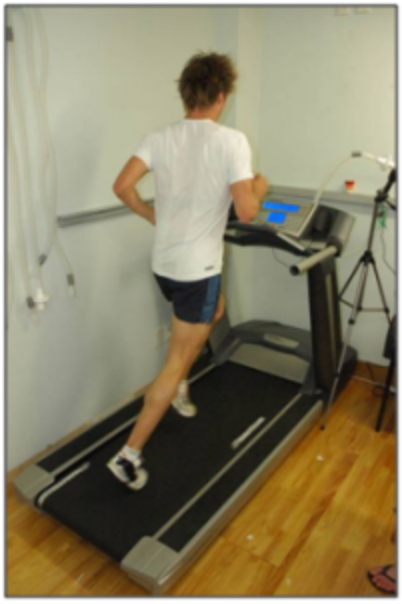
- Treadmill Test
- Beep Test
- Orthostatic Hypotension Test
- Jump Test
- Dash Test

11.1 Treadmill Test

To conduct an AT test using the PSM Training, use a treadmill:

The test should follow an incremental exercise test such as the ACSM ramp protocol, or a modified Conconi test, a treadmill version of which is described as follows:

1. 10 minute warm-up, including stretches..
2. Set the treadmill gradient at 5%.
3. Set the start speed at 6kph (3.7mph).
4. Every 3 minutes, increase the treadmill speed by 2kph (1.25mph)
5. To gain maximum benefit from the test, provide verbal encouragement to the athlete during the test.
6. The test finishes when the athlete can no longer continue.



The subject should reduce to walking or remain stationary for 30 seconds after the test to allow a Heart Rate Recovery measurement to be derived.

If this test is carried out using a PSM Responder system, better data will be captured by using the devices in logging mode, due to the latency of data transmitted over the radio network.

Download logged data directly into OmniSense Analysis.

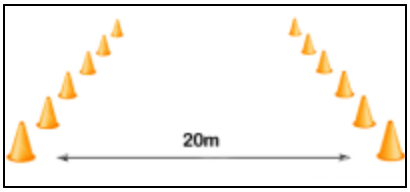
Note: it is important that the above speed and timing criteria are observed, as the automatic VO_2max calculation is determined by the speed at which the

subject stops running – specifically the duration they have been running for.

If different speed, gradient and timing criteria are used, the VO_2max calculation will be less accurate.

11.2 Beep Test

1. Place marks or cones 20 meters apart



2. Subjects should warm up and stretch for 10 minutes.
3. When ready, with all equipment operational, and OmniSense recording, start the audio recording to initiate the test. A sample of this recording can be found at: https://app.box.com/s/qnpds7wby5dq2g4yh2b5ay674uadpymq

The recording generates audio cues which are equivalent to the following running speeds between the markers:

Cycle Iteration	No. of shuttles at this level	Running Speed (kph)
1	7	8.0
2	8	9.0
3	8	9.5
4	9	10.0
5	9	10.5
6	10	11.0
7	10	11.5
8	11	12.0
9	11	12.5
10	11	13.0

Cycle Iteration	No. of shuttles at this level	Running Speed
11	12	13.5
12	12	14.0
13	13	14.5
14	13	15.0
15	13	15.5
16	14	16.0
17	14	16.5
18	15	17.0
19	15	17.5
20	16	18.0
21	16	18.5

Note: Beep Test protocols vary internationally, with markers being placed 20 yards or 20 meters apart. 20-meter spaced markers represent a 9.3% increase in distance over 20-yard spaced markers. Thus subjects using metric-spaced markers use 9.3% more effort for a given level in the test.

Likewise there are minor differences in the speed criteria for some audio recordings available, as different researchers have fine-tuned the test.

If different distance and timing increment criteria are used, the VO2max value will be less accurate.

11.3 40 Yard Dash Test

This test will populate a peak acceleration value Dg [Dash g-force] 'in the subject's BioGauge in the Live module, as well as record this value into the OmniSense database for access in the Analysis module.

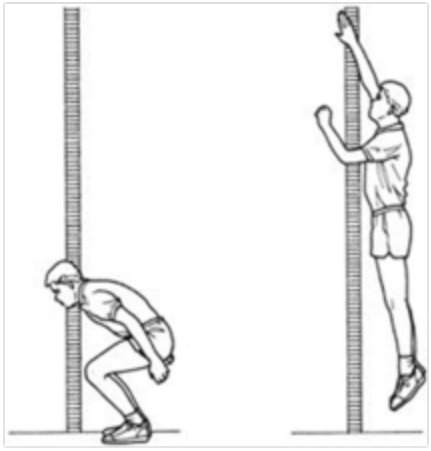
1. The subject must assume the half-crouch as shown above or full sprint crouch, and maintain for a minimum of one second. The posture value indicated when in the crouch position is required for the detection algorithm to initiate.

2. Start when directed and maintain sprint as required.

3. Note that other explosive activities or events which mimic the crouch posture , pause and explosive start may generate peak acceleration values which will populate or update the subject BioGauge Dg value, as well as record 'Dash' events in the database. Such activities should be avoided, or note made of exactly when a deliberate Dash event is attempted. Use the Marker facility in OmniSense Live if preferred.

11.4 Jump Test

This test will populate a peak acceleration value Jg [Jump g-force] 'in the subject's BioGauge in the Live module, as well as record this value and also Jump Height and Jump Time In The Air into the OmniSense database for access in the Analysis module.



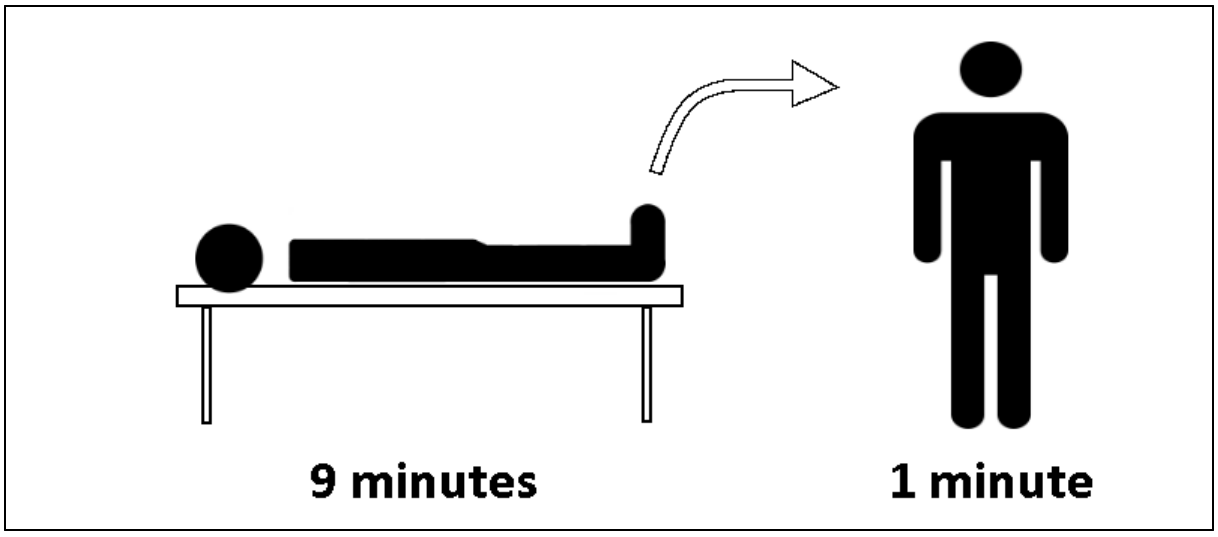
1. The subject should crouch, pause, and spring as high as they can. Note that the jump detection and calculation algorithm has been optimized for vertical jumping. It will also be triggered during a Broad Jump event, but the data for Jump Height and Time in the Air will be less valid.

2. The Jump Test is similar to the Dash Test in detection. Note that other explosive events which mimic the explosive start and vertical acceleration may generate peak vertical acceleration values which populate or update the subject BioGauge, and are also recorded into the OmniSense database. It is recommended that you use Markers when recording the data, to distinguish planned jump events from false detections.

11.5 Orthostatic Hypotension Test

This is a simple test to measure resting and standing heart rate, and resting HRV. These parameters are used in OmniSense Analysis to establish a Readiness estimate for training athletes, when combined with other factors.

For repetition, create a Session Name in OmniSense Live labeled 'Orthostatic Test' or similar, and label the session accordingly. The test can also be carried out using a BioModule in logging mode, and the data imported into Analysis.



1. Pick a quiet location with a comfortable temperature.

2. Lie down on a comfortable surface such as a bed or couch, and remain still and quiet for 9 minutes.
   This will establish your resting heart rate and heart rate variability.

3. Stand up and hold a comfortable standing position for 1 minute.
   This will establish your standing heart rate.

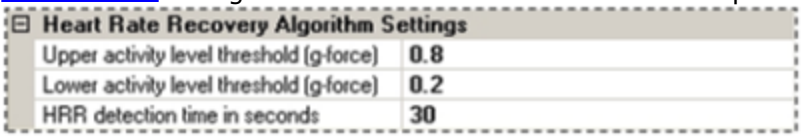
11.6 Heart Rate Recovery

Heart Rate Recovery Events are generated and transmitted by the BioHarness as Events if the following criteria are met.

This calculation is supported for Bluetooth systems only; not for ECHO BioHarness modules.

- Heart Rate 80% of subject's HRmax must be maintained for ~ 5 seconds prior to the recovery phase - if this HR level is not reached, no HRR will be calculated.

- Activity level above the *Upper activity level threshold (g-force)* value set in the User Preferences dialogue must be maintained for the same period.



Heart Rate Recovery Algorithm Settings	
Upper activity level threshold (g-force)	0.8
Lower activity level threshold (g-force)	0.2
HRR detection time in seconds	30

- Activity must then fall below the *Lower activity level threshold (g-force)* for the time interval specified at HRR detection time in seconds.

  Note that transient spikes in activity during this period are smoothed out, but if the subject moves too much while the HRR recovery period is elapsing, then the activity detector may be reset, and no HRR value calculated or displayed.

  HRR values can be displayed in the Analysis module of OmniSense

In previous versions of OmniSense, HRR was displayed in the subject BioGauge. This feature has been dropped.

Part 12

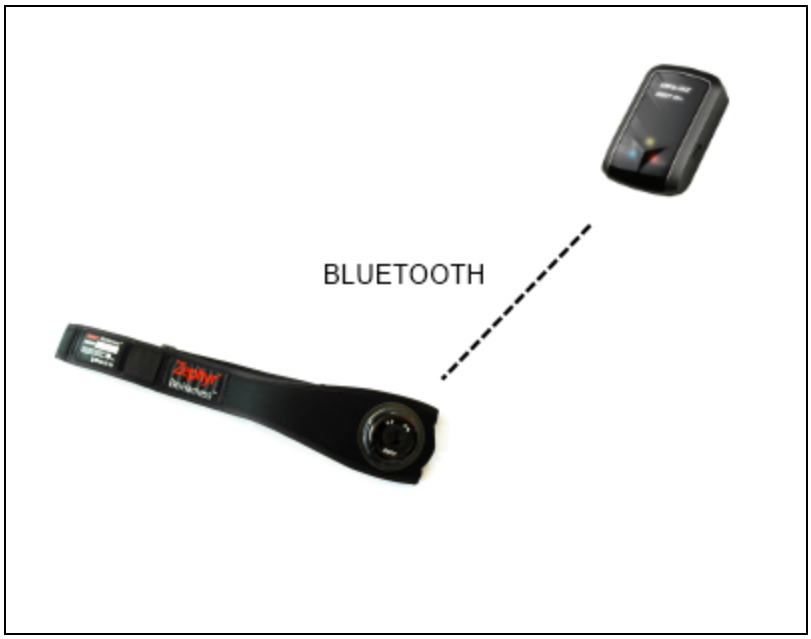
12 GPS Support

The BioHarness module supports communications with supported Bluetooth GPS devices. The BioHarness logs location, speed and distance data internally at 1 Hz. The BioHarness must be manually configured with the MAC address of its associated GPS device using the Zephyr Cfg Tool, or automatically when rapid deployment by barcode scanner is used. It must also be configured to Log the Summary Log Format

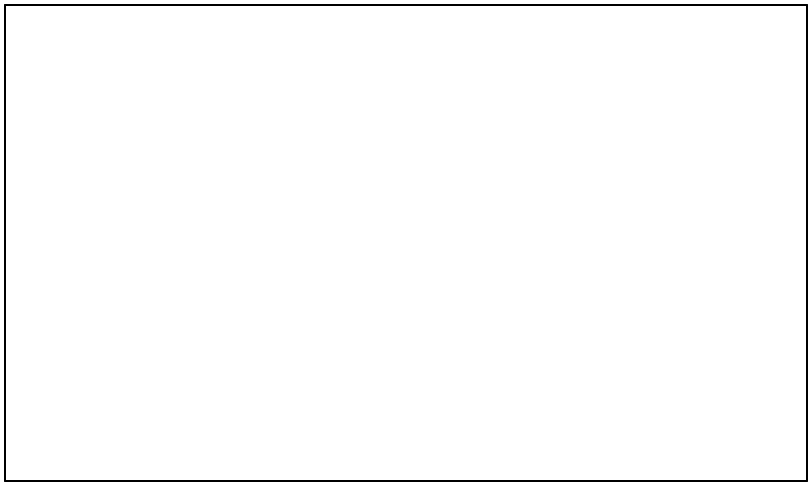
This data can be downloaded into the OmniSense database using the Zephyr Download tool accessed from the Analysis module toolbar.

The tool can also generate external .kml files.

From OmniSense 3.9 onwards, GPS devices can be added to the system using the Add Hardware Wizard, for eventual rapid deployment using a barcode scanner.



Live Operation - GPS communicates to BioHarness, which logs location data internally.



Download logged data via Analysis module

12.1 Supported GPS Devices

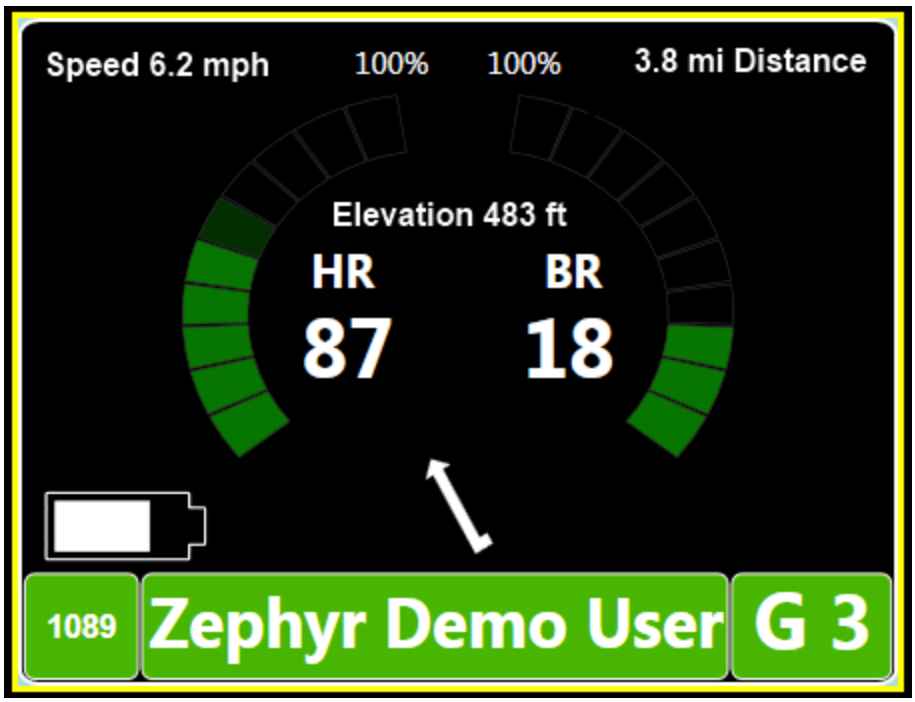
These are the currently supported GPS devices:

QSTARZ 818XT

QSTARZ 1300ST

12.2 BioGauge GPS Data

The subject BioGauge can be configured to display GPS data

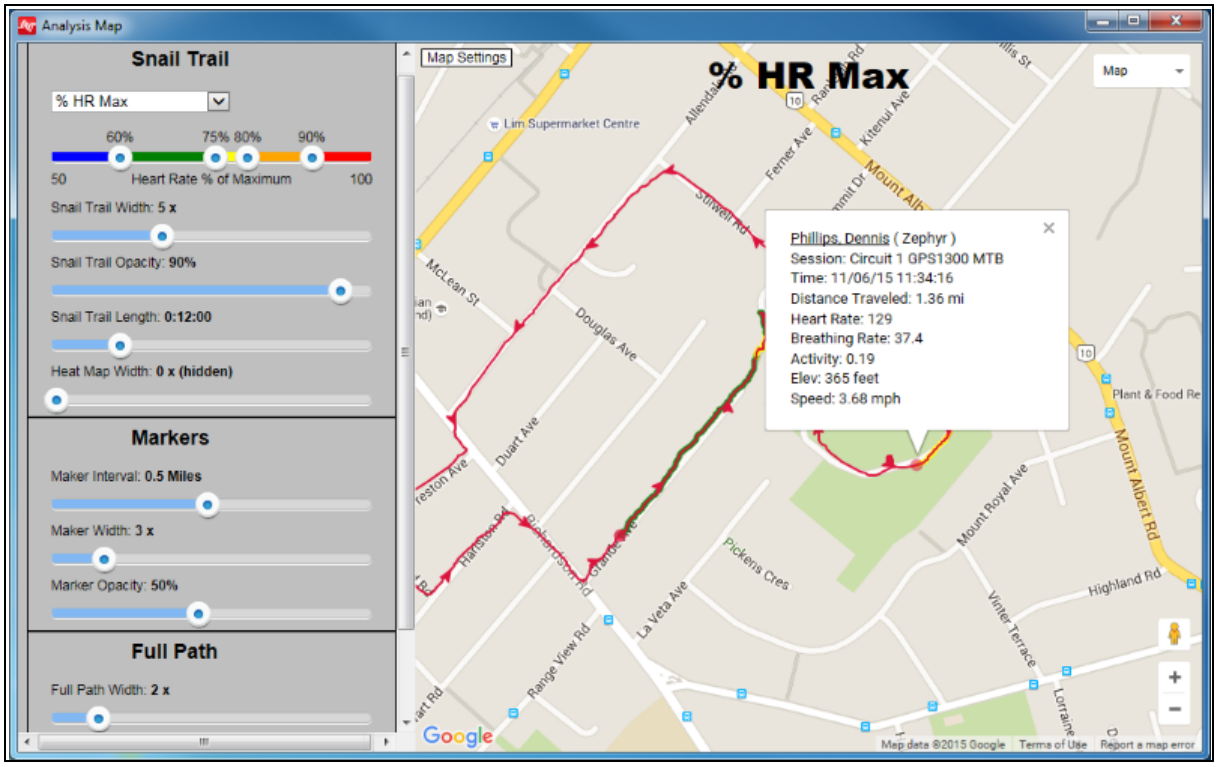


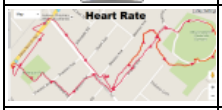
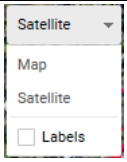
Note that GPS data is only displayed on the BioGauge for

- PSM Responder systems using Motorola XTS digital radios
- Some PSM Defense radio network variants
- PSM Training ECHO.

12.3 Map Window

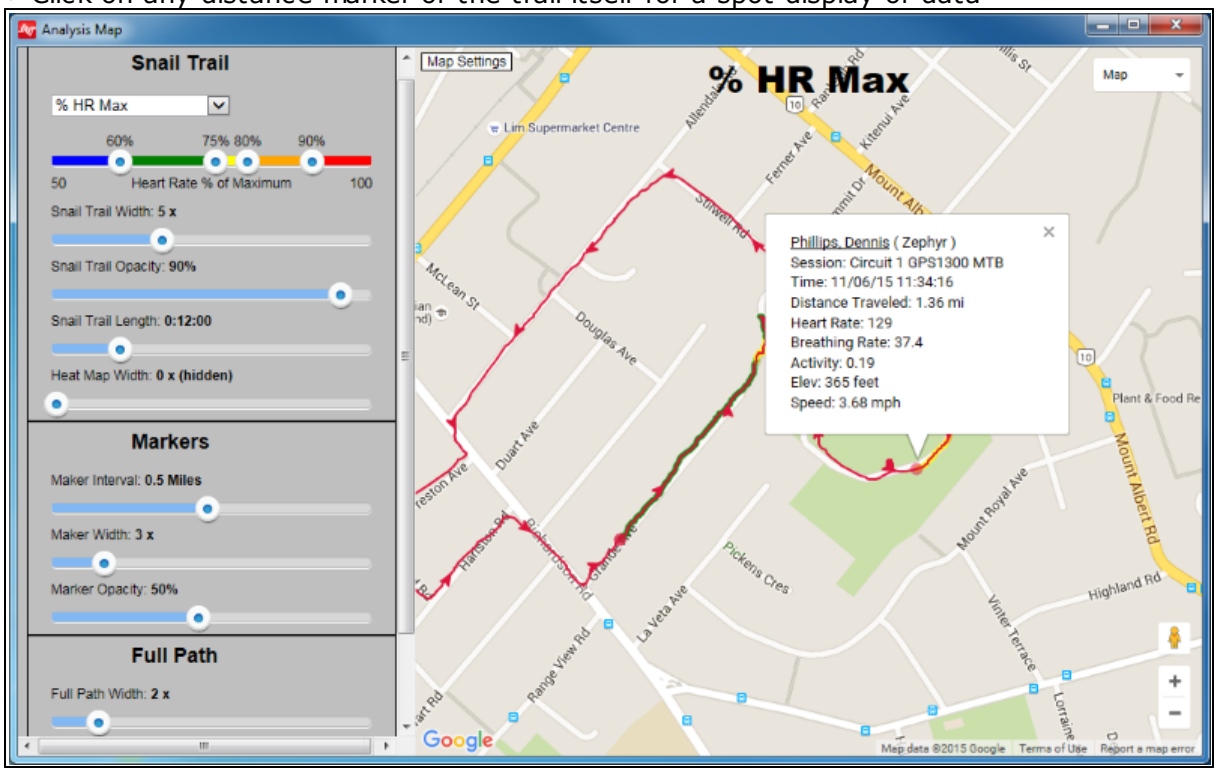
The Toolbar map button  will display an external popup window showing the location of all BioModules, with a configurable snail trail display for each.

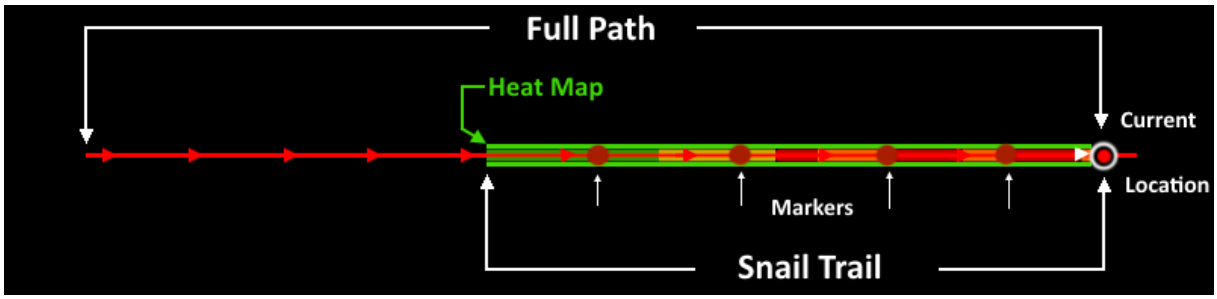


	The toolbar button toggles map display between an embedded panel, an external window, and hidden
	A map will display and scale automatically if the session contains valid GPS data
	Use the pulldown on the map  to switch between map and satellite view
Map Settings	Use the Map Settings button to show or hide the Snail Trail Panel
	Left-click and drag the map with the mouse cursor to reposition as needed
	Use the + / - button to zoom the map as needed
	Current location
	Full path - the full session path and direction travelled

12.3.1 Snail Trail

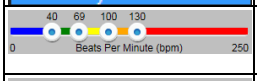
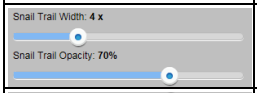
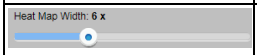
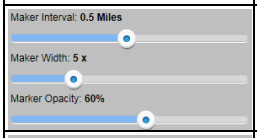
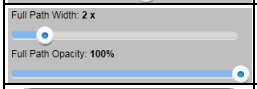
- The snail trail shows the immediate data history of a subject on the map or satellite view
- One of eight parameters can be color-indicated on the trail behind the current (vertical graph cursor) location on the map
- Click on any distance marker of the trail itself for a spot display of data





Snail against a black background for clarity

- Distance markers show on snail trail only
- Snail trail coloring changes according to thresholds set on Settings panel
- Snail trail length is set in settings, and show most recent selected data values for subject
- The heat map is an additional background to the snail trail. It changes from green (shown) to red as a subject reutrns to or stays in the same location. E.g. if the subject is stationary, their heat map will change to red if their location remains constant, or returns repeatedly to the same spot.

	The toolbar button will display a Google Map/Satellite view in an external window with snail trails for all live subjects (internet connection necessary)
Map Settings	Use the Map Settings button to show or hide the snail trail settings panel.
Heart Rate % HR Max % HR@AT Physiological Intensity Mechanical Intensity Speed Zones Altitude Zones ROG Safety Path Only	Parameter available for display on the snail trail.
	Adjust thresholds for the chosen parameter to color snail trail according to parameter values.
	Snail trail width & opacity - adjust to suit required visibility of snail trail. Width at leftmost = snail trail hidden.
	Set snail trail duration - the time history of data prior to the current location.
	The 'heat map' indicates persistence in a location. It is an additional background color surrounding the snail trail which changes from green to red as a location becomes more persistent.
	Display distance markers - configure distance separation, width and opacity to suit.
	Full path width & opacity - adjust to suit required visibility. Width at leftmost = full path hidden.
Save Settings	Save the current map settings. They will be used each time a map is displayed.
Default Settings	Revert to default map settings.

12.4 GPS Accuracy

GPS accuracy is subject to a number of factors:

- Position of the GPS receiver on the subject, if the subject's body blocks part of the sky view
- Number of satellites acquired by the receiver (this depends on location and time - it will vary at different times)
- How high above the horizon the acquired satellites are
- The presence of any blocking factors, such as tree cover, tall buildings etc
- Likelihood of signal reflection to the receiver, from building or other surfaces
- Atmospheric interference

The QStarz 818XT & 1300ST support Differential GPS (DGPS), an auxiliary transmitting system which uses signals from earth-based transmitters at known locations, to validate and correct satellite GPS data. DGPS offers greatly improved location data over conventional GPS.

BioHarness 3 modules send a message to turn on DGPS in the QStarz automatically when a

Bluetooth connection is established between the BioModule and the GPS.

13 Pebble Watch Support

Zephyr can now supply a Pebble watch with a Zephyr Application preloaded. Latest (_3G) versions of the BioModule, which support Bluetooth® Low Energy, can communicate directly with the watch to display vitals signs and training zones.

The application has three fields on screen, which can be customized from:

- Heart Rate
- Respiration Rate
- Training Zones
- Estimated Core Temperature
- Posture
- Activity Level
- Heart Rate Variability (after 300 beats)
- Stress (1 - 10)

Contact sales@zephyranywhere.com for more information

Note: The Pebble is shipped with customized Zephyr firmware containing the application. Care must be taken not to connect the Pebble with any mobile device which has the capacity to trigger an automatic Pebble proprietary firmware update. This will over-write the Zephyr firmware, and require the Pebble to be returned to Zephyr for reprogramming.

Part 14

14 Software Utilities

When OmniSense is installed, a number of software utilities are also installed. You can use these to:

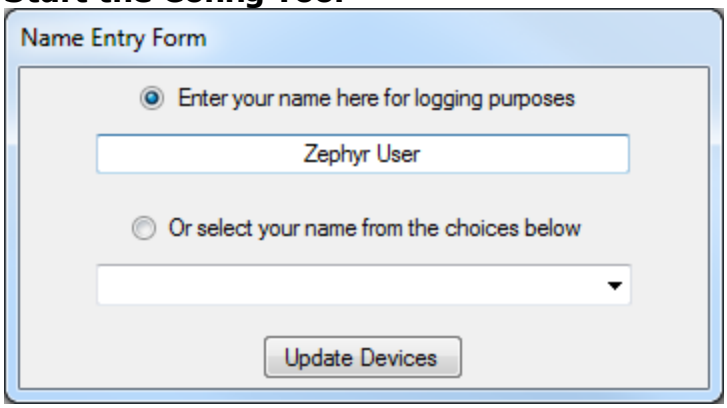
- Configure a Zephyr Bluetooth or ECHO BioHarness
- Download Logs from a Bluetooth BioHarness, and generate external files
- Download Logs from multiple Bluetooth BioHarness modules, and generate external files
- Upgrade device firmware

14.1 Zephyr Config Tool

The BioHarness BT versions are fully configurable using the Zephyr Cfg Tool. It is located at ***C:\Program Files (x86)\Zephyr\OmniSense\Tools***. It is installed automatically when OmniSense is installed.
The Config Tool can be used in a number of modes:
- Read and save a single connected device configuration as a template (XML file)
- Configure a connected device manually, or using a saved template file
- Clone a connected device and reprogram additional connected devices

Start the Config Tool
Read Devices
Configuration Templates
Polling Settings
Subject Info - General
Subject Info - Heart Rate Limits
Subject Info - Breathing Limits
Subject Info - Activity Thresholds
Subject Info - Posture Thresholds
User Config Settings
Time Settings
Accelerometer Settings (Garment Type)
ECHO Settings

Start the Config Tool

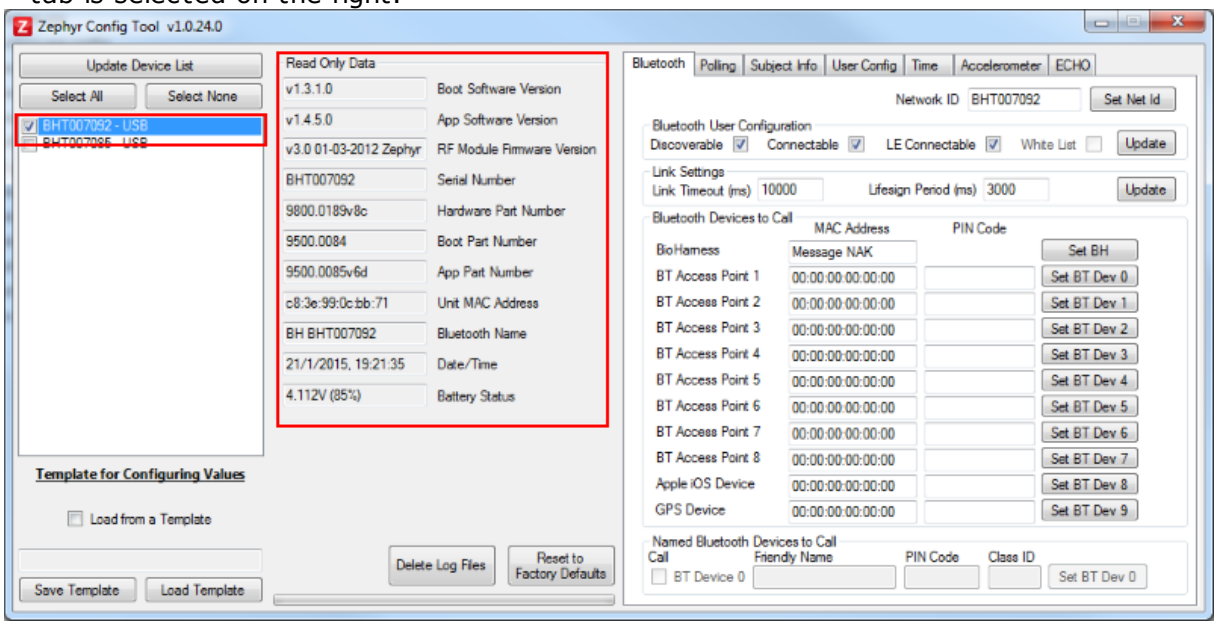


- Connect all BioModules to be reconfigured to the PC using the system case or charging/ configuration cradles. To take advantage of the multi-device capability, all devices should be of the same version, and the same configuration changes will be made to all devices
- Start the utility and enter a user name. This is not a security check - it merely records

a name against and device reconfigurations made, in a log file located at *C:\ProgramData\Zephyr\ZephyrDeviceUpdateLog.csv*
This will let system owners track configuration changes historically
- If a user has previously signed in, they can select their name from the pulldown list
- Click *Update Devices* to open the utility

Read Devices

- When the Config Tool opens, all detected devices will be listed. Select the *Update Device List* button to update the list if any devices are added or removed while the tool is open.
- Use the *Select All* and *Select None* buttons, or individual check boxes, according to the task intended
- The *Read Only Data* panel (circled below in red) will only be populated if a single device is selected, otherwise it will show appropriate values for all devices according to which tab is selected on the right.



Configuration Templates

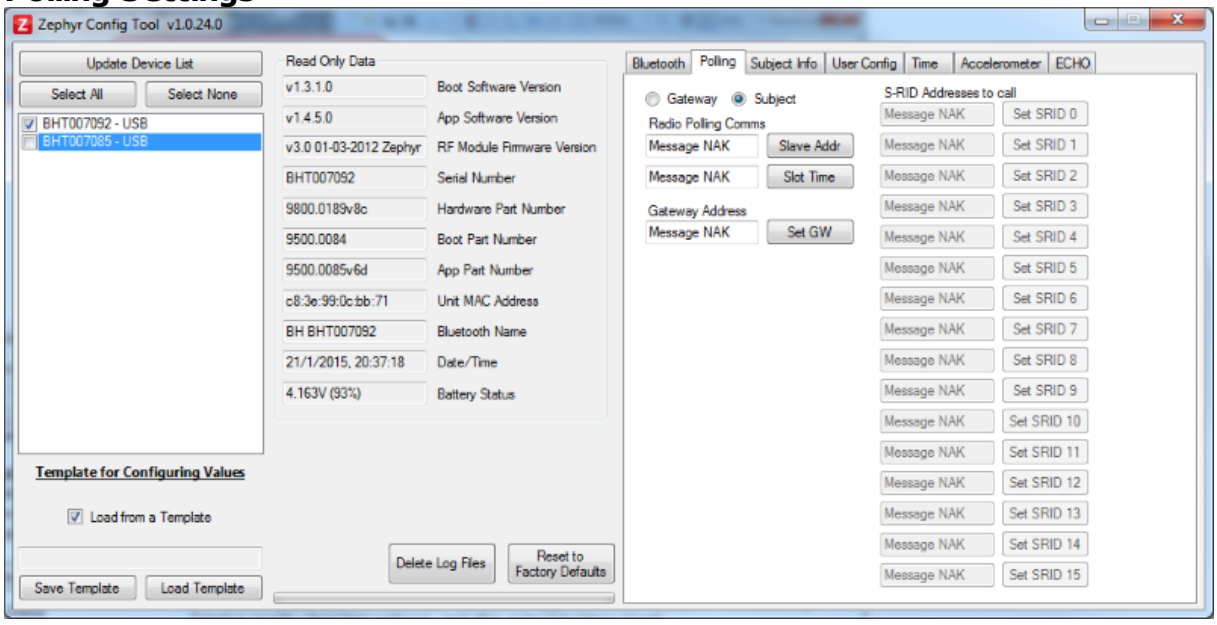
An entire device configuration can be saved as an .XML file, for rapid reconfiguration of devices.

- Single device selected - save the current configuration or load a saved configuration
- Multiple devices selected - save an individual configuration

Device Selection	Use to select device from a list
Read Only Data	All device parameters. Firmware version is '*App Software Version*'. The battery status reads charging voltage, not the actual battery level.
Load from a Template	Check if loading from a saved .XML template file
Delete Log Files	Permanently delete all logs from the device. Old logs are overwritten automatically - use for device sanitizing.
Reset to Factory Defaults	Reset all settings.

Save Template	Save the current template as an external .XML file
Load Template	Load settings from a saved external .XML file
Network ID	The name of the device when scanned for by other Bluetooth devices. Default is serial number. Use Set Net Id button if updating.
Bluetooth Discoverable	Default is checked - the BioModule can be discovered by scanning for BT devices
Connectable	Default is checked - the BioModule will be available for connection to other BT devices
LE Connectable	Valid only for BH3-BLE (Bluetooth Low Energy) - the BioModule will be available for connection to Pebble watch
White List	Not required for OmniSense
Link Timeout	Bluetooth Link setting - default is 30000
Lifesign Period	Bluetooth Link setting - default is 3000
Bluetooth Devices to Call	These fields are populated automatically for some legacy PSM systems which used a Bluetooth Access Point system case.
GPS Device	MAC of supported GPS device. This field was previously used for manual configuration of a GPS to the BioModule, but is not used for devices using OmniSense 3.9 or later, as the configuration is activated over-the-air when using PSM ECHO. Any value in this field will be overwritten with zeros by PSM ECHO if no GPS is assigned alongside the BioModule.
Named Bluetooth Devices to Call	As above

Polling Settings



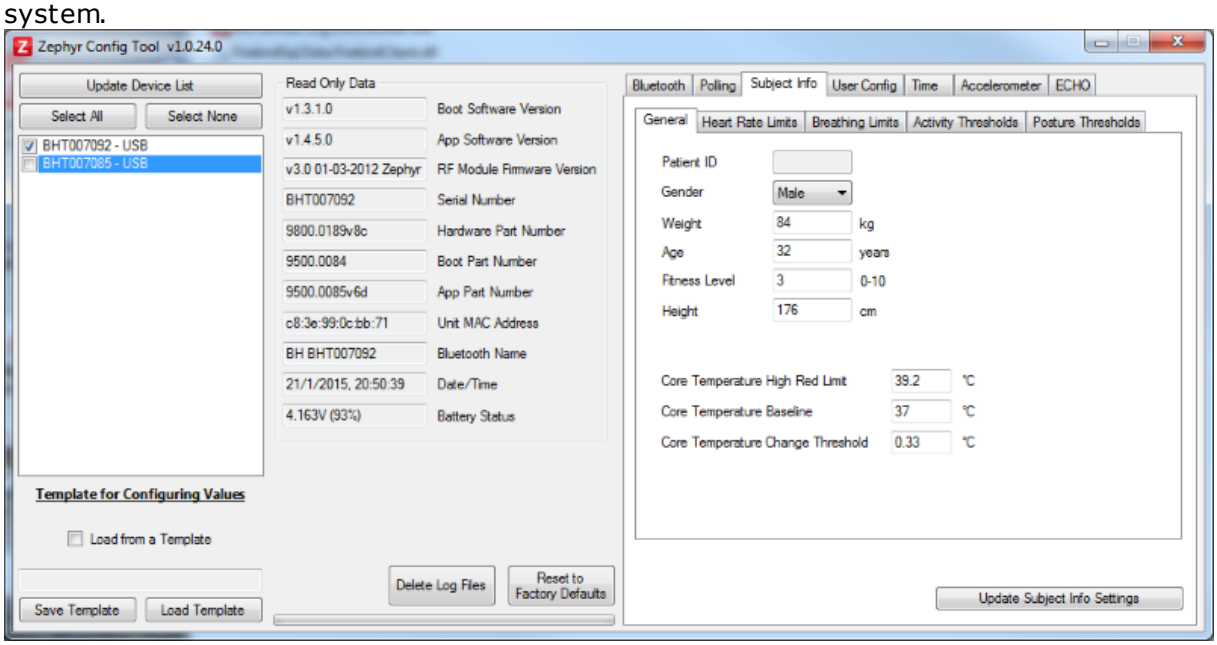
This page will only be needed for manual configuration of a Z-Modem in a legacy PSM Responder system.

Slave Addr	Should be in range 0 - 63. Must be unique for each Z-modem within a system. Normally factory-configured - may need to be reset manually if a faulty device is being replaced in a system

Slot Time	Factory set at 1000ms. Do not change.

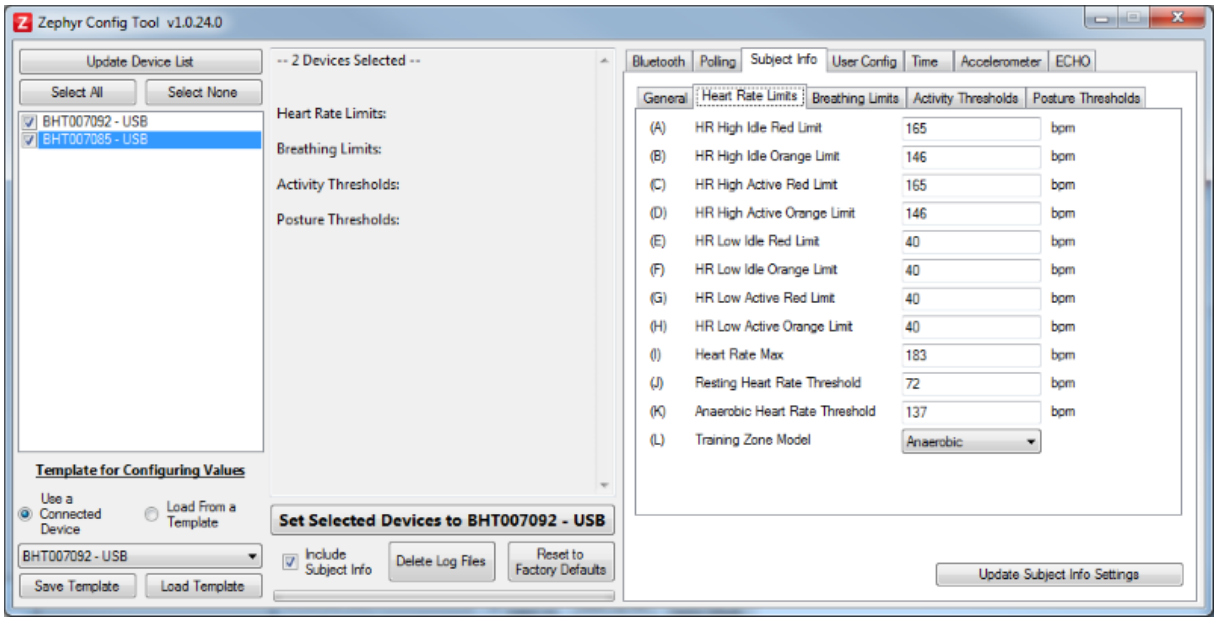
Subject Info - General

A large number of parameters are available for configuring v2 of the ROG algorithm. This is done at a top level using the subject physiological parameters in the setup screens. Further modification can be done to these parameters using the Subject Info tab, but users should be aware that for Direct Connect and ECHO systems, OmniSense resends it stored configurations to each device on initial connection. Thus settings configured manually using the Config Tool *may* be overwritten when the device is next used in a PSM system.

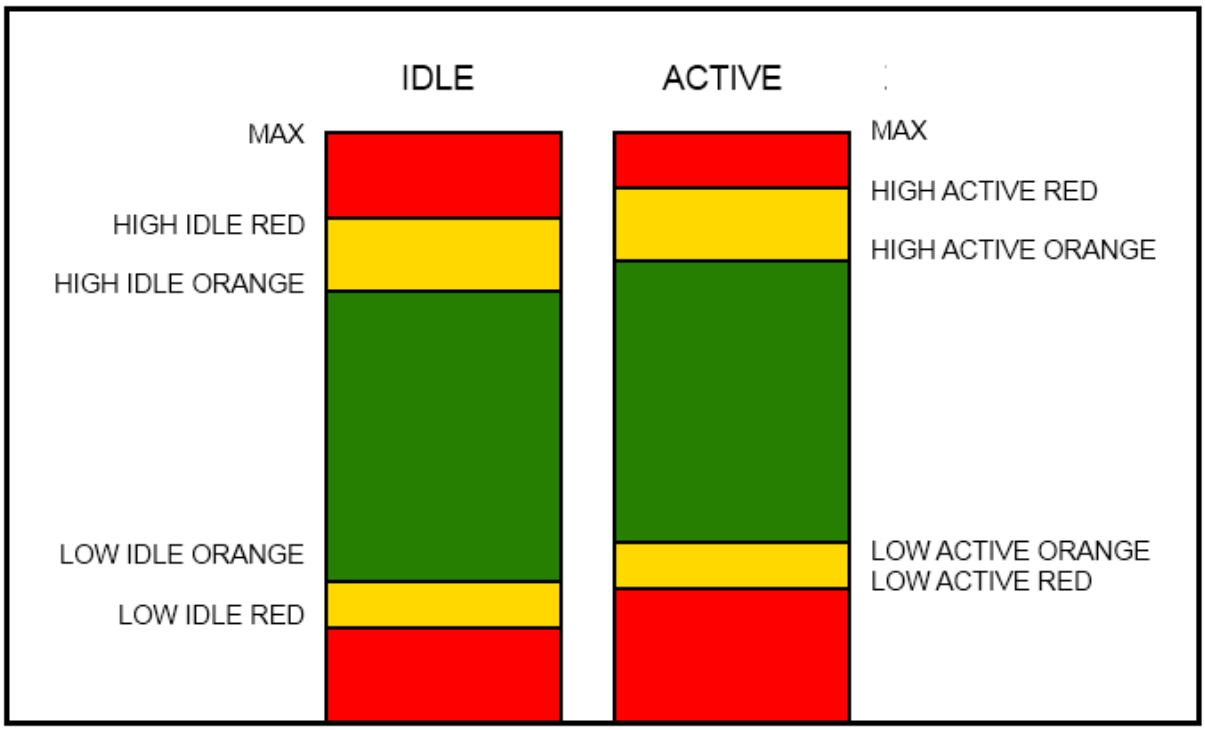


Patient ID	Not used in OmniSense systems
Gender	Used for some algorithms e.g. Calories burned
Weight	Used for some algorithms e.g. BMI
Age	Set in OmniSense Live > Setup > Subject tab - this will be overwritten by OmniSense if changed in the Cfg Tool
Fitness Level	As above. Level 10 = elite athlete
Height	Used for BMI calculation
Core Temp High Red Limit	Not used in OmniSense systems
Core Temp Baseline	Not used in OmniSense systems
Core Temp Change Threshold	Not used in OmniSense systems

Subject Info - Heart Rate Limits



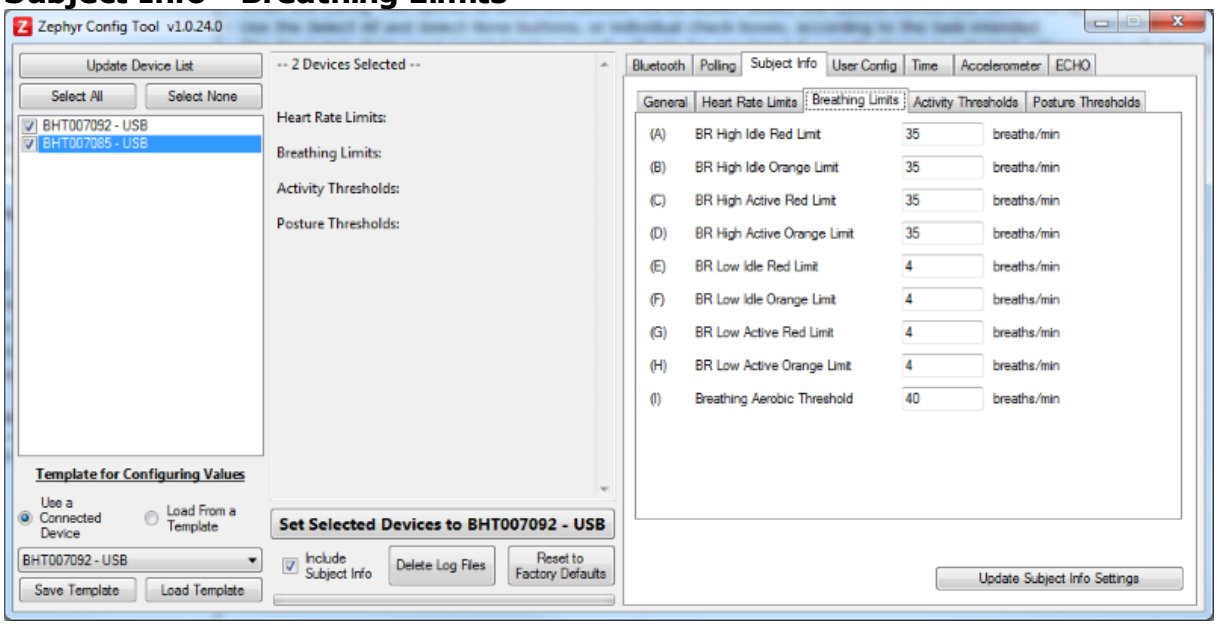
The limits correspond to the diagram below - green status becomes red or orange when thresholds are crossed



Whether a subject is in an idle or active state is determined by the *High Idle Activity* threshold in the Activity Thresholds tab.

Resting Heart Rate Threshold	Not used in OmniSense systems
Anaerobic Heart Rate Threshold	Not used in OmniSense systems
Training Zone Model	Anaerobic or HRmax

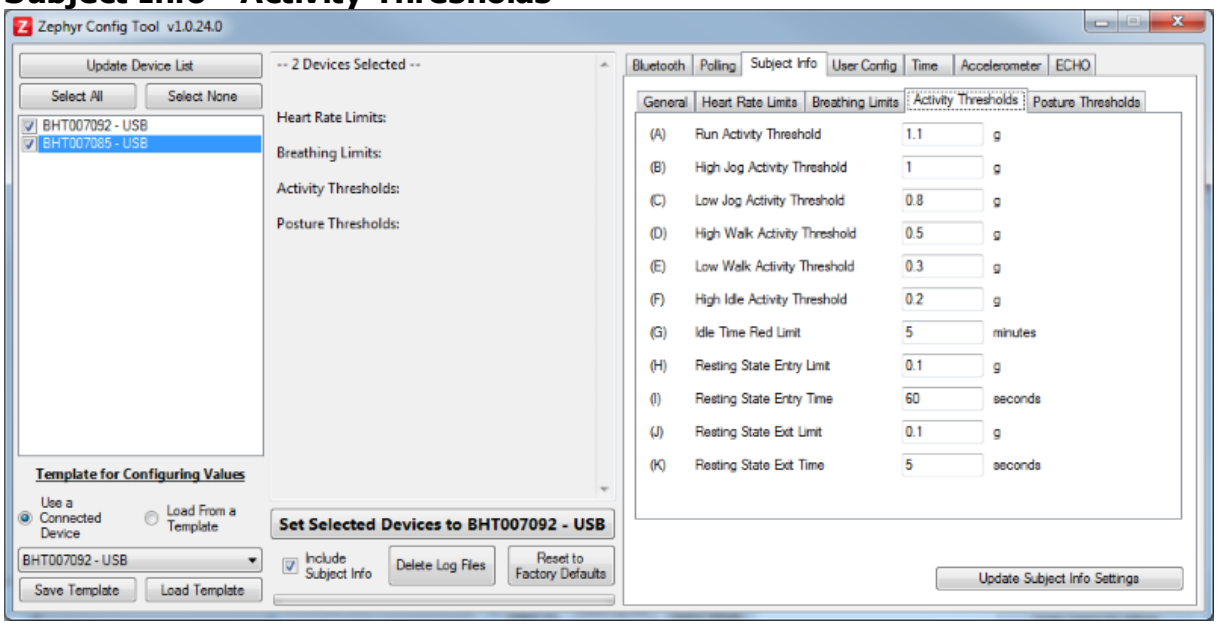
Subject Info - Breathing Limits

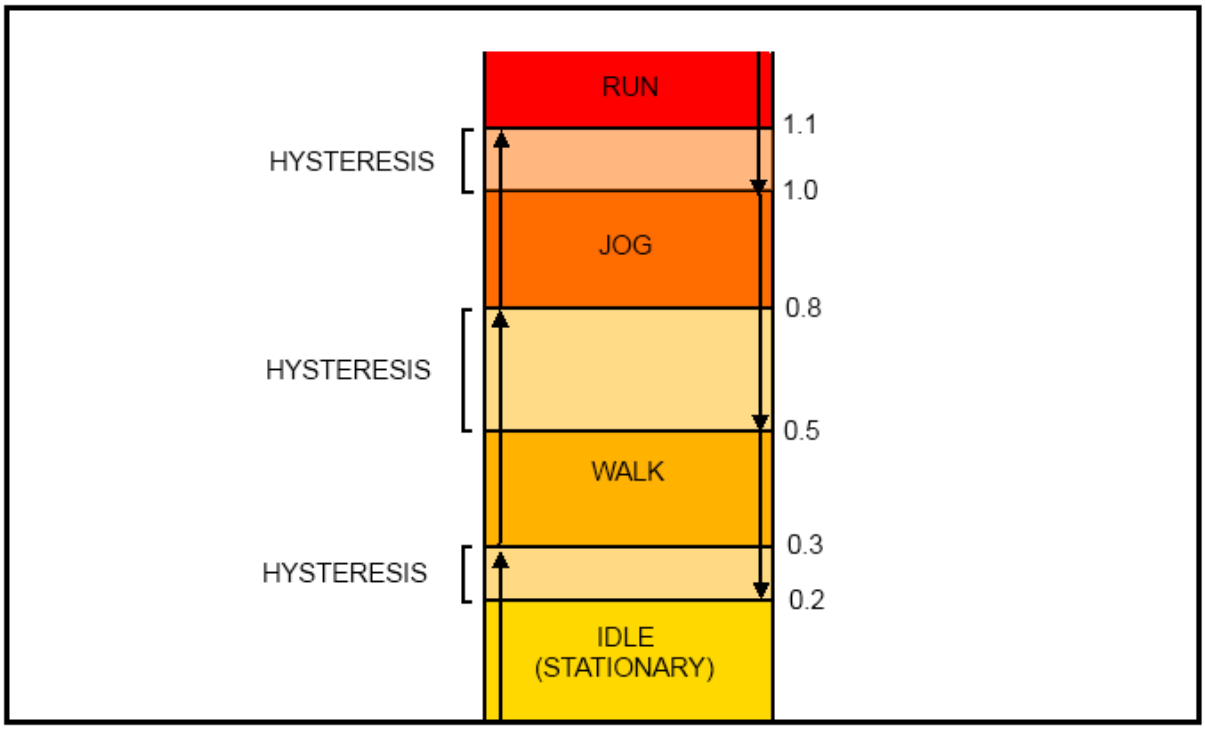


Breathing thresholds are assigned in a similar fashion, using the same diagram above.

Breathing Aerobic Threshold	Not used in OmniSense systems

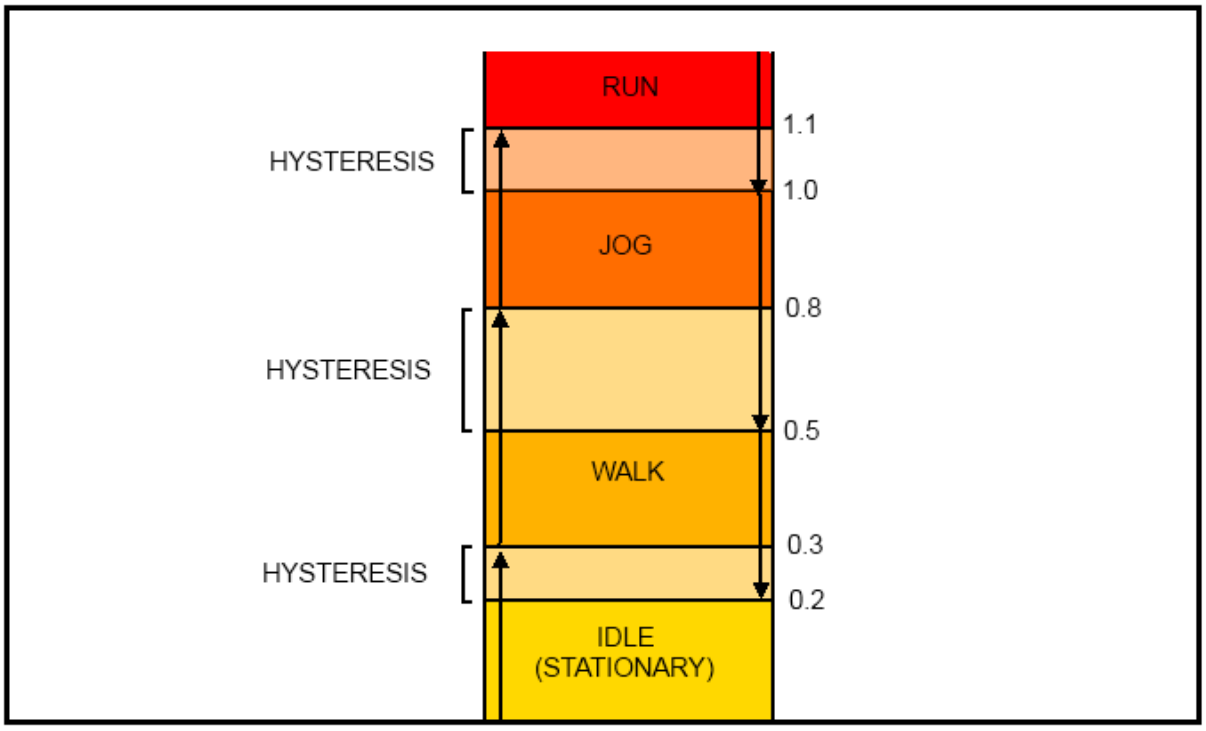
Subject Info - Activity Thresholds





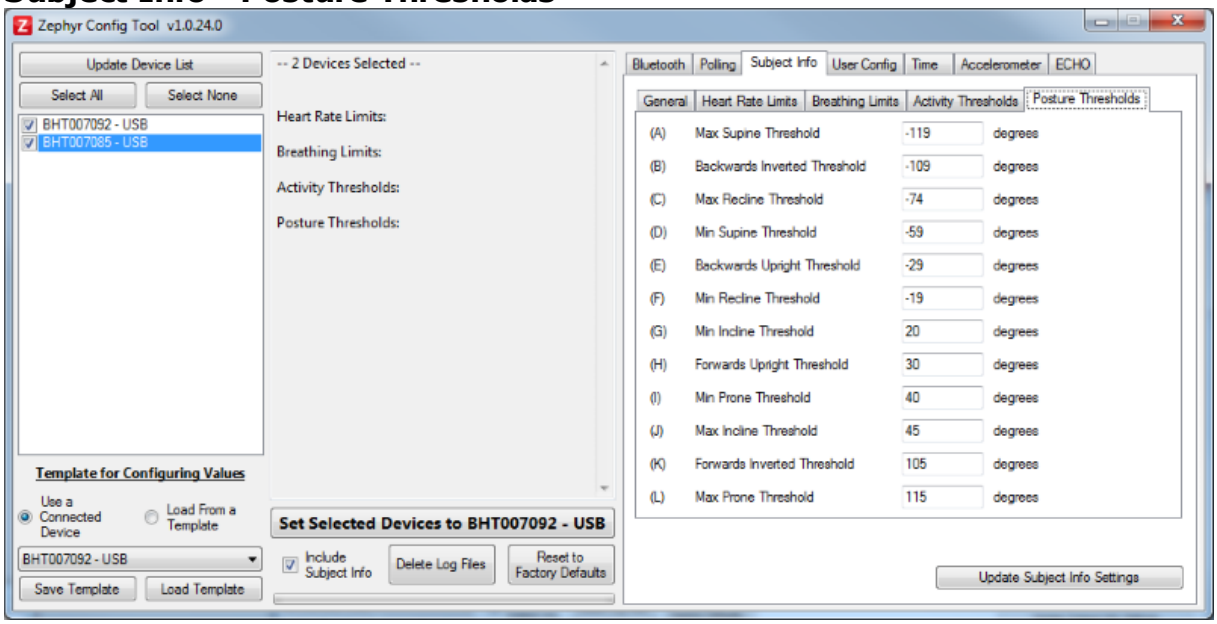
Idle Red Time Limit	Subject Status will be set to red if the subject remains stationary for longer than this limit. For example, 1st Responder monitors may use this value to alert to when a fire officer searching a building has ceased to move.
Resting State Entry Limit	Activity level below which a Resting State is deemed
Resting State Entry Time	Number of continuous seconds during which activity level must remain below the Entry Limit before state is deemed to be Resting
Resting State Exit Limit	Activity level *above* which state is no longer indicated to be Resting
Resting State Exit Time	Number of continuous seconds during which activity level must remain above Exit Limit for state to be no longer Resting

The activity thresholds are represented by the diagram below.

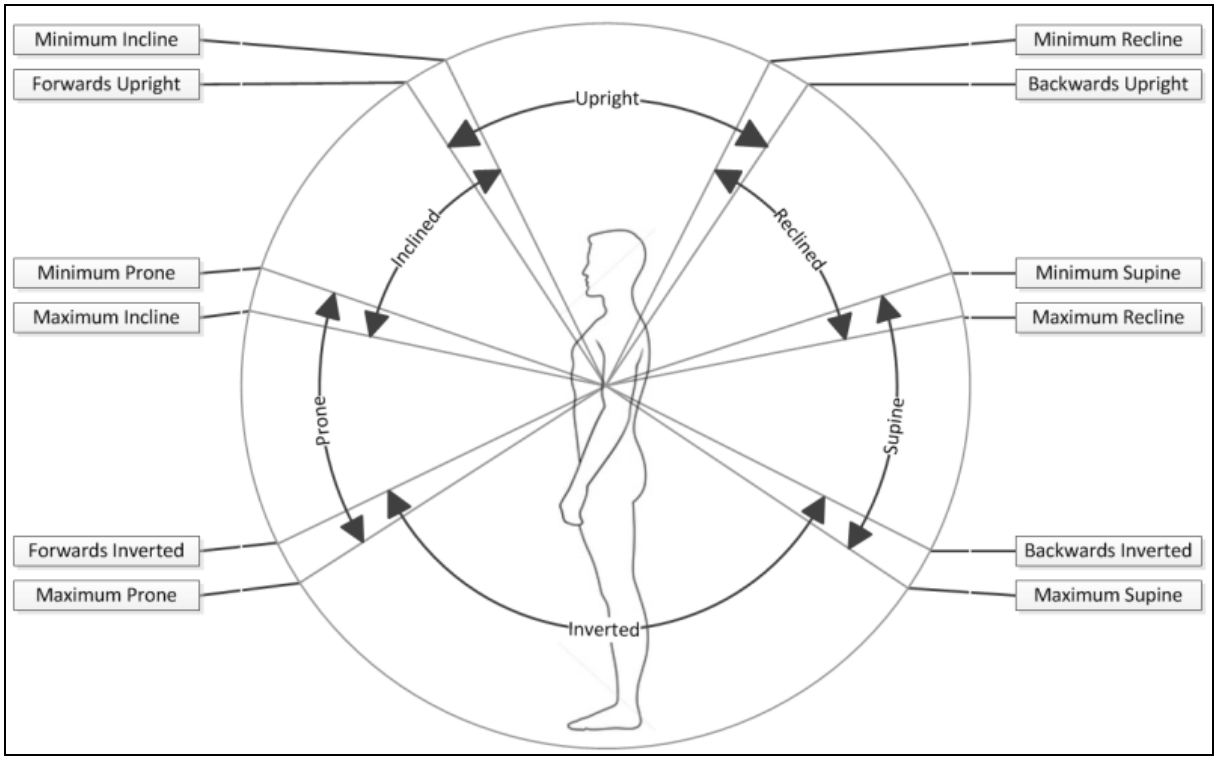


The hysteresis zones allow for a 'grey area' of transition from one activity level to the next - an increasing activity level of 0.25 is higher than an idle indication, but not sufficiently high to indicate a walking activity level, so activity indication remains 'idle'. However the same 0.25 activity level may indicate 'walk', if the activity level has decreased from above 0.3, the 'walk' indication lower limit.

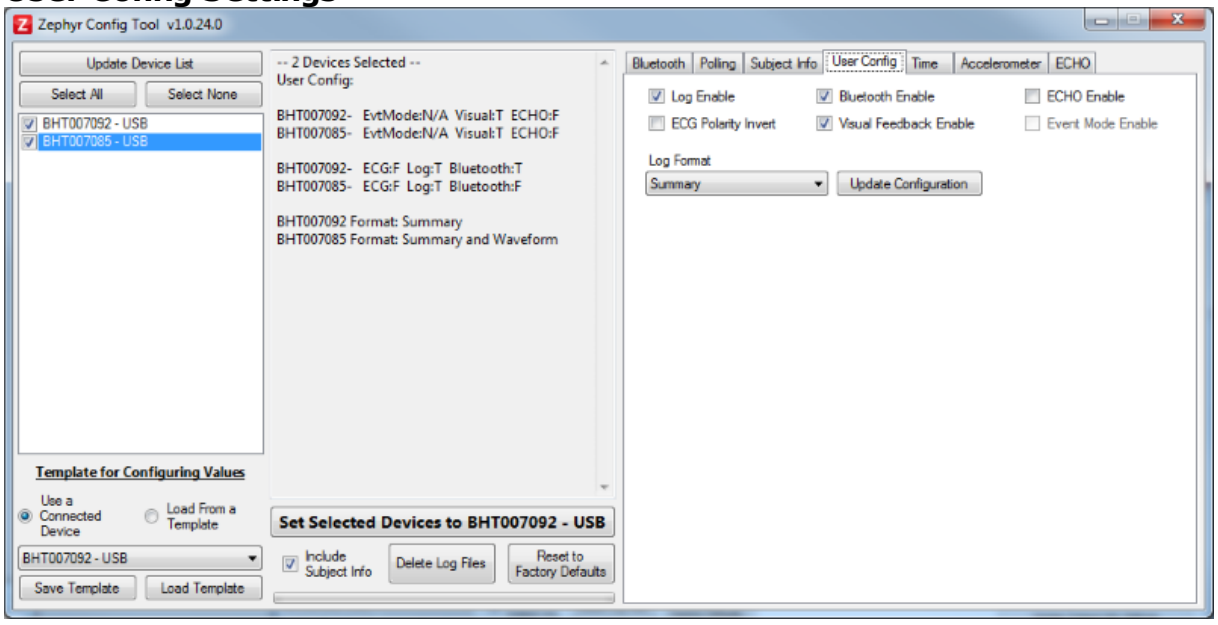
Subject Info - Posture Thresholds



The thresholds corresponds to the limits in this diagram:



User Config Settings

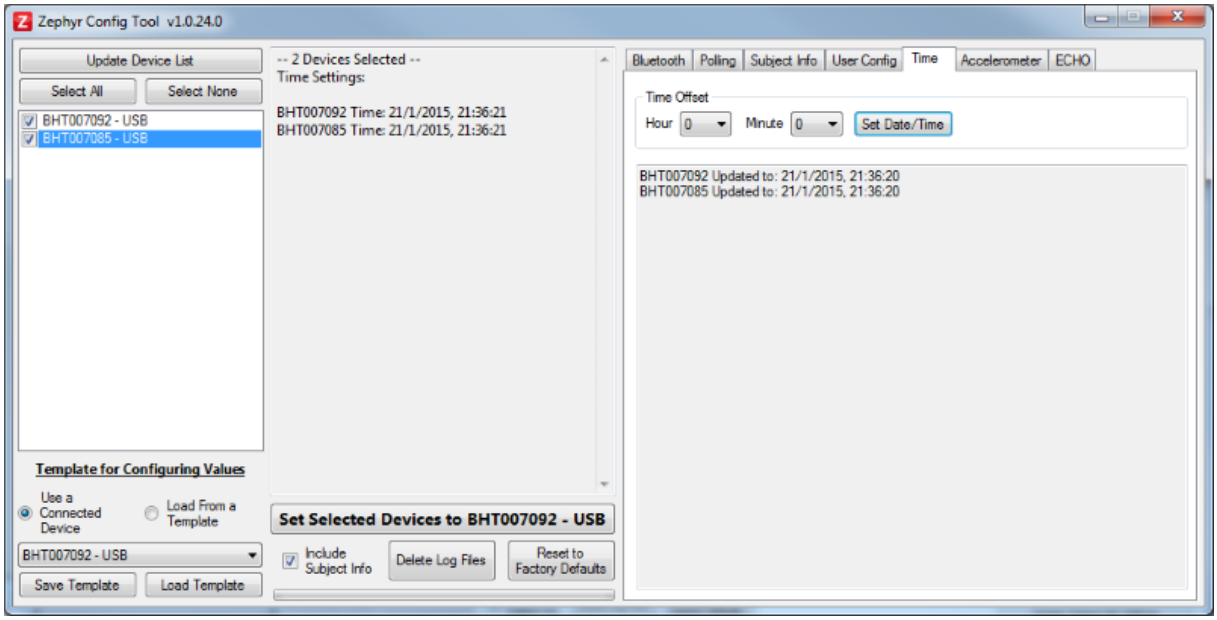


Log Enable	Turn on/off logging
Bluetooth Enable	Turn on/off Bluetooth transmit
ECHO Enable	Turn on/off ECHO transmit. Disabled for versions which do not support ECHO
ECG Polarity Invert	Invert ECG signal - required for some garment types, and for flexibility for future designs

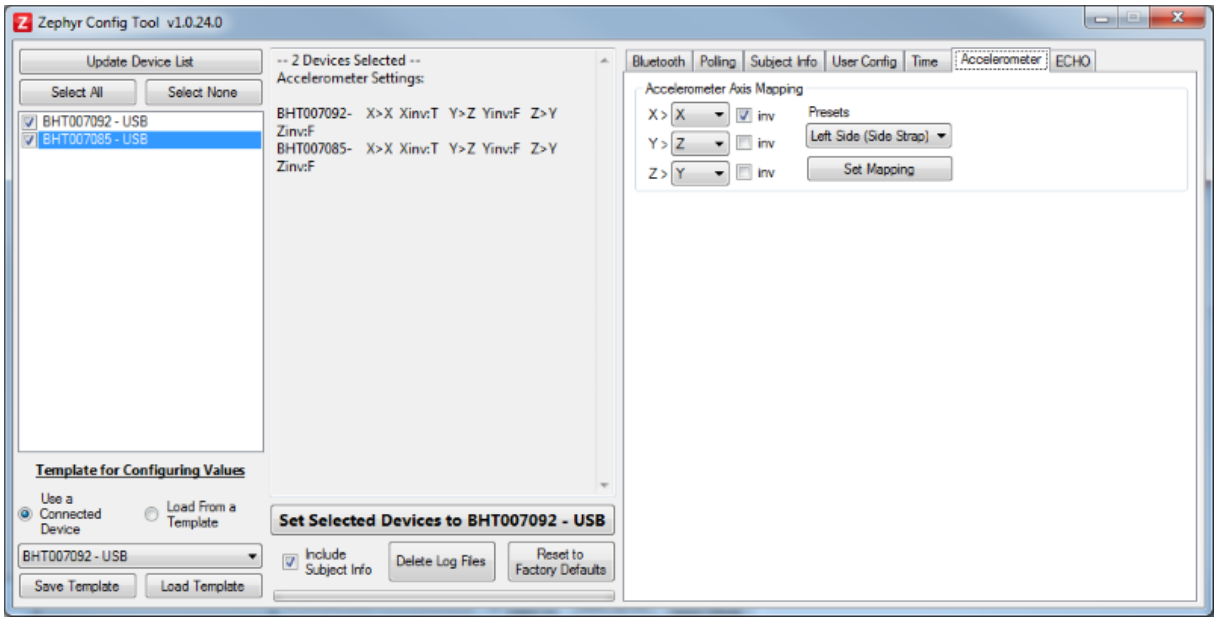
Visual Feedback Enable	Turn on/off LEDs, after initial illumination
Event Mode Enable	Future implementation. Devices which support Event mode - a battery saving mode to transmit every 15 seconds only, or when an alert is raised. Not used for PSM systems.
Log Format	Set Log Format: • General -1Hz general data + 18Hz breathing waveform & heart rate RR • General and ECG - General + 250Hz ECG • General and Accelerometer - General + 100Hz 3-axis accelerometer • Summary - extended 1 Hz data + 18Hz breathing waveform & heart rate RR + events • Summary and Waveform - Summary + 250Hz ECG + 100Hz accelerometer + events • Summary + Development - Summary + 1KHz ECG + 100Hz accelerometer + events • Enhanced Summary - additional 1 Hz accelerometer data • Enhanced Summary + Waveform - additional 1 Hz accelerometer data • Enhanced Summary + Development - additional 1 Hz accelerometer data

Time Settings

Use to resynchronize the device internal time to PC time, or add an offset as required. Note that when a device is connected by USB to OmniSense to add it to the system, or to download a log file, then the clock is automatically resynchronized at that point.
From OmniSense 3.8 and later, a PSM ECHO system will synchronize device clocks when Live is started.

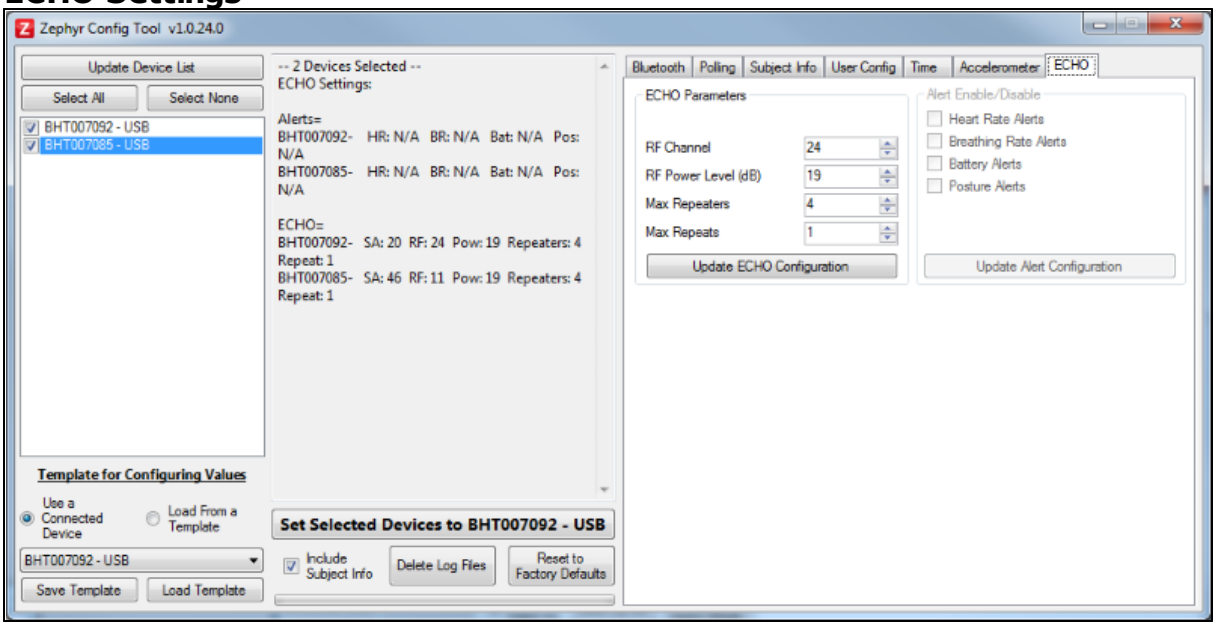


Accelerometer Settings (Garment Type)



Presets	Set garment type - this maps the accelerometer axes according to the orientation of the device, which may vary: • Front upright (shirt or BioPatch) • Left side (Side strap) and also some PSM Defense/Responder shirt designs OmniSense will configure this automatically according to the garment type set in the Setup > Hardware screen

ECHO Settings



Short Transceiver Address	This must be a unique value in the range 1 - 50. This value is pre-configured by Zephyr prior to shipping to a customer and

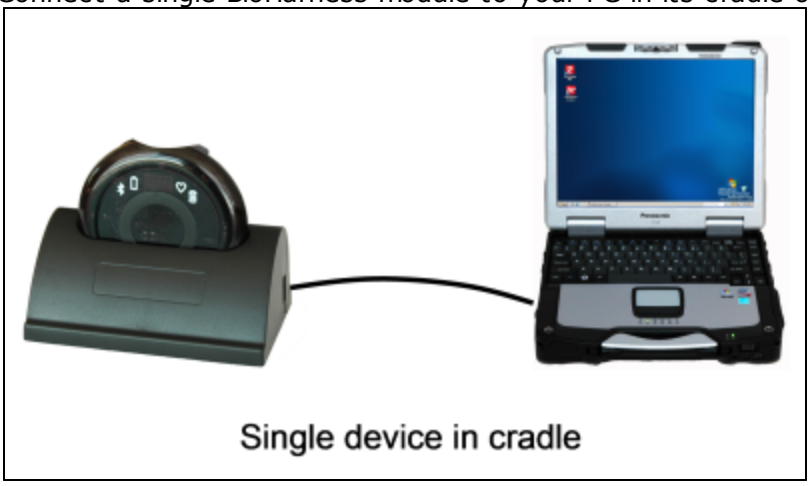
	indicated by a label on the front of the device. No two devices in any ECHO system can have the same address.
RF Channel	Factory Set. Do not change.
RF Power Level	19 - Factory Set. Do not change.
Max Repeaters	4 - Factory Set. Do not change.
Max repeats	1 - Factory Set. Do not change.
Alert Enable/Disable	Not used for OmniSense systems

14.2 BioHarness Log Downloader

The ***BioHarness Log Downloader.exe*** is a legacy utility which is installed automatically at ***C:\Program Files (x86)\Zephyr\OmniSense\Tools***

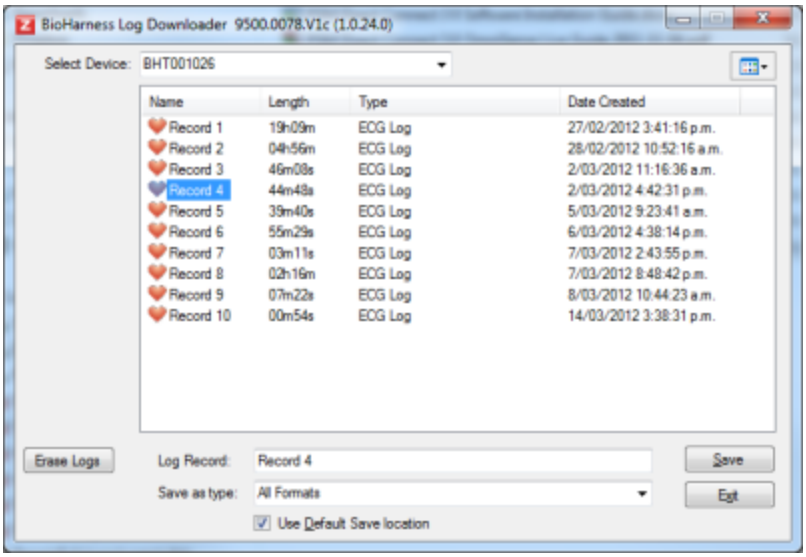
- It is used to download logs from a single BioHarness Module
- For downloading from Multiple devices simultaneously, use the Zephyr Downloader
- Can be used to import logs directly from the BioHarness module
- Output is in the form of csv (comma separated values, opened by Microsoft © Excel) and other files
- Log files remain external to OmniSense
- They cannot be imported into this application
- The logs contain more detailed information than is displayed in OmniSense, but data must be analysed manually, or using tools included with OmniSense.
- A variety of log formats are available. They are configured using the Zephyr Config Tool

1. Connect a single BioHarness module to your PC in its cradle or system case.



Single device in cradle

2. Double-click the BioHarness Log Downloader.exe at the location above, and select the device from the dropdown list



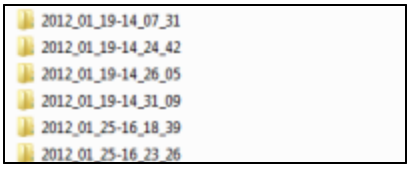
3. Select the session to be downloaded
4. Select the ***Save as Type*** as required

- CSV format - files which will open either in Excel or Notepad or similar. Excel has a limit of 1,000,000 lines per file. This equates to 66 minutes of 250Hz ECG data.
- DaDISP format - pairs of .HED/.DAT files intended for direct import into DaDISP or a similar application designed specifically for handling large data sets such as very long ECG logs

5. Click ***Save***

A progress bar will indicate time to download (calculated after 1% of the log is processed)

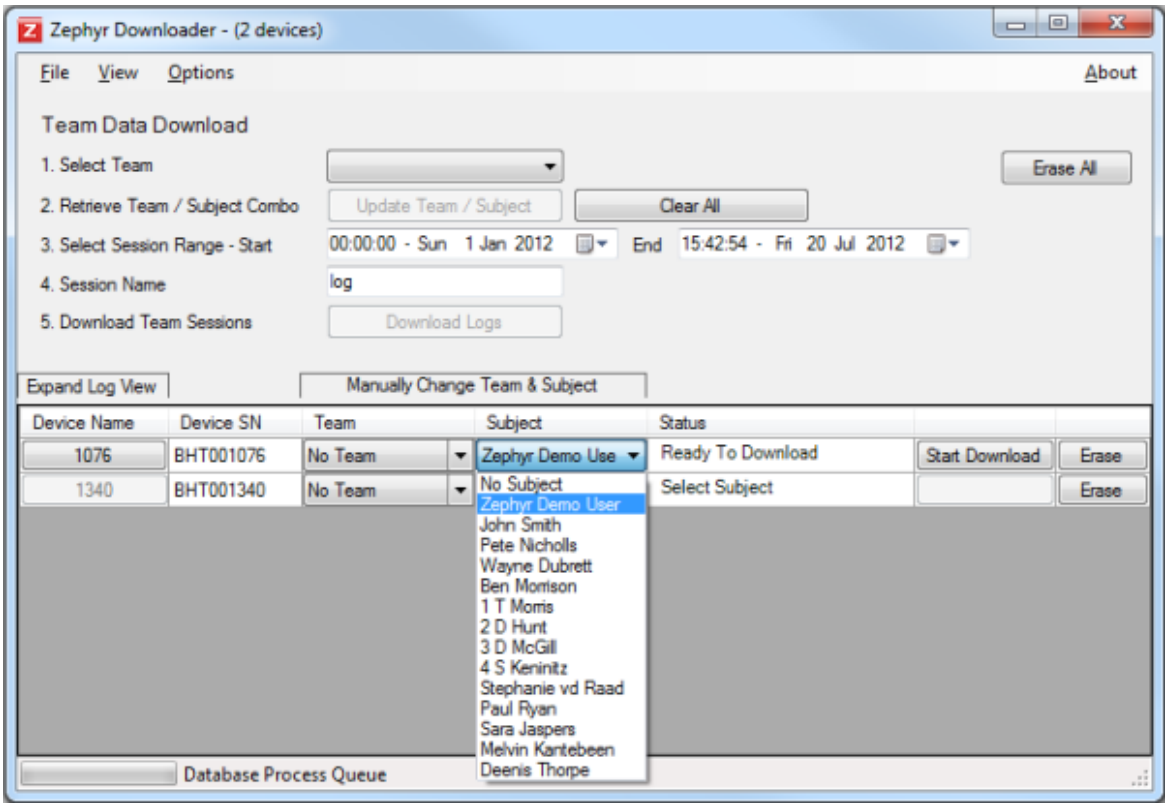
6. The log files will be deposited at ***..My Documents\BioHarness Test Logs*** in a directory labeled with the timestamp of the session



14.3 Zephyr Downloader

The Zephyr Downloader tool:

- is installed automatically when OmniSense is installed
- is accessed through the OmniSense Analysis module toolbar
- can download from multiple devices simultaneously, when they are connected to a PC using a system case, multi-device cradle or multiple cradles using a USB hub.
- downloads data both directly into the OmniSense database, and as external files



- A description of how to use the Zephyr Downloader is included in the OmniSense Analysis *Help > Data Import & Export > Import Log Data from a BioHarness*.

14.4 Firmware Upgrades

Bluetooth BioHarness

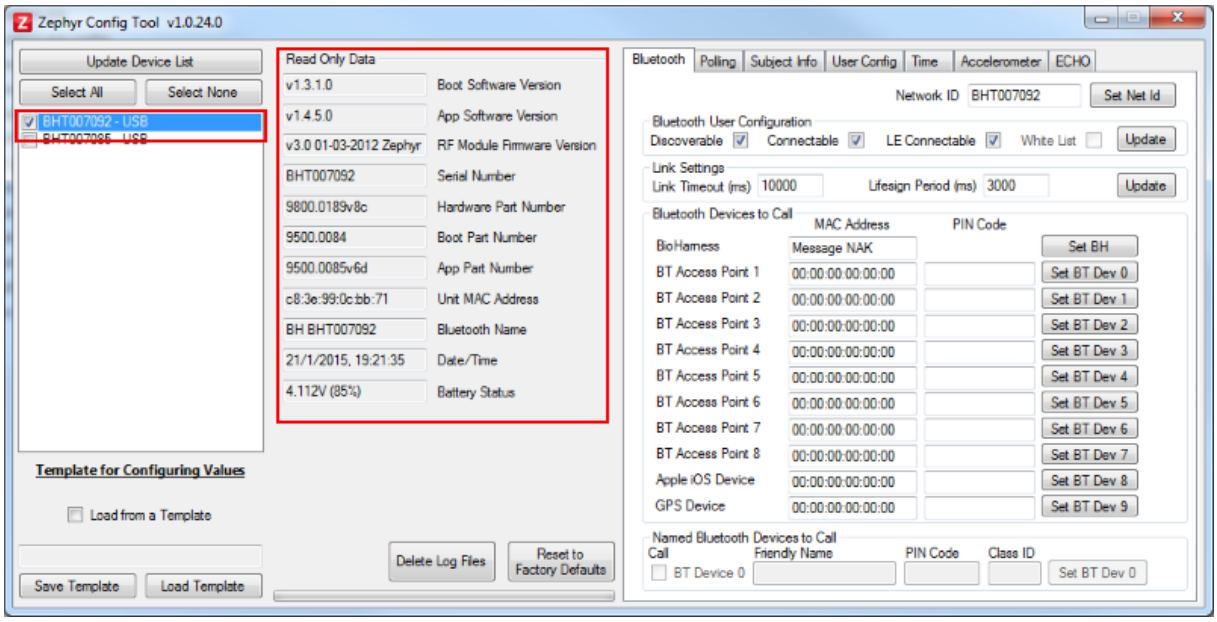
A Firmware Upgrade directory for Bluetooth BioHarness modules is supplied with each release of OmniSense. The required firmware version for each OmniSense release is listed in the New Features topic. Each OmniSense release includes a Firmware Upgrade directory which includes the necessary firmware image files, plus the *ZUSBUpdater.exe* tool.

Check Existing Firmware Version

1. Connect the device in a charge cradle or system case to a PC - or use a config connector if upgrading a Radio Interface Device.

2. Locate the Zephyr Config Tool located at ***C:\Program Files (x86)\Zephyr \OmniSense\Tools*** and double-click to start.

3. Click the *Refresh Device List* button and use the pulldown selector to choose the device you are updating.



4. The device firmware version is *App Software Version* which is 1.3.16.0 for BHT990251 in the example above.

5. The hardware version is 9800.0159v6a, which should be noted, as the relevant image file will include this number.

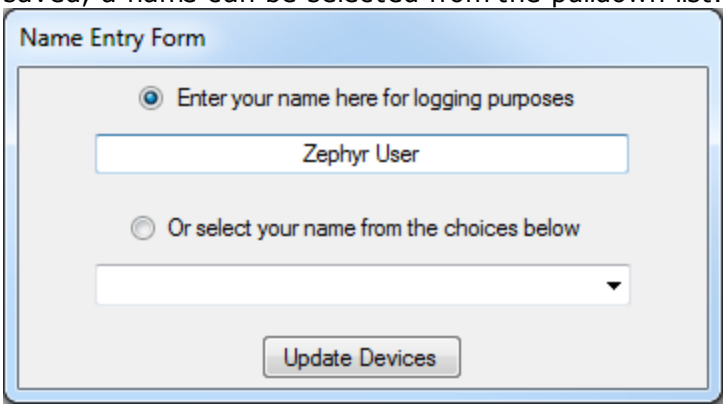
6. Exit the utility - do not change any other values.

Firmware Upgrade

1. Connect the device in a charge cradle or system case to a PC - or use a config connector if upgrading a Radio Interface Device.

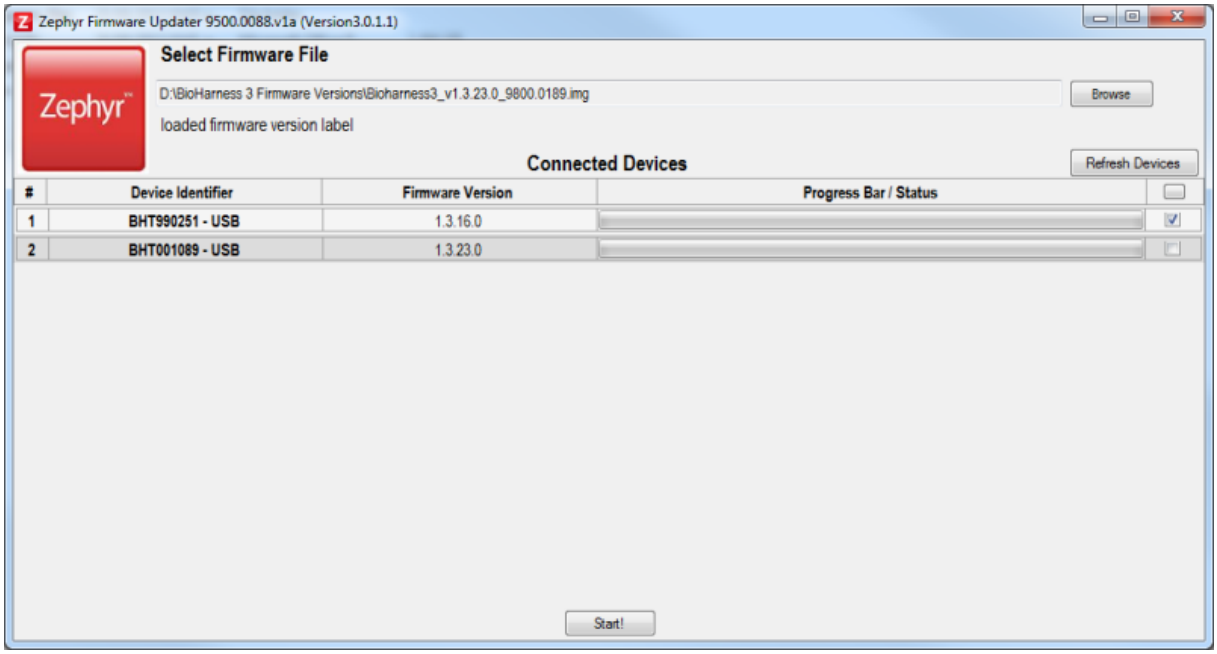
2. Locate the *ZUSBUpdater.exe* utility, which is in the *Firmware Upgrade* directory of every OmniSense CD or download image, and double-click to start.

3. A dialogue will display asking you to enter your name. This is not a security check - it merely records a name against and device reconfigurations made, in a log file located at
C:\ProgramData\Zephyr\ZephyrDeviceUpdateLog.csv
This will let system owners track configuration changes historically. Once entered and saved, a name can be selected from the pulldown list.



Select *Update Devices* to display the Updater tool.

3. All detected devices will be displayed



4. Click *Browse* to locate the desired *.img* firmware image file.

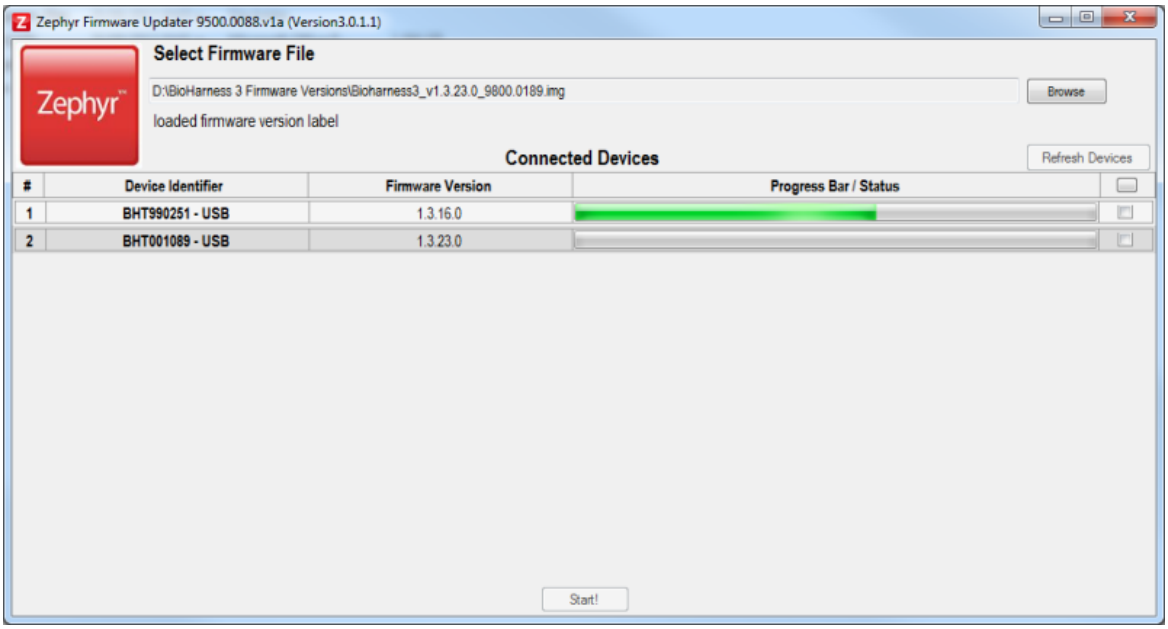
5. From BioHarness 2.0 firmware version v2.3.1.0 onwards, there are two or more alternative image files for each firmware version.
They are labeled according to the hardware part number appropriate for you device e.g.

Hardware Part No	Sample Firmware Image
9800..0070.v2a	BioHarness2.0_v2.3.10.0_9800.0070
9800.0151.v1c	BioHarness2.0_v2.3.10.0_9800.0151

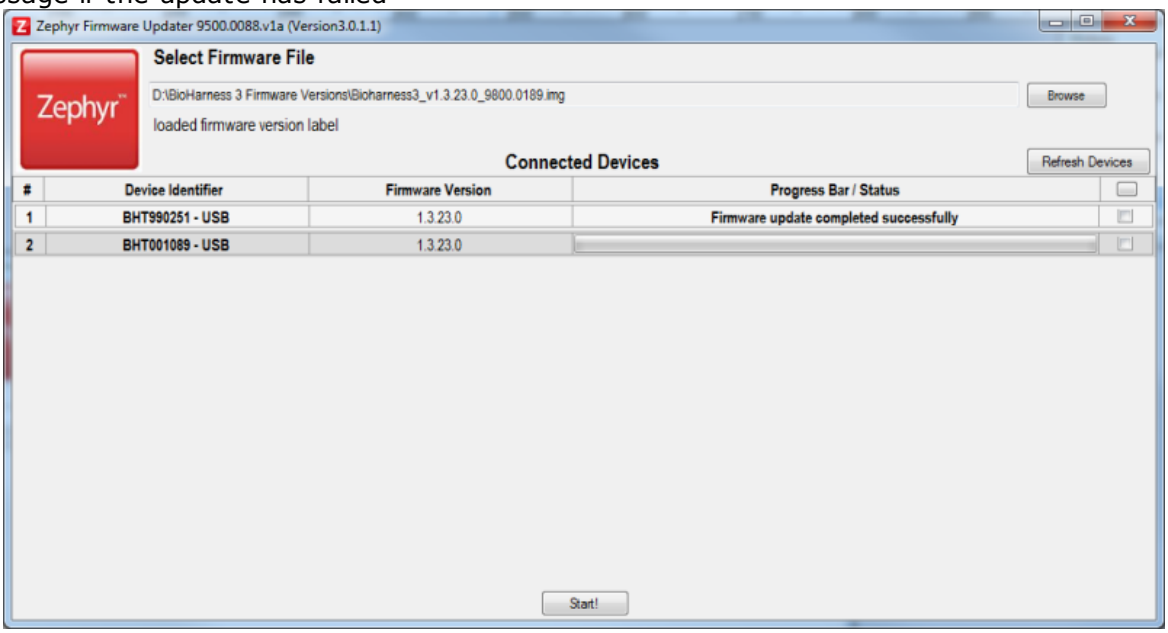
6. BioHarness 3 devices are now available as two types

Hardware Part No	Radio Network Type Supported	Sample Firmware Image
9800.0153	Bluetooth only	Bioharness3_v1.3.14.0_9800.0153
9800.0189	Bluetooth + ECHO	Bioharness3_v1.3.14.0_9800.0189

The updater utility will check hardware part number prior to reprogramming a device, and prevent the wrong image from being used.
7. Check the boxes of those devices to be updated, and select *Start!* to update



8. A message will display on successful update of device firmware, or display a diagnostic message if the update has failed



14.5 BioHarness Logging Formats

Logging mode is software configured in Bluetooth devices. ISM BioHarness modules have only a single logging mode - General Data

- Logging mode is configured using the Zephyr Config Tool located at ***C:\Program Files(x86)\Zephyr\OmniSense\Tools***
- A BioHarness Bluetooth transmits and logs simultaneously by default - either mode can be disabled
- The device can be configured to log in a variety of formats:

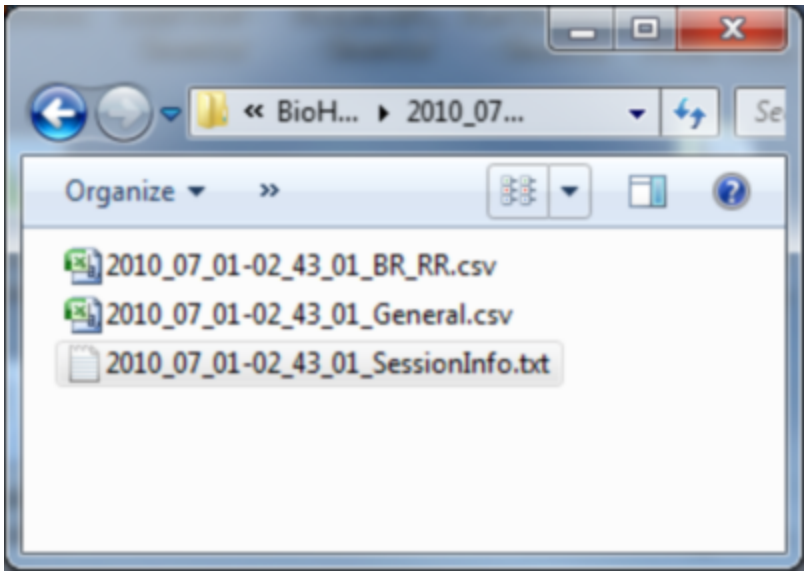
•

BioHarness 2.0	BioHarness 3.0
• General (1 Hz summary data, plus 18Hz breathing & RR data in separate files)	• General (1 Hz summary data, plus 18Hz breathing & RR data in separate files)
• General + ECG (250Hz indicative ECG waveform)	• General + ECG (250Hz indicative ECG waveform)
• General + Accelerometer (125Hz Accelerometer magnitude)	• General + Accelerometer (125Hz Accelerometer magnitude)
	• Summary (Extended 1 Hz summary data, plus 18Hz breathing & RR data in separate files, and Events)
	• Summary + Waveform (Summary + 250Hz ECG + 100Hz Accelerometer + Events)
	• Summary + Development (1000Hz ECG, Accelerometer waveforms reduced from 100Hz to 50Hz
	• Enhanced Summary (Summary + additional accelerometer parameters)
	• Enhanced Summary + Waveform
	• Enhanced Summary + Development

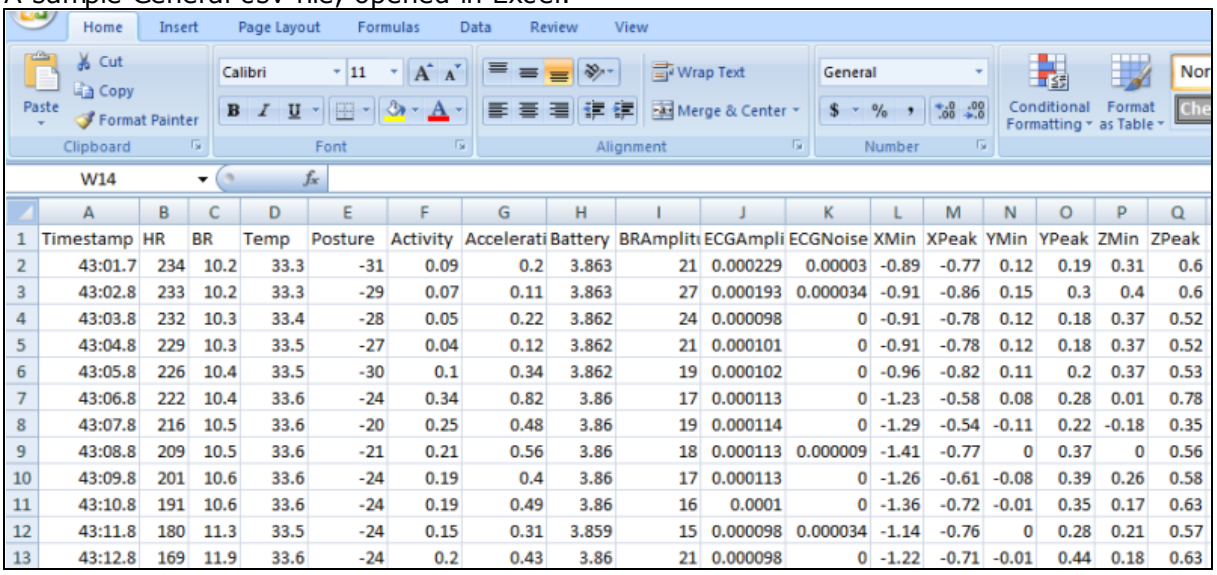
- Reconfiguring the log format erases all log data stored in the device
- General or Summary log data can be imported into the OmniSense Database as described in the OmniSense Analysis User Guide
- ECG and Accelerometer logs can be only downloaded using the BioHarness Log Downloader tool, at the same location as the Zephyr Cfg Tool above.
  This utility outputs .csv and .hed/.dat external data files. These files cannot be imported into the OmniSense database. They should be displayed and analysed using third party software designed for analyzing large data sets, such as DaDISP, Matlab or similar.

General Log

Output for a 1Hz General Log (csv format only):



A sample General csv file, opened in Excel:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Timestamp	HR	BR	Temp	Posture	Activity	Accelerati	Battery	BRAmplit	ECGAmpli	ECGNoise	XMin	XPeak	YMin	YPeak	ZMin	ZPeak
2	43:01.7	234	10.2	33.3	-31	0.09	0.2	3.863	21	0.000229	0.00003	-0.89	-0.77	0.12	0.19	0.31	0.6
3	43:02.8	233	10.2	33.3	-29	0.07	0.11	3.863	27	0.000193	0.000034	-0.91	-0.86	0.15	0.3	0.4	0.6
4	43:03.8	232	10.3	33.4	-28	0.05	0.22	3.862	24	0.000098	0	-0.91	-0.78	0.12	0.18	0.37	0.52
5	43:04.8	229	10.3	33.5	-27	0.04	0.12	3.862	21	0.000101	0	-0.91	-0.78	0.12	0.18	0.37	0.52
6	43:05.8	226	10.4	33.5	-30	0.1	0.34	3.862	19	0.000102	0	-0.96	-0.82	0.11	0.2	0.37	0.53
7	43:06.8	222	10.4	33.6	-24	0.34	0.82	3.86	17	0.000113	0	-1.23	-0.58	0.08	0.28	0.01	0.78
8	43:07.8	216	10.5	33.6	-20	0.25	0.48	3.86	19	0.000114	0	-1.29	-0.54	-0.11	0.22	-0.18	0.35
9	43:08.8	209	10.5	33.6	-21	0.21	0.56	3.86	18	0.000113	0.000009	-1.41	-0.77	0	0.37	0	0.56
10	43:09.8	201	10.6	33.6	-24	0.19	0.4	3.86	17	0.000113	0	-1.26	-0.61	-0.08	0.39	0.26	0.58
11	43:10.8	191	10.6	33.6	-24	0.19	0.49	3.86	16	0.0001	0	-1.36	-0.72	-0.01	0.35	0.17	0.63
12	43:11.8	180	11.3	33.5	-24	0.15	0.31	3.859	15	0.000098	0.000034	-1.14	-0.76	0	0.28	0.21	0.57
13	43:12.8	169	11.9	33.6	-24	0.2	0.43	3.86	21	0.000098	0	-1.22	-0.71	-0.01	0.44	0.18	0.63

A sample Breathing and R-R csv file, opened in Excel. Breathing data is raw pressure sensor output in ADC bits and should be used for debugging purposes only (to determine whether the sensor output range is adequate). Heart rate R-R values alternate in positive and negative values - the sign changes each time a new R event is detected, and this value repeats until the next detection. RR units are seconds.

	A	B	C
1	Timestamp	BR	RtoR
2	14:00:50.204	153	-0.252
3	14:00:50.260	156	-0.252
4	14:00:50.316	159	-0.252
5	14:00:50.372	162	-0.252
6	14:00:50.428	161	0.408
7	14:00:50.484	156	0.408

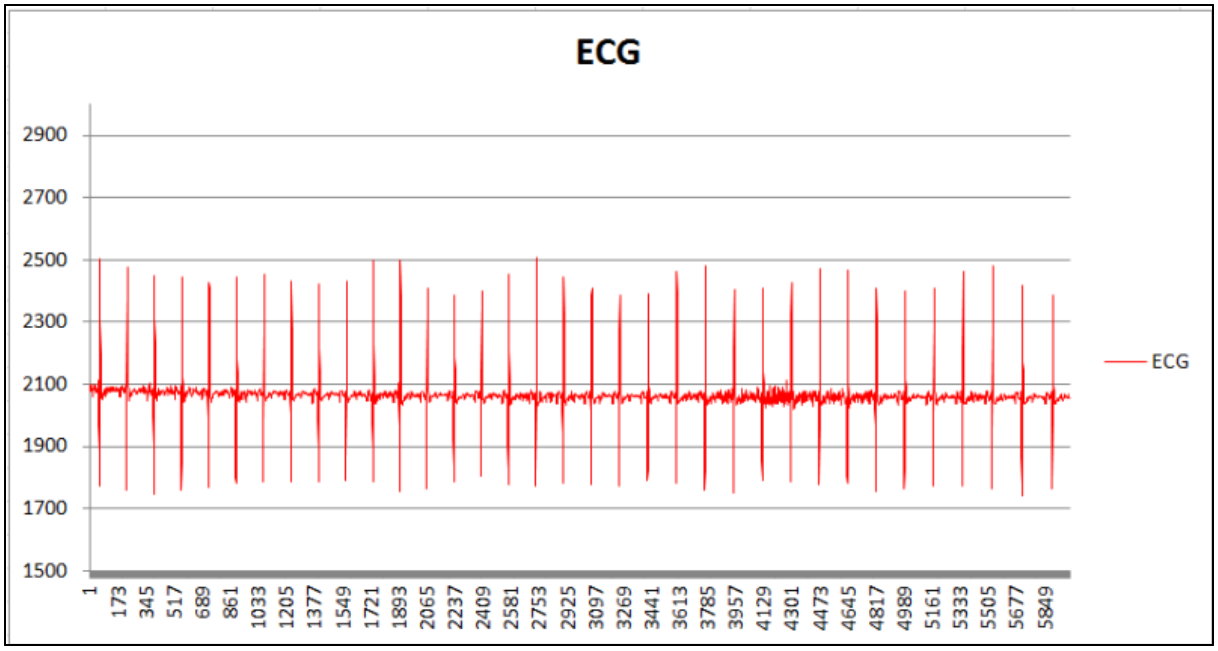
The default Excel Date Format is mm:ss.0. This can be changed to the full date format, which is recorded as dd/mm/yyyy hh:mm:ss.000

ECG Log Format

A sample ECG csv file, opened in Excel, with corrected date format:

	A	B	C
1	Timestamp	ECG	
2	14:00:45.444	2863	
3	14:00:45.448	2863	
4	14:00:45.452	2867	
5	14:00:45.456	2863	
6	14:00:45.460	2859	
7	14:00:45.464	2863	

A sample of the data from this file, graphed using Excel graphing tools:



Summary Log Format

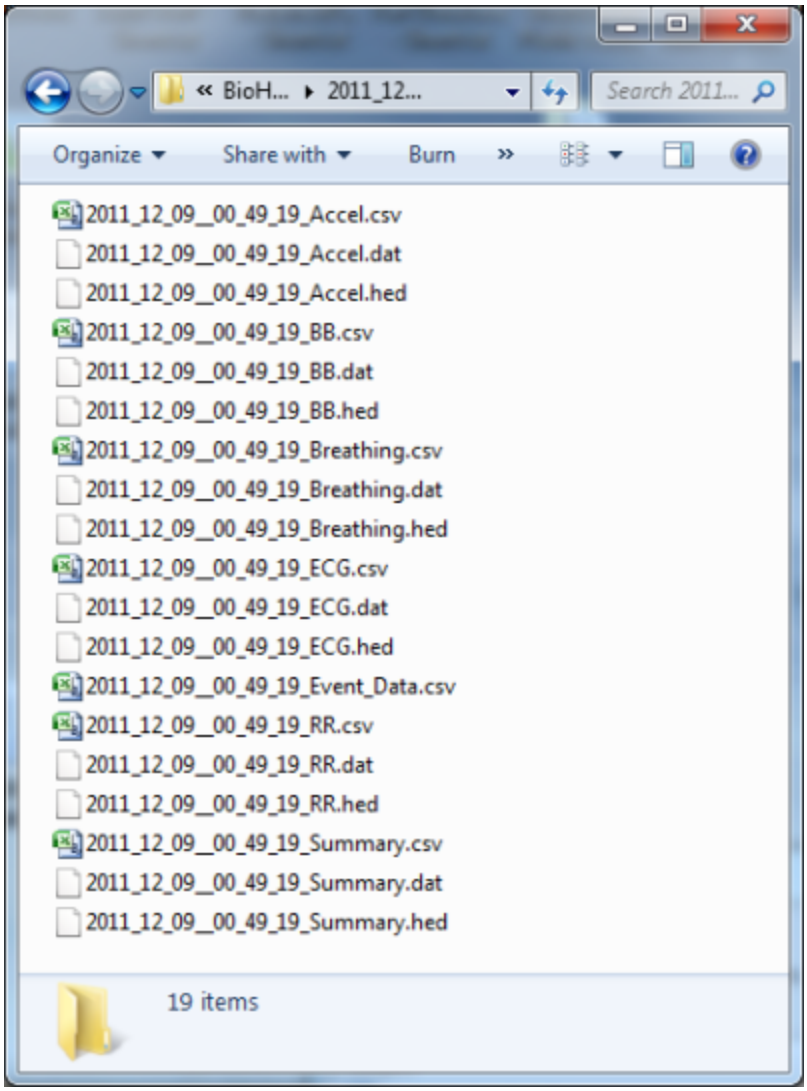
The Summary log is similar to general i.e. it is 1Hz, but has an extended set of physiological and system parameters:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Time	HR	BR	SkinTemp	Posture	Activity	PeakAccel	Battery Volts	Battery Level	BR Amplitude	BR Noise	BR Confidence	ECG Amplitude	ECG Noise	HR Confidence	HRV	System Confidence
2	10:59:31.408	65	8.1	-3276.8	-7	0.14	0.3	4.187	97	7158	65535	255	0.002	0.00104	0	65535	0
3	10:59:32.408	62	8.1	-3276.8	-6	0.09	0.21	4.187	97	7181	65535	255	0.002	0.00064	0	65535	0
4	10:59:33.408	67	7.3	-3276.8	-5	0.16	0.46	4.187	97	6943	65535	255	0.002	0.00044	0	65535	0
5	10:59:34.408	72	7.3	-3276.8	-8	0.19	0.36	4.187	97	6501	65535	255	0.002	0.00032	0	65535	0
6	10:59:35.408	73	6.6	-3276.8	-15	0.17	0.27	4.187	97	6001	65535	255	0.002	0.00028	13	65535	0
7	10:59:36.408	74	6.6	-3276.8	-17	0.06	0.13	4.187	97	5442	65535	255	0.002	0.00022	23	65535	100
8	10:59:37.408	75	5.9	-3276.8	-18	0.06	0.14	4.187	97	4946	65535	255	0.0026	0.00016	33	65535	100
9	10:59:38.408	75	5.9	-3276.8	-19	0.02	0.08	4.187	97	4412	65535	255	0.0026	0.0001	41	65535	0
10	10:59:39.408	73	5.3	-3276.8	-19	0.02	0.06	4.187	97	3951	65535	255	0.0024	0.00008	49	65535	100
11	10:59:40.408	74	5.3	-3276.8	-19	0.02	0.03	4.187	97	3496	65535	255	0.0024	0.00006	55	65535	100
12	10:59:41.408	73	4.8	-3276.8	-19	0.02	0.06	4.187	97	3100	65535	255	0.0026	0.00006	61	65535	100

This part spreadsheet shows approximately half of the available data columns from a Summary csv file.
[Skin Temperature is not a supported channel using the BioHarness 3.0 and always returns the invalid value of -3276.8]

Summary and Waveform Log Format

This is a comprehensive format, generating large amounts for data. A sample of the files - including the .hed/.dat pairs of the DaDISP format - generated by the Log Downloader:

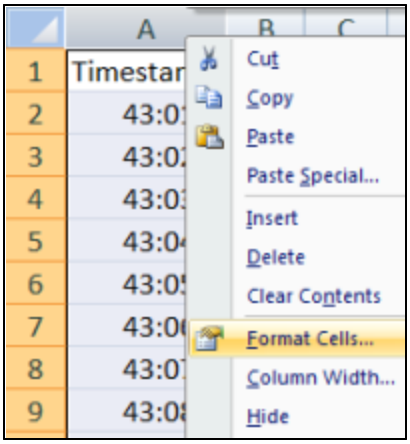


14.5.1 Change Excel Date Format

1. The default Excel date format, as seen in exported csv files produced by the BioHarness Log Downloader, is mm:ss.0

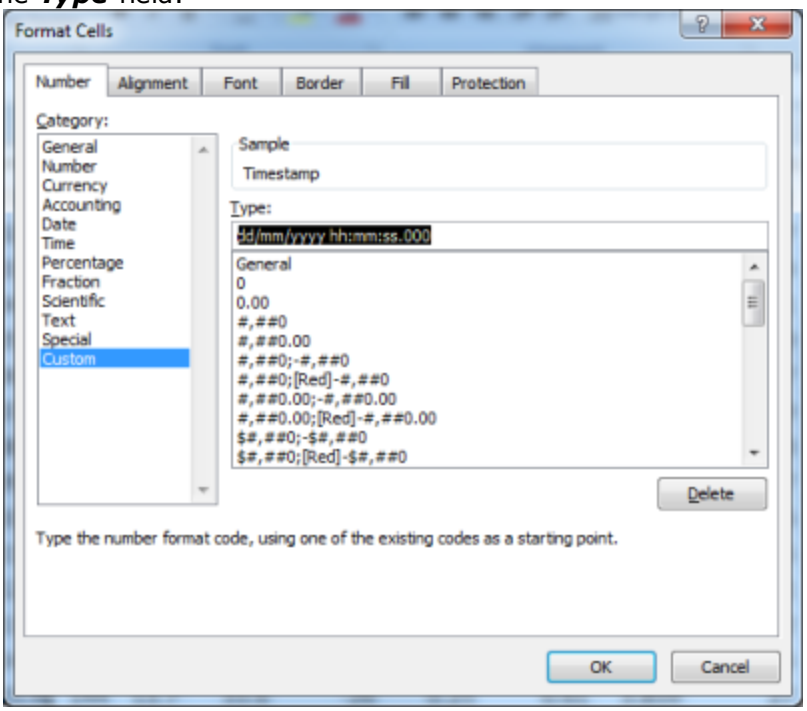
	A	B	C
1	Timestamp	HR	BR
2	43:01.7	234	10.2
3	43:02.8	233	10.2
4	43:03.8	232	10.3
5	43:04.8	229	10.3

2. To change the date format to show full milliseconds, or any other date or time information:



Highlight the entire timestamp column, right-click, and select ***Format Cells*** from the context menu

3. Select ***Custom*** from the Category List, and enter dd/mm/yyyy hh:mm:ss.000 (or any combination of these special characters, and any other delimiting characters or symbols) in the ***Type*** field:



4. The timestamp column will be converted to the required format

	A	B	C
1	Timestamp	HR	BR
2	01/07/2010 14:43:01.749	234	10.2
3	01/07/2010 14:43:02.757	233	10.2
4	01/07/2010 14:43:03.765	232	10.3
5	01/07/2010 14:43:04.773	229	10.3
6	01/07/2010 14:43:05.781	226	10.4
7	01/07/2010 14:43:06.789	222	10.4

Note that to preserve this formatting, the csv file must be saved as an ***.xlsx*** worksheet, and not as a ***.csv*** file.

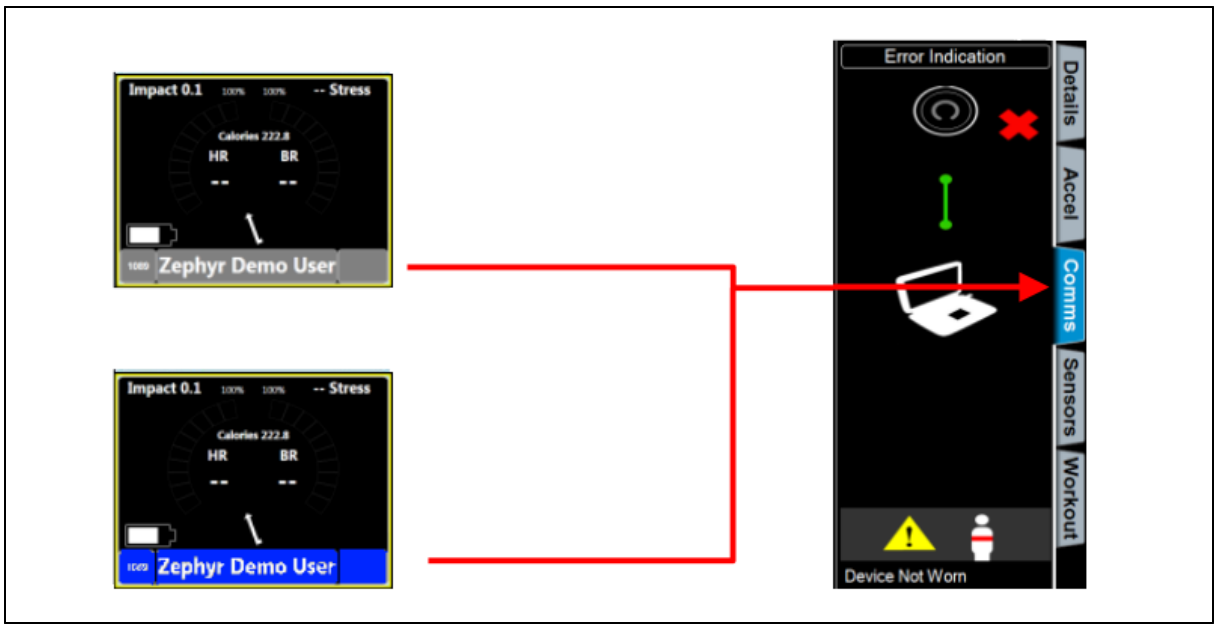
Part 15

15 Troubleshooting

Indicated errors in Live mode

Blue subject status indicates a problem with communications. Select the Comms side tab for more information. Display the Notification Area and check messages
Grey subject status indicates that the device is not worn, or that Heart Rate Confidence is below 50%

- ECG sensor pads on strap may be too dry
- Subject may have removed strap
- Poor contact between the BioHarness module and the strap receptacle - check the contacts are not contaminated or obscured



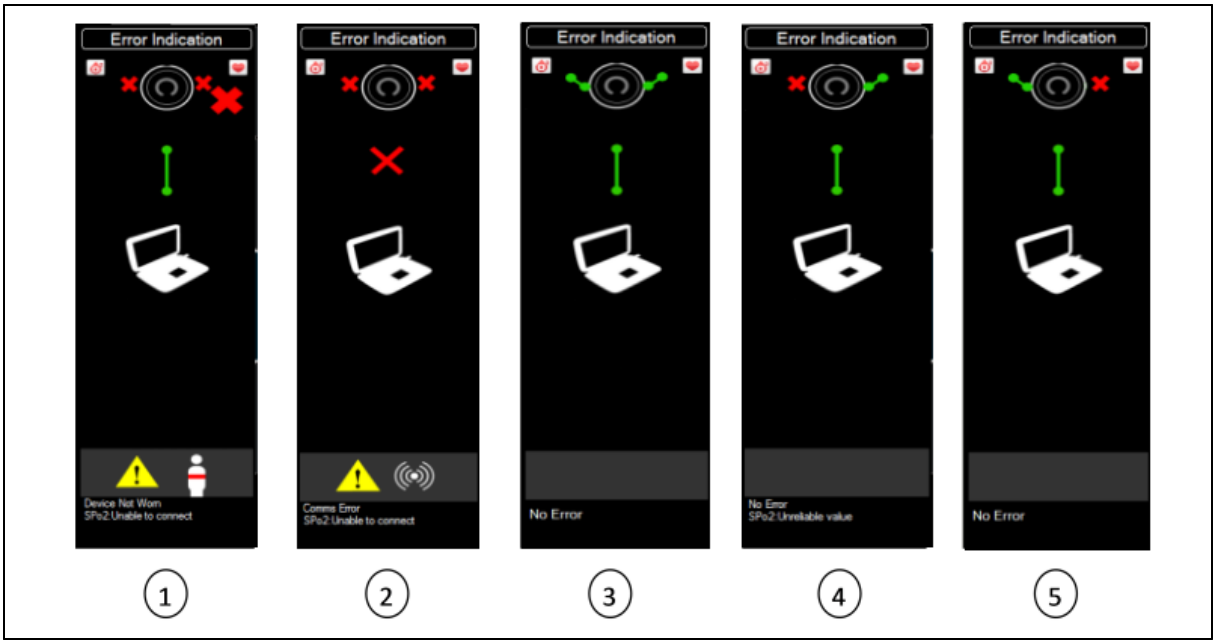
15.1 Comms Error Side Panel

The Comms side panel will give some indication on any blue or grey status error. The nature of the problem may depend on the radio network type being used.

- PSM Direct Connect
- PSM Responder
- PSM Training ECHO

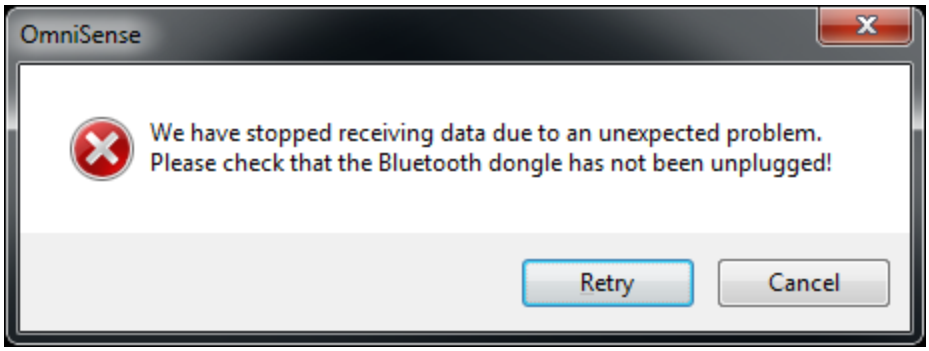
15.1.1 PSM Direct Connect

Details are for the subject whose BioGauge is selected



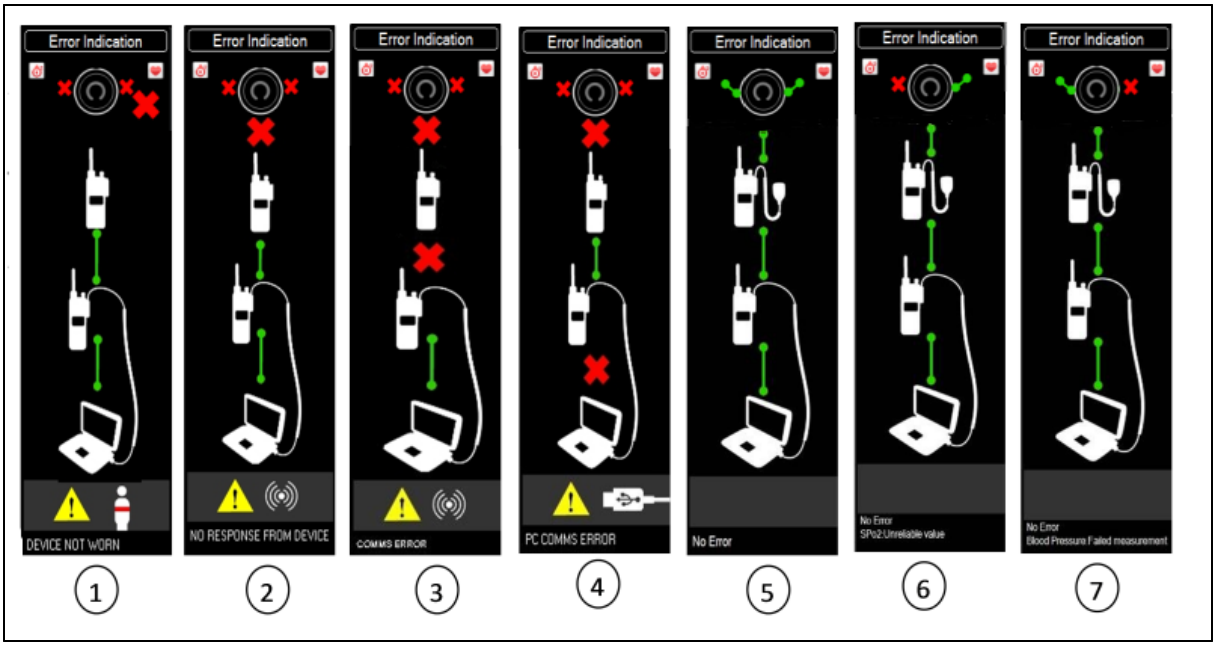
	Subject Status	Indication	Cause	Check/Remedy
1	Grey	Device not worn - response but no data	• Device removed from strap • Bad contact with receptacle • Dry sensor pads • Poor conductivity (dry skin) • Low HR Confidence	• Check device fit in receptacle, clean contacts • Moisten sensor pads on strap with water
2	Blue	No response from device	• Device powered off • Batteries flat • Out of range of PC/ antenna	• Check LEDs - no blue=no connection • Recharge battery • Check within range of antenna
3	Green Orange Red	No error		
4,5	Blue	External sensor comms error	• can't connect to ext. sensor (BP or SpO2)	• Check correct sensor assigned • Replace batteries • Note - other data reports as normal
4,5	Grey	Measurement failure	• Failed measurement or error from external sensor	• Check external sensor function • Replace batteries

If the USB Bluetooth dongle becomes accidentally disconnected, a dialogue will display:



15.1.2 PSM Responder

Details are for the subject whose BioGauge is selected

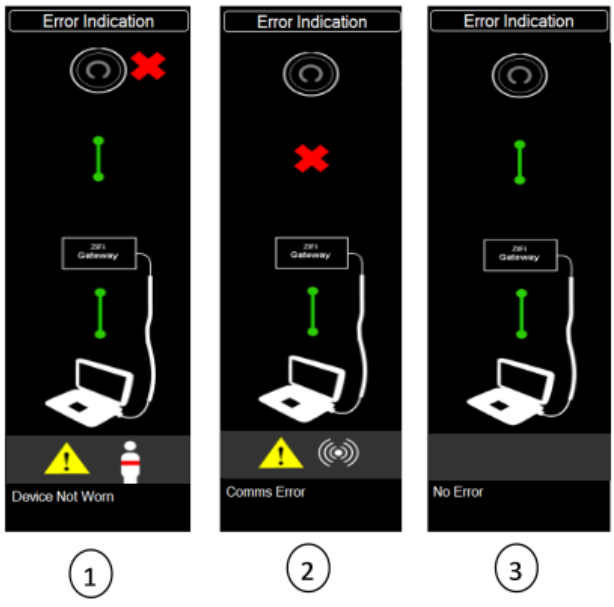


	Subject Status	Indication	Cause	Check/Remedy
1	Grey	Device not worn – response but no data.	• Device removed from strap. • Bad snap contact. • Poor skin conductivity • low HR Confidence	• Check device attachment to strap (clean contacts). • Moisten grey sensors on strap with water.
2	Blue	No response from Device.	• Device not switched on. • Batteries flat. • Out of range of Mic/ RID	• Check LED behavior. • Recharge batteries.
3	Blue	Comms Error.	• Radio Network Failure – out of range,	• Check all radio settings. (Confirm by voice

			interference, wrong channel etc	comms). • Check BioMic/RID detection by radio screen icon • resend configuration using toolbar button • restart OmniSense, reboot PC
4	Blue	PC Comms error.	• Wrong Medic radio channel. • Flat radio batteries. • Medic radio off/ failure. • PC connection problem.	• Check radio settings (CH1). • Check BioMic/RID detected ( ). • Disconnect/reconnect BioMic/RID • Resend configuration using toolbar button
5	Green Orange Red	No error		
6,7	Blue	Sensor Comms Error	• Cannot connect with external sensor (Blood pressure or SpO2)	• Check external sensor • Replace batteries • NB other data reports as normal
6,7	Grey	Measurement failure	• Failed measurement or error message from external sensor	• Check external sensor • Replace batteries

15.1.3 PSM Training ECHO

Details are for the subject whose BioGauge is selected



	Subject Status	Indication	Cause	Check/Remedy

1	Grey	Device not worn - response but no data	• Device removed from strap • Bad snap contact • Poor skin conductivity • Low HR confidence	• Check device attachment to receptacle (clean, intact contacts). • Moisten grey sensors on strap with water.
2	Blue	No response from device	• Device not switched on. • Batteries flat. • Out of range of PC/ Antenna • ECHO Gateway issue • BioModule short address conflict	• Check LED behavior. Recharge. • Check subjects are within range of antenna • Disconnect/reconnect Gateway • Check BioModule configurations
3	Green Orange Red	No error		

15.2 Physiological Data Anomalies

	Indication	Possible Cause	Check/Remedy
Heart Rate	Excessively high or erratic	• movement of sensor surface against skin • dry skin or strap • poor connection between device and strap receptacle	• check strap tension & location • moisten ECG sensor pads with water • Check spring contacts on rear of device not depressed
Heart Rate	Consistently 200 +bpm	• damaged strap	• replace strap to isolate issue
Breathing Rate	Abnormally low value	• constant compression of sensor by external force	• remove external agent
Breathing rate	Unrealistic value	• mechanical movement of torso creating artefacts i.e. excessive regular arm movements • Poorly located sensor	• change subject behaviour to isolate interfering action • On side strap, device should be located at peak of rib curvature under arm
Breathing Rate	Dropouts to zero	• Intermittent disconnection between device and receptacle on strap	• Check springs on rear of device have not become depressed. Carefully raise if so, taking care to ensure they will not catch on charge cradle when reinserted.
Blood Pressure	Unrealistic readings	• cuff too loose	• Refasten cuff adequately tight

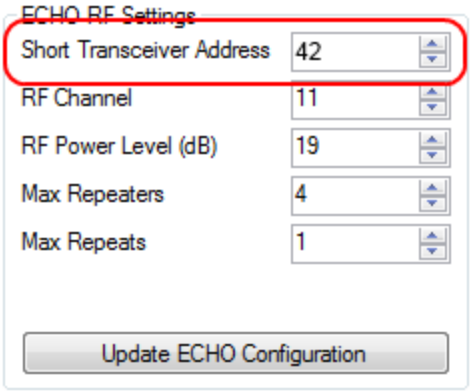
15.3 BioHarness Hardware

	Indication	Possible Cause	Check/Remedy
BioHarness Module	Any abnormal LED flash	• Internal component failure	• Power device off and on • If no button response. leave on for 36 hrs till LED off, recharge & retry • Check LED error patterns • Return to supplier for replacement/repair

15.4 ECHO Short Address Conflict

An ECHO system is a 'polling' system - each BioModule is configured with a *Short Address* with a value between 0 and 50.

If an additional BioModule is added into the system, and is already configured with the Short Address of an existing device, then a conflict is created, and data from both devices will not be received. Use the Zephyr Config Tool to confirm and note all device Short Addresses, and change the address of one of the conflicting devices.



Detail from the Zephyr Config Tool ECHO settings tab showing the Short Address location. Click the *Update ECHO Settings* button after setting a non-conflicting value.

15.5 General Issues

	Indication	Possible Cause	Check/Remedy
Communications	No data in BioGauges	• Radio Network Error	• Check all necessary components are powered on. Re-engage Live mode - switch to Setup mode and back
Communications	*'No Bluetooth Device detected'* error displayed	• Bluetooth USB dongle or native Bluetooth in PC is	• OmniSense supports *only* Windows default Bluetooth drivers. Other drivers must

		not using Windows Default Bluetooth drivers	be uninstalled, and Windows drivers installed automatically. See Bluetooth

15.5.1 Bluetooth

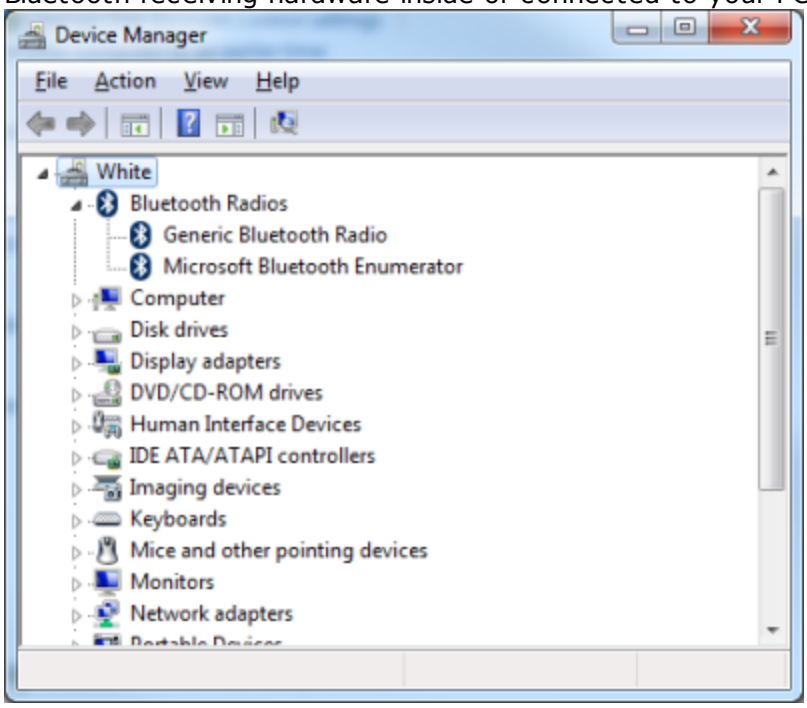
At present, OmniSense only supports Microsoft Windows default Bluetooth drivers. Driver files are installed in a PC so that when a hardware device such a USB Bluetooth receiver dongle (or even a Bluetooth module installed inside a PC) is connected, the PC can recognize it and interpret the data it receives. Some PCs may have alternative 3rd party Bluetooth drivers installed, such as Broadcomm, Intel or Toshiba.

For OmniSense to operate, 3rd party drivers must be uninstalled, and the USB receiver dongle reconnected so that Windows installs its own default drivers. A PC cannot have two distinct sets of driver files installed for one hardware device.

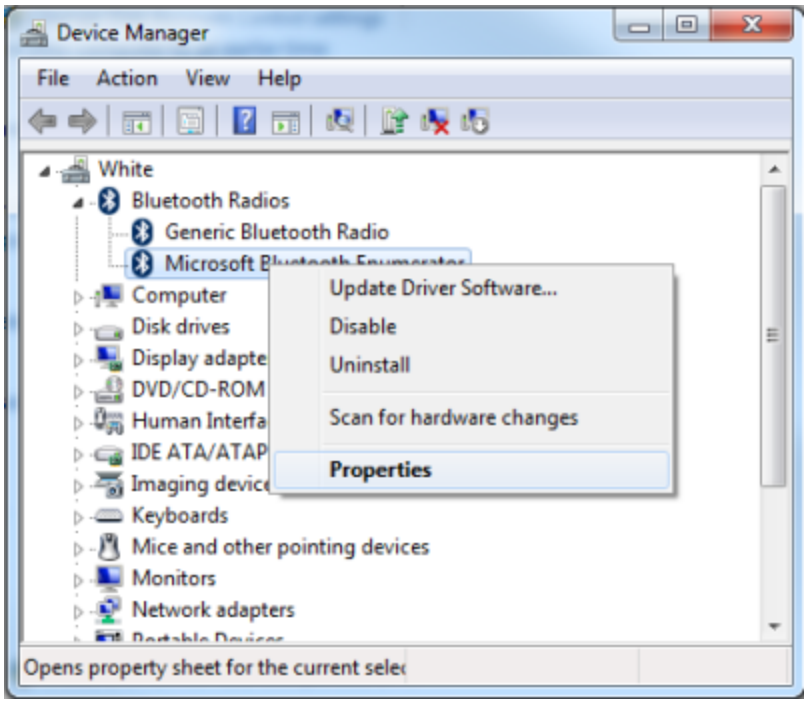
An error dialogue indicating 'No Bluetooth Device detected' may display, if non-Windows driver files are installed for a Bluetooth receiver. To check that the drivers you have installed are for Windows:

1. Go to Windows Start > System and Security > System > Device Manager

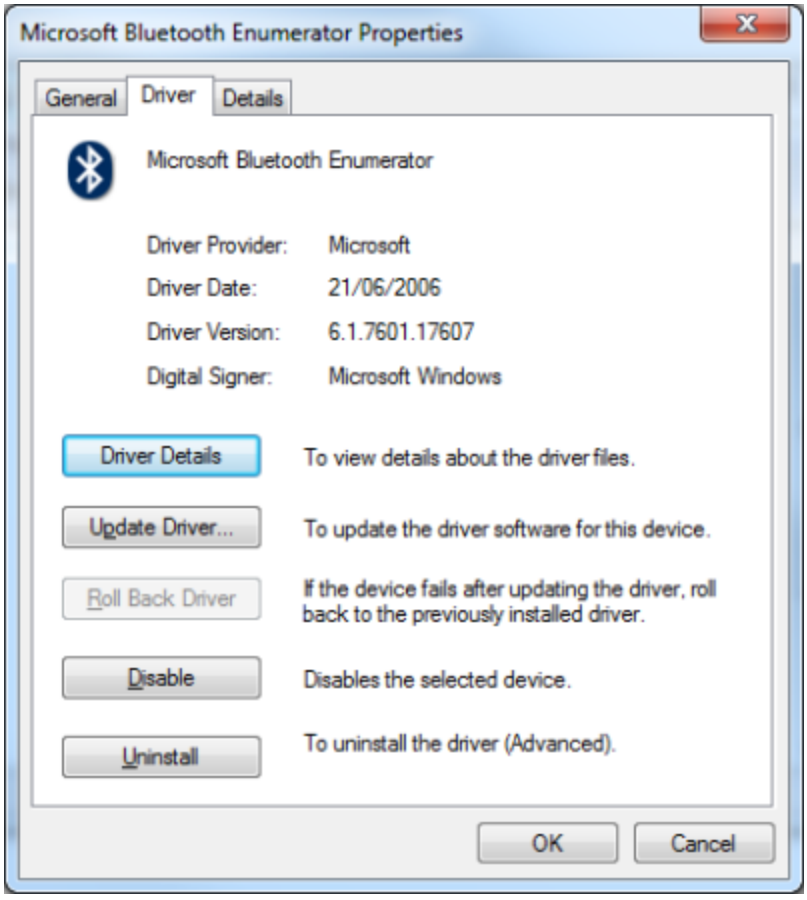
2. Expand the *Bluetooth Radios* node - if no node is present, you have no functioning Bluetooth receiving hardware inside or connected to your PC



3. Right-click *Microsoft Bluetooth Enumerator* and select *Properties*.



4. Select the *Driver* tab



Confirm the *Driver Provider* is Microsoft. If necessary, use the *Uninstall* button to

uninstall the driver files for the device. Disconnect the device, or reboot the PC. Windows should re-detect the device and install its own default Bluetooth driver files for the device.

15.6 Device LED Patterns

BioHarness Device types:

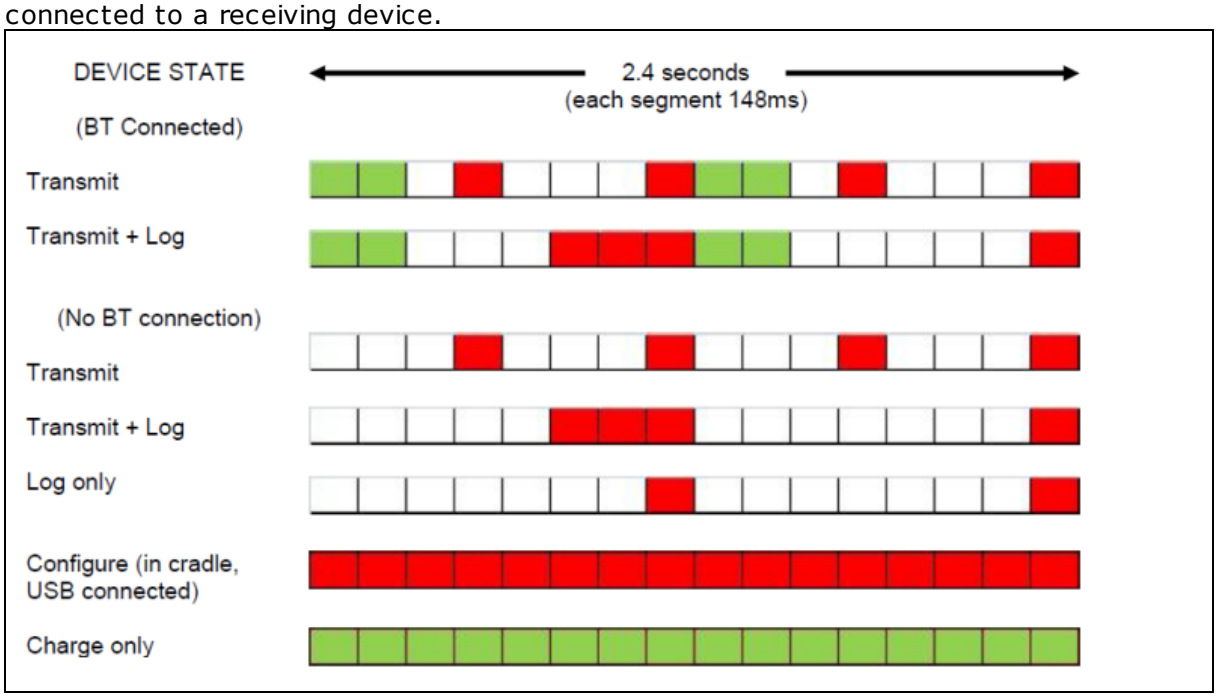
Bluetooth BioHarness v2.0

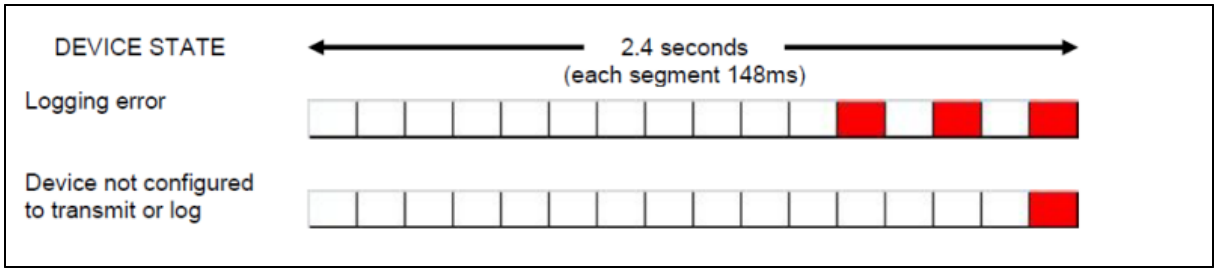
Bluetooth BioHarness 3.0

15.6.1 Bluetooth BioHarness 2.0

BioHarness 2.0

A BioHarness BT can transmit and log simultaneously. Mode of operation is set using the Zephyr Cfg Tool. The device can be set to transmit (red flash), even though it is not connected to a receiving device. An intermittent green flash indicates the device is connected to a receiving device.

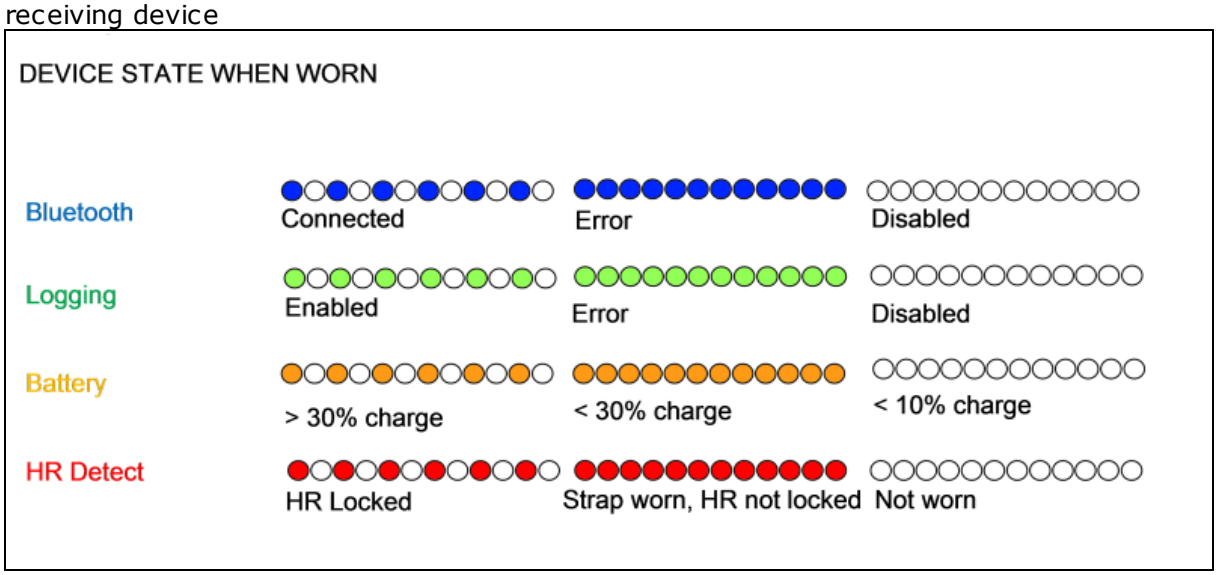




15.6.2 Bluetooth BioHarness 3.0

BioHarness 3.0

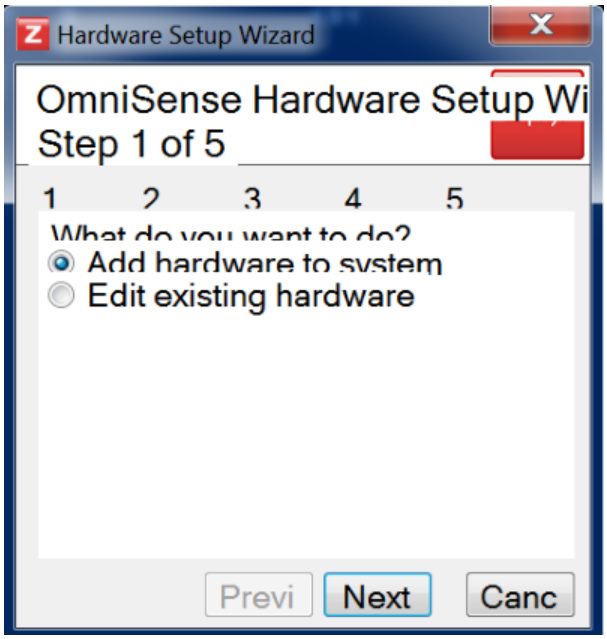
A BioHarness BT can transmit and log simultaneously. Mode of operation is set using the Zephyr Config Tool. The device can be set to transmit, even though it is not connected to a receiving device. An intermittent blue flash indicates the device is connected to a receiving device



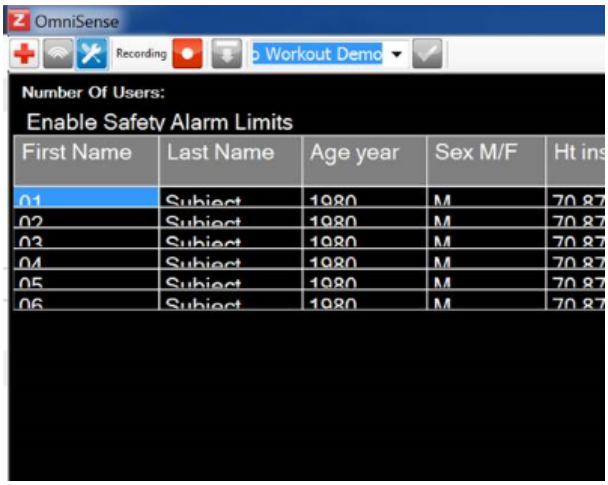
A constant blue LED may indicate that the wrong version of firmware is installed. Each firmware version includes _2G (for Bluetooth and ECHO BioModules) and _3G (for Bluetooth, ECHO and Bluetooth Low Energy BioModules) version. Check that you have the appropriate version installed.

15.7 Screen Setting Issues

After install, some users may see overlapping of screen components:



Overlapping text in a dialogue

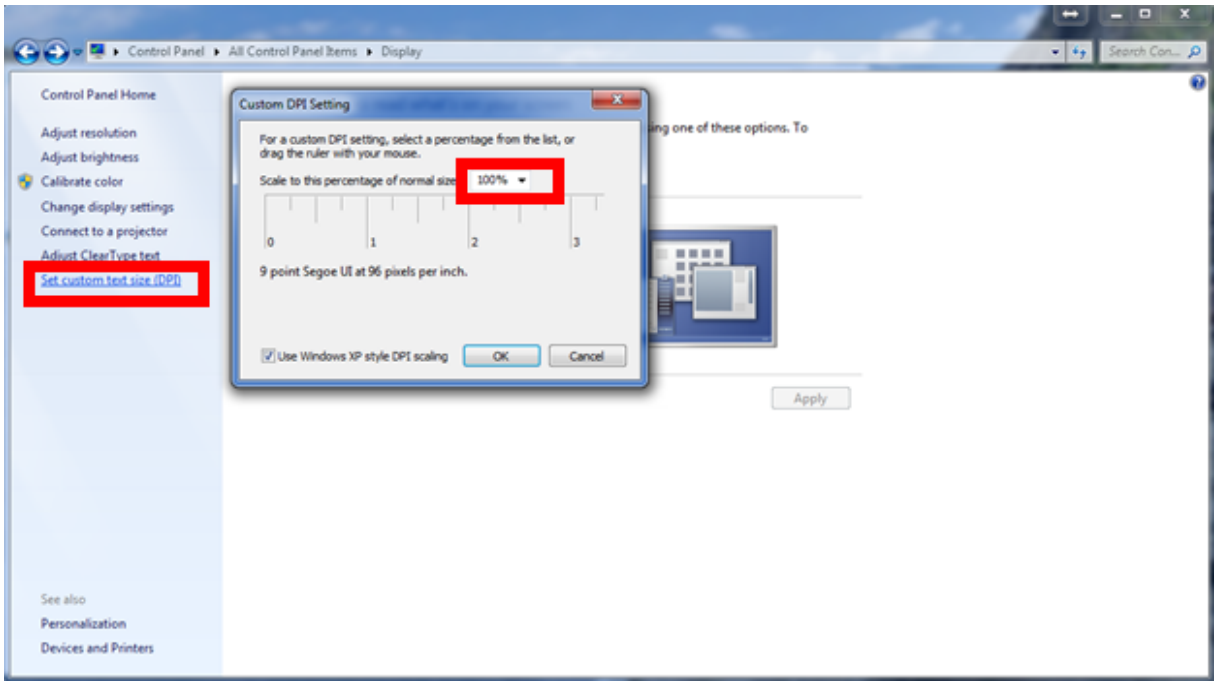


Overlapping cells in the subject table

These issues an be fixed by adjusting a DPI (dots per inch) scale setting in Windows.

Windows 7

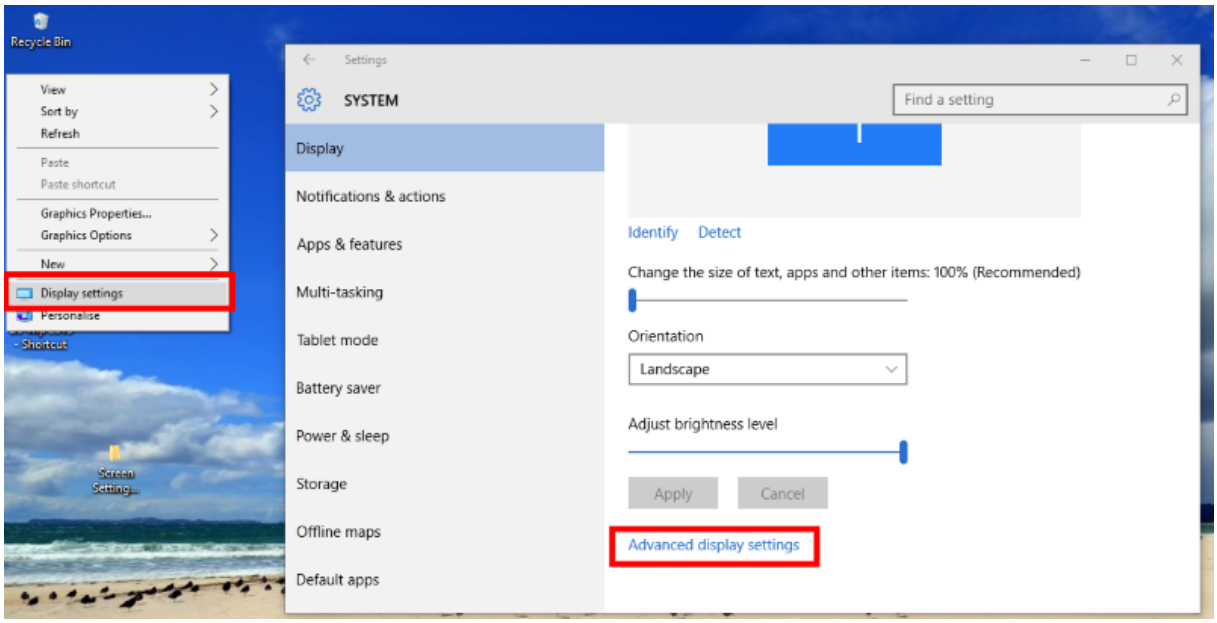
1. Go to *Windows > Start > Control Panel > Display* or
   Windows > Start > Control Panel > Appearance and Personalization > Display



2. Select *Set custom text size (DPI)* and in the dialogue displayed, set *Scale to this percentage...* to 100%

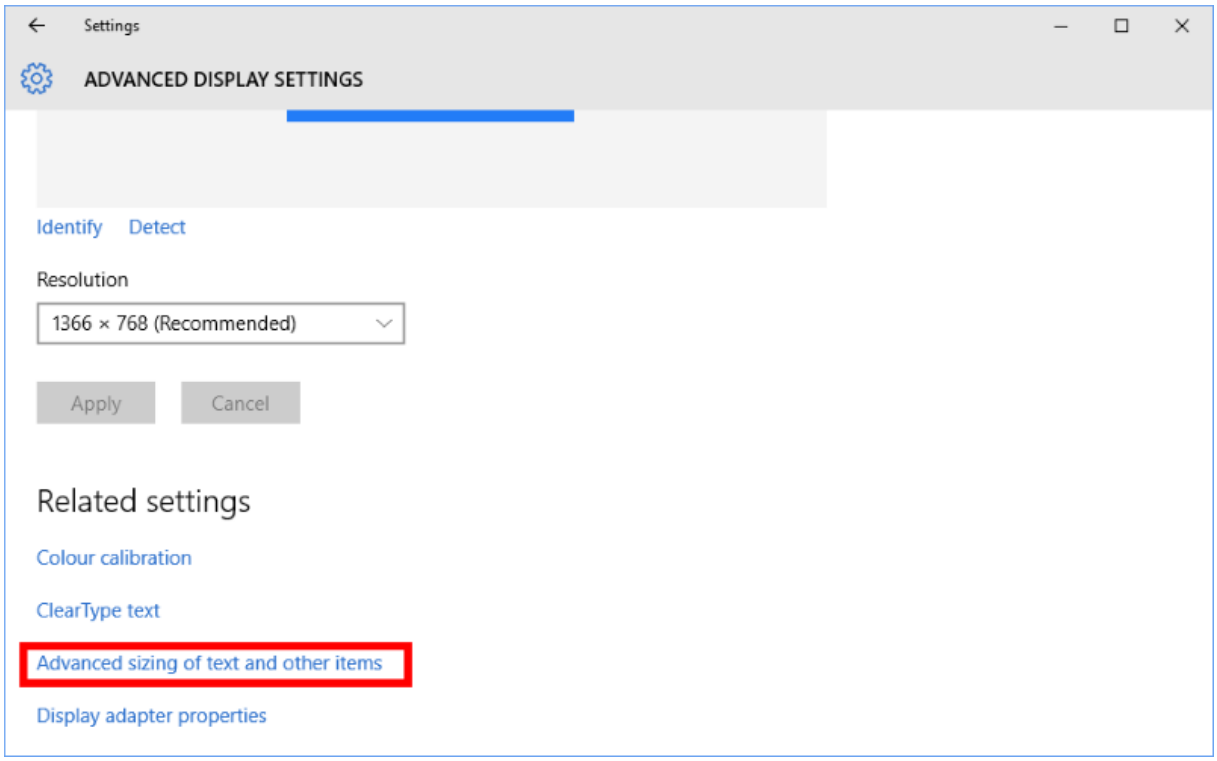
Windows 10

1. *Right*-click on the Windows desktop and select *Display settings* from the context menu (below left)

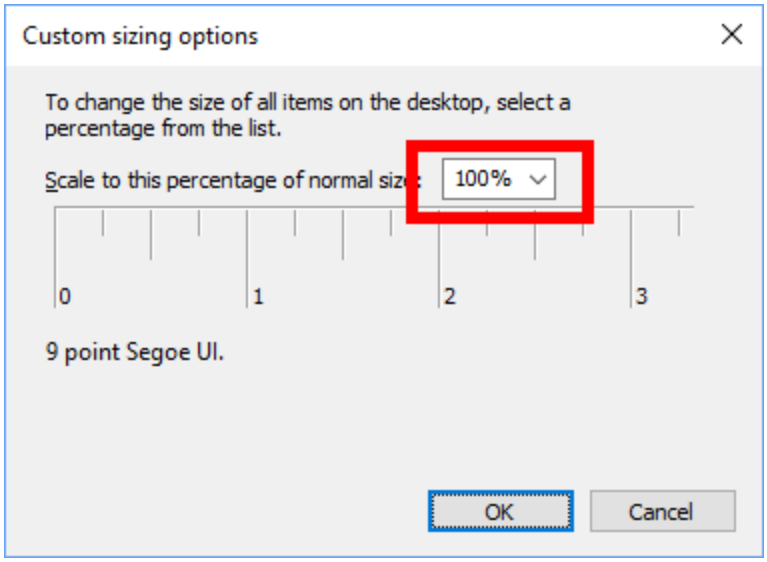


[Ignore the *Change size of text, apps and other items...* slider shown on this dialogue]
Scroll down the Display Settings dialogue and select *Advanced display settings*

2. In *Advanced Display Settings*, select *Advanced sizing of text and other items*.



3. In the *Advanced sizing...* dialogue, set *Scale to this percentage of normal size* to 100%



Part 16

16 Demonstration Mode

Live Module can be operated in Demo mode. In this mode, data can be sourced from configuration files to BioGauges, without the need for any hardware to be assigned to subjects.

Live data from subjects assigned hardware can be displayed at the same time as data sourced from files.

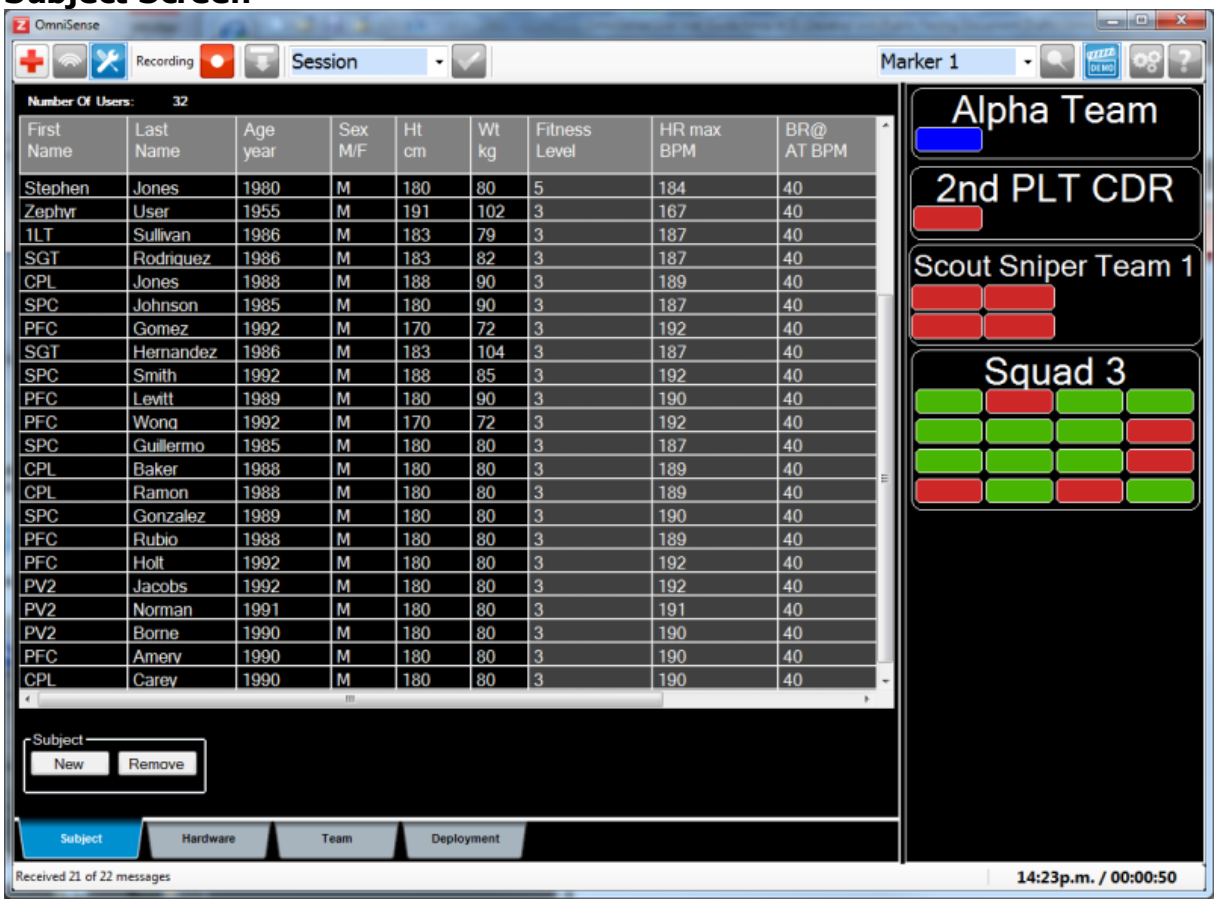
16.1 Live Demonstration

- To enable Demo Mode, use the Preferences button to display the Preferences dialogue, and set *Enable Demo Mode* to *True*.
- This will display the Demo Mode button on the Toolbar. Click this button to engage Demo mode.

- Click the *Live* button to engage
- All gauges and trend graphs behave identically, whether the data is real or simulated
- Real data is saved to the database to the 'No Team Assigned' node
- Simulated data coming from a file is not saved to the database
- Subjects not assigned hardware or a file will show as 'No Hardware'

16.2 Configure Demonstration

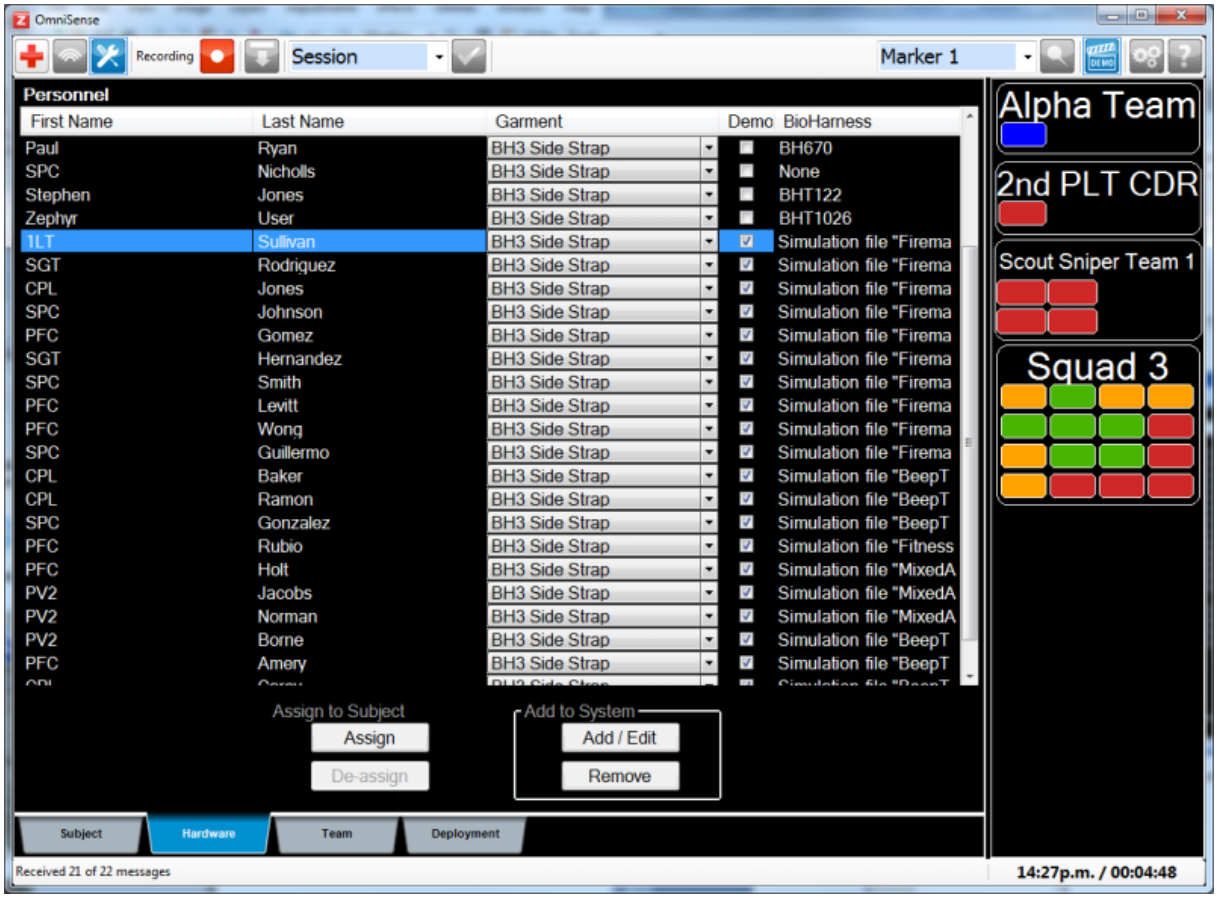
Subject Screen



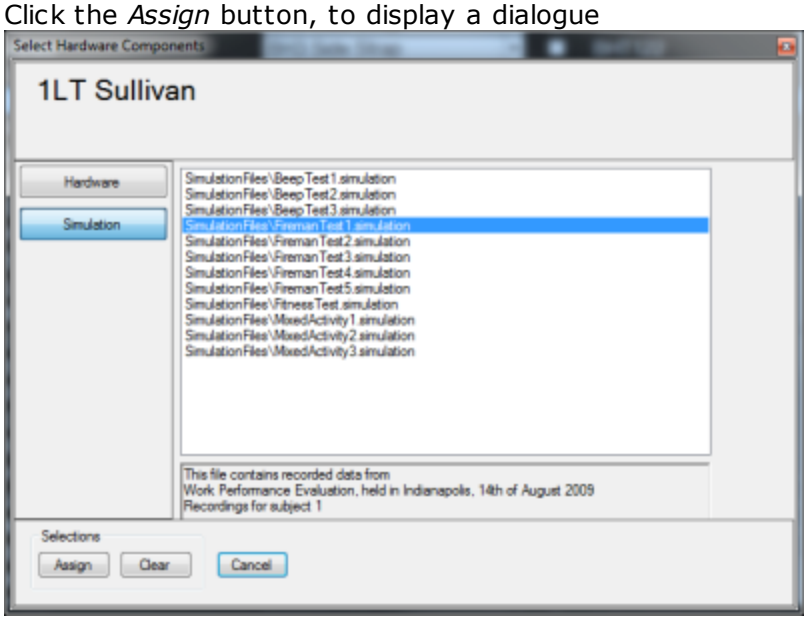
- All real subjects currently in the database are visible
- A number of demo subjects not in the database are visible [These subjects and their physiological parameters are sourced from the simulation files. Their names and data can be edited, but the changes will not be saved – so they will revert to their initial state each time Demo Mode is restarted]
- Extra subjects can be added as required – they are saved into the database as real subjects

16.2.1 Hardware Screen

Hardware Screen



1. Select a check box in the *Demo* column if you wish this subject (real or demo subject) to display simulated data
2. Click the *Assign* button, to display a dialogue



3. Select the desired simulation file and click Assign. (Click the Hardware button if you wish

to assign actual hardware to the subject). The same simulation file can be assigned to many subjects. Simulation files are located at *C:\Program Files (x86)\Zephyr \OmniSense\OmniSense* and can be opened and edited manually using Microsoft® Excel or Notepad. Uncheck and check the file to reassign.

4. Create and deploy teams as for live mode.

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