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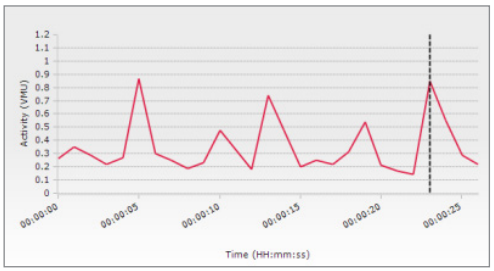
ANALYSIS IMPACT PROCESSING

Overview (1/7)

Accelerometry Overview

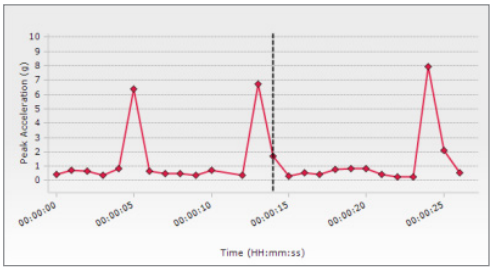
The BioModule contains a 3-axis accelerometer which samples at 100Hz over the range ±16g. The graphs below show the same data available for display in the Analysis module using a simple exercise - jumping from a 3 foot wall down to a hard surface on three occasions to show three clear (vertical) impact events.

Activity Level



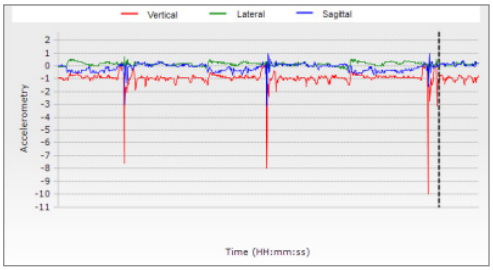
- Reported in Vector Magnitude Units (VMU, indicated in g), once per second. This metric represents the **average** acceleration in each axis, over the previous second. Max VMU is 0.85 in this example.

Peak Acceleration



- Reported in g, once per second. It uses the **peak** acceleration in any one single axis over the previous second. The value is always positive. Peak Acceleration is 7.95 g in this example.

Accelerometry



- Streaming data is reported in g at 50 Hz. Raw accelerometer data is shown. The effect of gravity is not filtered out. The minimum value in the example above is -10g in the vertical axis.

Although each of the three graphs above clearly show three major impacts, quantitative comparison of the impacts is not easy. Once meaningful data is collected in a session containing many large and small impacts, it is difficult to extract meaningful comparisons from raw accelerometer data.

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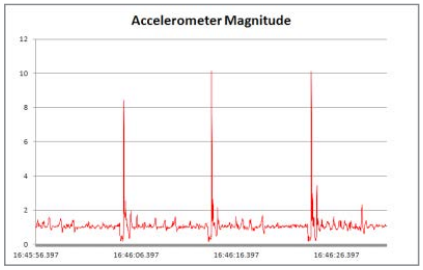
ANALYSIS IMPACT PROCESSING
Overview (2/7)

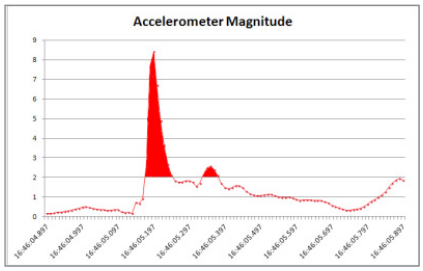
Accelerometer Magnitude

The same three impacts shown in the previous section are illustrated here using data from the external accelerometer magnitude (Accel) file generated by the Zephyr™ Downloader.



Three impacts

- Accelerometer Magnitude is calculated using the formula $\sqrt{(V_g^2 + L_g^2 + S_g^2)}$ where V_g, L_g and S_g are the three axial components of acceleration (Vertical, Lateral & Sagittal). This gives a single positive value.
- Two factors gauge how severe the impact is to the wearer:
  - Maximum value of the accelerometer magnitude
  - Duration of impact (in milliseconds)



Impact 1 detail

- Graph shows first of 3 impacts in more detail. Each dot is a single 100Hz sample.
- Maximum accelerometer magnitude is 8.4g
- The red area under the curve is split into two parts, where magnitude exceeds 2g - the impact, and rebound. The area, measured in Newton Seconds, gives an overall measure of the severity of the impact.
- The AccelPro report gives a very detailed breakdown of each detected impulse event.

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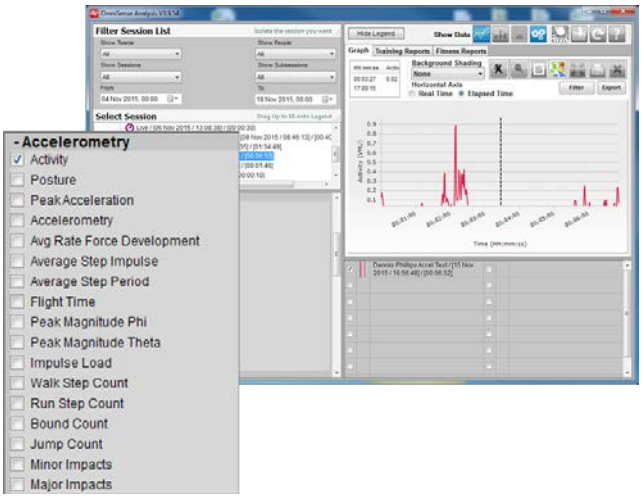
ANALYSIS IMPACT PROCESSING
Overview (3/7)

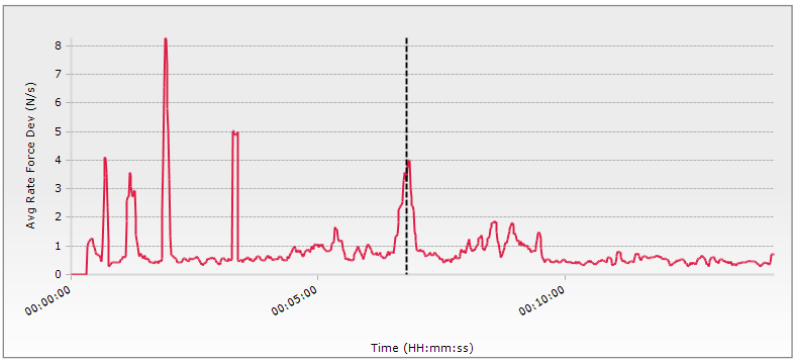
Enhanced Summary Data

Impact processing is dependent on detailed analysis of accelerometer data. Detailed 3-axis accelerometer data cannot be transmitted to OmniSense™ Live for more than one subject at a time, due to radio bandwidth limitations.

Some 3-axis impact calculations are performed internally in the BioModule, and parameters made available in OmniSense™ Analysis. They are available in the **Enhanced Summary** data packet and log format.



Most of the parameters listed above can be displayed from data received by OmniSense™ Live.



Average Rate of Force Development from an Enhanced Summary log

Note

The **Accelerometry** parameter listed above will only contain data if accelerometer data has been enabled in OmniSense™ Live. This is only available for one BioModule at a time.

1. Go to the **Accel** side panel.
2. Select desired BioGauge.
3. Click the **Add** button on the Accel panel to enable accelerometry data for the device.
4. Streaming 3-axis accelerometer data will display on the panel and be available in OmniSense™ Analysis.

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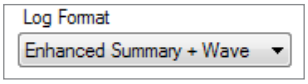
ANALYSIS IMPACT PROCESSING
Overview (4/7)

Accel Waveform Data

Detailed impact analysis - potentially on multiple subjects - is dependent on external files of accelerometer waveform data. The BioModule must be configured to log in **Summary and Waveform** or **Enhanced Summary and Waveform** format. These formats log 3-axis accelerometer waveform data at 100 Hz.



Log Format setting in the Zephyr™ Config Tool

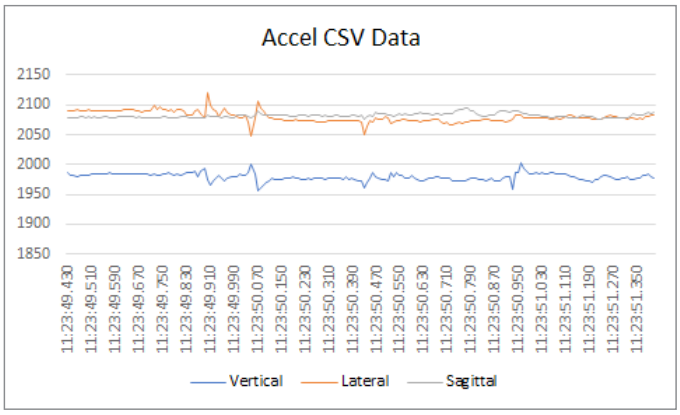
Specifically, the data is contained in the external CSV file generated by the Zephyr™ Downloader with the _Accel title suffix.

Sample BioModule Data_2018_10_05-11_23_49_Accel.csv

- This file contains raw accelerometer data in bits.

	A	B	C	D
1	Time	Vertical	Lateral	Sagittal
2	11:23:49.430	1986	2089	2078
3	11:23:49.440	1982	2090	2078
4	11:23:49.450	1982	2091	2078
5	11:23:49.460	1980	2093	2077
6	11:23:49.470	1982	2091	2080
7	11:23:49.480	1981	2091	2080

- Graphed, the three traces show the individual accelerometer data.



- This **Accel** CSV file contains the raw data for the Zephyr™ **Impact Processor** tool which will generate an **AccelPro Impact Report**.
- Refer to the **BioModule Log Data Descriptions** Appendix for converting accelerometer data from bits to g.

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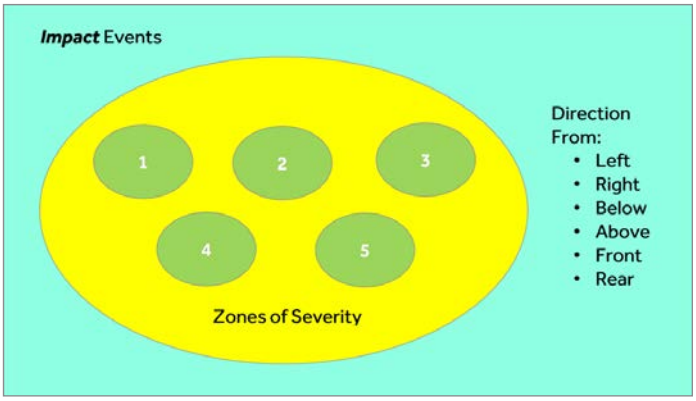
ANALYSIS IMPACT PROCESSING

Overview (5/7)

Types of Impulse

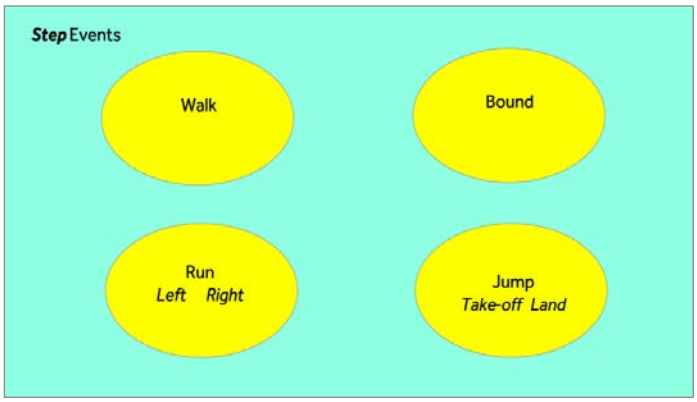
An impulse is any force event which results in a signature in the accelerometer data. OmniSense™ will analyze the accelerometer waveform data and classify impulse events into two types; impact events, and step events.

Impact Events



- An impact results from a collision between the BioModule wearer and an external object (including the ground) or another person, if in a contact sport.
- Impacts are classified into **Zones of Severity**, dependent on the **Peak Accelerometer Magnitude** value detected during the impulse.

Step Events



- A step event results from voluntary movement of the wearer.
- They are categorized into walking, running and bounding steps.
- Jumps have a recognized take-off and landing. These are specific stationary jumps, and not dynamic jumps occurring during periods of high activity.

In all event types, Zephyr™ proprietary algorithms analyze the magnitude, duration and direction of each impulse, together with intervals between successive events, to determine their type.

Some parameters e.g. **Step Period** are averaged over the 10 previous detected step events.

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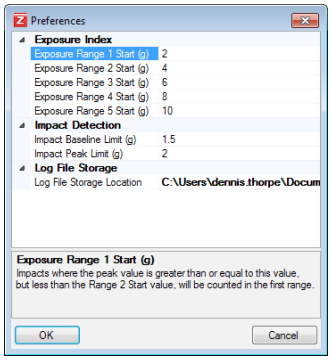
ANALYSIS IMPACT PROCESSING
Overview (6/7)

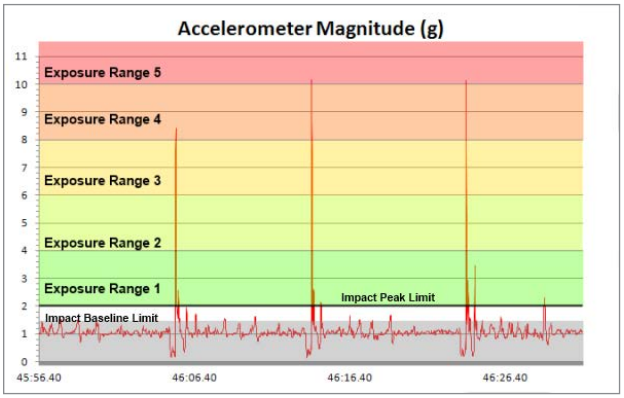
Impact Zones of Severity

Impacts are categorized into five **Zones of Severity** (Exposure Index) for ease of analysis. The zones are classified by Peak Accelerometer Magnitude and can be set in the **Edit > Preferences** menu option in the Zephyr™ Impact Processor Tool.



Item	Description
Exposure Index	Lower thresholds for the five zones, in g
Impact Detection	**Baseline Limit** - a data point with **Peak Accelerometer Magnitude** value above this limit will be considered part of the impact event. This will determine the beginning and the end of an event. **Impact Peak** - the impact event **Peak Accelerometer Magnitude** must be greater than this value to be considered a countable impact event. This allows for low peak value events to be discounted from analysis.
Log File Storage	Location from which the Zephyr™ Impact Processor looks to find **_Accel** waveform files. Defaults to where the Zephyr™ Downloader exports external CSV files.

This graph explains the zones in context of the raw accelerometer magnitude data.



- The majority of the data lies below the baseline limit of 1.5g - in the grey zone.
- From left to right, the first impact is in Exposure Range 4, with two following in Exposure Range 5. Each of these has a rebound which will be included in that impact event.
- One lesser impact in Exposure Range 1 follows at the end of the sample.

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ANALYSIS IMPACT PROCESSING

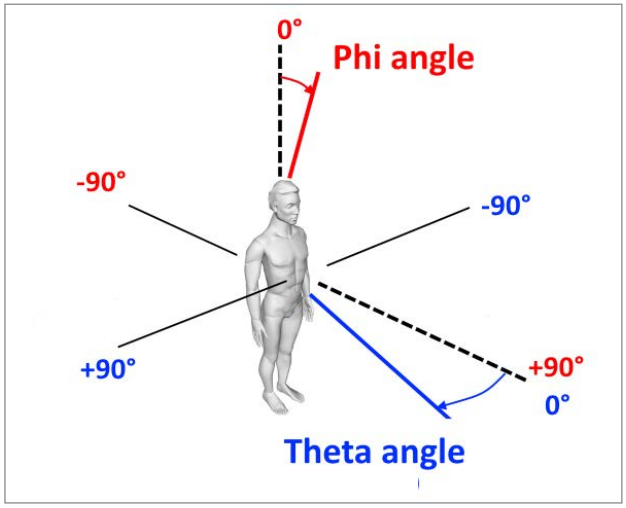
Overview (7/7)

Impact Angle

Analysis of the X, Y & Z accelerometer components can determine the direction from which the impact event has originated.

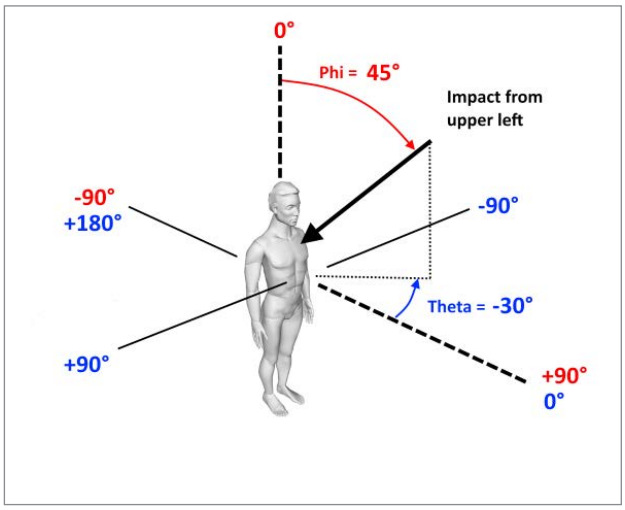
This is indicated by two angles, measured in degrees:

- **Theta** - angle in the horizontal plane. Subject straight ahead = 0°. From subject right is a positive value, from subject left is negative.
- **Phi** - angle in the vertical plane. Vertically upwards = 0°. Impact angle from in front of subject is a positive value, impact angle from behind subject is negative.



Theta and Phi angles of impact

Example



This example shows an impact from the subject's 10 o'clock position, angled from 45 degrees above the horizontal plane.

Theta is -30° (from subject's left), **Phi** is +45° (from vertical).

Any step-related impulse will have a Phi angle approaching +180° (from directly below the subject), which will flag the impulse event as a step.

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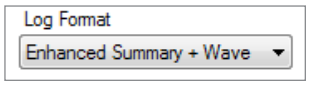
AccelPro Impact Report

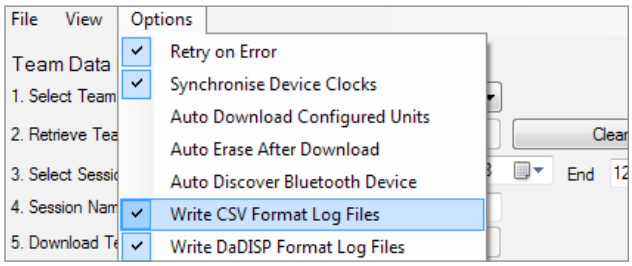
Prerequisites

In order to be able to generate an AccelPro report:

- Accelerometer waveform data must have been logged in the subject BioModule configured to log in **Summary and Waveform** or **Enhanced Summary and Waveform** format.



- The **Zephyr™ Downloader** must have the option **Write CSV Format Log Files** checked when data is imported from the subject BioModule. This preference is saved once it is checked.



- This will ensure that the '..**_Accel**' waveform files the **Zephyr™ Impact Processor** uses to generate a report are available.

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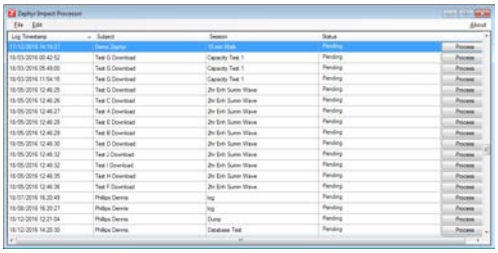
Impact Processor Tool

1. Start the Impact Processor Tool using the toolbar button in Analysis.

2. The Zephyr™ Impact Processor will display, showing all '**..._Accel**' files in the default file location which have not yet been processed by the tool. The default location can be reset in the Preferences of the tool . Use the column heading buttons to re-sort the entries by **Log Timestamp**, **Subject**, **Session Name** or **Status** to locate a record.



Note

Microsoft™* Excel™* 2010 or later must be installed to open a report.

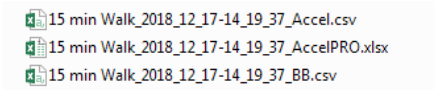
Note

Naming sessions effectively when recording in OmniSense™ Live, or when importing data using the Zephyr™ Downloader, will make them easier to locate in the Impact Processor tool.

3. Click the **Process** button for the record or records to be processed.

The **Status** will change to **Done**, and the button will now show **Open**.

4. To locate the report directly, browse to the location containing the original '**..._Accel**' file. The report is an additional Microsoft™* Excel™* file saved to that location, with the same Session Name_Timestamp_ prefix as the original Accel file.



The report will have the suffix and file extension '**_AccelPro.xlsx**'

Menu > File Options

- **Open Manually** - browse to the **_Accel** file if not in the default location.
- **Process All Unprocessed Files** - will process all records and generate a report for each.
- **Generate Accel Pro Report** - legacy option. An AccelPro report will be generated whether checked or unchecked.

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ANALYSIS IMPACT PROCESSING

AccelPro Impact Report (3/9)

5. The report spreadsheet contains 3 page tabs:
   - **Summary** - a breakdown of impulse types with some summary statistics

		Zone 1 Count < 4g	Zone 1 g Load	Zone 1 Impulse Load N*s	Zone 2 Count 4 - 6g	Zone 2 g Load	Zone 2 Impulse Load N*s	Zone 3 Count 6 - 8g	Zone 3 g Load	Zone 3 Impulse Load N*s	Zone 4 Count 8 - 10g	Zone 4 g Load	Zone 4 Impulse Load N*s	Zone 5 Count > 10g	Zone 5 g Load	Zone 5 Impulse Load N*s	Total Count	Total peak g Load	Total Impulse Load N*s	Ave Force Development N/s	Average Peak g	Average Impulse N*s	Average Period s	Max Flight Time s	Averages Period / Average R Period (VALID FOR RUNNING ALONG A STRAIGHT PATH)
I	From Left	3	7.6	6.6	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	14.6	2.5	4	22.2	9.1						
M	From Right	0	0.0	0.0	1	5.1	1.3	0	0.0	0.0	0	0.0	0.0	1	11.0	2.2	2	16.2	3.3						
P	From Front	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	15.0	2.4	1	15.0	2.4						
A	From Back	0	0.0	0.0	1	4.8	1.2	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	4.8	1.2						
C	From Above	0	0.0	0.0	1	5.0	2.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	5.0	2.0						
T	From Below	2	2.4	4.7	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2	2.4	4.7						
	Sub Total	5	10.4	11.3	3	14.9	4.5	0	0.0	0.0	0	0.0	0.0	3	40.6	7.1	11	65.9	22.9						
S	Walking																1397	2181.9	4464.6	0.655	1.56	3.196	0.561		
T	Running																53	151.7	105.9	5.623	2.86	1.999	0.393		
E	Intense Running																0	0.0	0.0						
P	Bounding																14	35.4	31.0	4.188	2.53	2.217	0.478		
S	Jumps																0	0.0	0.0					0.000	
	Sub Total																1464	2368.9	4601.6		1.62	3.143			
IMPULSE TOTAL																	1475	2434.9	4624.5						

   - **Impulse Data Lines** - more detailed data on detected impulse events. Each entry includes a hyperlink to the section of the Accelerometry Stream tab pertaining to that event.

Time of Peak	Magnitude g	Impulse N*s	Duration s	Rise Time s	Fall Time s	30 ms Rate of Force Development N/s	30 ms Rate of Force Decline N/s	Time since last Peak s	Phi Peak	Theta Peak	Classification	Tyre	Orientation
14:19:38.49	1.41	2.17	0.17	0.00	0.00	0.36	-0.44	1.06	171	-154	Impact	Zone 1	From Below
14:19:39.38	1.38	2.55	0.21	0.00	0.00	0.10	-0.35	0.89	160	166	Impact	Zone 1	From Below
14:19:40.12	1.45	2.28	0.18	0.00	0.02	0.10	-0.86	0.74	167	169	Step	Walk	
14:19:40.86	1.33	3.28	0.27	0.00	0.00	0.01	-0.78	0.74	172	109	Step	Walk	
14:19:41.53	1.36	2.59	0.22	0.00	0.00	0.18	-0.52	0.67	162	166	Step	Walk	
14:19:42.25	1.36	3.25	0.27	0.00	0.00	0.31	-0.14	0.72	165	178	Step	Walk	
14:19:42.90	1.42	2.53	0.21	0.00	0.00	0.70	-0.16	0.65	158	160	Step	Walk	
14:19:43.67	1.33	3.29	0.27	0.00	0.01	0.03	-0.76	0.77	171	47	Step	Walk	
14:19:44.27	1.57	2.12	0.16	0.00	0.02	0.64	-0.75	0.60	163	175	Step	Walk	
14:19:44.96	1.33	2.71	0.22	0.00	0.00	0.22	-0.57	0.69	166	180	Step	Walk	
14:19:45.65	1.35	2.44	0.21	0.00	0.00	0.30	-0.66	0.69	158	177	Step	Walk	
14:19:46.40	1.48	4.20	0.38	0.00	0.01	0.54	-0.73	0.75	167	148	Step	Walk	
14:19:46.89	0.98	2.46	0.25	0.00	0.00	0.02	-0.02	0.49	160	121	Step	Walk	
14:19:54.70	1.35	2.61	0.22	0.00	0.02	0.45	-0.83	7.81	162	165	Step	Walk	
14:19:55.63	1.12	1.93	0.18	0.00	0.00	0.21	-0.23	0.93	171	-86	Step	Walk	
14:19:56.29	1.90	1.96	0.13	0.04	0.03	1.61	-1.20	0.66	169	139	Step	Walk	
14:19:56.81	2.02	1.69	0.10	0.02	0.03	1.03	-1.69	0.52	160	-69	Step	Bound	

   - **Accelerometry Stream** - 100 Hz line-by-line values for accelerations in each axis and associated data.

Time	Vertical g	Lateral g	Sagittal g	Magnitude g	Phi	Theta	Instant Rate of Force N/s	Impulse N * s
14:19:38.40	-1.01	0.19	0.33	1.08	159	149	0.50	0.11
14:19:38.41	-1.08	0.17	0.37	1.16	159	155	0.80	0.23
14:19:38.42	-1.13	0.14	0.42	1.22	158	161	0.59	0.35
14:19:38.43	-1.14	0.13	0.43	1.23	158	163	0.14	0.48
14:19:38.44	-1.16	0.14	0.41	1.24	159	160	0.04	0.60
14:19:38.45	-1.18	0.12	0.37	1.24	161	162	0.09	0.73
14:19:38.46	-1.25	0.05	0.37	1.31	163	172	0.65	0.86
14:19:38.47	-1.33	0.00	0.30	1.36	167	180	0.52	1.00
14:19:38.48	-1.39	-0.06	0.24	1.41	169	-166	0.49	1.15
14:19:38.49	-1.40	-0.10	0.19	1.41	171	-154	0.07	1.29
14:19:38.50	-1.37	-0.16	0.13	1.39	171	-131	-0.26	1.43
14:19:38.51	-1.31	-0.13	0.07	1.32	173	-119	-0.68	1.57
14:19:38.52	-1.28	-0.12	0.04	1.28	174	-107	-0.39	1.70
14:19:38.53	-1.24	-0.08	0.04	1.24	175	-114	-0.40	1.82
14:19:38.54	-1.18	-0.04	0.08	1.18	175	-157	-0.61	1.95
14:19:38.55	-1.13	0.00	0.12	1.14	173	180	-0.46	2.06
14:19:38.56	-1.05	-0.02	0.12	1.06	172	-169	-0.85	2.17

The following sections describe each part of the report in more detail.

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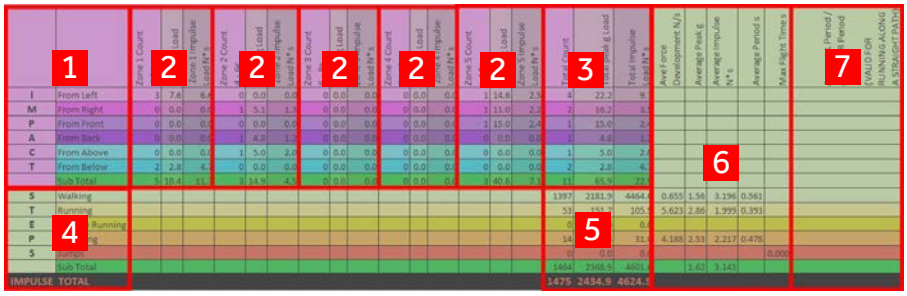
ANALYSIS IMPACT PROCESSING

AccelPro Impact Report (4/9)

Report Summary Tab

The **Summary** tab shows counts of the various impulse types and some summary values for the impact severity zones and step types.



#	
1	Impact types by direction of incoming impact.
2	Impact Zones 1-5 with counts (by incoming direction), peak g and total impulse load.
3	All impact zones total counts, cumulative peak g and total impulse load.
4	Steps by type.
5	All step types total count, cumulative peak g and total impulse load
6	Summary Data (see below) for step types
7	Average left/right running step period for straight line running, if detected.

Impact Parameters

Parameter	Description
Zone # Count	The number of impacts in the 1/2/3/4/5 Impact Zones as configured in the Edit>Preferences menu option of the Impact Processor tool.
Zone # g Load	The sum of the Peak g values for each impact in the given category.
Zone # Impulse Load	A summation of the accelerometer magnitude samples for the impulse expressed in Newton Seconds.
Total Count	The total number of impact events in each given category.
Total Peak g Load	The total Peak g Load of events categorized as above.
Total Impulse Load	The total Impulse Load of events categorized as above.

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AccelPro Impact Report (5/9)

Summary Parameters

Parameter	Description
Average Force Development Rate	Average of all events in each walking/running/bounding/jumping type in Newtons per Second. This is a measure of how 'sharp' or 'soft' an impulse is.
Average Peak g	Average Peak g of all events categorized as above.
Average Impulse	Measured in Newton seconds. This is the 'area under the curve' of accelerometer data.
Average Period	Average period between steps - a measure of cadence.
Max Flight Time	Maximum time in the air of all jump events.
Average L/R Period	Average left/right step time for running in a straight line.

Note

Flight Time for jump events is for a specific type of jump - that used in assessing a basketball player's performance.

The subject is stationary, crouches, pauses briefly, and then springs up vertically for their maximum upper reach to be measured.

Jumps which are embedded within other activities will not satisfy these criteria, and will not be registered as jump events.

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Impulse Data Lines Tab

The summary tab itemizes each detected impulse (impact or step type) and provides more detailed analysis. The first column in each record is a hyperlink to the relevant lines in the Accelerometry Stream tab of the report.

Note

The Impulse data lines contain **only** entries for

- Detected impact events which comply with impact filtering criteria set in the Preferences dialog of the Zephyr™ Impact Processor - the **Exposure Index**, **Impact Baseline Limit** and **Impact Peak Limit**.
- Step, run, bound or jump-type impulses.

Thus, **there will be gaps in the data** where impacts occur but these criteria are not met, or when the subject is perhaps stationary.

1	Time of Peak	Magnitude g	Impulse N*s	Duration s	Rise Time s	Fall Time s	30 ms Rate of Force Development N/s	30 ms Rate of Force Decline N/s	Time since last Peak s	Phi Peak	Theta Peak	Classification	Type	Orientation
2	14:19:38.49	1.41	2.17	0.17	0.00	0.00	0.36	-0.44	1.06	171	-154	Impact	Zone 1	From Below
3	14:19:39.38	1.38	2.55	0.21	0.00	0.00	0.10	-0.35	0.89	160	166	Impact	Zone 1	From Below
4	14:19:40.12	1.45	2.28	0.18	0.00	0.02	0.10	-0.86	0.74	167	169	Step	Walk	
5	14:19:40.86	1.33	3.28	0.27	0.00	0.00	0.01	-0.78	0.74	172	109	Step	Walk	
6	14:19:41.53	1.36	2.59	0.22	0.00	0.00	0.18	-0.52	0.67	162	166	Step	Walk	
7	14:19:42.25	1.36	3.25	0.27	0.00	0.00	0.31	-0.14	0.72	165	178	Step	Walk	
8	14:19:42.90	1.42	2.53	0.21	0.00	0.00	0.70	-0.16	0.65	158	160	Step	Walk	
9	14:19:43.67	1.33	3.29	0.27	0.00	0.01	0.03	-0.76	0.77	171	47	Step	Walk	
10	14:19:44.27	1.57	2.12	0.16	0.00	0.02	0.64	-0.75	0.60	163	175	Step	Walk	
11	14:19:44.96	1.33	2.71	0.22	0.00	0.00	0.22	-0.57	0.69	166	180	Step	Walk	

Column	Description
Time of Peak	Time stamp of peak g during the impulse event. A hyperlink to the relevant section in the **Accelerometry Stream**.
Magnitude g	Peak Magnitude g.
Impulse N*s	Total Impulse magnitude in newton seconds. This accumulates during the impulse and is the value shown on the final line in the accelerometer stream for the event. The 'area under the curve'.
Duration s	Duration of impulse.
Rise Time s	Time from start to peak g of impulse.
Fall Time s	Time from peak g to end of impulse.
30ms Rate of Force Development	Rate of increase of force in newtons per second, 30 milliseconds prior to peak g.
30ms Rate of Force Decline	Rate of decrease of force in newtons per second, 30 milliseconds after peak g.
Time since last peak	Time elapsed since peak g of previous detect impulse.
Phi Peak	Phi angle at peak g (see Impact Angle section).
Theta Peak	Theta Angle of peak g (see Impact Angle section).
Classification	Impact or Step.
Type	Impact Zone, or Step Type (walk, run, bound, jump).
Orientation	If impact, above/below left/right front/rear direction from which the impact originated.

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ANALYSIS IMPACT PROCESSING

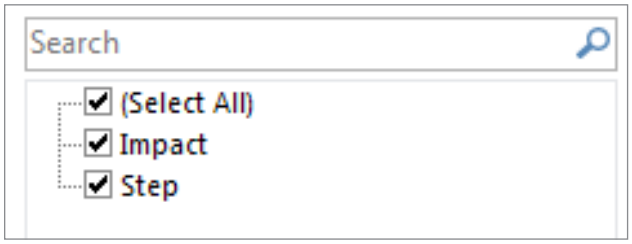
AccelPro Impact Report (7/9)

Report Summary Tab Data Filters

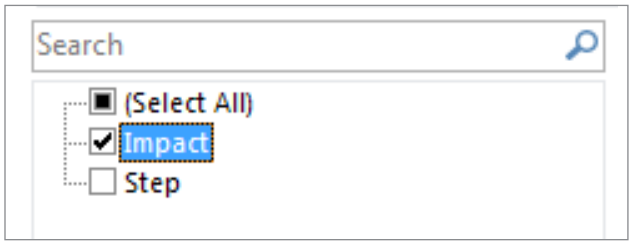
Each column heading in the Impulse Data Lines tab of the report has a data filtering pull down ▾.

Use this to select specific entries of interest.

1. For example, to only see Impact impulses, select the pull-down in the **Classification** column heading.



2. De-select the **Select All** check box to clear both **Impact** and **Step** classifications, and then re-select **Impact** only.



3. Select **OK** in the dialog. The report will now only show impulse events of classification **Impact**.

1	Time of Peak	Magnitude g	Impulse N*s	Duration s	Rise Time s	Fall Time s	30 ms Rate of Force Development N/s	30 ms Rate of Force Decline N/s	Time since last Peak s	Phi Peak	Theta Peak	Classification	Type	Orientation
333	14:22:52.99	14.97	2.38	0.03	0.01	0.02	47.56	-45.43	0.70	116	-41	Impact	Zone 5	From Front
334	14:22:53.32	14.61	2.50	0.03	0.01	0.02	46.85	-44.74	0.33	76	-59	Impact	Zone 5	From Left
1250	14:31:24.80	11.03	2.22	0.04	0.01	0.03	33.78	-30.72	0.71	113	82	Impact	Zone 5	From Right
1268	14:31:35.21	4.76	1.21	0.04	0.01	0.03	12.85	-9.64	0.51	73	147	Impact	Zone 2	From Back
1274	14:31:38.68	2.03	3.89	0.26	0.06	0.06	4.42	-1.50	0.45	105	-134	Impact	Zone 1	From Left
1290	14:31:48.04	2.81	0.49	0.02	0.01	0.01	7.08	-5.04	0.34	102	-84	Impact	Zone 1	From Left
1312	14:32:01.31	2.77	2.20	0.11	0.04	0.04	7.09	-2.45	0.39	108	-116	Impact	Zone 1	From Left

4. Use a similar approach to filter by any column; text or numerical value.
   - Deselect the **Select All** check box, then select the required entries from the entire list of values. All lists default to ascending numeric or alphanumeric order.
   - Reselect the **Select All** to return to the unfiltered report.
   - Any filtered columns will display a filtered data icon.

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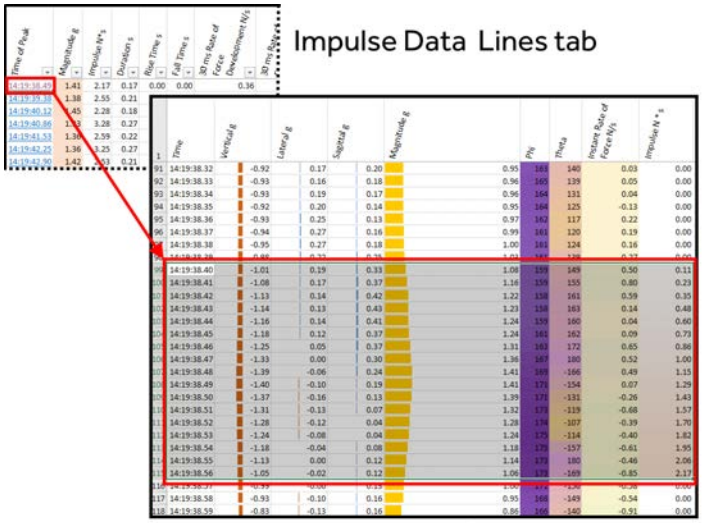
Accelerometry Stream Tab

This tab contains a line for every individual accelerometer sample at 100 Hz, and as such may contain a very large number of lines of data. Browsing the tab itself will be time consuming.

It is best accessed from the **Impulse Data Lines** tab, by selecting the hyperlink in the **Time of Peak** column entry for the desired impulse event.



Accelerometery Stream tab

- All of the accelerometry stream lines for the selected impulse event will be auto-selected in the Accelerometry Stream tab.

Note

If you accidentally click on any cell in the **Accelerometry Stream** tab, the preselected lines for an impulse event will be de-selected. Return to the **Impulse Data Lines** tab and re-select the hyperlink to resume selection of the **Accelerometry Stream** lines for the event.

- **Vertical**. **Lateral**, **Sagittal** and **Magnitude g** values in the tab are represented graphically by horizontal colored bars, to better represent the location of any individual line within the envelope of the entire impulse. Other cells are color-coded and shaded to show progressions of magnitude or direction.

Time	Vertical g	Lateral g	Sagittal g	Magnitude g	Phi	Theta	Instant Rate of Force N/s	Impulse N * s
14:22:53.31	-0.72	0.31	0.43	0.90	143	144	0.47	0.00
14:22:53.32	3.36	-12.07	-7.52	14.61	76	-59	139.85	1.49
14:22:53.33	0.19	-5.60	-3.37	6.54	88	-59	-82.30	2.16
14:22:53.34	0.19	-3.20	-0.99	3.36	86	-73	-32.46	2.50
14:22:53.35	-0.29	-1.40	0.27	1.45	101	-101	-19.45	0.00

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ANALYSIS IMPACT PROCESSING

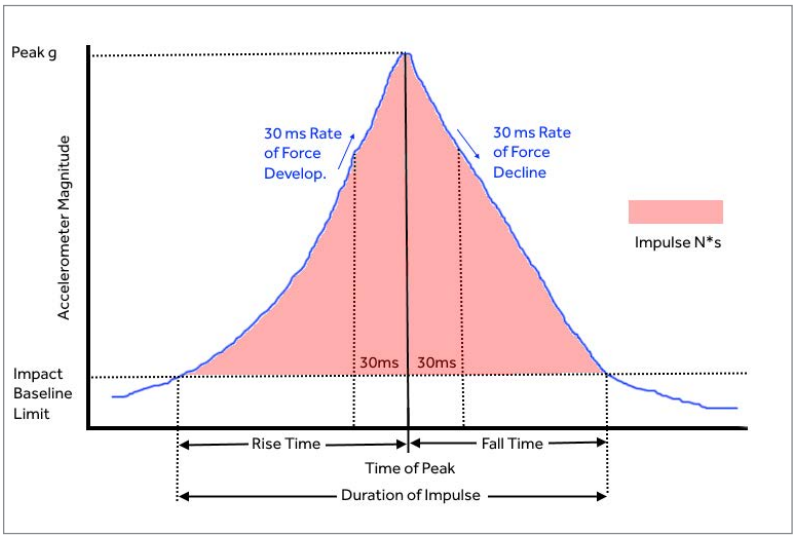
AccelPro Impact Report (9/9)

Accelerometry Stream Parameters

Parameter	Description
Time	Timestamp of 100 Hz accelerometer data sample.
Vertical g	Vertical 3-axis g component.
Lateral g	Lateral (subject side to side) g component.
Sagittal g	Sagittal (subject front to rear) g component.
Magnitude g	$\sqrt{(x^2 + y^2 + z^2)}$ where x, y & z are the vertical, lateral and sagittal g components.
Phi Rad	Vertical angle of incoming impact in Radians. (1 Radian = 57.296 degrees)
Theta Rad	Horizontal angle (bearing) of incoming impact in Radians.
Instant Rate of Force N/S	Rate of change of force. Positive during the rise of the impulse, negative during the fall.
Impulse (Load) N*S	The 'area under the curve' of the accelerometer data. This starts at 0 for each event, and accumulates to a total (maximum) value on the last line for the event.

Anatomy of an Impulse

This diagram shows an impulse, with the major parameters illustrated.



The total **Impulse Load** (area under the curve) takes into account both the magnitude and duration of the impulse.

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Fitness Reports

Fitness Reports make comparisons for a selection of fitness parameters which are **already held** in the OmniSense™ database. Not all parameters need be present for each athlete.

- VO_2 max
- % VO_2max @ AT
- HR max
- HR @ AT
- HR @ AT as a % of HR max
- BR @ AT
- Heart Rate Recovery 30 sec
- Min Heart Rate Standing
- Min Heart Rate Resting
- Min Breathing Rate Resting
- Resting Heart Rate Variability

These parameters will exist in the database because they have been

- Entered manually in the OmniSense™ Live **Setup > Subject** screen:

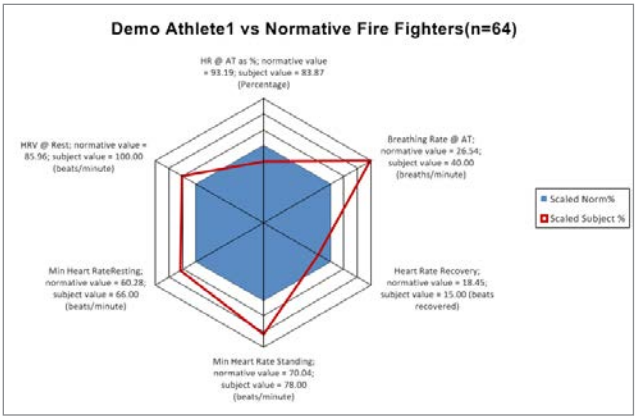
Enable Safety Alarm Limits

First Name	Last Name	Age year	Sex M/F	Ht cm	Wt kg	Fitness Level	HR max BPM	Wt kg	Fitness Level	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
Demo	Athlete1	1981	M	177.8	70.3	0	183	70.31	0	160	40	165	146	40	35	4	39.2		52	65	94

- Saved as a result of performing a Readiness Test, or analysis of a Treadmill or Beep test. Refer to the **Baseline Fitness Testing** section.
- Both types of report (Individual & Team) compare an individual's parameters against a normative sample. For Individual reports, the Normative can be a template supplied by Zephyr™ containing data from one of four examples:
  - Fire Fighter
  - Military Special Forces
  - Pro Soccer Player
  - Female College Basketball player
- Users can create a custom normative if necessary.
- For Team Fitness reports, the normative is the average for the Team.

Each report has two separate components.

Radar Plot



Axes are scaled so that the normative values (blue solid) form a regular shape. If some parameters have no value for the subject, they are omitted in the radar plot. The subject values are represented by the red polygon.

Note that some values - such as VO_2max - are considered advantageous when **high**, where as other - such as standing heart rate - are superior when **low**.

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Table

FITNESS TEST REPORT

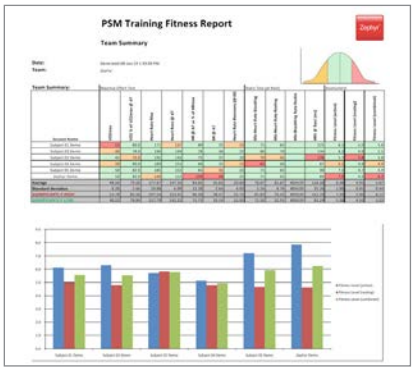
Name: **Demo Athlete1**
Comparison: Normative Fire Fighters(n=64)
Date: Generated:07-Jan-19 2:31:17 PM

Demo Athlete1	Scaled Subject %	Scaled Norm%	Min	Max	Subject	Normative	Description
HR @ AT as % of HRMax	0.40	0.50	48.51	137.87	83.87	93.19	HR @ AT as %; normative value = 93.19; subject value = 83.87 (Percentage)
Breathing Rate @ AT	0.79	0.50	3.54	49.55	40.00	26.54	Breathing Rate @ AT; normative value = 26.54; subject value = 40.00 (breaths/minute)
Heart Rate Recovery	0.41	0.50	-0.78	37.68	15.00	18.45	Heart Rate Recovery; normative value = 18.45; subject value = 15.00 (beats recovered)
Min Heart Rate Standing	0.72	0.50	51.52	88.55	78.00	70.04	Min Heart Rate Standing; normative value = 70.04; subject value = 78.00 (beats/minute)
Min Heart Rate Resting	0.61	0.50	34.69	85.87	66.00	60.28	Min Heart RateResting; normative value = 60.28; subject value = 66.00 (beats/minute)
HRV @ Rest	0.60	0.50	19.10	152.83	100.00	85.96	HRV @ Rest; normative value = 85.96; subject value = 100.00 (beats/minute)

- The table gives the same information as in the radar plot.

Team Fitness Report

Where the fitness report is for a team, no normative file is selected. The normative is the set of average values for the team.



Session Summary Page

Subject Page

- The **Session Summary** page shows a table and a bar chart with an entry for each team member. There is a separate **Subject Page** for each team member.

Note

Subscribed subjects can perform remote Readiness and Fitness Tests which will update their individual fitness parameters to the OmniSense™ Cloud database via the OmniSense™ Mobile application.

This will render fitness parameters saved in a local PC database out of date, until the PC user connects to the web portal.

At this point subject fitness parameters will be automatically synchronized with the cloud.

An equivalent process will trigger if fitness tests are carried out using a local PC - the cloud database will be updated with any fitness parameters established locally.

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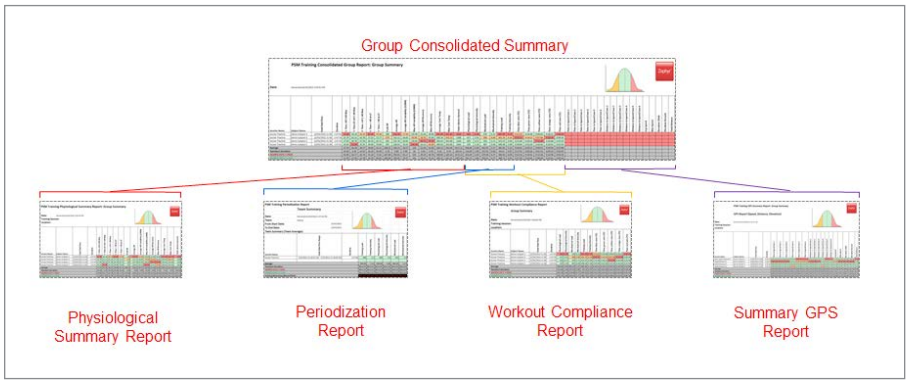
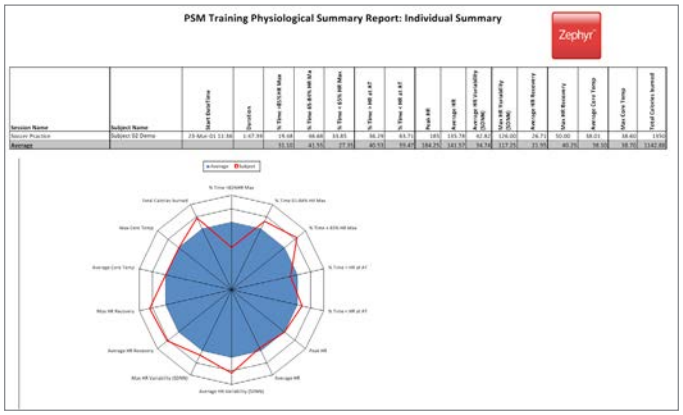
Training Reports

To create a Training Report, select specific sessions or subsessions from the **Select Sessions** pane and drag them to the **Training Report** pane. The Training Report will reflect a subject's performance - compared to the mean for all the sessions in the report.

There are five report options. Four are subsets of the **Group Consolidated Summary**, which shows all available parameters.



- As for Fitness Reports, the format is a multi-tab spreadsheet, with individual subject tabs.



- Each subject tab compares the subjects values compared to the session averages, in table and radar plot form.

Note

When a report of any kind is exported as an Microsoft™* Excel™* Spreadsheet, it can then be edited. Removing unwanted or empty parameter columns will also remove their axes from the radar plot.

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ANALYSIS REPORTS
Parameters & Color Coding (1/2)

Report Parameters

This table shows the parameters available in each report type.

Parameter				
Start Time	All			Start time of session.
Duration	All			Duration of session.
%Time >85%HRmax				% Time a subject's heart rate was above 85% of their maximum HR
%Time 65-84%HRmax				% Time a subject's heart rate was between 65-84% of their maximum HR
%Time <64%HRmax				% Time a subject's heart rate was below 64% of their maximum HR
%Time > HR at AT				%Time a subject's heart rate was above their HR at Anaerobic Threshold.
%Time < HR at AT				%Time a subject's heart rate was below their HR at Anaerobic Threshold.
Peak HR				Peak heart rate.
Average HR				Average heart rate.
Average HRV				Average heart rate variability.
Max HRV				Peak heart rate variability.
Average HRR				Average heart rate recovery (30sec).
Max HRR				Peak heart rate recovery (30sec.)
Average Core Temp				Average core body temperature (HR-based algorithm)
Max Core Temp				Peak core body temperature
Total Calories burned				Calculated from ACSM formula.
Physiological Load/Intensity				See Fitness Parameters section.
Mechanical Load/Intensity				See Fitness Parameters section.
Training Load/Intensity				See Fitness Parameters section.
Time in Workout Zones				Zones configured in OmniSense™ Live.
Time in Speed Zones				Zones configured in OmniSense™ Live. GPS data.
Distance in Speed Zones				GPS data.
Average Speed				GPS data.
Maximum Speed				GPS data.
Elevation Climb				GPS data.
Elevation Descent				GPS data.
Total Distance				Total distance travelled. GPS Data.

Group Consolidated Summary

Physiological Summary

Periodization

Workout Compliance

Summary GPS

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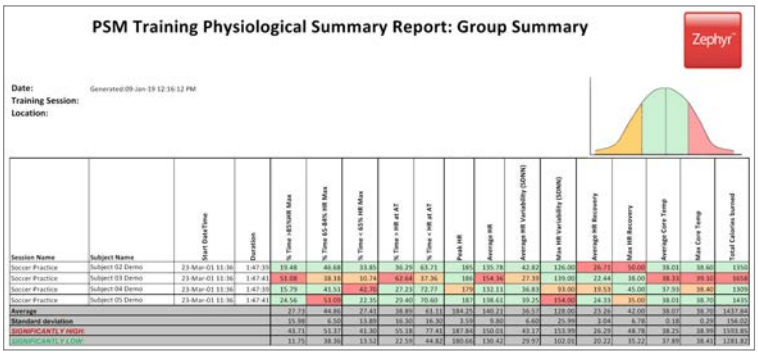
ANALYSIS REPORTS
Parameters & Color Coding (2/2)

Report Table Coloring

All training report SessionSummary tables use cell coloring to give an immediate representation of how one subject is performing relative to the team.

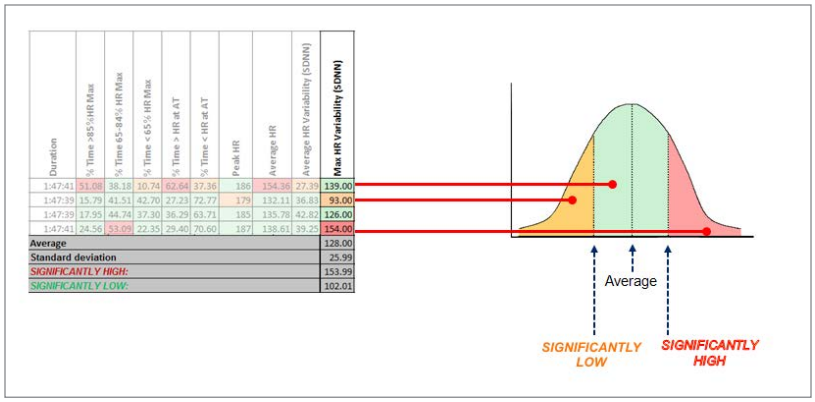


PSM Training Physiological Summary Report: Group Summary

Date: Generated:09-Jan-19 12:36:12 PM
Training Session:
Location:

Session Name	Subject Name	Start Date/Time	Duration	% Time >85%HR Max	% Time 65-84% HR Max	% Time < 65% HR Max	% Time > HR at AT	% Time < HR at AT	Peak HR	Average HR	Average HR Variability (SDNN)	Max HR Variability (SDNN)	Average HR Recovery	Max HR Recovery	Average Core Temp	Max Core Temp	Total Calories burned
Soccer Practice	Subject 02 Demo	23-Mar-01 11:36	1:47:39	19.48	46.68	33.85	36.29	63.71	185	135.78	42.82	126.00	26.73	50.00	38.01	38.60	1350
Soccer Practice	Subject 03 Demo	23-Mar-01 11:36	1:47:41	51.08	38.18	10.74	62.64	37.36	186	154.38	27.39	139.00	22.44	38.00	38.33	39.12	1858
Soccer Practice	Subject 04 Demo	23-Mar-01 11:36	1:47:39	15.79	41.51	42.70	27.23	72.77	179	132.11	36.83	93.00	19.53	45.00	37.93	38.40	1309
Soccer Practice	Subject 05 Demo	23-Mar-01 11:36	1:47:41	24.56	53.09	22.35	29.40	70.60	187	138.61	39.25	154.00	24.33	35.00	38.01	38.70	1435
Average				27.73	44.86	27.41	38.89	61.11	184.25	140.23	36.57	128.00	23.26	42.00	38.07	38.70	1437.84
Standard deviation				15.98	6.50	13.89	16.30	16.30	3.59	9.80	6.60	25.99	3.04	6.78	0.18	0.29	154.02
SIGNIFICANTLY HIGH:				43.71	51.37	41.30	55.18	77.41	187.84	150.03	43.17	153.99	26.29	48.78	38.25	38.99	1591.85
SIGNIFICANTLY LOW:				11.75	38.36	13.52	22.59	44.82	180.66	130.42	29.97	102.01	20.22	35.22	37.89	38.41	1281.82

- The SIGNIFICANTLY LOW and SIGNIFICANTLY HIGH thresholds are one standard deviation above and below the average value for the group.
- Any green cell value is within one standard deviation of the group average (above or below).
- Any orange (amber) cell value is more than one standard deviation below the group average.
- Any red cell is more than one standard deviation above the group average.



Duration	% Time >85%HR Max	% Time 65-84% HR Max	% Time < 65% HR Max	% Time > HR at AT	% Time < HR at AT	Peak HR	Average HR	Average HR Variability (SDNN)	Max HR Variability (SDNN)
1:47:41	51.08	38.18	10.74	62.64	37.36	186	154.38	27.39	139.00
1:47:39	15.79	41.51	42.70	27.23	72.77	179	132.11	36.83	93.00
1:47:39	17.95	44.74	37.30	36.29	63.71	185	135.78	42.82	126.00
1:47:41	24.56	53.09	22.35	29.40	70.60	187	138.61	39.25	154.00
Average									128.00
Standard deviation									25.99
SIGNIFICANTLY HIGH:									153.99
SIGNIFICANTLY LOW:									102.01

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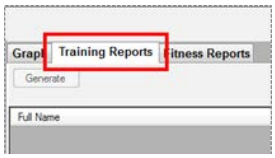
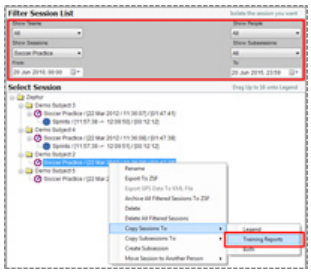
Create Report

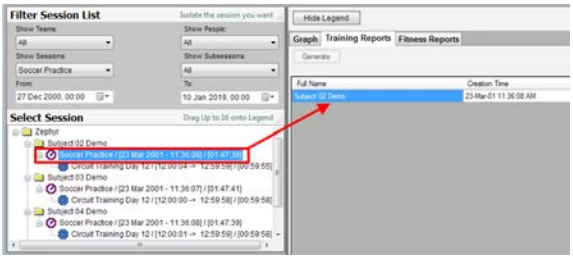
1. Select **Training Reports** tab.



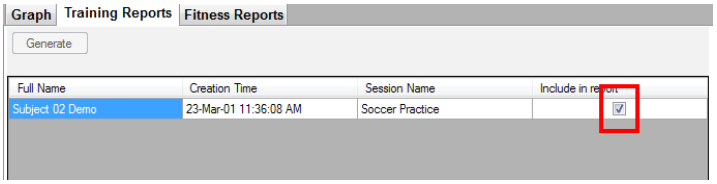
2. Use the **Filter Session List** to populate the **Select Session** pane with desired subjects and sessions.



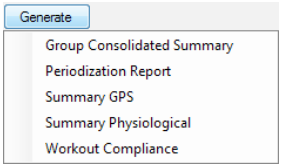
3. Right-click a session and select **Copy Sessions To > Training Reports** to populate the report pane, or click-and-drag individual sessions.



4. To remove a session from a report, de-select the check box at the right side of the entry.



5. When all desired sessions have been added, click the **Generate** button and select report type from list.



6. Once the report has been generated, you can return to the session list at any time using the **Sessions** button.

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Export Report

Once a report has been generated, viewing within the Analysis window is restricted by screen size. The best option is to export the report.

There are two options.

Print Report

1. Print the report using the Print button on the top right side of the report pane.

2. A print dialog will display.

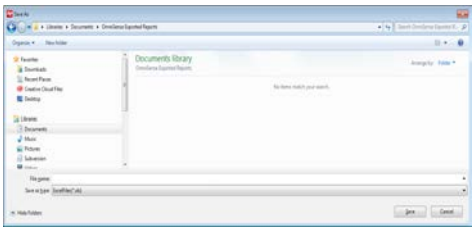
Note

The print function only prints the page (tab) of the report currently displayed. For a multi-tab report, each tab must be printed separately.

Export Report as a Spreadsheet

1. Export the entire report to an external Microsoft™* Excel™* spreadsheet using the export button.

2. A Save dialog will display. Save the report to your preferred location. (Microsoft™* Excel™* or an alternative will be needed to open the report).



3. Once saved externally, the report can be edited to remove any unwanted or redundant data columns, to reduce clutter in tables and radar plots. See the next page.

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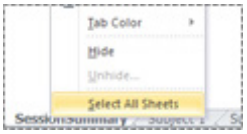
Edit Report

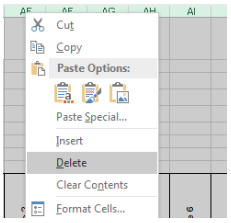
Some reports, particularly the Group Consolidated Summary, may contain columns with no data (usually GPS data), or columns of data supported by the Enhanced Summary data packet/log format, which are not used by other data packets or log formats.

These blank fields create unnecessary clutter in the report.

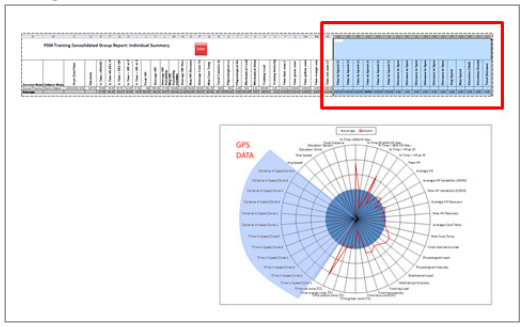
1. Export the report as an Microsoft™* Excel™* spreadsheet.
2. Open the report, right click on the tabs at the foot of the spreadsheet and select **Select All Sheets**. This will modify all tabs in the report in a single operation.



3. In the **SessionSummary** sheet, select all columns of data to be deleted. Click and drag mouse across all lettered column heading cells, and then right click and select **Delete** from the context menu.

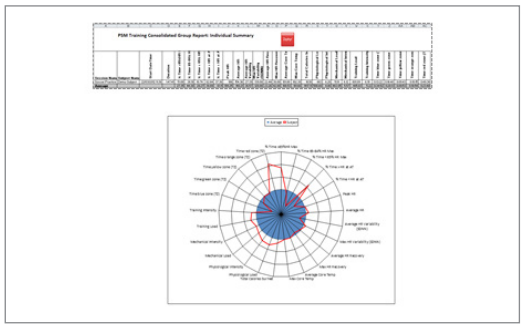


Report Before Editing



Report showing highlighted GPS data columns and blue segment in radar plot

Report After Editing



Report with truncated table and reduced-axes radar plot

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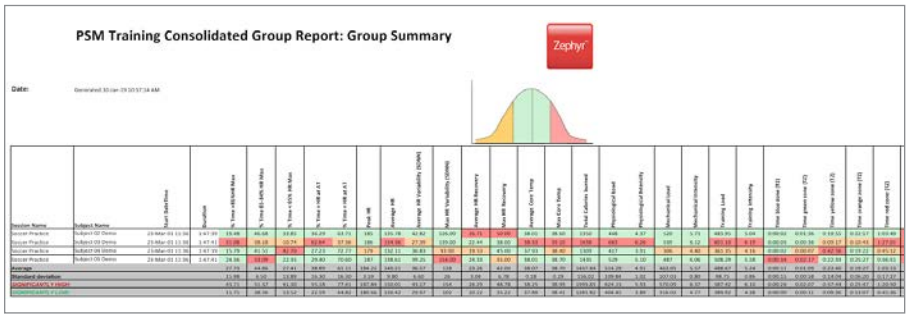
ANALYSIS REPORTS
Report Categories (1/5)

Group Consolidated Summary

The Consolidated Summary is the super-set of all other reports, and contains all available data parameters.

SessionSummary Tab

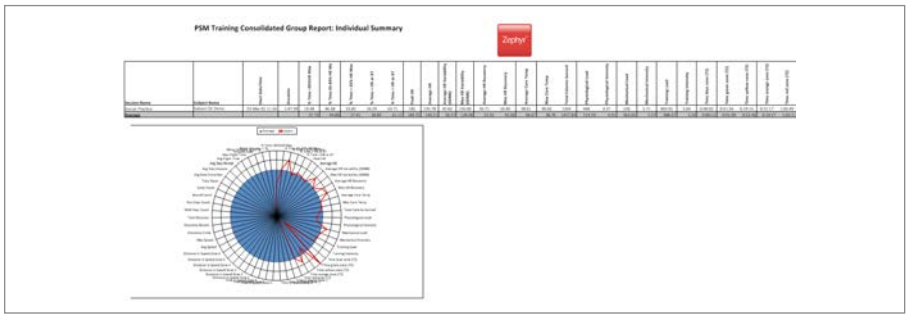


- Red/green/amber cell coloring indicates individual performance vs. group average performance for all sessions in report. Thresholds are 1 standard deviation in either direction of the average.

Parameter Categories

- Physiological - various relating to HR, BR, HRV, HRR, HR Zones, Estimated Core Temperature & Calories Burned.
- Physiological/Mechanical Training Load & Intensities. See **Fitness Parameters** section.
- Time in HR Zones
- Time/distance in speed zones (GPS data)
- Summary GPS data
- Accelerometer - counts of impulse (step & impact) types, summary impulse data.

Subject Tab



- Table of subject values and session averages for report
- Radar plot of the same.

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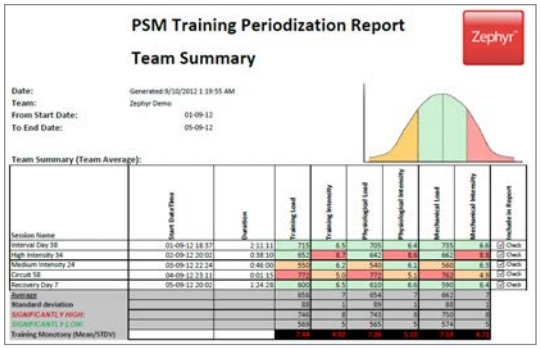
ANALYSIS REPORTS
Report Categories (2/5)

Periodization Report

This report shows Mechanical, Physiological and Training (average of Mechanical & Physical) loads and intensities. See the **Fitness Parameters** section for more detail. Its intended use is for a team training over a variety of different workouts for an extended period of time.

The **SessionSummary** and **Subject** tabs are identical in format.

Data Table

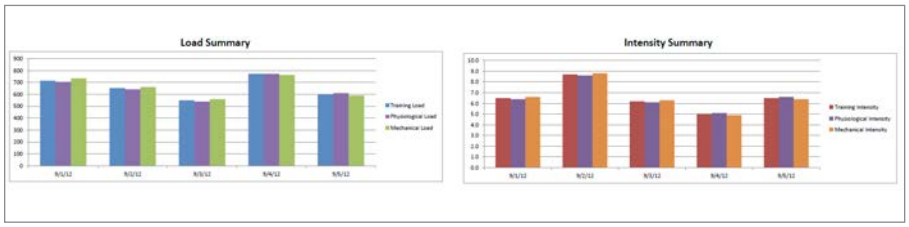


- Entries are aggregated by workout type.
- In the **SessionSummary** tab, the **Average** and **Standard Deviation** values are for the entire team over all workouts.
- In the **Subject** tabs, the same values are for that subject only, and each session/workout is itemized.
- Cell coloring is as previously described.

Caution

If multiple occurrences of only a single workout type are used (e.g. if all are 'Interval Day 38'), then by aggregation the table will contain a single entry, and the Average & Standard Deviation fields will contain a **#DIV/0!** error message as they cannot be calculated.

Summary Charts



- The charts aggregate activities by date, and so give a calendar progression of training efforts.
- In the **SessionSummary** tab, the charts show the team average values.
- In the **Subject** tabs, they show the calendar progression of workout levels for each individual subject.

Training Monotony

The report gives a measure of training consistency: Average value divided by Standard Deviation. This is intended as a guide to indicate when over-training may be occurring (variation in Training Monotony can help prevent this).

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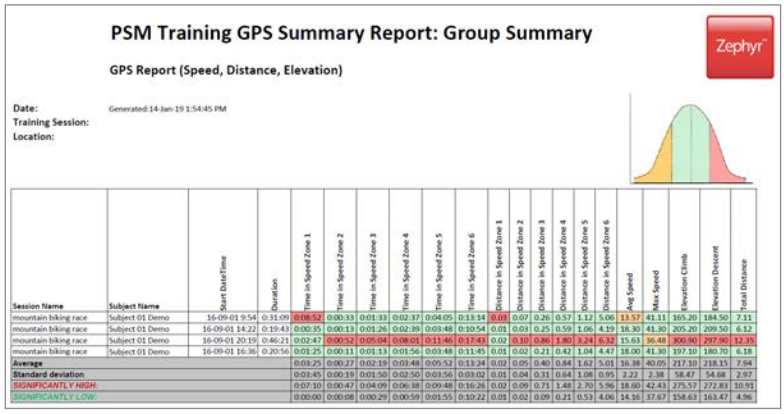
ANALYSIS REPORTS
Report Categories (3/5)

Summary GPS

This report contains distance, speed and elevation values derived from GPS data. The **Speed Zones** referred to are configurable in **Preferences** in both Live and Analysis.

Session Summary Tab



PSM Training GPS Summary Report: Group Summary

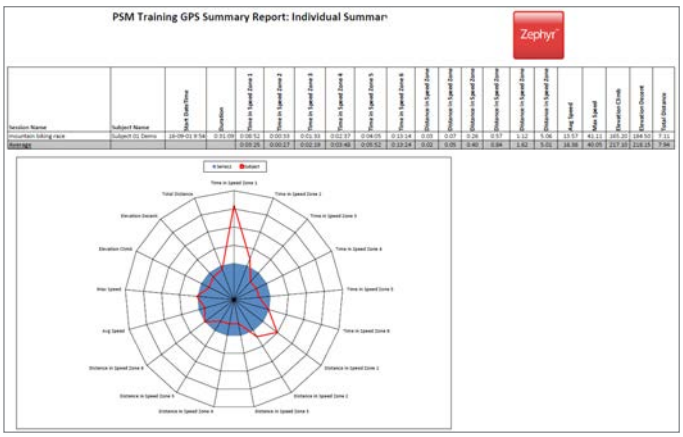
GPS Report (Speed, Distance, Elevation)

Date: Generated:14-Jan-19 1:54:45 PM
Training Session:
Location:

Session Name	Subject Name	Start Date/Time	Duration	Time in Speed Zone 1	Time in Speed Zone 2	Time in Speed Zone 3	Time in Speed Zone 4	Time in Speed Zone 5	Time in Speed Zone 6	Distance in Speed Zone 1	Distance in Speed Zone 2	Distance in Speed Zone 3	Distance in Speed Zone 4	Distance in Speed Zone 5	Distance in Speed Zone 6	Avg Speed	Max Speed	Elevation Climb	Elevation Descent	Total Distance
mountain biking race	Subject 01 Demo	16-09-01 9:54	0:31:09	0:08:52	0:00:33	0:01:33	0:02:37	0:04:05	0:13:14	0.03	0.07	0.26	0.57	1.12	5.06	13.57	41.11	165.20	184.50	7.11
mountain biking race	Subject 01 Demo	16-09-01 14:22	0:19:43	0:00:35	0:00:13	0:01:26	0:02:39	0:03:48	0:10:54	0.01	0.03	0.25	0.59	1.06	4.19	18.30	41.30	205.20	209.50	6.12
mountain biking race	Subject 01 Demo	16-09-01 20:19	0:46:21	0:02:47	0:00:52	0:05:04	0:08:01	0:11:46	0:17:43	0.02	0.10	0.86	1.80	3.24	6.32	15.63	36.48	300.90	297.90	12.35
mountain biking race	Subject 01 Demo	16-09-01 16:36	0:20:56	0:01:25	0:00:11	0:01:13	0:01:56	0:03:48	0:11:45	0.01	0.02	0.21	0.42	1.04	4.47	18.00	41.30	197.10	180.70	6.18
Average				0:03:25	0:00:27	0:02:19	0:03:48	0:05:52	0:13:24	0.02	0.05	0.40	0.84	1.62	5.01	16.38	40.05	217.10	218.15	7.94
Standard deviation				0:03:45	0:00:19	0:01:50	0:02:50	0:03:56	0:03:02	0.01	0.04	0.31	0.64	1.08	0.95	2.22	2.38	58.47	54.68	2.97
SIGNIFICANTLY HIGH:				0:07:10	0:00:47	0:04:09	0:06:38	0:09:48	0:16:26	0.02	0.09	0.71	1.48	2.70	5.96	18.60	42.43	275.57	272.83	10.91
SIGNIFICANTLY LOW:				0:00:00	0:00:08	0:00:29	0:00:59	0:01:55	0:10:22	0.01	0.02	0.09	0.21	0.53	4.06	14.16	37.67	158.63	163.47	4.96

- Sessions are listed individually (no aggregation).
- Sessions can be for the same subject or a mixture of subjects.
- Cell coloring is as previously described.

Subject Tab



PSM Training GPS Summary Report: Individual Summar

Session Name	Subject Name	Start Date/Time	Duration	Time in Speed Zone 1	Time in Speed Zone 2	Time in Speed Zone 3	Time in Speed Zone 4	Time in Speed Zone 5	Time in Speed Zone 6	Distance in Speed Zone	Distance in Speed Zone	Distance in Speed Zone	Distance in Speed Zone	Distance in Speed Zone	Distance in Speed Zone	Avg Speed	Max Speed	Elevation Climb	Elevation Descent	Total Distance
mountain biking race	Subject 01 Demo	16-09-01 9:54	0:31:09	0:08:52	0:00:33	0:01:33	0:02:37	0:04:05	0:13:14	0.03	0.07	0.26	0.57	1.12	5.06	13.57	41.11	165.20	184.50	7.11
Average				0:03:25	0:00:27	0:02:19	0:03:48	0:05:52	0:13:24	0.02	0.05	0.40	0.84	1.62	5.01	16.38	40.05	217.10	218.15	7.94

- Each record in the SummarySession tab is represented in a separate subject tab.
- The data table shows the individual session and the average values for all sessions in the report.
- The radar plot shows average value for all sessions (blue solid) against the individual subject (red polygon).

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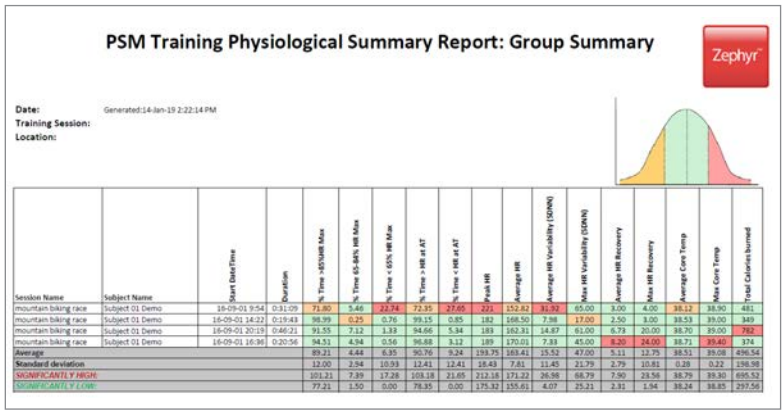
Summary Physiological

This report contains a number of parameters, all of which are heart rate-derived.

Session Summary Tab



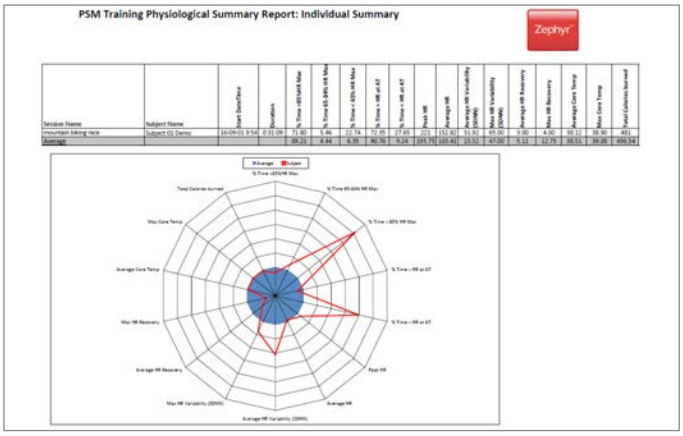
PSM Training Physiological Summary Report: Group Summary

Date: Generated:14-Jan-19 2:22:14 PM
Training Session:
Location:

Session Name	Subject Name	Start Date/Time	Duration	% Time >85%HR Max	% Time 65-84% HR Max	% Time < 65% HR Max	% Time > HR at AT	% Time < HR at AT	Peak HR	Average HR	Average HR Variability (SDNN)	Max HR Variability (SDNN)	Average HR Recovery	Max HR Recovery	Average Core Temp	Max Core Temp	Total Calories burned
mountain biking race	Subject 01 Demo	18-09-01 9:54	0:31:09	71.80	5.46	22.74	72.35	27.65	221	152.82	31.92	65.00	3.00	4.00	38.12	38.90	481
mountain biking race	Subject 01 Demo	16-09-01 14:22	0:19:43	98.99	0.25	0.76	99.15	0.85	182	168.50	7.98	17.00	2.50	3.00	38.53	39.00	349
mountain biking race	Subject 01 Demo	16-09-01 20:19	0:46:21	91.55	7.12	1.33	94.66	5.34	183	162.31	14.87	61.00	6.73	20.00	38.70	39.00	782
mountain biking race	Subject 01 Demo	16-09-01 16:36	0:20:56	94.51	4.94	0.56	96.88	3.12	189	170.01	7.83	45.00	8.20	24.00	38.71	39.40	374
Average				89.21	4.44	6.35	90.76	9.24	193.75	163.41	15.52	47.00	5.11	12.75	38.51	39.08	496.54
Standard deviation				12.00	2.94	10.93	12.41	12.41	18.43	7.81	11.45	21.79	2.79	10.81	0.28	0.22	198.98
SIGNIFICANTLY HIGH:				101.21	7.39	17.28	103.18	21.65	212.18	171.22	26.98	68.79	7.90	23.56	38.79	39.30	695.52
SIGNIFICANTLY LOW:				77.21	1.50	0.00	78.35	0.00	175.32	155.61	4.07	25.21	2.31	1.94	38.24	38.85	297.56

- Sessions are listed individually (no aggregation).
- Sessions can be for the same subject or a mixture of subjects.
- Cell coloring is as previously described.

Subject Tab



PSM Training Physiological Summary Report: Individual Summary

Session Name	Subject Name	Start Date/Time	Duration	% Time >85%HR Max	% Time 65-84% HR Max	% Time < 65% HR Max	% Time > HR at AT	% Time < HR at AT	Peak HR	Average HR	Average HR Variability (SDNN)	Max HR Variability (SDNN)	Average HR Recovery	Max HR Recovery	Average Core Temp	Max Core Temp	Total Calories burned
mountain biking race	Subject 01 Demo	18-09-01 9:54	0:31:09	71.80	5.46	22.74	72.35	27.65	221	152.82	31.92	65.00	3.00	4.00	38.12	38.90	481
Average				89.21	4.44	6.35	90.76	9.24	193.75	163.41	15.52	47.00	5.11	12.75	38.51	39.08	496.54

- Each record in the SummarySession tab is represented in a separate subject tab.
- The data table shows the individual session and the average values for the report.
- The radar plot shows average values for all sessions (blue solid) against the individual subject (red polygon).

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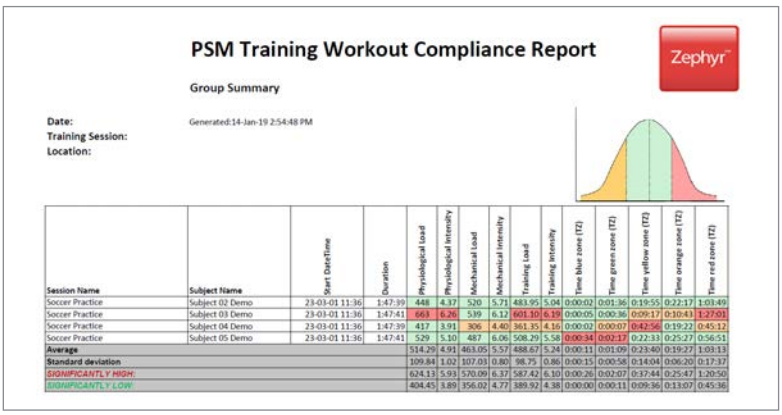
Workout Compliance

This report shares some parameters with the Periodization report, but also contains **Training Zone** data. Training Zone thresholds are configurable in Live & Analysis Preferences.

Session Summary Tab



PSM Training Workout Compliance Report

Group Summary

Date:
Training Session:
Location:

Generated:14-Jan-19 2:54:48 PM

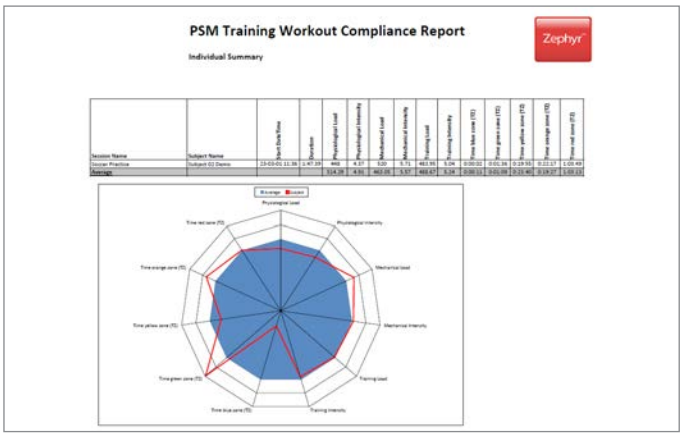
Session Name	Subject Name	Start Date/Time	Duration	Physiological Load	Physiological Intensity	Mechanical Load	Mechanical Intensity	Training Load	Training Intensity	Time blue zone (T2)	Time green zone (T2)	Time yellow zone (T2)	Time orange zone (T2)	Time red zone (T2)
Soccer Practice	Subject 02 Demo	23-03-01 11:36	1:47:39	448	4.37	520	5.71	483.95	5.04	0:00:02	0:01:36	0:19:55	0:22:17	1:03:49
Soccer Practice	Subject 03 Demo	23-03-01 11:36	1:47:41	663	6.26	539	6.12	601.10	6.19	0:00:05	0:00:36	0:09:17	0:10:43	1:27:01
Soccer Practice	Subject 04 Demo	23-03-01 11:36	1:47:39	417	3.91	306	4.40	361.35	4.16	0:00:02	0:00:07	0:42:56	0:19:22	0:45:12
Soccer Practice	Subject 05 Demo	23-03-01 11:36	1:47:41	529	5.10	487	6.06	508.29	5.58	0:00:34	0:02:17	0:22:33	0:25:27	0:56:51
Average				514.29	4.91	463.05	5.57	488.67	5.24	0:00:11	0:01:09	0:23:40	0:19:27	1:03:13
Standard deviation				109.84	1.02	107.03	0.80	98.75	0.86	0:00:15	0:00:58	0:14:04	0:06:20	0:17:37
SIGNIFICANTLY HIGH:				624.13	5.93	570.09	6.37	587.42	6.10	0:00:26	0:02:07	0:37:44	0:25:47	1:20:50
SIGNIFICANTLY LOW:				404.45	3.89	356.02	4.77	389.92	4.38	0:00:00	0:00:11	0:09:36	0:13:07	0:45:36

- Sessions are listed individually (no aggregation).
- Sessions can be for the same subject or a mixture of subjects.
- Cell coloring is as previously described.

Note

The Training Zone data is **not** cross-correlated with the relative proportions of each zone directed in the original workout, if selected from the Training Workouts. Thus comparisons in zone demographics can only be made between subjects in the report, and not related back to the demands of the original workouts.

Subject Tab



PSM Training Workout Compliance Report

Individual Summary

- Each record in the SummarySession tab is represented in a separate subject tab.
- The data table shows the individual session and the average values for the report.
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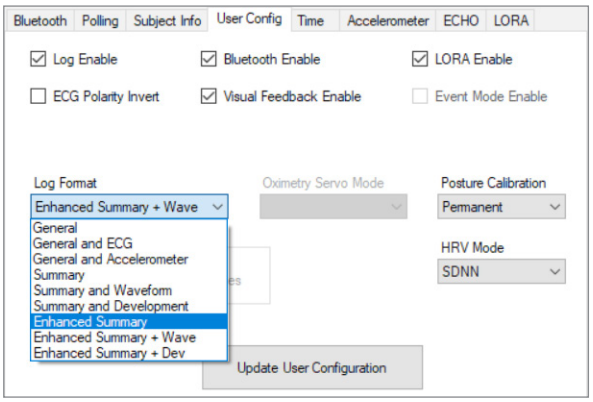
LOG DATA
Overview (1/5)

Overview

When new BioModules are shipped:

- Logging is enabled.
- The default logging format is **Enhanced Summary** (see Appendices 3 & 4 for complete descriptions of all the log formats).
- Log format is configured using the **Zephyr™ Config Tool**. Refer to the **OmniSense™ Tools** topic.



Log Format	Brief Description
Enhanced Summary	1 Hz data (default log format)
Enhanced Summary & Waveform	Additional 250Hz ECG + 100Hz Accelerometry [+ 1 Hz GPS]
Enhanced Summary & Development	Additional 1KHz ECG + 50 Hz Accelerometry, no GPS

Other legacy log formats are also available - General log and its variants.

Note

Waveform data is not viewable, or stored in the OmniSense™ database. It must be accessed by external files generated by the **Zephyr™ Downloader** tool.

Note

Data logging frequencies are as stated above, and are not dependent on radio network type or LoRa Mode.

Caution

When the log format is reconfigured in a BioModule, memory is reformatted and all previous logs are deleted. Thus all important log data should be downloaded before the log format is changed.

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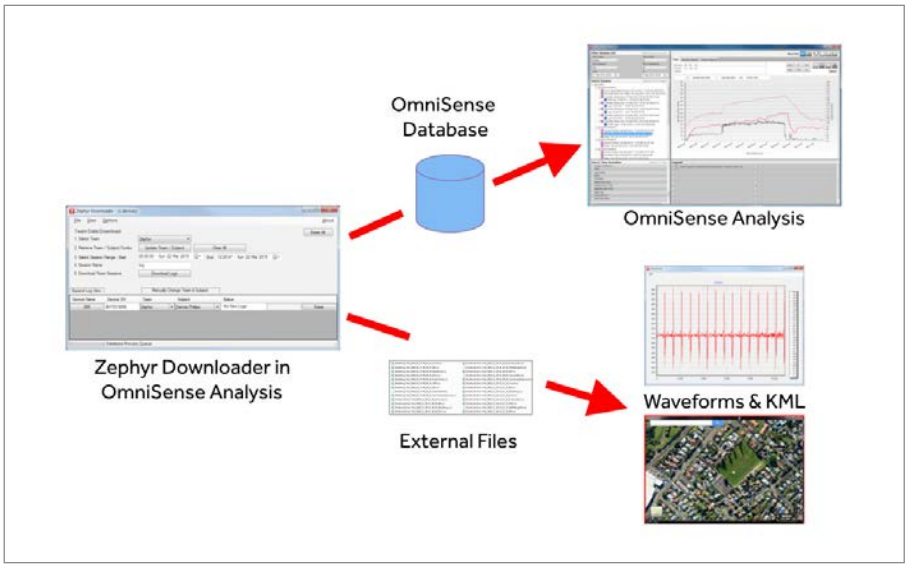
LOG DATA
Overview (2/5)



- A menu option in the Zephyr™ Downloader will cause external files to be generated when data is imported from the BioModule into OmniSense™ Analysis.
- All log data is generated to the external files - 1 Hz data + waveforms and others.
- Four formats of external file are available.

External File Format	Description
CSV	Default external format. A separate file for each reporting frequency is generated, for asynchronous HR beat-beat and BR breath-breath data, and for waveform data.
DaDISP	Binary files in .HED/.DAT pairs, specifically for import into DaDISP™* Data Analysis software
KML	GPS data, for import into Google Earth™*, if a supported GPS has been used.
TXT	Metadata - Session Info & debug data, generated automatically when CSV format option is selected.

Note

CSV files will open by default in Microsoft™* Excel™*, making available all of the functionality of this application. However, Microsoft™* Excel™* graphs are limited to 32,000 data points. This equates to approximately 5 minutes of ECG waveform data, so graphing large ECG data sets is not possible. The csv files must be imported into other 3rd party applications designed for large data sets.

Zephyr™ provides a script for importing ECG data into Matlab™* software, available from www.zephyranywhere.com

The Zephyr™ Data Plotter, available from the same website, can also be used. It is described in the **OmniSense™ Tools** section

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LOG DATA
Overview (3/5)

Log Download Times

- Download data via a 50 BioModule Charge Case (shown above), single- or 5-device cradles.
- The 50 BioModule Charge Case has 5 separate USB connectors to allow parallel download of 5 vertical banks of 10 devices. The USB connector must be manually moved between case connectors. This is a limitation of Microsoft™* Windows™*, which will not handle more than 10 simultaneous USB connections reliably.
- A menu option can configure the Downloader tool to detect powered-on BioModules via Bluetooth™*, and will download logs via Bluetooth™*. This method takes 5-10 times longer than direct USB connection, due to Bluetooth™* bandwidth limitations.

Log Format	1 Device	5 Devices	10 Devices	50 Devices
Enhanced Summary	12 sec	15 sec	50 sec	6 min
Enhanced Summary + Waveform	45 sec	65 sec	95 sec	9 min

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LOG DATA
Overview (4/5)

BioModule Logging Capacity

- The Summary format is an extended format compared to General.
- Enhanced Summary contains extended accelerometer data.

Log Format	Total Logging Capacity (Hours)
Summary	450
Summary & Waveform	60
Summary & Development	30
Enhanced Summary	450
Enhanced Summary & Waveform	60
Enhanced Summary & Development	30

Caution

When BioModule memory has reached capacity, the processor will start to overwrite the oldest logs. As soon as an older log has been partially overwritten, it is no longer available for download.

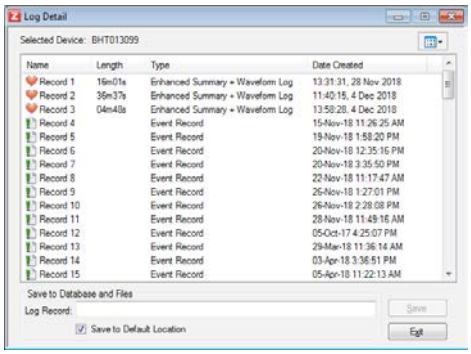
Caution

Changing the log format in a BioModule erases all existing logs. Download old logs first if they are important.

Note

It is good practice when using BioModules for research studies, to download the logs as often as possible, rather than use the BioModules as storage devices for log data.

- The **Log Detail** dialog, accessed from the **Zephyr™ Downloader** tool, can be used to directly view/download all logs on a device to ascertain current memory use.



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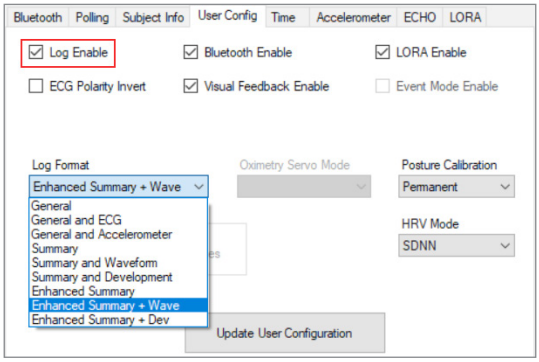
LOG DATA
Overview (5/5)

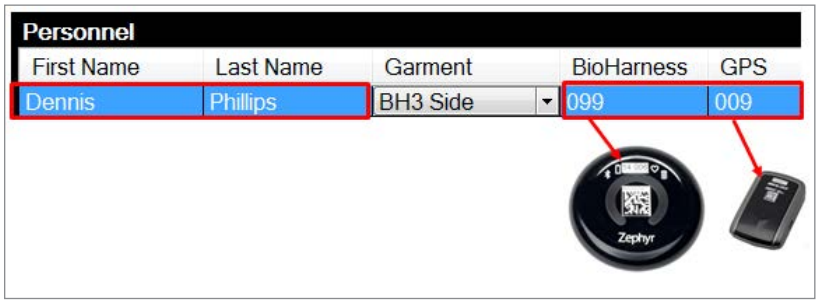
Logging Configuration Checklist

1. The BioModule must be configured to log (**Log Enable** is the default configuration for shipped BioModules).



2. Log Format: **Enhanced Summary** for general use, **Enhanced Summary + Wave** for use with a GPS.

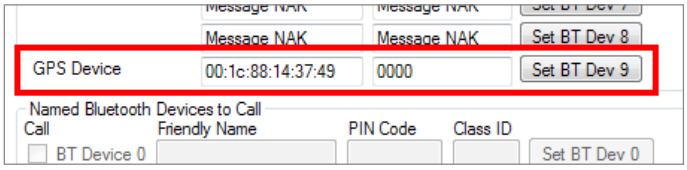
3. GPS should be assigned to the subject in OmniSense™. When used over LoRa, the GPS MAC address will be configured into the BioModule (otherwise this must be done manually - see **OmniSense™ Tools** section).



Caution

When a BioModule and GPS are assigned to a subject in OmniSense™ and the hardware deployed live in a LoRa session, the GPS MAC address is relayed to the BioModule over LoRa, so they can communicate with each other over Bluetooth™*. This configuration is saved in the BioModule. However, if the BioModule is subsequently used over LoRa with no GPS assigned to the subject, then the previous GPS MAC address is overwritten with the value 00:00:00:00:00:00.

The GPS must be re-assigned to address. This will enable continued GPS use..



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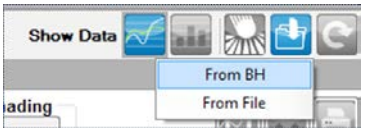
LOG DATA

Zephyr™ Downloader (1/5)

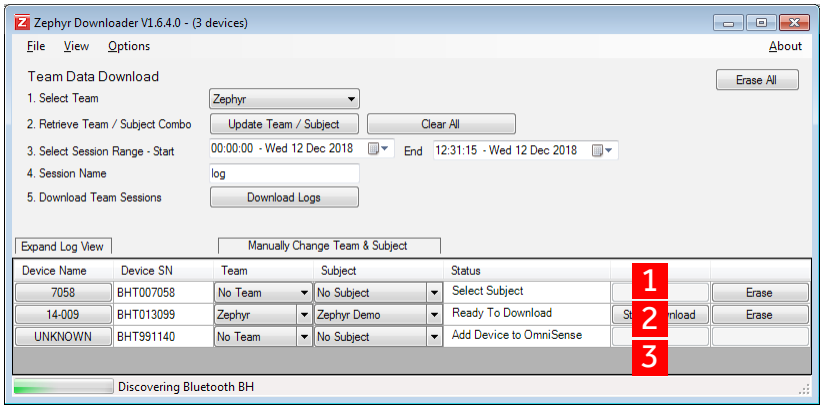
Overview

- Connect BioModules to the host PC in charge cradles or a 50 BioModule Charge Case:

- Start the Downloader using the **Launch Log Downloader** button, selecting the **From BH** option.



- BioModules **must** be assigned to a subject who exists in the database - the log data must be associated with a subject.
- The Downloader is designed to streamline download of logs from a set of devices assigned to the members of a currently-deployed team in OmniSense™ Live. If devices are not assigned to deployed subjects, then they may have to be assigned manually in the Downloader.



#	Status	Description
1	Select Subject	Device assigned to subject not in the selected Team. Select Team/Subject manually.
2	Ready to Download	Logs present which have not been downloaded.
3	Add Device to OmniSense™	Device does not exist in database. Must first be added using OmniSense™ **Live > Setup > Hardware**

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Zephyr™ Downloader (2/5)

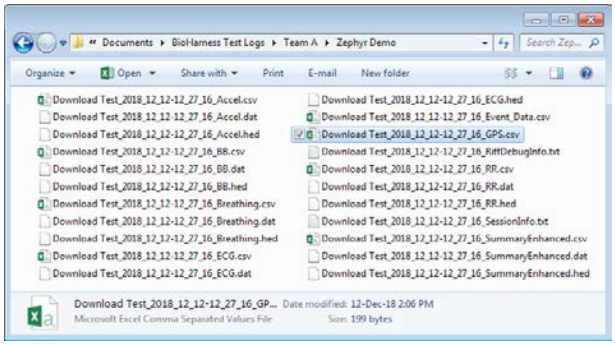
Downloader Menu Options

Menu Item	Description
File/Exit	Exit downloader
View/Show Wizard	Hide Show top panel with 1-5 step 'Wizard'.
Options	
Retry on Error	Automatically retry download if interrupted.
Synchronize Device Clocks	Synchronize BioModule internal clocks on connection. Recommended.
Autodownload Configured Units	If all units are assigned to members of a currently-deployed team, then team and subject will be selected automatically, and download initiated.
Auto Erase after Download	Erase logs after download.
Auto Discover Bluetooth Device	Search for Bluetooth™* devices. To be used when more than 10 devices require downloading. BioModule firmware version must support Bluetooth™* download of logs.
Write CSV Format Log Files	Generate external CSV files of logs.
Write DaDISP Format Log Files	Generate external .HED/.DAT files of logs.
Write GPS Data to KML File	Generate KML files of GPS data.

- Logs which have previously been downloaded to the database are not re-downloaded.
- External files (all types) are downloaded to the location

  My Documents > Bioharness Test Logs > Team > Subject

  where the **Team** and **Subject** directories will be created. If the subject is not in a currently deployed team, the logs will be saved to a '**No Team Assigned**' directory.
- An example of a set of external CSV & DaDISP Files saved externally



The **Session Name** was set to **Download Test** in the Downloader wizard.

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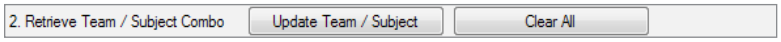
Zephyr™ Downloader Operation

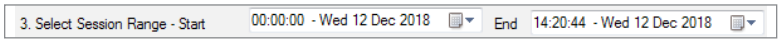
- Connect BioModules to PC using 50 BioModule Charge Case. Any other BioModule powered on will be detected over Bluetooth™* if the option is selected.

Team Data Download Wizard

1. **Select Team**
   If all, or most of the BioModules connected are assigned to members of the same team, select the team from the pull down list.



2. **Retrieve Team/Subject Combo**
   Clicking the **Update Team/Subject** button will populate the **Team** and **Subject** entries for all the listed BioModules automatically. Any devices assigned to subjects not in the selected team will have these entries as **No Team** and **No Subject**. They must be selected manually. A different team can be selected.



3. **Select Session Range**
   The **Start** field defaults to midnight at the start of the current day. Only logs not previously downloaded will be imported.

4. **Session Name**
   This name will appear in Analysis, and can be used in the **Filter Session List** to locate the session. It also prefixes all externally exported file names. Sessions in Analysis and external files can be renamed at any time to suit. The default is '**log**'. A user-set name is recommended.

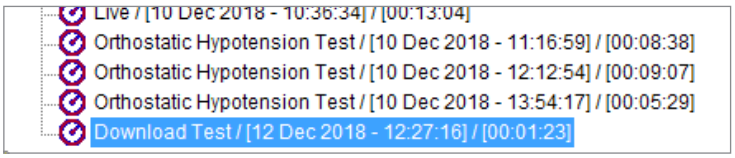
5. **Download Team Sessions**
   When steps 1-4 have been completed, devices with logs for download will display '**Ready to Download**' in the status field. Manually select **Team** and **Subject** for any entries not populated automatically. Selecting the **Download Logs** button initiates download of outstanding logs for all devices.

Caution

Care should be exercised when manually selecting subjects for log download. The system has no way of validating that the correct subject is chosen. If the wrong subject is selected in error, then data will be associated that subject. This can be corrected - if the error is realized - later in Analysis, by reassigning the session to a different subject.

Note

Selecting the **Session Name** appropriately will make for much easier retrieval of log data later.



'**Download Test**' in this example is descriptive, but too generic. '**Download Test #001**' would be more flexible, should more tests be likely.

Note

If duplicate entries for any BioModule appear in the list of BioModules, disconnect the USB cable connecting the PC to the charge cradle or 50 BioModule charge case. Wait a few seconds, then reconnect the USB cable. Duplicate entries should no longer appear.

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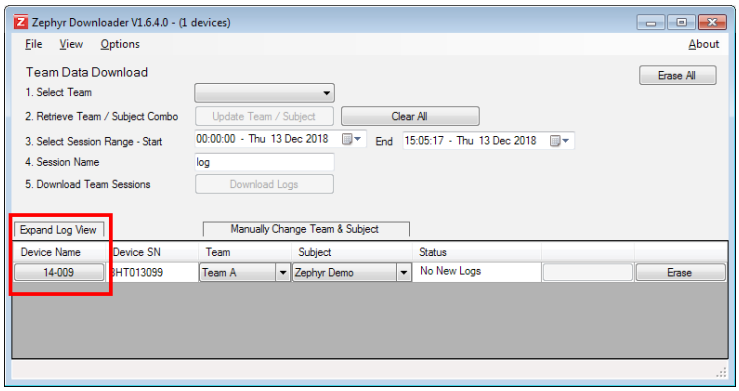
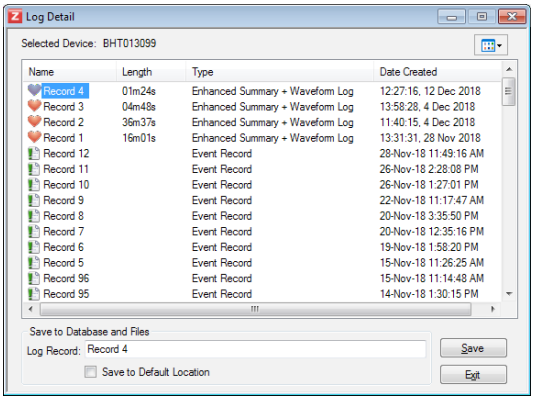
LOG DATA
Zephyr™ Downloader (4/5)

Expand Log View

When a known device is detected by the Downloader, a button will appear in the first column of each entry. This button will display all the logs in the device.



1. Click on the button for a device to display the **Log Detail** window.



The window shows all logs currently on the device, with log format, duration, and date saved.

2. Select any record to save to database, and generate external CSV files. They will be saved the default location of **My Documents/BioHarness Test Logs/Team/Subject** unless **Save To Default Location** is unchecked.

3. **Event Record** log files are not erased when logs are erased, or log file format changed. They contain event information and can be downloaded for reference.

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LOG DATA
Zephyr™ Downloader (5/5)

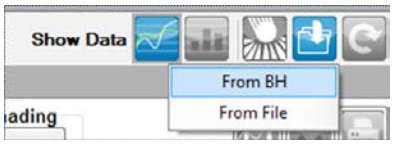
Auto Download

The Zephyr™ Downloader has been designed to streamline log download from multiple devices, but there are some pre-requisites:

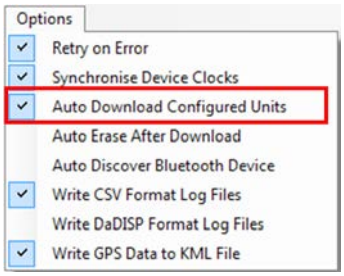
- All BioModules are assigned to a Team which is **currently deployed in Live mode** – the data will be associated with the subject the BioModules are currently assigned to.
- The logs are downloaded on the day they are recorded (otherwise Session Start Time will have to be selected manually.)
- Selecting the menu option **Auto Download Configured Units** (it is unchecked by default) will cause all new logs to be downloaded automatically.
- If **Auto Discover Bluetooth Device** is also checked, all BioModules in the case not located in USB-enabled bays will have logs downloaded over Bluetooth™*.

1. Locate all BioModules in 50 BioModule Charge Case.

2. Start the Zephyr™ Downloader.



3. Check the menu option **Auto Download Configured Units**.



4. All new logs will be downloaded automatically with no further input.

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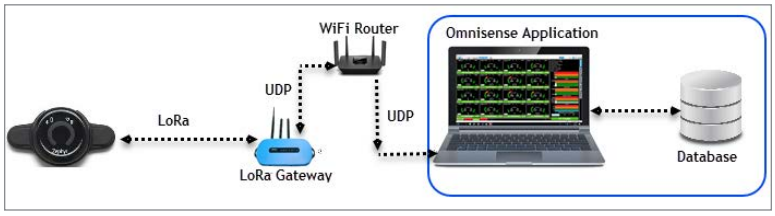
OMNISENSE™ WEB PORTAL
Overview (1/8)

OmniSense™ Local & OmniSense™ Cloud

OmniSense™ Local

OmniSense™ Local exists solely on the PC on which it is installed. The components are:

- OmniSense™ Live
- OmniSense™ Local Database
- OmniSense™ Analysis
- Tools

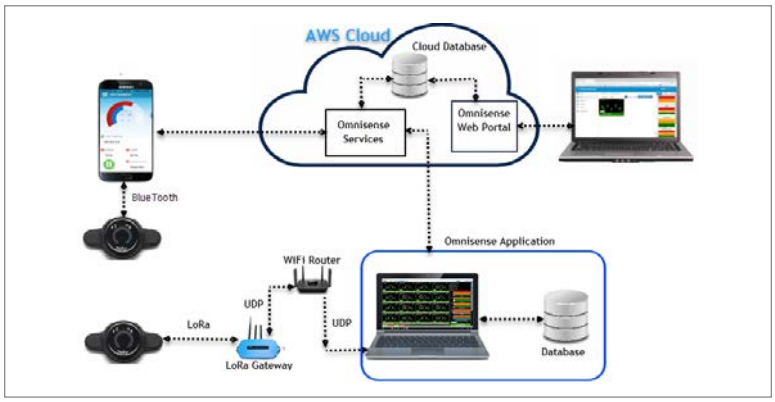


Use of the software requires the payment of a one-time license fee.

OmniSense™ Cloud

OmniSense™ Cloud features all the components of OmniSense™ Local but in addition has:

- OmniSense™ Web Portal
- OmniSense™ Secure Cloud Database
- OmniSense™ Mobile Application



Use of Software requires an annual subscription, which depends on the preferred level of service and product mix.

- A customer Account Administrator will create accounts for individual users.
- Users with the appropriate permissions can connect to the Cloud database from within OmniSense™ Live or Analysis on a PC.
- Data from subscribed users will be automatically uploaded from the local to the cloud database (it will exist in both locations).
- Users with the appropriate permissions can access the cloud data via the web portal.
- Subscribed users can use OmniSense™ Mobile, along with a BioModule or HxM device communicating via Bluetooth™* Low Energy to the mobile device, to upload data directly to the cloud database.

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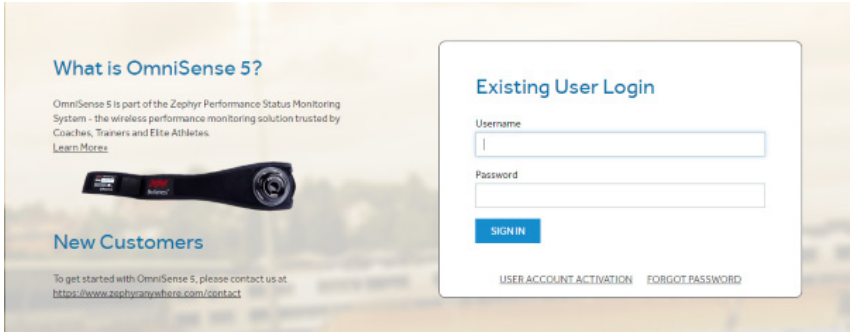
Portal Access

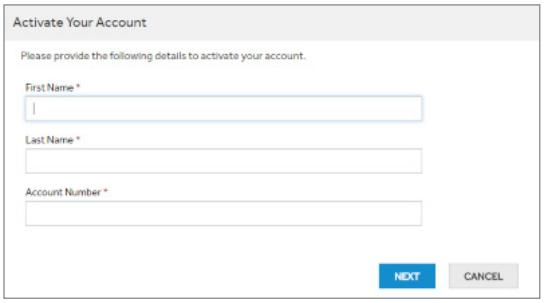
Prior to access, users must supply an email to their Account Administrator.

They will receive an email supplying a **Username**, **Password** and **Customer Number**.

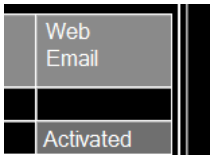
- To access the web portal, go to **https://os.zephyranywhere.com/om/login**.



- First access to the portal will require a user to activate their account.



- Once activated, this is recorded in their details in the **Setup > Subject** tab in the local OmniSense™ Live.



The data that users will be able to access on the portal will depend on the permissions they have been allocated by their Account Administrator.

- Athletes may be able to see their own data only.
- Coaches, Manager and Trainers may have wider access.

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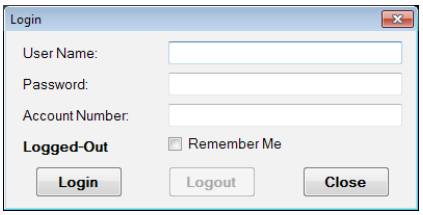
Connecting OmniSense™ Local to the Cloud

Both Live and Analysis local instances may be connected to the cloud database if a customer account exists. In both cases, there is an online/offline button in the application toolbar.

Offline

When this is selected, a **Login** dialog will display.



The user should enter the **Username**, **Password** and **Account Number** with which they originally validated their account. The Account Number will then be saved, so need not be remembered for subsequent logins.

The toolbar button will change to reflect their connection status.

Online

Note

An internet connection is required to connect to the cloud database.

Note

OmniSense™ users who have never subscribed to a cloud account will still see the offline/online button on their application tool bars, and the login dialog will display, but it is redundant without a valid customer account number.

Note

When a Live instance of OmniSense™ is connected to the cloud, two things will happen:

- User fitness parameters - which may have been updated remotely when using fitness or readiness tests in the OmniSense™ Mobile application, will be updated in the local database.
- Live streaming data (from subscribed users only) will be automatically uploaded to the cloud database. It will also exist in the local database. Non-subscribed users may coexist in a Live session, but their data will not be uploaded.

Note

When an Analysis instance is connected to the cloud:

- Any data which has been uploaded to the local database from BioModule log sessions from subscribed users, will be uploaded to the cloud database. It will continue to exist in the local database.
- At no point is any subject data ever downloaded from the cloud database to a local database, nor can it be. This is a security measure.

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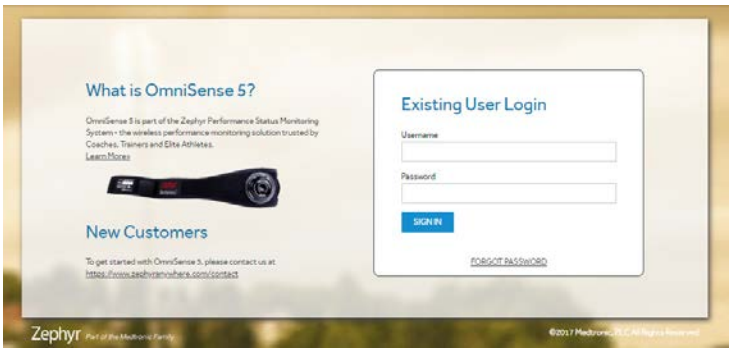
Lost Password

If a password is forgotten, you will need to return to the web portal itself.

https://os.zephyranywhere.com/om/login

- Enter your username into the login, and click on the **FORGOT PASSWORD** link below the **Sign In** button.
- An email will be sent to the email address you have opted to associate with OmniSense.



- For a forgotten username, contact your customer account administrator or coach. They can access your user name, but not the password.

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How Accounts Work

Definitions

Term	Description
Account	Client name for each customer.
Subscription Fee	Each account will have an affiliated monthly fee for each System, Administrator and Subject.
Subjects	Number of users in the system that are being monitored. Subjects can only view their own data, and not anyone else's.
Administrators	Number of back end admins who will have access to the data and who will be able to define who actually sees all, some or none of the data.
Reports	Customized or standardized graphs, spreadsheets or trends which are downloaded from the customer's data, and sent to the customer based on their viewing contract. An example would be five reports pulled for mechanical loads weekly.
Hardware	Zephyr™ product such as the straps, BioModules, gateways, etc., that make up the performance monitoring solution.
OmniSense™ Local	Local version of OmniSense™ running in conjunction with 5.X version.
Training	On-site Zephyr™ professional support for new customers learning the system.

- If a user wants to withdraw from acceptance of terms or wants their own user profile and data permanently deleted from the database for any reason, they can send a written request by email to support (**zephyrperformancesupport@medtronic.com**) originating from the email address associated with the user account. If the user profile is shared between multiple customer accounts, it must be specified which account's data (or all) should be deleted or retained. The support team will complete the action and send a reply email to the user to confirm completion.
- When you log in on the mobile or PC application, you will have to choose which account, if you are a member of more than one.

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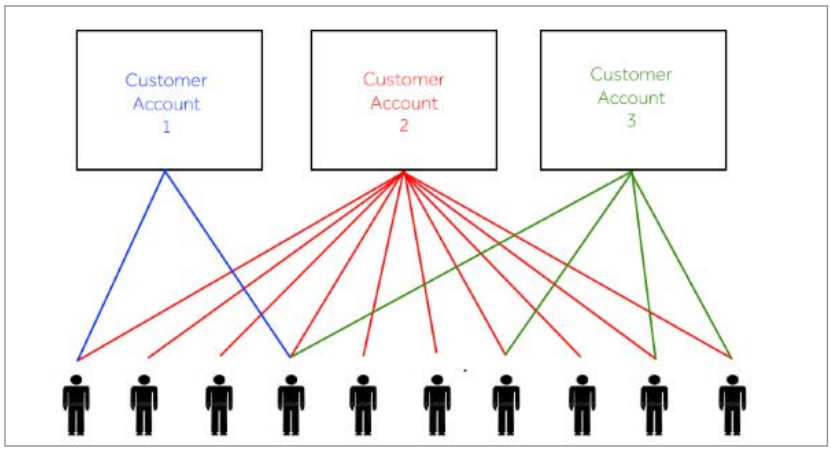
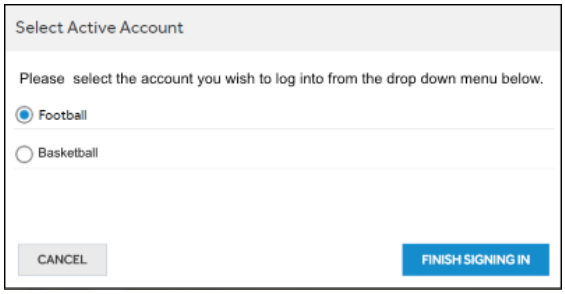
OMNISENSE™ WEB PORTAL

Overview (6/8)

- Each account can have multiple users & multiple roles.



- A user can be a member of multiple accounts (team, personal trainer etc.).
- If you are a member of multiple accounts, you will be prompted on login as to which to use, on a PC or using the Mobile Application.



- When logged on, any data uploaded is only uploaded to one account.
- You cannot transfer data between accounts.

Note

All account, user and session data is securely encrypted.

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User Roles and Permissions

- Different roles of user have different sets of permissions within an account, from **Administrator** to **Athlete.**
- The roles below are optional - they need not all be used.
- These roles can be customized, and additional roles created, by the **Admin** as needed.
- First and Last name must be unique to each user.

Pre-configured Roles

Role	Description
Admin	A customer user who has access to view and support a specific customer account with all customer permissions.
Assistant Coach	Has access to view a specific customer account with all customer permissions except Manage Account Settings & Defaults, Manage Roles and Manage Teams by default, with Include as Athlete enabled.
Athlete	Has access to view their own data, view Training Plans, view Workouts, view Live (own data only) and Included as Athlete.
Data Analyst	Has permissions to view all data, Workouts and Training Plans for any team they are assigned, and can Manage Reports and Dashboards for the same.
Head Coach	Has access to view a specific customer account with all customer permissions by default, with Include as Athlete enabled.
Team Captain	Has access to view own and View Team Data and View Workouts, Training Plans and Dashboards assigned to their own team(s).
Team Manager	Has all permissions except Manage Account Settings and Defaults, Manage Roles, Manage Teams, Manage Users, Manage Workouts and Manage Training Plans.
Undefined User	No permissions - existing users moving to a new account are automatically assigned this type until the new account Admin assigns their user role and permissions manually.

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Overview (8/8)

Permission Specifics

	Admin	Assistant Coach	Athlete	Data Analyst	Head Coach	Team Captain	Team Manager	Undefined User
Manage Account Settings & Defaults	●				●			
Manage Roles	●				●			
Manage Teams	●				●			
Manager Users	●	●			●			
View Team Data	●	●		●	●	●	●	
View Own Data	●	●	●		●	●	●	
View Training Plans	●	●	●	●	●	●	●	
View Workouts	●	●	●	●	●	●	●	
Manage Workouts	●	●			●			
Manage Training Plans	●	●			●			
Manage Reports & Dashboards	●	●		●	●		●	
Include as Athlete		●	●		●	●	●	
Include as Coach	●	●		●	●		●	
View Live	●	●	●		●	●	●	
View Device	●	●			●	●	●	
Manage Device	●	●			●	●	●	

- This user/permission matrix is pre-configured in the web portal, and a user type selected from a pull down list will have the permissions above allocated automatically.
- Any user can be individually customized later by the Account Administrator.

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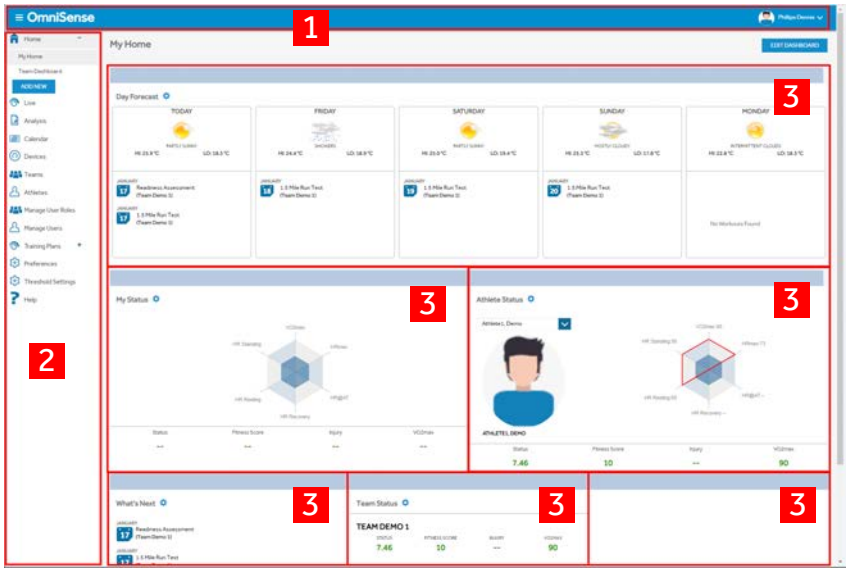
OMNISENSE™ WEB PORTAL

Home Screen (1/4)

Dashboard

On initial login, a user will be presented with their **Home** screen. The main panel within this is a **Dashboard**.

- The dashboard consists of an array of **Widgets** which can dynamically update their data at each login.
- The appearance of the dashboard will depend on the permissions granted the logged in user - an **Administrator** or **Coach** will have access to more information than an **Athlete**.
- The dashboard layout is completely configurable.



- The dashboard provides an overview of ongoing training programs, and performance and status of teams and individuals within those training programs.
- Workouts assigned to athletes within a training program are automatically pushed out to mobile devices hosting OmniSense™ Mobile.

#	Description
1	Header - maximize or minimize menu panel, show own profile, log out.
2	Navigation panel to access all other screens.
3	Dashboard array of 'widgets' - components which display a variety of summary aspects of training plans , team and individual performance.

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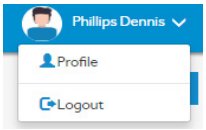
Dashboard Header & Navigation

Header

There are three active components in the header:

Item	Description
	Maximize or minimize (icons only) the navigation pane.
	Click to return to dashboard from other screens.
	Display own Profile, or log out.

Navigation

Maximized

Minimized

Item	Description
	Link to a specific screen. Not all users will see all items, depending on permissions.
	Click to expand the navigation item to view sub-items. A ' - ' will display, to collapse the item.
	Add new navigation item such as an additional dashboard.

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Home Screen (3/4)

Configure Dashboard

The dashboard consists or an array of rows of widgets. Each row can be configured to show 1,2 or 3 widgets. Some widgets require full row width for display.

A newly-created dashboard, using the Add New button, with no rows or widgets.

Note

All widgets update dynamically with the latest available data, according to their settings.

ROW 1		
Widget 1		
ROW 2		
Widget 2	Widget 3	Widget 4
ROW 3		
Widget 5	Widget 6	Widget 7
...add additional rows and widgets		

- A scroll bar on the right side of the screen will allow continuous expansion of a dashboard if needed.

Item	Description
EDIT DASHBOARD	Enter Edit mode to add or remove rows and columns for more widgets.
My Home	Edit the dashboard name, in Edit mode.
Add a Row	In Edit mode, Add a Row. A dialog will prompt for how many new rows and how many columns in each.
Delete Row	In Edit mode, delete a row and all the widgets in it.
	In Edit mode, delete a specific widget.
	In Edit mode, show the settings dialog for a specific widget.
Add Widget	In Edit mode, an Add Widget button will appear in each column of a newly created row.
EXIT EDIT MODE	Exit Edit mode.