



# VivoSense®

## User Manual - Hexoskin Import Module

VivoSense® Hexoskin Import Version 3.1

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**Cautions and disclaimer**

VivoSense® software is not a medical diagnostic tool and is intended for research and investigational purposes only. VivoSense® is not intended to be, or to replace, medical advice or review by a physician.

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# 1. Introduction

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## 1.1. VivoSense® for Hexoskin

This manual describes the use of the Hexoskin import module for VivoSense® software and its ability to import and analyze data collected with Hexoskin sensor system. The Hexoskin import module is generally included as part of the core version of VivoSense®.

For more information about available data and capabilities of the Hexoskin, please refer to the Hexoskin user manuals.

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## 1.2. System Requirements

The Hexoskin import module is an add-on module to VivoSense®. In addition to VivoSense® requirements, the Hexoskin import module has the following system requirements:

- Hexoskin Smart Shirt – to transmit signals via Bluetooth to PC/Mobile phone.
- Bluetooth wireless communication – to receive data wirelessly from the Hexoskin and transfer it to the online Dashboard.
- HxServices software – Hexoskin's data synchronization desktop software to upload raw waveforms to the online Dashboard.

## 2. Importing Data

Ambulatory physiological data from Hexoskin is recorded through Carre Technologies Inc.'s HxServices software and stored as a .zip file on the PC.

The .zip file and HxServices are discussed in the following two sections.

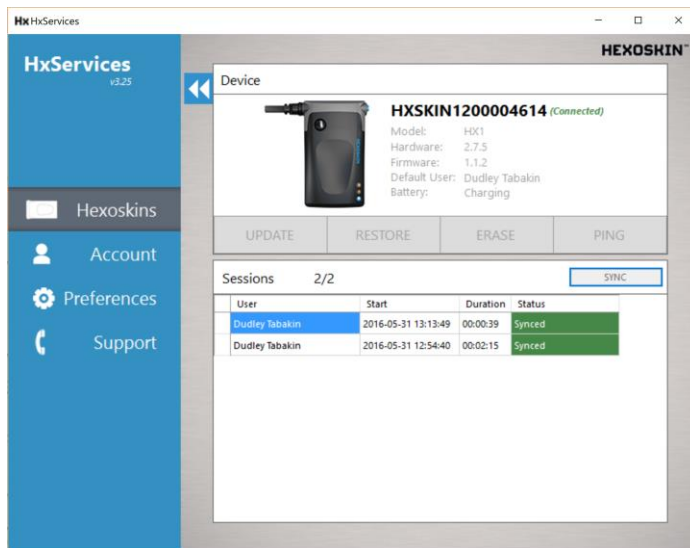
### 2.1. .zip Hexoskin File

VivoSense® can import .zip Hexoskin files. The Hexoskin import option is available from the File -> Import Hardware File menu. Upon selecting the Hexoskin zip file, VivoSense® will open the file and automatically import all the available channels along with the session start time. VivoSense® will automatically import the channels at the specified sample rate.

### 2.2. Hexoskin Web Dashboard

A brief overview of the upload process is provided here and a more detailed explanation can be found on the Hexoskin Quick Start webpage: <http://www.hexoskin.com/pages/start>

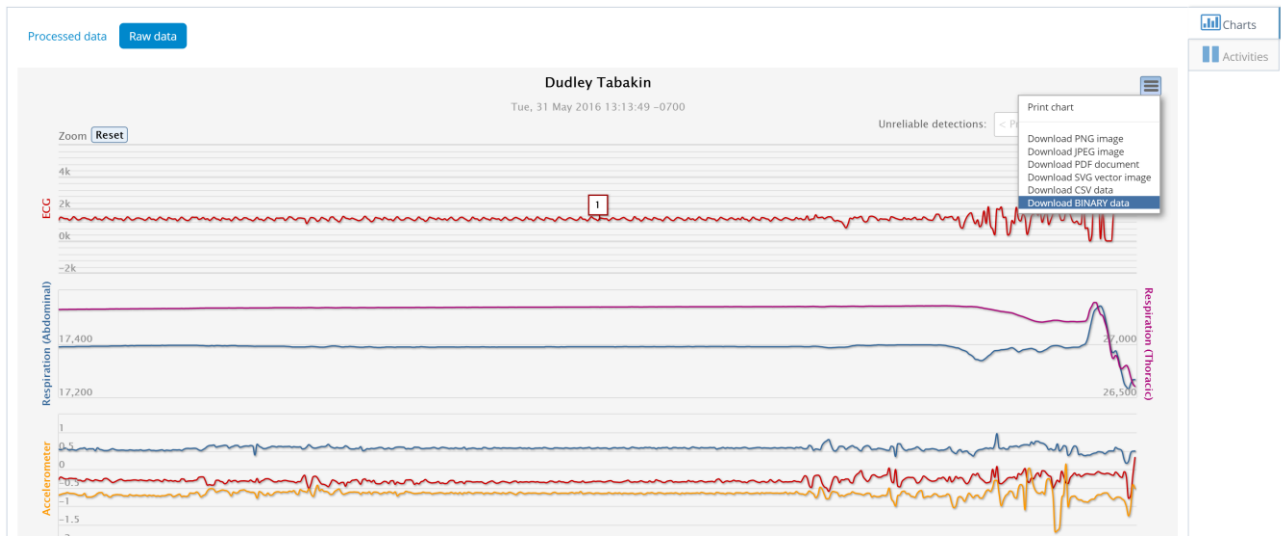
Once an activity or record is recorded, data can be uploaded to the Hexoskin Web Dashboard using the HxServices desktop app. Plug the Hexoskin device into the computer. HxServices will identify the device and will start to sync automatically. See Figure 1 for the HxServices desktop.



**Figure 1. HxServices desktop app: syncing data from HexoSkin device.**

As soon as the sync is complete, the data is available for your review on the Hexoskin Web Dashboard. Login to the online Dashboard at <http://my.hexoskin.com> and go to the Records tab to find the synced records.

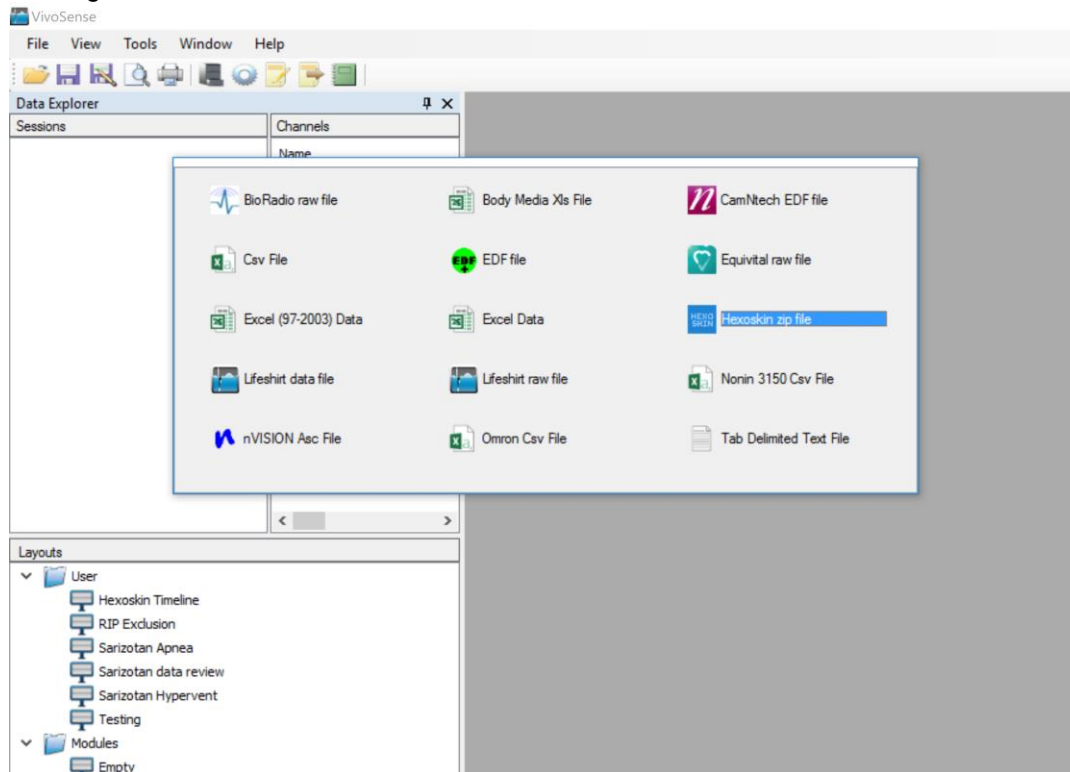
To download the raw zip file, find the data file you wish to download, click on the Raw data tab, select the menu in the right corner, and select Download BINARY data. See Figure 2.



**Figure 2. Records page on the Hexoskin online Dashboard: downloading BINARY data.**

You will then be prompted to select the file to save the raw zip file.

This file can then be uploaded to VivoSense® by selecting File > Import Hardware File > Hexoskin zip file. See Figure 3.

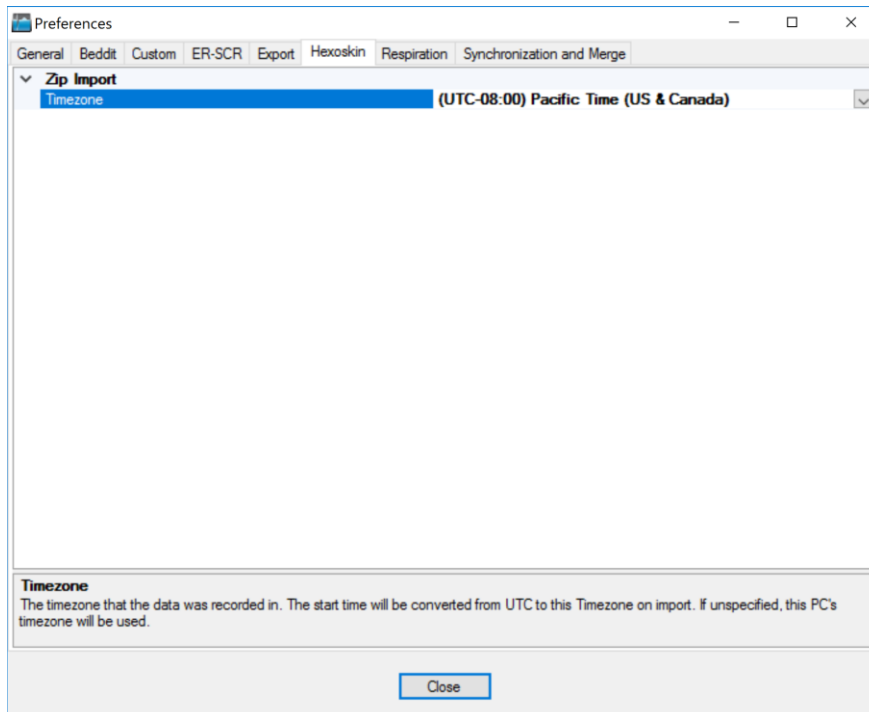


**Figure 3. VivoSense®: Importing Hexoskin zip file.**

## Adjusting Hexoskin Time Zone

The start time of the Hexoskin zip file is stored as Coordinated Universal Time (UTC). VivoSense® automatically converts this to local time by default. You may change the default time in the Tools -> Preferences > Hexoskin tab. This is useful if the data was collected in a different time zone than it is being analyzed in. Note, that the correct time zone must be adjusted before importing your Hexoskin file.

After importing the Hexoskin file, you may adjust the time zone and start time in the Session -> Properties window to automatically adjust the time. See Figure 4



**Figure 4. Hexoskin Timezone settings in Preferences.**

## 3. Processing Data Channels

Available data channels from Hexoskin devices may be divided into 2 categories: Raw data channels from the device and derived channels – as calculated by VivoSense®.

The raw data channels from Hexoskin are located in the Data Explorer under the “Raw” node. They include Waveforms as described in the following sections. For complete information regarding the data in each of these channels, please consult the hardware documentation for the specific Hexoskin unit.

The VivoSense® Core manual contains a general description of the derived channels. Only the derived channels that are particular to the Hexoskin product are described here.

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### 3.1. Accelerometer Data Channels

The Hexoskin accelerometer measures acceleration along 3 axes denoted by ACC\_X\_CHANNEL\_CHAR, ACC\_Y\_CHANNEL\_CHAR, ACC\_Z\_CHANNEL\_CHAR. The conversion to physical units in the derivation of Core Channels (AccX, AccY, AccZ) is obtained by scaling the raw data with a constant gain provided by the manufacturer and by shifting the offset by an amount specific to the individual hardware. This calibration is done automatically upon import. See the VivoSense® Core manual for additional information regarding axis definitions.

#### ***Raw Accelerometer Waveforms***

##### ACC X CHANNEL CHAR

Acceleration, measured along the X axis.

##### ACC Y CHANNEL CHAR

Acceleration, measured along the Y axis.

##### ACC Z CHANNEL CHAR

Acceleration, measured along the Z axis.

#### ***Accelerometer Waveforms***

##### AccX

Acceleration, measured along the X axis.

##### AccY

Acceleration, measured along the Y axis.

##### AccZ

Acceleration, measured along the Z axis.



## 3.2. Electrocardiogram (ECG) Data Channels

The Hexoskin ECG channel is denoted as ECG\_I\_CHANNEL\_CHAR, which is analog 256Hz ECG data. VivoSense® will process the channel and perform QRS detection to generate a R-wave marking.

### ***Raw Electrocardiogram Waveform***

#### ECG\_I\_CHANNEL\_CHAR

ECG raw signal.

### ***Electrocardiogram Waveform***

#### Ecg

Filtered ECG\_I\_CHANNEL\_CHAR.

### ***Electrocardiogram Markings***

#### Rwave

This channel identifies the peak of the R-wave on the corresponding Ecg waveform. These markings are provided as a result of the QRS detection algorithm implemented in VivoSense®.

### ***Electrocardiogram Measures***

#### RR

This channel represents the time interval between two consecutive R-waves in seconds as marked by Rwave. This channel may be further used to adjust specific parameters of the QRS detection algorithm for Ecg.

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## 3.3. Respiration Data Channels

There are 2 Hexoskin respiratory channels, which come from analog 128 Hz breathing sensor data.

### ***Raw Respiration Waveforms***

#### RESP\_ABDO\_CHANNEL\_CHAR

This is the raw respiration waveform recorded from the Hexoskin. Thoracic excursions are measured in non-physical computer units. The tidal volume waveform, RIP Vt, is derived from RESP\_ABDO\_CHANNEL\_CHAR by summing it with RESP\_THOR\_CHANNEL\_CHAR (if available) and then scaling with a gain factor obtained from a calibration procedure performed automatically on import. This calibration factor is determined by scaling the estimated average peak to trough excursions to 400 ml.

### RESP\_THOR\_CHANNEL\_CHAR

This is the raw respiration waveform recorded from the Hexoskin. Abdominal excursions are measured in non-physical computer units. The tidal volume waveform, RIP  $V_t$ , is derived from RESP\_ABDO\_CHANNEL\_CHAR by summing it with RESP\_THOR\_CHANNEL\_CHAR (if available) and then scaling with a gain factor obtained from a calibration procedure performed automatically on import. This calibration factor is determined by scaling the estimated average peak to trough excursions to 400 ml.

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## 4. Hexoskin Layouts

The following layout is provided with the Hexoskin Import module.

### Hexoskin Import

The Hexoskin Import contains the AB & RC, Tidal Volume (Vt max and min), ECG (Rwave) and Motion channels.

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## 5. Hexoskin Exports

### Hexoskin Import

The Hexoskin Import export layout contains the AB, RC, Vt, ECG and Motion channels.