

## ActiLife 6 User's Manual

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*U.S federal law restricts this device to sale by or on the order of a physician.*



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# USER'S MANUAL

## CHANGE PAGE

### ABOUT THE CHANGE PAGE

The following table describes the changes that have been made to this document since its original baseline. Documents affected by the changes made need to be listed and updated to keep procedures up to date. This table shall be maintained as long as this document is active.

<b>Revision</b>	<b>Description of Changes</b>	<b>Date of Approval</b>
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# USER'S MANUAL

## SIGNATURE PAGE

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# USER'S MANUAL

## CONTENTS

Getting Started.....	2
Downloading and Installing.....	2
Licensing.....	2
Activation over the Internet .....	3
Activation without an Internet Connection .....	4
ActiLife New Feature Overview .....	4
ActiLife Default Units Selection.....	5
ActiLife Data Formats.....	6
File Menu .....	6
Import/Export .....	6
AGD File Viewer .....	8
Load Template .....	10
Remove Template .....	11
Template Editor .....	11
Edit Menu.....	11
General Options .....	11
Directories.....	12
Downloading .....	12
Wear Time Validation .....	13
Data Scoring .....	13
Sleep Scoring.....	14
Colors .....	14
Communication Menu .....	14
Show Download Folder .....	14
Show CSV Folder .....	14
Update Firmware from File.....	14
Tools Menu .....	15



## USER'S MANUAL

Print Sleep Diary.....	15
Clinical Report .....	16
Correlate GPS Data.....	17
Merge AGD.....	17
Help Menu .....	18
Online Support.....	18
View Welcome Tour.....	18
Activation Details .....	18
Deactivate .....	18
Check for Updates.....	18
About ActiLife.....	19
Device Initialization and Download .....	20
Device.....	21
Serial #.....	21
Status .....	21
Progress.....	21
Firmware .....	22
Battery Voltage .....	22
Total Memory.....	22
Current Data Recorded .....	22
Epoch/Sample Rate.....	22
Subject Name .....	22
Start Date & Time.....	22
Stop Date & Time .....	22
Filter .....	22
Axis Enabled .....	22
Modes .....	22
More Info .....	23
Initializing Devices.....	23



# USER'S MANUAL

Setting Device Parameters.....	24
Subject Info .....	25
GT3X+ Biometric Info Storage.....	25
Downloading Devices.....	26
File Format .....	26
Downloading GT1M, GT3X, ASM, and/or ActiTrainer Devices .....	26
Downloading GT3X+ Devices .....	30
Scanning of GT3X+ Data during Download .....	30
Uncompressing *.gt3x Files .....	31
Building and Using a Template .....	33
Dataset Analysis Overview.....	37
Wear Time Validation .....	38
Define a non-wear period.....	39
Optional Screening Parameters .....	40
Viewing Details of Wear Time Validation Results.....	40
Export Report.....	42
Score Selected.....	42
Data Scoring.....	43
Date and Time Filters.....	43
Data Scoring Parameters and Algorithms.....	45
Energy Expenditure.....	45
METs.....	45
Cut Points.....	45
Bouts .....	46
Min Length .....	46
Min Counts.....	46
Max Counts .....	46
Drop Time.....	46
Bout Example .....	47



## USER'S MANUAL

Heart Rate EE .....	48
Use Validated Data if Available .....	48
Data Scoring Columns .....	48
Batch Exporting .....	52
Sleep Analysis.....	53
Manually Entering Sleep Times.....	54
Automatically Entering Sleep Times .....	55
Editing Auto Scored Times .....	55
Removing Sleep Times .....	56
Activity and Lux Scale.....	57
Changing Graph Colors .....	57
Lux .....	57
Sleep Scoring Algorithms .....	58
Cole-Kripke Algorithm.....	59
Sadeh Algorithm Summary .....	59
Custom Sleep Algorithms.....	59
Sleep Score Information .....	62
ActoGram View .....	62
Saving the ActoGram .....	63
Show Sleep Epochs .....	63
Save Sleep Report .....	64
PLM Analysis .....	65
Initializing Devices for PLM Analysis .....	65
Downloading Devices.....	65
Scoring the PLM Data.....	66
Interpreting the Periodic Limb Movement Output.....	67
Graphs.....	67
Stats.....	67
Graphing.....	68



## USER'S MANUAL

Exporting.....	68
Mode Options .....	68
Axes Scaling.....	69
Inclinometer.....	69
Creating an Inclinometer Report .....	71
Data Comparison .....	72
Loading Datasets for Comparison.....	72
Selecting NHANES Comparisons .....	73
Exporting Data Comparison Results.....	74
Data Vault .....	74
Adding Files to the Data Vault .....	75
Sub Folders.....	76
Sharing Data with Colleagues – License Grouping.....	76
Multipart Uploads.....	76
Viewing Upload Progress .....	76
File Types.....	77
Downloading Files from the Data Vault.....	77
Purchasing More Space.....	77
Appendix A - File Types in ActiLife .....	78
Comparison of GT3X+ and GT3X Devices.....	78
*.gt3x File Format .....	78
*.agd File Format .....	79
*.agd Data Table Format.....	80
*.dat File Format.....	80
Appendix B – Vector Magnitude.....	82





# USER'S MANUAL

## GETTING STARTED

### DOWNLOADING AND INSTALLING

Download ActiLife 6 from <http://www.theactigraph.com/actilife> to a known location. Double-click the icon to start the installer. After running the ActiLife5 installer, follow the installation instructions in the on-screen prompts.

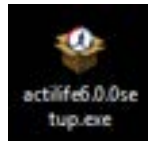


FIGURE 1 – ACTILIFE6 SETUP ICON

*IMPORTANT: Please be sure to remove any ActiGraph devices that you have connected to your computer during installation. Failure to do so could result in a faulty installation of your ActiLife software.*

*NOTE: Older versions of ActiLife (4 and 5) will be removed whenever ActiLife 6 is installed*

After installing ActiLife, an icon similar to the one shown here will appear on your desktop. Double click the icon to start ActiLife 6.



FIGURE 2 – ACTILIFE 6 PROGRAM DESKTOP SHORTCUT

## LICENSING

ActiLife software is a licensed program and requires users to obtain a product key before the software can be activated. If you have not purchased an ActiLife license, you may do so by visiting the ActiGraph store at [www.theactigraph.com/store](http://www.theactigraph.com/store). If you have misplaced your product key, contact ActiGraph sales support at [support@theactigraph.com](mailto:support@theactigraph.com) in order to proceed. Once ActiLife 6 has been purchased or upgraded from a previous version, users are entitled to free updates for 12 months. After that period, an optional maintenance plan may be purchased. **It is highly recommended that users purchase the maintenance plan in order to guarantee access to the newest updates, features, and bug fixes.**

## USER'S MANUAL

### ACTIVATION OVER THE INTERNET

The first time the program is launched, users will be presented with a screen similar to that shown in Figure 3. If you have already received a product key for your ActiLife Pro or ActiLife Lite software, type that product key in the box provided. If the license formatting is correct, a green check mark will appear to the right of the license box. Click "Activate". ActiLife will connect to ActiGraph's license server to confirm that the product key is correct and that it has indeed been purchased or upgraded. After activation, a screen similar to the one shown in Figure 4 will be displayed. This screen summarizes the product type and the number of activations used and available, as well as the name and contact information of the person to whom the license is registered. **Name, Email, and Organization fields must be populated in order to continue.** This activation process is required for each computer on which ActiLife is running.



FIGURE 3 – ACTILIFE ACTIVATION SCREEN

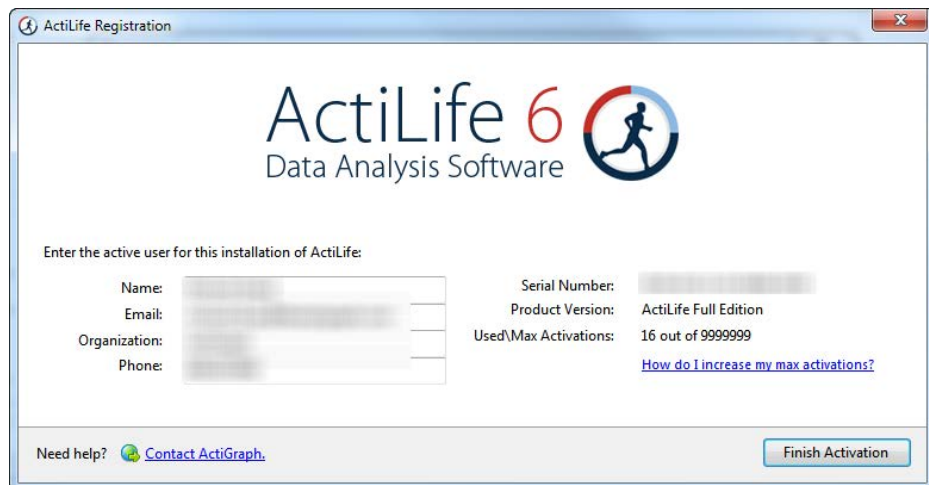


FIGURE 4 – ACTILIFE REGISTRATION CONFIRMATION

## USER'S MANUAL

### ACTIVATION WITHOUT AN INTERNET CONNECTION

For users without an internet connection, ActiLife can be activated by contacting our technical support staff either via email ([support@theactigraph.com](mailto:support@theactigraph.com)) or by phone (1-877-497-6996 option 1). Similar to the Internet activation, enter the ActiLife product key in the first box that appears after launching the program. After clicking "Continue," a screen similar to Figure 5 will appear. Provide the 24-character product key to ActiGraph customer service representative. After validating the product key, the representative will provide a confirmation code. Type or copy/paste the confirmation code into the box provided. Click 'Next' to activate ActiLife.

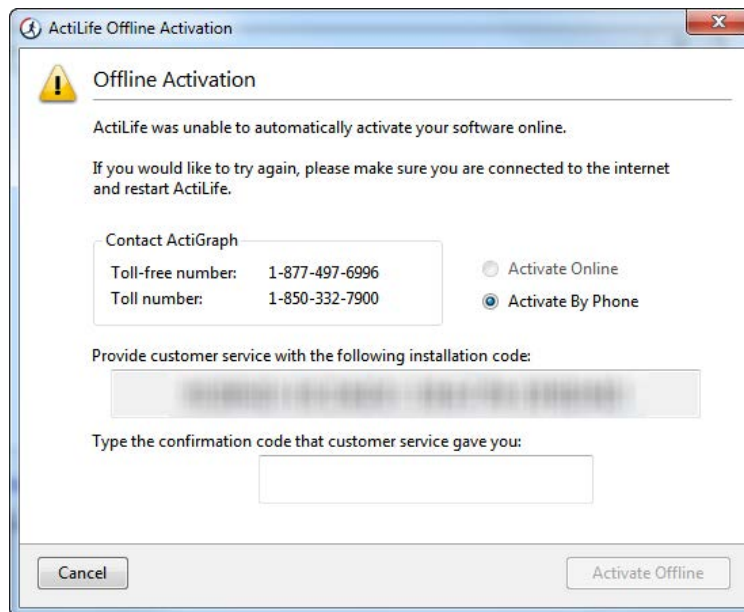


FIGURE 5 – NON-INTERNET ACTIVATION

### ACTILIFE NEW FEATURE OVERVIEW

Each release (update) of ActiLife provides users with a new feature overview. This screen (or similar) will appear immediately after loading ActiLife 6 for the first time. Note that this screen will change with each release to quickly illustrate the new features.



FIGURE 6 – ACTILIFE WELCOME SCREEN

To view this welcome screen again at any time, select the 'Help' tab in the menu bar and then select 'ActiLife Tour' as shown in Figure 7.



FIGURE 7 – RUN TOUR FROM HELP MENU

## ACTILIFE DEFAULT UNITS SELECTION

On first load, ActiLife gives users the option to choose which default units of measurement, time display format, and download directory they wish to use (see Figure 8). These settings can be changed at any time from the [Options menu](#).

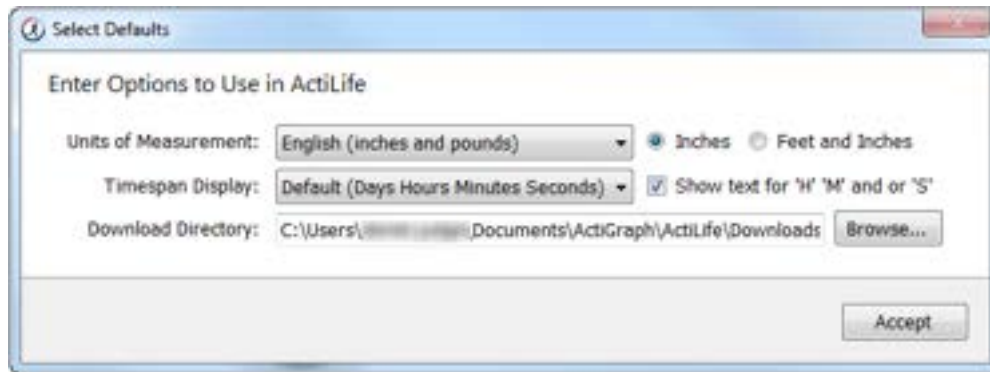


FIGURE 8 - DEFAULT UNITS SETTINGS ON FIRST LOAD

## ACTILIFE DATA FORMATS

ActiLife stores and uses data from native \*.agd files which are produced during the download or export process for all devices. These files are in SQLite Format, which is essentially a small database. ActiLife can import data from any legacy file formats by selecting “File->Import/Export” and selecting the appropriate action from the menu (see the ActiLife Main Menu discussion section in this manual). Multiple files can be imported simultaneously.

## ACTILIFE MAIN MENU

### FILE MENU

The file menu in ActiLife contains options related to file manipulation, AGD file analysis, and template loading and editing.

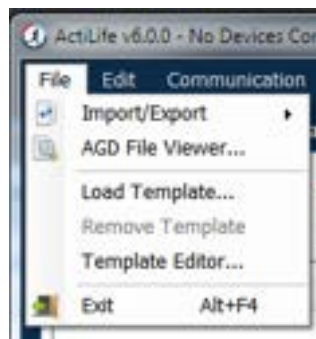


FIGURE 9 – ACTILIFE FILE MENU

### IMPORT/EXPORT

As discussed previously, users can import and export file formats to various formats to meet nearly any need. For details about the various file formats, see details in [Appendix A – File Types in ActiLife5](#). The table below explains the Import/Export options that are shown in Figure 10.



# USER'S MANUAL

Epoch to Epoch	<ul style="list-style-type: none"> <li>Imported files in this category contain epoch level data (e.g., 1s, 5s, 10s, 30s, 60s epochs).</li> <li>Exported files also contain epoch level data in the new file format.</li> <li>CSV-&gt;AGD conversion will convert both regular CSV files and Data Table CSV files.</li> <li>Use these options to simply switch file types (file extensions).</li> </ul>
Raw to Epoch	<ul style="list-style-type: none"> <li>Imported files in this category contain raw, 30Hz data or contain binary compressed data (*.gt3x format). Note, 12Hz import files are not allowed. See <a href="#">Uncompressing *.gt3x Files</a> for details.</li> <li>*.DAT files are file types used in ActiLife version 4.</li> <li>Exported files in this category contain epoch level data (e.g., 1s, 5s, 10s, 30s, 60s epochs).</li> <li>Exported files are first filtered then accumulated</li> <li>Supported export file formats include .CSV, .AGD, .DAT</li> </ul>
Raw to Raw	<ul style="list-style-type: none"> <li>Used to export binary*.gt3x files directly to *.csv format</li> <li>Both import and export file formats contain raw data at whatever frequency was used to produce the *.gt3x file</li> </ul>
Re-Integrate	<ul style="list-style-type: none"> <li>This feature is used to reintegrate epoch level post-filtered/post-accumulated *.agd files into larger epoch “buckets.”</li> <li>E.g., reintegrating a 10s epoch file into a 60s epoch file.</li> <li>Files cannot be reintegrated into smaller epoch lengths (e.g., 15s -&gt; 10s)</li> </ul>

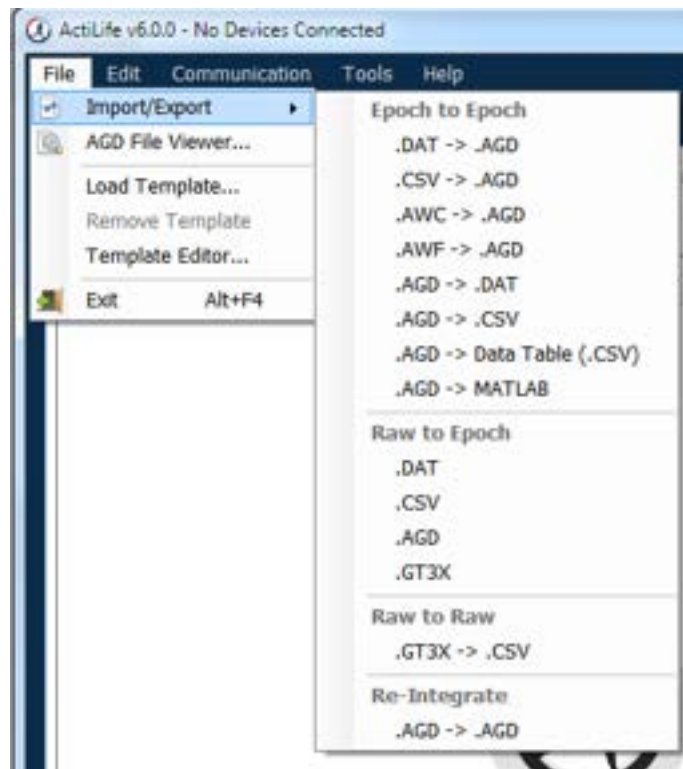


FIGURE 10 – ACTILIFE IMPORT/EXPORT MENU OPTION



# USER'S MANUAL

## CONVERTING TO A DATA TABLE VS. STANDARD .CSV

A data table \*.csv file contains separate columns with corresponding headers for each data type collected by the device and also includes the [Vector Magnitude](#) sum of each axis if data is collected for all three axes. A standard \*.csv file produced during conversion simply exports the data into \*.csv format. Column headers are not included unless that option is by checking “Add Column Headers to CSV” in the [options menu](#).

## MATLAB EXPORT OPTION

Users can export native \*.AGD files to \*.MAT format for easy importing into MathWorks Matlab® mathematical software platform.

## RE-INTEGRATING

The “Re-Integrate AGD File” option allows users to integrate AGD files to larger epoch periods (e.g., 1 second epoch data collection reintegrated to 60 second epoch periods for Sleep Analysis or Data Scoring). After selecting the file to be reintegrated, selected the desired epoch length as shown and click “OK.” The new file will be saved in the same directory as the existing file with an appended file name indicating the new epoch length.

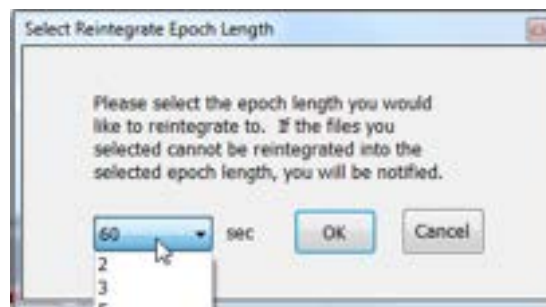


FIGURE 11 – RE-INTEGRATION OPTION

## AGD FILE VIEWER

The AGD File Viewer can be accessed from the File menu, by clicking “finished downloading” from the Devices grid after a download, or by double-clicking on an \*.agd file from within Windows Explorer.

Using the AGD viewer, users can instantly view the data they’ve just downloaded. With ActiLife 6.1 and later, the AGD viewer provides a graphical summary view of both activity cut points (according to the stored cut points in ActiLife) or daily activity counts which allow users to make quick observations about the subject’s compliance level (see Figure 12Figure 12).



# USER'S MANUAL

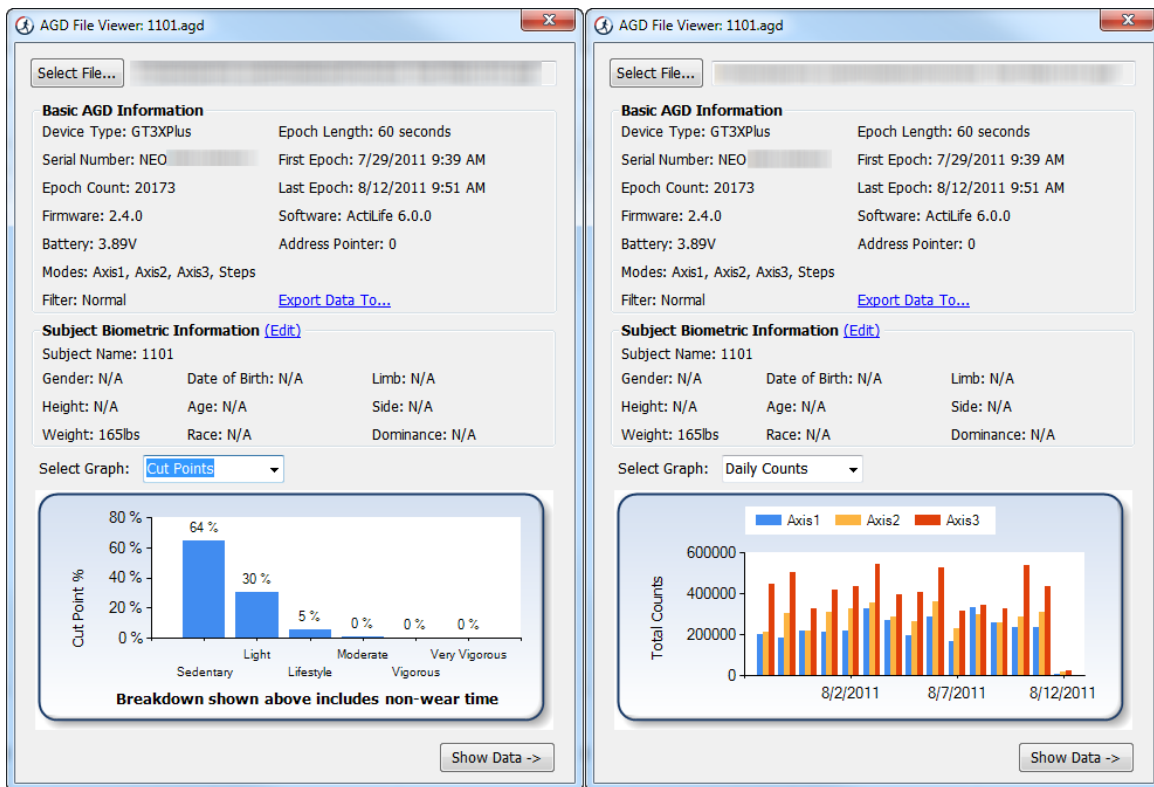


FIGURE 12 - AGD FILE VIEWER (SHOWING CUT POINTS OR DAILY COUNTS)

Click “Edit” near the “Subject Biometric Information” section to edit the stored biometric variables associated with the \*.agd file. Click “Save” to instantly update the file with these changes.

FIGURE 13 - EDIT SUBJECT BIOMETRICS FROM AGD VIEWER

Clicking “Show Data” in the AGD viewer will display hour-long previews of the data in a grid format. The hourly view can be changed by clicking the desired date/hour or by clicking “Next Hour->” to proceed sequentially through the hourly view. Data can be copied from the grid by selecting the data and pressing “Ctrl+C.” Data can then be pasted by pressing “Ctrl+V” in MS Excel® or any text editor.



# USER'S MANUAL

Data can be exported to any format directly from the AGD file viewer by clicking on “Export Data To...” above the data graph. This is equivalent to selecting “Export” from the File menu.

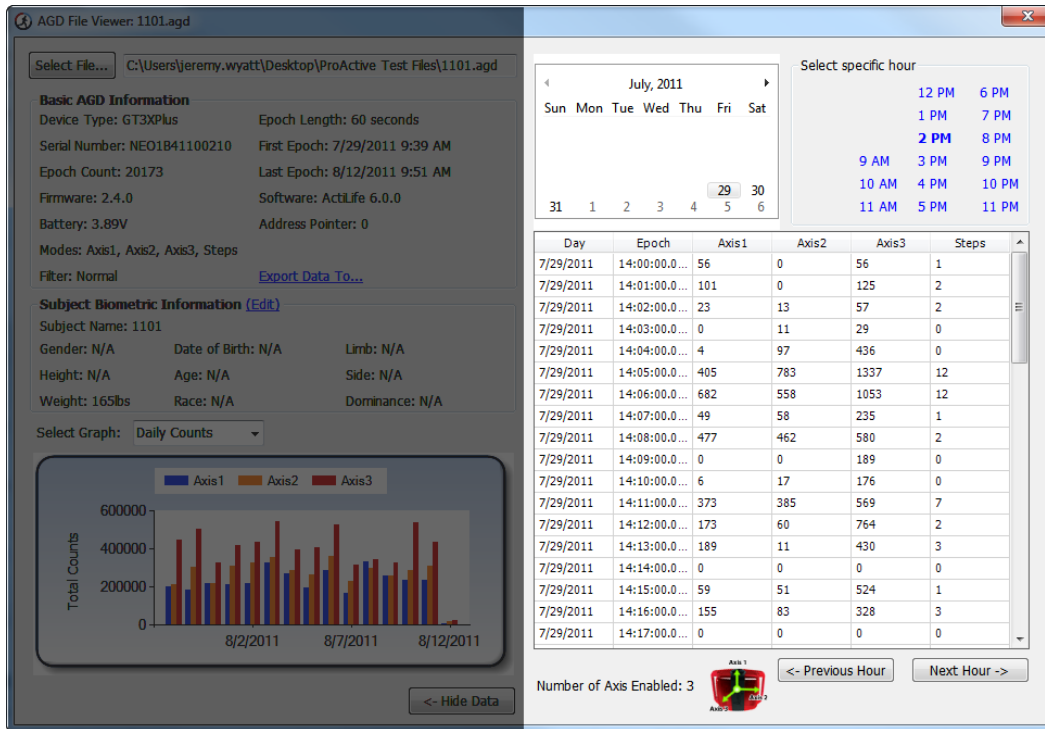


FIGURE 14 – AGD FILE VIEWER

## LOAD TEMPLATE

The ‘Load Template’ option allows users to browse and locate an ActiLife template file (\*.agt) which forces ActiLife to pre-defined initialization and/or download parameters to ensure consistency among all sites. For details on using the template editor, see [Building and Using a Template](#). Once a template is loaded, details about the template including the template name and ‘last modified’ date will appear in the upper right-hand corner of the ActiLife tool as shown in Figure 15.

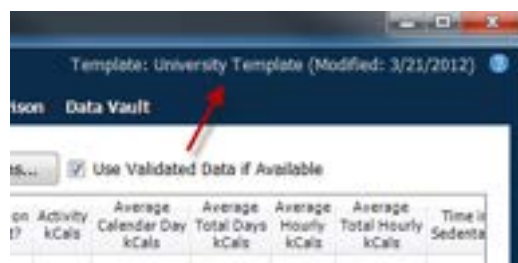


FIGURE 15 – TEMPLATE-IN-USE INFORMATION

## REMOVE TEMPLATE

The 'Remove Template' option simply disables any active template that ActiLife is using. The current template information as shown in Figure 15 will disappear after using this option. For more information about the template feature, see [Building and Using a Template](#).

## TEMPLATE EDITOR

The template editor loads the template editor form which can be used to create new or modify existing templates for use with all versions of ActiLife. For more information, see [Building and Using a Template](#).

*Note. The template editor is not available in ActiLife LITE.*

## EDIT MENU

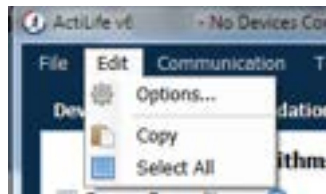


FIGURE 16 – EDIT MENU

The "Copy" and "Select All" options in the Edit menu allow users to select and copy elements in the selected grid so that they may be pasted into a text or spreadsheet editor. These apply to any tab within ActiLife. The "Options..." menu item allows ActiLife users to set system options that control how ActiLife functions. To change any option, make the change then click 'Apply' in the Options panel. Click 'OK' to close the panel.

## GENERAL OPTIONS

### UPDATE OPTIONS

Checking "Check for Program Updates" enables ActiLife's auto-update feature and allows ActiLife to check for program updates via the Internet when the program starts up. If an Internet connection is unavailable, ActiLife automatically skips this step.

*Important: It is strongly recommended that this option remain checked. Doing so ensures that the user has the latest version of ActiLife. Older versions of ActiLife may have bugs or issues which could affect data collection and/or device interaction. ActiGraph makes every effort to ensure that data collection and download are unaffected during program updates*

Each time a device is initialized, ActiLife checks the firmware version on the device. If it is not the latest version available from ActiGraph, it is automatically loaded onto the device prior to re-initialization. Because all data on a



## USER'S MANUAL

device is deleted prior to flashing firmware, firmware updates are only performed just prior to re-initialization during which time the device is fully erased. The “Update Firmware on Initialization” option allows the user to disable this feature. However, in order to guarantee that all devices remain up to date, this feature is permanently checked and enabled and cannot be unchecked. In order to disable this feature, contact ActiGraph support at [support@theactigraph.com](mailto:support@theactigraph.com).

It should be noted that ActiLife automatically downloads the latest version of firmware (for all ActiGraph devices) each time the program loads. In this way, ActiLife makes every effort to keep users updated with the latest firmware for their devices. The latest firmware files can be found in the *C:\Users\<user name>\Documents\ActiGraph\ActiLife\FirmwareFiles* directory.

ActiLife ships with the latest versions of firmware available in an effort to ensure that our offline customers remain updated.

### UNITS OF MEASUREMENT

Use these options to select the desired units of measurement throughout the ActiLife software (in all grids and in all exports). If “English” is selected, users have the option to display subject height information in inches or Ft/Inches.

### TIMESPAN DISPLAY

The Timespan Display settings set the default view for the ‘Current Data Recorded’ display in the Devices grid. Selecting the default (Days Hours Minutes Seconds) breaks the display of time parameters in ActiLife’s grids into four parts (days, hours, minutes, and seconds). Checking “Show text for ‘D’ ‘H’ ‘M’ and/or ‘S’” annotates the time with letters corresponding to hours, minutes or seconds (e.g., 820m versus 820 – useful for copy/pasting into a text or spreadsheet editor that may not use the h/m/s notation).

### DIRECTORIES

Use this option to set the default directories for data downloads, firmware storage, and CSV file creation

### DOWNLOADING

#### DOWNLOAD NAMING CONVENTION

These options set the default naming convention for downloaded files. During the download process, users have the option to change this option.

#### CREATE FILE OPTIONS

##### CREATE DAT AND CSV WITH AGD DOWNLOAD

Use these options to create a \*.dat or \*.csv file at the time of download. **Important:** These options only work whenever an AGD file is created. Hence, when downloading a GT3X+ device, \*.dat and \*.csv files will not be created when these options are checked *unless* the “Create AGD File” is checked during the download process (see [Downloading GT3X+ Devices](#) for details on creating an AGD file on download).



# USER'S MANUAL

## ADD COLUMN HEADERS TO CSV

Checking this option will add column header labels to the columns in CSV (like "Axis 1," "Axis 2," "Axis 3," "Steps," etc.) files when those files are created via export.

## COMPRESS GT3X+ FILES

This option will apply maximum file compression to \*.gt3x files when they are downloaded from GT3X+ devices. This compression can greatly reduce the file size of the \*.gt3x zip files, but can double the post-processing time (i.e., the time it takes to create an \*.agd file from a \*.gt3x file). For details on post-processing, see [Uncompressing \\*.gt3x Files](#).

## CREATE SUB-FOLDERS WHEN EXPORTING "RAW TO EPOCH"

Check this option to create sub-folders for \*.agd, \*.dat, and/or \*.csv files created when [exporting from "Raw to Epoch" files from the Import/Export menu](#).

## CREATE AGD DURING DOWNLOAD OF GT3X+ OR ACTISLEEP+

When checked, this option tells ActiLife to automatically create an \*.agd file immediately after downloading \*.gt3x files from ActiSleep+, GT3X+ or wGT3X+ devices. For more information on these file types, see [Appendix A – File Types in ActiLife](#).

## SCAN OF GT3X+ DOWNLOADS

When downloading GT3X+, ActiSleep+, or wGT3X+ data, this option allows users to be notified of large gaps (null data or 0s) in the data which may indicate either a problem with the device itself or non-compliance with the device end-user. Setting this option to a certain percentage will prompt the user if there are more than that percentage of the data contains 0s. For example, setting to 10% will cause notifications to appear when 10% or more of the data on the device contains null data (0s). Set this option to 100% to disable notifications.

## WEAR TIME VALIDATION

Wear Time Validation options are used to set the default values for the dataset filters in the Wear Time Validation tool. The user also has the option to switch between the Floating Window or Daily Wear Time Validation algorithms.

*Note: The daily algorithm has been deprecated and should be avoided.*

## DATA SCORING

The Data Scoring options are used to set default values for the algorithms available in the Data Scoring tool in ActiLife. Whenever the Data Scoring tab is opened, the default values set in this options dialog will be used; however, they can be changed directly from within the Data Scoring tool.

Note that clicking the "?" icons to the right of each algorithm option will open the ActiGraph support website and reveal the origin of each of the algorithms. Reference abstracts are available from the support site.

## USER'S MANUAL

### BOUTS – USE VECTOR MAGNITUDE

When this option is checked, the [vector magnitude](#) of 3-axis devices will be used to calculate bout levels.

### SLEEP SCORING

The Sleep Scoring option allows the user to set the default Sleep Scoring Formula for the Sleep Scoring Tool. See [Sleep Scoring Algorithms](#) for more information.

Checking the “Create Clinical Report on Download” will cause ActiLife to automatically create a clinical PDF report immediately after download. See [Clinical Report](#) for details.

### COLORS

The Colors option allows the user to set the default colors for all graphing items in ActiLife. The “Multiple Colors” checkbox in the Progress Bar section will cause ActiLife to use multi-colored progress bars in the Devices tab when interacting with multiple devices.

### COMMUNICATION MENU

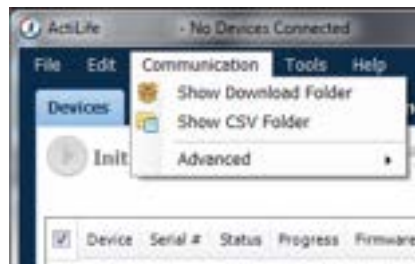


FIGURE 17 – COMMUNICATION MENU

### SHOW DOWNLOAD FOLDER

The Show Download Folder simply opens ActiLife’s default download folder. This option is useful for locating files downloaded from devices in the Devices tab.

### SHOW CSV FOLDER

The Show CSV Folder opens the default CSV conversion/download folder

### UPDATE FIRMWARE FROM FILE

Within the “Advanced” menu, the Update Firmware from File option allows users to manually upgrade (or downgrade) device firmware. From the Devices tab, select the devices that need to be upgraded then select the Update Firmware from File option. A dialog box will allow the user to select a firmware file for each of the connected devices types. After the file has been selected, click “OK to update the firmware.



## USER'S MANUAL

*Important: Manually upgrading or downgrading firmware is not recommended. Doing so could render your ActiGraph device unusable and could void the product's warranty. Contact ActiGraph support prior to manually changing the firmware. Under normal circumstances, ActiLife will automatically update the devices firmware.*

### TOOLS MENU



FIGURE 18 - TOOLS MENU

The Tools menu contains options for printing a sleep diary, creating a clinical report, correlating GPS data with data from ActiGraph devices and merging multiple AGD files together.

#### PRINT SLEEP DIARY

Many times, it is useful to provide patients with a sleep log for making subjective logs of time-in-bed (TIB) and time-out-of-bed (TOB) times so that sleep analyses can be properly performed. The "Print Sleep Diary" option in the Tools menu allows users to export a printable sleep diary for patients to use while they are wearing a device. Click the option and select a location to store the log diary (PDF format). A screenshot of the log diary is shown in Figure 19.



# USER'S MANUAL

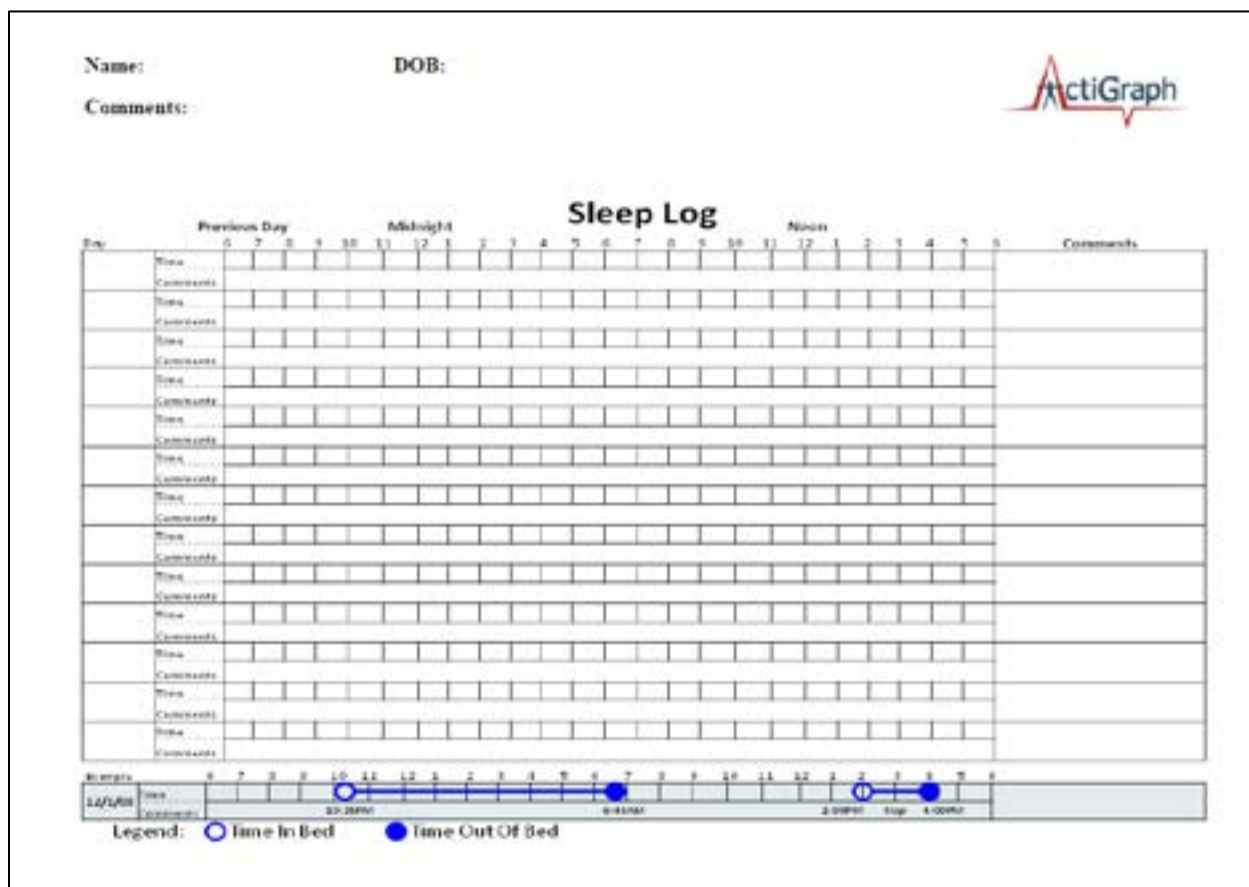


FIGURE 19 - SLEEP LOG (DIARY)

### CLINICAL REPORT

ActiLife can create a clinical report which contains the following information:

- Subject and Device Information (Name, Weight, Device Serial Number, Start/End Time)
- Wear Time Information
- Energy Expenditure
- Cut Points
- Sleep Graphs
- Sleep Period Breakdown and Summary

The clinical report can be used to quickly generate a report on an individual in a clinical environment without running through all of the tools in ActiLife.



## GENERATING A CLINICAL REPORT

When downloading data from an ActiSleep or ActiSleep+ device, users can generate a Clinical Report by simply checking the box "Create Clinical Report on Download..." as shown in Figure 20.

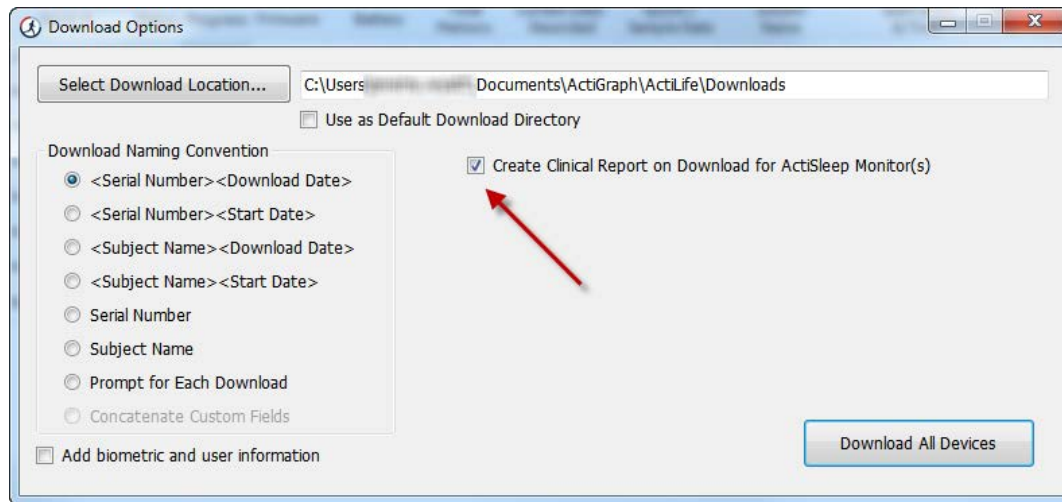


FIGURE 20 - CLINICAL REPORT ON DOWNLOAD

The report can also be generated after a data download through the tools menu. Select the \*.agd file that was generated from an ActiSleep or ActiSleep+ device and click "Open".

## CLINICAL REPORT DEFAULT VALUES

The Clinical Report generator uses the default values stored in the Wear Time Validation tool to calculate wear and non-wear time. Similarly, the tool also uses the default algorithms selected in Data Scoring (on last program close) to calculate Energy Expenditure. To change the algorithms, open ActiLife, navigate to the Data Scoring tab, switch to a new energy expenditure algorithm and close the program. If sleep times have already been entered via the Sleep Analysis tool, the Clinical Report tool will use those times to calculate the sleep score and graph information in the report. If not, the Auto Score feature will be utilized.

*Note: The Clinical Report tool is only available for data collected using the ActiSleep or ActiSleep+ devices. This feature can be enabled for non-ActiSleep devices for a small fee. Contact ActiGraph support at [support@theactigraph.com](mailto:support@theactigraph.com) for more information.*

## CORRELATE GPS DATA

More info coming soon.

## MERGE AGD

More info coming soon.





# USER'S MANUAL

## HELP MENU

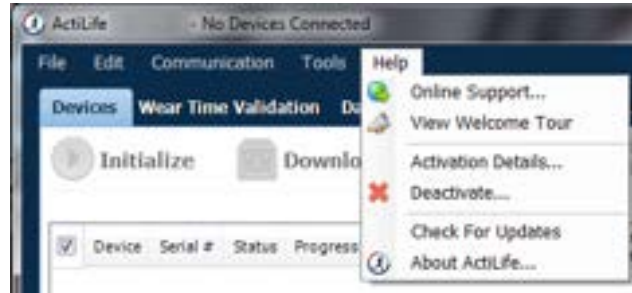


FIGURE 21 - HELP MENU

### ONLINE SUPPORT

Click this option to access our online support system

### VIEW WELCOME TOUR

This option launches the ActiLife introduction dialog that outlines what's new in the current release.

### ACTIVATION DETAILS

Click this option to view the ActiLife product key, the edition type, and the maintenance expiration date.

### DEACTIVATE

ActiLife licenses are node locked to the machine on which the software is installed. Users are allotted a specific number of activations on various machines. In order to prevent losing an activation, ActiLife should be deactivated before it is uninstalled and removed from its host computer. To deactivate ActiLife and reclaim the activation, select the Deactivate option and click "Deactivate ActiLife."



FIGURE 22 - DEACTIVATE DIALOG

### CHECK FOR UPDATES

Clicking this option will force ActiLife to check for any maintenance updates. This action is done automatically each time ActiLife is loaded, but may be manually done via this method.



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# USER'S MANUAL

## ABOUT ACTILIFE

The About ActiLife option displays information about the ActiLife program including the software version number (also available in the main dialog frame), copyright information, and a link to ActiGraph's corporate website.

# USER'S MANUAL

## DEVICE INITIALIZATION AND DOWNLOAD

Once ActiLife is properly installed and licensed, users will be presented with the “Devices” screen similar to the one shown in Figure 23. ActiLife is capable of initializing or downloading multiple devices simultaneously. Devices can be connected either before or after ActiLife is launched.

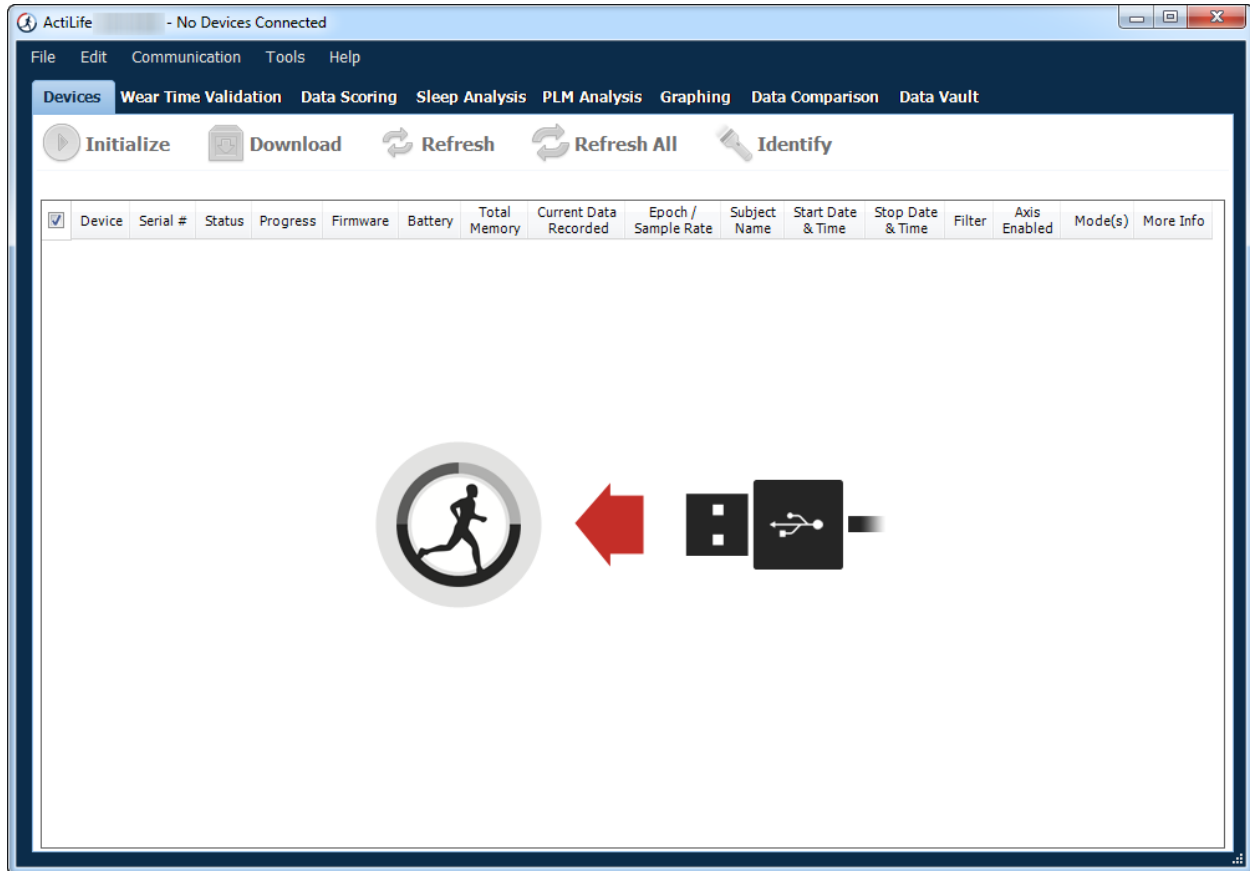
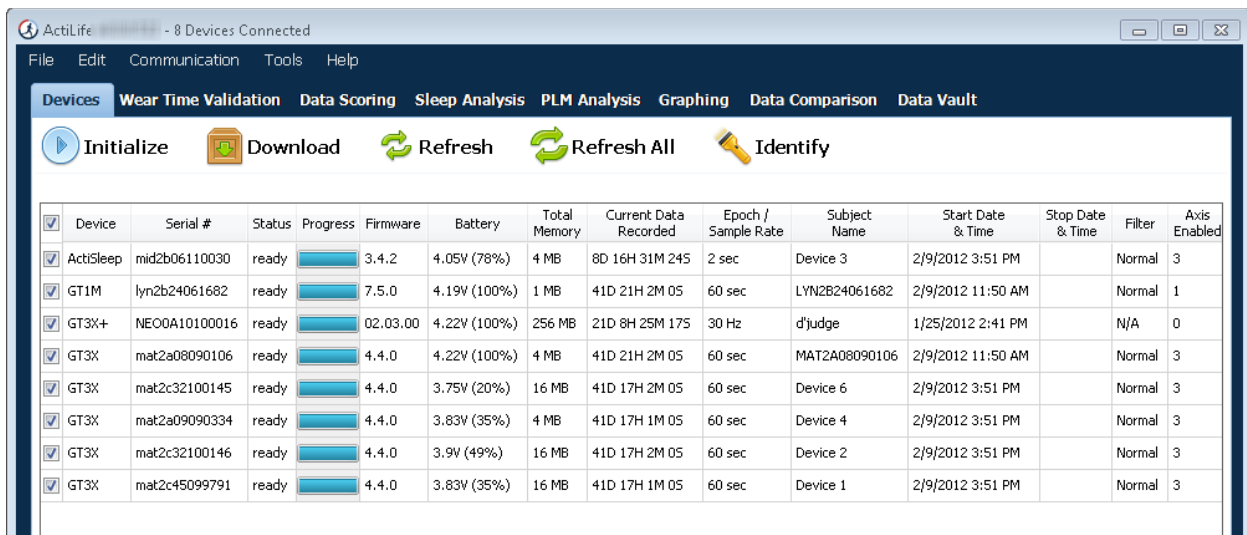


FIGURE 23 – OPENING SCREEN

*Important: Attempting to communicate with multiple GT1M and GT3X devices has been known to be problematic. Users may see an error similar to the one shown... To remedy the problem, ensure that the USB hub in use is a powered hub (ActiGraph recommends the 7-port ConnectLand sold on the theactigraph.com store). Sometimes a retry will fix the issue, but not always. Read more about the problem on our FAQ page [here](#).*

As shown in Figure 24, device status information will appear in the “Devices” tab as devices are connected to the computer. Device status information is provided in the Devices grid.



Device	Serial #	Status	Progress	Firmware	Battery	Total Memory	Current Data Recorded	Epoch / Sample Rate	Subject Name	Start Date & Time	Stop Date & Time	Filter	Axis Enabled
ActiSleep	mid2b06110030	ready	<div style="width: 100%;"></div>	3.4.2	4.05V (78%)	4 MB	8D 16H 31M 24S	2 sec	Device 3	2/9/2012 3:51 PM		Normal	3
GT1M	lyn2b24061682	ready	<div style="width: 100%;"></div>	7.5.0	4.19V (100%)	1 MB	41D 21H 2M 0S	60 sec	LYN2B24061682	2/9/2012 11:50 AM		Normal	1
GT3X+	NE00A10100016	ready	<div style="width: 100%;"></div>	02.03.00	4.22V (100%)	256 MB	21D 8H 25M 17S	30 Hz	d'judge	1/25/2012 2:41 PM		N/A	0
GT3X	mat2a08090106	ready	<div style="width: 100%;"></div>	4.4.0	4.22V (100%)	4 MB	41D 21H 2M 0S	60 sec	MAT2A08090106	2/9/2012 11:50 AM		Normal	3
GT3X	mat2c32100145	ready	<div style="width: 100%;"></div>	4.4.0	3.75V (20%)	16 MB	41D 17H 2M 0S	60 sec	Device 6	2/9/2012 3:51 PM		Normal	3
GT3X	mat2a09090334	ready	<div style="width: 100%;"></div>	4.4.0	3.83V (35%)	4 MB	41D 17H 1M 0S	60 sec	Device 4	2/9/2012 3:51 PM		Normal	3
GT3X	mat2c32100146	ready	<div style="width: 100%;"></div>	4.4.0	3.9V (49%)	16 MB	41D 17H 2M 0S	60 sec	Device 2	2/9/2012 3:51 PM		Normal	3
GT3X	mat2c45099791	ready	<div style="width: 100%;"></div>	4.4.0	3.83V (35%)	16 MB	41D 17H 1M 0S	60 sec	Device 1	2/9/2012 3:51 PM		Normal	3

FIGURE 24 - ACTILIFE DEVICES TOOL

## DEVICE

The “Device” column describes the type of ActiGraph device(s) connected to the PC. Mixing devices is allowed.

## SERIAL #

The “Serial #” column displays the serial number of the device connected.

## STATUS

The “Status” column displays the current status of the attached device. The status could be “Ready,” “Idle,” “Initializing,” “Finished Initializing,” “Updating,” “Downloading,” “Finished Downloading,” or “Finished Creating Clinical Report.”

## PROGRESS

The “Progress” column contains the progress bar indicating the progress toward completion of the status indicated in the “Status” column.



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# USER'S MANUAL

## FIRMWARE

The “Firmware” column displays the current firmware version on the device. Firmware is automatically updated during initialization. See [Update Options](#) for more details.

## BATTERY VOLTAGE

This column displays the device battery voltage and charge percentage. For more information, see device owners manual.

## TOTAL MEMORY

The Total Memory column displays the total memory available on the device. MB = Megabyte (or 1048576 bytes).

## CURRENT DATA RECORDED

This column displays the current number of days, hours, minutes, and seconds of recorded data on the device. To adjust how this appears, see [Timespan Display](#).

## EPOCH/SAMPLE RATE

For non-GT3X+ devices, this column represents the accumulation epoch length. For GT3X+ devices and non-GT3X+ devices in raw data collection mode, this column represents the sample/store rate.

## SUBJECT NAME

This column displays the subject name currently stored on the device.

## START DATE & TIME

This column displays the start date and time programmed on the device.

## STOP DATE & TIME

This column displays the stop date and time programmed on the device. This option can be set during initialization and is used to align the file lengths for multiple devices during large longitudinal studies.

## FILTER

The “Filter” column displays the on-board accelerometer filter setting for initialized devices (Normal or Low-Frequency-Extension). See [Setting Device Parameters](#) for details. This column is not applicable for GT3X+ devices as no on-board filtering is performed.

## AXIS ENABLED

The “Axis Enabled” column indicates which axes are being sampled and stored. 1 –vertical axis only (Axis 1); 2 – vertical and horizontal (Axes 1 and 2); 3 – vertical, horizontal, and lateral (Axes 1, 2, and 3).

## MODES

The “Modes” column displays icons representing the data channels that the device is set to log (if initialized). The icons and their meanings are interpreted in Table 1.



## USER'S MANUAL





Mode/Channel Icon	Interpretation
	Flash LED Mode Enabled (LED flashes periodically to indicate device is active). See <a href="#">Recharging and LED Decoding</a> for more details.
	Step counting enabled. Indicates that the device is recording step counts per epoch. See <a href="#">Steps</a> for more details.
	Inclinometer enabled. Indicates that the device is recording orientation data which will later be interpreted as sitting, standing, lying, or off. See <a href="#">Inclinometer</a> for more details.
	Lux (ambient light) sensor enabled. Indicates that the device is collecting light data. See <a href="#">Lux (Ambient Light)</a> for more details.

TABLE 1 – MODE/CHANNEL ICON DEFINITIONS

### MORE INFO

The button in the “More Info” column is for debug purposes by ActiGraph support and should not be required to operate the device(s).

The data in the Devices grid can be copied and pasted into any text editor by clicking on a cell, pressing and holding the Shift key and clicking on another cell to select a group of cells then pressing “Ctrl+C” to copy the data to the PC clipboard. This can be useful for studies in which device data must be logged.

**IMPORTANT:** Device drivers must load the first time a device is connected to a USB port. Devices may take a few seconds to load during device driver enumeration. GT3X+ and ActiSleep+ devices may cause Windows to display the AutoRun prompt (asking the user to choose a default action upon opening). The ActiGraph software development team is working on eliminating this action.

### INITIALIZING DEVICES

Select a check box corresponding to the devices to be initialized (or select all devices”) and click “Initialize.” A dialog similar to Figure 25 will appear.

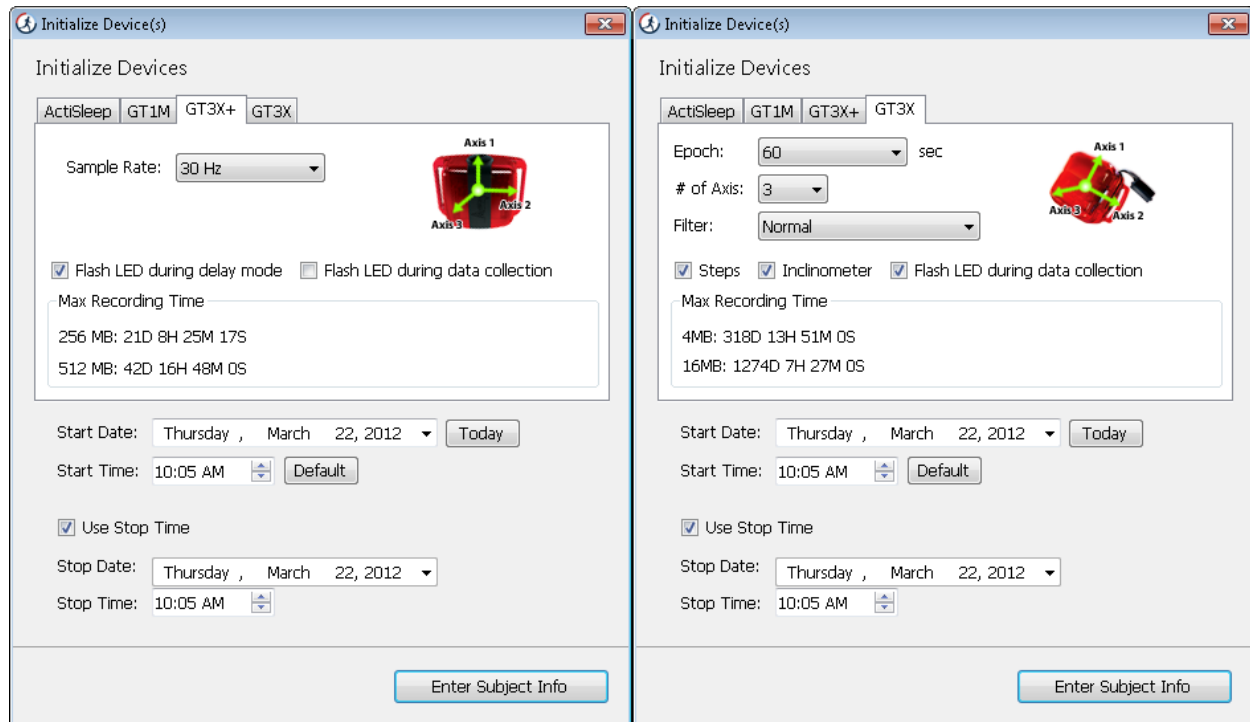


FIGURE 25 - INITIALIZATION DIALOG FOR GT3X+ VS GT3X

## SETTING DEVICE PARAMETERS

The 'Initialize Device(s)' screen contains a separate tab for each type of ActiGraph device connected to the PC and appears after clicking the "Initialize" button at the top of the "Devices" screen. Tabs across the top represent the types of devices to be initialized. If multiple devices of each type are selected, the tab group applies to all devices of that type.

Select the tab for the type of device you wish to configure and set the [specific data collection parameters](#). Filter information can also be set at the time of initialization. For more details about the low frequency extension, see [Low Frequency Extension](#). All ActiGraph devices of the same type that are initialized simultaneously will be initialized with the same data collection parameters.

Start Date and Time and Stop Date and Time apply to all devices and cannot be unique for each device group. Stop time is optional.

The "Max Recording Time" for each device is shown in the Initialization screen. This number will change depending upon the number of axes selected, the epoch length, and the number of active channels (see [Available Channels \(Modes\)](#) for details of the meaning of each setting). Most devices' "Max Recording Time" will far exceed the battery life of the device.

The icon in the top right corner of the initialization screen indicates which axes are selected. As the "# of Axis" dropdown box is increased, so too are the number of logged axes.



# USER'S MANUAL

GT3X+ devices collect data from all channels regardless of initialization settings. The only settings available for the GT3X+ are the raw Sample Rate and the “Flash LED” options as shown in Figure 25.

After data collection parameters have been set up for each model, select the ‘Enter Subject Info...’ button.

## SUBJECT INFO

The Subject Name screen allows users to enter a unique subject name for the attached devices. This data will be stored on the device and will be available at download and can help with file naming when data is downloaded from the device. To add or change a name, highlight the subject name cell. Note that GT3X+ devices (devices with serial numbers beginning with ‘NEO’) will store more information.

Serial Number	*Subject Name	Gender	Height (in)	Weight (lbs)	Date of Birth	Race	Limb	Side	Dominance
NEO0A10100016	NEO0A10100016	Male	70	165	12/15/1976	White / Caucasian	Wrist	Left	Non-Dominant
mid2b06110030	mid2b06110030								
mat2c45099791	mat2c45099791								
mat2c32100146	mat2c32100146								
mat2a09090334	mat2a09090334								
mat2a08090106	mat2a08090106								
lyn2b24061682	lyn2b24061682								

Subject Name Options:

\* Required Information

FIGURE 26 – SUBJECT NAME ENTRY FORM

If desired, the “Use Serial Number” button will populate the Subject Name column with the serial number of the device. Similarly, the “Use Device Info” button will automatically populate the Subject Name column with the Subject Name currently stored on the device. The “Clear” button will erase the fields for easier editing.

*Important: If any devices have a voltage less than 4.1 volts, we recommend leaving them connected, allowing them to charge fully if time allows. Updated voltage can be viewed by selecting the ‘Refresh All’ tab (or F5) from the devices screen.*

## GT3X+ BIOMETRIC INFO STORAGE

GT3X+ Devices (NEOxxxxxxx) can **optionally** store extra biometric information during initialization which can be used for post-processing after downloading data from the device (see Figure 26 for details). GT3X+ devices can store the following information in addition to the “Subject Name” which is standard on all devices:





## USER'S MANUAL

- **Gender** – Male or Female
- **Height** – Subject height in inches or ft. /inches depending upon the [settings](#).
- **Weight** – Subject weight in lbs. or kg, depending upon the [settings](#).
- **Date of Birth** – Subject's date of birth (mm/dd/yyyy)
- **Race** – Subject race: Asian/Pacific Islander, Black/African American, White/Caucasian, Latino/Hispanic, Other
- **Limb** – The limb on which the device is worn: Wrist, Waist, Ankle, Upper Arm
- **Side** – The side of the body that the patient is wearing the device. Left or Right
- **Dominance** – Dominant or Non-Dominant. This allows the researcher to store whether or not the wear location is on the subject's dominant or non-dominant side.

This data is stored in the info.txt file as part of the \*.gt3x zip file when data is downloaded from the GT3X+ device.

When all names have been entered, select the 'Initialize All' button and the progress is displayed in the 'Status' column (refer to Figure 24). When the initialization is complete, the devices are ready to be removed.

### DOWNLOADING DEVICES

#### FILE FORMAT

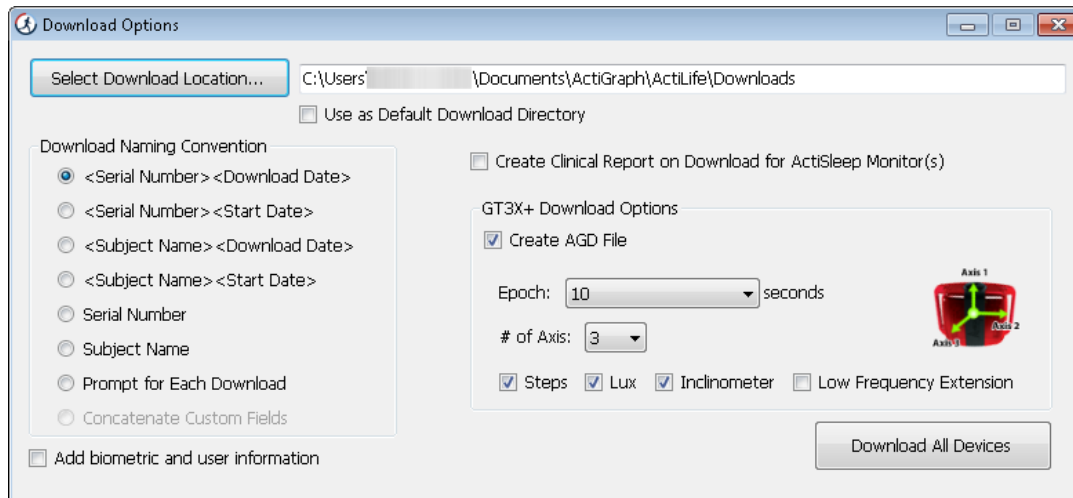
Downloading data from the actigraph device is a simple process. It is important to understand how the data on the device is formatted and what is contained in the file. Except for GT3X+ devices, ActiLife stores data from the devices into the \*.agd file format upon download. This file format is compatible with the popular open source database SQLite (<http://www.sqlite.org/>). The \*.agd file schema can be found in Appendix A of this users guide.

#### DOWNLOADING GT1M, GT3X, ASM, AND/OR ACTITRAINER DEVICES

To download data from GT1M, GT3X, ASM, or ActiTrainer devices, connect your device(s) to the computer – ActiLife will detect those devices and they will appear in the Devices grid. Select (check the box) the devices that you wish to download and click "Download" at the top of the screen. The Download Options screen will appear allowing you to select the type of file naming convention you would like. The names can always be changed later or you can select 'Prompt for Each Download' to enter unique names for each downloaded device. These options help to prevent name duplication during batch downloading.



# USER'S MANUAL



**FIGURE 27 – DOWNLOAD OPTIONS WINDOW**

To select a different download location, select “Select Download Location...” and browse to the desired download directory. To make this directory the default download directory, check the box below the download location in the Download Options prompt. This can also be changed by selecting the directory from the “Edit->Options->Directories” setting in the program’s [main menu](#).

## SAVING BIOMETRIC DATA DURING DOWNLOAD

During the download process, ActiLife gives the user the option to store metadata information associated with each device and corresponding device wearer. After clicking ‘Download’ from the devices grid, check the box entitled “Add biometric and user information” to expand the details grid below the download form. This form is shown in Figure 28. All of the fields shown here are optional.



# USER'S MANUAL

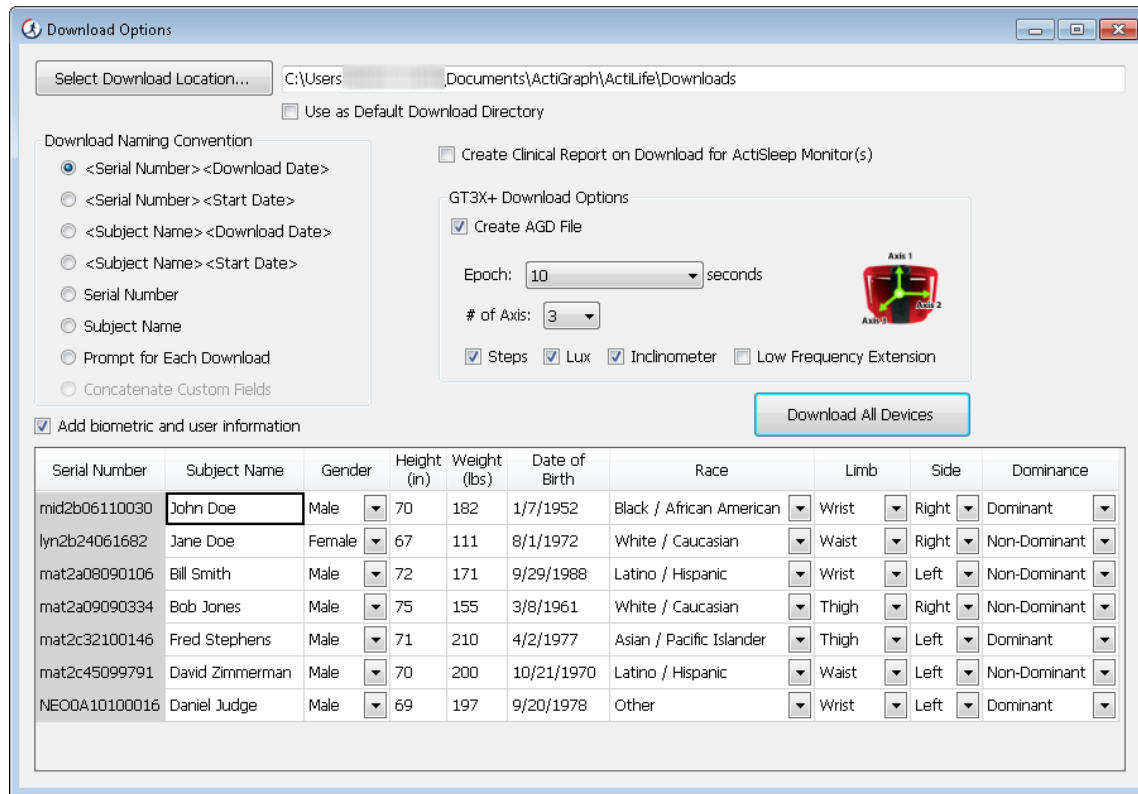


FIGURE 28 - DOWNLOAD OPTIONS WITH BIOMETRIC INFORMATION

## SUBJECT NAME

Unless it is changed, the "Subject Name" will default to the subject name used to initialize the device. Even if the biometric and user information grid is not expanded for population, the "Subject Name" will be stored with the \*.gt3x or \*.agd file upon download. From this grid, the "Subject Name" can be changed prior to downloading.

## GENDER

Click the "Gender" column to reveal a dropdown menu. Select Male or Female.

## HEIGHT

Use the "Height" column to enter the subject's height in inches, centimeters, or feet/inches. Select a different format by changing the [Units of Measurement](#) in the Options menu.

## WEIGHT

Use the "Weight" column to enter the subject's weight in lbs or kg. Select a different format by changing the [Units of Measurement](#) in the Options menu.



## USER'S MANUAL

### DATE OF BIRTH

Use the “Date of Birth” column to edit the subject’s date of birth. A calendar picker is provided, but it may be more convenient to simply type in the subject’s birthday. The date format is mm/dd/yyyy.

### RACE

Use the “Race” column to select the subject’s race. Select “White/Caucasian,” “Black/African American,” “Latino/Hispanic,” “Pacific Islander,” or “Other”.

### LIMB

Use the “Limb” column to select where the device was worn. Options include “Wrist,” “Waist,” “Ankle,” and “Thigh.”

### SIDE

Use the “Side” column to specify the device wear location (left or right side of the body).

### DOMINANCE

The “Dominance” option allows users to specify whether the wear location side was the subject’s dominant or non-dominant side.

### CUSTOM FIELDS

When custom fields are collected as part of a template (see [Building and Using a Template](#) for more details), those custom fields will appear in the metadata grid as shown in Figure 29. Additionally, the “Add Biometric and User Information” check box option will be permanently selected and entry of the custom fields will be required.

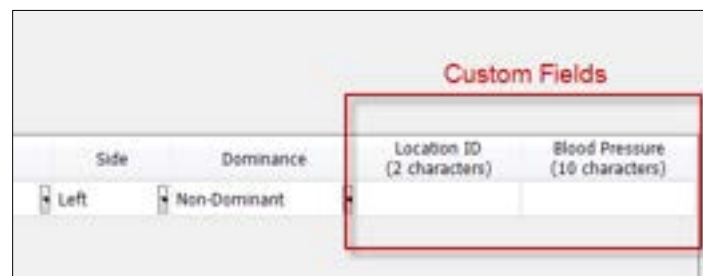


FIGURE 29 – CUSTOM FIELDS IN THE BIOMETRIC AND USER INFORMATION GRID

Clicking “Download All Devices” from the form will download the data from the selected units and store the data in SQLite format stored with a \*.agd file extension (See [Appendix A – File Types in ActiLife5](#)).

*ActiLife no longer stores data in DAT or CSV format. To convert data into one of those formats, select ‘File’ tab then the Import/Export option as shown in Figure 10.*



## USER'S MANUAL

*ActiLife can automatically create \*.csv files on download by setting this in the edit menu. Note that this only works for GT3X+ devices if an \*.agd file is created during the download process.*

### DOWNLOADING GT3X+ DEVICES

Downloading data from GT3X+ devices is very similar to download from other devices. It is important to understand the difference in the file handling for this device. In order to increase the efficiency of the download process, **data from GT3X+ devices is downloaded in raw, binary format with file extension \*.gt3x** (see [Appendix A – File Types in ActiLife](#) which explains the \*.gt3x format). This binary format mirrors the proprietary compressed raw data format stored on the device itself and is unreadable by standard text editors. In order to read the data or process the data with ActiLife, the \*.gt3x files need to be uncompressed (i.e., exported to \*.agd format) using ActiLife. This can occur either during download or later when processing files.

To download data from a GT3X+, select the device(s) from the grid in the Devices tab and click “Download”. A prompt similar to Figure 28 will appear. Clicking “Download All Devices” will immediately download all of the data from the GT3X+ into the user’s default download directory.

### SCANNING OF GT3X+ DATA DURING DOWNLOAD

Data downloaded from GT3X+ devices can be scanned for problems at the time of download. At this time, ActiLife can scan for null data (0s) which may indicate issues with the device accelerometer or non-compliance by the end-user. To enable this scanning, open the Edit->Options menu and choose the Downloading submenu. In the “Scan of GT3X+ Download” section, select the warning threshold. Doing so will warn the user during the download process if the number of 0s within the file exceed the threshold. To disable this feature, set the threshold to 100%.

To view the \*.gt3x files, select “[Communication->Show Download Folder](#)” from the main menu in ActiLife5. Files will appear in this folder as shown in Figure 30.



# USER'S MANUAL

Name	Date modified	Type	Size
PUL3F46091096 (2010-01-29).csv	1/29/2010 2:07 PM	Microsoft Excel C...	24 KB
PUL1B03080224 (2010-03-09).csv	7/6/2010 12:44 PM	Microsoft Excel C...	271 KB
NEO1B34100029 (2010-09-09).csv	9/13/2010 4:34 PM	Microsoft Excel C...	1 KB
NEO0A10100024 (2010-07-13).csv	7/13/2010 2:14 PM	Microsoft Excel C...	825 KB
LYN2B51065828.csv	9/15/2010 1:03 PM	Microsoft Excel C...	9 KB
PUL1B03080224 (2010-03-09).dat	7/6/2010 12:44 PM	DAT File	987 KB
NEO1B34100029 (2010-09-09).gt3x	9/9/2010 4:17 PM	ActiLife.gt3x	211 KB
NEO1B32103031 (2010-09-20).gt3x	9/20/2010 12:50 PM	ActiLife.gt3x	192,214 KB
NEO1B32103031 (2010-09-17).gt3x	9/17/2010 11:14 AM	ActiLife.gt3x	74,133 KB
NEO0A30100031 (2010-08-04).gt3x	8/4/2010 1:53 PM	ActiLife.gt3x	151,076 KB
NEO0A30100029 (2010-08-04).gt3x	8/4/2010 1:57 PM	ActiLife.gt3x	151,068 KB
NEO0A10100024 (2010-07-13).gt3x	7/13/2010 1:38 PM	ActiLife.gt3x	251 KB
NEO0A10100020 (2010-07-13).gt3x	7/13/2010 1:38 PM	ActiLife.gt3x	251 KB
NEO0A10100001 (2010-07-13).gt3x	7/13/2010 1:38 PM	ActiLife.gt3x	251 KB

FIGURE 30 – \*.GT3X FILES

## UNCOMPRESSING \*.GT3X FILES

Binary \*.gt3x files can be uncompressed to \*.agd (for use in ActiLife), \*.csv, or \*.dat file format. Users have the option of creating \*.agd files during the download process by checking “Create AGD File” from within the download prompt (see Figure 31). Because GT3X+ devices record raw accelerometer data (see [Appendix A – File Types in ActiLife](#) for details), the parameters for the uncompressed file must be set at the time of download if the “Create AGD File” option is checked. These parameters include the uncompressed epoch length, the number of axes, step counting, lux (light data), inclinometer (standing, sitting, lying, or off detection), and/or low frequency extension. For an explanation of these parameters, see [Available Channels \(Modes\)](#) for details.

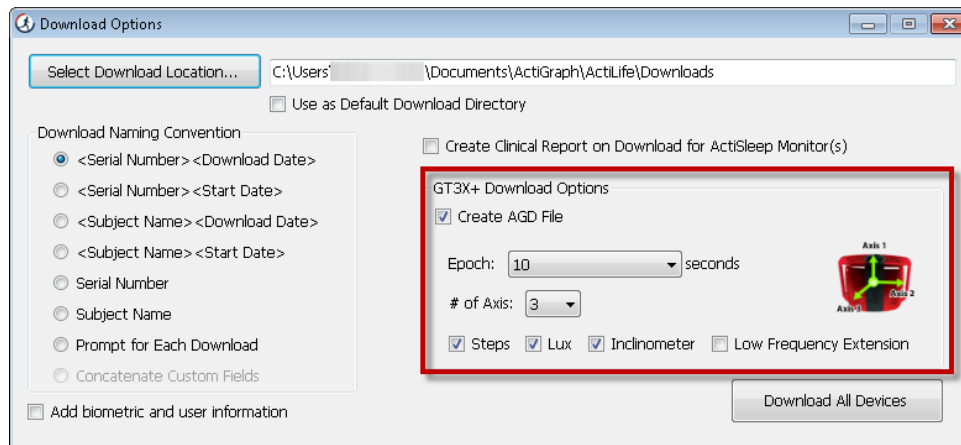


FIGURE 31 - CREATING AN AGD FILE ON DOWNLOAD



# USER'S MANUAL

**Important: Creating an AGD file during the download process will increase the download time significantly depending upon the size of the download.**

Binary \*.gt3x files can be uncompressed at a later time if desired (e.g., after emailing or sharing the files). To uncompress these files at a later time, select “File->Import/Export->Create AGD/CSV/DAT from Raw GT3X+” from the ActiLife main menu. An export window similar to the one shown in Figure 32 will appear. Individual \*.gt3x files can be added by selecting the “Add GT3X+ Files(s)” option. All of the \*.gt3x files in a directory can be added by selecting “Add Directory...” Once files are added, the desired file type(s), epoch length, and parameters can be selected within the export tool. Select “Create File(s)” to export these files to the default download directory.

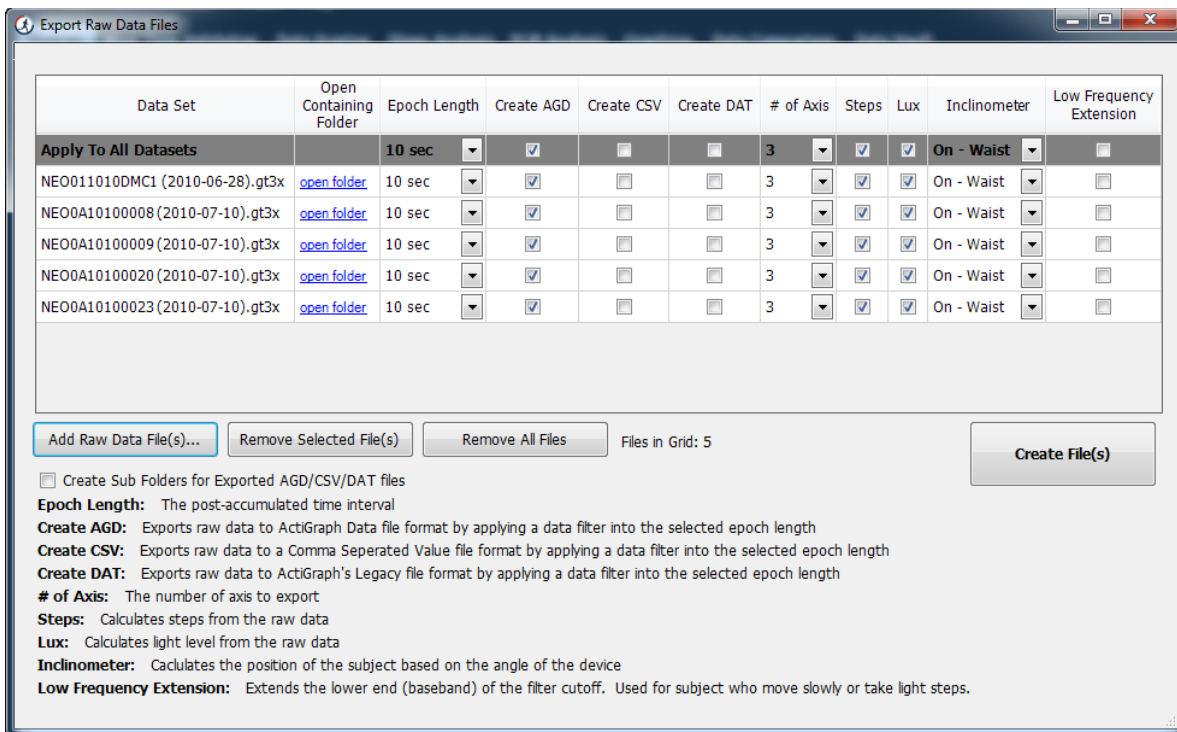


FIGURE 32 – GT3X+ EXPORT TOOL

The GT3X+ export tool can also be accessed by clicking “finished downloading” hyperlink from the devices grid after downloading as shown in Figure 33.



FIGURE 33 – FINISHED DOWNLOADING HYPERLINK IN DEVICES GRID

Clicking this link for GT3X or legacy ActiSleep devices as shown in Figure 34 will launch the [AGD viewer](#), since these downloads produce an \*.agd file by default (see [Appendix A – File Types in ActiLife](#) for more information).








Device	Serial #	Status	Progress	Firmware	Battery Voltage
	MAT2A16099993	No data to download		1.2.0	4.23
	MAT2E0809EN03	<a href="#">finished downloading...</a>		4.1.0	4.14
trainer	PUL1B01080088	No data to download		7.1.0	4.19
	LYN1A38050006	<a href="#">finished downloading...</a>		7.1.0	4.19
	LYN2AEN090005	<a href="#">finished downloading...</a>		7.2.0	4.24
	LYN2B51065828	<a href="#">finished downloading...</a>		7.2.0	4.21
	MAT2A0809EN05	<a href="#">finished downloading...</a>		4.0.0	4.06

FIGURE 34 – “FINISHED DOWNLOADING...” LINK IN STATUS COLUMN. LINKS TO AGD VIEWER FOR GT3X AND ACTISLEEP DEVICES

## BUILDING AND USING A TEMPLATE

Templates were created to assist customers who deploy ActiGraph devices using remote distribution centers or who need to ensure consistency in the initialization and/or download process when multiple people (e.g., lab assistants) are distributing devices to patients. Templates can be created only from within the full version of ActiLife (ActiLife Lite does not support template creation – only template usage).

Once a template is created, the template can be saved as an \*.agt file. This file can then be shared via email, jump drive, or any other means to various distribution centers or lab partners. Opening this file will force ActiLife to use the settings defined in the template editor to initialize and download devices, thus ensuring data collection consistency.

### TEMPLATE EDITOR

ActiLife Full users will find an option in the File menu entitled “[Template Editor](#).” Clicking this option will load a form similar to the one shown in Figure 35. Use this form to setup the desired default initialization and download parameters defined below in [Template Parameters](#).



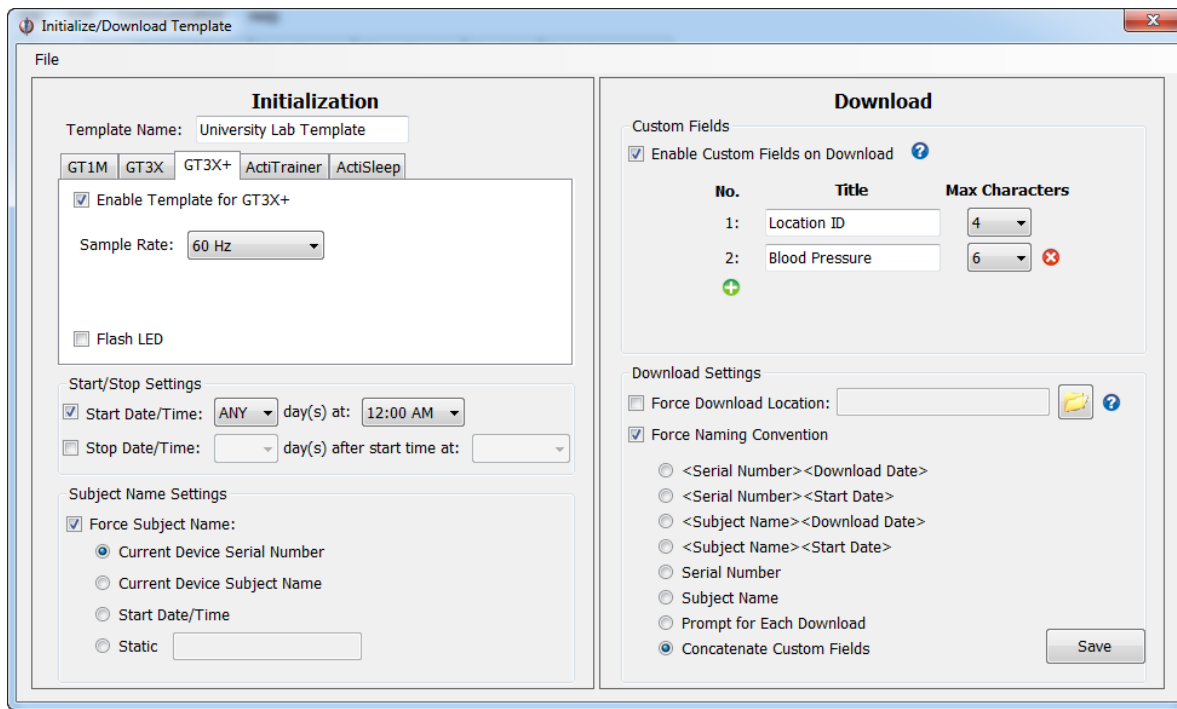


FIGURE 35 – INITIALIZATION/DOWNLOAD TEMPLATE EDITOR

## TEMPLATE PARAMETERS

### INITIALIZATION TEMPLATE OPTIONS

Use the initialization options on the left side of the template editor to force template users to use specific settings during the initialization process.

#### Template Name (required)

The name of the template that will appear at the top of ActiLife once the template is loaded. An illustration is shown in Figure 15. This is a required field.

### DEVICE SELECTION

Selecting “Enable Template for \*\*\*\*\*” within one or more of the device tabs will force ActiLife to use device-level settings during the initialization process for that particular device.

### START/STOP SETTINGS

Check either Start Date/Time or Stop Date/Time to force template users to use a Start or Stop time during the initialization process. Use the Day selection box to choose a forced start time offset (e.g., +0 day, +1 day, +2 days, etc.) and use the time selection box to set the start time. Use “Any” in the Day selection box to give the user the flexibility to choose which **day** the device should start collecting data but the rigidity to force a start **time** for data collection. If the template start time has already passed, ActiLife will automatically default to the next day with the



## USER'S MANUAL

same start time. For example, suppose the template is set to force users to start collecting data at "+0 day(s) at: 3:00pm." If a user initializes a device at 4:00pm, the start time will default to the next day at 3:00pm.

The Stop Date/Time option allows the template builder to set how many days the device should collect data before stopping. Note that the Day setting refers to the number of days AFTER the start time. Again, use "Any" in this field to give the user the flexibility of choosing the stop **date** but the rigidity of using a specific stop **time**. Be sure to keep the battery life and memory limitation considerations in mind. For more details about battery life, refer to the specific product manual for the ActiGraph device you are using.

Leaving either or both of the Start/Stop Settings unchecked will allow the user to select whether or not the start/stop times are used during the initialization process.

### SUBJECT NAME SETTINGS

Checking this option will force template users to use a certain convention when setting Subject Names for devices during the initialization process. These options are self-explanatory with the exception of the "Static" option. This option will force all Subject Names to exactly match the phrase typed here.

### DOWNLOAD TEMPLATE OPTIONS

Use the download options to force template users to use specific settings during the download process.

### CUSTOM FIELDS

Enable the "Custom Fields" option to force users to enter more information during the download process. Use the "Max Characters" dropdown box to select the maximum number of characters allowed for this field. This will prevent users from typing too many characters in this field.

The fields entered here will appear in the download grid as shown Figure 36 after clicking "Download" from the devices grid. Note that these fields must be populated before users can proceed with the download. In most cases (without a template in use), the "Add biometric and user information" check box can be de-selected (all of the biometric data is optional – see [Saving Biometric Data during Download](#) for details). However, when custom fields are enabled in the template, this is required and users are forced to enter values for the custom field parameters. Note that the custom fields are always on the right-hand side of the grid. Users may need to scroll to the right to enter the fields.

Custom fields are stored with the \*.gt3x files and/or \*.agd files at download time. When exporting \*.gt3x files to \*.agd format for analysis in ActiLife, the custom fields will be included as part of the export and will be contained in the \*.agd file. For details about the \*.agd schema, see [Appendix A – File Types in ActiLife](#). In ActiLife version 5.6.0 or later, custom fields appear in the [AGD File Viewer](#).

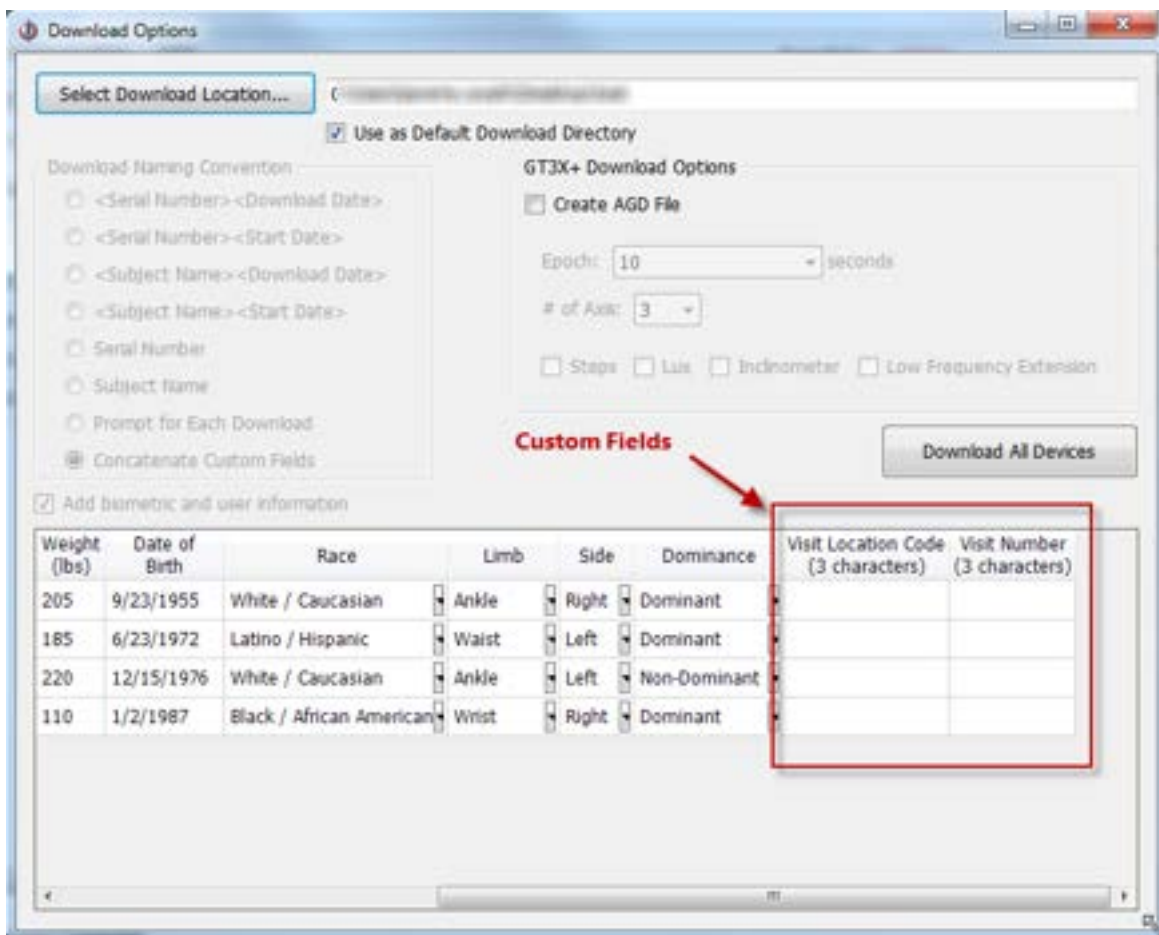


FIGURE 36 – CUSTOM FIELDS AS THEY APPEAR AFTER CLICKING “DOWNLOAD”

## DOWNLOAD SETTINGS

Use the “Download Settings” in the download section of the template builder to force template users to utilize a specific file download location and/or a specific file naming convention. By checking the “Force Download Location” and selecting a directory, template users will be forced to use the specific location. Template builders can type in network URLs or any local directory address that may be applicable for the end-users’ specific sites.

*Note: If the selected directory does not exist, ActiLife will attempt to create the directory (e.g., “C:\PatientDownloads”). If the user does not have administrative permissions or otherwise cannot create the directory, this feature will automatically disable itself, thus allowing the user to select the directory of their choice.*



## USER'S MANUAL

To force a file naming convention for template users, check the “Force Naming Convention” option and select the desired naming convention. During the download process, file names will be of the same format selected here for those users using the template. The “Concatenate Custom Fields” option will concatenate the custom field characters entered by the user during download time. Multiple custom fields will be concatenated with no dashes or separation punctuation. At this time, there are no options for reordering or hyphenating the file name parameters when using the custom field naming convention. These features will be added in later versions of ActiLife.

### SAVING AND SHARING TEMPLATES

Once the template parameters are set as desired, the template can be saved as a file and shared with other users. Users can click the “Save” button in the bottom right-hand corner of the template editor or use the “File” menu to save the template file. From the file menu, a template can be opened to make modifications (click “Open” then browse to the template file). In addition, the template can be saved and immediately put into use by clicking “Save and Use.” This option is helpful when testing the newly created template before emailing or sharing the template file.

Once the template is saved, a new file with an \*.agt file extension will be created similar to the one shown in Figure 37. This file can be emailed to distribution centers or shared over local networks within organizations. Users who load this template will be forced to use the parameters as they were defined in the template editor.



FIGURE 37 – TEMPLATE FILE SAVED TO A USER'S DESKTOP

### LOADING TEMPLATES

Once the \*.agt template file has been shared, ActiLife (Full or Lite) users can simply download the file to their local machine (anywhere) and double-click on the file. Doing so will launch ActiLife and load the template. When done correctly, the template name and “Last Modified” time will appear in the upper right-hand corner of the ActiLife software as shown in Figure 15 on page 10. Once the template has been loaded once, the \*.agt file can be removed from the end-user’s computer. It is not necessary that the file remain on the user’s computer.

An alternative way of loading a template file in ActiLife is to use the “Load Template” option in the File menu. Browse to the template file location and click ‘Open’ to load the template.

When a template is loaded in ActiLife, the template will remain present even after the software has been closed and re-opened. This ensures that the template settings remain unchanged when the host computer is shut down and restarted. To remove a template, click “Remove Template” from the file menu.

## DATASET ANALYSIS OVERVIEW



## USER'S MANUAL

To improve the efficiency of our customers' research and to reduce the time spent in post-data collection analysis, the full version of ActiLife includes several **Dataset Analysis** tools. These include the *Wear Time Validation* tool which can be used to filter out intervals of time within the dataset or entire datasets that do not meet patient wear criteria, *Data Scoring* which can be used to estimate energy expenditure, bouts, and more in one or more datasets, a *Sleep Scoring* tool, which is used to generate sleep statistics, and a *Graphing* tool which can be used to look at detailed epoch-by-epoch graphs of a dataset.

### WEAR TIME VALIDATION

The Wear Time Validation (WTV) tool in ActiLife allows users to easily flag invalid data (or data collected when a device was not worn) for exclusion from further analysis. WTV also provides a summary of the wear-time and non-wear time results from the datasets. The Data Screening Criteria allow users to define non-wear periods. Data flagged as non-wear is not removed from the \*.agd file - it is simply flagged (within the file) as "wear time" or "non-wear time".

The default Wear Time Validation algorithm uses the floating window technique. This algorithm does not define wear or non-wear time from calendar hours, but rather looks at contiguous time and discerns how many total hours (and/or minutes) of non-wear time are in the file without regard for breaks in the calendar day/hour. Conversely, the deprecated "Daily Algorithm" looks at calendar hours (e.g., 9:00am – 10:00am) and days (March 2 – March 3) to determine whether or not that hour (or day) is valid or not. The floating window algorithm allows users to do the same thing by using the "Flag Entire Day as Invalid..." option in the [Optional Screening Parameters](#) section.

The defaults defined for Wear Time screening (60 minutes of consecutive zeros with a 2 minute spike tolerance) were loosely derived from the research note *Identification of accelerometer non-wear time and sedentary behavior*, published in the Research Quarterly for Exercise and Sport, submitted to the journal on June 1, 2010. Permission to share this article publicly has been requested by ActiGraph to the managing editor of Research Quarterly for Exercise and Sport.



# USER'S MANUAL

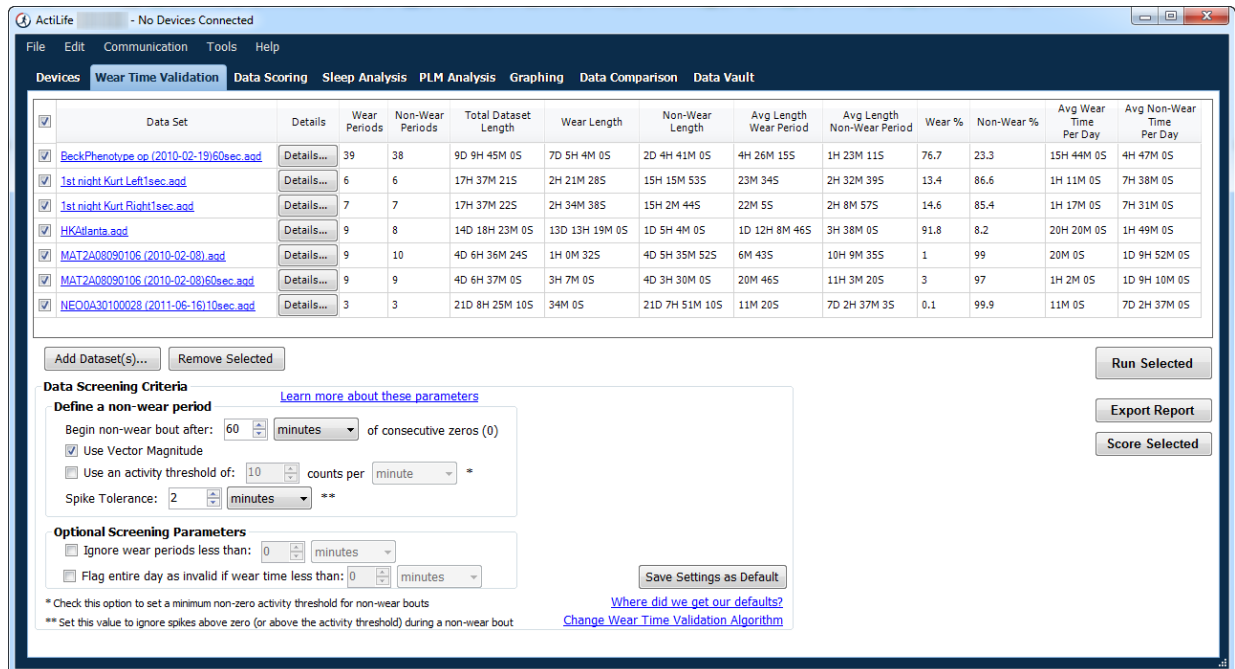


FIGURE 38 - WEAR TIME VALIDATION

## DEFINE A NON-WEAR PERIOD

This section provides options for defining the non-wear period. ActiLife will use this information to scan the data for non-wear bouts.

*Begin non-wear bout after \_\_\_\_ minutes/epochs of consecutive zeros* - After scanning the data and detecting the selected number of consecutive zeros, ActiLife will begin flagging data as "non-wear time". The leading zeros detected during this process will be flagged retroactively (after they have been initially scanned). Data will be flagged as "non-wear time" until the Spike Tolerance is exceeded.

*Use Vector Magnitude* - When checked, ActiLife scans the [vector magnitude](#) of three-axis data (when available) to detect wear or non-wear time. When unchecked, ActiLife scans only Axis 1 (the vertical axis - see users' manual for details) to detect wear/non-wear times.

*Use an activity threshold of \_\_\_\_ counts per minute/epoch* - Instead of looking for zeros to qualify non-wear time, this option allows the user to set a non-zero activity threshold requirement for wear-time. Data below this value will be qualified as "zero".

*Spike Tolerance \_\_\_\_ minutes/epochs* - This option allows the user to set a "spurious count" tolerance. ActiLife will continue scoring a non-wear bout as non-wear until it detects more than the Spike Tolerance number of minutes/epochs above zero (or above the activity threshold, if that option is enabled).



## USER'S MANUAL

### OPTIONAL SCREENING PARAMETERS

*Ignore wear periods less than \_\_\_\_\_ minutes/epochs* - Because of the WTV algorithms used, some wear periods may be very short (shorter than the spike tolerance). Use this option to set the minimum length of an acceptable wear period.

*Flag entire day as invalid if wear time less than \_\_\_\_\_ minutes/epochs* - Use this setting to flag an entire 24 hour day as invalid if there are less than the selected amount of valid (wear-time) minutes or epochs in the day.

*Change Wear Time Validation Algorithm* - This shortcut opens the Wear Time Validation options settings (also accessible from the Edit->Options menu) and allows the user to choose between the Floating Window and Daily WTV algorithm.

Once these settings are adjusted, press the "Run Selected" button to run the Wear Time Validation algorithm on the selected files. Clicking the "Save Settings as Default" button will save the settings; ActiLife will remember them and use them each time the Wear Time Validation tool is opened.

### VIEWING DETAILS OF WEAR TIME VALIDATION RESULTS

Summary-level results of the Wear Time Validation process are available in the main grid immediately after the process has completed. The following parameters are available:

- Wear Periods – The number of wear bouts detected by the algorithm for the entire data set
- Non-Wear Periods - The number of non-wear bouts detected by the algorithm for the entire data set.
- Wear Length – Total time the device was worn.
- Non-Wear Length – Total time the device was not worn.
- Avg Length Wear Period – Average length of the wear periods (or bouts).
- Avg Length Non-Wear Period - Average length of the non-wear periods (or bouts).
- Wear % - Percentage of wear-time for the entire data set
- Non-Wear % - Percentage of non-wear-time for the entire data set
- Avg Wear Time per Total Days (All Days) – Total wear time divided by the total number of days in the dataset.
- Avg Wear Time per Days with Wear Time – Total wear time divided by the total number of days in the dataset that have >0 wear time.
- Avg Non-Wear Time per Total Days - Total non-wear time divided by the total number of days in the dataset that have >0 wear time.
- Avg Non-Wear Time per Days with Wear Time - Total non-wear time divided by the total number of days in the dataset that have >0 wear time.

After the wear-time has been calculated, details of each wear and non-wear bout can be viewed by clicking the "Details" button to the right of each dataset file name as shown in Figure 39.





# USER'S MANUAL

	Details	Total Days	Valid Days
2-4-2008 11.06).agd	Details...	5	5

FIGURE 39 – DETAILS VIEW SHOWS EPOCH-BY-EPOCH VALIDATION

Details about which days are considered “valid” can be seen in the details view. An example is shown in Figure 40. The *Days* section details out the number of Wear Time and Non-Wear-Time (in minutes) per calendar day. The percentages of wear and non-wear for each day are also available here. The VM column represents the total “Total Vector Magnitude Counts” for that day (see [Appendix B – Vector Magnitude](#) for more details). This number can be used to gauge relative activity from day-to-day.

The *Wear Time and Non-Wear Time Periods* section details the wear and non-wear bouts as detected by the Wear Time Validation tool. The “Use?” column indicates whether or not that particular bout will be considered or excluded when calculating output scores in the Data Scoring tool. Non-wear periods are never used and wear periods are always used by default. This can be changed by checking or un-checking the bout of interest. Clicking “Save and Close” will store those changes in the \*.agd file.

Clicking the “More” button next to a wear or non-wear bout will reveal the epoch level breakdown for that particular bout on the right hand side. All data in this view can be copied/pasted by selecting the columns/rows of interest, pressing “Ctrl+C” on the keyboard to copy, then pressing “Ctrl+V” to paste the data into a spreadsheet or text editor. Use the individual “export” links to export a wear or non-wear period into a \*.csv file.

Days						Epoch Breakdown						
Date	Wear Time (minutes)	Non-Wear Time (minutes)	Wear %	Non-Wear %	VM	Day	Epoch	Axis1	Axis2	Axis3	VM	Low
10/5/2009	780	0	100	0	1243875.1	10/5/2009	04:00:00	879	803	846	1460.5	0
10/6/2009	1378	62	95.7	4.3	2223773.7	10/6/2009	04:01:00	1880	2691	2400	4064.4	0
10/7/2009	1378	62	95.7	4.3	2470233.1	10/6/2009	04:02:00	0	0	0	0	0
10/8/2009	1314	126	91.2	8.8	2259798.4	10/6/2009	04:03:00	12	9	0	35	0
10/9/2009	1027	413	71.3	28.7	2059471.9	10/6/2009	04:04:00	0	0	0	0	0
10/10/2009	1440	0	100	0	2434605.3	10/6/2009	04:05:00	366	1007	557	5207.6	0
10/11/2009	1346	94	93.5	6.5	2206379.8	10/6/2009	04:06:00	235	299	49	383.4	0
						10/6/2009	04:07:00	0	0	0	0	0
						10/6/2009	04:08:00	0	0	0	0	0
						10/6/2009	04:09:00	0	0	0	0	0
						10/6/2009	04:10:00	106	65	29	127.7	0
						10/6/2009	04:11:00	168	48	12	175.1	0
						10/6/2009	04:12:00	0	0	0	0	0
						10/6/2009	04:13:00	2246	2144	2536	4009.1	0
						10/6/2009	04:14:00	0	0	0	0	0
						10/6/2009	04:15:00	0	0	0	0	0
						10/6/2009	04:16:00	0	0	0	0	0

Wear Time and Non-Wear Time Periods						
Date/Time Start	Date/Time End	Wear or Non-Wear	Length (minutes)	Use?	Epochs	Export
10/5/2009 11:00:00 AM	10/6/2009 2:57:00 AM	Wear	958	<input checked="" type="checkbox"/>	more...	export...
10/6/2009 2:58:00 AM	10/6/2009 3:59:00 AM	Non-Wear	62	<input type="checkbox"/>	more...	export...
10/6/2009 4:00:00 AM	10/7/2009 1:03:00 AM	Wear	1264	<input checked="" type="checkbox"/>	more...	export...
10/7/2009 1:04:00 AM	10/7/2009 2:05:00 AM	Non-Wear	62	<input type="checkbox"/>	more...	export...
10/7/2009 2:06:00 AM	10/8/2009 9:53:00 PM	Wear	2628	<input checked="" type="checkbox"/>	more...	export...
10/8/2009 9:54:00 PM	10/8/2009 9:57:00 AM	Non-Wear	328	<input type="checkbox"/>	more...	export...

FIGURE 40 – DETAIL BREAKDOWN OF WEAR AND NON-WEAR TIME FOR A DATASET



## USER'S MANUAL

### EXPORT REPORT

The “Export Report” option exports the information in the Wear Time Validation grid to a comma separated value file for sharing and manipulation. Detailed data can be exported to CSV format from the “Details” view of each dataset.

### SCORE SELECTED

This option pushes the selected files into the Data Scoring tab. This is typically the next step after Wear-Time Validation. This button speeds up the process by eliminating the need to manually search for the files from the Data Scoring file importer.



# USER'S MANUAL

## DATA SCORING

Data Scoring in ActiLife allows users to analyze the details of their dataset(s) by examining Energy Expenditure, METs, Activity Cut Points, Activity Bouts, and Heart Rate Energy Expenditure. Figure 41 illustrates the Data Scoring tool in action.

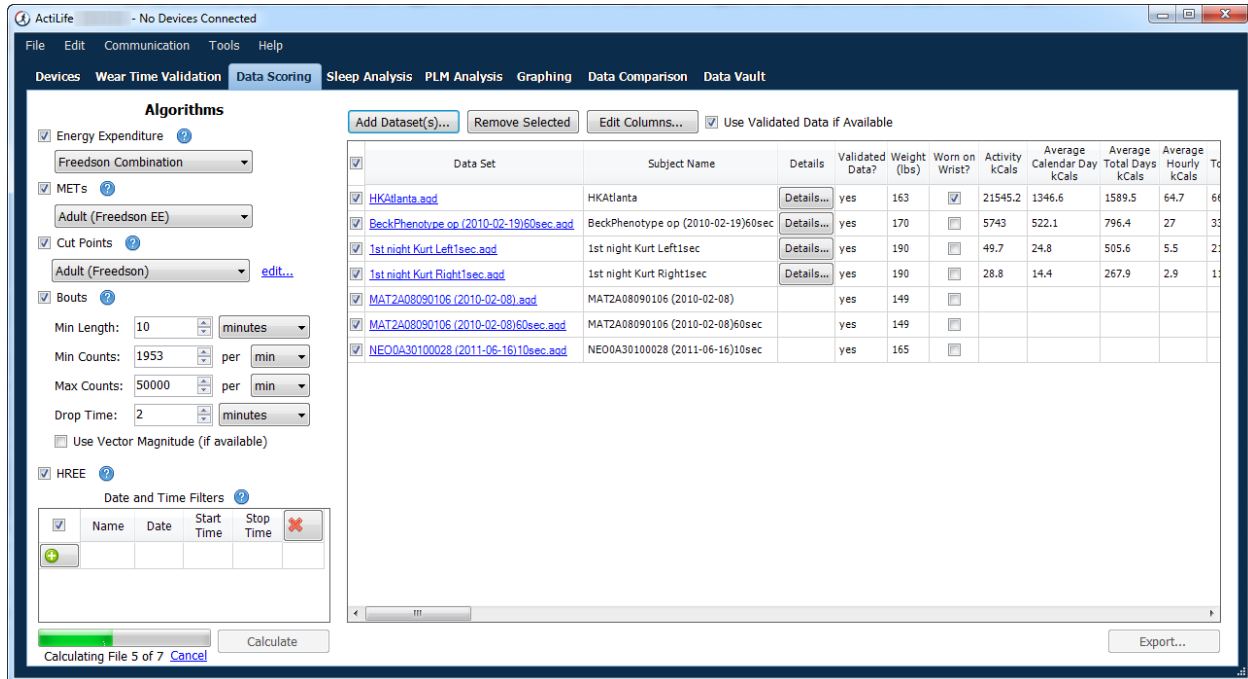


FIGURE 41 - DATA SCORING

## DATE AND TIME FILTERS

Date and time filtering allows users to isolate the data scoring to specific dates or times of interest. The results shown in the Data Scoring tool only apply to the date and time filters shown in the Date and Time Filters grid. If no filters are present, the Data Scoring results are not limited to any dates or times, but include the entire scope of the datasets.

Multiple filters can be added simultaneously to specifically target certain days or times. To add a filter, click the “+” button from within the Date and Time Filters grid as shown in Figure 42. Only checked filters will be applied during data scoring. Multiple filters can be checked which forces the Data Scoring tool to generate results for two different time periods. For example, creating a Weekend Mornings filter for Weekends from 6am-10am and then a Weekend Afternoons filter for Weekends from 3pm-6pm would produce data scoring results for both of those time periods only.

# USER'S MANUAL

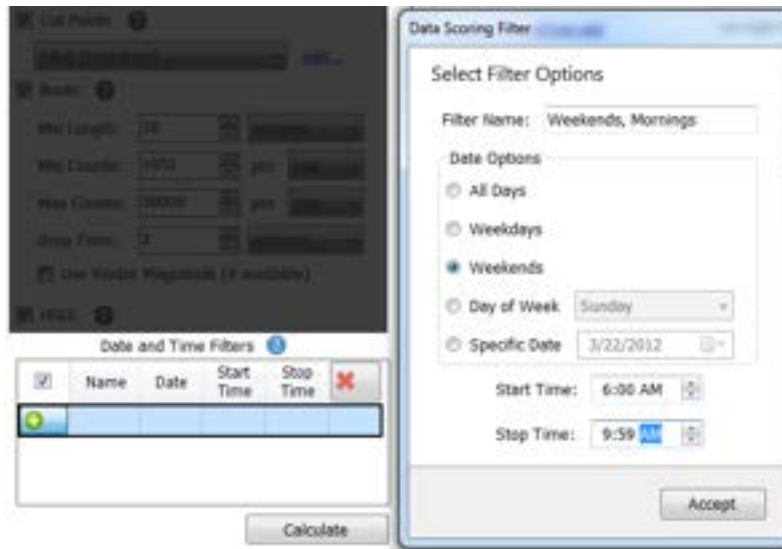


FIGURE 42 - DATE/TIME FILTER ENTRY

Date and time filters can be removed by clicking the “X” icon to the right of the filter. Remove all filters by clicking the “X” at the top of the grid. Date and Time Filters persist in ActiLife even if the program is closed and re-opened.



# USER'S MANUAL

## DATA SCORING PARAMETERS AND ALGORITHMS

There are five optional parameters that can be calculated from within the Data Scoring tool: Energy Expenditure, METs, Cut Points, Bouts, and Heart Rate Energy Expenditure (HREE). Each parameter has multiple algorithms from which to choose. Each algorithm has been derived by independent researchers from around the world using ActiGraph devices. To view details about the origin of each algorithm, click the “?” icon to the right of each scoring parameter. Check the checkbox next to each parameter you wish to calculate for your dataset(s). Unchecked parameters will not be calculated, displayed, or exported.

## ENERGY EXPENDITURE

To calculate energy expenditure, check the box next to the “Energy Expenditure” parameter in the Data Scoring tool. Each dataset in the Data Scoring grid must have an associated body. Weights can be added by clicking on the “Weight” box in the Data Scoring grid and typing in the subject’s weight. Select “Worn on Wrist” if the device was worn on the wrist to apply the appropriate scaling.

*Important: The “Worn On Wrist?” option scales down the activity counts based on an internally-developed algorithm. At this time, there are no validated energy expenditure algorithms for wrist-worn actigraphy. Validated energy expenditure can only be estimated from waist-worn devices.*

## METs

METs, or metabolic equivalent of task, can also be calculated from within the Data Scoring tool. Multiple algorithms are available. When calculating Children’s METs (Using the “Children Freedson” equation), an age must be entered for each file. If the device was worn on the wrist, the subject’s gender is required.

## CUT POINTS

Cut point data scoring option allows users to break out the proportion of time (total epochs) within each dataset the subject spent in different categories of activity intensity. Multiple validated cut point sets are available by default from within ActiLife. Users can create their own cut point set by clicking the “edit...” link to the right of the Cut Point dropdown and clicking the “+” icon at the bottom of the list as shown in Figure 43. Enter a Set Name for the new cut point set and type in the maximum values for each level (click the “+” icon to create new Cut Points). Once complete, click “Save”.

When the “Cut Points based on Vector Magnitude” box is checked, ActiLife will look at the [Vector Magnitude](#) count levels for each epoch. When left unchecked, the cut points apply only to the Axis 1 values for each epoch.

Details about the default Cut Point algorithms in ActiLife can be found by clicking the “?” icon next to the Cut Points option.

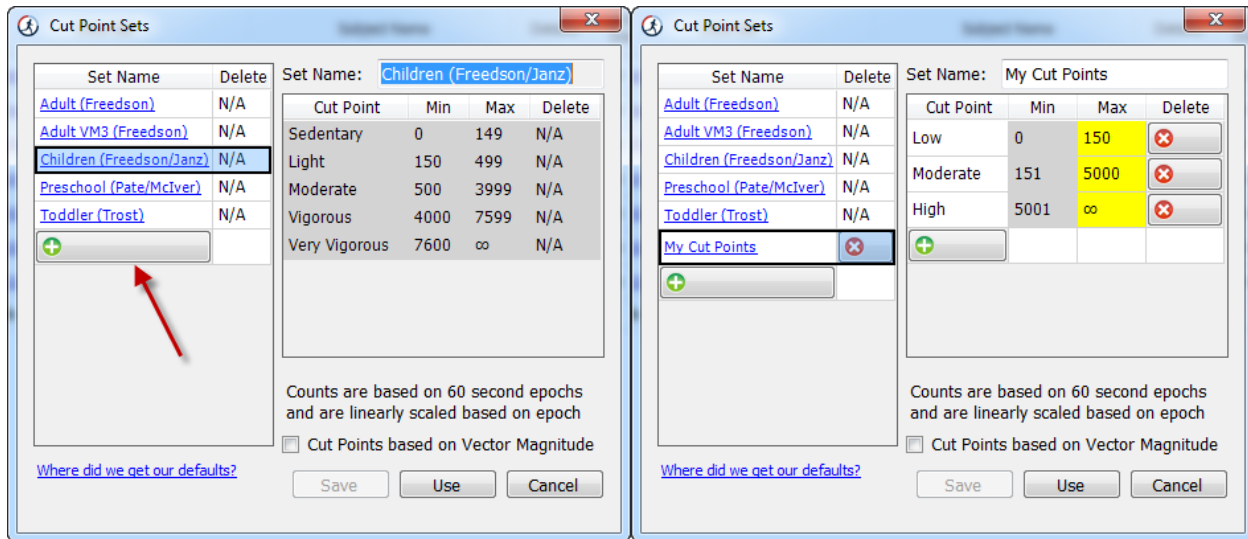


FIGURE 43 - CUSTOM AND DEFAULT CUT POINTS

## BOUTS

Bouts of activity can be detected within each data set in the Data Scoring tab. Use the “Bouts” option to define a bout length, the minimum per-epoch count level, the maximum per-epoch count level and the drop time.

### MIN LENGTH

This option tells ActiLife the minimum bout length to look for.

### MIN COUNTS

This option tells ActiLife the minimum count value for each consecutive epoch in the bout.

### MAX COUNTS

This option tells ActiLife the maximum count value for each consecutive epoch in the bout.

### DROP TIME

The drop time setting acts as a tolerance for bout detection and is best explained through an example. Suppose the bout detection settings (above) are set to Min Length = 10, Min Counts = 1953, and Max Counts = 50000. With the spike tolerance set to 0, the Bout tool will only identify a bout of activity as 10 consecutive epochs of data with a minimum activity count of 1953 and a maximum activity count of 50000. Table 2 illustrates a valid bout while Table 3 illustrates an invalid bout when Drop Time = 0. Because the value 1500 that occurs at 09:03 in Table 3 is below the Minimum Count Level and because there is no allowable tolerance, these epochs fail to register as a legitimate bout. The epoch string in Table 3 would, however, qualify as a valid bout if Drop Time were set to 1 or higher since the highlighted cell would actually count as a valid bout epoch.



## USER'S MANUAL

09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	2500	4000	6124	4510	2164	4518	2540	6000

TABLE 2 - EXAMPLE OF A VALID BOUT WITH DROP TIME = 0

09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	1500	4000	6124	4510	2164	4518	2540	6000

TABLE 3 - EXAMPLE OF AN INVALID BOUT WITH DROP TIME = 0

With a Drop Time = 2, the epoch string in Table 4 would be considered a valid bout since there are exactly 2 epochs that are outside of the min/max epoch levels (they count as valid epochs). If the epoch value at 06:10 were outside of the min/max range, that epoch would mark the end of the bout (it would be 10 epochs long). The epoch string in Table 5 would not qualify as a valid bout under these conditions.

06:00:00	06:01:00	06:02:00	06:03:00	06:04:00	06:05:00	06:06:00	06:07:00	06:08:00	06:09:00
2000	2100	2500	4000	1274	4510	2164	862	2540	6000

TABLE 4 - EXAMPLE OF A VALID BOUT WITH DROP TIME = 2

09:01:00	09:02:00	09:03:00	09:04:00	09:05:00	09:06:00	09:07:00	09:08:00	09:09:00	09:10:00
2000	2100	1500	4000	1824	4510	2164	1619	2540	6000

TABLE 5 - EXAMPLE OF AN INVALID BOUT WITH DROP TIME = 2

Once a bout is detected, the bout does not end until the drop time tolerance is exceeded. Suppose the epoch string in Table 4 continued as follows: 06:10 – 4305; 06:11 – 3390; 06:12 – 5530; 06:13 – 9930; 06:14 – 100. The epoch at 06:14 would mark the end of the bout which would be 14 minutes long.

### BOUT EXAMPLE

- Minimum Bout Length: 10 minutes
- Minimum Count Level to be considered a Bout: 1953
- Maximum Count Level to be considered a Bout: 5724
- Tolerance/Drop Time (in minutes): 2
- Dataset collected in one-minute epoch lengths
- A string of epoch values from the dataset
- 1805, 2048, 3159, 4651, 4216, 4673, 5531, 1846, 2615, 2648, 3894, 4869, 5201, 5756, 6165
- This string contains one bout:
- 2048, 3159, 4651, 4216, 4673, 5531, 1846, 2615, 2648, 3894, 4869, 5201
- The value 1846 is considered the first “drop” time
- The value 5756 is considered the second drop time
- The value 6165 is considered the third and final drop time. ActiLife regresses the dataset once 6165 is detected to find the last “good” value. This defines the end of the dataset.

The “Use Vector Magnitude” option within the bout parameter settings forces ActiLife to use the [Vector Magnitude](#) combination of all three axes for each epoch when making bout level determinations. With this option unchecked, ActiLife only uses Axis 1.

# USER'S MANUAL

## HEART RATE EE

The Heart Rate EE option calculates the following variables from any datasets that are loaded in the Data Scoring tab.

**ADL Heart Rate:** Average Daily Living Heart Rate. This is the average base (resting) heart rate of all ADL qualified epochs in the dataset. In order to qualify as ADL heart rate, an epoch must contain heart rate data below 79 beats per minute and one-minute activity data above 100 counts per epoch.

**Avg Active Heart Rate:** The average active heart rate in a given dataset. In order to qualify as active heart rate, epoch activity must exceed 1951 counts per minute epoch and heart rate must exceed 80 beats per minute.

**HR Delta:** The difference between the Average Active Heart Rate and the Average Daily Living Heart Rate for a given dataset

**Avg Active Caloric Expenditure:** The average minute-by-minute caloric expenditure (kcal) for all epochs that match the "Active Heart Rate" qualifier used to calculate Average Active Heart Rate. Calories are calculated using the Freedson Equation (1997).

**Calibration Ratio:** Average Active Caloric Expenditure / HR Delta. This value is used to determine calories-per-BPM, or calories that should be associated with the subject's BPM rate (Active Heart Rate) when activity counts are not reliable.

The HREE algorithm should not be used as a standard for measuring activity energy expenditure and is only an estimate of overall energy expenditure when ambulatory movement is not reliable. For example, HREE may be used when a user is riding a bicycle or lifting weights.

## USE VALIDATED DATA IF AVAILABLE

The "Use Validated Data if Available" checkbox option (shown in Figure 44) tells ActiLife whether to use only the wear time as calculated by the Wear Time Validation tool (checked) or whether to use all epochs within the file (unchecked) to perform the Data Scoring.

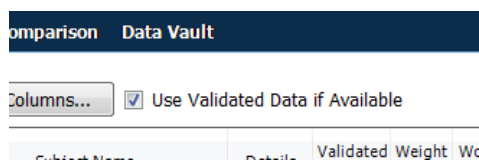


FIGURE 44 - USE VALIDATED DATA IF AVAILABLE

## DATA SCORING COLUMNS

There are 75 columns of possible optional calculations that can be made within the Data Scoring tool. Select the "Edit Columns" option to view the selected columns and to enable/disable columns. Enabling more columns will extend the time required for ActiLife to perform the calculations and the [batch data export](#) (if used).



# USER'S MANUAL

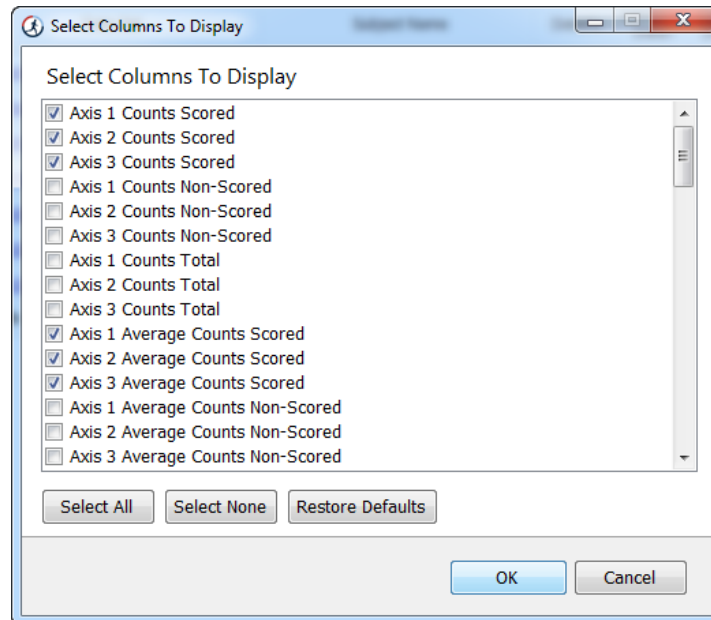


FIGURE 45 - DATA SCORING COLUMNS

The following parameters can be extracted from user datasets in the Data Scoring tab.

1. **Subject** - Name of the subject
2. **Filename** - Filename of the subject
3. **Epoch** - Epoch length in seconds
4. **Weight** - The weight of the subject in lbs.
5. **Age** - The age of the subject in years
6. **Gender** - The gender of the subject
7. **Date** - Date in local format
8. **Hour** - Hour in local format
9. **Day of Week** - Day of the week name in local format
10. **Day of Week Num** - Day of the week number: 1=Monday, 2=Tuesday, etc.
11. **kcal** - kcals during this hour
12. **METs** - MET rate for a period of time
13. **Bouts** - Number of Bouts starting in a period of time
14. **Total Time in Bouts** - Time of bouts during a period of time
15. **Avg Time per Bout** - Average length of time (in minutes) of bouts during a period of time
16. **Total Counts in Bouts** - Total counts in bouts during a period of time
17. **Bout Start** - The date and time of the start of a bout
18. **Bout End** - The date and time of the end of a bout
19. **Time in Bout** - The time of a bout in minutes
20. **ADL Heart Rate** - Average Non-Sedentary HR between 41 and 79
21. **Average Active Heart Rate** - Average HR during active activity (above light)





## USER'S MANUAL

22. **Heart Rate Delta** - The difference between Average Active Heart Rate and ADL Heart Rate
23. **Average Active Caloric Expenditure** - Average amount of calories burned above light activity
24. **Calibration Ratio** - Ratio of Average Active Caloric Expenditure divided by Heart Rate Delta
25. **Light** - Length of time in Light in minutes
26. **Moderate** - Length of time in Moderate in minutes
27. **Vigorous** - Length of time in Vigorous in minutes
28. **Very Vigorous** - Length of time in Very Vigorous in minutes
29. **Axis 1 Counts Scored** - Sum of counts for Axis 1 (Y-Axis) during scored time
30. **Axis 2 Counts Scored** - Sum of counts for Axis 2 (X-Axis) during scored time
31. **Axis 3 Counts Scored** - Sum of counts for Axis 3 (Z-Axis) during scored time
32. **Axis 1 Counts Non-Scored** - Sum of counts for Axis 1 (Y-Axis) during non-scored time
33. **Axis 2 Counts Non-Scored** - Sum of counts for Axis 2 (X-Axis) during non-scored time
34. **Axis 3 Counts Non-Scored** - Sum of counts for Axis 3 (Z-Axis) during non-scored time
35. **Axis 1 Counts Total** - Sum of counts for Axis 1 (Y-Axis) during scored and non-scored time
36. **Axis 2 Counts Total** - Sum of counts for Axis 2 (X-Axis) during scored and non-scored time
37. **Axis 3 Counts Total** - Sum of counts for Axis 3 (Z-Axis) during scored and non-scored time
38. **Axis 1 Average Counts Scored** - Average of counts for Axis 1 (Y-Axis) during scored time
39. **Axis 2 Average Counts Scored** - Average of counts for Axis 2 (X-Axis) during scored time
40. **Axis 3 Average Counts Scored** - Average of counts for Axis 3 (Z-Axis) during scored time
41. **Axis 1 Average Counts Non-Scored** - Average of counts for Axis 1 (Y-Axis) during non-scored time
42. **Axis 2 Average Counts Non-Scored** - Average of counts for Axis 2 (X-Axis) during non-scored time
43. **Axis 3 Average Counts Non-Scored** - Average of counts for Axis 3 (Z-Axis) during non-scored time
44. **Axis 1 Average Counts Total** - Average of counts for Axis 1 (Y-Axis) during scored and non-scored time
45. **Axis 2 Average Counts Total** - Average of counts for Axis 2 (X-Axis) during scored and non-scored time
46. **Axis 3 Average Counts Total** - Average of counts for Axis 3 (Z-Axis) during scored and non-scored time
47. **Axis 1 Max Counts Scored** - Maximum count value for Axis 1 (Y-Axis) during scored time
48. **Axis 2 Max Counts Scored** - Maximum count value for Axis 2 (X-Axis) during scored time
49. **Axis 3 Max Counts Scored** - Maximum count value for Axis 3 (Z-Axis) during scored time
50. **Axis 1 Max Counts Non-Scored** - Maximum count value for Axis 1 (Y-Axis) during non-scored time
51. **Axis 2 Max Counts Non-Scored** - Maximum count value for Axis 2 (X-Axis) during non-scored time
52. **Axis 3 Max Counts Non-Scored** - Maximum count value for Axis 3 (Z-Axis) during non-scored time
53. **Axis 1 Max Counts Total** - Maximum count value for Axis 1 (Y-Axis) during scored and non-scored time
54. **Axis 2 Max Counts Total** - Maximum count value for Axis 2 (X-Axis) during scored and non-scored time
55. **Axis 3 Max Counts Total** - Maximum count value for Axis 3 (Z-Axis) during scored and non-scored time
56. **Axis 1 CPM Scored** - Counts Per Minute for Axis 1 (Y-Axis) during scored time
57. **Axis 2 CPM Scored** - Counts Per Minute for Axis 2 (X-Axis) during scored time
58. **Axis 3 CPM Scored** - Counts Per Minute for Axis 3 (Z-Axis) during scored time
59. **Axis 1 CPM Non-Scored** - Counts Per Minute for Axis 1 (Y-Axis) during non-scored time
60. **Axis 2 CPM Non-Scored** - Counts Per Minute for Axis 2 (X-Axis) during non-scored time
61. **Axis 3 CPM Non-Scored** - Counts Per Minute for Axis 3 (Z-Axis) during non-scored time
62. **Axis 1 CPM Total** - Counts Per Minute for Axis 1 (Y-Axis) during scored and non-scored time



## USER'S MANUAL

63. **Axis 2 CPM Total** - Counts Per Minute for Axis 2 (X-Axis) during scored and non-scored time
64. **Axis 3 CPM Total** - Counts Per Minute for Axis 3 (Z-Axis) during scored and non-scored time
65. **Vector Magnitude Counts Scored** - Vector Magnitude of all 3 Axis during scored time
66. **Vector Magnitude Counts Non-Scored** - Vector Magnitude of all 3 Axis during non-scored time
67. **Vector Magnitude Counts Total** - Vector Magnitude of all 3 Axis during scored and non-scored time
68. **Vector Magnitude Average Counts Scored** - Average Vector Magnitude of all 3 Axis during scored time
69. **Vector Magnitude Average Counts Non-Scored** - Average Vector Magnitude of all 3 Axis during non-scored time
70. **Vector Magnitude Average Counts Total** - Average Vector Magnitude of all 3 Axis during scored and non-scored time
71. **Vector Magnitude Max Counts Scored** - Maximum Vector Magnitude of all 3 Axis during scored time
72. **Vector Magnitude Max Counts Non-Scored** - Maximum Vector Magnitude of all 3 Axis during non-scored time
73. **Vector Magnitude Max Counts Total** - Maximum Vector Magnitude of all 3 Axis during scored and non-scored time
74. **Vector Magnitude CPM Scored** - Vector Magnitude Counts Per Minute during scored time
75. **Vector Magnitude CPM Non-Scored** - Vector Magnitude Counts Per Minute during non-scored time
76. **Vector Magnitude CPM Total** - Vector Magnitude Counts Per Minute during scored and non-scored time
77. **Steps Counts Scored** - Sum of Step Counts during scored time
78. **Steps Counts Non-Scored** - Sum of Step Counts during non-scored time
79. **Steps Counts Total** - Sum of Step Counts during scored and non-scored time
80. **Steps Average Counts Scored** - Average Step Counts during scored time
81. **Steps Average Counts Non-Scored** - Average Step Counts during non-scored time
82. **Steps Average Counts Total** - Average Step Counts during scored and non-scored time
83. **Steps Max Counts Scored** - Maximum Step Counts during scored time
84. **Steps Max Counts Non-Scored** - Maximum Step Counts during non-scored time
85. **Steps Max Counts Total** - Maximum Step Counts during scored and non-scored time
86. **Steps Per Minute Scored** - Steps Per Minute during scored time
87. **Steps Per Minute Non-Scored** - Steps Per Minute during non-scored time
88. **Steps Per Minute Total** - Steps Per Minute during scored and non-scored time
89. **Lux Average Counts Scored** - Average Lux Value during scored time
90. **Lux Average Counts Non-Scored** - Average Lux Value during non-scored time
91. **Lux Average Counts Total** - Average Lux Value during scored and non-scored time
92. **Lux Max Counts Scored** - Maximum Lux Value during scored time
93. **Lux Max Counts Non-Scored** - Maximum Lux Value during non-scored time
94. **Lux Max Counts Total** - Maximum Lux Value during scored and non-scored time
95. **Number of Epochs Scored** - Number of epochs during scored time
96. **Number of Epochs Non-Scored** - Number of epochs during non-scored time
97. **Number of Epochs Total** - Number of epochs during scored and non-scored time
98. **Time Scored** - Length of scored time
99. **Time Non-Scored** - Length of non-scored time



## USER'S MANUAL

- 100. **Time Total** - Length of scored and non-scored time
- 101. **Calendar Days Scored** - Number of Calendar Days during scored time
- 102. **Calendar Days Non-Scored** - Number of Calendar Days during non-scored time
- 103. **Calendar Days Total** - Number of Calendar Days during scored and non-scored time
- 104. **Wear Time Start** - The start of a wear time
- 105. **Wear Time End** - The end of a wear time

### BATCH EXPORTING

Results from the Data Scoring tool can be batch exported to a Microsoft Excel<sup>®</sup> spreadsheet. The resulting export will contain a full list of all subjects with corresponding Data Scoring results broken down by hours, days, and Summary. Bout details and Wear Time Validation can also be exported along with a separate sheet showing which algorithms were used to produce the results and a “Definitions” sheet which defines all of the exported parameters.

To begin the export, click the “Export” button after performing a calculation in the Data Scoring tab. Check the “Create Batch View...” option as shown in Figure 46. Select any of the desired export options and click “Export...”

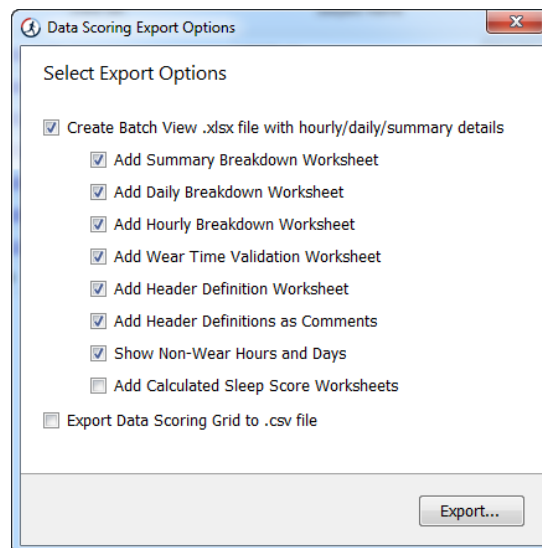


FIGURE 46 - DATA SCORING EXPORT OPTIONS

Depending on the number of variables and files, the export process could take anywhere from 10 seconds to 2 hours.

## SLEEP ANALYSIS

Sleep analysis can be performed on any dataset to determine sleep efficiency and other sleep statistics that may indicate sleep problems. Any combinations of the various initialization modes are allowed for a given dataset file (activity, dual-axis, steps and heart rate). ActiLife will attempt to re-integrate data collected at epoch intervals less than 60 seconds as all scoring is performed using 60 second epoch cycles.

To begin scoring a dataset, click the "Select Dataset" option from the top of the Sleep Scoring tool and browse to an .agd file that contains data collected during sleep episodes. Graphs of each day in the dataset will appear in the "Sleep Scoring" view.



FIGURE 47 – SLEEP SCORING

Areas on the graphs can be magnified by dragging the mouse pointer over the area of interest as shown in Figure 48. To return to the normal view, click the small circle in the bottom left-hand corner of the graph.

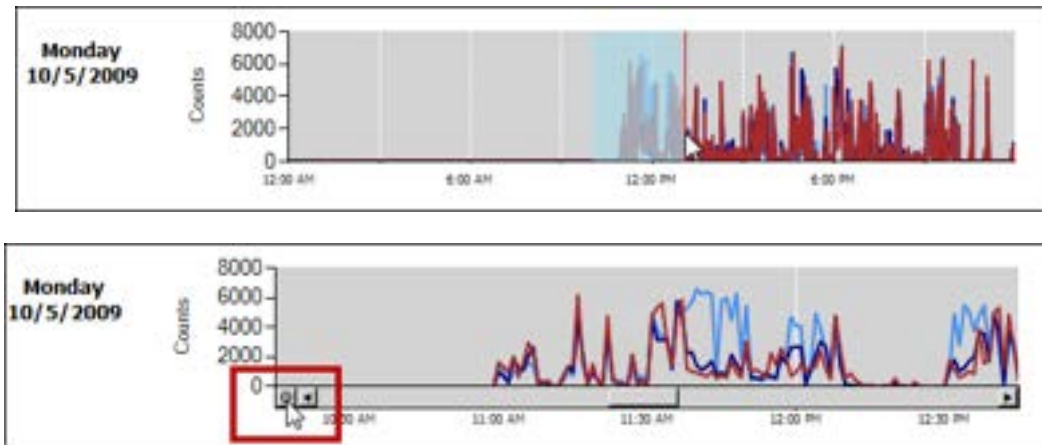


FIGURE 48 – GRAPHING

## MANUALLY ENTERING SLEEP TIMES

Sleep times (time in or out of bed) can be manually entered into the Sleep Analysis tool using two different techniques. To key-in sleep times, select the “Add Bed Time” button on the right of the Sleep Scoring tool. Enter the subject’s exact time in bed and time out of bed and click “ok.” The selected time slot will be highlighted in translucent red on the graph.

Sleep times can also be added directly on the graph itself by clicking anywhere on the graph and using the arrow keys to navigate to the sleep episode start time. Once a suitable start time is located, right-click anywhere on the graph and choose “Add New In Bed Time Here” This will mark the start of the sleep episode. Repeat this process and choose “Accept Out Of Bed Time” to mark the end of the sleep episode. Figure 49 illustrates this process.

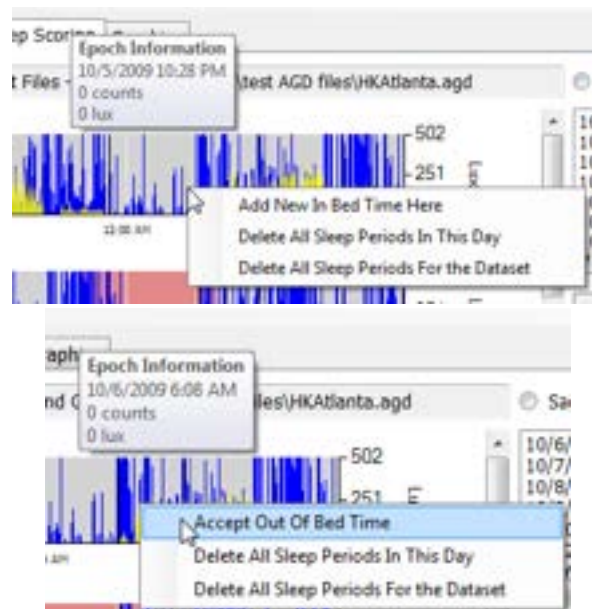




FIGURE 49 – MARKING SLEEP EPISODES GRAPHICALLY

## AUTOMATICALLY ENTERING SLEEP TIMES

ActiSleep+ users can automatically estimate bed times (Time in Bed [TOB] and Time Out of Bed [TOB]) in ActiLife by pressing the “Auto Score” button. ActiLife will estimate bed times for the current data set and apply the selected algorithm to those bed times.



FIGURE 50 - AUTO SCORE SLEEP TIMES

The Auto Score feature will not ignore non-wear times (as estimated by the Wear Time Validation tool), but the algorithm is designed to ignore gaps in the sleep data as shown in Figure 51.



FIGURE 51 - AUTO SCORE IGNORES PERIODS WHEN DEVICE WAS REMOVED

## EDITING AUTO SCORED TIMES

The bed times estimated by the Auto Score feature can be easily adjusted by right-clicking on the sleep period of interest, choosing “Adjust Out Bed Time” (or “Adjust In Bed Time”), using the left or right arrow keys on the keyboard to adjust the time, then right-clicking anywhere on the graph and selecting “Finished Entering Bed Times”. This is illustrated in Figure 52.

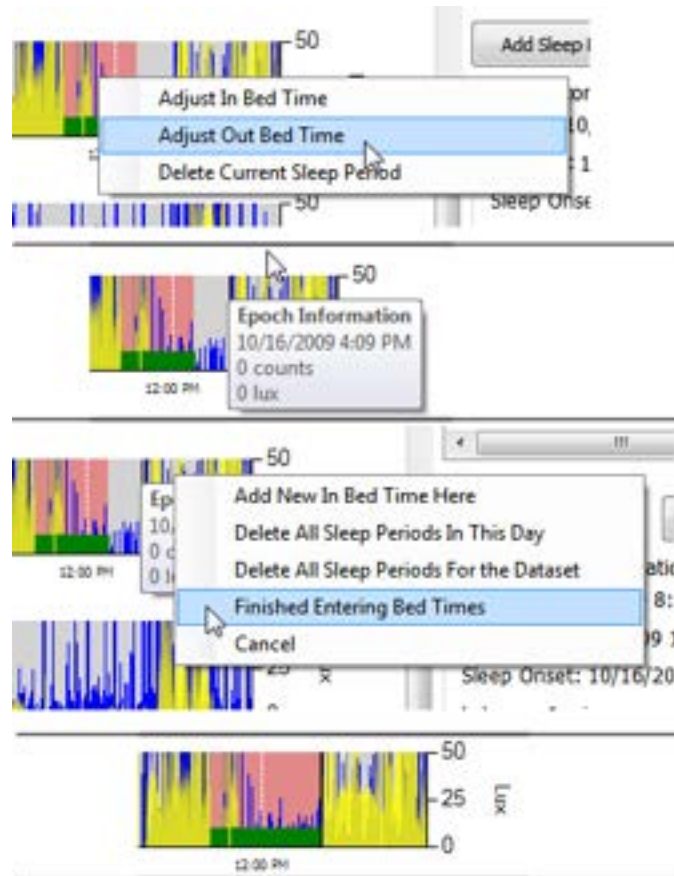


FIGURE 52 - ADJUSTING BED TIMES

*Important: The Auto Score can only be used with data collected from ActiSleep+ devices. The feature can be enabled for data collected from other ActiGraph devices for a small fee. Contact [support@theactigraph.com](mailto:support@theactigraph.com) for more information.*

## REMOVING SLEEP TIMES

Sleep periods can be removed by right-clicking on them on the graph and choosing “Delete Current Sleep Period.” To delete all of the sleep periods for a particular day or for the entire dataset, choose the proper corresponding option (“Delete All Sleep Periods in this Day” or “Delete All Sleep Periods for the Dataset”). Sleep periods can also be removed by selecting the sleep period in the list to the right and clicking the “Remove” button below the list.

## ACTIVITY AND LUX SCALE

The “Activity Scale” and “Lux Scale” settings below the sleep graphs adjust the maximum scale shown for Activity and Lux counts on the sleep graphs. Changing the value scales all of the graphs simultaneously.

## CHANGING GRAPH COLORS

Graph colors for activity, lux, the sleep score period, and the score indicator can be changed easily by clicking the color palette beside the corresponding item and choosing a different color as shown in Figure 53. Note that the “Period Color” is translucent and may appear slightly lighter than its selected color.

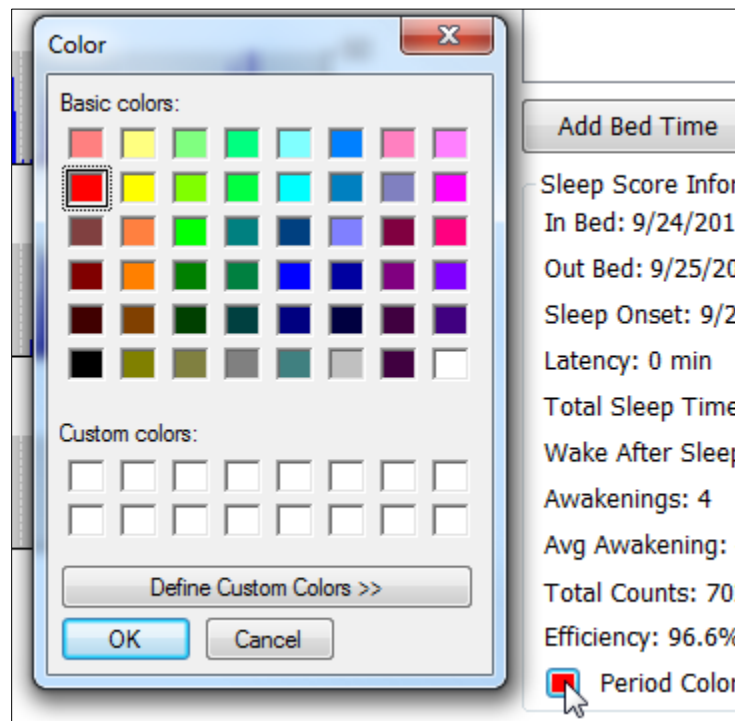


FIGURE 53 – COLOR PALETTE FOR SLEEP SCORING GRAPH

## LUX

Lux, or ambient light, is measured by ActiGraph’s ActiSleep+ monitor, the ActiTrainer and the GT3X+ devices. Ambient light may affect subject sleeping habits and thus is a useful tool in analyzing circadian rhythms and sleeping patterns. If lux data was recorded by the ActiGraph device, it will appear in yellow on the sleep graphs as shown below in Figure 54. The lux data can be hidden by deselecting the “Show LUX data” option at the bottom of the screen. Details regarding the significance of the lux values are revealed by hovering the mouse pointer over the “Lux Info” link at the bottom of the screen as shown in Figure 55. Note that these levels are only estimates and are not meant for exact interpretation of the light detected by the device.





# USER'S MANUAL

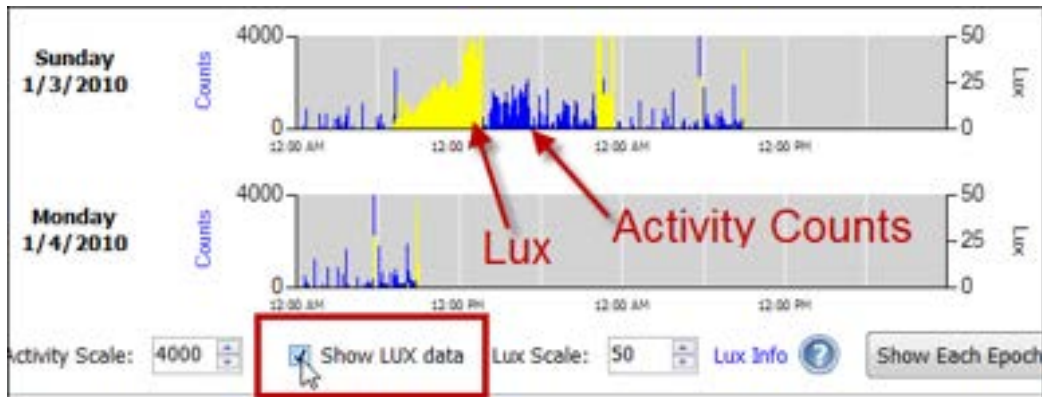


FIGURE 54 – LUX DATA OVERLAY ON SLEEP GRAPHS

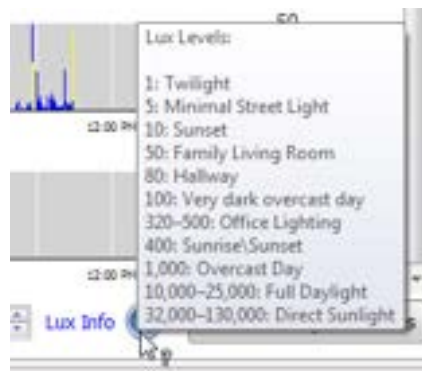


FIGURE 55 – LUX THRESHOLDS

## SLEEP SCORING ALGORITHMS

The Sleep Analysis tool comes standard with two validated algorithms (Sadeh<sup>1</sup> or Cole-Kripke<sup>2</sup>) to determine minute-by-minute asleep/awake status. These algorithms are selectable by the user and can be changed instantly for comparison purposes. The algorithms are described below. Select the desired algorithm by choosing it from the “Algorithm” drop-down menu at the top right-hand corner of the Sleep Analysis tool. More information is available about the origin of the algorithms by clicking “Sleep Algorithm Information” link below the algorithm dropdown menu.

<sup>1</sup> “Automatic Sleep/Wake Identification From Wrist Activity”, Roger J. Cole, Daniel F. Kripke, et al, Sleep 12(5):461-469, 1992 American Sleep Disorders Association and Sleep Research Society

<sup>2</sup> “Activity-Based Sleep-Wake Identification: An Empirical Test of Methodological Issues”, Avi Sadeh, K.M. Sharkey and M. A. Carskadon, Sleep 17(3): 201-207, 1994 American Sleep Disorders Association and Sleep Research Society

## USER'S MANUAL

### COLE-KRIPKE ALGORITHM

The Cole-Kripke algorithm is considered appropriate for use with adult populations because it was developed using subjects ranging from 35 to 65 years of age. Roger J. Cole and Daniel F. Kripke adapted a scoring method developed by J. B. Webster with an experimental wrist actigraph for the AMI actigraph in 1992. It was developed using 10, 30 and 60 epochs, with the highest level of accuracy resulting from data collected at 10 second epoch periods.

The algorithm was adapted to the ActiGraph ActiSleep monitor by performing a side by side test using the AMI device and the ActiSleep monitor worn together. The data were scaled then put through the algorithms until the ActiSleep monitor sleep score matched that from the AMI device.

### SADEH ALGORITHM SUMMARY

The Sadeh algorithm was developed by Dr. Avi Sadeh from Tel-Aviv University in Israel and is considered appropriate for younger populations because it was developed using subjects ranging from 10 to 25 years of age. He used the same device that Cole-Kripke used to develop their algorithm, and ActiGraph therefore adapted it in the same way by scaling our data until it matched up with the scoring results of the AMI device. In general terms, this algorithm determines a subject's sleep state by examining the ActiGraph activity over an 11 minute sliding window. For any given window, a "Sleep Score" (whether the person is asleep or not) can be determined by applying this formula. After selecting a sleep time (Time In Bed (TIB) and Time Out of Bed (TOB)) each minute of sleep data is analyzed this way.

### CUSTOM SLEEP ALGORITHMS

ActiSleep+ customers can create their own custom sleep scoring algorithm that uses the same "sliding window" concept as the Sadeh and Cole-Kripke algorithms. To get started, choose "Create New" from the Algorithm dropdown menu.

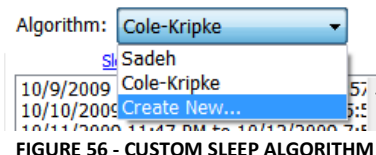


FIGURE 56 - CUSTOM SLEEP ALGORITHM

The *Custom Sleep Scoring Parameters* form shown in will load.



# USER'S MANUAL

FIGURE 57 - CUSTOM SLEEP SCORING DESIGN FORM

This tool will allow users to customize the following settings.

## ALGORITHM NAME

The Algorithm Name is the name that will appear in the drop-down menu after the algorithm design is complete.

## EPOCH WINDOW

The sliding window technique works as follows: All epochs in a given dataset are scanned. Each epoch of data receives a sleep or a *wake* score based on its count level as well as the count levels of other epochs before and after itself. This “window” of epochs and surrounding epochs then “slides” to the next epoch (and surrounding epochs) and the process repeats.

The *Epoch Window* defines the sliding window and the weighting which is given to the current and surrounding epochs in order to determine whether to score the current epoch as *sleep* or *wake*. To increase the size of the window, adjust the “Epochs to use before current” and “Epochs to use after current” options; the graphic will increase or decrease in width automatically.



# USER'S MANUAL

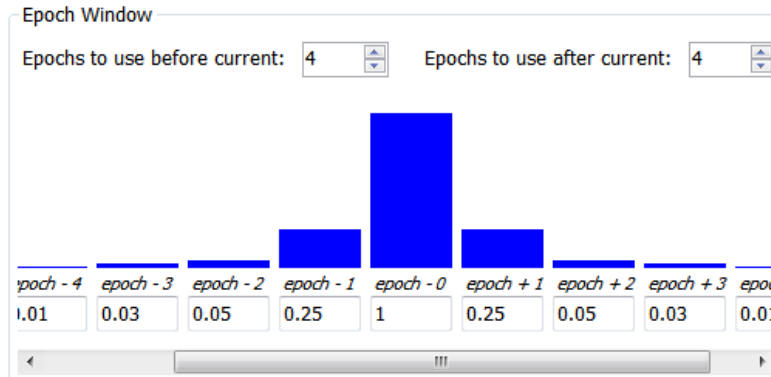


FIGURE 58 - CUSTOM SLEEP SCORE EPOCH WINDOW

Adjust the numbers below the surrounding epochs to change the weighting. Change the Wake Threshold in the Count Parameters section to adjust the comparison level. The Sleep/Wake formula at the bottom of the Custom Sleep Algorithm tool shows the formula used to determine whether the current epoch (*epoch-0*) is scored as *wake* or *sleep*. In the formula show in Figure 59, the current epoch will be scored as wake if the formula is greater than or equal to 10.

Sleep/Wake Formula:

```
wake: (epoch - 4)*0.01 + (epoch - 3)*0.03 + (epoch - 2)*0.05 + (epoch - 1)
*0.3 + (epoch - 0) * 1 + (epoch + 1) * 0.25 + (epoch + 2) * 0.05 + (epoch + 3)
* 0.03 + (epoch + 4) * 0.01 >= 10
```

FIGURE 59 - SLEEP/WAKE FORMULA

## COUNT PARAMETERS

**Wake Threshold** – This is the value which the sliding window is compared to in order to determine *sleep* or *wake* status for *epoch-0*

**Data to Use:** Users have the option of using Axis 1, Axis 2, or Axis 3 data to calculate the custom sleep score. Alternatively, the [Vector Magnitude \(VM\)](#) of all 3 axes can be used.

**Set Maximum Value of Count** – Use this option to put a limit on the maximum weight a particular epoch can have on the sleep/wake formula. For instance, if  $(\text{epoch}-2) * 0.05 = 500$  (see Figure 59), setting the Maximum Value of Count to 300 would actually limit that epoch's contribution to 300 (rather than 500).

**Epoch Length Required** – This option allows users to specify a required epoch length for datasets using the new customized formula. Datasets that do not meet this requirement cannot be used – ActiLife will automatically attempt to reintegrate lesser epoch sized datasets up to the required epoch length.

## PORTABILITY OF THE CUSTOM SLEEP ALGORITHM

Once the custom algorithm has been written, it can be shared with other ActiLife users. Simply run the custom algorithm against an \*.agd dataset to produce the [Sleep Score Information](#) for that dataset. That \*.agd will then



## USER'S MANUAL

contain the custom sleep score algorithm. Whenever the \*.agd file is shared with other users, this algorithm will automatically appear in their algorithm dropdown menu in the Sleep Analysis tool.

*Important: The Custom Sleep Algorithm tool can only be used with data collected from ActiSleep+ devices. The feature can be enabled for data collected from other ActiGraph devices for a small fee. Contact [support@theactigraph.com](mailto:support@theactigraph.com) for more information.*

### SLEEP SCORE INFORMATION

Both algorithms will yield the following information within ActiLife's Sleep Scoring tool for each sleep period. Sleep period scores can be seen by clicking on the sleep period of interest on the right-hand side of the screen (see Figure 47 for an illustration).

**Sleep Onset** - The first minute that the algorithm scores "asleep."

**Total Sleep Time (TST)** – The total number of minutes scored as "asleep."

**Wake after Sleep Onset (WASO)** – The total number of minutes the subject was awake after sleep onset occurred.

**Awakenings** - The number of different awakening episodes as scored by the algorithm. This is sometimes referred to as Frequency of Awakenings (shown as the number of awakenings per night).

**Avg Awakening** – The average length, in minutes, of all awakening episodes.

**Total Counts** – The total actigraphy counts summed together for the entire sleep period.

**Efficiency** – Number of sleep minutes divided by the total number of minutes the subject was in bed (i.e., the difference between the In-Bed and Out Bed time).

### ACTOGRAM VIEW

The ActoGram view option provides ActiSleep + users with the ability to quickly discern circadian patterns in sleep behavior by scaling and compressing the sleep graphs. Enable the ActoGram view by choosing the radio button corresponding to this view at the bottom of the Sleep Scoring tool. Figure 60 illustrates an ActoGram view.

Several options exist for editing the ActoGram view.

*Show 6 Hour Ticks* – This option will toggle the periodic 6 hour hash marks on the ActoGram graph.

*Show Hourly Ticks* – This option will toggle the periodic hourly hash marks on the ActoGram graph.

*Graphs Per Page* – Use this option to compress or expand the ActoGram view vertically.

# USER'S MANUAL

*Lux* – This check box toggles the ambient light data on the ActoGram view (in yellow)

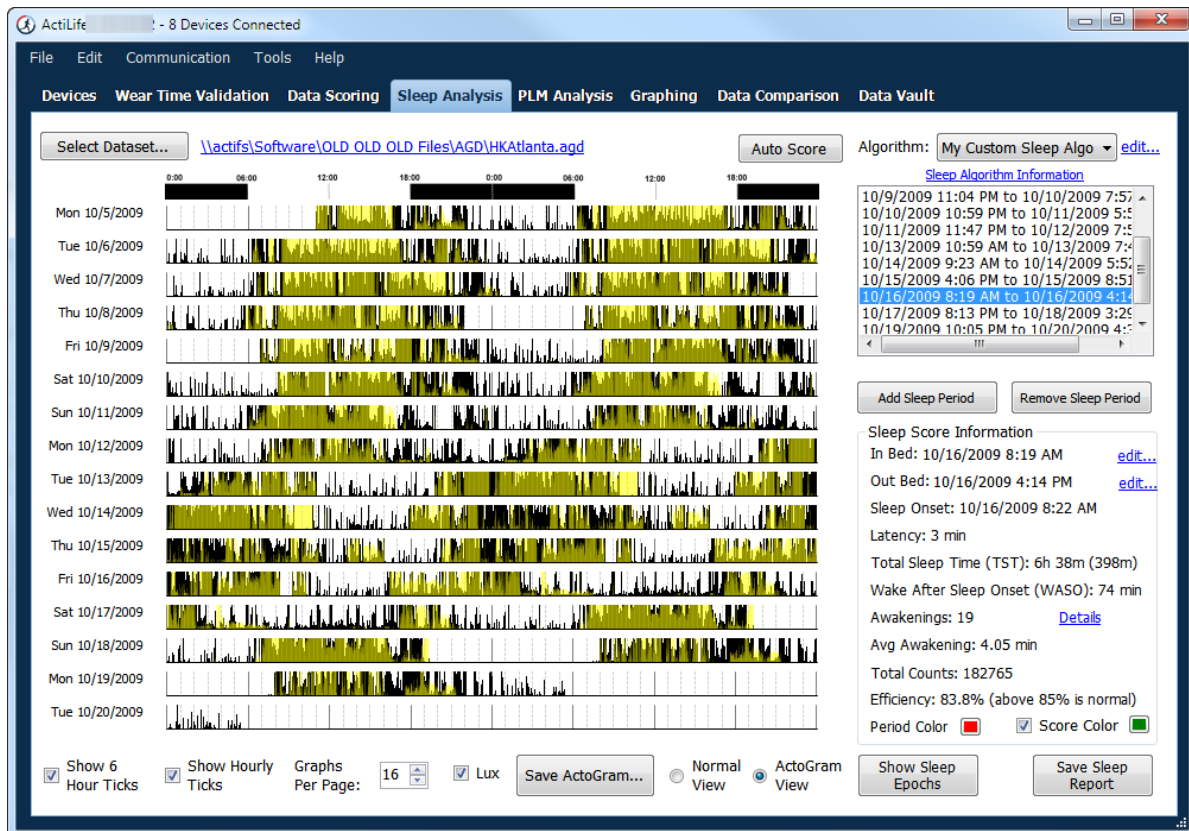


FIGURE 60 – ACTOGRAM VIEW

## SAVING THE ACTOGRAM

The ActoGram can be saved as a sharable image by clicking “Save ActoGram” at the bottom of the graph. This option will give the user the option to export the ActoGram to a .jpg image for sharing.

*Important: The ActoGram view can only be used with data collected from ActiSleep+ devices. The feature can be enabled for data collected from other ActiGraph devices for a small fee. Contact [support@theactigraph.com](mailto:support@theactigraph.com) for more information.*

## SHOW SLEEP EPOCHS

Clicking the “Show Sleep Epochs” button will load a matrix of each epoch in the dataset with details about whether the epoch was scored as a “Sleep Epoch” (indicated by an “S”) or a “Wake Epoch” (indicated by a “W”). This list

## USER'S MANUAL

can be exported to CSV by clicking “Save” at the bottom of the form or by copying and pasting the values. In addition, the entire list can be copied to the clipboard by clicking the corresponding button – the list can then be pasted into any text editor.

### SAVE SLEEP REPORT

Sleep scores produced in the Sleep Scoring tab can be exported to either a CSV or PDF file by clicking the “Save Sleep Report” option at the bottom right-hand side of the screen. Select the desired output from the options dialog that appears. Browse to the export location, type a file name, and click “Save” to begin the export.

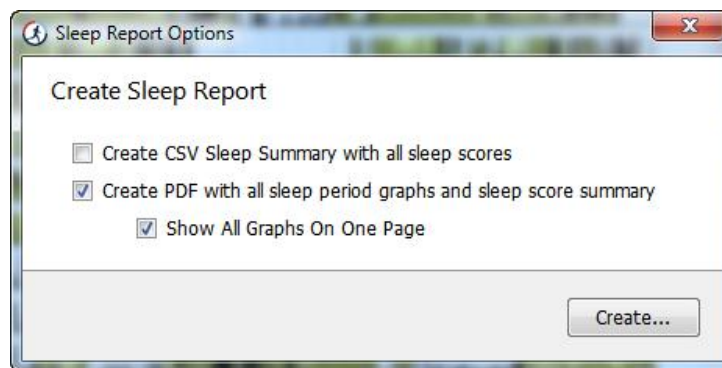


FIGURE 61 – SAVE SLEEP REPORT DIALOG





## USER'S MANUAL

### PLM ANALYSIS

The Periodic Leg Movement (PLM) tool allows users to detect and score periodic leg movements in patients with PLM disorder or restless leg syndrome. Note: The PLM tool is only compatible with data collected from the legacy ActiSleep or the new ActiSleep+ monitor devices. This analysis serves as a cost effective alternative to polysomnography (PSG) analysis.

*Note: ActiGraph is working with leading sleep institutions to obtain research-backed validation on the PLM Analysis tool. However, at this time, the PLM analysis uses existing research to make estimates on the presence of PLM in patients.*

### INITIALIZING DEVICES FOR PLM ANALYSIS

To use the tool, initialize an ActiSleep monitor through the devices tab to start collecting data at the desired time. (Info about ActiSleep battery life) ActiSleep+ devices only have one option for initialization (30Hz). Legacy ActiSleep devices should be initialized to collect data at 1s epochs. During initialization, ActiLife gives users the option to print a sleep diary. The sleep diary can be used by patients who choose to wear the devices for several nights in their own homes or for doctors who are logging multiple patients' sleep behaviors. Patients should be instructed to use the sleep diary to keep track of the time in bed (TIB) and time out of bed (TOB) for purposes of analysis.

Attach the ActiSleep monitor to the top interior of the patient's left and right feet around the ball of the foot as shown in the image below. This can be accomplished with bandage wrapping or with straps available from ActiGraph. Patients should wear the device during the entire duration of their total time in bed.



FIGURE 62 - WEAR LOCATION FOR PLM ANALYSIS

### DOWNLOADING DEVICES

After patients have worn the devices for the desired number of sleep periods, collect the devices and download them using the Devices tab. Legacy ActiSleep monitors will produce an \*.agd file on download. This file can be used for scoring PLM in the PLM tab. ActiSleep+ devices will create a \*.gt3x file on download. This file contains



## USER'S MANUAL

the raw acceleration data collected by the devices and needs to be post-processed (i.e., converted to \*.agd format) prior to PLM scoring. This can be accomplished by choosing “Create AGD File” from the download dialog as shown in the figure below. Select 1s epoch and 3 axes. The other options are optional, but “Low Frequency Extension” should not be selected.

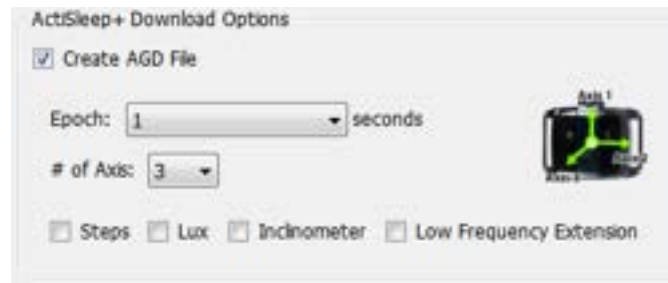


FIGURE 63 - DOWNLOAD SETTINGS FOR PLM ANALYSIS

After download, an AGD file will be created in the download folder which is also selected at the time of download.

### SCORING THE PLM DATA

To score periodic leg movements, open the PLM tab and select the left and right leg \*.agd files. Click the “Add Sleep Periods” button and select the entry method.

- *Add Period Using Bed Times* – Use this option to manually enter in times as recorded by the doctor or patient on the sleep diary.
- *Import from Separate AGD File* – Use this option to import sleep times from another AGD file that already contains the same sleep times.
- *Enter Period Graphically* – Coming soon.

Select which axis or axes to use to score the PLM data. The Vector Magnitude option combines all three axes using the vector magnitude formula. See [Appendix B – Vector Magnitude](#) for more information.

Select the thresholds for detecting legitimate “movement”.

*Note: these thresholds only set the level at which PLM activity occurs. ActiLife's built-in algorithm determines whether or not the movement qualifies as PLM.*

- *Onset Threshold* – The threshold (in counts-per-epoch) at which PLM movement detection starts
- *Decay Threshold* – The threshold (in counts-per-epoch) at which PLM movement detection ends.

Onset and decay thresholds are available to introduce [hysteresis](#) into the movement detection.



# USER'S MANUAL

## INTERPRETING THE PERIODIC LIMB MOVEMENT OUTPUT

After scoring files for Periodic Leg Movement, click on the different sleep periods to view the graph and PLM stats for each sleep period.

### GRAPHS

Clicking on a sleep period will load a PLM score graph. The green background represents the total time in bed (sleep period) as logged by the user. The graph will automatically show data 1 hour before the time in bed and 1 hour after the time out of bed. The blue horizontal line represents the onset threshold and the red horizontal line represents the decay threshold. The bar graph below the main activity graph gives users a quick reference to PLM bouts (bouts of activity that meet the qualifications of Periodic Leg Movement). Both graphs can be zoomed in or out simultaneously by dragging the mouse over the area of interest. To zoom back out, click the small circle in the lower left-hand corner of the graph until the desired zoom level is achieved.

### STATS

- *PLMI (per hour)* - PLMI stands for Periodic Leg Movement Indices. This value represents the number of qualifying periodic leg movements per hour, averaged over the entire sleep period.
- *Minutes of PLM Kicks* - The total number of minutes of "kicks" or activity spikes that exceed the onset threshold AND the total minutes of consecutive "kicks" thereafter that exceed the decay threshold.
- *Number of PLM Kicks* - The number of "kicks" or activity spikes that exceed the onset threshold AND the number of consecutive "kicks" that exceed the decay threshold.
- *Number of PLM Bouts* - A count of the number of bouts of PLM that occurred during the selected sleep period.
- *Average PLM Bout Length (min)* - The average length, in minutes, of all of the PLM bouts for the selected sleep period.
- *Minutes of PLM Bouts* - The total time, in minutes, of PLM bouts. This time is different from the PLM kicks because kicks do not necessarily qualify as valid PLM.
- *Avg PLMS Intensity* - The average intensity of the PLM during Sleep of all of the PLM bouts. Essentially, this is the duty cycle of all PLM bouts.  $\text{Avg PLMS Intensity} = \text{total minutes of valid PLM} / \text{total PLM bout length}$

For more information regarding the source of our PLM calculations, see our online FAQ, "[How were the Periodic Leg Movement algorithms derived?](#)".

## GRAPHING

ActiLife's graphing tab allows users to quickly see graphs of each day in a given dataset. Click "Select Dataset" and browse to an .agd file containing data. The graphs will load vertically and will be ordered from latest to most recent date, ascending downward. Zooming is accomplished by dragging the mouse over the area of interest as shown in Figure 48. Graphs can be reset by clicking the small icon in the bottom left-hand corner of the graph which is also illustrated in Figure 48.

## EXPORTING

Graphs can be exported to a PDF by clicking "Export to PDF" in the top right corner of the Graphing tab. Selecting "Keep any zoom information" will output the graph with the current zoom view (if any). Individual days can be exported to pdf by checking or unchecking the days in the Export dialog.

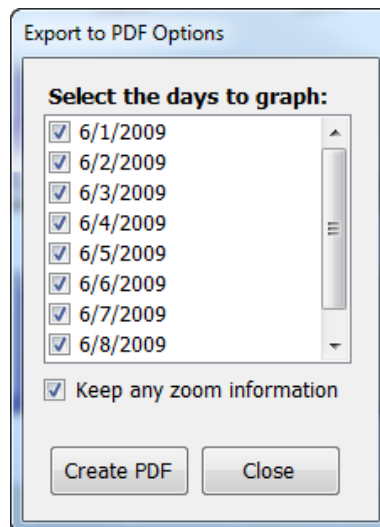


FIGURE 64 – GRAPHING EXPORT DIALOG

## MODE OPTIONS

The "Mode Options" section to the right of the graphs gives users the ability to add or remove data items and change the color of various items on the graphs. If a dataset contains three-axis activity information (i.e., if the device was set to collect three-axis data upon initialization), all three axes will be available for selection (not disabled) in the "Mode Options" section. Deselecting any axis will remove it from the graph view. Multiple axes can be enabled simultaneously; however, in order to avoid cluttering the graph view, only one alternative data point can be shown simultaneously with activity data. To enable Steps, Heart Rate, Lux, or Inclination, select the radio button corresponding to the correct data point. A legend explaining the meaning of each data point will appear below the "Mode Option" section when a given data point is selected as shown in Figure 65. Axis values can be scaled by entering new values into the activity scale boxes to the right of the graphs.



# USER'S MANUAL

Parameter graph colors can be selected by clicking the palette icon to the right of the variable of interest and choosing the desired color. The graph will immediately update with the new color.

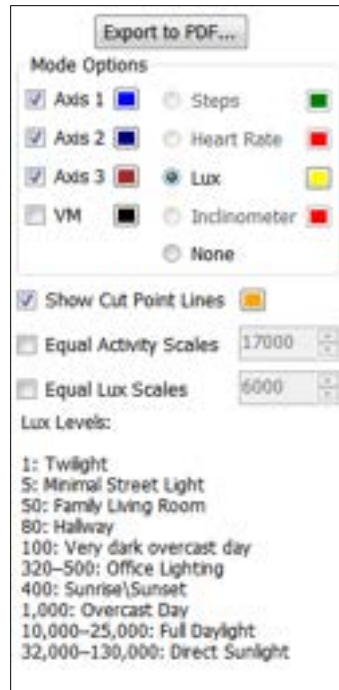


FIGURE 65 – GRAPH LEGENDS

## AXES SCALING

Unless specified, each day shown in the graphing area is scaled individually according to the maximum values collected on that day. By checking the “Equal Scales” option on the right, all activity graphs will be scaled evenly according to the number in the scale box. These scale boxes can be seen in Figure 65.

## INCLINOMETER

The inclinometer tool can be used to detect positional information when any 3 axis device is worn on the waist or thigh. Thigh-worn devices are inherently better at detecting sedentary (sitting/lying) versus non-sedentary (standing/stepping) than are waist-worn devices.

If an \*.agd dataset contains no inclinometer data, a message similar to the one shown in Figure 66 will appear. To utilize the inclinometer tool, select “Inclinometer” when initializing a GT3X or when creating an \*.agd file from a GT3X+ device. It is important that the device wear-location be specified for any \*.agd file. To edit the wear location, open the \*.agd file in the [AGD File Viewer](#) and edit the biometric information; update the “Limb” to be either “Waist” or “Thigh”.



# USER'S MANUAL

*Note: Only Waist and Thigh worn devices can be used with the Inclinator tool*

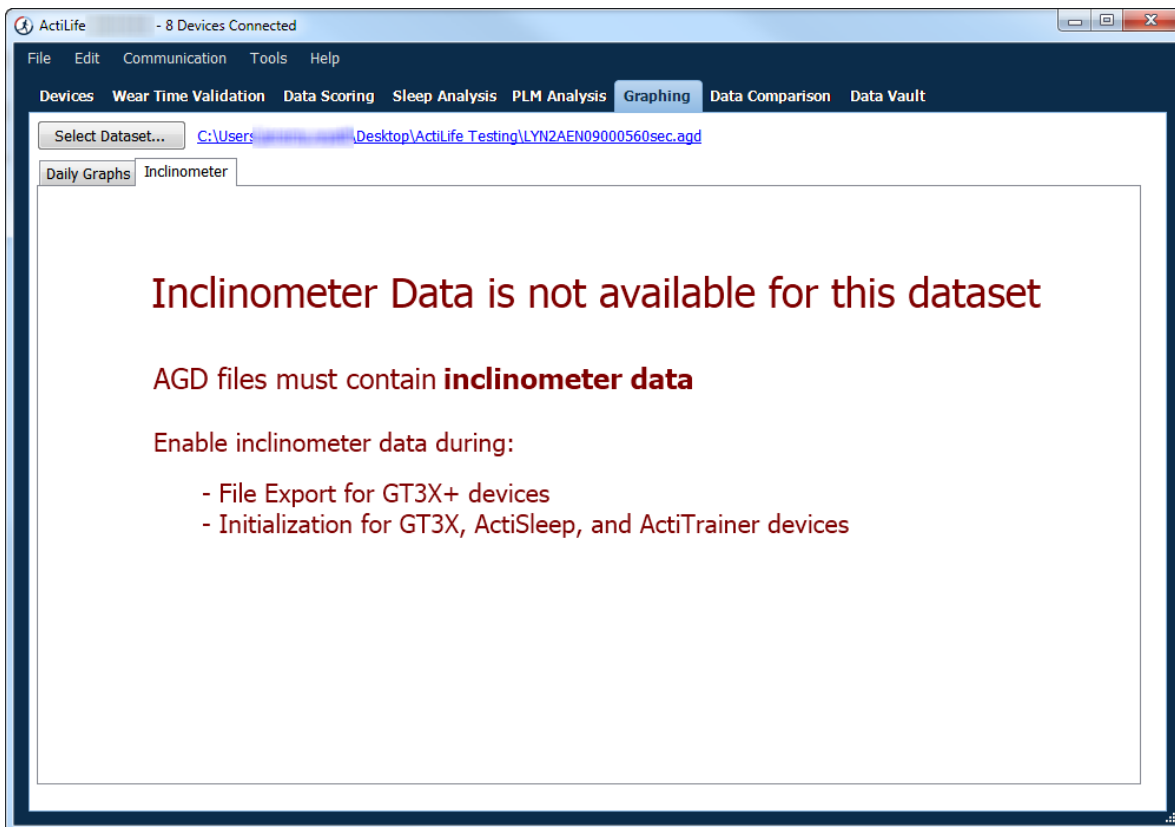


FIGURE 66 - FILE WITH NO INCLINOMETER DATA

Once an appropriate file has been loaded, the Inclinator tool will display a breakdown of hourly positional information as shown in Figure 67. The calendar on the right can be used to navigate among days in the dataset to quickly jump to an area of interest. Any notes written in the Notes area will be stored with the \*.agd file and will be available in the PDF report and in any subsequent interaction with the Inclinator tool for that particular file.



# USER'S MANUAL

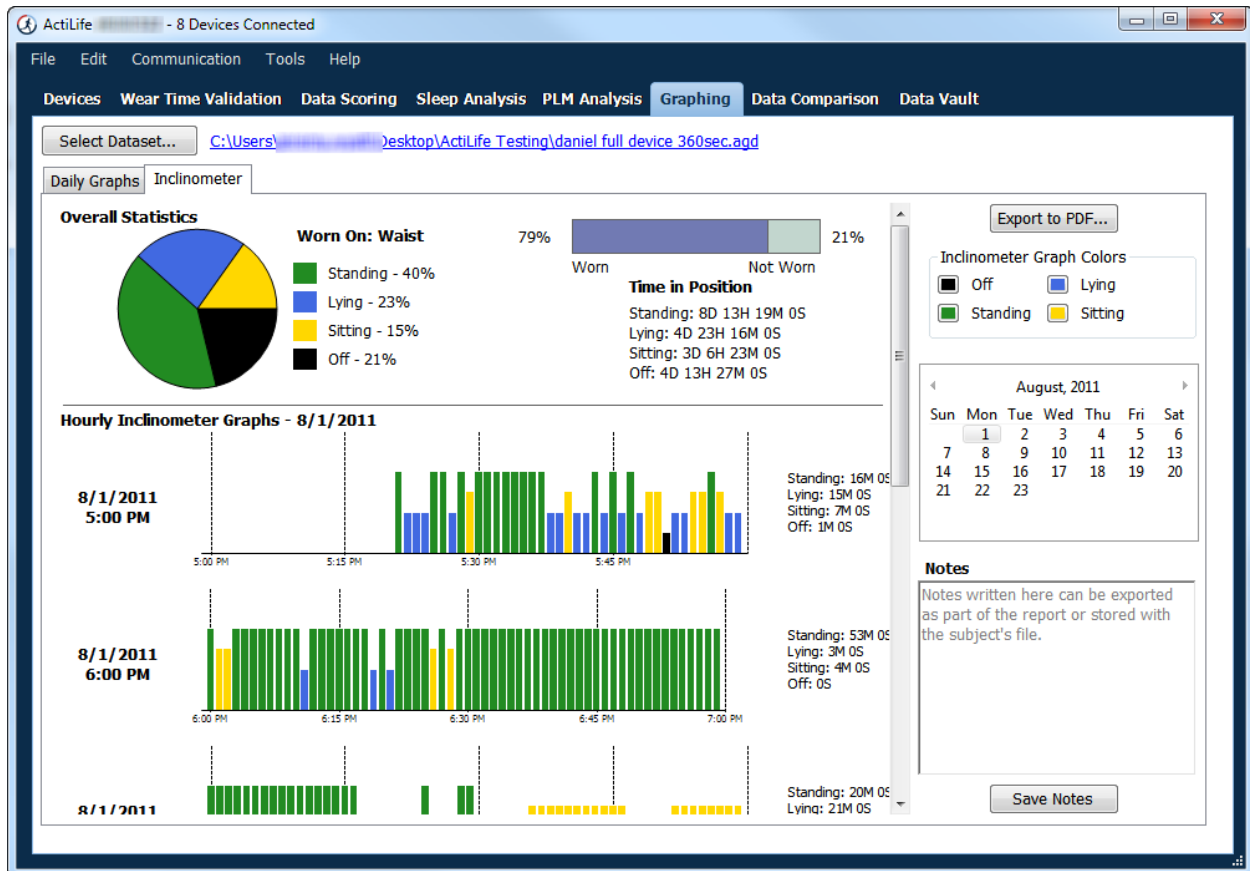


FIGURE 67 - INCLINOMETER OUTPUT

Note that the graph colors can be changed by using the color palette on the right hand side as well.

## CREATING AN INCLINOMETER REPORT

A PDF report of the Inclinometer output can be created by clicking the “Export to PDF...” button. Users will be given the option to choose which days to export to the report.

*Important: The inclinometer feature was designed by the ActiGraph engineering team as a viable way to detect user positional trends over a period of time. The thigh worn algorithm is best suited for positional detection as it is difficult to algorithmically determine the difference between sitting and standing for waist-worn devices. For more information about the waist-worn inclinometer algorithm, see our [Inclinometer White Paper](#).*

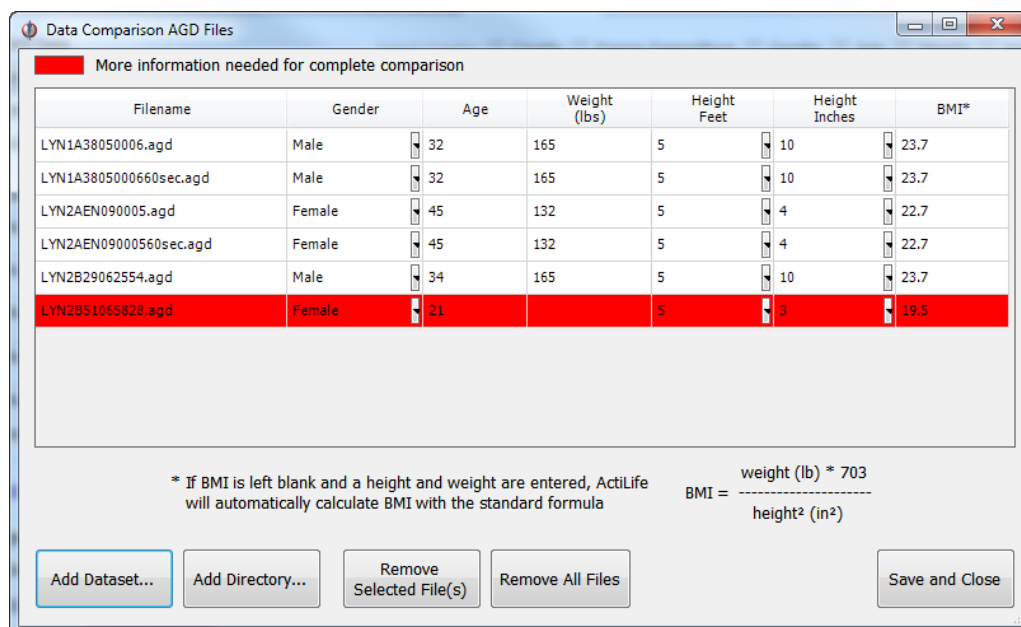
## DATA COMPARISON

The Data Comparison tool allows users to compare ambulatory activity data collected during private studies with other public activity datasets that were generated from ActiGraph devices. At the time of this writing, data comparison can be made against public dataset – the 2002-2003 and 2003-2004 National Health and Nutrition Examination Survey (NHANES) collected by the Center for Disease Control and Prevention. More information about this dataset can be found at [http://www.cdc.gov/nchs/nhanes/about\\_nhanes.htm](http://www.cdc.gov/nchs/nhanes/about_nhanes.htm).

The goal of the data comparison tool is to provide ActiLife users with the ability to objectively compare their own actigraphy data with that of national or world-wide standards in an effort to understand correlations among the datasets. As more datasets become available, ActiLife will continue to expand this offering, eventually providing various disease research study information and chronic illness baseline data.

## LOADING DATASETS FOR COMPARISON

As datasets are added to the Wear Time Validation and Data Scoring tools, they are automatically loaded into the Data Comparison tool. To view these datasets (or to load more), click the “Load/Edit Subjects...” button at the top of the Data Comparison grid. A form similar to the one shown in Figure 68 will appear. Rows highlighted in **red** indicate that more metadata information is required in order to fully compare this user to the other users in the baselines database(s). In the example shown in Figure 68, the user shown in red will be compared on all parameters except for weight. That is, three females and three males will appear in the gender comparison, but only five users will be compared in the weight category.



**More information needed for complete comparison**

Filename	Gender	Age	Weight (lbs)	Height Feet	Height Inches	BMI*
LYN1A38050006.agd	Male	32	165	5	10	23.7
LYN1A3805000660sec.agd	Male	32	165	5	10	23.7
LYN2AEN090005.agd	Female	45	132	5	4	22.7
LYN2AEN09000560sec.agd	Female	45	132	5	4	22.7
LYN2B29062554.agd	Male	34	165	5	10	23.7
LYN2B51065828.agd	Female	21		5	3	19.5

\* If BMI is left blank and a height and weight are entered, ActiLife will automatically calculate BMI with the standard formula

$$BMI = \frac{\text{weight (lb)} * 703}{\text{height}^2 (\text{in}^2)}$$

Buttons: Add Dataset..., Add Directory..., Remove Selected File(s), Remove All Files, Save and Close

FIGURE 68 – DATA COMPARISON SUBJECT FORM

## USER'S MANUAL

Once all edits are complete, click “Save and Close” from the subject form.

### SELECTING NHANES COMPARISONS

The NHANES Data Filter allows the user to set comparison parameters. To compare the user dataset to only males in the NHANES data population, select “Male” from the Gender dropdown. To set a custom age range for comparison, choose “Custom” from the Age dropdown and type in a custom age range to compare against. Use this process for all of the filter parameters until the desired comparisons are set. To apply the same filter parameters to the user dataset, check the box “Apply Filter to Your AGD Files”. This will force ActiLife to use only those datasets that meet the filter qualifications from both the NHANES data and the user’s local data.

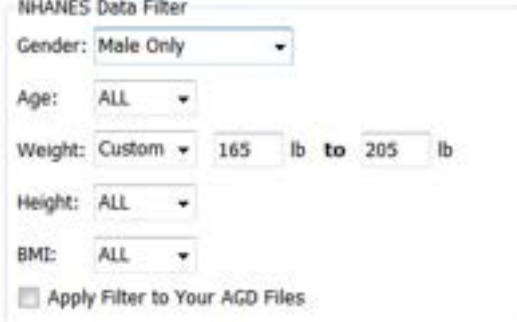


FIGURE 69 - NHANES AND SUBJECT DATA FILTER

The results of the filter will be summarized below the Data Filter section as shown in Figure 70.

# of Subjects that match the filter
Your Subjects: 12
NHANES: 2058

FIGURE 70 - FILTER RESULTS

Click “Calculate” to run the comparison. Once the calculation is complete, the resultant graphs will appear on the right-hand side. Use the “Select Graphs” options to turn specific graphs on or off. Double-click on any graph to make it larger. These graphs show comparison between the user’s data and the NHANES data set. Double click the graph again to return to the normal view.



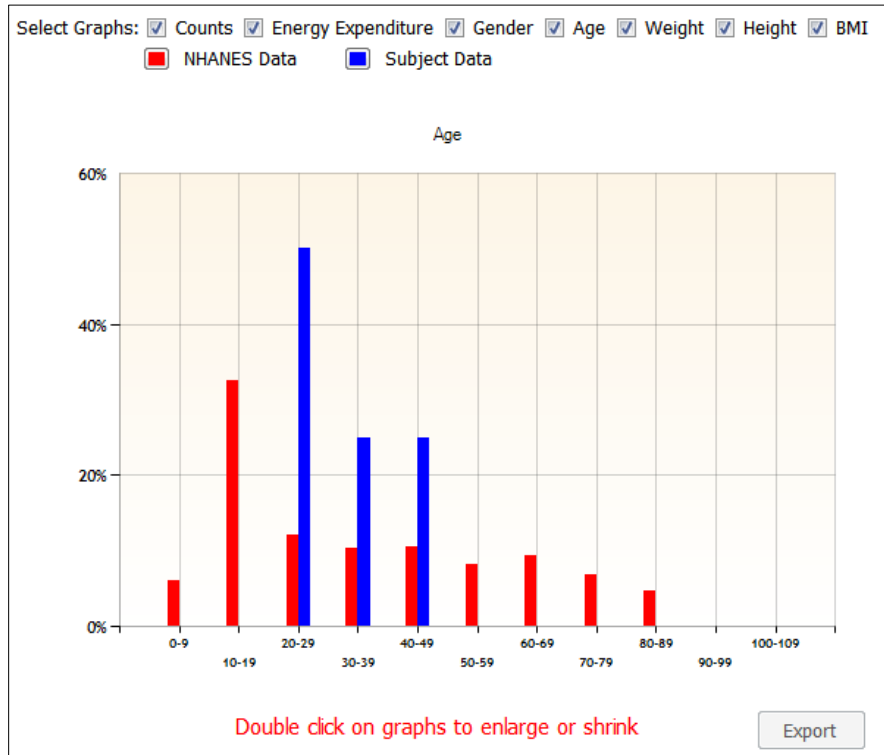


FIGURE 71 - ENLARGED AGE COMPARISON GRAPH

## EXPORTING DATA COMPARISON RESULTS

To export the graphical results of the comparisons, click the “Export” button in the lower right-hand corner of the Data Comparison tool. Select a location and a file name and click “Save.” This will generate a printable/shareable PDF document of the Data Comparison tool’s graphic results.

## DATA VAULT

The Data Vault tool is a secure, cloud-based storage system integrated into the ActiLife program that allows users to quickly and securely save files into their own personal cloud to share with others. There are many immediate benefits to the Data Vault system including:

- Simplified Data Sharing
- Reduced IT costs
- Built-in data backup and retention
- Fast storage



# USER'S MANUAL

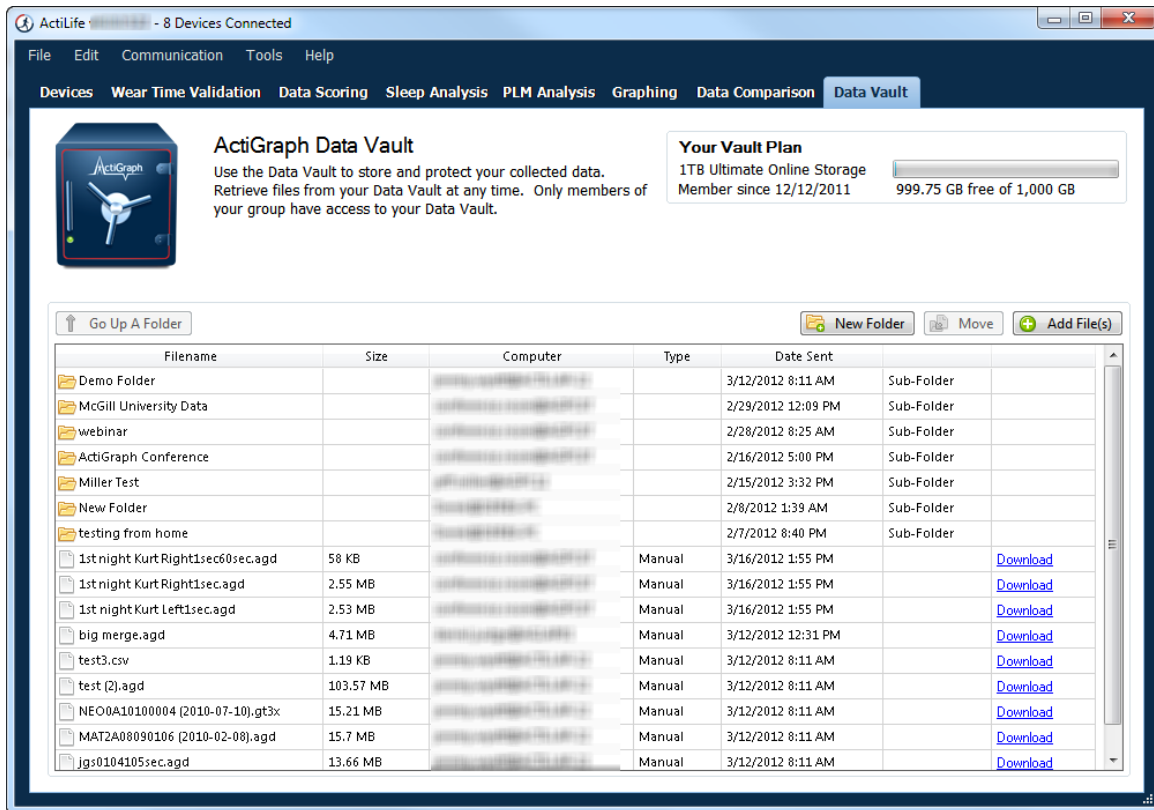


FIGURE 72 - ACTILIFE DATA VAULT

## ADDING FILES TO THE DATA VAULT

ActiLife 6 users receive 4GB of free space. To add files to the Data Vault, navigate to the Data Vault tab and click the “Add File(s)” button. Browse to the file location and select the files you wish to upload. Multiple files may be added by holding the “Shift” key on the keyboard while selecting files. Click “Open” to start the upload process.

## USER'S MANUAL

### SUB FOLDERS

Sub folder organization in the Data Vault is available in ActiLife version 6.0 and later. To add sub-folders, click the "New Folder" button in the Data Vault view. Users who are sharing license groups between ActiLife 5 and ActiLife 6 should be aware that ActiLife 5 users can only upload to the root directory and cannot see or utilize any subfolders that were created by ActiLife 6 users.

### SHARING DATA WITH COLLEAGUES – LICENSE GROUPING

License grouping allows dispersed Data Vault users to share their valuable data quickly and easily. ActiLife Full and Lite licenses are automatically grouped together. A Lite user who uploads files using their Data Vault tab will automatically see any files that a Full user uploads, and vice versa. This ensures centralization of important actigraphy data when that data is being collected across multiple study sites.

Institutions and Universities can also be grouped together under a single License Group for collaboration on studies. For information on License Grouping, contact ActiGraph support at [support@theactigraph.com](mailto:support@theactigraph.com)

### MULTIPART UPLOADS

The ActiLife Data Vault takes advantage of a technology known as multipart uploads. This technique delineates the files into multiple parts and uploads each part to the Data Vault. This technique results in much faster uploads over slow connections and increases reliability, since failed uploads can be restarted where they left off. For this reason, the Data Vault tool is superior to other methods of file sharing such as FTP, email, and network sharing.

### VIEWING UPLOAD PROGRESS

To view the upload progress for the queued files, click on the hyperlink below the progress indicator. This will open the Data Vault Transfers window. From there, file transfers can be cancelled and status information can be viewed.

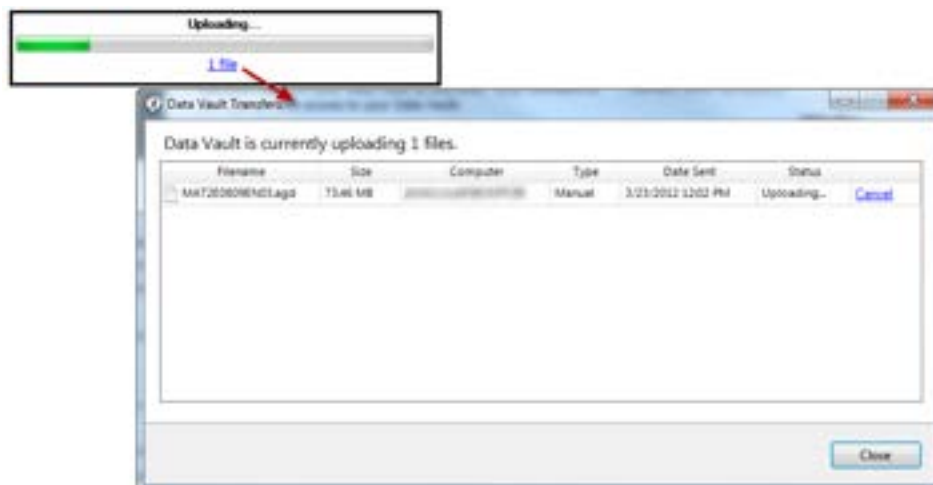


FIGURE 73 - DATA VAULT TRANSFERS WINDOW



## USER'S MANUAL

### FILE TYPES

Any type of file can be uploaded to the Data Vault. Simply change the file type to “All Files” in the File Upload dialog as shown in Figure 74.

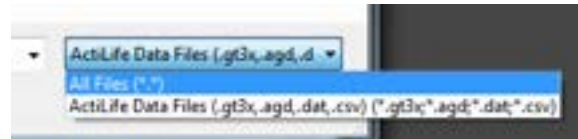


FIGURE 74 - CHANGING THE DATA VAULT FILE TYPE

### DOWNLOADING FILES FROM THE DATA VAULT

To download files stored in the Data Vault, simply click the ‘Download’ link to the right of the file you wish to download. Multi-file downloads are not supported as of version 6.1 but are coming soon.

### PURCHASING MORE SPACE

Various data plans are available for a monthly or yearly fee. Contact ActiGraph sales to inquire about more space for your organization at [sales@theactigraph.com](mailto:sales@theactigraph.com) or 1-877-497-6996.

## APPENDIX A - FILE TYPES IN ACTILIFE

### COMPARISON OF GT3X+ AND GT3X DEVICES

Before explaining the difference between the \*.gt3x and \*.agd files, it would be useful to explain the paradigm differences between the GT3X and GT3X+ device platforms. GT3X devices sample accelerometer data 30Hz (only). This data is then filtered and accumulated into user-selected epoch sizes (60s, for instance) inside of the device. Because this data is being processed and accumulated into epoch-size chunks, on-board storage requirements are relatively small. Whenever ActiLife downloads data from these devices, it produces an \*.agd file (epoch-level file) which can then be processed inside of ActiLife.

GT3X+ platform devices are different in that the user selects the rate at which raw data is sampled from the accelerometer (the user can choose any frequency between 30-100Hz in 10Hz increments). The GT3X+ then stores every sample, making the data storage requirement for this device type much greater. Upon download, the GT3X+ device produces a \*.gt3x file (raw data). The ActiLife software can then be used to band pass filter and accumulate that raw data into epoch-level data, thus producing an \*.agd file that is equivalent to the one produced from the GT3X device as described above. The benefit of the GT3X+ device is that the user can produce any epoch-level output from the raw data. In addition, the raw data is available to perform other analyses outside of the scope of this discussion.

Figure 75 graphically explains the difference between the GT3X and GT3X+ devices.

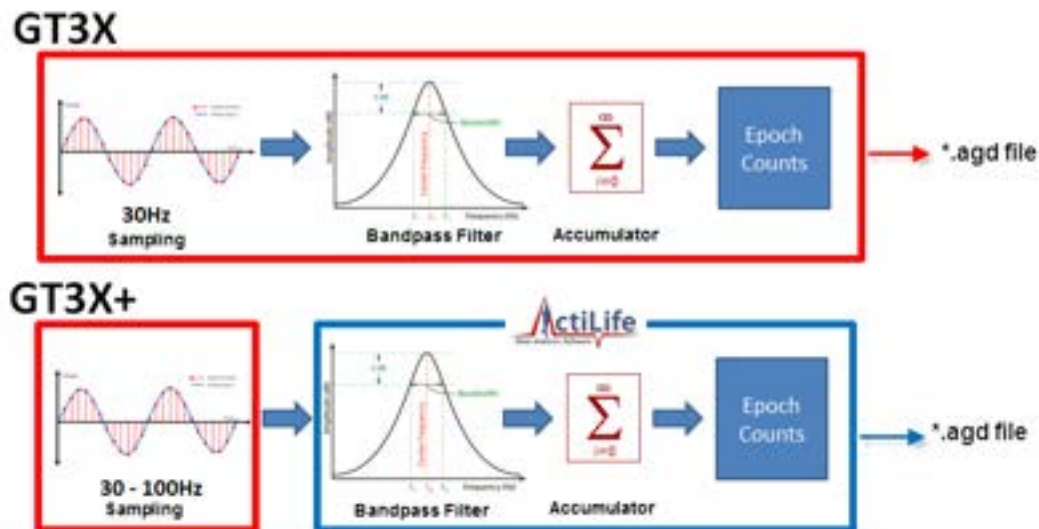


FIGURE 75 - COMPARISON OF THE GT3X AND GT3X+ DEVICES (AND ACTILIFE'S ROLE)

### \*.GT3X FILE FORMAT

GT3X+ devices produce an interim compressed file with file extension \*.gt3x. This is a compressed file and must be extracted to a usable format using ActiLife's import/export tool which is accessible from the File menu in ActiLife.



# USER'S MANUAL

The file can be exported to \*.agd format for processing in ActiLife or \*.csv/\*.dat format for processing using third party tools. The \*.gt3x file can also be exported directly to \*.agd format during the download process by checking “Create AGD File” from the download prompt (see [Downloading GT3X+ Devices](#) for more information).

## \*.AGD FILE FORMAT

The \*.agd file format is ActiLife’s native file format and is the desired file type for all ActiLife operations and tools such as Wear Time Validation, Data Scoring, Sleep Scoring, and Graphing. These \*.agd files are database files formatted for use with the popular SQLite architecture ([www.sqlite.org](http://www.sqlite.org)). These files can be viewed in the ActiLife AGD viewer (available from the File menu). Alternatively, the SQLite browser (publically available on the SQLite website) can be used to browse the details of the \*.agd files. A file schema is provided in Figure A1.

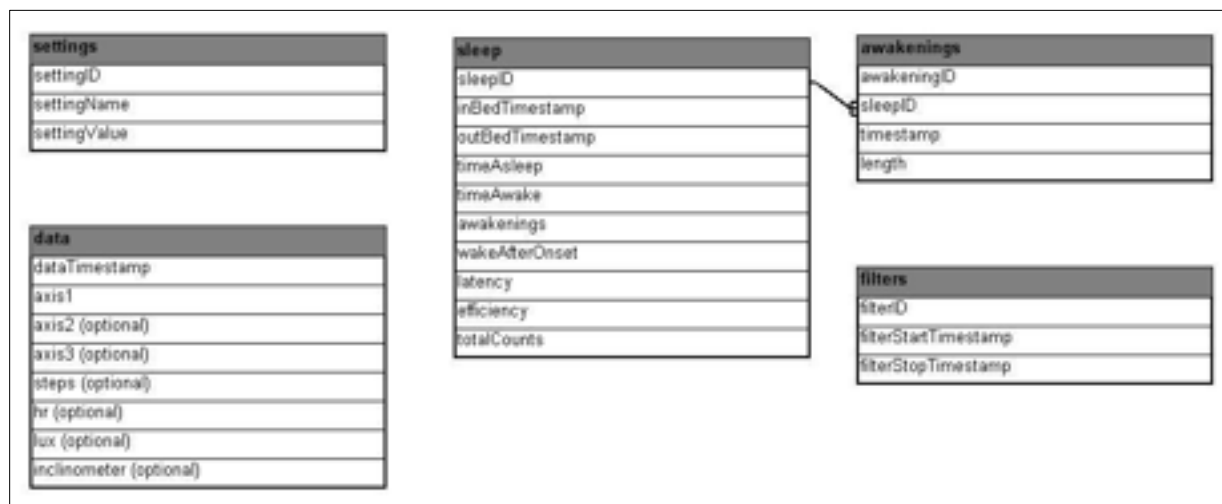


FIGURE 76 - \*.AGD FILE SCHEMA

\*.agd files are created in ActiLife immediately when data from a GT1M, GT3X, ActiTrainer, or ActiSleep device is downloaded through the “Devices” tab. These \*.agd files typically contain post-filtered and accumulated data as this is the only type of data that ActiLife can properly handle. The rows in the database represent whole-number epoch summations (1s, 5s, 10s, 30s, 60s, etc.). However, at the time of this writing all GT1M, GT3X, ActiTrainer, and ASM products that have been initialized to collect raw data (12Hz or 30Hz) will produce an \*.agd file on download. Although the file cannot be processed in ActiLife, the \*.agd format can be exported to \*.csv or \*.dat through ActiLife’s import/export tool or AGD viewer tool, both accessible from the File menu.

GT3X+ and ActiSleep+ devices produce a \*.gt3x file on download (see [\\*.gt3x File Format](#)). In order to process in ActiLife, the file must be exported to \*.agd format. This can be done at the time of download by checking “Create AGD File” from the download dialog box or by using ActiLife’s built-in import/export tool available from the File menu.



## USER'S MANUAL

### Q\*.AGD DATA TABLE FORMAT

The data table in the \*agd database consist of the following parameters. Their calculations are explained.

**dataTimeStamp** – a measure of total Ticks. A single tick represents one hundred nanoseconds or one ten-millionth of a second. There are 10,000 ticks in a millisecond. The value of this property represents the number of 100-nanosecond intervals that have elapsed since 12:00:00 midnight, January 1, 0001. More information available at <http://msdn.microsoft.com/en-us/library/system.datetime.ticks.aspx>

**axis 1** – Post filtered and accumulated per-epoch **vertical** activity data

**axis 2** (optional) – Post filtered and accumulated per-epoch **horizontal** activity data

**axis 3** (optional) – Post filtered and accumulated per-epoch **perpendicular** activity data

**steps** (optional) – Total steps per epoch

**hr** (optional) – Heart beats-per-epoch. This data is only gathered by ActiTrainer devices when those devices are initialized to collect heart rate data AND when the Polar® Heart Monitor (wireless heart strap) is worn by the user.

**Lux** (optional) – Ambient light sampled once per second (on GT3X+ and ASM devices only) and averaged over the length of the selected epoch. (e.g., for 60s epochs, this would be the light values summed once per second and divided by 60).

**Inclinometer** (optional) – Device orientation information. This is calculated by sampling the angle of the device over the entire length of the epoch (30 times per second) and selecting the predominant angle; i.e., the angle “range” that appeared the majority of the time over the epoch. For details about inclinometer functionality, see the [Inclinometer Whitepaper](#).

### \*.DAT FILE FORMAT

Older versions of ActiLife produced \*.dat files when downloading data from devices. These files consist of ten (10) lines of header data (meta information about the content) followed by epoch accumulated/filtered data. This “DAT” file stores all of the activity (1 to 3 axis), pedometer, Inclinometer, and/or heart rate data in ASCII format. This file also contains the Serial Number, Start Time, Start Date, Epoch Period, Download Time, Download Date, Current Memory Address Pointer, Current Battery Voltage, **Mode** and **First Start Time** (used to build the DAT file) as part of its ten (10) line header information. The file can be viewed with any standard text editor such as MS Notepad. The Mode value given in the header of the DAT file outlines which features were active during data collection for the file. **Error! Reference source not found.**Table 6 outlines the values of the Mode variable.





# USER'S MANUAL

Mode	Mode in binary	Activity	Dual Activity	3rd Axis	Steps	Heart Rate	Lux	Incline	Total Parameters
0	00000	X							1
1	00001	X			X				2
2	00010	X				X			2
3	00011	X			X	X			3
4	00100	X	X						2
5	00101	X	X		X				3
6	00110	X	X			X			3
7	00111	X	X		X	X			4
8	01000	X		X					2
9	01001	X		X	X				3
10	01010	X		X		X			3
11	01011	X		X	X	X			4
12	01100	X	X	X					3
13	01101	X	X	X	X				4
14	01110	X	X	X		X			4
15	01111	X	X	X	X	X			5
16	10000	X					X		2
17	10001	X			X		X		3
18	10010	X				X	X		3
19	10011	X			X	X	X		4
20	10100	X	X				X		3
21	10101	X	X		X		X		4
22	10110	X	X			X	X		4
23	10111	X	X		X	X	X		5
24	11000	X		X			X		3
25	11001	X		X	X		X		4
26	11010	X		X		X	X		4
27	11011	X		X	X	X	X		5
28	11100	X	X	X			X		4
29	11101	X	X	X	X		X		5
30	11110	X	X	X		X	X		5
31	11111	X	X	X	X	X	X		6
32	10000	X						X	2
33	10001	X			X			X	3
34	10010	X				X		X	3
35	10011	X			X	X		X	4
36	10100	X	X					X	3
37	10101	X	X		X			X	4
38	10110	X	X			X		X	4
39	10111	X	X		X	X		X	5
40	11000	X		X				X	3
41	11001	X		X	X			X	4
42	11010	X		X		X		X	4
43	11011	X		X	X	X		X	5
44	11100	X	X	X				X	4
45	11101	X	X	X	X			X	5
46	11110	X	X	X		X		X	5
47	11111	X	X	X	X	X		X	6
48	11000	X					X	X	3
49	11001	X			X		X	X	4
50	11010	X				X	X	X	4
51	11011	X			X	X	X	X	5
52	11010	X	X				X	X	4
53	11011	X	X		X		X	X	5
54	11011	X	X			X	X	X	5
55	11011	X	X		X	X	X	X	6
56	11000	X		X			X	X	3
57	11100	X		X	X		X	X	4
58	11101	X		X		X	X	X	4
59	11101	X		X	X	X	X	X	6
60	11110	X	X	X			X	X	5
61	11101	X	X	X	X		X	X	6
62	11111	X	X	X		X	X	X	6
63	11111	X	X	X	X	X	X	X	7

TABLE 6 - MODE WORD DEFINITIONS





# USER'S MANUAL

## APPENDIX B – VECTOR MAGNITUDE

The term Vector Magnitude is used frequently throughout this manual and often when working with ActiGraph devices. Vector Magnitude refers to the magnitude of the resulting vector that forms when combining the sampled acceleration from all three axes on any device. Figure 77 illustrates the axes orientation for all ActiGraph devices.



FIGURE 77 - AXIS DEFINITIONS FOR ACTIGRAPH DEVICES

When looking at epoch level data (post filtered and accumulated data), the Vector Magnitude (or VM) can be defined as

$$Vector\ Magnitude = VM = \sqrt{(Axis\ 1)^2 + (Axis\ 2)^2 + (Axis\ 3)^2}$$

This value can be calculated on a per-epoch basis or as a sum for all axes over time.