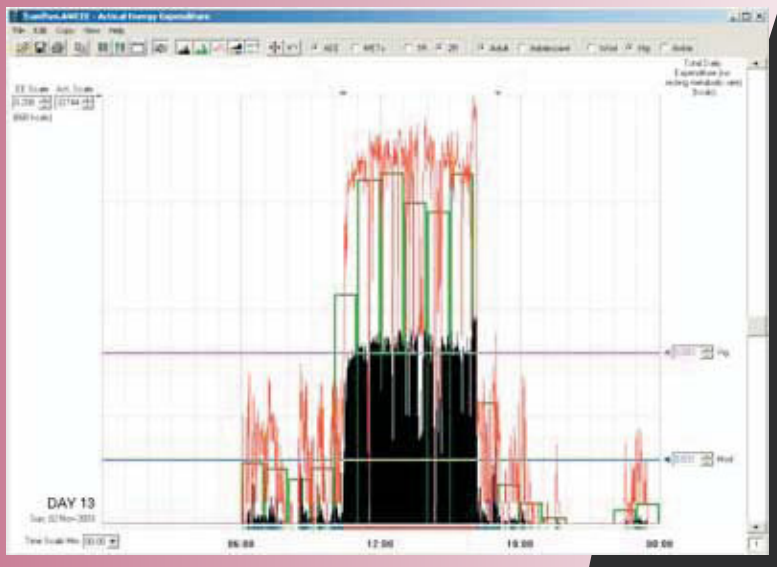
RESPIRONICS®



Actical®

Physical Activity Monitoring System

Actical Software

ActiReader™

Instruction Manual

RESPIRONICS®

Actical®

Physical Activity Monitoring System

Actical Software

Version 2.12

and ActiReader™

Instruction Manual

This document is Part Number 910-0021-04 Rev E

MINI MITTER, a Respironics Company

WARRANTY POLICY

1. **WARRANTY:** Mini Mitter, a Respironics Company, warrants that upon delivery the goods sold hereunder will be free of defects in materials and workmanship, and such goods will substantially conform to the specifications furnished by the Seller, and to any drawings or specifications furnished to the Buyer by the Manufacturer (Mini Mitter, a Respironics Company) if approved by the Manufacturer.

   a) **Commencement of Warranty** – The warranty period begins on the date of delivery.

   b) **Duration of Warranty** – The goods sold hereunder are warranted for a period of twelve months, except PDT-4000 and PDT-4000HR, which are warranted for two years.

   c) **Third Party Product Warranty –** Third party products purchased by Buyer through the Manufacturer are covered by the third party's warranty and ARE NOT COVERED BY THE MANUFACTURER WARRANTY.

   d) **Place of Repair or Replacement**. Buyer must return the defective or nonconforming goods upon request to Mini Mitter, a Respironics Company, at 20300 Empire Avenue, Building B-3; Bend, OR 97701, not later than 15 days after the Manufacturer's receipt of notice of the alleged defect or nonconformance. Buyer shall prepay transportation charges. The Manufacturer shall pay for the return of the goods to Buyer. No goods are to be returned to the Manufacturer without prior authorization and a valid Return Authorization (RA) number.

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   f) **Technical assistance –** The warranty set forth above shall not be enlarged, diminished or affected by and no obligation or liability shall arise from the Manufacturer's rendering of technical advice, assistance or services in connection with Buyer's order of the goods furnished hereunder. The Buyer is not relying on the Manufacturer's skill or judgment to select or furnish suitable goods.

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2. **LIMITATION OF REMEDIES AND LIABILITY**. The remedies provided herein are Buyer's sole and exclusive remedies. The Manufacturer shall have no responsibility other than, at the Manufacturer's option, to repair or replace defective or nonconforming goods or to refund the purchase price of defective or nonconforming goods in the event of breach of any warranty. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE FOR ANY DIRECT, INDIRECT SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFITS) WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY. In the event that any limitation of warranty or disclaimer of liability is found to be unlawful or inapplicable, or to have failed of its essential purpose, the Manufacturer's liability shall be limited to the amount paid by the Buyer for the specific goods that caused such liability.

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Thank You! .....for purchasing products from Mini Mitter, a Respironics Company. If you need assistance with your Actical products, remember our support continues after the purchase. If you have any problems or questions, please call our Technical Support staff of technicians, engineers and scientists. We are available by telephone, e-mail or website.

Contacting Technical Support

Mailing and Shipping Address: **Mini Mitter Company, Inc.**
A Respironics, Inc. Company
20300 Empire Avenue, Building B-3
Bend, Oregon 97701 USA

Telephone: **(800) 685-2999**
(541) 598-3800

E-Mail: **mm@respironics.com**

Website: **www.minimitter.com**

SECTION

1

INTRODUCTION

This is an instruction manual for the operation and care of the Actical physical activity monitoring system. Hardware includes the device which records motion data, the Actical activity monitor, and the ActiReader, the means by which data are sent and received from the Actical monitoring device. Actical has been designed for recording physical activity. The Actical activity monitor is lightweight, and can be worn on the hip (waist), wrist or ankle.

Actical Description

Components

- Actical® Activity Monitoring Device
- Hip belt and wrist/ankle band for mounting Actical
- Actical Software Application CD
- ActiReader, RS-232 Cable, and Power Cable
- This Manual

Symbols

The symbols shown below are used on Actical or ActiReader and throughout this manual.

	Attention, consult accompanying documents
	Type BF Applied Part
	Canadian/US Certification
IPX7	Protected against the effects of temporary immersion in water (Actical device)
	European Declaration of Conformity (conformance to Radio and Telecommunications Terminal Equipment (RTTE) Directive)
 0123 **5738**	European Declaration of Conformity (conformance to Medical Device Directive (MDD))
	Alignment indicator (ActiReader)
	Power On indicator (ActiReader)
	DC Power (ActiReader)
	Compliant with the Waste Electrical and Electronic Equipment/Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (WEEE/RoHS) recycling directives

Abbreviations

The following abbreviations are used in this manual.

1R	Single Regression Line
2R	Double Regression Line
AC	Activity Counts
ADV	Advanced Display
AEE	Active Energy Expenditure – the number of kilocalories expended per minute per kilogram of subject weight
AvgAC	Average Activity Counts
AvgEE	Average Energy Expenditure
EE	Energy Expenditure
Light	Light Physical Activity Level
Met	Metabolic Equivalent – the total amount of energy the body uses to sustain itself including the basal metabolic rate.
Mod	Moderate Physical Activity Level
NaN	Not a Number
Sed	Sedentary Physical Activity Level
Time	Time Accumulated
TotAC	Total Activity Counts
TotEE	Total Energy Expenditure
Vig	Vigorous Physical Activity Level

WEEE/RoHS Recycling Directives

If subject to the WEEE/RoHS directives, refer to www.respironics.com for the passport for recycling this product.

Warnings and Cautions

Warnings

A warning indicates a condition that may endanger the user.

- Do not dispose of lithium batteries in fire or flame. An explosion may result. Only dispose in accordance with manufacturer's recommendation or local codes.

Cautions

The following conditions indicate possible damage to the equipment, or erroneous or incomplete data.

- To retain the integrity of the waterproof seal, you should change the O-ring in the battery compartment at the same time you change the battery
- When changing the battery, use extreme care to avoid scratching the metal surface of the device or battery cover. Scratches can cause the Actical device to leak.
- Prolonged submersion may cause damage to the device.
- When replacing the battery, it is very important that the rubber O-ring in the battery compartment also be changed. The back mounting panel should be firmly screwed in place to achieve a waterproof seal. The waterproof seals of all devices are checked before leaving the factory. To preserve this integrity, it is imperative you follow the procedures in Appendix A.
- Alcohol may interfere with the integrity of the seals. When cleaning the device, non-alcohol-based disinfectants should be used. When cleaning the battery compartment cover or the metal frame, follow the battery change procedures in Appendix A.

Intended Use

The Actical is a compact, lightweight, waist-, wrist-, or ankle-worn activity monitor that may be used to assess human gross motor activity, caloric expenditure, and estimates of energy expenditure based on motor activity in any instance where quantifiable analysis of physical motion is desirable.

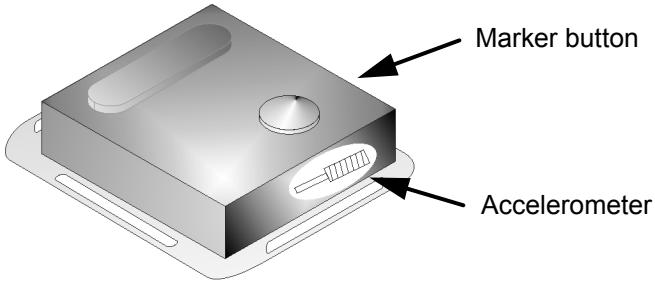
Contraindications

None.

Sensor Orientation

The Actical activity monitoring device uses an accelerometer to monitor the occurrence and intensity of motion. This type of sensor integrates the amplitude and frequency of motion and produces an electrical current that varies in magnitude. Therefore, an increased intensity of motion produces an increase in voltage. Actical stores this information in the form of activity counts.

Orientation of accelerometer



The shape of the sensor makes it most sensitive to motion in specific directions. NOTE: To obtain the most repeatable results, it is important to mount Actical in the prescribed manner for your physical activity study. A detailed description of the method is covered in Positioning Actical on page 3-1.

Marker Button

Actical is equipped with a marker button (shown above) on the device's front panel. When pressed, tactile feedback signals the subject that the date and time have been successfully marked, and they are recorded in memory.

Actical Features

The coin cell battery will typically last 180 days. To replace the battery, see Appendix A.

Calibration

Actical activity monitoring devices are calibrated at the factory, and the calibration offset factors are entered into the memory at that time. It is recommended that you return Actical to the factory periodically for operational evaluation and re-calibration.

NOTE: Additional information is available in Specifications in Appendix B.

Time Keeping

The computer clock sets the Actical start time. Inside the device, a crystal oscillator keeps elapsed time. When a sampling epoch is chosen, the device waits a specific number of oscillations before storing the number of activity counts. This also applies to delayed starting times. The time-keeping circuitry does not initiate until the device has been removed from the ActiReader.

NOTE: Actical cannot collect data or keep time while on the ActiReader. Do not put Actical on the ActiReader until you are ready to either download or setup the device for another data collection session.

Telemetric Communications Link

Actical requires no external communications port for uploading setups or downloading data. Communication between Actical and the reader is established via a wireless link.

Waterproof

Actical devices are waterproof to IEC Standard 60529 IPX7. They are resistant to water. These devices will tolerate normal daily experiences such as shower, spa (hot tub), swimming, skiing, rain, household chores, etc.

CAUTION: Prolonged submersion or exposure exceeding the above limits may cause damage to the device.

CAUTION! When replacing the battery, it is very important that the rubber O-ring in the battery compartment also be changed. The back compartment cover should be firmly attached with four screws to achieve a waterproof seal. The waterproof seals of all devices are checked before leaving the factory. To preserve this integrity, it is imperative you follow the procedures in Appendix A.

Maintenance

Actical has no user-serviceable parts. Return the device to the Manufacturer (Mini Mitter, a Respironics Company) for service.

Cleaning

Actical may be cleaned by using a cloth moistened with a mild detergent and warm water. Cleaning with alcohol-based solvents should be avoided to prevent deterioration of the seal.

CAUTION! Do not autoclave Actical.

Cleaning Actical Bands

Actical bands can be washed and reused. However, it should be noted that Actical studies involve mounting Actical on the body. With some subjects, this may raise particular sensitivities with respect to reusing the bands, and that should be taken into consideration. Additional bands are inexpensive and are available from the manufacturer. Clean the band as follows.

1 Remove the band from the device.
2 The band may be laundered as any other article of clothing, using household or industrial detergent and a regular cycle.
3 Air dry. It is not recommended that the band be dried in the clothes dryer.

Cleaning Actical Devices

Only when the battery cover is installed and the fully sealed should Actical be disinfected.

CAUTION! Do not disinfect this device while the battery cover is off.

Actical may be cleaned with disinfectants such as Cavicide®, Envirocide®, Extran®, and other commonly used laboratory and hospital products. Disinfecting with alcohols such as isopropanol and ethanol is not recommended. Repeated exposure may compromise the sealants used in Actical. Clean the Actical device as follows.

1 Follow the label directions for the disinfectant being used.
2 Disinfect with the battery cover on.
3 Spray or wipe down Actical thoroughly with the disinfectant. Do not soak.
4 Gently dry with a paper towel or soft cloth.
5 Mount Actical back on the laundered band.

SECTION

2

INSTALLING ACTICAL AND ACTIREADER

System Requirements

- Windows-compatible computer
- Use only an IEC/UL/CSA 60950 compliant computer
- Pentium® II Processor with a clock speed of at least 266 MHz
- 64 MB or more of internal memory (RAM)
- Windows® 98, Millennium, Windows NT 4.0, Windows 2000, or Windows XP
- CD-ROM drive
- 300 MB or more free space on the hard disk
- 9-pin or 25-pin RS-232 communications serial port
- Super Video Graphics Array (SVGA - 800 x 600 pixels required to view all data displays)
- Printer (optional)

NOTE: The recommended configuration is a Pentium III (or better), 866 MHz (or faster) processor, and at least 128MB of RAM.

Preferred Settings

Actical software is best used with the following computer display settings. Directions for changing these settings can be found in the Online Help feature of your specific operating system.

Monitor area or monitor resolution	Set the resolution for 800 x 600 or higher. The recommended resolution is 1024 x 768.
Appearance scheme (or theme)	Avoid “High Contrast” or “Extra Large” schemes. Windows Standard is recommended.
Font sizes	For display items related to fonts and font sizes, select “Normal” or “Small font” (font sizes of 12 points or less). Eight point font size is recommended because it allows you to see more information than with larger font sizes.

Installation Preparation

NOTE: Before beginning the installation procedure, make sure that no other applications are currently running on the computer. This includes MS Office® and any other utilities. These can interfere with proper installation, resulting in software conflicts.

Remove any previously installed versions of Actical software before installing a newer version.

Uninstalling Previous Actical Application Program

1. To remove the installed version of Actical, click the START button and open the Control Panel.

2. Click the Add/Remove Programs symbol and look for an item labeled Actical.

3. Select Actical and click Add/Remove.

4. Follow the displayed instructions. Once the uninstall program has completed, all program files and shortcuts will have been removed. If you find any desktop shortcuts on your desktop that you may have created, please delete them.

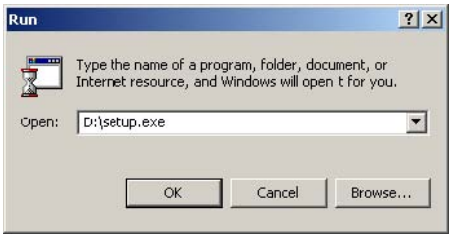
Installation of Actical Software

CAUTION: If you are upgrading from an earlier version of Actical software already installed on your computer, be sure to uninstall the previous version using the uninstall procedure described in the previous section. If the earlier version is not uninstalled, the program will not work correctly.

Order of Installation

1 Place the Application Program CD in the CD drive of the computer. The CD is set to auto-install. The installation window should appear.

NOTE: If your CD drive does not accommodate auto installation, click the Start button, then Run, and type the drive letter of your CD drive and colon (such as D: or E:), and then type setup.exe in the field, as shown below. Then click on OK.



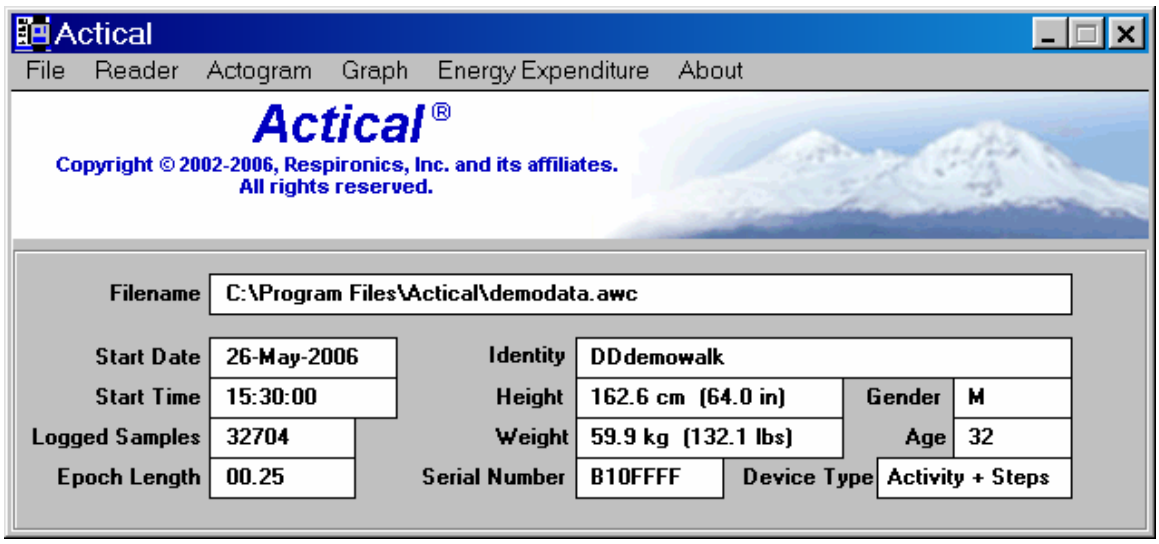
2 Follow the installation instructions to install the Actical Application Program.

3 If the installation is successful, you will see a message on the screen saying so. Click OK to complete installation.

Starting Actical

1. Click on the Windows Start button, and choose Programs.
2. Click Start > Programs > Actical > Actical. The Actical Main window will open (shown below).

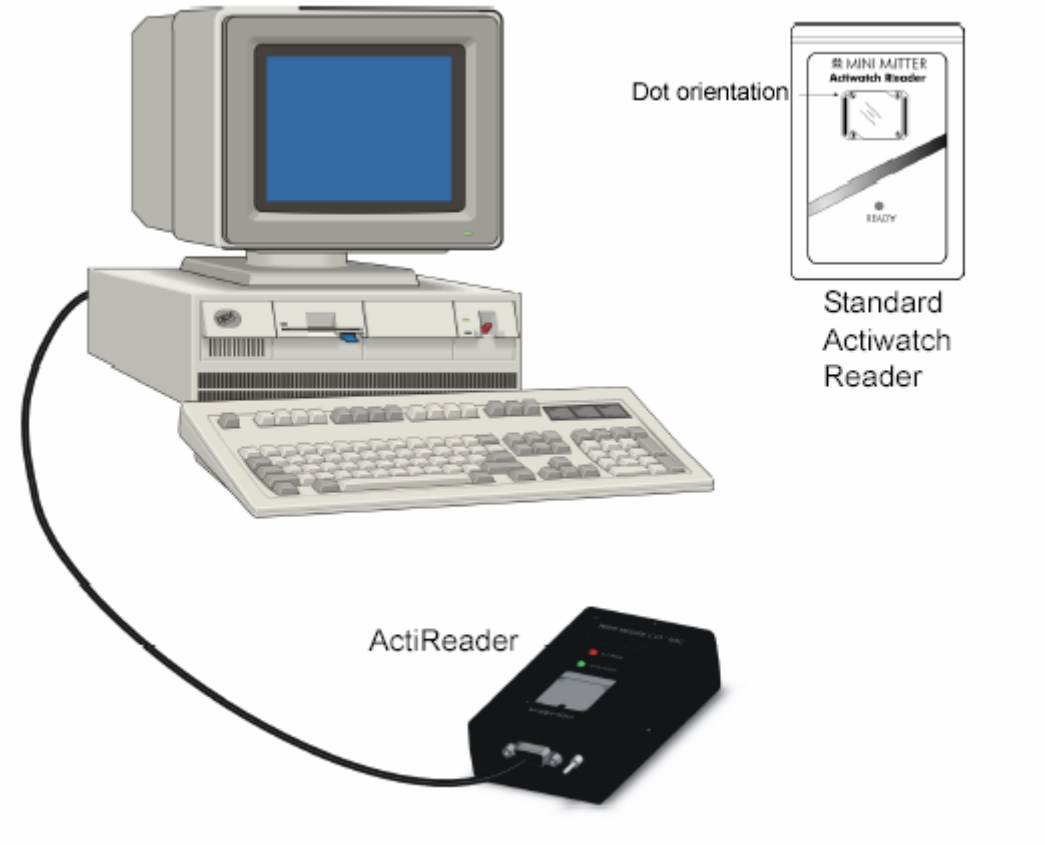
Main window



Installing ActiReader

An ActiReader or an Actiwatch® Reader is necessary to communicate with the Actical activity device. Connection to a computer or laptop is very similar to any other peripheral device.

Computer with ActiReader



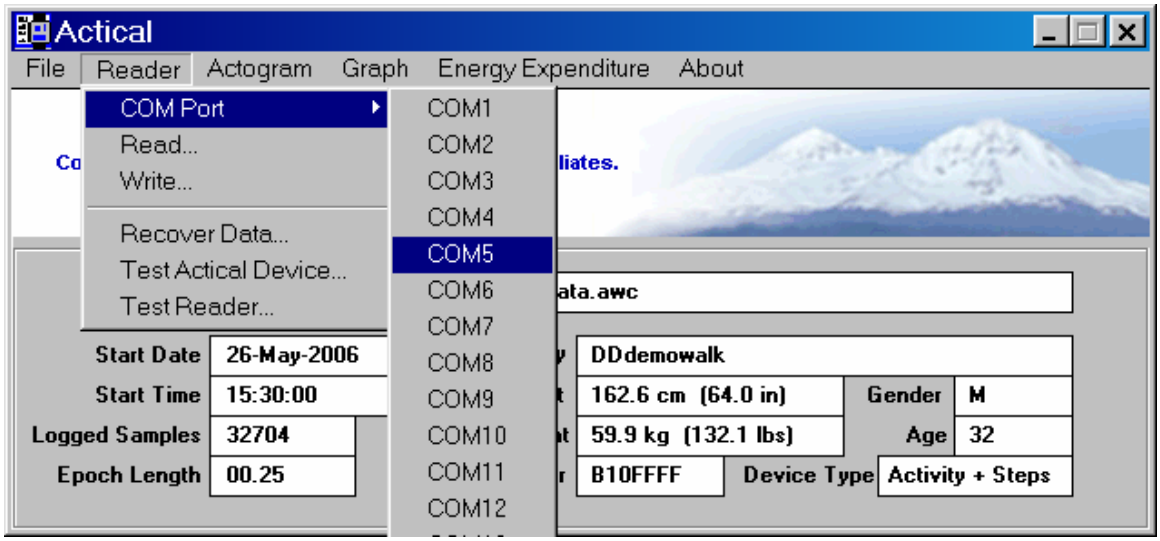
NOTE: Communication between the ActiReader or Actiwatch Reader and the computer is very similar for both Actical and Actiwatch.

NOTE: Follow the recommendations supplied with your computer when connecting peripheral devices. Most manufacturers suggest powering down the computer while connecting hardware to a COM Port.

1. Connect one end of the serial communication cable (supplied) to a COM Port on your computer.
2. Connect the other end of the communication cable to the ActiReader.

3 Make sure the COM Port of Actical is set to the same COM Port to which you have just connected in the previous step. Open the Actical software program and click on Reader > COM Port and then select your COM Port from the list as shown below.

Selecting a COM Port

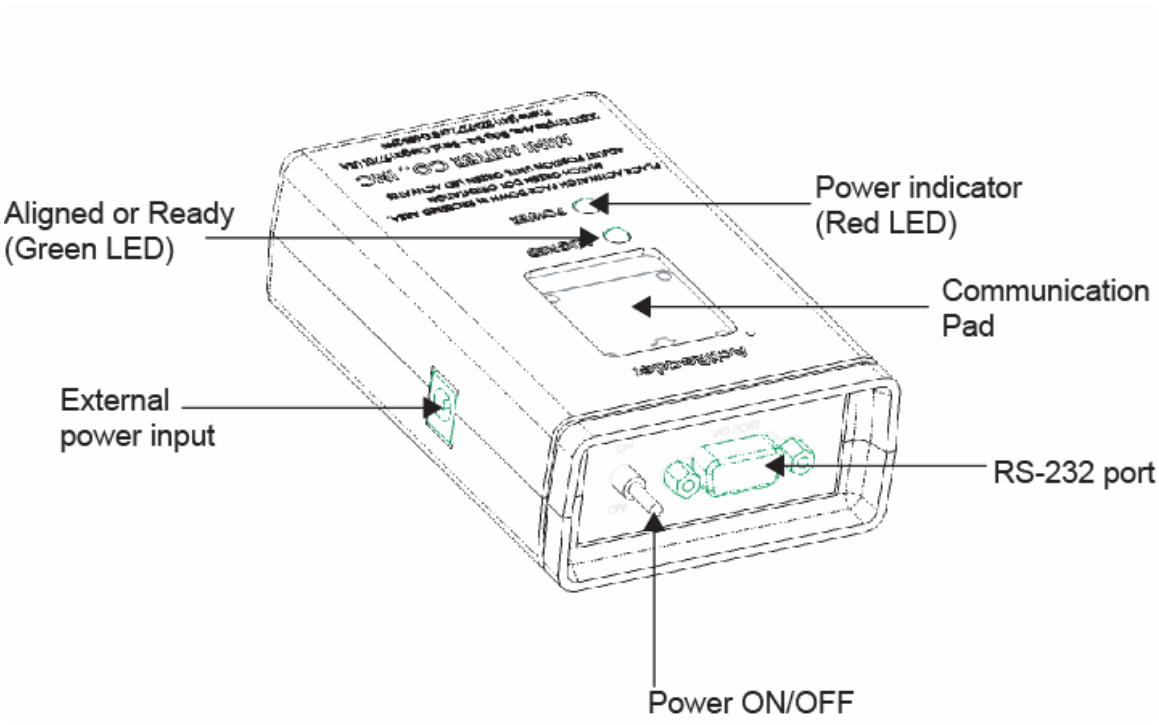


Using ActiReader

NOTE: Remove the Actical device from the patient before placing it on the ActiReader.

NOTE: Use only an IEC/UL/CSA 60950 compliant computer with the ActiReader.

ActiReader details



1. When the COM Port is set correctly and ActiReader is connected to the computer, open Actical (see Starting Actical on page 2-5).
2. It is possible that the green LED will light when the reader is first connected to the computer. This occurs when it is not connected to the COM port selected in the software. When the COM ports are properly set, the green LED will not light.

The following are ActiReader components:

External power source	ActiReader can be powered using an external power source cable (supplied). When plugged in to the side of the device, it will disconnect the battery to conserve it.
Power ON/OFF switch	This switch will disconnect ActiReader from its power source, whether AC or battery.
Power On indicator (Red LED)	Whether using external power or the internal battery, the red LED will light when the Power switch is ON.
Alignment indicator (Green LED)	When Actical is aligned properly with ActiReader, this green LED will light.
Communication pad indicator	This slot ensures Actical is placed properly. On the metal back of the Actical device is a green dot in one corner. When the dot is aligned with the green dot on ActiReader, the green LED on the ActiReader will light. This indicates that communication between the two devices is possible.
	NOTE: The back of the Actical device is metal. The front or face of the device is gray plastic.
RS-232 serial port connection	This is where the serial cable connects to ActiReader. The other end connects to the COM port on the computer.

However, please keep the following in mind when using the ActiReader or Actiwatch Reader:

- The ActiReader is black. The Actiwatch Reader is white.
- Researchers with laptop computers may switch the ActiReader to Battery Power for proper function.
- If using battery power, you may need to replace the reader battery periodically (see *Replacing ActiReader Battery* later in this section).
- The COM port selection in the software must be correct, and the communications wizard must be running, for the Ready LED to be lit.

CAUTION! The black ActiReader device uses a 9V Lithium battery. The white Actiwatch Reader uses a standard 9V battery. These batteries are not interchangeable, and may result in damage to your device. Use of the improper battery will void the warranty.

ActiReader Battery Installation or Replacement

CAUTION! It is important that you thoroughly read the following information prior to changing the battery. Failure to follow procedures may result in immediate or subsequent damage to the device.

1 Disconnect the AC electrical supply and set the power toggle switch to **OFF**.

2 Turn the ActiReader over so the battery cover is facing up.

3 Slide the battery cover in the direction of the arrow.

4 Carefully remove the battery from the housing unit and gently disconnect the battery terminals.

5 Replace the battery.

6 Slide the battery cover back into place on the ActiReader.

7 Set the power toggle switch to the **ON** position.

8 Verify the red LED power light is blinking.

WARNING! Do not dispose of lithium batteries in fire or flame. An explosion may result. Only dispose of batteries in accordance with the manufacturer's recommendation or local codes.

Testing Actical Hardware

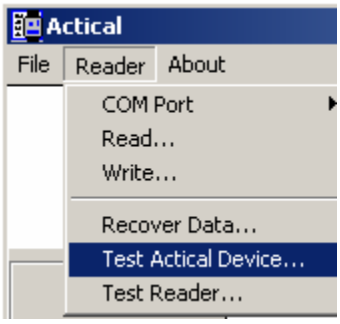
ActiReader and the Actical device can be tested using the Actical software. If you believe that your Actical device or ActiReader are not operating properly, you can use the following two operations to test their functionality and the communications link.

CAUTION! Testing an Actical device or ActiReader may result in data loss in the Actical device. Only use an Actical device that is not being used for data collection.

Testing the Actical Device

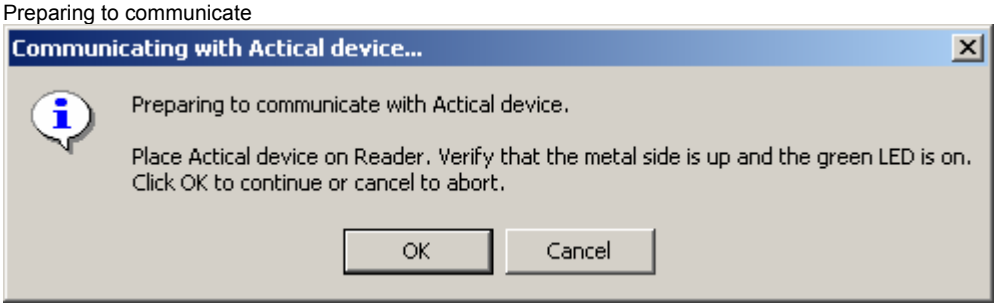
1 Open Actical software. Select from the drop-down menu, Test Actical Device.

Main > Reader > Test Actical device



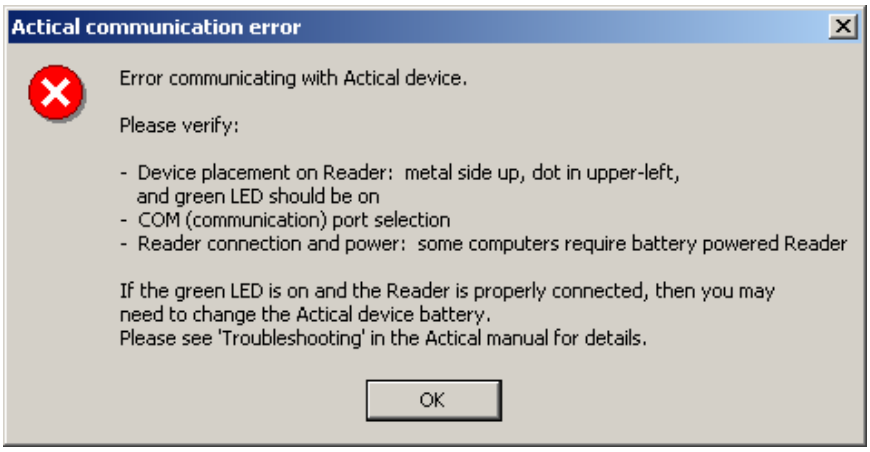
2 Follow the prompts through the test procedure.

Preparing to communicate



3 In the case of a communication error, you will be prompted, and will be given important steps to take to correct the problem.

Communication error with device



Testing the ActiReader

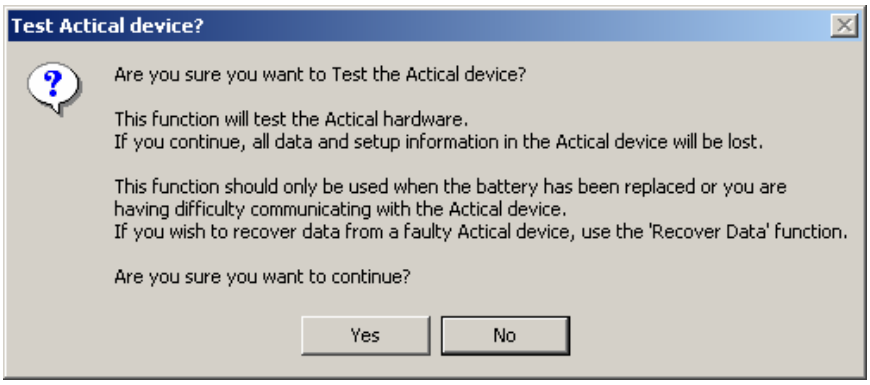
NOTE: This test may take several minutes.

1 Open Actical software. From the drop-down menu, select Test Reader.

Main > Reader > Test Reader

2 Follow the prompts through the test procedure.

Preparing to communicate



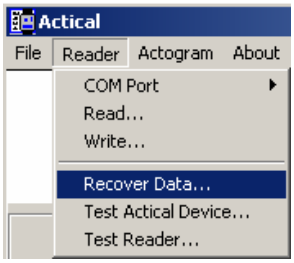
3 In the case of a communication error, you will be prompted, and given important steps you may take to correct the problem.

Failed ActiReader test

Recover Data

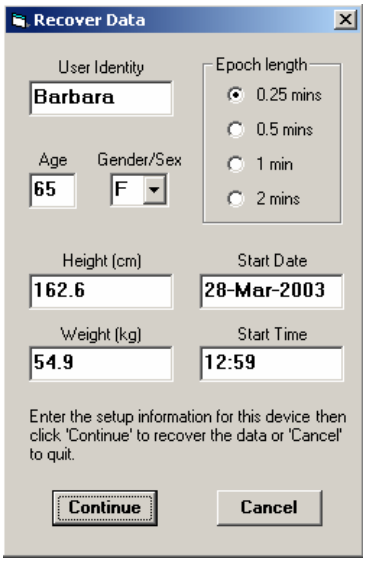
Activating Recover Data will strip off potentially corrupted header information, and replace it with a “recovery header.”

Reader > Recover data



The recovery header generates a new header based on input from the following prompt.

Recovery header



The header is then sent to the Actical device in the same manner as in a regular setup. Simply follow the prompts.

After the header is replaced, the data in the activity monitor memory may be recovered using the standard Read procedure.

NOTE: Completing Recover Data does not restore the data to the computer. It only corrects and repairs corrupted header information. You must still use the Read procedure to extract the data.

SECTION

3

POSITIONING ACTICAL

The Actical activity monitoring device may be worn on the hip (waist), wrist or ankle. The Actical monitoring device must be worn correctly for several reasons.

- A correctly positioned Actical will detect and record physical activity. Incorrect positioning may result in skewing the data, particularly in multiple subject studies.
- By mounting Actical in the same location on each subject, data consistency will be ensured.

NOTE: Research has shown that the optimal placement of the Actical device is the iliac crest of the hip.

- Hip (waist) – This is considered to be the most accurate. However, on occasion, younger subjects have shown to be intolerant of hip-mounted devices.
- Wrist - This is considered the second choice for accurate measurement of energy expenditure.
- Ankle - This is considered the third choice for accuracy, however, in many cases it has shown to be the most tolerated.

IMPORTANT: The Actical monitoring device must be mounted on the belt or wristband so the sensor is oriented correctly.

Hip/Waist Mounting

Hip mounting is considered to be the most accurate. When Actical is worn on the hip (waist), the device must be placed on the mounting tabs of the waist band as pictured below.

1 Using the hip belt, thread the hook and loop mounting tabs through the slots in the battery compartment cover *(not the frame)*.

When placed on the strap correctly, the Respironics logo will be parallel to the waist strap.

Tab orientation

2 Fold the tabs away from the device and affix to the band (see arrows).

Waist band complete

For other types of waist bands (those without mounting tabs) simply orientate the logo on the Actical device to be parallel with the waist band.

The belt should be mounted on the body so that the Actical device rests on the iliac crest of the hip. The iliac crest is the uppermost and widest of the three bones constituting either of the lateral halves of the pelvis.

Proper hip mount

Wrist Mounting

Placing Actical on the wrist is considered the second choice for accurate measurement of energy expenditure. Proper placement of the Actical is shown below.

Using the wrist/ankle band, mount the Actical device by threading the band through the battery compartment cover.

Proper band placement

When placed on the band correctly, the Respironics logo will be parallel to the band and on the edge of the device nearest the elbow.

Ankle Mounting

Ankle mounting is considered the third choice for accuracy; however, in many cases it has shown to be the most tolerated.

Using the wrist/ankle band, mount the Actical device by threading the band through the slots in the battery compartment cover *(not the frame)*. When placed on the band correctly, the Respironics logo will be parallel to the ankle strap.

Mount Actical on the ankle as shown below.

Proper ankle mount

SECTION

4

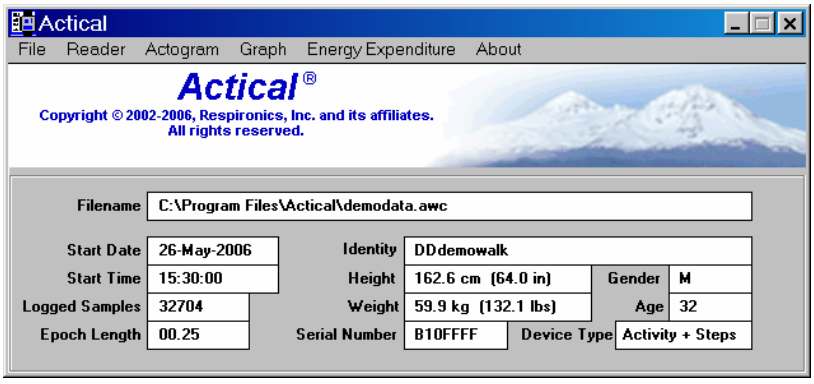
USING ACTICAL

Setting up the Actical Device

The Actical physical activity monitoring device must be uploaded with setup information prior to collecting data. This is done with the Actical software, and then loaded into the Actical device using ActiReader.

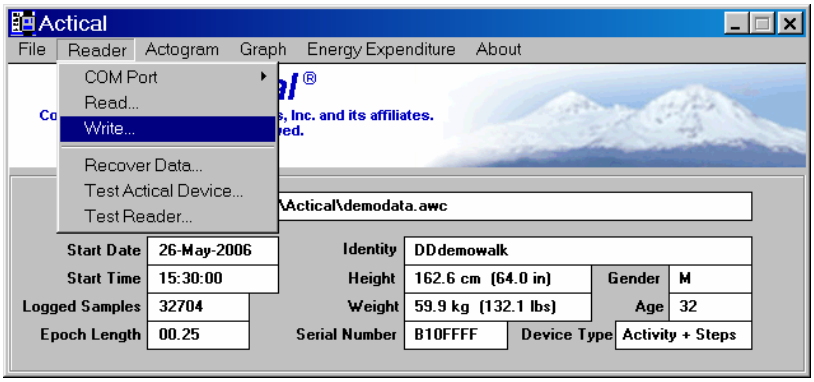
1 First, open the Actical software by clicking on the Actical symbol, or clicking on Start > Programs > Actical > Actical. The main window will open.

Main window



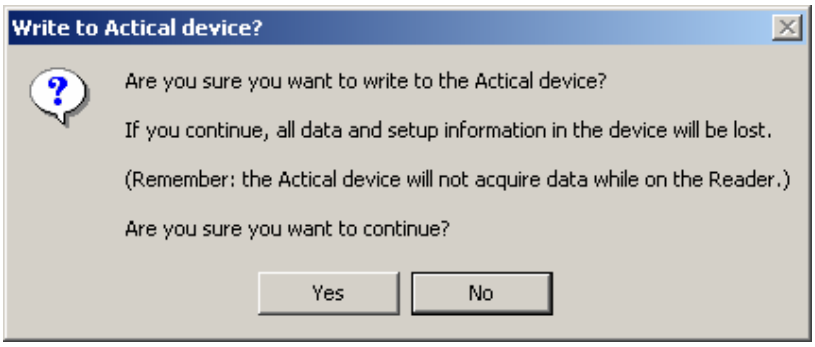
2 From the drop-down menu, choose Reader > Write, and follow the prompts. The setup procedure is as follows.

Main window > Reader



3 A warning will prompt you. Writing a setup to an Actical device erases previously stored data.

Main window > Reader > Write



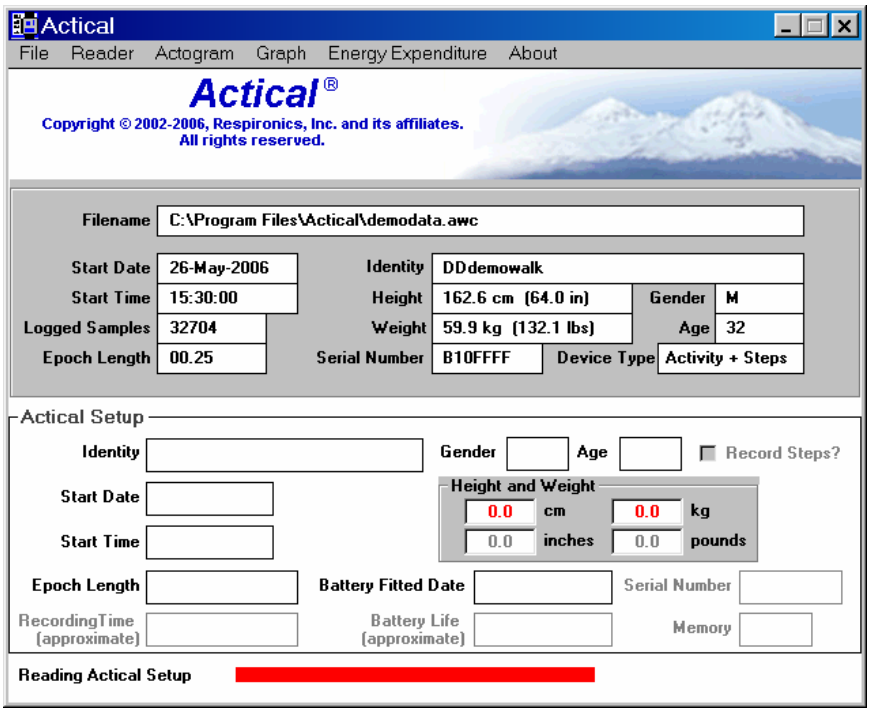
4 The prompt will instruct you to place the device on the ActiReader.

Place device on ActiReader

5 The Actical activity monitoring device must be placed on the Reader per the instructions on the top panel of the reader. (For details, see Using ActiReader on page 2-8). When aligned properly on the communication pad, the green LED will light.

6 Communication will commence as shown by the red progress bar at the bottom of the screen.

Communication in progress

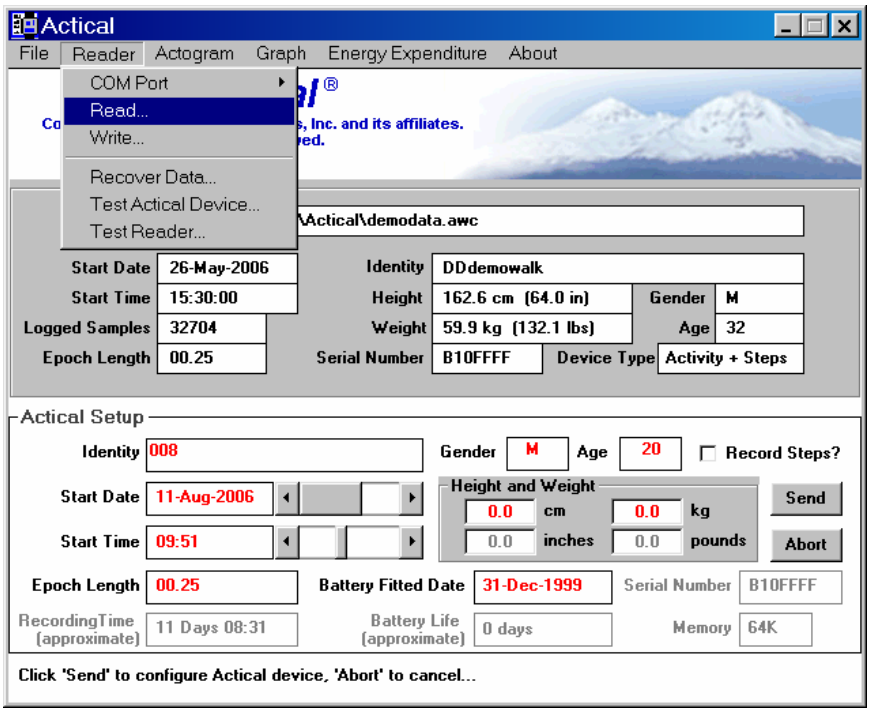


7 Click in each window to enter the information. You may also use the tab key to navigate from field to field. (You should only change the Battery Fitted Date field when you install a new battery.)

NOTE: Do not use the following characters or commands. They are delimiters. ***RETURN, TAB, COMMA, PERIOD***, or the following: < > */ ! £ $ % ^ * & ( ) @ ~*

On the Actical Setup screen shown below, the following setup fields are shown blank for clarity.

Actical Setup



Start date and Start time

The available delays for start time will depend on the epoch length. See the table below for maximum start times.

Epoch Length	Number of Epochs per Day	Maximum Delay in Start Time
15 seconds	5760	5 days
30 seconds	2880	11 days
1 minute	1440	22 days

Epoch length

This is the period of time Actical will accumulate activity counts before saving the sample, recording it to memory, and then resetting the counter to zero. Select the epoch length by clicking in this field. The choices will appear sequentially.

When all the information has been entered, click Send. The information will be sent to the Actical activity monitor.

NOTE: If you are using the Energy Expenditure function, the epoch length will be calculated based on 1-minute epochs even though 15- or 30-second epochs were chosen during setup. The activity counts within the shorter epochs will be added, resulting in no lost activity counts per 1-minute period.

Steps

Step function can be enabled or disabled. If enabled, Actical will record the number of steps taken during the collection period.

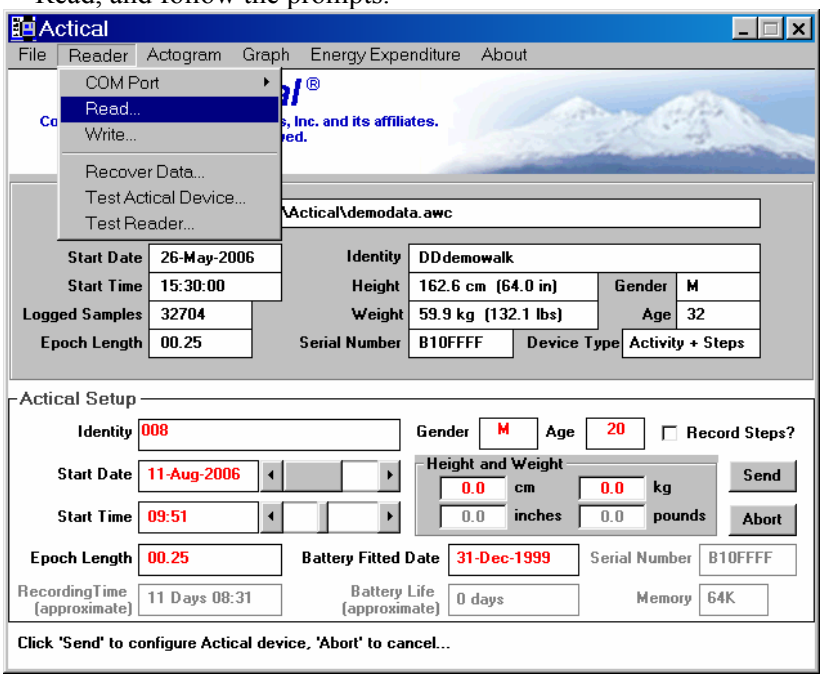
NOTE: If Step function is enabled, only 5.5 days (with 15-second epoch) of memory will be available.

Epoch Length	Number of Epochs per Day	Days Recording Time	Days Recording Time with Steps
15 seconds	5760	11 days	5.5 days
30 seconds	2880	22 days	11 days
1 minute	1440	44 days	22 days

Retrieving Data from Actical

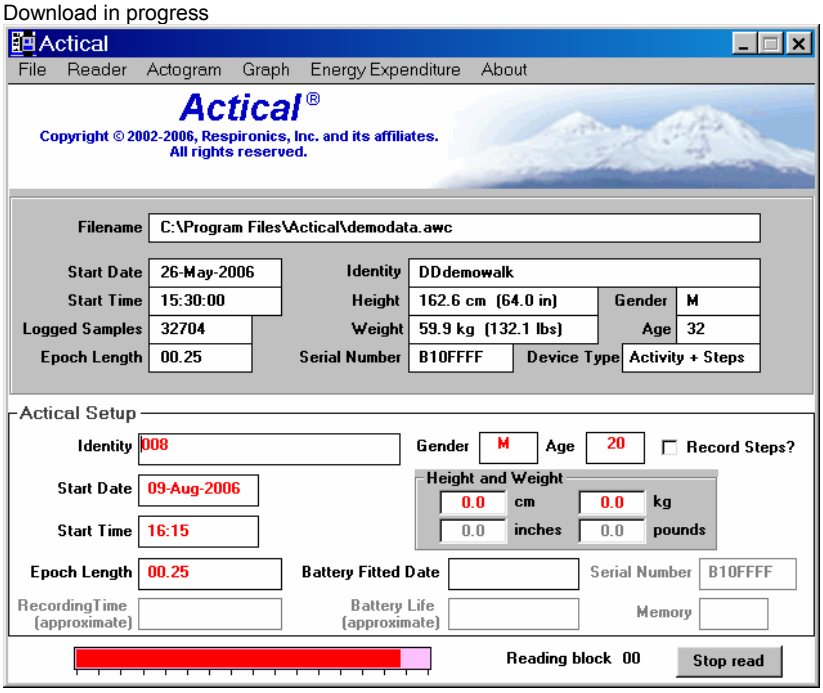
Retrieving data from the Actical activity monitoring device (Read function) is very similar to sending information to the device (Write).

1 From the drop-down menu bar (shown below), click on Reader > Read, and follow the prompts.



2 The data download will be shown by the red progress bar at the bottom of the window.

Download in progress



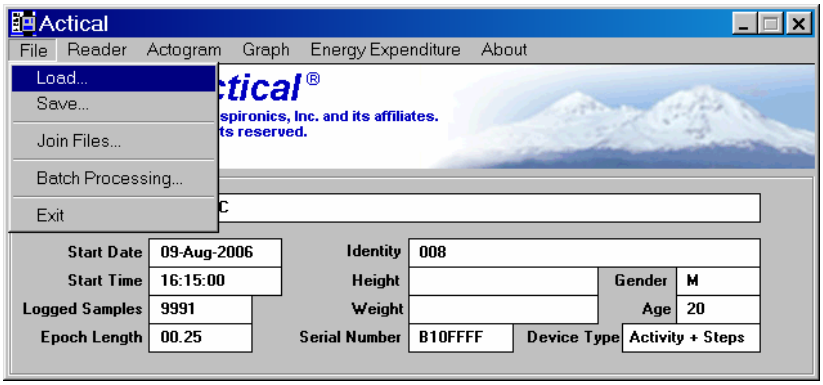
3 A message is displayed to tell you when the download is complete.

File Menu

Load

1 To load Actical data from a file for analysis, select File > Load.

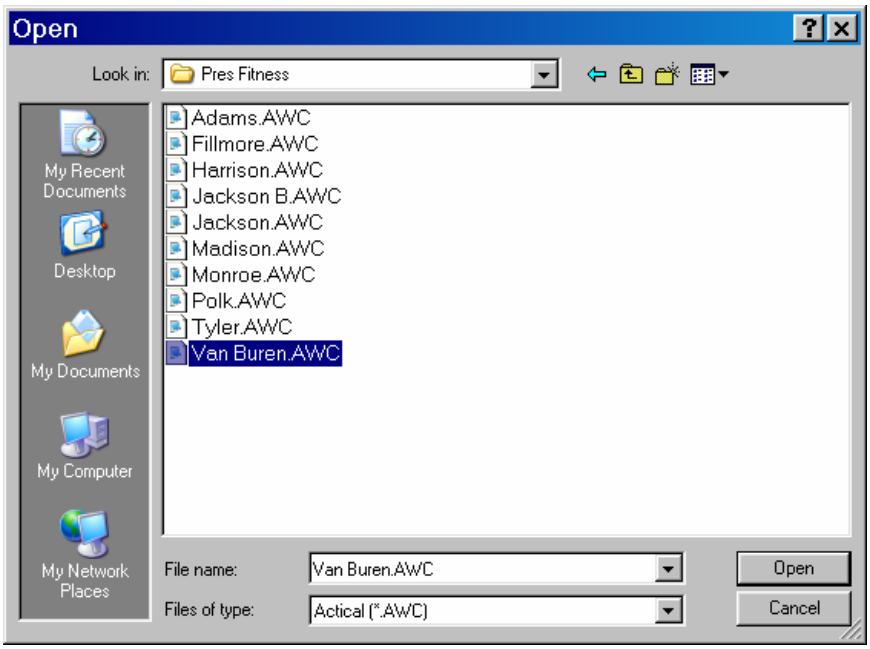
File loading



2 A file browser will appear and enable you to load .awc and .awcEE files.

NOTE: For details on file types, see File Formats on page 6-26.

Browser



3 Select the file and click on Open.

Save

This menu item will save data to an .awc file (see note).

NOTE: For details on file types, see File Formats on page 6-26.

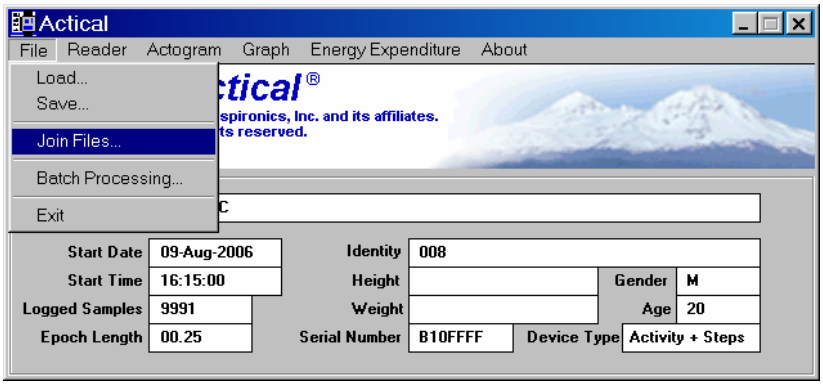
Join Files

This function appends one data file to another to form a single file. There are restrictions that apply to joining files:

- The two files to be joined must have been collected using the same epoch length.
- The two files to be joined may not overlap in time.
- The program has a load limitation of 365 days of data.
- The settings in File 1 will be the settings for the joined file. Make sure File 1 has the preferred settings for the resulting joined file.

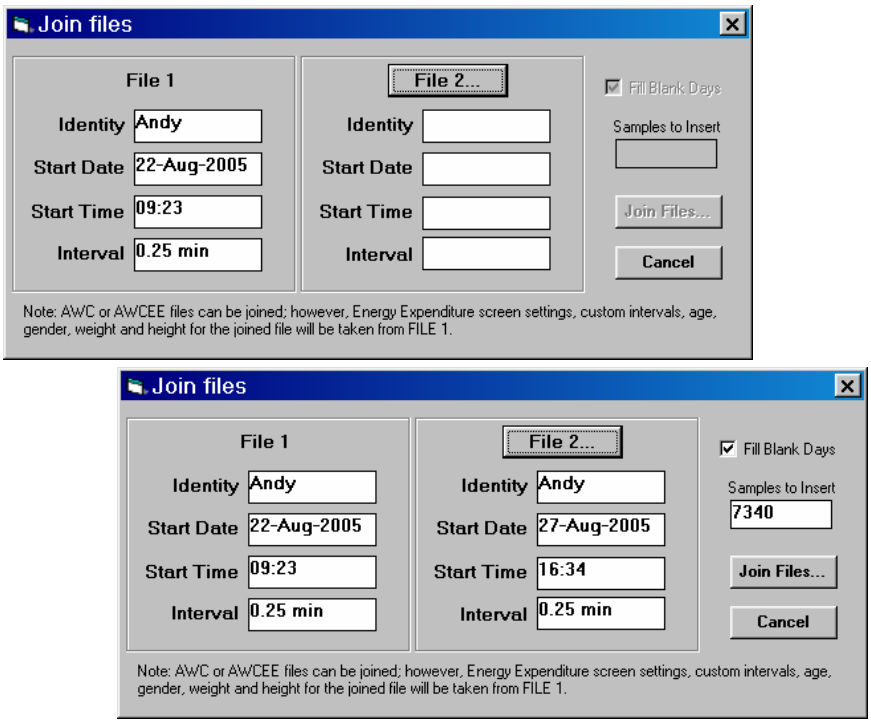
1 From the main menu, select File > Join Files.

Main window menu



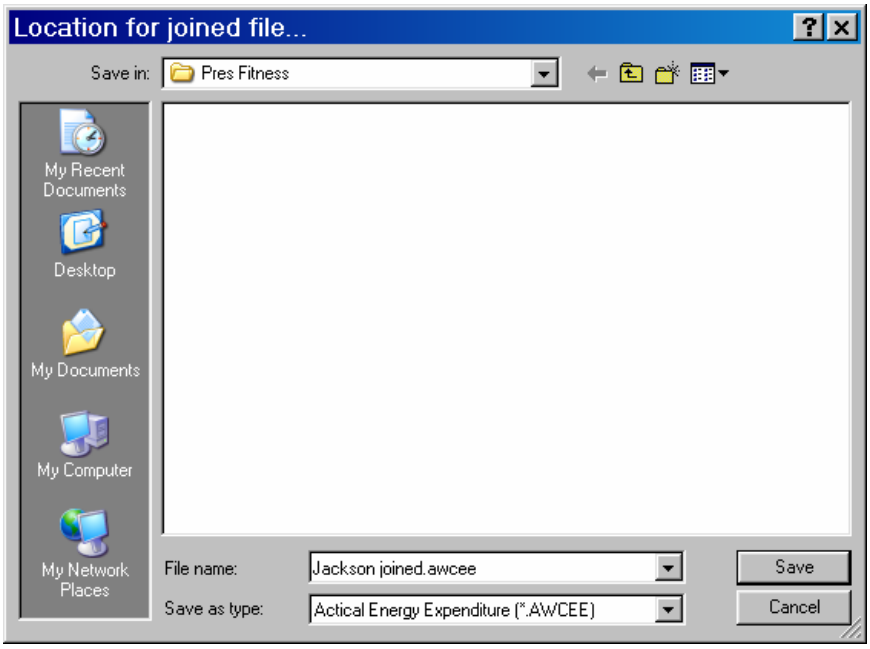
2 As shown below, the currently loaded file will appear under File 1. Click on File 2. Select the file to join to File 1. The second file has now appeared in the File 2 fields as shown below.

Joining files: File 1 goes on the left. File 2 goes on the right.

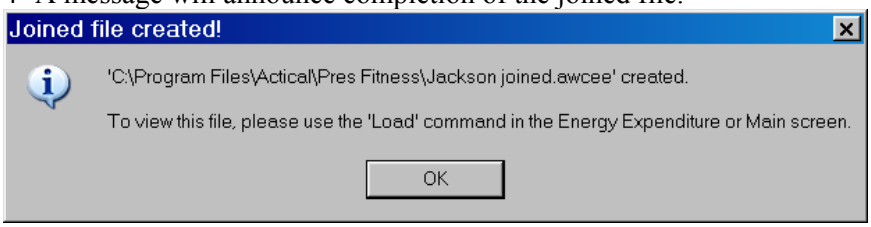


Note: Only those files that do not overlap in time and are collected with an identical sampling interval may be joined. If you have files with different epoch lengths, you may change the epoch length for one of them using the actogram display. (Details can be found under Epoch Length on page 4-5.) When the second file has been selected, click on OK.

3 To complete the process, click on Join Files. Direct where the file is to be saved. When finished, click on Save.



4 A message will announce completion of the joined file.



NOTE: If one or more days transpired between the stop time of the first file and the start time of the second file, you may elect to have zeros inserted for all epochs between the two dates. Click on Fill blank days. The number of samples is the number of data points that will result from joining files. This will include epochs inserted if you have elected to fill blank days.

Memory Limitations

- The largest file size in a collection period is 365 days. This is only possible by using the Join Files function. Because of the enormous amount of data in such a file, it is not recommended.
- The maximum number of event marks that can appear in a joined file is 4,000.
- When Step function is enabled, only 5.5 days (with 15 second epoch) of memory is available for data collection.

SECTION

5

ACTOGRAMS

Actogram Main Display

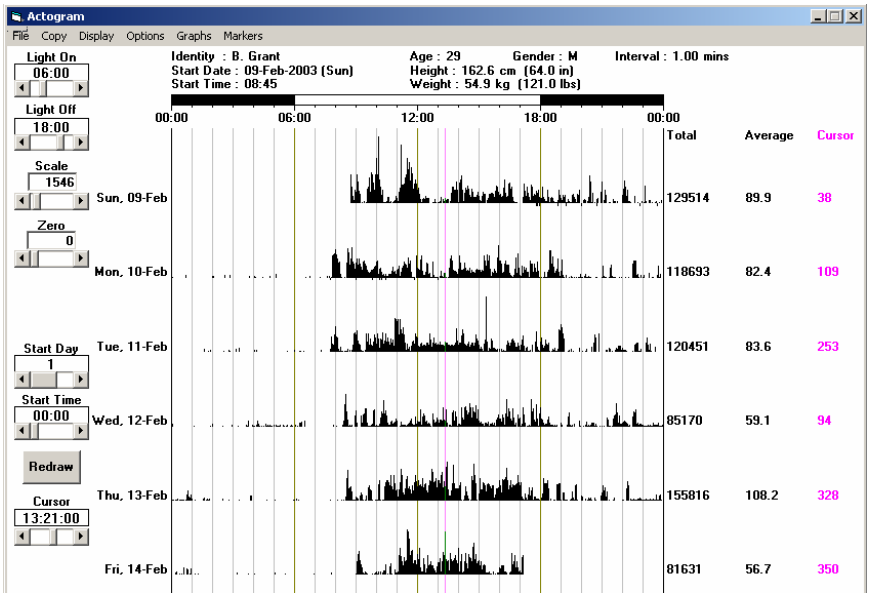
Actograms are visual displays of the daily activity-rest patterns. When a file is loaded, it may be opened as an actogram.

1 From the Main Actical window, select File > Load to load the file to be analyzed.

2 From the Main Menu, click on Actogram.

3 A display similar to the one shown below appears.

Typical Actogram

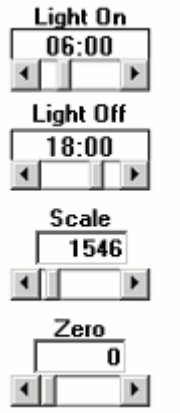


Actogram Sliding Bars and Buttons

Use the sliding bars described below, or click on the arrows to change the values.

NOTE: It may be necessary to click Redraw after changing settings.

Actogram Display Settings



Light On/Light Off

The light and dark bars on the actogram may be used to represent day and night, or periods of light and dark. You may use the sliding bar, or click on the button. Each click will result in a movement of 15 minutes.

Scale

The scale of the activity axis may be changed by adjusting the sliding bar. If you have a specific value you want to enter, double-click in the window and type in the value. This value is also seen on the zoom display. This adjustment is useful when observing detail of low activity periods.

Zero

This function offsets the activity scale. By adjusting the sliding bar, you may change the value assigned to the lowest point on the activity axis. This value also changes the scale on the zoom display. This adjustment may be useful when observing detail of high activity periods.

Actogram Display Settings

Start Day/Start Time

The time and day at which the actogram begins may be changed with the sliding bars.

Redraw

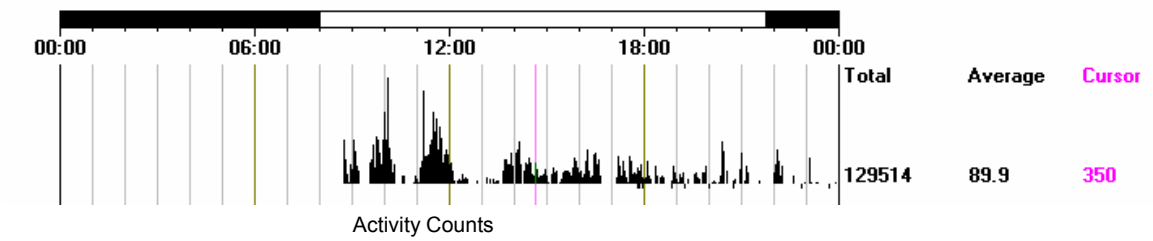
This refreshes the display.

Cursor

This function places the cursor to the specific time shown in the window. To do so, use the slide bar or click on the left or right arrows.

Actogram Display

The detail shown on the Actogram display is illustrated below.



Activity Counts

This is a graphical representation of the activity counts per epoch.

Cursor

A click anywhere in the actogram will produce a magenta cursor at that point in the activity. A third column of numbers will appear on the right. This column is the activity counts within the epoch on which the cursor is located.

Total

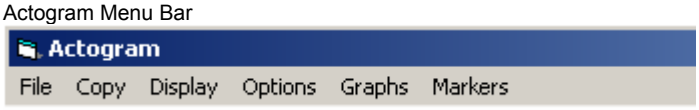
This is the total number of activity counts for the day selected.

Average

This is the average activity counts per epoch.

Actogram Menu Bar

Actogram Menu Bar



File

The file functions found in this menu are found in other analysis routines as well.

Load

This function loads data files into Actical software. Use the same procedure as Load in the Main window. Actical loads the following file types:

- .awc – Actical file
- .awcEE - Actical Energy Expenditure file

For more information on file types, see File Formats on page 6-24.

Print

This sends the actogram display to a printer.

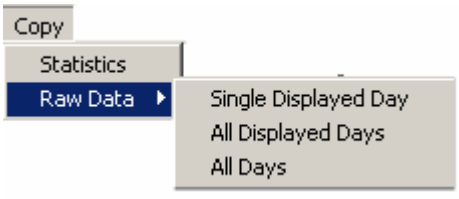
Exit

This closes the actogram display.

Copy

With the copy command, you may place the data for one day, all days displayed on the actogram, or all days of the data file, on the Windows clipboard for exportation to a spreadsheet or other application.

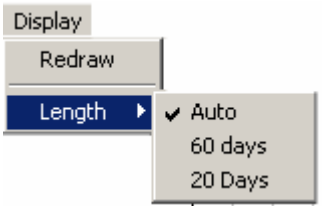
Main window > Actogram > Copy



Display

These options determine what is displayed on the actogram.

Main window > Actogram > Display



Redraw

This option refreshes the actogram display. When observing other windows or changing parameters, it may be necessary to redraw the actogram. There is also a redraw button near the bottom of the actogram.

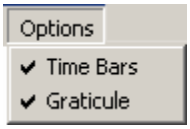
Length

Auto
Using Auto displays all of the data collected, beginning with the start day.

60 days, 20 days
This option limits the number of days displayed on the actogram. For example, 200 days of data in one actogram would be extremely "compressed" to the point of being difficult to see. Limiting the number of days displayed to 20 is often more practical.

Options

Main window > Actogram > Options



Time bars

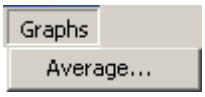
Toggles the time bars at the top of the actogram on or off (see below).

Graticule

This option toggles the hourly graticule on or off. (Graticules are illustrated on the next page.)

Graphs

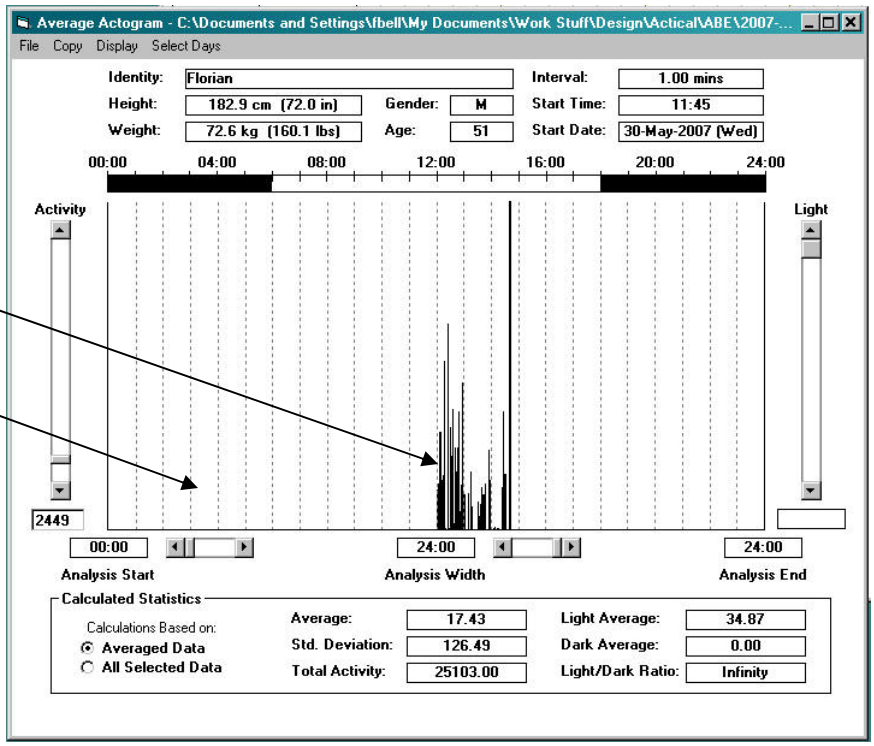
Main window > Actogram > Graphs



Average

This function results in data reduction by averaging multiple days of data, as well as calculating the average activity during light and dark periods.

Actogram > Graphs > Average



Time bars

Graticule

File

File has two functions: Print and Exit.

Copy

The results from the actogram average process may be copied to the Windows clipboard for use in other applications.

Average Actogram Screen

This function places the averaged activity and light values for each sampling epoch onto the Windows clipboard. The average is calculated over the days selected in the Select Days menu.

Statistics

This function places the calculations displayed in the lower portion of the display onto the Windows clipboard.

1. After you have selected the data you want to move, return to the application in which you want to paste the data.
2. Select the Paste command. (Ctrl-V is a typical keyboard shortcut for Paste.)

Data columns will appear in the destination application. A single record containing the ID string for the data file will be added to the beginning of the file. The first data column will contain time stamps. The second will contain activity data. Shown below is a two column copy-and-pasted data file.

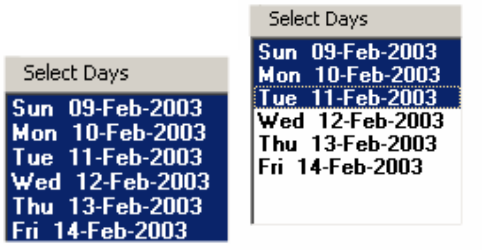
```
Lamplighter Study
Sat 07-Nov-05
7:30:00        76
7:31:00        452
7:32:00        801
7:33:00        467
7:34:00        937
7:35:00        452
7:36:00        288
7:37:00        328
7:38:00        182
7:39:00        64
7:40:00        79
```

Selecting Days to Average

Data from one or multiple days may be used to create an averaging display. By default, all days are included when the Average command is selected.

1. Activate the Select Days menu. Click to highlight the first day you wish to include in your average.
2. Drag the cursor down the list until you reach the final day to be included in the calculation.

Main window > Actogram > Graphs > Average > Select Days



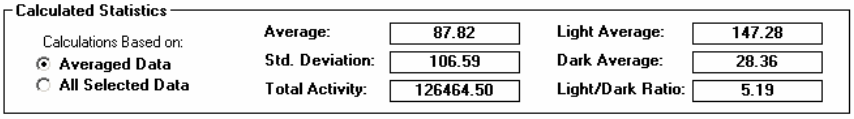
Activity

The activity bar changes the threshold of the Y axis of the display, using either the sliding button, or by double-clicking the activity window at the bottom and typing in the value.

Calculations Panel

Several calculations are performed on the selected data. Calculations are made automatically any time a menu option is selected.

Main window > Actogram > Graphs > Average



Averaged Data

Calculated statistics are based on displayed averaged data, i.e., consider this as the data on the display in front of you. These calculations make use of the calculated average data values for each epoch displayed, that is, they are "averages of averages."

NOTE: Downloaded data may not include a complete set of data values for each epoch on the first and final days of data collection. Epochs that fall before the start time, or after the download time, are included in the Averaged Data calculations as zeros. To eliminate those values from the calculation, it is necessary to set the Actogram Average screen to remove those data (by elimination of the first and last days, if they are not complete), or use the All Selected Data option, described below.

All Selected Data

When All Selected Data is chosen, the partial days at the beginning or end of the data set are eliminated. Calculated statistics are based upon all selected data. These calculations make use of actual recorded data values for the selected days and time interval.

Average

This is the average resulting from the above calculations.

Standard Deviation

This is a measure of how widely values are dispersed from the average value.

Light Average

Mean data value for those epochs that occur during the light period. The light and dark bars define this period. The settings for these bars can be changed in the actogram main display.

Dark Average

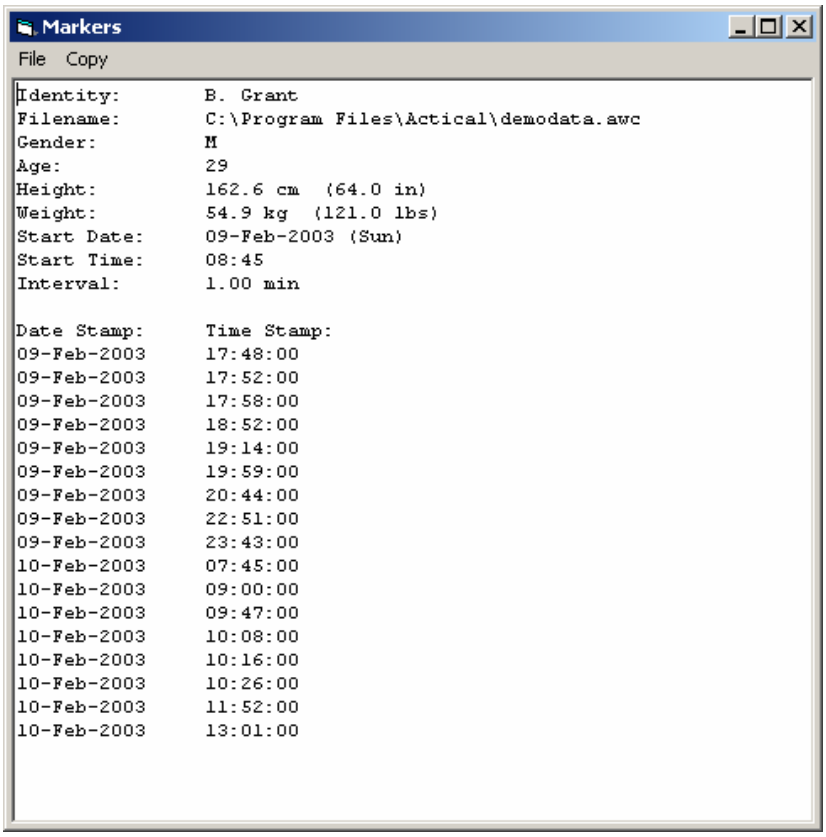
Mean data value for those epochs that occur during the dark period. The light and dark bars define this period. The settings for these bars can be changed in the actogram main display.

Light/Dark Ratio

This is the light average divided by the dark average.

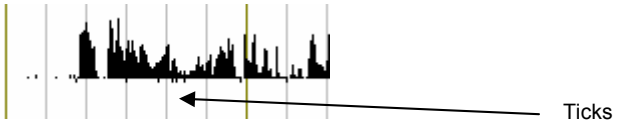
Markers

Main Window > Actogram > Markers



This is a list of the event markers in the currently loaded data file. This list may be printed or cut to the Windows clipboard for export.

Marker ticks

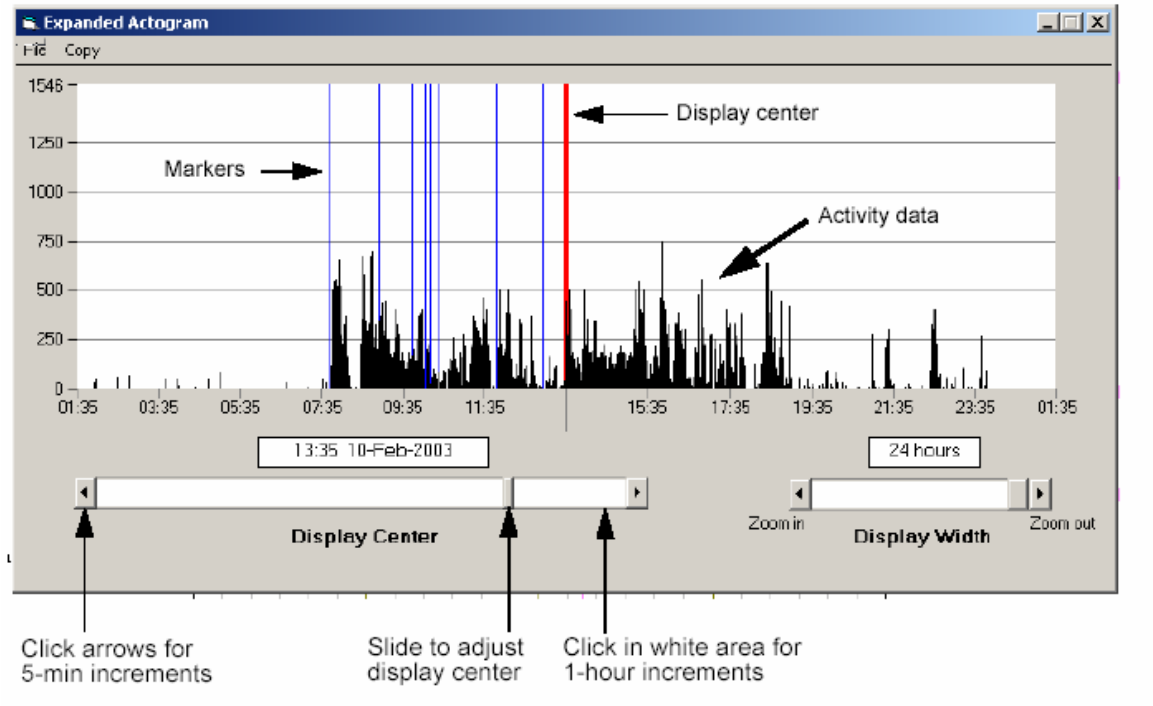


These markers can also be seen on the Actogram as small tick marks located below the baseline of the Actogram as shown above.

Zoom Function

This display is activated by double-clicking anywhere in an actogram.

Actogram zoom



Zoom Display Details

Display Center

The red line represents the center of the displayed time. Use the sliding bar labeled Display Center to change the center time.

Markers

The blue lines represent event markers.

Display Width

Data may appear much as it did in the full actogram when the display width is set for 24 hours. However, by adjusting the Display Width sliding bar, samples may be studied in extreme detail.

Graph

The horizontal scale is time. The window of time may be adjusted using the two sliding bars. Activity data are represented by black vertical lines.

The vertical scale is a quantitative number representing activity counts. When more activity occurs in one epoch, the number of counts increases. In the previous two illustrations, the epoch length is one minute. As the accelerometer detects motion during that minute, the activity counts are collected, and at the end of the minute displayed.

SECTION

6

ENERGY EXPENDITURE

This section explains Actical's Energy Expenditure feature. In this mode, Actical converts movement (activity counts) into energy units (calories). This display is accessed from the Main window toolbar.

Energy Expenditure display

Basic Display Properties

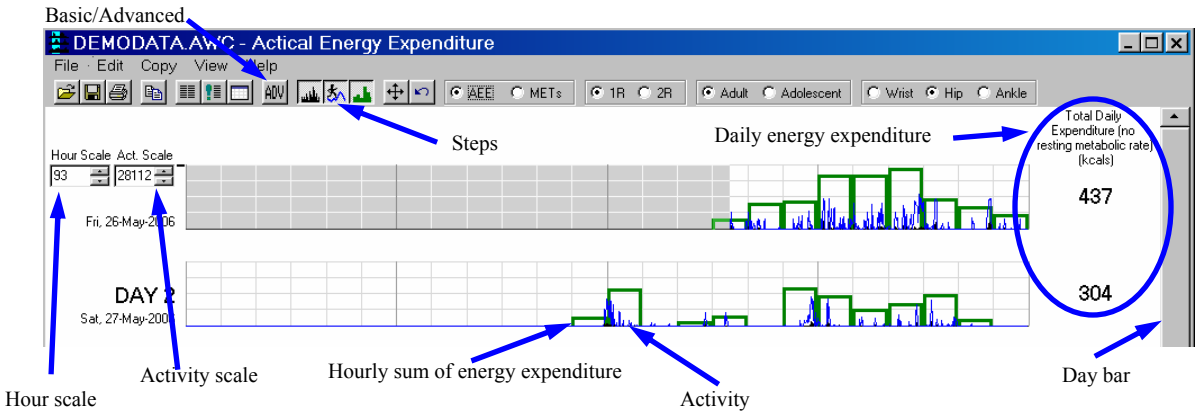
The Energy Expenditure display, portions of which are shown below, is a variety of graphically represented information, including activity, time, and energy expenditure.

The X-axis is time divided into hourly increments represented by the gray lines. The Y-axis is energy expended, expressed in kilocalories.

To assist in identifying the functions of the display, pop-up help tools will appear when the cursor is placed on certain areas of the graph or toolbar.

There are two ways to view Energy Expenditure: Basic and Advanced. These views can be toggled from the toolbar. The following are the Basic features of Energy Expenditure.

Basic Display (top)



Gray areas

This means there is no data there.

Activity Counts

The black graph within the green graph represents activity counts. The activity is similar to the actogram. This scale can be changed. See Activity Scale on the next page.

This function can be shown or hidden by using the toolbar symbol.

Steps

The blue graph represents steps taken per epoch.

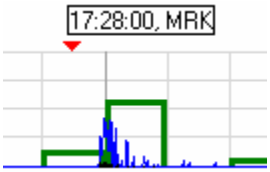
This function can be shown or hidden by using the toolbar symbol.

Hourly Energy Expenditure

The green graph represents the sum of energy expended per hour. Part of the equation factors in weight, and the results are expressed in kilocalories per hour. This scale can be changed (see Hour Scale below).

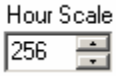
This function can be shown or hidden by the toolbar symbol.

Event Markers



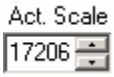
Event markers are shown as red triangles. Place the cursor above the triangle to show when the event marker button was pressed during data collection.

Hour Scale



The maximum value of the Y-axis (in kilocalories per hour) can be adjusted by either clicking on the arrows, or entering a value of your choice.

Activity Scale



The black graph activity scale (in counts per minute) can be changed by either clicking on the arrows, or entering a value.

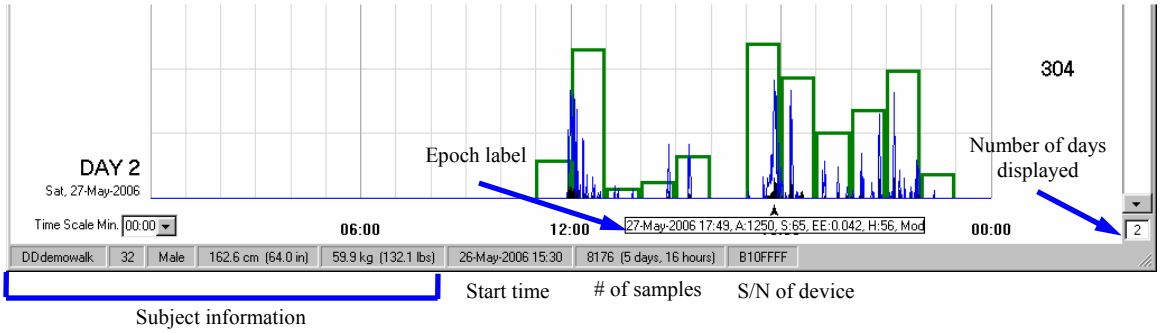
Daily Energy Expenditure

This information is given in the column on the right side of the display.

Day Bar

The bar on the right side of the display is used to shift the display one day at a time by clicking on the arrows, or jump to the first day or last day of collection by clicking in the area above or below the bar.

Basic Display (bottom)



The bottom half of the display contains other important information.

Status Bar

The Status Bar is located at the bottom of the Energy Expenditure display. It contains the description of the subject and other relevant information.

Time Scale Minimum

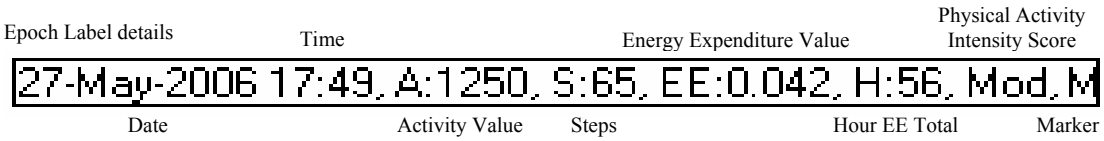
This function selects the portion of the day which is displayed, shifting the data horizontally. Activity of interest can be centered in the graph by clicking on the arrow. The pop-up allows you to choose from 00:00 to 23:00 hours.

Number of Days Displayed

The number of days shown in the Energy Expenditure display can be chosen by clicking in the field and entering the desired number. 1 to 99 days can be displayed. Note that when selecting higher numbers of days, the day-graphs become compressed.

Epoch Label

Placing the cursor and clicking anywhere above or within the activity graph will produce a label for the respective epoch. The Epoch Label contains the following information:



Individual epochs can be viewed by using the arrow keys:

- Up/down arrow keys shift the epoch cursor from day to day.
- Right/left arrow keys move the epoch cursor back and forth in one-minute increments.
- Ctrl + right/left arrow keys move the epoch cursor back and forth in one-hour increments.

The following is a synopsis of the Epoch Label. Additional information on these statistics can be found in section on the Statistics Table on page 6-16.

Date, Time

This is the time when the epoch was recorded.

Activity Value

Total activity counts within the epoch.

Steps

Steps taken within epoch.

Energy Expenditure Value

This is the energy expenditure for the epoch multiplied by the subject's weight.

Hourly energy expenditure

Total energy expenditure for the hour (green graph).

Physical Activity Intensity Scores

This is a series of physical activity energy levels. These are discussed in detail in the section on Advanced Analysis Properties on page 6-23. In essence, these are as follows:

Tag	Activity	Activity Example
Sed	Sedentary	Sleep or rest
Light	Light	Sorting cards, writing letter
Mod	Moderate	Sweeping floors, vacuuming, dusting
Vig	Vigorous	Treadmill walking 2.5 to 3.0 mph Treadmill jogging 4.5 mph

Marker

If the marker button was pressed during data collection, an M will indicate this action.

Basic Display Toolbar - Left Side

This is the toolbar at the top of the Energy Expenditure display. Activity count data and Hourly Energy Expenditure have already been explained (see Activity on page 5-9). Note that this toolbar will change when Advanced mode is activated.

Toolbar - left side

File

When clicked, this will open a new file. If a file is already open, it will ask to save the current file.

Save

This will save the data and current settings to an .awcEE file.

Print

Click to print an Actical Activity and Energy Expenditure Report. This report contains subject information, energy expenditure, activity counts, and statistics.

Copy to Clipboard

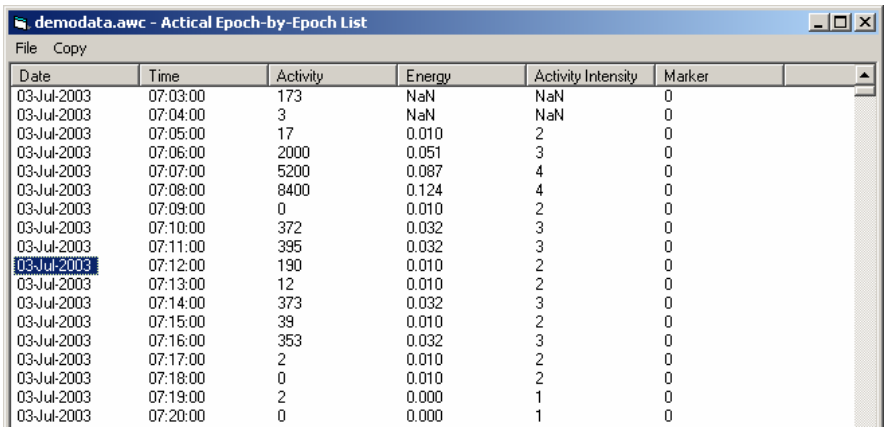
This function will copy the entire Energy Expenditure actogram to the Windows clipboard. It can then be pasted into a variety of application programs.

View Epoch-by-Epoch List

Clicking on this symbol presents a list of each epoch and the respective data. Within the View Epoch-by-Epoch List, there are options to allow exporting or copying the list to the Windows clipboard. If exporting, the file will have a .csv extension (Actical export file).

NOTE: Even if short (15 or 30 second) epochs have been chosen during setup, Actical has converted them into one-minute epochs for energy expenditure analysis. However, the raw 15 or 30 second epoch data are preserved in the .awc and .awcEE files.

Epoch-by-Epoch list



Date	Time	Activity	Energy	Activity Intensity	Marker
03-Jul-2003	07:03:00	173	NaN	NaN	0
03-Jul-2003	07:04:00	3	NaN	NaN	0
03-Jul-2003	07:05:00	17	0.010	2	0
03-Jul-2003	07:06:00	2000	0.051	3	0
03-Jul-2003	07:07:00	5200	0.087	4	0
03-Jul-2003	07:08:00	8400	0.124	4	0
03-Jul-2003	07:09:00	0	0.010	2	0
03-Jul-2003	07:10:00	372	0.032	3	0
03-Jul-2003	07:11:00	395	0.032	3	0
03-Jul-2003	07:12:00	190	0.010	2	0
03-Jul-2003	07:13:00	12	0.010	2	0
03-Jul-2003	07:14:00	373	0.032	3	0
03-Jul-2003	07:15:00	39	0.010	2	0
03-Jul-2003	07:16:00	353	0.032	3	0
03-Jul-2003	07:17:00	2	0.010	2	0
03-Jul-2003	07:18:00	0	0.010	2	0
03-Jul-2003	07:19:00	2	0.000	1	0
03-Jul-2003	07:20:00	0	0.000	1	0

NaN (Not a Number)

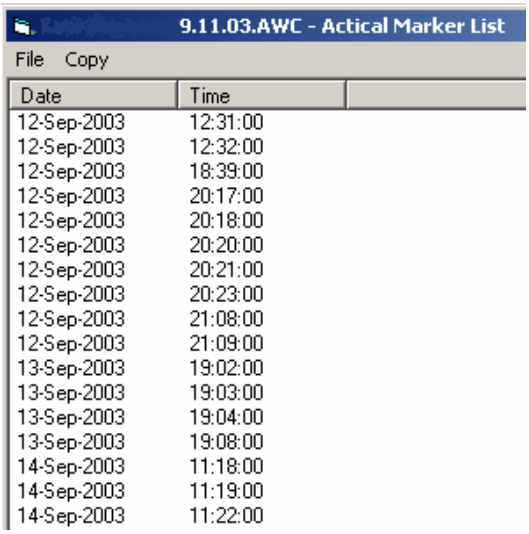
It is possible that due to device error, out-of-range activity, or not enough data to compute an output, an output for an epoch may be given as NaN. This is an acronym for Not a Number, a standard abbreviation for invalid data or incomplete computational data. Such an epoch will have a gray vertical line on the graph.

In the previous list, for example, the first two entries are NaN. Computing energy expenditure values requires three minutes of data history, which is not true until the end of the third minute. At the end of the first and second minutes, there was not enough data to compute the energy expenditure output. Therefore, NaN was inserted in the first two epochs.
When NaN appears on the Total Daily Energy Expenditure column (see Basic Display Properties), this means there was not enough data to compute one of the total daily outputs. To see the energy expenditure for the data acquired, select View > Statistics > Whole Data Set, and refer to the TotEE column. For details on this window, see the section on the Statistics Table on page 6-16.

View Marker List

Clicking the Event Marker symbol produces a list of markers generated during data collection. Within the Marker List, there are options to allow exporting or copying the list to the Windows clipboard. If exporting, the file will have a .csv extension (Actical export file).

Marker list



View Statistics Table

The statistics table is a comprehensive table of statistical results computed for given time intervals.

Because of the extent of this feature, the statistics table is discussed in a separate section (see the section on the Statistics Table on page 6-16).

Set Scales for Best Viewing

This autoscale function adjusts the Energy Expenditure and Activity Count scales to a nominal level so that the data are best viewed.

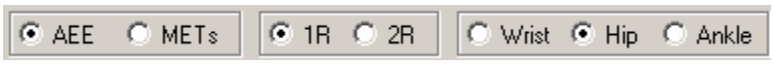
Restore Factory Defaults

All settings that are accessible by the researcher, e.g., graph scales, display size, window settings, etc., will be restored to Factory Default status.

Basic Toolbar - Right Side

The right side of the toolbar is more subject-related, and can be changed to match up to 24 subject models based on energy output type, regression type, age level, and location of the device.

Toolbar - right side



AEE and METs

Actical has two energy units available. The choice depends on whether the resting metabolic rate is to be included in the total energy expenditure.

- AEE is an acronym for Activity Energy Expenditure. This is the number of kilocalories expended per minute per kilogram of subject weight.

  The AEE values for a given time span are summed and multiplied by the subject's weight in kilograms. This yields the total kilocalories the subject expended during the time span as a result of their activity above the resting metabolic rate.

- MET is an acronym for Metabolic Equivalent. It is the total amount of energy the body uses to sustain itself, including the basal metabolic rate.

The difference can be easily seen by clicking between AEE and METs and observing the change in Total Daily Expenditure.

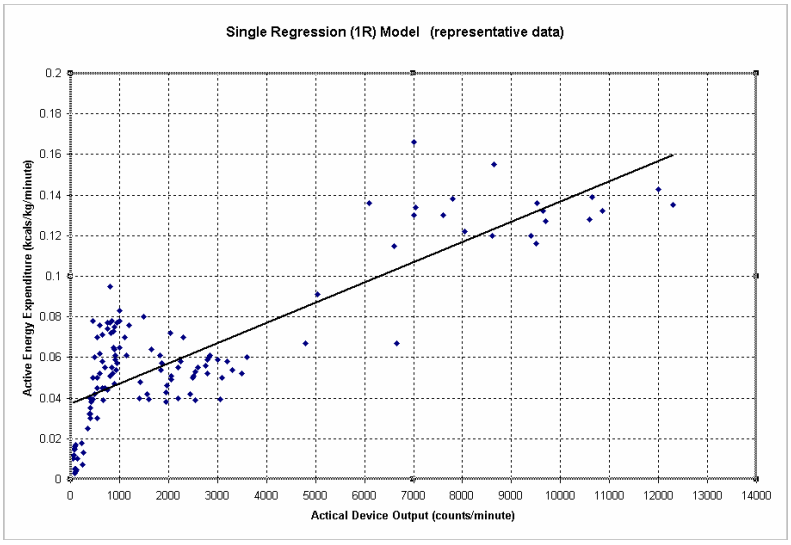
1R and 2R Scatter Plots

A linear regression line is a straight line through a set of observations that attempts to fit itself to the data. The linear regression process adjusts the line so that the sum of the squares of the residuals is made as small as possible (least squares).

Active energy expenditure and activity counts are shown on the following scatter plots.

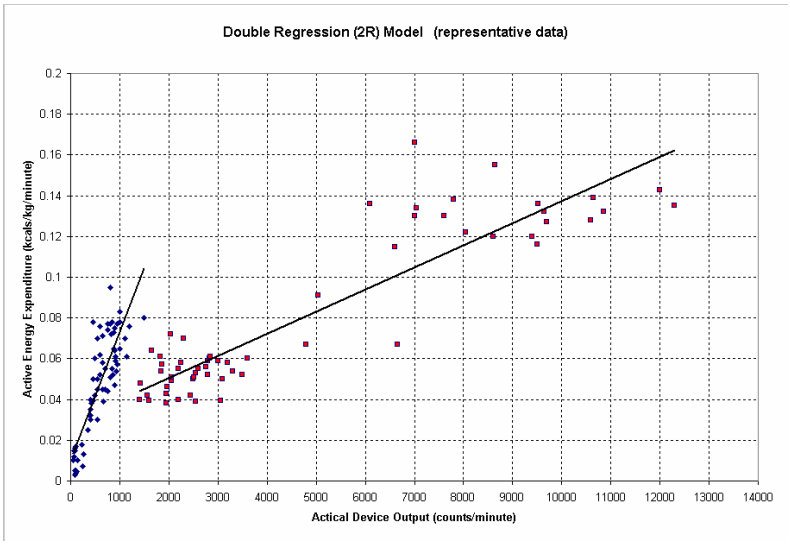
The following plots illustrate a mix of light-moderate to vigorous activity. The cluster of data points in the lower left is primarily light-moderate activity. The regression line is a best-fit to all data points shown. The first shows a single regression line (1R).

Single regression line model (1R)



In the scatter plot below, two regression lines have been fitted to the data: one to the light-moderate activity cluster; one to the vigorous (walking and jogging) activity cluster.

Double regression line model (2R)



It is beyond the scope of this publication to explain in detail the differences between the two models and which one should be used. That is best left up to the researcher considering the particular type of data collected, e.g., moderate or vigorous. However, if in doubt as to which regression model is appropriate, it is suggested that the 1R model be applied.

Age Level

This is an override function. The age entered at setup automatically adjusts this setting. However, it can be changed during analysis.

Location

Location of the Actical activity monitoring device during data collection has an effect on the algorithm and must be taken into account in the regression model. This is an override function. (When opening an .awc file for analysis, a prompt will ask you where the activity monitoring device was placed during data collection.)

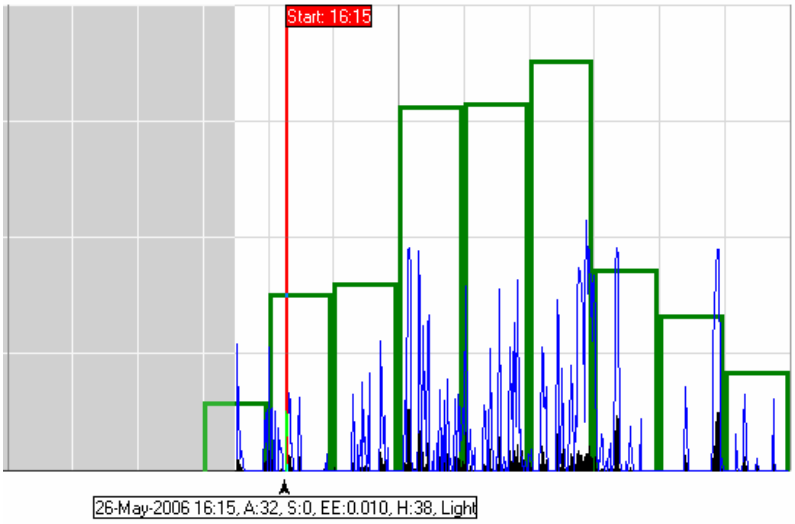
- Hip – This is considered to be the most accurate position. However, on occasion, younger subjects have shown to be intolerant of hip-mounted devices.
- Wrist – This is considered to be the second choice for accurate measurement of energy expenditure.
- Ankle – This is considered to be the third choice for accuracy, however, in many cases it has shown to be the most tolerated.

Custom Interval

Data of interest within a period of time can be computed by selecting the start and end times. Once selected, the Custom Interval computations can be seen in the Statistic Table under Custom Intervals (see the section on the Statistics Table on page 6-16). Up to 500 custom intervals may be selected.

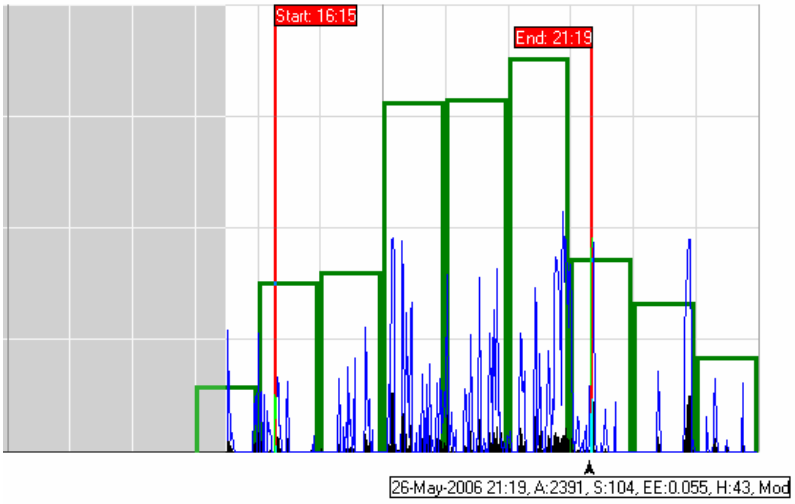
1 Left-click on the epoch with which you want to start the custom interval. Use the arrow keys to "fine select" the epoch. Press the letter C. The start interval will be shown in red.

Start interval



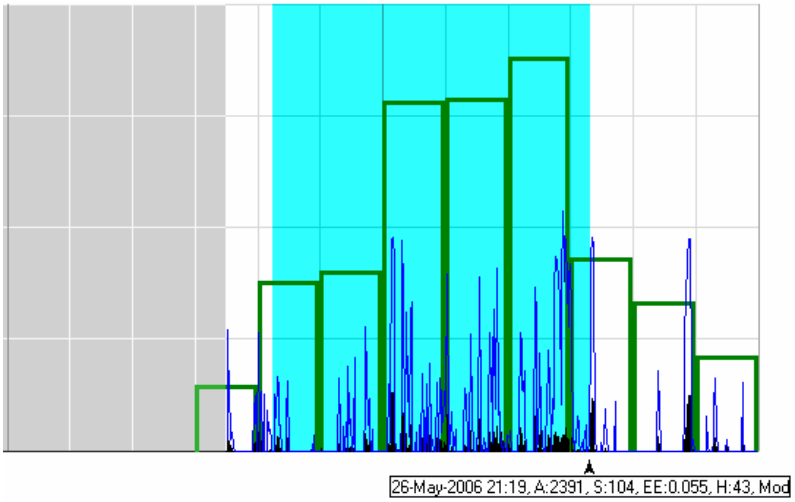
2 Left-click on the epoch with which you want to end the custom interval. Press Shift-C. The end of the interval will be shown in red.

End interval



3 Press Ctrl-C. This will create the custom interval (in blue), and make it available for computation.

Custom interval established



There are several methods by which custom intervals can be built:

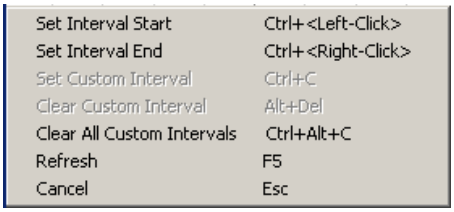
1 Ctrl-left-click - Begin custom interval

2 Ctrl-right-click - End custom interval

3 Ctrl-C - Create custom interval

You may also left-click to establish an epoch label, then right-click to use the pop-up menu.

Custom interval pop-up



Deleting Custom Intervals

To delete a single custom interval, select the custom interval by left-clicking within it, and press Alt-Delete.

You may also left-click within the custom interval, and use the pop-up menu.

To delete all custom intervals, press Ctrl-Alt-C.

Statistics Table

The statistics table is a compilation of 29 computations organized by time interval and category. In the following descriptions, the Statistics Table is broken down into segments to better facilitate explanation.

To observe the Statistics Table, click on the table symbol. 

The first five columns are essentially the "header" information. Each day of study is divided into Start Date, Start Time, End Date, End Time, and the time in that period given in minutes.

	Start Date	Start Time	End Date	End Time	Time
1	03-Jul-2003	00:00	04-Jul-2003	00:00	1440
2	04-Jul-2003	00:00	05-Jul-2003	00:00	1440
3	05-Jul-2003	00:00	06-Jul-2003	00:00	1440
4	06-Jul-2003	00:00	07-Jul-2003	00:00	1440
5	07-Jul-2003	00:00	08-Jul-2003	00:00	1440

Energy and Activity

Steps	TotEE	AvgEE	TotAC	AvgAC
7282	436.889	0.858	160346	314.4
3467	303.755	0.211	87266	60.6
1076	123.937	0.086	28495	19.79
9992	567.103	0.394	213402	148.2
2237	259.705	0.18	61450	42.67
518	66.135	0.046	62611	43.48
5	0.00	0.00	145	0.31

Steps

Total number of steps taken during the elapsed time.

TotEE

Total Energy Expenditure within the given time interval as expressed in kilocalories.

AvgEE

Average Energy Expenditure is the total energy expenditure within the given time interval, divided by the time interval duration in minutes as expressed in kilocalories per minute.

TotAC

Total Activity Counts are within the given time interval.

AvgAC

Average Activity Counts is the total activity counts within the given time interval, divided by the time interval duration (in minutes).

Energy Expenditure

	EE(sed)	EE(light)	EE(mod)	EE(vig)
1	0.0	268.76	621.42	15.16
2	0.0	263.14	955.94	130.39
3	0.0	124.11	784.18	0.0
4	0.0	2.25	0.0	0.0
5	0.0	16.47	23.81	0.0

Energy Expenditure is the energy expended within each activity range during the given time interval, expressed in kilocalories.

Average Energy Expenditure

	AvgEE(sed)	AvgEE(light)	AvgEE(mod)	AvgEE(vig)
1	0.0	0.79	2.86	7.85
2	0.0	0.81	3.52	7.94
3	0.0	0.84	3.71	NaN
4	0.0	0.75	NaN	NaN
5	0.0	0.75	2.58	NaN

Average Energy Expenditure is the energy expenditure within each activity range during the given time interval, divided by the total accumulated time within each activity range.

Time Accumulated

	Time(sed)	Time(light)	Time(mod)	Time(vig)
1	555	282	176	2
2	892	288	243	17
3	1103	135	202	0
4	1437	3	0	0
5	432	20	7	0

This shows the Total Time Accumulated in minutes within each activity range during the given time interval.

Ratio of Accumulated Time to Total Time

	%Time(sed)	%Time(light)	%Time(mod)	%Time(vig)
1	54.68	27.78	17.34	0.20
2	61.94	20.00	16.88	1.18
3	76.60	9.38	14.03	0.00
4	99.79	0.21	0.00	0.00
5	94.12	4.36	1.53	0.00

This is the total accumulated minutes within each activity range within the given time interval, divided by the time interval duration, multiplied by 100.

Sum of Activity Counts

	AC(sed)	AC(light)	AC(mod)	AC(vig)
1	4775	28780	186892	13600
2	2685	34472	447351	117419
3	1825	14757	406781	0
4	16	207	0	0
5	151	1646	4459	0

This is the total number of activity counts within each activity range within the given time interval.

Average Activity Counts

AvgAC(sed)	AvgAC(light)	AvgAC(mod)	AvgAC(vig)
8.6	71.0	934.93	6800.0
3.01	101.36	1704.36	6907.0
1.65	91.93	1934.18	NaN
0.01	69.0	NaN	NaN
0.35	69.16	598.88	NaN

Average Activity Counts is the total number of activity counts within each activity range within the given time interval, divided by the total accumulated time within each activity range.

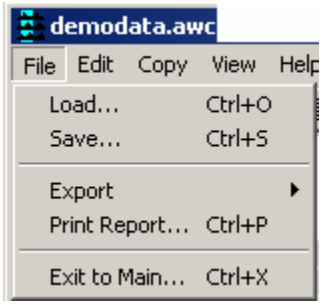
Statistics Interval Bar

Using the Statistics Interval Bar, the previously described statistics in the Statistics Table can be computed for the following intervals:

- Data accumulated for each day
- Data accumulated for each hour
- Data chosen within a custom interval
- Beginning to end of the entire data set

Basic Display Menu Items

File



Load

Load is identical to the Main Actical window menu functions.

Save

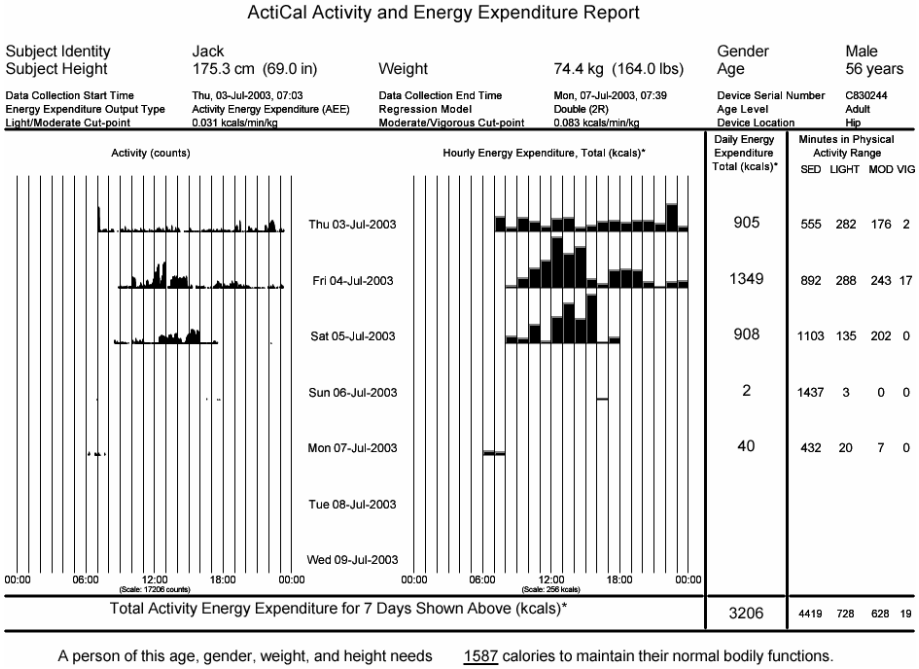
This menu item will save .awcEE files.

Export is explained later. See Exporting Energy Expenditure Data on page 6-27.

Print Report

The report contains subject information, header information, statistics, activity and EE graphs, markers, and more.

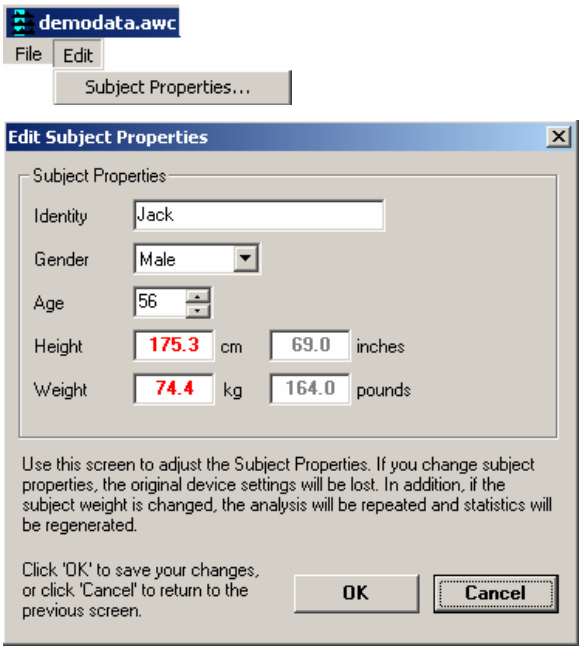
Print report



Edit

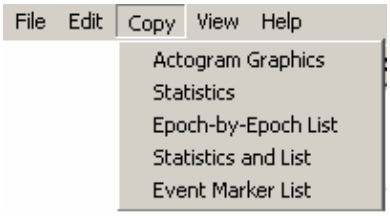
Edit allows editing of the subject information. A cautionary statement will appear warning that certain changes may affect the computations.

Editing subject information



Copy

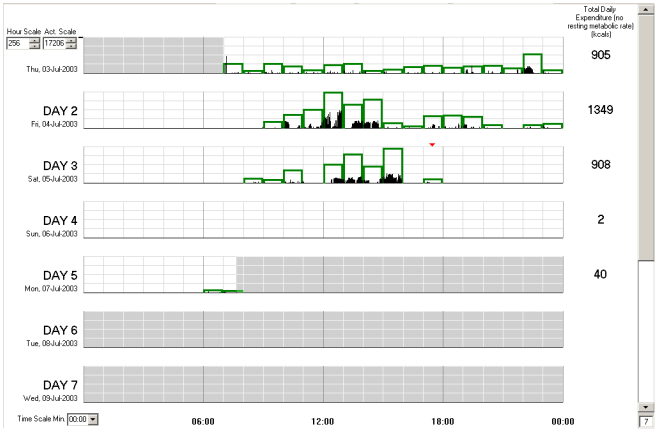
The copy function offers several choices which can be copied to the Windows clipboard and pasted in other applications.



Actogram Graphics

This selection copies the actogram onto the Windows clipboard.

Actogram graphics



Statistics

This function copies all statistics as seen in the statistics table.

Epoch-by-Epoch-List

This selection copies the epoch-by-epoch list to the clipboard.

DEMODATA.AWC - Actical Epoch-by-Epoch List

File Copy

Date	Time	Activity	Steps	Energy	Activity Intensity	Marker
26-May-2006	15:30:00	138	6	NaN	NaN	0
26-May-2006	15:31:00	1816	65	0.049	3	0
26-May-2006	15:32:00	698	23	0.036	3	0
26-May-2006	15:33:00	462	19	0.033	3	0
26-May-2006	15:34:00	177	6	0.010	2	0
26-May-2006	15:35:00	231	10	0.010	2	0
26-May-2006	15:36:00	111	3	0.010	2	0
26-May-2006	15:37:00	0	0	0.010	2	0
26-May-2006	15:38:00	4	0	0.000	1	0
26-May-2006	15:39:00	0	0	0.000	1	0
26-May-2006	15:40:00	0	0	0.000	1	0
26-May-2006	15:41:00	29	0	0.000	1	0
26-May-2006	15:42:00	0	0	0.000	1	0
26-May-2006	15:43:00	0	0	0.000	1	0

Statistics and List

This copies both the statistics table and the epoch-by-epoch list to the clipboard.

Event Marker List

This copies the event marker list to the clipboard.

Marker list

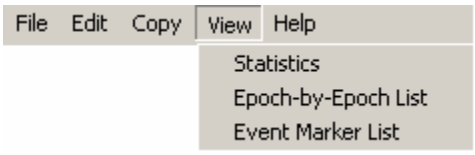
```
---------------- Subject and Device Settings -----------------
Identity:       Jack
Age:    56      years
Gender: Male
Height: 175.3   cm
        69.0    inches
Weight: 74.4    kg
        164.0   lbs
Start Date:     03-Jul-2003     (Thu)
Start Time:     07:03
Epoch Length:   15      seconds
Device Serial Number:   C830244


----- Date/Times that Event Marker Button was Pressed -----

Date    Time
05-Jul-2003     17:28:30
```

View

This menu has some redundant features for the convenience of the researcher.



Statistics

This menu item is identical to the toolbar symbol discussed on page 6-9.

Epoch-by-Epoch List

This menu item is identical to the toolbar symbol discussed on page 6-7.

Event Mark List

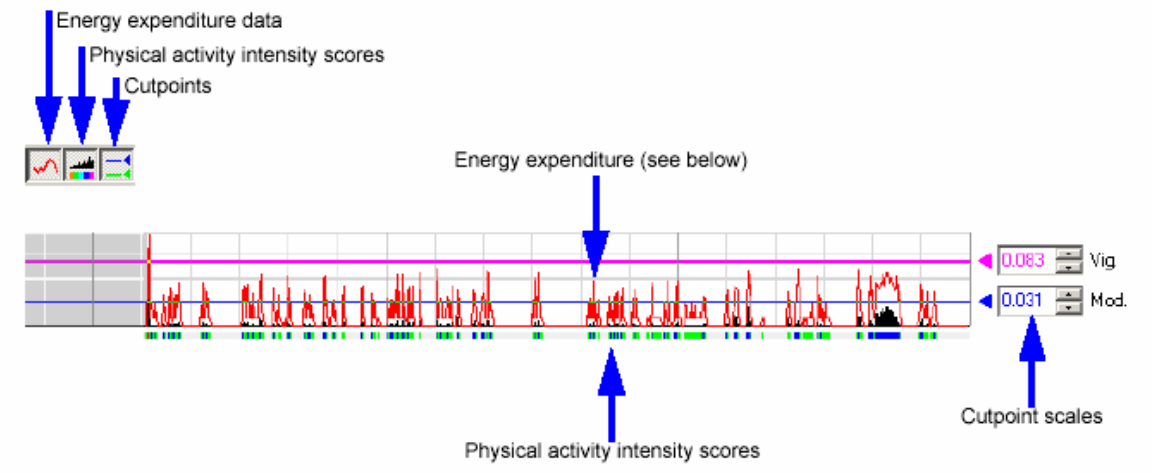
This menu item is identical to the Marker List toolbar symbol discussed on page 6-8.

Advanced Analysis Properties

The Advanced Display features are accessible by clicking on the symbol. Several changes are readily apparent. ADV

- Three additional buttons on the toolbar
- Three new types of outputs on the actogram
- Two additional controls

Advanced analysis actogram



Energy Expenditure Data

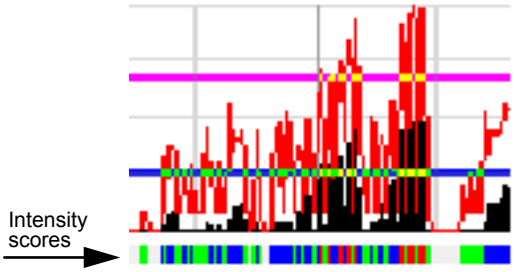
This advanced feature hides or shows the energy expenditure data. Note that this is the raw expenditure of energy without weight as part of the equation.

- When AEE output data is selected, the units of this graph are kcals/min/kg.
- When MET output data is selected, the units are in METs.

Physical Activity Intensity 

This controls the visibility of the physical activity intensity scores. The band of colors beneath the activity graph visually shows the intensity of activity. Here is a portion of the scale greatly expanded.

- Light gray - sedentary
- Green - light
- Blue - moderate
- Red - vigorous

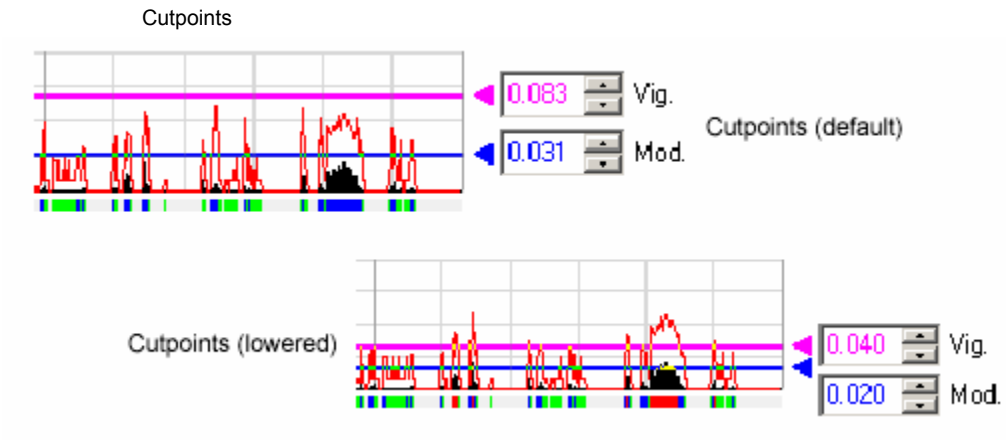


Cutpoints 

The light-to-moderate and moderate-to-vigorous cutpoints can be shown or hidden. Cutpoints are demarcation points between ranges of activity. For example, at a specified point (the cutpoint), the level of activity will switch from moderate to vigorous.

Although there are default cutpoints, special research projects may require different cutpoints to define what is considered moderate or vigorous. These cutpoints can be changed with the two cutpoint scales shown below.

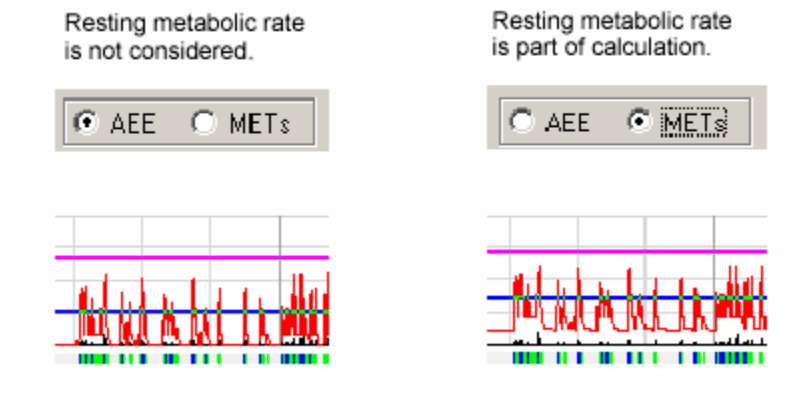
Note in the illustrations, the cutpoints of the bottom graph have been lowered so that less energy is required to produce moderate and vigorous activity. Also note the physical activity intensity scores have changed.



Cutpoint Defaults

The following are the default cutpoints used in Actical. Also note in the two displays below the table, the difference between AEE and MET cutpoints. The reason is that AEE and MET use different algorithms.

AEE **Active Energy Expenditure (kcal/min/kg)**		**MET** **(metabolic equivalents)**	
Light to Mod.	**Mod. to Vigorous**	**Light to Mod.**	**Mod. to Vigorous**
0.031	0.083	3.0	6.0



File Formats

File Types used in Energy Expenditure

Actical uses several file types, some of which are unique to Energy Expenditure.

.awc file

This is an ASCII text file that contains the raw activity data as well as containing subject information. It can be loaded from the File menu in the Main, Actogram, and Energy Expenditure windows.

.awcEE file

This is the same as the .awc file, except it contains Energy Expenditure display settings, custom interval data, and a file version number. It can be loaded from the File menu in the Main, Actogram, and Energy Expenditure windows.

.csv file

This is an export file in ASCII, comma delimited, spreadsheet format. There are 14 varieties of these files. Further information can be found in the next section under Export.

.csv files will load directly into Excel. They cannot be loaded back into Actical in that they are *export* files.

Here are the 14 types of .csv files:

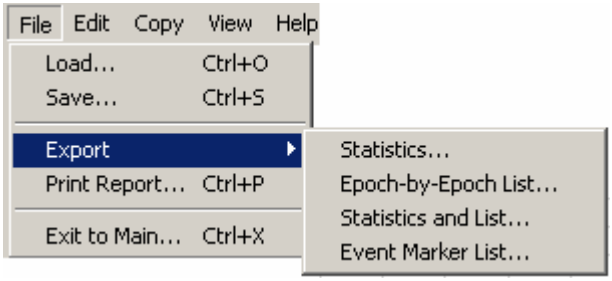
- _List.csv - Actical epoch-by-epoch data list
- _EE.csv - Energy Expenditure export file (all statistics and epoch-by-epoch data list).
- _Events.csv - Event marker list file
- _W_Stats.csv - Whole data set statistics file
- _D_Stats.csv - Daily statistics file
- _H_Stats.csv - Hourly statistics file
- _C_Stats.csv - Custom Interval statistics file
- _A_Stats.csv - All statistics file
- _SW_Stats.csv - Simplified whole data set statistics file
- _SD_Stats.csv - Simplified daily statistics file
- _SH_Stats.csv - Simplified hourly statistics file
- _SC_Stats.csv - Simplified Custom Interval statistics file
- _SA_Stats.csv - Simplified all statistics file
- _Combined_Stats.csv - Combined simplified statistics file

Exporting Energy Expenditure Data

Files containing a variety of information may be exported. Files are always exported in a comma delimited format, contain header information for data and subject identification, and are given a .csv extension. This extension enables the researcher to either open the file from Excel, or double-click on the file and the .csv file will open Excel and load the file automatically.

Additional information on File Types can be found in the previous section.

Exporting Actical data



Export Statistics
This option produces a file containing 29 statistics from the statistics table for all interval types and will include in its name: `_A_Stats.csv`. For example, it could be named "`demodata_A_Stats.csv`."

Export Epoch-by-Epoch List

This list contains the following data:

- Date
- Time
- Activity counts
- Steps
- Energy expenditure in kilocalories/minute/kilogram
- Activity Intensity Score
- Event Marker entries

This file includes in its name `_List.csv`. For example, it could be named "`demodata_List.csv`."

Export Statistics and List
This list contains the above Epoch-by-Epoch list in addition to the statistics table. This file includes in its name `_EE.csv`. For example, it could be named "`demodata_EE.csv`."

Export Event Marker List
This contains only the Event Markers. This file includes in its name `_Events.csv`. For example, it could be named "`demodata_Events.csv`."

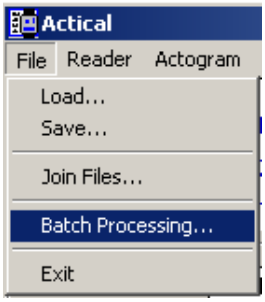
Batch Processing

Batch processing is a function that allows multiple files with similar characteristics to be processed together. It is done with the Batch Processing wizard from the Main Actical window.

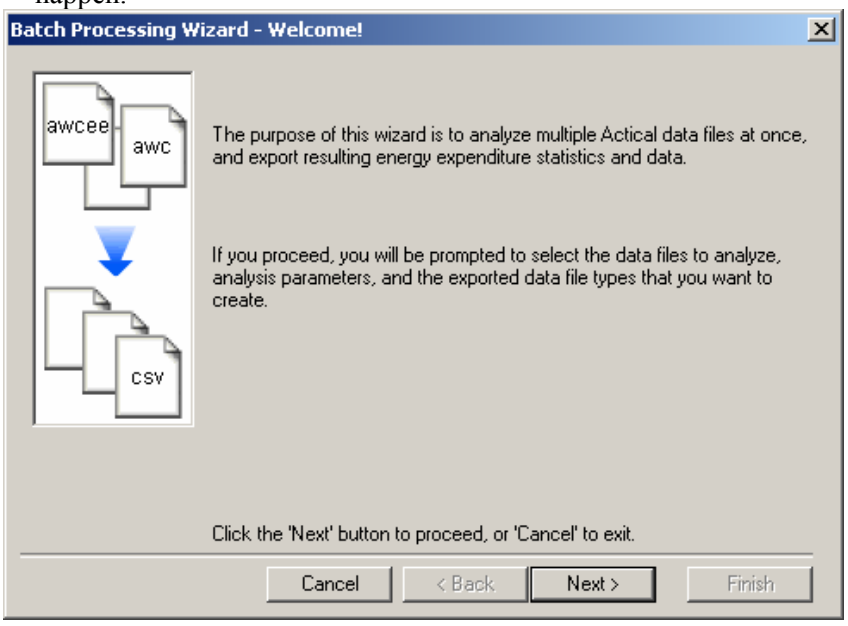
Before batch processing, consider that age differences and other characteristics may generate inappropriate data or errors. To properly batch process, the data should be similar.

1 From the Main window, select Batch Processing.

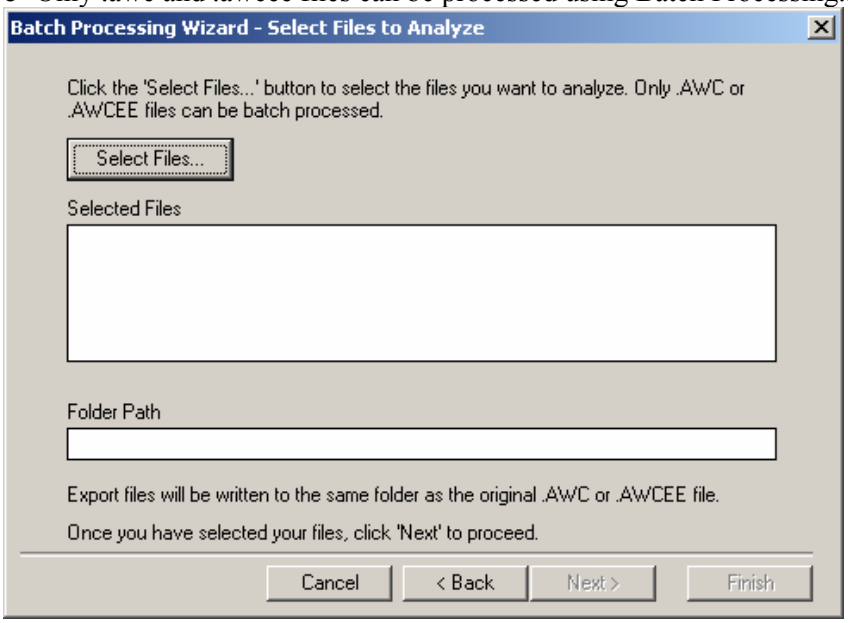
Batch processing menu



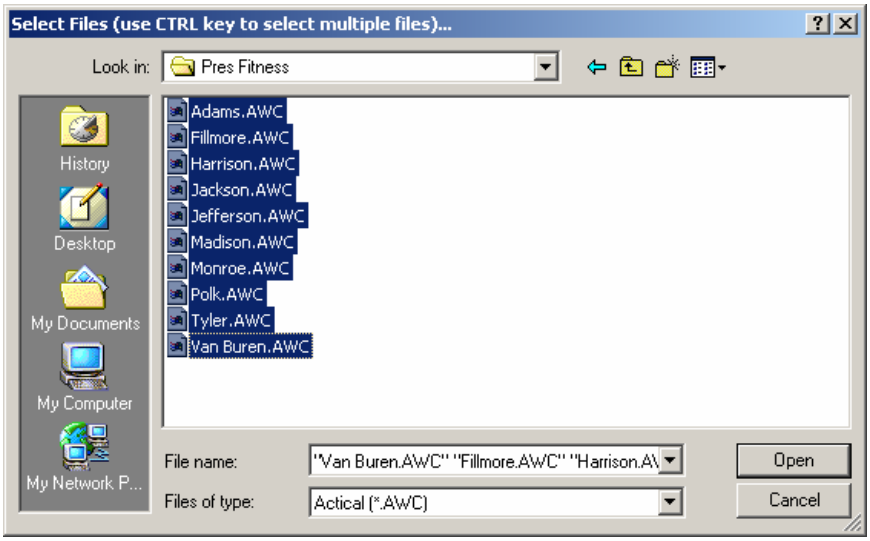
2 The wizard begins with a preliminary explanation of what is about to happen.

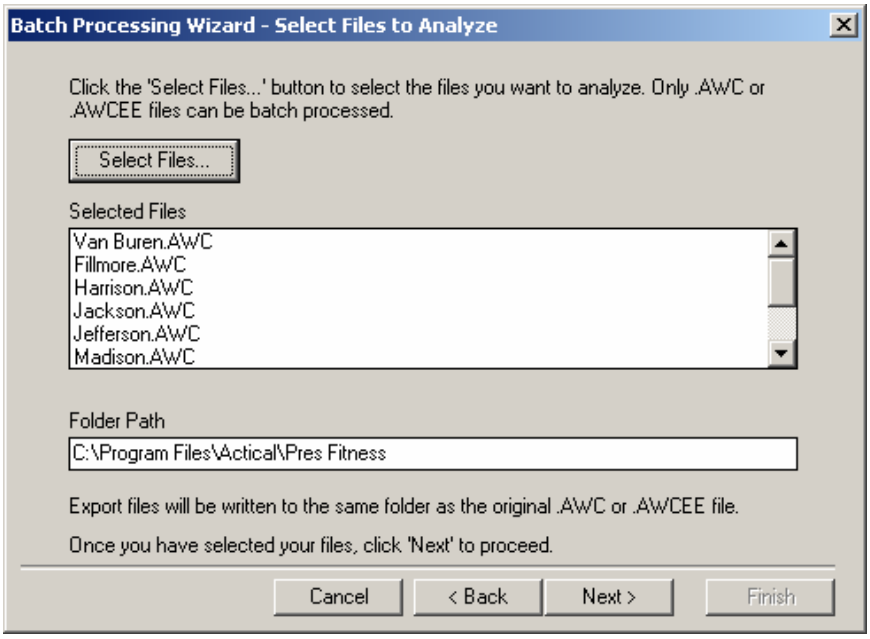


3 Only .awc and .awcee files can be processed using Batch Processing..



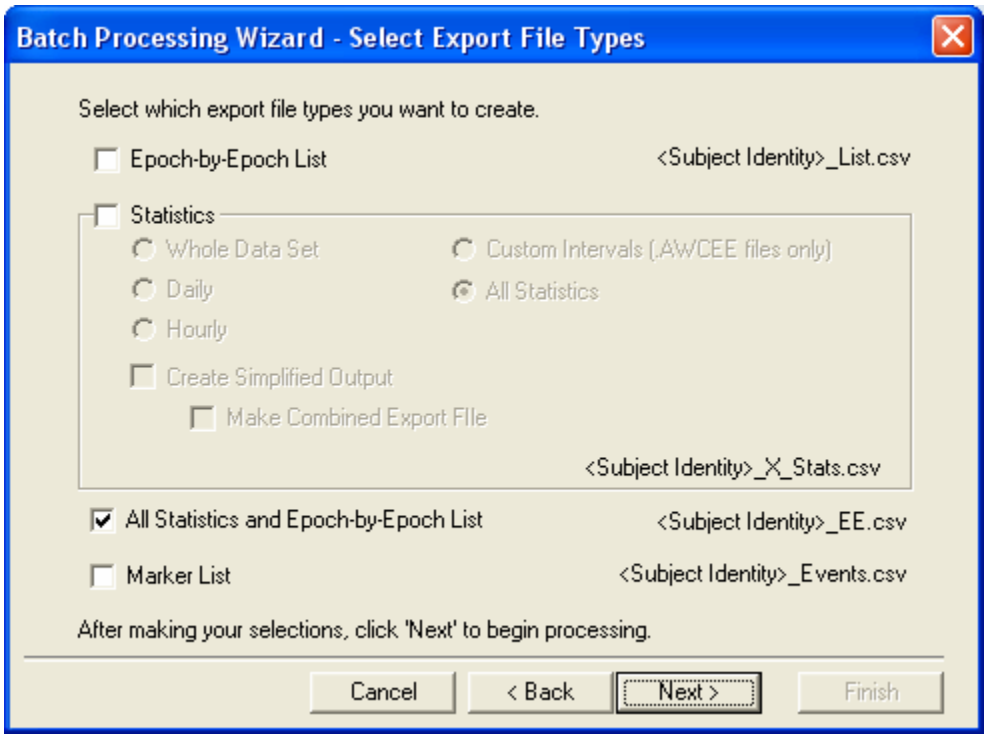
4 The wizard will activate a file browser. Then the multiple files can be selected.



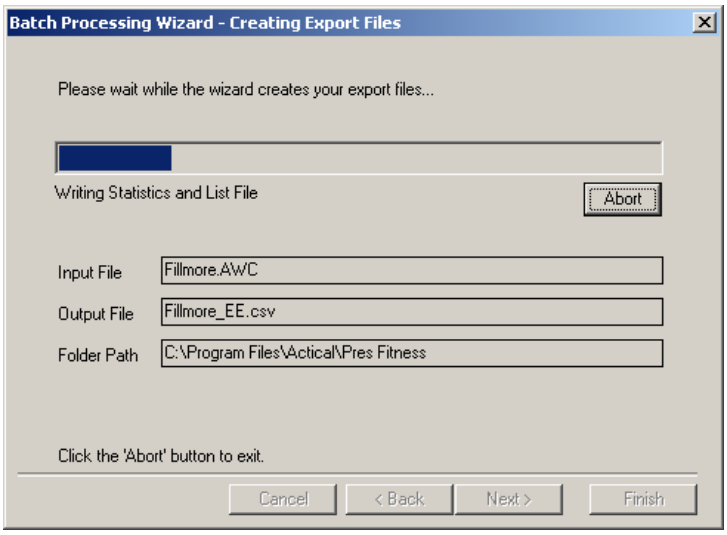


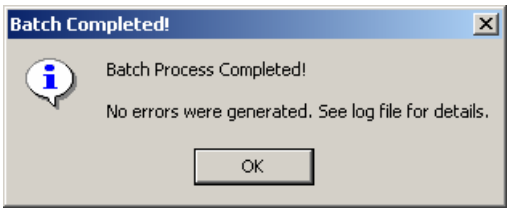
5 Once selected, the files will appear in the wizard analysis panel and a folder path will be given as to where the processed files will be placed.

6 A series of choices are produced by the wizard to ensure the analysis parameters are correct, and to reduce the possibility of error caused by conflicting data.

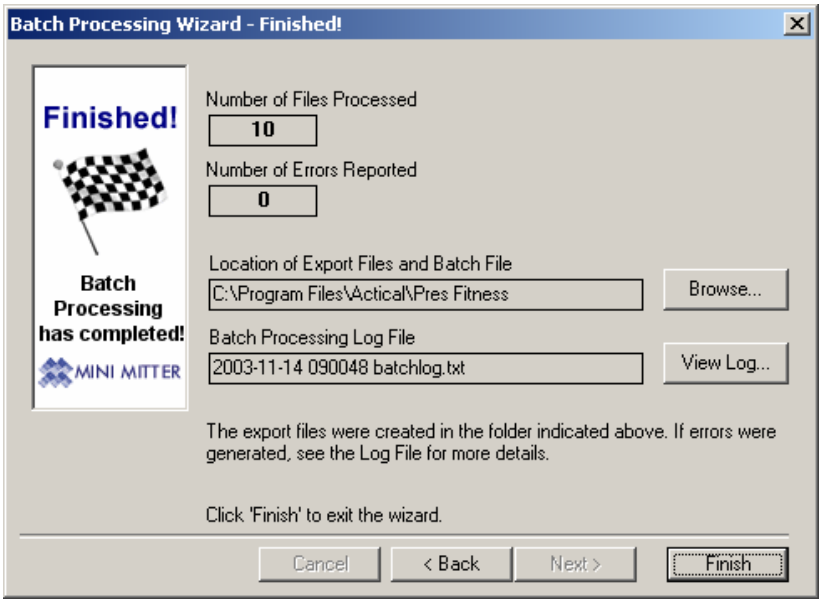


7 Progress will be noted as the export file is being processed.





8 The wizard will wrap up the process and give a final report on the results.



APPENDIX

A

Actical Battery Replacement

Actical Battery Replacement

All Actical devices use the CR2025 coin-cell battery.

Note: To change the battery in ActiReader, see page 2-10.

The Actical battery is required for data collection, reading and writing. Actical has a non-volatile memory, i.e., data stored are not lost after the battery has run down. If you are attempting to read a device with a low battery, the green LED will still light on the ActiReader. It is recommended that you keep a log noting the date of all battery changes for each Actical.

CAUTION! It is important that you thoroughly read the following information before changing the battery. Failure to follow procedures may result in immediate or subsequent damage to the product.

CAUTION! To retain the integrity of the waterproof seal, you should change the O-ring in the battery compartment at the same time you change the battery.

Replacement Items

The Actical battery is a CR2025, 3-Volt, 220-mAmp-hour Lithium Manganese cell. To properly install this battery, specific items may be required. The items in the table below are included in the Battery Replacement Kit.

Description
O-ring
Battery, 3V lithium cell (CR2025)
Screwdriver, flat head
Screw, machine, 1.6 x 6 mm
Cotton swabs
Instructions

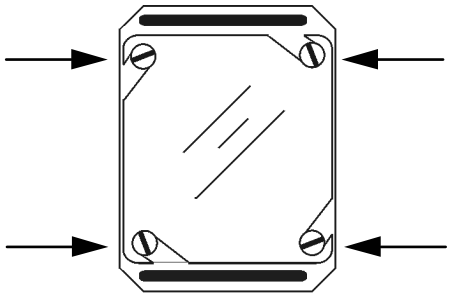
Additional materials that may be required:

- Denatured alcohol
- X-Acto® knife blade (with a flat tip) or another sharp knife

Battery Replacement Procedure

NOTE: In the following illustrations, a standard AW-16/64 is shown. Actical has a slightly different battery cover.

1 Remove the band from the watch. Use the screwdriver provided to loosen (approximately five full turns) or remove the screws in the slots in the back of the device.



2 Carefully remove the battery cover by lightly pressing downward, and rotating the back clockwise. Remove the battery and discard it. *See the warning below!*

WARNING! Do not dispose of lithium batteries in fire or flame. An explosion may result. Only dispose in accordance with manufacturer's recommendation or local codes.

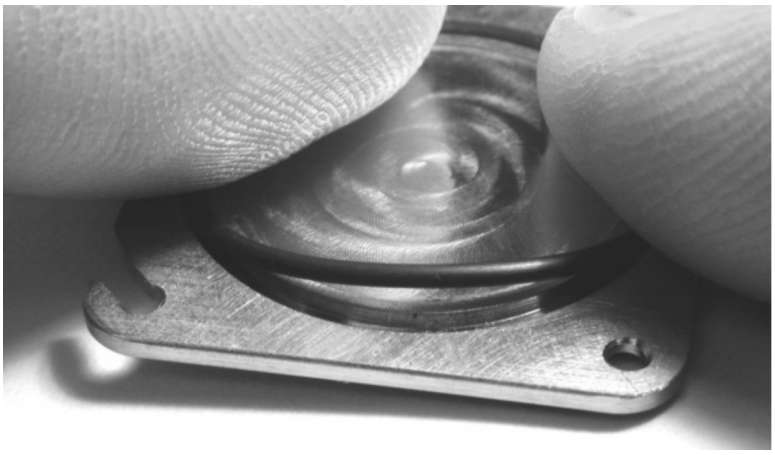
CAUTION! Use extreme care to avoid scratching the metal surface of the device or battery cover. Scratches can cause the Actical device to leak.

3 Thoroughly clean the O-ring channel with a solvent such as alcohol.

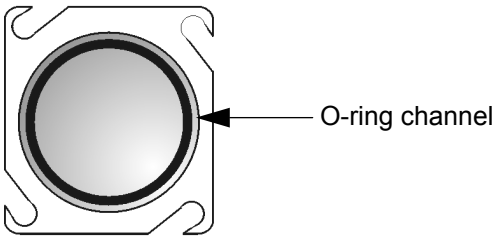
CAUTION! Prior to assembling the device, check carefully for lint, hairs, or other debris which may compromise the seal integrity.

4 Place a new O-ring into the channel in the back cover as shown below. Use the following technique:

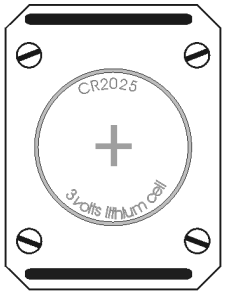
- Pre-stretch the O-ring by gently flexing it in several directions.
- Place a portion of the O-ring in the channel and hold it with your thumb or finger as shown below.



- Use a finger on the other hand to guide the O-ring into the channel.
- Be sure that the O-ring is properly seated in the channel, and is not twisted or deformed.

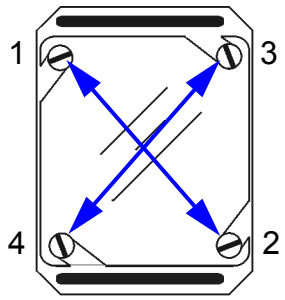


6 Place a new battery into the Actical case with the positive (+) side up, as shown below.



7 Replace the back cover on Actical and replace the screws. If the screws have not been removed completely, rotate the back cover counterclockwise until the slots in the back are firmly seated around the screws, and the back is square with the case.

8 Tighten all four screws in an “X” pattern until all screws are snug (see the illustration below). Take care not to over-tighten to the extent of stripping the threads or twisting off the heads.



CAUTION! DO NOT over-tighten the screws. They can be stripped easily.

Testing Actical

NOTE: If this Actical device contains data that need to be retrieved or saved, use **Reader > Read**, or **Reader > Recover Data** to download data before testing. For more information, see Recover Data on page 2-13.

Test the Actical battery replacement using the Actical test procedure which follows.

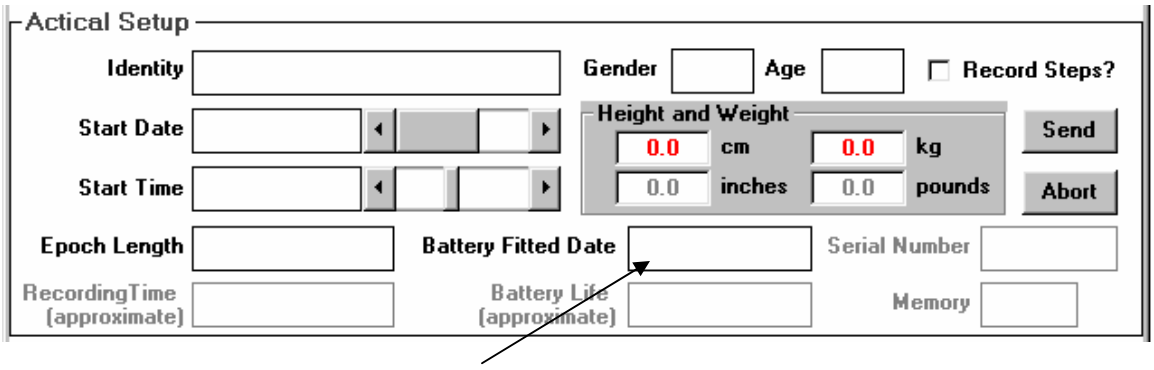
1 Select **Test Actical** from the Reader menu.

2 Place Actical on the ActiReader so that the green LED lights up. Click **OK**. The reader and device will attempt to communicate. If successful, then the Actical device will be tested and a confirmation notice will appear. If not, it is likely that the battery was improperly installed. Re-install the battery and try again.

3 When the test has been successfully completed, select **Write** from the Reader menu.

4 Click the **Battery Fitted Date** in the Actical Setup as shown below.

Entering Battery Fitted Date



5 You may now write a new Setup to Actical. See Setting Up Actical on page 4-1. Be sure to click **Send** to update the Battery Fitted Date.

6 Re-install the wrist band on the device.

APPENDIX

B

SPECIFICATIONS

Actical Device Physical Attributes

Parameter	Value	Condition/Note
Size	29 mm x 37 mm x 11 mm	without band
Weight	16 grams	without band
	22 grams	with standard band
Case Material	Polyurethane/Polyester alloy	
Frame and Battery Cover	Titanium	
Standard Wrist Band	Nylon with buckle	
Battery type	CR2025 lithium coin cell	User replaceable

Actical Device Environmental Attributes

Parameter	Value	Condition/Note
Moisture protection	Waterproof	IEC60529 IPX7
Storage temperature	-20 to 60 °C	15% to 95% relative humidity
Transportation temperature	-20 to 60 °C	15% to 95% relative humidity
Operating temperature range	5 to 40 °C	15% to 95% relative humidity

IEC 60601-1 Classification

- Internally Powered
- Continuous Operation
- Type BF Applied Part
- IPX7 Protection Against Water Ingress (Actical device)
- Not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

ActiReader Physical Attributes

Parameter	Value	Condition/Note
Size	114 mm x 72 mm x 34 mm	Outer dimensions
Weight	158 grams	
Case material	ABS plastic	
Indicators	Red & Green LEDs	

ActiReader Environmental Attributes

Parameter	Value	Condition/Note
Moisture protection	Not water resistant	
Storage temperature	-20 to 60 °C	15% to 95% relative humidity
Transportation temperature	-20 to 60 °C	15% to 95% relative humidity
Operating temperature range	5 to 40 °C	15% to 95% relative humidity

Regulatory Standards

Actical has been tested according to the following standards:

Test Standard	Description	Actical Sensor	ActiReader
IEC60601-1	Medical Electrical Equipment - Part 1: General Requirements for Safety	x	
IEC60601-1-2	Medical Electrical Equipment - Part 1-2: General Requirements for Safety - Collateral Standard: Electromagnetic Compatibility - Requirements and Tests	x	x
IEC60950-1	Information Technology Equipment - Safety - Part 1: General Requirements		x

Software Attributes

Parameter	Value	Condition/Note
Communication rate	600 baud	Configuration
Communication rate	4800 baud	Data retrieval
Hardware platform	Personal computer (Pentium II or later)	
Compatibility	Windows® 98, ME, NT 4, 2000, XP	
Display resolution	800 x 600 or better	
Communication interface	9-pin or 25-pin RS-232 serial ports	
Communication cable	Straight-through serial cable	

Hereby,

Mini Mitter Company, Inc.
A Respironics, Inc. Company
20300 Empire Avenue, Building B-3
Bend, OR 97701

declares that this class 1 radio equipment is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EEC. It complies with the following harmonized standards for radio equipment: EN 300 220-3 V1.1.1 (2000-09), EN 301 489-1 V1.4.1 (2002-08), and EN 301 489-3 V1.4.1 (2002-08).

Florian Bell Date
Director of Engineering

APPENDIX

C

EMC Requirements

Guidance and Manufacturer's Declaration – Electromagnetic Emissions

This device is intended for use in the electromagnetic environment specified below. The user of this device should make sure it is used in such an environment.

Emissions Test	**Compliance**	**Electromagnetic Environment - Guidance**
RF emissions CISPR 11	Group 1	This device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	This device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ Flicker emissions IEC 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

This device is intended for use in the electromagnetic environment specified below. The user of this device should make sure it is used in such an environment.

Immunity Test	**IEC 60601 Test Level**	**Compliance Level**	**Electromagnetic Environment - Guidance**
Electrostatic Discharge (ESD) IEC 61000-4-2	±6kV contact ±8kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast Transient/burst IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	±2kV for supply mains ±1kV for input/output lines	Mains power quality should be that of a typical home or hospital environment.
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	±1kV differential mode ±2kV common mode	Mains power quality should be that of a typical home or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	**<5% U_T** (>95% dip in U_T) for 0.5 cycle **40% U_T** (60% dip in U_T) for 5 cycles **70% U_T** (30% dip in U_T) for 25 cycles **<5% U_T** (>95% dip in U_T) for 5 sec	**<5% U_T** (>95% dip in U_T) for 0.5 cycle **40% U_T** (60% dip in U_T) for 5 cycles **70% U_T** (30% dip in U_T) for 25 cycles **<5% U_T** (>95% dip in U_T) for 5 sec	Mains power quality should be that of a typical home or hospital environment.
Note: U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

This device is intended for use in the electromagnetic environment specified below. The user of this device should make sure it is used in such an environment.

Immunity test	**IEC 60601 Test Level**	**Compliance Level (FDA)**	**Electromagnetic Environment - Guidance**
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical home or hospital environment.
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 Vrms 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended Separation Distance** $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

Note 1: At 80 MHz and 800 MHz the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people

a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device.

b Over the frequency range 150 kHz to 80 MHz, the field strengths should be less than 3 V/m.

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and This Device

This device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of this device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communication equipment (transmitters) and this device as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Power Output of Transmitter (W)	**Separation Distance According to Frequency of Transmitter (m)**		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

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