

**TOU SMART***logger*<sup>™</sup>  
&  
**SMART***ware*<sup>™</sup> 2004  
Software  
Operator's Manual



**February 6, 2004**



## Congratulations!

You have just purchased one of the most powerful, easy to use and lowest cost data loggers available. **TOU SMART loggers** are characterized by:

1. Ease of installation, no wires to connect
  - Installs in seconds. Really!
2. No Electricians needed
  - Save some serious money!
3. No computer needed for logger setup
  - Leave the expensive tools in the office!
4. Easy to use software for analysis and graphing
  - Lots of useful features!
5. High reliability (500,000 hours MTBF)
  - You can count on the reliability!
6. Longest battery life in the industry (10 years)
  - Won't die in the middle of your project!

We are certain that you will find the **TOU SMART loggers** to be one of your most-used survey tools.

# SMART<sup>TM</sup>ware 2004

What's Changed From SMARTware 2003, 2002, and 2001?

A number of significant changes have been made to the newest release of **SMARTware 2004**. The new features include the following items and many other “under the covers” changes to just make the software friendlier, more robust and easier to use.

## New Features For **SMARTware 2003**

1. **Added more “bucket” options to the Time Series Data feature**  
Now you can create Time Series Data from Transition Data and make load profiles with finer time resolution.
2. **The Usual Subtle Bug Fixes, Menu Enhancements and More!**

## Changes of **SMARTware 2003** from **SMARTware 2002**

1. **Data File Exporting From the Analysis Menu**
2. **Menu Item Changes**  
Makes more intuitive use of menus.

## Changes of **SMARTware 2002** from **SMARTware 2001**

1. **Communication Port Searching**  
SW 2002 now searches the Windows registry to find available COM ports for communication with the loggers.
2. **Data File Locations**  
Saved files are now kept in a more obvious folder.

## Changes of **SMARTware 2001** from **SMARTware 2000**

1. **File Aggregation**  
Combine multiple logger files into a single data set that can then be analyzed.
2. **Rate Schedule**  
Analyze the data by Rate Schedule. Compare energy use against a utility's Time of Use billing schedule. Play “what if” games.
3. **Time Series Graph**  
A new graph type has been created and new graphing features added.
4. **Manual In The Software**  
The entire SMARTware manual is now in the software. Now, everywhere you go you have the manual with you!

## ***Quick Start: Get you up and running in 5 minutes!***

### **Install the TOU Software **SMARTware™ 2004** on you Computer**

1. Place the software CD into your CD or DVD drive.
2. The software is Autoloading; just answer the questions!

*Note: If the Software is on floppy disks insert disk 1 and use Start; Run... A:\Setup.*

### **Setup the TOU Logger for a Monitoring Session**

1. From Windows, use Start; Programs; DENT Instruments; **SMARTware 2004**
2. Use the menu command: **T**ools; **P**C Setup to set the Direct Connect RS-232 communication port. This is usually COM1.
3. Connect the logger to a computer's serial port with the *TOU Communication* cable.  
(Note: **SMARTware** works with Windows 95, 98, 2000, XP and NT operating systems, but not Win 3.1)
4. With **SMARTware 2004** open, click on **L**ogger, and then **L**ogger **C**lock to set the Logger's real-time clock to the correct local time.
5. Use **L**ogger; **E**dit **L**ogger **D**escription **L**ine... to include an additional description in the logger. (optional)

### **Begin Monitoring**

1. Disconnect the logger from the serial cable.
2. Record the installation time on the back of the logger.
3. Choose an appropriate location to place your *TOU SmartLogger*. Page 7
4. If you are using a *Lighting or Current Transformer (CT) Logger* set the logger's sensitivity level. Page 8.
5. Verify that the logger display says "on" when the monitored device is on, and that the display is blank when the monitored device is off.
6. Clear the logger's memory with the RESET switch. The display flashes "on" twice.
7. Record the logger's serial number and location on a separate paper for easy retrieval.
8. Sometimes a photo of the installation (instant or digital) can make finding the logger at retrieval time much easier.

### **Retrieve and Analyze Data from a *SmartLogger***

1. Record the retrieval date and time on the logger back.
2. Connect the logger to the computer using the TOU cable.
3. Start **SMARTware 2004** and use the **L**ogger; **R**etrieve **D**ata... command to retrieve the data from the logger and save it to the computer hard drive.
4. Use any of the options in the **A**nalysis menu to study the data or use **F**ile; **S**ave **A**s to save the data file in a .CSV (comma separated variable) format for opening in a spreadsheet such as Excel.



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# I. INTRODUCTION TO SMARTLOGGER™ MODELS AND SOFTWARE



**TOU SMARTloggers™** are single channel, on-off status data loggers. They are designed to provide **time-of-use (TOU)** information on energy consuming devices with a constant power draw and the operating schedule for any device. The TOUs record the time to the second that a device turns on and then again when it turns off. The data saved by the loggers is a series of on-off transitions and time stamps such as shown below.

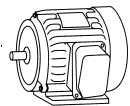
	Date	Time	Transition
1	4/6/99	7:23:54 PM	Was OFF
2	4/6/99	8:11:47 PM	Turned ON
3	4/6/99	8:24:39 PM	Turned OFF
4	4/6/99	8:35:21 PM	Turned ON
5	4/6/99	8:41:14 PM	Turned OFF
6	4/6/99	8:52:33 PM	Turned ON
7	4/6/99	8:58:37 PM	Turned OFF

You can then download these data to your computer, where the *TOU Software* will analyze and graph the data, or you can export the data and analyze them in the software of your choice.

There are three logger models:



- The **LIGHTINGlogger™, Model TOU-L**, for monitoring lights;



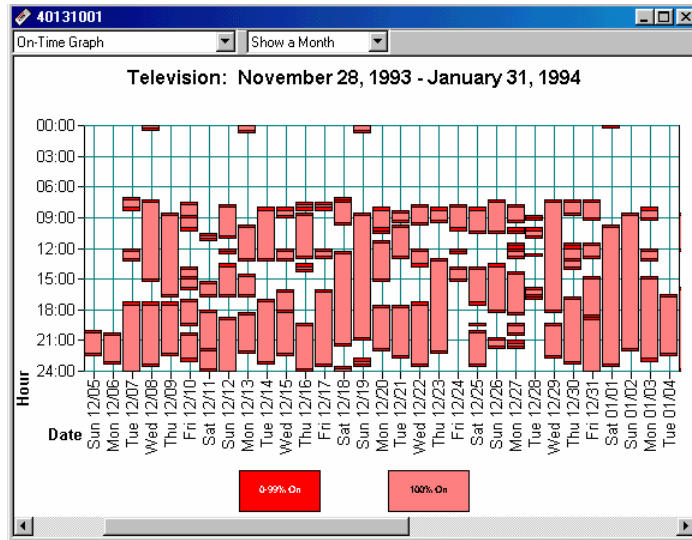
- The **MAGlogger™, Model TOU-M**, for monitoring electric motors, appliances, computers, or any device generating a magnetic field;



- The **CTlogger™, Model TOU-CT**, for monitoring electric load status using a clamp-on current probe.

The information you can retrieve includes:

- Statistics, such as operating schedule, cycling frequency and number, average on-time, and more.
- Graphs, including on-off transitions, line, and block graphs, like the one below.



**Example of an On-Time Graph**

Output formats you can choose from:

- Screen displays
- Printer
- Disk files

Export formats:

- Data can be exported as a .CSV file (comma separated variable) that can be easily read by spreadsheet programs such as Excel for further analysis.
- Graphs can be copied to the clipboard and pasted into other programs such as word processors for making reports.

## II. SPECIFICATIONS & SYSTEM REQUIREMENTS

### II.A. *SmartLogger* Specifications

Dimensions:	1 X 2 X 4" (2.5 X 5.1 X 10.2 cm)
Weight:	4 oz. (550gm) TOU-L and TOU-M
Mounting:	
<i>LIGHTINGlogger</i>	Magnetic strip with 32 oz. pull
<i>MAGlogger</i>	Velcro Strip
<i>CTlogger</i>	Velcro Strip
Display:	2 digit LCD ("on" when the logger is recording, blank when off)
Units:	Time stamp records in month, day, year, hour, minute, second.
Event Counting:	Max frequency = 1 Hz
Sensitivity:	
<i>LIGHTINGlogger</i>	At minimum sensitivity: ON: 500 foot-candles OFF: 500 foot-candles At maximum sensitivity: ON: 3 foot-candles OFF: 1 foot-candle
<i>MAGlogger</i>	40 milliGauss minimum
<i>CTlogger</i>	1/4 Amp minimum
Power:	Factory installed battery provides up to 10 years of operation.
Clock Accuracy:	True Calendar, Real-Time Clock Crystal controlled to 20 ppm, or better than 1 minute per month
Resolution:	1 second
Operating Environment:	0°C to 60°C, non-condensing humidity
Memory Capacity:	8192 transitions
Communication:	RS-232 with <b>SMARTware</b> communication cable
Data Analysis:	<b>SMARTware 2004</b> software provides statistics, min, max, and average, graphics, and the ability to export data in Excel (.CSV) format.
Warranty:	3 Years!

## **II.B. Minimum System Requirements**

**Computer:** IBM PC or equivalent

**CPU:** 486DX or higher processor (Pentium Class Recommended)

**Operating System:** Windows 95, 98, 2000, XP, NT 4.0 or higher

**RAM:** 16MB minimum

**Hard Drive:** 5MB minimum available

**Graphics:** SVGA or higher resolution (800X600)

**Communications Port:** One Serial Port or one USB Port with adapter

**CD Drive:** One CD or DVD drive required for software installation.

### III. USING THE *TOU SMARTLOGGERS™*

You can install the *TOU SmartLogger* in seconds, without an electrician, by following these simple steps:

1. Using the *TOU Software*, Set the logger's internal clock, and give the logger an identifying name.
2. Record the installation time on the back of the logger.
3. Choose an appropriate location to place your logger and attach it securely.
4. Set the logger's sensitivity level. Verify that the logger display says "**on**" when the monitored device is on, and that the display is blank when the monitored device is off.
5. Clear the logger's memory by pushing the RESET switch with a pencil tip or paper clip.
6. Record the logger's serial number and location for easy retrieval.
7. When the monitoring period is done, retrieve the logger. Record the removal date on the back of the logger. Connect the logger to a computer to retrieve the data.



These steps are described in more detail beginning in Section III.B on page 6

#### III.A. Introduction to **SMARTware™ 2004**

To use the **SMARTware 2004** software it must first be installed on your computer. Do this by inserting the CD in the computer CD drive. The software will self-launch and just follow the directions [If using floppy disks, put Disk 1 of the software into the floppy drive and then go to the Windows Start menu, then select Run... and type A:\setup.exe Then Ok and follow the directions in the Setup program.]

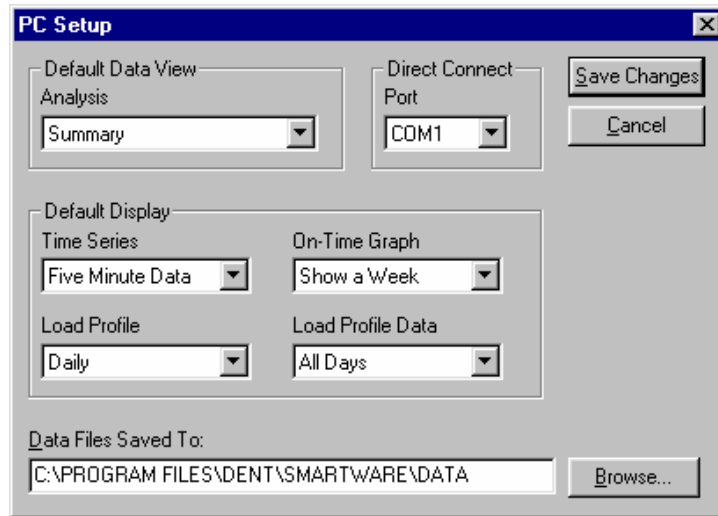
When the **SMARTware 2004** software is run, the MAIN MENU will appear which consists of one line of standard Windows menus structures and a lower line of "hot buttons" that can access many of the most commonly used software functions with just one click of the mouse.



**Communicating with the Logger:** Since the TOU SMARTLoggers have no user interface on the logger, all communication must happen through a computer (PC) using the serial port on the logger.

To make a direct connection from the PC to the logger, use the supplied **SmartLogger cable** to connect from the logger's serial port (a stereo headphone jack on the logger back) to the serial port on the PC. If necessary, use a 9 to 25 pin adapter on the PC.


Start **SMARTware 2004** and select **Tools; PC Setup...** from the menu. A screen similar to the one below will appear:



Use the upper right-hand box, **Direct Connect**, to configure the computer serial connection. Verify that the COM port corresponding to where the serial cable is connected on the PC is selected (COM 1, 2, 3 or 4).

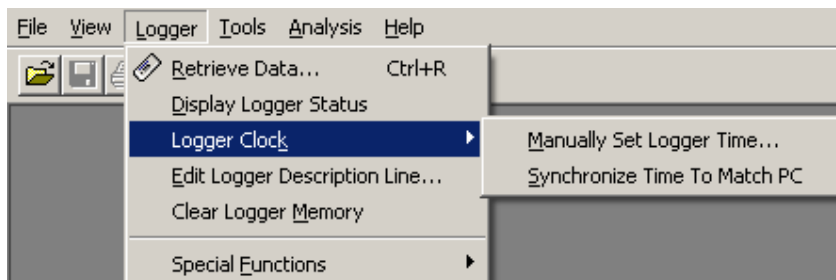
**Note:** The baud rate between the logger and PC is fixed.

**TECH TIP:** Most communication problems are a result of the PC trying to communicate with the logger on the wrong computer COM port or a cable that is not connected properly.

**TECH TIP:** Quickly set up the PC by clicking on the  **PC Setup** button on the screen.

### III.B. Detailed Explanation of Using the Logger

#### 1. Set the Clock



Connect the TOU Logger to the serial port of the computer with the TOU SmartLogger interface cable. Use the **SMARTware 2004** command **Logger; Logger Clock** and then manually set the time or let the PC clock be used to set the internal clock to your time zone.

Use **Logger; Edit Logger Description Line...** to give an identifying name to the logger (optional). This name will appear on all reports and graphs you create with the *TOU Software*. Disconnect the logger from the serial cable.

## 2. Record Installation Time

Record the installation time on the label space provided on the back of the logger, as shown at the right. Additional labels are available from DENT Instruments.

Date Installed	Date Removed
2/1/93	4/17/93
3/3/93	6/23/93

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Bend, Oregon (503) 888-4774  
Made in USA

## 3. Place The Logger

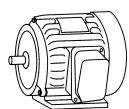


**LIGHTINGlogger, Model TOU-L:** The unlabeled hole in the middle of the left edge of the *LIGHTINGlogger* contains the light sensor. Install the *LIGHTINGlogger* so that the light sensor is aimed toward the light source *and* away from stray light sources such as lamps or windows, that could cause false monitoring. Watch for security lights that are on continuously.

When monitoring fluorescent lighting, place the *LIGHTINGlogger* inside the fixture and attach using the magnetic strip. When monitoring incandescent lighting, high temperatures must be considered. The maximum temperature rating of all *SmartLoggers* is 140°F (60°C). In terms of distance, that is approximately 8 inches (20 cm) horizontally from a 100 watt bulb in free-moving air. If it is not possible to mount the logger at an appropriate distance using the magnet supplied, then hang it with wire, or attach it with adhesive tape, or velcro.

Use a ziploc or similar plastic bag to protect the logger from moisture.

For high temperature or hard-to-reach locations, DENT Instruments offers a long-reach, flexible, fiber optic sensor, so that you can place the logger conveniently away from the light fixture. These fiber optic sensors are available in custom lengths from one foot up to twenty feet long.



**MAGlogger, Model TOU-M:** The *MAGlogger* is designed to attach to the motor case using the enclosed velcro fasteners. The surface of the motor case must be clean before the velcro will adhere to the motor. Duct tape or other fastener may also be used.

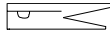
Use a ziploc bag to protect the logger from moisture and contaminants when in a harsh, wet, or outdoor location.

Because of differences in motors, some brief experimentation may be required to locate the logger in an optimum sensing position. The *MAGlogger's* sensitivity can depend on the orientation of the logger on the motor being monitored.

The internal magnetic field sensor is located at the left side of the logger, behind the display. First place the logger on the running motor right side up, if required, rotate it until the *MAGlogger's* display reads "on." If you cannot find a location on the motor that activates the logger, try rotating the logger onto its sides, ends, and back at different locations on the motor, until it displays "on."

The *MAGlogger* can also be used to monitor individual conductors carrying one amp or more. This ability makes the *MAGlogger* a versatile monitoring tool. For example, a water heater can be monitored by attaching the logger to the power wiring with tape or by laying it on top of the heater near where the wiring enters at the top of the tank. Separating the wires may be unnecessary for larger loads.

Use the *MAGlogger* on water heaters, furnaces, boilers, appliances, and of course, motors.



**CTlogger, Model TOU-CT:** Simply clip the CT (current transformer) over any conductor carrying 0.25 amp AC or more.

Secure the logger itself with velcro or duct tape. Use a ziploc bag to protect the logger from moisture if necessary.

**Note:** You cannot place the current transformer around both wires of different phases (on appliances with two-conductor power cords, for example). To monitor equipment with two conductor power cords, separate the wires so that the current transformer is placed around only one wire.

**TECH TIP:** When monitoring devices that have power cords, use a short extension cord where the individual wires have been separated to clamp the CT around just one. Exercise extreme care that none of the insulation around any of the wires is cut or otherwise exposes a wire.

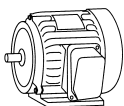
The logger is activated when there is more than 0.25 amp of current flowing through the wire to the device being monitored. The logger is sensing the load when the display reads "on."

#### 4. Set the Logger Sensitivity



**LIGHTINGlogger, Model TOU-L:** You can adjust the *LIGHTINGlogger* for various ambient light conditions by turning the screw labeled "SENSITIVITY." The *LIGHTINGlogger* is sensing the lights when the display says "on." Adjust the sensitivity using a small screwdriver so that, in the highest ambient light conditions and with the light to be monitored off, the logger is off (display is blank). The logger should then show "on" when the monitored light is turned on.

Using a screwdriver to turn the sensitivity screw clockwise towards the "+" will make the *LIGHTINGlogger* more sensitive to light. Greater sensitivity allows it to be used in areas of low ambient light and will allow a dimmer light source to activate the *LIGHTINGlogger*. Making the *LIGHTINGlogger* less sensitive to light allows it to be used in areas of high ambient light, without activating until the monitored light is turned on.



**MAGlogger, Model TOU-M:** and **CTlogger, Model TOU-CT:** Normally set the sensitivity to maximum (all the way clockwise). Otherwise, if a constant background load is not to be monitored (e.g. the defrost cycle in a refrigerator),



## IV. SMARTware 2004 MENU COMMANDS

This section is a line-by-line description of each menu item in the **SMARTware** software. The order of presentation is from left to right and top to bottom for each command.

When the **SMARTware** software is launched, the MAIN MENU will appear which consists of one line of standard Windows menus and a lower line of "hot buttons" that can access many of the most commonly used software functions with just one click of the mouse.



### MAIN MENU

**Note:** Because Windows 95 and higher uses (context sensitive) Automatic Menu Switching, only the commands that are active will appear. When you click on File you will probably see a different list of commands.

**Note:** For "power users" many of the menu commands can be accessed through shortcut keyboard commands (e.g., Ctrl + O for open an existing file) or from the speed buttons located on the line below the main menu.

### File

Typical Windows commands are found in this menu.

#### Open...

The **O**pen function opens an existing Data File already stored somewhere on the computer hard disk. It operates the same whether or not you are connected to a Logger.

#### Close

Closes only the currently active file. If multiple files are open, the active file is the one with the illuminated top border.

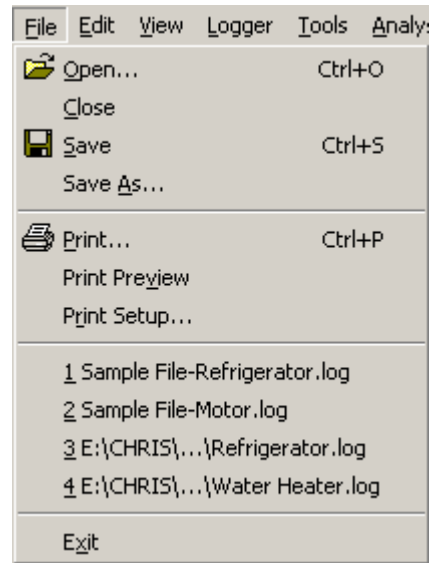
#### Save

Saves a data file that has been **E**xtracted from another file.

#### Save As...

Saves a Data File that has been retrieved from a logger to a new name or location. It also allows saving Transition Data Points, Time Series Data Points or Load Profile Data Points to a .CSV (Comma Separated Variable) that can be easily imported into spreadsheets such as Excel.

**Note:** Graphs cannot currently be saved. However, they can be printed using the File; Print command.



**TECH TIP:** Graphs (and any other image on the computer screen) can be copied and pasted to other applications using Print Screen key (PrtScn). Then Ctrl + V to paste. To edit the image first, paste it into Microsoft Paint (in Start; Programs; Accessories).

## **Print**

Initiates printing and select the pages to be printed. Print Setup may also be accessed from this menu.

## **Print Preview**

Displays on the computer screen the document to be printed as it will appear on the paper.

## **Print Setup...**

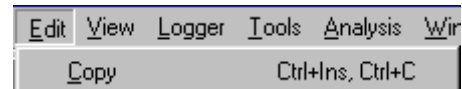
Allows the user to select the printer to be used, paper tray source, and paper orientation.

## **Exit**

Exits and closes the **SMARTware 2004** program.

## **Edit**

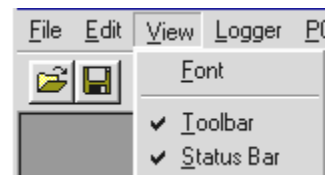
The function **Copy**, is a standard Windows clipboard function. It allows copying text or graphics for pasting into other applications such as word processors.



## **View**

The View functions relate to what is shown on the computer monitor.

Font can be used to change the font of the text in either the Summary report or in the Transition, Time Series or Load Profile Data Points view. It does not affect any of the graphical views.

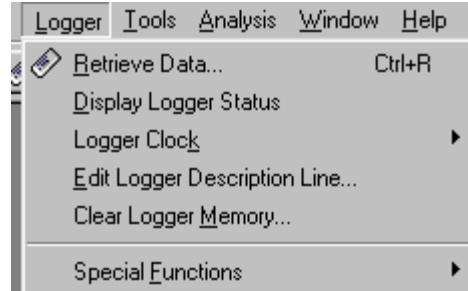


The change made to the default fonts can be printed but they do not persist in a copy command.

The toolbar line (Hot Buttons under the main menu, see Page 31 for a description of the Hot Buttons) and the status bar at the bottom of the screen may be turned on or off by selecting (✓) or deselecting by clicking on them with the mouse. The status bar provides additional explanation of the function of a menu command when the mouse cursor is held over the command in question.

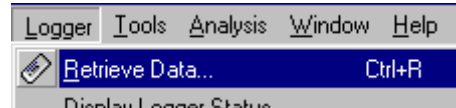
## **Logger**

Use the **Logger** menu to retrieve data, set the logger clock and interact with the logger.



## **Retrieve Data...**

Retrieves data from the logger and saves as a .LOG file to the hard disk. First connect the logger to the computer with the TOU Interface cable and then click on the **Retrieve Data...** command. Before retrieving the data, the software will check the connection to the logger and prompt you for a data file name. The default will be the Logger serial number plus 2 digits that correspond to the number of times that data has been retrieved from the Logger and stored in that folder.



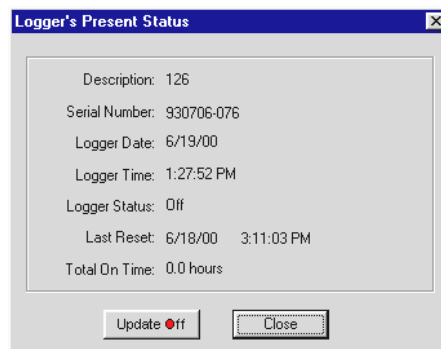
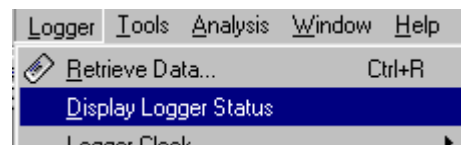
The data will be saved to the default folder unless you choose to send it into another folder. The data folder can be set in **Tools; PC Setup; Data Files Saved To:** (See also page 14) The default data folder is C:\Program Files\DENT\SMARTWARE\DATA. The **Retrieve Data** command will not affect the data stored in the logger; the data is not erased when read.

To view a data file, use **Analysis; Open...** and then choose the file desired.

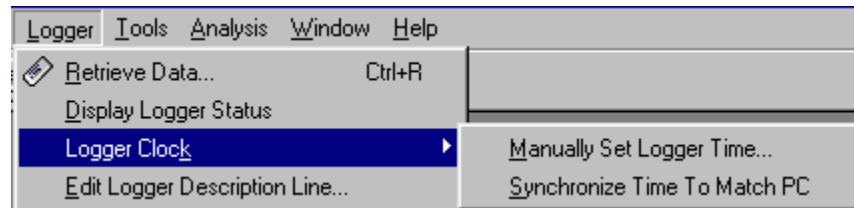
The binary .log data files may also be exported in a comma separated variable (.CSV) ASCII file that can be used in other applications such as a spreadsheet or database. Use **File; Save As...** to save in the .csv format

## **Display Logger Status**

Reads and displays current state of logger's sensor (on or off), current date and time of logger's internal clock, last reset time, cumulative on-time, and other information. Using this function returns a screen similar to the one below:



## Logger Clock



This function allows you to change the logger's internal clock. You may set the time manually or synchronize the logger's clock to the PC.

**Manually Set Logger Time...** Allows user to set the logger date using the MM/DD/YY format. Also allows user to manually set the internal clock. *Use a 24-hour format.*

**Synchronize Time To Match PC** With this option the computer clock is read and automatically updates the Logger.

**Note:** The **Synchronize...** function does not ask if you are sure if you want to set the logger clock to match the PC before doing so.



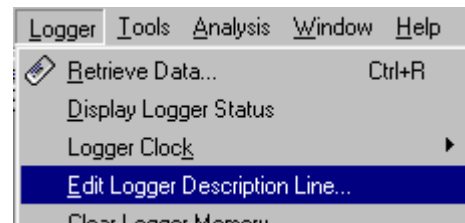
**WARNING:** Changing the logger's date or time in the middle of a monitoring session can have undesirable effects. If the date or time is advanced, a gap in the data would result. If the date and/or time is set back, overlapping data will result.

In both cases, statistical summaries and graphs would provide invalid results. We recommend that you export the entire data set to a spreadsheet if a global time change is required. Otherwise use the function **Analysis; Extract a Range of Data** to extract and analyze only part of the data.

## Edit Logger Description Line...

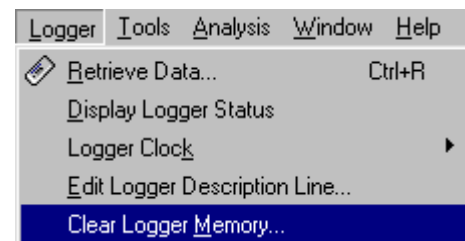
A user-defined description is stored in the logger to help identify the specific logger.

If you wish to change this description after retrieving data from the logger (with an open file) use **Analysis; Edit File's Description Line**.

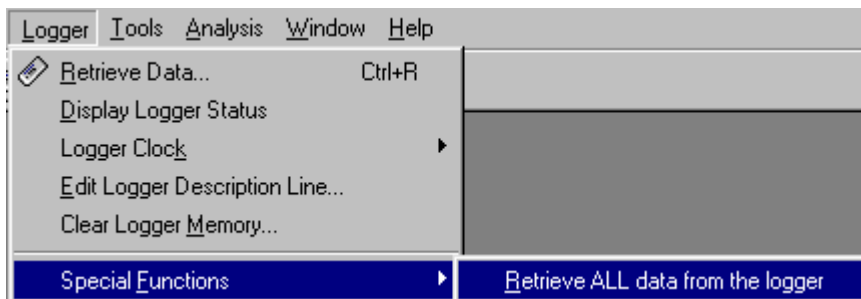


## Clear Logger Memory...

Performs the same function as manually pressing the RESET button on the logger. It will clear the entire memory in the logger. If reset accidentally, the data can still be retrieved (for loggers with serial numbers 930513-001 and higher) using the **Special Functions** command below.



## ***Special Functions; Retrieve ALL Data from the Logger***

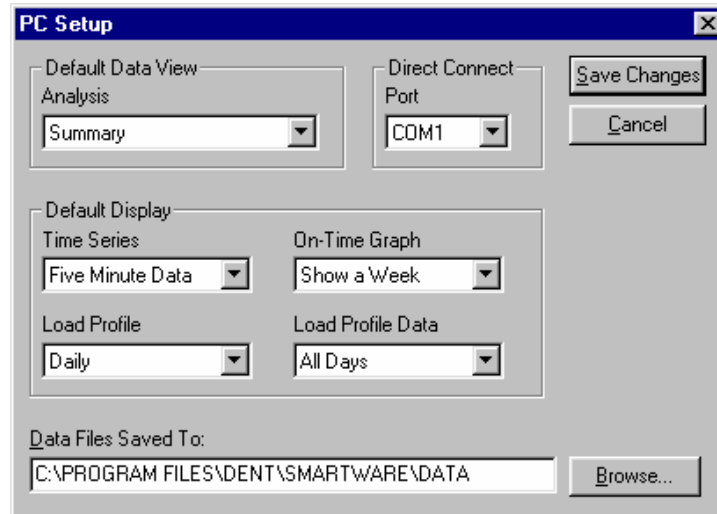
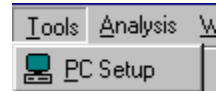


Retrieves ALL data from the logger's memory. Use this after an accidental reset of the logger.

All 8,192 data points in the logger's memory will be retrieved; only a portion of which are the actual or "real" data. Use **Analysis; Extract a Range of Data** to clip out only the records which represent good data.

## Tools; PC Setup

PC Setup allows the user to configure the host computer to work with the TOU Loggers. It sets the default analysis views, file storage folders and selects the direct connect (RS-232) port.



**Default Data View** Sets the default for how the data will first be displayed when a data file is opened.

**Direct Connect Port** Sets the RS-232 communication port on the computer to be used for communicating with the loggers.

*Note: Windows will only show the COM ports that are available.*

**Default Display** Sets various data analysis default values.

**Time Series** Default for the time bucket size when viewing the data in a time series format or the load profile data points.


**On-Time Graph** Shows the On-Time graph as a week or a month.

**Load Profile** Shows the Load Profile graph as a Daily (24 hour) or weekly load profile.

**Load Profile Data** Sets which days will be used in the Load Profile.

**Data Files Saved To:** Sets the default folder the data files will be saved in. When retrieving data files using the **Logger; Retrieve Data...** function, the data files will be sent to the folder specified here.

*Note: All of these default values can be overridden during the actual viewing of the graphs or data presentation.*


**TECH TIP:** Setup the PC quickly by clicking on the  **PC Setup** button on the Hot Button line.

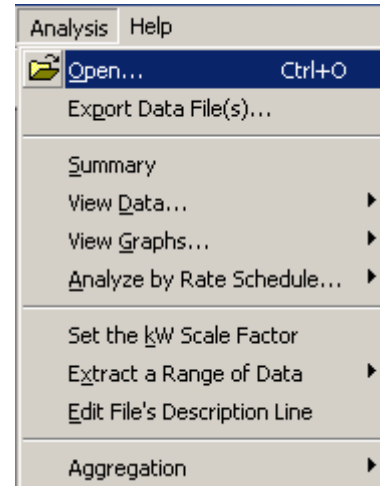
## Analysis

### Open...

Has the same function as **File; Open...** It is used to select and open a data file for viewing, graphing or analysis.

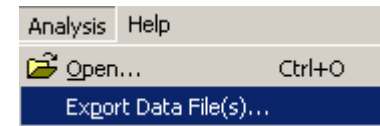
**Note:** After opening a data file, Summary, View Data... View Graphs... as well as additional controls can be accessed from the drop-down menus at the top of the open data window(s).

**TECH TIP:** Quickly open a file for analysis by clicking on the  **File Open** button on the Hot Button line. Or use the **Ctrl + O** keys together.



### Export Data File(s)...

Export allows a quick and simple way to convert one, or several files simultaneously, from a .log binary file to a .csv comma separated variable file that can be read by a number of third party applications such as Microsoft Excel.



To view the data from a spreadsheet program such as Excel, follow these steps:

1. Retrieve the data from the Logger
2. Use **A**nalysis | **E**xport Data File(s)...to select the file to export
2. Click Open to begin the export the data to .CSV file
3. Start the spreadsheet program (Lotus or Excel).
4. Use the File | Open command in the spreadsheet and select "All Files" in the Files of type: box
5. Open the .CSV data file from the folder you specified, for example, C:\Program Files\DENT\SMARTware\Data\name of file.csv

Export may also be used to convert multiple files simultaneously to a .csv format. Use the standard windows commands **Ctrl + mouse click** to select non-adjacent files or **Shift + mouse click** to select all files between the first and last selected.

## Summary

Provides a statistical summary (total and average on-times and off-times, min/max, etc.) of data stored in file.

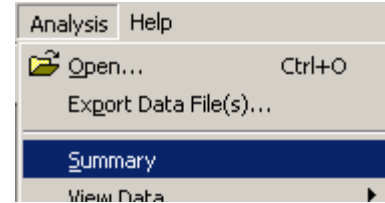
### Example Summary Report

Data File Name: F:\Data\40131001.log  
Logger Serial Number: 930922-364  
Description: Television  
Logger Reset: 11/28/98 2:39:10 PM  
Data Starts: 11/28/98 2:39:10 PM  
Data Ends: 1/31/99 7:20:13 PM  
Total Elapsed Time: 1540.68 hrs  
On-Time since Reset: 582.5 hrs

Number of Turn Ons: 216  
Percent On: 37.8 %  
Total On-Time: 582.56 hrs  
Average On-Time: 2.70 hrs  
Longest On-Time: 14.53 hrs  
Shortest On-Time: < 0.01 hrs

Number of Turn Offs: 215  
Percent Off: 62.2 %  
Total Off-Time: 958.12 hrs  
Average Off-Time: 4.46 hrs  
Longest Off-Time: 69.69 hrs  
Shortest Off-Time: < 0.01 hrs

**TECH TIP:** If a connected load kW value has been set (see **Set the kW Scale Factor** below) then a kWh number will also appear with every on-time value in the Summary.

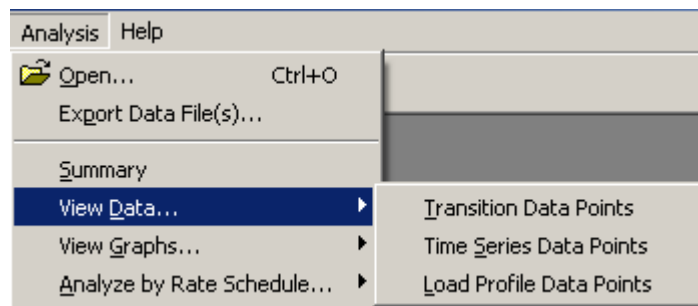


## View Data...

View Data is used to choose how the data is displayed.

**Note:** For Time Series Data and Load Profile Data the data views will use the default values set in **Tools; PC Setup**.

**TECH TIP:** Once a data file has been opened, the view can also be changed by clicking on the data presentation box at the top left of the data window.



**Transition Data Points** This view is of the raw data as it is stored in the logger. A brief excerpt is shown below:

	<b>Date</b>	<b>Time</b>	<b>Transition</b>
1	11/28/98	2:39:10 PM	Was ON
2	11/28/98	4:28:35 PM	Turned OFF
3	11/28/98	8:02:09 PM	Turned ON
4	11/28/98	11:30:54 PM	Turned OFF
5	11/29/98	7:35:41 AM	Turned ON
6	11/29/98	7:35:43 AM	Turned OFF
:	:	:	:

**Time Series Data Points** This view is similar to Transition Data Points and shows data after it has been converted to Time Series format. "Bin" sizes may be set from 5 minutes to 24 hours. The time series data may also be exported in a .CSV format for further analysis in spreadsheet(s) or other programs. An example of a Time Series Data set (converted from the Transition Data above) is shown below:

<b>Date</b>	<b>Starting</b>	<b>Ending</b>	<b>Percent On</b>
11/28/98	2:45:00 PM	2:59:59 PM	100.0%
11/28/98	3:00:00 PM	3:14:59 PM	100.0%
11/28/98	3:15:00 PM	3:29:59 PM	100.0%
11/28/98	3:30:00 PM	3:44:59 PM	100.0%

The Percent On column is the percentage of time in the interval that the monitored load was on. Note that the interval size is set to 15 minutes in this example.

**Load Profile Data Points** creates a 24 hour or one week load profile from the data. Note that the load profile interval is set to 1 hour in this example.

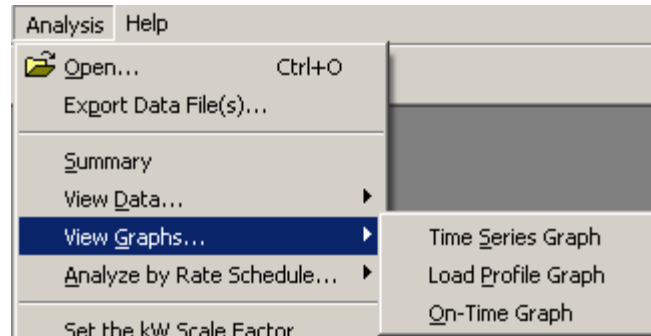
A load profile takes all of the data collected by the logger and creates an average day (or week). It does this by overlaying each day on top of one another and calculating an average day. In the example below, for all of the days that the logger was monitoring and for the hour from 09:00 until 10:00, the load was on the 51.4% of the time.

<b>Starting</b>	<b>Ending</b>	<b>Percent On</b>
7:00:00 AM	7:59:59 AM	19.0%
8:00:00 AM	8:59:59 AM	51.8%
9:00:00 AM	9:59:59 AM	51.4%
10:00:00 AM	10:59:59 AM	41.7%
11:00:00 AM	11:59:59 AM	36.0%

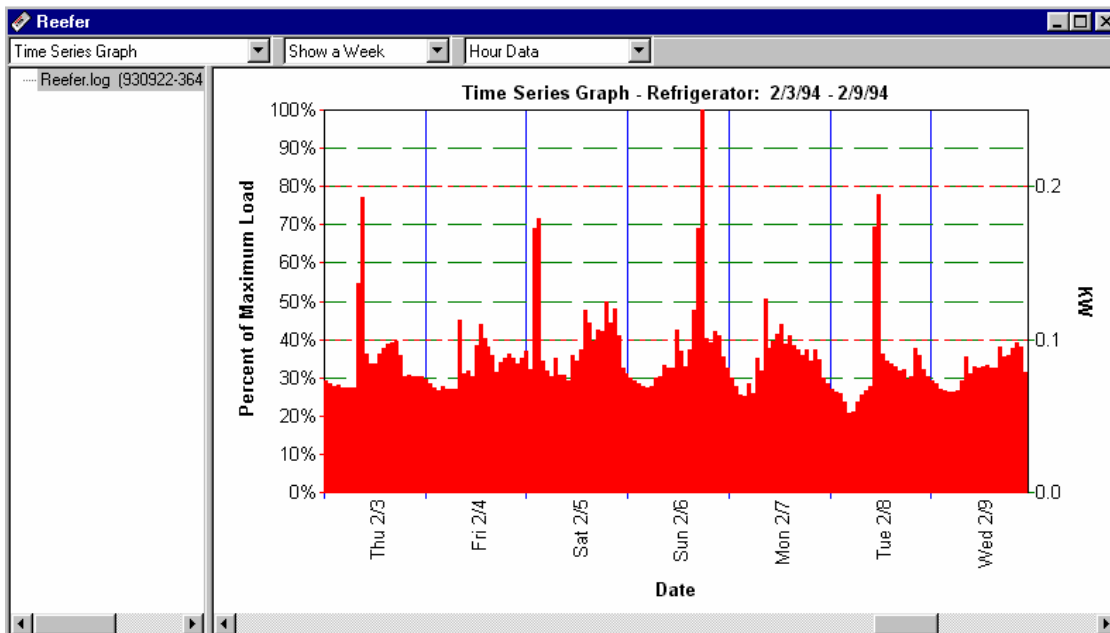
The load profile function is very powerful and allows you to change a number of parameters including which days are used in the calculation (weekdays only, weekend days only or all days).

## View Graphs...

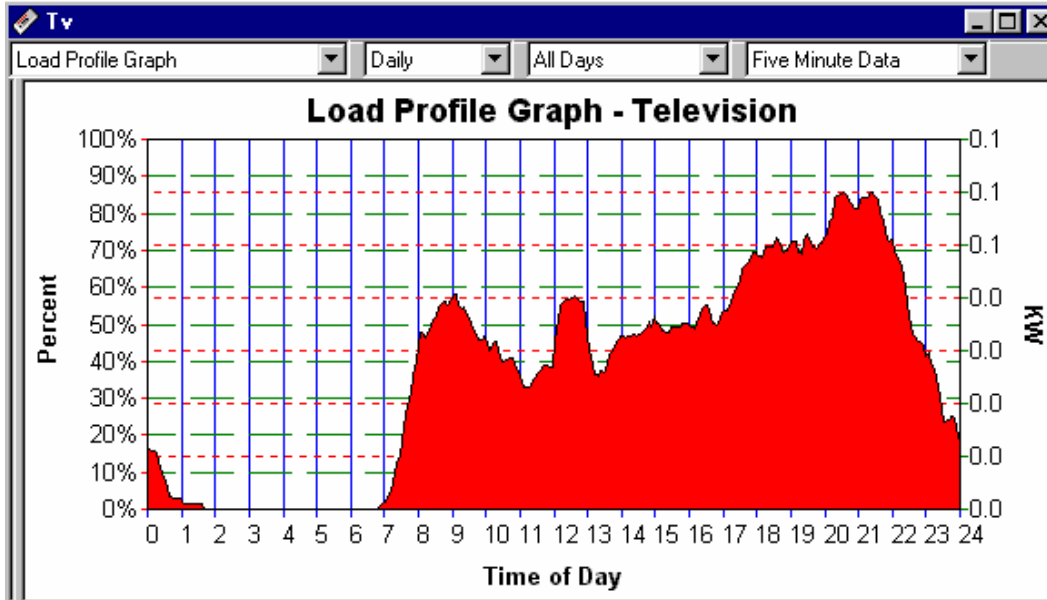
View Graphs... is used to show the logged data in various graphical formats. The graphs types are explained in detail below.



**Time Series Graph** is shown in the example below. To create this graph, the software first converts the transition data into a time series format. The drop down boxes along the top of the graph allow changing the view from a week of data at a time to viewing one month of data. The data interval may also be selected from 1 minute to 24 hours. An example graph is shown below.

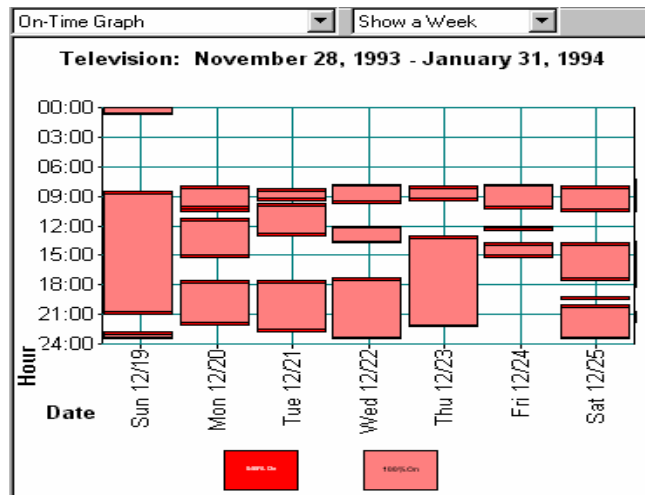


**Load Profile Graph** plots the load profile data points. The interval size (1 minute to 24 hours) may be changed on the graph as can the type of days included in the graph. An example is shown below.



**Note:** Any of the graph parameters can be changed by clicking on any of the menu boxes at the top of the graph.

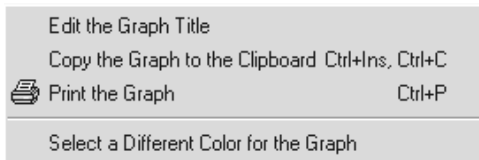
**On-Time Graph** is a simple way to view the data collected by the logger:



This graph depicts the on-time as recorded by the logger. The days are shown across the bottom of the graph and the time of day along the vertical axis. The white space is where the monitored load was off and the colored area is where the load was on. This presentation shows the logged data in a way that makes interpreting on and off times very simple. The On-time graph is usually the first graph to look at after downloading data from a logger. It is also

very simple to understand and is useful as a presentation tool for clients when performing energy audits.

**Editing A Graph** Along the top row of the graph are several drop down boxes that allow defining some of the graph parameters such as the data interval or amount of data shown. Different graphs have different editing capability. Only the functions that are available for a given graph will be available.

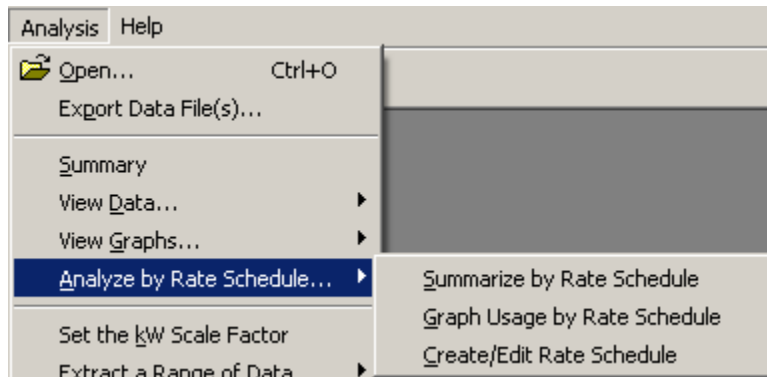


A number of changes can be made to all graphs such as changing the graph title and graph color. To edit the graph, place the mouse cursor anywhere in the graph and then right-click. For all graphs, using the right mouse click gives a menu shown to the right.

Double (left) clicking the mouse on the title also allows editing. The color can be changed by double clicking anywhere in the graph.

### **Analyze by Rate Schedule...**

This function is used to analyze energy usage or operating patterns by disaggregating all of the run-time hours into user specified time periods. These time periods can be arbitrarily defined and are often used in conjunction with a utility's time-of-use rate schedule. An example Rate Schedule might include on-peak, mid-peak, and off-peak times. Any number of different Rate periods may be defined.



Run-times, energy consumption and summary statistics and other useful data are then re-calculated by **SMARTware** for each defined period.

**Summarize by Rate Schedule** To view the summary statistics for each defined rate period, select this option. Each major period is summarized on a separate screen. The different summaries for each rate period can be accessed using the drop down menu at the top of the screen.

The default summary is All Rate Schedule Periods. Before using this feature, a Rate Schedule needs to be defined as described below.

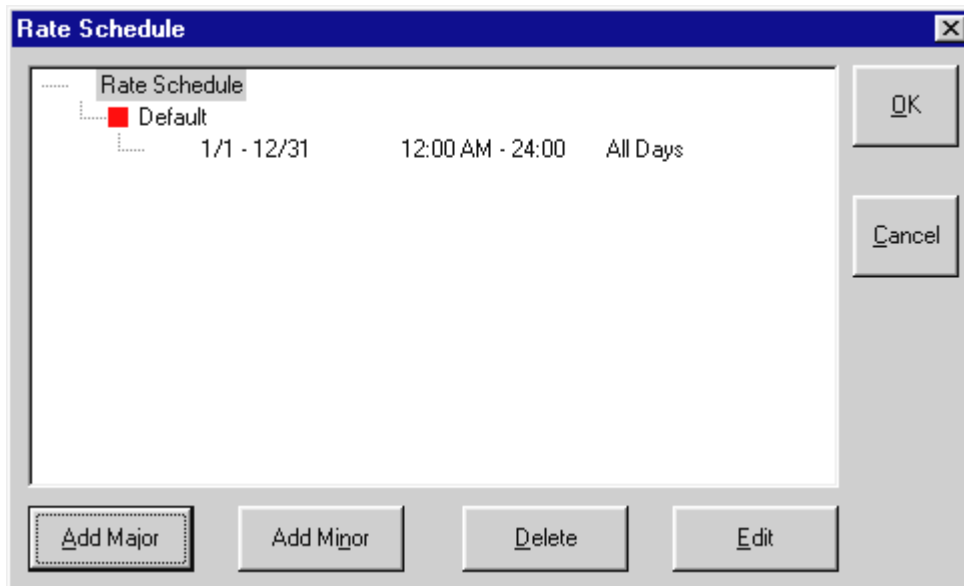
**TECH TIP:** *Input the connected load of the monitored device using the **Set the kWh Scale Factor** function in the Analysis menu before viewing your rate schedule. Total values for kWh energy consumption will then be displayed for each period.*

**Graph Usage by Rate Schedule** Select this option to view a graph of the on-times for each rate period. This graph is similar to the time series graph described earlier but here each period shown in a different color as defined when the rate schedule was created. The colors and the rate schedule definition maybe changed by right clicking on the graph.

**Create/Edit Rate Schedule** Allows you to set up or modify a rate schedule.

Before setting up a rate schedule, define the major and minor periods to be used. For example, if you want a schedule that includes the rate periods On-Peak, Mid-Peak, and Off-Peak, you need three “major” periods and enough “minor” periods to fill a 24 hour day and to span the time period of data being analyzed. The software will allow you to designate any number of major and minor time period combinations.

The first time a rate schedule is created, a default screen will appear as shown below. This can be considered a single period rate schedule and encompasses all days of the year and all hours of the day.

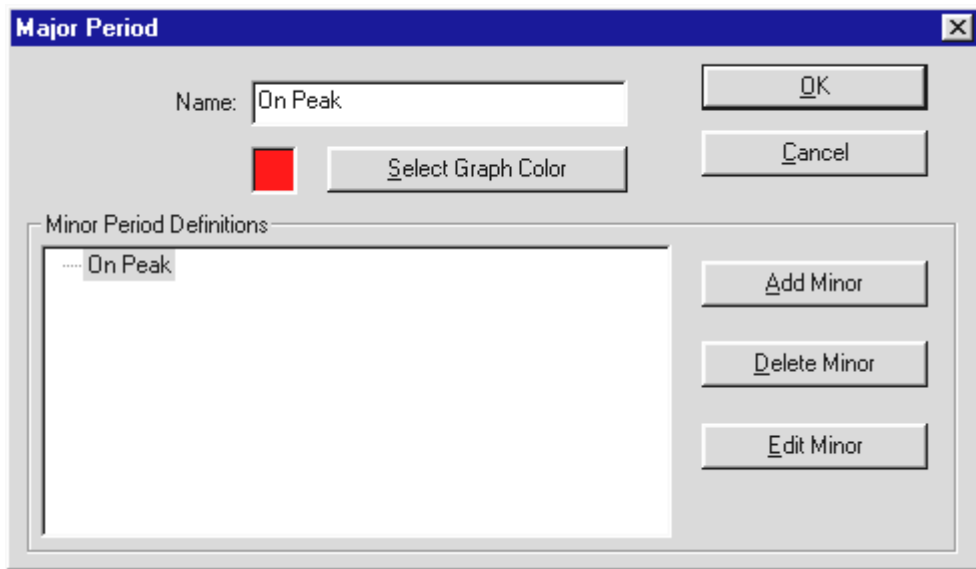


**Minor Rate Period:** Minor rate periods are used to define the major rate periods. To create minor periods use the **Add Minor** button. Use the **Edit (Minor)** button to define the three parameters which may be set for each minor rate period: Day Type; Days; and Hours of Day. Double clicking on a rate period also brings up the edit box.

**Day Type:** Choose from All Days, Week Days Only, or Weekend Days Only.

**Days:** Set the dates that you want to include in the rate schedule. Use this to define seasonal rate periods.

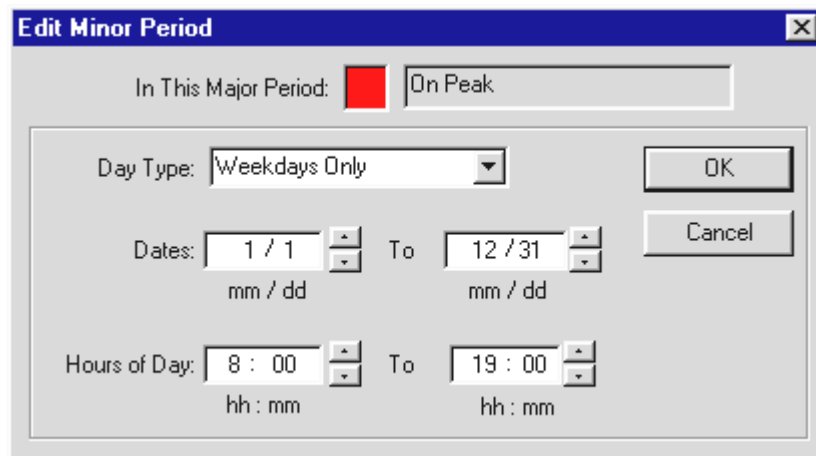
**Hours of Day:** Choose the hours for this minor period. Remember, the software uses a 24 hour clock (for example, 1:00 pm is 13:00).



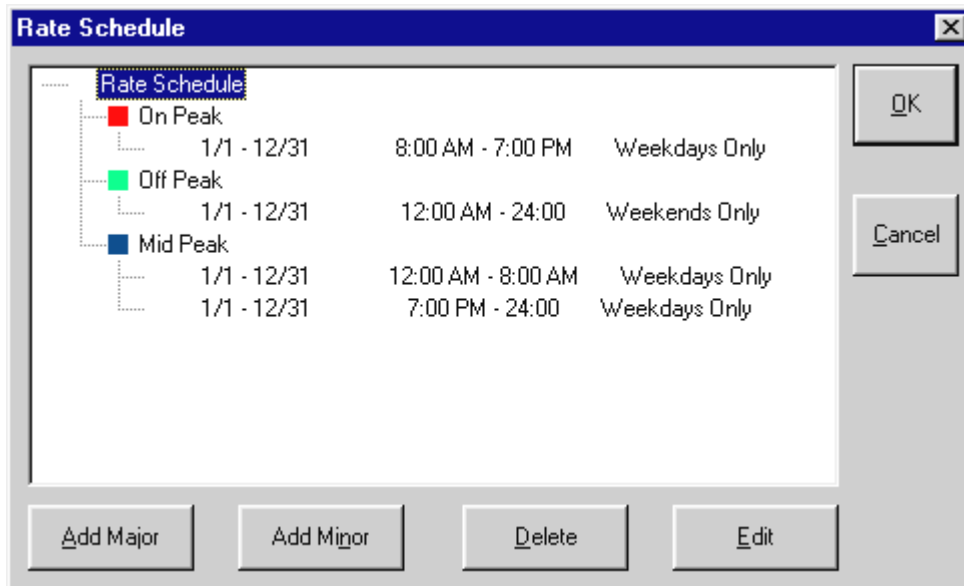
To demonstrate a multiple period Rate Schedule, a three period is defined below. To create the Rate Schedule, click on the **Add Major** button to add a new, major rate period.

**Graph Color:** After you name a major period, you can choose a unique color to appear on the graph.

Next, use the **Add Minor** button to define the Major Period. A minor period includes the days and times of the day that defines the rate period. Use **Day Type** to select Weekdays, Weekend days or All Days (both). Set the **Dates** and **Hours of Day** as appropriate. In this example the On Peak time is defined as all weekdays in the year from 8 am until 7 pm.



Similarly, the Mid Peak period was defined as the weekday times that were not On Peak. Off Peak days were defined as weekends. The resulting Rate Schedule is shown below.



To edit any of the periods, double click on an existing period to bring up an edit box.

Repeat the process of adding and defining minor rate periods until you have specified all relevant time periods for the major period. Your rate schedule will be complete when all hours of the day and all days of the chosen monitoring period are included in the minor rate periods.

Once you have completed your rate schedule, press **OK**. At this point, the computer will check for errors in the rate schedule. If there are any gaps or overlaps in your schedule, the software will alert you to *what* periods are in conflict and *where* they are in conflict. You can elect to ignore the conflicts or correct them. If there are no errors or you choose to ignore them, then you can view the rate schedules in graphical or summary form.

**TECH TIP:** *Holidays may require a unique rate schedule. Create a major period called Holiday and then create a minor period for each day to be included. For example, if January 1 is a holiday create a minor period like this:*

Day Type:	All Days
Days:	01/01-01/01
Hours of Day:	0:00 - 24:00

*Repeat this step for each holiday that is included in the monitoring period.*

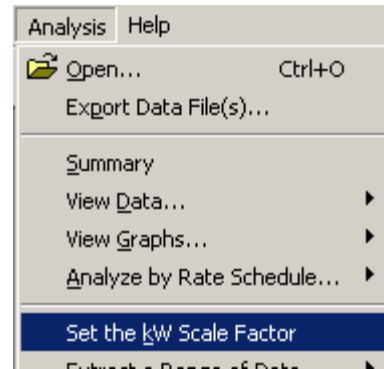
**Remember:** *You must “remove” holidays from all the major periods. If they are not removed, an “overlap error” will be reported.*

**Note:** *Only one Rate Schedule may be used at a time. To analyze the data with another Rate Schedule the new schedule must be created. Only one Rate Schedule can exist at a time. Closing the program does not delete the created Rate Schedule.*

### Set the kW Scale Factor

The **kW Scale Factor** is a unique feature that allows scaling of the on-time measured by the TOU Logger by the draw of the connected load.

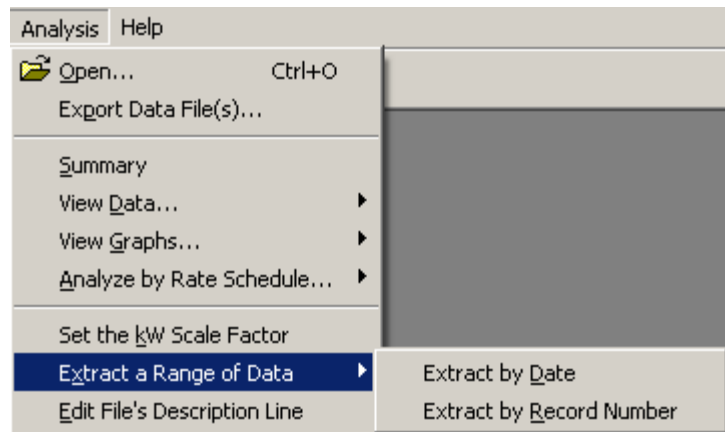
For example, assume that the logger is monitoring the on-time of an electric motor of 50 kW. With the data file open, select the **Set kW Scale Factor** menu item and enter 50. Now, whenever an on-time is shown in any of the analysis or graphical views, next to the on-time will be a new number which is the kWh consumed.



The kWh reported is the on-time (hours) multiplied by the connected load scale factor (kW).

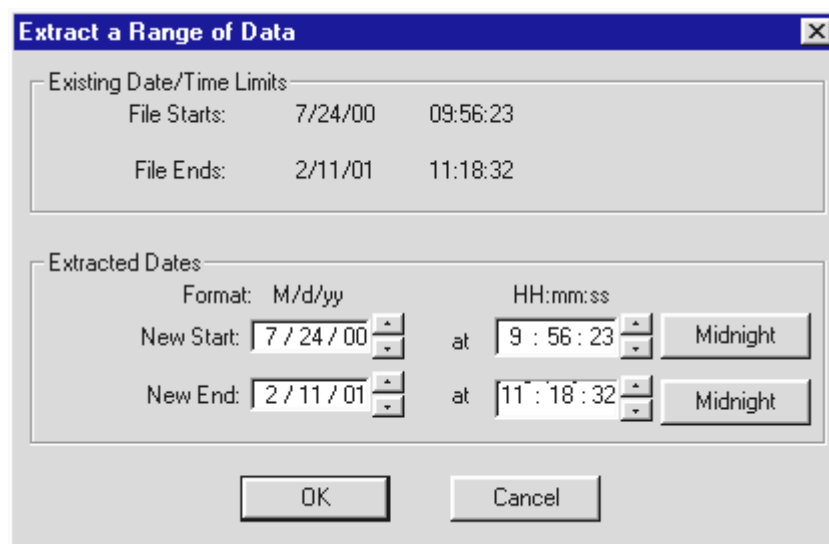
### Extract a Range of Data

Occasionally there will be extra transitions recorded into a data file that are not part of the measurement. These can occur during setup and removal. Also, there are times when it is desirable to analyze only a part of the data, perhaps for only one month of a several month measurement period. For these times, the **Extract a Range of Data** command can be used to extract only a section of data for analysis.



To use this function, first open the desired data file, then select **Extract a Range of Data**. There are two ways to select the data range to extract: by record number and by date range. In addition to the date and time of the transition, each transition is assigned a record number, which appears in the left-most column when viewing the data.

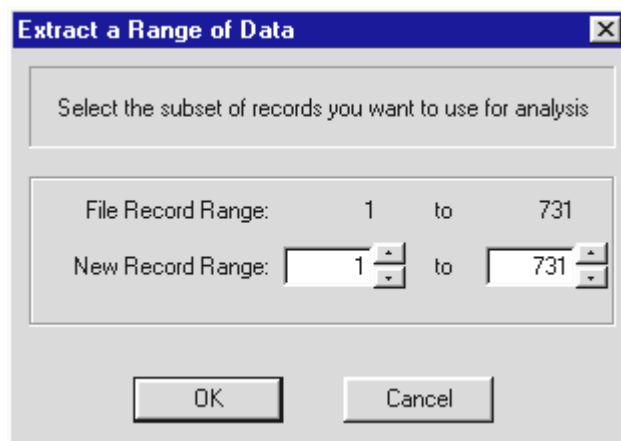
When you click on **Extract by Date** the following box appears:



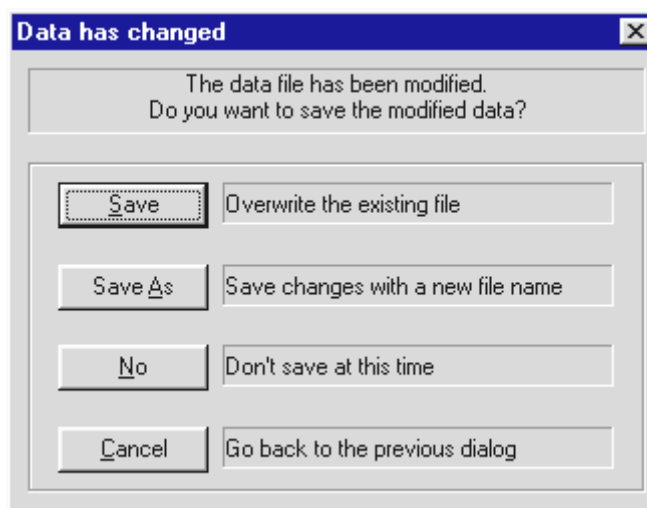
The upper portion of the box [Existing Date/Time Limits] provides the date range that the data covers. In the lower portion [Extracted Dates] enter the desired, new begin and end dates of the clipped file. Since many analyses begin on a day boundary, note the **Midnight** button that quickly sets the time to 00:00:00.

**Note:** The time 24:00:00 is not allowed. Use 00:00:00 of the next day.

The data file may also be trimmed by choose a range of record numbers. The logged data has a number assigned to each record starting with 1 and continuing to the last record. Clicking on the **Extract By Record Number** menu item brings up the following window.



Look at the original data file to determine which record numbers bound the data that you wish to extract. Then enter those numbers in the **New Record Range** using the first and last records *you want to keep*.



Then select **Ok**. The extracted data file becomes the active file. You will be prompted to save the data. If you want to keep the original data file (recommended), use **Save As** to save the clipped file under a new name or folder.

When you have created a clipped data file you have four choices as shown below.

**Save** overwrites the existing data file with the new, extracted data. The original data file is lost.

**Save As** allows you to create a new file with a different name than the original and preserves the original data file.

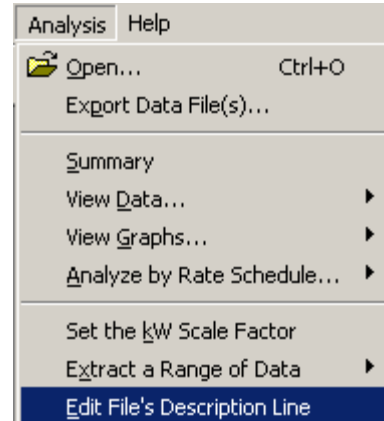
**No** lets you work with the extracted file but does not save it. When you close the data file or exit **SMART ware 2004** you will be prompted again to save the clipped file.

**Cancel** ends the data extracting function.

### **Edit File's Description Line**

A 40 character description may be added to the data file. It can be used for any purpose such as describing the installation, dates, location and so on.

The Description Line appears in the data Summary page, the Rate Schedule Summary and in all graph titles.



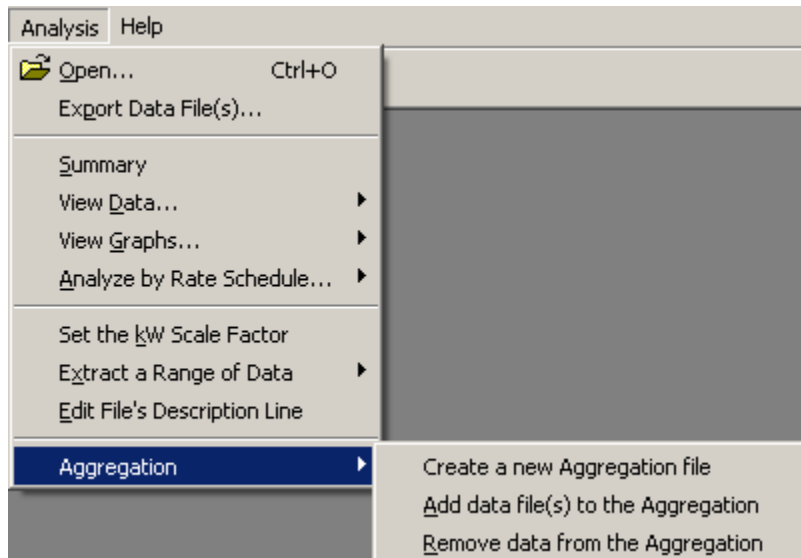
### **Aggregation**

Aggregation is the ability to combine a number of logger data files together into a single file that can then be analyzed. For example, a number of different data files that together represent the entire lighting of an office building can be aggregated to provide energy use data for the entire lighting load of the building.

Each individual logger file must have the connected load that they represent included in the analysis to "weight" the contribution of

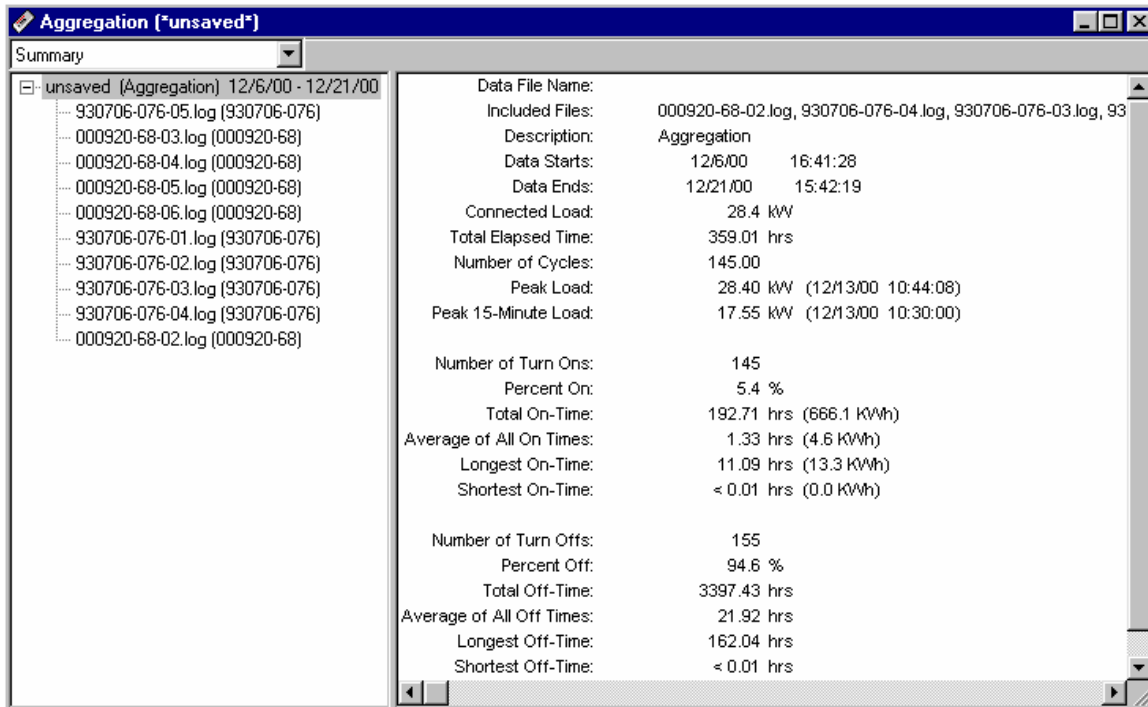
any one logger to the overall energy use. [See **Set the kW Scale Factor** menu item above.] All summary and analysis functions offered by **SMART ware** can be used on aggregated files.

**Create a new Aggregation file** To create an aggregated file for analysis use this menu item. You will be shown a folder from which you may select the files you wish to combine into a single file. You may select files to aggregate using standard Microsoft Windows commands such as left mouse click and Shift+click to select all included files and Ctrl+click to add an individual file. You may also combine files from different folders but you may find it easier to first move all of the files to be aggregated into a single folder.



**Note:** Creating an aggregated file does not affect the original data files.

After selecting the files to be combined, **SMARTware** first checks that all data files have a connected load (kW Scale Factor) assigned to them. If not, you will be prompted to add the connected load kW to files where missing or to delete that file from the aggregation. Next, **SMARTware** checks the beginning and ending dates of each file and trims the ends of each data set as necessary so that the aggregated data file will include a date range common to all the data files.

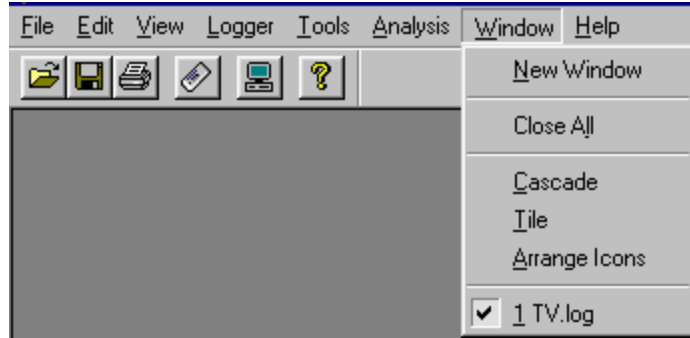


After these tests, **SMARTware** displays the aggregated file such as shown below and, on the left side of the window, the names of the files that are used in the aggregation. At this point the aggregated data file has not been saved. Before closing the window or exiting **SMARTware** you will be prompted to save or discard the aggregated file.

**Add data file(s) to the Aggregation** Additional data files may be added to an open aggregation "on the fly" by simply using this menu command. A folder window will open that allows you to select one or more files for adding to the aggregated file.

**Remove data from the Aggregation** Similarly, data files can be removed from an open aggregation by using this command as many times as necessary. Multiple files may be removed simultaneously by selected all that are desired. Data files may also be removed by clicking on the file name in the open aggregation window and hitting the Delete key.

## Window



### New Window

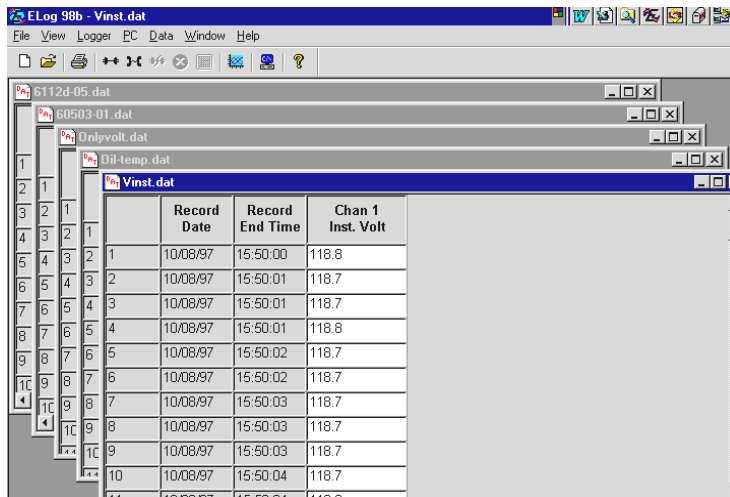
Opens another copy of the data file to view or from which to make graphs.

### Close All

Closes all open windows (data files or graphs).

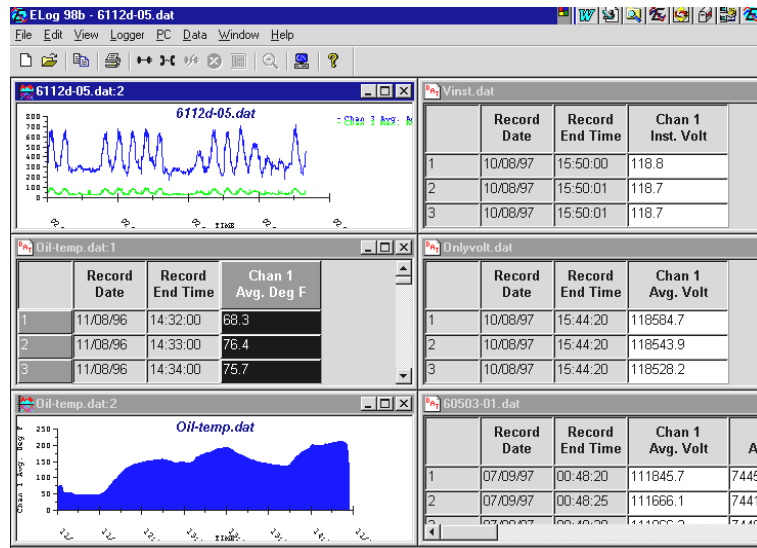
### Cascade

If multiple windows (data files or graphs) are open simultaneously, using the Cascade command will organize the open files one on top of the other as shown below.



## Tile

If multiple windows (data files or graphs) are open simultaneously, using the **T**ile command will organize the open files side by side for simultaneous viewing as shown below.



## Arrange Icons

If multiple graphs or data files have been opened and then minimized, the Arrange Icons command will order them neatly along the bottom of the screen.

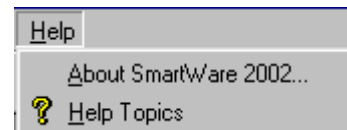
## Help

### About SmartWare 2004...


This menu item is used to check the date and version of the software and for contact information for DENT Instruments.

### Help Topics

Help Topics provides the entire **SMARTware 2004** manual. The blue "hot links" correspond with the chapters of the manual.



## Hot Buttons

**SMARTware 2004** has a number of Hot Buttons that can be used to speed some of the more commonly used commands such as retrieving data from the logger or printing. Instead of using the menu commands **F**ile; **O**pen simply click on the  button. The button tool bar can be toggled on and off by checking or unchecking the **V**iew; **T**oolbar box.

A description of the hot buttons follows:



**File Open:** Opens data files for analysis



**Save:** Saves changes to data files or aggregated data files



**Print:** Prints the active window (graph or data)





**Retrieve Data:** Retrieves data from the logger



**Setup PC:** Quickly access PC setup configurations



**Help About:** Information on **SMARTware 2004**

**NOTE:** Some buttons are not available (grayed out) if they cannot be used. For example,  and  require an open data file in order to be used.

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