TOU SMART*logger*™
&
SMART*ware*™ *2006*
Software

Operator's Manual

February 11, 2006

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
   - ➢ You can count on the instruments to provide years of reliable data!

6. *Still* the longest battery life in the industry (5+ years)
   - ➢ Won't let your project be derailed by a dead battery!

7. NEW, Third Generation TOU **SMART*logger*** features include:
   - ➢ New Total On-Time Display!
   - ➢ New Percent On Display!
   - ➢ USB communications for faster data retrieval!
   - ➢ Smaller size! 1/3 the size of the old ones!
   - ➢ Replaceable Battery

We are certain that you will find the new 3rd Generation **TOU SMART*loggers*** to be one of your most-used survey tools.

What's New With The 3rd Generation
SMART*loggers*™*?*

A lot! The TOU 3G Loggers are completely redesigned.

Smaller: About 1/3 the size of the old loggers.
Lighter: Only 1.4 oz (200 grams)
Faster: USB communication for <7 second downloads!
Upgradeable: New features can be added through firmware updates
More Information: 5 digit LCD shows On-Time, Percent On
Easier: User replaceable battery
New Version: **CONTACT***logger* for switches and relays

SMART*ware*™ 2006

Though it looks almost the same, **SMART***ware* 200*6* is very different from earlier versions. 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 SMART*ware* 2006
1. **USB communication:**
   - Take advantage of the faster communication speeds of USB. Download a full memory from the logger in 7 seconds!
   - Don't worry about setting the port number in software. The USB does it automatically.
2. **Reprogrammable TOU Firmware**: Now changes, updates, and improvements can be uploaded into the loggers
3. **Import CSV File:** Makes changes to a data file in Excel then import it back to SMARTware for more analysis.
4. **Edit the Data:** Now the data can be edited for errors in the clock or removing records that are unneeded.
5. **Backward compatible** with all legacy TOU SMARTloggers.
6. **Autolauncher** starts SMARTware automatically when the communication cable is connected to the PC
7. **More information** is shown in Status Screen including number of transitions recorded.
8. **More intuitive** menu commands.

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

Install the SMART*ware*™ 2006 Software on your Computer

1. **INSTALL THE SOFTWARE BEFORE CONNECTING THE USB CABLE!** Place the software CD into your CD or DVD drive. The software is Autoloading; just answer the questions.
2. At the *Choose Setup Type* window click *Typical* then *Next>*.
3. Windows will display a caution screen that says the software has not been tested for compatibility with XP. Don't worry, it HAS! Click *Continue Anyway* and complete the installation.
4. Next connect the USB communication cable to any USB port on the computer.
5. When the New Hardware Wizard starts click the circle *No, not this time* and then *Next>*.
6. Click *Install the software automatically* and then *Next>*.
7. The Windows compatibility message will appear again, click *Continue Anyway* then *Next>*.
8. **SMART*ware*** and your USB com cable are now ready to use with a **SMART*logger***.

Setup the TOU Logger for a Monitoring Session

1. Double click on the **SMART*ware*** icon on the Windows Desktop to start the application.
2. Connect the logger to a computer USB port with the USB *Communication* cable.

(Note: **SMART*ware*** works with Windows 2000, XP and NT operating systems, but *not* Windows 98 or earlier operating systems.)

3. With **SMART*ware*** open, click on **Logger**, and then **Logger Clock** to set the Logger's real-time clock to the correct, local time.
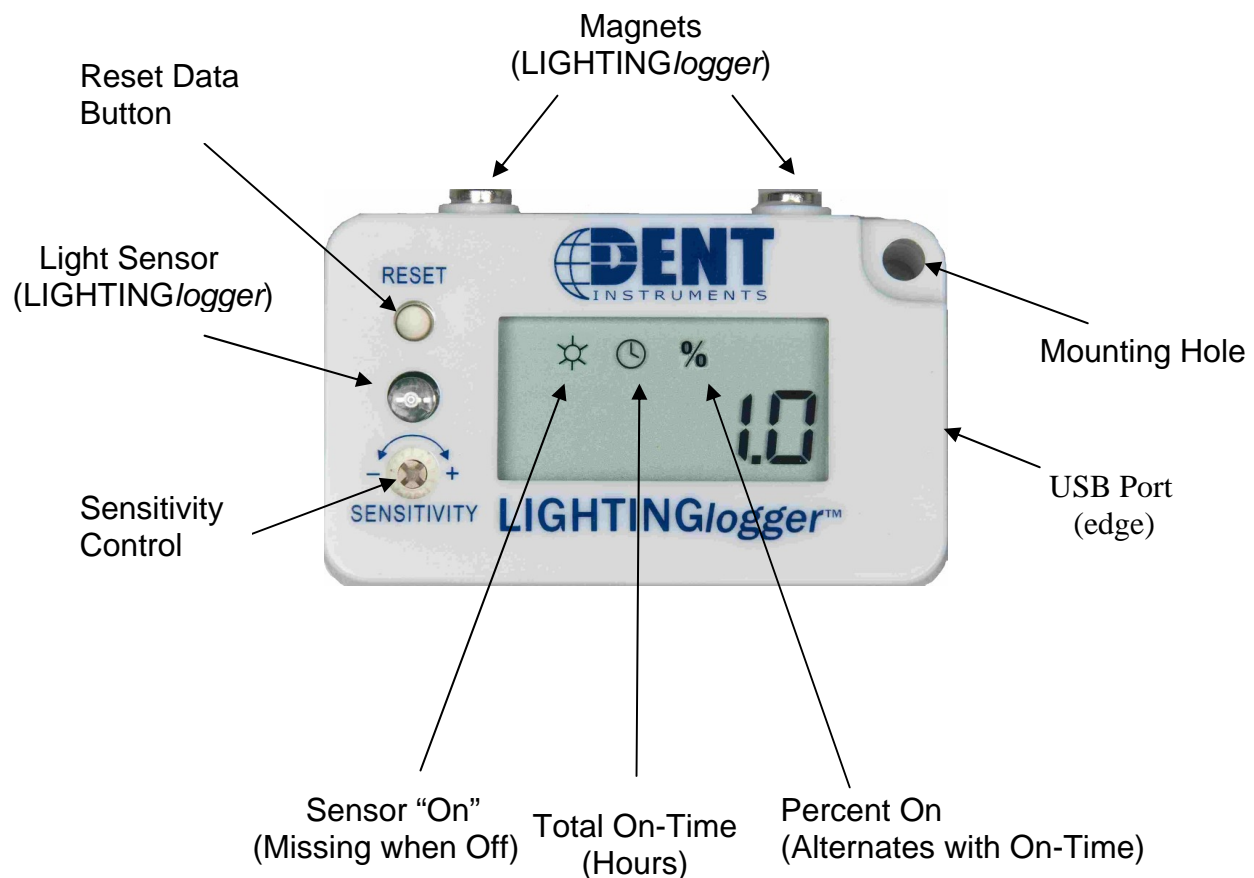4. (Optional) Use **Logger; Edit Logger Description Line…** to include an additional description in the logger.

Begin Monitoring

1. Disconnect the logger from the communication cable.
2. Choose an appropriate location to place your *TOU SMARTlogger*. Page 7
3. If using a **LIGHTING, MAG, or CT*logger*** you may wish to set the logger's sensitivity level. Page 8.
4. Verify that the on symbol , is displayed when the monitored device is on, and that the symbol disappears when the monitored device is off.
5. Clear the logger's memory with the RESET switch. Push and hold the button for several seconds until the display shows "rESEt."
6. Record the logger's location and serial number on a separate piece of paper for easy retrieval later.
7. Sometimes a photo of the installation can make finding the logger at retrieval much easier.

Retrieve and Analyze Data from a *SMARTlogger*

1. Connect the logger to the computer using the USB Communication cable.
2. Start **SMART***ware* and use the **Logger; Retrieve Data…** command to retrieve the data from the logger and save it to the computer hard drive.
3. Use any of the options in the **Data** menu to study the data or use **File; Save As** to save the data file in a .CSV (comma separated variable) format for opening in a spreadsheet such as Excel.

The TOU **SMART***logger* Layout

Magnets
(LIGHTING*logger*)

Reset Data
Button

Light Sensor
(LIGHTING*logger*)

RESET

Mounting Hole

Sensitivity
Control

SENSITIVITY

USB Port
(edge)

LIGHTING*logger*™

Sensor "On"
(Missing when Off)

Total On-Time
(Hours)

Percent On
(Alternates with On-Time)

Table of Contents

I. INTRODUCTION TO THE SMART*LOGGER*™ MODELS AND SOFTWARE

TOU SMART*loggers* are single channel, on-off status data loggers. They are designed to provide **Total On-Time** and **Time-Of-Use** (TOU) information about energy consuming devices with a constant power draw as well as 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 to the logger's memory is a series of on-off transitions and time stamps such as shown below. The Total On-Time and Percent On are shown on the logger's 5 digit LCD screen.

	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

Data stored in the logger can be downloaded to your computer, where the **SMART*ware* 2006** Software will analyze and graph the data, or let you export the data and analyze it in the software of your choice such as Excel.
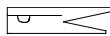
There are four logger models:

- The **LIGHTING*logger*™, Model TOU-L**, for monitoring lights;
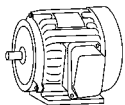
- The **MAG*logger*™, Model TOU-M**, for monitoring electric motors, appliances, computers, or any device generating a magnetic field;

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

- The **CONTACT*logger*™, Model TOU-C**, for monitoring relay closures, switches, and digital on/off signals.   **{NEW!}**

The information you can obtain includes:

- Total On-Time and Percentage of the time the device was on since Reset from the display, and from the stored data:
- 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.
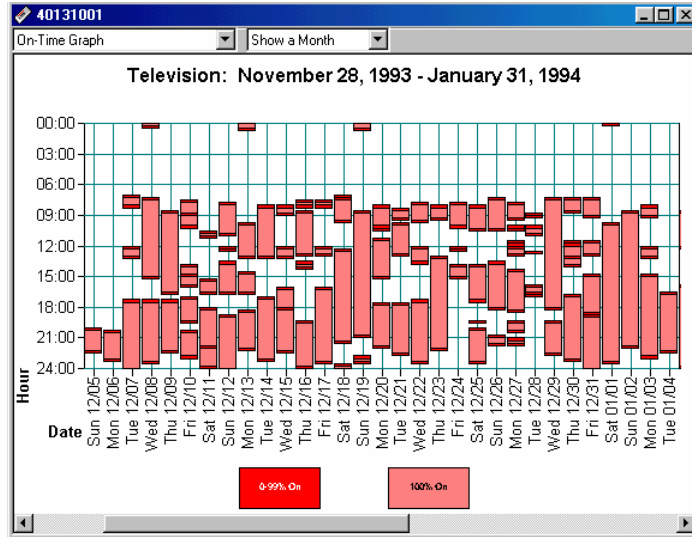
Example of an On-Time Graph

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 Windows clipboard and pasted into other programs such as word processors for making reports.

II. SPECIFICATIONS & SYSTEM REQUIREMENTS

II.A. *SMARTlogger* Specifications

Dimensions: .75 X 1.5 X 2.5" (19 X 38 X 64 mm)

Weight: 1.5 oz. (200gm) TOU-L and TOU-M

Mounting:
LIGHTING*logger*	Rare Earth Magnets with 4 lb (18N) breakaway force from steel or mounting hole
MAG*logger*	Velcro Strip® or mounting hole
CT*logger*	Velcro Strip® or mounting hole
CONTACT*logger*	Velcro Strip® or mounting hole

Display: 5 digit LCD showing logger sensing, Total On-Time and Percent On since Reset

Units: Time stamp records in month, day, year, hour, minute, second.

Event Counting: Max frequency = 1 Hz

Sensitivity:
LIGHTING*logger*	At maximum sensitivity: 23 foot-candles
	At minimum sensitivity: 5000 foot-candles
MAG*logger*	At maximum sensitivity: 15 milliGauss
	At minimum sensitivity: 3000 milliGauss
CT*logger*	At minimum sensitivity: 0.25 amps
	At maximum sensitivity: 16 amps
CONTACT*logger*	Dry contact, unenergized switch or open collector transistor

Power: User replaceable battery provides 5+ 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: 8000 transitions

Communication: USB with **SMART*ware* 2006** communication cable

Data Analysis: **SMART*ware* 2006** 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
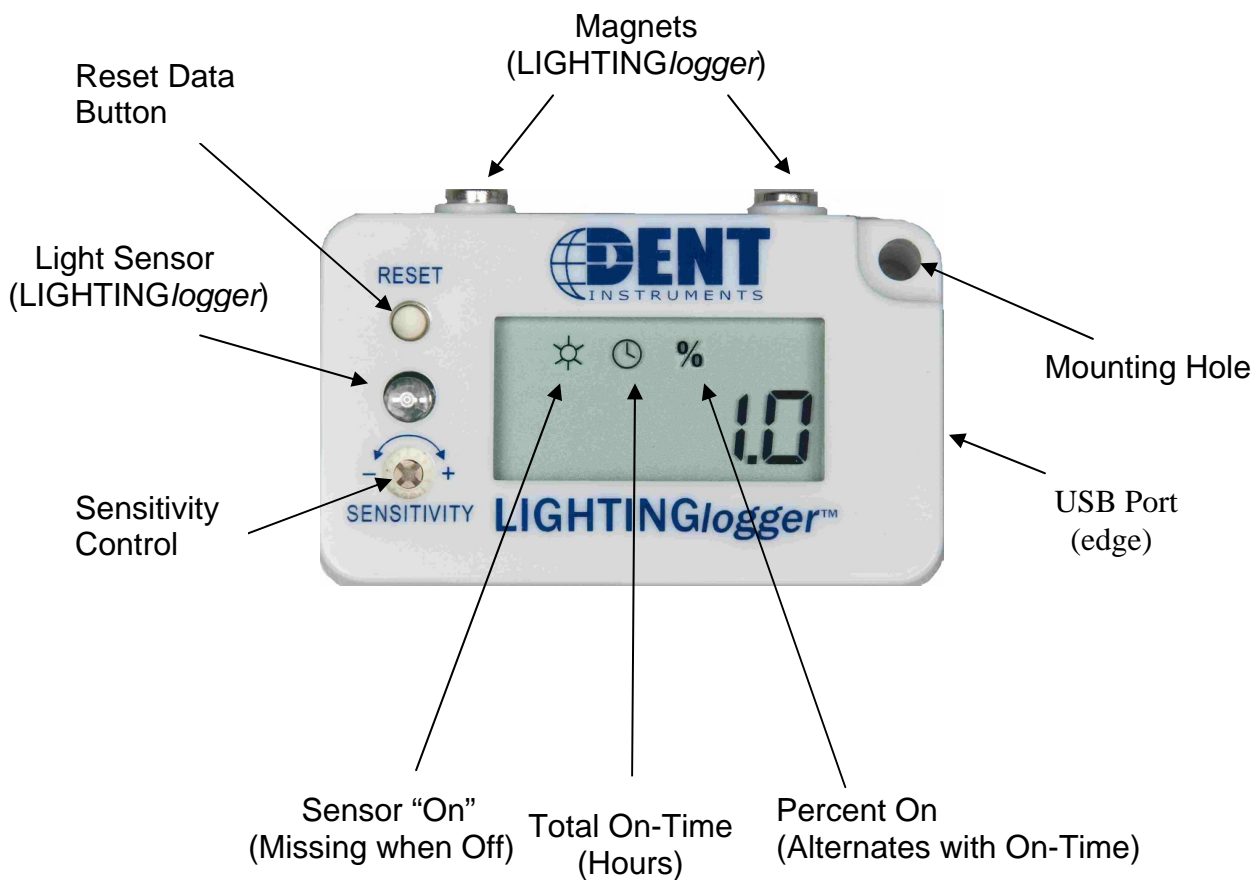
Operating System: Windows® 2000, NT, and XP

Hard Drive: 50MB minimum available

Graphics: SVGA or higher resolution (800X600)

Communications Port: One USB Port

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

The TOU **SMART***logger* Layout

Magnets
(LIGHTING*logger*)

Reset Data
Button

Light Sensor
(LIGHTING*logger*)

Mounting Hole

Sensitivity
Control

USB Port
(edge)

Sensor "On"
(Missing when Off)

Total On-Time
(Hours)

Percent On
(Alternates with On-Time)

III. USING THE *TOU Series SMARTLOGGERS*™

You can install the *TOU* SMART*logger* in seconds, without an electrician, by following these simple steps (explained in more detail in section III.B):

1. Using the **SMART*ware*** software, Set the logger's internal clock, and give the logger an identifying name.

2. Record the installation date or 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 symbol is displayed when the monitored device is on, and that the symbol is blank when the monitored device is off.

5. Clear the logger's memory by pushing and holding the RESET switch with a pencil tip or paper clip and hold until the LCD shows rESEt.

6. Record the logger's location and serial number on a separate piece of paper 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 SMART*ware*™ 2006

To use the **SMART*ware 2006*** software it must first be installed on your computer.

1. **INSTALL THE SOFTWARE BEFORE CONNECTING THE USB CABLE!** Place the software CD into your CD or DVD drive. The software is Autoloading; just answer the questions.
2. At the *Choose Setup Type* window click *Typical* then *Next>*.
3. Windows will put a caution screen that says the software has not been tested for compatibility with XP. Don't worry, it REALLY has! Click *Continue Anyway* and complete the installation.
4. Connect the USB communication cable to any USB port on the computer.
5. When the New Hardware Wizard starts click the circle *No, not this time* and then *Next>*.
6. Click *Install the software automatically* and then *Next>*.
7. The Windows compatibility warning will appear again, click *Continue Anyway* then *Next>*.
8. **SMART*ware*** and your USB com cable are now ready to use with a **SMART*logger***.

When the **SMART*ware 2006*** software is run, 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
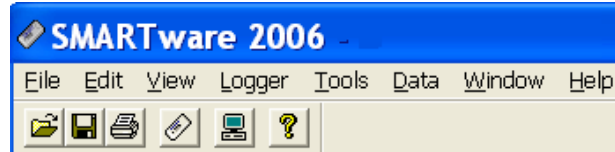
Communicating with the Logger: Since the TOU SMARTloggers have no user interface on the logger, all communication must happen through a computer (PC) using the SMARTlogger USB Communication Cable. Note that the cable only connects to the logger one way with the tab down.
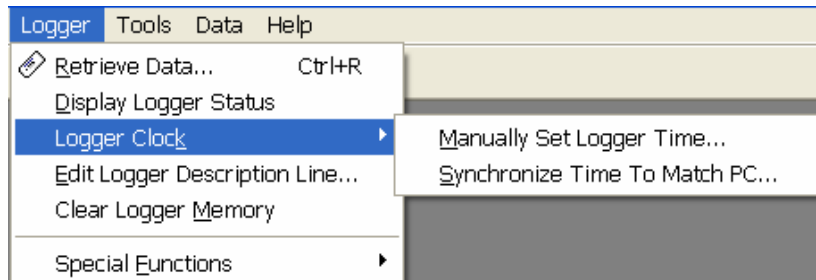
TECH TIP: *If you have difficulty getting the PC to connect to the SMARTlogger try plugging the Communication Cable into a different USB port. Do not use a USB hub.*

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

III.B.   Detailed Explanation of Using the Logger

1. Set the Clock

Connect the SMARTlogger to the computer with the USB communication cable. Use the **SMART*ware 2006*** command: **Logger; Logger Clock** and then manually set the time or use the PC clock to automatically set the logger 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 USB 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.


6
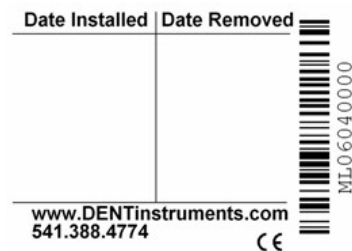
3. Place The Logger

LIGHTING*logger*™: The unlabeled hole in the middle of the left edge of the LIGHTING*logger* contains the light sensor. Install the LIGHTING*logger* so that the light sensor is aimed toward the light source to be monitored *and* away from any 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 LIGHTING*logger* inside the fixture and attach using the magnets on top. When monitoring incandescent lighting, high temperatures must be considered. The maximum temperature rating of all **SMART***loggers* 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. Contact DENT for availability.
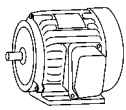
MAG*logger*™: The MAG*logger* is designed to attach to the motor case using the enclosed Velcro® fasteners. The surface of the motor case must be clean before the Velcro® will adhere to the motor. Duct tape or other fastener may also be used.

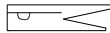Use a Ziploc® bag to protect the logger from moisture and contaminants when in a harsh, wet, or outdoor location.

Because of differences in motors, some brief experimentation may be required to locate the logger in an optimum sensing position. The MAG*logger'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 MAG*logger's* on symbol is shown. 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 the ON symbol is displayed.

The MAG*logger* can also be used to monitor individual conductors carrying one amp or more. This ability makes the MAG*logger* 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 or over the thermostat cover. Separating the wires may be unnecessary for larger loads.

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

CT*logger*™: 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 bare 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 on indicator shows in the display.

CONTACT*logger*™: The CONTACTlogger is designed to monitor switches and relays. It comes with a 3 foot (90 cm) pair of wires that are connected to the switch or relay. The CONTACTlogger can only be used on un-energized, "dry contact" devices.

Secure the logger itself with Velcro® or duct tape. Use a Ziploc® bag to protect the logger from moisture, if necessary.
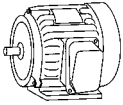
4. Set the Logger Sensitivity

LIGHTING*logger*: You can adjust the LIGHTING*logger* for various ambient light conditions by turning the screw labeled "SENSITIVITY."   The LIGHTING*logger* is sensing the lights when the display ON symbol 🔆 is shown. 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 (ON symbol is missing). The logger should then show the ON symbole 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. **DO NOT OVERTURN! THE SCREW WILL ONLY TURN THROUGH ABOUT 270°**. 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.

MAG*logger* and **CT*logger***: Normally set the sensitivity to maximum (all the way clockwise). Otherwise, if a constant background load is <u>not</u> to be monitored (e.g. the defrost cycle in a refrigerator), set the sensitivity so that the unwanted load will not activate the logger. Use a screwdriver to turn the sensitivity screw clockwise for greater sensitivity or counter-clockwise for less sensitivity. Some experimentation may be needed to find the right setting.

The **CONTACT*logger*** does not have a sensitivity adjustment.

5. Reset the Memory

If the data in memory are not part of the current experiment, insert a small screwdriver or toothpick into the hole labeled "RESET" and push and hold down the recessed button for approximately 2 seconds until the word "rESEt" appears in the display. This will clear any data from the logger's memory. Be sure to do this after you have set the sensitivity.

CAUTION: This will clear all data from the logger memory. In the event this happens inadvertently, see the section "Special Functions" on page 14 to find out how to retrieve lost data.

6. Record Serial Number and Location

☞ It is important to note the location of the logger on a separate piece of paper, since it is easy to forget where you put it. Using a digital camera to take a picture can also be very helpful at the time of retrieval to find then again.

7. Retrieve Data From The *SMARTlogger*

At the end of a monitoring session, remove the logger from its monitoring location. Record the removal date on the back of the logger. Recording the beginning and end times of the monitoring is useful when additional transitions are recorded by the logger before or after the monitoring and it is desirable to "clip" the ends off of the data. See also page 26 for a description of how to extract a range of data from the file.

Connect the Logger to your computer with the SMART*logger* USB Communication Cable. The communication cable is required for proper communication between the computer and logger. <u>Do not use any other USB cable.</u>

All models of the *TOU SMARTlogger* family communicate with the same type of communication cable and SMART*ware* software.

8. Data Analysis

SMART*ware* 2006 offers a number of "one-touch" analyses including: Summary statistics; Load Profiles; Multiple logger file aggregation; Analysis by Time-Of-Use rate periods (Rate Schedule Analysis); Run-Time graphs and numerous other features. These are described in detail in Section IV beginning on page 10.

In addition to the built-in analysis capability, **SMART*ware* 2006** allows you to export the data in a .CSV format (ASCII) which can be opened in Excel and other spreadsheet programs for even more analysis.

IV. SMART*ware 2006* MENU COMMANDS

This section is a line-by-line description of every feature in the **SMART*ware*** software. The order of presentation is from left to right and top to bottom for each command.

When the **SMART*ware*** software is first launched, the MAIN MENU will appear which consists of one line of standard Windows menus and a lower line of "hot buttons" (Page 32) that can access many of the most commonly used software functions with just one click of the mouse.

MAIN MENU

Note: Because Windows 2000 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 to 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 **Open** 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 **Extract**ed 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 compute 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).*
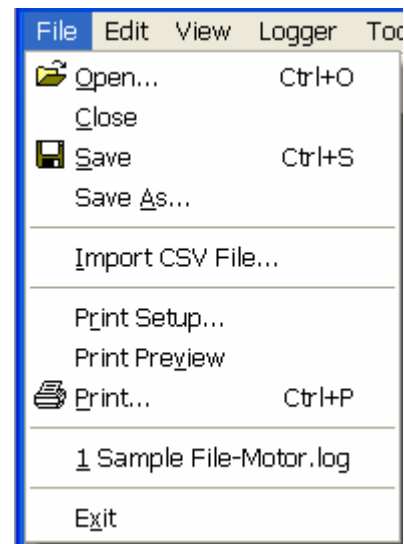
Import CSV File…

Allows a data file that had been modified in Excel (for example) to be imported back into a .log format and analyzed in **SMART*ware***.

Print Setup…

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

Print Preview

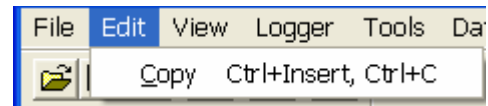Displays on the computer screen the document to be printed as it will appear on the paper.

Print

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

Exit

Exits and closes the **SMART*ware*** 2006 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.
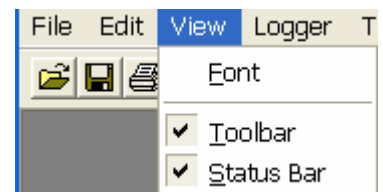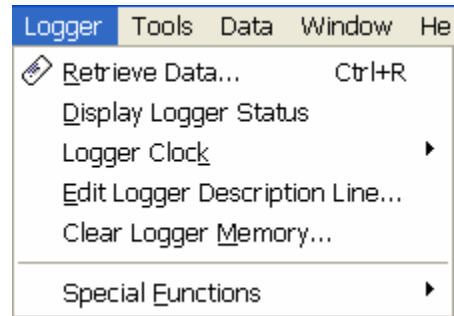
The change made to the default fonts can be printed but they do not persist in a copy command.

The toolbar line (Hot Buttons under the main menu, see Page 32 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 the selection box 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.

Menu shown:
Logger | Tools | Data | Window | He

- Retrieve Data...   Ctrl+R
- Display Logger Status
- Logger Clock   ▶
- Edit Logger Description Line...
- Clear Logger Memory...
- Special Functions   ▶

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 SMARTlogger USB 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 15-16) 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 **Data; 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
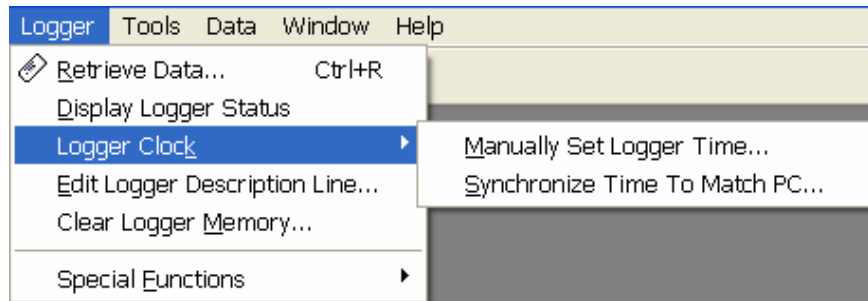
Display Logger Status

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's Present Status

Description:	DENT TOU Logger
Serial Number:	060130-
Logger Date:	4/13/2006
Logger Time:	10:31:40 AM
Logger Status:	On
Last Reset:	3/23/2006 10:45:50 AM
Current Record Count:	655
Total On Time:	75.1 hours

Close
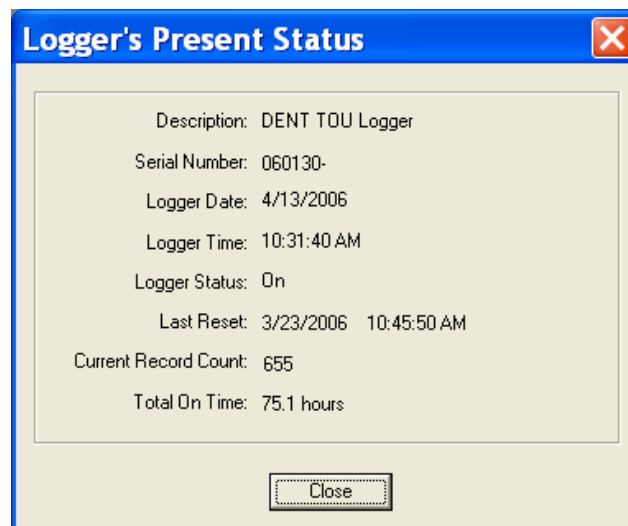
Logger Clock

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

Logger	Tools	Data	Window	Help

- ✎ Retrieve Data...   Ctrl+R
- Display Logger Status
- Logger Clock   ▶   Manually Set Logger Time...
- Edit Logger Description Line...   Synchronize Time To Match PC...
- Clear Logger Memory...
- Special Functions   ▶

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 **Data; 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 **Data; 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 using the **Special Functions** command below.
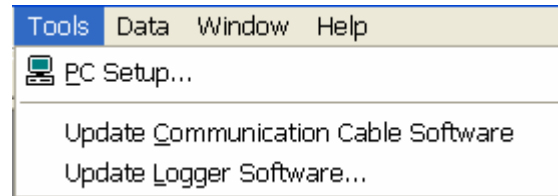
Special Functions; Retrieve ALL Data from the Logger
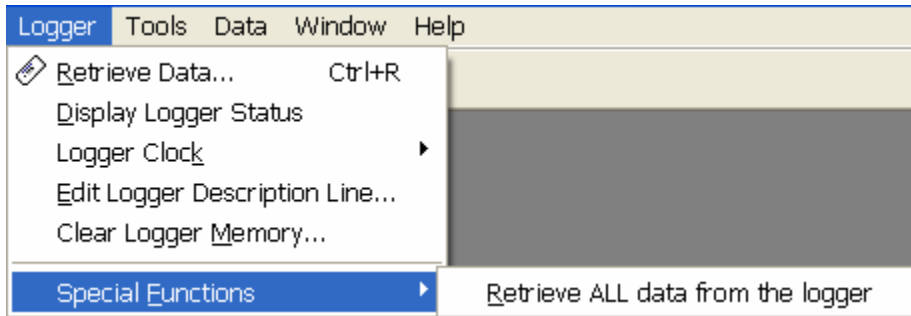
Retrieves ALL data from the logger's memory. Use this after an accidental reset of the logger.

All 8,000 data points in the logger's memory will be retrieved; only a portion of which are the actual or "real" data. Use **Data; 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 when used with older, legacy SMARTloggers.
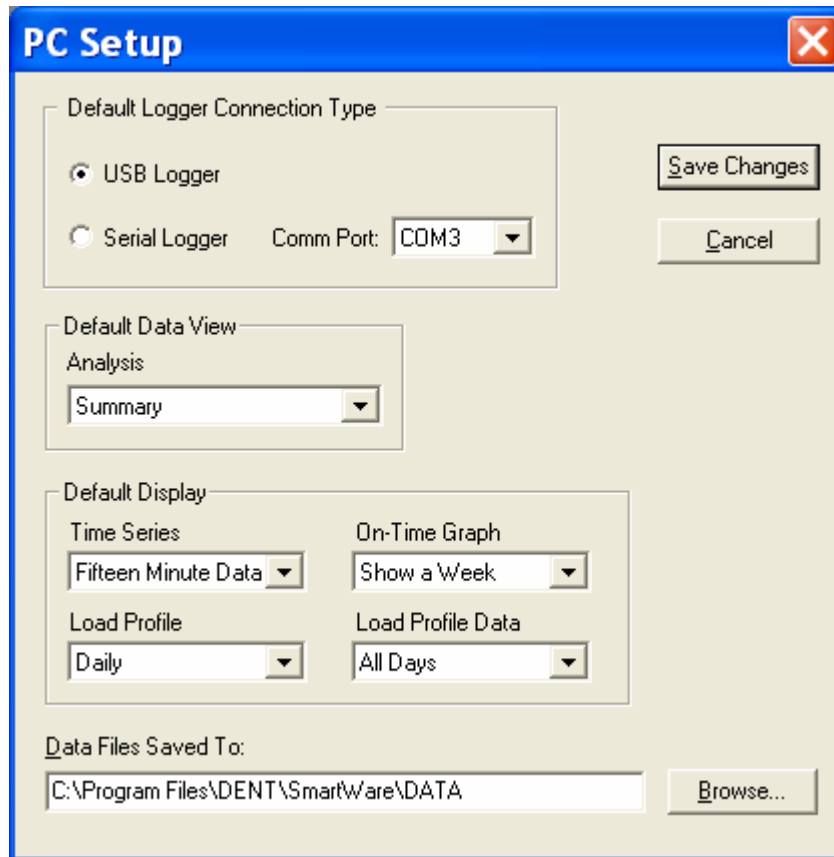
Default Logger Connection Type   Sets the default for which type of logger is to be connected to the PC. Note that SMARTware will automatically detect which logger type is connected to the PC. If an older, serial logger is used the Com Port it is connected to must be specified. If a serial logger is used it must have a separate serial communication cable.

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

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 in a weekly or a monthly format.

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 viewing of the graphs or data

.

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

The 3G (Third Generation) SMARTloggers offer a feature found in no other loggers of similar price. In addition to updates and features being added to the SMARTware, new features that are added to the "firmware" in the loggers can also be added. Contact DENT instruments for more information.

Update Communication Software…   **{New With SMARTware 2006}**

Use this to add new features to the USB Communication Cable

Update Logger Software…   **{New With SMARTware 2006}**

Use this function to add new features to the SMARTlogger.

Data

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.*

```
Data  Window  Help
📂  Open Data File...        Ctrl+O
✎  Retrieve Data...          Ctrl+R
    Export Data File(s)...
    Import CSV File...

    Summary
    View Data...                    ▶
    View Graphs...                  ▶
    Analyze by Rate Schedule...     ▶

    Set the kW Scale Factor
    Extract a Range of Data         ▶
    Edit File's Description Line

    Aggregation                     ▶
```
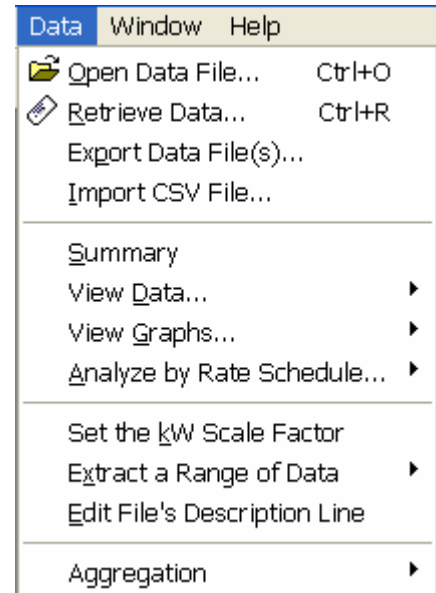
Retrieve Data...   **{New With SMARTware 2006}**

Retrieves data from the logger and saves as a .log file to the hard disk.

Export Data File(s)…

Export allows a quick and simple way to convert one, or several files simultaneously, from a .log binary file into 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. After retrieving the data from the Logger and saving the file on the PC use Data | Export Data File(s)…to select the file to export.
2. Click Open to begin the export the data to .CSV file.
3. To view the .csv file start the spreadsheet program (Lotus or Excel).
4. Use the File | Open command in the spreadsheet and select "All Files" in the box Files of type:
5. Open the .CSV data file from the folder you specified, for example,
   C:\Program Files\DENT\SMARTware\Data*name of file.csv*

Note: The new file will be placed in the data folder specified in the Tools | PC Setup… menu.

Export may 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.

Import CSV File…   **{New With SMARTware 2006}**

Import is used to convert a .csv file back to a .log that can then be read by SMARTware. This is a very useful feature when a .log file needs to be edited. For example, assume the logger clock was not set to the correct time before the metering project began. The .log data could be exported, opened in Excel and all of the date & time stamps edited to the correct time. The .csv file could then be imported back into SMARTware for further analysis.

Summary

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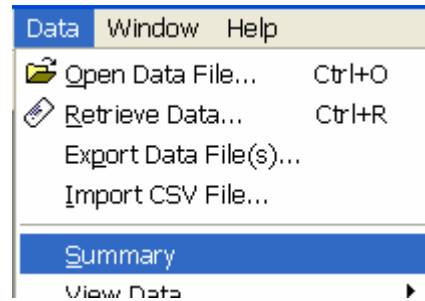
Example Summary Report

Data File Name:	F:\Data\40131001.log
Logger Serial Number:	930922-364
Description:	Television
Logger Reset:	11/28/05 2:39:10 PM
Data Starts:	11/28/05 2:39:10 PM
Data Ends:	1/31/06 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 the format of 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.***
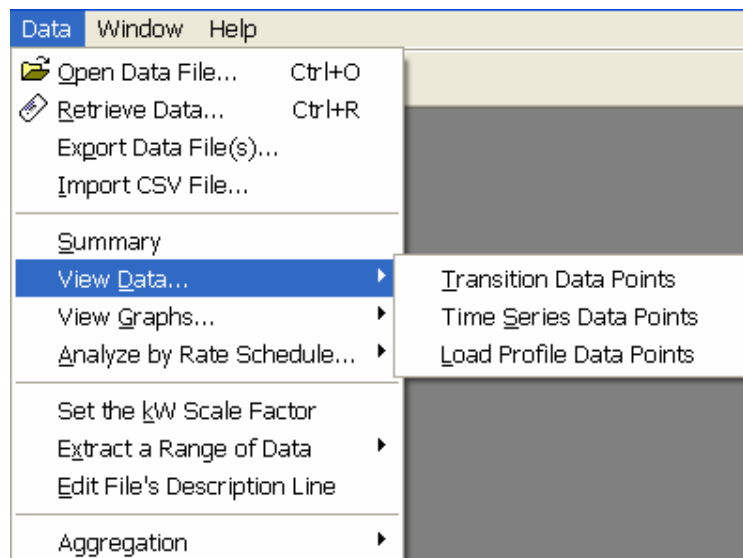
TECH TIP: *Once a data file has been opened, the view can also be changed by clicking on the data presentation box at the top left of the data window.*

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

	Date	Time	Transition
1	11/28/05	2:39:10 PM	Was ON
2	11/28/05	4:28:35 PM	Turned OFF
3	11/28/05	8:02:09 PM	Turned ON
4	11/28/05	11:30:54 PM	Turned OFF
5	11/29/05	7:35:41 AM	Turned ON
6	11/29/05	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:

Date	Starting	Ending	Percent On
11/28/05	2:45:00 PM	2:59:59 PM	100.0%
11/28/05	3:00:00 PM	3:14:59 PM	100.0%
11/28/05	3:15:00 PM	3:29:59 PM	100.0%
11/28/05	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.

Starting	Ending	Percent On
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 *G*raphs…

View *G*raphs… is used to show the logged data in various graphical formats. The graphs types are explained in detail below.
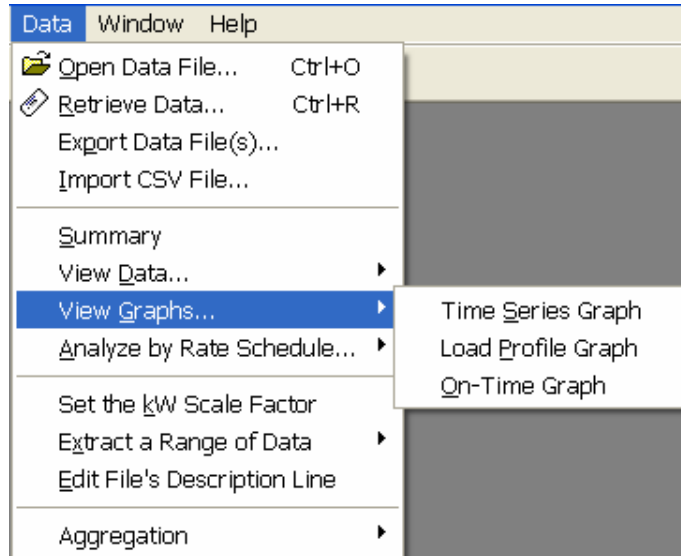
Time Series Graph is shown in the example below. To create this graph, the software first converts the transition data into a time series format. An example graph is shown below. The drop down boxes along the top of the graph allow changing the view from a week of data at a time to viewing one month of data. The data interval may also be selected from 5 minutes to 24 hours.
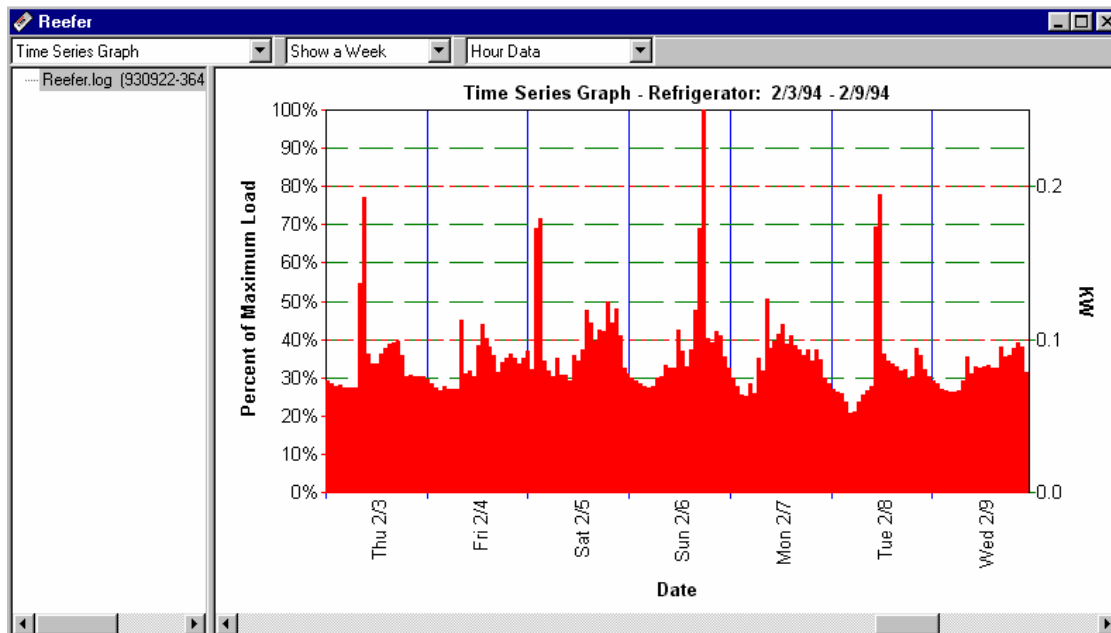
Load _Profile_ Graph plots the load profile data points. The interval size (1 minute to 24 hours) may be changed on the graph as can the type of days included in the graph. An example is shown below.
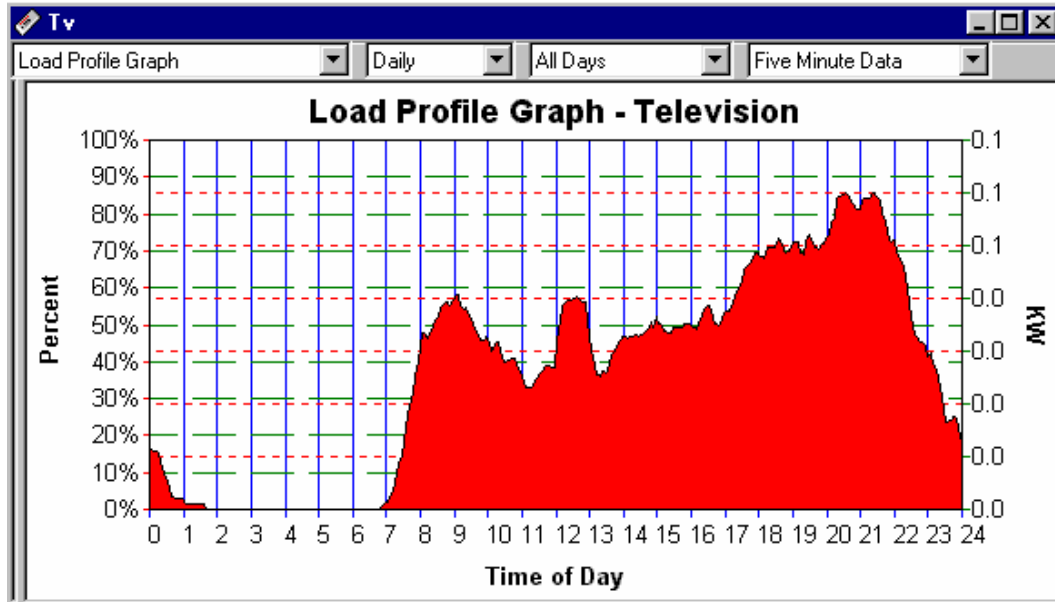
Note: Any of the graph parameters can be changed by clicking on any of the menu boxes at the top of the graph.

On-Time Graph is a simple way to view the data collected by the logger:
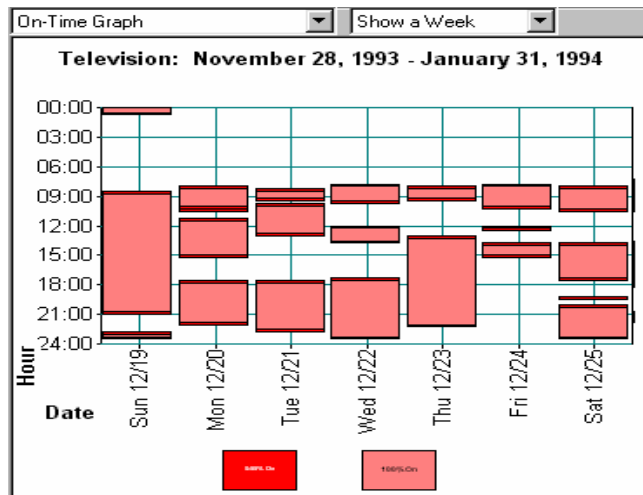
This graph depicts the on-time as recorded by the logger. The days are shown across the bottom of the graph and the time of day along the vertical axis. The white space is where the monitored load was off and the colored area is where the load was on. This presentation shows the logged data in a way 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.

Edit the Graph Title
Copy the Graph to the Clipboard Ctrl+Ins, Ctrl+C
🖨 Print the Graph   Ctrl+P
Select a Different Color for the Graph
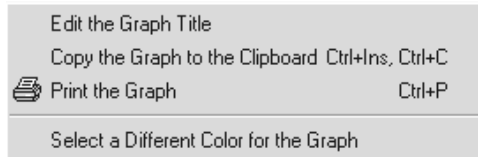
A number of changes can be made to all graphs such as changing the graph title and graph color. To edit the graph, place the mouse cursor anywhere in the graph and then right-click. For all graphs, using the right mouse click gives a menu shown to the right.

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

Data   Window   Help
📂 Open Data File...   Ctrl+O
✏ Retrieve Data...   Ctrl+R
Export Data File(s)...
Import CSV File...
Summary
View Data...   ▶
View Graphs...   ▶
Analyze by Rate Schedule...   ▶
Set the kW Scale Factor
Extract a Range of Data   ▶
Edit File's Description Line
Aggregation   ▶

Submenu:
- Summarize by Rate Schedule
- Graph Usage by Rate Schedule
- Create/Edit Rate Schedule

consumption and summary statistics and other useful data are then re-calculated by **SMART*ware*** for each defined period.
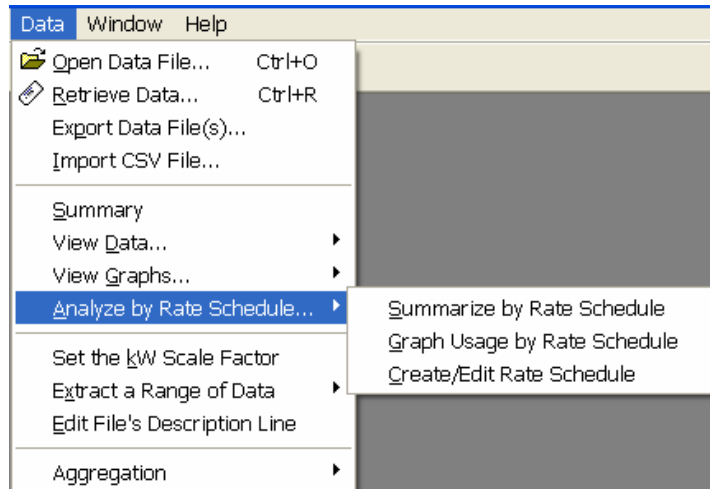
Summarize by Rate Schedule   To view the summary statistics for each defined rate period, select this option. Each major period is summarized on a separate screen. The different summaries for each rate period can be accessed using the drop down menu at the top of the screen.

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 Data 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.
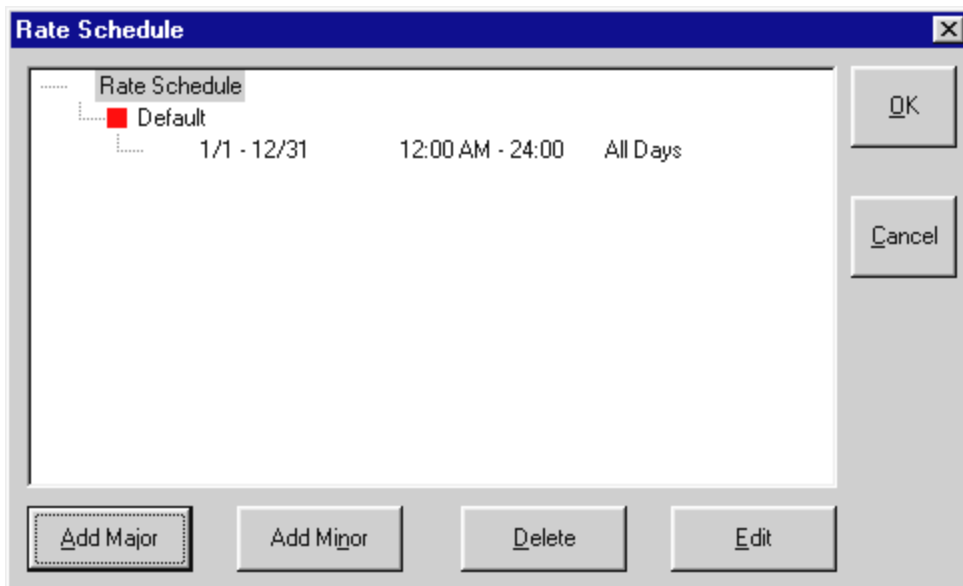
Minor Rate Period: Minor rate periods are used to define the major rate periods. To create minor periods use the **Add Minor** button. Use the **Edit** (Minor) button to define the three parameters which may be set for each minor rate period: Day Type; Days; and Hours of Day. Double clicking on a rate 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).
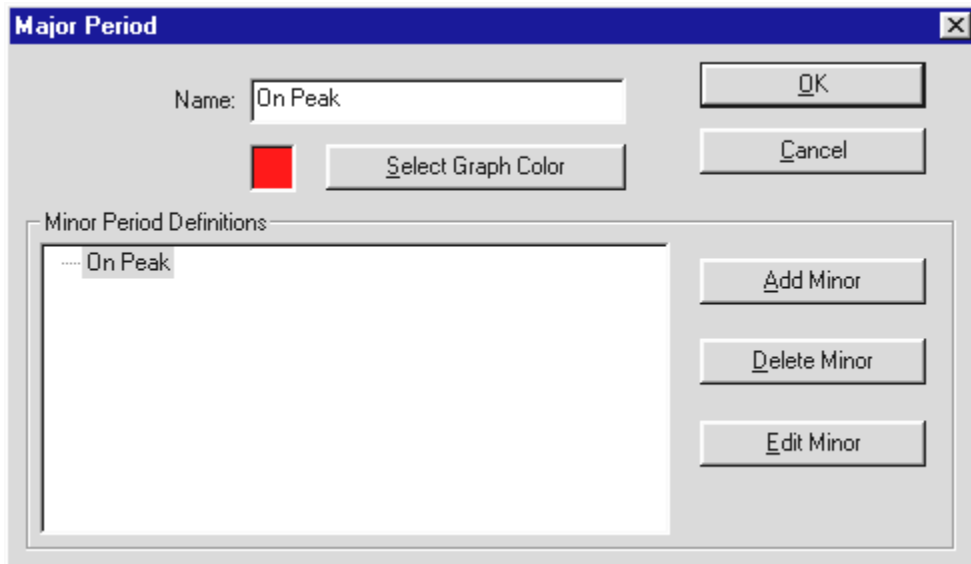
To demonstrate a multiple period Rate Schedule, a three period is defined below. To create the Rate Schedule, click on the **Add Major** button to add a new, major rate period.

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.
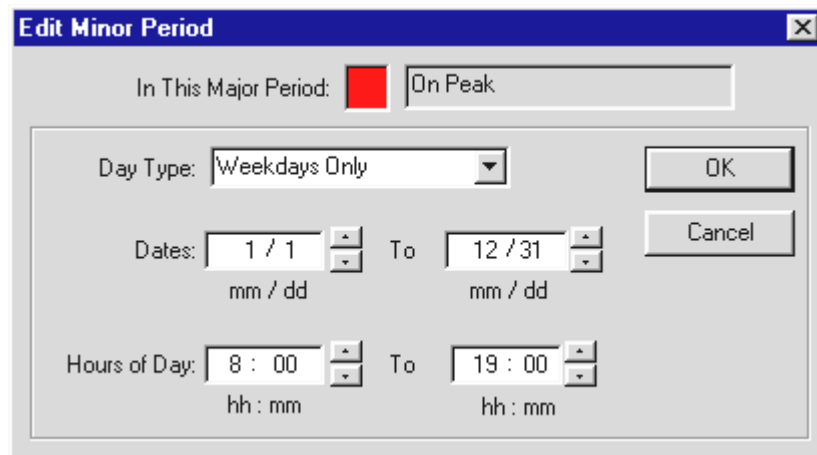
Similarly, the Mid Peak period was defined as the weekday times that were not On Peak. Off Peak days were defined as weekends. The resulting Rate Schedule is shown below.
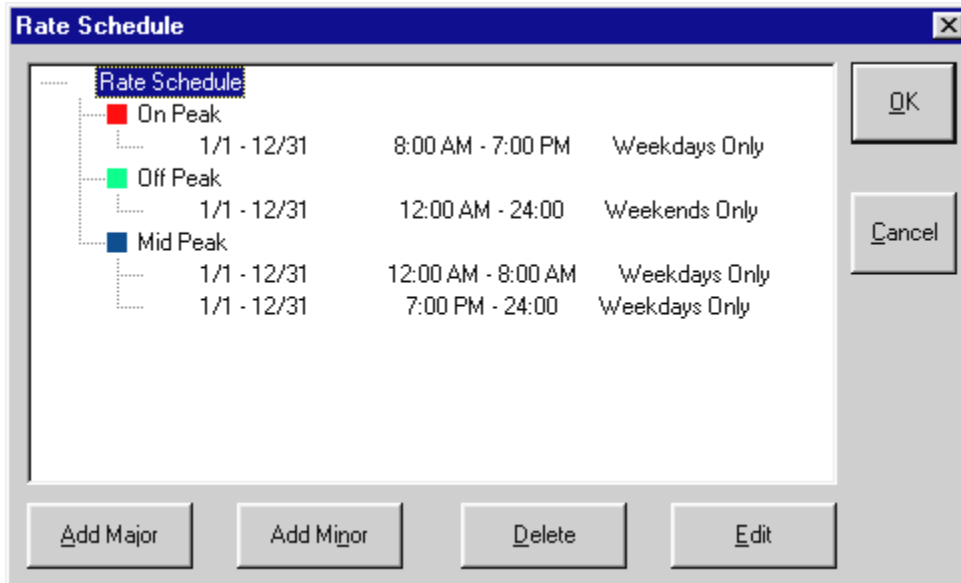
To edit any of the periods, double click on an existing period to bring up an edit box.

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).
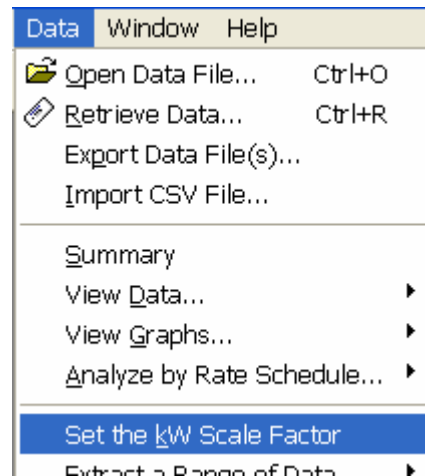
Extract a Range of Data

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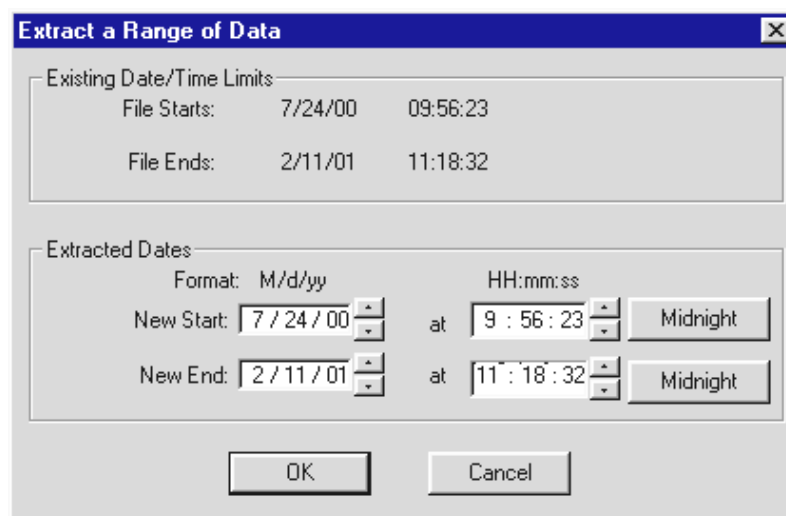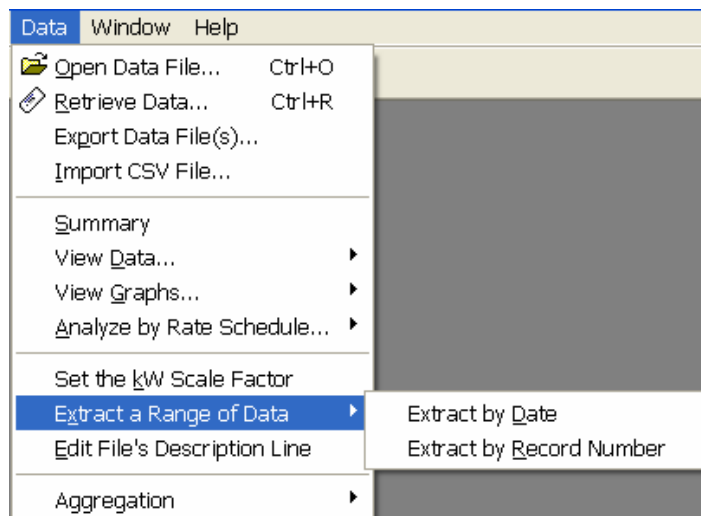
When you click on **Extract by Date** the following box appears:

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.
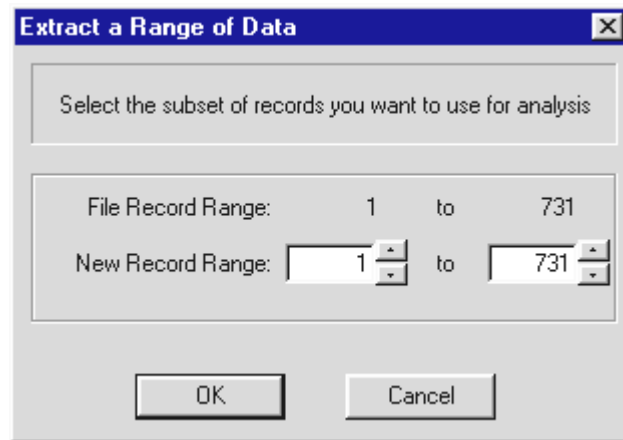
Look at the original data file to determine which record numbers bound the data that you wish to extract. Then enter those numbers in the **New Record Range** using the first and last records *you want to keep*.
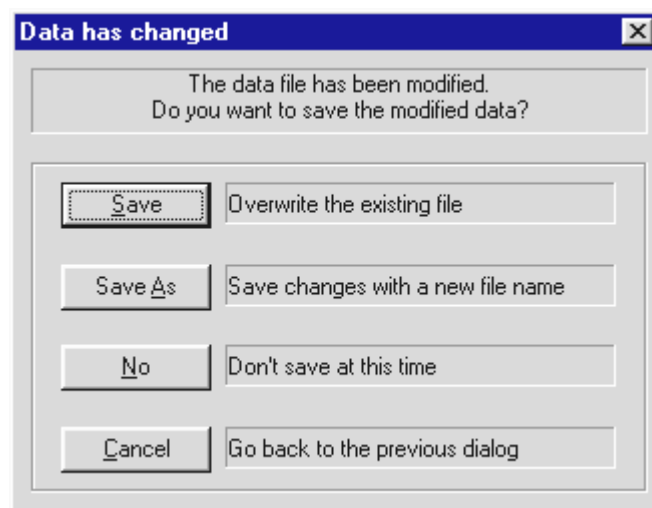
Then select **Ok**. The extracted data file becomes the active file. You will be prompted to save the data. If you want to keep the original data file (recommended), use **Save As** to save the clipped file under a new name or folder.

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* 2006** 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.
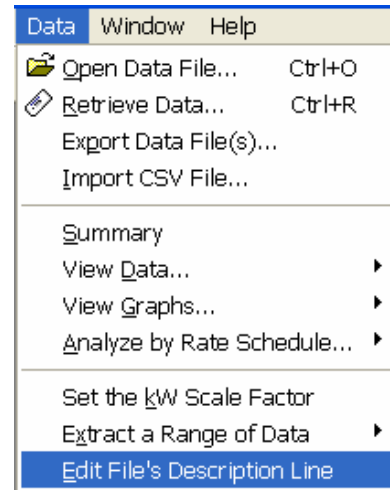
Aggregation

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.
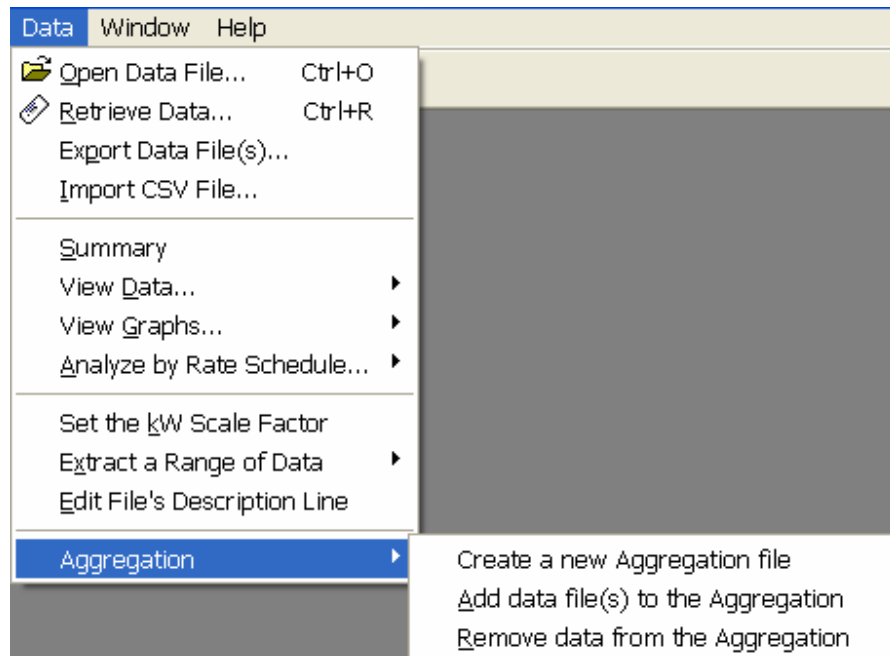
Create a new Aggregation file To create an aggregated file for analysis use this menu item. You will be shown a folder from which you may select the files you wish to combine into a single file. You may select files to aggregate using standard Microsoft Windows commands such as left mouse click and Shift+click 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, **SMART*ware*** 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, **SMART*ware*** 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.
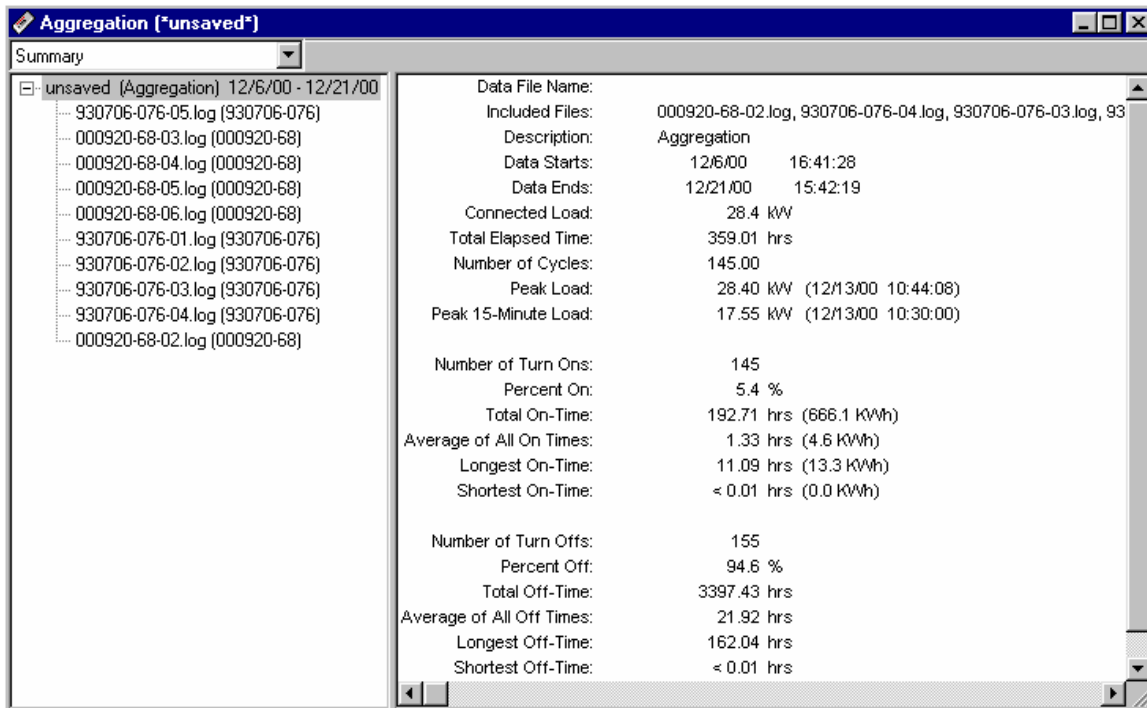
After these tests, **SMART*ware*** displays the aggregated file such as shown below and, on the left side of the window, the names of the files that are used in the aggregation. At this point the aggregated data file has not been saved. Before closing the window or exiting **SMART*ware*** you will be 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
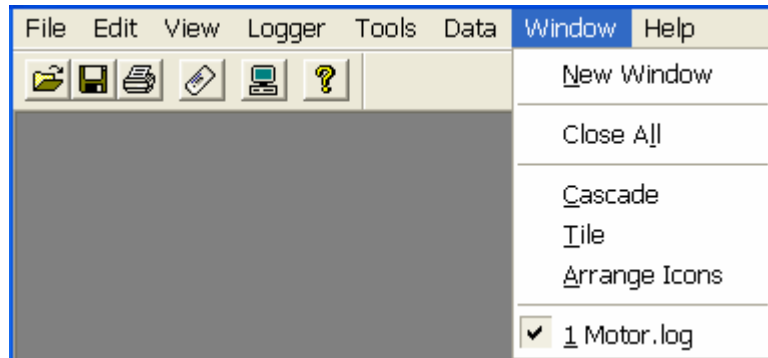
New Window

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

Close A<u>l</u>l

Closes all open windows (data files or graphs).

<u>C</u>ascade

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.
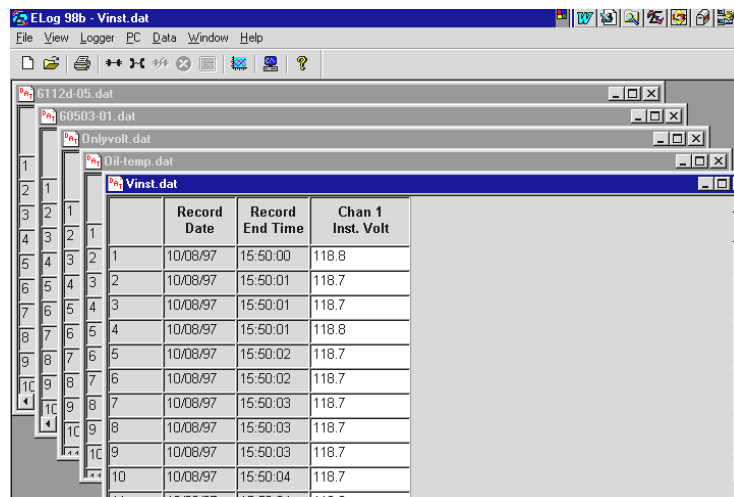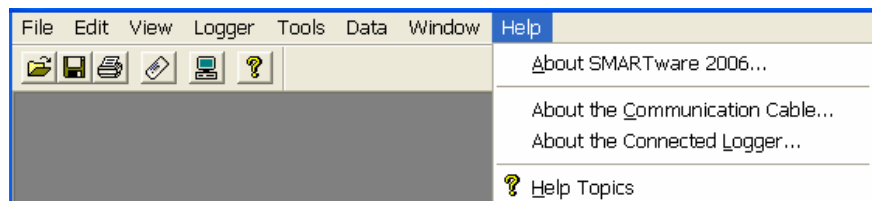
Tile

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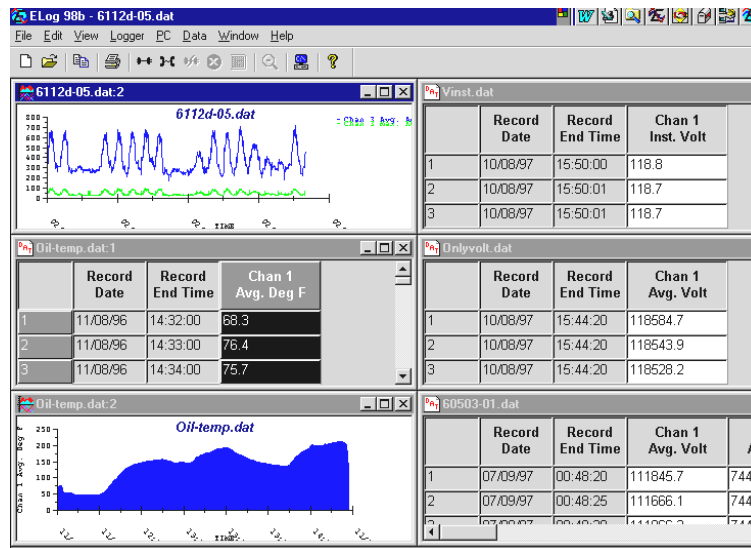
Arrange Icons

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 SMART*ware 2006…*

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

About the Communication Cable…

This menu item is used to check the date and version of the software in the SMARTlogger Communication Cable as well as the serial number of the cable.

About the Connected Logger…

This menu item is used to check the date and version of the software in the SMARTlogger as well as the serial number of the logger.

Help Topics

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

Hot Buttons

SMART*ware* 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 **File; Open** simply click on the 🗁 button. The button tool bar can be toggled on and off by checking or unchecking the **View; Toolbar** 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:** Opens the **SMART*logger*** manual.

> *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.*

Appendix A: Using SMART*ware* 2006 with Legacy (Serial) SMART*loggers*

SMART*ware* 2006 is backward compatible with older, serial DENT Instrument SMARTloggers (However, older versions of SMARTware will not work on the new, 3rd Generation USB SMARTloggers.)

To use SMARTware 2006 with serial loggers first connect the TOU Serial Cable from a serial port on the PC (or to a USB to Serial adapter) and into the jack on the back of the logger. SMARTware will automatically switch to the new logger and you should be able to connect to it as you would any of the SMARTloggers.

TECH TIP: *If you have both new USB logger and an older Serial logger connected simultaneously, SMARTware will always try to connect to the USB logger. Disconnect the new USB logger before trying to connect to the Serial logger.*

If SMARTware does not connect to the Serial logger the problem is usually the Com Port that SMARTware is using to find the logger is <u>not</u> the Com Port the logger is connected to. To change the serial port use the menu command: Tools; PC Setup to set the Direct Connect RS-232 communication port. Normally the PC Com Port is COM1 but can be any number up to 32. (Com Port 3 is used in the example below.)
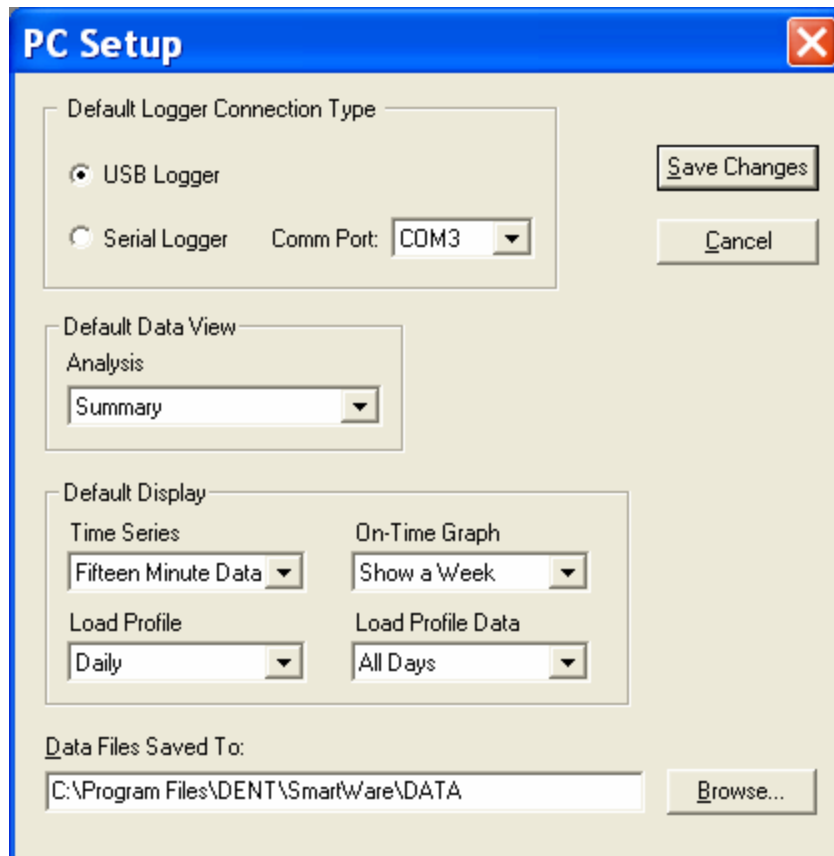
To make a direct connection from the PC to the logger, use the supplied SMARTlogger cable to connect from the logger's serial port (a stereo headphone jack on the logger back) to the serial port on the PC. If necessary, use a 9 to 25 pin adapter on the PC.

TECH TIP: *If the PC you use does not have a serial por,t obtain a "USB to Serial adapter" from DENT Instruments. The adapter instructions will explain how to determine which Com Port number the PC assigns to the adapter. That number should be the one used in PC Setup for the Com Port.*

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

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

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