

Table of Contents

Chapter 1: Getting Started 8

- Welcome 8
- What You Need to Run TrendReader 8
- What's in the Software Package 8
- Installing TrendReader 9
- Connecting a Logger to Your Computer 10
 - SmartReader and SmartReader Plus 10
 - OWL Data Logger 10
 - If the interface cable doesn't fit a serial port 11
- Windows Terminology 11
 - The parts of a Window 11
 - Dialog Boxes 12
 - Using the Mouse 12
 - Typographical Conventions 13
 - Using the Keyboard 13
 - Keystroke Shortcuts 13
- Delay Timer 13

Chapter 2: A Quick Tour of TrendReader 14

- Quick Tour For SmartReader 14
- Quick Tour For SmartReader Plus 17
- Quick Tour For OWL Data Logger 21

Chapter 3: Setting Up a Logger 27

- SETUP FOR A SMARTREADER 27
 - Opening the SmartReader Window 27
 - Setting Up a SmartReader 29
 - Setup mode and realtime mode..... 29
 - Enabling and disabling channels..... 29
 - Choosing equation numbers..... 30
 - Checking calibrations (Low, Mid, High)..... 30
 - Viewing realtime readings..... 30
 - Choosing a sample rate..... 31
 - Delaying start time..... 31
 - Stop/Continue taking readings when memory is full..... 32
 - Saving changes..... 32
 - Erasing a SmartReader's Data..... 32

Setup For A SmartReader Plus	33
Opening the SmartReader Plus Window	33
Serial Number.....	33
Filename	34
COM	34
The Current Time	34
Setting Up a SmartReader Plus	34
Stop When Full and Continuous Mode.....	34
Stopping realtime	35
Clearing the logger's stored data.....	35
Enabling and disabling channels.....	35
Choosing equation numbers.....	35
Checking calibrations (Low, Mid, High).....	35
Viewing realtime readings.....	35
Choosing a sample rate.....	36
Delaying a logger's start time	37
Number of readings.....	37
Saving changes.....	37
Fast Read Mode	37
About Fast Read Mode.....	38
Sample rates for Fast Read Mode.....	38
Start delay for Fast Read mode.....	38
Alarm Dialout	39
How Alarm Dialout Works.....	39
Equipment needed to receive an alarm.....	39
Setting up Alarm Dialout	40
Activating Alarm Dialout	40
Setting high and low alarm thresholds.....	40
Choosing a baud rate.....	41
Entering the number to dial.....	41
Setting Call Delay	41
Setting Retry Delay.....	42
Setting Reset Delay.....	42
Sending the setup to the logger.....	42
Responding to an alarm call.....	42
Fast Read Mode disabled.....	42
Precautions.....	42
Operating a SmartReader Plus Network	43
Identifying loggers on a network.....	43
Deleting a site and its loggers.....	44
Deleting one logger from a list.....	44
Viewing realtime readings of all networked loggers.....	44
Contacting a networked logger	45
Contacting a logger from the SmartReader Plus Logger List dialog box.....	45
Contacting a logger from the Network Realtime window.....	45
Contacting a logger from the SmartReader Plus window.....	45
Setup For An OWL Data Logger	46
Opening the OWL Setup Window	46
Setting up an OWL Data Logger	48
Stop when Full mode / Continuous mode	48
Logger type.....	48
Choosing a sample rate.....	48
Memory size.....	48

Start Time and End Time..... 49

Setting a start delay..... 49

Choosing a graph title..... 50

Choosing a filename..... 50

Choosing equation numbers..... 50

Checking calibrations..... 50

Selecting the range..... 52

Setting High and Low Trigger..... 52

Alarm 52

Flash 53

Fast Read mode 53

Sending the Setup to the OWL 54

Erasing Data 54

Chapter 4: Backing Up a Logger 55

Backup For A SmartReader 55

Backing Up One SmartReader 55

 Baud rate for IC-101 users 55

 Baud rate for IC-200 users 55

 Opening a graph after backup..... 55

 Opening the Backup dialog box..... 55

 Setting Start Time and End Time..... 56

 Choosing a graph title..... 56

 Choosing a filename..... 57

Starting Backup 57

 Closing the Backup dialog box..... 57

Backing Up Multiple SmartReaders 57

 Opening the IC-200 window..... 58

Backup For A SmartReader Plus 59

Backing Up One SmartReader Plus 59

 Baud rate (for IC-100/101 users)..... 59

 Opening a graph after backup..... 60

Backing Up Networked Loggers 60

Starting Backup 60

 Naming a file..... 60

Backup For An OWL Data Logger 61

 Backing Up 61

 Erasing Data 62

Chapter 5: Working With Graphs 63

The Difference between Logger Files and Graph Files 63

 Logger Files 63

 Graph Files 63

To View Logger Data Without Altering It 63

Opening Logger Files to Display Graphs 63

 Choosing logger channels for graphing 64

Opening a Graph File 65

A graph Window	65
The status bar	65
Showing the legend	66
Hiding the legend	66
Enlarging a graph window	66
Closing a graph window [Ctrl+F4]	66
Different Channels Displayed on One Graph	66
Giving Graph a Title	66
Moving a title	67
Zooming	67
Autoscaling on zoom	68
Unzooming [Ctrl+Z]	68
Adding Comments to a Graph	68
Moving a comment	68
Editing a comment	69
Deleting a comment	69
Deleting all comments	69
Adding Arrows	69
Moving an arrow	69
Deleting an arrow	69
Deleting all arrows	70
Labeling Data Points	70
Labeling data points using an arrow	70
Changing the Range of the Vertical Axis	70
Default divisions	71
Choosing Fonts and Font Sizes	72
Setting the default font	72
Changing fonts on an existing graph	72
Using Colored Lines	72
Changing colors on the default palette	72
Changing line colors on a graph	73
Draw with Patterned Lines	74
Changing line styles	74
Changing line width	75
Displaying a Graph's Statistics	75
Displaying a Graph as a Table	75
Converting STK Files	76
Page Setup	77
Top margin and left margin	77
Vertical and horizontal scale	77

Printing a Graph[Ctrl+P] 77

Setting Up Your Printer 77

 Looking for your printer 77

 Landscape and portrait orientation 78

 Darkness and fineness of printing 78

Saving a Graph [Ctrl+S] 78

Revising a Logger File 79

 Changing the start date and start time 80

 Number of readings 80

 Changing the sample rate 80

 Changing the graph title 80

 Changing a channel name 80

 Changing an equation number 80

 Changing calibrations 81

Deleting Files 82

 Deleting logger files 82

Exporting TrendReader Files 83

 Exporting to a spreadsheet 83

 Copying a graph to the clipboard[Shift+Ins] 83

Chapter 6: Custom Equations 85

How Standard Equations Work 85

Creating Custom Equations 85

 Creating a thermistor equation 85

 The Steinhart-Hart Equation 86

 Creating a linear equation 87

Writing Custom Equations 89

 The Equation window 89

 Writing a custom equation 90

 Writing a linear equation 91

 Example of a linear equation 92

 Equation coding table 93

 An equation that prevents negative readings 94

 Adding a compound line 95

 Writing a time integral equation 96

 Predefined variables 97

Equation Language Syntax 97

 Input source variable tables 97

 User variables 98

 Labels 99

 Table of commands 99

 If Then Else command 99

 Table of operators 99

 Square root operators 100

 Table of functions 100

Chapter 7: Communicating With Loggers by Modem	102
Equipment Needed	102
Connecting the System	102
At the computer station	102
At a remote logger station	103
Configuring Modems	103
Setting Up the Computer Station Modem	103
DIP switch settings	104
Software setup	104
Attention code	105
Initialization string	105
Setup string	105
Dial prefix string	105
Saving phone numbers	106
Viewing your list of phone numbers	106
Deleting a phone number	106
Timeout	106
Escape code	106
Hangup string	107
Accept	107
Setting Up the Remote Station Modem	107
Software configuration	107
DIP switch settings	108
Communicating with Remote Loggers	110
Phoning a remote site	110
Hanging up	110
Saving a new phone number	110
If you cannot complete your call	111
Appendix A: Sample Rate Tables	112
How a Data Logger Stores Readings	112
SmartReader Sample Rate Tables	112
SmartReader Plus Sample Rate Tables	115
OWL Data Logger Sample Rate Table	121
Appendix B: Communicating with Multiple Loggers	122
Linking SmartReader Loggers Together	122
The features of the IC-200 Interface Module	122
In the IC-200 Package	122
Using Longer Cables	122
Connecting an IC-200 to Your Computer	123
Connecting an IC-200 to a Modem at a Remote Site	123
Creating a SmartReader Plus Network	123
Connecting Loggers on a Network	124

Connecting loggers on a Basic Network	124
Connecting loggers on a Modular Network	125
Connecting loggers on a Shielded Network.....	126
Communication Problems and Solutions	126
Appendix C: Troubleshooting	128
Why Won't TrendReader Communicate with My Logger?	128
How Come TrendReader Won't Backup My Logger?	128
Why Do My Graphs Have the Wrong Date and Time on Them?	128
How Accurate are TrendReader Time Measurements?	129
What Rights are Needed to Run TrendReader on a Network?	129
Why Doesn't My Printer Work?	129
Why Can't I Contact My SmartReader Plus Network?	130
Technical Support	130
Glossary	131

Chapter 1: Getting Started

An introduction to TrendReader and to this reference guide.

Welcome

Welcome to TrendReader for Windows, an easy-to-use program for displaying and analyzing data from SmartReader, SmartReader Plus, and OWL Data Loggers.

This reference guide is divided into two parts; the first part (which you are reading now) explains how to use TrendReader software, the second part gives you information about your ACR Data Logger. With TrendReader you can:

- Quickly retrieve information from a data logger by connecting the logger to your computer.
- Produce annotated, automatically scaled presentation-quality graphs of your logged data.
- Overlay graphs from different loggers, or from different time periods, on top of one another.
- Retrieve and analyze information from one or more remote SmartReader or SmartReader Plus loggers by using a modem.
- Display realtime *as they happen* readings from a SmartReader Plus logger.
- Transfer logger information to other software packages, for instance, to spreadsheets.
- Write mathematical equations that enable you interpret your data.

What You Need to Run TrendReader

The minimum requirements:

- A personal computer with a 486 processor or higher
- 2MB of hard drive space
- A 3 1/2" floppy drive
- 2MB of RAM
- Windows 3.1 running in enhanced mode, 95, 98, NT or Windows 2000
- A mouse (highly recommended)
- Available serial port

What's in the Software Package

- One 3 1/2 inch HD floppy diskette

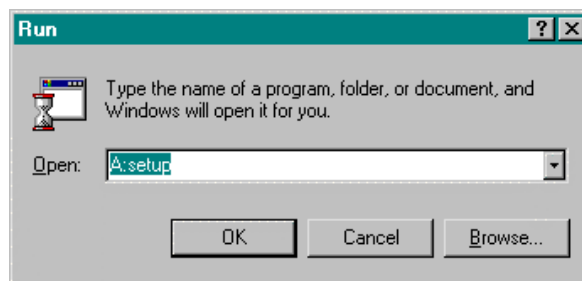
- One IC-101 interface cable that connects a logger to a serial port of your computer. (OWL users have an LIC-101 Lite-Link interface cable.)
- One 25 to 9 pin adapter (in case your computer has a 25 pin serial port).
- This reference guide.

Installing TrendReader

1. Restart Windows to clear modules from memory before installing TrendReader.
2. For Windows 3.1, select **File** from the menu bar in the Program Manager and choose **Run...**

For Windows 95, 98, NT or Windows 2000 select **Start** from the Taskbar on the Desktop and choose **Run...**

The Run dialog box appears.

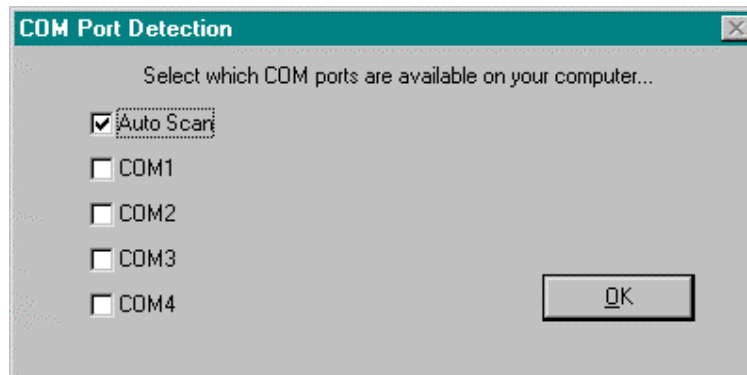


3. Insert the TrendReader disk into disk drive A or B.
4. In the Run window, type **a: setup** for drive A and press **Enter** (the Return key on some keyboards). If you are using drive B, type **b:setup**.
5. A warning dialog box will ask you if you are installing from a clean boot. Click **OK** to continue.
6. A setup dialog will appear asking you to click Continue if you want to continue installing TrendReader on your hard drive. Unless you want to install the program in a different directory you will click **Continue**.

Another dialog box will appear showing you the names of the files as they are being installed. The last dialog box will tell you that installation is complete.

If an overwrite newer or older file version dialog box appears, select the default answer by pressing **Enter**.

When all the files have been installed, the COM Port Detection dialog box will appear.



7. Check Autoscan or the COM port that the interface cable is connected to and click **OK**.

If you choose Autoscan, when TrendReader opens its main window it will display the available COM ports and you will choose the one that logger is connected to. If you know that number of the COM port that you are connecting the interface cable to, you can check that COM port and TrendReader will display only that COM port.

Note: On some computers, when Autoscan is chosen the mouse is disabled while running TrendReader. If this happens you will have to install the program again and in the COM Port Detection dialog box check the COM port that the interface cable is connected to.

8. Click **OK** to acknowledge completion of TRWIN setup. The ACR Data Loggers window appears. To open TrendReader, double-click on the Trendreader icon. However, you may want to connect a logger to your computer first.

Connecting a Logger to Your Computer

SmartReader and SmartReader Plus

You transfer information from a SmartReader or from a SmartReader Plus to your computer using the IC-101 interface cable. Connect one end of the cable to the logger and the other end into a serial port on the back of your computer.

If you are communicating with multiple SmartReader loggers, you will use an IC-200 Interface Module instead of an IC-101 cable. Information about using an IC-200 is in *Appendix B*.

OWL Data Logger

You transfer information from an OWL Data Logger to your computer using the LIC-101 interface cable. Connect the LIC-101 to a serial port on the back of your computer.

A connection on the back of your computer that fits your interface cable is a serial port. If your computer has more than one serial port (some computers may have up to four,) choose any port that is available.

If the interface cable doesn't fit a serial port

If the cable doesn't fit any port on your computer, use the adapter that comes with your package. Plug the cable into the adapter, and plug the adapter into a serial port on the back of your computer - a connection on the back of your computer that fits the adapter is a serial port too.

Windows Terminology

In this guide we use Windows naming conventions - we talk about windows, menus, dialog boxes, clicking with the mouse, etc. If you find any of these terms confusing, refer to your Windows User's Guide.

If you prefer, you can open Windows Online Help. Switching from TrendReader to Windows Help is very easy for Windows version 3.1:

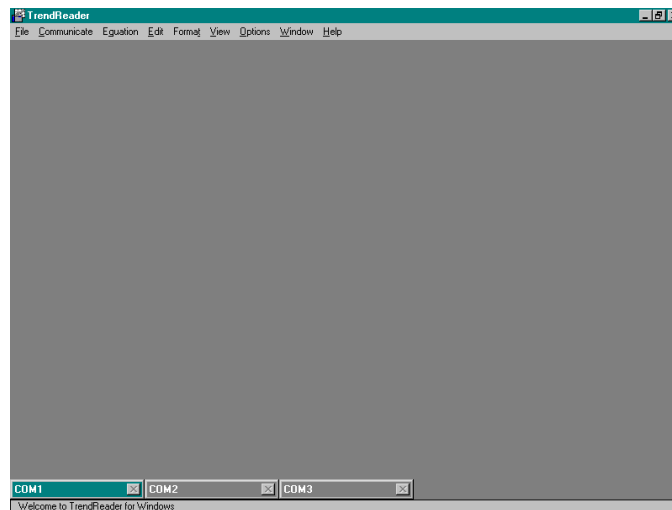
1. Press **Alt+Tab**.
2. As you hold down **Alt**, keep tapping **Tab** until Program Manager appears, then release **Alt**.
3. Click the **Help** menu and then click the item you want from the pulldown menu.
4. When you have finished and closed Help, press **Alt+Tab**.
5. As you hold down **Alt**, keep tapping **Tab** until **TRWIN** appears, then release **Alt**.

Under Windows 95, 98, NT or 2000, press **Start - Help**.

In the next sections, you will see tips for becoming familiar with windows and dialog boxes.

The parts of a Window

In case you are not familiar with the main elements of a window, here's a quick summary, using the main TrendReader window as an example:



This is the window that you see when you open TrendReader under Windows 95, 98, NT, or 2000.

- The *control-menu box* enables you to close a window and, in case of this main TrendReader window, switch to another program in Windows, for instance, to Windows Online Help or to a spreadsheet.

The *minimize button* enables you to reduce the window to an icon at the bottom your screen. To change the icon back to a window, double-click on the icon with the mouse pointer.

- The *restore button* restores the window to its original size (the main TrendReader window is always displayed at full-screen size, which is larger than its original size). When you click the restore button, the window changes to its original size and the restore button becomes a *maximize button*. Click on the maximize button to enlarge a window to full-screen size.
- The *title bar* shows the name of the application.
- The *menu bar* lists the available menus.
- The *Status bar* displays progress reports of TrendReader operations and also error messages.

Dialog Boxes

Dialog boxes are message boxes that supply or request information about the task you are performing. The main difference between a window and a dialog box is that a window can be left open while you perform some other task in TrendReader whereas a dialog box usually require a response before closing and allowing you to continue.

Using the Mouse

- **Click** means to press and release the left mouse button.
- **Double-click** means to press and release the left mouse button twice in quick succession.
- **Drag** means to hold down the left button while you move the mouse.

Typographical Conventions

The following typographical conventions are used in the software section of this guide:

Bold type

is used to describe an action you are asked to take, for example: Press **Enter**; or Choose **Preferred Logger** from the **Communicate** menu.

Monospaced type

is used for words or characters you are asked to type, for example: Type **a:setup**.

Using the Keyboard

Although you probably will use a mouse with TrendReader, you may find keystrokes more convenient in some situations. Keystrokes usually involve the use of two keys. For instance, **Alt+F** means that you press the **Alt** key, hold it down while you press **F**, and then release both keys. (Although the letters are displayed as capitals, you don't have to use capitals.)

You will notice in the main TrendReader window that each heading on the menu bar has a letter underlined. This underlining is to enable you to use keystrokes. For instance, File has the **F** underlined. If you want to open the File menu from the keyboard, press **Alt+F**; if you then want to open a logger file, press **L**.

If you find that you like using the keystrokes for choosing menu items but some items you want have no corresponding keystrokes, here's what to do: open the menu and click the *down* arrow until the menu item you want is highlighted, then press **Enter**.

Keystroke Shortcuts

The quickest way to choose menu items is to use keyboard shortcuts. These shortcuts are two-key combinations, the first key usually being **Ctrl**. These shortcuts are displayed on the menus.

On the **File** Menu you will see keyboard combinations after most of the menu items. For instance, after **Open Logger File** is **Ctrl+L**. The shortcut is that you can choose a menu without opening the menu - when you press **Ctrl+L** from the TrendReader window, the **Open Logger** dialog box will open. (Obviously, you have to memorize the keystroke shortcuts in order to be able to make use of them.)

Delay Timer

Delay Timer is provided to start TrendReader for Windows at a designated time. It is also designed to automate a program's functions by the use of macro keystrokes. Delay Timer is found in the ACR Data Loggers group in Windows.

When you open Delay Timer, press F1 to get online help and a detailed explanation of Delay Timer's functions.

Please use Delay Timer with discretion since it is unable to anticipate certain errors which may occur.

Chapter 2: A Quick Tour of TrendReader

A step by step tutorial showing you how to open TrendReader, set up a logger, record temperatures, save the information in your computer, display the information as a graph, and print the graph. This tour will just take a few minutes.

Quick Tour For SmartReader

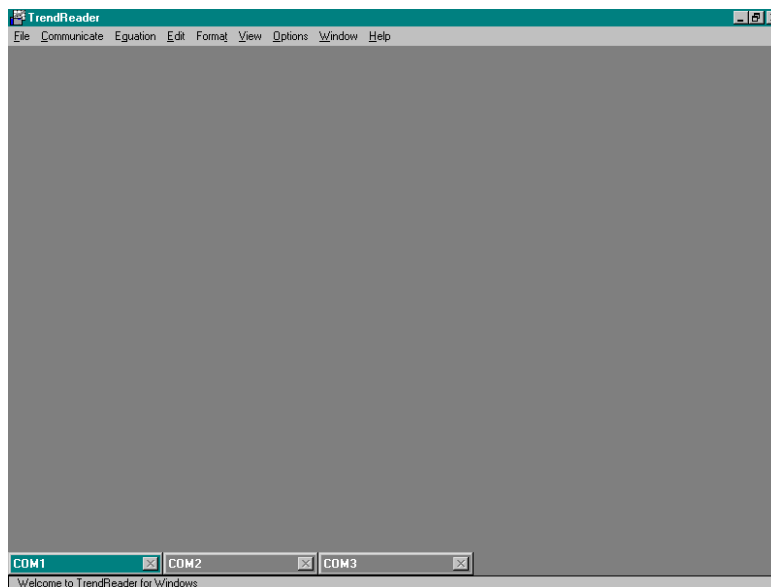
We assume that you have already installed TrendReader on your computer and connected an 8-bit SmartReader logger to your computer. If you haven't done this yet, see *Chapter 1, Getting started*, to find out how.

Under Windows 3.1:

1. From Windows, double-click the **TrendReader Standard** icon in the **ACR Data Logger Software** group.

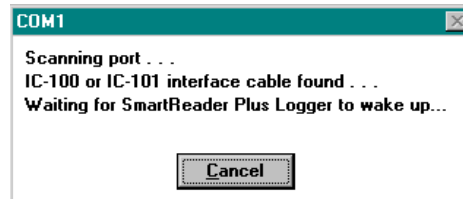
Under Windows 95, 98, NT or Windows 2000:

- Press **Start**
- Choose **Programs - ACR Data Logger Software - TrendReader Standard** - click left mouse-key. TrendReader will open and the main TrendReader window will be displayed.

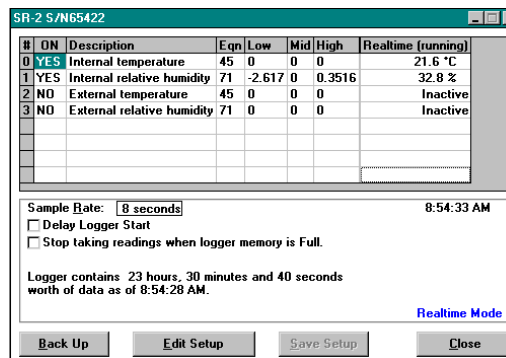


2. From the **Communicate** menu, choose **Preferred Logger** and **SmartReader (8 bit)**.
3. Double-click the logger icon in the lower left corner of the window, or click **Communicate** on the menu bar and then choose the communication port that connects the logger to your computer. (If your computer has more than one logger icon in the window or more than one COM port in bold print on the Communicate menu or taskbar, your computer has two or more COM ports.)

The COM dialog box appears.



The purpose of this dialog box is to tell you whether you have the logger cable properly connected to your computer and to your logger. If everything is properly connected, this dialog box will disappear and the SmartReader window will be displayed. The SmartReader window's title bar will always show the serial number of the SmartReader that's connected to your computer.



We are going to change some of the settings in this window.

4. Before changing settings, click the **Edit Setup** button at the bottom of the window.
5. Since you are going to record temperature only, make sure that the internal temperature channel is active. This channel is active when YES is in the ON column of line zero. If it is NO, click it to change it to YES. You are not recording information from any other channel, so if YES is in the ON column of any other channel, click it to change it to NO.
6. We want the logger to record the temperature every eight seconds. To do this, go to Sample Rate and click on the box displaying the current rate.
7. In the dialog box that appears, click the *down* arrow to open the pulldown menu showing the available sample rates.
8. Click **8 seconds**.

Notice that when you choose a sample rate, the Sample Rate dialog box tells you for how many days and hours the logger will take readings at the sample rate you have chosen (For instance, at eight seconds, the logger will record readings for over three days.)

9. Click **Accept**.

Having altered some of the settings we will need to save this new setup.

10. Click the **Save Setup** button.

A dialog box will warn you that all data that the logger has gathered up to this moment will be cleared (erased.)

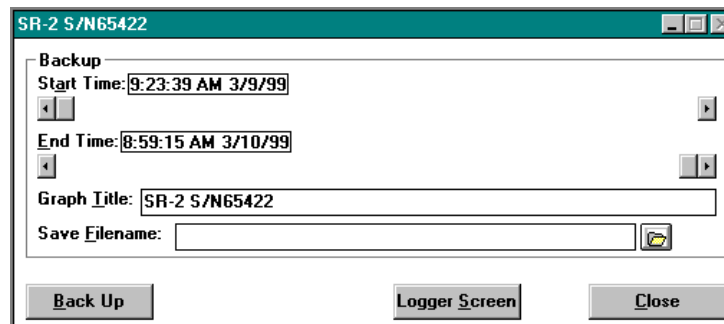
(The logger has data in it because it was activated at the factory. But don't worry, the battery is good for ten years.)

11. Click **OK**. The logger is now gathering data.
12. Click **Enable Realtime**. (This action allows the Logger window to display the logger data as the logger is gathering it. This button controls only the display in the Logger window; it has no effect in the logger's data gathering.)
13. For this short test, in order to produce a temperature variation and avoid a flat-line graph, you can either disconnect the logger and take it outside for a moment, or leave it connected to your computer and put your finger over the temperature sensor on the logger to change the temperature. If you put your finger over the sensor, you will be able to watch the temperature reading change in the Logger window - remembering that the display will take eight seconds to change. Let the logger gather data for about three minutes.

Before you download the data from your logger, go to the menu bar at the top of the TrendReader window.

14. Click **Options**.
15. Look for **Open Graph after Backup**. Enable this item so that a graph of your data will automatically be displayed after backup. (An option is enabled when there is a check mark in front of it.)
16. To download the data from the logger (with the logger connected to your computer and the SmartReader window open) click **Backup**.

The Backup dialog box appears.



You can see the period of time that the backup will cover from when you clicked **Save Setup** and **OK** until the moment that you opened the Backup dialog box.

The Graph Title is the caption that will appear on the top of your graph when you open the file or when you print it. You can write this title in words with spaces between them and with capital

letters mixed with lower case letters. (When you open the Backup dialog box, the model and serial number of the logger is always displayed as the graph title.)

17. To change the graph title, drag the cursor across it to highlight it. Then type the name you want to see at the top of your graph.

The file must now be given a filename that the computer understands.

18. Click in the Save Filename box. You can type a maximum of eight letters or numbers (no spaces). TrendReader will give this filename the extension .TRW to indicate that it is a logger file. It is important to give the file a name that will make sense to you since this is the name that will appear in the Open Logger File dialog box when you want to find it again.

19. Click **Backup**.

You now have a copy of the logger data in your computer. The graph will open and your graph title will be displayed at the top.

The vertical axis measures temperature, the horizontal axis measures time.

To get a closer look at part of your graph, you can enlarge it by zooming.

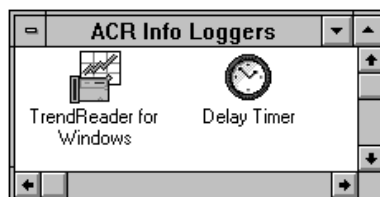
20. Pick an area on the graph where the temperature changes. Move the mouse so that the cross hairs are just to the left of that area and then press and hold down the left mouse button. Drag the cross hairs to the right. The two vertical lines that have appeared will enclose the area to be enlarged.
21. When you are satisfied with the area to be zoomed, release the mouse button.
22. To view the graph at its original size, click **Unzoom X-Axis** in the **View** menu (or press **Ctrl+Z**.)
23. To print your graph, choose **Print** from the **File** menu.

Quick Tour For SmartReader Plus

We assume that you have already installed TrendReader Standard on your computer and connected a 12 bit SmartReader Plus logger to your computer. If you haven't done this yet, see *Chapter 1, Getting started*, to find out how.

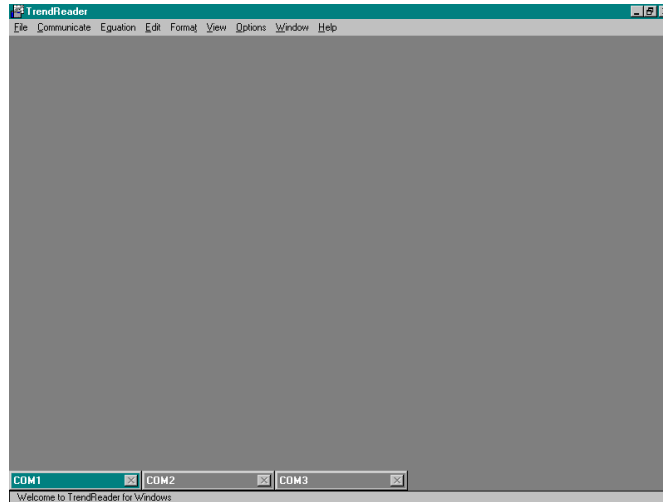
Under Windows 3.1:

1. From Windows, double-click the **TrendReader Standard** icon in the **ACR Data Logger Software** group.



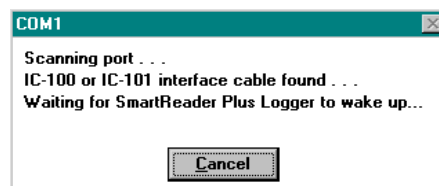
Under Windows 95, 98, NT or Windows 2000:

- Press **Start**
- Choose **Programs - ACR Data Logger Software - TrendReader Standard** - click left mouse-key. TrendReader will open and the main TrendReader window will be displayed.



2. From the **Communicate** menu, choose **Preferred Logger** and **SmartReader Plus (12- bit)**.
3. Double-click the logger icon in the lower left corner of the window, or click **Communicate** on the menu bar and then choose the communication port that connects the logger to your computer (If your computer has more than one logger icon in the window or more than one COM port in bold print on the Communicate menu, your computer has two or more COM ports.)

The COM dialog box appears.



The purpose of this dialog box is to tell you whether you have the logger cable properly connected to your computer and to your logger. If everything is properly connected, this dialog box will disappear and the SmartReader Plus window will open.

#	ON	Channel	Eqn #	Low	Mid	High	Ext	Realtime
0	YES	Int. Temp.	45	0	0	0	0	22.86 °C
1	YES	Int. RH	71	-1.094	0	0.1172	0	29.87 %
2	NO	Ext. Temp.	45	0	0	0	0	Inactive
3	NO	Ext. RH	71	0	0	0	0	Inactive

We are going to change some of the settings in this window.

4. Before changing settings, click the **Edit Setup** button at the bottom of the window. (This action stops the window displaying the logger data as the logger is gathering it. This button controls only the display in the Logger window; it has no effect in the logger's data gathering.)
5. Since you are going to record temperature only, make sure that the internal temperature channel is active. This channel is active when YES is in the ON column of line zero. If it is NO, click it to change it to YES. You are not recording information from any other channel, so if YES is in the ON column of any other channel, click it to change it to NO.
6. In the Options box click **Stop when Full** (These options are explained in *Chapter 3, Setting up a logger*.)
7. We want the logger to record the temperature every eight seconds. To do this, go to Sample Rate and click on the box displaying the current rate.
8. In the dialog box that appears, click the *down* arrow to open the pulldown menu showing the available sample rates.
9. Click **8 seconds**.

Notice that when you choose a sample rate, the Sample Rate dialog box tells you for how many days and hours the logger will take readings at the sample rate you have chosen (For instance, at eight seconds, a 32K-SRP Logger, with only one channel turned on, will take readings for almost two days.)

10. Click **Accept**.

Start Delay and Number of Readings are explained in *Chapter 3, Setting up a Logger*. These settings do not need to be changed for this short test.

Having altered some of the settings we will need to save this new setup.

11. Click the **Save Setup** button.

A dialog box will warn you that all data that the logger has gathered up to this moment will be

cleared (erased).

(The logger has data in it because it was activated at the factory. But don't worry, the battery is good for ten years.)

12. Click **OK**.

A dialog box will confirm that the new setup has been saved to the logger.

13. Click **OK**.

The logger is now gathering data.

14. Click **Enable Realtime**. (This action allows the Logger window to display the logger data as the logger is gathering it. This button controls only the display in the Logger window; it has no effect in the logger's data gathering.)

Note: data gathering will stop if the logger is set to FastRead mode and the logger is contacted. You cannot view realtime readings when in FastRead mode.

15. For this short test, in order to produce a temperature variation and avoid a flat-line graph, you can either disconnect the logger and take it outside for a moment, or leave it connected to your computer and put your finger over the temperature sensor on the logger to change the temperature. If you put your finger over the sensor, you will be able to watch the temperature reading change in the Logger window - remembering that the display will take eight seconds to change. Let the logger gather data for about three minutes.

Before you download the data from your logger, go to the menu bar at the top of the TrendReader window.

16. Click **Options**.

17. Look for **Open Graph after Backup**. Enable this item so that a graph of your data will automatically be displayed after backup (A menu item is enabled when there is a check mark in front of it).

18. To download the data from the logger (with the logger connected to your computer and the SmartReader Plus window open) click **Backup**.

A dialog box appears displaying the progress of the backup.

Then the Save As dialog appears to enable you to name the file. The default name is the serial number of the logger. Click **OK** if you want to keep that name as the filename. If you want to change the name, type the new name and then click **OK**.

You can type a maximum of eight letters or numbers (no spaces). TrendReader will give this filename the extension .TRW to indicate that it is a logger file. It is important to give the file a name that will make sense to you since this is the name that will appear in the Open Logger File dialog box when you want to find it again.

19. Click **Backup**.

You now have a copy of the logger data in your computer. The graph will open.

The vertical axis measures temperature, the horizontal axis measures time.

To get a closer look at part of your graph, you can enlarge it by zooming.

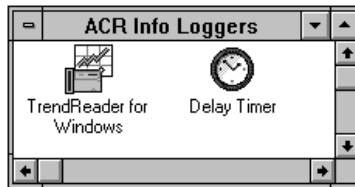
20. Pick an area on the graph where the temperature changes. Move the mouse so that the cross hairs are just to the left of that area and then press and hold down the left mouse button. Drag the cross hairs to the right. The two vertical lines that have appeared will enclose the area to be enlarged.
21. When you are satisfied with the area to be zoomed, release the mouse button.
22. To view the graph at its original size, click **Unzoom X-Axis** in the **View** menu (or press **Ctrl+Z**).
23. To print your graph, click **Print** in the **File** menu.

Quick Tour For OWL Data Logger

We assume that you have already installed TrendReader Standard on your computer and connected the LIC-101 interface cable to your computer. If you haven't done this yet, see *chapter 1, Getting Started* to find out how.

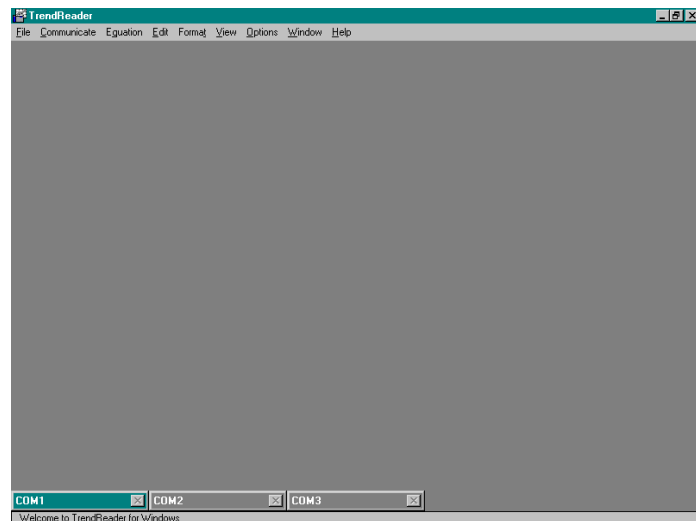
Under Windows 3.1:

1. From Windows, double-click on the **TrendReader Standard** icon in the **ACR Data Logger Software** group.



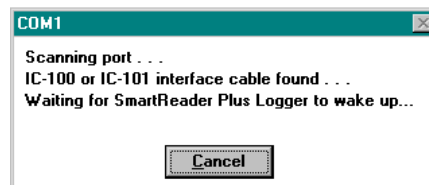
Under Windows 95,98,NT or 2000:

- Press Start
- Choose **Programs - ACR Data Logger Software - TrendReader Standard** - click left mouse-key. TrendReader will open and the main TrendReader window will be displayed.

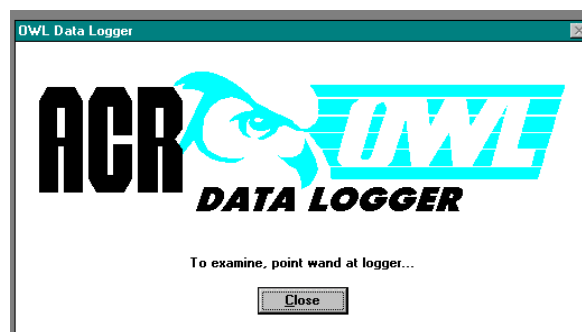


2. From the **Communicate** menu, choose **Preferred Logger** and **OWL Data Logger**.
3. Double-click the logger icon in the lower left corner of the window, or click **Communicate** on the menu bar and then choose the communication port that connects the logger to your computer (If your computer has more than one logger icon in the window or more than one COM port in bold print on the Communicate menu, your computer has two or more COM ports.)

The COM dialog box appears.



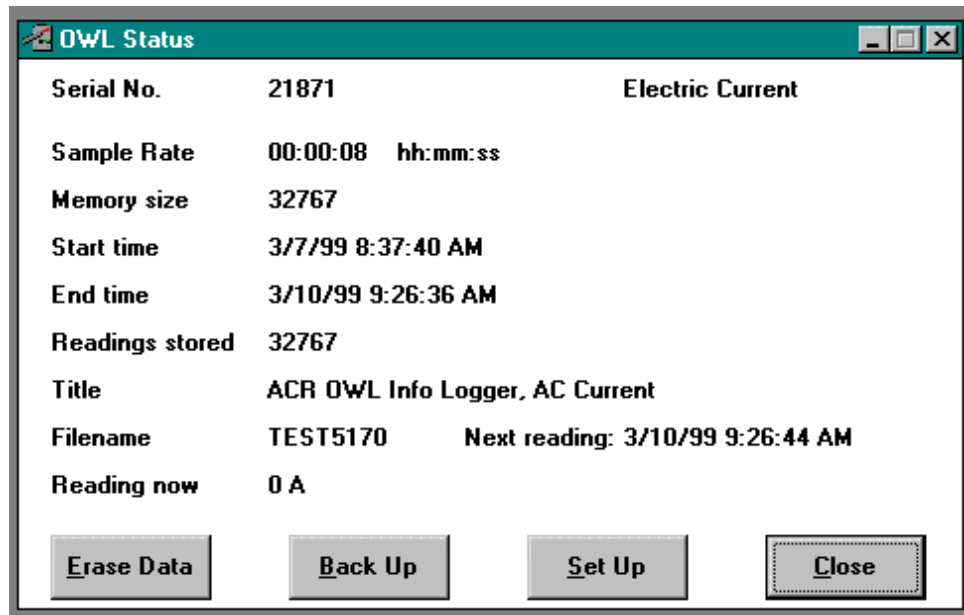
The purpose of this dialog box is to tell you whether to have the LIC-101 cable properly connected to your computer. If it is properly connected, this dialog box will disappear and the OWL Data Logger dialog box will appear.



The wand flashes, looking for a logger (the status bar at the bottom left of your screen indicates that TrendReader is scanning for OWL Loggers.) The dialog box asks you to point the wand at the logger to examine the data.

4. Hold the wand within an inch of the logger, pointing it at the optical port (If your OWL isn't behind glass or under water, you can fit the wand into the logger over the optical port.)

When the wand makes contact with the logger, your computer will beep and the OWL Data Logger Status window will open.



This window displays what the logger is measuring (temperature) and how it was set up. We are going to change some of these settings. To do this, we open the Setup window.

5. Click the **Setup** button.

First we will change the Sample Rate. The sample rate is the frequency at which the logger takes readings. We will set the sample rate to 12 seconds.

6. Place the cursor after the seconds and backspace through the numbers you want to change.
7. Type **12**.

Next, we will give the graph a title. The title will appear above the graph.

8. Drag through the current title to highlight it, and type **Room temperature**.

Next, we will give the file a name that the computer understands. The name can have eight characters (no spaces.)

9. Type **roomtemp**.

We don't need to change the equation. Equation # 200 is internal temperature.

Next, we will set the temperature range (If you have a logger other than a temperature logger, refer to the hardware section of this guide to select the range. Then skip to step 11.)

We set two numbers. The first number is the midpoint of the range we want to measure. Since we are going to measure room temperature we will set this to somewhere close to 20° C.

10. Move the slider bar until the midpoint is close to 20° C.

You will notice that as you change the first number, the second number changes also. The second number determines the size of the range in which the logger will gather readings. For instance, with a midpoint set at 20.33° C, the size of the range will be $\pm 8.72^\circ$ C (the highest possible temperature will be 29.05° and the lowest will be 11.61°.)

11. Click the left or right arrow until you find a range size that suits your purpose (As you change the

temperature range size values, you will notice that the midpoint values change also - they will only change by a few degrees.)

The last three settings in this window (High Trigger, Low Trigger, and Flash) will be explained in detail in *Chapter 3, Setting Up a Logger*; for now, we will set the logger to flash continuously.

12. Click the *down* arrow on the Flash box.
13. Choose Flash **always** from the pulldown menu.

To send this new setup to the logger:

14. Click the **Send Setup** button. A dialog box will warn you that all data that the logger has gathered up to this moment will be erased.

(The logger has data in it because it was activated at the factory. But don't worry, the battery is good for ten years.)

15. Click **YES** to proceed.

The send dialog box appears asking you to point the wand at the logger to send the new setup to the logger.

16. Point the wand at the logger's optical port.

When the logger has accepted the new setup, the computer will beep and the logger will start gathering data.

17. Close the logger windows.
18. For this short test, in order to produce a temperature variation and avoid a flat-line graph, put your finger over the temperature sensor on the logger to change the temperature (with loggers other than temperature loggers, refer to the hardware section of this guide to find out how to vary the signal.) Let the logger gather data for about three minutes.

Before you copy the data from your logger, go to the menu bar at the top of the TrendReader window.

19. Click **Options**.
20. Look for **Open Graph after Backup**. Enable this item so that a graph of your data will automatically be displayed after backup (A menu item is enabled when there is a check mark in front of it.)
21. To copy the data from the logger, open the OWL Data Logger window.
22. Put the wand over the logger's optical port.

In the Status window, Readings Stored tells you how many readings the logger has taken until the moment you opened the Status window.

23. Click **Backup** to download the data from the logger to your computer.

A dialog box will ask you to point the wand at the logger.

24. Point the wand at the logger's optical port.

The Save As dialog box will open to confirm the filename that you gave this file during setup.

25. Click **OK**.

You may have a copy of the logger data in your computer. The graph will open and your graph title will be displayed at the top.

The vertical axis measures the variable, the horizontal axis measures time.

To get a closer look at part of your graph, you can enlarge it by zooming.

26. Pick an area on the graph where the variable changes. Move the mouse so that the cross hairs are just to the left of that area and then press and hold down the left mouse button. Drag the cross hairs to the right. The two vertical lines that have appeared will enclose the area to be enlarged.

27. When you are satisfied with the area to be zoomed, release the mouse button.

28. To view the graph at its original size, click **Unzoom X-Axis** in the **View** menu (or press **Ctrl+Z**).

29. To print your graph, click **Print** in the **File** menu.

Chapter 3: Setting Up a Logger

Setting up a logger by enabling channels, choosing equation numbers, selecting a sample rate, etc.

SETUP FOR A SMARTREADER

Setting up an 8-bit SmartReader logger means using TrendReader software to program the logger's internal settings. Please refer to the SmartReader section of this guide for specifications of your model of logger.

Opening the SmartReader Window

From the **Communicate** menu, choose **Preferred Logger** and **SmartReader (8 Bit)**.

Using an IC-101 cable

Open the SmartReader window by double-clicking the taskbar (or logger icon) in the lower left corner of the main TrendReader window, or by clicking **Communicate** on the menu bar and choosing the highlighted **Open COM** from the menu.

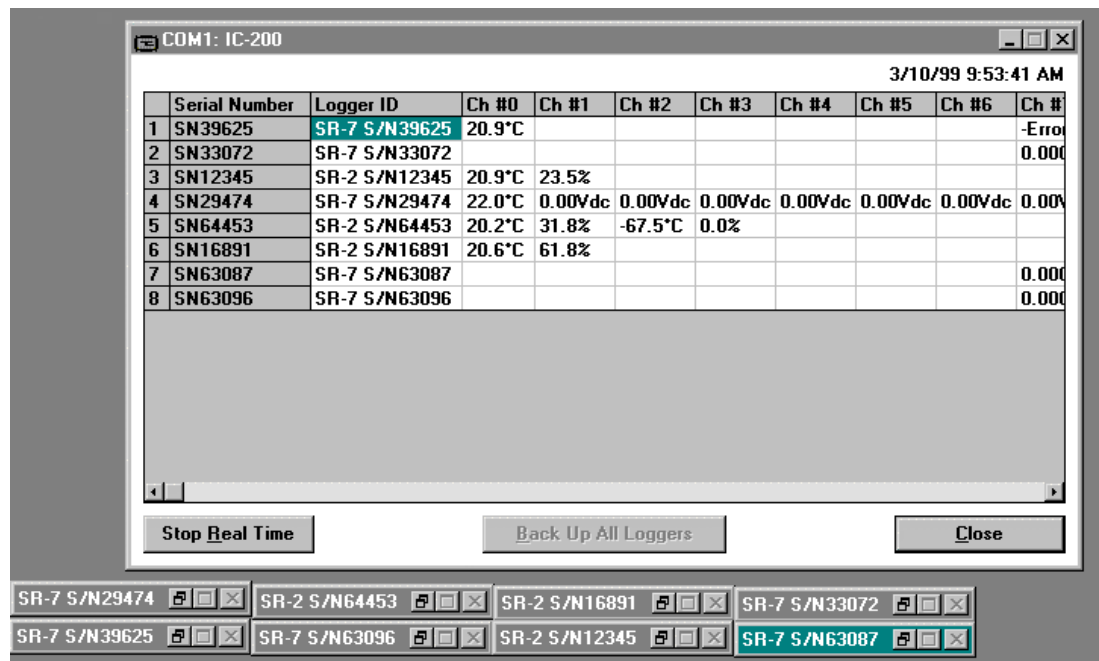
If there is more than one taskbar (or logger icon) on the screen (and more than one Open COM highlighted on the Communicate menu) that means you have more than one COM port available on your computer. Choose the port that your logger is connected to.

Using an IC-200 module

To set up a number of loggers using the IC-200 module:

1. Open SmartReader window.

The IC-200 window will open.



TrendReader automatically starts scanning for loggers connected to the IC-200. TrendReader scans the IC-200 inputs starting with input #1 and finishing with input #8. Therefore, if you have fewer than eight loggers connected to your IC-200, you should connect them to inputs 1, 2, 3, etc. A logger may be missed on the first attempt to contact it.

Also, to save time when you have fewer than eight loggers, click Stop Real Time when all your loggers have been scanned. Then you won't have to wait while TrendReader scans the remaining unused inputs. You can now set up your loggers one by one.

- To set up your first logger, either double-click on the taskbar (or logger's icon) at the bottom of the screen, or click anywhere in that logger's row in the window.

The SmartReader window will open.

SR-7 S/N29474

#	ON	Description	Eqn	Low	Mid	High	Realtime (running)
0	YES	Internal temperature	45	0	0	0	22.7 °C
1	YES	10 V channel #1	17	0	1.797	0	0.00 Vdc
2	YES	10 V channel #2	17	0	1.367	0	0.00 Vdc
3	YES	10 V channel #3	17	0	1.797	0	0.00 Vdc
4	YES	10 V channel #4	17	0	2.656	0	0.00 Vdc
5	YES	10 V channel #5	17	0	1.797	0	0.00 Vdc
6	YES	10 V channel #6	17	0	1.797	0	0.00 Vdc
7	YES	10 V channel #7	17	0	1.797	-5	0.00 Vdc

Sample Rate: 9:59:23 AM

Delay Logger Start

Stop taking readings when logger memory is Full.

Activate the Logger's battery switch?

Logger contains 5 days, 16 hours, 30 minutes worth of data as of 9:53:00 AM.

Realtime Mode

Whether you are using an IC-101 cable or an IC-200 interface module, the same SmartReader window will open.

Setting Up a SmartReader

Setup mode and realtime mode

The SmartReader window is in either setup mode or realtime mode. (In the lower right corner of the logger window, either Realtime Mode or Setup Mode will be displayed.)

When you open the SmartReader window it is always in realtime mode, which simply means that the logger's current readings are being displayed in the window.

Before you can change any settings, you have to change the window to setup mode. To do this, click **Edit Setup**.

Enabling and disabling channels

When you enable a channel on a logger, it becomes an active channel and it continually records readings and stores them in the logger's memory. In the SmartReader window, the channel numbers are in the column on the left. In the example of a logger window in the previous section (Setup mode and realtime mode), channel zero records internal temperature.

In the channel (ON) column, YES means that a channel is active, NO means that it is not. Click YES to disable the channel (NO will be displayed); click NO to enable it (YES will be displayed). Disable any channels you are not using so that there is as much memory as possible available for the active channel(s).

Choosing equation numbers

Equations are calculations that TrendReader makes to convert raw logger data to understandable units.

To choose the equation number(s) that works with your logger, refer to the SmartReader section of this guide where it describes your model of logger.

To see the list of standard equations available, double-click one of the equation numbers in the Eqn column. The Select an Equation dialog box will appear, enabling you to scroll through TrendReader's standard equations. If you want to choose one of the equations on the list, click it to highlight it, and click Accept. You can also choose an equation by typing the equation number in the Selected Equation Number box and clicking Accept.

You may also create custom equations and assign them to a SmartReader. For information about how to do this, refer to *Chapter 6, Custom Equations*.

Checking calibrations (Low, Mid, High)

Calibrating a logger is the process of adjusting it so that its readings are accurate.

The calibration values displayed in the Low, Mid, and High columns are factory set and match the sensor supplied.

Viewing realtime readings

The realtime column displays Realtime (running) in realtime mode, or Realtime (halted) in setup mode.

Realtime mode's only function is to allow you to view the logger's readings as it is recording them. Viewing current readings can be useful if you want to monitor remote loggers.

You change from setup mode to realtime mode by clicking Enable Realtime.

Don't leave realtime running if you want to perform tasks in TrendReader – or if you want to switch to another Windows application. The operation of TrendReader, or of any other Windows program, will be slowed considerably with realtime running. With realtime halted you will be able to open dialog boxes, make changes to graphs, save files, etc., much faster.

To stop realtime, click the Edit Setup button. Stopping realtime has no effect on a SmartReader's information gathering.

Choosing a sample rate

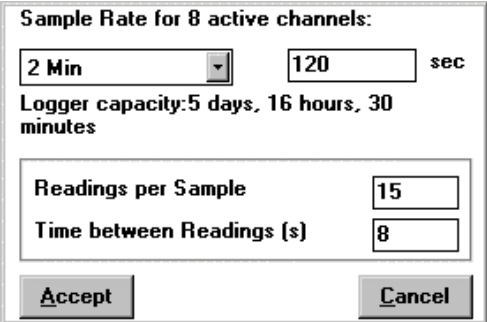
The Sample Rate is the frequency with which a SmartReader takes readings.

The current sample rate is always displayed.

To change the current rate:

1. Click the current rate.

The Sample Rate dialog box appears.



Sample Rate for 8 active channels:

2 Min 120 sec

Logger capacity: 5 days, 16 hours, 30 minutes

Readings per Sample 15

Time between Readings (s) 8

Accept Cancel

This box shows you the current sample rate, the number of channels that are active, and the length of time it will take for the logger's memory to fill using that number of channels at that rate.

If you need to know a logger's capacity,
enable the channels you are going to use *before*
you choose a sample rate.

2. Click the down arrow to see the available sample rates (they range from 8 seconds to 5 days).
Scroll if necessary, and then click the rate you want.
3. Click **Accept**.

The new sample rate will apply to all active channels.

If you don't want to change the rate, click Cancel.

To find out more about sample rates, and to view a complete set of sample rate tables, turn to Appendix A.

Delaying start time

Make sure that the correct time is displayed in the SmartReader window before you use this function.

As soon as you have set up a logger and clicked **Save Setup**, the logger will start gathering data. If you don't want it to start so soon, you can set the start time for later.

To delay the logger's start time:

1. Click **Delay Logger Start**.

A "3" (or an X) will appear in the box and the **Select a Delay Time** dialog box will be displayed.

2. Drag across the items you want to change to highlight them.

3. Type the new values.

4. Click **Accept**.

The logger's delayed start time will be displayed in the SmartReader window.

You can set a SmartReader's starting time for up to two years ahead.

Stop/Continue taking readings when memory is full

You can set a SmartReader to either stop taking readings when its memory is full, or to continue taking readings when its memory is full.

If you choose the second option, the SmartReader will discard its oldest readings as it records new ones.

Click the option you want. A "3" (or an X) in the check box indicates that the logger will stop taking readings when it is full. The maximum number of readings a SmartReader can store is 32,767.

Saving changes

When you have finished setting up your SmartReader, click **Save Setup**. A dialog box will appear asking you if you want to clear the logger and save setup.

(Setting up a logger erases all its previously gathered data.) If you have backed up your old data, click **OK**.

If you have not backed up the data in the logger, click **Backup** and copy the data to your computer before you set up the logger.

Erasing a SmartReader's Data

To erase a logger's data (clear a logger):

1. In the Logger window, click **Edit Setup**.

2. Click **Save Setup**.

3. Click **OK** in the dialog box that appears.

Setup For A SmartReader Plus

Setting up a 12-bit SmartReader Plus means using TrendReader software to program its internal settings. Please refer to the SmartReader Plus section of this guide for specifications of your model of logger.

Opening the SmartReader Plus Window

1. From the Communicate menu, choose preferred Logger and SmartReader Plus (12 Bit).
2. Open the SmartReader Plus window by double-clicking the taskbar (or logger icon) in the lower left corner of the main TrendReader window, or by clicking Communicate on the menu bar and choosing the highlighted Open COM from the menu.

If there is more than one logger icon on the screen (and more than one Open COM highlighted on the Communicate menu) that means you have more than one COM port available on your computer. Choose the port that your logger is connected to.

The SmartReader Plus window will open.

The screenshot shows the SmartReader Plus window with the following configuration:

- Serial Number: 44671
- Filename: (empty)
- COM: COM1
- Time: 10:08:17 AM
- Graph Title: SN44671
- Buttons: Back Up, Edit Setup, Clear Stored Data, Close
- Sample Rate: 120 sec.
- Start Delay: 0 sec.
- Number of Readings: 21500
- Mode:
 - Stop When Full
 - Fast Read
 - Alarm Dialout
- Logger is Full
- Firmware 1.4
- Data Stored: 14 days, 22 hours, 20 minutes.

#	ON	Channel	Eqn #	Low	Mid	High	Ext	Realtime
0	YES	Int Temp	45	0	0	0	-5	20.69 °C
1	YES	25 mA	6	0	2.266	0	-5	0.000019 A
2	NO	25 mA	6	0	2.109	0	-5	Inactive
3	NO	200 mV	19	0	-0.5859	0	-5	Inactive
4	NO	2.5 Volt	7	0	0.3125	0	-5	Inactive
5	NO	5 Volt	18	0	-2.266	0	-5	Inactive
6	NO	5 Volt	18	0	-1.641	0	-5	Inactive
7	NO	10 Volt	17	0	-0.7031	0	-5	Inactive

Serial Number

The serial number of the logger that TrendReader has made contact with is displayed.

Filename

You cannot name the file during setup. Name a file when you are backing up a SmartReader Plus.

COM

COM displays the number of the communication port that your computer is using to contact the logger.

The Current Time

Make sure that the current time displayed in this window is correct.

To change the time display under Windows 95, 98, NT or 2000:

1. Double-click on Windows time display in the bottom right hand corner of the screen.
2. On the Date/Time Properties window change the time.
3. Press **Apply**.

To change the time display under Windows 3.1:

1. Switch to Program Manager by pressing **Alt+Tab**.
2. As you hold down **Alt**, keep tapping **Tab** until **Program Manager** appears, then release **Alt**.
3. From the main Program Manager window, double-click **Control Panel**.
4. Open **Date/Time** and make your changes.
5. To get back to TrendReader, press **Alt+Tab**.
6. Hold down **Alt** and keep tapping **Tab** until **TRWIN** appears, then release **Alt**.

Setting Up a SmartReader Plus

Stop When Full and Continuous Mode

You can set a logger to either stop taking readings when its memory is full, or to continue to take readings when its memory is full.

To choose the first option click the box in front of Stop When Full so that there is a "✓" (or an "X") in it.

The logger will take readings until its memory is full and then stop.

To choose the second option, Continuous mode, deselect the box in front of Stop when full. (This option is not available in fast read mode).

The logger will take readings, continuing to do so when its memory is full, discarding its oldest readings as it records new ones.

Stopping realtime

When you open the logger window it is in realtime mode, which simply means that the logger's current readings are being displayed in the window. Before you change any settings, click **Edit Setup**.

Clearing the logger's stored data

To empty the logger's memory, click **Clear Stored Data**.

Enabling and disabling channels

When you enable a channel on a logger, it becomes an active channel and it continually records readings and stores them in the logger's memory. In the Logger window, the channel numbers are in the column on the left. In the example of a logger window in the **Opening the SmartReader Plus Window** section, channel zero records internal temperature.

In the channel (ON) column, YES means that a channel is active, NO means that it is not. Click YES to disable the channel (NO will be displayed); click NO to enable it (YES will be displayed). Disable any channels you are not using so that there is as much memory as possible available for the active channel(s).

Choosing equation numbers

Equations are calculations that TrendReader makes to convert raw logger data to understandable units.

To choose the equation number that works best with your logger, refer to the SmartReader Plus section of this guide where it describes your model of logger.

To see the list of standard equations available, double-click one of the equation numbers in the Eqn column. The "Select an Equation" dialog box will appear, enabling you to scroll through TrendReader's standard equations. If you want to choose one of the equations on the list, click it to highlight it, and click Accept. You can also choose an equation by typing the equation number in the Selected Equation Number box and Clicking Accept.

You may also create custom equations and assign them to your logger's channels. For information about how to do this, refer to *Chapter 6, Writing Equations*.

Checking calibrations (Low, Mid, High)

Calibrating a logger is the process of adjusting it so that its readings are accurate. The calibration values displayed in the Low, Mid, and High columns are factory set and match the sensor supplied.

Viewing realtime readings

The realtime column's only function is to allow you to view the logger's readings as it is recording them. Viewing current readings can be useful if you want to monitor remote loggers by modem.

Don't leave realtime running if you want to perform tasks in TrendReader – or if you want to switch to another Windows application. The operation of TrendReader or of any other Windows program will be slowed considerably with realtime running. With realtime stopped you will be able to open dialog boxes, make changes to graphs, save files, etc., much faster.

To stop or start realtime, click the Edit Setup button. Stopping realtime has no effect on a SmartReader's information gathering. Realtime mode is not possible in FastRead mode.

Choosing a sample rate

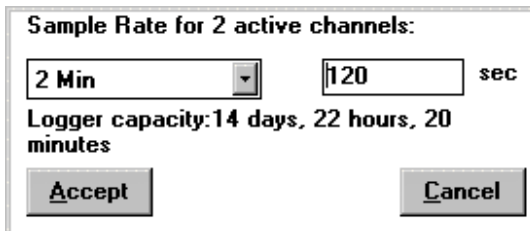
The Sample Rate is the frequency with which a logger takes readings.

The current sample rate is always displayed.

To change the current rate:

1. Click the current rate.

The Sample Rate dialog box appears.



This box shows you the current sample rate, the number of channels that are active, and the length of time it will take for the logger's memory to fill using that number of channels at that rate.

If you need to know a logger's capacity, enable the channels you are going to use *before* you choose a sample rate.

2. Click the down arrow to see the available sample rates (they range from eight seconds to eight hours in Continuous and Stop when Full mode.) Scroll if necessary, and then click the rate you want. In Fast Read mode you can choose sample rates of less than eight seconds.
3. Click Accept.

The new sample rate will apply to all active channels.

If you don't want to change the rate, click **Cancel**.

To find out more about sample rates, and to view a complete set of sample rate tables, turn to *Appendix A*.

Delaying a logger's start time

Make sure that the correct time is displayed in the SmartReader Plus window before you use this function.

As soon as you have set up a SmartReader Plus and clicked **Save Setup**, it will start gathering data. If you don't want it to start so soon, you can set the start time for later.

To delay the logger's start time:

1. Double-click in the Start Delay box to open the Select a Time dialog box.
2. Set the time and / or date that you want the SmartReader Plus to start logging.
3. Click **Accept**.

You can set a SmartReader Plus's starting time for up to six days, one hour and 39 minutes ahead.

Number of readings

A SmartReader Plus's memory capacity is expressed in number of readings. The maximum number of readings that a SmartReader Plus, 32 KB, can store is 21,500. You can change the number in this box (in increments of 500) if you want to take fewer than 21,500 readings.

To calculate the number of readings a particular time span will need, divide the time span by the sample rate (making sure that both figures are in seconds or minutes, etc.).

For example, if you are going to take readings at eight-second intervals for 24 hours, and you want to know what the total number of readings will be, convert 24 hours to seconds (86400) and divide the total by the sample rate of eight seconds. The number of readings will be 10,800.

Since the number of readings can be changed by increments of 500, set the number of readings to 11,000. When you back up the logger it will stop backing up after 11,000 readings rather than spending time looking through the rest of its memory.

Saving changes

1. When you have finished setting up your logger, click **Save Setup**.

A dialog box will appear asking you if you want to clear the logger and save setup. (Setting up a logger erases all its previously gathered data.)

2. Click **OK**.

Fast Read Mode

Choose Fast Read Mode when you need a sample rate of less than eight seconds.

About Fast Read Mode

- Fast Read Mode allows you to choose sample rates from 0.04 seconds (25 readings per second) to 2 minutes.
- A SmartReader Plus in Fast Read Mode needs power in order to be able to take readings; it gets power either from the computer it is connected to, or from a BP-101 battery pack, or PS-201 power supply.
- A SmartReader Plus in Fast Read Mode will stop taking readings as soon as its memory is full (it cannot work in Continuous mode).
- A SmartReader Plus in Fast Read Mode (whose memory is not full) will stop taking readings as soon as you contact it with Trend Reader. (See the note of caution in the *Start Delay for Fast Read Mode* section.)

Sample rates for Fast Read Mode

You can choose from the list of sample rate times in the Sample Rate dialog box. You can also choose your own rate as long as it is between 0.04 seconds and 2 minutes, and as long as it is a multiple of 0.04.

Start delay for Fast Read mode

When you are using sample rates as short as 0.04 seconds, you can run out of logger memory very quickly (two active channels at 0.04 seconds gives you 7 minutes and 10 seconds of memory). It is important that you don't waste any logger memory by starting the logger too soon.

There are two ways to delay the start of a SmartReader Plus.

In the first case (when you keep the logger connected to your computer, or it stays connected to a battery pack at a remote location):

- Set the delay time in seconds in the Start Delay box, or set the date and time when it is to start.

In the second case (when you are going to disconnect the logger from your computer and connect the battery pack at a later time):

- The logger will start taking readings when you connect the power source providing the start delay has expired. Otherwise the logger will start when the start delay times out if it has external power applied to it prior to the timing out of the start delay.

You must follow this procedure before you disconnect the logger:

- Before you click Save Setup, set Start Delay for long enough that you can save the setup and disconnect the logger while it is "asleep". The logger must be "asleep" (on start delay) when it is disconnected from the PC in order for it to be able to start taking readings when you connect the power source to it.

You must set a minimum start delay of 16 seconds before you disconnect the logger from your computer, and then you must disconnect the logger within eight seconds of setting that delay. If you omit these steps the logger will not start when you connect the power source.

Do not contact a SmartReader Plus in Fast Read Mode after setup until you are going to back it up. Remember that contacting it will stop it from taking readings. You contact a SmartReader Plus by either clicking Contact in the SmartReader Plus window, or by opening the window again once you have closed it.

Alarm Dialout

Alarm Dialout enables you to setup a SmartReader Plus logger at a remote site so that it will dial a phone number when its readings have exceeded preset alarm thresholds. You can setup a remote logger to dial a telephone or a pager.

How Alarm Dialout Works

Alarm Dialout is enabled in the SmartReader Plus window by setting high and low alarm thresholds, entering the number of the telephone or the pager that is to receive the alarm call, and sending the setup to the logger.

As soon as an alarm condition occurs the logger will dial out and leave the remote site number on a receiving telephone's caller ID display or on a pager's display (Alarm Dialout doesn't leave a verbal message.)

Equipment needed to receive an alarm

An alarm call may be received by a telephone or a pager.

(No special equipment is needed for Alarm Dialout at the remote site. For information about how to set up a modem at a remote site, please read *Chapter 7, Communicating with Loggers by Modem*.)

Telephone If you set the remote logger to dial telephone number, the receiving telephone will need to have caller ID in order to display the remote site's telephone number. When you see that the remote site has called, you can call the site to find out which logger caused the alarm.

Pager If you set the remote logger to dial a pager you will be able to include with the phone number a code (possibly the logger's serial number) that will show the person with the pager which logger initiated the alarm call. However, in order to be able to do this you must choose a pager system that accepts touch-tone codes that can be displayed on the pager. Since there can be as many as ten loggers on a network, being able to identify the logger that initiated the alarm can save quite a bit of time.

Setting up Alarm Dialout

Activating Alarm Dialout

- To activate Alarm Dialout on a SmartReader Plus, from the SmartReader Plus window click **Alarm Dialout** so that there is a check mark in front of it.

The Alarm Dialout section will appear at the bottom of the SmartReader Plus window and High and Low Alarm settings will appear to the right of the Realtime column.

The screenshot shows the SmartReader Plus window with the following settings:

- Serial Number: 44671
- Filename: [Empty]
- COM1
- 10:14:53 AM
- Contact button
- Graph Title: SN44671
- Buttons: Back Up, Edit Setup, Save Setup, Close
- Sample Rate: 120 sec.
- Start Delay: 0 sec.
- Number of Readings: 21500
- Mode:
 - Stop When Full
 - Fast Read
 - Alarm Dialout
- Logger is Full
- Firmware 1.4
- Data Stored: 14 days, 22 hours, 20 minutes.

#	ON	Channel	Eqn #	Low	Mid	High	Ext	Realtime	High Alarm
0	YES	Int Temp	45	0	0	0	-5	22.33 °C	228.98 °C
1	YES	25 mA	6	0	2.266	0	-5	0.000025 A	0.025186 A
2	NO	25 mA	6	0	2.109	0	-5	Inactive	0.025159 A
3	NO	200 mV	19	0	-0.5859	0	-5	Inactive	0.24948 V
4	NO	2.5 Volt	7	0	0.3125	0	-5	Inactive	2.4901 Vdc
5	NO	5 Volt	18	0	-2.266	0	-5	Inactive	4.857 Vdc
6	NO	5 Volt	18	0	-1.641	0	-5	Inactive	4.898 Vdc
7	NO	10 Volt	17	0	-0.7031	0	-5	Inactive	10.126 Vdc

Alarm Dialout Settings:

- Baud Rate: 1200
- Call Delay: 1600 sec.
- Retry Delay: 8 min.
- Reset Delay: 27 min.
- Alarm disabled for 00:26:56.
- Number to Dial: ATDT 555-2222.....43567

Setting high and low alarm thresholds

- Set high and low thresholds for each active channel on the logger. Any reading lower than the low alarm threshold or higher than the high alarm threshold will cause the logger to dial out from the remote site.

If you don't want the high and / or low alarm activated on a channel, set the high alarm threshold to

the highest possible value and set the low alarm threshold to the lowest possible value on that channel.

Choosing a baud rate

Baud rate is a measure of the transmission speed of dial commands that the logger sends to the modem. The default baud rate is 1200, which is reliable and adequate for most situations. Higher baud rates are available in the baud rate box.

Entering the number to dial

Alarm Dialout can call a telephone or a pager.

A. Calling a telephone Remember that the telephone receiving the alarm call must have caller ID to display the remote site's phone number otherwise you will have no way of knowing where the call came from.

1. In the Number to Dial box in the SmartReader Plus window, you must type a *dial command* for the modem. If the phone line at the remote site has tone dial, type ATDT. If the phone line has plus dial, type ATDP.
2. After the dial command, type the number of the telephone that is to receive the alarm call. For example, if you wanted a logger to dial a number from a tone dial phone line you would type: ATDT 555-2222

B. Calling a pager In order to be able to include with the phone number a code that will identify the logger that called, you must choose a pager system *that accepts touch-tone codes that can be displayed on the pager.*

1. In the Number to Dial box in the SmartReader Plus window, type the *dial command* ATDT.
2. After the dial command, type the number of the pager that is to receive the alarm call.
3. After the pager number and before the identifying code there must be a pause to allow the receiving station to answer. Enter this pause by typing commas. (For most modems each comma causes a pause of two seconds.)
4. Type a code that will identify the logger.

For example, if you want a logger to dial a pager number, pause for ten seconds, and then send the logger's serial number, you would type:
ATDT 555-2222,,,,,40167

Setting Call Delay

Call Delay is the length of time that a logger will wait before dialing out once an alarm condition has occurred. If you don't want the remote logger to dial out immediately when one or more of its channels goes into an alarm condition, you can set the Call Delay to designate the number of seconds that the logger is to wait before dialing. Maximum delay is 2040 seconds.

If the alarm condition does not exist for the entire call delay period the logger will not dial out. If the logger comes out of an alarm condition during the call delay period, the delay timer will stop and will start again from zero at the next alarm event.

Setting Retry Delay

If a remote logger dials out an alarm but can't get through (for example, the line is busy,) it keeps dialing out until it gets through. Retry Delay is the length of time that the logger will wait between unsuccessful tries. We recommend setting a retry delay of five minutes. Maximum retry delay is 30 minutes.

Note that a logger will continue to dial out after every retry delay time as long as an alarm condition exists and the alarm has not been acknowledged.

Setting Reset Delay

Reset Delay begins when you acknowledge the alarm by backing up the logger that dialed out. Reset Delay deactivates Alarm Dialout to give you time to fix the problem that caused the alarm. Maximum reset delay is 720 minutes.

When the reset delay period has elapsed, Alarm Dialout will reactivate and if an alarm condition exists, the logger will dial out again.

IMPORTANT: If an alarm condition occurs and a Reset Delay has been initiated by the last backup, the logger will wait until the Reset Delay period is over before dialing out.

To bypass the Reset Delay period (if you have fixed the alarm problem but there is time remaining on Reset Delay that is preventing Alarm Dialout from being activated) click the Clear Stored Data button and follow the subsequent prompts.

Sending the setup to the logger

- When you have chosen Alarm Dialout settings, send the setup to the logger by clicking the **Save Setup / Clear Stored Data** button and following the subsequent prompts.

Responding to an alarm call

1. When a logger dials out to warn of an alarm condition, dial into the site and back up the logger.
2. Fix the problem that caused the alarm.
3. Reactivate Alarm Dialout by contacting the logger and clicking **Clear Stored Data**.

Fast Read Mode disabled

- Alarm Dialout is not designed to operate in Fast Read Mode. When you enable Alarm Dialout, Fast Read Mode is disabled; when you enable Fast Read Mode, Alarm Dialout is disabled.

Precautions

- If you are monitoring perishable goods (such as food in a freezer) you should make sure that all systems related to monitoring (the modem and telephone equipment) are powered by an uninterruptable power supply (UPS). A battery powered UPS will keep power running to the

equipment for a certain period of time.

- Test Alarm Dialout regularly to ensure that a logger initiates a call from the site whenever one of its channels goes into an alarm condition.

Operating a SmartReader Plus Network

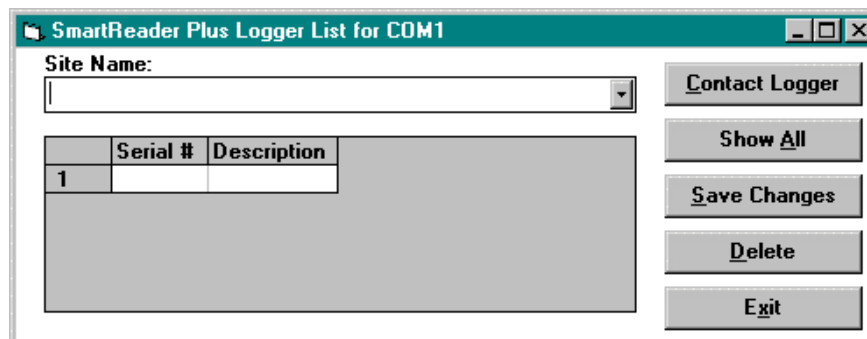
For information about the different types of network setup available, and how to set up a SmartReader Plus network, please read Appendix B, *Communicating with Multiple Loggers*.

Identifying loggers on a network

Before you can contact a networked group of loggers at a site for the first time you must name the site and list the loggers' serial numbers in the TrendReader program so that they can be identified.

1. From the **Communicate** menu in the main TrendReader window choose **SR+ Network** so that there is a check mark in front of it.
2. Choose the COM port that the loggers are connected to.

The SmartReader Plus Logger List dialog box will appear. In this dialog box you will name the site and list the serial numbers of the loggers at that site.



3. In the Site Name box type a unique name for the site and press **Enter**.
4. Click in the Serial # column, type the serial number of one of the loggers, and press **Enter**.

(The order of the loggers on this list doesn't matter, however, if you click **Show All** to view the realtime readings of all loggers, TrendReader will look for the loggers in the order that you put them on the list.)

5. If you want to describe the logger in your own words, click in the Description column, type a description, and press **Enter**.
6. Repeat steps 4 and 5 until all the loggers at the site are listed in this dialog box.
7. Click **Save Changes**.

You can now contact any of the loggers in the list.

Deleting a site and its loggers

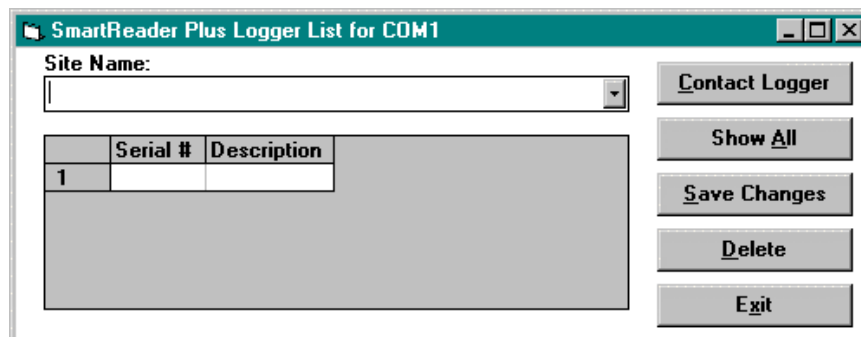
1. Make sure that the name of the site that you want to delete is displayed in the Site Name box and highlighted. (if necessary, click the down arrow to view the site names and to select the site.)
2. Click **Delete**.
The site name, serial numbers and descriptions will be deleted.
3. Click **Save Changes**.

Deleting one logger from a list

1. Click in the logger's serial number box to highlight the number.
The serial number and the description will be deleted.
2. Click **Delete**.
3. Click **Save Changes**.

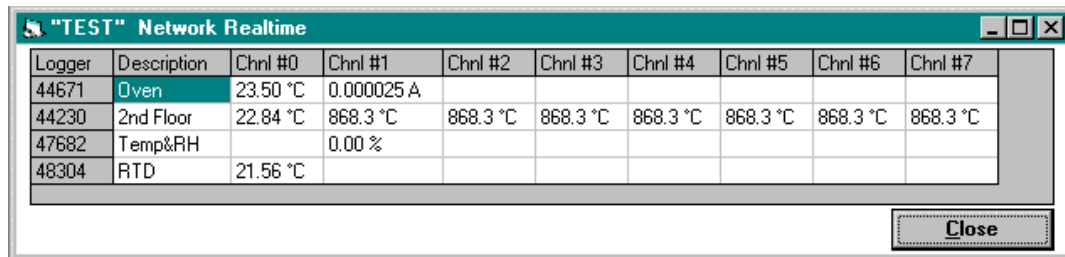
Viewing realtime readings of all networked loggers

1. From the **Communicate** menu in the main TrendReader window, click SR+ Network so that there is a check mark in front of it.
2. Choose the COM port that the network is connected to.
The SmartReader Plus Logger List dialog box will appear.



3. Click **Show All**.

The Network Realtime window will open displaying each logger's realtime readings.



The screenshot shows a window titled "TEST Network Realtime" with a table of data. The table has columns for Logger, Description, Chnl #0, Chnl #1, Chnl #2, Chnl #3, Chnl #4, Chnl #5, Chnl #6, and Chnl #7. The data rows are as follows:

Logger	Description	Chnl #0	Chnl #1	Chnl #2	Chnl #3	Chnl #4	Chnl #5	Chnl #6	Chnl #7
44671	Oven	23.50 °C	0.000025 A						
44230	2nd Floor	22.84 °C	868.3 °C	868.3 °C	868.3 °C	868.3 °C	868.3 °C	868.3 °C	868.3 °C
47682	Temp&RH		0.00 %						
48304	RTD	21.56 °C							

A "Close" button is located at the bottom right of the window.

When you have finished viewing the realtime readings, either click Close to close the window, or double-click a logger's serial number to open that logger's window.

Contacting a networked logger

There are three ways to contact a logger on a network:

- From the SmartReader Plus Logger List dialog box
- From the Network Realtime window
- From the SmartReader Plus window

Contacting a logger from the SmartReader Plus Logger List dialog box

1. Double-click the logger's serial number (or click the logger's serial number and click **Contact Logger**).

The logger's main window will open.

Contacting a logger from the Network Realtime window

- Double-click the serial number of the logger you want to contact.

The logger's main window will open.

Contacting a logger from the SmartReader Plus window

When you have contacted a logger by one of the previous two methods and you have that logger's window open, you can contact another logger on the network by taking the following steps:

1. Click Edit Setup.
2. Double-click the serial number in the Serial Number box.
3. Type the number of the logger you want to contact.
4. Click the Contact button to open that logger's window.

Do not set up networked loggers in Fast Read mode. Any networked SmartReader Plus that is set up in Fast Read mode will stop logging as soon as it or any other logger on the network is contacted.

Setup For An OWL Data Logger

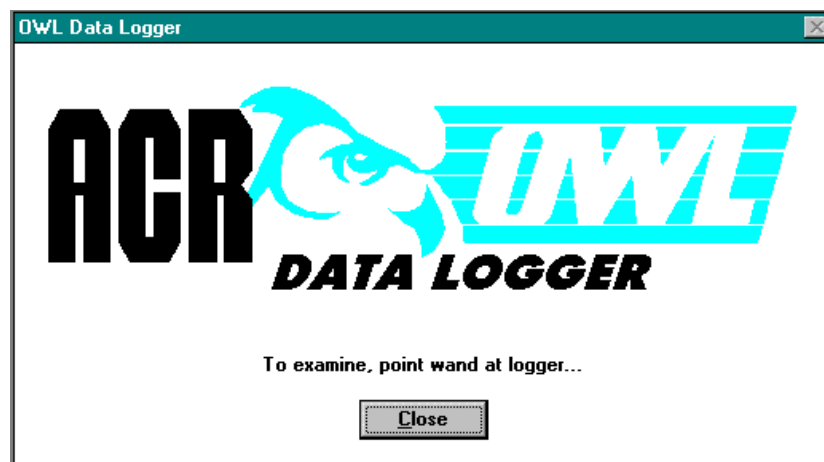
Setting up a logger means using TrendReader software to program the internal settings of a logger. Please refer to the OWL Data Logger section of this guide for specifications for your model of OWL.

Opening the OWL Setup Window

1. From the **Communicate** menu, choose **Preferred Logger** and **OWL Data Logger**.
2. Open the OWL Status window by double-clicking the taskbar (or logger icon) in the lower left corner of the main TrendReader window, or by clicking **Communicate** on the menu bar and choosing the highlighted **Open COM** from the menu.

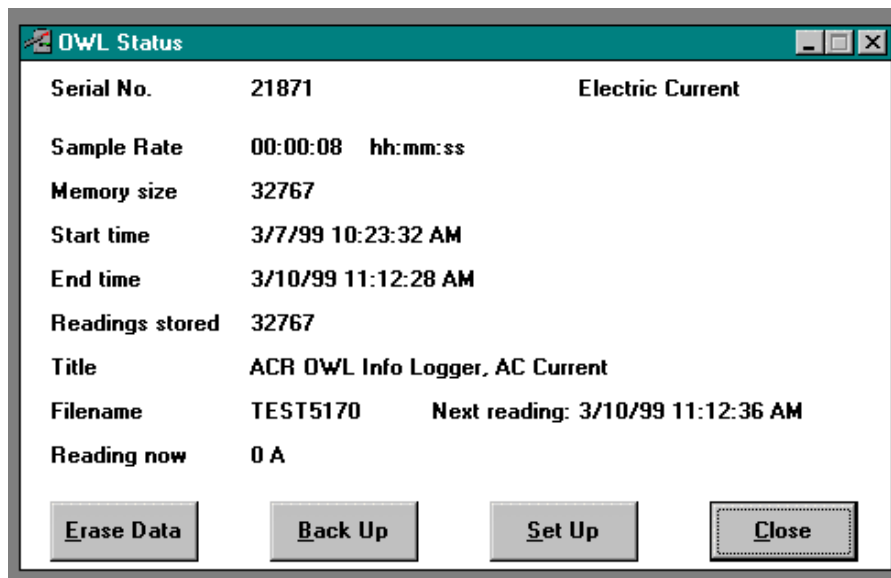
If there is more than one OWL icon on the screen (and more than one Open COM highlighted on the Communicate menu) that means you have more than one COM port available on your computer. Choose the port that your LIC-101 cable is connected to.

The OWL Data Logger dialog box will appear asking you to point the wand at the logger. The wand starts to flash, looking for a logger (the status bar at the bottom left of your screen indicates that TrendReader is scanning for OWL loggers.)



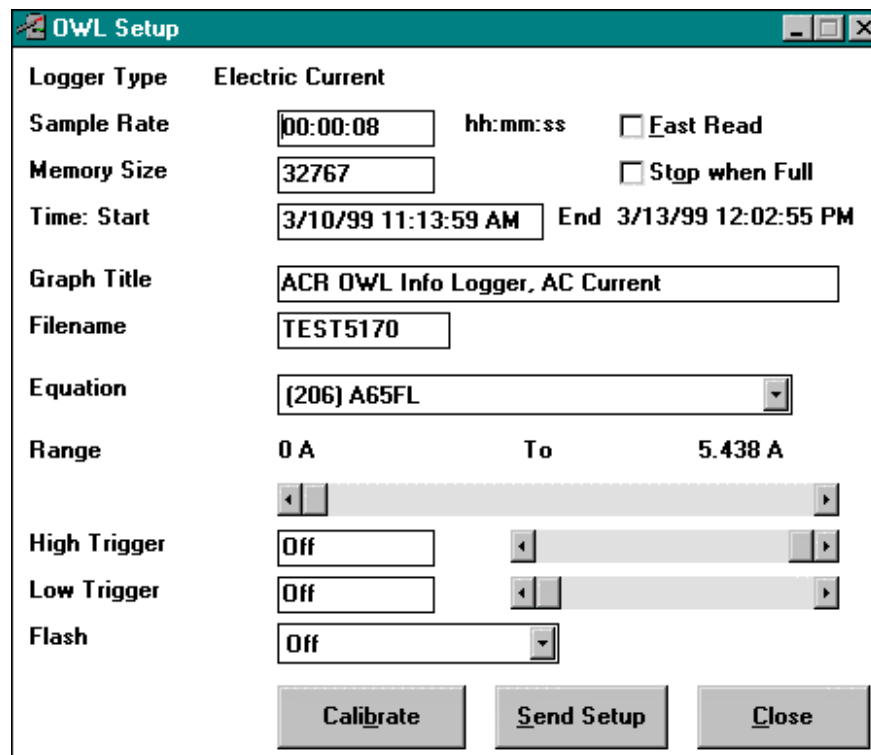
Hold the wand within an inch of the logger, pointing it at the optical port. (If your OWL isn't behind glass or under water, you can fit the wand into the logger over the optical port.)

When the wand makes contact with the logger, your computer will beep and the OWL Status window will open.



This window displays what the logger is measuring and how it was set up previously. We will deal with this window in *Chapter 4, Backing up a Logger*.

5. Click the **Setup** button to open the Setup window.



Setting up an OWL Data Logger

An OWL runs in any one of three modes: Continuous, Stop when Full, or Fast Read.

Stop when Full mode / Continuous mode

You can set up an OWL to either stop taking readings when its memory is full, or to continue taking readings when its memory is full.

If you choose the first mode (Stop when Full), the OWL will take readings until its memory is full, then stop. Choose this option by clicking in the Stop when Full box.

If you click again in this box, so that there is no "✓" (or X) in the box, the OWL will be in continuous mode - it will continue taking readings when it is full, discarding its oldest readings as it records new ones.

Fast Read is a slightly different setup and is dealt with farther on in the Fast Read mode section.

Logger type

The logger type that TrendReader has made contact with is displayed at the top of the Setup window.

Choosing a sample rate

The Sample Rate is the frequency with which an OWL takes readings. The current sample rate is always displayed in hours, minutes and seconds.

To change the rate, you can either double-click in the sample rate box and type the new rate, or place the cursor after the seconds, backspace through the numbers you want to change, then type the new numbers.

Memory size

The memory size of an OWL is expressed in number of readings. The maximum number of readings an OWL can store is 32,767. At an eight second sample rate, an OWL will take a reading every eight seconds and its memory will fill in 32,767 times 8 seconds, which is approximately three days.

To see how long it will take to fill the memory at a particular sample rate, subtract the start time from the end time.

You can reduce the memory size to save backup time. For instance, if you know you need only 500 readings, change the memory size to 500. This means that when you back up the OWL's data, TrendReader will stop looking for readings when it has found 500 (rather than spending time looking through the full-size memory of 32,767 readings).

Reducing the memory size to match the number of readings you need, will save you backup time

especially when the data values you are measuring fluctuate widely between readings. The minimum number of readings that an OWL will log is 255.

If you have chosen the sample rate and the time span that you want to cover, and you need to find out the memory size required to store the data, divide the time span by the sample rate (making sure that both figures are in seconds or minutes, etc.).

Start Time and End Time

Start Time and End Time displays the time span that will be logged. The Start Time displayed will be the current time (if your computer's clock is accurate).

To correct the current time under Windows 3.1:

1. Switch to Program Manager by pressing **Alt+Tab**, and tapping **Tab** as you hold down **Alt** until **Program Manager** appears.
2. From the Task List dialog box, choose **Program Manager**.
3. From the main Program Manager window, double-click **Control Panel**.
4. Open **Date/Time** and make your changes.
5. To get back to TrendReader, press **Alt+Tab** and tapping **Tab** as you hold down **Alt** until **TRWIN** appears.
6. From the Task List dialog box, choose **TrendReader**.

To change the time display under Windows 95, 98, NT or 2000:

1. Double click on Windows time display in the bottom right hand corner of the screen.
2. On the Date / Time Properties window change the time.
3. Press **Apply**.

Setting a start delay

You can delay the logging start by changing the start time. Maximum delay is six days, one hour and 39 minutes.

To delay an OWL's start:

1. Place the cursor to the right of the numbers you want to change.
2. Backspace through those numbers.
3. Type the new numbers.

The End Time will move forward so that the time span will remain the same.

Choosing a graph title

The graph title is the caption that will be displayed above your graph when you open the file or print it. You can type the title in words with spaces between them, and with capital letters mixed with lower case letters.

To change this title:

1. Drag the cursor across the title to highlight it.
2. Type the new title.

You will have the opportunity of changing this title when you view the graph.

Choosing a filename

To choose a filename that the computer understands, give the name a maximum of eight letters or numbers (no spaces). TrendReader automatically gives this filename a .TRW extension.

You cannot type anything after the dot in a TrendReader file since TrendReader gives all its files three-letter extensions automatically.

Choosing equation numbers

Equations are calculations that TrendReader makes to convert raw logger data to understandable units.

When TrendReader makes contact with an OWL, the appropriate equation number appears in the Setup window. However, in the case of some OWLs, a choice of equation numbers will appear in the pull-down menu. To choose the correct equation number, refer to the OWL Data Logger section of this Reference Guide where your model of logger is described.

You may also create custom equations and assign them to an OWL. For information about how to do this, refer to Chapter 6, Writing Equations.

Checking calibrations

Calibrating a logger is the process of adjusting it so that its readings correlate to the values it measures. The calibrations are factory set and match the sensors supplied. You should not need to change them.

If, however you want to check the calibrations, click **Calibrate** to open the Calibrate dialog box.

	Logger Value	Actual Value
First Data Point	<input type="text"/>	<input type="text"/>
Second Data Point	<input type="text"/>	<input type="text"/>
Generate	Zero <input type="text" value="0"/>	Span <input type="text" value="0"/>
	Accept	Cancel

Please note that the range must be selected and saved before calibration. Calibration values only apply to that specific range.

You can test an OWL's calibrations by comparing them against values that you know to be accurate. When you have done this, you can enter the logger values and the actual values in the Calibrate dialog box.

For the two data points, choose two values that are as far as possible.

For example:

1. If you discover that at 100 the logger registers 100.3, type **100.3** as the First Data Point in the Logger Value box, and type **100** in the Actual Value box.
2. Then, if you discover that at 0 the logger registers 0.4, type **0.4** as the Second Data Point in the Logger Value box, and type **0** in the Actual Value box.
3. Click **Generate**. Values will appear in the Zero and Span boxes.
4. Click **Accept**.

This information still has to be sent to the logger.

5. Click Send Setup in the Setup window.

It is vital to follow the correct procedure when recalibrating an OWL. An OWL that has been calibrated will have values other than zero in the Zero and Span boxes. When you see values other than zero in the Zero and Span boxes, you must again test the logger's readings against readings that you know to be accurate before you enter any values in the Calibrate dialog box.

Selecting the range

TrendReader enables you choose the size of a range and to choose a midpoint for a range.

The advantages of taking these two steps are:

1. The smaller the size of a range the higher the resolution of the readings.
2. The readings closest to the midpoint of a temperature range are higher in resolution than those at each end of the range.

The first number (on the left above the slider bar) is the midpoint of the range you want to measure, and the second number (on the right) is the size of that range.

To set the midpoint of the range, click the left or right arrow on the scroll bar until the midpoint value is close to where you want it to be.

In the case of temperature, you will notice that as you change the midpoint value, the second number changes also. The second number determines the size of the range in which the logger will gather readings. For instance, on a temperature logger with a midpoint set at 20.33° C, the size of the range will be $\pm 8.72^{\circ}$ C (the highest possible temperature will be 29.05° and the lowest will be 11.61°.) To see all the possible midpoint temperatures and their associated range sizes, refer to the OWL Data Logger section of this Reference Guide.

To set the size of the range (not applied to OWL-500), click the left or right arrow until you find a range size that suits your purpose.

Setting High and Low Trigger

High and Low Trigger enables you to set upper and lower limits inside which the OWL will not log. But as soon as a reading goes above the high trigger point or below the low trigger point, the OWL will start logging and continue to do so.

Click the left or right arrows on the slider bars to change the values.

Alarm

Under Flash, choose **Alarm** or **Failsafe Alarm** to indicate a trigger point has been reached while recording before and after the event.

Flash

The Flash pulldown menu lists the conditions under which the logger's light will flash.

- **Off:** the light will never flash.
- **Until Tripped:** the light will flash until the OWL starts logging.
- **Until Full:** the light will flash until the logger is full.
- **While Logging:** the light will flash while the logger is taking readings.
- **Always:** the light will always flash.
- **Alarm:** the light will blink after a trigger value has been exceeded.
- **Failsafe Alarm:** the light will blink only if a trigger value has not been exceeded.

Choose Fast Read mode when you need a sample rate of less than eight seconds.

Operating an OWL in Fast Read mode will shorten its battery life. If the sample rate you need is available in normal mode, use that mode to conserve the battery.

Fast Read mode

About Fast Read mode:

- In Fast Read mode you can choose sample rates from 0.2 seconds to 10 seconds in 0.1 second increments.
- An OWL in Fast Read mode will stop taking readings as soon as its memory is full (it cannot work in Continuous mode).
- An OWL in Fast Read mode (whose memory is not full) will stop taking readings as soon as you contact it with TrendReader. (See the note of caution below.)
- The Flash function is unavailable in Fast Read mode.

Do not contact an OWL in Fast Read mode once you have set it up. Remember that contacting it will stop it from taking readings. Once you have set it up and clicked Save Setup, do not contact it again until you want to back it up.

Sending the Setup to the OWL

When you have finished making changes in the Setup window, send the changes to the logger.

1. Click **Send Setup**.

A dialog box will warn you that all data that the logger has gathered up to this moment will be erased and asks you if you want to proceed.

2. Click **YES** to proceed.

The Send dialog box appears asking you to point the wand at the logger to send the new setup to the logger.

3. point the wand at the OWL's optical port.

When the OWL has accepted the new setup, the computer will beep and the OWL will start gathering data (unless you have set a time delay or trigger value).

4. Close the logger windows.

Erasing Data

If, after backing up an OWL, you are going to use it again without changing the setup, you can save backup time by erasing its previously gathered data. The Erase Data button is in the Status window.

Clicking Erase Data will also start the logger.

Chapter 4: Backing Up a Logger

Copying data from one or more loggers to your computer.

Backup For A SmartReader

Backing Up One SmartReader

Copying the data from a SmartReader 8-bit logger to your computer.

Baud rate for IC-101 users

Baud rate is a measure of data transmission speed. Backing up a logger can take a number of minutes, depending on the speed of your computer and the amount of data being backed up. You can speed up the process by choosing **Set Baud Rate, Fastest Available** from the **Communicate** menu.

If you have problems backing up a logger, try a slower baud rate. On some computers, choosing the fastest available baud rate causes timing conflicts.

Baud rate for IC-200 users

A choice of baud rate is not available to IC-200 users since IC-200s automatically transmit at a rate of 1200 baud.

But if you are an IC-200 user who sometimes wants to back up a single logger, you will perform the operation much faster by using an IC-101 cable and setting the baud rate to Fastest Available.

Opening a graph after backup

If you want TrendReader to display the backed up data as a graph immediately after backup, open the **Options** menu in the main TrendReader window and make sure there is a check mark in front of **Open Graph after Backup**.

Opening the Backup dialog box

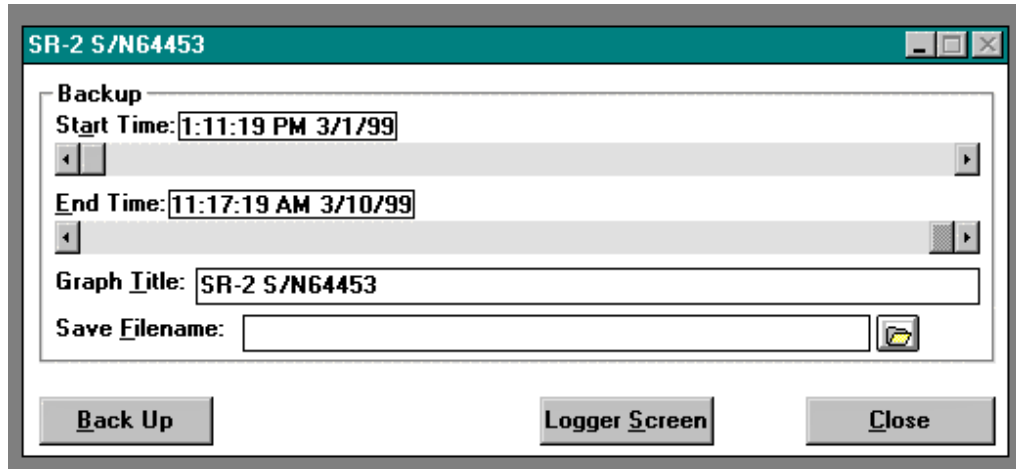
With TrendReader running and a logger connected to your computer by an IC-101 interface cable:

1. Open the Logger window by double-clicking on the taskbar (or logger icon) or by clicking **Communicate** on the menu bar and choosing the **Open COM** that is highlighted. (*Open COM* refers to a serial port on your computer. TrendReader finds the ones that are available.)

The Logger window will open, displaying the settings that you programmed in the logger during setup. The period of time that the logger gathered data will also be displayed.

2. Click **Backup**.

The Backup dialog box appears.



Setting Start Time and End Time

Start Time and End Time show you the period of time that will be covered when you back up all the data on the logger. You don't have to change either of these times if you are going to back up all the logger's data.

To back up a portion of the logger's data, change one or both of these times. For example, you may not need the data from the last four hours when the logger was being brought from its location to your office.

To omit this period of time from the backup, hold the mouse button on the left arrow of the End Time scroll bar. The scroll box will move across the scroll bar and simultaneously you will be able to see the time changing in the time box. You can also change the time by placing the pointer on the scroll box and dragging the scroll box to the new location on the slider bar.

To be more exact in your choice of time period:

1. Click the box that displays the end date and time.
2. Type your time changes in the selection box that appears.
3. Click **Accept**.

Choosing a graph title

The graph title is the caption that will be displayed above your graph when you open the file or print it. You can type the title in words with spaces between them, and with capital letters mixed with lower case letters.

When you open the Backup dialog box, the serial number of the logger is always displayed as the default graph title.

To change this title:

1. Drag the cursor across the title to highlight it.
2. Type the new title.

You will have the opportunity of changing this title when you open the graph.

Choosing a filename

TrendReader Standard saves all data from a logger in one file. That data must be given a filename that the computer understand. The filename can have eight letters or numbers (no spaces).

You can name the file either by typing a filename into the Save Filename box or clicking the file button to the right of the box and typing a name into the Save As dialog box. The Save As dialog box also enables you to choose which directory you want the file saved in.

If you don't need to give a file a special name you can omit this step and leave it to TrendReader to name the file. After backup TrendReader will automatically use the logger's serial number as the default filename. The second time you back up the logger, TrendReader will add the letter "a" to the serial number so that the previous file will not be overwritten - and so on through the alphabet. Files that are backed up from a logger are logger files, and TrendReader gives them a .TRW extension automatically.

You cannot type anything after the dot in a TrendReader file name since TrendReader gives all its files three-letter extensions automatically.

Starting Backup

When you have set the time period, given the graph a title, and given the file a name, click **Back Up**.

A dialog box will appear showing the baud rate and the progress of the backup. You may cancel the backup procedure by clicking **Cancel**.

Closing the Backup dialog box

The Backup dialog box will stay on your screen in case you want to back up different time spans of the SmartReader's data as different files.

When you have finished backing up, you can return to the Logger window by clicking Logger Screen, or you can click Close and return to the Main TrendReader window.

Backing Up Multiple SmartReaders

With up to eight loggers connected to an IC-200, and the IC-200 connected to your computer, you can give TrendReader one command to back up all the loggers.

You may want to disable the opening a graph after backup function when you are backing up several loggers, otherwise TrendReader will take time to open each graph after backing up each logger, increasing the total backup time considerably.

To disable this function, open the **Options** menu and make sure there is no check mark in front of **Open Graph after Backup**.

Opening the IC-200 window

From the Main TrendReader window:

1. Open the IC-200 window by double-clicking on the taskbar (or logger icon) in the lower left corner of the window, or by clicking **Communicate** on the menu bar and choosing the **Open COM** that is highlighted. (*open COM* refers to a serial port on your computer. TrendReader will find the one that is available.)

The IC-200 window will open, and TrendReader will start scanning for loggers connected to the IC-200.

TrendReader scans the IC-200 inputs starting with input # 1 and finishing with input # 8, so if you have fewer than eight loggers, connect them to inputs 1, 2, 3, etc.

Whenever you want to stop the scanning process, click **Stop Real Time**. (If you have fewer than eight loggers connected to the IC-200, you will want to halt scanning when the last logger has been scanned.)

2. Click **Back Up All Loggers**.

The Backup IC-200 dialog box appears.

Logger	Filename
1 SN39625	SN39625.TRW
2 SN33072	SN33072.TRW
3 SN64453	SN64453.TRW
4 SN29474	SN29474.TRW
5 SN63087	SN63087.TRW
6 SN16891	SN16891.TRW
7 SN63096	SN63096.TRW
8 SN12345	SN12345.TRW

The loggers that have been contacted will appear with their serial numbers as their default filenames. You may keep these names or change them.

3. Click **Accept**.

A dialog box will appear listing the loggers that will be backed up.

4. Click **OK**.

As each logger is being backed up, a dialog box will be displayed showing the logger number and the progress of the backup. If you want to stop the backup, click **Cancel**. Clicking Cancel will stop the backup for all loggers.

When all the loggers have been backed up, the IC-200 dialog box will reappear. To open one of these logger windows either double-click the logger icon or double-click anywhere in the logger's row in the IC-200 window.

You may want to disable the opening a graph after backup function when you are backing up several loggers, otherwise TrendReader will take time to open each graph after backing up each logger, increasing the total backup time considerably.

To disable this function, open the **Options** menu and make sure there is no check mark in front of **Open Graph after Backup**.

Backup For A SmartReader Plus

Backing Up One SmartReader Plus

Copying the data from a SmartReader Plus 12-bit logger to your computer.

Baud rate (for IC-100/101 users)

Baud rate is a measure of data transmission speed. Backing up a logger can take a number of minutes, depending on the speed of your computer and the amount of data being backed up. You can speed up the process by choosing **Set Baud Rate, Fastest Available** from the **Communicate** menu.

If you have problems backing up a logger, try a slower baud rate (on the Communicate menu.) On some computers, choosing the fastest available baud rate causes timing conflicts.

Opening a graph after backup

If you want TrendReader to display the backed up data as a graph immediately after backup, open the **Options** menu in the main TrendReader window and make sure there is a check mark in front of **Open Graph after Backup**.

Backing Up Networked Loggers

From the SmartReader Plus Logger List dialog box, click the serial number of a logger you want to backup and click **Contact Logger**, or click **Show All**, and from the Network Realtime window double-click the logger that you want to back up. Either of these steps will open the logger's main window.

You may want to disable the opening a graph after backup function when you are backing up several loggers, otherwise TrendReader will take time to open each graph after backing up each logger, increasing the total backup time considerably.

To disable this function, open the **Options** menu and make sure there is no check mark in front of **Open Graph after Backup**.

Starting Backup

- Click **Backup**. A dialog box appears showing the baud rate, the serial number of the logger, and the progress of the backup. (You may cancel the backup procedure by clicking **Cancel**.)

Naming a file

When backup is completed, the Save As dialog box appears to enable you to name the file. The default name is always the serial number of the logger.

- If you want to keep the logger's serial number as the filename, click **OK**. If you want to give the file a different name, type the new name and click **OK**.

You can not type anything after the dot in a TrendReader filename since TrendReader gives its files three-letter extensions automatically.

Backup For An OWL Data Logger

Copying the data from an OWL Data Logger to your computer.

Opening a graph after backup

If you want TrendReader to display the backed up data as a graph immediately after backup, open the **Options** menu in the main TrendReader window and make sure there is a check mark in front of **Open Graph after Backup**.

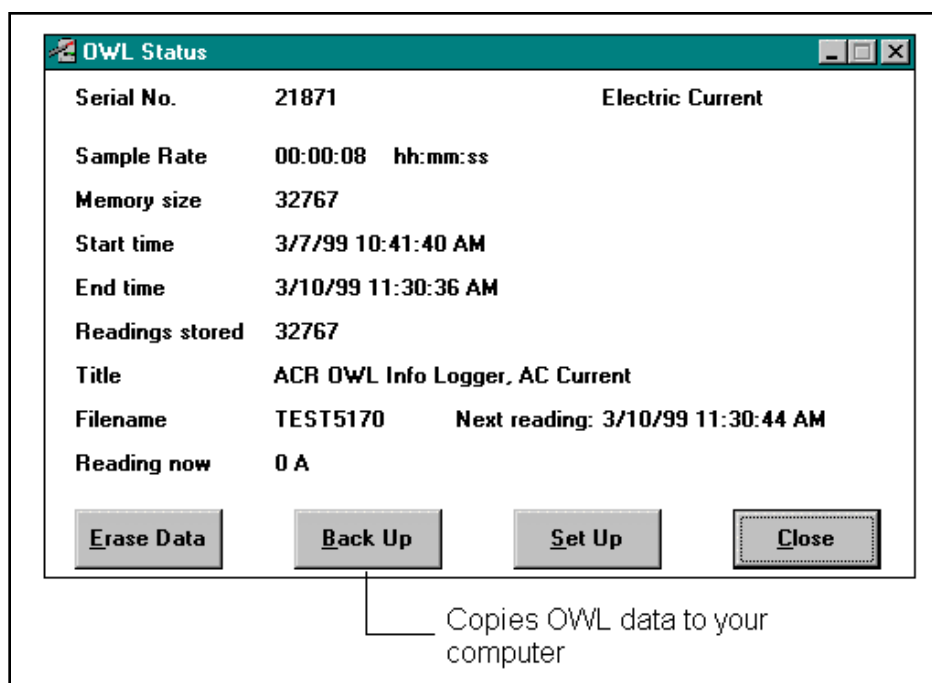
Backing Up

1. From the **Communicate** menu, choose **Preferred Logger** and **OWL Data Logger**.
2. Open the OWL Status window by double-clicking the taskbar (or logger icon) in the lower left corner of the main TrendReader window, or by clicking **Communicate** on the menu bar and choosing an **Open COM** from the menu. Choose the port that your LIC-101 cable is connected to.

A dialog box will appear asking you to point the wand at the logger. The wand flashes, looking for a logger (the status bar at the bottom left of your screen indicates that TrendReader is scanning for OWL Loggers.)

3. Hold the wand within an inch of the logger, pointing it at the optical port. (If your OWL isn't behind glass or under water, you can fit the wand into the logger over the optical port.)

When the wand makes contact with the logger, your computer will beep and the OWL Status window will open.



This window displays what the logger is measuring and how it was set up previously. The displayed settings cannot be changed in this window.

4. Click **Backup**.

The OWL Backup dialog box appears, asking you to point the wand at the logger.

5. point the wand at the OWL's optical port.

The Save As dialog box appears.

6. Click **OK** if you want to keep the name you chose during setup, or type a new name and then click **OK**.

Erasing Data

If, after backing up an OWL, you are going to use it again without changing the setup, you can save backup time by erasing its previously gathered data. The **Erase Data** button is in the **Status** window.

As well as erasing data, clicking **Erase Data** will also start the logger.

Chapter 5: Working With Graphs

Opening, adding comments to, sizing, saving and exporting graphs.

The Difference between Logger Files and Graph Files

TrendReader usually follows the Windows style of handling files. There is, however, one important difference: how TrendReader distinguishes between logger files and graph files.

Logger Files

When you copy a logger's data to your computer using the backup function, TrendReader will automatically save all the data (internal and /or external channels) in one file. TrendReader calls this file a logger file and gives it a **.TRW** extension.

Graph Files

When you open a logger file and choose one or more channels, a graph will be displayed. If you make any changes or add any comments to the graph, give it a name and save it, TrendReader will save the graph as a graph file. It will give the file the **.GPW** extension to signify that it is a graph file. To find this file the next time, open the Graph File dialog box. Do Not move a logger file once it is created and saved. The graph file will not be able to find it and will not open. Try to move the logger file before you create any graph files.

Never delete a logger file just because you have made a graph file from the logger file's data and you think that you don't need the logger file anymore. A graph file cannot exist on it's own. Every time you open a graph file it has to get data from its logger file(s) in order to open.

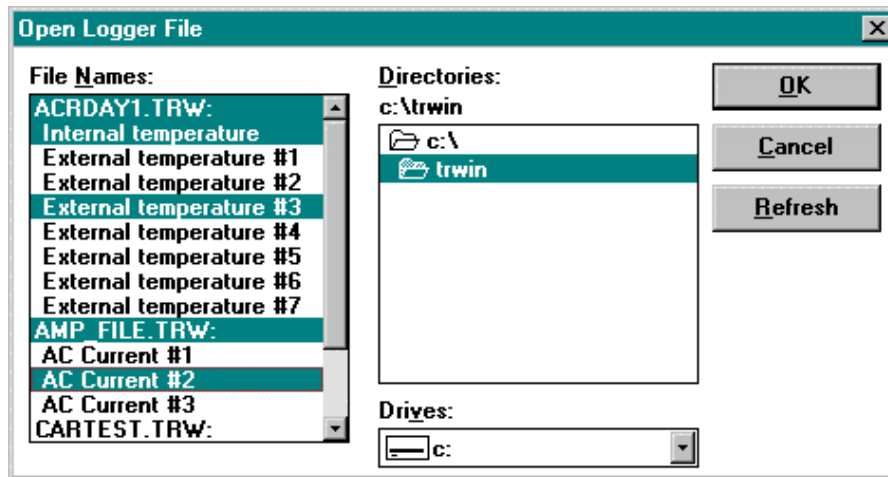
To View Logger Data Without Altering It

If, when you open logger files, all you do is view the information (as a graph or a table) and sometimes print the information, you don't have to bother with graph files. When you have finished viewing or printing a graph or a table, close it. If you want to look it again, open that logger file again.

As long as you don't alter it and save it under another name, you can open and close a logger file as many times as you like.

Opening Logger Files to Display Graphs

When you open a logger file from the File menu, the Open Logger File dialog box will appear.



TrendReader's display of logger files in this dialog box departs slightly from the usual Windows style of displaying files. A logger filename is displayed in capital letters and the names of its channels are displayed below it in lower case letters. The dialog box above is displaying two of the sample logger files that come with the TrendReader program.

The filename of the first logger file is ACRDAY1.TRW. This file contains data from one internal channel and from seven external channels. It looks as if these channels are separate files, but they are not. They are all part of the file ACRDAY1.TRW.

ACRDAY1 is the name that the user gave to the file; .TRW is the extension that TrendReader gives to every logger file.

Choosing logger channels for graphing

TrendReader allows you to combine readings from different logger channels on a single graph. These readings can be from the same time period, from different time periods, from one logger, or from different loggers.

To choose channels, open the **Open Logger File** dialog box from the File menu. In this box, a name in capital letters is a filename and refers to a logger. The information from the various channels of that logger is listed after the filename. All the data from a logger is in one file.

From the Open Logger File dialog box:

- To Choose a single channel to display as a graph, click that channel and then click **OK**.
- To choose more than one channel, click the channels you want to highlight, and click **OK**. You may choose channels from different loggers.
- To choose all channels from one logger file (one logger), click the filename (all that file's channels will be highlighted). Click **OK**.
- To deselect all channels from one file, click the filename.
- To deselect any individual channel(s), click the channel(s) to remove the highlighting.

When you have chosen the channel or channels you want to display as a graph, click **OK**.

Opening a Graph File

If you have opened a logger file previously, made changes to the graph, given it a name, and saved it, the file is now a graph file. (The original logger file still exists.)

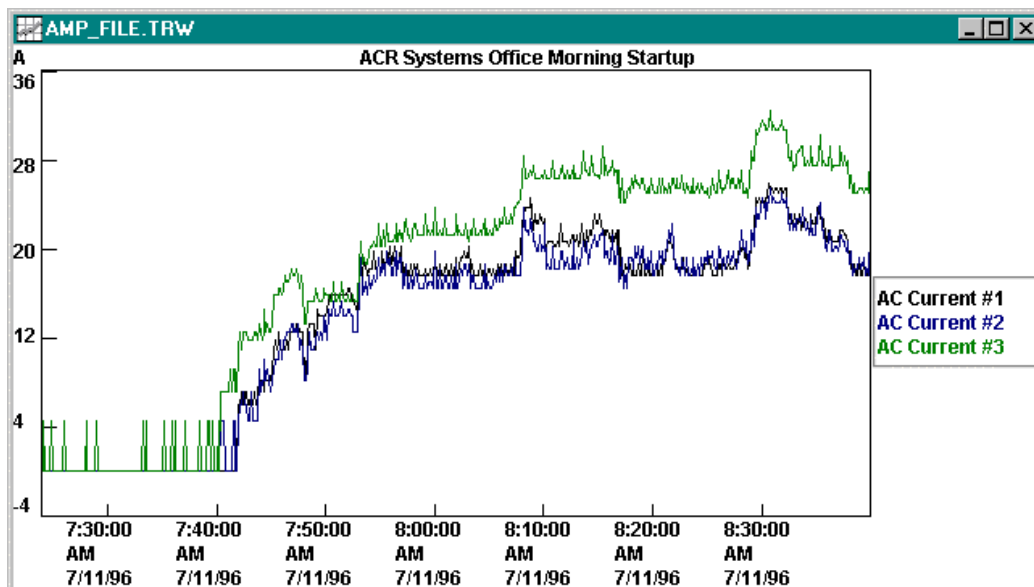
To open this file again:

1. From the **File** menu, choose **Open Graph File**.
2. From the Open Graph File dialog box, choose the file you want.
3. Click **OK**.

You can make changes to a graph file, but you cannot combine different graph files and display them as one graph. If you want to combine data from different logger channels or from different loggers onto one graph, you can do this only with logger files. Open the Logger File dialog box and combine your data from there by clicking on the channels you want to display on one graph.

A graph Window

Whether you have opened a logger file or a graph file, your graph will be displayed in the graph window.



The status bar

The status bar, at the bottom of your screen, displays data relating to the coordinates of the cross hairs on the graph. As you move the cross hairs with the mouse you will see the coordinates changing on the status bar.

Showing the legend

The legend (the names of the channels that are displayed on the graph) appears to the right of the graph when there is a check mark in front of Legend on the View menu.

Hiding the legend

If you don't want the names of the channels displayed on a graph, delete the check mark in front of Legend on the View menu.

Enlarging a graph window

When you open a graph file, the graph window will not be displayed at its maximum size. You can make it fill the whole screen by clicking the maximize button in the top right corner of the window.

The maximize button will become a restore button.

Closing a graph window [Ctrl+F4]

To close a graph window, either press Ctrl+F4 or click the control-menu box in the top left corner of the window, and choose Close from the pulldown menu.

Different Channels Displayed on One Graph

You can compare logger data from the same time period from different channels of a logger, or from different loggers (or from different time periods) by combining all the data on one graph. The display will show a number of graphs overlaid.

To select the data you want to combine:

1. Select the Open Logger File dialog box.
2. Click the channels you want to combine on one graph.
3. Open the graph by either, double-clicking the last channel you select, or by clicking **OK**.

Giving Graph a Title

TrendReader allows you to place a title above a graph. The graph title is for display purposes and will appear just above the graph when you print it. You can type a title in words with spaces between them, and with capital letters mixed with lower case letters. There are two ways you can add a title.

First, from the Backup dialog box:

1. When you are copying the logger data to your computer you will open the Backup dialog box. You will see a default graph title (the serial number of the logger). Drag the cursor across the existing graph title to highlight it.
2. Type the new title. This title will appear above the graph.

Second, from the graph:

1. Click on the existing title to highlight it. (The existing title may be the logger's serial number).
2. Type a new title.
3. press **Enter**.

Moving a title

You can move title to the left or to the right by dragging it with the right mouse button.

Zooming

The zoom function magnifies the horizontal axis (the time axis). It does not affect the vertical axis. The zoom function enables you to magnify a section of a graph so that you can see it in greater detail. The zoomed area becomes the full width of the graph, therefore the narrower the section you choose to zoom, the greater the magnification.

There are two ways to zoom: by using the mouse, or by specifying the start and end time of the zoom from the Graph Zoom dialog box. You may zoom more than once.

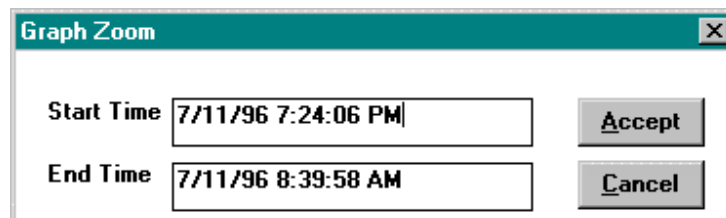
A. Using the mouse to zoom in on a section of a graph:

1. Position the cross hairs to the left of the area that you want to magnify. (It doesn't matter where you place the cross hairs vertically.)
2. Press and hold the left mouse button and drag to the right. The vertical lines that appear will be the boundaries of the magnified area.
3. Release the mouse button when you have enclosed the area that you want to magnify.

B. Using the Graph Zoom dialog box to zoom in on a section of a graph:

1. Click anywhere below the graph.

The Graph Zoom dialog box appears.



2. Place the cursor to the right of the numbers you want to change, backspace through them, and type the new times / dates. Change AM or PM if necessary.

3. Click **Accept**.

Autoscaling on zoom

To magnify the vertical axis with the horizontal axis, choose the **autoscale on Zoom** command before you zoom. It is on the **Options** menu.

Unzooming [Ctrl+Z]

To view the graph at its original scale, go to the **View** menu and choose **Unzoom X-Axis**.

Adding Comments to a Graph

A comment is a description in words that you can place anywhere on a graph. The Add Comment command is on the Format menu.

Make sure the graph is the size you want it to be before you start adding comments. If you resize a graph by zooming or by changing the window size *after* you have added comments, the comments will not move with the graph and will be out of place after the resizing.

1. Click **Add Comment** on the **Format** menu.

A test box will appear in the top left corner of the graph.

2. Type the comment.
3. Press **Enter** to remove the text box.

Always press Enter to remove a text box when you have finished typing a comment. TrendReader will not save a comment on a graph if the comment is still enclosed by the text box.

If you want to delete a text box before you enter any text, press **Enter**.

TrendReader allows you to place a comment on a graph and use an arrow to point to the area it is referring to. (See *Adding Arrows*.)

Moving a comment

When you have typed a comment and pressed Return to remove the text box, you can move the comment to anywhere on the graph.

1. Move the cursor over the text until it becomes an arrowhead.
2. Holding down the left mouse button (a gray outline box will appear,) drag the comment to a new position on the graph.

Editing a comment

1. Double-click on the comment to highlight it.
2. Type the new text.
3. Press **Enter** to remove the text box.

Deleting a comment

1. Double-click on the comment to highlight it.
2. Press **Backspace** or **Delete**.
3. Press **Enter** to remove the text box.

Deleting all comments

If you have inserted a number of comments in a graph and you want to delete them all, use the **Clear All Comments** command on the **Format** menu.

Adding Arrows

The Add Arrow command enables you to insert an arrow in a graph. For instance, you may want to insert an arrow from a comment to the location on the graph that the comment is referring to. The Add Arrow command is on the Format menu.

When you choose the Add Arrow command, an arrow appears in the center of the graph.

Moving an arrow

1. Move the cross hairs over the head of the arrow until they change to a pointer.
2. Press and hold the left mouse button and drag the arrowhead to its new position.
3. Release the mouse button.

Follow the same steps with the other end of the arrow.

Deleting an arrow

To delete an arrow:

1. Press and hold the left mouse button and drag one end of the arrow on top of the other end.

2. Release the mouse button when the arrow disappears.

Deleting all arrows

If you have inserted a number of arrows on a graph and you want to delete them all, use the **Clear All Arrows** command on the **Format** menu.

Labeling Data Points

The **Label Data Points** command enables you to display or insert the coordinates of any point on a graph. For example, you may want to label the highest readings on a graph so that the reading and the time that it occurred are displayed in numbers on the graph.

The **Label Data Points** command is on the **Format** menu.

To label a point:

1. Click **Label Data Points** on the **Format** menu.
2. Point to the location on the graph that you want to label.
3. Click the left mouse button.

The coordinates of that position will be displayed on the graph at that location.

4. Click **Label Data Points** on the **Format** menu again to disable the function.

Labeling data points using an arrow

If you find that by placing a label it is going to obscure something else on the graph, you can place the label in another position and have an arrow pointing from it to the location it is referring to.

1. Click **Label Data Points** on the **Format** menu.
2. Point to the location on the graph that you want to label and hold down the left mouse button.
3. Drag to where you want to place the label.
4. Release the mouse button.

You can adjust the position of an arrow by dragging either end to a new location.

Changing the Range of the Vertical Axis

It is possible to change the maximum and minimum values of the vertical axis. This is useful when you want to compare data from different graphs.

If, for example, you wanted to compare temperatures from different graphs and display the graphs side by side, to get a true comparison you would set the same maximum and minimum vertical axis values on each graph.

Changing the maximum and minimum values can also give you a sense of the magnitude of the

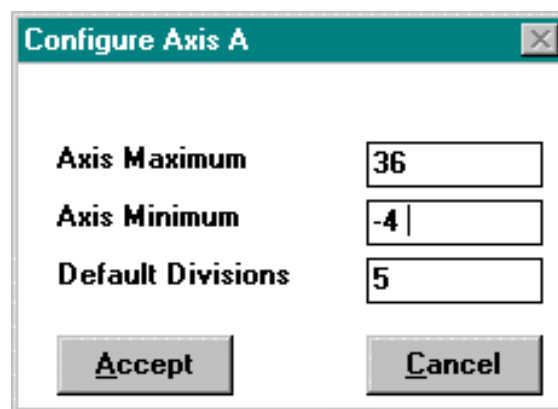
data from a reference point. If, for example, you wanted to compare a logger's temperature readings against freezing point you would set the minimum axis value to 0° C (32° F).

This function can also be used as a vertical zoom. For example, if you have a graph with a maximum vertical value of 80 and a minimum vertical value of 20, and you want to have a closer look at the values between 60 and 50, you can set the axis maximum to 60 and the axis minimum to 50.

To change these values:

1. Click one of the values in the vertical axis.

The Configure Axis dialog box appears.



2. Double-click the value in the Axis Maximum box to highlight it (you will notice that the value in the box is the maximum value of the vertical scale).
3. Type the value that you want as the maximum value in the graph.
4. Double-click the value in the Axis Minimum box to highlight it (you will notice that the value in the box is the minimum value of the vertical scale).
5. Type the value that you want as the minimum value in the graph.
6. Click **Accept**.

Default divisions

Default divisions are the number of values displayed on the vertical axis. If you change this number, the number you choose will be the default for all graphs that you open.

There are various reasons why you might want to change the number of divisions. Some users like to display divisions without decimal places. For example, on a graph in which the values ranged between 3 and 24, the axis maximum could be set to 25, the axis minimum to 0, and the number of divisions to 5. The values would then be displayed in increments of 5.

Choosing Fonts and Font Sizes

Setting the default font

To set the default font and font size of the graph title, the vertical values, horizontal values, and the legend:

- With no graph displayed, choose **Font** from the **Format** menu and make your changes in the font dialog box. The settings you choose will apply to every new graph you open.

The recommended default font is Arial, 8 point, bold.

(If you are familiar with point sizes, you will notice when you print a graph, that the point size prints larger than the size indicated in the font dialog box. This is because TrendReader's point sizes in the font dialog box are screen font sizes.)

Changing fonts on an existing graph

To change the size or style of the graph title, and the vertical and horizontal values:

1. Open the Font dialog box and make your changes.

If you want to change the size or style of the legend, you will have to do that separately.

To change the style or size of legend text:

1. Click the legend to highlight it.
2. Open the **Font** dialog box from the **Format** menu and make your changes.

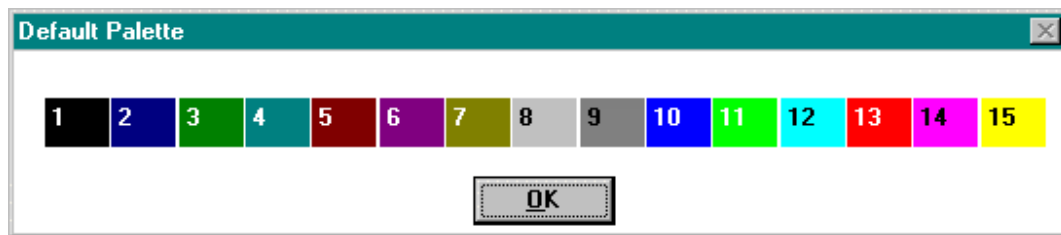
Using Colored Lines

If you have a color printer or a color monitor, you will find that TrendReader allows you to choose the colors for graph lines. This feature is very useful if you want to overlay a number of graph lines on top of each other on one graph.

TrendReader allows default colors to be assigned for each of the graph lines displayed. Default color # 1 is assigned to the first channel listed in the legend, default color # 2 is assigned to the second channel listed in the legend, etc.

Changing colors on the default palette

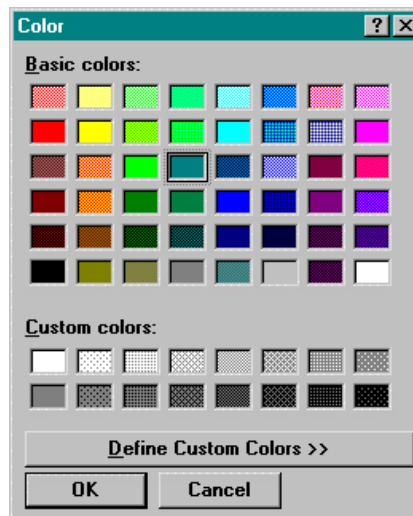
When you have more than one channel (graph line) displayed on a graph, TrendReader automatically gives each channel a different color from the default palette.



To change any of these default colors, open the Set Default Palette (on the Format menu).

1. Choose **Set Default Palette** from the **Format** menu.
2. Click the color you want to change to.

The Color dialog box appears.



3. Click **OK**.
4. Click **OK** in the **Default Palette** dialog box.

The default colors will remain the same until you change them.

(If you want to go wild with custom colors, click **Define Custom Colors** in the **Color** dialog box and start experimenting. The color of the lines will not change until the graph is redrawn.)

To change line colors on a graph without changing the defaults, read the next paragraph.

Changing line colors on a graph

To change the color of a line without changing any default colors:

1. In the Legend box, double-click the name of the channel you want to change the color of (the

name will be the same color as the line it refers to on the graph).

The Color dialog box appears.

2. Click the new color.
3. Click **OK**.

The line color will change immediately.

Draw with Patterned Lines

On the Format menu, Draw with Patterned Lines enables you to distinguish between different lines on a graph if you have a monochrome monitor or a monochrome printer.

To enable Draw with Patterned Lines:

- Make sure there is a check mark in front of **Draw with Patterned Lines** on the **Format** menu.

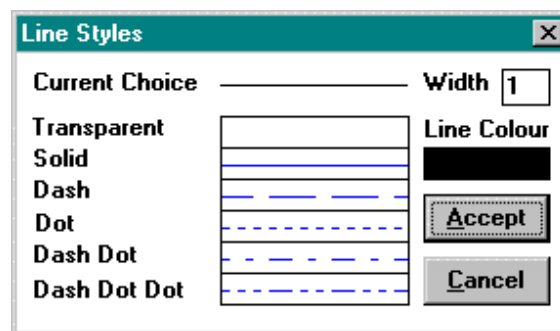
TrendReader will assign lines with various combinations of dots and dashes to the different channels on the graph.

Changing line styles

To change one or more line styles on a graph:

1. Make sure there is a check mark in front of **Draw with Patterned Lines** on the **Format** menu.
2. In the legend, click the line that you want to change (don't click the line description).

The Line Styles dialog box appears.



3. Click the line style you want to change to.

The Current Choice at the top of the box will change to the line style you chose.

4. Click **Accept**.

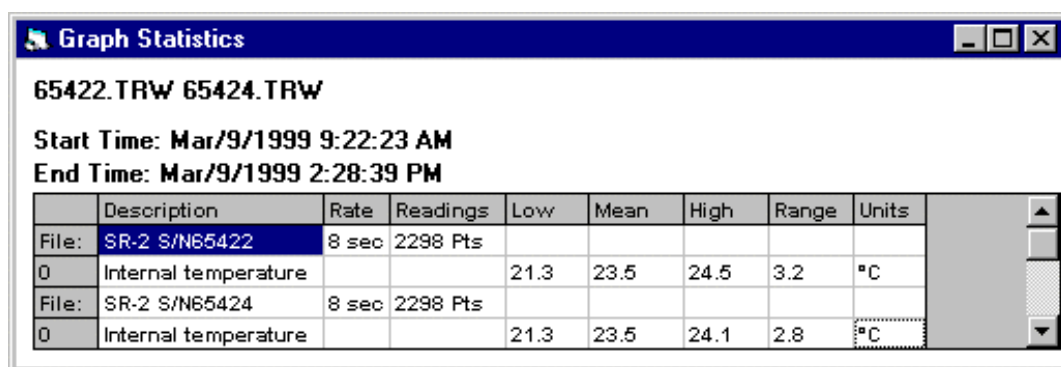
Changing line width

This feature will only work with solid lines. To change line width on a graph:

1. Open the Line Styles dialog box by clicking on the line to the right of the legend you want to change.
2. Drag across the number in the width box to highlight it.
3. Type the width you want (the higher the number, the wider the line).

Displaying a Graph's Statistics

The Graph Statistics window, on the View menu, displays for each channel, in numerical form, the highest and lowest values on the graph as well as the range between them, and the mean (the average reading).



The screenshot shows a window titled "Graph Statistics" with a blue title bar. Below the title bar, the text "65422.TRW 65424.TRW" is displayed. Below that, the start and end times are shown: "Start Time: Mar/9/1999 9:22:23 AM" and "End Time: Mar/9/1999 2:28:39 PM". A table with 9 columns (Description, Rate, Readings, Low, Mean, High, Range, Units) and 4 rows is shown. The first row is a header, and the next three rows represent data for two channels. The first channel is "SR-2 S/N65422" with a rate of "8 sec" and "2298 Pts" readings. The second channel is "SR-2 S/N65424" with a rate of "8 sec" and "2298 Pts" readings. The units for both are "°C".

	Description	Rate	Readings	Low	Mean	High	Range	Units
File:	SR-2 S/N65422	8 sec	2298 Pts					
0	Internal temperature			21.3	23.5	24.5	3.2	°C
File:	SR-2 S/N65424	8 sec	2298 Pts					
0	Internal temperature			21.3	23.5	24.1	2.8	°C

Displaying a Graph as a Table

To display logger data as a table you have to open a graph first:

1. Open the logger file or the graph file that you want to display as a table.
2. When the graph appears, choose **Graph as Table** from the **View** menu.

65422.TRW		65424.TRW	
	Internal temperature		Internal temperature
	°C		°C
3/09/99 9:22:54 AM	21.27585	3/09/99 9:22:23 AM	21.27585
3/09/99 9:23:02 AM	21.27585	3/09/99 9:22:31 AM	21.27585
3/09/99 9:23:10 AM	21.27585	3/09/99 9:22:39 AM	21.27585
3/09/99 9:23:18 AM	21.27585	3/09/99 9:22:47 AM	21.27585
3/09/99 9:23:26 AM	21.27585	3/09/99 9:22:55 AM	21.27585
3/09/99 9:23:34 AM	21.27585	3/09/99 9:23:03 AM	21.27585
3/09/99 9:23:42 AM	21.27585	3/09/99 9:23:11 AM	21.27585
3/09/99 9:23:50 AM	21.27585	3/09/99 9:23:19 AM	21.27585
3/09/99 9:23:58 AM	21.27585	3/09/99 9:23:27 AM	21.27585
3/09/99 9:24:06 AM	21.27585	3/09/99 9:23:35 AM	21.27585
3/09/99 9:24:14 AM	21.62836	3/09/99 9:23:43 AM	21.27585
3/09/99 9:24:22 AM	21.62836	3/09/99 9:23:51 AM	21.27585
3/09/99 9:24:30 AM	21.62836	3/09/99 9:23:59 AM	21.27585
3/09/99 9:24:38 AM	21.62836	3/09/99 9:24:07 AM	21.62836
3/09/99 9:24:46 AM	21.62836	3/09/99 9:24:15 AM	21.62836
3/09/99 9:24:54 AM	21.62836	3/09/99 9:24:23 AM	21.62836

Converting STK Files

If you have the DOS version of TrendReader and you want to use your STK files in TrendReader Standard, you can convert the STK files to logger files.

In TrendReader Standard, all the channels from the same time period from one logger should be in one file. In DOS, each channel (STK file) is in its own file.

1. Choose **Convert STK File** from the **File** menu.

The Select STK File(s) to Convert dialog box appears.

2. From the list of STK files, highlight the ones you want to convert. You can select all the channels from one logger by holding down the left mouse button and dragging through the list.

If the files you are looking for are not in the file window on the left, they must be in another directory. Click in the directories window and scroll until you find them.

3. When you have highlighted the files to convert, click **OK**.

The Save Conversions as Logger File dialog box appears.

4. Type a filename (maximum of eight characters). TrendReader will put a .TRW extension after it to indicate that the file is a logger file.

5. Click **OK**.

You will find this file in the Open Logger File dialog box.

Page Setup

The Page Setup command enables you to choose the size of a graph and its position on the page before you print it.

To open the Page Setup dialog box, click **Page Setup** on the **File** menu. The margin settings determine where the graph is positioned on the page; the scale settings determine the size of the printed graph.

Top margin and left margin

The default position of a TrendReader graph on a page is the top left corner. Once you have set the top and left margins, the size of the bottom and right margins depends on the size of the graph.

Vertical and horizontal scale

These settings are expressed as percentages of the page size.

For example (using an 8-1/2" x 11" page in landscape orientation), if you set the vertical and horizontal scales to 80% and the top and left margins to one inch, the graph's dimensions will be six inches tall by eight-and-a-half inches wide, with one-inch margins.

If you want to accentuate the time axis by reducing the vertical scale to 40%, the graph will be three inches tall, and the bottom margin will be four inches.

By experimenting, you will find the graph size and positioning that suits you best. If, when you try to print a graph, a dialog box appears telling you that the graph won't fit on the page, you will have to reduce the size of the graph or the size of the margins.

Settings that you type in the Page Setup dialog box become the default settings.

Printing a Graph[Ctrl+P]

The Print command is on the File menu. Before you start printing graphs, you may want to look at some of the useful settings in the Printer Setup dialog box.

The printer Setup dialog box is on the File menu.

Setting Up Your Printer

Looking for your printer

When you open this dialog box, make sure that your printer is listed. If it is not, click the *down* arrow to view more printers. If your printer is not listed here, go to **Print Manager** in **Windows Program Manager**.

Under Windows 95, 98, NT or 2000:

1. Press **Start**
2. Choose **Settings, Printers**
3. Open Printer Windows and follow the instructions.

Under Windows 3.1:

1. Click **Alt+Tab** to switch from TrendReader to Program Manager.
2. While holding down **Alt**, keep tapping Tab until **Program Manager** appears, then release **Alt**.
3. Double-click **Print Manager** in the main Program Manager window.
4. Choose **Printer Setup** from the **Options** menu.
5. Click **Add** in the **Printers** dialog box.

The list of available printers appears, If your printer is not listed here, and a Windows printer driver did not come with your printer, contact your printer dealer.

Landscape and portrait orientation

Most graphs look better when the time axis (the horizontal axis) is longer than vertical axis. This orientation is called *landscape*. The upright orientation is called *portrait*.



Portrait



Landscape

Darkness and fineness of printing

Click **Options** in the **Print Setup** dialog box and experiment with the settings in the Options dialog box to see which one gives you the best printout resolution. Click the Help button to get useful information about the settings in this dialog box.

Saving a Graph [Ctrl+S]

If you have opened a logger file, made changes to the graph, and want to save the graph:

1. Choose **Save** from the **File** menu.
The Save As dialog box will appear.
2. Name the file, using up to eight characters (no spaces).

TrendReader will give it a .GPW extension. Remember to look for this file in the Graph File dialog box.

Revising a Logger File

Revising a logger file allows you to change various aspects of the file. You can only revise logger files, you cannot revise graph files.

1. Choose **Revise a Logger File** from the **File** menu.

A dialog box appears allowing you to scroll through all your logger files.

2. Select the logger file you want to revise by clicking on it and clicking **OK** (or by double-clicking on the filename).

The Revise Logger File dialog box opens.

No.	Channel	Equation	Low	Mid	High	Ext
0	Internal temperature	45	0	0	0	0
1	External temperature #1	45	0	0	0	0
2	External temperature #2	45	0	2.96875	-2.03125	0
3	External temperature #3	45	0	0	0	0
4	External temperature #4	45	-1.015625	0	-2.03125	0
5	External temperature #5	45	0	2.96875	.9765625	0
6	External temperature #6	45	0	0	1.9921875	0
7	External temperature #7	45	0	0	-3.0078125	0

3. Make your changes (see how to do this below).

4. Click **Accept**.

A dialog box will appear, asking you if you want to give the revised file a new name. If you want to keep the original logger file unchanged with its original name, click **OK** and give your revised file a new name in the Save As dialog box.

If you want to revise the file and keep the original logger filename, click **NO**.

If, when you click Accept, a dialog box appears telling you that the logger file you have revised is read-only and may be part of a GPW file, this means that there is a graph file that you made from the logger file, and that any changes that you make to the logger file will appear on the graph file if you keep the same logger filename.

Changing the start date and start time

If you want to compare the readings from different logger files from different time periods by overlaying graphs, you will have to give each logger file the same start date and start time.

1. Drag the cursor through the existing date/ time to highlight it.
2. Type the new date/ time.

Number of readings

The box displays the number of readings (data points) that the logger file has gathered. You cannot change the numbers in this box, but they will change if you change the sample rate. (See more about data points in *Changing the sample rate* below.)

Changing the sample rate

You may change this rate, but only to longer time intervals.

Users sometimes need to change the sample rate when they export a logger file to a spreadsheet. A typical spreadsheet can accommodate a maximum of 4,000 data points; a logger file can hold up to 32,767 data points. The number of data points can be reduced by choosing a longer sample rate. (Double the length of the sample rate to halve the number of data points.)

Changing the graph title

To change the graph title (the caption that appears over a graph):

1. Drag the cursor over the existing title to highlight it.
2. Type the new title.

Changing a channel name

To change a channel name:

1. Click the existing channel name.
2. Drag the cursor through the name to highlight it.
3. Type the new name.

Changing an equation number

To change an equation number:

1. Click the existing equation number.
2. Drag the cursor through the number to highlight it.

3. Type the new number.

Changing calibrations

To change a calibration number:

1. Click the existing calibration number.
2. Drag the cursor through the number to highlight it.
3. Type the new number.

When you have finished making changes, click **Accept**.

Deleting Files

To delete a TrendReader file under Windows 95, 98, NT or 2000:

1. Place Windows cursor on **Start**.
2. Press the right button of the mouse.
3. Open **Explore** by clicking the left button.
4. Open TRWIN directory.
5. Highlight the file you want to delete.
6. Press the **Delete** button of your keyboard.

OR

To delete a TrendReader file under Windows 3.1 you have to get to file manager window:

1. Choose **File Manager** from the **File** menu.

The File Manager window opens.

Check that the drive you are in is displayed (probably C drive).

2. Scroll through the left hand window to find the directory that the TrendReader files are in (probably the TRWIN directory).
3. Double-click on that directory.

The files from that directory will be displayed in the window on the right.

4. Click on the file you want to delete.
5. Choose **Delete** from the **File** menu.

A Delete dialog box will appear, highlighting the file that you want to delete.

6. Click **OK**.

To make sure you know what you're doing, another dialog box will appear, confirming that you want to delete that file.

7. Click **YES**.

Deleting logger files

If you try to delete a logger file that has one or more graph files attached to it, File Manager will warn you that the logger file is a read-only file. Delete the logger file only if you do not need the graph file(s).

Exporting TrendReader Files

Exporting to a spreadsheet

Before a TrendReader file can be exported to a spreadsheet, it has to be converted to ASCII format. TrendReader provides you with two ways of doing this:

You can make an ASCII copy of a file when you are backing it up, or you can make an ASCII copy of a file that TrendReader has previously saved.

A. To make an ASCII copy of a file as you are backing it up, Click **Save as ASCII after Backup** on the **Options** menu. TrendReader will save two files: a TrendReader file with a TRW extension, and an ASCII file with either an .ASC or a .CSV extension.

To find out which extension your spreadsheet requires, consult your spreadsheet manual.

B. To make an ASCII copy of a file that has been previously saved by TrendReader:

1. Choose **Convert TRW File to ASCII** from the **File** menu.

The Select Logging File to Convert dialog box appears.

2. Click the file you want to convert.

3. Click **OK**.

The Save Conversion as ASCII File dialog box appears to enable you to name the file.

You can either keep the original filename (TrendReader will give it a new extension that will differentiate it from the TRW file) or you can give it a new name.

4. Confirm the name and click **OK**.

Copying a graph to the clipboard[Shift+Ins]

Copying a graph to the clipboard is an extremely fast and easy way of transferring a graph to another Windows application, for example, to a word processing program, where it can be included in a report. **Copy Graph** to Clipboard is on the **Edit** menu.

The clipboard (a temporary storage area) is a Windows feature; you can read about it in your Windows Guide.

As an example, we will transfer a graph to a word processing program:

1. Open the graph that you want to place in the word processing program.

If you don't have a word processing program, you will find one in the Accessories of Windows.

2. From the **Edit** menu, choose **Copy Graph to Clipboard**.

3. Press **Alt+Tab** to transfer to **Program Manager** for windows 3.1. Left click **Start** select **Programs** for Windows 95, 98, NT or 2000.

4. Open the **Accessories** window and double-click **Write**.

5. When the word processing program opens, choose **Paste** from the **Edit** menu, for Windows 3.1 or Print for Windows 95, 98, NT or 2000.

The graph will be copied from the clipboard to the word processing program.

Chapter 6: Custom Equations

Using TrendReader Software to write equations for your info logging applications.

How Standard Equations Work

Your data logger records readings in internal values (computer measurement units). To make these computer readings meaningful, TrendReader Software applies an equation to the logger data, converting the readings into measurement units such as degrees Celsius, volts, or PSI (pounds per square inch).

For example, if you set up a SmartReader to record temperature until it is full, the logger will store 32,767 readings. When you graph the data to your computer, TrendReader will execute equation #45 32,767 times to translate each computer reading to a temperature reading.

TrendReader software includes over 80 standard equations for its SmartReader, SmartReader Plus, and OWL loggers. The hardware section of this guide describes the standard equations that are most appropriate for your logger.

These standard equations will normally be all you need to get the data you want. For example, a SmartReader temperature logger automatically uses equation #45 to make the resistance values of its internal thermistor linear, and to convert those values into temperature readings. Another type of logger will use an equation appropriate for the parameter being measured, whether it be voltage, pressure, humidity, etc.

However, there can be situations in which no standard equation suits your purpose. In these cases, it is possible to create custom equations.

Creating and Writing: In this guide we differentiate between *creating* an equation and *writing* an equation. *Creating* an equation means using one of TrendReader's equation windows (Thermistor Equation window, or Linear Equation window) to type values into the boxes provided. *Writing* an equation means using TrendReader's equation language syntax to write an equation in the Equation window.

Creating Custom Equations

You can create custom equations for situations in which none of TrendReader's standard equations are appropriate. Two such situations would be if you were using a type of sensor unknown to TrendReader, or if you were measuring a phenomenon for which TrendReader had no equation.

The two most common types of custom equations are thermistor equations and linear equations. To make it easy to create these two types of equations, TrendReader provides you with dialog boxes into which you type known values.

Creating a thermistor equation

Thermistor equations are for use with NTC negative temperature coefficient thermistor temperature sensors. To create a thermistor equation, choose **Create Thermistor Equation** from the **Equation** menu. The Thermistor Equations dialog box appears.

TrendReader assigns the first available equation number to the equation. This number appears in

the Equation Number box (numbers 100 to 199 are reserved for custom equations).

	Temperature (°C)	Resistance
Equation Number	101	
Low	<input type="text"/>	<input type="text"/>
Mid	<input type="text"/>	<input type="text"/>
High	<input type="text"/>	<input type="text"/>

Accept Cancel

The temperature is displayed in Celsius. (To change this to Fahrenheit or Kelvin, choose **Units** from the Options menu, then temperature and the unit of your choice).

Use your thermistor's temperature-resistance chart or your own calibration data to enter information in this dialog box.

1. In the Low temperature box, type a low temperature from your thermistor's temperature resistance chart. (Use a temperature in the lower quarter of the chart's temperature data.)
2. In the corresponding Resistance box, type the corresponding resistance value for the low thermistor temperature.
3. In the Mid temperature box, type a temperature from the middle of your thermistor's temperature-resistance chart.
4. In the corresponding Resistance box, type the corresponding resistance value for the mid thermistor temperature.
5. In the High temperature box, type a high temperature from your thermistor's temperature resistance chart. (Use a temperature in the upper quarter of the chart's temperature data.)
6. In the corresponding Resistance box, type the corresponding resistance value for the high thermistor temperature.
7. Click **Accept**.

To see your equation, choose **Open Equation** from the **Equation** menu and select the equation number that TrendReader assigned to this equation from the Open Equation dialog box.

The Steinhart-Hart Equation

The Steinhart-Hart equation can very closely approximate the non-linearity of the thermistor's temperature-resistance relationship. The Steinhart-Hart is generally acknowledged as the best

equation available for making the thermistor response curve linear, and is routinely performed on your computer by TrendReader Software. The basic form of the equation is as follows:

$$\frac{1}{T} = A + B(\text{LnR}) + C(\text{LnR})^3$$

where:

T = degrees Kelvin (degrees Celsius + 273.15)

LnR = natural logarithm of the resistance of the thermistor (in ohms)

A,B,C = Curve-fitting constants derived from measurement.

A,B,C are found by selecting three data points (low, mid, and high) on the published data curve (or from your own calibration testing) and solving the following three simultaneous equations:

$$\frac{1}{T_{\text{low}}} = A + B(\text{LnR}_{\text{low}}) + C(\text{LnR}_{\text{low}})^3$$

$$\frac{1}{T_{\text{mid}}} = A + B(\text{LnR}_{\text{mid}}) + C(\text{LnR}_{\text{mid}})^3$$

$$\frac{1}{T_{\text{high}}} = A + B(\text{LnR}_{\text{high}}) + C(\text{LnR}_{\text{high}})^3$$

When the data points are chosen to span no more than 100 degrees Celsius (180 degrees Fahrenheit) and no less than 10 degrees Celsius within the nominal center of the thermistor's temperature range, this equation can make the data linear, with accuracy of ± 0.02 degrees Celsius.

Creating a linear equation

The most common custom equation involves the use of *linear output transducers*. A linear output transducer is a device that measures a phenomenon (for example, wind speed, power, or acidity) and produces an electrical signal, in proportion to that phenomenon.

A linear equation requires two values. Choose values at or near each end of the measurement range.

To write a linear equation (with the transducer connected to the logger, and the logger connected to your computer):

1. Open the logger window.
2. Set the channel you want to equation number 38, for SR and OWL Loggers, equation 81 for SRP Loggers (unprocessed byte reading).
3. Make sure realtime is running.
4. From the **Equation** menu, choose **Create Linear Equation**.

The Linear Equations dialog box appears.

TrendReader assigns the first available equation number to the equation. This number appears in the Equation Number box.

The image shows a dialog box titled "Linear Equations". It contains the following fields and controls:

- Title:** An empty text box.
- Units:** An empty text box.
- Equation:** A text box containing the number "101".
- X) Raw Byte value:** A column of two text boxes labeled "A)" and "B)".
- Y) Actual (true) value:** A column of two text boxes labeled "A)" and "B)".
- Buttons:** "Accept" and "Cancel" buttons are located to the right of the "A)" boxes.
- Radio Buttons:** Two radio buttons at the bottom: "SmartReader Range (0-255)" (which is selected) and "SmartReader Plus Range (0-4095)".

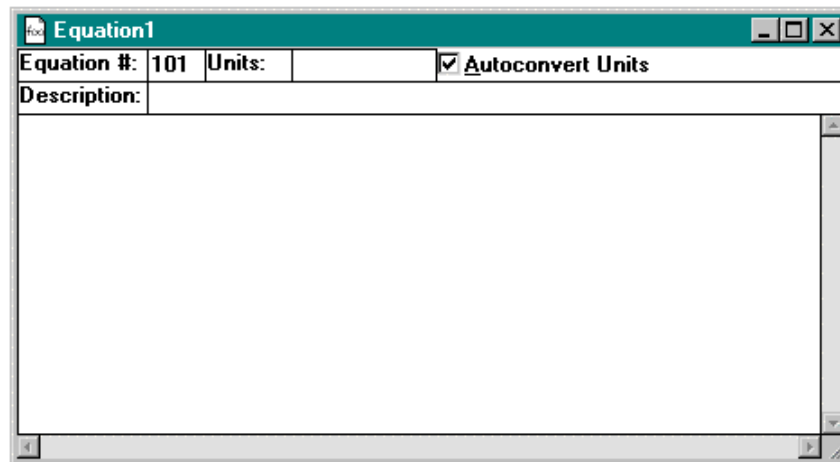
5. If you are creating an equation for a SmartReader, choose the **SmartReader Range** option; if you are creating an equation for a SmartReader Plus, choose the **SmartReader Plus Range** option.
6. Measure a known value with the transducer, and make a note of the realtime byte value reading from the logger window.
7. In the Linear Equations dialog box, type this value in box A (Source0 value).
8. Type the corresponding known value in box A (Actual value).
9. Measure another known value and make a note of the realtime byte reading from the logger window.
10. In the Linear Equations dialog box, type this value in box B (Source0 value).
11. Type the corresponding known value in box B (Actual value).
12. In the Linear Equations dialog box, you can give the equation a name in your own words (in the Title box).
13. In the Units box, type the unit of measurement you are measuring.

If you need a special character such as a degrees sign (°) choose Insert Special Character from the Edit menu.
14. Click **Accept**.

Writing Custom Equations

The Equation window

To open the equation window, choose **New Equation** from the **Equation** menu.



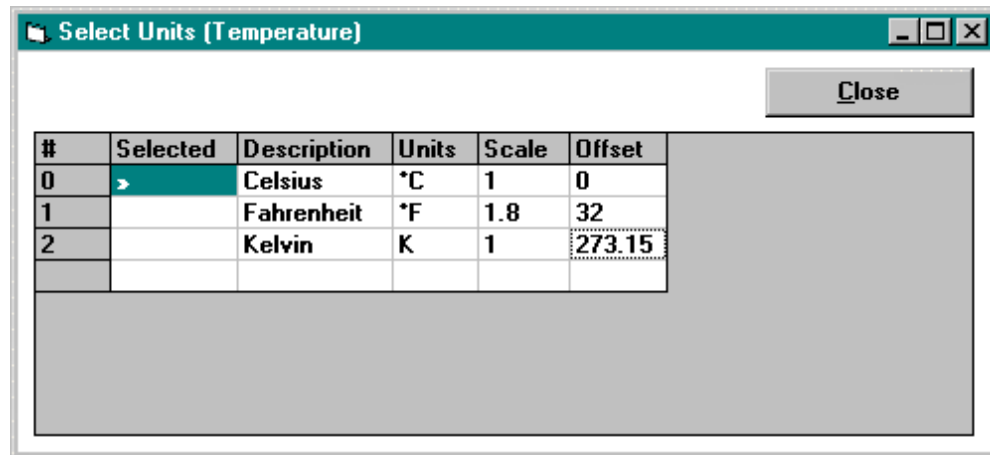
Equation # TrendReader automatically chooses the next available equation number for you.

Units Type the units that the equation is using (for example, Celsius). *Please read about Autoconvert Units first.*

Autoconvert Units: Autoconvert Units enables you to change units within a category on a graph or in a table (for example, change Celsius to Fahrenheit or Kelvin in the temperature category).

To ensure that Autoconvert will operate you must choose the *primary* unit in a category.

1. Choose **Units** from the **Options** menu.
2. From the pulldown menu, choose the category that you will use in the equation.



3. In the Select Units dialog box, take note of the unit that is first in the list (the primary unit) and type that unit in the Equation window (in the temperature category you would choose Celsius).

Description: Type in your own words a title for the equation.

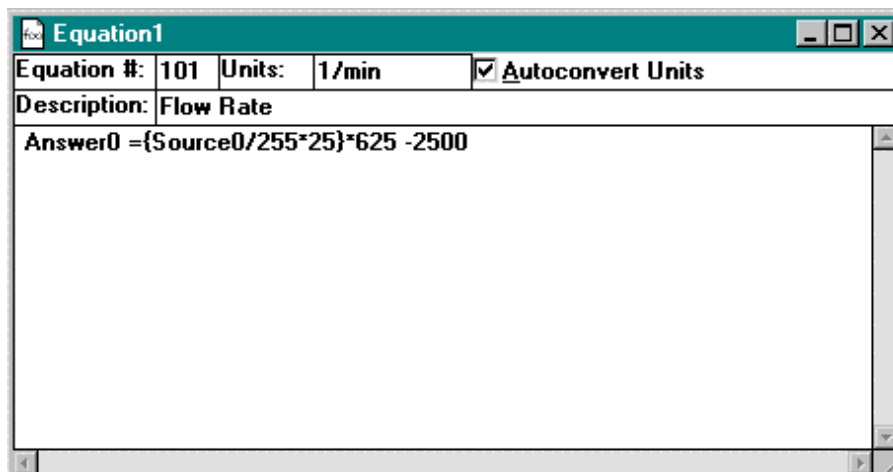
Writing a custom equation

The following example of a custom equation shows how to display a graph in liters per minute with a process logger (SmartReader 7) hooked up to a 4-20mA flow meter output.

To write this equation (assuming that a 0 to 10000 1/min is represented by the 4-20mA signal):

1. From the **Equation** menu, choose **New Equation**.

The Equation window opens.

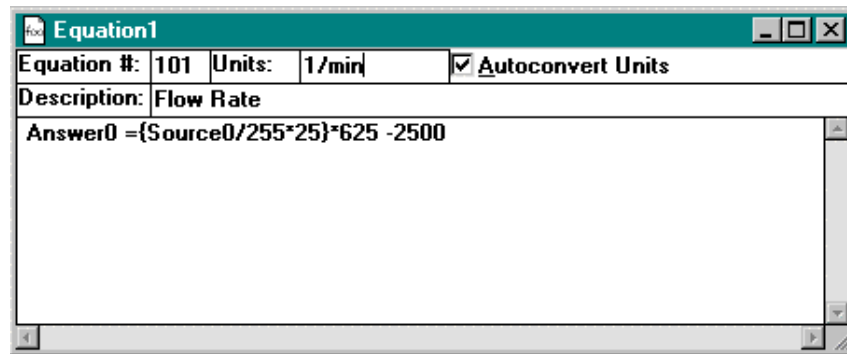


TrendReader chooses the next available equation number.

2. Place the cursor in the Units box, type **l/min**.
3. Place the cursor in the Description box, and type, in your own words, a title, Type **Flow Rate**.
4. Place the cursor below the Description box.
5. Type

$$\text{answer0}=(\text{source0}/255*25)*625-2500.$$

answer0 is the final result that will be graphed; source0 is the value recorded.
6. Close the equation window.
7. In the dialog box that appears, click **Yes**.
8. In the Save As dialog box, click **OK** to save the equation.



Writing a linear equation

To write the equation line for a linear output transducer, follow this format:

$$\text{answer0}=\{N\} * \left\{ \frac{Y_{\max} - Y_{\min}}{X_{\max} - X_{\min}} \right\} - \left\{ X_{\max} * \left\{ \frac{Y_{\max} - Y_{\min}}{X_{\max} - X_{\min}} \right\} - Y_{\max} \right\}$$

where:

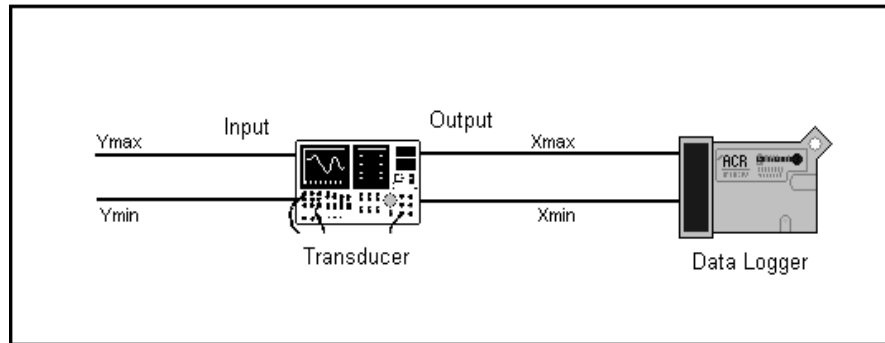
N = The actual value of the output transducer signal (the input to the data logger). N is expressed as an input channel equation. The third column in table 6-1 lists the equation coding for each transducer input channel.

Ymax = the transducer's maximum measurement (input signal).

Ymin = the transducer's minimum measurement.

Xmax = the transducer's maximum output (the signal from the transducer to your data logger).

Xmin = the transducer's minimum output.



Identifying the Variables on a Transducer

Example of a linear equation

Suppose you want to monitor a pressure transducer that has an input range of 0 to 100 kiloPascals (kPa) and an output signal of 4 to 20 milliamperes (mA) using a 0 to 25 mA data logger channel. To write the *equation line*, follow these steps:

1. Identify the variables. From the above information:

$$Y_{\min} = 0$$

$$Y_{\max} = 100$$

$$X_{\min} = 4$$

$$X_{\max} = 20$$

2. Plug the variables into the standard equation for linear transducers:

$$\text{answer}0 = \{N\} * \left\{ \frac{Y_{\max} - Y_{\min}}{X_{\max} - X_{\min}} \right\} - \left\{ X_{\max} * \left\{ \frac{Y_{\max} - Y_{\min}}{X_{\max} - X_{\min}} \right\} - Y_{\max} \right\}$$

$$\text{answer}0 = \{N\} * \left\{ \frac{100 - 0}{20 - 4} \right\} - \left\{ 20 * \left\{ \frac{100 - 0}{20 - 4} \right\} - 100 \right\}$$

3. Simplify the equation:

$$\text{answer}0 = N * 6.25 - 25$$

4. Test the equation to see if it works. To do this, substitute a transducer output value for N. For example, we know that at 4 mA the pressure should read "0" and that at 20 mA the pressure should read "100".

$$4 * 6.25 - 25 = 0$$

$$20 * 6.25 - 25 = 100$$

5. Now substitute the correct value for N from table 6-1 to arrive at the completed equation line that you would use in your custom equation:

$$\text{answer0} = (\text{source0} / 255 * 25) * 6.25 - 25$$

Equation coding table

Table 6-1: Equation Coding for "N"

TrendReader Equation Number	Input Channel Description	Equation Coding (N)
6	0 to 25 mA	Source0 / 255 * 25
7	0 to 2.5 Volts	Source0 / 255 * 2.5
17	0 to 10 Volts	Source0 / 255 * 10
18	0 to 5 Volts	Source0 / 255 * 5
19	0 to 200 mV or 30 to 250 mV	Source0
31	32 Hz Pulse Channel Accumulate Mode	Source0
32	64 Hz Pulse Channel Accumulate Mode	Source0 * 2
33	128 Hz Pulse Channel	Source0 * 4
34	32 Hz Pulse Channel Normal Rate Mode	Source0 / 8
35	64 Hz Pulse Channel Normal Rate Mode	Source0 / 4
36	128 Hz Pulse Channel Normal Rate Mode	Source0 / 2
44	Resistance (in Ohms)	$(10000 * \text{Source0}) / 255 - \text{Source0}$

The equation coding for OWL Loggers

(variable "N") is:

$$(\text{Source0}/248)*(\text{full scale of range selected})$$

The standard equations (numbered 0-99) supplied with TrendReader incorporate the calibration values (Low, Mid, High) stored in the SmartReader plus logger on each channel respectively. This way an equation will calculate an output (Answer0) utilizing the calibrated input of what ever channel it is assigned to. If we embed a standard equation in a custom equation, then the custom equation will use the calibrated input of the channel it is assigned to.

Example of embedding a standard equation in a custom equation

In this example we will have a pressure transducer that measures 0-100 psi and outputs a proportional, linear signal from 4-20mA. The transducer would be connected to one of the 0-25 mA channels on the SRP007 logger. The standard equation for the 25 mA channel is "eqn(6)" and substitute this expression for the letter "N" in the linear equation. Work through the rest of the formula:

$$\text{answer0} = \{N\} * \left\{ \frac{100 - 0}{20 - 4} \right\} - \left\{ 20 * \left\{ \frac{100 - 0}{20 - 4} \right\} - 100 \right\}$$

the final equation will look like this:

$$\text{answer0} = 1000 * \text{eqn}(6) * 6.25 - 25$$

Note: The 1000 factor is for converting Amps to mAmps since equation 306 output is in amps.

This is the equation that you will enter in the main text box of "New Equation" in TrendReader Standard when you actually create the equation and save it in your computer. (See "Writing Custom Equations" in the TrendReader Reference manual.)

Note: It should be noted that when creating custom equations for the SmartReader Plus 10, even equation numbers are to be used with 100 ohm RTD probes and odd equation numbers are to be used with 1000 ohm RTD probes. You may need to adjust the equation number in the TrendReader software to accommodate this.

An equation that prevents negative readings

Here is a sample equation that prevents a graph from displaying values that are less than zero. The equation involves a 4 to 20 milliamp (mA) flow meter (l/min) transducer with a range of zero to 50 l/min. One might use this transducer with a zero to 25 mA data logger channel.

Equation1			
Equation #:	105	Units:	L\min <input checked="" type="checkbox"/> Autoconvert Units
Description:	Water Flow		
<p>'Water flow is measured from 0 to 50L/min by transducer which outputs '4-20 mA of current. This is connected to a 0-25 mA channel of a logger 'which converts it to byte values between 0 and 255. The transducer has a ' linear output</p> <p>'50L/min =20mA =204 byte counts '0L/min =4mA =40.8 byte counts 'Standard linear equationis Y = mx + b where 'm (slope) + (y2 - y1) / (x2 - x1) = (50 - 0) / (204 - 40.8) = 0.3063725 'b (y-intercept) = 50 - 204 * = 50 - 204 * .3063725 = -12.5</p> <p>Temp[val = 0.3063725 * Source0 - 12.5</p> <p>'now to prevent egative readings</p> <p>If Tempval < 0 then Tempval = 0</p> <p>Answer0 = Tempval</p>			

Adding a compound line

A compound line is a line that is derived from one or more lines on a graph.

For example, if you wanted to find the average of two graph lines and display the average as a third line on the same graph, the third line would be a compound line.

To produce a compound line, you write a custom equation, open a graph, and apply the custom equation to the graph line(s). See the example below.

For this example, we will produce a compound line that is an average of two graph lines.

The graph lines we use to calculate the compound line are called *source* lines, the first line being *source0*, the second *source1*, etc. The compound line is *answer0*.

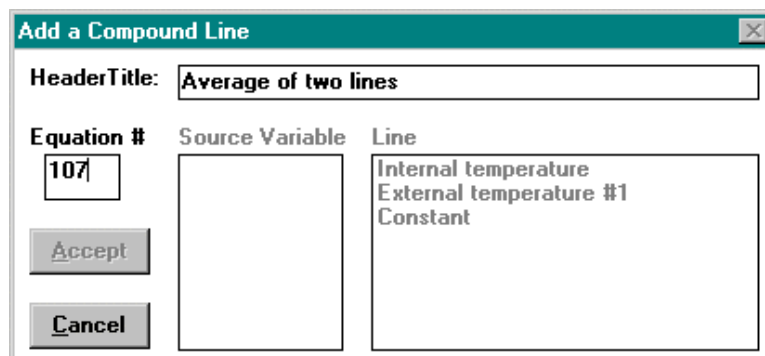
1. Choose **New Equation** from the **Equation** menu.

The Equation window opens.

TrendReader will assign the next available equation number to the equation.

2. In the Units box, type **c** for Celsius.
3. In the Description box, type **average of two channels**.
4. For the equation, type **answer0 = (source0 + source1) / 2**
5. Close the window.
6. In the dialog box that appears, click **OK** to save the equation.
7. Open a logger file with two channels (an internal and an external channel).
8. From the Equation menu choose **Add Compound line to Graph**.

The Add Compound Line dialog box appears.



9. If you want a name that describes the compound line to appear on the graph, click in the Header Title box and type a title.

10. Click in the **Equation #** box and type the number of the equation you wrote or double-click in this box and choose the equation from the **Select an Equation** dialog box.
11. In the Add a Compound Line dialog box, click **source0**
12. Click **Internal temperature**
13. Click **source1**
14. Click **External temperature**
15. Click **Accept**.

In the graph, the compound line (average of two channels) will be displayed between the other two lines. If you typed a title it will be displayed above the graph and also in the legend.

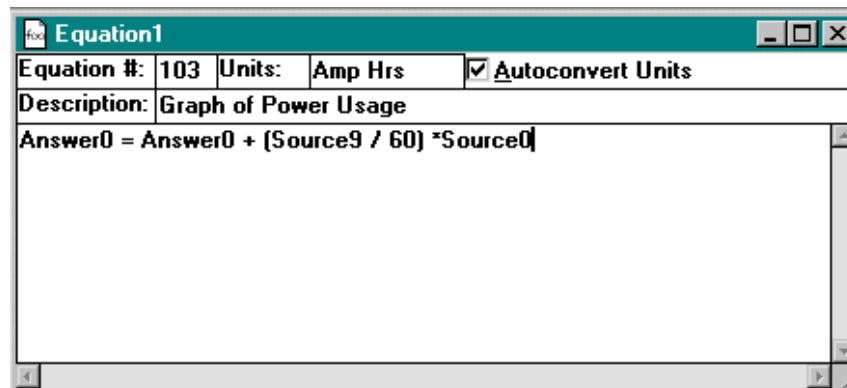
If you want to display the compound line by itself, you can hide the source lines (the original graph lines) by changing their line style to transparent or their color to white.

NOTE:

- The **Constant - Line** allows you to assign a value to an equation **Source Variable**.
- It is possible to assign multiple sources to the same line.
- If more than one source line is used, the shortest sample rate is used for the compound line. The time periods need not match exactly, but they must overlap by at least two readings.
- Compound lines can be nested, that is, a compound line can reference another compound line.

Writing a time integral equation

Here is a sample equation that integrates a graph of amperage values with time, producing a graph of Amp-Hours:



- Answer0, on the left side of the equation, is the final result that will be graphed.

- Answer0, on the right side of the equation, is the result of the previous calculated reading. For the first reading plotted, this value will start at zero.
- Source9 is the value (in minutes) between the last plotted point on the graph and the point that TrendReader is now plotting (the equation uses the value 60 to convert the Source9 value to hours, from minutes).
- Source0 is the amperage reading from the graph.

Predefined variables

You can use the variables **Answer0** through **Answer9** on either side of an equals sign. You can use **Source0** through **Source9** on the right side of an equals sign only.

Equation Language Syntax

This section explains how to write custom equations using TrendReader's equation language syntax. To make use of this part of the guide you should be familiar with a programming language such as BASIC.

The simplest *equation line* you can write is to find the internal values (computer measurement units) collected by the logger:

Answer0 = Source0

Where:

Answer0 is the result of your equation after it has been processed (that is, the value that TrendReader will graph).

Source0 is the byte value that the logger collected (a number from zero to 255, normalized on a SmartReader Plus).

The SmartReader Plus byte value may be denormalized by first adding the code $\text{source0} * 4095 / 255$. This is required on pulse equations to make the count resolution equal to one.

The following tables list the input source variables to be used with different loggers and with compound line equations. Input source variables have different meanings when used with different loggers or different equations.

Input source variable tables

Table 6-2: Input Source Variables for SmartReader and SmartReader Plus Loggers

Variable	Description
Source0	Internal reading normalized between 0 and 255
Source1	Time in seconds between data points
Source2	Low calibration value
Source3	Mid calibration value
Source4	High calibration value
Source5	Span calibration value
Source6	Temperature compensation channel (-1 if not used)
Source7	Pulse counter
Source8	Reserved for future use
Source9	Time in minutes between data points

Table 6-3: Input Source Variables for OWL Info Logger

Variable	Description
Source0	Internal reading between 0 and 248
Source1	Time in seconds between data points
Source2	Zero calibration value
Source3	Span calibration value
Source4	Factory zero calibration value
Source5	Factory span calibration value
Source6	Range size
Source7	Range resistor
Source8	Range gain
Source9	Range offset

Table 6-4: Input Source Variable for Compound Line Equation

Variable	Description
Source0 to Source9	Correspond to lines on a graph

User variables

Variables may be one to fifteen characters long. The first character of a variable must be a letter, or an underscore character (_). The remaining characters may be letters, numbers, or underscores.

Labels

A label must be the first item on its line. (The line containing the label must not be a continuation of the previous statement.) A label may be one to fifteen characters long. The first character of a label must be a letter, or an underscore character (_). The remaining characters may be letters, numbers, or underscores. A label must end with a colon(:).

Do not place a colon anywhere in an equation except at the end of a label.

Table of commands

Table 6-5: Equation Commands

Commands	Usage	Example
GOTO <label>	Branch unconditionally to the specified line label. This statement must be last statement on a line.	IF TEMP > 73 THEN GOTO S1
(expression)	Evaluate the expression in parentheses first.	TEMP = (SOURCE0 + SOURCE1)/2
,<comma>	Separates multiple statements on 1 line.	A = 3, B=9
'<apostrophe>	Comment.	' This is a comment.

If Then Else command

Use the following form for the IF, THEN and ELSE function:

IF<condition> THEN [<statement>]

[ELSE[<statement>]]

With the IF function, <condition> may be any valid expression. TrendReader considers an expression true if the expression is not zero. It considers the expression false if the expression is zero.

The statement to be executed in the THEN clause of an IF function may be any single valid statement. The statement may include another IF function. The statement may *not* be a compound statement (a single line containing multiple statements, separated by commas).

Table of operators

Table 6-6: Equation Operators

Commands	Usage	Example
NOT	Logical complement	IF NOT B THEN ANSWER0 = C1
*	Multiplication	A = B * C
/	Division	A = B / C
+	Addition	A = B + C
-	Subtraction	A = B - C
>	Greater than	IF TEMP > 75 THEN ANSWER0 = P0
>=	Greater than or equal to	IF TEMP >= 75 THEN ANSWER0 = X1
<=	Less than or equal to	IF TEMP <= 75 THEN ANSWER0 = T2
=	Equal to	IF TEMP = 75 THEN ANSWER0 = Z0
=	Assigns a value to a variable	TEMPERATURE3 = SOURCE3
OR	Logical OR	IF A = 3 OR B = 9 THEN C = D
AND	Logical AND	IF A = 3 AND B = 9 THEN C = D
\	The statement continues on next line	Resistance = (a+b+c+f) \ Source2-Load1
^	Exponent	A = B ^{3.19}

Square root operators

You can write equations involving square roots by using the Exponent ^ command. For example, a number raised to the power of 0.5 (e.g., 45 ^ 0.5) is equivalent to the square root of that number (e.g., 45). When you raise a variable to the power of a number less than one, that variable must always be greater than or equal to zero. If the variable is less than zero in any part of the file, your square root equation will not work. In this case you must prevent negative readings, refer to *An Equation that prevents negative readings* in the *writing custom equations* section.

Table of functions

Table 6-7: Equation Functions

Commands	Usage	Example
ABS	Return the absolute value of a numeric expression	Answer0 = ABS(HUMIDITY)
ATN	Return the arctangent of a numeric expression (in radians), or the angle whose tangent is the numeric expression	ANGLE1 = ATN(B)
COS	Return the cosine of angle in radians	FACTOR1 = COS(ANGLE1)
EXP	Calculate the exponential function	C = EXP(TEMPERATURE)
LOG	Return the natural logarithm of a number or an expression	D = LOG(VOLTAGE)
SIN	Return the sine of an angle, in radians	E = SIN(ANGLE1)
TAN	Return the tangent of an angle in radians	F = TAN(ANGLE1)

Chapter 7: Communicating With Loggers by Modem

Setting up, monitoring, and retrieving data from loggers at remote sites using modems.

Equipment Needed

- A telephone line to the remote logger site. (Modems communicate over telephone lines.)
- Two modems: one at your computer and one at the remote logger site. These modems should respond to AT commands.
- At least one standard modem cable. This cable connects a modem to your computer.
- An IC-101 interface cable or an IC-200 interface module at the remote site.

If you are communicating with only one logger, you can use an IC-101 and a 9 to 25 pin adapter, plus an MA-100 (a null modem adapter).

For communicating with multiple SmartReader loggers, you will need an IC-200 interface module to connect the loggers to the remote modem.

For communicating with multiple SmartReader Plus loggers, you will need a YA-200 stereo Y adapter / cable or YA-201 for each additional logger.

Connecting the System

At the computer station

The computer station consists of your computer and a modem. From one computer station, you can call an unlimited number of remote logger stations.

1. When communicating with an external modem, connect it to your computer using a standard modem cable. (This is the same as a serial port cable.)
2. Connect the modem to a phone jack.

At a remote logger station

The remote logger station consists of any one of the following combinations:

A. One SmartReader or SmartReader Plus logger connected to:

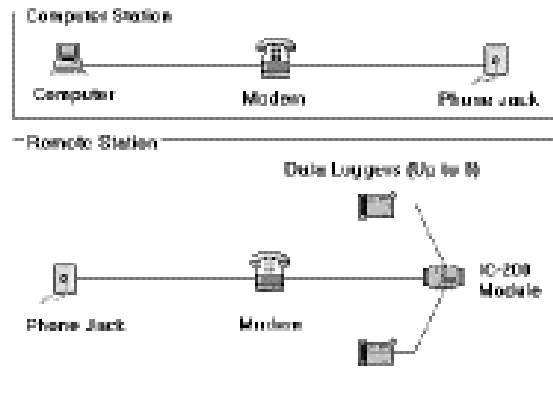
1. an IC-101 interface cable and a 9 to 25 pin adapter which connects to
2. an MA-100 null modem adapter, which connects to
3. a modem

B. Up to eight SmartReader loggers connected to:

An IC-200 interface module. The "modem" end of the IC-200 is connected to a modem (with a serial port extension cable).

C. Multiple SmartReader Plus loggers connected together with YA-200 Y adapters or YA-201 to:

1. an IC-101 interface cable and a 9 to 25 pin adapter which connects to
2. an MA-100 null modem adapter, which connects to
3. a modem



Configuring Modems

In order to communicate with remote data logger sites, modems have to be configured. The computer modem and remote site modem each require their own setup parameters. The number of modem makes and models is so large it's impractical to produce a comprehensive list of settings. The following setup is for the popular US Robotics Sportster 56K fax modem.

Setting Up the Computer Station Modem

Application programs on a computer usually issue initial commands to modems to establish their

setup. When the application is terminated, other programs are free to re-configure the modem. TrendReader provides a dialog box to set up the modem's required configuration. Commands are sent to the modem to initialize it before placing a call to the remote logger site.

DIP switch settings

The following parameters can be matched with their equivalent settings to work with the most modems:

1. UP Normal DTR operation
2. UP Verbal result codes
3. DOWN Result codes enabled
4. UP Echo offline commands
5. UP Auto answer enabled
6. UP Normal CD operation
7. UP Load user defaults
8. DOWN AT command recognition

Software setup

From the **Communicate** menu, choose **Modem Setup**. The Modem Setup window appears. As well as allowing you to change the modem setup, this window enables you to store the phone numbers of remote logger sites.

Modem Setup

Attention Code: AT

Initialization String: &F1 V0 X0

Setup String: E1 Q0 &B1 &C1 &D2 &M0 &K0

Dial Prefix String: DT

Timeout: 045 Escape Code: +++ Hangup String: H0

Phone Book

Site Description: [Dropdown]

Delete Phone Number: [Input] Save

The modem commands in this window default for the US Robotics Sportster 56K fax modem. However, you can change any of them as necessary.

Attention code

The attention code prefixes all command strings.

AT Attention (command prefix)

Initialization string

The initialization string is a command that clears the modem of any previous setup and puts it in a known operating state.

&F1 Load factory defaults (hardware flow control)

V0 Numeric result codes

X0 Set range for result codes

Setup string

The setup string determines the modem parameters such as handshaking, protocol, etc. If your modem does not work with the parameters shown, consult the manual that came with it to find the equivalent settings.

E1 Echo offline commands

Q0 Result codes enabled

S0 = 1

&B1 Fixed serial port rate

&C1 Normal CD operation

&D2 Normal DTR operation

&H0 Flow control disabled

&I0 Software control disabled

&M0 Normal mode-error control disabled

&K0 Disable data compression

Dial prefix string

The dial prefix string is used before the number dialed to issue a dial command, either:

DT Tone dial for Touch-Tone phone lines

DP Pulse dial for rotary phone lines

Numbers can be appended to access outside lines or long distance suppliers. A "**W**" after the number causes the modem to wait for another dial tone. For example, **DT9W** tone dials 9 then waits for another dial tone before dialing the number from the Phone Book.

Saving phone numbers

In the *Phone Book* section of this window, you can store phone numbers of your remote logger sites.

1. In the Site Description box, type a name for your remote logger site.
2. In the Phone Number box, type the phone number.
3. Click **Save**.

Viewing your list of phone numbers

1. Click the *down* arrow to the right of the Site Description box.

The list of site description names you saved appears.

2. To see a site description's phone number, click the name.

The number appears in the phone number box.

Deleting a phone number

1. Click the *down* arrow to view your list of numbers.
2. Click the site name you want to delete.

The name and number appears.

3. Click **Delete**

The name and number will be erased.

Timeout

Timeout is the length of time your computer will wait for a remote site to answer before it hangs up.

Escape code

The escape code forces the modem into command mode while a link is established.

+++ Escape sequence

Hangup string

The hangup string is used to disconnect.

HØ Go on-hook

Accept

Click **Accept** to save any changes you have made.

Setting Up the Remote Station Modem

To save yourself time and trouble, before you install at the remote site, set up your computer station and your remote logger station close to each other – preferably in the same building. Test their operation before you install at the remote site. Then, when you install at the remote site, have someone call the remote site from the computer station while you are still there.

The modem used at the remote logger site needs to be configured to work with data loggers. The timing of signals generated from TrendReader must be preserved over the modem link. High-speed modems have features such as data compression, error correction, extra buffers and proprietary protocols. These enhance computer-to-computer communications but interfere with data logger transmission.

Software configuration

Connect the remote modem to your computer (you cannot configure a modem remotely). **Then, set the remote modem's DIP switches to the same settings as the computer station modem.**

In Windows 3.1 switch to the **Accessories** window of **Program Manager** and open **Terminal**. In Windows 95, 98, NT or 2000 - **Start, Accessories, Hyperterminal**, then **Hyper Terminal**. When you have chosen the correct COM port:

1. Type: **AT & F** and press **Enter**. The modem should respond, "OK".
2. Type the following command string: **AT EØ Q1 SØ=1 VØ &BØ &CØ &DØ &HØ &KØ &MØ &W** and press **Enter**.

The modem will not respond. This is normal. The modem response mode command **Q1** tells the modem not to respond to instructions. You have now correctly set up the modem for use at the remote logger station.

EØ Offline commands not echoed

Q1	Result codes disabled
SØ=1	Auto Answer enabled (pick up after first ring)
VØ	Numeric result codes
&BØ	Serial port rate follows connection rate
&CØ	Override CD operation
&DØ	Override DTR operation
&HØ	Flow control disabled
&IØ	Software flow control disabled
&KØ	Data compression disabled
&MØ	Error control disabled
&W	Write settings to nonvolatile memory

DIP switch settings

After configuring the modem, set the DIP switches as follows (or equivalent settings if you are using a different brand of modem).

1. DOWN Override DTR operation
2. DOWN Numeric result codes
3. UP Result codes disabled
4. DOWN Offline commands not echoed
5. UP Auto Answer enabled
6. DOWN Override CD operation
7. UP Load user defaults
8. DOWN AT command recognition

To verify that the settings are correct, type the following command.

```
AT I4<enter>
```

Note: you will not be able to see the above command being typed, but when the enter key is pressed the modem will respond with one or more screens to show the current settings. The screen should look similar to the following.

USRobotics Sportster 56K Fax Settings.

```
B0 E0 F1 M1 Q1 V0 X0 Y0  
BAUD=9600 PARITY=N WORDLEN=8  
DIAL=TONE ON HOOK
```

```
&A3 &B0 &C0 &D0 &G0 &H0 &J0 &K0 &M0 &N0  
&P0 &R2 &S0 &T5 &U0 &Y1
```

```
S00=001 S01=000 S02=043 S03=013 S04=010 S05=008 S06=002  
S07=060 S08=002 S09=006 S10=014 S11=070 S12=050 S13=000  
S15=000 S16=000 S18=000 S19=000 S21=010 S22=017 S23=019  
S25=005 S27=000 S28=008 S29=020 S30=000 S31=128 S32=002  
S33=000 S34=000 S36=014 S38=000 S39=000 S41=000
```

```
LAST DIALED #: T71,5911192
```

Communicating with Remote Loggers

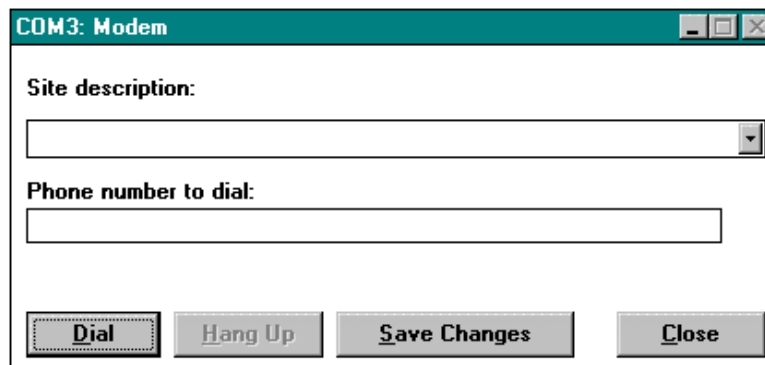
Phoning a remote site

When you have connected all equipment, phone your remote site.

1. Open TrendReader.
2. Double-click the taskbar (or logger icon) corresponding to the modem.

The COM dialog box appears and indicates that a modem has been found. (This message refers to the modem connected to your computer.)

The COM Modem window will open.



3. Click the *down* arrow to view your list of sites.
4. Click the number you want to dial.
5. Click **Dial**.

A dialog box appears for a few seconds, indicating that either an IC-101 or an IC-200 has been found. Then the Logger window will open, allowing you to set up, monitor, or back up your logger(s).

Hanging up

After clicking Dial, you have a few seconds to cancel the call by clicking Hang Up before the window closes.

Saving a new phone number

You may add a new phone number to your list from this window. Remember to add a site name as well as a number. Click **Save Ph#** when you have added the new number.

If you cannot complete your call

Dial again and make sure you leave at least 45 seconds before you hang up.

If you still cannot communicate with the remote site, consult the troubleshooting section of your modem manual.

Appendix A: Sample Rate Tables

How a data logger stores readings. Sample rate tables showing a logger's memory capacity at different sample rates and with different numbers of channels enabled.

How a Data Logger Stores Readings

The sample rate of your data logger is the frequency with which it stores readings in its memory. A selected sample will apply for all channels on a SmartReader or a SmartReader Plus (an OWL Data Logger has only one channel).

If you set your data logger's sample rate to eight seconds, it reads its input channels and stores the readings once every eight seconds. If you choose a sample rate longer than eight seconds, the logger still reads its input channels once every eight seconds, and stores an averaged reading at the end of the sample interval you have chosen.

For example, if you use a two-minute sample rate, the data logger takes fifteen separate readings over each two-minute interval. At the end of each two-minute interval, the logger calculates the average of the fifteen readings, and stores that average in its memory.

SmartReader Sample Rate Tables

The following tables list the maximum time spans over which your SmartReader will record readings. The time spans depend on the number of channels enabled and the length of the sample rate. A SmartReader has a memory capacity of 32,767 readings.

In each table, the *Sample Rate* column lists the available sample rates. The *Days*, *Hours*, *Minutes* and *Seconds* columns list the time spans over which your logger will record readings at each sample rate.

For example, a SmartReader with two channels enabled, using a sample rate of ten minutes, will store readings for 113 days, 18 hours and 40 minutes. After that time, the logger will either continue to take readings and replace the oldest readings with the new readings, or it will stop taking readings.

Table A-1: SmartReader Sample Rate - One Channel Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	3	0	48	56
16 sec.	6	1	37	52
32 sec.	12	3	15	44
56 sec.	21	5	42	32
2 min.	45	12	14	0
4 min. 56 sec.	112	6	15	28
10 min.	227	13	10	0
20 min.	455	2	20	0
30 min.	682	16	0	0

Table A-2: SmartReader Sample Rate - Two Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	1	12	24	32
16 sec.	3	0	49	4
32 sec.	6	1	38	8
56 sec.	10	14	51	44
2 min.	22	18	8	0
4 min. 56 sec.	56	3	7	44
10 min.	113	18	40	0
20 min.	227	13	20	0
30 min.	341	8	0	0

Table A-3: SmartReader Sample Rate - Three Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec	1	0	16	16
16 sec	2	0	32	32
32 sec	4	1	5	4
56 sec	7	1	53	52
2 min	15	4	4	0
4 min 56 sec	37	10	1	52
10 min	75	20	20	0
20 min	151	16	40	0
30 min	227	13	0	0

Table A-4: SmartReader Sample Rate - Four Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	0	18	12	16
16 sec.	1	12	24	32
32 sec.	3	0	49	4
56 sec.	5	7	25	52
2 min.	11	9	2	0
4 min 56 sec.	28	1	33	52
10 min.	56	21	10	0
20 min.	113	18	20	0
30 min.	170	16	0	0

Table A-5: SmartReader Sample Rate - Five Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	0	14	33	44
16 sec.	1	5	7	28
32 sec.	2	10	14	56
56 sec.	4	5	56	8
2 min.	9	2	26	0
4 min. 56 sec.	22	10	48	8
10 min.	45	12	10	0
20 min.	91	0	20	0
30 min.	136	12	30	0

Table A-6: SmartReader Sample Rate - Six Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	0	12	8	8
16 sec.	1	0	16	16
32 sec.	2	0	32	32
56 sec.	3	12	56	56
2 min.	7	14	2	0
4 min. 56 sec.	18	17	0	56
10 min.	37	22	10	0
20 min.	75	20	20	0
30 min.	113	18	30	0

Table A-7: SmartReader Sample Rate - Seven Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	0	10	24	8
16 sec.	0	20	48	16
32 sec.	1	17	36	32
56 sec.	3	0	48	56
2 min.	6	12	2	0
4 min. 56. sec	16	0	52	56
10 min.	32	12	10	0
20 min.	65	0	20	0
30 min.	97	12	30	0

Table A-8: SmartReader Sample Rate - Eight Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
8 sec.	0	9	6	8
16 sec.	0	18	12	16
32 sec.	1	12	24	32
56 sec.	2	15	42	56
2 min.	5	16	32	0
4 min. 56 sec.	14	0	46	56
10 min.	28	10	40	0
20 min.	56	21	20	0
30 min.	85	8	0	0

SmartReader Plus Sample Rate Tables

The following tables list the maximum time spans over which your SmartReader Plus will record readings. The time spans depend on the number of channels enabled and the length of the sample rate. A SmartReader Plus-32 K has a memory capacity of 21,500 readings. A SmartReader Plus-128 K can store 87,000 readings and a 1.5 MB version can store 1,048,000 readings.

In each table, the *Sample Rate* column lists the available sample rates. The *Days*, *Hours*, *Minutes* and *Seconds* columns list the time spans over which your logger will record readings at each sample rate.

For example, a SmartReader Plus with two channels enabled, using a sample rate of ten minutes, will store readings for 75 days, 15 hours and 40 minutes. After that time, depending on how it was set up, the logger will either continue to take readings and replace the oldest readings with the new readings, or it will stop taking readings.

Table A-9: SmartReader Plus 32K Sample Rate - One Channel Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	14	20
0.1 sec.	0	0	35	50
0.2 sec.	0	1	11	40
0.5 sec.	0	2	59	10
1 sec.	0	5	58	20
2 sec.	0	11	56	40
5 sec.	1	5	51	40
8 sec.	1	23	46	40
20 sec.	4	23	26	40
1 min.	14	22	20	0
2 min	29	20	40	0
5 min	74	15	40	0
10 min	149	7	20	0
30 min	447	22	0	0
1 hr	895	20	0	0
2 hrs	1791	16	0	0
4 hrs	3583	8	0	0

Table A-10: SmartReader Plus 32K Sample Rate Table - Two Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	7	10
0.1 sec.	0	0	17	55
0.2 sec.	0	0	35	50
0.5 sec.	0	1	29	35
1 sec.	0	2	59	10
2 sec	0	5	58	20
5 sec	0	14	55	50
8 sec	0	23	53	20
20 sec	2	11	43	20
1 min	7	11	10	0
2 min	14	22	20	0
5 min	37	7	50	0
10 min	74	15	40	0
30 min	223	23	0	0
1 hr	447	22	0	0
2 hrs	895	20	0	0
4 hrs	1791	16	0	0

Table A-11: SmartReader Plus 32K Sample Rate - Three Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	4	46
0.1 sec.	0	0	11	56
0.2 sec.	0	0	23	53
0.5 sec.	0	0	59	43
1 sec.	0	1	59	26
2 sec.	0	3	58	53
5 sec.	0	9	57	13
8 sec.	0	15	55	33
20 sec.	1	15	48	53
1 min.	4	23	26	40
2 min.	9	22	53	20
5 min.	24	21	13	20
10 min.	49	18	26	40
30 min.	149	7	20	0
1 hr.	298	14	40	0
2 hrs.	597	5	20	0
4 hrs.	1194	10	40	0

Table A-12: SmartReader Plus 32K Sample Rate - Four Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	3	35
0.1 sec.	0	0	8	57
0.2 sec.	0	0	17	55
0.5 sec.	0	0	44	47
1 sec.	0	1	29	35
2 sec.	0	2	59	10
5 sec.	0	7	27	55
8 sec.	0	11	56	40
20 sec.	1	5	51	40
1 min.	3	17	35	0
2 min.	7	11	10	0
5 min.	18	15	55	0
10 min.	37	7	50	0
30 min.	111	23	30	0
1 hr.	223	23	0	0
2 hrs.	447	22	0	0
4 hrs.	895	20	0	0

Table A-13: SmartReader Plus 32K Sample Rate - Five Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	2	52
0.1 sec.	0	0	7	10
0.2 sec.	0	0	14	20
0.5 sec.	0	0	35	50
1 sec.	0	1	11	40
2 sec.	0	2	23	20
5 sec.	0	5	58	20
8 sec.	0	9	33	20
20 sec.	0	23	53	20
1 min.	2	23	40	0
2 min.	5	23	20	0
5 min.	14	22	20	0
10 min.	29	20	40	0
30 min.	89	14	0	0
1 hr.	179	4	0	0
2 hrs.	358	8	0	0
4 hrs.	716	16	0	0

Table A-14: SmartReader Plus 32K Sample Rate - Six Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	2	23
0.1 sec.	0	0	5	58
0.2 sec.	0	0	11	56
0.5 sec.	0	0	29	51
1 sec.	0	0	59	43
2 sec.	0	1	59	26
5 sec.	0	4	58	36
8 sec.	0	7	57	46
20 sec.	0	19	54	26
1 min.	2	11	43	20
2 min.	4	23	26	40
5 min.	12	10	36	40
10 min.	24	21	13	20
30 min.	74	15	40	0
1 hr.	149	7	20	0
2 hrs.	298	14	40	0
4 hrs.	597	5	20	0

Table A-15: SmartReader Plus 32 K Sample Rate - Seven Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	2	2
0.1 sec.	0	0	5	7
0.2 sec.	0	0	10	14
0.5 sec.	0	0	25	35
1 sec.	0	0	51	11
2 sec.	0	1	42	22
5 sec.	0	4	15	57
8 sec.	0	6	49	31
20 sec.	0	17	3	48
1 min.	2	3	11	25
2 min.	4	6	22	51
5 min.	10	15	57	8
10 min.	21	7	54	17
30 min.	63	23	42	51
1 hr.	127	23	25	42
2 hrs.	255	22	51	25
4 hrs.	511	21	42	51

Table A-16: SmartReader Plus 32 K Sample Rate - Eight Channels Enabled

Sample Rate	Days	Hours	Minutes	Seconds
0.04 sec.	0	0	1	47
0.1 sec.	0	0	4	28
0.2 sec.	0	0	8	57
0.5 sec.	0	0	22	23
1 sec.	0	0	44	47
2 sec.	0	1	29	35
5 sec.	0	3	43	57
8 sec.	0	5	58	20
20 sec.	0	14	55	50
1 min.	1	20	47	30
2 min.	3	17	35	0
5 min.	9	7	57	30
10 min.	18	15	55	0
30 min.	55	23	45	0
1 hr.	111	23	30	0
2 hrs.	223	23	0	0
4 hrs.	447	22	0	0

OWL Data Logger Sample Rate Table

The following table lists the maximum time spans over which your OWL Data Logger will record readings. The time spans depend on the length of the sample rate. An OWL Data Logger has a memory capacity of 32,767 readings.

The *Sample Rate* column lists the available sample rates. The *Days*, *Hours*, *Minutes* and *Seconds* columns list the time spans over which your logger will record readings at each sample rate.

For example, an OWL Data Logger, using a sample rate of ten minutes, will store readings for 225 days, 13 hours and 10 minutes. After that time, depending on how it was set up, the OWL will either continue to take readings and replace the oldest readings with the new readings, or it will stop taking readings.

Table A-17: OWL Data Logger Sample Rate Table

Sample Rate	Days	Hours	Minutes
8 sec.	3	0	48
20 sec.	7	14	2
1 min.	22	18	7
2 min.	45	12	14
5 min.	113	18	35
10 min.	227	13	10
20 min.	455	2	20
30 min.	682	15	30

Appendix B: Communicating with Multiple Loggers

Setting up an IC-200 Interface Module to link SmartReader (8-bit) loggers. Setting up various network configurations to link SmartReader Plus (12-bit) loggers.

Linking SmartReader Loggers Together

The features of the IC-200 Interface Module

The IC-200 Interface Module is an eight-logger version of the standard IC-101 interface module. It provides a way to connect as many as eight loggers to your computer simultaneously - either directly to your computer's serial port, or from a remoter site by modem. The IC-200 is used only with the SmartReader 8-bit logger.

With the IC-200 Interface Module you can:

- back up as many as eight SmartReader loggers, one after the other, with one command;
- display, in real time, data from up to sixty-four channels (as many as eight loggers, each with as many as eight channels) on a single screen;
- analyze data from remote sites;
- set up a permanent network of SmartReader loggers to provide monitoring capability.

In the IC-200 Package

An IC-200 Interface Module package includes:

- One IC-200 Interface Module
- One 36-inch (90 cm) serial port extension cable to connect the IC-200 to your computer
- a 25-to-9 pin serial port adapter
- eight 12-inch (300 mm) logger cables with 1/8 inch (3.5mm) stereo jack connectors to connect loggers to the IC-200
- a power supply to provide the IC-200 with power

Using Longer Cables

The cables that connect loggers to an IC-200 module are 1/8 inch (3.5 mm) shielded two-conductor stereo cables. Longer cables can be used. Most stereo equipment stores sell these kinds of cables. The maximum recommended length for these cables is 100 feet (30 m).

If you want to make up your own cables, use 22 gauge standard wire, with two conductors and a shield. Connect the wiring tip-to-tip, ring-to-ring and common-to-common. Use the shield for your common connection.

You can extend the cable connection between the IC-200 and your computer or between the IC-200 and a modem. The maximum recommended length for this cable is 500 feet (150 m).

Connecting an IC-200 to Your Computer

1. Connect the serial port extension cable's female end to your computer's 25-pin serial port. (If your computer has a 9-pin serial port, attach the 25-to-9-pin adapter to the cable, and attach the adapter to your computer.)
2. Connect the cable's other end to the IC-200 connection marked "PC."
3. Connect the 6VDC power supply to the IC-200.

Connecting an IC-200 to a Modem at a Remote Site

1. Connect the serial port extension cable to the modem.
2. Connect the cable's other end to the IC-200 connection marked "modem."
3. Connect the gender changer to the other end of the IC-200 (the end marked "PC".)
4. Connect the 6VDC power supply to the adapter.

Creating a SmartReader Plus Network

ACR provides three network configurations for SmartReader Plus loggers:

- the Basic Network
- The Modular Network
- the Shielded Network

The Basic Network can accommodate up to three loggers and a total cable length of 100 feet (30m). The Modular and Shielded Networks can accommodate up to ten loggers and a total cable length of 1000 feet (300m). The Shielded Network is used in electrically noisy environments.

The table below shows the equipment needed for each network.

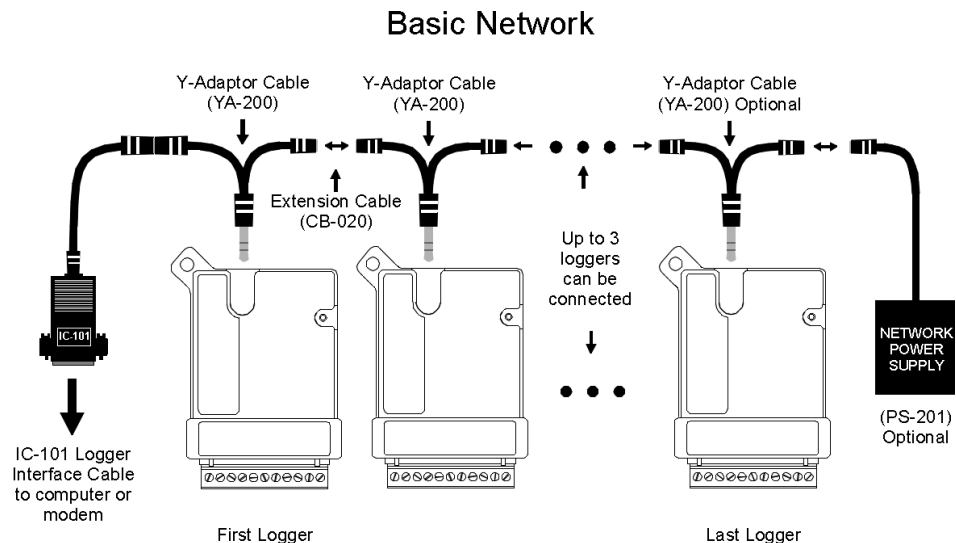
Network Configuration	Maximum # of Loggers	Total Cable Length	Computer/ Modem Connection	Network Cable	Logger Connections	External Power to Last Logger
Basic Network	3	100 ft. (30m)	IC-101 Interface Cable	CB-020 20 ft. (6m) Extension Cable	YA-200 Y Adapter Cable	Optional*
Modular Network	10	1000 ft. (300m)	IC-101 Plug and YA-201 Modular Y adapter	Modular Flat Cable	YA-201 Modular Y Adapter (except to last logger)	PS-201 Network Power Supply and YA-200 Y Adapter
Shielded Network	10	1000 ft. (300m)	IC-101 Interface Cable	Shielded Cable	YA-200 Y Adapter Cable	PS-201 Network Power Supply

*PS-201 Network Power Supply may be required for some computers or modems.

Connecting Loggers on a Network

Connecting loggers on a Basic Network

The Basic Network accommodates a maximum of three loggers.



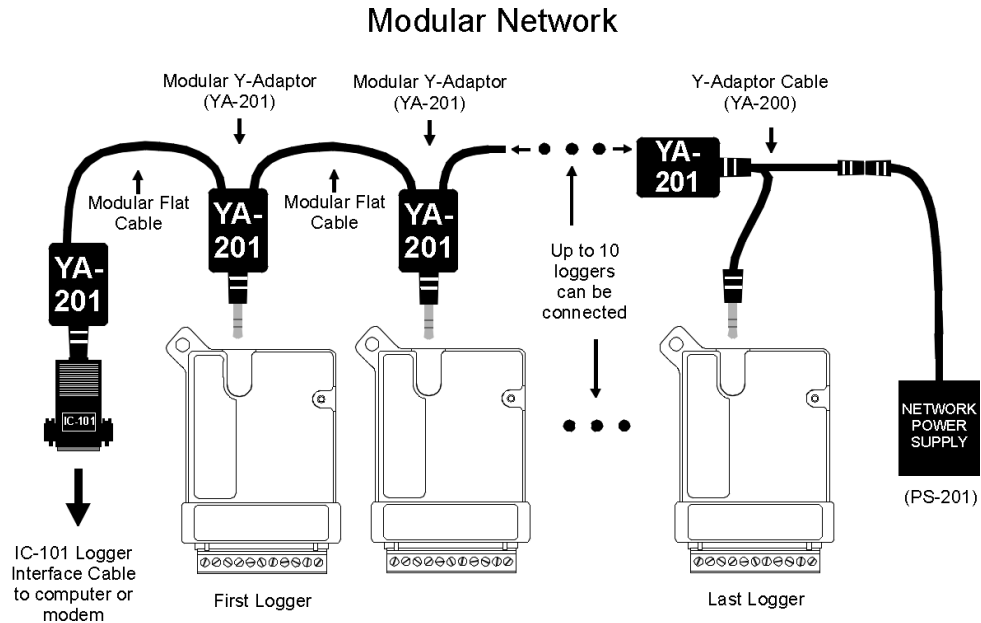
1. Insert Y adaptor cables (YA-200) into logger except the last one on the network.
2. Connect the first logger to your computer (or remote modem) using the IC-101 interface cable. If you are connecting to a modem, refer to *Connecting the System* in Chapter 7 of this guide.

3. Connect the loggers together with extension cables (CB-020).

The loggers are ready to be contacted by the TrendReader program.

Connecting loggers on a Modular Network

The Modular Network accommodates a maximum of ten loggers.



1. Insert a Y adaptor cable (YA-200) into the last logger on the network.

2. Insert a Modular Y adaptor (YA-201) into:

- the plug portion of the IC-101 Interface Cable
- each logger except the last one on the network
- one end of the last logger's Y adaptor cable

3. Cut and crimp the Modular Flat Cable.

Note:

Do not use modular cable crimped for telephone use as the wiring will be "mirror image". Instead, crimp your own jacks using a "straight through" wiring method.

4. Connect the IC-101 to the first logger, and all the loggers to each other, using Modular Flat Cable.

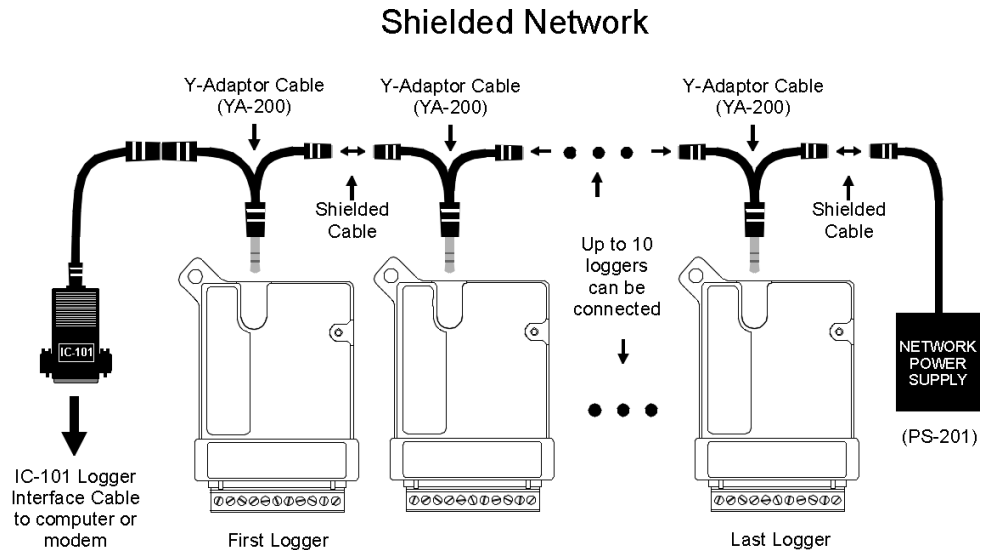
5. Connect the Network Power Supply (PS-201) to the last logger using the available end of the Y adaptor cable.

6. Plug the power supply into an electrical outlet.

The loggers are ready to be contacted by the TrendReader program.

Connecting loggers on a Shielded Network

The Shielded Network accommodates a maximum of ten loggers.



1. Insert Y adaptor cables (YA-200) into each logger on the network.
2. Connect the IC-101 Interface Cable to the first logger.
3. Connect all the loggers to each other, using shielded cable.
4. Connect the Network Power Supply (PS-201) to the last logger using the available end of the Y adaptor cable.
5. Plug the power supply into an electrical outlet.

The loggers are ready to be contacted by the TrendReader program.

Communication Problems and Solutions

Network communication can be affected by:

- network cable length
- type of network cable
- number of loggers on network
- interference from electrical equipment
- lack of external power supply

If you have problems communicating with loggers on a network please try the following steps:

1. Slow the baud rate.
2. Use the PS-201 Power Supply connected to the last logger on the network, or any where along the line, where ever the lone voltage may sag below 45VDC
3. Reroute the cable (to avoid electrical interference).
5. Use shielded cable.

Appendix C: Troubleshooting

Answering the most common questions about running TrendReader for Windows software, and providing information about obtaining technical support.

Why Won't TrendReader Communicate with My Logger?

If your logger does not respond when communication is attempted, check that:

- the logger or modem is attached to the selected COM port
- all connections are secure between the computer and the logger
- there are no other applications using the COM port
- only one serial port is hardware configured for each COM designation
- there are no conflicting IRQ assignments

If the logger still does not work try:

- testing the serial port with another application
- the software on another computer
- other loggers or interface cables

How Come TrendReader Won't Backup My Logger?

If the software cannot back up the logger's data, make sure there is enough room on the hard drive to store the data.

Why Do My Graphs Have the Wrong Date and Time on Them?

This happens if your computer's clock is incorrect when you backed up the logger. The TrendReader software depends on your computer having the correct time and date. If your graphs have the wrong time or date you can:

Under Windows 3.1:

- Set the clock on the computer by selecting the Time / Date icon in the Control Panel from the Main Window of the Program Manager. Then backup your logger again.

Under Windows 95, 98, NT or 2000:

- Set the clock on the computer by:
 1. Double click on Windows time display in the bottom right hand corner of the screen.

2. On the Date / Time Properties window change the time.
 3. Press **Apply**.
- Correct the original file by choosing Revise a Logger File from the Options menu. Change the Backup time/ date to the actual time you backed up the logger.

How Accurate are TrenReader Time Measurements?

There are two answers to this question. The first answer describes the relative accuracy of each reading. The second answer describes the absolute accuracy of the readings.

Relative accuracy

The relative time measurements in normal mode (the time that elapses between one reading and the next reading) are precise to within $\pm 2 * \text{sample rate} / 24 * 3600$. The accuracy of the clock inside the logger is ± 2 seconds per day.

Absolute accuracy

TrenReader's absolute time accuracy (the difference between the time the data logger took a reading and the time that TrendReader reports the reading was taken) depends on the time base in the logger. The absolute time of TrendReader's readings are accurate to within ± 4 seconds.

When you back up your data, the logger is unable to tell TrendReader precisely when it stored its last reading. TrendReader only knows the current time and the elapsed time in 8-seconds intervals.

What Rights are Needed to Run TrendReader on a Network?

The method for granting rights varies according to which network operating system is being used. You should have the following rights:

- create
- erase
- search
- modify
- read
- write

(or their equivalent) to both the TrendReader Standard and the file path directory used to store data.

Why Doesn't My Printer Work?

1. Make sure the printer is powered and online by checking that it is plugged in and the associated lamps are on.
2. Check that the printer cable is connected to the appropriate port on your computer.
3. Under Windows 95, 98, NT, or 2000:

- 1) Press **Start**.
- 2) Choose **Settings, Printers**.
- 3) Open Printer Windows and follow the instructions to add your printer driver.

Under Windows 3.1:

Select the corresponding printer driver by going to Program Manager, opening Print Manager, and choosing Print Setup from the Options menu:

- (i) Press **Alt+Tab**, holding down **Alt** as you tap **Tab** until **Program Manager** appears, then release **Alt**.
- (ii) Double-click on **Print Manager** in the main **Program Manager** window.
- (iii) From the **Options** menu, choose **Printer Setup**.
- (iv) Click **Add** in the **Printers** dialog box.

The list of available printers appears. If your printer is not listed here, and a Windows printer driver did not come with your printer, contact your printer dealer.

4. Try the printer's self-test function. If the printer fails the self test, repair or replace your printer.

Why Can't I Contact My SmartReader Plus Network?

You probably don't have **SR+Network** checked on the Communicate menu. Make sure there is a check mark in front of **SR+Network** before you try to contact the network.

Technical Support

If you need assistance with TrendReader Standard or ACR Data Loggers, please have the following available when you call:

- description of problem or question
- access to the computer with the software
- version number which appears on the opening window
- logger model and serial number being used
- interface cable or module part number
- this reference guide and all related material

Software operation and hardware support questions should be directed to your dealer. However, if you experience difficulty using TrendReader software or related products please contact ACR Systems Inc. by phone (604) 591-1128 or fax (604) 591-2252, or email us: acr@acrsystems.com

Glossary

backup: To copy data from a data logger to your computer.

baud rate: A measure of transmission speed, usually associated with a COM (communication) port. On a SmartReader and SmartReader Plus, baud rate also has an effect on backup speed.

calibrating: The process of adjusting an instrument so that its readings are accurate.

channel: The path through which a logger receives the signals it measures.

COM port: A communication port by which a logger is connected to your computer.

comments: Words you can insert in a graph to describe the graph data.

continuous mode: This mode, for a SmartReader, a SmartReader Plus and an OWL, sets the logger to continue taking readings when it is full, discarding its oldest readings as it stores new ones.

default: A value that TrendReader uses when you do not specify an alternative.

default divisions: The number of divisions on the vertical axis of every graph you open.

dial prefix string: A series of characters used before the number to be dialed to issue the dial command.

DIP switches: Rocker or slider switches that configure settings on modems and other electronic devices. (Acronym for dual in-line package.)

equation: A mathematical calculation that TrendReader performs to convert internal readings to understandable measurement units.

escape code: A code that forces the modem into command mode while a link is established.

fast read mode: A function on a SmartReader Plus and an OWL that allows you to take readings at sample rates faster than eight seconds.

filename: A name of eight characters or less (no spaces) that you give to a file.

file extension: A set of characters (up to three) added to an eight-character filename. TrendReader adds its own extension to filenames.

flash: An OWL Info Logger function that controls the conditions under which the OWL'S light will flash.

hangup string: A series of characters that tells the modem to hang up.

initialization string: A modem command that clears a modem of any previous setup and puts it in a known operating state.

landscape orientation: The page is oriented so that its width is greater than its height. *See Portrait orientation.*

linear equation: An equation that uses linear output transducers (devices that measure a phenomenon such as wind speed, power, or acidity, etc., and produces an electrical signal in

proportion to that phenomenon).

null modem: An adapter that connects an IC-101 interface cable to a modem.

port: See *COM port*.

portrait orientation: This page is oriented so that its height is greater than its width. See *landscape orientation*.

realtime: Refers to whether the current readings of a logger can be seen on your computer screen.

sample rate: The frequency at which a logger takes readings.

setup string: The setup string determines the modem parameters such as handshaking, protocol, etc.

Steinhart-Hart equation: The Steinhart-Hart equation is generally acknowledged as being the best equation available for linearizing the thermistor response curve.

STK files: Logger files from the DOS version of TrendReader software.

stop when full: In stop when full mode a logger will stop taking readings when it is full. (See *continuous mode*).

string: A computer term for a series of letters and / or numbers.

thermistor: A temperature-sensing element made of semiconductor material.

thermistor equation: An equation that converts internal data into measurements of temperature.

timeout: The length of time (in seconds) that your computer will wait for a remoter site to answer before hanging up.

transducer: A device that converts energy from one form to another. Transducer generally refers to a device that take physical phenomena (for example, temperature, pressure, humidity, flow) and converts them to electrical signals.

trigger: An OWL Data Logger function that allows you to set upper and lower limits inside which the OWL will not log.

zooming: Enlarging part of a graph.