

---

User Manual for

# DL2e Data Logger

## *Getting Started*



Version 5.0

# AT

*Delta-T Devices Ltd*

---

## VERSION

Document code : DL2-UM-04-05

Version : 5.0

Date : 18 Jan 2001

### See also:

The following online documents are installed on your PC in the Ls2Win program group

On-line **Help** is provided for each of the Ls2Win Programs:- DL2 Control Panel, DL2 Program Editor, Dataset Viewer and Dataset Import Wizard.

- **DL2e Hardware Reference.** Your main source of information about the logger (From the Start Menu select Programs = Ls2Win = Documents).

The following are also available online:

- **Weather Station Applications Note.**
- **DL2e Programmers Guide** (communications guide for specialist programmers only).
- **Command Line Data Retrieval.**

The following can be obtained from Delta-T

- **DL2e Technical Reference Manual** (circuit board schematics for technicians).

Our web site also contains useful information.

## TRADEMARKS

IBM PC, PC-XT, PC-AT, PS/2 and PC-DOS are registered trademarks of International Business Machines Corporation

MS-DOS, Windows, Windows NT and Excel are registered trademarks of Microsoft® Corporation

Lotus 1-2-3 is a registered trademark of Lotus Development Corporation

Hayes is a registered trademark of Hayes Microcomputer Products Inc.

## COPYRIGHT

This manual is Copyright© 1992, 1993, 1996, 2000 Delta-T Devices Ltd., 128 Low Road, Burwell, Cambridge CB5 0EJ, UK. All rights reserved.

Under the copyright laws, this book may not be copied in whole or in part, without the written consent of Delta-T Devices Ltd. Under the law, copying includes translation into another language.

## ELECTRO-MAGNETIC COMPATIBILITY

The DL2e Logger has been assessed under the European Union EMC Directive 89/336/EEC, and conforms with the following harmonised emissions and immunity standards:

EN 50081-1 : 1992

EN 50082-1 : 1992

# Table of Contents

<b>Table of Contents</b>	<b>i</b>
<b>Introduction</b>	<b>3</b>
<b>Welcome to the Delta-T DL2e Logger</b>	<b>3</b>
Summary of DL2e Logger features	3
<b>How to use this manual</b>	<b>4</b>
<b>Preliminary Instructions</b>	<b>6</b>
<b>Unpacking</b>	<b>6</b>
<b>Guided tour of the logger</b>	<b>7</b>
Front panel	7
Side panel	7
Terminal compartment	7
Opening the main case	7
Behind the front panel	7
Main Circuit Board	9
The terminal panel	12
Channels	12
On-board channels	12
Terminal groups	12
Cold junction thermistor	12
Supplying power to relay channels	14
When finished	14
<b>Checking that the DL2e Logger works</b>	<b>15</b>
Waking the logger	15
Autosleep	15
<b>Installing Ls2Win software</b>	<b>16</b>
Items required	16
Installing Ls2Win	16
Checking communications	17
<b>Tutorial</b>	<b>20</b>
<b>Lesson 1 Using the DL2e Logger's keypad</b>	<b>22</b>
The front panel	22
The DL2e default program	27
Short cuts	28
Logging	28
Stopping logging	29
<b>Lesson 2 Retrieving logged data to PC</b>	<b>31</b>
DL2 Control Panel	31
Logger Panel : Inspect the Logger Status & Start Logging	31
Sensors Panel: Watch the sensor readings	33
Datasets panel: Retrieve the dataset	34
Dataset Viewer	36
About file formats	36
<b>Lesson 3 Program the DL2e Logger</b>	<b>37</b>
The DL2 Program Editor	38
Modifying the program	40
<b>Lesson 4 Graph your Data</b>	<b>44</b>
Dataset Import Wizard Step 1	45

Dataset Import Wizard Step 2	45
Dataset Import Wizard Step 3	46
Dataset Import Wizard Step 4	46
Dataset Import Wizard Step 5	47
Dataset Import Wizard Step 6	48
More Wizard Features!	49
Wizard Graphing Tips	50
See also the Weather Station Application Note	50
<b>What else you need to know about the DL2e Logger</b>	<b>51</b>
<b>Creating new sensor types</b>	<b>51</b>
<b>Modifying Sensor Types</b>	<b>52</b>
<b>Modifying Channel Properties Directly</b>	<b>52</b>
<b>Importing &amp; exporting library sensor types</b>	<b>52</b>
<b>Linearisation tables</b>	<b>52</b>
<b>Batteries and alternative power supplies</b>	<b>53</b>
<b>Installing and setting up cards</b>	<b>53</b>
<b>Using the logger with modems</b>	<b>53</b>
<b>Passwords</b>	<b>53</b>
<b>Outputting data directly from the logger</b>	<b>53</b>
<b>Auto-wrap (overwrite mode)</b>	<b>53</b>
<b>Relay channel functions</b>	<b>53</b>
<b>Event trigger functions</b>	<b>54</b>
<b>Installation considerations</b>	<b>54</b>
<b>Command Reference for the PC software Ls2Win</b>	<b>54</b>
<b>Resetting or Coldbooting the logger</b>	<b>54</b>
<b>Weather Stations</b>	<b>54</b>
<b>Command Line Operation and Automated Data Retrieval</b>	<b>54</b>
<b>Index</b>	<b>58</b>

---

# Introduction

---

## Welcome to the Delta-T DL2e Logger

### Summary of DL2e Logger features

The DL2e Logger is a programmable data logging device, capable of taking readings and storing data from a wide variety of sources. It is independently powered, capable of operating under wet conditions, and at high and low temperatures. The DL2e Logger is therefore an excellent choice for all classes of logging applications.

PC software Ls2Win is first used to program the logger, specify what sensors are to be connected to the logger, and how frequently to record data. Once the logger has been set up, the PC can be disconnected and the logger can be left to operate on its own. Data recorded from sensors is stored in the logger's own memory, and can be periodically transferred to a PC or to any device which has an RS232 serial port, for example a printer. When data has been collected from the logger, it can be cleared from the logger's memory to make room for more data.

Only one PC is needed to operate any number of loggers, and it only needs to be connected while setting up the logger and collecting the stored data. You need a PC running Windows 95, 98, 2000 or NT4.0 Service Pack 4, or later. A CD-ROM drive is also required for installation. Ls2Win is not a demanding application, so assume sufficient RAM and disk space will be available.

The logger also has a front panel with keypad and display that can be used to check and control logger operation without using a PC.

The DL2e Logger is modular in design. Depending on the input cards installed, the logger can record data from up to 62 sensors. Input cards are available for analogue and pulse output sensors.

Each logger has on-board digital input channels for pulse counting or event detection, and two relays, for powering up sensors or simple control applications.

The logger has an internal clock and can be set up to record data at regular intervals. This is known as **timed data**. In addition, it can also record data when events are detected - known as **event triggered data**.

The logger can be powered from an external DC power supply, or from its own internal batteries. It has extremely low power consumption and can operate for extended periods on a set of batteries. With a rugged weatherproof case, it is equally suited for use as a laboratory instrument or for outdoor installations in remote locations. Being modular and programmable, it is an extremely flexible tool, and easily adaptable for a wide variety of applications.

# How to use this manual

This introduces you to using the standard DL2e Logger, and its major accessories. If you have a non-standard DL2e-based logger, without a LAC1 input card, disregard those sections of the tutorial that assume that a LAC1 card is fitted.

---

Note: Old loggers running type LCS or LS2e DOS software should be upgraded to the PC software Ls2Win. If you cannot upgrade, use Version 2.02 of the DL2e User Manual.

---

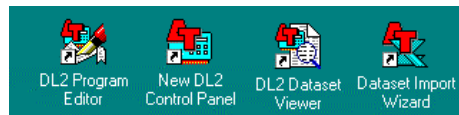
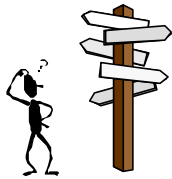
If you have a brand-new DL2e Logger, work through this manual first.

- See "Preliminary Instructions" on page 6 for installation instructions.
- Take "A Guided Tour" for an introduction to some of the logger's facilities on page 7.
- Learn the basics of logger operation in the "Tutorial" on page 20.
- "What else you need to know about the logger" briefly introduces features not covered in the tutorial - see page 50.

If you have acquired a logger that has been previously used, take particular care to work through these Preliminary Instructions, to ensure that the logger is correctly set up for the tutorial.

### See Also:

There are four PC programs. Each provides **on-line Help**.



The separate **DL2e Hardware Reference** manual contains information about:

- using the keypad on the front panel
- setting internal switches and rebooting,
- installing additional cards and components,
- connecting sensors and cable assemblies,
- communications cables and modems,
- sensor type linearisation tables,
- accuracy and technical specifications,
- maintenance, storage, repairs and guarantee.

It also contains general guidance on the scope and application of the measurement techniques supported by the logger.

It is installed on your PC when you install the PC software, as a .PDF format file, readable using Adobe Acrobat. Printed copies may be purchased.

For completeness, note the following specialist manuals:

- **Application Note** - It describes how to program a Delta-T Weather Station, and how to import and chart weather station data in Microsoft® Excel®. It is installed on your PC under Ls2Win, Weather Station.

Separate Contents and Indexes exist for :  
- each on-line Help,  
- Hardware Reference,  
- Getting Started.

So keep searching!

- **DL2e Programmers Guide.** This contains information about communicating with the logger via a modem. It is installed on your PC under Ls2Win, Online Documents.
- **Command Line Data Retrieval.** This document describes the use of command line programs supplied with Ls2Win and how to automatically retrieve data from DL2e logger installations at pre-determined times. It is installed on your PC under Ls2Win, Online Documents.
- **DL2e Technical Reference** manual, consisting solely of printed circuit board schematics for the various cards and accessories.

# Preliminary Instructions

This chapter explains how to prepare your DL2e Logger for use. It contains the following sections:

- Unpacking
- Guided tour - introduces the DL2e Logger and other features that you will need access to.

This section also describes how to set up your logger in order to proceed successfully with the tutorial.

- Checking that the DL2e Logger works
- Installing and running the Ls2Win Software

---

## Unpacking

On first receiving your DL2e Logger, check you have the following:

- DL2e, ready fitted with any of the following options (if ordered):
  - additional input cards, types LAC1, ACD1, LFW1, DLC1
  - AC source card Type ACS1
  - case height extension.
- DL2e Logger PC software, type Ls2Win on a CD-ROM and a Tutorial Kit.
- DL2e - PC communication cable, type LRS1 (complete with 9-25 pin adapter).
- Spares and Accessory pack.

Check the contents against their respective packing lists.

The Spares and Accessory pack contains the following items:

- Desiccant packs: the logger needs to be kept dry internally for reliable and accurate results. See also "Field Installation, Moisture" in Chapter 4: DL2 Logger Hardware of the DL2e Hardware Reference.
- External power connector pack, containing:
  - a flying lead for making connections to an external power supply (see "External power supplies" in Chapter 4: DL2 Logger Hardware of the DL2e Hardware Reference for alternative power supply details)
  - spare caps for the DL2e's power supply socket
  - jumpers for connecting the DL2e's internal power supply to the on-board relay channels (see Relay Channels in the online Help for the DL2 Program Editor )
- Spare ribbon cables, depending on the configuration ordered,
- Spare terminal compartment sealing strips.
- Terminal label set.

The following are supplied packed separately (if ordered):

- Attenuator card type LPR1.
- Input protection card type LPR1V.
- Rechargeable battery pack, type LBK1.
- Battery charger.



---

# Guided tour of the logger

## Front panel

The logger's front panel has the following features:

### Keypad

A set of 7 touch-sensitive keys for logger operation.

### Display

A display for showing messages about logger operation and results.

### Humidity indicator

Should be blue for normal logger operation. When it turns pink, a fresh bag of desiccant should be fitted to the logger (see "Field Installation, Moisture" in Chapter 4 of the Hardware Reference).

## Side panel

### External power supply socket

As an alternative to internal batteries, the logger can be powered from an external 7-15V DC supply via this socket (see "External power supplies in Chapter 4 of the Hardware Reference). A suitable flying lead is provided in the Spares and Accessory pack.

### Sealed RS232 socket

Use this to connect the DL2e to a PC or printer.

### Safety earth terminal

Use this to connect the DL2e to a suitable safety earth.

## Terminal compartment

A weatherproof compartment contains terminals for connecting sensors to the logger (see "The terminal panel" on page 12).

## Opening the main case

You will need to have a look inside the main case to check that the logger's internal settings are correctly set up for the tutorial or your particular requirements.

You will also need to open up the case periodically to change the logger's batteries or desiccant pack.

- Stand the logger on its base.
- Unscrew the four wing screws until they lift up. Two of them will have to be unlocked if the logger has been supplied with a lock kit. The screws will not come out completely; they just lift up.
- Gently remove the lid. Do not remove it too quickly because there is a ribbon cable connecting the lid to the main circuit board.
- If you need to work within the logger's main case, secure the lid in the offset position as shown in Figure 2 - Main features of DL2e Logger

## Behind the front panel

On the rear of the front panel is mounted:

## Battery holder

Holds 6 alkaline cells, which need to be replaced periodically, unless an external power supply is used.

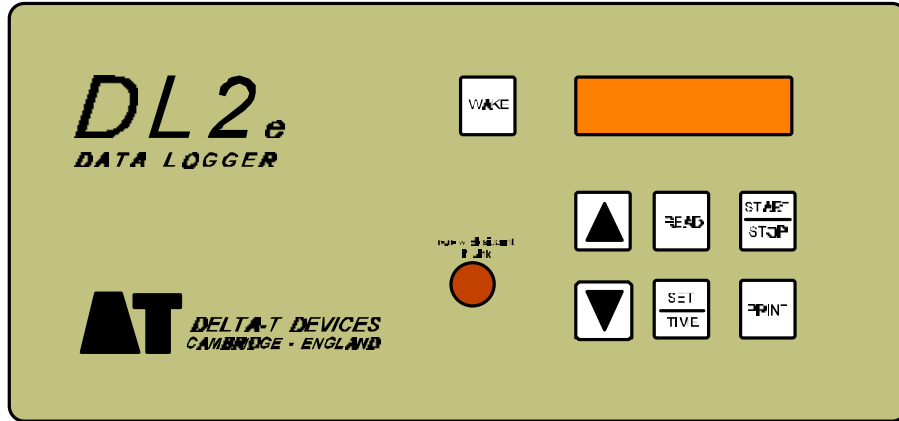


Figure 1 - DL2e Logger Front Panel layout

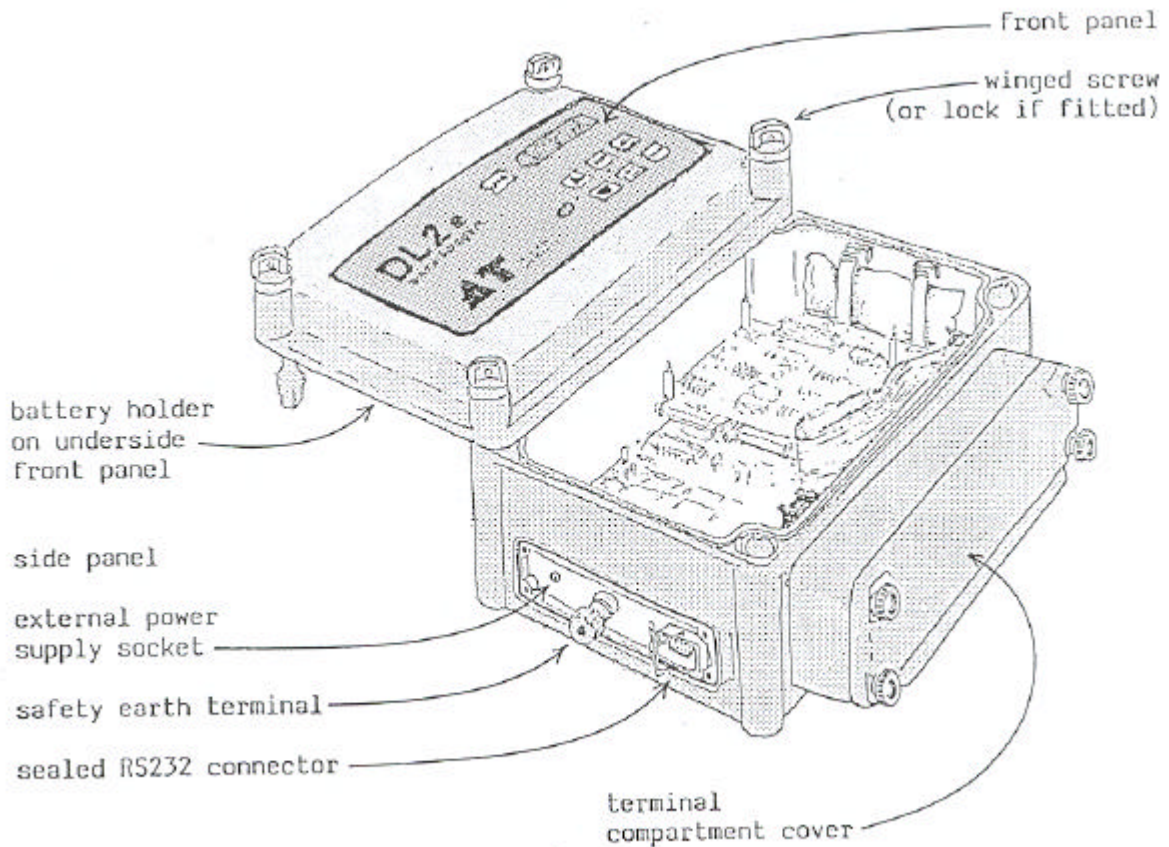


Figure 2 - Main features of DL2e Logger

## Main Circuit Board

- The **main circuit board** is mounted on the bottom of the case, with one or more input cards mounted on the input card stack: This should be set to the 'INTL' position if powering the logger from its internal batteries. See also "Power supplies" of Chapter 4: DL2e Hardware in the DL2e Hardware Reference.
- **Memory IC sockets:** Sockets containing memory chips where logged data is stored. In Figure 3 on page 11 these are labelled DATA RAM and DATA RAM expansion. See also "Installing ICs" in Chapter 4: DL2e Hardware in the DL2e Hardware Reference.
- **PROM:** Contains the logger's internal 'program' (not to be confused with logging programs you created on the PC). The PROM is labelled with a version number, which you should quote if making a technical enquiry.
- **Baud rate** selection switch: Determines the speed of RS232 communication (with PC or printer). Set it to "9600" for the Tutorial. See also "Communication Parameters" in Chapter 4: DL2e Hardware in the DL2e Hardware Reference.
- **Lithium cell:** A backup battery which enables the logger to retain information stored in its memory in the absence of other power supplies, for example while changing internal batteries, or if batteries are flat. See also "Lithium cell" in Chapter 4: DL2e Hardware in the DL2e Hardware Reference.
- **LAC1 input card on top of stack:** Up to 4 input cards can be mounted on the stack. New loggers are normally supplied with analogue card LAC1 on top of the

- stack, and any other input cards you've ordered underneath.
- **Ribbon from terminal group 1-15:** For the tutorial, a single ribbon cable must be fitted between the connector marked '3-wire/differential' on the LAC1 card and the terminal group 1-15 on the rear of the terminal panel. No other ribbon cables should be connected to the LAC1, but leave ribbons connected to other cards. The rear of the terminal panel is illustrated in Figure 6 - Rear of terminal panel. Take care when moving ribbon cables not to apply excessive force to the latches on the connectors. They are easily broken.
  - **15/30 switch:** On the LAC1 input card set this to "15" for the Tutorial.
  - **LCD Contrast Adjustment** (marked 'LCD' on the circuit board): Sets the optimum contrast for the logger's display. You may need to adjust this to make the logger's display more readable when you move on to "Checking that the logger works" later in this chapter.
  - **DIP Switch.**  
**Switches 1-3** determine the logger's communication parameters, along with the BAUD RATE switch. For the Tutorial, they should be set to 8 data bits, no parity, as illustrated in Figure 3 - Main circuit board.  
See also: "Communications parameters" in Chapter 4: DL2e Hardware in the DL2e Hardware Reference.  
**DIP Switch 4** is factory set to the '50' position. You should change it to '60' if your local electrical mains frequency is 60 Hz. When set to '60', the logger's display of dates is changed to American month-day format (see "Electrical mains environment" in Chapter 4: DL2e Hardware in the DL2e Hardware Reference).
  - **STOP LOGGING** button: Used to stop logging, or in conjunction with the COLD BOOT button to coldboot the logger (see "Stopping logging" in Chapter 2 of the DL2e Hardware Reference ).
  - **RESET** button: Used to reset the logger in the event of a malfunction (see "Resetting the logger" in Chapter 1 of the Hardware Reference).
  - **COLD BOOT** button: Used to coldboot the logger, i.e. to reset the logger to a known, well-defined state (see "Resetting the logger" in Chapter 1 of the Hardware Reference).

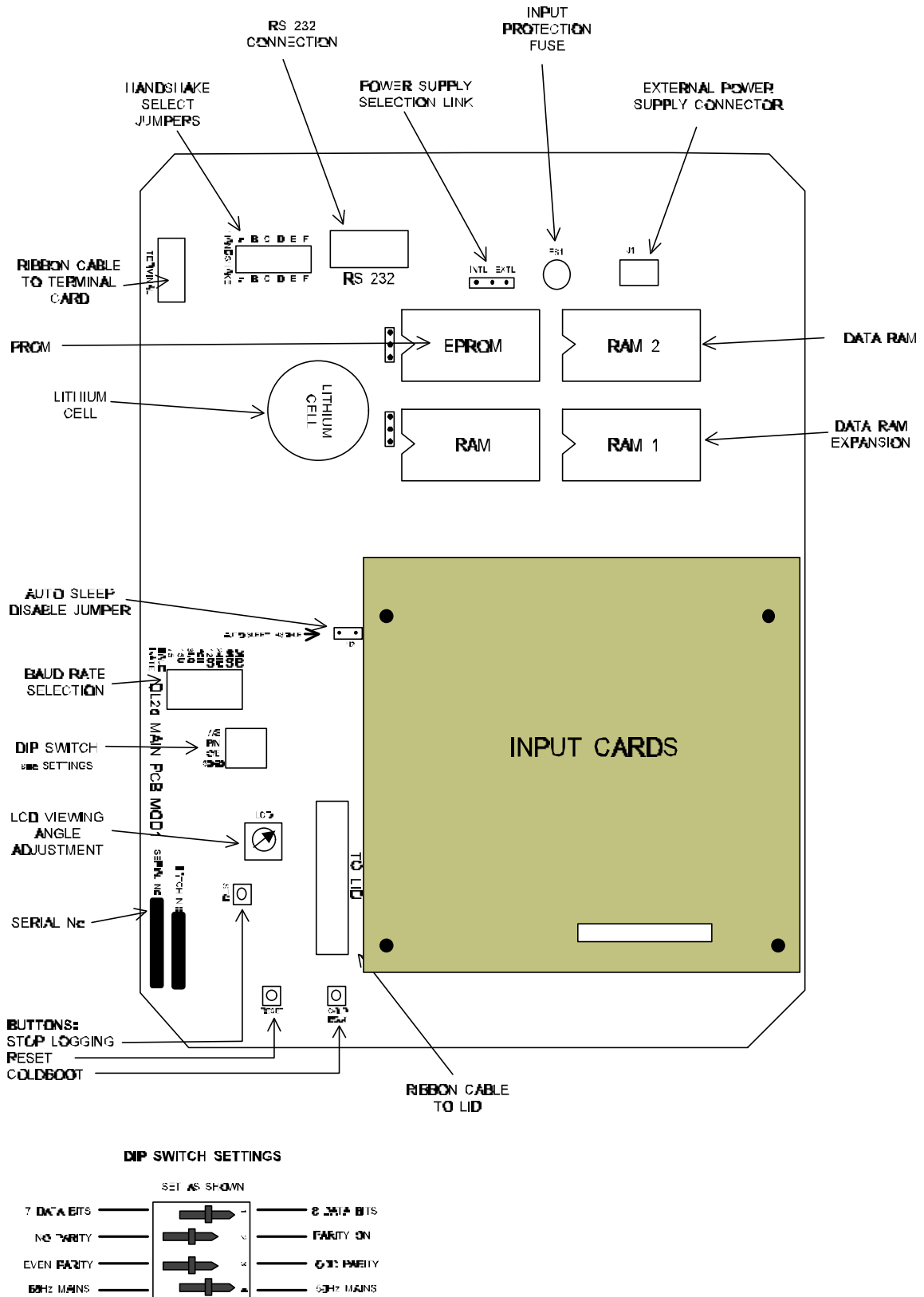


Figure 3 - Main circuit board

## The terminal panel

Sensors are connected to the logger by means of screw-terminal connector blocks which plug into the logger's terminal panel.

### Removing the terminal compartment cover

Undo the four knurled screws and pull off the two-piece cover, as shown Figure 4 - Removing the terminal panel cover. You will find a complete set of 13 terminal blocks plugged into the terminal panel.

### Using the terminal blocks

To connect a sensor to the logger, you have to remove a terminal block first to gain access to the screw clamp mechanism. Grip the rubber pads at each end between thumb and finger, and pull the terminal block off. If you find the block difficult to remove, insert a small screwdriver in the gap behind it and prise it off.

Sensor leads can now be clamped in place, and the terminal block plugged back into the panel to make the connection.

## Channels

The logger identifies sensors connected to it by channel numbers. Up to 64 channels may be available in your logger, depending on the combination of input cards it contains. Terminals corresponding to each channel are numbered on the terminal panel and on some of the pluggable terminal blocks. Terminal labels are provided so you can label the remaining terminal blocks.

### On-board channels

Channels 61 to 64 are 'on-board channels': they are available in every logger. Channels 61 and 62 are digital input channels. Channels 63 and 64 are relay channels, which can be used for switching or powering up sensors or other devices.

### Terminal groups

The remaining channels, 1 to 60, are arranged in four terminal groups, corresponding to channels 1-15, 16-30, 31-45, 46-60. On the rear of the terminal panel, a ribbon cable connector is provided for each terminal group (see Figure 6 - Rear of terminal panel), and one or more terminal groups in your logger will be connected by a ribbon cable to an input card on the input card stack. Only the channels connected to an input card are available to the logger, and the type of input card it is connected to determines the capability of each channel. For example, channels connected to a LAC1 analogue input card are suitable for making analogue measurements, whereas channels connected to a DLC1 counter card are suitable for counting and frequency measurements from digital sensors.

Each channel on the LFW1 card requires 5 terminals, so only 6 channels are available in each terminal group connected via an LFW1 card. An alternative terminal label set is supplied with LFW1 cards.

### Cold junction thermistor

The terminal panel is designed to be isothermal under typical operating conditions. It is fitted with a thermistor for measuring its temperature and providing a cold junction reference for thermocouple measurements.

The **cold junction thermistor** is switched into channel 1 by means of a dual miniature slider switch in the top right-hand corner of the terminal panel (see Figure 5). for the tutorial you will need to have the thermistor switched in to channel 1: slide both switch sections upwards (i.e. ON).

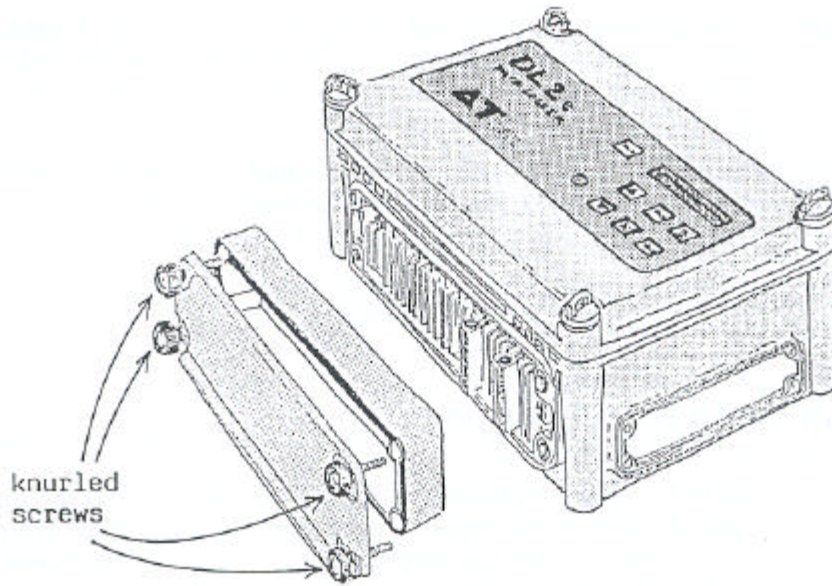


Figure 4 - Removing the terminal panel cover

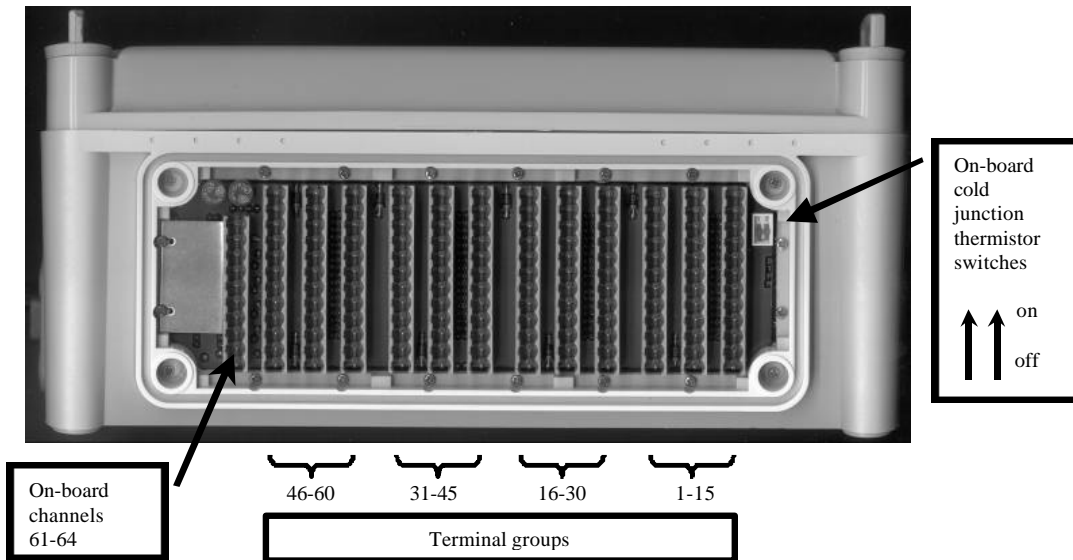


Figure 5 - Access to terminal groups

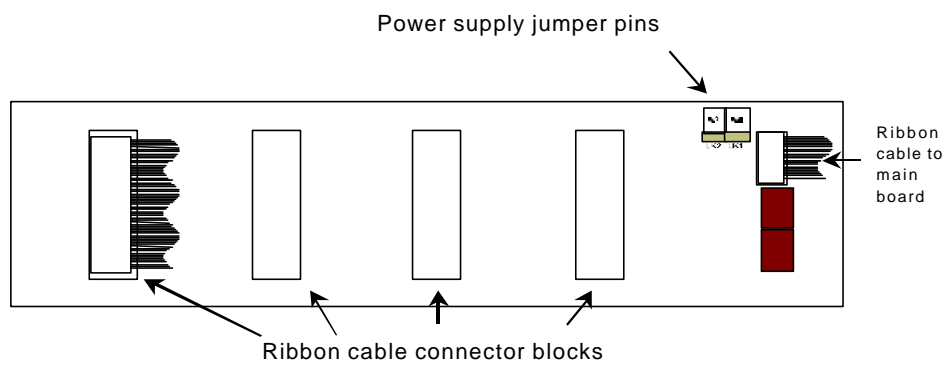


Figure 6 - Rear of terminal panel

## Supplying power to relay channels

You can connect the logger's power supply to relay channels 63 and 64 by fitting jumpers (supplied fitted as shipped) to jumper pins (Figure 6 - Rear of terminal panel). See also "Relay channels" in the on-line Help and in Chapter 4 of the Hardware Reference.

You will need to fit one of these jumpers if you are using the Delta-T Weather Station. **WARNING:** proceed with caution when fitting these jumpers. If sensors are connected incorrectly, there is a risk of accidentally shorting out the logger's batteries, losing logged data and causing damage to the logger.

## When finished

Replace the logger lid and terminal panel cover.



---

## Checking that the DL2e Logger works

The logger operates in two states, 'awake' and 'asleep'. When the logger is awake, the front panel keypad and display are fully operational. When the logger is asleep it continues to operate, but to conserve battery power the display and many of its other functions are turned off.

The logger will be asleep when it is supplied, and the display will be blank. You can check that the logger works by waking it up.

### Waking the logger

Click the WAKE key. You will see the confirmation message WAKE in the logger's display. The logger will then perform a number of checks and a series of test messages will appear on the display.

Most of these messages can be disregarded for the time being, but make a note of the message giving the battery status, which appears like this:

```
battery 8.2volts
approx. 80% left
```

If all tests are successfully completed, the following **keypad main menu** appears.

### The Keypad Main Menu

```
Click key if
required..
```

This indicates that commands can be issued by pressing any of the front panel keys. At the end of each command sequence, the keypad main menu re-appears.

The use of these keys is described in the Tutorial and Hardware Reference.

If the logger doesn't wake as above then:

- if the logger is new, contact your supplier
- if you have inherited the logger, the most likely cause of fault is a flat battery: see "Internal battery operation" in Chapter 4 of the Hardware Reference.

### Autosleep

After waking the logger (or reaching the end of a command sequence) the keypad main menu will remain on the display for only ten seconds. If a front panel key is not pressed during this time, the logger will automatically go to sleep. This process is called 'autosleeping'.

The following message appears briefly and then the display blanks.

```
sleeping..
```

To prevent the logger sleeping, see "Disabling autosleep" under AutoPrinting in Chapter 3 of the Hardware Reference.

## Installing Ls2Win software

Ls2Win enables a PC to communicate with the logger, edit logging programs and collect accumulated data. It is supplied on CD-ROM and is not the same as the program in the logger's PROM.

The following sections describe how to install Ls2Win, connect the logger to a PC, and check they are communicating correctly.

### Items required

To operate the logger from your PC you need the following:

- A PC running Windows 95, 98, 2000 or NT4.0 Service Pack 4, or later.
- One free RS232 serial port.
- CD-ROM drive (required for installation).
- At least 16M RAM memory and 5M of hard disk space.
- Logger-PC RS232 cable: Type LRS1 available from Delta-T, or you can make one up. See "Communications cables" on page 51 of the Hardware Reference manual.
- Ls2Win distribution disk.

### Installing Ls2Win

Insert the distribution disk into your CD ROM drive.

If autorun is enabled on your PC your CD will automatically start to lead you through the installation process.

If autorun is not enabled, or if you choose to install the Adobe Acrobat reader first, you will need to start the install program as follows:

From the Start menu select Settings, Control Panel.

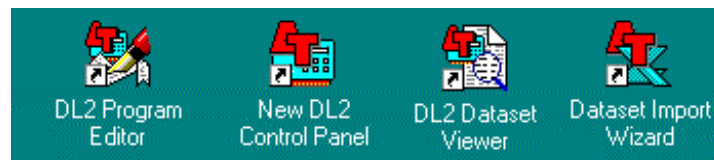
In Control Panel, select Add/Remove programs.

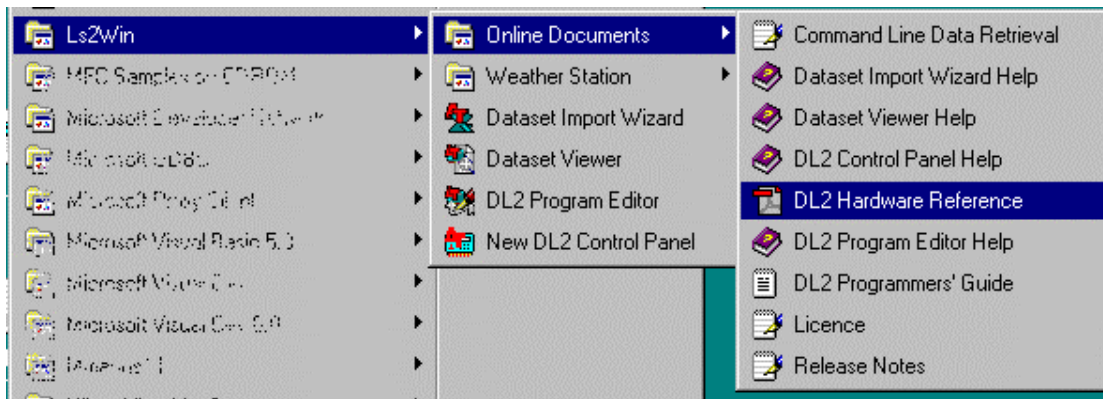
In Add/Remove Programs Properties, select the Install/Uninstall tab, click Install, and follow the on-screen instructions.

Setup installs a program group named Ls2Win on the Programs menu, which contains the following items:

- **New DL2 Control Panel**, for creating 'DL2 Control Panels' which you use to communicate with your logger;
- **DL2 Program Editor**, for creating and viewing logging programs;
- **Dataset Viewer**, for inspecting the contents of 'dataset' files (files containing logged data);
- **Dataset Import Wizard**, for importing logged data into Microsoft Excel.

Setup also installs desktop shortcuts that correspond to each item in the Ls2Win program group.

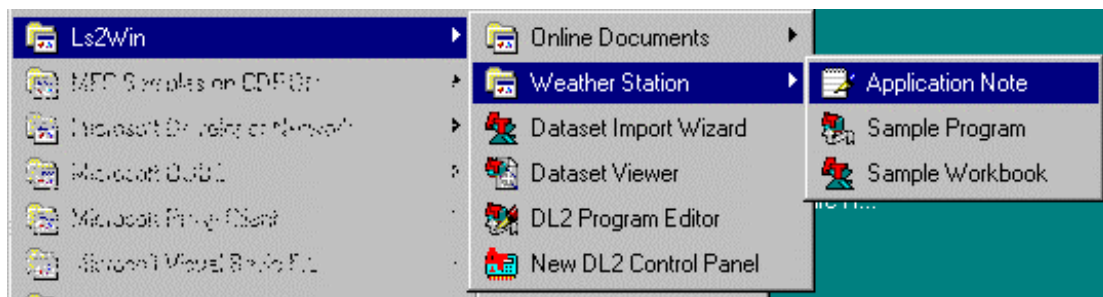




**Figure 7 Programs and Applications Notes available from the Windows Start menu**

Note the documents and help accessible in the **Online Documents** group, including the **DL2e Hardware Reference**, see Figure 7.

The **Weather Station** group includes the following:



**Figure 8 Weather Station applications installed**

- A sample weather station program - easy to copy and modify.
- A sample Microsoft® Excel® workbook with nice graphs of a week of weather data. You can reuse it with your own data.
- An Applications Note on how to program a Delta-T Weather Station, and how to import and chart weather station data in Microsoft® Excel®.

## Checking communications

In the following sections you will:-

- Connect logger to your PC with an RS232 cable.
- Check the logger Baud Rate Sections and DIP switches are set to 9600 baud, 8 data bits, no parity and 1 stop bit.
- Set the PC to 9600 baud and COM1 or COM2.
- Save the PC Communications Properties to file.
- Create a new DL2 Control Panel and specify its Connection Properties.
- Observe your logger's current status displayed on the Control Panel.

## Connect the RS232 cable

Connect the logger to your PC serial port (typically COM1 or COM2 - refer to your PC manual), using a suitable logger-to-PC RS232 cable. If there is only one port, it may be labelled RS232. Do not try to use the PC's parallel port(s).

A message may appear on the logger's display, indicating that the logger has woken up. Ignore any message that appears at this stage and let the logger autosleep. The logger normally wakes whenever it detects a signal, or in this case, electrical noise on its RS232 input line. If the logger is left connected to the PC, you may also find that the logger wakes when the PC is switched on or reset, or when certain software

applications are run.

### Check Logger DIP and Baud Rate Selection switches

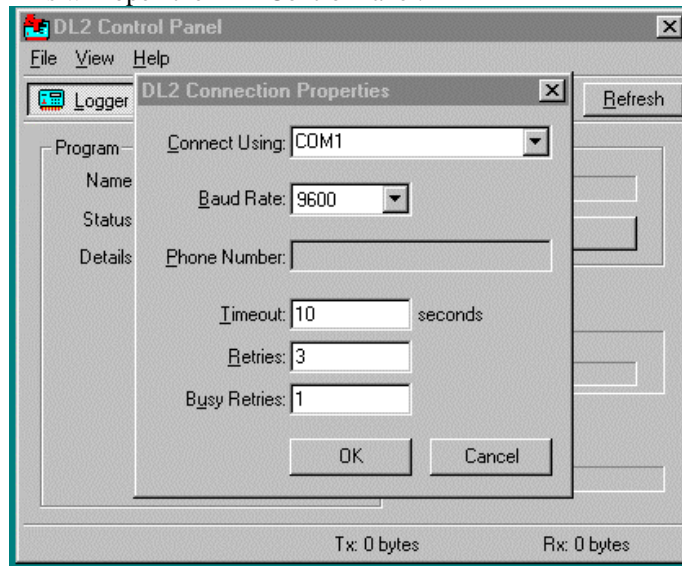
Check the DIP switch settings on the DL2e main board are set to 8 data bits and no parity see Figure 3.

Check the Baud Rate Selection switch is set to 9600 (or if not, ensure it matches that set for the DL2 Control Panel, see below).

### Create a new DL2 Control Panel

Double-click the New DL2 Control Panel desktop icon (or select New DL2 Control Panel from the Start, Programs, Ls2Win menu).

This will open the DL2 Control Panel.



**Figure 9 Showing the DL2 Control Panel with a Connections Properties dialog box superimposed.**

Specify the same serial port (or modem) and baud rate that you set previously on the logger's main circuit board. This ensures the PC and the Logger use the same settings. The detailed use of modems is not covered in this tutorial. If you have several loggers on modem links, you can create a separate DL2 Control Panel for each logger, each with its own unique phone number and desktop icon. Many DL2 Control Panels may be created and opened on your Windows desktop, one for each logger. Note that only one can be in control of a communications port, or modem, at any one time. Select COM1 or COM2. .

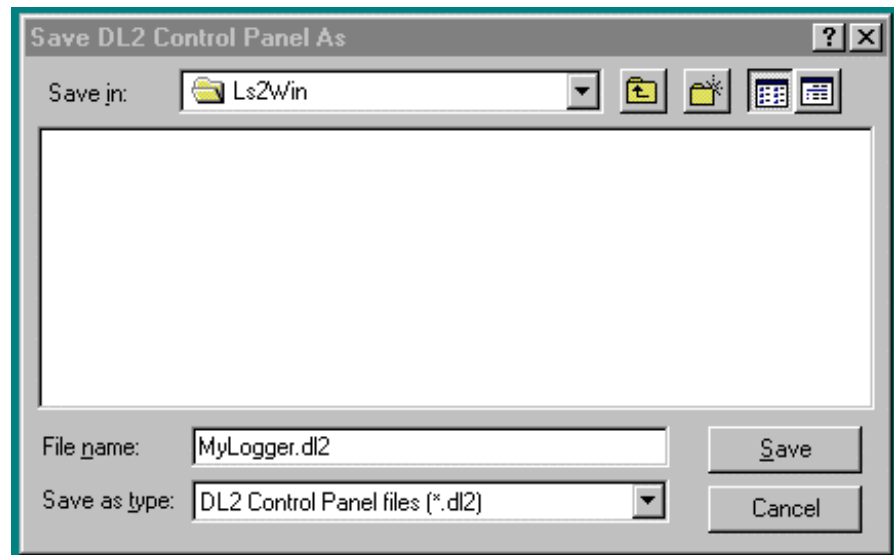
Accept the default baud rate of 9600 and ignore the other options, Timeout, Retries and Busy Retries, which are advanced settings for fine-tuning the connection.

Click OK to accept the settings.

Before you can proceed, you must save the connection properties as a DL2 Control Panel file.

A Save DL2 Control Panel As dialog will now appear as shown below.

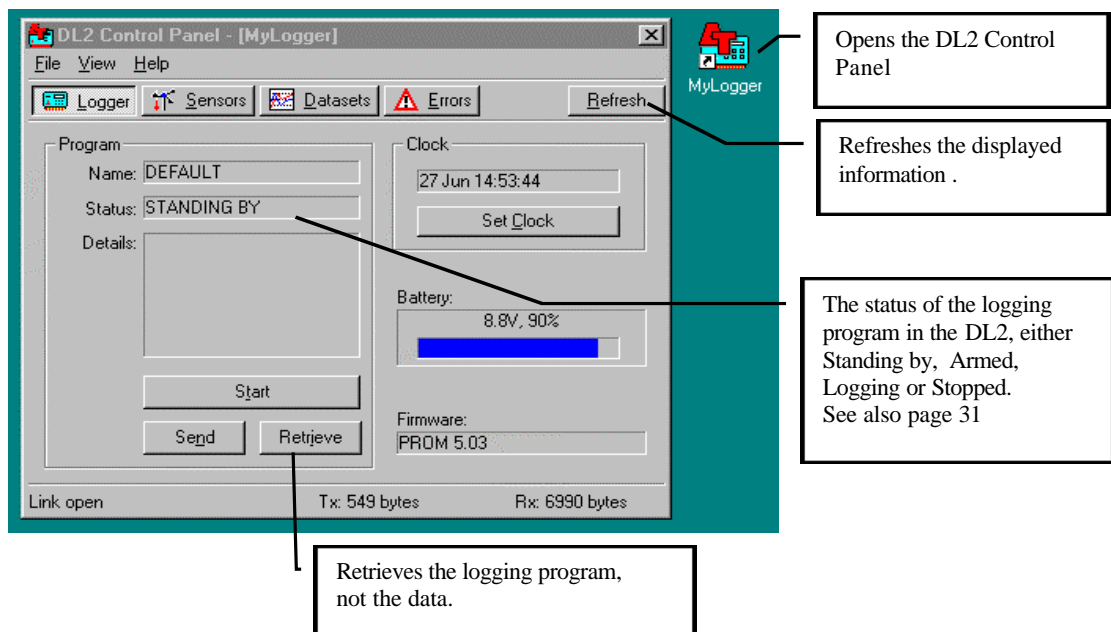
Click OK to accept the default file name suggested - MyLogger.dl2.



**Figure 10 Save DL2 Control Panel dialog.**

DL2 Control Panel now creates a shortcut icon to itself on the desktop and retrieves and displays status information from the logger. You have now established communications with the logger!

If you have selected the incorrect connection settings, select Properties from the File menu, change the settings in the DL2 Connection Properties dialog, and click Refresh to refresh DL2 Control Panel.



**Figure 11 Logger panel on the DL2 Control Panel**

# Tutorial

This tutorial gives an introduction to using the logger. It covers the following:

- Lesson 1 - How to operate the front panel keypad.
- Lesson 2 - How to operate the logger from your PC, and retrieve logged data to a dataset file.
- Lesson 3 - How to program the logger.
- Lesson 4 - How to graph your data.

"What else you need to know about the logger" at the end of this chapter briefly introduces logger features which are not covered in the tutorial.

## Items required

You will need a small flat blade screwdriver, and the tutorial kit supplied with Ls2Win, consisting of:

- Resistors: 100 $\Omega$ , 2.2k $\Omega$ , 33k $\Omega$ , 470k $\Omega$
- Five wire links.
- A copper/constantan thermocouple.
- A push button switch.

## Preparation

Before attempting the tutorial, ensure that the logger is set up as described in "Preliminary Instructions" on page 6.

The tutorial assumes the logger is:

- Fitted with an analogue input card type LAC1.
- Set up according to "Preliminary Instructions" on page 6.
- Working correctly, both on its own and under the control of a PC and can communicate with Ls2Win's DL2 Control Panel.
- Configured with its DEFAULT logging program installed.

A **logging program** is a set of instructions telling the logger what to do. It can be created and edited on your PC and downloaded as a file into the logger.

If the logger has been previously used, you will need to coldboot it to reinstall the DEFAULT program. See "Coldbooting" in Chapter 1 of the Hardware Reference.

## If the program in your logger is not "DEFAULT"

If the program in your logger is **not** called DEFAULT when you receive it then it may be wise to save it before continuing this Tutorial.

Your logger may have a special program pre-installed in it, for you or a colleague.

For instance, if you purchase the logger with a standard Delta-T Weather Station it may come pre-installed with a weather station program. Just to be on the safe side, retrieve any pre-installed logging program to your PC and save it to disk as described above under "Create a new DL2 Control Panel" on Page 18.

To proceed with this tutorial, coldboot your logger (see "Coldbooting" in Chapter 1 of

the Hardware Reference).

Coldbooting the logger will erase any custom logging program and restore the DEFAULT program.

(Note: On completing the Tutorial, to reload a saved program, use the File, Open command in the DL2 Program Editor and then use the Send to DL2 command to send it to the logger. See also the on-line Help for the DL2 Program Editor.)

## Lesson 1 Using the DL2e Logger's keypad

In this lesson you will learn to:

- Wake the logger to obtain a General Status Report, followed by the keypad main menu.
- Display the temperature from the logger's internal cold-junction thermistor.
- Connect simple sensors to the logger and display their realtime readings.
- Start and stop logging.

### The front panel

The logger's front panel has seven keys. In this manual we will refer to them as WAKE, READ, SET TIME, START, PRINT,  $\sigma$  and  $\tau$ .

### Waking the logger, and General Status Report

To conserve battery power, the logger spends most of its time asleep, a concept which has already been explained on page 15. When the logger is asleep, the display is completely blank.

First ensure that the logger is asleep, then wake it by pressing WAKE. You will see the following sequence on the logger's LCD display:

The logger confirms the keypress:

```
<WAKE>
```

It starts displaying a General Status Report, with the remaining battery life and voltage:

```
Battery 8.5volts  
approx. 99% left
```

The current date and time are displayed:

```
date: 09-02  
time: 22:01:27
```

The current program name, DEFAULT appears. More about the DEFAULT program later in this lesson.

```
conf'n: DEFAULT
```

---

Ls2Win calls logging instructions "programs" whereas the Front Panel displays "conf'n" for "configuration". Both mean the same thing.

---

The next message, standing by, indicating that no data is currently stored in memory.

```
standing by
```

The following refer to the amount of available memory (RAM) and number of stored readings for each of TIMED and event triggered (TRIG/61 and TRIG/62) readings.



```
TIMED RAM: 32K
0 readings
```

```
TRIG/61 RAM: 0K
0 readings
```

```
TRIG/62 RAM: 0K
0 readings
```

## TIMED and Event triggered readings

TIMED readings are taken at regular intervals. Event triggered readings are taken when events are detected via on-board channels 61 and 62, and are designated as TRIG/61 and TRIG/62 data. The logger creates separate TIMED, TRIG/61 and TRIG/62 datasets, and allocates separate blocks of memory to each dataset. The total memory corresponds to the RAM chips installed in the logger. The illustrations here correspond to a logger that has no stored readings.

The logger provides malfunction reports, giving details of any malfunctions that have occurred during a previous logging session.

```
malfunction
report..
```

See also "Error Status" in Chapter 2 of the Hardware Reference.

## Keypad main menu

After the malfunction reports, the keypad main menu appears.

```
Press key if
required..
```

From the keypad main menu, any of the logger's 7 keypad functions can be selected, by pressing one of the seven keys.

The keypad functions are named after their respective keys, e.g. WAKE function, READ function.

For information about the General Status Report, see Chapter 2 of the Hardware Reference

If a key is not pressed within about 10 seconds after the keypad main menu has appeared, the logger automatically goes to sleep (autosleeps) and the display goes blank.

```
sleeping..
```

## Displaying the cold junction temperature

The cold junction thermistor is a temperature sensor mounted on the logger's terminal panel. In "Cold junction thermistor" on page 12, you have set switches to connect the thermistor to channel 1.

You can use the READ function to display the temperature of the logger's terminal panel on the logger's display.

Wake the logger by pressing WAKE while it is asleep, and wait for the keypad main menu to appear.

```
Press key if
required..
```

Before the logger goes back to sleep again, press READ. The keypress is briefly echoed on the display.

```
required..
<READ>
```

The logger displays a channel identification...

```
ch reading units
1 TM1 cold-jn
```

- 1 is the channel number.
  - TM1 is a sensor type code, which identifies the type of sensor connected to channel 1.
  - cold-jn is a label which describes the function of channel 1.
- ...followed by a temperature reading in degrees C.

```
ch reading units
1 22.87 deg C
```

To return to the keypad main menu, press READ again.

```
Press key if
required..
```

Repeat the steps above to display the cold junction temperature again. Now, instead of pressing READ to get back to the keypad main menu, allow the logger to autosleep - it takes longer than before.

When the logger is left in the middle of a keypad function, it autosleeps after one to two minutes of no keypad activity.

```
ch reading units
sleeping.. deg C
```

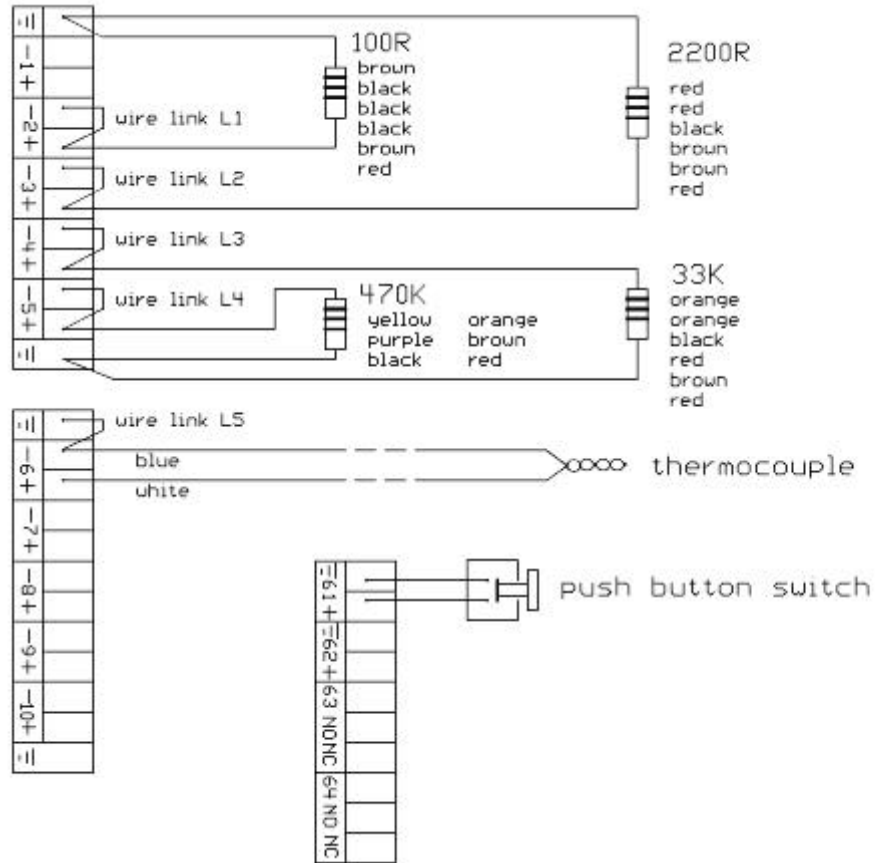
If you want to observe readings on a particular channel for longer than this period, press WAKE once every minute or so to prevent the logger from autosleeping.

### Connect sensors and push button switch to channels

Remove the terminal blocks for channels 1 to 5, 6 to 10 and 61 to 64 so that the screws are accessible. The blocks are removed by pulling them away. If you find a terminal block difficult to pull off, insert a screwdriver into the gap behind the block and gently prise it off.

Wire up the components supplied in the tutorial kit as follows:

Channel	Component
2	resistor 100Ω (100R)
3	resistor 2200Ω (2200R)
4	resistor 33kΩ (33K)
5	resistor 470kΩ (470K)
6	thermocouple
61	push button switch



**Figure 12 - Connections for tutorial kit components**

Fit wire links L1 to L5 as illustrated above. Resistor connections are 3-wire, and require that the channel's '+' and '-' input terminals are linked. These connections are not as you might expect them to be made, but are shown correctly above! See "Resistance, 3-wire" in the Hardware Reference for more information about 3-wire resistance connections. Ensure that the leads aren't forced out when you turn down the screw. Where more than one lead goes into a terminal, check both leads by pulling on them. Plug the terminal blocks back into the terminal panel.

### Displaying readings from other channels

The READ function may be used to display readings from the components that you have connected to the logger.

Follow the steps of the previous section to display a temperature reading on channel 1.

```

ch reading units
1 22.87 deg C
    
```

To display a reading on channel 2, press  $\tau$ . Channel 1 moves up to the top line and Channel 2 appears on the bottom line. The cursor (an underline symbol '\_') drops down to the bottom line.

```

1 22.87 deg C
2 RR1 Res/2mA
    
```

The sensor type code and label are replaced by the reading and units.

```

1 22.87 deg C
2 100.00 ohm
    
```

Note that the resistors supplied in the tutorial kit are accurate to  $\pm 1\%$ , so their displayed values may differ a little from the nominal.

Press  $\tau$  three more times to display the values of resistors connected to channels 3, 4 and 5.

```

2 100.00 ohm
3 2200.0 ohm
    
```

```

4 33.00 kohm
5 470.0 kohm
    
```

Press  $\tau$  again to display channel 6, the output of the thermocouple, which is a small voltage.

```

5 470.0 kohm
6 VLT voltage
    
```

```

5 470.0 kohm
6 0.032 mV
    
```

Hold the thermocouple between your fingers and watch the reading rise. Let it cool and watch the reading fall. 0.040 mV represents a temperature difference between the thermocouple tip and the cold junction of approximately 1 °C.

Press  $\tau$  again. The logger jumps to channel 61, a counter channel.

```

6 0.032 mV
61_CNT counter
    
```

```

6 0.032 mV
61 0 count
    
```

Press the push button switch connected to channel 61. Each time the switch is pressed, the number of counts increments by one.

```

6 0.032 mV
61 15 count
    
```

Note the cursor on channel 61, a '\_' symbol. Only one of the two lines of the logger's display is continuously updated, and the cursor marks the channel which is active, in this case channel 61.

Try warming the thermocouple between your fingertips now - you will see no change to the channel 6 reading. It remains as it was when you pressed the  $\tau$  key.

Now press  $\sigma$ . The cursor jumps to the top line, and channel 6 becomes the active channel. Try warming the thermocouple to confirm this. Press the push button switch and you will see no change to channel 61.

```

6 VLT voltage
15 count
    
```

```

6 0.477 mV
61 15 count
    
```

Try using the  $\sigma$  and  $\tau$  keys some more. You will find that channel 62 is an event trigger channel, and channels 63 and 64 are relay channels.

```

62 d-trigger CLR
63_WRM warm-up
    
```

When you make channel 63 or 64 the active channel, you should be able to hear the

relays switch between the ON and OFF states as they perform their test functions.

```
62 d-trigger CLR
63_relay OFF
```

```
62 d-trigger CLR
63_relay ON
```

Note that when you use  $\sigma$  or  $\tau$  to move onto another channel from a relay channel, the relay remains in the state (either ON or OFF) it held at the moment you pressed the key. You can use this feature to force the relay channel to be either ON or OFF for test purposes.

```
63 relay ON
64_OUT control
```

For more about Relay and Event trigger channels, see "Relay Channels" in Chapter 6 of the Hardware Reference and in the on-line Help.

## Fast scrolling between channels in the READ function

Hold down  $\sigma$  or  $\tau$  after displaying the temperature on channel 1. The logger scrolls rapidly through the channels without pausing to display a reading. You can stop on the channel you want to read by releasing the key.

When you have finished, press READ to return to the keypad main menu.

```
Press key if
required..
```

## Errors and malfunctions

If you have made an error in wiring the tutorial components to the terminal blocks, you will see an incorrect reading displayed. You may also see an error message such as

- o/s limits (outside limits)
- over range
- noisy

Check your wiring and repeat. See also *Error Status* in the DL2e Hardware Reference.

## The DL2e default program

The logger is dispatched with a DEFAULT program installed. This is the program to which it reverts when coldbooted.

The logging program defines which channels are in use, and what type of sensor is connected to each channel. In the DEFAULT program, only channels 1 to 6, and 61 to 64 are in use. That's why the logger skips from 6 to 61 in the procedure above. The functions of the channels are selected to be representative of the logger's capabilities:

Channel 1 - 2K thermistor  
 Channel 2 - resistance reading to 850 $\Omega$   
 Channel 3 - resistance reading to 10k $\Omega$   
 Channel 4 - resistance reading to 100k $\Omega$   
 Channel 5 - resistance reading to 1000k $\Omega$   
 Channel 6 - voltage (auto-ranging)  
 Channel 61 - counter  
 Channel 62 - data-trigger  
 Channel 63 - warmup relay  
 Channel 64 - control output relay

When you come to use the logger for your own applications, you will configure it to your own requirements, as described in lesson 3.

## Short cuts

### Interrupting the General Status Report

When the logger is woken up by pressing WAKE, it goes through a General Status Report, as described earlier. This report can be interrupted at any time by pressing any of the logger's keys.

For example, wake the logger, then press any key, e.g. READ before the General Status Report has finished. The keypad main menu appears.

```
Press key if
required..
```

### By-passing the keypad main menu

You can by pass both the General Status Report and the keypad main menu by pressing and holding down a key corresponding to the function you require, while the General Status Report is in progress.

Allow the logger to sleep and press WAKE. Press and hold down READ. The General Status Report is interrupted, the keypad main menu does not appear, and the logger starts displaying the first channel reading.

```
ch reading units
1 TM1 cold-jn
```

```
ch reading units
1 22.87 deg C
```

It is possible to by-pass the main menu only while the logger is going through the General Status Report. To go from one menu option to another (for example to move from the READ function to START logging) it is always necessary to return to the main menu.

## Logging

You now know how to display readings on the logger's display. To store (or log) data in the logger's memory, you need to start logging.

Wake the logger in the usual way so that the keypad main menu appears.

```
Press key if
required..
```

Press START. The keypress is echoed in the display.

```
required..
<START>
```

Press START again to confirm that you want to start logging.

```
<START> confirms
other keys abort
```

Logging starts.

```
other keys abort
logging started
```

After one to two seconds, the first readings are logged, and the message LOG appears briefly in the display, indicating that the logger is busy taking readings and storing them to memory. This brief period of logger activity is referred to as a LOG.

```
other keys abort
LOG ing started
```

The keypad main menu reappears, and then the logger sleeps as normal. The logger

does not need to be awake continuously in order to take readings.

```
Press key if
required..
```

In the DEFAULT program, the interval between readings is specified as 10s. You will see the logger waking at 10s intervals to perform a LOG. The default program also contains a warmup relay function for powering up sensors.

Once a minute you will see the message

```
WARM-UP
```

to indicate that the logger is switching on the warmup relay (channel 63 in the default program). You should hear the relay switch off after the next LOG 10s later.

## Using the logger's keypad while logging

The logger is now said to be in a logging state, or simply logging, even though it is only occupied in recording data during the brief periods when the LOG message is on display. In between, it autosleeps normally, and all the keypad functions are available. Press WAKE. You will see a General Status Report, but with the following changes:

```
Logging started:
16-01 17:55:02
```

The report shows the date and time when logging started, and the number of stored TIMED readings.

```
TIMED RAM: 32K
108 readings
```

You might also get malfunction reports. See Error Status in the DL2e Hardware Reference.

At the keypad main menu, press READ. You can display readings as before, with occasional interruptions as the logger displays the LOG message and stores readings to memory.

## Stopping logging

Allow logging to continue for a few minutes. To stop logging, wake the logger and press START at the keypad main menu (or press and hold down START to by-pass the General Status Report and menu).

```
<START>
```

The logger prompts you to press START again to confirm that you want to stop logging.

```
already logging
to STOP:
```

```
<START> confirms
other keys abort
```

Logging stops after confirmation and the keypad main menu reappears.

```
logging stopped
```

```
Press key if
required..
```

Press WAKE to obtain a General Status Report. Note that it now contains in addition a

message giving the date and time at which logging stopped:

```
logging stopped
16-01 18:06:42
```

For further information on starting and stopping logging, refer to Chapter 9 of the DL2e User Manual.



## Lesson 2 Retrieving logged data to PC

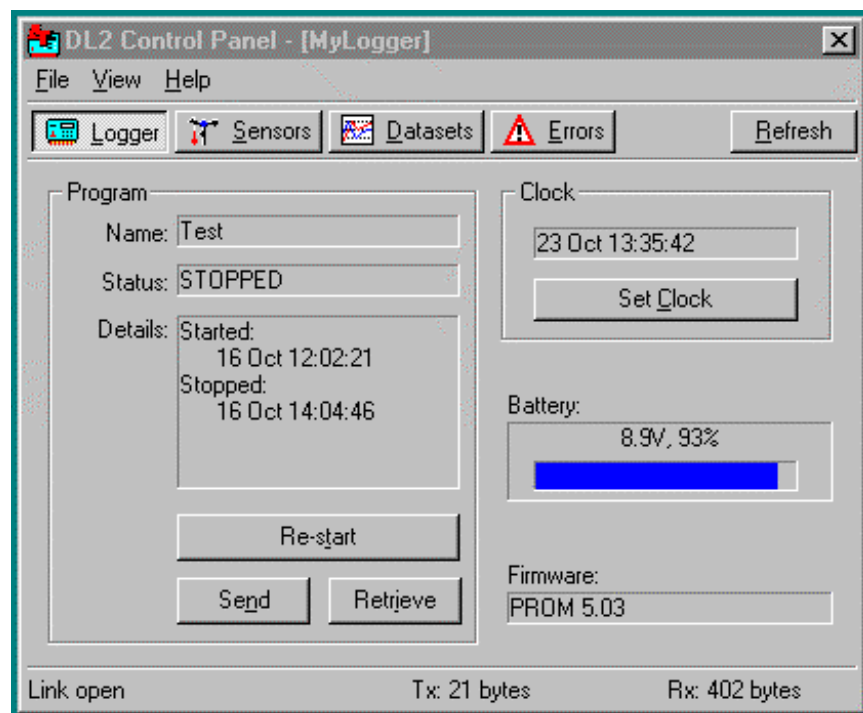
This part of the tutorial assumes that you have completed Lesson 1 successfully.

In this lesson you will learn how to use the Ls2Win program called **DL2 Control Panel** to:

- display information about the logger and its datasets
- display sensor readings in real-time
- retrieve logged data from the logger to a PC disk file
- display the data on your PC screen.

### DL2 Control Panel

Open the DL2 Control Panel by clicking on the MyLogger icon on your desktop or follow the instructions Create a new DL2 Control Panel on page 18.



Inspect the DL2 Control Panel.

There are four panels of information: you switch between them by clicking the Logger, Sensors, Datasets and Errors buttons. The current panel – Logger – shows general information about the state of the logger.

### Logger Panel : Inspect the Logger Status & Start Logging

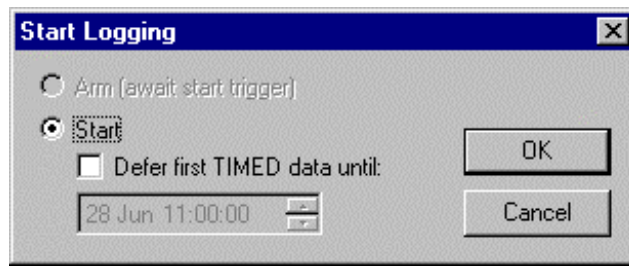
Program **Name** is the name of the logging program currently stored in the DL2.

Program **Status** can be:-

- **Standing By** – not logging, no logged data
- **Armed** – awaiting a start trigger, but NOT awaiting first TIMED data
- **Logging** – actively recording data (or awaiting first TIMED data)
- **Stopped** – not logging, logged data exists.

**Start** offers three options for starting the logging program.

Click on Start in the Logger panel to display the following Start Logging dialog:



**Figure 13 Start Logging dialog**

**Start** - starts logging immediately.

**Defer first TIMED data** - logging starts at the date and time selected.

**Arm** - activates a **Start Trigger** channel. Logging then starts when a signal is detected on the Start Trigger channel, which may be channel(s) 61 and/or 62.

In this example the Arm option is greyed-out signifying it is not available - because the current program does not have a Start Trigger channel defined.

Select **Start** and click **OK**.

The logger will start logging immediately with an audible click, as the logger switches a warmup relay.

If you listen you will hear a warmup relay on the logger click on every minute, and click off 10 seconds later.

The program status on the Logger panel of the Control Panel is now updated as shown below.



**Figure 14 Status Details updated after logging starts**

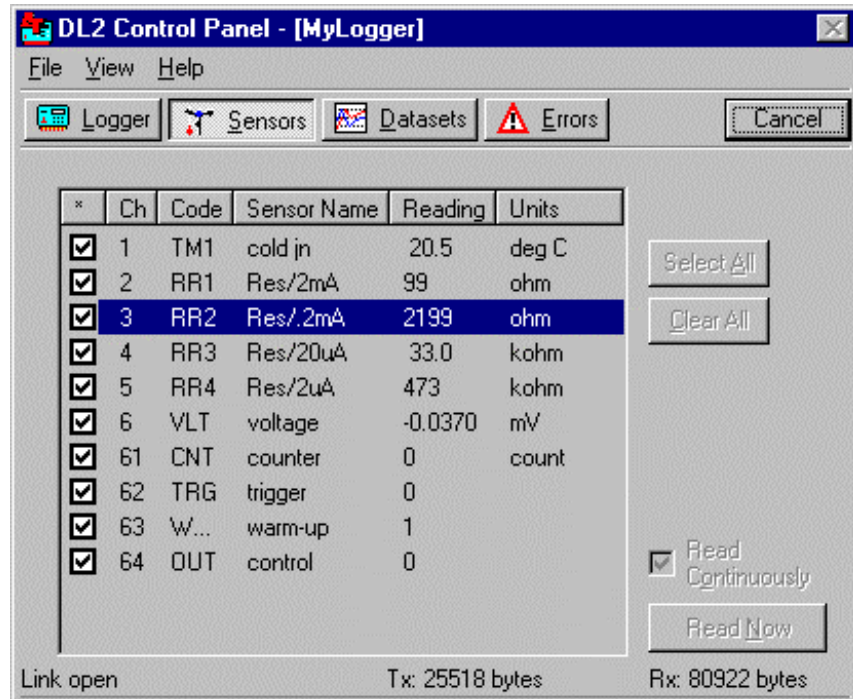
Your logger is now recording readings.

We shall inspect the rest of the DL2 Control Panel.

## Sensors Panel: Watch the sensor readings

Click on the Sensors button.

Enable **Read Continuously** and click **Select All** and **Read Now**:



**Figure 15 Sensors Panel showing real time readings from the Tutorial Kit sensors using the DEFAULT logging program.**

The display shows the sensors being read continuously.

You can see this whether or not the logger is logging.

This is useful for inspecting sensors before logging starts.

Note 1: The presence of readings does not guarantee you have a sensor connected! To demonstrate this pull out the sensor connector plug for sensor 1 to 5. Some values will go out of range and indicate an error such as outside range or noisy. Some may float within the permitted signal range or indicate and give a false reading.

When installing or auditing sensors you should also check that the reading is physically reasonable. If in doubt then independently check both the sensor and the channel.

Note 2: Counter channel real-time display only appears to work when logging.

If the logger is logging, the counter channel shows the accumulated count without affecting logged data.

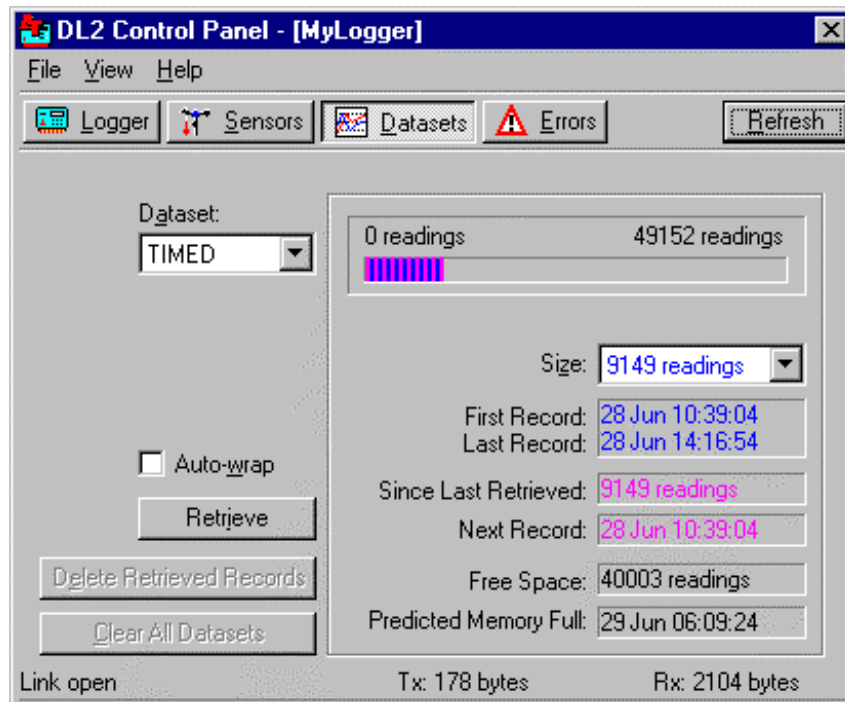
If the logger is not logging, the count is reset to zero before the accumulated value in the counter is read.

This means you see a zero, if not logging. (If you are super-fast pressing the button on channel 61 you might see a '1').

This behaviour when not logging, is a limitation of the design.

## Datasets panel: Retrieve the dataset

Click **Datasets** and then **Refresh**:



**Figure 16 Datasets tab of the Control Panel, displays information about readings stored in the DL2.**

The Datasets panel displays information about readings stored in the logger. Inspect the dialog, most of the indicated values should be self-explanatory.

**Dataset** A logging program can generate up to three datasets: the TIMED dataset contains data recorded at regular recording intervals, and TRIG/61 and TRG/62 datasets which contain data recorded on detection of events on digital input channels 61 and 62 respectively.

**Auto-wrap** If selected, when memory is full, the most recent data overwrites the oldest readings. The most recent data are retained, the oldest data are overwritten by new data. This option is only available for the TIMED dataset.

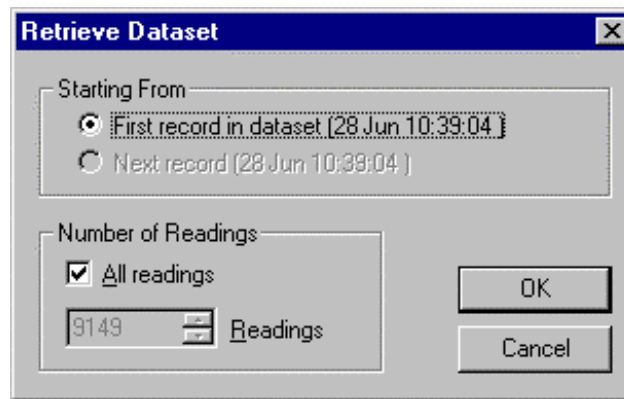
**Retrieve** Retrieves the selected dataset to a PC disk file.

**Delete Retrieved Records** Deletes the most recently retrieved dataset records from the logger's memory. This option is only available for the TIMED dataset. For TRIG/61 and TRIG/62 datasets, the alternative command is **Delete All Records**, which deletes the entire contents of the selected dataset from the logger's memory.

**Clear All Datasets** Deletes the contents of all datasets from the logger's memory. This command is only enabled when the logger is not logging.

**Size** Determines how used and available memory is displayed from a large drop down list of options.

Click **Retrieve** to retrieve the selected dataset to a PC disk file..

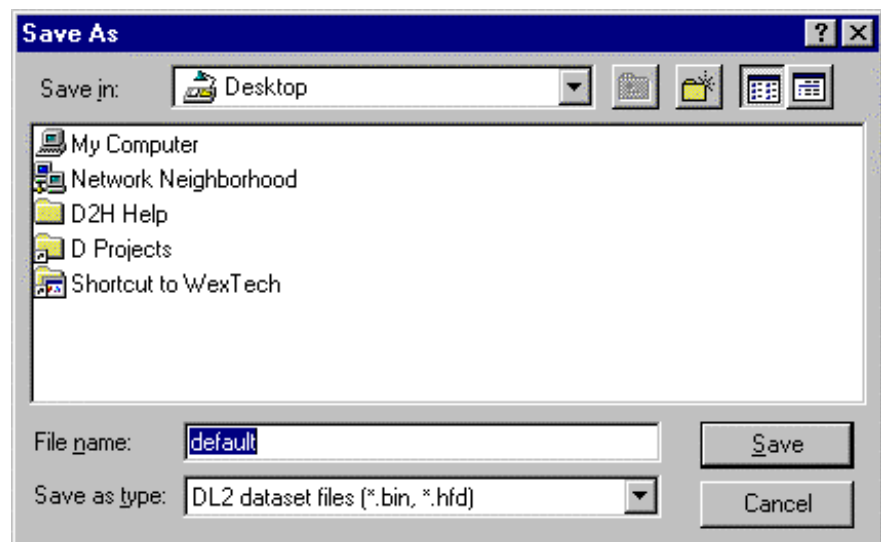


**Figure 17 The Retrieve Dataset dialog choices permit some or all of the stored readings to be retrieved.**

Click **OK** to retrieve all of the readings in the dataset.

A **Save As** dialog appears. Select a suitable directory and enter a file name.

NB: the current version offers the installation directory as the default **Save As** location.



Click **Save** to copy the dataset to file on your PC.

The default file format saved is binary format (with .bin after the file name).

This is recommended because it is quickest.

The dataset is automatically displayed in the **Dataset Viewer**.

## Dataset Viewer

This is a separate program that automatically opens on your desktop when you retrieve a dataset via the DL2 Control Panel.

This shows readings every 10 seconds.

The screenshot shows a window titled "default.bin - DL2 Dataset Viewer" with a menu bar (File, View, Help) and a table of data. The table has 8 columns: Channel, Label, Sensor Type, Units, and five unlabeled columns with units in the header row. The data rows show timestamps from 2024 Oct 21:01:02 to 2024 Oct 21:02:02. The status bar at the bottom shows "Ready" and a "NUM" button.

Channel	61	1	2	3	4	5	€ ▲
Label	counter	cold in	Res/2mA	Res/.2mA	Res/20uA	Res/2uA	voltage
Sensor Type	CNT	TM1	RR1	RR2	RR3	RR4	VLT
Units	count	deg C	ohm	ohm	kohm	kohm	mV
24 Oct 21:01:02	0.000000	24.180000	99.776000	196.480000	33.024000	472.832000	0.003000
24 Oct 21:01:12	0.000000	24.220000	99.776000	196.480000	33.024000	472.832000	0.003000
24 Oct 21:01:22	0.000000	24.220000	99.808000	196.480000	33.024000	472.832000	0.003000
24 Oct 21:01:32	12.000000	24.220000	99.776000	196.480000	33.024000	472.832000	0.003000
24 Oct 21:01:42	15.000000	24.220000	99.808000	196.480000	33.024000	472.832000	0.002000
24 Oct 21:01:52	0.000000	24.220000	99.808000	196.480000	33.024000	472.832000	0.002000
24 Oct 21:02:02	0.000000	24.220000	99.808000	196.480000	33.024000	472.832000	0.002000

Figure 18 Dataset retrieved from the logger to file and also displayed as a table. The binary format dataset is displayed in the Dataset Viewer.

The Dataset Viewer is also available as an icon on your desktop.

The Dataset Viewer offers the following commands:

**Open** command (File menu) opens and displays a DL2e dataset file.

**Save As** command (File menu) saves the dataset which is currently open in the dataset viewer as a .dat format file - a comma separated ASCII format, which is compatible with most data processing applications.

**Date Format..** command (View menu) allows you to select the Day/Month order for interpreting ambiguous .dat file timestamps.

## About file formats

You can retrieve data from the logger using a binary or hexadecimal protocol by selecting .bin or .hfd (respectively) as the file name suffix in the Save As dialog. The default is the binary protocol, which is faster and perfectly reliable in most situations. The hexadecimal protocol performs frequent integrity checks during transmission, and may be used in situations where reliability is an issue, but is considerably slower. The resulting .bin and .hfd dataset files contain data in a proprietary format, which cannot be used directly by other programs.

The Dataset Viewer provides a Save As command (File menu), which saves datasets as .dat format files - this is a comma separated ASCII format, which is readily interpreted by most data processing programs. You can also use Dataset Import Wizard to directly import .bin and .hfd files into Microsoft® Excel®.

## Lesson 3 Program the DL2e Logger

Up to now you have been using the logger's default logging program, which the logger installs when it is coldbooted. The program is named 'DEFAULT'.

For real logging applications you need your own program.

In this tutorial you learn how to use the **DL2 Program Editor** to produce your own logging program, and run it.

A logging program specifies some or all of the following:

- what sensor types will be connected to each of the logger's channels,
- how frequently readings are to be logged from each channel,
- what type of units the raw readings are converted to,
- when or how logging should start,
- what happens when memory is full,
- how long a sensor receives power before taking a reading.

In this lesson we

- retrieve a copy of the default logging program from the DL2e,
- inspect it using the DL2 Program Editor,
- visit the Program Editor's Sensor Library for a quick look round,
- modify channel 6 of the program to display temperature,
- save the modified program with a new name to a PC file,
- send the new program back to the logger to replace the default program.

At the end of this lesson, you will repeat the steps of Lesson 2, that is:

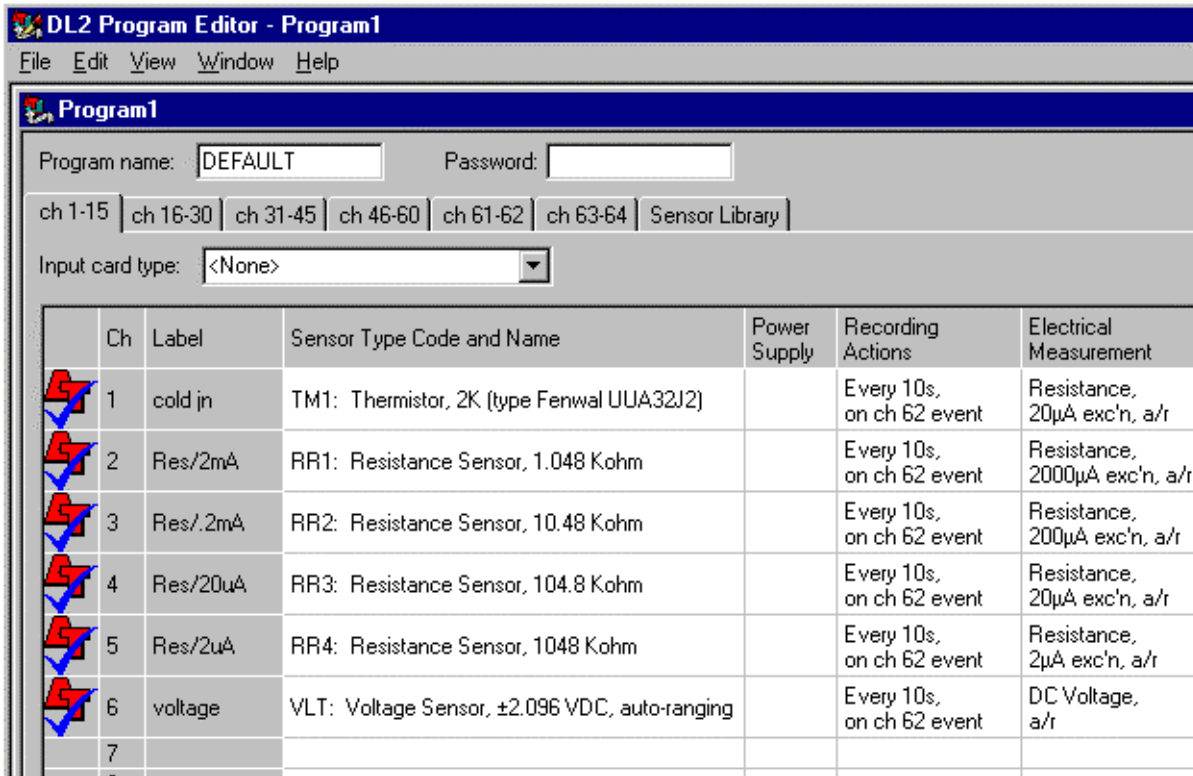
- check the readings, live,
- start logging,
- retrieve logged data into a table.

On completing Tutorial 3, you will be proficient at programming and running simple logging programs.

## The DL2 Program Editor

Following on from the last lesson, select the **Logger** panel in the **DL2 Control Panel** and Click **Retrieve**.

The program will appear, laid out as tables in a row of tab sheets, in the DL2 Program Editor.

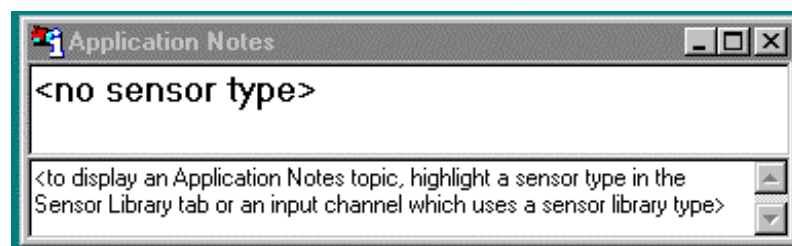


**Figure 19** A copy of the default logging program in the DL2 is retrieved and displayed in the Program Editor.

You now have both the DL2 Program Editor and the DL2 Control Panel open on your PC.

The DEFAULT logging program is open in DL2 Program Editor.

In addition an Application Notes box will open:



**Figure 20** Applications notes will display here on selecting a sensor type in the sensor library, or an input channel which uses a sensor type defined in the sensor library.

To see the usefulness of the Applications Notes click on various sensor types in the Sensor Library tab. Many contain useful wiring instructions and other advice.

Examine the channel 1-15 tab as shown in **Error! Reference source not found.**

The rows represent channels in the logger and show how each channel is programmed.

**Channels 1-60** may be programmed to read sensors attached to terminals 1-60 (if you have enough input cards of the right type installed).



**Channels 61 & 62** read digital signals and do not need an input card. These can be used as digital inputs in the normal way, or they can be programmed to trigger the start of logging, or recording of data when they detect an input signal.

**Channels 63 & 64** are relay channels, which can be used to apply power to sensors as required (for power saving), or as control or malfunction warning outputs.

The **DEFAULT** program shows the following:

- Channel 1 takes readings from the logger's internal cold junction thermistor.
- Channels 2-5 measure resistance in a variety of different ranges.
- Channel 6 measures voltage.
- Channel 61 is a counter channel.
- Channel 62 is a trigger channel. All sensors are read both every 10 seconds and also whenever channel 62 detects a signal it triggers a reading.
- Channel 63 is a Warmup channel, set up for applying power to sensors for 10s in advance of readings taken once a minute – this is provided as a test facility only; it serves no useful purpose in the program, as each channel is read and recorded every 10s.
- Channel 64 is an output relay, controlled by channel 6.

**Input Card Type** is initially set to <unknown>. Before making changes, you will need to inform the DL2 Program Editor what type of input card is installed for each channel group. This will allow the DL2 Program Editor to ensure that you only select suitable sensor types for each channel.

The default logging program used for this tutorial needs a LAC1 card configured for 15 channels in channel numbers 1-15. Later, before we edit the program we will select the right Input card type from drop down list in the **Logger panel**.

Inspect the column headings.

Click on the various tabs in the DL2 Program Editor and have a look round.

Note that only channels 1-6 and 61-64 have been programmed.

Note the Sensor Library tab. It shows all the sensor types in your sensor library.

Code	Sensor Type Name	Electrical Measurement	Engineering Units	Measurement Range	Linearisation Table >>	(1)
AN1	Anemometer (type AN1)	Frequency, min sample rate 10m, 5s	m.s-1 = Hz / 0.8000	0.000000 to 100.0000 m.s-1		
A3A	Anemometer, high resolution (type AN3)	DC Voltage (Single-ended), a/r, 5s warmup	m.s-1 = mV / 32.383	-0.0999907 to 64.74508 m.s-1		
BS4	Barometric Pressure Sensor (types BS4, BS4/N)	DC Voltage (Single-ended), a/r, 1s warmup	hPa, using table 'BS4' table	600.3200 to 1060.480 hPa	hPa mV	600.00 0.000000
BSA	Barometric Pressure Sensor, high altitude (types BS3A, BS3A/N)	DC Voltage (Differential), a/r	hPa, using table 'BSA' table	600.0000 to 1060.000 hPa	hPa mV	600.00 0.000000
BS3	Barometric Pressure Sensor, low altitude (types BS3, BS3/N)	DC Voltage (Differential), a/r	hPa, using table 'BS3' table	800.0000 to 1060.000 hPa	hPa mV	800.00 0.000000
DGT	Digital Status Sensor	Logic Level	status = logic / 1.0000	0.000000 to 1.000000 status		
GS1	Dome Solarimeter (types GS1, GS2)	DC Voltage (Single-ended), a/r	kW.m-2 = mV / 35.000	-0.100000 to 1.499429 kW.m-2		

**Figure 21** Sensor Library tab in the Program Editor



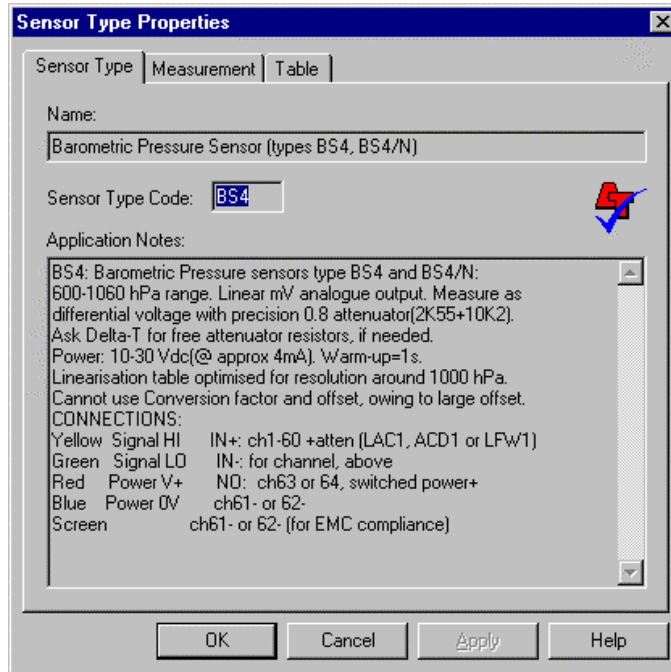
Library sensor types defined and approved by Delta-T are indicated by a check symbol.

A single click on any row displays Applications Notes in a separate window. You can find wiring instructions here where appropriate.

Double clicking on a sensor type in the Sensor Library tab pops up the **Sensor Type Properties** dialog, which contains a collection of tab sheets.

These are used when:

- Copying and modifying an existing sensor type in the library
- Creating a new sensor type in the library.



**Figure 22** Sensor Type properties include detailed applications notes on each sensor, including wiring instructions

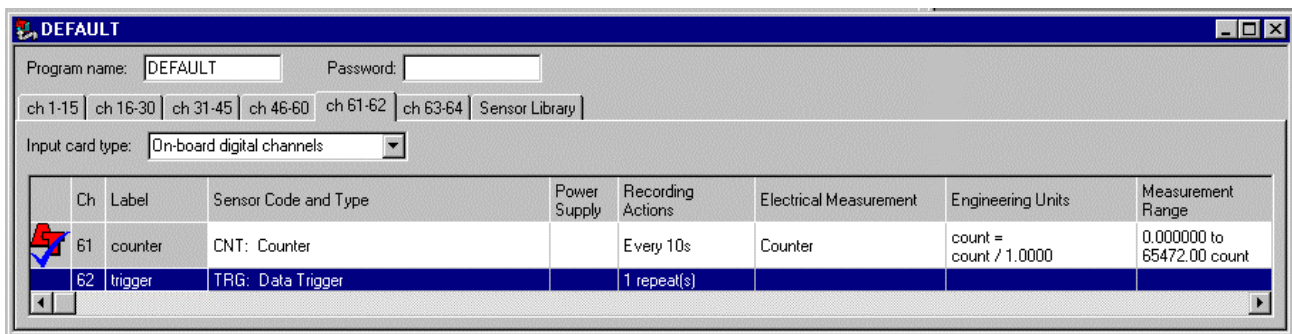
## Modifying the program

Select the **ch 1-15** tab

Note that the column - **Recording Actions** :

It indicates that each of sensors 1 - 6 is recorded every 10 s AND should channel 62 indicate an event then data will also be logged.

Select the **ch 61-62** tab.



**Figure 23** Showing the logging program for channels 61 and 62.

We do not need channel 62 configured as a Data Trigger.  
Highlight Channel 62 and Click Delete (on your keyboard ).

We also do not need channel 64 as a Warmup channel.  
Highlight channel 64 and delete that also.

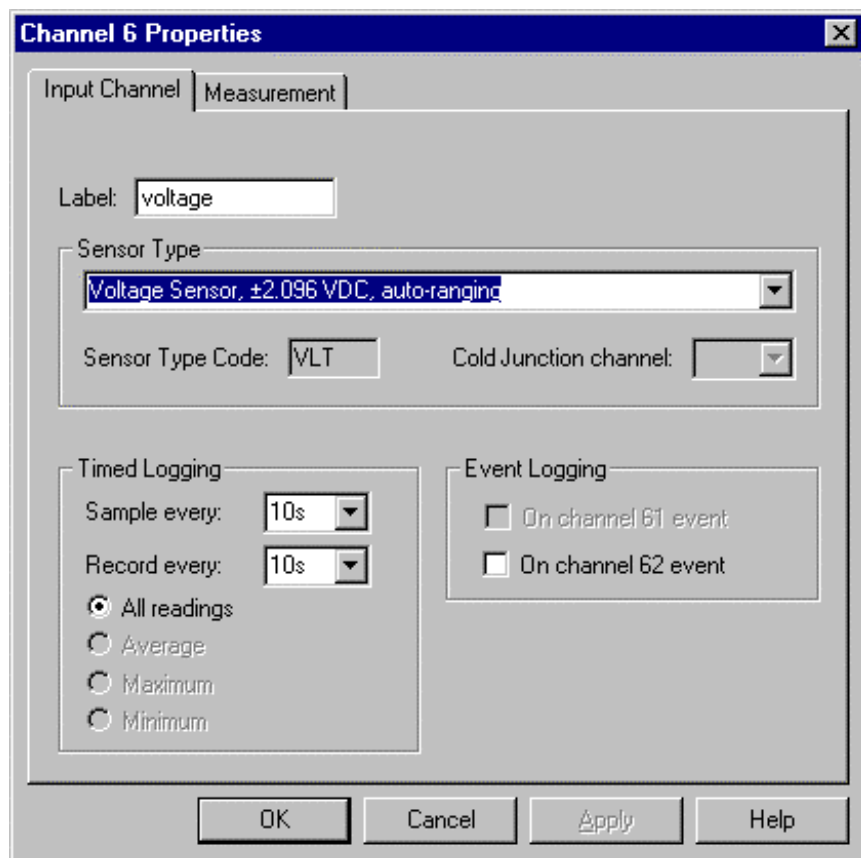
Return to the **ch 1-15 tab** and highlight channel 6.  
Note that entries in the Recording Actions column has changed  
We are going to modify channel 6 to read temperature.

Recording Actions
Every 10s

The sensor with the blue and white cable is a copper/constantan thermocouple.  
Channel 6 is currently reading the thermocouple output in mV.

The appropriate sensor type code for it is a Thermocouple, Copper/Constantan (type T).  
If we program channel 6 with this sensor type it will take the raw mV reading and look up the equivalent temperature from a look-up table, using the on-board cold junction thermistor on channel 1 as a cold junction reference.

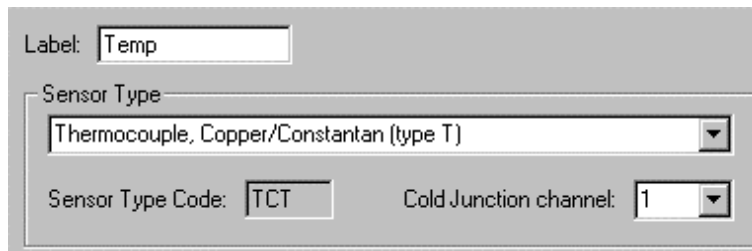
You can read the details in the Sensor Library tab, but what we are going to do is -  
double click on channel 6 in the Ch 1-15 tab to open the Channel 6 Properties dialog.



**Figure 24 Channel 6 Properties dialog is the default logging program prior to us selecting a different Sensor Type.**

From the **Sensor Type** drop down list on the Input Channel tab, select **Thermocouple: Copper/Constantan (type T)**.

Type in a new label or up to 8 characters, such as 'Temp'.



**Figure 25 Changes to the Input Channel tab of the Channel 6 Properties dialog**

Select channel 1 for the **Cold Junction channel**. (All thermocouples need a cold junction reference sensor. The DL2e's built-in cold junction thermistor connected to channel 1 is conveniently used for this job).

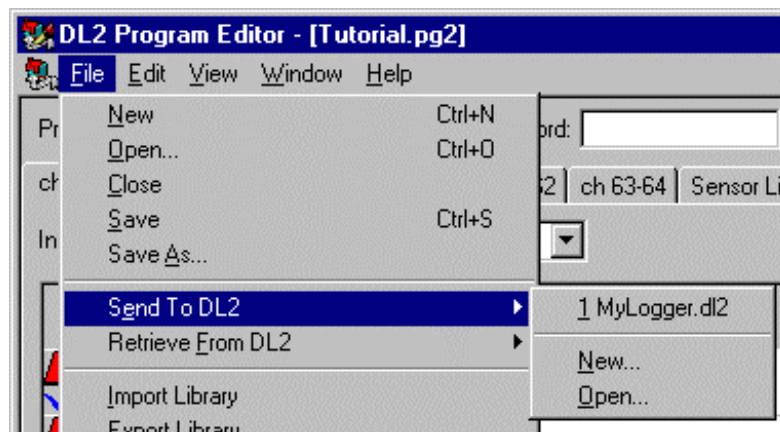
Click **OK** and inspect Channel 6.

It is now configured to read type T copper/constantan thermocouples.

Enter a unique **Program name** of up to 8 characters in the Program Name window. Save your new logging program to file with a unique **File name**.

Note: Program name and File name are different entities.  
 The Program name only appears in the program. It is visible when you interrogate a logger.  
 The File name only appears when loading and saving the program to file.  
 The Program name and default File name will become different if you change the Program name from the default offered, i.e. Prog1 , Prog2...etc.

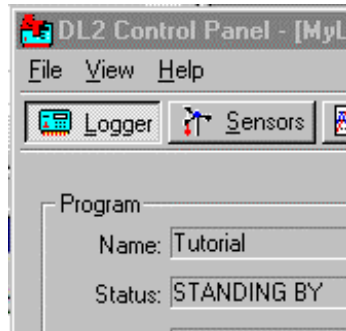
In the DL2 Program Editor select **File, Send to DL2**.  
 A choice of DL2 Control Panels will appear in the sub menu.  
 Select the name of your current DL2 Control Panels, such as MyLogger



**Figure 26 Selecting the logger to which you want to send your current program, using the Program Editor.**

Your chosen DL2 Control Panel should then automatically open and the logging program automatically sent to it.

The new **Program Name** should then appear on the **Logger panel**



**Figure 27** Showing the new program "Tutorial" now loaded in the logger

Select the **Sensors** tab and check your thermocouple readings are reasonable, that is, the units are deg C and fairly close to the cold junction thermistor on channel 1.

Select the **Datasets** panel and check to see if you have any readings stored. Select **Delete All Records** if you have readings stored.

The rest of this section is to repeat parts of Tutorial 2.

From the **Logger panel**, **Start** logging, let it run for a few minutes then **Stop** logging.

**Retrieve** the data from the **Datasets** panel.

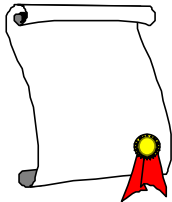
Well done, you have completed the Lesson 3!

To recap:

You created your own logging program, by modifying an existing one.

You used the Sensor Library.

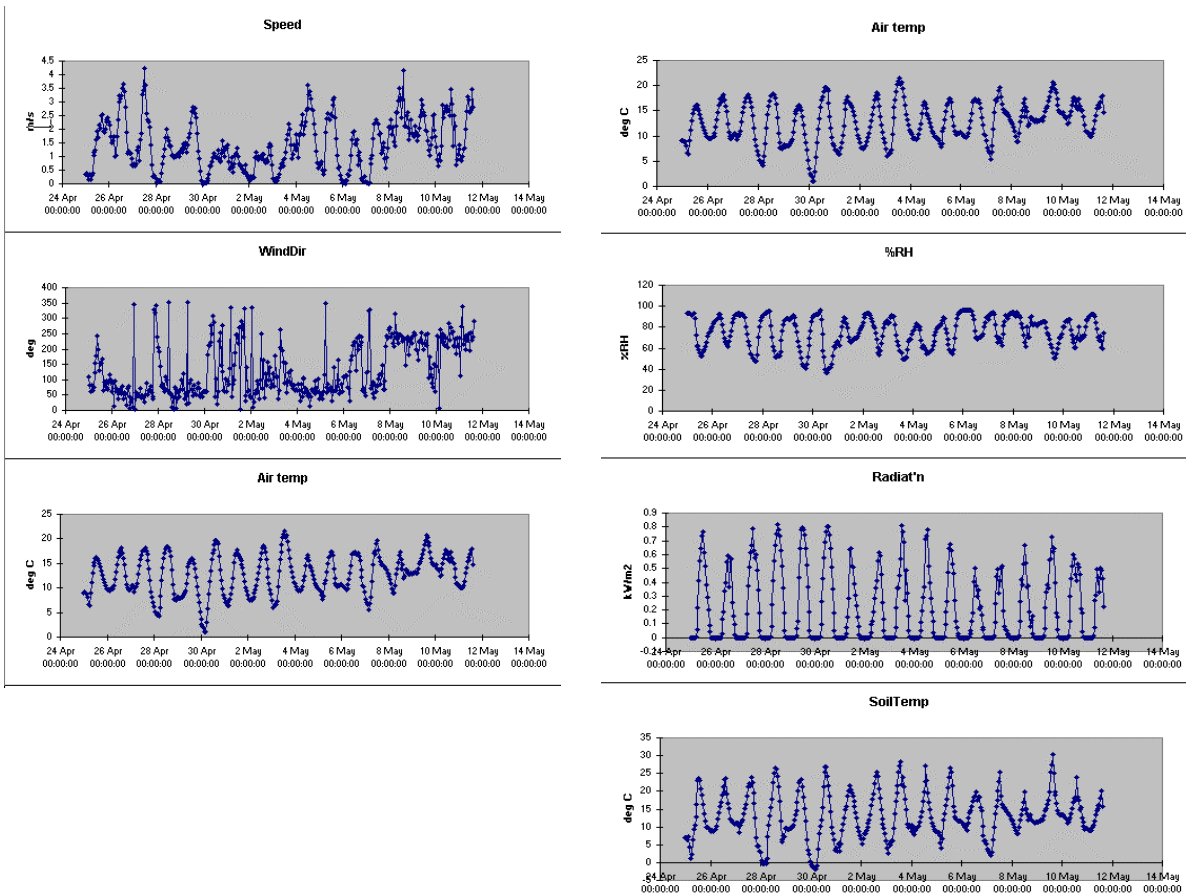
You logged and retrieved data.



# Lesson 4 Graph your Data

To proceed with this lesson, you need an installation of Microsoft Excel 97 (or later). In this lesson we graph some sample data previously obtained from a DL2e connected to a set of Delta-T Weather Station sensors.

To do this we will use the **Dataset Import Wizard**. The end result looks something like this:



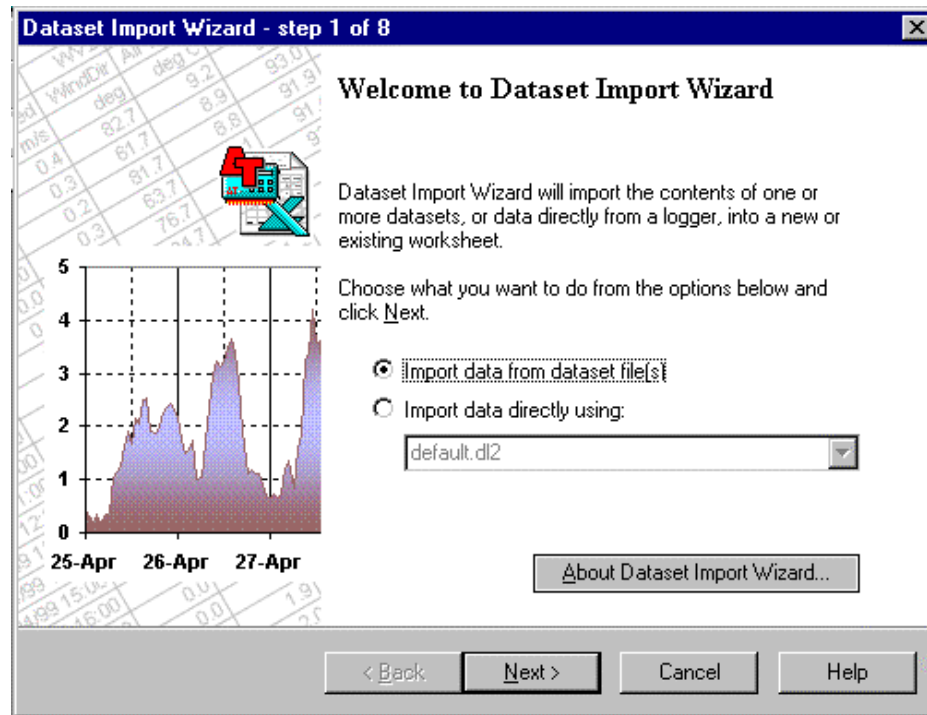
**Figure 28** Graphs produced by Dataset Import Wizard using a sample data file **WstnData.dat** installed in your Samples sub-folder.

The Dataset Import Wizard is also useful for importing and appending data to existing data sheets.

When you first run the Dataset Import Wizard it searches your PC for Microsoft Excel 97 (or later versions) and installs itself as an option in the Excel File menu, called **Import Dataset(s) ...**

- Run the Dataset Import Wizard. The wizard then takes you through the following 8 pages of options.

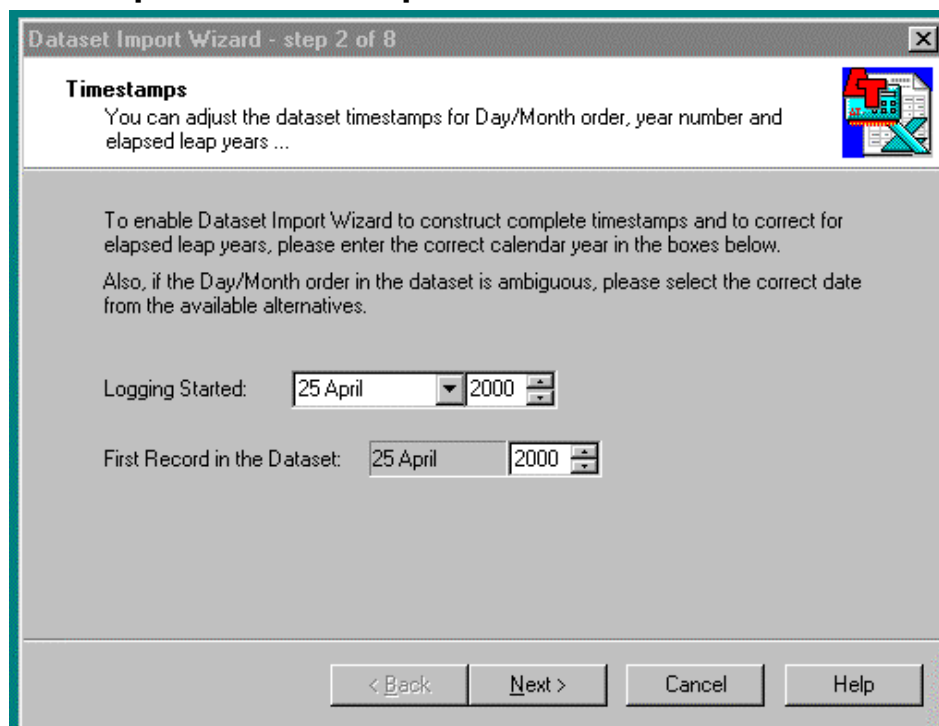
## Dataset Import Wizard Step 1



Notice that you can choose to load data directly from your logger. Accept the default option "**Import data from dataset file(s)**" and Click **Next** to display a file **Open** dialog.

- Select WStation.dat in the Samples\Wstation directory under your Ls2Win installation directory.

## Dataset Import Wizard Step 2

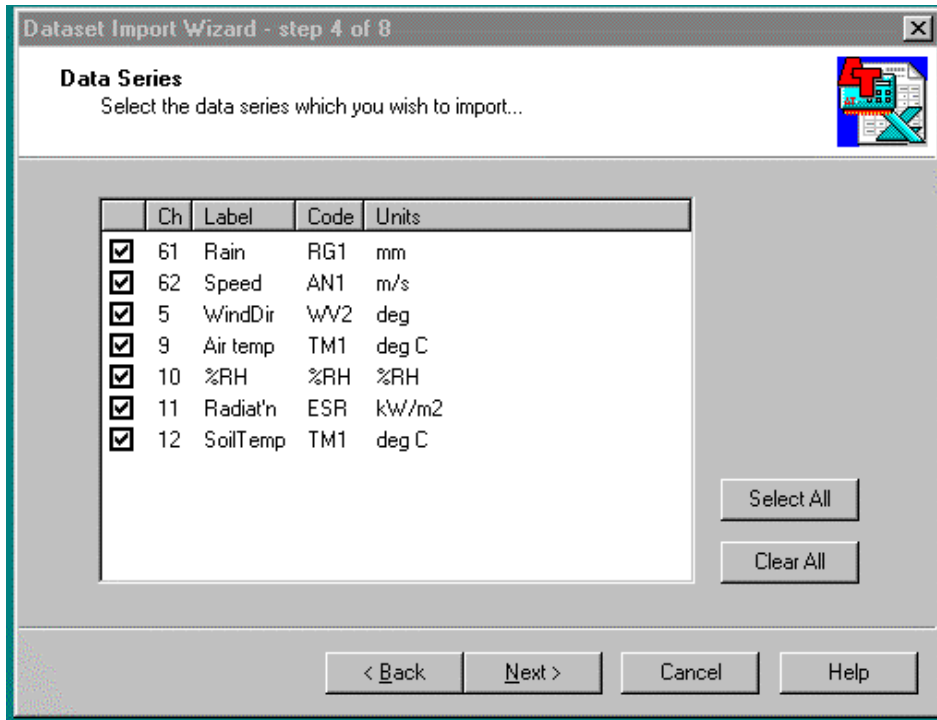


Step 2 is useful for dates because the DL2e does not know about years or leap years. We don't care, so Click **Next**.

### Dataset Import Wizard Step 3

This should show a progress bar as the data loads and immediately move onto the next step.

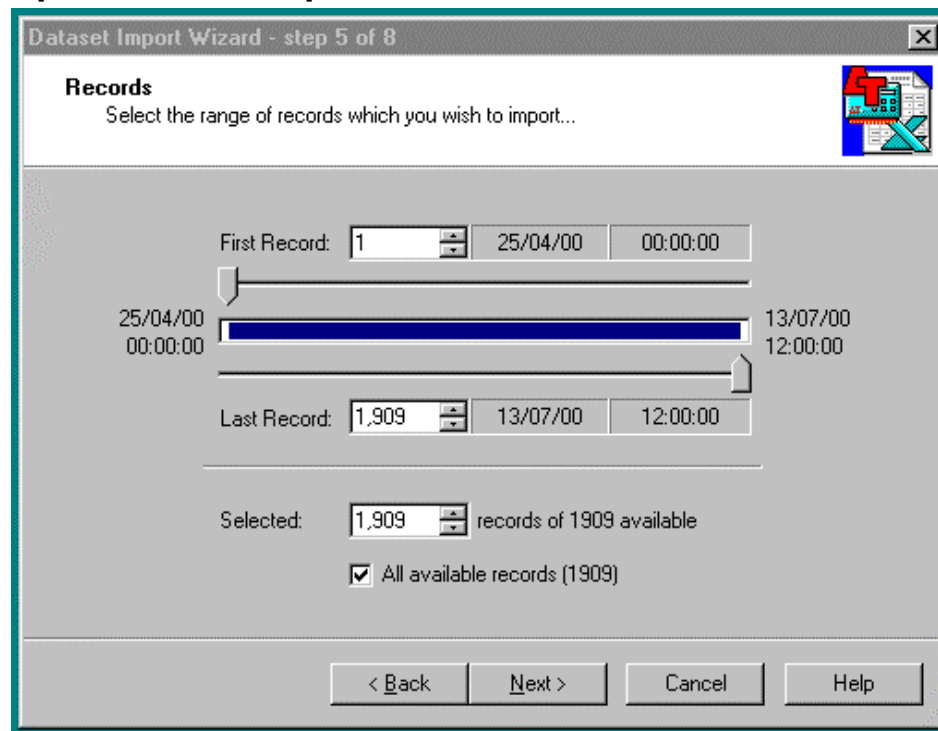
### Dataset Import Wizard Step 4



Note the ticks, indicating all sensors are selected, and click **Next**.

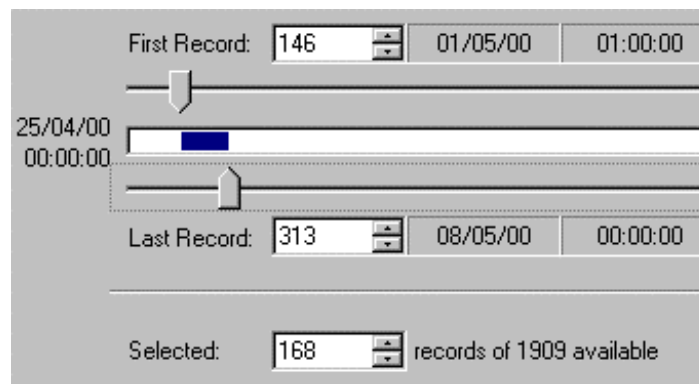


## Dataset Import Wizard Step 5



We could carry on to the end now just pressing **Next** and still get graphs, but if you plot too many days of data together the individual daily variations cannot be seen.

So, try to select exactly 7 days of readings, starting and stopping at midnight.

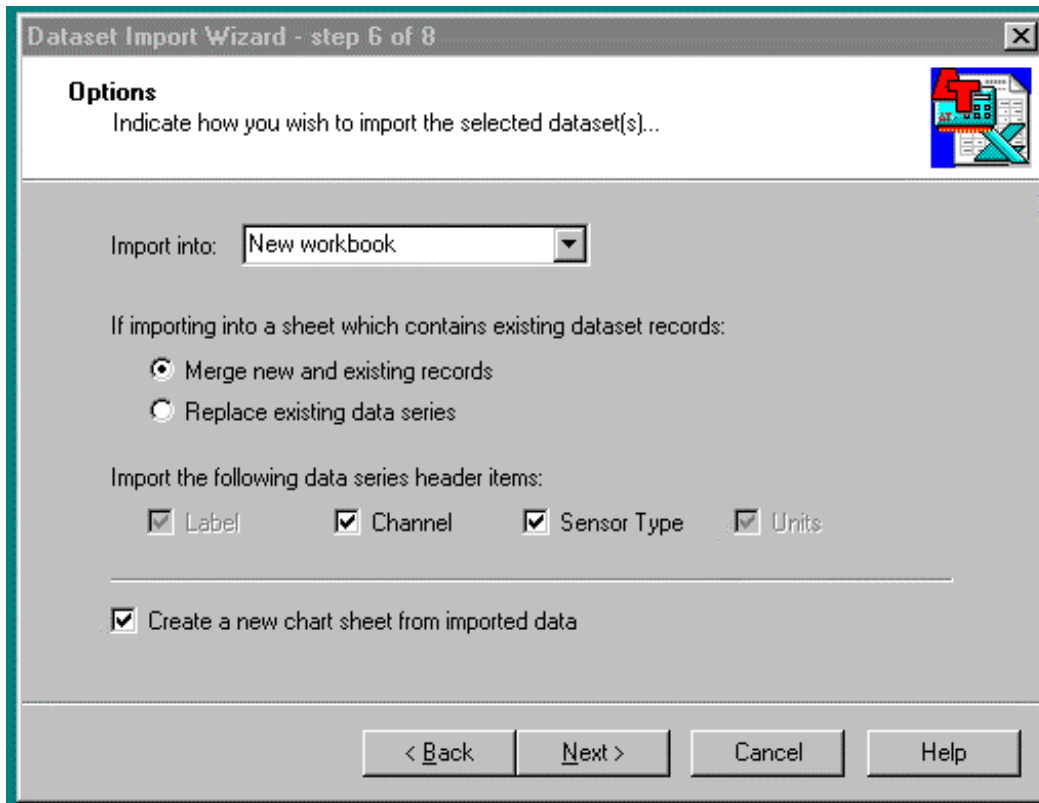


Click on the upper or lower slider and drag them with your mouse to change the date and time of the First Record and Last Record .

For fine control use the keyboard left and right arrow keys.

Alternatively click on the up and down arrows of the spin controls.

## Dataset Import Wizard Step 6



Select the default options and click **Next**.

Another progress bar takes you through to the Step 8 where you click **Finish**.

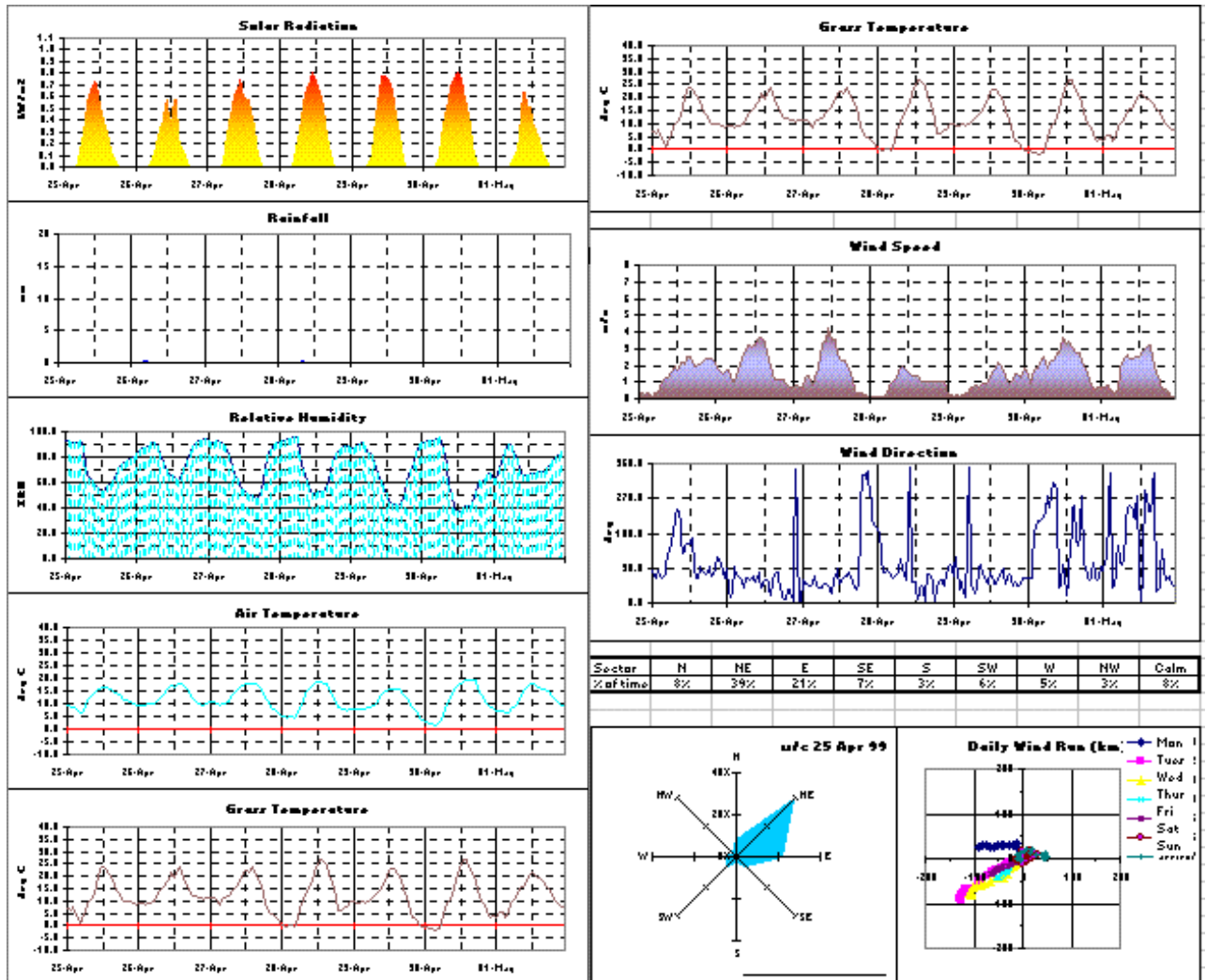
The data should now appear tabulated and graphed in Excel as shown below and at the start of the lesson.:

	A	B	C	D	E	F	G	H
1	Label	Rain	Speed	WindDir	Air temp	%RH	Radiat'n	SoilTemp
2	Channel	61	62	5	9	10	11	12
3	Sensor Type	RG1	AN1	WW2	TM1	%RH	ESR	TM1
4	Units	mm	m/s	deg	deg C	%RH	kW/m2	deg C
5	25 Apr 00:00:00	0	0.3281	110.4	8.99	93.5	0.00009	7.01
6	25 Apr 01:00:00	0	0.3996	82.7	9.18	93.31	0.00009	6.85
7	25 Apr 02:00:00	0	0.2965	61.67	8.91	92.99	0	6.32
8	25 Apr 03:00:00	0	0.173	81.7	8.79	91.9	0	7.31
9	25 Apr 04:00:00	0	0.3372	63.7	8.11	91.39	0.00009	7.44

## More Wizard Features!

- We have seen the Wizard can do simple graphs.
- It can import and append or overwrite data directly from the logger or from file.
- It can do more!
- Once your data is up and graphed you can customise your graphs and reuse them!
- You can append data to your existing graphs
- You can also replace data.

For example, we have created an Excel spreadsheet of weather data containing some fancy graphs, as shown below .



**Figure 29** Weather station data as displayed by file WStation.xls opened in Excel

Load WStation.xls into Excel from the Samples sub-folder of Ls2Win.

It looks even nicer in colour.

You can do the same or similar with any simple graphs you create with the Wizard.

Once modified you can reuse the spreadsheet and append or replace the data with the Wizard.

## Wizard Graphing Tips

Each set of graphs in WStation.xls represents one week of data, so the best way to use these graphs is to **replace** the existing data set with another week's worth of data.

The simple graphs created by the Wizard occupy the first column only of the spreadsheet.

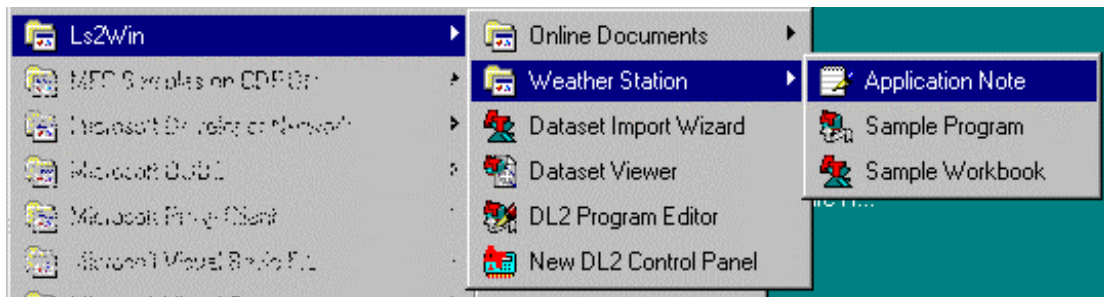
This means you can resize or stretch all the graphs in a synchronised way by dragging the column and row resize icons.

To see the other cells in the spreadsheet, select **Format, Row, Unhide** and **Format, Column, Unhide**.

## See also the Weather Station Application Note

For a more detailed exercise on using the Dataset Import Wizard, see the Weather Station Application Note installed on your PC along with Ls2Win.

From the Start menu select Programs\Ls2Win\Weather Station\Application Note.



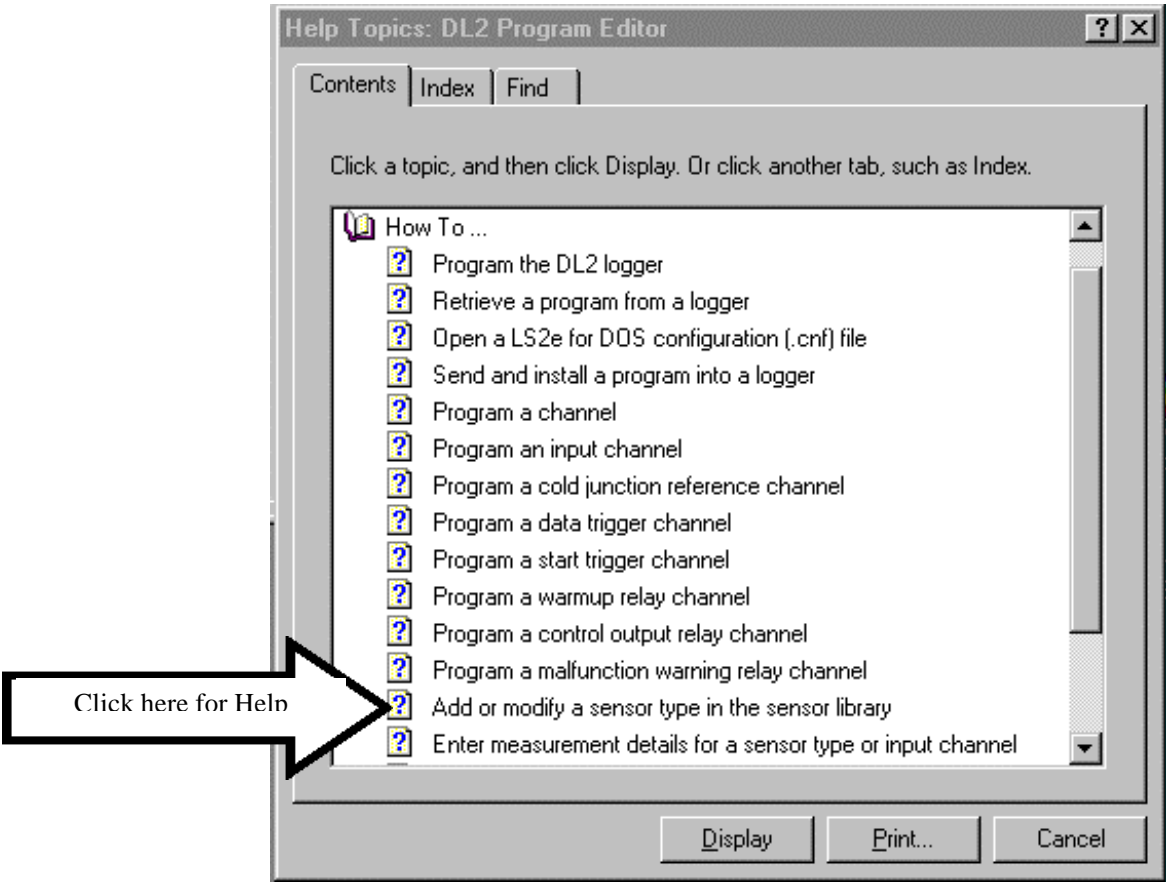
# What else you need to know about the DL2e Logger

The preceding tutorials covered the main techniques for using the logger. There are several important topics the tutorial did not cover. These topics can be found in the online Help supplied with Ls2Win and in the online DL2e Hardware Reference – from the Start menu select Programs, Ls2Win, Online Documents, DL2e Hardware Reference.

## Creating new sensor types

To create a new sensor type run the DL2 Program Editor. Select the Sensor Library tab and select **New Sensor Type...** command (Edit menu). This pops up the **Sensor Type Properties** dialog containing a copy of the sensor type which was highlighted in the Sensor Library tab – so you can easily create new sensor types which are variants of existing types.

For more details click on Help, Contents, How to - in the DL2e Program Editor:



**Sensor type code** is a 3-letter mnemonic for the sensor type. It serves no purpose in the logger other than being an additional label.

**Sensor type name** is the name of the information stored in the sensor library. For instance, there could be two sensor types defined for a given type of thermocouple, covering different temperature ranges.

---

## Modifying Sensor Types

To modify a sensor type, open the DL2e Program Editor. Select the Sensor Library panel and select the **Edit Sensor Type...** command (Edit menu). This pops up the Sensor Type Properties dialog for the sensor type. Note that you cannot modify approved Delta-T sensor types – if you need a variant on a standard Delta-T sensor type, you will need to create a copy and adapt that (as described above). See also the online Help for the DL2e Program Editor.

---

## Modifying Channel Properties Directly

You can modify channel properties directly (as apposed to modifying sensor types in the Sensor Library).

Open the DL2e Program Editor, highlight the channel and select the **Edit Channel...** command (Edit menu). In the Channel tab, Sensor Type, select <Custom sensor type>. You can now select the Measurement tab and make changes to the measurement made on the channel. When you close the Channel Properties dialog, you will see that the channel's sensor type is set to <Custom sensor type> because its properties no longer match any sensor type in the sensor library.

See also the online Help for the DL2e Program Editor.

---

## Importing & exporting library sensor types

**Import** and **Export Library** commands (File menu) of the DL2e Program Editor allow you to import your old DL2e sensor library (DL.SNS, created with the DOS version of the PC software). The DL2 Program Editor is fully compatible with old sensor type libraries.

You can **Export** sensor types to a separate file - for instance you could share a set of novel sensor types with a friend. (The Ls2e DOS program cannot work with the new sensor library types - so get an upgrade!)

See also the online Help for the DL2e Program Editor.

---

## Linearisation tables

Sensor types may be created which use linearisation tables to convert the measured input signal into engineering units. Examples of sensor types using linearisation tables can be found in the Sensors library (e.g. thermistors and thermocouples).

To add a linearisation table when creating or modifying a new sensor type as outlined above, click on **New Table** in the **Measurements** tab of the **Sensor Type Properties** dialog.

This will display a Table tab for you to edit..

NOTE : You can optimise the logger accuracy by limiting the range of the linearisation table defined in the sensor type.

For context sensitive online Help press F1.

Pressing F1 when the Table tab has the focus will display online help about it.

See also "Linearisation Errors" in Appendix B and "Resident Linearisation Tables" in Appendix D of the DL2e Hardware Reference.

## Batteries and alternative power supplies

In the DL2e Hardware Reference, refer to

- "Power Supplies" in Chapter 5,
- "Battery voltage and % life expectancy" under Logger Status in Chapter 2,
- "Power supplies to sensors (and other devices)" in Chapter 6,
- "Earth loops and common mode voltages" in Chapter 6.

---

## Installing and setting up cards

There is an alternative method of setting up the LAC1 input card to give 30 input channels, and you may need to set up other cards fitted into your logger. Refer to Chapter 6 of the DL2e Hardware Reference.

---

## Using the logger with modems

Any modem installed in your Windows operating system will work with and be recognised by the Ls2Win software.

Use of modems with the Windows version of Ls2Win is very much a "plug & play" operation.

See also the DL2 Control Panel Help.

---

## Passwords

Passwords help prevent loss of data or interruption of logging as a result of unauthorised tampering. These are set up as part of the logging program using the DL2 Program Editor.

See also "Password" in Chapter 1 of the DL2e Hardware Reference.

For online Help press F1 in the DL2 Program Editor.

---

## Outputting data directly from the logger

The PRINT function can be used to output data directly from the logger to a printer or other data collection device.

Delta-T can supply a portable data collection terminal based on a Psion Workabout Palmtop computer.

See "Outputting data directly to a printer" and "Using other data collection devices" in Chapter 4 of the Hardware Reference.

---

## Auto-wrap (overwrite mode)

When memory is full the logger stops logging and issues a MEMORY FILLED error report (if Auto-wrap is not enabled) or it overwrites the oldest data in memory (if Auto-wrap is selected).

It can be turned on or off anytime, even when logging, via the Datasets tab in the DL2 Control Panel, by selecting the Auto-wrap option.

See also the on-line Help.

---

## Relay channel functions

The logger's on board relay channels 63 and 64 can be programmed as a

- **Warmup relay** - for powering up a sensor for a short period in advance of taking a reading,
- **Control output relay** - which switches when the reading on an input channel crosses a threshold, or

- **Malfunction warning relay** - which switches whenever the logger detects a battery failure, memory full or sensor malfunction.  
See "Relay Channels" in Chapter 6 of the DL2 hardware reference and the on-line Help.

---

## Event trigger functions

The logger's on board digital channels 61 and 62 can also be configured as event triggers, detecting the occurrence of events and waking the logger.

Two modes are available:

- **Data trigger.** Each time the logger detects an event it records the date and time and takes readings from a specified event trigger sequence of channels.
- **Start trigger.** Channel 61 and 62 can be programmed to wait for an event which then causes the logger to start logging.
- The Channel Properties dialog for the on-board digital channels contains an additional tab Digital Channel which allows you to select either of these functions, or to program the channel as an input channel. Additionally, a data trigger channel is created for you automatically if you select On channel 61 event or On channel 62 event in the Channel tab of any input channel.

See also "Event trigger channels" in the on-line Help.

---

## Installation considerations

See "Field Installation" in Chapter 5 and "Earth loops and common mode voltages" in Chapter 6 of the DL2e Hardware Reference.

---

## Command Reference for the PC software Ls2Win

See the on-line Help

---

## Resetting or Coldbooting the logger

See "Resetting the Logger" in Chapter 1 of the DL2e Hardware Reference.

---

## Weather Stations

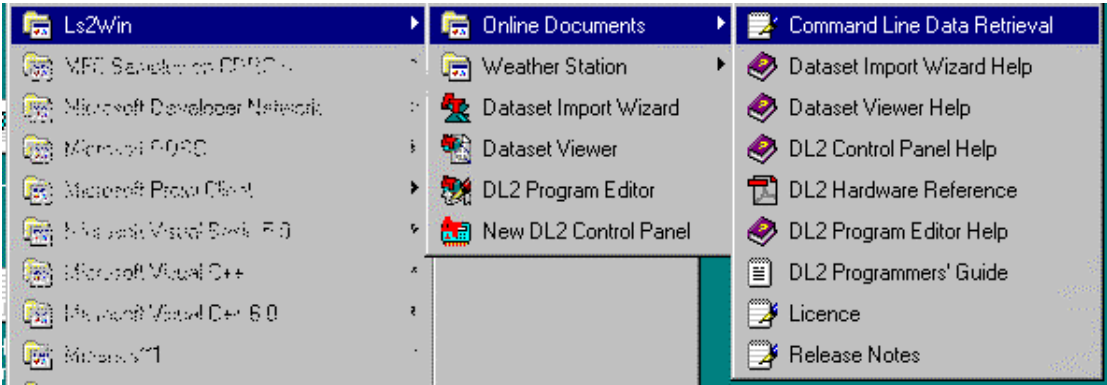
The folder Weather Station in the Ls2Win program group contains an application note and sample program and worksheet, to help you set up and process data from a weather station or environmental monitoring installation..

---

## Command Line Operation and Automated Data Retrieval

The folder Online Documents in the Ls2Win program group contains an application note 'Command Line Data Retrieval' which describes how to write simple command lines for retrieving data using a DL2 Control Panel, and how to schedule a data retrieval task to execute automatically at regular intervals.









# Index

- A**
- Asleep, 15
  - Autosleep, 15, 23, 24, 29
  - Auto-wrap, 53
  - Awake, 15
- B**
- Backup battery, 9
  - Battery, 53
    - backup, 9
    - holder, 8
  - Baud rate selector switch, 9
  - Button
    - COLD BOOT, 10
    - RESET, 10
    - STOP LOGGING, 10
- C**
- Channel, 12
    - on-board, 12
  - Channel Properties, 52
  - Circuit board**
    - main**, 9
  - COLD BOOT button, 10
  - Cold junction
    - displaying temperature, 23
    - on-board thermistor, 12
  - Command Reference, 54
  - Configuration
    - DEFAULT, 27
  - Connector
    - screw-terminal block, 12
  - Control output**, 53
- D**
- data collection device, 53
  - Data Retrieval
    - automated, 54
  - DEFAULT configuration, 27
- E**
- event triggers, 54
- F**
- front panel, 7
- H**
- Humidity indicator
    - window, 7
- I**
- input card, 53
  - Input card
    - stack., 9
  - INTL>, 9
- K**
- Keypad
    - main menu, 23
    - main menu, by-passing, 28
- L**
- LCD, 10
  - Linearisation tables, 52
  - Lithium cell, 9
  - LOG, 28
  - Logger PC Software
    - requirements, 16
- M**
- Main**
    - circuit board**, 9
    - Malfunction warning**, 54
  - Memory
    - IC socket, 9
  - MEMORY FILLED
    - error message, 53
  - modem, 53
- P**
- Passwords, 53
  - Power Supplies, 53
  - Power supply
    - socket, 7
  - printer

output data directly to, 53  
PROM, 9

## R

RAM  
chip socket, 9  
relay channels, 53  
RESET button, 10  
RS232 socket  
sealed, 7

## S

Screw-terminal connector block, 12  
sensor  
library, importing and exporting sensor types, 52  
sensor types  
new, 51  
Sensor Types  
modifying, 52  
Short cut, 28  
Socket

memory IC, 9  
STOP LOGGING button, 10  
Switch  
baud rate selector, 9

## T

Terminal  
group, 12  
panel, 12  
Thermistor  
on-board cold junction, 12

## V

Viewing angle adjustment, 10

## W

Wake, 15  
**Warmup relay**, 53  
Weather Station, 54