



# **NIWA - ECOLOGGER**

## **Data Logger**

## **USER Guide**

Version 1.0

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## Acknowledgement



The Ecologger has been developed for NIWA Ltd in collaboration with UNIDATA Pty Ltd of Australia. The Ecologger utilises UNIDATA Starlogger firmware and is intended to operate using Unidata V3 support software and custom NIWA Instrument libraries.

## Warranty Details

All NIWA Instrument Systems products are covered by a 12-month **“return to base”** warranty. The instruments should not be dismantled unless under instruction from NIWA personnel. Incorrect handling will void the warranty.

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## 1. INTRODUCTION



Externally, the NIWA Ecollogger comprises a waterproof plastic enclosure with a set of seven connectors mounted along its front edge and a red scan indicator, visible through a window in the lid.

Internally, the Ecollogger comprises a Micrologger datalogging circuit board (a Unidata Pty 8010 Micrologger engine) with flat ribbon cable connections to each of the seven external connectors.

The Ecollogger can simultaneously measure two analogue instruments and rainfall from a tipping bucket rainfall sensor connected to its event counting input.

Other parameters can also be measured (and logged) via an SDI-12 (serial) instrument channel and a custom protocol high-speed serial input/output (HSIO) channel. (See below for detailed Ecollogger specifications.)

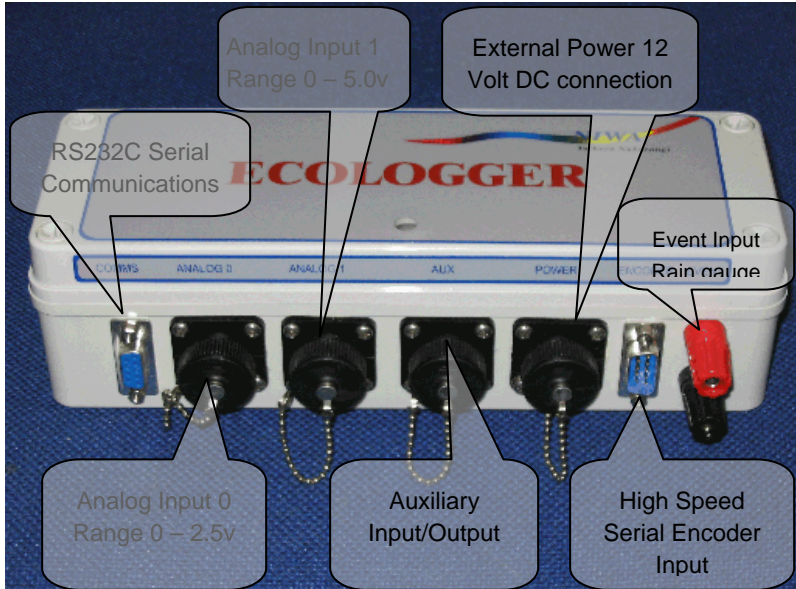
The Ecologger can also be used to control external equipment such as a water sampler or other processing equipment, and provide remote telemetry.

### 1.1. Ecologger Specifications

- **Dimensions** L 230, W 100, H 70 mm  
High impact PVC enclosure
- **Protection** Rated IP 67
- **Power supply** Ext 12 V DC (nominal)  
Quiescent current 50  $\mu$ A typ.  
Scan current 30 mA typ.
- **Inputs** 1 x HS serial channel (encoder)  
1 x 20kHz counter channel (rainfall)  
1 x SDI 12 input/output channel  
2 x 10 bit SE analog channels\*\*  
A0 range 0 – 2.5v  
A1 range 0 – 5.0v  
12V UPS with thermal protection
- **Output** 1 x open collector output control
- **Memory** 128 KB battery backed CMOS RAM
- **Log interval** 0.25 sec to 1 week, programmable
- **Scan rate** 0.25 sec to 5 min, programmable
- **Indicator** Red LED on front panel  
(Blinks to indicate logger scan)
- **Operating temp** -20<sup>0</sup>C to +60<sup>0</sup>C
- **Data output** RS232C, 300 – 76,800 baud
- **Warranty period** 12 months (Return to base)

## 1.2. Ecologger Connections

Access to the majority of Ecologger functionality is provided through the seven external connections on the side of the Instrument.



The Ecologger connections provide the following functions (left to right):

- **Communications (COMMS)** – A female, DB9 format, RS232 serial communications port that can be software-configured for 300–38400 baud using data logger support software. The default speed is 9600 baud (9600,N, 8,1).
- **Analog (ANALOG 0, ANALOG 1)** – Each has a 4-pin AMP socket to allow connection to two analog sensors. The analog resolution is 1 in 1024 (10 bit) for both channels. The input range of A0 is 0 – 2.5v and of A1 is 0 – 5.0v. A 12v User Power Supply (UPS) is available through each of these sockets and has an inline thermal fuse for external over-current protection.



- **Auxiliary Input/Output (AUX)** – This 8 pin AMP connector provides access to other inputs and outputs of the Ecologger's internal Micrologger data logger. Standard connections of the Aux port are the **SDI-12 input/output** channel, for connection to/from SDI-12 compliant devices, and an **open collector** output for control.
- **External Power (POWER)** - A 4-pin AMP socket allows connection of 12-volt DC battery power to the Ecologger. The standard power cable includes two sets of push-on terminals (red/black) for connection to a 7Ah sealed lead-acid battery. The second set has been provided to allow battery exchange without disrupting the external power.
- **High Speed Serial (ENCODER)** – A male DB9 format for input from a HSIO high-speed serial device, (usually a water level encoder).
- **Event (EVENT)** – A pair of Belling-Lee format terminals to allow the simple connection of a two-conductor cable from a tipping bucket rain gauge. The **Event input** is a 20kHz counter channel that has a low frequency filter suitable for pulses from a tipping-bucket rain gauge.

## 2. PREPARING FOR INSTALLATION

This section describes:

- The equipment supplied with your Ecologger
- The instrument options.
- How to test the system.

You should assemble and bench test a new system before installing it on site.

Testing should include the logging and recovery of a period of data. This will allow you to confirm satisfactory operation of the entire system and for the site operators to become familiar with the instruments and software.

### 2.1. Ecologger equipment

The equipment supplied is as follows:

- 1 x Ecologger data logging instrument (NIWA code UNIECLO)
- 1 x external power cable (NIWA code CABLOPW)
- 1 x DB9 - DB9 PC to datalogger, communications cable.
- 1 x copy of NIWA Ecologger User Guide including:
- NIWA Custom Ecologger scheme files update disc
- NIWA Custom Library files installation disc
- Unidata Starlog Version 3 support software discs and manual

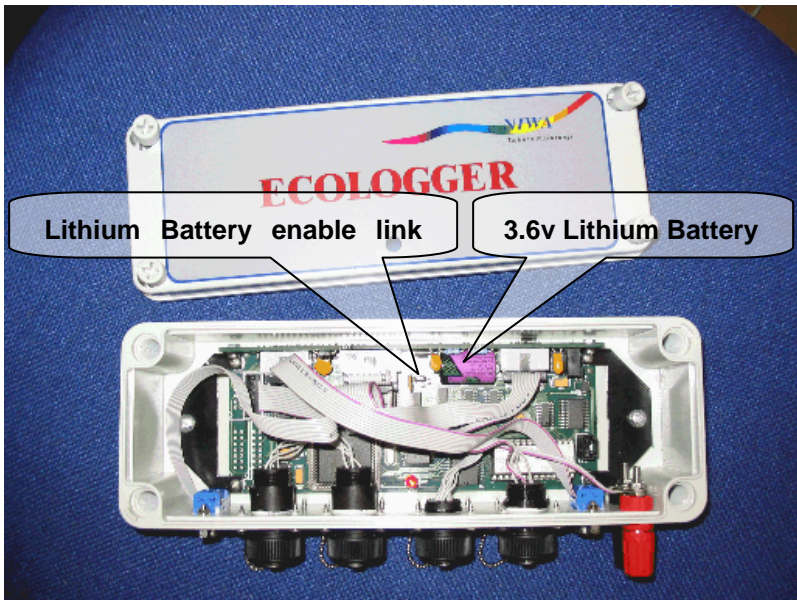
### 2.2. Controls and Settings

There is only one user-accessible control inside the Ecologger. This is the lithium back-up battery-enable link (J51). This must be fitted correctly to ensure that the logger's data is backed up in the event of 12volt power supply failure. It is fitted before leaving

NIWA. The lithium battery voltage should be checked periodically, typically once a year.

**The Ecologger contains static sensitive componentry and it is recommended that access to the datalogger PCB is carried out by a suitably qualified technician, only under anti-static conditions.**

To access both the lithium battery and its enable link, unscrew the four fasteners and remove the top cover. The link, J51, is located to the left of the purple lithium battery (see photo graph below). This link is normally “parked” on a single pin when the battery-backup function is disabled. To enable battery-backup, carefully fit the link across both pins. To check lithium battery voltage, connect a voltmeter directly across the wire ends of the lithium battery. Its nominal voltage is about 3.6v and it should be replaced if this is lower than 3.0v



### 2.3. Bench Testing the Instrument System

If practical, assemble the equipment in the housings and on the mounting you will be using at the field site. This will ensure you have everything you need.

With the DB9-DB9 serial cable provided, connect your PC to the Ecologger via the COMMS socket, run the STARLOG software, and select the scheme required.

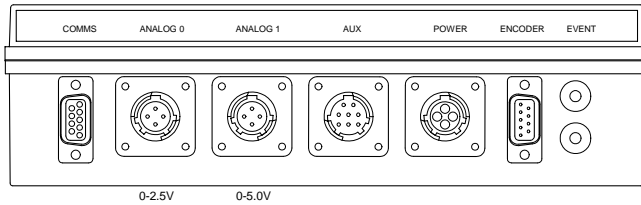
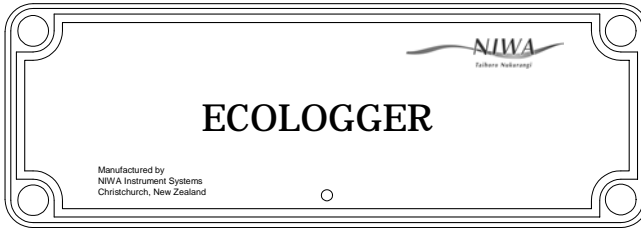
**(Refer: Custom scheme notes, for further details on Ecologger schemes.)**

**Select** - “Program Logger with Scheme”, then “Scheme Test Mode”.

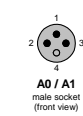
The screen display should show the correct scheme details.

After logging some data, unload and review it using the scheme report menu. Ensure the data you require are being logged and that the system is operating correctly. Dismantle the instruments system and repack it for transport to the installation site.

## 2.4. Connector Pin Functions

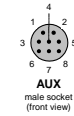


Pin	Function
1	n/c
2	RX
3	TX
4	n/c
5	Gnd
6	DSR
7	RTS
8	n/c
9	n/c

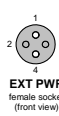


Pin	Function
1	A.Gnd
2	+12V
3	Signal
4	n/c

**Note:**  
+12V on A0 & A1 sockets is only available when the User Power Supply (UPS) is on



Pin	Function
1	n/c
2	n/c
3	n/c
4	+12V
5	Gnd
6	SDI-12
7	n/c
8	OUTO (open collector output)



Pin	Function
1	Gnd
2	n/c
3	n/c
4	+12V



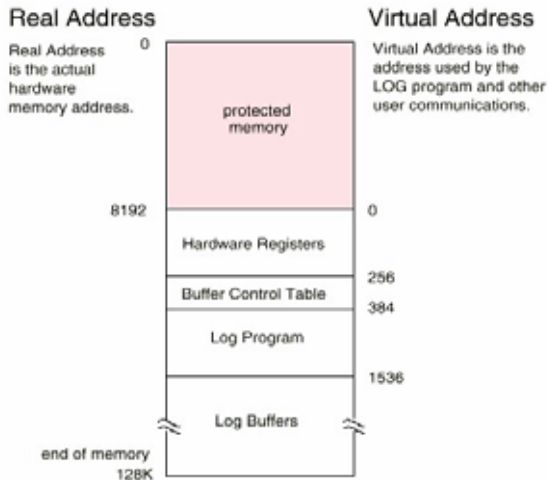
Pin	Function
1	n/c
2	Dig. Gnd
3	Dig. Gnd
4	up counts
5	HSIO Clock
6	+12V
7	HSIO Data
8	+5V pulse
9	down counts



Pin	Function
Red	C0
Black	Gnd

### 3. ECOLOGGER MEMORY ORGANISATION

#### 3.1. RAM Memory layout



#### Data logger memory map

Memory Layout is effectively the same for all the Unidata loggers.

Addresses 0-101 of the Hardware Register area are used for system variable space.

Addresses starting from 102 may be allocated to some instrument channels, or virtual channels included in a scheme.

Remaining addresses from 102-199, can be used by the programmer for custom coding.

##### 3.1.1. Displaying the Contents of Memory Addresses

The contents of addresses throughout the loggers memory can be viewed in real-time using Scheme Test mode screens (Ref;

3.5.7). The addresses displayed in a Test mode screen are specified in a file with the extension **.FTU**.

The screen named **STLINFO.FTU** can be opened as follows:

From the Test mode menu, select **Open Test Display (F3)**

Select **..\** from the **Files** box

Select **Eng** from the new **Files** box

The STLINFO screen displays four columns of fields on the right hand side. The field in the first row are addresses 0-3, and those in the second row are 4-7 etc.

Addresses further into memory can be displayed by keying Alt &A. An address offset box will appear.

Type the address you wish to display, and press ENTER. The specified address will be displayed as the first field in the 1st row. The addresses displayed in the following fields are those following the selected address.

### **3.1.2. Interpreting Values Displayed in the STLINFO Screen**

Each field of the 4 columns displayed in the STLINFO screen corresponds to a 1-byte address, which can contain a value from 1-255.

Sensor readings and recorded data are usually 2 byte values, occupying 2 addresses.

For example, counts per scan on the counter channel, C0, (used for Ecologger rainfall measurements), are written to the 2-byte address 24 (ie. addresses 24 and 25). Values displayed in the 1st byte are equivalent to their decimal value. Values displayed in the second byte are in units of 256, e.g. total counts in 2-byte address 24:

<b>1<sup>st</sup> byte</b>	<b>2<sup>nd</sup> byte</b>	<b>Decimal equivalent</b>
1	0	1
234	0	234
0	1	256
10	1	266
100	2	612

Raw voltage readings from the analog channels are written to fixed 2 byte addresses, in units of "bits". 1 bit is equivalent to 1.221 mV.

The 2 byte reading from channel A0 is always written to address 200, A1 to 202...etc.

For example: A0 readings:

<b>1<sup>st</sup> Byte</b>	<b>2<sup>nd</sup> Byte</b>	<b>Decimal Bit Total</b>	<b>mV equivalent</b>
1	0	1	1.221
100	0	100	122.1
0	1	256	312.6
100	4	1124	1372.4



### 3.1.3. Useful Addresses to Know

Memory addresses corresponding to Ecologger input channels:

Channel	Description	Address (byte)
<b>C0</b>	<b>Counter channel 0</b>	<b>24 (2)</b>
<b>A0</b>	<b>Analog Channel 0</b>	<b>200 (2)</b>
<b>A1</b>	<b>Analog Channel 1</b>	<b>202 (2)</b>

Other memory addresses:

Variable / Buffer	Address(bytes)	Units
Date/Time	4 (4)	No. of Scans since 01 Jan 1980
Log Interval	60 (2)	Scans
Scheme Name	80 (8)	ASCII
Current Buffer Pointer	256 (4)	
Start Buffer Pointer	268 (4)	
1 <sup>st</sup> Program Instruction	384 (4)	
Buffer 6 (stores date/time of 1 <sup>st</sup> log)	376 (4)	
Buffer 7 (stores date/time of last log)	380 (4)	

### 3.1.4. Logging Sequence

Data values logged on a fixed interval basis are written to the log buffer, which begins immediately after the program, at the address “pointed to” in address 268 (the start buffer pointer). The date and time are not recorded in the log buffer, but are updated in buffer 7 at each log. Buffer 7 always contains the date and time for the most recent log. Following a log, the current buffer pointer is updated to point to the address immediately following the latest recorded data. (Prior to the 1<sup>st</sup> log the value of the start buffer pointer and the current buffer pointer are the same).

When data are logged on an event basis, the date and time (4 bytes) are written to the log buffer, for every log, followed by the data values.

When a scheme is created, the log buffer may be set to linear (fill and stop) or circular (wrap around).

When a linear buffer is specified no new data will be recorded when the log buffer fills. When a circular buffer is specified, after the log buffer has filled, new data will continue to be recorded, from the start of the log buffer, overwriting data recorded previously.

At the time of the incremental data unloads a file **scheme\_name.iup**, in the schemes directory is updated.

This file contains three values:

- the incremental unload “pointer” = the address to begin the next incremental unload
- the number of times the memory has filled and wrapped around
- the date and time for the first log.

### 3.2. Logger Firmware

The logger firmware interprets and actions the series of instructions that make up the logger programme or “scheme”. From time to time, as new logger features are added, or a firmware bug is fixed, new firmware is made available from UNIDATA, in the form of a file (there is one firmware file for each logger type).

When required a new firmware file can be downloaded from UNIDATA’s web site, or obtained from NIWA. Firmware files reside in the STARLOG system directory, and can be downloaded from there to a logger.

A logger’s current firmware version can be viewed, by using the STARLOG Configuration Table (CDT) editor to upload the logger’s CDT settings. The firmware version is displayed at the top of the screen.

New firmware can be loaded to a logger by carrying out the following steps:

Select **CDT Editor** from the STARLOG **System** menu

Select **Upgrade Firmware** from the **CDT** menu

The firmware file matching the logger type will be loaded to the logger.

**NB: Always unload data before loading new firmware to a logger. The logger must be reprogrammed after new firmware has been loaded.**

### 3.3. The Configuration Table (CDT)

The CDT governs many aspects of the loggers operation. Settings specific to a new scheme are normally automatically loaded when the scheme is loaded. The CDT resides in an EEPROM, with a copy in the protected area of RAM.

Occasionally it is necessary to change some CDT settings using the CDT Editor.

For example, the logger's RS232 timeout may need to be extended to enable radio telemetry, or its SDI-12 status may need to be changed.

To use the CDT Editor:

Select **CDT Editor** from the **System** menu

A message will appear "About to Upload CDT"

Press Enter, or click on OK

Relevant CDT settings will be uploaded from the logger and displayed.

Two state (on/off) settings can be altered by selecting the required field (Tab or mouse), and clicking, or pressing the space bar. A cross in the field indicates that the option is selected.

Numerical settings can be edited from the keyboard.

After any necessary changes have been made, the new settings can be downloaded to the logger:

Select **Download** from the **CDT** menu.

CDT settings required for a scheme built from the NIWA Instrument Library are automatically achieved when the scheme is loaded to a logger.

## 4. Ecologger compatible SOFTWARE

Because the Ecologger uses a standard Unidata Micrologger engine, several packages may be used with the Ecologger.

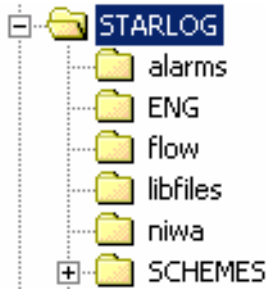
- Starlog Version 3 (Unidata) - can be used for all logger and scheme operations. Note that because this program uses MS-DOS some users experience communications problems with newer laptops and PC's
- StarLite 4W (Unidata) - can be used for all logger operations when provided with a pre-written logger scheme, can be integrated with Starlog Version 3 if any scheme changes or new schemes are required.
- Recorder (Unidata) – can be used for all logger operations and can be used to create basic schemes
- Flosys (NIWA) – used for remote telemetry data retrieval from a large network of remote sites

Because Starlog V3 is the currently accepted standard, the following section covers operation of the Ecologger with Starlog version 3 software. For other software packages please refer to the appropriate software user manual for further information.

The Version 3 STARLOG Software Users Manual supplied by Unidata describes the features of the software in detail. Information provided here describes the common applications of this datalogger support software.

### 4.1. Directory structure

Following installation of STARLOG Version 3 software and the NIWA -Instrument Library to a PC, the directory structure is:



The Eng directory contains the English language specific files, Fra contains the French files and Deu the German files. The Fra and Deu directories can be deleted to save space if these languages are not required.

The Alarms, Flow, and Niwa directories contain NIWA Instrument Library files. The NIWA Instrument Library is described in Section 4.

The Eng directory contains files that define instruments that may be used to build schemes and files defining some useful non-scheme-specific Test mode screens, and some custom scheme-specific screens.

## 4.2. Scheme files

There are sets of files for each scheme on the schemes directory. The files are created when a new scheme is “saved” from the Scheme Editor, or may be supplied, as a set, by NIWA. A copy of a scheme, with the same functions but a new name, can be made by opening the original scheme in the Scheme Editor, and “Saving As”, to the new name. The function of some of the scheme files are:

<b>EXTENSION NAME</b>	<b>FUNCTION</b>
.CDT	Contains scheme-specific CDT settings, which are loaded to the logger when the logger is programmed.
.FTU	Defines the default Test mode screen for the scheme. Contains one line for each quantity displayed in the screen, specifying the source logger address and scaling to be applied, the position on the screen, and the label and units to be displayed.
.INP	Contains addresses assigned to scheme variables/channels when the scheme is saved
.IDU	Contains an index of data unload files.
.IUP	Contains address for the start of the next incremental unload.
.LDR	Contains the assembled logger program code, ready for loading to the logger.

### **4.3. STARLOG functions**

STARLOG software allows the following operations to be carried out:

- a logger program or scheme can be created
- a logger can be programmed with a scheme
- the logger and sensors status can be viewed in real time
- recorded data can be unloaded from the logger
- unloaded data can be displayed as plots, screen or printer listings, or written to an ASCII file.

The functions commonly used can be considered as two groups:

- the scheme editor
- the Control Panel operations

The scheme editor is used when a scheme is created or modified. The scheme editor is described in Section 4.3.3

The control panel menu lists operations that can be carried out for a selected, existing scheme.

#### 4.3.1. Hot keys

STARLOG is a Windows-like DOS package. User operation of the software consists of selecting options, or typing values into fields within windows, or dialog boxes. All operations can be carried out using a mouse, or by using "hot keys". Knowledge of the common hot keys can be an advantage when operating a PC in poor visibility.

A selection of hotkeys and their functions are listed in the **Starlog V3 User Manual** section 4.6.1, pages 29,30.

Useful key/hot key functions include:

**Tab** moves the cursor to the next field, option or sub box within a dialog box

**Shift + Tab** moves the cursor to the previous box

**Alt and 1<sup>st</sup> letter of a drop menu** drops the menu

**Enter** actions a highlighted command button (such as OK or Cancel)

**Alt + Underlined letter of a command** actions the command



**Alt + X** exits the scheme editor, the CDT Editor, Test mode, and STARLOG itself

Hot keys for **drop menu items** are labelled alongside the item.

**Alt + F6** opens the scheme editor from the front STARLOG screen. If a scheme has been selected after running STARLOG, the scheme editor will automatically open that scheme when Alt + F6 are keyed.

Several windows or boxes may be simultaneously open in Test mode or the scheme editor. The boxes can be successively made active by keying **F6**.

Keying **F3** from the STARLOG front screen or from the scheme editor will open the list of existing schemes.

Keying **F3** from within Test mode will open the list of screens available.

The boxes containing list of schemes or screens can be closed by key **Esc**.

**Alt F3** will close the currently active box or Test mode screen.

**F7** will open the communications window from within STARLOG.

**Alt + T** will open an SDI-12 test ("Transparent mode") session from the communications window.

Menu items can be selected by using the arrow keys to select the item and pressing **Enter**, or pressing the key for the menu item letter that is highlighted.

Keying **F5** will maximise or minimise the currently active window.

Alt + Enter will display STARLOG as full screen, or as a window, when STARLOG is run from Microsoft Windows.

**Double clicking on the STARLOG icon runs STARLOG.** STARLOG can be run from a C:\STARLOG DOS prompt by typing STARLOG and pressing Enter.

### 4.3.2. The Control Panel Menu

Figure 1 shows an example of a box containing a list of schemes that is displayed when STARLOG is initially run.

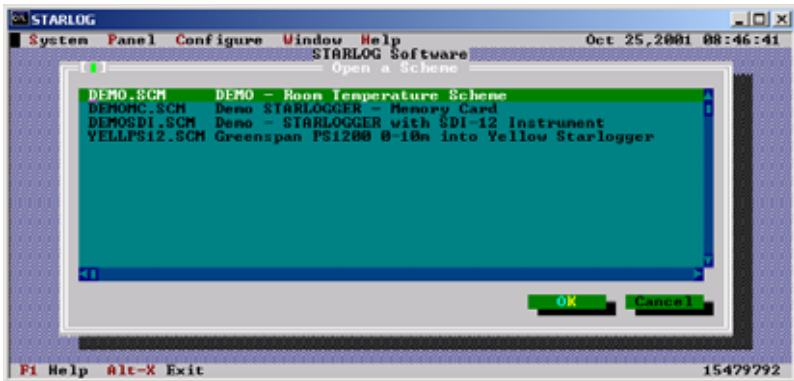


FIGURE 1.

On choosing a scheme a "Control Panel" menu is displayed. The menu items are operations, which can be selected for the chosen scheme.

Control panel options that require connection to a logger can be used only when the PC and logger are connected by an RS232 communications cable, or by a modem link.

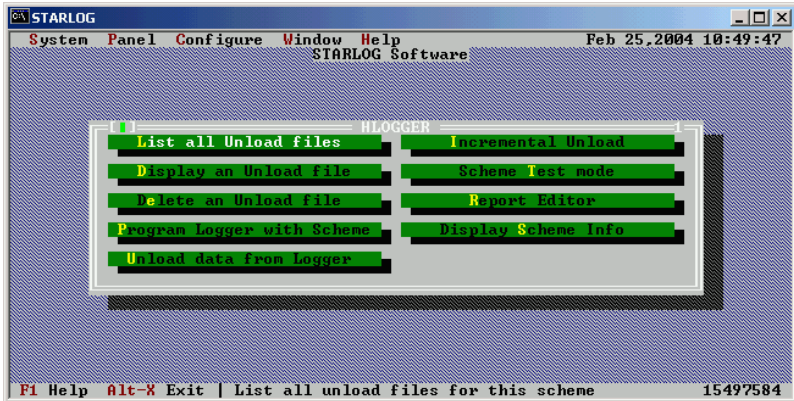


FIGURE 2.

The most common Control Panel operations are:

**Program Logger with scheme** loads the selected scheme from the PC to the connected logger.

**Unload data from Logger** uploads recorded data from the logger to the PC.

**Incremental Unload** upload data recorded since the last incremental unload to the same PC.

**Scheme test mode** is a terminal mode that allows the PC to display in real time selected information from the logger's memory such as the logger's date and time and current sensor reading.

**Report Editor** allows reports to be created for the selected scheme, that define how unloaded data will be "displayed" when the **Display an Unload file** option is chosen.

#### 4.3.3. The Scheme Editor

The scheme editor can be used to create a new scheme or to modify an existing scheme.

The scheme editor can be opened by keying Alt + F6 from the front STARLOG screen, or by dropping the System Menu (Alt + S) and selecting Scheme Editor.

When the scheme editor is opened while the control panel is open for a selected scheme, windows defining features of that scheme will automatically be displayed. A scheme editor screen is shown in Figure 3.

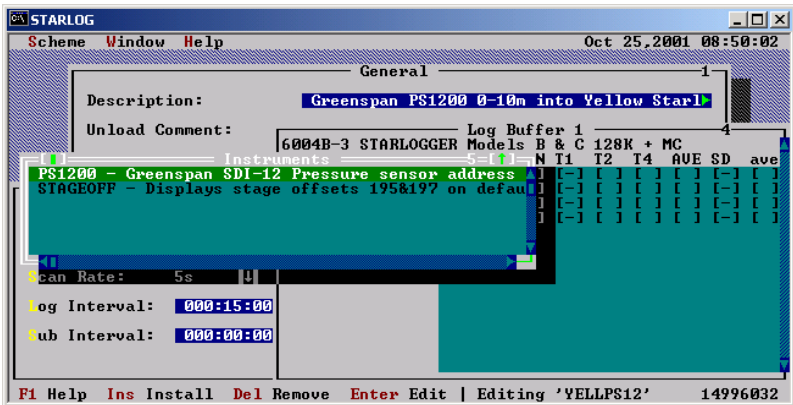


FIGURE 3.

Another scheme can be selected and opened from within the scheme editor by keying F3 and choosing a scheme from the list displayed.

The scheme editor boxes displayed are those that were open when the previous scheme editor session was closed for that scheme.

### A new scheme

A new scheme can be created by keying Alt + S to open the scheme drop menu, and selecting create. A window opens display a Logger field and a list of Extensions. A list of the logger models is displayed by pressing the down arrow key, as shown in Figure 4. For the Ecologger select the 8010A-1 Ecologger Model A (for Starlog versions 3.10A and higher), or 8007A-1

Micrologger (Generic) models A and B for previous versions of Starlog

One of the listed extensions may be required for special event outputs.

Press Enter after the logger has been selected to return to the scheme editor window. The logger type for a scheme cannot be subsequently altered.

Any of the scheme editor windows can be opened by dropping the Window menu (key Alt + W) and selecting the required window. The open windows can be successively made active by **keying F6**.

The functions of the scheme editor windows are:

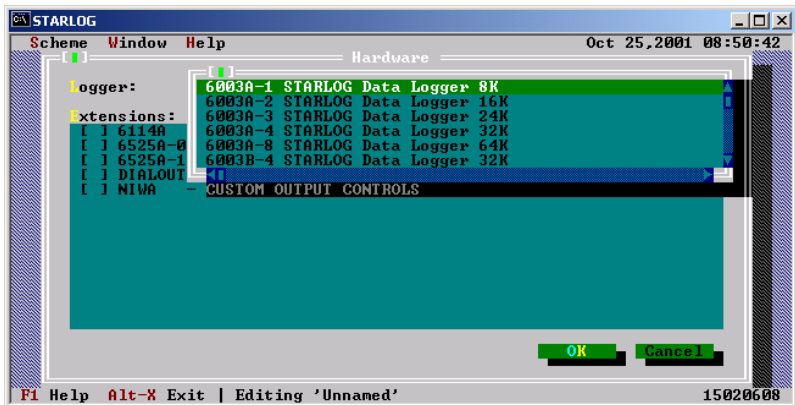


FIGURE 4.

### General window

The **General** window allows a description of the scheme to be typed that will identify the purpose of the scheme, in a list of schemes. The **space bar** is used to select or un-select the Unload comment option when this field is active. An X is displayed when the option is selected. When this option has been selected, at the time of a data unload, the unload sequence

will prompt the operator to type a comment that will identify or qualify the unload.

### **Instruments window**

The **Instruments** window displays the instruments that are part of the scheme. To add an instrument to a scheme, key **Ins** and select the required instrument from one of the lists or families of instruments contained in the listed **.met** files. For example, the DEPTH. MET file, part of the NIWA Instrument Library, contains a range of water level instruments.

### **Program window**

The Program window allows the log buffer (the area of RAM where data is recorded) to be configured as circular or linear. Use the down arrow key to toggle between these two options.

The logger will “wrap around” and begin to over-write the oldest data, when the log buffer has been configured as circular, and the memory has filled.

The logger will stop recording any new data when the log buffer has been configured as linear, and the memory has filled.

The **logger scan rate** is selected from a list of options in the Program window. The required log interval can be typed in the Log Interval field.

A **Sub Interval** may be defined if required. The sub interval is a portion of the log interval prior to the log time. Sometimes a sub interval average is logged, where the recorded value is the average of on-scan readings over the sub interval period.

Quantities to be logged are selected in the Log Buffer window. One or several quantities can be selected to be logged for each channel defined for the scheme. Use the arrow keys to highlight the required fields and the space bar to select or un-select the quantity.

## Events window

“Events” can be created using the **Events window**. The logger program tests to see if events defined are true at each scan. The defined “output” will be executed when an event is true. Output actions may include switching power to an external device such as a modem. A log may be forced when an event is true.

## Communications window

The communications window allows the phone number for a remote station to be defined. STARLOG will dial this number automatically for operations that require it to connect to the logger running the scheme. Where an identical scheme is to be run at more than one phone-telemetered station, the scheme must be “saved as” to a distinct scheme names, each with their own phone number. STARLOG will only dial the station when the communications window, **Via Modem** field has been checked. Modem communications are selected (X) or unselected by pressing the space bar when the **Via Modem** field is active.

## 4.4. User Programmable Power Supply Programming

Sensors connected to the A0 and A1 ports on a Ecologger/Micrologger 2000 and an Ecologger can be powered up for a pre-log warm-up period by a logger feature called the User Programmable Supply (UPS).

Programmable +12V power is also available from the UPS terminal on the logger terminal strip.

For a Micrologger or Ecologger to be used in this way the logger must be configured **as UPS ON**.

Use the CDT editor to check that this setting is correct, before programming the logger.

Steps required to build UPS sensor power-up into a scheme are described below.

From the Scheme Editor, the NIWA-CUSTOM OUTPUT CONTROLS “Extension” must be selected from the Hardware

window, from which the logger type (in this case Micrologger) is selected, at the time the scheme is created.

UPS 6 scan, 12 scan and 33 scan options will appear in the Events dialog box Output options list.

Add the instrument "6004X Time Till Log to the scheme from PDLTRANS.MET list.

Then set up an event to initiate a UPS power-up prior to each log.

**NB** - the units of T2L are seconds, and the units of the respective UPS periods are scans.

- the UPS period begins 1 scan after the T2L time that initiates it.

For example to warm up a sensor using the UPS 6 scan option, make the following settings in the Event dialog box:

Select Channel A=B

Set channel to T2L

Set B=30 (sec)

Set Output as MICROLOGGER 6 scans (= 30 sec for 5 sec scan)

These settings will cause the UPS to switch power to sensors connected to A0 and A1, for a period beginning 25 seconds before the log, and ending 5 sec after the log.

That is, the warm-up period prior to the log scan will be 5 scans (= 25 sec for a 5 sec scan), and the sensor will be powered up until just after the log.

UPS 12 scan or UPS 33 scan can be used where longer warm-up periods are required.

Provision for operator-initiated between-log power-up can be achieved by adding the MFLAG instrument from the NIWA



Instrument Library UTILITY.MET list, and creating the following Event:

Select Channel A=B

Set channel to MFLAG = 1

Set B = 1

Set Output as MICROLOGGER UPS 6 scan

The Event will cause analog sensors to be powered-up for 6 scans whenever the operator "PUTS" 1 to address 199.

The NIWA Instrument Library is described in **Section 4**.

The Scheme Test mode "PUT" operation is described in Section 4.5.4.

## 4.5. Scheme Test Mode

Scheme test mode connects the PC as a terminal to the logger and allows real-time viewing of values in the logger's memory, including the latest sensor readings. Test mode is versatile and has many features. The most common features are described below.

Each Test mode screen is defined by a file, with the extension .FTU.

**Note: Test mode displays are empty when the PC is not connected to a logger.**

### 4.5.1. Default screens

Two screens are displayed when Test mode is initially run. Figure 5 shows example default screens.

The top screen is specific to the scheme and displays items from the logger's memory including the scheme name, the logger's date and time, the dates and times for the first and most recent logs and the current sensor readings.

The bottom screen shows the most recently logged data. Earlier recorded data can also be displayed by scrolling back through the log buffer memory.

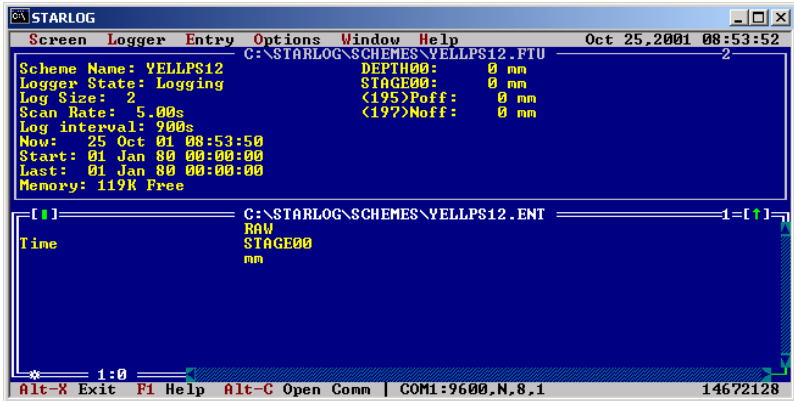


FIGURE 5.

#### 4.5.2. Multiple screens

Several test mode screens can be open at one time. The currently active screen is bordered by double white lines and can be maximised or minimised by keying F5.

Other screens can be successively made active by keying F6.

The currently open screens can be “tiled” by keying Shift + F5.

#### 4.5.3. Correct logger time

The logger’s time can be corrected to the current PC time by dropping the **Logger menu** and selecting **Correct time**. The adjustment of the logger’s time is affected gradually, over several scans.

The adjustment will continue to completion even if Test mode is exited and the PC disconnected.

#### 4.5.4. “PUTting” or writing values to the logger’s memory

Values such as thresholds or offsets that may be operated on by the logger scheme can be written to logger memory addresses from the PC keyboard.

There are two methods for writing values to logger addresses.

The first method does not require use of a mouse or other pointer, but does require that the address the value is to be written to, is known. Alt + P are keyed and a box appears with Address and Value fields. Figure 6 shows the PUT box. These fields can be made active by keying Alt + A and Alt + V, or the Tab key can be used to move from one to another. The entered value is written to the specified address when the Enter key is pressed.

This method may be used to “PUT” or write a one byte value (<256) to a two byte address currently containing a value >256 (the second byte value will be >0). In this case 0 must be put to the second byte. The entry to the value field could be, for example, i.e. 23 0 (23 space 0).

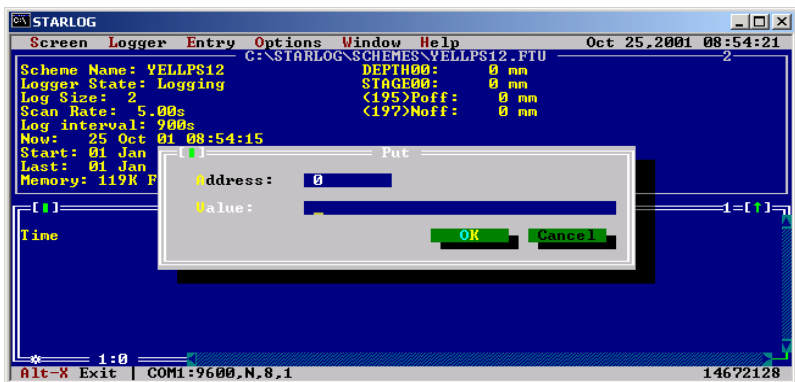


FIGURE 6.

The second method for writing a value to a logger address does not require that the address is known, but does require the use of a mouse.

The mouse is used to select and right-click on the Test mode field displaying the quantity to be altered. Figure 7 shows the box displayed.

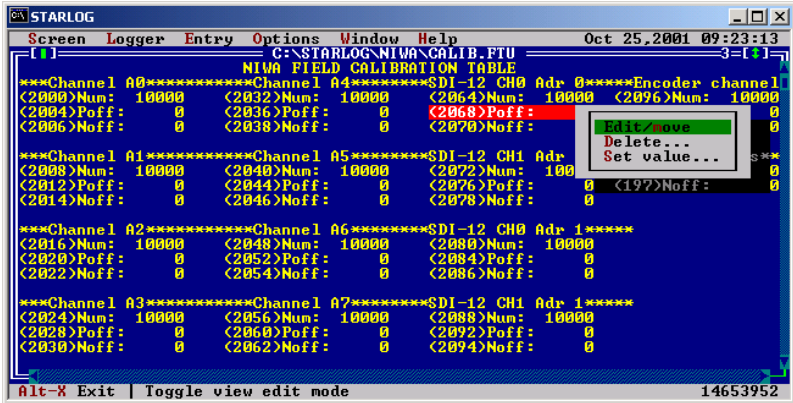


FIGURE 7.

Select the Set Value option and second box is displayed as shown in Figure 8. The required value is typed in the value field, and Enter is keyed to write the value to the address corresponding to the selected field.

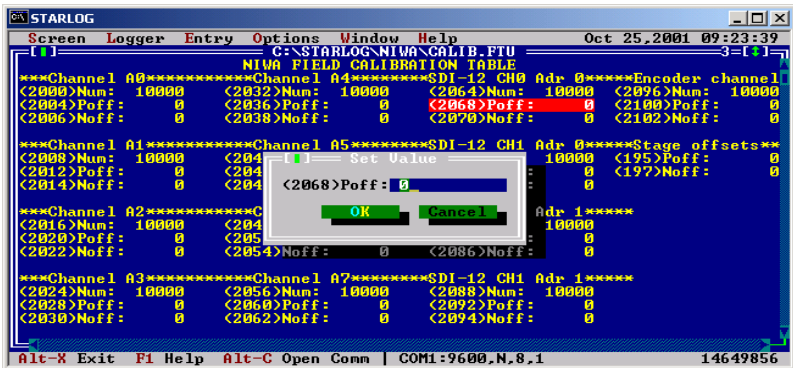


FIGURE 8.

#### 4.5.5. Setting up modems

A non-scheme-specific version of Test mode can be run for this purpose, from the STARLOG front screen, by keying Alt + F9.

STARLOG software can be used to send a setup string to a modem that is connected to the PC. To do this, drop the **Options menu (key Alt + 0)** from test mode, and selected **Setup modem**. A box will appear, Figure 9, from which “For computer” or “For logger” is selected, depending on whether the modem is to be connected to a computer running STARLOG, or to a remote logger. The appropriate setup string will be loaded to the modem.

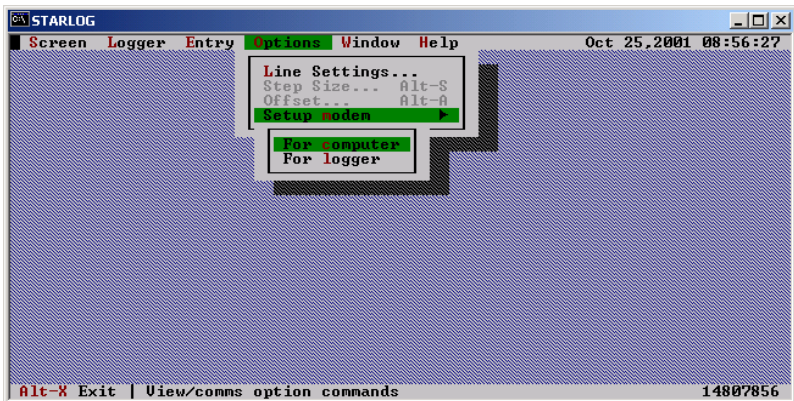


FIGURE 9.

#### 4.5.6. SDI-12 Test or “Transparent Mode”

SDI-12 test mode can be run from within Scheme Test mode by keying F7 to open the Com Window, shown in Figure 10. This window displays a set of characters and scrolls every scan. Alt + T are keyed to open a transparent mode session from the Com Window. In this mode the computer and SDI-12 sensors can communicate, via the logger as an interface. SDI-12 commands can be sent from the keyboard and the responses from the sensor are displayed on the screen. Figure 11 shows an SDI-12 test session in progress.

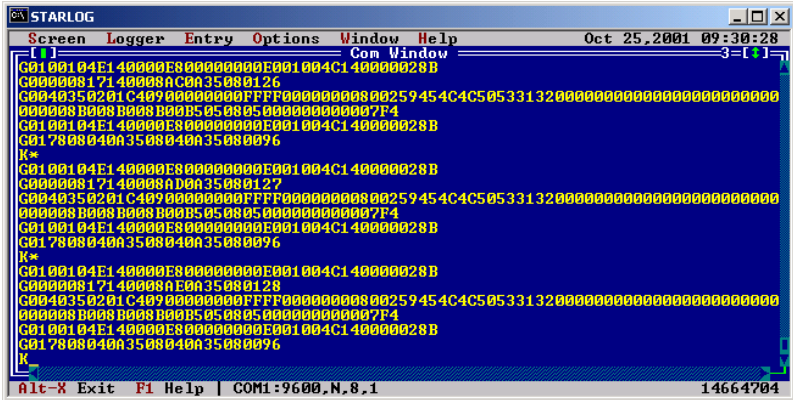


FIGURE 10.

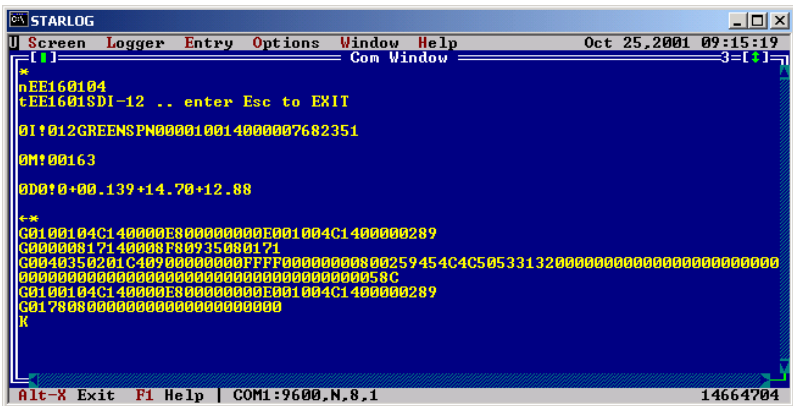


FIGURE 11.

Some sensors can recognise a small number of commands, and some many. The alpha characters of the commands must be in upper case, so it is convenient to set the keyboard caps lock on at the start of a transparent mode session.

Successful transparent mode communications demonstrates that the logger/sensor connection is correct, and that 12V power is available to the sensor.

To end an SDI-12 Test session, press Esc, and then Alt + F3 to close the Com Window and return to Test mode, or Alt + X to exit Test mode.

#### 4.5.7. The STLINFO screen

Unidata provide the STLINFO screen, which can be used to look at any addresses in the logger's memory for test or diagnostic purposes.

Figure 12 shows the STLINFO screen.

The screen can be opened by keying F3 from Test mode to open a window containing a list of screens. Key Tab makes the **Files** box active. Press PgDn until **..** is highlighted and press Enter. A new Files box will appear with a list of the directories under STARLOG. Select **ENG** and a new file box will appear containing the STLINFO screen.

Where the STLINFO screen is to be used frequently, the file STLINFO.FTU can be copied from ENG\ to SCHEMES\, and renamed to 00TEST.FTU. The screen, under its new name will then appear at the top of the list of screens in the window opened when F3 is pressed from Test mode.

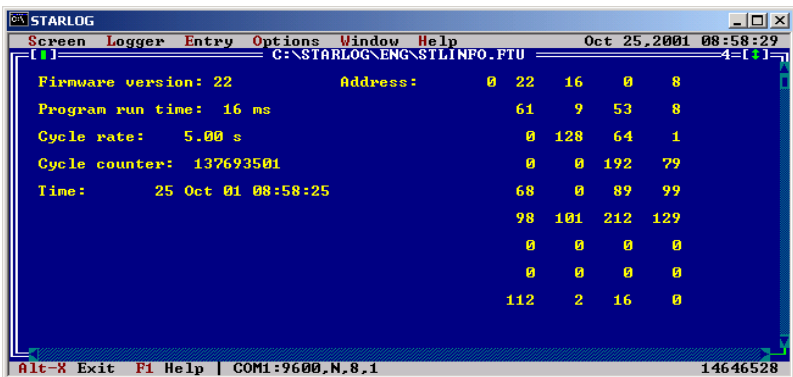


FIGURE 12.

The four values displayed to the right of the “Address:” in the STLINFO screen, are the current values for the four consecutive bytes, starting from the address shown. The subsequent rows of four fields correspond to the addresses following on from the first row.

Selected addresses can be displayed by keying Alt + A, typing the required address in the Offset field in the box displayed, and pressing Enter. Section 2.1.2 describes how the values in the addresses displayed are interpreted.

### 4.5.8. Customising Test mode screens

Special purpose Test mode screens can be created. Headings and instructions can be added to screens. Additional addresses can be displayed. Figure 13 shows a custom screen.

Custom screens, saved to a name other than the scheme name, can be stored in the Schemes directory. Custom screens saved to the Scheme name are vulnerable to being over-written if the scheme is saved again. A custom screen with the same name as the scheme, but stored in the ENG/ directory, will not be over-written when the scheme is saved, and will open by default when Test mode is run.

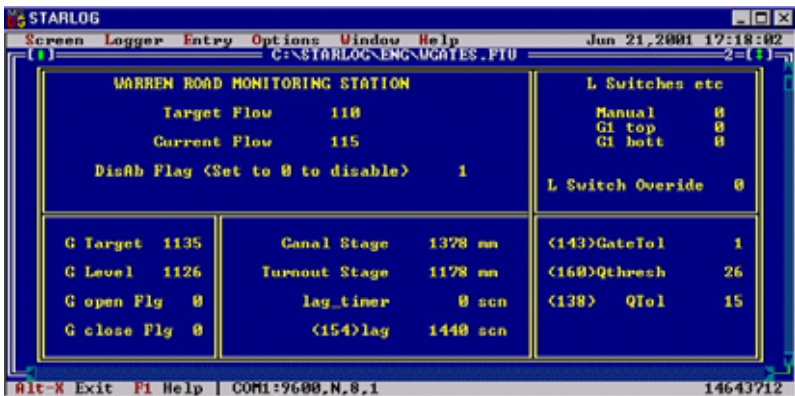


FIGURE 13.



## 4.6. Further Drop Menu Functions

### 4.6.1. The CDT Editor

The screen shown in Figure 14 will be displayed when **CDT Editor** is selected from the front screen, **System** drop menu. A copy of the CDT can be uploaded, Figure 15, and checked or edited before downloading again, if required. This is not usually required for schemes built using the NIWA Instrument Library. CDT settings for schemes built using the NIWA Instrument Library will automatically change any CDT settings required, when the scheme is loaded to the logger.



FIGURE 14.

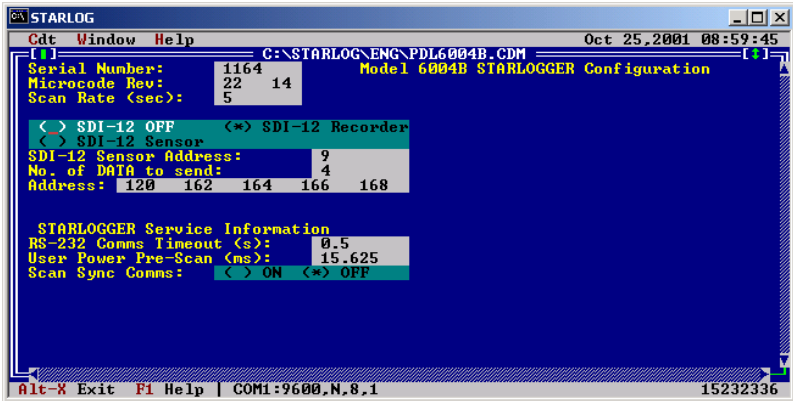


FIGURE 15.

The **CDT** drop menu of the CDT window includes the item **“Upgrade Firmware”**. The firmware file specific to the logger type will be loaded to the logger when this item is selected. The firmware files live on the STARLOG directory and may need to be replaced if a new firmware feature has been added, in-between software upgrades.

The CDT window is closed by keying Alt + X.

#### 4.6.2. The Configure menu **“Use modem”** option

The **Use modem** item is available from the front screen **Configure** drop menu. A box displaying the options is shown in Figure 16. Selecting, **never** will over-ride the **"via modem"** setting in the scheme editor communications box.

The method can be used to temporarily allow direct connection to a logger from a PC that is normally connected via a modem.

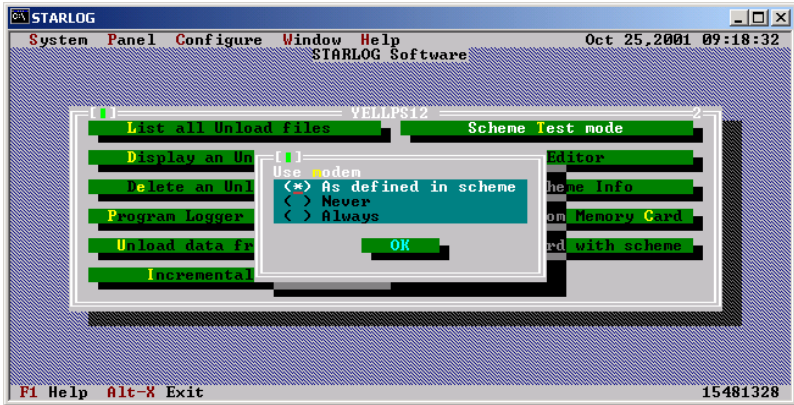


FIGURE 16.

#### 4.6.3. STARLOG version loaded

The **About** item of the front screen **Help** drop menu can be selected to identify the version of STARLOG software that is loaded to the PC.

### 4.7. The Report Editor

“Reports” created using the **Report Editor** are used, following a data unload, when the **Display an Unload file** option is selected from the control panel. Reports can be created to plot the data to the PC screen, to print the data to the PC screen or a printer, and to create an ASCII file. Data can be imported into TIDEDA from an ASCII file using the program, TLOGGER.

Reports are created or edited by opening the **Control Panel** for the scheme, and selecting **Report Editor**. A box containing a list of existing reports will open, as shown in Figure 17.

The box will be empty for a new scheme.

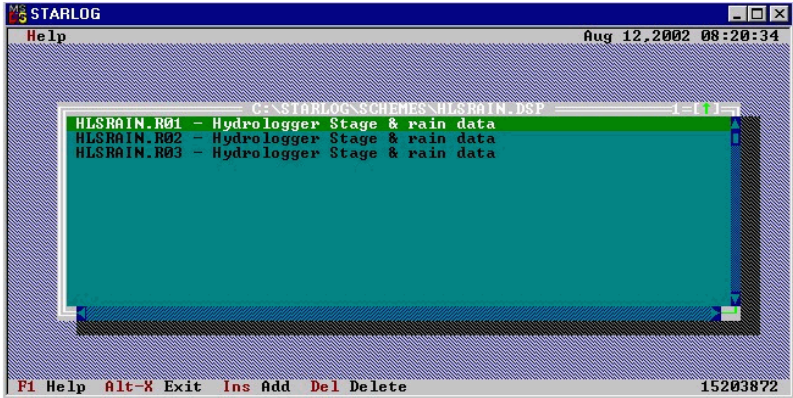


FIGURE 17.

To create a new report, key **Ins**, and the box shown in Figure 18 will be displayed.

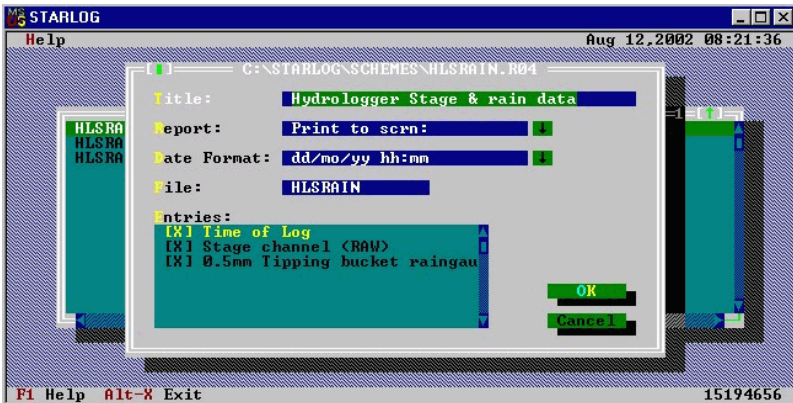


FIGURE 18.

The default title can be edited if required.

The **Report** type is selected from the list of options. The list is displayed by pressing the down arrow.

The **Date Format** is selected from the list of options.

For ASCII files that will subsequently be imported into NIWA's TIDEDA time series data manager using TLOGGER, the date format selected must be **yy/mo/dd hh:mm:ss**

The default directory for ASCII files created using an ASCII File report is the STARLOG/SCHEMES directory. The files can be "pathed" to a station data directory by typing the path to the directory, in the Report Editor File field.

The File field entry required to write ASCII files for the scheme "stationa" to the directory C:\stationa, is:

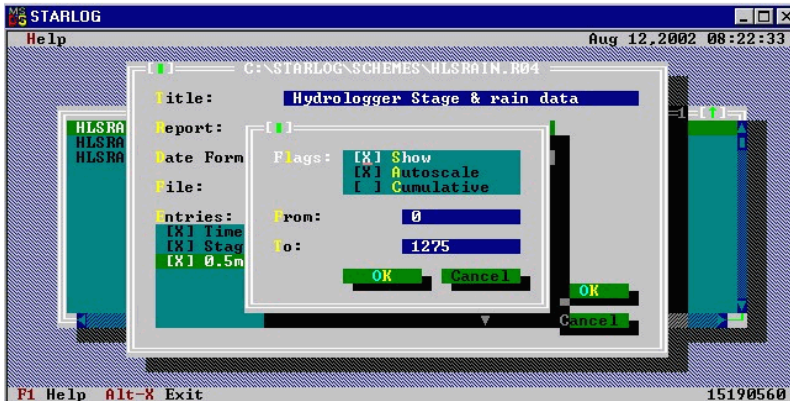
\\.\stationa\stationa.A\$z.

The directory, C:\stationa, must exist on the PC.

Logged quantities to be displayed are selected from the Entries field. Normally, all the quantities would be included in a Print to screen, or ASCII file report.

For stations where several quantities are logged, more than one plot report may be created, each displaying related quantities. To exclude a quantity from a plot, select the quantity from the Entries field.

A box similar to that shown in Figure 19 will open.



**Figure 19.**

The space bar can be used to unselect or re-select “**show**” for the quantity.

Exit the Report Editor by keying **Alt X**.

## 5. THE NIWA INSTRUMENT LIBRARY

The STARLOG scheme editor is quite versatile and allows a variety of functions to be readily built into a scheme, without the need to write the program instructions that comprise the program which is loaded to a logger.

Unidata loggers are however capable of a greater variety, and more complex schemes than can be built from the scheme editor and the instruments provided with the STARLOG software.

The NIWA Instrument Library is made up of three sections:

- a set of families of instruments that can be added to the Instruments box in the scheme editor. This is the major section of the library.
- a set of custom outputs, which can be built into Events defined in the scheme editor, and executed when the events are true.
- a set of external programs that can be launched from STARLOG.

### 5.1. Library Instruments

Library instruments can be added to a scheme to provide features that require custom programming, which is automatically built into a scheme with the instrument. The custom programming added to the scheme may be simple or complex.

CDT settings required for a scheme are built into the scheme with Library instruments, and loaded to the logger when the logger is programmed. For example, the FLOSY12 instrument will automatically configure a logger's RS232 timeout to 12 sec. Some instruments for schemes where the logger is to be deployed as an SDI-12 sensor will set the relevant CDT addresses to configure the logger as a sensor, and set the number of values to be sent in response to an SDI-12 request, and the addresses they will be sent from.

The instruments that make up the library may correspond to actual hardware sensors, or may be purely “virtual” instruments whose role is to build features into a scheme that are not directly related to particular sensors.

Most instruments provide “channels” that are copied to the scheme editor Log Buffer box, and can be logged. The channels may correspond to quantities that have been estimated on the logger from sensor readings, for example, flow estimated from stage readings, or wind speed statistics are estimated from wind speed readings.

A Library feature common to all hardware instruments, is code that converts raw sensor readings to engineering units on the logger. Data recorded for instruments from UNIDATA’s PDLTRANS.MET list, are logged as raw readings, and converted to engineering units on the PC after the data has been unloaded.

Library instruments corresponding to actual sensors are listed in families named after the environmental parameter the sensors measure. The DEPTH.MET family contains a list of water level instruments.

The UTILITY.MET family contains a number of non-sensor-specific instruments such as “HLBATT”. This instrument is added to a Ecologger Scheme in order to display the external battery voltage. The HLBATT channel provided can be logged, which allows battery voltage at telemetered stations to be monitored remotely.

## **5.2. Custom outputs**

The lower box of the Hardware Window, from which the logger model is selected when a scheme is created, allow “Extensions” to be added to the new scheme. The extension listed as “NIWA-CUSTOM OUTPUT CONTROLS” is part of the NIWA Instrument Library.

Some additional “outputs” that can be built into Scheme events are added to the Events box output list when this extension is selected. They provided options to switch logger control ports,



and the Micrologger or Ecologger UPS on for a fixed number of scans. The outputs can be used to provide warm-up power to sensors prior to a log.

### **5.3. External programs launched from within STARLOG**

The NIWA Instrument Library includes some programs that are listed in the STARLOG front screen **System** drop menu. The most frequently used is identified in the menu as “GENERATE FLOW TABLE”.

The program is run by selecting this menu item. It operates on a file containing a list of stage/discharge pairs and creates a file containing coefficients of a series of quadratic equations fitted to the stage/discharge rating. The second file becomes part of a scheme that estimates flow, from the stage sensor reading, at each scan.

A second external program is identified as “SETUP NIWA ALARMS” in the System menu. This program prompts the operator for station-specific details required for an alarms-capable scheme, and builds files containing alarms code into the scheme.

## 6. APPENDIX A SDI-12 INSTRUMENTS

As well as being a fully self contained instrument the Ecologger can be configured for operation as an SDI-12 sensor with connection via the Auxiliary connector.

### 6.1. SDI-12 Concept

The SDI-12 protocol for interfacing sensors and loggers was conceived by the USGS in 1988 to simplify the wiring and programming involved.

The range of other types of sensor signals include analog, frequency and other types of digital signals.

To accept this range of signals dataloggers need many input channels, and the incoming signals often need to be conditioned (V dividers, current loads, RC filters) to match the logger channels. A variety of excitation voltages also need to be provided by the logger.

By contrast **SDI-12 instruments all have only three leads.** (+12V, G and signal). Since the sensor can have its address set (0-9 possible, 0 is default), up to 10 sensors (extended in later versions) can have their signal wires connected to one logger signal channel.

**No conditioning or other excitation is required. Wiring for SDI-12 sensors is simple.**

The output of other ("**dumb**") sensors (a voltage, current or frequency) is related, according to the sensors calibration, to the magnitude of the parameter being measured, by a linear, or sometimes non-linear, relationship. Having checked that the wiring/signal conditioning are correct, the logger programmer must then ensure that the raw readings from the dumb sensors are correctly converted to their respective engineering units.

SDI-12 instruments are "**Smart**". Prior to installation they can be configured to report the parameter(s) value in the required engineering units, and so programming a logger to read an SDI-

12 instrument is relatively simple. The program instructs the logger to obtain a reading, and the reading sent is already in engineering units.

## 6.2. SDI-12 Technical details

SDI-12 commands and responses are sent in an asynchronous serial mode, via the one bi-directional signal line. Command characters and data are sent at 1200 baud as ASCII characters, at TTL (0-5V) voltage levels.

In response to a program instruction to read an SDI-12 sensor, the datalogger sends two commands to the sensor. The first command is the measurement command, **aM!** (a is the address for the sensor (0-9, default is 0). The sensor with address a responds immediately by sending **attn.** (a is the sensor address, **ttt** is the delay in seconds till the reading(s) will be available, **n** is the number of readings to be sent).

After the period ttt has elapsed, the logger calls the sensor again, with the "data" command **aDO!** (a is the sensor address). The logger responds by sending a string of one or more readings, depending on the number of parameters measured.

The delay before the readings are ready, ttt seconds, is often 5-7 seconds, but may be significantly longer. During this time the transducers are powered up, and after a warm up period, read and processed to engineering units. Because of this finite delay, SDI-12 sensors are generally not suitable for high frequency sampling applications, such as measurement of waves.

SDI-12 sensor manufacturers may define several commands (listed in the sensor manual) in addition to the **M** and **DO** commands, to allow the sensor to be configured.

For example the units and number of decimal places can often be set and the address can be changed. These commands can be sent to the sensor from a PC keyboard by connecting to the sensor via a "level shifter" (converts the PC RS232C voltage levels to TTL levels), or by using a data logger as an interface. Logger software provides a terminal emulator mode called

“Transparent Mode” to allow the latter method. Transparent Mode is simple to learn to use and is useful when setting up a system, or faultfinding an existing system. If transparent mode communication is possible, the datalogger program should be able to communicate successfully with the sensor.

If the sensor will not respond to transparent mode commands, the logger program will also fail.

A lack of response indicates one or more of the following:

- The sensor address being used is incorrect.
- The sensor is not wired to the logger correctly.
- 12 volts is not available at the +12V terminal.
- The sensor is faulty.

### **6.3. Cable length**

Cable lengths between loggers and SDI-12 sensors are normally limited to 60 m.

The maximum operating distances are dependent on cabling quality.

### **6.4. Loggers configured as SDI-12 sensors**

SDI-12 capable loggers or recorders can usually be configured as SDI-12 “sensors” so that readings from the sensors they are connected to, or other derived values, may in turn be read by another SDI-12 “recorder” or “master”.

Examples are:

- The data from one or more Starflows (Doppler Velocity Loggers) measuring velocity or flow in a channel, can be retrieved by a master logger measuring other sensors (such as water quality sensors), which may itself be telemetered.

- A telemetered logger at a flow station may “share” its data with a nearby SDI-12 capable PLC.
- A telemetered logger may share its readings/derived values with an SDI-12 capable dataphone, so that the values may be “voiced” to callers.

## **6.5. Multiple transducers**

An SDI-12 instrument may have one or several transducers

An SDI-12 capable water quality Sonde, comprising several sensors, can be connected to a logger by one set of three wires (+12V, Sig, Gnd) and in response to one data logger instruction, send a string of sensor readings, all in engineering units requiring no further scaling.

The simplicity of SDI-12 is especially notable in the case of multiple transducer SDI-12 instruments.

## **6.6. The impact of SDI-12 to date**

The USGS vision of very simple data loggers with only three terminals has not come to pass.

SDI-12 has been adopted by many manufacturers of hydrometric instruments and more recently water quality instruments. However most environmental monitoring agencies still need to use instruments presenting other types of signals and therefore use data loggers that can accept these signals and SDI-12.

Many excellent SDI-12 instruments are available and offer the envisaged advantages. The ability of loggers to be configured as SDI-12 sensors is occasionally a significant advantage.