Performance Analyser 8:7

Logger Board

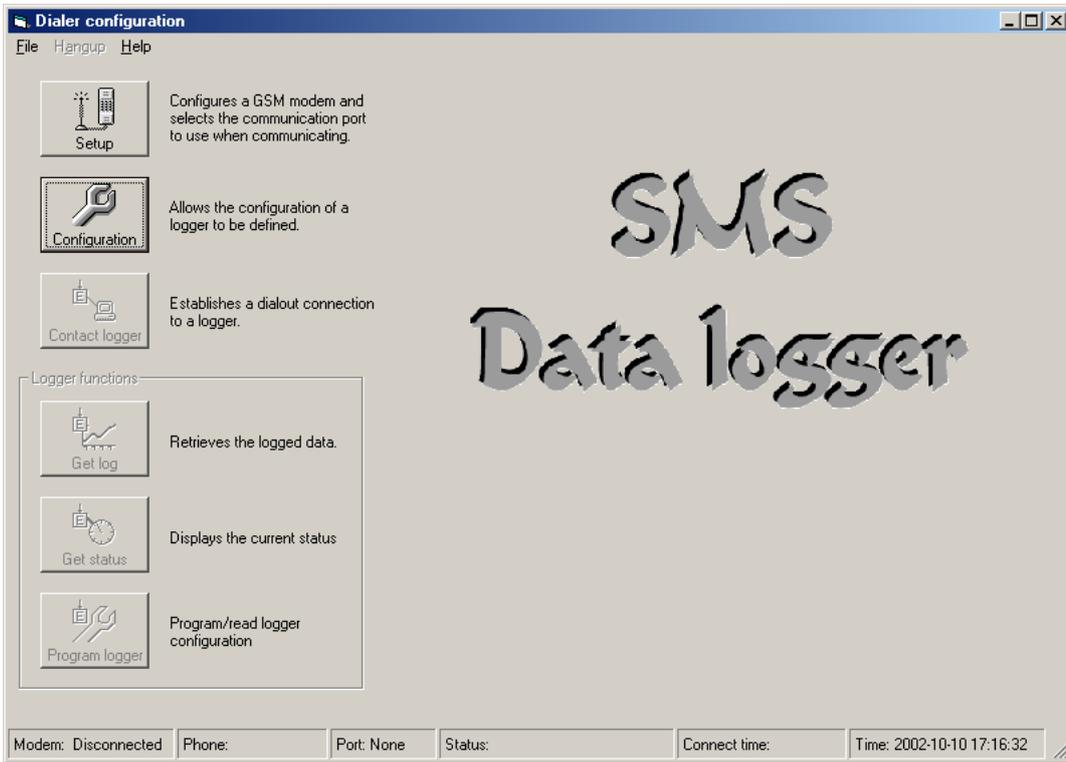# Users Manual

1 January 2005

ClimaCheck

Table of Contents

Main screen

The main screen as shown above has a number of areas.

The left hand side of the screen displays a list of menu buttons not all of which are enabled. The first time the program is started it is necessary to select the com port by clicking the top button.

The next step is to click the **Configuration** button and then either import a logger configuration or save the logger configuration. (The **File** menu also allows you to import or save a configuration.) The com port setting is not restored or saved as part of the configuration.

To select the com port refer to the next section of this manual.

Once the com port has been defined it is possible to contact the logger. Click the **Contact logger** button. If the logger is connected directly to a com port as part of the configuration setup then the **Logger functions** frame will be enabled. Otherwise a dialup session to the logger will be initiated.

The three buttons in the **Logger functions** frame are used to read the logged data, display the current state or program or read the logger configuration.

The bottom line of the screen shows a status bar which has fields for showing a variety of parameters.

Setup and GSM modem configuration

Setup and GSM configuration

Comm port selection
- Com1 Com2 Com3 Com4
- Com5 Com6 Com7 Com8

Baud rate
- 9600 baud   57600 baud

Set Com Port

Dialout modem initialisation

Enter here any additional commands required to configure the modem. This should only be necessary for non-standard modems.

Configure GSM Modem

Configuration of the GSM modem requires that it is connected directly to the PC with a straight through modem cable. This configuration only needs to be done once.

The setup and modem configuration screen allows the selection of the com port which should be used for communication. It also allows the communication speed to the Nudl/Wudl to be switched from 9600 to 57600baud. Click the desired port in the **Comm port selection** frame and select the correct communication baud rate and then click the **Set Com Port** button. The selected com port must be set each time you want to communicate with a Nudl. If you don't match the communication speed of the Nudl to whatever it is connected to then you won't be able to talk to it.

Note that this selection of baud rate ONLY applies when you are directly connected to the Nudl. If the connection is made via a dialup phone connection then the program will always set the communication speed to the modem connected to the PC to 9600 baud.

The GSM modem is usually preconfigured before shipping but it is possible to configure it using this program. Connect the modem to the correct com port using a standard modem cable and then click the **Configure GSM Modem** button. This will identify the modem and configure it for use with the logger. If the modem is not a standard supported modem then there is the capability of entering other AT type commands by typing them in the **Dialout modem initialisation** box. Note that it will be necessary to refer to the manual which comes with the modem to find out what commands need to be entered. Commands should be entered without the **AT** prefix and multiple commands can be entered.

WARNING: Do not try and configure CDMA modems with this program as they have a different command set to GSM modems. Attempting to configure a CDMA modem will almost certainly make it impossible to work with a Nudl.

The GSM modem should be set to 9600 baud, 8 data bits 2 stop bits, no parity. It is also necessary to disable handshaking and error correction. Auto answer should be enabled to allow remote connection to the logger. The modem should also be set to quiet mode with no local echo. Note that many of these commands are completely standard and do not need to be entered as they are already built into the configuration process.

General configuration

The **General** tab allows you to set some configuration parameters for the logger.

You can set whether the frontend program is going to communicate directly with the logger over RS232 link or whether a dialup connection should be made. To make a direct connection check the **Direct connection to a PC port** checkbox. To use a dialup modem uncheck this box and enter the phone number in the **Phone number** field.

The logger will attempt to send a failed SMS message a number of times. Both the number of retries and the time the logger should wait between retries can be set by the configuration screen. Due to the nature of the SMS message service, it is recommended that the time between retries should not be less than 30 seconds. The maximum time between retries is 255 seconds.

When a mechanical switch changes state (ie changes from OFF to ON or vice versa) the spring action together with the flexibility in the contacts results in the contacts making and breaking contact several times before reaching their stable positions. This bouncing action causes the switch to close and open rapidly for a short period of time, typically 10-20mS. This gives the effect of repeated opening and closing the switch. The digital inputs to the logger can be optionally debounced. Debouncing should be enabled if the inputs are connected to a physical switch. Debouncing increases the time for recognition of a switch closure from under 1 sec to between 2 and 3 seconds.

The logger has an inbuilt counter which counts the number of SMS messages sent in a day. Each time a new alarm is sent this counter is incremented (sending the same alarm to a number of different telephone numbers counts as sending a single alarm). When this counter reaches 50 the alarm system is disabled and no further alarms will be generated. This check can be activated by checking the **Enable internal alarm limit on sending messages**. Note that this count does NOT include replies to incoming SMS messages. Once disabled, the logger will reset this counter at midnight. The alarm system status can be determined by sending the SMS "S' command to the logger. The alarm counter can be reset at any time by either re-programming the logger or by sending the SMS "A" command

The logger can just save the data in a log file or it can, in addition, send the logged data out of the serial port as a comma delimited (csv style) data packet. To enable this serial transmission of data check the **Send logged data to serial port as it is recorded** checkbox. For a GSM modem the only data sent is the actual logged data. For an ETM9500 modem the logged data will be sent as a GPRS packet. Note that if you enable this transmission of data then while the logger is sending data you won't be able to talk to it. This isn't likely to be obvious or cause any problems provided the logging interval is greater than 30 seconds or so. If the logging interval is very short, in the order of seconds, then it might prove difficult to establish communications with the logger. The device serial number is unique to each logger. If the **Send logged data to serial port as it is recorded** checkbox is checked then the device serial number is output as the first character string sent. This will have most of the leading 0's blanked. There is a comma after the serial number. There is some control over how the data is sent out the serial port. If the **Format time** checkbox is checked then the time data will be sent as *2003-05-03 12:23:45* but if the **Format time** checkbox is not checked all formatting will be removed and the time sill be sent as *20030503122345*. Similarly if the **Include units** checkbox is checked then units information will sent after each value. If this checkbox is not checked then the units information will not be sent. If the sent data is to be sent to an Excel spreadsheet it is highly recommended that you do not check the **Include units** checkbox. If the **Compressed** checkbox is checked then the data will be sent in binary rather than ASCII. This produces the maximum compression but you will need to use a program to decode the data. The **Include alarms** option allows the logger to send both data and alarms as they are logged. If this box is checked, then the format for the sent data includes an identifying field after the time. The identifying field will contain a **D** for a data field or an **Axx** for an alarm, where **xx** is the alarm number.

The **GPS system used** checkbox is used to tell the program that it can expect the logger to send position information. Most GPS receivers send the NMEA data at 4800baud but there are few which default to 9600 baud. By checking the **9600 baud** checkbox you can make the logger communicate at 9600 baud to the GPS system.

5

The **Nudl** and the **Wudl** option buttons allow you to select the type of Nudl you are configuring (For ClimaCheck Performance Analyser 8:7 it should be set to Wudl-Pt). Once you connect to a logger the type will be automatically detected and you cannot change this until you have hungup the connection.

The **Modem type** panel tells the logger what sort of modem it is connected to. The ETM9500 is a GPRS enabled intelligent modem and by selecting this type the logger will attempt to open a GPRS connection and transfer data via GPRS. This requires that the modem can connect to a fixed IP address. Transmission can be either via UDP or TCP protocols. Check the **UDP** box to select the UDP mode. Note that the mode selected must match the configuration of the ETM9500 modem. When the modem connects to the GPRS network and the Nudl is configured in the *Send data* mode there can be a backlog of data to be sent. This data will be automatically sent. You can change the time between sending successive records by the **Packet delay** textbox. The delay can be set from 1 to 8 seconds. In UDP mode this should not be less than 2 seconds otherwise there can be data loss. **DV24** (digital variable 24) is set while backlogged data is being sent. You can use this variable together with a delay function to control power to the modem. If the modem is powered off after all logged data is sent then you MUST check the **Disconnect on DO1 off** checkbox and use DO1 as the power control to the modem. This simulates a disconnection of the GPRS network. This allows the Nudl to stop sending data as it is received and store a bookmark as to when the last lot of data was sent. If you don't follow this procedure then the Nudl will quite happily assume that it can still send data to the disconnected GPRS network and when the connection to GPRS is restored there will be NO saved data sent. When using a GPRS network you can control the time delay between sending individual data frames which have already been saved to the log (ie when the GPRS connection has been lost). You can set a time delay between 1 and 8 seconds. Having too short a delay can cause a problem with data loss where the modem has not had time to send the previous frame before a new frame has been sent to it. In general, a 2 second delay will avoid this problem. You change the delay time by entering the desired delay in seconds in the **Packet delay** box**.** The **CDMA** option allows alarms to be sent out using a CDMA phone. Note that this modem should NOT be configured with the frontend.

The Nudl/Wudl can have its communication speed changed from 9600 to 57600 baud. You select the communication speed by selecting the desired communication speed by selecting either the **Nudl set to 9600 baud** or the **Nudl set to 57600 baud** option. Baud rate changes will only take effect after the device has been re-programmed with the updated configuration AND the device has had its power removed and re-applied.

The **File import/export** panel allows you to save the entire logger configuration to a file or load a previous configuration file. This will also save/load the phone number and com port details.

To export a logger configuration

Click the **Save configuration** button and select the file name and directory as per normal Windows methods in the popup window. Click the OK button when finished.

To import a logger configuration

Click the **Import configuration** button and choose the file name. Then click the OK button.

NOTE:
The logger configuration entered into the various tabs and fields in the configuration is volatile. It will not be saved to disk unless you actually click the **Save configuration** button.

It is highly recommended that before attempting to contact a logger you import the logger configuration or immediately after contacting a logger you read the logger configuration. Doing this will avoid confusion if you look at the logger configuration.

Using the Phonebook

The configuration system includes a simple phonebook which you can access through the menu on the front screen. Clicking the menu brings up the Phonebook:
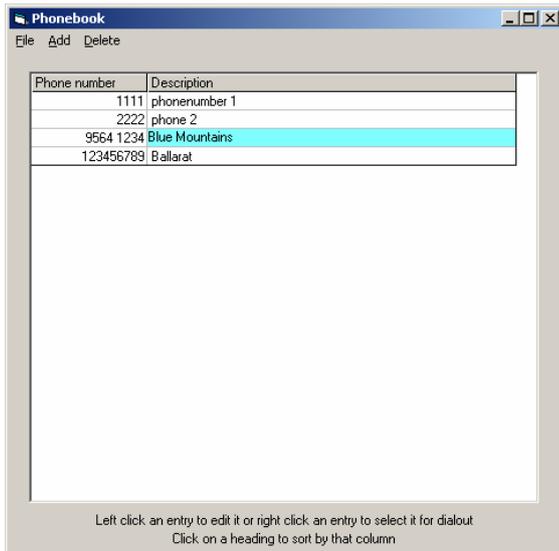
You can **edit** an entry by clicking the appropriate cell in the grid using the left mouse button. This will change the cell background colour to cyan. Type in or edit the test and then press the *Enter* key to save the changes.

To **add** a new phone number click the **Add** menu. This will bring up a new, blank line at the end of the list and then you can edit the entries.

To **delete** a line click the line using the left mouse button and then click the **Delete** menu item. This will remove the row.

You can **Sort** the phonebook by clicking on the top row in the desired column. Clicking **Description** will sort the list on that field in an ascending order.

To **Select** a given entry for dialing, click the row using the right mouse button. This will copy the phone number to the phone number field in the General tab of the configuration menu.

When you close the form either by clicking the corner **X** or by selecting the **File/Exit** menu the phone book will be saved in an ascii file called *Phonebook.txt*. You can edit this file with a text based editor such as *Notepad*. The format of the file is:

Phone number Tab Description

There is one entry per line and you must use the *Tab* key to separate the entries. There are no restrictions on what characters can be placed in either field. It is up to the user to ensure that the phone numbers are valid as no checking is done.

Setting the Site message/ PIN number and Phone numbers

These parameters are set using the **Set Site/Phone** tab.

Time schedules	Exceptions	Logic functions	Delay/Counter	Alarms
General	**Set Site/Phone**	Input config	Input trip levels	Output config

Internet connection - ETM9500 only

IP address 192.168.25.25   Port 2049

SMS call centre number +61418706700

Site message for all alarms Factory test

PIN code for SMS messages APIN

	Phone number	Enabled	Weekly schedule
1	111	Yes	Always
2	222	Yes	Always
3	333	Yes	Always
4	444	Yes	Always
5	555	Yes	4
6	666	No	5
7	777	No	Always
8	888	No	1

The **Internet connection** frame is enabled if you have selected the ETM9500 modem type in the **General configuration** tab. This frame allows you to enter the FIXED IP address of the device the ETM9500 modem should connect to. The port number is fixed at 2049.

The **SMS call centre number** is only required if the SIM card in the modem hasn't been configured on purchase.

The **Site message** consists of up to 16 characters. Type the message into the **Site message for all alarms** field. This message will be sent at the start of all SMS messages.

The **PIN code** is the access code which has to be entered at the start of a SMS message to the unit.

The PIN code is case sensitive and can consist of any alphabetic, numeric or symbol code which can be sent by a GSM mobile phone. The 4 characters thus allow a total of about 40,000,000 combinations. Type the characters in the **PIN code for SMS messages** field.

There are 8 possible phone numbers where alarms can be sent to. Each phone number can be individually enabled or controlled by a weekly schedule.

You enter a phone number by clicking on the field to bring up the cyan editing box. Type the phone number in and press the Enter key or select a new field with the mouse. Phone numbers can be up to 16 digits long.

You **enable** or disable a phone number by clicking on the entry in the **Enabled** column.

You assign a weekly schedule to a phone number by clicking in the **Weekly schedule** column and selecting one of the entries from the drop down list. An entry of **Always** means that the phone is always enabled and not controlled by a weekly schedule.

Analogue inputs

Each analogue input has a resolution of 12 bits (1 part in 4096) and can be configured to operate as either a 4-20mA, a 0-2.5V or a 0-5V input. When operated as a 4-20mA input the logger will drop about 3.5V across it's input terminals at 20mA. When operated as a 0-2.5V or 0-5V logger it is essential to ensure that the voltage on the analogue inputs does not exceed 6V under any circumstances otherwise damage may result to the logger. The inputs are protected against transients. Negative voltages should not be applied to the logger.

The logger always displays the measured analogue value in terms of engineering units. These must be chosen so that the maximum and minimum values are in the range of -9999 to +9999. You can adjust the scaling using the appropriate choice of units. To configure the logger inputs refer to the section on *configuring analogue inputs*.

The logger has a powerful set of internal functions which accept Digital inputs (On or Off). To convert the analogue inputs to something which can send alarms or which can be used in internal functions, it is necessary to have some transformation function to convert the analogue value to a Digital value. There are 4 different conversion functions provided. Refer to the section on *configuring analogue trip levels*.

There are 2 types of addon board which can be used to extend the number of analogue inputs. The standard board just adds an extra 4 inputs. These are identical to the inputs on the baseboard. The programmable gain addon board provides 4 analogue inputs which are true differential instrumentation type inputs and have a programmable gain amplifier. This allows each of these inputs to be set with a fullspan ranging from 2.5mV to 10V. Each input can be set to a different gain. Note that the GPS positioning system cannot be used with this board. By placing a shunt resistor across an input that input can be configured as a 4-20mA input.

Wudl-PT analogue inputs

The Wudl-PT has 8 PT1000 analogue inputs (AI1 through AI8). These have a fixed range of -50 to +150°C and require the sensor to be connected from the input to an adjacent ground pin. There are also 7 general purpose analogue inputs (AI9-AI15) with a range of 0-2.5V but this can be switched by software to a range of 0-5V. The first 3 of these inputs (AI9-AI11) can be software switched to a 4-20mA range as well while the other 4 (AI12-AI15) require jumpers to be inserted to convert them to 4-20mA.

Wudl analogue inputs

The Wudl has 8 analogue inputs with a range of 0-2.5V. These inputs can also be converted to 0-5V inputs by inserting a jumper. 3 of the inputs can be software selected to be 4-20 mA and the other 4 require jumpers for this selection.

> **Kommentar:** Is this correct I believed that they are software switchable between 0-2.5 and 0-5

Configuring analogue inputs

	Input type	Input range	Zero	Full scale	Units	Log
1	Volts	0 to 2.5V	0.00	14	pH	Yes
2	Volts	0 to 2.5V	0.00	2345.	kPa	No
3	Volts	0 to 2.5V	0.00	100	RH	Yes
4	Volts	0 to 2.5V	0.00	250	degC	No
5	Volts	0 - 2.5mV	-50.	100.00	degC	No
6	Volts	0 - 5mV	20	40	degC	No
7	4 to 20mA	0 - 10mV	0.00	100.00	degC	No
8	Volts	0 - 2.5V	0.00	100.00	degC	No

The input calibration for the analogue inputs is set using the **Input config** tab in the Configuration screen. This screen displays the list of inputs and the zero and full scale values for each inputs and the units appropriate to that input. To change a value click on the field. In the case of the Input type field the input type will change from Volts to 4-20mA.

The **Input range** column is fixed at 0 to 2.5V for inputs 1 through 4. For inputs 4 through 8 refer to the section **I/O expansion board installed** later in this section.

For the zero, full scale and units fields a cyan box will appear and you can type the desired value into this box. Pressing the Enter key or selecting another field will enter the data. The units can be any characters up to a maximum of 6. Note that you cannot use symbols as these are not standard characters and cannot be displayed on mobile phones.

Sensor powerup time

Before an analogue to digital conversion is made, the sensor power output is powered up. You can change this time from a minimum of 20ms to a maximum of 65seconds. Choose a value which is long enough to allow the sensor to stabilise it's output to within 0.05%. If you are not using the switched output supply you can set this value to 0.

Analogue input sampling interval

The analogue inputs are normally sampled every second but you can change this. The reason for changing this parameter is if you are trying to save power usage and if the sensor powerup time is longer than 1 second.
Notes:
1. If you use the analogue inputs to generate alarms the alarms cannot be generated more rapidly than this interval.
2. If you are logging the inputs then the sensor powerup time plus the analogue input sampling interval must be less than the logging interval.

Average samples over log interval

The value saved in the log can either be the instantaneous value at the time the log is recorded, or if this box is checked, it is the average value over the time between the last log sample and the current sample. Note that the alarm values saved in the log and the values read out by the status command or via a SMS message are always the instantaneous value.

I/O expansion board installed

This checkbox only affects how analogue inputs 5 through 8 are displayed. These inputs are located on the expansion board. If the checkbox is not checked then these inputs are displayed greyed out on various forms. These inputs can still be configured or used in functions. Without the expansion board installed the behaviour of any function using these inputs can be erratic. This checkbox also greys out digital outputs 2 through 6 as they are also only located on the expansion board.

If you check this checkbox you then have the option of selecting the type of addon board used. If the **Programmable gain** checkbox is unchecked then the system assumes the type of addon board provides 4 analogue inputs identical to those on the baseboard. You cannot change the range from 0-2.5V. If this box is checked then if you click an entry in the **Input range** column for inputs 4 through 8 a popup list will appear allowing you to select the fullscale range for that input. Click on the desired range. Note that you can still select inputs 4 through 8 to be 4-20mA type inputs. You will however need to place a shunt resistor across the input. The size of the shunt resistor is such as to make the input voltage the selected fullscale value with 20mA flowing through it.

Logging of inputs

The configuration screen also allows you to choose which analogue inputs you want to log and how often you want to log them. Click an entry in the Log column to enable or disable logging for that input. In the diagram above inputs 1 and 3 will be logged.

The **Logging interval** frame allows you to choose how often an input is logged. If you choose one of the minute times then logging will occur at the cardinal times (eg every 30 minutes at 9:00, 9:30, 10:00 etc). If you choose the Secs option, then logging will occur at the set intervals but the starting time is not locked to any particular second or minute. You select the logging interval by typing a value into the **Log interval** field. The log interval can be anywhere from 5 seconds to 255 seconds.

For the Secs logging, the data will be lost if power to the logger is removed. For minute logging the data is left in memory even in the absence of power. If the system is switched from seconds logging to minute logging then the previously recorded seconds logging will be saved in permanent memory immediately after the next minute log. Every 15 minutes when using seconds logging the data is saved permanently in memory. Thus if you lose power the most data that can be lost is the last 15 minutes worth.

The logging interval can be changed to an alternate value dynamically. The selection of the logging interval is determined by the state of a selected point. This can be any analogue input, digital input, digital variable or time schedule. If the selected point is **True** then logging will be at the interval selected by the righthand selection drop down box and textbox. If the selected point is **False** then the logging interval is controlled by the lefthand selection. To choose the controlling point click on the **Interval controlled by** box and choose one of the options in the popup panel.

If the logging interval in the lefthand panel is disabled then the only logging which will occur is that controlled by the selected point. This allows the system to be configured to only log at certain times during the week or when an external or internal event occurs.

Configuring analogue trip levels

To convert the analogue input value into a Digital value which can be used to generate an alarm or which can be used in an internal function requires a transformation function. The screen at the left shows the 4 possible methods of converting the analogue value to a Digital value. There are 2 basic operations, viz a switch and a window. The switch function compares the input value with a fixed value. If the input is higher than the fixed value the output is **True** or **On**. If the input is less than the fixed value the output is **False** or **Off**. If the input wanders around the fixed value, it is possible to get rapid changes of output state. To solve this problem hysteresis is used. Hysteresis modifies the algorithm. Once the input is greater than the fixed value the output is **True**. It remains True until the input falls below the fixed value minus the hysteresis value at which stage it becomes **False**. Thus the input can have some noise on it without making the output continually change state. The amount of hysteresis to select depends on the amount of possible noise on the input signal. In the case of the switch function, the output becomes True when the input is greater than the **Upper** trip point and only goes False when the input falls below the **Lower** trip point.

	Lower	Upper	Hyst's	Units	Discriminator mode	Delay
1	5	8	0.5	pH	Input above upper limit	5
2	500	2000	20	kPa	Input above upper limit	0
3	50	75	10	RH	Input above upper limit	0
4	45	186	4.7	degC	Input above upper limit	0
5	-10	4	1	degC	Above upper/below lower	20
6	25	30	1	degC	Between lower and upper	0
7	0	100	1	degC	Above upper/below lower	0
8	0	100	1	degC	Between lower and upper	0

How inputs are set and cleared

	Input set	Input cleared
Normal switch	When input is above the upper trip level	When the input falls below the lower trip level
Inverted switch	When the input is below the lower trip level	When the input is above the upper trip level
Normal window	When the input is above the upper trip level or below the lower trip level.	When the input is below the upper trip level minus the hysteresis and the input is above the lower trip level plus the hysteresis
Inverted window	When the input is above the lower trip level and below the upper trip level	When the input is above the upper trip level plus the hysteresis or the input is below the lower trip level minus the hysteresis.

Vup — SET
— Unchanged
Vlo — Cleared

The **Inverted switch** works in exactly the same way but now the output becomes True when the input is **Below** the Lower trip point. The input has to go above the **Upper** trip point to become False.

The **Window** function works by having the output going True whenever the input is either **Above** the **Upper** trip point **OR** it is **Below** the **Lower** trip point. In the case of the window function we need an additional value for the hysteresis. The hysteresis is applied to both the Upper and Lower trip points. Once true the input has to go below the upper trip point minus the hysteresis and it has to be above the lower trip point plus the hysteresis to become False again.

The **Inverted window** is basically just the opposite of the window. Here the input has to be above the lower trip point and below the upper trip point to be True. It becomes False whenever the input is above the upper trip point plus the hysteresis or is below the lower trip point minus the hysteresis.

You set the **Upper**, **Lower** and **Hysteresis** values using the **Input trip levels** tab. Click in one of these 3 columns to be able to change the value. Clicking in the column will bring up a cyan editing window. Type the desired data in this field and press the Enter key or select another field to commit the change. The Units field cannot be changed. You must change this from the **Input config** tab. You select the type of function by clicking in the **Discriminator mode** list. That will bring up the form displaying the list of possible operations. Choose the desired operation by clicking the desired option button.

The **Delay** field allows you to set a delay on how long the input should be in the "alarm" condition before the output will become True. The input has to be in this state for the entire delay time. Any transition to a "not in alarm" state will reset the time delay. The time delay is set in seconds and can range from 0 (no delay) to 255. You would typically use the delay if the input is likely to wander around with noise and the hysteresis required cannot be set to take account of this change in the input level.

Variables

Variables are internal to the logger. They store the outputs of the various functions so that they can be referenced by the inputs of the various functional blocks. Each function drives a dedicated variable. The list of these variables can be displayed using the **Input type selection** form.
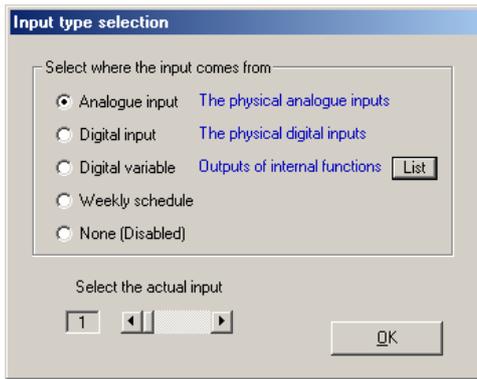
Click the **List** button to display the list of variables.

Clicking an entry in the list will automatically close the **List of variables** window and set the variable number in the **Input type selection** form.

Note:
In the Nudl, digital variables DV19, 20 and 21 are internally mapped to digital outputs 7, 8 and 9. These are not physical outputs and cannot be accessed other than by SMS commands or the frontend status screen. They can be used to provide manual overrides.
In the Wudl, digital variables DV19, 20 and 21 are internally mapped to digital outputs 8,9 and 10.

Appendix A gives the list of digital variables for both the Nudl and Wudl.

Time schedules

Time schedules are objects built up from a basic list of times with an action (either **On** or **Off**) associated with each time. You can have up to 8 items in the list. These basic time/actions are then combined to form **Daily schedules**. You can have up to 8 time/actions per schedule and you can have up to 4 daily schedules. The daily schedules are then combined to form a **weekly schedule**. This specifies which daily schedule should be used for each day of the week and for public holidays. There can be up to 6 different weekly schedules. The weekly schedules can be used as inputs to logic, delay, outputs, counters and alarms.

To configure the time scheduling you start by clicking the **Time schedule** tab. The screen shows 8 time/actions and 4 daily schedules.

Interpreting Times/Actions and Daily Schedules.

Looking at *daily schedule* 1
At midnight all actions are set to Off.
It stays Off until 9:00 when it turns On.
It stays On until 10:20 when it turns Off.
It stays Off until 12:00 when it turns On again.
It stays On until 17:00 when it turns Off.
It then stays Off until midnight.

Daily schedule 4 will be Off at midnight and remain Off until 9:00 when it turns On. It stays On until 19:30 at which stage it turns Off and stays Off until midnight.

The weekly schedules are built up from the 4 daily schedules. Taking weekly schedule 1 as an example. On Mondays through Fridays it will follow daily schedule 2 but on weekends and public holidays it will follow daily schedule 2. Likewise, weekly schedule 3 follows daily schedule 3 for the entire week but on public holidays it follows daily schedule 1.

To create the Time/Action list.

Start by entering the times. Click in the field and enter the desired time in the cyan window.
Click another field or press the Enter key to save that time. Note that the list is sorted in hours each time you enter a new time.
Once all the times have been entered you then click the **Action** field to toggle the action from On to Off to On.

To create the Daily schedules

Click on the desired field to add or delete it from the schedule. An **X** indicates that the Time/Action should be a member of that schedule.

To create the Weekly schedules

Click in the desired field and select one of the 4 schedules that appears in the drop down list box.

Daylight saving

The logger internal clock can be programmed to work in daylight saving or normal time. If the **Enable daylight saving operation** checkbox is checked then the logger internal clock will switch to daylight saving time at 2am on the start date and switch back to normal time at 2am on the end date. The start and end dates are selected by clicking the appropriate button and then selecting the day by single clicking in the popup calendar. When operating in daylight saving mode all times are displayed in daylight saving time. For this to operate correctly it is imperative that the programming PC clock is also set to daylight saving time. Any mismatch between the PC and logger daylight saving clocks will cause a problem.

Note that when in daylight saving mode even though the displayed times are in daylight saving time the logging still works in normal time. If this did not occur then there would be 2 entries at the same time for all logs between 2am and 3am on the day daylight saving starts and there would also be a 1 hour gap when daylight saving ends. When reading back the logs though the displayed times are corrected for daylight saving so the displayed data will contain duplicate times at the start of daylight saving and have a gap at the end of daylight saving. It is up to the user to correct for this.

Exceptions

	Holidays
	Date
1	2002-12-24
2	2002-12-25
3	2002-12-26
4	2002-12-31
5	2003-1-1
6	
7	
8	

Delete date

January 2003

Mon	Tue	Wed	Thu	Fri	Sat	Sun
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Today: 05-Nov-02

Holiday date range

	Starting date	Ending date
1	2002-12-20	2003-01-28
2		
3		
4		

Exceptions are a list of dates which override the normal weekly schedule. Basically they are made up of public holidays and other special days. You display the list of exceptions by clicking the **Exceptions** tab.
To add a new date just click the day in the calendar.

To delete a date select the date in thelist and then click the **Delete date** button.

The list is automatically sorted whenever a date is added or deleted.

Note that the logger will automatically delete dates from it's internal list when the current day is after the exception day.

The **Holiday date range** allows the setting of more than a single holiday date. There are 4 date ranges available and if the current date is greater or equal to the starting date and less than or equal to the ending date then the current date is taken as a holiday.

To set a starting or ending date click the desired entry in the table. This will cause the selected cell to go cyan and the calendar background will go cyan as well. Select the desired date and single click it. The background colours will revert to white and the selected date will appear in the cell.

Digital Input/Output configuration

There is one output on the Nudl base board. This output is an open drain MOSFET and can sink a maximum current of 500mA at a voltage of 30Volts. The expansion board adds another 5 outputs each of which can sink 100mA. 4 of these outputs can be configured as Digital inputs. The Wudl has up to 7 outputs and up to 16 inputs as shown in the screen capture below. I/O 1 is always an output. I/O 2 through 7 can be individually configured as an output or an input. The Wudl-PT has 3 digital outputs (DO1 - DO3) and 8 digital inputs (DI1 - DI8).

	Time schedules	Exceptions	Logic functions	Delay/Counter	Alarms
	General	Set Site/Phone	Input config	Input trip levels	**Output config**

I/O	Source	Direction	Log	Reset	Scale	Units	Limit	Cnt/Freq	Chg State
1	Alarm	Output	No						0
2	AI 1	Output	No						0
3	DV 1	Input-Hi	No	No	1.234	kg		25 Cnt	
4	AI 3	Input-Lo	No	No	532	Hz		700 Freq	None
5	AI 2	Output	No	No			0	0	0
6	DI 6	Input-Hi	No	No			0	0	None
7		Output	No	No	1		0	0	Rising
8		Output	No	No	1		0	0	Falling
9		Output	No	No	1		0	0	Both
10		Output	No	No	1		0	0	0
11		Output	No	No	1		0	0	0
12		Output	No	No	1		0	0	0
13		Output	No	No	1		0	0	0
14		Output	No	No	1		0	0	0
15		Output	No	No	1		0	0	0
16		Output	No	No	1		0	0	0
17		Output	No	No	1		0	0	0

☑ Enable change of state logging of digital inputs

Early warning of impending frequency or counter limit (applies to all inputs): 0

DV 23 will clear the counters   DI 6 is the input to the edge detector

Any output can be driven by any Digital input, Digital variable, analogue input or weekly schedule. You configure an output by clicking on the desired entry in the list of Sources. This will bring up the **Descriptor** form.
Select the type of input from one of the 5 listed. Then select the actual input for that type by using the slider bar..
Click the OK button.

Input type selection

Select where the input comes from
- ● Analogue input   The physical analogue inputs
- ○ Digital input   The physical digital inputs
- ○ Digital variable   Outputs of internal functions [List]
- ○ Weekly schedule
- ○ None (Disabled)

Select the actual input
[1] ◄ ▒ ►   [OK]

Note:
The loggers support an additional 3 digital outputs. These are not physically present in hardware though. Digital outputs 7, 8 and 9 are mapped internally to digital variables DV19, 20 and 21. (On the Wudl the digital outputs are 8,9 and 10). The only way on controlling these outputs is via SMS commands or by the Status configuration screen in the frontend program. These variables allow the system to configured to allow manual input to logic and other functions. This enables the provision of a manual override to functions.

Selecting the polarity of the digital inputs - rev 1.58 or later firmware only

A digital input can be in one of 2 states *On* or *Off* (or *True* or *False*). This internal logic state has to be mapped to the real world. In the real world we can have an *On* state represented by a high voltage or a low voltage or by a pair of normally open or normally closed contacts.
Let's look at how a digital input can be used. We can either enable or disable the onboard pullup (Wudl and Analyser only. The Nudl does not have pullups).
If we enable a pullup on a digital input then the voltage level on that input is high. If we now connect a set of normally open (NO) contacts across the input then when the contacts close the input goes low. In this case we probably want a low input voltage to represent the *On* state. If however we connect a set of normally closed (NC) contacts across the input then when the contacts open the voltage level goes high and we usually want this high level to represent the *On* state. This is opposite to the previous case.
If we don't use the onboard pullups, as a way of saving current consumption, then we have to supply a voltage to the input to control it's state.
The Nudl family allows you to select whether a high voltage (high means about 2.5Volts) to represent either the *On* or the *Off* state. When you click an entry in the second column it toggles between *Output, Input-Hi* and *Input-Lo*. (In the case of pins which are input only then the *Output* option will not appear). *Input-Hi* means that a high level input will be treated as the *On* state.

Minimising current consumption

If you need to minimise the current consumption then it is recommended that you do not use the onboard pullups as these draw a standing current. In this case you need to supply a voltage, referenced to ground, to control the state of an input. Minimum current consumption will occur when the voltage level is kept below about 2.5Volts. Input voltages above about 2.5Volts will start to turn on the input protective circuitry and hence will have a current drain. In order for an input to be turned off the input voltage level must be below 0.8Volts. To guarantee an input to be turned on the input voltage must be above 2Volts.
The optically isolated inputs in the Wudl and Analyser are basically current driven inputs. The output of the optocoupler is high when no current is being passed through the coupler. To turn the coupler on and have the output fall below the low level threshold requires a current of about 100uA.

Logging of inputs

Each pin configured as a digital input has a 32 bit counter associated with it. This counter increments each time there is a positive going change of state on the input pin. You can save the counts on each input in the system log. To enable a counter to be logged, click on the appropriate line in the **Log** column above. The counts are saved whenever the system enters a new set of analogue values into the log. The entry for the **Log** column will cycle through 3 different choices.

- **No** - The input will not be logged
- **Yes** - The input will be logged
- **Init** - The input will be logged. Whenever a pulse is detected on this input a new entry will be written into the log memory. All inputs marked to be logged will be saved. The maximum rate at which logs can be saved is once per second. Each log record is timestamped.

The logger provides the option of resetting the counts on an input to 0 whenever the counter is logged. This is controlled by clicking the appropriate entry in the **Reset** column. If the entry is **Yes** then the counter will be reset after the current value is logged.

Scaling of input counts

The logger supports the optional scaling of what a count represents. If the entry in the **Scale** column is 0 or a blank then the counts are not scaled. To use this scaling just enter what each count represents. The system accepts up to 2 decimal places. There are limits on the maximum number that can be displayed. This must be less than 1,000,000. In general that doesn't cause any limitations as you can use scaling in units as kilo, Mega etc. Note that as the maximum count is 4,294,967,295 and the biggest number that can be displayed with scaling is 999,999.99 you must set the scaling factor to an appropriate level. In general this isn't likely to cause any problems if the counts can get to such a large value. The **Units** column allows you to display the units after the actual value. The units can be up to 4 characters in length.

Counter limits

Each counter has a limit value. If the counts in that input are greater than the limit value a digital variable will be set, otherwise the variable will be cleared. You can use these digital variables in any of the functions which support variables. The counter limit can be switched from the counts to a frequency measured as pulses/second. Click the entry in the **Cnt/Freq** column to select which sort of limit to use.

Change of state logging

Digital inputs are logged at routine intervals together with the analogue values. You can also enable an input to be logged whenever a change of state occurs on that input. You select the edge by clicking in the righthand column for the appropriate row and this brings up a dropdown list. Select the desired edge from the list. You must also check the **Enable change of state logging for Digital Inputs** box to enable change of state logging. Inputs logged when they change state can be retrieved from the log without reading any other logged data.

Clearing of counters

The counters can be cleared via logic as well as by being reset whenever a log is taken. In the screen shot shown above whenever **DV23** becomes True (or set) all counters will be cleared. They are cleared when DV23 becomes True and DV23 staying True will not prevent the counters from incrementing. You can select what, if anything, should reset the counters. Click in the text box to bring up the **Input type selection** form.

Edge detection

The Nudl and Wudl both have edge detector logic built into their firmware. This allows latching inputs, clearing counters etc to be done on the rising edge (ie when the selected source changes from False to True). The output of the edge detector is digital variable 23. DV23 will go True (high) for 1 second when an edge is detected. The edge detector works after all other functions have been evaluated.

Logic functions
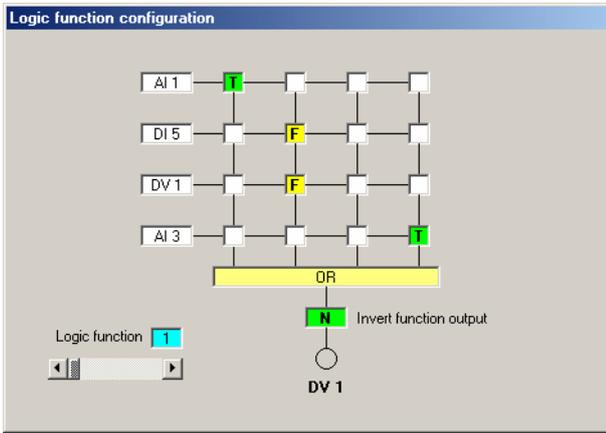
The logger has 8 logic functions. Each function takes up to 4 inputs and feeds them into an AND/NOT array. The inputs to each term in the AND array can be logically inverted. The output of each function can also be inverted so that True becomes False and vice versa.

The screen shot at the left shows a typical logic function. The vertical columns represent the AND function on the inputs and the output of each of these columns is OR'd together. If any one column is true then the output of the function is True.

In the example shown, the inputs are Analogue input 1, Digital input 5, Digital variable 1 and Analogue input 3. The output of the function is not inverted, indicated by the **N** in the **Invert function output** box. The output of the function drives Digital variable 1 and this cannot be changed. The logic function implemented becomes True when either AI1 is true (first column) OR when DI5 is false AND DV1 is False OR when AI3 is True. We can write this in symbolic form as:

$$\text{Output} = \text{AI1 } \mathbf{OR} \text{ } (\mathbf{Not} \text{ DI5 } \mathbf{AND} \text{ } \mathbf{Not} \text{ DV1}) \text{ } \mathbf{OR} \text{ AI3}$$

To select the inputs
1. Click on one of the lefthand boxes to bring up the **Descriptor** form.
2. Select the type of input you want by clicking on one of the option buttons.
3. Select the actual input by using the slider bar.
4. Click the OK button when you have finished.
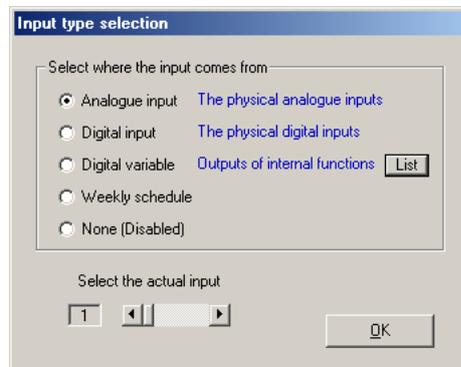
To configure the AND functions
Click in the box at the intersection of the black lines. Each time you click it, the text will cycle through the sequence **T F blank**. A **T** means that the input has to be True, a **F** means that the input has to be False and a **blank** indicates that the input is not used in this AND function.

Clicking in the **Invert function output** box toggles the invert of the function. An **N** indicates that the function output is not inverted while a **T** indicates that it is inverted.
Use the slider bar to select which function you wish to configure.

Cascading logic functions

Note that logic functions are evaluated sequentially 2 at a time. Like all Digital systems, this can create a problem where the output of one function is used as the input of another function. If, once a function has been evaluated, it results in the change of state of the output of another function and that output is used as an input to the function already evaluated it won't have any effect on the first function until it is again evaluated. An example might make this a bit clearer.

Consider the function: DV1 = AI1 **OR** (DV8 **AND** DI5). The output of this function depends on the state of 2 inputs (AI1 and DI5) and the output of logic function 8 (DV8). If AI1 is False and DI5 and DV8 are both True then DV1 will be True. If DV8 changes state as a result of evaluating another logic function, then this change will not be reflected in the output until the next iteration.

This "propagation delay" can cause problems in complicated logic. It can be partially avoided by the careful choice of which logic functions drive which functions. The internal logic evaluates logic functions in pairs (1,2 3,4 etc). This means that the output of logic functions 1 and 2 are available to drive higher functions immediately. There will be no effective propagation delay in this "feed forward" case. Reverse feedback from a higher function to a lower function will not have any effect until the next evaluation of the function. The same applies to each pair of functions.

Wudl logical OR functions

The Wudl incorporates 2 additional logic functions compared to the Nudl and Wudl-PT. These provide a logical OR of digital variables 33 through 48. DV 25 and DV26 are the logical OR of the state of all variables where the entry in the boxes in each row have a **Y** in them. Thus in the example shown below we have:

DV	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
25	Y	Y		Y		Y		Y		Y		Y				
26			Y	Y	Y				Y		Y					

DV25 = DV33 or DV34 or DV36 or DV38 or DV40 or DV42 or DV44
DV26 = DV35 or DV36 or DV37 or DV41 or DV43

The logical OR function configuration is located in the **Logic** tab.

Delay functions

The logger has 4 delay functions each of which takes an input and drives one of the Digital variables DV9 through DV12. You cannot change which Digital variable is driven by a delay function.

Delay functions are configured by using the **Delay/Counter** tab.
The delay time is measured in seconds and can vary from 1 to 65535 seconds. A delay of 0 basically has no meaning.
There are basically 3 different type of delay available and each delay gan either be generated on the rising or falling edge of the input.
The input to a delay function can come from any Analogue input, any Digital input, any Digital variable or any weekly time schedule.

To select the input to a delay function
1. Click on an entry in the **Source** column to bring up the **Descriptor** form.
2. Select the type of input you want.
3. Select the number of that input by using the slider bar.
4. Click the OK button.

To select a delay time
1. Click in the desired entry in the **Delay** column to bring up the edit window.
2. Type the desired delay in this window. Delays can range from 0 to 255 seconds.
3. Press the Enter key or click another entry.

To select the delay type
Click in the delay mode to bring up the **Delay configuration** form. This shows the 3 different type of delay and what sort of output they generate.

The **Delayed turnon** delay starts the timer on the selected edge of the input. It keeps the output of the function low (False) until the delay time has expired.
After this time it makes the output of the function follow the input. If the input goes False before the delay time expires then the output of the function always remains False.

The **Fixed width pulse** sets the output True immediately the selected edge is detected. The output stays True for the delay time and then goes to False irrespective of the state of the input.

The **Variable width pulse** makes the output of the function go True immediately the input goes True and it stays True for the duration of the input being True and for the delay time after the input reverts to False.

Check the **Start on False** checkbox if the delay should start on the falling edge (the True to False transition) otherwise the delay starts on the False to True transition.
Select the delay type by clicking one of the option buttons.
Click the OK button

Counter functions

	Output	Source	Delay mode	Delay
1	DV 9	AI 1	Delayed turnon Start on True	1
2	DV 10	DI 5	Fixed width pulse Start on True	2
3	DV 11	DV 1	Variable width pulse Start on True	3
4	DV 12	WK 1	Delayed turnon Start on False	4

Delay configuration

Counter configuration

	Source	Counter limit	Clear
1	AI 1	1234	DV 1
2	AI 2	25	DV 1

There are 2 counter functions. These count the False to True transitions from the selected source. If the count exceeds a preset threshold then the corresponding Digital Variable will be set. The counter can also be cleared by anyone of the Digital inputs, Digital variables, Analogue inputs or weekly time schedules.

This is a very versatile system and easily allows the generation of an alarms based on counts. For example an alarm can be generated if the number of counts on a Digital input exceeds a threshold number between the hours of 9am to 5pm on a Monday through Friday.

You configure the counters by clicking the **Delay/Counter** tab.

To select the input to a counter function
1. Click on an entry in the **Source** column to bring up the **Descriptor** form.
2. Select the type of input you want.
3. Select the number of that input by using the slider bar.
4. Click the OK button.

To select the number of counts to trigger the output
1. Click in the **Counter limit** column for the desired counter.
2. Type the counter limit in the cyan window which appears. Note that the counts can be between 1 and 65535.
3. Either press the Enter key or select another field.

To select the input to be used to clear a counter
1. Click on an entry in the **Clear** column to bring up the **Descriptor** form.
2. Select the type of input you want.
3. Select the number of that input by using the slider bar. Note that if you select the **None** entry the counter will never be cleared by the internal logic.
4. Click the OK button.

Alarms

There are 8 alarms. Each alarm can be generated from any Digital input, Digital variable, Analogue input or weekly time schedule. Each alarm has a message associated with it. These messages are sent out as part of the alarm.

Each alarm also can be sent to any combination of the 8 telephone numbers. The dialout can be immediately to each selected phone number or you can allow each alarm to escalate.

Alarm escalation works by sending the alarm to the first selected phone number. If the recipient does not acknowledge the alarm within the escalation time then the alarm will be sent to the next phone number on the list. This process continues until all selected phone numbers have been reached.

| General | Set Site/Phone | Input config | Input trip levels | Output config |
| Time schedules | Exceptions | Logic functions | Delay/Counter | Alarms |

Send alarm to phone number

	Alarm message	1	2	3	4	5	6	7	8	Escalate	Source	Delay
1	Alarm 1	Y	Y	Y	Y	N	N	N	N	Yes	AI 1	1
2	Alarm 2	N	Y	Y	N	N	N	N	Y	No	AI 2	2
3	Alarm 3	N	N	Y	N	N	N	N	N	No	DV 1	3
4	Alarm 4	N	N	N	Y	N	N	N	N	No	DI 6	4
5	Alarm 5	N	N	N	N	Y	N	N	N	No	AI 5	5
6	Alarm 6	N	N	N	N	N	Y	N	N	No	AI 6	6
7	Alarm 7	N	N	N	N	N	N	Y	N	No	AI 7	7
8	Alarm 8	N	N	N	N	N	N	N	Y	No	AI 8	8

Escalation time delay: 10 minutes

Note that a phone number has to be manually enabled during configuration but this phone number is still subject to enabling by the weekly schedules. Phone numbers which are enabled manually but not enabled by the weekly schedule do not participate in the escalation process until enabled to do so by the schedule.

Each alarm has a programmable delay time. The alarm condition has to exist continuously for that delay time before it is sent.

To set a new alarm message
1. Click in the desired entry in the **Alarm message** column to bring up the edit window.
2. Type the desired message of 16 characters or less in this window.
3. Press the Enter key or click another entry.

To enable a phone number
Click in the appropriate column to enable a phone number for this alarm (column entry is Y) or to disable a phone number for this alarm (column entry is N). Repeatedly clicking an entry toggles it between Y and N.

To enable an alarm for escalation
Click the appropriate entry in the **Escalate** column to toggle it between **Yes** for escalation enabled and **No** escalation disabled.

To select the source for an alarm
1. Click on an entry in the **Source** column to bring up the **Descriptor** form.
2. Select the type of input you want.
3. Select the number of that input by using the slider bar.
4. Click the OK button.

To set the delay time for an alarm
1. Click in the desired entry in the **Delay** column to bring up the edit window.
2. Type the desired delay in this window. A delay can range from 0 to 255 seconds.
3. Press the Enter key or click another entry.

Viewing the logger status

Current logger status

Analogue inputs

	Current value	Alarm state
1	9.41pH	Outside limits
2	2345.00kPa	Outside limits
3	23.12RH	not in alarm
4	29.05degC	not in alarm
5	-1.06degC	not in alarm
6	39.72degC	not in alarm
7	0.00degC	not in alarm
8	0.09degC	not in alarm

Digital in/out/variables

Dig out 1	Off
Dig out 2	ON
Dig out 3	Off
Dig out 4	ON
Dig out 5	ON
Dig out 6	Off
Dig in 4	Off
Dig in 5	Off
Dig in 6	Off

Alarms: Enabled   1 2 3 4 5 6 7 8   Current temperature: 27 degC

Device serial number: 27403E700089   Alarms sent: 3

Current logger time: 2002-10-01 17:42:12   Incoming SMS: 2

SMS replies: 2

Counters
Counter 1: 2
Counter 2: 1
Set counters

Location
GMT: No valid fix
Latitude:
Longitude:

Reset logger time

Enable alarms

Disable alarms

Update Status

The logger status can be displayed by clicking the **View status** button. This brings up the screen shown on the left. This screen is divided into a number of regions.

The **Analogue inputs** table lists the current value of each analogue input together with its "alarm state". This is an indication of whether the input is within or outside the limit set for that input. For example, if the input is higher than the Upper threshold in a switch function then the alarm state would be *outside limits*. A value "in alarm" is shown in red.

The **Alarms** window shows whether the alarm system for the logger is currently enabled or disabled. It also shows the state of the 4 alarms. An alarm input which is not in an alarm state is shown in green, like inputs 3 through 8 in the screen shot on the left. If the input is in alarm but the delay associated with that alarm has not yet expired the background colour for the alarm will be yellow, as in alarm 2. If the input is in alarm and has been in that state for longer than the delay time then the background colour will be red, as for alarm 1.

The **Location** panel displays the current location of the logger together with a time stamp in Universal time (GMT) as to when that location fix was taken. Note that this display requires that the logger be enabled for GPS operation. If no valid fix is available then the time field will indicate **No valid fix**.

The **Device serial number** gives the unique serial number for this logger.

The **Current logger time** gives the current time internal to the logger. This is displayed as years-month-day hours:minutes:seconds.

The **Counters** panel displays the current counts for each of the 2 counters. You can change these counts by typing the desired count into the relevant box and then clicking the Set counters **button**. This will upload the counts for both counters to the logger.

The **Update status** button is used to update the status display.

The **Digital in/out/variables** table lists the state of each of the digital inputs. digital outputs and the digital variables in the logger. You can also change the state of the digital outputs by clicking on the desired row. This will toggle the state between the **On** and **Off** states. The background colour will also change as is shown for Dig out 4 indicating that the status for that output has been altered.

The **Current temperature** box shows the current temperature of the logger.

The **Alarms sent** box shows the number of alarms that have been sent by the logger. This increments each time an alarm is sent.

The **Incoming SMS** box shows the total number of SMS messages received by the logger.

The **SMS replies** box shows the number of replies to incoming SMS messages.
There are also 3 buttons which allow you to reset the logger time and enable and disable the logger alarm system.

Reading the logged data

Retrieve logged data

Get data from: `22 Jan 2002 11:20` to `22 Dec 2002 11:25`

Type of records to get: `All logged data` ▼   Get logged data

Time of log	Type	In 1	In 2	In 3	In 4	In 5	In 6	In 7	In 8
02-09-20 17:33:27	Alm3	1955.	1994.	1983.	2018.	46.10	98.70	0.00	0.07
02-09-20 17:33:28	Alm3	1951.	1990.	1983.	2017.	45.66	98.65	0.00	0.09
02-09-20 17:33:29	Alm3	1951.	1992.	1983.	2017.	45.71	98.60	0.00	0.09
02-09-20 17:33:30	Alm3	1950.	1987.	1983.	2019.	46.25	98.63	0.00	0.07
02-09-20 17:34:06	Prog								
02-09-20 17:35:00	Data	1956.	1987.	1983.	2019.				
02-09-20 17:36:23	Alm1	1955.	1992.	1983.	2021.	46.15	98.63	0.00	0.09
02-09-20 17:40:00	Data	1954.	1995.	1983.	2024.				
02-09-20 17:45:00	Data	1955.	1990.	1983.	2018.				
02-09-20 18:04:32	Alm3	1954.	1992.	1983.	2015.	46.17	98.65	0.00	0.07
02-09-20 18:04:33	Alm3	1954.	1992.	1983.	2019.	45.49	98.63	0.00	0.07
02-09-20 18:04:34	Alm3	1951.	1990.	1983.	2021.	46.49	98.63	0.00	0.07
02-09-20 18:04:35	Alm3	1951.	1987.	1983.	2019.	46.34	98.60	0.00	0.07
02-09-20 18:05:00	Data	1954	1990	1979	2018				

Export log to csv file   Plot data   STOP Stop getting logged data

To retrieve logged data the first step is to set the start and end dates. Enter these dates and times an dd mmm yyyy hh:mm format in the top 2 boxes as shown in the screen snapshot.

There is a choice of what data can be downloaded. This choice is made by clicking in the **Type of records to get** dropdown list. The choices are basically between downloading the logged data only and combinations of data and other events or just other events. If the logged data is to be exported to a csv file then it is recommended that you download just the logged data. The example on the left shows the sort of information displayed if all logged data is downloaded.

Not shown in this screen shot is the **phone number/location** field, the **counts** for each digital input and the **state of the digital inputs** when the log was taken. These appear to the right of the **In 8** field. The **phone number/location** displays the sending phone number when the analogue limits are changed or the Universal Time (GMT), Latitude and Longitude for logged data and alarms. Note that display of location data is only possible for GPS enabled loggers. The **counts** fields display the number of counts recorded on each digital inputs and the **state** field lists those digital inputs which were ON when the log was taken.

The **STOP** button can be used to stop the download at any time.

There 2 ways to handle the downloaded data. If the download has been of logged data only, then the downloaded data can be displayed in graphical format by clicking the **Plot data** button. This button is only enabled when the data can be plotted.

The data can also be exported to a csv file for import into Excel. Click the **Export log to csv file** button to bring up a file save dialog box. Select the folder and desired filename as per standard windows operations.

Note: The logging form is expandable in size. If the form's width is changed using the standard windows drag method, then the size of the logged data display box will also expand or contract.

Nudl PCB Connections

Baseboard

Vsupply
GND
Digout

RS232

Vsw
In4
GND
In3
In2
GND
In1
GND

Expansion board

GND O2 O3 GND O4 O5 GND O6

4   5   6

IN

Vsw
In8
GND
In7
In6
GND
In5
GND

RS232
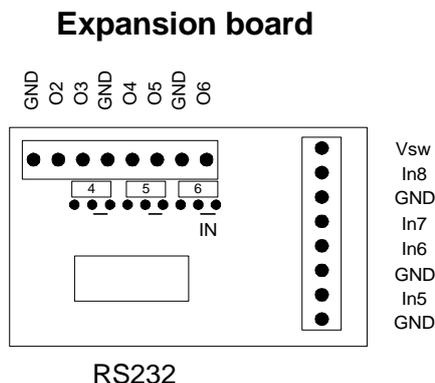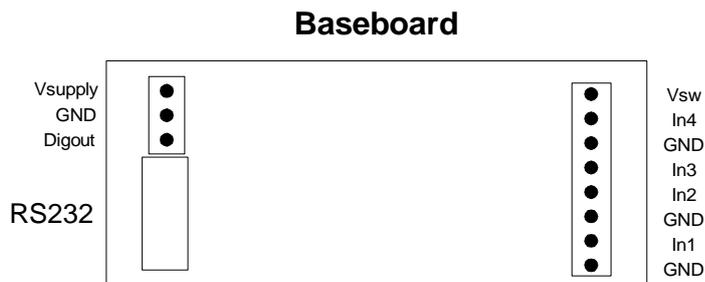
Vsupply- from 3.3V up to 15V DC at a typical current of 200uA. Reverse polarity protected.
Vsw   - switched Vsupply for sensors. Maximum current is 100mA. Do NOT short to ground.
In1-4   - Analogue inputs. 6V maximum. 170ohm nominal resistance in 4-20mA configuration.
Digout   - Digital output 1. MOSFET switch to ground. Rated at 200mA maximum sink current.
RS232   - RS232 serial connection. When connected to a 9 pin male D it has the same pinout as a PC com port.

Note that the jumper pins on the PCB are for expansion and should never have jumpers installed.

Expansion board jumpers
The expansion board can have digital outputs 3,4,5 and 6 configured for digital outputs or digital inputs. A jumper/pin is used to select the pin function. With the jumpers installed in the **In** position as shown above by the underline, the pin will be a digital input. If the jumper is installed on the non-underlined position the pin will be an output.

Programmable gain expansion board
The programmable gain expansion board has 4 differential inputs. It is essential that the correct polarity is observed on each input. Failure to do this can result in permanent damage.
While the inputs are fully differential and can tolerate a common mode range from several volts either side of ground it is essential that there is a ground connection from both of the inputs. This can be through a moderately high value resistor. The purpose of this resistor is to allow the input bias current from each input to flow to ground. Failure to have a resistance to ground from both inputs will cause incorrect readings.

GPS enabling

To interface the logger to a GPS receiver requires an expansion module and a GPS receiver which can transmit the standard NMEA sentences. A baud rate output of 4800 baud with 8 data bits and no parity is required together with a standard RS232 interface. The expansion module pinout matches that of a standard 9 pin comm port for a PC.

Wudl PCB connections

Select RS232 control between CTS and CD

GROUND •
GROUND •
GROUND •
DI/DO 2 •
GROUND •
DI/DO 3 •
DI/DO 4 •
GROUND •
DI/DO 5 •
DI/DO 6 •
GROUND •
DI/DO 7 •
GROUND •
AI 1 •
GROUND •
AI 2 •
AI 3 •
GROUND •
AI 4 •
AI 5 •
GROUND •
AI 6 •
AI 7 •
GROUND •
AI 8 •
Vsw •

CTS CD

RS 232 COMMS

• GROUND
• NC
• NC
DI8/9 RET • DI 8
• RET
• DI 9
DI10/11 RET • DI 10
• RET
• DI 11
DI12/13 RET • DI 12
• RET
• DI 13
DI14/15 RET • DI 14
• RET
• DI 15
DI 17 pullup
+12 IN • DI 16
• DI 17
DI 16 pullup
DI18 / DO1 • DO 1
• GROUND
0-5V • Vsupply

IN OUT 2 3 4 5 6 7
Pullups DI2-7 2 3 4 5 6 7
Pullups DI8-15 8 15
AI5-8 4-20mA select 5 6 7 8
0-5V 1 4 5 8
0-5V

Vsupply- from 3.3V up to 15V DC at a typical current of <1mA. Reverse polarity protected.

Vsw - switched Vsupply for sensors. Maximum current is 100mA. Do NOT short to ground.

AI1-8 - Analogue inputs. 6V maximum. 170ohm nominal resistance in 4-20mA configuration. Inputs 1 through 4 have onboard software controlled switches to switch between 0-2.5V and 4-20mA. Inputs 5 through 8 use jumpers. Insert a jumper to connect the input terminating resistor for 4-20mA operation.
- Each analogue input can be attenuated to provide a 0-5V input range (or 8-40mA current range). Insert the required jumpers in the 0-5V jumper blocks. There are 2 separate blocks one for inputs 1 through 4 and one for inputs 5 through 8.

DO 1 - Digital output 1. MOSFET switch to ground. Rated at 200mA maximum sink current. The jumper switching between DO1 and DI18 must be in the DO1 position. DI18 cannot be accessed by the Wudl firmware.

DI/DO - Jumper selectable between being an input or an output. Jumpers are located near the point and are labelled on the board. Place the jumper in the *IN* position to configure the point as in input or in the *OUT* position to configure it as an output. Inputs can have an internal pullup resistor connected by turning the appropriate switch on the pullup block *ON*.

27

DI8-15 - Optically isolated digital inputs. The **RET** pin is the common return for the pair of digital inputs on either side of it. It can be connected to ground by inserting the *DI xx/yy RET* jumper.

- Inputs can have an internal pullup resistor connected by turning the appropriate switch on the pullup block ON. *Note that the pullup is on the input side of the optical isolation so by using the pullup the optical isolation is effectively removed!* The *DI xx/yy RET* jumper must be inserted if the internal pullups are used.

DI16-17 - Non-optically isolated digital inputs. 6V maximum. The internal pullup is connected by placing the jumper in the *IN* position.

RS232 - RS232 serial connection. It has the same pinout as a PC com port. Either the Carrier Detect (CD) line or the Clear to Send (CTS) line can be connected to the Wudl. This jumper is located near the RS232 connector.

There are several other jumpers on the board which should not be moved.

Wudl-PT PCB connections

GROUND	●		
DO 3	●		
GROUND	●		RS 232
AI 1	●		COMMS
GROUND	●		
AI 2	●		
AI 3	●	●	GROUND
GROUND	●	●	NC
AI 4	●	●	NC
AI 5	●	●	DI 1
GROUND	●	●	RET 1/2
AI 6	●	●	DI 2
AI 7	●	●	DI 3
GROUND	●	●	RET 3/4
AI 8	●	●	DI 4
AI 9	●	●	DI 5
AI 10	●	●	RET 5/6
GROUND	●	●	DI 6
AI 11	●	●	DI 7
AI 12	●	●	RET 7/8
GROUND	●	●	DI 8
AI 13	●	●	DO 2
AI 14	●	●	GROUND
GROUND	●	●	DO 1
AI 15	●	●	GROUND
Vsw	●	●	V supply

Cellular Modem Connections

RS232

The RS232 connected allows the logger to be connected to a cellular modem for normal operation and a PC for configuration. The communication parameters are 9600 baud, 8 data bits, one stop bit and no parity. The RS232 connection is a via a 10 pin ribbon cable. It is pin compatible with a PC 9 pin COM1 connector. The matching connector is a female type allowing the use of standard extension cables. When extending this cable the RS232 specification should be followed and the cable length should be kept to below 15 metres. Longer lengths *may* work but are not guaranteed to work.

PC 9 pin connections are as follows:

PIN NUMBER	SIGNAL
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	NC
7	RTS
8	NC
9	NC

The signal mapping on the RS232 10 pin header is as follows:

Header 10 pin	RS232 Connections 9 Pin
1	Carrier Detect
2	NC
3	Rx Data
4	DTR
5	Tx Data
6	NC
7	DTR
8	NC
9	Ground
10	NC

This mapping allows a connecting cable to be constructed using 10 conductor flat cable and insulation displacement connectors. The wire connected to pin 10 of the PCB header is cut back leaving 9 wires to be crimped to the DE9 female connector.

SMS commands

The logger accepts a number of commands sent via SMS messages. Each command will result in a reply either sending information about the state of the logger or an acknowledgment of the command. The way of sending a command is slightly different for a GSM modem and one using the ETM9500.
The format of a command for a GSM modem is:

xxxxCdddd

where:

- **xxxx** is the 4 character PIN number. This is case sensitive and can be any 4 characters which can be sent via the mobile phone. If the sent PIN number does not match the PIN number programmed into the logger then no action will be taken. The default PIN number programmed into the logger at the factory is **APIN**.
- **C** is the single letter command, it is case sensitive and must be a capital letter.
- **dddd** is a variable data string for the command

For an ETM9500 modem configured to use GPRS you can still send SMS messages while the modem is connected to the GPRS network but the format is:

*SMSxxxxCdddd   The leading ***SMS** can be either upper or lower case.

The commands accepted are as follows:

A - enable alarm system

No data. This command enabled the alarm system and zeroes the alarm count.

Cn - cancel alarm

The parameter **n** is the alarm number to acknowledge. It must be a number between 1 and 8 for the Nudl and between 1 and 16 for the Wudl.

Acknowledges an alarm and clears the escalation system for that alarm

Dn - turn off an output

The parameter **n** is the output number to turn off. It must be between 1 and 6.

Note that if the output is being controlled by an internal assignment this command will only turn the output off for a maximum of 1 second.

En - turn on an output

The parameter **n** is the output number to turn on. . It must be between 1 and 6.

Note that if the output is being controlled by an internal assignment this command will only turn the output on for a maximum of 1 second.

H - display holiday list/set a new public holiday

There are several forms of this command.

1. **H?** returns the current list of public holidays
2. **HRnyyyy-mm-dd** replaces holiday number **n** in the list by the new date which is entered year first. The command will return the updated holiday list.
3. **Hyyyy-mm-dd** will add the new holiday to the list provided that there is at least one empty entry in the list. The command will return the updated holiday list.

If the holiday cannot be added then the command will return a ?? response.

I - disable alarm system

No data. The command will disable the alarm system.

L - send current location (GPS required)

This command only works for GPS enabled loggers.

N - send the digital input counters

This command sends the current value of the counters attached to the digital inputs 3 through 6.

The data is displayed as raw counts NOT as scaled values.

R - read analogue inputs

This command will return the current value of all 8 analogue inputs in engineering units.

Sx - read digital status

This command will return the alarm state and state of all digital inputs and outputs.

SI returns the inputs and **SO** returns the outputs.

P? - send list of phone numbers

This command will send the list of phone numbers. Unused phone numbers will be displayed as an **N**.

Pnxxxx# - changes a phone number

This command sets the phone number **n**. Note that **n** must be between 1 and 8. **xxxxx** is the new phone number. You must terminate the phone number with a **#** symbol. To delete a phone number just don't enter the **xxxx** data as for example **P5#** which deletes phone number 5. This command will return the updated list of phone numbers.

Unxxx# - changes a delay counter time

This command can be used to change the delay time of one of the 4 delay function. **n** is the counter funtion number and **xxx** is the new delay time which can range from1 to 65000 seconds. The # must be

used to terminate the delay time. The command returns an **OK** is successful or a **???** if the command contained illegal characters or the # was missing.

T? - returns the counter limits
> This command returns the counter limits for digital inputs 3 through 6.

Tnxxxxxxxx - changes the counter limit for a digital counter
> **n** is the input number and must be a 3, 4 ,5 or 6. **xxxxxxxx** is the new limit. Numbers greater than 8 digits will be truncated to 8 digits. The maximum value you can set is 99,999,999. The format is flexible and you can just have 1, 2 or 3… characters so that **T345** would set counter 3 limit to 45. Sending and invalid channel number will result in a **???** reply.

Wn? - returns the alarm limits for a channel
> This command returns the upper and lower trip levels for analogue input **n**.

WnUsxxxx.dd Lsxxxx.dd - write new alarm limits
> This command allows the upper and lower trip levels for an analogue input to be changed.

- **n** is the input number and must be between1 and 8.
- **Usxxxx.dd** is the upper trip level. **s** is an optional minus sign. It should be omitted if the number is greater or equal to 0. **xxxx** is the integer part of the limit. This can have between 1 and 4 digits. So it can range from 0 to 9999. **dd** is the fractional part of the value. The decimal point is always required but the fractional part can be omitted if it is 00.
- There must be a single space between the end of the **U** parameter and the **L**.
- **Lsxxxx.dd** is the lower trip level. It has the same meaning as the upper trip level. The decimal point is mandatory.

Notes:
- The logger is designed to accept incoming SMS messages with a time interval of a few seconds between messages. You should always wait for the reply to a message before sending a new message. If a reply is not received within about 2 minutes it is advisable to resend the message.

Examples of SMS commands

Note that all replies to SMS commands are prefixed with the site message. This has been omitted from the following examples.

APINE3	will turn digital output 3 on and send a reply.
APINU	will list the existing telephone numbers. For example the reply will be 0427123456 0409888777 N N.N N N N Where phone numbers 3 through 8 are unused.
APINP30402123#	will replace the existing telephone number 3 with 0402123. The logger will send the message 0427123456 0409888777 0402123 N N N N N in reply.
APINW2U100.12 L25.	Set the upper trip level for analogue input 2 to 100.12 and the lower trip level to 25

SMS Acknowledgement

When the logger receives a valid SMS control message with the correct PIN, it performs the required action and then replies with an SMS message confirming the action. Note that this message is sent to the number from which the SMS control message was received. The list of internal telephone numbers is not used for this acknowledgment.

Appendix A   Digital variables for the Nudl, Wudl and Wudl-PT

Nudl digital variables

DV	Description
1	Logic function 1 output
2	Logic function 2 output
3	Logic function 3 output
4	Logic function 4 output
5	Logic function 5 output
6	Logic function 6 output
7	Logic function 7 output
8	Logic function 8 output
9	Delay function 1 output
10	Delay function 2 output
11	Delay function 3 output
12	Delay function 4 output
13	Set if an alarm is to be sent
14	Set if any alarm is in an alarm condition
15	Set if AI1 is greater than AI2
16	Set if AI3 is greater than AI4
17	Set if counter 1 is over its limit
18	Set if counter 2 is over its limit
19	Digital output 7
20	Digital output 8
21	Digital output 9
22	Reserved
23	Output of edge detector
24	Set if stored data is being sent over the GPRS network
25	Set if DI 3 counter is over its limit
26	Set if DI 4 counter is over its limit
27	Set if DI 5 counter is over its limit
28	Set if DI 6 counter is over its limit
29	Set if change of state on DI 3
30	Set if change of state on DI 4
31	Set if change of state on DI 5
32	Set if change of state on DI 6
33	Set if DI 3 counter is above its early limit
34	Set if DI 4 counter is above its early limit
35	Set if DI 5 counter is above its early limit
36	Set if DI 6 counter is above its early limit

Wudl digital variables

DV	Description
1	Logic function 1 output
2	Logic function 2 output
3	Logic function 3 output
4	Logic function 4 output
5	Logic function 5 output
6	Logic function 6 output
7	Logic function 7 output
8	Logic function 8 output
9	Delay function 1 output
10	Delay function 2 output
11	Delay function 3 output
12	Delay function 4 output
13	Set if an alarm is to be sent
14	Set if any alarm is in an alarm condition
15	Set if AI1 is greater than AI2
16	Set if AI3 is greater than AI4
17	Set if counter 1 is over its limit
18	Set if counter 2 is over its limit
19	Digital output 7
20	Digital output 8
21	Digital output 9
22	Reserved
23	Output of edge detector
24	Set if stored data is being sent over the GPRS network
25	OR function 1 (uses DVs 33 to 48)
26	OR function 2 (uses DVs 33 to 48)
27	OR function 3 (uses DVs 49 to 64)
28	OR function 4 (uses DVs 49 to 64)
29	Set if change of state on DI 2
30	Set if change of state on DI 3
31	Set if change of state on DI 4
32	Set if change of state on DI 5
33	Set if DI 2 counter is over its limit
34	Set if DI 3 counter is over its limit
35	Set if DI 4 counter is over its limit
36	Set if DI 5 counter is over its limit
37	Set if DI 6 counter is over its limit
38	Set if DI 7 counter is over its limit
39	Set if DI 8 counter is over its limit
40	Set if DI 9 counter is over its limit
41	Set if DI 10 counter is over its limit
42	Set if DI 11 counter is over its limit
43	Set if DI 12 counter is over its limit
44	Set if DI 13 counter is over its limit
45	Set if DI 14 counter is over its limit
46	Set if DI 15 counter is over its limit
47	Set if DI 16 counter is over its limit
48	Set if DI 17 counter is over its limit
49	Set if DI 2 counter is above its early limit
50	Set if DI 3 counter is above its early limit
51	Set if DI 4 counter is above its early limit
52	Set if DI 5 counter is above its early limit
53	Set if DI 6 counter is above its early limit
54	Set if DI 7 counter is above its early limit
55	Set if DI 8 counter is above its early limit
56	Set if DI 9 counter is above its early limit
57	Set if DI 10 counter is above its early limit
58	Set if DI 11 counter is above its early limit
59	Set if DI 12 counter is above its early limit
60	Set if DI 13 counter is above its early limit
61	Set if DI 14 counter is above its early limit
62	Set if DI 15 counter is above its early limit

63	Set if DI 16 counter is above its early limit
64	Set if DI 17 counter is above its early limit

Wudl-PT digital variables

DV	Description
1	Logic function 1 output
2	Logic function 2 output
3	Logic function 3 output
4	Logic function 4 output
5	Logic function 5 output
6	Logic function 6 output
7	Logic function 7 output
8	Logic function 8 output
9	Delay function 1 output
10	Delay function 2 output
11	Delay function 3 output
12	Delay function 4 output
13	Set if an alarm is to be sent
14	Set if any alarm is in an alarm condition
15	Set if AI1 is greater than AI2
16	Set if AI3 is greater than AI4
17	Set if counter 1 is over its limit
18	Set if counter 2 is over its limit
19	Digital output 7
20	Digital output 8
21	Digital output 9
22	Reserved
23	Output of edge detector
24	Set if stored data is being sent over the GPRS network
25	Set if DI 3 counter is over its limit
26	Set if DI 4 counter is over its limit
27	Set if DI 5 counter is over its limit
28	Set if DI 6 counter is over its limit
29	Set if change of state on DI 1
30	Set if change of state on DI 2
31	Set if change of state on DI 3
32	Set if change of state on DI 4
33	Set if DI 3 counter is above its early limit
34	Set if DI 4 counter is above its early limit
35	Set if DI 5 counter is above its early limit
36	Set if DI 6 counter is above its early limit

Appendix B Firmware revisions

Various functions are only available depending on the Firmware revision inside the device. Details of what features apply to different revisions are listed below.

Revision number	New Features
1.4	Included switchable baud rates for GPS receivers
1.7	Allows automatic disconnection of the ETM9500 from the GPRS network to send SMS alarms.
1.20	Included UDP mode for GPRS
1.25	Included the early warning limit on digital input counters.
1.30	Included change of state logging on digital inputs.
1.32	Increased number of alarms for the Wudl to 16.
1.33	Included the use of DO1 to allow the Nudl to control power to an ETM9500.
1.35	Included the use of the *SMS prefix to allow the ETM9500 to accept incoming SMS messages.
1.37	Included a counter to count GPRS connects.
1.45	Included a variable time delay between sending GPRS packets.
1.49	Included the U command to set counter delays via SMS command.
1.55	Added the capability of sending alarms via a CDMA phone
1.58	Added the reverse action on digital inputs
1.59	Included 9600/57600 baud operation
1.69	Allows the sending of the analogue inputs in a SMS alarm message
1.71	Included option of putting the time in a SMS alarm message
1.75	Includes digital input status in SMS messages together with AIs
1.77	Limited sending of AIs in SMS msg to logged values
1.85	Increased range of long-to-string by 2 digits. Removed fractions in di counts
1.86	Included software switchable gain for the FET switches on the Wudl-PT
1.87	Restored decimal point fractions to counter logs
1.88	Send alarms via serial port as well as logged data
1.90	Allowed selective sending of data or data plus alarms as they are logged
1.92	Included NudlLog option
1.96	Included speed and direction in GPS data.
1.98	Implemented rejection of highest and lowest values in Wudl-PT averaging also does a bit of low pass filtering.