MultiSmart
Pump Controller & RTU

This Manual is the support documentation for the installation,
commissioning and operation of MultiTrode MultiSmart Pump Controller / RTU and Reservoir Monitor.

Revision 13

25 March 2009

This manual is used for v2.1 of the MultiSmart pump controller

Contents

1 Warnings & Cautions

1.1 Information to User

Read through this manual to obtain a good working knowledge in order to get maximum performance from the product for your application. After reading, put the manual away in a safe place for future reference.

1.2 Documentation Standards

DANGER:
THIS SYMBOL IS USED WHERE NON-COMPLIANCE COULD RESULT IN INJURY OR DEATH.

WARNING:
THIS SYMBOL IS USED WHERE NON-COMPLIANCE COULD RESULT IN INCORRECT OPERATION, DAMAGE TO OR FAILURE OF THE EQUIPMENT.

NOTE:
THIS SYMBOL IS USED TO HIGHLIGHT AN ISSUE OR SPECIAL CASE WITHIN THE BODY OF THE MANUAL.

1.3 Installation Notes

WARNING:
THE MULTISMART INSTALLATION AND WIRING MUST BE PERFORMED BY QUALIFIED PERSONNEL.

DANGER:
THE MULTISMART HAS NO USER SERVICEABLE PARTS. TO REDUCE THE RISK OF ELECTRIC SHOCK, LEAVE ALL SERVICING TO QUALIFIED MULTITRODE TECHNICAL STAFF.

DANGER:
INSTALLATION OR USE OF THIS EQUIPMENT OTHER THAN IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS MAY RESULT IN EXPOSURE TO HARM, SERIOUS INJURY OR DEATH.

2   Glossary & Symbols

Activation Level	The point at which a pump or alarm is switched On.
Alternate Mode	The pump controller automatically switches the lead (duty) pump each cycle.
Deactivation Level	The point at which a pump or alarm is switched Off.
Decommissioned Pump	A pump that has been removed from duty or an installation, e.g. for maintenance purposes.
Duty (Lead) Pump	The main pump or the first pump to start within a pumping cycle.
Empty (Discharge) Mode	When the pump controller is set to empty a tank or pit.
Fill (Charge) Mode	When the pump controller is set to fill a tank or pit.
Fixed Sequence	Pump 1 or pump 2 is fixed as the lead (duty) pump.
InterPump Start Delay	The delay between any two pumps starting.
InterPump Stop Delay	The delay between any two pumps stopping.
Probe	MultiTrode manufactures a range of conductive level sensors. They have many advantages over traditional devices such as ball floats. Advantages include: resistance to fatty deposit build-up, tangle-free and an adjustable sensitivity to liquid to prevent false readings.
Standby (Lag) Pump	The secondary pump or the next pump to start within a pumping cycle.
ISaGRAF	ISaGRAF is a control software environment which supports all of the internationally recognised IEC61131-3 control languages and offers a combination of highly portable and robust control engine.

Ω	Resistance Value (Ohm)
EMC	Electromagnetic Compatibility
Hz	Frequency (Hertz)
LED	Light Emitting Diode
MTU	Master Terminal Unit
N/O	Normally Open
N/C	Normally Closed
RTU	Remote Telemetry Unit
VAC	Alternating Current Voltage
VDC	Direct Current Voltage

3   New Features in MultiSmart Version 2.1

3.1   Screen changes

- Ability to view MODBUS and DNP3 logs in **Info** screens
- Ability to view in the Communication overview in **Settings** screens
- Ability to invert the display screen

3.2   New features

- Duo Probe Support
- Remote reconfiguration of DNP points list
- I^2T Motor protection
- Support for Acromag external I/O devices
- Multiple sources can be assigned to the Digital Outputs
- Ability to enable and disable DNP and MODBUS logging via MultiSmart faceplate
- Superior flow calculation with ability to differentiate blocked pump from a large inflow
- Ability to compare two analog input levels and raise alarm if they differ by more than a specified percentage
- Advanced level locked detection
- Support for multiple thresholds for Insulation Resistance Test
- Capability to calculate the time period until the station starts spilling
- Automatic DSP upgrade along with the main software update

Part 1 – Operations

4   Introduction

Congratulations on your purchase of the MultiTrode MultiSmart unit.

Depending on the options you have purchased, the unit may be configurable as either a pump controller or a reservoir monitor or as a Remote Telemetry Unit. The generic product description of MultiSmart pump manager is used throughout the manual and for convenience refers to either configuration.

The pump station manager is an "out of the box" pump controller for water and sewerage pump stations. The large LCD screen with softkeys eliminates the need for selector switches, push buttons, fault lights, meters, accumulators and other additional panel items.   This simplifies panel wiring and reduces cost.

The product has a very low "whole of life" cost compared with a PLC due to the pump control functionality already developed in the product. Users simply configure the parameters, rather than program the unit. This reduces engineering cost and greatly increases reliability.

The MultiSmart pump station manager has the option of an IEC61131-3 PLC programming language so that additional functionality can be added by the user if required.

The MultiSmart unit is fully open and has DNP3 and Modbus options. The product can also be shipped just as an RTU without any pump control functionality or user interface.

The Reservoir Monitor is a version of the product for monitoring reservoirs and communicating with remote pump stations.

4.1   Range of Options

The functionality of the basic product can be enhanced with additional software modules:

- DNP3 RTU with Security

- Modbus protocols (RTU, TCP, ASCII) - standard feature in some markets

- Flow calculations for "Empty (Discharge)" applications – no flow meter required

- VFD control

- "Energy Monitoring and Motor protection" option which allows power, energy, power factor and pump efficiency monitoring as well as 3-phase currents, motor protection functions and insulation resistance tests (requires energy monitoring and motor protection I/O module)

- Logic engine (for custom logic additions)

- ISaGRAF 5 IEC61131-3 PLC programming

The unit can be shipped with these modules enabled, or they can be enabled in the field with the appropriate enable code. Additional I/O boards can be installed in the factory to allow expansion of I/O as well as motor protection options.

4.2   Intuitive Operator Interface

The product has screens which have been designed for operators of pump stations. The operator can see at a glance:

- Level
- Pump mode
- Pump availability
- Detailed fault information
- Date/time of each fault occurring and clearing
- Single or 3-phase supply, D.C supply
- History (50,000 events)
- Accumulators (starts, hours, faults, etc)
- Pump efficiency (requires energy monitoring, motor protection and flow enabled)
- Status of all I/O
- Status of the communication link

The screen also allows easy control of pumps and resetting of faults.

4.3   Intuitive Engineering Interface

The product has clear menu screens for altering:

- Pump setpoints
- Alarm setpoints
- Delays
- Alternation and grouping
- Level device and backup level device
- Number of pumps
- I/O and fault configuration
- Supply protection
- Energy Monitoring and Motor protection (where installed)
- Station optimization parameters (max run time, max off time, max starts per hour, plus many more)
- Data logging parameters
- Communications
- Profiles

4.4 "Out of the Box" Control of a Pump Station

The I/O unit clips onto DIN rail and has plug in terminal blocks. When the unit is powered ON for the first time, the controller will start with a setup wizard, which will generate a basic pump station controller configuration by taking input from the user. The basic configuration will take into account of the MultiTrode probes and other level devices, Fill/Empty application, number of pumps, number of wells, station power supply and DNP communication settings.

Even though the basic setup meets most of the normal pump station requirements, with a few button presses the MultiSmart can be setup to perform most of the complex pump station management requirements.

Changing between a reservoir and a pump station, changing the level device to a 4-20mA (e.g. ultrasonic or pressure transducer), the number of pumps, the number of wells, or Empty (Discharge) to Fill (Charge) is done through the setup wizard or through the settings menu and takes only a few minutes, which is far less than time required to implement the same functionality using a standard PLC.

Complete station setups can be saved and/or loaded via a compact flash card.

5 Operator Interface

The MultiSmart Pump Controller has an easy to use interface featuring a large graphical LCD display. A large amount of information can be displayed on the screen making it simple for an operator to determine the current status at a glance. The buttons around the edge of the screen are used to access features depending on what is displayed at the time.
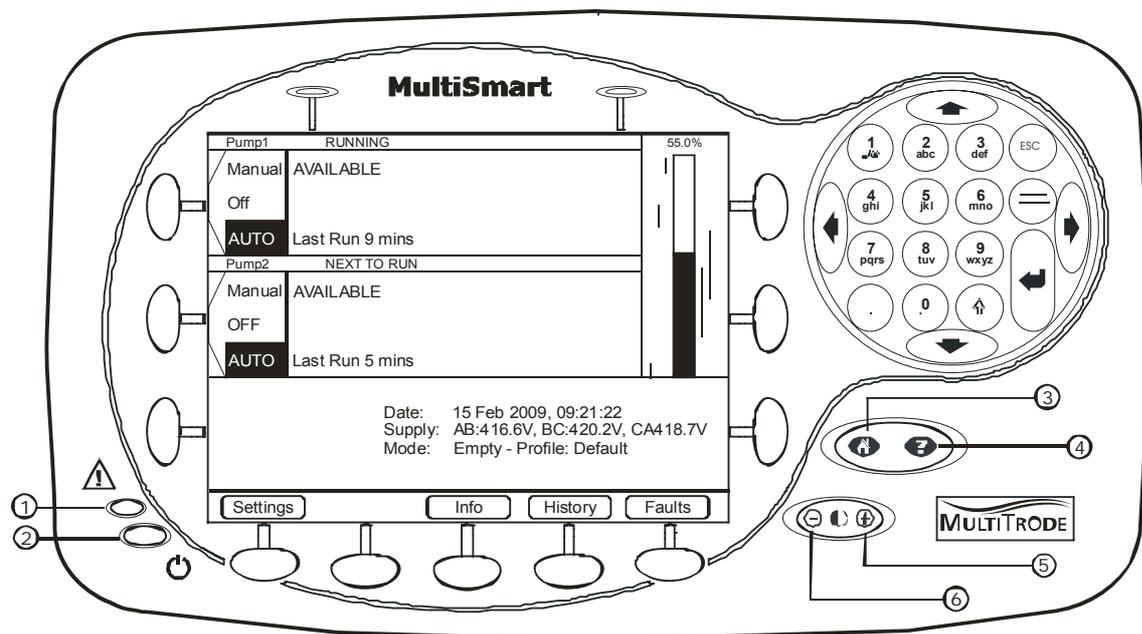
Figure 1 - MultiSmart Display

1. Fault Indication LED
2. Power Status LED
3. Home Button
4. Help Button
5. Increase Contrast
6. Decrease Contrast

5.1   LCD Display

The large LCD display gives the operator a clear view of how the pump station is operating. Water levels are shown graphically. A backlight turns on when any of the panel buttons are pushed. The backlight turns off again after a set time of inactivity (time is user configurable). The display method is invertible as well, that is, we can set the LCD to display data in a dark colour with a light background or vice versa. This feature is especially good under bright sunlight.

5.2   LED Indicators

5.2.1   Power

The Power LED is at the bottom left hand corner of the panel and indicates that the DC supply is connected and turned on.

5.2.2   Faults

The fault LED is above the power LED. It flashes once a second when a pump station fault is detected. This gives the operator a quick indication of whether a fault is present without having to access the LCD screen.

5.3   Buttons

5.3.1   Home/Help Button

The Home/Help button has two positions:

- Pressing the home icon returns the user to the main status screen.
- Pressing the Help icon displays online help for the currently displayed screen.

5.3.2   Contrast Button

The contrast button is used to adjust the LCD screen's contrast. Press "**+**" or "**–**" as required to optimise the display for the light conditions.

5.3.3   Display Buttons

Eleven buttons are located around the edge of the LCD display. These are used to access menu items and other data on the display. The display will indicate what each button is used for on a particular screen.

5.3.4   Numerical Keypad

A numerical keypad is located at the right of the interface. This is used to enter alpha-numeric characters during configuration.

5.4   Using the Interface

5.4.1   Main Status Screen

Pressing the Home button turns on the LCD backlight and also returns the MultiSmart display to the main status screen. This screen displays the current status of all pumps connected to the MultiSmart Pump Controller. The buttons located next to each pump can be used to switch the pump between Manual (Hand), Off, or Auto. The Off mode can be disabled from the advanced menu if need be, to meet security requirements. While doing so if the pump is already in Off mode, it will stay Off until the mode is changed.
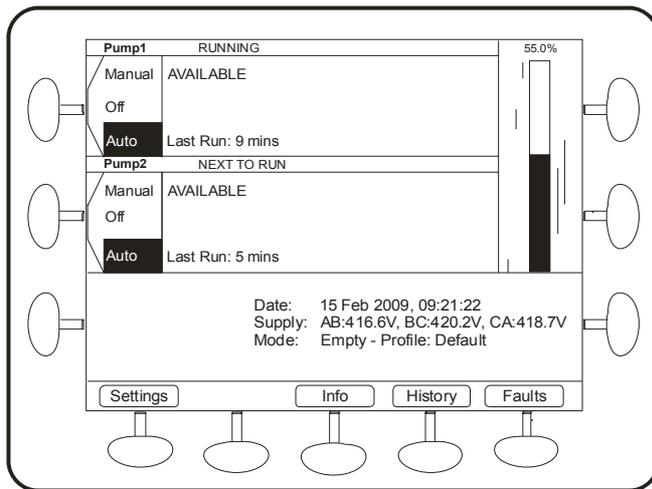
Figure 2 - Main Status Screen

Note:

Manual (Hand) is semi-automatic manual, as the mode returns automatically to Auto when the deactivation setpoint of the pump is reached. This is to prevent pumps being left on unintentionally as occasionally staff can forget to turn the pumps back to Auto before leaving a station. A pump is put into full manual mode as follows: when the pump is in Off mode, instead of just briefly pressing the Auto/Off/Manual button, press and hold it in. This puts the pump into Full Manual mode for as long as the button continues to be pressed down. The Off selection can be disabled from the settings menu if needed.

Note:

The Pump status shown in the screen for the possible different states of each pump is as follows. **Stopped** *– Pump Stopped,* **Running** *– Pump Running,* **Unavailable** *– Fault present and hence unavailable,* **Request to Run** *– Contactor Auxiliary is wired in and the control to run the pump has been sent and waiting for the feedback,* **Next to Run** *– Next pump to run in pump alternation mode or pump group alternation mode. If the contactor auxiliary is used and if the pump is run by an external controller the status will now say* **External Run** *and the MultiSmart will update the pump run time statistics and other relevant historical data. In this mode the relevant faults and warning are generated, however the pump will not be faulted by the MultiSmart.*

A bar graph is displayed next to the pumps and shows:

- the current water level

- each pump's activation and deactivation levels

- any level alarms that may have been configured
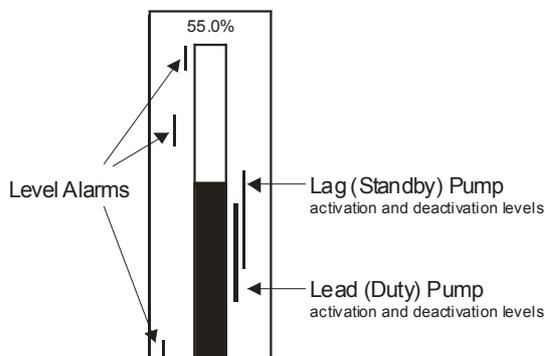
Figure 3 - Main Status Screen Bar Graph

The buttons at the bottom of the screen are used to access the following areas:

- Settings: Used to configure the MultiSmart pump station manager
- Info: Displays full station and pump information
- History: Shows alarms and event history
- Faults: Shows fault specific details

Note:

*when the unit is controlling more than 4-pumps, a **Next Pumps** button also appears, which allows access to pumps 5, 6, etc.*

5.4.2 Faults / History

When a fault occurs, the LCD screen will display a large **FAULT** box at the bottom of the screen. The pump with the fault present (if the fault is pump related), will also be indicated.
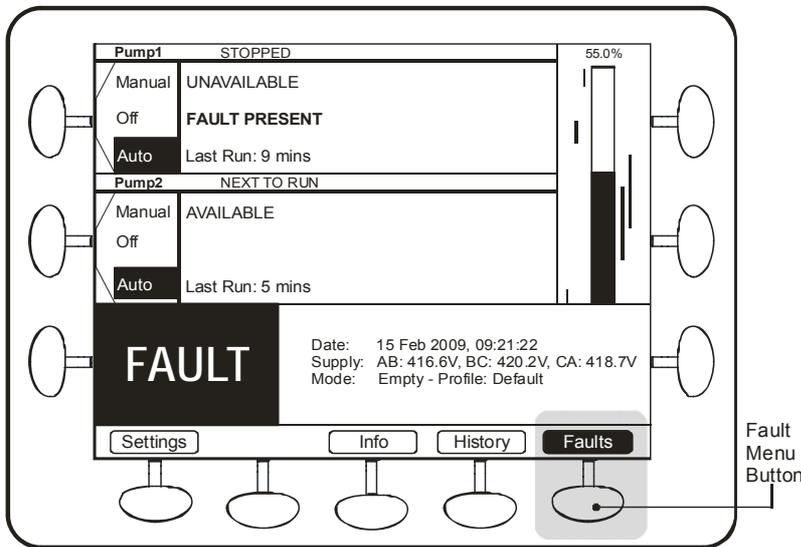
Figure 4 - Fault Indication

The **Fault** menu button will flash when a fault is present. Pushing this button will take the operator to a screen which details the exact fault (a detailed description of all faults is found in Appendix A).
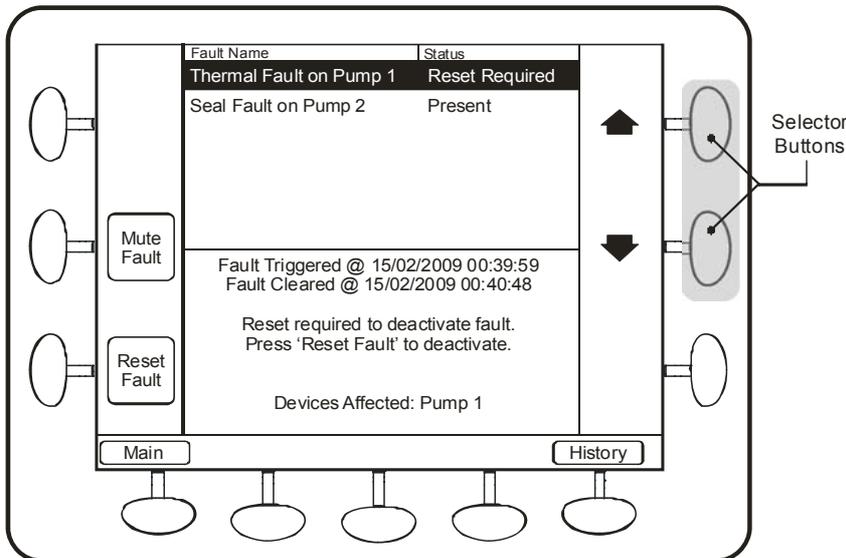
Figure 5 - Fault Reset Screen

Use the selector arrows to select each fault in turn.

From this screen the operator can reset the fault if the fault condition is no longer present. If the fault is still present the operator will be told that they cannot reset the fault.

A **Mute Fault** button will appear for faults that can be muted. It is used to stop any sirens or flashing lights that may have been activated by the fault.

By default, digital output 4 (DO4) is linked to the high-level alarm and can be muted. The output can be configured for Pulsed or Steady operation and is designed to be connected to an external warning light or alarm.

- The mute button will only be available for other faults if the user has configured them to be available for muting.

- Pressing the **History** button will display the entire history log.

- Pressing the **Main** button returns the operator to the main status screen.
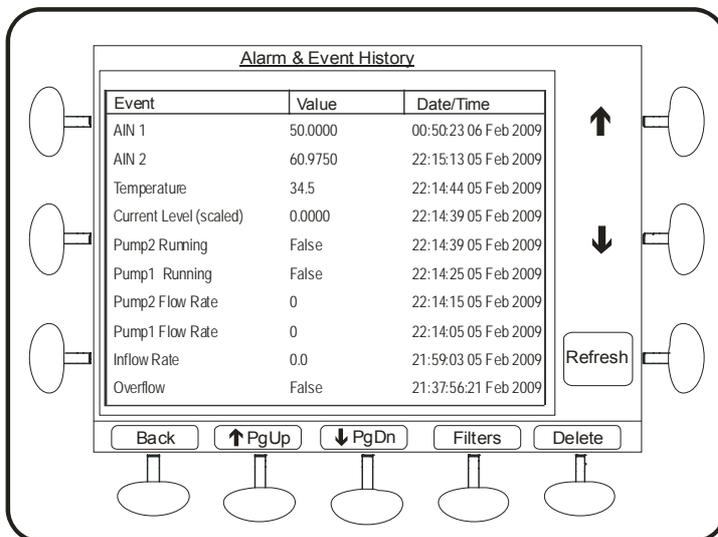
Figure 6 – Fault History Screen

5.4.3   Information Screen

The Information screens show:

- Hours run, starts and faults for each pump and the station

- The status of all I/O

- Flow data (when the optional flow module is installed)

- System log (identifies any application problems)

- Version and modules installed in the unit

- Power and Efficiency – kW, kVA, power factor, pump efficiency, energy accumulators (kWh and kVAh) for various periods: today/yesterday; this week/last week

- Communications statistics for DNP3/MODBUS slave and the current DNP3 Modbus tag values[1]

- Option to browse MultiSmart internal tag database[2]

- Option to view ISaGRAF 5 tags and values useful for PLC programming

To navigate to the **Information Screen** press the **Info** button on the main operator screen.
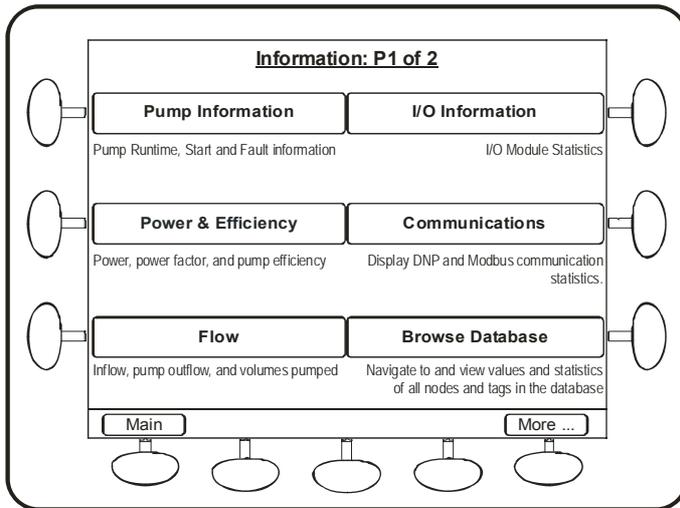
Figure 7 - Information Screen 1of 2

Pressing **More** brings you to the second screen which includes the **Version** button to give details on the version installed on the unit. Note that free upgrades of firmware are available on the MultiTrode web site.
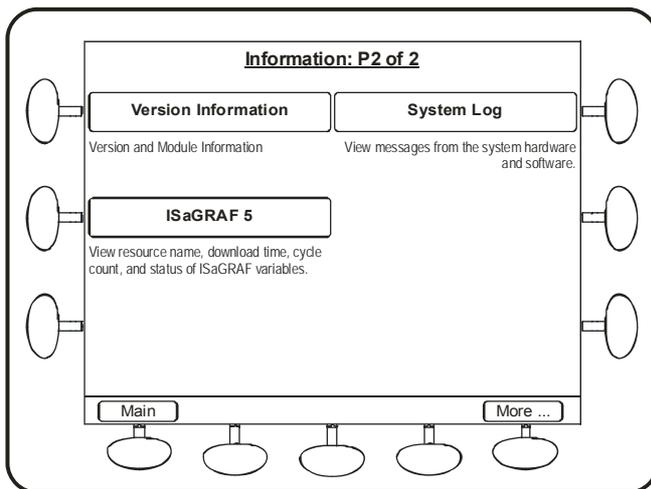
Figure 8 - Information Screen2 of 2

5.4.3.1   Power & Efficiency

This screen shows the value of power, power factor and efficiency of the pumps. Efficiency, energy and apparent energy of the present day, yesterday, this week, last week, this month, last month and their total can be observed through this screen.

Calc Pump Power and Efficiency	Pump 1	Pump 2	Pump 3
Power (kw)	11.2	10.9	0.0
Power Factor	0.86	0.85	0.00
Apparent Power	13.1	12.9	0.0
Efficiency (L/kW):			
. . Today	6530	6108	0
. . Yesterday	6540	6045	0
. . This Week	6535	6197	0
. . Last Week	6600	6133	0
. . This Month	6590	6084	0
. . Last Month	6821	6085	0
. . Total	6623	6105	0

Back   ←   →   Set   Reset
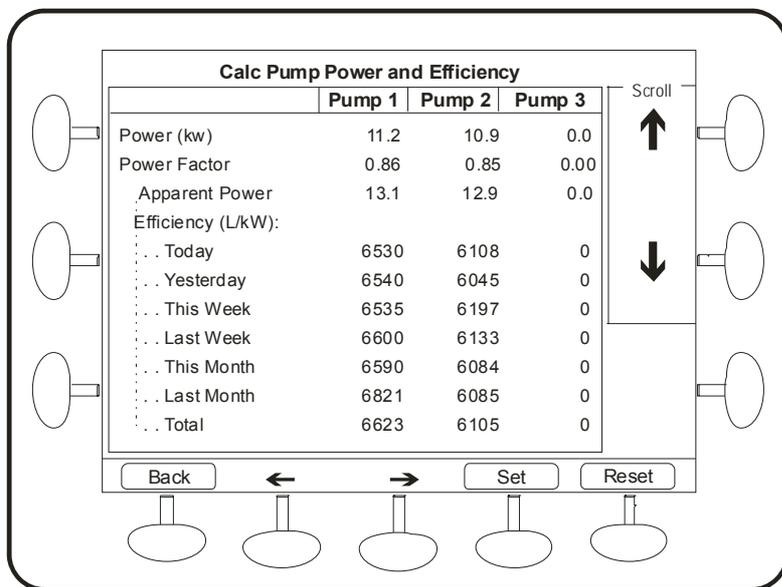
Figure 9 - Power Efficiency Screen

5.4.3.2   I/O Information

Information about the System, DC Voltage, Top Board, Bottom Board and Probe can be seen in this screen. These are especially useful in troubleshooting input/output related issues. Insulation Resistance test can be accessed from within the I/O information screen. However the test can only be performed when the pumps are not running.

I/O Information

System   DC Voltage

Top Board   Probe

Pump Control I/O board (3PC)

Bottom Board

Motor Protection board (3MP)

Back
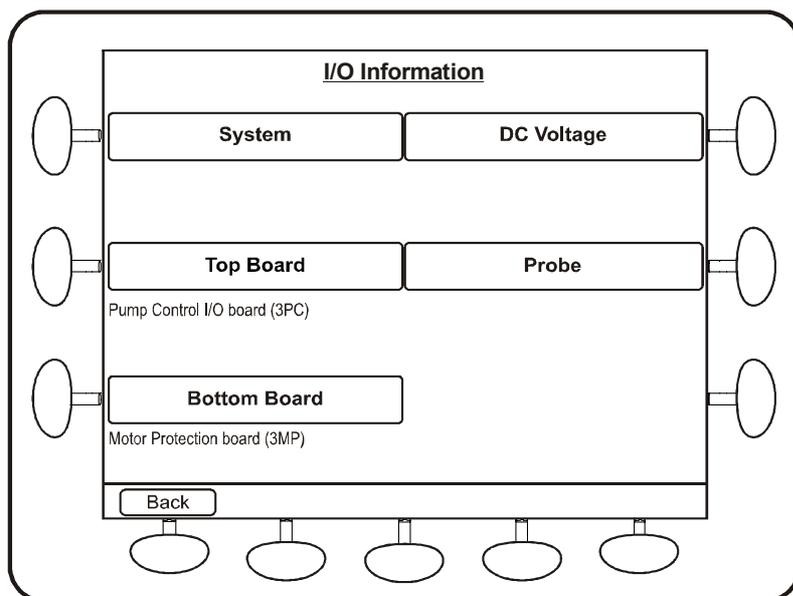
Figure 10 – I/O Information Screen

5.4.3.3 Flow

The station inflow rate, pump outflow rate, volume pumped during a range of intervals, number of overflows, last over flow time, last overflow duration, duration to overflow and total overflow volume can be seen in this screen.
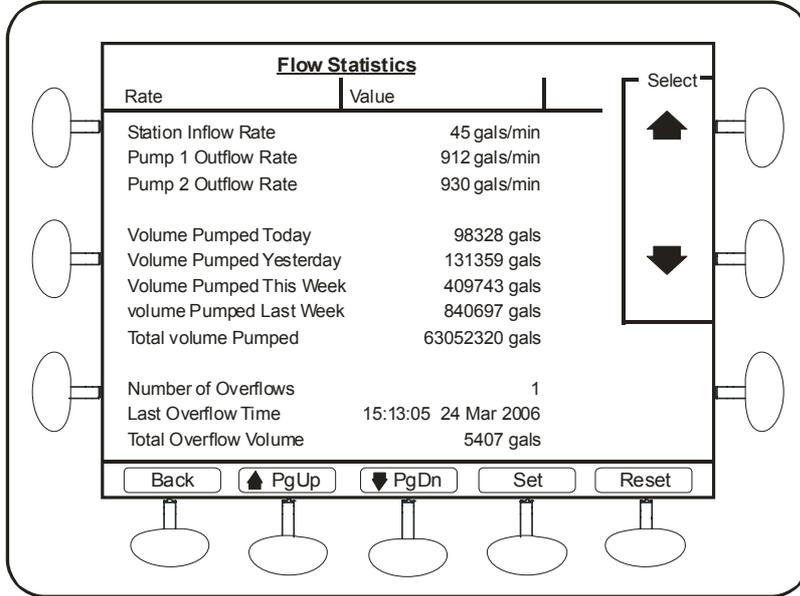
Figure 11 - Flow Screen

5.4.3.4 Pump Information

The station, pump and generator runtime, start and fault statics is displayed in this screen. In the case of runtime statistics, if Pump1 is running for 1 hour by itself, Pump 2 is running for 1 hour by itself and if both of them are running for 1 hour together then Pump 1 and Pump2 runtimes will be 2 hours each where as the Station runtime will be 3 hours since both the pumps were running together for an hour.

Main → Info → Pump Information → Starts Statistics
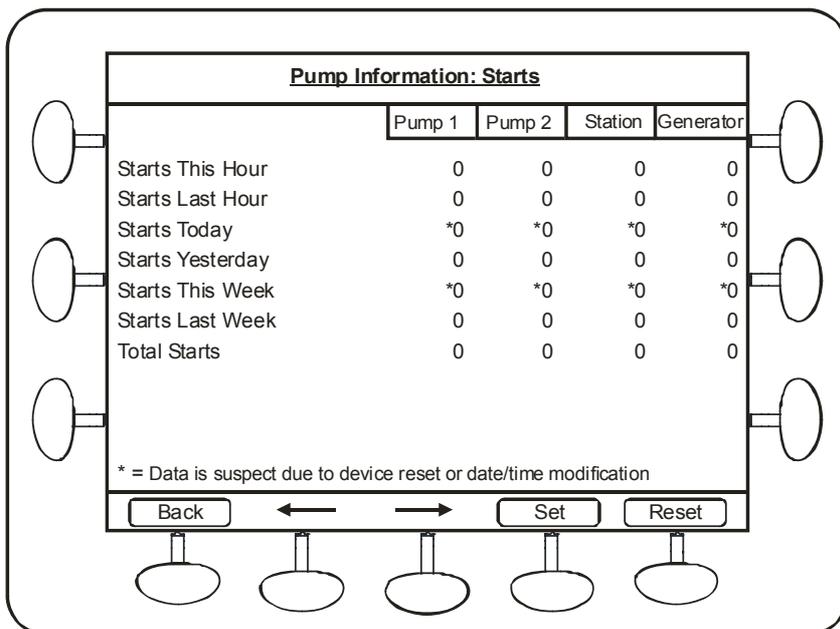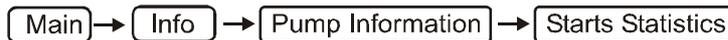
Figure 12 – Pump Start Statistics

For the Generator runtime statistics to be calculated; a digital input needs to be wired in to the MultiSmart and that should be configured to the generator running fault.

Main → Info → Pump Information → Runtime Statistics

Pump Information: Run Time	Pump 1	Pump 2	Station	Generator
Last (mins)	2.5	6.2	3.4	0.0
This hour (mins)	9.7	15.4	0.0	0.0
Last Hour (mins)	10.1	14.4	0.0	5.2
Today (hrs)	1.3	1.5	0.0	0.0
Yesterday (hrs)	*1.2	*1.4	0.0	1.4
This Week (hrs)	*4.6	*4.7	0.4	1.5
Last Week (hrs)	4.7	2.1	2.4	0.4
Multiple (hrs)				
Total (hrs)	1045.3	1288.1	621.0	1.9

* = Data is suspect due to device reset or date/time modification

Back   ←   →   Set   Reset

Figure 13 – Pump Information Screen for a 3-pump station

The insulation resistance test can be triggered from the corresponding menu in the Pump Information section. The result of the test and the related values can also be observed in this screen. The test can be performed only when the pump is not running. Insulation Resistance test can also be accessed from the I/O information screen.

5.4.3.5   Communications

The DNP and MODBUS master and slave status and values can be seen from this menu. Viewing the tag values real-time will help in troubleshooting any communication errors. If logging is enabled then we could see the logged events related to communication in this menu by selecting View Log.

Communications Information

DNP Slave Stats	DNP Slave Values
DNP Slave Statistics and Diagnostics	Display values of DNP Slave Points
Modbus Slave Stats	**Modbus Slave Values**
Modbus Slave Statistics and Diagnostics	Display values of Modbus Slave Points
DNP Master Stats	**DNP Master Values**
DNP Master Statistics and Diagnostics	Display values of DNP Master Points

Back   View Log

Figure 14 –Communications

5.4.3.6   Browse Database

Browse database lists all nodes within the real-time database on the MultiSmart. The tags are categorized and grouped into these nodes. Each node can contain a list of tags as well as a number of child nodes. This screen enables the real-time viewing of all the tags and their values.
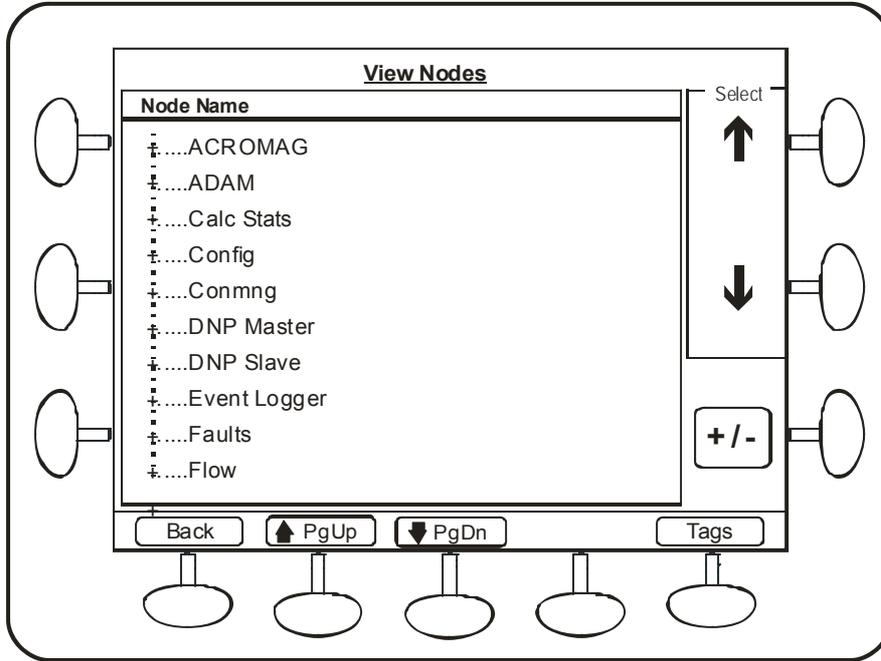
Figure 15 –Browse Database

5.4.3.7   Version Information

The hardware and software information is available in this screen. This must be quoted if MultiSmart technical support is requested. The DSP Software Version number and the MultiSmart serial number are available in this menu.
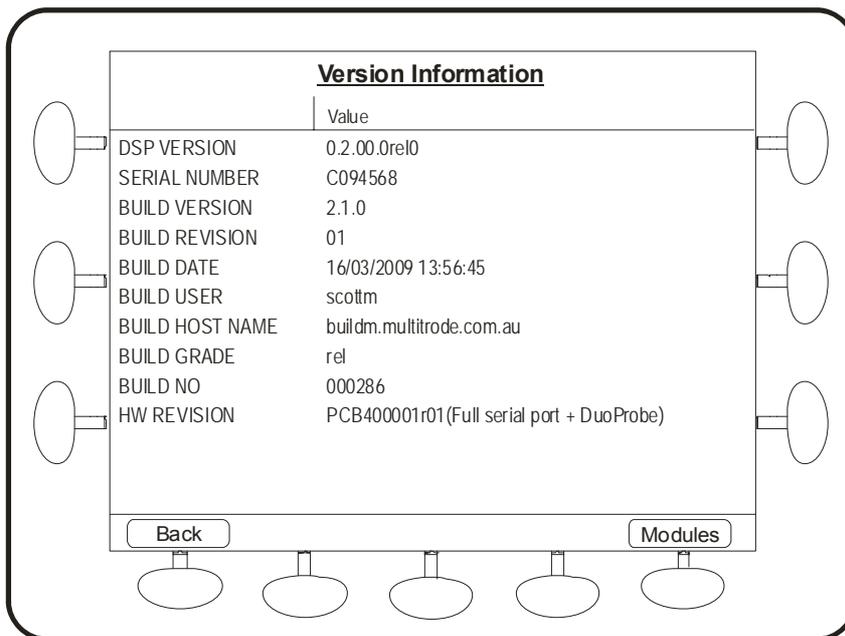
Figure 16 –Version Information

5.4.3.8 ISaGRAF 5

ISaGRAF resource information including compile data, download rate, mode, cycle time, cycle overflow, cycle count, and tags, parameters and variables can be viewed through this screen. Also the value of the parameters can be changed from this menu.

ISaGRAF 5 Info - Resource Number 1

Resource Name	
Compile Date	1 1970, 00:00:00
Download Date	
Mode	No resource available
Cycle Time (ms)	0
Cycle Overflows	0
Cycle Count	0

Tags

Back | ← | → | Params | Variables
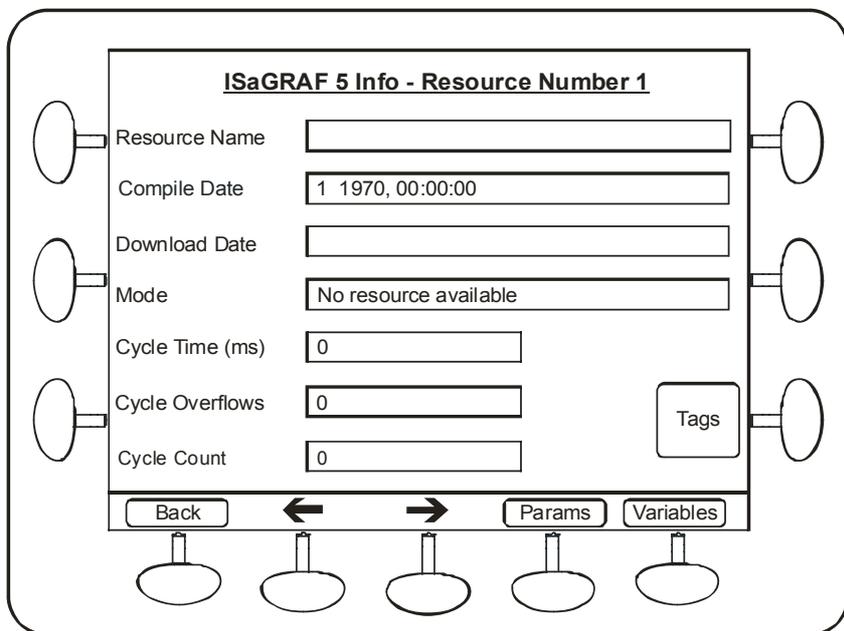
Figure 17 –ISaGRAF

5.4.3.9 System Log

System Log displays any system errors with the time stamp.

System Log

Date/Time	Event	Value
11:41:37 03/19/2009	System	Enable code set to"05BAD"
08:42:18 03/10/2009	IO Module	CAN ID:0.Incorrect IO Board

Select

Back | ▲ PgUp | ▼ PgDn
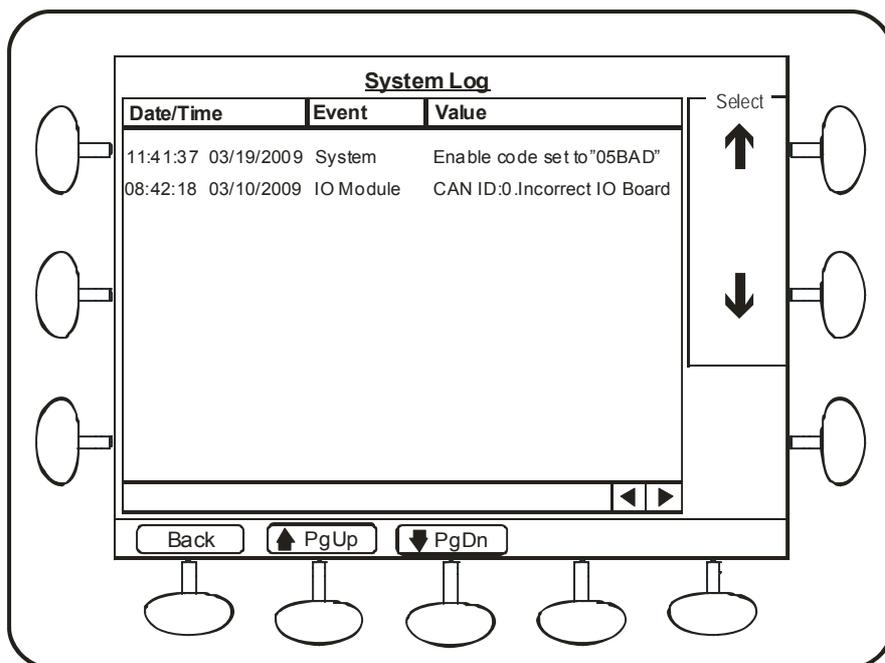
Figure 18 –System Log

5.4.4 Settings Screen

Changes to the operation of the MultiSmart unit can be done by accessing this menu. Most of the general pump station requirements can be configured from the sub sections under **Settings**. However a wide range of advanced configuration options are also available which could be accessed and configured through the **Advaced** button in the **Settings** menu.

Some of the settings require a reboot of the MultiSmart unit for it to come into effect after the change, where as a few others will come into effect as soon as the changes are saved. If a restart is required MultiSmart prompts the user with three options, **Restart Now**, **Restart Later** and **Continue** as shown the figure below.
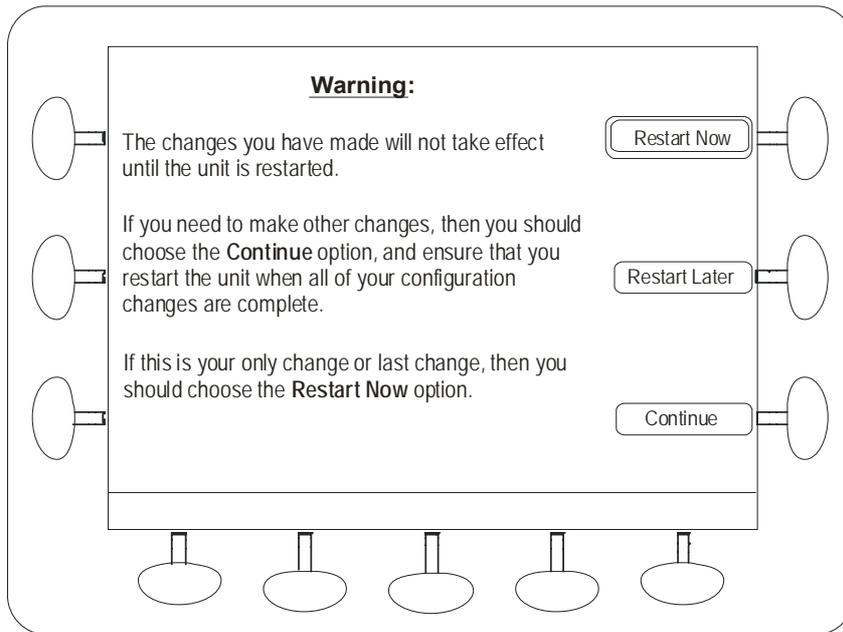
Figure 19 –Warning Screen

If **Restart Now** is selected the unit will save the current values and reboot immediately before any further configuration changes can be performed. If we need to do several configuration changes, we could either choose **Restart Later** or **Continue**.

If **Restart Later** is selected the MultiSmart will resume normal operation, however the new changes will not be in effect. If this option is selected once, the restart prompt will be disabled until the next reboot of the unit and all the configuration changes will be saved in the unit. This can save some time to the operator while making several changes together which requires a reboot. The **Restart Later** need to be selected when prompted after the first change which requires rebooting, and this prompt will not come up even if all or some of the subsequent changes requires a reboot. However in the main screen a fault, which will be cleared only after a reboot, appears in the main screen, as an obvious reminder, mentioning that a restart is necessary for the new changes to be in effect.

The **Continue** option is similar, that it also prevents an immediate reboot of the unit, but a restart will be prompted for every subsequent change in the configuration. There are no other faults or indicators in the MultiSmart which will point out to the user that the new changes are not in effect if this option is selected.

> *Note:*
> *The restart option does not work like this always. For some major changes like adding a new DNP slave profile, the MultiSmart will ignore the restart option selected and does an immediate reboot to bring the new changes into immediate effect.*

Part 2 – Installation & Commissioning

6   Mounting Instructions

The MultiSmart pump station manager is mounted on a standard DIN rail inside a panel. The operator interface is usually mounted on the outside of the panel. The two units are connected together with a supplied cable.

6.1   Mounting the Operator Interface Display

The operator interface is mounted to the switchboard panel with 8 x M4 hex head screws. A 20mm hole must also be cut to accommodate the cable connecting the interface to the controller. Drilling dimensions are given below.
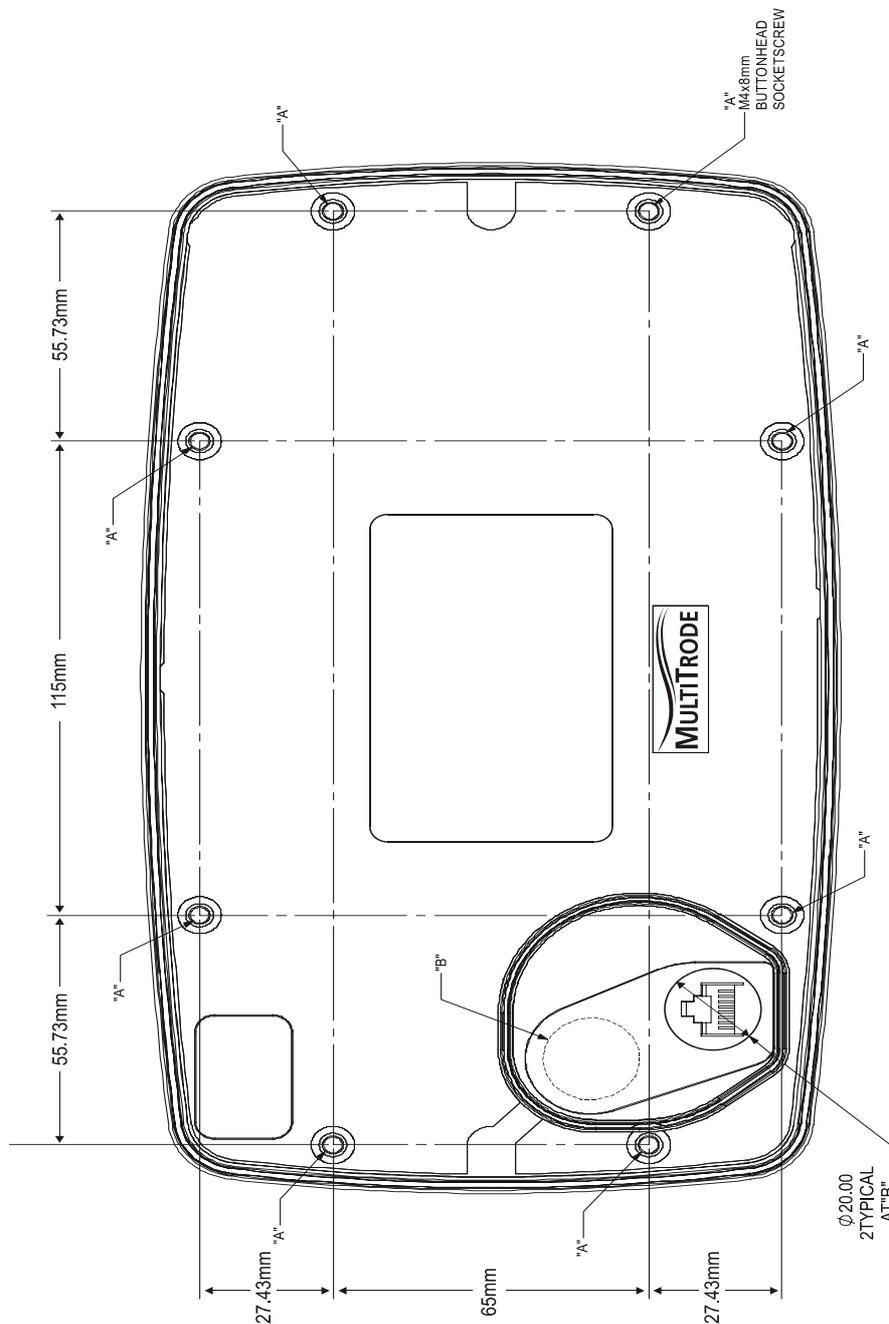
Figure 20 - Mounting the Display

6.2   Mounting the Pump Controller

The pump station manager is designed to mount onto 35mm DIN rail. Overall dimensions are given below.
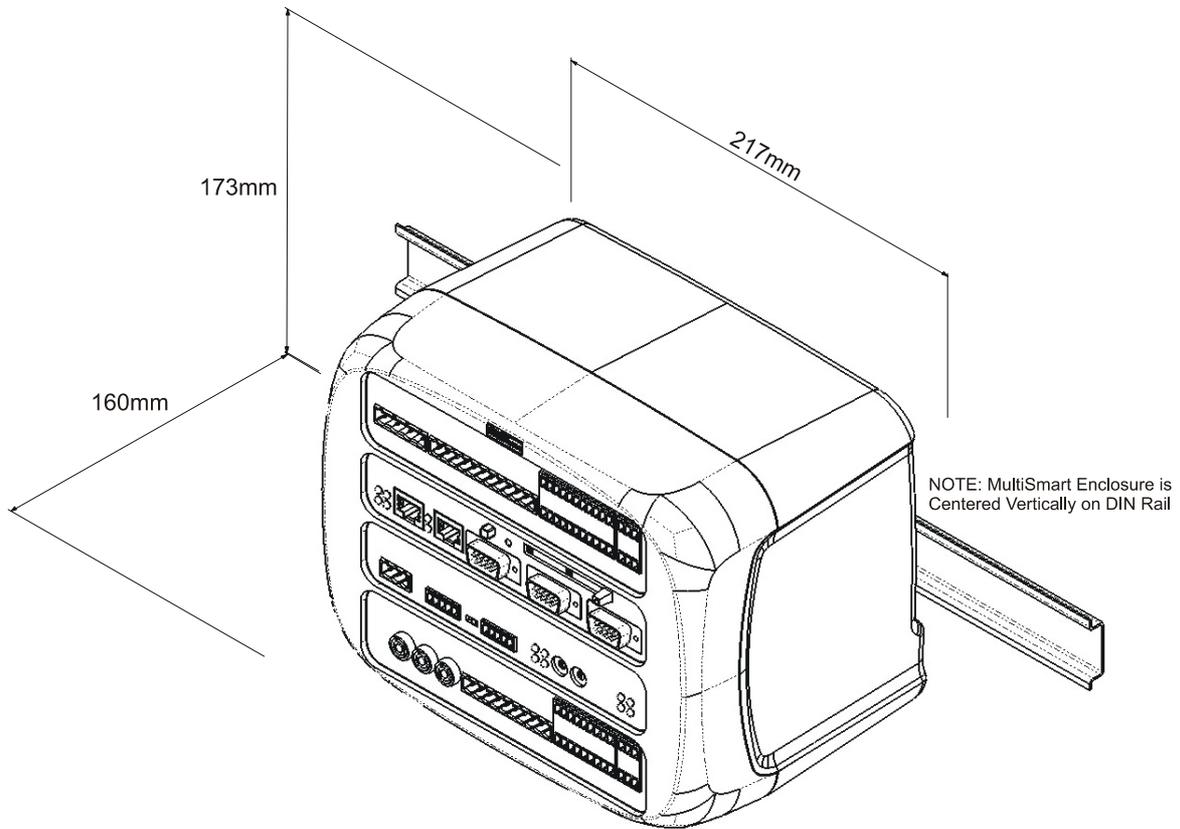
Figure 21 - Mounting the Controller

6.3   Connecting the Operator Interface to the Pump Station Manager

The interface and pump station manager are connected together with a supplied cable. Connect one end into the RJ45 socket on the back of the interface. Connect the other end into the RJ45 socket marked **DISPLAY** on the MultiSmart CPU Board.
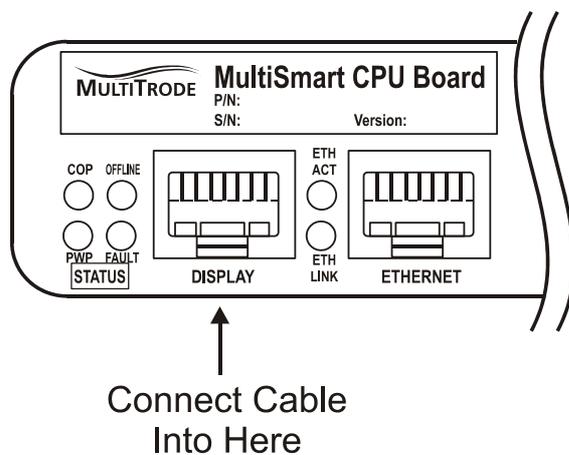
Figure 22 - Connecting the display interface

7 MultiSmart Boards

The MultiSmart pump station manager has up to four boards plugged into it depending on the application. The most common configuration is shown below.

Pump Control I/O Board (3PC) - The pump control board monitors the single or 3-phase supply and provides digital and analog I/O. Level sensing can be from a MultiTrode conductive probe or any 4-20mA device (e.g., pressure transducer, ultrasonic device). Pump faults can be contact closures or pump specific inputs such as seal, PTC thermistor or Flygt FLS and CLS. Digital outputs drive the pump contactors. (I/O = 20 x DIN, 2 x AIN, 7 x DOUT, 1 x AOUT)

CPU Board - Houses the microprocessor running the MultiSmart unit, provides serial and Ethernet communications ports, connects to the display, and has an optional compact flash card port.

⚠️ **WARNING:**
BEFORE REMOVING THE COMPACT FLASH CARD, YOU MUST PRESS THE YELLOW **SAVE CF DATA** BUTTON. FAILURE TO DO SO MAY CAUSE CORRUPTION OF DATA OR DAMAGE TO THE FLASH CARD.

⚠️ **WARNING:**
THE DIGITAL INPUTS ARE VOLT-FREE INPUTS. DO NOT APPLY ANY SOURCING VOLTAGE TO THEM.

DSP Board

This board handles the IO and communicates between multiple IO Module modules.

Energy Monitoring and Motor Protection (3MP)

Monitors single or 3-phase motor currents direct from a CT, and provides motor protection, power monitoring, and includes datalogging. The board also carries out an automatic 1000v insulation resistance test of the motor windings (I/O = 9 x IIN, 3 x IRT, 3 x AOUT, 5 x DOUT).
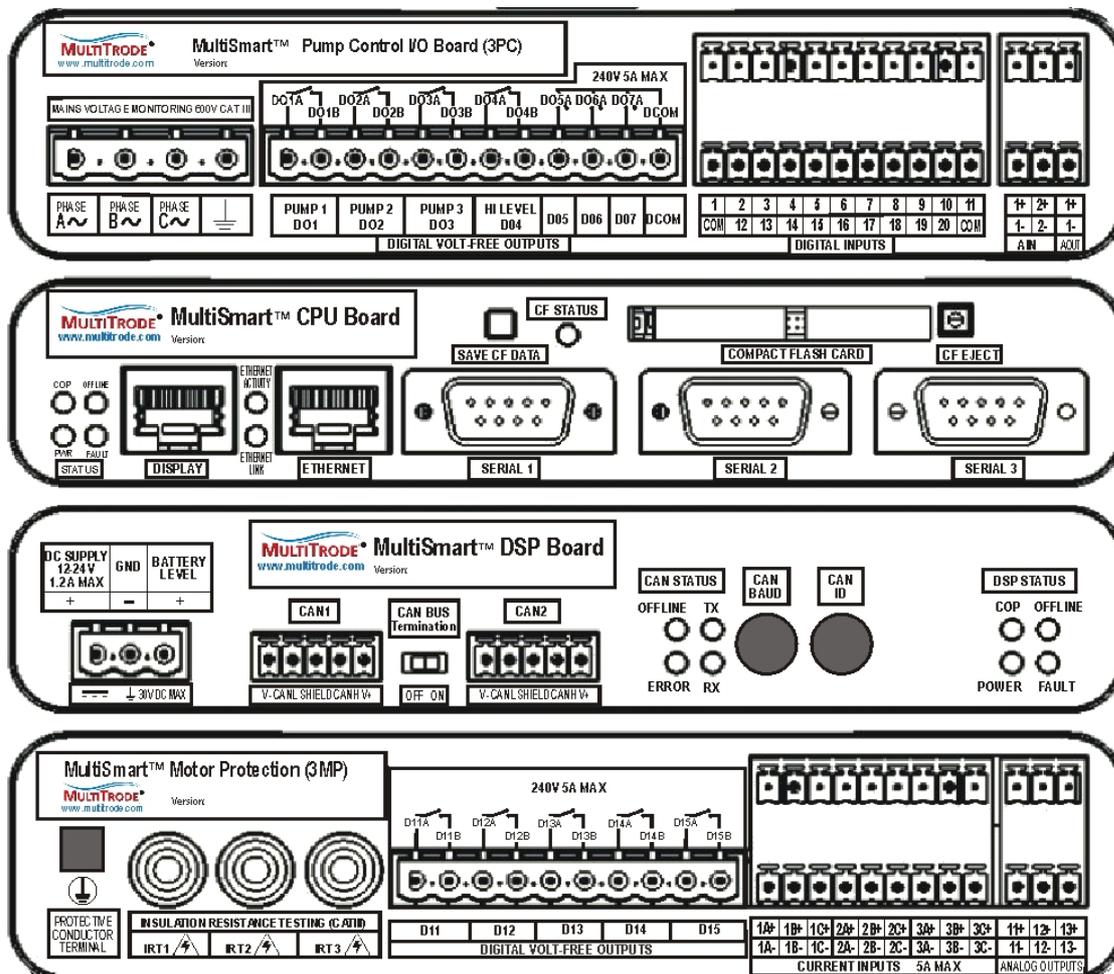
Figure 23 – MultiSmart Boards

7.1 Power Supply

The MultiSmart pump station manager runs from an external 12 – 24 VDC (+/- 5%). This external DC supply is connected into the DSP board as shown below:
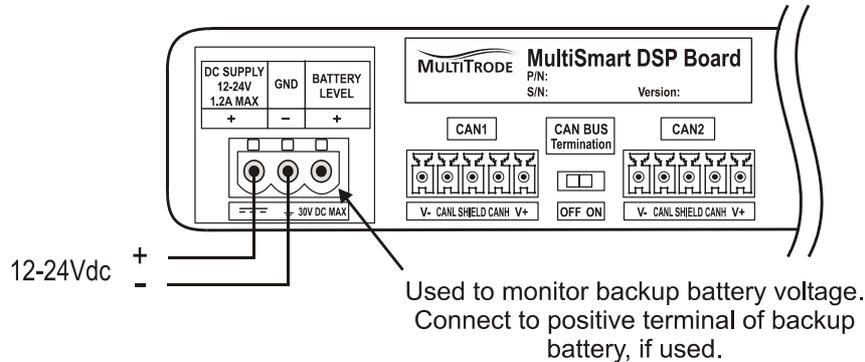
Figure 24 - Power Supply

7.1.1 Power Consumption

The MultiSmart unit consumes up to 30W per unit during initial start-up, (inrush current), and 15W per unit during continuous operation.

7.1.2 Power Supply Requirements

The product must be used in conjunction with a power supply that meets or exceeds the specifications listed in Table 1 - Power Supply Specifications.

⚠️ **NOTE:**
To maintain UL compliance of the product, the power supply must also be UL Listed.

OUTPUT	DC Voltage	12 – 24 VDC
	Power	>30W
	Voltage Tolerance	+ - 2.0%
	Line Regulation	+ - 0.5%
	Load Regulation	+ - 0.5%
INPUT	Voltage Range	85 ~ 264VAC (120~370VDC)
	Frequency Range	47-63Hz
ENVIRONMENT	Working Temp	-10°C ~ +60°C
	Working Humidity	20-90% RH non-condensing
	Storage Temp/ Humidity	-20°C~ +85°C, (10~95RH)

Table 1 - Power Supply Specifications

7.2 Default Wiring Setup for Pump Control Board

The Pump Control Board has 4 different default configurations which can be used to simplify setup. These default configurations can be applied by completing the "Setup Wizard" in the Settings Menu. After a default configuration has been applied changes can be made as required. Refer to Section 7.3 for a complete description of the Pump Control Board I/O interface.

7.2.1 Default 1 – 10 Sensor Probe and 2 Pumps
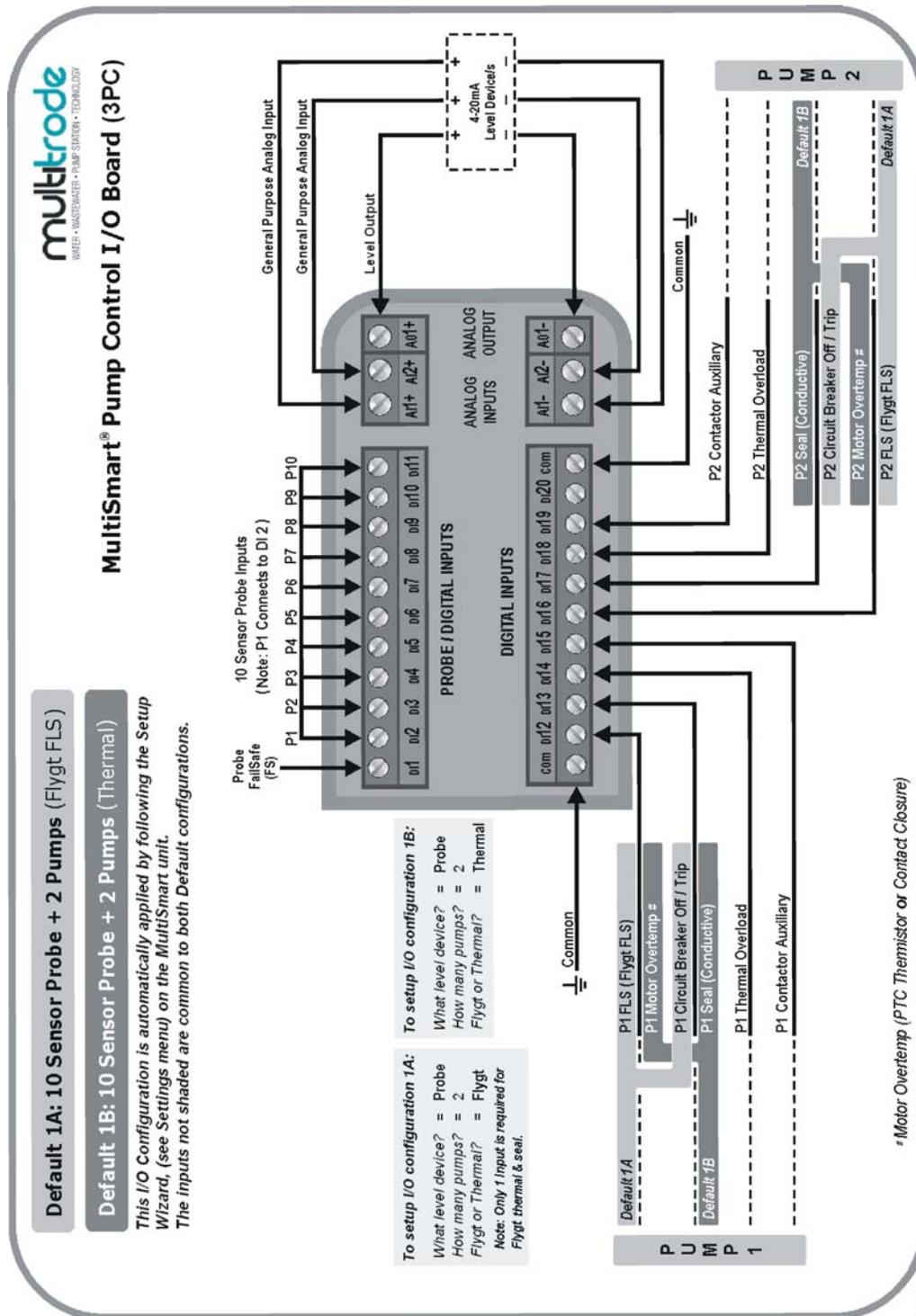
Figure 25 - Default 1

7.2.2 Default 2 – 10 Sensor Probe and 3 Pumps
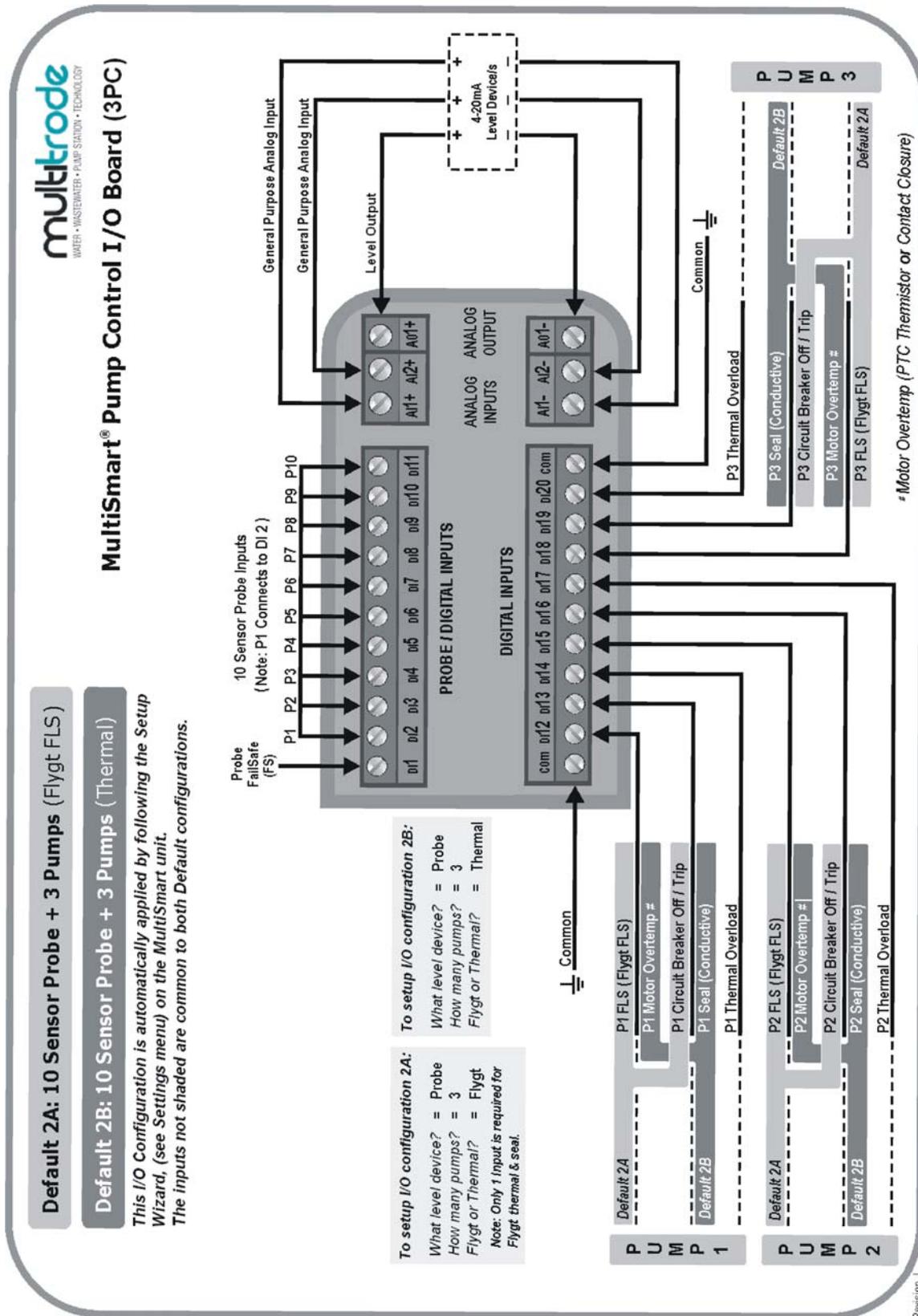
Figure 26 - Default 2

7.2.3 Default 3 – 4-20mA Level/Control and 2 pumps
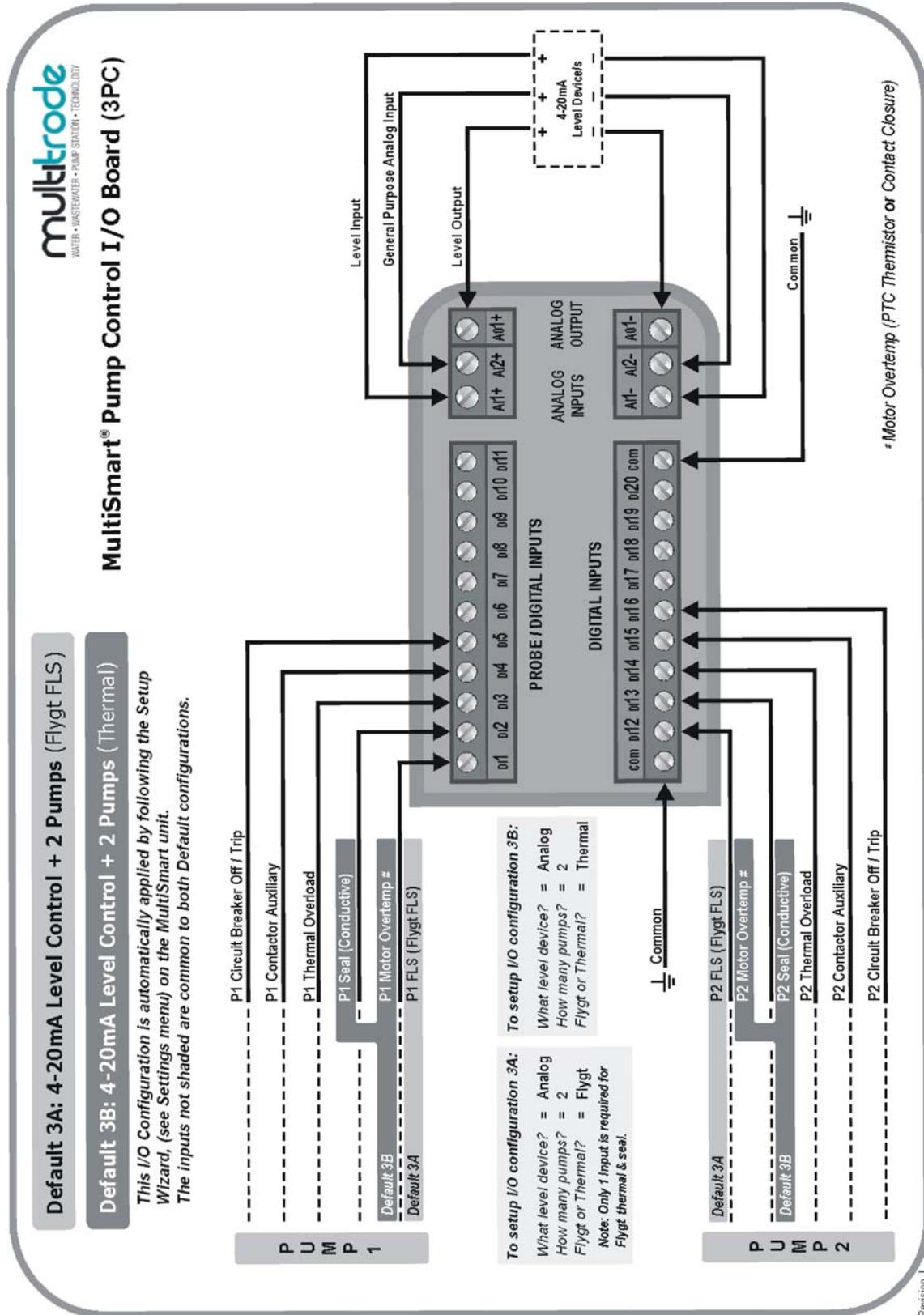
Figure 27 - Default 3

7.2.4   Default 4 – 4-20mA Level/Control and 3 Pumps
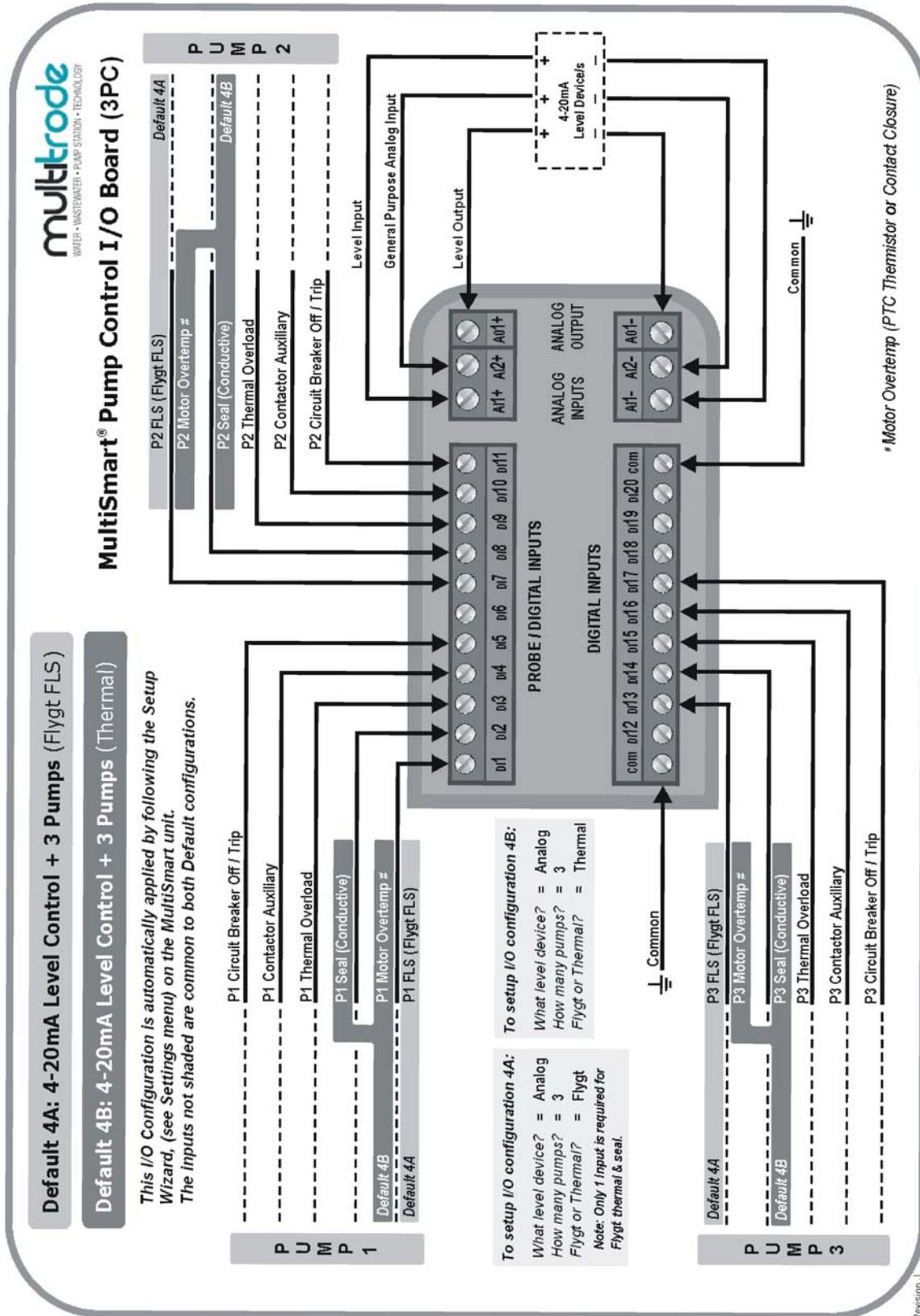
Figure 28 - Default 4

7.2.5   Contactor Auxiliary Fault

If the contactor auxiliary is wired, there is a slight difference in the LCD status display for pump running. If the contactor auxiliary wiring is not present, which is used to get the feedback of pump running status, as soon as the pump running command is sent, MultiSmart will display the status of the pump as **Running**. However if contactor auxiliary is wired, MultiSmart will display **Request to Run** after issuing the command to run the pump, and when the contactor is closed the status will be updated as **Running**.

7.3   Pump Control Board

The pump control board monitors mains voltage and provides digital and analog I/O. Level sensing can be from a MultiTrode conductive probe, or any 4-20mA device, e.g. pressure transducer or ultrasonic. Pump faults can be contact closures or pump specific inputs such as seal, PTC thermistor, or Flygt FLS and CLS. Digital outputs drive the pump contactors.

7.3.1   Mains Voltage Monitoring

For voltage monitoring to work connect the main supply to the Pump Control Board. To configure voltage monitoring and protection see Section 18. MultiSmart also supports single phase AC power supplies.
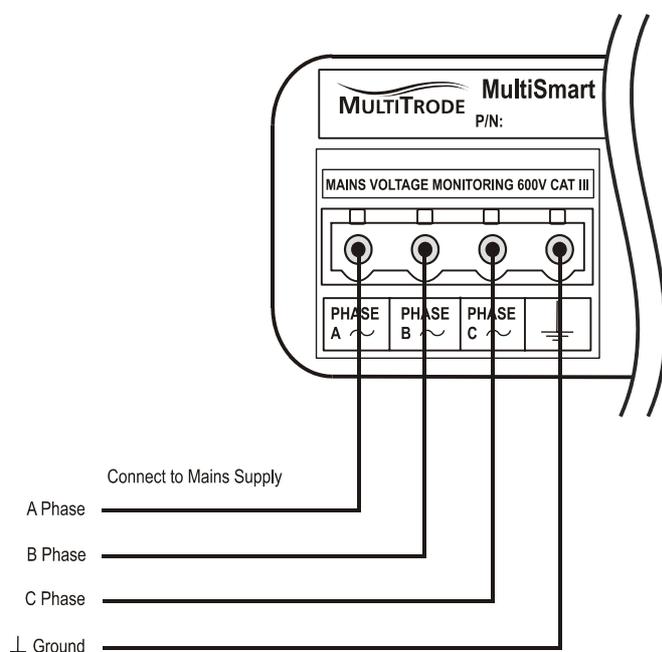
Figure 29 – Connecting Mains Supply to MultiSmart for Monitoring and Protection Purposes.

7.3.2   Digital Inputs

There are 20 digital inputs on the pump control board. All inputs can be used as volt-free digital inputs, but also have additional functionality:

WARNING:
THE DIGITAL INPUTS ARE VOLT-FREE INPUTS. DO NOT APPLY ANY SOURCING VOLTAGE TO THEM.

7.3.2.1   Sensor Types

The digital inputs are configured through the interface to accept many types of inputs.

- Flygt FLS

- Thermal Switch

- Voltage Free Contact (switch or relay)

- Transistor (inc. opto-coupler)

- Conductive Probe

- Conductive Seal

- Thermistor (non-linear PTC)

- Counters
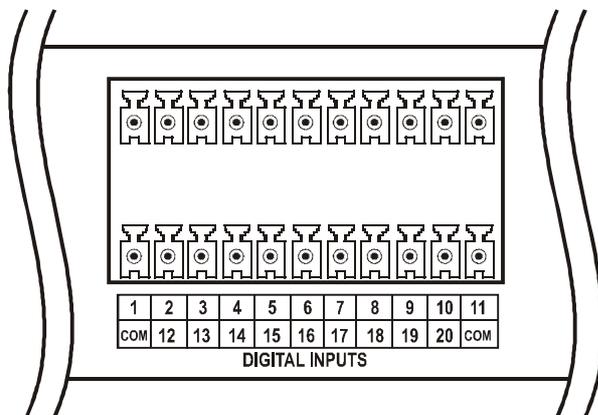
Figure 30 - Digital Inputs

Certain DIN's have added capability:

- DI 19-20 High speed inputs (up to 1kHz).
  Used for pulsed inputs such as Pulse Flow Meters. Can also be used as general inputs.

- DI 16-18
  These three inputs can also be used with Flygt CLS (Capacitive Leakage Sensors)

- DI 1 Fail-safe probe input.
  This input is used to connect a fail safe probe input to the pump station manager. It is tested periodically by switching the input to ground. If a break or disconnection is detected a probe fault is generated. See the MultiTrode website for details on the fail-safe probe.

7.3.2.2   10 Sensor Probe (or Ball Floats)

An example of how to wire a 10 sensor probe is shown below. If no failsafe sensor is available on the probe, you should still wire the 10 sensors from DI 2 – DI 11 (to match the MultiSmart default configuration). DI 1 can be used for any other general Digital Input.
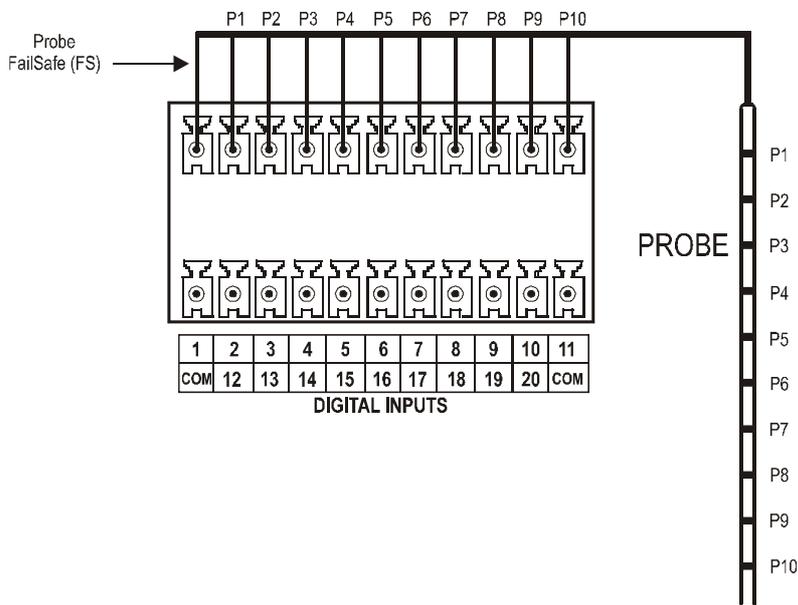
NOTE:
Where a FailSafe probe is being installed, Probe wire 11 is the FailSafe connection and is wired to DI 1.

Figure 31 - Probe Inputs

7.3.2.3   Single Sensor Probe (or Ball Floats)

An example of wiring single sensor probes is shown below. Any input could be used as long as they have been configured to accept a single sensor probe using the interface.
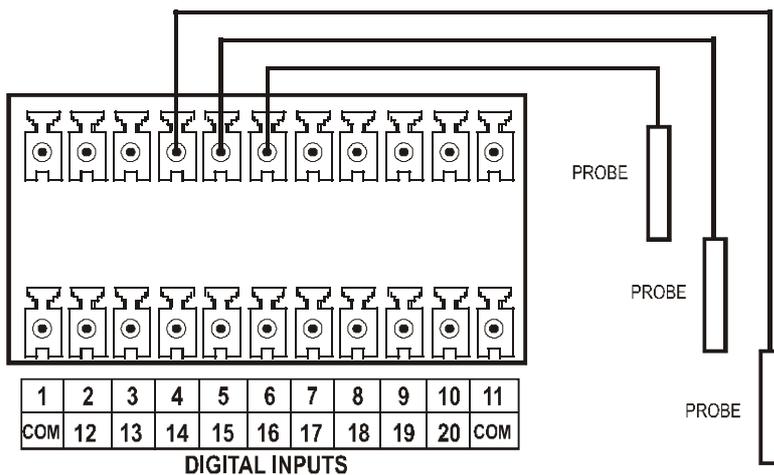
NOTE:
Where FailSafe probe/s are being installed, although each probe may have a FailSafe wire; only one (1) probe can be connected to the FailSafe input.

Figure 32 - Single Sensor Inputs

7.3.3 Digital Volt-Free Outputs

The pump control board has seven 240V, 5A, and digital volt-free outputs:
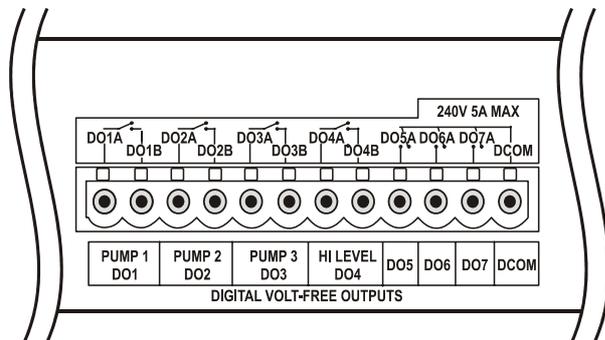
Figure 33 - Digital Volt-free Outputs

- DO 1-4 – Isolated voltage free contacts.
- DO 5-7 – Common rail voltage free contacts.

NOTE:

DO1-4 ARE CONFIGURED BY DEFAULT. HOWEVER, WHEN THE SYSTEM HAS LESS THAN 3-PUMPS THE RELEVANT DIGITAL OUTPUTS WILL NOT BE CONFIGURED, E.G. WITH 2-PUMPS DO3 IS NOT CONFIGURED.

NOTE:

MULTITRODE RECOMMENDS THAT SNUBBERS ARE FITTED TO THE CONTACTOR COILS THE DIGITAL OUTPUTS ARE DRIVING.

NOTE:

MUITIPLE SOURCES CAN BE ASSIGNED TO THE DIGITAL OUTPUT WITH AND, OR AND XOR OPERATIONS CAN BE DONE TO THE SOURCES.

7.3.4 Analog Inputs

The pump control board has two 4-20mA analog inputs.

- Maximum Load – 120ohms

- Resolution 0.2%
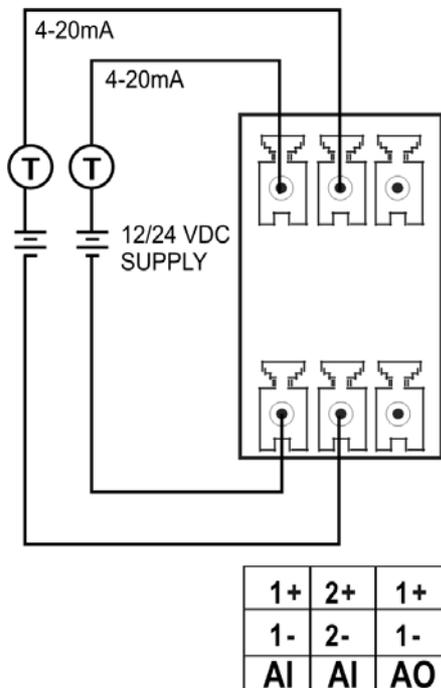
Figure 34 - Analog Input - External Excitation: 2-Wire   *Figure 35 – Analog Input - External Excitation: 3-Wire*
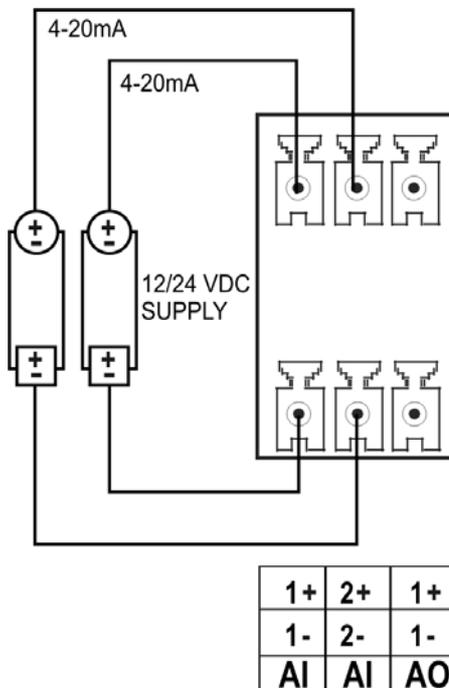
7.3.5 Analog Output

The pump control board has one analog output which produces a 4-20mA output signal. This output can be used to transmit the water level (or reflect the value in any AIN on the MultiSmart unit) or to control a Variable Frequency Drive, i.e. VFD. (VFD functionality is an optional feature which needs to be ordered if required. It can be enabled after purchase.)

- Maximum Load – 800ohms

- Resolution 0.2%
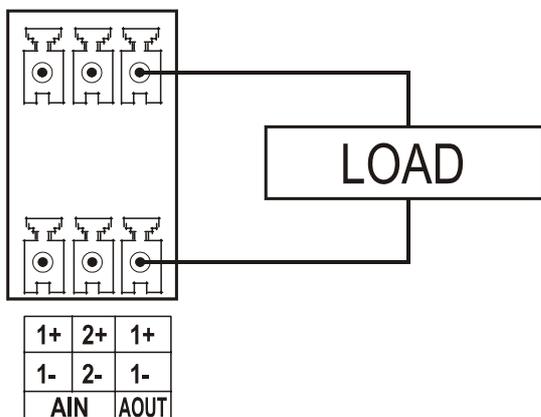
Figure 36 - Analog Output

7.4   CPU Board

The CPU Board is the core of the MultiSmart pump station manager and provides serial and Ethernet communications ports, controls the user interface and has a flash card interface.

7.4.1   Connecting the User Interface Display

Connect the display into the RJ45 socket on the MultiSmart unit CPU Board as shown below.
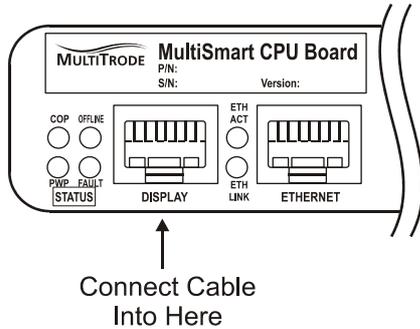
Figure 37 - Connecting the display cable

WARNING: *DO NOT CONNECT THE DISPLAY INTO THE ETHERNET PORT*

7.4.2   Ethernet Port

The CPU Board has a 10Mbit/s, RJ45, Ethernet port. This port can be used for SCADA communications when using radios with an Ethernet port.

7.4.3   Serial Ports

There are three RS232 (DB-9 - male) serial ports on the CPU Board. Any of these ports can be assigned to a communications channel. See **Error! Reference source not found.** for more information. All I/O lines are implemented.

The MultiSmart serial ports use the standard RS232 pinouts as tabled below.

Pin	Name	Abbrev	Direction
1	Carrier Detect	CD	Input
2	Receive Data	RX	Input
3	Transmit Data	TX	Output
4	Data Terminal Ready	DTR	Output
5	System Ground	GND	-
6	Data Set Ready	DSR	Input
7	Request to Send	RTS	Output
8	Clear to Send	CTS	Input
9	Ring Indicator	RI	Input

Table 2 - Serial Port Pin Out

7.4.4 Flash Memory Card

The flash memory card socket takes standard CF memory cards. MultiTrode recommends the use of SanDisk CF cards as these have been tested by MultiTrode. Some brands may not function correctly. The CF card can be used in a number of ways:

- As extra storage space for data logging.

- To install new firmware.

- Can be used to load or save configuration files into the MultiSmart unit.

WARNING:
*Before removing the compact flash card, **you must press the yellow save CF data button**. Failure to do so may cause corruption of data or damage to the flash card.*

7.5 DSP Board

The Digital Signal Processor board handles the I/O, communicates between multiple I/O modules and is where the main power supply is connected.

7.5.1 Power Supply Connector

The 12-24VDC power supply is connected into the DSP board as shown below:
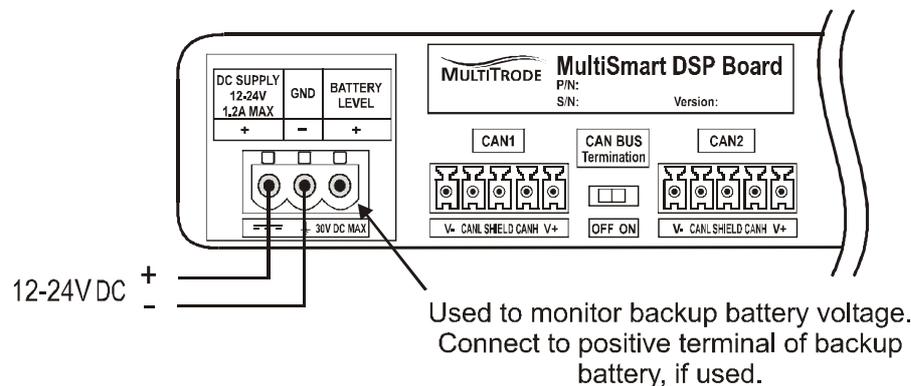
Figure 38 - Connecting the power supply

7.5.2   DSP Status LEDs

There are four DSP status LEDs labelled COP, Power, Offline and Fault.

(a) COP (Computer Operating Properly) (Correct State: Slow Flash)

Off: This occurs when the DSP is waiting for the first communications on the bus.

This LED remains off until the Host processor starts running I/O. If the LED stays off, then most likely a fault is present with the bus and it is preventing the DSP from receiving initial communications from the Host processor.

Slow Flash: Flashes about once every 2 seconds when the main software is running.

Quick Flash: A faster flash rate (approx 2Hz) indicates that the bootloader is running and waiting for commands. This will be seen for about 5 seconds after the Host starts running the I/O and also during a DSP firmware upgrade.

(b) Power (Correct State: On)

This is a Power indicator.

(c) Offline (Correct State: Off)

Off: The main software is running.

This means that the I/O is running.

On: The bootloader is running.

The main software is not running so no I/O is running.

(d) Fault (Red) (Correct State: Off)

Off: Status OK

On: At least one of the I/O boards attached has I/O calibration data which the current firmware cannot handle and as a result, the I/O is not calibrated. Firstly upgrade the DSP firmware and if the Fault LED remains on, contact MultiTrode as the I/O is not calibrated.

Flashing: This indicates that at least one of the I/O boards found is incompatible with the firmware.

It means that no I/O at all can operate on the unit. Upgrading the DSP firmware should solve the problem.

7.5.3 Add PSU & Battery Backup

7.5.3.1 Connections to the Power Supply

The figure below illustrates the connections to the Mean Well power supply, model AD-155A, (Part No. PSU-BATT-02).
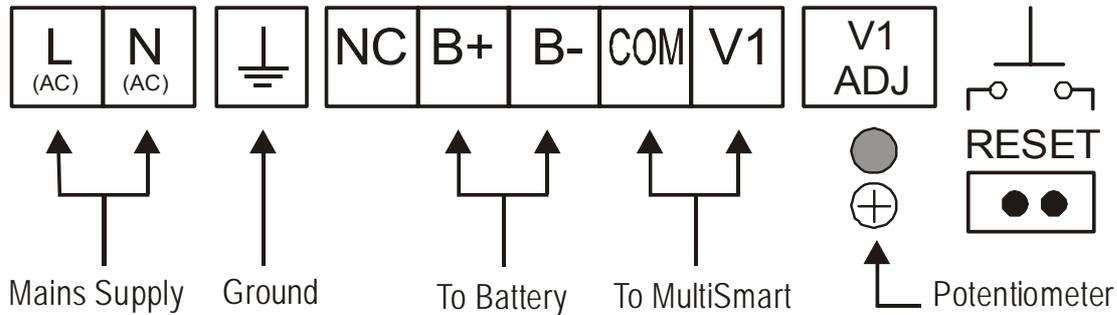
Figure 39 - Power Supply Terminal Block Connections

7.5.3.2 Setting the Correct Charge Voltage

To help maximize battery life it is essential that the correct charge voltage from the power supply to the battery is set. The correct value is 13.7VDC +/- .1VDC*.

* This value applies to the current 12VDC, 28Ah batteries supplied (Yuasa and Panasonic brands - alternative brands may however be supplied).

To verify the charge voltage:	Measure the voltage between terminals **B+** and **B-**
To alter the charge voltage:	Adjust the small potentiometer (labelled **V1 ADJ**) until the correct value is displayed.

7.5.3.3 Power Supply Reset

NOTE:
If mains power is lost <u>and</u> the connections to the battery are removed and then reconnected, it will be necessary to reset the power supply in order to restore operation (unless mains power is also restored).

The reset connector is located on the right hand side of the terminal connections on the power supply (labelled "**RESET**"). Bridge the two terminals within the reset connector to reset the power supply.

7.5.4 CAN Bus & Expanded I/O

I/O expansion units are connected to the main MultiSmart unit using a CAN Bus network or through the Ethernet *RJ45) connector (See Section 14.4). Any I/O module which supports DNP and MODBUS communication can also be interfaced to the MultiSmart which requires custom Engineering. MultiSmart units are preconfigured to support four such Ethernet expansion modules mentioned below.

ADAM-6017

ADAM-6050

ACROMAG-961

ACROMAG-983

The CAN bus baud rate and the device ID are set using the dial switches shown below. The ID must be unique for each device on the CAN bus.

The baud rate should be set to the same speed on every device connected to the bus. Select a suitable speed for the length of cable between devices as shown in the table below.

	Baud Rate	Max Cable Length
0	125Kbps (default)	500m
1	10Kbps	1km
2	20Kbps	1km
3	50Kbps	1km
4	100Kbps	500m
5	125Kbps	500m
6	250Kbps	250m
7	500Kbps	100m
8	800Kbps	50m
9	1Mbps	25m
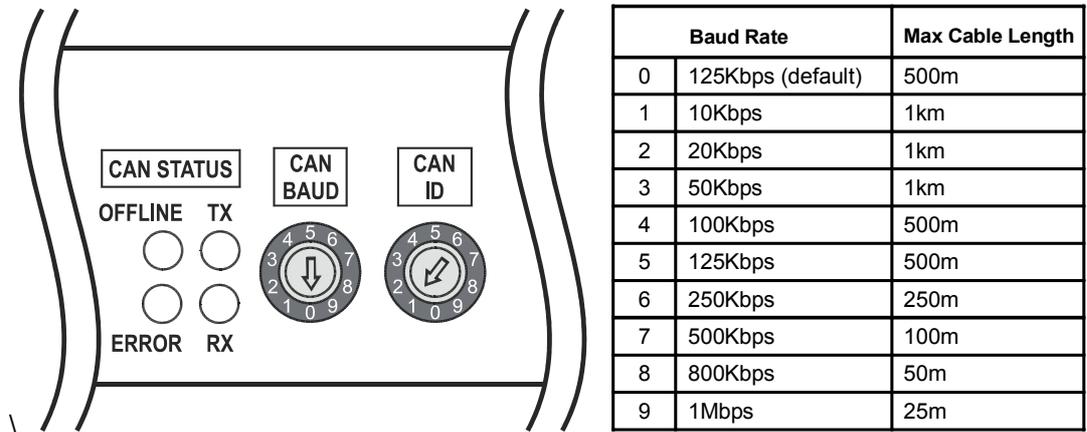
Figure 40 - CAN Bus Settings

If you change the CAN bus baud rate on the unit you will also need to make the same change in the configuration. Go to:

Settings → Advanced → IO → CAN Bus Baud Rate

and select the appropriate value.

7.5.5 CAN Bus Settings
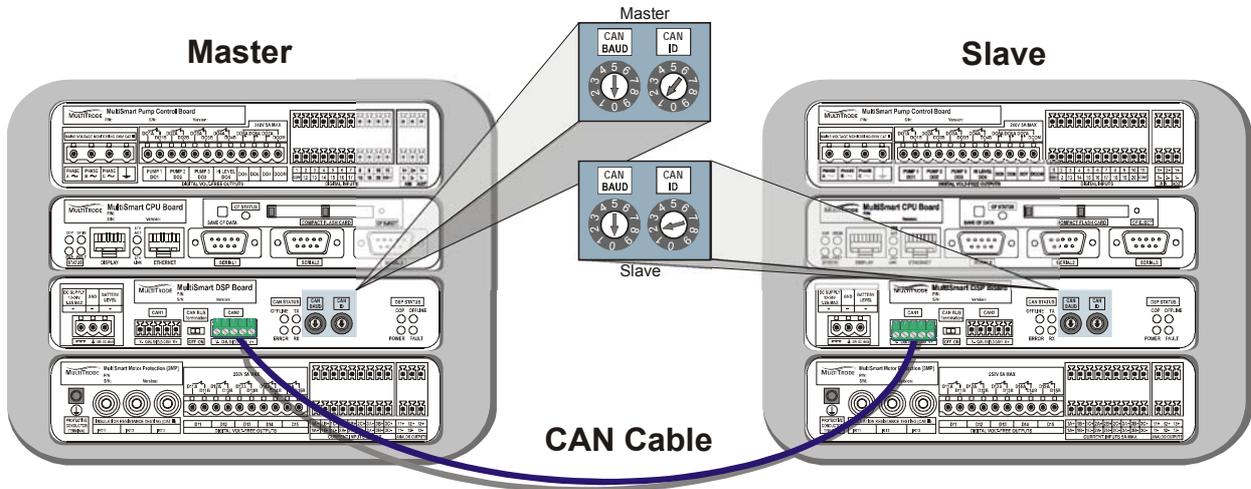
Figure 41 - Connecting Expanded I/O

⚠️ **Note:**
The CAN Bus Termination is set to ON for standalone MultiSmart units. Termination is only set to ON when this device is the LAST device on the CAN Bus network.

Hardware Configuration	Master Unit		First Slave		Second Slave		Comment
	CAN Bus Termination	CAN ID	CAN Bus Termination	CAN ID	CAN Bus Termination	CAN ID	
Master device only	ON	1	n/a	n/a	n/a	n/a	Default setting
Master + Slave	OFF	1	ON	2	n/a	n/a	Single slave device
Master + Slave(s)	OFF	1	OFF	2	ON	3	Multiple slave devices
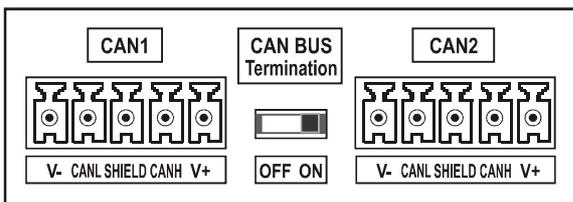
Figure 42 - CAN Bus Settings - Single unit only
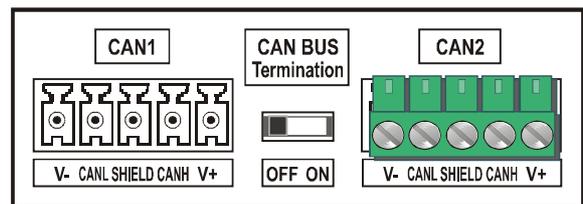
Figure 43 - CAN Bus Settings – Master Unit
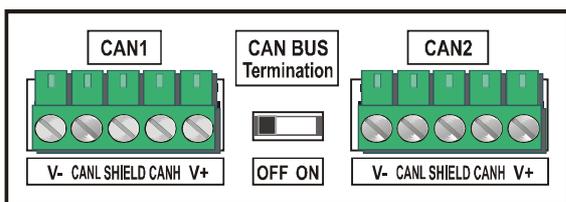
Figure 44 - CAN Bus Settings – Intermediate Slave Unit
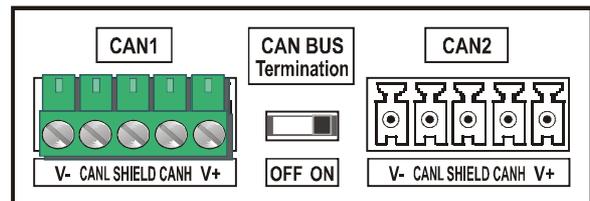
Figure 45 - CAN Bus Settings – Last Slave Unit
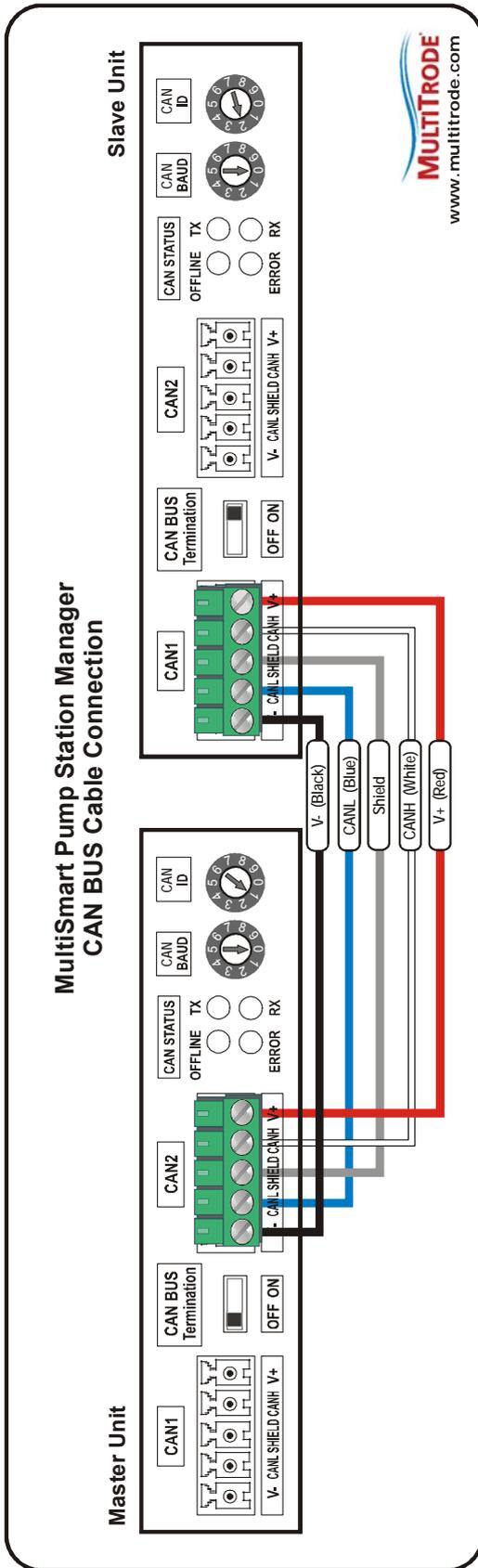
Figure 46 - CAN BUS Cable Connection Wiring

7.5.6   CAN Status LEDs

Consists of 4 LEDs labelled; Offline, Error, TX and RX.

(a)   Offline (Correct State: Off)

Off: The CAN bus sub-system is in Operation mode.

This means that everything is up and running and the Slave (DSP) is completely configured and sending status data to the Master (Host processor).

On: The CAN bus sub-system is not in Operational mode.

Slave (DSP) to Master (Host processor) communications have not been established.

This LED normally activates soon after power-up (whilst it is waiting for and receiving configuration from the Master (Host processor). Once the Master has configured the Slave (DSP), then the Master will send a command to switch the CAN sub-system to Operational mode. The Slave will then start sending status data automatically to the Master.

(b)   Error (Correct State: Off)

This LED indicates errors on the CAN bus.

This can be due to either a connection or termination problem on the bus or to a Baud Rate mismatch between either the Master or one of the slaves. Bad connections, bit errors (due to poor wiring or too long a bus) can also cause bus errors.

The Slave and the Master both attempt to recover automatically from the errors but unless the fault is rectified the errors will continue.

Off: Status OK

On: The Slave has switched to "Error Passive" mode on the bus.

This means that the unit will receive but not transmit. This is due to the detection of packet errors on the bus. The unit will attempt to recover automatically.

Flashing (approx 5Hz): The Slave has switched to "Bus Off" mode.

This means that the unit has stopped communicating on the bus. The unit will attempt to recover automatically. The auto-recovery mechanism will mean that the total duration of the flashing period will be short.

(c) TX & RX (Transmit and Receive) (Correct State: fast flash)

Indicates activity on the bus. These LEDs simply flash with the data on the bus.

At high baud rates the LEDs are only illuminated briefly so they will appear fairly dim - this is normal.

7.6 Energy Monitoring & Motor Protection Board

The Energy Monitoring and Motor Protection Board is an optional board for up to 3 pumps. It monitors single or 3-phase motor currents for up to 3 pumps, direct from CT's, and provides motor protection and power monitoring. The board also carries out an automatic 1000v insulation resistance test of the motor windings. An additional 5 digital outputs and 3 analog outputs are on board.

> **Note:** Power monitoring requires 3-phase supply monitoring located in the same MultiSmart enclosure. The 3PC board has 3-phase supply inputs. Therefore you must have a 3PC board and a 3MP board in the same enclosure to do power measurements. MultiSmart can monitor single phase supply as well.

7.6.1 Insulation Resistance Tester

The 1000VDC Insulation Resistance Tester is connected to the pump motor windings and periodically tests them for insulation breakdown. See Section 17.2 for details on how to configure the tester.
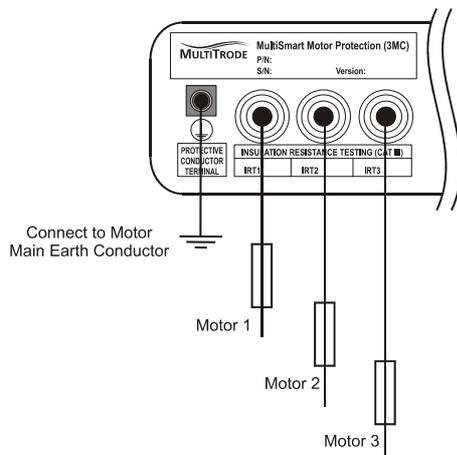
Figure 47 – Connecting the IRT

Insulation resistance measurements are performed when the motor is stopped. Therefore the motor windings must be connected in a star or delta configuration when it is stopped in order to ensure all windings are tested. The MultiSmart can be set with multiple thresholds for the Insulation Resistance Test. The default setting of this warning is not to fault the pumps and to provide only an indication.

Wire one winding from each motor controlled by the MultiSmart pump station manager.

Connect the Protective Conductor Terminal to the Earth Conductor connected to the motors.

> **Note:** Follow the manufacturer's guidelines regarding motor insulation testing when using soft starters or VFD's. Functionality is included in the software so the DOUT's can drive isolation contactors while IRT is in progress.

7.6.2 Digital Volt-Free Outputs

The board has five isolated voltage free contacts rated for 5A at 240V AC.
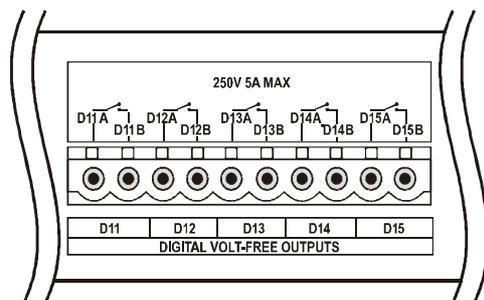
Figure 48 - Digital Volt-free Outputs

7.6.3   Current Inputs

The Energy Monitoring and Motor Protection Board has three sets of three-phase current inputs. These measure between 0-5A and are connected to the secondaries of external CT's to measure higher currents. The CT's must be wired with the correct polarity and ensure that the current phase is corresponding to the voltage phase. Shielded twisted pair cables are recommended and only the shielding should be grounded. This ground can be connected either at the MultiSmart end or both at the MultiSmart and at the CT's.

Note: *During the wiring of CT's if the polarity is wrong the current reading will be correct. However the power and energy calculations will be wrong. MultiSmart is capable of detecting the difference in polarity. The phase rotation fault in the MultiSmart can be enabled during installation to verify if the polarity is correct.*

During CT section two things that are to be considered are the input resistance of around 40mΩ for the MultiSmart terminal & the resistance of the copper wire used for the installation.
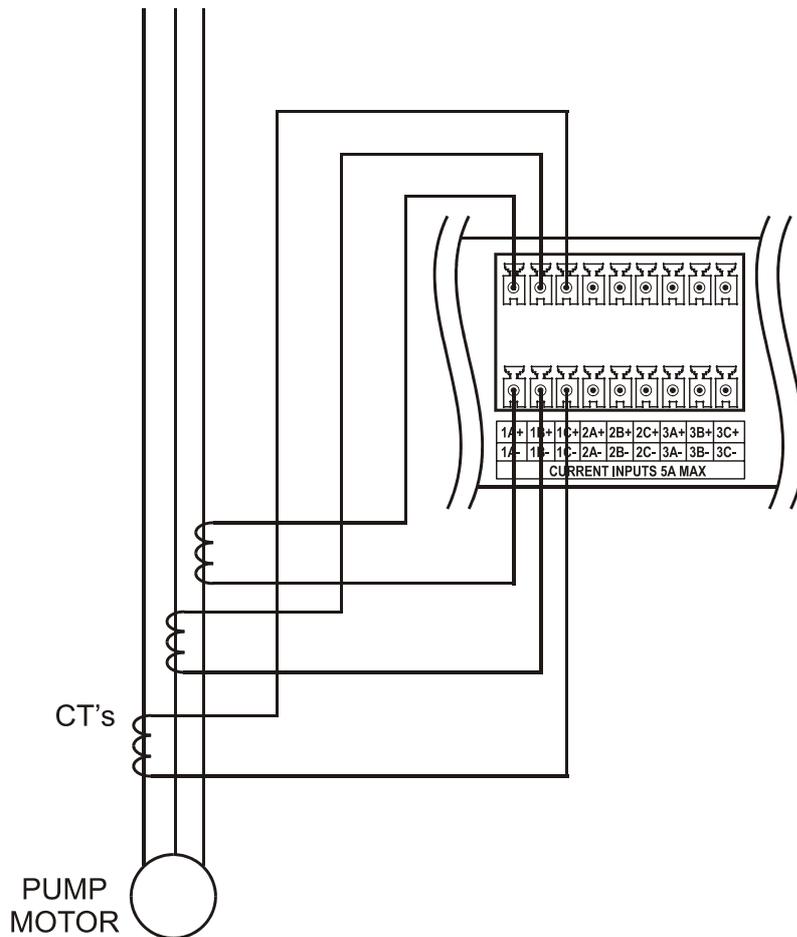
Figure 49 - Current Inputs

Note: *The CT's must not be grounded/ earthed. Otherwise incorrect current readings will be measured.*

7.6.4 Analog Output

The energy monitoring and motor protection board has three analog outputs which produces a 4-20mA output signal.

- Maximum Load – 800ohms
- Resolution 0.2%
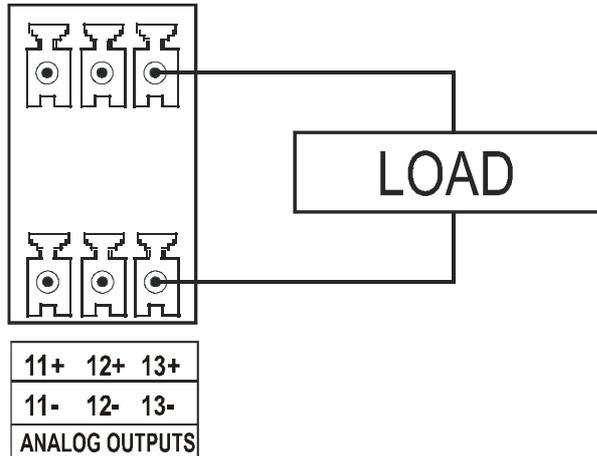
Figure 50 - Analog Output

8   PumpView Hardware Setup

PumpView is a web-based monitoring and control system. There is no software to install, and no server or radios required. All that is needed is a web browser and a cellular based internet connection at the site(s). While primarily aimed at the water and wastewater sector, it can be used in a variety of industries.

Once the hardware is installed and the MultiSmart configured, the site can be monitored and controlled via the web. Fault conditions can be configured to generate alarm messages and sent by email or to a cellular phone.

CAUTION:
To avoid damaging the modem, always have an antenna connected before applying power to the modem. Failure to do so may result in damage to the modem.

NOTE:
The antenna must be installed outside the panel. A standard omni-directional antenna as supplied by MultiTrode (smooth cylinder or rod with no protusions) should be mounted vertically, such that the cable exit point is directed towards the ground. This will ensure correct operation and prevention of water ingress into the antenna. Antennas are unlikely to funtion if they are directed horizontally. Ensure the cable is not kinked or bent tighter than a 25mm (1") radius curve.

Using the RS232 cable provided, connect the modem to the MultiSmart unit on serial 3 (as shown in Figure 51.)
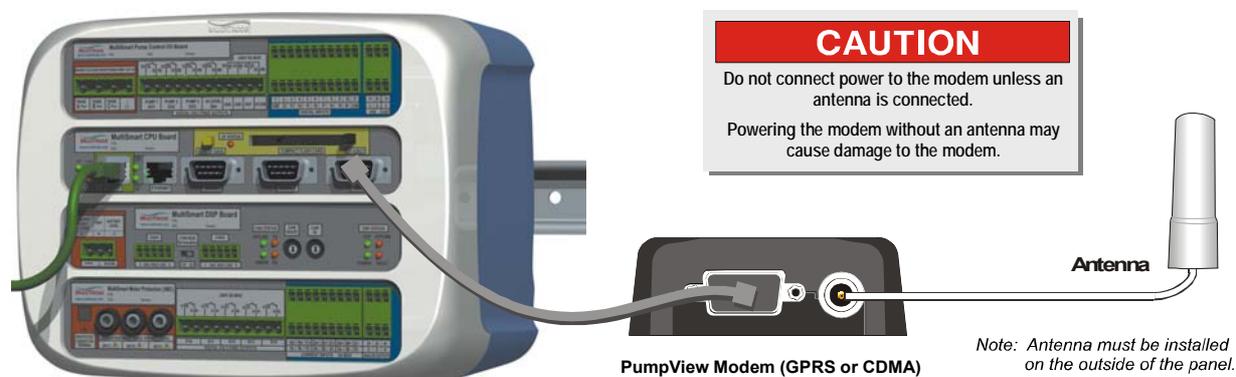
Figure 51 – Connecting the PumpView modem to MultiSmart

8.1.1   Cellular Modem (PumpView) Setup

The following setup is typically completed prior to shipment but circumstances may arise when this procedure must be performed on-site.
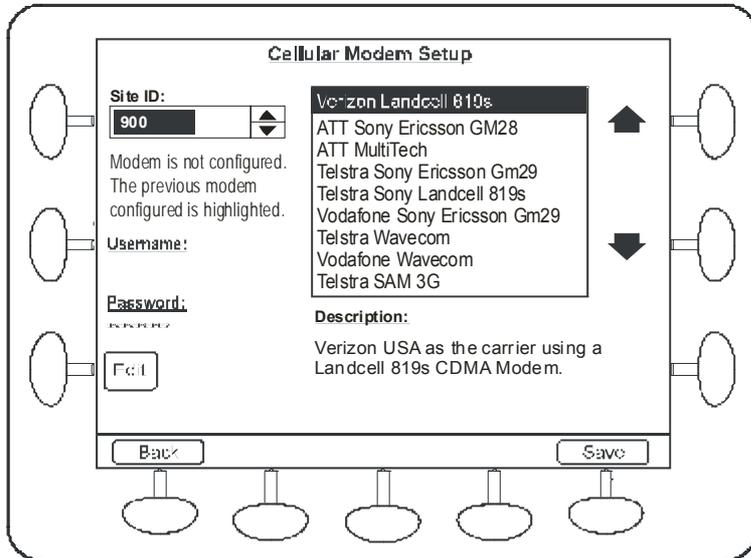
Figure 52 –Modem Setup Screen

Settings ⟶ More ... ⟶ Communications... ⟶ Cellular/PumpView

- Enter the 4 digit Site ID (this is supplied by MultiTrode)
- Select the modem (based on the Telco and the modem brand)
- Depending on the Telco, a Username may be needed. The text "Username:" will appear on the left hand side if a username is required.
- The username has the format:

   pv[Site ID]@multitrode.com

   where [Site ID] is the same as the 4 digit number previously entered above, e.g. pv1009@ multitrode.com

Press the **Edit** button to change or to enter a Username, make the changes then press **Save**

- The Password should not be changed from the default (displayed as xxxxxxxxx)
- Press Save and then Restart Now

The MultiSmart will reboot and cellular communications should be established within a few minutes.

8.1.2   Fault Finding

For the Sony Ericsson, Wavecom and SAM 3G modems, an LED on the modem will flash when power is applied and the device is communicating (it may take a minute or so to establish communications).

If the LED is on but not flashing this means it cannot connect to the cellular network. If you have previously determined that there is adequate signal strength for this site, it may indicate a temporary cell tower problem. However, it is more likely to indicate that there is a signal strength problem at this location. Possible solutions are:

- Using a higher gain antenna
- Installing the antenna at a higher point

9   Quick Commissioning Guide

The MultiSmart is pre-programmed with a number of standard configurations for typical water/wastewater applications. This includes:

- Pump station manager with local level

- Pump station manager with remote level (reservoir)

- Reservoir monitor communicating with remote pump station

The Setup Wizard in the Settings menu takes you through a number of questions to configure the product.

Settings   ⟶   Setup Wizard

> ⚠ **Note:** *If the unit has already been setup by a previous user then Security may be enabled either via a DIN or by a PIN number. Refer to Section 11 for more detail.*
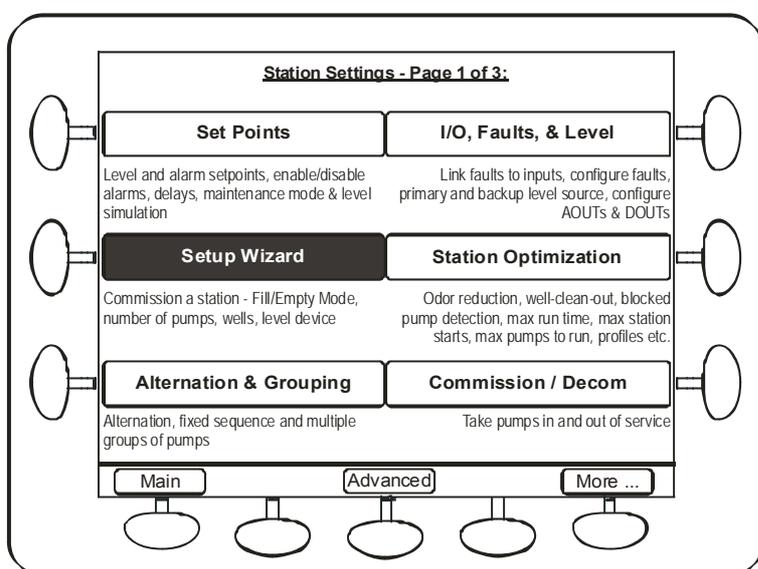
Figure 53 - Settings Screen

When a pump station manager is selected this also establishes one of the standard I/O connection diagrams (see Section 7.2 to Section 7.2.4). The MultiSmart pump station manager establishes 1 of 4 standard connection diagrams depending on whether the configuration is:

- 2 pumps with a MultiTrode Probe / Duo probe

- 3 pumps with a MultiTrode Probe / Duo probe

- 2 pumps with a 4-20mA level device

- 3 pumps with a 4-20mA level device

These connections diagrams have a complete set of pump faults wired in (contactor auxiliary input, C/B off trip, pump seal and thermal (or Flygt FLS), thermal overload).

> ⚠ **Note:** *Disabling any faults not required is a very simple task – see Section 9.3 at the end of the Quick Commissioning Guide.*

9.1 Setup Wizard Flow Diagrams

The following diagrams outline the steps taken to complete the Setup Wizard.

9.1.1 Wizard Start
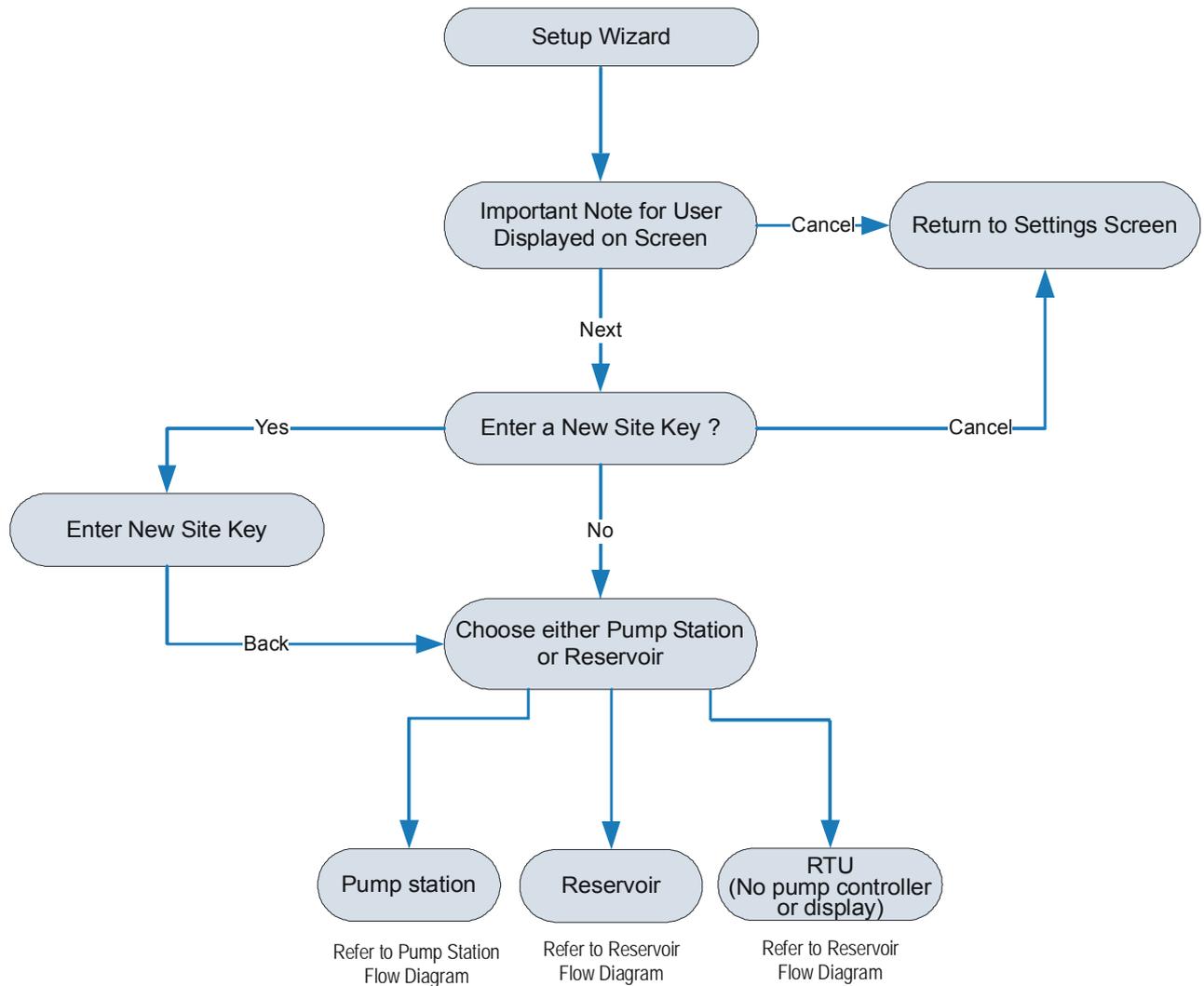
Figure 54 - Setup Wizard - 1 of 4

9.1.2 Pump Station Setup
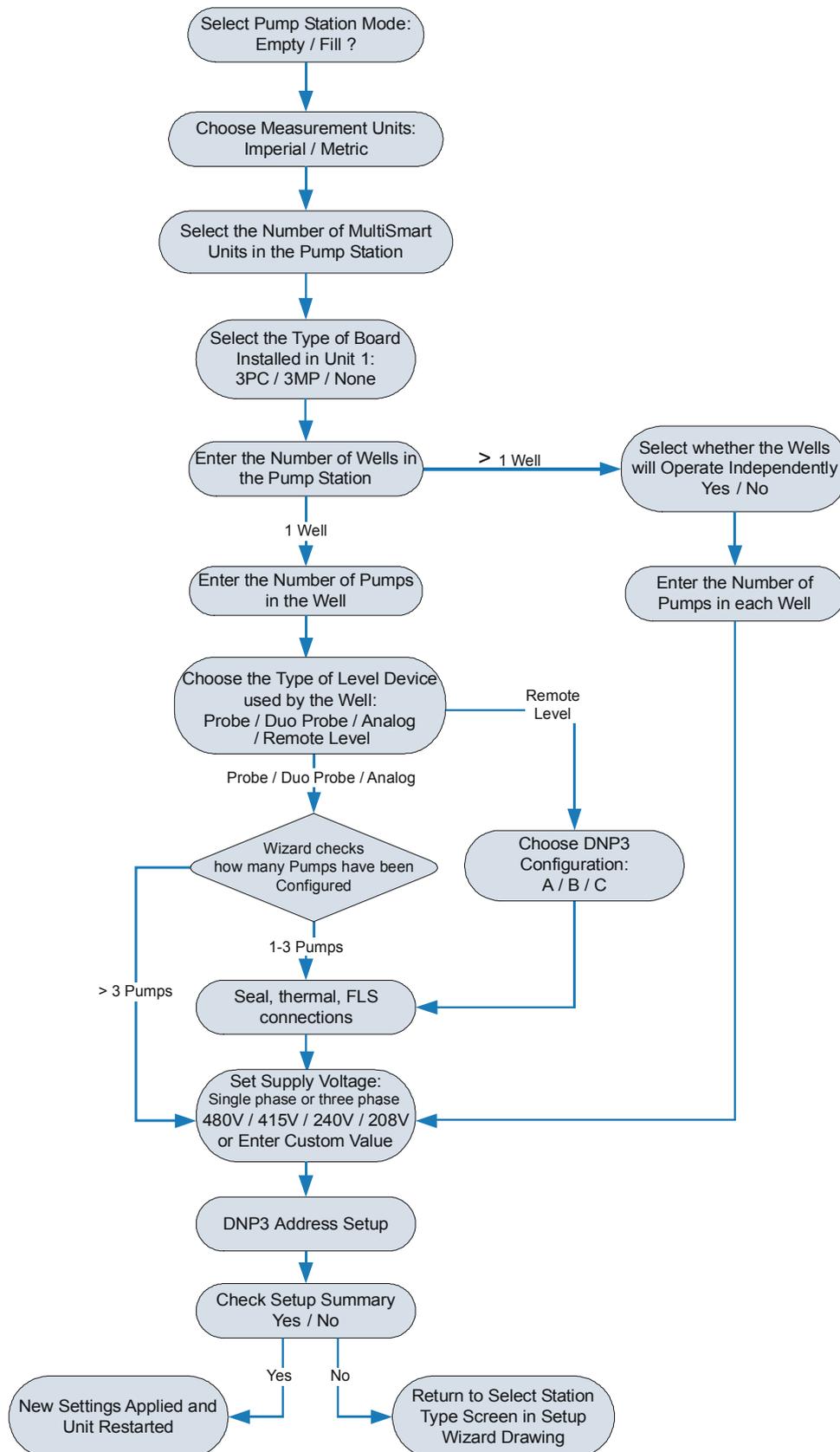
Figure 55 - Setup Wizard - 2 of 4

9.1.3   Reservoir Setup
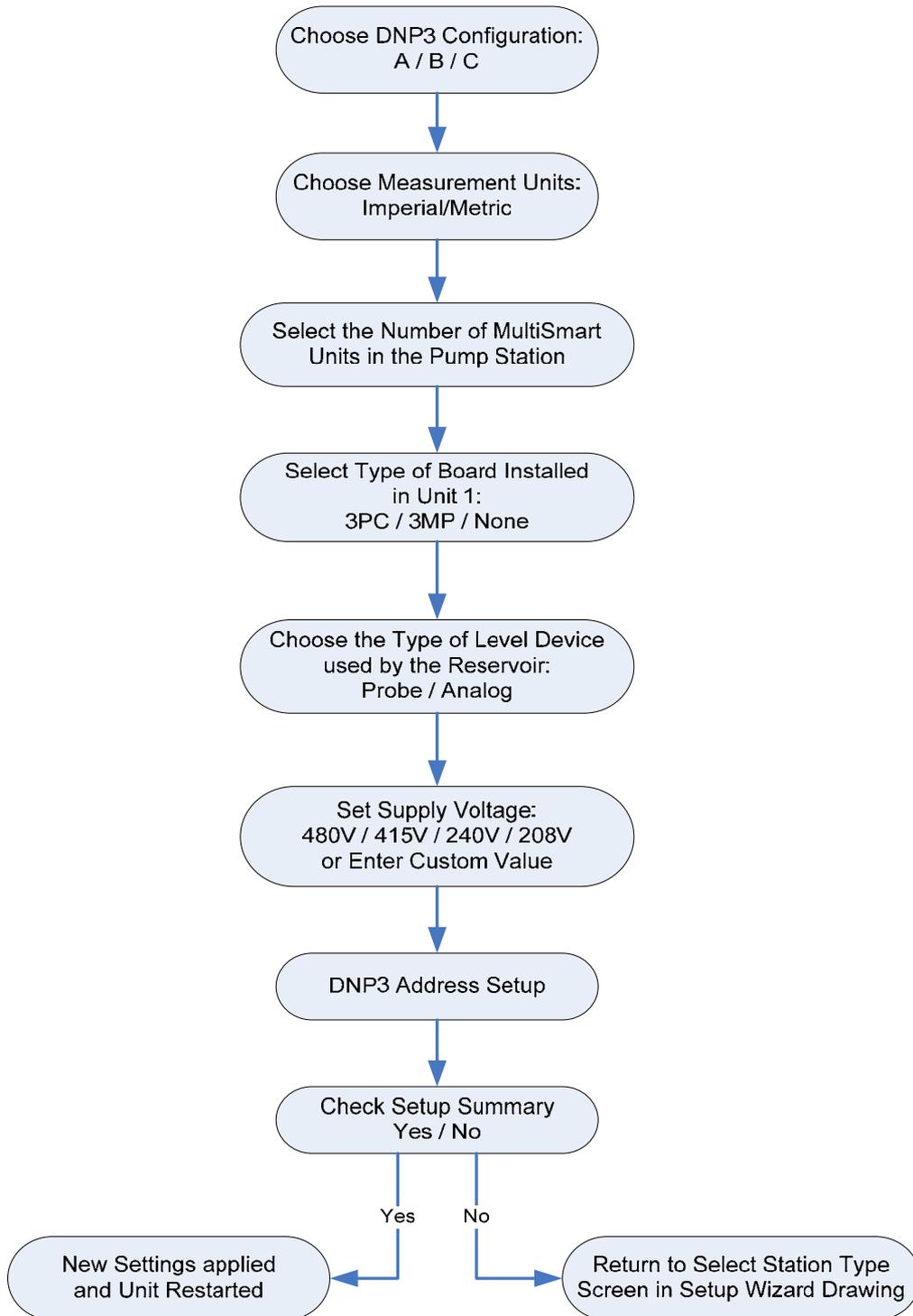
Figure 56 - Setup Wizard - 3 of 4

9.1.4 RTU Setup
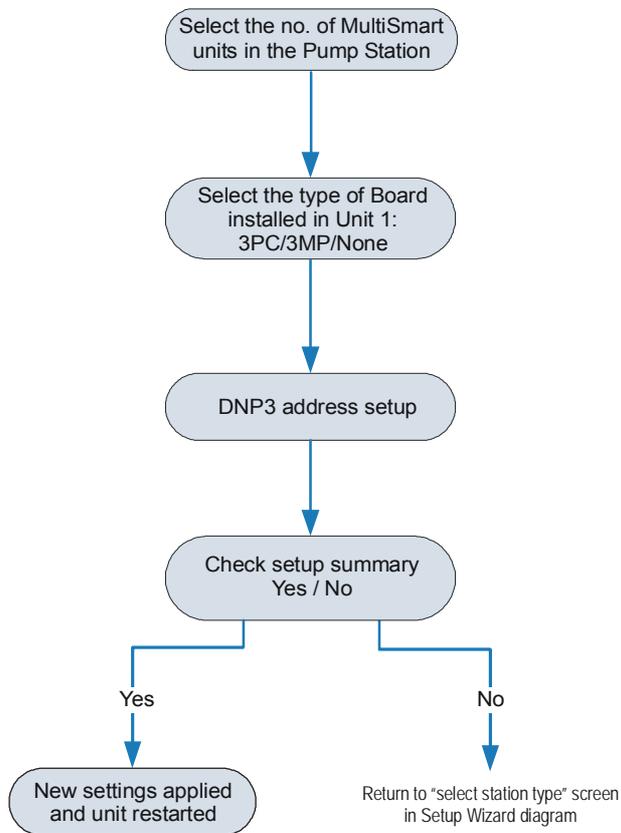
Figure 57 - Setup Wizard - 3 of 4

9.2 Setup Wizard Notes

9.2.1 Activating New Modules

Each MultiSmart unit comes with certain modules enabled. New modules are activated with a new site key. New site keys can be entered at any time when new modules need to be activated.

9.2.2 Fill (Charge) or Empty (Discharge) Modes

A pump station can be configured to either Fill (Charge), or Empty (Discharge) the well.

9.2.3 Number of MultiSmart Units in Installation

Multiple MultiSmart units can be connected together using the CAN Bus interface. This allows additional I/O to be added to the station if required. A "unit" is defined as a separate DIN mounted housing containing at least a DSP Board and one other board, a 3PC Pump Control Board for example.

9.2.4 Configuring the Type of Board Located in the Bottom Slot

There are four board slots in a MultiSmart unit. By setting what type of board is located in the bottom slot the setup wizard can determine the correct I/O configuration for the unit.

9.2.5 Number of Wells in Station

A station can have up to three wells.

9.2.6 Level Devices

There is a choice of Probe (MultiTrode conductive probe), Duo Probe (MultiTrode conductive probe with pressure transducer, Analog (e.g. Pressure transducer or ultrasonic) or Remote Level. Remote level is typically used where the pump station is pumping to a reservoir.

> **Note:** *If you later want to change the level device, there is no need to go back through the setup wizard, simply see Section 14.8.*

9.2.7 Number of Pumps in each Well

If more than one well is configured, you will be asked to repeat the process of selecting the number of pumps for each well(s).

> **Note:** *The number of pumps available for the system is limited to 3, 6 or 9 depending on the options you have purchased.*

> **Note:** *If more than 3 pumps or more than 1 well are selected then no I/O defaults will be applied.*

9.2.8   Select Fault Input Sensor Type

The digital inputs can be setup to handle either a Flygt FLS sensor, or a Thermal/Seal type sensor direct from the pumps.

> **Note:** *This specific pump fault input is identified because the FLS uses one input, whereas a typical thermistor/seal combination uses two inputs. The answer to this question establishes a complete connection diagram*

If you have neither a Flygt FLS sensor or a Thermal/Seal type sensor, choose **None**. You may also want to disable any other faults from the connection diagram that are not actually connected in your panel. Refer to Section 9.3 at the end of Quick Commissioning in Section 9 Quick Commissioning Guide.

9.2.9   Configure Phase to Phase Voltage

A phase to phase pump supply voltage is required in order for the voltage protection functionality to work correctly. Either select one of the options, or enter a custom voltage.

9.2.10   Choose DNP3 Configuration (Reservoir Setup Only)

One of three standard DNP3 configurations must be chosen when setting up the MultiSmart as a Reservoir monitor. These set the method of communication between the reservoir and the remote pump station.

Configuration B is the preferred method. It will setup the DNP3 configuration for situations where a direct communications link between the pump station and reservoir station exists.

Configurations A and C are used where a direct communications link is not present. Instead, these configurations setup the MultiSmart to receive the level via a DNP Master (MTU).

See section 21 for more information.

9.2.11   Accepting New Configuration & Resetting Controller

The final commissioning screen will display a summary of all settings entered. Check the configuration carefully and press the **Yes** button if it is correct.

All current settings will be replaced by the new configuration. The controller will restart with the new settings. This process will take a few minutes to complete.

9.3   Unassign Any Faults Not Used

To speed up the process of establishing a new station, four standard configurations are used. These include a number of useful pump faults inputs, some of which may not be needed or not available in your station.

Note: Some of the standard configurations include a contactor auxiliary input for each pump. If no contactor auxiliary is connected to this input a pump fault will be generated.

To unassign any fault inputs, go to Settings/I/O faults and level/Digital Inputs

Settings ⟶ I/O Faults, & Levels ⟶ Digital Inputs
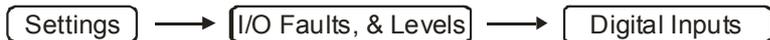
This screen will show you how all DIN's have been assigned:
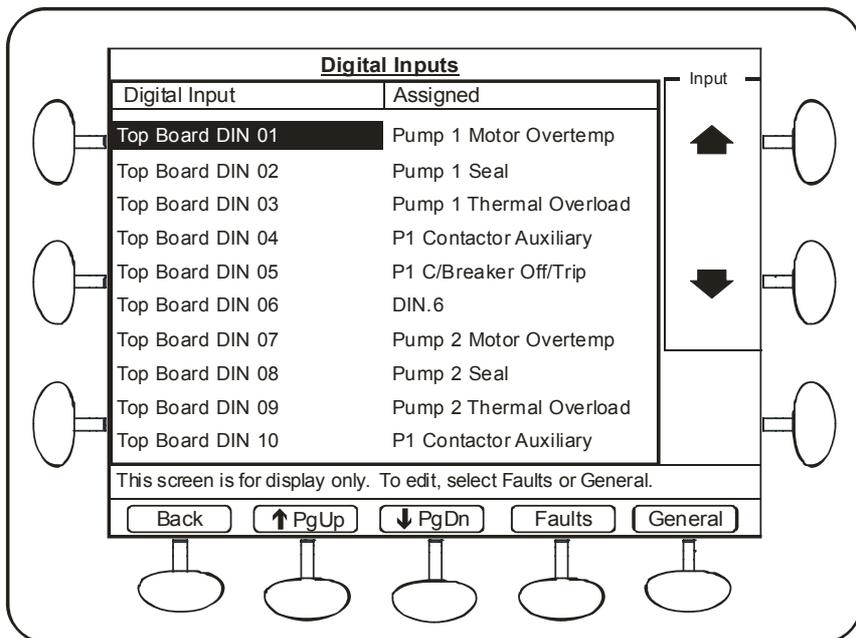
Figure 58 – Digital Input assignments

Select the Faults option: Faults   This screen identifies all faults that have been pre-configured in the system, along with any that are currently linked to DIN's.
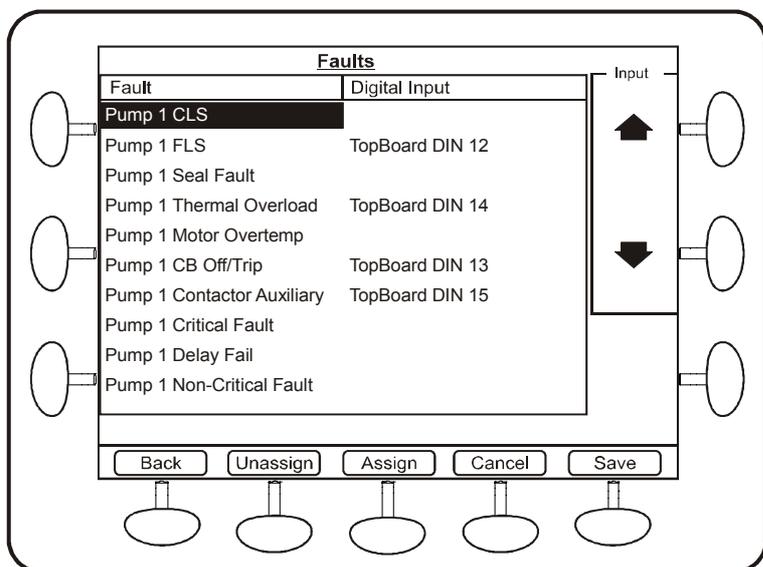
Figure 59 - Pre-configured Faults

Select the fault you want to unassign, and press the **Unassign** softkey. Repeat for any other faults to be unassigned, and press the **Save** softkey.

For certain faults which are assigned or unassigned the MultiSmart will need to be restarted. If restart is necessary the following prompt will come up on the screen, from which choose the desired option, keeping in mind that a restart is required for those changes to come into effect.
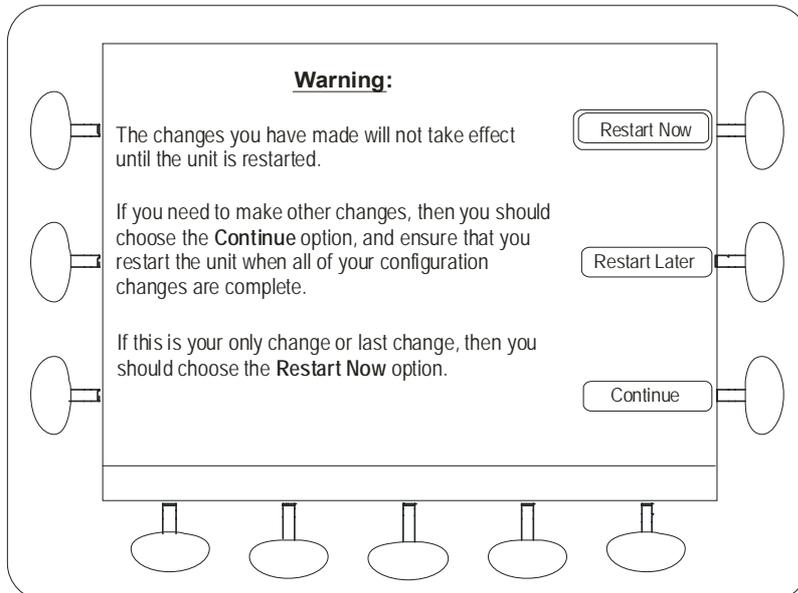
Figure 60 – Select to ***Restart Now*** *or* ***Continue***

Choose **Restart Now** if you have completed configuring faults. Choose **Continue** if you still have other configuration changes to make or **Restart Later** to continue the operation or make further changes without again being warned for a restart. However the last option will be shown as a fault which can only be cleared with a MultiSmart restart.
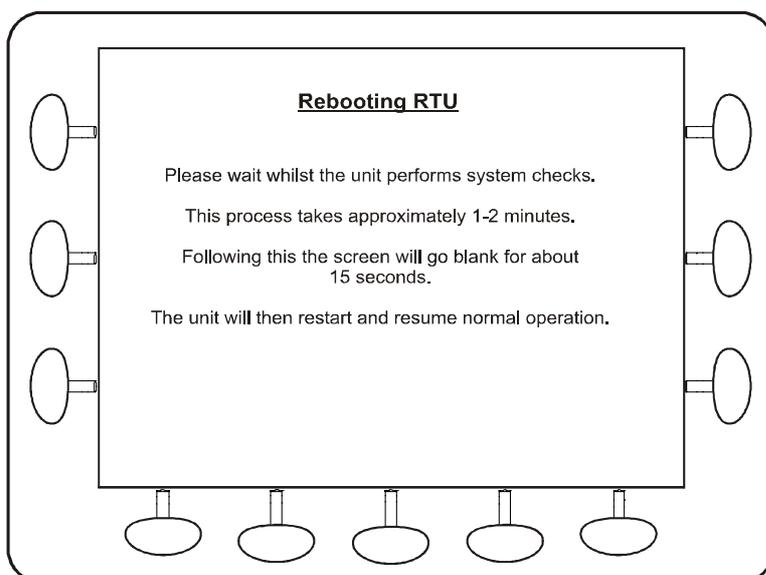
Figure 61 - Restart Screen

9.4 Level Simulation Mode

9.4.1 Simulating Levels for Safety/Commissioning Purposes

The pump station manager can simulate levels for safety or commissioning purposes. This function allows you to increase or decrease the level in 1% steps from the keypad. Using this facility you can test the control panel before it is installed at the pump station.

Navigate to the Level Simulation screen:

| Settings | → | Set Points | → | Level Simulation |
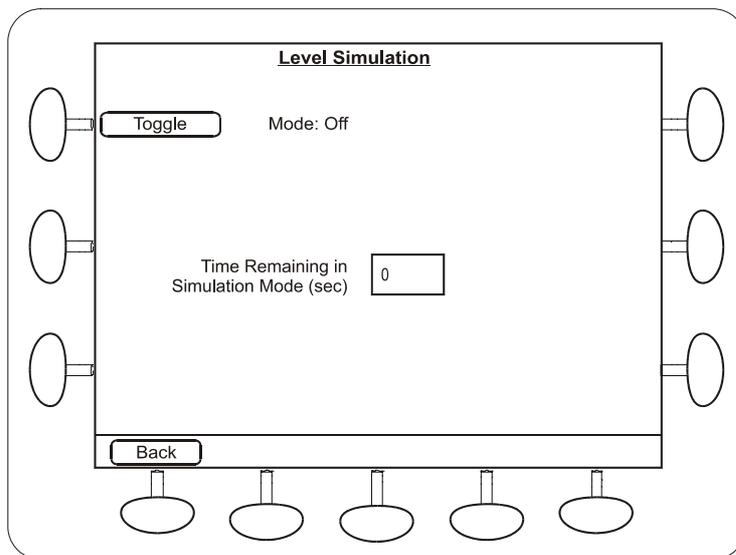
Figure 62 – Simulating Levels

- Press the **Toggle** button

- The time remaining will start counting down to zero. When the time runs out the level simulation mode will automatically turn off

- Navigate back to the Main screen

- Use the up and down arrows on the keypad to raise or lower the simulated level

- When you have completed your test of the station, you can either let the level simulation time out, or you can go back to the level simulation page and Toggle Off.

⚠️ **Health and Safety Feature**: This feature allows operators to test pump and alarm levels without having to open the pit cover to move level sensing devices.

⚡ **WARNING:** The pumps will respond to the simulated level exactly as they would to a real level. Therefore, it is possible to run the pumps with no actual liquid IN THE WELL, thereby running the pumps dry and damaging them.

Part 3 – Advanced Settings

10 High Level Overview

10.1 MultiSmart Pump Station Manager Overview

MultiSmart Pump Station Manager has enormous functionalities built in, some of which are shown in the figure below. Functionality wise MultiSmart can be considered as a Pump Controlller and an RTU integrated together. MultiSmart pump station manager can handle all the common water and sewage pump station applications. But its capabilities are not limited to that. MultiSmart Pump Station Manager has support from PLC functionality which can be configured to meet all the advanced requirements.
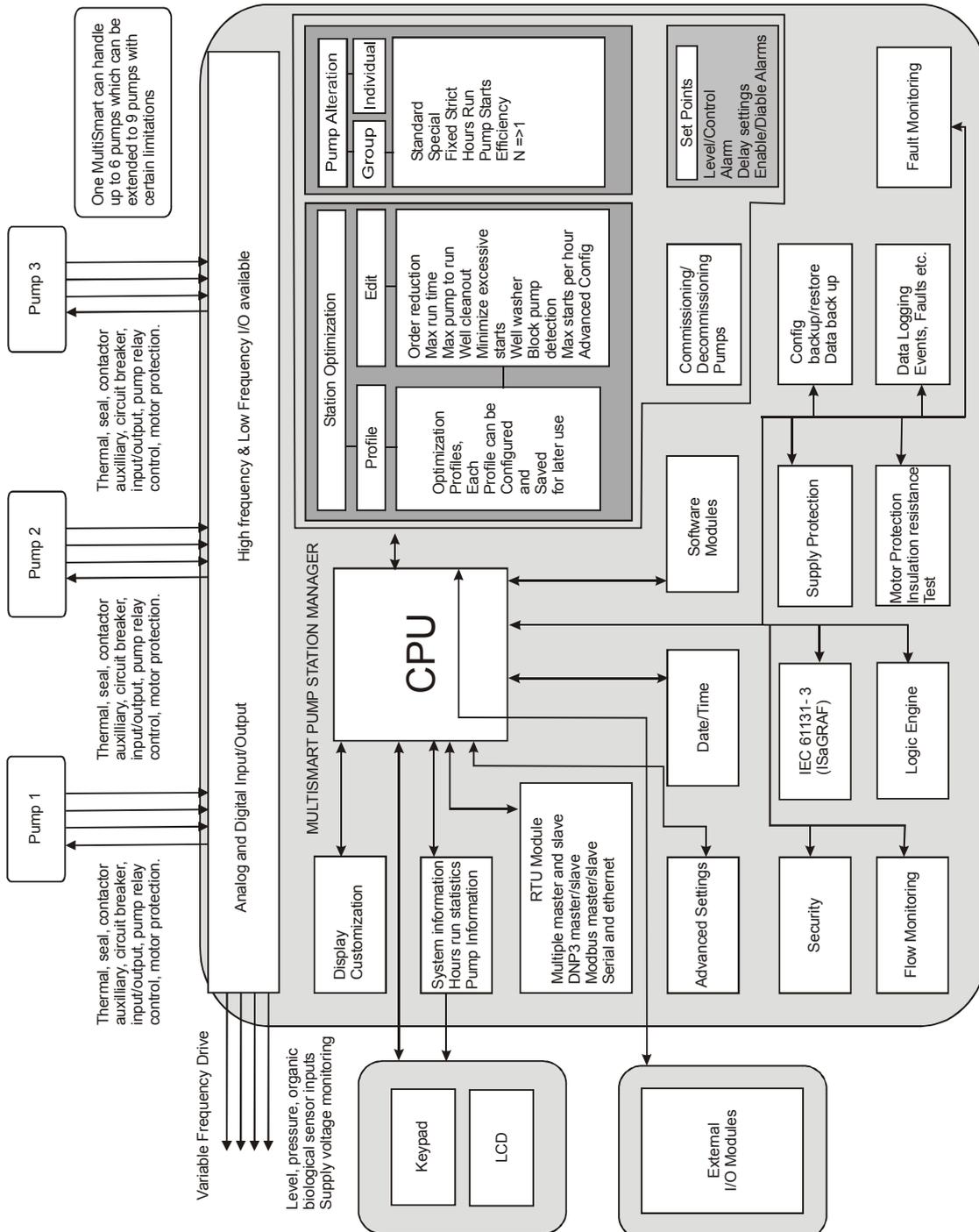
Figure 63 – MultiSmart Pump Controller Overview

10.2 Pump Controller

The pump controller module provides all of the logic to control and monitor water and sewer pump stations. In conjunction with the LCD module (and the LCD itself), it provides a complete operator interface for control, monitoring and commissioning.
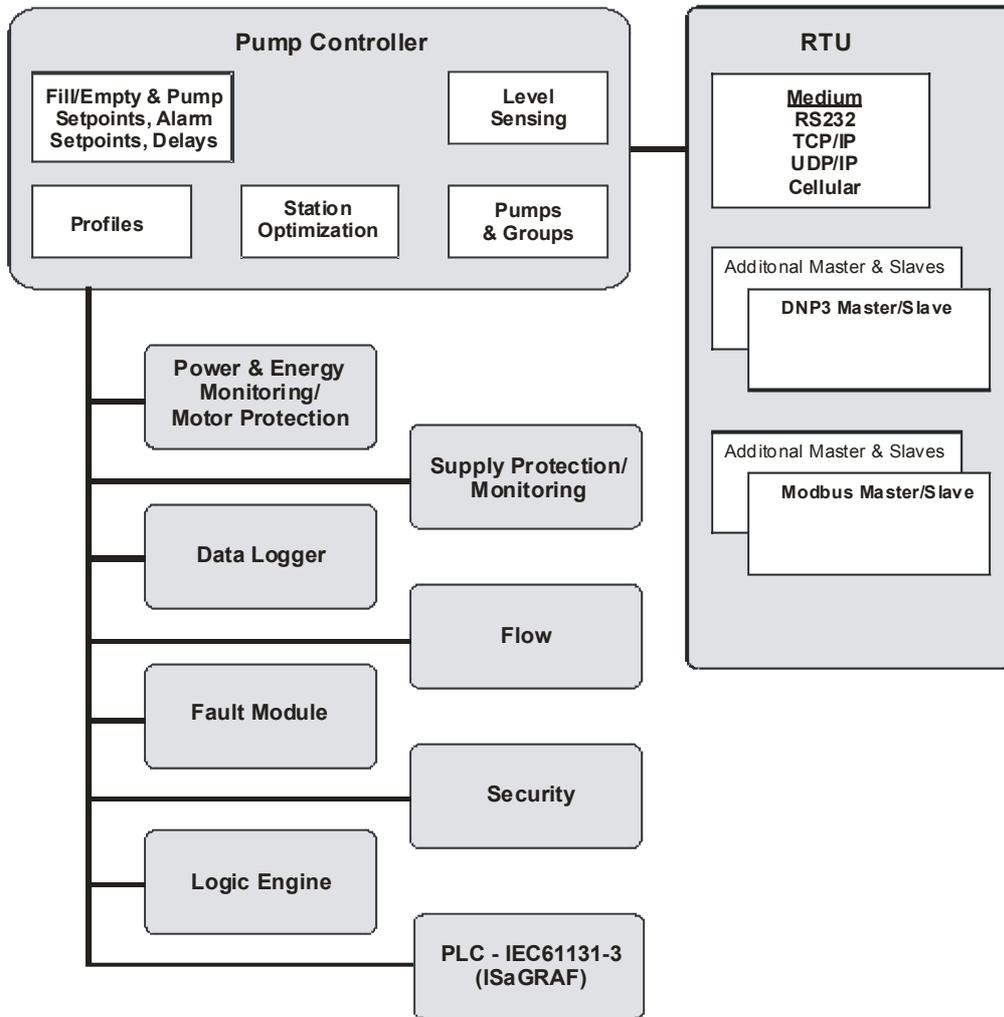
Figure 64 - Pump Control Functionality Overview

10.3 Reservoir Monitor

The MultiSmart can also be configured as a Reservoir Monitor. In this mode, there are no pumps to control so all functionality related to pumps and groups are unavailable. All remaining functionality is the same as for the Pump Controller Module.

Reservoir Monitor
- Alarm Setpoints
- Level Sensing
- Profiles

RTU
- Comms Ports
- Comms Protocols

- Supply Protection
- Data Logger
- Flow
- Security
- Logic Engine
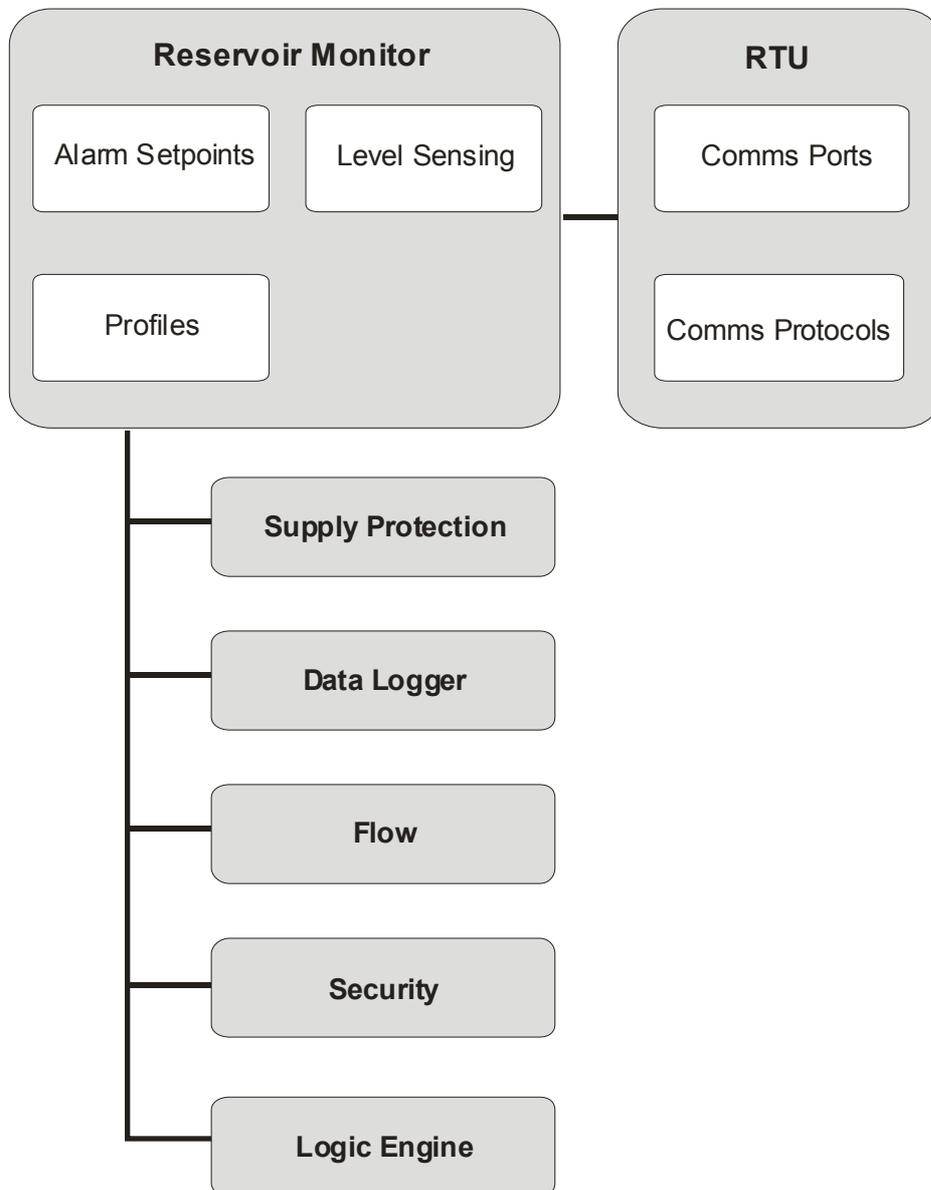
Figure 65 - MultiSmart Reservoir Monitor Overview

10.4 Pump Control Module

10.4.1 Pump Modes

Three pump modes exist for each pump controlled by the MultiSmart Pump Station Manager. They are Manual, Off and Auto.

If the manual mode is selected the pump will be turned on unless faulty or unavailable and goes to Off mode when the lower level cut off point is reached. In Off mode the pump will not start, unless put into Manual or Automatic modes, even when the cut in setpoint is reached. In Automatic mode the advanced pump control module take over the duties of starting and stopping the pumps.

The Off mode can be disabled from being used, if desired, from the advanced settings menu. As a safety measure, when this feature is turned off while the pump is already in Off mode, it will remain in that state until the mode is changed.

10.4.2 Fill / Empty & Pump Setpoints, Alarm Setpoints, Delays

Emptying or filling a well is supported. Each mode has a default set of activation/deactivation points for pumps and alarms. Four level alarms are supported for each well (where more than one well exists), with the ability to disable/enable any alarms. Each level alarm has an activation and deactivation point. Activation and deactivation delays are supported for each pump, as well as inter-pump delays. See Section 12 for more information.

10.4.3 Pumps & Groups

The module supports up to 6 pumps (depending on the product configuration ordered), which can be assigned to more than one well if required. Multiple groups of pumps are supported. Typical applications are jockey pumps and flood pumps. Within a group, pumps can alternate or be in fixed sequence, and maximum pumps running can be set. Groups of pumps can be alternated or in fixed sequence, and maximum number of groups running can be set.

Some configuration parameters for pumps relate to whether they are the lead (duty) pump or the lag (standby) pump. This capability is supported in the module – parameters can relate to the pump position in the alternation sequence rather than the physical pump, e.g. activation and deactivation delays. See Section 13 for more information.

10.4.4 I/O, Faults & Level Devices

Inputs and Outputs (I/O), Faults and Level Devices are closely related. They all work together to provide the functionality required to run a pump station.

- **I/O**
  General purpose I/O can be used to interface to a wide range of devices. Some inputs have extra capabilities for interfacing to devices such as Flygt CLS sensors.

- **Faults**
  Faults can be assigned to both digital and analog I/O. Inputs are used to detect faults within the pump station, such as pump faults. Outputs are used to signal when a pump is present, or to turn off a pump.

- **Level Sensors**
  The module supports multiple level sensors, including 4-20mA analog sensors (e.g. pressure transducer, ultrasonic); MultiTrode conductive probe, ball floats. Support for redundant level sensing is built-in.

See Section 14 for more information.

10.4.5 Profiles

The module supports multiple profiles. Each profile consists of pump activation/deactivation setpoints, as well as some station optimization functions (max pumps running, max off time, max run time). Profiles can be switched via the user interface, via SCADA, or at pre-set date/times. See Section 15 for more information.

10.4.6   Station Optimization Functions

Many desirable functions are pre-defined, with the user simply enabling/disabling or choosing parameters for the functions. Functions include:

- Odour reduction (via maximum off time)
- Blocked pump detection
- Maximum run time to switch from inefficient pumps
- Minimize excessive starts
- Reduce fat build-up (via random duty start)
- Maximum pumps running (electrical or hydraulic overload protection)
- Periodic well clean out
- Well washer functionality

See Section 16 for more information.

10.5 Energy Monitoring and Motor Protection

An optional Energy Monitoring Motor Protection module can be supplied with the MultiSmart pump station manager. The module monitors currents, and provides protection from:

- I^2T protection
- Over and Under current
- Phase fail (current)
- Phase rotation (current)
- Ground (earth) fault

The module also monitors Insulation Resistance values with pump lockout or fault notification when IRT values fall below a user-defined threshold.

10.6 Supply Protection

The Pump Control/General I/O Board monitors the three phase supply through the "Mains Voltage Monitoring" inputs. Single or 3 phase supplies can be monitored by the MultiSmart. The voltage is constantly measured and is used to detect the following conditions:

- Under Voltage
- Over Voltage
- Phase Imbalance (or Phase Failure)
- Phase Rotation

10.7 Data Logger

The MultiSmart unit has a datalogger. The logged data can be viewed directly on the screen, or downloaded onto a laptop and viewed via Excel, Access, or any other reporting/databasing tool. The datalogger stores approximately 50,000 events and faults. Each event or fault is date/time stamped. See Section 19 for more information.

10.8 Flow

The flow module is used to calculate inflow, pump flow rates and total station volume. This allows flow to be derived without needing a flow meter. See Section 20 for more information.

10.9 Fault Module

The fault module handles pump and station faults. Many pre-defined faults exist, e.g., thermal overload, contactor auxiliary and Flygt FLS. A fault only needs to be assigned to an I/O (within the configuration) to begin to function. New faults can of course be defined.

Any fault can be configured to lock out a pump, well or station until a manual (or SCADA) reset is performed. A fault can also be configured to allow the pump to become available when the fault clears, or after a deactivation delay.

10.10 Security

The MultiSmart can restrict access to the configuration menus. Each user is assigned a PIN number which they will have to enter before they are allowed access. By enabling the security users will not be able to clear the history of the logged data from the information screen. Alternatively, a digital input can be used instead of a PIN. User access rights are managed by an administrator. See Section 11 for more information.

10.11 PLC Extension (IEC61131-3)

ISaGRAF, a control software environment which supports all of the internationally recognized IEC61131 control languages and offering a combination of highly portable and robust control engine, is available in MultiSmart. MultiSmart currently only supports ISaGRAF version 5. Earlier versions of ISaGRAF are not supported. See Section 24 for more details.

10.12 Logic Engine

A simple, Boolean, logic engine has been built into the MultiSmart to allow basic customization of control capabilities where the existing functionality is not suitable. It uses mathematical expressions which are evaluated at regular intervals to determine if they are true or false. The expressions are associated with a tag within the MultiSmart to create actions when an expression changes state. See Section 25 for more information.

10.13 RTU

The MultiSmart can be supplied with an optional RTU. Supported communication protocols are Modbus and DNP3 with security. The MultiSmart can also be shipped just as an RTU without any pump controller functionality or user interface. See Section 21 for more information.

The diagram below illustrates the extensive communication capabilities of MultiSmart, even though in practice it is highly likely to use all of these in the same installation. MultiSmart can be interfaced with most of the common industry standard equipments and SCADA networks.
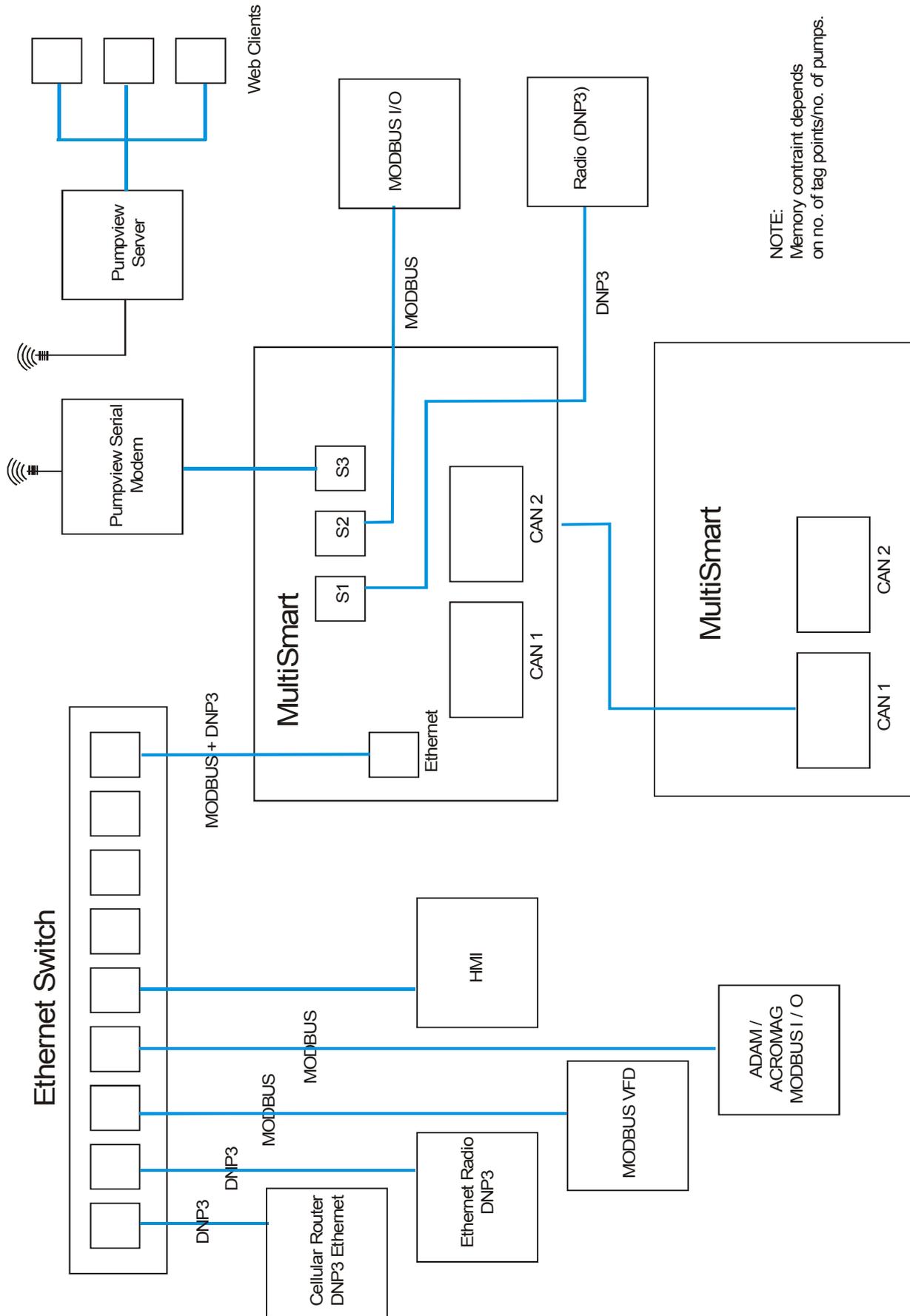
Figure 66 - MultiSmart Communication Capability Overview

11 Security

The MultiSmart restricts access to the configuration menus by creating users. Users gain access to the settings menus by either:

- Entering a 4 digit PIN number when prompted
- Activating a digital input (a key switch, for example)

Each user is assigned a PIN number or digital input access, by an administrator.

The administrator user account is enabled and a password automatically generated by default at the factory before despatch. The administrator password can be changed from the Security Screen accessed from the Settings menus.

Security access for users is not activated until the first user has been configured. The administrator will need to go to the Security Screen in the settings menus and configure a user to activate access control.

⚠️ *Note: The factory set security password can be found on the inside back cover of the product manual.*

⚠️ *Note: It is important the administrator password is kept in a secure location. If the password is lost the unit may need to be returned to MultiTrode for re-configuration.*

⚠️ *Note: The Admin user needs to create an Admin PIN number to enter the Settings menu. This makes access into the Settings menu relatively easy via a 4 digit PIN, whereas access into administrator user is intended to be a difficult alphanumeric password.*

⚠️ *Note: If the security is enabled, users will not be able to clear the accumulators from the information screen. Thus the historical data can be secured from being erased.*

The administrator is the only user allowed to add, delete or edit user accounts.

To access the security screen go to:

- [Settings] enter a PIN if requested and push **Continue**
- Go to page 3 of the settings screens and press **Security**
- Enter the administrator password and press **Continue**
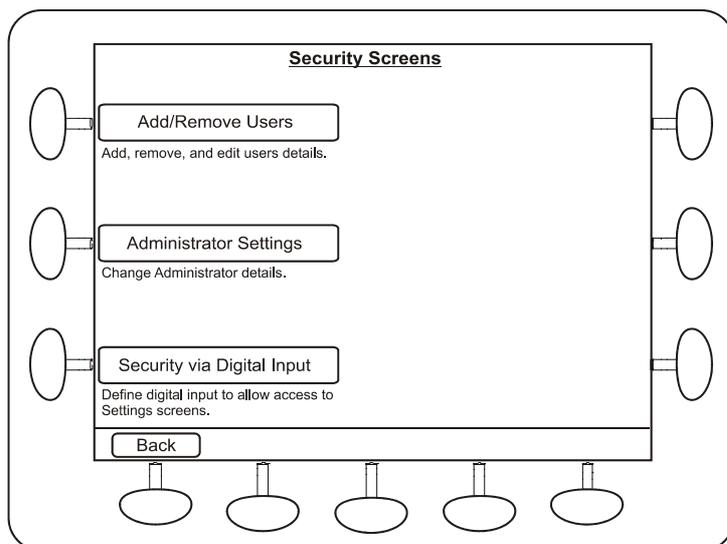
Figure 67 – Security Screen

To edit, add or delete a user press **Add/Remove Users**

The following user settings can be edited:

- User ID

- PIN

- User Name
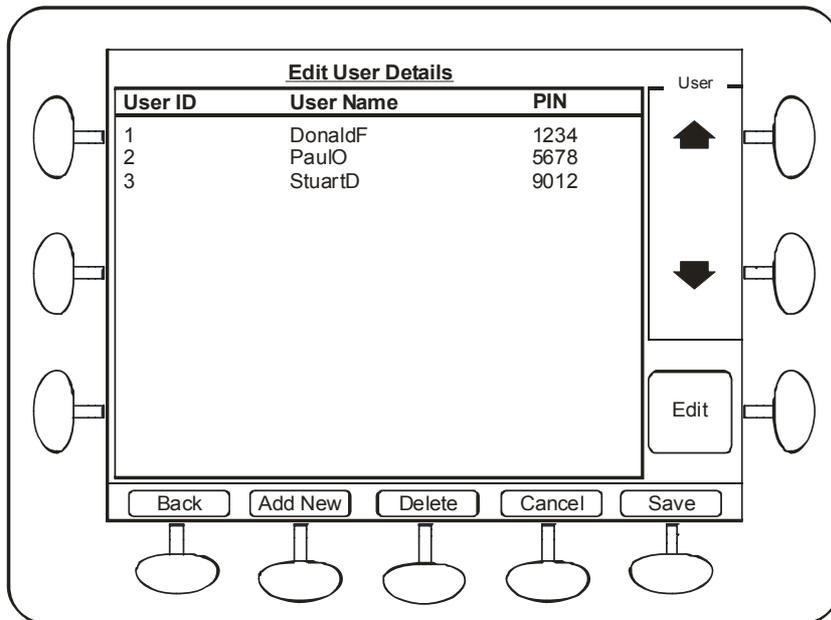
Figure 68 – Edit User Security Details

To change the administrator password:

- Press Administrator Settings

- Enter a new password

- Press Save
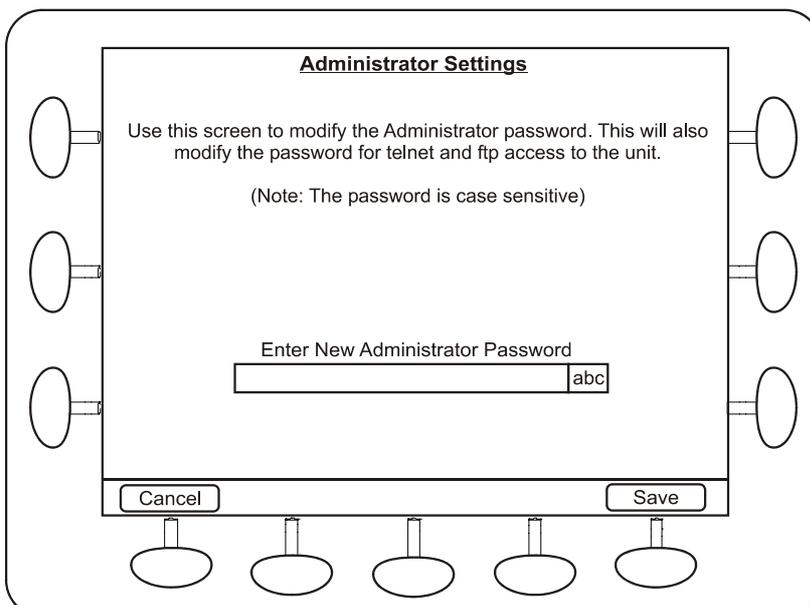
Figure 69 – Change Administrator Password

To configure security to be activated by a digital input press **Security via Digital Input**

- Enable security via DIN by pressing the Toggle button

- Select a digital input tag. By default, this is set to DIN 20 on the top board. Any digital tag in the system can be selected, allowing greater flexibility then just using Digital Inputs. To choose another Digital Input, simply use the tag browser to find the appropriate DIN, and choose **ValueDigital** (see Figure 71 and Figure 72 in Section 11.1 below).

- Press **Save**
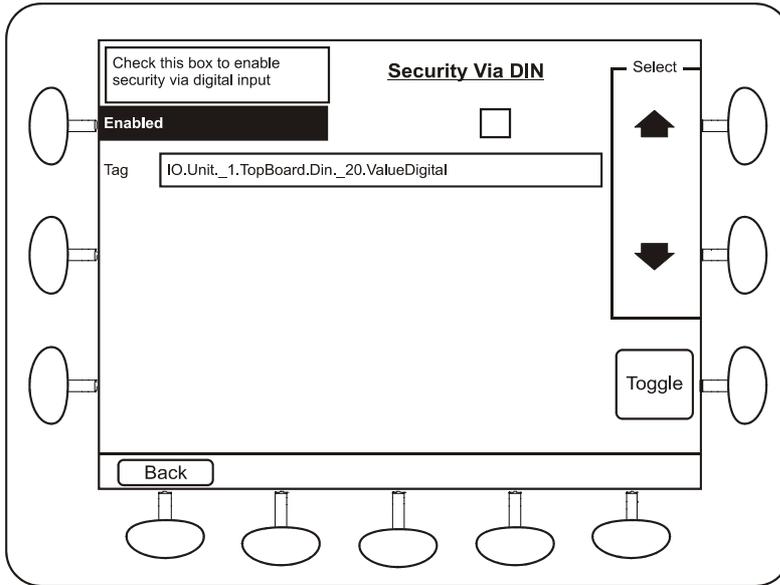
Figure 70 – Configure Security via DIN

11.1 Selecting any Digital Tag

The screens below show how to navigate to any digital input. Find **IO Module** and using the +/- button expand out the tree view to get to the Digital Input you are looking for.
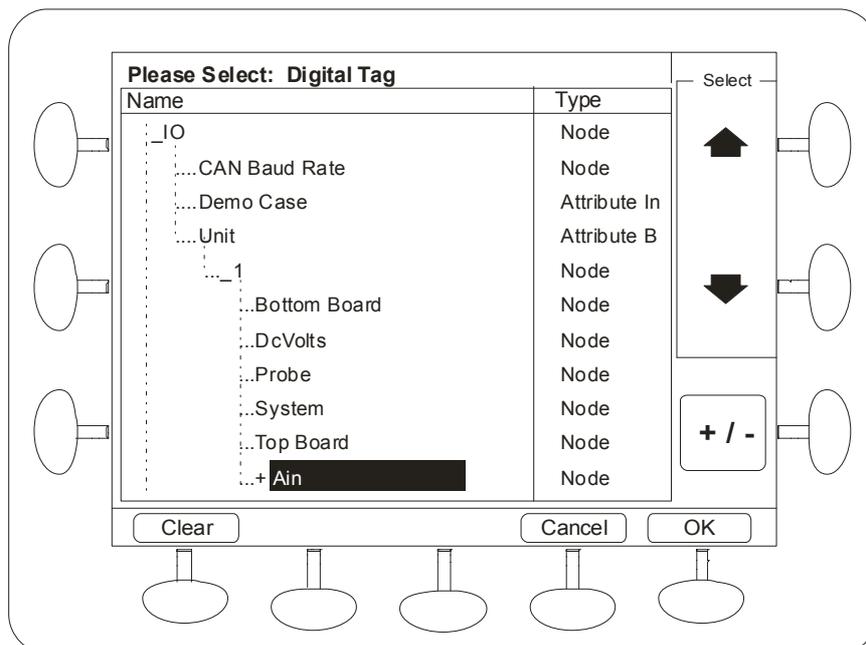
Figure 71 – Tag browser screen
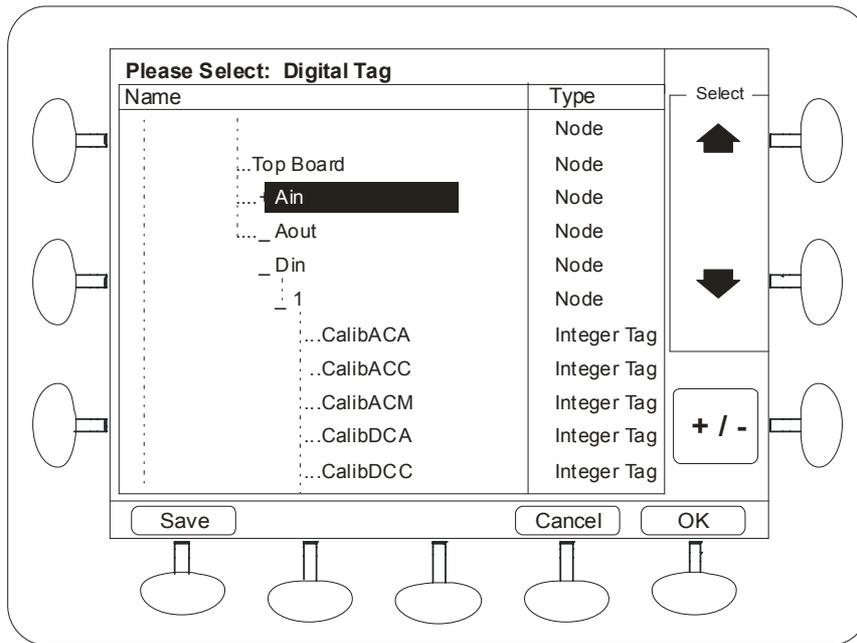
Figure 72 – Tag browser screen –continued.

Once you have found the Digital Input (DIN) you are looking for, expand the selection using the ⌊+/-⌋ button, and scroll down to **ValueDigital** and press **OK**.

> ⚠️ ***Note:*** *The tag browser gives you access to any tag in the MultiSmart unit, including tags generated by the logic engine.*

12 Fill / Empty & Pump Setpoints, Alarm Setpoints, Delays

12.1 Fill / Empty (Charge / Discharge)

This parameter is selected during the Setup Wizard, as described in Section 9.

12.2 Default Pump and Alarm Setpoints

The MultiSmart pump station manager has an activation and deactivation setpoint for each pump, and 4 independent level alarm setpoints; high, high-high, low, low-low, each with their own activation and deactivation points. In the case of multi-well mode, the alarm setpoints are replicated for each well.

The MultiSmart unit applies **default** setpoints depending on whether fill or empty (charge or discharge) is chosen during the Setup Wizard.

There can also be multiple profiles – each with their own setpoints (refer to Section 15). For most applications the default level settings should be appropriate for correct operation of the installation.
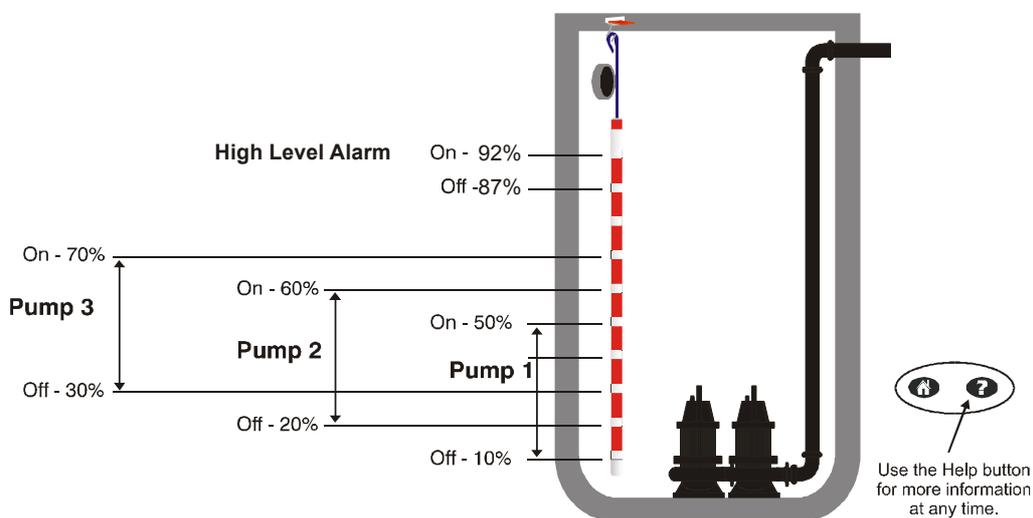
Figure 73: Empty (Discharge) Mode—Default Normal Levels
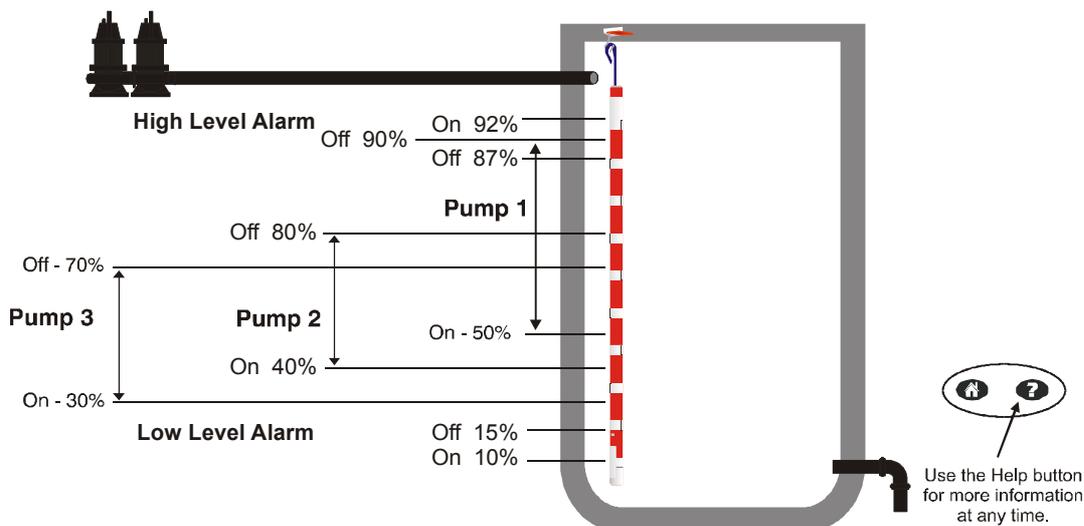
Figure 74: Fill (Charge) Mode – Default Normal Levels

12.3 Changing Pump and Alarm Levels Setpoints

12.3.1 Limitations

The MultiSmart unit will not allow the user to set invalid activation and deactivation levels, for example:

- When in **Empty (Discharge) mode** the Lag (Standby) pump cannot be configured to activate or deactivate before the Lead (Duty) pump.

- When in **Fill (Charge) mode** the activation level for any particular pump cannot be higher than the level for the previous pump in the duty order. The deactivation level also cannot be higher than the previous pump in the duty order.

12.3.2 Setting Pump Setpoints

From the main screen navigate to the Level/Control Setpoints screen:

Settings ⟶ Set Points ⟶ Level/Control Setpoints
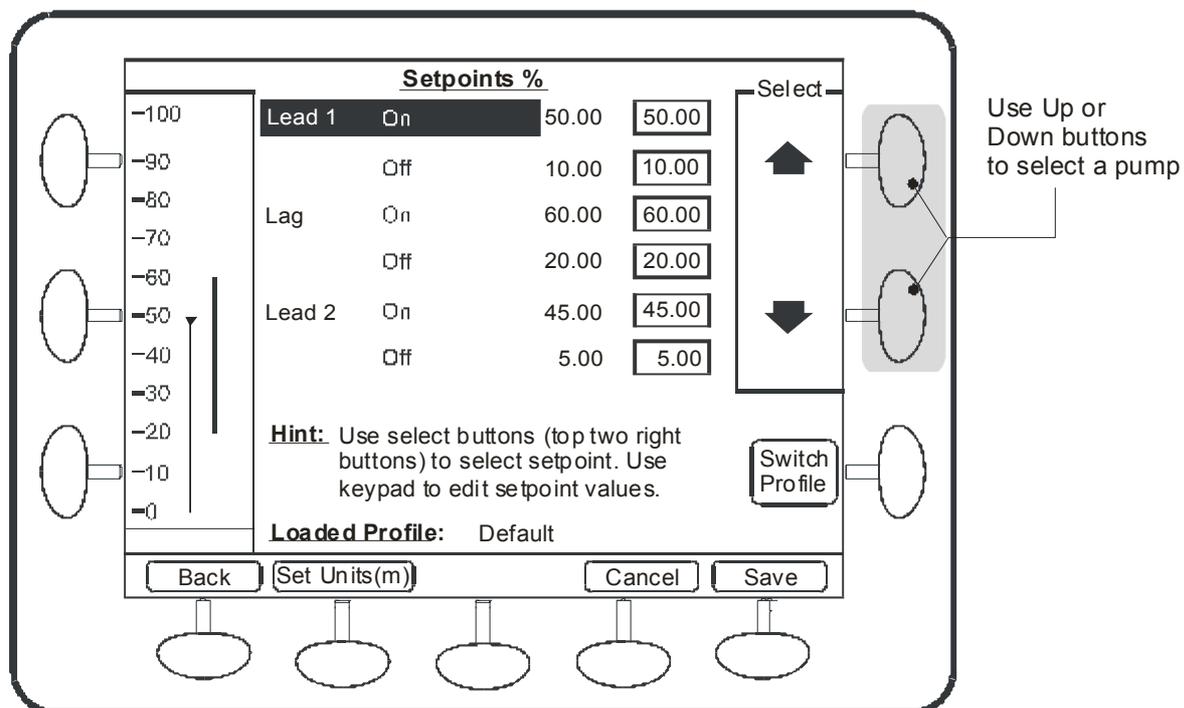
Figure 75 - Setting Pump Levels

- Use the arrows to select a pump

- Enter new values using the keypad

- Push the **Save** button to commit the changes

- If the settings are invalid an error message will be displayed

Note: If there are more than one well and if they are independent, the first set of Lead/Lag pump/s listed in this menu will corresponds to the pumps in well 1 and the next set will corresponds to the pump/s in the second well.

12.3.3   Setting Alarms Activation/Deactivation points

The pump controller provides four independent level alarms (per well if more than one well exists).

- High-High Level

- High Level

- Low Level

- Low-Low Level

The alarms operate the same for both Fill (Charge) mode and Empty (Discharge) modes. Any level alarm can be disabled using the Enable/Disable level alarms screen (see Section 12.3.4).

From the main screen navigate to the Alarm Levels screen:

| Settings | → | Set Points | → | Alarm Setpoints |
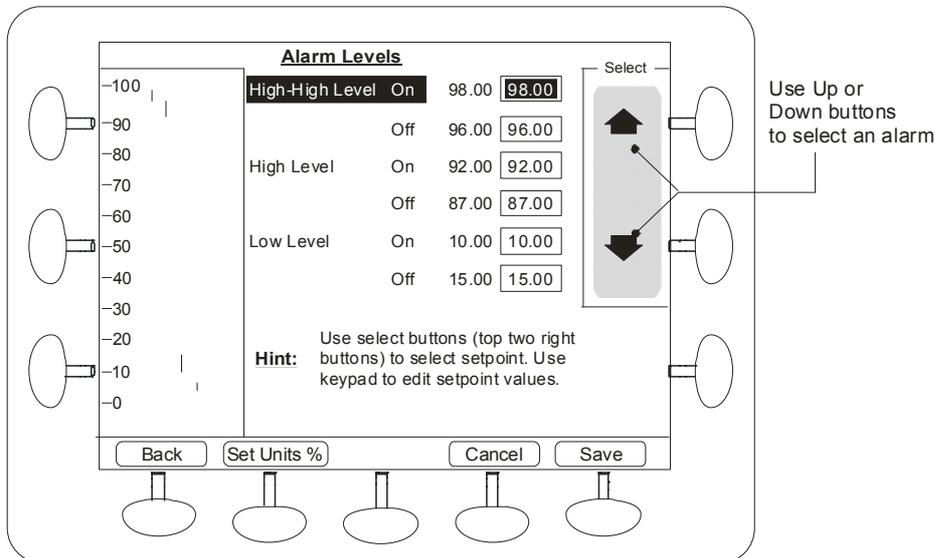
Figure 76 - Setting Alarms

- Use the arrows to select an alarm

- Enter new values using the keypad

- Push the **Save** button to commit the changes

- If the settings are invalid an error message will be displayed

⚠ *Note: In the case of a configuration for more than one well, a well selector will appear in the upper left of the LCD screen.*

12.3.4   Enable/Disable Alarms

From the main screen navigate to the Enable/Disable Alarms screen:

Settings ⟶ Set Points ⟶ Enable/Disable Alarms
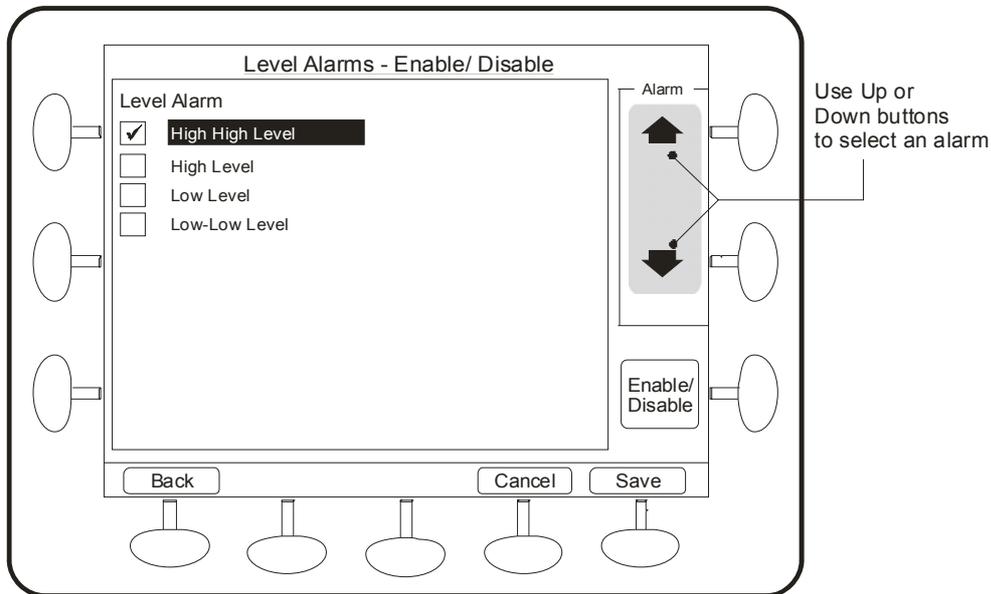
Figure 77 - Enable/Disable Alarms

- Use the arrows to select an alarm

- Use the **Enable/Disable** button to Select or Unselect each alarm.

- Push the **Save** button to commit the changes

12.4 Setting Pump & Alarm Delays

Activation delays are used to prevent a pump or alarm from turning on when it reaches its activation level until the activation delay has timed out. Deactivation delays do the same with turning off an alarm or pump. The unit also contains inter-pump delays to prevent 2 pumps starting or stopping with too short a time delay. This can prevent water hammer and electrical overload.

12.4.1   Inter-pump delays

- Start-Start

- Stop-Stop

- Start-Stop

- Stop-Start

12.4.2   Activation & Deactivation delays for individual pumps

- Pump (activate/deactivate)

12.4.3 Activation & Deactivation delays for level alarms

- High-High Level (activate/deactivate)

- High Level (activate/deactivate)

- Low Level (activate/deactivate)

- Low-Low Level (activate/deactivate)

NOTE: Activation delays can be used to stagger equipment starts from a common level point. Deactivation delays allow you to pump beyond the normal deactivation level for a set period of time.

NOTE: Activation delays can be used to prevent false alarm trips due to splashing or foam build-up, so an alarm will only be raised if the level is above the alarm level for a certain time period. Deactivation delays allow you to be sure the alarm condition has passed before clearing the alarm.

NOTE: The Pump Station Manager can be set up so that it periodically runs past the normal deactivation level for a configured time, to enable a full well clean-out. This is the well clean out mode in Station Optimization.

12.4.4 Setting Pump & Alarm Delays

All pump and alarm activation and deactivation delays have a factory default setting. These may be adjusted as required. Navigate to the Delays screen. (This screen changes the delays for all profiles).

Settings → Set Points → Delays
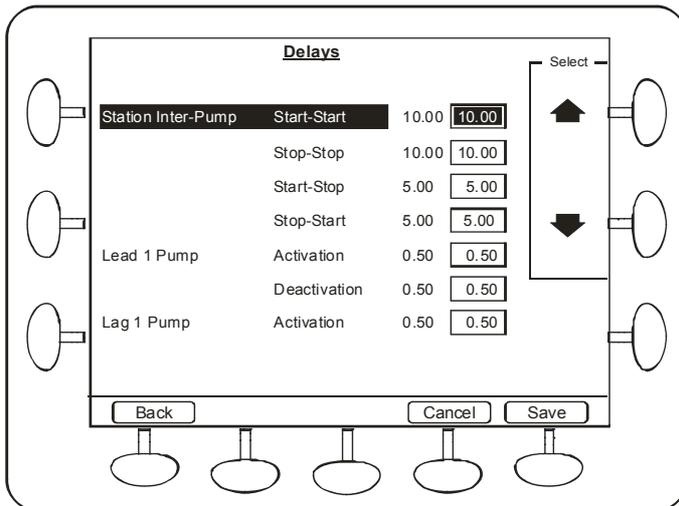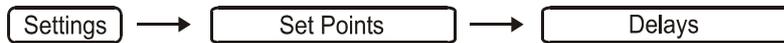
Figure 78 - Setting Delays

- Use the arrows to select an alarm.

- Enter new values, in seconds, using the keypad.

- Push the **Save** button to commit the changes.

13 Pumps & Groups

The number of pumps is selected during the Setup Wizard. Depending on the configuration you have purchased, you will be limited to 3, 6 or 9 pumps. By default, alternation of pumps is on. Also by default, pumps are all in one group.

The following schemes are available for sequencing pumps within a group:

- Alternation (std)

- Fixed (std)

- Alternation Special

- Fixed Strict

- Alternation on Pump Hours

- Alternation on Pump Starts

- **Alternation by Efficiency** (reduces the energy cost)

- Alternation by N to 1

Most installations would use the first 2 options: alternation or fixed.

Alternation (std)	The pumps alternate on each start. If a pump faults, the next pump in the cycle takes over.
Fixed (std)	The pumps do not alternate on each start. If a pump faults, the next pump in the cycle takes over.
Alternation Special	The pumps alternate on each start. If a pump faults, the next pump in the cycle does not start until the activation point for that pump is reached.
Fixed Strict	The pumps do not alternate on each start. If a pump faults, the next pump in the cycle does not take over until activation point for that pump is reached.
Pump Hours and Pump Start	Options allow alternation based on hours and starts. This can be useful in special circumstances. For example, a large 2-pump water station. Each day one pump runs for about 4 hrs in the morning, and the other for around 1-2 hrs in the afternoon. So even though they have alternation, P1 always runs in the morning and the hours run on P1 is much higher than P2.
Efficiency	In this mode the pump alternation occurs with the most efficient pump being favoured. This mode is especially useful where an old pump, scheduled for replacement, is coupled with a new pump. The most efficient pump is run N times in a row before alternating the duty cycle to the other pumps and this minimises the energy cost. The default of N is 10 and this the most efficient pump will be altered once every 10 runs (this frequency can be changed in the MultiSmart advanced mode). For the efficiency mode to be active the pumps have to run at least 10 cycles and the power efficiency data should be available for calculations. This mode uses pump efficiency last week and this it won't be active if the efficiency results are reset or unavailable.
N to 1	The first pump defined in this section is run as the duty pump N times in a row before alternating the duty cycle to the other pumps.

⚠️ **NOTE:** *The current implementation is based on the last hour. This will be changed in a future version to the last week.*

To make changes to pump groups and alternation schemes, go into the Alternation and Grouping setup.
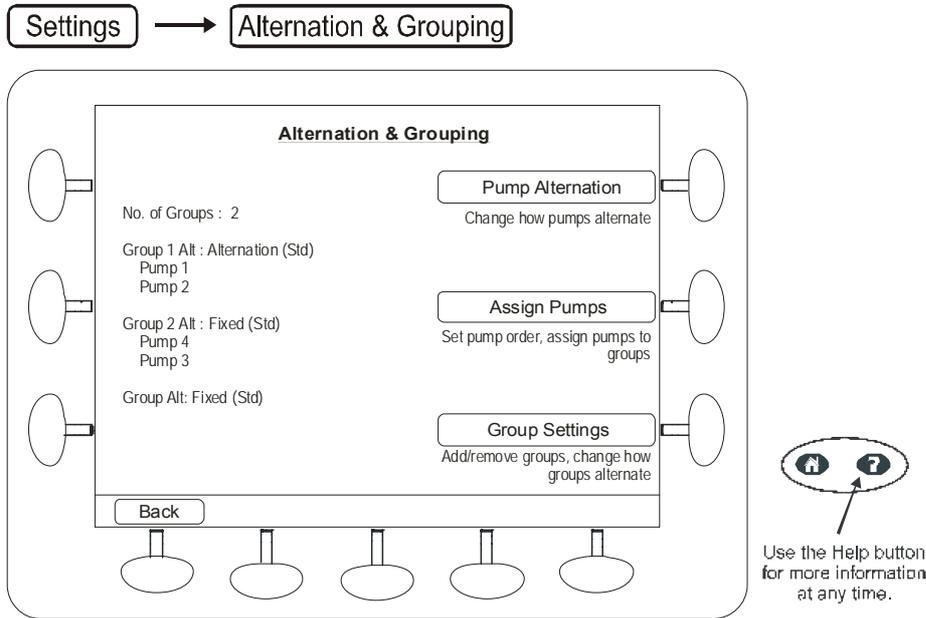
Figure 79 - Alternation & Grouping Screen

This example screen shows that the 4 pumps are divided into 2 groups. Group 1 pumps are alternating. Group 2 pumps are fixed sequence, with pump 4 starting before pump 3. The Group Alternation is set to Fixed, which means that Group 1 always starts before Group 2.

13.1 Change Alternation & Fixed Duty

Choose the Pump Alternation option to change the alternation scheme. For more than one group, use the Group arrows on the left to select each group in turn, then the Alter arrows on the right to change the alternation scheme.
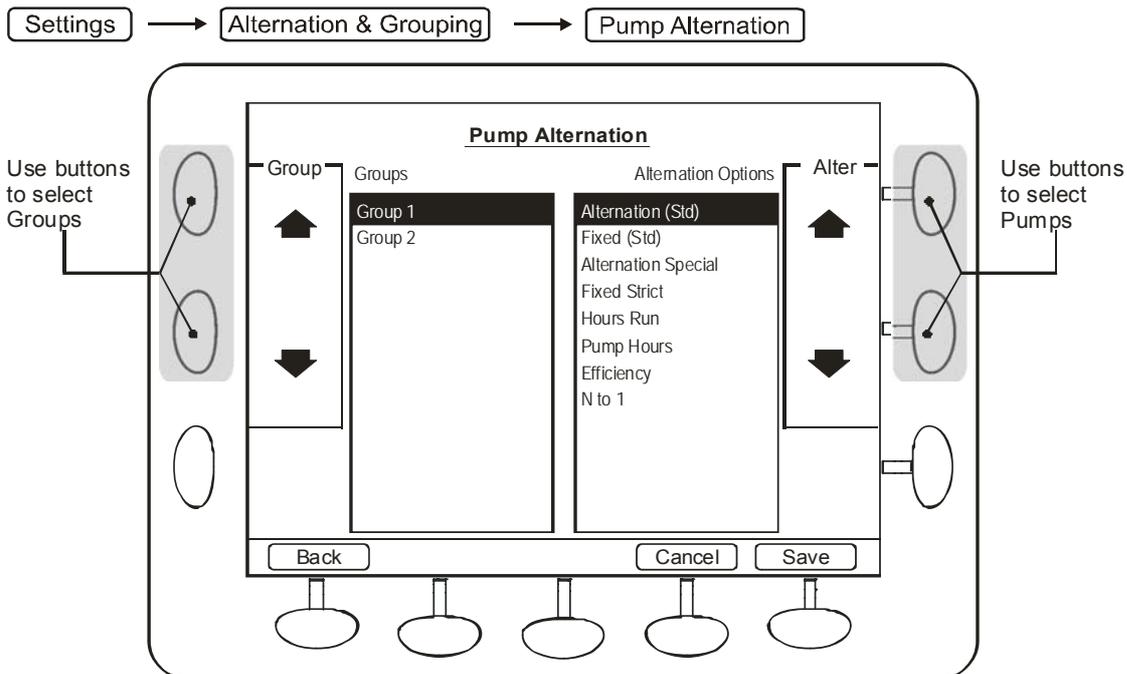
Figure 80 –Changing Group Alternation & Fixed Duty

Press **Save** to apply changes and go back to the Alternation and Grouping screen. The summary will show any changes that have been made.

13.2 Moving pumps between Groups, or Changing the order of Pumps

To move pumps between groups, or change the order of pumps (when they are in fixed sequence), press the Assign Pumps button.

Settings ⟶ Alternation & Grouping ⟶ Assign Pumps
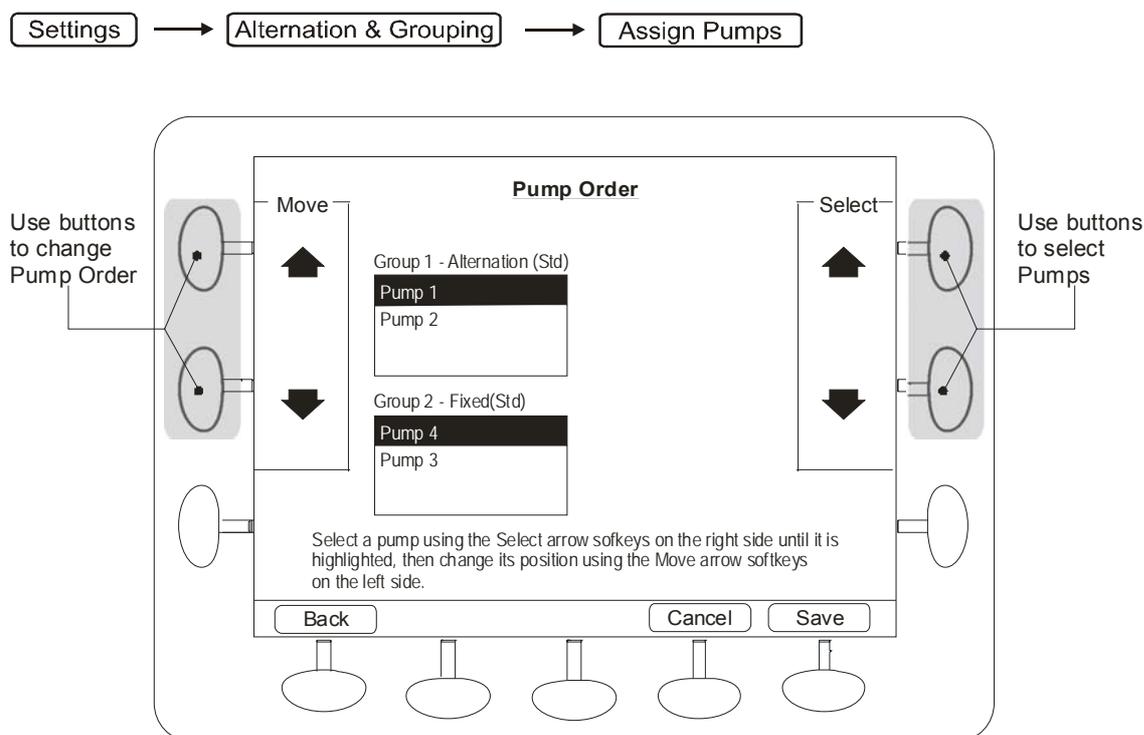
Figure 81 - Moving pumps between Groups and changing the order of Pumps

Select a pump using the Select arrows and move it using the Move arrows. Press **Save** to apply any changes.

> **NOTE:** *Moving pumps between groups will require a restart.*

13.3 Adding or Deleting Groups & Changing Group Alternation

To add or remove a group press the **Group Settings** button.
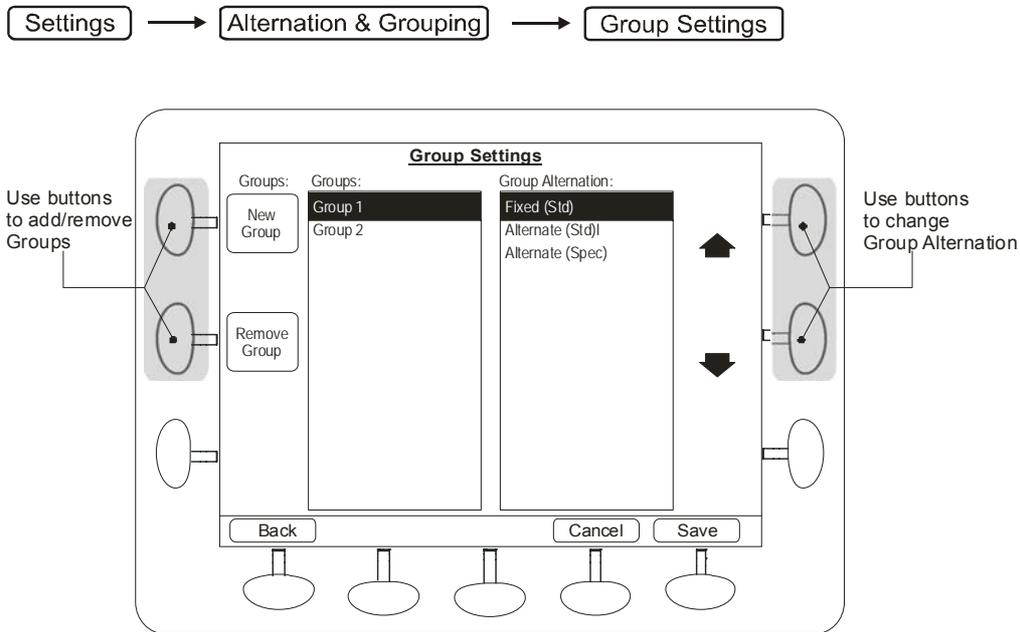
Figure 82 – Add/Remove Groups Screen

To add a group, press the **New Group** button. To remove a group, press the **Remove Group** button.

> **NOTE:**
> *The group to be deleted can't be selected – the unit always deletes the highest numbered group. Adding or removing a group requires the unit to restart*

13.3.1 Maximum Groups Running

Maximum Groups Running can be used to control the number of groups running when there is more than one group.

For example, if you had an installation containing jockey pumps and flood pumps it is usual to ensure the jockey pumps are never running at the same time as the flood pumps. To achieve this you go to Maximum Groups Running, enable **Block running pumps** and set the **Quantity** to 1.

These settings will turn off group 1 (the jockey pumps) whenever group 2 starts (the flood pumps). This means the jockey pumps will never run at the same time as the flood pumps.

13.3.2 Pump Logic in Multi-well Mode

In the case of independent wells, the two wells simply operate as two independent entities with the pumps allocated to a particular well operating dependant on the level in that well.

In the case of hydraulically connected wells, the pump control module is more complex. If alternation is enabled (the default), each pump in turn will start regardless of which well it is in, based on the highest level in either well. De-activation of a pump is dependant on the level in the well where the pump is located. This is to prevent problems with equalization between the two wells allowing a well to run dry while a pump is still operating.

13.4 Decommissioning Pumps

Individual pumps can be decommissioned. This prevents the pump from running under any circumstances, and also displays a "Decommissioned" notice under the pump on the main operator display. To decommission a pump, navigate to the Commission/Decommission Pumps screen:

Settings ⟶ Commission / Decom

Commission / Decommission Pumps

Select

Pump	Current	New
Pump 1	Commissioned	Commissioned
Pump 2	Commissioned	Commissioned
Pump 3	Commissioned	Commissioned

Note:
The system will be rebooted to make your changes.
You might want to turn off all pumps before going
through this process.

Decommission

Back   Cancel   Save
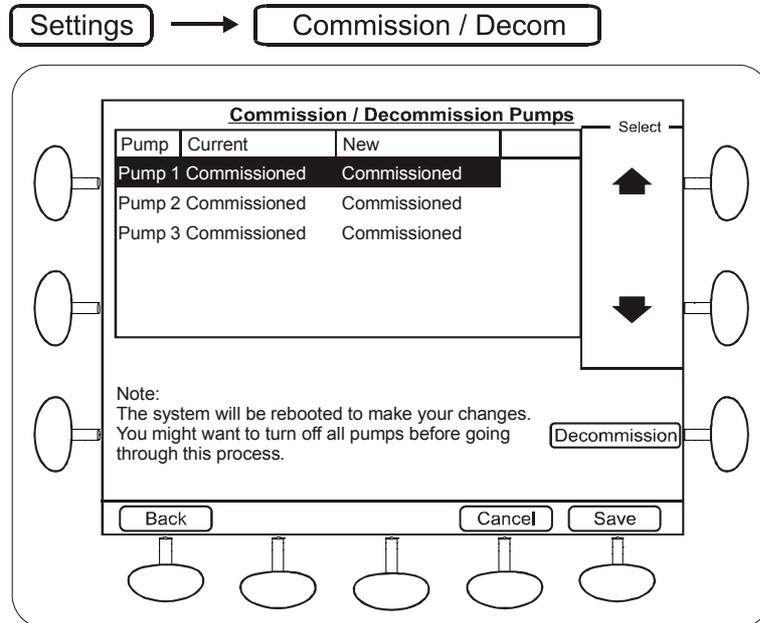
Figure 83 - Decommissioning Pumps

- Select the pump you wish to decommission using the arrow buttons.
- Press the Decommission button.

14 Configuring I/O, Fault & Level Devices

The MultiSmart unit can interface directly to a wide range of Input/Output, Fault and Level Devices. Connection diagrams for these are described in Section 7. This section describes how to configure these devices on the pump station manager itself.

14.1 Digital Inputs

Various types of devices can be connected to DIN's. Some inputs have special functions for particular purposes. These are summarised in Sections 7.3, 7.6 and 14.4. To view the current digital input configuration, navigate to the Digital Input screen:

Settings → I/O, Faults, & Level → Digital Inputs
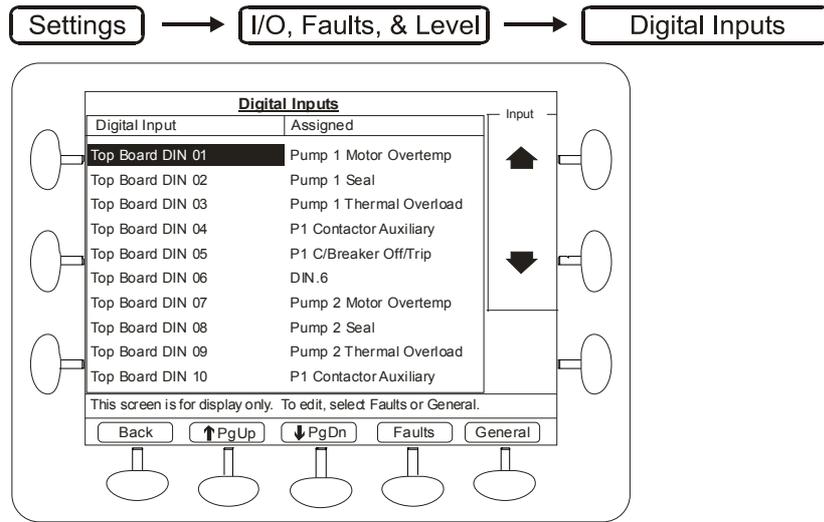
Figure 84 - Digital Input Assignments

To change the I/O configuration go to either the **Faults** or **General** screen:

- **Faults** - Used to assign/unassign a particular type of fault input device such as a thermal overload or a pump seal input.

- **General** - Used to set individual inputs as a generic normally open/normally closed input or as a counter.

14.2 Assigning Faults to Digital Inputs
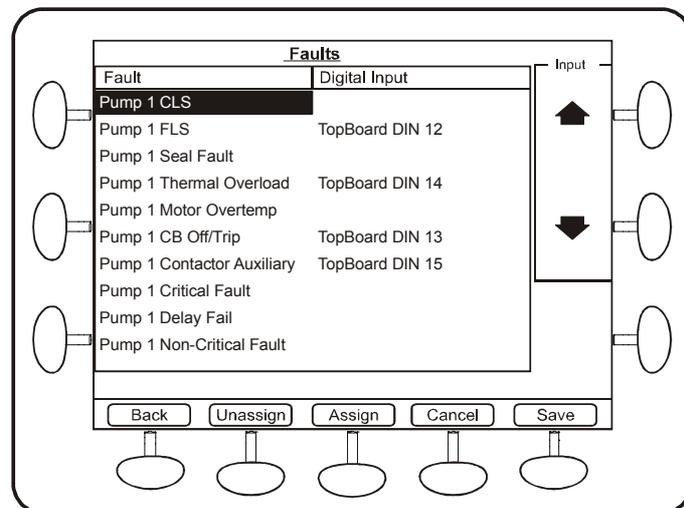
Figure 85 – Select a Fault Type

NOTE: *The pump station manager will reboot to make the changes. It is recommended all pumps are turned off during this process if possible.*

- Use the scroll buttons to highlight the type of fault input required
- Press the **Assign** button
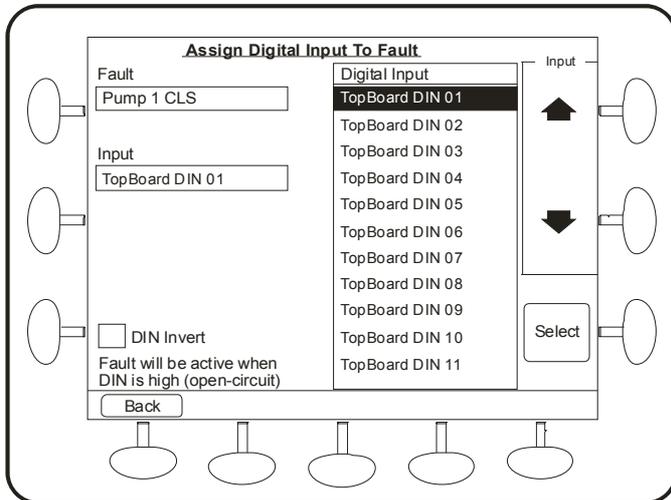
Figure 86 - Assign the Fault Sensor to a Digital Input

- Use the scroll buttons to highlight a Digital Input number.
- Press the **Select** button to assign this input to the selected fault sensor.
- Select DIN Invert if the fault need to be activated when the input is Low (short circuit), else the fault will be active when the DIN I High (open circuit).
- Press **Back** to go back and repeat for each fault you would like to assign.
- Press **Save** at the end of the process.

The Pump Holdout fault is defined as a hidden fault by default within the MultiSmart. This fault can holdout the pump without generating a fault in the fault screen. Thus it can be used to holdout a pump with a digital input.

14.3 Unassigning Fault Inputs

Settings ⟶ I/O Faults & Levels ⟶ Digital Inputs ⟶ Faults
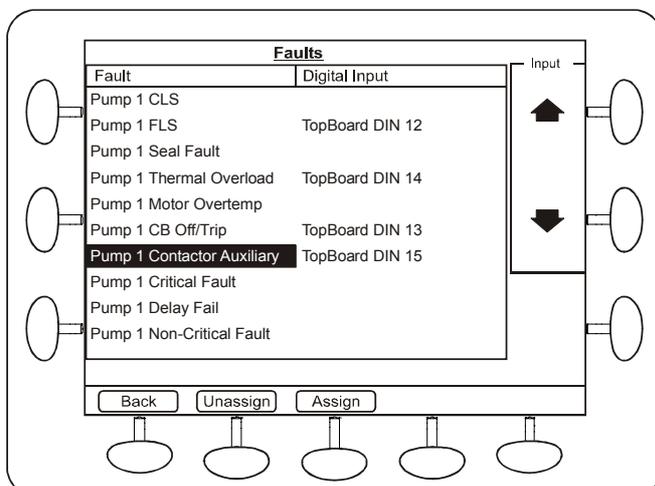
Figure 87 – Fault Screen

- Use the scroll buttons to highlight the Fault to be unassigned.

- Press the **Unassign** button, (**Cancel** and **Save** buttons will appear).

- Press **Back** to go back and repeat for each fault you would like to unassign.

- Press **Save** at the end of the process.

14.4 Configuring General Purpose Digital Inputs

Navigate to the Digital Inputs screen and press the **General** button.
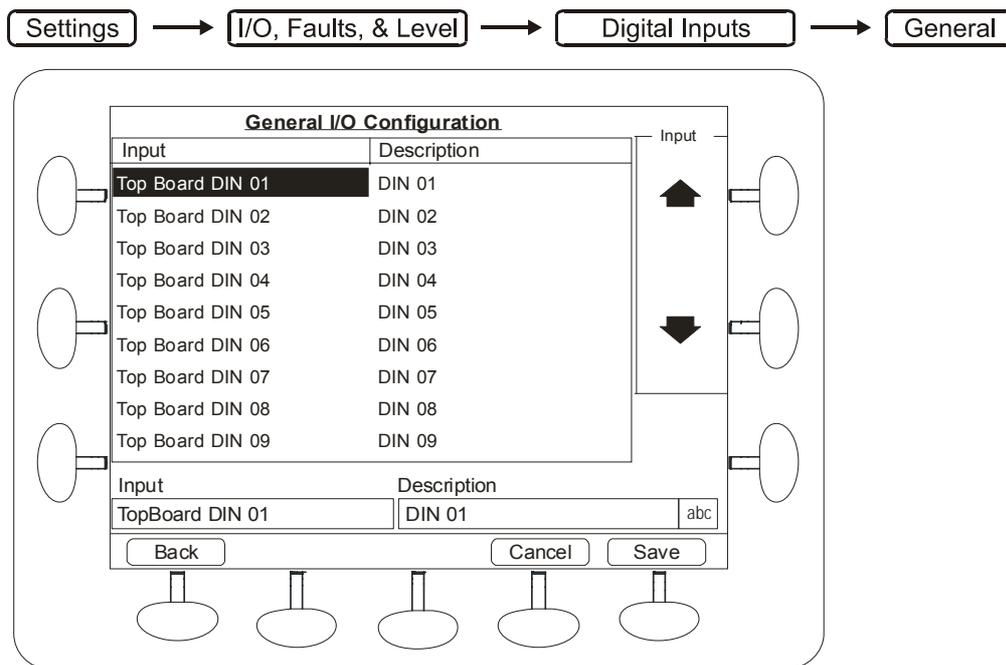
Figure 88 – Digital Input Configuration Screen

- This screen only allows the description of the input to be changed.

- Advanced configuration options can be found in the advanced menu. These options include inverting the input to change to N/C and changing the scaling, e.g. for a pulse accumulator such as a rain gauge.

  Settings ⟶ Advanced

- From the tree select: **IO Module** [+/-] **Unit** [+/-]

- Select the correct unit and press [+/-]

- Select which module the inputs are located (ie: TopBoard) then [+/-] select **Digital Inputs** then [+/-]

- Select the Input to configure and press the centre button on the left-hand side marked *"Use this button to see additional values"*

14.4.1   Advanced Digital Input Options

Navigating to the Advanced Digital Input options is shown in Section 14.4

⚠️ *NOTE:*
When faults are assigned to digital inputs the digital input options are automatically set.

Name	Description	Range/Type
Delay	The length of time the input must be present before it is considered active. This can be used to add debounce and prevent spurious signals.	
Description	Description of the input. This is the name shown in the Info / IO Module screens.	Text
Edge Mode	Sets which edge of an input signal will trigger counting of the input.	Negative Edge Positive Edge Double Edge
Invert?	Changes the input between Normally Open or Normally Closed. If False (unticked) then the input is Normally Open. If True (ticked) the input is Normally Closed.	True/False
Mode	Sets the input mode type. Various modes are available depending on the capability of the input you are configuring.	See table below
Probe (only shows up when' Show More Options' is used – section 31.1)	Sets whether this input is part of a multi-sensor conductive level sensor or probe and which sensor it is connected to (for example sensor number 1 in a 10 sensor probe). *Note:* Go to the "Level Devices" screen to assign and configure the probe.	N/A
Scale Factor	Sets a scale factor for a pulsed counter such as a rain gauge or flow meter. For example, one pulse might be equivalent to 5mm of water in a rain gauge.	
Sensitivity	Sets the input sensitivity in ohms. For example, a seal sensor sensitivity. When a seal fault is assigned to a Digital Input, the sensitivity is automatically set, but the value can be adjusted to meet specific requirements. (Not applicable for High Speed and Digital Modes). The sensitivity for the MultiTrode conductive probe is setup separately, see Section 14.8.3	
Value Resistance	Used to set deadband parameters such as Type and Value.	

⚠️ *NOTE: When a MultiTrode conductive probe is used, the sensitivity settings above for DINs are not used. Instead the overall setting for the probe is independently used. See Section 14.8.5 for more detail.*

Digital Input configuration - for reference only:

Type of input	Mode	Typical Sensitivity, Ohms	Invert?
Normal volt free contact closure	Digital	n/a	No (default for N/O) / Yes (N/C)
Conductive probe	AC	20,000	No
Seal sensor (conductive)	AC	40,000	No
PTC thermistor	DC	3,000	Yes
High Speed Counter	High Speed	n/a	No (default) / Yes
Flygt FLS	DC	n/a – special setup for this device	No
Flygt CLS	DC	n/a – special setup for this device	No

14.4.2 Digital Input Summary Table

This table summarises the capabilities of the digital inputs on the pump controller (3PC) board:

DIN#	Volt Free Input	PTC Thermistor, Seal Sensor, Flygt FLS	Conductive Probe	Low Speed Counter (4Hz)	High Speed Counter (1kHz)	Flygt CLS	Fail Safe Probe
Mode	Digital	DC	AC	Digital	High Speed	CLS	FailSafe
1	✓	✓	✓	✓			✓
2	✓	✓	✓	✓			
3	✓	✓	✓	✓			
4	✓	✓	✓	✓			
5	✓	✓	✓	✓			
6	✓	✓	✓	✓			
7	✓	✓	✓	✓			
8	✓	✓	✓	✓			
9	✓	✓	✓	✓			
10	✓	✓	✓	✓			
11	✓	✓	✓	✓			
12	✓	✓	✓	✓			
13	✓	✓	✓	✓			
14	✓	✓	✓	✓			
15	✓	✓	✓	✓			
16	✓	✓	✓	✓		✓	
17	✓	✓	✓	✓		✓	
18	✓	✓	✓	✓		✓	
19	✓	✓	✓	✓	✓		
20	✓	✓	✓	✓	✓		

14.5 Configuring Analog Inputs

Navigate to the Analog Inputs screen, select an input and press the **General** button.

Settings ⟶ I/O, Faults, & Level ⟶ Analog Inputs
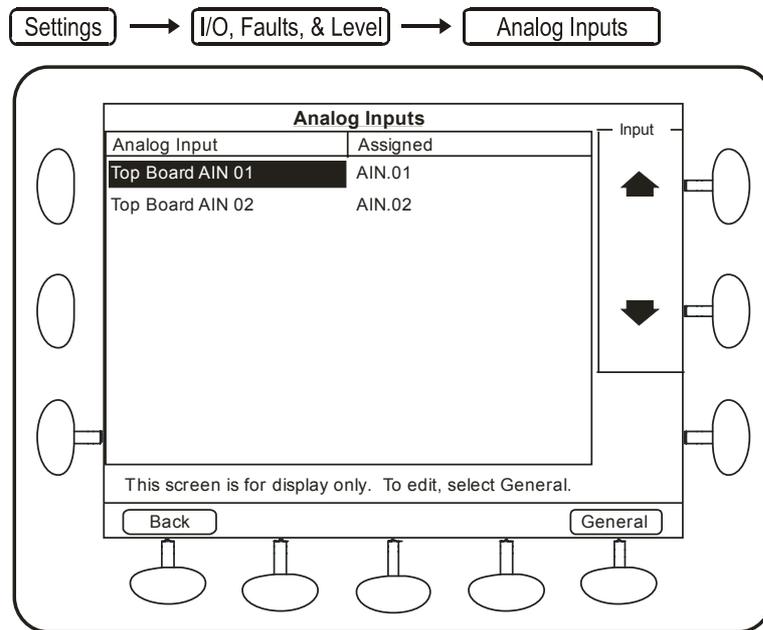
Figure 89 - Analog Input Configuration

Settings ⟶ I/O Faults & Level ⟶ Analog Inputs ⟶ General

This screen allows the AIN to be zeroed and spanned, as well as the description of the input to be changed. (This description appears in the **Info** screens, in the Section 14 Configuring I/O, Fault & Level Devices.) Advanced configuration options can be found in the advanced menu.

> **NOTE:** *In most cases the default settings will be correct as they are. Only make changes in the advanced menu if you are have a good understanding of analog sensors and their configuration.*

Settings ⟶ Advanced

- From the tree structure select: **IO Module** [+/-] **Unit** [+/-]

- Select the correct unit and press [+/-]

- Select which module the inputs are located, i.e. **TopBoard** then [+/-] select **Analog Inputs** then [+/-]

- Select the Input, i.e. **Analog Input 1** to configure and press the centre button on the left-hand side marked *"Use this button to see additional values"*

- The centre button on the left-hand side marked *"Use keypad to enter new value, or use ⬆⬇ on keypad to change values".*

14.6 Advanced Analog Input Options

Name	Description	Range/Type
Delay	This delay is used as a low pass filter.	0- 100000 ms
Description	Description of the input. This is the same item as the one shown on the General IO Module Configuration Screen.	Text
Enable Over Range?	Sets whether the Over Range feature is enabled or disabled.	True/False
Enable Under Range?	Sets whether the Under Range feature is enabled or disabled.	True/False
Over Range Delay (sees)	The time to wait after the Over Range Set Point has been reached before an over range event is generated.	0-120s
Over Range Set Point (%)	This is the set point for over range detection.	0-100%
Under Range Delay (sec)	The time to wait after the Under Range Set Point has been reached before an under range event is generated.	0-120s
Under Range Set Point (%)	This is the set point for under range detection.	0-100%
Value	This sets advanced parameters affecting the value produced by the analog input. These include: Deadband Raw Max Raw Min Scaled Max Scaled Min	

14.7 External Digital & Analog Modules

If an IO unit has Modbus or DNP3 capabilities, then a MultiSmart unit can be configured to communicate to the device. The configuration will usually require custom engineering, increasing the effort required for integration.

To speed up this process, certain IO units have been selected as standard MultiSmart solutions. MultiSmart has wizard functionality which can be used to greatly simplify configuration. Once configured, these analog inputs, analog outputs and digital inputs are listed in the respective LCD screen menus wherever the corresponding MultiSmart I/Os are displayed. Hence they can be assigned to any faults or configured to use with other functionality in the unit, with the same procedure of how you can configure the MultiSmart I/O.

Currently, this wizard functionality supports the following units:

- ADAM-6017 - Ethernet, 8AIN, 2DOT

- ADAM-6050 - Ethernet, 12DIN, 6DOT

- ACROMAG-961 - Ethernet, 6 DC Current Input Channels

- ACROMAG-983 - Ethernet, 12 Discrete Input Output Channels

14.7.1 Point List Configuration

The first step to setting up communications to an external IO block is to create a new Modbus master. In order to do this, the MultiSmart unit must have **Modbus Master** enabled. The slave profiles for the external IO unit/units which is/are talking over the Ethernet port needs to be created under this Master.

To check if the **Modbus Master** is enabled browse to:

Settings → More → More → Software Modules → Enable_Disable Modules

If Modbus Master is disabled please contact MultiTrode to find out how to enable it.

To create a new Modbus Master, via the LCD, navigate to:

Settings → More → Communications → Modbus Points List
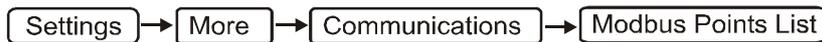
then click on

Add Modbus Master

When the Modbus Master is created, a Modbus Slave under the master will also be created by default. Hence we only need to reconfigure the points list for that slave to match the Modbus profile of the external IO unit. To do this, via the LCD, navigate to:

Settings → More → Communications → Modbus Points Lists

↳ Modbus Master → Regenerate Points List
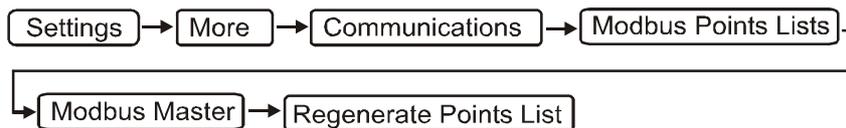
You are then able to select the desired Ethernet expansion module which MultiSmart supports. If the module is not listed you have to do some custom engineering to interface it with MultiSmart. Confirming your action will require a restart of the unit. Once the unit has restarted, the points list will be complete. Jump to section 14.7.2 if you don't have more than one IO unit to be configured.

If we need to interface more IO expansion module we need to create additional slave profiles under the same Modbus Master and configure the Modbus points list for that slave profile.

To create an additional slave via the LCD, navigate to:

Settings → More → Communications → Modbus Points Lists → Add Modbus Master/Slave

Once the slave is created and after the MultiSmart is restarted navigate to the following location via the LCD.

Settings → More → Communications → Modbus Points Lists → Modbus Master
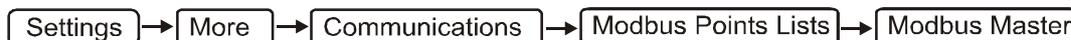
You can now see a new option "Next Slave" at the bottom of the screen. If you select that you will be able to browse to the points list settings of the next slave. Now, at the bottom of the screen, you can see "Prev Slave" if there are only two slaves or "Next Slave" and "Prev Slave" if more than two slaves are present under that Modbus Master.

Thus, browse to the appropriate slave and regenerate the points list to suit the IO device's Modbus profile for every new Modbus Slave created. To regenerate the points list, select the appropriate slave, and select the **Regenerate Points List** option under that particular slave.

14.7.2 Configuring the Communication

If the Ethernet point in the MultiSmart is available for interfacing and only one ADAM/ACROMAG unit is required to be connected then the connection can be established by using a single shielded RJ45 cross over cable. However, if more than one ADAM/ACROMAG units are to be interfaced and/or if MultiSmart is connected to an Ethernet network, then an Ethernet switch is required for establishing the connection. In this method shielded RJ45 straight through cables are to be used in connecting the MultiSmart and ADAM/ACROMAG units to the switch. The two different ways of interfacing the devices are shown in the figures below.
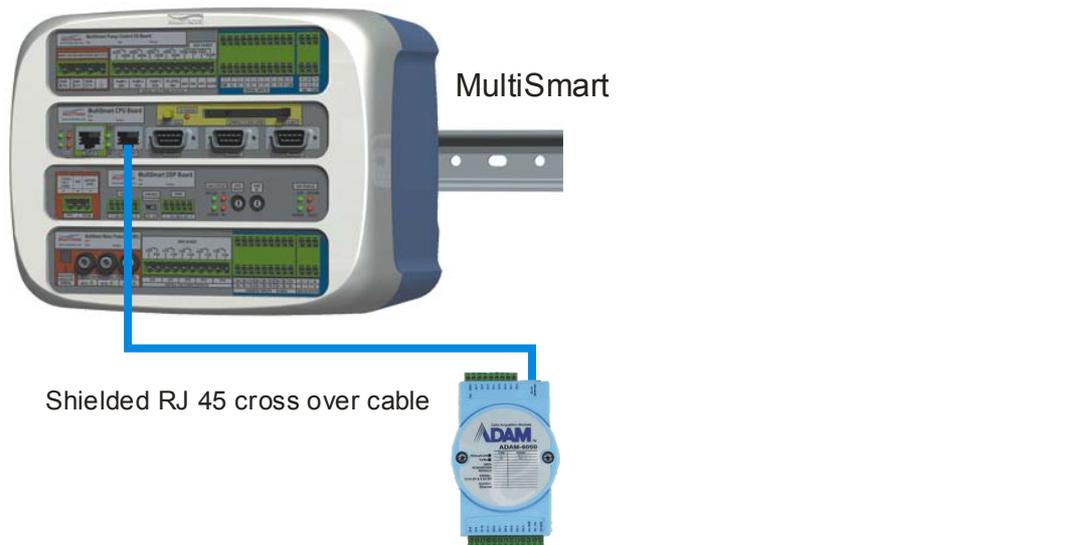
Figure 90 - MultiSmart + Adam Unit
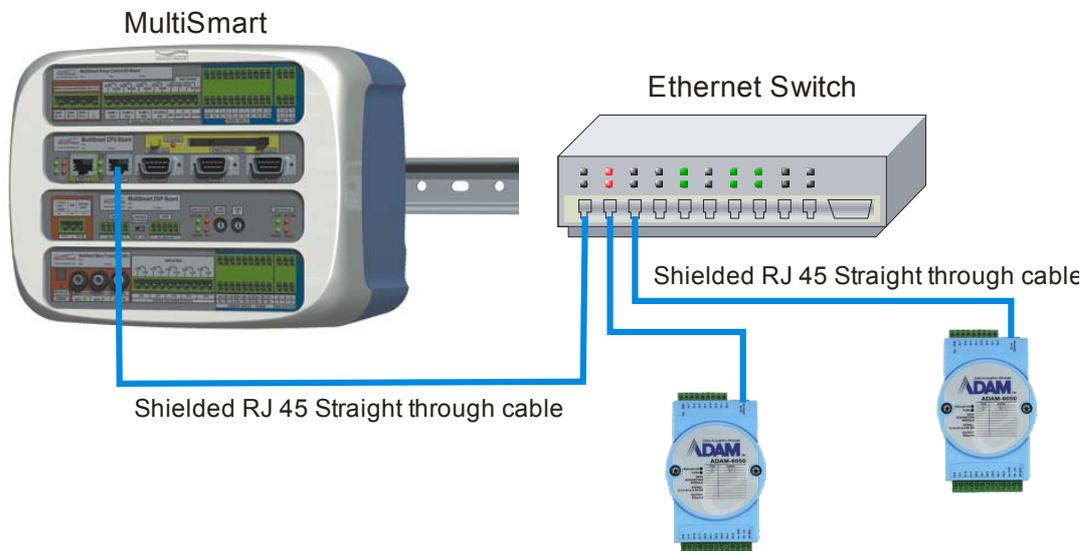
Figure 91 - MultiSmart + Ethernet Switch = 2 x Adam Units

14.7.3 ADAM Ethernet Units

ADAM Ethernet units currently supported include,

- ADAM-6017

- ADAM-6050

These ADAM units, if purchased from MultiTrode, will be preconfigured to be able to interface with the MultiSmart. However if you may want to change the IP address of the ADAM units to one matching that of your domain you can do it by following the instructions below.

Both of these units are packaged with a CD, which includes a utility, called *Adam.NET Utility,* for configuring the IO device. Install this utility on a Windows PC.

In order to establish communications to the device, first connect the device to a DC power supply (10-30V) via the *(R) +Vs* and *(B) GND* pins. Then connect the device to the network used by the Windows machine via an RJ-45 connection.

Now run the *Adam.NET Utility.* From the displayed window, highlight *ADAM5000TCP_6000.* Then click on the magnifying glass. This will detect the connected device. Highlighting this device will allow you to reconfigure its IP address via the Network tab. Once the desired IP address has been set, click on *Apply Change.*

NOTE:
If you are using an ADAM-6017 device which is not purchased through MultiTrode, you have to go through the ADAM unit user manual and configure the I/O to make it suitable for interfacing with the MultiSmart.

The default IP address of the ADAM unit is 10.0.0.1 unless it is specified and purchased from MultiTrode.

The MultiSmart RTU now needs to be reconfigured to communicate to this device.

Check the IP address of the MultiSmart and modify it if it does not match with that of the ADAM unit. To verify and to change the IP address of the MultiSmart if required browse to:

Settings → More → Communications → IP Address

Set the MultiSmart IP Address to 10.0.0.2 if the ADAM unit is interfaced to the MultiSmart using a cross over cable. To configure the IP address of the ADAM units for advanced installations please refer to the unit manual available for download at http://advantech.com.tw. Ensure that no more than one ADAM unit is having the same IP address. Otherwise it would result in an IP address conflict. If you need to setup advanced routing in MultiSmart, refer to section 22.4.

In the LCD screen, navigate to:

Settings → More → Communication → Protocol Settings

Select the Modbus Master, which is having the slave profiles of the IO units, using the select arrow buttons and press **Select**.

Set the **Comms Channel** to TCP/IP 1, 2 or 3 whichever is available for use, **Link Type** to TCP and press **Save**. Choose **Restart Later** option if prompted. Use the select arrow button and select the first slave and press **Edit**. Select the **Enabled?** option if it is not selected already, set the **Slave Address** to 1 and press **Save**.

Now select the **IP Address** button, enter the ADAM unit's IP address in the **Dest IP Address** tab, set the **TCP Port** to 502 and press **Save**. Now press **Back** button twice to navigate to the Modbus Master settings.

If there is more than one slave, edit the settings for each additional slaves by following the above procedure.

Now press the Channel button, set the **Connection Type** to Initiating end-point and press **Save**.

Once these have been completed, save your changes and restart the unit.

14.7.4 ACROMAG Ethernet Units

ACROMAG Ethernet units currently supported by MultiSmart include:

- ACROMAG-961

- ACROMAG-983

Each device includes a CD, which has full instructions on how to set up and use all devices within their product range. The following description here presents a very quick discussion of how to configure the devices for communications to a MultiSmart. Refer to the full instructions for more details.

In order to establish communications to the device, first connect the device to a DC power supply (15-36V, although ACROMAG claim that the units will operate at 11V) via the DC+ and DC- pins. Then connect the device to the network used by the Windows machine via the RJ-45 connection.

ACROMAG Ethernet IO units are able to serve html pages. Therefore, to configure a unit, only a web browser is required. All ACROMAG Ethernet IO devices have a pre-programmed IP address of: 128.1.1.100

In order to set up communications to a device, your computer must be able to address this IP range. The simplest way to achieve this is to use a laptop and change the IP address of the laptop to 128.1.1.101. Load a web browser and type the following http://128.1.1,100.

This will load the configuration page for the device. The user name is User and the password is passwordOO. By clicking on Network Configuration, you can reassign the IP address of the device as desired. Ensure that no more than one ACROMAG unit is having the same IP address. Otherwise it would result in an IP address conflict.

For the ACROMAG-961 analog input device, it is necessary to configure the ranges of the inputs. This can be done via the Test Page. You should select the ranges to be 4-20mA, unless another range is desired. If another range is selected, the raw ranges of the analog tags in MultiSmart should be modified to reflect this also.

The MultiSmart RTU now needs to be reconfigured to communicate to this device.

The default IP address of the ACROMAG unit is 128.1.1.100 unless it is specified and purchased from MultiTrode.

Check the IP address of the MultiSmart and modify it if it does not match with that of the ADAM unit. To verify and to change the IP address of the MultiSmart if required browse to:

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Communications}} \rightarrow \boxed{\text{IP Address}}$$
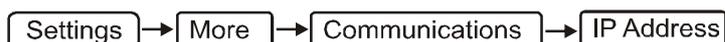
Set the MultiSmart IP address to 128.1.1.101 if the ACROMAG unit is interfaced to the MultiSmart using a cross over cable. To configure the IP address of the ACROMAG units for advanced installations please refer the unit manual available for download at www.acromag.com. If you need to setup advanced routing in MultiSmart, refer to section 22.4.

In the LCD screen, navigate to:

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Communication}} \rightarrow \boxed{\text{Protocol Settings}}$$

Select the Modbus Master, which is having the slave profiles of the IO units, using the select arrow buttons and press **Select**.

Set the **Comms Channel** to TCP/IP 1, 2 or 3 whichever is available for use, **Link Type** to TCP and press **Save**. Choose **Restart Later** option if prompted. Use the select arrow button and select the first slave and press **Edit**. Select the **Enabled?** option if it is not selected already, set the **Slave Address** to 1 and press **Save**.

Now select the **IP Address** button, enter the ADAM unit's IP address in the **Dest IP Address** tab, set the **TCP Port** to 502 and press **Save**. Now press **Back** button twice to navigate to the Modbus Master settings.

If there is more than one slave, edit the settings for each additional slaves by following the above procedure.

Now press the Channel button, set the **Connection Type** to Initiating end-point and press **Save**.

Once these have been completed, save your changes and restart the unit.

14.7.5   Verifying the Communication & Values

Communications to an external IO device can be verified by navigating to:

Info → Communications → Modbus Master Stats

Info → Communications → Modbus Master Values
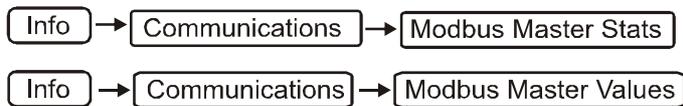
If communications have been successfully established, then the **Online** value will be negative and the **Comms Fail** value will be positive. You should also see the **Transmitted** and **Received** counts incrementing frequently. By default, scans are configured to occur every 2 seconds, allowing for data to be kept up to date.

To view the values read from the unit, press the **Back** button and then navigate to: **Modbus Master Values**, and then select one of the point classes. This will show all of the values read from the IO device, and will dynamically update these values.

Selecting a point and pressing the **Details** button will then display more detailed information for the selected point. For example, if an analog value (input register) is selected, then the raw and scaled values can be compared from this screen.

14.8 Configuring Level Devices

Navigate to the Level Devices screen. From this menu you can assign or unassign a primary and/or backup level device for the MultiSmart.

Settings → I/O Faults & Level → Level/Control Devices
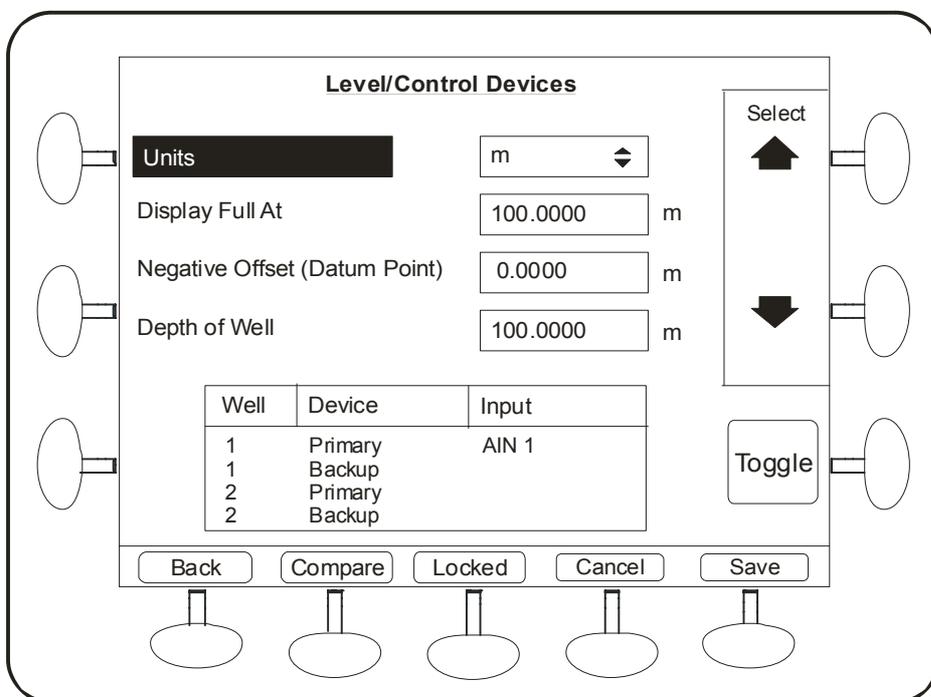
Figure 92 – Level Devices Screen

From here you can configure:

- The type of units used to display levels on the screen
- The level at which the bar graph display will show as full
- The range of the device (except % which is always 0 – 100%)
- The unit of the level value if 'Custom' unit is selected

Display Level Units can be set to:

- %   Percentage.
- m   Meters
- ft   Feet
- in   Inches
- Custom: enter custom unit name, e.g. kPa

To configure a level device select either a primary or backup level device and press the **Configure** button.

```
[ Settings ] → [ I/O Faults & Level ] → [ Level/Control Devices ]
```

Scroll down and select the primary level input and press config.
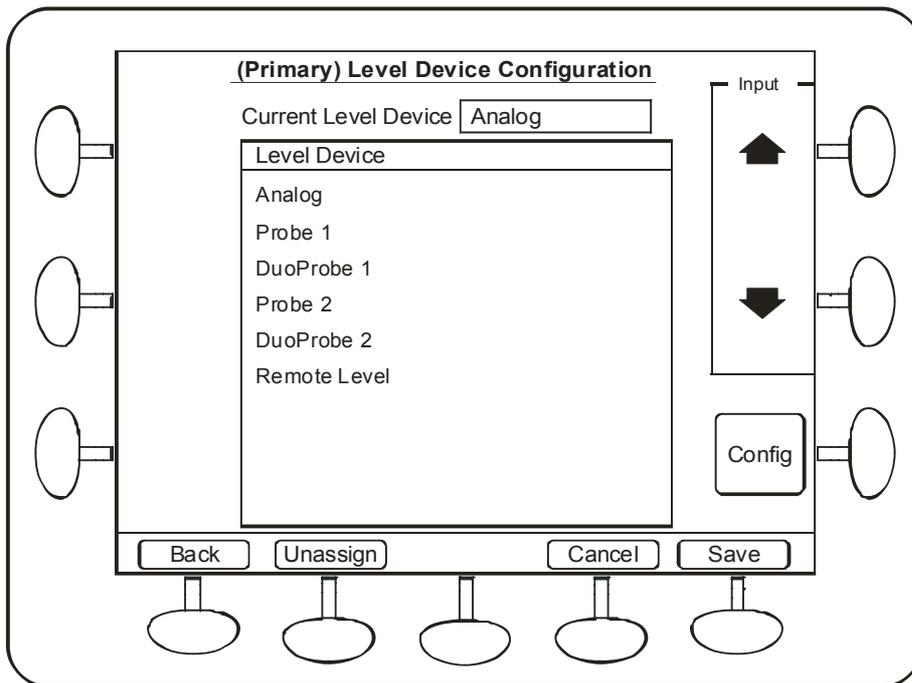
Figure 93 – Select a device for configuration

- Select **Analog, Probe, DuoProbe or Remote level** as the level device to use and press **Save**.
- Select **Restart Later** if prompted.
- Now press **Config** to change additional settings for the level device in use.

14.8.1 Probe Configuration

In the probe configuration window you can assign or unassign the digital inputs which are required for the probe wiring. You can configure more than one probe for a system, e.g. 2 wells, or probe in primary and backup configuration.

Pressing the **Config** button takes you through the probe configurations. By default there are 2 probes pre-defined per I/O box.

Probe Configuration

Length of Probe (m) [100.00]

Sensor	Input
1	TopBoard DIN 02
2	TopBoard DIN 03
3	TopBoard DIN 04
4	TopBoard DIN 05
5	TopBoard DIN 06
6	TopBoard DIN 07
7	TopBoard DIN 08
8	TopBoard DIN 09
9	TopBoard DIN 10

Input

Config Sensor

Back   Unassign   Cancel   Save
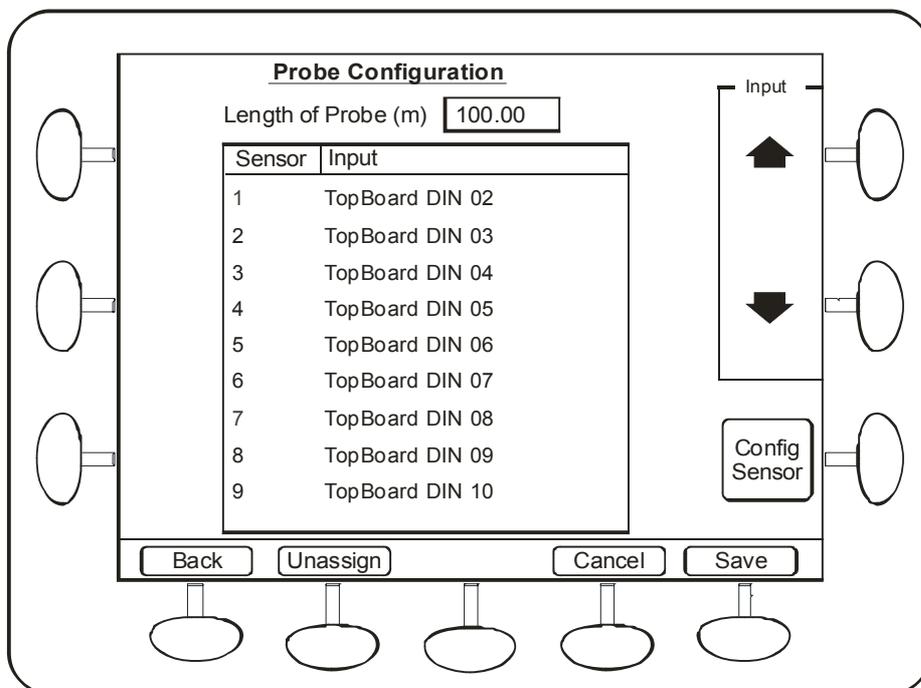
Figure 94 – Probe configuration

In a typical system where only one probe is used the 2nd probe is simply unassigned and has no impact on the system setup.

NOTE:
When a 2nd probe is defined, it is important to assign the Digital Inputs to which this 2nd probe is connected.

Press the **Config Sensor** button to make changes to the Digital Input assigned or to the % value that each sensor indicates. By default, each sensor represents 10% level change. You can define the length of the probe as well here.

14.8.2 Single-Sensor Mode

The MultiSmart can be configured with less than 10 level sensors – this is called Single Sensor Mode.

Single or three sensor MultiTrode probes or Ball floats may be used.

To configure the MultiSmart for Single Sensor Mode.

1.   To Enable Single Sensor Mode go to:

Settings → Advanced → I/O Module → Unit → Unit 01 → Probe → Probe 01

Scroll down to **Single Sensor Mode?** and check the box. This prevents the "IO Unit 1 Probe Error" from occurring on the "missing" sensors.

2. **To Assign the Sensors** go to:

Settings → I/O Faults & Level → Level_Control Devices

Scroll down and highlight the **Primary Probe** and press Configure. Now select the probe and press **Config**. Unassign sensors not required.

With one of the remaining sensors highlighted, press the **Config Sensor** button to modify the digital input or the level represented by that sensor (if necessary).

> ⚠ **NOTE:** *The highest level assigned must start at Sensor 1 and decrease from there (e.g. Sensor 1 =100%, Sensor 3 = 50%, Sensor 4 = 10%). A "Well 1 Primary Level Invalid" fault is displayed if Sensor 1 is not assigned to a probe.*

3. **To Verify Digital Input Mode** go to:

Info → I/O Information → Top Board → Digital Inputs

and press the **Advanced** button.

For Probes the "**Mode**" must be "**AC**". For ball floats the "**Mode**" should be "**Digital**".

4. **To Modify Digital Input Mode** go to:

Settings → Advanced → I/O Module → Unit → Unit 01 → Top Board → Digital Inputs

Select the appropriate digital input, expand and scroll down to **Mode**. Select the correct mode and press **Save**.

14.8.3 Probe Sensitivity

Extra probe settings, including probe sensitivity, can be accessed by going to:

Settings → Advanced

- From the tree structure select: **IO Module** `+/-` **Unit** `+/-`

- Select the correct unit and press `+/-`

- Select **Probe** then `+/-`

- Select a probe then press `+/-`

Name	Description
Delay (ms)	Sets a delay before a probe sensor change is accepted.
Description	Text description of the probe.
Sensitivity (Ohms)	Sets the sensitivity of the entire probe in ohms.
Sensors	Settings for individual sensors in a probe. Normally no need to change these.
Value	Settings for deadband and raw min/max values. Normally no need to change these.

14.8.4 DuoProbe Level Sensor Configuration

Similar to the normal probe, you can configure more than one DuoProbe for a system, e.g. 2 wells, or probe in primary and backup configuration. There are several hardware and firmware requirements which you need to satisfy to be able to use the DuoProbe as the level device with MultiSmart. The MultiSmart must have a processor board with version PCB40001r01 or higher and software version 2.04 or higher to be able to use with the DuoProbe.

In order to confirm this, navigate to,

[Info] → [More] → [Version Information] and verify the HW Version and Build Version.

Browse to,

[Settings] → [I/O Faults & Level] → [Level/Control Devices]

A simple wiring diagram for the DuoProbe interfacing with the MultiSmart is shown below. For detailed wiring information refer section 7.2.
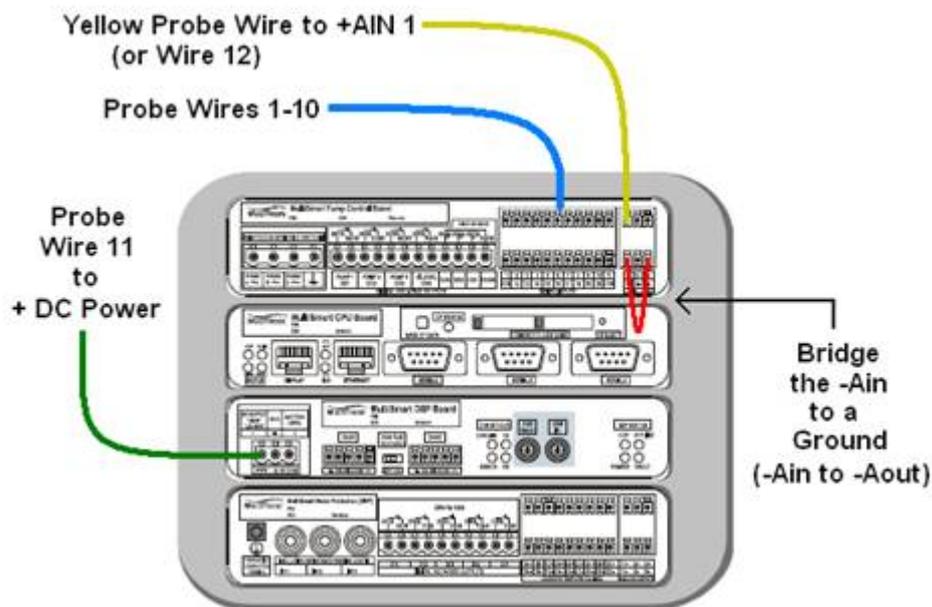
Figure 95 – DuoProbe Wiring to MultiSmart

If the well depth is represented as percentage then you can leave the **Display Full At** and **Negative Offset (Datum Point)** options with their default values of 100 and 0. However if the well depth is specified as a linear measurement then select the appropriate Units and configure the Display Full At, Negative Offset (datum Point) and the Depth of Well by highlighting the options and entering the new values. See examples below for finding out the relationship of **Depth of Well** with the length of probe.

Now scroll down and select the Primary/Backup level device for which the DuoProbe needs to be configured and press **Config**.

⚠️ **NOTE:** *If you need to unassign any DuoProbe you need to press the **Unassign** button in this screen.*

Select DuoProbe 1, or DuoProbe 2 if the first one is already assigned, **Save** the settings and press **Config**. In this menu you can configure the length of the probe and assign or unassign the digital inputs which are required for the wiring.

In a typical system where only one DuoProbe is used the 2nd DuoProbe is simply unassigned and has no impact on the system setup.

> **NOTE:** *If the standard MultiSmart wiring diagram is followed for the DuoProbe interfacing you don't need to change these default digital input configurations. When a 2nd DuoProbe is defined, it is important to assign the Digital Inputs to which this 2nd DuoProbe is connected.*

The DuoProbe length must be entered as a fraction of the effective well depth.

Example 1:

With percentage as the unit of measure for well depth, a 1m probe in a well with an effective well depth of 2m, gives a value of 50 (1m / 2m x 100% = 50%).

Example 2:

If the units of measure for well depth are metres or feet, then simply enter the length of the probe in those units.

For configuring the digital inputs for the well level it represents, highlight the input and press **Config Sensor**. However if you are following the standard MultiSmart DuoProbe wiring for the primary level device you do not require to configure these settings. Remember to **Save** the changes.

Press the **Pressure** button to configure the pressure sensor in the DuoProbe.

Select the analog input for the pressure sensor and **Save** the settings. The Min and Max pressures, (70 and 220 kPa respectively) that appear at the bottom of the DuoProbe Pressure Configuration screen, are the pressure ranges of the DuoProbe pressure sensor and hence they do not need to be modified. At all times the MultiSmart recalibrates the level measurement from the pressure input with that of the digital input. However the recalibration process is inhibited if 2 sensors are uncovered faster than a preset time interval (Level Change Time, default = 5s). The calibration process is re-enabled when 2 digital input sensors are again covered.

> **NOTE:** *The analog input for the pressure transducer is not automatically assigned even when selected through the Setup Wizard. By default no DuoProbe pressure sensor fault is displayed when the pressure sensor fails (i.e. analog input current falls below 4mA or above 20mA). However a fault can be created and manually linked to the active tag – (IO.Unit._1.Probe._1.DuoProbe.Active).*

Follow the sensitivity settings for the normal probe, to configure the DuoProbe advanced sensitivity parameters (Ref section 14.8.3). The sensitivity settings of Probe 1 are applicable to that of the DuoProbe 1 and the sensitivity settings of Probe 2 are applicable to that of the DuoProbe 2.

Refer to section 14.8.2 for more information on configuring the mode of the digital inputs used for the DuoProbe and for details on configuring it to be able to operate with less than 10 digital inputs.

> **NOTE:** *DuoProbe require atleast 3 sensors wired to the digital inputs and hence in cannot be configured to work like a normal probe in single sensor mode.*

14.8.5   Analog Level Sensor Configuration

| Settings | → | I/O Faults & Level | → | Level Control/Devices |
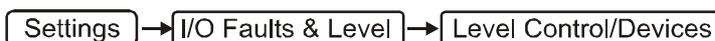
Select **Analog** then press the **Config** button. The available Analog Inputs are listed in the **Inputs** box, you can use the Input arrows to highlight the correct input, then press **Select**.

You can also navigate, using the Input arrows, to the 4-20mA values.

14.8.5.1   Zero and Span the Well

To zero and span the well, perform the following steps:

- Bring level of the well to the desired "Zero" level

- Press the **Zero** button, the current value will be read from the Analog Input and be entered into the **Raw Min** setting box.

- Bring level of the well to the desired "Span" level

- Press the **Span** button, the current value will be read from the Analog Input and be entered into the **Raw Max** setting box.

- Press **Save** to confirm the changes.

> ⚠️ **NOTE:**
> There is also a parameter under **Advanced-Pump Control- Well** which is the level that the pump control module assumes when both primary and backup (if configured) have failed. This parameter is **Input invalid sensor**.

14.8.5.2   Options Available for Special Applications

The MultiSmart supports a relative offset around a datum point which can be set through the control panel. In the Level Devices section mentioned above you can specify an offset around a particular datum point which is to be added to the MultiSmart level input. These scaled set points can be verified using the DNP or MODBUS points list whichever is applicable.

The MultiSmart supports also inverted levels when the analog input is used as the level device. In order to do this in the **Advanced** menu navigate to;

[Pump Control] → [Well] → [Well 01] → [Primary Level Input] → [Function]
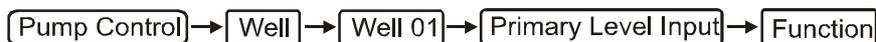
Toggle the parameter to: 100 - SourceX

This will invert the level. To invert the set points, navigate to:

[Pump Control] → [Invert Set Points]   Toggle this to true.

14.8.6   Remote Level Sensor Configuration

The MultiSmart can receive levels from a remote level sensor such as a reservoir monitor.

Select **Remote Level** to assign a Remote Level Sensor to the level device chosen (Primary or Backup). Press **Save** to confirm the change.

To remove a Remote Level Sensor from the system press the **Unassign** button.

Configuring the Remote Level during the setup wizard (rather than subsequently via this screen), has the advantage that the units asks a number of questions as to DNP3 configuration and master/slave addresses. See Section 9.1. The disadvantage of going through the setup wizard is that any configuration already created will be overwritten.

14.8.7   Backup Level Devices & Failover

The MultiSmart can accept two level devices monitoring the same well - a primary and a secondary level device (Ref Section 14.8). Typically the primary level device is an analog device (4-20mA) and the backup or secondary level device is a MultiTrode probe. The probe is backup as it is highly reliable while the analog device has higher resolution hence it is the primary level device.

The failover or switch-over to the backup level device is based on the comparison of the level returned from each device with predefined values or a window. There are two windows, a low and a high and each has two values associated with it. When both of the levels returned fall outside the window, one of two possible faults is displayed.

The **Primary Level High Range** fault is displayed when the result of the comparison to the predefined high window fails. Similarly, the **Primary Level Low Range** fault is displayed when the result of the comparison to the predefined low window fails.

> ⚠️ **NOTE:**
> *These faults only detect a fault within the specified window, for a full range comparison see the Analog Compare feature, section 14.8.9.*

How to setup the windows is explained in the following section. The faults associated with the backup probe are automatically enabled when a backup probe is assigned.

The primary level device is restored as the primary level source when the comparison of the current levels to the windows no longer fails.

14.8.7.1 Primary Level High Range Setup

The High Range Primary, High Range Backup and Low Range Primary & Low Range Backup values (as well as the delays for each) are located at:

Settings → I/O Faults & Level → Level/Control Devices → Compare

Definitions

High Range Primary - the maximum level at which the <u>primary</u> must indicate in order to trigger a **Primary Level High Range** fault. (The default value is 80%).

High Range Backup - the minimum level at which the <u>backup</u> must indicate in order to trigger a **Primary Level High Range** fault. (The default value is 95%).

14.8.8 Configuring Remote and Local Level

MultiSmart can be configured to switch to the local level if the remote level times out. To set this up navigate to Settings → I/O Faults & Level → Level/Control Devices

Configure the primary device to use the remote level and configure the backup device to the appropriate source (eg probe, analog, or even another remote source).

The unit is already configured to use a remote and local level. However, by default, it will switch to use the local level if there is a high or low rage error defined. A high range error will occur, for example, when the backup level is about a certain set point whilst the primary level (remote source) is below another level. If it is not desired to switch over when these conditions occur, then it is possible to disable these features. To do this, go the **Advanced** screen and locate

Pump Control → Well → Well 01 → Primary Level Input

Under this note are two parameters called *High range enabled* and *Low range enabled*. It is possible to disable these features later on. The local level will then only be used if the remote level becomes invalid. If the remote level is being sourced via DNP, then when a communication fail alarm is raised to the remote site, the remote level is marked as invalid and the local level will be used. When communications are restored to the remote site, the remote level will be used again.

Note that if the setup wizard is used to configure and if a remote source is used, then DNP Master and Slave on the unit will be configured to use Connection Manager as their communications channel. If it is preferred to use separate channels for these applications, then the *Use conmng* parameter should be disabled via the Advanced screen which can be accessed via

Settings → Advanced → DNPMaster → Master → Master 01 → Use Conmng

in the case of the DNP master or

Settings → Advanced → DNP Slave → Slave → Slave 01 → Use Conmng

in the case of DNP Salve.

14.8.9 Analog Level Compare

This feature is recommended for use when two <u>analog</u> level devices (a primary and a backup device) are used in the same well.

When the primary and backup level devices differ by more than a predefined threshold, a **Well 1 Analog Compare** fault is triggered. (The fault is disabled by until manually enabled).

If the fault is triggered, the behaviour of the controller remains unchanged i.e. the primary level device continues to be used as the primary source of level.

NOTE:
*If the primary analog device fails such that no 4-20mA signal is generated, then in this situation the fault **Well 1 Primary Level Ain Under Range** is displayed and the backup analog level device becomes the source of level information.*

To configure the Analog Compare, navigate to the following screen in the display panel.

Settings → I/O Faults & Level → Level/Control Devices

- Press the **Compare** button

- With the **Enabled** check box highlighted, press the **Toggle** button to check the box

- Scroll to **Threshold %** and enter the required threshold (5% is the default)

Level Locked

The **Level Locked** alarm indicates that the level returned by the level device has not changed by more than a predefined amount in a specified period of time. The timed period can be a period of the day (e.g. 14:30 to 17:00) or the entire day. Up to four different time periods can be set.

To configure navigate to the following menu in the LCD screen:-

Settings → I/O Faults & Level → Level/Control Devices

- Press the **Locked** button

- With one of the four periods highlighted, press the **Configure** button

- With **Enabled** highlighted, press the **Toggle** button to check the box

- Scroll down to **Change Threshold (%)** and enter the minimum percentage by which the level should change during the set period

- Scroll down to **Duration** and enter the period of time over which to monitor the minimum percentage change. (e.g. with a threshold of 5% set**,** the level should change by at least 5% in 30 minutes).

- Press **Save**

If you want to specify a period of the day, rather than the whole day,

- Scroll down to **Always** and press **Toggle** to uncheck the box

- Enter a start and finish time.

If a start and finish time is specified, any 'Locked' time immediately prior to the start time is taken into account when the period starts. For example, with a 5% threshold, a 30 minute duration and a start time of 06:00 set; if the level changes by no more than 1% in 25 minutes <u>prior</u> to the start time and continues like this for another 5 minutes, a **Level Locked** alarm is generated at 06:05.

14.9 Configuring Faults

To configure fault options navigate to the Faults screen, select a fault type then press the **Configure** button. The unit comes with a large number of pre-configured faults. The faults can be assigned to a particular context as well (Ref Section 14.9.3).

⚠️ *NOTE: Supply Protection and Motor Protection faults have screens specifically designed for them and are not found in this general fault screen.*

Settings ⟶ I/O, Faults, & Level ⟶ Faults
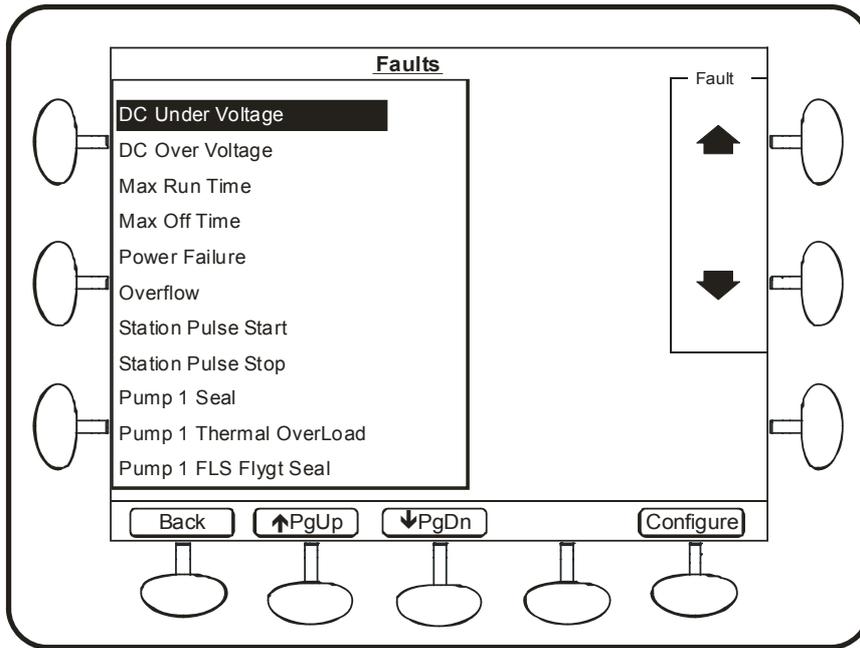
Figure 96 - Select Fault Type
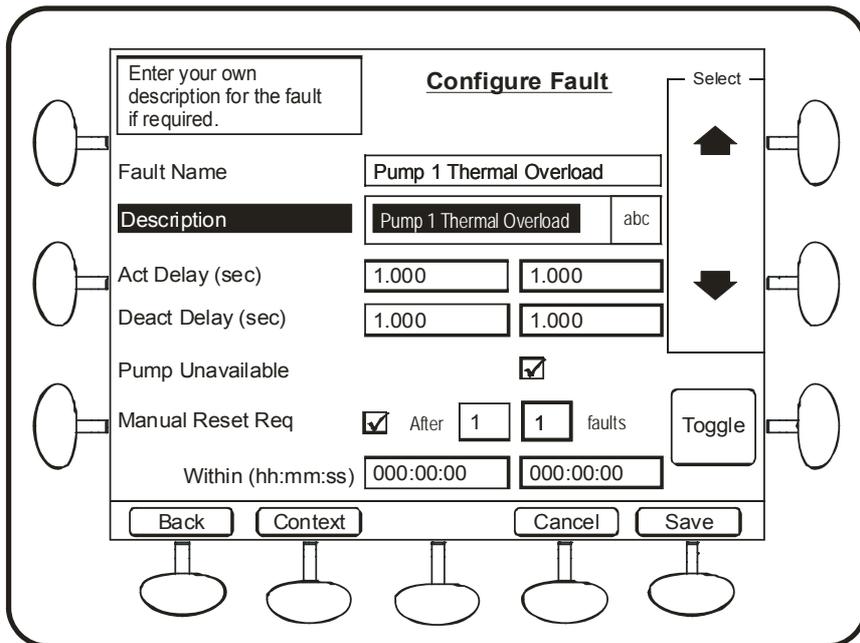
Figure 97 - Configure Advanced Fault Options

The following items can be configured for each fault:

Name	Description	Range/Type
Description	Text description of the fault.	Text
Act Delay	Activation delay in seconds. The time period before the fault becomes active.	Seconds
Deact Delay	Deactivation delay in seconds. The amount of time the fault must have cleared before the pump becomes available again.	Seconds
Pump Unavailable	Check this box to make the pump unavailable when the fault is active.	True/False
Manual Reset Req	Determines whether the pump station manager performs an auto-reset of the fault or an operator is required to manually <u>reset</u> the fault. (Note, even if auto-reset is selected, an operator must still manually acknowledge the fault via the display (or via SCADA) before it is removed from the screen). The manual reset can be further configured so that a manual reset is required only if a preset number of faults occur within a set period of time. i.e. when the number of faults equals the preset value and they occurred within the set period, the pump becomes unavailable (locked out) until an operator resets the fault. This is configured as follows: Enable **Pump Unavailable** Enable **Manual Reset Req** (this also displays the extra settings) Set the **After [x] faults** to the number of faults Set the **Within** (hh:mm:ss) field to the length of time that the number of faults must occur within to trigger a Manual Reset lockout (pump unavailable). Press **Save** to confirm.	True/False

14.9.1   Delay Fail (No Flow) Fault Setup

A predefined fault called **Pump n Delay Fail** fault is available that monitors a digital input and only faults if the input does not change state after preset time expires after a pump starts. It is typically used as a "No Flow" fault but can be used in many other applications that require the status of an input to be checked after a preset time expires after a pump starts running.

The procedure to configure the Delay Fail fault is listed below. The setup is very similar to any of the predefined faults except the delay period can only be adjusted in the **Advanced** menu.

1.   Set the Delay Fail Source (Digital Input)

Settings → I/O Faults & Level → Digital Inputs → Faults

Scroll down to **Pump 1 Delay Fail**

Press **Assign**

Scroll down to the required digital input and press **Select**

Press **Back** and **Save**

2.   Modify the Fault Description (Optional)

Settings → I/O Faults & Level → Faults

Scroll down to Pump 1 Delay Fail

Press Configure, modify the description as required.

⚠ *NOTE: The Act Delay shown in this screen is not the timed delay, it only delays the displaying of the already triggered fault. To avoid confusion leave this set to 1 second.*

3. Set the Delay Time

This is the period of time that expires before the state of the digital input is checked.

- The Show more options in the **Advanced** section must be enabled <u>before</u> this fault can be viewed.

Go to: [Settings] → [Advanced] → [LCD] → [Show More Options] . Check the box (bottom left hand corner) and press **Save** and then press **Back**.

- Now go to:

[Advanced] → [Pump Control] → [Pump Parameters] → [Pump 1]

↳ [Delay Fault] → [Delay Fault 02*] → [Delay]
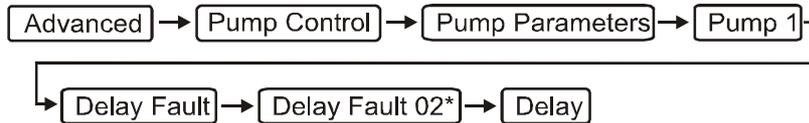
Change this value to the required amount (the default setting is 10 seconds).

Press Save and press **Back** twice.

⚠️ *NOTE: Use Delay fault 02 not 01 as this is already used for the Contactor Auxiliary Fault.*

If the input changes state before the timed period expires, no fault is displayed. The input is continually monitored while the pump is running so if the input reverts back to its initial state then a Pump n Delay Fail fault is displayed (after the delay period expires).

Repeat the above steps for each pump that requires a Delay Fail fault.

14.9.2 Configuring General Faults

Up to ten (10) General purpose (or custom) faults can be created. A General fault is typically used when none of the predefined faults are a close match to the required functionality (based on the name of the fault) however all the predefined faults can be renamed.

Note, the predefined faults are always listed in the Advanced menu under the <u>original</u> name so if the functionality is not similar it can become difficult to locate the renamed fault in this list.

The same parameters are present for General faults as for the predefined faults. So a General fault can be created to stop one or more pumps, fault acknowledgement can be set to auto or manual and activation delay set, to name a few of the options. The source, description, activation and deactivation delays for a General fault can be modified in the low level menus.

To illustrate the configuration of a General fault, the following two examples will be implemented.

Example 1:

A fault called **Manual Mode** is required to stops all pumps when a digital input (Din 16) becomes active. A manual reset is required before the pumps are free to run again. The setup for this fault follows.

1. Set the Source

Go to: [Settings] → [I/O Faults & Level] → [Digital Inputs] → [Faults]

- Scroll down to **General fault 1**
- Press **Assign**
- Scroll down to **Digital Input 16**
- Press **Select**
- Press **Back**, **Sav**e and the **Home** key

2. Set the other Parameters

From the main screen go to: `Settings` → `I/O Faults & Level` → `Faults`

- Scroll down to **General fault 1**

- Press **Configure**

- Enter the new fault description – **Manual Mode**

- Scroll down to **Manual Reset Req** and press **Toggle** to check the box

- Press **Context**

- Press **Toggle** to check the **Station** box (This will stop all pumps)

- Press **Save** and **Restart Now**

Now whenever digital input 16 becomes active, all the pumps will stop and the fault message **Manual Mode** will be displayed.

Example 2:

A low level fuel warning is required. A resistive fuel gauge is connected to digital input 16. A resistance of less 500 ohms indicates low fuel remaining. A 10 second activation delay is required to prevent false triggering. Pump operation is not affected by the fault.

1. Set the Source

Go to: `Settings` → `I/O Faults & Level` → `Digital Inputs` → `Faults`
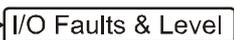
- Scroll down to **General fault 1**

- Press **Assign**

- Scroll down to **Digital Input 16**

- Press **Select**

- Press **Back**, **Save** and the **Home** key

2. Set the other Parameters

From the main screen go to: `Settings` → `I/O Faults & Level` → `Faults`
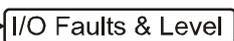
- Scroll down to **General fault 1**

- Press **Configure**

- Enter the new fault description – **Low Fuel Warning**

- Scroll down to **Act Delay** and enter 10

- Scroll down to **Pumps Unavailable** and press **Toggle** to uncheck the box

- Press **Save** and the **Home** key

3. Enter the Required Resistance Threshold

This value can only be set in the advance menu under the digital input assigned.
From the main screen go to:-

`Settings` → `Advanced` → `I/O Module` → `Unit` → `Unit 01` → `Top Board` →

→ `Digital Input` → `DIN 16` → `Sensitivity (Ohms)`
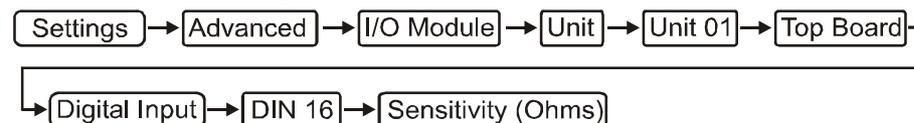
- Enter 500

- Press **Save** and **Restart Now**

Now whenever the resistance of the fuel gauge falls below 500 ohms (for more than 10s) , the message, **Low Fuel Warning** will be displayed.

A similar configuration would be used for a PTC sensor.

14.9.3   Assigning Faults to a Context

The faults while configuring can be assigned to specific contexts. To do this, while in the **Configure Fault** screen, press **Context** button which is visible at the bottom of the screen. You can select single or multiple contexts out of Station, Pump, Well and Group. If none are selected the fault will still come up in the fault information screen, however no actions like 'stop pump until fault is cleared' will be executed when the fault comes up. More advanced fault configuration can be configured from the **Advanced** screen. Navigate to

[Settings] → [Advanced] → [Fault Module]

in the LCD display to access these options.

14.9.4   Rest All Faults Trigger

A ResetAllFaults tag is present in the MultiSmart which can be assigned to a digital input or a DNP or Modbus digital control point which in turn can be used to reset faults which requires reset or acknowledgement. The tag needs to be set to 1 to reset the faults which are cleared already. The tag's location in the MultiSmart is 'PumpControl.FaultStatistics.ResetAllFaults'.

14.10   Configuring Analog Outputs

The MultiSmart Pump Control I/O Board (3PC) has one analog output available.   The optional Motor Protection Board (3MP) has three analog outputs available.

These can be used for tasks such as re-transmitting an analog input's values or producing an analog output value that matches the level in a well measured by a non-analog sensor such as a probe.

Analog outputs are configured in the "I/O, Faults and Level" screen.

[Settings] ⟶ [I/O, Faults & Levels] ⟶ [Analog Outputs]
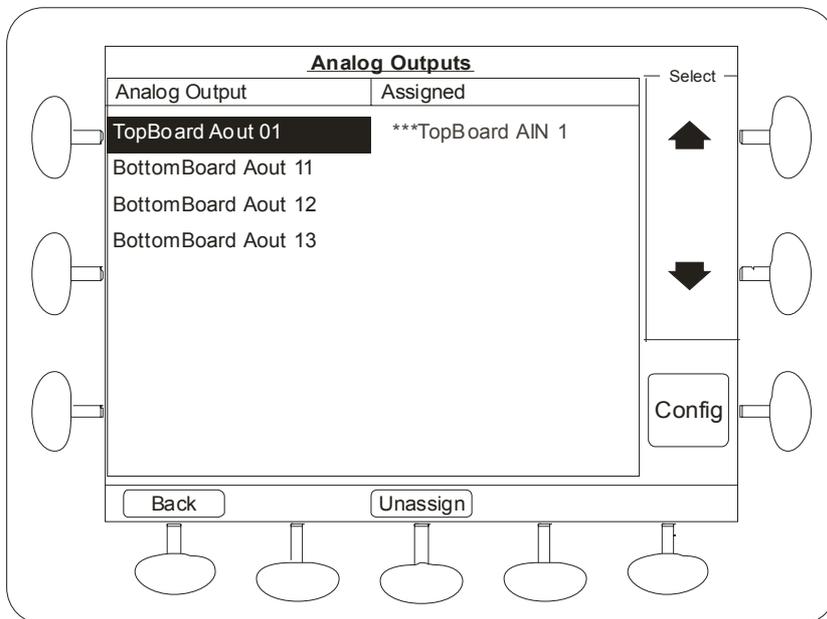
Figure 98 - Select the Analog Output and press "Config"
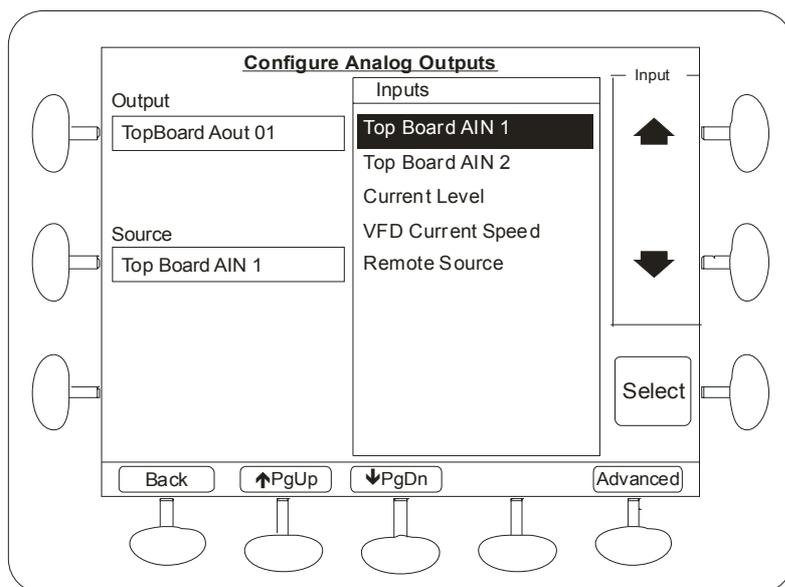
Figure 99 - Select the source Analog Input and press "Select"

⚠️ **NOTE:** *By default, AOUT1 on the main 3PC board follows primary level*

14.11   Configuring Digital Outputs

Digital outputs can be sourced from a wide variety of events occurring in the MultiSmart.   They can be used to activate external alarms, control pumps, send signals to SCADA systems and connect to other external logic (PLC's, relays, etc).

⚠️ **NOTE:** *Some digital outputs will already be in use as part of the initial configuration.   D01 to D03 may already be configured to control pumps and DO4 will be configured as an alarm output.   Any output can be reconfigured.*

Digital outputs are configured from the I/O, Faults & Level screen.

Settings ⟶ I/O, Faults & Levels ⟶ Digital Outputs
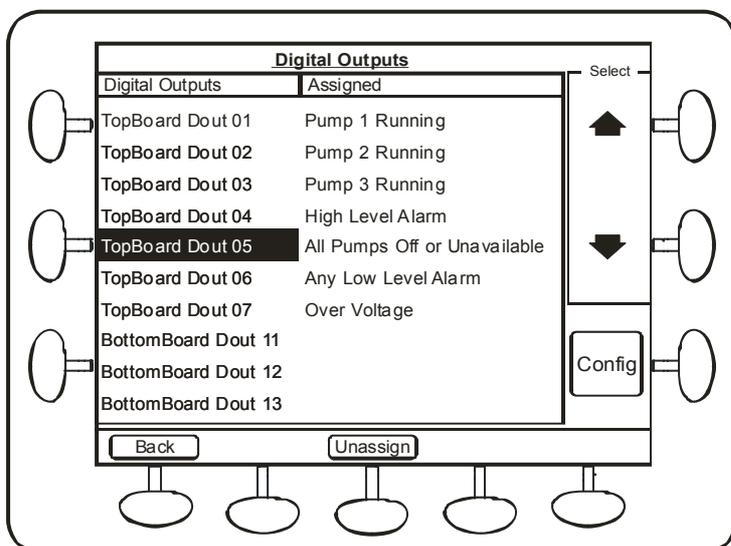
Figure 100 - Select the Digital Output and press "Config"
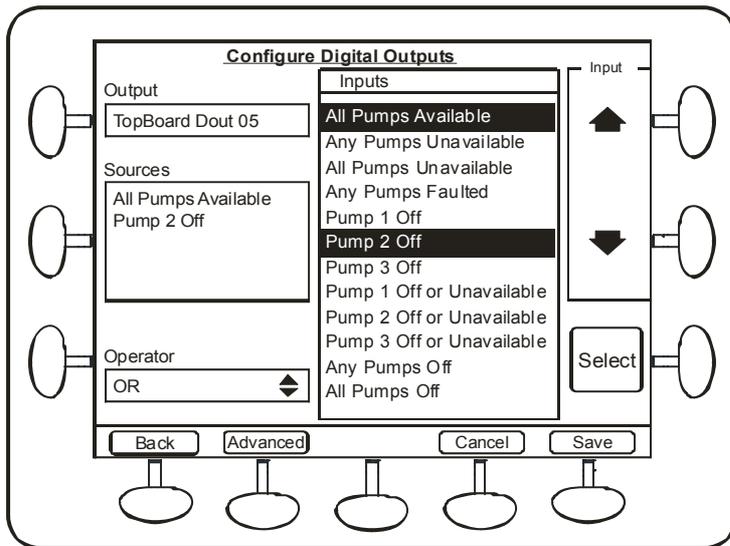
Figure 101 - Select the source and press "Select"

Multiple sources can be selected for the Digital output. We can choose from AND, OR, or XOR operations which will be performed on the multiple sources before the digital output is set. Choose the first source, press **Select** and now select the second source; now you can see the operator selection box.

After you have selected the source, press **Back**, and repeat the process for each Digital Output you wish to assign. The sources in this setup screen include:

Any Fault	Well washer active	All pumps available	Any pumps off or unavailable
Remote Source	Probe Sensor Fault	Any pumps unavailable	All pumps off or unavailable
High High level alarm	Pump 1 Running	All pumps unavailable	Over voltage
High level alarm	Pump 2 Running	Pump 1 off	Under voltage
Low level alarm	-etc to number of pumps	Pump 2 off	DC over voltage
Low Low level alarm	Any pumps running	-etc to number of pumps	DC under voltage
Any level alarm	All pumps running	Pump 1 off or unavailable	Application Failure
Any high level alarm	No pumps running	Pump 2 off or unavailable	AIN1 over range
Any low level alarm	Pump 1 unavailable	-etc to number of pumps	AIN1 under range
Primary level fault	Pump 2 unavailable	Any pumps off	AIN2 over range
Backup level fault	-etc to number of pumps	All pumps off	AIN2 under range

Application failure is the internal watchdog functionality.

If you want to use a source which is not in the list, press the **Advanced** button. This will take you into the Tag Browser and allow you to select from any digital tag within the system. The complete tag structure is outlined in Section 31.

14.12 Example: How To Make a Digital Output State Follow a Digital Input State

- Select Advanced, select IO Module [+/-] Unit [+/-]

- Select the Unit which has the digital input you wish to follow (ie: _1) then [+/-]

- Select which board the digital input is located on (e.g. "Top Board") then [+/-] Din [+/-]

- Select which digital input you want the output to follow (ie: _1) then [+/-]

- Select ValueDigital then press the OK button

Please select : DigitalTag	
Name	**Type**
DinType	Attribute
EdgeCount	Digital
EdgeMode	Attribute
FSActive	Digital
Invert	Attribute
ModeFS	Attribute
+ Probe	Node
ScaleFactor	Attribute
Sensitivity	Attribute
UsedByProbe	Digital
ValueDigital	Digital

Select ▲ ▼ +/-

Clear   Cancel   Ok
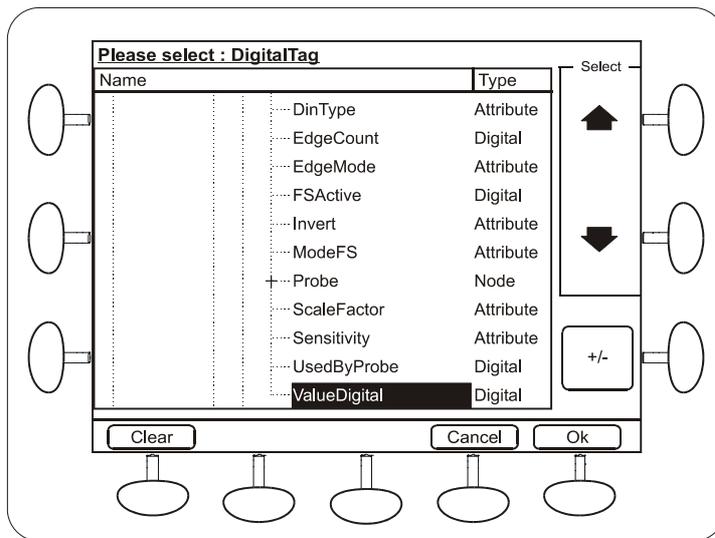
Figure 102 – Making a Digital Output Follow a Digital Input

15   Profiles

The MultiSmart can have multiple sets of fully programmable profiles. Each profile can have independent setpoints and a few specific pump control parameters, e.g. maximum pumps to run. These can be used by an operator to switch the pump station into another mode of operation simply by selecting one profile. Profiles can be selected via:

- User interface

- Date/time (and multiple timers can be setup)

- Digital input

- SCADA

Multiple profiles can be configured by the user. This flexibility allows efficient pump station control both locally and remotely. The MultiSmart is supplied with three profiles pre-configured:

- **Default**
  Suitable for most sewerage applications as shipped from the factory. It is intended to be the standard mode of operation for the pump station.

- **Spill Management**
  A set of peak levels for use in emergency spill management situations. The pump station can be switched to this profile rather than manually set new levels.

- **GenSet/Load Shedding**
  Uses a set of levels designed to limit how long pumps are run to minimise the load. This profile can be used in power outage situations where a generator set is being used temporarily.

There are also some generic profiles (profiles 4-6) that can be named and configured according to user requirements. Profiles can be switched using the MultiSmart user interface, a digital input or a timer with a set date/time.

15.1 Selecting Profiles with the User Interface

To change the current Profile, navigate to the Select Current Profile screen:

Settings → Station Optimization → Select Profile

NOTE:
The profiles selection screen has been moved from its location in v1.0 to v1.3.
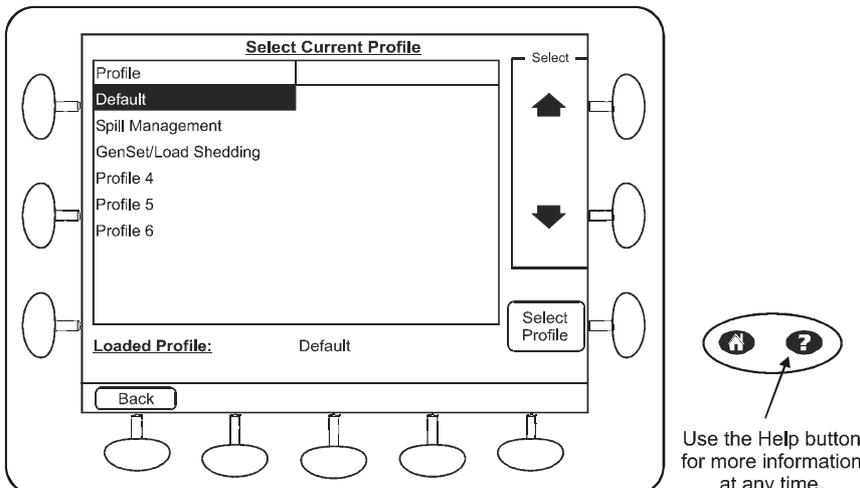
Figure 103 – Current Profile screen

- Use the arrow buttons to select a Profile from the list.

- Push the **Select Profile** button.

15.2 Selecting Profiles Using a Digital Input

A Digital Input can be assigned to select any profile:

Settings ⟶ Advanced

- From the tree select: **Pump Control** +/- **Profile** +/-

- Select the desired profile from the list and press +/-

- From the tree select: **DIN Activation** +/-

The following values should be set:

- Enabled? (check the box to enable, uncheck to disable)

- Source (used to select a Digital Input as a source) and press "**Use this button to see additional values**".

- Scroll down to **I/O**, press +/- , **Unit**, +/- , **_1**, +/- , **TopBoard**, +/- , **DIN**, +/-

- Select the DIN you wish to use. Scroll down to **ValueDigital**, and Press **OK** (bottom right softkey).

⚠️ *NOTE: This example assumes a DIN in the top slot of the first IO Module unit is to be used*

15.3 Selecting Profiles Using a Timer

A timer can be used to set a specific date/time for a profile to be selected. Timer settings for each profile are accessed through the advanced menu:

Settings ⟶ Advanced

- From the tree select: **Pump Control** +/- **Profile** +/-

- Select the desired profile from the list and press +/-

- From the tree select: **Timers** +/-

- Select the desired timer and press +/-

The following values can be set for each timer:

- Enabled? (check the box to enable, uncheck to disable)

- Period (Days)

- Start date (only the date is actually used on this screen, the time is not used). This start date only needs to be set if the timer is to be activated at some time in the future, or you want the timer to run on a specific day each week (in which case you would set **Period** = 7)

- Start time (this is the actual start time used by the timer)

- Stop time

15.4 Configuring the Setpoints of Profiles

See Section 12.3.2 for changing setpoints.   When in the Level/Control Setpoints screen, press the **Switch Profile** button (bottom right) to select the profile setpoints you want to edit. MultiSmart supports inverted level input as well. Refer section 14.8 for more details.

15.5 Configuring other Profile properties

Profiles are configured through the Advanced menu:

Settings ⟶ Advanced

- From the tree select: **Pump Control** [+/-] **Profile** [+/-]

- Select the desired profile from the list and press [+/-]

The following values can be set for each profile:

- DIN Activation
- Lead/Lag pump parameters

> ⚠️ **NOTE:**   The easiest way to configure these settings is through the main menu) *Settings -> Set Points -> Level/Control Setpoints.*

- Activation Delay
- Activation Set Point
- Deactivation Delay
- Deactivation Set Point
- Maximum Off Time Duration
- Maximum Time Enabled?
- Maximum Off Time Quantity
- Maximum On Time Duration
- Maximum On Time Enabled?
- Maximum Pumps Running Mode
- Maximum Pumps Running Quantity
- Name
- Timers

> ⚠️ **NOTE:** Currently, if the unit is operating with the profile you are editing, to activate the new parameters for this profile the unit needs to be switched out of the profile and back in, see Section 15.1 for how to do this.

16 Station Optimization

The MultiSmart pump station manager includes a wide range of configurable parameters for optimizing your pump station, such as:

Parameter	Description
Odor Reduction via maximum off time	Sewer stations with both high and low-use periods often generate odours. During the low use period (e.g. a weekend) the station may take a number of days to reach the activation level for the pump. This allows the station to become septic. This feature allows a maximum off time to be applied so the station is completely emptied in order to reduce septic odours occurring.
Max Run Time	Maximum run time is used to prevent any pump from running too long. It does this by cycling the pumps when a maximum run time is reached. A fault notification can be triggered when this happens, if desired.
Max Pumps to Run	This feature is used to limit the total number of pumps allowed to run at any one time. This is usually done to prevent damage to equipment from either electric or hydraulic overload.
Minimize Fat Build-up	This feature sets a random activation delay for a pump in order to stop fat building up at the activation level in the well.
Well Cleanout	This feature allows the pumps to be run past the normal deactivation point for a set time or to a set level in order to completely empty the well. This can be set to occur at regular periods.
Minimize Excessive Starts	This feature helps keep the maximum starts per hour of a pump below the level recommended by the manufacturer. It works by automatically adjusting the activation level upwards to minimise starts whenever the settings are exceeded. There is an over-ride level to ensure that the activation point does not move too high.
Well Washer	A variety of parameters can be set to optimize use of a well-washer to clean the well.
Blocked Pump Detection	If the lag (standby) pump keeps cycling on and off, while the lead (duty) pump stays on, it indicates a blocked pump.
Max Pump Starts p/hour	Individual pumps can be limited to a maximum number of starts per hour if required. There is an over-ride level to ensure that an overflow is not risked.

The most common settings are found in the main station optimization screen. The pump controller functionality has a whole range of advanced pump station parameters and can support multiple wells, multiple groups of pumps and multiple profiles.

The **Advanced** button gives access to these complete settings which are listed under Pump Control in the Advanced screen. Some parameters are found under the heading "Wells", some under "Groups" and so on, even when there is only one well and one group.

16.1 Station Optimization Menu

Station Optimization is accessed by:

Settings → Station Optimization → Optimize Station
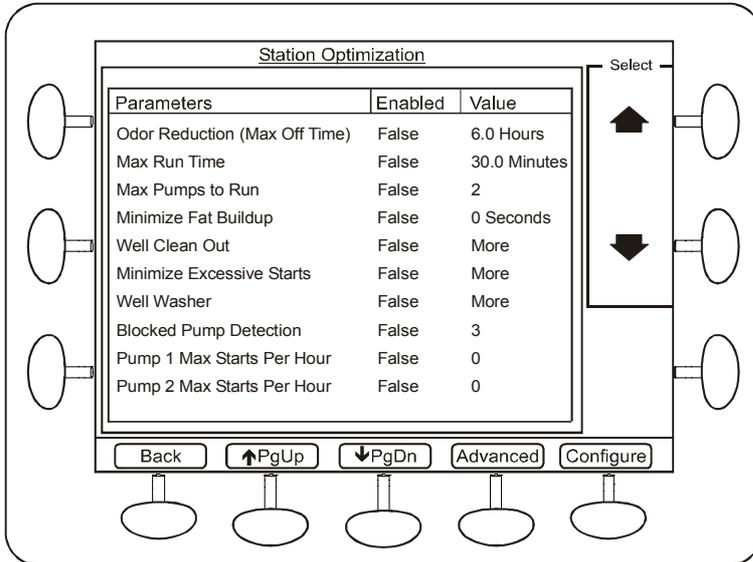
Figure 104 - Station Optimization Screen

For the complete list of station optimization parameters, please view the MultiSmart reference manual (see Section 31.2), under the main heading of Pump Control.

Select the parameter you wish to change, and press **Configure**. Each screen is self-explanatory, but several examples are covered here.

16.2 Odor Reduction

Sewer stations with both high and low-use periods often generate odors. During the low use period (e.g. a weekend) the station may take a number of days to reach the activation level for the pump. This allows the station to become septic. This feature allows a maximum off time to be applied so the station is regularly emptied in order to reduce septic odors occurring.
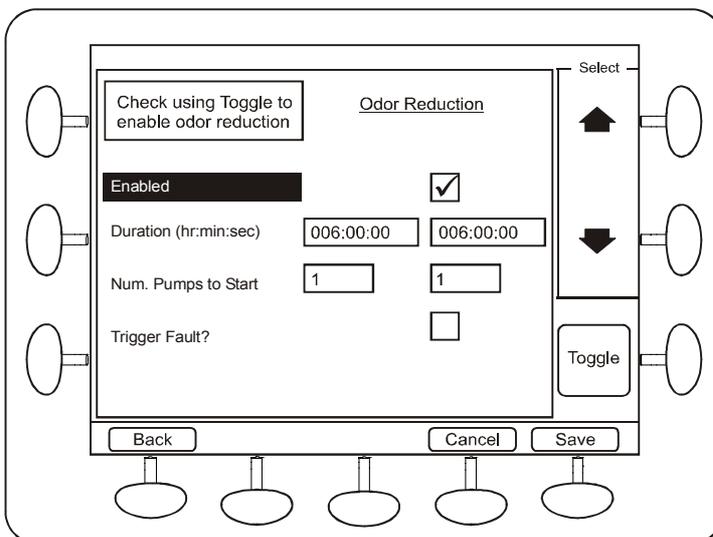
Figure 105 - Odor Reduction Screen

	Odor Reduction Help Text
Use the Helpl button for more information at any time.	*Check this box to enable Odor Reduction. Odor Reduction is usually used to reduce H2S build-up.* *Odor Reduction defines the maximum time for which pumps within the station should remain off. If no pumps are activated within the time period defined by the Duration parameter, and Odor Reduction has been enabled, then Odor Reduction will attempt to start the number of pumps defined by the Num Pumps to Start parameter.*

NOTE: *If the level of the well is beneath a pump's deactivation set point, then that pump will not be activated, (i.e. Pumps will not be forced on if the well is empty).*

16.3 Maximum Run Time

Maximum Run Time is used to prevent any pump from running too long. It does this by cycling the pumps when a maximum run time is reached.
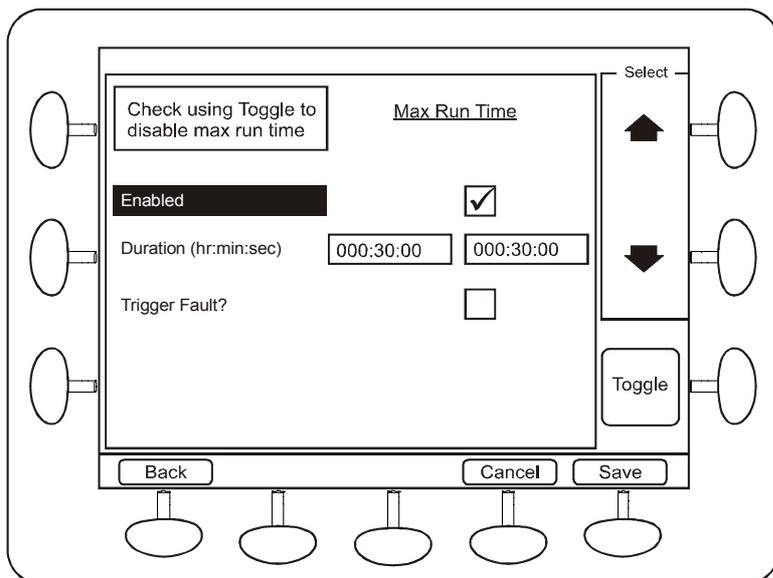
Figure 106 - Max Run Time Screen

	Max. Runtime Help Text
Use the Helpl button for more information at any time.	*Check this box to enable Maximum Run Time.* *Maximum Run Time defines the maximum time for which pumps may run continuously. If this duration is exceeded, then a fault may be triggered, notifying operators of potential problems within the station.*

16.4 Well Cleanout

This feature allows the pumps to be run past the normal deactivation point for a set time or to a set level in order to completely empty the well. This can be made to occur at regular periods.
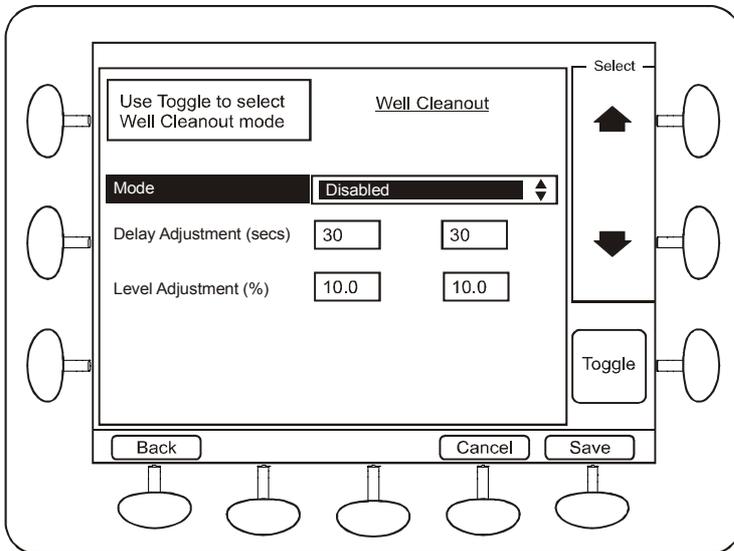
Figure 107 - Well Cleanout Screen

Use the Helpl button for more information at any time.	**Well Cleanout Help Text** *The Mode defines the condition upon which a well cleanout will be activated. The following modes are available:* • *Disabled* • *Pump Cycles (activate well cleanout after a defined no. of pump cycles)* • *Timers (activate well cleanout when a timer becomes active)* *Pump Cycles and Timers (activate well cleanout after a no. of pump cycles or when a timer become active)*

16.5 Well Washer

A well washer can be controlled by the MultiSmart in order to coordinate its use with the pumping cycles.

Name	Description
Enabled?	Toggle this value to enable or disable the well-washer feature.
Activation Level	Sets the level at which the washer is activated.
Activation Delay	Sets a delay after the Activation Level is reached before the well washer is started.
Max On time	Maximum run time for the well-washer
Inter-Start Period	Ensures the well washer does not run too often
Maximum Off Time	Sets a maximum time the well-washer can be off. This ensures the washer is run at a minimum interval even if the well level has not reached the activation level.

NOTE: *It will also be necessary to configure a digital output to activate the well washer. In particular you will need to set the digital output source to the well washer "active" tag. See Section 0 for a description of how to configure digital outputs.*

16.6 Additional Parameters

Pressing the Advanced button takes you to the advanced settings screen where a large number of additional pump control settings may be found, including the following settings.

16.7 Max. Number Groups Running

This feature is used to control how many groups will run at one time. This function is only required when you are using more than one group. It can be used to restrict groups from running at the same time, for example, making sure jockey pumps don't run when flood pumps are running. See Section 13.3.1 for more information.

16.8 Group

When more than one group of pumps has been configured (see Section 0), this parameter will list, e.g. Group 01, Group 02, and different parameters can be set for each group. For example, Max Pumps Running can be set differently for group 1 and group 2.

16.9 Pulse Start & Pulse Stop

A Digital Input can be assigned to the Pulse Start option through the advanced menu. The example below shows how to assign Digital Input 12 to Pulse Start:

[Settings] ⟶ [Advanced]

- From the tree select Pump Control [+/-] Pulse Start [+/-] Pulse Start 01 [+/-]

- Scroll down to Source and press "Use this button to view or change value."

- From within the Digital tag tree, scroll down to IO Module [+/-] Unit [+/-] _1 [+/-]

- Select the board that contains the Digital Input, in this case the Topboard [+/-] then Din [+/-]

- Scroll down to chosen digital input, (DIN.12 shown here) _12 [+/-]

- Scroll down to a DigitalTag, select ValueDigital, press Ok, then press Save

- Use the Back button to return to the main screen.

To activate the Digital Input a restart is required.

[Settings] ⟶ [More...] ⟶ [More...] ⟶ [Restart Unit]

(Alternatively cycle the power).

16.9.1 Assigning a Name to Digital Inputs (Optional)

A descriptive name such as "Pulse Start Input" can be assigned to Digital Input 12 as shown below:

[Settings] ⟶ [Advanced]

- Navigate through the tree:
IO [+/-] **Unit** [+/-] **Unit 01** [+/-] **Topboard** [+/-] **Digital Input** [+/-] **DIN.12** [+/-]

- Under **Description** enter a new name.

- Press **Save** and return to the main screen using the **Back** button.

The changes to the Digital Input name can be confirmed by going to:

[Settings] ⟶ [I/O, Faults, & Level] ⟶ [Digital Inputs]

Scroll down to **TopBoard Din 12** and the new name should be in right column.

16.10 Well

Parameters can be set for how primary and backup level devices function, and when backup devices take over.

17 Energy Monitoring and Motor Protection

Energy Monitoring and Motor protection is an optional module consisting of the Energy Monitoring and Motor Protection board (3MP board) and software.

⚠ **WARNING: IF THIS MODULE IS NOT CONFIGURED YOUR PUMPS WILL NOT BE PROTECTED**

The module monitors currents, and provides protection from:

- I^2T Protection
- Over-current
- Under-current
- Phase fail (current)
- Phase rotation (current)
- Ground (earth) fault

The module also monitors Insulation Resistance values with pump lockout or fault notification when IRT values fall below a user-defined threshold. Two separate areas must be configured:

- Current Transformer (CT) Values
- Motor Protection Values

17.1 Setting Motor Protection Values

Motor Protection configuration is accessed by:

Settings → More → Motor Protection
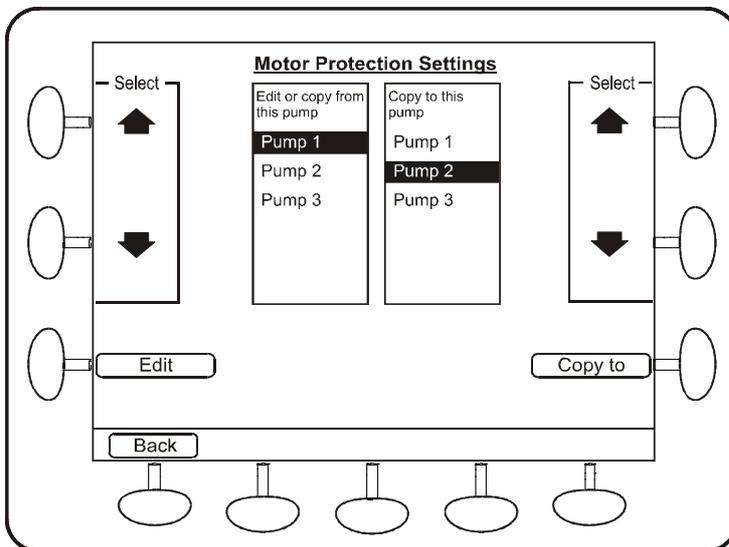
Figure 108 – Select a Pump for Protection Configuration

This screen can be used to copy motor protection settings from one pump to another. This can speed up the configuration process if all the pumps in a well are the same. Simply configure the first pump, then copy the configuration to the others using the **Copy to** button.

To edit motor protection settings, select a pump in the left hand column and press the **Edit** button.
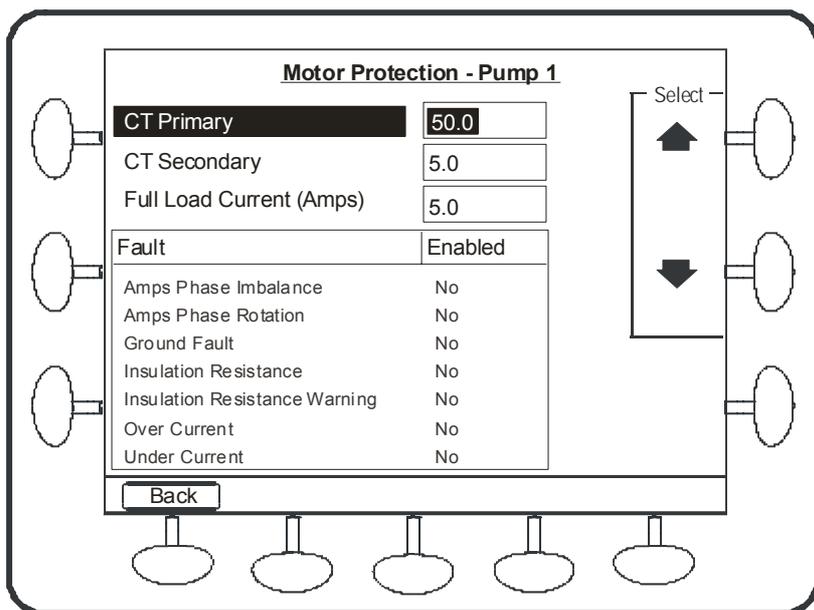
Figure 109 – Motor Protection Settings for an Individual Pump

17.1.1 Configuring CT Values

Current transformers (CT's) wired into the Energy Monitoring and Motor Protection board (3MP) are used to monitor motor currents. The pump station manager needs to know what ratio the CT's are in order to work correctly.

The default configuration is for a 50:5A CT for each current input.

Name	Description
CT Primary	Enter the CT Primary current in Amps.
CT Secondary	Enter the CT Secondary current in Amps. ***Note:** 5A is the maximum CT Secondary current allowable.*
Full Load Current (Amps)	Sets the Full Load Current of the pump motor. This setting must be correctly entered by the user for the threshold values to correctly work.

17.1.2 Configuring Motor Protection Faults

Name	Description
Amps Phase Imbalance	Detects a current imbalance between phases. The threshold value sets how much imbalance is acceptable before a fault condition exists.
Amps Phase Rotation	Detects if the phase rotation is incorrect.
Ground(Earth) Fault	Detects a fault to ground. The threshold value sets what amount of phase to ground current is required to be considered a fault.
Insulation Resistance	The energy monitoring and motor protection board has a built in insulation tester. This parameter sets fault conditions. The threshold value sets the insulation resistance level to raise a fault condition in Mohms. See Section 17.2 for more detail on configuring the insulation resistance tester itself.
Insulation Resistance Warning	This option if enabled will give a warning and will not fault the pumps by default. However we can set this to fault the pump if required. The main use for this is to generate a warning at the first threshold set for the test.
Over Current	Detects an Over Current condition. The threshold value sets the level of over current required before a fault condition exists.
Over Current I^2T	Calculates the instantaneous I^2T and faults the pump if the calculated value goes above the threshold.
Under Current	Detects an Under Current condition. The threshold value sets the level of under current required before a fault condition exists.

Most parameters use a % of Full Load Current (FLC) as the threshold. Ensure that FLC is correctly setup for each pump, and ensure that any motor protection threshold % is set, and the function is enabled.

On screen help is available for most or all parameters.

> **NOTE:**
> *Motor Protection must be configured by the user. The defaults are designed to alert the panel builder, or contractor commissioning the station, to the fact that values for full load current must be entered.*

17.1.3 Configuring Faults

Each fault described in Section 17.1.2 above has the following configuration settings:

Name	Description
Enabled?	Enables or disables the fault.
Threshold	Sets a threshold where it is relevant. When this is reached a fault condition is activated.
Act Delay (secs)	Activation delay in seconds. This sets how many seconds to wait after a fault has been detected before an alarm condition is raised.
Deact Delay (secs)	Deactivation delay in seconds. Sets how many seconds to wait before deactivating an alarm condition after the fault condition is no longer present.
Pump Unavailable?	Sets whether to fault the pump when a fault is detected. This will effectively make the pump unavailable to run.
Man Reset Required?	Sets whether a Manual Reset is required after a fault condition has been detected.

To configure each of the motor protection faults, navigate to

Settings → More → Motor Protection select the pump and press **Edit**. Now scrolls down to select the desired fault and press **Configure**. Remember to press **Save** after making the necessary changes.

17.2 Insulation Resistance Tester

The energy monitoring and motor protection board has a built in insulation tester. It can be configured to conduct tests at regular intervals. A wiring diagram can be found in Section 7.6.1.

Navigate to Settings → More → Motor Protection select the pump and press **Edit**.

You will find two options there,

- Insulation Resistance Test
- Insulation Resistance Warning

Both of these can be set to fault the pump if the test result is fail. However as the name suggest we can configure the Insulation Resistance Warning fault to generate a fault and not to fault the pump. In order to configure the threshold, scroll down the select the appropriate option and press **Configure**. **Save** the settings after the changes are done.

The test will be carried out only if the pumps are not running. The MultiSmart will check if the pump is currently running and skip the test if it is still running. Insulation Resistance Test can be carried out automatically over a changeable time period. It can also be done manually from the information screen (Ref Section 17.2.4).

Advanced configurations for the Insulation Resistance Test can be done from the **Advanced** menu.

Browse to **Advanced** menu:

Settings → Advanced

Navigate to the "Motor Protection" section and select a pump:

- From the tree select: **Motor Protection** +/- **Pump** +/-

- Select the correct pump and press +/-

- Select **Insulation Resistance Test (IRT)** +/- .

- Select **Insulation Resistance Test (IRT)** and press the centre button on the left-hand side marked *"Use this button to see additional values".*

The following parameters can be set:

Name	Description	Default
Clear To Run	If linked to a digital input, when true IRT is allowed to run, when false IRT is blocked. If no tag is assigned then IRT is allowed to run.	None
Cool Down Period (sec)	The Cool Down Period gives the pump a set amount of time to cool down before the insulation resistance test is run.	10s
Enabled?	Enables or disables the insulation resistance test.	Disabled
IRT Hardware Input	A pointer to the actual hardware performing the function. For pump 1 it is usually IRT1. You don't usually need to change this parameter.	
MOhms	Sets a measurement threshold in Mega Ohms. When this is reached a fault condition is activated.	
MOhms	Sets the measurement threshold in Mega Ohms for the IRT warning to be generated. Default setting will not fault the pump.	1.0MΩ
Test Duration	Sets how many seconds the insulation test will last. The recommended time is 60 seconds.	60s
Test Interval	Time interval between tests in hours. Tests are only conducted when the pump is stopped and the Cool Down Period has expired.	4h
Test Voltage	The insulation tester can operate at either 500V or 1000V.	1000VDC
Warning Enabled	Insulation Resistance Test Warning Threshold is enabled	

17.2.1 Enabling Insulation Resistance Testing (IRT)

During the setup wizard, the IRT terminals are automatically assigned, although for safety reasons the IRT functionality is not enabled.

To enable IRT for each motor perform the following procedure.

Settings → More → Motor Protection
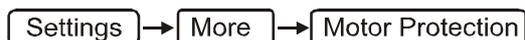
- Select the required pump with the down/up arrow keys.

- Press Edit

- Scroll down to **Insulation Resistance** and press **Configure**

- Press **Toggle** to check the enable box

- Change the default threshold resistance of 1.0M ohms if necessary

- Press **Save** and **Back**

- Repeat for each pump

An **Insulation Resistance Warning** can also be configured in the same way – enable and enter a suitable warning threshold resistance.

> ⚠️ **NOTE:**
>
> *By default IRT is not enabled.*

17.2.2   Soft Starter and Pump Isolation for IRT

When a Soft Starter (or VFD) is used it is essential (in most cases) to isolate it from the Insulation Resistance Test voltage (1000VDC). This can be accomplished using isolation contactors positioned after the Soft Starter. A digital output (one for each pump) is assigned to a **pump isolation** tag which becomes active whenever the Insulation Resistance Test is in progress.

17.2.2.1   Assigning the Pump Isolation Tag to a Digital Output

To isolate the IRT voltage from a Soft Starter a digital output is used to activate the Isolation contactor.

The procedure to configure a digital output for this purpose follows.

- Firstly identify a free digital output for each pump

- Go to: [Settings] → [I/O Faults & Level] → [Digital Outputs] {highlight the selected Dout}

- Press **Config** and then press the **Advanced** button

- Now find the source (**pump isolation** tag)

- Scroll to

[Motor Protection] → [Pump] → [_1] → [InsulResistance] → [_1] → [PumpIsolation]

- Once **PumpIsolation** is highlighted, press **Ok**

- Press **Ok, Back, Save** and **Continue**

- Repeat this procedure for each pump – allocating the selected Dout to the appropriate **pump isolation** tag.

- Press **Restart Now** when the last tag is assigned.

17.2.2.2   Inverting IRT (Pump Isolation) Dout

As configured the digital output will be active whenever the IRT is active and the Isolation contactor must be open during this time (i.e. the Contactor will be normally closed) so typically it will be necessary to invert the digital output.

To Invert a digital output

- Go to:

[Settings] → [Advanced] → [I/O Module] → [Unit] → [Unit 01] → [Top Board] →
[Digital Inputs] → [Dout n] → [Invert?]
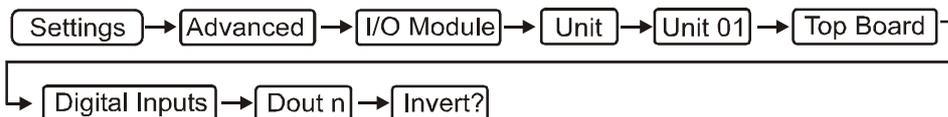
- Press the bottom button on the left-hand side marked **Invert?**

- Press **Save** and **Restart Now**

17.2.3   IRT Inhibit

Case 1: Before performing a test, the IRT monitors the voltage on the IRT terminal. If it is above a threshold (50V), the test is aborted (not performed).

Case 2: In addition, during the test, it monitors the load (current). If this is too high (as it will normally be if the mains voltage is present, rather than an isolated motor), then the test will be aborted. (This is done in hardware, not in software).

In both of the above cases, the Last Test Status is updated, but the resistance is not (it retains the value of the last successful test).

This means that a test will not normally be performed when there is power to the motor, but Case 2 can occur, which means that the high IRT voltage will attempt to drive, but the resistance won't be updated. If the IRT attempts to drive a running motor, Case 2 is sufficient to protect MultiSmart and the very limited current available means that driving the IRT will have no effect on the motor. The fact that the value is not updated in either of these cases means that trends of the IRT value should be unaffected.

17.2.4   Manual Activation of the Insulation Resistance Test

An Insulation Resistance Test (IRT) can be manually activated. To perform an IRT:-

- Press: Info → Pump Information → Insulation Resistance or

- Press: Info → I/O Information → Bottom Board → IRT

- Press the left / right arrow keys at the bottom of the screen to highlight an IRT corresponding to a pump.

⚠️ **CAUTION:** Once activated 1000VDC will be present on the IRT terminals.

- Press the **Test Now** button. The test will last for the time specified under **Duration** (default 60s)

⚠️ **CAUTION:** A test will be conducted for each press of the **Test Now** button.

17.2.5   IRT Wiring for 6-Star Delta Starter

Figure 110 below illustrates the wiring when the Insulation Resistance Test (IRT) is used with a 6 wire Star-Delta Starter. The MultiSmart IRT outputs are connected to one phase of each pump as shown.
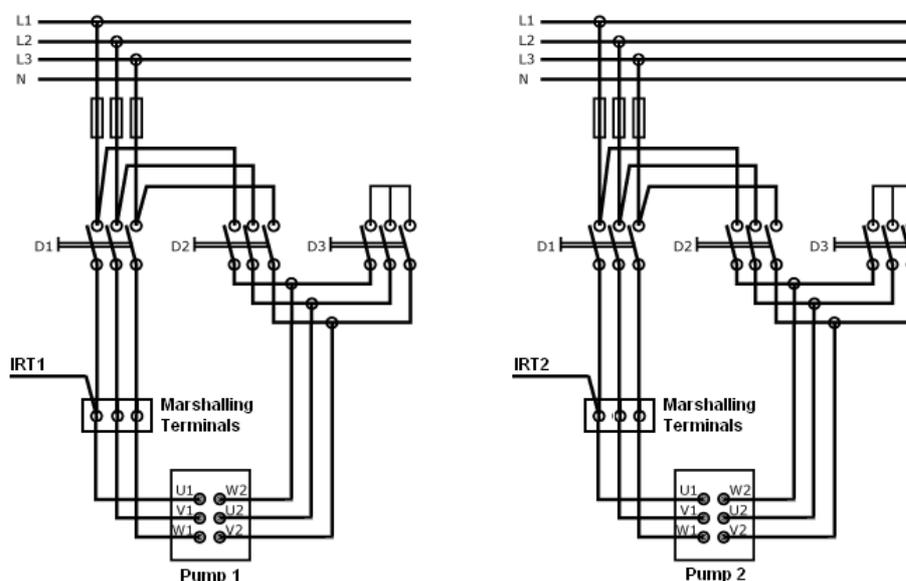
Figure 110 - IRT Wiring for 6-Star Delta Starter

17.3 Reassigning (Motor) Current Inputs used in Motor Protection

If an Energy Monitoring and Motor Protection (3MP) board is installed and is selected during the Setup Wizard (as being in the bottom slot), then the motor Current Inputs (for each phase) for three motors are automatically assigned.

The following procedure only applies if it becomes necessary to modify the default motor Current Inputs. As an example:

Settings ⟶ Advanced ⟶ Motor Protection ⟶ Pump ⟶ Pump 01 ⟶ IIN

- Press the "Use this button to view or change value." button to reveal the node list.
  (The highlighted node that appears in this screen is the currently assigned Current Input.)

- Scroll down to:- **IO Module / Unit / _1 / BottomBoard / IIN / _2**

- Press **Ok** and then press **Save**

This has reassigned **Current Inputs** "**2**" (ie. current inputs **2A, 2B** and **2C**) to pump 1 (rather than pump 2).

Repeat this procedure for each pump that requires the default motor Input Currents to be modified from the default.

17.4 Calculating Efficiency

The MultiSmart has support for calculating the pump efficiency and displaying it in the LCD screen as well as sending it to SCADA. To be able to calculate the efficiency; energy monitoring, motor protection and flow should be enabled. Refer section 17 for more information on energy monitoring and motor protection and refer section 20 for more information about flow.

Efficiency can be displayed in Litres/kWh or kWh/MegaLitre. You can configure this by navigating to

Settings ⟶ More ⟶ Flow ⟶ General Settings screen by selecting the **Efficiency Units**.

Efficiency information for today, yesterday, this week, last week, this month & last month and total efficiency can be observed at the following menu in the LCD screen.

Info ⟶ Power & Efficiency

The efficiency can also be set to be displayed in the main screen. To set this, navigate to

Settings ⟶ More ⟶ Customize Display ⟶ Pump Data Display

and select the efficiency data which you want to display.

The efficiency calculations are updated dynamically in all flow calculation modes except for calculated mode where the efficiency is updated at the end of the pump cycle.

When an overflow condition is detected, a constant flow rate which is the previous average of the pump outflow rate will be use for the current pump cycle for efficiency calculations. As soon as the pumps catch up and the overflow is cleared the MultiSmart will resume normal flow calculations.

There are occasions where manual override of power factor is desirable. For example, Modbus communications to a VFD may not include power factor, and energy and efficiency calculations may therefore be incalculable. In this scenario you can measure the power factor manually and store this into the MultiSmart as a parameter which will then be used by the MultiSmart for energy and efficiency calculations.

To configure this navigate to,

Settings ⟶ Advanced ⟶ I/O Module ⟶ Unit ⟶ Unit 01 ⟶ Bottom Board ⟶ Power and select the corresponding power (Power 01 etc) option with respect to the pump number, set the power factor value of **Manual Power Factor** option and **Save** the settings.
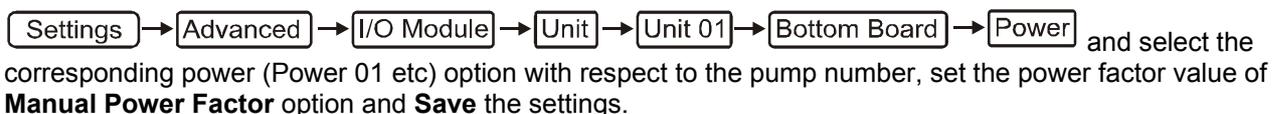
MultiSmart will now use the new power factor for the efficiency calculations.

18 Supply Protection

The Pump Control/General I/O Board monitors the single or three phase supply through the "Mains Voltage Monitoring" inputs. Single and 3 phase power supplies can be monitored by the MultiSmart. The voltage is constantly measured and is used to detect the following conditions:

- Under Voltage
- Over Voltage
- Phase Imbalance (or Phase Failure)
- Phase Rotation

Supply protection is usually automatically enabled when the setup wizard is completed. However the under voltage fault is temporarily ignored during the starting of the pumps.

To configure supply protection go to:

Settings ⟶ More... ⟶ Supply Protection
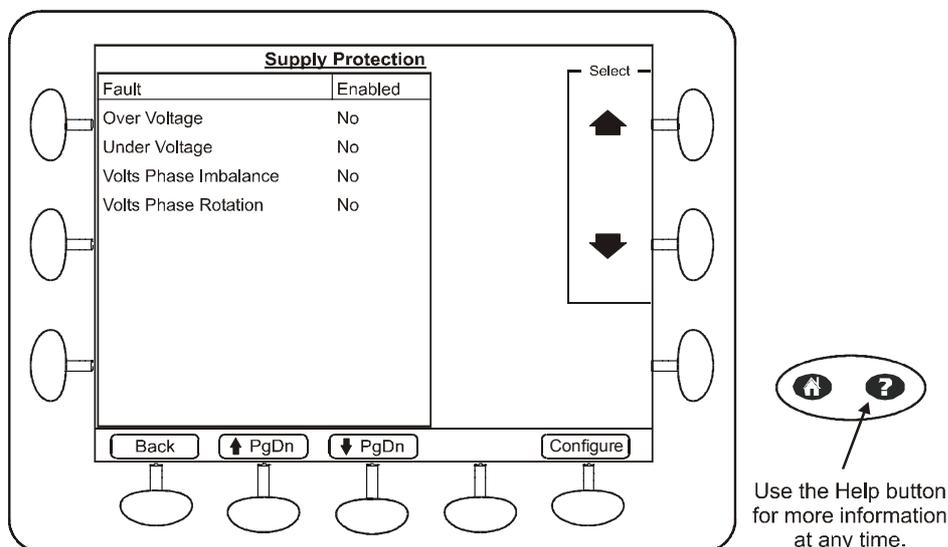
Figure 111 – Configuring Supply Protection Faults

A range of parameters can be set:

Name	Description
Over Voltage	Used to protect the station from over voltage conditions. An over voltage condition is set as a percentage of the Phase to Phase Voltage.
Under Voltage	Used to protect the station from under voltage conditions. An under voltage condition is set as a percentage of the Phase to Phase Voltage. While the pump is starting this fault is disabled for a short while.
Volts Phase Imbalance	Protects the station from a change in voltage in relation to the other phases. This can also be used to detect phase failure. An imbalance is set as a percentage of the Phase to Phase Voltage.
Volts Phase Rotation	Protects against a change in phase rotation.

18.1 Configuring Faults

Each Supply Protection fault described in above has the following configuration settings:

Name	Description
Enabled?	Enables or disables the fault.
Threshold	Sets a threshold where it is relevant. When this is reached a fault condition is activated.
Act Delay (secs)	Activation delay in seconds. This sets how many seconds to wait after a fault has been detected before an alarm condition is raised.
Deact Delay (secs)	Deactivation delay in seconds. Sets how many seconds to wait before deactivating an alarm condition after the fault condition is no longer present.
Fault Station?	Sets whether to fault the station when a fault is detected
Man Reset Required?	Sets whether a Manual Reset is required after a fault condition has been detected.

19   Datalogger

The MultiSmart comes with a datalogger. The datalogger can be viewed by pressing the History button from the main screen. Also, the data can be downloaded onto a laptop and viewed via Excel, Access, or any other reporting/database tool.

The datalogger stores approximately 50,000 events and faults. Each event or fault is date/time stamped.

By default, the following are configured to be logged:

- All faults
- Level
- Pump starts/stops
- Pump mode changes
- Changes to analog inputs and level by more than 5%
- Voltage changes of more than 10v
- Flow values and overflow events – if the optional flow module is installed
- Profile changes
- Energy accumulators per pump
- IRT changes
- Single or 3-phase current changes
- User logins, invalid logins, invalid administrator logins
- Unforced restarts (watchdog)
- Temperature changes of more than 10'C

19.1 Basis of Datalogging – Change of State and Deadbands

Logging of events is based on change of state. In the case of analog values, this is based on a deadband. By default, the deadband for analog values is 5%. The deadband for any analog can by changed in the I/O module.

[Settings] ⟶ [Advanced]

- From the tree select: **IO Module** [+/-] **Unit** [+/-]

- Select the correct unit and press [+/-]

- Select which module the inputs are located (i.e. TopBoard) then [+/-] **Analog Input** [+/-]

- Select the analog input to log, scroll through to the **Value** parameter and expand using [+/-]

- Change the value of the deadband as required

19.2 Adding/Removing Tags from the Datalogger

Data points within MultiSmart are referred to as **Tags**. Every aspect of the MultiSmart has a tag associated with it and therefore can be logged if required. Users can add or remove tags from the datalogger as required.

The datalogger is accessed as follows:

[Settings] ⟶ [More...] ⟶ [Data Logger]

The datalogger records two types of data:

- Events – Logs changes to tag values
- Faults – Logs faults and the events surrounding the fault

Removing and adding tags is the same for both.

19.2.1 Removing Tags from the Datalogger

To remove a tag:

- Select Event Logging or Fault Logging
- Use the selector keys to highlight the tag
- Press the Delete Event or Delete Fault button
- Confirm the deletion by pressing the Yes button

19.2.2 Adding Tags to the Datalogger

To add a tag:

- Select Event Logging or Fault Logging
- Press the New Event or New Fault button
- Enter a description using the keypad
- Select the Edit Tag button to go to the MultiSmart tag browser
- Browse through the tree structure until you find the tag you want to log. The tag browser gives you access to the entire tag database for MultiSmart.
- Press the OK button to select the tag
- Press the OK button again to add the tag and return back to the list screen.

Most tags of interest will be found in the I/O module and the pump controller module, but a wide variety of tags can be logged.

Repeat the process for as many tags as you would like to add, and press the Save button.

At the end you will be prompted to restart – this is because the database is rebuilt and is a major configuration change. If you have further changes which would also require a restart, then it is best to choose the **Continue** option, carry out those changes and restart the unit using the **Restart** option in the **Settings** menu.

Changing the values of deadbands is also a task which requires a restart, so if you need to make changes to the deadband of analog inputs (AINs), supply voltages inputs (VIN's), current inputs (IIN's), then you should make these changes and finally restart the unit.

19.3 Filtering the Data Viewed in the History Page

From the main operator screen, pressing the History button shows all events and faults logged. The History page has the option for filtering the data to make it easier to find specific events or faults.

While in the History page press:

[More...] ⟶ [Filters]

Filters can be applied to the following areas:

- Pump/General
- Pump Fault
- Station Fault
- Time
- Include
- Exclude

⚠️ **NOTE:** *Any filters you apply will remain in place for any future users of the History page, so if there are many users of the system, it is best to remove the filters before leaving the station.*

19.4 Storing the Datalogger on the Compact Flash Card

There are two ways to get data onto a Compact Flash (CF) card:

- Use the Backup menu to save the datalogger file to a CF card
- Configuring the MultiSmart unit to save directly onto a CF card

This latter option would normally be used when the on-board 50,000 event datalogger was not sufficient. Putting in a 1GByte CF card, for example, gives storage of around 10,000,000 events.

19.4.1 Using Backup to Save the Datalogger onto a Compact Flash Card

To save datalogger files onto a CF card, insert a CF card into the Compact Flash Card slot on the MultiSmart and go to:

[Settings] ⟶ [More...] ⟶ [More...] ⟶ [Backup Options] ⟶ [Backup Log Files]
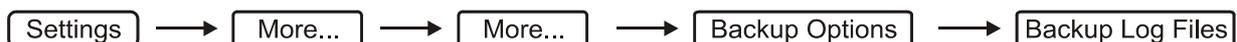
There are three options:

- Backup Fault Logs – copies the fault log to the CF card.
- Backup Event Logs – copies the event log to the CF card.
- Backup Fault Event Logs – copies events surrounding fault events to the CF card (this is useful for analysing fault events on a PC).

NOTE: *The history page on the screen displays both the Faults and the Events together. To get a full history saved onto the CF card, use both **Backup Fault Logs** and **Backup Event Logs**. The final option is only useful if you have configured the Fault Logger to capture events surrounding faults.*

NOTE: *If the yellow **Save CF Data** button is not pressed before the card is removed the data maybe corrupted. Insert the CF card into any laptop or PC equipped with a CF card reader.*

19.4.2   Viewing the Data Logger Files on a Computer

The following procedures allow the data from the Data Logger in the MultiSmart (files:- faults.txt and events.log) to be imported into Microsoft WordPad or Microsoft Office Excel.

Importing the Data Logger Files into Microsoft WordPad

1.   With the Data Logger files copied to the CF card, insert the card into a PC based reader

2.   Copy the two Data Logger files - faults.txt and events.log to a local directory

3.   Open WordPad (Under Start / Programs / Accessories)

4.   Click on File then Open

5.   At the bottom of the file Open window is "Files of type", select "All Documents (*.*)"

6.   Locate and highlight the faults.txt (or the events.log) file

7.   Click on Open

8.   The faults (or events) listed in the file should now be displayed

Importing the Data Logger Files into Microsoft Excel

1.   With the Data Logger files copied to the CF card, insert the card into a PC based reader

2.   Copy the two Data Logger files - faults.txt and events.log to a local directory

3.   Start Excel

4.   Click on **File** then **Open**

5.   Located at the bottom of the file Open window is "Files of type", select "All Files (*.*)"

6.   Locate and highlight the faults.txt (or the events.log) file

7.   Click on **Open**

8.   Select **Delimited** then **Next**

9.   Uncheck **Tab** and check the **Comma** check box, then click **Finish**

10.   The faults (or events) listed in the file should now be displayed

11.   Adjust column widths to view full text

19.5 Configuring the datalogger to write directly to a Compact Flash Card

When a Compact Flash (CF) card is installed in the unit, the Datalogger can be configured so that event or fault data is saved to the card as the event or fault occurs. If not all event or fault data are required, the unwanted tags can be removed before the data is saved. See Section 19.2 Adding/Removing Tags from the Datalogger. The following steps show how to setup the Datalogger to save data to the compact flash card:

19.5.1 Activating Detailed Advanced Options

[Settings] ⟶ [Advanced]

- Scroll down to **Lcd** then press [+ / -]

- Scroll down to **Show More Options?**

- Check the **"Show More Options?"** box on the left-hand side

- Press **Save** and then press the **Back** button

19.5.2 Setting the EventLogger File Name

[Settings] ⟶ [Advanced]

- Scroll down to **EventLogger** then press [+ / -]

- Scroll down to **Log file name**

- Press an arrow key located on the keypad (such as ⟵) and change the default path and filename (/var/log/events.log) to:

```
/mnt/cf/events
```

where "events" is the filename. Enter a maximum of 8 characters for the filename (the file extension, i.e. *.log is optional).

- Press **Save**, then **Back**, and **Back** again, and restart the unit using the menu option:

[Settings] ⟶ [More ...] ⟶ [More ...] ⟶ [Restart Unit]

⚠ **NOTE:** *Data will be saved to the previous file name until the unit is restarted.*

⚠ **NOTE:** *The fault file name found above the Log file name only records configured faults around a "crisis" or critical fault. To save all or selected faults to the CF card, follow the procedure described above except use the Log file name found under the Faults directory: **Advanced / Faults / Log file name.***

⚠ **NOTE:** *An event is saved to the CF card as soon as it occurs, however if no card is present or an invalid file name has been entered, no data will be saved, not even to internal memory.*

⚠ **NOTE:** *New data is always appended to the file (if it exists), so if only new data is required, delete the file from the compact flash card before re-installing it. (The default event file size is 1MB and the default fault file size is 20kB).*

19.6 Summary of Datalogger File Functions

Following is a summary of the function of the Datalogger files saved to the compact flash card. (The name of the datalogger file changes slightly when saved to the compact flash card).

Fault Log

The fault log records all faults that occur. Around 50 000 records are saved per file after which the file rolls over to faults.0.

Event Log

The event log records all events that occur within defined dead bands (a minimum amount by which the value must change before it is logged). Around 50 000 records are saved per file after which the file rolls over to events.log.0.

EFault Log

Events are logged surrounding a fault. Around 50 000 records are saved per file after which the file rolls over to faults.log.0. The events logged are **timed based** (not dead band based as per events.log) i.e. after a fixed amount of time, the status of the event is logged. A buffer is maintained so that these events are captured before and after a fault occurs.

Fault Type	Function	On MultiSmart		On CF Card	
		Current File	Previous Files	Current File	Previous Files
Fault Log	Records all faults that occur.	faults.txt	faults.txt.0 faults.txt.1 faults.txt.2 (See note 1)	faults.txt	faults.0 faults.1 faults.2
Event Log	Records all events that occur within a defined dead band.	events.log	events.log.0 events.log.1 events.log.2	events.log	events.0 events.1 events.2
Efault Log (Fault-Event Log)	Records all events before & after a fault. The events logged are timed based (not dead band).	faults.log	faults.log.0 faults.log.1 faults.log.2	efaults.log	efaults.0 efaults.1 efaults.2

1. A configurable number of previous files (or file generations) can be retained.*
   - For the Fault Log:- **Settings / Advanced / FaultModule / Number of file generations**, by default it's set to 3.
   - For the Event Log & Efault Log:- **Settings / Advanced / Event Logger / Number of file generations**, by default it's set to 2.

⚠️ **NOTE:** *Show More Options must be enabled.

20 Flow

The flow module provides the ability to calculate flow without use of a flow meter in most empty/discharge applications. The flow menu can be used to assign and make changes to configuration of the flow input devices or to unassign the input device. The Smart Outflow feature present in the flow module can detect a partially blocked pump from a large inflow. The 'time required to spill' feature calculates and displays the time period within which a spill may happen if the current conditions are not changing.

It also allows a flow meter to be used, either 4-20mA for instantaneous flow, a pulse counter for totalized flow, or both.

The advantage of using the flow module when a flow meter is installed is the data appears on the **Flow** section of the **Info** screens. Accumulators such as Flow today, yesterday, this week, last week are calculated, and flow rates are also apportioned to individual pumps.

In addition, the flow module uses specific flow tags, and when SCADA is used, these tags are available at SCADA, providing a common tag structure across a network of pump stations.

The flow module also provides 2 low flow and 2 high flow alarms.

⚠️ **NOTE:** After calculated flow is configured, one complete fill cycle and one complete empty cycle are needed before any flow calculations show up in the **Info** page.

20.1 Configure General Flow Settings

To configure Flow settings go to:

Settings ➞ More ➞ Flow ➞ General Settings

The following parameters can be set:

Name	Description	Range
Flow Enabled	Enables or disables flow calculations for the station.	Enabled/Disabled
Mode	Sets the flow measurement mode. The flow mode specifies whether the station outflow should be calculated or measured using one of the following flow metering methods: Metered F & V uses an analog input for instantaneous flow (F) and a pulse counter input for volume (V). In Metered Flow mode, the flow module uses an analog input to measure the flow, and derives the total volume, (if the flow rate is <1 gal/sec or <1 litre/sec the total flow will not be accumulated). In Metered Volume mode, a digital input is used to count pulses from a flow meter to measure the volume pumped, and periodically it derives the flow rates.	Calculated Metered F & V Metered Flow (der.vol) Metered Volume (der.flow)
Units	Flow measurement units.	Litres/Second Litres/Minute Gallons/Minute
Efficiency Units	Efficiency measurement units	Litres/kWh kWh/MegaLitre
Overflow Enabled	Enables overflow detection.	Enabled/Disabled
% Level for Overflow	Sets the level at which an overflow condition is detected.	0 – 100%
Averaging Cycles	Sets how many pump cycles are used in the outflow averaging calculations. Only used for Calculated and Metered Volume (der.flow) Modes.	0 - 100

20.2 Configuring Analog Inputs for Flow Measurement

An analog flow meter can be used to measure instantaneous flow. To select and configure an analog input for this purpose go to:

Settings ⟶ More... ⟶ Flow ⟶ Analog Input Flow

Select an analog input from the list. Press the **Configure** button to make changes to the general analog input setup, e.g. to span and zero the flow meter. When finished, press the **Save** button.

Press the **Unassign** button if the analog input device needs to be deselected.

20.3 Configuring Digital Inputs for Flow Measurement

A digital input can be used to count pulses from a flow meter to measure totalized flows. To select and configure a digital input to count pulses go to:

Settings ⟶ More... ⟶ Flow ⟶ Pulse Input Flow

Select a digital input from the list. Press the **Configure** button to make changes to the digital input setup if the flow meter to be connected has special interface requirements. When finished, press the **Save** button. Refer section 14.4.1 for more information on the configuration options for the digital input.

Press the **Unassign** button if the pulse input device needs to be deselected.

> **NOTE:** *The Pump Control/General I/O Board (3PC) has two high-speed digital inputs designed specifically for use with pulse counters (DIN 19 and 20). It is recommended one of these inputs is used where possible. It is important to use the* **Configure** *option to change the* **Mode** *to* **High Speed** *and the* **Scale Factor** *to the volume that each pulse represents.*

20.4 Configuring Calculated Flow Settings

When using the Calculated Flow method it is necessary to tell the Flow Module how much liquid volume exists for each 10% in the well level. Once this has been entered flows can be calculated across pumping cycles. To configure calculated volumes go to:

Settings ⟶ More... ⟶ Flow ⟶ Volumes for Calc Flow

> **NOTE:** *When using a flow meter (mode-"metered f&v"), it is also possible to use the volumes in the well to calculate inflows. Volume can be in litres or gallons, depending on the unit setting selected in the general settings screen.*
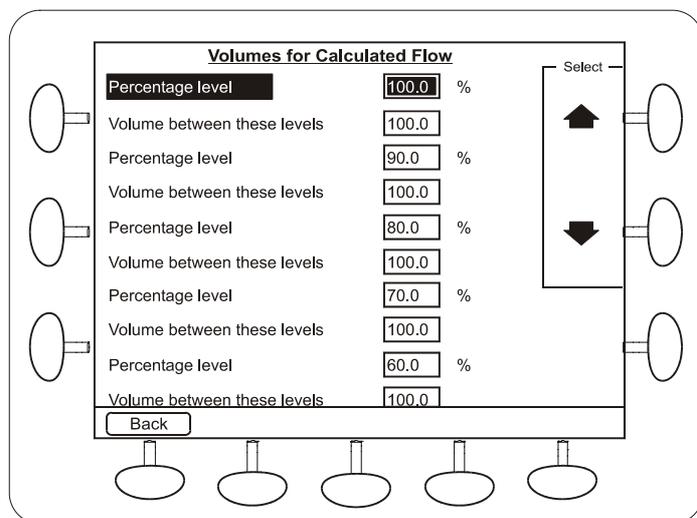
Figure 112 – Entering volumes for each level in well.

20.4.1 MultiTrode Probe

If using a MultiTrode probe as the primary level device, enter the volume of liquid between each sensor into each of the volume fields. Since there are 10 evenly spaced sensors the percentages will range from 10 – 100% in equal increments.

20.4.2 Analog Level Device

If using a 4-20mA Level device then the percentage values can be altered to reflect any volumes required to be entered.

For example, in a 5m well, the lead/duty pump may be set to start at 1.5m (from the bottom) and stop at 0.5m. In this case the activation point is 30% and the deactivation point is 10%. Setpoints may change, and the level may rise above the activation point, therefore the volumes should ideally be set to 10%, 15%, 20%, 25%, 30%, 35%, 40%, 60%, 80% and 100%. The volumes for each step will then have to be calculated and entered.

20.5 Flow Alarms

Flow alarms are used to indicate when nominal flow rates fall outside acceptable limits. To select and configure alarms go to:

Settings → More... → Flow → Flow Alarms
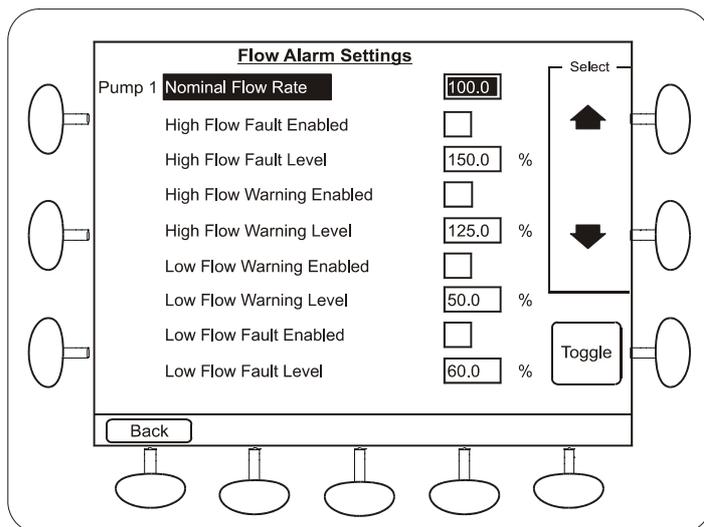
Figure 113 – Configuring Flow Alarms

The first step is to enter a Nominal Flow Rate for the well. All the alarms are defined as percentages of this rate. The rate is expressed as litres/second, litres/minute or gallons/minute depending on the Unit configuration made in the General Settings screen.

Select and enable an alarm by pressing the **Toggle** button. When finished press the **Save** button.

Additional parameters relating to the flow alarms can be found in the **Advanced** menu:

Settings → Advanced

- From the tree select: **Faults** [+/-] **Pump** [+/-]
- Select a pump and press [+/-]
- Select **Flow** [+/-], then select a specific flow alarm, e.g. **High Flow Fault** [+/-] then **Status** [+/-]

You can then choose to change parameters such as the Delay (before fault activates), Deactivation Delay, whether Manual reset required, etc.

20.6 Smart Outflow

This is a MultiSmart patent pending feature. Smart outflow feature allows the MultiSmart to recalculate the inflow by stopping pump(s) for a short period when pump runtime is excessive.

Flow calculations have an inherent uncertainty - when the pump is pumping the inflow is unknown. In most cases, assuming the inflow from the last cycle and averaging pump flow rates over a number of cycles reduces or eliminates the inaccuracies arising from unknown inflow.

However, one case is common - during peak wet weather events, high inflows may cause the pump(s) to run for a long period. This scenario is not easily differentiated from a partially blocked pump. The Smart Outflow feature, if enabled, will turn off the pump (only if a spill is highly unlikely and depends on the smart outflow parameters) and check the increase in level to verify the current inflow. If the inflow is the same, the other most common reason for this is a partially blocked pump.

To be able to use this feature flow module needs to be enabled in the MultiSmart. If not please refer to section 0 for turning on this feature. In the flow general settings select the **Flow Enabled** and configure the **Mode** to Calculated. Navigate to Settings → More → Flow → General Settings and use the **Toggle** button to change the settings after highlighting it. Select the **Averaging Cycles** desired for which the default value is 10. This sets how many pump cycles are used in the outflow averaging calculations (Ref section 20.1). Remember to **Save** the changes.

To enable this feature navigate to Settings → More → Flow → Smart Outflow via LCD and select **Smart Outflow Enabled**. Now set the following parameters.

Name	Description
Recheck Inflow after Pump Run Time	The continuous pump running time period after which the recalculation of the inflow needs to be performed
Recheck Inflow Pump Stop Time	The time period after which the pumps are restarted and inflow is calculated
Over-ride Level	Define the level above which the smart outflow feature is disabled

Smart Outflow feature only deactivates the pumps in order to recalculate inflow a maximum of once in any pump down cycle.

It is also recommended that you set maximum pump running time to ensure that if a pump is blocked, the station will cycle to the next pump. To do this navigate to Settings → Station Optimization → Optimize Station and configure the **Max Run Time**. You need to make sure that, while using this feature, **Max Run Time** is set to a longer time than the value for **Recheck Inflow after Pump Run Time**. Otherwise the Smart Outflow calculation will never occur as the pumps will alternate after the max pump running time is reaching.

20.7 Estimating Duration to Overflow

When the well level is rising (pumps on or not, the inflow may defeat the pumps) the MultiSmart can estimate the duration to overflow and display it until the level reaches the overflow level. This calculation is dynamic and based on the dynamic rate of level increase. This time estimation is available in the DNP and MODBUS points list so that it can be sent to SCADA.

To be able to use this feature flow module needs to be enabled in the MultiSmart. If not please refer to section 0 for turning on this feature. In the flow general settings select the **Flow Enabled** and **Overflow Enabled** parameters and set the **% Level for Overflow**. Navigate to Settings → More → Flow → General Settings and use the **Toggle** button and keypad to change the settings after highlighting it.

To display the Duration to Overflow in the main screen browse to

Settings ➔ More ➔ Customize Display ➔ Bottom Section in the LCD display. Select the **Line** in which the data is to be displayed from the left column and select **Duration To Overflow** from the right column and press **Save**. Now you can see this in the selected line at the bottom section in the main screen display.

⚠️ **NOTE:** *When probe is selected as the level device the setpoints needs to be atleast 20 percent wide so that the duration to overflow can be calculated.*

21 Reservoir Monitor

The MultiSmart can be configured as a Reservoir Monitor when this module has been purchased. In this mode, there are no pumps to control so all functionality related to pumps, groups and motor protection are unavailable.
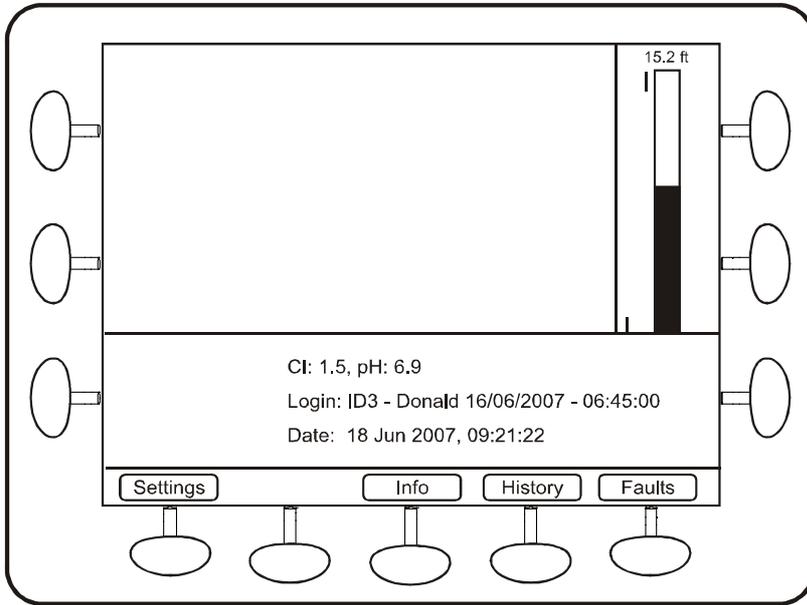
Figure 114 – Typical Reservoir Monitor Main Screen

21.1 Communications Configuration

When configuring the MultiSmart as a Reservoir Monitor the first question asked by the Setup Wizard is which DNP3 Communications configuration should be used. There are three options – A, B or C.

⚠️ **NOTE:**
Configuration B is the recommended setup.

When running through the Setup Wizard for the corresponding pump station, if you select **Remote Level** and enter the corresponding DNP3 addresses, the two stations will be linked.

21.1.1 Configuration A

In this configuration the Pump Station receives the level from the Reservoir Monitor via the DNP3 Master (MTU). This configuration is used when there is no direct communications link between the pump station and reservoir monitor or the communications network is complex.

MultiTrode recommends using a redundant MTU when using this configuration.
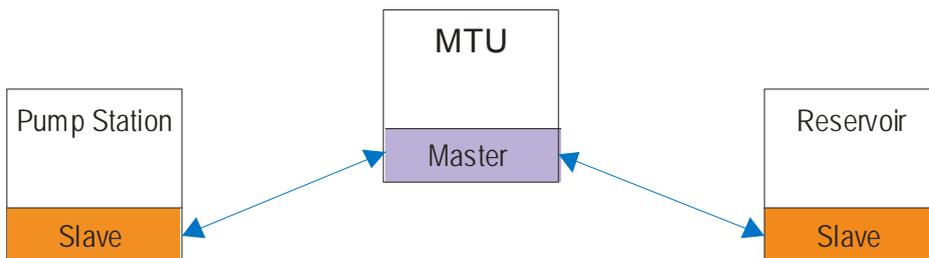
Figure 115 – Communications Configuration A

21.1.2   Configuration B (Recommended)

In this configuration the Pump Station receives the level over a direct communications link with the Reservoir Monitor. This is the preferred configuration.

The Pump Station must be configured as a DNP Master (choosing remote level and configuration B for the pump station will ensure this is the case).
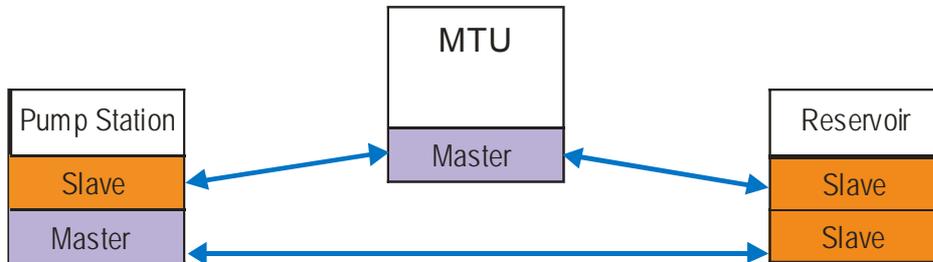
Figure 116 - Communications Configuration B

21.1.3   Configuration C

This configuration is also used when there is no direct communications link between the Pump Station and the Reservoir Monitor. In this mode the Pump Station will establish a second connection to the DNP3 Master (MTU) in order to retrieve levels from the Reservoir Monitor.

This configuration can be used instead of Configuration A when there is no redundant MTU available.

When using this configuration Connection Manager must be enabled on the Pump Station. The Pump Station must also be configured as a DNP Master (choosing remote level and configuration B for the pump station will ensure this is the case).
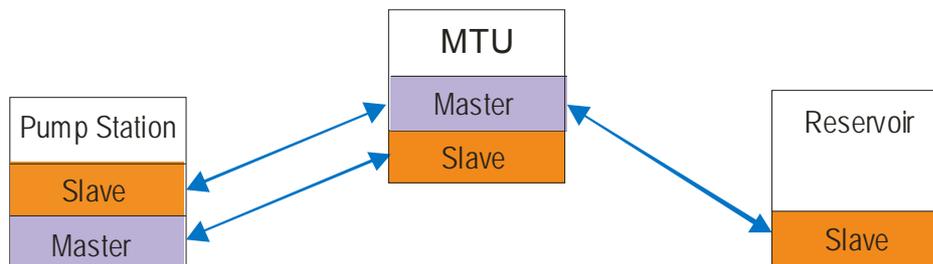
Figure 117 - Configuration C

> ⚠️ **NOTE:**
> *Connection manager is functionality which should be enabled as standard on the multismart. Check the software modules screen to ensure this is the case.*

21.2 User Interface

The Reservoir Monitor user interface mirrors the Pump Controller, with all the pump functionality and options removed. This ensures that menu options are always in the same place for both products to make training of operations staff more effective.

The following is Settings Menu options still available on the Reservoir Monitor.

21.2.1 Set Points (but Level/Control Setpoints sub-menu item removed)

- I/O faults and Level

- Setup Wizard

- Station Optimization (only Profile selection remains)

- Supply Protection

- Customize Display

- Communications

- Flow

- Datalogger

- Backup Options

- Security

- Date/Time

- Software Modules

- Logic Engine

- Restart Unit

21.2.2 Settings Menu options removed from the Reservoir Monitor:

- Level/Control Setpoints (under the main Setpoints menu item)

- Alternation and Grouping

- Commission / De-commission pumps

- Energy Monitoring and Motor Protection

21.3 Connection Manager

21.3.1 Overview

The Connection Manager allows multiple DNP channels (slaves or masters) to communicate over <u>one physical</u> serial port.

The software module (Connection Mgr) must be enabled. To view the currently enabled modules, go to

Settings → More → More → Software Modules → Enable_Disable Modules

If the module is enabled it will appear in the left column.

Any one of the 3* serial ports can be assigned as the physical port.

The Connection Manager can only be configured for use on a Reservoir Monitor and the associated Pump Controller (with Remote Level). When the Connection Manager is enabled, ("Use conmng" is checked), the individual Comms Channel settings are <u>ignored</u>. This applies to both DNP Slaves and DNP Masters.

The following diagram illustrates the functionality of the Connection Manager.
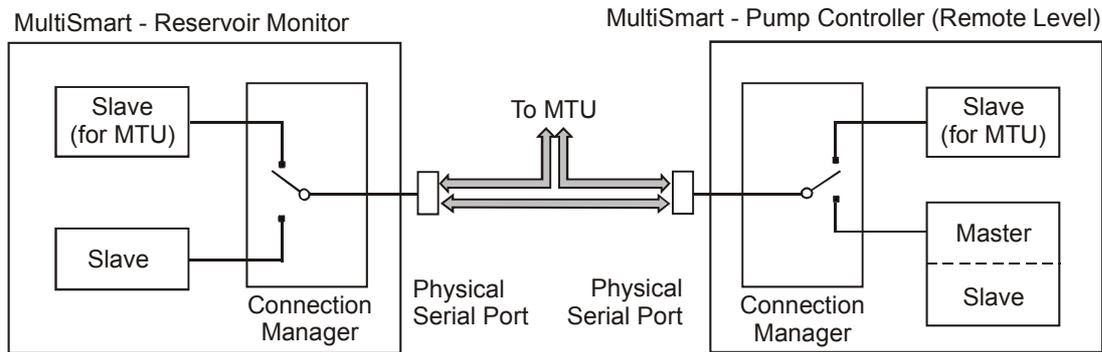
21.3.2   Reservoir Monitor Setup

Whenever a Reservoir Monitor or an associated Pump Controller (with Remote Level) are configured using the Setup Wizard, the Connection Manager is configured by default. The 2 slaves within the Reservoir Monitor both communicate on Serial 2 by default. The associated pump station manager also uses Serial 2 for both the slave and the master.

If necessary a different physical channel (other than Serial 2) can be assigned. Go to:

Settings → Advanced → Connection Manager → Manager → Manager → Manager 01 → Comms Channel
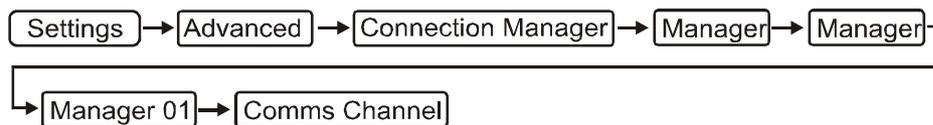
If <u>separate</u> physical communication ports are required, the following changes must be made.

(a) The software module (Connection Mgr) must be disabled – a new Site Key is required.

Go to:

Settings → More → More → Software Modules → Enable_Disable Modules → Modify

and enter the new Site Key).

(b) The Connection Manager must be disabled in <u>both</u> slaves in the case of a Reservoir Monitor. For a pump station manager with Remote Level, disable the Connection Manager in the master and both slaves. Go to:

Settings → Advanced → DNPSlave → Slave → Slave 0x → Session → Use conmng?

and clear the check-box in both slaves. For a master, the Connection Manager enable is located at:

Settings → Advanced → DNPMaster → Master → Master 01 → Use conmng?

(c) Assign individual Comms Channels. Go to:

Settings → Advanced → DNP Slave → Slave → Slave 0x → Session → Comms Channel

and

Settings → Advanced → DNPMaster → Master → Master 01 → Comms Channel
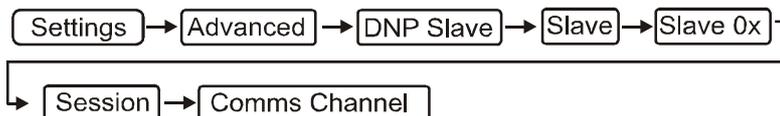
If Remote Level is assigned as the level device <u>after</u> the Pump Controller is configured (i.e. after running the Set Wizard), then the Connection Manager is not enabled.

NOTE: * This applies to hardware version PCB400001 r01 or later. (To view the hardware version go to Info / Version Information - HW VERSION). For hardware versions "R09-aa" and less only serial ports 2 or 3 can be used.

22 RTU Module

The MultiSmart pump station manager can be supplied with a fully functional RTU. Modbus RTU/ASCII/TCP and/or DNP3 communications protocols are available. To check which protocols are installed go to the **Software Modules** section in the **Settings** screen.

> ⚠ *NOTE: The MultiSmart can also be shipped just as an RTU without any pump controller functionality or user interface.*

> ⚠ *NOTE: The Integrators Manual contains more detail and examples in some areas of communication, SCADA integration and communication troubleshooting.*

22.1 Communications Screen

Settings → More → Communications

The main communications screen allows access to view and configure the communication protocols and setup the points list, view and edit the communication port settings, view and edit the IP address and Routing table of the MultiSmart and also to configure the communications via cellular modem.

Communications Protocols Settings

Protocol Settings	DNP3 Points Lists
Configure DNP3 & Modbus Settings and Comms Channels	Configure DNP3 Master and Slave Points Lists
IP Address	Modbus Points Lists
Configure the IP addresses and subnet	Configure Modbus Master & Slave Point Lists
Cellular / PumpView	Routing
Setup a cellular modem for PumpView or other protocols	Add and delete entries to the routing table.

Back

Figure 118 – MultiSmart Communications Settings Screen

22.2 Communication Protocols

The MultiSmart RTU can communicate using MODBUS RTU/ASCII/TCP and DNP3 protocols depending on which software modules have been purchased. If these MODBUS or DNP3 modules are not enabled, please contact MultiTrode for more information on how to enable them. Visit the MultiTrode website www.multitrode.com for the DNP3 and MODBUS manuals.

> ⚠ *NOTE: If you have dnp3 and modbus enabled, ensure they are not both active and pointing to the same channel. If both are active and pointing to the same channel, modbus will be disabled and a fault will be activated.*

22.2.1   DNP3 Configuration

The entire list of DNP3 points can be accessed and configured by going to:

Settings → More → Communications → DNP3 Points Lists

Multiple DNP Masters and DNP Slaves can be configured in MultiSmart. However considerations should be given to the number of physical communication ports available and the size of the points list which in turn affects the available free memory in the MultiSmart.

The MultiSmart has support for remote reconfiguration of DNP points list via DNP file transfer from the master station. Contact MultiTrode to find out more details about how to configure the DNP master station to support this.

22.2.1.1   Add DNP Slave

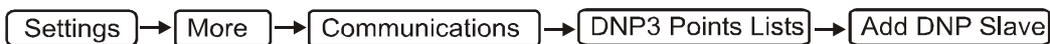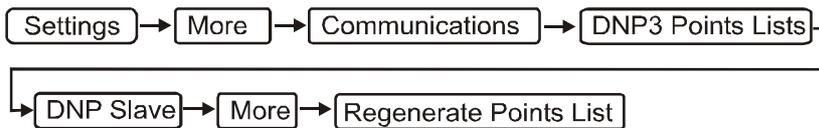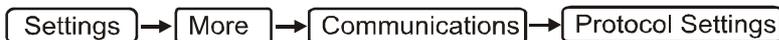Settings → More → Communications → DNP3 Points Lists → Add DNP Slave

A DNP slave is created by default in the MultiSmart when the default configuration is used or the setup wizard is being used to generate a standard configuration. Select this option if a new slave is to be added. This requires a reboot of the MultiSmart.

Once a slave is added go to the **DNP Slave** option to configure the points list. You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured.

Settings → More → Communications → DNP3 Points Lists →
DNP Slave → More → Regenerate Points List

Then select the **Protocol Settings** to configure the communication channel.

Settings → More → Communications → Protocol Settings

22.2.1.2   Add DNP Master

Settings → More → Communications → DNP3 Points Lists → Add DNP Slave

Select this option to create a DNP Master. When a master is created a slave profile for that particular master is also created by default. To add another slave profile under the master, use the **Add DNP Master Slave** option. Multiple masters can be created by selecting this option again. A restart of the MultiSmart is required for each addition of a master.

Once a master is added go to the **DNP Master** option to configure the points list. You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured under the same master or if multiple masters are present.

Settings → More → Communications → DNP3 Points Lists →
DNP Master → More → Regenerate Points List

Then select the **Protocol Settings** to configure the communication channel.
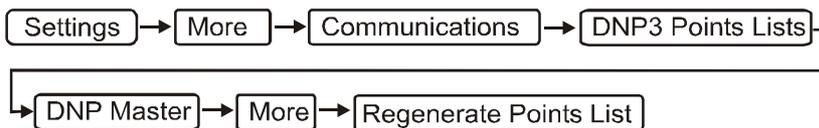
Settings → More → Communications → Protocol Settings
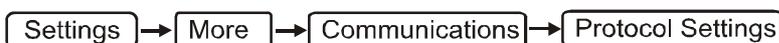
22.2.1.3   Add DNP Master Slave

A slave profile for the master is created by default when a DNP Master is created. When more than one slave is to be configured under that master select this option. This feature requires a reboot of the MultiSmart. If multiple masters are configured the wizard will ask; under which master the new slave profile needs to be created.

22.2.1.4   DNP Slave

This menu gives access to viewing and editing of the points list configurations of all the DNP Slaves present. To switch between the subsequent slaves, if more than one slave is present, press **Next Slave** or **Prev Slave** appearing at the bottom of the LCD screen. The screen title in that menu shows the information about the currently selected slave. All binary inputs, binary outputs, analog inputs, analog outputs, counters, frozen counters and strings can be viewed under this menu. The properties of the points can be edited as well as new points can be added in their respective categories by accessing the corresponding sub sections.

Settings → More → Communications → DNP3 Points Lists → DNP Slave
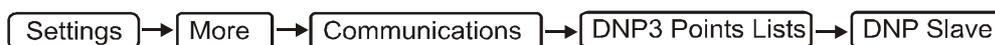
Select the appropriate slave settings from the list below:

- Binary Inputs

- Binary Outputs

- Analog Inputs

- Analog Outputs

- Counters

- Frozen Counters

To add a new point browse, click Add New .

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured.

22.2.1.5   DNP Master

This menu gives access to viewing and editing of the slave profiles of all the DNP slaves configured under all the DNP masters created in the MultiSmart unit. To switch between the different slave profiles, if there are more than one present, press **Next Slave** or **Prev Slave** appearing at the bottom of the LCD screen. The screen title in that menu shows the information about the currently selected master slave pair. Similar to the **DNP Slave** menu, all binary inputs, binary outputs, analog inputs, analog outputs, counters, frozen counters and strings can be viewed under this menu. The properties of the points can be edited as well as new points can be added in their respective categories by accessing the corresponding sub sections.

Settings → More → Communications → DNP3 Points Lists → DNP Master

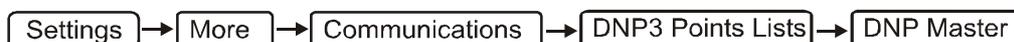Select the appropriate slave settings from the list below:

- Binary Inputs

- Binary Outputs

- Analog Inputs

- Analog Outputs

- Counters

- Frozen Counters

To add a new point browse, click Add New .

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured under the same master or if multiple masters are present.

22.2.2   MODBUS Configuration

The entire list of Modbus points can be accessed and configured by going to:

`Settings` → `More` → `Communications` → `Modbus Points Lists`

Multiple Modbus Masters and Modbus Slaves can be configured in MultiSmart. However considerations should be given to the number of physical communication ports available and the size of the points list which in turn affects the available free memory in the MultiSmart.

22.2.2.1   Add Modbus Slave

`Settings` → `More` → `Communications` → `Modbus Points Lists` → `Add Modbus Slave`

A Modbus slave is created by default in the MultiSmart when the default configuration is used or the setup wizard is being used to generate a standard configuration. Select this option if a new slave is to be added. This requires a reboot of the MultiSmart.

Once a slave is added go to the **Modbus Slave** option to configure the points list.
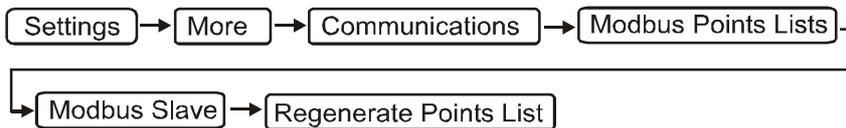
`Settings` → `More` → `Communications` → `Modbus Points Lists`
↳ `Modbus Slave` → `Regenerate Points List`

Then select the **Protocol Settings** to configure the communication channel.

`Settings` → `More` → `Communications` → `Protocol Settings`

22.2.2.2   Add Modbus Master

Select this option to create a Modbus Master. When a master is created a slave profile for that particular master is also created by default. To add another slave profile under the master, use the **Add Modbus Master Slave** option. Multiple masters can be created by selecting this option again. A restart of the MultiSmart is required for each addition of a master.

Once a master is added go to the **Modbus Master** option to configure the points list.
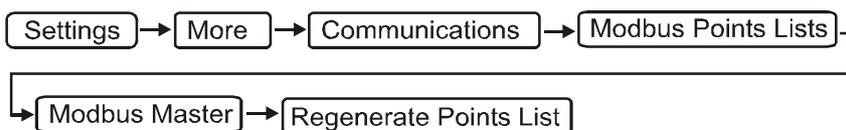
`Settings` → `More` → `Communications` → `Modbus Points Lists`
↳ `Modbus Master` → `Regenerate Points List`

Then select the **Protocol Settings** to configure the communication channel.

`Settings` → `More` → `Communications` → `Protocol Settings`
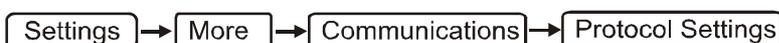
22.2.2.3   Add Modbus Master Slave

A slave profile for the master is created by default when a Modbus Master is created. When more than one slave is to be configured under that master select this option. This feature requires a reboot of the MultiSmart. If multiple masters are configured the wizard will ask; under which master the new slave profile needs to be created.

22.2.2.4   Modbus Slave

This menu gives access to viewing and editing of the points list configurations of all the Modbus Slaves present. To switch between the subsequent slaves, if more than one slave is present, press **Next Slave** or **Prev Slave** appearing at the bottom of the LCD screen. The screen title in that menu shows the information about the currently selected slave. All dis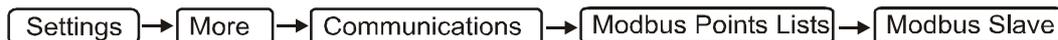crete inputs, coils, input registers and holding registers can be viewed under this menu. The properties of the points can be edited as well as new points can be added in their respective categories by accessing the corresponding sub sections.

To add a new point browse to the corresponding section as shown below and select **Add New.**

Settings → More → Communications → Modbus Points Lists → Modbus Slave

Select the appropriate slave settings from the list below:

- Binary Inputs
- Binary Outputs
- Analog Inputs
- Analog Outputs
- Counters
- Frozen Counters

To add a new point browse, click Add New .

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured.

22.2.2.5   MODBUS Master

This menu gives access to viewing and editing of the slave profiles of all the Modbus slaves configured under all the Modbus masters created in the MultiSmart unit. To switch between the different slave profiles, if there are more than one present, press **Next Slave** or **Prev Slave** appearing at the bottom of the LCD screen. The screen title in that menu shows the information about the currently selected master slave pair. Similar to the **Modbus Slave** menu, all discrete inputs, coils, input registers and holding registers can be viewed under this menu. The properties of the points can be edited as well as new points can be added in their respective categories by accessing the corresponding sub sections.

Settings → More → Communications → Modbus Points Lists → Modbus Master

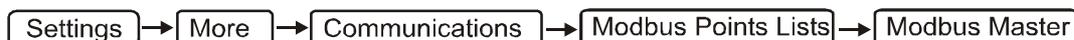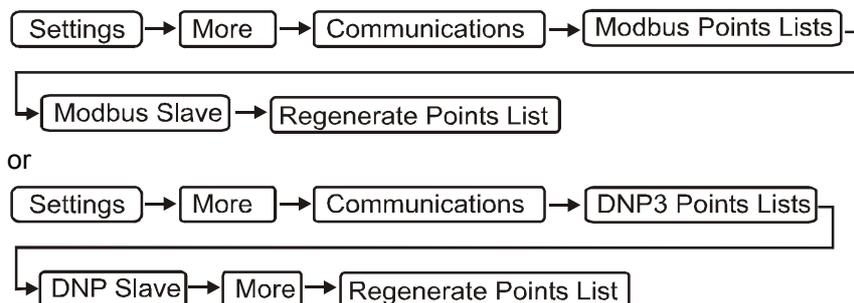Select the appropriate slave settings from the list below:

- Binary Inputs
- Binary Outputs
- Analog Inputs
- Analog Outputs
- Counters
- Frozen Counters

To add a new point browse, click Add New .

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more then one slave is configured under the same master or if multiple masters are present.

22.2.3 Points List Regeneration for DNP3 and Modbus Slaves

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Communications}} \rightarrow \boxed{\text{Modbus Points Lists}}$$

$$\boxed{\text{Modbus Slave}} \rightarrow \boxed{\text{Regenerate Points List}}$$

or

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Communications}} \rightarrow \boxed{\text{DNP3 Points Lists}}$$

$$\boxed{\text{DNP Slave}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Regenerate Points List}}$$

> ⚠️ **CAUTION:** *Do not perform a points list regeneration unless you fully understand the options and are aware of the implications.*

Very occasionally it may be necessary to regenerate a DNP3 or Modbus slave points list. For example, a newer version of the MultiSmart firmware may contain new points which are required in an existing installation. The firmware would be upgraded first and then based on the type of the points list already in use, one of the options described below selected. If the points list has been customised, these customised points will be lost and must be re-entered.

In the case of Fixed points list, the new points are located in reserved locations. For a Dynamic points list, the new points are located throughout the list. A firmware upgrade does <u>not</u> add these new points into the existing points list - the existing points list is preserved. This is done in case the points list has been customised.

Three different operations can be performed on the points lists.

(a) **Fixed List** – This generates a Fixed points list. The points list contains 'gaps' or reserved points in amongst the valid points. These reserve points have no immediate function except to reserve a location for a potential future point. (This allows for the addition of new points to be grouped with points of similar functionality rather than simply attached to the end of the list).

   A MultiSmart leaves the factory with a Fixed points list.

(b) **Dynamic List** – This generates a Dynamic points list. All points in the list are contiguous – there are no 'gaps' or reserved points.

(c) **Clear List** – Clears the entire points list, i.e. the points list contains no points.

> ⚠️ **CAUTION:** *Performing any of the above options on an existing pump station overwrites the existing points list so any customised points will be lost and must be re-entered.*

However, the points regeneration for the slaves configured under the Modbus master has a different set of choices as follows.

(a) Clear List – Clears the entire points list, i.e. the points list contains no points.

(b) ADAM-6017 – Generates the points list for the ADAM 6017 external IO unit.

(c) ADAM-6050 – Generates the points list for the ADAM 6050 external IO unit.

(d) Acromag 961EN-4006 – Generates the points list for the Acromag 961EN-4006 external IO unit.

(e) Acromag 983EN-4012 – Generates the points list for the Acromag 983EN-4012 external IO unit.

The MultiSmart has support for remote reconfiguration of DNP points list via DNP file transfer from the master station. Contact MultiTrode to find out more details about how to configure the DNP master station to support this.

22.2.4   Exporting and Importing DNP3 / MODBUS Points List

MultiSmart can export DNP and MODBUS 'Slave' or 'Master Slave' points list to a compact flash card or saved to the /tmp directory where it can be copied from the unit using FTP.

Settings → Communications → DNP3*
or Modbus → DNP3 Slave / DNP3* Master → Export to CSV
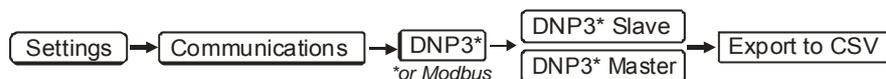
The DNP slave and MODBUS slave points list can be edited and imported back into the unit using the Import CSV option in MultiSmart. The corresponding options can be accessed by browsing through the following menu,

Settings → Communications → DNP3*
or Modbus → DNP3 Slave / DNP3* Master → Import to CSV

22.2.5   Protocol Settings

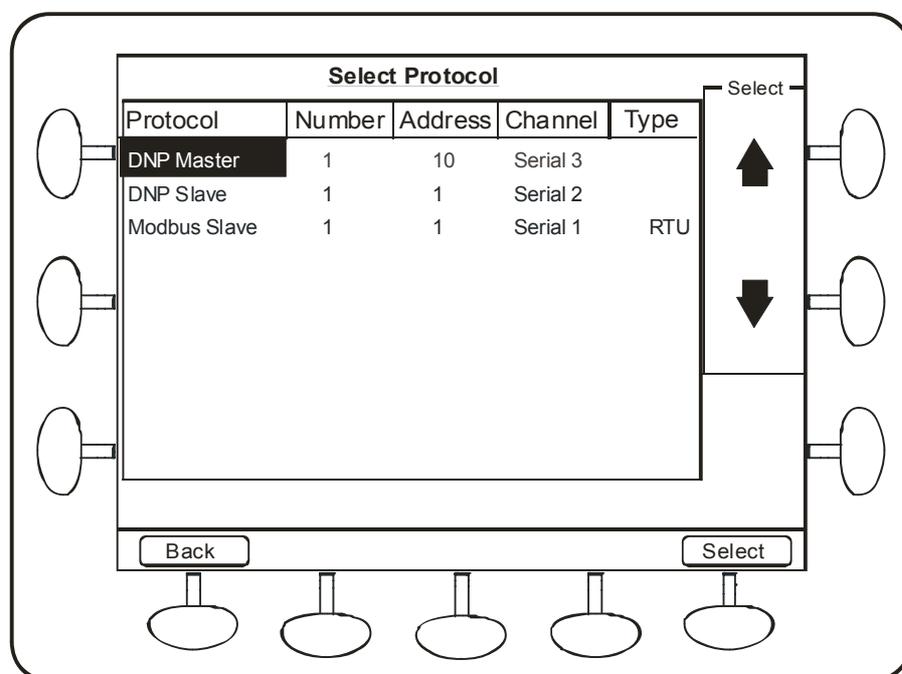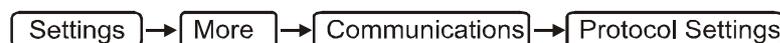Settings → More → Communications → Protocol Settings

Figure 119 – Protocol Settings

In this menu we can see the list of all DNP & MODBUS, Master/s and Slave/s configured in the MultiSmart unit. The menu also shows the master/slave number, master/slave address, communication channel and the type of the communication link. Most of the common settings can be accessed from this menu. However, if further advanced settings are to be configured, you have to go into the **Advanced** menu.

To edit the settings of a particular master or slave, select the item in the list and press **Select**.

Once you are in this menu, input the new values using the keypad or use the **Toggle** button to cycle through the options. When the changes have been done, press the **Save** button for that to be written to the configuration files. Most of the communication settings changes need a restart of the unit them to come into effect. Press the **Channel** button to view and edit the channel settings and press the **IP Address** wherever applicable while configuring the communication over TCP/IP to change the IP Address and the port used.

22.2.5.1   Modbus / DNP Slave

Settings → More → Communications → Protocol Settings

Scroll down to the DNP or Modbus slave and press select.

Enabled – Select this for the slave to be active.

Comms Channel – Select from Serial 1, Serial 2, Serial 3, TCP/IP 1, TCP/IP 2, TCP/IP 3, Modem 1 or PSTN.

Slave Address – DNP Slave address.

DNP slave specific settings:

Master Address – Address of the DNP Master to which the slave is talking to.

Unsolicited – Select this if unsolicited communication needs to be enabled for the slave.

Modbus slave specific settings:

Link Type – Select the link type out of TCP, RTU, ASCII and PLUS

Save the settings and press the **Channel** button to view or modify the communication channel settings. Refer section 22.2.6 for the appropriate channel settings.

22.2.5.2   Modbus / DNP Master

Settings → More → Communications → Protocol Settings

Scroll down to the DNP or Modbus master and press select.

Comms Channel – Select from Serial 1, Serial 2, Serial 3, TCP/IP 1, TCP/IP 2, TCP/IP 3, Modem 1 or PSTN.

DNP Master specific settings:

Master Address – Address of the DNP Master to which the slave is talking to.

Listener – Select this to accept unsolicited responses from the slaves.

Modbus Master specific settings:

Link Type – Select the link type out of TCP, RTU, ASCII and PLUS

Save the settings and press the **Channel** button to view or modify the communication channel settings. Refer section 22.2.6 for the appropriate channel settings.

The slave settings for the particular master are also shown in this menu. The details shown are the number of slaves under the master, the slave addresses and the IP address of the slave if TCP/IP channel is selected. To edit the slave settings highlight the particular slave and press **Edit**.

DNP Master Slave specific settings:

- Enabled – Select this to make the slave active under the master.
- Slave Address – Enter the DNP slave address.
- Integrity Scan Pd (hhh:mm:ss) – Time period for the integrity scan in the specified time format.
- Class 1 Scan Pd (hhh:mm:ss) – Time period for the Class 1 points scan in the specified time format.
- Class 2 Scan Pd (hhh:mm:ss) – Time period for the Class 2 points scan in the specified time format.
- Class 3 Scan Pd (hhh:mm:ss) – Time period for the Class 3 points scan in the specified time format.
- Response Timeout (hhh:mm:ss) – Time period to wait for a response in the specified time format.

Modbus Master Slave specific settings:

- Enabled – Select this to make the slave active under the master.
- Slave Address – Enter the Modbus slave address.
- Discrete Input Scan Pd (hhh:mm:ss) – Time period for the Discrete Input scan in the specified time format.
- Coil Scan Pd (hhh:mm:ss) – Time period for the Coil scan in the specified time format.
- Input Reg Scan Pd (hhh:mm:ss) – Time period for the Input Registers scan in the specified time format.
- Holding Reg Scan Pd (hhh:mm:ss) – Time period for the Holding Registers scan in the specified time format.
- Response Timeout (hhh:mm:ss) – Time period to wait for a response in the specified time format.

22.2.6   Communication Channel Settings

The specific communication channel settings are described in the following subsections.

22.2.6.1   TCP/IP Chanel Settings

- Connection Type – Choose from Initiating end point, Listening end point, Dual end point or UDP.
- Destination IP – Enter the destination IP address.
- TCP Port – Enter the TCP port number if TCP mode is used.
- Idle Timeout – Time period after which the connection is closed. Applicable only to TCP as UDP is connectionless protocol. Setting this to zero disable the idle timeout.
- Keep-alive Timeout – Time period after which a keep alive message is sent when no response is being received from the remote host. Applicable only to TCP as UDP is connectionless protocol.

- Dual end-point port – Enter the dual end point port number when Dual end point type is selected.

- Local UDP Port – Enter the local UDP port number when UDP mode is selected.
- Dest UDP Port – Enter the destination UDP port number when UDP mode is selected.
- UDP Port Mode – Choose from Use configured port, Use source port and None.

    Save the settings. Select the **Advanced** button to configure advanced parameters.

22.2.6.2   Serial / Modem Chanel Settings

- Baud Rate – Choose the appropriate baud rate.
- Data/Stop Bits/Parity – Select the number of data bits, stop bits and parity.
- First Char Timeout (ms) – Wait period before the message timing out.
- RTS Control – Enable or Disable Request To Send control.
- Radio On Time (ms) – Time period to wait before the Radio is ON, ignored if RTS is disabled.
- Radio Off Time (ms) – Time period to wait after the Radio is OFF, ignored if RTS is disabled.
- Comms Port – The physical port used by this channel. In most cases this need not be changed.

Name	Description	Range/Type	Default
Baud Rate	Sets the baud rate for the channel.	1200, 2400, 4800, 9600, 19200, 38400, 76800, 115200	9600
Communications Port	Selects which port this channel communicates through.	Serial 1, Serial 2, Serial 3	-
First Character Timeout (msec)	Sets a timeout for the first character in milliseconds.	0 – 9999ms	1000
MultiTrode RTU		Enable/Disable	Disabled
Number of Wakeups	Sets the number of wakeups.	0 - 120	60
Number of Data Bits	Sets the number of data bits.	7 or 8	8
Number of Stop Bits	Sets the number of stop bits.	1 or 2	1
Parity	Sets the type of parity.	Odd, Even or None	None
RTS Control	Sets whether RTS is controlled.	Enable/Disable	Disabled
Radio Off Time (msec)	Creates delays for use with analog radios	0 – 9999ms	0
Radio On Time (msec)	Creates delays for use with analog radios	0 – 9999ms	0

22.2.6.3   PSTN Chanel Settings

- Phone Number – Enter the destination phone number.
- Baud Rate – Choose the appropriate baud rate.
- Data/Stop Bits/Parity – Select the number of data bits, stop bits and parity.
- Connect Timeout (sec) – Time period to establish connection before the dial up connection to timeout.
- Retry Delay (sec) – Time period to wait after a failed connection before retrying.
- Idle Timeout (sec) – Time period to wait after the last data transmission before hanging up.
- Comms Port – The physical port used by this channel. In most cases this need not be changed.

22.2.7 Communications Redundancy

In a totally polled environment, communications redundancy is controlled by the master station (MTU). The master station decides which communications channel is used.

Say, for example, there is a radio on Channel 1, and GPRS cellular data on channel 2. If the master station could not communicate via radio, it would try to communicate via the cellular connection. In this case the MultiSmart would have two DNP3 slaves running, one connected to Channel 1 and one connected to Channel 2.

An RTU can support multiple instances of DNP Slave over separate channels. Where unsolicited responses are supported, it is possible to configure the slaves so only one sends unsolicited responses at a time. The remaining steps can be configured via the **Advanced** screen, but are described here as if editing manually.

- Set the CommsChannel appropriately.

- Set SourceAddress to the address of the new slave.

- Set DestAddress to the address of the master it will be talking to.

For the first slave:

- Set UnsolAllowed to true

- Set UnsolClassMask to the desired classes (7 = all)

- Under the Comms node, set UnsolPrimary to true.

- Set the alias for UnsolPairActivate to DnpSlave.Slave._2.Comms.UnsolActivate

- Set the alias for UnsolPairDeactivate to DnpSlave.Slave._2.Comms.UnsolDeactivate

For the second slave:

- Set UnsolAllowed to true

- Set UnsolClassMask to the desired classes (7 = all)

- Under the Comms node, set UnsolPrimary to false.

- Set the alias for UnsolPairActivate to DnpSlave.Slave._1.Comms.UnsolActivate

- Set the alias for UnsolPairDeactivate to DnpSlave.Slave._2.Comms.UnsolDeactivate

When the device is started, the first slave will have unsolicited responses enabled, and the second will have them disabled. If the first slave attempts to send an unsolicited response, but receives no confirmation from its master, it will eventually go into comms fail state after the period of time defined by CommsFailTime. When this occurs, it will disable unsolicited responses and activate unsolicited responses for the other slave.

If the second slave has unsolicited responses enabled, and it goes into comms fail state, then it will disable unsolicited responses and activate unsolicited responses for the primary slave again.

If the primary slave has unsolicited responses disabled, and it goes back online (i.e. its master sends through a successful poll), then it will automatically re-enable unsolicited responses, and deactivate unsolicited responses for the secondary slave.

22.3 Enabling and Viewing of DNP and MODBUS Logs

The MultiSmart RTU can display the DNP and MODBUS event logs in the LCD screen, which is helpful for troubleshooting the communication. This is a handy feature for system integrators.

If logging needs to be enabled, navigate to the corresponding DNP/MODBUS Master/Slave menu in the **Advanced** settings menu.

[Settings] → [Advanced] then using the Select arrows move up and down to select any of the following options:

- DNP Slave
- DNP Master
- Modbus Slave
- Modbus Master

Select the master or slave for which the logging needs to be enabled. Select the parameter **Enable Log File** and press **Save**. The default log file location is /var/log/. You can change the name and location of the log file by editing the **Log File Name** parameter. However certain locations are not writable by the MultiSmart unit and hence /tmp/, /var/log/ and /mnt/cf/ are the best locations for saving the log file. /mnt/cf/ refers to the flash memory card. Thus the log can be saved to the memory card if desired.

In order to view the log file from the MultiSmart LCD screen navigate [Info] → [Communication] and press **View Log** button visible at the bottom of the screen.

Now you can see the following four options.

- DNP Slave
- DNP Master
- Modbus Slave
- Modbus Master

Select the appropriate option to view the log. In this menu you can scroll up and down by pressing the **PgUp** and **PgDn** buttons. If **Auto** button is pressed the new log messages are dynamically updated to the screen which eliminates the need for scrolling. Once in **Auto** mode you can switch back to the manual mode by pressing the **Manual** button which will prevent the new messages to be automatically displayed on the screen, which is a useful feature for analyzing the log messages.

22.4 IP Address & Routing Settings

[Settings] → [More] → [Communications] → [IP Address]

Enter the IP Address and Subnet mask in this menu using the keypad. The subnet mask is usually 222.255.255.0 for standard networks.

[Settings] → [More] → [Communications] → [Routing]

The current routing table entries are visible in this screen. If the remote hosts to which the MultiSmart is talking are on the same network we do not need to update the routing table. If the routing table is updated a restart is required for the changes to come into effect.

If the MultiSmart is in a network which has a dedicated Gateway for all communications enter the IP address of the Gateway as the New Gateway, add 0.0.0.0 as the New Netmask and leave the New Target field blank. Select **Add** to update the routing table. This effectively means that all the IP traffic, after reboot, will go through the gateway.

If the MultiSmart needs to go through the Gateway for communicating to specific target networks, and ignore that Gateway for communications to other networks, enter the Gateway IP address in the New Gateway, add 255.255.255.0 as the New Netmask and add the target IP address in the New Target with the last part of it as zero. For example if the target IP address is 192.168.3.54 enter the New Target as 192.168.3.0. Press **Add** to update the routing table and restart the MultiSmart.

If we need to delete an existing routing table entry, scroll down to highlight the routing entry and press **Delete**. A restart is again required for this change to come into effect.

22.5 Configuring PumpView & Cellular Communications

Settings → More → Communications → Cellular/PumpView
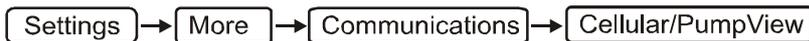
This screen allows the user to configure a cellular modem for use with PumpView – the hosted SCADA system run by MultiTrode – or for general DNP3/Modbus over a cellular network. A number of modems are supported and there is also a username and password for access onto the cellular network.

NOTE: If you have purchased the PumpView option with your MultiSmart unit, you will not usually need to change the settings in this screen.
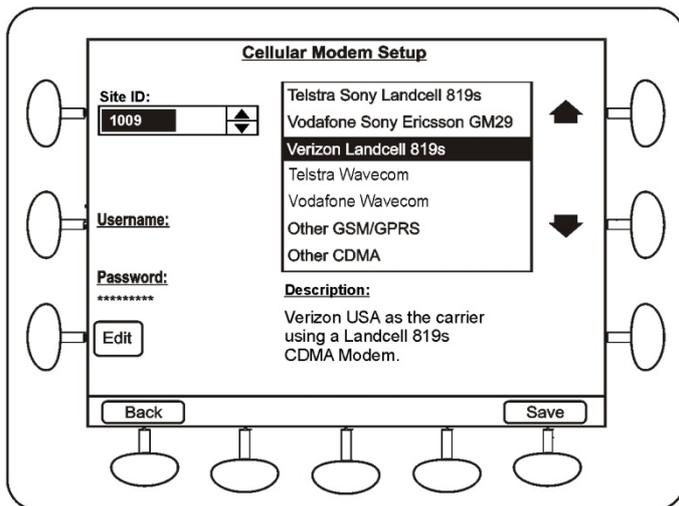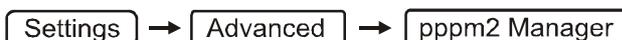

Figure 120 - Cellular Modem Setup Screen

Advanced settings are found under:

Settings → Advanced → pppm2 Manager

The pppm manager (the point to point protocol manager) is the module which handles cellular communications.

Note:
From v1.4 onwards the original pppm module was replaced by pppm2. If you purchased your MultiSmart prior to the v1.4 release you can contact MultiTrode for a free enable code upgrade from pppm to pppm2 to get some improved modem and cellular handling.

By default the PumpView modem should be connected to serial 3. If you need to check this setting, go to **Channel03** under **Telemetry** settings to ensure the modem is connected to the correct serial port.

22.5.1   Modem Strings and Modem Configuration

The following parameters should only be modified by an experienced modem user (only the DNP3 protocol can be used over PSTN). The modem initialization string can be found at

Settings → More → Communications → Protocol Settings   select the Option which says PSTN and press **Select**. Now browse to Channel → More . You can see the default modem initialization string at Init String 2 option.

The modem initialization string can be also found at:

Settings → Advanced → Telemetry → Channel → PSTN → Modem Channel → Init String 2

```
    The default initialisation string is:    AT&FE0Q1M0V1S0=2&C1&D2W2&Y0
```

This string can be modified as required or another string variable, **Init String 3** is available for additional commands if required. Other important modem related parameters can also be found under Modem Channel, such as:

- Baud Rate

- Communications Port

- Dialing Mode

23 Variable Frequency Drive (VFD)

The MultiSmart can control VFD drives through an analog output. This is an optional feature that must be enabled on the MultiSmart before it can be used.

The VFD feature coordinates and alternates drives so the flow does not fluctuate as extra pumps are turned on and off. A single analog output is used as the control signal to all the VFD drives. As new pumps are started the overall VFD speed is reduced.

For example, if you have one pump running at 100% and a second one is about to start at 30%, the algorithm in the pump station manager will adjust the speeds of both so that they are run at 65% each. This ensures a smooth power curve with both pumps running at the same speed.

As the VFD algorithm will vary the speed of the pumps as the well level varies, it is likely that during steady inflows the system will equalise, and hence run continuously with the outflow matching the inflow. We highly recommend that you enable the **Maximum Run Time** function (section 16.3) to ensure that the pumps alternate under this situation.

The following steps are required to configure VFD:

1) Enable and configure VFD functionality

2) Setup the individual pump control parameters

3) Configure the analog output as a source to drive the VFD

23.1 Configure VFD Drive Functionality

To enable and configure VFD drive functionality:

- From Pump Control select VFD Configuration then +/-

- Configure the settings listed in the table below as required for the application

- Press the Save button when finished

Name	Description	Range/Value
Compensation	The compensation factor is used to adjust how the algorithm averages out the speeds of multiple pumps. This might be necessary to account for losses in the system (e.g. losses in the discharge pipework).	-50 to 50
Fixed Speed Manual Enabled?	Allows the pump speed to be fixed when running in manual/hand mode. A common situation would be where operators want the pump to operate at full speed when used in manual mode.	True/False
Fixed Speed Start Duration	This setting sets the length of time a pump is started at a fixed speed when "Fixed Speed Start" is enabled.	secs
Fixed Speed Start Enabled?	This feature allows the pump to be started at a fixed speed for a specified time period. This is normally done to clear the pipes by running the pumps at a higher speed for a short time.	True/False
Fixed Speed Start Speed	Sets the starting speed when "Fixed Speed Start" is enabled.	0-100%
Fixed Speed Manual Speed	Sets the pump speed when "Fixed Speed Manual" is enabled.	0-100%
Mode	Activates the VFD functionality. This must be set to "Enabled" before VFD will work.	Enabled/Disabled

23.2 Configure an Individual Pump's VFD settings

- From Pump Control select Lead/Lag Pump Parameters then `+/-`

- Select a pump e.g.: Lead, Lag or Standby and press `+/-`

- Select VFD Configuration then `+/-`

- Set a level at which the pump will be running at 100% speed in "Full Speed Level"

- Set the speed the pump will start at when it reaches its activation point in "Start Speed %"

Press the **Save** button when finished

23.3 Setup an Analog Output for use with a VFD Drive

`Settings` ⟶ `I/O, Faults & Levels` ⟶ `Analog Outputs`

For more information, see Section 14.10

Choose **Restart Now** if you have completed configuring faults. Choose **Continue** if you still have other configuration changes to make. If you select **Restart Later**, MultiSmart will not prompt for a restart option for further changes done before the next restart, but a fault will appear in the main screen as an obvious indicator which will be cleared only after a restart.

The changes will not take effect until the MultiSmart has been restarted.

23.4 Controlling a VFD Drive Using MODBUS

A VFD drive can be controlled using a MODBUS rather than an analog output.

To do this the VFD drive MODBUS master will need to be configured to read Input Register point 2 from the MultiSmart. This MODBUS point is assigned to the **PumpControl.VFD.VFDCurrentSpeed** tag. Refer to the MultiSmart MODBUS protocol manual for further information.

23.5 Displaying VFD speed on Main Screen

See Section 26 **Customizing the Display** for information on how to display the VFD speed on the Main Screen.

24 PLC Extension IEC61131-3 (ISaGRAF)

ISaGRAF, a control software environment which supports all of the internationally recognised IEC61131-3 control languages and offering a combination of highly portable and robust control engine, is available in MultiSmart. MultiSmart currently only supports ISaGRAF version 5. Earlier versions of ISaGRAF are not supported.

This new development of MultiSmart allows system integrators and end-users to further enhance or adapt the capability of MultiSmart. The existing functionality set in the product is very high, but there are always customers or applications that push the envelope. The product has 1000s of tags, and Si's or end-users can now interface to these with the PLC engine. This means they can extend the capability without having to rewrite existing functions.

The ISaGRAF implementation of IEC61131-3 is added because it is the most proven platform and v5 is chosen as it offers a number of advantages over v3. One example is the ability in v5 to run different 'resources', or applications, at different rates to allow more critical applications to run more frequently.

> **Note:**
> *This is an optional feature that must be purchased with the MultiSmart, or enabled later on the MultiSmart before it can be used. To check if this feature is enabled go to*
>
> *To check if this features is enabled go to:*
>
> Settings → More → More → Software Modules → Enable/Disable Module

ISaGRAF 5 and patches if any, which is needed for the ISaGRAF logic development, can be downloaded from www.isagraf.com. The MultiSmart definition file required for the ISaGRAF programming can be downloaded from the Training and Support section of the MultiTrode website, www.multitrode.com. The logic, after building, should be downloaded into the MultiSmart for ISaGRAF to run.
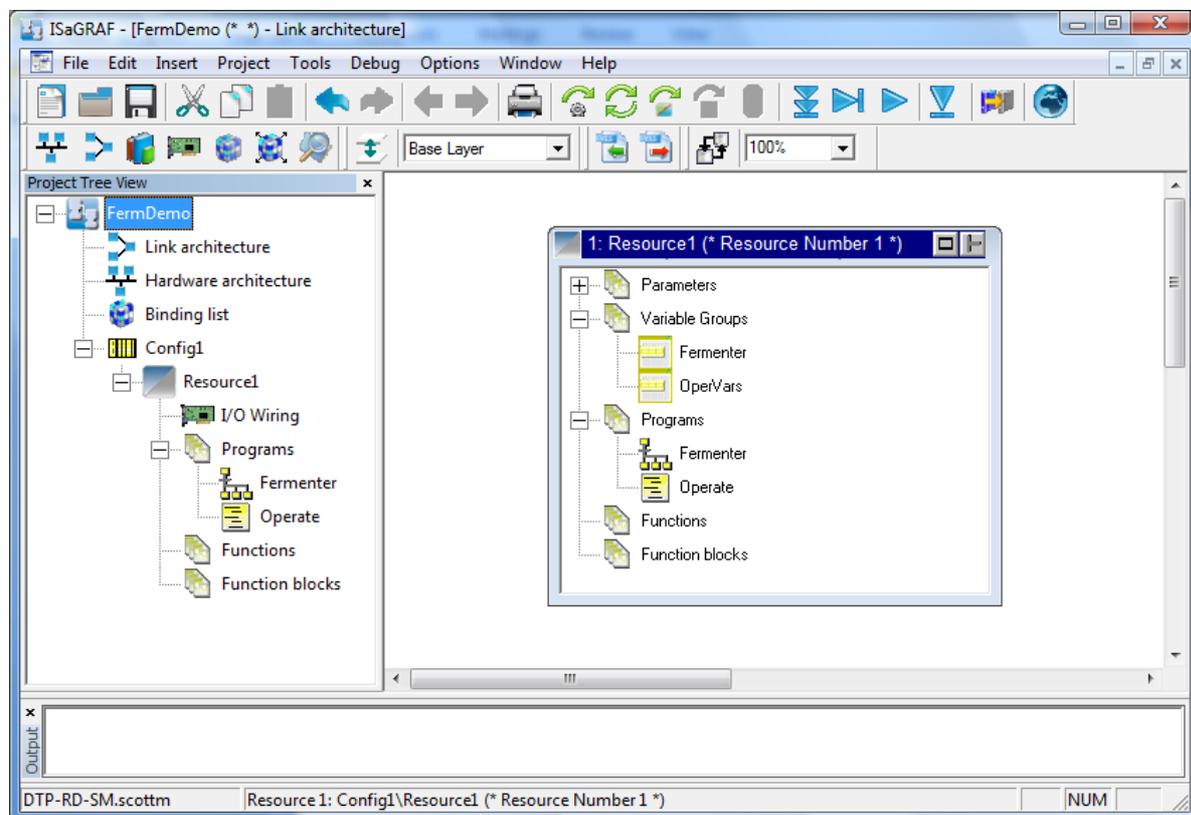

Figure 121 - ISaGRAF Workbench

24.1 Setting up the Workbench

Once the workbench has been installed and started, you can open a new project. Give the project a meaningful name and comment, and select the `Prjmonoresource` template. You will then need to import the MultiSmart PLC definition, which defines the I/O and pre-defined function blocks for the MultiSmart. To do this, click on:

```
File->Import->Plc Definition
```

Select the file `MultiSmart. txt`. This file is included with each release of the MultiSmart.

Once the MultiSmart definition has been imported, highlight the `Resource` window and right click. Then select `Properties`. The name and comment of this resource can be modified to something more meaningful. Then select the `Target/Code` tab. In the `Target` combo-box, select `MULTISMART`. In the `Settings` tab, it is recommended to change the `Cycle Timing (ms)` to 1000 or more, unless execution of the resource is particularly time critical. It s also possible to set up security for the project, if so desired.

24.2 Setting up I/O

In order to be able to access I/O Points within ISaGRAF programs, the I/O devices must first be defined. Click on the `I/O Wiring` icon. Then click on the `Add Device` icon. You will see the following devices:

Device Name	Description
multismart: pc: MultiSmartPCboard(* *)	Pump Control board
multismart: pc: MultiSmartMPboard (* *)	Energy Monitoring and Motor Protection board
multismart: pc: adam6017: ADAM6017(* *)	ADAM-6017 Analog Input Unit
multismart: pc: adam6050: ADAM6050(* *)	ADAM-6050 Digital Input Unit
multismart: pc: acromag961: ACROMAG961(* *)	ACROMAG-961 Analog Input Unit
multismart: pc: acromag983: ACROMAG983(* *)	ACROMAG-983 Digital Input Unit

You can select the desired device. For example, make the following selection:

```
multistmart : pc multiSmartPCboard(* *)
```

Then expand the new device and then expand Parameters. There are two parameters defined for this device:

1. `Unit` – The unit number (1 by default)

2. `topBoard` – Whether this unit represents to top (1) or bottom (0) board (1 by default)

These parameters can be modified, for example, to define the pump control board to be the bottom board, or to define a board on unit 2. Additional devices of the same type can also be defined, with difference paramerters.

Now make the following selection:

```
multismart : mp: MultiSmartMPboard(* *)
```

The same tow parameters exist for this device. The only difference is that the topBoard parameter for this device defaults to 0 (which defined it to be the bottom board, by default).

24.3 MultiSmart Functions & I/O Blocks

In order to support the greatest power and flexibility of a MultiSmart unit, a number of functions and function blocks have been defined.

MultiSmart function blocks can be categorized in one of two groups:

- High level – function blocks for controlling pumps, determining the current level of the well, etc.

- Low level – function blocks for interacting directly with the MultiSmart tag database.

24.3.1 High Level Functions & Function Blocks

24.3.1.1 CurrentLevelPercent

This function returns the current level of well 1 as percentage.

24.3.1.2 CurrentLevelScaled

This function returns the scaled level of well 1.

With a MultiSmart unit, it is possible to redefine the scaling of the level of the well. For example, it is possible to express the level of the well in feet, with the full depth of the well defined as 10ft. It is also possible to define an offset, or datum point. The `CurrentLevelScaled` function takes all of these definition into account for its calculations. If no scaling has been defined for a unit, then this function returns the same result as `CurrentLevelPercent.`

24.3.1.3 CurrentTime

This function returns the current time of the MultiSmart as seconds (UDINT) since 1/1/1970.

24.3.1.4 CurrentTimeOfDay

This function returns the current time of the day in ISaGRAF TIME format.

24.3.1.5 DateTime

This function takes the number of seconds of the particular time since 1/1/1970 as input (UDINT) and outputs the year, month, day, day of the week (0= Sun, up to 6=Sat), hour, minute and seconds. All outputs are Unsigned Integers. This function is especially useful when used with the CurrentTime function.

24.3.1.6 IsPumpAvailable

Pumps become unavailable due to critical faults. For example, a Motor Over-Temperature fault will cause the pump to be locked out by default, so that it cannot be run. Other faults (eg. Contactor Auxilliary) do not cause the pump to be locked out. The `IsPumpAvailable` function block returns whether a specified pump is currently available to be run. It received a pump bumber (1,2,3...) as an input, and returns a Boolean result specifying whether the selected pump is available.

24.3.1.7 NextPumpRunning

This function block returns whether a specified pump is currently running. It receives a pump number (1,2,3…) as an input, and returns a Boolean result specifying whether the selected pump is running.

24.3.1.8 NextPumpToRun

This function returns the pump number (1,2,3…) of the next pump which will be run. This takes into account any pump alternation scheme defined in the unit.

24.3.1.9 NumRunningPumps

This function returns the number of currently running pumps which are managed by the MultiSmart.

24.3.1.10 PumpAuto

This function block can be used to place a pump into AUTO mode. It receives a pump number as an input, as well as a Boolean variable which defines whether the function block should be activated. It returns a Boolean result, indicating whether the operation was successful.

24.3.1.11   PumpHoldout

As of MultiSmart version 2.0.0, a new Holdout fault has been defined. This fault can be used to hold out a pump without "faulting" it. (ie. There is to fault indication on the unit). The `PumpHoldout` function block can be used to activate this condition. However, its operation depends upon the unit being configured appropriately.

This function block actually writes to the source of the `PumpHolout` fault. If the source is not defined, then this action will have no effect. As well, if the source is defined to be a digital input, then the value of the digital input will override any attempt made by this function block to modify the source. Therefore, if use of this function block is desired, then the source of the `PumpHoldout` fault should be set to a digital tag not defined by a physical input. The tags defined under `Isagraf5.Values` are most appropriate for this purpose. In order to do this, first go to the `Advanced` screen. Then navigate to:

`FaultModule->Pump->Pump_?->Pump Holdout->Status`

The highlight `Source` and press the middle left button. Then navigate to `Isagraf5.Values` and select one of the digital tags (eg. `Digital01`). Then press `OK`.

The `PumpHoldout` function block can then be used to hold out the pump. The function block receives a pump number as an input, as well as Boolean variable which defines whether activate or clear the holdout condition. It returns a Boolean result, indicating whether the operation was successful.

24.3.1.12   PumpManual

This function block can be used to place a pump into MANUAL mode. It receives a pump number as an input, as well as a Boolean variable which defines whether the function block should be activated. It returns a Boolean result, indicating whether the operation was successful.

24.3.1.13   PumpOff

This function block can be used to place a pump into OFF mode. It receives a pump number as an input, as well as a Boolean variable which defines whether the function block should be activated. It returns a Boolean result, indicating whether the operation was successful.

24.3.1.14   Ramp

This function block can be used to generate a ramp output. It receives four values as inputs. They are the SVAL- Starting Value (DINT), EVAL – Ending Value (DINT), STIM – Starting Time (TIME) and ETIM – Ending Time (TIME). It returns a Boolean result ACT, indicating whether the Ramp function is currently running and DINT output, RES which shows the current value of the ramp output.

24.3.2   Low Level Functions & Function Blocks

Low level functions and function blocks give direct access to the MultiSmart tag database. As such, they offer great flexibility and power for ISaGRAF programs. However, their use requires a more detailed understanding of the tag database.

The MultiSmart tag database has three types of tags:

1.   Status tags – these include Analog, Digital, Integer, Fixed-Point, Date, and String tags.

2.   Command tags – these include Analog Control and Digital Control tags, and are used for sending commands to various processes.

3.   Configuration tags – these include Boolean Attribute, Date Attribute, Integer Attribute, Fixed-Point Attribute, and Sting Attribute tags, and are used for configuration of various processes. As such, that values of these tags are stored in non-volatile memory, such that these values can be restored if the unit restarts.

24.3.2.1   CommitSetPoint

Command tags and configuration tags all consist of a set point and value. When you write to one of these tags, the set point is modified. This does not actually effect any change in the unit until the value is also updated.

The `CommitSetPoint` function block can be used to update the value of a command or configuration tag with its modified set point. It receives the full name of the tag as an input, together with a Boolean variable which defines whether the function block should be activated. It then returns a Boolean result, indicating whether the operation was successful.

24.3.2.2   RollbackSetPoint

This function block performs the reverse of the `CommitSetPoint` function block. It is used to reject set point changes.

24.3.2.3   IsSetPointPending

This function block is used to determine whether a set point change has been made to a command or configuration tag. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the set point is pending for the selected tag.

24.3.2.4   ReadBoolSetPoint

This function block can be used to read the value of Digital, Digital Control, and Boolean Attribute tags. It receives the full name of the tag as an input. It then returns a Boolean result indicating whether the operation was successful, together with the value of the selected tag.

24.3.2.5   ReadBoolValue

This function block can be used to read the value of Digital, Digital Control, and Boolean Attribute tags. It receives the full name of the tag as an input. It then returns a Boolean result indicating whether the operation was successful, together with the value of the selected tag.

24.3.2.6   ReadFloatSetPoint

This function block can be used to read the set point of Analog Control and Fixed-Point Attribute tags. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the operation was successful, together with the set point of the selected tag.

24.3.2.7   ReadFloatValue

This function block can be used to read the value of Analog, Analog Control, Fixed-Point, and Fixed-Point Attribute tags. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the operation was successful, together with the value of the selected tag.

24.3.2.8   ReadIntegerSetPoint

This function block can be used to read the set point of Integer Attribute tags. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the operation was successful, together with the set point of the selected tag.

24.3.2.9   ReadIntergerValue

This function block can be used to read the value of Integer, Integer Attribute, and Digital tags. When selecting a Digital tag, the function block returns the number of time the tag has changed state. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the operation was successful, together with the value of the selected tag.

24.3.2.10   ReadTimeStamp

This function block can be used to read the Timestamp of a tag. It receives the full name of the tag as an input. It then returns a Boolean result, indicating whether the operation was successful, together with the timestamp in seconds (UDINT) of the selected tag.

24.3.2.11   WriteBool

This function block can be used to write to the value of Digital tags, or to the set point of Digital Control and Boolean Attribute tags. It receives the full name of the tag as an input, together with a Boolean variable which defines whether the function block should be activated. It also receives the value which is to be written to the tag. It then returns a Boolean result, indicating whether the operation was successful.

24.3.2.12   WriteFloat

This function block can be used to write to the value of Analog and Fixed-Point tags, or to the set point of Analog Control and Fixed-Point Attribute tags. It receives the full name of the tag as an input, together with a Boolean variable which defines whether the function block should be activated. It also receives the value which is to be written to the tag. It then returns a Boolean result, indicating whether the operation was successful.

24.3.2.13   WriteInteger

This function block can be used to write to the value of Integer tags, or to the set point of Integer Attribute tags. It receives the full name of the tag as an input, together with a Boolean variable which defines whether the function block should be activated. It also receives the value which is to be written to the tag. It then returns a Boolean result, indicating whether the operation was successful.

24.3.2.14   TouchTimeStamp

This function block can be used to update the Timestamp of a tag with the current MultiSmart time. The function receives the full name of a tag and a Boolean input depending on which the write operation is being performed. The status of the operation is output as another Boolean value.

24.4 Downloading ISAGRAF Resources to MultiSmart

Once ISaGRAF programs have been completed, it is time to download them to the MultiSmart unit. MultiSmart only supports downloading via Ethernet. To do this, first click on the `Hardware Architecture` icon on workbench, and then double-click on the vertical line which connects the configuration to the horizontal line labelled `ETCP`. You will then see an entry for specifying an IP address. This needs to be the IP address of the MultiSmart unit.

Once the IP address has been specified, click on the `Download` icon. This may first compile the resources, if they have not been previously compiled. If this is the case, you will need to click on the `Download` icon again once this is completed.

It should be noted that ISaGRAF 5 must be enabled via the enable code on the MultiSmart unit. Otherwise, the download process will fail.

24.5   Compiling and Downloading Multiple Resources

ISaGRAF 5 and MultiSmart support the concept of multiple resources. A new resource can be added from the `Link Architecture` view of workbench by selecting `Insert->Resource`. The second resource can be defined to run at a different frequency from the first resource. This is especially useful where there is a time-critical resource which needs to be run frequently, as well as a non-time-critical resource which can be run at a much slower frequency. It can also be useful as a means of dividing unrelated functionality. Each resource defines its own separate dictionary.

As explained in the following section, MultiSmart allows viewing of ISaGRAF variables from the LCD, and supports this in a multi-resource environment. However, in order for this to work, the symbol table for each resource must be downloaded to MultiSmart. This can be defined by right-clicking on a resource and selecting `Properties`. Then navigate to the `Target/Code` tab and ensure that `Embed Symbol Table` is checked. By default, this option is checked for the first resource, but is unchecked for additional resources.

24.6   Viewing the Status of ISaGRAF Variables

Once ISaGRAF resources have been compiled and downloaded to a MultiSmart unit, it is possible to view the values of all ISaGRAF variables from the LCD. To do so, navigate to `Info->More->ISaGRAF 5`. From there, you will see the status information for the first resource. If multiple resources have been downloaded, then information for additional resources can be displayed by using the arrow keys at the bottom of the screen.

Of particular interest is the `Variables` button at the bottom-right of the screen. If you press this button, all ISaGRAF variables for the selected resource will be displayed, together with their values. The values of these variables are updated dynamically. This is an extremely valuable tool for confirming that a resource is behaving properly, and for debugging any problems. If you then highlight a variable and select the `Details` button, you will see additional information for that variable, such as whether it is retained (in non-volatile memory), and whether it has Read or Write access.

24.7 The Tags Button

On the Resource Information page is a `Tags` button. Selecting this button will display a list of general purpose tags defined under the `Isagraf5.Values` node in the database. The values of these tags are updated dynamically. New values for these tags can be assigned from this menu.

These tags are designed for use within ISaGRAF programs. They can be used for updating the status and controlling set points of algorithms. They can also be added to a DNP or Modbus points list, thereby allowing remote access to ISaGRAF functionality.

The values of these tags can be read and controlled via the low-level functions blocks defined in a previous section.

24.8 The Params Button

On the Resource Information page is also a `Params` button. Selecting this button will display a list of configuration tags defined under the `Isagraf5.Parameters` node in the database. The values of these tags are updated dynamically. The values of these parameters can be changed from this menu itself.

These tags are designed to be used as configuration parameters within ISaGRAF programs. They can be modified via the **advanced** screen by navigating to `IsaGRAF5->Parameters`, and will persist in non-volatile memory. They can also be added to a DNP or Modbus points list, thereby allowing remote configuration of ISaGRAF functionality. For increasing readability and easiness in understanding during programming, ISaGRAF parameter descriptions can be renamed and this will be displayed in the information screen. The renaming can be done via the **information** screen or via the **advanced** menu.

They can also be added to a DNP or Modbus points list, thereby allowing remote access to ISaGRAF functionality.

24.9 Backing UP ISaGRAF Recources

All ISaGRAF resource and symbol information is downloaded to the `/var/config/isagraf5` directory on the MultiSmart. These files are all backed up to compact flash whenever a full backup of the MultiSmart configuration is performed. This is done by navigating to:

| Settings | → | More | → | More | → | Backup Options | → | Configurations | → | Backup Current |

Restoring a saved configuration will also restore any ISaGRAF resource files.

It is also possible to restore only the ISaGRAF configuration files from compact flash. This is especially useful for deploying new ISaGRAF resources to existing devices. For example, if resources are compiled and downloaded to one device, and then backup up onto compact flash, these files can then be transferred to other devices via this functionality. This is done by navigating to:

Settings → More → More → Backup Options → ISaGRAF5 Files

24.10 ISaGRAF Application Examples

Brief overview of some of the applications which are implemented with the help of ISaGRAF is mentioned in the subsections below.

24.10.1 Battery Testing

This application was written to perform a Battery Voltage test, which is to be performed at the specified time on a periodic basis. The application initiate at the specified time, activates a relay to switch to Battery mode for a very short duration, check the voltage status and switch back to the main power supply.

24.10.2 Redundant Communication over TCP/IP

This application switches the communication from the MultiSmart from the Primary Server to the Backup Server in case of a server failure. The Program check if the communication channel is still alive periodically. If a communication failure occurs the IP address of the Primary Server to which the MultiSmart is talking will be changed with the IP address of the Backup Server. This will enable communication from MultiSmart to the Backup Server.

25   Logic Engine

A simple, Boolean, engine has been built into the MultiSmart to allow basic customization of control capabilities where the existing functionality is not suitable.

> *Note: This is an optional feature that must be purchased with the MultiSmart, or enabled later on the MultiSmart before it can be used.*

The logic engine uses mathematical expressions which are evaluated at regular intervals to determine if they are true or false. The expressions are associated with a tag within the MultiSmart to create actions when an expression changes state.

Expressions are written on a single line in a simple text file. Multiple expressions can be included in a text file, but only one expression is allowed per line. The text file can be created in any basic text editor and saved as a basic text file with an ".lge" extension so the MultiSmart can identify it as a logic engine file.

Files are transferred to the MultiSmart using an FTP program or the configuration utility. From there they must be activated from the Logic Engine settings screen on the MultiSmart.

> *NOTE: When creating a logic engine file, use a simple text editor such as Windows Notepad. Using MS Word may cause problems with formatting tags being added. Also ensure that the filename created is not of the form example.lge.txt – i.e. be sure to remove any .txt or .doc from the end of the filename otherwise the Logic Engine will not recognize it.*

> *NOTE: The logic engine is limited in its capability and should only be used in simple situations where existing functionality within the MultiSmart is insufficient to cover a particular scenario. Before using the logic engine it is recommended that you first make sure the same functionality is not already provided by the MultiSmart.*

25.1 MultiSmart Tags

The MultiSmart has a comprehensive tag database, which includes the full setup and status of all I/O, the setup and status of all pump control functionality and other station tags.

25.1.1   I/O Tags

Finding I/O values is straightforward. For example:

Description	Tag
AIN1 on the top board of I/O unit 1	IO.Unit._1.TopBoard.Ain._1.Value
AIN2 on the top board of I/O unit 1	IO.Unit._1.TopBoard.Ain._2.Value
DIN15 on the top board of I/O unit 1	IO.Unit._1.TopBoard.Din._15.ValueDigital
DOUT11 on the bottom board of I/O unit 2	IO.Unit._2.BottomBoard.Dout._11.Value

From these examples you should be able to identify the tag for any I/O. There is also a complete list of I/O with the tag name in the DNP3 and Modbus manuals.

25.1.2   Pump Control Tags

The pump station manager is a sophisticated pump control engine with advanced capabilities. A few examples of pump controller tags are shown in the table below:

Description	Tag
Current Level (in well 1)	PumpControl.Well._1.CurrentLevel
Pump 1 Running?	PumpControl.Pump._1.Running
Pump 2 Running?	PumpControl.Pump._2.Running
Pump 1 Mode (0=auto, 1=full manual, 2=semi-auto manual, 3=off, 4=decommissioned. Values 1 & 4 cannot be written)	PumpControl.Pump._1.PumpMode
Next pump to run	PumpControl.NextToRun
Current active profile number	PumpControl.ProfileNumber
VFD current speed (when VFD functionality is enabled)	PumpControl.VFD.VFDCurrentSpeed
Lead (duty) pump activation set point (for writing to a value)	PumpControl.Behaviour._1.ActSetPoint
Lag (standby) pump activation set point (for writing to a value)	PumpControl.Behaviour._2.ActSetPoint
Lag (standby) pump deactivation set point	PumpControl.Behaviour._2.DeactSetPoint

A comprehensive list of tags can be found in the DNP3 or Modbus manuals, where the tag names and descriptions, along with valid ranges, are listed.

25.2 Logic Engine Tags

Extra tags have been provided within the MultiSmart database for use with the logic engine. These are used to access digital and analog tags or as "scratchpad tags" (i.e. temporary values).

Logic engine tags available for use with the logic engine include:

- Digital Tags - Logic.Values.Digital01 up to Digital20

- Analog Tags - Logic.Values.Analog01 up to Analog20

- Fixed Point Tags - Logic.Values.Decimal01 up to Decimal20

- Integer Tags - Logic.Values.Integer01 up to Integer20

25.3 Mathematical Operators

The following mathematic operators can be used to create expressions:

Operation	Description
and	Logical and
or	Logical or
Xor	Logical xor
!	Logical Not
+	addition
-	subtraction
*	multiplication
/	floating point division
>=	greater than or equal to
<=	less than or equal to
!=	not equal t
==	equal to
>	greater than
<	less than
^	raise x to the power of y
()	parenthesis

25.4 MultiSmart Logic Functions

The following table lists MultiSmart-specific logic functions which can be used to build expressions:

Function	Description
valueof	Get the value of a MultiSmart tag: valueof("pump.1.running")
now	Get the current date/time using the local time
date	Convert a time broken into segments to seconds .e.g. Date (1, 1, 2005, 12, 0, 0)
hour	Returns the hour of the day in 24 hour localtime.
minute	Returns the minutes of the current hour.
second	Returns the seconds of the current minute.
day	Returns the day of the month in localtime.
month	Returns the month of the year in localtime.
year	Returns the year in localtime.
delay	Pause the running of this expression for the number of milliseconds as specified by the delay parameter.

25.5 Advanced Functions

Function	Description
sin	Sine
cos	Cosine
tan	Tangent
asin	Arc sine
acos	Arc cosine
atan	Arc tangent
sinh	Hyperbolic sine
cosh	Hyperbolic cosine
tanh	Hyperbolic tangent
log2	logarithm to the base 2
log10	logarithm to the base 10
ln	logarithm to the base e
log	logarithm to the base 10
exp	e raised to the power of x
sqrt	Square root
sign	-1 if x<0; 1 if x > 0
round	round to nearest integer
floor	Round down to nearest integer
ceil	Round up to nearest integer
mod	Modulus
abs	absolute value
min	minimum of an unlimited parameter list
max	maximum of an unlimited parameter list
sum	sum of an unlimited parameter list
avg	average of unlimited parameter list
if	if ... then ... else e.g. if (10 > 1, 1, 0) if arg1, then arg2 else arg3

25.6 Logic Examples

Some examples of logic expressions are shown below:

25.6.1 Example 1: Changing the Lead (Duty) Pump Setpoint from an Analog Input

This example allows the Lead (Duty) pump to have its activation setpoint changed via an analog input.

- The left side of the expression above represents the activation setpoint for the lead pump.

- The right side of the expression is AIN1 on the top board multiplied by a factor of 4. So if AIN1 is 15mA, the lead (duty) pump setpoint will be 60%.

```
PumpControl.Behaviour._1.ActSetPoint =
valueof("IO.Unit._1.TopBoard.Ain._1.Value")*4
```

NOTE: *A "Behaviour" is the name used internally for lead/lag pumps. In alternation mode, the setpoints aren't assigned to physical pumps but rather to their position in the cycle.*

25.6.2 Example 2: Start the Station if an Analog Input Falls below a Certain Value

The MultiSmart includes a station function called **Pulse Start**. This was originally designed so that a Digital Input, when closed or opened, could start one or more pumps. See Section 16.9 for a description of this feature.

In this example, a logic engine tag is set to trigger the pulse start instead of "ValueDigital". A logic file is then used to define when this feature is activated. Rather than just activating in response to the digital input, this example uses an analog input to trigger the digital input when it passes a set value.

```
Logic.Values.Digital01 = valueof("IO.Unit._1.TopBoard.Ain._2.Value") < 12
```

What this does is test if AIN2 in the top board of I/O unit 1 is less than 12mA. This Boolean expression resolves to 0 if AIN2 >=12mA, and resolves to 1 if AIN2 <12mA. As a result, the virtual Digital Input01 gets set to 1 or 0.

When it changes from 0 to 1, i.e. when AIN2 falls below 12mA each time, the station operates its pulse start functionality.

25.6.3 Example 3: Change Pump Mode if an Analog Input Falls Below a Set Value

```
PumpControl.Pump._1.PumpMode = 2 *
(valueof("IO.Unit._1.TopBoard.Ain._2.Value") < 7)
```

If AIN2 is below 7mA, the value of the expression on the right =2. This value for pump mode puts the pump into semi-automatic manual (i.e., manual until the pump reaches its deactivation setpoint, at which time it reverts to auto mode).

If AIN2 is above 7mA the value of the expression on the right =0. This puts the pump into Auto mode. The above expression could also be achieved by the following:

```
PumpControl.Pump._1.PumpMode = if
(valueof("IO.Unit._1.TopBoard.Ain._2.Value") < 7, 2, 0)
```

25.7 Uploading Logic Files Using FTP

The easiest way to transfer files into the MultiSmart unit is by using FTP. In order to do this you will need an Ethernet crossover cable, and have your PC's IP address on the same subnet as the MultiSmart. See Section **Error! Reference source not found.** for how to change the Ethernet address of the MultiSmart.

If you have Windows XP on your PC, you can change the IP address from:

- Start-> Settings ->Network Connections and then right click the Local Area Network icon.
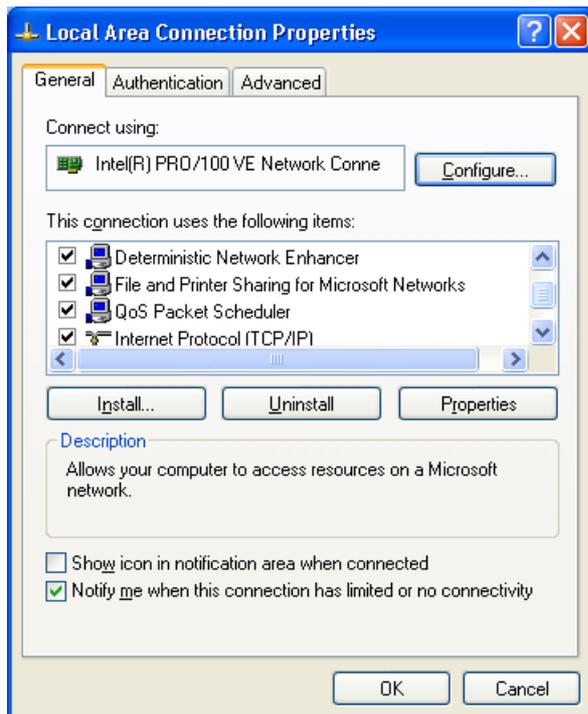
Figure 122 – Select TCP/IP and click Properties:
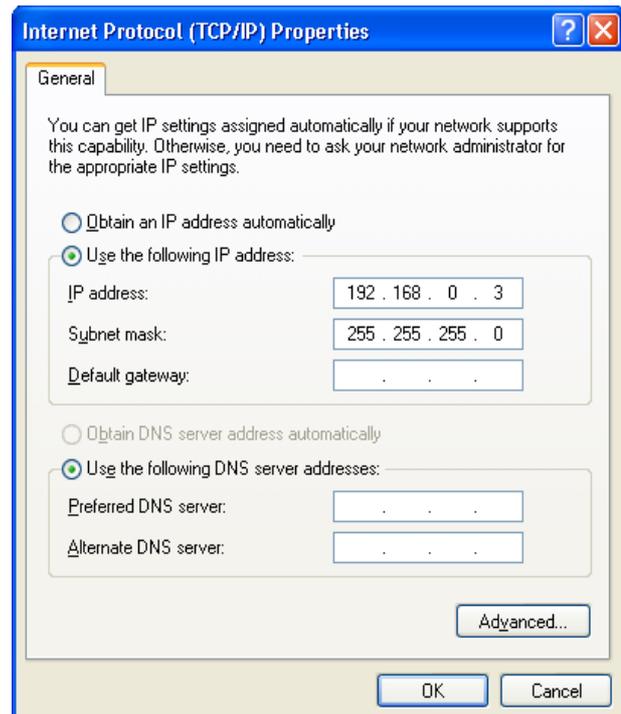
Figure 123 –Enter IP Address

Now check the "Use the following IP address" button and enter an IP address, for example, the one shown above.

The easiest way to ftp a file into the unit is using MS Internet Explorer. For example, if you had set the IP address of MultiSmart to 192.168.0.10, at the address (URL) field type the following:

ftp://user@192.168.0.10

When prompted for the password you need to enter the administrator password for the unit.

> ⚠ **Note:** *Each unit is shipped with the administrator password is on the inside back cover of the Installation and Operation manual. See Section 11 for details.*

Open the folder /var/config and copy your logic engine files into this directory.

25.8 Enabling Logic Files

Once a logic file has been uploaded it can be:

- Enabled

- Disabled

- Assigned an execution interval

- Have a description edited

The first time a logic engine file is enabled, the MultiSmart will require a restart. Subsequently, it can be disabled or re-enabled any number of times without a restart. Also, the file can be completely changed via FTP without a restart.

To access the Logic Engine screen go to:

Settings → More... → More... → Logic Engine
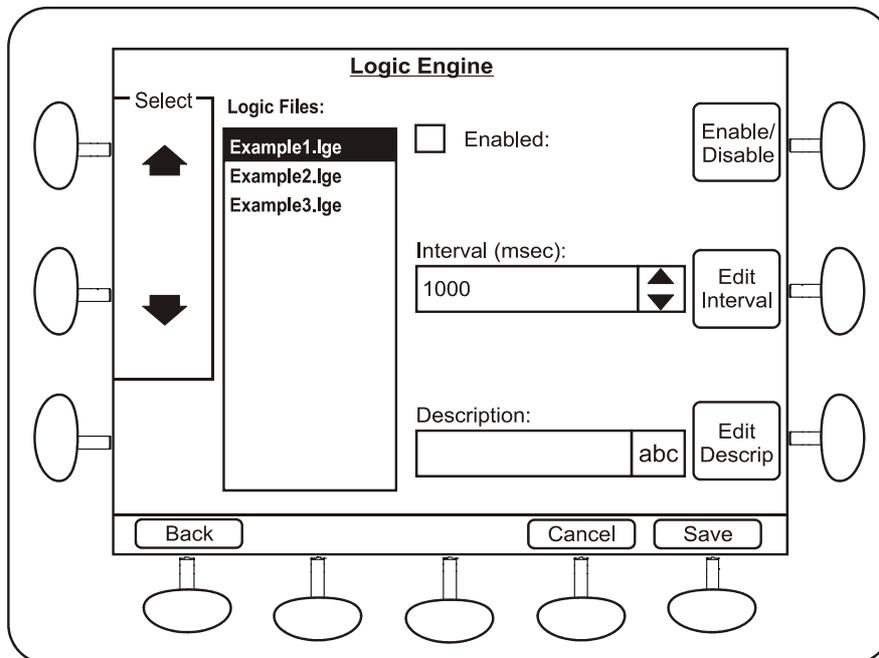
Figure 124 – Logic Engine Screen

26 Customizing the Display

Some elements of the main operator screen can be customized by the user:

Settings ⟶ More ... ⟶ Customize Display
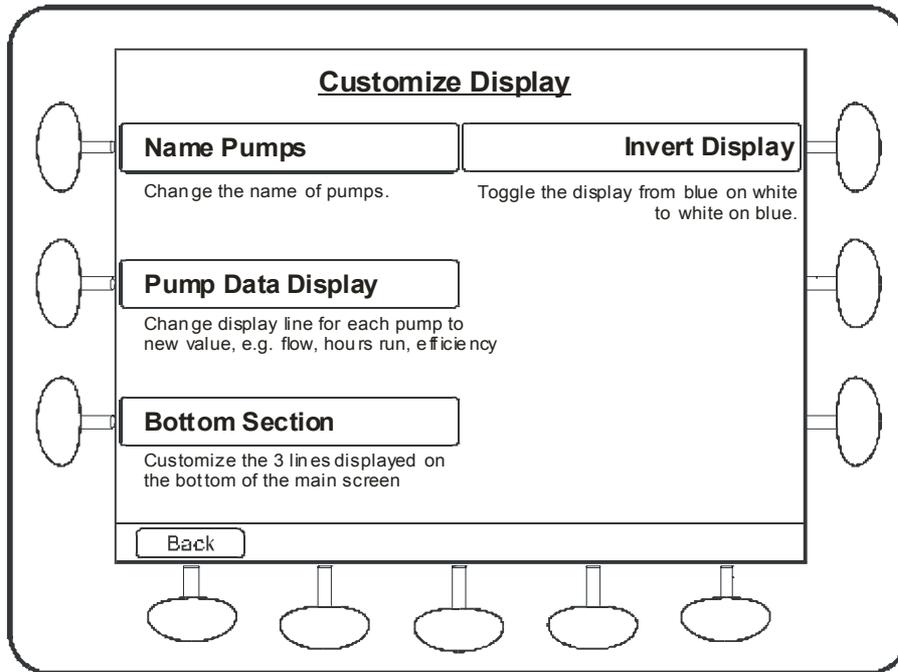
Figure 125 - Customize Display Screen

26.1 Naming Pumps

One or more pumps can be given a custom name, which is reflected through the Faults, History and Info screens, (except Set Points screen). If you want to rename pumps and pump faults, be sure to rename the pump first. The most common naming conventions for the pump are Lead/Lag and Duty/Standby. The new pump names will be shown in the main display, pump set point screen and in the pump delay screen.

> **NOTE:**
> *Some advanced settings screens will not contain the customized names.*

26.2 Pump Data Display

This allows a number of different values to be shown at the bottom of each pump section.
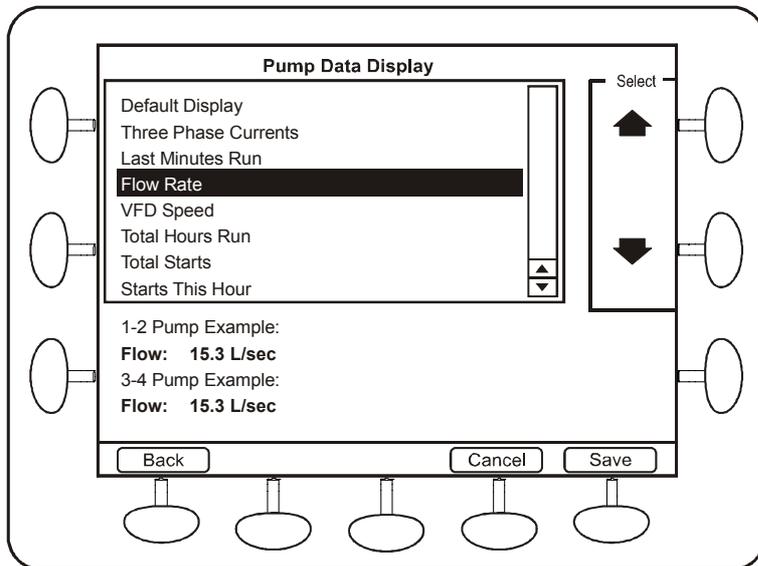
Figure 126 – Choosing a new value to display

Values available include:

- Flow per pump
- Power
- VFD speed
- Insulation resistance of motor winding
- Energy accumulators (kWh)
- Apparent energy accumulators (kVAh)
- Pump efficiency (litres or gallons per kWh or KWh per Mega Litre)
- Various starts and hours run accumulators

26.3 Bottom Section

The bottom 3 lines of the Pump Station display can be customized from the default of:

- Date/time
- 3-phase supply
- Mode (empty/fill) and current profile

The choices include:

- I/O values (scaled with custom names where chosen)
- Inflow and volume
- Last login with user and date/time
- Invalid logins with date/time
- Station run time and starts
- Temperature
- Firmware version

Example of a customized display:
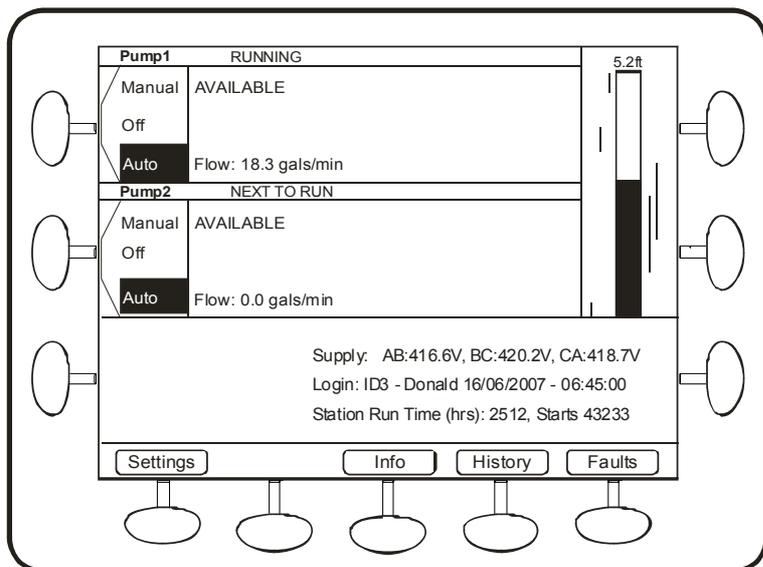
Figure 127 - Customized Display Screen

26.4 Invert Display

Selecting this option will invert the dark text on a light background to light coloured text in a dark background. This option requires restarting of the MultiSmart unit. This is especially useful where it is hard to read the display due to bright sun light.

27 Restarting the MultiSmart

A manual restart of the MultiSmart controller can be performed at any time by pressing the following buttons:

Settings ⟶ More... ⟶ More... ⟶ Restart Unit

Press the **Yes** button to confirm you wish to restart the controller. This process will take one or two minutes to complete.

⚠ *NOTE: Accumulators and counters are saved every half hour. The correct way to do a restart is to use the menu so they are saved before restarting.*

28 Site Keys and Enabling New Modules

One of the menu options in the Settings menu is Site Key. This is entered as the unit leaves the factory. A new Site Key is only required if you purchase more modules from MultiTrode, for example:

- VFD functionality
- More than 3-pump control
- DNP3 RTU
- Modbus
- Flow calculations via draw down test
- Logic Engine for customized logic
- ISaGRAF 6 IEC61131-3 PLC programming

The Site Key is obtained from MultiTrode and is based on the serial number of the unit. Entering the site key is done via the keypad, in a similar way to using a mobile phone – pressing the number 4, for example, steps the character display through g, h, i, 4.

29 Upgrading MultiSmart Firmware

Firmware can be upgraded via a Compact Flash card. Upgrades of firmware do not overwrite the existing configuration. Any new tags which are available in the system are simply set to their new default value.

An automatic DSP upgrade also is done when the firmware is updated. This behaviour can be changed by setting the following parameter in the **Advanced** menu.

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{Advanced}} \rightarrow \boxed{\text{LCD}} \rightarrow \boxed{\text{Auto DSP}}$$

Download the firmware image from MultiTrode's website onto your PC and use a flash card reader/writer to copy the image onto a compact flash card. (A USB compact flash reader/writer can be purchased for less than $50).

Insert the compact flash card into the MultiSmart unit and restart (see Section 27). The MultiSmart will prompt for an update with the current version information of the firmware and with the version information of the update image present in the CF card. This prompting can be disabled by configuring the following in the **Advanced** screen. If none of the options are selected the MultiSmart will resume normal operation without performing a firmware upgrade after a predefined timeout period.

$$\boxed{\text{Settings}} \rightarrow \boxed{\text{Advanced}} \rightarrow \boxed{\text{General Configuration}} \rightarrow \boxed{\text{Auto Upgrade}}$$

If this option is not visible, enable $\boxed{\text{LCD}} \rightarrow \boxed{\text{Show More Options}}$ in the **Advanced** menu to be able to access it.

The unit will use the upgrade image file to upgrade to the latest version of firmware. Your existing configuration will be preserved. After the new firmware is installed, the MultiSmart will automatically upgrade the existing configuration to the latest firmware version.

> **NOTE:**
> *This process takes approximately 10 minutes. This is a consequence of having forwards and backwards compatibility. MultiSmart will interrogate every tag in the existing configuration and check for any new tags in the firmware. Any new tags found are set to default status.*
>
> **NOTE:**
> *During the upgrade process the MultiSmart will not control the pumps so a backup method of level monitoring and pump control may be required.*

MultiTrode recommends that after the firmware is upgraded; resave the configuration immediately (under a new name) to a compact flash card. This ensures that a configuration matching the current firmware version is available.

30 Backing Up & Restoring Configuration Settings

The MultiSmart automatically stores a copy of the previous settings anytime a change is made. You can also backup the current configuration. This gives you two choices when restoring configuration settings:

- Restore the previous settings or,
- Restore from a backup

If the MultiSmart has a flash card port installed, and a flash card is inserted into the port, then multiple configurations can be saved. If no flash card is present then only one backup can be saved.

WARNING:
*BEFORE REMOVING THE COMPACT FLASH CARD, **YOU MUST PRESS THE YELLOW SAVE CF DATA BUTTON**. FAILURE TO DO SO MAY CAUSE CORRUPTION OF DATA OR DAMAGE TO THE FLASH CARD.*

Backing up and restoring configuration settings is done from the "Backup Options" screen:
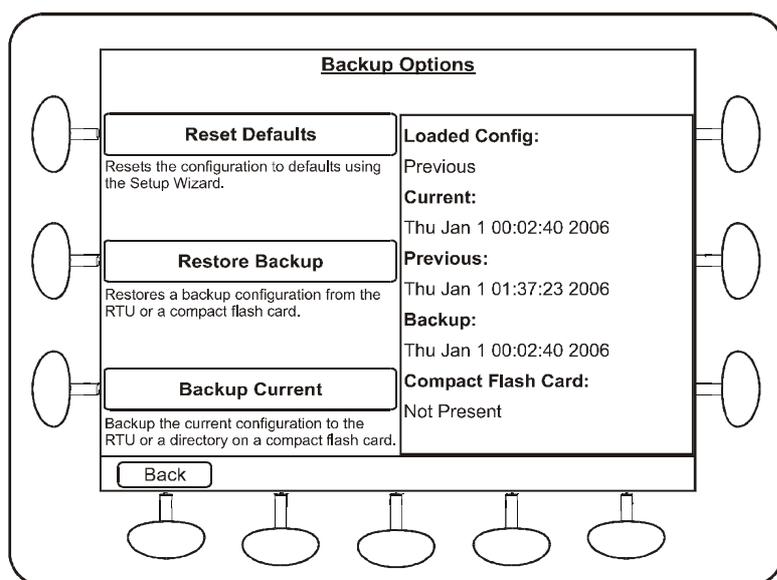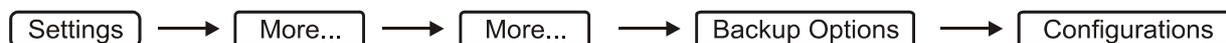
Settings ⟶ More... ⟶ More... ⟶ Backup Options ⟶ Configurations

Figure 128 – Backup Options

30.1 Resetting Defaults

Pressing the "Reset Defaults" button will take you back through the setup wizard as described in Section 9.

30.2 Back Up Current Configuration

To backup the current configuration, press the **Backup Current** button. If a flashcard is installed, multiple backups can be stored.
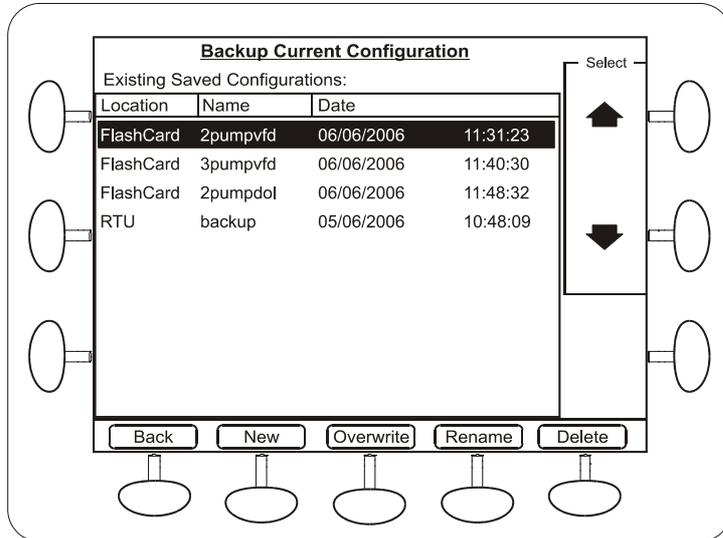
Figure 129 – Backing up a current configuration

From this screen you can choose to overwrite an existing backup file, create a new backup file, delete a backup file, or rename an existing file.

If you choose to overwrite or delete an existing file, you will have to confirm the action before proceeding.

The backup located on the RTU cannot be deleted or renamed.

30.3 Restoring Backups

Press the **Restore Backup** button to restore previously saved configurations.
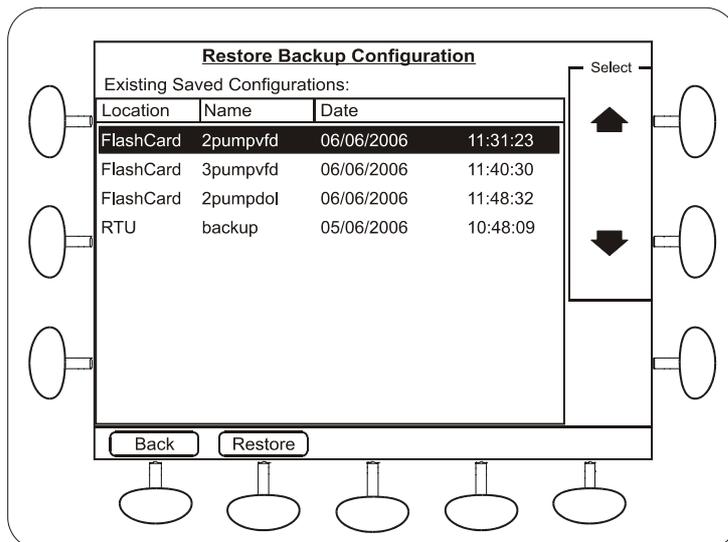
Figure 130 – Restoring Saved Configurations

Select a configuration from the list and press the **Restore** button. You will be asked to confirm the action before proceeding.

31 More Advanced Configuration

Part 3 has detailed many of the configuration settings beyond the Quick Commissioning Guide. The MultiSmart unit has a great deal of flexibility and therefore presents opportunity for advanced users to customize the product for any application. Go to:

[Settings] ⟶ [Advanced]

You will see a Windows Explorer style screen which shows all of the main functional blocks inside the product.

Pressing the [+/-] key by any of these will expand out the options available for that module.
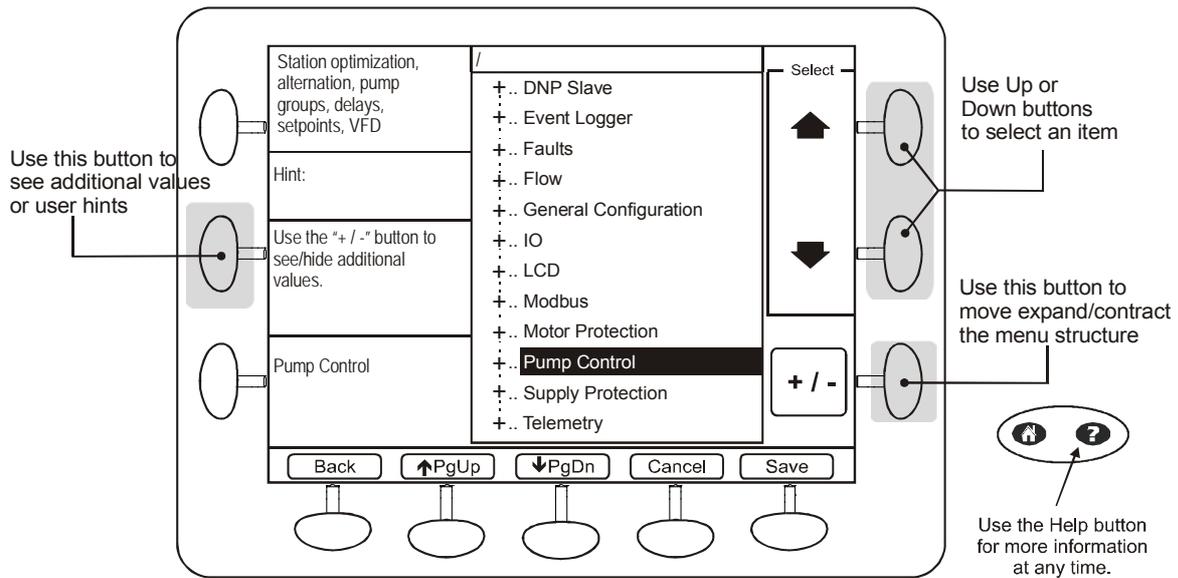
Figure 131 - Advanced Screens

⚠ **NOTE:**
Please refer to the Short Help in the top left corner for each setting.

Pressing the Help key will often provide additional information on the feature or setting.

31.1 Default Mode vs. Showing More Options

There are 2 modes within the Advanced screens. The default mode shows many parameters, but hides some of the more complex or less used features.

To uncover these additional parameters and features, go to:
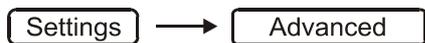
[Settings] ⟶ [Advanced]

- From the tree select: **LCD** [+/-]

- Select **"Show More Options"**

- Press [+/-]

Then exit to the main settings screen via the Back button, and now when you again press Advanced the full list of parameters will be displayed.

31.2 Reference Manual

The full list of all parameters, along with a description, help, the defaults, and the ranges is available in the MultiSmart reference manual, available at www.multitrode.com as an html manual.

32 Troubleshooting

Common problems and their resolution:

32.1 There is no level displayed on my unit

First check the I/O module is reading the input(s) correctly. From the main operator screen, press **Info**, then **I/O Information**, then choose a board (typically Top Board), then select the relevant input type.

32.1.1 Analog level device

If you are using a 4-20mA level device, choose **Analog Input**. If the input is at 0mA then one of the following is the case:

- the level device is not properly connected
- the level device is not properly configured
- there is a problem with the MultiSmart I/O card. Problems with I/O cards can often be seen in the system log in **Info**, **System Log**.

If the input **is** reading between 4-20mA, the pump control module is not configured to use this level device. From the main operator screen, press **Settings**, **I/O faults & level**, **Level devices**. The primary level device will probably be showing a different analog input or a MultiTrode probe – i.e. it has not been correctly configured. You can go back through the **Setup Wizard** which will give you a completely new configuration, or you can simply configure the level device using the **Level Devices** screen, (see Section 14.8).

32.1.2 Probe

If you are using a MultiTrode conductive probe, choose **Digital Inputs**. Check that some of the sensors are covered (the value should be showing as ON). If none of the probe sensors are reading ON, then one of the following is the problem:

- You have not connected the probe
- The probe is not covered with conductive liquid
- There is no ground (earth) return for the probe
- There is a problem with the MultiSmart I/O card. Problems with I/O cards can often be seen in the system log in **Info**, **System Log**.

If the DIN's are showing an ON status, then the pump control module is not configured correctly. From the main operator screen, press **Settings**, **I/O faults & level**, **Level Devices**. The primary level device needs to be changed to **Probe** – or the correct sensors needs to be assigned, (e.g. when the probe is made the level device, by default, DIN2-11 are configured for the 10 sensors. If you have wired the probe to different sensors you can rewire, or change the sensor configuration). You can also go back through the **Setup Wizard** which will give you a completely new configuration, or you can simply configure the probe using this **Level Devices** screen, (see Section 14.8).

32.2 Every time the pump starts I see a Contactor Auxiliary fault

The default wiring diagram for the pump station manager usually includes feedback from the contactor to indicate that the pump has started. If you have followed the wiring diagram correctly then the MultiSmart unit is indicating one of the following

- That the contactor has failed (check contactor)
- The pump output relay is not wired to the contactor (check wiring)
- The output relay has been reconfigured (see Section 14)
- The output relay has a problem (check the **System Log** in the **Info** screen)

If you don't have a contactor auxiliary output, see Section 9.3 for how to unassign this fault.

32.3 My unit is showing a "Current Config Fail" fault

This indicates that the configuration loaded into the unit has a conflict with either enabled modules or boards which have been loaded.

For example, if you copy a configuration file from a unit with energy monitoring and motor protection enabled, into a unit without energy monitoring and motor protection, you may get a Configuration Fail.

Solution – go through the Setup Wizard to re-create your configuration, or load a configuration file from your CF card which is appropriate for the unit.

32.4 My unit has started with the message "Fail Safe Mode"

When in Fail Safe mode, we can see the list of enabled and disabled software modules in the MultiSmart. This may be due to a similar cause to Section 32.3. Follow the same steps.

32.5 PPP2 Manager Connection Error

To find out the cause of the problem enable Debug mode from the **Advanced** menu. To enable this navigate to $\boxed{\text{Settings}} \rightarrow \boxed{\text{Advanced}}$. Using the select arrows navigate to $\boxed{\text{PPP 2 Manager}} \rightarrow \boxed{\text{Connecting Procedures}}$ select your type of modem then select $\boxed{\text{Debug}}$. Restart the MultiSmart so that the debug information about the chat script initialisation can be captured. Remember to turn off debugging mode after the fault finding.

32.6 My unit keeps restarting

When the unit goes through a power cycle hold down the 2 bottom left buttons and the Backspace button, (similar to "Ctrl, Alt, Delete" for a computer). This puts the unit into failsafe mode. (See the highlighted buttons in Figure 132). Every time when the MultiSmart restarts a log is entered into history for which if the value is 3 then it is a hard power restart and if it is 0 then it is a soft restart from:

$\boxed{\text{Settings}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{More}} \rightarrow \boxed{\text{Restart Unit}}$.
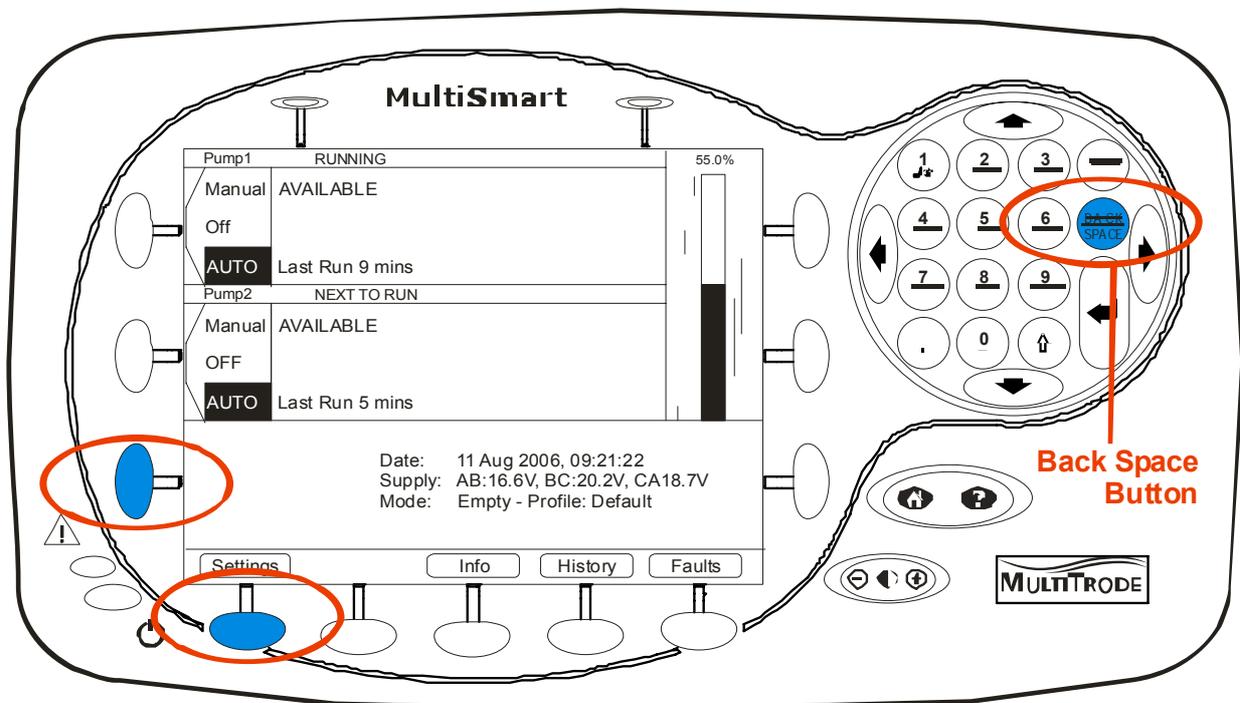
Figure 132 - Setting Failsafe Mode

You should now be able to follow the solution in Section 32.3.

33 Appendix A – Fault Message Glossary

Listed below are the predefined faults that may appear on the MultiSmart.

The faults are based on an empty (or discharge) pump station with 1 pump, 1 well, Motor Protection and Flow enabled.

Fault Name	Description	Default Setting	Default Status	Section Reference
Configuration Faults				
Application Failure	A software module or application has failed	-	On	0
Current config failure	The current configuration has failed	-	On	32
Fail Safe	The current config has failed or the config upgrade process has failed	-	On	32
Config changed – reboot required	The current configuration is changed and the MultiSmart need a reboot for the changes to come into effect; a reminder to the operator	-	On	-
Previous config failure	The previous configuration has failed	-	On	32
Communication Faults				
Comms Channel Conflict-Modbus Slave disabled	A communication channel clash has occurred between DNP3 & Modbus	-	On	-
Comms Channel Failure	The same communication channel has been selected for both DNP3 & Modbus	-	On	-
IO Unit 1 DSP Comms Fault	Unit 1 can not communicate to all other units connected on the Can Bus	-	On	-
Modem Connection Failure	Cellular / PumpView communications can not be established	-	On	-
DC Supply Faults				
DC Over Voltage	DC supply is greater than the specified maximum	100V	On	-
DC Under Voltage	DC supply is less than the specified minimum	0V	On	-
AC Supply Faults (The AC voltage is specified during the Setup Wizard)\				
Over Voltage	AC voltage is greater than the specified maximum	115%	On	18
Under Voltage	AC voltage is less than the specified minimum	90%	On	18
Volts Phase Imbalance	Phase-phase voltages differs by more than the specified minimum	15%	On	18
Volts Phase Rotation	The incorrect phase rotation (or phase sequence) is connected	-	On	18
Probe Faults				
IO Unit 1 Probe 1 Error	A sensor lower than the highest active sensor is not active - on Probe 1	-	On	-
IO Unit 1 Probe 2 Error	A sensor lower than the highest active sensor is not active - on Probe 2	-	On	-
Pump – Standard Faults				
Pump 1 CB Off/Trip	Circuit Breaker has tripped	-	On[1]	-
Pump 1 Contactor Auxiliary	Contactor has failed to close (Active input (1) = no fault)	-	On	9.3
Pump 1 Critical	A user definable fault (A link or source required)	-	On	-
Pump 1 Delay Fail	Fault input timed out after pump started (Active input (1) = no fault)	-	On	-
Pump 1 Holdout	A user definable fault (A link or source required)	-	Off	-
Pump 1 Max Starts	Number of pump starts is greater than the specified maximum	0	Off	-
Pump 1 Motor Over Temp	Motor Thermal switch (e.g. PTC Thermistor) has activated (Input inverted)	-	On	-
Pump 1 Non Critical	A user definable fault (A link or source required)	-	On	-
Pump 1 Pulse Start	A pump based Pulse Start has been initiated	-	Off	16.9
Pump 1 Pulse Stop	A pump based Pulse Stop has been initiated	-	Off	16.9
Pump 1 Seal	Conductive Seal sensor has activated (Sensitivity 40 k Ohms)	-	On[2]	9.2.8

Fault Name	Description	Default Setting	Default Status	Section Reference
Pump 1 Thermal Overload	In circuit Thermal Overload device has activated	-	On[2]	9.2.8
Pump – CLS / FLS Faults				
Pump 1 CLS (assigned input description) (2 faults, 1 digital input) (Threshold resistance values are fixed)				
Displayed as Pump 1 CLS Flygt Thermal	CLS (Capacitive Leakage Sensor) Thermal fault (motor over temperature)	$>4k\Omega$	Off	7.3.2.1
Displayed as Pump 1 CLS Flygt Seal	CLS (Capacitive Leakage Sensor) Seal fault (water in oil chamber)	$<1k\Omega$	Off	7.3.2.1
Pump 1 FLS (assigned input description) (2 faults, 1 digital input) (Threshold resistance values are fixed)				
Displayed as Pump 1 FLS Flygt Thermal	FLS (Flygt Leakage Sensor) Thermal fault (motor over temperature)	$>4k\Omega$	On[1]	7.3.2.1
Displayed as Pump 1 FLS Flygt Seal	FLS (Flygt Leakage Sensor) Seal fault (liquid in the stator housing)	$<545\Omega$	On[1]	7.3.2.1
Pump – Flow Faults (Default nominal flow rate of 100.0)				
Pump 1 High Flow Fault	Flow rate is greater than the specified maximum	150%	Off	20.5
Pump 1 High Flow Warning	Flow rate is greater than the specified maximum	150%	Off	20.5
Pump 1 Low Flow Fault	Flow rate is less than the specified minimum	150%	Off	20.5
Pump 1 Low Flow Warning	Flow rate is less than the specified minimum	150%	Off	20.5
Pump – Motor Protection Faults (Default FLC = 5.0 A)				
Pump 1 Amps Phase Imbalance	Phase-phase current differs by more than the specified maximum	20%	Off	17.1.2
Pump 1 Amps Phase Rotation	The incorrect phase rotation (or phase sequence) is connected	-	Off	17.1.2
Pump 1 Ground (Earth) Fault	The sum of the phase currents is greater than the specified maximum	25% FLC	Off	17.1.2
Pump 1 Insulation Resistance	The insulation resistance measured is less than the specified maximum	$1.0\,M\Omega$	Off	17.2
Pump 1 Insulation Res Warning	The insulation resistance measured is greater than the specified warning level	$5M\Omega$	Off	-
Pump 1 Over Current	The motor current is greater than the specified maximum	110% FLC	Off	17.1.2
Pump 1 Over Current I2T	The I2T motor current is greater than the specified maximum	$3000A^2s$	Off	-
Pump 1 Under Current	The motor current is less than the specified minimum	1% FLC	Off	17.1.2
Groups				
Group 1 Blocked Pump Detection	Number of Standby pump starts equals the specified maximum	3	Off	16
Group 1 Pulse Start	A group based Pulse Start has been initiated	-	Off	16.9
Group 1 Pulse Stop	A group based Pulse Stop has been initiated	-	Off	16.9
Well Faults (First 3 faults in Well Faults List)				
Overflow	The level is greater than the specified Overflow level (Flow module must be enabled)	100%	Off	-
Well 1 Analog Compare Fault	The difference in the level between the primary and the backup level devices is greater than the specified threshold.	5%	Off	-
Well 1 Level Locked	The level has changed by less than the specified amount in the specified time. (The timed period can be a fixed amount of time or a period of the day, e.g. 14:30 to 17:00). Up to four timed periods can be specified.	5%, 30min	Off	-
Well 1 High High Level	Level has reached the High High level	96.0 - 98.0	Off	12.3.3
Well 1 High Level	Level has reached the High level	87.0 - 92.0	On	12.3.3
Well 1 Low Low Level	Level has reached the Low Low level	4.0 - 6.0	Off	12.3.3
Well 1 Low Level	Level has reached the Low level	10.0 - 15.0	Off	12.3.3
Well 1 Backup Level Ain Over Range	The current of backup level device is greater than specified maximum	20mA	On	-
Well 1 Backup Level Ain Under Range	The current of backup level device is less than the specified minimum	4mA	On	-
Well 1 Backup Level Invalid	Communications to the backup remote level has failed	-	On	-
Well 1 Primary Level Ain Over Range	Primary level device current is greater than the specified maximum	20mA	On	14.6

Fault Name	Description	Default Setting	Default Status	Section Reference
Well 1 Primary Level Ain Under Range	Primary level device current is less than the specified minimum	4mA	On	14.6
Well 1 Primary Level High Range	Primary Level < HRP and Backup level > HRB HRP = High Range Primary level, HRB = High Range Backup level	80%, 95%	On	14.6
Well 1 Primary Level Invalid	Communications to the primary remote level has failed	-	On	-
Well 1 Primary Level Low Range	Primary Level > LRP and Backup level < LRB LRP = Low Range Primary level, LRB = Low Range Backup level	15%, 5%	On	14.6
Well 1 Pulse Start	A well based Pulse Start has been initiated	-	Off	16.9
Well 1 Pulse Stop	A well based Pulse Stop has been initiated	-	Off	16.9
Station Faults				
Max Off Time	Off time of any pump is greater than the specified maximum	6h	Off	16
Max Run Time	The run time of any pump is greater than the specified maximum	30min	Off	16
Power Failure	A user definable fault (A link or source required)	-	On	-
Station Pulse Start	A station based Pulse Start has been initiated	-	Off	16.9
Station Pulse Stop	A station based Pulse Stop has been initiated	-	Off	16.9
Station Low Flow Fault	Station Flow rate is lower than the expected flow rate by an amount of preconfigured percentage of the expected flow	100%	Off	20
Station Low Flow Warning	Station Flow rate is lower than the expected flow rate by an amount of preconfigured percentage of the expected flow, to give a warning to the operator	120%	Off	
IO Unit – Analog Inputs (No default Sources are linked to these faults)				
IO Unit 1 Ain 1 Over Range	Analog input current is greater than the specified maximum	20mA	On	-
IO Unit 1 Ain 1 Under Range	Analog input current is less than the specified minimum	4mA	On	-
IO Unit 1 Ain 2 Over Range	Analog input current is greater than the specified maximum	20mA	On	-
IO Unit 1 Ain 2 Under Range	Analog input current is less than the specified minimum	4mA	On	-
Generator faults (No default Sources are linked to these faults)				
Generator Running	Generator supply is currently being used	-	Off	-
Generator Fault	Generator is faulty	-	Off	-

⚠️ *1:*
*These are default inputs only when **Flygt FLS** inputs are selected as part of the Setup Wizard*

⚠️ *2:*
*These are default inputs only when **Thermal/Seal** inputs are selected as part of the Setup Wizard*

34 Technical Specifications

34.1 Processor Unit

Type	Intel PXA255
Speed	200MHz
Flash Memory	32MByte
RAM	64MByte
Real-time Clock	Yes
Serial Ports	RS232 x 3 115kBit/s
Ethernet Port	10Mbit/s
Compact Flash Port (CF)	Yes

34.2 RTU/Communications

Protocols	DNP3 level 2, Modbus
Media	TCP, RS232
Datalogging	Change of state for digital, deadbanding for analog. Date, time and quality stamped 50,000 events stored (more with Compact Flash option)

34.3 Firmware/Application Upgrade Capability

Local	Via serial or Ethernet from PC Via Compact Flash

34.4 I/O Standard Modules

Digital Inputs (DIN)	20
Digital Outputs (DOUT)	7
Analog Inputs (AIN)	2
Analog Outputs (AOUT)	1
Voltage Inputs (VIN)	3

34.5 I/O-3MP: Motor Protection I/O Board

Current Inputs (IIN)	9
Insulation Resistance Testing (IRT)	1000v x 3
Digital Outputs (DOUT)	5
Analog Outputs (AOUT)	3

34.6 Power (per unit)

Start Up	30w
Continuous	15w

34.7 Power Supply & Environmental

DC Supply (monitored to 5% accuracy)	11v-25v
Ambient Temperature	-10°C to +60°C
Storage Temperature	-40°C to +90°C
Humidity	5% to 95% (non-condensing)
IP Rating	Controller: IP20 (Nema 1 equivalent) Display (Faceplate): IP65 (Nema 4 equivalent)

34.8 Product Dimensions

Controller	H 173 x W 217 x D 159 (mm)	H $6^{3/4}$ x W $8^{1/2}$ x D $6^{1/4}$ (in)
Display (Faceplate)	H 144 x W 250 x D 42 (mm)	H $5^{5/8}$ x W $9^{7/8}$ x D1$^{5/8}$ (in)

35 MultiTrode Terms & Conditions of Sale

A full copy of the MultiTrode Standard Terms and Conditions of Sale is available for download from the website: www.multitrode.com.

Index

Administrative Password

The administrative password and site code for this MultiSmart unit are as follows:

**Place Security Password
Label here.**

You will need this password to make use of the security features of the product.
MultiTrode recommends changing the password during the initial setup process.
See Section 11 Security for more information.

WATER • WASTEWATER • PUMP STATION • TECHNOLOGY

MultiTrode Pty Ltd—UK Operations	MultiTrode Pty Ltd—Head Office	MultiTrode Inc—USA
Ph: +44 1173 660156	Ph: +61 7 3340 7000	Ph: +1 561 994 8090
Fx: +44 1794 518810	Fx: +61 7 3340 7077	Fx: +1 561 994 6282
E-mail:UKsales@multitrode.com	E-mail: AUsales@multitrode.com	E-mail: USsales@multitrode.net

Visit www.multitrode.com for the latest information