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MultiSmart
Pump Station Manager & RTU

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

Revision 17

15 April 2011

This manual is used for v2.3.5 of the MultiSmart Pump Station Manager

Summary of Tables

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 MultiSmart for your application. After reading, place the manual 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

Terminology

Activation Level	The point at which a pump or alarm is switched On.
Alternate Mode	The Pump Station Manager 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 Station Manager is set to empty a tank or pit.
Fill (Charge) Mode	When the Pump Station Manager 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 IEC 61131-3 control languages and offers a combination of highly portable and robust control engine.

Abbreviations, Symbols & Units

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

3 Major New Features & Enhancements in Recent Firmware Releases

3.1 Version 2.3.2 – 2.3.5

- Support for PumpView v3
- Pump efficiency as a function of head pressure
- Alternation by pump efficiency now supports N:1 ratio
- Pump alternation supports N:M ratio, e.g. 3:2
- New “heartbeat” or watchdog functionality for the pump control module
- Multiple flow meter support added
- ISaGRAF serial port functions

3.1.1 Screen Changes

- User selectable flow units added: kLitres, MLitres, kgals, Mgals
- N:1 alternation ratio can be changed via the alternation screen

3.2 Version 2.3.2

3.2.1 New Features

- Analog Watcher
- Restart tag added
- Disable individual ISaGRAF program via user interface
- Maintenance mode added for Modbus
- Alternation by efficiency improvements

3.2.2 Screen Changes

- Main screen displays current as a percentage of motor FLC

Part 1 – Operations

4 Introduction

Congratulations on your purchase of the MultiTrode MultiSmart Pump Station Manager.

Depending on the options you have purchased, the unit may be configured as either a Pump Station Manager or a reservoir monitor or as a Remote Telemetry Unit. The generic product description of MultiSmart Pump Station Manager is used throughout the manual and for convenience refers to any of the three configurations.

The pump station manager is an "out of the box" Pump Station Manager 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 costs.

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 IEC 61131-3 PLC programming language so that additional functionality can be added by the user if required.

The MultiSmart has fully open communications and can be supplied with Modbus and DNP3 protocols. A MultiSmart 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.

MultiSmart is fully configurable from the LCD user interface. However, there is also a PC-based configurator program with limited functionality now available.

4.1 Range of Options

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

- DNP3 RTU with security
- Security key - based on the ‘Dallas Key’
- VFD control - variable frequency/speed drive
- “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 (IEC 61131-3) PLC programming
- Well Mixer
- PumpView – a web-based monitoring and control system via the cellular/mobile network

The product can be shipped with these software modules enabled or they can be enabled in the field with the appropriate enable code. To the base unit, an additional I/O board can be installed in the factory to allow for either an expansion of I/O or motor protection options.

4.2 Intuitive Operator Interface

The MultiSmart 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, DC supply
- Fault and event history (up to 50,000 records)
- 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
- Duration to Overflow

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

When the unit is first powered up, it starts controlling a pump station using its default parameters. Although it's shipped with this basic configuration, by running through the **Setup Wizard**, the configuration can be easily modified to suit a wide range of applications.

The Setup Wizard takes into account the MultiTrode probe or other level devices, fill or empty applications, number of pumps, number of wells, station power supply, type of pump sensors 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, the number of pumps, the number of wells, or empty (discharge) to fill (charge) is done through the Setup Wizard and takes only a few minutes, which is far less time than that required to implement the same functionality using a standard PLC.

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

If the extensive range of existing features do not cover a particular requirement, additional functionality can be added by writing new code using either, Logic Engine (a simple Boolean language) or ISaGRAF (a suite of PLC languages).

5 Operator Interface

The MultiSmart pump station manager has an easy to use interface featuring a large graphical LCD display A large amount of critical information is displayed on the main screen making it simple for an operator to determine the current status at a glance.

The buttons (or softkeys) around the edge of the screen are used to access features depending on what is displayed at the time.

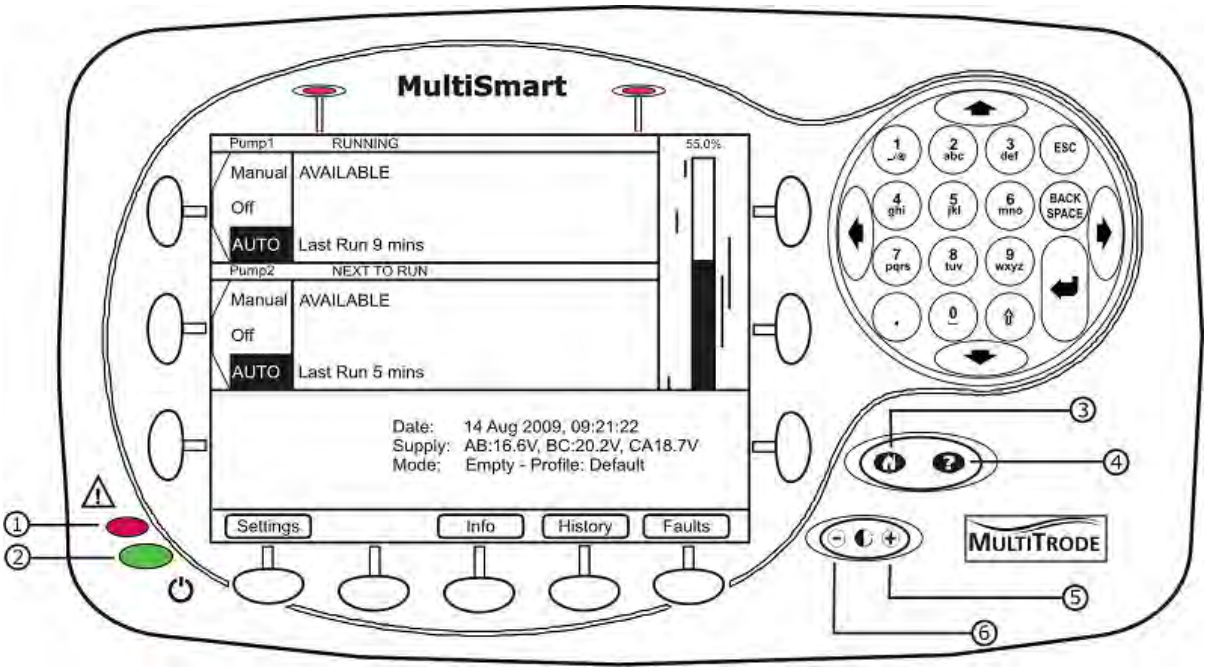


Figure 1 – MultiSmart Display

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

5.1 LCD Panel

The large LCD 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 display buttons are pushed. The backlight turns off again after a set time of inactivity (this time is user configurable). The display colours can be inverted, that is, the LCD panel can be set to display text in a dark colour with a light background.

5.2 LED Indicators

5.2.1 Power

The Power LED is at the bottom left hand corner of the display 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 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. For any screen, the display indicates what each button is used for.

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. The following screen displays the current status of all pumps connected to the MultiSmart:

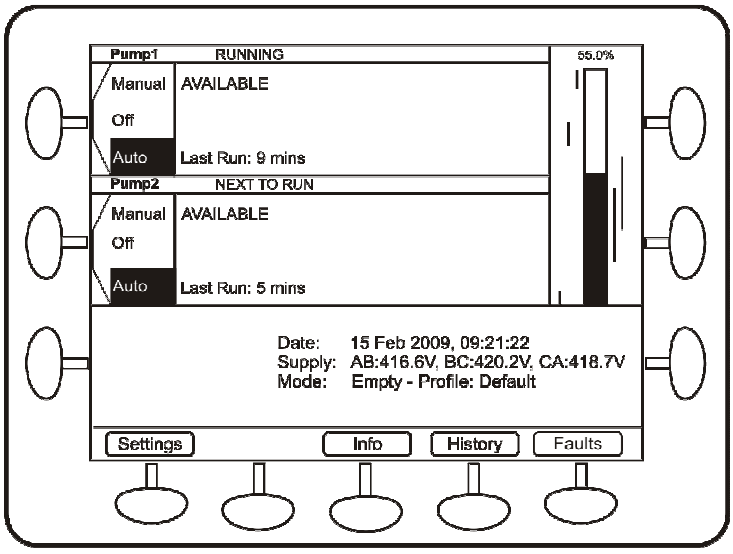


Figure 2 – Main Status Screen

5.4.1.1 Pump Mode

The buttons located next to each pump are used to switch the pump into Manual (Hand), Off, or Auto modes.

- **Auto** – In this mode a pump starts when the activation setpoint is reached. The pump automatically stops when the deactivation setpoint is reached.
- **Off** – This turns a pump off, so pump run commands are ignored by the off pump regardless of level. In order to meet security requirements, the Off mode can be disabled from the advanced menu. (If changed while the pump is already in the Off mode, it stays off until the mode changes).
- **Manual** (Hand) – is semi-automatic manual, as the mode returns automatically to Auto when the deactivation setpoint of the pump is reached. (This prevents pumps from being left on unintentionally).

  A pump is placed 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 on. This puts the pump into Full Manual mode for as long as the button is pressed.

5.4.1.2 Running Status

The *Running Status* of each pump appears to the right of the *Pump Name*. The various states are:

- **Stopped** – Pump is stopped
- **Starting in x seconds** – Pump is about to start and a delay is counting down
- **Running** – Pump is running
- **Stopping in x seconds** – Pump is about to stop and a delay is counting down
- **Next to Run** – Indicates the next pump to run. (Not applicable in multiple well configurations).
- **Request to Run** – The controller is waiting for the feedback from the contactor. (A contactor auxiliary is wired in and the command to run a pump has been sent).
- **External Run** - If the pump is started by an external control method (for example, via a manual override switch), the contactor will be closed but no run command would have been sent by the controller, hence *External Run* is displayed. The MultiSmart continues to update the pump run time statistics and other relevant historical data, in addition the relevant faults and warnings are generated.
- **Reversing in x seconds** – the pump is about to reverse
- **Reversing for x seconds** – the pump is currently being reversed
- **Decommissioned** – the pump has been taken out of service

5.4.1.3 Availability Status

The *Availability* of each pump is displayed below the *Running Status*. The states are:

- **Available** – There are no current faults for this pump. The pump is available to run (this condition does not consider the mode of the pump, so if the pump is OFF the pump will not run).
- **Unavailable** – A fault is present or a fault requires manual acknowledgment.
- **Hold Out** – The text," Hold Out" flashes indicating a fault is present and the pump is unavailable.
- **Inhibit** – Station or individual pump inhibited from SCADA

5.4.1.4 Fault Status

The *Fault Status* of each pump is displayed below the *Availability Status*. The states are:

- **Fault Present**
- **Ack Required** – A fault condition has cleared and is not holding out the pump, but requires acknowledgement.
- **Reset Required** – A fault condition has cleared and is holding out the pump, so requires reset (see Section 5.4.2).
- **Reset in x sec** – A fault condition has cleared and the pump will auto-reset when the countdown is complete.

5.4.1.5 Level Indication and Setpoints Display

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

- Current liquid level
- Each pump's activation and deactivation levels
- Level alarms that have been enabled

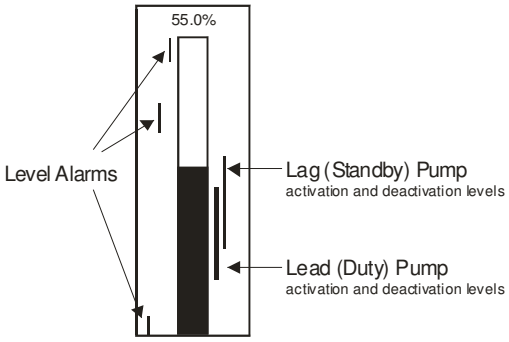


Figure 3 – Level Indication

5.4.1.6 Softkeys

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 5 or more pumps, a **Next Pumps** button also appears on the bottom line allowing access to pumps 5 and 6, etc. This button is also present when the unit is configured for more than 1 well.*

5.4.2 Faults / History

When a fault occurs a large **FAULT** box is displayed at the bottom of the screen. At the same time, the fault status changes to **Fault Present**.

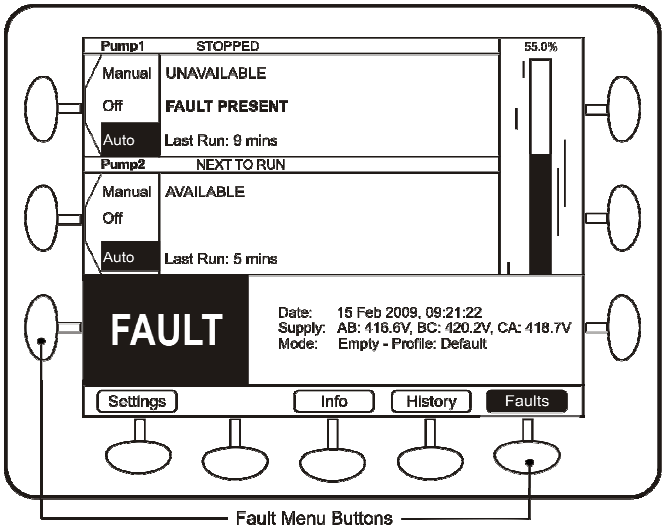


Figure 4 – Fault Indication

The left **Fault** Softkey button flashes when a fault is present. Pushing this button (or the right Faults button) displays a screen which details the fault. (Appendix A contains a description of all faults displayed).

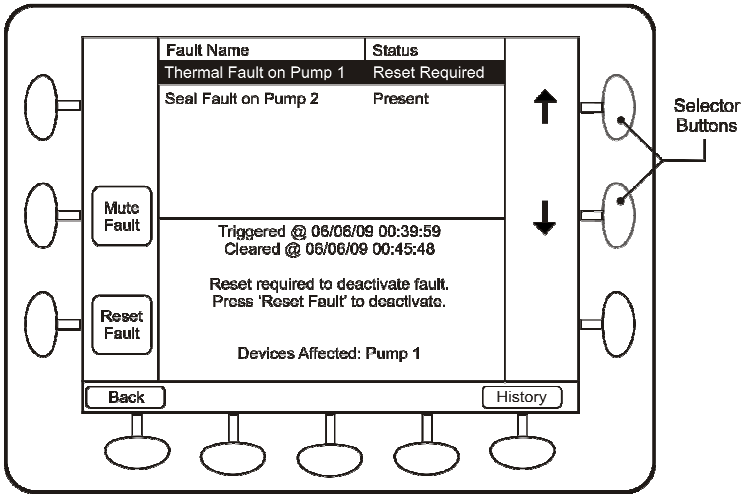


Figure 5 – Fault Reset Screen

Use the selector buttons 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 **Reset Fault** button does not appear**.**

A **Mute Fault** button appears for faults that can be muted. It is used to stop 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 digital output can be configured for *Pulsed* or *Steady* operation and is typically connected to an external warning light or alarm.

- The **Mute button** is only available for other faults, if the user has configured them to be mutable.
- Pressing the **History** button displays the entire fault & event history log (up to 50 000 records).
- Pressing the **Main** button returns the operator to the main status screen.

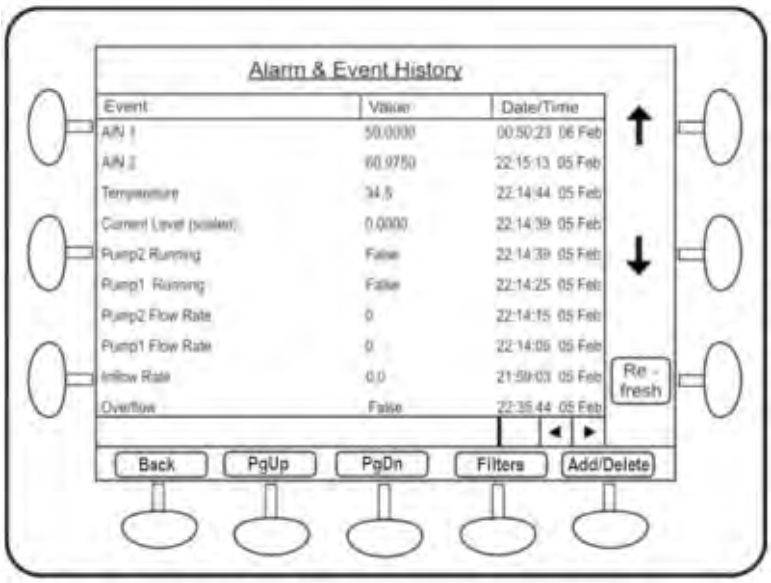


Figure 6 – Fault History Screen

Section 19.4 explains more about **Filters** and section 19.7explains the **Add**/**Delete** button.

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
- Option to browse MultiSmart internal tag database
- 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.

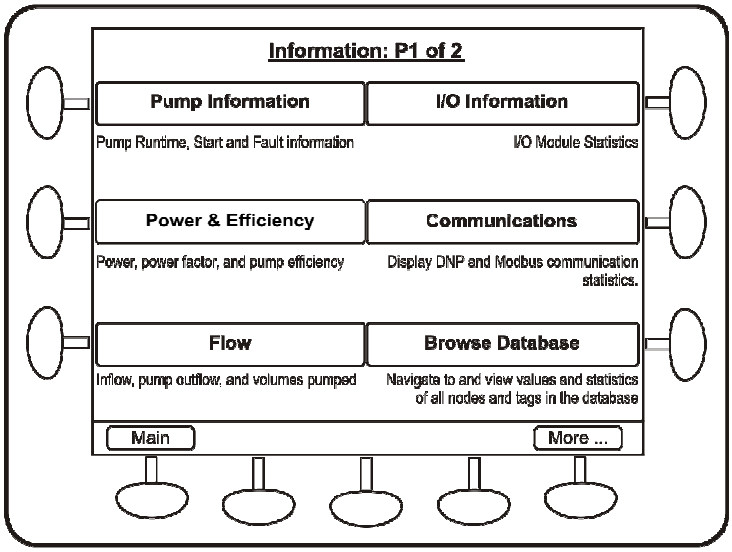


Figure 7 – Information Screen 1 of 2

Pressing **More** displays the second screen which includes the **Version** button which gives details on the firmware version installed on the unit. (Free firmware upgrades are available from the MultiTrode website).

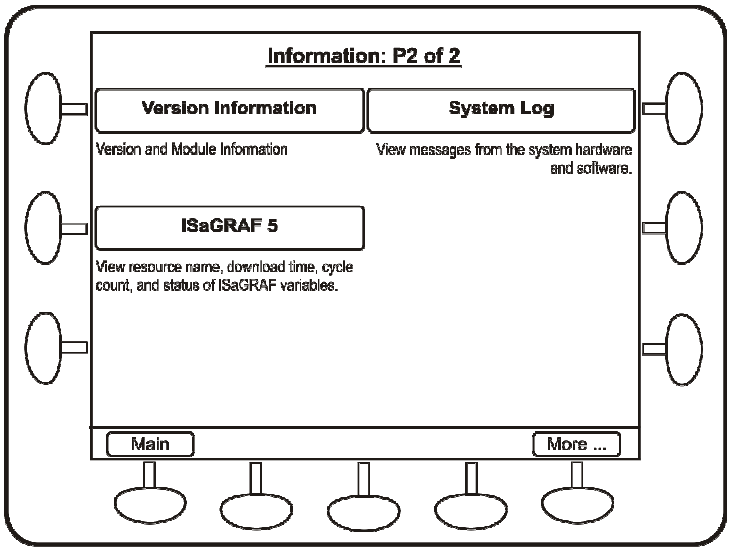


Figure 8 – Information Screen 2 of 2

5.4.3.1 Power & Efficiency

This screen shows the value of 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 are displayed on this screen. There is also a **Benchmark Efficiency** (further down the screen) which can be entered as a comparison value (see section 17.1).

Navigate to: Info → Power & Efficiency

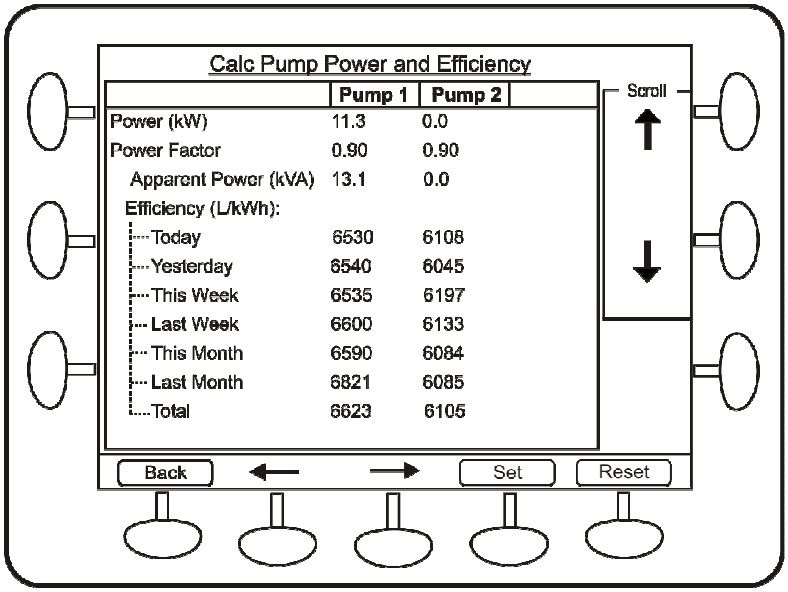


Figure 9 – Power Efficiency Screen

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. The I/O information screens are especially useful in troubleshooting input/output related issues. Insulation Resistance test (IRT) can be accessed from within the I/O information screen, (the test is only performed when the pumps are not running).

Navigate to: Info → I/O Information

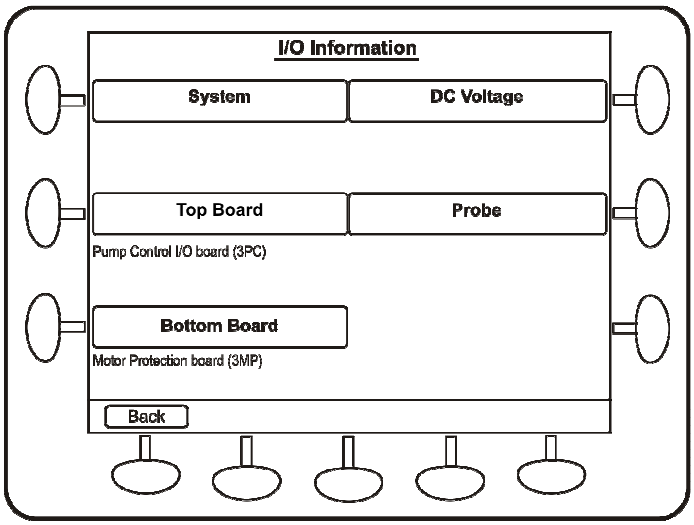


Figure 10 – I/O Information Screen

To determine the configuration and current state of the digital inputs, navigate to the **I/O Information: Digital Inputs** screen. Info → I/O Information → Top Board → Digital Inputs

The current state of a digital input is displayed on the top line; **Value**.

Press the **Advanced** button to display configuration information on the digital inputs, for example Mode and Sensitivity.

The resistance as measured by the input can also be displayed. Press the 4th button on the button row to display the resistance (not labelled on screen). When the measured resistance is below the Sensitivity then the input turns on.

NOTE:

The Sensitivity used by the probe (default of 22k ohms, Section 14.8.3) is not the same Sensitivity found in the digital inputs advanced options.

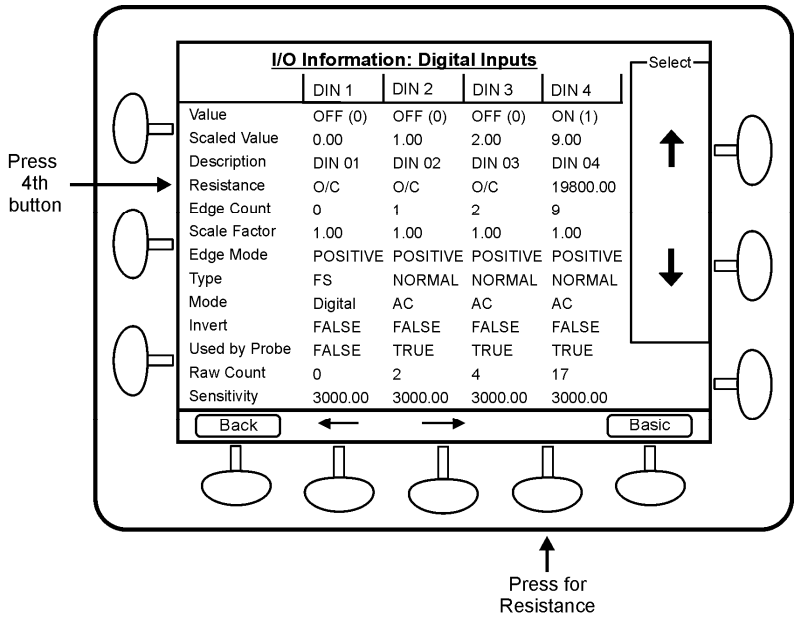


Figure 11 – Digital Inputs Information Screen

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.

Navigate to: Info → Flow

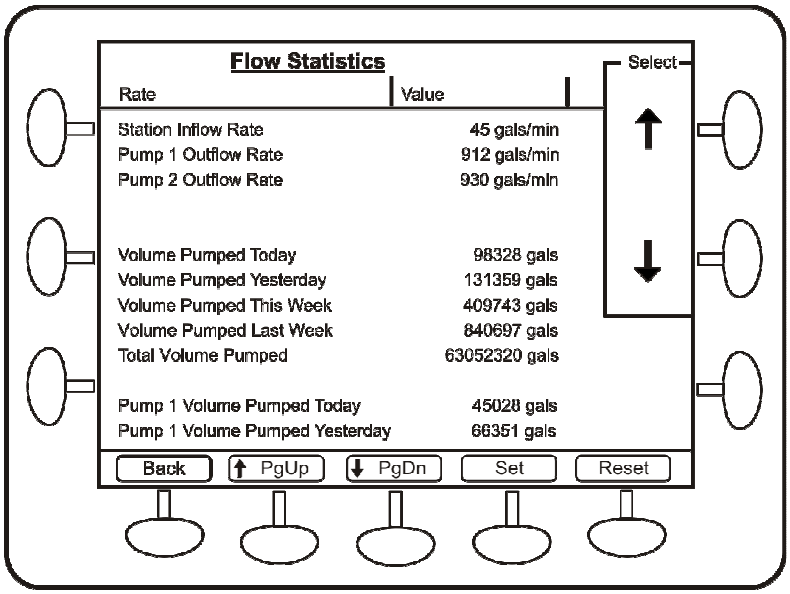


Figure 12 – Flow Screen – Part 1

Navigate to: Info → Flow and scroll down.

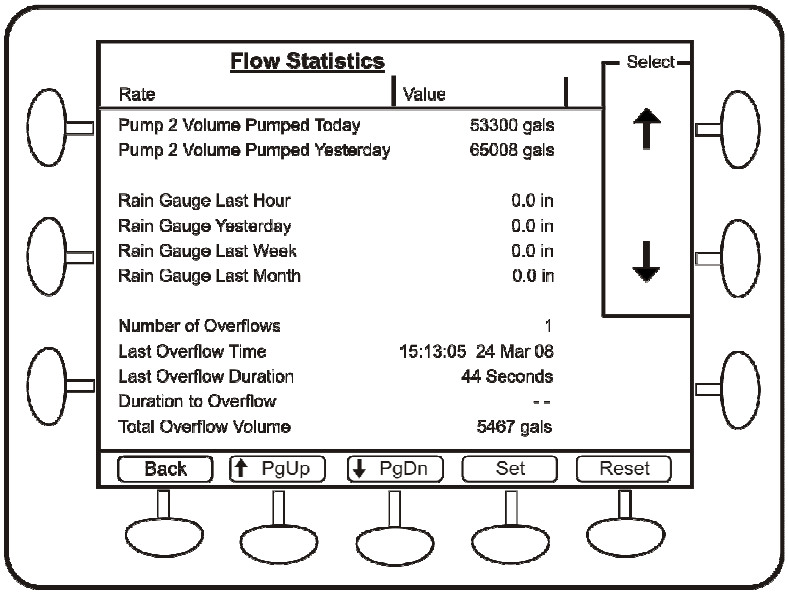


Figure 13 – Flow Screen - Part 2

5.4.3.4 Pump Information

Under this screen, the Runtime, Start and Fault statistics as well as IRT information can be accessed. These options are illustrated in this section.

(a) Runtime Statistics

Navigate to: Info → Pump Information → Runtime Statistics

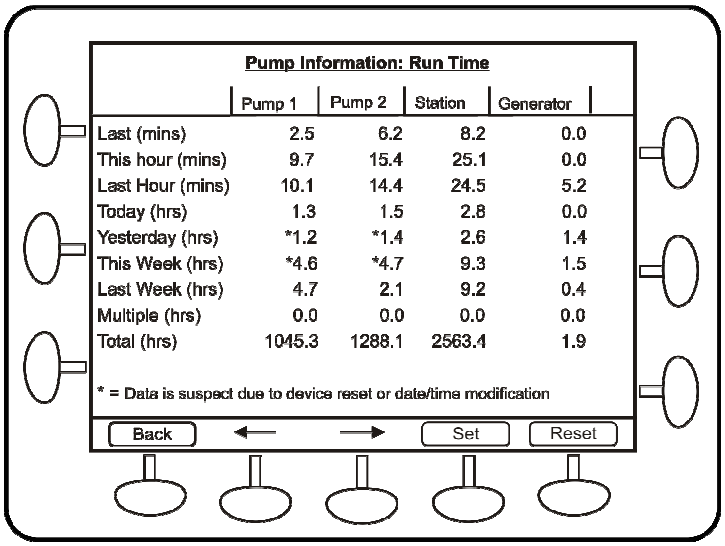


Figure 14 – Pump Run Time Statistics

Runtime is calculated based on when the pump is considered running via the contactor auxiliary status. This includes when the pump is externally run (determined via the contactor auxiliary status). If no contactor auxiliary is wired in the runtime is calculated from when the pump is called for by MultiSmart and external pump runs (e.g. via external switch) will not be included. This is also the case for Starts (below).

In the case of the runtime statistics, the station runtime may not equal the sum of the pump runtimes. For example, if Pump 1 is running for 1 hour by itself, followed by Pump 2 running for 1 hour by itself, then both pumps run for 1 hour together. The Pump 1 and Pump 2 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.

For the Generator Run Time statistics to be calculated; a digital input must be wired into the MultiSmart and configured as the **Generator Running** fault.

(b) Start Statistics

Navigate to: Info → Pump Information → Starts Statistics

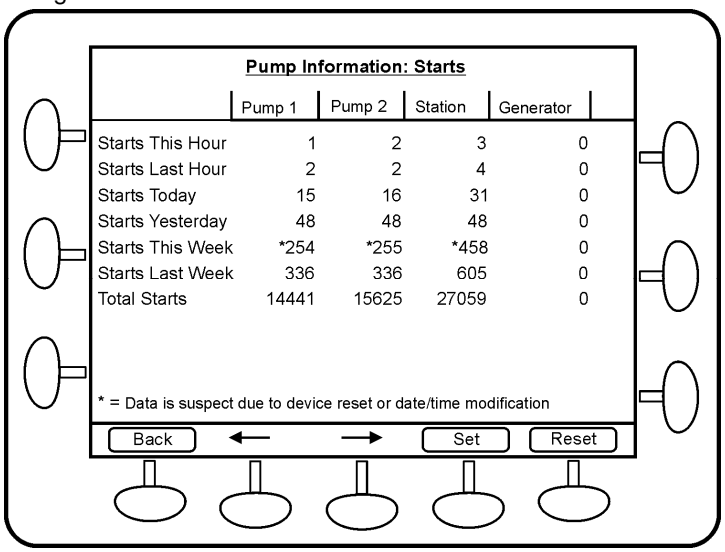


Figure 15 – Pump Start Statistics

(c) Fault Statistics

Navigated to: Info → Pump Information → Faults Statistics

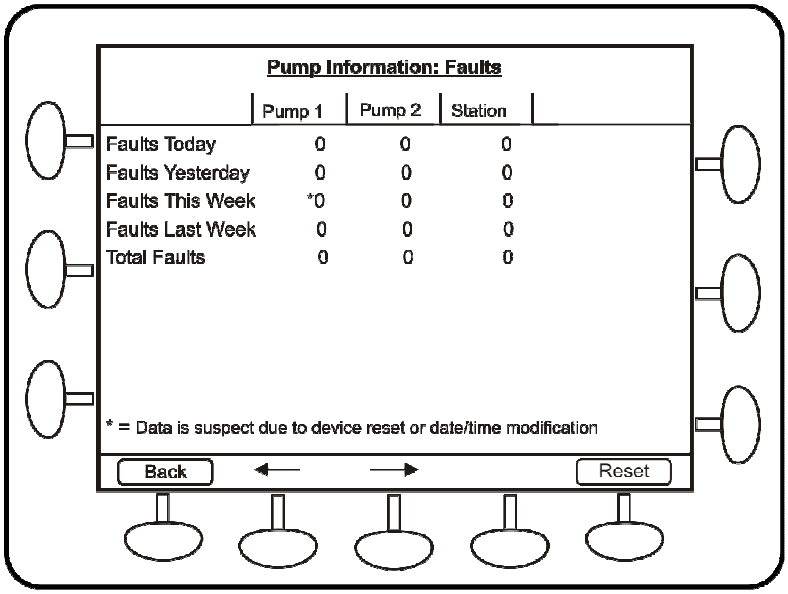


Figure 16 – Fault Statistics

Displays the total faults that occurred, today, yesterday, this week and last week for each pump and the station.

(d) Insulation Resistance

Navigated to: Info → Pump Information → Insulation Resistance

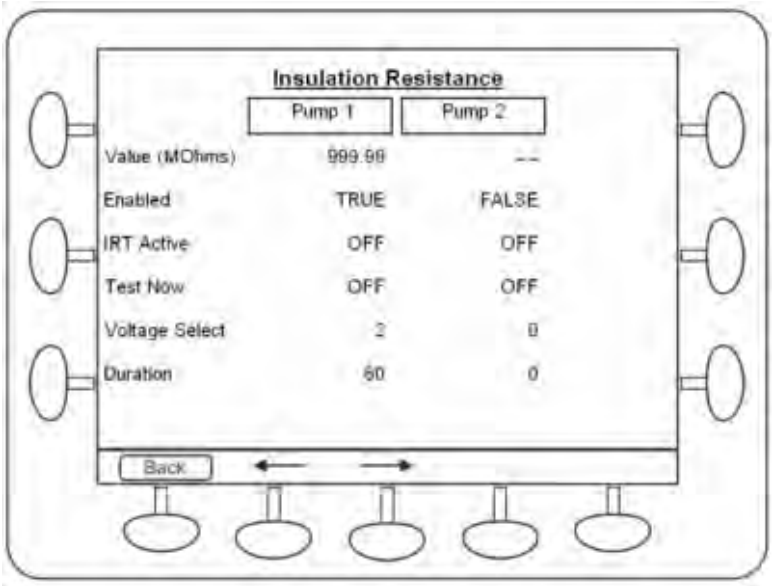


Figure 17 – Insulation Resistance

The insulation resistance test can be activated from this screen. The result of the test and related values are displayed in this screen. This test can only be performed when the pump is not running. (IRT 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 in real-time helps with trouble shooting communication errors. If logging is enabled (via the **Advanced** menu) and the **View Log** button is pressed, then the related communications messages are displayed. (If both DNP and Modbus masters and slaves are present, a second screen is created to cover all stats and values).

Navigate to: Info → Communications

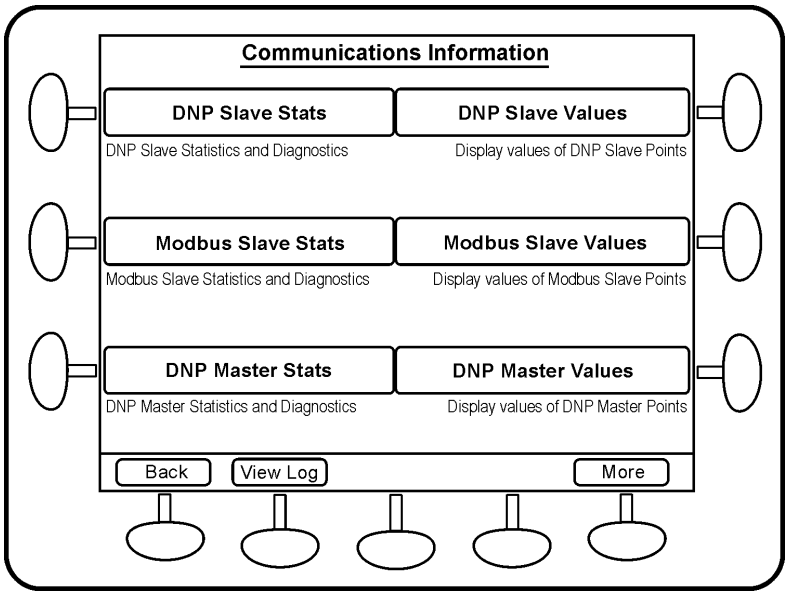


Figure 18 – Communications

5.4.3.6 Browse Database

The **Browse Database** menu options lists all nodes within the real-time database in the MultiSmart. The tags are categorized and grouped into nodes as illustrated below. Each node can contain a list of tags as well as a number of child nodes. This screen allows for the selection & display of the real-time value of a tag.

Navigate to: Info → Browse Database

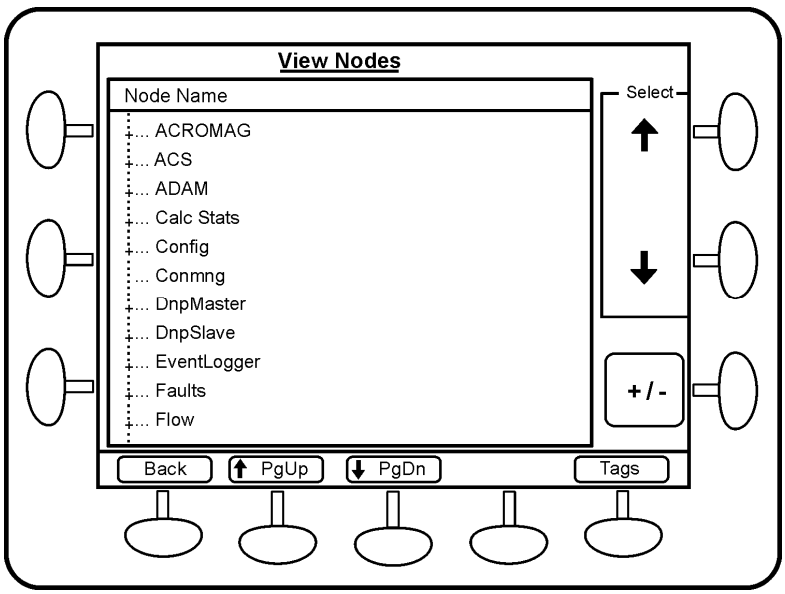


Figure 19 – Browse Database

5.4.3.7 Version Information

The hardware and software versions and the MultiSmart serial number are displayed in this screen. This information may be required if MultiSmart technical support is requested. (The MultiSmart firmware version is listed beside the **Build Version**).

Navigate to: Info → More... → Version Information

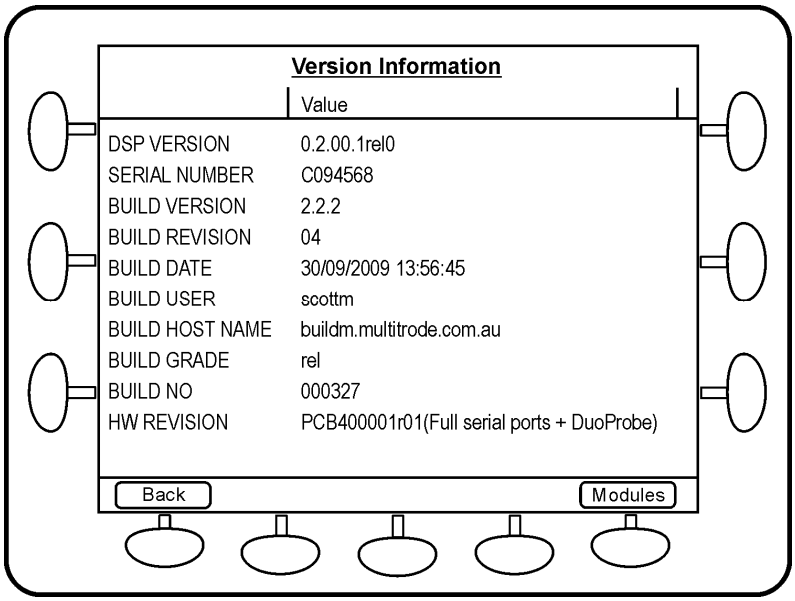


Figure 20 – Version Information

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.

Navigate to: Info → More... → ISaGRAF 5

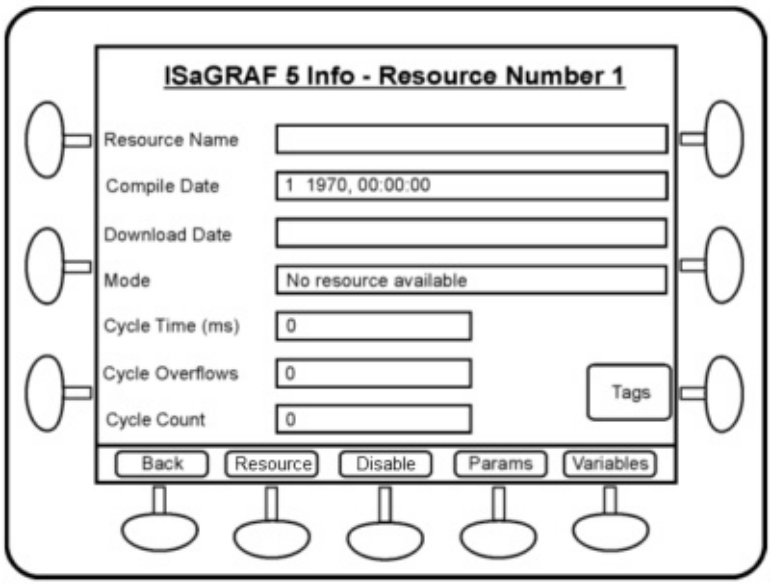


Figure 21 – ISaGRAF Resource Summary Screen

Pressing **Resource** cycles to the next "application" and **Disable** allows the user to stop one or many ISaGRAF "Resources" from running.

5.4.3.9 System Log

System Log displays any system errors with a time stamp.

Navigate to: Info → More... → System Log

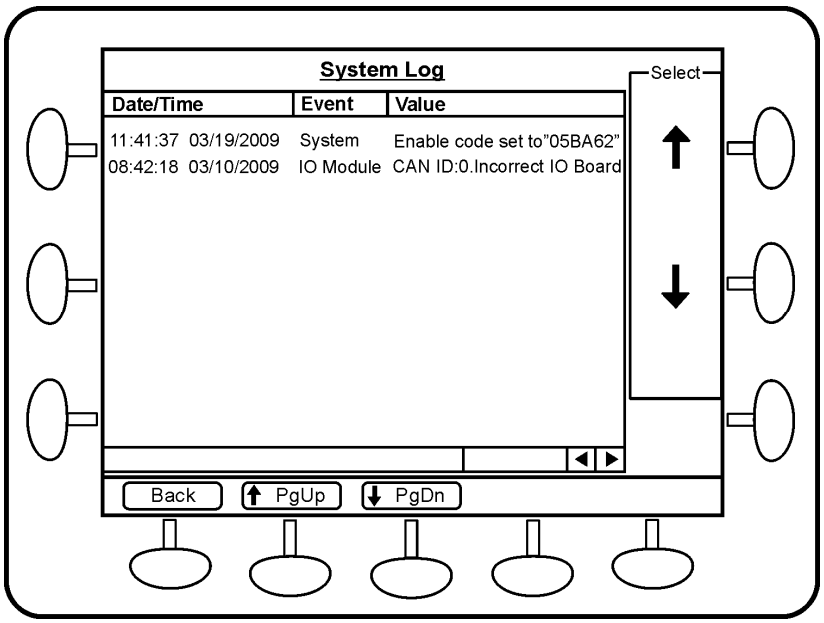


Figure 22 – System Log

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 **Advanced** button in the **Settings** menu.

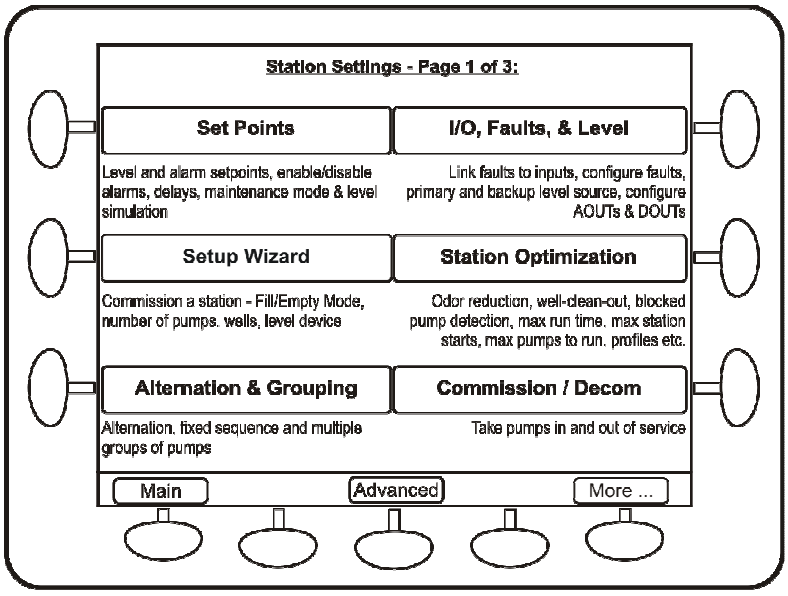


Figure 23 – Settings Screen

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 come into effect as soon as the changes are saved. If a restart is required MultiSmart prompts the user with two options, **Restart Now** and **Restart Later** as shown in the figure below.

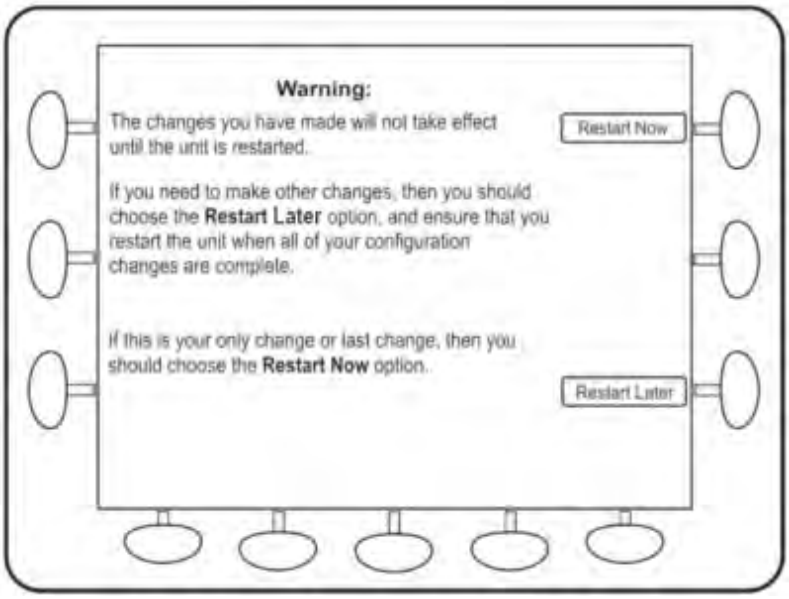


Figure 24 – Reboot Screen

If **Restart Now** is selected the unit saves the current values and reboots immediately before any further configuration changes can be performed. If further configuration changes are needed, choose **Restart Later**.

If **Restart Later** is selected the MultiSmart resumes normal operation, however the new changes do not come into effect until after a reboot, and the restart prompt is no longer displayed. A fault is displayed on the main screen to remind the user that a reboot is required.

NOTE:
The restart option in some cases is not displayed. For example, for some major changes like adding a new DNP slave profile, the MultiSmart skips the restart option prompt and performs an immediate reboot to bring the new changes into effect immediately.

Part 2 – Installation & Commissioning

6 Mounting Instructions

The MultiSmart pump station manager is mounted on a standard DIN rail on a panel inside an enclosure. The operator interface is usually mounted on the (dead) front door of the enclosure. The two units are connected together with the cable supplied.

6.1 Mounting the Operator Interface Display

The operator interface (LCD display) is mounted to the door with 8 x M4 hex head screws (supplied). A 25mm (1") hole must be cut to accommodate the cable connecting the interface to the controller. Drilling dimensions are given below. Note, this drawing is not to scale. (See Appendix B for a mounting template).

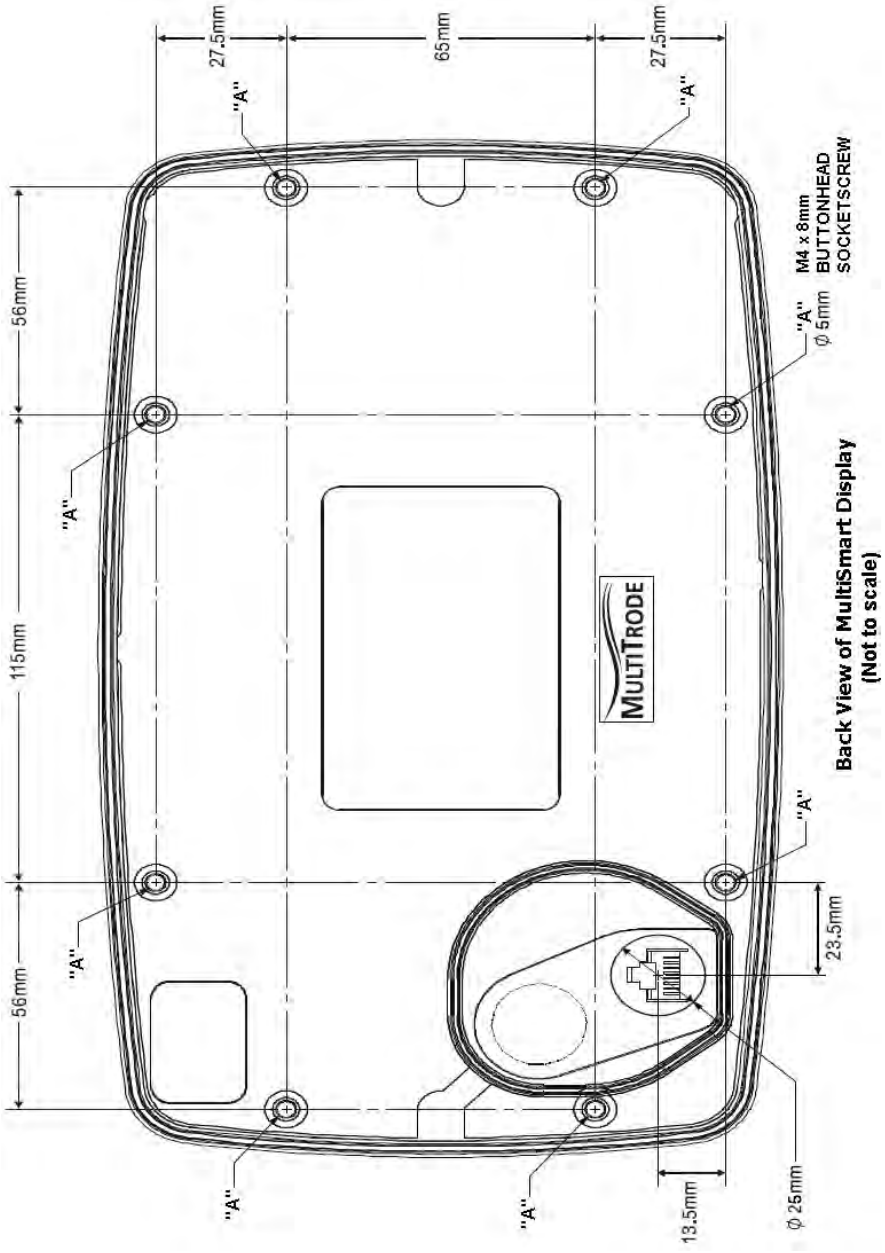


Figure 25 – Mounting the Display

6.2 Mounting the Pump Station Manager

The pump station manager is designed to mount onto 35mm DIN rail. Overall dimensions are given below.

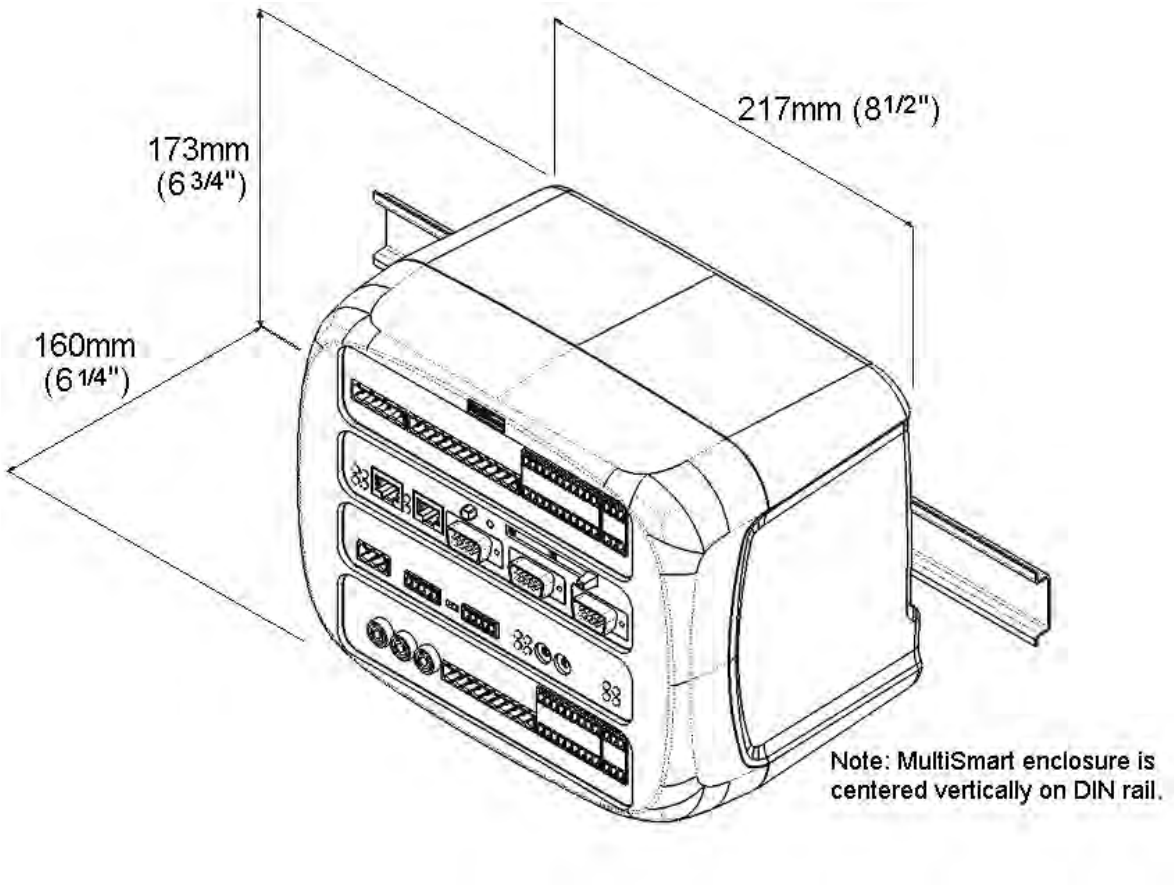


Figure 26 – Mounting the Controller

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.

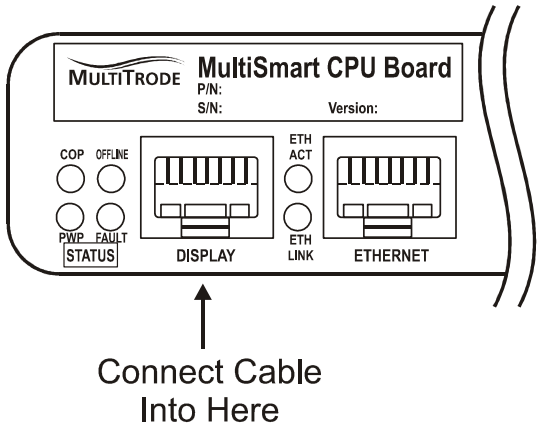


Figure 27 – Connecting the display interface

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 one Ethernet and three serial and communications ports, connects to the display, and has a 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 I/O and communicates between multiple I/O 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 1000VDC insulation resistance test of the motor windings (I/O = 9 x IIN, 3 x IRT, 3 x AOUT, 5 x DOUT).

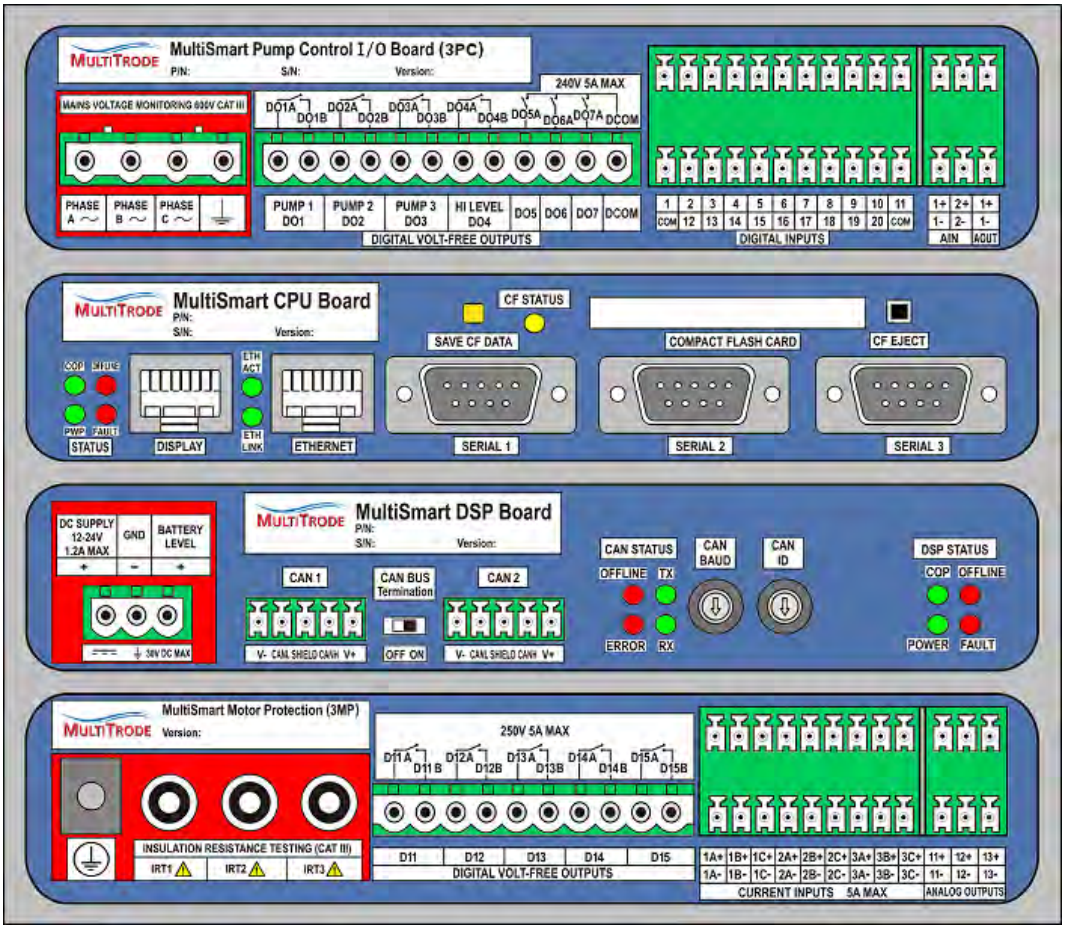


Figure 28 – MultiSmart Boards

7.1 Power Supply

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

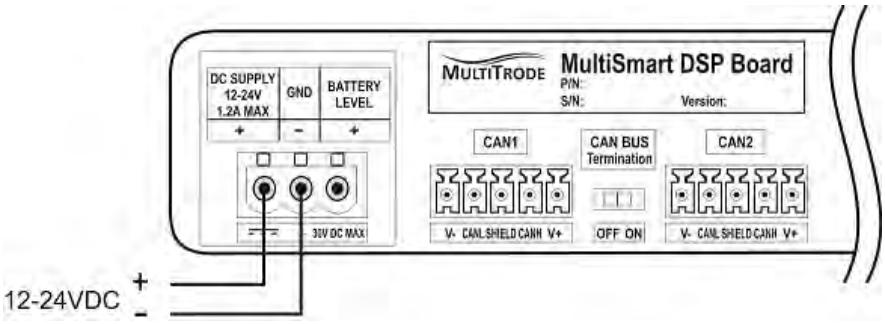


Figure 29 – Power Supply

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 MultiSmart 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	14℉ ~ 140℉ / -10℃ ~ +60℃
	Working Humidity	20-90% Relative Humidity non-condensing
	Storage Temp/ Humidity	-40℉ ~ 185℉ / -40℃~ +85℃, (10~95% Relative Humidity)

Table 1 – Power Supply Specifications

7.2 Default Wiring Setup for Pump Control Board

While many different configurations of the MultiSmart are possible, four common configurations are illustrated in this section.. 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 I/O Board.

7.2.1 Default 1 – 10 Sensor Probe and 2 Pumps

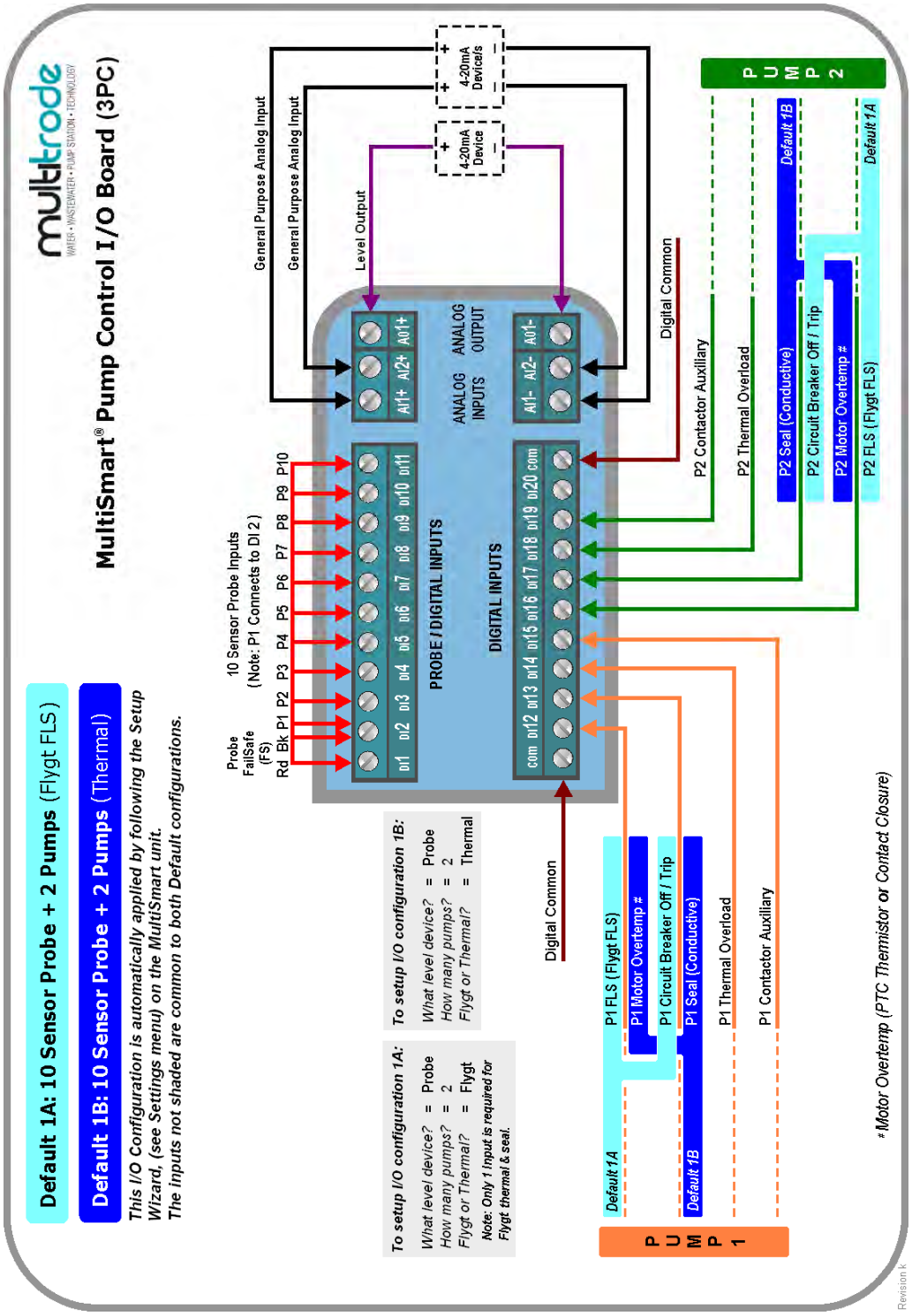


Figure 30 – Default 1

7.2.2 Default 2 – 10 Sensor Probe and 3 Pumps

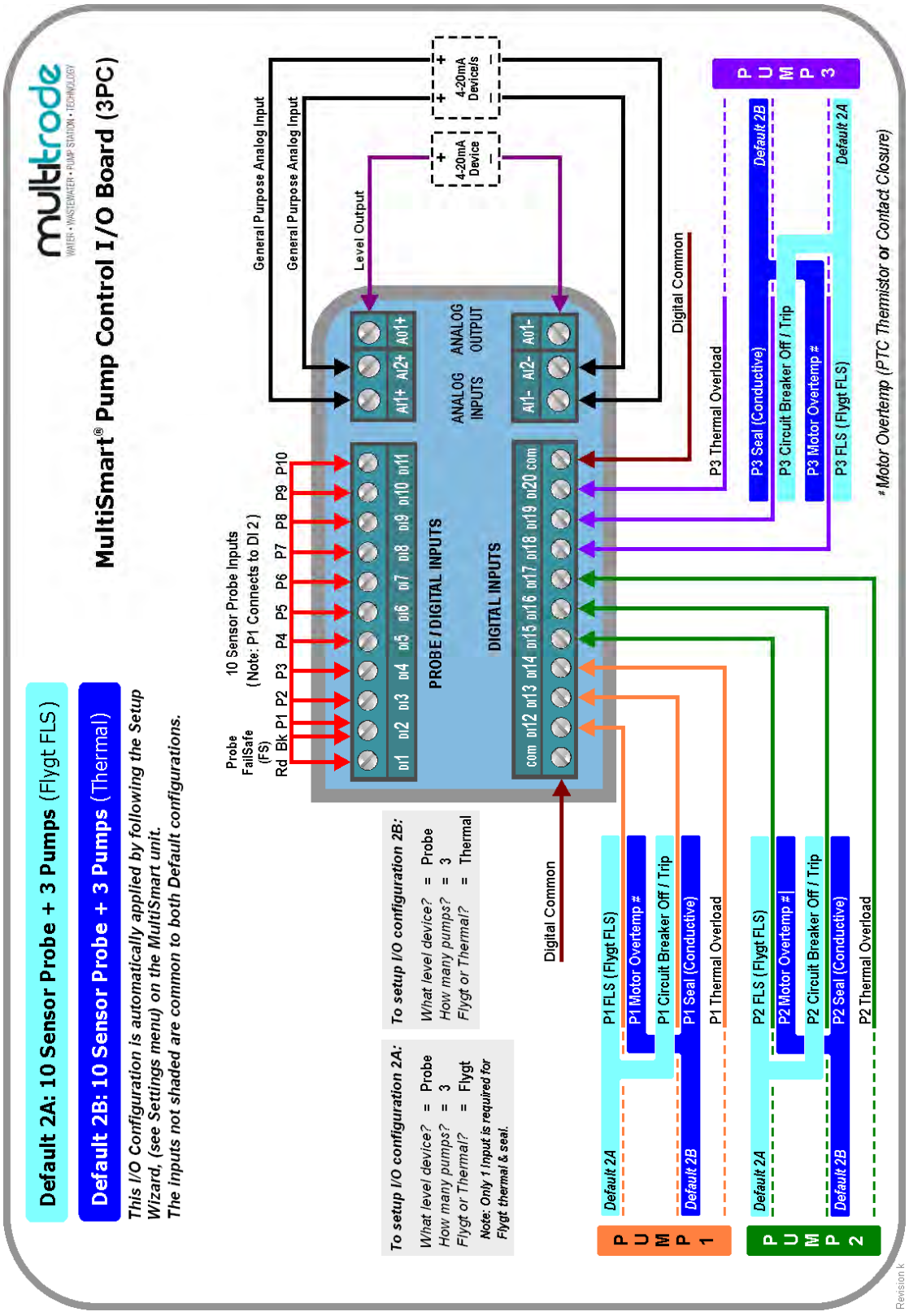


Figure 31 – Default 2

7.2.3 Default 3 – Analog Level Device and 2 Pumps

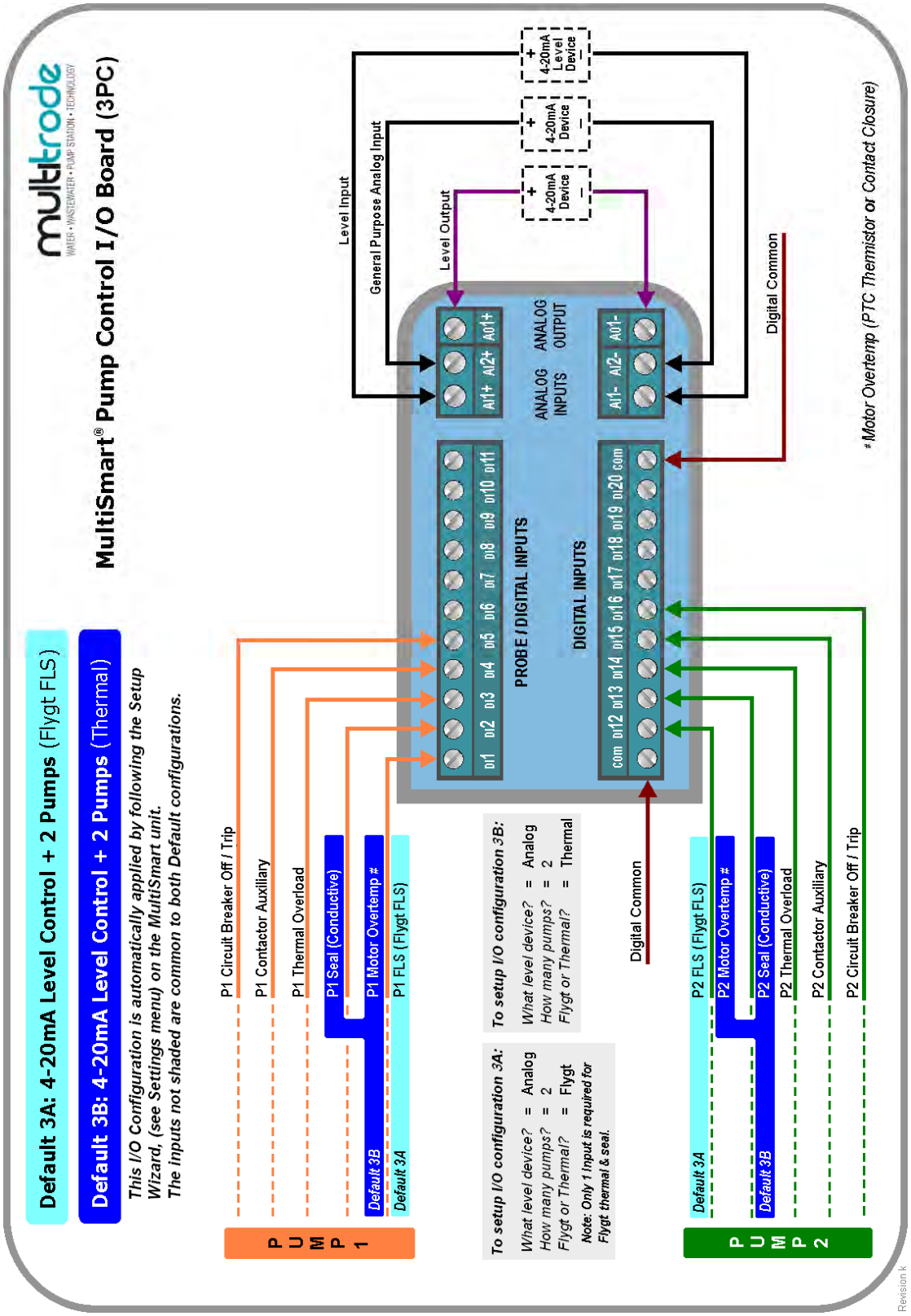


Figure 32 – Default 3

7.2.4 Default 4 – Analog Level Device and 3 Pumps

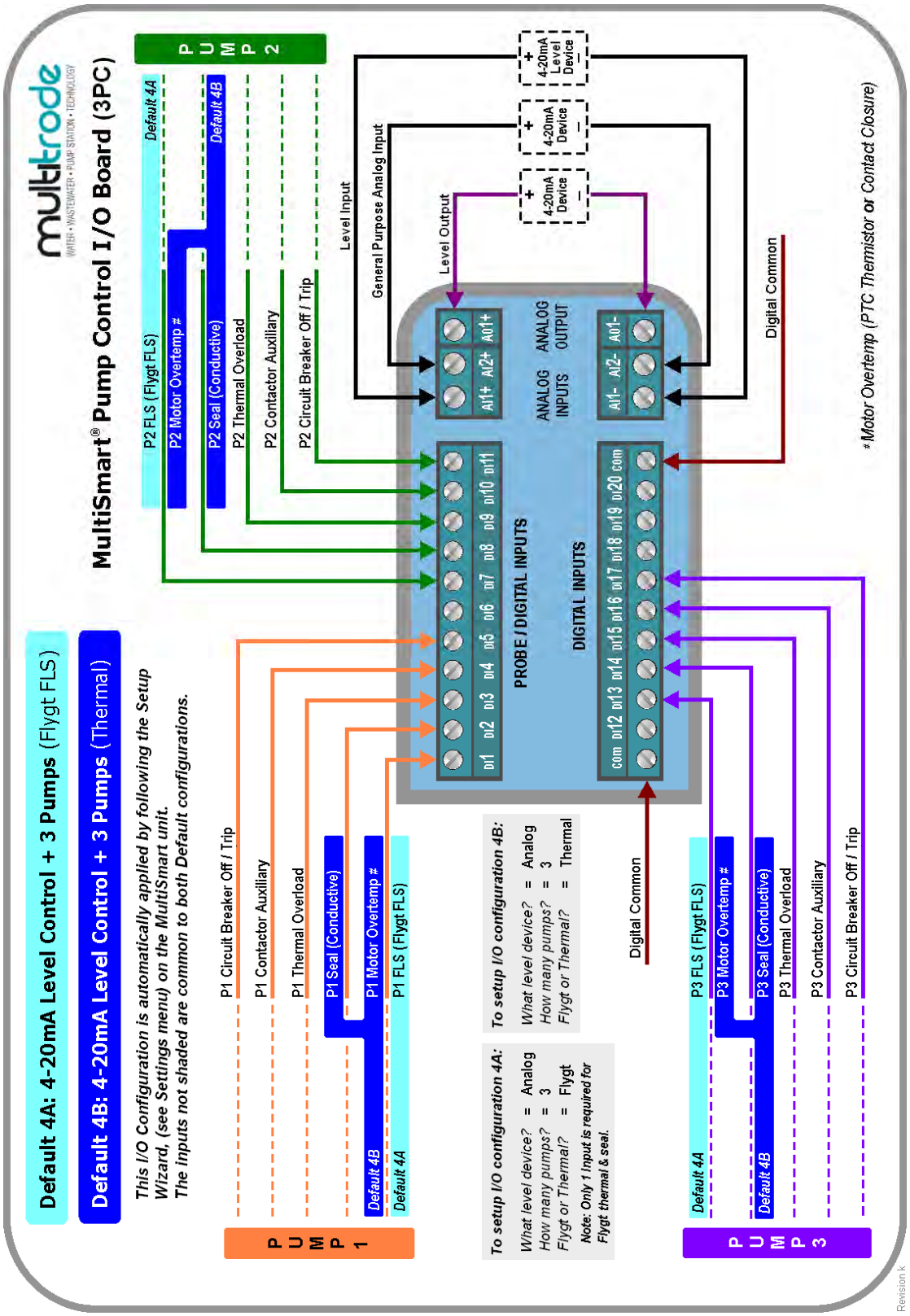


Figure 33 – Default 4

7.2.5 Default 5 – DuoProbe and 3 Pumps

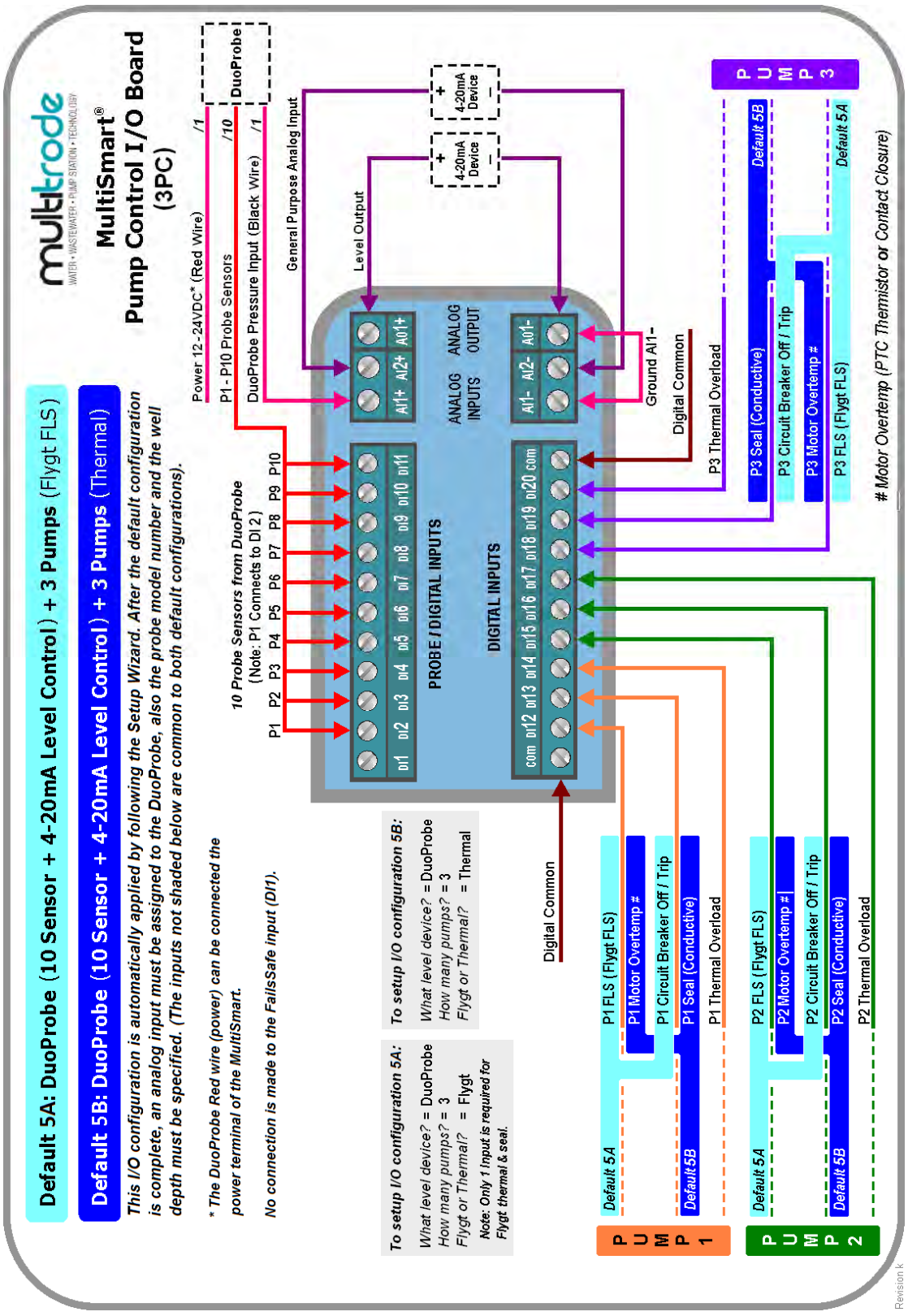


Figure 34 – Default 5

7.2.6 Contactor Auxiliary Fault

If the contactor auxiliary is wired in, the pump status is displayed differently for when a pump is called to run. The contactor auxiliary is used to provide feedback to the MultiSmart as to when the contactor is closed and the pump is actually running. As soon as the pump running command is sent, the MultiSmart displays the status of the pump as **Request to Run** and when the contactor closes the status is updated to **Running**. If the contactor takes too long to close or fails to close at all, the preset delay will expire and a pump fault is displayed but the pump is not faulted. As per all faults this can be modified to fault the pump thereby calling the next pump to run.

7.3 Pump Control Board

The pump control I/O 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 I/O board. To configure voltage monitoring and protection see Section 18. MultiSmart also supports single phase AC power supplies.

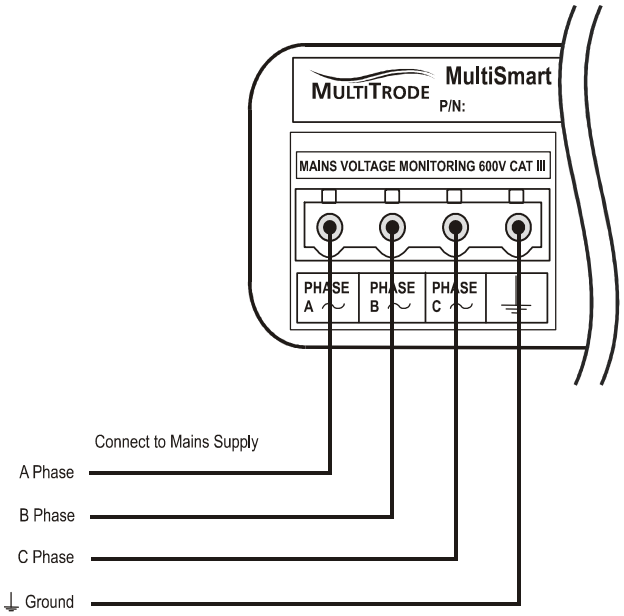


Figure 35 – Connecting Mains Supply to MultiSmart for Monitoring and Protection Purposes.

7.3.2 Digital Inputs

There are 20 digital inputs on the Pump Control I/O (3PC) board. All inputs can be used as **volt-free digital** inputs, but also have additional functionality. An example of the digital input wiring follows.

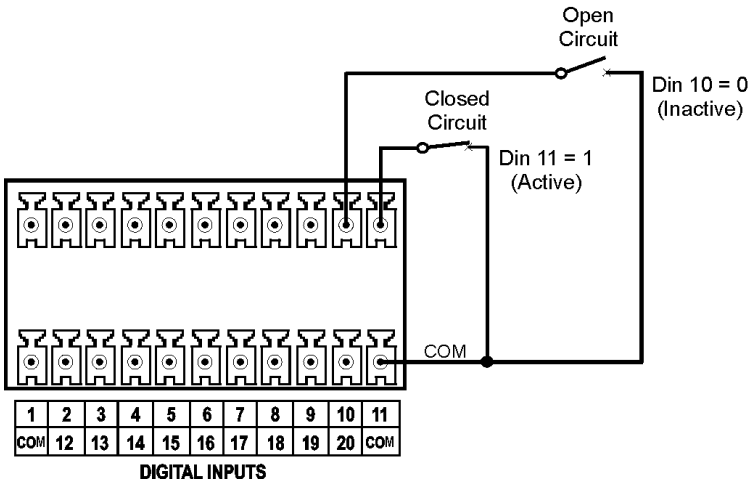


Figure 36 – Digital Input Wiring Example

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. For example;

- Flygt FLS (thermal & seal)
- Thermal Switch
- Voltage Free Contact (switch or relay)
- Transistor (inc. opto-coupler)
- Conductive Probe
- Conductive Seal
- Thermistor (non-linear PTC)
- Counters

Certain DINs have added capability:

- DI 19-20 High speed inputs (up to 1 kHz).
  Used for high speed pulsed inputs such as Pulse Flow Meters.
- DI 16-18
  These three inputs can be used with Flygt CLS (Capacitive Leakage Sensors)
- DI 1 Fail-Safe probe input.
  Used to connect the failsafe sensor wire from a MultiTrode Failsafe probe.

All the above inputs can be used as general purpose digital inputs.

7.3.2.2 10 Sensor Probe (or Ball Floats)

An example of how to wire a 10 sensor probe using 10 and 12 core cables is shown below. If no Failsafe sensor is present, connect the 10 sensors from DI 2 to DI 11 (this matches the MultiSmart default configuration). DI 1 can be used for any other general digital input.

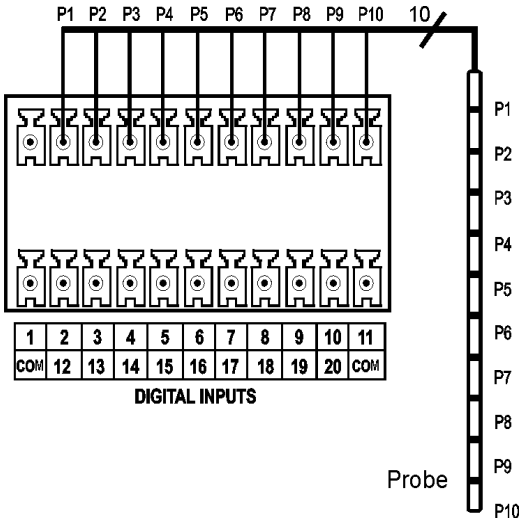


Figure 37 – Probe Connections – 10 Core Cable

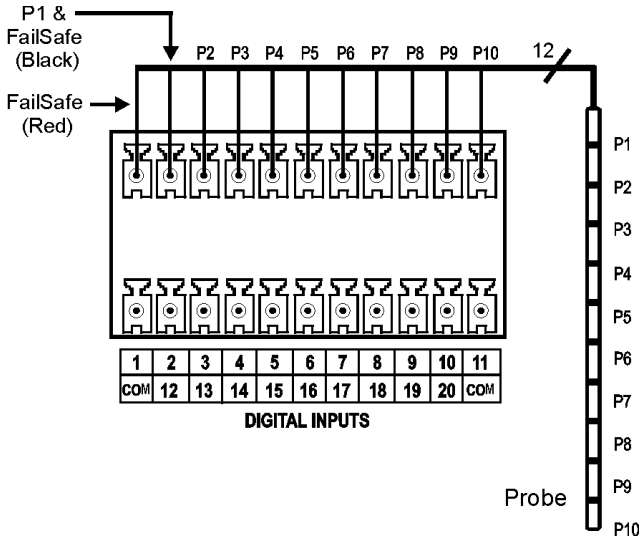


Figure 38 – Probe Connections – 12 Core Cable

For further Probe configuration information including DuoProbe connections refer to Section 14.8.

NOTE:
The Fail Safe feature requires a compatible probe and firmware version 2.2.2 or later.

NOTE:
If more than one Fail Safe probe is installed, only one (1) Failsafe probe (the highest) is connected to the Fail Safe input.

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. (See Section 14.8.4 - Single Sensor Mode for more information).

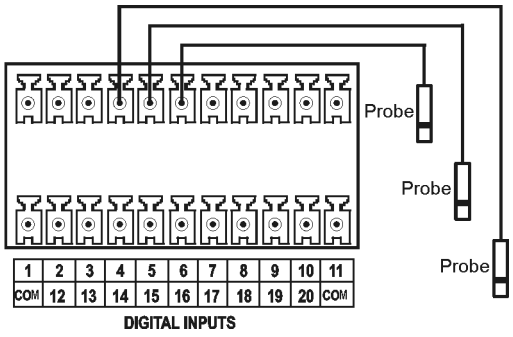


Figure 39 – Single Sensor Inputs

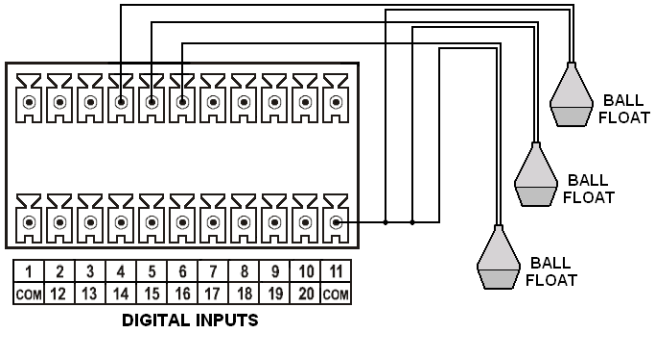


Figure 40 – Ball Floats

7.3.3 Digital Volt-Free Outputs

The pump control I/O board has seven 240V, 5A, and digital volt-free outputs:

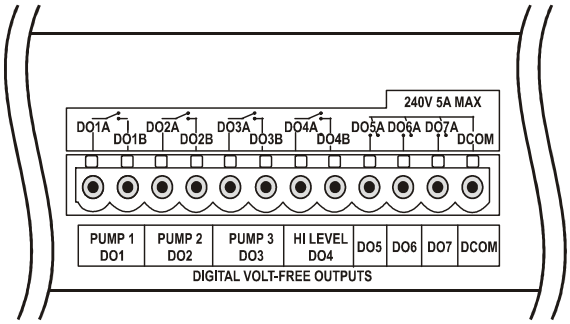


Figure 41 – Digital Volt-free Outputs

- DO 1-4 – Isolated **voltage free** contacts
- DO 5-7 – Common rail **voltage free** contacts
- *Multiple sources can be assigned to a digital output with the option of AND, OR and XOR operations performed on the source*

NOTE:
DO1-4 are configured by default if 3 pumps were selected during the Setup Wizard. For a system which has less than 3 pumps, only the relevant digital outputs are configured. (For 4 pumps or more, no digital outputs are configured).

NOTE:
MultiTrode recommends that snubbers are fitted to the contactor coils that the digital outputs are driving.

7.3.4 Analog Inputs

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

- Maximum Load (Input Impedance) – 120 ohms
- Resolution 0.2%
- Isolated

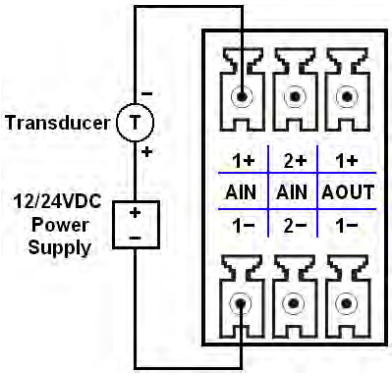


Figure 42 – Analog Input – External Excitation: 2-Wire

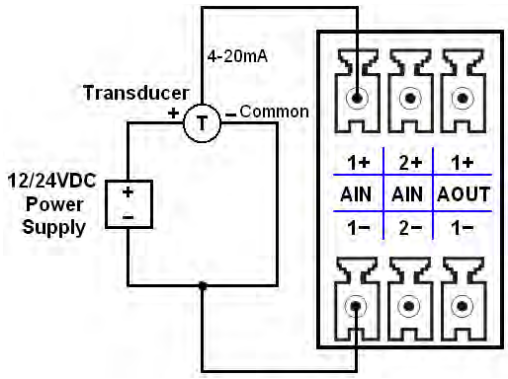


Figure 43 – Analog Input - External Excitation: 3-Wire

7.3.5 Analog Output

The pump control I/O board has one analog output (non-isolated) 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/Speed 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 (Impedance) – 800 ohms
- Resolution 0.2%
- Non-isolated

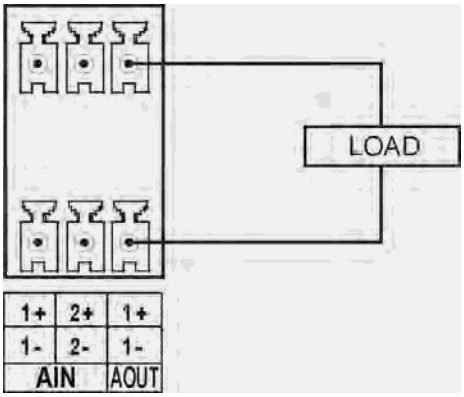


Figure 44 – Analog Output

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.

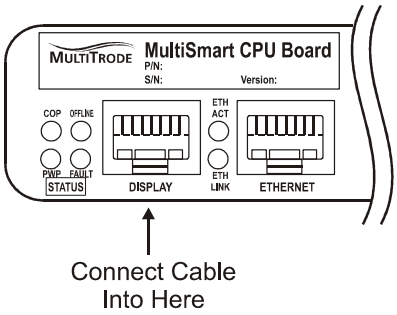


Figure 45 – Connecting the display cable

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 for SCADA communications using one of the following protocols: Modbus or DNP3 embedded in TCP/IP.

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. All I/O lines are implemented (for hardware version PCB400001 r01 or later).

The MultiSmart serial ports use the standard RS232 pin outs as tabled below. When connecting to say a laptop, a cross over cable is required – as a minimum RX, TX and GND are required.

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 Outs

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 from/to 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:

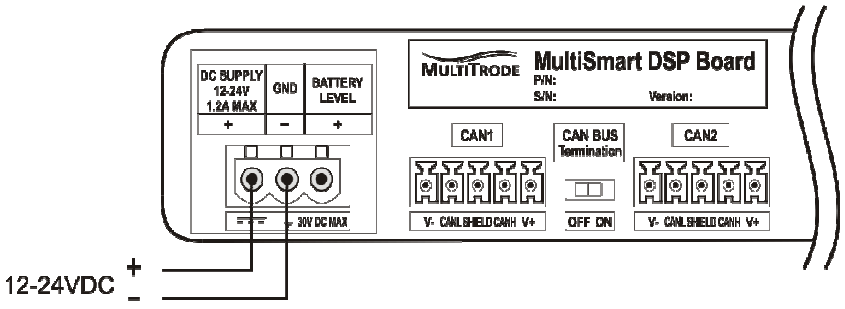


Figure 46 – Connecting the power supply

NOTE:
Unless the MultiSmart is configured in a specific way, the ***Battery Level*** *terminal will only measure the battery charger voltage – not the actual battery voltage.*

7.5.2 DSP Status LEDs

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

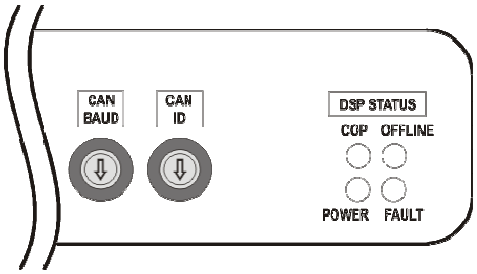


Figure 47 – DSP Board Status LEDs

(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).

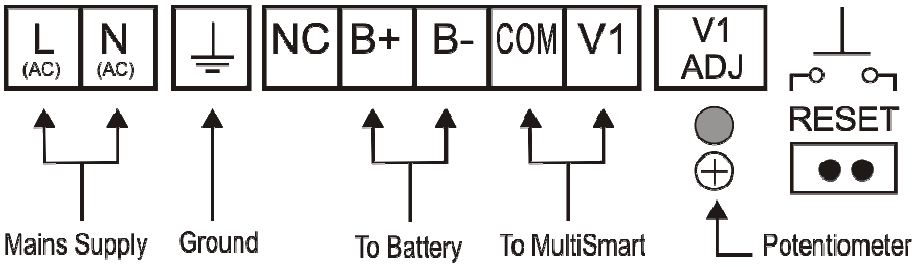


Figure 48 – Power Supply Terminal Block Connections

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 and 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 I/O Expansion

MultiSmart I/O expansion units are connected to the main MultiSmart unit using the CAN Bus network. The CAN Bus cannot be used for other external devices.

Third party external I/O modules are connected through the Ethernet port (See Section 14.7). With custom engineering, any I/O module that supports DNP3 or Modbus communications can be interfaced to the MultiSmart.

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.

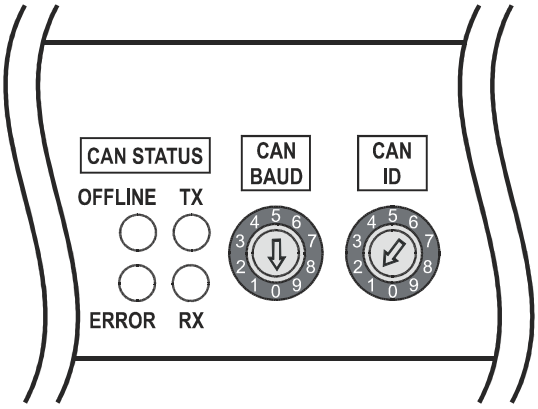


Figure 49 – CAN Bus Settings

#	Baud Rate	Max Cable Length	
	(kb/s)	(m)	(ft)
0	125 (default)	500	1640
1	10	1000	3280
2	20	1000	3280
3	50	1000	3280
4	100	500	1640
5	125	500	1640
6	250	250	820
7	500	100	328
8	800	50	164
9	1000	25	82

Table 3 – Max. Cable Length at Specific Baud Rates

If the CAN Bus baud rate is changed on the unit, the same change must be made in the **Advanced** menu.

Navigate to:

Settings → Advanced → IOModule → CAN Bus Baud Rate

Then select the appropriate value.

7.5.4.1 CAN Bus Settings

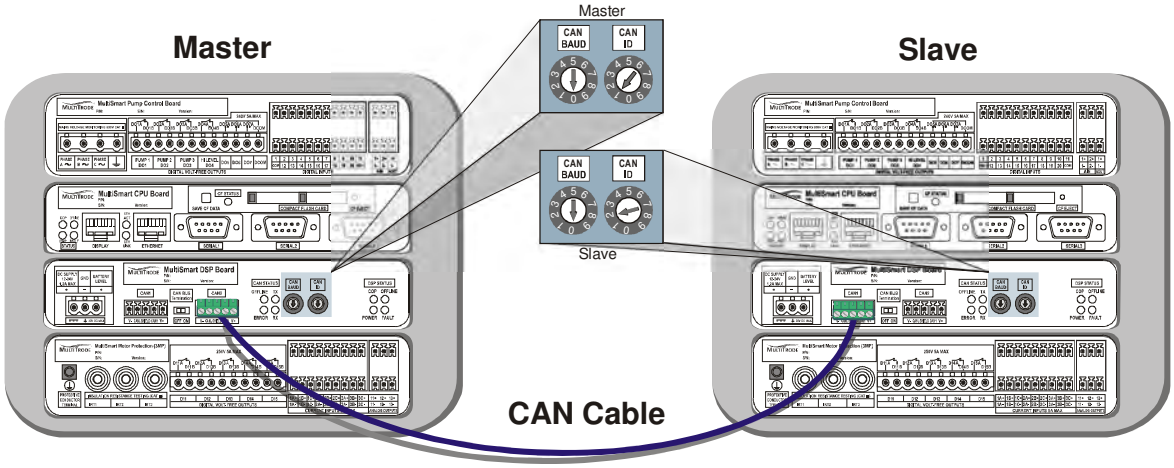


Figure 50 – Connecting Expanded I/O

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

Table 4 – Can BUS and Can ID Settings

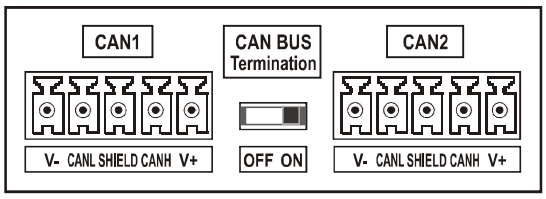


Figure 51 – CAN Bus Settings - Single unit only

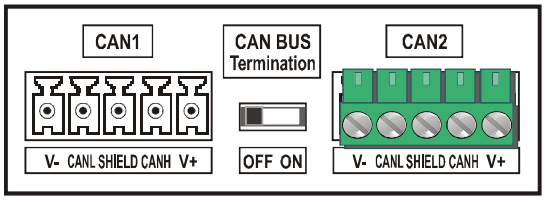


Figure 52 – CAN Bus Settings – Master Unit

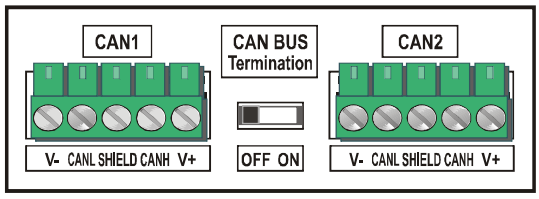


Figure 53 – CAN Bus Settings – Intermediate Slave Unit

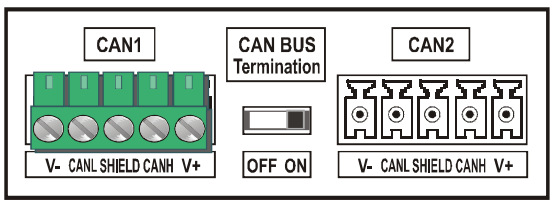


Figure 54 – CAN Bus Settings – Last Slave Unit

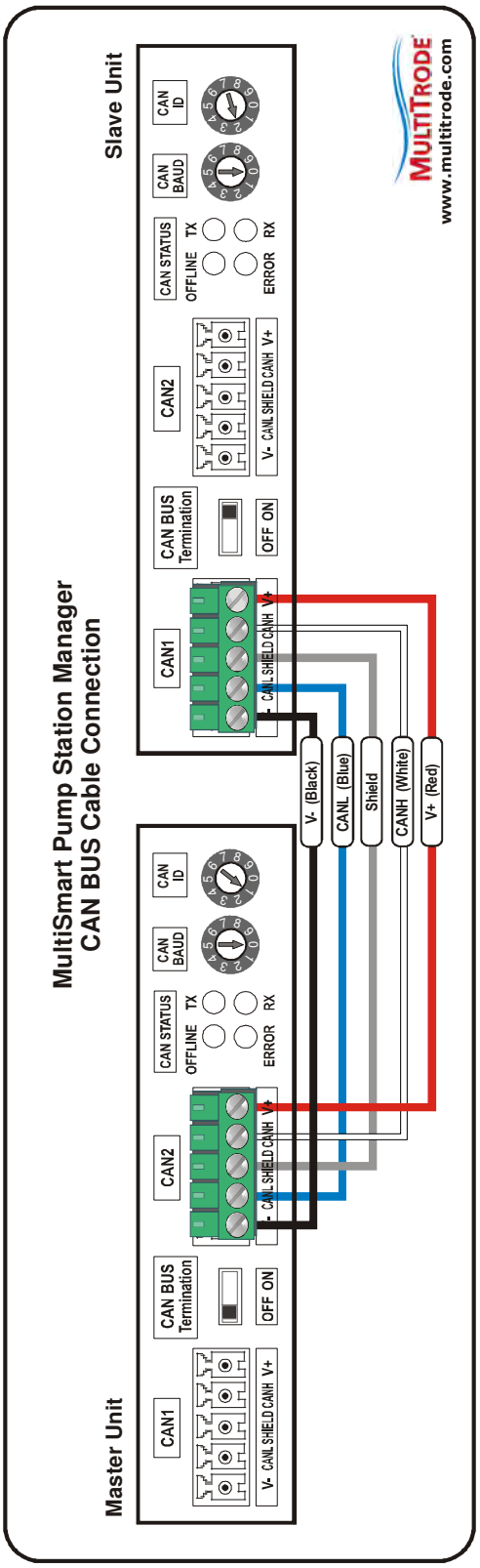


Figure 55 – CAN Bus Cable Connection Wiring

7.5.4.2 CAN Status LEDs

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

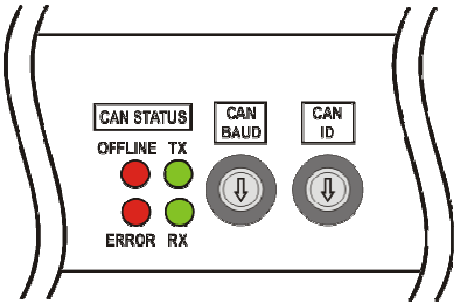


Figure 56 – CAN Bus Status LEDs

(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 (3MP) is an optional board. It monitors single or 3-phase motor currents for up to 3 pumps, direct from CTs, and provides motor protection and power monitoring. The board also carries out an automatic 1000V DC insulation resistance test on 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 unit. The 3PC board has 3-phase supply inputs. Therefore you must have a 3PC board and a 3MP board in the same unit to do power measurements. MultiSmart can monitor single phase supply as well.*

7.6.1 Insulation Resistance Tester

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

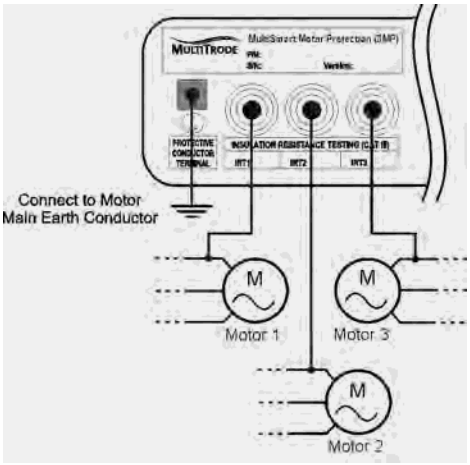


Figure 57 – Connecting the IRT

Insulation resistance measurements are only 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 two thresholds for the Insulation Resistance Test, one for a warning message, the second for a fault message. The default setting of the IRT warning does not stop the pump whereas the IRT fault message does stop the pump.

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

Connect the **Protective Conductor Terminal**, to earth/ground.

NOTE: *Follow the manufacturer's guidelines regarding motor insulation testing when using soft starters and VFDs. Functionality is included in the MultiSmart software so that a DOUT can drive isolation contactors while IRT is in progress - refer to Section 17.2.2.*

7.6.2 Digital Volt-Free Outputs

The board has five isolated volt free outputs rated for 5A at 240V AC.

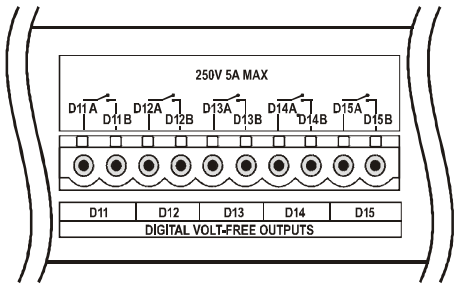


Figure 58 – Digital Volt-free Outputs

7.6.3 Current Inputs

The Energy Monitoring and Motor Protection Board has three sets of three-phase current inputs. These inputs measure between 0 - 5A and are connected to the secondaries of external CTs to measure higher currents. The CTs must be wired with the correct polarity and ensure that the current phase corresponds to the voltage phase. Shielded twisted pair cable is recommended between the CTs and MultiSmart The shield ground can be connected at either the MultiSmart end or at both, the MultiSmart and the CT, depending on the predominate interference – electrical or magnetic.

NOTE: *If the CTs are wired such that the polarity is wrong, the current reading will be correct, however the power and energy calculations will be incorrect as the power factor will be zero.*

NOTE: *The CTs must <u>not</u> be grounded / earthed. Otherwise incorrect current readings will be measured.*

When selecting CTs consider the MultiSmart input resistance (around 40mΩ) & the resistance of the copper wire used in the installation. To avoid losing accuracy of the current readings, do not burden the CTs.

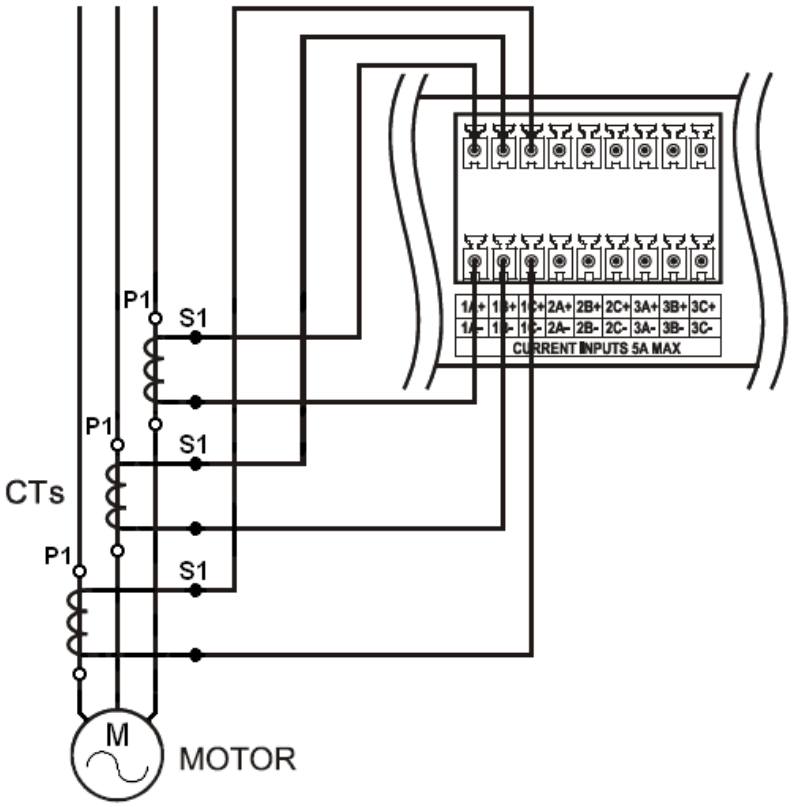


Figure 59 – Current Inputs per Motor

7.6.4 Analog Output

The energy monitoring/motor protection board has 3 analog outputs which produce a 4-20mA output signal.

- Maximum Load (Impedance) – 800 ohms
- Resolution 0.2%
- Non-isolated

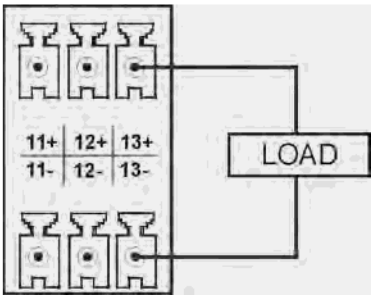


Figure 60 – Analog Output

8 PumpView Hardware Setup

PumpView is a web-based monitoring and control system. There is no software to install and no server or radios are required. All that is needed is a web browser (with internet access) and a cellular / mobile based 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. Faults can be configured to generate alarm messages and users notified by email and/or SMS.

CAUTION:
To avoid damaging the modem, always have the 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 protrusions) 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 function if they are directed horizontally. Ensure the cable is not kinked or bent tighter than a 25mm (1") radius.

Using the RS232 cable provided, connect the modem to the MultiSmart unit on serial 3 (as shown in Figure 61).

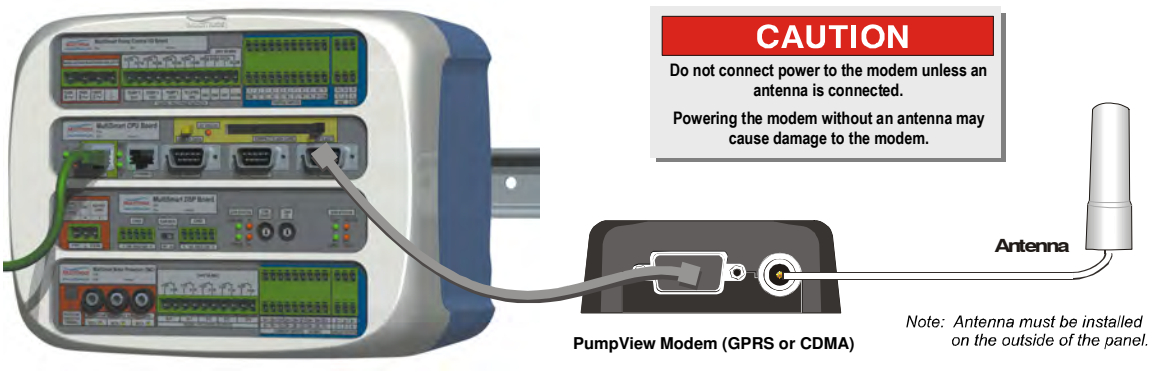


Figure 61 – Connecting the PumpView modem to MultiSmart

8.1 Fault Finding

For the Sony Ericsson, Wavecom and SAM 3G modems (except for the SAM 3G Plus modem), an LED on the modem flashes when power is applied and the device is communicating (it may take a few minutes 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

8.2 Configuring PumpView for a Serial Cellular Modem

The following setup is typically completed prior to shipment but circumstances may arise when this procedure must be performed on-site. From the factory, a PumpView serial modem is configured to use **Serial 3**.

Navigate to: Settings → More → Communications → PumpView

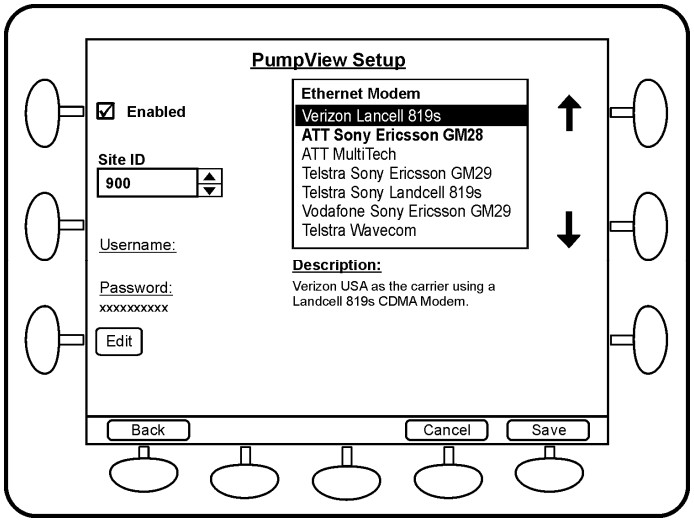


Figure 62 – Modem Setup Screen for Serial Modem

This screen allows the user to configure a cellular modem for use with PumpView – MultiTrode's hosted Website – or for general DNP3/Modbus over a cellular network. A number of modems are supported. A username and password for access onto the cellular network is required by some of the communication carriers. PumpView setup procedure:

- Enable PumpView – tick the checkbox
- 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, then press **Save**
- The Password should not be changed from the default (displayed as xxxxxxxxx)
- Press **Save** and then **Restart Later**

The serial port that the modem is connected to must be selected. This is done in the **Advanced** settings in the PPP2 Manager module. The PPPM (point to point protocol manager) is the module which handles cellular communications. Navigate to this module.

Settings → Advanced → PPP 2 Manager

- Under **Comms Channel** select a serial port – for example **Serial 3**.
- Press **Save** and then **Restart Now**

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

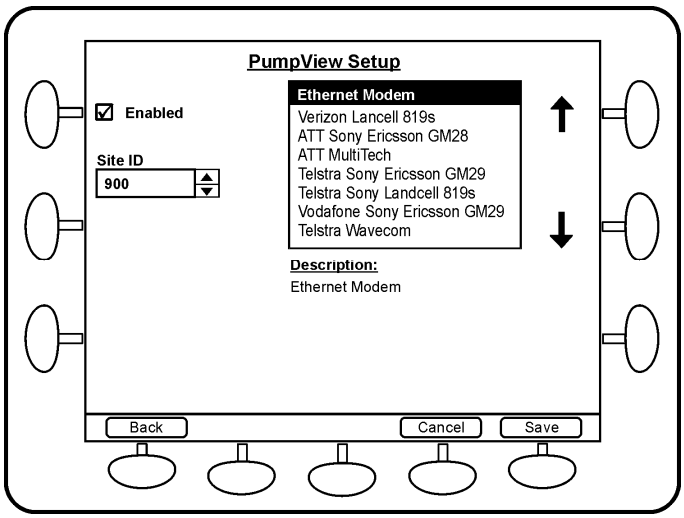
NOTE: *From firmware version 1.4 onwards the original pppm module was replaced by pppm2. If you purchased your MultiSmart prior to the v1.4 release you can contact MultiTrode for a free enable code upgrade from pppm to pppm2 for improved modem and cellular handling.*

8.3 Configuring PumpView for an Ethernet Cellular Router

The following setup is typically completed prior to shipment but circumstances may arise when this procedure must be performed on-site. A Cellular Router is connected to the **Ethernet** port on the MultiSmart via a crossover cable.

1. Select the Ethernet Modem

Navigate to: Settings → More → Communications → PumpView



- Enable PumpView – tick the checkbox
- Enter the 4 digit **Site ID** (this is supplied by MultiTrode)
- Select **Ethernet Modem**
- Press **Save** and then **Restart Later**

Figure 63 - Modem Setup Screen for Ethernet Modem

2. Configure the DNP Slave

There may be more than one DNP3 slave present. The PumpView related DNP3 slave will have the channel **TCP/IP3**.

Navigate to: Settings → More → Communications → Protocol Settings

- Highlight the correct DNP Slave & press **Select**

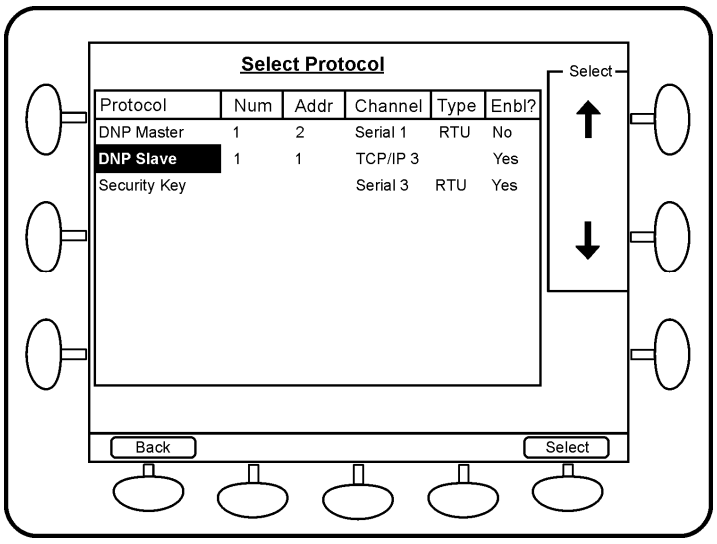
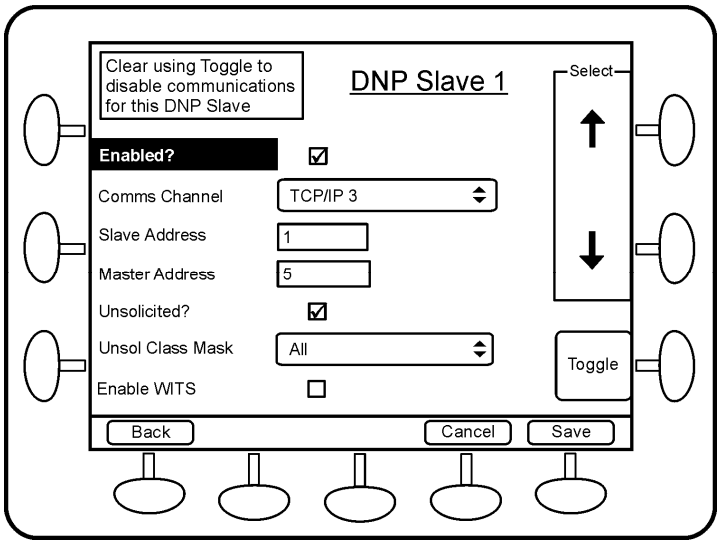


Figure 64 – Selecting PumpView Protocol

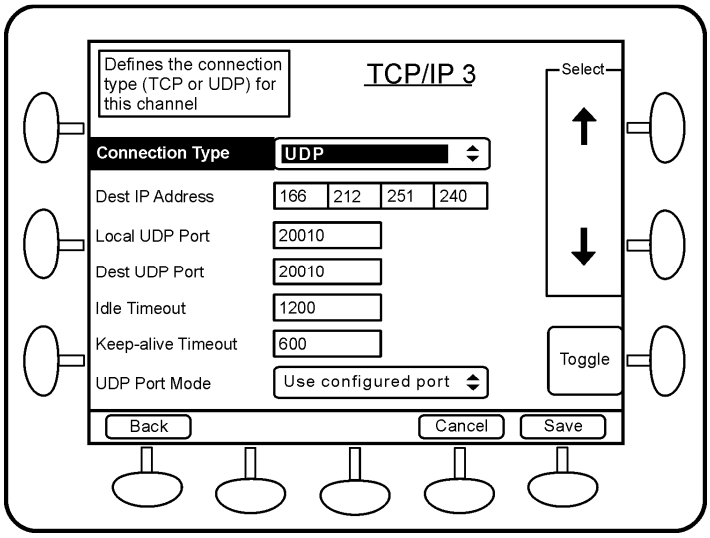
NOTE: *The Site ID can be found at the end of the URL. Visit the PumpView website, select the site of interest. The Site ID is the last 4 digits that appear at the end of the URL. (The URL or website address is located at the top of the web browser). Example: http://www.pumpview.com/t3000/...&siteId=**1234***



- Set Unsol Class Mask = All

3. Enter the TCP/IP Channel Information

- Press the **Channel** button & enter the channel information and press **Save**



- Connection Type = UDP
- Dest IP Address = 166.212.251.240
- Local UDP Port = 20010
- Dest UDP Port = 20010
- Keep-alive Timeout = 600

Figure 65 – TCP/IP 1 Parameters

4. Enter the IP Address and Subnet Mask into the MultiSmart.

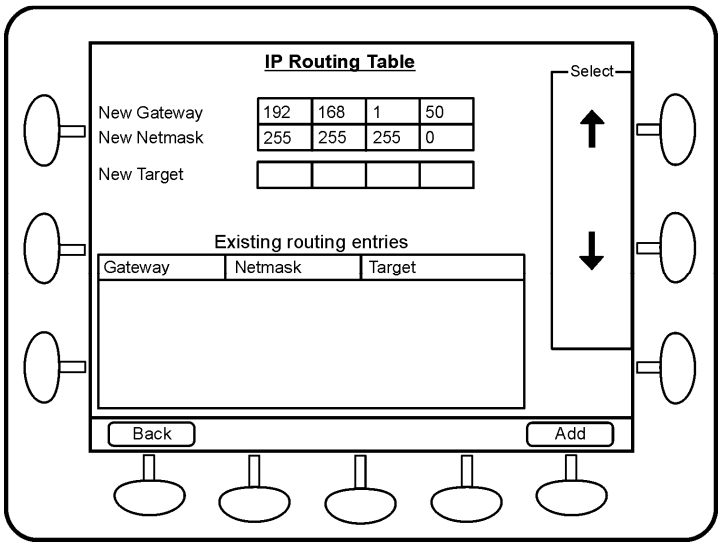
Settings → More → Communications → IP Address

The subnet mask must allow for communications to the router. The MultiSmart must be on the same subnet as the router. If the router's IP address is A.B.C.D with a subnet mask of 255.255.255.0 then the MultiSmart must have an IP address of A.B.C.x where x is unique on the subnet. For example, if the router's IP address is 192.168.1.230 then MultiSmart IP address would be 192.168.3.x.

5. Enter the Gateway and Netmask.

Settings → More → Communications → Routing

The router is the default gateway for the MultiSmart unit. Enter the routing information and press **Add** and **Restart Now**.



- Enter the IP address for the router in the **New Gateway** field
- Enter the subnet mask for the router in the **New Netmask** field
- Leave the **New Target** field empty

Figure 66 – IP Routing Table

If an incorrect Gateway is displayed in the *Existing routing entries* table, it can be deleted by highlighting it and then pressing **Delete**.

9 Quick Commissioning Guide

MultiSmart is fully configurable from the LCD user interface. However, there is also a PC-based configurator program with limited functionality now available.

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 via a DIN or by a PIN number. Refer to Section 11 for more detail.*

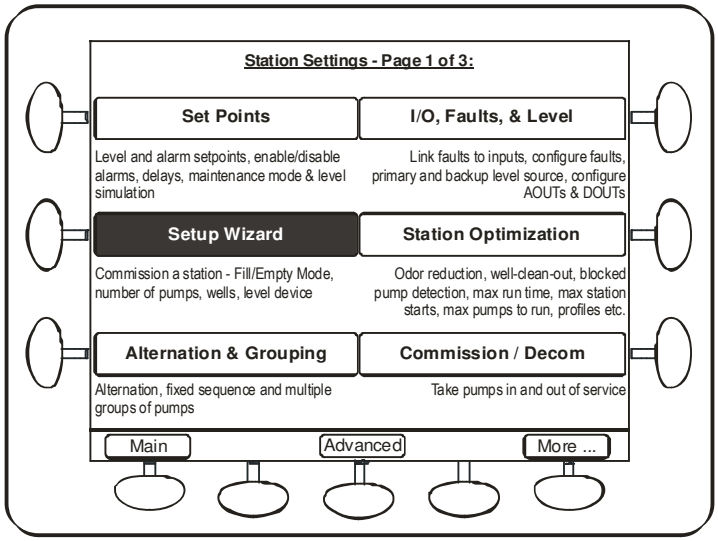


Figure 67 – Settings Screen

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

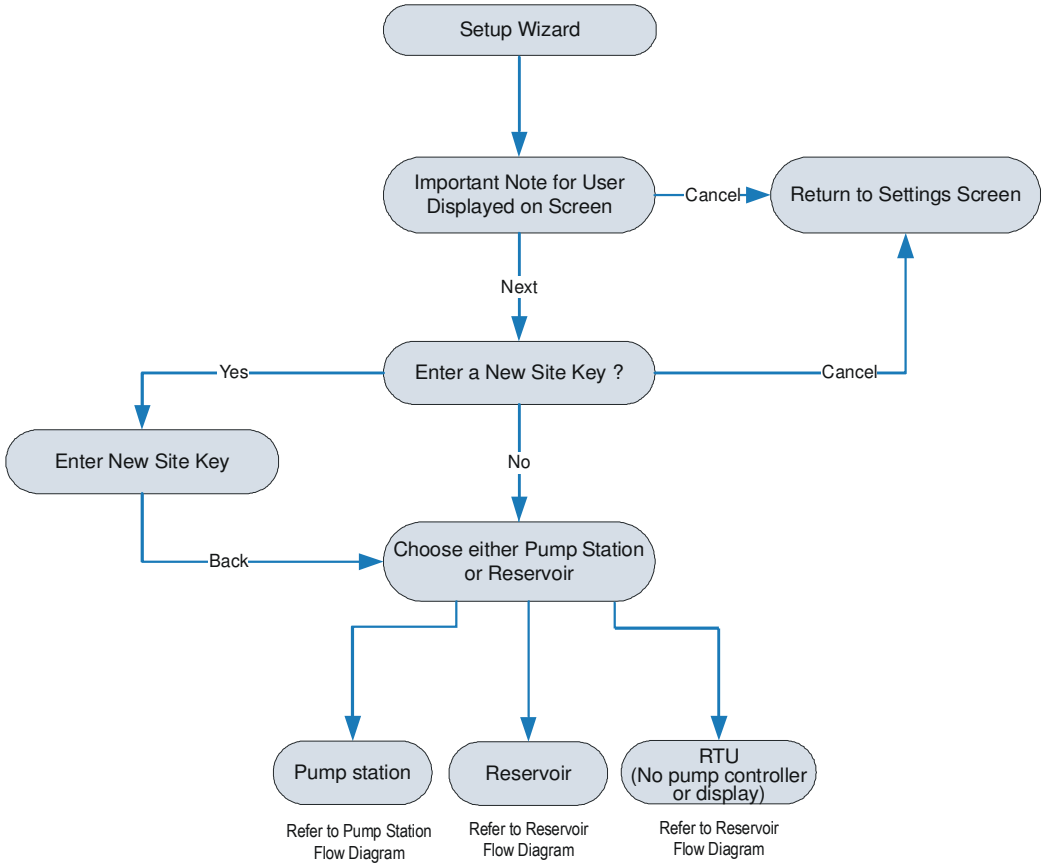


Figure 68 – Setup Wizard - 1 of 4

9.1.2 Pump Station Setup

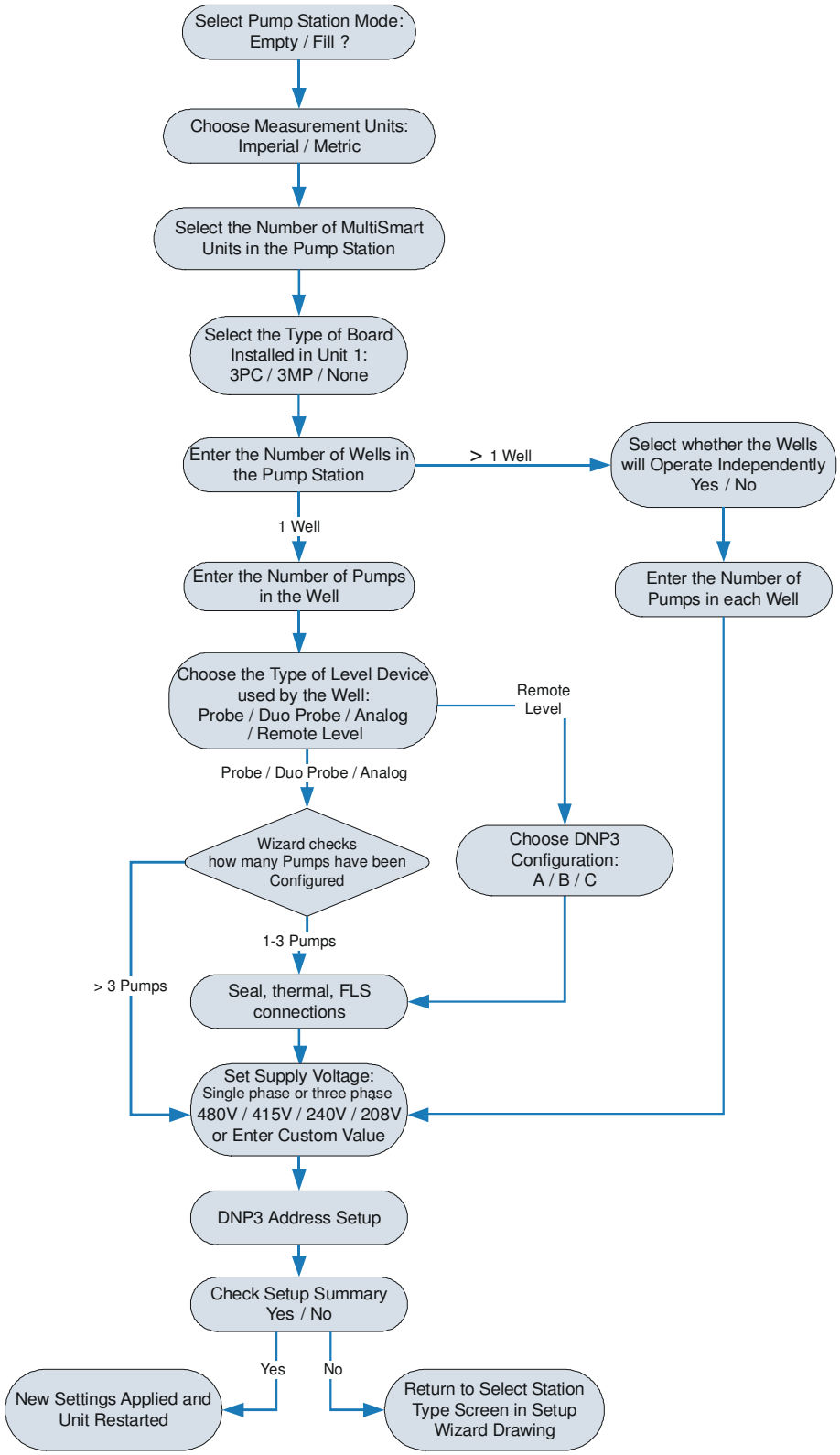


Figure 69 – Setup Wizard - 2 of 4

9.1.3 Reservoir Setup

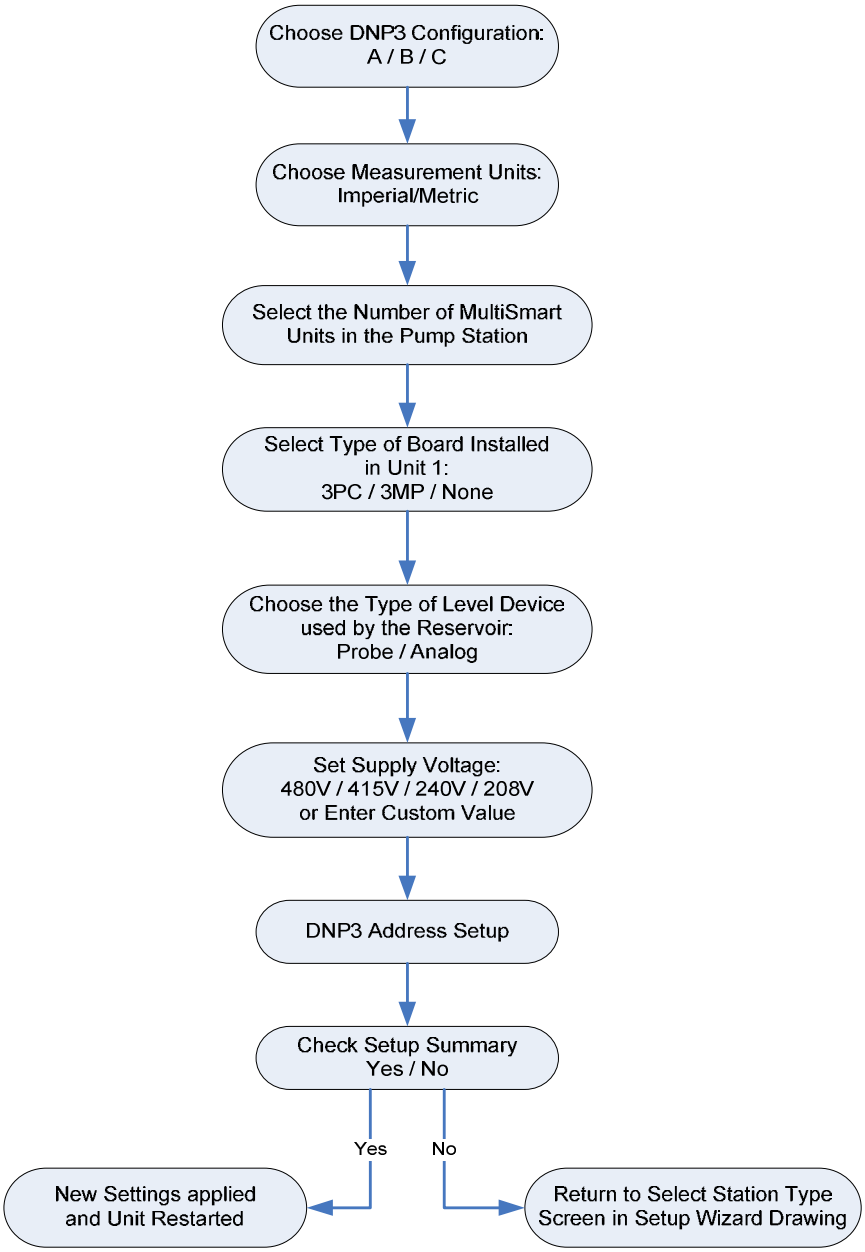


Figure 70 – Setup Wizard - 3 of 4

9.1.4 RTU Setup

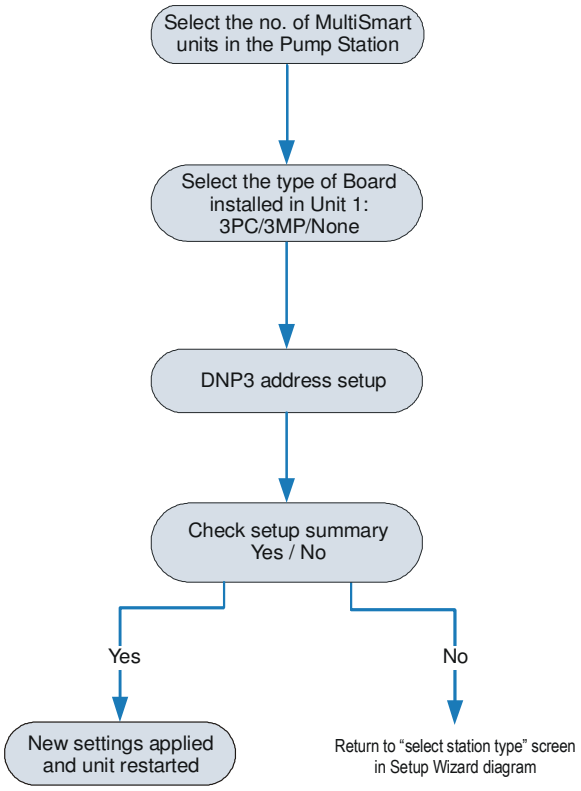


Figure 71 – Setup Wizard - 4 of 4

9.2 Setup Wizard Notes

9.2.1 Key Setup Wizard Parameters

While half of the parameters specified during the Setup Wizard can be modified (if necessary) at a later date through other menus, the remaining key setup parameters can only be changed through the Setup Wizard so it's important that these parameters are correct the first time.

The Setup Wizard can be run any number of times but each time it clears the memory so any other configuration changes made are lost and must be re-entered (if still required). The key setup parameters are listed below.

Key Setup Parameter	Options
Station Type	Pump Station, Reservoir, RTU
Station Mode	Fill, Empty
Number of MultiSmart Units	1-10
Board in Bottom Slot	3PC, 3MP, None
Number of Wells	1-3
Number of Pumps	1-9

Table 5 – Key Setup Parameters (can only be modified through the Setup Wizard)

9.2.2 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.

9.2.3 Fill (Charge) or Empty (Discharge) Modes

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

9.2.4 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 one DSP Board and at least one other board, a 3PC Pump Control Board for example.

9.2.5 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.

9.2.6 Number of Wells in Station

A station can have up to three wells.

9.2.7 Level Devices

There is a choice of Probe (MultiTrode conductive probe), DuoProbe (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 later it becomes necessary to change the level device, there is no need to go back through the setup wizard, simply see Section 14.8.*

9.2.8 Number of Pumps in each Well

If more than one well is configured, consecutive prompts are displayed requesting the number of pumps in each well.

NOTE: *The number of pumps available for the system is limited to 3, 6 or 9 depending on the software and hardware options purchased.*

NOTE: *If more than 3 pumps or more than 1 well are selected during the Setup Wizard, then* ***no*** *I/O defaults will be applied.*

9.2.9 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 default connection diagram*

If the pumps have neither a Flygt FLS sensor nor a Thermal/Seal type sensor, choose **None**. (After the MultiSmart is configured, it may be necessary to unassign some of the default digital inputs or faults that are not used in the panel. Refer to Section 9.3 at the end of this Quick Commissioning Section).

9.2.10 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. The over-voltage, under-voltage and phase fail thresholds are then automatically configured.

To modify the threshold settings after the setup wizard is completed, go to:

Settings → More → Supply Protection and select the parameter to modify (see section 18).

9.2.11 Choose DNP3 Configuration (Reservoir Setup Only)

One of three standard DNP3 configurations must be chosen when setting up the MultiSmart as a Reservoir monitor. The selected configuration sets the method of communications between the reservoir and the remote pump station.

Configuration B is the preferred method. It sets up 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.

9.2.12 Accepting New Configuration & Resetting Controller

The final commissioning screen displays a summary of the major settings entered. Check the configuration carefully and press the **Yes** button if it is correct. All current settings are replaced by the new configuration. The controller restarts with the new settings. This process takes a several 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, some of which may not be needed or not available in the 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 displayed but the pump will continue to run. If not used, this fault should be unassigned.*

To unassign any fault inputs, go to:

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

This screen shows what DINs have been assigned:

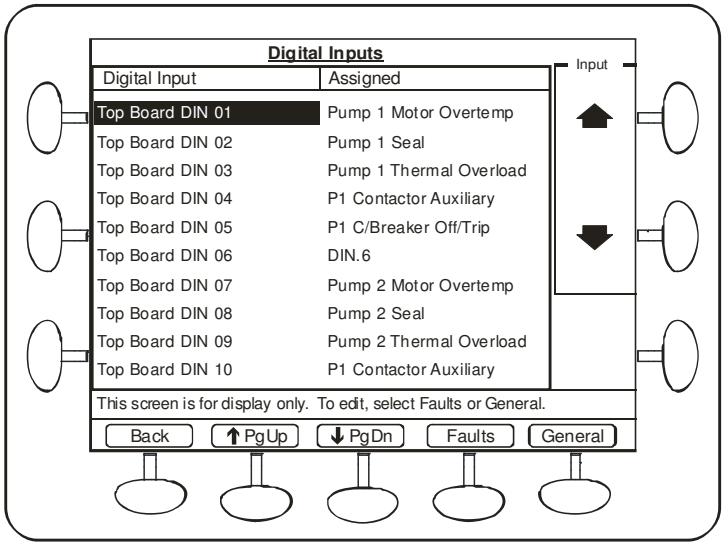


Figure 72 – Digital Input assignments

Select the **Faults** option button: Faults This screen identifies all faults that have been pre-configured in the system, along with any that are currently linked to digital inputs.

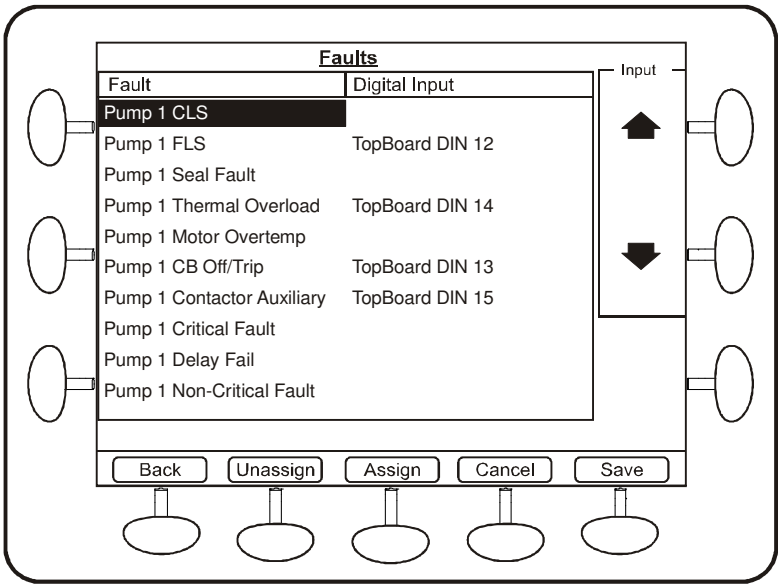


Figure 73 – Pre-configured Faults

Select the required fault to be unassigned, and press the **Unassign** softkey. Repeat this process for any other faults to be unassigned, and then press the **Save** button.

For certain faults which are assigned or unassigned the MultiSmart needs to be restarted. If a restart is necessary the following prompt is displayed. Select the desired option, keeping in mind that a restart is required before those changes come into effect.

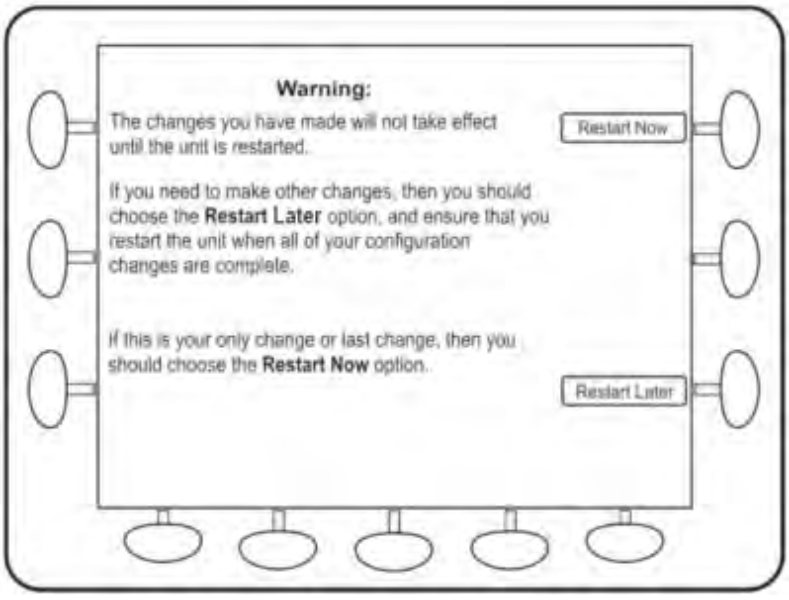


Figure 74 – Reboot Options

Choose **Restart Now** if all the faults have been configured. Choose **Restart Later** to continue making further changes without again being prompted for a restart. If **Restart Later** is selected a fault appears in the fault list which can only be cleared with a MultiSmart restart. This is to ensure that the user doesn't forget to do the final restart.

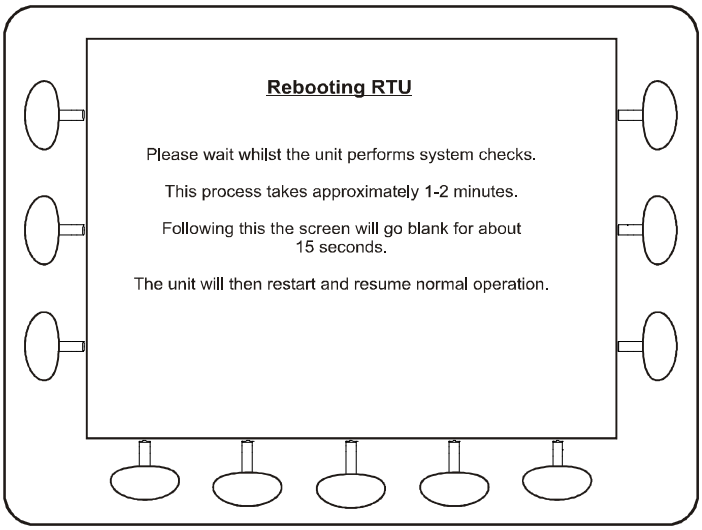


Figure 75 – Restart Screen

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 the level to be increased or decreased in 1% steps from the keypad. Using this feature to test the control panel before it is installed at the pump station.

Navigate to the Level Simulation screen:

Settings → Set Points → Level Sim / Maintenance

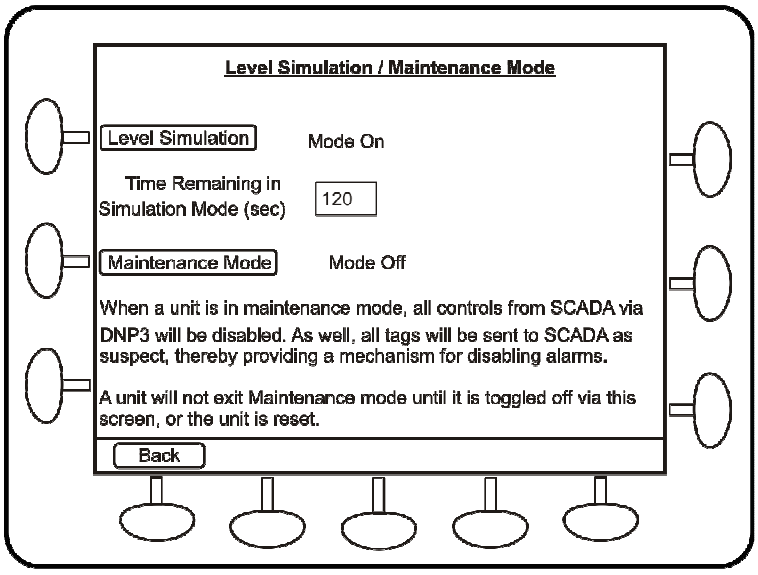


Figure 76 – Simulating Levels

- Press the **Level Simulation** button.
- The time remaining starts counting down. Simulation mode automatically turns off at zero.
- Press the Home key.
- Use the up and down arrows on the keypad to raise or lower the simulated level.
- When the tests on the station are complete, either let the level simulation time out, or go back to the level simulation page and press the **Level Simulation** button to turn it off.

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

***WARNING:** The pumps 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.*

9.5 Maintenance Mode

When a unit is placed into **Maintenance Mode** all controls from SCADA via DNP3 and Modbus are disabled. This provides a level of isolation for operators, for example preventing remote control of pumps. (Local control is not affected).

Additionally, all of the tags sent to SCADA by DNP3 are be flagged as suspect (not by Modbus because Modbus tags do not have this capability). This means the SCADA system can be programmed not to create alarms from this station while in maintenance mode.

The main operator screen (the home page) displays a flashing **MAINTCE** indication in the level bar graph whilst the unit is in maintenance mode.

Pressing the **Configure** button displays the **Simulation/Maintenance Mode Config** screen. In this screen the duration of maintenance mode can be configured. The three options are:

- **Mode (On)** – remains in maintenance mode for the preset time
- **Always?** – remains in maintenance mode indefinitely
- **Duration hh:mm** – user entered duration (to access, press the down arrow key 3 times)

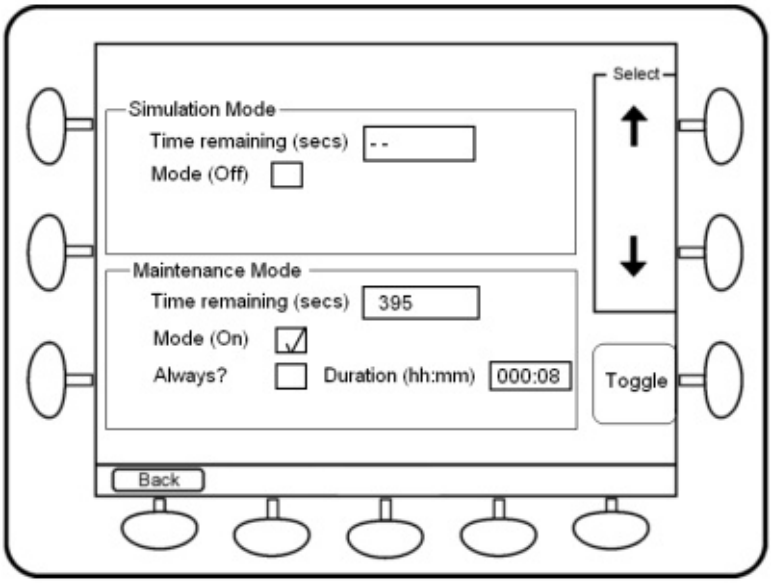


Figure 77 - Level Simulation / Maintenance Mode Screen

Use the up/down arrows on the softkeys to navigate to the appropriate field. When a checkbox is highlighted, the right-hand softkey changes to a **Toggle** option. When the **Duration** field is highlighted a new duration in hours and minutes can be entered via the keypad. Pressing the **Add** button (right-hand softkey) adds the current preset time interval to the countdown.

If the **Always** box is checked, the unit will stay in maintenance mode until an operator manually changes the state via the **Maintenance Mode** button.

If the **Always** box is unchecked, the unit will count down using the value set in the **Time Remaining** field – or until an operator turns off the feature using the **Maintenance Mode** button (in the previous screen).

The Maintenance Mode state is retained after a restart of the unit.

Part 3 – Advanced Settings

10 High Level Overview

10.1 MultiSmart Pump Station Manager Overview

The MultiSmart Pump Station Manager has a large range of features and functionalities built in, some of which are shown in the figure below. Functionality wise, MultiSmart can be considered as a Pump Station Manager and an RTU integrated together. MultiSmart can handle all the common water and sewage pump station applications but its capabilities are not limited to that. MultiSmart has support from PLC functionality thereby allowing further advanced requirements to be met.

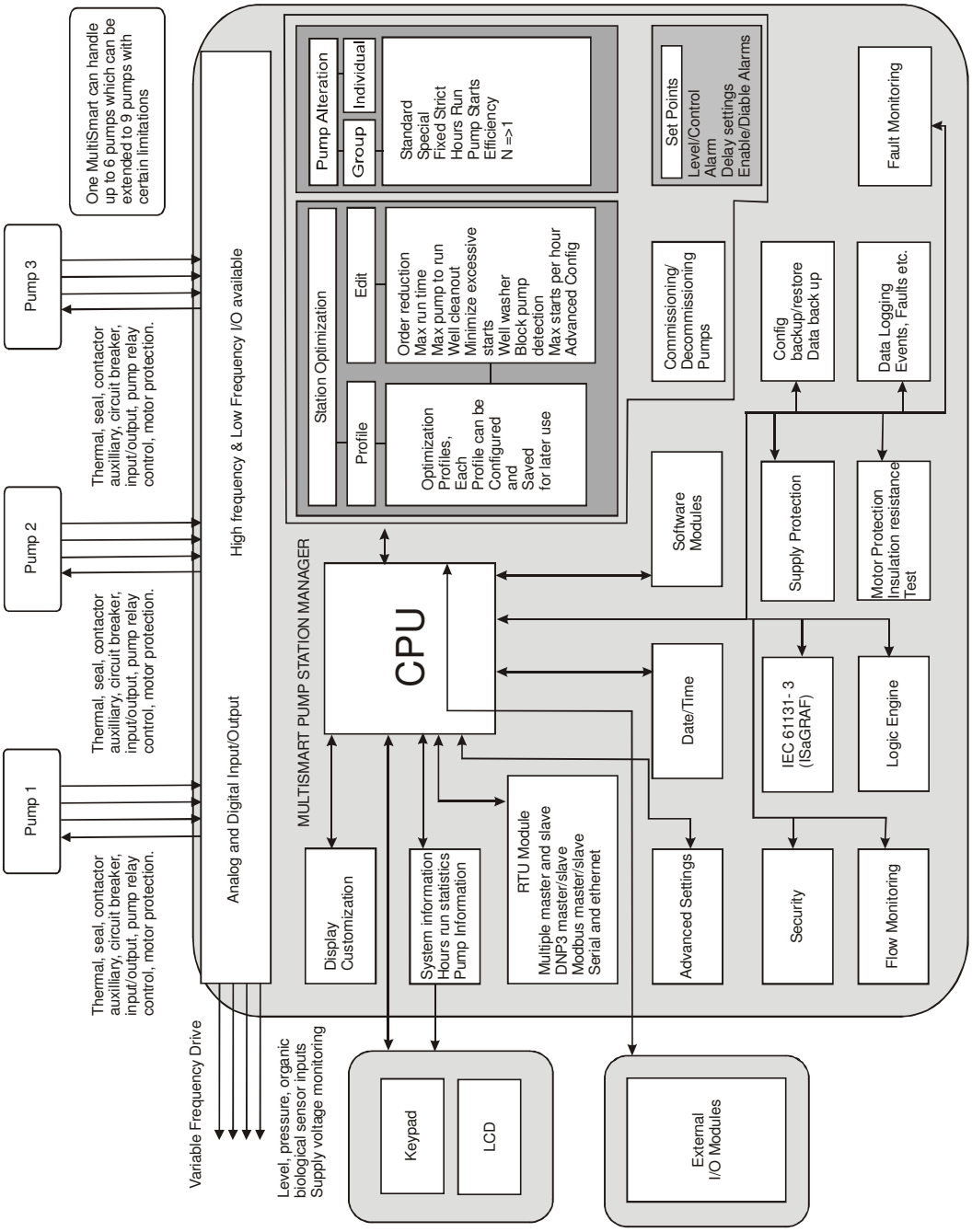


Figure 78 – MultiSmart Pump Station Manager Overview

10.2 Pump Station Manager

The Pump Station Manager module provides all 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.

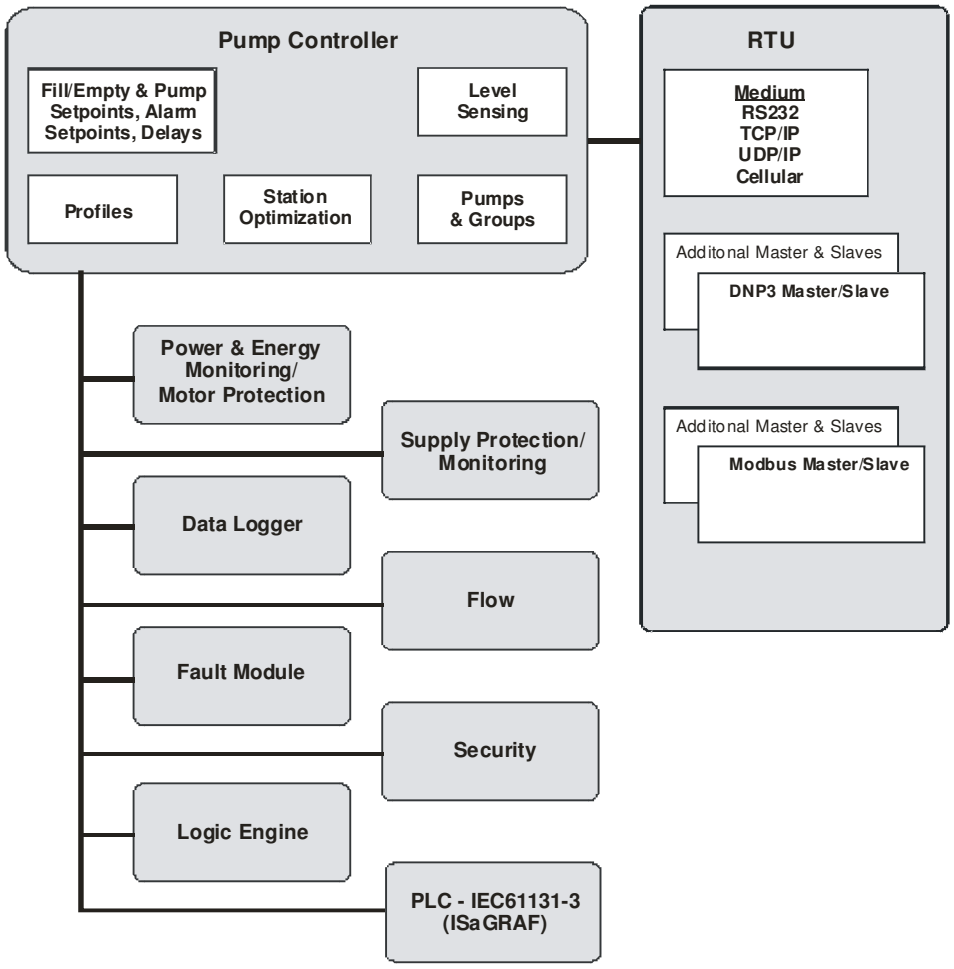


Figure 79 - Pump Control Functionality Overview

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 Station Manager Module.

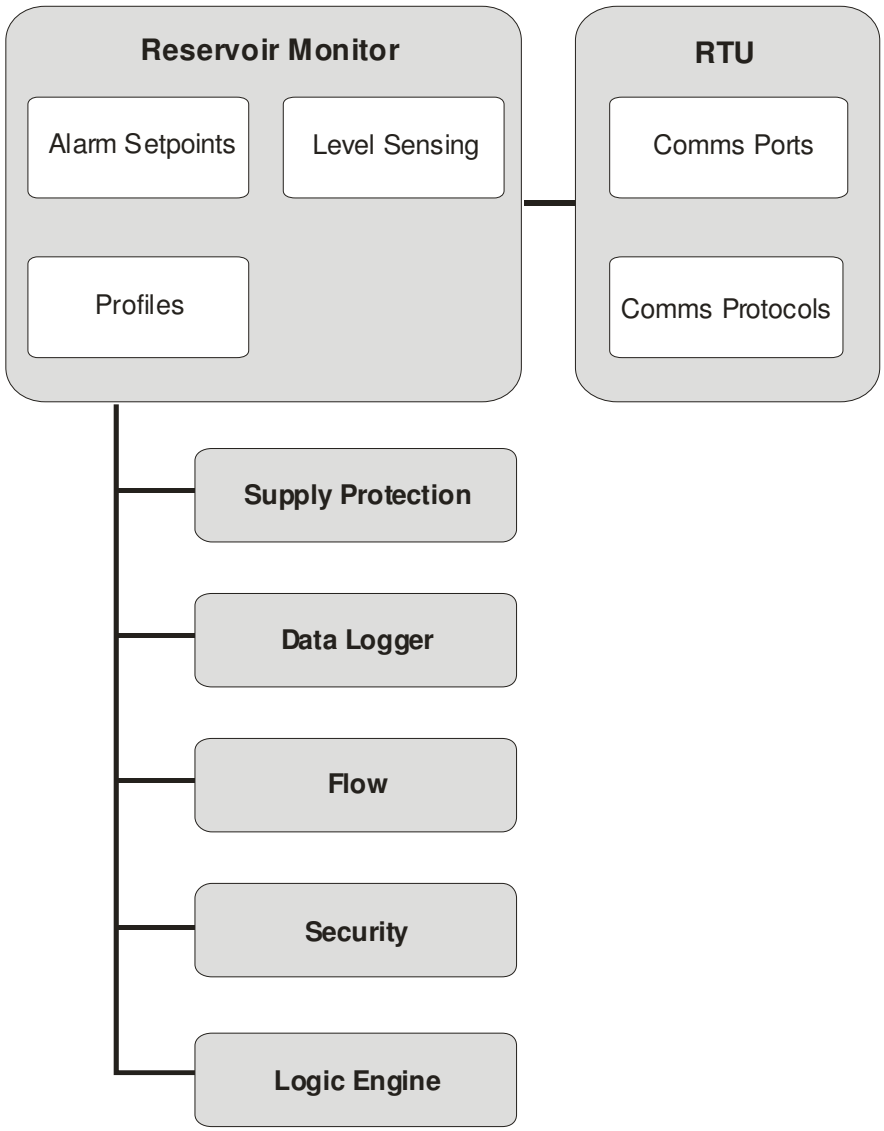


Figure 80 - MultiSmart Reservoir Monitor Overview

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 **Manual (Hand)** mode is selected, the pump turns on unless the pump is faulted or unavailable. It returns to Automatic mode when the deactivation setpoint is reached.

In **Off** mode the pump does not start, unless put into Manual or Automatic modes, even when the activation setpoint is reached.

In **Automatic** mode the advanced pump control module takes over the duties of starting and stopping the pumps.

NOTE: *The Off mode can be disabled (skipped), 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 change.*

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

Emptying or filling a well is supported along with multiple wells, either independent or balanced (however all wells must be of the same type - empty or fill). 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 alarm. 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

A single MultiSmart unit can support up to 6 pumps (depending on the configuration), which can be assigned to more than one well if required. Multiple groups of pumps are supported. Typical applications for groups 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 also 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 pump control 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. Digital outputs are used (via contactors or soft starters) to start and stop pumps, and to switch external hardware such as solenoids, mixers or beacons. Some digital 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 related faults.
- **Level Sensors**
  The pump control module supports multiple level sensors, including 4-20mA analog sensors (e.g. pressure transducer, ultrasonic); MultiTrode conductive probe and ball floats. Support for redundant level sensing is built-in.

See Section 14 for more information.

10.4.5 Profiles

The pump control module supports six (6) profiles. Each profile consists of pump activation/deactivation setpoints, as well as three station optimization functions (Max Off Time, Max Run Time & Station Max Pumps to Run). Profiles can be switched via any of the following methods: (See Section 15 for more information).

- User interface
- SCADA
- A timer (e.g. time of day)
- Digital input (e.g. a switch on the panel) or any digital tag (e.g. an alarm condition)
- Logic engine script or ISaGRAF program

10.4.6 Station Optimization Functions

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

- Pump Reversal (to avoid blockages)
- Odor Reduction (via maximum off time)
- Maximum Run Time
- Station Maximum Pumps to Run (for electrical or hydraulic overload protection)
- Minimize Fat Buildup (via random duty start)
- Well Clean Out
- Minimize Excessive Starts
- High Inflow
- Well Washer
- Well Mixer
- Blocked Pump Detection
- Pump n Max Starts per Hour

See Section 16 for more information.

10.4.7 Watchdog

The pump control module includes a watchdog function which counts up while the pump control module is functioning. This value is available as a tag in DNP3 and Modbus so that a SCADA system can monitor the health of this module.

10.5 Energy Monitoring and Motor Protection

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

- Over and Under Current
- Over Current I^2T
- Current Phase Imbalance (or Phase Failure)
- Current Phase Rotation
- Ground (Earth) fault

This module also periodically tests the insulation resistance of the motor windings. Two user defined thresholds can be entered one for a warning message and a second for a fault message, neither or both can be configured to fault a pump if the IRT value falls below the thresholds.

A Pump Efficiency Warning is also available which displays a warning if efficiency (in say L/kWh) falls below a threshold.

10.6 Supply Protection

The Pump Control 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 & Over Voltage
- Voltage Phase Imbalance (or Phase Failure)
- Voltage Phase Rotation

10.7 Data Logger

The MultiSmart unit has a datalogger. The logged data can be downloaded onto a compact flash card and then transferred to a computer 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. 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 enter before being allowed access. By enabling security, a user must log-in before making changes to the configuration and before accumulators can be cleared. Pump information (such as Runtime Statistics) can still be viewed without a PIN number. An alternative method to log-in is via a digital input. A third method requires a Security or Dallas key which is placed on a reader. User access rights are managed by an administrator. See Section 11 for more information.

10.11 PLC Extension (IEC 61131-3)

ISaGRAF, a control software environment which supports all of the internationally recognized IEC 61131 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 thereby extending existing functionality or allowing new functionality to be added. 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 DNP3 with security. The MultiSmart can also be shipped just as an RTU without any Pump Station Manager functionality or user interface. See Section 21 for more information.

The diagram below illustrates the extensive communication capabilities of the MultiSmart, even though in practice it is highly unlikely to use all of these in the same installation. MultiSmart can be interfaced with most industry standard equipment and SCADA networks.

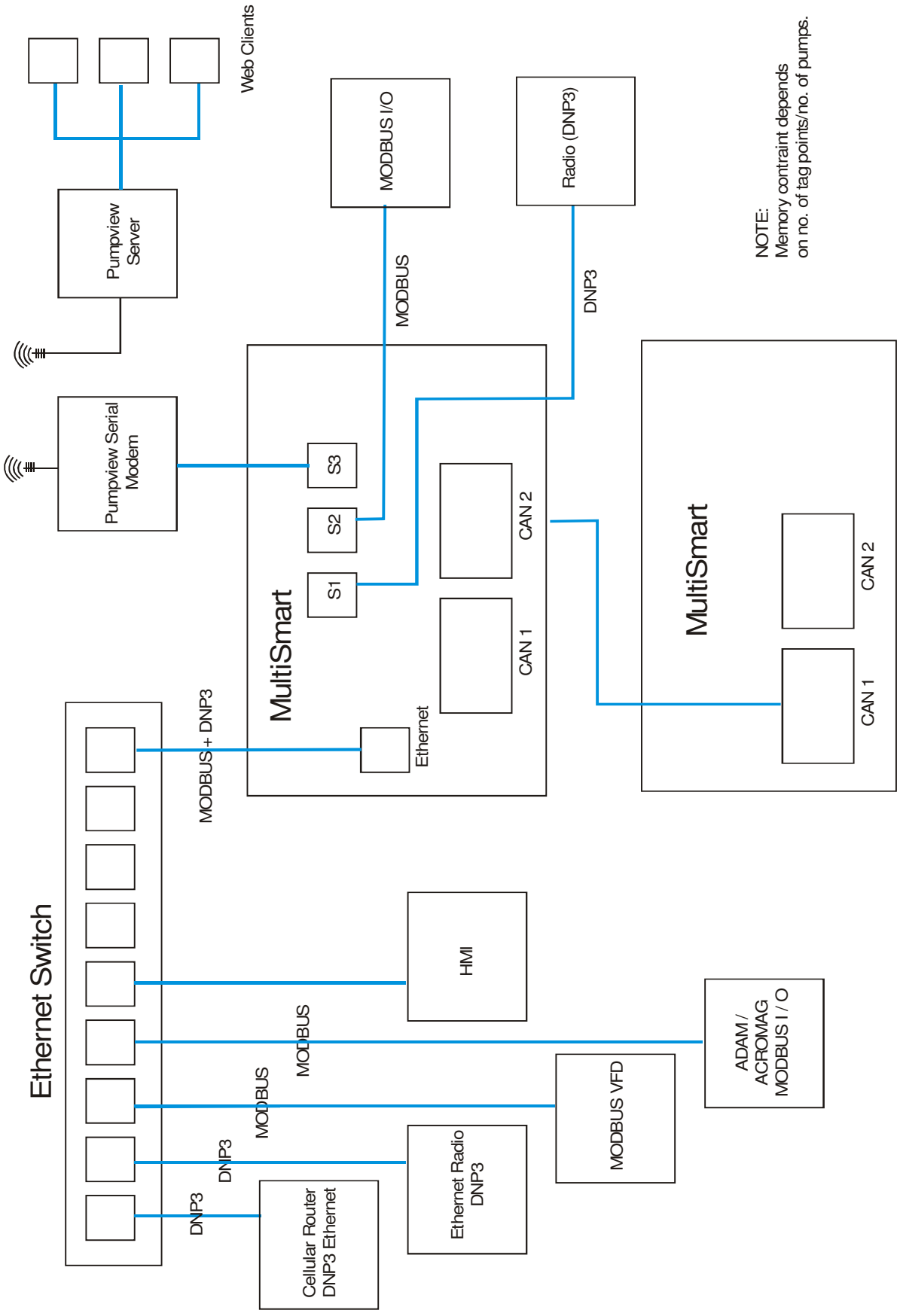


Figure 81 - MultiSmart Communication Capability Overview

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)
- Placing the Security Key (Dallas Key) on the reader

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 must go to the Security Screen in the settings menus and configure a user before security is enabled.

NOTE: *The factory set security password can be found on the sleeve of the product manual CD.*

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 security is enabled, users are not able to make configuration changes or clear the accumulators from the information screen without first logging in.*

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

To access the security screen:

- Press 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**

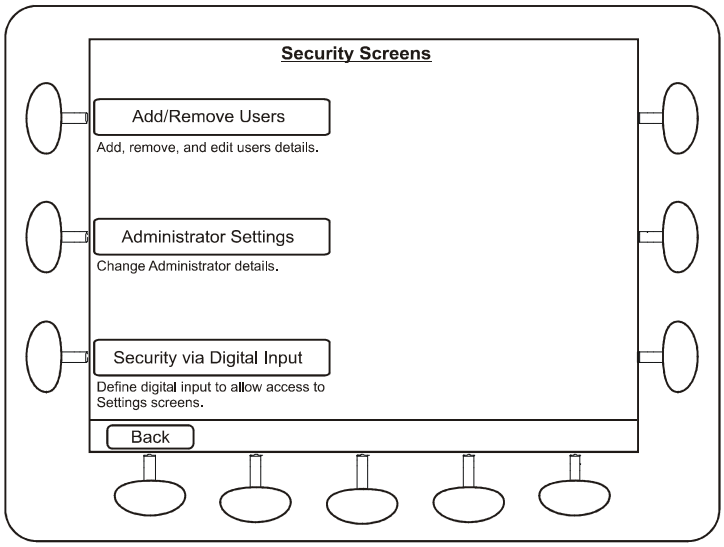


Figure 82 – Security Screen

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

The following user settings can be edited:

- User ID
- PIN
- User Name

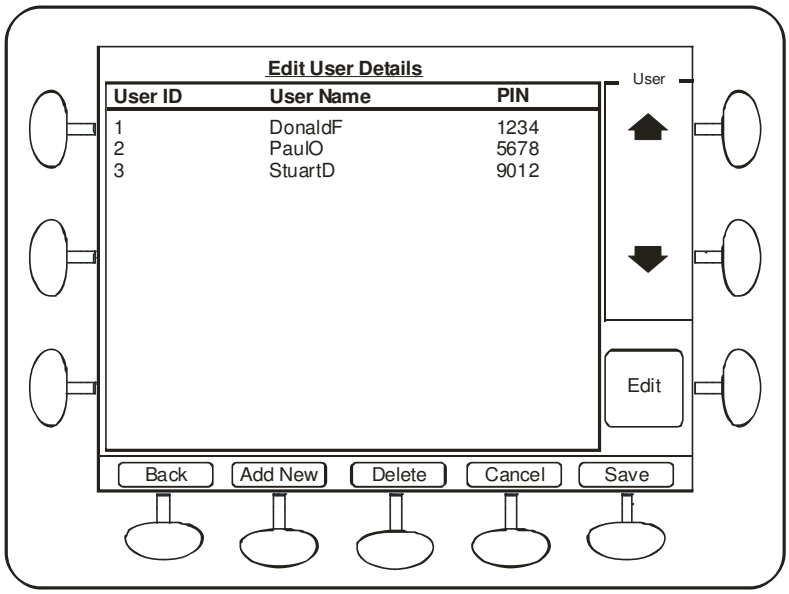


Figure 83 – Edit User Security Details

To change the administrator password:

- Press **Administrator Settings**
- Enter a new password
- Press Save

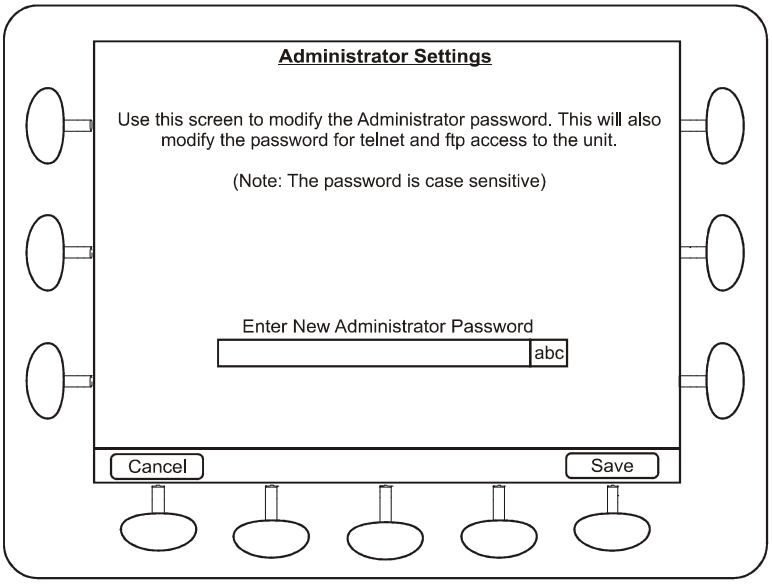


Figure 84 – Change Administrator Password

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 86 and Figure 87 in Section 11.1 below).
- Press **Save**

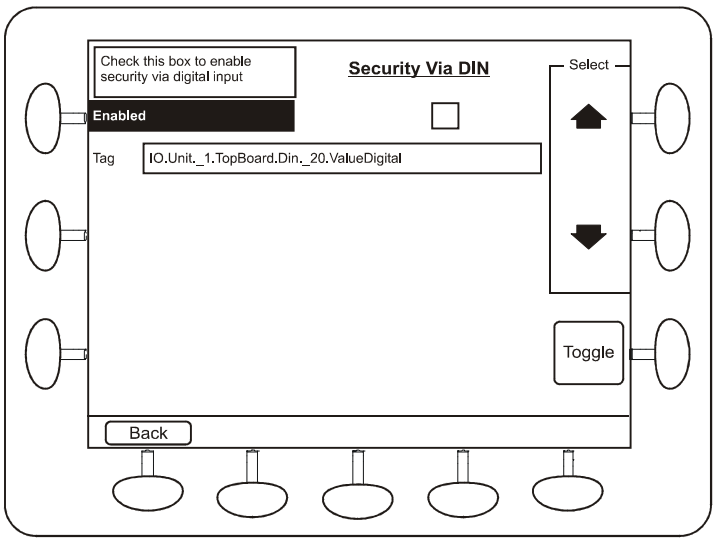


Figure 85 – Configure Security via DIN

11.1 Selecting any Digital Input Tag

The screens below show how to navigate to any digital input tag.

Find the **IO Module** in **Advanced** and using the +/- button expand out the tree view to get to the Digital Input you are looking for.

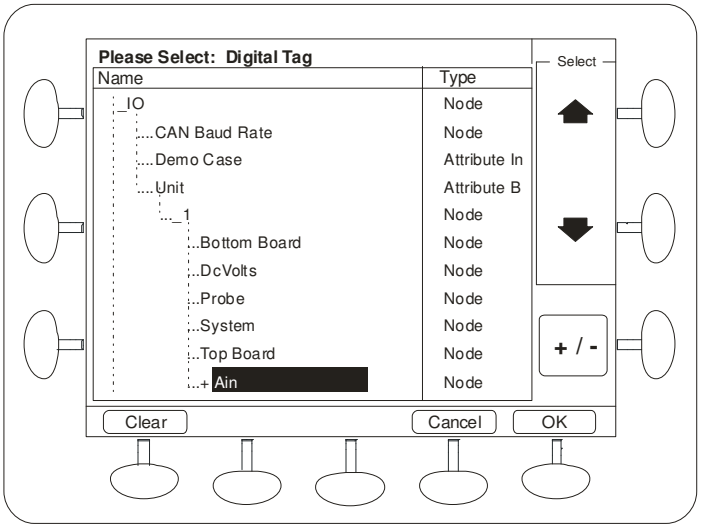


Figure 86 – Tag browser screen

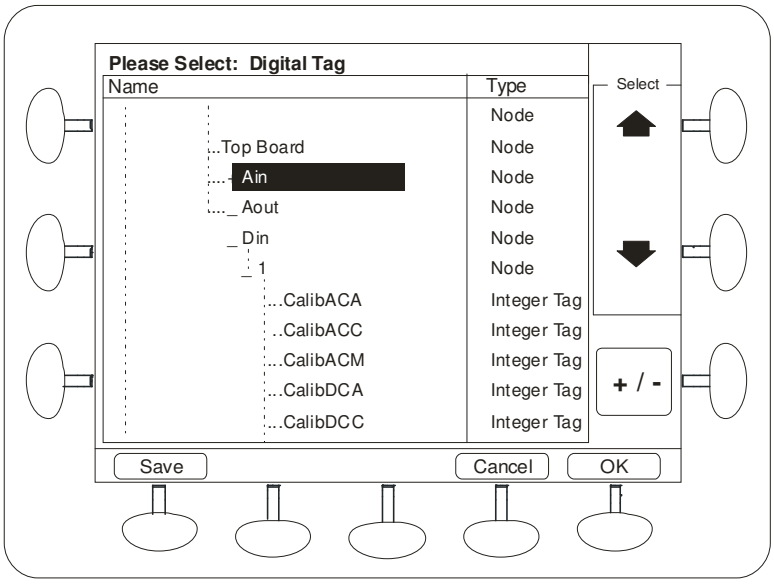


Figure 87 – Tag browser screen –continued.

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.*

11.2 Security Key Setup

The Security (or Dallas) key allows a quick and easy method of accessing the MultiSmart whilst maintaining a high level of security, as only those users with a Security key (in which the Administrator has registered the PIN) can gain access the MultiSmart menus.

The Security key module is a separate software module which can be enabled after purchased. (Only present in MultiSmart firmware version 2.2.0 or later).

11.2.1 Initial Hardware Setup

To enable the Security key reader:

- If not purchased with the MultiSmart, enter the new Site Key provided by MultiTrode (See Section 9.2.1 for procedure).
- Navigate to the **Protocols Settings** screen.

Settings → More → Communications → Protocol Settings

- The Security key is assigned to serial port 3 by default. Verify that no other device is using this port, if so, reassign a device to an unused serial port. (See Figure below).
- Connect the Security key reader to the selected port (or the default port 3).
- Reboot the MultiSmart.

NOTE: If at any time the Security Key reader is disconnected from the MultiSmart, a reboot is necessary in order to re-establish communications to the reader.

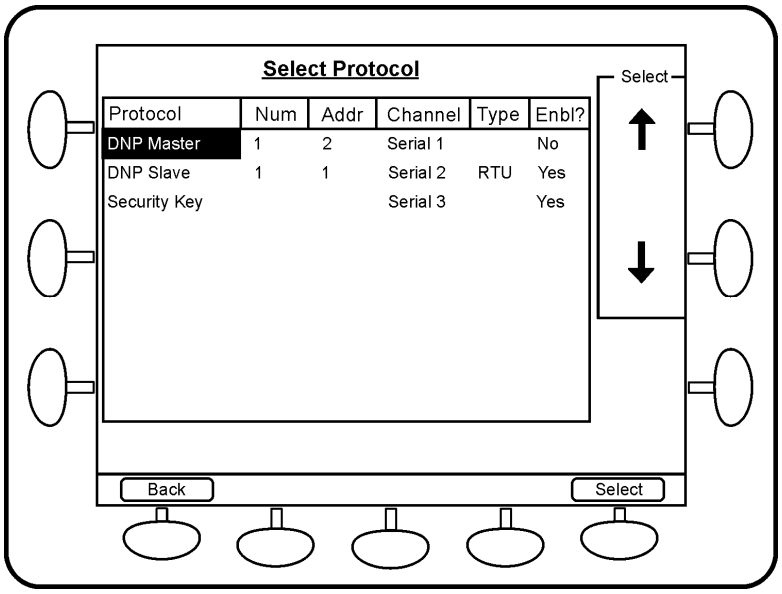


Figure 88 – Allocation of Serial Ports

11.2.2 Adding Security Key Users

The Administrator must now create a user that matches the PIN of the Security key. This procedure differs slightly compared to a PIN only user as details are automatically entered.

- Navigate to the Security screen

  Settings → More → More → Security

- Enter the MultiSmart Administrator password
- Press the **Add** / **Remove Users** button
- With the **Edit User Details** screen displayed, place a security key on the reader until the details are displayed on the screen (These details include a User ID, User Name and PIN).
- The User ID and User Name can be edited at this point by pressing the **Edit** button. The PIN can not be changed – only deleted.
- Press **Save**.

11.2.3 Accessing the MultiSmart with a Security Key

The Security key must already be registered by the Administrator (see Section 11.2.2).

- Press the **Settings** button to display the 'Login' screen
- Place the Security Key on the reader until the menus are accessed
- If an unregistered Security key is read, the screen does not change
- If an invalid PIN is manually entered an **Access Denied** message is displayed

NOTE:
It is recommended that the Administrator maintains a record of all Security Key PINs registered. In the event the Security Key reader fails, a PIN can be manually entered via the key pad.

NOTE:
The Security Key must make firm contact with the outer ring of the reader before it can read the key.

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 four 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 different **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.

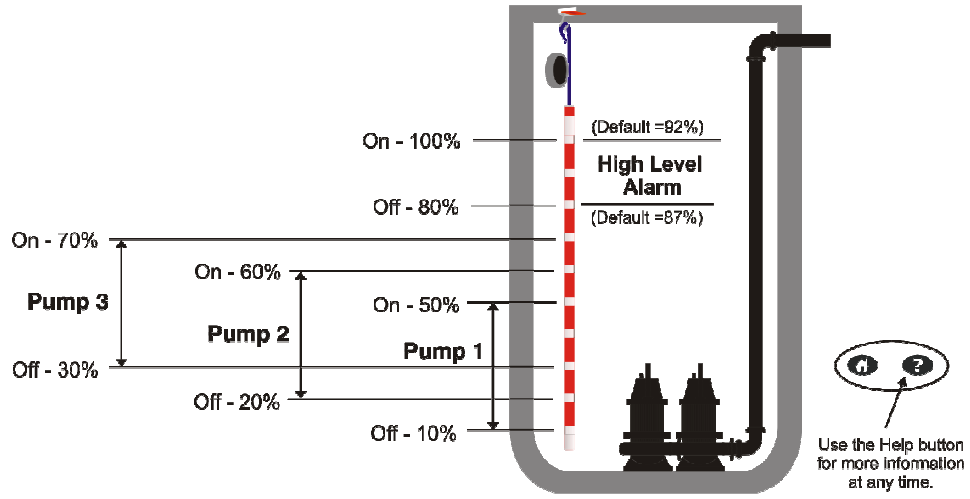


Figure 89: Empty (Discharge) Mode—Default Normal Levels

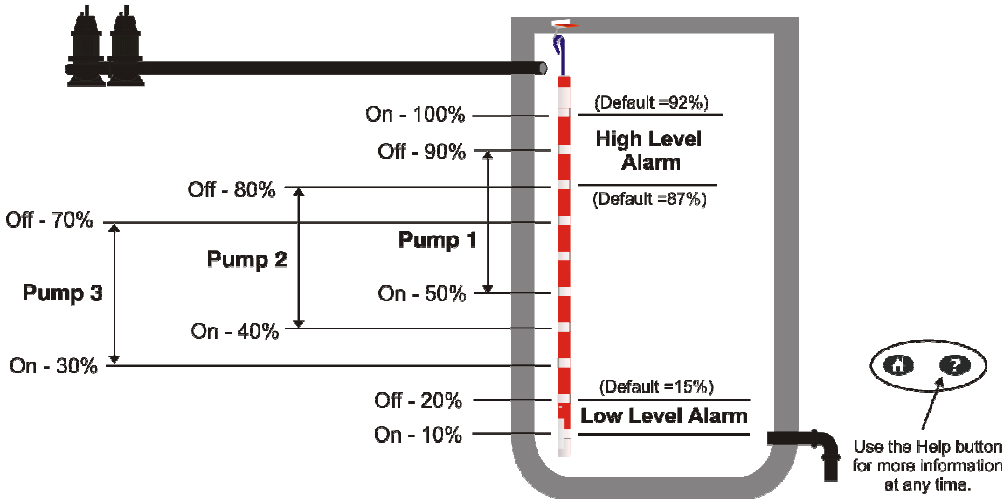


Figure 90: Fill (Charge) Mode – Default Normal Levels

12.3 Changing Pump and Alarm Levels Setpoints

12.3.1 Limitations

The MultiSmart unit does not allow the user to set invalid activation and deactivation setpoints, 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

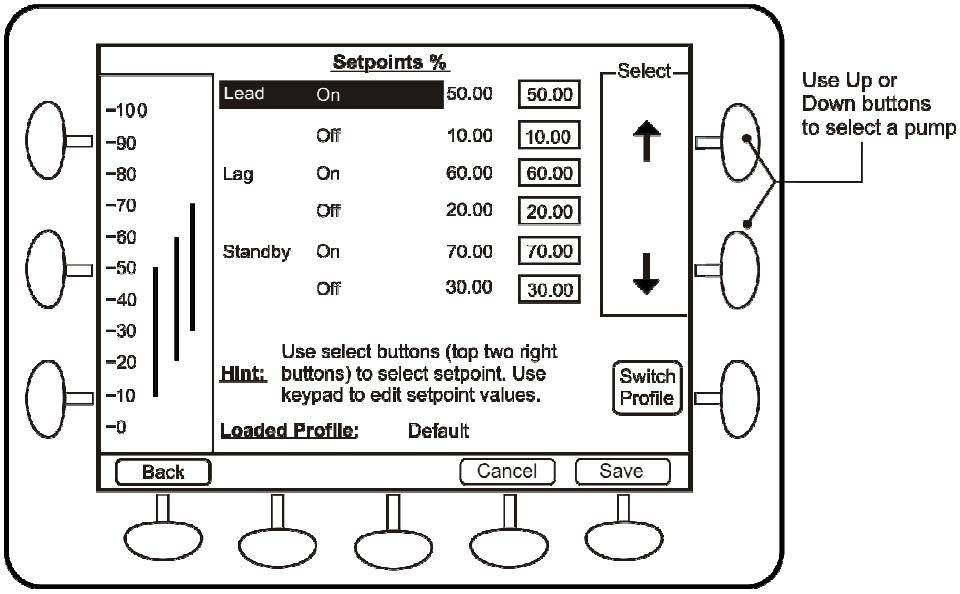


Figure 91 - Setting Pump Levels

- 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 is 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 correspond to the pumps in well 1 and the next set will correspond to the pump/s in the second well.*

12.3.3 Pump setpoints with two independent wells

The Setup Wizard allows the user to create a pump control configuration with more than one well. If "independent wells" is selected, (i.e. no hydraulic connection between the wells), this section explains how to change pump setpoints.

The standard pump setpoints screen is still used but certain rules are in place for normal operation which makes the setup for independent wells a little more difficult.

The following example is a 4-pump station with 2 pumps in well 1 and 2 pumps in well 2.

- P1 and P2 are automatically assigned to well 1.
- The required start/stop points are 50/10 for lead (duty) and 60/20 for lag (standby) for both wells.
- The pump setpoint screen will be similar to Figure 89 - Setting Pump Levels (except with 4 pumps). Change the setpoints to 50/10, 50/10, 60/20, 60/20.
- Now go to the Alternation and Grouping screen (see Section 13.2), and while keeping the pumps in alternation mode, change the order of the pumps to P1, P3, P2, P4.

If the station operation is now tested, P1 and P2 are in well 1 and the start points are 50% for the lead pump, and 60% for the lag pump. Well 2 contains P3 and P4 and have identical start/stop points.

To enable or disable the Independent Wells options, navigate to:

Settings → Advanced → Pump Control → Independent Wells?

12.3.4 Setting Alarms Activation/Deactivation points

The Pump Station Manager 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 12.3.5).

From the main screen navigate to the Alarm Levels screen:

Settings → Set Points → Alarm Setpoints

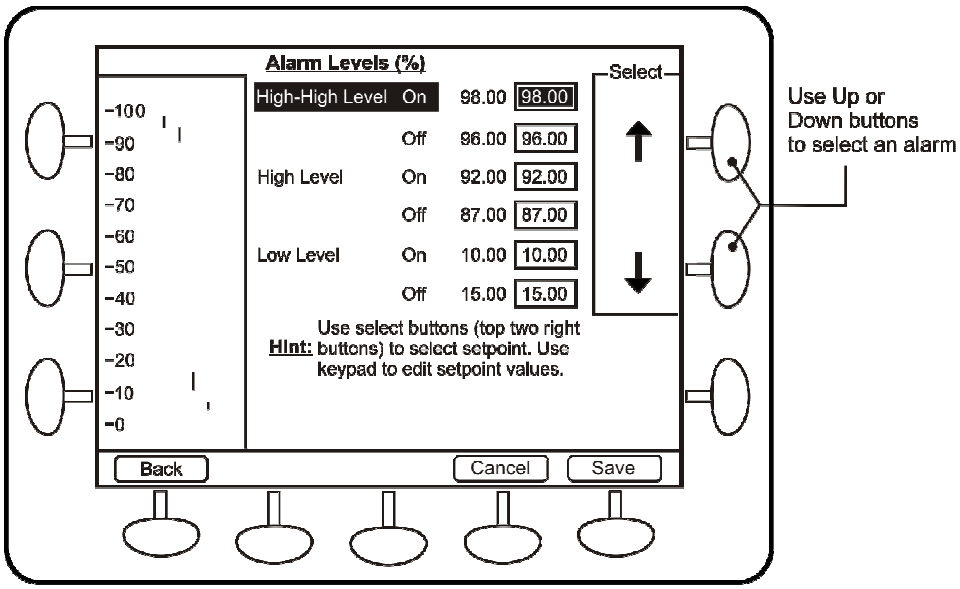


Figure 92 - Setting Alarms

- 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 is 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.*

12.3.5 Enable/Disable Alarms

From the main screen navigate to the **Level Alarms** screen:

Settings → Set Points → Enable/Disable Alarms

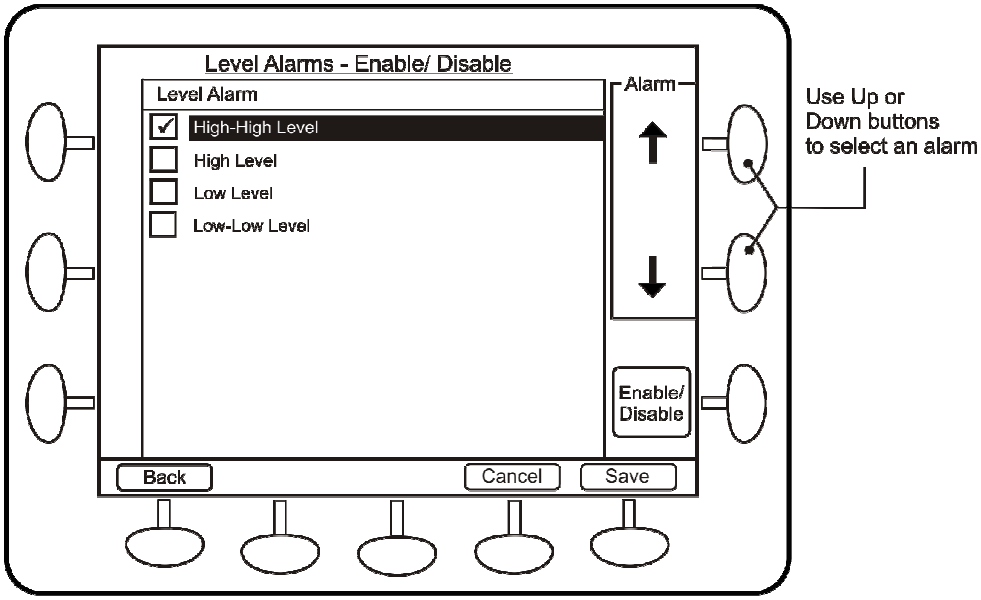


Figure 93 - Enable/Disable Alarms

- 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 expired. Deactivation delays do the same for turning off an alarm or pump. The unit also contains inter-pump delays to prevent two pumps starting or stopping within a predefined period of time. This can prevent water hammer and electrical overload. All pump and alarm activation and deactivation delays have a factory default setting. These may be adjusted as required.

Navigate to:

Settings → Set Points → Delays

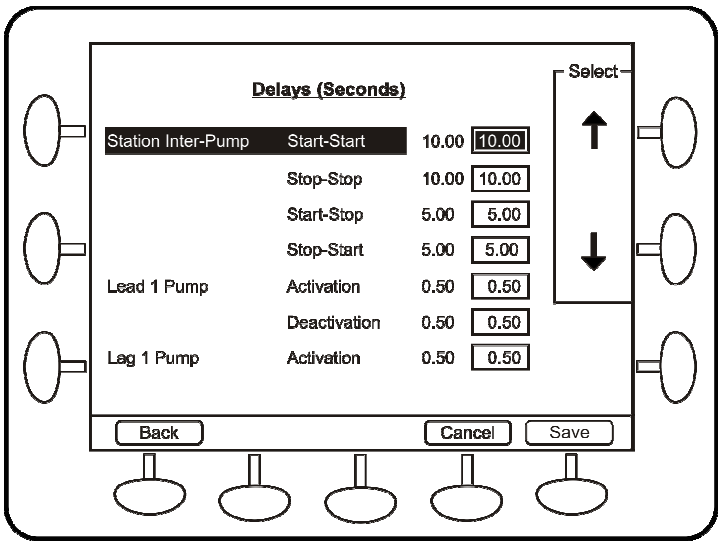


Figure 94 - Pump and Level Alarm Delays

- Use the arrows to select an alarm.
- Enter new values, in seconds, using the keypad.
- Push the **Save** button to commit the changes.

This screen changes the delays for all profiles.

12.4.1 Inter-pump delays

There are four different delays that operate between one pump stopping or starting and a second pump starting or stopping.

- Start-Start (10s default)
- Stop-Stop (10s default)
- Start-Stop (5s default)
- Stop-Start (5s default)

12.4.2 Activation & Deactivation delays for individual pumps

An activation and deactivation delay is present for each pump.

- Pump Activation Delay (0.5s default)
- Pump Deactivation Delay (0.5s default)

12.4.3 Activation & Deactivation delays for level alarms

Each of the four level alarms have an activation delay (5s default) and a deactivation delay (10s default).

- High-High Level
- High Level
- Low Level
- Low-Low Level

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.*

13 Pumps and Groups

The number of pumps is specified during the Setup Wizard. Depending on the hardware and software configuration purchased, the number of pumps is limited to 3, 6 or 9 pumps.

Alternation of pumps is on and set to Alternation (std) by default. All pumps are placed into one group (and maximum groups to run is set to one).

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

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 must be available for calculations. This mode uses pump efficiency last week and this will not be active if the efficiency results are reset or unavailable. See section 13.1.1.
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.
First On First Off	The first pump that starts is the first pump to turn off. For example, if the lead pump starts & is later followed by the lag pump, when the level falls, the lead pump is the first to turn off.
N to M	The pumps run in the ratio defined by N and M. For example, a common ratio is 3:2.

Table 6 – Alternation Schemes

Most installations use the first 2 options: Alternation or Fixed.

There are three alternations schemes available for sequencing between groups they are; Alternation (std), Fixed (std), Alternation Special.

NOTE: *The number of pumps is specified during the Setup Wizard and can only be modified by running the Setup Wizard again. Any configuration changes made must be re-entered.*

NOTE: *Efficiency alternation is based on the calculated efficiency for 'last week'.*

To make changes to pump groups and alternation schemes, go into the Alternation and Grouping setup.

Settings → Alternation & Grouping

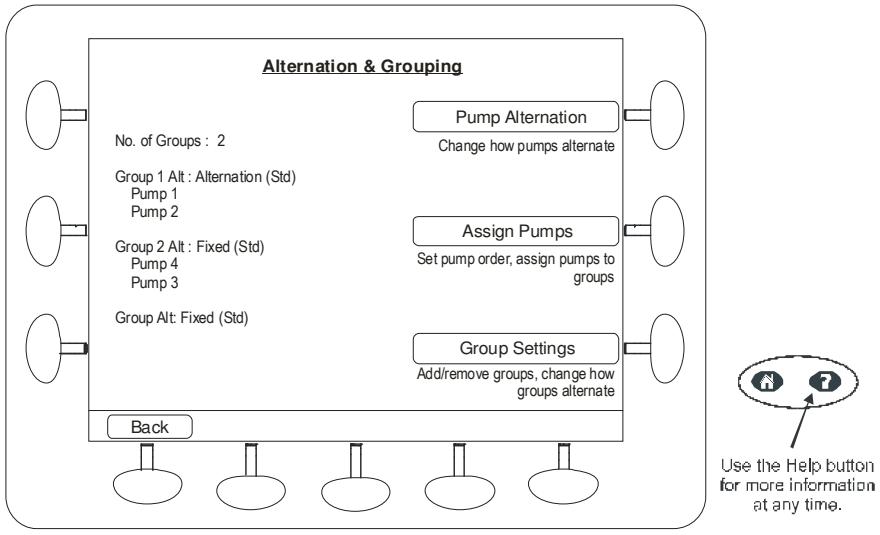


Figure 95 - Alternation & Grouping Screen

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

Settings → Alternation & Grouping → Pump Alternation

Choose the **Pump Alternation** option to change the alternation scheme. In the usual situation of only one group:

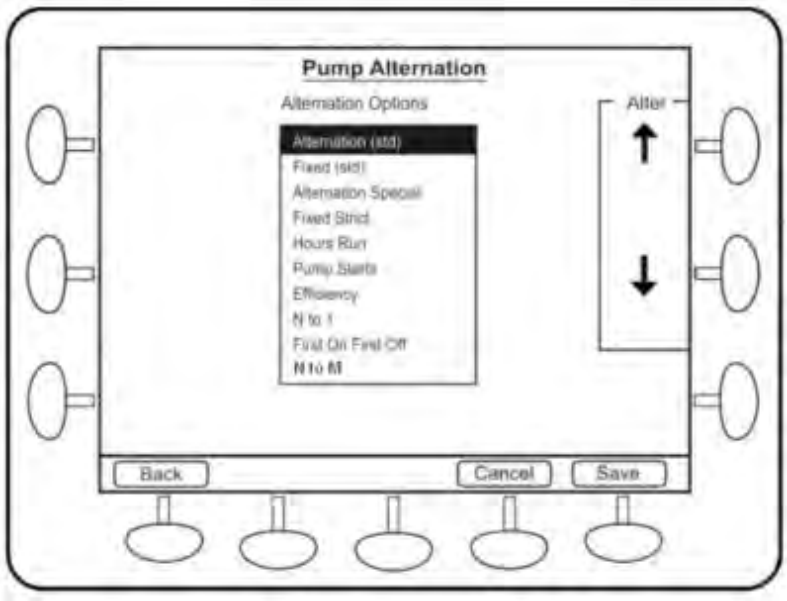


Figure 96 - Configuring Alternation Options

Simply select the new alternation scheme using the **Alter** arrows on the right and press **Save**. Some of the options produce additional options below the list. For example, if “N to 1” is selected a box with: **N to 1 ratio** appears for user configuration.

If **N to M** is selected, the user saves this option then presses the **Edit** button which appears on the right, and enters the values N and M in a new screen.

If there is more than one group the screen has additional options:

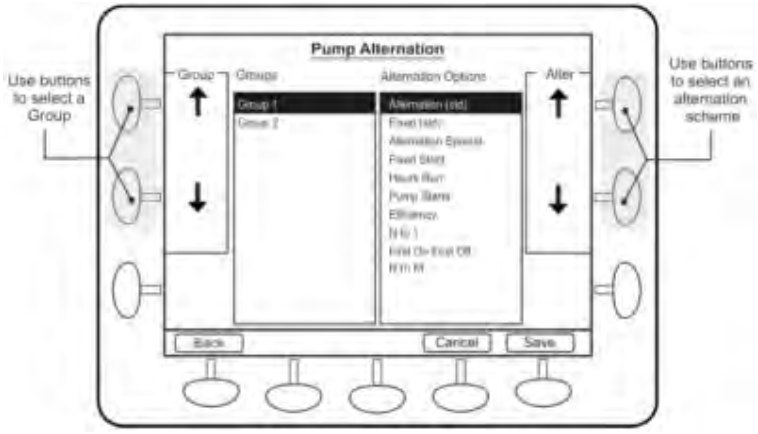


Figure 97 –Changing Group Alternation & Fixed Duty

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.

*Press **Save** to apply changes and go back to the **Alternation and Grouping** screen. The summary now shows the changes made as the current settings .*

13.1.1 Alternation by Efficiency

This feature can provide a valuable energy saving function, as the most efficiency pump will be run more often than the less efficient pump.

When **Efficiency** is highlighted two fields appear below the selection box:

- Efficiency Deadband
- N to 1 ratio

An arrow appears by the bottom left softkey to move the selection between the main alternation options and these two parameters.

The Efficiency Deadband ensures that a marginally more efficient pump is not run in preference. When the efficiencies of the pumps are within the deadband, a secondary alternation scheme of **Alternation (Std)** is used instead. This ensures even wear between pumps with similar efficiencies.

Once outside of the efficiency deadband, the more efficient pump will be run N times for every one time the less efficient pump is run. N is defaulted to 10.

13.2 Moving Pumps Between Groups, or Changing the Order of Pumps

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

Settings → Alternation & Grouping → Assign Pumps

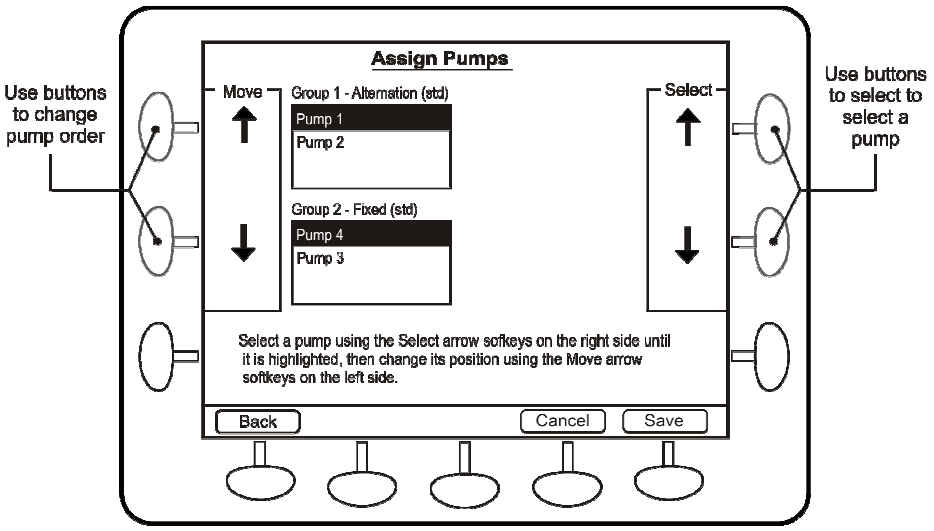


Figure 98 - Moving pumps between Groups and changing the order of pumps

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

NOTE: *Moving pumps between groups requires a restart.*

13.3 Adding or Deleting Groups & Changing Group Alternation

To add or remove a group navigate to **Group Settings**.

Settings → Alternation & Grouping → Group Settings

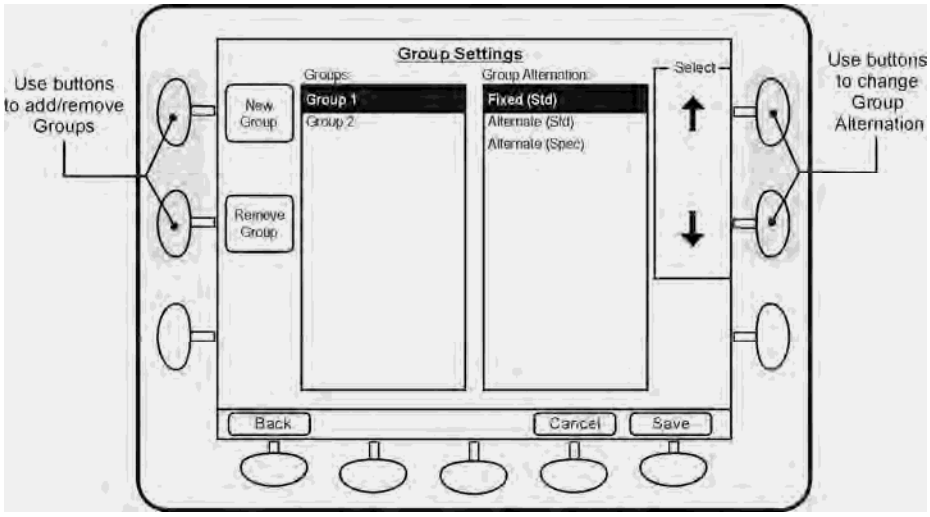


Figure 99 – Add/Remove Groups Screen

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

NOTE: *A particular group can not be selected and deleted, rather the highest numbered group is always deleted. Adding or removing a group requires a restart of the unit.*

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 (default is 1, i.e. only pumps in the same group can run).

For example, for 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, go to Maximum Groups Running, enable **Block running pumps** and set the **Quantity** to 1.

These settings turns 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. Deactivation of a pump is dependent 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

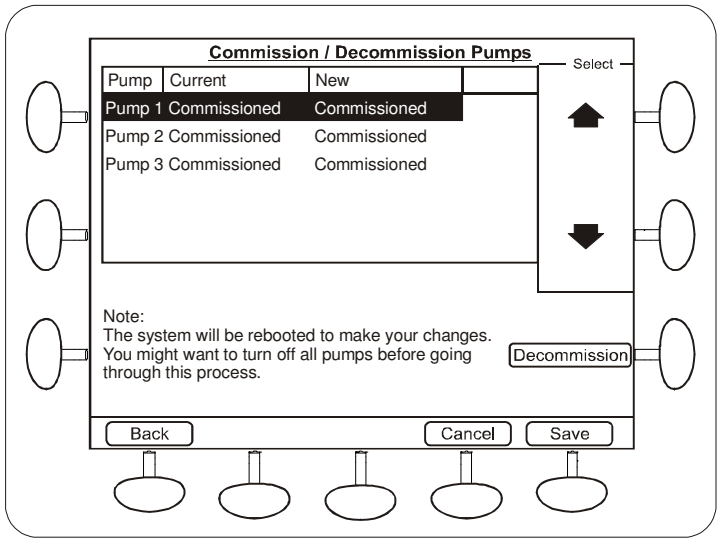


Figure 100 - Decommissioning Pumps

- Select the pump to be decommissioned 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 7.2. 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 DINs. Some inputs have special functions for particular purposes. These are summarized in Sections 7.3, 7.6 and 14.4. To view the current digital input configuration, navigate to the **Digital Inputs** screen:

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

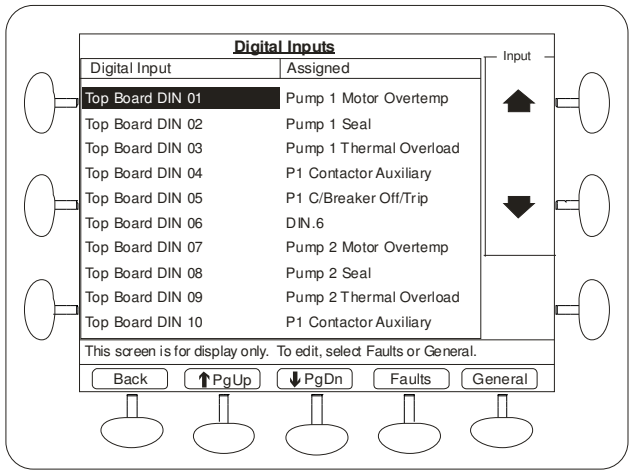


Figure 101 - Digital Input Assignments

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

- **Faults** - Used to assign/unassign a particular type of fault such as pump seal fault.
- **General** - Allows the description of the input (i.e. DIN 12) to be renamed.

14.2 Assigning Faults to Digital Inputs

Navigate to:

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

The predefined faults that can be linked to a digital input are listed below.

Generator Running	Pump 1 Thermal Overload	Pump 1 Non Critical
Generator Fault	Pump 1 Motor Over Temp	Pump 1 Holdout
Station Inhibit Override	Pump 1 CB Off/Trip	Pump 1 Inhibit Override
Pump 1 CLS	Pump 1 Contactor Auxiliary	- etc, repeated for each pump
Pump 1 FLS	Pump 1 Delay Fail	General fault 1 - 10
Pump 1 Seal	Pump 1 Critical	-

Table 7 – Digital Input Fault Sources

NOTE: *For a full list of faults and their function, see Appendix A.*

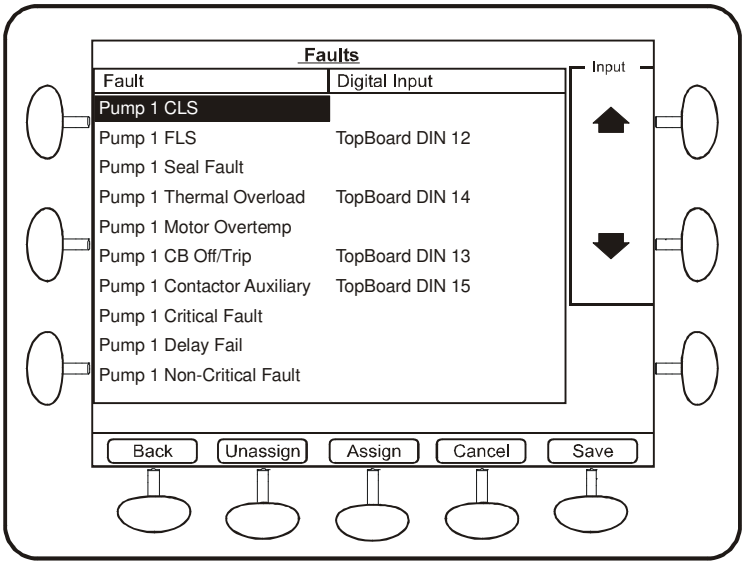


Figure 102 – Select a Fault

- Use the scroll buttons to highlight the type of fault input required
- Press the **Assign** button

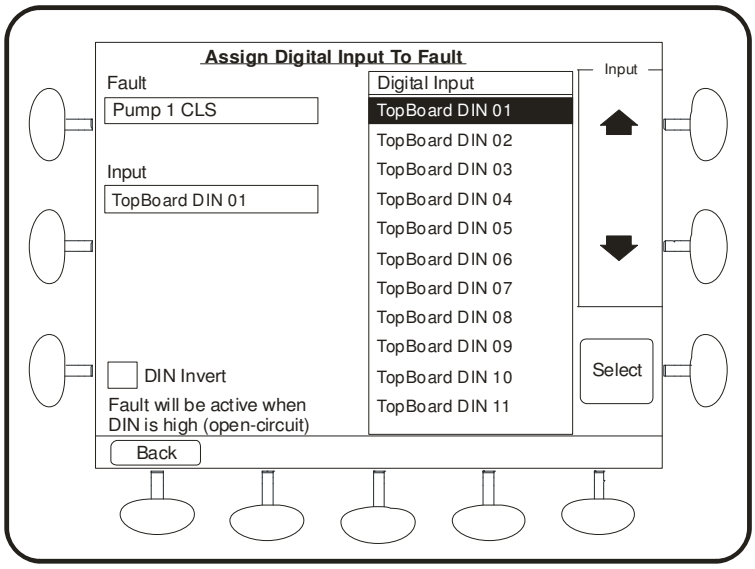


Figure 103 - Assign the Selected Fault to a Digital Input

- Use the scroll buttons to highlight a Digital Input.
- Press the **Select** button to assign this input to the selected fault.
- Select **DIN Invert** if the fault needs to be active when the input is Low (open circuit), else the fault will be active when the DIN is High (closed circuit).
- Press **Back** and repeat for each fault that needs to be assigned.
- Press **Save** at the end of the process.

NOTE: *The Pump Holdout fault is hidden by default so, the "Fault" button does not flash when this fault is active, instead the text "Holdout" appears in the pump status section.*

NOTE: *In order to make some changes, a reboot of the pump station manager may be necessary – a message will be displayed. It is recommended that all pumps are turned off prior to rebooting.*

14.3 Unassigning Fault Inputs

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

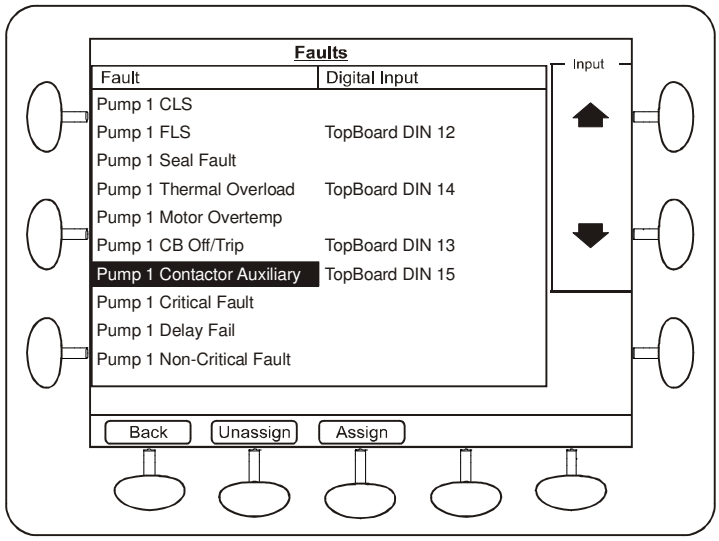


Figure 104 – Fault Screen

- Use the scroll buttons to highlight the Fault to be unassigned.
- Press the **Unassign** button, (**Cancel** and **Save** buttons will appear).
- Press **Back** and repeat for each fault needs to be unassign.
- Press **Save** at the end of the process.

14.4 Configuring Digital Inputs

Navigate to the Digital Inputs screen and press the **General** button.

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

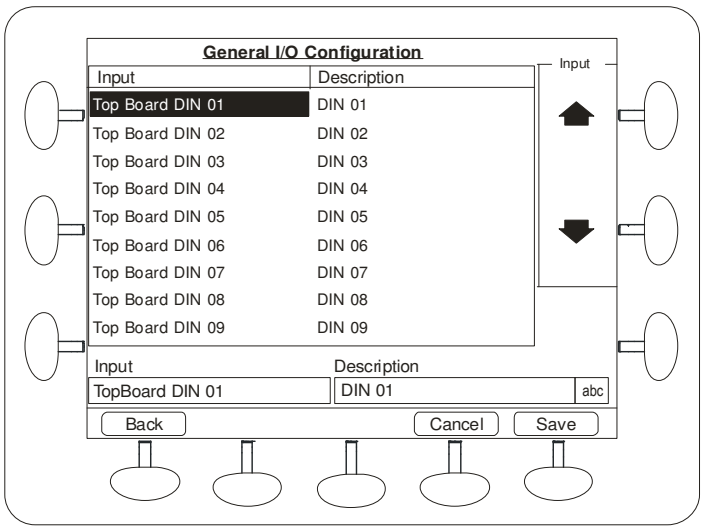


Figure 105 – Digital Input Configuration Screen

This screen only allows the description of the input (DIN 09) to be changed.

Advanced configuration options can be found in the **Advanced** menu. These options include changing the scaling, e.g. for a pulse accumulator such as a flow meter or rain gauge.

Settings → Advanced

- From the tree select: **IO Module** [+/-] **Unit** [+/-]
- Select the correct unit (i.e. **Unit 01**) and press [+/-]
- Select which module the inputs are located (i.e.: **TopBoard**) then [+/-]
- Select **Digital Input** then [+/-]
- Select the digital input to configure (i.e. **DIN 01**) and press [+/-]

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 (ms)	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.	Integer
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) 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 being configured.	See table below
Probe (requires 'Show More Options' checked – 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 14.8.5	
Value Resistance	Used to set dead band parameters such as Type and Value.	

Table 8 – Advanced Digital Input Options

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 14.8.7 for more detail.*

Digital Input configuration - for reference only:

Type of Input	Mode	Typical Sensitivity or Range	Invert?
Conductive Probe	AC	20,000Ω	No
Seal Sensor (conductive)	AC	40,000Ω	No
Flygt CLS	CLS	Seal >4kΩ, Thermal <1kΩ	No
PTC Thermistor	DC	3,000Ω	Yes
Flygt FLS	DC	Seal >4kΩ, Thermal <545Ω	No
Normal Volt Free Contact Closure	Digital	4Hz	No (default) / Yes (N/C)
Failsafe Probe Sensor	Fail Safe	4,000Ω	No
High Speed Counter	High Speed	1kHz	No (default) / Yes

Table 9 – Digital Input Mode Examples

14.4.2 Digital Input Summary Table

This table summarizes the capabilities of the digital inputs on the Pump Station Manager (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	✓	✓	✓	✓	✓		

Table 10 – Digital Input Capabilities

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

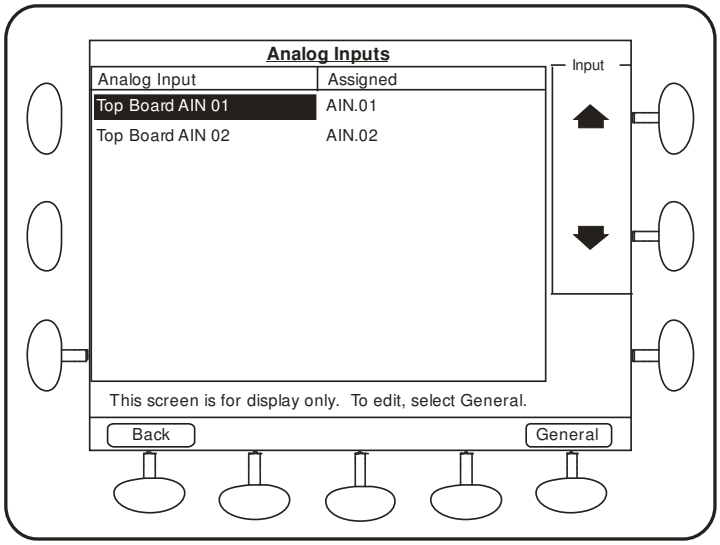


Figure 106 - Analog Input Configuration

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 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 suitable. 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 (i.e. **Unit 01**) and press [+/-]
- Select which module the inputs are located, i.e. **TopBoard** then [+/-]
- Select **Analog Inputs** then [+/-]
- Select the appropriate analog input (i.e. **AIN 01**) to configure and press [+/-]

14.6 Advanced Analog Input Options

Name	Description	Range/Type
Delay (ms)	This delay is used as a low pass filter.	0 - 100000ms
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	

Table 11 – Advanced Analog Input Options

14.7 External Digital & Analog Modules

If an I/O 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 I/O 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, digital 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 using the same procedure as that for native MultiSmart I/O.

Currently, this wizard functionality supports the following units:

- ADAM-6017 - Ethernet, 8 x AIN, 2 x DOT
- ADAM-6050 - Ethernet, 12 x DIN, 6 x DOT
- ADAM-6051 – Ethernet, 12 x DIN, 2 x DOT
- ACROMAG-961 - Ethernet, 6 DC Current Input Channels (6 x AIN)
- 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 profile for the external IO unit that communicates over the Ethernet port must 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 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 is also created by default. It is only necessary for reconfigure the points list for that slave to match the Modbus profile of the external IO unit. To do this navigate to:

Settings → More → Communications → Modbus Points Lists → Modbus Master → Regenerate Points List

Select the desired Ethernet expansion module that MultiSmart supports (If the module is not listed, custom engineering is required to interface it with MultiSmart). Confirming the selection will require a restart of the unit. Once 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 more I/O expansion modules are to be added, simply create additional slave profiles under the same Modbus Master and configure the Modbus points list to 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 has restarted, navigate to the following location:

Settings → More → Communications → Modbus Points Lists → Modbus Master

The option "Next Slave" will appear at the bottom of the screen. This makes it possible to browse the points list settings of the next slave.

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.

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 required to connect the MultiSmart and ADAM/ACROMAG units to the switch. The two different methods of interfacing the devices are shown in the figures below.

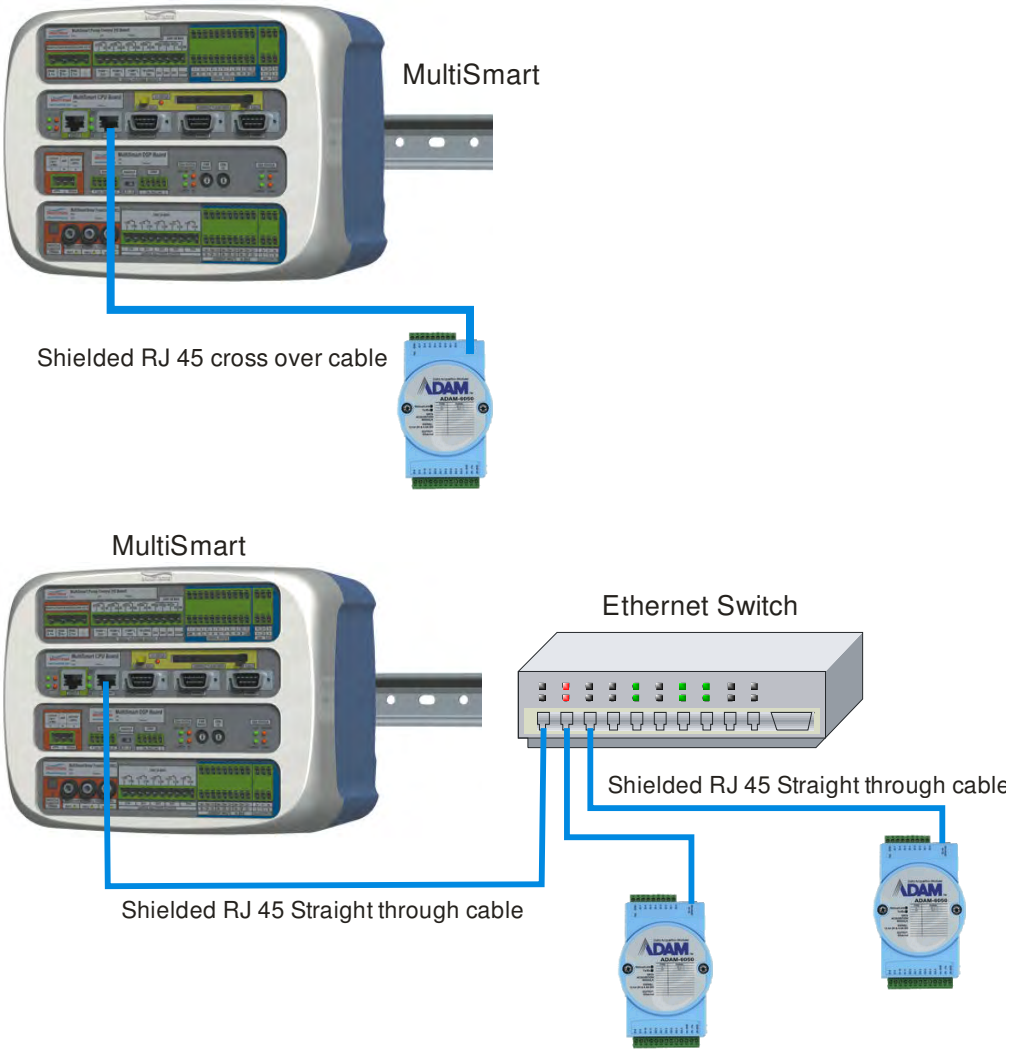


Figure 107 - MultiSmart + Ethernet Switch = 2 x Adam Units

14.7.3 ADAM Ethernet Units

ADAM Ethernet units currently supported include:

- ADAM-6017
- ADAM-6050
- ADAM-6051

The ADAM units, if purchased from MultiTrode are preconfigured to interface with the MultiSmart.

The ADAM units are packaged with a CD which includes a program called *Adam.NET.* This program is installed on a Windows PC and is used to configure the I/O device. It allows the IP address of the ADAM unit to be changed, in order to match a specific domain.

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.

Run the *Adam.NET* program. From the displayed window, highlight **ADAM5000TCP_6000**, then click on the magnifying glass icon. This detects the connected device. Highlighting this device allows the IP Address to be reconfigured 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 must 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 now needs to be reconfigured to communicate to this device.

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

Settings → More → Communications → IP Address

If the ADAM unit is directly connected to the MultiSmart using a cross over cable, set the MultiSmart IP Address to 10.0.0.2. To configure the IP address of the ADAM units for advanced installations refer to the unit manual (available for download from http://advantech.com.tw). Ensure that no more than one ADAM unit has the same IP address, otherwise an IP address conflict will occur. If advanced routing needs to be setup in the MultiSmart, refer to Section 22.4.

Navigate to: Settings → More → Communication → Protocol Settings

1. Select the Modbus Master, which contains the slave profiles of the I/O units, using the select arrow buttons and press **Select**.
2. 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.
3. 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**.
4. 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)
5. Press the Channel button, set the **Connection Type** to Initiating end-point and press **Save**.
6. Once the changes are complete, press **Save** 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 presents a very quick discussion of how to configure the devices for communications to a MultiSmart. Refer to the full instructions from the manufacturer 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 I/O units are able to serve html pages. Therefore, to configure a unit, only a web browser is required. All ACROMAG Ethernet I/O devices have a pre-programmed IP address of: 128.1.1.100.

In order to set up communications to a device, the computer connected must be able to address the unit's 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 loads the configuration page of the device. The user name is User and the password is passwordOO. By clicking on **Network Configuration**, the IP address of the device can be modified. Ensure that no more than one ACROMAG unit has the same IP address, otherwise it will result in an IP address conflict.

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

The MultiSmart 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 ACROMAG unit. To verify or change the IP address of the MultiSmart, browse to:

Settings → More → Communications → IP Address

If the ACROMAG unit is directly connected to the MultiSmart using a cross over cable, set the MultiSmart IP address to 128.1.1.101. To configure the IP address of the ACROMAG unit for advanced installations, refer to the unit manual (available for download from www.acromag.com). If advanced routing needs to be setup in MultiSmart, refer to Section 22.4.

Navigate to: Settings → More → Communication → Protocol Settings

1. Select the Modbus Master, which contains the slave profiles of the I/O units, using the select arrow buttons and press **Select**.
2. 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.
3. 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**.
4. 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)
5. Press the **Channel** button, set the **Connection Type** to Initiating end-point and press **Save**.
6. From the **Advanced** screen, navigate to : Modbus Master → Master → Master 01
7. Change the **Comms Channel** parameter to TCP/IP 1 (or TCP/IP 2 or 3 if channel 1 is already used by another application). Then change the **Link Type** parameter to TCP.
8. Next, from the Advanced screen, navigate to:

   Telemetry → Channel → TCP/IP 1 → TCP/IP Channel
9. Change the **Connection Type** parameter to **Initiating end-point**
10. Then navigate to: IP Address → IP Address 01
11. Set the **IP Address** parameter to the address selected for the ADAM IO device, and then set the **TCP Port** parameter to 502 (which is the default for Modbus communications).
12. Once the changes are complete, press **Save** and restart the unit.

14.7.5 Verifying Communications & Values

Communications to an external I/O device can be verified by navigating to:

Info → Communications → Modbus Master Stats

If communications have been successfully established then **Online** is *True* and **Comms Fail** is *False*.

- **Online** status indicates whether the last message sent was acknowledged by the receiving device. If no acknowledgment is received within a preset time, then Online is set to *False*. (Relevant parameter - Default Response Timeout, default is 20s).
- **Comms Fail** – if the channel remains offline for longer than a preset time, then Comms Fail is set to *False*. (Relevant parameter - Comms Fail Time, default is 2 mins).

The **Transmitted** and **Received** counts are incremented on each message received or transmitted. By default, scans are configured to occur every 2 seconds.

To view the values read by the MultiSmart, press the **Back** button, select the **Modbus Master Values** button, and then select one of the point classes. All the points values read from the I/O device are displayed and are dynamically updated as new values are read.

The full menu path is:

Info → Communications → Modbus Master Values

Highlight a point and pressing the **Details** button displays 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 the primary and backup level devices can be assigned or unassigned.

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

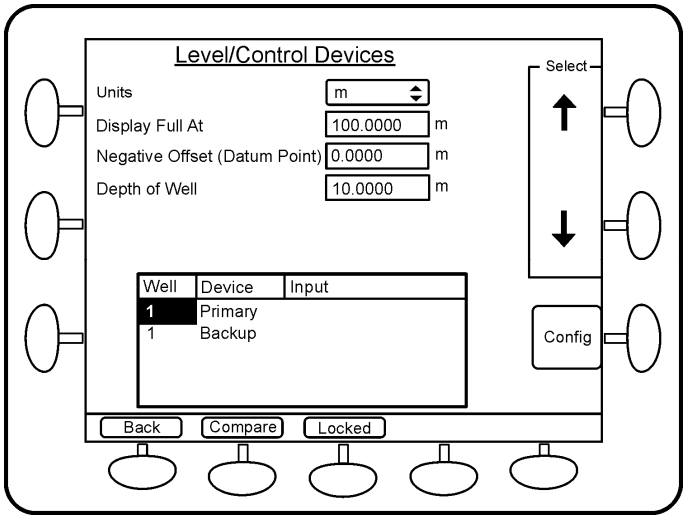


Figure 108 – Level Devices Screen

From this screen the following can be configured:

- level units (in, ft, m, % or custom)
- level at which the bar graph shows full
- range of the device (except % which is always 0 – 100%)

To configure the primary level device scroll down, highlight **Primary**, and press the **Config** button.

The **(Primary) Level Device Configuration** screen loads:

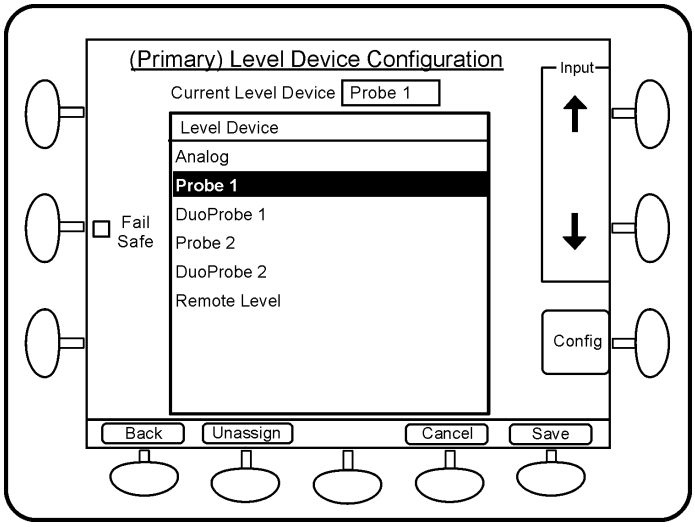


Figure 109 – Selection of the Primary Level Device

- Scroll down to the appropriate device in the list
- For Probes, FailSafe can be enabled (requires a compatible probe & firmware version 2.2.2 or later)
- Press **Save,** if a restart message is displayed, press **Restart Later**
- Press **Config** to change additional settings for the level device, for example for Analog devices, the port it's connected to and the range (zero and span values) can be entered. For Probes and DuoProbes, the model number, units and depth of well can be entered.

14.8.1 Probe Selection

If you have selected a Probe and pressed **Config**, the next screen, **Probe Model Configuration** lists all of the standard models for you to select from.

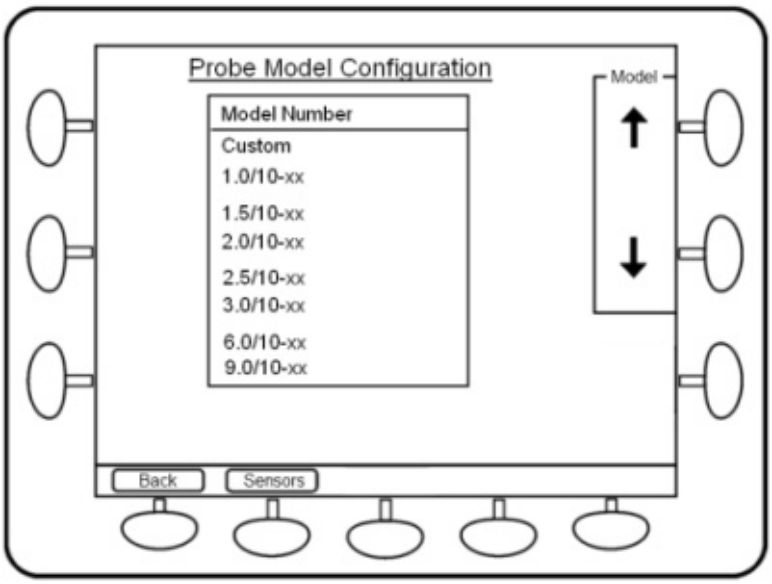


Figure 110 – Probe Model Selection Screen

Select using the **Model** up and down arrows. If the units for the level display have not been changed from percentage (0 -100%) another screen is displayed, **Probe Model – Extra Details.** This screen prompts the user to enter the depth of the well (and the units). Without this information, entering the probe model has no meaning. Once **Save** is pressed, another prompt is displayed asking if the setpoints should be rescaled. This rescaling (if answer "**Yes**") ensures that the *physical* activation and deactivation setpoints remain unchanged (strongly recommended). If answer "**No**", then the *values* of the existing setpoints remain

unchanged but now represent depths in the well rather than points along the probe. For example, a setpoint of 100% previous represented 100% on the probe but now represents 100% of the well depth – i.e. a full well. An example follows.

Example of Probe Selection

The units have not been changed from the default percentage and the setpoint for lead pump activation is 50%, while lag pump activation is 60%. This means that the lead pump will start when the level is halfway up the probe (not halfway up the well).

The user selects 1.0/10-xx (a 1m, 10-sensor probe) from the list and is now requested to enter the depth of well and units. The well depth of 4m is entered. After the MultiSmart has reconfigured, the bar graph will only show a quarter full when the top sensor on the probe is covered. This is because the probe is only 1m high in a 4m well. The bar graph display can be changed by the parameter **Show Full At** in the first Level Device configuration screen (section 14.8).

If the user does not select "**Yes**" to the option to *Recalculate the setpoints*, the lead activation setpoint will be at 50% of the well - not 50% of the probe. If the user does select "**Yes**" – which is strongly recommended – then the lead activation setpoint will be at 50% of the probe, or 0.5m.

14.8.2 Three Sensor and Single Sensor Probes

Further down in the list of model numbers (not shown in the graphic above) there are also the options of selecting Single Sensor probe (0.2/1-xx) or 3-sensor probe (0.5/3-xx).

To use a number of **single sensor probes** the recommended approach is to select a 10-sensor probe from the list and follow section 14.8.4 for configuration. This is because typically at least three or four single sensor probes are needed to control a pump station and the method above only allows a maximum of two probes to be selected.

14.8.3 Probe Configuration and Sensitivity

From the previous screen, when the **Sensors** button is pressed, the probe sensitivity and the digital inputs assigned to the probe are listed. Use the **Input** arrows to select the value to change. By pressing **Config Sensor** these inputs can be assigned or unassigned as required to match the probe wiring. (The default is Din 2 to Din 11, with Din 1 being 100%).

If necessary more than one probe can be configured for a system, e.g. for 2 wells, or probe in primary and backup configuration.

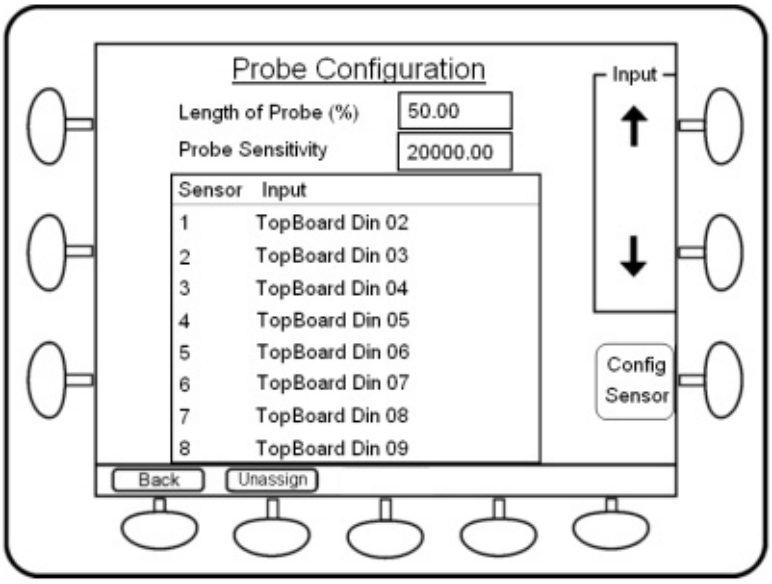


Figure 111 – Probe configuration

In a typical system where only one probe is used, the 2nd probe is not assigned.

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. By selecting the model number, the length of the probe can also be defined.

14.8.4 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 → IOModule → Unit → Unit 01 → Probe → Probe 01

   Scroll down to **Single Sensor Mode?** and check the box. This prevents the "Probe 1 Failed Sensor" 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: *To avoid an **Invalid Input** message, the highest level must be assigned to the lowest digital input used, e.g. for 3 sensors, 100% = Din 2, 50% = Din 3 and 10% = Din 4.*

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 → IOModule → 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**.

14.8.5 Advanced Probe Configuration

The probe sensitivity, as of version 2.3 can be configured without going to the advanced screen (see section 14.8.3). Extra probe settings, including probe sensitivity can be accessed by navigating to:

Settings → Advanced → IOModule → Unit → Unit 01 → Probe → Probe 01

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.

Table 12 – Advanced Probe Settings

14.8.6 DuoProbe Level Sensor Configuration

Similar to the normal MultiTrode probe, a DuoProbe is comprised of ten (10) conductive sensors, with the addition of a pressure transducer located at the end of the probe. (As for the standard probe, more than one DuoProbe can be configured for a system, e.g. 2 wells, or a DuoProbe in primary and backup configuration).

For calibration purposes, a second pressure transducer is present in the MultiSmart to sense ground level atmospheric pressure. The calibration process takes into account, the pressure reading from the DuoProbe and the atmospheric pressure measured by the sensor in the MultiSmart. To maintain accuracy, a re-calibration occurs when either of the following conditions are met; the level rises over the 10th sensor (from the bottom) or the total level rise equals 40% of the probe length. The recalibration process is inhibited when two or more sensors are uncovered faster than a preset time, e.g. if the probe is manually raised too fast. (The relevant parameter is the **Level Change Time** and has a default of 5s). The recalibration process is re-enabled when two or more sensors are uncovered slower than the preset time.

There are hardware and firmware requirements which must be satisfied before the DuoProbe can be used as the level device on a MultiSmart.

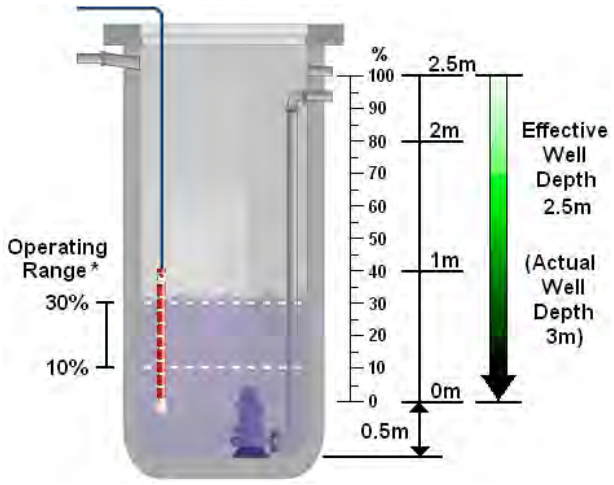
- Build Version - firmware installed must be version 2.20 or higher
- HW Version – the processor board must be version PCB40001r01 or higher

To confirm the versions are correct, navigate to:

Info → More → Version Information and verify the Build and HW Versions.

14.8.6.1 DuoProbe Placement – **IMPORTANT** Considerations

While the DuoProbe is capable of measuring the full depth of the well, MultiTrode recommends that the probe is positioned such that the pumps operating range is *within* the probe range, i.e. the pump(s) activation setpoint is below the top most sensor of the probe. See Figure 112. This best utilises the redundancy feature of the DuoProbe should the analog pressure transducer fail.



* The operating range of the pump falls within the 10 sensor probe. Should the analog pressure sensor fail, the setpoints will shift slightly so that they coincide with the probe sensor immediately above for the activation point and the probe sensor immediately below for the deactivation point.

Figure 112 – DuoProbe Positioned Within Operating Range of the Pump(s)

If the DuoProbe is positioned such that the activation setpoint is above the highest probe sensor then at least one of the following safeguards should be implemented.

- Monitor via SCADA the **Duo-probe 1 Error** and treat it as a serious fault. (This fault is displayed if the difference between the pressure sensor and the probe exceeds pre-defined limits).
- Configure the **Level Locked** feature and monitor it via SCADA and treat it as a serious alarm. (See Section 14.8.12 for setup procedure.).
- Install a backup level sensor. (See Section **14.8.9**).
- Use a single sensor probe connected to the top most sensor input and positioned slightly higher than the activation point for the second pump. Having the single sensor present provides a turn on point for at least one pump should the pressure transducer fail.

- Setup a second profile that is switched in when either; the **Duo-probe 1 Error** occurs or the **Level Locked** fault occurs. This second profile would have setpoints that fall within the physical length of the probe.

WARNING: *If the pumps operating range is outside the probe range and the pressure sensor fails, the level will appear to lock at the level of the highest probe sensor (below the activation setpoint), meanwhile the Well will continue to fill and if no safeguard or backup level device is installed, a spill will result if the DuoProbe fault is not rectified.*

14.8.6.2 Configuring the DuoProbe

To configure the DuoProbe, navigate to:

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

A simple wiring diagram for the DuoProbe interfacing with the MultiSmart is shown below.

The negative terminal of the analog input (AIN 1-) must be connected to a ground such as the GND on the **DSP** board or the negative input on the analog output (AOUT 1-) as illustrated below.

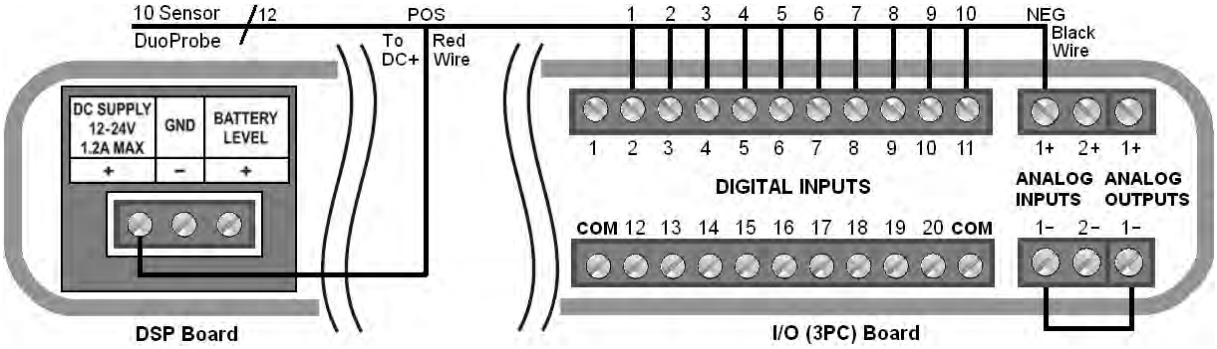


Figure 113 – DuoProbe Wiring to MultiSmart

WARNING:
If the polarity to the pressure sensor in the DuoProbe is incorrect, it may permanently damage the sensor or the MultiSmart or both.

If the well depth is represented as percentage then the **Display Full At** and **Negative Offset (Datum Point)** options (with default values of 100 and 0) can be left unchanged. However if the well depth is specified as a linear measurement then select the appropriate **Units** and configure the **Display Full At**, **Negative Offset** and the **Depth of Well** by highlighting the options and entering the new values. See the screen below.

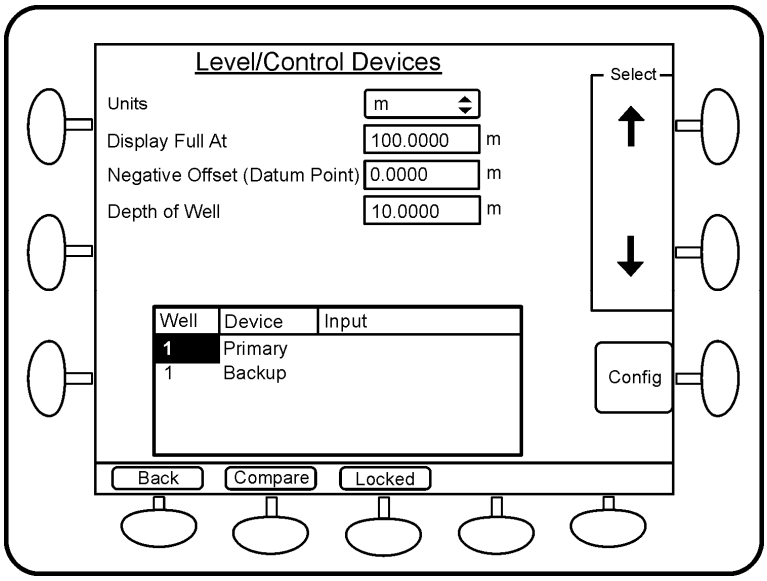


Figure 114 – Well Parameters

Scroll down and select the **Primary** (or Backup) level device for which the DuoProbe requires configuration and press **Config**.

Select **DuoProbe 1** (or DuoProbe 2 if the first one is already assigned) and press **Config**. Select **Save changes & continue** to the unsaved data prompt and then select the **Restart Later** option.

Select the DuoProbe length based on the model number and press **Save**. (The first number represents the length of the probe in metres). The adjacent table below lists the various probe lengths in inches.

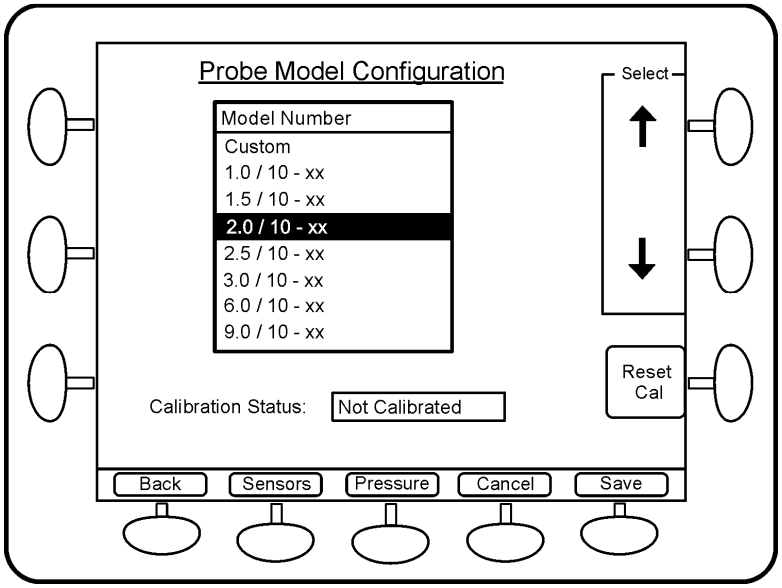


Figure 115 – DuoProbe Model Selection

Model Number	Inches*
Custom	-
1.0 / 10 - xx	39
1.5 / 10 - xx	59
2.0 / 10 - xx	79
2.5 / 10 - xx	98
3.0 / 10 - xx	118
6.0 / 10 - xx	236
9.0 / 10 - xx	354

* Approximate value

Table 13 – Probe Length in Inches

The **Sensors** button allows the digital inputs to be reconfigured – this is not necessary if the defaults are used on DuoProbe 1 (Dins 2 to 11).

NOTE: *If the standard MultiSmart wiring diagram is followed for the DuoProbe interfacing there is no need to change the default digital inputs (Din 2 to 11). However if a 2nd DuoProbe is defined, it is essential that the correct digital inputs are assigned to the 2nd DuoProbe.*

Press the **Pressure** button to select the analog input to be used for the DuoProbe.

Scroll down to the appropriate analog input (e.g. TopBoard Ain 01) and press **Select** and **Save**.

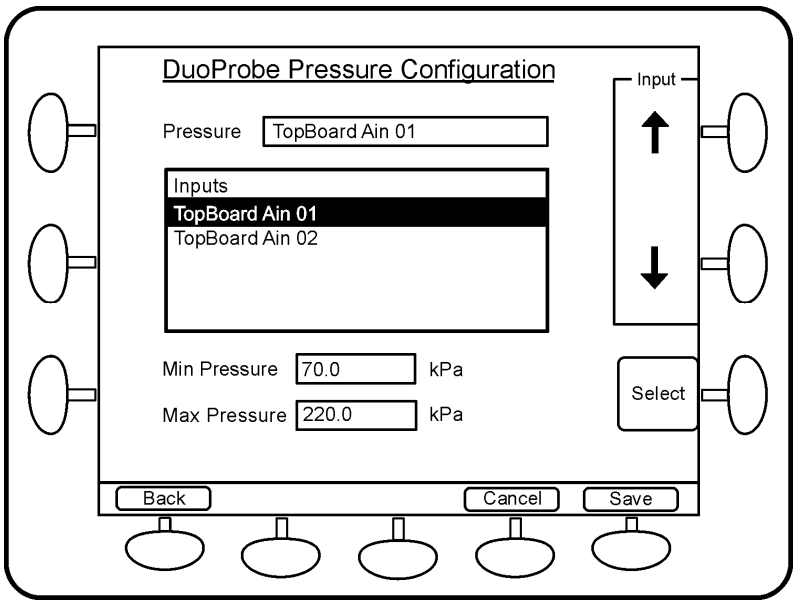


Figure 116 – Analog Input Selection for DuoProbe

NOTE: *The analog input for the pressure transducer is not automatically assigned even when selected through the Setup Wizard.*

Perform a **Restart** (Settings / More / More / Restart Unit).

The DuoProbe is now configured. "NO CAL" flashes in the Well on the main screen until the first automatic calibration is performed.

The Min and Max pressures, (70 and 220 kPa respectively) that appear at the bottom of the DuoProbe Pressure Configuration screen, represent the pressure range of the DuoProbe pressure sensor and hence should not need to be modified.

Follow the sensitivity settings for the normal probe, to configure the DuoProbe advanced sensitivity parameters (Refer to Section 14.8.5). 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 14.8.4 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 at least 3 sensors wired to the digital inputs and hence in cannot be configured to work like a normal probe in single sensor mode.*

14.8.7 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, 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.

14.8.7.1 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 is read from the Analog Input and entered into the **Raw Min** setting box.
- Bring the level of the well to the desired "Span" level
- Press the **Span** button, the current value is read from the Analog Input and 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****.*

14.8.7.2 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.

The MultiSmart also supports inverted levels when an 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 inverts the level. To invert the set points, navigate to:

Pump Control → Invert Set Points? and Toggle this to true.

14.8.8 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 displays a number of questions related to DNP3 configuration and master/slave addresses. See Section 9.1. The disadvantage of going through the Setup Wizard is that any configuration already performed is overwritten.

14.8.9 Backup Level Devices & Failover

The MultiSmart can accept two level devices monitoring the same well - a primary and a backup level device (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, 14.8.11.

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.

14.8.9.1 Primary Level High Range Setup

The High Range Primary and High Range Backup values (& the associated delay) are located at:

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

Definitions:

High Range Primary - the maximum level at which the primary 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 backup must indicate in order to trigger a **Primary Level High Range** fault. (The default value is 95%).

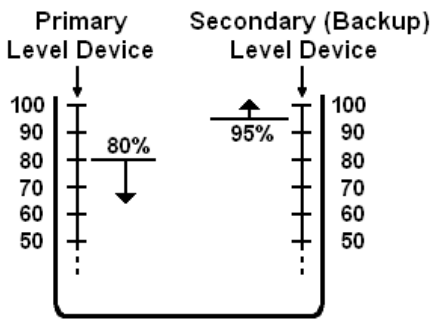


Figure 117 – Primary and Backup High Range Values

For example, (with reference to the Figure above) the **High Range Primary** value = 80% and the **High Range Backup** value = 95%. If the primary level device is reading less than 80% while the backup level device is reading greater than 95%, a **Well 1 Primary Level High Range** fault is triggered (after the **High Range Delay** has expired). The MultiSmart switches over to the backup level device as the source of level information.

14.8.9.2 Primary Level Low Range Setup

Similarly the Low Range Primary and Low Range Backup values (& the associated delay) are set at the same location as for the High Range values (see Section above). Following is an example of the **Well 1 Primary Level Low Range** fault.

Definitions:

Low Range Primary - the minimum level at which the primary must indicate in order to trigger a **Primary Level Low Range** fault. (The default value is 15%).

Low Range Backup - the maximum level at which the backup must indicate in order to trigger a **Primary Level Low Range** fault. (The default value is 5%).

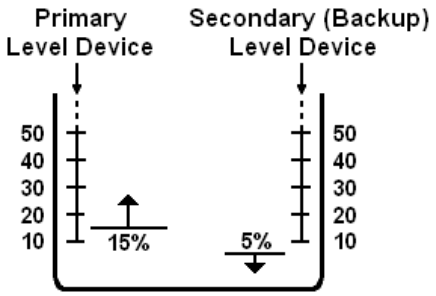


Figure 118 – Primary and Backup Low Range Values

For example, (with reference to the Figure above) the **Low Range Primary** value = 15% and the **Low Range Backup** value = 5%. If the primary level device is reading greater than 15% while the backup level device is reading less than 5%, a **Well 1 Primary Level Low Range** fault is triggered (after the **Low Range Delay** has expired). The MultiSmart switches over to the backup level device as the source of level information.

14.8.10 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 (e.g. 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 menu, 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 Slave.

14.8.11 Analog Level Compare

This feature is recommended for use when two analog 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 default).

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:

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)
- Press **Save**

14.8.12 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 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 only a period of the day is to be specified, 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 and if the level changes by no more than 1% in 25 minutes prior 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 the fault options, navigate to the Faults screen, select a fault type then press the **Configure** button. MultiSmart comes with a large number of pre-configured faults. Any fault can be assigned to a particular context as well (Refer to Section 14.9.5).

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

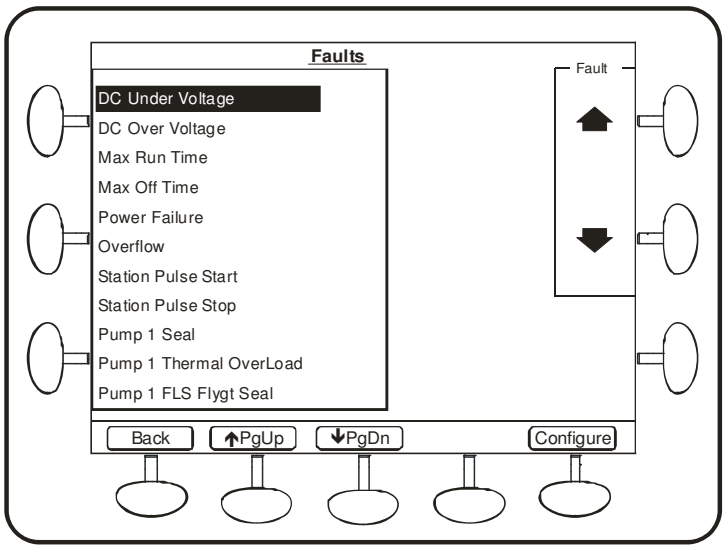


Figure 119 - Select Fault Type

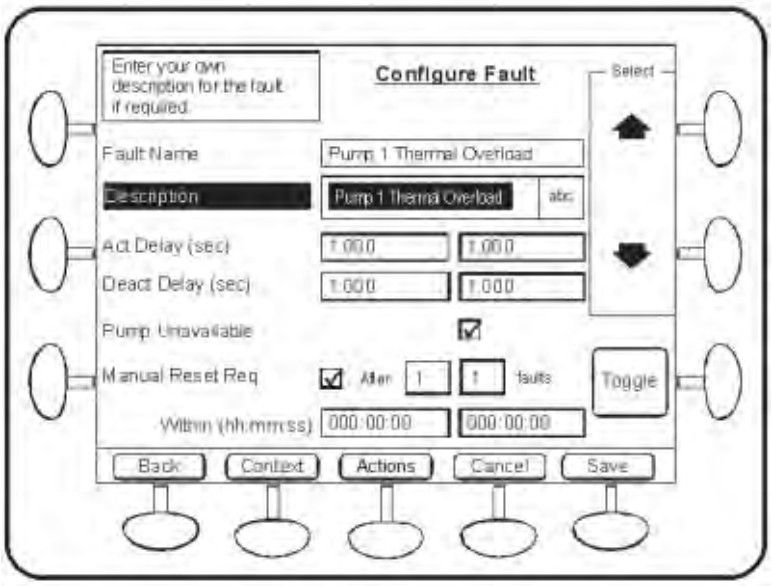


Figure 120 - Configure Basic Fault Options

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 reset 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

Table 14 – Advanced Fault Parameters

14.9.1 Fault "Actions" including Pump Reversal

The **Actions** button provides some more advanced functionality, including Pump Reversal:

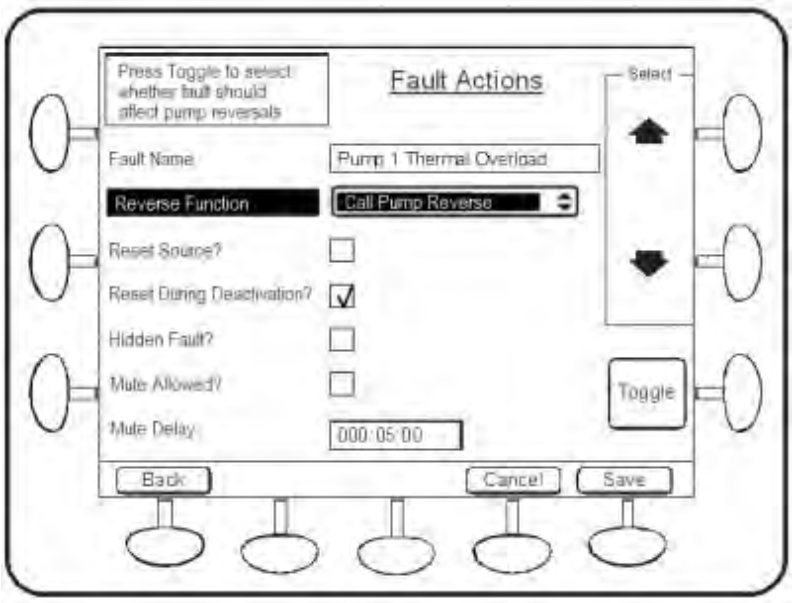


Figure 121 – Fault Actions Screen

Faults can be configured to automatically trigger pump reversals. For example, over-current may be triggered by a pump blockage. Reversing the pump for a short duration has the potential to clear the blockage.

To configure a fault to automatically trigger a pump reversal, set the **Reverse Function** to **Call Pump Reverse**. After the fault activates, the pump reversal will start after the **Fault-Reverse** delay defined in the **Station Optimization – Pump Reversals** screen. The reversal duration is also set in that screen (see Section 16.1.1), however, more than one fault can occur within a short time frame and reversal may not be desirable under some fault conditions. Therefore, those faults should have **Reverse Function** set to **Block Pump Reverse.**

The following items can be configured for this screen:

Name	Description	Range/Type
Reverse Function	Described above, choice of No Action, Call Pump Reverse, Block Pump Reverse	Selection
Reset Source?	**Not usually required for most faults**. Fault conditions like "Maximum Run Time Exceeded" requires this feature so that after the fault has occurred it can clear. Faults like Thermal Overload, Under-current **do not need this feature** enabled, because when the thermal overload cools down the input to MultiSmart resets, and when the under-current trips the pump under-current is no longer active.	True/False
Reset During Deactivation?	When this is enabled (default) – the fault can be reset from the user interface or by SCADA while the deactivation delay is counting down. If this parameter is disabled, then even after the fault condition has cleared and while the deactivation timer is counting down, no reset is possible.	True/False
Hidden Fault?	Disabled by default. If this is enabled, when the fault condition occurs it will hold out the pump but will not be displayed as a fault on the **Faults** screen.	True/False
Mute Allowed?	This allows a fault to be "muted" from the faults screen. A muted fault still continues to take any configured actions but is hidden on the faults screen until the Mute Delay expires.	True/False
Mute Delay	The delay described in "Mute Allowed".	Time

Table 15 – Fault Actions Parameters

Block Pump Reverse is the default pump reversal action for the (default) faults that make the pump unavailable. There are three faults which this action does not apply, they are:

- Under-current
- Over-current
- I^2T faults

The default pump reversal action for these faults is **No Action**.

14.9.2 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.

- Navigate to:

Advanced → Pump Control → Pump parameters → Pump 1 → Delay fault → Delay fault 02* → Delay (sec)

- Change this value to the required amount (the default setting is 10 seconds). Note that "Show More Options" must be enabled to view this setting (section 31.1)
- Press **Save** and press **Back** twice.
- Repeat the above steps for each pump that requires a Delay Fail fault.

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 initial state then a **Pump n Delay Fail** fault is displayed (after the delay period expires).

14.9.3 Low Flow Fault – Using Analog Signal

A 'Pump n Low Flow' fault can also be configured using the analog output of the flow meter. One flow meter on the outflow is sufficient. A Low Flow fault for a specific pump is displayed whenever the flow rate falls below a predefined value.

There are 3 main steps involved: enable flow, set flow rates and configure the flow faults.

1. Enable Flow

Navigate to: Settings → More → Flow → General Settings

- Enable Flow – tick the **Flow Enabled** check box
- For **Mode**, select **Metered flow (der vol)**
- Select the appropriate **Units**
- Press **Save**

2. Set Flow Rates

Navigate to: Settings → More → Flow → Flow Alarms

- Scroll down to **Nominal Flow Rate** & enter a nominal flow rate for Pump 1 (default is 100L/s)
- Scroll down and tick the **Low Flow Fault Enabled** for Pump 1
- Scroll down and enter a value for the **Low Flow Fault Level**. A percentage of the nominal flow (default is 50% which in this case equates to 50L/s)
- Repeat the first 3 steps above for Pump 2
- Press **Save**

3. Configure the Low Flow Faults

Navigate to: Settings → I/O, Faults & Level → Faults

- Scroll down and highlight **Pump 1 Low Flow Fault** and press **Configure**
- Set the **Act Delay** (Activation Delay) (typically 10 or more seconds)
- Set the **Deact Delay** (It's a good idea to set to at least 30s or more, that way if the second pump is faulted, the first pump is not continually starting and stopping if **Manual Request Req** (Required) is turned off.
- Tick the **Pumps Unavailable** check box (This option forces the pump to stop)
- If the **Manual Reset Req** (Required) is checked an operator must acknowledge the fault on the display (or remotely via SCADA) before the pump can run again.
- Press **Save**

For this example, whenever a pump is running and the flow rate falls below 50L/s (after the activation delay expires), the pump is stopped and the standby pump is started. Note, any given flow rate from the Flow Meter is halved when both pumps are running.

14.9.4 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.

Be aware that the predefined faults are always listed in the **Advanced** menu under the original name so if the functionality is not similar it can become difficult to locate the renamed fault in the **Advanced** menu.

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

Navigate 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

Navigate 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 **Toggl**e to check the **Station** box (This will stop all pumps)
- Press **Save** and **Restart Now**

Whenever Din 16 becomes active, all the pumps will stop and the fault message **Manual Mode** is displayed.

Example 2:

A low level fuel warning is required. A resistive fuel gauge is connected to digital input 16. A resistance of less than 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

Navigate 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

Navigate 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 → IOModule → 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** is displayed. A similar configuration would be used for a PTC sensor.

14.9.5 Assigning Faults to a Context

You can select single or multiple contexts from, Station to 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 is active. More advanced fault configuration can be configured from the **Advanced** screen.

Navigate to:

Settings → Advanced → Fault Module

14.9.6 Reset All Faults Trigger

A **ResetAllFaults** tag is present in the MultiSmart which can be assigned to a digital input, DNP or Modbus digital control point. It is used to reset faults that require a reset or an acknowledgement. The tag needs to be set to 1 to reset. 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 analog outputs can be used for tasks such as re-transmitting an analog input 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 **Analog Output** screen.

Settings → I/O, Faults & Level → Analog Outputs

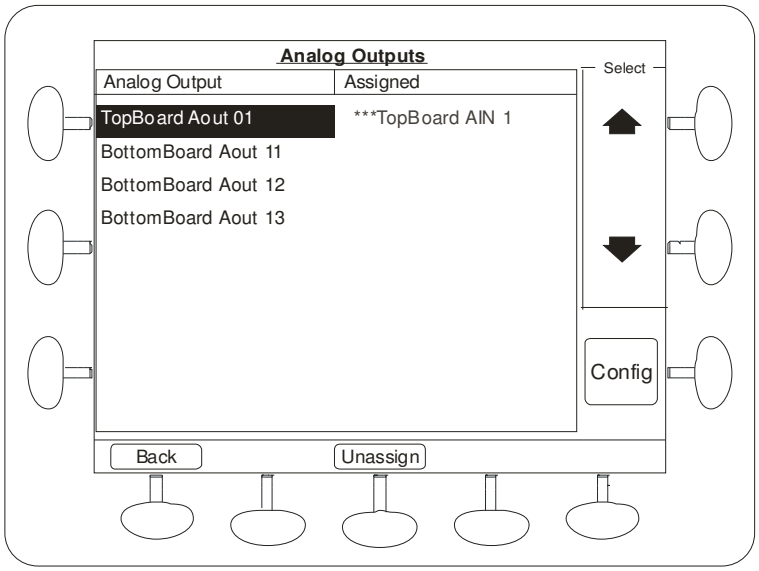


Figure 122 – Analog Outputs Screen

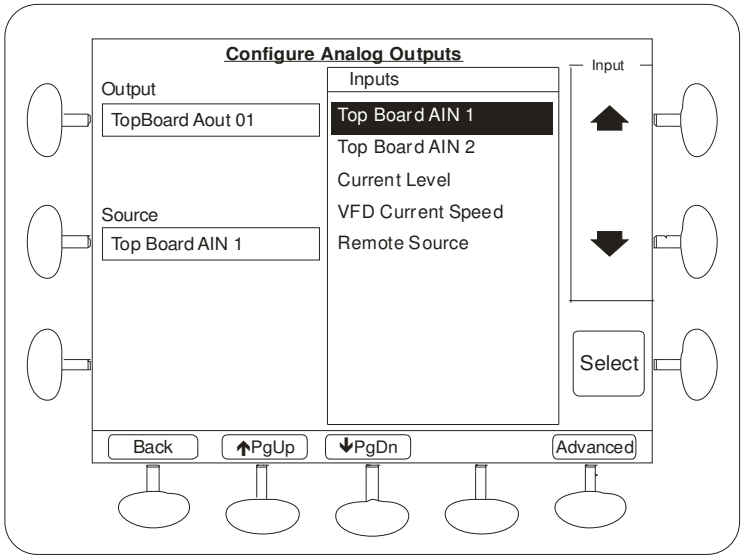


Figure 123 – Select the source Analog Input and press "Select"

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, reverse pumps, send signals to SCADA systems and connect to other external logic (PLCs, 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 & Level → Digital Outputs

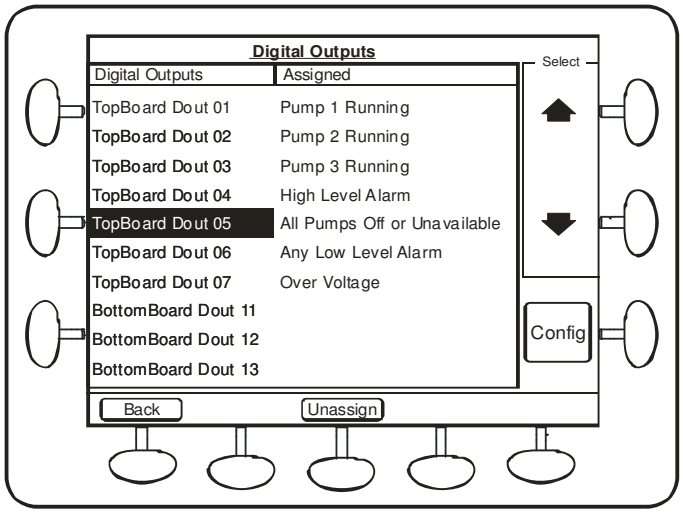


Figure 124 – Digital Outputs Screen

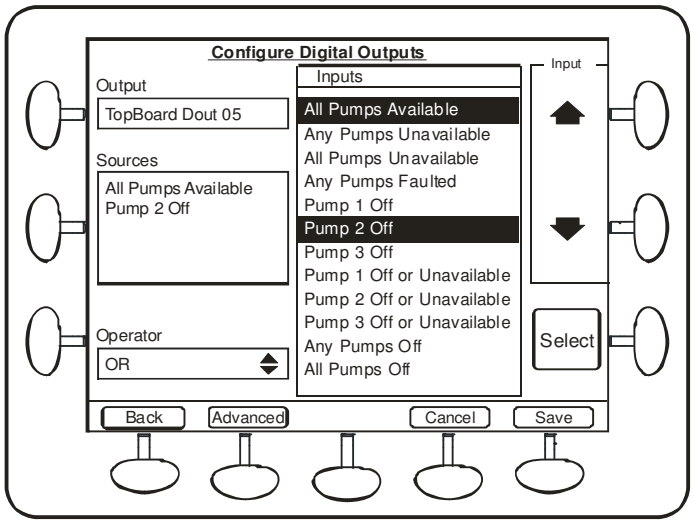


Figure 125 – Configure Digital Outputs Screen

Multiple sources can be selected for a digital output. The operations, AND, OR & XOR can be performed on the multiple sources before the digital output is set. Choose the first source, press **Select** and then select the second source; the operator selection box then appears.

After the source is selected, press **Back**, and repeat the process for each digital output. The sources listed in this setup screen include:

Any Fault	Well Washer Active	All Pumps Available	All Pumps Off or Unavailable
Remote Source	Probe 1 Sensor Fault	Any Pumps Unavailable	Over Voltage
High High Level Alarm	Probe 2 Sensor Fault	All Pumps Unavailable	Under Voltage
High Level Alarm	Pump 1 Running	Any Pump Faulted	DC Over Voltage
Low Level Alarm	-etc to number of pumps	All Pumps Faulted	DC Under Voltage
Low Low Level Alarm	Pump 1 Reversing	Pump 1 Off	Application Failure*
Any Level Alarm	-etc to number of pumps	-etc to number of pumps	AIN1 Over Range
Any High Level Alarm	Any Pumps Running	Pump 1 Off or Unavailable	AIN1 Under Range
Any Low Level Alarm	All Pumps Running	-etc to number of pumps	AIN2 Over Range
Primary Level Fault	No Pumps Running	Any Pumps Off	AIN2 Under Range
Backup Level Fault	Pump 1 Unavailable	All Pumps Off	
Well Mixer Active	-etc to number of pumps	Any Pumps Off or Unavailable	

Table 16 – Digital Output Sources

***Application failure** is the internal watchdog functionality.

If the desired source can not be found in this list, press the **Advanced** button, this displays the Tag Browser and it allows the selection of any digital tag within the system.

14.11.1 Advanced Digital Output Options

Advanced configuration options for Digital Outputs can be found in the **Advanced** menu. These options include inverting, enabling it to flash and delaying the activation or deactivation of the output.

A source (or multiple sources) and the Boolean operator can be assigned in the **Digital Outputs** screen.

Settings → I/O, Faults & Level → Digital Outputs → Config

Refer to the previous section for details.

To perform the advanced operations navigate to:

Settings → Advanced → IOModule → Unit → Unit 01 → Top Board → Digital Output

and select a digital output.

Name	Description		Range/Type
Count	Sets the number of times to pulse the output but only applies if Mode is set to one of the pulsing modes.		Integer
Description	Description of the output. This is the name displayed in the Info screens.		Text
Invert?	Turns the Normally Open output into a Normally Closed output.		True/False
Mode (5 modes)	Normal/Latch	Output is on for the duration the source is active (default).	
	Flash	Output toggles according to the T Closed & T Opened values.	
	Delay	The activation or deactivation of the output is delayed according to the T Closed & T Opened values.	
	Pulse, Pos Trigger	Uses the 'Count' variable to pulse the output while T Closed & T Opened sets the period.	
	Pulse, Neg Trigger	Uses the 'Count' variable to pulse the output while T Closed & T Opened sets the period.	

Multiple Sources Logic	Allows a Boolean operation to be performed on the multiple sources. (The one operator is applied to all sources).	And, Or, Xor
Non Volatile?	If set to true, the state of the output will be restored after a restart.	True/False
Source	The primary source for the digital output.	Digital Tag
Sources 2,3,4	Up to 3 more sources can be specified.	Digital Tag
T Closed	Number of milliseconds that the relay is to be closed (on) for when flashing or pulsing.	Integer
T Opened	Number of milliseconds that the relay is to be opened (off) for when flashing or pulsing.	Integer

Table 17 – Advanced Digital Output Options

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

In this example, Digital Output 5 is configured to follow Digital Input 1.

- Select **Advanced**, select **IO Module** [+/-] **Unit** [+/-]
- Select the Unit (e.g. **Unit 01**) then [+/-]
- Select which board the digital output is located on (e.g. **Top Board**) then [+/-]
- Select **Digital Output** then [+/-]
- Select the free digital output that is to follow the digital input (e.g. **DOUT 05**) then [+/-]
- Select **Source** and press "**Use this button to view or change value**"
- Select **IO** [+/-] **Unit** [+/-]
- Select the Unit (e.g. **_1**) then [+/-]
- Select which board the digital input is located on (e.g. **Top Board**) then [+/-]
- Select **Din** [+/-]
- Select the digital input that that the digital output is to follow (e.g. **_1**) [+/-]
- Select **ValueDigital** (a digital tag) then press the **Ok** button
- Press the **Save** button

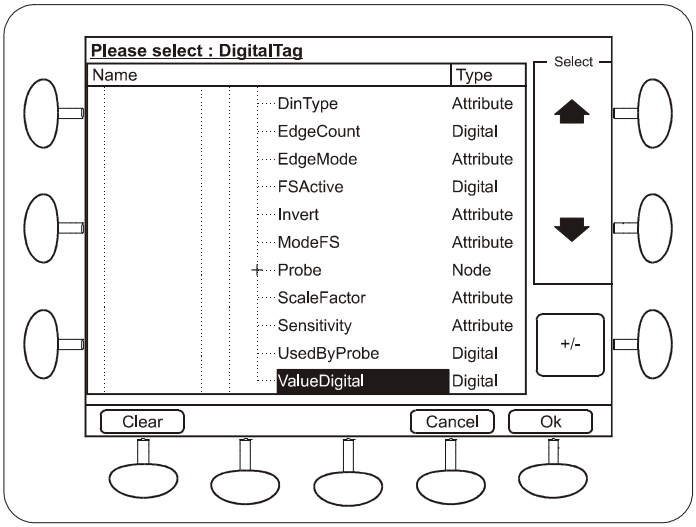


Figure 126 – Making a Digital Output Follow a Digital Input

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 the following methods:

- User interface
- A digital input or any digital tag (e.g. an alarm condition)
- A timer (e.g. time of day and multiple timers can be setup)
- SCADA
- Logic engine script or ISaGRAF program

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

There are also 3 generic profiles (profiles 4-6) that can be named & configured according to user requirements.

15.1 Profile Selection Methods

Three of the five different ways to select a profile are discussed in this section.

15.1.1 Select a Profile with the User Interface:

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

Settings → Station Optimization → Select Profile

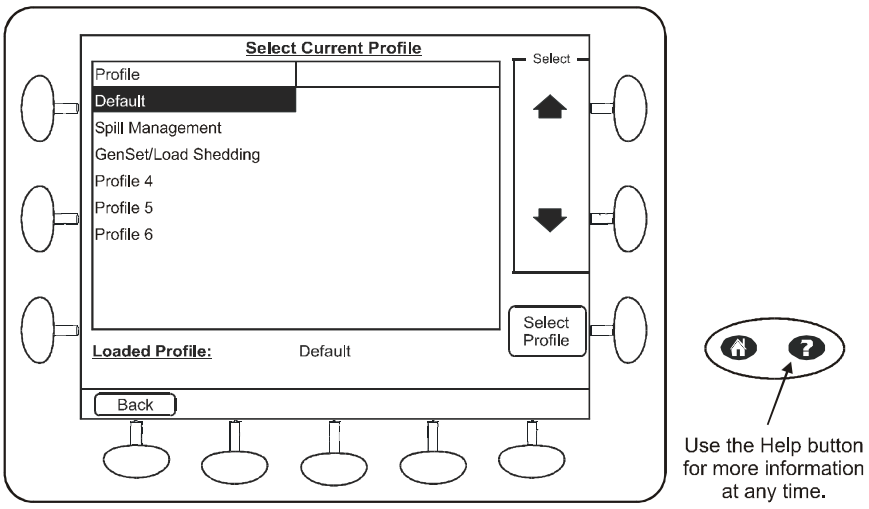


Figure 127 –Profile Selection Screen

- Use the arrow buttons to select a Profile from the list.
- Press the **Select Profile** button.

15.1.2 Selecting Profiles Using a Digital Tag

A digital tag whether for a digital input or for some other source can be assigned to select a 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** [+/-]

Any digital tag (of type "DigitalTag") can be selected. In this example a digital input is the source.
The following values should be set:

- Enabled? (check the box to enable, uncheck to disable)
- Source (contains the digital tag source), press "**Use this button to see additional values**".
- Scroll down to **IO**, press [+/-], **Unit**, [+/-], **_1**, [+/-], **TopBoard**, [+/-], **DIN**, [+/-]
- Select the DIN to be use. Scroll down to **ValueDigital**, and Press **Ok**.

15.1.3 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) (The repeat period for the timer, 1-28 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

15.2 Configuring the Setpoints of Profiles

Settings → Set Points → Level/Control Setpoints → Switch Profile

To edit the setpoints of a profile, select that profile first by pressing the **Switch Profile** button in the Level/Control Setpoints screen. This button only switches to that profile for editing purposes. See Section 12.3.2 for changing setpoints.

To switch to a different profile that is used by the station see Section 15.1.1.

15.3 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
- Timers
- Name

The above values can only be set in the **Advanced** menu

- Activation Delay
- Activation Set Point
- Deactivation Delay
- Deactivation Set Point

The setpoints and delays are best set by switching to that profile using the **Switch Profile** button (under Settings -> Set Points -> Level/Control Setpoints) and edit as per the default profile.

- Maximum Off Time Duration
- Maximum Off Time Enabled?
- Maximum Off Time Quantity
- Maximum Pumps Running Mode
- Maximum Pumps Running Quantity
- Maximum (Pump) Run Time Duration
- Maximum (Pump) Run Time Enabled?

These maximum values can be set under **Station Optimization**.

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 15.1.1 for how to do this.*

16 Station Optimization

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

Parameter	Description
Pump Reversal	Many wastewater utilities reverse pumps periodically to help avoid blockages. They also reverse pumps on certain faults (where those faults are believed to be mainly caused by blockages). Pump reversal can easily be configured to operate on a set numbers of cycles and/or under certain fault conditions. **CAUTION**: Check with your pump manufacturer before using this feature.
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 Clean Out	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.
High Inflow	Enables detection of a high inflow rate and if present, a fault is displayed and/or the lead pump is pulsed started.
Well Washer	A variety of parameters can be set to optimize use of a well-washer to clean the well.
Well Mixer	Allows control over a well mixer. Two modes, Every Pump Cycle and Every x Hours.
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 Per 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.

Table 18 – Station Optimization Parameters

The most common settings are found in the main station optimization screen. The Pump Station Manager 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” etc., even when there is only one well or one group.

16.1 Station Optimization Menu

Station Optimization is accessed by:

Settings → Station Optimization → Optimize Station

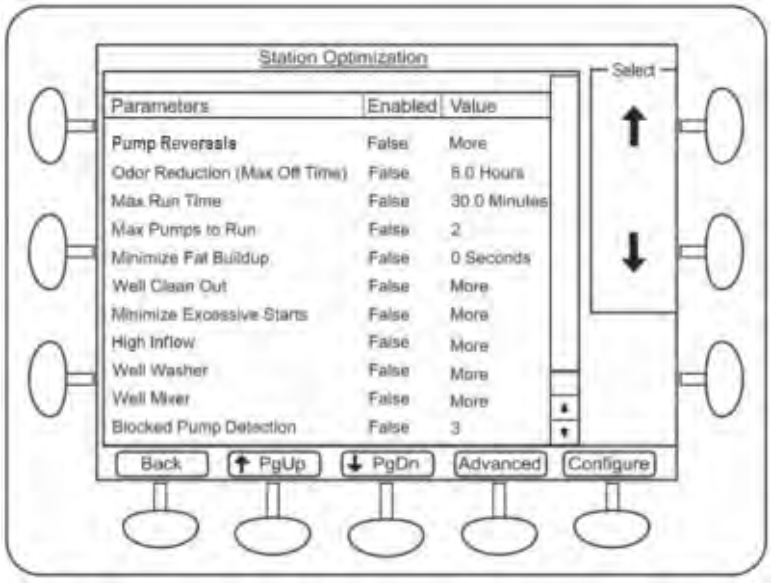


Figure 128 – Station Optimization Screen

To configure, highlight the optimization feature of interest and press **Configure**. The configuration screens are mostly self-explanatory and five examples are covered in this section. The first example, pump reversals, is the most complex.

16.1.1 Pump Reversing

The concept behind pump reversing is to prevent blockages by frequent and short pump reversing cycles. There is also the option of reversing on specific faults. Manual reversing can be carried out from within this configuration screen.

There are a few elements to configuring pump reversal:

- Wiring a reversing contactor/starter for each pump and connecting each contactor input to a Digital Output on MultiSmart
- Configuring those Digital Outputs to activate from Pump Reversing (see section 14.11)
- Configuring the duration and delays for pump reversal (this section)
- Configuring automatic pump reversal on start or stop (this section)
- Configuring certain faults to trigger pump reversal (see section 14.9.1), **note** that the duration and delays are still set via the description in this section

With **Pump Reversals** highlighted in the **Station Optimization** screen, press **Configure** to setup the automatic pump reversal - the **Pump Reversals** screen is displayed. (See figure below).

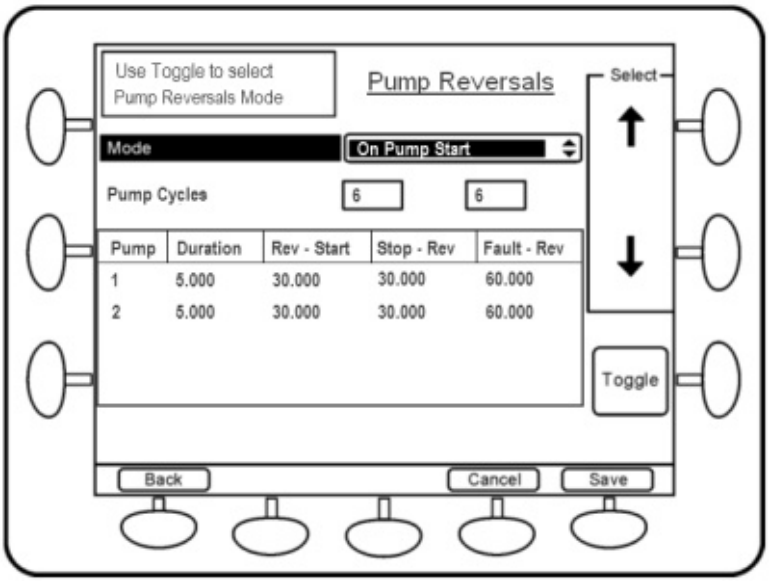


Figure 129 – Pump Reversal Mode Screen

Mode by default is Disabled. There are two active modes:

- On Pump Start – reversal is triggered before the pump run command
- On Pump Stop – reversal is triggered after the pump stop command

To change the mode, press the **Toggle** button when **Mode** is highlighted. Once either of these active modes is enabled, the MultiSmart uses the **Pump Cycles** parameter to determine how often to invoke the feature.

For example, with **Mode** = On Pump Start, and **Pump Cycles** = 6, each pump will reverse before starting once every 6 pump starts for that pump.

These parameters just described apply to all pumps.

The next set of parameters – the duration and delays – are individually applied to each pump. To change the parameters scroll down using the **Select** arrows and once the timing row for a particular pump is highlighted, the **Toggle** button changes to **Edit**. Press **Edit** to enter the **Duration**/**Delays** screen:

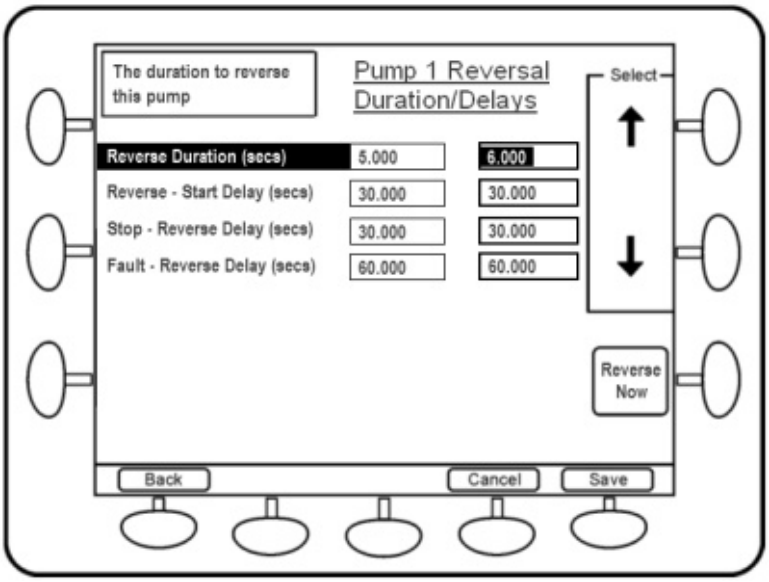


Figure 130 – Pump Reversal Duration and Delays Screen

The explanation of each parameter is as follows:

Name	Description
Reverse Duration (secs)	The length of time the pump will run in reverse. This value is used by all reversing features regardless of the trigger. It is also the reversing time for manual triggering.
Reverse - Start Delay (secs)	Used when the mode is “On Pump Start” – the time delay between the reversal finishing and when the pump starts running normally.
Stop – Reverse Delay (secs)	Used when the mode is “On Pump Stop” – the time delay between the pump stopping and the reversal starting.
Fault – Reverse Delay (secs)	When a fault has activated a pump reversal this value defines the minimum delay after the fault before the pump can be run in reverse.

Table 19 – Pump Reversal Parameters

Once the parameters have been set to the desired value, press **Save** and return to the home screen. Remember that each fault that is to trigger a pump reversal must be set in the respective fault screen – see Section 14.9.1.

16.1.1.1 Manual Operation

The reversing function can be operated manually from the **Pump n Reversal Duration/Delays** screen (as shown above in Figure 130). Note that each pump has its own configuration screen – be sure you are in the correct screen before manually reversing.

Press the **Reverse Now** button to reverse the pump - the display returns to the home screen.

The pump will not reverse if it is currently running or any condition is in place such as an active fault which has been configured to block a reversal. If for some reason the pump cannot reverse, the screen still returns to the home screen but no pump reversal takes place.

16.1.2 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 delay allows the station to become septic. The Odor Reduction feature allows a maximum off time to be applied so the station is regularly emptied in order to reduce odors occurring.

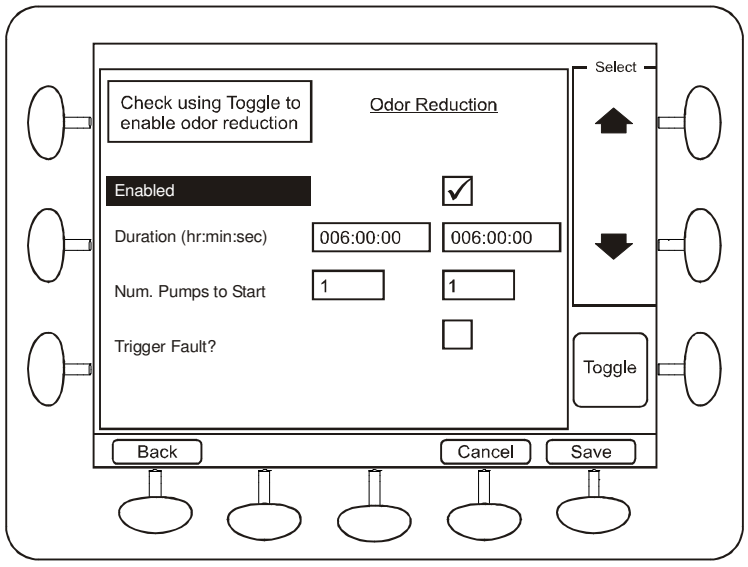


Figure 131 - Odor Reduction Screen

Use the Help button for more information at any time.	***Odor Reduction Help Text*** *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).*

16.1.3 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.

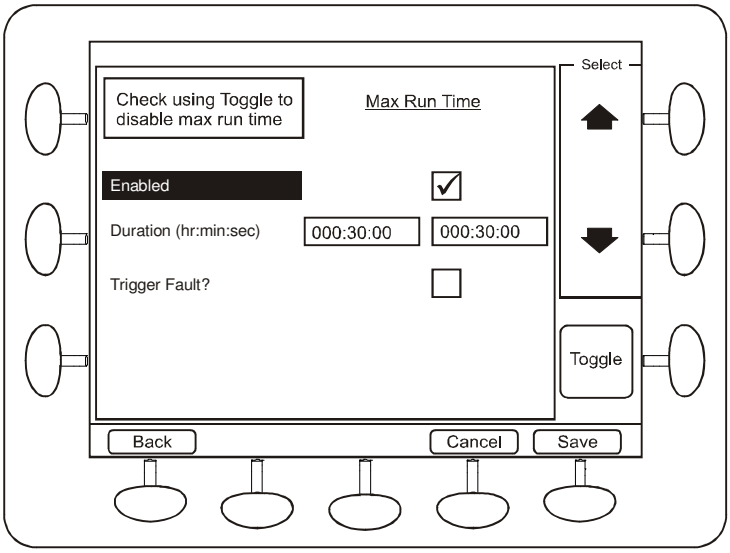


Figure 132 - Max Run Time Screen

Use the Help button for more information at any time.	***Max. Runtime Help Text*** *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.*

16.1.4 Well Clean Out

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.

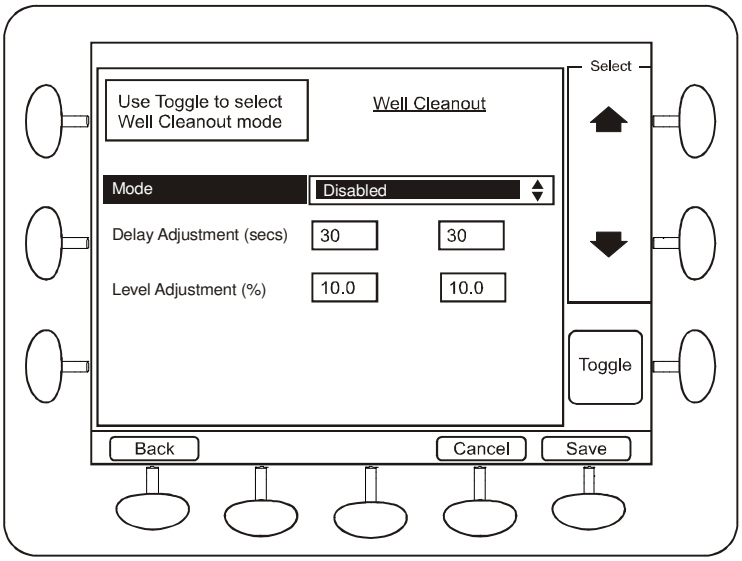


Figure 133 - Well Cleanout Screen

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)

16.1.5 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.

Table 20 – Well Washer Parameters

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 14.11 for a description of how to configure digital outputs.*

16.1.6 Well Mixer

The Well Mixer feature allows well mixers to be controlled in one of two ways:

- Every Pump Cycle
- Every x Hours

In addition to each mode, the pumps can be allowed or inhibited to run with the mixer.

For both modes, a digital output must be assigned to the source **Well Mixer Active**. (Not to be confused with the Well Washer Active source). (See Section 14.11)

This Well Mixer feature is part of a separate module which if not enabled at the time of purchase can be enabled later with a new Site Key (requires firmware version 2.2.0 or later).

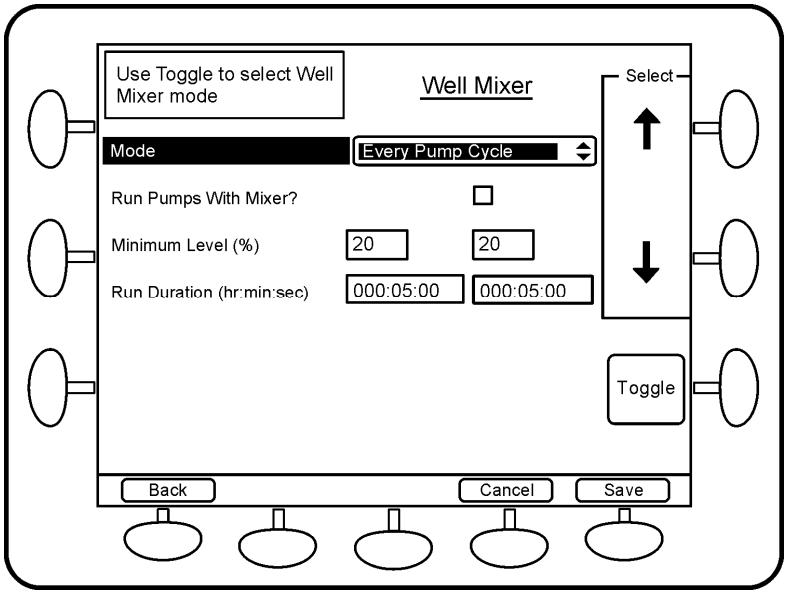


Figure 134 – Well Mixer Screen

16.1.6.1 Every Pump Cycle

In this mode, the mixer starts when the lead pump run command is sent, however the actual pump start is delayed until the mixer stops (providing the **Run Pumps With Mixer** check box is unchecked). The mixer runs for the specified **Run Duration** or until the level reaches the **Minimum Level**.

16.1.6.2 Every x Hours

In this mode, the mixer starts periodically based on the specified **Frequency** (e.g. once every 4 hours). If the **Run Pumps With Mixer** check box is unchecked then the pump and mixer do not run simultaneously. The mixer runs for the specified **Run Duration** or until the level reaches the **Minimum Level**.

If the **Run Pumps With Mixer** is unchecked and the pump happens to be running when the time period expires, the mixer runs for the full duration after the pump stops.

16.2 Additional Parameters

Pressing the Advanced button on the Optimization screen, displays the advanced settings screen where a large number of additional pump control settings may be found, including the following settings.

16.2.1 Max. Number Groups Running

This feature is used to control how many groups run at same time. This function is only required when more than one group has been configured. It can be used to restrict groups from running at the same time, for

example, making sure jockey pumps do not run when flood pumps are running. The feature is on by default and set to 1.

16.2.2 Group

When more than one group of pumps have been configured (see Section 13.3), different parameters can be set for each group. For example, Max Pumps Running can be set differently for group 1 and group 2.

16.2.3 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 (This is the direct path).

- 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** [+/-] **Unit** [+/-] _1 [+/-]
- Select the board that contains the Digital Input, in this case the **Top Board** [+/-] 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.

The pulse start function will normally only allow a pump to start if the level is above the pump's deactivation point. An additional configuration parameter allows the Pulse Start and Pulse Stop feature to ignore the level. This feature is configured by the parameter:

Settings → Advanced → Pump Control → Ignore Set Points?

Once this configuration parameter is activated the Setpoints will be hidden both on the main display and in the **Settings** menu option.

To activate the Digital Input a restart is required.

Settings → More → More → Restart Unit

(Alternatively cycle the power).

16.2.4 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:
  IOModule [+/-] **Unit** [+/-] **Unit 01** [+/-] **Top Board** [+/-] **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 appear in right column.

16.2.5 Well

Parameters can be set for how primary & 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.

This module monitors currents and provides protection from:

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

This 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 navigating to:

Settings → More → Motor Prot & Efficiency

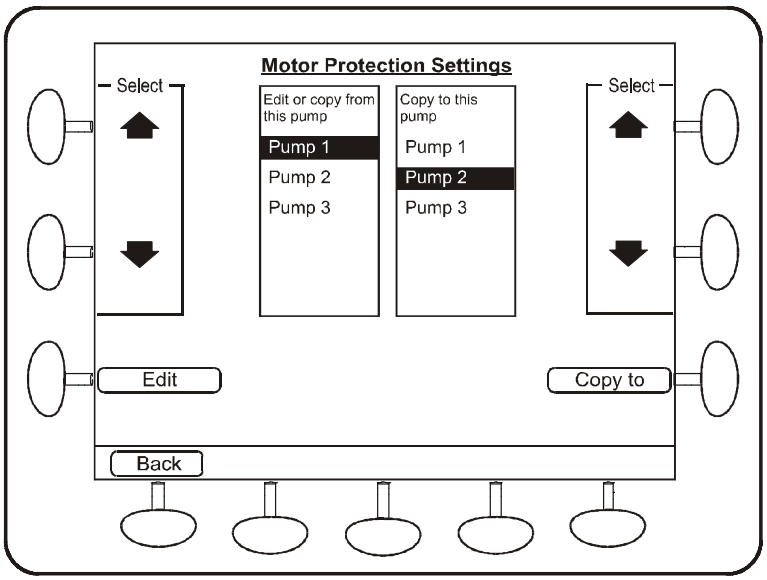


Figure 135 – Motor Protection Settings Screen

This screen can be used to copy motor protection settings from one pump to another. This speeds up the configuration process if all the pumps in a well are the same. Simply configure the first pump and 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.

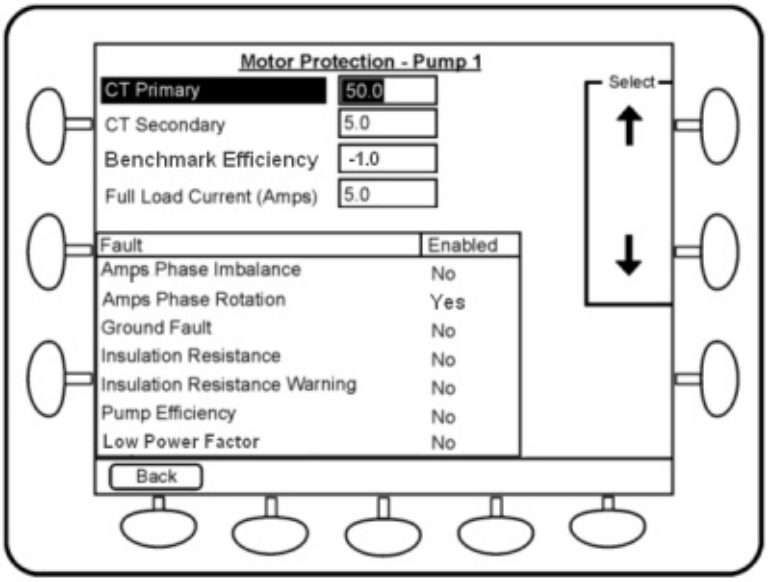


Figure 136 – Motor Protection Settings for an Individual Pump.

17.1.1 Configuring CT Values

Current transformers (CTs) wired into the Energy Monitoring and Motor Protection board (3MP) are used to monitor motor currents. In order for the correct currents to be calculated, the ratio the CTs must be entered.

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.*
Benchmark Efficiency	If required, enter the value which ongoing efficiency measurements will be compared against. This value is displayed in the Efficiency screen (see Section 5.4.3.1). The default is -1.0 to indicate that nothing has been entered.
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.

Table 21 – CT & FLC Parameters

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.
Pump Efficiency	This functions as a fault. If the calculated efficiency is larger than a preset amount, a Pump Efficiency fault is displayed.
Under Current	Detects an Under Current condition. The threshold value sets the level of under current required before a fault condition exists.

Table 22 – Motor Protection Faults

Most parameters use a % of Full Load Current (FLC) as the threshold. Ensure that the 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 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 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?	Check this box to make the pump unavailable when the fault is active.
Man Reset Required?	Determines whether MultiSmart performs an auto-reset of the fault or an operator is required to manually reset 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 cleared 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.

Table 23 – Basic Fault Options

To configure each of the motor protection faults, navigate to

Settings → More → Motor Prot & Efficiency and select the pump and press **Edit**. Scroll down to select the desired fault and press **Configure**. The left box contains the current value while the right box contains the last modified value. 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 Prot & Efficiency and select the pump and press **Edit**.

There are two options listed,

- Insulation Resistance Warning
- Insulation Resistance (Test)

Both can be set to fault the pump, however as the name suggests, the Insulation Resistance Warning fault is configured to generate a fault and not to fault the pump. In order to configure the threshold, scroll down and select the appropriate option and press **Configure**. **Save** the settings after the changes are completed.

An Insulation Resistance test is only carried out when the pumps are not running. The MultiSmart checks if the pump is currently running and skips 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 (Refer to 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:

- From the tree select: **Motor Protection** [+/-] **Pump** [+/-]
- Select the correct pump (i.e. Pump 01) and press [+/-]
- Select **Insulation Resistance Test (IRT)** [+/-].
- And again select **Insulation Resistance Test (IRT)** [+/-].

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.	1.0MΩ
MOhms	Sets the measurement threshold in Mega Ohms for the IRT warning to be generated. Default setting will not fault the pump.	5.0MΩ
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	Disabled

Table 24 – IRT Parameters

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.

Navigate to:

Settings → More → Motor Prot & Efficiency

- Select the required pump with the 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** and 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 (1000V DC). 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
- Navigate 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)

  Navigate to:

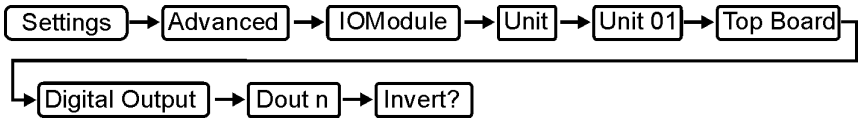
  MotorProt → Pump → _1 → InsulResistance → _1 → PumpIsolation
- Once **PumpIsolation** is highlighted, press **Ok**
- Press **Ok, Back, Save** and **Restart Later**
- Repeat this procedure for each pump – allocating the selected Dout to the appropriate **pump isolation** tag.
- When the last tag is assigned restart the unit.

17.2.2.2 Inverting IRT (Pump Isolation) Dout

As configured the digital output is 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:

- Navigate to:



- Press the bottom button on the left-hand side marked **Invert?**
- Press **Save** and **Restart Now**

17.2.3 IRT Inhibited

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 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 is 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 is not normally 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 affect 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 1000 VDC 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 137 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.

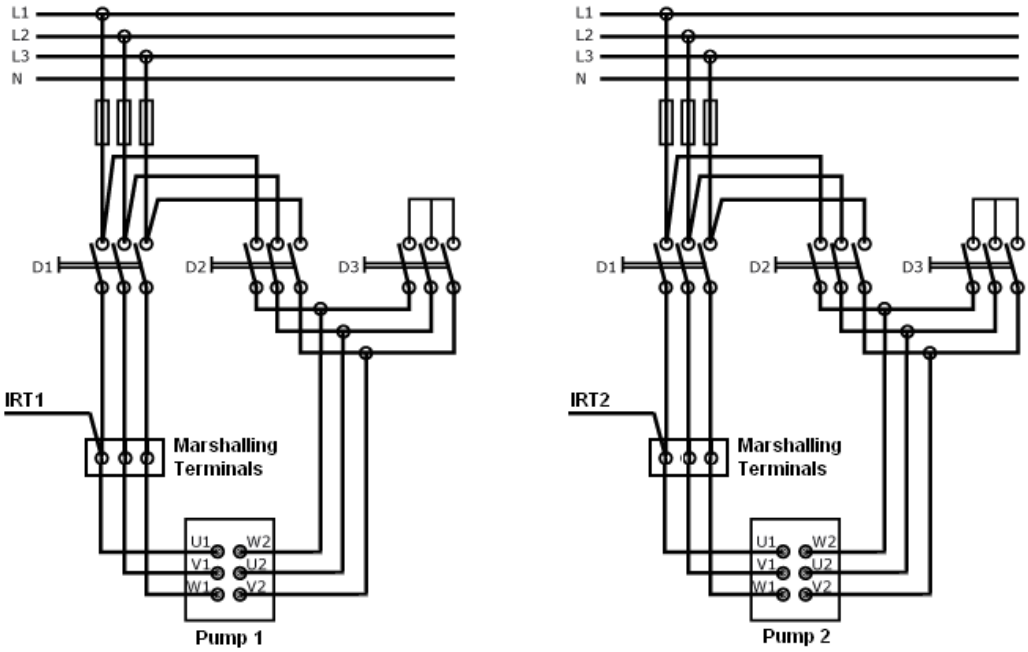


Figure 137 - IRT Wiring for 6-Star Delta Starter

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, navigate to:

Settings → Advanced → Motor Protection → Pump → Pump 01 → IIN

- Select **Amps A**
- 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:- … **IIN** / **_2** / **Amps A ,** and press **Ok**
- Repeat for the other 2 phases and then press **Save**

This has reassigned **Current Inputs** "**2**" (i.e. 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 on the LCD screen as well as sending it to SCADA. To be able to calculate the efficiency; energy monitoring, motor protection and flow must be enabled. Refer to Section 17 for more information on energy monitoring and motor protection and refer to Section 20 for more information on flow.

Efficiency is calculated as Volume/Energy AND as Volume/Energy/Head.

17.4.1 Efficiency

Efficiency can be displayed in Litres/kWh or kWh/Megalitre. This can be configured by navigating to:

Settings → More → Flow → General Settings and 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 on 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

Select the desired efficiency data to be displayed.

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 is 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 the power factor can be measured manually and stored into the MultiSmart as a parameter which is then be used by the MultiSmart for energy and efficiency calculations.

To configure this navigate to:

Settings → Advanced → IOModule → 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.

17.4.2 Efficiency per Unit Head

To make use of this calculation, the parameter **Head** must be altered in the advanced screens:

Settings → Advanced → Motor Protection → Pump → Pump 01 → Head

This value is used to display the **True Efficiency** calculations in the **Power & Efficiency** page in the **Info** screens.

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.

NOTE:
The Under Voltage threshold is temporarily ignored during the starting of a pump.

To configure supply protection navigate to:

Settings → More → Supply Protection

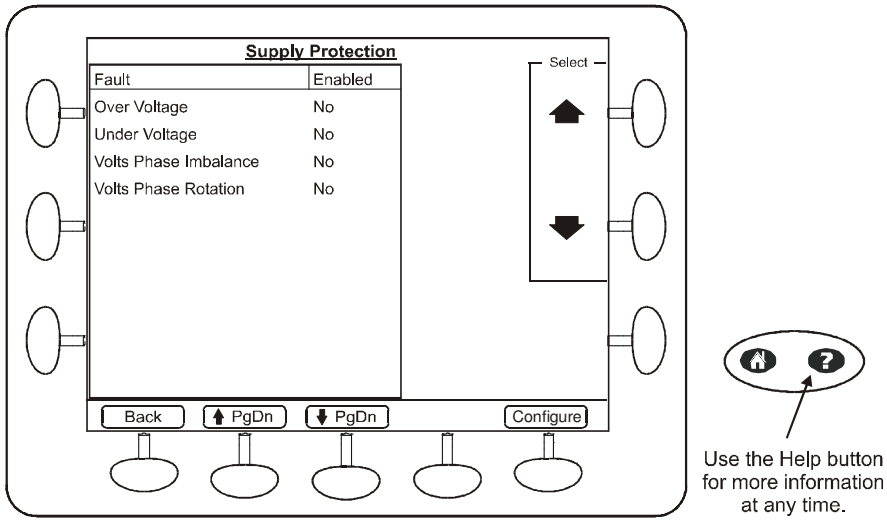


Figure 138 – Configuring Supply Protection Faults

A range of parameters can be set:

Name	Description
Over Voltage	Used to protect the station from over voltage conditions. The setup wizard automatically configures an initial value to 15% above the nominal phase to phase voltage.
Under Voltage	Used to protect the station from under voltage conditions. While the pump is starting this fault is disabled for a short while. The setup wizard automatically configures an initial value to 10% below the nominal phase to phase voltage.
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. The setup wizard automatically configures an initial value to 15% of the nominal phase to phase voltage.
Volts Phase Rotation	Protects against a change in phase rotation.

Table 25 – Supply Protection Faults

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

Name	Description
Enabled?	Enables or disables the fault.
Threshold	Sets a voltage threshold where it is relevant. When this is reached a fault condition is activated.
Act Delay (sec)	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 (sec)	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
Manual Reset Required?	Sets whether a Manual Reset is required after a fault condition has been detected.

Table 26 – Supply Protection Fault Parameters

19 Datalogger

The MultiSmart comes with a sophisticated datalogger. The results 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 primary datalogger – called the **Event Logger** - stores faults and events and is fully configurable.

There are additional datalogging options (which are explained later in this section):

- Crisis Logging
- Interval Logging

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 10 V
- Flow values and overflow events – if the optional flow module is installed
- Profile changes
- Pump efficiency yesterday
- 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 Configuring the Event Logger

Event Logger configuration is through the **Settings** menu:

Settings → More → Datalogger → Event Logging

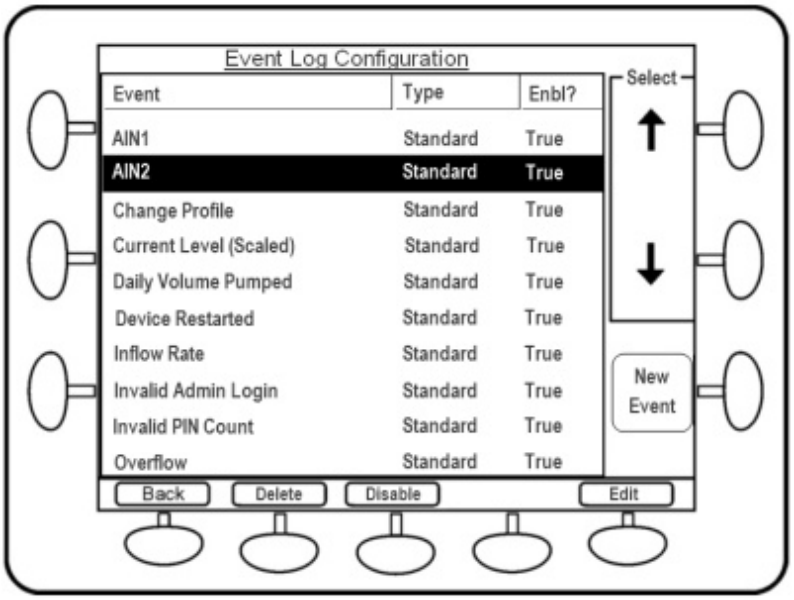


Figure 139 – Event Logger Main Configuration Screen

To stop logging "tags" (as each fault or event is called), there are two options - **Delete,** which removes them from this list, or **Disable** which stops them logging but retains the setup in the **Event Log Configuration** screen.

Edit and **New Event** buttons displays the same screen but in the case of **Edit**, the configuration screen is already populated:

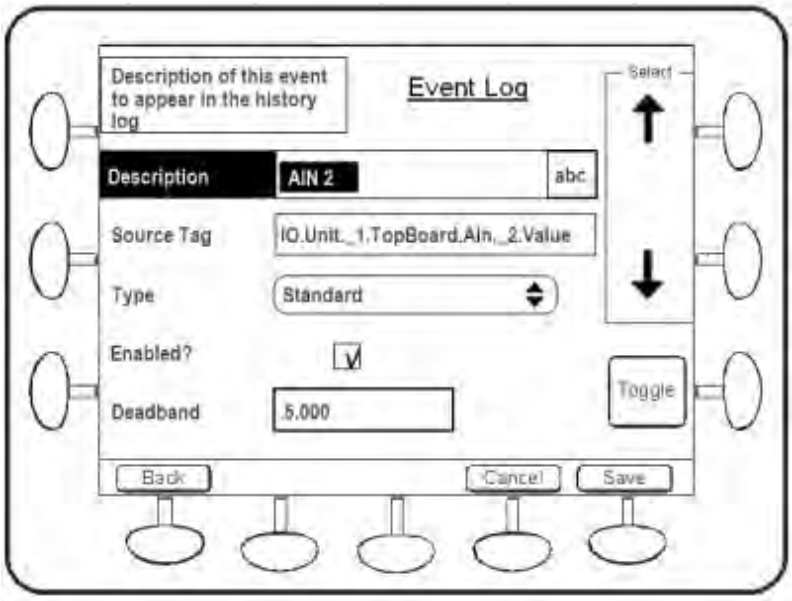


Figure 140 – Event Logger Parameter Configuration Screen

In the case of a new tag, if no **Description** is entered, the value defaults to the tag name. Tag names can appear cryptic to a lot of users. The value for the **Description** is what appears in the entry in the history screen (Section 5.4.2).

Once **Source Tag** is highlighted the **Toggle** button changes to **Select**. Pressing this button brings up the Tag Browser where any tag can be selected. The most useful tags to datalog are usually found under *Pump Control*, *IO* and *Flow*. A full list of tags can be found in the Modbus and DNP3 manuals (available online at www.multitrode.com).

The parameters in this screen are described as follows:

Name	Description
Description	Description of the event as it will appear in the history page.
Source Tag	The tag being monitored and logged. The value of this tag will be saved to the history log when it changes state, or in the case of an analog tag, when it changes by more than the **Deadband**.
Type	Event types can be used for changing how a value is displayed in the history page or for filtering purposes. **Standard** mode is the default. The setup wizard configures the datalogger as part of station configuration and will automatically select the appropriate value for **Type**. Additional modes are: • Pump Mode (displays Auto, Manual, Off) • Config Log (for identifying changes in configuration) • Pump Start/Stop (displays “Started” and “Stopped” instead of True/False) • Currents (Amps) • Voltage
Enabled?	This checkbox allows logging to be disabled without deleting the tag and its configuration. This allows later re-enabling if required.
Deadband	The **Deadband** is an important parameter for analog values. Logging of events is based on change of state. In the case of analog values, it is based on a deadband. The deadband is always an absolute value. For analog inputs however, the deadband is associated with the scaled value, which is 0-100 by default. Therefore the deadband is actually a percentage in this case. However, for duo-probe, the scaled range is 70-220 for an analog input. For volts and currents, every station is different so the appropriate deadband needs to be set.

Table 27 – Event Datalogger Parameters

NOTE:

If the deadband is set with too small a value (e.g. zero), there will a huge amount of datalogging on this one tag. The correct value of deadband depends completely on the installation and the importance for the organization of capturing changes in each tag.

19.2 Crisis Logger

The crisis logger is a very powerful datalogging feature which allows for higher resolution logging around particular faults and events – without filling up the datalogger memory.

For example, the organization might have chosen not to log motor currents because the datalogger memory fills up too quickly. However, when a motor over-temperature fault occurs, the currents immediately before this fault might be of great interest.

The crisis logger allows the user to:

- Select “triggers” that activate the crisis logger
- Define the time period before and after each trigger to log
- Define the time interval between each log
- Select multiple tags to log when the trigger event occurs

Settings → More → Datalogger → Crisis Logging

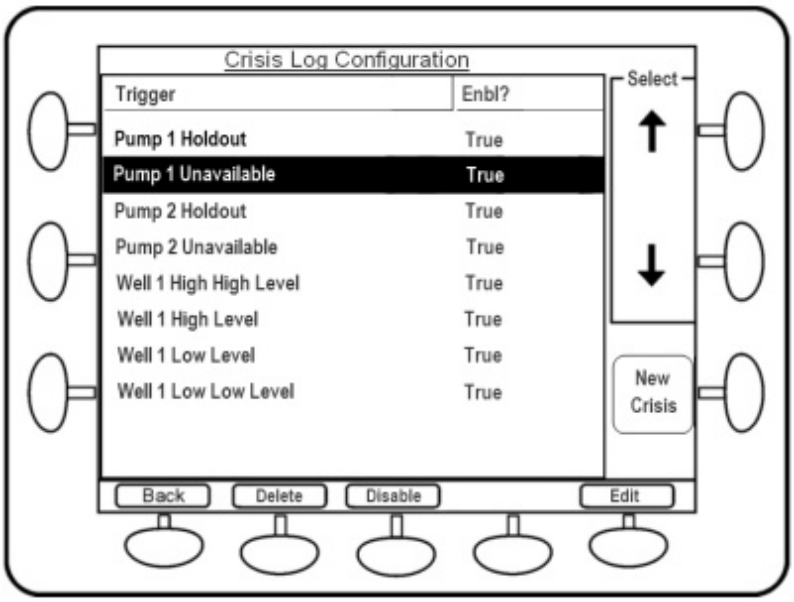


Figure 141 –Crisis Logger Main Configuration Screen

Navigation is similar to the Event Logger, simply use the **Select** up and down arrows via the soft keys on the right to select a trigger, then click **Edit**.

To add a new trigger, click **New Crisis**. Both of these actions lead to the same screen, but in the case of **Edit** the screen is already populated with the existing information:

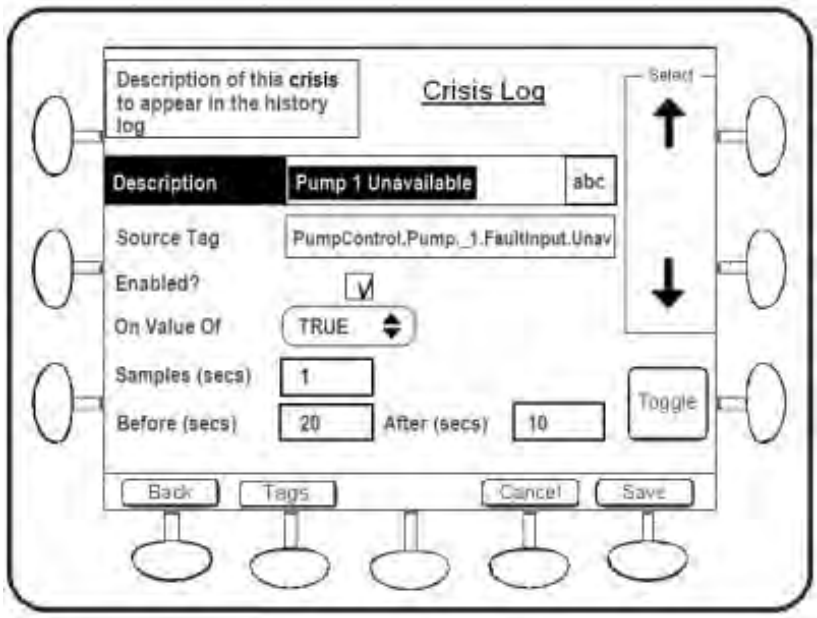


Figure 142 – Configuration of Crisis Log "Trigger" Parameters

This screen defines how the trigger tag is configured and the time periods and interval for logging. The **Tags** button at the bottom navigates into the list of tags that are logged when the trigger event occurs. In that screen (not shown), **New Tag** and **Edit** (of existing tags) both use the tag browser.

Parameters in this screen are explained below:

Name	Description
Description	Description of the "trigger" or event as it will appear in the history page.
Trigger	The tag being monitored which will trigger intensive logging of other tags. This can only be a digital tag (on or off), e.g. a fault, a digital input, a digital output, etc.
Enabled?	This checkbox allows logging to be disabled without deleting the tag and its configuration. This allows later re-enabling if required.
On Value of	Selectable as "True" or "False" – if set to "False" then when the tag being monitored changes from On to Off, the crisis logger will be triggered.
Samples (secs)	Time between each log of the tags associated with the trigger.
Before (secs)	Time before the trigger occurs to record data.
After (secs)	Time after the trigger has occurred to record data.

Table 28 – Crisis Logger Configuration for "Trigger" Parameters

Example: With **Samples** = 1, **Before** = 20 and **After** = 10, all of the tags associated with this trigger will be logged for 20 seconds before the trigger occurs and until 10 seconds afterwards at 1 second intervals.

19.3 Interval Logger

The best use of memory is to log on change of state however, some organizations may wish to log specific tags on exact time intervals. Examples of where logging on an interval might be required are:

- Regulatory reporting requirements
- Hydraulic modeling software data input
- Internal requirements for values in reservoir levels at midday and midnight

The interval logger provides this functionality.

Settings → More → Datalogger → Interval Logging

The configuration screens are similar to the event logger and crisis logger above. The parameters that can be set for interval logging for each tag are explained below:

Name	Description
Description	Description of the event as it will appear in the history page.
Source Tag	The tag being monitored and logged. The value of this tag will be saved to the history log at a frequency defined by the **interval**.
Type	Event types can be used for changing how a value is displayed in the history page or for filtering purposes. **Standard** mode is the default.
Enabled?	This checkbox allows logging to be disabled without deleting, to allow later re-enabling if required
DNP Event?	DNP events are usually only triggered on change of state (a change outside deadband for an analog tag). If enabled a DNP event will also be triggered when the value is logged to history – allowing these interval logs to be reported to SCADA.
Interval Type	Intervals can be set as **hh:mm:ss** for more frequently logged data. There are also options for: days, weeks and months.
Interval	This value, in conjunction with **Interval Type**, is what sets the logging frequency. For example, if **Interval Type** = "Days" and **Interval** = 5, this parameter will be logged every 5 days. The exact time of logging is set by the **Offset** parameter.
Offset	This defines the offset to each time period at which to trigger the event log. For example, if the interval is set to 1 hour and the offset is 30 minutes, the value will be logged at 30 minutes past each hour. If the **interval** is defined to be a multiple of one day, then the offset specifies the time of the day to trigger an event. If the **interval** is defined to be a multiple of one week then there is also the option to specify the day of the week. If **interval** is monthly there is the option to specify the day of the month.

Table 29 – Interval Logger Configuration Parameters

19.4 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 **Filters**. This brings up a screen with five filter options. The screen also shows if any filters are currently applied under each type.

By selecting each of the options on this screen, filters can be applied to a number of different areas as explained in the following sections. A filter does not start or stop any data being logged, it only affects viewing of that data in **History**.

NOTE: *Any filters you apply 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.*

19.4.1 Log Type / Pump Filters

History → Filters → Log Type / Pump Filters

Within this filter, the first option is **Log Type** with a selection between different logging methods (described earlier in this chapter):

- Faults and Events
- Interval Logs
- Crisis Logs
- Config Logs

These different logs cannot be displayed together. Additional to Log Type there are check boxes for:

- Events
- Faults
- Pump 1
- Pump 2 etc

To only view faults, uncheck the **Events** box. To remove faults from the view, uncheck the **History** box. To view station data not relating to a pump, uncheck both (or all) the pump boxes.

Once changes are made, press **Saved**, then **Back** -> **Back** and the History screen will now show the filtered data.

19.4.2 General Event Filters

History → Filters → General Event Filters

There are 17 useful filters:

Analog Inputs	Device Restarts	Pump Mode	Voltages
Comments	Flow	Pump Starts	All other events
Currents	Insulation Resistance	Pump Stops	
Current Profile	Level	Temperature	
DC Supply	Level Alarms	User Logins	

Table 30 – Predefined Filters Available in General Filters

By default, all of these filters are enabled (checked). To remove any from the history view simply uncheck the box.

19.4.3 Include Filters and Exclude Filters

History → Filters → Include Filters

This simply allows text strings to be filtered in or out.

For example, to find any "Energy" related information, go to the **Include Filter**, enter the text string "Energy" and press **Add Filter**. Then press **Save, Back** and **Back**, now the history page will **only** show logged data with the text "Energy",

e.g. Pump 1 Energy, Pump 2 Energy.

History → Filters → Exclude Filters

The **Exclude Filte**r does the opposite and both can be used together if necessary – even though this would be an unusual requirement.

19.4.4 Time Filter

History → Filters → Time Filters

To find data between specific dates and times, use the **Time Filter**. Dates and time of day can be entered. With a lot of data stored this is much quicker than using the **PgDn** button to move to older data.

19.5 Storing the Datalogger on the Compact Flash Card

There are two ways to save 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 is not sufficient. Putting in a 1GB CF card, for example, gives storage of around 10,000,000 events.

19.5.1 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 in the MultiSmart and go to:

Settings → More → More → Backup Options → Backup Log Files

There are six options:

- Backup Fault & Event – copies the fault & events and time interval logs to the CF card
- Backup Crisis Logs – copies the crisis log to the CF card. This data is stored in a different format from the faults and events
- Backup Config Logs – copies configuration change log (i.e. details of user changes to the configuration)
- Backup Device Info – serial number, hardware and software version and IP address of the unit
- Backup System Logs – copies the system logs which contain advanced diagnostic information
- All Logs files – all of the above in one key press

NOTE: *If the yellow* ***Save CF Data*** *button is not pressed before the card is removed the data may become corrupted. Insert the CF card into any laptop or PC equipped with a CF card reader.*

For the first three options (and "All Logs files" option) the user will be prompted with the question "Do you want to save in native or in human-readable format?"

Generally, the **Human Readable** option should be chosen if the data will be read via Excel, Access or a text-based application.

19.5.2 File Names and Generations

Name	Description and Data Structure	Filename when copied to CF card
Event Logger & Interval Logger	Events and faults – the main "Event Logger" (Section 19.1) and the time-based "Interval Logger" (Section 19.3)	history.log
Crisis Logger	High resolution datalogging around "trigger" events (Section 19.2)	crisis.log
Configuration Logger	Configuration changes to the MultiSmart are logged along with the user ID (if security is setup). Fields: Tag Name, Tag Type, New Value, Old Value, Time Stamp, User ID	config.log
System Log	Information which can be useful to MultiTrode engineers when diagnosing serious problems	messages
Device Information	Stores data about a unit which is not evident from its configuration files: MAC address, serial number, enable code, hardware and software version, IP address	Device.inf

Table 31 – Filenames for Each Type of Datalog file

To avoid log files becoming too large, MultiSmart has a file size limit defined (see below). Once this file size is reached, a new log file is started and the old log file has a name change to identify it.

This is easiest to see with an example of the history.log file.

Initially history.log is the only file. Once the file size limit is reached (usually around 50,000 records):

1. history.log becomes history.0
2. A new history.log file is started

Once this second file reaches the size limit:

3. history.0 becomes history.1
4. history.log becomes history.0
5. A new history.log file is started

This continues to the maximum number of file generations. Both maximum file size and maximum number of generations can be configured in the advanced menus.

This means that history.log is always the newest file, history.0 is the next file and so on.

A configurable number of previous files (or file generations) can be retained.*

- For the Event Logger:- **Settings** / **Advanced** / **FaultModule** / **Number of file generations**, by default it is set to 3.
- For the Crisis Log:- **Settings** / **Advanced** / **Event Logger** / **Number of file generations**, by default it is set to 2.

NOTE: **Show More Options** must be enabled (see Section 31.1)

19.5.3 Viewing the Event Logger Files on a Computer

The following procedures allow the data from the Event Logger in MultiSmart (file: history.log) to be imported into Microsoft WordPad or Microsoft Office Excel.

Importing the Event Logger File into Microsoft WordPad

1. With the Event Logger file copied to the CF card, insert the card into a PC based reader
2. Copy the file history.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 history.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 Event Logger file copied to the CF card, insert the card into a PC based reader
2. Copy the file history.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 history.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

19.6 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. The following steps show how to setup the Datalogger to save data to the compact flash card.

19.6.1 Setting the Event Logger and Crisis Logger File Location

Settings → Advanced

- Scroll down to **Event Logger** then press +/-
- Scroll down to **Log file name (***Show More Options*, section 31.1, must be enabled for this to be displayed)
- 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).

If the Crisis Logger is also being used (section 19.2) it can also be logged directly to compact flash.

- Scroll up (from **Log file name**) to **Fault file name**
- Press an arrow key located on the keypad (such as ←) and change the default path and filename (/var/log/crisis.log) to:

```
/mnt/cf/crisis
```

When either or both of these tasks are done:

- 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: *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).*

19.7 Adding Comments and Deleting Logs

From the History screen, press **Add**/**Delete** to navigate to the screen: “Add Comment / Delete History Logs”.

This screen has two different functions:

Firstly, the user can add comments to the datalog. For example, “Serviced Pump 2”. This text entry will appear in the history page along with the data/time it was entered.

Secondly, from this screen the user can delete the datalogs.

NOTE: *Deleted log files cannot be restored.*

20 Flow

The flow module provides the ability to calculate flow without the use of a flow meter in most empty/discharge applications. The flow menu can be used to assign and make changes to the 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 to Spill** feature calculates and displays the time period within which a spill may happen if the current conditions do not change.

The flow module 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 Setting

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). This method supports more than one flow meter. 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
Volume Units	Allows selection of kl or Ml (instead of litres), and the same for gallons. Takes the litres or gallons selection from *Units*	Normal, Kilo or Mega
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

Table 32 – General Flow Fault Parameters

NOTE: *If the Units are changed, the existing flow statistics are not converted into the new units so a reset of the flow statistics is recommended. (Navigate to: Info ➔ Flow ➔ Reset).*

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 → Outflow Analog Input

Use the **Toggle** button in the top left to select between **Meter Mode** = "Standard" or "Per Pump". Selecting "Per Pump" allows a different meter for each pump, a common configuration for large pump stations:

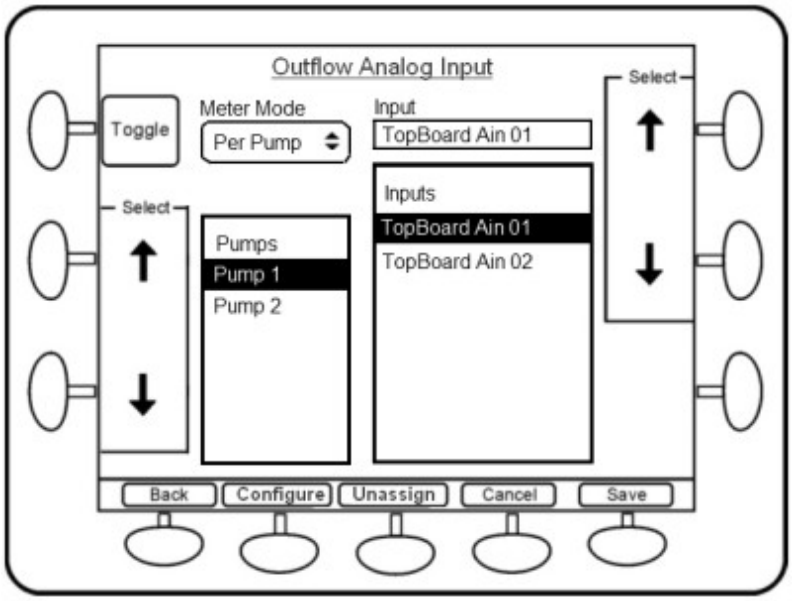


Figure 143 - Selecting Analog Device for Flow Meter

If "Per Pump" is chosen the left hand **Select** arrows and the pump selection box appear. Select each pump in turn and, using the **Select** arrows in the top right, choose from the available analog inputs.

Note: if "Standard" is chosen then the Pumps box and select arrows will not appear.

Press the **Configure** button to make changes to the analog input selected. This allows span and zero for 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 & Rain Gauge

Press the **Config** button, select a digital input from the list. Press **Configure** to make changes to the digital input setup if the flow meter has special interface requirements. If a high speed input is required (1kHz), then use Din 19 or 20 and select the **Mode** as **High speed**. 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 that 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.*

Currently only one pump is supported for the totalized results to be displayed in the flow screen (**Info – Flow**).

However, additional flow meter pulse counters can still be assigned to digital inputs. Although they won't appear in **Info – Flow**, they will still appear in the **Info - I/O Information** screens. See Section 14.4 for independently configuring digital inputs.

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 between a number of level values in the well (e.g. each 10%, each 0.5m, each 1ft, etc). 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.*

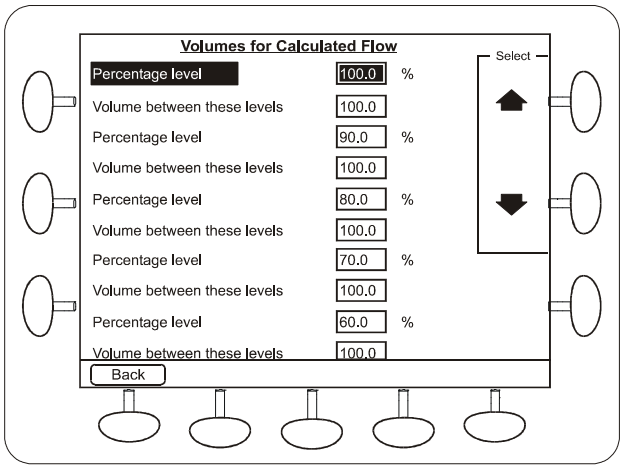


Figure 144 – Entering volumes for each level in well.

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. If feet or metres has been set as the level units (see section 14.8) then the configuration display will change accordingly.

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 warnings and faults are used to indicate when flow rates fall outside acceptable limits. To select and configure alarms navigate to:

Settings → More → Flow → Flow Alarms

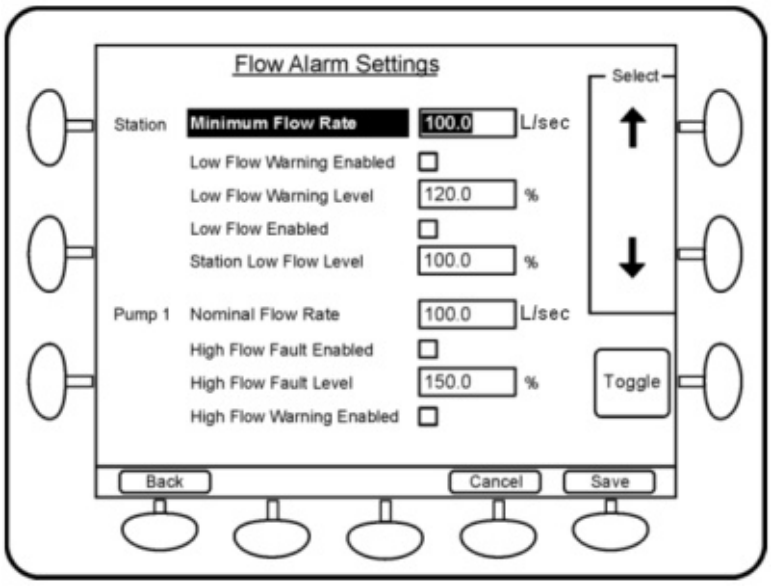


Figure 145 – Configuring Flow Alarms

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.

In a similar manner, Low Flow alarms can also be configured for the station; enter the minimum Flow Rate. All the alarms are defined as percentages of this rate.

Select and enable an alarm by pressing the **Toggle** button. When finished press the **Save** button.

The basic fault parameters such as activation delay, deactivation delay, pump context and fault reset method can be modified by navigating to:

Settings → Set Points → I/O, Faults, & Level → Faults

and select the appropriate fault and then press **Configure**.

Additional fault parameters can be found in the **Advanced** menu:

Settings → Advanced → Fault Module → Pump

- Select a pump and press [+/-]
- Select **Flow** [+/-], then select a specific flow alarm, e.g. **High Flow Fault** [+/-] then **Status** [+/-]

20.6 Smart Outflow

This is a MultiSmart patent pending feature. The 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 turns off the pump (but only if a spill is highly unlikely) and checks the increase in level to verify the current inflow. If the inflow is effectively unchanged from the previous calculated inflow, then the long pump runtime is most likely due to a partially blocked pump.

To be able to use this feature, the flow module must enabled in the MultiSmart. (If not, refer to Section 28 for turning on this feature). Navigate to:

Settings → More → Flow → General Settings

In the flow **General Settings** select the **Flow Enabled** and set the **Mode** to **Calculated**. Enter the desired **Averaging Cycles** (the default is 10). This sets how many pump cycles are used in the outflow averaging calculations (Refer to Section 20.1). Remember to **Save** the changes.

The Smart Outflow must now be enabled, navigate to:

Settings → More → Flow → Smart Outflow 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

Table 33 – Smart Outflow Parameters

The Smart Outflow feature only deactivates the pumps (in order to recalculate inflow) once in any one pump down cycle.

It is also recommended to 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**. Ensure 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 reached.

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, the flow module must be enabled in the MultiSmart. (If not enabled, refer to Section 20.1).

Navigate to:

Settings → More → Flow → General Settings

Under the flow **General Settings** button, check the **Flow Enabled** and **Overflow Enabled** check boxes and set the **% Level for Overflow**.

To display the Duration to Overflow in the main screen browse to:

Settings → More → Customize Display → Bottom Section

Select the **Line** in which the data is to be displayed from the left column and then select **Duration To Overflow** from the right column and press **Save**. This value now appears in the bottom section of the main screen display.

NOTE: *When a probe is selected as the level device the setpoints need to be at least 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.

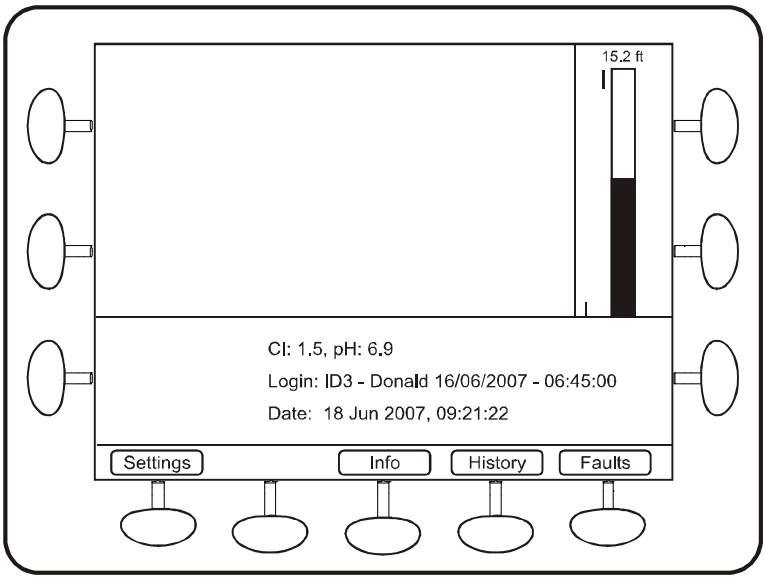


Figure 146 – Typical Reservoir Monitor Main Screen

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.

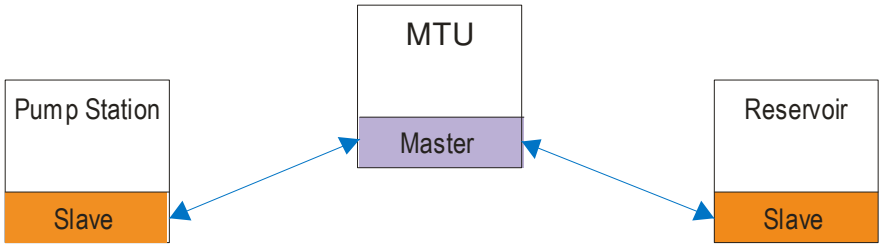


Figure 147 - Communications Configuration B

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).

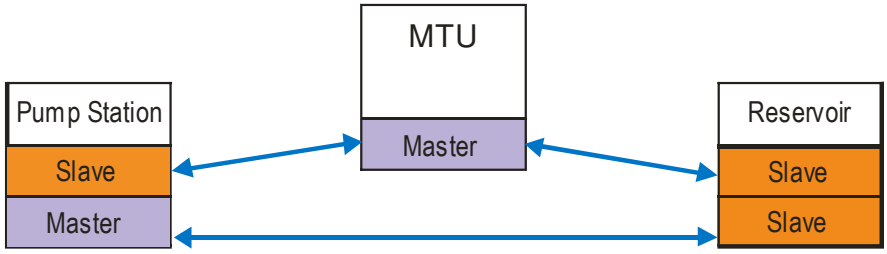


Figure 148 - Communications Configuration B

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).

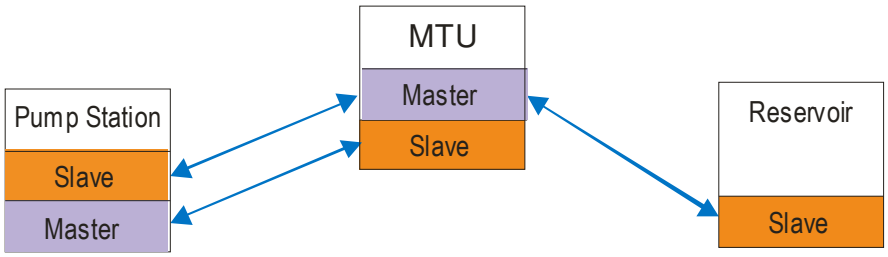


Figure 149 - Configuration C

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 Station Manager, 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.

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 one physical serial port.

The software module (Connection Mgr) must be enabled. To view the currently enabled modules, navigate 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 Station Manager (with Remote Level). When the Connection Manager is enabled, ("Use conmng" is checked), the individual Comms Channel settings are ignored. This applies to both DNP Slaves and DNP Masters.

The following diagram illustrates the functionality of the Connection Manager.

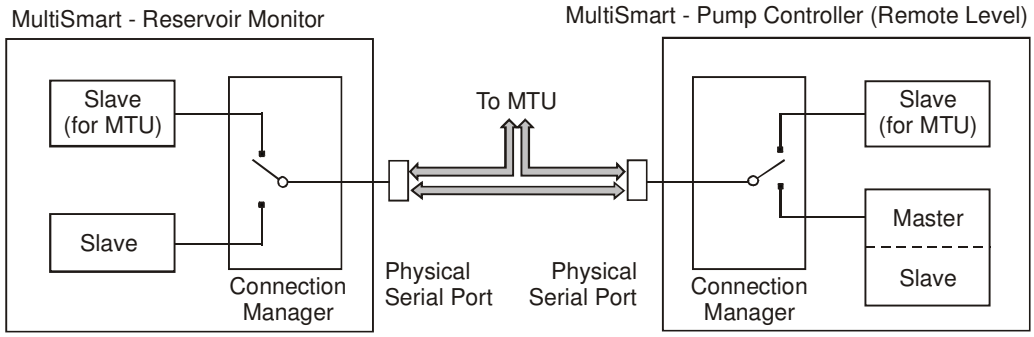


Figure 150 – Functionality of Connection Manager

21.3.2 Reservoir Monitor Setup

Whenever a Reservoir Monitor or an associated Pump Station Manager (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. Navigate to:

Settings → Advanced → Connection Manger → Manager → Manager 01 → Comms Channel

If separate 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.

Navigate to:

Settings → More → More → Software Modules → Enable_Disable Modules → Modify

and enter the new Site Key).

(b) The Connection Manager must be disabled in both 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. Navigate 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. Navigate 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 after the Pump Station Manager 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 "R06-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, (page 3 of the **Settings** menu).

NOTE: *The MultiSmart can also be shipped just as an RTU without any Pump Station Manager 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.

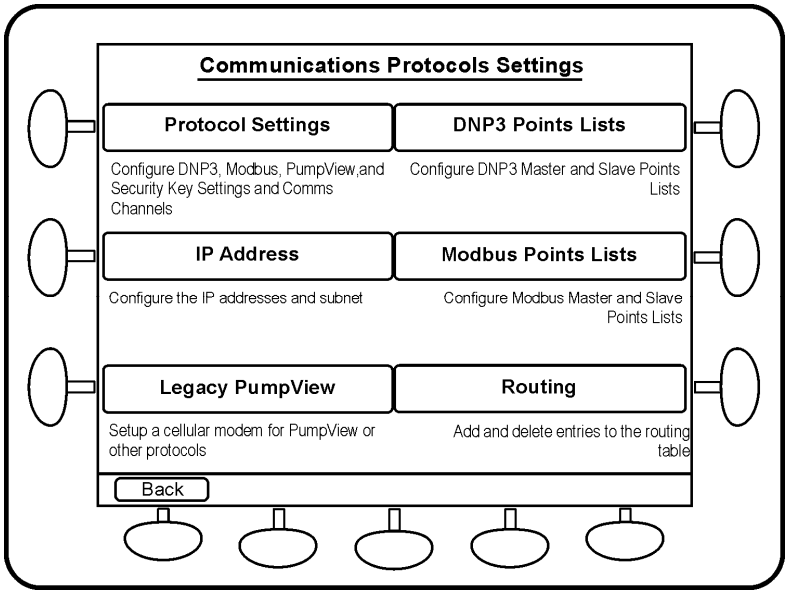


Figure 151 – MultiSmart Communications Settings Screen

22.2 Communication Protocols

The MultiSmart RTU can communicate using MODBUS (RTU/ASCII/TCP) and/or DNP3 protocols depending on which software modules have been purchased. If these modules are not enabled, 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 DNP3 and Modbus are both enabled, ensure that they are not pointing to the same channel. If they are, Modbus will be disabled and a fault will be displayed ("Comms Channel Conflict").

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 than 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 than 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 prompt**;** 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, click Add New.

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more than 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 than 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 consideration 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 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.

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 than 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

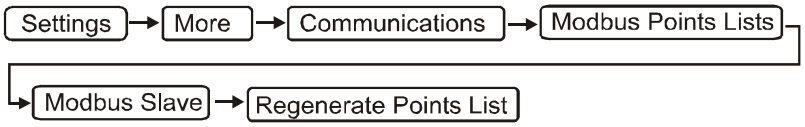
Select the appropriate slave settings from the list below:

- Binary Inputs
- Binary Outputs
- Analog Inputs
- Analog Outputs
- Counters
- Frozen Counters

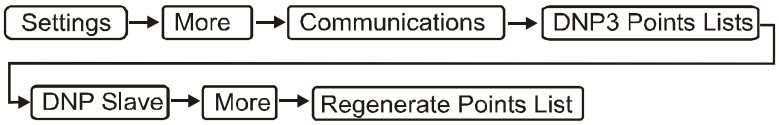
To add a new point browse, click Add New.

You may have to select the appropriate slave using "*Next Slave*" or "*Previous Slave*" buttons which are visible if more than 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



or



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 not 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) ADAM-6051 – Generates the points list for the ADAM 6051 external IO unit.

(e) Acromag 961EN-4006 – Generates the points list for the Acromag 961EN-4006 external IO unit.

(f) 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 → More → Communications → DNP3 Points Lists → DNP* Slave / DNP* Master → More → Export to CSV

or Modbus Points Lists

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 → More → Communications → DNP3 Points Lists → DNP* Slave / DNP* Master → More → Import to CSV

or Modbus Points Lists

22.2.5 Protocol Settings

Settings → More → Communications → Protocol Settings

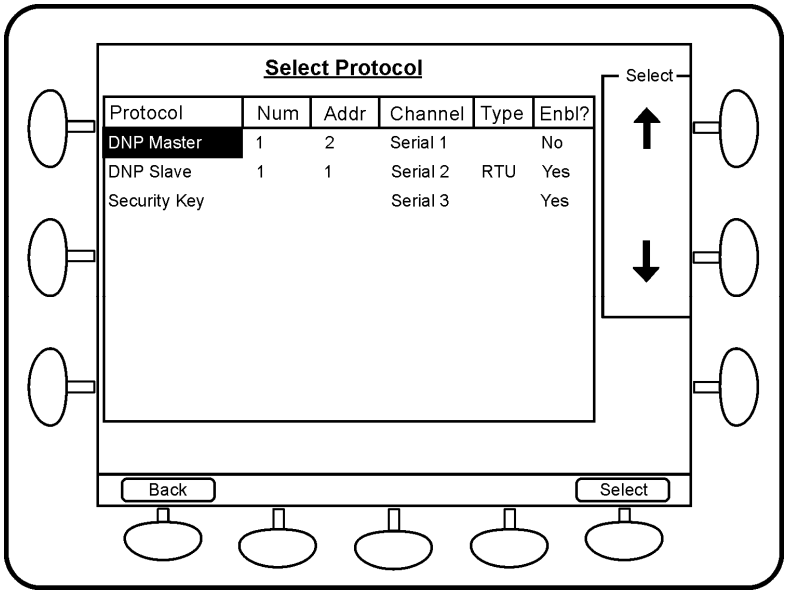


Figure 152 – Protocol Settings

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) – 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 Channel 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.

Example: Modbus over TCP

- Comms Channel = TCP/IP 1.
- Slave Address = 1
- Link Type = TCP

Channel Options

- Connection Type: Listening end-point (Default).
  Master I.P. Address. (Default). Cs to any master.Other I.P. Address options:
- (a)(b) TCP Port = 502 (Default = 20 000)

22.2.6.2 Serial / Modem Channel 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.

Further serial port parameters can be found in the **Advanced** menu, navigate to:

Settings → Advanced → Telemetry → Channel → Serial n → RS 232 Channel

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 (ms)	Sets a timeout for the first character in milliseconds.	0 – 9999 ms	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 (ms)	Creates delays for use with analog radios	0 – 9999 ms	0
Radio On Time (ms)	Creates delays for use with analog radios	0 – 9999 ms	0

Table 34 – Advanced Serial Port Parameters

22.2.6.3 PSTN Channel Settings

The following parameters should only be modified by an experienced modem user. Only the DNP3 protocol can be used over PSTN.

- Navigate to: Settings → More → Communications → Protocol Settings
- Highlight a **DNP Slave** and press **Select**
- Set the **Comms Channel** to **PSTN** and press **Save**.
- Press **Channel** to modify the following modem related parameters;

  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) – Period to establish connection before dial up connection times out

  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 – Physical port used by this channel. In most cases this need not be changed

The default modem initialization string (Init String 2) can be 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.

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 or 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 to 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 the **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

Navigate to:

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.

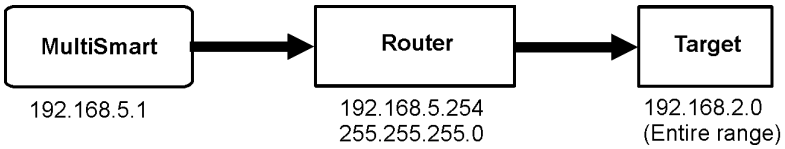
If the MultiSmart needs to go through the Gateway for communicating to specific target networks, and ignore that Gateway for communications to other networks, enter the Gateway IP address in the New Gateway, add

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 an existing routing table needs to be deleted, scroll down to highlight the routing entry and press **Delete**. A restart is again required for this change to come into effect.

Example 1: Targeting a Private Subnet

You are using a cellular router with an IP address of 192.168.5.254 and a subnet mask of 255.255.255.0 and the MultiSmart is using an IP address of 192.168.5.1. The target is an entire subnet of 192.168.2.0.

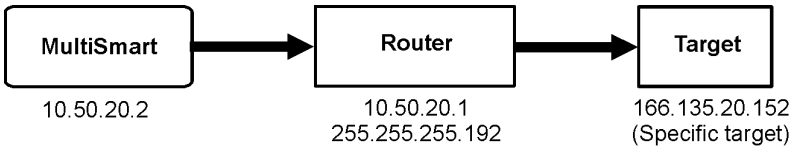


Enter into the MultiSmart IP Routing Table:

- New Gateway: 192.168.5.254
- New Netmask: 255.255.255.0
- New Target: 192.168.2.0

Example 2: Targeting a Specific IP Address

You are connected to a router with an IP address of 10.50.20.1 with a subnet of 255.255.255.192 and your target is a specific computer on the internet with an IP address of 166.135.20.152. The MultiSmart has an IP address of 10.50.20.2.



Enter into the MultiSmart IP Routing Table:

- New Gateway: 10.50.20.1
- New Netmask: 255.255.255.255
- New Target: 166.135.20.152

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. (If not enabled at the time of purchase, it can be enabled later with a new Site Key).

The VFD feature coordinates and alternates drives so that 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 VFD drives. As new pumps are started the overall VFD speed is reduced.

For example, if one pump is running at 100% and a second one is about to start at 30%, the algorithm in the pump station manager adjusts the speed of both so that they run at 65%. This ensures a smooth power curve with both pumps running at the same speed.

Also the VFD algorithm varies the speed of the pumps as the well level varies, it is likely that during steady inflows the system may 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 Enabling VFD

To enable and configure the VFD drive functionality:

Navigate to:

Settings → Set Points → VFD Settings

- Configure the settings listed in the screen and table below as required for the application
- Press the **Save** button when finished

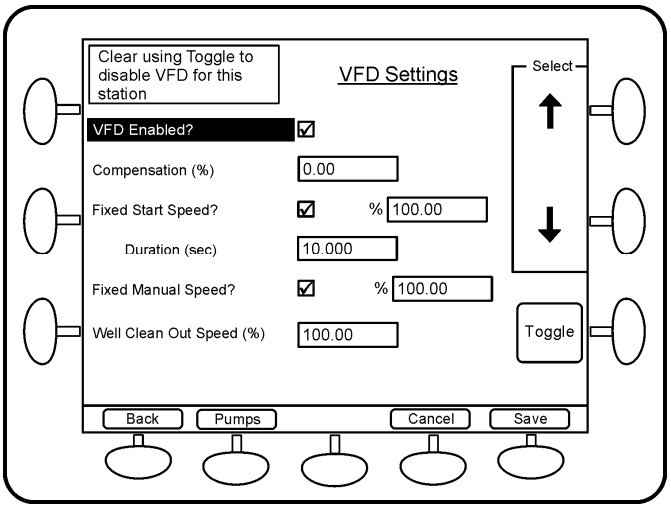


Figure 153- VFD Settings Screen

Name	Description	Range/Value
VFD Enabled?	Activates the VFD functionality. This must be checked before VFD will work.	Enabled/Disabled
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 pipe work).	-50 to 50
Fixed Start Speed 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 Start Speed	Sets the starting speed when “Fixed Start Speed” is enabled.	0 -100%
Fixed Start Speed Duration	Sets the length of time a pump is started at a fixed speed when “Fixed Start Speed” is enabled.	seconds
Fixed Manual Speed 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 Manual Speed	Sets the pump speed when “Fixed Manual Speed” is enabled.	0 -100%
Well Clean Out Speed	The fixed speed to run when “Well Clean Out” is active.	0 - 100%

Table 35 – VFD Parameters

23.2 Individual Pump Parameters

To set the start, minimum and maximum pump speeds:

- Press the **Pumps** button displayed in the **VFD Settings** screen (See Figure above)
- Set the speed at which to start the pump
- Set a minimum speed (the minimum speed setting of the actual VFD unit may override this value)
- Set a level at which the pump will be running at 100% speed
- Repeat for each pump and press the **Save** button when finished

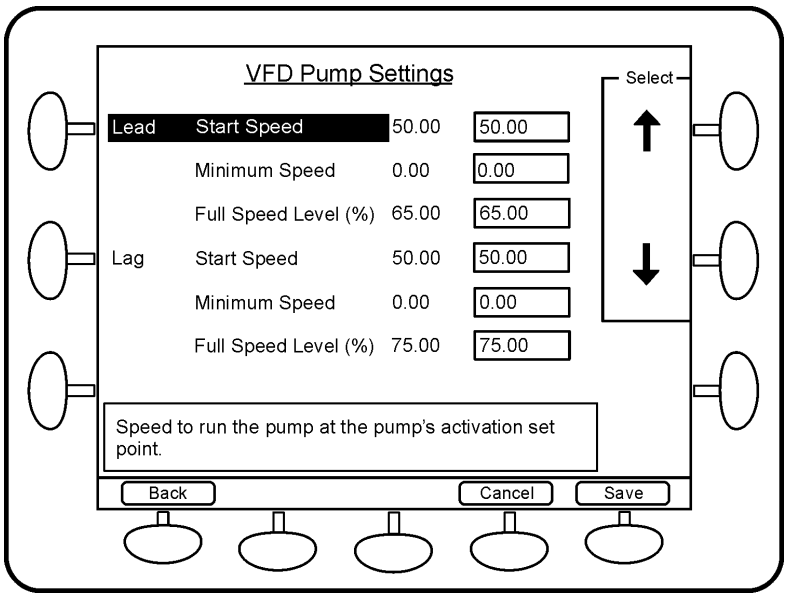


Figure 154 – VFD Pump Speeds Settings Screen

23.3 Setup an Analog Output for use with a VFD Drive

Navigate to:

Settings → I/O, Faults & Level → Analog Outputs

Press **Config** and assign **VFD Current Speed** to an analog output. For more information, see Section 14.10.

23.4 Controlling a VFD Drive Using MODBUS

A VFD drive can be controlled using Modbus communications rather than an analog output.

To do this the VFD drive Modbus master needs 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.

23.4.1 ABB VFD Drive Support

The VFD drive points list can be automatically configured for two drives manufactured by ABB – models ACS 550 and ACS 800.

To configure the MultiSmart:

- Create a Modbus Master and Slave configuration (If an existing one is to be used, the points list must be cleared first).
- Configure the protocol and communications channel for the Modbus Master/Slave configuration just created.
- A **Config Modbus** button now appears in the **Motor Protection** screen. This allows selection of the drive model and the configured Modbus Master/Slave. A points list is now created.

For a detailed procedure, a Knowledge Based Article is available ("*Modbus Connection to ACS550 or ACS800 VFD for Motor Protection, MultiSmart Firmware 2.2.0")* - contact MultiTrode.

NOTE:

Only selected points from Profile 3 of the ABB points list are supported.

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 IEC 61131-3 (ISaGRAF)

ISaGRAF, a control software environment which supports all of the internationally recognised IEC 61131-3 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 system integrators 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 IEC 61131-3 is added because it is the most proven platform and version 5 is chosen as it offers a number of advantages over version 3. 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 refer to Section 28.1

ISaGRAF 5 (and patches if any, which are 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.

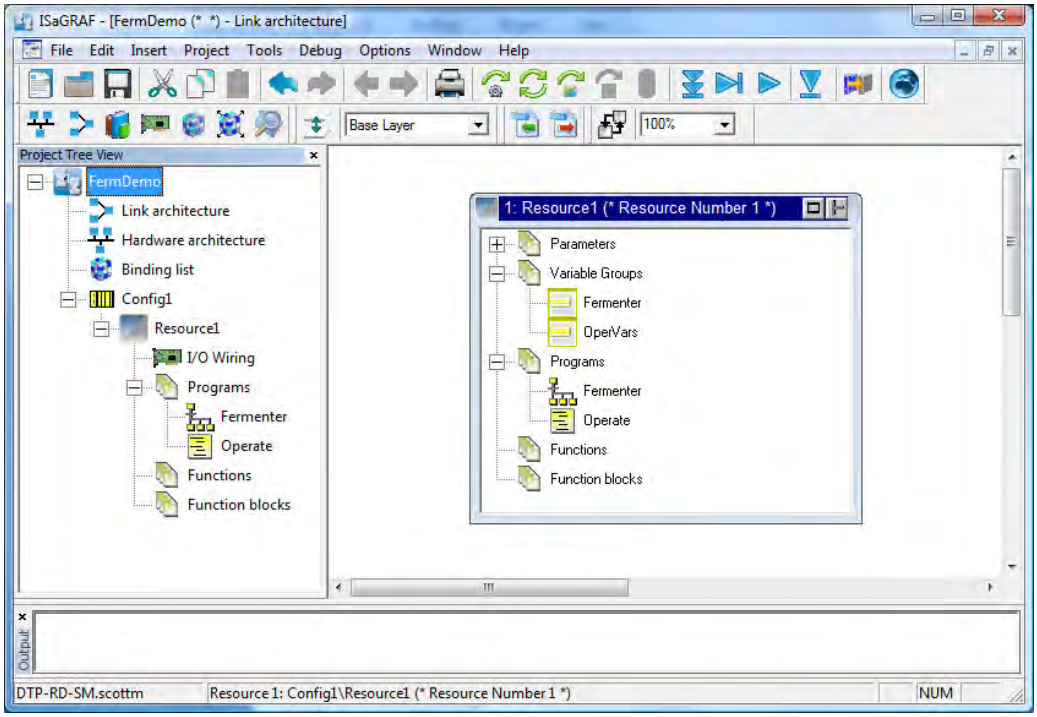


Figure 155 - ISaGRAF Workbench

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: adam6051: ADAM6051(* *)	ADAM-6051 Digital Input Unit
multismart: pc: acromag961: ACROMAG961(* *)	ACROMAG-961 Analog Input Unit
multismart: pc: acromag983: ACROMAG983(* *)	ACROMAG-983 Digital Input Unit

Table 36 – ISaGRAF Device Names

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 parameters.

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 (e.g. Contactor Auxiliary) 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 number (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. (i.e. 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 `PumpHoldout` 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_n->Pump Holdout->Status`

The highlight `Source` and press the middle left button. Then navigate to `Isagraf5.Values` and select one of the digital tags (e.g. `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 SerialOpen

This function block opens the serial port.

24.3.2.12 SerialRead

This function block reads the serial port.

24.3.2.13 SerialWrite

This function block writes to the serial port.

24.3.2.14 SerialClose

This function block closes the serial port.

24.3.2.15 SerialFlush

This function block clears the serial port buffer.

24.3.2.16 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.

24.3.2.17 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.

24.3.2.18 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.

24.3.2.19 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 & downloaded to MultiSmart 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 Disabling ISaGRAF Resources

The user can disable ISaGRAF resources via the **Info** page. See section 5.4.3.8

24.10 Backing Up ISaGRAF Resources

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

24.11 ISaGRAF Application Examples

Brief overview of some of the applications which are implemented with the help of ISaGRAF is mentioned in the subsections below.

24.11.1 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.

24.11.2 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.

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 Station Manager 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

Table 37 – Example of MultiSmart Tags

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

Table 38 – Logic Engine Mathematic Operators

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.

Table 39 – Logic Engine Functions

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

Table 40 – Logic Engine Advanced Functions

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 16.2.3 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 22.4 on 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.

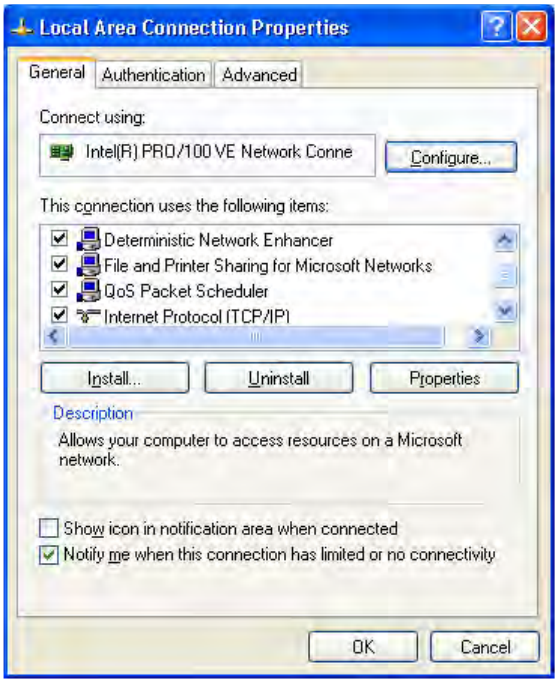


Figure 156 – Select TCP/IP and click Properties:

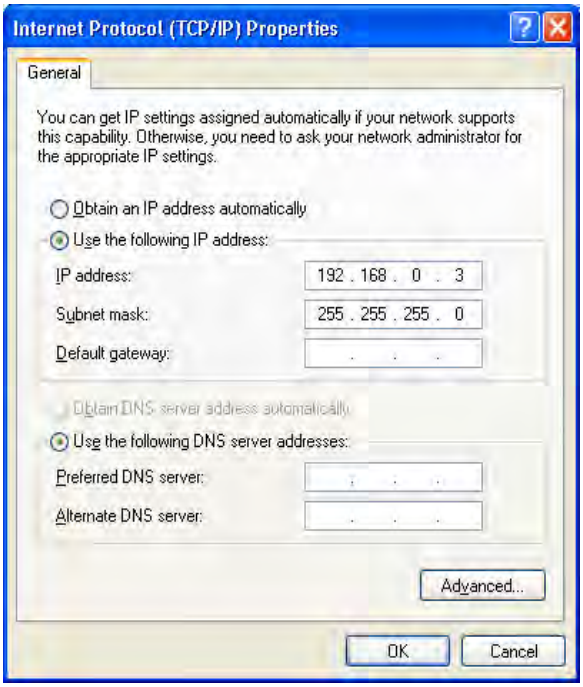


Figure 157 –Enter IP Address

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

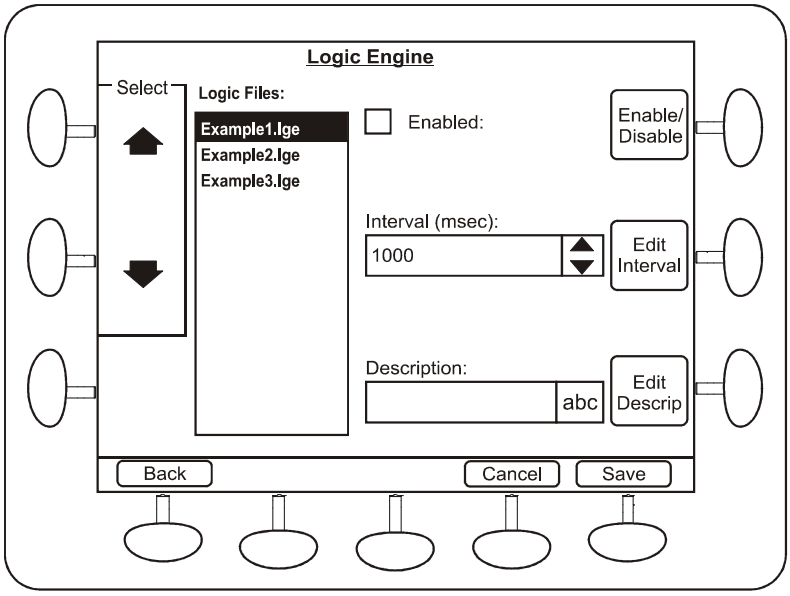


Figure 158 – Logic Engine Screen

26 Customizing the Display

Some elements of the main operator screen can be customized by the user.

Settings → More → Customize Display

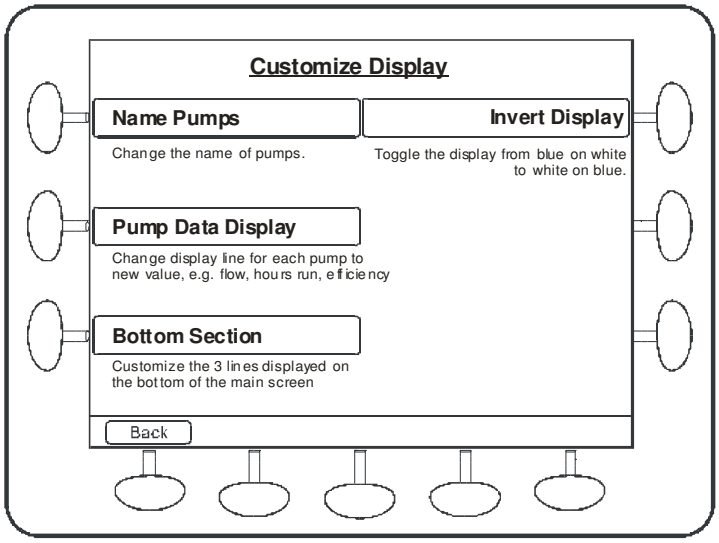


Figure 159 - Customize Display Screen

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 the 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 are shown in the main display, pump set point screen and in the pump delay screen.

NOTE:
Some advanced settings screens do 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.

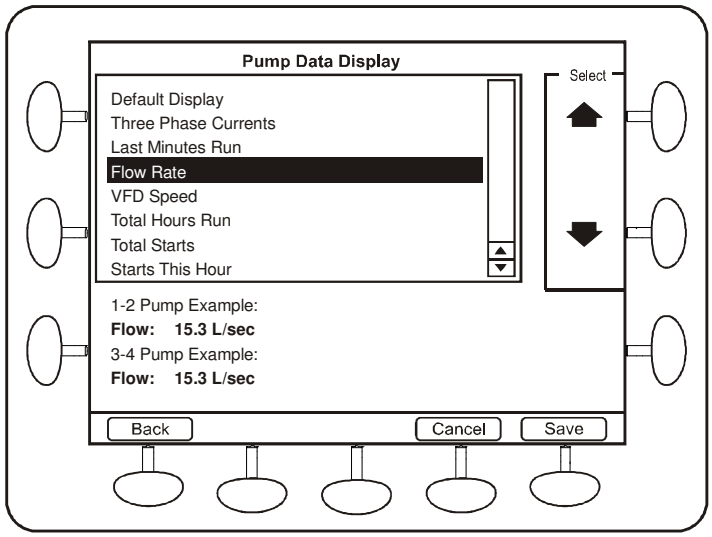


Figure 160 – Choosing a new value to display

Values available include:

Apparent Energy (kVAh) [1]	Hours Run [3]
Apparent Power (kVA)	Total Hours Run
Efficiency (L/kWh, Gal/kWh, kWh/ML or kWh/MGal) [1] *	Starts [2,3]
Energy (kWh) [1]	Total Starts
Flow Rate (L/sec, L/min or gpm) *	VFD Speed (%)
Insulation Resistance (MΩ)	Power (kW)
Last Minutes Run	Power Factor
Minutes Run [2]	Three Phase Currents (A) (%FLC)

[1] Last Week, This Week, Today or Yesterday, [2] Last Hour or This Hour

[3] Today or Yesterday, * Some units may require changes to Flow Settings (Section 20).

Table 41 - Customize Display - Pump Data

26.3 Bottom Section

The bottom 3 lines of the Pump Station display can also be customized. Options are:

Date and Time*	DSP Firmware Version
Supply Volts* (3-Phase Supply)	Last Login ID, Name and Date/Time
Mode and Profile*	Invalid Login Count and Date/Time
Alternation Mode	Invalid Admin Login Count and Date/Time
Inflow and Volume	Topboard Ains
Duration To Overflow	Topboard Aouts
Station Run Time (hrs) and Starts	Topboard Dins[1]
Temperature	Topboard Douts[1]

* Defaults, [1] Maximum of 3 Dins or Douts displayed

Table 42 - Customize Display - Bottom 3 Lines

Example of a customized display:

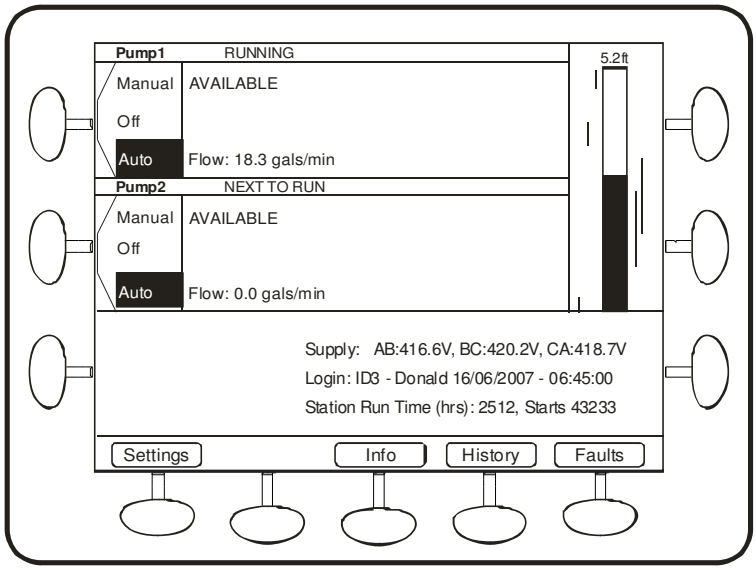


Figure 161 - Customized Display Screen

26.4 Invert Display

Selecting this option inverts the light text on a dark background to dark text in a light background. This option requires a restart of the MultiSmart unit.

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 a restart of the controller. This process takes one or two minutes to complete.

NOTE: *Accumulators and counters are saved every half an hour. So to ensure that these values are saved, use this menu option to restart the MultiSmart.*

The MultiSmart can also be restarted via a "tag" – which allows remote restart, or via ISaGRAF or the logic engine.

28 Site Keys and Enabling New Modules

The Site Key is entered before the MultiSmart leaves the factory. It enables those software modules that have been purchased with the unit. A new Site Key is only required if one or more modules have been purchased from MultiTrode, for example:

- VFD functionality
- More than 3-pump control (additional hardware may be required)
- DNP3 RTU (Master & Slave)
- Security Key
- Well Mixer Control
- PumpView Protocol
- Logic Engine for customized logic
- ISaGRAF 5 - IEC 61131-3 PLC programming

28.1 Software Modules Available

To view what software modules are enabled and the optional modules, navigate to:

Settings → More → More → Software Modules → Enable/Disable Modules

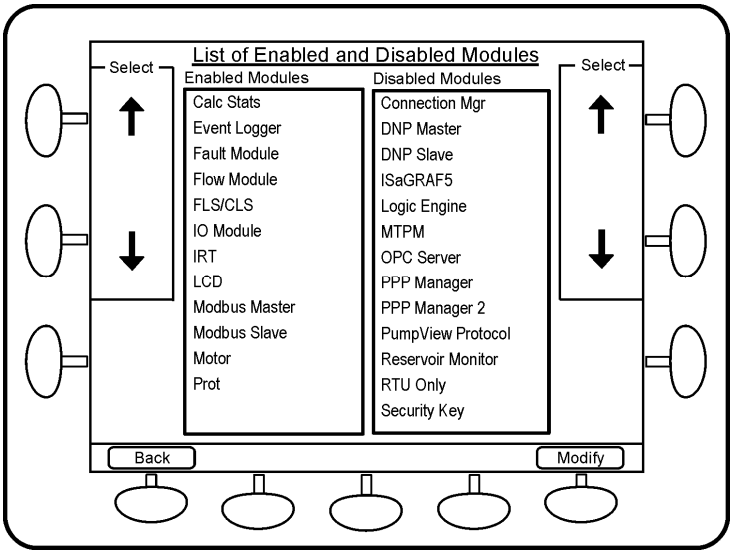


Figure 162 – Enabled & Disabled Software Modules

28.2 Enabling Software Modules with a New Site Key

A new Site Key can be obtained from MultiTrode to enabled one or more software modules that are currently disabled. The Site Key is entered via the keypad in a similar way to using a mobile phone, e.g. pressing the number 3, steps the character displayed through 3,d,e and f. (The Site Code is unique to each MultiSmart and can not be changed).

Navigate to:

Settings → More → More → Software Modules → Enable/Disable Modules → Modify

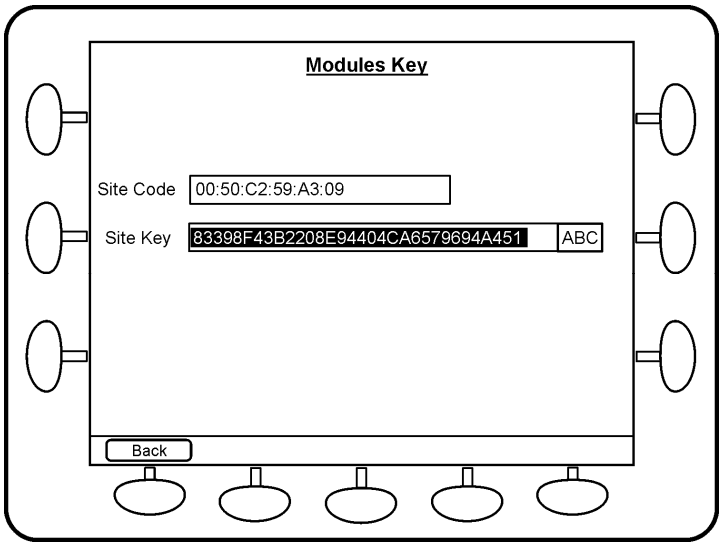


Figure 163 - Enabling Software Modules

NOTE: *The Site Key is based on the serial number of the unit so a different Site Key is required for a each MultiSmart.*

29 Upgrading MultiSmart Firmware

29.1 Upgrading via PC Configuration Utility

To upgrade the firmware insert the compact flash card into the MultiSmart unit and restart (see Section 27). It is recommended to save your current configuration prior to commencing a firmware upgrade

The MultiSmart displays a firmware update prompt with the version information of the current version and the update image present on the CF card. If neither option is selected after a predefined time period, the MultiSmart resumes normal operation without performing a firmware upgrade.

The unit uses the file of upgrade image to upgrade to the latest version of firmware. The existing configuration is preserved. After the new firmware is installed, the MultiSmart automatically upgrades 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 interrogates every tag in the existing configuration and checks for any new tags in the firmware. Any new tags found are set to the default status.

NOTE:
During the upgrade process, the MultiSmart does not control the pumps so a backup method of level monitoring and pump control may be required.

30 Backing Up & Restoring Configuration Settings

The MultiSmart automatically stores a copy of the previous settings anytime a change is made. It is also possible to backup the current configuration to internal memory or to a compact flash card. Thus there are three options when restoring the configuration settings:

- Restore the previous settings
- Restore from the internal backup file
- Restore from a CF card

If 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

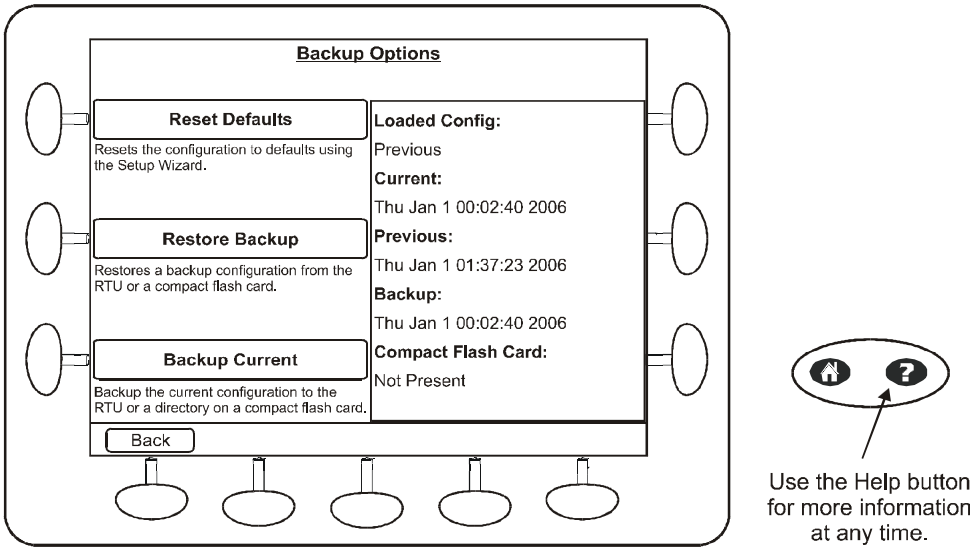


Figure 164 – Configuration Backup Options

30.1 Resetting Defaults

Pressing the **Reset Defaults** button displays the Setup Wizard as described in Section 9.

30.2 Restore a Backup

Navigate to: Settings → More → More → Backup Options → Configurations → Restore Backup

This allows an existing configuration to be loaded into the MultiSmart. There are three possibilities; restore the previous configuration (automatically saved to internal memory), restore a (manually saved) backup version (stored in internal memory) or restore from a Compact Flash card.

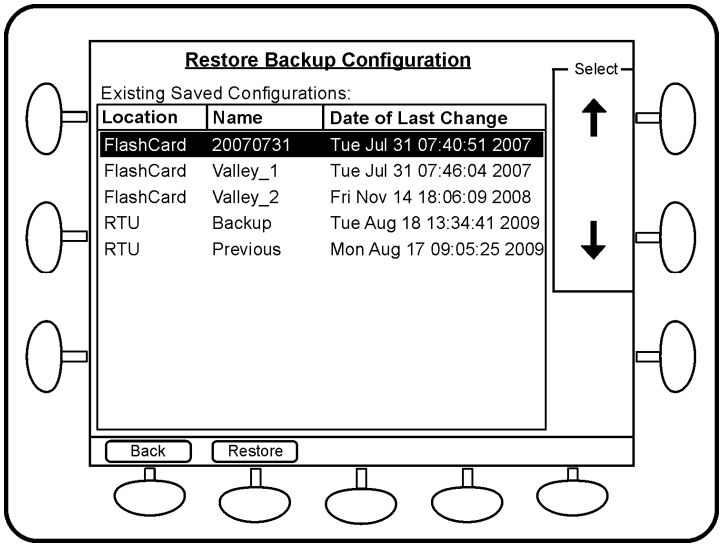


Figure 165 – Restoring Saved Configurations

30.2.1 Restore from Previous Configuration

Restores the previous automatically saved configuration. The configuration is automatically saved every time prior to a change taking effect. To restore the previous configuration, select **RTU Previous** and then press **Restore**, a confirmation message is then displayed.

NOTE: *In the event that the current configuration becomes corrupt, (displayed as an Application Failure), the MultiSmart loads the Previous Configuration and if this too fails, the Backup configuration is loaded.*

30.2.2 Restore from Backup Configuration

This restores the last backup of the configuration that was saved by the user to internal memory. To restore the backup configuration, select **RTU Backup** and then press **Restore**, a confirmation message is then displayed.

30.2.3 Restore from External Memory (CF Card)

A configuration can be restored from a Compact Flash card. To restore a saved configuration, insert the CF card, select the desired configuration from the list and then press **Restore**, a confirmation message is then displayed.

30.3 Back Up Current Configuration

Navigate to: Settings → More → More → Backup Options → Configurations → Backup Current

A backup of the configuration can be saved to internal memory or a compact flash card.

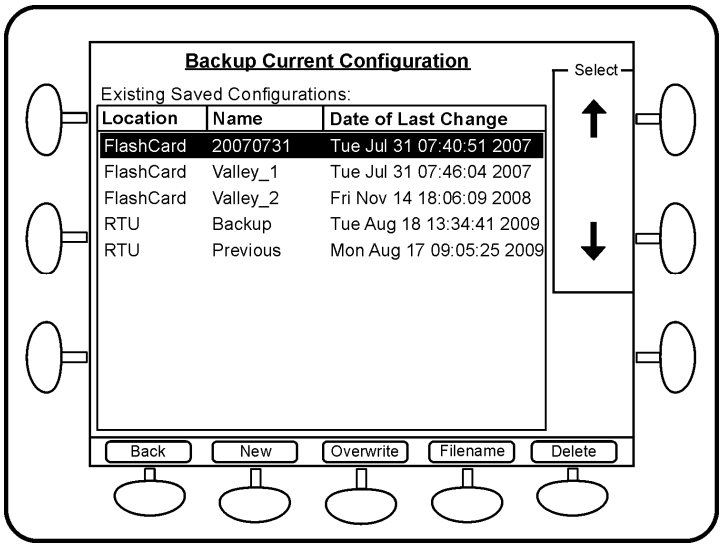


Figure 166 – Backing up a current configuration

30.3.1 Save to External Memory (CF Card)

A backup of the configuration can be saved to a Compact Flash card. Either a new backup file can be created or an existing one over-written. To create a new backup,

- Press **New** – the default filename is the current date (in the format YYYYMMDD).
- Modify the filename if necessary using the keypad – the filename can be up 8 characters long.
- Press **Save**

A flashcard can store multiple backups. (A configuration requires about 1.5 to 3 MB).

30.3.2 Save to Backup Configuration

If no CF card is present the configuration can be saved to internal memory.

- Select the file **Backup** (stored on the "RTU")
- Press **Overwrite** and answer **Yes.**

The **Backup** filename can not be renamed or new filename added to internal memory.

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 a large variety of complex applications. Navigate to:

Settings → Advanced

A Windows Explorer style screen is displayed which shows all of the main functional modules inside the MultiSmart.

Pressing the [+/-] key by any of the modules expands out the options available for that module.

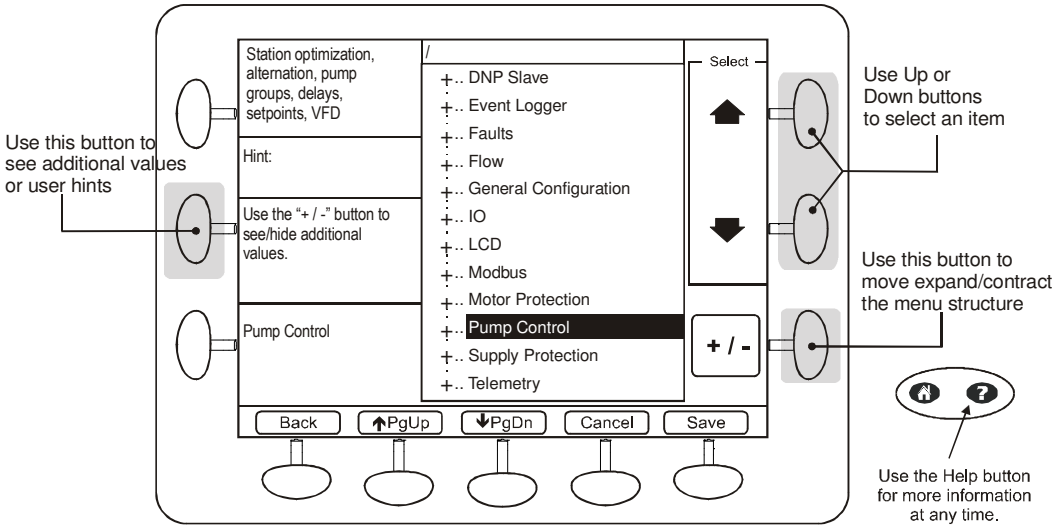


Figure 167 - Advanced Screens

NOTE:
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 Less Options

There are two modes within the Advanced screens. As of v2.3.3 the default mode shows all parameters. The option (previously the default) is to hide some of the more complex / less-used features.

To hide these less-used parameters and features, navigate to:

Settings → Advanced

- From the list of modules select: **LCD** [+/-]
- Highlight **Show More Options?**
- Press the **Show More Option?** button (bottom left corner) to uncheck the box
- Press **Save**
- Exit to the main settings screen via the **Back** button
- Again press **Advanced**

The reduced list of parameters are now displayed whenever the [+/-] is pressed.

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 as described below.

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 maybe the cause:

- 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. It's possible to go back through the **Setup Wizard** at any time to generate a completely new configuration, however it is easier to 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 DINs 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 need to be assigned. For example, when the probe is selected as the level device, by default, DIN 2-11 are configured for the 10 sensors. If the probe has been wired differently, either rewire the probe to the default connections or edit the sensor configuration (using the **Level Devices** screen - see Section 14.8). It is also possible to go back through the **Setup Wizard** however this will create a completely new configuration.

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 fault indicates that a conflict exist with the current configuration due to either the enabled modules or with specified bottom board or some other conflict.

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"

A conflict with either one or more of the enabled modules or with the specified bottom board (during the running of the Setup Wizard). The list of enabled and disabled software modules in the MultiSmart can be viewed in Fail Safe Mode. Follow the same steps as outline in the previous section.

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:

Settings → Advanced → PPP 2 Manager → Connecting Procedures

and select the type of modem in use, then select Debug

Restart the MultiSmart so that the debug information about the chat script initialisation can be captured.

Remember to turn debugging mode off after the fault finding.

32.6 My unit keeps restarting

To stop the restarting - 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 168. You should now be able to follow the solution in Section 32.3.

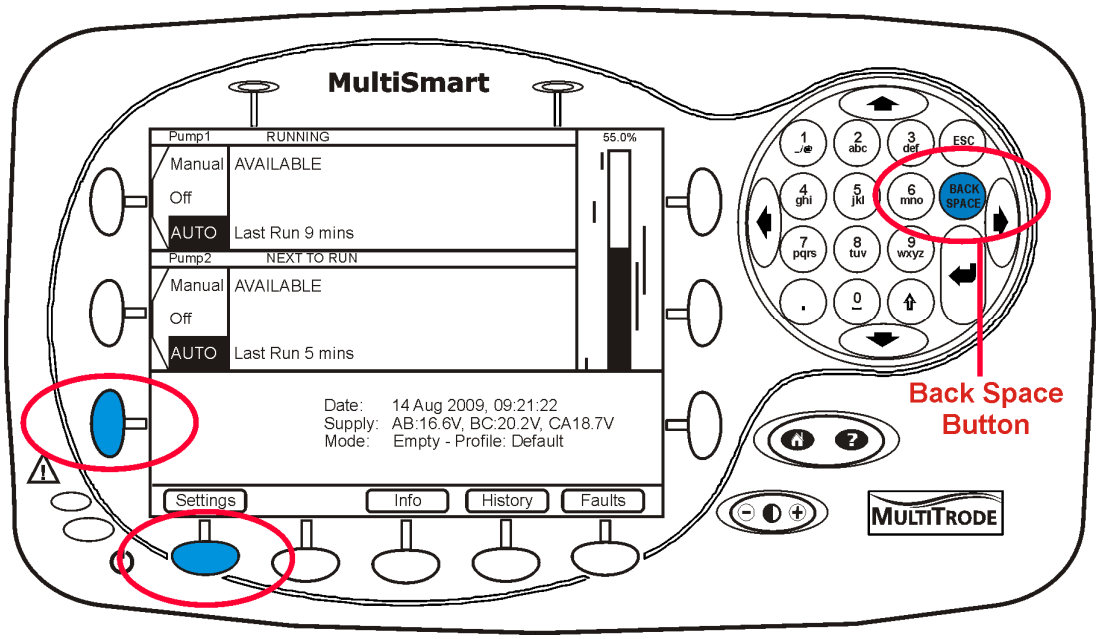


Figure 168 – Forced Failsafe Mode

33 Appendix A – Fault Message Glossary

Listed below are the predefined faults that may appear on the MultiSmart.

The faults shown 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	14.11
Config changed – reboot required	The current configuration has changed and it will come into effect after a reboot	-	On	-
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
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	-
IO Unit 1 DSP Failed Init	A failure of the comms between the DSP board and the 3PC board initiated a reboot	-	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
DuoProbe / Probe Faults				
Duo-probe 1 Error	If the difference between the level from the pressure sensor & the probe is too great e.g. probe = 40% & press. < 30% **or** probe = 40% & press. >60% then fault displayed	>10,>20	On	-
Duo-probe 1 Low Range Error [1]	All pumps are held out if the pressure transducer level is above the low range limit and the probe is reading 0%. The pressure transducer is still used as the level source.	12%	On	-
Probe 1 Failed Sensor n	Where 'n' is the sensor that has failed to activate. (Not applicable to highest sensor,"1")	-	On	14.8.4
Probe 1 Fail Safe Error	The Fail Safe loop in the probe has become open circuit (i.e. >4k ohms)	-	Off	7.3.2.2, 14.8
Pump – Standard Faults				
Pump 1 CB Off/Trip [2]	Circuit Breaker has tripped	-	On	-
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	14.9.1
Pump 1 Holdout	A user definable fault (It's a 'Hidden' fault so "Fault" does not flash only "Holdout")	-	Off	24.3.1.11
Pump 1 Low Power Factor	The Power Factor has fallen below a specified threshold	0.5	Off	-
Pump 1 Max Starts	Number of pump starts has exceeded the specified maximum within a 1 hour period	0	Off	16

Fault Name	Description	Default Setting	Default Status	Section Reference
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	16.2.3
Pump 1 Pulse Stop	A pump based Pulse Stop has been initiated	-	Off	16.2.3
Pump 1 Seal [2]	Conductive Seal sensor has activated (Sensitivity 40 k Ohms)	-	On	9.2.9
Pump 1 Thermal Overload [2]	In circuit Thermal Overload device has activated	-	On	9.2.9
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)	>4kΩ	Off	7.3.2.1
Displayed as Pump 1 CLS Flygt Seal	CLS (Capacitive Leakage Sensor) Seal fault (water in oil chamber)	<1kΩ	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 [3]	FLS (Flygt Leakage Sensor) Thermal fault (motor over temperature)	>4kΩ	On	7.3.2.1
Displayed as Pump 1 FLS Flygt Seal [3]	FLS (Flygt Leakage Sensor) Seal fault (liquid in the stator housing)	<545Ω	On	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 1 Low Efficiency	Pump efficiency has fallen below a nominal value by a specified amount	85%	Off	10.5
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	10.5
Pump 1 Amps Phase Rotation	The incorrect phase rotation (or phase sequence) is connected	-	Off	10.5
Pump 1 Ground (Earth) Fault	The sum of the phase currents is greater than the specified maximum	25% FLC	Off	10.5
Pump 1 Inhibited [5]	Activated via SCADA - Pump 1 become unavailable ('Inhibit' flashes on display)	-	On	-
Pump 1 Insulation Resistance	The insulation resistance measured is less than the specified maximum	1.0 MΩ	Off	17.2
Pump 1 Insulation Res Warning	The insulation resistance measured is greater than the specified warning level	5MΩ	Off	17.2
Pump 1 Over Current	The motor current is greater than the specified maximum	110% FLC	Off	10.5
Pump 1 Over Current I^2T	The I^2T motor current is greater than the specified maximum	3000A^2s	Off	10.5
Pump 1 Under Current	The motor current is less than the specified minimum	1% FLC	Off	10.5
VFD – Variable Frequency Drive (Only applies if the ABB VFD Macro is selected)				
Pump 1 VFD Comms Fail	The MultiSmart is unable to communicate to the VFD	-	On	23.4
Pump 1 VFD Fault	The VFD has returned a fault	-	On	23.4
Pump 1 VFD Warning	The VFD has returned a warning	-	On	23.4
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	16.2.3
Group 1 Pulse Stop	A group based Pulse Stop has been initiated	-	Off	16.2.3
Well Faults				
High Inflow	If level rises > a specified amount within a preset time, lead pump is pulse started	10%, 2min	Off	16
Overflow	The level is greater than the specified Overflow level (Flow module must be enabled)	100%	Off	20.1

Fault Name	Description	Default Setting	Default Status	Section Reference
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	14.8.11
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	14.8.12
Well 1 High High Level	Level has reached the High High level	96.0 - 98.0	Off	12.3.4
Well 1 High Level	Level has reached the High level	87.0 - 92.0	On	12.3.40
Well 1 Low Low Level	Level has reached the Low Low level	4.0 - 6.0	Off	12.3.4
Well 1 Low Level	Level has reached the Low level	10.0 - 15.0	Off	12.3.4
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
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%, 5s	On	14.8.9.1
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%, 5s	On	14.8.9.2
Well 1 Pulse Start	A well based Pulse Start has been initiated	-	Off	16.2.3
Well 1 Pulse Stop	A well based Pulse Stop has been initiated	-	Off	16.2.3
Station Faults				
Max Off Time [4]	Off time of any pump is greater than the specified maximum	6h	Off	16
Max Run Time [4]	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 Inhibited [5]	Activated via SCADA - all pumps in station become unavailable ('Inhibit' flashes)	-	On	-
Station Pulse Start	A station based Pulse Start has been initiated	-	Off	16.2.3
Station Pulse Stop	A station based Pulse Stop has been initiated	-	Off	16.2.3
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	20.5
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	20.5
IO Unit – Analog Inputs				
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	5.4.3.4
Generator Fault	Generator is faulty	-	Off	5.4.3.4
Rain Gauge Fault	A predefined fault for a rain gauge	-	Off	-

NOTES:

1. The Low Range Limit is found under: Advanced / IOModule / Unit / Unit 01 / Probe / Probe01 / Duo Probe / Low Range Limit.

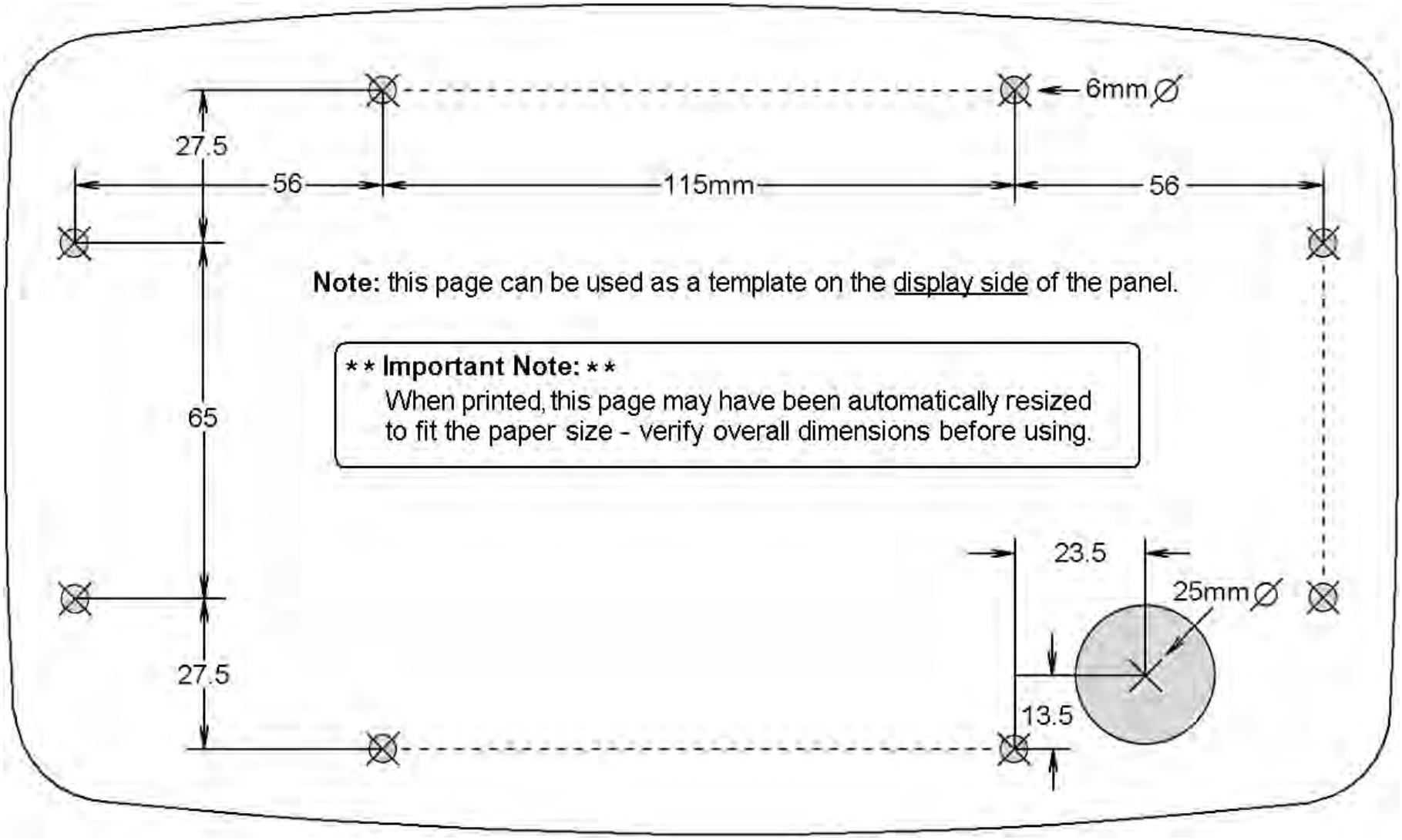
2. These are the default inputs only when Thermal/Seal inputs are selected as part of the Setup Wizard.

3. These are the default inputs only when Flygt FLS inputs are selected as part of the Setup Wizard.

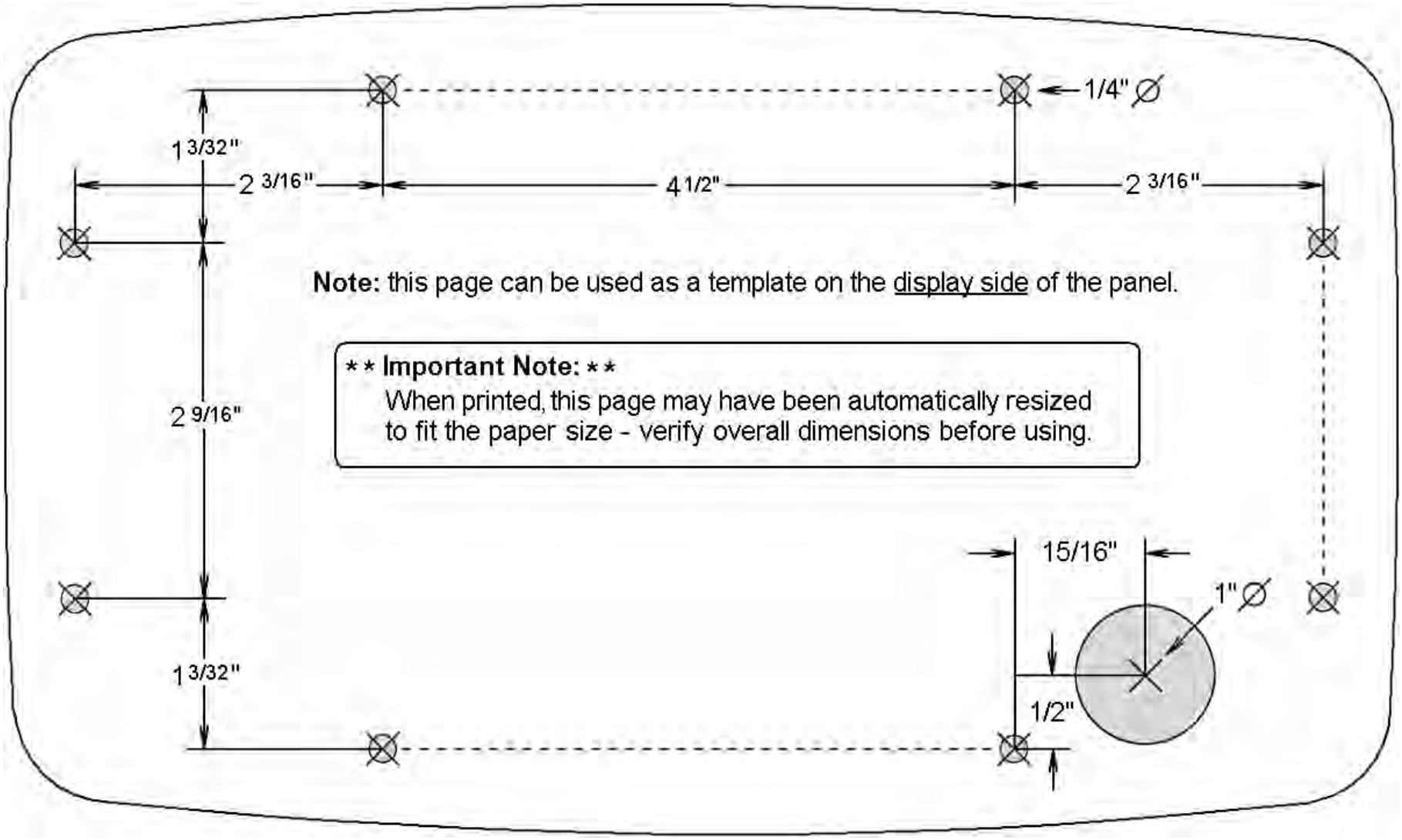
4. These faults are specific to each profile.

5. The Inhibit faults (Station & Pump) can be overridden by a digital input (if configured) (e.g. Station Inhibit Override or Pump x Inhibit))

34 Appendix B – Display Mounting Template – Metric Units



35 Appendix C – Display Mounting Template – US / Imperial Units



36 Technical Specifications

36.1 Processor Unit

Type	Intel PXA255
Speed	200MHz
Flash Memory	32MByte
RAM	128MByte (from April 2010) (64MByte previously)
Real-time Clock	Yes
Serial Ports	RS232 x 3 (115kbit/s)
Ethernet Port	10Mbit/s
Compact Flash Port (CF)	Yes

36.2 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)

36.3 Firmware/Application Upgrade Capability

Local	Via serial or Ethernet from PC Via Compact Flash

36.4 I/O Standard Modules

Digital Inputs (DIN)	20
Digital Outputs (DOUT)	7
Analog Inputs (AIN)	2
Analog Outputs (AOUT)	1
Voltage Inputs (VIN)	3

36.5 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

36.6 Power (per unit)

Start Up	30W
Continuous	15W

36.7 Power Supply & Environmental

DC Supply (monitored to 5% accuracy)	11 – 25V	
Ambient Temperature	-10℃ to +60℃	
Storage Temperature	-40℃ to +90℃	
Humidity	5% to 95% (non-condensing)	
IP Rating	Controller: IP20	(Nema 1 equivalent)
	Display (Faceplate): IP65	(Nema 4 equivalent)

36.8 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 D$1^{5/8}$ (in)

37 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 in the training and support section.

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