Installation &
Operation Manual
MT3PC and MT3SPC

MultiTrode Triplex Pump Controller &

Triplex SCADA Pump Controller

MultiTrode Pty Ltd—Head Office
Brisbane Technology Park
18 Brandl Street
PO Box 4633
Eight Mile Plains QLD 4113, Australia
Ph: +61 7 3340 7000
Fx: +61 7 3340 7077
E-mail: sales@multitrode.com.au

MultiTrode Inc—USA
990 South Rogers Circle, Suite 3
Boca Raton, FL 33487, USA
Ph: +1 561 994 8090
Fx: +1 561 994 6282

E-mail: sales@multitrode.net

Visit http://www.multitrode.com/ for the latest information

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MultiTrode Pty. Ltd
Head Office & Factory
Brisbane Australia

Brisbane Technology Park
18 Brandl Street
Eight Mile Plains, Qld 4113

PO Box 4633 Eight Mile Plains Qld 4113

E-mail: sales@multitrode.com.au

Tel: +61 7 3340 7000
Fax: +61 7 3340 7077

MultiTrode Inc. – USA
Distribution and product support office

990 South Rogers Circle, Suite 3
Boca Raton Florida 33487

E-mail: sales@multitrode.net

Tel: +1 561 994 8090
Fax: +1 561 994 6282

This Manual is the support documentation for the installation, commissioning, and operation of the MultiTrode MT3PC and MT3SPC.

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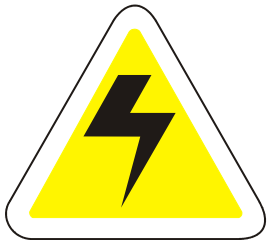
Comprehensive Release MT3PC

23 June 2003

Warning and Cautions

WARNING: THE MT3PC'S INSTALLATION AND WIRING MUST BE PERFORMED BY QUALIFIED PERSONNEL.

THE MT3PC HAS NO USER SERVICEABLE PARTS. TO REDUCE THE RISK OF ELECTRIC SHOCK, LEAVE ALL SERVICING TO QUALIFIED MULTITRODE TECHNICAL STAFF.



Documentation Standards

WARNING: THIS IS A WARNING NOTICE AND IS USED WHERE NON-COMPLIANCE COULD RESULT IN INJURY OR DEATH.

AS AN EXAMPLE, NOTE THE WARNINGS AT THE HEAD OF THIS PAGE.

CAUTION: THIS IS A CAUTION NOTICE AND IS USED WHERE NON-COMPLIANCE COULD RESULT IN INCORRECT OPERATION, DAMAGE TO OR FAILURE OF THE EQUIPMENT.

Note: This is a general information notice. This is used to highlight an issue or special case within the body of the manual.

This symbol marks a useful tip or particularly interesting feature of the product.

Glossary of Terms and Abbreviations

%r	The symbol *%r* denotes a measurement as a percentage of range. For example 25%r, if a pump has a range 1000–1400 rpm, 25%r equates to1100rpm.
AIN	Analog Input
AOUT	Analog Output
CDS	MultiTrode's Control and Diagnostic Software
CMF	Central Monitoring Facility for SCADA systems.
DIN	Digital Input DIN also refers to an industry standard switchboard component mounting system, as in DIN Rail, DIN mounting clips and so on.
DNP3	Industry standard industrial communications protocol
DOT	Digital Output
EDS	Electronic Dip Switch. Software switches, or configurable parameters, used to configure items such as delays and levels. See Chapter 7. There are three types of EDS: On/Off, Numerical Value and Settings types. Refer to section 7.1 for details.
LAN	Local Area Network.
MiniCAS	Relay to drive the combined thermal sensor and conductivity sensor, © Flygt Pumps.
Modbus	Industry standard industrial communications protocol
MTxPC	Any of the controllers in the MT2PC and MT3PC family, including the MT2PC, MT2SPC, MT2PCVFD, MT2SPCVFD, MT3PC, MT3SPC, MT3PCVFD and MT3SPCVFD.
N/C	Normally Closed.
N/O	Normally Open.
Outpost	MultiTrode's SCADA software package
PC	Personal Computer
PLC	Programmable Logic Controller
Probe	A Conductive Liquid Level Detection Device with multiple sensing points. MultiTrode manufactures a range of such 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 Adjustable sensitivity to liquid to prevent false readings.
RTU	Remote Telemetry Unit
SCADA	Supervisory Control And Data Acquisition – A software package and communications system to monitor and control remote systems, such as MultiTrode Outpost.
VFD	Variable Frequency Drive.
Zero and Span	Zero refers to the pressure measurement in an analog sensor where the water level is said to be at zero. The span is the measurement at which it is said to be full. See section 9.2 for a complete explanation.

Table of Contents

Part 1

Operator's Manual

Chapter 1 Introduction

The MultiTrode Pump Controller is an advanced microprocessor based pump controller designed to control two pumps (MT2PC) or three pumps (MT3PC). The pump controller is specifically designed for use in water and sewer pumping stations. It combines automatic level control, level indication, pump alternation, pump protection logic, and level alarms with an intuitive operator interface.

More than 50 preset essential and useful pump management functions are incorporated to safeguard and protect equipment, as well as reducing or eliminating common problems such as water hammer, excessive starts, station odors and fat build-up problems.

At a glance, an operator can determine the pump station status, with easy resetting of faults and alarms. The interface also allows changing setpoints and configuring the pump management functions simply and easily through the faceplate.

The panel wiring is greatly simplified, as components such as timers, and relays for thermistor fault, seal fault and alternation are no longer needed. This increases reliability and reduces cost. For example, with Flygt pumps, the thermal and seal fault can be directly wired into the MTxPC, saving over $500 on the miniCAS relay.

Level inputs can come from pressure transducers, ultrasonic, the patented MultiTrode probe or from ball floats. Redundancy options are built in ready for use after being properly configured.

The pump controller has 240v/110v options, both with backup 10-30v dc for battery backup in the event of mains failure.

1.1.1. Increasing functionality with variations on the basic MTxPC

Up to 9 pumps can be controlled in a variety of modes – grouping of pumps, multi-well mode, mimic mode – by networking pump controllers together.

The pump controller also has a couple of optional versions

- VFD control – for simplifying control of duty/standby pumps (MTxPC-VFD)
- SCADA – the pump controller with a built-in RTU (MTxSPC)

The pump controller also interfaces directly to the MultiTrode MonitorPro - an innovative station supervisor that protects motors, automatically carries out insulation resistance testing, measures flow without a flow meter, and has an in-built datalogger and RTU.

1.1.2. Rapid installation, commissioning and fault finding

The pump controller is DIN rail mounted with plug in terminal blocks. The unit ships with default settings that cater for 90% of sewer (discharge mode) applications. Switching to water (charge mode) is a 30 second task.

Fault finding is much simpler than either relay/timer based panels or PLC panels. Relay based panels tend to have out of date wiring diagrams and non-standard components, with each panel in a network being different from the last. PLC panels have frequent software issues, and a significant overhead of software maintenance.

A panel based on the MultiTrode pump controller is simple, and with more than 5,000 units in the field, software issues are rare, allowing MultiTrode personnel or distributors to rapidly identify any actual problem.

1.1.3. Easy interfacing

The product comes with a number of configurable outputs which can be "connected" to over 60 internally derived sources. For example, outputs can be set to close (or open) when specific faults occur on specific pumps, when level alarms occur, when any pump faults, when 2 pump run together, and so on. This makes interfacing the pump controller to other telemetry systems very straightforward. In addition, the SCADA version of the MTxPC has an optional Modbus/DNP3 translator to allow serial connection from other PLCs or SCADA systems.

1.2. Terminology and conventions

When this manual refers to a button on the controller, the button's name appears in a font resembling the printing on the controller. For example, "Press the SELECT ONE button", or "Press SELECT ONE".

In certain regions, different terminology is used to describe the same functions. For these functions, the manual will refer to the terminology used on the international version of the controllers, followed by the regional alternate in brackets. Where the regional terminology is shown on the faceplate, diagrams of both faceplates will be shown.

For example, the international version uses the terminology "Manual Mode" to describe when a pump is under control of the operator rather than the control system, where the regional version of the controller referes to this state as being in "Hand Mode". This manual will therefore use terminology such as:

> "To place the controller into Manual (Hand) mode, press the SELECT ONE or SELECT TWO button once."

Chapter 2 Pump Controller Operation

2.1. Overview

The pump controller is primarily programmed and operated through the front panel.

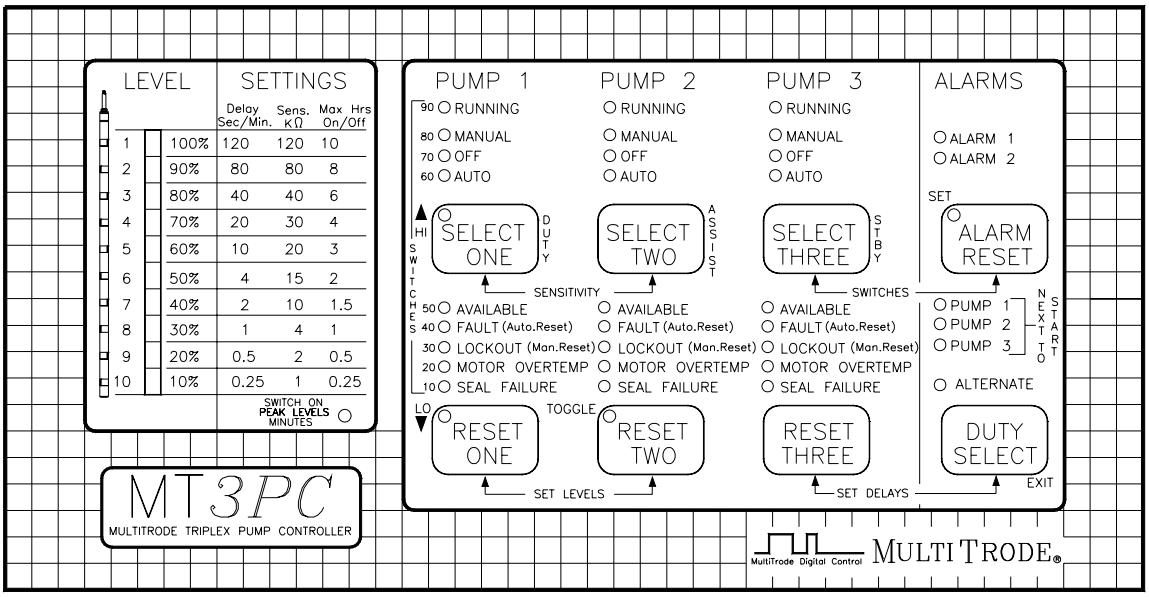


Figure 1: The International MT3PC Front Panel

The following sections describe the front panel and the terminology used.

2.1.1. Indicators

LED indicators are used to display liquid level, current status' of each pump, and other information when programming the device. MultiTrode documentation refers to these indicators as

- On
- Off
- Flashing slowly (1Hz, i.e. on for ½ second then off for ½ second)
- Flashing quickly (2Hz, i.e. on for ¼ second then off for ¼ second)
- Strobing (On for ¾ second then off for ¼ second)

2.1.2. Buttons

Buttons are used to turn pumps on and off, reset faults and alarms, program functions and adjust settings. Note that some of these functions may be disabled if the Keypad Lockout input has been asserted. Refer to Section 4.1—Keypad Lockout Feature on page 15 for more information.

2.1.3. Default display

When the controller is showing its default display, the keys have their default functionality and the lights show the current status for the level, pumps, alternation and alarms.

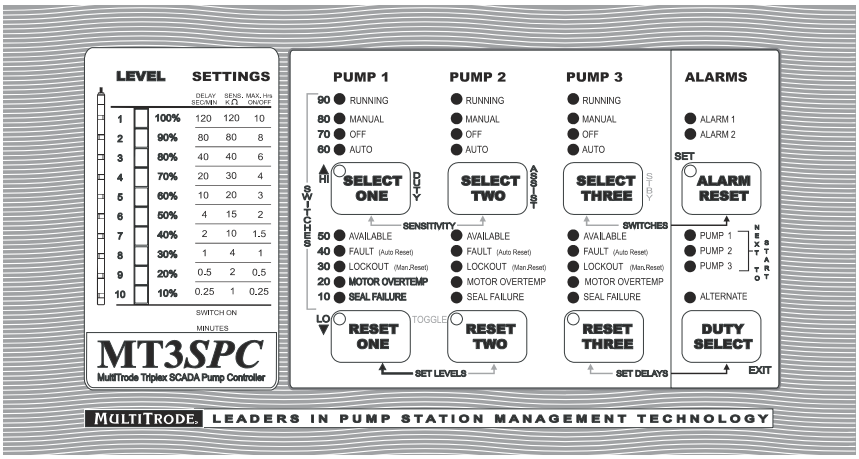


Figure 2: The International MT3SPC Front Panel

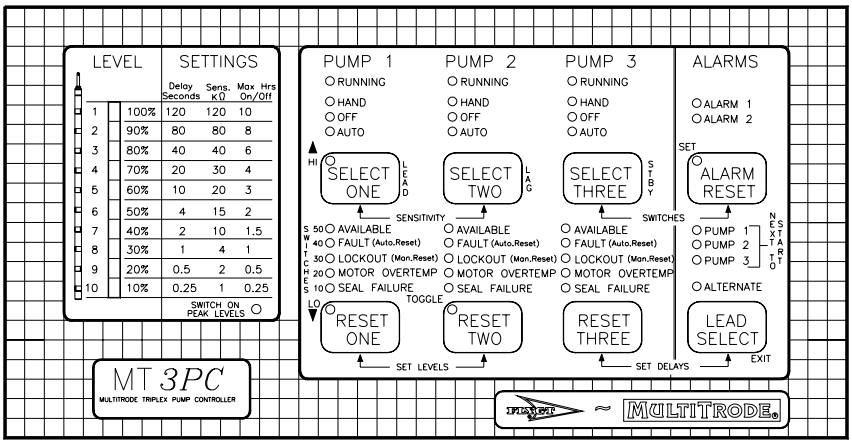


Figure 3: The Regional MT3PC Front Panel

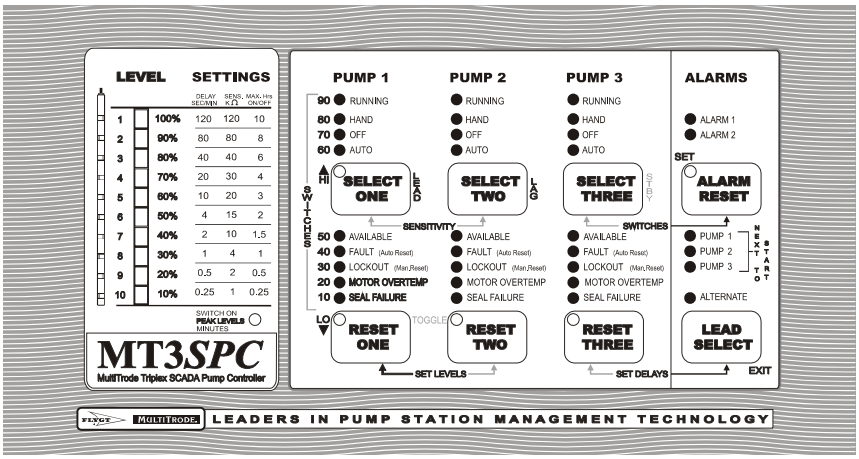


Figure 4: The Regional MT3SPC Front Panel

2.1.4. Bar graph

The Bar Graph on the left of the front panel has two basic functions. The primary function is to indicate the present level of the liquid. The secondary function is for parameter value indication during programming of the controller.

2.1.4.1. Level Indication

The percentages to the right of the bar graph indicate the level of the pit or reservoir in 10% steps. If a particular indicator is flashing slowly (1 Hz) this indicates that the controller has detected a fault with that sensor. Although the controller will continue to function it is recommended that the fault be cleared.

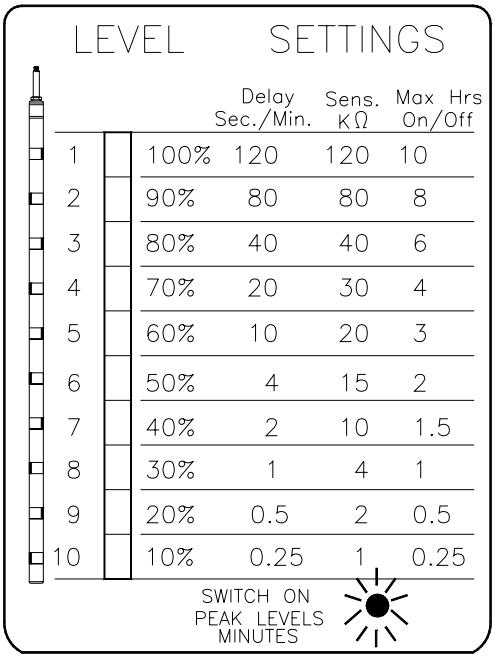


Figure 5: The Bar Graph

During normal operation the peak levels indicator, at the bottom right corner of the Settings block, indicates that the controller is using Peak Levels. For more information on peak levels see section 8.1.1.

2.1.5. Select One, Select Two, and Select Three Buttons

A select mode button is provided for each pump and is used to cycle a pump through the selections of Auto, Off and Manual (Hand). Only the MT3PC has a 'Select Three' button.

2.1.6. RESET ONE, TWO and THREE Buttons

Use these buttons to reset unacknowledged pump faults. Only the MT3PC has a RESET THREE button. Note that a fault cannot be reset if the fault condition is still present.

2.1.7. ALARM 1 and ALARM 2 Indicators

These indicate that an abnormal level condition has been detected.

2.1.8. DUTY SELECT (LEAD SELECT)

The pump controller has pump alternation capability built in to allow you to share the workload between all pumps more evenly, and is easily configured. This pump controller can be put into alternation mode, or you may specify which of the pumps will always be first to start.

The NEXT TO START lights, on the right hand side of the controller, indicate which pump will be the first to run when the next pump cycle is started. If you press the DUTY SELECT (LEAD SELECT) button momentarily, the next pump to start will be cycled through the available pumps. If you hold down the DUTY SELECT (LEAD SELECT) button, the controller will change between alternation modes of alternating the duty (lead) pump, or using a fixed duty (lead) sequence.

If no pump lights are on then all pumps must be either running, decommissioned or unavailable. When the ALTERNATE light is on, the controller is automatically alternating the pump sequence, so that a different pump is first to start each time.

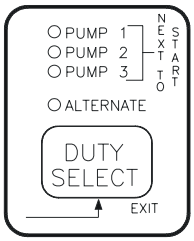


Figure 6: International Next To Start Selector

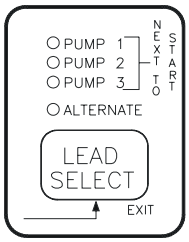


Figure 7: Regional Next To Start Selector

2.2. Pump Operation

The buttons on the front panel allow you to control pumps manually, reset alarms, monitor the pump status and program the controller.

2.2.1. MANUAL (HAND)–Off–Auto

Each pump at an installation can be set to run in Auto, Off, Manual (Hand) and Semi-Automatic mode. Cycle through Auto, Off, and Manual (Hand) by using the select key for that pump.

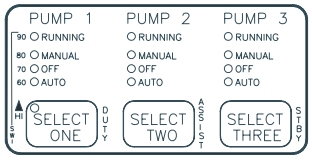
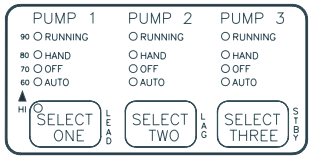


Figure 8: International Pump Selectors



F igure 9: Regional Pump Selectors

2.2.1.1. MANUAL (HAND) Operation

To place a pump into MANUAL (HAND) mode, select MANUAL (HAND) using its SELECT button. In MANUAL (HAND) mode it is necessary to hold the SELECT button continuously once MANUAL (HAND) has been selected. This allows the pump to run outside of its operating range. When you release the SELECT button the pump will either:

- change to Semi-Automatic mode (if the level is within its operating range), or
- change to Automatic mode (if the level is outside its operating range)

EXAMPLE: In Discharge mode the level is above the pump deactivation level but has not yet reached the activation level. Select MANUAL (HAND) using the pump's SELECT button, ensuring that when MANUAL (HAND) is selected you hold the button depressed. The pump will continue to run regardless of level, provided the SELECT button remains depressed. When you release the SELECT button the pump will either:

- continue to run in Semi-Automatic Mode (if the level is above its deactivation level) or
- revert to Automatic Mode and switch the pump OFF (if the level is below its deactivation level)

CAUTION: THE PUMPS WILL RUN AS LONG AS THE MANUAL (HAND) BUTTON IS HELD DOWN. THEREFORE, IT IS POSSIBLE TO RUN THE PUMPS WITH NO LIQUID IN THE WELL, THEREBY RUNNING THE PUMPS DRY AND DAMAGING THEM.

2.2.1.2. Semi Automatic Operation

To put pumps into Semi-Automatic mode, press the respective SELECT button for each pump until the respective status lights show MANUAL (HAND). In Semi-Automatic mode it is not necessary to hold the SELECT button continuously. Semi automatic operation allows you to start a pump prior to its activation level, provided the liquid level is above the normal deactivation level. The controller will automatically deactivate the pump at the appropriate deactivation level and return to the automatic mode.

Example: In Discharge mode the level is above the pump deactivation level but has not yet reached the Activation level. **Press and release** the pump's SELECT button twice. The pump's lights will change from AUTO to OFF on the first press, then from OFF to MANUAL (HAND) on the second press, and the pump will run. The pump will continue to run until the level reaches the Deactivation level. At this point the pump will stop and the pump will revert to automatic mode.

2.2.2. Analysing a pump's status

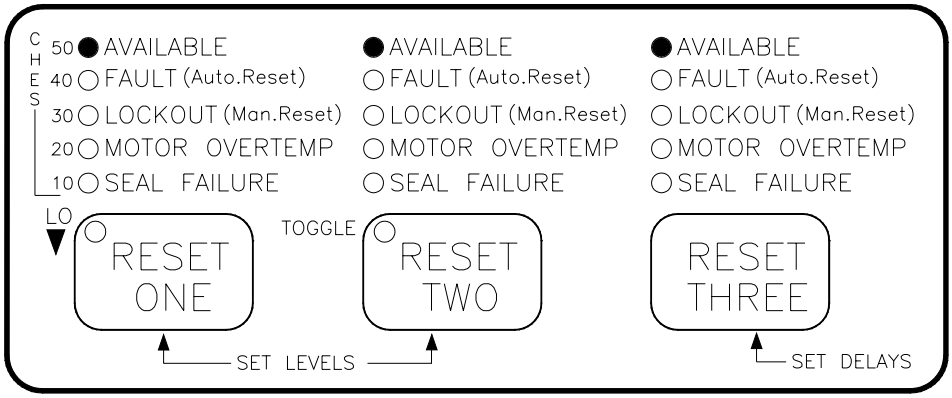


Figure 10: MT3PC Pump Fault indication on the front panel

2.2.2.1. Fault states

A fault may be in one of three states: present, unacknowledged or cleared.

Fault Present: A fault condition exists on one of the inputs.

Fault Unacknowledged: A fault has occurred but no longer exists. There will be an indication on the controller to show this. If the fault was a **critical** fault the pump will remain unavailable until reset by the operator. If the fault was **non-critical** the pump will become available once the fault condition clears.

Fault Cleared: A fault which has occurred is no longer present and has been reset by the operator, or no fault has occurred since the last fault was cleared or the unit was reset.

2.2.2.2. Fault types

The primary types of fault input are critical, non-critical, delay fail, conductive seal, thermistor, Flygt thermal, Flygt seal and delay lockout.

Faults are cleared from their unacknowledged state by pressing the appropriate pump's reset button.

2.2.2.3. Fault indication

All fault lights flash at different rates to indicate their current status, as such:

Flash quickly	= fault is present
flash slowly	= fault is unacknowledged
OFF	= fault is cleared

Note: Delay fail faults produce different indication to other faults. Refer to Table 1—Fault indication Quick Reference.

2.2.2.4. Fault indication quick reference

The table below is a quick reference to determine which fault is being indicated.

Light	Visual Effect	Description
All Fault Lights	Flash Quick	A fault detected by the MonitorPro or fault with SCADA system is present
	Flash Slow	A fault detected by the MonitorPro or SCADA is unacknowledged
	Off	No faults detected by the MonitorPro or SCADA, or any other other fault conditions, exist.
FAULT (Auto Reset)	Flash Quick	Non Critical Fault Present
	Flash Slow	Non Critical Fault Unacknowledged
	On	Delay Fail Fault Present
	Off	No critical or delay fault conditions exist.
LOCKOUT (Man Reset)	Flash Quick	Critical Fault Present
	Flash Slow	Critical Fault Unacknowledged
	On	Max number of delay fails exceeded
	Off	No critical or delay fault lockout conditions exist.
MOTOR OVERTEMP	Flash Quick	Thermal Fault Present (Thermistor or Flygt)
	Flash Slow	Thermal Fault Unacknowledged (Thermistor or Flygt)
	On	The thermistor is indicating an elevated temperature condition after a fault has been present which may be manually reset by the operator.
	Off	No thermistor or Flygt Thermal fault conditions exist.
SEAL FAILURE	Flash Quick	Conductive Seal or Flygt Seal Fault Present
	Flash Slow	Conductive Seal or Flygt Seal Fault Unacknowledged
	Off	No conductive seal or Flygt seal conditions exist.
AUTO	Flash Quick	Individual Pump is being held out on its start to try to suit the desired starts per hour. (See Section 8.3.8)
	Flash Slow	Maximum Station Starts Per Hour has been exceeded. (See Section 8.3.7)
AVAILABLE	Flash Quick	LAN Fault is present
	Flash Slow	Power fail / hold out present
	On	Pump available
	Off	Pump unavailable or decommissioned.
RUNNING	Flash Quick	Pump about to start
	Flash Slow	Pump about to stop
	On	Pump running
	Off	Pump Stopped
All Level Lights	Flash Slow	Analog Sensor Fail or Comms level Fail
Individual Level Light	Flash Slow	Probe input determined to have failed (as another sensor higher in the well is wet and the failed sensor is dry). See section 8.2.

Light	Visual Effect	Description
Alarm Light (see section 6.4)	On	Alarm has been muted
	Off	No alarm condition are present
	Flash Slow	Unacknoweldged Alarm
	Flash Quick	Alarm condition is present
	Strobing	Alarm has been temporarily disabled

Table 1—Fault indication Quick Reference

2.2.2.5. Pump availability

Any of the following items can make a pump unavailable:

- A fault is present on the critical, non-critical ordelay fail inputs
- Maximum consecutive number of delay fails has been exceeded (EDS 16).
- An unacknowledged Critical fault is present
- A seal fault is present and seal is set to critical or non critical
- A seal fault is unacknowledged and seal is set to critical
- A thermistor fault is present and thermal is set to critical or non critical
- A thermistor fault is unacknowledged and thermal is set to critical
- A Flygt thermal fault is present and thermal is set to critical or non critical
- A Flygt thermal fault is unacknowledged and thermal is set to critical
- A hold out condition is present (See section 8.1.2)
- A level input fault is present (a valid level can not be determined)
- The pump is not in a Duty (Lead) group
- There is a MonitorPro or SCADA Fault on a pump
- The consecutive Standby starts before Duty (Lead) lockout have been exceeded
- The pump is decommissioned (See EDSs 35, 36, 37)
- A communications fault is present and the LAN network communications have been set to fail-safe operation in EDS 44
- The LAN has timed out

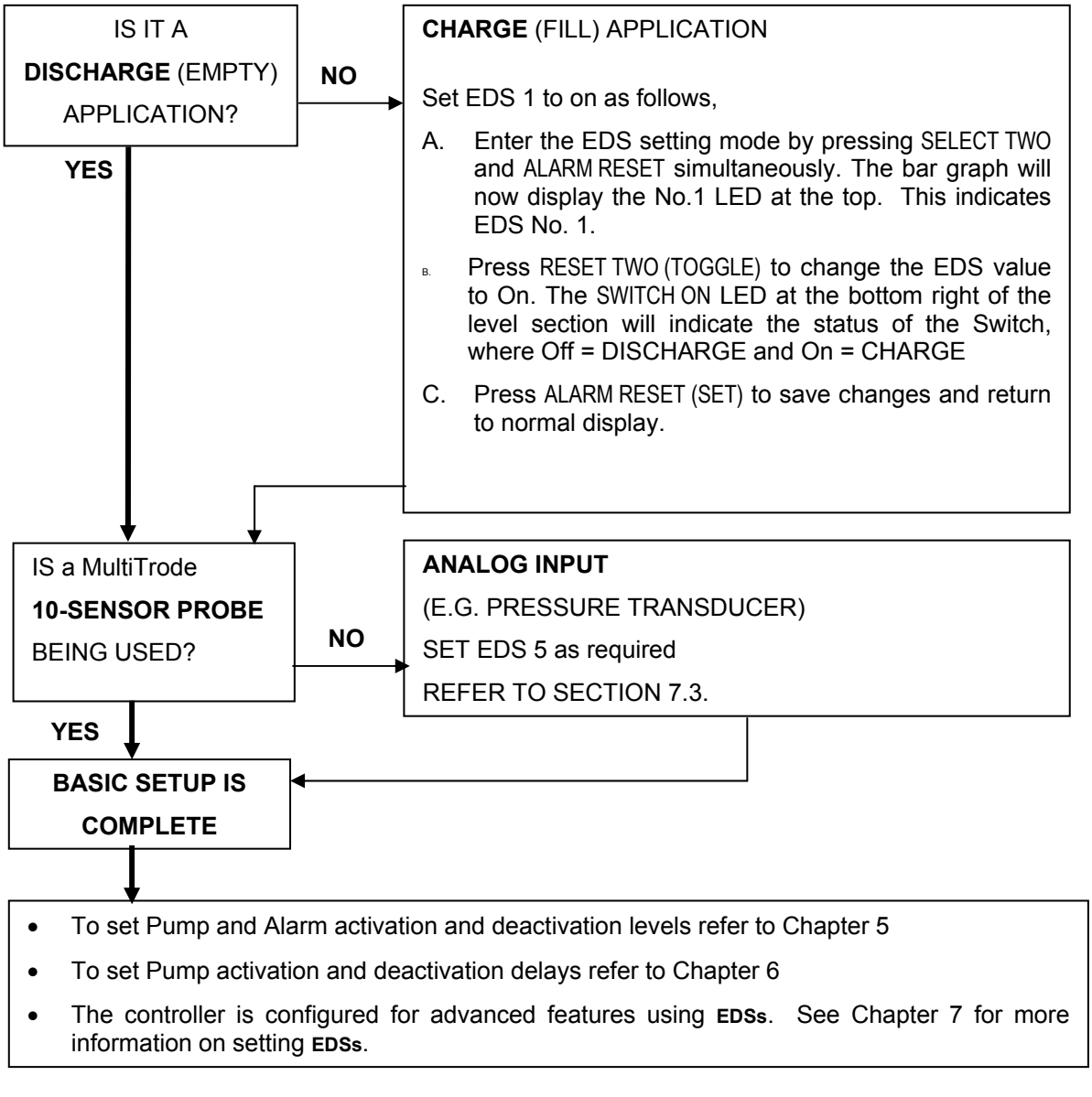
Part 2

Installation & Commissioning Manual

Chapter 3 Quick Commissioning Guide

The pump controller is configured by setting parameters via configurable parameters. For historical reasons these were known to the customer base as Electronic DIP Switches or EDSs, and therefore we have continued to use this term in the current manual. Refer to Chapter 7 for information on EDSs. All settings on the Pump Controller are easily programmed using the buttons on the front panel. In addition to the EDSs, there are also a number of activation and deactivation levels and delays programmed from the front panel.

MultiTrode has pre-programmed the controller with **factory default** settings to suit typical sewerage applications. Little or no adjustment should be necessary in the majority of cases. Prior to installation check the procedure shown in the chart below.



Chapter 4 Key Combinations

The pump controller is programmed by pressing key combinations on the faceplate or from a laptop PC via the CDS software.

To move away from the default display and access the configuration areas of the controller you must use key combinations, often abbreviated to “key combos”. A key combo is a combination of two or three keys to be pressed simultaneously.

The two illustrations below show the combinations, and Table 2 sumarises these. Notice that the combinations are marked on the front panel (SENSITIVITY, SWITCHES, SET LEVELS, SET DELAYS).

> **Note**: These combos only function correctly while the unit is in the normal operating mode.

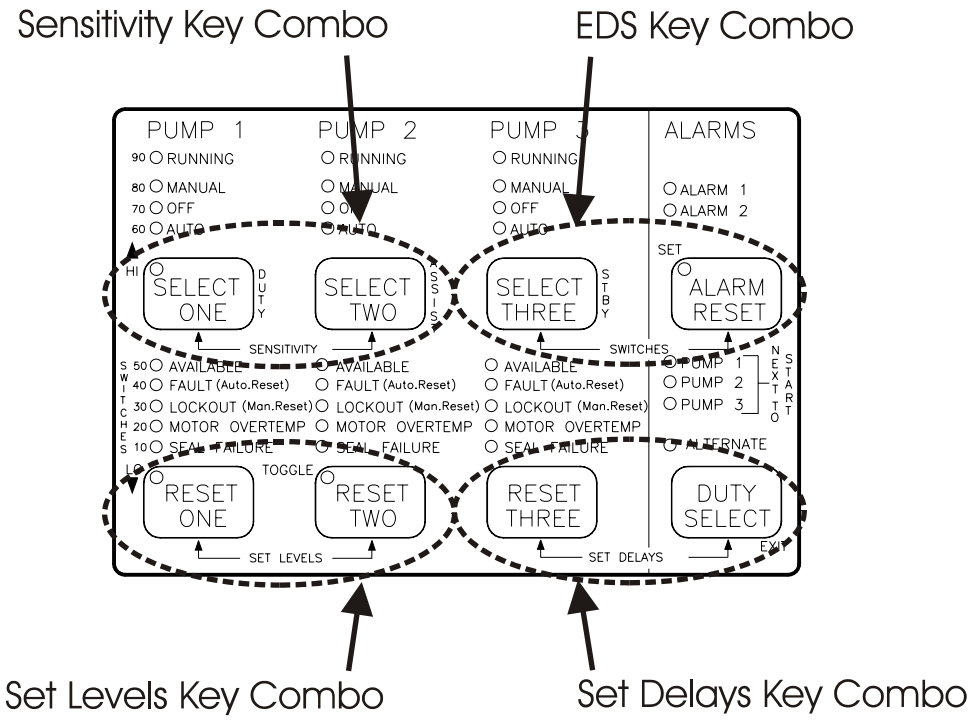


Figure 11: Key Combos to Set Levels, Set Delays, Sensitivity and EDSs

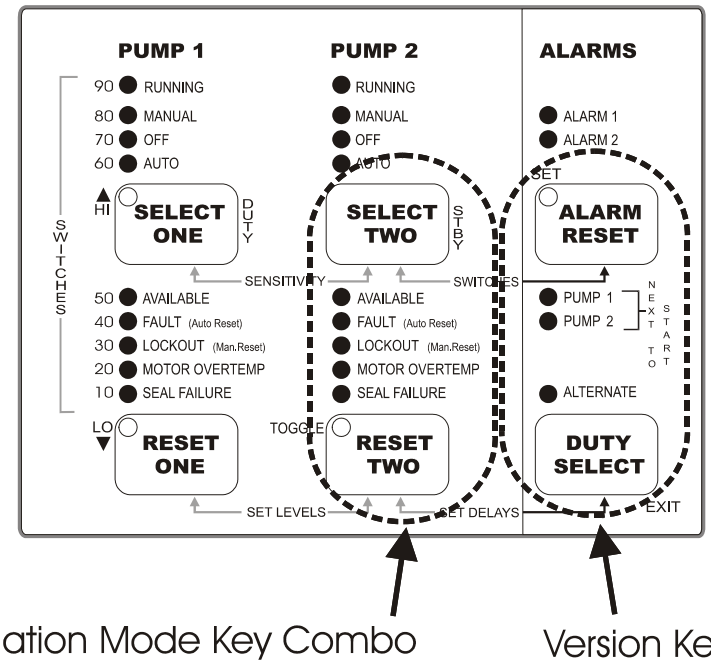


Figure 12: Key Combos to enter commissioning mode (level simulation) and to display version information

The table below shows where you can find more information on the functions you can perform with these key combos:

Key Combo	Keys to press simultaneously	Function	Refer to
EDS Key Combo	SELECT THREE + ALARM RESET	Modifies EDS values	Chapter 7
Set Delays Key Combo	RESET THREE + DUTY SELECT (LEAD SELECT)	Set Pump and Alarm Activation and Deactivation Delays	Chapter 6
Set Levels Key Combos	RESET ONE + RESET TWO	Set Pump and Alarm Activation and Deactivation Levels	Chapter 5
Sensitivity Key Combo	SELECT ONE + SELECT TWO	Changes probe sensitivity or analog calibration	Section 9.1
Simulation Mode Key Combo	SELECT TWO + RESET TWO	Commissioning Mode (Level Simulation)	Section 5.4
Version Key Combo	ALARM RESET + DUTY SELECT (LEAD SELECT)	Displays software version.	Section 11.3

Table 2 – Summary table of key combinations

4.1. Keypad Lockout Feature

Access to certain features can be restricted if a key lock switch has been wired into the controller. Access may be restricted in one of three ways:

1. None—All keys will function as normal.
2. Partial—Only the ‘Select’ and ‘Reset’ keys will work.
3. Full Keylock—No keys will work on the panel.

Section 12.2.4.11 describes how to wire a key lock into the controller.

Chapter 5 Pump Alarm Activation and Deactivation Levels

Use the procedure below to set activation and deactivation levels for each pump connected to the controller.

5.1. Default Level Settings

For most applications the default level settings should be appropriate for correct operation of the installation. These levels are shown in the illustrations below. Note that the controller stores two sets of all parameters: a “Normal” set and a “Peak”set. Refer to section 8.1.1 for a description of Peak Levels.

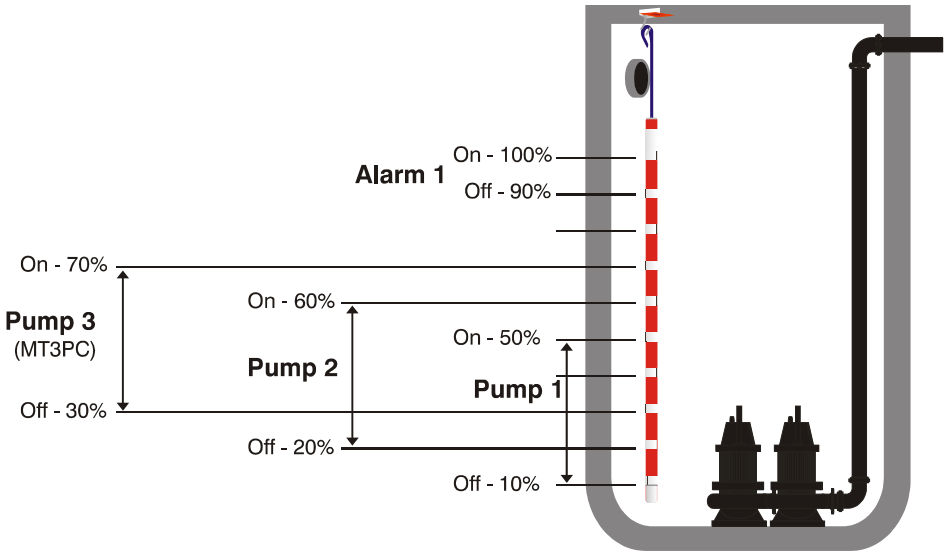


Figure 13: Discharge Mode—Default Normal Levels

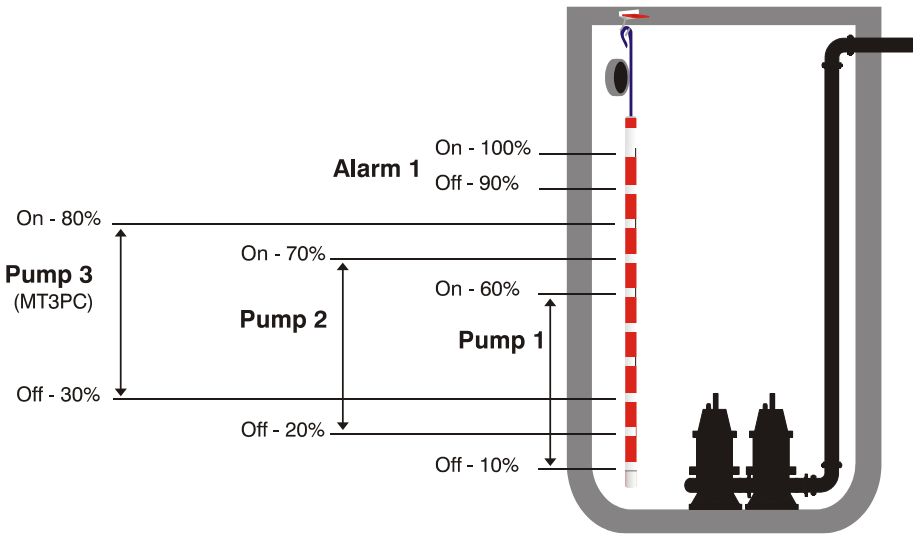


Figure 14: Discharge Mode—Default Peak Levels

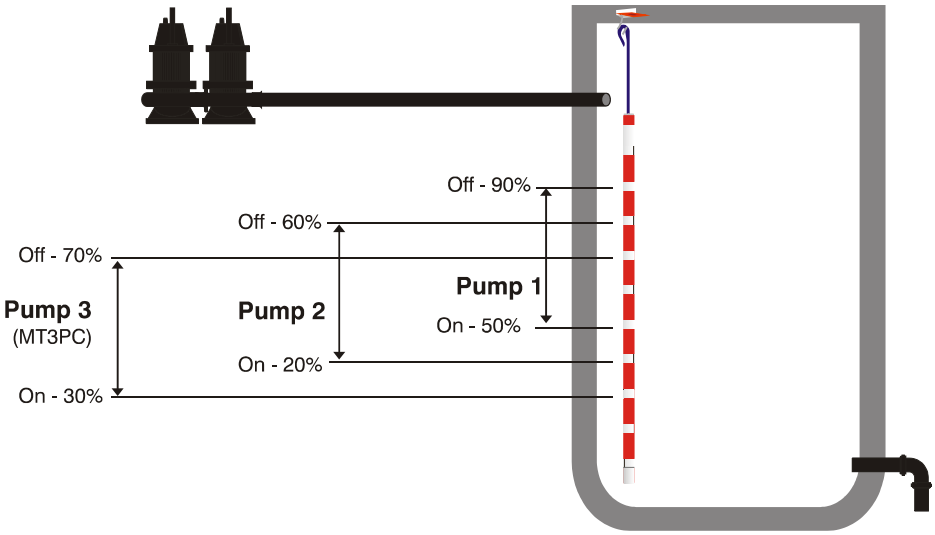


Figure 15: Charge Mode – Default Normal Levels

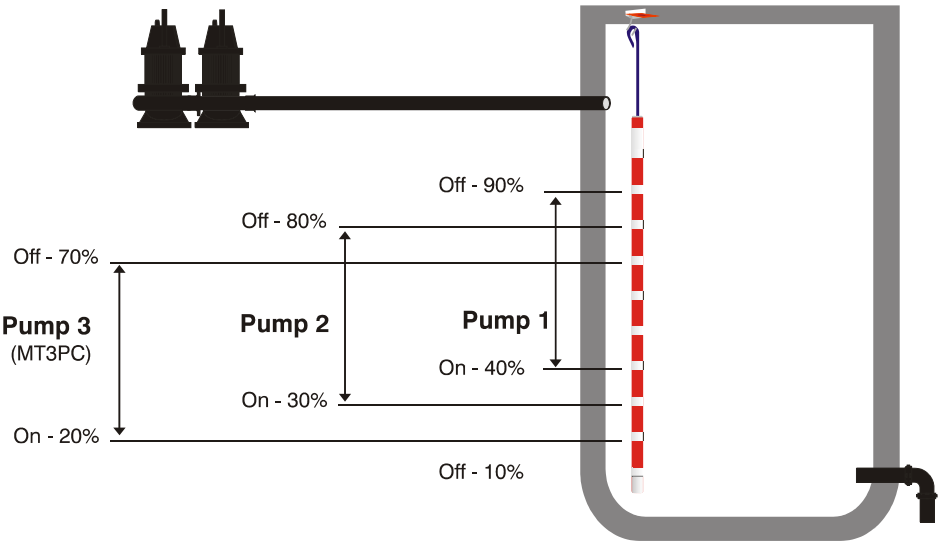


Figure 16: Charge Mode—Default Peak Levels

5.2. Setting Pump and Alarm Levels (Activaton/Deactivation)

5.2.1. Limitations

Note that when setting Activaton and Deactivation levels for pumps, you must observe certain restrictions on the levels. In the case of a system in **discharge mode**, these restrictions are:

- The activation level for the Standby pump cannot be less than the activation level for the Assist (Lag) pump, and the activation level for the Assist (Lag) pump cannot be less than the activation level for the Duty (Lead) pump.
- The deactivation level for the Standby pump cannot be less than the deactivation level for the Assist (Lag) pump, and the deactivation level for the Assist (Lag) pump cannot be less than the deactivation level for the Duty (Lead) pump.

In the case of a system in **charge mode**, these conditions are inverted:

- The activation level for any particular pump cannot be more than the activation level for the pevious pump in the duty (lead) order.
- The deactivation level for any particular pump cannot be more than the deactivation level for the pevious pump in the duty (lead) order.

5.2.2. Use of the Two Alarm Levels

The pump controller provides two independent level alarms. These are usually set up to operate as a high level and a low level alarm but they may be set as two High Level Alarms or two Low Level Alarms. The Level Alarms will operate as High Level Alarms if their activation levels are set higher than the Duty (Lead) Pump Activation level. The Level Alarms will operate as Low level Alarms if their activation levels are set lower than the Duty (Lead) Pump Activation level.

The usage of the alarams is the same for both charge mode and discharge mode.

5.2.3. Setting Levels when Using Probe Input only

Use this procedure to set levels when using probe input only (that is, EDS 5 is set to OFF).

1. Press the ‘Set Levels Key Combo’.

   The pump and alarm lights are now flashing.

2. Press one of the following keys to select which levels to adjust:

   SELECT ONE to adjust Duty (Lead) levels.
   SELECT TWO to adjust Assist (Lag) levels.
   SELECT THREE to adjust Standby levels.
   ALARM RESET to set alarm levels.
   DUTY SELECT (LEAD SELECT) to exit and return to normal operation.

   If you pressed ALARM RESET to set alarm levels, press

   SELECT ONE to set Alarm 1 levels or
   RESET ONE to set Alarm 2 levels.

   The running light for the selected pump or alarm will now be lit.

   The bar graph indicators alternate between the current activation and deactivation levels for the pump (or alarm).

3. Press one of the following keys to select which level to adjust:

SELECT ONE (HI)	This is the Activation level in Discharge mode or the Deactivation level in Charge mode.
RESET ONE (LO)	This is the Activation level in Charge mode. or the Deactivation level in Discharge mode.
DUTY SELECT (LEAD SELECT) (EXIT)	exits and returns to normal operation.

4. Raise or lower the level using one of these keys:

SELECT ONE	(▲)	to raise the level.
RESET ONE	(▼)	to lower the level.

5. To return to normal operation , press either :

ALARM RESET (SET)	To return and **save** the new settings, or
DUTY SELECT (LEAD SELECT) (EXIT)	To return and **discard** the changes.

5.2.4. Setting Levels when Using Analog Input only

Use this procedure to set levels when using analog input only (EDS 5 set to 1 or 4), or if you are using both probe and analog inputs.

Steps 1 to 3 are the same as the method for the pevious section, 5.2.3.

The level will now be displayed for the selected point. Unlike probe levels, when you use an analog (4–20 mA) input you may set the level from 0 to 100% in 0.5% increments. The Bar Graph displays 10% increments while indicators in the pump two column display the 0.5% and 1% increments. The 0.5% levels are indicated by a flashing light and 1% levels are shown with a steady light.

For example, if

- the bottom two lights in the Bar Graph are on, and
- RESET TWO (TOGGLE), SEAL FAILURE and PUMP 2 MOTOR OVERTEMP are on, and
- the PUMP 2 LOCKOUT light flashes,

this indicates 23.5%.

4. Raise or lower the level using one of these keys:

SELECT ONE	(▲)	to raise the level in 0.5% steps
RESET ONE	(▼)	to lower the level in 0.5% steps
SELECT TWO	(▲)	to raise the level in 10% steps
RESET TWO	(▼)	to lower the level in 10% steps

5. To return to normal operation , press either :

ALARM RESET (SET)	To return and **save** the new settings, or
DUTY SELECT (LEAD SELECT) (EXIT)	To return and **discard** the changes.

5.2.5. Probe and Analog Combinations

If you are using both probe and analog inputs for level detection, set pump levels using the procedure for Analog Input only.

5.3. Setting Peak Levels

This procedure for setting peak levels is similar to the one for setting normal levels except that you must place the controller into Peak Level mode prior to setting levels. Refer to section 8.1.1 for information on how to place the controller into Peak Levels mode.

5.4. Simulating Levels for Safety or Commissioning Purposes

The pump controller can simulate levels for safety or commissioning purposes. This function allows you to increase or decrease the level in 10% steps from the keypad. Using this facility you can test the control switchboard before it is installed at the pump station.

Enter Level Commissioning Mode by pressing the 'Simulation Key Combo'. In this mode the SELECT ONE (HI) and RESET ONE (LO) lights flash alternately. When these lights are flashing, the following buttons have the following functions:

SELECT ONE (▲) raise the current level by 10%
RESET ONE (▼) lower the current level by 10%
DUTY SELECT (LEAD SELECT) (EXIT) exit this mode and return to the default display, using the currently configured level input device.

Note: In level commissioning mode the normal Manual (Hand)-Off-Auto functions and fault/alarm reset functions are not available. To make use of these functions, exit the commissioning mode by using the DUTY SELECT (LEAD SELECT) (EXIT) key.

CAUTION: THE PUMPS WILL RESPOND TO THE SIMULATED LEVEL EXACTLY AS THEY WOULD TO A REAL LEVEL. THEREFORE, IT IS POSSIBLE TO RUN THE PUMPS WITH A "SIMULATED LIQUID" IN THE WELL AND NO ACTUAL LIQUID, THEREBY RUNNING THE PUMPS DRY AND DAMAGING THEM.

As a safeguard against the possible dangers associated with simulating levels, as described in the caution above, if the operator presses no keys for 30 seconds, the controller will return to using the normal level sensor to determine the level and cancel the simulation.

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

Chapter 6 Pump and Alarm Activation and Deactivation Delays

Activation and deactivation delays are used to prevent a pump or alarm from turning on when it reaches its activation level until the activation delay has timed out. The procedures for setting delays are similar to those for setting levels, except with a different key combo.

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.

The Pump Controller can be set up so that it periodically runs past the normal deactivation level for a configured time, to enable a full sump clean-out. Refer to EDSs 86 and 87 in section 0 for details.

Activation delays can be used to prevent false alarm trips due to splashing or foam build-up, so that the 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.

6.1. Default Delay Settings

All Pump and Alarm activation and deactivation delays have a factory Default setting of one second. These may be adjusted as required as shown below.

6.2. Setting Pump and Alarm Delays

1. Press the SET DELAYS key combination as defined in Chapter 4. The pump and alarm lights are now flashing.
2. Press one of the following keys to select which delays to adjust:

SELECT ONE	to adjust Duty (Lead) delays
SELECT TWO	to adjust Assist (Lag) delays
SELECT THREE	to adjust Standby delays
ALARM RESET	to set alarm delays
DUTY SELECT (LEAD SELECT)	to exit and return to normal operation.

If you pressed ALARM RESET to set alarm delays, press SELECT ONE to set Alarm 1 delays or RESET ONE to set Alarm 2 delays.

The point selected is now displayed on the bar graph.

The bar graph is fully illuminated except for one segment. Read the delay from the table column labelled Delay Sec./Min. to the right of the bar graph. The extinguished segment denotes the current value.

Note: If the SWITCH ON/PEAK LEVELS/MINUTES light at the bottom of the bar graph panel is off, then the delay values are in seconds. If it is on the delay values are in minutes.

3. Increase or reduce the delay using one of these keys:

   SELECT ONE (▲) to increase the delay
   RESET ONE (▼) to reduce the delay

4. To return to normal operation , press either :

   ALARM RESET (SET) To return and **save** the new settings, or

   DUTY SELECT (LEAD SELECT) (EXIT) To return and **discard** the changes.

6.3. Setting Peak Delays

This procedure for setting peak delays is the similar to the one for setting Normal Delays except you must place the controller into Peak Level mode prior to setting delays. Refer to section 8.1.1 for information on how to place the controller into Peak Levels mode.

6.4. Muting or Disabling Level Alarms

6.4.1. Muting Level Alarms

When a Level Alarm is present it can be muted for a preset period by pushing the ALARM RESET button. The preset period is set using EDS 4—Level Alarm Mute Time. (See section 7.3 for more information).

6.4.2. Temporarily Disabling Level Alarms

When a Level Alarm is present it can be temporarily disabled by holding down the ALARM RESET key for five seconds. This mutes the alarm until the deactivation point is reached.

An alarm that has been disabled in this way is indicated by a strobing alarm light. The strobe is a three quarter second on pulse followed by a quarter second off pulse.

To return to normal mute mode, hold down the ALARM RESET key again for five seconds.

Note: Only unacknowledged faults may be reset. Present faults may not be reset as the fault condition still exists.

Chapter 7 Setting Electronic DIP Switches (EDSs)

The MTxPC pump controller has a large number of parameters that may be configured by the user. Instead of being set physically via traditional "DIP" switches, they are set via the front panel. For historical reasons these were known to the customer base as Electronic DIP switches, and therefore we have continued to use this term in the current manual.

There are 87 EDSs in total, grouped into ten sections. These sections are:

- Level
- Pump
- Fault
- LAN
- Analog Output
- Digital Output
- Well Washer
- SCADA Communications (SPC versions only)
- Configurable Inputs
- Sump Clean-out

The EDS value is displayed using the bar graph and the lights in the PUMP 1 column. The bar graph displays the units (0–9) while the PUMP 1 column represents the tens.

For an interactive guide to setting the EDSs, see the MultiTrode web site at www.multitrode.com.au. Follow the menu items to "Training & Support", followed by "Interactive Training". This training is also available on CD. Please request this from your local MultiTrode sales office.

7.1. Types of EDS

There are three types of EDS, On/Off EDSs, Numerical Value EDSs and Settings EDSs.

7.1.1. On/Off EDS

An On/Off EDS may only have one of two possible values, On or Off. While you are setting or inspecting it, the state of the EDS is indicated by the SWITCH ON light as shown in Figure 17.

7.1.2. Numerical Value EDS

A Numerical Value EDS has a numerical value between limits for that particular parameter. Absolute limits are 0 and 255. The value may be the actual number used for a parameter (such as in EDS 10—Pulse start number of pump, where the value is the number of pumps to start), or it can refer to a value or description in a lookup table (such as EDS 5—Level Sensing Device, where 0 indicates a probe, 1 indicates an analog input, etc.).

While you are setting or inspecting it, the value of the EDS is displayed on the bar graph as shown in Figure 17.

- The “1’s” digit of the value is shown on the Level bar graph. All the segments will be lit except one. Read the value next to the unlit segment from the list of numbers (1–9) to the left of the bar graph.

  If the “1’s” digit is 0, all the segments will be lit.

- The “10’s” digit of the value is shown on the Pump 1 LEDs. Read the value next to the lit LED from the list of numbers (10–90) to the left of the LEDs.

  If the “10’s” digit is 0, none of the LEDS will be lit.

- The “100’s” digit of the value is shown on the Pump 2 LEDs. The LED that is lit will indicate the value as with tens digit, but starting with 100 at the bottom of the LEDs and working up. I.e., the Seal Failure LED indicates 100, Motor Overtemp indicates 200, and so on.

  If the “100’s” digit is 0, none of the LEDS will be lit.

The LEDs pictured in Figure 17 are showing a value of 145.

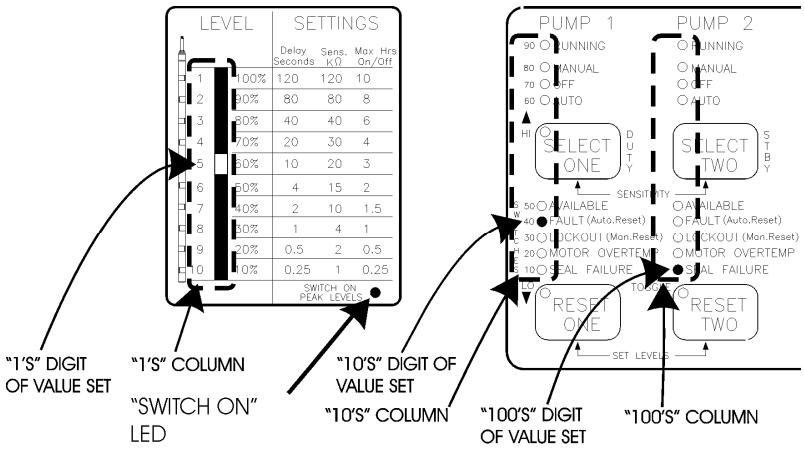


Figure 17 how to read an EDS numerical value

7.1.3. Settings EDS

A Settings EDS has a range of possible values that are indicated in the table beside the bar graph, as shown in Figure 18.

While you are setting or inspecting it, the value of the EDS is displayed on the bar graph.

- The bar graph will be fully lit apart from one segment.
- Read the value from the Settings table that corresponds to the unlit LED, in the column that corresponds to the type of values for the EDS being set. E.g. If the EDS value is a delay, read the value in the column under Delay Sec./Min.. The Switch On light distinguishes between minutes and seconds. The delay values are in minutes if the light is on and seconds if the light is off.

The LEDs pictured in Figure 18 show a setting of 10 minutes.

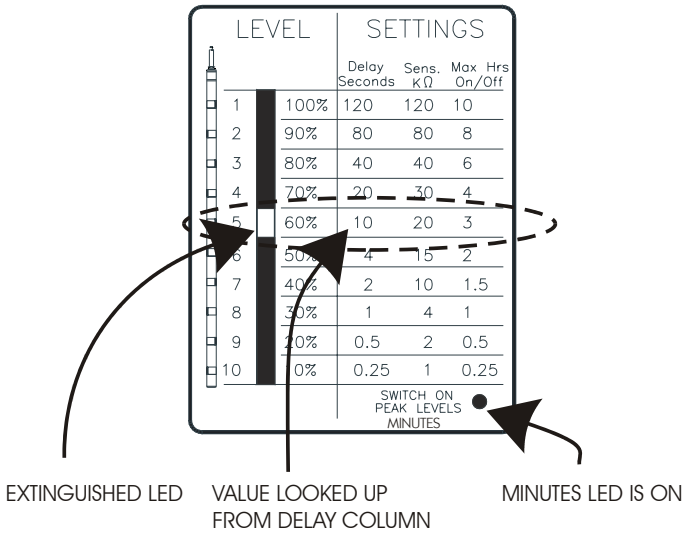


Figure 18 Bar graph displaying a time for a settings type EDS

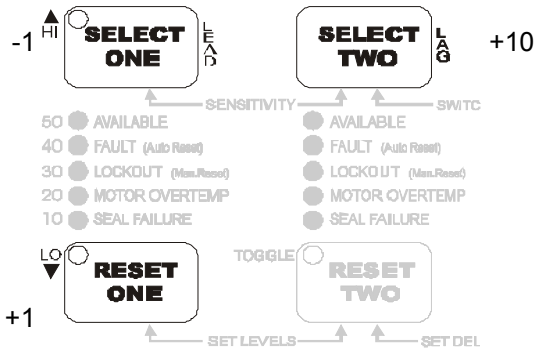
7.2. EDS setting procedure

Note that if the pump controller is networked to a MultiTrode MonitorPro, the text display on the MonitorPro will display context sensitive help while the EDSs are being edited, which will describe the use of the EDS currently selected, and the function of the current value of that EDS.

1. Press the 'EDS Key Combo'. The currently selected EDS number will be displayed in the format shown in Figure 17. The flashing HI and LO lights are a prompt to change the current EDS number.

2. Now select the desired EDS number. Press:

RESET ONE	(▲)	to increase the EDS number by 1
SELECT ONE	(▼)	to decrease the EDS number by 1
SELECT TWO		to increases the EDS number by 10.



Note that EDS settings not valid for the current setup will be skipped. See Section 7.2.3.

3. Now that the number of the required EDS is displayed, you may display or change its value.

   - For **On/Off** type EDSs:

The current value will be displayed on the SWITCH ON LED as soon as the EDS is selected. If the LED is lit, the EDS is on and vice versa.

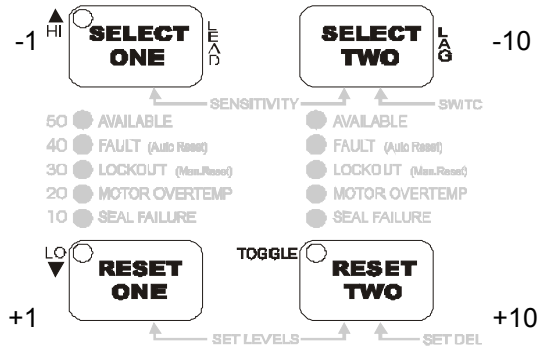
To toggle the value of that EDS between On and Off, press RESET TWO (TOGGLE). The LED will show the new value of the EDS.

   - For **Numerical Value** type EDSs:

To display the current value, you must press RESET TWO (TOGGLE).

To change the value, use

RESET ONE	(▲)	to increase the values by 1
SELECT ONE	(▼)	to decrease the value by 1
SELECT TWO		to decrease the value by 10
RESET TWO		to increase the value by 10



Note that the key usages are slightly different from those used to select the EDS number.

When you are satisfied with the value, press ALARM RESET (SET) to enter the new value and return to EDS selection mode. If you wish to abandon the setting procedure, press DUTY SELECT (LEAD SELECT) (EXIT) to return to EDS selection mode without changing the value of the current EDS.

- For **Settings** type EDSs:

The procedure for setting values for Settings EDSs is similar to the procedure used for Numerical Value EDSs, except that you must read the values from the bar graph, and you may use only SELECT ONE and RESET ONE to change values. In the case of an EDS that specifies a time, as you successively press RESET ONE to move up through the values, they cycle through 0.25 second, 0.5 second, and on to 120 seconds. The next in sequence is 0.25 minute, so the lowest LED lights, and the MINUTES indicator also lights. 0.25 minute is then followed by 0.5 minute, and through to 120 minutes. Pressing SELECT ONE cycles back down in the reverse manner.

Note that it is possible to set periods of 15, 30 and 60 seconds—these are 0.25, 0.5 and 1 minute.

4. Press ALARM RESET again to save all settings. Remember that you can press DUTY SELECT (LEAD SELECT) (EXIT) at any time during the procedure to discard **all** the changes and return to the default display.

7.2.1. Example: updating an On/Off EDS

In this example we will change the Level Alarm from steady to a flashing output.

According to the EDS table on following pages, EDS 3 selects this function.

1. Enter EDS setting mode by pressing the 'EDS Setting Key Combo'.
2. The HI and LO lights flash to prompt you to select the EDS number. Press the RESET ONE key once then release it. The EDS changes from 1 to 2. Press and release RESET ONE once again to move to EDS 3.

   Now that we have located the correct EDS, we need to change the value. The Toggle light in the RESET TWO key is a prompt to do this.
3. The SWITCH ON LED displays the current status of the EDS. If the LED is not lit, the EDS is off. (According to the EDS table, EDS 3 off means Level

Alarm output is steady on.) If the LED is lit (red), the EDS is on. (Again, referring to the EDS table, EDS 3 on means Level Alarm output is flashing.)

4. Press RESET TWO (TOGGLE). The SWITCH ON light will change state with each press of this key. When the SWITCH ON light is on, as required, press ALARM RESET (SET) to save the change and return to normal operation.

7.2.2. Example: updating a Settings EDS

In this example we will configure the controller to acquire level information from a pressure transducer.

According to the EDS table on following pages, EDS 5 configures the level sensing device, and this EDS must be set to 1 because a pressure transducer is a single analog input.

1. Enter the EDS setting mode by pressing the EDS key combo.
2. The HI and LO lights flash to prompt you to select the EDS number. Press and release RESET ONE. The EDS changes from 1 to 2. Each additional press of RESET ONE increases the EDS number by 1 (and if you press SELECT ONE, the EDS number reduces by one). Press RESET ONE until EDS 5 is displayed (segment 5 on the bar graph is ON).
3. To display the current value, press RESET TWO (TOGGLE). You have now entered value setting mode for EDS 5.
4. With all bar graph lights ON, the value is ZERO or OFF. Press RESET ONE and SELECT ONE until the value is the required 1. The level bar graph will indicate this with all lights on except number 1.
5. Press ALARM RESET (SET) to return to EDS setting mode.
6. Press ALARM RESET (SET) key once more to save the change and return to normal operation.

The controller is now set to operate from a single analog input, e.g. pressure transducer.

7.2.3. EDSs not available

In certain circumstances, particular EDSs will not be available to be programmed. One example is mentioned above—if you are programming a non-SCADA controller, the controller will skip EDSs relating to SCADA.

For another example, consider EDS 21, which sets the Maximum Starts per Hour for Pump 3. This EDS is not available on a 2-pump controller (MT2PC or MT2SPC), so while programming a 2-pump controller, this can occur:

1. In EDS Editing mode, scroll through the EDS Numbers until EDS 19 is selected.
2. Press RESET ONE to increase the EDS number. The EDS number jumps to 20.
3. Press RESET ONE to increase the EDS number again. EDS 21 is not valid on a 2-pump controller, so the controller now shows the next valid EDS, which is EDS 22.

7.2.4. Disabling Restrictions set in EDSs

Note that there are several EDSs that affect the station behaviour by limiting a certain parameter to certain constraints. Examples of this are the Maximum Pumps to Run at one time in EDS 15 and the Consecutive Standby Starts before Duty Lockout in EDS 16. For these types of EDSs, a value of 0 disables the particular restriction on the control of the system.

7.3. Full EDS List

The following table is a list of all EDSs with their descriptions, defaults and allowable ranges.

EDS	Switch Function	Default Setting	Range
	LEVEL EDSs (See section 8.2 for more information)		
1	Charge (ON) / Discharge Mode (OFF)	Off = Discharge	On/Off
2	Level Alarm Reset Mode (Off= Alarm condition resets automatically when alarm condition not present, On=manual reset required)	Off = Auto Reset	On/Off
3	Level Alarm Flash (Off=steady, On=flash)	Off = Steady	On/Off
4	Level Alarm Mute Time (Enables muting of alarm by pushing Alarm Reset button)	10 mins	0.25s – 120m
5	Level Sensing Device Off = probe, 1 = analog input, 2 = analog input with probe backup 4 = dual analog input 7 = remote level device (via SCADA)	Off = Probe	Off – 10
6	Level Sensor Timeout (before backup level sensor operates)	10 mins	0.25s – 120m
7	Probe Single sensor/ Multi-sensor Input (not important if 4–20mA used as level device)	Off = Multi-sensor Probe	On/Off
8	Use Normal Levels (Off) or Peak Levels (On)	Off = Use Normal Levels	On/Off
	PUMP EDSs (See Section 8.3 for more information)		
9	Duty (Lead) Select Key Operation Off = no changes can be made 1 = Lead (Duty) select key cycles through alternation modes (Quickset Operation) 2 = customizable Fullset operation) - see MultiTrode web-site	1 = Quickset Operation	Off – 2
10	Pulse Start Number of pumps (when PS input closes or SCADA signal received)	1 = 1 pump	Off – 9
11	Group Configuration	Off = All Groups can run	Off – 5
12	Interpump Start Delay	10 seconds	0.25s – 120m
13	Interpump Stop Delay	0.25 seconds	0.25s – 120m
14	Random Duty (Lead) Start Delay (for minimizing fat build-up at the pump setpoint)	0.25 seconds	0.25s – 120m
15	Maximum Pumps to Run at One Time	Off = No Limit	Off – 9
16	Consecutive Assist (Lag) Starts Before Duty (Lead) Lockout (blocked pump detection)	Off = No Limit	Off – 10 starts
17	Desired Station Starts per Hour (adaptive level control)	Off = No Limit	Off – 60
18	Override Level for Control Functions (Limits adaptive values in EDSs 11, 16, 17, 19 – 21)	Discharge mode = 90% Charge Mode = 10%	0 – 100%
19	Maximum Starts per Hour Pump 1	Off = No Limit	Off – 60
20	Maximum Starts per Hour Pump 2	Off = No Limit	Off – 60
21	Maximum Starts per Hour Pump 3 (MT3PC Only)	Off = No Limit	Off – 60
22	Maximum Run Time hrs for Any Pumps (Inefficient pump detection)	Off = No Limit	Off – 10hrs
23	Maximum Off Time hrs for Any Pumps (Odor reduction function)	Off = No Limit	Off – 10hrs
	FAULT EDSs (See Section 8.4 for more information)		
24	Critical Fault Inputs NO /NC	Off = Normally Open	On/Off
25	Non Critical Fault Inputs NO/NC	Off = Normally Open	On/Off
26	Delay Fail Inputs NO/NC	Off = Normally Open	On/Off

EDS	Switch Function	Default Setting	Range
27	Thermal and Seal Fault Sources Off = No seal or thermal protection 1 = Conductive Seal (default) 2 = PTC Thermistor 3 = Conductive Seal and PTC Thermistor 4 = Flygt Seal and Thermal 5 = Conductive Seal with Delay Fail Disabled 6 = Conductive Seal and PTC Thermistor, with Delay Fail Disabled	1 = Conductive Seal	Off – 6
28	Seal/Thermal Fault Buffer Time	0.25 seconds	0.25s – 120m
29	Thermal Fault Display (0 = Off, 1 = Non Critical, 2 = Critical)	Off = Display Only	Off – 2
30	Seal Fault Display (0 = Off, 1 = Non Critical, 2 = Critical)	Off = Display Only	Off – 2
31	Seal Sensitivity	40K Ohms	1K – 120K
32	Delay Fault Trip Time	10 seconds	0.25s – 120m
33	Delay Fault Recovery Time	1 minute	0.25s – 120m
34	Consecutive Delay Faults Before Lockout	Off = No Limit	Off – 10
35	Decommission Pump 1	Off = Pump 1 Present	On/Off
36	Decommission Pump 2	Off = Pump 2 Present	On/Off
37	Decommission Pump 3 (MT3PC Only)	Off = Pump 3 Present	On/Off
	LAN EDSs (See Section 8.6 for more information)		
38	LAN Mode (0 = Multi-Pump Mode, 1 = Mimic Mode, 2 = Multi Well Mode)	Off = Multi-Mode	Off – 2
39	Master / Slave Mode (Off = Master, On = Slave)	Off = Master Mode	On/Off
40	Slave 1 / Slave 2 Mode (Off = Slave1, On = Slave2)	Off = Slave 1	On/Off
41	Number MT2/3PCs in a Group	1	1 – 3
42	Group ID (RS485 comms)	1	1 – 9
43	Maximum Groups in LAN	1	1 – 9
44	Communications with MultiTrode network Off = no LAN, set while CDS software is used 1 = comms with MonitorPro 2 = comms with MonitorPro but lockout pumps if comms fail 3 (SPC only) = comms with SCADA enabled but LAN disabled 4 (SPC only) = comms with LAN and SCADA enabled	1 = Comms. Enabled (MTxPC) 4 = MTxSPC comms enabled (MTxSPC)	Off – 4
45	LAN Communications Mode (Off=normal, On= aux. Telemetry device)	Off = Normal LAN Comms	On/Off
46	Analog/Comms. Level % Change before logging	10%	1–20%
	ANALOG OUTPUT EDSs (See Chapter 10 for more information)		
47	Analog Output Mode Off = Analog Output Disabled 1 = Analog Output is Linear Level 2 = Analog Output is Inverted Linear Level 3 = Analog Output is VFD Output 4 = Analog Output is Inverted VFD Output 5 = Analog Output is set by CMF via comms	Linear	Off – 5
48	Analog Output Ramp Time	0.25 seconds	0.25s – 120m
49	VFD Equaliser Group One Compensation Coefficient	50%	0–100%
50	VFD Equaliser Group Two Compensation Coefficient	50%	0–100%
	DIGITAL OUTPUT EDSs (See Section 8.7 for source types)		
51	Digital (Relay) Output 1 Source	1 = Alarm 1	0–59
52	Digital (Relay) Output 2 Source	2 = Alarm 2	0–59
53	Digital (Relay) Output 3 Source	3 = Common Alarm	0–59

EDS	Switch Function	Default Setting	Range
54	Digital (Relay) Output 4 Source	0 = Null	0–59
55	Digital (Relay) Output 5 Source (MT2PC Only)	0 = Null	0–59
56	Digital (Relay) Output 1 NO/NC	Off = N/O	On/Off
57	Digital (Relay) Output 2 NO/NC	Off = N/O	On/Off
58	Digital (Relay) Output 3 NO/NC	Off = N/O	On/Off
59	Digital (Relay) Output 4 NO/NC	Off = N/O	On/Off
60	Digital (Relay) Output 5 NO/NC (MT2PC Only)	Off = N/O	On/Off
	WELL WASHER EDSs (See section 8.8 for more information)		
61	Washer Activation Level	20%	0–100%
62	Washer Maximum Run Time	2 minutes	0.25s – 120m
63	Washer Interstart Period (minimizes water usage)	2 hrs	Off – 10hrs
64	Washer Maximum Off Time (minimizes odors)	3 hrs	Off – 10hrs
	SCADA COMMUNICATION EDSs (MT2SPC AND MT3SPC ONLY)		
65	SCADA Site number	11	11 – 255
66	SCADA Quick Poll Region Number (see Outpost manual)	0	1 – 255
67	SCADA Quick Poll Sequence Number (see Outpost manual)	0	1 – 255
68	Power Up Radio Delay (Multiples of 20ms.)	20 = 400 ms.	0 – 100
69	SCADA transmission BAUD Rate (0 = 1200, 1 = 2400 and 2 = 4800)	0 = 1200	0 – 2
	CONFIGURABLE INPUTS EDSs		
70	Key Lock (KL) / Configurable Input Telemetry	Off = Key Lock (KL)	On/Off
71	Critical Fault Pump A (AC) / Configurable Input Telemetry	Off = Critical fault Pump A	On/Off
72	Non-critical Fault Pump A (AN) / Configurable Input Telemetry	Off = NC Fault Pump A	On/Off
73	Delay Fault Pump A (AD) / Configurable Input Telemetry	Off = Delay Fault Pump A	On/Off
74	Seal Fault Pump A (AS) / Configurable Input Telemetry	Off = Seal Fault Pump A	On/Off
75	Critical Fault Pump B (BC) / Configurable Input Telemetry	Off = Critical fault Pump B	On/Off
76	Non-critical Fault Pump B (BN) / Configurable Input Telemetry	Off = NC Fault Pump B	On/Off
77	Delay Fault Pump B (BD) / Configurable Input Telemetry	Off = Delay Fault Pump B	On/Off
78	Seal Fault Pump B (BS) / Configurable Input Telemetry	Off = Seal Fault Pump B	On/Off
79	Critical Fault Pump C (CC) / Configurable Input Telemetry	Off = Critical fault Pump C	On/Off
80	Non-critical Fault Pump C (CN) / Configurable Input Telemetry	Off = NC Fault Pump C	On/Off
81	Delay Fault Pump C (CD) / Configurable Input Telemetry	Off = Delay Fault Pump C	On/Off
82	Seal Fault Pump C (CS) / Configurable Input Telemetry	Off = Seal Fault Pump C	On/Off
83	Peak Levels (PL) / Configurable Input Telemetry	Off = Peak Levels (PL)	On/Off
84	Power Fail (PF) / Configurable Input Telemetry	Off = Power Failure (PF)	On/Off
85	Pulse Start (PS) / Configurable Input Telemetry	Off = Pulse Start (PS)	On/Off
	SUMP CLEAN-OUT EDSs (See section 0 for more information)		
86	Number of full pump cycles between clean-outs	0 = Off	0ff – 255
87	Run-on time for clean-out	10 seconds	0.25s – 120m

Table 3 – EDS functions

This table is duplicated at the back of the manual for quick reference.

Chapter 8 Functional Description of the Pump Controller

8.1. Advanced interaction with the operating environment

The MultiTrode pump controllers have features to allow dynamic optimisation and protection of the pump station using the following inputs.

8.1.1. Spill Management and Energy Efficiency (Peak Levels)

The Pump Controller stores two separate sets of levels and delays for both pumps and alarms. These are known as “Normal” and “Peak” Levels. Peal Levels can be used for energy efficiency during peak periods or for spill management. If a pump station fails, placing upstream stations into peak levels will minimise any spilliage at the failed station by delaying the flow into the failed station. Simply ‘holding out’ the upstream station is risky, as this may just cause two separate spills.

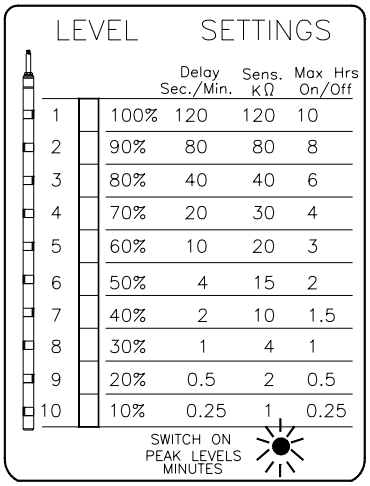


Figure 19. The PEAK LEVELS LED at the bottom of bar graph is lit when unit is in Peak Levels while showing the normal display

There are three ways to put the pump controller into Peak Levels mode.

- Set EDS 8 to On.
- Use the PL input on the controller. A voltage free contact closure between PL and E1 will place the controller into Peak Levels mode.
- Set the mode via telemetry. A SCADA message can be delivered via the MultiTrode MonitorPro RTU or directly to the SPC RTU to place the pump controller into Peak Levels mode.

NOTE THAT IF ANY OF THESE METHODS ARE ACTIVE THEN THE CONTROLLER IS IN PEAK LEVELS MODE.

8.1.2. Power Fail (Hold out)

Use the Power Fail (PF) digital input to hold out all of the pumps. This may be necessary to stop a station from running based upon inputs from limit switches on actuated valves, for process control, to stop pressure fluctuations in pipework for a period or to prevent pumps running on high electrical tariffs.

When the Power Fail digital input is connected to ground the holdout condition will be present. When the digital input is open circuit there will be no holdout condition. The Holdout condition can also be iniated by the SCADA system. If either source (the digital input of the SCADA system) is active, the Holdout condition will be true.

The holdout condition is represented on the display by flashing all of the available lights.

WARNING: THIS INPUT SHOULD NOT BE USED TO ELECTRICALLY ISOLATE PUMPS. DISCONNECTION FROM THE SUPPLY VIA SUITABLE APPROVED CIRCUIT BREAKING DEVICES IS THE ONLY RECOMMENDED MEANS OF ISOLATION.

CAUTION: NO PUMP WILL RUN UNDER ANY CIRCUMSTANCE WHILE THE POWER FAIL (HOLDOUT) CONDITION IS ACTIVE.

CAUTION: IF POWER FAIL IS ACTIVATED WHILE PUMPS ARE RUNNING THEY WILL BE STOPPED IMMEDIATELY AND WILL NOT PRESERVE THE INTERPUMP STOP DELAYS.

8.1.3. Pulse Start Operation

Your installation may require pumps to start on some external trigger. This may be for purging components of a system, or maximising use of a particular electrical tariff by trying to empty the pit just before the end of a low-tariff period. The MultiTrode Pump Controller provides functionality for "Pulse Starting" one or more pumps. This means that a configurable number of pumps will start when the trigger occurs, if and only if they are within their working range (i.e. between their activation and deactivation levels). When pumps are started with a Pulse Start, they will operate in "semi-automatic" mode (Refer to section 2.2.1.2), and return to normal operation when they reach their normal deactivation levels.

To understand how this feature operates, suppose two pumps are set to pulse start and no pumps are running. When the trigger occurs then the Duty (Lead) and Assist (Lag) pumps will start if and only if the current liquid level is within their working range. If these pumps were already running then two more pumps **would not** be started. That is, the controller will start pumps—if they are within their operating ranges—until the number of pumps required by the pulse start setting are actually running.

There are two methods of applying a Pulse start.

- A voltage free contact closure between PS and E1. Note: This closure must be present for a minimum of two seconds. To ensure a return to normal operation this must be a momentary closure.
- A SCADA signal from a MultiTrode Monitor Pro RTU.

The number of pumps to start when a Pulse start is applied is set via EDS 10. The Default setting for EDS 10 is 1. Refer to Chapter 7 for information on setting EDS 10.

8.2. Level

The pump controller provides control for 2 (MT2PC) or 3 (MT3PC) pumps. The primary determiner is fluid level, acquired from either a MultiTrode probe, or a 4-20 mA device. A 4–20 mA device can have a backup of another 4–20 mA device or a MultiTrode probe. EDS 5 selects how the input devices should be handled to derive the level signal. EDS 6 sets the periodic rechecking time of the primary device after a failure.

For one 4-20mA device with a probe backup, set EDS 5 =2. The controller will continuously check the analog device for correct operation. There must be a minimum of two probe sensors, with one below or equal to the zero level of the analog input, and the other equal to or above the 100% point. The bottom sensor is connected to probe input P10, and the top to probe input P1. The 4-20mA device will be considered to have failed if

- The analog level is less than 95% and the top probe sensor is covered
- The analog level is greater than 5% and the bottom sensor is not covered

During an analog failure, the bar-graph will flash. The current level detected by the probe will be on continuously. The time period for rechecking the primary device is set by EDS 6 (Level Sensor Timeout).

For two 4-20mA devices, set EDS 5 = 4. The controller uses the higher of the two analog inputs to determine liquid level. If both inputs fail (<3.5mA), all pumps will be prevented from running. When a reliable signal is again detected, operation will recommece immediately. EDS 6 has no effect with two 4-20mA devices.

For level input via a MonitorPro (e.g. from SCADA), set EDS 5 = 7. If a level is not received within the time period set in EDS 6, all pumps will be locked out until a new level is received.

There are some specialist options for level sensing, set by EDS 5 & 6. Please refer to the MultiTrode web site at www.multitrode.com.au for application notes on these options.

8.3. Station efficiency and optimisation

8.3.1. Interpump Start and Stop Delays (EDS 12 and 13)

Standard pump start and stop delays are described in Chapter 6, but in addition the pump controller has an interpump start delay (EDS 12) and an interpump stop delay (EDS 13). These are intended to reduce electrical overload and water hammer respectively. Note that these delays are overridden in the event of manual starts, manual stops or any sort of fault which will stop a pump, including the Power Fail input.

8.3.2. Maximum Pumps to run Concurrently (EDS 15)

The maximum pumps to run at any one time can be limited with EDS 15, which can also assist in reducing overload.

Note that if the level continues to rise to the next activation level while the maximum number of pumps is running, the pump that has been running the longest will stop, and another pump will start, in case the first pump was blocked or has a damaged impeller.

8.3.3. Fat build-up reduction (Random Duty Start) (EDS 14)

Fat build-up can be reduced with the random duty (lead) start delay set in EDS 14. When this parameter is enabled, the duty (lead) pump will start at a random time

after the normal activation point has been reached. More precisely, the random time is a time somewhere between

- the normal activation delay, and
- the sum of the normal activation delay and the value of EDS 14

Note that if a second pump is called to start during the random delay (e.g. if the second setpoint is reached), the random delay function will be temporarily disabled and the duty (lead) pump will start immediately, followed by the second pump after its normal activation delay, which will be the greater of either the second pump start delay or the interpump start delay.

8.3.4. Maximum Run Time (EDS 22)

To reduce possible damage caused by running a pump for too long, the Maximum Run Time can be set in EDS 22. If any pump runs for longer than this time, and the well level is below the activation level for that pump, the pump will be stopped.

If the Maximum Run Time is exceeded and the well level is at or above the activation level for that pump, and there is another pump that is able to run (i.e., in Auto mode with no faults), and the pumps are not operating in a fixed duty (lead) sequence, the first pump will be stopped and the second will be started.

If on the other hand the level equals or exceeds the activation level and there are no other pumps available, or if the pumps are operating in a fixed duty (lead) sequence, the pump will not be stopped when the Maximum Run Time is exceeded.

8.3.5. Odor Reduction (Maximum Off Time) (EDS 23)

To remove stagnant liquids from the well, thereby reducing odor problems, pumps can be forced to run on a regular basis by setting the maximum off time in EDS 23. If this time has elapsed since the last pump run, and the duty (lead) pump is above its deactivation level, the duty (lead) pump will be started.

8.3.6. Blocked Pump Detection (Assist (Lag) Starts before Duty (Lead) lockout) (EDS 16, 18)

If the Assist (Lag) pump starts unusually often during one cycle of the duty (lead) pump, it is a strong (but not certain) indication that the duty (lead) pump has a damaged impeller or is obstructed.

If the number of starts exceeds the value set in EDS 16, the duty pump will be faulted. However, if the liquid in the well reaches the override level set in EDS 18, the duty pump will be re-enabled.

> Care should be taken with this function, and if normal inflow may require the running of two pumps for more than brief periods this should not be used.

8.3.7. Achieving Desired Station Starts Per Hour (EDS 17)

Many studies have shown that longer, less frequent pump runs are more efficient than shorter, more frequent pump runs when moving the same volumes of liquid. Adaptive level control minimises pump starts and extends pump run times by extending the pump activation levels to attempt to match the “Desired Station Starts per Hour” set in EDS 17. Each time the desired pump starts are exceeded in one hour, the activation level is dynamically changed, but cannot be increased past the over-ride level set in EDS 18. Note that if the adaptive level control has increased a starting level, and a subsequent series of pump runs in one hour is less than EDS 17, the adapted level will be reduced, towards the programmed activation

level. If adaptive level control has altered the activation points of the pumps, all of the AUTO lights on the display will flash slowly.

8.3.8. Limiting Individual Pump Starts Per Hour (EDS 19–21)

A maximum number of pump starts per hour can be set for individual pump by EDSs 19, 20 and 21 for pumps 1, 2 and 3 respectivley. This functionality is necessary in some instances for station efficiency, to minimise thermal build-up in the motor, or to preserve manufacturer's guidelines for pump operation. When the maximum pump starts per hour has been exceeded for a particular pump, that pump will be prevented from running, and the respective AUTO light for that pump will flash quickly. If the liquid level reaches the override level set by EDS 18 while a pump is being held off, the pump will be made available to run again.

8.4. Fault conditions (EDS 24–34)

The pump controller has a number of physical fault inputs for different applications. These are described in detail in section 12.2.4 in the wiring chapter. EDSs 24–34 allow some configuration of these fault inputs:

- Fault inputs can be made normally open or normally closed (EDSs 24–26).
- Buffer times can be introduced to avoid false trips due to noise (EDS 28).
- Some faults can be made to only display, or to act as a non-critical fault (reset when the fault condition disappears), or to act as a critical fault (only reset when an operator clears the fault) (EDSs 29–30).
- The delay fail input is used in conjunction with a flow or pressure sensor to diagnose a damaged impeller, locked rotor or a blockage preventing flow. When a pump turns on the sensor should register a fluid flowing condition within a period of time. This period of time is called the trip time (EDS 32).
- In the event of a delay fail faulting a pump, the pump will be made unavailable for a set period of time before it becomes available again, known as the recovery time (EDS 33). The drop in pressure when the pump stops may have dislodged the blockage so a number or retries may be required. A maximum number of retries can be set with EDS 34 to force a critical (manual reset) fault if the condition persists.
- Thermal and Seal Fault Sources and Seal Sensitivity are as shown in the EDS table (EDSs 27, 31).

Reduced Switchboard components: Thermistors, Flygt FLS sensors, and Seal Fail Sensors can all be wired directly into the MT3PC without the need for external Thermistor Relays or MiniCas systems.

8.5. Decomissioning Pumps (EDS 35–37)

Individual pumps can be decommissioned by setting EDSs 35, 36 and 37 to "on", for Pumps 1, 2 and 3 respectively. Each of these eliminates all lights and controls for the specified pump, and prevents it from running under any circumstances.

8.6. Communications for LAN (EDS 44)

Up to three pump controllers can be grouped together for complex pumping applications including multi-well mode. See the MultiTrode web site at www.multitrode.com.au for more details on these applications.

When communicating with CDS software directly, EDS 44 must be set to off. When communicating with CDS via a MonitorPro, or when CDS is not actually in use, EDS 44 should be set to 1 to enable normal communications between the Pump Controller and the MonitorPro.

For convenience (**On non-SPC versions**) you may use these shortcut methods for changing EDS 44:

- To set EDS 44 to Off, press SELECT ONE, SELECT TWO and ALARM RESET simultaneously.
- To set EDS 44 to 1, press RESET ONE, RESET TWO and DUTY SELECT (LEAD SELECT) simultaneously.

8.7. Configurable Digital Outputs (EDSs 51– 59)

The pump controller can connect to RTUs or to other panel logic via configurable outputs, which can be individually set to Normally Open or Normally Closed. EDSs 51–54 determine the source of the condition used to set the Digital Outputs 1 to 4 respectivley, and EDSs 56–59 determine if these outputs are used in N/O or N/C mode.

The sources are conditions with the product as in this table.

Nr	Description	Nr	Description
0	None	33	Critical Fault Pump 1
1	Alarm 1 Present	34	Critical Fault Pump 2
2	Alarm 2 Present	35	Critical Fault Pump 3
3	Common Alarm	36	Critical Fault Any Pump
4	Pump 1 Running	37	Non Critical Fault Pump 1
5	Pump 2 Running	38	Non Critical Fault Pump 2
6	Pump 3 Running	39	Non Critical Fault Pump 3
7	Any pump running	40	Non Critical Fault Any Pump
8	No pumps running	41	Delay Fault Pump 1
9	All pumps running	42	Delay Fault Pump 2
10	All pumps Available to Run	43	Delay Fault Pump 3
11	All pumps Available	44	Delay Fault Any Pump
12	Any Pump Unavailable	45	Seal Fault Pump 1
13	All Pumps Unavailable	46	Seal Fault Pump 2
14	Pump 1 Unavailable	47	Seal Fault Pump 3
15	Pump 2 Unavailable	48	Seal Fault Any Pump
16	Pump 3 Unavailable	49	Thermal Fault Pump 1
17	Any Pump Off or Unavailable	50	Thermal Fault Pump 2
18	All Pumps Off or Unavailable	51	Thermal Fault Pump 3
19	Pump 1 Off or Unavailable	52	Thermal Fault Any Pump
20	Pump 2 Off or Unavailable	53	Max pump starts exceeded pump 1
21	Pump 3 Off or Unavailable	54	Max pump starts exceeded pump 2
22	All pumps off	55	Max pump starts exceeded pump 3
23	Pump 1 off	56	Max pump starts exceeded any pump
24	Pump 2 off	57	Desired station starts exceeded
25	Pump 3 off	58	Peak Levels
26	Any pump off	59	Well Washer
27	Communications Fault	60	Level Activation
28	Level Device Fault	61	Level Activation with Interstart
29	Probe sensor fail	62	Analog Compare Unidirectional 1
30	Analog Input 1 fault	63	Analog Compare Unidirectional 2
31	Analog Input 2 fault	64	Analog Compare Bi-directional
32	Remote Telemetry Source		

Table 4 – Digital Output Sources.

8.8. Well Washer functions (EDSs 61–64)

The pump controller has built in well washer control, with four configurable functions to minimise odors while minimising water usage.

After the delay set in EDS 63 has passed since either the previous well washer cycle or a controller reset, the pump controller will activate the Well Washer digital output (any digital output whose source has been set to "Well Washer" as described in section 8.7) as soon as the level in the well falls below the activation level set in EDS 61 (for discharge mode, or above this level for charge mode). This output will stay activated for the period set by the Well Washer Run Time, in EDS 62, irrespective of the pump status'. The Well Washer digital output will become active regardless of the level and the pump statuses if the Well Washer Maximum Off Time set in EDS 64 has expired since either the previous well washer cycle or a controller reset, and again, will stay activated for the period set in EDS 62.

If any pump is placed in manual or semi-automatic mode, this output will be activated.

8.9. Analog Compare Outputs

Three configurable digital output sources are linked to the well washer Level Activation, EDS 61 and use the analog input states for sources.

Note: If either of the Analog Inputs have failed (IE below 3.5mA) all of the Analog Compare Outputs will be in the inactive state. To determine if an input has failed refer to the Digital Output Sources which specifically deal with analog failures.

8.9.1. Analog Compare Unidirectional 1

This output is active when Analog 1 exceeds Analog 2 by the amount set in level set in EDS 61, and remains inactive while Analog 2 exceeds Analog 1.

8.9.2. Analog Compare Unidirectional 2

This output is active when Analog 2 exceeds Analog 1 by the amount set in level set in EDS 61, and remains inactive while Analog 1 exceeds Analog 2.

8.9.3. Analog Compare Bi-directional

This output is active when the difference between Analog Input 1 and Analog Input 2 exceeds the level set in EDS 61. This is referred to as bi-directional because the output will become active irrespective of whether Analog 1 or 2 is the higher value, as long as the difference between them exceeds the set value.

8.10. Sump Clean-Out functions (EDSs 86 and 87)

The Sump Clean-Out function will keep the pumps running past their normal deactivation level and stop delay by the time set in EDS 87, every time the number of pump cycles specified in EDS 86 have elapsed. Note that if EDS 86 is set to 0, the extra run-on time will never be used.

8.11. Configurable Telemetry Inputs (SPC Only) (EDS 70–85)

Many of the inputs to the MultiTrode MT3SPC can be used as general-purpose digital inputs for monitoring from the CMF using MultiTrode Outpost SCADA. Typical uses for these general purpose inputs might be door open or passive infra-red intruder detector, low level of additive, overflow level or dry well flooded.

To use such a digital input, choose one of the EDSs 70–85 and set it On. That input is now configured as a telemetry input, and its normal functionality is disabled.

CAUTION: CONFIGURABLE TELEMETRY INPUTS PROVIDE INDICATION ONLY. THEY DO NOT GENERATE FAULT CONDITIONS.

For example, suppose there is an additive reservoir with a low-level detector and you wish to pass the condition of the detector back to the CMF. Wire the output of the level detector into Pump B Delay Fail input (BD), then set EDS 77 to On. Thus it no longer has its default function Pump B Delay Fail, but indicates additive level (low or adequate) instead—and will not generate a fault condition.

You will then configure your CMF to show the appropriate indication.

A closed dry contact making a circuit between the input terminal and the E1 terminal activates that digital input. For the Critical, Non-critical and Delay Fault inputs, set EDS 24, 25 or 26 respectively to make those inputs Normally Open or Normally Closed when used as telemetry digital inputs.

Chapter 9 Configuring Level Devices

MultiTrode's pump controllers can be used with almost any kind of level sensing device. Common sensors include probes, ball floats and 4–20 mA pressure sensors.

9.1. Adjusting Probe Sensitivity

MultiTrode's probe is a conductive sensing device, which creates a path back to the controller from earth as each sensor is submerged in liquid. In some cases it may be necessary to adjust the sensitivity of the probe to allow for the conductive properties of different types of liquid. To do this, follow the procedure shown below:

1. Press SELECT ONE and SELECT TWO simultaneously.
2. If the Level Source in EDS 5 **is set** to 2, 3, 5 or 6, PUMP 1 RUNNING and ALARM lights will flash alternately to prompt you to choose between probe sensitivity and analog calibration. To adjust the analog zero and span when using any of these settings for EDS 5, see section 9.2 below. To select probe sensitivity, press SELECT ONE. One segment only will be illuminated on the bar graph. If EDS 5 **is not set** to 2, 3, 5, or 6 this step will be skipped.
3. One segment only will be illuminated on the bar graph, which will indicate the current sensitivity, using the Sens. KΩ column in the settings table beside the bar graph.

   Raise or lower the sensitivity by pressing one of the following keys:

SELECT ONE	(▲)	to raise the sensitivity
RESET ONE	(▼)	to lower the sensitivity.

4. To return to normal operation , press either :

ALARM RESET (SET)	To return and **save** the new settings, or
DUTY SELECT (LEAD SELECT) (EXIT)	To return and **discard** the changes.

9.2. Setting the analog input zero and span

Analog 4–20 mA devices are often used to detect liquid level in applications where a high resolution is required or the liquid is not conductive. Before using these devices it is necessary to set their operating range. This range is referred to as the zero and the span.

Zero is the current at which the tank or pit is considered to be empty. Span is the current at which the tank is full. The difference between these two settings is the operating range of the device.

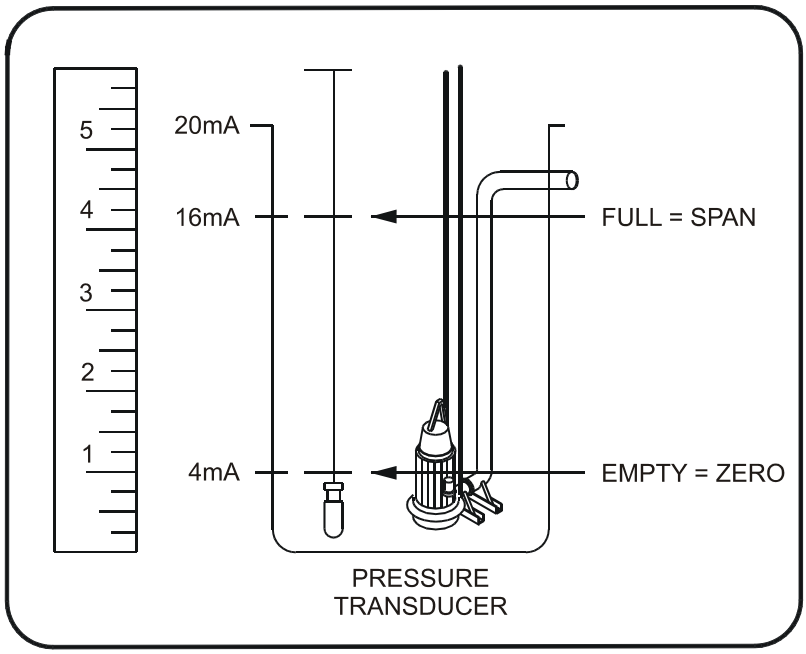


Figure 20: Understanding Zero And Span

For example, a 4 metre deep sewerage pit has a 5 m pressure transducer as the level device, and we require the pump controller to register 4 m as 100% and 1 m as empty. These values are the span and the zero respectively.

If the transducer registers 20mA at 5m of depth in the well, and 4 mA at 0m depths, giving (4/5 X 16 +4 =) 16.8 mA at 4 m and (1/5 X 16 + 4 =) 7.2mA at 1m. For the pump control, the span point will be 16.8 mA and the zero point will be 7.2mA.

There are two ways to set zero and span. A quick set method allows the value to be set to the current liquid level. A full set method requires a mathematical calculation to determine the correct input levels.

9.2.1. Quick Set Zero and Span

This method is used to set the zero or span to the current level. The usual method is to let the level fall to the empty position and set this as the zero, then wait for the level to rise up to the full position and set this level as the span.

Before setting the zero and span, make sure EDS 5 (Level Sensing Device) is set to analog input. See section 7.3.

1. Wait until the current level is at the empty position.
2. Press SELECT ONE and SELECT TWO simultaneously.
3. If two analog sensors are in use, the HI and LO lights will flash in unison with the ALARM 1 and ALARM 2 lights. Select the correct one by pressing SELECT ONE for analog input 1 or RESET ONE for analog input 2. If only one analog input is used the controller will skip this step.
4. Press RESET ONE to set zero to the current level.
5. Wait until the level is at the full position.
6. Press SELECT ONE and SELECT TWO simultaneously again.
7. Once again, choose the correct analog input if more than one is in use.
8. Press SELECT ONE to set the span.

9.2.2. Full Set Zero and Span

This method allows you to program the zero and span current values manually. The controller then uses these values to calculate the correct current levels for each setting.

9.2.2.1. Calculating the values

The calculations below are used to determine the zero and span values for the full set method:

$$\text{Zero Current} = \left(\frac{\text{Zero Height}}{\text{Transducer Range}} \times 16\,\text{mA} \right) + 4\,\text{mA} \quad (1)$$

$$\text{Span Current} = \left(\frac{\text{Span Height}}{\text{Transducer Range}} \times 16\,\text{mA} \right) + 4\,\text{mA} \quad (2)$$

$$\text{Zero Value} = \frac{\text{Zero Current}}{20.5\,\text{mA}} \times 255 \quad (3)$$

$$\text{Span Value} = \frac{\text{Span Current}}{20.5\,\text{mA}} \times 255 \quad (4)$$

The span value should always be greater than the zero value. Two examples for using the above equations are given below:

9.2.2.2. Example 1

A pressure transducer has a 5m range and the target application has a tank height of 4m. The transducer is lowered to the bottom of the vessel and the zero measurement is to be taken 1 m from the bottom of the vessel.

Using equations (1) and (3) to calculate the zero:

$$\text{Zero Current} = \left(\frac{1\,\text{m}}{5\,\text{m}} \times 16\,\text{mA} \right) + 4\,\text{mA} = 7.2\,\text{mA}$$

$$\text{Zero Value} = \frac{7.2\,\text{mA}}{20.5\,\text{mA}} \times 255 = 90$$

Now using equations (2) and (4) to calculate the span:

$$\text{Span Current} = \left(\frac{4\,\text{m}}{5\,\text{m}} \times 16\,\text{mA} \right) + 4\,\text{mA} = 16.8\,\text{mA}$$

$$\text{Span Value} = \frac{16.8\,\text{mA}}{20.5\,\text{mA}} \times 255 = 209$$

The steps below show how to enter the zero (90) and span (209) values into the pump controller.

9.2.2.3. Example 2

A pressure transducer in a sewerage well has 6 mA as the value used to indicate 0%, and 18 mA is the value used to indicate 100%. Using equations 3 and 4:

$$\text{Zero Value} = \frac{6.0\,\text{mA}}{20.5\,\text{mA}} \times 255 = 75$$

$$\text{SpanValue} = \frac{18.0\,\text{mA}}{20.5\,\text{mA}} \times 255 = 224$$

When these values are programmed into the pump controller, 6 mA will correspond to 0% and 18 mA will correspond to 100%.

Before entering these values into the controller, make sure EDS 5 (Level Sensing Device) is set to Analog Input. See section 8.2.

9.2.2.4. To enter the values into the controller:

1. Press SELECT ONE and SELECT TWO simultaneously.
2. If analog input with probe backup is used as the level source (EDS 5 = 2, 3, 5, or 6), the PUMP 1 RUNNING indicator and the ALARM 1 indicator will be flashing. Press SELECT ONE to set the sensitivities for the probes, or ALARM RESET to set the analog zero and span. If probe backup is not used, the controller will skip this step.
3. If two analog sensors are in use, the HI and LO lights will flash in unison with the ALARM 1 and ALARM 2 lights. Select the correct one by pressing SELECT ONE for analog input 1 or RESET ONE for analog input 2. If only one analog input is used the controller will skip this step.
4. Press SELECT ONE and SELECT TWO again. The SWITCH ON/PEAK LEVELS light will turn on.
5. Press RESET ONE to set zero or SELECT ONE to set the span value.
6. Use SELECT ONE or RESET ONE to respectively raise or lower the value to match the figure you calculated above. Units are indicated by the bar graph, tens by the LEDs in the pump 1 column and hundreds by the LEDs in the pump 2 column (similarly to the way numbers are indicated while programming EDS values).
7. Press ALARM RESET (SET) to enter the new value.
8. Press DUTY SELECT (LEAD SELECT) (EXIT) to exit without making any changes.
9. Repeat the steps for both the zero and span values.

Chapter 10 Variable Frequency Drive Equalizer

The Variable Frequency Drive Equalizer, or VFD Equalizer, controls multiple variable frequency drives. It allows installations using variable frequency drives to take advantage of the advanced alternation and control functionality of the pump controller while providing intelligent and adaptive speed control.

Note: The VFD Equalizer functionality is only available on the -VFD models of the MultiTrode Pump Controller, which are MT2PC-VFD or MT3PC-VFD. Contact your local distributor if you wish to enquire further about obtaining this extra functionality.

In VFD units the Analog Output Source, EDS 47, should be set to 3. Refer to section 7.3.

Note: This is **not** the default setting. In the event of a Defaults Reset being carried out, you will need to set EDS 47 for VFD operation.

10.1. Intelligent Pump Control—The VFD Equalizer

One of the main problems affecting installations with multiple VFDs is co-ordinating the drives so that the flow through the installation does not fluctuate as extra pumps are turned on and off. MultiTrode's VFD Equalizer function solves this by automatically adjusting a 4–20 mA control signal to compensate for the extra pump. This is achieved with only one extra set point when setting up the pump controller. No extra hardware is required.

The 4–20 mA signal produced by the equalizer is used to control the VFD's speed range. For example, the VFD might change the motor frequency from 38 Hz to 50 Hz in order to vary the motor from off to full speed. This is the operating range of the drives. Therefore, the 4–20 mA range is here equivalent to the speed range of the drive, which is 38–50 Hz.

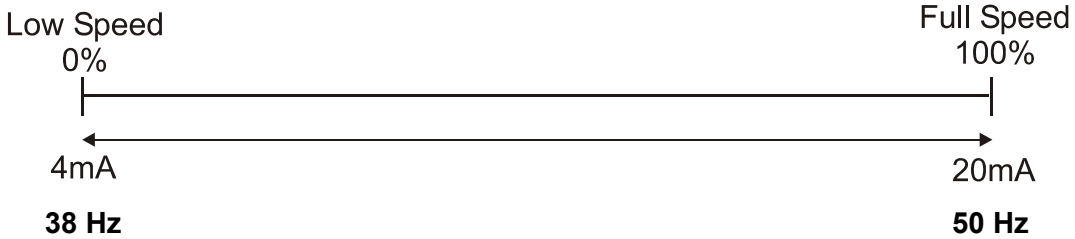


Figure 21—Analog output compared to speed range set on VFD

A single analog output from the pump controller is used to control multiple VFDs in the installation. As pumps turn on and off, the analog output signal is recalculated so the net flow through the installation is averaged over the two pumps. The controller always tries to adjust the controlling signal so that both pumps are running at the same speed to produce the required flow.

For example, in Figure 22, pump 1 is running at full speed (100%r) by the time pump 2 starts (level 60%). The controller drops the speed of pump 1 to 65%r and starts pump 2 at 65%r instead of 30%r. This is because 65%r speed is the average of 30%r + 100%r. The controller continues to calculate this average as long as the well level is in pump 2's operating range.

When the level drops to 30%, pump 2 will turn off and pump 1 reverts to its normal curve.

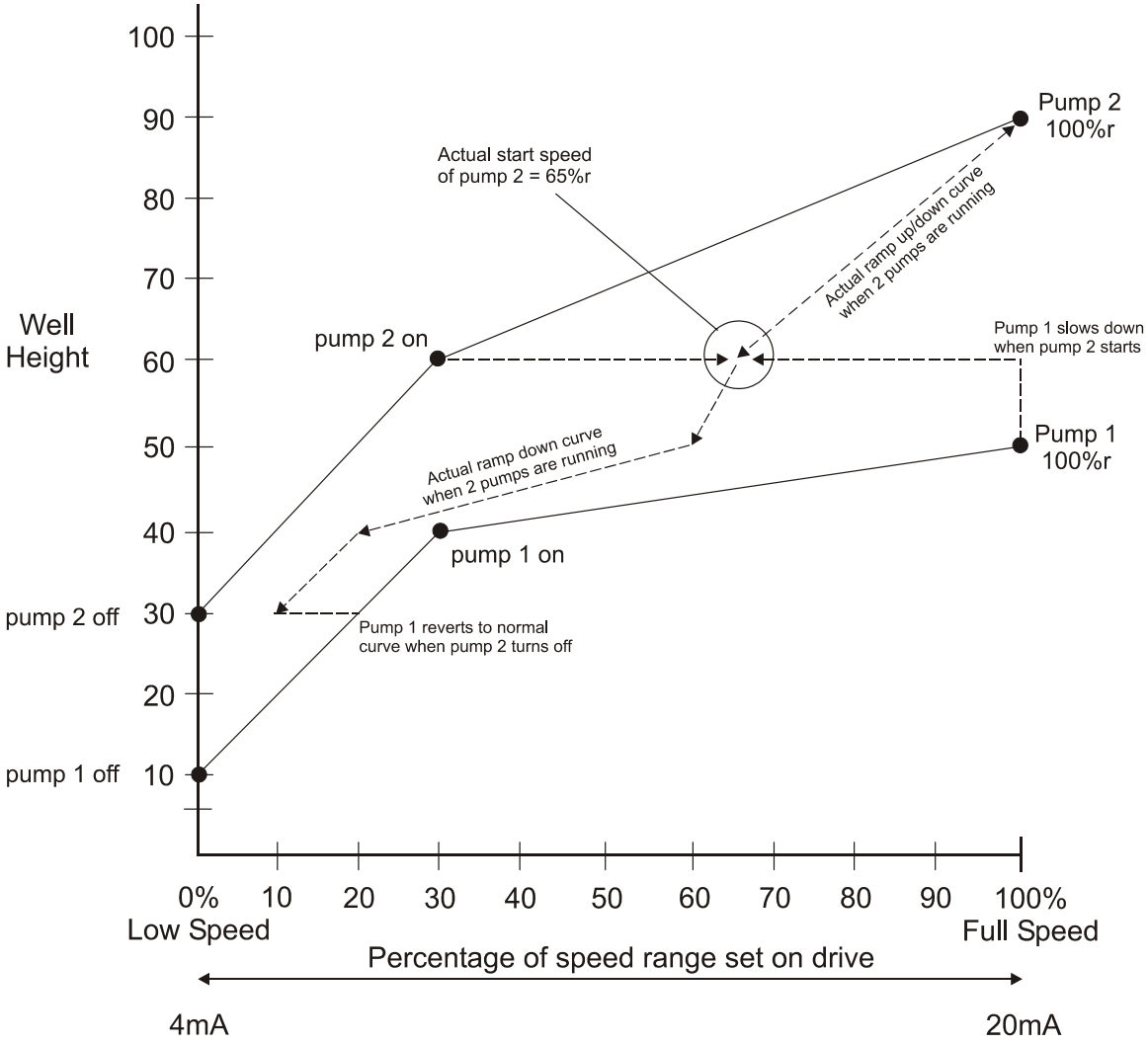


Figure 22—Pump speeds relative to well height

Figure 23 illustrates a typical sequence of events sequence of events during the filling and emptying of a well controlled by a MultiTrode VFD Pump Controller. The numbered steps in the explanation refer to the time events on the bottom of the graph.

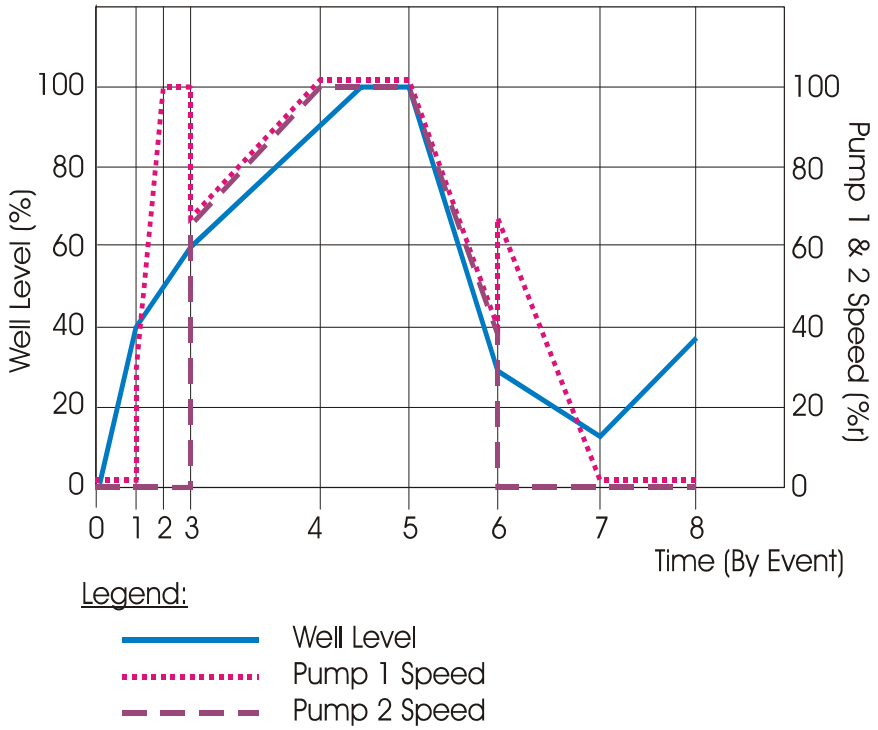


Figure 23—VFD control sequence

Time Event:

0. Well starts filling, no pumps running.
1. Well level reaches Pump 1 activation level (40%), pump 1 starts at the speed set by the VFD Start Speed key combo (30%r).
2. Pump 1 increases its speed in proportion to the well level, until it reaches 100% at it's 100% level, 50% of well.
3. The well level reaches the Pump 2 activation level (60%), at which point Pump 2 is started. Each pump runs at a speed that is the average of the last Pump 1 speed and the Pump 2 Start Speed (65%).
4. Both pumps increase their speed proportionally to the well level, until they reach 100%.
5. The inflow decreases, to the point where the pumps are able to cope with the flow, and the well level starts to drop.
6. The level reaches the pump 2 deactivation level (30%), so pump 2 stops. Pump 1 runs at its calculated speed for that well level.
7. Pump 1 continues to run until it reaches its deactivation level (10%), at which point it stops.
8. The well level continues to increase again.

10.2. VFD Setup Procedure

Three steps are needed to set up the VFD equaliser for operation:

1. Set the activation and deactivation levels for each pump.
2. Set the start speed for each pump.
3. Set the fluid level at which each pump will be at 100% speed (100%r).

Note: The symbol *%r* is used to denote a measurement as a percentage of range. For example 25%r means 25% of the preset range of pump speeds, where the range is from minimum pump speed to maximum pump speed. In a range from 1000 rpm to 1400 rpm, 25%r equates to1100 rpm.

Step 1 uses the procedure described in Chapter 5. Make sure the activation and deactivation levels have been set correctly for the installation before proceeding. The next two sections describe steps 2 and 3.

10.2.1. Setting the VFD Start Speed for each pump

1. Press SELECT ONE and RESET TWO simultaneously.
2. Select one of these keys to select which start speed to adjust:

   SELECT ONE to adjust Duty (Lead) pump start speed
   SELECT TWO to adjust Assist (Lag) start speed.
   SELECT THREE to adjust Standby start speed
   DUTY SELECT (LEAD SELECT) to exit and return to normal operation.

   The setting is now displayed on the bar graph and pump 2 column as a value 0–100%. The pump 2 column shows the units and half units and the bar graph shows tens.
3. Raise or lower the start speed to the desired value.

   Use these keys to raise or lower the speed:

   SELECT ONE (▲) to raise the start speed in 0.5% steps
   RESET ONE (▼) to reduce the start speed in 0.5% steps
   SELECT TWO to raise the start speed in 10% steps
   RESET TWO to reduce the start speed in 10% steps.
4. Save the new setting by pressing ALARM RESET (SET).
   Or, press DUTY SELECT (LEAD SELECT) (EXIT) to discard the changes and return to normal operation.

10.2.2. Setting the 100%r Fluid Levels

The 100%r setting is the liquid level at which a pump will have reached the maximum speed in the VFD's speed range. For example, in Figure 23 above, the 100%r level for pump 1 is 62%, so that when the well liquid level reaches 62%, pump 1 should be running at full speed.

The equalizer overrides this value when pump 2 starts.

1. Press SELECT TWO and RESET ONE simultaneously.
2. Select one of the following three keys to select which 100%r level to adjust:

   SELECT ONE to adjust Duty (Lead) pump 100%r
   SELECT TWO to adjust Assist (Lag) 100%r.
   SELECT THREE to adjust Standby 100%r
   DUTY SELECT (LEAD SELECT) to exit and return to normal operation.

The setting is now displayed on the bar graph and pump 2 column as a value in the range 0–100%. The pump 2 column shows the units and half units and the bar graph shows tens.

3. Raise or lower the 100%r level to the desired value.

   Use these keys to raise or lower the 100%r level:

   SELECT ONE (▲) to raise the level in 0.5% steps
   RESET ONE (▼) to reduce the level in 0.5% steps
   SELECT TWO to raise the level in 10% steps
   RESET TWO to reduce the level in 10% steps.

4. Save the new setting by pressing ALARM RESET (SET).

   Or, press DUTY SELECT (LEAD SELECT) (EXIT) to discard the changes and return to normal operation.

10.2.3. Effects on station flow and Compensation

The VFD Equalizer algorithm does not attempt to model station dynamics or flow as each of these quantities is determined by many hydraulic and non hydraulic factors specific and unique to every installation.

A compensation factor is provided to help overcome large steps in the flow rate due to hydraulic inefficiencies in the installation. These inefficiencies can be caused by constrictive discharge piping, dynamic friction and head losses. The minimum pump speed can also affect outflow by having a positive effect on the flow rate when a second pump starts.

The compensation factor (cf) may be positive, negative or unity (no effect). The control signal for a single running pump is not affected because compensation is designed to tune pump transitions.

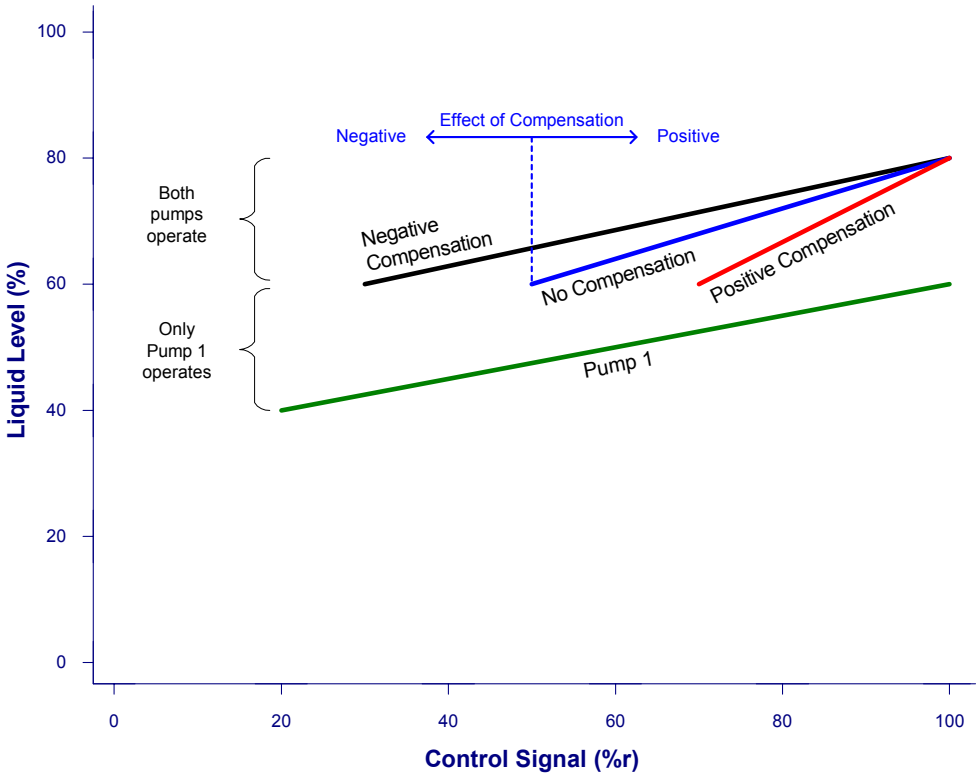


Figure 24: The Effect of the Compensation Coefficient

An example of the combined pump VFD output control signal is shown above in Figure 24. In this example the second pump starts when the liquid level reaches the

60% point and the combined control signal lowers to 50%r accordingly. As can be seen, if the compensation factor is positive, the control signal will be greater than 50% i.e. the two pumps will have to work harder to achieve the desired flow. Conversely, if the compensation factor is negative, the result is that the two pumps run at a slower speed than normal to negate the unwanted effects on flow.

The compensation coefficients are set in EDS 49 and 50, and can be set between –50 and +50 in steps of 0.5. The nunber relates to the compensation filter function and does not have a direct numerical equivalent in change of control signal or outflow. This allows for accurate fine-tuning during commissioning and re-tuning of the system during maintenance without changing the pump profiles.

10.2.4. Setting Compensation Factors

The VFD Equalizer has two compensation parameters for tuning the VFD system depending on how EDS 11—Group Configuration is set:

- If EDS 11 is Off, only EDS 49 is used.
- If Group One pumps are set to turn off when Group Two pumps turn on, then both EDSs 49 and 50 are used to set compensation. The compensator for Group One pumps is set with EDS 49 and that for Group Two pumps with EDS 50.

The value to enter into the EDS setting will 50 plus the compensation factor to use. (Because negative numbers cannot be represented on the bar graph.) To simplifiy this, the translation table below can be used when entering compensation factors.

VFD Compensation Coefficient (cf)	Entered Value for EDS 49 or 50
-50cf	0
-40cf	10
-30cf	20
-20cf	30
-10cf	40
0cf	50 (default)
10cf	60
20cf	70
30cf	80
40cf	90
50cf	100

Table 5 – How to enter VFD Compensation Coefficients

Chapter 11 Resetting and Upgrading the Controller

11.1. Resetting Controller Defaults

You can return the MultiTrode Pump Controller's settings to their default state by performing either a full or partial reset.

- A **full default reset** returns all EDSs, Levels, Delays, Sensitivities and Alternation information to their default values.
- A **partial defaults reset** only resets the levels and delays.

The default values for all EDS's and other settings are shown in Appendix A.

To perform a full or partial defaults reset:

1. From the default display, reset the unit by pressing RESET ONE, RESET TWO and ALARM RESET simultaneously.
2. During the lamp test press RESET ONE.
3. While the toggle light is flashing,
   - press RESET TWO to perform a **partial** reset, or
   - press SELECT TWO to perform a **full** reset.
4. The controller will confirm the factory defaults reset by performing another reset, indicated by a lamp test. **If the controller does not perform the lamp test, this procedure did not occur correctly. The procedure should be repeated.**

CAUTION: RESETTING A UNIT WILL STOP ALL RUNNING PUMPS WITHOUT INTERPUMP DELAYS, RESET ALL FAULTS AND ALARMS AND CLEAR ALL PENDING CONDITIONS.

The tables in Appendix A show the default settings for all controllers in a multi-controller network.

11.2. Restarting the Controller

To restart the controller, press SELECT ONE, SELECT TWO and DUTY SELECT (LEAD SELECT) simultaneously. This is equivalent to cycling the power and is necessary when entering the MultiTrode Firmware Upgrade utility.

CAUTION: A RESTART WILL STOP ALL PUMPS WITHOUT INTERPUMP DELAYS AND RESET ALL FAULTS AND ALARMS.

11.3. Controller Software Version

To determine the current software version of the controller, press ALARM RESET and DUTY SELECT (LEAD SELECT) simultaneously.

The major version number will be displayed on the screen on the bar graph, the minor numbers on the PUMP 1 and PUMP 2 columns. For example, Version 7.2.3 would be shown as the bottom seven segments of the bar graph lit, the bottom two segments of the PUMP 1 column lit and the bottom three segments of the PUMP 2 column lit.

11.4. Controller Serial Number

Each Version 7 controller has an individual serial number to uniquely identify the unit.

To read the serial number from the unit:

1. Press ALARM RESET and DUTY SELECT (LEAD SELECT) simultaneously.

   The version number should now be displayed as described in section 11.3.

2. Press ALARM RESET and DUTY SELECT (LEAD SELECT) simultaneously **again** to view the serial number.

3. Now read the serial number:

   The bar graph shows the value. The PUMP 1 column indicates which digit is being displayed. The display moves to the next digit every two seconds.

   For example: The Pump One SEAL FAILURE light turns on to indicate the first digit is being displayed. sensor 1 on the bar graph (read from the top) is lit on the bar to indicate that the first digit is a 1. The display then moves to the MOTOR OVERTEMP light to indicate the second digit is being displayed on the bar graph. This might be, say, sensor 3 to indicate that the second digit is a 3.

   There are eight digits in total. The first three or four digits will normally be zeros.

4. The controller continues displaying the serial number until you press DUTY SELECT (LEAD SELECT) (EXIT).

11.5. Upgrading Firmware

To upgrade firmware, connect a PC or laptop, running MultiTrode's MTCDS software suit, to the rear of the installed MT3PC using the MultiTrode upgrade lead. See the MTCDS manual for more details.

CAUTION: ONLY MULTITRODE APPROVED CABLES ARE TO BE USED FOR CONNECTING TO THE COMMUNICATIONS PORT. HARDWARE DAMAGE MAY OCCUR IF OTHER CABLES ARE USED.

Chapter 12 Installing and Wiring the MT3PC

12.1. Installation Instructions

The following sections describe the two methods of mounting the MT3PC.

12.1.1. Method 1—DIN Rail (Preferred)

This is the preferred method of mounting. The controller is mounted on the gear plate using the DIN rail clips and the keypad is screwed to the inner door of the switchboard. The keypad is then plugged into the keypad port on the controller.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD TWO KEYPAD FRONT PANELS BE CONNECTED TO A SINGLE CONTROLLER.

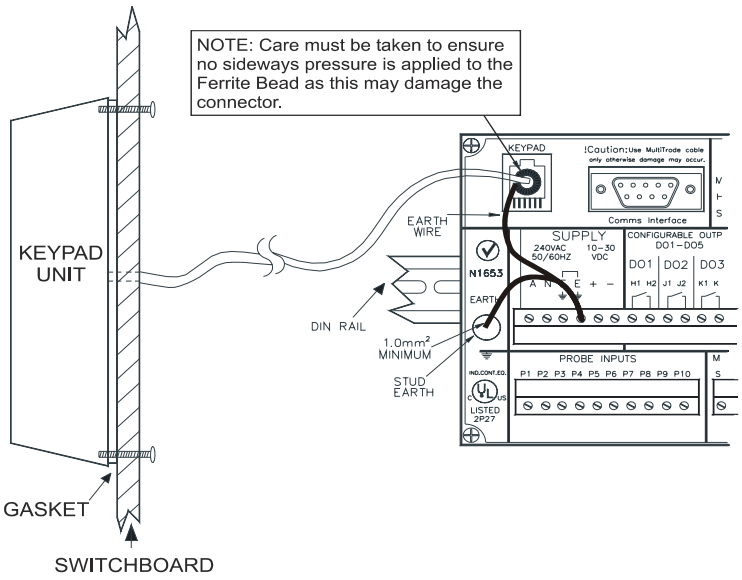


Figure 25: Standard Installation of MT3PC

CAUTION: THE SHIELDED CABLE MUST BE CONNECTED TO THE EARTH TERMINAL AS SHOWN IN FIGURE 25 TO ENSURE COMPLIANCE WITH EMC. THE EARTH STUD MUST ALSO BE CONNECTED TO THE EARTH TERMINAL TO MEET EMC REQUIREMENTS.

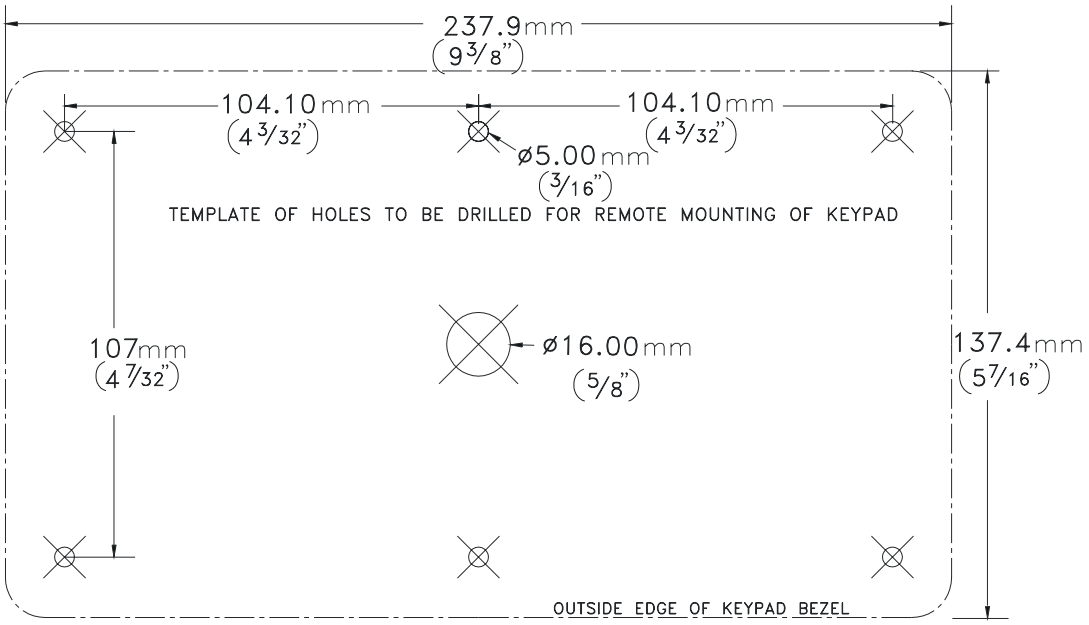


Figure 26: Mounting template for Keypad (for reference only; not actual size)

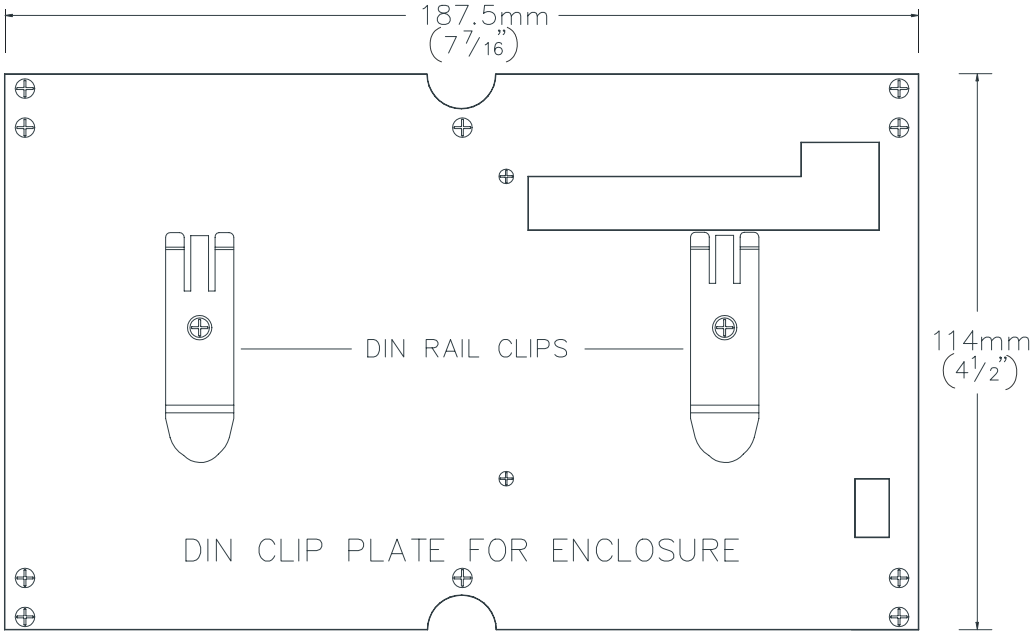


Figure 27: Mounting template for controller showing DIN mounting clips (for reference only; not actual size)

12.1.2. Method 2—Panel Mount

The MT3PC can be panel mounted as a complete unit on an inner door, as shown in the diagrams following.

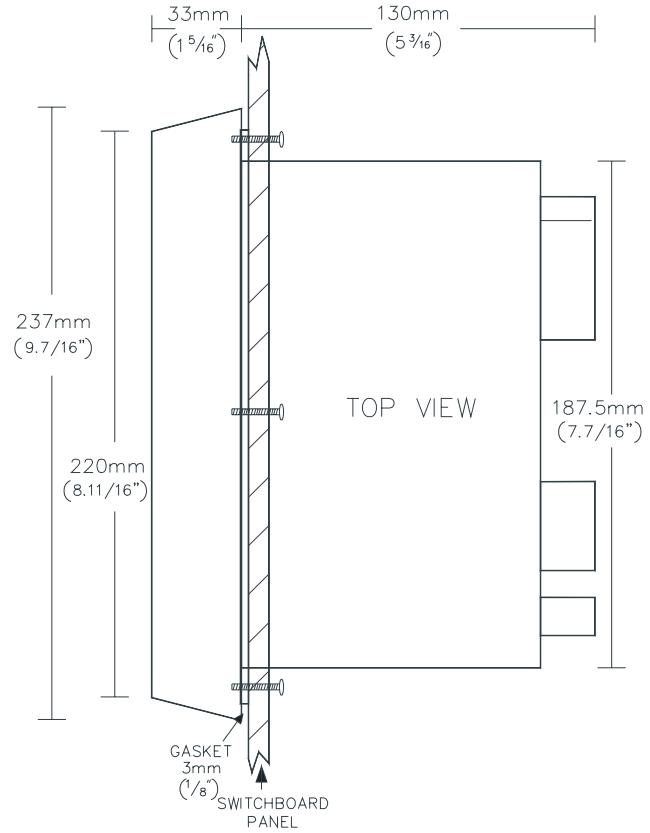


Figure 28: Top View of a Panel Mounted MT3PC

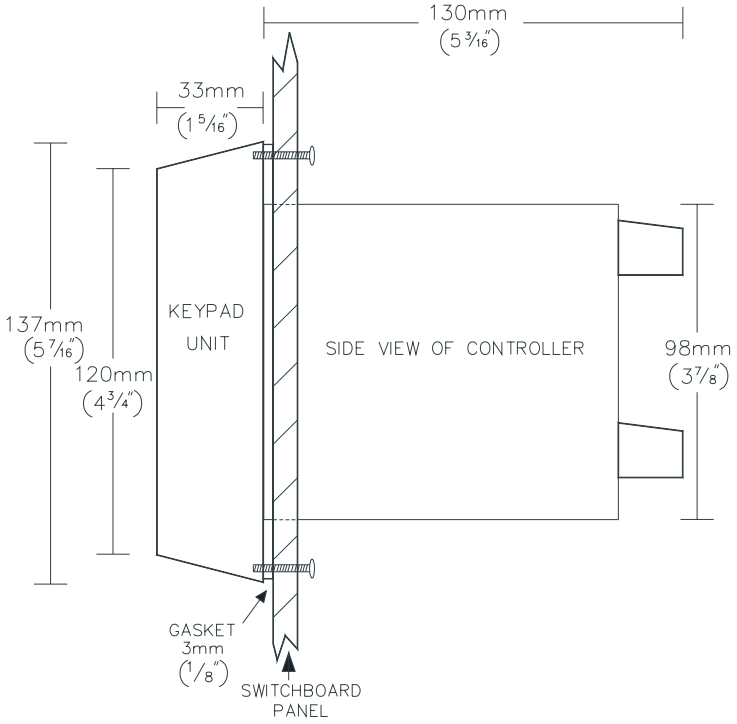


Figure 29: Side View of a Panel Mounted MT3PC

If this method of installation is used, connect the short cable (optionally supplied in the MTxPC Panel Mounting Kit) between the keypad and the controller as shown below, then screw the two sections together with the screws supplied in the Panel Mounting Kit. Ensure that the keypad cable is placed in the recess at the back of the keypad unit and not pinched as the controller is screwed on to the keypad.

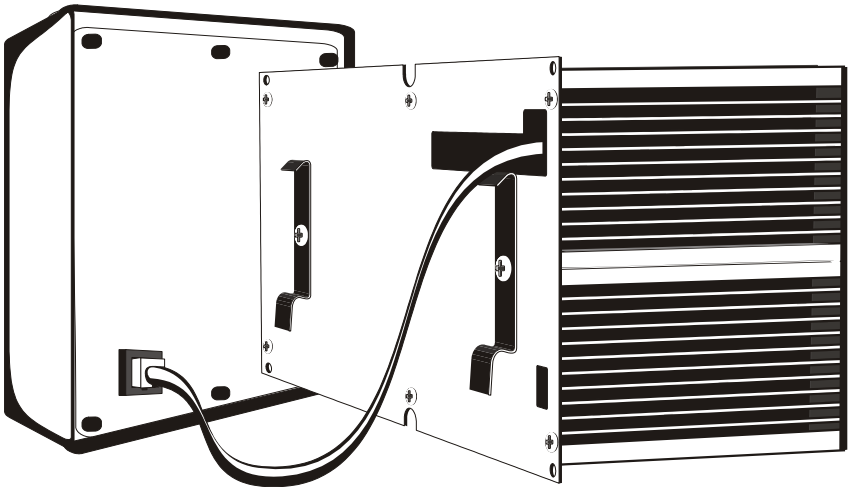


Figure 30: Connecting the short keypad cable between the keypad and controller.

12.2. Wiring Instructions

The following sections provide a detailed description of how to wire the MT3PC.

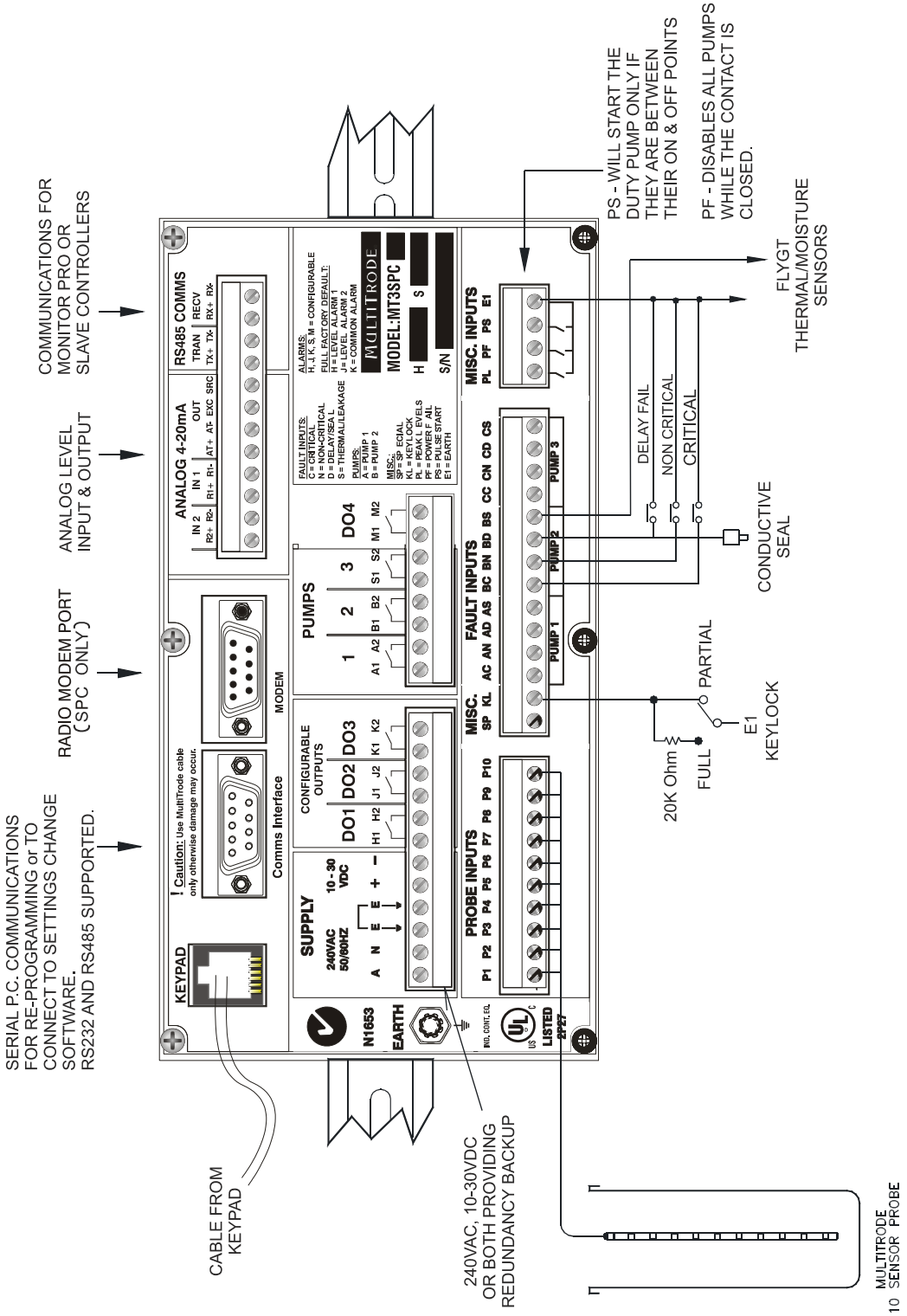


Figure 31: Back Panel Wiring Connections.

12.2.1. Supply Voltage

The power supply for the MT3PC can be a mains supply (240 V or 110 V) at 50 / 60 Hz, and/or a DC supply between 10 and 30 V simultaneously. Both supplies can be connected at the same time for redundancy.

A suitably rated circuit breaker (20VA, delay acting) should be installed in series with the Active Line, and the equipment should be suitably isolated with an isolation switch, as there is no power switch on the unit.

All installations, including DC powered installations, require the Power Earth to be connected to a secure earth, both for safety and for the correct operation of conductive probes.

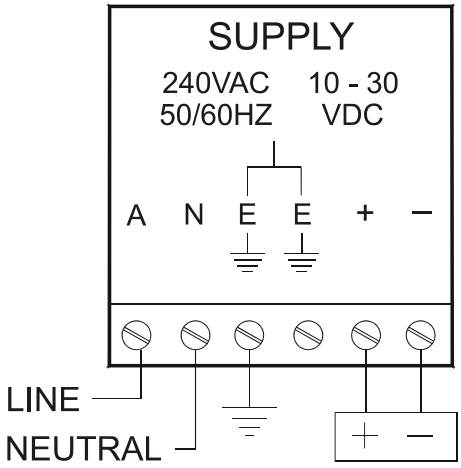


Figure 32: Power Supply Wiring.

WARNING: FAILURE TO CONNECT THE EQUIPMENT TO A SUITABLE EARTH COULD LEAD TO INCORRECT OPERATION, EQUIPMENT DAMAGE, INJURY OR DEATH.

12.2.2. Level Devices

There are many types of level sensing devices compatible with the MT3PC. The most common types are listed below.

12.2.2.1. 10 Sensor Probe

Wire each cable of the multi-sensor probe into its corresponding probe input terminal. Each wire from the probe is numbered from 1 to 10. Number 1 connects to input P1. Number 10 connects to P10. When the probe is suspended from its cable, number 1 is the top sensor and number 10 is the bottom.

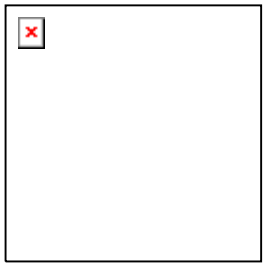


Figure 33: Probe Inputs

12.2.2.2. Single Sensor Probes

Connect the single sensor probes to the appropriate probe terminals on the MT3PC.

When used with single sensor probes, you must configure the MT3PC to operate in Single Sensor Mode with **EDS** 7. A probe sensor must be connected to each level input where an activation or deactivation point has been set..

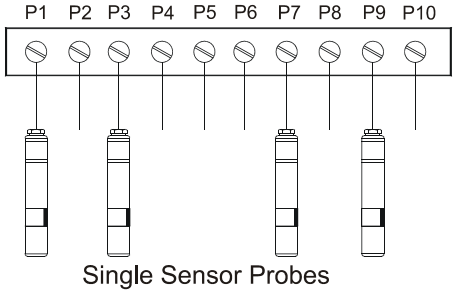


Figure 34: Probe Inputs.

12.2.2.3. Ball Floats

Wire each ball float into the desired input terminal on the rear of the MT3PC.

When ball floats are in use, the MT3PC must be set to operate in Single Sensor Mode with EDS 7. A ball float must be connected to each level input which has an activation or deactivation level assigned to it. The ball float N/O contacts should close between the "E" terminal and the corresponding "P" terminal when the float is in its "wet" state.

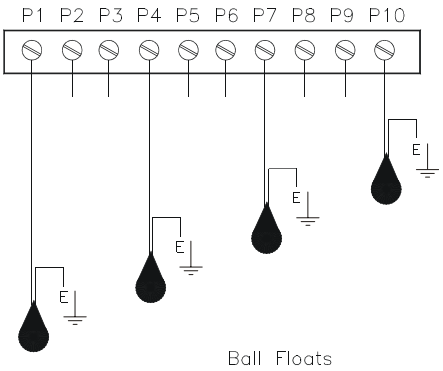


Figure 35: Ball Float Inputs

12.2.2.4. Analog Input

Use the following configurations if analog devices are used.

Notes: 1. When using external excitation do not exceed 13.75 VDC.

2. Analog input resistance = 75Ω.

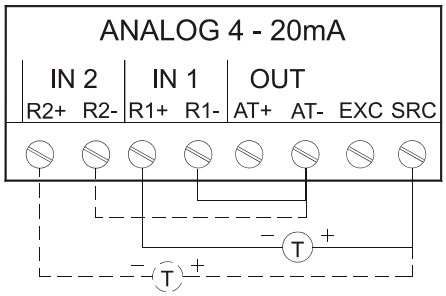


Figure 36: MT3PC Excitation—Two Wire.

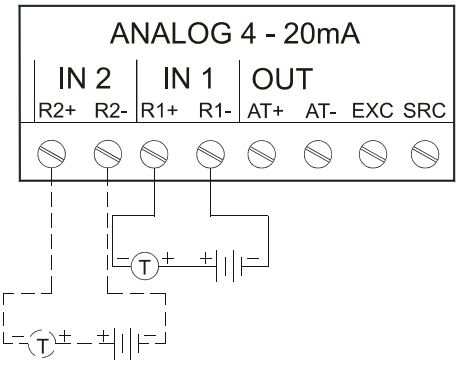


Figure 37: External Excitation—Two Wire.

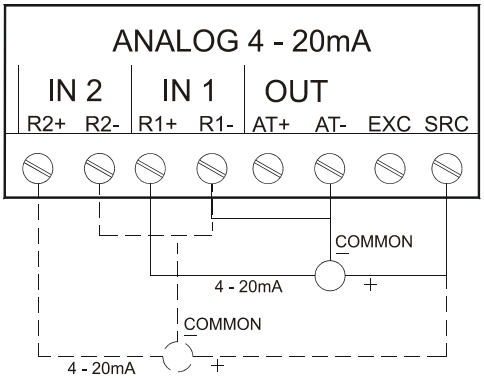


Figure 38: MT3PC Excitation—Three Wire.

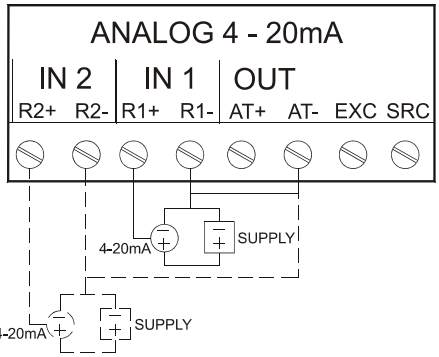


Figure 39: External Excitation—Three Wire.

Note: If the analog input is to be wired as in Figure 37, it is preferable to earth the negative leg of the loop supply. Check the manuals of your transducer and power supply to determine if this will be acceptable.

12.2.3. Outputs

This section describes the wiring for the Pump Controller outputs.

12.2.3.1. Pump Relays

Connect the Active (Line) to A1, B1 and C1. Wire the pump contactor coils or start relays to outputs A2, B2 and C2. Relays are rated at 250 V, 5 amp resistive or 2 amp inductive.

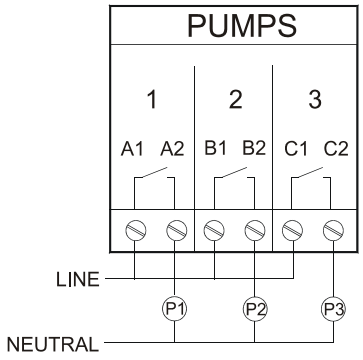


Figure 40: Relay Contact.

IMPORTANT**: CONTACT SPIKE SUPPRESSORS**

EACH RELAY HAS AN RC SUPPRESSOR FITTED. ENSURE THE ACTIVE (LINE) / LOAD CONNECTIONS ARE AS FOLLOWS:

CONNECT ACTIVE TO A1, B1, H1, J1, K1 AND M1.

CONNECT LOAD TO A2, B2, H2, J2, K2 AND M2.

MULTITRODE RECOMMENDS USING SLAVE RELAYS WHEN CONNECTING A VARIABLE FREQUENCY DRIVE TO THESE OUTPUTS. THIS IS TO STOP ANY LEAKAGE CURRENT TURNING ON THE MOTORS.

REVERSAL OF THE CONTACT CONNECTIONS WILL RENDER THE CONTACT SPIKE SUPPRESSORS INEFFECTIVE.

Note: If switching contactors via slave relays directly connected to the controller, the internal RCs will not be effective against spikes generated by these contactors. RCs are available from your local MultiTrode distributor or electrical wholesaler.

12.2.3.2. Configurable Digital Outputs

A digital output is activated when its selected source condition is met (see section 8.7 for more information on how to configure a digital (relay) output.

Note: See 12.2.3.1—Pump Relays for important information concerning spike suppressors present on these outputs.

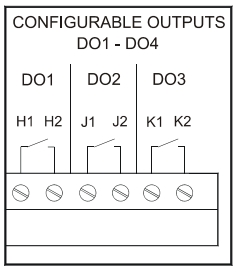


Figure 41: Configurable Relay Connections.

12.2.3.3. Analog Output

A 4–20 mA signal, representing the level being measured, is output at terminals AT+ and AT–.

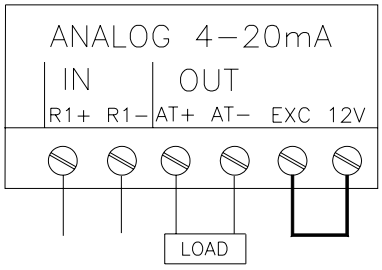


Figure 42: Internal Excitation for Analog Output

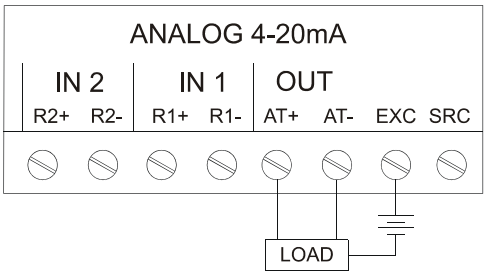


Figure 43: External Excitation for Analog Output

Note: The load resistance must not exceed 500Ω

12.2.4. Inputs

12.2.4.1. Critical, Non-Critical and Delay Fault Inputs

Wire the pump fault inputs as follows:

AC, BC, CC. Critical faults

AN, BN, CN. Non-critical faults

AD, BD, CD. Delay faults and conductive seals

A closed dry contact making a circuit between the fault-input terminal and the E1 terminal activates that fault.

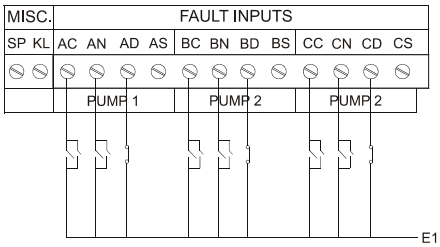


Figure 44: Fault Connections.

You can configure the fault inputs to accept open or closed contacts for fault detection (see section 8.4).

12.2.4.2. Flygt FLS

When using the Flygt FLS sensors connect as shown in the diagram. You can configure the seal fault and thermal fault to lock out the pump if required independently.

After wiring in the sensor, set EDS 27 to 4—Flygt Seal and Thermal so that the controller will operate correctly.

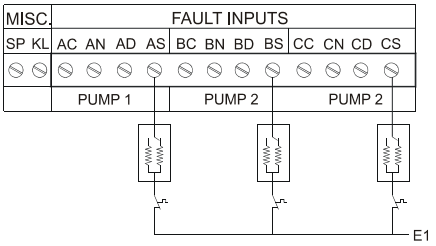


Figure 45: Flygt /Thermistor Connections.

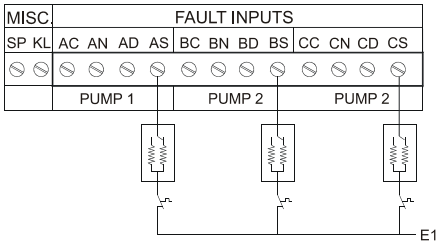
12.2.4.3. Thermistor

Wire a PTC Thermistor into the AS and BS fault inputs and CS. The condition of the fault is as follows:

3.3kΩ–O/C: Fault

1.8kΩ–2.5kΩ: Manually reset.

0–1.8k: Automatic reset.



After wiring, set EDS 27, 28 and 29 to the correct values for your installation.

Figure 46: Thermistor Connections.

12.2.4.4. Seal Failure Detection

Conductive seal sensors and relays are wired into the delay fail inputs (AD or BD).

After wiring, set EDS 27, 30 and 31 to the correct values for your installation.

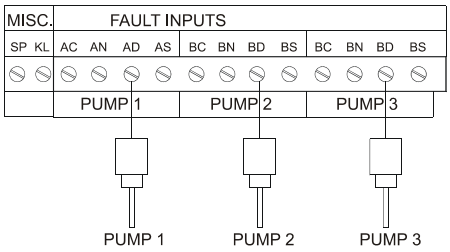
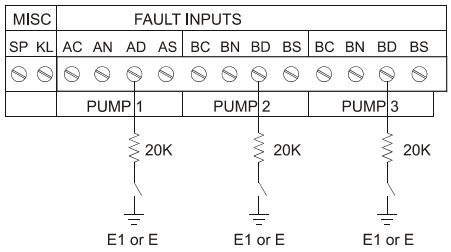


Figure 47: Inputs for conductive seal sensors



Insert a 20KΩ±20% resistor when External Seal Fail Relay is used

Figure 48: External Seal Fail Relay

12.2.4.5. "MiniCas" Relay

Minicas Relays have clean contact outputs, and so should just be wired into the Critical or non-Critical fault inputs, as shown in section 12.2.4.1.

12.2.4.6. Bi-Metal Strip

When using Bi-Metal Strips as a thermal overload device, connect to the Critical Fault inputs as shown in the diagram.

Then program EDS 24—Critical Fault Inputs NO/NC to On = Normally Closed. (i.e. open on fault.)

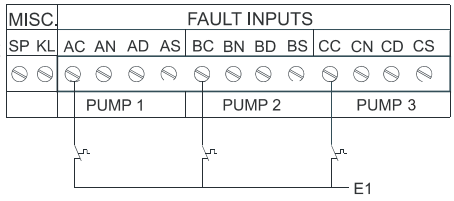


Figure 49: Bi-Metal Strip Connections.

12.2.4.7. Multiple Fault devices per motor

If a motor has both Flygt FLS outputs and Thermistor outputs, connect the FLS outputs as shown above in section 12.2.4.2, then use a separate thermistor relay to drive the thermistor, and connect the clean contact outputs between E1 and the critical fault input.

12.2.4.8. PF—Power Fail Input

To monitor the state of mains power when using a DC supply, wire a dry contact from an external relay from terminal PF to E1, e.g. Phase fail or phase rotation relay. This feature ensures that pumps start up in the correct sequence and with the correct delays when mains power returns. This input is also used as a hold out input to hold out pumps during peak electricity periods.

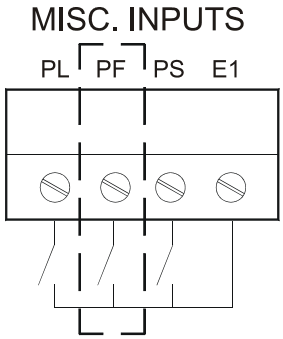


Figure 50: Power Fail Wiring

12.2.4.9. PS—Pulse Start

Closing a contact across PS and E1 activates a number of pumps. The number of pumps that will be started when this input is activated will determined by EDS 10. The pumps will keep running until their respective Deactivation levels are reached.

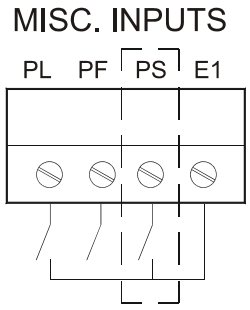


Figure 51: Pulse Start Wiring.

12.2.4.10. PL—Peak Levels

When the PL contact is closed, the MT3PC will use the controller's Peak Levels, otherwise it will use its Normal Levels.

If any of the Peak Level sources are active (refer to section 8.1.1), the controller will operate in Peak Levels Mode.

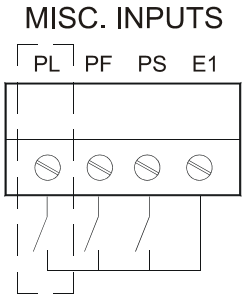


Figure 52: Peak Levels Wiring

12.2.4.11. KL—Keylock

There are three levels of key lockout security available.

No Lock. When the KL terminal is open circuit there is No Lock. All settings can be accessed via the front panel.

Partial. Connect the terminal directly to ground. This disables any programming button operations, but enables normal operation such as fault reset and mode selection.

Full. Connect KL to ground through a 20kΩ resistor. This locks out all buttons on the controller (The nearest standard resistor values of 18kΩ or 22 kΩ are acceptable).

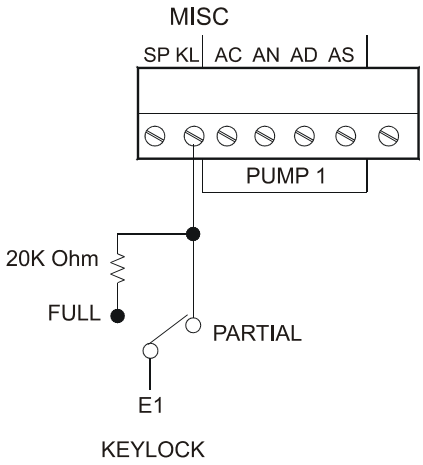


Figure 53: Keypad Lockout Wiring

12.2.5. Remote Keypad

A shielded cable is supplied to connect the controller to the display via the keypad sockets.

Note: the earth wire from the shielded cable must be connected to the earth terminal

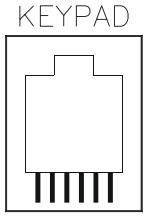


Figure 54: Keypad Socket

CAUTION: CARE MUST BE TAKEN TO ENSURE SIDEWAYS PRESSURE IS NOT APPLIED TO THE CABLE OTHERWISE DAMAGE MAY OCCUR.

UNDER NO CIRCUMSTANCES SHOULD TWO KEYPAD FRONT PANELS BE CONNECTED TO A SINGLE CONTROLLER.

12.2.6. Wiring the Well washer

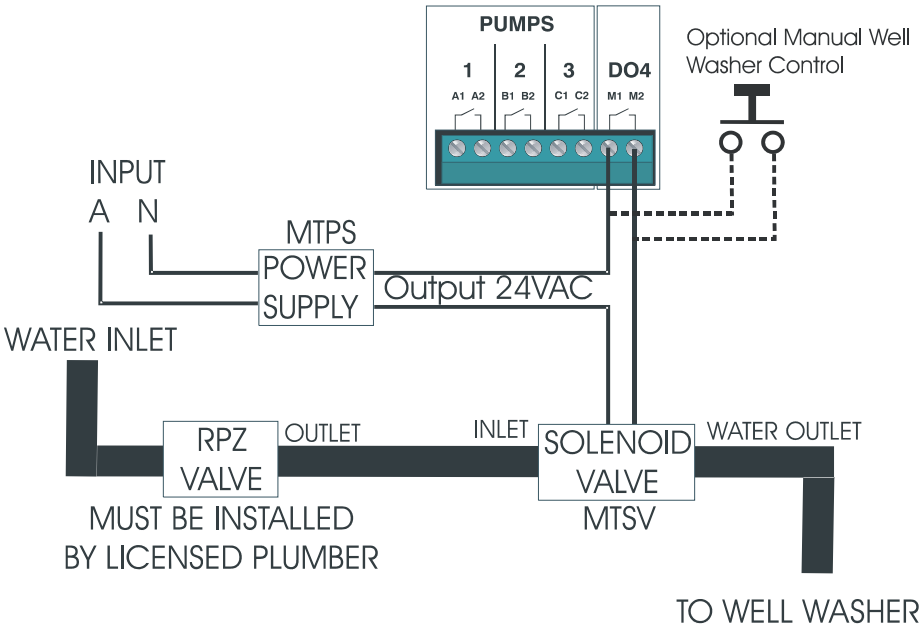


Figure 55: Wiring diagram for the well washer

12.3. Wiring the MT3PC to Other Units

12.3.1. Connecting the MT3PC to a MonitorPro

Follow the diagram below when connecting units together using the RS485 LAN.

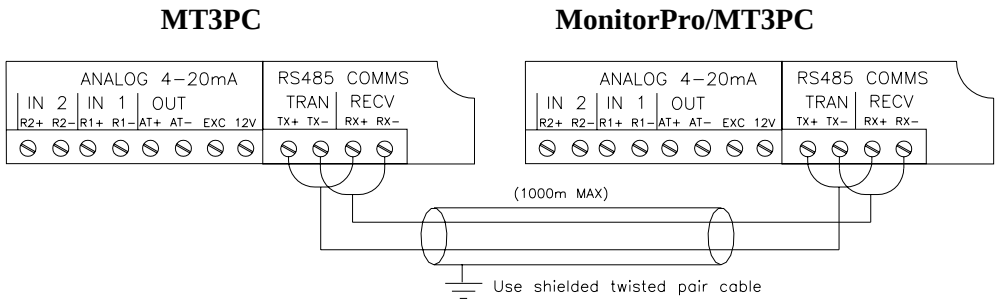


Figure 56: MonitorPro Wiring Connections with the MT3PC

12.3.1.1. Communications Interface

The female DB9 connection is a proprietary RS232/RS485 connection for use with the MTCDS Control and Diagnostics Software, and approved Digital Radios.

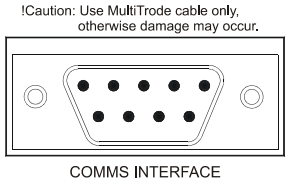


Figure 57: Communication DB9 Plug

CAUTION: ONLY MULTITRODE APPROVED CABLES ARE TO BE USED FOR CONNECTING TO THE COMMUNICATIONS PORT. HARDWARE DAMAGE MAY OCCUR IF OTHER CABLES ARE USED.

12.3.2. Connecting the MT3SPC to an Analog Radio for SCADA communications (SPC Version Only).

The Modem port is used to connect the MT3SPC to a MultiTrode approved analog radio.

The following table is the pinout of the DB9 modem port. All wiring to the radio should be confirmed with the radio manufacturer.

Pin Number	Function
1	Transmit—Audio out
2	Ground
3	Push to Talk—TX Enable
4	Receive—Audio in
5	Not Connected
6	Not Connected
7	Not Connected
8	Not Connected
9	Not Connected

Table 6 — Wiring Connections for the Radio Modem

12.3.3. Connecting the MT3PC to an Indicator Controller (MTIC)

The MT3PC can be connected to a MultiTrode Indicator Controller (MTIC) by wiring the unit as shown in the following diagram.

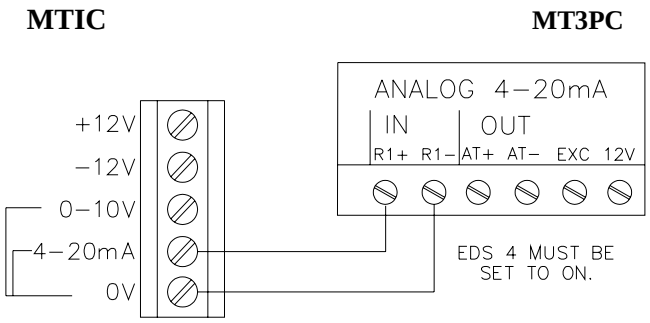


Figure 58: MT3PC connected to a MTIC

Note: Under no circumstances should R1– be connected to AT–.

12.4. Wiring Diagram

12.4.1. Non-VFD Versions

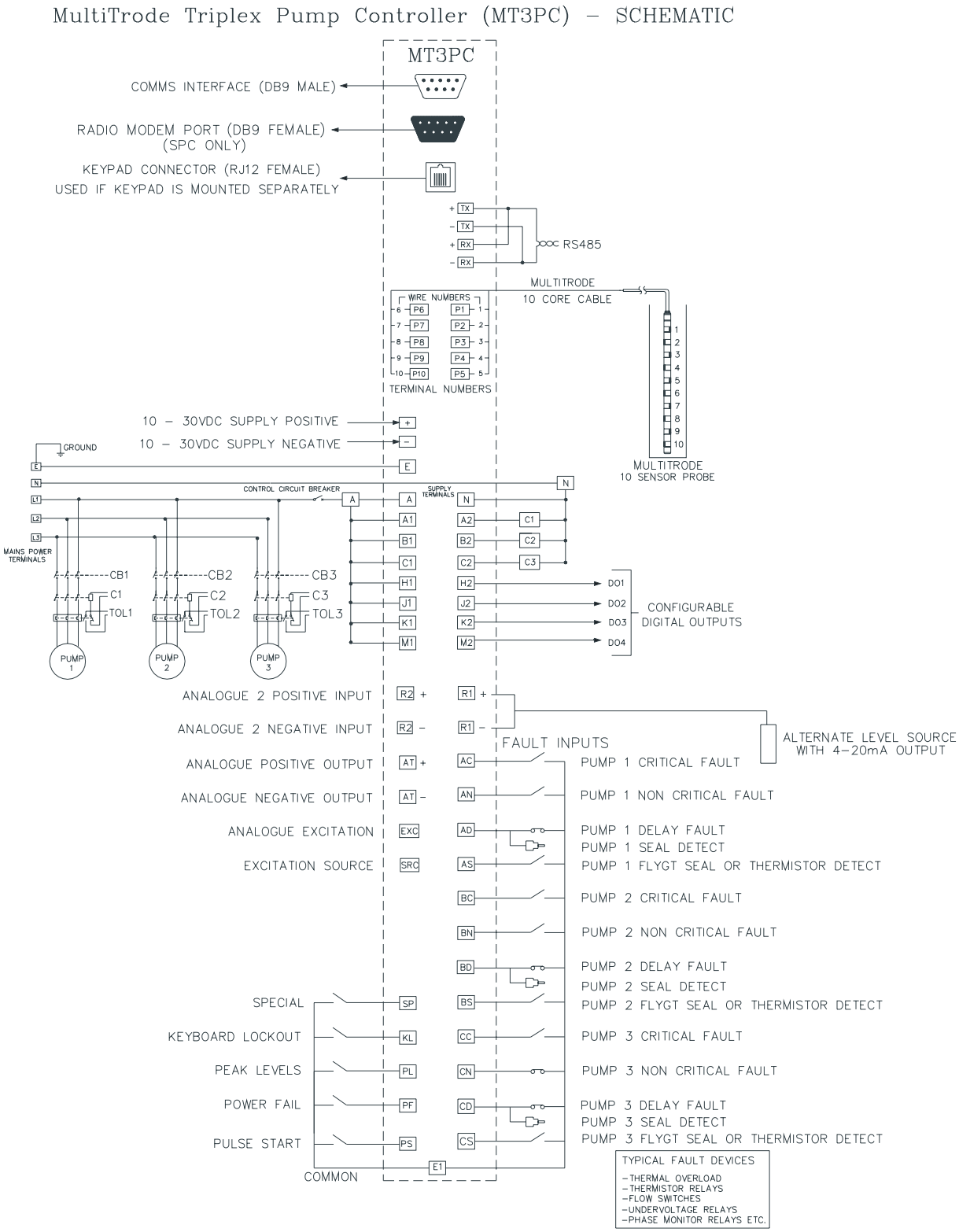


Figure 59: Non-VFD Schematic Diagram

12.4.2. VFD Versions

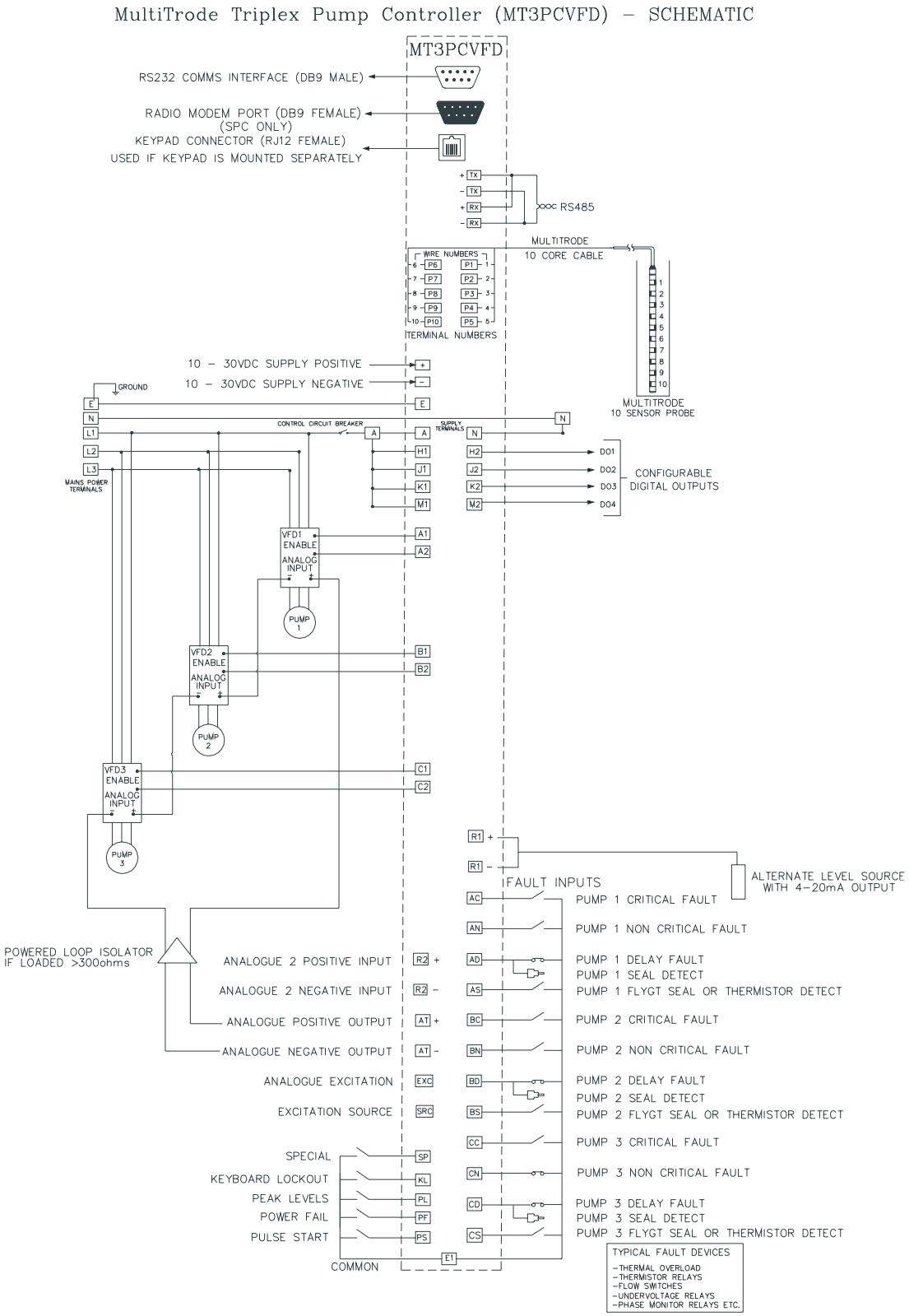


Figure 60: VFD Schematic Diagram

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Appendix A. Settings Quick Reference

A.1. EDS Quick Reference

EDS	Switch Function	Default Setting	Range	Your Setting
	LEVEL EDSs (See section 8.2 for more information)			
1	Charge (ON) / Discharge Mode (OFF)	Off = Discharge	On/Off	
2	Level Alarm Reset Mode (Off= Alarm condition resets automatically when alarm condition not present, On=manual reset required)	Off = Auto Reset	On/Off	
3	Level Alarm Flash (Off=steady, On=flash)	Off = Steady	On/Off	
4	Level Alarm Mute Time (Enables muting of alarm by pushing Alarm Reset button)	10 mins	0.25s – 120m	
5	Level Sensing Device Off = probe, 1 = analog input, 2 = analog input with probe backup 4 = dual analog input 7 = remote level device (via SCADA)	Off = Probe	Off – 10	
6	Level Sensor Timeout (before backup level sensor operates)	10 mins	0.25s – 120m	
7	Probe Single sensor/ Multi-sensor Input (not important if 4–20mA used as level device)	Off = Multi-sensor Probe	On/Off	
8	Use Normal Levels (Off) or Peak Levels (On)	Off = Use Normal Levels	On/Off	
	PUMP EDSs (See Section 8.3 for more information)			
9	Duty (Lead) Select Key Operation Off = no changes can be made 1 = Lead (Duty) select key cycles through alternation modes (Quickset Operation) 2 = customizable Fullset operation) - see MultiTrode web-site	1 = Quickset Operation	Off – 2	
10	Pulse Start Number of pumps (when PS input closes or SCADA signal received)	1 = 1 pump	Off – 9	
11	Group Configuration	Off = All Groups can run	Off – 5	
12	Interpump Start Delay	10 seconds	0.25s – 120m	
13	Interpump Stop Delay	0.25 seconds	0.25s – 120m	
14	Random Duty (Lead) Start Delay (for minimizing fat build-up at the pump setpoint)	0.25 seconds	0.25s – 120m	
15	Maximum Pumps to Run at One Time	Off = No Limit	Off – 9	
16	Consecutive Assist (Lag) Starts Before Duty (Lead) Lockout (blocked pump detection)	Off = No Limit	Off – 10 starts	
17	Desired Station Starts per Hour (adaptive level control)	Off = No Limit	Off – 60	
18	Override Level for Control Functions (Limits adaptive values in EDSs 11, 16, 17, 19 – 21)	Discharge mode = 90% Charge Mode = 10%	0 – 100%	
19	Maximum Starts per Hour Pump 1	Off = No Limit	Off – 60	

EDS	Switch Function	Default Setting	Range	Your Setting
20	Maximum Starts per Hour Pump 2	Off = No Limit	Off – 60	
21	Maximum Starts per Hour Pump 3 (MT3PC Only)	Off = No Limit	Off – 60	
22	Maximum Run Time hrs for Any Pumps (Inefficient pump detection)	Off = No Limit	Off – 10hrs	
23	Maximum Off Time hrs for Any Pumps (Odor reduction function)	Off = No Limit	Off – 10hrs	
	FAULT EDSs (See Section 8.4 for more information)			
24	Critical Fault Inputs NO /NC	Off = Normally Open	On/Off	
25	Non Critical Fault Inputs NO/NC	Off = Normally Open	On/Off	
26	Delay Fail Inputs NO/NC	Off = Normally Open	On/Off	
27	Thermal and Seal Fault Sources Off = No seal or thermal protection 1 = Conductive Seal (default) 2 = PTC Thermistor 3 = Conductive Seal and PTC Thermistor 4 = Flygt Seal and Thermal 5 = Conductive Seal with Delay Fail Disabled 6 = Conductive Seal and PTC Thermistor, with Delay Fail Disabled	1 = Conductive Seal	Off – 6	
28	Seal/Thermal Fault Buffer Time	0.25 seconds	0.25s – 120m	
29	Thermal Fault Display (0 = Off, 1 = Non Critical, 2 = Critical)	Off = Display Only	Off – 2	
30	Seal Fault Display (0 = Off, 1 = Non Critical, 2 = Critical)	Off = Display Only	Off – 2	
31	Seal Sensitivity	40K Ohms	1K – 120K	
32	Delay Fault Trip Time	10 seconds	0.25s – 120m	
33	Delay Fault Recovery Time	1 minute	0.25s – 120m	
34	Consecutive Delay Faults Before Lockout	Off = No Limit	Off – 10	
35	Decommission Pump 1	Off = Pump 1 Present	On/Off	
36	Decommission Pump 2	Off = Pump 2 Present	On/Off	
37	Decommission Pump 3 (MT3PC Only)	Off = Pump 3 Present	On/Off	
	LAN EDSs (See Section 8.6 for more information)			
38	LAN Mode (0 = Multi-Pump Mode, 1 = Mimic Mode, 2 = Multi Well Mode)	Off = Multi-Mode	Off – 2	
39	Master / Slave Mode (Off = Master, On = Slave)	Off = Master Mode	On/Off	
40	Slave 1 / Slave 2 Mode (Off = Slave1, On = Slave2)	Off = Slave 1	On/Off	
41	Number MT2/3PCs in a Group	1	1 – 3	
42	Group ID (RS485 comms)	1	1 – 9	
43	Maximum Groups in LAN	1	1 – 9	
44	Communications with MultiTrode network Off = no LAN, set while CDS software is used 1 = comms with MonitorPro 2 = comms with MonitorPro but lockout pumps if comms fail 3 (SPC only) = comms with SCADA enabled but LAN disabled 4 (SPC only) = comms with LAN and SCADA enabled	1 = Comms. Enabled (MTxPC) 4 = MTxSPC comms enabled (MTxSPC)	Off – 4	
45	LAN Communications Mode (Off=normal, On= aux. Telemetry device)	Off = Normal LAN Comms	On/Off	
46	Analog/Comms. Level % Change before logging	10%	1–20%	

EDS	Switch Function	Default Setting	Range	Your Setting
	ANALOG OUTPUT EDSs (See Chapter 10 for more information)			
47	Analog Output Mode Off = Analog Output Disabled 1 = Analog Output is Linear Level 2 = Analog Output is Inverted Linear Level 3 = Analog Output is VFD Output 4 = Analog Output is Inverted VFD Output 5 = Analog Output is set by CMF via comms	Linear	Off – 5	
48	Analog Output Ramp Time	0.25 seconds	0.25s – 120m	
49	VFD Equaliser Group One Compensation Coefficient	50%	0–100%	
50	VFD Equaliser Group Two Compensation Coefficient	50%	0–100%	
	DIGITAL OUTPUT EDSs (See Section 8.7 for source types)			
51	Digital (Relay) Output 1 Source	1 = Alarm 1	0–59	
52	Digital (Relay) Output 2 Source	2 = Alarm 2	0–59	
53	Digital (Relay) Output 3 Source	3 = Common Alarm	0–59	
54	Digital (Relay) Output 4 Source	0 = Null	0–59	
55	Digital (Relay) Output 5 Source (MT2PC Only)	0 = Null	0–59	
56	Digital (Relay) Output 1 NO/NC	Off = N/O	On/Off	
57	Digital (Relay) Output 2 NO/NC	Off = N/O	On/Off	
58	Digital (Relay) Output 3 NO/NC	Off = N/O	On/Off	
59	Digital (Relay) Output 4 NO/NC	Off = N/O	On/Off	
60	Digital (Relay) Output 5 NO/NC (MT2PC Only)	Off = N/O	On/Off	
	WELL WASHER EDSs (See section 0 for more information)			
61	Washer Activation Level	20%	0–100%	
62	Washer Maximum Run Time	2 minutes	0.25s – 120m	
63	Washer Interstart Period (minimizes water usage)	2 hrs	Off – 10hrs	
64	Washer Maximum Off Time (minimizes odors)	3 hrs	Off – 10hrs	
	SCADA COMMUNICATION EDSs (MT2SPC AND MT3SPC ONLY)			
65	SCADA Site number	11	11 – 255	
66	SCADA Quick Poll Region Number (see Outpost manual)	0	1 – 255	
67	SCADA Quick Poll Sequence Number (see Outpost manual)	0	1 – 255	
68	Power Up Radio Delay (Multiples of 20ms.)	20 = 400 ms.	0 – 100	
69	SCADA transmission BAUD Rate (0 = 1200, 1 = 2400 and 2 = 4800)	0 = 1200	0 – 2	
	CONFIGURABLE INPUTS EDSs			
70	Key Lock (KL) / Configurable Input Telemetry	Off = Key Lock (KL)	On/Off	
71	Critical Fault Pump A (AC) / Configurable Input Telemetry	Off = Critical fault Pump A	On/Off	
72	Non-critical Fault Pump A (AN) / Configurable Input Telemetry	Off = NC Fault Pump A	On/Off	
73	Delay Fault Pump A (AD) / Configurable Input Telemetry	Off = Delay Fault Pump A	On/Off	
74	Seal Fault Pump A (AS) / Configurable Input Telemetry	Off = Seal Fault Pump A	On/Off	
75	Critical Fault Pump B (BC) / Configurable Input Telemetry	Off = Critical fault Pump B	On/Off	
76	Non-critical Fault Pump B (BN) / Configurable Input Telemetry	Off = NC Fault Pump B	On/Off	
77	Delay Fault Pump B (BD) / Configurable Input Telemetry	Off = Delay Fault Pump B	On/Off	
78	Seal Fault Pump B (BS) / Configurable Input Telemetry	Off = Seal Fault Pump B	On/Off	
79	Critical Fault Pump C (CC) / Configurable Input Telemetry	Off = Critical fault Pump C	On/Off	
80	Non-critical Fault Pump C (CN) / Configurable Input Telemetry	Off = NC Fault Pump C	On/Off	
81	Delay Fault Pump C (CD) / Configurable Input Telemetry	Off = Delay Fault Pump C	On/Off	
82	Seal Fault Pump C (CS) / Configurable Input Telemetry	Off = Seal Fault Pump C	On/Off	
83	Peak Levels (PL) / Configurable Input Telemetry	Off = Peak Levels (PL)	On/Off	

EDS	Switch Function	Default Setting	Range	Your Setting
84	Power Fail (PF) / Configurable Input Telemetry	Off = Power Failure (PF)	On/Off	
85	Pulse Start (PS) / Configurable Input Telemetry	Off = Pulse Start (PS)	On/Off	
	SUMP CLEAN-OUT EDSs (See section 8.8 for more information)			
86	Number of full pump cycles between clean-outs	0 = Off	0ff – 255	
87	Run-on time for clean-out	10 seconds	0.25s – 120m	

A.2. Other Settings Quick Reference

Normal Levels												
Pump	Activation			Deactivation			VFD Start Speed			VFD 100%r Level		
	Default		Your Setting	Default		Your Setting	Default		Your Setting	Default		Your Setting
	Discharge Mode	Charge Mode		Discharge Mode	Charge Mode		Discharge Mode	Charge Mode		Discharge Mode	Charge Mode	
1	50	50		10	90		50	50		65	35	
2	60	40		20	80		50	50		75	25	
3	70	30		30	70		50	50		85	15	
4	80	20		40	60		50	50		95	5	
5	90	10		40	60		50	50		95	5	
6	90	10		40	60		50	50		95	5	
7	90	10		40	60		50	50		95	5	
8	90	10		40	60		50	50		95	5	
9	90	10		40	60		50	50		95	5	

Peak Levels												
Pump	Activation			Deactivation			VFD Start Speed			VFD 100%r Level		
	Default		Your Setting	Default		Your Setting	Default		Your Setting	Default		Your Setting
	Discharge Mode	Charge Mode		Discharge Mode	Charge Mode		Discharge Mode	Charge Mode		Discharge Mode	Charge Mode	
1	60	40		10	90		60	60		70	30	
2	70	30		20	80		60	60		80	20	
3	80	20		30	70		60	60		90	10	
4	90	10		40	60		60	60		95	5	
5	90	10		40	60		60	60		95	5	
6	90	10		40	60		60	60		95	5	
7	90	10		40	60		60	60		95	5	
8	90	10		40	60		60	60		95	5	
9	90	10		40	60		60	60		95	5	

Alarm Levels								
	Normal Levels				Peak Levels			
Alarm	Activation		Deactivation		Activation		Deactivation	
	Default	Your Setting	Default	Your Setting	Default	Your Setting	Default	Your Setting
1	100		90		100		90	
2	Disabled		Disabled		Disabled		Disabled	
3	100		90		100		90	
4	Disabled		Disabled		Disabled		Disabled	
5	100		90		100		90	
6	Disabled		Disabled		Disabled		Disabled	

Delays								
Normal Levels					Peak Levels			
Pump	Activation		Deactivation		Activation		Deactivation	
	Default	Your Setting	Default	Your Setting	Default	Your Setting	Default	Your Setting
1	1 sec		1 sec		1 sec		1 sec	
2	1 sec		1 sec		1 sec		1 sec	
3	1 sec		1 sec		1 sec		1 sec	
4	1 sec		1 sec		1 sec		1 sec	
5	1 sec		1 sec		1 sec		1 sec	
6	1 sec		1 sec		1 sec		1 sec	
7	1 sec		1 sec		1 sec		1 sec	
8	1 sec		1 sec		1 sec		1 sec	
9	1 sec		1 sec		1 sec		1 sec	

Setting	Default	Your Setting
Sensitivity	20KΩ	
Analog Input 1 Zero	4.08	
Analog Input 1 Span	20.4	
Analog Input 2 Zero	4.08	
Analog Input 2 Span	20.4	
Group 1 Sequence	123456789	
Group 1 Alternation	On	
Group 2 Sequence	-	
Group 2 Alternation	On	
Software Version Number	-	

Appendix B. Technical Specifications

B.1. Mode of Operation

Charge or Discharge (Fill or Empty)

B.2. Probe Inputs

Sensor Inputs	10
Sensor Voltag	12VAC Nominal
Sensor Current	0.8mA max (per sensor)
Sensitivity	1kΩ, 2kΩ, 4kΩ, 10kΩ, 15kΩ, 20kΩ, 30kΩ, 40kΩ, 80kΩ, 120kΩ

B.3. Other Inputs

Analogue	2 x 4-20mA
Other inputs	Pulse start / Hold-Out / Peak levels

B.4. Relay Outputs

MT2PC relay outputs	2 pumps and 5 configurable
MT3PC relay outputs	3 pumps and 4 configurable
Output delays	0.25 to 120 sec, 0.25 to 120 minutes
Relay contact rating	250VAC 5A Resistive, 2A Inductive
Relay contact life	10^5 Operations
Terminal size	2 x 2.5mm^2, 13#

B.5. Other Outputs

Analog	4-20mA RL < 500 Ω
Keypad Remote	

B.6. Communications

Digital	RS485 / RS422, RS232

B.7. Display

LEDs	High Intensity (Red & Green)

B.8. Dimensions

Dimensions mm	137H x 237W x 162D

Mounting	Panel mounted or DIN Rail
	keypad may be remotely mounted
Enclosure	Extruded aluminium

B.9. Power Supply

Supply Voltage AC	110VAC ± 10%(MTx[S]PC[-VFD]-**2**) or
	240VAC ± 10%(MTx[S]PC[-VFD]-**3**) Nominal
	50/60Hz
Power Consumption	18VA max
Supply Voltage DC	10-30VDC - 12W max

B.10. Environmental Range

Operating Temperature Range	-10 C to + 60 C (Celsius)
	+14 F to + 140 F (Fahrenheit)
Humidity	90% non condensing
Protection	IP20 (controller)
	IP56 (Keypad when mounted correctly with gasket)
Altitude	<2000m above sea level

B.11. Approvals

N1653

C-tick – Emissions AS/NZS2064:1997 Group1, Class A; (EN50081-2)

US LISTED 2P27

UL Listing to UL507, sixteenth edition.