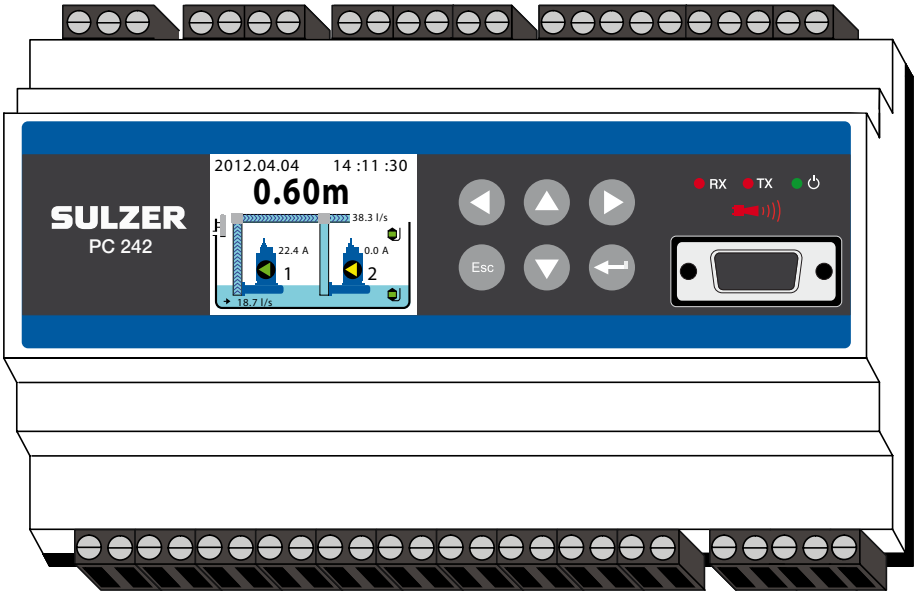
Pump Controller Type ABS PC 242



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User Guide SW 1.48

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ABOUT THIS GUIDE, AUDIENCE AND CONCEPTS

This guide describes the pump control units PC 242. PC 242 has a graphical display where you can see and control all aspects of the pumps and the conditions in the pit. These pump controller can either be used stand-alone or communicate all values and conditions to a central supervisory and operating system, such as AquaWeb from Sulzer.

Audience This guide is intended for system administrators and operators of PC 242 pump controller.

Prerequisites This guide assumes that you already are acquainted with those pumps you are set to control and have the sensor connected to PC 242.

The system administrator must also know the following:

1. The pump controller can either use an analogue level- sensor, which measures the water level in the pit, for precise control over start and stop levels, or it can use simple float switches placed at start and stop levels.
   - Float switches can be used in addition to an analogue level-sensor, as a backup, and as an additional alarm input.
   - An analogue level-sensor has several advantages over float switches: it is more robust (can not get stuck or be mechanically jammed); it is more accurate; it is more flexible (you can easily change the start and stop levels); you can get readings of the water level in the pit, the inflow, overflow and the pump capacity; you can optimize the pump performance in various ways, including exercising, alternative stop levels, tariff control etcetera.
   - It is also possible to employ an alternative stop level, usually a lower level than normal, which is effective once after a number of pump starts. This can be useful if it is desirable to “completely” empty the pit once in a while.
2. You need to know if the pump(s) should be exercised in case of long idle periods. If the installation has two pumps or more, you need to decide if the pumps should alternate.
3. If the electricity has daily varying tariffs, you must know the times of high/low tariffs.
4. You must know how overflow will be measured; if it will be measured using both an overflow sensor (to detect the start of the overflow) and a level sensor (to measure the actual flow), you must know the parameters (exponents and constants) to be entered as settings so that the overflow can be accurately measured by a calculation in PC 242.
5. You need to know which alarm class, A-alarm or B-alarm (see Glossary and conventions), to assign each alarm.
6. You must know how the unit should communicate—via a modem or via a fixed line, and any details that may require.
7. You should have a plan that includes such issues as: which alarm class (A-alarm or B-alarm) to assign each alarm; if pumps should alternate; if they should be exercised in case of long idle periods, etc.

Installation guide There is a separate installation guide, see reference [1] below.

NOTE! The default settings are listed in the Installation Guide

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Reading guide

Start by reading Chapter 1 *Overview on page 3*. It describes the general functionality, the graphical display (PC 242), the meaning and usage of the buttons, pass codes etc.

The system administrator must ensure that all settings according to Chapter 2 *Make Your Settings* are suitable for your application. For PC 242, these settings are accessed directly via menu items in the graphical display.

Most settings in Chapter 2 only apply to the system administrator, but the following also apply to those who only operate the controller: language selection, date and time settings, units, backlight timeout, pass codes, start/stop levels.

Chapter 3 *Daily Operation (PC 242)* on page 23 covers the topics needed for the regular daily operation of PC 242.

Related literature

(1) *Advanced Pump Controller PC 242, Installation Guide*
(included both on the CD and as a multilingual printed booklet)

(2) *COMLI/Modbus PC 242* (included on the CD)

(3) AquaProg 4 (for configuring pump controllers)

(4) AquaVision 6 (a supervisory and operating system for pump stations)

Glossary and conventions

To designate a menu item in a hierarchy, an angle bracket is used to separate the levels. Example: *Settings* > *System* means the menu item you reach by first choosing the menu item *Settings*, which has a number of submenus, where you choose the menu item *System*. Text in blue (like blue) indicates a hypertext link. If you read this document on a computer, you can click on the item and you will be taken to the link destination.

Alarm class: The alarm class can be either A-alarm or B-alarm. A-alarms are those that require immediate action, so operational staff in the field should be alerted regardless of the time of day. B-alarms are less important, but should be taken care of during normal work hours.

Pump exercising: Long idle periods in a corrosive contaminated environment are not good for pumps. As a countermeasure, they can be “exercised” at regular intervals, which will reduce corrosion and other detrimental effects.

Digital In means a signal that is either *on* or *off* (*high* or *low*), where *high* is anything between 5 and 34 volts DC, and *low* is anything below 2 volts.

Digital Output means a relay that may either be *normally closed* or *normally open*.

Analogue Inputs are for sensors, and these inputs sense current in the range 4–20mA or 0–20mA.

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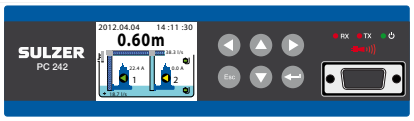
1 OVERVIEW



PC 242 is a control unit for two pumps. PC 242 has a graphical display where you can see and control all aspects of the pumps and the conditions in the pit. This pump controller can either be used stand-alone or communicate all values and conditions to a central supervisory and operating system, such as AquaWeb from Sulzer.

The unit includes all the means necessary for communicating all values and conditions to a central supervisory and operating system.
Communication methods include:

- Analogue modem
- GSM modem
- GPRS modem
- Fixed connection over radio or cable
- Fix IP TCP Listen

Alarms may be sent to the central supervisory system or sent as SMS to a mobile phone. When the PC 242 communicates via a modem, four phone numbers can be defined, which are attempted in sequence until it successfully can deliver the alarm or until an attempt limit is reached. These attempts are all configurable for various conditions, such as the alarm class. As an example: if it fails to deliver an alarm to the central supervisory system, it can send an SMS to a mobile phone, but only if the alarm class is an A-alarm.
If the PC 242 is setup for alarm handling via SMS direct to a mobile phone and not via a SCADA system, the alarm will be sent out when the alarm trips. No SMS will be sent out when the alarm is acknowledged or returned to normal status.

Alarms accumulate in an alarm log, and they can be acknowledged either remotely or locally on the controller.

In the following, we describe the panel of PC 242 (Section 1.1) including its buttons and light indicators:

1.1 *The PC 242 panel*

The default (top-level) view of the display on the PC 242 dynamically shows the operating status of the pumps and conditions in the pit, displaying just about everything you need to know about the current situation. Figure 1-1 shows the symbols and explains their meanings. The unit will always revert to this view after 10 minutes of inactivity in any other view (such as showing menus).

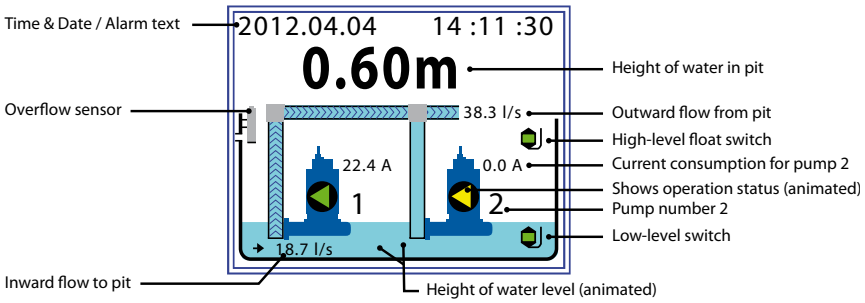


Figure 1-1 The display on the PC 242 dynamically shows the status of the pumps, displaying just about everything you need to know. The alarm symbol and text will only show when there really is an alarm, and in that case a red light will blink on the right side of the panel.
The overflow and high/low-level sensors will be coloured red when they are triggered. The Triangle in the pump will be green and rotate while the pump operates normally, whereas it will be red in failure conditions and yellow when it is idle.
If any values are negative, that indicates a failure in the sensor or the communication with the sensor.

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To the right of the display, there are six buttons with which you navigate in menus and control settings. Figure 1-2 shows the layout and explains the functions of the buttons

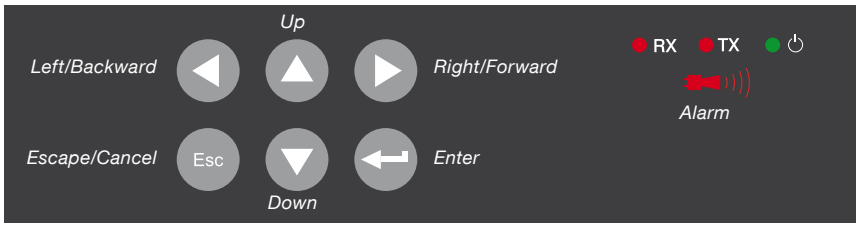

Figure 1-2 You navigate in the menus by the arrow buttons. You go "into" a menu item by pressing either the *Right/Forward* button or the *Enter* button. You confirm an operation with the *Enter* button. The *Escape* button will cancel the current operation or take you directly to the overview image of the pump pit.

The green light indicates that the unit is powered. The Rx and Tx will only light during communication (receive and transmit respectively). The red Alarm indicator will blink whenever there is an unacknowledged alarm (the display tells you the type of the alarm). When the alarm is acknowledged, the light turns steady red and remains so until the cause disappears.

Button functions

- To leave the overview image of the pump pit and go into the menus, press either the *Up* or *Down* arrow button.
- You go "into" a menu item by pressing either the *Right/Forward* button or the Enter button.
- You confirm (or perform/execute) an operation with the *Enter* button. When the top-level view of the display shows that there is an alarm, pressing the *Enter* button will bring up a prompt to acknowledge the alarm, and if you press *Enter* once more, it will be acknowledged.
- To cancel the current operation, or leave the menus and go back to overview image of the pump pit, press the *Escape* button.

Light indicators

To the right of the buttons, there are four light indicators that show:

- A green light indicates that the unit is powered.
- Tx will light when transmitting data to the modem.
- Rx will light when it is receiving data from the modem.
- The Alarm indicator will blink whenever there is an unacknowledged alarm, and the display will tell you the type of the alarm. When the alarm is acknowledged, the light will turn steady red and remains so until the cause disappears.

Main menu

Figure 1-3 shows the *Main Menu*, which you reach from the overview image by pressing either the *Up* or *Down* arrow:

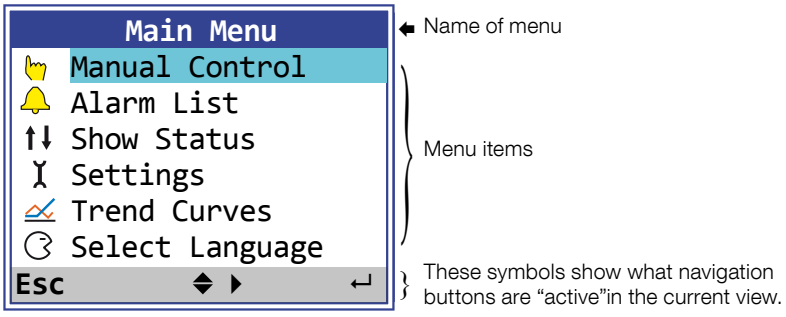

Figure 1-3 The top-level menu of the PC 242 graphical display.

How to adjust the contrast

The contrast of the display can be adjusted by the following procedure:

- Brighter: Hold down the *Right/Forward* button and push the *Escape* button.
- Darker: Hold down the *Left/Backward* button and push the *Escape* button.

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How to enter values and strings Use the *Up*/*Down* buttons to step a value or a letter up or down. For values/strings longer than one digit/character, use the *Left*/*Right* buttons to move the insertion point to the desired field so you can change its value with the *Up*/*Down* buttons etc.

Pass codes There are three security levels:

1. Daily operations, such as acknowledging an alarm or stopping a pump, do not require any pass code or authorization.
2. Operational settings, such as setting the start or stop levels for the pump, require a pass code at the level of *Operator*;
3. Configuration settings that affect the basic functionality or access, such as setting the date format, require a pass code at the level of *System*.

The factory default pass codes are 1 and 2 respectively, but the codes can be changed under the menu item *Settings* > *System*. Whenever a pass code for Operator is requested, you may supply either the pass code for Operator or System.

1.2 *Personal alarm, and how to reset it*

When the pump station is manned, a personal alarm can be issued if the maintenance person hasn't shown activity within a certain period of time. For details about settings related to this, see Section 2.3 *System settings* on page 8 (assigning *Alarm Type, Alarm Delay* and *Max Time to Reset*), Section 2.10 *Settings for digital inputs* on page 18 (assigning *Staff in Station* to a Digital In), and Section 2.11 *Settings for digital outputs* on page 19 (assigning *Personal Alarm Ind* to one of Digital Out 4 or 5).

After the specified *Max Time to Reset*, the assigned Digital Out relay is activated so a visual or audio signal can alert the maintenance person that the alarm timer must be reset. If the alarm timer is not reset within *Alarm Delay*, a personal alarm is sent out.

To reset the timer, just push any button on the pump controller.

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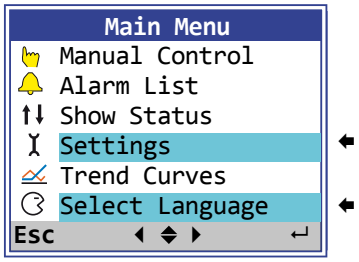
2 MAKE YOUR SETTINGS

The procedure to make these settings is described for PC 242, which has a graphical interface (see Section 1.2 on page 5).



2.1 *Select language*

1. Choose the menu item *Select Language* and press *Enter* twice.
2. Enter the pass code *Operator* (default is 1). Press *Enter*.
3. Scroll to the language of your choice by using the *Up*/*Down* buttons.
4. Press *Enter* and then the *Left*/*Backward* arrow.

2.2 *Overview of settings*

The menu item *Settings* has 12 submenus with a large number of settings that need to be entered by the system administrator, although they all have sensible default values. The following are the 12 submenus:

1. System (Table 2-1 in Section 2.3 on page 8)
2. Pump Pit (Table 2-2 in Section 2.4 on page 9))
3. Pump 1 (Table 2-3 in Section 2.5 on page 13)
4. Pump 2 (Table 2-3 in Section 2.5 on page 13)
5. Common P1-P2 (Table 2-4 in Section 2.6 on page 15)
6. Analogue Logging (Table 2-5 in Section 2.7 on page 16)
7. Trend Curves (Table 2-6 in Section 2.8 on page 16)
8. Analogue Inputs (Table 2-7 in Section 2.9 on page 17)
9. Digital Inputs (Table 2-8 in Section 2.10 on page 18)
10. Digital Outputs (Table 2-9 in Section 2.11 on page 19)
11. Pulse Channels (Table 2-10 in Section 2.12 on page 20)
12. Communication (Table 2-11 in Section 2.13 on page 21)

All settings require a pass code for *System* except some settings under the sub-menu *System* and the start/stop levels under submenus *Pump 1* and *Pump 2*, which only require a pass code for *Operator*.

Each of the 12 submenus are described in separate tables. The exact procedure how the tables should be interpreted is exemplified below for the settings under the menu item *Settings* > *System* > *System Alarms* > *Power* Fail in Table 2-1.

1. Choose the menu item *Settings* and press *Enter*.
1. The topmost menu item *System* will be selected. Press *Enter* again.
1. Select the menu item *System Alarms* by using the *Up*/*Down* buttons, press *Enter*.
1. Select the menu item *Power Fail*, press *Enter*.
1. Select the menu item *Alarm Type*, press *Enter* and enter the pass code for *System*. Choose one of *{Inactive, B-Alarm, A-Alarm}* and press *Enter*.
1. Select the menu item *Alarm Delay*, press *Enter* and give the pass code for *System*. Set the number of seconds and press *Enter*

The pass code will be remembered for a few seconds, so in step 5 above, you may not need to enter the pass code. How the buttons on the panel are used is described in Chapter 1 *Overview* on page 3.

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2.3 *System settings*

System ⬅

Table 2-1 shows the complete list of system settings.

Table 2-1 System settings, under the menu item 'Settings > System'

Submenu	Submenu	Setting	Value	Pass code	Comment
—		Select Language	Select a language	Operator	Same as the setting described in Section 2.1
		Date Format	(YYYY.MM.DD, DD.MM.YYYY, MM.DD.YYYY)	System	
		Set Date	Date	Operator	
		Set Time	Time		
		Select Units	(Metric units, US units)	System	Metric: m, m^2, m^3, l/s (liters/s), bar, mm, °C US: ft, ft^2, gal, GPM (gal/min), °F
		Backlight Timeout	Minutes	Operator	If you enter a value of 0, the backlight will always be on.
		Level Graphics Range	m, ft		
System Alarms	Power Fail	Alarm Type	(Inactive, B-Alarm, A-Alarm)	System	
		Alarm Delay	Seconds		
	Low Supply Voltage	Alarm Type	(Inactive, B-Alarm, A-Alarm)		
		Alarm Delay	Seconds		
		Alarm Limit	Volts		
		Hysteresis	Volts		
	NV Check-sum Error	Alarm Type	(Inactive, B-Alarm, A-Alarm)		*NV Checksum Error* is issued if the checksum for the non-volatile memory indicates error. Alarm stays active until power is switched off-on.
		Alarm Delay	Seconds		
	Personal Alarm	Alarm Type	(Inactive, B-Alarm, A-Alarm)		
		Alarm Delay	Seconds		
		Max Time to Reset	Hours and minutes		After this time, the maintenance person must reset the timer (by pushing any button), or a Personal Alarm is sent out after *Alarm Delay*.
Change Pass code		Operator	Integer	Operator	For Operator access. The code may be 1 to 4 digits long. The factory default code is 1.
		System	Integer	System	For System (administrator) access. The code may be 1 to 4 digits long. The factory default code is 2.
History/Alarm Reset		All History Log	{Cancel, Reset}	System	
		All Alarms	{Cancel, Reset}		

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2.4 *Pump pit settings*

Pump Pit ←

Table 2-2 shows the complete list of settings under the submenu *Pump Pit*.

Table 2-2 Pump pit settings, under 'Settings > Pump Pit'

Submenu	Submenu	Setting	Value	Pass code	Comment
Level Sensor Type		Select Type	{Analogue Sensor, Start/Stop Float}	System	
Max No. Pumps Running		Select Pumps Running	{2 Pumps, Max 1 Pump}	System	
Min Relay Interval		Min Time	Seconds	System	To minimize power surges or spikes caused by pumps starting or stopping simultaneously, there should always be a minimum time between two relays switching states.
Alternation	—	Alt. Function	{OFF, Normal, Asymmetrical}	System	
	Normal Alternation	Alternation After	{Each Pump Stop, Both Pumps Stopped}		
	Asymmet. Alternation	Primary Pump	{Pump 1, Pump 2}		Will switch only after a certain number of stops of the primary pump.
		No. Stops to Altern.	Integer		
	Runtime Alternation	Runtime Alternation	{ON, OFF, }		In addition to the normal or asymmetrical alternation, you can set the controller to switch pump when that pump has been running continuously for a certain period of time.
		After Cont. Runtime.	Hours and minutes		
Alternat. Stop Level		Alternat. Stop Level	{OFF, ON}	System	
		After No Starts	value		
		Stop Level	m, ft		
		Stop Delay	Seconds		
Start on Fast Change		Start Function	{OFF, ON}	System	If the level increases at least *Start Level Change* during the time period *Per,* then one pump will start. If the level continues to increase that much, the next pump will start.
		Start Level Change	m, ft		
		Per	Minutes		
		Stop Function	{OFF, ON}		If the level decreases more than *Stop Level* Change during the time period *Per,* then one pump will stop. If the level continues to decrease that much, the other pump will stop.
		Stop Level Change	m, ft		
		Per	Minutes		
Station Flow	Meas. Parameters	Calculate Inflow	{OFF, ON}	System	
		Pit Shape	{Rectangular, Conical}		
		Emptying/Filling	{Emptying Pit, Filling Pit}		Is the pump filling or emptying the pit?
		Inflow Calc Interval	Seconds		Time interval between measurements.
		Flow Compen. 2 Pumps	Percentage		100 % means that 2 pumps deliver twice as much as a single pump. 50 % means that 2 pumps deliver not more than a single pump.
	Pit Area	Level 0	Fixed at 0 m, ft	System	You can specify the shape of the pit by specifying the area at 10 different levels from the bottom of the pit, level 0, to the top, level 9.
		Area 0	m^2, ft^2		
		… …	… …		
		Level 9	m, ft		
		Area 9	m^2, ft^2		

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Submenu	Submenu	Setting	Value	Pass code	Comment
Calc. Pump Capacity		Function	{OFF, ON}	System	For submersed pumps, set ***Min Level P.Cap Calc*** to be the top of the pump — it improves accuracy. Calculation starts after ***Start Delay,*** when pump flows are stabilized, and goes on for ***Calculation Time.Stop Delay*** does not affect pump capacity calculation, but the calculation of the inflow is inhibited during ***Stop Delay*** after the pump stops as the flow stabilizes.
		Min Level P.Cap Calc	m, ft		
		Start Delay	Seconds		
		Calculation Time	Seconds		
		Stop Delay	Seconds		
Overflow	—	Overflow Detect	{OFF, Overflow Sensor, Level Limit}	System	To detect overflow, an overflow sensor is much more accurate than a threshold from the level sensor. By setting parameters (exponents and constants) the overflow can also be accurately measured by a calculation. “Lock on Inflow” simly uses the historical value of inflow.
		Overflow Calculation	{Lock on Inflow, Exp. & Constant}		
	Exponent & Constant	Exponent 1	Number		Overflow = $h^{e_1}c_1 + h^{e_2}c_2$ [m^3/s or ft^3/s] h = height of water. [m or ft]
		Constant 1	Number		
		Exponent 2	Number		
		Constant 2	Number		
	Overflow Level	Level Limit	m, ft		The level at which overflow is expected. Note: not as accurate as using an overflow switch.
Backup Running		Pump 1 Backup Start	{OFF, ON}	System	If the normal control via start and stop levels fails, this may act as an emergency backup: If the high-level float triggers, pumps 1 and/or 2 may be set to start running for a period of ***Running Time***.
		Pump 2 Backup Start	{OFF, ON}		
		Running Time	Seconds		
Pit Alarms	High Level	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
		Alarm Limit	m, ft		
		Hysteresis	m, ft		
	Low Level	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	m, ft		
		Hysteresis	m, ft		
	High-Level Float	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Block al. if pumps OK	{NO, YES}		YES: Block alarm if pumps running NO: No blocking of alarm
		Alarm Delay	Seconds		
	Low-Level Float	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	High Inflow	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Liters/second, GPM		
		Hysteresis	Liters/second, GPM		

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Submenu	Submenu	Setting	Value	Pass code	Comment
Pit Alarms	Low Inflow	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
		Alarm Limit	Liters/second, GPM		
		Hysteresis	Liters/second, GPM		
	Backup Start	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Remote Blocking	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	High Pressure	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	bar, ft		
		Hysteresis	bar, ft		
	Low Pressure	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	bar, ft		
		Hysteresis	bar, ft		
	Overflow Alarm	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Pressure Blocking	Alarm Type	{Inactive, B-Alarm, A-Alarm}		The pressure threshold for the alarm is set in the menu below for Pump Blocking.
		Alarm Delay	Seconds		
	Drain Pump Running	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Sensor Error	Alarm Type	{Inactive, B-Alarm, A-Alarm		
		Alarm Delay	Seconds		
	Motor Protect. DO 6	Alarm Type	{Inactive, B-Alarm, A-Alarm		
		Alarm Delay	Seconds		
	Both Pumps Blocked	Alarm Type	{Inactive, B-Alarm, A-Alarm		
		Alarm Delay	Seconds		
Pump Blocking	Remote Blocking	Remote Blocking	{OFF, ON}	System	A value of zero for ***Block Timeout*** means that the blocking will never timeout.
		Block Timeout	Seconds		
	Low-Level Float	Low-Level Float	{OFF, ON}		
	Pressure Blocking	Pressure Blocking	{OFF, ON}		Note: ***Pressure Blocking*** may be used when a pressure sensor is installed on the outflow side; when it indicates too high pressure for the pump, it can be blocked. A value of zero for ***Block Timeout*** means that the blocking will never time out.
		Block Delay	Seconds		
		Block Pressure	bar, ft		
		Block Timeout	Seconds		
	Block on Leakage	Block on Leakage	{OFF, ON}		
		Block Delay	Seconds		

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Submenu	Submenu	Setting	Value	Pass code	Comment
This menu follows the setting of DO 6 in Table 2-9, which may be set to one of the menus on the right.	Mixer Control	Stop Pump during Mix	{NO, YES}	System	
		Mixer Time	Seconds		
		Start Count Interval	Integer		The mixer is either started after ***Start Count*** Interval pump starts, or after ***Timer Interva***l. Entering zero disables the corresponding trigger.
		Timer Interval	Hours and minutes		
		Max Level	m, ft		If max > min level, this is the window where the mixer may run. If max < min level, the mixer may only run outside that window.
		Min Level	m, ft		
	Cleaning Control	Flush At	{Pump Start, Pump Stop}		
		Flushing Time	Seconds		
		No. Starts to Flush	Integer		
	Drain Pump Control	Start Delay	Seconds		Slave contact to Digital In type ***Drain Pump Float***
		Stop Delay	Seconds		
Level-Sensor Check		At High-Level Float	{OFF, ON}	System	Checks that the level sensor is functioning properly. Checks can be made at high float, at low float and to ensure that the output varies. At high/low float, a sensor alarm can be issued if the level sensor gives a value that is not within ***Max Deviation*** from the specified level of the high/low float. To ensure that values vary, see below:
		Level at High Float	m, ft		
		Max Deviation +/–	m, ft		
		At Low-Level Float	{OFF, ON}		
		Level at Low Float	m, ft		
		Max Deviation +/–	m, ft		
		Level Change Check	{OFF, ON}		A sensor alarm can be issued if the level sensor does not change its output value at least ***Min Level Change*** in the time period ***Level Change Time***.
		Level Change Time	Seconds		
		Min Level Change +/–	m, ft		
Tariff Control	—	Tariff Control	{OFF, ON}	System	If tariff control is used, you can set the pumps to start emptying the pit ***Lead Time*** before high tariff starts. In this case, it will empty the pit down to ***Pump Down Level*** (or to a stop level, whichever is triggered first). For each day of the week, you can specify two time periods of high tariff (by specifying its On and Off times).
		Lead Time	Minutes		
		Pump Down Level	m, ft		
	Peak Monday through Peak Sunday	Peak Time 1 On	Hours and minutes		
		Peak Time 1 Off	Hours and minutes		
		Peak Time 2 On	Hours and minutes		
		Peak Time 2 Off	Hours and minutes		
Level Above Sea		Level	m, ft	System	If the display of current levels should be absolute levels above sea, enter the level of the pump pit above sea level.

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2.5 *Pump 1 and 2 settings*

Pump 1 ⬅
Pump 2 ⬅

Table 2-3 shows the complete list of settings under the submenus *Pump 1* and *Pump 2*.

Table 2-3 Pump 1 and 2 settings, under 'Settings > Pump 1' and 'Settings > Pump 2''

Submenu	Submenu	Setting	Value	Pass code	Comment
Relay Control		Pump Connected?	{NO, YES}	System	If a pump is not connected, the relay is still operating according to start/stop levels.
Start/Stop Levels		Start Level	m, ft	Operator	Note: These levels are only used during low-tariff times if tariff control in used.
		Stop Level	m, ft		
		Random Start Range+–	m, ft		The start level is randomized ± this range around *Start Level*.
		Start Level H.Tariff	m, ft		During high-tariff times, these levels are used as the start and stop levels.
		Stop Level H.Tarriff	m, ft		
Running Indication		Select Type	{OFF, Digital Input, Motor Current}	System	The means/sensor by which a pump is regarded as running.
		Current Threshold	Amperes		Pump is regarded as running above threshold.
Time Settings		Threshold-On Delay	Seconds	System	To suppress spikes and noise, triggered thresholds from sensors can be required to persist for a certain time before a state change is accepted.
		Threshold-Off Delay	Seconds		
		Max Cont. Runtime	Hours and minutes		Pumps are stopped when *Max Cont. Runtime* is reached. The timer is reset each time a start level is reached.
Pump Capacity		Low Capacity Limit	Liters/second, GPM	System	An alarm is issued if the measured capacity is below this threshold.
Pump Alarms	No Run Indication	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
	Fallen Motor Protect	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Motor Prot Reset Err	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	High Motor Current	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Amperes		
		Hysteresis	Amperes		
	Low Motor Current	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Amperes		
		Hysteresis	Amperes		
	Leakage	Alarm Type	{Inactive, B-Alarm, A-Alarm}		Requires a leakage sensor in the pump.
		Alarm Delay	Seconds		
	High Temperature	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	°C, °F		
		Hysteresis	°C, °F		
	Low Pump Capacity	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Liters/second, GPM		
		Hysteresis	Liters/second, GPM		

Submenu	Submenu	Setting	Value	Pass code	Comment
Pump Alarms	Pump Not in Auto	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
	Pump Error	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Max Cont. Runtime	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Pump Alarm Blocked	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
Block Pump on Alarm		High Motor Current	{NO, YES}	System	If setting is *NO*, the pump will only be blocked as long as the cause for the alarm persists. If setting is *YES*, the pump will be blocked until the alarm is acknowledged.
		Low Motor Current	{NO, YES}		
		Fallen Motor Protect	{NO, YES}		
		High Temperature	{NO, YES}		
		Low Pump Capacity	{NO, YES}		
		Leakage	{NO, YES}		
		No Run Indication	{NO, YES}		
		Pump Error	{NO, YES}		
Dry Run Detect		Low Current Block	{OFF, ON}	System	To detect that the pump is running dry, a threshold on low current is used.
		Block Delay	Seconds		
		Block Current	Amperes		
		Block Timeout	Seconds		

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2.6 *Common settings for pump 1 and pump 2*

Common P1-P2 ⬅

Table 2-4 shows the complete list of settings you can make under the submenu *Common P1-P2*.

Table 2-4 Common settings for pump 1 and pump 2, under 'Settings > Common P1-P2'

Submenu	Setting	Value	Pass code	Comment
Motor Prot Auto Reset	Reset Motor Prot. P1	{NO, YES}	System	Pulse Time is the duration of the reset pulse. Delay Time is used for two purposes: (1) the cooling time before a new reset is attempted; (2) the counter for *Max No. Attempts* is reset when the pump has been running for Delay Time.
	Reset Motor Prot. P2	{NO, YES}		
	Pulse Time	Seconds		
	Delay Time	Seconds		
	Max No. Attempts	Integer		
Pump Exercising	Exercise P1	{NO, YES}	System	This is used to "exercise" the pumps if they have been standing still for *Max Standstill Time*. If '*Start If Level* >' is lower than '*Start If Level* <', this is the window where the pump(s) may run. In the opposite case, the pump(s) may only run outside that window. When the condition is met, the pump(s) will run for *Running Time*.
	Exercise P2	{NO, YES}		
	Max Standstill Time	Hours and minutes		
	Running Time	Seconds		
	Start If Level >	m, ft		
	Start If Level <	m, ft		
Pump Reversing	Reversing P1	{NO, YES}	System	
	Reversing P2	{NO, YES}		
	Rev. On Pump Fail	{NO, YES}		
	Rev. On Fallen M.Prot.	{NO, YES}		
	Start Rev. Delay	Seconds		
	Rev. Run Time	Seconds		
	Max No. Attempts	Integer		
	Stop Second Pump	{NO, YES}		
	Pump Relay When Rev.	{ON, OFF}		
Log Pump Events	Log Pump Events	{NO, YES}	System	

2.7 *Analogue logging*

Analogue Logging ⬅

Table 2-5 shows the complete list of settings you can make under the submenu *Analogue Logging.*

Table 2-5 Analogue logging, under 'Settings > Analogue Logging'

Submenu	Setting	Value	Pass code	Comment
Log Channel 1 through Log Channel 8	Log Signal	{Closed, Level in Pump Pit, Inflow, Outflow, Motor Current P1, Motor Current P2, Pressure/Optional, Temperature P1, Temperature P2, Overflow Level, Overflow Flow, Pump Capacity P1, Pump Capacity P2, Pulse Channel 1, Pulse Channel 2, Supply Voltage}	System	A total of 8 analogue channels whose outputs you can choose from the list. *Pressure/Optional* is intended for either a pressure sensor or an optional user defined sensor. *Pulse Channel 1* and *Pulse Channel 2* are used for rain and energy values.
	Log Interval	Minutes		
	Log Function	{Closed, Actual Value, Average Value, Min Value, Max Value}		

2.8 *Settings for trend curves*

Trend Curves ⬅

Table 2-6 shows the complete list of settings you can make under the submenu *Trend Curves*.

Table 2-6 Settings for trend curves, under 'Settings > Trend Curves'

Submenu	Setting	Value	Pass code	Comment
—	Sample Time	Seconds	System	
Trend Curve 1 through Trend Curve 4	Trend Signal	{Closed, Level in Pump Pit, Inflow, Outflow, Motor Current P1, Motor Current P2, Pressure/Optional Temperature P1 Temperature P2 Overflow Level, Overflow Flow, Pump Capacity P1, Pump Capacity P2}	System	A total of 4 trend curves you can choose from the list.
	Max Value	Any number		The maximum and minimum values are used to set the scales of the graphs.
	Min Value	Any number		

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2.9 *Settings for analogue inputs*

Analogue Inputs ⬅

Table 2-7 shows the complete list of settings you can make under the submenu *Analogue Inputs*.

Table 2-7 Settings for analogue inputs, under 'Settings > Analogue Inputs'

Submenu	Submenu	Setting	Value	Pass ode	Comment
AI 1 Level Sensor		Signal Range	{4-20 mA, 0-20 mA}	System	
		Scaling 0% =	m, ft		
		Scaling 100% =	m, ft		
		Zero Offset	m, ft		
		Filter Constant	Seconds		
AI 2 Current P1		Signal Range	{4-20 mA, 0-20 mA}		
		Scaling 0% =	Amperes		
		Scaling 100% =	Amperes		
		Deadband	Amperes		
		Filter Constant	Seconds		
AI 3 Current P2		Signal Range	{4-20 mA, 0-20 mA}		
		Scaling 0% =	Amperes		
		Scaling 100% =	Amperes		
		Deadband	Amperes		
		Filter Constant	Seconds		
AI 4 Pressure/ Option	—	Function	{Back-Pressure, Free choice}		*Pressure/Option* is intended for either a pressure sensor or an optional user defined sensor.
	Settings	Designation	String		Only available for Free choice, i.e when an optional user defined sensor is used.
		No. of Decimals	Integer		
		Unit	String		
		Signal Range	{4-20 mA, 0-20 mA}		
		Scaling 0% =	bar, ft, user		
		Scaling 100% =	bar, ft, user		
		Filter Constant	Seconds		
		AI 4 High Alarm	Alarm Type: {Inactive, B-Alarm, A-Alarm} Alarm Delay: Seconds Alarm Limit: Value Hysteresis: Value		Only available for *Free choice*, i.e when an optional user defined sensor is used.
		AI 4 Low Alarm	Alarm Type: {Inactive, B-Alarm, A-Alarm} Alarm Delay: Seconds Alarm Limit: Value Hysteresis: Value		
AI 5 Temperature P1		Sensor Type	{PTC, Pt100}		
		Filter Constant	Seconds		
		Pt100 Cable Offset	°C, °F		
AI 6 Temperature P2		Sensor Type	{PTC, Pt100}		
		Filter Constant	Seconds		
		Pt100 Cable Offset	°C, °F		

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2.10 *Settings for digital inputs*

Digital Inputs ⬅

Table 2-8 shows the complete list of settings you can make under the submenu *Digital Inputs*. The default configuration for the digital inputs are is listed in the Installation Guide.

Table 2-8 Settings for digital inputs, under 'Settings > Digital Inputs'

Submenu	Setting	Value[i]	Sub setting	Value	Pass code	Comment
Digital In 1 to Digital In 12	Function	{OFF, Run Indicator P1, Run Indicator P2, Manual Start P1, Manual Start P2, P1 Not in Auto, P2 Not in Auto, Start Float P1, Start Float P2, Stop Float P1-P2, P1 Pump Fail; P2 Pump Fail, Low-Level Float, Power Fail, Drain Pump Float, Staff in Station, Alarm Reset, High-Level Float, Overflow Sensor, Motor Prot. P1, Motor Prot. P2, Motor Prot. DO 6, Alarm Input}			System	There is a total of 14 digital (on/off) input channels. The first 12 ones can be chosen from a list of 20 functions. However, we recommend to keep the default configuration, which is listed in the Installation Guide. *Staff in Station* is used for personal alarm; a switch is usually connected to the light switch to indicate that a person is currently working in the vicinity of the pit. *Not in Auto* is usually a signal from a manual switch that disconnects the pump completely from being controlled from this unit. *Manual Start* may be connected to a manual switch — its function will be identical to that of starting the pump by using the menu (see *Section 3.1 Manual Control on page 23*.)
		Norm. Open/Closed	{NO, NC}			NO stands for ***Normally Open***. NC stands for ***Normally Closed***.
		Alarm Settings	Alarm Type	Inactive A-alarm B-alarm		
			Alarm Delay	Seconds		
			Alarm Text	String		Only used when a digital input is set as function ***Alarm Input***: Custom design text of 18 characters
Digital In 13 and Digital In 14	Function	{Same as Digital In 1 – 12 above with additional functions: Pulse Ch.1, Pulse Ch.2}				
		Norm. Open/Closed	{NO, NC}			NO stands for ***Normally Open***. NC stands for ***Normally Closed***.

[i] The same value may not be assigned to two different Digital In.

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2.11 *Settings for digital outputs*

Digital Ouputs ⬅

Table 2-9 hows the complete list of settings you can make under the submenu *Digital Outputs*. The default configuration for the digital outputs are is listed in the Installation Guide.

Table 2-9 Settings for digital outputs, under 'Settings > Digital Outputs'

Submenu	Setting	Value[i]	Pass code	Comment
Digital Out 1 to Digital Out 5	Function	{OFF, Pump Relay P1, Pump Relay P2, Not Ackn. Alarm, Active Alarm, Reset M.Prot P1 Pump Fail P1, Reset M.Prot P2, Pump Fail P2, Modem Supply, Remote Control, Personal Alarm Ind, Reset M.Prot P1+P2, Alarm Alert, Reversing Relay P1,} Reversing Relay P2, Active A-alarm Active B-alarm, Not Ackn. A-alarm, Not Ackn. B-alarm}	System	There is a total of 22 digital (on/off) output channels. The first five ones can be chosen from a list of 19 functions. Digital out 6 has additional function as; Mixer, Cleaner and drain (only one of those functions can be selected). However, we recommend keeping the default configuration, which is listed in the Installation Guide.
	Norm. Open/Closed	{NO, NC}		NO stands for *Normally Open*. NC stands for *Normally Closed*.
Digital Out 6	Function	{Same as Digital Out 1 – 5 above with additional functions: Mixer Control, Cleanser Control, Drain Pump Control}		
	Norm. Open/Closed	{NO, NC}		NO stands for *Normally Open*. NC stands for *Normally Closed*

[i] The same value may not be assigned to two different Digital In.

2.12 *Settings for pulse channels*

Pulse Channels ⬅

Table 2-10 shows the complete list of settings you can make under the submenu *Pulse Channels*.

Table 2-10 Settings for pulse channels, under 'Settings > Pulse Channels'

Submenu	Setting	Value	Pass code	Comment
—	Function Ch.1	{Precipitation, Energy}		
	Function Ch.2	{Precipitation, Energy}		
Settings Ch.1 and Settings Ch.2	1 Pulse =	mm or kWh inch or kWh		The menus adapt to the choice you made for the function of channel 1 and channel 2.
	Alarm High Precipitation/ Alarm High Power	{Inacactive, B-Alarm, A-Alarm}		
	Alarm Delay	Seconds		
	Alarm Limit	l / (s . ha), Inch/h or kW		l/(s . ha) is: litres per second and hectare, which equals 0.36 mm per hour.
	Hysteresis	l / (s . ha) Inch/h or kW		

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2.13 *Communication settings*

Communication ←

Table 2-11 shows the complete list of settings you can make under the submenu *Communication*.

Table 2-11 Communication settings, under 'Settings > Communication'

Submenu	Setting	Value	Pass code	Comment
Protocol	Protocol	{Modbus, Comli}	System	
	Cross Ref. Table	{OFF, ON}		See Appendix 4.7
Service Port	Baudrate	{OFF, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, 115 200}	System	
Communication Port	Station ID	Integer	System	
	Station Name	String		
	Baudrate	{OFF, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, 115 200}		
	Parity	{None, Odd, Even}		
	Handshake	{OFF, ON}		
	Comli/Modbus ID	Integer		
	Comli/Mod-bus Timeout	Seconds		
Modem	Modem Connected	{NO, Analogue, GSM, GPRS modem CA 521, Fix IP TCP Listen}	System	Modem is not needed for fixed line connections.
	Modem Init	{Cancel, Init}		
	Hayes Before Calling	String		Default: ATH0E0V1Q0S0=1
	Hayes After Discon.	String		Default: Q0&W
	Sign. Before Answer	Integer		Minimum **1** for call up modem
	Modem PIN Code	String		
	Modem PUK Code	String		
	SMSC Serv-Center No.	String		Leave blank to use the default SIM-card. Otherwise, it must be in international format (but the leading '+' character may be omitted).
	GPRS APN	String		
	GPRS APN Cont.	String		
	GPRS Heart Beat	Minutes		
	GPRS Remote IP Addr.	String		
	GPRS TCP-IP Port	Integer		
	GPRS User Name	String		
	GPRS Password	String		
	GPRS SMS backup	{OFF, ON}		

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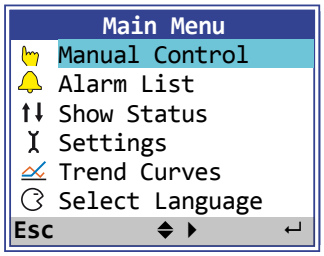
Submenu	Setting	Value	Pass code	Comment
Modem	SMS backup number		System	Phone no to SMS receiver
	GPRS Event log	{OFF, ON}		
	HB operator scan	{OFF, ON}		
Alarm Call Up	Max No. Calls/ Alarms	Integer	System	The maximum number of attempts to call. It cycles through Call Attempt 1-4 (see settings below) until *Max No. Calls/Alarms* is reached.
	Interval Call Attemp	Seconds		The time between call attempts.
	Call Up Ac-knowledge.	{No Acknowledgement, Ring Signal, Write to Reg. 333, All Data Com}		
	Alarm Ackn. Reg 333.	{NO, YES}		This is for the local indication. If *YES*, it is acknowledged when the central system has taken care of the alarm.
	Connect ID-String	String		
Call Attempt 1 through Call Attempt 4	Phone Number	String	System	Call Attempt 1-4 assume that a modem is connected. Not needed for fixed line connections. For SMS, the GSM number must be in international format (but the leading '+' character may be omitted).
	Alarm Receiver	{OFF, Central System, SMS GSM (PDU)}		Type of alarm receiver. If *OFF*, it skips to the next Call Attempt in the list.
	Cond. for Alarm Call	{A-Alarm On, A-Alarm On/Off, A+B-Alarm On, A+B-Alarm On/Off}		A call is attempted only if the condition is true. On/Off indicates whether the alarm goes on or off. Example: *A+B-Alarm On/Off* means either A or B alarm that either goes on or off.
	Parallel Call	{NO, YES}		Parallel call, calls all the numbers in Attemps 1 - 4 directly. *See Appendix 4.6.5*
	Timeout Alarm Ackn.	Seconds		The time until it skips this attempt and tries the next one.
	Send ID-String	{NO, YES}		
	ID-String Delay	Seconds		The time between the start of the connection until the ID-String is being sent (if set to YES).

3 DAILY OPERATION

Manual Control, Alarm List Show Status, Trend Curves

For the daily operation, when settings do not need to be changed, there are only four menus you need to care about, in addition to the top-level view that graphically displays the current conditions. The four menus are: Manual Control, Alarms List, Show Status, Trend Curves, and they are each described in the following sections

When the top-level view of the display shows that there is an alarm (see Chapter 1 Overview on page 3), pressing the Enter button will bring up a prompt to acknowledge the alarm, and if you press Enter once more, it will be acknowledged.

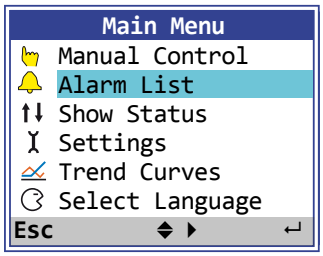


3.1 *Manual control*

The menu item *Manual Control* is used to start and stop pumps, reset the motor protection, start the cleaner, and remove any remote blocking of the pumps. Table 3-1 shows the complete list of manual operations you can do.

Table 3-1 Manual Control

Menu	Setting	Comment
Manual Control	Start/Stop P1	Start/stop with the *Enter* button. (Applicable when the level is within the configured start/stop levels.)
	Start/Stop P2	
	Reset Motor Prot. P1	Reset with the *Enter* button.
	Reset Motor Prot. P2	
	Reversing P1	Reversing start with the *Enter* button.
	Reversing P2	
	DO 6 Mixer/ Cleaner/Drain	Depending on the setting of DO 6. Start/stop the mixer/cleaner/drain pump with the *Enter* button.
	Remote Blocking	If the pump has been blocked from a remote centre, you can inhibit (remove) that remote blocking by pressing the *Enter* button.



3.2 *Alarm list*

Table 3-2 shows the contents under the menu item Alarm List.

Table 3-2 Alarm List

Submenu	Value	Comment
Unackn. Alarms	Shows a list of unacknowledged alarms.	Press *Enter* to acknowledge the selected alarm.
Active Alarm	A list of active alarms is shown in reverse chronological order.	
All Events	A list of all events is shown in reverse chronological order.	Events are: start/stop of pump, when an alarm goes on, when it is acknowledged, and when the alarm goes *off*.

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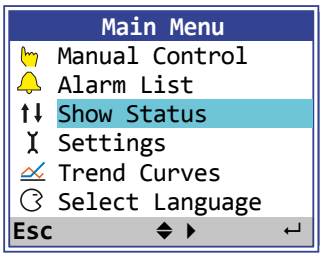
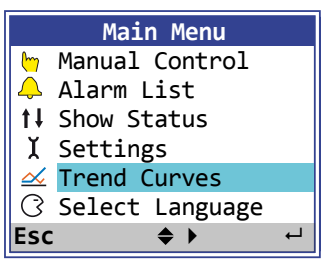


3.3 *Show status*

Table 3-3 shows the complete list of information under the menu item *Show Status*.

Table 3-3 Show Status

Submenu	Submenu	Value	Comment
System		PC 242 Version Option Supply Voltage	
GPRS Modem		Status, IP Address	
Pump Pit	-	Level Inflow Outflow	
	Pumped Volume	Total Today Day 1 - Day 7	
Pump 1/ Pump 2	-	Motor Current Temperature	If sensors are connected.
	Running Time	Total Today Day 1 - Day 7	
	No. of Starts	Total Today Day 1 - Day 7	
	Pump Capacity	Last Sample Nominal Avg. Today Avg. Day 1 – Avg. Day 7	
Overflow	-	Overflow Level Overflow Flow	
	Overflow Time	Total Today Day 1 – Day 7	
	Overflow Volume	Total Today Day 1 – Day 7	
	No. of Overflows	Total Today Day 1 – Day 7	
Back-Pressure /Free choice	-	Back-Pressure/ Free choice	Depending on the setting of AI 4 in Table 2-7 on page 17.
Precipitation Ch.1/ Energy Ch.2	-	Current value	There's a menu each for channel 1 and 2 respectively, and they may be either for precipitation or energy depending on your choice in Table 2-10 on page 20.
	Accumulated Value	Total Today Day 1 – Day 7	



3.4 *Trend curves*

Entering into this menu item will show a graph over the last 100 samples according to your settings in Table 2-6 on page 16. Pressing the Down button will show a legend for the curves, i.e. the interpretation of the colours, and also the latest values. Pressing the Up button will remove the legend box.

4 APPENDIX

4.1 *Pump capacity and In/Outflow of the pit*

General
By entering the shape and size of the pump pit *(Pump pit settings)* together with an accurate level measuring device, the unit will at all times know the momentary volume in the pit.

A new pump capacity calculation is performed every time the pump starts alone with no other pump running. If one or more pumps are already running, the controller will use the existing nominal pump capacity for the outflow calculation. Inflow is calculated at a preset interval. Outflow is recalculated every second and the values are presented and updated according to the parameters set.

Calculation
When one pump starts alone:

- The actual inflow value when the pump starts is temporarily stored and the indicated inflow value frozen.
- The outflow value is now ramped up for a configurable time frame. “Start delay”
- The pump capacity is calculated during a configurable time frame. “Calculation Time”
- The inflow indication lock is released. The inflow is now a function of pump capacity and level.
- The outflow is ramped down for a configurable time frame after pump stop. “Stop delay”

Calculation rules
- The level must be over “Min Level for Calculation”
- The level must be under “Max Level for Calculation”
- The level after calculation must be lower than when the calculation started.

Presentation of the Pump Capacity calculation
The pump capacity is presented as a Nominal and Last Sample value.

Nominal
- The nominal value is re-calculated to point 1 and filtered by taking median value of last 5 samples.

Last Sample
- As it sounds, the last calculation, unfiltered!

4.2 *Pit shape*

The continuous flow measurement is based on the fact that the PC 242 can calculate the volume by measuring the level difference during a set calculation time. For this calculation is to exact it is necessary that the area /level should be always known. This can be achieved by setting the level and area for all level where the pit changes shape, up to 9 break points + the area at zero point can be set.

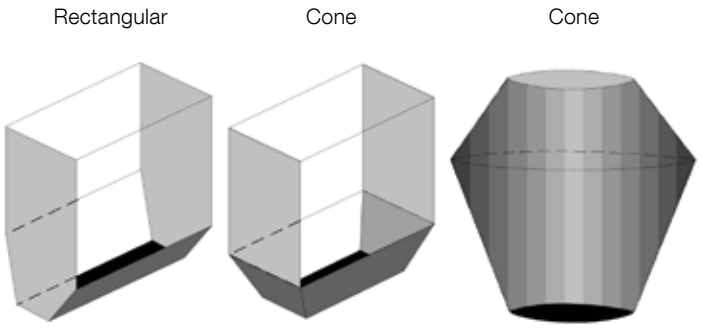
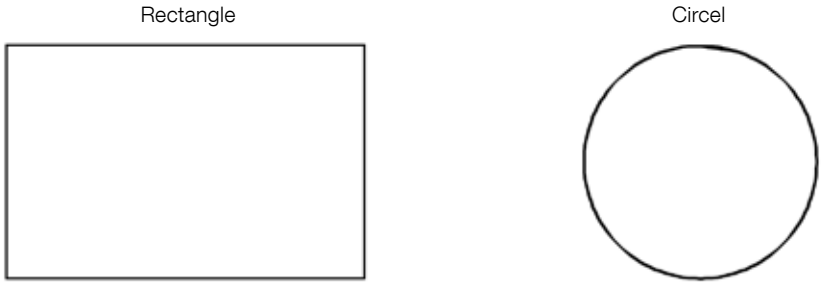


Figure 4-1 Example of pit shapes.

To get a correct calculation at all levels even the pit shape has to be set as the calculation is different for different geometrical shapes. A shape that ends in a point is set as conical, if it ends as a wedge (2 parallel sides) it is set as rectangular shape, see figure above.

Example for area calculation:



A = L * W	**Ex.**	**A = pi * r²**	**Ex.**
A = Area **L** = Length **W** = Width	**A** = ? **L** = 2.20 Meter **W** = 1.75 meter	**A** = Area **pi** = 3.14... **R** = Radius = D/2	**A** = ? **D** = 2.50 meter **R** = 2.5 / 2 = 1.25 m
	A = 2.2 * 1.75		**A** = 3.14 * $(1.25)^2$
	A = 3.85 m^2		A = 4.91 m^2

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4.3 *Overlow flow calculation*

There are three methods that can be used to measure and calculate overflow flow:

1. Use a conventional flow meter.

Advantage: In most cases for standard PLC-systems this will increase the accuracy on the measurement.

Drawbacks: Expensive and on sensors that only measure the overflow can dirt and mud dry on it, when the pit is operating in normal conditions. The sensor has to be cleaned regularly to ensure correct measurements.

2. Use the same sensor that is used for the level measurement in the pit and a weir and start the flow measurement on analogue set point.

Advantage: The investment cost is low and the sensor will not need to be cleaned regularly.

Drawbacks: The system must have a very good resolution on the input to be able to measure the overflow correctly and a very accurate 0-point otherwise the measurement is wrong.

3. Use the same level sensor that is used for the level measuring in the pit and a weir, and use a level switch to start the overflow measurement.

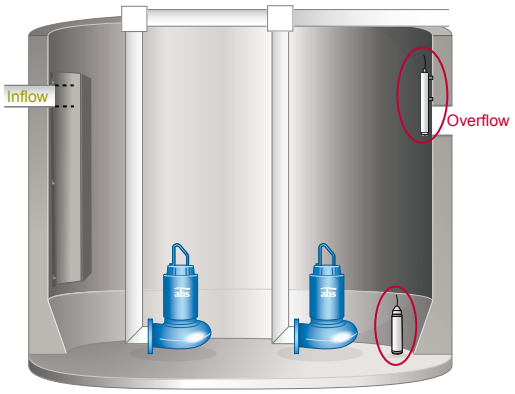
Advantage: The Investment cost is low and the sensor needs not to be cleaned regularly. The accuracy of the 0-point is not affecting the measurements due to that the switch is used as a 0-point.

Drawbacks: The analogue input needs to have a very good resolution to be able to measure the signal. The PC 242 has no problem with this in ex. a sensor with the range of 10 meters the PC 242 has the resolution of < 0.7 mm.

The third method is preferred and used in the PC 242.

A digital input indicates if an overflow is occurring independent of what the level signal shows. The PC 242 locks this actual level and the PC 242 starts calculating the overflow level / flow from this value.

This means that the level is measured with a very high accuracy with a right 0 - point. If an exact flow measurement is needed a weir or channel should be used.



The PC 242 program has all the functions available for calculating flow in weirs and channels. The overflow is measured separately for each pump pit. Number of overflows, overflow time and overflow level and the flow are logged.

The levels sensor is used as the actual level signal when the switch is activated it sets the 0 - point for the flow measurement. If no level switch is connected to the PC 242 the 0- point for the overflow can be set in "*Settings* / *Pump Pit* / *Calc. Overflow* / *Overflow Detect* "manually. Overflow will be registered when the level exceeds pre-set overflow level on the usual level sensor.

Note! This set point has no function if a digital input (Overflow switch) is set for overflow indication in the pump pit.

A delay can be set to prevent disturbances and that waves trigger the switch. After this delay the flow measurement starts and the time of the overflow is

recorded. A counter keeps track of how many times the pit has overflowed. The overflow time is only trigged when the level is higher than the stored (set) 0- point . If a float sensor is used for a pump pit, which has no level sensor, the overflow time counts all the time the float is active.

The overflow alarm will stop after the float goes back to normal and the stop delay to avoid errors in the counter and to compensate for the start delay.

Note! Overflow *alarm* and *counter* is only detected if alarm is enabled.

Ext. Flow meters with pulse output can be used for measure the overflow. This flow meter has to be connected to one of the two digital inputs (D:in13 or D:in14) which is set up as an *Input Pulse Channel X*. And there are only *Digital In 13* and *Digital In 14* which can act as a pulse channels. Further setting has to be done in *Settings* / *Pulse Channels*. PC 242 can then add and calculate digital pulses from sensors.

4.3.1 *How to calculating overflows by using constants and exponents*

- In *Settings* / *Pump Pit* / *Overflow/* you can type in the constant and exponents manually.

There are two different exponents and two constants which can be set in PC 242 and it's depending on manufactures and nature of the weirs. Those constants shall normally be provided by the manufactures. If you don't have the e2 and c2 values, you can put e2 and c2 to 0 (zero), only use the left side of the equation. For the basic weir types are c2 constant set to 0 (zero).

Overflow = $h^{e1}c_1 + h^{e2}c_2 \quad [m^3/s]$

Type of Weir	Exp	Constant
Thompson 30°	2.5	0.373
Thompson 45°	2.5	0.569
Thompson 60°	2.5	0.789
Thompson 90°	2.5	1.368
Straight weir 1 m	1.5	1.76

For other width on straight weirs, multiply the constant with the width in meters. Ex. C = b * 1.76 (b in meters)

Note! If "*Locked on inflow*" is chosen, it assume overflow be the last calculation of inflow in the pit minus the capacity of the pumps who are running.

4.4 *Pump reversing*

You can reverse pumps in case of *Pump Fail* and *Fallen Motor-protection.*

- In *Settings* / *Common P1-P2* / *Pump Reversing* and *Settings* / *Common P1-P2* / *Auto reset* motor.

This are the options there events can trig pump reversing.

Reverse on *Pump Fail*.
Reverse cycle start when digital input signal Pump Fail goes active.
The signal must go back to inactive state before the pump start reversing
If not reversing cycle is aborted.

Reverse on *Fallen Motor-protector.*
Reverse cycle start when the digital input signal Motor Protector goes active.
Motor protector will be reset before the pump start reversing.
You must enable auto reset motor protector function for the pump.
Set the cold down time and pulse time in the auto reset menu.
If the motor protector reset fails reversing cycle is aborted.

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4.4.1 *Other settings regarding Pump Reversing:*

In menu *Settings* / *Common P1-P2* / *Pump Reversing*

-Set [**Reversing Pump x**] to [**Yes**].

-Set [**Start Rev. Delay**]. The time to hold the pump in off position before the start of pump reversing

-Set [**Rev. Run Time**]. The reversing run time.

-Set [**Max No. Attempts**]. After the reversing the pump will start again. If the pump fails again, a new reversing cycle will begin. Here you set max number of attempts.

-Set [**Stop Second Pump**]. If you want the other pump to stop before reversing the first one

-Set [**Pump Relay When Rev.**] Indicate how the pump relay shall act during the reversing (ON or OFF).

4.5 *Pump alternation*

PC 242 has three different methods in order to alternate pumps.

1. **Normal alternation**
   Pumps are started alternately according to a rotating schedule. The pump that started first in the pump cycle, next time will be started last. In this way the running time is divided equally between alternating pumps.

   One can choose between that alternate at each pump stop or when all pumps are stopped.

   Alternate at each pump stop method is to prefer if the normal inflow to the pit is so high that the pumps don't have the capacity to emptying it. If alternate when all pumps stop method is selected in this situation this could arises some problems since at least one pump always is running and therefore no alternation is done. Alternation criteria all pumps stop never occur.

   Alternate when all pumps stop method is to prefer if the pumps has the capacity to emptying the pit at normal inflow. Then all pumps stop and the start/stop levels alternate.

2. **Asymmetrical alternation**
   The difference against normal alternation is that the pumps are divided in to two alternating pumps, primary and secondary pump. Normally the primary pump starts numbered times. After an adjustable number of pump stops of the in primary pump, the secondary pump starts. The stop counter reset and at next pump cycle primary pump starts first again. This is for secure that the pumps don't reach the end of life time at the same time.

   If the primary pump does not have the capacity to pump down and the pit level continue to increase, the secondary pump will be started independent of the stop counter.

3. **Runtime alternation**
   As addition to above can the pumps alternate related to continuous run time. At exceeded maximum run time the pump will stop and an alternative pump will be started. The pump will only stop if the secondary pump is ready to run.

4.6 *Communication*

The first thing witch has to be set, is the *Protocol*. You can choose between Modbus RTU, Modbus TCP or Comli.

- *Settings / Communication / Protocol*

Other protocol could be available if there is an external converter from Modbus or Comli to requested protocol.

4.6.1 *Communication ports*

There are two RS232 ports for communication, one RS232 at the screw terminals (screw 22 – 26) and one D-Sub9F in the front. Only the port at the screw terminal has full modem support (except power supply).

4.6.2 *Com port (screw terminals 22 – 26)*

This port is design for modem communication and has protocol Modbus RTU, Modbus TCP or Comli. Other protocol such as TCP/IP can be used by using modem which converts the signal. Default this port has Modbus RTU, baud rate: 115200, parity: None, handshake: Off, and Protocol ID: 1. Message Time Out: 2 s Optional: Station name.

On this port there are possibilities to change the properties of baud rate (300 – 115200), protocol ID (1 – 255) and station ID (1 – 65535), Parity (None, Odd, Even) and handshake (on/off) as well. Necessary for AquaWeb concept is the **Station ID** set correctly and that the protocol ID is set to 1!

4.6.3 *Service port (9-pols D-Sub in the front)*

This port follows "***Com Port***" in protocol and has always protocol ID 1. There is however possibilities to change the properties of baud rate separate from *Com Port*. This port is consider to be used for download configuration and updating the firmware by using Aquaprog. To connect this port to a computer, you need a strait cable DB9F-DB9M.

4.6.4 *Modem*

Only the port at the screw terminals (Com Port) is supporting modem.

There are a number of different modems which can be used on PC 242. Normally is a CA 521 connected to the PC 242 which calls by GSM to a SCADA trigged by an event or that a SCADA calls up for catching log values. If PC 242 is connected to AquaWeb, then shall the CA 521 be working as a GPRS modem. It's also possible to connect a TCP/IP or analogue modem.

TCP/IP modem For fixed TCP/IP line. Communication through RS232 to external IP modem. This just like a direct line and in the settings under Settings – Communication – Modem – Modem Connected in the PC 242 shall be **[No]**.

Analogue modem For fixed telephone line. Signals before answer, minimum 1.Hayes settings normally works with default. Settings under Communication – Modem – Modem Connected in the PC 242 shall be **[Analogue]**

GSM modem For GSM connection e.g. CA 521.Signals before answer, minimum 1.Hayes settings normally works with default. Set PIN code if SIM card is equipped with one. Settings under Communication – Modem – Modem Connected in the PC 242 shall be set to **[GSM Modem]**.

Note! The PIN code can be deleted with a cell phone.

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GPRS modem Based on internal TCP/IP stack in Cinterion (former Siemens) GSM/GPRS modules. All data access is via the Hayes commands defined by Cinterion.
Most common is dynamic IP adressing. GPRS default is that the pump controller connects to TCP server in Sulzer AquaWeb system. If Scada system should connect to station see TCP-server section.
Communication via GSM and GPRS uses the same network. If subscription allows, both can be used one at a time.
Set PIN code if SIM card is equipped with one (deleted on AquaWeb SIM cards).

Note! The PIN code can be disabled with a cell phone.

Heart beat interval 30 min (default). Can be adjusted but can raise costs if set to low.
Server TCP port; Must be the same as in GPRS Server (default 2000 for AquaWeb).
Servers IP address; The Public/global IP (normally in fire wall/router) address to the GPRS Server must be a static IP address.
APN is provided by SIM card supplier. GPRS APN part 1 and GPRS part 2. If APN string is long it can be divided between the two parts. (Default is AquaWeb APN).
SMS fallback: 0046708728550 for AquaWeb only!

Settings under *Communication – Modem – Modem Connected* in the PC 242 shall be set to [**GPRS Modem CA 521**].
Set GPRS User name and Password if demanded from subscription provider.
GPRS Event Log and Heart beat operator scan for error search only. Default off.

TCP-Server If you have a SIM card subscription with a fixed IP address, then you can connect the station by GPRS on a local network by using CA 521 and set the function in modem settings to *FIX IP TCP LISTEN* – TCP-server

FIX IP TCP LISTEN demands a SIM with fixed IP address from the provider on the station so that an external SCADA can contact remotely.

Settings under *Communication – Modem – Modem Connected* in the PC 242 shall be set to [**FIX IP TCP LISTEN**].

Other types of modem Profibus gateway, radio modems etc.

Connect CA 521 according to Figure 4-4 to the Com port on PC 242.

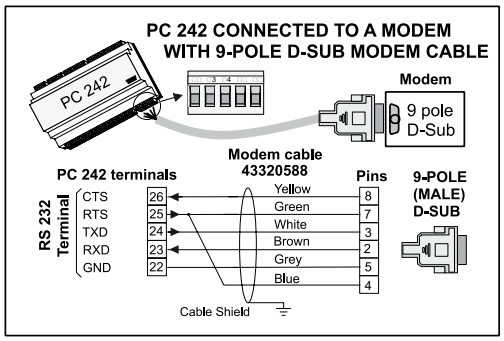

Figure 4-2 Connect PC 242 to 9-pole D-sub. Cable can be ordered, item no 433020588.

4.6.5 *Alarms*

There are mainly two ways to handle alarms from PC 242; through modem or direct communication. Most common is a GPRS/GSM modem solution. The alarms can be transferred to a SCADA system or as a SMS to a mobile phone.

When using the GSM functionality to send SMS, there are possibilities to set up four attempts to call out. These attempts can be set as parallel calls; call multiple numbers in a sequence. Or as back up call; call first number in the attempt list and then wait for acknowledgement before trying with same number again in total three times, and then call next number in the attempt list. As soonest as the substation gets an acknowledgement of an alarm call out; it will terminate the outgoing calls. Alarm will be sent out at ON/OFF state and A-alarms or A+B-alarms depending of settings

4.7 *Aquaprog*

Aquaprog is Windows based software specially made for setting and monitoring of Sulzer substations. Communication with the controller is established via RS 232 or Modem (analogue or GPRS) connection between substation and computer.

Features

- Configuring substation PC 242
- Checking and acknowledging alarms
- Checking events
- Collecting log data
- Showing the display and LED of the substation
- Showing the status of the in- and outputs of the substation
- Collecting and sending the configuration data of the substation
- Substation software upgrade

4.7.1 *How to set up Aquaprog*

It assumes that the readers are all ready familiar to Aquaprog on the basic level. Therefore there is no closer explanation about Aquaprog in detail.

PC 242 is communicates default with **Modbus RTU** and has **Comli ID 1** and **Station ID 1**. The baud rate is **115200**, **8 data bits** and **No Parity**.

Start to create a new substation and follow the text below.

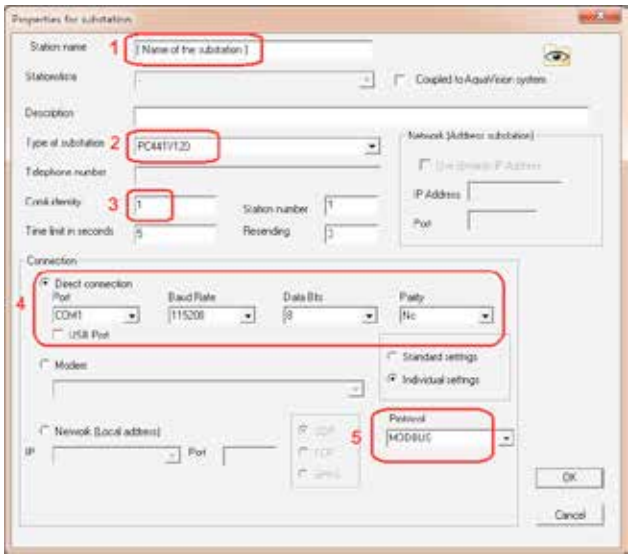

Figure 4-3 Create a new substation in Aquaprog

1. Give your station a name
2. Choose “Type of substation” – PC242V1xx
3. Comli ID is critical for Aquaprog, default is 1. If there is wrong station ID – Aquaprog can handle that, but **not** wrong Comli ID. If you use the **Service Port** –then it’s always **Comli ID = 1**.
4. Setup your com.port and the properties according to your substation
5. Modbus is default
6. Press OK

After this is set, you can call the substation and change the properties as normal.

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4.8 *Cross reference table*

Cross reference is available in firmware 1.42 or later and in Aquaprog version 4.90 or later.

Cross reference table can be set-up in Aquaprog to optimize the data flow in Comli/Modbus to the supervision system. Register 0-254 (telegram type 0 and 2) can be defined to hold preferred data by a cross reference table and can be set for data for any register. See further information in Comli/Modbus Register Manual.

There are possibility for certain rescaling of data, for ex. ***Running time*** in seconds can be rescaled to minutes with the factor 60. The scale factor can be between 0-32767. With the factor 0 no rescaling is done.

Certain supervision systems only handle positive values when using the Comli protocol. Settings can be selected for 2-compl. +/-32767 or pure integers 0-65535. If positive numbers are used will 0 be returned for negative values.

The extended Comli telegram (max 65535 reg.) is not affected by the cross reference.

Together with the cross reference table there is a possibility to set an individual scale factor between 0 and 32767, for each position in the cross-reference list.
When reading data, the value is divided with corresponding scale factor.
When writing data the value will be multiplied with corresponding scale factor.
Scale factor is ignored when set to 0.

For data in double registers (32 bits), the highest register number should be used together with scale factors. Writing to the highest double register number will also set data in the lower register number if scale factor is set. If scale factor is set to zero, each register is handled individually.

Many registers allow negative values (signed 2-complement data). This can cause some systems to treat negative data as large positive numbers (ex. –1 is read as 65535 by the system). To avoid this to cause problems there is a possibility to individually set cross reference registers to only positive data. Negative values will give zero readout.

Note! Cross reference table are only available to set up in Aquaprog. In the menus of PC 242 you have possibility to activate or deactivate the table.

IO-bits IO 0-255 can be redirected to any IO number when cross reference table is enabled. IO-bit 0-255 is also available in register 312-327. With cross reference enabled this is useful in systems that optimize data screens into single messages.

To activate the cross reference table in menu:

– S*ettings* / *Communication* / *Protocol* / *Register Cross Ref*; Set to ON [or OFF]

By using Aquaprog you can also save and download your cross reference table to other PC 242 units.

5 TECHNICAL DATA AND EMC COMPATIBILITY

5.1 *Technical data*

Ambient operating temperature	–20 to +70° C (–4 to +158° F)
Ambient storage temperature	–30 to +80° C (–22 to +176° F)
Degree of protection	IP 20 or NEMA: Type 1
Housing material	PPO and PC
Mounting	DIN Rail 35 mm
Flame rated	V0 (E45329)
Pullution degree	2
Humidity	0–95 % RH non-condensing
Dimensions	H x W x D: 86 x 160 x 60 mm (3.39 x 6.30 x 2.36 inch)
Power supply	9–34 V DC SELV or Class 2
Power consumption	< 4 W
Max load Digital-Out relays	250 VAC 4 A Max 100 VA resistive load
Installation catagory	CAT II
Digital-Input voltage	5–34 V DC
Digital-Input resistance	10 kohm
Max pulse rate on Digital In 13 and 14	500 Hz
Analogue Input	0–20 or 4–20 mA
Temperature sensor	PTC or Pt100
Analogue-Input resolution	16 bits for Level sensor; 10 bits for other AI
Log capacity	8 channels for 15 days (plus current day).
Telemetry interface	RS-232

5.2 *Electromagnetic compatibility*

Description	Standard	Class	Level	Remarks	Criteria[i]
Electrostatic discharge immunity (ESD)	EN 61000-4-2	4	15 kV	Air discharge	A
		4	8 kV	Contact discharge	A
Fast transient/burst immunity (Burst)	EN 61000-4-4	4	4 kV		A
Surge immunity 1.2 / 50 µs (Surge)	EN 61000-4-5	4	4 kV CMV		A
		4	2 kV NMV		A
Immunity to RF-field induced disturbances in conductors	EN 61000-4-6	3	10 V	150 kHz – 80 MHz	A
Immunity to radiated RF fields	EN 61000-4-3	3	10 V/m	80 MHz – 1 GHz	A
Immunity to voltage dips and variations	EN 61000-4-11				B

i Performance criteria A is normal performance within the specification limits.

Performance criteria B is temporary degradation or loss of function or performance which is self-recoverable.

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6 ACCESSORIES

6.1 *Pump controller*

Article	Description
12700001	PC 242, 2-pump controller with LCD colour display

6.2 *Accessories*

Article	Description
28007000	Power supply / battery charger 27.2 VDC 1.2A DIN rail mount
47000000	Lead accumulator 1 2 V 4 Ah
39000041	Lead accumulator holder for 2 pieces 47000000
17000664	MD 124 DIN rail mount pressure sensor 4–20 mA / 0–3.5 meter water column
28000011	CA 521 GSM–GPRS modem
43320588	9-pole RS232 male modem cable
28000011	9-pole RS232 PC cable M-F

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