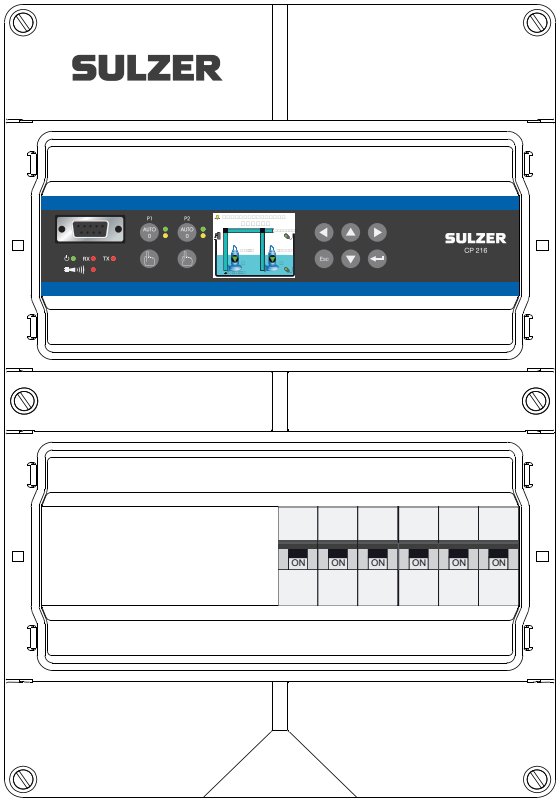
Control Panel Type ABS CP 116/216



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User Guide SW 1.33

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ABOUT THIS GUIDE, AUDIENCE AND CONCEPTS

This guide describes the pump control panels CP 116/216. The difference between the two products is that CP 116 controls one pump whereas CP 216 can control two pumps. CP 116 does not include any circuit breaker, whereas CP 216 includes a 3-pole circuit breaker for each pump.

Installation Guide

There is a separate document Installation Guide that describes how to physically install the control panel (printed document in the installation package, and also a PDF on the CD).

Audience

This guide is intended for system administrators and operators of control panel CP 116/216.

Prerequisites

This guide assumes that you already are acquainted with those pumps you are set to control and the sensors connected to CP 116/216.

The system administrator must also know and decide on the following:

The control panel 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 optimise 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, that 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.

You need to know if the pump(s) should be exercised in case of long idle periods. If the installation has two pumps, you need to decide if the pumps should alternate.

If the electricity has daily varying tariffs, you must know the times of high/low tariffs.

You must know how overflow will be measured: if it will be measured using both an overflow detector (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 CP 116/216.

You need to know which alarm class, A-alarm or B-alarm (see Glossary and conventions on page 6), to assign each alarm.

Reading guide

For installation, see the separate document *Installation Guide*, which covers both CP 116/216 and CP 112/212. Before you make any settings, or use the control panel, read Chapter 1 Overview of functions and usage; it describes the general functionality and the meaning and usage of the controls on the panel.

The system administrator must ensure that all settings according to Chapter 2 Settings are suitable for your application. The default settings are listed in the Installation Guide.

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, buzzer, operator passcode, start/stop levels.

Chapter 3 on page 25 covers the topics needed for the regular daily operation.

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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 indicates a hypertext link. If you read this document on a computer, you can click on the item, which will take you to the link destination.

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.

Cos φ: Cosine of the phase angle φ between the motor current and the voltage.

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.

Digital In means a signal that is either on or off (high or low), where high is anything between 5 and 24 volts DC, and low is anything below 2 volts.

Digital Output means an alarm relay that may either be normally closed or normally open.

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

1 OVERVIEW OF FUNCTIONS AND USAGE

CP 116 and CP 216 are control panels for one and two pumps respectively. These units have the same functionality in terms of their capability to control pumps and manage alarms — the only difference is that CP 216 is intended for two pumps whereas CP 116 is intended for one pump.

Figure 1-1 shows the panel, and describes the functions of the buttons and the meaning of the indicator lamps. The six buttons to the right of the display are used to navigate in menus and change settings, whereas the buttons to the left of the display are used to control the pump mode and for manual control of the pump.

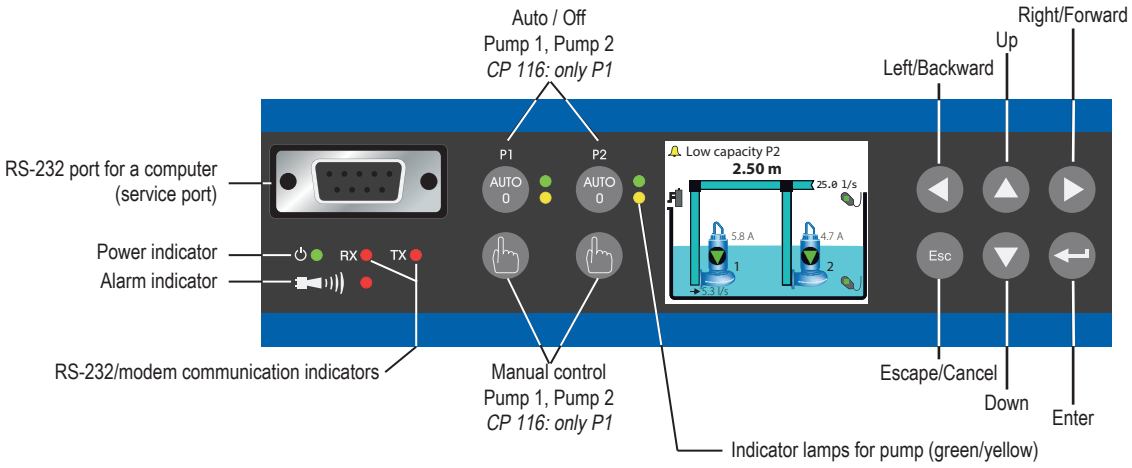

Figure 1-1 A green lamp at the very left indicates that the unit is powered (either battery or mains). The red alarm indicator will blink whenever there is an unacknowledged alarm.

For each pump (P1 and P2), there is a button with which you can set the pump in either Auto mode or blocked. An indicator lamp shows whether the pump is in Auto mode (green) or manually blocked (yellow). Below that, there is a button (hand symbol) with which you can control the pump manually.

You navigate the menus by the arrow buttons. Press either the Up or Down arrow button to switch to the menu view. You confirm an operation with the Enter button, or acknowledge an alarm. Pressing the Escape button will cancel the current operation.

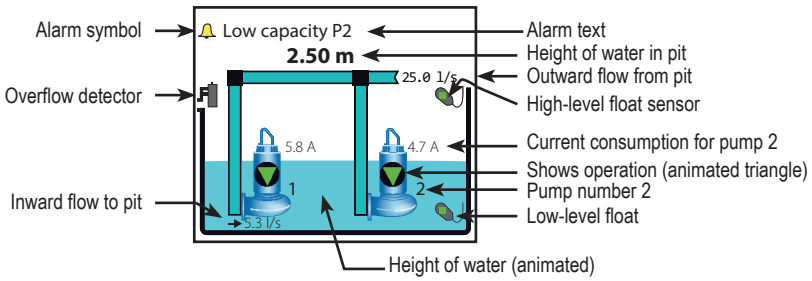

Figure 1-2 The display and its information fields in the default top-level view (CP 216).

The default (top-level) view of the display dynamically shows the operating status of the pumps and conditions in the pit. Figure 1-2 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).

The view shows only one pump on CP 116, and when CP 216 is set to use only one pump, the view adapts to show only one pump.

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Power and alarm indicator

The two leftmost symbols on the panel are for power and alarm indication:

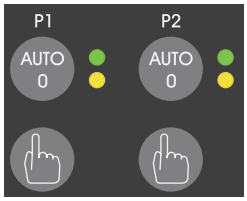
- A green light indicates that the unit is powered.
- The red alarm indicator blinks whenever there is an unacknowledged alarm, and the display tells you the type of the alarm. When the alarm is acknowledged, the light turns steady red, and remains lit until there are no active alarms.

Communication indicators Tx and Rx

To the right of the power indicator, there are two communication indicators:

- Tx will light when transmitting data to the RS-232 port or a modem.
- Rx will light when receiving data from the RS-232 port or a modem.

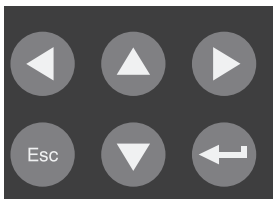
Left-hand buttons



The buttons to the left of the display have the following functions:

- The button labelled Auto/0 is used to toggle the pump control to either Auto mode or turning it off. In Auto, the green lamp to the right is lit, and the control panel is controlling the pump. In 0, the yellow lamp to the right is lit, and the pump is turned off, (disabled).
- The button with a hand symbol is used to attempt to start the pump, overriding the pump controller, or stop the pump if it is running. It is only effective while the mode is Auto, i.e while the green lamp is lit.

Right-hand buttons



The buttons to the right of the display have the following 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 stop the buzzer and 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.

Main menu

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

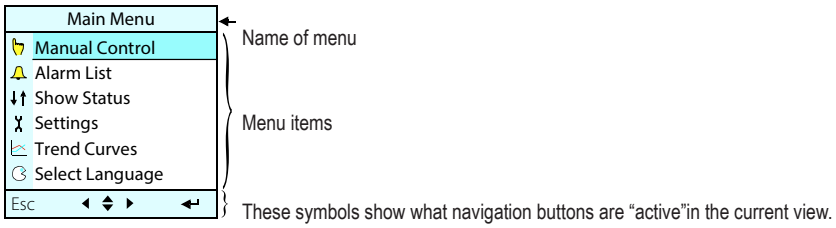


Figure 1-3 The top-level menu of the CP 116/216 graphical display.

How to select language and make all settings (menu items Select Language and Settings) are described in Chapter 2 Settings. The items Manual Control, Alarm List, Show Status, and Trend Curves are meant to be used in the daily operation of the unit, and are described in Chapter 3 Daily Operation.

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 etcetera.

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Passcodes

There are three security levels:

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

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

Battery backup

CP 116/216 includes a charger for a lead-acid battery backup. The battery itself is optional, and can be installed inside the cabinet. During battery operation (no mains power), the pump relays are always off. The power indicator will remain active, and the alarm indicator will be active. The alarm relay will function according to the setting in Table 2-9 Settings for alarm relays, under 'Settings > Digital Outputs' on page 21.

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 12 (assigning Alarm Type, Alarm Delay and Max Time to Reset), Table 2-8 Settings for digital inputs under 'Settings > Digital Inputs' on page 21 (assigning Staff in Station to a Digital In), and Section 2.11 Settings for digital outputs (alarm relays) on page 21 (assigning Personal Alarm Ind to one of the alarm relays).

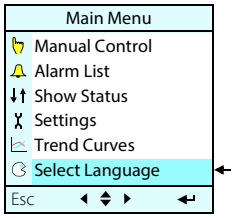
After the specified Max Time to Reset, the assigned alarm relay is activated so a visual or audio signal can alert the maintenance person that the alarm timer must be reset. If the alarm timer is not reset within Alarm Delay, a personal alarm is sent out.

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

2 SETTINGS

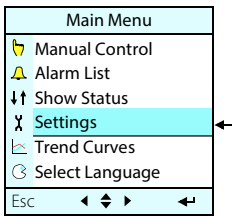
This chapter describes menu items and all settings that need to be properly set before the pump controller is used. How to navigate in the menus and enter values is described in Chapter 1 Overview of functions and usage. The default settings are listed in the Installation Guide.

For your convenience, in addition to controlling the settings directly from the control panel, they can all be controlled from a computer running AquaProg (sold separately).



2.1 *Select language*

1. Choose the menu item Select Language and press Enter twice.
2. Enter the passcode for 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 many 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 submenus:

1. System settings (Table 2-1 in Section 2.3 on page 12)
2. Pump pit settings (Table 2-2 in Section 2.4 on page 13)
3. CP 116: Pump
   CP 216: Pump 1, Pump 2
   (Table 2-3 in Section 2.5 on page 16)
4. CP 216: Common settings P1-P2 (Table 2-4 in Section 2.6 on page 18)
5. Analogue logging (Table 2-5 in Section 2.7 on page 19)
6. Trend curves (Table 2-6 in Section 2.8 on page 19)
7. Analogue inputs (Table 2-7 in Section 2.9 on page 20)
8. Digital inputs (Table 2-8 in Section 2.10 on page 21)
9. Digital outputs (Table 2-9 in Section 2.11 on page 21)
10. Pulse channel (Table 2-10 in Section 2.12 on page 22)
11. Communication (Table 2-11 in Section 2.13 on page 22)

All settings require a passcode for System except some settings under the sub-menu System and the start/stop levels (page 16) which only require a passcode for Operator.

Each of the submenus are described in separate tables. How to interpret the tables is exemplified as follows for the settings under the menu item Settings > System > System Alarms > Power Fail in Table 2-1:

1. Choose the menu item Settings by using the Up/Down buttons, and press Enter. The topmost menu item System will be selected. Press Enter again. All submenus under System are shown in Table 2-1.
2. Select the menu item System Alarms, press Enter.
3. Select the menu item Power Fail, press Enter.
4. Select the menu item Alarm Type, press Enter and enter the passcode for System. Choose one of {Inactive, B-Alarm, A-Alarm} and press Enter.
5. Select the menu item Alarm Delay, press Enter, and if prompted, give the passcode for System. Set the number of seconds and press Enter.

The passcode will be remembered for 50 seconds, so in step 5 above, you may not need to enter the passcode. How the buttons on the panel are used is described in Chapter 1 Overview of functions and usage on page 3.

2.3 *System settings*

Table 2-1 shows the complete list of settings under the submenu System.

Table 2- 1. *System settings, under the menu item 'Settings > System' (Sheet 1 of 2)*

Submenu	Submenu	Setting	Value	Passcode	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 (litres/s), bar, mm, °C US: ft, ft^2, gal, GPM (gal/min), °F
		Backlight Timeout	Minutes	Operator	If set to zero, the backlight will always be on.
		Level Graphics Range	m, ft		
		Buzzer	{OFF, ON}	Operator	These times are also used when an alarm relay is set to Alarm Alert (Section 2.11 Settings for digital outputs (alarm relays) on page 21).
		Buzzer Alert Time	Minutes		
		Buzzer Pause Time	Minutes		
System Alarms	Power Fail	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
	Phase Error	Alarm Type	{Inactive, B-Alarm, A-Alarm}		An alarm Phase Missing In is issued if one the phases on incoming power is missing.
		Alarm Delay	Seconds		
	NV Checksum 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}		After the Max Time to Reset, the maintenance person must reset the timer (by pushing any button), or a Personal Alarm is sent out after Alarm Delay.
		Alarm Delay	Seconds		
		Max Time to Reset	Hours and minutes		
	Wrong Phase Order	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Com. Error I/O PCB	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		

Table 2- 1. *System settings, under the menu item 'Settings > System' (Sheet 2 of 2)*

Submenu	Submenu	Setting	Value	Passcode	Comment
System Alarms	NV Error I/O PCB	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
Change Passcode		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}		

Pump Pit ←

2.4 *Pump pit settings*

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

Table 2- 2. *Pump pit settings, under 'Settings > Pump Pit' (Sheet 1 of 4)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Level Sensor Type		Select Type	{Analogue Sensor, Start/Stop Float}	System	
		Analogue Input	{Int. Press. Sensor, Ext. Sensor mA 1}	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.
		After No. Stops	Integer		
	Runtime Alternation	Runtime Alternation	{OFF, ON}		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	The Alternat. Stop Level, usually a lower level than normal, is effective once every After No. Starts of pump starts. By setting a Stop Delay, the actual level at which the pump stops will be even lower. (Any low-level alarm or low-level float is blocked, but a dry-run detect will still block the pump.)
		After No. Starts	Integer		
		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 StopLevel 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		

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Table 2- 2. *Pump pit settings, under 'Settings > Pump Pit' (Sheet 2 of 4)*

Submenu	Submenu	Setting	Value	Passcode	Comment
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		
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' simply 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}		
		Alarm Delay	Seconds		

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Table 2- 2. *Pump pit settings, under 'Settings > Pump Pit' (Sheet 3 of 4)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Pit Alarms	Low-Level Float	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		Alarm Delay	Seconds		
	High Inflow	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	litres/second, GPM		
		Hysteresis	litres/second, GPM		
	Low Inflow	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	litres/second, GPM		
		Hysteresis	litres/second, GPM		
	Backup Start	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
	Remote Blocking	Alarm Type	{Inactive, B-Alarm, A-Alam}		
		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		
	Sensor Error	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	If Block Timeout is set to zero, 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. If Block Timeout is set to zero, the blocking will never time out.
		Block Delay	Seconds		
		Block Pressure	bar, ft		
		Block Timeout	Seconds		

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Table 2- 2. *Pump pit settings, under 'Settings > Pump Pit' (Sheet 4 of 4)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Pump Blocking	Block on Leakage	Block on Leakage	{OFF, ON}	System	
		Block 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.

Pump ← *CP 116*
Pump 1 ← *CP 216*
Pump 2 ← *CP 216*

2.5 *Pump settings*

Table 2-3 shows the complete list of settings you can make under the submenu Pump (CP 116) or for CP 216: Pump 1 and Pump 2.

Table 2- 3. *Pump settings, under 'Settings > Pump' or 'Settings > Pump 1/2' (Sheet 1 of 3)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Relay Control		Pump Connected?	{NO, YES}	System	If a pump is not connected, the relay is still operating according to start/stop levels.
Pump Parameters		Nominal Current	Amperes	System	
		Nominal Cos φ	Number		
		Temperature Monitor	{OFF, ON}		
		Leakage Monitor	{OFF, ON}		
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		Current Threshold	Amperes	System	Pump is regarded as running above threshold. If set to zero, the function is turned off, and also the pump phase-error detection.

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Table 2- 3. *Pump settings, under 'Settings > Pump' or 'Settings > Pump 1/2' (Sheet 2 of 3)*

Submenu	Submenu	Setting	Value	Passcode	Comment
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	litres/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 Curernt	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Amperes		
		Hysteresis	Amperes		
	Low Motor Curernt	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 monitor in the pump.
		Alarm Delay	Seconds		
	High Temperature	Alarm Type	{Inactive, B-Alarm, A-Alarm}		Requires a temperature monitor in the pump.
		Alarm Delay	Seconds		
	Low Pump Capacity	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	litres/second, GPM		
		Hysteresis	litres/second, GPM		
	Pump Not in Auto	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		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		
	Phase Missing	Alarm Type	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		

Table 2- 3. *Pump settings, under 'Settings > Pump' or 'Settings > Pump 1/2' (Sheet 3 of 3)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Pump Alarms	Dry Run	Alarm Type	{Inactive, B-Alarm, A-Alarm}	System	
		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}		
		Phase Missing	{NO, YES}		
Dry Run Detect		Low Cos φ	{OFF, ON}	System	To detect that the pump is running dry, a threshold on the change of cos φ is used.
		Block Delay	Seconds		
		Block Delta Cos φ	Number		
		Block Timeout	Seconds		
⇓		⇓	⇓	⇓	For CP 116, menus in Table 2-4 (next table) follow directly here.

Common P1-P2 ←

2.6 *Common settings for pump 1 and pump 2*

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	Submenu	Setting	Value	Passcode	Comment
Motor Prot Autoreset		Reset Motor Prot. P1	{NO, YES}	System	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}		
		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		
Log Pump Events		Log Pump Events	{NO, YES}	System	

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Analogue Logging ←

2.7 *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	Submenu	Setting	Value	Passcode	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, Cos φ P1, Cos φ P2, Overflow Level, Overflow Flow, Pump Capacity P1, Pump Capacity P2, Pulse Channel}	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 is used for precipitation (rain), energy or flow values.
		Log Interval	Minutes		
		Log Function	{Closed, Actual Value, Average Value, Min Value, Max Value}		

Trend Curves ←

2.8 *Settings for 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	Submenu	Setting	Value	Passcode	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 Cos φ P1, Cos φ 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	Number		The maximum and minimum values are used to set the scales of the graphs.
		Min Value	Number		

Analogue Inputs

2.9 *Settings for 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	Passcode	Comment
Ext. Level Sensor		Signal Range	{4-20 mA, 0-20 mA}	System	This is an optional sensor connected to the terminal labelled 'mA in 1'.
		Scaling 0% =	m, ft		
		Scaling 100% =	m, ft		
		Zero Offset	m, ft		
		Filter Constant	Seconds		
Current P1		Deadband	Amperes		
		Filter Constant	Seconds		
Current P2		Deadband	Amperes		
		Filter Constant	Seconds		
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		
		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.
		Low Alarm	Alarm Type: {Inactive, B-Alarm, A-Alarm} Alarm Delay: Seconds Alarm Limit: Value Hysteresis: Value		
Int. Press Sensor		Zero Offset	m, ft		The built-in pressure sensor.
		Filter Constant	Seconds		

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Digital Inputs

2.10 *Settings for 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 is listed in the Installation Guide.

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

Submenu	Submenu	Setting	Value[i]	Passcode	Comment
Digital In 1 through Digtal In 6		Function	{OFF, Manual Start P1, Manual Start P2, Start Float P1, Start Float P2, Stop Float P1-P2, P1 Pump Fail; P2 Pump Fail, Low-Level Float, Staff in Station, Alarm Reset, High-Level Float, Overflow Sensor} Digital In 2 can also be set to Pulse Channel	System	There is a total of 6 digital (on/off) input channels that can be configured for different usage. Digital In 2 is special in that it is the only one that can be configured as the Pulse Channel. 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. Manual Start may be connected to a manual switch — its function will be identical to that of starting the pump by using the button on the panel (see Chapter 1on page 3).
		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.

Digital Outputs

2.11 *Settings for digital outputs (alarm relays)*

Table 2-9 shows the complete list of settings you can make under the submenu Digital Outputs. The default configuration is listed in the Installation Guide.

Table 2- 9. *Settings for alarm relays, under 'Settings > Digital Outputs'*

Submenu	Submenu	Setting	Value	Passcode	Comment
Alarm Relay 1, Alarm Relay 2, Alarm Relay 3		Relay Function	{OFF, Not Ackn. A-Alarm, Not Ackn. A-B Alarm, Active A-Alarm, Active A-B Alarm, High Level, Pump Fail P1, Remote Control, Personal Alarm Ind, Alarm Alert, Pump Fail P2, Pump Fail P1 or P2, Pump Fail P1 & P2}	System	NO stands for *Normally Open.* NC stands for *Normally Closed.* Personal Alarm Ind should be used in combination with a Digital In set to Staff in Station. It is intended for an alert device, such as a buzzer, that periodically alerts staff to confirm activity by pressing a button on the control panel, which will silence the buzzer/alert device. For Alarm Alert, the times follow the Buzzer alert times specified in Section 2.3 System settings on page 8.
		Norm. Open/Closed	{NO, NC}		

Pulse Channel

2.12 *Settings for pulse channel*

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

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

Submenu	Submenu	Setting	Value	Passcode	Comment
—		Function	{Precipitation, Energy, Flow}	System	Digital In 2 must be set Pulse Channel. (See Section 2.10 Settings for digital inputs on page 21.)
Settings		1 Pulse =	Metric: mm, kWh, m^3 US: inch, kWh, gal		The menus adapt to the choice you made for the function of the pulse channel.
		Alarm High Precipit./ Alarm High Power/ Alarm High Flow	{Inactive, B-Alarm, A-Alarm}		
		Alarm Delay	Seconds		
		Alarm Limit	Metric: l/(s · ha), kW, m^3/h US: Inch/h, kW, GPM		l/(s · ha) is: litres per second and hectare, which equals 0.36 mm per hour. GPM is gallons per minute.
		Hysteresis	Metric: l/(s · ha), kW, m^3/h US: Inch/h, kW, GPM		

Communication

2.13 *Communication settings*

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

Table 2- 11. *Communication settings, under 'Settings > Communication' (Sheet 1 of 3)*

Submenu	Submenu	Setting	Value	Passcode	Comment
Protocol		Protocol	{Modbus, Comli, Modbus TCP}	System	
		Cross Ref. Table	{OFF, ON}		
Service Port		Baudrate	{OFF, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 38 400, 57 600, 115 200}	System	

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Table 2- 11. *Communication settings, under 'Settings > Communication' (Sheet 2 of 3)*

Submenu	Submenu	Setting	Value	Passcode	Comment
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/Modbus Timeout	Seconds		
Modem		Modem Connected	{NO, Analogue RS232, CA 522 GSM dial-up, CA 522 AWeb client, CA 522 TCP server, CA 523 AWeb client, CA 523 TCP server, CA 523 GSM dial-up}		Analogue or external modems only supported on newer generations. See Chapter 4.5.
		Modem Init	{Cancel, Init}	System	
		Hayes Before Calling	String		
		Hayes After Discon.	String		
		Sign. Before Answer	Integer		
		Modem PIN Code	String		
		Modem PUK Code	String		
		SMSC ServCenter 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 Username	String		
		GPRS Password	String		
		GPRS SMS Backup	{OFF, ON}		
		SMS Backup number	String		
		GPRS Event log	{OFF, ON}		
		HB Operator scan	{OFF, ON}		

Table 2- 11. *Communication settings, under 'Settings > Communication' (Sheet 3 of 3)*

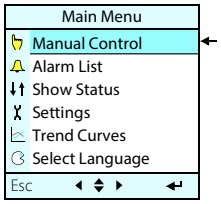
Submenu	Submenu	Setting	Value	Passcode	Comment
Alarm Call Up		Max No. Calls/Alarms	Integer	System	The maximum number of attempts to call. It cycles through Call Attempt 1-4 (see settings below) until Max No. Calls/Alarms is reached.
		Interval Call Attemp	Seconds		The time between call attempts.
		Call Up Acknowledge.	{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.
		Call Order	Backup Number or Parallel call		See Appendix 4.5.4
		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 described separately in the following sections.

When the top-level view of the display shows that there is an alarm (see Chapter 1 Overview of functions and usage on page 7, pressing the Enter button will bring up a prompt to acknowledge the alarm, and if you press Enter once more, it will be acknowledged.



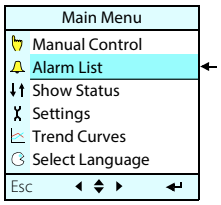
3.1 *Manual Control*

The menu item Manual Control is used to reset the motor protection or remove any remote blocking of the pumps.

Table 3-1 shows the list of manual operations you can do.

Table 3- 1. *Manual Control*

Menu	Setting	Comment
Manual Control	Reset Motor Prot. P1	Reset with the Enter button.
	Reset Motor Prot. P2	
	Remote Blocking	If the pump has been blocked from a remote centre, you can inhibit (remove) that remote blocking by pressing the Enter button.

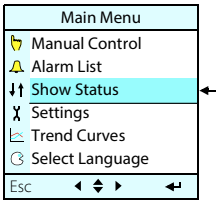


3.2 *Alarm List*

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 Alarms	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*.



3.3 *Show Status*

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

Table 3- 3. *Show Status*

Submenu	Submenu	Value	Comment
System	—	Version Option	
	I/O Cpu Status	Program Version Cabinet Temperature	
GPRS Modem		Status, IP Address, Signal Strength, Manufacturer, Model, Firmware, SIM card ID, Subscriber ID, Equipment ID, Connect error cause, Operator 1-7, Cell info 1-7	
Pump Pit	—	Level Inflow Outflow	
	Pumped Volume	Total Today Day 1 – Day 7	
Pump 1/ Pump 2	—	Motor Current Cos φ	
	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 to 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 Pressure/ Option in Table 2-7 on page 20.
Precipitation/ Energy/ Puls Flow	—	Current value	Depending on the setting of the pulse channel in Table 2-10 on page 22.
	Ackumulated Value	Total Today Day 1 – Day 7	

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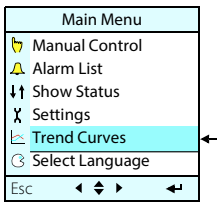


3.4 *Trend Curves*

Entering into this menu item will show a graph over the last 100 samples according to your settings in Table 2-6 on page 19. 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/Out flow 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 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 CP 116/216 can calculate the volume by measuring the level difference during a set calculation time. For this calculation to be 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.

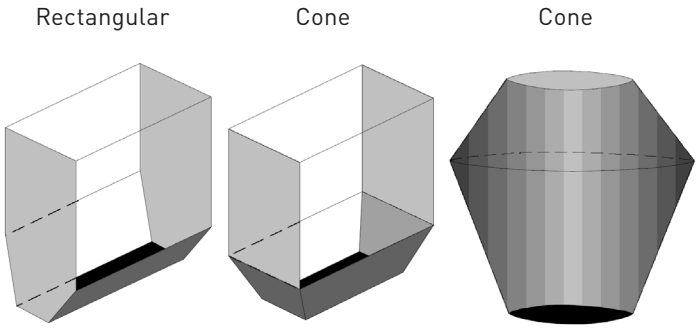
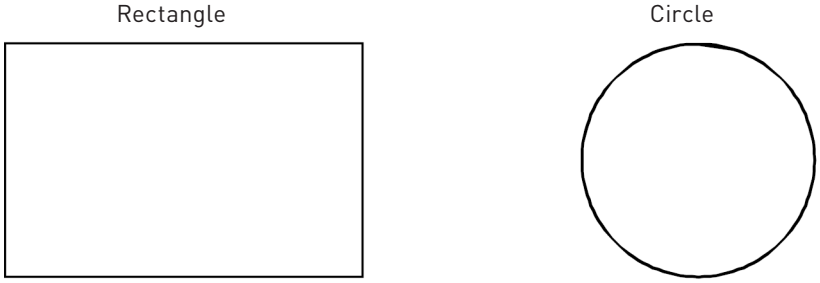


Figure 4-1 Example of pit shapes.

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	**A** = ?	**A** = Area	**A** = ?
L = Length	**L** = 2.20 Meter	**pi** = 3.14...	**D** = 2.50 meter
W = Width	**W** = 1.75 meter	**R** = Radius = D/2	**R** = 2.5 / 2 = 1.25 meter
	A = 2.2 * 1.75		**A** = 3.14 * (1.25)²
	A = 3.85 m²		A = 4.91 m²

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4.3 *Overflow 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 Specific sensors for overflow measurement are expensive and can be clogged with mud and dirt when the pit is back to normal operating conditions after an overflow. The sensors have to be cleaned regularly to ensure correct measurements.

2. **Use the same level sensor to detect overflow and trig the overflow calculation by an 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 to detect overflow and trig the overflow calculation with a level switch.**

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 CP 116/216 has no problem with this in ex. a sensor with the range of 10 meters the CP 116/216 has the resolution of < 0.7 mm.

The third method is preferred and used in the CP 116/216.

A digital input indicates if an overflow is occurring independent of what the level signal shows. The CP 116/216 locks this actual level and the CP 116/216 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 CP 116/216 program has all the functions available for calculating flow in weirs and channels. Number of overflows, overflow time and overflow level and the flow are logged.

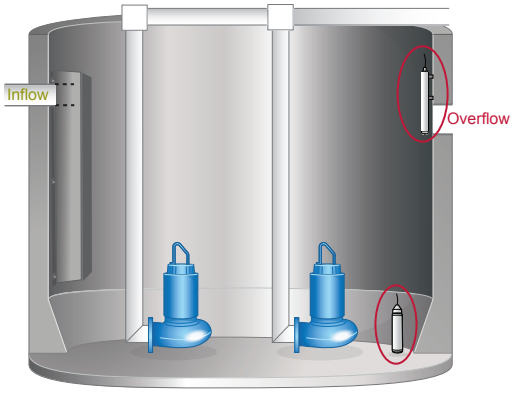

Figure 4-2

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 CP 116/216 the 0- point for the overflow can be set in "*Settings / Pump Pit / 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 the *Digital Input 2* which is set up as an *Input Pulse Channel*. And there is only *Digital In 2* which can act as a pulse channel. Further setting has to be done in *Settings / Pulse Channel*. CP 116/216 can then add and calculate digital pulses from sensors.

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

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

There are two different exponents and two constants which can be set in CP 116/216 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 = = $h^{e1}c_1 + h^{e2}c_2 \ \ [m^3/s]$

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 alternation (*only CP 216)

CP 216 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 in primary pump, the secondary pump starts. The stop counter reset and at next pump cycle primary pump starts first again. This is to 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 the pumps can 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.

4.5 *Communication*

It's only newer generations of CP 116/216 with an extra communication port on the front panel board that supports external modems and direct RS232.
New generation panel boards with this feature have been produced since Q2 2016. Earlier versions only had a DSUB service port on the front panel board.
The text in this chapter and subchapters is partly addressing features depending on the extra communication port. (Screw terminal situated under the hood.) For example CA 523 cannot be used with older generations of panel boards.

CP116/216 has two com ports, one for service up front and one port under the hood which is to use for communication with a surveillance system, directly by RS232, optional modem or other converter.

Choose protocol in the menu:
- *Settings / Communication / Protocol*

Choose between Modbus, Modbus TCP or Comli according to the SCADA/surveillance system used. Other protocols could be used only if there is an external converter from Modbus or Comli to the requested protocol.

Setup the communication parameters in
– *Settings – Communication – Communication port menu:*

For default settings see table below.

Necessary for AquaWeb (if used) is that the **Station ID** set correctly and that the protocol ID is set to **1**!

Setting	Modem and com port defaults	Service port defaults	Span
Baud rate	115200	115200	300-115200
Parity	None	None, always	None/Odd/Even
Handshake	Off	Off, always	On/Off
Comli/Modbus ID	1	1, always	1-255
Station ID	No default	n/a	1-65535
Station Name	No default	n/a	Text string
Comli/Modbus Time Out	2 sec	n/a	

It is possible but not recommended to change the communication properties for the modem and communication port.

4.5.1 *Modem options*

Modem is an add-on option and only com port under the hood supports modem handling. CP 116/216 has support for Sulzer CA 523 modem and the obsolete CA 522.

Most used setup is

CA 523 connected to the CP 116/216 which makes calls to a SCADA system triggered by an event or that a SCADA calls up for catching log values.
In that case the modem shall be set as a GSM-dial-up modem (see below).

Or

CP 116/216 connected to AquaWeb, the CA 523 shall be set as a CA 523 AWeb Client modem (see below).

Settings in the menu for modem types are here:
- *Settings – Communication – Modem.*

There are several types of modem settings that can be selected:

NO No modem is installed. The communication port is always open for use of direct RS232 or a LAN-converter.

Analogue modem For older stations with existing land line.

CA 522/523 GSM dial-up This option will use the connected modem to answer calls from a SCADA system or make contact itself upon given occasions.
It is also valid when modem used as SMS alarm transmitter.

Following settings are needed,
- *Settings – Communication – Modem.*
Signals before answer - minimum 1, 0 will disable auto answering,
Hayes settings - normally works with default,
Modem PIN Code - if SIM card is equipped with one.
- *Settings – Communication –….*
Also phone numbers and different acknowledge settings are needed for alarm calls.

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

CA 522/523 AWeb client (AWeb is short for AquaWeb)
Use this option when you have been provided with AquaWeb Sim-card (P/N: 28007004) from Sulzer.

Set the:
– Settings – Communication – Protocol:
Protocol -Shall be Modbus.

– Settings – Communication – Communication port menu:
Station ID -According to AquaWeb contract. If CP116/216 has a faulty station ID, the AquaWeb-server will not be able to find the station.

Comli/Modbus ID -Shall be set to 1.

- Settings – Communication – Modem.
TCP-IP port -Must be the same as in GPRS Server (default 2000 for AquaWeb).

Remote IP address -The Public/global IP (normally in fire wall/router) address to the GPRS Server. Witch has to be a static IP address.

APN -Is provided by SIM card supplier. If APN string is long it can be divided between the two parts. GPRS APN (part 1) and GPRS APN Cont. (part 2). (Default is AquaWeb APN).

Modem PIN Code -Set PIN code if SIM card is equipped with one (No PIN on AquaWeb SIM cards).

Heart beat -Heart beat interval 10 min (default). Can be adjusted, but can create communication interrupts if too long. Very narrow Heart Beats can effect and raise costs.

Hayes settings must be default.

CA 522/523 TCP-Server For SIM card subscriptions with a fixed IP addresses, it is possible to connect the station to a local network by using modem setting TCP-server.
TCP server demands a SIM with fixed IP address from the network provider, so that an external SCADA can contact remotely.

Set GPRS User name and Password if demanded and the APN from the provider. Select *Modbus* or *Modbus TCP* or *Comli* as Protocol according to the SCADA/surveillance system. Default is Modbus. Other protocol could be available if there is an external converter from Modbus or Comli to requested protocol.

In deeper All data access is via the Hayes commands defined by Cinterion.

If the subscription allows
CA 522 can communicate via GSM and GPRS and
CA 523 can communicate via 3G, GPRS and GSM.
GSM and GPRS use the same network and 3G is a separate network.
CA 523 will use 3G and fallback to GPRS if 3G fails.

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

This port follows the modem settings in protocol and has always protocol ID 1. There is however possibilities to change the properties of baud rate separate from modem settings.
This port is thought to be used for downloading configurations and updating the firmware by using PC software AquaProg.
To connect this port to a computer, use a straight cable DB9F-DB9M intended for RS232 serial communication. This port does not have support for modem or converter

4.5.3 *Alarms*

There are mainly two ways to handle alarms from CP 216; by the alarm relays to an external device, like alarm transmitter or a flash light or using an optional modem. With modem communication, alarms can be transferred to a SCADA system or as a SMS to a mobile phone. When communicating with a SCADA system, it could be done by GPRS or with GSM communication solution.

If 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 soon 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.

4.6 *AquaProg*

AquaProg is Windows based software specially made for setting and monitoring of Sulzer substations. Communication with the controller is established via the RS 232 port in the front or GSM modem connection between substation and computer.

Features

- Configuring substation CP 116/216
- 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

4.6.1 *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.

CP 116/216 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.

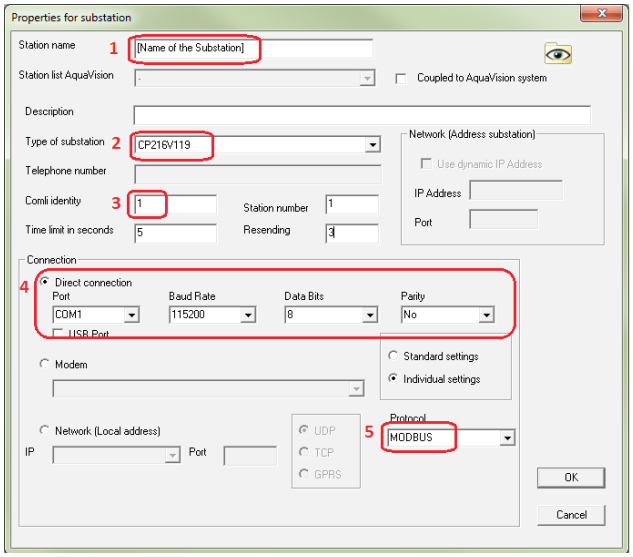

Figure 4-3 Create a new substation in AquaProg.

1. Give your station a name
2. Choose “Type of substation” – CP216V1xx or CP116V1xx
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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4.7 *Cross reference table*

Cross reference is available in firmware 1.22 or later and in AquaProg version 4.93 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 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:

- *Settings / 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 CP 116/216 units.

4.8 *How to clean the unit*

Power off the unit. Only outside/front shall be cleaned by using a dry, soft cloth. A good choice would be the microfiber type of cloth. Gently wipe the CP 116/216 front in order not to scratch the cover and/or the windows/display. If the dry cloth did not completely remove the dirt, do not press harder in an attempt to scrub it off. If necessary, moisten the cloth by adding a small amount of water with thin solution of mild detergent and try again. Never use detergent with polish or solvent which can have an impact of the plastic surface

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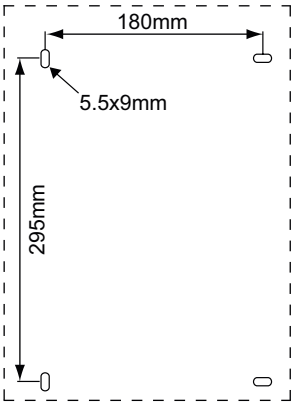
5 TECHNICAL DATA AND EMC COMPATIBILITY



5.1 *Technical data*

Ambient operating temperature:	–20 to +50 °C
Ambient storage temperature:	–30 to +80 °C
Cabinet and mounting:	DIN rail, IP65. Mounting holes: see figure
Dimensions:	H x W x D: 370 x 250 x 123 mm
Weight:	< 5 kg, CP 216 with battery
Humidity:	0–95 % RH non-condensing
Power supply:	230/400 V AC, maximum 16 A fused
Power consumption:	< 16 VA
Contactor, max load:	ABB B7-30-10, 5.5 kW, 12 A, coil 24 V AC
Fuses (only CP 216):	3 x10 A 3-pole type D circuit breakers
Fuse for external air pump:	500 mA slow blow
Max load on alarm relays:	250 V AC, 4 A, 100 VA resistive load
Max current from 12 V DC out:	50 mA
Input voltage at Digital In and Block Pump:	5–24 V DC
Resistance at Digital In and Block Pump:	5 kohm
Analogue sensor:	4–20 mA
Analogue input resistance:	110 ohm
Temperature sensor:	PTC, limit: 3 kohm
Leakage sensor:	Limit: 50 kohm
Maximum length of I/O cables:	30 meters
Charge for lead-acid battery:	Max 80 mA, 13.7 V DC

5.2 *Built-in pressure sensor*

Measuring range	3.5 mWc
Accuracy	<1.5 % error
Repeatable & hysteresis	0.2 % deviation
Long term stability	0.5 % year
Operating temperature	-40° to 85°C
Max over pressure	1.4 Bar (14mWc)

5.3 *Maximum load*

CP 116 Since it does not have fuses, it is only limited by the contactor. Maximum load is 5.5 kW, 12 A at 400 V AC.

CP 216 This version has two fuses. Maximum load is 3.5 kW, 7.5 A at 400 V AC if both pumps can run simultaneously. If set so that only one pump may run (menu item Max Run. Pumps set to 1), a higher load is permitted: maximum load is limited by the fuses, which means about 4.3 kW, 9.5 A.

Sulzer Pump Solutions Ireland Ltd, Clonard Road, Wexford, Ireland
Tel +353 53 91 63 200, Fax +353 53 91 42 335, www.sulzer.com