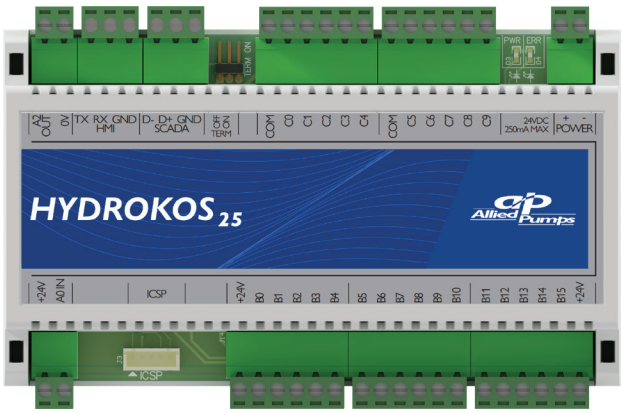
OPERATION MANUAL

Hydrokos Pump Controllers - VSD

V1.7

Single Phase - ALC-63X21 (1-6 Pumps)
Three Phase - ALC-63X20 (1-6 Pumps)



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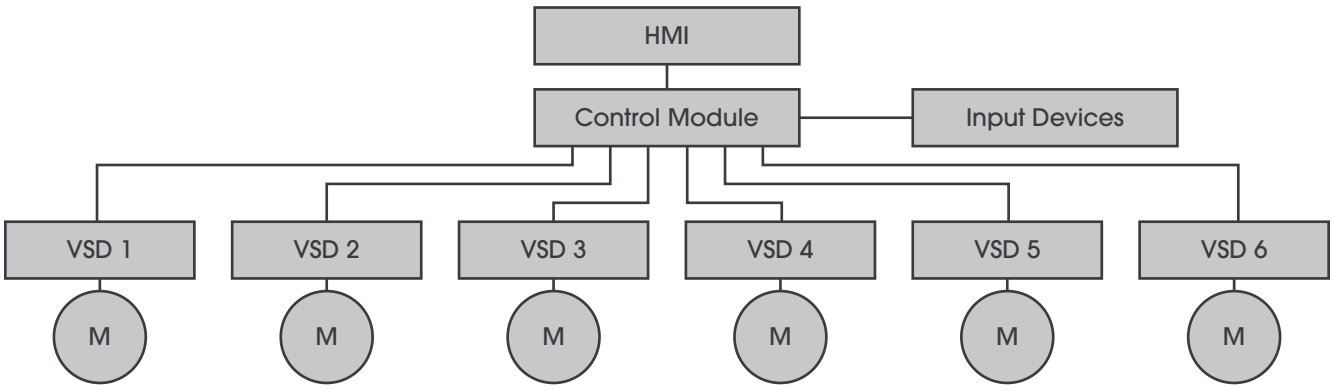
INTRODUCTION

The Hydrokos Controller has been designed with ease of use at the core of the system design. Building on the wealth of the pump control features in the Advanced controller, the Hydrokos brings these features into a new age with a color touch screen interface and a streamlined setup process. In a world where information is power the Hydrokos has extensive time and date stamped alarms, logged data, trend graphs and diagnostic pages to provide the user with all the information required for optimisation and preventative maintenance. Featuring the flexibility of level, pressure and temperature system modes with a wide range of functions and protections, the Hydrokos VSD controller is ideal for a wide range of applications including water transfer, stormwater and sewage pump out, constant pressure, hot water circulation and chiller supply, to name a few.

This Operation Manual applies to the Hydrokos VSD (Variable Speed Drives) version, and the BMS and RMC (Rain/Mains Changeover) variations of this.

OVERALL SOLUTION

Electrically, the Hydrokos Controller is comprised of three main components: The control module, the variable speed drives (for 1-6 pumps) and the Human Machine Interface (HMI). The following diagram depicts the basic layout:



SAFETY

This control panel has been designed and built for applications that are Commercial and/or Industrial in nature, operation, function and location. If the control panel is to be used in Domestic/Residential applications, where specific Wiring Rules in respect of 'electrical supply' protection may apply, it is the responsibility of the installing electrician to ensure compliance with relevant standards.

- Prior to installation, ensure power supply is isolated.
- Power supply must be circuit breaker protected (qualified electrician to determine appropriate amp rating).
- **It is highly recommended that RCDs are NOT used to protect the supply to this panel. The VSDs in this panel have EMC filtering which can cause nuisance tripping of RCDs. It is recommended to use alternative protection for the incoming cables. If RCDs are required, type B RCDs must be used, taking into consideration the VSD earth leakage current to avoid nuisance tripping.**
- Electrical connection to the panel must be carried out in accordance with the following pages.
- Additions or modifications to the control panel are not permitted and will void warranty.
- The controller is not intended for use by children or infirm persons without supervision.
- Repairs to the controller must only be carried out by a suitably qualified electrician.

This manual makes use of the following symbols to indicate warnings that must be paid specific attention to:

Damage to equipment or personal harm may occur if this instruction is not followed

Electrical risk (electrocution hazard) may occur if this instruction is not followed

HARMONIC CONSIDERATION

With all variable speed drives there will be some harmonic distortion on the main power supply. The drives used in the Hydrokos VSD have internal filters to reduce the amount of distortion, however in some applications additional filtering may be required. If additional harmonic filtering is required to meet site specifications this can be requested. See below an excerpt from the Australian Standard AS/NZS 61000.3.6 "Limits - Assessment of emission limits for distorting loads in MV and HV power systems":

'Power utility companies and Australian Standards stipulate maximum harmonic levels which apply at a customer's PCC (point of common coupling). Generally, the maximum permissible harmonic levels are given in terms of % THVD however to achieve a reduction in THVD, the customer is required to reduce their THID through the use of harmonic mitigation equipment. Commonly, THVD levels are required to be between 5-8%, however this will vary from state to state. IEEE STD 519 (1992) and AS/NZS 61000.3.6 (2001) are two widely used harmonic limit standards, however other standards may also be relevant including AS/NZS 61000.3.2 2007. Please confirm harmonic requirements with your utility provider. For more information please refer to the relevant standard.'

EMC REQUIREMENTS (ELECTROMAGNETIC COMPATIBILITY)

The EMC requirements depend on the intended use of this controller, and it is the requirement of electrical/electronic equipment to comply with EN/AS 61800-3:2004.

This controller incorporates ABB ACS180 Variable Speed Drives as standard which are fitted with an internal EMC C3 Filter. (Other VSD models may be used in the event of supply shortage at the discretion of MATelec Australia).
This VSD C3 filter fits into the Class A Environment of AS61800-3 standards which includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes e.g. Industrial areas, or technical areas of any building fed from a dedicated transformer.
The ACS180 VSD complies with the EMC C3 Filter standard as long as the cable length to the motor does not exceed 10mtrs length for up to 3kw 230V 1phase and 7.5kw 400V 3phase or 30mtrs length for 11kw to 22kw 400V 3phase.

*When the controller is installed in residential areas or directly connected to a low voltage power supply network, supplementary measures may be required to prevent the variable speed drives causing radio interference. Please contact MATelec Australia to discuss this requirement.

FUNCTIONS & FAULT PROTECTION - GENERAL

MULTI PUMP CONTROL

The Hydrokos controller can control up to 6 pumps in any number of Duty/Duty assist/Standby configurations. In the setup the number of pumps connected is set by *number of pumps*. The number of duty assist pumps, that is the maximum number of pumps running at one time, is set by *pump limit*.

SYSTEM TYPES & CONTROL DIRECTION

The Hydrokos controller has the ability to operate three system types: Level, Pressure & Temperature control. In each of these types the controller can operate in either direction; filling or emptying a tank in level mode, raising or lowering pressure in pressure mode and cooling or heating in temperature mode. This flexibility makes the Hydrokos VSD controller suitable for a wide range of applications, including pressurised water supply, water transfer, stormwater and sewerage pump out, hot water circulation and chiller supply, to name a few. The functions and protections specific to each system type are explained on the following pages.

DUTY SHARING & ALTERNATION

The duty pump will alternate after the *duty change period* entered in the setup, to the pump with the least run hours. When duty alternates, the original duty pump will remain on for 10 seconds while the new duty pump is starting to ensure a bumpless transfer. Duty will also alternate after the system wakes up from sleep, or if a pump is shut down due to a fault.

SYSTEM ENABLE INPUT

In addition to the digital inputs used for pump control and low/high protection, the Hydrokos controller features a System Enable input which is used to enable and disable the system in auto mode. This could be controlled by auxiliary sensors from tanks, irrigation systems or BMS systems, for example.
In Level Fill mode, this input can be used for supply tank low level protection, shutting down the system when the supply tank, if in use, runs out of water. In Level Empty mode this input can be used for destination tank high level protection, shutting down the system when the destination tank, if in use, is full. These features are ideal for transfer pumping applications.

MANUAL MODE

An individual pump can be put in manual in both the auto and manual system modes. To put a pump into manual touch on the pump to access the pump's screen, make sure it is enabled and press the manual toggle to enable manual operation.
If the system is in auto mode, the pump will run in manual if there are no system lockout faults. The pump will run at the *manual speed* entered in the setup, which will differ from the auto speed shown on the main screen.
If the system is put into manual mode all the system protections are overridden, allowing the pumps to run manually at the *manual speed*, which can be adjusted in the setup or by tapping on the speed on the main screen. After 10 minutes in this mode the system will revert back to the auto mode.

BMS & SCADA

The Hydrokos VSD controller features a single digital volt free output for common fault. The BMS variation features additional volt free outputs for power on, low pressure, individual pump run and individual pump fault as standard, see 'Hydrokos BMS Variation' on page 47 for more information. For more advanced interface ability, the Hydrokos features Serial RS485 connections for communicating with SCADA systems over Modbus RTU protocol, providing full remote monitoring and control of the system.

PROTECTION MODES

There are many different protection triggers which can be used for alarm or pump protection. Most of these protections are setup with auto reset triggers which will reset the protection function once the auto reset conditions have been met. Below are the different modes which can be chosen.

- **Alarm -** Once the trigger condition has been met an alarm will be activated and a time and date stamp added the fault history when it occurred. This mode will not stop the pumps from running.
- **Lockout** - Once the trigger condition has been met an alarm will be activated and a time and date stamp added the fault history when it occurred. In addition to the alarm all the pumps will be stopped and locked out of operation until a manual or auto reset has occurred.
- **Inhibit** - Instead of activating an alarm there are times when the pumps need to be stopped or paused until a trigger condition is removed. In these cases an alarm is not necessary. In 'inhibit' mode all the pumps will be stopped but no alarm will be activated. Once the auto reset condition has been met the pumps will resume normal system operation. To view which trigger is inhibiting the system when 'Inhibit' is displayed on the system state go to the faults page and it will show the active trigger. The inhibit condition will not log as a fault in the alarm history.

These protection modes apply to high and low level, pressure and temperature protection, and pump cycle protection, which are explained on the following pages.

PUMP ANTI-SEIZE PROTECTION

For systems that have extensive pump idle times the anti-seize feature will run the pump for 5 seconds every 7 days if the pump has not run. Every pump has an individual pump idle timer to ensure each pump is prevented from seizing and not started if it has run within the 7 day period. This timer counts in any system state but will only run the pumps in the following modes: Sleep, Off, Disabled or Inhibit. If system is in the 'auto running' state the controller will wait until the system goes to sleep before running any pumps that have reached their anti-seize timer. This protection can be enabled or disabled in the setup.

PUMP CYCLE PROTECTION

If the system has a faulty non-return valve or similar fault where it can fail to maintain pressure, a lot of energy can be wasted due to continual pump starting and stopping (cycling). If the system goes to sleep but wakes up within 5 seconds 10 times within an hour, the pump cycle fault will be activated.

MAX RUN PROTECTION

The max run protection protects the system when pumps run continuously at maximum speed, as would occur in the event of a burst pipe. If the *Max run fault protection* is set to 'Alarm' and a pump is running at maximum speed for the *Max run fault delay* a pump fault will be activated. If set to 'Pump', the pump will be inhibited. After a random delay between 30 seconds and 10 minutes, the controller will restart the pump. If the pump runs for less than the *Max run fault delay*, the fault will be reset. If the fault condition is met again, however, the pump will be inhibited again. After 5 consecutive failed restart attempts a pump lockout will occur. If the *Max run fault protection* is set to 'System' and all available pumps are running at maximum speed for the *Max run fault delay,* the system will be inhibited. After a random delay between 30 seconds and 10 minutes, the controller will restart the system. If not all the available pumps run for a period of 60 seconds, the fault will be reset. If the fault condition continues to be met, however, the system will be inhibited again. After 5 consecutive failed restart attempts a system lockout will occur.

NO FLOW PROTECTION

A flow switch may be connected to the low level alarm input, instead of a float switch, to provide no flow protection. If a pump is running but there is no flow in the system for 30 seconds, the *no flow protection* will be activated. If the *no flow protection* is set to 'Alarm', an alarm only will occur. If set to 'Pump' the pump will be inhibited and another pump brought into operation. If set to 'System' the whole system will be inhibited. After 30 minutes, the controller will attempt to restart the inhibited pump or system. If flow is achieved for period of 30 seconds, the fault will be reset. If the pump or system is still unable to achieve flow, however, it will be inhibited again. After 5 consecutive failed restart attempts, a pump or system lockout will occur.

ANALOG FAULT PROTECTION

If the analog input is in use and the feedback signal drops below 3mA for 2 seconds, the A0 input fault will be triggered and the system will lockout, shutting down all the pumps. If the fault condition is removed the A0 input fault will automatically reset and the system will resume normal operation.

PUMP VSD FAULT PROTECTION

Each pump's variable speed drive has its own thermal overload, supply phase loss, under/over voltage and earth fault protection. All of these protections will trigger a pump fault on the HMI screen, and the drives will display the relevant fault code.

PUMP SHORT CIRCUIT PROTECTION

Each individual pump is protected by its own circuit breaker in the event of an electrical short in the pump or cable. If the supply circuit breaker is sized suitably this will ensure a fault with a single pump and should not disrupt power to the other pumps available.

FUNCTIONS & FAULT PROTECTION - LEVEL CONTROL

CONTROL DIRECTIONS

In level operation there are two modes, 'fill' and 'empty', which work opposite to one other. 'Empty' will increase the number of pumps running as the level rises to keep a tank empty whereas 'fill' will increase the pumps running as the level falls to try and fill the tank.

SENSOR CONTROL

In the 'Level' *System type*, the Hydrokos is controlled by a 4-20mA level transducer and optional backup high and low level float switches, submerged in a tank or pit. If the backup float switches are not required they can be left as open contacts, except for the high level input if in fill mode and the low level input if in empty mode, which will need to be bridged.

WAKEUP & SLEEP

As the level in the tank rises or falls (depending on the *control direction)* and the analog *wakeup level step* from the *setpoint stop level* is reached, the duty pump will start, after a 1 second delay. Once the water level returns to the analog *setpoint stop level,* the controller will stop the duty pump and go to sleep, after the *sleep delay* period entered in the setup.

PROPORTIONAL SPEED CONTROL

The level *system type* uses proportional speed control of the pumps to maintain the *setpoint stop level*. The controller will linearly increase the speed from the minimum speed (*VSD speed at stop level* in the setup) when the level is at the *setpoint stop level,* to the maximum speed at the *VSD full speed level* entered in the setup.

PUMP STAGING & DESTAGING

Additional pumps will be staged into operation to assist the duty pump after each analog *standby start level step* from the *wakeup level step* is reached, after a 5 second delay. The *pump limit* will limit the number of standby pumps that can be used to assist the duty pump, keeping additional pumps available only on a pump fault.
Pumps will be destaged as the analog value returns past each previous analog *standby start level step*, or in the case of the 1st standby pump, when the *wakeup level step* from the *setpoint stop level* is reached, after a 5 second delay.

MAINTAIN MINIMUM LEVEL

If the *system type* is set to 'level' and *control direction* to 'empty', the duty pump will start if analog level is above the *setpoint* for a period of 4 hours, but the pumps have not run due to the level not reaching the analog *wakeup level step*. This helps to maintain the minimum level in the tank.

MAINS TANK TOP UP VALVE CONTROL

For systems requiring a backup water supply in addition to the primary supply, the tank top up function can be used to maintain a minimum water level in the storage tank, ensuring no loss of water supply. In such instances, a normally closed valve can be controlled to open and close based on set levels in the storage tank. This feature can be enabled in the level setup by turning the *top up valve enable* setting on, if the level analog is enabled. The turn on and turn off levels are set via the *top up on threshold* and t*op up off threshold* respectively. The off level must be set higher than the on level for this function to operate correctly. **Note -** The valve output is not included as standard, available upon request.

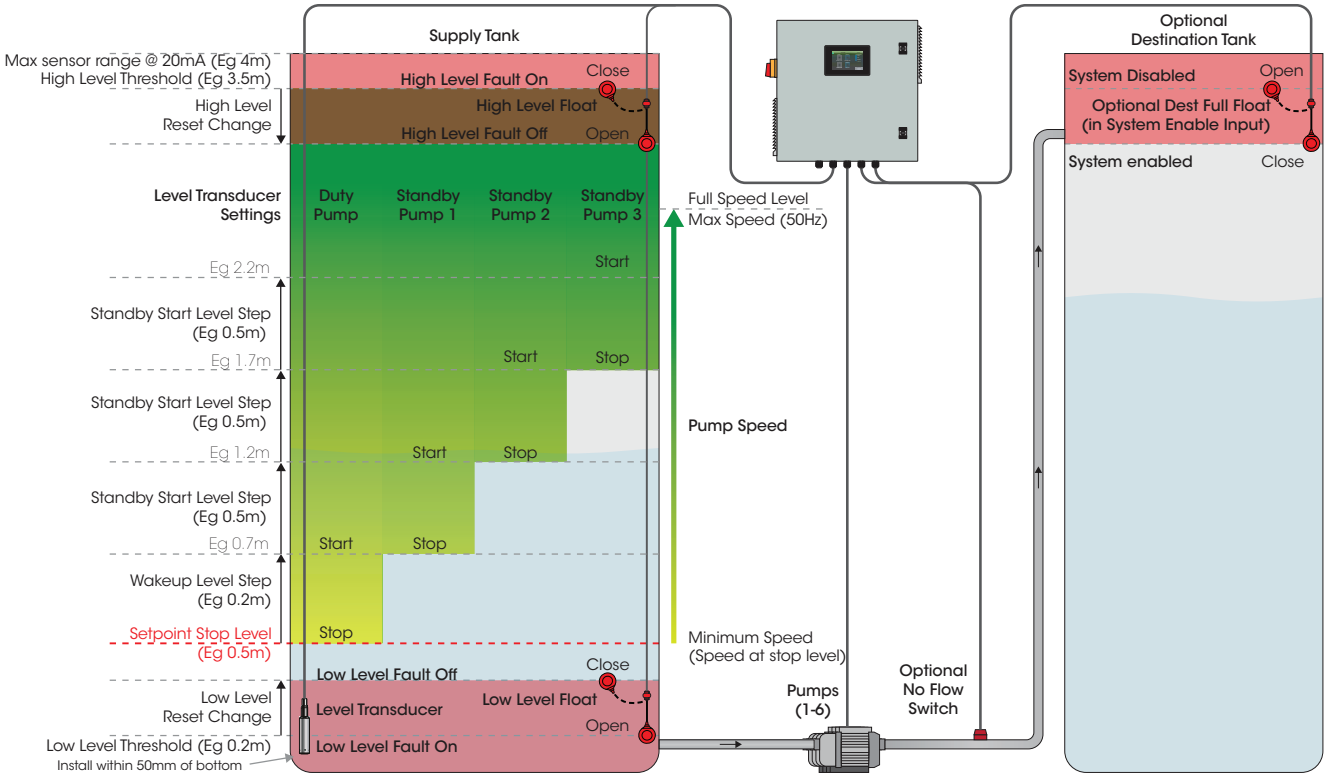
HIGH LEVEL PROTECTION

The high level fault is triggered 3 seconds after the high level input opens (fill *control direction*) or closes (empty *control direction*), and/or the analog *high level threshold* is reached. It automatically resets 3 seconds after the high level input closes (fill *control direction*) or opens (empty *control direction*), and/or the analog value drops 0.2m below the *high level threshold.* This protection can be set to alarm, lockout or inhibit in the setup.

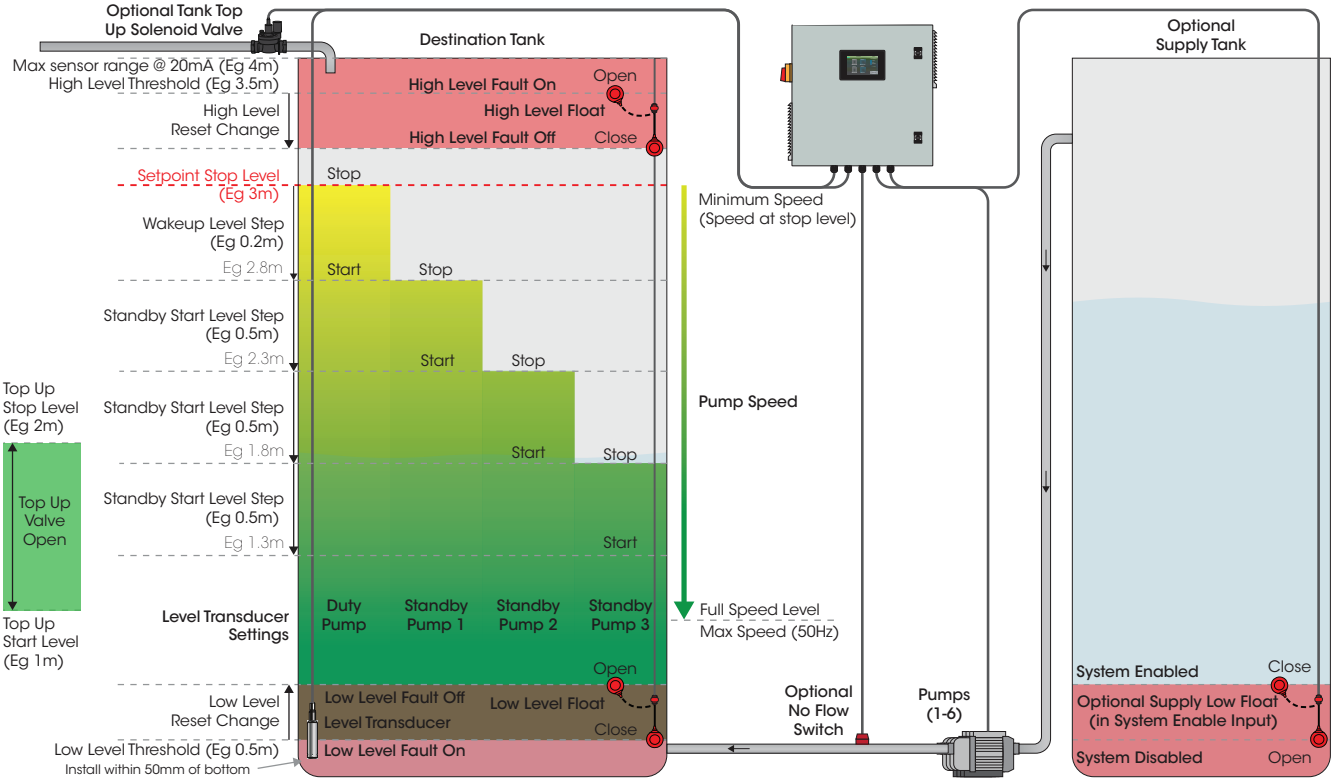
LOW LEVEL PROTECTION

The low level fault is triggered 3 seconds after the low level input opens (empty *control direction*) or closes (fill *control direction*), and/or the analog *low level threshold* is reached. The low level fault is automatically reset 3 seconds after the low level input closes (empty *control direction*) or opens (fill *control direction*), and/or the analog value rises 0.2m above the *low level threshold.* This protection can be set to alarm, lockout or inhibit in the setup.

LEVEL EMPTY APPLICATION DIAGRAM



LEVEL FILL APPLICATION DIAGRAM



Note: These application diagrams shows the input and output options available for a Hydrokos pump controller configured to control 4 pumps (max number of pumps is 6).

FUNCTIONS & FAULT PROTECTION - PRESSURE CONTROL

SENSOR CONTROL

In the 'pressure' *System type,* the Hydrokos is by a 4-20mA pipe mounted pressure transducer and optional high and low alarm pressure switches. If the low pressure input is not required it can be left as an open contact. If the high pressure input is not required it needs to be bridged.

WAKEUP & SLEEP

As the system pressure falls and the analog *wakeup pressure drop* from *setpoint* is reached, the duty pump will start, after a 1 second delay. Once the water level returns to the analog *setpoint* and there is no more demand for water based on the *no demand speed* the controller will stop the duty pump and go to sleep, after the *sleep delay* period entered in the setup.

SLEEP ASSIST

The Sleep Assist function is specific to the Pressure VSD mode and is used to assist the pumps in going to sleep in situations with changing no demand points or where the slip in centrifugal pumps is hard to detect. There are two options within Sleep Assist:
Speed Minimise - When the system is at setpoint and pump speed is not varying more than 0.1Hz for 20 seconds, the system will slowly drop the pump speed to try and reach the *no demand speed,* to help the pump go to sleep sooner. If the pressure deviates from the setpoint by a certain amount the system will leave speed minimise and return to normal running state.
Boost - When there is no water being used and the system is about to go to sleep, the system *setpoint* is adjusted to *setpoint + sleep boost pressure increase* to increase the system pressure before going to sleep. This allows the system to stay in sleep for a longer period of time to reduce pump cycling. If the system can't build the pressure to this new setpoint within 5 seconds and the sleep condition is still met, the system will go to sleep anyway. If the pressure drops below the *setpoint* by a certain amount while attempting a sleep boost the system will return to normal running mode.

PID SPEED CONTROL

The Pressure system type uses PID (proportional, integral and derivative) speed control of the pumps to maintain the *setpoint* pressure. The *proportional* and *integral* values can be adjusted in the setup to alter the acceleration and deceleration of the variable speed drives to suit specific pump sizes and applications.

PUMP STAGING & DESTAGING

Additional pumps will be staged into operation to assist the duty pump if it cannot keep up with demand. When the pump speed reaches 50Hz, and if the analog feedback's distance from setpoint is greater than 6kPa, the controller will stage in another pump, after a 5 second delay. The *pump limit* will limit the number of standby pumps that can be used to assist the duty pump, keeping additional pumps available only on a pump fault.
Pumps will be destaged from operation as they are no longer required. When the pump speed falls to the destage threshold (which depends on the *no demand speed*), the controller will destage it from operation, after a 5 second delay.

MAINS WATER BYPASS VALVE CONTROL

For systems supplying water from a storage tank, a normally open solenoid valve can be used to supply water when the pumping system is out of water or in a fault condition. This is enabled through the pressure setup by turning on the *mains bypass valve enable.*
Note - This function is available upon request. The RMC variation features the valve output as standard, see 'Hydrokos RMC Variation' on page 48 for more information.

JACKING PUMP CONTROL

For situations where one pump is smaller than the other pumps to suit various flow rates, the *jacking pump* can be enabled in the setup. In this mode the jacking pump will always be the first to wake from sleep. If the jacking pump can't keep up with demand one of the main pumps will start and the jacking pump will turn off after 10 seconds, to ensure a smooth transition. When the last main pump's speed falls to the duty destage threshold speed and the pump is no longer required, the jacking pump will start and the last main pump running will switch off after 5 seconds. If the jacking pump is also not required to run the system will go to sleep and await the next wakeup signal.

PIPE FILL

The pipe fill function can be enabled in the setup for the Pressure VSD mode, and is used to gently build pipe pressure. If the system wakes from sleep and the pressure is 20% of the pressure sensor range or more below the *setpoint,* the system will run a single duty pump at 45Hz to increase the pressure slowly. If the pump fails to increase the pressure to less than 20% of the pressure sensor range from the setpoint in 10 minutes a pipe fill fault will lockout the pumps. **Note -** In some continual water demand applications, the pipe fill function should be disabled after initial commissioning, to prevent the pipe fill fail fault from activating during normal operation.

HIGH PRESSURE PROTECTION

The high pressure fault is triggered 3 seconds after the high pressure input opens and/or the analog *high pressure threshold* is reached. It automatically resets 20 seconds after the high pressure input closes and/or the analog value drops 50kPa below the *high pressure threshold.* This protection can be set to alarm, lockout or inhibit in the setup.

LOW PRESSURE PROTECTION

The low pressure fault is triggered 30 seconds after the low pressure input closes and/or the analog *low pressure threshold* is reached, if the pump speed is above the *No demand speed*. The low pressure fault is automatically reset 60 seconds after the low pressure input opens and/or the analog value rises 50kPa above the *low pressure threshold*. This protection can be set to alarm, lockout or inhibit in the setup. The inhibit mode for the low pressure fault features automatic restart attempts, as explained below.

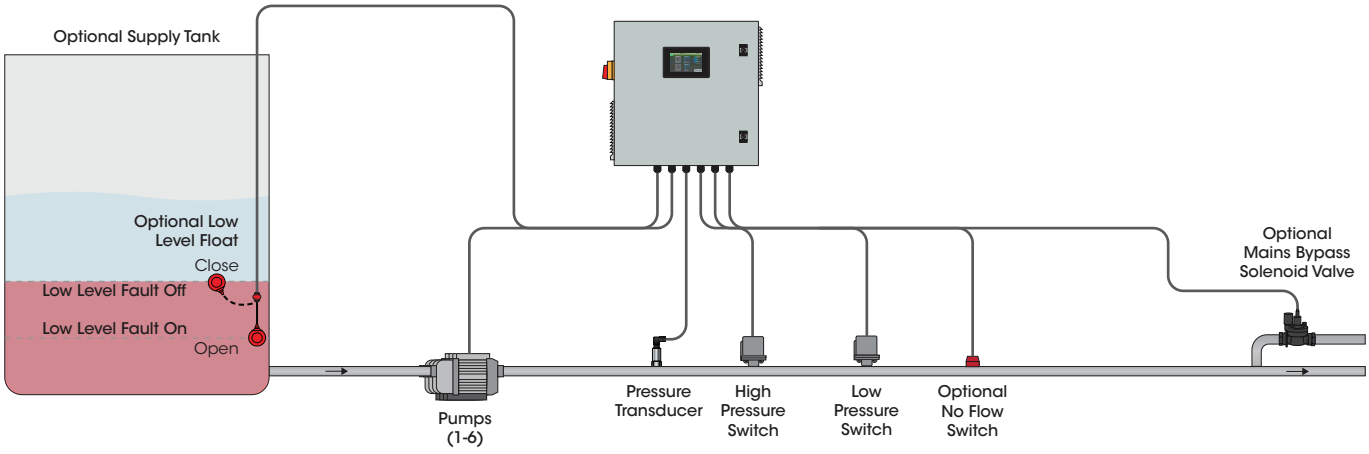
LOW PRESSURE AUTO RESTART

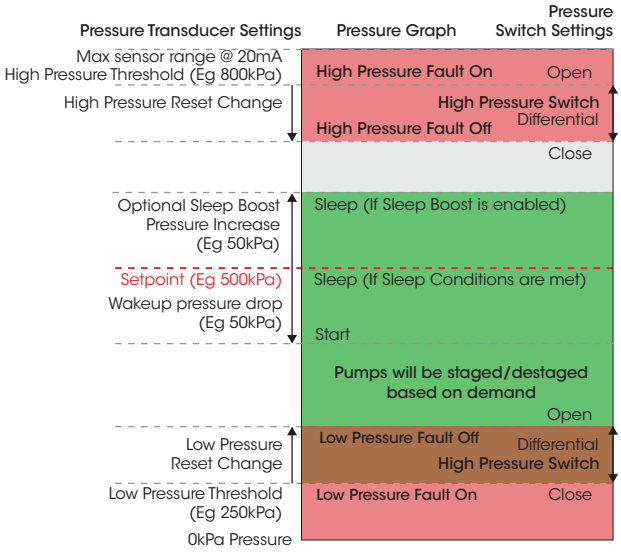
If the *Low pressure protection* is set to 'Inhibit', the controller will automatically attempt to restart the system even if the reset conditions are not met. This allows the system to try to run a pump and re-pressurise the system after a low pressure event without user intervention. 60 seconds after the system being inhibited due to a low pressure fault, the controller will attempt to restart a pump and build pressure. If the pressure rises 50kPa above the analog *low pressure threshold* and/or the low pressure input opens for 60 seconds, the fault will be reset and the system will resume normal operation. If the low pressure fault condition continues, however, the system will be inhibited again. After 5 consecutive failed restart attempts, the system will be locked out and the fault will require manual reset.

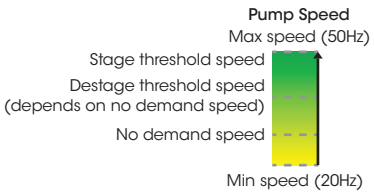
LOW LEVEL PROTECTION

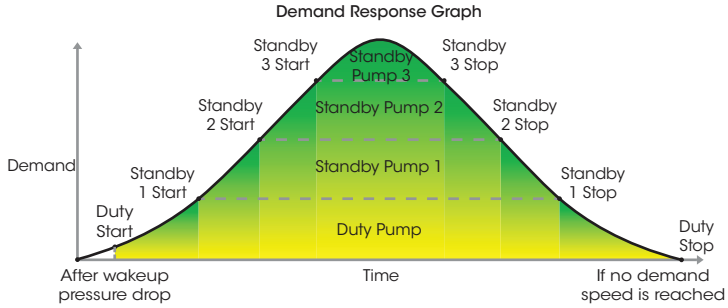
In the Pressure *system type,* the low level input may be used for a low level float switch in a supply tank, shutting down the pumps when this input opens to prevent them from running when there is no water available.

CONSTANT PRESSURE APPLICATION DIAGRAM









Note: This application diagram shows the connection options and settings available for a Hydrokos pump controller configured to control 4 pumps (max number of pumps is 6).

FUNCTIONS & FAULT PROTECTION - TEMPERATURE CONTROL

CONTROL DIRECTIONS

In the Temperature *System type,* there are two modes, 'heat' and 'cool', which work opposite to one other. 'Cool' will start pumps as the temperature rises to maintain a low temperature whereas 'heat' will start pumps as temperature falls to try and maintain a high temperature.

SENSOR CONTROL

In the Temperature *System type,* the Hydrokos is controlled by a 4-20mA temperature transducer and optional high and low temperature alarm thermostats. If the low temperature thermostat input is not required it can be left as an open contact. If the high temperature thermostat is not required it needs to be bridged.

WAKEUP & SLEEP

As the temperature rises or falls, depending on the *control direction,* and the analog *wakeup temperature step* from the *setpoint* is reached, the duty pump will start, after a 1 second delay. Once the water level returns to the analog *setpoint,* the controller will stop the duty pump and go to sleep, after the *sleep delay* period entered in the setup, if the *sleep mode* is set to 'Setpoint based'. If the *sleep mode* is set to 'None', however, the duty pump will always remain running to circulate water, and will alternate every *duty change period*.

PROPORTIONAL SPEED CONTROL

The Temperature *system type* uses proportional speed control of the pumps to maintain the *setpoint* temperature. The controller will increase the pump speed from the minimum speed (*VSD speed at setpoint* in the setup) when the temperature is at the *setpoint,* to maximum speed at the *VSD full speed temperature* entered in the setup.

PUMP STAGING & DESTAGING

Additional pumps will be staged into operation to assist the duty pump after each analog *standby start temp step* is reached, after a 5 second delay. The *pump limit* will limit the number of standby pumps that can be used to assist the duty pump, keeping some pumps available only on a pump fault.
Pumps will be destaged as the analog value returns past each previous analog *standby start temp step,* or in the case of the 1st standby pump, when the *wakeup temperature step* from the *setpoint* is reached, after a 5 second delay.

HIGH TEMPERATURE PROTECTION

The high temperature fault is triggered 3 seconds after the high temperature input opens *(heat control direction)* and/or the analog *high temperature threshold* is reached. It automatically resets 3 seconds after the high temperature input closes (heat *control direction*) and/or the analog value drops 2.0°C below the analog *high temperature threshold.*

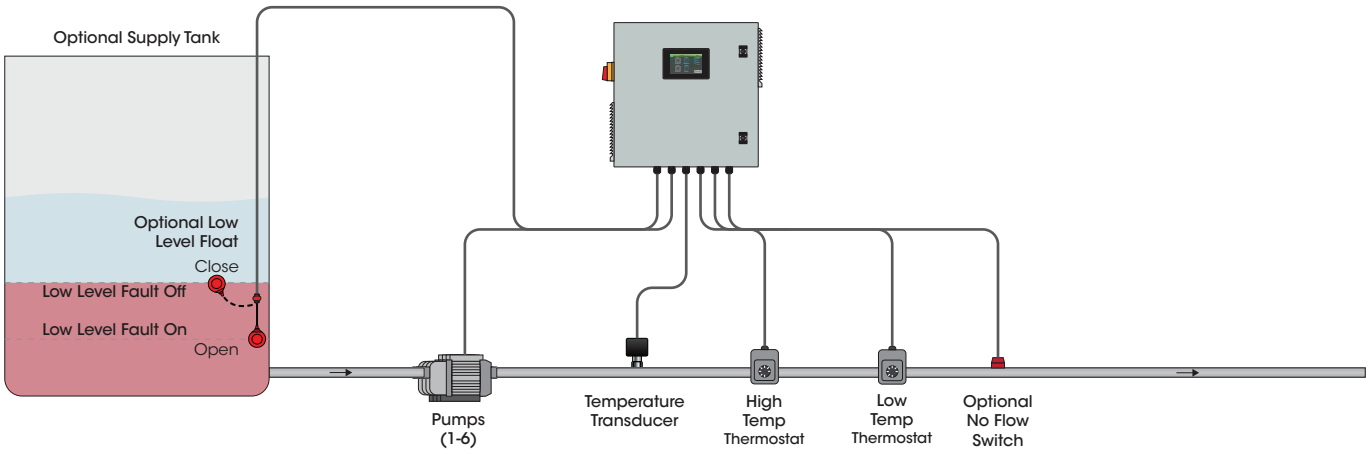
LOW TEMPERATURE PROTECTION

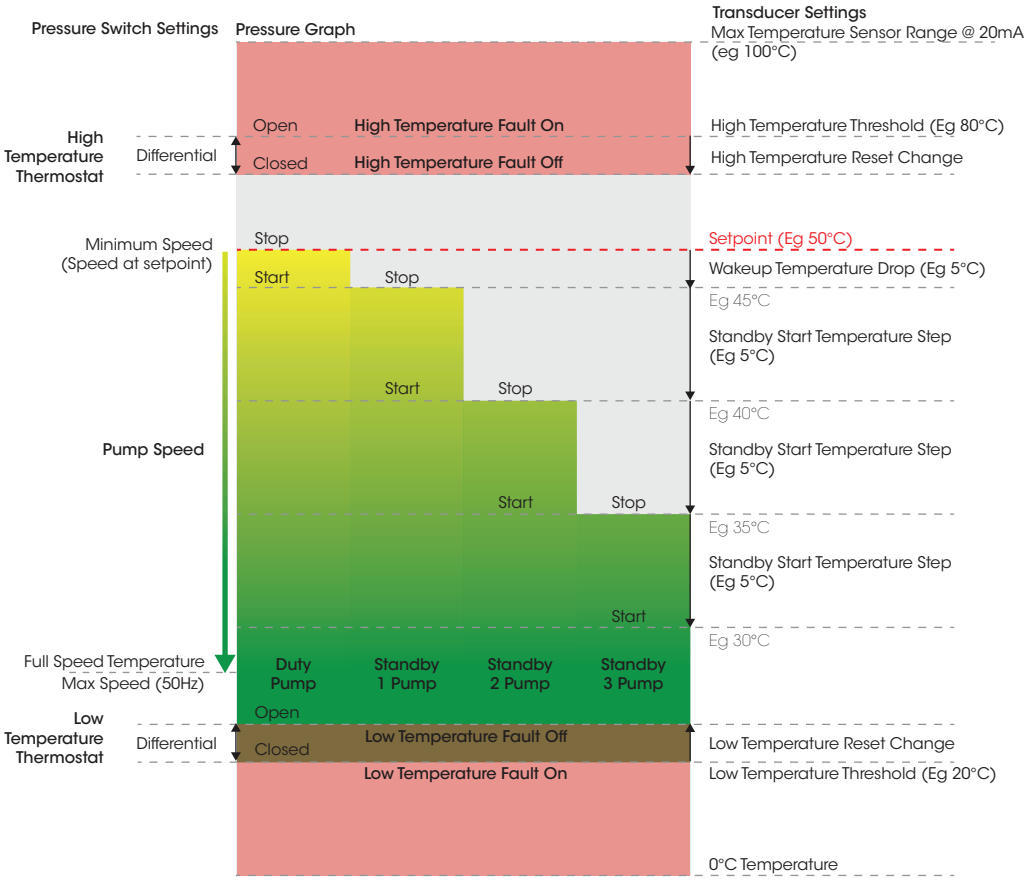
The low temperature fault is triggered 3 seconds after the low temperature input closes *(heat control direction)* and/or the analog *low temperature threshold* is reached. The low pressure fault is automatically reset 3 seconds after the low temperature input opens *(heat control direction)* and/or the analog value rises 2.0°C above the analog *low temperature threshold.* This protection can be set to alarm, lockout or inhibit in the setup.

LOW LEVEL PROTECTION

In the Temperature *System type,* the low level input may be used for a low level float switch in a supply tank, shutting down the pumps when this input opens to prevent them from running when there is no water available.

TEMPERATURE HEAT APPLICATION DIAGRAM

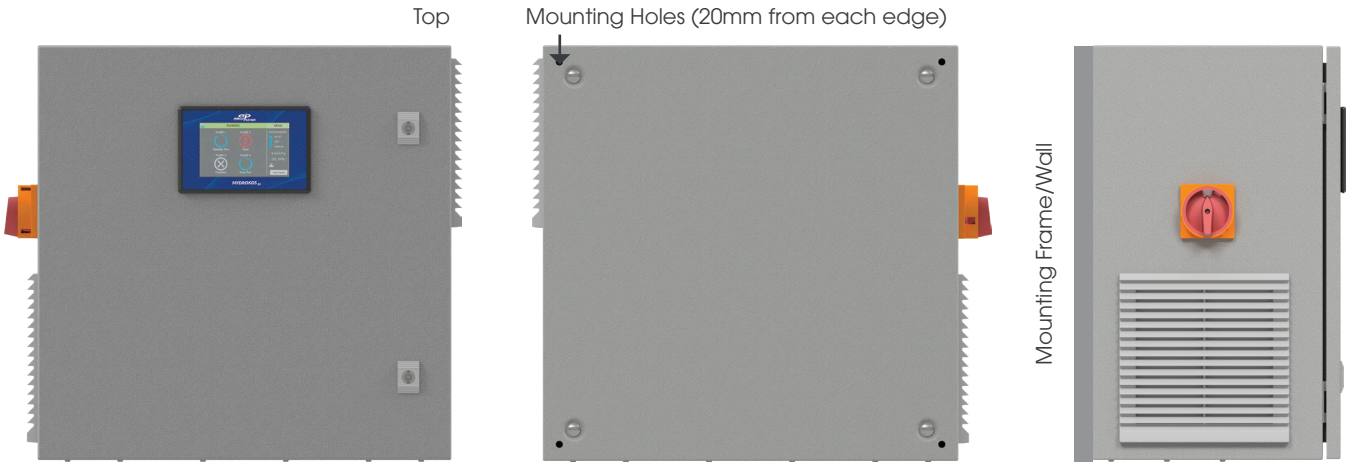




Note: This application diagram shows the connection options and settings available for a Hydrokos pump controller configured to control 4 pumps (max number of pumps is 6).

INSTALLATION

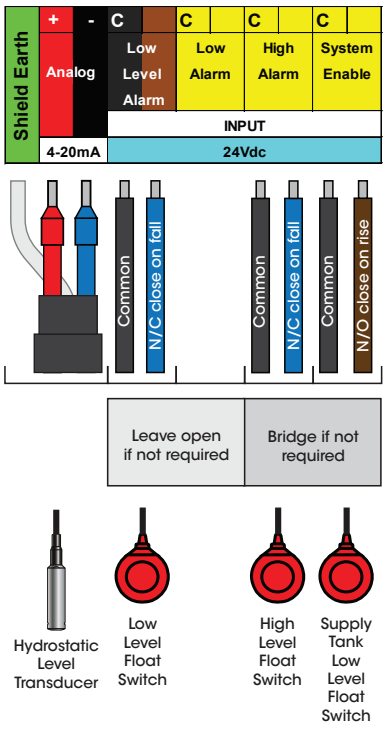
- Controller enclosure must be mounted in a vertical position.
- Ensure mounting method does not compromise enclosure weatherproof rating.
- Ensure access to main isolator is not restricted.
- Ensure cables/conduits entering the panel have mechanical protection and that the penetrations are sealed and do not compromise the weatherproof rating of the enclosure.



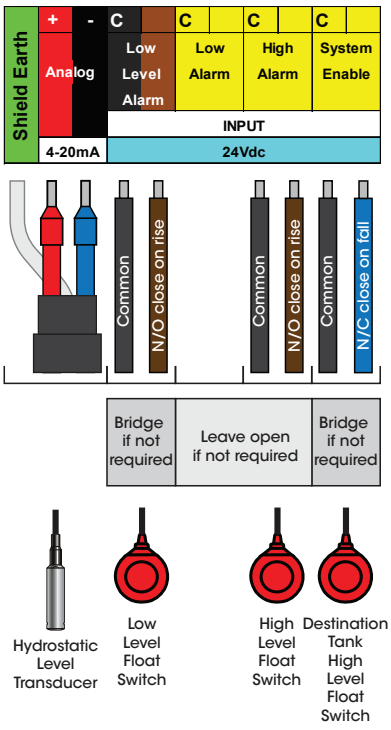
CONNECTIONS

Warning: All electrical connections must be carried out by a suitably qualified and registered electrician

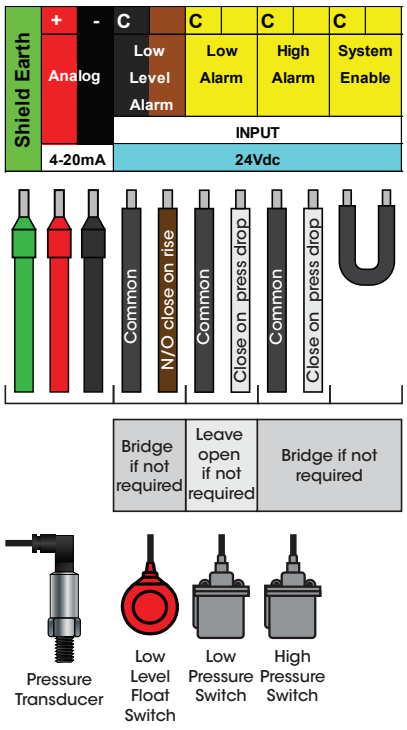
LEVEL FILL CONNECTIONS



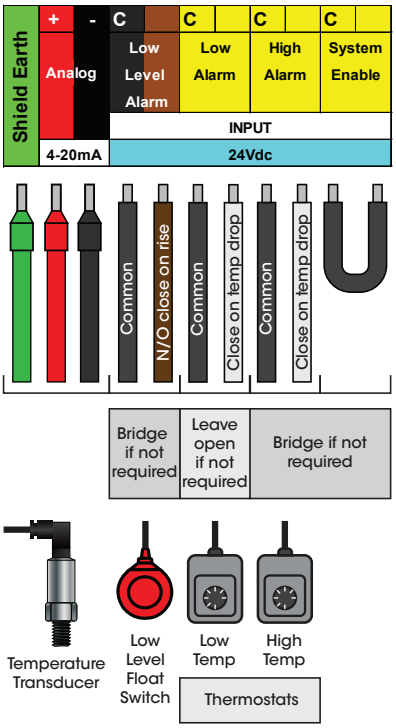
LEVEL EMPTY CONNECTIONS



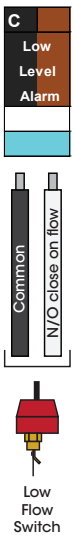
PRESSURE BOOST CONNECTIONS



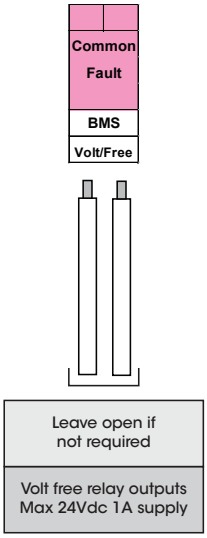
TEMPERATURE HEAT CONNECTIONS



NO FLOW CONNECTION (INSTEAD OF LOW LEVEL)



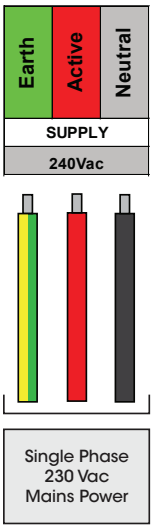
VF CONNECTIONS



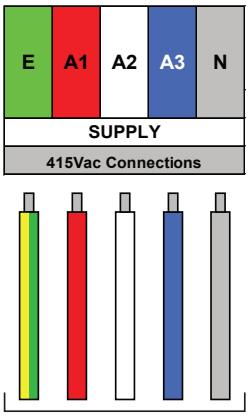
Note:

- The above shows the full range of connections available. While the analog input must be used, the digital inputs are not required for correct operation. Refer to the controller's **Inner Door Label** for common connections.
- Modbus RTU Serial RS485 connections for SCADA are also available on the Hydrokos control module. Din rail terminals are not provided as standard for these connections, but they can be wired directly to the module. See 'Control Module Connections' on page 14 for more information.

1 PHASE POWER SUPPLY



3 PHASE POWER SUPPLY



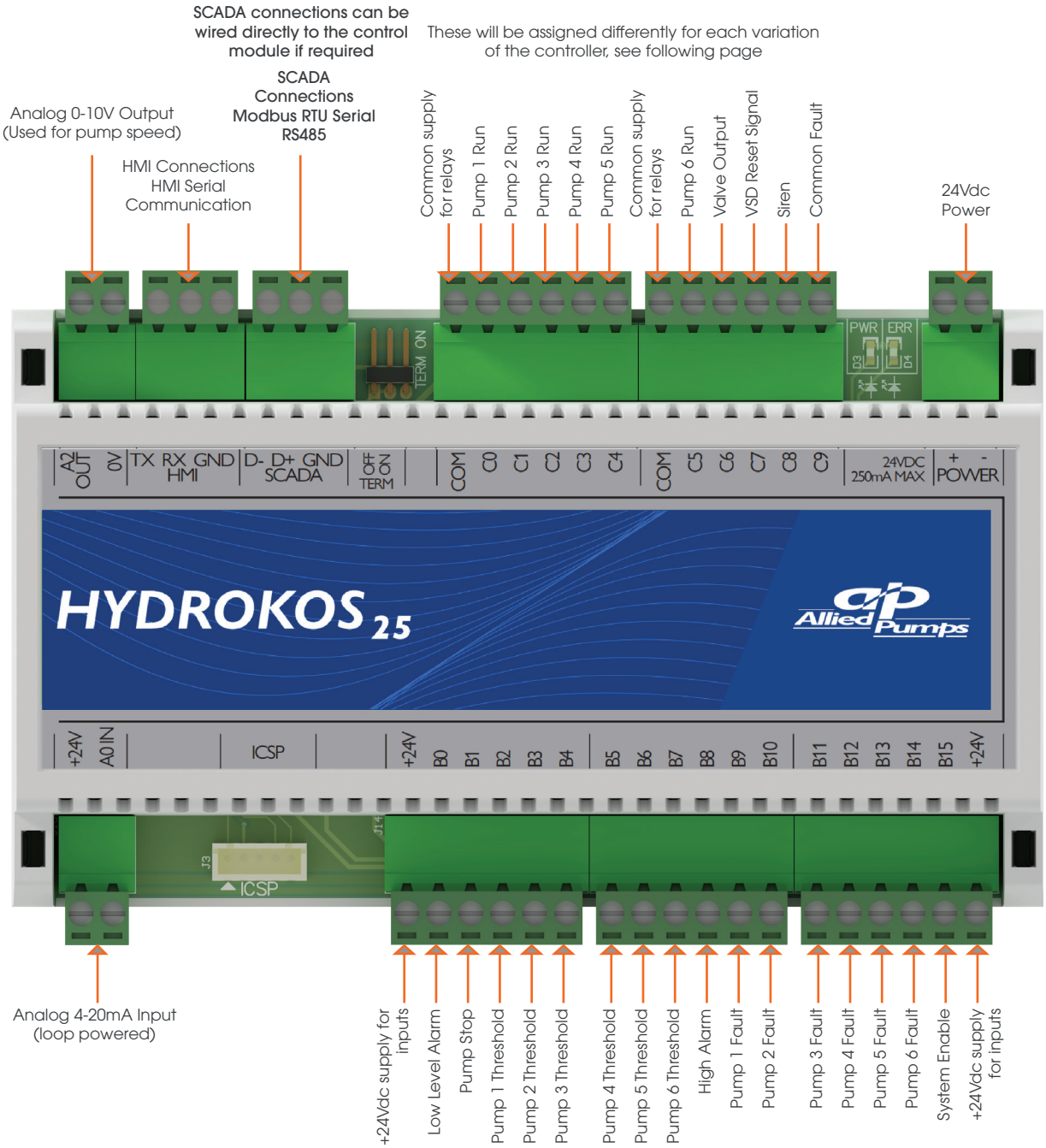
Note: Neutral Wire Required
A 4 Core and Earth Supply with a Neutral Wire is required on 3 Phase Supply. If no Neutral Wire is available, a customised panel can be supplied.

It is highly recommended that RCDs are not used to protect the supply to this panel. Please refer to the Safety section in for more information.

CONTROL MODULE CONNECTIONS

DEFAULT CONNECTIONS

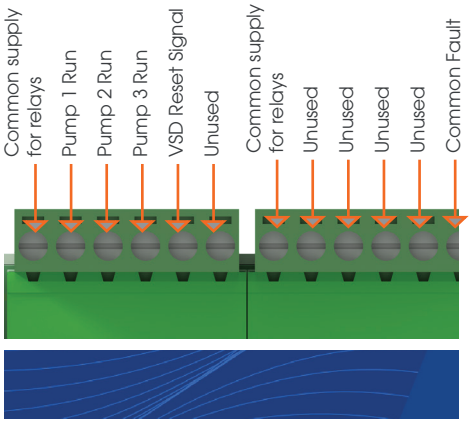
The below connections are the default connections for the Hydrokos control module. These connections will be consistent on each controller, except for the relay outputs (C0 to C9). The relay outputs will be assigned in the most efficient way for each version of the Hydrokos VSD to minimise the number of additional relays and circuitry needed to provide all the outputs required for operation. See the following page for the output assignment used for each version of the Hydrokos VSD.
If the controller's parameters are factory reset on the diagnostics HMI screen, the control module's outputs will reset back to this default configuration. The outputs will need to be reassigned as required in the parameters list (parameters 19.X). See 'Parameters' on page 28 for information on the operation of the Parameters screen.



OUTPUTS - STANDARD VARIATION (1-3 PUMPS)

These outputs apply to the standard variation of the Hydrokos VSD Controller, configured to control 1-3 pumps. For 4-6 pumps, the control module connections will differ as additional pump run outputs will be required on the board.

See the controller's circuit diagram for specific connections.



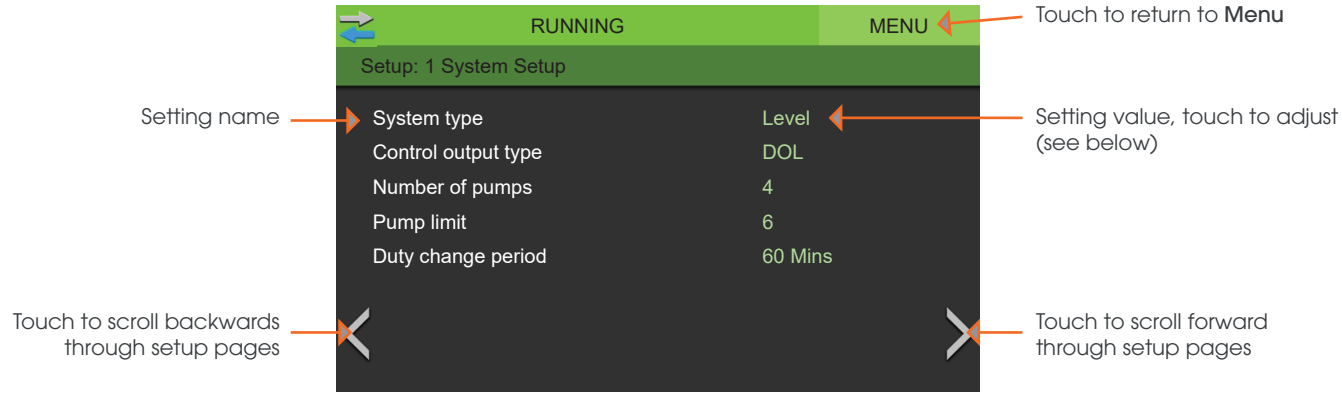
For the control module output assignments for other Hydrokos variations, see:

- **BMS variation -** See 'Hydrokos BMS Variation' on page 47.
- **RMC variation -** See 'Hydrokos RMC Variation' on page 43.

SETUP

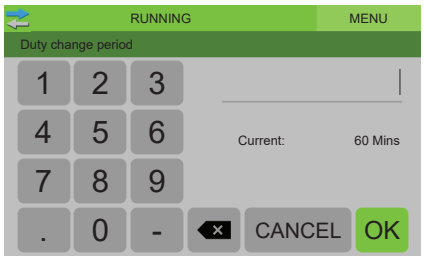
The Setup Screen is where the controller is configured for operation. To access the Setup from the Main screen, tap on the menu in the top-right corner then tap the Setup icon. Login is required to access this screen. For the login 'Login' on page 26 .
If the system mode is in auto, tapping on a setting will bring up a warning screen. Press OK to turn the system off to prevent any unexpected behaviour while the system is configured.
The pages following the System Setup page will change depending on whether the 'Level', 'Pressure' or 'Temperature' *system type* is selected, allowing users to adjust settings that are specific to each mode.
After the setup is complete the system mode needs to be changed back to auto on the main screen.

SETUP SCREEN OPERATION



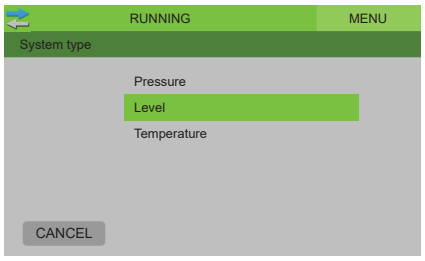
Setting Adjustment - Value

If a value setting, such as *Duty change period*, is pressed on, the keyboard screen will appear and the desired value can be entered or the process cancelled.



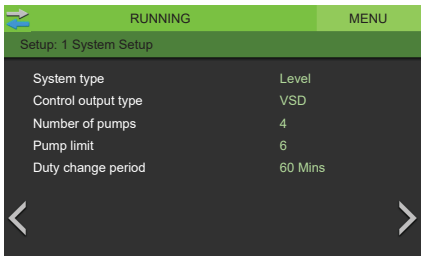
Setting Adjustment - Selection

If a selection setting, such as *System type*, is pressed on, a drop down list of all the available options for the setting will appear and the desired option can be selected or the process cancelled.



1 - SYSTEM SETUP

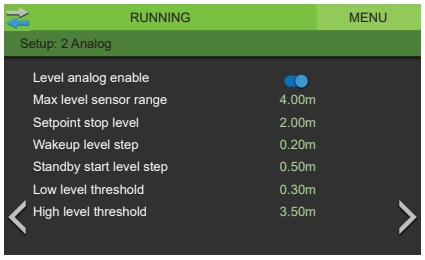
The main setup for the system and pump control method. See 'Functions & Fault Protection' for more information on the function of the system.



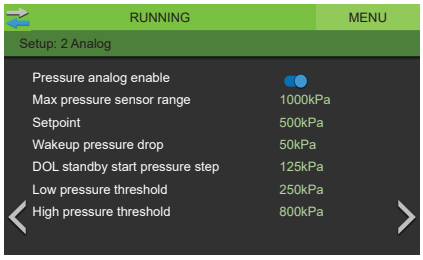
System type	Sets default system settings for the pressure, level or temperature system types.
Control output type	Sets default system settings for the DOL, Soft start or VSD controlled pumps. This setting is factory set and does not require adjustment.
Number of pumps	Total number of pumps connected which configures the display and pump selection. This setting is factory set and does not require adjustment.
Pump limit	Maximum number pumps to be running at the same time. Used to limit max flow or max power requirements.
Duty change period	Duty pump running time before initiating a duty change to the next pump.

2 - ANALOG

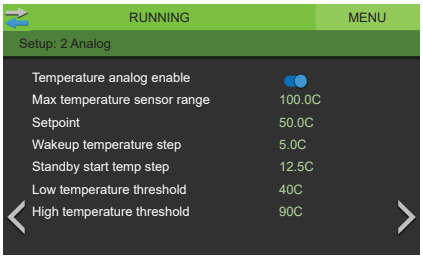
The analog setup if using the analog input for a transducer. This must be used for VSD controllers. See 'Functions & Fault Protection' for more information on the analog settings and operation for each *system type*.



Level Control



Pressure Control



Temperature Control

Level

Level analog enable	If enabled the analog input will be used in conjunction with the digital inputs for alarms.
Max level sensor range	The maximum range of the analog level sensor used.
Setpoint stop level	Target *Setpoint stop level* to be reached by the system.
Wakeup level step	The analog level step from the *setpoint stop level* before the system will wake from sleep and start the duty pump. For example, in a level empty application, if the *setpoint stop level* = 0.5m and *wakeup level step* = 0.2m, the duty pump will start at 0.5m + 0.2m = 0.7m.
Standby start level step	The analog level steps from the *wakeup level step* at which the standby pumps start. Following on from the above example, if the *standby start level step* = 0.5m, the 1st standby pump will start at 0.5m + 0.2m + 0.5m = 1.2m. The 2nd standby pump will start after another 0.5m step, therefore at 1.7m, and so on for any additional standby pumps.
Low level threshold	When the analog goes below this threshold for 3 seconds the *Low level protection* will be activated.
High level threshold	When the analog goes above this threshold for 3 seconds the *High level protection* will be activated.

Pressure

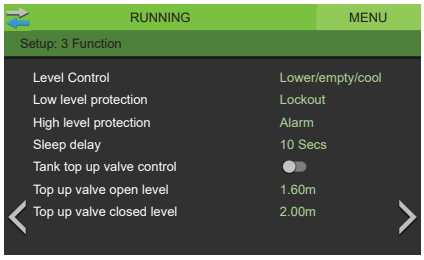
Pressure analog enable	If enabled the analog input will be used as well as the digital inputs for the pressure control and alarms.
Max pressure sensor range	The maximum range of the analog pressure sensor used.
Setpoint	Target *Setpoint* to be reached by the system.
Wakeup pressure drop	The analog pressure step below the *setpoint* before the system will wake from sleep and start the duty pump. For example, if the *setpoint* = 500kPa and the *wakeup pressure drop* = 50kPa, the duty pump will start at 500kPa - 50kPa = 450kPa.
DOL Standby start pressure step	The analog pressure steps below the *Wakeup pressure drop* at which the standby pumps start in the DOL *Control output type*. This setting is not used in the VSD *Control output type*.
Low pressure threshold	While a pump is running above the *No demand speed*, if the analog goes below this threshold for 30 seconds the *Low pressure protection* will be activated.
High pressure threshold	When the analog goes above this threshold for 3 seconds the *High pressure protection* will be activated.

Temperature

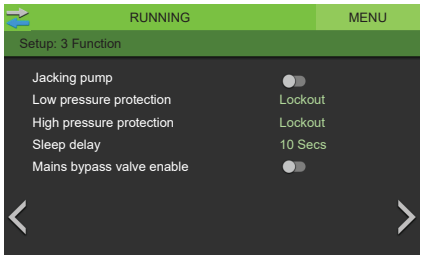
Temperature analog enable	If enabled the analog input will be used in conjunction with the digital inputs for the temperature control and alarms.
Max temperature sensor range	The maximum range of the analog level sensor used.
Setpoint	Target *Setpoint* to be reached by the system.
Wakeup temperature step	The analog temperature step from the *Setpoint* before the system will wake from sleep and start the duty pump.
Standby start temp step	The analog temperature steps from the *Wakeup temperature step* at which the standby pumps start.
Low temperature threshold	When the analog goes below this threshold for 3 seconds the *Low temperature protection* will be activated.
High temperature threshold	When the analog goes above this threshold for 3 seconds the *High temperature protection* will be activated.

3 - FUNCTION

The functional setup for the system. See 'Functions & Fault Protection' for additional information on the functions and protections of the system.



Level Control



Pressure Control

Temperature Control

Level

Level control	Sets the control direction for the corresponding *System type*. Level = empty/fill
Low level protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only. All modes will auto reset when condition clears.
High level protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only. All modes will auto reset when condition clears.
Sleep delay	The delay once the analog *Setpoint* is reached before the pumps will go to sleep.
Tank top up valve enable	If enabled the valve output will be used for a normally closed tank top up valve using the *Tank top up valve open level* and *Tank top up valve closed level*.
Top up valve open level	The analog level at which the valve output will be energised to open the valve. Must be below the *Tank top up valve closed level*.
Top up valve closed level	The analog level at which the valve output will be de-energised to close the valve. Must be above the *Tank top up valve open level*.

Pressure

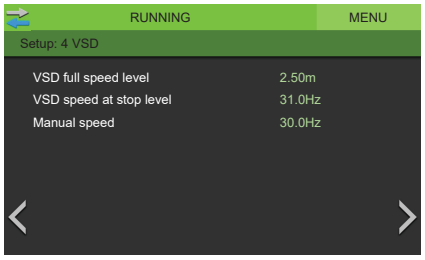
Jacking pump	If enabled jacking pump 1 will always be the first to wake from sleep. When it can't keep up with demand, one of the main pumps will start and the jacking pump will switch off after 10 seconds.
Low pressure protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only and waits 60 seconds before auto restart. 5 failed restarts will active a lockout.
High pressure protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only. All modes will auto reset when condition clears.
Sleep delay	The delay once the analog *Setpoint* is reached before the pumps will go to sleep.
Mains bypass valve enable	If enabled, the valve output will be used for a normally open mains bypass valve, energising it shut during normal operation and de-energising the valve open on digital low level, system off, disabled or lockout.

Temperature

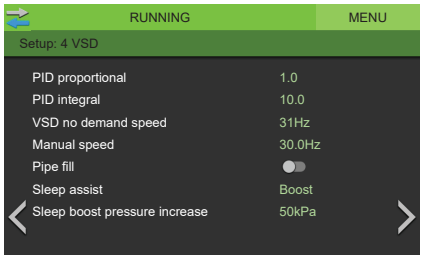
Temperature control	Sets the control direction for the corresponding *System type*. Temperature = cool/heat
Low temperature protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only. All modes will auto reset when condition clears.
High temperature protection	Alarm = Triggers alarm only, Lockout = Triggers an alarm and shuts down the pumps, Inhibit = Shuts down the pumps only. All modes will auto reset when condition clears.
Sleep mode	None = System won't sleep, always at least 1 pump running, Setpoint based = System will go to sleep after the *sleep delay* when the analog *Setpoint* has been reached and/or all digital start inputs are open. Speed based = Not applicable in temperature operation.
Sleep delay	If *Sleep mode* = Setpoint based, this is the delay once the analog *Setpoint* is reached before the pumps will go to sleep.

4 - VSD

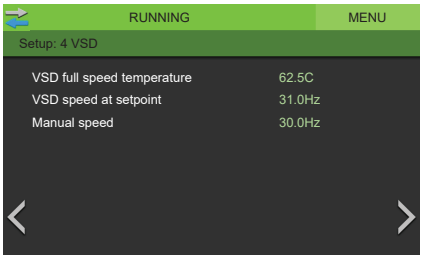
The VSD setup for proportional or PID speed control if the output type is set to VSD. See 'Functions & Fault Protection' for more information on the VSD functions of the system.



Level Control



Pressure Control



Temperature Control

Level

VSD full speed level	This is the analog level at which all the pumps will be running at full speed. Ensure that it is set lower than the *setpoint* if the *control direction* = 'Fill' and higher than the setpoint if the *control direction* = 'Empty'.
VSD speed at stop level	This is the speed the pumps will be running at when at the *setpoint* stop level.
Manual speed	This is the speed a VSD controlled pump will run in manual. If the system is in auto and a duty or standby pump is running then the auto speed will override the *manual speed*.

Pressure

PID Proportional	Proportional is the controlled speed response based on the analog feedback distance from *setpoint* when configured for pressure VSD. 'Increase' = More responsive, 'Decrease' = Less responsive. **See next page for more information on setting the PID.**
PID Integral	Integral is the controlled speed response based on the analog feedback time from *setpoint* when configured for pressure VSD. 'Increase' = Slower response, 'Decrease' = Faster response. **See next page for more information on setting the PID.**
VSD No demand speed	Once the pump speed has dropped below the *No demand speed* for the *Sleep delay* the system will go to sleep. **See next page for more information on setting the *No demand speed*.**
Manual speed	This is the speed a VSD controlled pump will run in manual. If the system is in auto and a duty or standby pump is running then the auto speed will override the *manual speed*.
Pipe fill	If enabled, when the system wakes up from sleep and the analog pressure is more than 20% of the transducer range below *setpoint* the system will run a single duty pump at 45Hz to increase the pressure slowly. If the pump fails to increase pressure to less than 20% of the transducer range from *setpoint* in 10 minutes a pipe fill fault will lockout the pumps.
Sleep assist	When the pump speed is not varying more than 0.1Hz for 20 seconds the system will initiate one of the following sleep assist modes if selected. 'Speed minimise' will slowly drop the pump speed to try and reach the *No demand speed*. If the pressure drops from *setpoint* the system will resume normal running. 'Boost' will temporarily adjust the *setpoint* to *setpoint* + *sleep boost pressure* increase to increase the system pressure, before returning to the normal running and *setpoint*. This should slow the pump speed to below the *No demand speed* if there is no system demand.
Sleep boost pressure increase	This is the target pressure above the *setpoint* which the sleep boost will try and reach before returning to normal operation.

Temperature

VSD full speed temperature	This is the analog temperature at which all the pumps will be running at full speed. Ensure that it is set lower than the *setpoint* if the *control direction* = 'Heat' and higher than the *setpoint* if the *control direction* = 'Cool'.
VSD speed at setpoint	This is the speed the pumps will be running at when at the *setpoint*.
Manual speed	This is the speed a VSD controlled pump will run in manual. If the system is in auto and a duty or standby pump is running then the auto speed will override the *manual speed*.

ADDITIONAL INFORMATION FOR SETTING THE PID

The PID algorithm is used to control the speed of the pumps in the pressure VSD configuration to maintain a stable *setpoint*. Generally larger pumps will need to have a slower PID response to smaller pumps. Care must be taken adjusting these values as they can cause the system to become unstable. Also if the VSD acceleration and deceleration times are too large these delays can cause the system pressure to oscillate. It is best to keep the VSD acceleration and deceleration as quick as possible without causing drive high DC bus faults. Below are some tips to setting the PID:

- ***Proportional*** - Increasing the proportional will increase the speed of the PID causing quicker response accelerating and decelerating. Too fast or too slow can cause system pressure over shoot. Set between 0.5(slow) and 2(fast).
- ***Integral*** - Increasing the integral will smooth out the PID when close to the *setpoint*. This increases the time to get to stable set point if flow is not changing. Set between 1 (fast/unstable) to 50 (slow/stable).
- ***Derivative*** - Derivative should be left at 1 and not be changed.

Note - PID responsiveness changes based on the analog range. Increasing the analog range will slow down the PID. For example, at 1000kPa with P = 1 and I = 10 would be similar to 1600kPa with P=1 and I = 3.

ADDITIONAL INFORMATION FOR SETTING THE NO DEMAND SPEED

The *No demand speed* is a critical parameter for the proper operation of the pressure VSD configuration, particularly for the correct operation of the sleep and destaging functions. The no demand is to be set at the speed (Hz) at which one pump achieves the *setpoint* against a dead head (shut discharge valve). If the system is operating as a mains boosting system with fluctuating mains pressure it is best to set the *no demand speed* for the highest incoming mains pressure.

Follow these steps to find the no demand speed:

- Enter the required operating *setpoint* in the setup.
- On the main screen, place the system into auto mode.
- Open the main valve/tap of the system slightly. One pump should start.
- While the pump is running, slowly close the main discharge valve until it is just leaking a little water. The VSD should slow down to a stable speed holding pressure at the required *setpoint*.
- Read the pump speed on the main screen. The *no demand speed* should be set 0.5Hz above this speed in the setup.
- If the speed is 25Hz the test failed, run the test again. This time try reopening the valve then closing with a slightly larger leak.

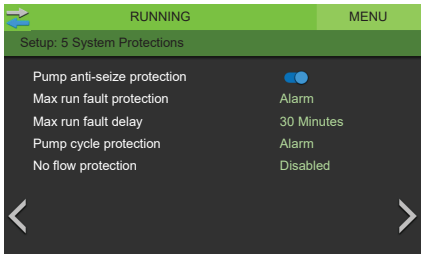
Alternatively, if there is no main discharge valve and no water is being used, follow these steps:

- Enter the required *setpoint* in the setup.
- On the main screen, place the system into manual mode.
- Ensure that the system pressure is less than the required *setpoint*.
- Put one pump into manual at an initial speed of 25Hz. The *manual speed* can be adjusted by touching on the speed on the main screen. The system must be in manual mode to do this.
- Check if the pressure reading is at the required *setpoint*.
- If not, increase the *manual speed* in small steps until the system pressure is at the required *setpoint*.
- Once the *setpoint* is reached, read the pump speed on the main screen. The *no demand speed* should be set 0.5Hz above this speed in the setup.

If the *setpoint* is changed then the *no demand speed* will need to be recalculated because it relates to the pump performance at the system pressure.

5 - SYSTEM PROTECTIONS

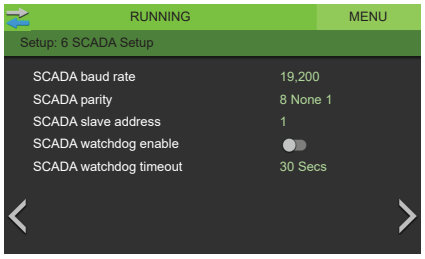
The optional additional system protections. See 'Functions & Fault Protection' for more information on the system protections.



Pump anti-seize protection	If any pump has not run for 7 days, the pump run for 5 seconds to prevent seizing, as long as the system mode is in sleep, disabled or inhibit.
Max run fault protection	Alarm = Alarm only if a pump runs at the maximum speed for the *max run fault delay*. Pump = If a pump runs at maximum speed for the *Max run fault delay* then the pump will be inhibited, with 5 restart attempts before locking out the pump. System = If all available pumps run at the maximum speed for the *Max run fault delay* then the system will be inhibited, with 5 restart attempts before locking out the system.
Max run fault delay	The delay that the pumps run at maximum speed for, before the *Max run fault protection* is activated.
Pump cycle protection	If the system goes to sleep but wakes up within 5 seconds 10 times within an hour, the fault will be activated. Alarm = Alarm only, Lockout = Alarm and pump shut down.
No flow protection	Alarm = Alarm only if a pump runs with no flow for 30 seconds. Pump = If a pump runs with no flow for 30 seconds then it will be inhibited and another pump brought into operation. System = If a pump runs with no flow for 30 seconds then the system will be inhibited. The controller will attempt to restart the inhibited pump or system after a 30 minute delay. If 5 consecutive restarts fail to achieve flow the pump or system will be locked out. **Note -** This function uses a 'close on flow' flow switch connected to the low level alarm input instead of a low level float switch.

6 - SCADA SETUP

The SCADA setup for remote monitoring and control over the Modbus RS485 connection. See 'SCADA Communication' on page 29 for more information.



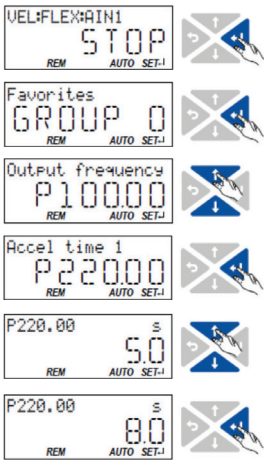
SCADA baud rate	The speed of the modbus communications.
SCADA parity	The bit format of the modbus packets.
SCADA slave address	The slave ID of the device. Each device on the one serial link must have a different device number.
SCADA watchdog enable	If enabled modbus register 3817 must be successful written =1 less than every *SCADA watchdog period* otherwise a SCADA watchdog alarm will be activated and the pumps shutdown. This is used as a 'Keep alive' function.
SCADA watchdog period	The delay after the last successful modbus command before the SCADA watchdog alarm would be activated.

VSD COMMISSIONING (LENZE DRIVES)

See following pages for ABB or Nidec drive commissioning.
To commission VSDs access to live parts is required. This step should only be completed by someone suitably qualified to do so.

KEYPAD NAVIGATION

Follow the steps below to enter and edit the parameters list.



1. Use the ↵ key in the operating mode to navigate to the parameterisation mode one level below. You are now in the group level. All parameters are divided into different groups according to their function .Group '0' contains the 'favourites'. Note: By using the ↩ key you can navigate upwards again anytime.
2. Use the ↵ key to navigate to one level below. You are now in the parameter level of the group selected.
3. Use the ↑ and ↓ navigation keys to select the desired parameter.
4. Use the ↵ key to navigate to one level below. You are now in the editing mode.
5. Set the desired value using the ↑ and ↓ navigation keys.
6. Use the ↵ key to accept the changed setting. The editing mode is exited. Note: By using the ↩ key you can exit the editing mode without accepting the new setting (abort).

SAVING THE PARAMETER SETTING WITH THE KEYPAD

If one parameter setting has been changed with the keypad but has not been saved in the memory module with the mains failure protection, the SET display is blinking. In order to save the parameter settings in the user memory of the module, press the keypad enter key for more than 3s.

SET PUMP PARAMETERS

The pump motor data MUST be entered into each drive to ensure proper control and direction.
The main pump parameters (GROUP 3) should be entered as below.

0x2C01:004 (P320.04)	Motor parameters: Rated speed (Motor parameters: Rated speed) Device for 50-Hz mains: 50... (1450) ...50000 rpm Device for 60-Hz mains: 50... (1750) ...50000 rpm	General motor data. Carry out settings as specified by motor nameplate data. Note! When you enter the motor nameplate data, take into account the phase connection implemented for the motor (star or delta connection). Only enter the data applying to the connection type selected.
0x2C01:005 (P320.05)	Motor parameters: Rated frequency (Motor parameters: Rated frequency) Device for 50-Hz mains: 1.0... (50.0) ...1000.0 Hz Device for 60-Hz mains: 1.0... (60.0) ...1000.0 Hz	
0x2C01:006 (P320.06)	Motor parameters: Rated power (Motor parameters: Rated power) 0.00 ... (0.25)* ... 655.35 kW * Default setting depending on the size.	
0x2C01:007 (P320.07)	Motor parameters: Rated voltage (Motor parameters: Rated voltage) 0 ... (230)* ... 65535 V * Default setting depending on the size.	
0x2C01:008 (P320.08)	Motor parameters: Cosine phi (Motor parameters: Cosine phi) 0 ... (0.80) ... 1.00	General motor data. Carry out settings as specified by motor nameplate data.
0x6075 (P323.00)	Motor rated current (Motor current) 0.001 ... (1.700) ... 500.000 A * Default setting depending on the size. • Setting can only be changed if the inverter is inhibited.	The rated motor current that needs to be set here serves as a reference value for different parameters that involve a setting for/display of a current value in percent. Example: • Motor rated current = 1.7 A • Max current 0x6073 (P324.00) = 200% Motor rated current = 3.4A

REPEAT FOR ALL VSDS IN THE PANEL

Once setup is completed for the first VSD, remove the screen and connect to the other VSDs in the panel and commission them.

VSD COMMISSIONING (ABB)

See previous page for Lenze drive commissioning or following page for Nidec drive commissioning.
To commission VSDs access to live parts is required. This step should only be completed by someone suitably qualified to do so.

VSD CONTROL PANEL OVERVIEW

The following table summarises the key functions and displays on the basic control panel.

No.	Use
1	LCD display – Divided into five areas: a. Upper left – Control location: LOC: drive control is local, that is, from the control panel REM: drive control is remote, such as the drive I/O or fieldbus. b. Upper right – Unit of the displayed value. c. Center – Variable; in general, shows parameter and signal values, menus or lists. Shows also fault and alarm codes. d. Lower left and center – Panel operation state: OUTPUT: Output mode PAR: Parameter mode MENU: Main menu FAULT: Fault mode e. Lower right – Indicators: FWD (forward) / REV (reverse): direction of the motor rotation Flashing slowly: stopped Flashing rapidly: running, not at setpoint Steady: running, at setpoint SET: Displayed value can be modified (in the Parameter and Reference modes).
2	RESET/EXIT – Exits to the next higher menu level without saving changed values. Resets faults in the Output and Fault modes.
3	MENU/ENTER – Enters deeper into menu level. In the Parameter mode, saves the displayed value as the new setting.
4	Up – • Scrolls up through a menu or list. • Increases a value if a parameter is selected. • Increases the reference value in the Reference mode. • Holding the key down changes the value faster.
5	Down – • Scrolls down through a menu or list. • Decreases a value if a parameter is selected. • Decreases the reference value in the Reference mode. • Holding the key down changes the value faster.
6	LOC/REM – Changes between local and remote control of the drive.
7	DIR – Changes the direction of the motor rotation.
8	STOP – Stops the drive in local control.
9	START – Starts the drive in local control.

SET PUMP PARAMETERS

No	Name	Description	Units
9905	MOTOR NOM VOLT	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	Volts
9906	MOTOR NOM CURR	Defines the nominal motor current. Must be equal to the value on the motor rating plate.	Amps
9907	MOTOR NOM FREQ	Defines the nominal motor frequency, ie the frequency at which the output voltage equals the nominal motor voltage	Hz
9908	MOTOR NOM SPEED	Defines the nominal motor speed. Must be equal to the value on the motor rating plate.	rpm
9909	MOTOR NOM POWER	Defines the nominal motor power. Must equal the value on the motor rating plate.	kW

REPEAT FOR ALL VSDS IN THE PANEL

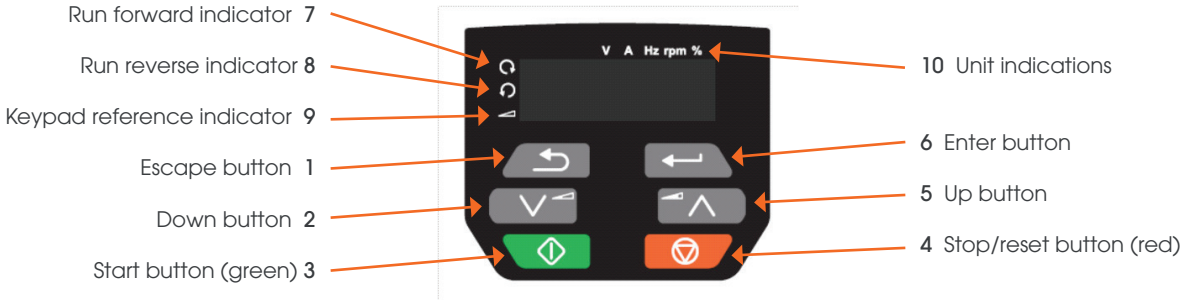
Once setup is completed for the first VSD, remove the screen and connect to the other VSDs in the panel and commission them.

VSD COMMISSIONING (NIDEC DRIVES)

See previous pages for Lenze or ABB drive commissioning.
To commission VSDs access to live parts is required. This step should only be completed by someone suitably qualified to do so.

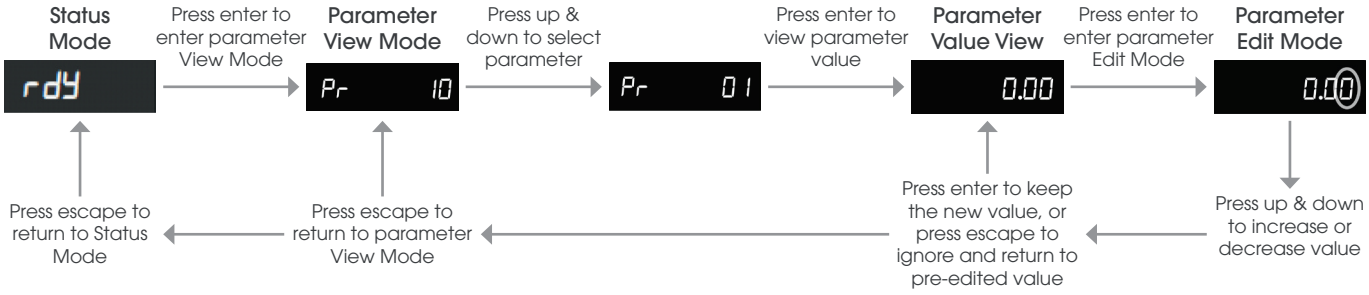
VSD CONTROL PANEL OVERVIEW

The following table summarises the key functions and displays on the basic control panel.



No.	Description	Use
6	Enter button	Used to change between parameter edit and view mode, as well as entering data. This button can also select between slot menu and parameter display.
2 & 5	Up and down buttons	Used to navigate the parameter structure and change parameter values.
1	Escape button	Used to exit from parameter edit and view mode, as well as entering data. In parameter edit mode, if parameter values are edited and the escape button is pressed, the parameter value will be restored to the value it had on entry to edit mode.
3	Start button (green)	Used to provide a run command if keypad mode is selected.
4	Stop/reset button (red)	Used to reset the drive. In keypad mode can be used for 'stop'.

VSD CONTROL PANEL NAVIGATION



SAVING PARAMETERS

After parameters have been changed, parameter 00 must be set to 'save', then press the red Stop/Reset Button to save them.

SET PUMP PARAMETERS

No	Name	Description	Units
0.06	Motor Rated Current	Defines the nominal motor current. Must be equal to the value on the motor rating plate.	Amps
0.07	Motor Rated Speed	Defines the nominal motor speed. Must be equal to the value on the motor rating plate.	rpm
0.08	Motor Rated Voltage	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	Volts
0.09	Motor Rated Power Cosine	Defines the motor rated power factor. Must be equal to the value on the motor rating plate.	ϕ
0.39	Motor Rated Frequency	Defines the nominal motor frequency, ie the frequency at which the output voltage equals the nominal motor voltage	Hz

REPEAT FOR ALL VSDS IN THE PANEL

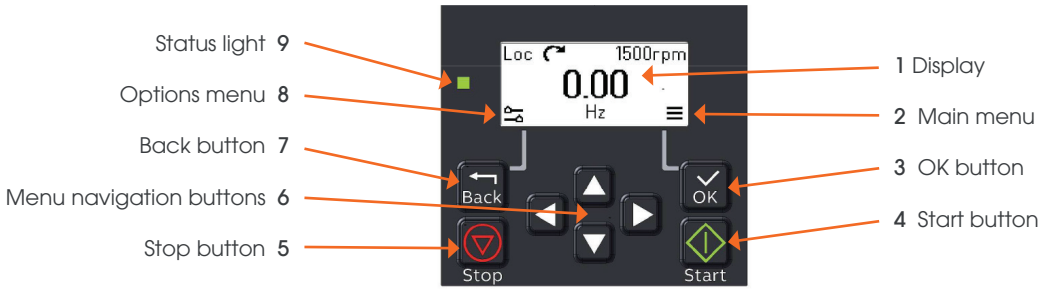
Once setup is completed for the first VSD, remove the screen and connect to the other VSDs in the panel and commission them.

VSD COMMISSIONING (ABB ACS180)

See previous pages for Lenze or ABB drive commissioning.
To commission VSDs access to live parts is required. This step should only be completed by someone suitably qualified to do so.

VSD CONTROL PANEL OVERVIEW

The following table summarises the key functions and displays on the basic control panel.



No.	Description	Use
1	Display	shows the *Home* view as default.
2	Main menu	Main menu display.
3	OK button	open the Main menu, select and save settings.
4	Start button	Start the drive.
5	Stop button	stop the drive.
6	Menu navigation buttons	Move in the menus and set values.
7	Back button	Open the Options menu, and move back in the menu.
8	Options menu	Options menu display.
9	Status light	Green and red colors indicate the state and potential problems.

1 - SET PUMP PARAMETERS

No	Name	Description	Units
99:06	MOTOR NOM CURR	Defines the nominal motor current. Must be equal to the value on the motor rating plate.	Amps
99:07	MOTOR NOM VOLT	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	Volts
99:08	MOTOR NOM FREQ	Defines the nominal motor frequency, ie the frequency at which the output voltage equals the nominal motor voltage	Hz
99:09	MOTOR NOM SPEED	Defines the nominal motor speed. Must be equal to the value on the motor rating plate.	rpm
99:10	MOTOR NOM POWER	Defines the nominal motor power. Must equal the value on the motor rating plate.	kW

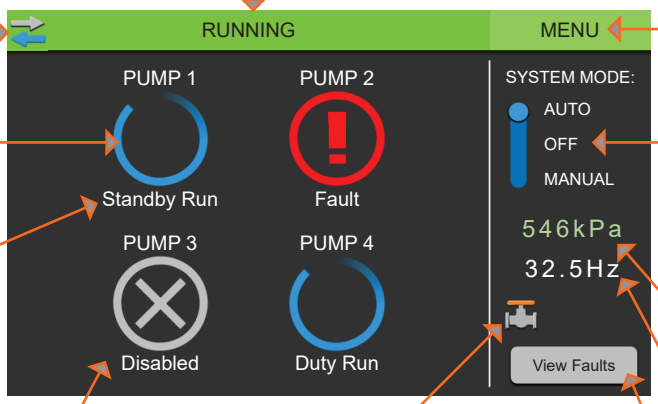
2 - REPEAT FOR ALL VSDS IN THE PANEL

Once setup is completed for the first VSD, remove the screen and connect to the other VSDs in the panel and commission them.

HMI OPERATION

MAIN SCREEN

The default screen on the Hydrokos HMI, providing an overview of the system, pump and valve status and auto/off/manual control.



System Status (see 'Diagnostics' on page 31 for a list of system states)

HMI Communication Status, HMI is communicating with module if symbol is flashing

Touch to go to individual **Pump** screen for additional information and auto or manual control

Pump status (see 'Diagnostics' on page 33 for a list of pump states)

The number of pumps displayed on this screen is based on the selection in the setup (1-6 pumps)

Valve status if a tank top up or bypass valve is enabled in the setup


Valve Closed


Valve Open

Touch to go to **Menu** screen for access to other HMI screens

Touch to change the **System Mode** to auto, off or manual. Manual mode will override the system protections if individual pump manual operation is required (login required).

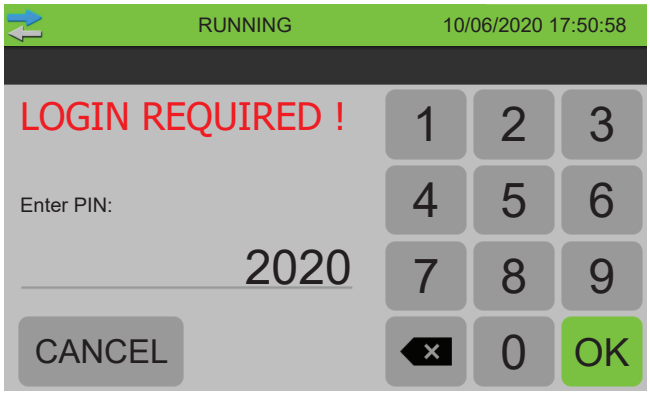
Current analog reading based on level, pressure or temperature selection in the setup

Current pump speed and speed adjustment if in the manual **System Mode**

Touch to access **Alarms** screen to view current and historical alarms, mute siren and reset faults. Button flashes red when there is an active fault.

LOGIN

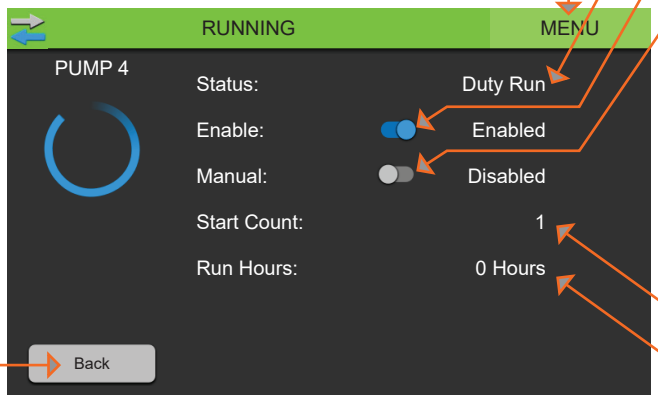
Login is required for performing various actions on the HMI, such as putting the system in manual mode, resetting logged data and configuring the controller on the setup screens. The default PIN is 2020.



PUMP SCREEN

The individual pump monitoring and control screen.

Touch to access **Menu** screen



Pump Status (see 'Diagnostics' on page 33 for a list of pump states)

Touch to enable or disable the pump

Touch to enable or disable pump manual mode. If this is enabled the pump will override the automatic controls and run if no lockout faults are active. The pump enable switch must also be on for this to function. If the system is in auto mode, the pump will run as per the *manual speed* in the setup, and will differ from the auto speed on the main screen

Number of pump starts

Number of pump run hours

Touch to return to the **Main** screen

MENU

The Menu Screen provides access to the other screens within the Hydrokos HMI.

See 'Fault Diagnosis' on page 34 for information on this screen

See 'Logged Data' on page 27 for information on this screen

See 'Setup' on page 16 for information on this screen

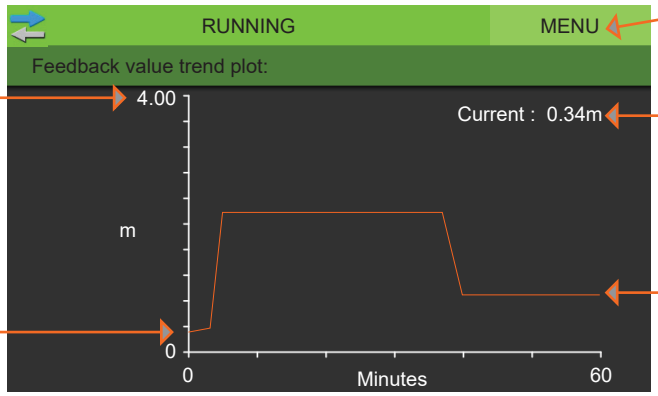
See 'Parameters' on page 28 for information on this screen

Current date and time. This must be set under the Set Time & Date screen (see below)

See 'Diagnostics' on page 31 for information on this screen

TREND PLOT

Displays a graph of the analog level, pressure and temperature value over the last 60 minutes, as well as the current value.



Maximum sensor range

Current analog reading

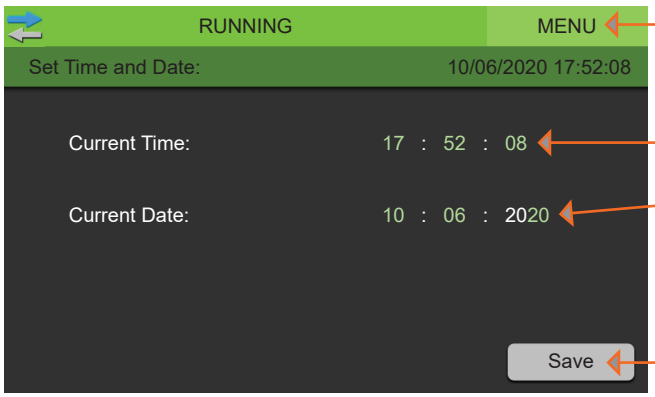
Touch to return to **Menu**

Current analog value

Analog value 60 minutes ago

SET TIME & DATE

Allows the user to set the current time and date.



Touch to return to **Menu**

Touch to adjust the time (set as 24 hour time)

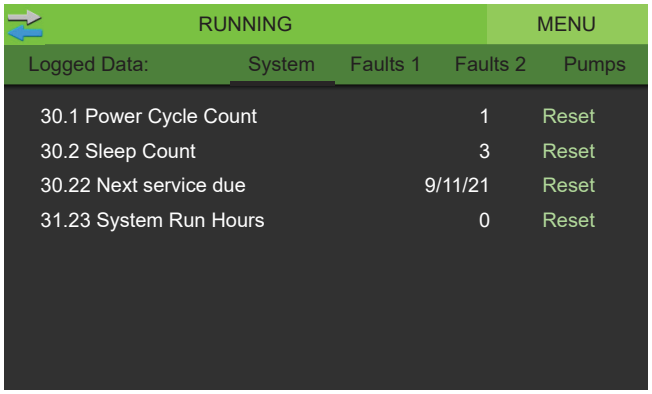
Touch to adjust the date

Touch to apply above values to the controller

LOGGED DATA

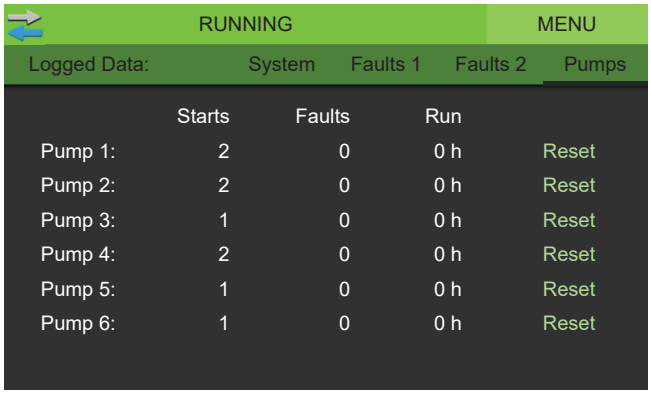
SYSTEM LOGGED DATA

Displays various system event counters, overall system run hours and the next service due date.



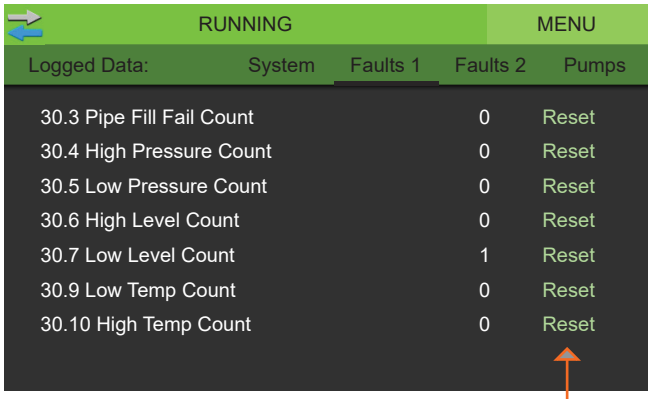
PUMP LOGGED DATA

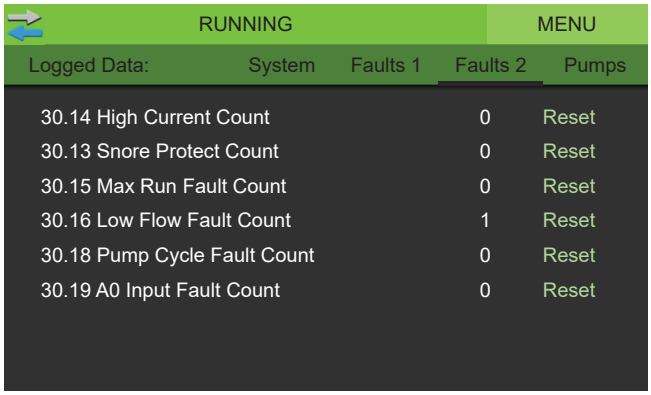
Displays number of starts, number of faults and total run hours for each pump.



FAULT LOGGED DATA

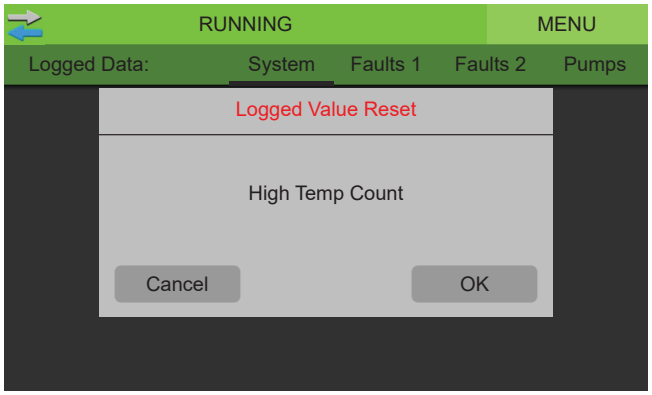
Displays counters for the various faults.





RESETTING LOGGED DATA

Pressing reset beside any logged value on the Logged Data Screens will bring up the 'Logged Value Reset' box, allowing you to confirm or cancel the reset of the data. Login will be required first if not already logged in.
Note: If the Hydrokos is set back to the factory defaults on the Diagnostics page, all the logged data will be reset.

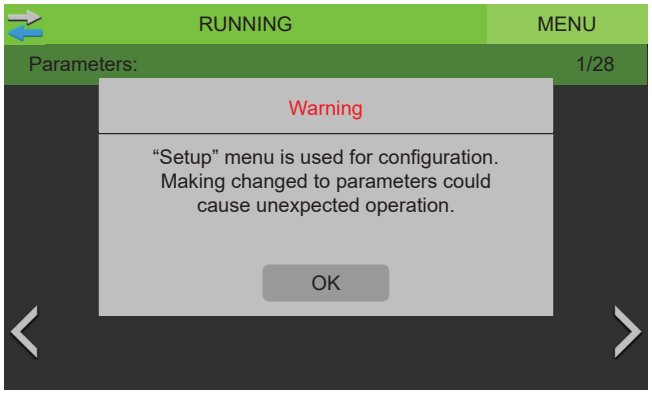


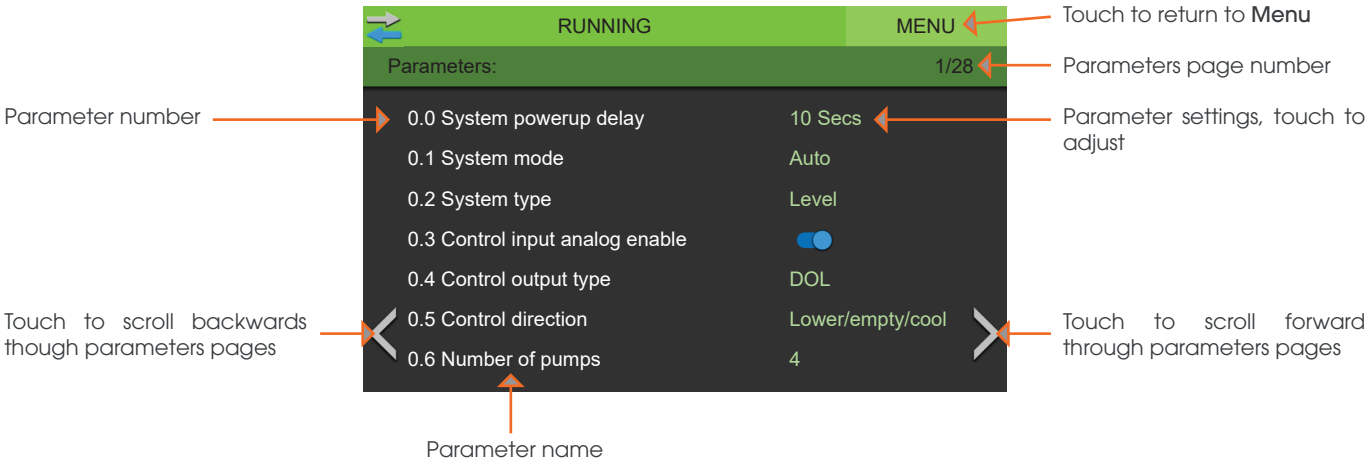
PARAMETERS

Warning: Adjusting any individual parameters through this menu may cause unexpected issues with the function and operation of the controller and should only be done after consulting a technician. Adjustments to settings should be made through the SETUP menu where possible.

PARAMETERS SCREEN OPERATION

The parameters screen displays a list of all the parameters that are used in the operation of the system. The Setup screen is used for configuration of the controller, not the parameters screen. However, if the parameters are factory reset on the diagnostics page, the control module's outputs will need to be reassigned in the parameters list (parameters 19.X). See 'Control Module Connections' on page 14 for more information. Adjusting any other parameters in this screen may cause issues with the function and operation of the controller and should only be done after consulting a technician.





PARAMETERS LIST

For a full list of all the parameters with default settings and descriptions, see the **Hydrokos Parameter List** document.

SCADA COMMUNICATION

DEFAULT COMMUNICATION SETTINGS

The default Modbus RTU SCADA communication settings are Baud:19200, Parity: 8N1, Slave:1. These settings can be changed through the SCADA setup page on the HMI.

ACCEPTED MODBUS FUNCTION CODES

The Hydrokos Modbus links support the following function codes:

01	Read coil status
02	Read input status
03	Read holding registers
05	Force single coil
06	Preset single register
16	Preset multiple registers (maximum of 32)

Care should be taken not to poll the communications too frequently, as this can cause the controller's response to become sluggish.

DATA FORMAT

All data is stored as big endian unsigned integers with the MSB on the left, unless otherwise stated. The first register starts at 1 and the actual number sent in the Modbus packet will be the register number -1.

WATCHDOG TIMER

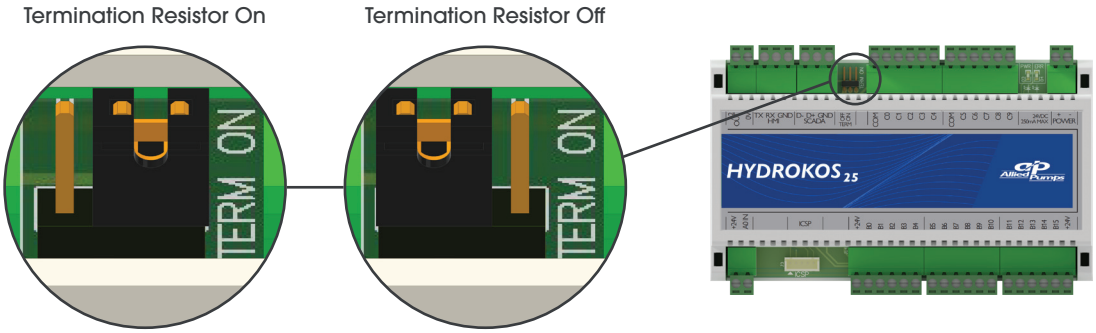
The SCADA communication has the ability to enable a watchdog timer to shutdown the pump operation and trigger an alarm if communication with the SCADA system is lost. If the watchdog timer is enabled, register 3817 needs to be written to 1 at a faster frequency than the SCADA Watchdog Timer otherwise the 'SCADA Watchdog Timeout' alarm will activate and the pumps shutdown. As soon as this register is written successfully again the system will automatically restart operation and clear the fault.

MODBUS REGISTERS

See the **Hydrokos Modbus Registers** document for full list of Modbus registers.

TERMINATION RESISTOR

On long cable runs a termination resistor may be required. To enable the resistor, move the jumper at the top of the Hydrokos module to the ON position. In shorter cable runs, or with some connected devices, the termination resistor may not be required and can be put in the OFF position.



FAULT FINDING

If there is trouble communicating with the Hydrokos controller, follow the below steps:

1. Try reading a single Modbus register using function code 03.
2. Check the connections and try swapping the A and B wires.
3. Check the SCADA fault codes under 'Diagnostics' on page 32 and check the causes and remedies under 'Fault Diagnosis' on page 37 of this manual.
4. Turn the SCADA termination resistor on or off with the jumper bridge on the Hydrokos module.
5. For specific fault finding see 'Fault Diagnosis' on page 37 of this manual.

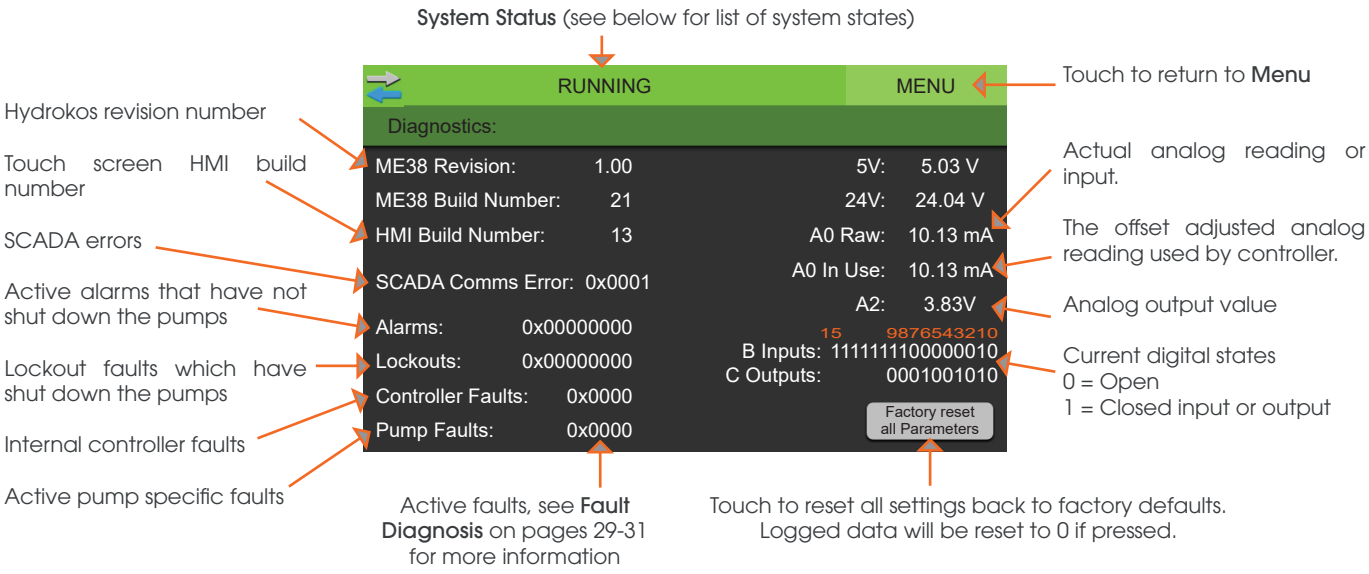
MAINTENANCE

Below is a recommended maintenace routine for the controller. How regularly it should be performed is dependent on the environment the controller is located in. Maintenance will need to be performed more regularly on controllers that are installed in more extreme environemnts, including those subject to corrosion, dust and vibration.

- Tighten screws, as these may have loosed over time, due to temperature changes
- Inspect all cables for damage
- Test correct operation of the controller touch screen HMI
- Check that the alarm strobe and buzzer are operating correctly, if applicable
- Manually start and stop the pumps to ensure the controller is operating correctly
- Clean out the enclosure fan and vents, if applicable
- Wipe down the enclosure, remove any build up of material on on the exterior and interior
- Check intergity of enclosure for rusting and moisture ingress, ensure the door seal is sealing the enclosure correctly
- Conduct a thermography test to detect hot spots in the panel

DIAGNOSTICS

DIAGNOSTICS SCREEN



SYSTEM STATES

Initialise	The system is setting up the configuration after a power failure before going into the powerup state.
Powerup	The system is powering up after power is switched on or the system is restarted.
Off	The system is turned off and will not run any pumps.
Startup	The system has woken from sleep and is configuring itself before going into the running state.
Setpoint Ramp	The system has woken from sleep and the pressure was low so a single pump will ramp smoothly to full speed before going to running mode.
Pipe Fill	The system has woken from sleep when the pressure was very low so a single pump will run at a fixed speed to increase pressure before going to running mode.
Running	The system is in auto and pumps are running and speed is set based on the PID algorithm.
Speed Minimise	The system is using the speed minimise sleep assist function to slow the pump speed down to attempt to put the pumps to sleep.
Stage	The system is not keeping up with demand and is starting an additional standby pump to assist.
Destage	The system demand has dropped and the system is shutting down a standby pump to meet the new demand.
Duty Change	The system is changing the duty pump according to the duty share settings.
Sleep Boost	The system is using the sleep boost assist function to increase pressure to attempt to put the pumps to sleep.
Sleep	The system is available for operation but not at the analog wakeup threshold and no digital start inputs are active.
Lockout	The system has an active fault that is stopping the pumps from running in auto. The fault can been seen on the alarms page with a manual reset required once fault is fixed.
Disabled	The system is disabled via the digital system enable input. If not in use this input must be bridged.
Mains Water	The system is configured for mains water bypass and the tank is low or the system has an active lockout fault.
Duty Destage	The system is destaging the main duty pump to return to the jacking pump as the duty pump.
Inhibit	The system has been inhibited by an auxiliary condition which when cleared will re-initiate the system. If a timer is displayed the system will automatically restart after the timer has finished the count down. The active inhibit condition can be seen on the alarms page.
System Manual	The system has been put into manual mode which will allow pumps to be individually run in manual irrespective of any fault protections.

The fault values on the Diagnostic page are displayed in hexadecimal format which needs to be converted to binary to work out which faults are active. The easiest way is to enter the hexadecimal number into a hex to binary converter and then check the resultant binary bits, which are =1 against the tables below. Binary bit 0 is the right most digit (bit).
Example: HEX = C0 = 1100 = bit 6 and bit 7 are on = Low pressure fault and high level faults are active.

ALARMS & LOCKOUTS

Bit 0: A0 Input Fault
Bit 4: No Feedback
Bit 5: High Pressure
Bit 6: Low Pressure
Bit 7: High Level
Bit 8: Low Level
Bit 10: High Temperature
Bit 11: Low Temperature
Bit 12: Prime Loss
Bit 13: Pipe Fill Fail
Bit 14: Pump Cycle
Bit 15: No Pumps Available
Bit 18: Service Alarm
Bit 19: Scada Watchdog
Bit 20: System Manual

Bit 35: Max Run
Bit 36: Pump 1 Max Run
Bit 37: Pump 2 Max Run
Bit 38: Pump 3 Max Run
Bit 39: Pump 4 Max Run
Bit 40: Pump 5 Max Run
Bit 41: Pump 6 Max Run
Bit 42: No Flow
Bit 43: Pump 1 No Flow
Bit 44: Pump 2 No Flow
Bit 45: Pump 3 No Flow
Bit 46: Pump 4 No Flow
Bit 47: Pump 5 No Flow
Bit 48: Pump 6 No Flow

See 'Functions & Fault Protection' on page 4 and 'Fault Diagnosis' on page 34 for further information

SCADA COMMS ERROR

Bit 0: No error
Bit 1: UART error
Bit 2: Receive timing error
Bit 3: Receive overflow error
Bit 4: CRC error
Bit 5: Incorrect Modbus slave
Bit 6: Illegal Modbus function code
Bit 7: Illegal Modbus data address
Bit 8: Illegal Modbus data value
Bit 9: Modbus slave device failure
Bit 10: Unknown Modbus exception
Bit 11: Response timeout
Bit 12: Bad response

See 'Fault Diagnosis' on page 37 or the **Hydrokos Modbus Registers document** for further information

CONTROLLER FAULTS

Bit 0: EEPROM hardware failure
Bit 1: Data load error
Bit 2: 5V power rail fault
Bit 3: 24V power rail fault
Bit 4: Watchdog reset
Bit 5: Data reinitialised
Bit 6: Data initialised
Bit 7: EEPROM bank 0 checksum
Bit 8: EEPROM bank 2 checksum
Bit 9: No EEPROM signature
Bit 10: EEPROM parameter load limits
Bit 11: Real time clock failure
Bit 12: RTC low/no battery

See 'Fault Diagnosis' on page 37 for further information

PUMP FAULTS

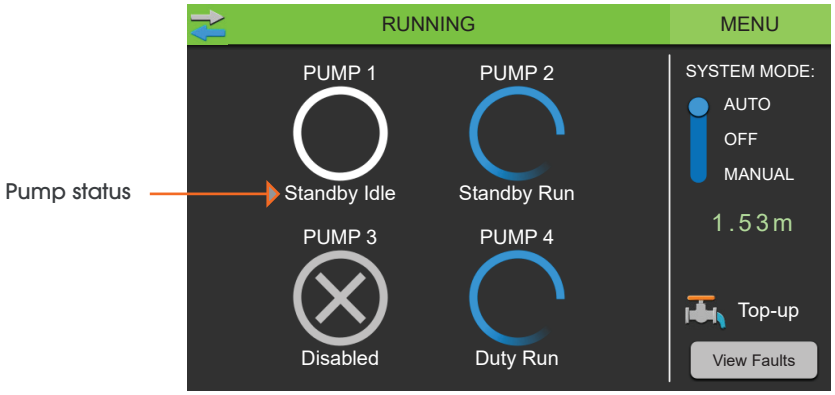
Bit 0: Pump 1	Pump 1 in fault
Bit 1: Pump 2	Pump 2 in fault
Bit 2: Pump 3	Pump 3 in fault
Bit 3: Pump 4	Pump 4 in fault
Bit 4: Pump 5	Pump 5 in fault
Bit 5: Pump 6	Pump 6 in fault

See 'Fault Diagnosis' on page 34 for further information

Note: For all bit states
0 = Not active
1 = Active

PUMP STATES

Main screen

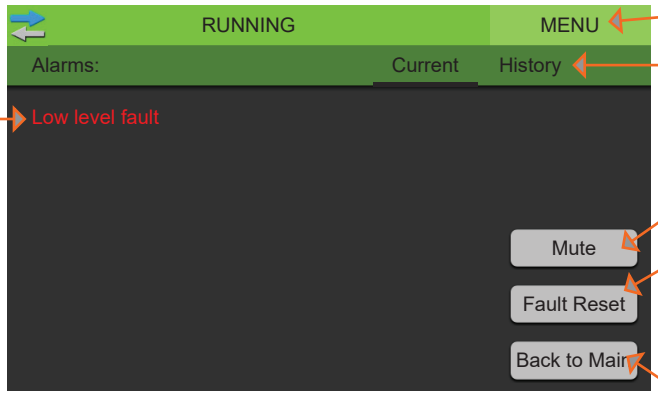


Off	Pump is off and will not run in auto or manual operation.
Disabled	Pump is disabled and will not run in auto or manual operation.
Man Off	Pump is in manual but is not running due to other restrictions, if the system is in auto mode.
Man Run	Pump is in manual and running.
Standby Idle	Pump is in auto, assigned as a standby pump and available to run.
Standby Run	Pump is in auto, assigned as a standby pump and is running.
Duty Idle	Pump is in auto, assigned as the duty pump and available to run.
Duty Run	Pump is in auto, assigned as the duty pump and is running.
New Duty	On a duty pump alternation this pump will be the pump starting to take over the duty.
Fault	Pump is in fault and will require a fault reset to resume operation.
Jacking Idle	The pump is setup as a jacking pump to always start first and is available to run.
Jacking Run	The pump is setup as a jacking pump to always start first and is running.
Start Delay	The pump is being delayed from starting to ensure smooth operation when starting multiple pumps.
Stop Delay	The pump is being delayed from stopping to reduce water hammer when stopping multiple pumps.
Antiseize Run	The pump is running based on the antiseize protection to avoid pump seizure.
Inhibit	The pump is in auto and has been inhibited by another condition, see the current alarms for active inhibit conditions.

FAULT DIAGNOSIS

CURRENT ALARMS SCREEN

List of all the active alarms and inhibit conditions (See **Fault Diagnosis** for a list of all alarms and remedies)



Touch to return to **Menu**

Touch to access the **History** screen for historical alarms

Mutes the audible alarm

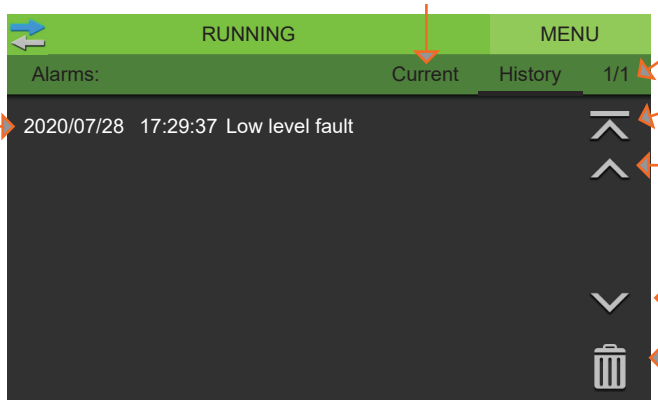
Resets any latched faults. If an alarm will not clear or comes back the alarm condition is still active and needs to be rectified before resetting.

Touch to return to **Main** screen

HISTORICAL ALARMS SCREEN

Touch to return to **Current** alarms screen

List of all the historical alarms with date and time stamps for time of alarm activation (Note: Inhibit conditions will not display on this page)



Current page/total number of pages

Touch to return to top of list

Touch to scroll up to more recent alarms

Touch to scroll down to older alarms

Clears the fault history

FAULT CAUSES & REMEDIES

Fault	Cause	Remedy
	Alarms and lockouts	
Pump Fault (1-6)	The Hydrokos is not receiving healthy feedback from the VSD, check if there is a fault code on the VSD screen. See 'VSD Fault Diagnosis' on page 38 for VSD fault causes and remedies.	• See 'VSD Fault Diagnosis' on page 38 for VSD fault causes and remedies. • If there is no fault code on the VSD, check the wiring between the VSD's healthy output (NO) and the correspoding Hydrokos module inputs (B9-B14). Some Lenze VSDs have the NO output on a grey plug which may have come loose, check it is pushed in properly.
A0 Input Fault	Analog reading is outside of the 4-20mA acceptable reading, possibly due to: • Transducer not connected • Broken or loose connection • Short circuit in transducer or cable	• Check sensor connections are correct • Check sensor is passive 'loop powered' • Replace sensor if faulty • If analog sensor is not in use, turn off the analog enable on page 2 of the setup
No Feedback Available	Same as A0 input fault, but could also be caused by incorrect parameter settings.	• Same as A0 input fault • If analog input is not in use, ensure analog enable is turned off on page 2 of the setup.

Fault	Cause	Remedy
High Pressure	System pressure has gone above the *High pressure threshold* and/or the high pressure input has received an open contact for the fault delay, possibly due to: • System overshoot. • Incorrect settings entered in the setup.. • System blockage or shut valve. • High pressure switch installed or wired incorrectly.	• Check that the *High pressure threshold* setting is set adequately above the *setpoint* pressure in the setup. • Ensure a backup high pressure switch is 'open to fault' . • If the high pressure input is not in use it must be bridged. • Ensure the high pressure switch is installed correctly. • Test the high pressure switch. Replace if faulty. • Investigate cause of high pressure event
Low Pressure	System pressure has gone below the *Low pressure threshold* and/or the low pressure input has received a closed contact for the fault delay, possibly due to: • Burst pipe. • Pump loss of prime. • Incorrect setup settings. • Low pressure switch installed or wired incorrectly.	• Check that the *Low pressure threshold* setting is set adequately below the *setpoint* in the setup • Ensure the backup low pressure switch is 'close on fault'. • Test the low pressure input. Replace if faulty. • Investigate cause of low pressure event.
High Level	Tank level analog value has gone above the *High level threshold* and/or the high level input has received an open contact in fill mode, or closed contact in empty mode, for the fault delay, possibly due to: • High level float switch installed or wired incorrectly, or has malfunctioned. • High level threshold is set incorrectly. • System overshoot in level fill mode, possibly due to incorrect analog reading. • Pumps are unable to keep up with inflow into the tank/pit, in level empty mode.	• Inspect the level in the tank/pit. • Check that the *High level threshold* setting is set to a suitable value above the *setpoint stop level* in the setup. • Ensure the high level float switch is at the correct position in the tank/pit. • Ensure the high level float switch is wired as close on rise (typically black and brown wires are used) in empty mode, or close on fall (black and blue wires) in fill mode. • If in fill mode and the high level input is not in use, ensure it is bridged. • If the tank/pit is not at high level, remove the high level float from the input and test. Replace if needed.
Low Level	Tank level analog value has gone below the *Low level threshold* and/or the low level input has received a close contact in fill mode, or open contact in empty mode, for the fault delay, possibly due to: • Low level float switch installed or wired incorrectly, or has malfunctioned. • Incorrect settings entered in the setup. • System overshoot in level empty mode, possibly due to incorrect analog reading. • Pumps are unable to pump enough water into the tank/pit, in level fill mode.	• Inspect the level in the tank/pit. • Check that the *Low level threshold* setting is set to a suitable value below the *setpoint stop level* in the setup. • Ensure the low level float switch is at the correct position in the tank/pit. • Ensure the low level float switch is wired as close on rise (typically black and brown wires are used) in empty mode, or close on fall (black and blue wires) in fill mode. • If in empty mode and the low level input is not in use, ensure it is bridged. • If the level in the tank/pit is not at low level, remove the low level float switch from the input and test. Replace if faulty.
High Temperature	Temperature analog value has gone above the *High temperature threshold* and/or the high temperature input has received an open contact in heat mode, or closed contact in cool mode, for the delay period, possibly due to: • High temperature thermostat installed or wired incorrectly. • High temperature settings entered incorrectly • System overshoot in temperature heat mode. • Pumps unable to keep up with demand in temperature cool mode.	• Check that the *High temperature threshold* setting is set correctly in the setup. • Ensure that the high temperature input is wired as close on fault in heat mode, or open on fault in cool mode. • If in heat mode and high alarm input is not in use, ensure it is bridged. • Ensure high temperature thermostat is installed correctly. • Test the high temperature thermostat. Replace if faulty.
Low Temperature	Temperature analog value has gone below the *Low temperature threshold* and/or the low temperature input has received a close contact in heat mode, or open contact in cool mode, for the fault delay, possibly due to: • Low temperature thermostat installed or wired incorrectly. • Low temperature settings entered incorrectly in the Setup. • System overshoot in temperature cool mode. • Pumps unable to keep up with demand in temperature heat mode.	• Check that the *Low temperature threshold* setting is set correctly in the setup. • If the low temperature input is assigned but is not required, either unassign it or bridge the input. • Ensure that the low temperature input is wired as open on fault. • Test the low temperature thermostat. Replace if faulty.

Fault	Cause	Remedy
Pipe Fill Fail	Running the pipe fill function but pump is unable to reach required pressure in 10 minutes, possibly due to: • Demand is greater than the pump output while pipe fill is operating. • A pipe has burst.	• If demand is frequently too high for the pipe fill function to operate correctly, disable this function. • Inspect pipes for damage.
Pump Cycle	The system has woken too quickly from sleep more than 10 times in a row, possibly due to: • Insufficient sensor settings • Poor wiring connections • Leaks in pipe work for pressure systems	• Inspect pipe work for leaks • Inspect pressure vessel for correct setting • Ensure check valves are shutting upon entering sleep • Check the *VSD no demand speed* is set correctly on page 4 of the setup, it may be too high
No Pumps Available	There are no available pumps to operate in auto	• Ensure pump faults are reset • Ensure available pumps are not disabled
Max Run	A pump or all available pumps (depending on protection mode) have been running continuously at maximum speed for the *Max run fault delay*. Possible causes are burst pipe, loss of prime or no water available.	• Check the cause for all pumps running. If normal operation extend the *Max run fault delay* or disable the protection. • Fix hydraulic faults.
No Flow	The low level alarm input is not receiving a closed contact from a flow switch, possible due to: • Flow switch installed or wired incorrectly • A pump not producing flow when called to run due to a loss of prime or stalled pump.	• Check that a flow switch is wired as close on flow into the low level alarm terminals • Check that the flow switch is installed in the correct orientation and pipe for the pump or system • Check the pump is adequately primed. • Check the pump is mechanically free. • If a flow switch is not in use then disable the no flow protection in the setup menu on page 5 - System protections.
Service Alarm	The next service due date has been reached indicating the pumps need a service.	• Call the pump system service provider. • If no servicing is required disable the service alarm feature.
System Manual	The system has been put into manual overriding any system protections for the manual timeout period.	• Return the system back to off or auto if manual mode is not required. • Wait for the manual timeout period to finish, the system will automatically return to auto mode • Put the system in auto and put an individual pump into manual to maintain protections while running a pump manually
Controller Faults		
EEPROM hardware fault	Internal controller fault - Failure with the EEPROM memory.	• Contact Supplier for support
Data load fault	Internal controller fault - Data has not loaded correctly out of EEPROM to be used for operation.	• Contact Supplier for support
5V power rail fault	Internal controller fault - A power supply issue with the internal 5V supply.	• Contact Supplier for support
24V power rail fault	Internal controller fault - A power supply issue with the external 24V supply.	• Inspect 24Vdc power supply is at correct voltage and replace if necessary, contact Supplier for support if external power supply is working correctly.
Watchdog reset	Internal controller fault - Internal hardware or software fault.	• Contact supplier for support
Data reinitialised	Internal controller fault - A data fault has occurred causing the data settings to be set back to defaults.	• Reset controller back to factory defaults and setup again. If issue persists contact Supplier for support.
Data initialised	Internal controller fault - Initial data configuration, this alarm should only display momentarily.	• If fault persists contact Supplier for support
EEPROM bank 0 checksum	Internal controller fault - Internal data corruption with primary data.	• Controller should run off the backup data, reset the fault and if fault persists contact Supplier for support.
EEPROM bank 2 checksum	Internal controller fault - Internal data corruption with backup data.	• Controller should run off the primary data, reset the fault and if fault persists contact Supplier for support.
No EEPROM signature	Internal controller fault - Issue with EEPROM memory signature.	• Contact Supplier for support

Fault	Cause	Remedy
EEPROM parameter load limits	Internal controller fault - Internal software fault or EEPROM fault	• Reset the fault, if fault persists contact Supplier for support
Real time clock failure	Internal controller fault - Internal hardware fault.	• Contact Supplier for support
RTC low/no battery	Internal controller fault - Internal RTC battery low or disconnected.	• Check the internal coin cell battery is not dislodged from its holder. Note, this does not apply to earlier modules which have a soldered battery. • Contact Supplier for support
SCADA Comms Error		
Scada Watchdog	The watchdog reset (keep alive) register 3817 has not been written to 1 within the watchdog timeout period.	• Setup continual polled write =1 to modbus register 3817 at a frequency shorter than the SCADA watchdog period • Disable the SCADA watchdog in the setup if not required
SCADA UART error	Data packets not being received correctly	• Confirm baud rate and number of bits. • Ensure that RS-485 connections are correct
SCADA Receive timing error	Signals from the Modbus master are being received before the Hydrokos slave is ready to receive them.	• Check the baud rate is the same on the master and the slave. • Increase the time between modbus packets
SCADA receive overflow error	Too many bytes have been received by the Hydrokos slave exceeding the receive buffer.	• Check the parity stop bit • Increase the time between modbus packets • Check the framing of the modbus packet is correct
SCADA CRC Error	Modbus checksum does not equal the data in the packet.	• Check Modbus baud rate and parity settings • Check cable route and shield earthing for potential sources of interference
SCADA Incorrect Modbus slave	Slave number was not an acceptable ID number.	• Check the slave ID number used is the same as the Hydrokos SCADA slave ID parameter
SCADA Illegal modbus function code	Function code is not a permissible function code for this controller	• See 'SCADA Communication' on page 29 for permissible function codes
SCADA Illegal Modbus address	Address used is not available or may be read or write only.	• Check the address is an available address • Check that the register is not out by + or - 1 • Check that Master Modbus reads are reading readable registers and writing to writable registers
SCADA Illegal Modbus data value	The value of a Modbus write is outside of the acceptable range.	• Check the value is in an acceptable range for the register being written to. Ranges are listed in the **Hydrokos Modbus Registers** document.
SCADA Modbus slave device failure	There has been an internal fault with the Hydrokos Modbus port.	• Try power cycling the Hydrokos module. • If fault persists then a replacement module may be required.

LENZE VSD FAULTS

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
8784 0x2250	CIA: Continuous over current (internal)	PU over current	Fault The inverter is inhibited immediately. The motor becomes torqueless (coasts). The error can only be reset after a blocking time (5 sec).	• Continuous overcurrent on the inverter/motor side • Overcurrent at the brake chopper (brake transistor) • DC bus relay has not been closed due to a malfunction	• Check motor and wiring for short circuits • Check brake resistor and wiring
8892 0x2320	CIA: Short circuit/earth leakage (internal)	Earth leak	Fault The inverter is inhibited immediately. The motor becomes torqueless (coasts). The error can only be reset after a blocking time (5 sec).	• Short circuit/earth fault of motor cable • Capacitive charging current of the motor cable too high	• Check motor cable • Check length of motor cable • User shorter or lower capacitance motor cable
9024 0x2340	CiA: Short circuit (device internal)	Motor shorted	Fault The inverter is inhibited immediately. The motor becomes torqueless (coasts). The error can only be reset after a blocking time (5 sec).	Short circuit of motor cable	• Check motor cable for short circuit
9040 0x2350	CiA: i^2*t overload (thermal state)	i2t motor	Fault (configurable) The error can only be reset after a blocking time (5 sec). Setting parameters: 0x2D4B:003	Motor thermally overloaded, e.g. by an impermissible continuous current or by frequent or too long acceleration processes.	• Check drive dimensioning • Check machine/ driven mechanics for excessive load
9090 0x2382	I*t error	Ixt error	Fault (configurable) The error can only be reset after a blocking time (3 sec). Setting parameters: 0x2D40:005	Device utilisation (I*t) too high by frequent and too long acceleration processes.	• Check drive dimensioning
9091 0x2383	I*t warning	Ixt warning	Warning	Device utilisation (I*t) too high by frequent and too long acceleration processes.	• Check drive dimensioning
9095 0x2387	Imax: Clamp responded too often	Clamp timeout	Fault	Maximum current of the axis (display in ox2DDF:002) has been reached too often in succession.	• Select a flatter speed ramp • Reduce the load • Set imax controller more dynamically
9096 0x2388	SL-PSM stall detection active	SL-PSM stall det.	Trouble The inverter is inhibited immediately. The motor becomes torqueless.	Overload of the motor with sensorless control for synchronous motors (SL-PSM).	• Reduce load at the axis • Check settings of the SL-PSM parameters
9098 0x238A	Maximum current reached	Imax reached	Information	The current motor current 0x6078 is equal to or higher than the max. overload current 0x6073	• Reduce the load on the motor or change the settings for the maximum overload current 0x6073
12576 0x3120	Mains phase fault	Mains Phase fail	Fault	Mains phase failure	• Check wiring of the mains connection • Check fuses

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
12672 0x3180	UPS operation active	UPS oper. active	Warning	Operation on uninterrupted 1x230V current supply has been activated: Only a reduced output current is provided.	• Switch back to operation with regular mains voltage
12816 0x3210	DC bus overvoltage	DC Bus OV	Fault	DC-bus voltage has exceeded the error threshold for overvoltage due to a too high braking energy or a too high mains voltage. The error threshold (display in 0x2540:006) results from the setting of the rated mains voltage in 0x2540:001.	• Reduce dynamic performance of the load profile • Check mains voltage • Check settings for brake energy management • Connect brake resistor to the power unit and activate the integrated brake chopper
12817 0x3211	DC bus overvoltage warning	Warn.DC Bus OV	Warning	DC-bus voltage has exceeded the warning threshold for overvoltage set in 0x2540:005 due to a too high braking energy or a too high mains voltage.	• Reduce dynamic performance of the load profile • Check mains voltage • Check settings for brake energy management • Connect brake resistor to the power unit and activate the integrated brake chopper
12832 0x3220	DC bus undervoltage	DC Bus UV	Trouble	DC-bus voltage has fallen below the error threshold for undervoltage. The error threshold (display in 0x2540:003) results from the setting of the rated mains voltage in 0x2540:001.	• Check mains voltage. • Check DC-bus voltage. • Check mains settings.
12833 0x3221	DC bus undervoltage warning	Warn.DC Bus UV	Warning	DC-bus voltage has fallen below the warning threshold for undervoltage set in 0x2540:002.	• Check mains voltage. • Check DC-bus voltage. • Check mains settings.
12834 0x3222	DC-bus voltage to low for power up	DC-bus on-UV	Warning	The input voltage is too low to switch on the inverter.	• Check mains voltage. • Check mains settings.
16912 0x4210	PU: overtemperature fault	PU Overtemp.	Fault	The heatsink temperature of the power unit (display in 0x2D84:001) has exceeded the fixed error threshold (100 °C). • Ambient temperature too high. • Fan or ventilation slots are polluted. • Fan is defective.	• Provide for a sufficient cooling of the device. • Clean fan and ventilation slots. • If required, replace fan.
17024 0x4280	Heat sink temperature sensor fault	Heatsink sensor	Fault	Sensor for the temperature monitoring of the power unit is defective. The failure of the temperature monitoring function poses the risk of overheating!	• Hardware error: it is necessary to contact the manufacturer, since the device must be replaced.
17025 0x4281	Heat sink fan warning	Heatsink fan	Warning	Warning of the heatsink fan.	• Check/replace the heatsink fan.

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
17029 0x4285	PU overtemperature warning	Warn.PU Overtemp	Warning	The heatsink temperature of the power unit (display in 0x2D84:001) has exceeded the warning threshold set in 0x2D84:002. • Ambient temperature too high. • Fan or ventilation slots are polluted. • Fan is defective.	• Provide for a sufficient cooling of the device. • Clean fan and ventilation slots. • If required, replace fan.
17168 0x4310	Motor temperature error	Overtemp. motor	Fault (Configurable) The error can only be reset after a blocking time (5 sec). Setting parameters: 0x2D49:002	The motor temperature sensor connected to terminals X109/ T1 and X109/T2 measures a too high motor temperature. • Motor too hot by impermissibly high currents. • Motor too hot by frequent and too long acceleration processes.	• Check drive dimensioning. • Check motor temperature sensor and wiring.
20754 0x5112	24 V supply critical	24V supply low	Warning	24V voltage failed or too low.	• Check optional external 24V voltage supply (terminal X3/24E), if connected. • Check mains voltage.
20864 0x5180	Overload 24 V supply	Overload 24V	Warning	Output current at the 24V output or at the digital outputs too high.	• Check 24V output and digital outputs for earth fault or overload.
21376 0x5380	OEM hardware incompatible	Incomp. OEM HW	Fault The inverter is inhibited immediately. The motor becomes torqueless (coasts). The error can only be reset by mains switching.	The control unit (OEM hardware) is not compatible with the power unit (OEM hardware).	• Use compatible hardware. • Contact the OEM.
24970 0x618A	Internal fan warning	Internal fan	Warning	Warning of the internal fan.	• Check/replace internal fan.
25216 0x6280	Trigger/functions connected incorrectly	P400 config err	Trouble	The assignment directives have not been observed. • If the "flexible I/O configuration" is active as control source, the "Enable inverter" or "Run" function must be connected to a digital input in order that the motor can be stopped again any time! • The use of the "Start forward (CW)" and "Start reverse (CCW)" functions excludes the use of the "Run forward (CW)" and "Run reverse (CCW)" functions, and vice versa.	Check and correct the assignment of the triggers for the functions. • With keypad or network control, the two functions "Enable inverter" and "Run" can also be set to "Constant TRUE (1)" to start the motor.
25217 0x6281	User-defined fault 1	User fault 1	Fault	Flexible I/O configuration: the "Activate fault 1" function was activated via the trigger selected in 0x2631:043.	• Eliminate error cause and then reset error.

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
25218 0x6282	User-defined fault 2	User fault 2	Fault	Flexible I/O configuration: the "Activate fault 2" function was activated via the trigger selected in 0x2631:044.	• Eliminate error cause and then reset error.
25232 0x6290	Warning invert rotation	Invert rotation	Warning The motor is brought to a standstill, since a reversal of the rotating direction is not permissible	• Negative setpoint selection with an active limitation of rotation 0x283A. • The "Reverse rotational direction" 0x2631:013 function was requested with an active limitation of rotation 0x283A.	• Check setpoint selection and trigger. • Check setting in 0x283A.
25233 0x6291	Maximum allowed troubles exceeded	Trouble overflow	Fault The motor remains at a standstill, no automatic restart is executed.	The number of permitted restart attempts after a fault set in 0x2839:003 was exceeded. The fault occurred to frequently and could not be reset.	• Check and the eliminate the fault.
28801 0x7081	Analog input 1 fault	AI1 fault	Fault (Configurable) Setting parameters: 0x2636:010 (P430.10)	The monitoring function of the input signal configured for analog input 1 in 0x2636:008 and 0x2636:009 has been triggered.	• Check input signal at analog input 1. • Check configuration of the monitoring function.
28802 0x7082	Analog input 2 fault	AI2 fault	Fault (Configurable) Setting parameters: 0x2637:010	The monitoring function of the input signal configured for analog input 2 in 0x2637:008 and 0x2637:009 has been triggered.	• Check input signal at analog input 2. • Check configuration of the monitoring function.
29056 0x7180	Motor overcurrent	Mot max current	Fault (Configurable) The error can only be reset after a blocking time (1 sec) Setting parameters: 0x2D46:002	The motor current has exceeded the warning/error threshold for the motor current monitoring set in 0x2D46:001	• Check motor load. • Check drive dimensioning. • Check warning threshold or error threshold set in 0x2D46:001
29573 0x7385	Feedback system: speed limit	F.fdb spd limit	Warning	The feedback system exceeds the maximum permissible frequency range of the digital inputs.	• Check feedback system.
33553 0x8311	Torque limit reached	Torque limit	No response (Configurable) Setting parameters: 0x2D67:001	Motor has reached the torque limit: • 0x2949:003: Actual positive torque limit • 0x2949:004: Actual negative torque limit	• Observe load requirements. • Reduce motor load. • Check set torque limits and sources for the torque limits.
33664 0x8380	Function not allowed in selected operating mode	Func. n. allowed	Warning	The selected function is not permissible in the chosen operating mode. • Selection of torque mode (-1) in 40x6060 with incompatible motor control in 40x2C00. • Selection of invalid drive mode (0) in 40x6060.	• Note: selection of torque mode (-1) in 40x6060 with incompatible motor control in 40x2C00. • Check settings of operation modes.
36992 0x9080	Keypad removed	Keypad removed	Fault	The keypad was removed while the keypad control was activated.	• Plug keypad back in or activate another control source.

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
65282 0xFF02	Brake resistor: overload fault	BrkResistor OL.F	Fault (Configurable) The error can only be reset after a blocking time (5 sec). Setting parameters: 0x2550:011	The calculated thermal load of the brake resistor has reached the error threshold set in 0x2550:009. The regenerative energy is too high.	• Check drive dimensioning. • Check settings for the brake energy management. • Note: The error status will be reset if the thermal load falls below the error threshold - 20 %.
65285 0xFF05	Safe Torque Off is locked	STO locked	Fault The inverter is inhibited immediately. The motor becomes torqueless (coasts). The error can only be reset by mains switching.	The safety module or safety circuit of the device was detected as being defective.	• Hardware error: it is necessary to contact the manufacturer since the device must be replaced.
65286 0xFF06 0xFF06	Motor overspeed	Motor overspeed	Fault (Configurable) The error can only be reset after a blocking time (1 sec). Setting parameters: 0x2D44:002 (P350.02)	The motor speed has reached the error threshold for overspeed set in 0x2D44:001.	• Check application.
65289 0xFF09	Motor phase missing	Mot.Phase miss.	No response (Configurable) The error can only be reset after a blocking time (2 sec). Setting parameters: 0x2D45:001 (P310.01)	A failure of several motor phases has been detected.	• Check wiring between inverter and motor. • In case of a false tripping, adapt the settings for the motor phase failure detection.
65290 0xFF0A	Motor phase failure phase U	Phase U failure	No response (Configurable) The error can only be reset after a blocking time (2 sec). Setting parameters: 0x2D45:001	A failure of the motor phase U has been detected.	• Check wiring between inverter and motor. • In case of a false tripping, adapt the settings for the motor phase failure detection.
65291 0xFF0B	Motor phase failure phase V	Phase V failure	No response (Configurable) The error can only be reset after a blocking time (2 sec). Setting parameters: 0x2D45:001	A failure of the motor phase V has been detected.	• Check wiring between inverter and motor. • In case of a false tripping, adapt the settings for the motor phase failure detection.
65292 0xFF0C	Motor phase failure phase W	Phase W failure	No response (Configurable) The error can only be reset after a blocking time (2 sec). Setting parameters: 0x2D45:001	A failure of the motor phase W has been detected.	• Check wiring between inverter and motor. • In case of a false tripping, adapt the settings for the motor phase failure detection.
65305 0xFF19	Motor parameter identification fault	Motor ID fault	Fault	During the automatic identification of the motor, an error has occurred.	• Set motor data so that they comply with the data on the motor nameplate. • Check wiring of the motor.

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
65334 0xFF36	Brake resistor: overload warning	BrkResistor OL.W	Warning (Configurable) Setting parameters: 0x2550:010	The calculated thermal load of the brake resistor has reached the warning threshold set in 0x2550:008. The regenerative energy is too high.	• Check drive dimensioning. • Check settings for the brake energy management. Note: The warning status is reset if the thermal load falls below the warning threshold of - 20 %.
65335 0xFF37	Automatic start disabled	Auto start disab	Fault	At mains connection, a start command was already available and the automatic start at power-up is set in 0x2838:002 to "Off (0)".	• Deactivate starting command and reset error.
65336 0xFF38	Load loss detected	Load loss	No response (Configurable) Setting parameters: 0x4006:003	In a running motor, the motor load (current) is monitored. When the motor load falls below the threshold value specified in Load loss detection: threshold (0x4006:001) for the period of time specified in Load loss detection: delay time (0x4006:002), load loss protection is triggered.	• Check utilisation
65337 0xFF39	Motor overload	Motor overload	No response (Configurable) Setting parameters: 0x4007:00	If the apparent motor current exceeds a defined threshold value 0x4007:002 for a certain amount of time 0x4007:001, heavy duty monitoring is triggered.	• Check the motor load
65366 0xFF56	Maximum motor frequency reached	Max. motor freq.	Warning	• The maximum motor speed set in 0x6080 is active. • The maximum output frequency of the inverter has been reached.	• Check application.
65393 0xFF71	Wrong password	Wrong password	Warning The blocking time for entering a password is more than 10 seconds. (The blocking time is doubled every time an incorrect password is entered.) No password can be entered as long as the blocking time is active.	A wrong password has been entered several times.	• Wait until the blocking time has elapsed and then enter the correct password.
65394 0xFF72	Warning	Warning	Warning No response from the inverter. The decision on whether the machine will be commissioned or not is made by the Controller.	Inverter is not compatible with the Controller/PLC (brand protection). • The Controller has not written a deactivation password in the parameter yet. • The deactivation password written by the Controller is incorrect.	• Use corresponding (compatible) OEM components.

LENZE VSD FAULTS (CONTINUED)

Code	Fault	Keypad display	Error type/ Response	Cause	Remedy
65395 0xFF73	Fatal Error	Fatal Error	Fault Operation of the inverter is not possible.	Error when reading the data from the control unit.	• Switch inverter off and on again. • If the error occurs again, the manufacturer must be contacted, since the control unit or the device has to be replaced.
65396 0xFF74	Power unit fatal error	PU fatal error	Fault Operation of the inverter is not possible.	Error when reading the data from the power unit.	• Switch inverter off and on again. • If the error occurs again, the manufacturer must be contacted, since the power unit or the device has to be replaced.
65413 0xFF85	Keypad full control active	Keypad full ctrl	Warning Both the activity of controlling and the setpoint selection are carried out via the keypad.	If the "Keypad Full Control" control mode is active.	• Clicking the CTRL keypad key stops the control mode again.

For any other faults, see the Lenze VSD manual.

ABB ACS180 FAULTS

Code	Fault / Aux. code	Cause	Remedy
2310	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this fault may also be caused by an earth fault or supply phase loss.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling, 46.02 Frequency scaling* and *46.03 Torque scaling.* Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable.
2340	Short circuit	Short-circuit in motor cable(s) or motor. Aux code 0x0080 indicates that the state feedback from output phases does not match the control signals.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. Cycle the power to the drive.
3130	Input phase loss	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3210	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter *30.30 Overvoltage control*). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear.
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (any of the three phases not connected). In scalar control mode, the drive detects fault only when the output frequency is above 10% of the motor nominal frequency.	Connect motor cable. If the drive is in scalar mode and nominal current of the motor is less than 1/6 of the nominal output current of the drive, set parameter *31.19 Motor phase loss* to *No action*.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 50 °C /122 °F, ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the hardware manual of the drive. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.

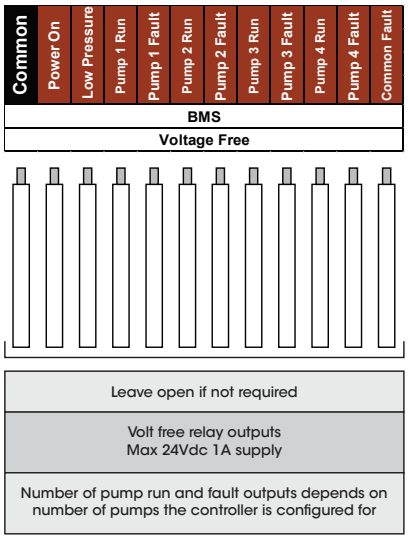
ABB ACS180 FAULTS (CONTINUED)

Code	Fault / Aux. code	Cause	Remedy
4310	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
5091	Safe torque off Programmable fault:*31.22 STO indication run/ stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is broken during start or run.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/ stop*.
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/ offline/error etc.). Check cable connections to the EIA-485 terminals 25, 26, 27 and 28 on the control unit.
7122	Motor overload	Motor current is too high.	Check the motor, and the machinery coupled to motor, for overload. Adjust the parameters used for the motor overload function (*35.51...35.53*) and *35.55...35.56*.
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/ maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed* and *30.12 Maximum speed*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Check minimum/maximum frequency settings, parameters *30.13 Minimum frequency* and *30.14 Maximum frequency*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
9081	External fault 1 (Editable message text) Programmable fault: *31.01 External event 1 source* *31.02 External event 1 source*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
FA81	Safe torque off 1	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/ stop* (page *216*).
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 is broken.	

BMS VARIATION

The BMS variation of the Hydrokos VSD features additional volt free outputs for power on, low pressure, individual pump run and individual pump fault as standard, in addition to the common fault output included on other variations.

VF CONNECTIONS



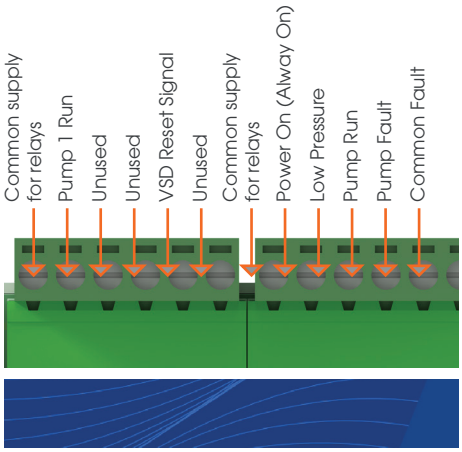
CONTROL MODULE OUTPUTS

These outputs are pre-configured for the BMS variation of the Hydrokos. The outputs differ for each number of pumps, and additional relays are required to provide all the BMS outputs. The control module outputs for 1-4 pumps are shown below.

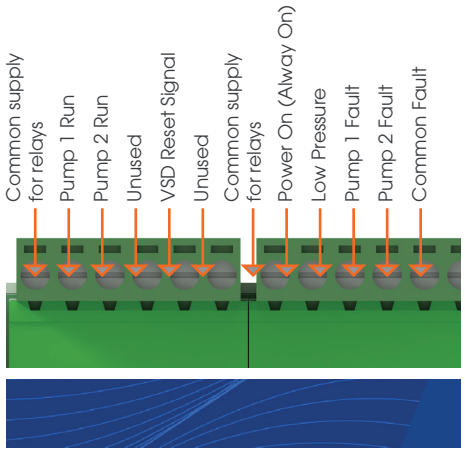
See the controller's circuit diagram for specific connections.

If the controller's parameters are factory reset on the Diagnostics screen, these outputs will need to be reassigned in the parameters list (parameters 19.X). See 'Parameters' on page 27 for more information on the operation of the parameters screen.

Single Pump

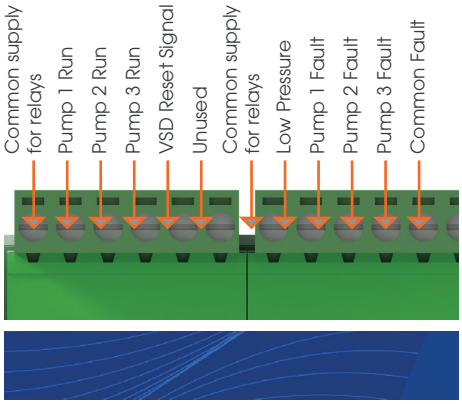


Dual Pump



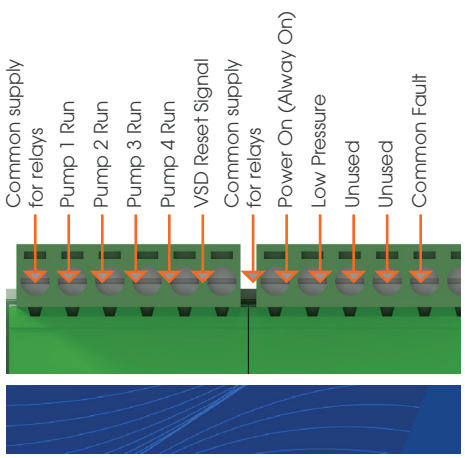
Additional relays used for Pump 1 & 2 Run BMS Outputs

Triplex Pump



Additional relays used for Power On, Pump 1-3 Run BMS Outputs

Quad Pump



Additional relays used for Pump 1-4 Run and Fault BMS Outputs

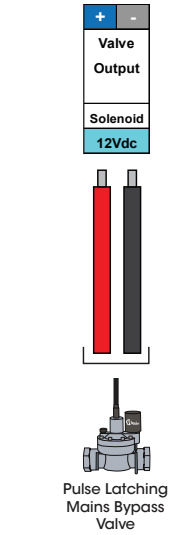
RMC VARIATION

The Hydrokos with Rain/Mains Changeover is designed for pressure pumping applications that require mains bypass, featuring an output for a pulse latching solenoid valve to maintain water supply when the pumping system is off or locked out due to a fault, the supply tank is low or on power failure. This is pre-configured by enabling the *mains bypass valve enable* in the pressure setup.

VALVE INSTALLATION

- Valve must be installed in accordance with appropriate Plumbing Industry 'Code of Practice'.
- Valve must be installed on discharge side of the pump, not on the suction side.
- Ensure the direction of flow shown on the valve is adhered to when installing the valve.
- For best performance, the valve should be mounted in a horizontal position with the solenoid upright.
- If the valve has a manual override lever, ensure it is in the off/closed or auto position.
- If the valve has a flow control handle, screw it down until just tight, then back off two full turns to start with. This can then be adjusted further depending on the system pressure.
- The valve requires a certain amount of head pressure (varies depending on valve size) to operate correctly.
- Check the valve specifications and ensure that the pressure and flow ranges are within the limits.
- Ensure that no foreign materials enter the valve during installation to ensure the valve operates correctly.

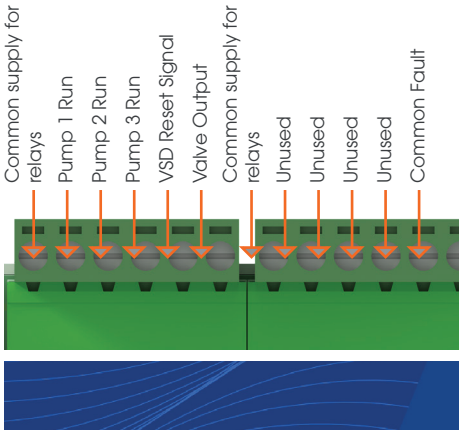
VALVE CONNECTIONS



Pulse Latching
Mains Bypass
Valve

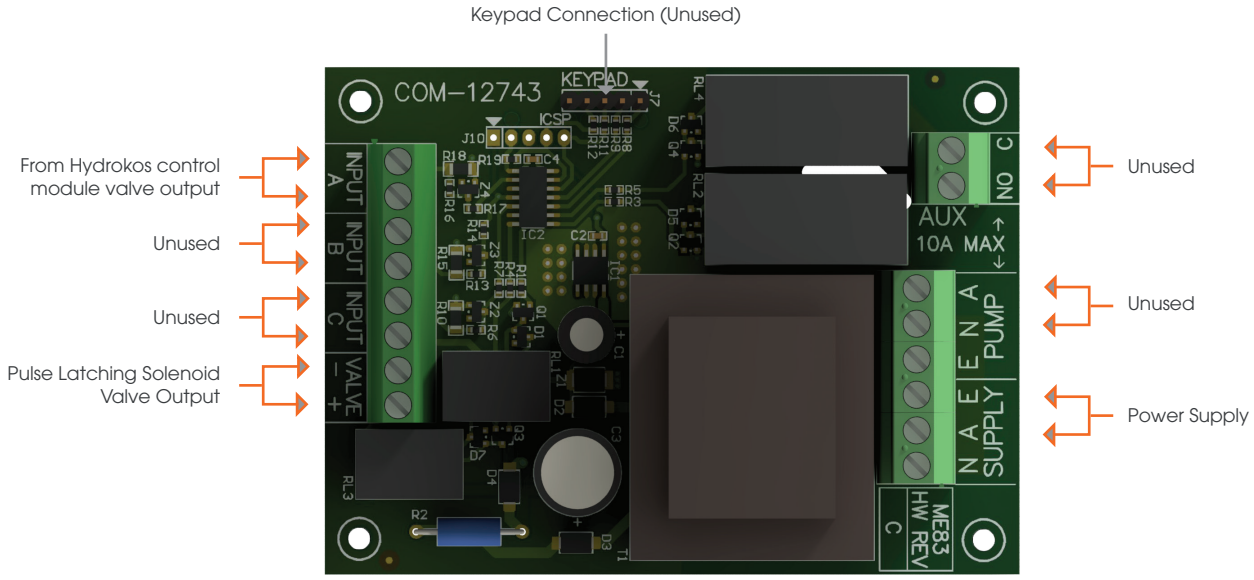
CONTROL MODULE OUTPUTS (1-3 PUMPS)

These outputs are pre-configured for the RMC variation of the Hydrokos VSD Controller, configured to control 1-3 pumps. For 4-6 pumps, the control module connections will differ as additional pump run outputs will be required on the board. See the controller's circuit diagram for specific connections. If the parameters are reset on the Diagnostics screen, these outputs will need to be reassigned in the parameters list (parameters 19.X). See 'Parameters' on page 28 for more information.



RAIN/MAINS CONTROL MODULE CONNECTIONS

The RMC variation of the Hydrokos features an additional rain/mains control module, providing the output for the pulse latching solenoid valve. The valve output from the Hydrokos control module is connected to input A on the rain/mains module, via a relay. The module gives two consecutive pulses to ensure the valve opens or closes, with a short delay in between to charge the capacitor. When power to the panel is turned off or fails, power stored in the onboard capacitors sends a single pulse to open the valve.



VALVE FAULT DIAGNOSIS

If the pulse latching solenoid valve is not opening or closing, firstly ensure that the valve is installed according to 'Valve Installation' on the previous page. Check that the specifications of the valve suits the installation and ensure that the solenoid is wired into the controller in the correct polarity.

Firstly, ensure that the system is in auto mode and not in mains bypass state. The valve icon on the main screen should show:  Then perform the following steps:

Solenoid and rain/mains module test:

- Isolate water supply to the valve.
- Turn off power to the panel.
- Carefully unscrew the solenoid from the valve.
- Ensure the spring is inserted into the plunger correctly and push the plunger in flush with the top of the solenoid.
- With a thumb hovered over the plunger, turn on power to the panel and see if the plunger pops out of the solenoid.
- Wait at least 10 seconds then remove power to the panel and see if the plunger sucks in flush with the top of the solenoid.
- If the plunger does not move successfully to both of these positions, the solenoid or rain/mains control module is faulty and should be replaced.
- If the plunger moves successfully, however, continue through the below steps.

Valve test:

- Clean any dirt or grit out of the hole that the solenoid screws into.
- Re-insert the solenoid with the plunger pushed in flush and open the water supply to the valve.
- Adjust the flow control handle in or out until you can hear water flowing through the valve.
- Once water is flowing, turn on power to the panel. Check that the water stops flowing through the valve.
- If not, adjust the vale open or closed until the water stops flowing and retest the valve opening by turning off power to the panel.
- If the valve still fails to open or close without adjustment, check the pressure and flow ranges suits the valve used. If so, only the valve needs replacing.

USER SETTING

Setting	User Value	Setting	User Value	Setting	User Value
1 - System Setup					
System type					
Control output type	VSD				
Number of pumps					
Pump limit					
Duty change period					
2 - Analog					
Level		**Pressure**		**Temperature**	
Level analog enable		Pressure analog enable		Temperature analog enable	
Max level sensor range		Max level sensor range		Max temperature sensor range	
Setpoint		Setpoint		Setpoint	
Wakeup level step		Wakeup pressure drop		Wakeup temperature step	
Standby start level step		DOL Standby start pressure step	Not Used For VSD	Standby start temp step	
Low level threshold		Low pressure threshold		Low temperature threshold	
High level threshold		High pressure threshold		High temperature threshold	
3 - Function					
Level		**Pressure**		**Temperature**	
Level control		Jacking pump		Temperature control	
Low level protection		Low pressure protection		Low temperature protection	
High level protection		High pressure protection		High temperature protection	
Sleep delay		Sleep delay		Sleep mode	
Tank top up valve enable		Mains bypass valve enable		Sleep delay	
Top up valve open level					
Top up valve closed level					
4 - VSD					
Level		**Pressure**		**Temperature**	
VSD full speed level		PID Proportional		VSD full speed temperature	
VSD speed at stop level		PID Integral		VSD speed at setpoint	
Manual speed		VSD No demand speed		Manual speed	
		Manual speed			
		Pipe fill			
		Sleep Assist			
		Sleep boost pressure increase			

Additional user settings on following page

5 - System Protections	
Pump anti-seize protection	
Max run fault protection	
Max run fault delay	
Pump cycle protection	
No flow protection	
6 - SCADA	
SCADA baud rate	
SCADA parity	
SCADA slave address	
SCADA watchdog enable	
SCADA watchdog period	