

# Dutypoint<sup>®</sup>

## VR (Hydrovar) Cold Water Booster Sets



## Operation and Maintenance Manual

DOC-VRHOM1701

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## Operation and Maintenance Manual

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# 1 Important Safety Information

## 1.1 Health & Safety at Work Act 1974

Section 6(a) of this Act requires manufacturers to advise their customers on the safety and the handling precautions to be observed when installing, operating, maintaining and servicing their products. The user's attention is therefore drawn to the following:

- The appropriate sections of this manual must be read before working on the equipment.
- Installation, operating and maintenance must only be carried out by suitably trained/qualified personnel.
- Normal safety precautions must be taken and appropriate procedures observed to avoid accidents.

Refer to Dutypoint for any technical advice or product information. It is the responsibility of the customer and/or the contractor:

- To ensure that anyone working on the equipment is wearing all necessary protective gear/clothing;
- Is aware of appropriate health & safety warnings and to read the information in this manual.

## 1.2 Mechanical Device Servicing

- Familiarise yourself with the relevant contents of this manual
- Installation, maintenance and repair work must only be carried out by trained, skilled and suitably qualified personnel.
- Disconnect or lock-out the power source to ensure that the item(s) will remain inoperative. Locking out the equipment by switching off the release mechanism or set value WILL NOT prevent accidental starting.
- Allow the item(s) to cool if over-heated.
- CLOSE the isolating valves on the suction and discharge connections of the affected item(s).
- If working on pump, VENT slowly and cautiously – Refer to the relevant section of this manual.
- DRAIN the pump(s).

## 1.3 Pump Hand Control Mode (Where Fitted)

In the 'HAND' position the pump(s) controlled by the switch will normally run at full speed and completely independently of any control devices, and can result in pump(s) running against a closed valve head if there is no draw. This can cause the system to be maintained at the maximum pressure produced by the pump plus any incoming pressure and additional pressure caused by water surge and can potentially damage the pump and other parts of the system.

The 'HAND' option should only be used with a competent operator in attendance, or when there is a continued demand sufficient to provide constant flow through the pumps to maintain the running pressure of the system to an acceptable level.

## 1.4 Electrical Safety - High Voltages

This information is especially applicable when Variable Speed Controllers (Inverters) are fitted to pumps.

When the inverter variable speed drive head is connected to the power supply the components of the power unit as well as certain components of the master control unit – are also connected to the power supply.

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### **TOUCHING THESE COMPONENTS CAN SERIOUSLY ENDANGER LIFE!**

- Before removing the frequency inverter cover, the system must be disconnected from the power supply
  - After switching off the power supply wait at least 5 minutes before starting work on or in the inverter drive head - the capacitors in the intermediate circuit must be given time to discharge completely via the discharge restors.
- 

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### **UP TO 800V CAN BE PRESENT - IF THERE ARE FAULTS THIS CAN BE HIGHER**

- All work carried out when the frequency inverter is open must be performed only by suitably qualified and properly authorised personnel.
-

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**THE SYSTEM MUST ONLY BE OPERATED WHEN IT HAS BEEN CORRECTLY EARTHED AND PIPES BONDED TO EARTH IN ACCORDANCE WITH IEE REGULATIONS**

- When connecting external control wires care must be taken not to short circuit adjacent components. Bare cable ends which are not in use must be insulated.
- 

## 1.5 Electronic Safety Devices

- Inverter drives contain electronic safety devices which switch off the control element in the event of a fault developing.
  - A motor can also be stopped by 'mechanical blocking'
  - If it is switched off electronically, the motor is disconnected from the mains voltage supply via the electronics in the inverter drive.
  - Voltage fluctuation and power failures (temporary outages) can cause the motor to switch itself off.
- 

**A MOTOR WILL HAVE ZERO CURRENT BUT WILL REMAIN ENERGISED AS IT STOPS**

- Take necessary precautions - the motor is not voltage-free in the circuit itself
- 

**REPAIR OF FAULTS CAN CAUSE ITEMS TO START UP AGAIN UNEXPECTEDLY**

- Ensure the motor is isolated before commencing any work
- 

**HIGH VOLTAGE TESTS OF INVERTERS MAY DAMAGE THE ELECTRICAL COMPONENTS.**

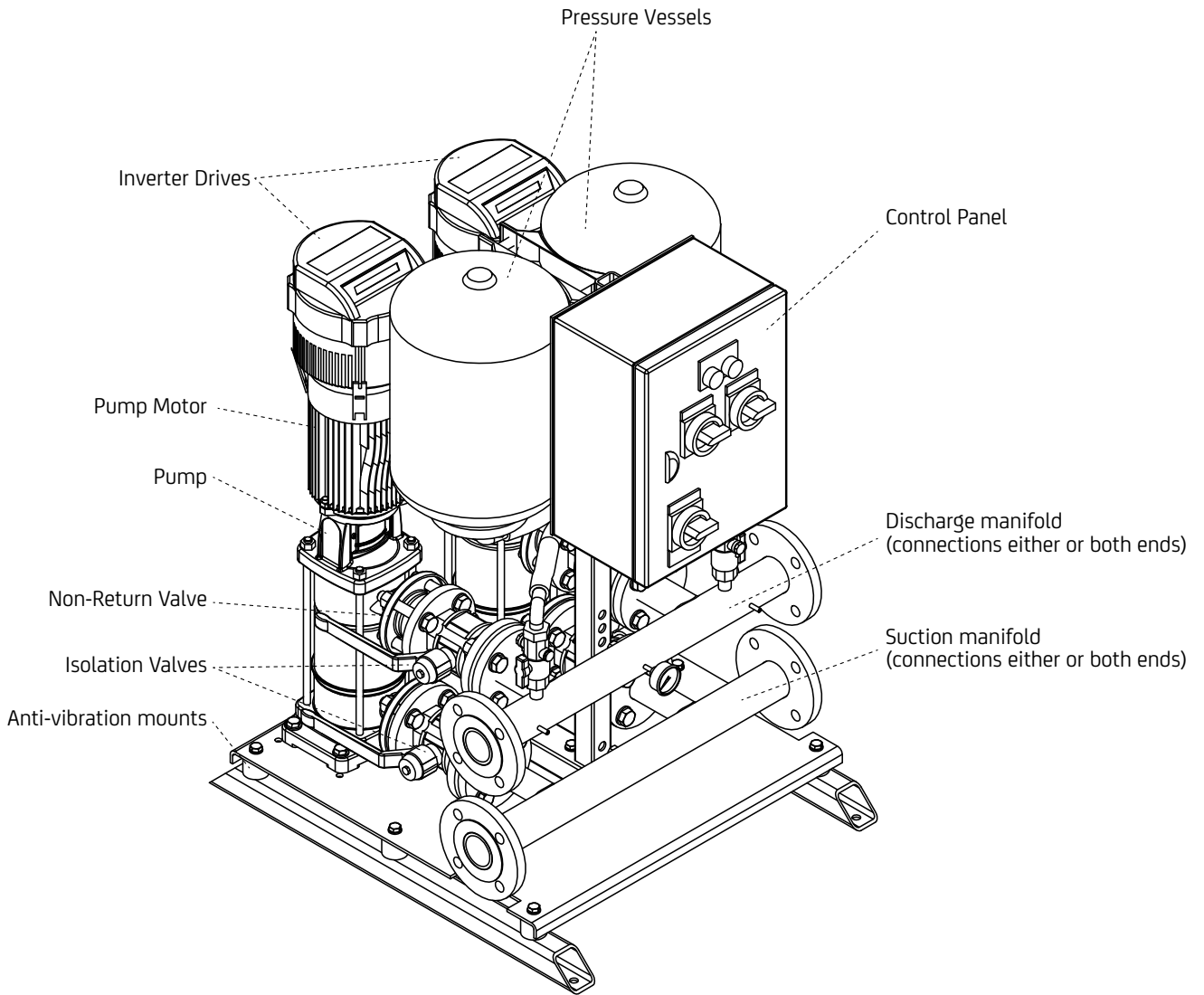
- Bridge before the incoming/outgoing terminals L-L2-L3 and U-V-W.
  - To avoid incorrect metering by capacitors incorporated in the electronic circuits, isolate the motor from the inverter drive head.
-

## 2 Operating Limits

### Operating limits for standard Dutypoint pump sets

Type of pumped liquids	Water with no gas or aggressive substances
Maximum pumped liquids temperature	+23°C domestic uses (EN 60335-2-41), +40°C other purposes
Minimum pumped liquid temperature	+1°C to avoid icing
Operating ambient temperature	+5°C to 40°C for indoor installation. (CEI EN 60439-1)
Relative humidity	Max 50% at 40°C
Air impurities	The air must be clean and free of acid vapours, corrosive gases and excessive amounts of dust
Storage temperature	+5°C to 50°C
Suction conditions	Minimum positive pressure 0.1 Bar. Maximum positive pressure 0.5 Bar.

### 3 VR Booster Set Components



## 4 Control Panel Overview

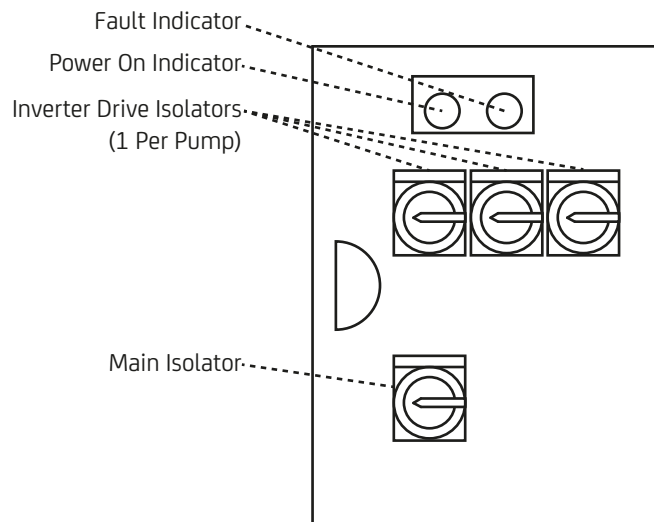
The Dutypoint control panel for booster sets provides external user control, internal protection and fault monitoring circuitry.

### 4.1 External Features

Externally the panel provides:

- An overall (main) isolator, single phase or three phase as appropriate
- A separate isolator for each inverter drive, used to independently switch each controller and its pump on or off
- A white indicator light to show 'power on' status
- An amber indicator light to show a 'fault condition' warning
- (Optional) hand/off/auto switch per pump

**Figure 1: Control Panel External Layout**



### 4.2 Internal Features

The internal circuitry provides the following protection and monitoring:

- Power feed via D-type rated magnetic circuit breakers (MCBs) giving overload current protection for each inverter/ pump.
- A low water detection relay triggered by the system low level float switch. This sets the fault indicator on the front of the panel and sends a control signal to each inverter controller.
- A system volt free (0v) alarm line link which is broken in the event of any failure
- A routing to connect the RS485 link between the inverter controllers to allow them to fully interact with each other
- A 24V supply for the protection and indicator circuitry

# 5 Commissioning

## 5.1 Installation and Commissioning Overview

Before shipment, all Dutypoint pump sets are pre-commissioned. Whilst important procedures such as venting and rotational direction checks need to be carried out on site, initial parameters including pressure settings and delay timers will be adjusted to suit the site conditions previously advised to Dutypoint.

In practice, a system can almost invariably be made to perform more efficiently if further re-commissioning is carried out on site. Please note that engineer visits by Dutypoint are priced at one visit to commission one pump set. If there are multiple units on a site, special terms can be negotiated. To arrange a commissioning visit, please call the Technical Service Help line 01452 300590. The following checks should be carried out at the initial installation before any run tests are performed.

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**WARNING**

- Ensure that you have read and understood [Important Safety Information](#).
- 

## 5.2 Pipework and mechanical components

- 1) Ensure that the mounting area and any associated groundwork provides adequate support for the pump set.
- 2) Ensure all supports/brackets are in place and secure.
- 3) Verify all pipe joints are sealed and tight.

## 5.3 Electrical

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**WARNING**

- These checks MUST be carried out by a competent electrician.
  - Ensure that the power source is sufficient to allow the running of two (twin pump sets) or three (triple pump sets) pumps together.
- 

- 1) Check the motor voltage and frequency information on all the motor nameplates and on controllers etc. correspond with that of the source power supply.
- 2) Check that all electrical connections are correctly made and secure. Pay particular attention to Earth and bonding connections.
- 3) Carry out specific checks for Earth bonding.
- 4) Carry out NICEIC certification checks as required for the installation, e.g Earth Loop Impedance, Insulation Tests, etc.
- 5) Carry out any other pre-start checks recommended by the pump manufacturer. Refer to the pump manual in the Appendix of this manual. DO NOT POWER UP AT THIS STAGE.

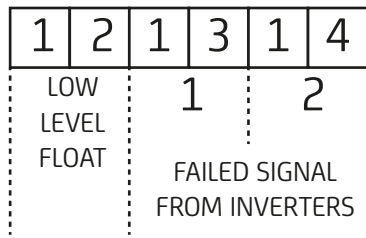
## 5.4 Low Level Float Switch Wiring (Optional)

Terminal 1 and 3 require a normally closed contact in order to allow the pump set to operate. To facilitate this the unit will be supplied with a wire loop between 1 and 2. To install a low level float switch this loop has to be removed and the float switch wired to operate as an open on fail scenario.

If 2 or more float switches are required (due to twin compartment or multiple tanks) all float switches are wired into terminals 1 and 2 in parallel.



**Figure 2: Terminal Wiring**



If installing a Dutypoint FS-series float switch, the following terminals should be used:

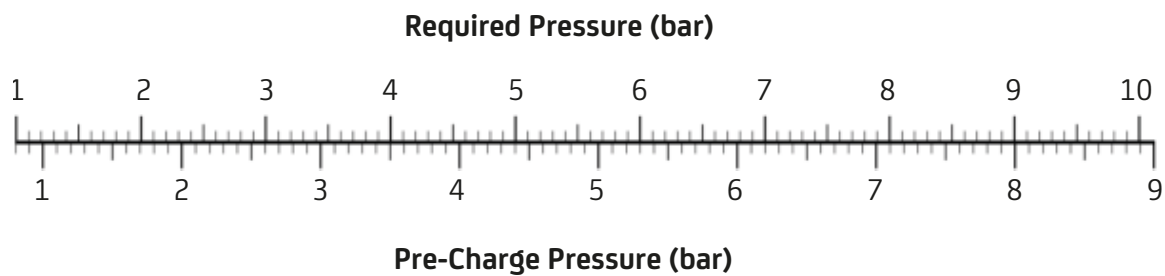
- BROWN: Terminal 1
- BLACK: Terminal 2
- BLUE: Not used - terminate safely

## 5.5 Final Checks Before Commissioning

- 1) Re-check all equipment for any accidental damage caused during installation.
- 2) Carry out the pre-charging and venting procedures described next.

## 5.6 Pressure Vessel Pre-Charging

**Figure 3: Pressure Vessel Pre-charge**



Before commissioning starts the pre-charge of the pressure vessels should be checked.

On variable speed systems the pre-charge air pressure for vessels should be 90% of the maximum pressure generated by the pump in the pipework system

e.g: If the maximum pressure generated by the pump in a system is 6 bar, this will require a pre-charge pressure of  $6 \times 90\% = 5.4$  bar.

To verify the pre-charge pressure:

- 1) First check that the expansion or pressure vessel(s) are totally drained of water, and that the system is switched off and no electrical parts are live.
- 2) Locate the charging valve on each vessel, accessed by removing the plastic cover on the top of the vessel.
- 3) Connect a portable pressure gauge with a measuring range compatible with the expected pressures in your application, which has a flexible hose and Schrader-type connector to the charging valve.
- 4) Check the pre-charge pressure above the diaphragm in each pressure vessel correspond to criteria given in the text above.
- 5) If necessary, release or add additional air to correct.

## 5.7 Venting Pumps

It is important to bleed all air from the pump body before initial start-up.

## 5.8 Procedure for flooded suction

Flooded Suction is defined as the condition where there is positive pressure on the suction (inlet) side of the pump(s) as is the case where the storage tank water level is at the same or higher level than the pump bleed point.

This procedure should be carried out individually for each pump in the pump set.

- 1) Open all valves on the suction (inlet) side of the pump.
- 2) Using the vent screw at the top of the pump (refer to Appendix to locate), allow any air in the pump body and suction pipework to vent to atmosphere.
- 3) When water (under pressure from the storage tank feeding the pump on the suction side) escapes through the vent screw hole - and no more air bubbles can be seen - close the vent screw.
- 4) Switch on the electrical supply to the pump motor and start the pump in AUTO mode. As each motor starts verify that the direction of rotation correctly corresponds with the direction of the arrow shown on the body of the pump. If rotation is backward STOP, switch off the pump and investigate.
- 5) Slowly open the valve on the discharge manifold outlet to the system allowing water to be pumped into the system.
- 6) Switch off, re-close the discharge valve and repeat steps 3 to 6 several times to ensure that all air is released from the pump body and local pipework.

The above procedure should be carried out individually for each pump in the pump set.

## 5.9 Procedure for Lift Suction

Lift Suction is defined where the water storage tank is at a lower level than the pump set. In this case a negative pressure condition may exist at the pump suction.

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**WARNING: THE "LIFT SUCTION" MODE OF OPERATION REQUIRES SPECIFIC VENTING PROCEDURES.**

- Please call Dutypoint Systems Technical Support on +44 (0)1452 300590 for advice before attempting to vent the pump(s).
- 

The advised procedure should then be carried out individually for each pump in the pump set.

## 5.10 Programming the Controller

Dutypoint Systems fit a design of Inverter/Controller that is most suitable for the design duty of the pump set.

Manufacturer's information for them is detailed in the Appendices to this manual.

Carefully follow the appropriate step-by-step setting-up procedures contained in the manual, ensuring that any data required to be entered by the end user is accurately inserted where requested.

If in doubt please call Dutypoint Systems Technical Support on 01452 300590 for advice.

## 5.11 Operation and Performance Tests

Having checked that the pump set is installed, pre-charged, vented in accordance with the procedures set out earlier, carry out the following running tests before handing over the pump set for operational use.

- 1) Run each pump by selecting HAND (Manual) control.
- 2) Re-select to AUTO mode.
- 3) Create the conditions for a normal start and run and allow the selected 'Duty' pump to run. Whilst running observe the pressure values. Verify the pump motor speeds up / slows down in accordance with the desired control philosophy.

## 5.12 Duty/Standby Twin Pump Sets

- 1) On Duty/Standby sets, wait for a normal stop to take place (or create the conditions where this would happen) and check that the 'Duty' pump stops. Whilst stopped simulate a fault by inhibiting the 'Duty' pump and then recreate the conditions for a normal start to take place. Check that the 'Standby' Pump now starts and runs in place of the inhibited 'Duty' pump and observe the pressure values. Verify that the pump motor speeds up / slows down in accordance with the desired control philosophy.
- 2) Wait for a normal stop to take place (or create the conditions where this would happen) and check the 'Standby' pump stops. Whilst stopped undo the inhibit to the 'Duty' pump which should now return to normal.

### 5.13 Duty/Assist Twin Pump Sets

- 1) For 'Duty/Assist' applications, run the system up to pressure using the 'Duty' Pump only, then deliberately create the condition(s) which will require the 'Assist' Pump to operate as well. (e.g: open taps to reduce the pressure in the system to a point where one pump only cannot maintain the required output. Verify that the 'Assist' Pump starts and runs together with the 'Duty' Pump and that the desired pressure is duly restored and maintained.
- 2) Close the taps again (thereby reducing the demand) and check the 'Assist' Pump slows down and stops, allowing the 'Duty' Pump to continue on its own.

### 5.14 Commissioning/Handover Check

- 1) Record any indicated voltage / amperage / pressure data / controller passwords for future reference.
- 2) Re-check all isolating valves are fully open and replace any cover(s).
- 3) With all the isolators ON and the switches and/or control programs set to AUTO, the pump set is now fully operational in automatic control mode.

**NOTE:** No manual operation or attendance is required other than for routine servicing and maintenance checks. Other than for maintenance purposes, the supply to the Controller(s) and the Pump motor(s) should never be switched off.

# 6 User Maintenance

## Routine user maintenance for Dutypoint pump sets.

Dutypoint pump sets have been designed to keep major maintenance requirements to a minimum. Planned maintenance of the pumps and other principal components should therefore be undertaken at the intervals recommended in the manuals referenced below.

It is essential that a full test following the Pre-Commissioning procedure on is carried out on an annual basis.

In addition, the operator in charge should routinely make visual checks of the equipment during use, noting particularly any unusual noises or vibrations. This will give an immediate indication of any irregularity in the operation of the system.

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**DANGER: DO NOT COMMENCE ANY MAINTENANCE WORK UNTIL:**

- You have read [Important Safety Information](#)
  - You have the appropriate personal protective equipment
  - You have all necessary safety equipment to hand
- 

Refer to the appropriate manufacturer’s information that is provided in the appendices of this manual for the equipment being serviced.

**Table 1: Periodic User Checks for Pump Sets**

Timing	Checks
Weekly	1) Visually check the complete pump set 2) Observe the running of the pump(s) and note any unusual vibrations or sounds.
Quarterly	1) Visually check the complete pump set 2) Observe the running of the pump(s) and note any unusual vibration, etc. 3) Check the cooling fan and vents on the Control Unit(s) and clear any dust or other obstructions 4) Operate each manual isolating valve three times to ensure continued efficient working
6-monthly	The pressure vessel should be drained and the pre-charge pressure checked. See <a href="#">Pressure Vessel Pre-Charge Instructions</a> for more details.
12-monthly (essential)	Carry out the full pre-commissioning procedure to verify safe operation - see <a href="#">Commissioning</a> .

# 7 Pressure Vessel

The pressure vessel supplied as part of your Dutypoint product is used to absorb and conserve the potential energy of pressurised liquid. Stored energy from liquid under pressure is transferred to the water system when required.

## 7.1 Installation Safety Notes

These notes are taken from the pressure vessel installation manual:

- This product is designed to hold water up to +110°C
- Never exceed the maximum working pressure and temperature of the expansion tank; ensure appropriate controls are installed for this purpose.
- During installation prepare adequate systems for drainage to limit damage caused by leakage from the tank, draining and venting.
- During installation the installer should account for external stress such as traffic, wind and earthquakes.
- Always install the appliance in conformity to current legislation.
- This product must be installed and regularly inspected by qualified personnel only.
- The manufacturer shall not be held liable for any personal or material damage caused by the product if installed and/or used improperly or in way anyhow diversely from manufacturer's specifications.
- Exceeding temperature and pressure limits specified by the manufacturer will give cause to cancel any guarantee covering the product as well as any manufacturer's liability.
- For fluids other than water, check compatibility before installing.
- The appliance must be installed in a safe place with access for authorized personnel only.
- The appliance must be protected by an appropriate earthing systems or isolated from the system by a dielectric joint.

## 7.2 Periodic Maintenance

Periodic maintenance is recommended at least twice a year and should be carried out by authorised specialised personnel only.

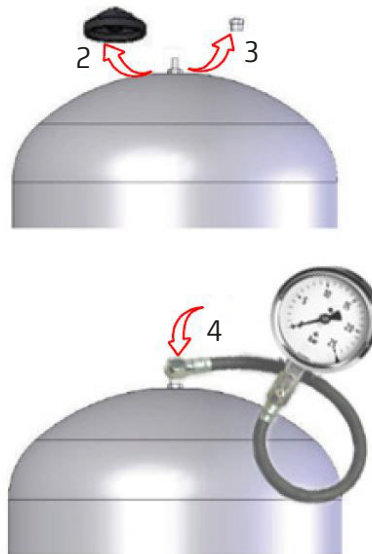
- 1) First check that the expansion or pressure tank is totally drained of water, and that the system is switched off and no electrical parts are live.
- 2) Check and, if necessary reset the pre-charge pressure, using the instruction in [Pressure Vessel Pre-Charging](#). Ensure that the pressure does not exceed the value specified in the procedure.

## 7.3 General Maintenance and Repair

Disconnect all electrical equipment before starting on any maintenance jobs or checking the installation pressure and temperature. The pre-charge pressure should be checked and if necessary corrected during any maintenance work.

## 7.4 Pressure Vessel Pre-Charge Instructions

- 1) First check that the expansion or pressure tank is totally drained of water, and that the system is switched off and no electrical parts are live.
- 2) Refer to [Pre-Charging a Pressure Vessel](#). Remove the air vent cover.
- 3) Unscrew the air valve cap.
- 4) Connect a pressure gauge. Verify that the pre-charge pressure is correct. If it is low then the vessel pre-charge must be corrected by additional inflation of the diaphragm.
- 5) When the pre-charge pressure is correct replace the air valve cap and vent cover.

**Figure 4: Pre-Charging a Pressure Vessel**

## 7.5 Diaphragm Replacement

To replace a diaphragm:

- 1) Empty the expansion tank
- 2) Remove the pre-charging by releasing the air vent.
- 3) Loosen the M8 screws fastening the flange
- 4) Remove the flange
- 5) Extract the diaphragm and replace it

## 7.6 Installing a Replacement Vessel

Read these instructions carefully before installing the product:

- 1) Make sure the product is in good condition. If the product is damaged do not start on installation but take it back to the seller for immediate replacement.
- 2) The product must be installed in the position (vertical or horizontal) specified in the technical specifications.
- 3) While the system is cold, measure the static pressure with a gauge, at the point where the tank has to be installed.
- 4) Set the pre-charge pressure, using the procedure earlier in this section. Ensure that the pressure does not exceed the value specified in the procedure.
- 5) The appliance must be supplied with efficient and sufficient safety and control facilities, in particular the safety valve must be connected to the appliance and be free from interference and must be gauged to the quantity of fluid to be discharged. The safety valve should also be designed to ensure that the pressure does not permanently exceed the maximum tolerated pressure (a temporary pressure peak, limited to 10% of the maximum tolerated pressure, is allowed).
- 6) Make sure the cap of the valve is fitted tightly after pre-loading and that there is no leakage.

# 8 Troubleshooting

The information in this section is common to all Hydrovar-equipped Dutypoint pump sets. For more detailed troubleshooting information that is specific to the type and model of pump and controller used in this product, please refer to the manufacturer's literature.

**FIRST STEP WHEN A FAULT OCCURS:**

- When a fault first occurs, turn off the main power to the pump set and leave off for around 1 minute.
- Switching power back on and re-energising the system may be sufficient to clear the fault.

## 8.1 Lack of Water Error 21

Possible Causes	Recommended Action
Low water contact is opened	1) Check incoming mains pressure is as expected 2) The error will reset automatically when the low water contact is closed

## 8.2 Min. Threshold Error 22

Possible Causes	Recommended Action
Minimum pressure requirement not reached within set period	1) Turn off main electrical isolator 2) Close discharge isolation valve 3) Vent pumps 4) Turn on main electrical isolator 5) Check unit runs up to set pressure and pump motors shut down 6) Open discharge valve slowly ensuring set pressure is maintained

## 8.3 Pump Will Not Start

Possible Causes	Recommended Action
No electrical power	Check and rectify
Blown fuse	Check and rectify
Overload trip	Check and rectify

## 8.4 Low (or Zero) Output Discharge

Possible Causes	Recommended Action
The rotating part(s) of the pump is/are partially or completely obstructed, e.g. impeller obstructed by foreign matter	Strip the pump to inspect and rectify
Pump not primed - WARNING: running the pump 'dry' can cause serious damage to the mechanical seal.	Having first checked the mechanical seal for damage, prime and air-bleed the pump and try again
Valve in suction pipework closed or partially closed.	Check all appropriate valves are fully open.
Incorrect pump rotation	Check and rectify.

## 8.5 Pump Vibrates and/or is Noisy

Possible Causes	Recommended Action
Pump is cavitating	Increase the discharge back pressure slightly by progressively closing a manual isolating valve on the discharge side until the cavitation stops.
Motor bearings worn	Check and rectify
The rotating part(s) of the pump is(are) partially or completely obstructed. E.g. impeller obstructed by foreign matter.	Strip the pump to inspect and rectify

## 8.6 Pump Runs Continuously

Possible Causes	Recommended Action
If the pump has a “Hand Control” option on it’s control panel.	Switching to “Auto” should restore normal control. If normal control is not returned an immediate service visit is required.
Pump has no “Hand Control” option.	An immediate service visit is required.

## 8.7 Overload Trip

Possible Causes	Recommended Action
Pipework or the pump chamber has a partial blockage.	Check and rectify
Momentary loss of one phase of power supply	Check and try again
Discharge flow rate too high	Reduce by the discharge flow rate by increasing the discharge back pressure slightly, progressively closing a manual isolating valve on the discharge side: then try again
Overload trip setting too low for rated duty	Check and (if necessary) reset the overload trip value



# 9 Control Panel Wiring Diagrams

## 9.1 Twin Pump Wiring Diagrams

Figure 5: Twin Pump, Single Phase

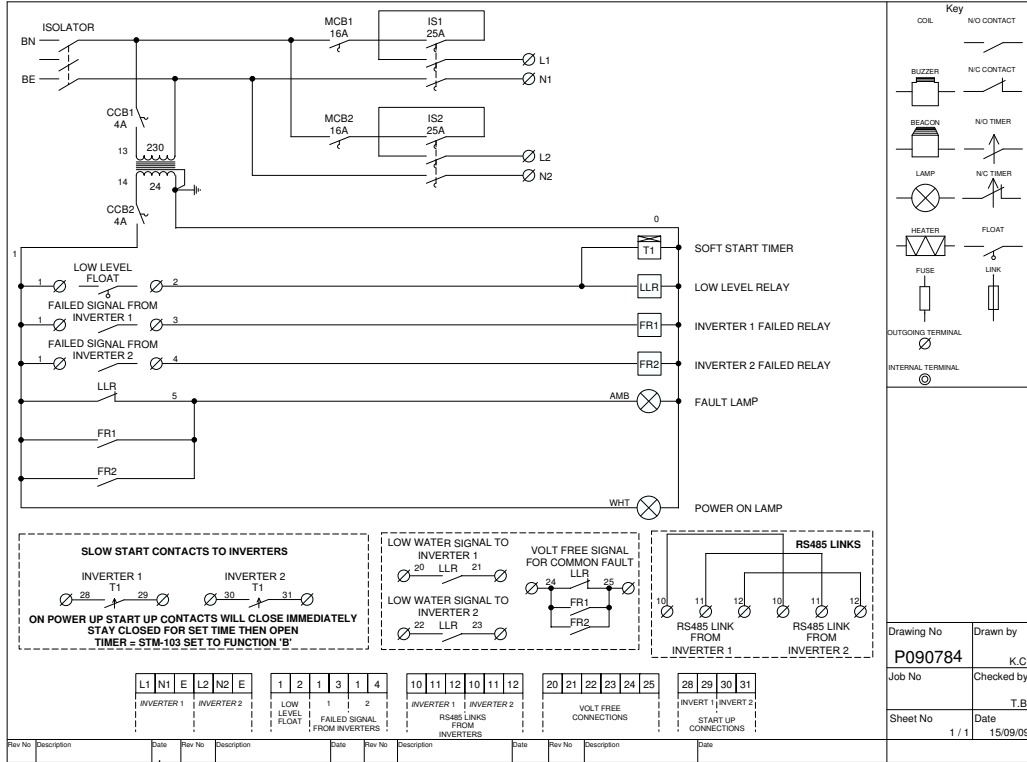
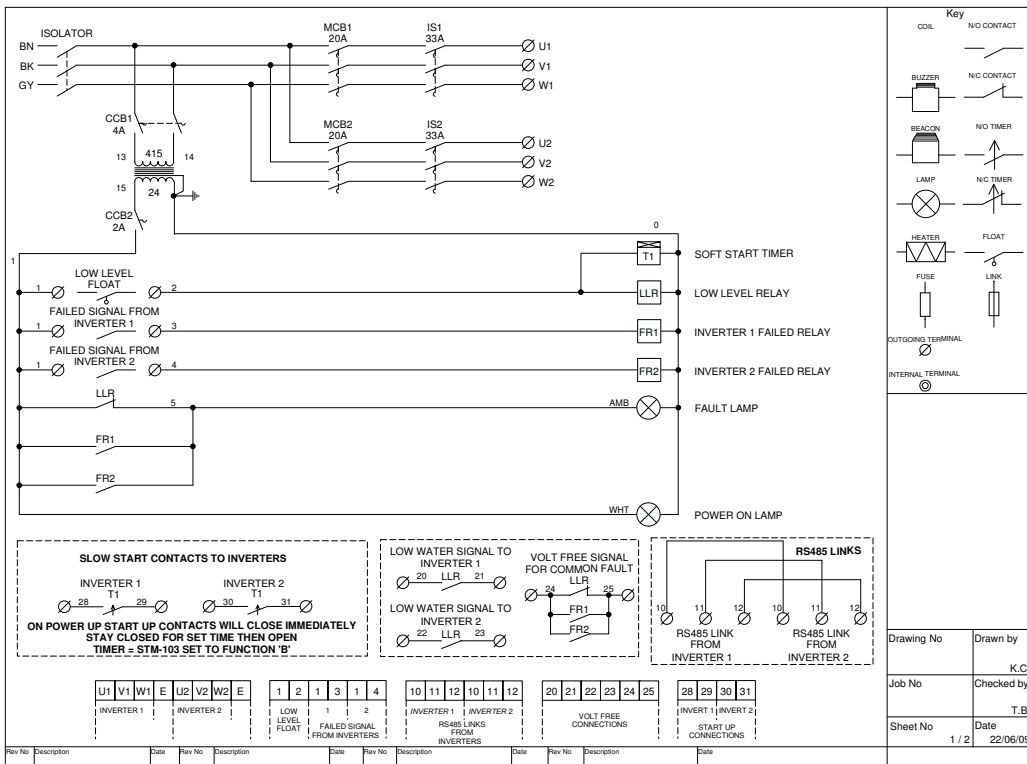


Figure 6: Twin Pump, Three Phase



# 9.2 Three Pump Wiring Diagrams

Figure 7: Three Pump, Single Phase

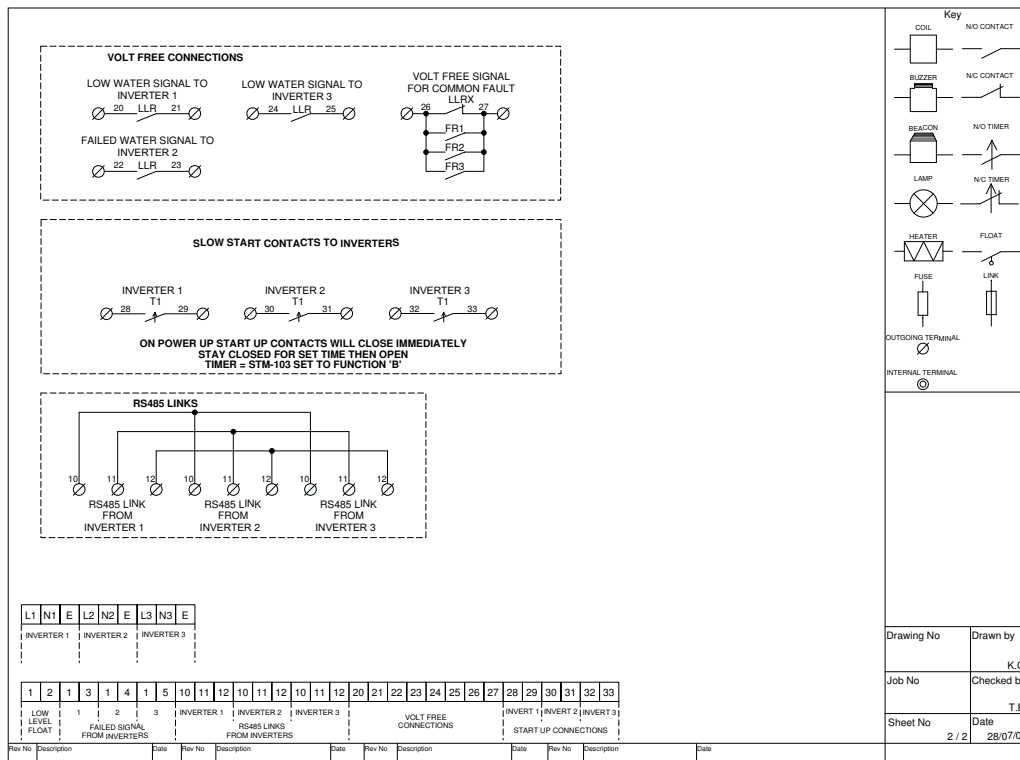
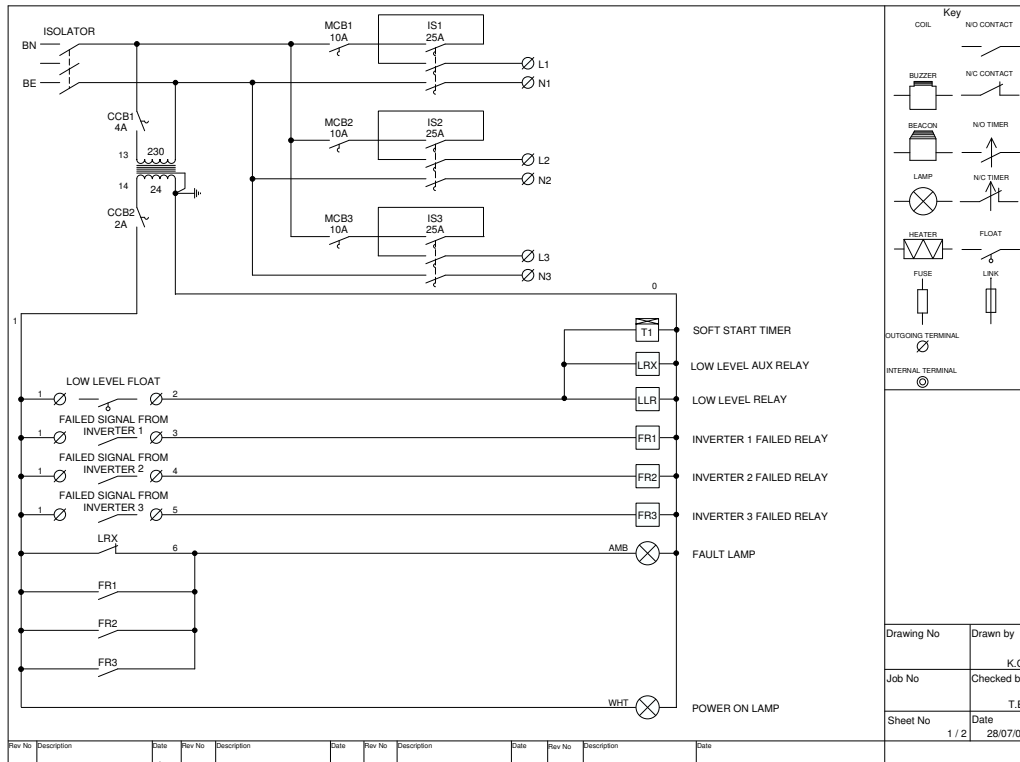
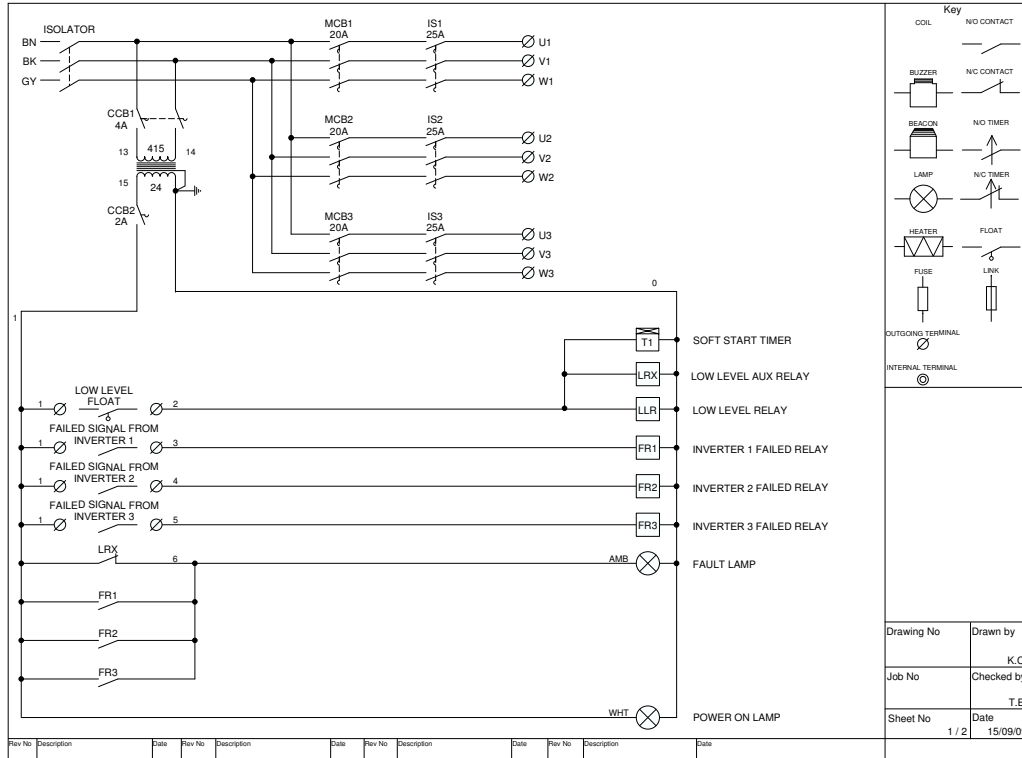


Figure 8: Three Pump, Three Phase



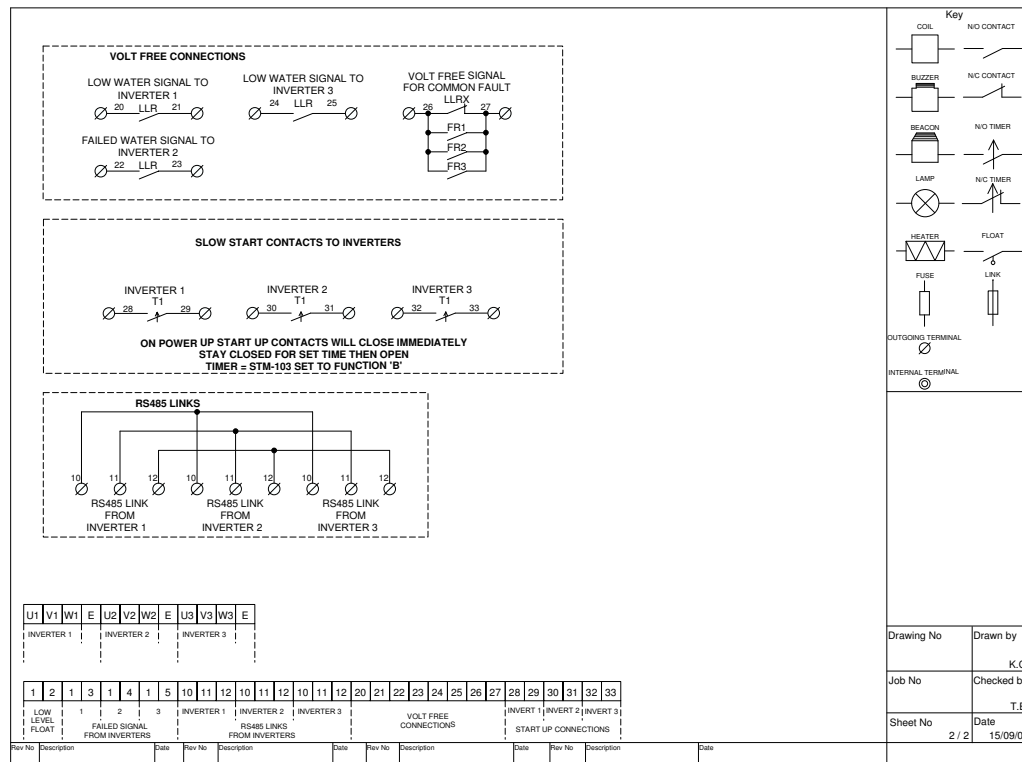
**Key**

- COIL
- NO CONTACT
- BUZZER
- NC CONTACT
- BEACON
- NO TIMER
- LAMP
- NC TIMER
- HEATER
- FLOAT
- FUSE
- LNK

OUTGOING TERMINAL

INTERNAL TERMINAL

Drawing No	Drawn by
Job No	Checked by
Sheet No	Date
1 / 2	15/09/09



**Key**

- COIL
- NO CONTACT
- BUZZER
- NC CONTACT
- BEACON
- NO TIMER
- LAMP
- NC TIMER
- HEATER
- FLOAT
- FUSE
- LNK

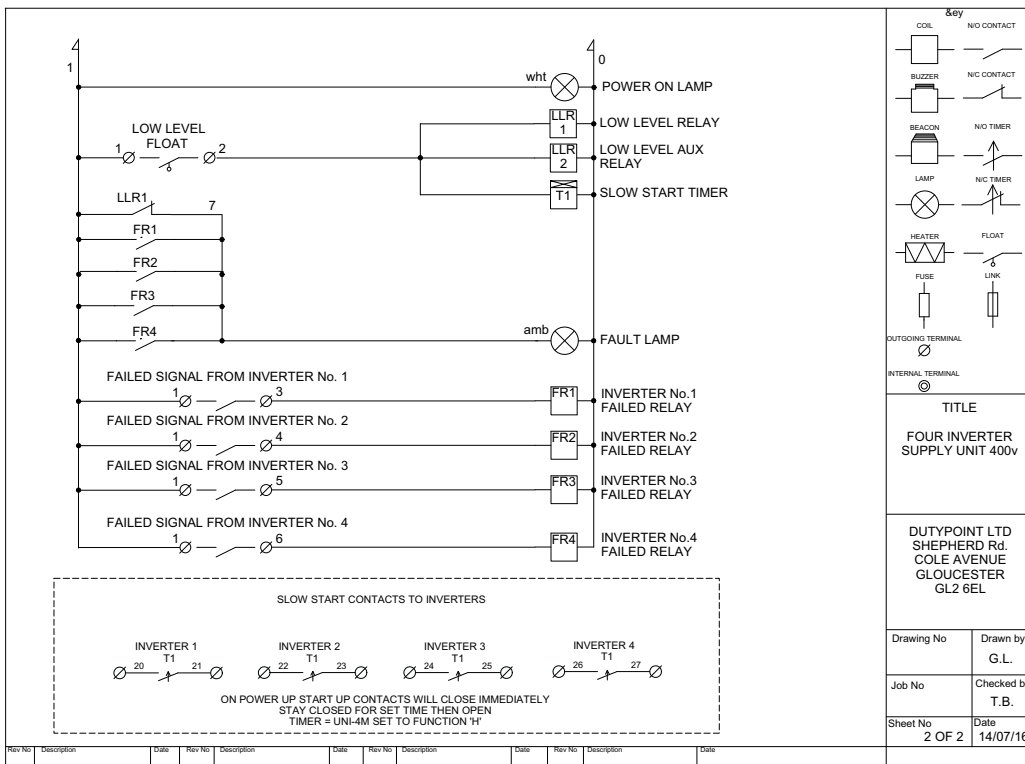
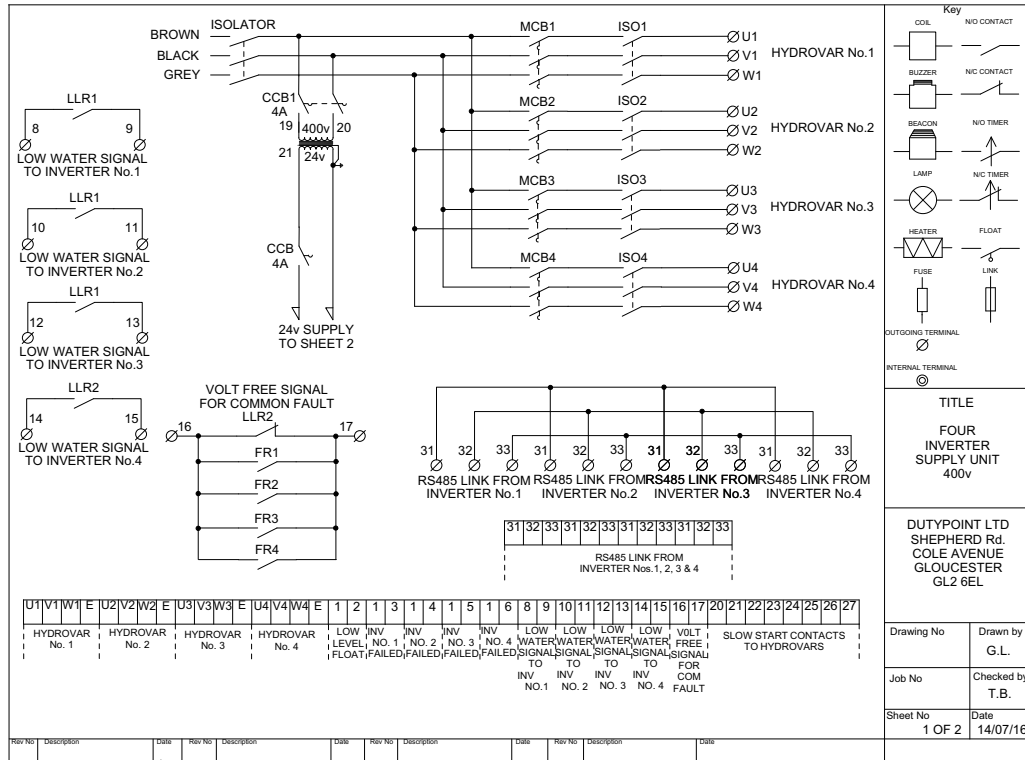
OUTGOING TERMINAL

INTERNAL TERMINAL

Drawing No	Drawn by
Job No	Checked by
Sheet No	Date
2 / 2	15/09/09

### 9.3 Four Pump Wiring Diagrams

Figure 9: Four Pump, Three Phase



# 10 Lowara e-SV Pump O&M Manual



# 1 Introduction and Safety

## 1.1 Introduction

### Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance



#### CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

### NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

### 1.1.1 Inexperienced users



#### WARNING:

This product is intended to be operated by qualified personnel only.

Be aware of the following precautions:

- Persons with diminished capacities should not operate the product unless they are supervised or have been properly trained by a professional.
- Children must be supervised to ensure that they do not play on or around the product.

## 1.2 Safety terminology and symbols

### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

### Hazard levels

Hazard level	Indication
<b>DANGER:</b>	A hazardous situation which, if not avoided, will result in death or serious injury
<b>WARNING:</b>	A hazardous situation which, if not avoided, could result in death or serious injury
<b>CAUTION:</b>	A hazardous situation which, if not avoided, could result in minor or moderate injury
<b>NOTICE:</b>	<ul style="list-style-type: none"> <li>• A potential situation which, if not avoided, could result in undesirable conditions</li> <li>• A practice not related to personal injury</li> </ul>

### Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:



#### WARNING:

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

### Hot surface hazard

Hot surface hazards are indicated by a specific symbol that replaces the typical hazard level symbols:



#### CAUTION:

### Description of user and installer symbols

Specific information for personnel in charge of installing the product in the system (plumbing and/or electrical aspects) or in charge of maintenance.
Specific information for users of the product.

### Instructions

The instructions and warnings that are provided in this manual concern the standard version, as described in the sales document. Special version pumps may be supplied with supplementary instruction leaflets. Refer to sales contract for any modifications or special version characteristics. For instructions, situations, or events that is not considered in this manual or the sales document, contact the nearest Lowara Service Center.

## 1.3 Disposal of packaging and product

Observe the local regulations and codes in force regarding sorted waste disposal.

## 1.4 Warranty

For information about warranty, see the sales contract.

## 1.5 Spare parts



#### WARNING:

Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the guarantee.



#### CAUTION:

Always specify the exact product type and part number when requesting technical information or spare parts from the Sales and Service Department.

For more information about the product's spare parts, see *Figure 25*, *Figure 26*, or *Figure 27*.

## 1.6 EC DECLARATION OF CONFORMITY (TRANSLATION)

LOWARA SRL UNIPERSONALE, WITH HEADQUARTERS IN VIA VITTORIO LOMBARDI 14 - 36075 MONTECCHIO MAGGIORE VI - ITALIA, HEREBY DECLARES THAT THE FOLLOWING PRODUCT:

ELECTRIC PUMP UNIT (SEE LABEL ON FIRST PAGE)

FULFILLS THE RELEVANT PROVISIONS OF THE FOLLOWING EUROPEAN DIRECTIVES:

- MACHINERY DIRECTIVE: 2006/42/EC (THE TECHNICAL FILE IS AVAILABLE FROM LOWARA SRL UNIPERSONALE).
- ELECTROMAGNETIC COMPATIBILITY 2004/108/EC
- ECO-DESIGN 2009/125/CE, REGULATION (EC) 640/2009 (3 ~, 50 Hz, P<sub>N</sub> ≥ 0,75 kW) IF IE2 or IE3 MARKED

AND THE FOLLOWING TECHNICAL STANDARDS

- EN 809, EN 60335-1, EN 60335-2-41, EN 62233
- EN 61000-6-1:2007, EN 61000-6-3:2007
- EN 60034-30

PUMP (SEE LABEL ON THE FIRST PAGE)

FULFILLS THE RELEVANT PROVISIONS OF THE FOLLOWING EUROPEAN DIRECTIVES:

- MACHINERY 2006/42/EC (THE TECHNICAL FILE IS AVAILABLE FROM LOWARA SRL UNIPERSONALE).

AND OF THE FOLLOWING TECHNICAL STANDARDS:

- EN 809

MONTECCHIO MAGGIORE, 16.06.2011

AMEDEO VALENTE

(DIRECTOR OF ENGINEERING AND R&D)

rev:01



Lowara is a trademark of Lowara srl Unipersonale, subsidiary of Xylem Inc.

## 2 Transportation and Storage



### 2.1 Inspect the delivery

1. Check the outside of the package for evident signs of damage.
2. Notify our distributor within eight days of the delivery date, if the product bears visible signs of damage.

#### Unpack the unit

1. Follow applicable step:
  - If the unit is packed in a carton, remove the staples and open the carton.
  - If the unit is packed in a wooden crate, open the cover while paying attention to the nails and straps.
2. Remove the securing screws or the straps from the wooden base.

#### Inspect the unit

1. Remove packing materials from the product. Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps. For your personal safety, be careful when you handle nails and straps.
4. Contact your Sales and Service Department if anything is out of order.

### 2.2 Transportation guidelines

#### Precautions



#### WARNING:

- Observe accident prevention regulations in force.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.

Check the gross weight that is indicated on the package in order to select proper lifting equipment.

#### Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is securely fastened during transportation, and cannot roll or fall over.



#### WARNING:

Do not use eyebolts screwed on the motor for handling the whole electric pump unit.

- Use straps surrounding the motor if the power of the motor is between 0.25 kW and 4.0 kW.
- Use ropes or straps that are linked to the two flanges (eye bolts if provided) located near the mating zone between the motor and pump, if the power of the motor is between 5.5 kW and 55.0 kW.
- Eyebolts screwed onto the motor may be exclusively used to handle the individual motor or, in case of a not balanced distribution of weights, to partially lift the unit vertically starting from a horizontal displacement.
- To move the pump unit only, use straps firmly linked to the motor adapter.

For more information about how to securely harness the unit, see *Figure 4*.

#### Unit without motor

If the unit is not delivered with a motor, the calibrated fork-shaped shim is already inserted between the adapter and the transmission coupling. The

shim is inserted to keep the impeller stack in the correct axial position. In order to prevent damage during transportation the shaft is also held into place with expanded polystyrene and plastic straps.

The bolt and nuts used to fasten the motor are not included. For more information about how to couple the motor, see *Figure 23*.



#### WARNING:

A pump and motor that are purchased separately and then coupled together results in a new machine under the Machinery directive 2006/42/EC. The person making the coupling is responsible for all safety aspects of the combined unit.

### 2.3 Storage guidelines

#### Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

#### NOTICE:

- Protect the product against humidity, heat sources, and mechanical damage.
- Do not place heavy weights on the packed product.

#### Ambient temperature

The product must be stored at an ambient temperature from -5°C to +40°C (23°F to 104°F).

## 3 Product Description



### 3.1 Pump design

This is a vertical, multistage, non-self priming pump, which can be coupled to standard electric motors. The pump can be used to pump:

- Cold water
- Warm water

The metallic parts of the pump that come in contact with water are made of the following:

Series	Material
1, 3, 5, 10, 15, 22	Stainless steel
33, 46, 66, 92, 125	Stainless steel and cast iron A special version is available where all parts are made of stainless steel.

The SV pumps 1, 3, 5, 10, 15, and 22 are available in different versions according to the position of the suction and delivery ports and the shape of the connection flange.

The product can be supplied as a pump unit (pump and electric motor) or only as a pump.

#### NOTICE:

If you have purchased a pump without motor, make sure that the motor is suitable for coupling to the pump.

#### Mechanical seal

Series	Basic characteristics
1, 3, 5	Nominal diameter 12 mm (0.47 in.), unbalanced, right hand rotation, K version (EN 12756)
10, 15, 22	Nominal diameter 16 mm (0.63 in.), unbalanced, right hand rotation, K version (EN 12756) Balanced with motor power ≥ 5 kW
33, 46, 66, 92, 125	Nominal diameter 22 mm (0.86 in.), balanced, right hand rotation, K version (EN 12756)

#### Intended use

The pump is suitable for:

- Civil and industrial water distribution systems
- Irrigation (for example, agriculture and sporting facilities)
- Water treatment
- Boiler feed
- Washing plants
- Cooling (for example, air conditioning and refrigeration)
- Fire fighting applications



**Improper use**



**WARNING:**  
Improper use of the pump may create dangerous conditions and cause personal injury and damage to property.

An improper use of the product leads to the loss of the warranty.

Examples of improper use:

- Liquids not compatible with the pump construction materials
- Hazardous liquids (such as toxic, explosive, flammable, or corrosive liquids)
- Potable liquids other than water (for example, wine or milk)

Examples of improper installation:

- Hazardous locations (such as explosive, or corrosive atmospheres).
- Location where the air temperature is very high or there is poor ventilation.
- Outdoor installations where there is no protection against rain or freezing temperatures.



**DANGER:**  
Do not use this pump to handle flammable and/or explosive liquids.

**NOTICE:**

- Do not use this pump to handle liquids containing abrasive, solid, or fibrous substances.
- Do not use the pump for flow rates beyond the specified flow rates on the data plate.

**Special applications**

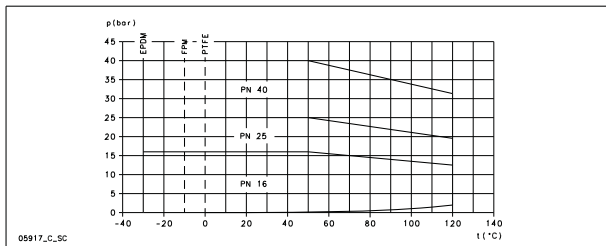
Contact the Sales and Service Department in the following cases:

- If the density and/or viscosity value of the pumped liquid exceeds the value of water, such as water with glycol; as it may require a more powerful motor.
- If the pumped liquid is chemically treated (for example softened, deionized, demineralized etc.).
- If the pump will be installed horizontally, a special version and mounting brackets must be requested.
- Any situation that is different from the ones that is described and relate to the nature of the liquid.

**3.2 Application limits**

**Maximum working pressure**

This flow chart shows the maximum working pressure depending on the pump model and the temperature of the pumped liquid.



The following formula is valid for motors that are provided with the drive-end bearing axially locked (such as the Lowara standard motors for e-SV), see Figure 6. For other situations, contact the Sales and Service Department.

$$P_{1max} + P_{max} \leq PN$$

- P<sub>1max</sub>** Maximum inlet pressure
- P<sub>max</sub>** Maximum pressure generated by the pump
- PN** Maximum operating pressure

**Liquid temperature intervals**

Version	Gasket	Minimum	Maximum <sup>5</sup>	Maximum
Standard	EPDM	-30°C (-22°F)	90°C (194°F)	120°C (248°F)
Special	FPM (FKM)	-10°C (14°F)	90°C (194°F)	120°C <sup>6</sup> (248°F)
Special	PTFE	0°C (32°F)	90°C (194°F)	120°C (248°F)

For special requirements, contact the Sales and Service Department.

**Maximum number of starts per hour**

This table shows the number of starts allowed per hour for motors supplied by Lowara:

kW	0.25 - 3.00	4.00 - 7.50	11.0 - 15.0	18.5 - 22.0	30.0 - 37.0	45.0	55.0
Starts per hour	60	40	30	24	16	8	4

**NOTICE:**

If you use a different motor from the standard one supplied with the electric-pump, check the relevant instructions to find out the permitted number of starts per hour.

**3.3 Data plate**

The data plate is a metal label that is located on the adaptor. The data plate lists key product specifications. For more information, see Figure 1.

The data plate provides information regarding the material of the gasket and the mechanical seal. For information about how to interpret the code on the data plate, see Figure 2.

**Product denomination**

See Figure 3 for an explanation of the identification code for the pump and for an example.

**WRAS label - Installation Requirements and Notes (for UK market only)**

A WRAS label on the pump means it is a Water Regulations Advisory Scheme approved product. This product is suited to be used with cold potable water for human consumption. For more information, refer to IRNs R001 and R420 in the WRAS Water Fittings and Materials Directory ([www.wras.co.uk](http://www.wras.co.uk)).

**IMQ or TUV or IRAM or other marks (for electric pump only)**

Unless otherwise specified, for products with a mark of electrical-related safety approval, the approval refers exclusively to the electrical pump.

**4 Installation**



**Precautions**



- WARNING:**
- Observe accident prevention regulations in force.
  - Use suitable equipment and protection.
  - Always refer to the local and/or national regulations, legislation, and codes in force regarding the selection of the installation site, and water and power connections.



- WARNING:**
- Make sure that all connections are performed by qualified installation technicians and in compliance with the regulations in force.
  - Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

<sup>5</sup> EN 60335-2-41 is the norm about electric-related safety pumps for household and similar applications

<sup>6</sup> Maximum 100°C for water

### 4.1 Earthing grounding



**WARNING:**

- Always connect the external protection conductor to earth (ground) terminal before making other electrical connections.
- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
- If the motor cable is jerked loose by mistake, the earth (ground) conductor should be the last conductor to come loose from its terminal. Make sure that the earth (ground) conductor is longer than the phase conductors. This applies to both ends of the motor cable.
- Add additional protection against lethal shock. Install a high-sensitivity differential switch (30 mA) [residual current device RCD].

### 4.2 Facility requirements

#### 4.2.1 Pump location



**DANGER:**

Do not use this pump in environments that may contain flammable/explosive or chemically aggressive gasses or powders.

**Guidelines**

Observe the following guidelines regarding the location of the product:

- Make sure that no obstructions hinder the normal flow of the cooling air that is delivered by the motor fan.
- Make sure that the installation area is protected from any fluid leaks, or flooding.
- If possible, place the pump slightly higher than the floor level.
- The ambient temperature must be between 0°C (+32°F) and +40°C (+104°F).
- The relative humidity of the ambient air must be less than 50% at +40°C (+104°F).
- Contact the Sales and Service Department if:
  - The relative air humidity conditions exceed the guidelines.
  - The room temperature exceeds +40°C (+104°F).
  - The unit is located more than 1000 m (3000 ft) above the sea level. The motor performance may need to be de-rated or replaced with a more powerful motor.

For information about which value to de-rate the motor with, see *Table 8*.

**Pump positions and clearance**

**NOTICE:**

Horizontal mounting of the pump requires special adaptation.

Provide adequate light and clearance around the pump. Make sure that it is easily accessible for installation and maintenance operations.

**Installation above liquid source (suction lift)**

The theoretical maximum suction height of any pump is 10.33m. In practice, the following affect the suction capacity of the pump:

- Temperature of the liquid
- Elevation above the sea level (in an open system)
- System pressure (in a closed system)
- Resistance of the pipes
- Own intrinsic flow resistance of the pump
- Height differences

The following equation is used to calculate the maximum height above the liquid level which the pump can be installed:

$$(p_b * 10.2 - Z) \geq NPSH + H_f + H_v + 0.5$$

- p<sub>b</sub>** Barometric pressure in bar (in closed system is system pressure)
- NPSH** Value in meter of the pump intrinsic flow resistance
- H<sub>f</sub>** Total losses in meters caused by passage of liquid in the suction pipe of the pump
- H<sub>v</sub>** Steam pressure in meters that correspond to the temperature of the liquid T °C
- 0.5** Recommended safety margin (m)

- Z** Maximum height at which the pump can be installed (m)

For more information, see *Figure 7*.

(p<sub>b</sub>\*10.2 - Z) must always be a positive number.

For more information about the performance, see *Figure 5*.

**NOTICE:**

Do not exceed the pumps suction capacity as this could cause cavitation and damage the pump.

### 4.2.2 Piping requirements

**Precautions**



**WARNING:**

- Use pipes suited to the maximum working pressure of the pump. Failure to do so can cause the system to rupture, with the risk of injury.
- Make sure that all connections are performed by qualified installation technicians and in compliance with the regulations in force.

**NOTICE:**

Observe all regulations issued by the municipal authorities if the pump is connected to the municipal water system. If required by the authorities, install appropriate backflow-prevention device on the suction side.

**Suction and discharge piping checklist**

Check that the following requirements are met:

- All piping is independently supported, piping must not place a burden on the unit.
- Flexible pipes or unions are used, in order to avoid transmission of pump vibrations to the pipes and vice versa.
- Use wide bends, avoid using elbows which cause excessive flow resistance.
- The suction piping is perfectly sealed and airtight.
- If the pump is used in an open circuit, then the diameter of the suction pipe is suited to the installation conditions. The suction pipe must not be smaller than the diameter of the suction port.
- If the suction piping must be larger than the suction side of the pump, then an eccentric pipe reducer is installed.
- If the pump is placed above liquid level, a foot valve is installed at the end of the suction piping.
- The foot valve is fully immersed into the liquid so that air cannot enter through the suction vortex, when the liquid is at the minimum level and the pump is installed above the liquid source.
- Appropriately sized on-off valves are installed on the suction piping and on the delivery piping (downstream to the check valve) for regulation of the pump capacity, for pump inspection, and for maintenance.
- In order to prevent back flow into the pump when pump is turned off a check valve is installed on the delivery piping.



**WARNING:**

Do not use the on-off valve on the discharge side in the closed position in order to throttle the pump for more than a few seconds. If the pump must operate with the discharge side closed for more than a few seconds, a bypass circuit must be installed to prevent overheating of the water inside the pump.

For illustrations that show the piping requirements, see *Figure 12*.

### 4.3 Electrical requirements

- The local regulations in force overrule these specified requirements.
- In the case of fire fighting systems (hydrants and/or sprinklers), check the local regulations in force.

**Electrical connection checklist**

Check that the following requirements are met:

- The electrical leads are protected from high temperature, vibrations, and collisions.
- The power supply line is provided with:
  - A short-circuit protection device
  - A high-sensitivity differential switch (30 mA) [residual current device RCD] to provide additional protection against electric shock
  - A mains isolator switch with a contact gap of at least 3 mm

**The electrical control panel checklist**

**NOTICE:**

The control panel must match the ratings of the electric pump. Improper combinations could fail to guarantee the protection of the motor.

Check that the following requirements are met:

- The control panel must protect the motor against overload and short-circuit.
- Install the correct overload protection (thermal relay or motor protector).

Pump Type	Protection
Single phase standard electric pump ≤ 1,5 kW	<ul style="list-style-type: none"> <li>• Built-in automatic reset thermal-amperometric protection (motor protector)</li> <li>• Short circuit protection (must be supplied by the installer)<sup>7</sup></li> </ul>
Three phase electric pump and other single phase pumps <sup>8</sup>	<ul style="list-style-type: none"> <li>• Thermal protection (must be supplied by the installer)</li> <li>• Short circuit protection (must be supplied by the installer)</li> </ul>

- The control panel must be equipped with a dry-running protection system to which a pressure switch, float switch, probes, or other suitable device is connected.
- The following devices are recommended for use on the suction side of the pump:
  - When the water is pumped from a water system, use a pressure switch.
  - When the water is pumped from a storage tank or reservoir, use a float switch or probes.
- When thermal relays are used, relays that are sensitive to phase failure are recommended.

**The motor checklist**



**WARNING:**

- Read the operating instructions in order to ensure whether a protection device is provided if another motor other than the standard is used.
- If the motor is equipped with automatic thermal protectors, be aware of the risk of unexpected starts in connection to overload. Do not use such motors for fire-fighting applications and sprinkler systems.

**NOTICE:**

- Only use dynamically balanced motors with a half-sized key in the shaft extension (IEC 60034-14) and with normal vibration rate (N).
- The mains voltage and frequency must agree with the specifications on the data plate.
- Only use single-phase or three-phase motors whose size and power comply with the European standards.

In general, motors can operate under the following mains voltage tolerances:

Frequency Hz	Phase ~	UN [V] ± %
50	1	220 – 240 ± 6
	3	230/400 ± 10
		400/690 ± 10
60	1	220 – 230 ± 6
	3	220/380 ± 5
		380/660 ± 10

Use cable according to rules with 3 leads (2+earth/ground) for single phase versions and with 4 leads (3+earth/ground) for three phase version.

Electric pump with motor:

Type	Cable gland Outer cable diameter range in mm		
	M20 x 1.5, 6–12	M25 x 1.5, 13–18	M32 x 1.5, 18–25
SM	X	–	–
PLM	X	X	X
LLM	X	X	X

**4.4 Install the pump**

**4.4.1 Mechanical installation**

For information about the pump base and anchor holes, see *Figure 13*.

1. Put the pump onto the concrete foundation or equivalent metal structure.  
If the transmission of vibrations can be disturbing, provide vibration-damping supports between the pump and the foundation.
2. Remove the plugs covering the ports.
3. Align the pump and piping flanges on both sides of the pump. Check the alignment of the bolts.
4. Fasten the piping with bolts to the pump.  
Do not force the piping into place.
5. Anchor the pump securely with bolts to the concrete foundation or metal structure.

**4.4.2 Electrical installation**

1. To facilitate the connection, the motor can be rotated to obtain the most convenient position for the connection:
  - a) Remove the four bolts that attach the motor to the pump.
  - b) Rotate the motor to the desired position. Do not remove the coupling between the motor shaft and the pump shaft.
  - c) Replace the four bolts and tighten them.
2. Remove the screws of the terminal box cover.
3. Connect and fasten the power cables according to the applicable wiring diagram.  
For wiring diagrams, see *Figure 14*. The diagrams are also available on the back of the terminal box cover.
  - a) Connect the earth (ground) lead.  
Make sure that the earth (ground) lead is longer than the phase leads.
  - b) Connect the phase leads.
4. Replace the terminal box cover.

**NOTICE:**

Tighten the cable glands carefully to ensure protection against cable slipping and humidity entering the terminal box.

5. If the motor is not equipped with automatic reset thermal protection, then adjust the overload protection according to the list below:
  - If the motor is used with full load, then set the value to the nominal current value of electric pump (data plate)
  - If the motor is used with partial load, then set the value to the operating current (for example measured with a current pincer).
  - If the pump has a star-delta starting system, then adjust the thermal relay to 58% of the nominal current or operating current (only for three-phase motors).

**5 Commissioning, Startup, Operation, and Shutdown**



**Precautions**



**WARNING:**

- Make sure that the drained liquid does not cause damage or injuries.
- The motor protectors can cause the motor to restart unexpectedly. This could result in serious injury.
- Never operate the pump without the coupling guard correctly installed.



**CAUTION:**

- The outer surfaces of the pump and motor can exceed 40°C (104°F) during operation. Do not touch with any part of the body without protective gear.
- Do not put any combustible material near the pump.

<sup>7</sup> fuses aM (motor starting), or magneto-thermal switch with curve C and Icn ≥ 4,5 kA or other equivalent device.

<sup>8</sup> Overload thermal relay with operation class 10A + fuses aM (motor starting) or motor protection magneto-thermal switch with operation class 10A.

**NOTICE:**

- Never operate the pump below the minimum rated flow, when dry, or without prime.
- Never operate the pump with the delivery ON-OFF valve closed for longer than a few seconds.
- Never operate the pump with the suction ON-OFF valve closed.
- To prevent overheating of the internal pump-components, make sure that a minimum water flow is always guaranteed when the pump is running. If this cannot be achieved, then a bypass or re-circulate line is recommended. Refer to the minimal nominal flow rate values given in the Appendix.
- Do not expose an idle pump to freezing conditions. Drain all liquid that is inside the pump. Failure to do so can cause liquid to freeze and damage the pump.
- The sum of the pressure on the suction side (water mains, gravity tank) and the maximum pressure that is delivered by the pump must not exceed the maximum working pressure allowed (nominal pressure PN) for the pump.
- Do not use the pump if cavitation occurs. Cavitation can damage the internal components.
- If you pump hot water, you must guarantee a minimum pressure on the suction side to prevent cavitation.

**Noise level**

For information about noise levels emitted by units equipped with a Lowara supplied motor, see *Table 10*.

**5.1 Prime the pump**

For information about plug placement, see *Figure 15*.

**Installations with liquid level above the pump (suction head)**

For an illustration that shows the pump parts, see *Figure 16*.

1. Close the on-off valve located downstream from the pump. Select the applicable steps:
2. Series 1, 3, 5:
  - a) Loosen the drain plug pin (2).
  - b) Remove the fill and vent plug (1) and open the on-off valve upstream until the water flows out of the hole.
  - c) Tighten the drain plug pin (2).
  - d) Replace the fill and vent plug (1).
3. Series 10, 15, 22, 33, 46, 66, 92, 125:
  - a) Remove the fill and vent plug (1) and open the on/off valve upstream until the water flows out of the hole.
  - b) Close the fill and vent plug (1). Fill plug (3) can be used instead of (1).

**Installations with liquid level below the pump (suction lift)**

For an illustration that shows the pump parts, see *Figure 17*.

1. Open the on-off valve located upstream from the pump and close the on-off valve downstream. Select the applicable steps:
2. Series 1, 3, 5:
  - a) Loosen the drain plug pin (2).
  - b) Remove the fill and vent plug (1) and use a funnel to fill the pump until water flows out of the hole.
  - c) Replace the fill and vent plug (1).
  - d) Tighten the drain plug pin (2).
3. Series 10, 15, 22, 33, 46, 66, 92, 125:
  - a) Remove the fill and vent plug (1) and use a funnel (4) to fill the pump until water flows out of the hole.
  - b) Replace the fill and vent plug (1). Fill plug (3) can be used instead of (1).

**5.2 Check the rotation direction (three-phase motor)**

Follow this procedure before startup.

1. Locate the arrows on the adaptor or the motor fan cover to determine the correct rotation direction.
2. Start the motor.
3. Quickly check the direction of rotation through the coupling guard or through the motor fan cover.
4. Stop the motor.
5. If the rotation direction is incorrect, do as follows:
  - a) Disconnect the power supply.
  - b) In the terminal board of the motor or in the electric control panel, exchange the position of two of the three wires of the supply cable. For the wiring diagrams, see *Figure 14*.
  - c) Check the direction of rotation again.

**5.3 Start the pump**

Before starting the pump, make sure that:

- The pump is correctly connected to the power supply.
  - The pump is correctly primed according to instruction in the *Prime the pump*.
  - The on-off valve located downstream from the pump is closed.
1. Start the motor.
  2. Gradually open the on-off valve on the discharge side of the pump. At the expected operating conditions, the pump must run smoothly and quietly. If not, refer to *Troubleshooting*.

**6 Maintenance**



**Precautions**



**WARNING:**

Disconnect and lock out electrical power before installing or servicing the pump.



**WARNING:**

- Maintenance and service must be performed by skilled and qualified personnel only.
- Observe accident prevention regulations in force.
- Use suitable equipment and protection.
- Make sure that the drained liquid does not cause damage or injuries.

**6.1 Service**

The pump does not require any scheduled routine maintenance. If the user wishes to schedule regular maintenance deadlines, they are dependent on the type of pumped liquid and on the operating conditions of the pump.

Contact the Sales and Service Department for any requests or information regarding routine maintenance or service.

Extraordinary maintenance may be necessary to clean the liquid end and/or replace worn parts.

**6.2 Torque values**

For information about torque values, see *Table 18*, *Table 19*, or *Table 20*.

For information about the applicable thrust and torques on the flanges by the piping, see *Figure 21*.

**6.3 Replace the electric motor**

The pump is supplied with a calibrated fork-shaped shim designed to facilitate the motor coupling and replacement operations.

- See instructions about how to replace the motor in *Figure 23*. If the calibrated fork-shaped shim is not available use a  $5 \pm 0.1$  mm ( $0.2 \pm 0.004$  in.) shim.

**6.4 Replace the mechanical seal**

Series	Instruction
1, 3, 5	Contact the Sales and Service Department.
10, 15, 22: $\leq 4$ kW	Contact the Sales and Service Department.
10, 15, 22: $> 4$ kW	See the instructions in <i>Figure 24</i> . Use alcohol for cleaning and lubrication.
33, 46, 66, 92, 125	See the instructions in <i>Figure 24</i> . Use alcohol for cleaning and lubrication.

**7 Troubleshooting**

**7.1 Troubleshooting for users**



The main switch is on, but the electric pump does not start.

Cause	Remedy
The thermal protector incorporated in the pump (if any) has tripped.	Wait until the pump has cooled down. The thermal protector will automatically reset.

Cause	Remedy
The protective device against dry running has tripped.	Check the water level in the tank, or the mains pressure.

The electric pump starts, but the thermal protection trips a varying time after.

Cause	Remedy
There are foreign objects (solids or fibrous substances) inside the pump which have jammed the impeller.	Contact the Sales and Service Department.
The pump is overloaded because it is pumping liquid that is too dense and viscous.	Check the actual power requirements based on the characteristics of the pumped liquid and then contact the Sales and Service Department.

The pump runs but delivers too little or no water.

Cause	Remedy
The pump is clogged.	Contact the Sales and Service Department.

The troubleshooting instructions in the tables below are for installers only.

## 7.2 The main switch is on, but the electric pump does not start



Cause	Remedy
There is no power supply.	<ul style="list-style-type: none"> <li>Restore the power supply.</li> <li>Make sure all electrical connections to the power supply are intact.</li> </ul>
The thermal protector incorporated in the pump (if any) has tripped.	Wait until the pump has cooled down. The thermal protector will automatically reset.
The thermal relay or motor protector in the electric control panel has tripped.	Reset the thermal protection.
The protective device against dry running has tripped.	Check the: <ul style="list-style-type: none"> <li>water level in the tank, or the mains pressure</li> <li>protective device and its connecting cables</li> </ul>
The fuses for the pump or auxiliary circuits are blown.	Replace the fuses.

## 7.3 The electric pump starts, but the thermal protector trips or the fuses blow immediately after



Cause	Remedy
The power supply cable is damaged.	Check the cable and replace as necessary.
The thermal protection or fuses are not suited for the motor current.	Check the components and replace as necessary.
The electric motor is short circuit.	Check the components and replace as necessary.
The motor overloads.	Check the operating conditions of the pump and reset the protection.

## 7.4 The electric pump starts, but the thermal protector trips or the fuses blow a short time after



Cause	Remedy
The electrical panel is situated in an excessively heated area or is exposed to direct sunlight.	Protect the electrical panel from heat source and direct sunlight.
The power supply voltage is not within the working limits of the motor.	Check the operating conditions of the motor.
A power phase is missing.	Check the <ul style="list-style-type: none"> <li>power supply</li> <li>electrical connection</li> </ul>

## 7.5 The electric pump starts, but the thermal protector trips a varying time after



Cause	Remedy
There are foreign objects (solids or fibrous substances) inside the pump which have jammed the impeller.	Contact the Sales and Service Department.
The pumps delivery rate is higher than the limits specified on the data plate.	Partially close the on-off valve down stream until the delivery rate is equal or less than the limits specified on the data plate.
The pump is overloaded because it is pumping liquid that is too dense and viscous.	Check the actual power requirements based on the characteristics of the pumped liquid and replace the motor accordingly.
The motor bearings are worn.	Contact the Sales and Service Department.

## 7.6 The electric pump starts, but the system's general protection is activated



Cause	Remedy
A short circuit in the electrical system.	Check the electrical system.

## 7.7 The electric pump starts, but the system's residual current device (RCD) is activated



Cause	Remedy
There is an earth (ground) leakage.	Check the insulation of the electrical system components.

## 7.8 The pump runs but delivers too little or no water



Cause	Remedy
There is air inside the pump or the piping.	<ul style="list-style-type: none"> <li>Bleed the air</li> </ul>
The pump is not correctly primed.	Stop the pump and repeat the prime procedure. If the problem continues: <ul style="list-style-type: none"> <li>Check that the mechanical seal is not leaking.</li> <li>Check the suction pipe for perfect tightness.</li> <li>Replace any valves that are leaking.</li> </ul>
The throttling on the delivery side is too extensive.	Open the valve.
Valves are locked in closed or partially closed position.	Disassemble and clean the valves.
The pump is clogged.	Contact the Sales and Service Department.
The piping is clogged.	Check and clean the pipes.
The rotation direction of the impeller is wrong (three-phase version).	Change the position of two of the phases on the terminal board of the motor or in the electric control panel.
The suction lift is too high or the flow resistance in the suction pipes is too great.	Check the operating conditions of the pump. If necessary, do the following: <ul style="list-style-type: none"> <li>Decrease the suction lift</li> <li>Increase the diameter of the suction pipe</li> </ul>

## 7.9 The electric pump stops, and then rotates in the wrong direction



Cause	Remedy
There is a leakage in one or both of the following components: <ul style="list-style-type: none"> <li>The suction pipe</li> <li>The foot valve or the check valve</li> </ul>	Repair or replace the faulty component.
There is air in the suction pipe.	Bleed the air.

### 7.10 The pump starts up too frequently



Cause	Remedy
There is a leakage in one or both of the following components: <ul style="list-style-type: none"> <li>• The suction pipe</li> <li>• The foot valve or the check valve</li> </ul>	Repair or replace the faulty component.
There is a ruptured membrane or no air pre-charge in the pressure tank.	See the relevant instructions in the pressure tank manual.

### 7.11 The pump vibrates and generates too much noise

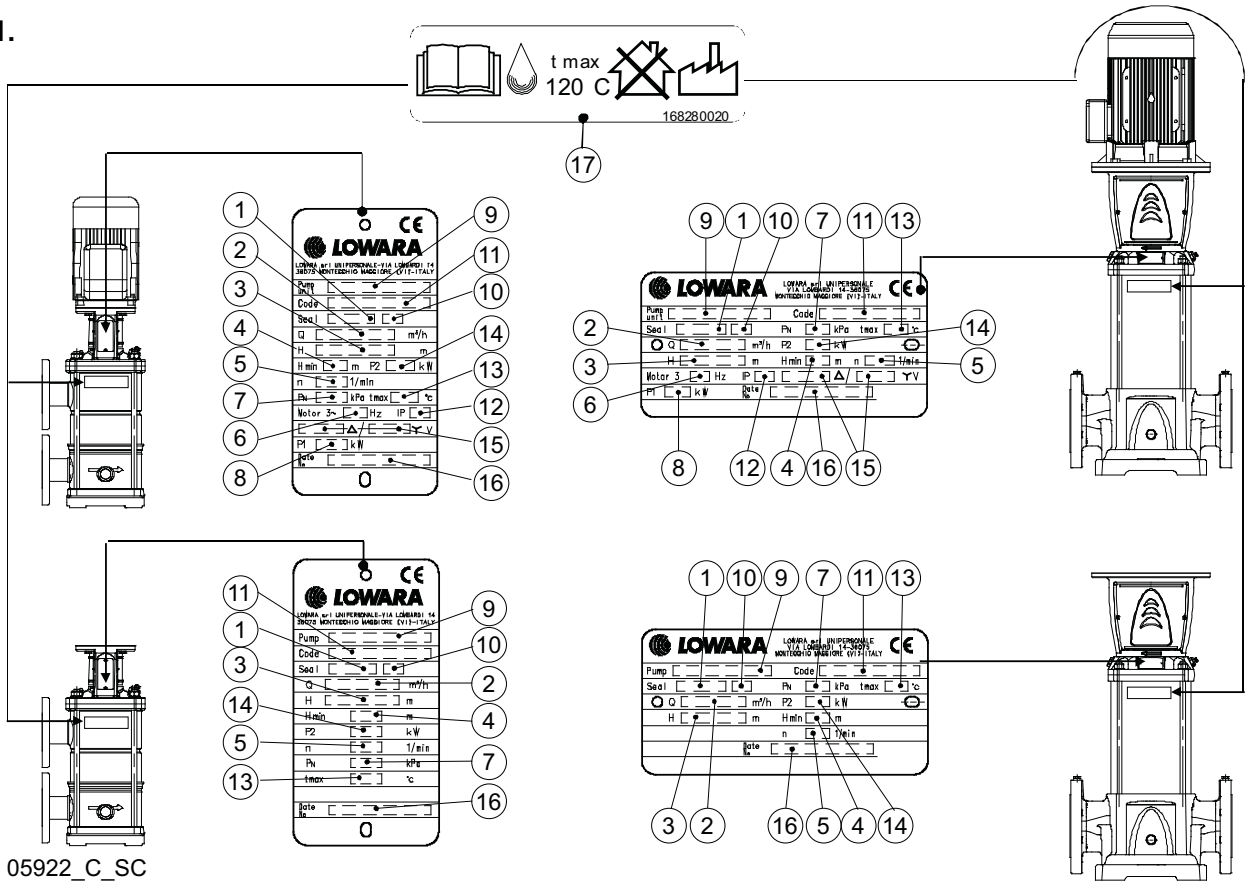


Cause	Remedy
Pump cavitation	Reduce the required flow rate by partially closing the on-off valve downstream from the pump. If the problem persists check the operating conditions of the pump (for example height difference, flow resistance, liquid temperature).
The motor bearings are worn.	Contact the Sales and Service Department.
There are foreign objects inside the pump.	Contact the Sales and Service Department.

For any other situation, refer to the Sales and Service Department.

Technical appendix

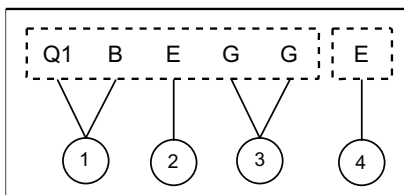
1.



05922\_C\_SC

1. Mechanical seal material identification code
2. Capacity range
3. Head range
4. Minimum head (IEC 60335-2-41)
5. Speed
6. Frequency
7. Maximum operating pressure
8. Electric pump unit absorbed power
9. Pump/electric pump unit type
10. O-ring material identification code
11. Electric pump unit/ pump part number
12. Protection class
13. Maximum operating liquid temperature (uses as IEC 60335-2-41)
14. Motor nominal power
15. Rated voltage range
16. Serial number (date + progressive number)
17. Maximum operating liquid temperature (uses other than IEC 60335-2-41)

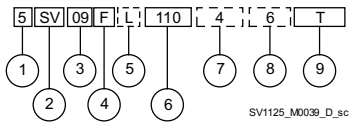
2.



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1. Mechanical Seal
  - A Metal impregnated carbon
  - B Resin impregnated carbon
  - C Special resin impregnated carbon
  - Q1 Silicon carbide
2.
  - E EPDM
  - T PTFE
  - V FPM (FKM)
3.
  - G 1.4401 (AISI 316)
4. Other o-ring gaskets
  - E EPDM
  - T PTFE
  - V FPM (FKM)

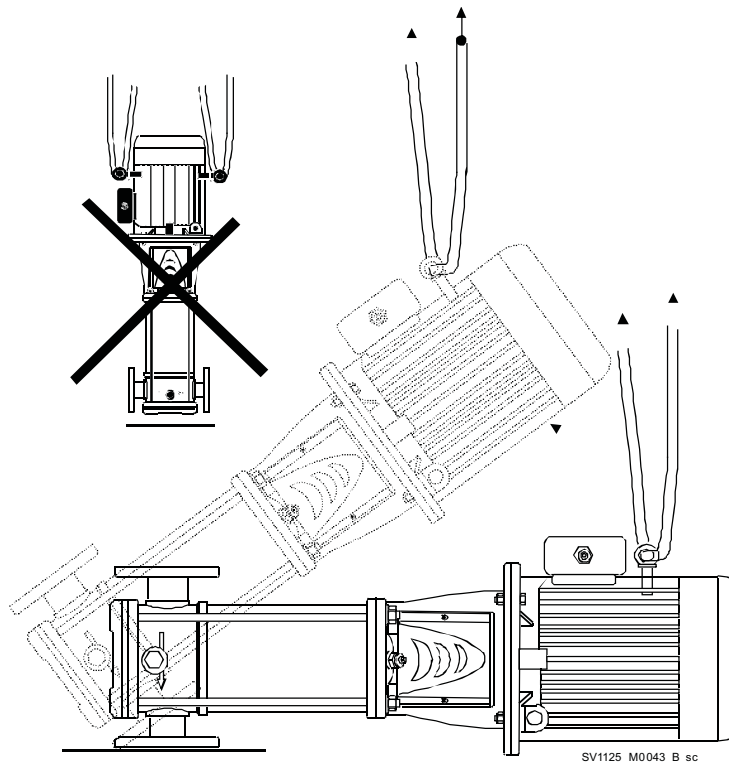
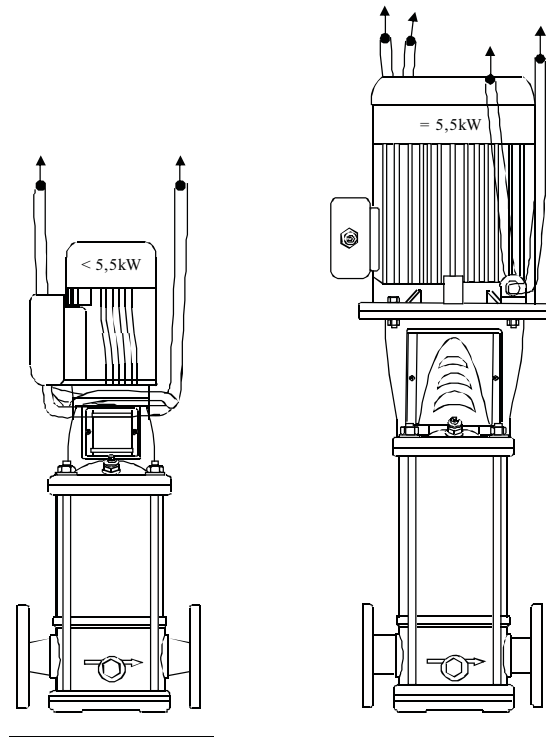
3.



1. Flow rate in m<sup>3</sup>/h
2. Series name
3. Number of impellers  
**8/2A** 8 impellers, 2 with outer diameter reduced  
**A or B** Reduction type
4. **1, 3, 5, 10, 15, 22**  
**F** AISI 304, round flanges (PN25) **T** AISI 304, oval flanges (PN16)  
**R** AISI 304, discharge port above suction, round flanges (PN25)  
**N** AISI 316, round flanges (PN25) **V** AISI 316, Victaulic® couplings (PN25)  
**P** AISI 316, Victaulic® couplings (PN40)  
**C** AISI 316, clamp couplings (PN40)  
**K** AISI 316, threaded couplings (PN25)  
**DIN32676** (PN25)  
**K** AISI 316, threaded couplings (PN40)  
**DIN11851** (PN25)  
**33, 46, 66, 92, 125**  
**G** AISI 304/Cast Iron, round flanges **N** AISI 316, round flanges  
**P** AISI 316, round flanges (PN40)
5. **1, 3, 5, 10, 15, 22**  
**Blank** Standard version  
  
**L** Low NPSH, round flanges, PN25 (F, N versions)  
**H** High temperature, 150°C, round flanges, PN25 (F, N versions)  
**B** High temperature, 180°C, round flanges, PN25 (N version)  
**E** Passivated and electro-polished (N, V, C, K versions)  
**33, 46, 66, 92, 125**  
**Blank** Standard version  
**L** Low NPSH, round flanges (G, N versions)  
**H** High temperature, 150°C, round flanges, PN25 (G, N versions)  
**B** High temperature, 180°C, round flanges, PN25 (N version)  
**E** Passivated and electro-polished (N version)
6. Rated motor power (kW x 10)  
**Blank** 2-pole  
**4** 4-pole
8. **Blank** 50 Hz  
**6** 60 Hz
9. **M** Single-phase  
**T** Three-phase

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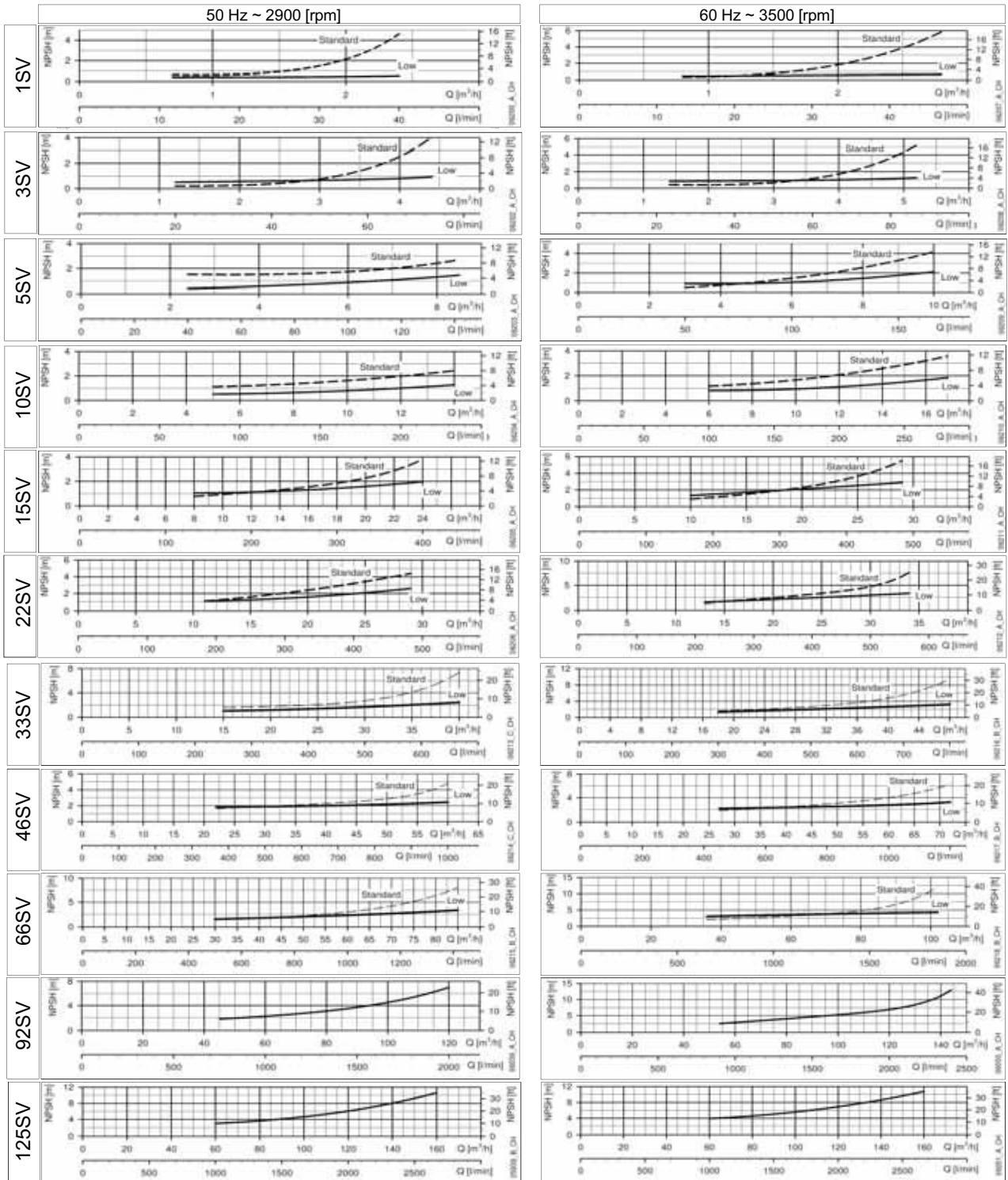
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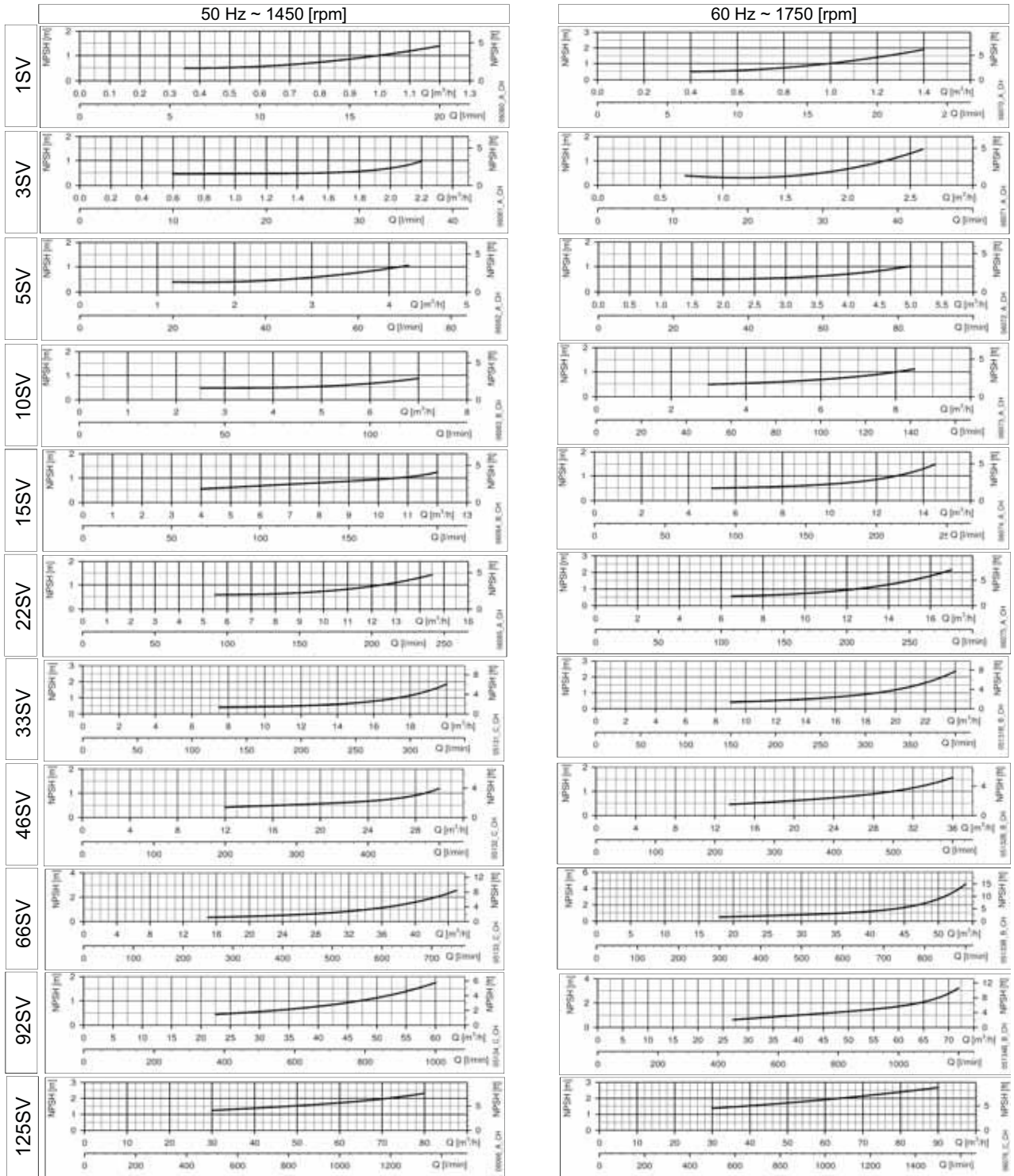


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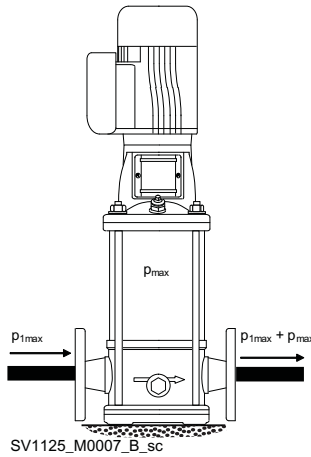
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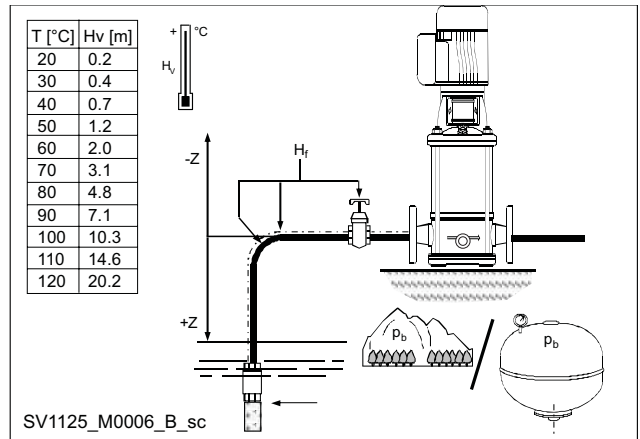


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6.



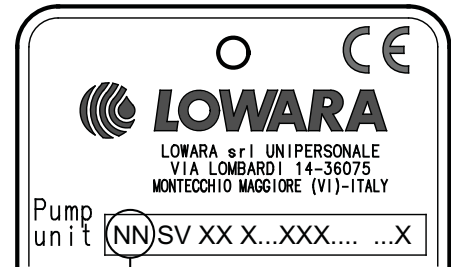
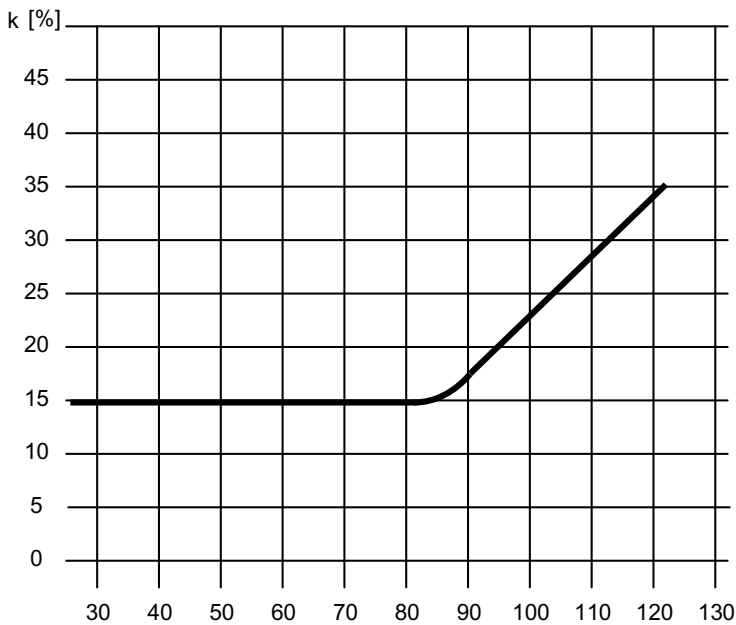
7.



8.

H (m)	0°C	10°C	20°C	30°C	40°C	45°C	50°C	55°C	60°C
0	1,00	1,00	1,00	1,00	1,00	0,95	0,90	0,85	0,80
500	1,00	1,00	1,00	1,00	1,00	0,95	0,90	0,85	0,80
1000	1,00	1,00	1,00	1,00	1,00	0,95	0,90	0,85	0,80
1500	0,97	0,97	0,97	0,97	0,97	0,92	0,87	0,82	0,78
2000	0,95	0,95	0,95	0,95	0,95	0,90	0,85	0,80	0,76

9.



$$Q_{min} = \text{NN} \cdot k \text{ [m}^3\text{/h]}$$

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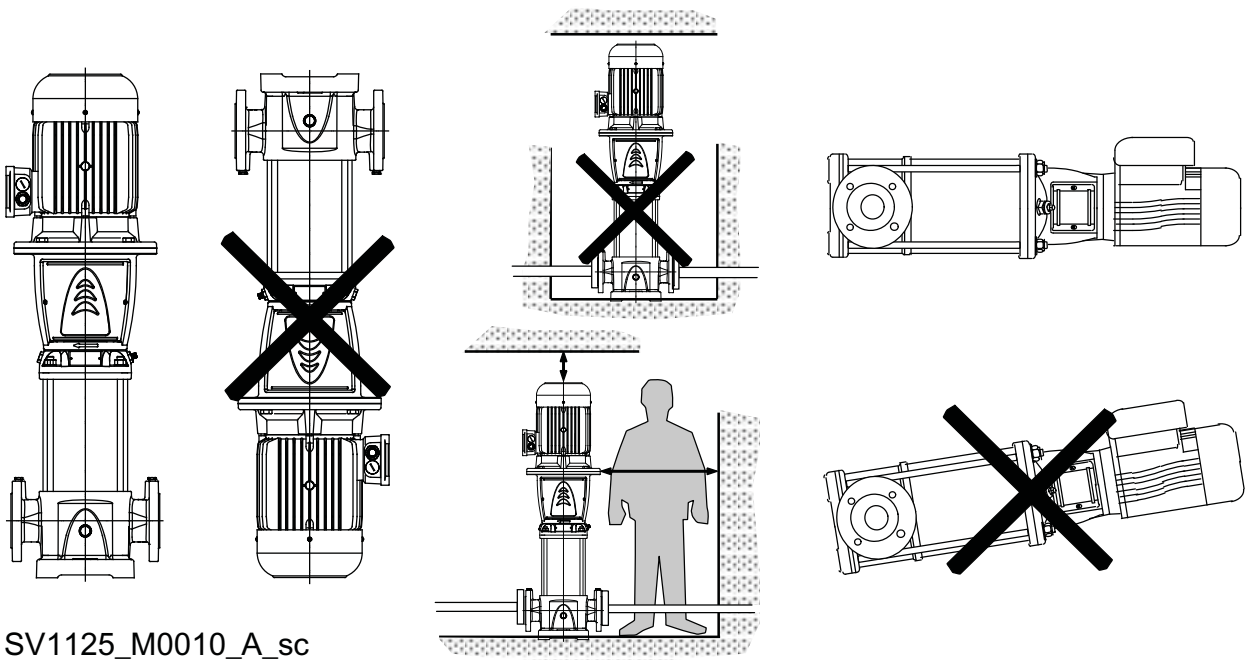
10.

P2 (kW)	dB ± 2							
	50 Hz 2900 min <sup>-1</sup>		50 Hz 1450 min <sup>-1</sup>		60 Hz 3500 min <sup>-1</sup>		60 Hz 1750 min <sup>-1</sup>	
	IEC	LpA*	IEC	LpA*	IEC	LpA*	IEC	LpA*
0,25	-	<70	71	<70	-	-	71	<70
0,37	71R	<70	71	<70	-	-	71	<70
0,55	71	<70	80	<70	71	<70	80	<70
0,75	80R	<70	80	<70	80R	<70	80	<70
1,00	80	<70	90	<70	80	<70	90	<70
1,50	90R	<70	90	<70	90R	<70	90	<70
2,20	90R	<70	100	<70	90R	70	100	<70
3,00	100R	<70	100	<70	100R	70	100	<70
4,00	112R	<70	112	<70	112R	71	112	<70

P2 (kW)	dB ± 2							
5,50	132R	<70	132	<70	132R	73	132	<70
7,50	132R	<70	132	<70	132R	73	132	<70
11,00	160R	73	-	-	160R	79	160	<70
15,00	160	75	-	-	160	80	160	<70
18,50	160	75	-	-	160	80	-	-
22,00	180R	75	-	-	180R	80	-	-
30,00	200	74	-	-	200	78	-	-
37,00	200	74	-	-	200	78	-	-
45,00	225	78	-	-	225	83	-	-
55,00	250	84	-	-	250	89	-	-

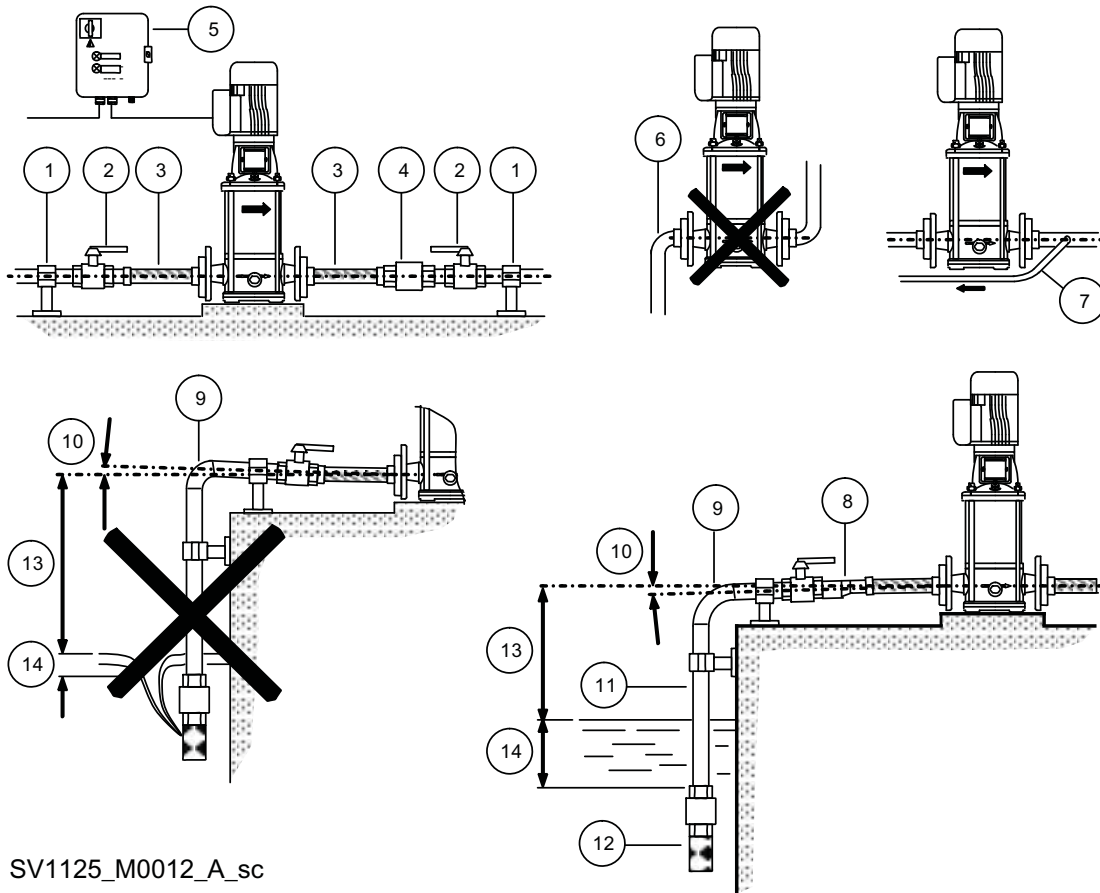
Sound pressure level measured in a free field at 1 m distance from the electric pump.

11.



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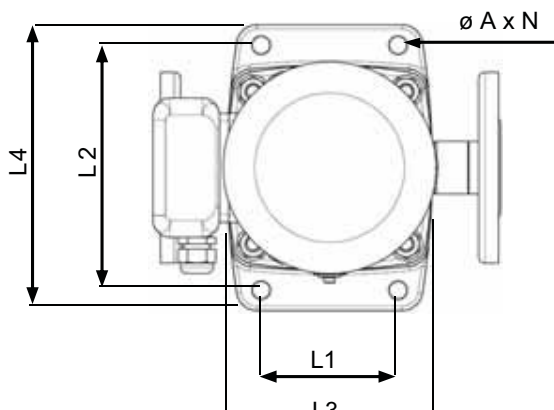
12.



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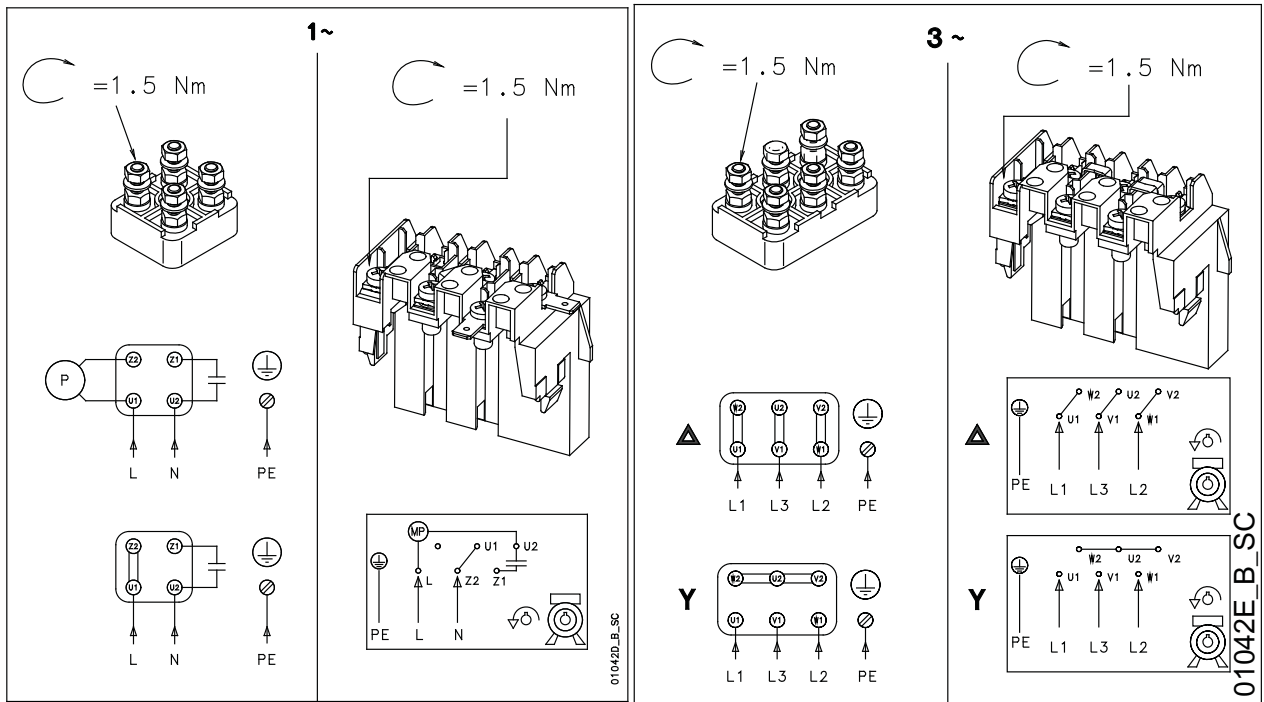
- 1. Piping support
- 2. On-off valve
- 3. Flexible pipe or joint
- 4. Check valve
- 5. Control panel
- 5. Do not install elbows close to the pump
- 7. Bypass circuit
- 3. Eccentric reducer
- 7. Use wide bends
- 10. Positive gradient
- 11. Piping with equal or greater diameter than the suction port
- 12. Use foot valve
- 13. Do not exceed maximum height difference
- 14. Ensure adequate submersion depth

13.

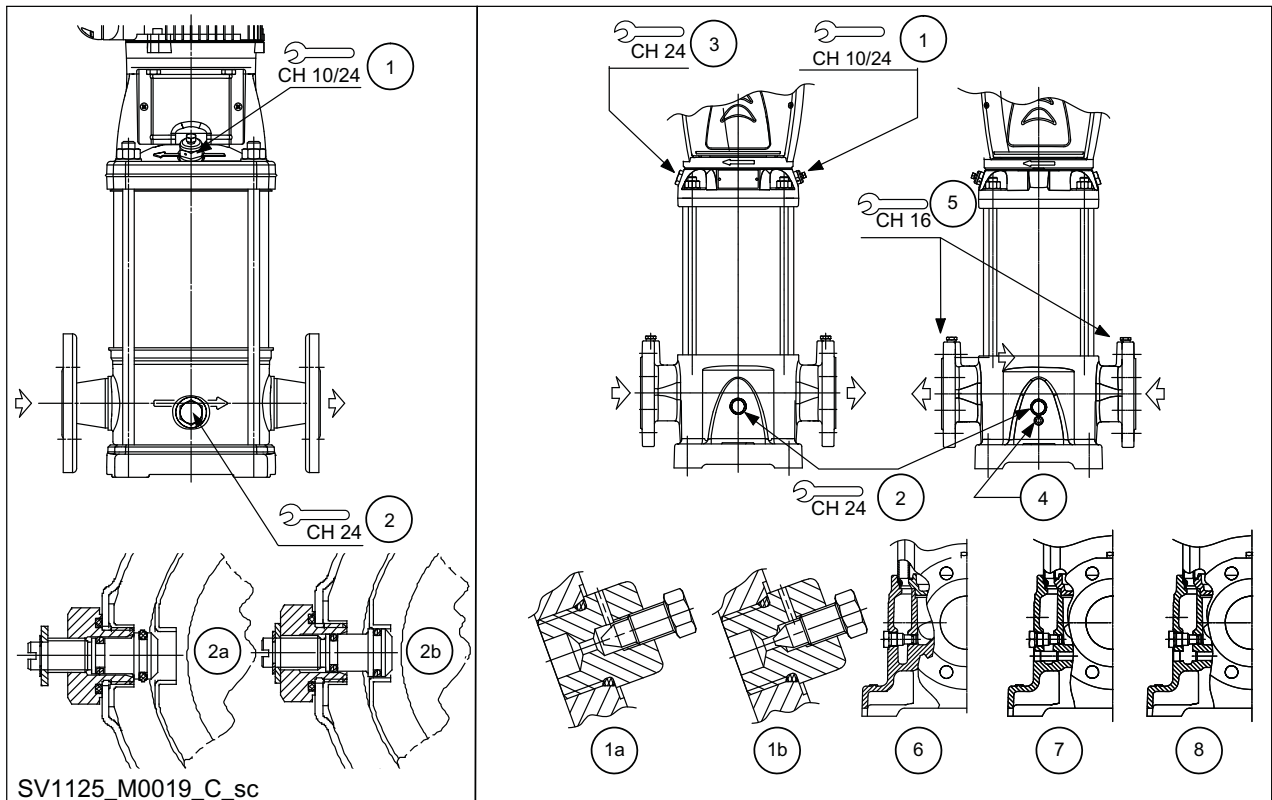


	1, 3, 5SV	10, 15, 22SV	33SV	46, 66, 92SV	125SV
	[mm]				
L1	100	130	170	190	275
L2	180	215	240	265	380
L3	150	185	220	240	330
L4	210	245	290	315	450
ØA	13		15		19
N	4				

14.



15.

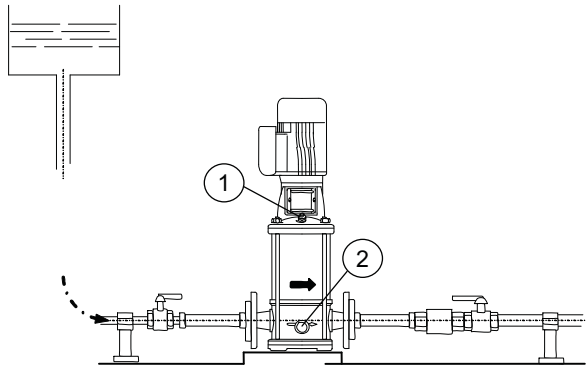


1. Fill and vent plug (a: vent open, b: vent closed)
  - 1, 3, 5, 10, 15, 22 SV: G 3/8
  - 33, 46, 66, 92, 125 SV: G 1/2
2. Drain plug (a: central pin open, b: central pin closed)
  - 1, 3, 5, 10, 15 22 SV: G 3/8
  - 33, 46, 66, 92, 125 SV: G 1/2

3. Fill plug
  - 10, 15, 22 SV: G 3/8
  - 33, 46, 66, 92, 125 SV: G 1/2
4. Plug for drum, if present (do not unscrew)
5. Gauge connection plug, only 33, 46, 66, 92, 125 SV: G 3/8
6. Version without plug and drum, only 33, 46, 66, 92, 125 SV
7. Version with plug but no drum (do not unscrew), only 33, 46, 66, 92, 125 SV

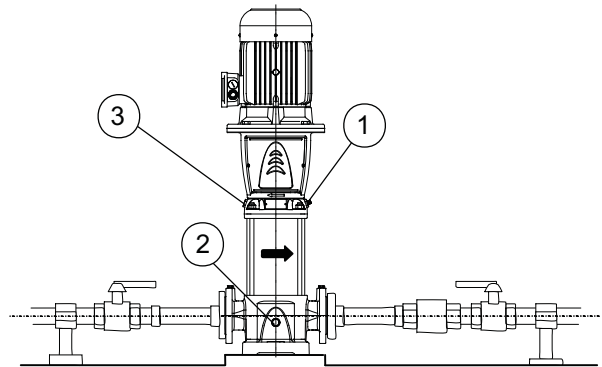
16.

1, 3, 5SV



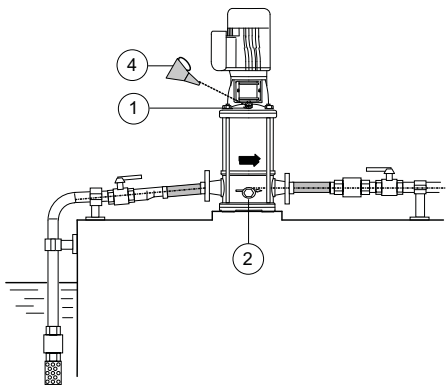
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10, 15, 22, 33, 46, 66, 92, 125SV

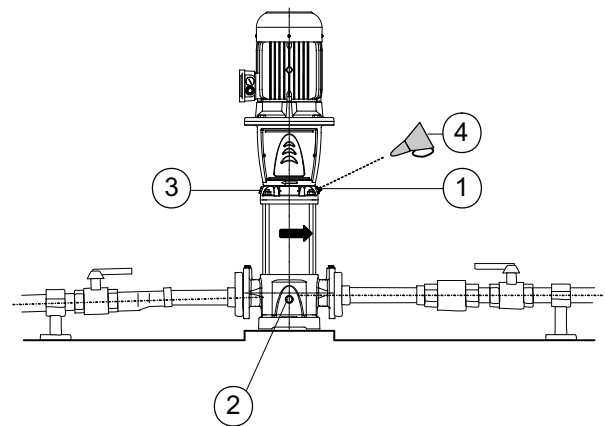


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17.



SV1125\_M0015\_A\_sc



SV1125\_M0015\_A\_sc

- 1. Fill and vent plug
- 2. Drain plug
- 3. Fill plug
- 4. Funnel

**18.**

	A		B		C		D		E		F		G		H		I	
	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm	Ø	Nm
1SV	M8	20	M12	25	-	-	-	-	-	-	G3/8	25	-	-	M12	50	M10	30
3SV																		
5SV															M16	100		
10SV	M10	35	M14	30			M8	25									M12	50
15SV																		
22SV																		
33SV	M12	55	M16	60	M6	8	M10	35	G1/2	40	G1/2	40	R3/8	40	M16	100	-	-
46SV																		
66SV-PN16																		
66SV-PN25															M20	200		
92SV-PN16															M16	100		
92SV-PN25															M20	200		
125SV-PN16															M16	100		
125SV-PN25															M24	350		

A Impeller locking screws

B Tie rod nuts

C Drum (33, 46, 66, 92, 125 SV) and diffuser bushings (125 SV) locking plate screws

D Mechanical seal housing (33, 46, 66, 92, 125 SV) and diffuser (125 SV) locking screws

E Fill and vent plug

F Fill or drain plugs


G Gauge connection plugs  
Ø Diameter

H Round counter flange screws  
Nm Driving torque


I Oval counter flange screws

Ø Diameter

**19.**

A		71	80	90	100	112	132	160	180	200	225	250
B	Ø	M6			M8			M12	M16			
	Nm	6			15			50	75			
CH		10			13			19	24			

**20.**

	1, 3, 5, 10, 15, 22 SV						1, 3, 5 SV			10, 15, 22 SV								33, 46, 66, 92, 125 SV							
A	71	80	90	100	112	132	132	160	90	100	112	132	160	180	200	225	250								
C	Ø	M6				M8		M8	M10	M10				M12											
	Nm	15				25		25	50	50				75											
CH		5			6		6	8	8				10												

A Motor size

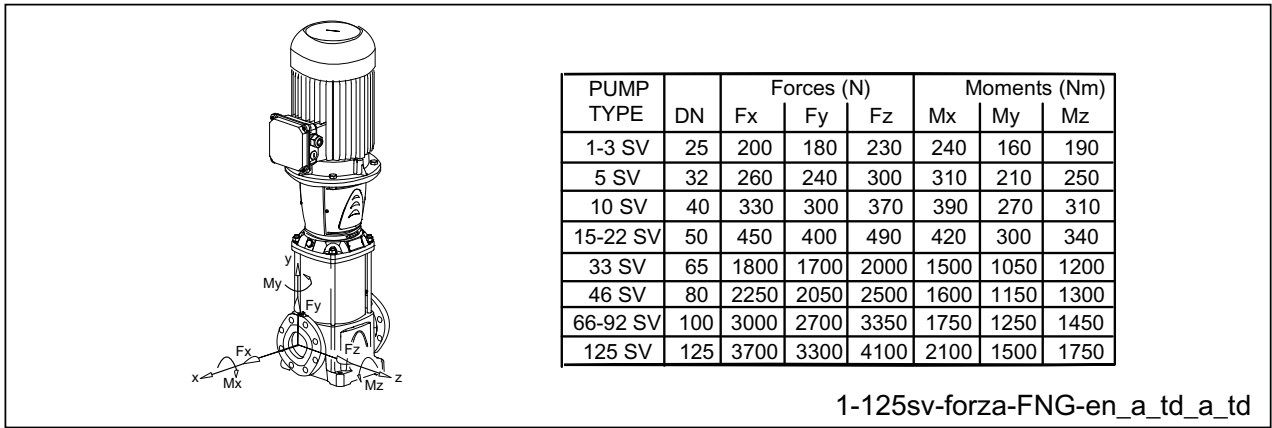
B Adapter/motor screw

C Coupling screw

Ø Diameter



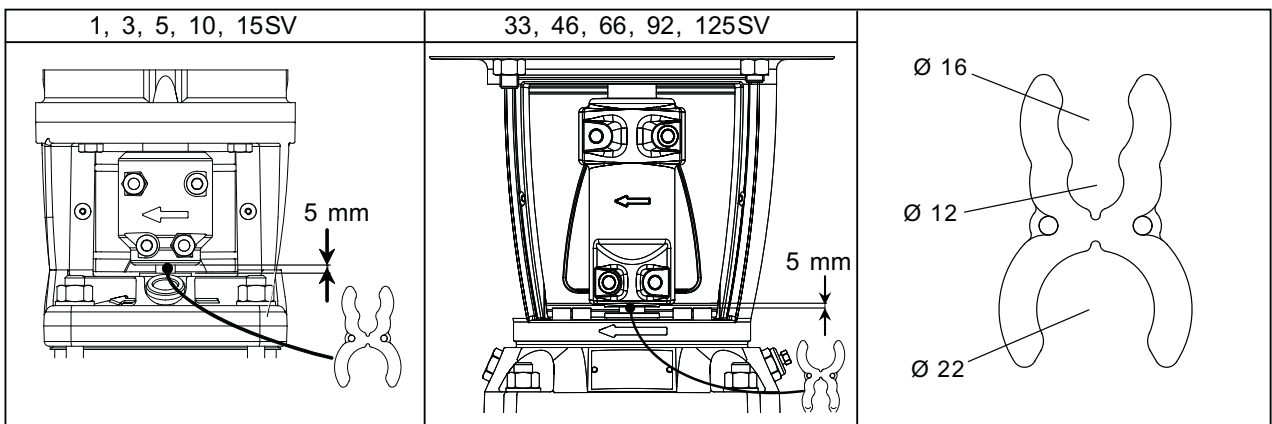
21.



PUMP TYPE	DN	Forces (N)			Moments (Nm)		
		F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
1-3 SV	25	200	180	230	240	160	190
5 SV	32	260	240	300	310	210	250
10 SV	40	330	300	370	390	270	310
15-22 SV	50	450	400	490	420	300	340
33 SV	65	1800	1700	2000	1500	1050	1200
46 SV	80	2250	2050	2500	1600	1150	1300
66-92 SV	100	3000	2700	3350	1750	1250	1450
125 SV	125	3700	3300	4100	2100	1500	1750

1-125sv-forza-FNG-en\_a\_td\_a\_td

22.



1, 3, 5, 10, 15SV

33, 46, 66, 92, 125SV

5 mm

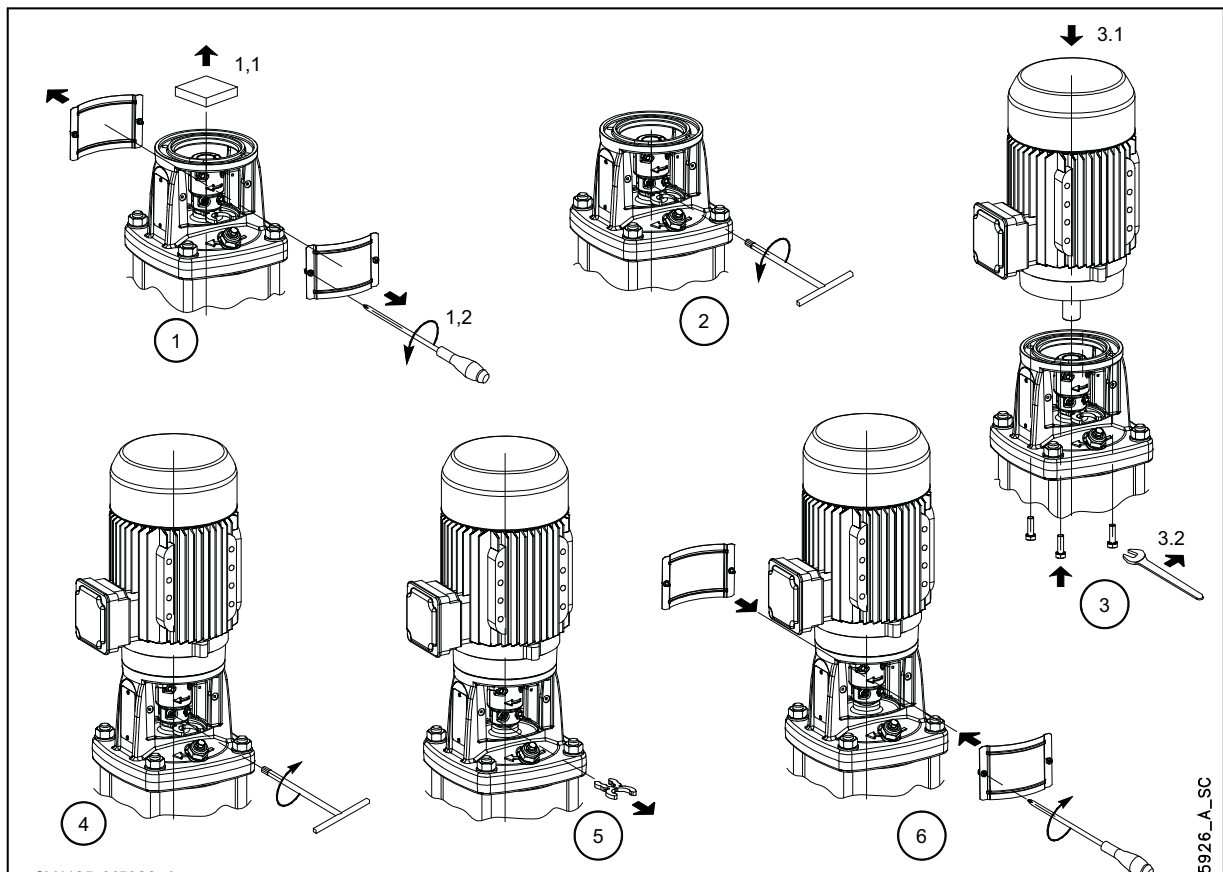
5 mm

Ø 16

Ø 12

Ø 22

23.



1,1

1,2

2

3,1

3,2

3

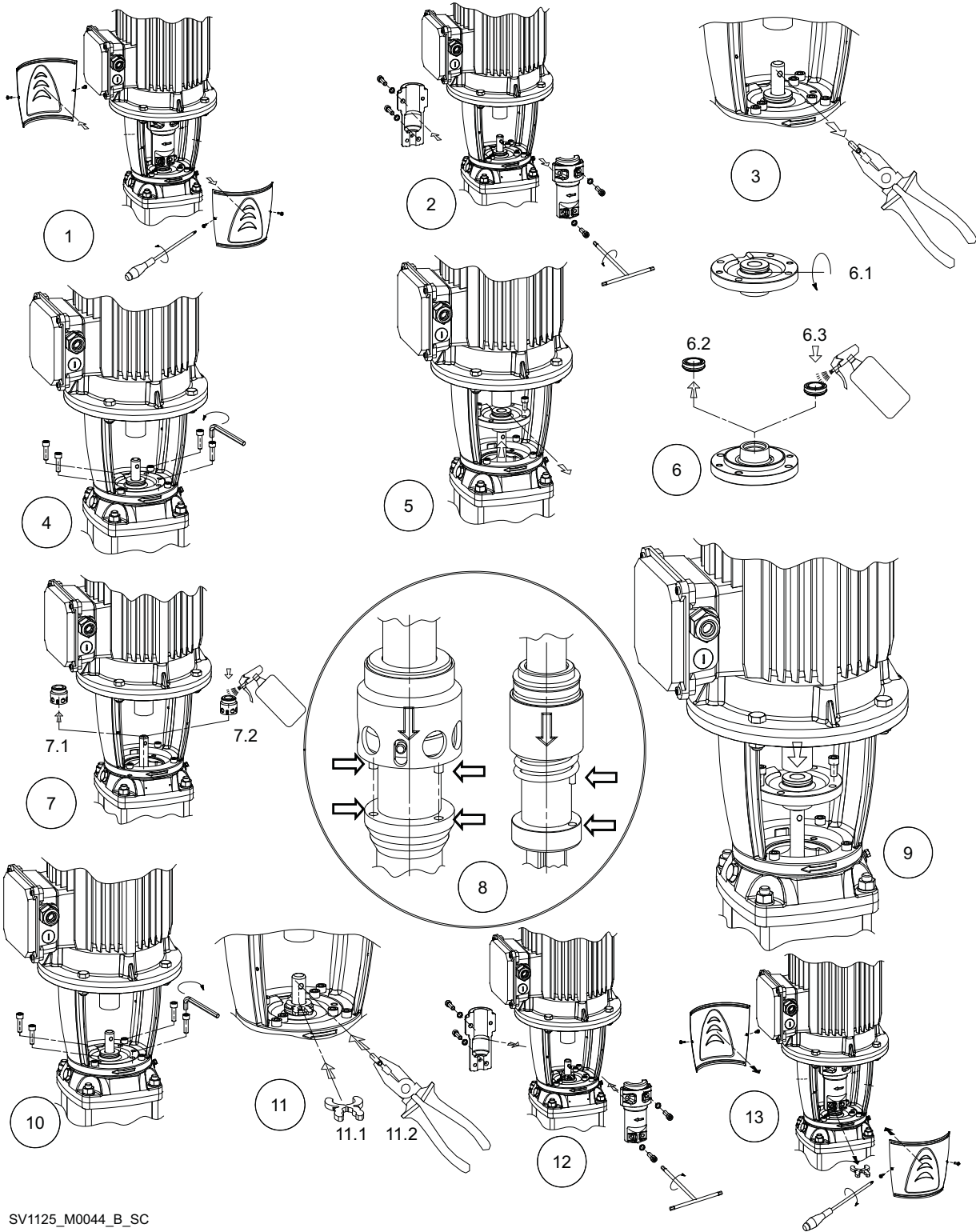
4

5

6

5926\_A\_SC

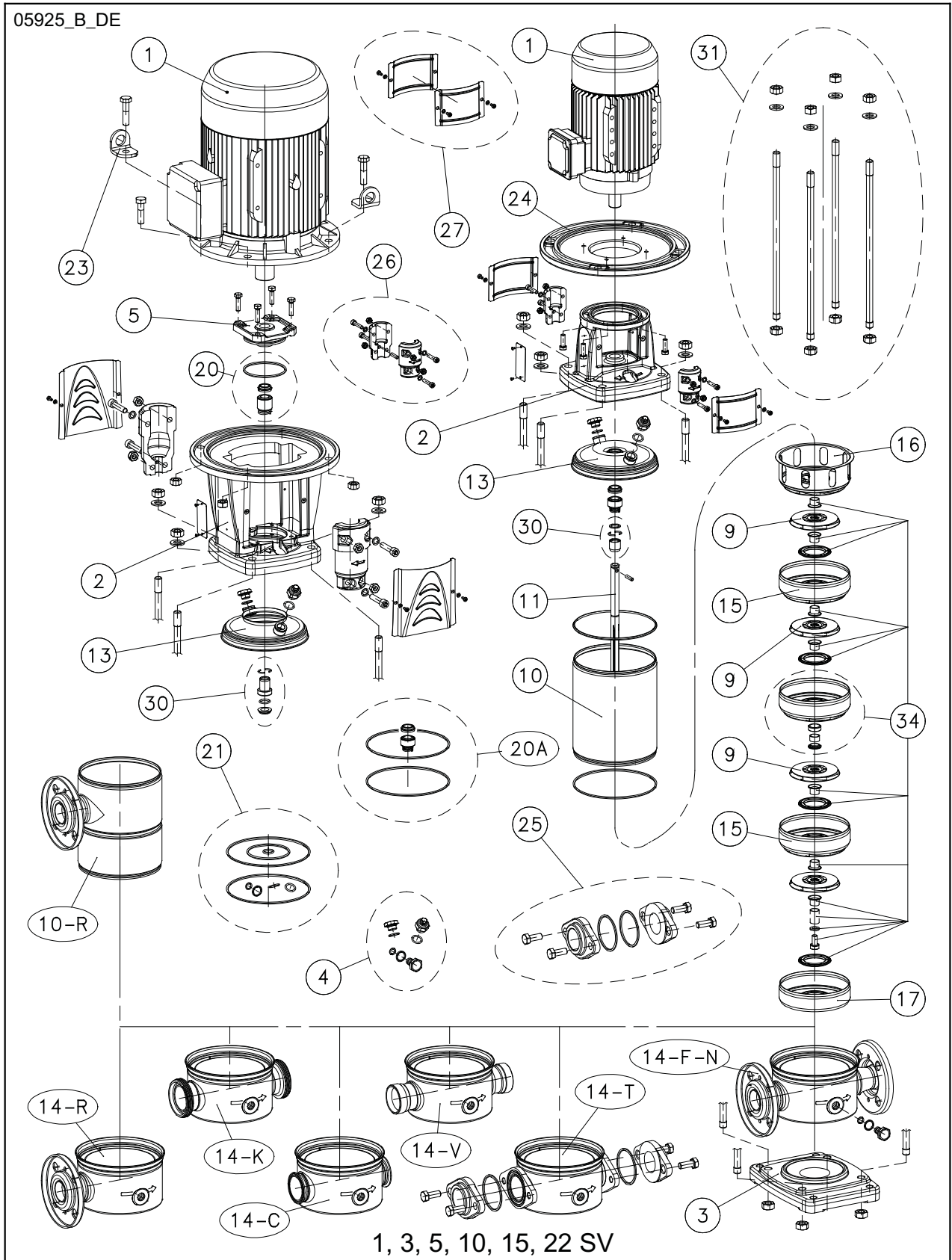
24.



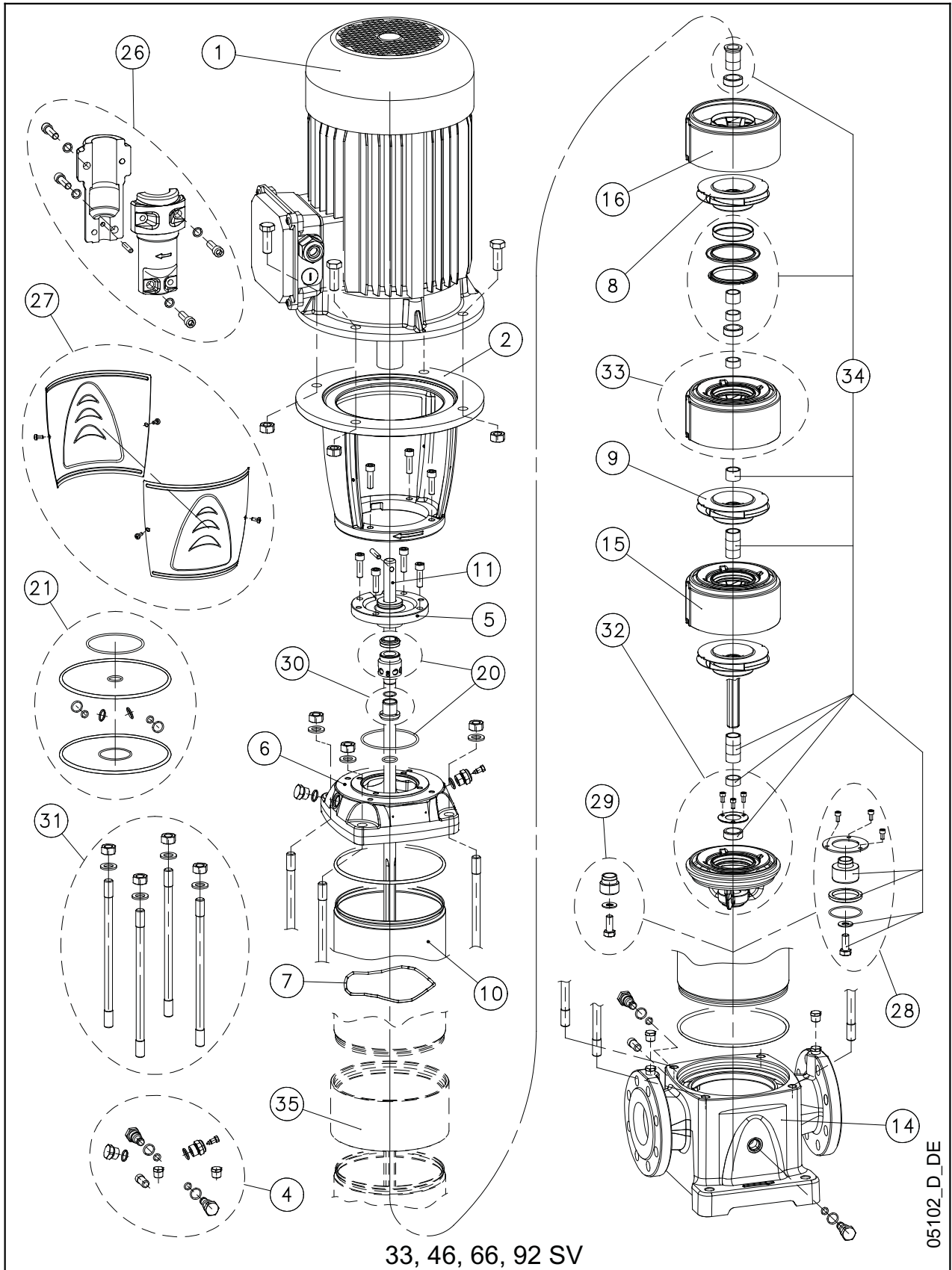
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25.

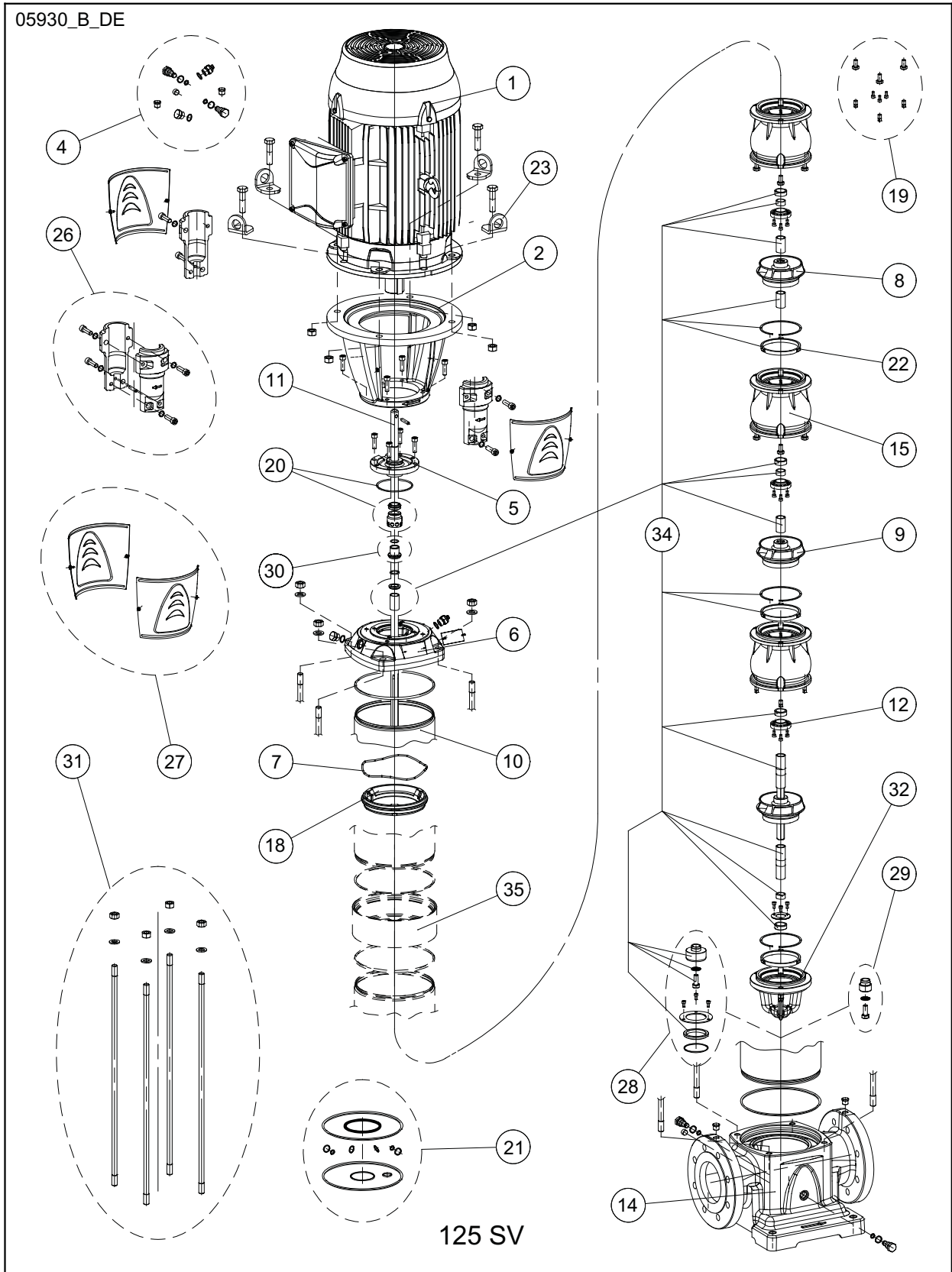
05925\_B\_DE



26.



05930\_B\_DE



125 SV

- |                           |   |                                     |  |                                |
|---------------------------|---|-------------------------------------|--|--------------------------------|
| 1. Motor                  | 9. Impeller (full diameter)               | 16. Last stage diffuser kit         | 24. Flange for motor                             | 30. Mechanical seal bush kit   |
| 2. Adapter                | 10. Sleeve                                | 17. First stage box                 | 25. Oval counterflange & O-ring kit (for T type) | 31. Tie rods kit               |
| 3. Base                   | 11. Shaft                                 | 18. Adapter ring                    | 26. Pair of half couplings kit                   | 32. Lower support and bush kit |
| 4. Plug & o-ring kit      | 12. Bush locking cover                    | 19. Diffuser bolts kit              | 27. Coupling guards                              | 33. Diffuser and bush kit      |
| 5. Seal Housing Plate     | 13. Upper pressed holder with connections | 20. Mechanical seal                 | 28. Thrust drum and impeller stack locking kit   | 34. Wear parts kit             |
| 6. Upper Head             | 14. Pump body F, N, R, K C V T type       | 21. O-ring kit                      |  | 35. Ring for sleeve            |
| 7. Diffusers stack spring |   | 22. Diffuser wear ring support ring |  |                                |

28.

T				T			
50 Hz 2900 min-1				50 Hz 2900 min-1			
1~	H (m)*	3~	H (m)*	1~	H (m)*	3~	H (m)*
1SV02F003M	12,2	1SV02F003T	12,2	5SV13F022M	98,3	5SV13F022T	98,3
1SV03F003M	18	1SV03F003T	18	5SV14F022M	105,7	5SV14F022T	105,7
1SV04F003M	23,7	1SV04F003T	23,7	5SV15F022M	113,1	5SV15F022T	113,1
1SV05F003M	29,3	1SV05F003T	29,3	5SV16F022M	120,5	5SV16F022T	120,5
1SV06F003M	34,8	1SV06F003T	34,8	-	-	5SV18F030T	135,8
1SV07F003M	40,2	1SV07F003T	40,2	-	-	5SV21F030T	157,9
1SV08F005M	48,1	1SV08F005T	48,1	-	-	5SV23F040T	174,4
1SV09F005M	53,7	1SV09F005T	53,7	-	-	5SV25F040T	189,2
1SV10F005M	59,4	1SV10F005T	59,4	-	-	5SV28F040T	211,5
1SV11F005M	65,1	1SV11F005T	65,1	-	-	5SV30F055T	227
1SV12F007M	73,3	1SV12F007T	73,3	-	-	5SV33F055T	249,2
1SV13F007M	79,2	1SV13F007T	79,2	10SV01F007M	11,8	10SV01F007T	11,8
1SV15F007M	90,9	1SV15F007T	90,9	10SV02F007M	23,6	10SV02F007T	23,6
1SV17F011M	105,2	1SV17F011T	105,2	10SV03F011M	35,7	10SV03F011T	35,7
1SV19F011M	117	1SV19F011T	117	10SV04F015M	47,7	10SV04F015T	47,7
1SV22F011M	134,6	1SV22F011T	134,6	10SV05F022M	60	10SV05F022T	60
1SV25F015M	152,6	1SV25F015T	152,6	10SV06F022M	71,	10SV06F022T	71,8
1SV27F015M	164,3	1SV27F015T	164,3	-	-	10SV07F030T	83,6

T				T			
50 Hz 2900 min-1				50 Hz 2900 min-1			
1~	H (m)*	3~	H (m)*	1~	H (m)*	3~	H (m)*
1SV30F015M	181,7	1SV30F015T	181,7	-	-	10SV08F030T	95,3
1SV32F022M	197,2	1SV32F022T	197,2	-	-	10SV09F040T	106,3
1SV34F022M	209,2	1SV34F022T	209,2	-	-	10SV10F040T	118
1SV37F022M	225,9	1SV37F022T	225,9	-	-	10SV11F040T	129,6
3SV02F003M	14,9	3SV02F003T	14,9	-	-	10SV13F055T	156
3SV03F003M	22	3SV03F003T	22	-	-	10SV15F055T	179,5
3SV04F003M	28,9	3SV04F003T	28,9	-	-	10SV17F075T	205
3SV05F005M	37,2	3SV05F005T	37,2	-	-	10SV18F075T	216,9
3SV06F005M	44,4	3SV06F005T	44,4	-	-	10SV20F075T	240,6
3SV07F007M	52,5	3SV07F007T	52,5	-	-	10SV21F110T	253,6
3SV08F007M	60	3SV08F007T	60	15SV01F011M	14	15SV01F011T	14
3SV09F011M	67,7	3SV09F011T	67,7	15SV02F022M	28,7	15SV02F022T	28,7
3SV10F011M	75	3SV10F011T	75	-	-	15SV03F030T	43,3
3SV11F011M	82,3	3SV11F011T	82,3	-	-	15SV04F040T	58,4
3SV12F011M	89,6	3SV12F011T	89,6	-	-	15SV05F040T	72,7
3SV13F015M	98,1	3SV13F015T	98,1	-	-	15SV06F055T	87,6
3SV14F015M	105,6	3SV14F015T	105,6	-	-	15SV07F055T	101,9
3SV16F015M	119,9	3SV16F015T	119,9	-	-	15SV08F075T	117,4
3SV19F022M	144,3	3SV19F022T	144,3	-	-	15SV09F075T	131,9
3SV21F022M	159,3	3SV21F022T	159,3	-	-	15SV10F110T	147,7
3SV23F022M	174	3SV23F022T	174	-	-	15SV11F110T	162,3
3SV25F022M	188,5	3SV25F022T	188,5	-	-	15SV13F110T	191,3
-	-	3SV27F030T	204,4	-	-	15SV15F150T	222,1
-	-	3SV29F030T	219,3	-	-	15SV17F150T	251,6
-	-	3SV31F030T	233,8	22SV01F011M	14,7	22SV01F011T	14,7
-	-	3SV33F030T	248,5	22SV02F022M	30,4	22SV02F022T	30,4
5SV02F003M	14,8	5SV02F003T	14,8	-	-	22SV03F030T	45,4
5SV03F005M	21,8	5SV03F005T	21,8	-	-	22SV04F040T	60,9
5SV04F005M	30	5SV04F005T	30	-	-	22SV05F055T	76
5SV05F007M	38	5SV05F007T	38	-	-	22SV06F075T	93,2
5SV06F011M	45,3	5SV06F011T	45,3	-	-	22SV07F075T	108,5
5SV07F011M	52,7	5SV07F011T	52,7	-	-	22SV08F110T	124,6
5SV08F011M	60,1	5SV08F011T	60,1	-	-	22SV09F110T	140,1
5SV09F015M	68	5SV09F015T	68	-	-	22SV10F110T	155,4
5SV10F015M	75,5	5SV10F015T	75,5	-	-	22SV12F150T	186,1
5SV11F015M	82,8	5SV11F015T	82,8	-	-	22SV14F150T	216,6
5SV12F022M	90,8	5SV12F022T	90,8	-	-	22SV17F185T	263,5

T				T			
50 Hz 2900 min-1				50 Hz 1,450 min-1			
3~	H (m)*	3~	H (m)*	3~	H (m)*	3~	H (m)*
33SV1/1AG022T	17,4	46SV9/2AG300T	224,8	1SV02F0024T	3,1	22SV14F0224T	53,9
33SV1G030T	23,8	46SV9G370T	240,9	1SV05F0024T	7,7	22SV17F0304T	65,3
33SV2/2AG040T	35,1	46SV10/2AG370T	252,7	1SV08F0024T	12,2	33SV3/2AG0114T	14,4
33SV2/1AG040T	40,8	46SV10G370T	267,6	1SV11F0024T	16,7	33SV4/1AG0114T	21,8
33SV2G055T	47,8	46SV11/2AG450T	280,4	1SV15F0024T	22,6	33SV5G0154T	29,4
33SV3/2AG055T	57,7	46SV11G450T	295,5	1SV19F0024T	28,8	33SV6G0224T	35,9
33SV3/1AG075T	64,5	46SV12/2AG450T	307,3	1SV22F0024T	33,2	33SV7G0224T	41,6
33SV3G075T	71,5	46SV12G450T	321,8	1SV27F0024T	40,1	33SV8G0304T	47,9
33SV4/2AG075T	82	46SV13/2AG450T	332,5	1SV30F0024T	44,4	33SV9G0304T	53,3
33SV4/1AG110T	88,9	66SV1/1AG040T	23,8	1SV34F0024T	50	33SV10G0304T	59
33SV4G110T	95,9	66SV1G055T	29,2	1SV37F0024T	54,2	33SV11G0404T	65,7
33SV5/2AG110T	106	66SV2/2AG075T	47,5	3SV02F0024T	3,8	33SV12G0404T	71,5
33SV5/1AG110T	112,7	66SV2/1AG110T	54,2	3SV05F0024T	9,5	33SV13G0404T	77,2
33SV5G150T	120,4	66SV2G110T	60,4	3SV08F0024T	15,1	46SV2G0114T	13
33SV6/2AG150T	131,2	66SV3/2AG150T	78,4	3SV11F0024T	20,6	46SV3G0154T	19,8
33SV6/1AG150T	139,1	66SV3/1AG150T	84,7	3SV14F0024T	26,1	46SV4G0224T	26,3
33SV6G150T	145,6	66SV3G185T	91,4	3SV19F0024T	33,3	46SV5G0224T	32,6
33SV7/2AG150T	156	66SV4/2AG185T	108,9	3SV23F0024T	42,2	46SV6G0304T	39,3
33SV7/1AG185T	163,3	66SV4/1AG220T	115,2	3SV27F0034T	49,7	46SV7G0304T	45,5
33SV7G185T	170,3	66SV4G220T	121,6	3SV33F0034T	60,2	46SV8G0404T	52,5
33SV8/2AG185T	180,6	66SV5/2AG300T	139,1	5SV03F0024T	5,7	46SV9G0404T	58,9
33SV8/1AG185T	187,4	66SV5/1AG300T	145,6	5SV06F0024T	11,3	46SV10G0554T	66,2
33SV8G220T	194,1	66SV5G300T	152	5SV09F0024T	16,8	46SV11G0554T	72,6
33SV9/2AG220T	202,1	66SV6/2AG300T	169,5	5SV12F0024T	22,2	46SV12G0554T	78,9
33SV9/1AG220T	210,2	66SV6/1AG300T	176	5SV15F0034T	27,5	66SV1G0114T	7,3

T				T			
50 Hz 2900 min-1				50 Hz 1,450 min-1			
3~	H (m)*	3~	H (m)*	3~	H (m)*	3~	H (m)*
33SV9G220T	216,8	66SV6G370T	182,4	5SV18F0034T	33,1	66SV2G0154T	14,8
33SV10/2AG220T	226,4	66SV7/2AG370T	199,9	5SV21F0034T	38,4	66SV3G0224T	22,3
33SV10/1AG300T	234,5	66SV7/1AG370T	206,4	5SV25F0054T	45,3	66SV4G0304T	29,7
33SV10G300T	241,8	66SV7G450T	212,8	5SV28F0054T	51,7	66SV5G0404T	37,5
33SV11/2AG300T	252	66SV8/2AG450T	230,3	5SV33F0074T	60,5	66SV6G0404T	44,7
33SV11/1AG300T	259	66SV8/1AG450T	236,8	10SV03F0054T	9	66SV7G0554T	52,8
33SV11G300T	265,7	66SV8G450T	243,2	10SV04F0054T	12	66SV8G0554T	60,1
33SV12/2AG300T	275,9	92SV1/1AG055T	24,5	10SV06F0054T	17,9	92SV1G0114T	8,3
33SV12/1AG300T	282,8	92SV1G075T	33,5	10SV08F0054T	23,6	92SV2G0224T	16,3
33SV12G300T	289,8	92SV2/2AG110T	49,4	10SV10F0054T	28,9	92SV3G0304T	24,4
33SV13/2AG300T	300,5	92SV2G150T	67,8	10SV13F0074T	37,9	92SV4G0404T	32,9
33SV13/1AG300T	306,9	92SV3/2AG185T	82,4	10SV15F0074T	44,1	92SV5G0554T	41,6
46SV1/1AG030T	19,5	92SV3G220T	102,2	10SV17F0114T	49,6	92SV6G0554T	49,5
46SV1G040T	27,2	92SV4/2AG300T	115,7	10SV19F0114T	55,2	92SV7G0754T	58
46SV2/2AG055T	38,8	92SV4G300T	133,1	10SV21F0114T	62,8	92SV8G0754T	65,9
46SV2G075T	52,6	92SV5/2AG370T	149	15SV03F0054T	10,7	125SV1G0114T	6,9
46SV3/2AG110T	64,7	92SV5G370T	166,4	15SV05F0054T	17,8	125SV2G0224T	13,5
46SV3G110T	80,8	92SV6/2AG450T	183,3	15SV07F0074T	24,6	125SV3/3BG0224T	17,5
46SV4/2AG150T	92,4	92SV6G450T	200,9	15SV09F0114T	32,8	125SV4/4BG030T	23,3
46SV4G150T	107,3	92SV7/2AG450T	216,8	15SV11F0114T	40,1	125SV5/5AG040T	31,4
46SV5/2AG185T	117,2	125SV1G075T	27,6	15SV13F0154T	47,6	125SV6G055T	40,4
46SV5G185T	134,5	125SV2G150T	53,8	15SV15F0154T	54,8	125SV7G075T	47,1
46SV6/2AG220T	143,7	125SV3G220T	80,7	15SV17F0224T	62,5	125SV8G075T	53,8
46SV6G220T	161	125SV4G300T	107,6	22SV04F0054T	14,9		
46SV7/2AG300T	171,3	125SV5G370T	134,5	22SV06F0114T	22,6		
46SV7G300T	188,6	125SV6G450T	161,4	22SV08F0114T	30,8		
46SV8/2AG300T	198,2	125SV7G550T	188,3	22SV10F0154T	38,6		
46SV8G300T	213,1	125SV8/2AG550T	211,5	22SV12F0224T	46		

T				T			
60 Hz 3500 min-1				60 Hz 3500 min-1			
1~	H (m)*	3~	H (m)*	1~	H (m)*	3~	H (m)*
1SV02F0036M	17,4	1SV02F0036T	17,4	-	-	5SV10F0306T	109,2
1SV03F0036M	25,7	1SV03F0036T	25,7	-	-	5SV11F0306T	119,9
1SV04F0036M	33,9	1SV04F0036T	33,9	-	-	5SV12F0306T	130,6
1SV05F0056M	43,6	1SV05F0056T	43,6	-	-	5SV13F0406T	142,5
1SV06F0056M	52,1	1SV06F0056T	52,1	-	-	5SV14F0406T	153,4
1SV07F0076M	61	1SV07F0076T	61	-	-	5SV15F0406T	164,2
1SV08F0076M	69,4	1SV08F0076T	69,4	-	-	5SV16F0406T	174,9
1SV09F0076M	77,9	1SV09F0076T	77,9	-	-	5SV17F0556T	186,4
1SV10F0116M	87,6	1SV10F0116T	87,6	-	-	5SV19F0556T	208
1SV11F0116M	96,2	1SV11F0116T	96,2	-	-	5SV21F0556T	229,6
1SV12F0116M	104,7	1SV12F0116T	104,7	-	-	5SV23F0556T	251
1SV13F0116M	113,2	1SV13F0116T	113,2	10SV01F0076M	17	10SV01F0076T	17
1SV15F0156M	131,2	1SV15F0156T	131,2	10SV02F0156M	34,2	10SV02F0156T	34,2
1SV17F0156M	148,3	1SV17F0156T	148,3	10SV03F0226M	51,8	10SV03F0226T	51,8
1SV18F0226M	158,4	1SV18F0226T	158,4	-	-	10SV04F0306T	69,2
1SV20F0226M	175,7	1SV20F0226T	175,7	-	-	10SV05F0406T	87,3
1SV22F0226M	192,9	1SV22F0226T	192,9	-	-	10SV06F0406T	104,5
1SV24F0226M	210,1	1SV24F0226T	210,1	-	-	10SV07F0556T	122,1
1SV26F0226M	227,3	1SV26F0226T	227,3	-	-	10SV08F0556T	139,2
1SV28F0306M	245,4	1SV28F0306T	245,4	-	-	10SV09F0756T	157,4
3SV02F0036M	21,3	3SV02F0036T	21,3	-	-	10SV10F0756T	174,7
3SV03F0056M	32,6	3SV03F0056T	32,6	-	-	10SV11F0756T	192
3SV04F0076M	43,4	3SV04F0076T	43,4	-	-	10SV13F1106T	226,7
3SV05F0116M	54,7	3SV05F0116T	54,7	-	-	10SV15F1106T	261,2
3SV06F0116M	65,4	3SV06F0116T	65,4	15SV01F0156M	19,9	15SV01F0156T	19,9
3SV07F0116M	76,1	3SV07F0116T	76,1	-	-	15SV02F0306T	41,9
3SV08F0156M	87,2	3SV08F0156T	87,2	-	-	15SV03F0406T	63
3SV09F0156M	97,8	3SV09F0156T	97,8	-	-	15SV04F0556T	83,9
3SV10F0226M	109,5	3SV10F0226T	109,5	-	-	15SV05F0756T	105,4
3SV11F0226M	120,3	3SV11F0226T	120,3	-	-	15SV06F1106T	126,7
3SV12F0226M	131	3SV12F0226T	131	-	-	15SV07F1106T	147,6
3SV13F0226M	141,8	3SV13F0226T	141,8	-	-	15SV08F1506T	171,9
3SV14F0226M	152,5	3SV14F0226T	152,5	-	-	15SV09F1506T	193,2
-	-	3SV15F0306T	164,4	-	-	15SV10F1506T	214,4



T				T			
60 Hz 3500 min-1				60 Hz 3500 min-1			
~	H (m)*	3~	H (m)*	1~	H (m)*	3~	H (m)*
-	-	3SV17F0306T	185,9	-	-	15SV11F1856T	236,4
-	-	3SV19F0306T	207,3	-	-	15SV12F1856T	257,8
-	-	3SV21F0406T	230,9	22SV01F0226M	22,2	22SV01F0226T	22,2
-	-	3SV23F0406T	252,5	-	-	22SV02F0406T	44,5
5SV02F0056M	21,9	5SV02F0056T	21,9	-	-	22SV03F0556T	66,7
5SV03F0076M	32,7	5SV03F0076T	32,7	-	-	22SV04F0756T	89
5SV04F0116M	43,9	5SV04F0116T	43,9	-	-	22SV05F1106T	111,5
5SV05F0156M	55	5SV05F0156T	55	-	-	22SV06F1106T	133,5
5SV06F0156M	65,9	5SV06F0156T	65,9	-	-	22SV07F1506T	156,4
5SV07F0226M	76,5	5SV07F0226T	76,5	-	-	22SV08F1506T	178,6
5SV08F0226M	87,2	5SV08F0226T	87,2	-	-	22SV09F1856T	201,3
5SV09F0226M	97,8	5SV09F0226T	97,8	-	-	22SV10F1856T	223,5

T				T			
60 Hz 3500 min-1				60 Hz 3500 min-1			
3~	H (m)*	3~	H (m)*	3~	H (m)*	3~	H (m)*
33SV1/1AG0306T	24,5	33SV7/1AG3006T	233,9	46SV5G3706T	194,6	66SV5/2AG4506T	191,9
33SV1G0556T	34,5	33SV7G3006T	243,3	46SV6/2AG3706T	210,5	66SV5/1AG4506T	202
33SV2/2AG0556T	49,6	33SV8/2AG3706T	259,3	46SV6/1AG3706T	222	66SV5G4506T	212,2
33SV2/1AG0756T	59,6	33SV8/1AG3706T	268,7	46SV6G3706T	233,6	92SV1/1AG1106T	36,4
33SV2G1106T	69,4	33SV8G3706T	278,1	46SV7/2AG4506T	250,3	92SV1G1506T	49,5
33SV3/2AG1106T	86	46SV1/1AG0556T	29,1	46SV7/1AG4506T	261,8	92SV2/2AG1856T	69,9
33SV3/1AG1106T	94,7	46SV1G0756T	39,9	46SV7G4506T	273,4	92SV2/1AG2206T	83,6
33SV3G1506T	104,2	46SV2/2AG1106T	56,7	66SV1/1AG0756T	31,4	92SV2G3006T	97,9
33SV4/2AG1506T	119,8	46SV2/1AG1106T	67,8	66SV1G1106T	43,8	92SV3/2AG3706T	117,4
33SV4/1AG1506T	128,9	46SV2G1506T	78,2	66SV2/2AG1506T	64,5	92SV3/1AG3706T	131,5
33SV4G1856T	138,3	46SV3/2AG1856T	95,5	66SV2/1AG1856T	74,9	92SV3G4506T	144,9
33SV5/2AG1856T	155,8	46SV3/1AG1856T	106,1	66SV2G1856T	85,4	92SV4/2AG4506T	163
33SV5/1AG2206T	163,9	46SV3G1856T	117,2	66SV3/2AG2206T	106,6	125SV1G1506T	40,1
33SV5G2206T	173	46SV4/2AG2206T	134,1	66SV3/1AG3006T	117,4	125SV2/2AG2206T	73
33SV6/2AG2206T	189	46SV4/1AG3006T	144,2	66SV3G3006T	127,8	125SV3/3BG3006T	101,9
33SV6/1AG3006T	199,2	46SV4G3006T	155,7	66SV4/2AG3706T	149,1	125SV3G3706T	117,5
33SV6G3006T	208,5	46SV5/2AG3006T	171,6	66SV4/1AG3706T	159,2	125SV4/4AG4506T	146,1
33SV7/2AG3006T	224,6	46SV5/1AG3006T	183,1	66SV4G3706T	169,3	125SV5/5AG5506T	182,6

T				T			
60 Hz 1,750 min-1				60 Hz 1,750 min-1			
3~	H (m)*	3~	H (m)*	3~	H (m)*	3~	H (m)*
1SV03F00246T	6,6	5SV07F00246T	18,8	22SV04F01146T	22,2	46SV11G11046T	105,7
1SV05F00246T	11	5SV09F00346T	24	22SV05F01546T	27,7	46SV12G11046T	115,3
1SV07F00246T	15,3	5SV11F00346T	29,5	22SV06F01546T	33,3	46SV13G11046T	124,9
1SV09F00246T	19,6	5SV13F00546T	34,7	22SV07F02246T	39,1	66SV1G01546T	10,8
1SV11F00246T	23,9	5SV15F00546T	40,4	22SV08F02246T	44,6	66SV2G03046T	21,1
1SV13F00246T	28,2	5SV17F00546T	45,6	22SV09F02246T	50,1	66SV3G04046T	31,4
1SV15F00246T	32,4	5SV19F00746T	50,8	22SV10F03046T	55,6	66SV4G05546T	42
1SV17F00246T	36,6	5SV21F00746T	56,7	33SV2G01146T	17	66SV5G07546T	52,5
1SV18F00246T	38,7	5SV23F00746T	61,9	33SV3G01546T	25,7	66SV6G07546T	62,7
1SV20F00246T	42,9	10SV03F00546T	13	33SV4G02246T	34	66SV7G11046T	73,2
1SV22F00246T	47	10SV05F00546T	21,6	33SV5G03046T	42,7	66SV8G11046T	83,7
1SV24F00246T	51,1	10SV07F00746T	29,9	33SV6G03046T	51,5	92SV1G01546T	11,8
1SV26F00346T	55,2	10SV09F00746T	38,5	33SV7G04046T	59,9	92SV2G03046T	23,4
1SV28F00346T	60	10SV11F01146T	47,8	33SV8G05546T	69	92SV3G05546T	35,4
3SV02F00246T	5,5	10SV13F01146T	56,2	33SV9G05546T	77,5	92SV4G07546T	47,2
3SV04F00246T	10,9	10SV15F01546T	65,1	33SV10G05546T	85,9	92SV5G07546T	58,5
3SV06F00246T	16,3	15SV03F00546T	15,4	33SV11G07546T	94,9	92SV6G11046T	70,2
3SV08F00246T	21,6	15SV04F00746T	20,6	33SV12G07546T	103,3	92SV7G11046T	81,9
3SV10F00246T	26,8	15SV05F01146T	26,2	33SV13G07546T	111,8	92SV8G15046T	93,6
3SV12F00246T	32	15SV06F01146T	31,3	46SV2G01546T	19	125SV1G02246T	10
3SV14F00346T	37,6	15SV07F01546T	36,7	46SV3G02246T	28,8	125SV2/2AG03046T	18,3
3SV15F00346T	40,4	15SV08F01546T	42,4	46SV4G03046T	37,9	125SV3/3BG04046T	25,5
3SV17F00346T	45,5	15SV09F02246T	48	46SV5G04046T	47,6	125SV4/4AG05546T	36,5
3SV19F00346T	50,7	15SV10F02246T	53,3	46SV6G05546T	57,7	125SV5/5AG07546T	45,6
3SV21F00546T	55,8	15SV11F02246T	58,5	46SV7G05546T	67,1	125SV6G11046T	58,7
3SV23F00546T	61,9	15SV12F02246T	63,8	46SV8G07546T	77	125SV7G11046T	68,5
5SV03F00246T	8,3	22SV02F00546T	11	46SV9G07546T	86,4	125SV8G15046T	78,3
5SV05F00246T	13,7	22SV03F00746T	16,5	46SV10G07546T	95,7		

T				T			
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-	-	3SV19F0306T	207,3	-	-	15SV12F1856T	257,8
-	-	3SV21F0406T	230,9	22SV01F0226M	22,2	22SV01F0226T	22,2
-	-	3SV23F0406T	252,5	-	-	22SV02F0406T	44,5
5SV02F0056M	21,9	5SV02F0056T	21,9	-	-	22SV03F0556T	66,7
5SV03F0076M	32,7	5SV03F0076T	32,7	-	-	22SV04F0756T	89
5SV04F0116M	43,9	5SV04F0116T	43,9	-	-	22SV05F1106T	111,5
5SV05F0156M	55	5SV05F0156T	55	-	-	22SV06F1106T	133,5
5SV06F0156M	65,9	5SV06F0156T	65,9	-	-	22SV07F1506T	156,4
5SV07F0226M	76,5	5SV07F0226T	76,5	-	-	22SV08F1506T	178,6
5SV08F0226M	87,2	5SV08F0226T	87,2	-	-	22SV09F1856T	201,3
5SV09F0226M	97,8	5SV09F0226T	97,8	-	-	22SV10F1856T	223,5

T				T			
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33SV1G0556T	34,5	33SV7G3006T	243,3	46SV6/2AG3706T	210,5	66SV5/1AG4506T	202
33SV2/2AG0556T	49,6	33SV8/2AG3706T	259,3	46SV6/1AG3706T	222	66SV5G4506T	212,2
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33SV2G1106T	69,4	33SV8G3706T	278,1	46SV7/2AG4506T	250,3	92SV1G1506T	49,5
33SV3/2AG1106T	86	46SV1/1AG0556T	29,1	46SV7/1AG4506T	261,8	92SV2/2AG1856T	69,9
33SV3/1AG1106T	94,7	46SV1G0756T	39,9	46SV7G4506T	273,4	92SV2/1AG2206T	83,6
33SV3G1506T	104,2	46SV2/2AG1106T	56,7	66SV1/1AG0756T	31,4	92SV2G3006T	97,9
33SV4/2AG1506T	119,8	46SV2/1AG1106T	67,8	66SV1G1106T	43,8	92SV3/2AG3706T	117,4
33SV4/1AG1506T	128,9	46SV2G1506T	78,2	66SV2/2AG1506T	64,5	92SV3/1AG3706T	131,5
33SV4G1856T	138,3	46SV3/2AG1856T	95,5	66SV2/1AG1856T	74,9	92SV3G4506T	144,9
33SV5/2AG1856T	155,8	46SV3/1AG1856T	106,1	66SV2G1856T	85,4	92SV4/2AG4506T	163
33SV5/1AG2206T	163,9	46SV3G1856T	117,2	66SV3/2AG2206T	106,6	125SV1G1506T	40,1
33SV5G2206T	173	46SV4/2AG2206T	134,1	66SV3/1AG3006T	117,4	125SV2/2AG2206T	73
33SV6/2AG2206T	189	46SV4/1AG3006T	144,2	66SV3G3006T	127,8	125SV3/3BG3006T	101,9
33SV6/1AG3006T	199,2	46SV4G3006T	155,7	66SV4/2AG3706T	149,1	125SV3G3706T	117,5
33SV6G3006T	208,5	46SV5/2AG3006T	171,6	66SV4/1AG3706T	159,2	125SV4/4AG4506T	146,1
33SV7/2AG3006T	224,6	46SV5/1AG3006T	183,1	66SV4G3706T	169,3	125SV5/5AG5506T	182,6

T				T			
60 Hz 1,750 min-1				60 Hz 1,750 min-1			
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1SV03F00246T	6,6	5SV07F00246T	18,8	22SV04F01146T	22,2	46SV11G11046T	105,7
1SV05F00246T	11	5SV09F00346T	24	22SV05F01546T	27,7	46SV12G11046T	115,3
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1SV09F00246T	19,6	5SV13F00546T	34,7	22SV07F02246T	39,1	66SV1G01546T	10,8
1SV11F00246T	23,9	5SV15F00546T	40,4	22SV08F02246T	44,6	66SV2G03046T	21,1
1SV13F00246T	28,2	5SV17F00546T	45,6	22SV09F02246T	50,1	66SV3G04046T	31,4
1SV15F00246T	32,4	5SV19F00746T	50,8	22SV10F03046T	55,6	66SV4G05546T	42
1SV17F00246T	36,6	5SV21F00746T	56,7	33SV2G01146T	17	66SV5G07546T	52,5
1SV18F00246T	38,7	5SV23F00746T	61,9	33SV3G01546T	25,7	66SV6G07546T	62,7
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1SV22F00246T	47	10SV05F00546T	21,6	33SV5G03046T	42,7	66SV8G11046T	83,7
1SV24F00246T	51,1	10SV07F00746T	29,9	33SV6G03046T	51,5	92SV1G01546T	11,8
1SV26F00346T	55,2	10SV09F00746T	38,5	33SV7G04046T	59,9	92SV2G03046T	23,4
1SV28F00346T	60	10SV11F01146T	47,8	33SV8G05546T	69	92SV3G05546T	35,4
3SV02F00246T	5,5	10SV13F01146T	56,2	33SV9G05546T	77,5	92SV4G07546T	47,2
3SV04F00246T	10,9	10SV15F01546T	65,1	33SV10G05546T	85,9	92SV5G07546T	58,5
3SV06F00246T	16,3	15SV03F00546T	15,4	33SV11G07546T	94,9	92SV6G11046T	70,2
3SV08F00246T	21,6	15SV04F00746T	20,6	33SV12G07546T	103,3	92SV7G11046T	81,9
3SV10F00246T	26,8	15SV05F01146T	26,2	33SV13G07546T	111,8	92SV8G15046T	93,6
3SV12F00246T	32	15SV06F01146T	31,3	46SV2G01546T	19	125SV1G02246T	10
3SV14F00346T	37,6	15SV07F01546T	36,7	46SV3G02246T	28,8	125SV2/2AG03046T	18,3
3SV15F00346T	40,4	15SV08F01546T	42,4	46SV4G03046T	37,9	125SV3/3BG04046T	25,5
3SV17F00346T	45,5	15SV09F02246T	48	46SV5G04046T	47,6	125SV4/4AG05546T	36,5
3SV19F00346T	50,7	15SV10F02246T	53,3	46SV6G05546T	57,7	125SV5/5AG07546T	45,6
3SV21F00546T	55,8	15SV11F02246T	58,5	46SV7G05546T	67,1	125SV6G11046T	58,7
3SV23F00546T	61,9	15SV12F02246T	63,8	46SV8G07546T	77	125SV7G11046T	68,5
5SV03F00246T	8,3	22SV02F00546T	11	46SV9G07546T	86,4	125SV8G15046T	78,3
5SV05F00246T	13,7	22SV03F00746T	16,5	46SV10G07546T	95,7		

# 11 Hydrovar Inverter Manual





### 1.2.1 Safety message levels

#### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

#### Definitions

Safety message level	Indication
 <b>DANGER:</b>	A hazardous situation which, if not avoided, will result in death or serious injury
 <b>WARNING:</b>	A hazardous situation which, if not avoided, could result in death or serious injury
 <b>CAUTION:</b>	A hazardous situation which, if not avoided, could result in minor or moderate injury
 <b>Electrical Hazard:</b>	The possibility of electrical risks if instructions are not followed in a proper manner
<b>NOTICE:</b>	<ul style="list-style-type: none"> <li>• A potential situation which, if not avoided, could result in undesirable conditions</li> <li>• A practice not related to personal injury</li> </ul>

#### Hot surface hazard

Hot surface hazards are indicated by a specific symbol that replaces the typical hazard level symbols:



**CAUTION:**

## 1.3 User safety

#### General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

### Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Hard hat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

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**NOTICE:**

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

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### Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

### Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

### Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.

Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	<ol style="list-style-type: none"> <li>1. Hold your eyelids apart forcibly with your fingers.</li> <li>2. Rinse the eyes with eyewash or running water for at least 15 minutes.</li> <li>3. Seek medical attention.</li> </ol>
Chemicals or hazardous fluids on skin	<ol style="list-style-type: none"> <li>1. Remove contaminated clothing.</li> <li>2. Wash the skin with soap and water for at least 1 minute.</li> <li>3. Seek medical attention, if necessary.</li> </ol>

## 1.4 Protecting the environment

### Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

### Exceptional sites



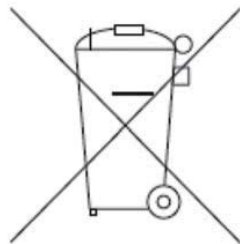
**CAUTION: Radiation Hazard**

Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

### Recycling guidelines

Always follow local laws and regulations regarding recycling.

### Waste and emissions guidelines



Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with local and currently valid legislation.

## 1.5 Warranty

For information about warranty, see the sales contract.

## 1.6 Spare parts



**WARNING:**

Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the guarantee.

For more information about the product's spare parts, refer to the Sales and Service department.

## 1.7 EU declaration of conformity (No LVD/EMCD05)

1. Apparatus model/Product: → data plate
  2. Name and address of the manufacturer: Xylem Service Italia S.r.l.  
Via Vittorio Lombardi 14  
36100 Vicenza VI  
Italy
  3. This declaration of conformity is issued under the sole responsibility of the manufacturer.
  4. Object of the declaration: Frequency converter (variable speed drive) HYDROVAR® for electric pump in one of the following models
 

HVL2.015-A0010	HVL4.015-A0010
HVL2.022-A0010	HVL4.022-A0010
HVL2.030-A0010	HVL4.030-A0010
HVL2.040-A0010	HVL4.040-A0010
HVL3.015-A0010	HVL4.055-A0010
HVL3.022-A0010	HVL4.075-A0010
HVL3.030-A0010	HVL4.110-A0010
HVL3.040-A0010	HVL4.150-A0010
HVL3.055-A0010	HVL4.185-A0010
HVL3.075-A0010	HVL4.220-A0010
HVL3.110-A0010	
  5. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:
    - Directive 2014/35/UE of 26 February 2014 (electrical equipment designed for use within certain voltage limits)
    - Directive 2014/30/UE of 26 February 2014 (electromagnetic compatibility)
  6. References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared:
    - EN 61800-5-1:2007
    - EN 61800-3:2004+A1:2012 (\*), EN 61000-6-1:2007, EN 61000-6-2:2005, EN 61000-6-4:2007+A1:2011
 (\*) Category C3
  7. Notified body: -
  8. Additional information: -
- Signed for and on behalf of: Xylem Service Italia S.r.l.  
Montecchio Maggiore, 18/04/2016  
Amedeo Valente  
Director of Engineering and R&D  
Rev. 00

## 1.8 EU declaration of conformity

1. Unique identification of the EEE: No HVL
2. Name and address of the manufacturer: Xylem Service Italia S.r.l.  
Via Vittorio Lombardi 14  
36100 Vicenza VI  
Italy
3. This declaration of conformity is issued under the sole responsibility of the manufacturer.

4. Object of the declaration: Frequency converter (variable speed drive) HYDROVAR® for electric pump in one of the following models

HVL2.015-A0010	HVL4.015-A0010
HVL2.022-A0010	HVL4.022-A0010
HVL2.030-A0010	HVL4.030-A0010
HVL2.040-A0010	HVL4.040-A0010
HVL3.015-A0010	HVL4.055-A0010
HVL3.022-A0010	HVL4.075-A0010
HVL3.030-A0010	HVL4.110-A0010
HVL3.040-A0010	HVL4.150-A0010
HVL3.055-A0010	HVL4.185-A0010
HVL3.075-A0010	HVL4.220-A0010
HVL3.110-A0010	

5. The object of the declaration described above is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

6. References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared: -

7. Additional information: -

Signed for and on behalf of:  
 Montecchio Maggiore, 18/04/2016  
 Amedeo Valente  
 Director of Engineering and R&D  
 Rev. 01

Xylem Service Italia S.r.l.





## 2 Transportation and Storage

### 2.1 Inspect the delivery

#### 2.1.1 Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.  
If the product has been picked up at a distributor, make a claim directly to the distributor.

#### 2.1.2 Inspect the unit

1. Remove packing materials from the product.  
Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.  
For your personal safety, be careful when you handle nails and straps.
4. Contact the local sales representative if there is any issue.

### 2.2 System lifting



---

**WARNING:**

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.

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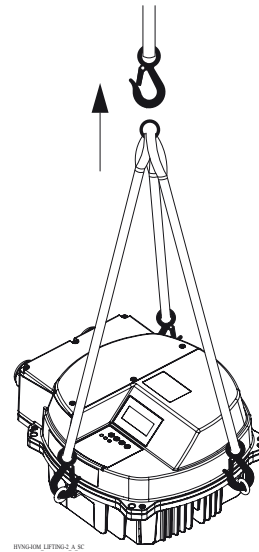
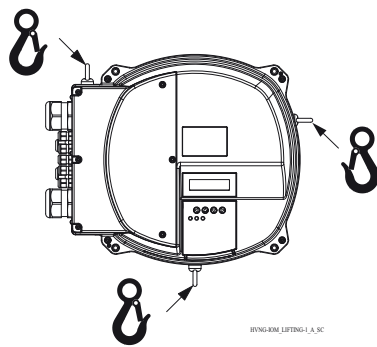
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**WARNING: Crush Hazard**

1) Always lift the unit by its designated lifting points. 2) Use suitable lifting equipment and ensure that the product is properly harnessed. 3) Wear personal protective equipment. 4) Stay clear of cables and suspended loads.

---

Lifting diagrams



## 2.3 Transportation guidelines

Precautions



**WARNING:**

- Stay clear of suspended loads.
- Observe accident prevention regulations in force.
- Do not damage the cables during transport; do not squeeze, bend or drag the cable.
- Always keep the cable ends dry.
- Secure the unit against tipping over and slipping until it is mounted and fixed in its final location.
- Lift and handle the product carefully, using suitable lifting equipment (stacker, crane, crane mounting device, lifting blocks, sling ropes, etc.).
- Always lift the unit by its lifting handle. Never lift the unit by the motor cable or by the hose.

## 2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

**NOTICE:**

Protect the product against humidity, heat sources, and mechanical damage.

**NOTICE:**

Do not place heavy weights on the packed product.

# 3 Product Description

## 3.1 System description

### System layout

The images show a typical single-pump and multi-pump system using the unit. When the system is connected directly to the water supply use a low-pressure switch on the suction side.

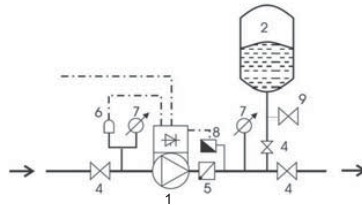


Figure 1: Single-pump system

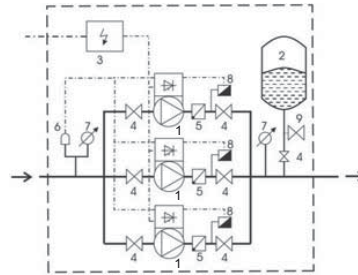


Figure 2: Multi-pump system

1. Pump with HYDROVAR
2. Diaphragm pressure tank
3. Distribution panel
4. Gate valve
5. Non-return valve
6. Low water control
7. Pressure gauge
8. Pressure sensor
9. Drain tap

### Pressure tank

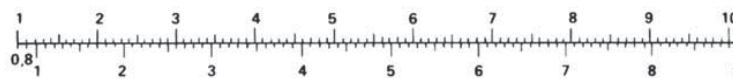
A diaphragm pressure tank is used on the discharge side of the pump to maintain pressure in the pipes when there is no water demand. The unit stops the pump from continuing to run at zero demand and reduce the size of the tank that is required for supply purposes.

The tank must be permitted and suitable for systems pressure.

The capacity of the tank must be 10% of the maximum system flow rate of the pump or pumps (0.1 times the flow rate in l/min or gal/min). Turn off the unit to reduce the water pressure to check and set the correct pre-charged pressure.

The pre-charge pressure of the tank can be determined by using the following table:

Required pressure or Start Value when active [bar]



Pre-charge pressure [bar]

## 3.2 Product function and use

### Description

HYDROVAR is a pump-mounted variable speed, microprocessor-based system controller. It can be mounted onto virtually any model of fan cooled motor and is simple to integrate into BMS systems with ModBus or Bacnet communication as standard.

In a variable speed controlled system, the pump works every time with the speed where it produces at the reduced flow exactly the required head. Therefore there is no wasted energy given to the system like on/off or bypass control.

### Intended use

HYDROVAR is made for the following pump applications:

- Pressure, level, and flow regulation
- Closed loop systems
- Irrigation applications with single or multiple pumps

### Improper use

The product must not be used for constant torque applications.

### Approvals and certifications



The unit complies with UL508C thermal memory retention requirements.

## 3.3 Applications

### Application alternatives

The application alternatives for the product are the following:

- Actuator
- Controller
- Cascade serial / Synchronous
- Cascade relay

#### 3.3.1 Actuator

This mode is used for a unit in a single pump operation only. The unit operates as an actuator according to an external speed signal or continuous operation on either one or two programmed frequencies. This is done by using the corresponding digital input.

#### 3.3.2 Controller

This mode is set as the default operating mode and is used for a unit in a single pump operation.

#### 3.3.3 Cascade serial / Synchronous

In these applications, each of the pumps (up to eight pumps) must be equipped with a unit.

The units are connected via the RS485 interface and communicate via the provided protocol.

The combination of the different units which are used in a multi-pump-system depends on the system requirements.

It is possible to run all pumps in cascade serial mode and synchronous mode as well. If one unit fails, then each pump of the system can become the lead pump and can take control.

### 3.3.4 Cascade relay

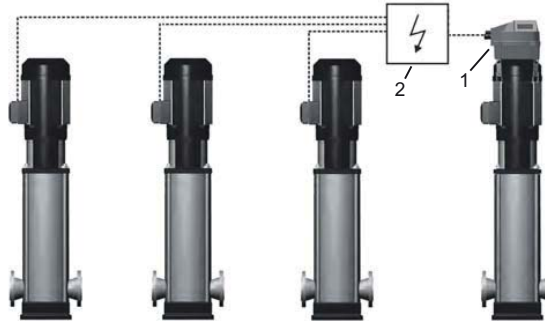
**Description**

One pump is fitted with the unit and up to five slave pumps can be switched to on/off on demand. The unit uses an additional Premium Card for this purpose.

For switching the slave pumps an external switchboard has to be installed.

**Example**

The example shows a booster set with four pumps where only one speed-controlled pump and the others are fixed speed.



1. HYDROVAR  
2. External panel

### 3.4 The data plate

Type definition code

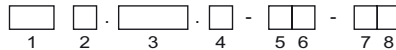


Figure 3: Definition code and placement

No.	Description	Alternatives
1	Brand	HVL - HYDROVAR
2	Power supply	<b>2:</b> 1~ 230 VAC <b>3:</b> 3~ 230 VAC <b>4:</b> 3~ 380-460 VAC
3	Shaft power *10 [kW]	<b>015:</b> 1.5 kW (2.0 HP) <b>022:</b> 2.2 kW (3.0 HP) <b>030:</b> 3.0 kW (4.0 HP) <b>040:</b> 4.0 kW (5.0 HP) <b>055:</b> 5.5 kW (7.5 HP) <b>075:</b> 7.5 kW (10.0 HP) <b>110:</b> 11.0 kW (15.0 HP) <b>150:</b> 15.0 kW (20.0 HP) <b>185:</b> 18.5 kW (25.0 HP) <b>220:</b> 22.0 kW (30.0 HP)
4	Enclosure rate	<b>A:</b> IP 55 / Type1
5	Bus communication	<b>0:</b> Standard communication

No.	Description	Alternatives
6	Optional cards	<b>0:</b> No optional cards
7	Internal display	<b>1:</b> Standard internal display installed
8	Other options	<b>0:</b> No other options installed

Example

HVL 4 . 075 . A - 0 0 - 1 0  
 1 2 3 4 5 6 7 8

No.	Example	Description
1	HVL	HYDROVAR
2	4	Power Supply: 3~ 380-460 VAC
3	075	Shaft power: 7.5 kW (10.0 HP)
4	A	Enclosure rate: IP 55 / Type1
5	0	Standard communication
6	0	No optional cards installed
7	1	Standard internal display installed
8	0	No other options installed

### 3.5 Technical Data

Electrical specification

		HVL																				
		2.015	2.022	2.030	2.040	3.015	3.022	3.030	3.040	3.055	3.075	3.110	4.015	4.022	4.030	4.040	4.055	4.075	4.110	4.150	4.185	4.220
<b>Input</b>																						
Mains Supply	LN	L1 L2 L3										L1 L2 L3										
Nominal input voltage (Vin):	208-240±10%	208-240±10%										380-460±15%										
Maximum Input Current, continuous [A]:	11.6 15.1 22.3 27.6 7.0 9.1 13.3 16.5 23.5 29.6 43.9 3.9 5.3 7.2 10.1 12.8 16.9 24.2 33.3 38.1 44.7																					
efficiency, rated [%], typically:	94.0 93.5 93.5 93.5 96.0 96.0 96.0 96.0 96.0 96.0 96.0 96.0 96.5 96.5 96.5 97.0 97.0 97.0 97.0 97.0 97.0 97.0																					
<b>Output</b>																						
Output voltage (V)	0-240	0-100% of supply voltage										0-100% of supply voltage										
Maximum output current, continuous [A]:	7.5 10 14.3 16.7 7.5 10 14.3 16.7 24.2 31 44 4.1 5.7 7.3 10 13.5 17 24 32 38 44																					
Output frequency (Hz)	15-70																					

Environmental specification

Storage temperature	-30°C [-22°F] to 70°C [158°F]
Relative humidity	5%-95% - Condensation is not permitted
Operational temperature	-10°C [-14°F] to 55°C [131°F] 100% power rating -10°C [-14°F] to 40°C [104°F] with de-rating 40°C [104°F] to 55°C [131°F]

Air pollution	The air may contain dry dust as found in workshops where there is excessive dust due to machines. Excessive amounts of dust, acids, corrosive gases, salts etc are not permitted.
Altitude	Max. 1000 m above sea level. For installation over 1000 m above sea level, the maximum output power has to be de-rated by 1% for every additional 100 m. If the installation site is over 2000 m above sea level, please contact your local distributor or service contact.

Installation specification

Protection	Motor drive input have to be protected by an external circuit breaker/ fuse
Motor wire type	shielded power cable
Maximum motor cable length (no EMC compliant), screened	50m (164ft)
Maximum motor cable length (no EMC compliant), unscreened	100m (328ft)

EMC compliance

In accordance with IEC 61800-3 and EN 61000 series standards, shield cable will be used for motor drive output and communication.

Installations must be done according EMC correct installations and avoiding pigtails (on the drive side), otherwise EMC cannot be guaranteed.

Class of protection

- IP55, Enclosure Type 1
- Protect the product from direct sunlight
- Protect the product from direct rainfall
- Outdoor installation without protection, to especially keep the temperature limits of the product, is not permitted

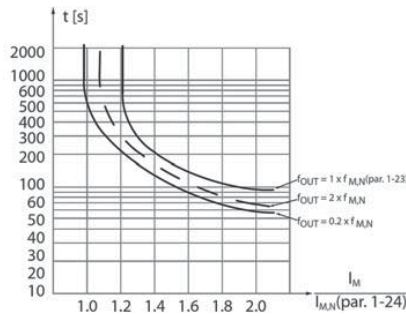
### 3.6 Motor thermal protection

Motor thermal protection can be implemented using various techniques: PTC sensor in motor windings or Software Thermal Control (STC).

Protection against motor overheating comes from par. 290 "STC Motor Protection", which by default is pre-set to data value "STC trip".

**NOTICE:** The STC function is initialized at 1.125 x rated motor current and rated motor frequency. The STC function provides class 20 motor overload protection in accordance with the NEC.

Motor thermal protection prevents the motor from overheating. The STC function is an electronic feature that simulates a bimetal relay that is based on internal measurements. The characteristic is shown in the following figure.



The X-axis shows the ratio between I<sub>motor</sub> actual and I<sub>motor</sub> nominal. The Y-axis shows the time in seconds before the STC cuts off and trips the frequency converter. The curves show the characteristic nominal speed, at twice the nominal speed and at 20% of the nominal speed. The curve shows that at lower speed the STC cuts off at lower heat due to less cooling of the motor. In that way, the motor is protected from overheating even at low speed. The STC function calculates the motor temperature that is based on actual current and speed.

The calculated percentage of allowed maximum temperature is visible as a readout in par. 293 "Motor Thermal".

With the STC the motor is protected from being overheated and there is no need for any further motor protection. That means when the motor is heated up the STC timer controls how long the motor can be operated at the high temperature before it is stopped in order to prevent overheating.

Motor thermal protection can also be achieved using an external thermistor: set par. 290 "STC Motor Protection" to data value "Thermistor trip".

### 3.7 Dimensions and weights

#### Reading instructions

All measurements are in millimeters (inches).

The images are not to scale.

#### Free distance

Area	Models	Free distance
Above the unit	All	> 300 mm (12 in)
Center-distance between units (to ensure space for cabling):	HVL 2.015 ÷ 2.022   3.015 ÷ 3.022   4.015 ÷ 4.040	> 300 mm (12 in)
	HVL 2.030 ÷ 2.040   3.030 ÷ 3.055   4.055 ÷ 4.110	> 430 mm (17 in)
	HVL 3.075 ÷ 3.110   4.150 ÷ 4.220	> 550 mm (21,6 in)

#### Dimensional drawings

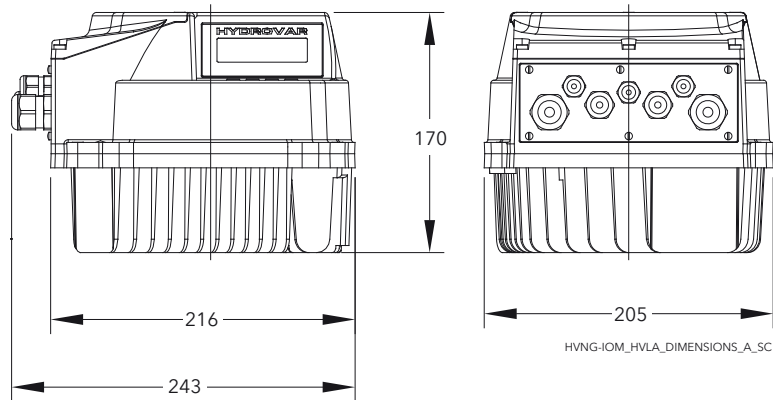


Figure 4: HVL2.015, HVL2.022, HVL3.015, HVL3.022, HVL4.015 ÷ HVL4.040



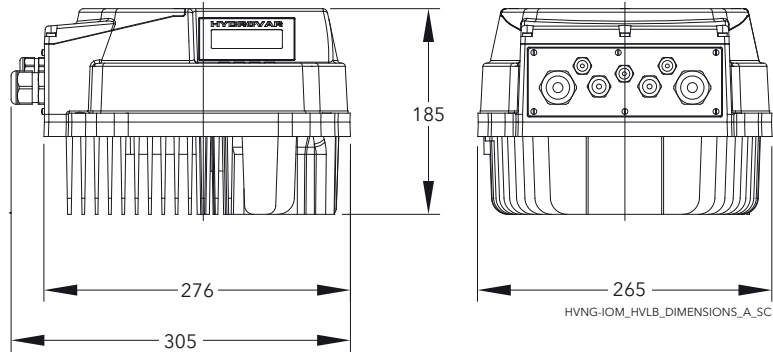


Figure 5: HVL2.030, HVL2.040, HVL3.030 + HVL3.055, HVL4.055 + HVL4.110

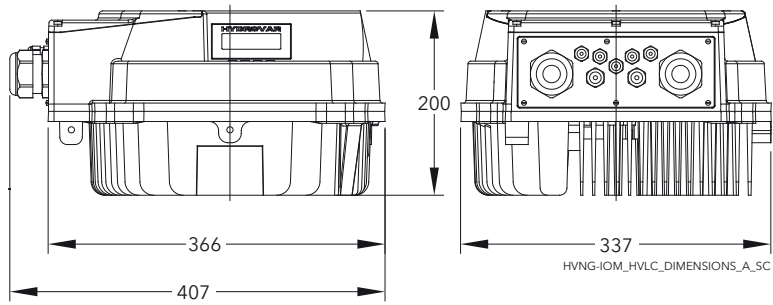


Figure 6: HVL3.075 + HVL3.110, HVL4.150 + HVL4.220

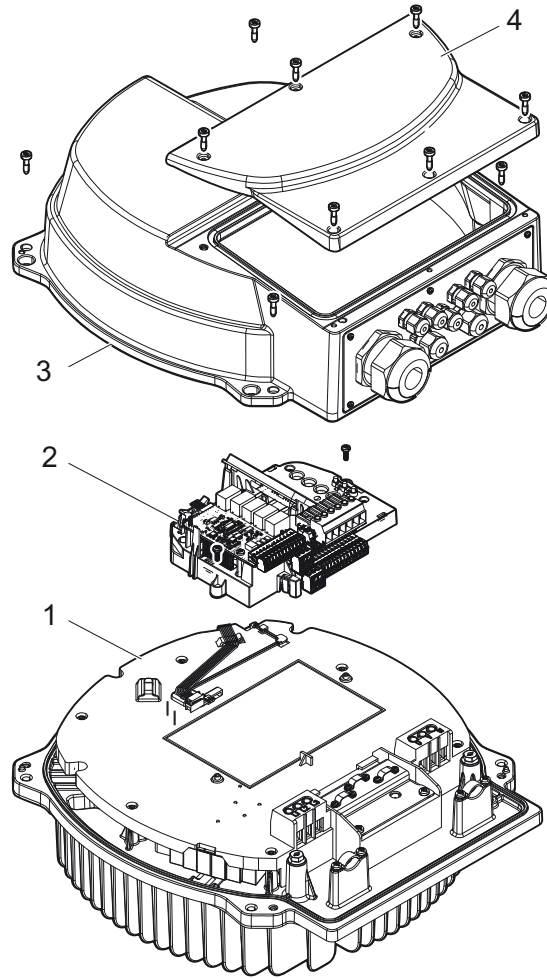
Weight

Models	Maximum Weight
HVL 2.015 ÷ 2.022   3.015 ÷ 3.022   4.015 ÷ 4.040	5,6 Kg (12,3 lbs)
HVL 2.030 ÷ 2.040   3.030 ÷ 3.055   4.055 ÷ 4.110	10,5 Kg (23 lbs)
HVL 3.075 ÷ 3.110   4.150 ÷ 4.220	15,6 Kg (34,4 lbs)

### 3.8 Design and layout

Parts and descriptions

The unit can be fitted with the features the application requires.

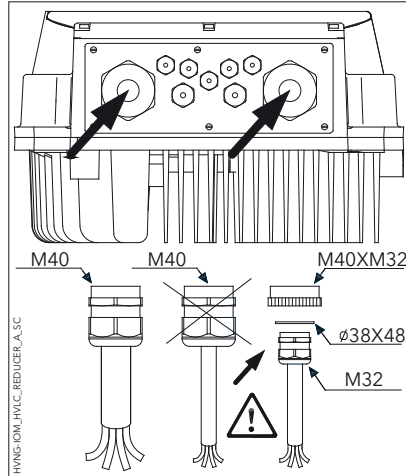


Position number	Description
1	Power board, heatsink, EMC filter
2	Control board
3	Cover
4	Plastic cover

### 3.9 Included mounting components

Included components		Cable outer diameter		Model		
		(mm)	inches	HVL 2.015 ÷ 2.022   3.015 ÷ 3.022   4.015 ÷ 4.040	HVL 2.030 ÷ 2.040   3.030 ÷ 3.055   4.055 ÷ 4.110	HVL 3.075 ÷ 3.110   4.150 ÷ 4.220
Cable Gland(s) and Lock Nut(s)	M12	3.5 ÷ 7.0	0.138 ÷ 0.275	3	3	3
	M16	5.0 ÷ 10.0	0.197 ÷ 0.394	2	2	2
	M20	7.0 ÷ 13.0	0.275 ÷ 0.512	2		
	M25	10.0 ÷ 17.0	0.394 ÷ 0.669		2	
	M32	13.0 ÷ 21.0	0.512 ÷ 0.827			2
	M40	19.0 ÷ 28.0	0.748 ÷ 1.102			2
Entry Thread Reducer	M40 -> M32					2
Plug(s) for Cable Gland(s)	M12			3	3	3
	M16			2	2	2
Screws	M5x30			4		
	M5x40			4		
	M6x40				4	4
	M6x50				4	4
Spade Connector(s) for PE conductors	RF-U 4			2	2	
	BF-U 4			2	2	
	GF-U 4			2	2	
Spares sealing ring					2	
Centering pin				1	1	1
Mounting Clamps				4	4	4

For HVL 3.075 ÷ 3.110 or HVL 4.150 ÷ 4.220, if the cables outer diameter is incompatible with the included cable glands, use the supplied Entry Thread Reducers (and spares sealing rings).



### 3.10 Optional components

#### Components

Component	Description
Motor cables	The motor cable that is ready to connect to the unit.
Mounting ring	If the motor fan is made of plastic, then a mounting ring is used. It is available in two diameters: 140 mm (5.5 in) and 155 mm (6.1 in).
Sensors	The following sensors can be used with the unit: <ul style="list-style-type: none"> <li>• Pressure-transducer</li> <li>• Differential pressure-transducer</li> <li>• Temperature-sensor</li> <li>• Flow indicator (orifice plate, inductive flow meter)</li> <li>• Level-sensor</li> </ul>
Premium Card HYDROVAR	Card to control up to five slave pumps and to connect additional analog and digital I/Os
Wi-Fi Card HYDROVAR	To connect and interact wireless with HYDROVAR

## 4 Installation

### 4.1 Installation site checklist

**DANGER:**

Never install the system controller in an explosive or flammable environment.

**WARNING:**

- Always refer to the local and national regulations, legislation, and codes in force regarding selection of installation site, and water and power connections.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operation instructions. It is important that the manual is available for equipment operators.
- Install the unit on the motor fan cover. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances.
- For wall mounting installations with long motor cables, use the output filter option to protect the motor.
- Ensure that the ingress protection rating of Hydrovar (IP55, Type1) is suitable for the installation environment.

**CAUTION:**

- Ingress protection. IP55 (Type 1) rating can only be guaranteed if the unit is properly closed.
- Make sure that there is no liquid on the unit before opening the plastic cover.
- Ensure all cable glands and unused holes for glands are properly sealed.
- Ensure that the plastic cover is properly closed.
- Device damage through contamination. Do not leave Hydrovar uncovered.

### 4.2 Frequency converter and motor pre-installation check list

- Compare the model number of the unit on the nameplate to what was ordered to verify the proper equipment.
- Ensure each of the following are rated for same voltage:
  - Mains (power)
  - Frequency converter
  - Motor
- Ensure that the frequency converter output current rating is equal to or greater than motor service factor current for peak motor performance.
  - Motor size and frequency converter power must match for proper overload protection.
  - If frequency converter rating is less than motor, full motor output cannot be achieved.

# 5 Mechanical Installation

## 5.1 Cooling

- The frequency converter is cooled by means of air circulation. To protect the unit from overheating, it must be ensured that the ambient temperature does not exceed the maximum temperature stated for the frequency converter and that the 24-hour average temperature is not exceeded.
- Derating for temperatures between 40°C (104°F) and 50°C (122°F) and elevation 1000 m (3300 ft) above sea level must be considered.
- Improper mounting can result in overheating and reduced performance.



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**CAUTION:**

During the normal operation, the heat sink surfaces may be so hot that only the buttons should be touched to avoid burns.

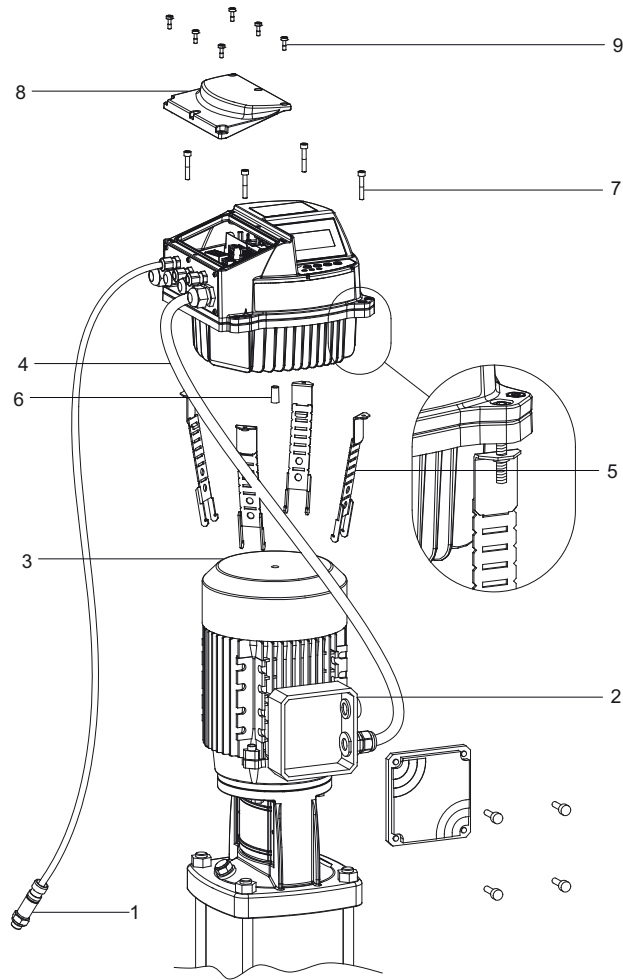
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## 5.2 Lifting

- Check the weight of the unit to determine a safe lifting method.
- Ensure that the lifting device is suitable for the task.
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit.
- For lifting, use hoist rings on the unit, when provided.

## 5.3 Mounting

- Install the unit on the motor fan cover. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances.



HVNG-IOM\_MOUNT\_EXPLD-1\_B\_SC

1. Actual value sensor
2. Motor conduit box
3. Motor fan cover
4. Motor cable
5. Mounting clamps
6. Centring pin
7. Screws for mounting clamps
8. Plastic cover
9. Screws for plastic cover

Refer to callouts in preceding image.

1. Fit the rubber centering pin [6] on the bottom of the HYDROVAR®.

**NOTICE:**

Always use a stainless steel mounting ring if the motors fan cover is made of plastic.

2. Center the unit on the motor fan cover [3] using the centering pin [6].
3. Adjust mounting clamps [5] length for smaller motor sizes, as indicated in the picture that follows.

**NOTICE:**

Take care about sharp edges and remove them properly.

4. Fasten the unit:
  - a. Fasten the mounting clamps [5] and relative screws [7].
  - b. Tighten the screws [7] until the two bottom teeth in the brackets grip the fan cover.
  - c. Tighten the screws until the unit is securely fastened.
5. Remove the screws for plastic cover [9].
6. Remove the plastic cover [8].
7. Make the electrical connections.
  - For more information about how to make the electrical connections, see [Electrical Installation](#).

**NOTICE:**

You can remove the metal plate to make the electrical installation easier.

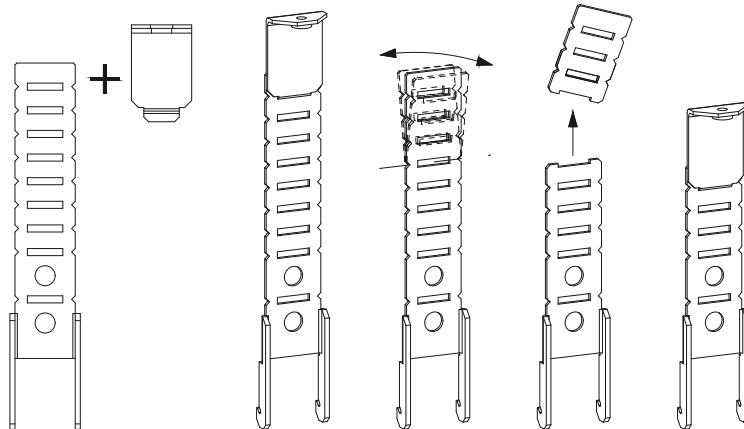
8. Mount and fasten the plastic cover [8] using 2,0 Nm tightening torque.



**Electrical Hazard:**

Make sure that all the cable glands are mounted properly and that all the unused cable entries use closing plugs.

Mounting clamps





## 6 Electrical Installation

### 6.1 Precautions

**WARNING:**

- **EQUIPMENT HAZARD.** Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. Installation, start-up, and maintenance must be performed by trained and qualified personnel. Failure to follow these guidelines could result in death or serious injury.

**Electrical Hazard:**

- All electrical wiring must be carried out by an authorized electrician, in accordance with the electrical regulations locally in force.

**NOTICE:**

**WIRING ISOLATION.** Run input power, motor wiring and control wiring in three separate metallic conduits or use separated shielded cable for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum frequency converter and associated equipment performance.

For your safety comply with the following requirement:

- Electronic control equipment is connected to hazardous mains voltage. Extreme care should be taken to protect against electrical hazards when applying power to the unit.

**Earth (grounding) requirements****WARNING:**

For operator safety, it is important to ground the frequency converter properly in accordance with national and local electrical codes as well as instructions contained within this document. Ground currents are higher than 3.5 mA. Failure to ground the frequency converter properly could result in death or serious injury.

**NOTICE:**

It is the responsibility of the user or certified electrical installer to ensure correct grounding (earthing) of the equipment in accordance with national and local electrical codes and standards.

- Follow all local and national electrical codes to ground electrical equipment properly.
- Proper protective grounding for equipment with ground currents higher than 3.5 mA must be established. See the Leakage current (>3.5 mA) section for details.
- A dedicated ground wire is required for input power, motor power and control wiring.
- Use the clamps provided with the equipment for proper ground connections.
- Do not ground one frequency converter to another in a "daisy chain" fashion.
- Keep the ground wire connections as short as possible.
- Using high-strand wire to reduce electrical noise is recommended.
- Follow motor manufacturer wiring requirements.

**Leakage current (>3.5 mA)**

Follow national and local codes regarding protective earthing of equipment with a leakage current > 3.5 mA. Frequency converter technology implies high frequency switching at high power. This will generate a leakage current in the earth connection. A fault current in the frequency converter at the output power terminals might contain a DC component which can charge the filter capacitors and cause a transient earth current. The

earth leakage current depends on various system configurations including RFI filtering, screened motor cables, and frequency converter power.

EN/EC61800-5-1 (Power Drive System Product standard) requires special care if the leakage current exceeds 3.5 mA. Earth grounding must be reinforced in one of the following ways:

- Earth ground wire of at least 8 AWG or 10 mm<sup>2</sup> Cu (or 16mm<sup>2</sup> Al).
- Two separate earth ground wires of the same cross sectional area.

See EN60364-5-54 section 543.7 for further information.

On HYDROVAR, the phase conductor and the corresponding protective earthing conductor can be of the same cross-sectional area, provided they are made of the same metal (because the cross-sectional area of the phase conductor is less than 16 mm<sup>2</sup>).

The cross-sectional area of every protective earthing conductor which does not form a part of the supply cable or cable enclosure shall, in any case, be not less than:

- 2.5 mm<sup>2</sup> if mechanical protection is provided or
- 4 mm<sup>2</sup> if mechanical protection is not provided. For cord-connected equipment, provisions shall be made so that the protective earthing conductor in the cord shall, in the case of failure of the strain-relief mechanism, be the last conductor to be interrupted.

## 6.2 Protection devices

### Fuses and Circuit Breakers

- An electronically activated function within the frequency converter provides overload protection in the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See Warnings and alarms for details on the trip function.
- Hydrovar must be provided with short-circuit and over-current protection to avoid overheating of the cables in the installation. Input fusing and/or circuit breakers are required to provide this protection. Fuses and Circuit Breakers must be provided by the installer as part of installations.
- Use recommended fuses and/or circuit breakers on the supply side as protection in case of component breakdown inside the adjustable frequency drive (first fault). Use of recommended fuses and circuit breakers ensures possible damage to the adjustable frequency drive is limited to damages inside the unit. For other circuit breaker types, ensure that the energy into the adjustable frequency drive is equal to or lower than the energy provided by recommended types.
- The fuses below are suitable for use on a circuit capable of delivering 100,000 Ams (symmetrical), 480V maximum. With the proper fusing the adjustable frequency drive Short Circuit Current Rating (SCCR) is 100,000 Ams.

Table 1: Recommended fuses and circuit breakers




Voltage supply	HVL	Fuse					Circuit breaker
		UL				Non UL	
		Bussmann	Edison	Littelfuse	Ferraz-Shawmut	Fuse	ABB
		Type T				Type gG	MCB S200
1~ 230 VAC	2.015	JJN-20	TJN (20)	JLLN 20	A3T20	20	S201-C20
	2.022	JJN-25	TJN (25)	JLLN 25	A3T25	25	S201-C25
	2.030	JJN-35	TJN (35)	JLLN 35	A3T35	35	S201-C32
	2.040	JJN-35	TJN (35)	JLLN 35	A3T35	35	S201-C40

Voltage supply	HVL	Fuse					Circuit breaker
		UL				Non UL	
		Bussmann	Edison	Littelfuse	Ferraz-Shawmut	Fuse	ABB
		Type T				Type gG	MCB S200
3~ 230 VAC	3.015	JJN-15	TJN (15)	JLLN 15	A3T15	16	S203-C16
	3.022	JJN-15	TJN (15)	JLLN 15	A3T15	16	S203-C16
	3.030	JJN-20	TJN (20)	JLLN 20	A3T20	16	S203-C20
	3.040	JJN-25	TJN (25)	JLLN 25	A3T25	25	S203-C25
	3.055	JJN-30	TJN (30)	JLLN 30	A3T30	25	S203-C32
	3.075	JJN-50	TKN (50)	JLLN 50	A3T50	50	S203-C50
3~ 380-460 VAC	3.110	JJN-60	TJN (60)	JLLN 60	A3T60	63	S203-C63
	4.015	JJS-10	TJS (10)	JLLS 10	A6T10	10	S203-C10
	4.022	JJS-10	TJS (10)	JLLS 10	A6T10	10	S203-C13
	4.030	JJS-15	TJS (15)	JLLS 15	A6T15	16	S203-C13
	4.040	JJS-15	TJS (15)	JLLS 15	A6T15	16	S203-C16
	4.055	JJS-20	TJS (20)	JLLS 20	A6T20	20	S203-C20
	4.075	JJS-20	TJS (20)	JLLS 20	A6T20	20	S203-C25
	4.110	JJS-30	TJS (30)	JLLS 30	A6T30	30	S203-C32
	4.150	JJS-50	TJS (50)	JLLS 50	A6T50	50	S203-C50
	4.185	JJS-50	TJS (50)	JLLS 50	A6T50	50	S203-C50
4.220	JJS-60	TJS (60)	JLLS 60	A6T60	63	S203-C63	

Type gG fuses in the table are reporting the fuses rated current.

**Residual Current Devices, RCDs (GFCIs)**

Where Ground Fault Circuit Interrupters (GFCIs) and residual current devices (RCDs), also know as earth leakage circuit breakers (ELCDs), are used, comply with the following:

- for HVL 2.015 ÷ 2.040, use GFCIs (RCDs) which are capable of detecting AC currents and pulsating currents with DC components. These GFCIs (RCDs) are marked with the following symbol: 
- for HVL 3.015 ÷ 3.110 and 4.015 ÷ 4.220, use GFCIs (RCDs) which are capable of detecting AC and DC currents. These GFCIs (RCDs) are marked with the following symbols:  
- Use GFCIs (RCDs) with an inrush delay to prevent faults due to transient earth currents.
- Dimension GFCIs (RCDs) according to the system configuration and environmental considerations.

**NOTICE:**

When an earth leakage circuit breaker or ground fault circuit interrupter is selected, the total leakage current of all the electrical equipment in the installation must be taken into account.

### 6.3 Wire type and ratings

- All wiring must comply with local and national regulations regarding cross section and ambient temperature requirements.
- Use cables with a minimum heat resistance of +70 °C (158 °F); to obey the UL (Underwriters Laboratories) regulations, it is recommended that all power connections be made with a minimum 75°C rated copper wire of the following types: THW, THWN.

Table 2: Recommended power connections cables

HVL	Power supply input cable + PE		Motor output cables + PE	
	Wire numbers x Max. copper section	Wire numbers x Max. AWG	Wire numbers x Max. copper section	Wire numbers x Max. AWG
2.015	3 x 2mm <sup>2</sup>	3 x 14AWG	4 x 2mm <sup>2</sup>	4 x 14AWG
2.022				
2.030	3 x 6mm <sup>2</sup>	3 x 10AWG	4 x 6mm <sup>2</sup>	4 x 10AWG
2.040				
3.015	4 x 2mm <sup>2</sup>	4 x 14AWG	4 x 2mm <sup>2</sup>	4 x 14AWG
3.022				
3.030	4 x 6mm <sup>2</sup>	4 x 10AWG	4 x 6mm <sup>2</sup>	4 x 10AWG
3.040				
3.055				
3.075	4 x 16mm <sup>2</sup>	4 x 5AWG	4 x 16mm <sup>2</sup>	4 x 5AWG
3.110				
4.015	4 x 2mm <sup>2</sup>	4 x 14AWG	4 x 2mm <sup>2</sup>	4 x 14AWG
4.022				
4.030				
4.040				
4.055	4 x 6mm <sup>2</sup>	4 x 10AWG	4 x 6mm <sup>2</sup>	4 x 10AWG
4.075				
4.110				
4.150	4 x 16mm <sup>2</sup>	4 x 5AWG	4 x 16mm <sup>2</sup>	4 x 5AWG
4.185				
4.220				

Table 3: Tightening torques for power connections

HVL	Tightening torque			
	Mains and motor cable terminals		Earth conductor	
	Nm	lb-in	Nm	lb-in
2.015 ÷ 2.022 3.015 ÷ 3.022 4.015 ÷ 4.040	0.8	7.1	3	26.6
2.030 ÷ 2.040 3.030 ÷ 3.055 4.055 ÷ 4.110	1.2	10.6	3	26.6
3.075 ÷ 3.110 4.150 ÷ 4.220	1.2	10.6	3	26.6

Control cables

All control cables that are connected to the control board must be screened.  
External volt free contacts must be suitable for switching < 10 VDC.

**NOTICE:**

If unscreened control cables are used, then signal interference with the incoming signals and the function of the unit can be compromised.

Table 4: Recommended control cables

Hydrovar Control Cables	Copper section		Tightening torque	
	mm <sup>2</sup>	AWG	Nm	lb-in.
All I/O conductors	0.2 ÷ 1.6	25 ÷ 16	0.5-0.6	4.5-5.4

## 6.4 EMC compatibility

### 6.4.1 EMC requirements

Hydrovar fulfills the product standard EN61800-3:2004 + A1:2012, which defines categories (C1 to C4) for device application areas.

Depending on the motor cable length, a classification of Hydrovar by category (based on EN61800-3) is reported in the following table:

Table 5: EMC categories

HVL	Hydrovar classification by categories based on 61800-3
2.015 ÷ 2.040	C1 (*)
3.015 ÷ 3.110	C2 (*)
4.015 ÷ 4.220	C2 (*)

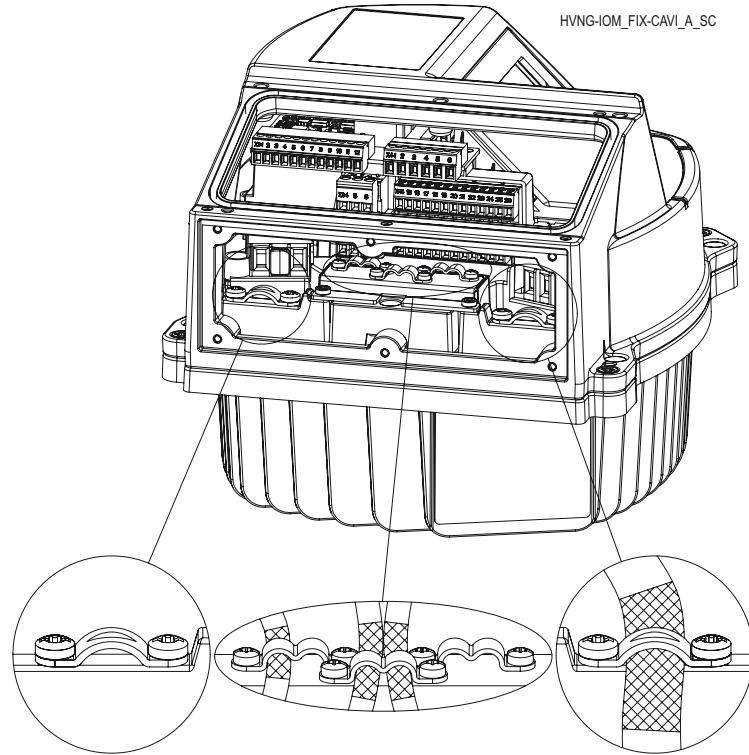
(\*) 0,75 motor cable length; contact Xylem for further information

NOTICE: No external EMC filters are required to make Hydrovar compliant with the limit values of each category reported in the preceding table; motor cable shall be shielded.

### 6.4.2 Wiring the cables

To ensure electromagnetic compatibility the following points must be observed for cable installation:

- Ground cables should be as short as possible and with lowest impedance.
- Signal cables should be screened types to prevent disturbances from outside. Connect the shield to ground on one end only (to prevent ground loops), preferably to HYDROVAR GND using the pre mounted cable-clips; to connect a shield with lowest impedance to ground, remove the insulation from the signal cable and connect the shield to ground, as shown in the following image.
- Shielded Motor cable should be as short as possible; connect the shield to ground on both ends!



**NOTICE:**

Signal cables must be installed separate both from motor cable and power supply cable. If signal cables are installed in parallel to power supply cable or to motor cable for a longer distance, the distance between these cables should be more than 200mm. Do not cross power cables and control cables - if this is not possible, cross them only in an angle of 90°.

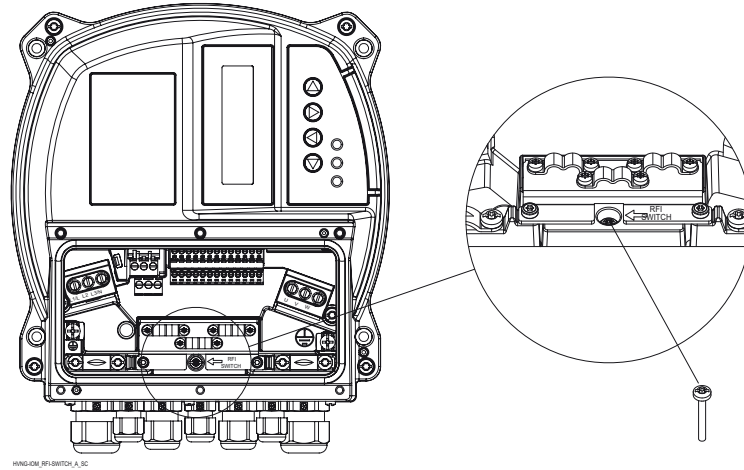
**6.4.3 RFI switch**

In case mains power supply is impedance-grounded (IT), the AC drive must have the EMC protection level C4 as per product standard EN61800-3:2004 + A1:2012: it is then necessary to deactivate the RFI filter of Hydrovar, by unscrewing the RFI switch depicted in the following image.



**WARNING:**

Do not make changes on Hydrovar when it is connected to mains: Make sure that the unit is disconnected from the power supply before removing the screw.

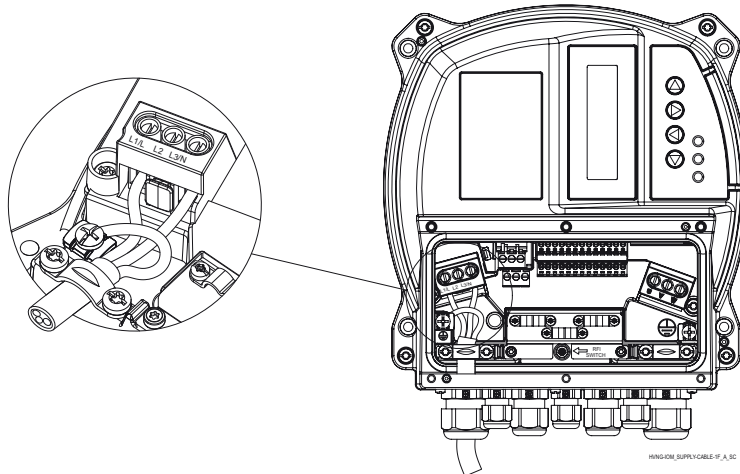


## 6.5 AC mains and motor connection terminals

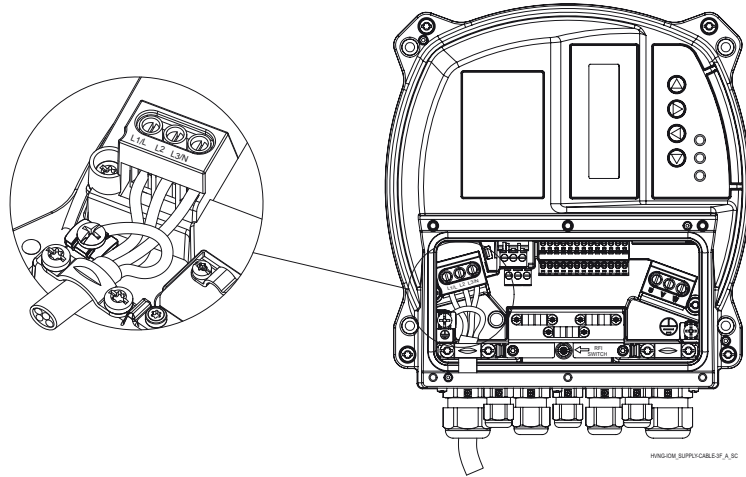
Unscrew the dedicated 6 screws and remove the plastic cover of Hydrovar, in order to proceed wiring the power supply and the motor terminal, as described in the following paragraphs.

### 6.5.1 AC Mains (power supply) connection

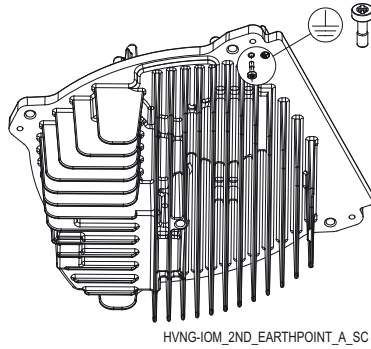
1. Size wiring based upon the input current of Hydrovar  
Comply with local and national electrical codes for cable sizes.
2. Connect 1-phase AC input power wiring to terminals L and N: make sure phase and neutral are properly aligned to provided terminals L and N.



3. Connect 3-phase AC input power wiring to terminals L1, L2, and L3.



4. Ground the cable in accordance with grounding instructions provided.
5. If a double earthing is necessary, use the earth terminal under the heatsink of the drive.



### 6.5.2 Motor connection



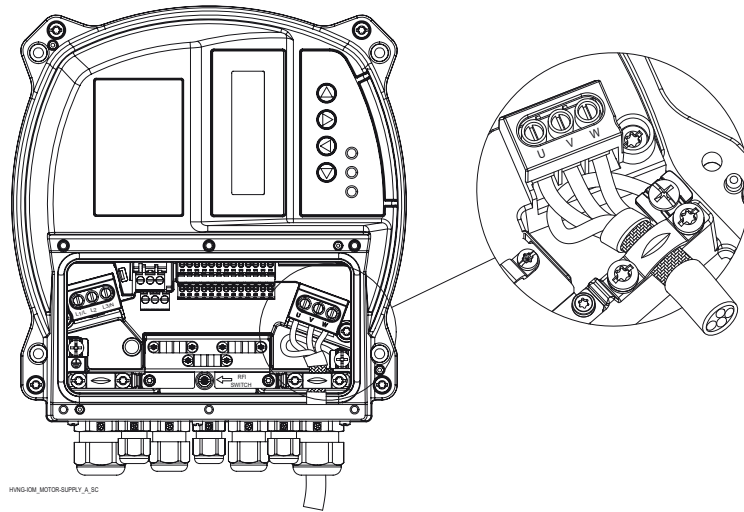
**WARNING:**

INDUCED VOLTAGE. Run output motor cables from multiple frequency converters separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

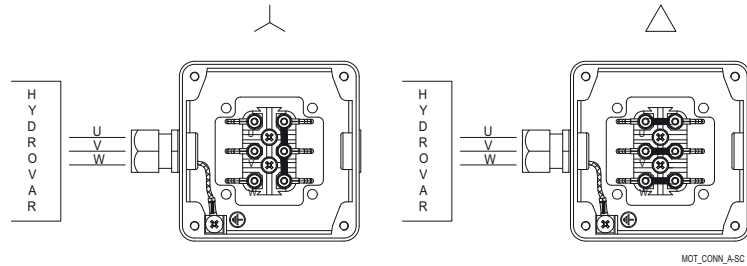
- Comply with local and national electrical codes
- Do not install power factor correction capacitors between the frequency converter and the motor
- Do not wire a starting or pole-changing device between Hydrovar and the motor



- Connect 3-phase motor wiring to terminals U, V, and W.

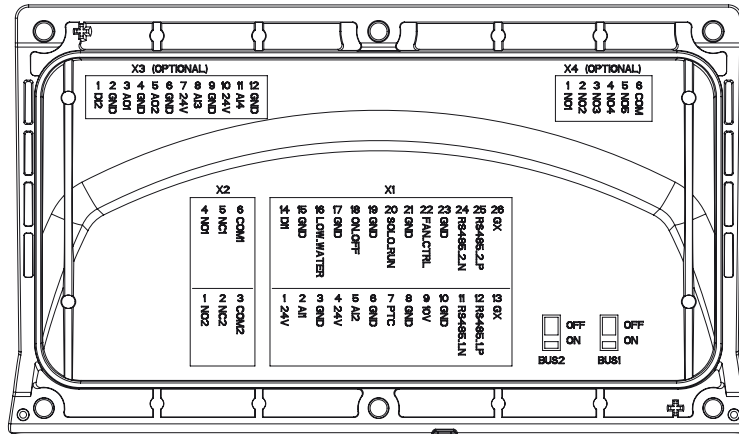


- Ground the cable in accordance with grounding instructions provided
- Torque terminals in accordance with the informations provided.
- Follow motor manufacturer wiring requirements
- The connection of the motor cable depends on the type of motor and can be done in star or delta connection: the right connection of the motor has to be selected as shown on the motor label according to the output voltage of the Hydrovar.
- The connection of the motor cable shield can be done using a pigtail connected to a PE screw (see image below), or by using a metallic cable gland in case of motor with metallic conduit box connected to PE.



## 6.6 Control terminals

Unscrew the dedicated 6 screws and remove the plastic cover of the Hydrovar, in order to proceed wiring the control terminals, as described in the following paragraphs; for reference, the wiring harness scheme is reported on the backside of the plastic cover too.



COVER\_B-SIDE\_A\_SC

Figure 7: Cover

Do not connect the ground of the control card to other voltage potentials. All ground terminals and ground of the RS485 connection are connected internally.

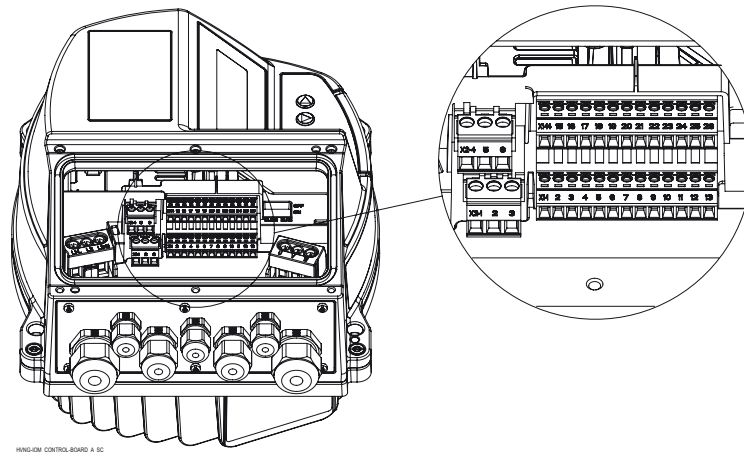


Figure 8: Control board

### 6.6.1 Motor sensor connection

Terminals X1/7 and X1/8 are used to connect a motor sensor (PTC or thermal switch) to stop the unit in case of failure; any other protective device can be connected to these terminals.

As described in par. 3.6 Motor thermal protection, this input can be enabled by setting par. 290 "STC Motor Protection" to data value "Thermistor trip".

Table 6: PTC terminals

Terminals	Description
X1/7	PTC or thermal switch input
X1/8	PTC or thermal switch input (Ground)

### 6.6.2 Input for emergency basic operations

Terminals X1/20 and X1/21 are used to connect an external switch which forces (when closed) Hydrovar to perform a manual start-up till reaching the maximum frequency (fixed speed) set by par. 245 "Maximum Frequency

Table 7: SL terminals

Terminals	Description
X1/20	External switch (SOLO RUN) input
X1/21	External switch (SOLO RUN) input (Ground)

### 6.6.3 Digital and analog I/O

Several terminals, from X1/1 to X1/24, are used to connect analog and digital I/Os to correspondent input signals, most of them configurable by specific parameters.

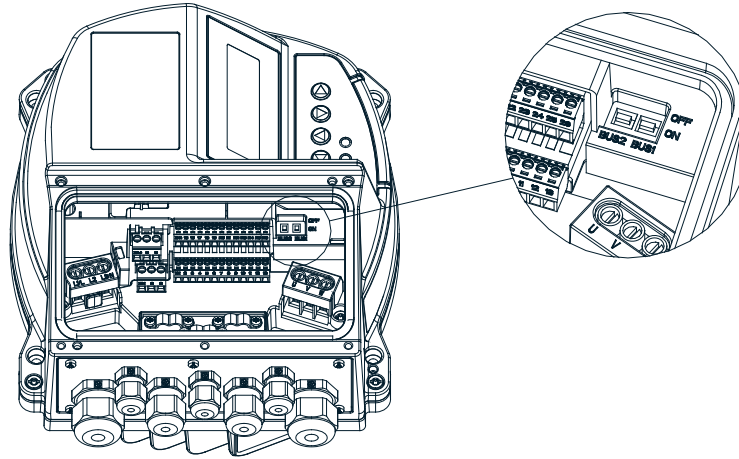
Table 8: I/O terminals

Item	Terminals	Description	Comments
Sensor 1	X1/1	Power supply for external sensor 1	24VDC, $\Sigma$ max. 100mA
	X1/2	Actual value current/voltage input sensor 1	0-20mA / 4-20mA / 0-10 VDC / 2-10 VDC
	X1/3	Ground for external sensor 1	GND, electronic ground (for X1/2)
Sensor 2	X1/4	Power supply for external sensor 2	24VDC, $\Sigma$ max. 100mA
	X1/5	Actual value current/voltage input sensor 2	0-20mA / 4-20mA / 0-10 VDC / 2-10 VDC
	X1/6	Ground for external sensor 2	GND, electronic ground (for X1/5)
Auxiliary	X1/9	Auxiliary voltage supply	10VDC, max. 3mA
	X1/10	Ground for auxiliary voltage supply	GND, electronic ground (for X1/9)
Digital Input	X1/14	Configurable digital input 1	Active low
	X1/15	Ground for configurable digital input 1	GND, electronic ground (for X1/14)
Low water	X1/16	Low water input	Active low
	X1/17	Ground for low water input	GND, electronic ground (for X1/16)
External ON/OFF	X1/18	External ON/OFF input	Active low
	X1/19	Ground for external ON/OFF input	GND, electronic ground (for X1/18)
External fan (Not to be used: only for Wall Mounting kit connection!)	X1/22	External fan control	
	X1/23	Ground for external fan control	GND, electronic ground (for X1/22)

### 6.6.4 RS485 connection

Terminals X1/11, X1/12 and X1/13 are used for the communication among up to 8 Hydrovar in a multi-pump application; a dedicated termination resistor switch (BUS1, see image below) is made available to add a parallel terminator resistor to this RS485 port: if the resistor is needed put BUS1 switch on ON position.

Terminals X1/24, X1/25 and X1/26 are used for the communication (via Modbus or Bacnet protocol) with an external-control-device (e.g. PLC, BMS or a PC too); a dedicated termination resistor switch (BUS2, see image below) is made available to add a parallel terminator resistor to this RS485 port: if the resistor is needed put BUS2 switch on ON position.



HYVAR-DM-BUS-SWITCH\_A\_02

Table 9: RS485 ports

Terminals	Description	Comments
X1/11	RS485 port 1: RS485-1N	RS485 port 1 for multi-pump systems
X1/12	RS485 port 1: RS485-1P	
X1/13	GND, electronic ground	
BUS1	Termination resistor for port 1	
X1/24	RS485 port 2: RS485-2N	RS485 port 2 for external communication
X1/25	RS485 port 2: RS485-2P	
X1/26	GND, electronic ground	
BUS2	Termination resistor for port 2	

### 6.6.5 Status relays

Terminals X2/4, X2/5 and X2/6 are used to make available Status Relay 1 contacts, for driving an external relay used as pump status configurable indicator.

Terminals X2/1, X2/2 and X2/3 are used to make available Status Relay 2 contacts, for driving an external relay used as pump status configurable indicator.

Table 10: Status relays

Terminals	Description	Comments
X2/1	Status Relay 2: NO	Status Relay 2 Maximum 250 VAC, 0.25 A Maximum 220 VDC, 0.25 A Maximum 30 VDC, 2 A
X2/2	Status Relay 2: NC	
X2/3	Status Relay 2: CC	
X2/4	Status Relay 1: NO	Status Relay 1 Maximum 250 VAC, 0.25 A Maximum 220 VDC, 0.25 A Maximum 30 VDC, 2 A
X2/5	Status Relay 1: NC	
X2/6	Status Relay 1: CC	

## 6.7 Premium card terminals

### 6.7.1 Digital and analog I/O (X3)

Several terminals, from X3/1 to X3/12, are used to connect additional analog and digital I/Os to correspondent input signals, most of them configurable by specific parameters.

Table 11: PC I/O terminals

Item	Terminals	Description	Comments
Digital Input	X3/1	Configurable digital input 2	Active low
	X3/2	Ground for configurable digital input 2	GND, electronic ground (for X3/1)
Signal 1	X3/3	Analog output signal 1	4-20mA
	X3/4	Ground for analog output signal 1	GND, electronic ground (for X3/3)
Signal 2	X3/5	Analog output signal 2	0-10 VDC
	X3/6	Ground for analog output signal 2	GND, electronic ground (for X3/5)
Sensor 3	X3/7	Power supply for external sensor 3	24VDC, $\Sigma$ max. 100mA
	X3/8	Actual value current/voltage input sensor 3	0-20mA / 4-20mA / 0-10 VDC / 2-10 VDC
	X3/9	Ground for external sensor 3	GND, electronic ground (for X3/8)
Sensor 4	X3/10	Power supply for external sensor 4	24VDC, $\Sigma$ max. 100mA
	X3/11	Actual value current/voltage input sensor 4	0-20mA / 4-20mA / 0-10 VDC / 2-10 VDC
	X3/12	Ground for external sensor 4	GND, electronic ground (for X3/11)

### 6.7.2 Relays (X4)

Several terminals, from X4/1 to X4/6, are used to connect up to 5 fixed speed pumps through an external panel.

Table 12: Relay terminals

Terminals	Description	Comments
X4/1	Relay 1: NO	Maximum 250 VAC, 0.25 A Maximum 220 VDC, 0.25 A Maximum 30 VDC, 0.25 A
X4/2	Relay 2: NO	
X4/3	Relay 3: NO	
X4/4	Relay 4: NO	
X4/5	Relay 5: NO	
X4/6	Ground for relays	

# 7 Operation

## 7.1 Pre-start procedure



**Electrical Hazard:**

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the frequency converter, even when disconnected from mains input. For initial start up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

1. Make sure input power to unit is OFF and locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
2. In case of 1-phase AC input power, verify that there is no voltage on input terminals L and N, phase-to-phase and phase-to-ground.
3. In case of 3-phase AC input power, verify that there is no voltage on input terminals L1, L2 and L3, phase-to-phase and phase-to-ground.
4. Verify that there is no voltage on output terminals U, V and W, phase-to-phase and phase-to-ground.
5. Confirm continuity of the motor by measuring ohm values on U-V, V-W and W-U.
6. Check for proper grounding of the frequency converter as well as the motor.
7. Inspect the frequency converter for loose connections on terminals.
8. Record the following motor-nameplate data: power, voltage, frequency, full load current, and nominal speed. These values are needed to program motor nameplate data later.
9. Confirm that the supply voltage matches voltage of frequency converter and motor.

## 7.2 Pre-startup inspections

Item to Inspect	Description	Checked
Auxiliary equipment	<ul style="list-style-type: none"> <li>• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on input power side of the frequency converter or output side to motor. Ensure they are ready for full speed operation.</li> <li>• Check function and installation of any sensors used for feedback to the frequency converter.</li> <li>• Remove power factor correction caps on motor(s), if present.</li> </ul>	
Cable routing	<ul style="list-style-type: none"> <li>• Ensure that input power, motor wiring and control wiring are separated or in three separate metallic conduits for high frequency noise isolation.</li> </ul>	
Control wiring	<ul style="list-style-type: none"> <li>• Check for broken or damaged wires and connections.</li> <li>• Check that control wiring is isolated from power and motor wiring for noise immunity.</li> <li>• Check the voltage source of the signals, if necessary.</li> <li>• The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.</li> </ul>	
Cooling clearance	<ul style="list-style-type: none"> <li>• Measure that top and bottom clearance is adequate to ensure proper air flow for cooling.</li> </ul>	
EMC considerations	<ul style="list-style-type: none"> <li>• Check for proper installation with regard to electromagnetic capability.</li> </ul>	
Environmental conditions	<ul style="list-style-type: none"> <li>• See equipment tech label for the maximum ambient operation temperature limits.</li> <li>• Humidity levels must be 5-95% non-condensing.</li> </ul>	
Fusing and circuit breakers	<ul style="list-style-type: none"> <li>• Check for proper fusing or circuit breakers.</li> <li>• Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position.</li> </ul>	

Item to Inspect	Description	Checked
Grounding (earthing)	<ul style="list-style-type: none"> <li>Check for good earth connections (ground connections) that are tight and free of oxidation.</li> <li>Grounding (earthing) to conduit is not a suitable ground (earth) .</li> </ul>	
Input and output power wiring	<ul style="list-style-type: none"> <li>Check for loose connections.</li> <li>Check that motor and mains are in separate conduit or separated screened cables.</li> </ul>	
Switches	<ul style="list-style-type: none"> <li>Ensure that all switch and disconnect settings are in the proper positions.</li> </ul>	
Vibration	<ul style="list-style-type: none"> <li>Check that the unit is mounted solidly.</li> <li>Check for an unusual amount of vibration.</li> </ul>	

Checked by:

Date:

### 7.3 Apply power

**NOTICE:**

- HIGH VOLTAGE.** Frequency converters contain high voltage when connected to AC mains. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to comply could result in death or serious injury.
- UNINTENDED START.** When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to comply could result in death, serious injury, equipment, or property damage.
- POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE!** Risk of personal injury when the frequency converter is not properly closed. Before applying power, ensure all safety covers are in place and securely fastened.

1. Confirm that the input voltage is balanced with 3%. If not, correct voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
2. Ensure that optional equipment wiring, if present, matches the installation application.
3. Ensure that all operator and start enable devices are in the OFF position. Panel doors should be closed or cover mounted.
4. Apply power to the unit. DO NOT start the frequency converter at this time. For units with a disconnect switch, turn to the ON position to apply power to the frequency converter.

### 7.4 Discharge time



**WARNING:**

Disconnect and lock out electrical power and wait for the minimum waiting time specified below. Failure to wait the specified time after power has been removed before performing service or repair could result in death or serious injury.

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect:

- AC mains
- Any permanent magnet type motors
- Any remote DC-link power supplies, including battery backups, ups and DC-link connections to other frequency converters.

Wait for the capacitors to discharge completely before performing any service or repair work. Refer to the following table for wait times:

HVL	Minimum waiting times (min)
2.015 ÷ 2.040	15
3.015 ÷ 3.055	4



HVL	Minimum waiting times (min)
3.075 ÷ 3.110	15
4.015 ÷ 4.110	4
4.150 ÷ 4.220	15

High voltage may be present even when the warning LED indicator lights are off.

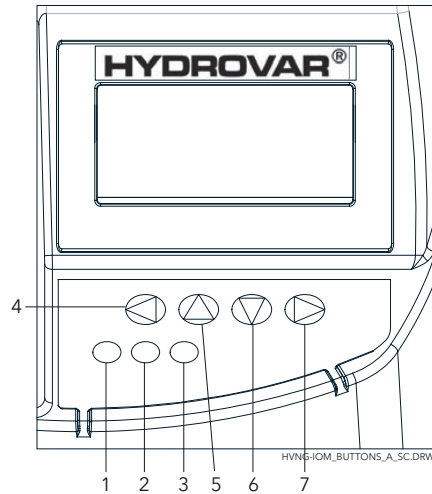
# 8 Programming

Notice

**NOTICE:**

Read and follow the operating instructions carefully before you start programming. This is to prevent incorrect settings which cause malfunction. All modifications must be done by qualified technicians!

## 8.1 Display and control panel



- 1. Power
- 2. Run
- 3. Error
- 4. Left
- 5. Up
- 6. Down
- 7. Right

## 8.2 Functions of push buttons

Push button	Description
▲	Start of the unit in the 1 <sup>st</sup> window.
▼	Stop of the unit in the 1 <sup>st</sup> window.
◀ and ▶	Reset: press both buttons simultaneously for 5 seconds.
▲	Increase of a value / selection of the submenu.
▼	Decrease of a value / selection of the submenu.
▲ + short ▼	Change to faster scrolling up of a value.
▼ + short ▲	Change to faster scrolling down of a value.
Short press ▶	Enter submenu / change to next parameter in the menu.
Short press ◀	Leave submenu / change to previous parameter in the menu.
Long press ◀	Change back to main menu.

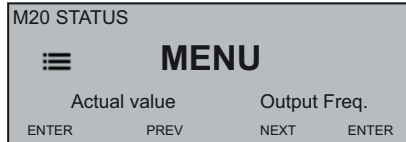
Functions associated to each push button may change, but they are shown in every moment, for reference, on the lowest row of the display.

### 8.3 Software parameters

Parameters are organized in 2 distinct groups:

- The set of parameters only defining menus
- The set of parameters necessary for HYDROVAR configuration

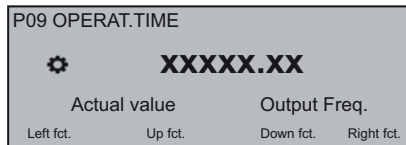
Referring to the first set (those parameters defining menus), each of them is presented with an image of the display containing (for example) the following information:



where:

- M20: is the Menu number
- STATUS: is the Menu name
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **OUTPUT FREQ.:** current frequency supplied by the drive to the motor
- ENTER/PREV/NEXT: actual functions of the related push buttons

Referring to the second set (those parameters configuring HYDROVAR), each of them is presented with an image of the display containing (for example) the following information:



where:

- P09: is the parameter number
- **OPERAT.TIME:** is the parameter name
- XXXXX.XX: is the current parameter value
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right fct.: actual functions of the related push buttons

The parameters are applicable for all HYDROVAR with the following exceptions:

- If a setting is transferred automatically on all HYDROVAR within one system, this is marked with the symbol (Global):
- If a parameter is read-only, this is marked with the symbol (Read-only):



### 8.3.1 M00 MAIN MENU

#### Menu scope

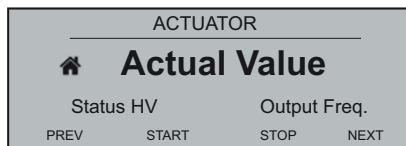
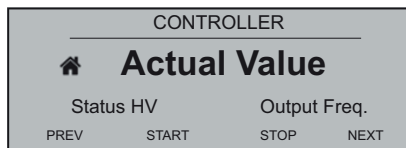
This submenu includes the following software parameters:

- Home
- Selection of required value
- Regulation restart value
- Language selection
- Date and time setup
- Auto - start
- Operating hours

#### HOME

The information shown on the display depends on the selection done in parameter 105 **MODE**; for more details, see [P105 MODE](#) (page 55)

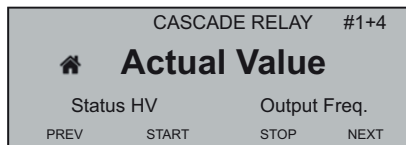
When P105 **MODE** is set to **Controller** or **Actuator**, display shows the following information:



where:

- **Actual value**: is the input signal supplied by the selected transducer (set by menu 400)
- **Status HV**: is the HYDROVAR status (ON / OFF / STOP) depending on manual setting on push buttons and external contact X1/18-19)
- **Output frequency**: current frequency supplied by the drive to the motor
- **PREV/START/STOP/NEXT**: actual functions of the related push buttons

When parameter 105 **MODE** is set to **Cascade Relay**, display shows the following information:

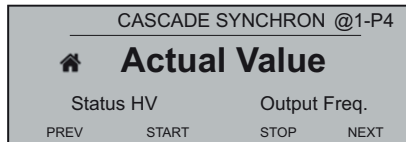
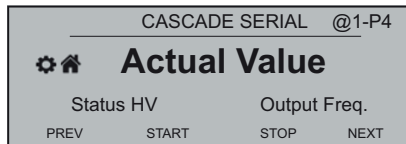


where:

- **Cascade Relay**: is the value of parameter 105
- **#1+4**: is the indication that the system is running with 1 Master (#1) and, for example, 4 fixed speed pumps (+4)
- **Actual value**: is the input signal supplied by the selected transducer (set by menu 400)

- Status HV: is the HYDROVAR status (ON / OFF / STOP) depending on manual setting on push buttons and external contact X1/18-19)
- **Output frequency:** current frequency supplied by the drive to the motor
- PREV/START/STOP/NEXT: actual functions of the related push buttons

When. 105 **MODE** is set to **Cascade Serial** or **Cascade Synchron**, display shows the following information:



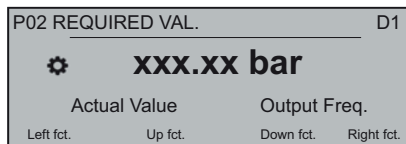
where:

- **Cascade Serial** or **Cascade Synchron:** is the value of parameter 105
- @1: shows, for example, the value of parameter 1220 (**PUMP ADDR.**)
- P4: shows, for example, the address of the pump which is currently acting as Master of the cascade, depending on settings of menu 500
- **Actual value:** is the input signal supplied by the selected transducer (set by menu 400)
- Status HV: is the HYDROVAR status (ON / OFF / STOP) depending on manual setting on push buttons and external contact X1/18-19)
- **Output frequency:** current frequency supplied by the drive to the motor
- PREV/START/STOP/NEXT: actual functions of the related push buttons

P02 REQUIRED VAL. **G**

The information shown on the display depend on the selection done in parameter 105; for more details, see *P105 MODE* (page 55)

When parameter 105 **MODE** is set to **Controller**, **Cascade Relay**, **Cascade Serial** or **Cascade Synchron**, display shows the following information:

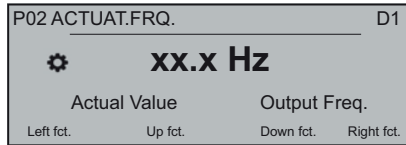


where:

- **REQUIRED VAL.:** is the parameter description
- D1: is (for example) the selected source for the parameter, set by submenu 800
- XXX.XX: is the current parameter value
- bar: is the dimension unit set by parameter 405
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405

- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right: actual functions of the related push buttons

When parameter 105 **MODE** is set to **Actuator**, display shows the following information:



where:

- **ACTUAT.FRQ.1.:** is the parameter description
- D1: is (for example) the selected source for the parameter, set by submenu 800
- XX.X: is the current parameter value
- Hz: is the dimension unit
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right: actual functions of the related push buttons

P03 EFF.REQ.VAL. 

The information shown on the display depends on the selection done in par. 105; for more details, see [P105 MODE](#) (page 55)

When parameter 105 **MODE** is set to **Controller**, **Cascade Relay**, **Cascade Serial** or **Cascade Synchron**, display shows the following information:



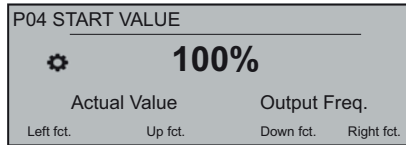
where:

- **EFF.REQ.VAL.:** is the parameter description
- D1: is (for example) the selected source for the parameter, set by submenu 800
- XXX.XX: is the current parameter value
- bar: is the dimension unit set by parameter 405
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right: actual functions of the related push buttons

When parameter 105 **MODE** is set to **Actuator**, P03 is not shown!

Parameter 03 **EFF.REQ.VAL.** shows the current required value that is calculated based on parameter 505 **ACT.VAL.INC.**, parameter 510 **ACT.VAL.DEC.** and parameter 330 **LIFT AMOUNT**. If the required value is influenced by an offset signal (set by submenu 900), then the current active required value is also shown in this window.

P04 START VALUE G

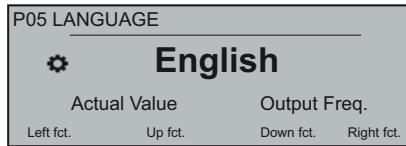


This parameter defines, in percentage (0-100%) of the required value (P02 **REQUIRED VAL.**), the start value after pump stops.

If P02 **REQUIRED VAL.** is met and there is no more consumption, then the pump stops. The pump starts again when the pressure drops below P04 **START VALUE.**

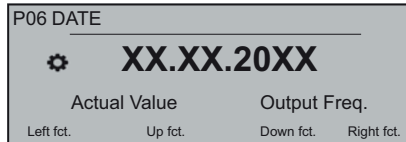
Value 100% makes this parameter not effective (100%=off)!

P05 LANGUAGE



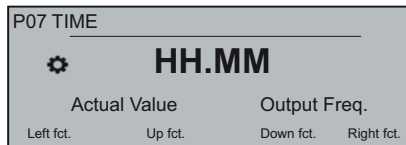
This parameter selects the display language.

P06 DATE



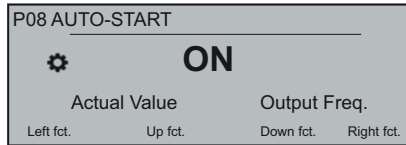
This parameter set current date.

P07 TIME



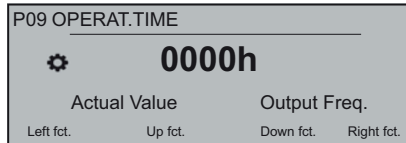
This parameter set current time.

P08 AUTO-START 



If **AUTO-START = On**, then the HYDROVAR starts automatically (in case of demand) following a power disconnection.

P09 OPERAT.TIME 



This parameter shows the total operating time (in hours).  
For an instruction on how to reset the counter, see P1135 **CLR.OPERAT.**.

### 8.3.2 M20 STATUS

#### MENU SCOPE

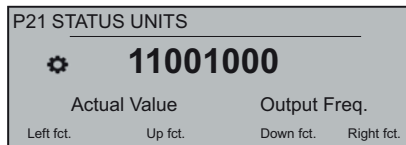
Using this submenu it is possible to check the status (including failures and motor hours) of all connected units.

P21 STATUS UNITS  

This parameter gives a overview about the status of the connected units.

The information shown on the display depend on the selection done in parameter 105 **MODE**; for more details, see [P105 MODE](#) (page 55).

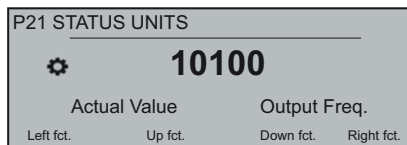
When parameter 105 **MODE** is set to **Cascade Serial** or **Cascade Synchron**, display shows (for example) the following information:



where the status of all (max. 8) connected units is shown (whereas 1=activated / 0=deactivated).

When parameter 105 **MODE** is set to **Cascade Relay**, display shows (for example) the following information:



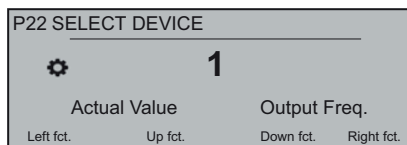


where (HYDROVAR is equipped with additional Premium Card) the status of the 5 Relay-switching contacts is shown. (where as 1=activated / 0=deactivated).

**P22 SELECT DEVICE**

This parameter lets the user select a specific unit (1-8) in a cascade system, so that current status, motor hours and last failures occurred can be checked.

The information shown on the display depends on the selection done in parameter 105 **MODE**; for more details, see *P105 MODE* (page 55).



When P105 **MODE** is set to **Cascade Serial** or **Cascade Synchron**, the value selected for P22 **SELECT DEVICE** specifies the address of the HYDROVAR units,

When P105 **MODE** is set to **Cascade Relay**, the value selected for P22 **SELECT DEVICE** follows the subsequent table:

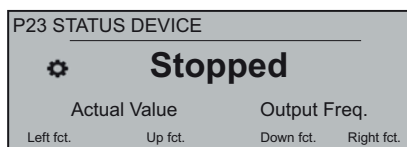
Device		enabled by
1	MASTER Inverter	
2	fixed speed pump	Relay 1 X4 /1
3	fixed speed pump	Relay 2 X4 /2
4	fixed speed pump	Relay 3 X4 /3
5	fixed speed pump	Relay 4 X4 /4
6	fixed speed pump	Relay 5 X4 /5
7	N/A	N/A
8	N/A	N/A

**P23 STATUS DEVICE**  

This parameter shows the status of the selected device (by means of parameter 22 **SELECT DEVICE**).

The information shown on the display depend on the selection done in parameter 105 **MODE**; for more details, see *P105 MODE* (page 55).

When P105 **MODE** is set to **Cascade Serial** or **Cascade Synchron**, display shows (for example) the following information:



where the value displayed may change as per the following table:

Displayed value	Description
Running	The pump runs.
Stopped	The pump is stopped since the pump is not requested.
Disabled	The pump is manually stopped using the: - buttons - parameter P24 <b>ENABLE DEVICE</b> - external device
OFF	The pump is not connected to the power supply or the RS485.
Preparing	A new unit is connected to the system and data is transferring.
Fault	A failure that occurred on the current unit.

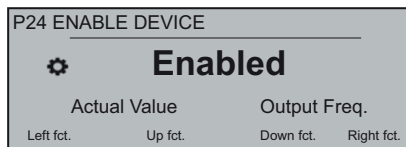
When P105 **MODE** is set to **Cascade Relay**, the value displayed may change as per the following table:

Displayed value	Description
Relay On	The relay contact is closed and the fixed-speed pump operates.
Relay Off	The relay contact is open and the fixed-speed pump is stopped
Fault	A failure that occurred on the current unit.

P24 ENABLE DEVICE 

By using this parameter, the user can manually enable and disable the selected device (by means of parameter 22 **SELECT DEVICE**).

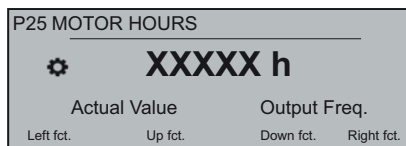
When parameter 105 **MODE** is set to **Controller**, **Cascade Relay**, **Cascade Serial** or **Cascade Synchron**, display shows the following information:





where possible settings are "**Enabled**" or "**Disabled**".

P25 MOTOR HOURS  

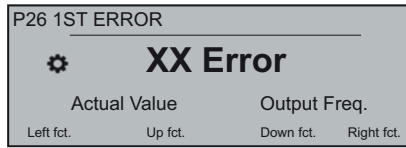
This parameter shows the operation time in hours of the selected device. Thus, the time period during which HYDROVAR has powered the motor.



For information about how to reset the count, see parameter 1130 **CLR.MOTOR H.**


P26 thru P30: ERROR memory  

These parameters hold the error memory information. All errors are saved and shown in these parameters.

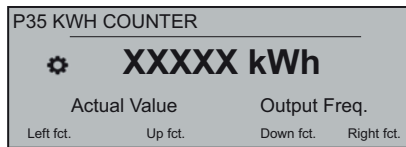


The errors include the following information:

- XX = error code / Error = description
- Date and time of when the error occurred

P35 KWH COUNTER 

This parameter registers the power consumption of the motor as a mean value over 1 hour.



For information about how to reset the counter, see parameter 1140 CLR.KWH CNT.

### 8.3.3 M40 DIAGNOSTICS

#### MENU SCOPE

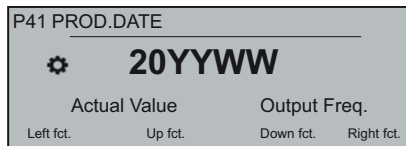
This submenu includes the following software parameters:

- Production date
- Actual temperature
- Actual output current
- Actual input voltage
- Actual output frequency
- Software version of the Power Board

During operation, the information in these parameters is read-only. No changes are permitted.

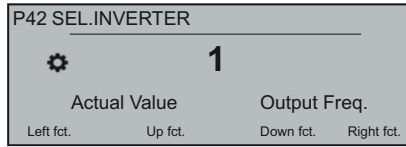
P41 PROD.DATE 

Shows the production date of the control board; the display format is YYYYWW (year, week).



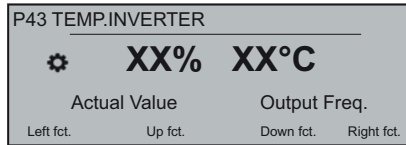
P42 SEL.INVERTER 

Select the desired inverter unit (1-8).



P43 TEMP.INVERTER  

Shows the temperature inside the selected (by mean of parameter 42) unit,

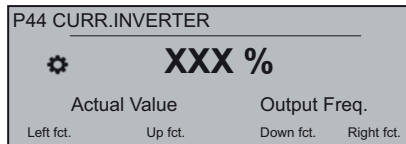


with the following data:

- Temperature inside (°C)
- % of the maximum temperature

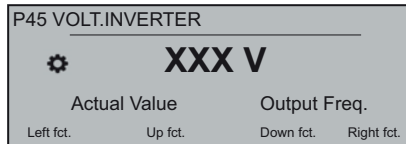
P44 CURR.INVERTER  

Shows the output current in percentage of the maximum rated current for the selected (by mean of parameter 42) unit.



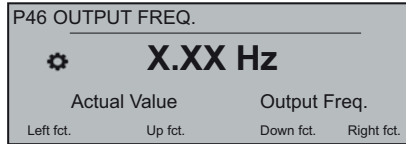
P45 VOLT.INVERTER  



Shows the input voltage (V) for the selected (by mean of parameter 42) unit.



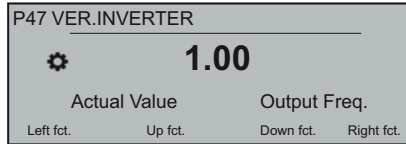
P46 OUTPUT FREQ.  

Shows the output frequency (Hz) for the selected (by mean of parameter 42) unit.



P47 VER.INVERTER : POWER  

Shows information about the software version of the power board for the selected (by means of parameter 42) unit.



For details, see table below.

Displayed value	Versions (power sizes)	Additional information
1.00	All	First Release 12/2015

### 8.3.4 M60 SETTINGS

#### MENU SCOPE

This submenu includes the following software parameters:

- PASSWORD
- JOG



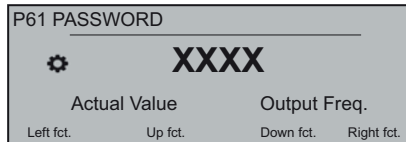
**CAUTION:**

Read these instructions carefully before changing any parameter in this sub menu. The settings must be carried out by trained and qualified persons. Incorrect settings will cause malfunction.

It is possible to change all parameters during operation, but it is highly recommended that the unit is stopped when changing parameters.

#### P61 PASSWORD

Enter the system password, which gives access to all system parameters: default setting is 00066.

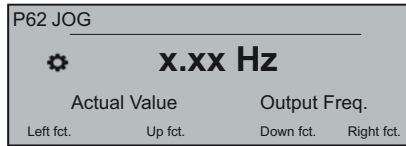


When a correct password is entered, the system remains unlocked for 10 minutes.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

P62 JOG

This parameter deactivates the internal controller of HYDROVAR and changes to manual mode. Display shows the following information:



Where:

- **JOG:** is the parameter description
- **X.XX:** is the current parameter value (0Hz - P245 **MAX.FREQ.**); at 0.0 Hz, the unit stops.
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right fct.: actual functions of the related push buttons

8.3.5 M100 BASIC SETTINGS

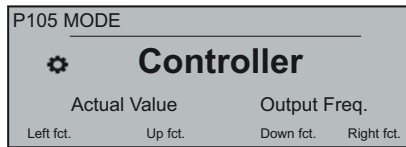
MENU SCOPE

This submenu includes the following software parameters:

- Operation mode
- Pump address
- Password
- Lock function
- Display contrast
- Display brightness

P105 MODE

By using this parameter, the user can select an operation mode.



where possible settings are:

MODE	Operable unit(s)
<b>Controller</b> (Default)	1 Hydrovar
<b>Cascade Relay</b>	1 Hydrovar and Premium Card
<b>Cascade Serial</b>	More than one pump
<b>Cascade Synchron</b>	All pumps operate on the same frequency
<b>Actuator</b>	1 Hydrovar

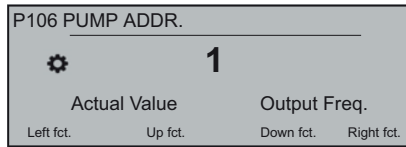
The **Actuator** mode is used if the HYDROVAR is a standard VFD with:

- Fixed speed requirements or
- An external speed signal is connected.

For more information, see [Example: P105 ACTUATOR mode](#) (page 102).

P106 PUMP ADDR.

Selects an address (1-8) for each HYDROVAR



If several MASTER inverters are connected via the internal RS-485 interface (maximum eight in **Cascade Serial** mode), then the following must apply:

- Each HYDROVAR needs an individual pump-address (1-8)
- Each address can only be used once.

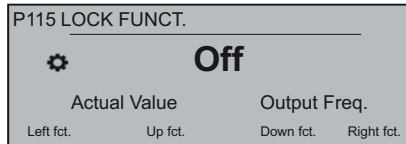
P110 SET PASSW.

Set a system password (00000 - 09999); default setting is 00066.



P115 LOCK FUNCT.

By using this parameter, the user can lock or unlock parameter settings in the main menu.

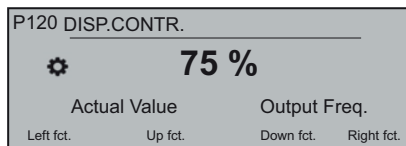


where possible settings are:

Setting	Description
ON	No parameters can be changed without the system password.
OFF	All parameters in the main menu can be changed.

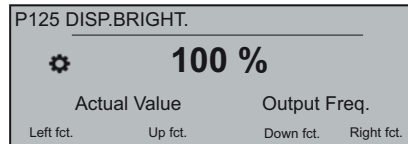
P120 DISP.CONTR.

Adjust the display contrast (10 - 100%)



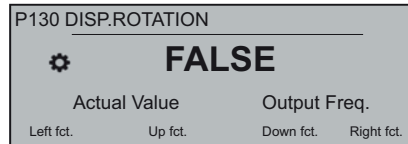
P125 DISP.BRIGHT.

Adjust the backlight brightness of the display (10 - 100%)

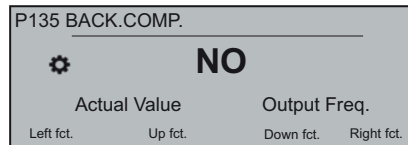


**P130 DISP.ROTATION**

This parameter enables the rotation, by 180°, of display and push buttons relative to standard position.



**P135 BACK.COMP.**



This parameter activates the Backward Compatibility mode: when set to YES, it forces HYDROVAR to work in a multi-pump application acting and communicating as the previous generation HYDROVAR (HV 2.015-4.220).

HVL and HV 2.015-4.220 multi-pump communication protocol are not compatible! Thus in a multi-pump application where there is present at least one previous generation HYDROVAR (HV 2.015-4.220), all the other HVL model shall be forced in backward compatibility mode. For further information check the dedicated HVL Backward compatibility Set-up and programming guide.

**8.3.6 M200 CONF.INVERTER**

**MENU SCOPE**

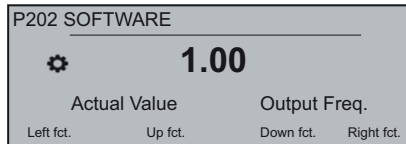
This submenu includes the following software parameters:

- Software
- Number of units
- Ramp settings
- Motor settings
- Frequency settings
- STC protection

**P202 SOFTWARE** 

Shows information about the software version of the control board.



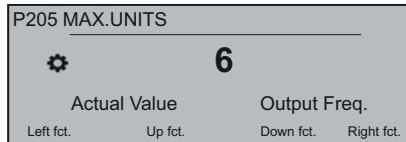


For details, see the table below.

Displayed value	Additional information
1.00	First Release 12/2015

P205 MAX.UNITS **G**

Set the maximum number of units that operate simultaneously.

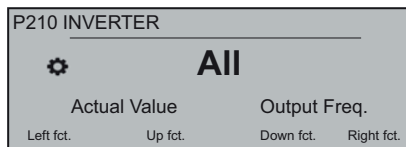


Reasonable values are:

Value	MODE
1-8	Cascade Serial
2-6	Cascade Relay

P210 INVERTER **G**

Select the HYDROVAR address for parameterization.



Possible settings are:

Setting	Description
All	All units in the group are programmed at the same time; in any case all new settings are copied to all units.
1- 8	Used if one specific unit is programmed. Select that unit (1-8).

P215 RAMP 1 **G**

**NOTICE:**

- Fast running up time can cause errors (overload) during the startup.
- Slow running up time can cause a drop of the outgoing operating pressure.

P215 RAMP 1

4 sec

Actual Value
Output Freq.

Left fct.
Up fct.
Down fct.
Right fct.

This parameter adjusts the fast acceleration time, and it effects the control of the pump; the ramp depends on the type of HYDROVAR and the type of pump.

HVL	Possible setting (sec)	Default setting (sec)
2.015 ÷ 2.040	1-250	4
3.015 ÷ 3.040		
4.015 ÷ 4.040		
3.055 ÷ 3.110	1-1000	8
4.055 ÷ 4.110		
4.150 ÷ 4.220	1-1000	12

For more information, see [Example: P200 Ramp Settings](#) (page 102).

P220 RAMP 2 G

**NOTICE:**

- Fast running down time often causes overvoltage.
- Slow running down time often causes over-pressure.

P220 RAMP 2

4 sec

Actual Value
Output Freq.

Left fct.
Up fct.
Down fct.
Right fct.

This parameter adjusts the fast deceleration time, and it effects the control of the pump; the ramp depends on the type of HYDROVAR and the type of pump.

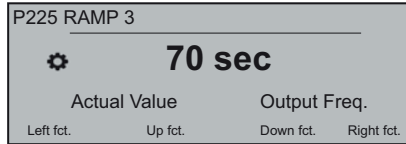
HVL	Possible setting (sec)	Default setting (sec)
2.015 ÷ 2.040	1-250	4
3.015 ÷ 3.040		
4.015 ÷ 4.040		
3.055 ÷ 3.110	1-1000	8
4.055 ÷ 4.110		
4.150 ÷ 4.220	1-1000	12

For more information, see [Example: P200 Ramp Settings](#) (page 102).

P225 RAMP 3 G

**NOTICE:**

- Fast running up time can cause oscillation and overload.
- Slow running up time can cause a drop of the outgoing operating pressure, during variation of the demand.



This parameter adjusts the slow acceleration time, thus determining:

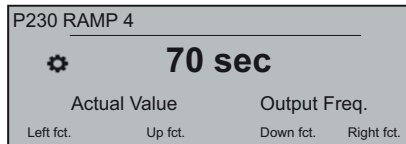
- The regulation speed of the internal HYDROVAR controller for small changes in demand.
- The constant outgoing pressure.

The ramp (default value 70 sec, possible setting 1-1000 sec) depends on the system which has to be controlled. For more information, see [Example: P200 Ramp Settings](#) (page 102).

P230 RAMP 4 G

NOTICE:

- Fast running down time can cause oscillation of the unit and the pump
- Slow running down time can cause pressure fluctuations during variation of the demand.



This parameter adjusts the slow deceleration time, thus determining:

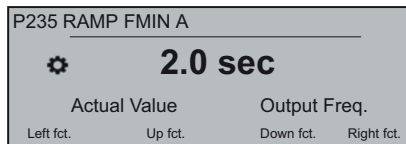
- The regulation speed of the internal HYDROVAR controller for small changes in demand.
- The constant outgoing pressure.

The ramp (default value 70 sec, possible setting 1-1000 sec) depends on the system which has to be controlled. For more information, see [Example: P200 Ramp Settings](#) (page 102).

P235 RAMP FMIN A G

NOTICE:

Fast running up time can cause errors (overload) during start.

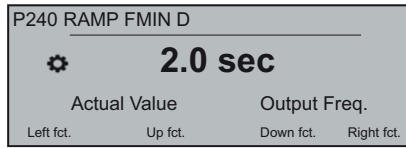


This parameter (default value 2.0 sec, possible setting 1.0- 25.0 sec) sets the ramp Fmin acceleration (fast running up time), and it operates HYDROVAR until the selected P250 **MIN.FREQ.** is reached; after Fmin is passed, P215 **RAMP 1** starts to work. For more information, see [Example: P200 Ramp Settings](#) (page 102).

P240 RAMP FMIN D G

NOTICE:

Fast running down time often causes overvoltage.

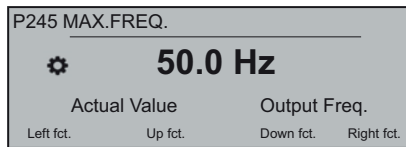


This parameter (default value 2.0 sec, possible setting 1.0- 25.0 sec) sets the ramp Fmin deceleration (fast running down time), and it stops HYDROVAR when it gets below P250 **MIN.FREQ.** For more information, see Example: P200 Ramp Settings.

P245 MAX.FREQ. G

NOTICE:

Settings higher than standard can cause overload of the motor.

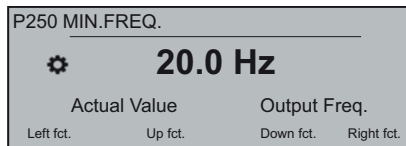


This parameter (default value 50 Hz, possible setting 30.0- 70.0 Hz) sets the maximum frequency, and thus the maximum speed of the pump; the standard setting according to the nominal frequency of the connected motor.

P250 MIN.FREQ. G

NOTICE:

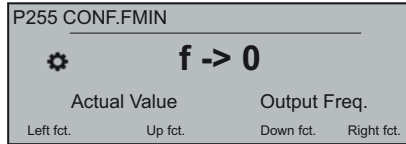
The minimum frequency depends on the selected pump type and application. For borehole applications in particular, the minimum frequency must be set to  $\geq 30$  Hz\*.



This parameter (default value 20 Hz, possible setting 0.0 Hz- P245 **MAX.FREQ.**) sets the minimum frequency; operations below this value are done with P235 **RAMP FMIN A** and P240 **RAMP FMIN D**.

P255 CONF.FMIN G

This parameter defines the operation at minimum frequency.



Possible settings are:

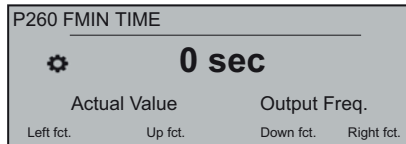
Setting	Description
f-> 0	Once the required pressure is reached and no further consumption is needed, the frequency goes down to the selected P250 <b>MIN.FREQ.</b> : HYDROVAR will then keep running for the selected P260 <b>FMIN TIME</b> and after this time stops automatically.
f-> fmin	With this setting the pump never stop automatically: the frequency goes down to the selected P250 <b>MIN.FREQ.</b> . To stop the pump the external ON/OFF must be opened or the provided push button must be pressed.

**NOTICE:**

For circulation systems, the setting "f -> fmin" can overheat the pump in case there is no flow through it!

P260 FMIN TIME G

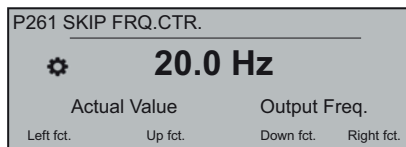
This parameter (default value 0 sec, possible setting 0-100 sec) sets the delay time before a shut-off below P250 **MIN.FREQ.** occurs.



It is used to prevent problems with a shut off of the pump at no demand (too small or no pressure tank), as the system pressure increases during this delay time. This parameter is only active if P255 **CONF.FMIN** is set to "f -> 0".

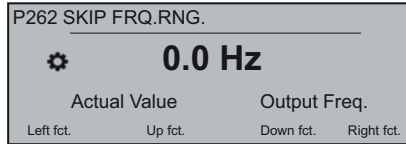
P261 SKIP FRQ.CTR. G

This parameter (possible setting P250 **MIN.FREQ.** - P245 **MAX.FREQ.**) sets the skip frequency center.



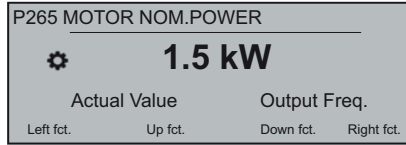
P262 SKIP FRQ.RNG. G

This parameter (possible setting 0.0 - 5.0 Hz) sets the skip frequency range.



**P265 MOTOR NOM.POWER**

Sets the nominal power of the motor coupled with HYDROVAR, as reported in the motor nameplate.



Possible settings are:

HVL	Undersized motor 2	Undersized motor 1	Default	Oversized motor
2,015	0.75 kW - 1.0 hp	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp
2,022	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp
2,030	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp
2,040	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp
3,015	0.75 kW - 1.0 hp	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp
3,022	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp
3,030	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp
3,040	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp
3,055	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp
3,075	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp	11.0 kW - 15.0 hp
3,110	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp	11.0 kW - 15.0 hp	15.0 kW - 20.0 hp
4,015	0.75 kW - 1.0 hp	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp
4,022	1.1 kW - 1.5 hp	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp
4,030	1.5 kW - 2.0 hp	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp
4,040	2.2 kW - 3.0 hp	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp
4,055	3.0 kW - 4.0 hp	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp
4,075	4.0 kW - 5.0 hp	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp	11.0 kW - 15.0 hp
4,110	5.5 kW - 7.5 hp	7.5 kW - 10.0 hp	11.0 kW - 15.0 hp	15.0 kW - 20.0 hp
4,150	7.5 kW - 10.0 hp	11.0 kW - 15.0 hp	15.0 kW - 20.0 hp	18.5 kW - 25.0 hp
4,185	11.0 kW - 15.0 hp	15.0 kW - 20.0 hp	18.5 kW - 25.0 hp	22.0 kW - 30.0 hp
4,220	15.0 kW - 20.0 hp	18.5 kW - 25.0 hp	22.0 kW - 30.0 hp	30.0 kW - 40.0 hp

**P266 MOTOR NOM.VOLT.**

Sets the motor nominal voltage, as reported in the motor nameplate, according to

- the chosen motor connection
- the output voltage of the HYDROVAR

P266 MOTOR NOM.VOLT.

**230 V**

Actual Value      Output Freq.

Left fct.      Up fct.      Down fct.      Right fct.

Possible settings are:

HVL	Possible setting (V)	Default setting (V)
2.015 ÷ 2.040	208-240	230
3.015 ÷ 3.110	208-240	230
4.015 ÷ 4.220	380-460	400

P267 MOTOR NOM.FRQ.

Sets the motor nominal frequency, as reported in the motor nameplate

P267 MOTOR NOM.FRQ.

**50.0 Hz**

Actual Value      Output Freq.

Left fct.      Up fct.      Down fct.      Right fct.

P268 MOTOR NOM.CURR.

Sets the motor nominal current, as reported in the motor nameplate, according to

- the chosen motor connection
- the output voltage of the HYDROVAR

P268 MOTOR NOM.CURR.

**7.5 A**

Actual Value      Output Freq.

Left fct.      Up fct.      Down fct.      Right fct.

P269 MOTOR NOM.SPEED

Sets the motor nominal speed, as reported in the motor nameplate

P269 MOTOR NOM.SPEED

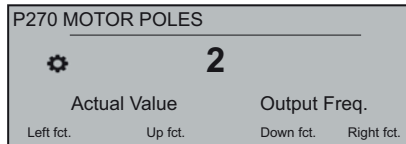
**3000 rpm**

Actual Value      Output Freq.

Left fct.      Up fct.      Down fct.      Right fct.

P270 MOTOR POLES

This parameter (possible setting 2 or 4) sets the number of motor poles (display showing, for example, the following information)



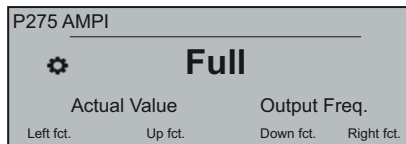
P275 AMPI

NOTICE:

- For the best adaptation of HYDROVAR, run **AMPI** on a cold motor
- **AMPI** cannot be performed while the motor runs
- **AMPI** cannot be performed on a motor with a bigger power rating than HYDROVAR that is, when a 5.5 kW motor is coupled with a 4 kW drive
- Avoid generating external torque during **AMPI**.

This parameter activates the Automatic Motor Parameter Identification; possible settings are "Off" (**AMPI** not active), "Full" or "Reduced" (procedure to be performed only in case LC filters are applied on the motor cable).

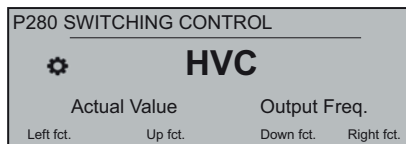
For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.



Once the **AMPI** procedure is activated (when either "Full" or "Reduced" option is selected), it takes up to 3 min for the identification of the motor: during this period HYDROVAR prevents the user from any action ("Running" message on the display, push-buttons deactivated).

Possible outcomes are "OK" (**AMPI** succeeded in self-configuring the motor) or "Fault" (**AMPI** result unsuccessful): once one of these two messages is displayed, HYDROVAR unlocks the push buttons to standard related functions.

P280 SWITCHING CONTROL



Sets the motor control method. Possible settings are "V/f" or "HVC" (default)

"V/f" represents the Scalar Control: the open loop volts/hertz control of an induction motor is by far most popular method of speed control because of its simplicity.

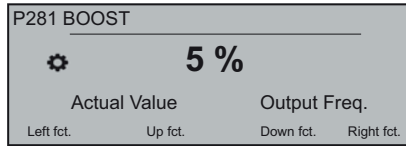
"HVC" represents the HYDROVAR Vector Control: this method improves dynamic and stability, both when speed reference is changed and in relation to the load torque. This type of control is adaptive to motor load and adaptation to speed and torque changes is less than 3 milliseconds. Motor torque can remain constant regardless to speed changes.



P281 BOOST G

NOTICE:

- If this parameter is set too low or too high, then there is a risk for overload due to too high starting current.
- Keep the settings as low as possible to reduce the risk of thermal overload of the motor at lower frequencies.



This parameter (possible setting 0-25%) sets the motor starting voltage in % of connected supply voltage, thus determining the characteristics of the voltage/frequency curve.

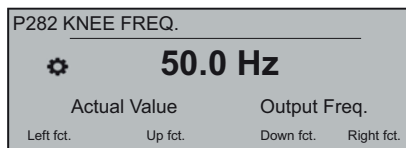
The default value depends on the type of HYDROVAR:

HVL	Default setting (%)
2.015 ÷ 2.040	5
3.015 ÷ 3.040	
4.015 ÷ 4.040	
3.055 ÷ 3.110	8
4.055 ÷ 4.110	
4.150 ÷ 4.220	10

P282 KNEE FREQ. G

NOTICE:

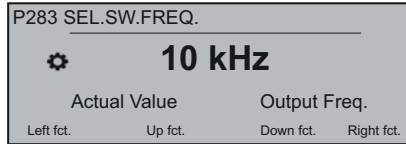
This parameter must be used for special applications only. An incorrect setting can cause overload or damage of the motor.



This parameter (default value 50 Hz, possible setting 30.0- 90.0 Hz) sets the knee frequency, where HYDROVAR generates its maximum output voltage. For standard applications, set this value according to nominal frequency of the motor.

P283 SEL.SW.FREQ. G

This parameter sets the switching frequency.

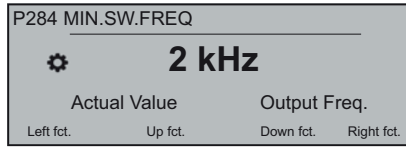


HYDROVAR, in any case, can decrease automatically the switching frequency applying the derating criteria. Possible settings are:

HVL	Possible setting					
					Default	
2,015	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
2,022	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
2,030	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
2,040	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,015	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,022	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,030	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,040	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,055	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
3,075		2 kHz	4 kHz	8 kHz	10 kHz	16 kHz
3,110		2 kHz	4 kHz	8 kHz	10 kHz	16 kHz
4,015	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,022	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,030	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,040	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,055	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,075	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,110	Random ~5 kHz	2 kHz	5 kHz	8 kHz	10 kHz	16 kHz
4,150		2 kHz	4 kHz	8 kHz	10 kHz	16 kHz
4,185		2 kHz	4 kHz	8 kHz	10 kHz	16 kHz
4,220		2 kHz	4 kHz	8 kHz	10 kHz	16 kHz

P284MIN.SW.FREQ. **G**

This parameter sets the minimum switching frequency HYDROVAR can generate.



This parameter is useful to force HYDROVAR to generate:

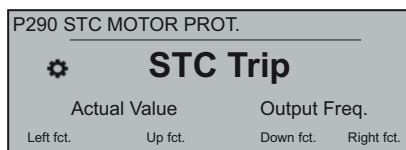
- switching frequencies in a certain bandwidth (upper limit defined by P283 - lower limit defined by P284)
- a fixed switching frequency (when P283 = P284).

Possible settings are:


HVL	Default				
2,015	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
2,022	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
2,030	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
2,040	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,015	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,022	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,030	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,040	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,055	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
3,075	2 kHz	4 kHz	8 kHz	10 kHz	16kHz
3,110	2 kHz	4 kHz	8 kHz	10 kHz	16kHz
4,015	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,022	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,030	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,040	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,055	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,075	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,110	2 kHz	5 kHz	8 kHz	10 kHz	16kHz
4,150	2 kHz	4 kHz	8 kHz	10 kHz	16kHz
4,185	2 kHz	4 kHz	8 kHz	10 kHz	16kHz
4,220	2 kHz	4 kHz	8 kHz	10 kHz	16kHz

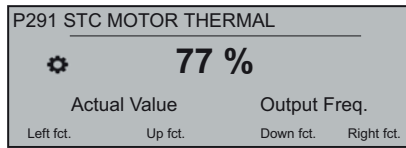
P290 STC MOTOR PROT.

This parameter sets the protection technique against motor overheating.



Possible settings are "Thermistor trip" or "STC trip" (default).

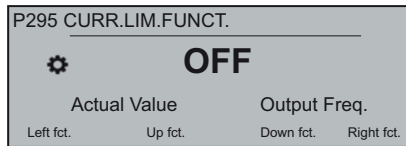
P291 STC MOTOR THERMAL 



This parameter shows the calculated percentage of allowed maximum temperature (for the motor) calculated by STC, based on actual current and speed.

P295 CURR.LIM.FUNCT.

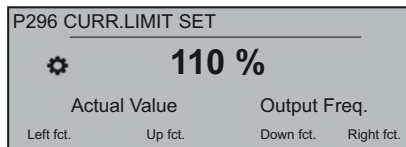
This parameter activates (ON) or deactivates (OFF, default) the current limit functionality.



P296 CURR.LIMIT SET

This parameter (default value 110%, possible setting 10-300%) sets the current limit for motor (in % of rated motor current)

If the set value is higher than HYDROVAR maximum rated output, then current is still limited to the maximum rated output.



### 8.3.7 M300 REGULATION

MENU SCOPE

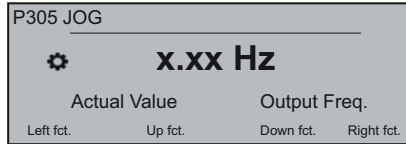
This submenu includes the following software parameters:

- Jog
- Window
- Hysteresis
- Regulation mode
- Lift settings

P305 JOG

This parameter deactivates the internal controller of HYDROVAR and changes to manual mode.

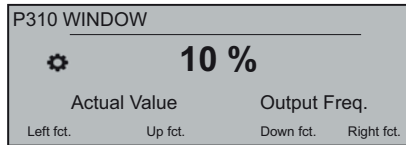
Display shows the following information:



Where:

- **JOG:** is the parameter description
- **X.XX:** is the current parameter value (0Hz - P245 **MAX.FREQ.**); at 0.0 Hz, the unit stops.
- **Actual value:** is the input signal supplied by the selected transducer (set by submenu 400), expressed with the dimension unit set by parameter 405
- **Output frequency:** current frequency supplied by the drive to the motor
- Left/Up/Down/Right fct.: actual functions of the related push buttons

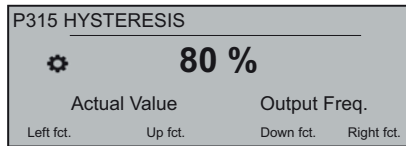
P310 WINDOW G



This parameter (default value 10%, possible setting 0-100%) sets the range for ramp control; from slow to fast.

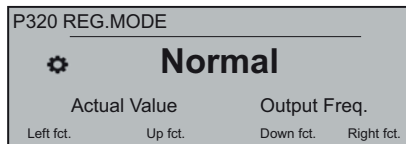
P315 HYSTERESIS G

This parameter (default value 80%, possible setting 0-100%) sets the hysteresis for ramp switching. It determines where the normal regulation is done; value = 99% indicates an accurate control without automatic shut-off.



P320 REG.MODE G

This parameter selects the regulation mode.



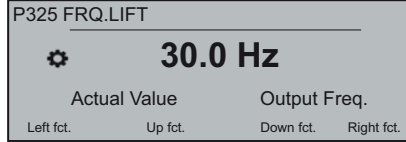
Possible setting are:

Setting	Description
Normal	Increased speed with falling actual value signal.

Setting	Description
Inverse	Reduced speed with falling actual value signal.

P325 FRQ.LIFT **G**

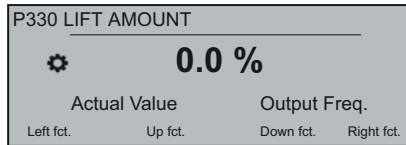
This parameter (default value 30.0 Hz, possible setting 0.0-70.0 Hz) sets the frequency limit for the required lift value where the required pressure starts to be increased.



The correct frequency is when the pump reaches the set pressure at zero flow. This can be determined by using P305 JOG.

P330 LIFT AMOUNT **G**

This parameter (default value 0.0 %, possible setting 0.0-200.0%) sets the lift amount for the required lift value in HVAC systems or for compensation of friction losses in long pipe work.



It determines the increase of the set value until the maximum speed (and maximum volume) is reached.

For an application example, see Example P330 LIFT AMOUNT.

### 8.3.8 M400 SENSOR

#### MENU SCOPE

In this submenu it is possible to configure all actual-value sensors that are connected to the HYDROVAR. However, the following limitations apply:

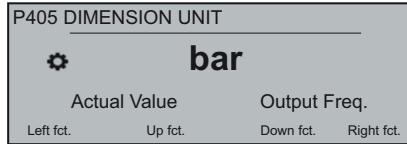
- It is possible to have maximum two transducers with current output or voltage-signal output.
- The transducer types: it is not possible to install two different transducer types because the main configuration is the same for all connected sensors.

This submenu includes the following software parameters:

- Dimension unit
- Configuration
- Type of sensor
- Sensor range
- Sensor curve
- Calibration

#### P405 DIMENSION UNIT

Selects the unit of measure for the system.

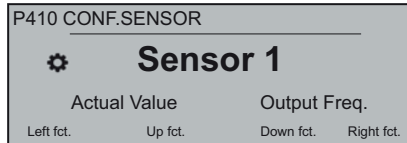


In case a change of this parameter is needed, consider to change P420 **SENSOR RANGE** to the corresponding dimension unit too!

**P410 CONF.SENSOR**

Sets how the connected sensors are used and which sensor is active.

It is also possible to measure the difference of two connected sensors or to configure an automatic switch-over in case of a faulty sensor.



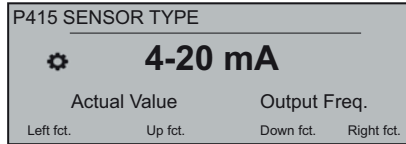
Possible setting are:

Table 13: Possible settings

Setting	Property	Description
<b>Sensor 1</b>	Constantly active	0/4 - 20 mA signal: connected to X1/2 and X1/1 (+24V)
		0/2 - 10 V signal: connected to X1/2, X1/1 (+24V) and X1/3 (GND)
<b>Sensor 2</b>	Constantly active	0/4 - 20 mA signal: connected to X1/5 and X1/4 (+24V)
		0/2 - 10 V signal: connected to X1/5, X1/4 (+24V) and X1/6 (GND)
<b>Auto</b>	Automatic switch over	In case of faulty sensor
<b>Switch Dig1</b>	Manual switching	Close digital input 1 (X1/14 - X1/15)
<b>Switch Dig2</b>	Manual switching	Close digital input 2 (X3/1 - X3/2, on Premium Card)
<b>Switch Dig3</b>	Manual switching	Close digital input 3 (X3/5 - GND)
<b>Switch Dig4</b>	Manual switching	Close digital input 4 (X3/15 - 16)
<b>Auto Lower</b>	Automatic switch over	The sensor with the lower actual value is active
<b>Auto Higher</b>	Automatic switch over	The sensor with the highest actual value is active
<b>Sens.1 - Sens.2</b>	-	The difference of the connected sensors as actual value

**P415 SENSOR TYPE**

Selects the sensor type and the input terminal.



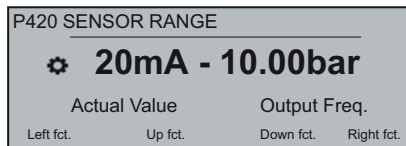
Possible setting are:

Table 14: Selection of the sensor type and input terminal

Setting	Input Terminals	Actual Value
<ul style="list-style-type: none"> <li>Analog I 4 - 20 mA</li> <li>Analog I 0- 20 mA</li> </ul>	<ul style="list-style-type: none"> <li>X1/2: <b>Sensor 1</b></li> <li>X1/5: <b>Sensor 2</b></li> </ul>	It is determined by a current signal connected to the given input terminal.
Analog U 0-10 V	<ul style="list-style-type: none"> <li>X1/2: <b>Sensor 1</b></li> <li>X1/5: <b>Sensor 2</b></li> </ul>	It is determined from a voltage signal connected to the given input terminal.

P420 SENSOR RANGE G

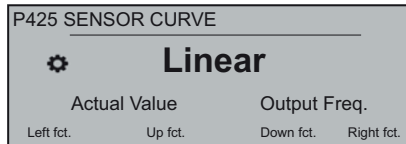
Sets the end range value (20 mA or 10 V) of the connected sensor.



In particular, the end range value (20mA or 10V) shall be always equal to the 100% of the sensor range (i.e. for a 0.4bar differential pressure sensor, will be 20mA=0.4bar)

P425 SENSOR CURVE

Sets the mathematical function (curve) to determine the Actual Value based on the Sensor signal.



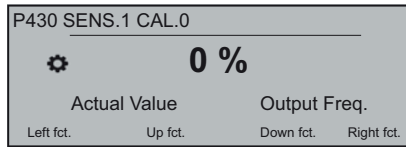
Possible setting are:

Setting	Application
Linear	<ul style="list-style-type: none"> <li>Pressure control</li> <li>Differential Pressure control</li> <li>Level</li> <li>Temperature</li> <li>Flow control (inductive or mechanical)</li> </ul>
Quadratic	<ul style="list-style-type: none"> <li>Flow control (using an orifice plate with a differential pressure sensor)</li> </ul>



P430 SENS.1 CAL.0

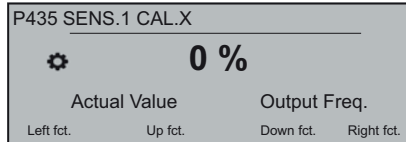
This parameter is used to calibrate the minimum value of Sensor 1.



After setting P405 **DIMENSION UNIT** and P420 **SENSOR RANGE**, the zero point for this sensor can be adjusted between -10 % and +10 %.

P435 SENS.1 CAL.X

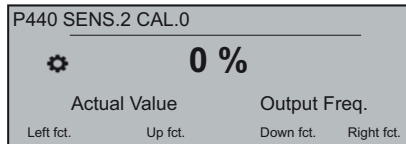
This parameter is used to calibrate the upper range value of sensor 1.



After setting P405 **DIMENSION UNIT** and P420 **SENSOR RANGE**, the upper range value can be adjusted between -10 and +10%.

P440 SENS.2 CAL.0

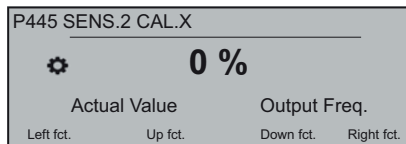
This parameter is used to calibrate the minimum value of Sensor 2.



After setting P405 **DIMENSION UNIT** and P420 **SENSOR RANGE**, the zero point for this sensor can be adjusted between -10 % and +10 %.

P445 SENS.2 CAL.X

This parameter is used to calibrate the upper range value of sensor 2.



After setting P405 **DIMENSION UNIT** and P420 **SENSOR RANGE**, the upper range value can be adjusted between -10 and +10%.

8.3.9 M500 SEQUENCE CONTR.

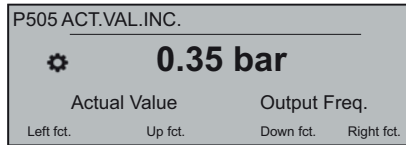
MENU SCOPE

In this submenu it is possible to configure parameters for running a multi-pump system. This submenu includes the following software parameters:

- Actual value (increase, decrease)
- Frequency (enable, disable, drop)
- Delay (enable, switch, disable)
- Overvalue
- Overvalue delay
- Switch intervals
- Synchronous frequency limit and window

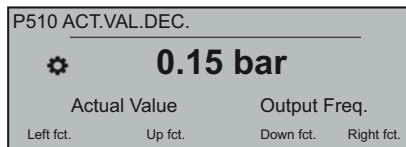
For example and more information, see P500 *Example: P500 SUBMENU SEQUENCE CNTR.* (page 104).

P505 ACT.VAL.INC. G



Sets the lift value on the range 0.00 - P420 **SENSOR RANGE**.

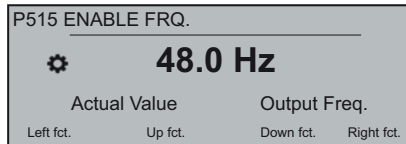
P510 ACT.VAL.DEC. G



Sets the drop value on the range 0.00 - P420 **SENSOR RANGE**.

P515 ENABLE FRQ. G

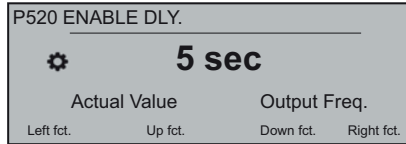
This parameter (default value 48.0Hz, possible setting 0.0-70.0Hz) sets the desired release frequency for the following pumps.



The next pump starts when this value is reached and the system pressure drops below the difference (P02 **REQUIRED VAL.** - P510 **ACT.VAL.DEC.**).

P520 ENABLE DLY.

This parameter only applies to cascade relay!



It sets the enable delay time: the fixed-speed pump starts after the selected time.

P525 SWITCH DLY.

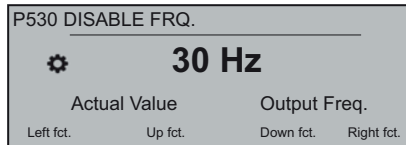
This parameter only applies to cascade relay!



It sets the switch delay time, thus avoiding repeated switching caused by consumption variation.

P530 DISABLE FRQ.

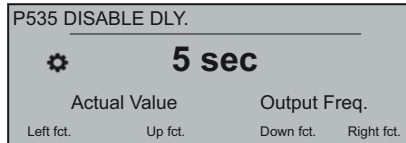
This parameter only applies to cascade relay!



It sets the frequency to switch off the fixed speed pumps. If the MASTER Inverter goes below this frequency for longer time than the pre-selected P535 **DISABLE DLY.** and the system pressure is higher than P03 **EFF.REQ.VAL.**, the MASTER stops another assist pump.

P535 DISABLE DLY.

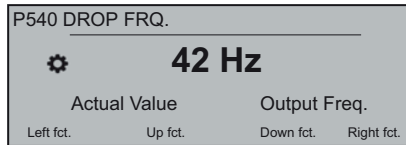
This parameter only applies to cascade relay!



It sets the delay time before switching off the assist pumps.

P540 DROP FRQ.

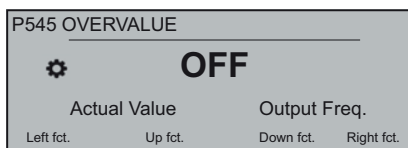
This parameter only applies to cascade relay!



It is used to prevent the system from pressure hammers. Before the MASTER starts a new assist pump, it drops to this frequency and then (when the frequency is reached) the assist pump is started; at that point the MASTER Inverter returns to normal operation.

**P545 OVERVALUE**

This parameter only applies to cascade relay!

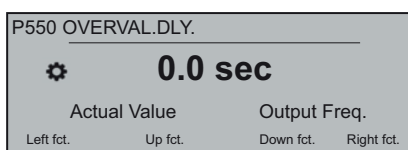


This parameter prevents the system against overpressure in case the HYDROVAR has been parameterized incorrectly: if this selected value is reached, an immediate shut-off of the follow-up-pumps is executed.

Possible settings are "Off" (default) or P420 **SENSOR RANGE**.

**P550 OVERVAL.DLY.**

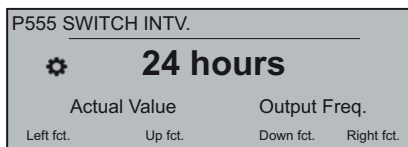
This parameter only applies to cascade relay!



This parameter sets the delay time to switch off an assist pump in case the actual value exceeds P545 **OVERVALUE** limit.

**P555 SWITCH INTV.** G

This parameter only applies to cascade serial and synchronous!



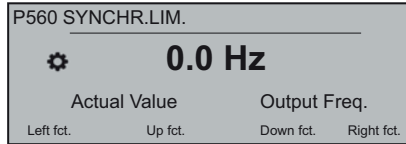
This parameter sets the switch interval for the cyclic change-over: it allows an automatic change-over of the MASTER pump and the assist pumps.

As soon as the switch time is reached the next pump becomes MASTER and the counter restarts; this gives even wear and similar operating hours to all pumps. The switch interval is active as long as the MASTER does not stop.

For information about how to find the correct setting, see [Example: P500 SUBMENU SEQUENCE CNTR.](#) (page 104).

**P560 SYNCHR.LIM.** G

This parameter only applies to cascade synchronous!

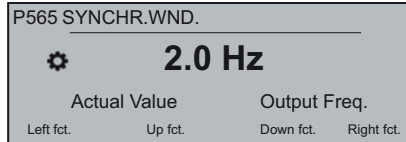


This parameter sets the frequency limit: the first assist pump shuts off if the frequency goes below this parameter's value.

For information about how to find the correct setting, see [Example: P500 SUBMENU SEQUENCE CNTR.](#) (page 104).

P565 SYNCHR.WND. G

This parameter only applies to cascade synchronous!



This parameter sets the frequency window: the limit for switching off the next assist pump.

For information about how to find the correct setting, see [Example: P500 SUBMENU SEQUENCE CNTR.](#) (page 104).

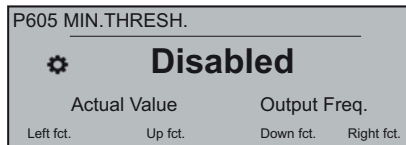
8.3.10 M600 ERROR

MENU SCOPE

This submenu includes the following software parameters:

- Minimum threshold limit
- Delay time
- Automatic error reset

P605 MIN.THRESH.

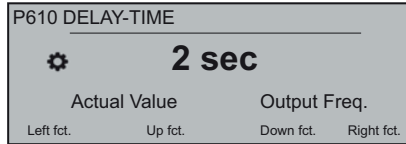


Selects the minimum threshold limit: if an adjusted value > 0.00 is not reached within the P610 **DELAY-TIME**, the unit stops (failure message: **MIN.THRESH.ERROR**).

P610 DELAY-TIME G

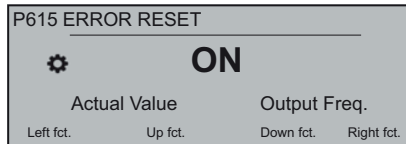
**NOTICE:**

The minimum threshold function is also active during the start-up of the pump. Therefore, the delay time must be set higher than the time required to start up the pump and fill the system.



Selects the delay time of the minimum threshold limit: it shuts off the HYDROVAR if the actual value drops below P605 **MIN.THRESH.** or if a low-water protection (at terminals X1/16-17) becomes open.

P615 ERROR RESET **G**



Selects automatic reset of errors; if a manual reset is selected, switch an external ON/OFF contactor to the terminal X1/18-19. Possible settings are:

Setting	Description
ON	<ul style="list-style-type: none"> <li>Allows an automatic restart five times when an error occurs</li> <li>Shuts off the unit after the fifth restart.</li> <li>The internal counter is decreased by one after each operating hour.</li> </ul>
OFF	<ul style="list-style-type: none"> <li>Each error shown on the display.</li> <li>Each error must be reset manually.</li> </ul>

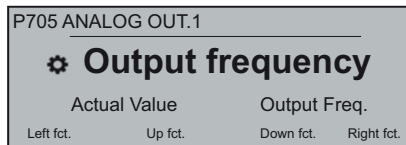
8.3.11 M700 OUTPUTS

MENU SCOPE

This submenu includes the following software parameters:

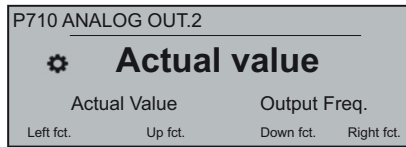
- Analog output 1 and 2
- Configuration of status relay 1 and 2

P705 ANALOG OUT.1



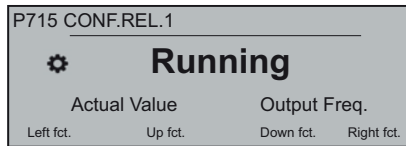
Selects the first analog output, which is connected to terminal X3/3-4 on the Premim Card (analogue output 0 - 10 V = 0 - 100%).

P710 ANALOG OUT.2



Selects the second analog output, which is connected to terminal X3/5-6 on the Premim Card (analog output 4 - 20 mA = 0 - 100%).

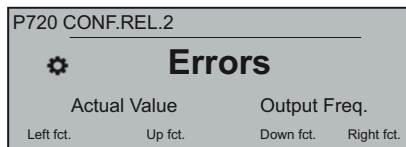
P715 CONF.REL.1



Selects the status relay 1 (X2/4 - 5 - 6). Possible settings are:

Setting	Description	Action if status = YES
Power	HYDROVAR is connected to the power supply.	Relay 1: X2/ 4 - 6 closed
Running	The motor is running	Relay 1: X2/ 4 - 6 closed
Errors	An error is indicated on HYDROVAR (including power failure).	Relay 1: X2/ 5 - 6 closed
Warnings	A warning is indicated in the HYDROVAR	Relay 1: X2/ 5 - 6 closed
StandBy	The pump is released manually and by external release, no error/warning is indicated and the HYDROVAR does not run.	Relay 1: X2/ 4 - 6 closed
Errorreset	If the parameter P615 <b>ERROR RESET</b> is activated and a warning occurs five times -> Error ->	Relay 1: X2/ 4 - 6 closed

P720 CONF.REL.2



Selects the status relay 2 (X2/1 - 2 - 3). Possible settings are:

Setting	Description	Action if status = YES
Power	HYDROVAR is connected to the power supply.	Relay 2: X2/ 1 - 3 closed
Running	The motor is running	Relay 2: X2/ 1 - 3 closed
Errors	An error is indicated on HYDROVAR (including power failure).	Relay 2: X2/ 2 - 3 closed

Setting	Description	Action if status = YES
Warnings	A warning is indicated in the HYDROVAR	Relay 2: X2/ 2 - 3 closed
StandBy	The pump is released manually and by external release, no error/warning is indicated and the HYDROVAR does not run.	Relay 2: X2/ 1 - 3 closed
Errorreset	If the parameter P615 <b>ERROR RESET</b> is activated and a warning occurs five times -> Error ->	Relay 2: X2/ 1 - 3 closed

### 8.3.12 M800 REQUIRED VALUES

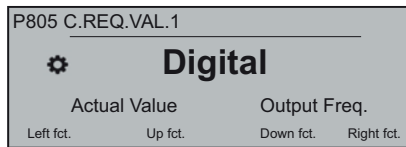
#### MENU SCOPE

This submenu includes the following software parameters:

- Configuration of the required value
- Switching between required values
- Required frequencies for Actuator mode

For an example, see *Example: P105 ACTUATOR mode* (page 102).

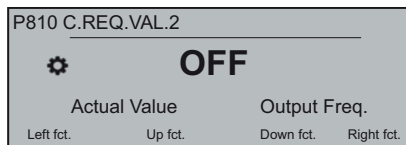
#### P805 C.REQ.VAL.1



Configures the required value 1. Possible setting are:

Setting	Description	Connected to terminals (Premium Card)
Digital	The internal required value 1 is used. For setting, see P02 <b>REQUIRED VAL.</b> or P820 <b>REQ.VAL.1</b>	-
Analog U 0-10V	The required value 1 is set by the value of voltage signal.	X3/8-9
Analog I 0-20mA	The required value 1 is set by the value of current signal.	X3/7-8
Analog I 4-20mA	The required value 1 is set by the value of current signal.	X3/7-8

#### P810 C.REQ.VAL.2

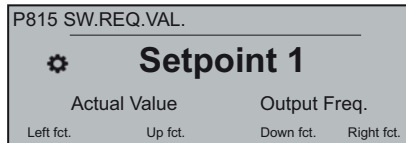


Configures the required value 2. Possible settings are:



Setting	Description	Connected to terminals (Premium Card)
Off	Required value 2 not used.	-
Digital Digital	The internal required value 2 is used. For setting, see P02 <b>REQUIRED VAL.</b> or P825 <b>REQ.VAL.2</b>	-
Analog U 0-10V	The required value 2 is set by the value of voltage signal.	X3/11-12
Analog I 0-20mA	The required value 2 is set by the value of current signal.	X3/10-11
Analog I 4-20mA	The required value 2 is set by the value of current signal.	X3/10-11

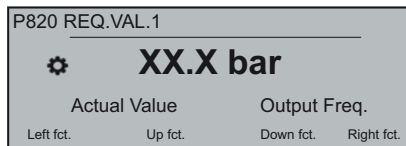
P815 SW.REQ.VAL.



Configure the switching between required value 1 and 2. Possible setting are:

Setting	Switching possibilities	Action
Setpoint 1	No	Only required value 1 is active
Setpoint 2	No	Only required value 2 is active
Switch Dig 1	Manual	Close digital input 1 (X1/14-15)
Switch Dig 2	Manual	Close digital input 2 (X3/1-2) on Premium Card

P820 REQ.VAL.1



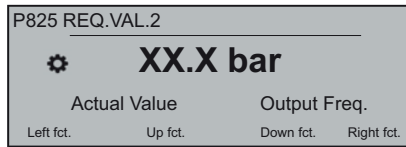
Sets the digital required value 1 in bar (possible setting 0.0 - P420 **SENSOR RANGE**).

The value is active in all operation mode (but not Actuator mode), if the following applies:

- P805 **C.REQ.VAL.1** is set to **Digital**.
- P815 **SW.REQ.VAL.** is set to **Setpoint 1** or the **REQUIRED VALUE 1** is selected via digital input (open).

If the current required value is active, P02 **REQUIRED VAL.** can override the pre-selected required value.

P825 REQ.VAL.2

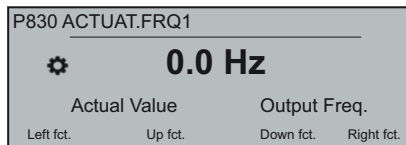


Sets the digital required value 2 in bar (possible setting 0.0 - P420 **SENSOR RANGE**).  
 The value is active in all operation mode (but not Actuator mode), if the following applies:

- P810 **C.REQ.VAL.2** is set to **Digital**.
- P815 **SW.REQ.VAL.** is set to **Setpoint 1** or the **REQUIRED VALUE 2** is selected via digital input (open).

If the current required value is active, P02 **REQUIRED VAL.** can override the pre-selected required value.

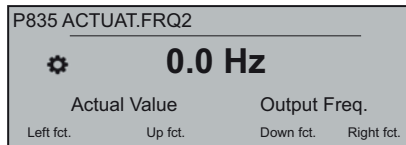
P830 ACTUAT.FRQ1



Set the required frequency 1 for Actuator mode (possible setting 0.0 Hz - P245 **MAX.FREQ.**).  
 The selected frequency is only active in Actuator mode, if the following applies:

- P805 **C.REQ.VAL.1** is set to **Digital**.
- P815 **SW.REQ.VAL.** is set to **Setpoint 1** or the **ACTUATOR FREQUENCY 1** is selected via digital input (open).

P835 ACTUAT.FRQ2



Set the required frequency 2 for Actuator mode (possible setting 0.0 Hz - P245 **MAX.FREQ.**).  
 The selected frequency is only active in Actuator mode, if the following applies:

- P810 **C.REQ.VAL.2** is set to **Digital**
- P815 **SW.REQ.VAL.** is set to **Setpoint 2** or the **ACTUATOR FREQUENCY 2** is selected via digital input (closed).

8.3.13 M900 OFFSET

Menu scope

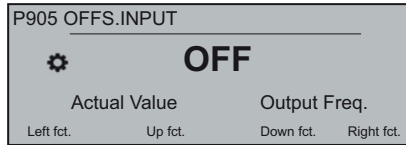
This submenu includes the following software parameters:

- Offset (input, range)
- Level (1, 2)

- Offset (X1, Y1)
- Offset (X2, Y2)

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

P905 OFFS.INPUT

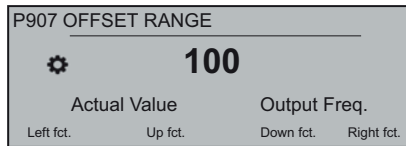


Selects the offset input. Possible setting are:

Setting	Offset calculation
<b>Off</b>	Disabled
An. U1 0-10V	Calculated from the voltage signal (0 - 10 V) connected to the terminals X3/7-8-9 (Required Value 1)
An. U2 0-10V	Calculated from the voltage signal (0 - 10 V) connected to the terminals X3/10-11-12 (Required Value 2)
An. I1 0-20mA	Calculated from the current signal (0 - 20 mA) connected to the terminals X3/7-8 (Required Value 1)
An. I1 4-20mA	Calculated from the current signal (4 - 20 mA) connected to the terminals X3/7-8 (Required Value 1)
An. I2 0-20mA	Calculated from the current signal (0 - 20 mA) connected to the terminals X3/10-11 (Required Value 2)
An. I2 4-20mA	Calculated from the current signal (4 - 20 mA) connected to the terminals X3/10-11 (Required Value 2)

If the incoming current signal drops to below 4 mA, a warning message is shown on the display; however, HYDROVAR continues to operate without the offset function.

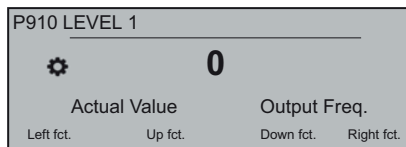
P907 OFFSET RANGE



Set the representation of the sensor range: the value depends on the maximum range of the connected offset sensor. A higher offset range gives a higher signal input resolution.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

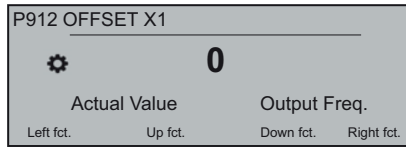
P910 LEVEL 1



Selects the first level until the offset function 1 is active.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

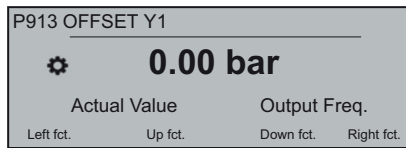
P912 OFFSET X1



Sets the offset signal value (X1), which is a fixed point.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

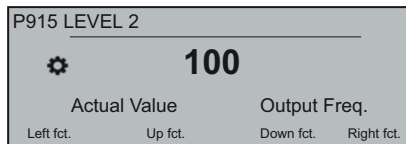
P913 OFFSET Y1



Set the maximum allowed pressure at P912 **OFFSET X1**.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

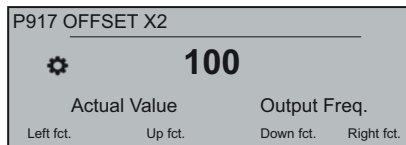
P915 LEVEL 2



Selects the second limit where the offset function 2 starts to be active.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

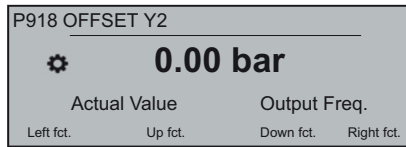
P917 OFFSET X2



Sets the offset signal value (X2), which is a fixed point.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

P918 OFFSET Y2



Set the required pressure at this flow rate.

For an example of the offset function and more information, see [Example: P900 SUBMENU OFFSET](#) (page 105).

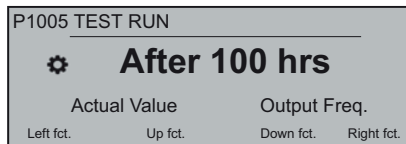
8.3.14 M1000 TEST RUN

Menu scope

This submenu includes the following software parameters:

- Automatic test run
- Test run frequency
- Test run boost
- Test run time
- Selecting Inverter for test run
- Manual test run

P1005 TEST RUN G

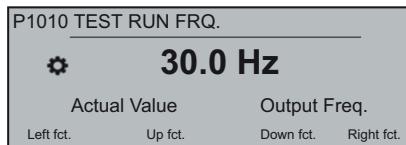


Controls the automatic test run, which starts up the pump after the last stop, to prevent the pump from blocking (possible settings are "Off" or "After 100 hrs").

Automatic test run is only active when both of the following occur:

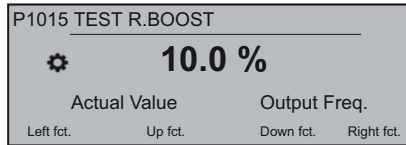
- HYDROVAR is stopped but manually released.
- The external ON/OFF contact (X1/18 - 19) is closed.

P1010 TEST RUN FRQ. G



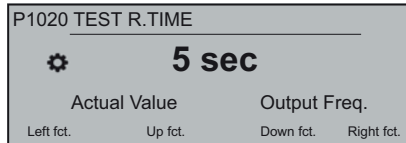
Sets the frequency for manual and automatic test run.

P1015 TEST R.BOOST G



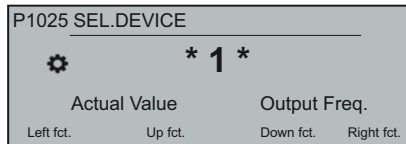
Sets the motor starting voltage (possible setting 0 -25%) as a percentage of the rated input voltage.

P1020 TEST R.TIME G



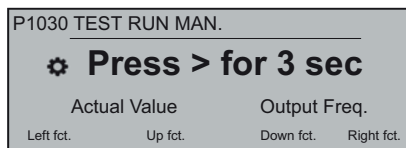
Sets the time for the test run.

P1025 SEL.DEVICE



Selects the inverter for the manual test run.

P1030 TEST RUN MAN.



Performs a manual test run for the unit selected by P1025 **SEL.DEVICE**: this function is also valid for fixed-speed pumps in Cascade relay mode.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

### 8.3.15 M1100 SETUP

#### MENU SCOPE

This submenu includes the following software parameters:

- Restore factory setting
- Password 2
- Clear error memory

- Clear motor hours
- Clear operation time

P1110 FACTORY SET

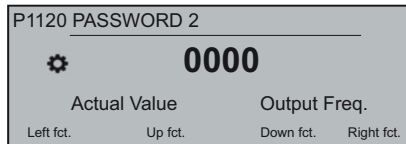


Restores the factory settings. Possible settings are:

Setting	Offset calculation
Europe	Restore the factory setting for European versions.
USA	Restore the factory setting for US versions.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

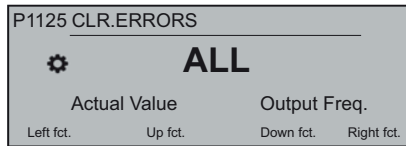
P1120 PASSWORD 2



Enter the system password, which gives access to factory parameters.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

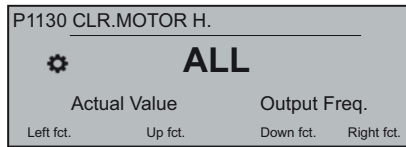
P1125 CLR.ERRORS



Used to clear the error memory either (1-8) for one specific unit or ALL for all units in Cascade Serial or Synchronous.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

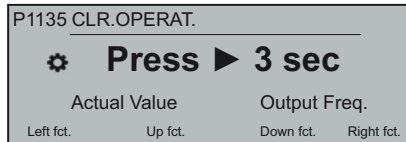
P1130 CLR.MOTOR H.



Used to clear the motor hours either (1-8) for one specific unit or ALL for all units in Cascade Serial or Synchronous.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

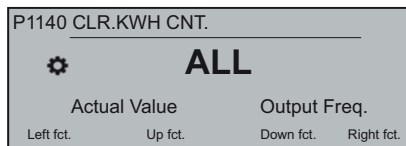
P1135 CLR.OPERAT.



Clear the operation time, which stores the total time the HYDROVAR is connected to power supply.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

P1140 CLR.KWH CNT.



Used to clear the kilowatt-hours counter either (1-8) for one specific unit or ALL for all units in Cascade Serial or Synchronous.

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

8.3.16 M1200 RS-485 INTERFACE

MENU SCOPE

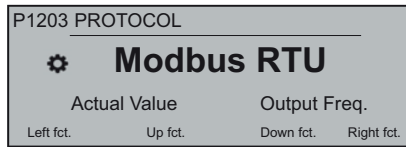
This submenu includes the following software parameters:

- User interface (address, baudrate, format)
- Internal interface (pump address)

The following parameters are necessary for the communication between HYDROVAR and an external device (e.g. PLC) via standardized Modbus-protocol. Set desired address, Baudrate and Format according to the system requirements.



P1203 PROTOCOL

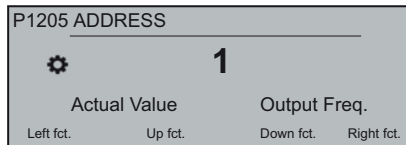


Sets the desired communication protocol.

Possible settings are:

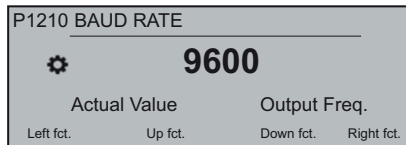
- Disabled
- Modbus RTU
- Modbus ASCII
- BACNet MS/TP

P1205 ADDRESS



Sets the desired address (possible setting 1 - 247) for the user interface.

P1210 BAUD RATE

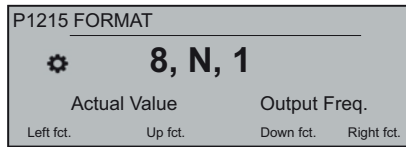


Set the **BAUD RATE** for the user interface.

Possible settings are:

- 1200
- 2400
- 4800
- 9600
- 14400
- 19200
- 38400
- 57600
- 76800
- 115200

P1215 FORMAT

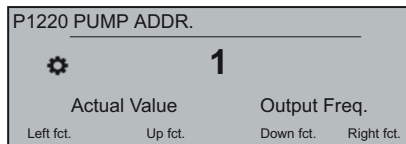


Set the data **FORMAT** for the communication port, depending on the value of P1203 **PROTOCOL**

Possible settings are:

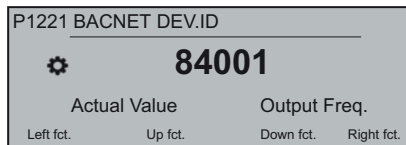
- 8, E, 1
- 8, O, 1
- 8, N, 2
- 8, N, 1
- 7, E, 1
- 7, O, 1
- 7, N, 2
- 7, N, 1

P1220 PUMP ADDR.



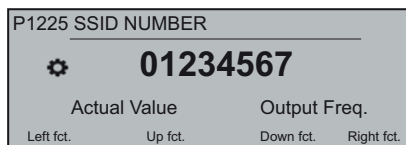
Selects an address for each inverter.

P1221 BACNET DEV. ID



Sets Bacnet Device Object ID

P1225 SSID NUMBER

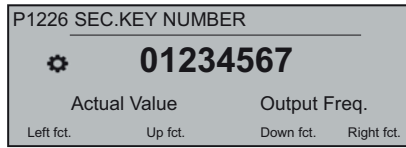


This parameter shows the identification number of the Wi-Fi network generated when the wireless module is assembled into HYDROVAR.

In particular, the network name will be: "hydrovar\_\_P1225\_\_", where P1225 is the value of this parameter, expressed as an 8 character word.

Example: if P1225 = a1b2c3d4, wifi network name = "hydrovara1b2c3d4"

P1226 SEC.KEY NUMBER



This parameter shows the security key number to access the Wi-Fi network generated when the wireless module is assembled into HYDROVAR.

In particular, the security key number will be: "xylem\_\_P1226\_\_", where P1226 is the value of this parameter, expressed as an 8 character word.

Example: if P1226 = b5c6d7e8, security key number = "xylemb5c6d7e8"

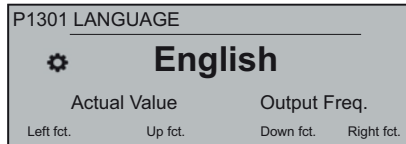
8.3.17 M1300 START-UP

MENU SCOPE

This submenu includes all the parameters necessary for a quick start-up of HYDROVAR:

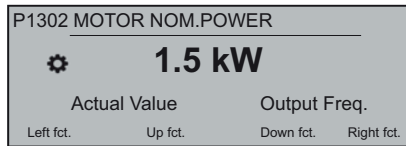
- Language
- Motor Configuration (Power, Voltage, ...)
- Single/Multi Pump configuration
- Required Value

P1301 LANGUAGE



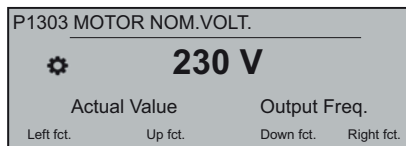
This parameter selects the display language.

P1302 MOTOR NOM.POWER



This parameter set the nominal power of the motor coupled with HYDROVAR, as reported on the motor nameplate. For possible setting, see [P265 MOTOR NOM.POWER](#) (page 63)

P1303 MOTOR NOM.VOLT.

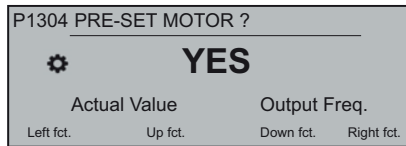


Sets the motor nominal voltage, as reported in the motor nameplate, according to

- the chosen motor connection
- the output voltage of the HYDROVAR

For possible setting, see [P266 MOTOR NOM.VOLT.](#) (page 63)

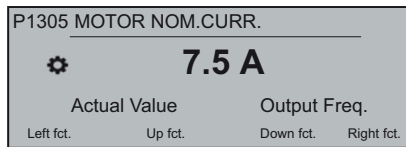
P1304 PRE-SET MOTOR ?



By selecting "Yes", the user is declaring the use of a Lowara IE3 surface 2-poles motor 50Hz (without Motor Filter): in this case, the motor's electrical parameters are already available to HYDROVAR, so the start-up procedure skips to P1308 **STC MOTOR PROT.**

By selecting "NO", the user is declaring the use of any other motor: in this case the motor's electrical parameters need to be set into HYDROVAR, so the start-up procedure goes to the next step (P1305 **MOTOR NOM.CURR.**)

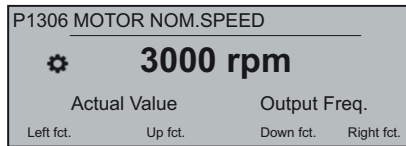
P1305 MOTOR NOM.CURR.



Sets the motor nominal current, as reported in the motor nameplate, according to

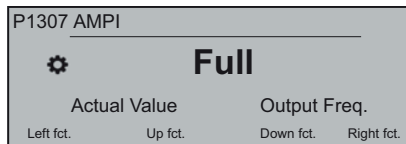
- the chosen motor connection
- the output voltage of the HYDROVAR

P1306 MOTOR NOM.SPEED



Sets the motor nominal speed, as reported in the motor nameplate.

P1307 AMPI

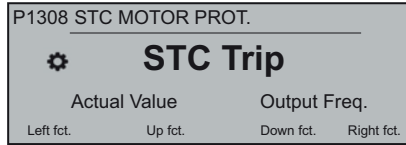


This parameter activates the Automatic Motor Parameter Identification; possible settings are "Off" (AMPI not active), "Full" or "Reduced" (procedure to be performed only in case LC filters are applied on the motor cable).

For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

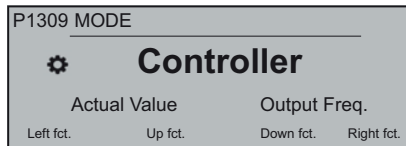
For further information, see [P275 AMPI](#) (page 65)

P1308 STC MOTOR PROT.



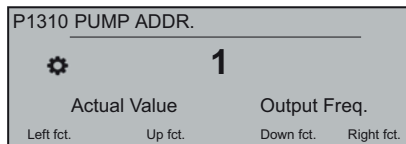
This parameter sets the protection technique against motor overheating; possible the settings are "Thermistor trip" or "STC trip" (default).

P1309 MODE



This parameter selects which operating mode to set the unit to. For possible setting, see [P105 MODE](#) (page 55).

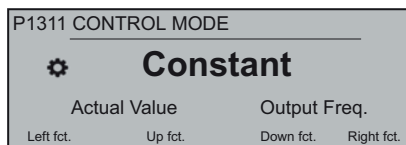
P1310 PUMP ADDR.



This parameter selects an address (1-8) for each HYDROVAR. If several MASTER inverters are connected via the internal RS-485 connection (maximum eight in Cascade serial mode), then the following must apply:

- Each HYDROVAR needs an individual pump-address (1-8)
- Each address can only be used once.

P1311 CONTROL MODE



For this parameter please note that, once entered into edit mode (by pressing the provided push button), the user can confirm the new value by pressing for 3 sec the right (▶) push button.

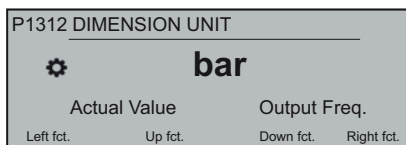
This parameter sets the pressure control mode for the pump system (single and multi pump): depending on the setting ("Constant" or "Differential") a set of further parameters are automatically configured.

Whenever P1311 **CONTROL MODE** is set to a new value, each parameter in the below table is overwritten to its own specified value, regardless of previous different settings.

	P1311 = Constant	P1311 = Differential
P225 RAMP 3	70 sec	90 sec
P230 RAMP 4	70 sec	90 sec
P250 MIN.FREQ.	20 Hz	25 Hz
P255 CONF.FMIN	f -> 0	f -> fmin
P260 FMIN TIME	0 sec	3 sec
P315 HYSTERESIS	80%	90%
P410CONF.SENSOR	Sensor 1	Sens.1 - Sens.2

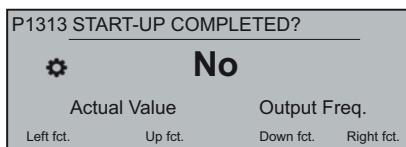
**P1312 DIMENSION UNIT**

Selects the unit of measure for the system.



For further information, see [P405 DIMENSION UNIT](#) (page 71)

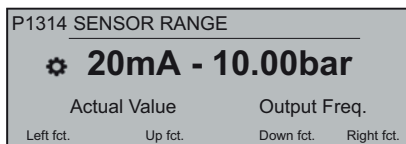
**P1313 START-UP COMPLETED?**



If the application the is a multi-pump, then the startup procedure for the first [N-1] pumps is stopped here when selecting Yes.

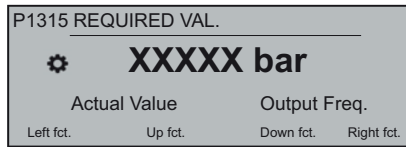
If the application the is a single-pump or the last pump of a Multi-pump, then select No .

**P1314 SENSOR RANGE**



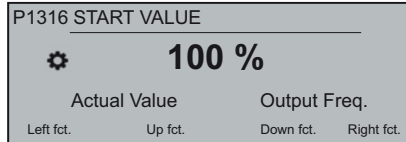
Sets the end range value (20 mA or 10 V) of the connected sensor. In particular, the end range value (20 mA or 10 V) must be always equal to the 100% of the sensor range (that is, for a 0.4 bar differential pressure sensor, is 20 mA=0.4 bar).

P1315 REQUIRED VAL.



For further information, see [P02 REQUIRED VAL.](#) (page 46).

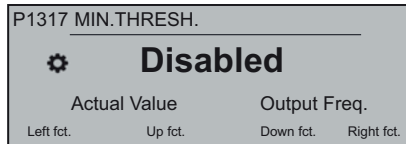
P1316 START VALUE



Sets the end range value (20 mA or 10 V) of the connected sensor. In particular, the end range. This parameter defines, in percentage (0-100%) of the required value (P1314 **REQUIRED VAL.**), the start value after pump stops.

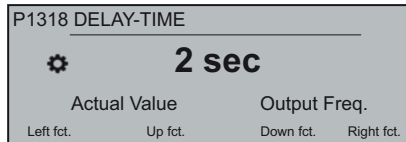
If P1315 **REQUIRED VAL.** is met and there is no more consumption, then the pump stops. The pump starts again when the pressure drops below P04 **START VALUE**. Value 100% makes this parameter not effective (100%=off)!

P1317 MIN.THRESH.



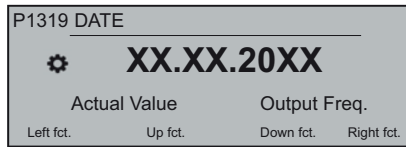
Selects the minimum threshold limit: if an adjusted value > 0.00 is not reached within the P1317 **DELAY-TIME**, then the unit stops (failure message: MIN.THRESH.ERROR).

P1318 DELAY-TIME



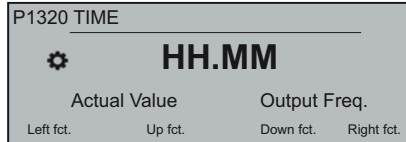
Selects the delay time of the minimum threshold limit: it shuts off the HYDROVAR if the actual value drops below P1317 **MIN.THRESH.** or if a low-water protection (at terminals X1/16-17) becomes open.

P1319 DATE



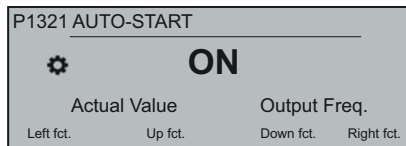
Using this parameter current date can be set.

P1320 TIME



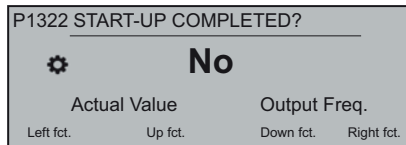
Using this parameter current time can be set.

P1321 AUTO-START



If **AUTO-START** = ON, then the HYDROVAR starts automatically (in case of demand) after reconnection of power following disconnection.

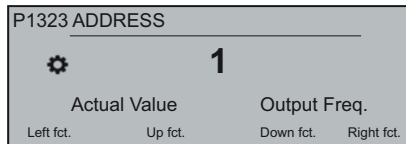
P1322 START-UP COMPLETED?



If the user configured the whole application by selecting "YES" then the HYDROVAR will not make available the Start-up menu at every power-on.

By selecting "NO" at next power-on, the HYDROVAR will offer to the user the start-up procedure.

P1323 ADDRESS



Sets the desired address (possible setting 1 - 247) for the user interface.



# 9 Maintenance

## 9.1 General



---

**Electrical Hazard:**

Before any service or maintenance disconnect the system from the power supply and wait at least 5 minutes before starting work on or in the unit (the capacitors in the intermediate circuit are discharged by the internal discharge resistors).

---

The unit does not require any special maintenance.

**Check list**

- Make sure that the cooling fan and the vents are free from dust.
- Make sure that the ambient temperature is correct according to the limits of the unit.
- Make sure that qualified personal perform all modifications of the unit.
- Make sure that the unit is disconnected from the power supply before any work is carried out. Always consider the pump- and motor-instruction.

For further information, contact the local distributor.

## 9.2 Check error codes

Check the error codes in parameters P26 - P30 on a regular basis.

For more information about the parameters, see [P26 thru P30: ERROR memory](#) (page 52).

For detailed information about the error codes, see [Warnings and errors](#) (page 99).

## 9.3 Check the functions and parameters

If the hydraulic system is changed then follow this procedure.

1. Make sure that all functions and parameters are correct.
2. Adjust the functions and parameters if necessary.

# 10 Troubleshooting

## Precaution

### NOTICE:

- Always disconnect the unit from the power supply before you perform any installation and maintenance tasks.

## Warnings and errors

- Warnings and errors are shown on the display and/or by the red LED.
- When a warning is active and the cause is not remedied within 20 seconds, then an error is shown and the unit stops. For some warnings, the unit keeps running depending on the type of error.
- When an error is active, the connected motor is stopped immediately. All errors are shown in plain text and saved in the error memory including date and time when the error appeared.
- An automatic error-reset can be activated in P600 **SUBMENU ERRORS** to reset an occurred error automatically five times. For more information about this function, see P615 **ERROR RESET**.
- All error signals and warnings can be indicated via the two status-relays on terminals X2/1-3 or X2/4-6 depending on the configuration. For more information, see P715 **CONF REL 1** and P720 **CONF REL 2**.

The errors can be reset automatically (depending on the setting in parameter P615 **ERROR RESET**) or manually in the following ways:

- Disable the power supply for more than 60 seconds.
- Press ◀ and ▶ simultaneously for 5 seconds.
- Open and close the external ON/OFF (X1/18-19).

## 10.1 No error message on the display

Error	Cause	Remedy
No <b>AUTO-START</b> after the power failure.	Parameter P08 <b>AUTO-START</b> is set to <b>OFF</b> .	Check parameter P08 <b>AUTO-START</b> .
The system pressure is not steady.	Pressure higher than the <b>START VALUE</b> or <b>REG. MODE</b> has been changed to <b>Inverse</b> .	Check parameter P04 <b>START VALUE</b> and/or P320 <b>REG. MODE</b> .

## 10.2 Error message on the display

Error	Cause	Remedy
OVERCURRENT ERROR 11	Power limit exceeded - too high motor current (fast rise detected).	Check the following: <ul style="list-style-type: none"> <li>• The connection terminals of the unit</li> <li>• The connection terminals of the motor and the motor cable</li> <li>• The winding of the motor</li> </ul> Make sure all the connections, cables, and windings are OK and reset the error by disabling the power for more than 60 seconds.

The automatic error-reset is not available for this failure so the power supply has to be cut for more than 60 seconds to reset the error.

Error	Cause	Check the following:
OVERLOAD ERROR 12	Power limit exceeded - motor current too high (slow rise detected).	<ul style="list-style-type: none"> <li>Is the parameter P215/P220 <b>RAMP 1/RAMP 2</b> too short and P265 <b>BOOST</b> too low?</li> <li>Do the cables and connection work?</li> <li>Is the pump is blocked?</li> <li>Does the motor rotate in the wrong direction before running (non-return valve defect)? Not allowed operation point or P245 <b>MAX.FREQ.</b> is too high, also check the P265 <b>BOOST</b> value.</li> </ul>
OVERVOLTAGE ERROR 13	The voltage is too high.	<ul style="list-style-type: none"> <li>Is the parameter P220 <b>RAMP 2</b> too fast?</li> <li>Is the power supply too high?</li> <li>Are the voltage peaks too high?</li> </ul> <p>If the error is power or voltage-related, line filters, line inductors, or RC-elements can be installed to resolve the issue.</p>
INVERT. OVERHEAT ERROR 14	The temperature inside the unit is too high.	<ul style="list-style-type: none"> <li>Is the unit properly cooled?</li> <li>Are the units motor vents contaminated?</li> <li>Is the ambient temperature too high?</li> </ul>
THERMO MOT/EXT ERROR 15	The PTC sensor has reached its release temperature.	<ul style="list-style-type: none"> <li>Close X1/PTC if there is no external protective device connected..</li> <li>Refer to <i>Motor sensor connection</i> (page 35) for detailed information..</li> </ul>
PHASELOSS ERROR 16	One phase of the power supply does not work.	<ul style="list-style-type: none"> <li>The power supply under full load</li> <li>If phase failure occurs at the input.</li> <li>The circuit breakers</li> <li>And visually inspect the points at the input terminals.</li> </ul>
UNDERVOLTAGE	The voltage is too low.	<ul style="list-style-type: none"> <li>Is the supply voltage too low?</li> <li>Is there phase failure at the input?</li> <li>Is there asymmetry between the phases?</li> </ul>
COMM LOST	The communication between the power unit and the control board does not work correctly.	Is the connection between the control board and the power unit correct?
LACK OF WATER ERROR 21	The low water sensor connection, terminals X3/11-12, is opened. The sensor is only active when the pump runs.	<ul style="list-style-type: none"> <li>The incoming pressure or minimum water level values are set too low, then change the settings.</li> <li>The error only happens for a short time, then adjust parameter P610 <b>DELAY TIME</b>.</li> </ul> <p>If a sensor is not used, then the terminals X3/11-12 must be bridged.<sup>1</sup></p>
MIN. THRESHOLD ERROR 22	The defined value of parameter P605 <b>MIN.THRESH.</b> was not reached during the preselected P610 <b>DELAY TIME</b> .	<ul style="list-style-type: none"> <li>The booster unit and adjust the parameter P610 <b>DELAY TIME</b>.</li> <li>Set the parameter P615 <b>ERROR RESET</b> set to <b>ON</b>, to enable five restarts in the empty system.</li> </ul>
FAILURE SENSOR 1, ACT. VAL. SENSOR 1 ERROR 23	Sensor signal on terminals X3/2 is less than 4 mA which an active sensor must deliver.	<ul style="list-style-type: none"> <li>The <b>Actual value</b> signal from the pressure transducer is faulty.</li> <li>The connection is faulty.</li> <li>The sensor or cables are faulty.</li> <li>Check the configuration of the sensors in P400 <b>SUBMENU SENSOR</b>.</li> </ul>

<sup>1</sup> The unit is reset when the terminals X3/11-12 are closed.

Error	Cause	Check the following:
FAILURE SENSOR 2, ACT. VAL. SENSOR 2 ERROR 24	Sensor signal on terminals X3/4 is less than 4 mA which an active sensor must deliver.	<ul style="list-style-type: none"> <li>The <b>Actual value</b> signal from the pressure transducer is faulty.</li> <li>The connection is faulty.</li> <li>The sensor or cables are faulty.</li> <li>Check the configuration of the sensors in P400 <b>SUBMENU SENSOR</b>.</li> </ul>
SETPOINT 1 I < 4mA, SETPOINT 1 I < 4 mA ERROR 25	Current signal input of required values is active, but no signal between 4-20 mA is connected.	<ul style="list-style-type: none"> <li>External analog signal on terminals X3/17-18</li> <li>Configuration of the required values in P800 <b>SUBMENU REQUIRED VALUES</b>.</li> </ul>
SETPOINT 2 I < 4 mA, SETPOINT 2 I < 4 mA ERROR 26	Current signal input of required values is active, but no signal between 4-20 mA is connected.	<ul style="list-style-type: none"> <li>External analog signal on terminals X3/22-23</li> <li>Configuration of the required values in P800 <b>SUBMENU REQUIRED VALUES</b>.</li> </ul>

### 10.3 Internal error, on display or red LED ON

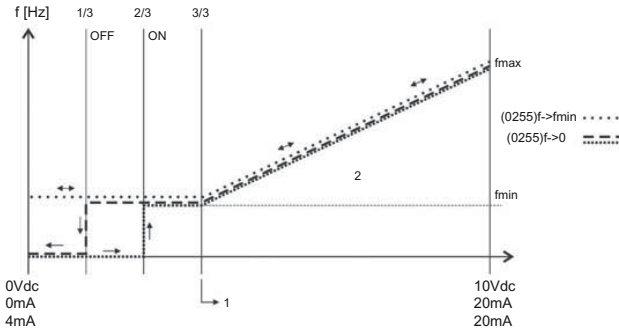
To reset errors, the power supply has to be cut for more than 60 seconds. If the error message is still shown on the display, then contact your local distributor and provide a detailed description of the error.

Error	Cause	Remedy
ERROR 1	EEPROM-ERROR, data block malfunction	Reset the unit. If the error message repeats then change control board.
ERROR 4	Button error, for example a jammed key	Check and make sure that the push buttons are OK. If the push buttons are faulty, then change the display-board.
ERROR 5	EPROM-ERROR, checksum error	Reset the unit. If the error message repeats then change control board.
ERROR 6	Program error: Watchdog error	Reset the unit. If the error message repeats then change control board.
ERROR 7	Program error: Processor pulse error	Reset the unit. If the error message repeats then change control board.
CODE ERROR	Code error: invalid processor command	Check and make sure that the: <ul style="list-style-type: none"> <li>Installation of the cables, connection of the screen and potential equalization is correct.</li> <li>Ground is correctly installed.</li> <li>Signal is strong enough, if not, install additional ferrite inductances to boost the signal.</li> </ul>

# 11 Technical Reference

## 11.1 Example: P105 ACTUATOR mode

Graph

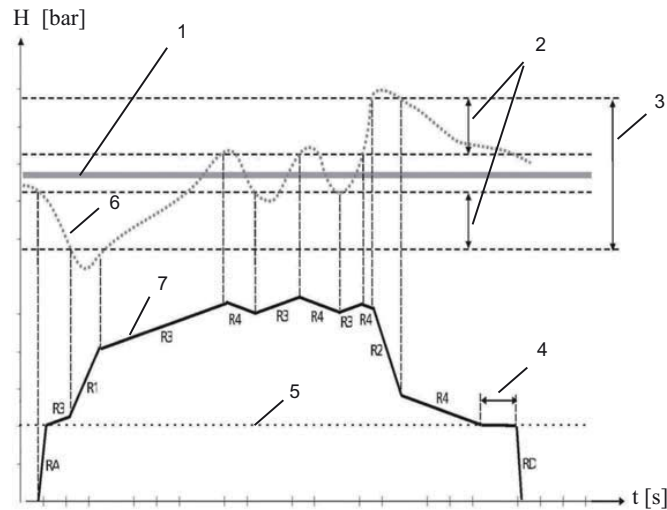


Position numbers

1. Signal range \*  $(f_{min} / f_{max}) + \text{zeropoint}$
2. Range of control

## 11.2 Example: P200 Ramp Settings

Graph



Position numbers

1. P02 **REQUIRED VAL.**
2. P315 **HYSTERESIS** in % of P310 **WINDOW.**

3. P310 **WINDOW** in % of P02 **REQUIRED VAL.**
4. P260 **FMIN TIME**FMIN TIME
5. P250 **MIN.FREQ.**
6. **Actual value**
7. **Output frequency**

## Description

RA: **RAMP FMIN A**  
 RD: **RAMP FMIN D**  
 R1: **RAMP 1** - speed ramp fast increase  
 R2: **RAMP 2** - speed ramp fast decrease  
 R3: **RAMP 3** - speed ramp slow increase  
 R4: **RAMP 4** - speed ramp slow decrease

## Adjust ramp settings

To adjust the ramps presented above, see separate sections in [M200 CONF.INVERTER](#) (page 57).

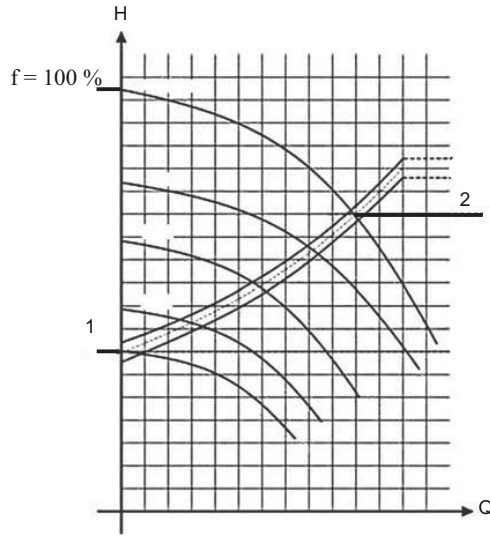
### 11.3 Example: P330 LIFT AMOUNT

Follow these instructions to set the lift amount.

1. Enter the set pressure.  
See [P02 REQUIRED VAL.](#) (page 46).
2. Close all valves in the system and start the HYDROVAR® to read the frequency displayed.  
Another possibility to find out the frequency for the set pressure at zero demand is to use the P305 **JOG** mode. For more information, see [P305 JOG](#) (page 69).
3. Set the frequency value (set pressure at zero demand) in P325 **FRQ. LIFT**.  
For more information, see [P325 FRQ.LIFT](#) (page 71).
4. Set the P330 **LIFT AMOUNT** (increase in % of the set pressure) to compensate the friction losses in the system.  
Example: set pressure = 4 bar, lift amount: a) 0% (= 4 bar, no lift), b) 100% (= 8 bar), c) 200% (=12 bar)  
For more information see [P330 LIFT AMOUNT](#) (page 71). This is set as % of the set pressure.

**Graph**

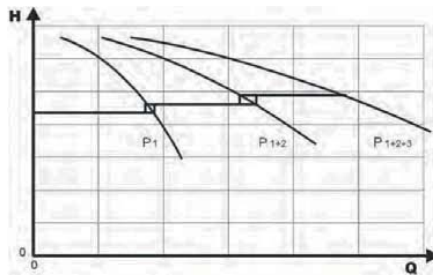
**Position numbers**



1. The pressure at zero demand (all valves closed).
2. The pressure plus lift amount to compensate the friction loss.

**11.4 Example: P500 SUBMENU SEQUENCE CNTR.**

Graph



Calculation process for the sequence centre value

1. Lead pump reaches its P515 **ENABLE FRQ.**
2. Actual value falls to the cut in-value of the 1<sup>st</sup> assist pump. The 1<sup>st</sup> assist pump switches on automatically. (Cut in-value = P02 **REQUIRED VAL** - P510 **ACT.VAL.DEC**)
3. A new required value, P03 **EFF.REQ.VAL** is calculated after the start up. P03 **EFF.REQ.VAL** = P02 **REQUIRED VAL** - P510 **ACT.VAL.DEC** + P505 **ACT.VAL.INC**

Calculations of the new required value for multi pump applications

k.... number of active pumps (k > 1)

$$p = p_{\text{set}} + (k-1) * (P505 \text{ ACT.VAL.INC} - P510 \text{ ACT.VAL.DEC})$$

- P505 **ACT.VAL.INC** = P510 **ACT.VAL.DEC** → Pressure constant, independent of how many pumps are in operation.
- P505 **ACT.VAL.INC** > P510 **ACT.VAL.DEC** → Pressure rises when assist pump switches on.
- P505 **ACT.VAL.INC** < P510 **ACT.VAL.DEC** → Pressure falls when assist pump switches on.

To find out the right setting for Synchronous control

1. Start the first pump in P62 **JOG** mode.
2. Increase the frequency until the required value is met. Check the frequency at zero consumption,  $f_0$ .
3. Set the synchronous limit,  $f_0 + 2..3$  Hz.
4. Set the synchronous window between 1 or 2 Hz depending on the pump curve and the set point.

## 11.5 Example: P900 SUBMENU OFFSET

### General settings

Constant pressure system with the required value of 5 bar.

Additionally a flow sensor is connected to the offset input.

Parameter P907 **OFFS.RANGE** = 160 (maximum range of flow sensor = 16 m<sup>3</sup>/h).

### System requirement 1

- Constant pressure: 5 bar
- Flow rate: 5 - 12 m<sup>3</sup>/h

Below 5 m<sup>3</sup>/h decrease the pressure to maximum 2,5 bar at a flow rate of 2 m<sup>3</sup>/h.

Settings:

- Parameter P910 **LEVEL 1** = 50 = 5 m<sup>3</sup>/h. First limit where the offset function is active.
- Parameter P912 **OFFSET X1** = 20 = 2 m<sup>3</sup>/h. Fixed point according to the requirements.
- Parameter P913 **OFFSET Y1** = 2,5 = 2,5 bar. Maximum allowed pressure at this flow rate.

### System requirement 2

- Constant pressure: 5 bar
- Flow rate: 5 - 12 m<sup>3</sup>/h

Above 12 m<sup>3</sup>/h increase the pressure with the limitation to have maximum 6,0 bar at maximum flow rate of 16 m<sup>3</sup>/h.

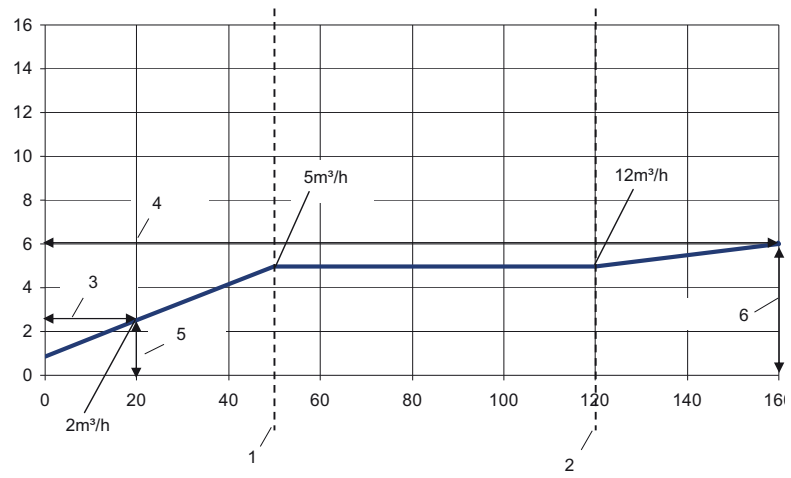
Settings:

- Parameter P915 **LEVEL 2** = 120 = 120 m<sup>3</sup>/h. Second limit where the offset function is active.
- Parameter P917 **OFFSET X2** = 160 = 16 m<sup>3</sup>/h. Fixed point according to the requirements.
- Parameter P918 **OFFSET Y2** = 6 = 6 bar. Required pressure at this flow rate.



Graph

See graph below for more details.



Position numbers

- 1. LEVEL 1
- 2. LEVEL 2
- 3. OFFSET X1
- 4. OFFSET X2
- 5. OFFSET Y1
- 6. OFFSET Y2

## 11.6 Programming flow charts

Submenu 0 - 40

Submenu 0-40	ID	Name	Example menu
0	0	MAIN	
HOME	HOME		Actual value
2	2	REQUIRED VAL.	3,5 bar
3	3	EFF.REQ.VAL.	3,5 bar
4	4	START VALUE	Off
5	5	LANGUAGE	English
6	6	DATE	xx.xx.20xx
7	7	TIME	xx:xx
8	8	AUTO-START	Off
9	9	OPERAT.TIME	xxxx:xx
20	20	STATUS	
21	21	STATUS UNITS	00000000
22	22	SELECT DEVICE	* 1 *
23	23	STATUS DEVICE	Running
24	24	ENABLE DEVICE	Enabled
25	25	MOTOR HOURS	xxxx:xx
26	26	1ST ERROR	No Error
27	27	2ND ERROR	No Error
28	28	3RD ERROR	No Error
29	29	4TH ERROR	No Error
30	30	5TH ERROR	No Error
35	35	KWH COUNTER	kWh
40	40	DIAGNOSTICS	
41	41	PROD.DATE	xx.xx.20xx
42	42	SEL.INVERTER	* 11
43	43	TEMP.INVERTER	x: <xx % <xx C
44	44	CURR.INVERTER	x: xx %
45	45	VOLT.INVERTER	x: xxx V
46	46	OUTPUT FREQ.	x: xx.x Hz
47	47	VER.INVERTER	x: xx

Submenu 60 - 300

Submenu 60-300	ID	Name	Example menu
60   61   62 ↔ 60	60	SETTINGS	
	61	PASSWORD	0000
	62	JOG	xx.x Hz 3,5 bar
100   105   106   110   115   120   125 ↔ 100	100	BASIC SETTINGS	
	105	MODE	Controller
	106	PUMP ADDR.	1
	110	SET PASSW.	0066
	115	LOCK FUNCT.	OFF
	120	DISP.CONTR.	75 %
	125	DISP.BRIGHT.	100 %
200   202   205   210   215   220   225	200	CONF.INVERTER	
230   235   240   245   250   255	202	SOFTWARE	HV V01.4
260   261   262   265   266   267	205	MAX.UNITS	6
268   269   270   275   280   281	210	INVERTER	All
282   283   290   291   295   296 ↔ 200	215	RAMP 1	4 sec
	220	RAMP 2	4 sec
	225	RAMP 3	70 sec
	230	RAMP 4	70 sec
	235	RAMP FMIN A	2,0 sec
	240	RAMP FMIN D	2,0 sec
	245	MAX.FREQ.	50 Hz
	250	MIN.FREQ.	20 Hz
	255	CONF.FMIN	f->0
	260	FMIN TIME	0 sec
	261	SKIP FRQ.CTR.	20.0 Hz
	262	SKIP FRQ.RNG.	0.0 Hz
	265	MOTOR NOM.POWER	1.5 kW
	266	MOTOR NOM.VOLT.	230 V
	267	MOTOR NOM.FRQ.	50.0 Hz
	268	MOTOR NOM.CURR.	7.5 A
	269	MOTOR NOM.SPEED	3000 rpm
	270	MOTOR POLES	2
	275	AMPI	Full
	280	SWITCHING CONTROL	HVC
	281	BOOST	5 %
	282	KNEE FREQ.	50.0 Hz
	283	SEL.SW.FREQ.	10 kHz
	290	STC MOTOR PROT.	STC Trip
	291	STC MOTOR THERMAL	77 %
	295	CURR.LIM.FUNCT.	Off
	296	CURR.LIMIT SET	110 %
300   305   310   315   320   325   330 ↔ 300	300	REGULATION	

Submenu 60-300	ID	Name	Example menu
	310	WINDOW	10 %
	315	HYSTERESIS	80 %
	320	REG.MODE	Normal
	325	FRQ.LIFT	30,0 Hz
	330	LIFT AMOUNT	0,0 %

Submenu 400 - 500

Submenu 400-500	ID	Name	Example menu
400	400	SENSOR	
405	405	DIMENSION UNIT	bar
410	410	CONF.SENSOR	Sensor 1
415	415	SENSOR TYPE	Analog I 4 - 20 mA
420	420	SENSOR RANGE	10.00 bar
425	425	SENSOR CURVE	linear
430	430	SENS.1 CAL.0	0% = x.xx bar
435	435	SENS.1 CAL.X	0% = xx.xx bar
440	440	SENS.2 CAL.0	0% = xx.xx bar
445	445	SENS.2 CAL.X	0% = xx.xx bar
500	500	SEQUENCE CONTR.	
505	505	ACT.VAL.INC.	0,35 bar
510	510	ACT.VAL.DEC.	0,15 bar
515	515	ENABLE FRQ.	48 Hz
520	520	ENABLE DLY.	5 sec
525	525	SWITCH DLY.	2 sec
530	530	DISABLE FRQ.	30,0 Hz
535	535	DISABLE DLY.	5 sec
540	540	DROP FRQ.	42,0 Hz
545	545	OVERVALUE	Disabled
550	550	OVERVAL.DLY.	0.0 sec
555	555	SWITCH INTV.	24 hours
560	560	SYNCHR.LIM.	0,0 Hz
565	565	SYNCHR.WND.	2.0 Hz

Submenu 600 - 1200

Submenu 600-1200		ID	Name	Example menu
600	605 610 615 ← → 600	600	ERROR	
		605	MIN.THRESH.	Disabled
		610	DELAY-TIME	2 sec
		615	ERROR RESET	On
700	705 710 715 720 ← → 700	700	OUTPUTS	
		705	ANALOG OUT.1	Output frequency
		710	ANALOG OUT.2	Actual value
		715	CONF.REL.1	Running
		720	CONF.REL.2	Errors
800	805 810 815 820 825	800	REQUIRED VALUES	
	830 835 ↔ 800	805	C.REQ.VAL.1	Digital
		810	C.REQ.VAL.2	Off
		815	SW.REQ.VAL.	Setpoint 1
		820	REQ.VAL.1	3,5 bar
		825	REQ.VAL.2	3,5 bar
		830	ACTUAT.FRQ1	0.0 Hz
		835	ACTUAT.FRQ2	0.0 Hz
900	905 907 910 912 913	900	OFFSET	
	915 917 918 ↔ 900	905	OFFS.INPUT	Off
		907	OFFSET RANGE	100
		910	LEVEL 1	0
		912	OFFSET X1	0
		913	OFFSET Y1	0,00 bar
		915	LEVEL 2	100
		917	OFFSET X2	100
		918	OFFSET Y2	0,00 bar
1000	1005 1010 1015 1020 1025	1000	TEST RUN	
	1030 ↔ 1000	1005	TEST RUN	
		1010	TEST RUN FRQ.	30.0 Hz
		1015	TEST R.BOOST	10%
		1020	TEST R.TIME	5 sec
		1025	SEL.DEVICE	*1*
		1030	TEST RUN MAN.	Press > for 3 sec
1100	1110 1120	1100	SETUP	
		1110	FACTORY SET	Europe
		1120	PASSWORD 2	0000
1200	1205 1210 1215 1220 ← → 1200	1200	RS-485 INTERFACE	
		1203	PROTOCOL	Modbus RTU
		1205	ADDRESS	1
		1210	BAUD RATE	9600
		1215	FORMAT	RTU N81
		1220	PUMP ADDR.	1
		1221	BACNET DEV. ID	84001

Submenu 1300

Submenu 1300	ID	Name	Example menu
1300	1300	START-UP	
1301	1301	LANGUAGE	English
1302	1302	MOTOR NOM.POWER	
1303	1303	MOTOR NOM.VOLT.	
1304	1304	PRE-SET MOTOR ?	Yes
1305	1305	MOTOR NOM.CURR.	
1306	1306	MOTOR NOM.SPEED	
1307	1307	AMPI	Full
1308	1308	STC MOTOR PROT.	STC Trip
1309	1309	MODE	Controller
1310	1310	PUMP ADDR.	1
1311	1311	CONTROL MODE	Constant
1312	1312	DIMENSION UNIT	bar
1313	1313	START-UP COMPLETED?	No
1314	1314	SENSOR RANGE	
1315	1315	REQUIRED VAL.	
1316	1316	START VALUE	100 %
1317	1317	MIN.THRESH.	Disabled
1318	1318	DELAY-TIME	2 sec
1319	1319	DATE	XX.XX.20XX
1320	1320	TIME	HH.MM
1321	1321	AUTO-START	On
1322	1322	START-UP COMPLETED?	No
1323	1323	ADDRESS	1

Submenu 1300

Submenu 1300	ID	Name	Example menu
1300	1300	START-UP	
1301	1301	LANGUAGE	English
1302	1302	MOTOR NOM.POWER	
1303	1303	MOTOR NOM.VOLT.	
1304	1304	PRE-SET MOTOR ?	Yes
1305	1305	MOTOR NOM.CURR.	
1306	1306	MOTOR NOM.SPEED	
1307	1307	AMPI	Full
1308	1308	STC MOTOR PROT.	STC Trip
1309	1309	MODE	Controller
1310	1310	PUMP ADDR.	1
1311	1311	CONTROL MODE	Constant
1312	1312	DIMENSION UNIT	bar
1313	1313	START-UP COMPLETED?	No
1314	1314	SENSOR RANGE	
1315	1315	REQUIRED VAL.	
1316	1316	START VALUE	100 %
1317	1317	MIN.THRESH.	Disabled
1318	1318	DELAY-TIME	2 sec
1319	1319	DATE	XX.XX.20XX
1320	1320	TIME	HH.MM
1321	1321	AUTO-START	On
1322	1322	START-UP COMPLETED?	No
1323	1323	ADDRESS	1

# 12 EC Declaration of Conformity

We: Dutypoint Limited

Of: Shepherd Road, Gloucester, GL2 5EL, United Kingdom

In accordance with the following directives:

- 2014/65/EU: The Low Voltage Directive
- 4104/30/EU: The Electromagnetic Compatibility Directive
- 2006/95/EU: The Machinery Directive

Hereby declare that the equipment:

Description	Dutypoint VR Cold Water Booster Set
Model Code	VRx-xxxx-LHx

Is in conformity with the applicable requirements of the following documents:

- EN 809:1998+A1:2009: Pumps and pump units for liquids - Common safety requirements
- EN 60204-1:2006: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- EN ISO 12100:2010: Safety of machinery - General principles for design
- EN 61000-6-2:2005: Electromagnetic compatibility (EMC) — Part 6-2: Generic standards
- EN 61000-6-4:2007: Electromagnetic compatibility (EMC) — Part 6-4: Generic standards

I hereby declare that the equipment described above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all applicable Essential Requirements of the Directives.

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