ITT

Lowara

Variable Speed Control HYDROVAR®

New generation - Increased flexibility and control

EDITION 04-2007

Engineered for life

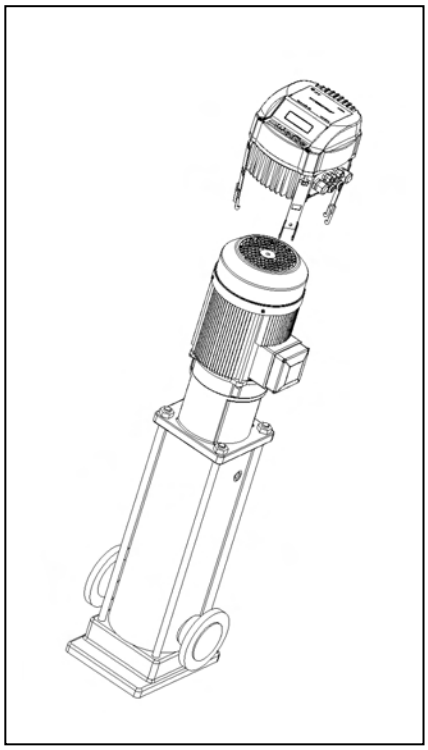
General Overview

HYDROVAR®

is a pump-mounted variable speed, microprocessor-based system controller, and was the world's first of its type to manage motor speed and match pump performance to a range of hot and cold water applications.

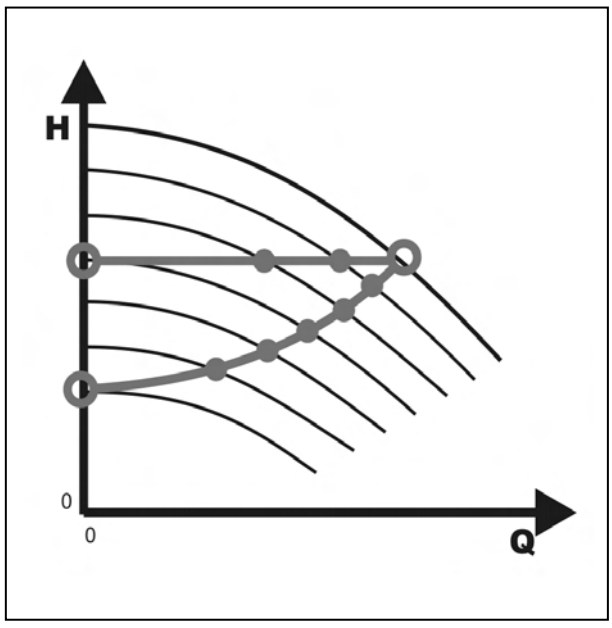
The new HYDROVAR Generation's unique modular design needs no additional master control, and enables virtually any configuration of pumps: up to 8 master drives or a mix of master and slave drives.

This is the long-awaited solution for high-level installations requiring failsafe systems with a superior range of features, while its modularity also provides a cost-effective solution for low-level, reduced feature demands.



HYDROVAR can be mounted onto virtually any make or model of pump. It can be mounted during new installations or retrofitted onto existing pumps, and is simple to integrate into BMS systems with ModBus communication as standard.

This eliminates the need for expensive additional master control panels and circuitry. In fact, everything's included in one compact unit – asynchronous motor, microprocessor, controller, sensors, upgraded management software and a comprehensive back-lit LCD control panel.



Varying the speed of pumps ensures maximum efficiency and when demand is low, pumps not required can be automatically switched off. This can contribute to substantial Life Cycle Cost (LCC) savings, with considerably lower running costs and broader energy efficiencies. In independent tests when compared to mains operated pumps, HYDROVAR provided cost savings of more than 70%.

Pump servicing costs are reduced too. The 'soft start' technology ensures no additional load to the pumps during starting, and since they tend to run at a lower speed there's less mechanical stress and longer maintenance periods.

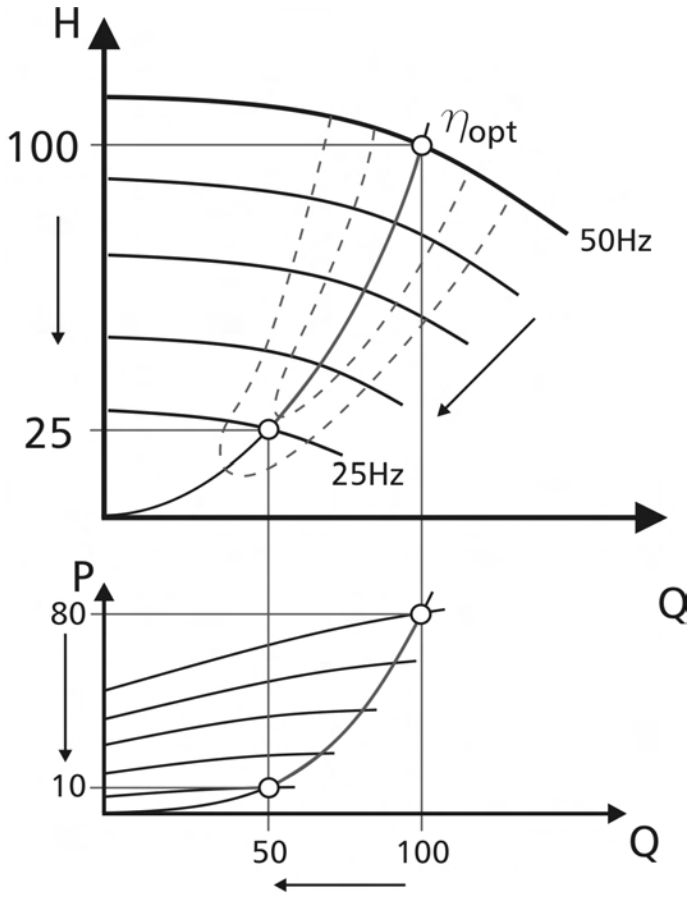
In a variable speed controlled system the pump works every time with the speed where it produces at the reduced flow exactly the required head. Therefore there is no wasted energy given to the system like On/Off or bypass control.

The heart of the energy-saving principle of variable-speed pumps is the basic hydrodynamic law:

$$\frac{Q_x}{Q} = \frac{n_x}{n} \qquad Q = Qx\,\frac{n_x}{n}$$

$$\frac{H_x}{H} = \left(\frac{n_x}{n}\right)^2 \qquad H_x = Hx\left(\frac{n_x}{n}\right)^2$$

$$\frac{P_x}{P} = \left(\frac{n_x}{n}\right)^3 \qquad P_x = Px\left(\frac{n_x}{n}\right)^3$$

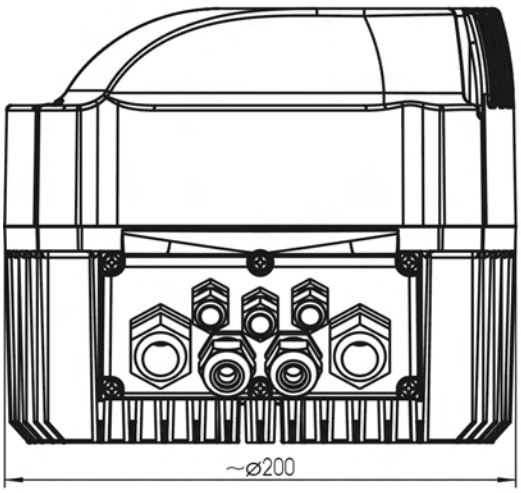


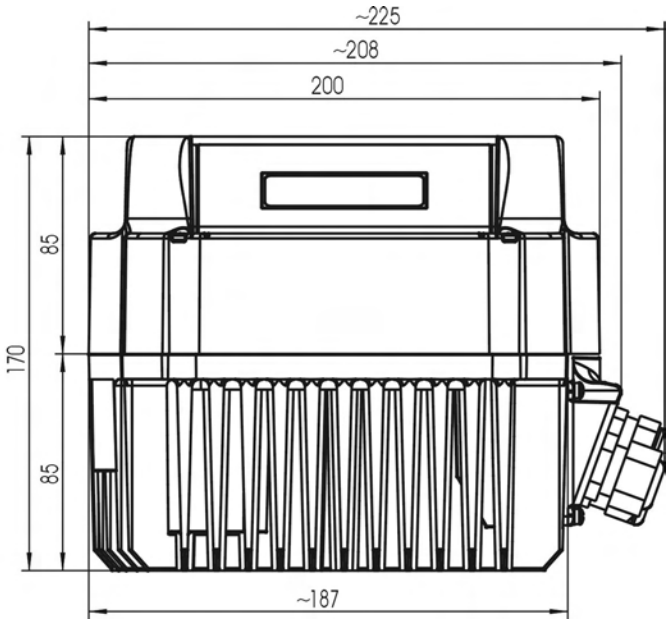
- **a lowering of the flow acc. to the linear function**
- **a reduction of the head according to a quadratic function**
- **a reduction of the power consumption acc. to a cubic function!**

If pump speed is reduced to half of the speed, energy consumption is reduced to an eighth of the power consumption at full speed.

Technical Data - Dimensions and Weights

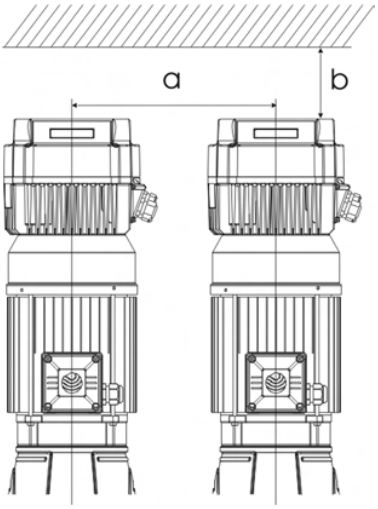
HV 2.015 / 2.022
HV 4.022 / 4.030 / 4.040





All dimensions in millimetres!

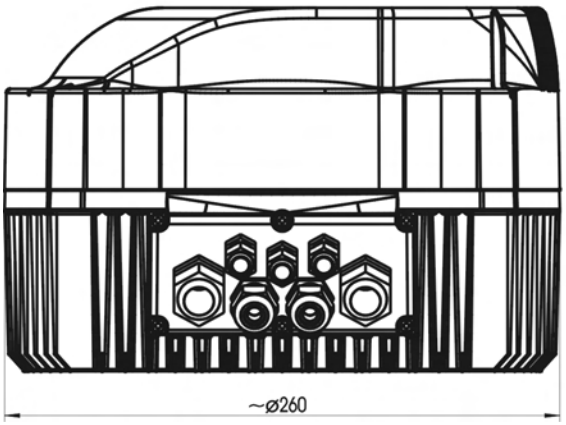
Drawings are not in scale!

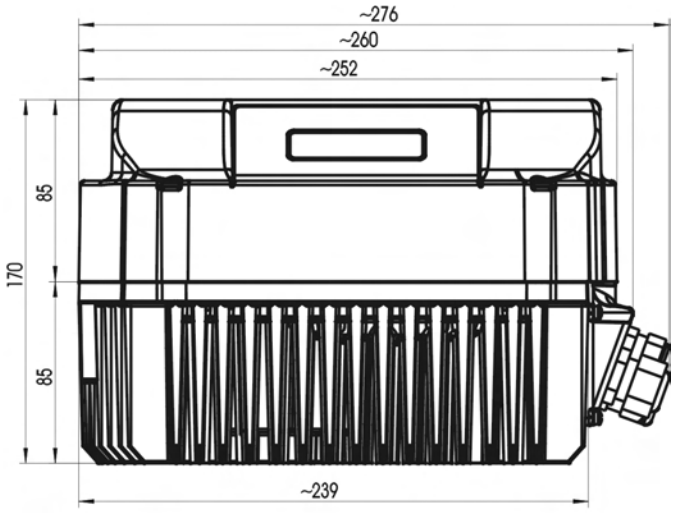


Type	Weight [kg]	
	Basic	Master/ Single
HV 2.015	4,00	4,40
HV 2.022		
HV 4.022		
HV 4.030		
HV 4.040		

a … minimum centre-distance between the HYDROVAR 300 [mm]
b … expansion space for maintenance 110 [mm]

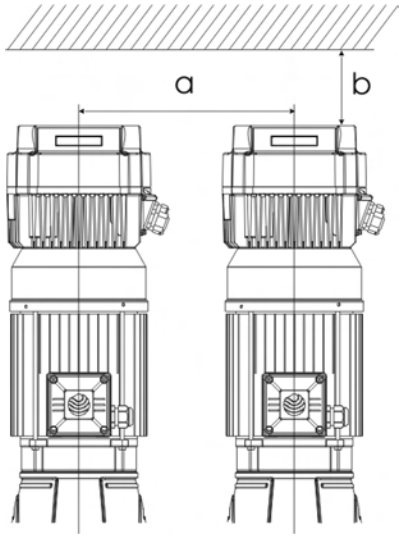
HV 4.055 / 4.075 / 4.110





All dimensions in millimetres!

Drawings are not in scale!



Type	Weight [kg]	
	Basic	Master/ Single
HV 4.055	7,70	8,10
HV 4.075		
HV 4.110		

a … minimum centre-distance between the HYDROVAR 430 [mm]
b … expansion space for maintenance 110 [mm]

Technical Data

HYDROVAR		Power Supply			
Type	Rated output	Voltage limits 48-62 Hz	Rated current input	Recommended line protection	Maximum connection
HV	[kW]	[V]	[A]	[A]	[mm²]
2.015	1,5	1~230 ± 15%	14,0	20	10
2.022	2,2		20,0	25	
4.022	2,2	3~380-460 ± 15%	7,6	13	10
4.030	3		9,1	13	
4.040	4		11,4	16	
4.055	5,5	3~380-460 ± 15%	15,1	20	10
4.075	7,5		19,6	25	
4.110	11		27,8	32	

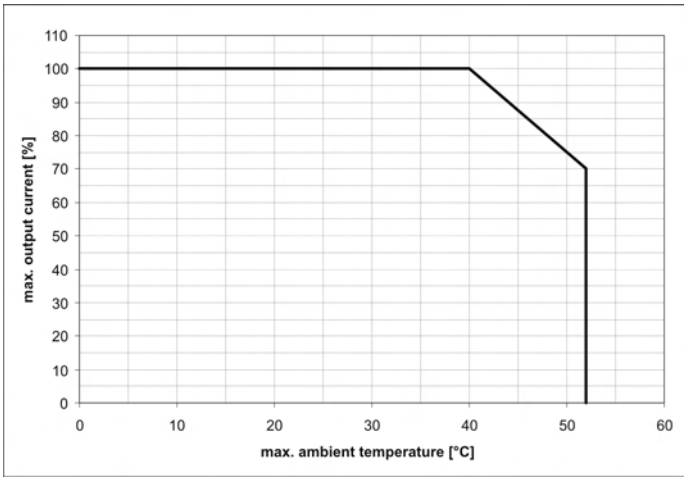
HYDROVAR		Output to the motor		
Type	Rated Output	Max. Voltage Output	Rated Current output	Motor connection cables
HV	[kW]	[V]	[A]	mm²
2.015	1,5	3~ U_{in}	7	4x1,5 – 4x4
2.022	2,2		10	
4.022	2,2	3~ U_{in}	5,7	4x1,5 – 4x4
4.030	3		7,3	
4.040	4		9	
4.055	5,5	3~ U_{in}	13,5	4x2,5 – 4x6
4.075	7,5		17	
4.110	11		23	

Make sure that the HYDROVAR's electrical data match those of the electric pump.

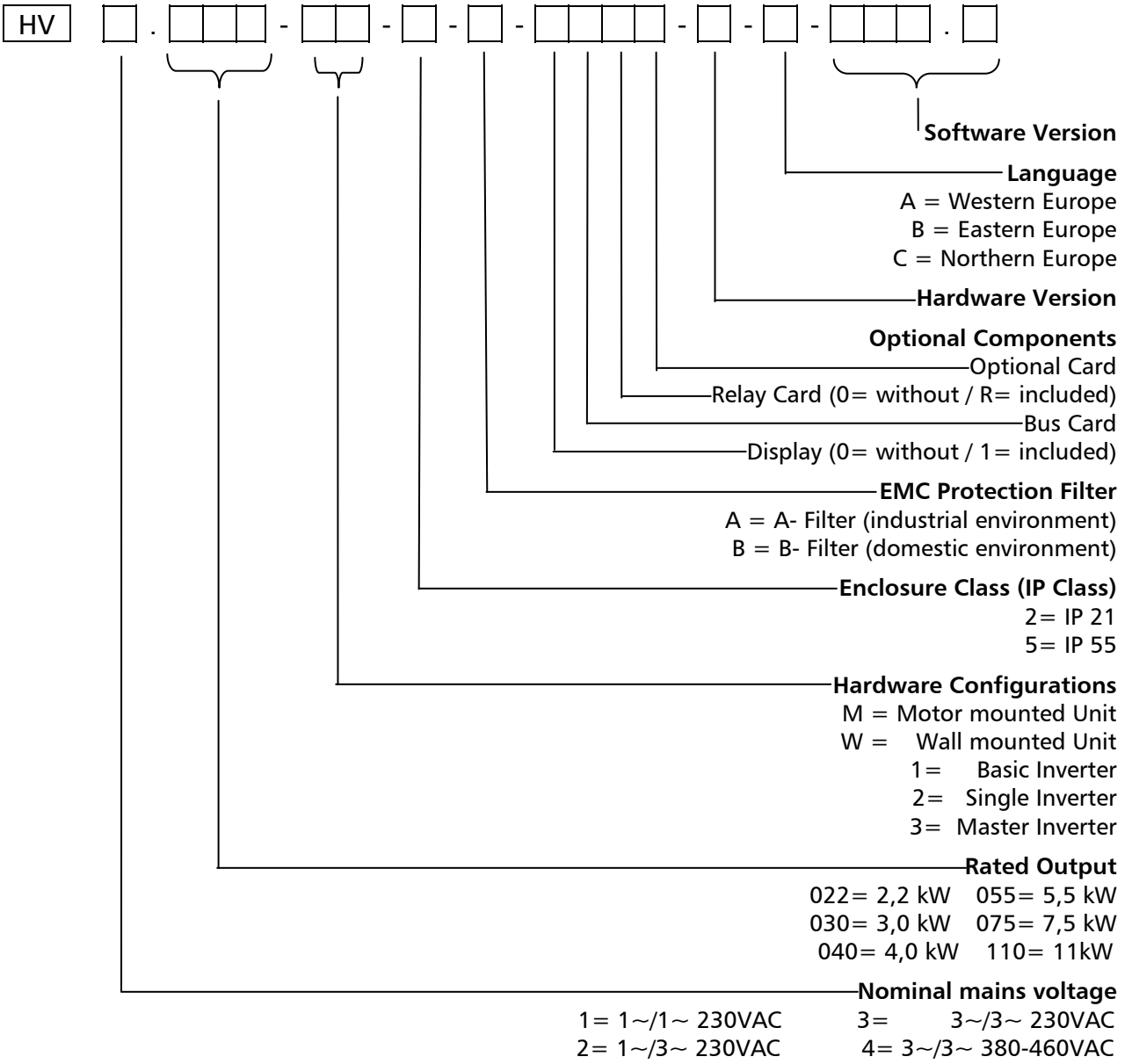
Improper combinations may cause malfunctions and fail to ensure the protection of the electric motor.

The rated current of the motor must be lower than the rated current of the HYDROVAR to prevent overheating or shutdown due to "OVERLOAD".

Technical Data

Ambient temperature:	0° C ... +40°C At higher temperatures a reduction of the output current or the use of the next HYDROVAR type is necessary.  o Protect the HYDROVAR against direct sunlight! o Outdoor installation without protection of the HYDROVAR is not permitted!
Storage temperature:	-25° .C ... +55° C (+70°C during max. 24 hours.)
Humidity:	RH max. 50% at 40°C, unlimited RH max. 90% at 20°C, max. 30 days per year 75% average per year (Class F) **Condensation is not permitted!**
Air pollution:	The air may contain dry dust as found in workshops where there is no excessive quantity of dust due to machines. Excessive amounts of dust, acids, corrosive gases, salts etc. are not permitted
Altitude:	max. 1000m above sea level At sites over 1000 m above sea level, the maximum output power has to be de-rated by 1% for every additional 100m. If the installation site is higher than 2000 m above sea level, please contact your local distributor.
Class of protection:	HV 2.015 / 2.022 HV 4.022 / 4.030 / 4.040 IP 55, NEMA 4 (Indoor only) HV 4.055 / 4.075 / 4.110
Certifications:	CE, UL,

Type designation code



Example

HV | 4 | . | 0 | 4 | 0 | - | M | 3 | - | 5 | - | B | - | 1 | 0 | R | 0 | - | G | - | A | - | V | 0 | 1 | . | 1 |

The mentioned HYDROVAR in this example is specified with following technical data:

Nominal mains voltage:	3~/3~ 380-460VAC
Rated Output:	4 kW
Hardware Configurations:	Motor mounted unit - Master Inverter
Enclosure Class:	IP 55
EMC-filter:	B - Filter (domestic environment)
Optional Components:	Display, Relay-Card
Hardware Version:	G
Language:	A: Western Europe (DE, EN, FR, NL, IT, ES, PT)
Software Version:	V01.1

Product Overview - Hardware Configurations

The HYDROVAR Modul Concept consists mechanically of two main parts, the Power Unit and the Control Card. In its basic configuration (consists only of the Power Unit) the HYDROVAR can be used as "Basic Inverter" without the need of the Control Card. In that form the HYDROVAR can be used as a sequence pump in a multi pump system, but also as a simple soft starter for single pump applications.
By extending this "Basic Inverter" with the additional Control Card, the HYDROVAR is able to work in different modes and can be extended by the implementation of different modules.

General Versions:

Master Inverter – Full featured HYDROVAR including the high level Control Card (supports also the optional modules like the optional "Relay Card" and all special software features).

Application:
- Single pump control including all extended features
- Multi pump system of "Master" and "Basic Inverters" (up to 8 pumps)
- Multi pump system equipped with up to 8 "Master Inverters"
- in combination with the optional "Relay Card" up to 5 fixed speed pumps can be controlled with this kind of configuration

Single Inverter – HYDROVAR with Control Card developed only for Single pump operation and less features in comparison with the Master Inverter.
The Single Inverter does not support any optional Modules like the Relay Card.

Application:
- Single pump control

Basic Inverter – HYDROVAR in its simplest configuration consists only of the power unit.

Application:
- Single pump operation as soft-starter, sequence pump (Slave) in a multi pump system

Operation Modes

Cascade Serial

In this mode there are various possibilities to combine the different versions of the HYDROVAR, which will be explained on the following pages.
In general each of the pumps is equipped with a HYDROVAR unit. All units are connected via the internal RS485 interface .

To realise a fully controlled system at least one "Master Inverter" is needed, the other pumps could be fitted just with a "Basic Inverter".
The controller in the "Master Inverter" is informed about the status and a possible failure of the "Basic Inverters" all the time. All possible failures are indicated on the Master unit, including also date and real time when the failure happened.

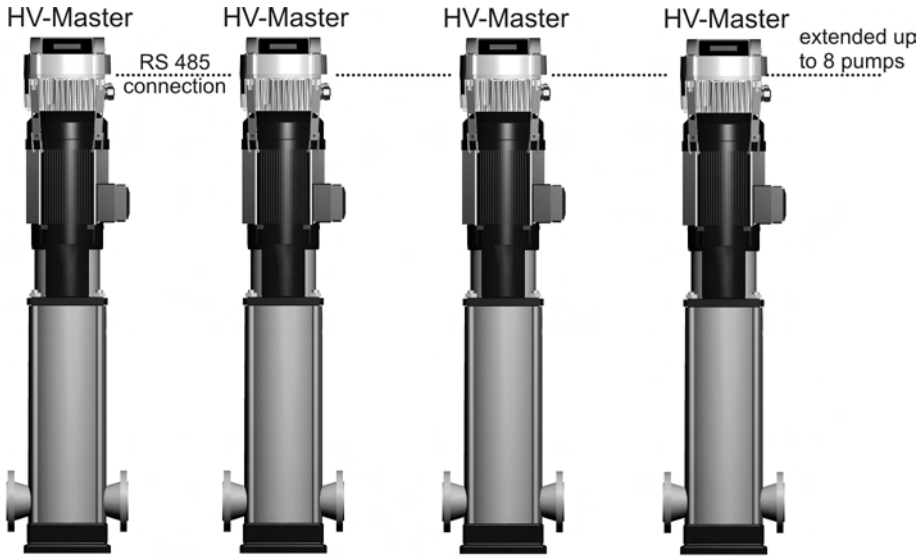
The complete control is done by the "Master Inverter" every time, but also an automatic change over of the lag pumps to provide even wear and achieve even operating hours will be possible .

If the Control Card of a "Master Inverter" fails, each of the "Basic Inverters" can be manually started by an external switch (manual operation) in order to ensure an "emergency operation" of the system.

Application Example:
Each pump of the system (extended up to 8 pumps) is equipped with a HYDROVAR unit (at least one "Master Inverter" and the others can be "Basic Inverters" in order to ensure a proper control of the system) which are connected via the serial interface.

The combination of the different HYDROVAR units that are used in a multi-pump-system depends on the system requirements (i.e. in a 6 pump system 2 "Master Inverters" can be used due to safety reasons and 4 "Basic Inverters" without Control Card – or just any other configuration)

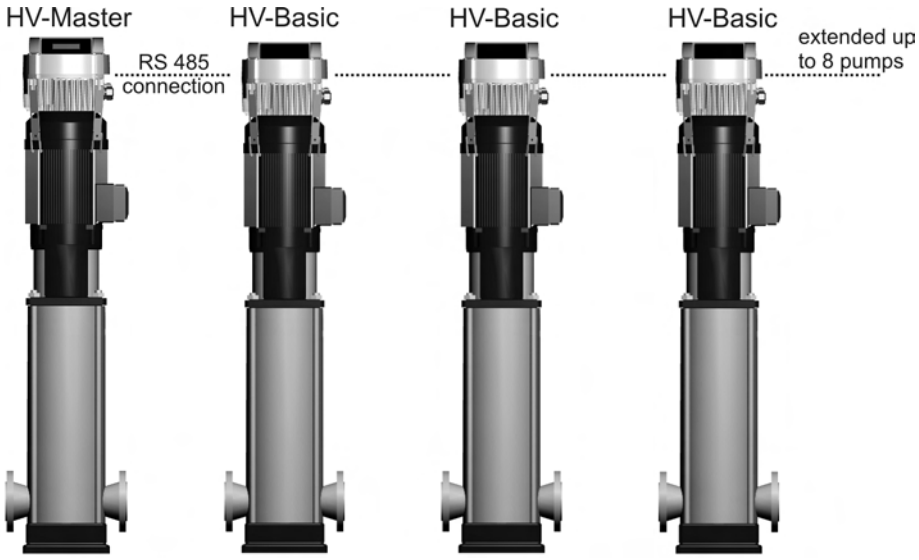
Full-featured Possibility: Each pump is equipped with a "Master Inverter"



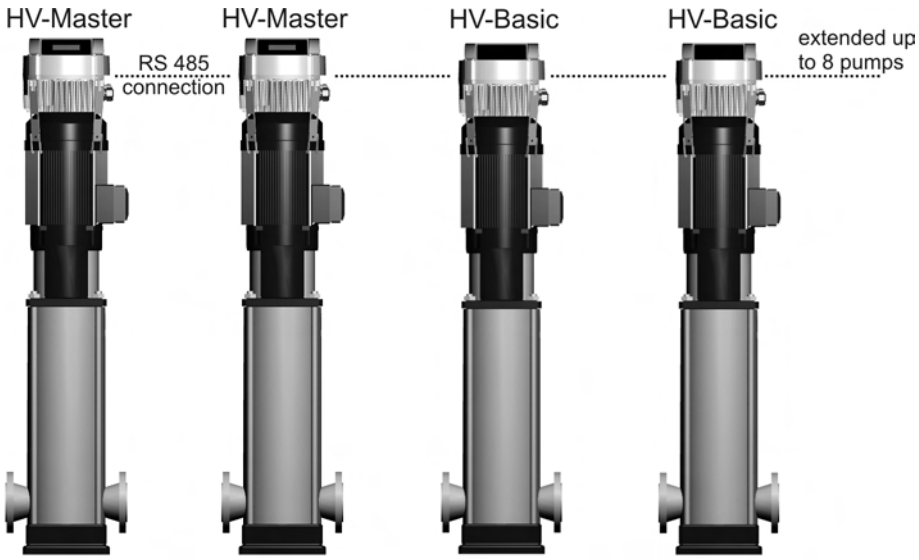
In this mode it is possible to run all pumps in multi-controller mode and synchronous mode as well!

This configuration allows each pump of the system to become a lead pump. This ensures a proper operation if one "Master Inverter" fails, either another one is used to take the "full responsibility" and a steady control of the system. That ensures that the operating hours of each separate pump will be on the same level to ensure even wear of the pumps.

Minimum requirement: 1 “Master Inverter” and the others equipped with “Basic Inverters”



To increase the operating safety of such a system, also a second “Master Inverter” could be used:



Cascade Relay

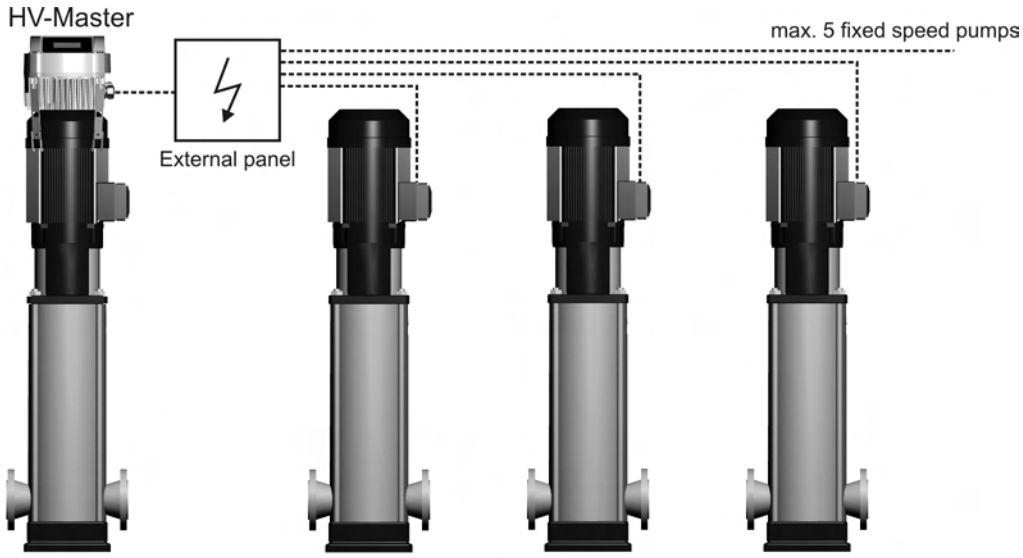
One pump is fitted with a HYDROVAR "Master Inverter" and up to 5 full speed slave pumps can be switched ON and OFF on demand. For this purpose an additional relay card with 5 relays is used in the "Master Inverter". Each Relay can be activated or deactivated depending on how many pumps are connected. Basically an external panel is needed for all the motor relays, because the relays in the HYDROVAR can't switch the pumps directly as they are just used as switch contacts.

Also an automatic change over of the fixed speed pumps to provide even wear and achieve even operating hours is possible in this mode.

This configuration would be a simple alternative compared with other solutions using VFD's on each pump, but in any case care has to be taken due to the lower operating safety of such a system.

Application Example

Booster sets up to 6 pumps where only one pump is speed controlled by the HYDROVAR and the others are fixed speed (1 HYDROVAR Master Inverter+5 fixed speed). This should be the standard configuration when the additional "Relay Card" is used.



Actuator (for single pump operation only!)

In this mode the HYDROVAR operates as an Actuator with external speed signal or switching between 2 programmed frequencies by using the corresponding digital input. For this application the HYDROVAR operates like a standard frequency converter when an external controller is used.

!!! Please consider that this mode is only possible by using a HYDROVAR Master or Single Inverter and is limited for single pump operation only!!!

Controller

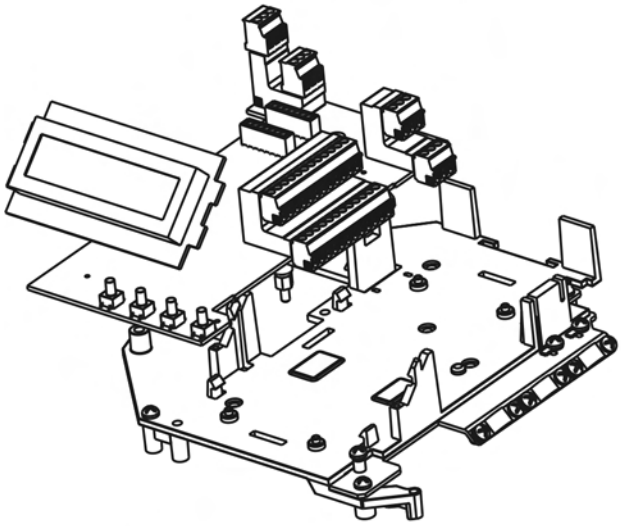
This mode should be selected if only one HYDROVAR pump is in operation and there is no connection to any other HYDROVAR via RS485 interface.

Modules

Regarding to your application the needed configuration which is available for the HYDROVAR can be selected. Due to this possibility the HYDROVAR can be configured regarding the operation safety and cost effectiveness for your specific application.

Relay Card

The optional Relay Card allows to control up to 5 fixed speed pumps (can be only used in combination with one Master Inverter).



Upgrade Kit

Consist of Control Card, Display unit and Mounting Kit

Control Card

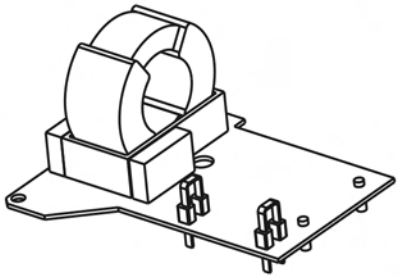
The control card is used for the Master/Single Inverter and includes the I/O's for the digital and analogue signals (i.e. actual value input, run/fault relay output) and the Display unit

Display Unit

Depending to the installation position the display can be turned to your prefered position!
(The push-buttons will change automatically when turning the display!)

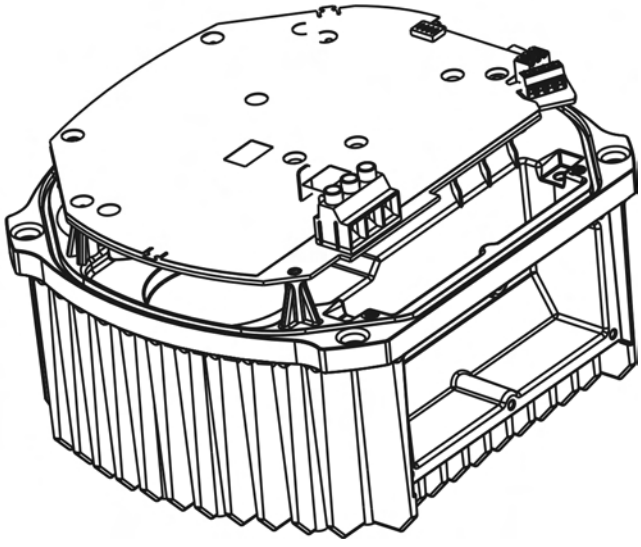
Mounting Kit

The Mounting Kit consists of all necessary parts to fix and support the control card and the display.



Filter Card

Optional Filter Card to ensure EMC regulations for domestic environments (Class B Filter).



Power Unit

In its standard form it will be used as Basic Inverter or as simple soft starter in a single pump application!
When using a Master configuration the power unit is fitted with an additional control card.

Electrical installation and wiring

All installations and maintenance have to be performed by properly trained and qualified personnel with proper tools!!
Use personally protection equipment.

Means of protection

Ask your power supply company which means of protection are required.

Applicable:
- protective earthing
- AC and DC residual current operated protective devices (RCD)
- TN systems

Protective earthing:

- Please note that a current to earth can occur due to the capacitors in the input filter.
- A suitable protection unit has to be selected (according local regulations).

Residual current device (RCD/RCCB):

- When using a RCD, make sure that it also releases in the event of a short circuit inside the DC-part of the HYDROVAR to earth!
  - single phase HYDROVAR => use pulse sensitive RCDs
  - three phase HYDROVAR => use AC/DC sensitive RCDs
- The RCD has to be installed according local regulations!

Automatic circuit breaker:

- Use automatic circuit breaker with C-type characteristic curve
- Rating of the line-protection (see chapter Technical Data)

Internal protective devices of the HYDROVAR:

- The malfunctions short circuit, under- and over-voltage, overload and the overheating of the electronic components are monitored internally by the HYDROVAR.

External protective devices:

- Additional protective functions like motor overheat and low water protection, are controlled by external equipment.

EMC requirements (Electromagnetic compatibility)

The EMC requirements differ between two environments which depends to the intended use.

- **First environment – class B**

Environment that includes domestic premises, it also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.

E.g. Houses, apartments, commercial premises or offices in a residential building are typical examples of first environment locations.

Be careful: The relevant EMC regulations for which the HYDROVAR is tested in the first environment consider that the HYDROVAR is a restricted available product.
That means the voltage of the inverter is less than 1 000 V, it is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a person or an organisation having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

- **Second environment – class A**

Environment that includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes

E.g. Industrial areas, technical areas of any building fed from a dedicated transformer are typical examples of second environment locations.

The HYDROVAR complies with the general EMC regulations and is tested according to the following standards:

EN 61800-3/2005

EN 55011 (2002) Disturbance voltages / Disturbance field strength

	First environment – class B	Second Environment – class A
Disturbance voltages	OK	OK
Disturbance field stength	*)	OK
*) Warning - In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.		

EN 61000-4-2	**(2001)**	Electrostatic Discharge
EN 61000-4-3	**(2002)**	Electromagnetic field immunity test
EN 61000-4-4	**(2001)**	Burst Immunity Test
EN 61000-4-5	**(2001)**	Surge Immunity Test
EN 61000-4-6	**(1996)**	Immunity of Conducted Rf-Disturbance
EN 61000-4-11	**(2001)**	Voltage dips and interruptions

EMC-electromagnetic compatibility

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

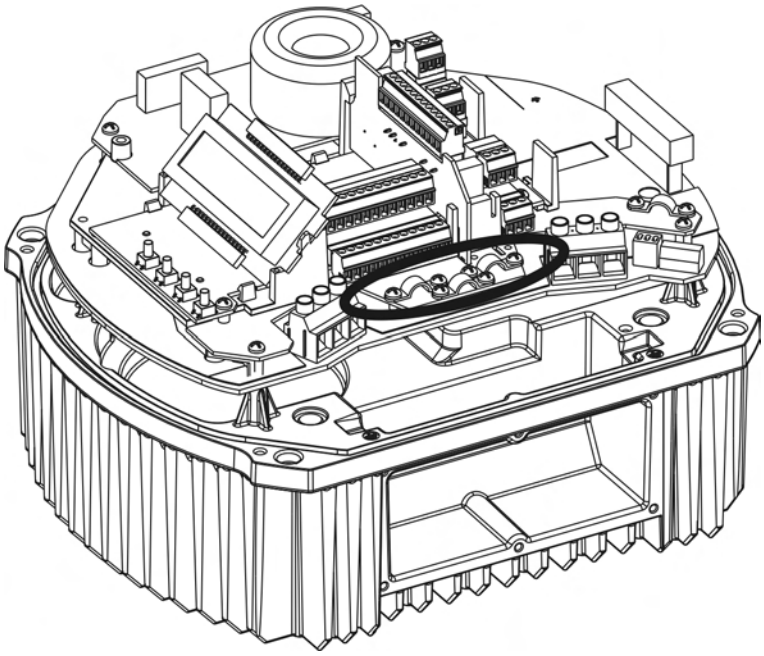
Earth / ground to ensure EMC

- **Protection earth**
  It is important to connect the HYDROVAR to PE, because of the earth leakage current.
- **HF earth connection**
  Ground cables should be as short as possible and with lowest impedance.

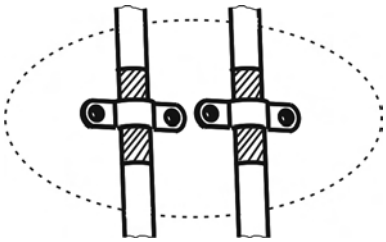
Signal cables

Control and signal cables should be screened types to prevent disturbances from outside.

The screen should be only connected to ground on one side; otherwise it is possible that the screen has a ground current. The screen should be extensively connected with cable-clips to HYDROVAR GND (use pre mounted cable-clips).



Pre-mounted cable-clips



To connect a screen with lowest impedance to ground, remove the isolation from the signal cable and connect the screen extensive to ground.

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

Motor cables
To ensure the EMC compatibility and minimize noise level and leakage currents, keep the motor cable as short as possible.

Additional component: Line Choke (coil)
Line coils are available as an option and should be mounted between the HYDROVAR and the main fuse.
The Line coil should be as near as possible to the HYDROVAR.

Advantages:
- better efficiency
- reduction of harmonic currents

For the following applications additional line chokes are strongly recommended:
- high short circuit currents (low supply net impedance)
- compensation-plants without a coil
- asynchronous motors which are responsible for a voltage drop >20% of the line voltage

EMC summary

- Install potential equalization according local regulations
- Don't install the power-cable in parallel to signal-cables
- Use screened signal-cables
- Connect only one end of the screen of a signal-cable to ground
- If screened motor-cables are used, both ends of the screen have to be connected to ground
- Motor-cable as short as possible
- "Pigtails" should be prevented

Recommended Cable Types

To ensure the above mentioned points to guarantee EMC compatibility and a correct function of the HYDROVAR the mentioned cable types should be used.

Application	**Recommended Cable-Type**
- Motor-cables HV 2.015-2.022 HV 4.022-4.040 HV 4.055-4.075 HV 4.011	4G1,5 + (2 x 0.75) FDF 4G1,5 + (2 x 0,75) FDF 4G2,5 + (2 x 0,75) FDF 4G 4 + (2 x 0,75) FDF
- Control- and Signal- Cables	JE-Y(ST)Y … BD JE-LiYCY … BD
- Cables connected to RS485 interface	JE-Y(ST)Y 2 x 2 x 0,8 BD

Wiring and connections

Control Terminals HYDROVAR Master Inverter

All control cables connected to the control-unit have to be screened.

NOTE:
If unscreened control cables are used, signal interference may occur and could interfere the incoming signals and the function of the HYDROVAR.

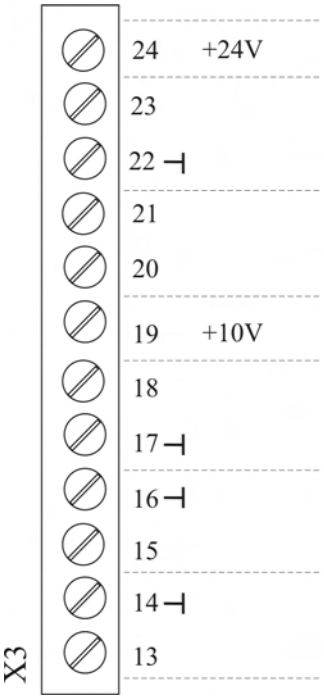
Don't connect the ground of the Control Card to different voltage potentials.
All electronic ground terminals and GND of the RS 485-interface are connected internally.

X3 Digital and Analogue I/O				
X3/	1	GND, electronic ground		
	2	Actual value current input Sensor 1		0-20mA / 4-20mA [Ri=50Ω]
	3	Power supply for external sensors		24VDC, ** max. 100mA
	4	Actual value current input Sensor 2		0-20mA / 4-20mA [Ri=50Ω]
	5	Actual value voltage input Sensor 2	*Dig 3	0-10 VDC
	6	Actual value voltage input Sensor 1	*Dig 2	0-10 VDC
	7	External ON/OFF (release)		Active Low
	8	GND, electronic ground		
	9	Configurable Digital Input 1	Dig 1	Active Low
	10	GND, electronic ground		
	11	Low water		Active Low
	12	GND, electronic ground		
	13	Voltage signal input (Required Value 1)	(Offset)	0-10VDC
	14	GND, electronic ground	(Offset)	
	15	Voltage signal input (Required Value 2)	*Dig 4	0-10VDC
	16	GND, electronic ground	(Offset)	
	17	GND, electronic ground	(Offset)	
	18	Current signal input (Required Value 1)	(Offset)	0-20mA / 4-20mA [Ri=50Ω]
	19	+10V Internal Ref. for Analogue Output		10,00VDC, max. 3mA
	20	Analogue Output 1		0-10VDC, max. 2mA
	21	Analogue Output 2		4-20mA
	22	GND, electronic ground	(Offset)	
	23	Current signal input (Required Value 2)	(Offset)	0-20mA / 4-20mA [Ri=50Ω]
	24	+24V Power supply for control inputs		24VDC, ** max. 100mA

* Terminals 5 and 6 can be used as actual value voltage input and even as Digital Input without any additional configuration.
Also the voltage signal input on terminal X3/15 can be used as Digital Input.

** X3/3 and X3/24 – 24VDC and $\sum$ max. 100mA

Control Terminals HYDROVAR Master Inverter



Additional Power supply ** max. 100 mA

Current signal input (Required Val. 2) 0-20mA / 4-20mA [Ri=50Ω]
To determine the required value or the offset

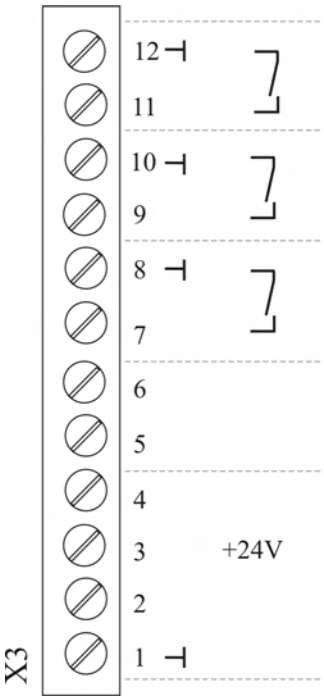
Analogue Output 2 4-20mA

Analogue Output 1 0-10 VDC

Current signal input (Required Val. 1) 0-20mA / 4-20mA [Ri=50Ω]
To determine the required value or the offset

Voltage signal input (Required Value 2) 0-10 VDC ***DIG 4**
To determine the required value or the offset

Voltage signal input (Required Value 1) 0-10 VDC
To determine the required value or the offset



Low water
e.g. incoming pressure switch or water level switch

Configurable Digital Input 1 **DIG 1**
e.g. for switching between 2 required values or sensors

External ON/OFF (release)

Actual-value-voltage input Sensor 1 0-10 VDC ***DIG 2**

Actual-value-voltage input Sensor 2 0-10 VDC ***DIG 3**

Actual-value-current input Sensor 2 0-20mA / 4-20mA [Ri=50Ω]

Sensor supply ** max. 100 mA

Actual-value-current input Sensor 1 0-20mA / 4-20mA [Ri=50Ω]

Ground

* Terminals X3/5 and 6 can be used as actual value voltage input and even as Digital Input without any additional configuration. Also the voltage signal input on terminal X3/15 can be used as Digital Input.

** X3/3 and X3/24 – 24VDC and ∑ max. 100mA

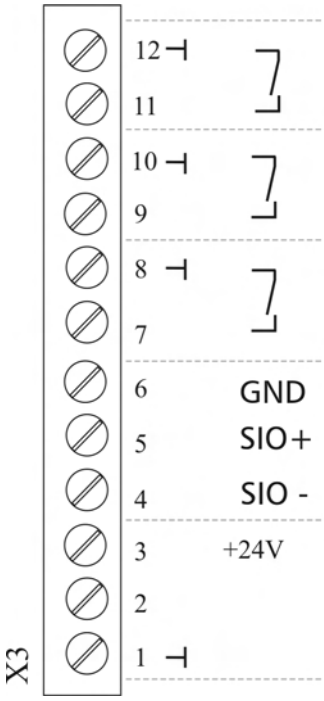
Control Terminals HYDROVAR Single Inverter

All control cables connected to the control-unit have to be screened (Refer to "Recommended Cable Types").

NOTE:
If unscreened control cables are used, signal interference may occur and could interfere the incoming signals and the function of the HYDROVAR.

Don't connect the ground of the Control Card to different voltage potentials.
All electronic ground terminals and GND of the RS 485-interface are connected internally.

X3 Digital and Analogue I/O			
X3/	**1**	GND, electronic ground	
	2	Actual value input Sensor 1	0-10VDC or 0-20mA / 4-20mA [Ri=50Ω]
	3	Power supply for external sensors	24VDC, max. 50mA
	4	User SIO-Interface: SIO-	**User Interface** for external usage
	5	User SIO-Interface: SIO+	
	6	**GND**, electronic ground	
	7	External ON/OFF (release)	Active Low
	8	GND, electronic ground	
	9	Configurable Digital Input 1	Active Low
	10	GND, electronic ground	
	11	Low water	Active Low
	12	GND, electronic ground	



Low water
e.g. incoming pressure switch or water level switch

Configurable Digital Input 1
e.g. to enable 2nd required value

External ON/OFF (release)

GND, electronic ground

User SIO-Interface:SIO+

User SIO-Interface: SIO-

Sensor supply max. 50 mA

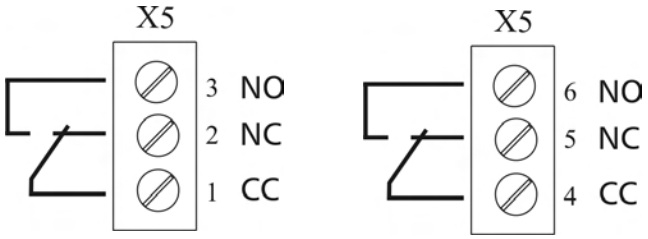
Actual-value input Sensor 1 0-10V or 0-20mA / 4-20mA [Ri=50Ω]

Ground

Terminals Status Relay HYDROVAR (Master + Single Inverter)

X5 Status-Relays					
X5/	1	Status Relay 1	CC	[Max. 250VAC]	[0,25A general use]
	2		NC	[Max. 220VDC]	[0,25A general use]
	3		NO	[Max. 30VDC]	[2A general use]
	4	Status Relay 2	CC		
	5		NC		
	6		NO		

Status Relay 1 **Status Relay 2**



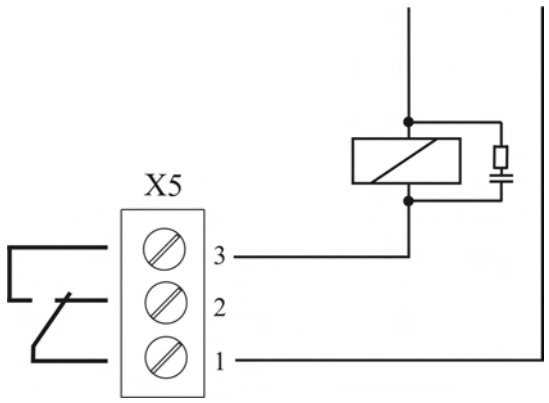
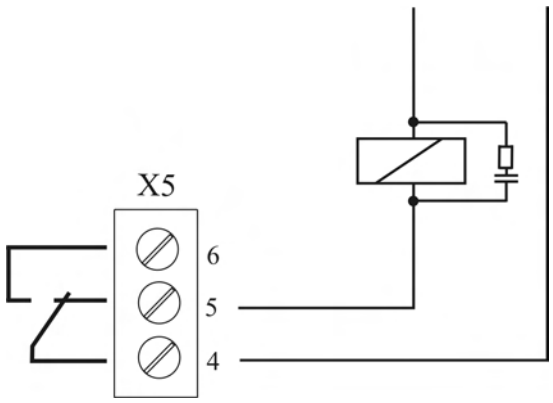
Please Note:

When using the relay contacts for driving an external relay, a corresponding RC-snubber-circuit is recommended, to prevent disturbances arising during a switching action of the relay!

Both Status-Relays on the Control Card can be used regarding the programmed configuration.

Depending to the programming, both relays can be used to indicate the current status and failure messages of the HYDROVAR.
For example the two relays are used as Pump-running or Fault-signal-relay.

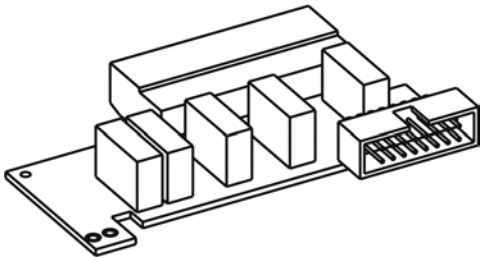
Connection examples:

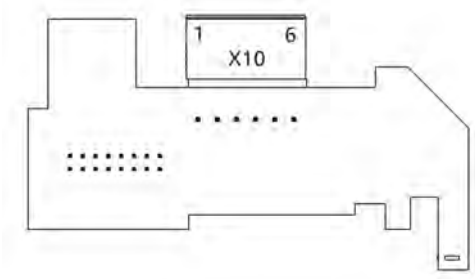
Pump running signal Ext. 250VAC / 220VDC	**Fault signal**
Ext. 250VAC / 220VDC 	Ext. 250VAC / 220VDC 
X5/ 1 and 3 closed: - motor run indication	X5/ 4 and 5 closed: - if there is a Fault/Error - if the supply of the HYDROVAR is cut off

Optional Relay Card (Application Cascade Controller)

Optional Component can be used only in combination with a HYDROVAR Master Inverter.

The Relay Card is connected to the Control Card using connection slot X6.



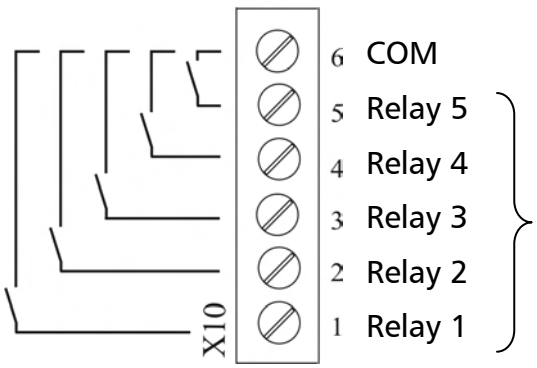


Please Note:

When using the relay contacts for driving an external relay, a corresponding RC-snubber-circuit is recommended, to prevent disturbances arising during a switching action of the relay!

Terminals Relay Card

X10 Relay Card				
X10/	**1**	Relay 1	[Max. 250VAC]	[1A general use]
	2	Relay 2		
	3	Relay 3		
	4	Relay 4	[Max. 30VDC]	[1A general use]
	5	Relay 5		
	6	COMMON		



Contacts for switching the fixed speed pumps.

Please consider that the fixed speed pumps can't be switched directly by the Relay Card (an external panel for the contactors of the D.O.L or STAR/DELTA starters is necessary).

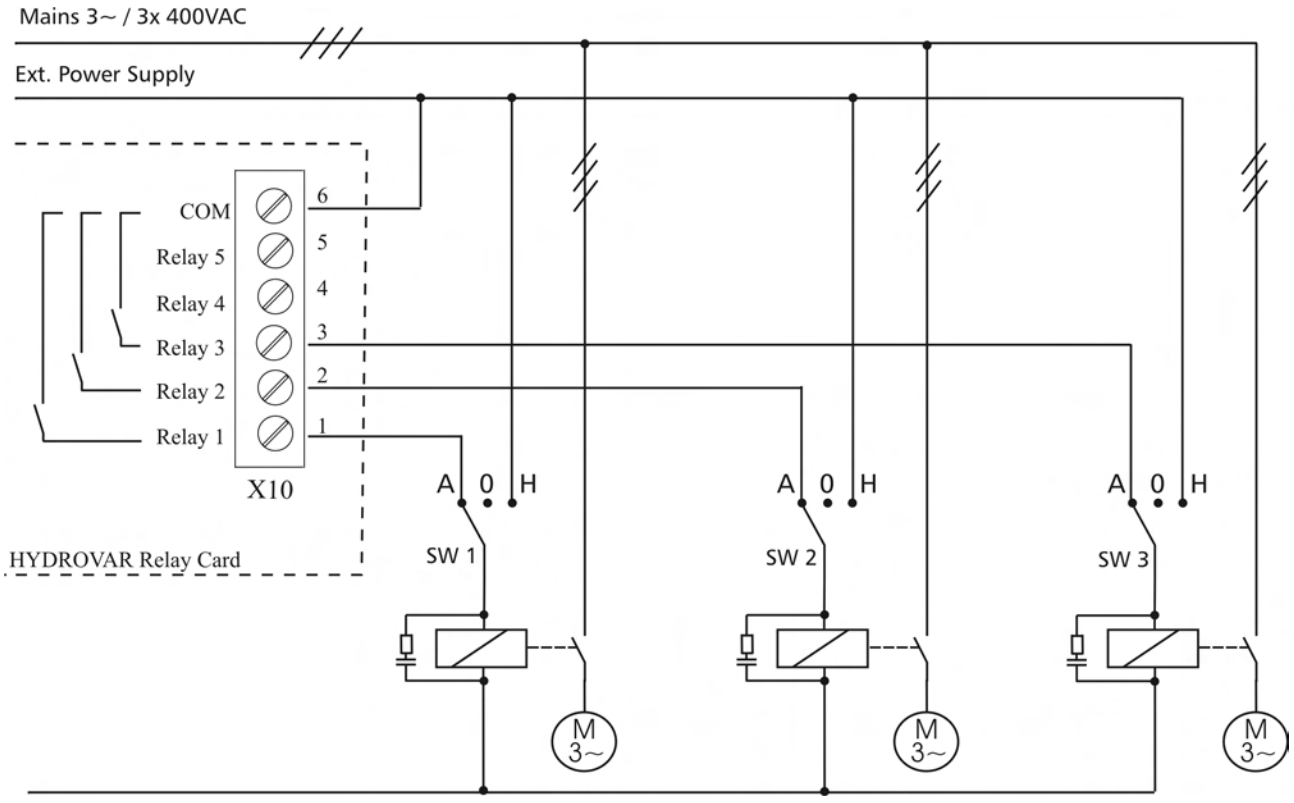
Connection example:

The following wiring diagram shows a standard cascade control system where the HYDROVAR is fitted with an additional Relay card, in selected mode "Cascade Relay".

To switch the fixed speed pumps via the internal relay card, an external panel for the contactors of the D.O.L or STAR/DELTA starters (and optional A/0/M – switch) is required.

In the example below 3 fixed speed pumps (motors) are connected to the Relay Card. For such an application, an optional HAND/OFF/AUTO switch (SW1, SW2, SW3) is recommended.

- During normal operation the switch is set to AUTO, so the Relay Card of the HYDROVAR would start and stop the follow-up pumps.
- The "HAND" position allows a manual operation of the pumps.
- If one of the additional switches is in OFF position, the related relay must be disabled in the submenu STATUS [20] to ensure correct operation of the multi-pump system.

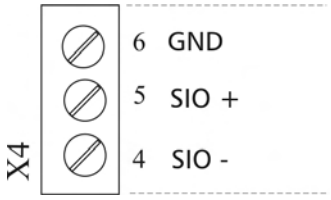


Communication – HYDROVAR Interface Connection

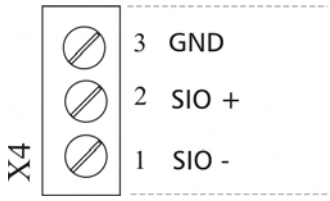
The HYDROVAR provides two Interface Types:

X4 RS485-Interface			
X4/	1	User SIO-Interface: SIO-	**User Interface for external usage (Modbus)**
	2	User SIO-Interface: SIO+	
	3	**GND**, electronic ground	
	4	Internal SIO-Interface: SIO-	**Internal Interface for multi-pump-systems**
	5	Internal SIO-Interface: SIO+	
	6	**GND**, electronic ground	

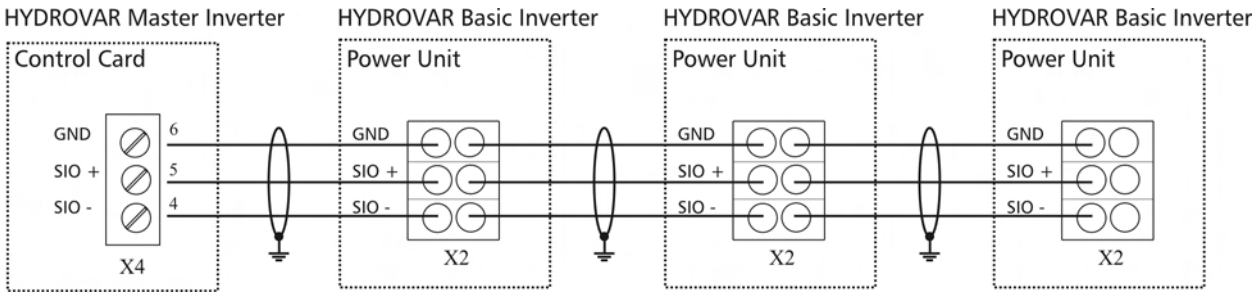
RS-485 – Internal Interface



RS-485 - User Interface (Modbus)



The **internal RS-485 Interface** is used for the communication between up to 8 HYDROVARs in a multi-pump application. For the connection of each HYDROVAR via the RS-485 interface the terminals X4/4-6 on the Control Card, and even the terminals X2/1-3 on the power unit can be used.
(**Connection example:** using one Master- and three Basic - Inverters.)



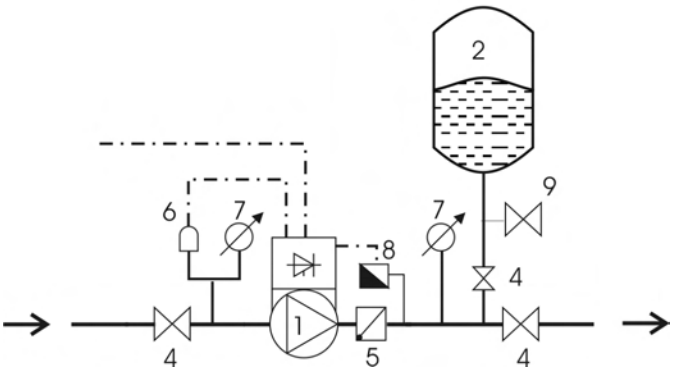
By using the **RS-485 – User Interface** on the Control Card, one or more HYDROVAR can communicate via the standardized Modbus-protocol with an external-control-device (e.g. PLC). This interface can be used for parameterising and controlling the HYDROVAR via external devices. **Also active for HYDROVAR Single Inverter - Configuration.**

Do not use the Internal Interface as User Interface and vice versa!

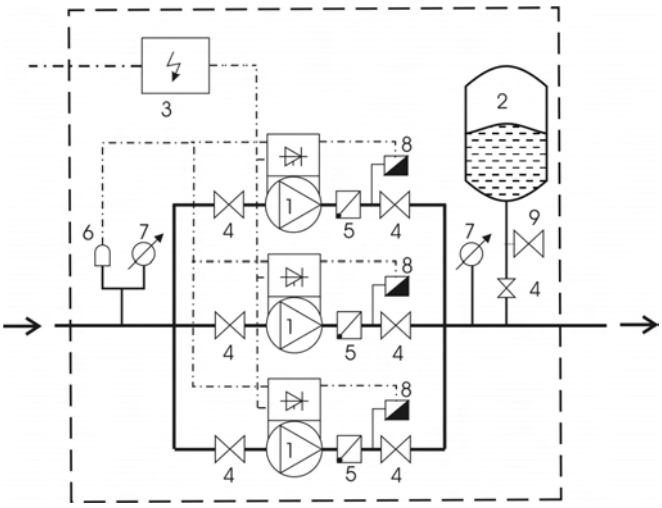
System Design

The following diagrams show typical single pump and multi-pump systems using the HYDROVAR control unit. Connection can be made directly to a water supply. In such a case, a pressure switch on the suction side should be used.

Single Pump Layout



Multi Pump Layout



(1)	pump with HYDROVAR	(4)	gate valve	(7)	pressure gauge
(2)	diaphragm tank	(5)	non return valve	(8)	pressure transmitter
(3)	distribution panel	(6)	low water control	(9)	drain tap

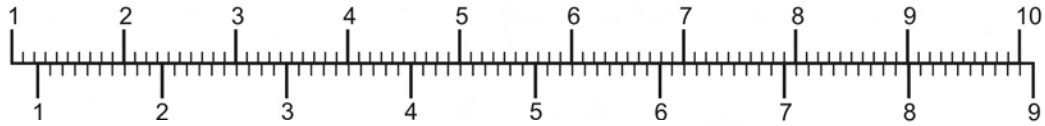
Pressure tank

A diaphragm pressure tank is used on the discharge side of the pump to maintain pressure in the line when there is no demand. This will keep the pumps from continuing to run at zero demand. With the HYDROVAR, no large tanks are required for supply purposes.
The tank must be permitted and suitable for systems pressure. The tank should have a capacity of min. 10% of the maximum flow rate [l/min] of one pump (also valid for multi-pump system).

Example:
Maximum flow rate of the pump = 250 litres per minute
Minimum volume of the tank = 250 x 0.10 = 25 litres

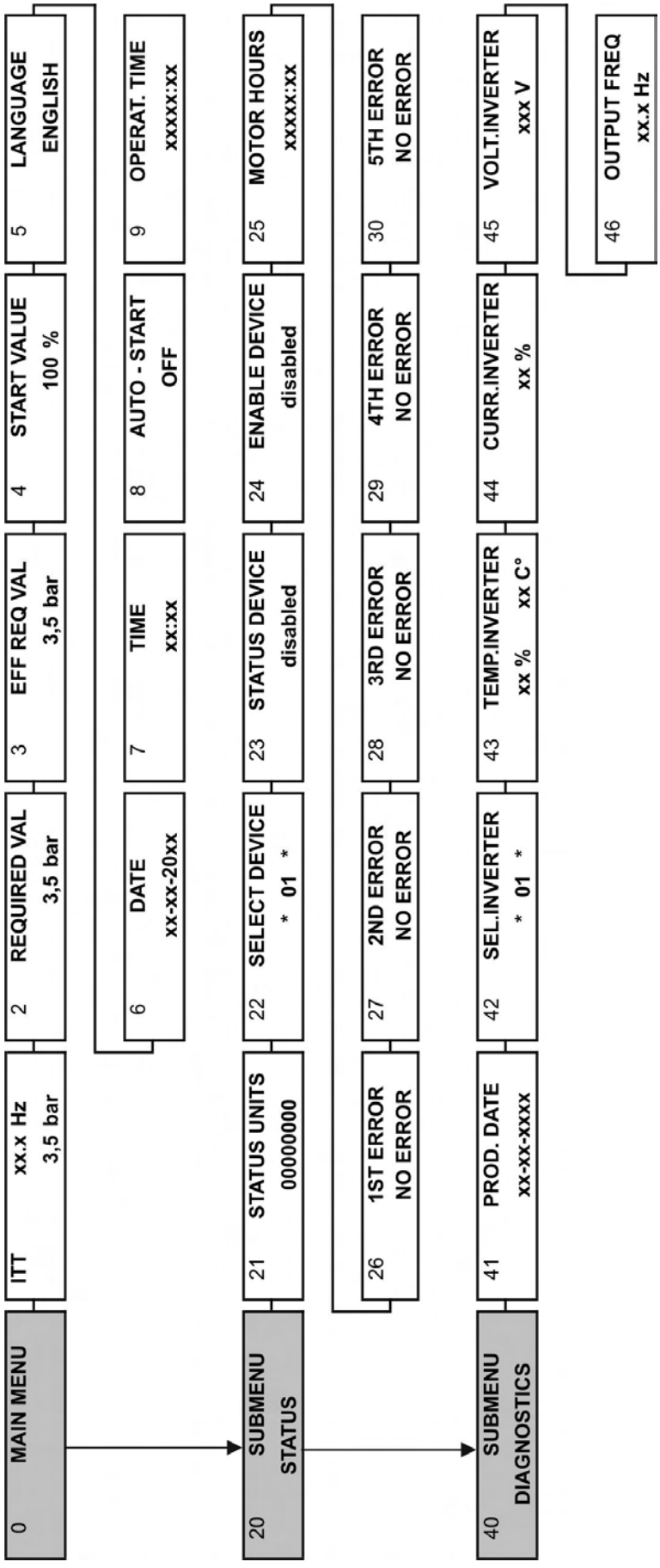
The pre-charge pressure of the tank can be determined by using the following table:

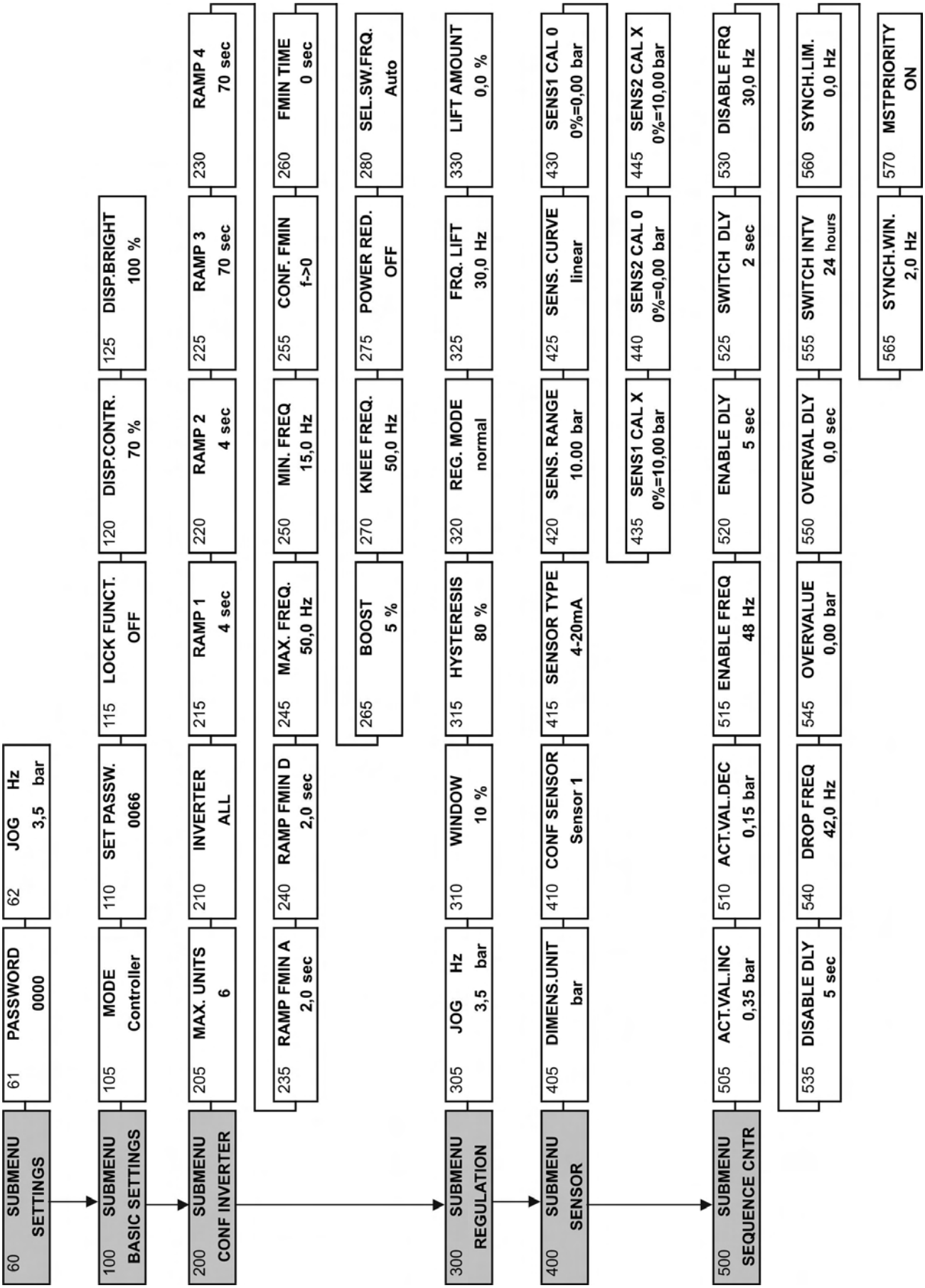
Required pressure [bar] (system pressure)

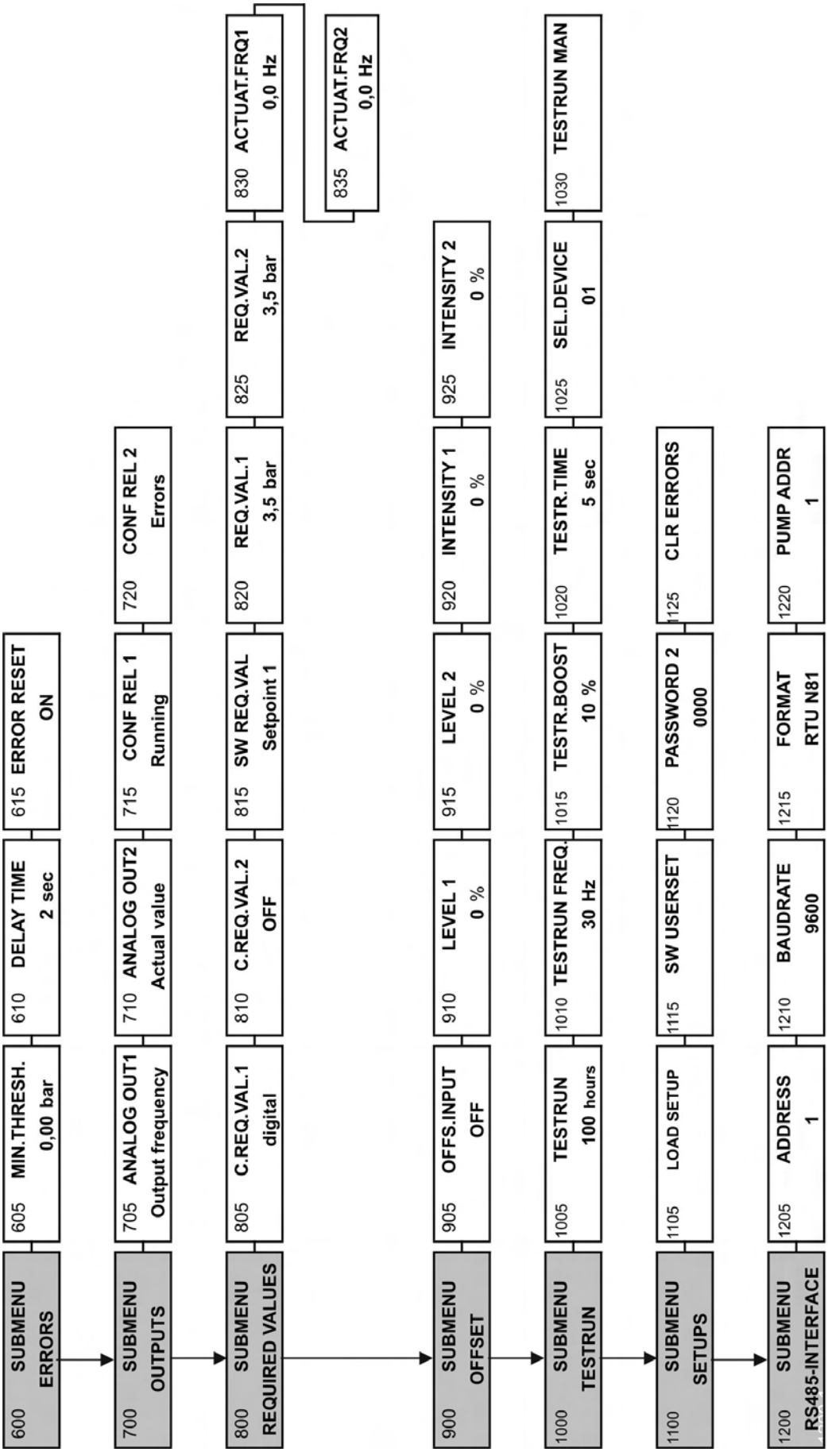


Pre-charge pressure [bar] (air pressure)

Notes:


0 MAIN MENU
ITT xx.x Hz 3,5 bar
2 REQUIRED VAL 3,5 bar
3 EFF REQ VAL 3,5 bar
4 START VALUE 100 %
5 LANGUAGE ENGLISH
6 DATE xx-xx-20xx
7 TIME xx:xx
8 AUTO - START OFF
9 OPERAT. TIME xxxxx:xx
20 SUBMENU STATUS
21 STATUS UNITS 00000000
22 SELECT DEVICE * 01 *
23 STATUS DEVICE disabled
24 ENABLE DEVICE disabled
25 MOTOR HOURS xxxxx:xx
26 1ST ERROR NO ERROR
27 2ND ERROR NO ERROR
28 3RD ERROR NO ERROR
29 4TH ERROR NO ERROR
30 5TH ERROR NO ERROR
40 SUBMENU DIAGNOSTICS
41 PROD. DATE xx-xx-xxxx
42 SEL.INVERTER * 01 *
43 TEMP.INVERTER xx % xx C°
44 CURR.INVERTER xx %
45 VOLT.INVERTER xxx V
46 OUTPUT FREQ xx.x Hz


60 SUBMENU SETTINGS
61 PASSWORD 0000
62 JOG Hz 3,5 bar
100 SUBMENU BASIC SETTINGS
105 MODE Controller
110 SET PASSW. 0066
115 LOCK FUNCT. OFF
120 DISP.CONTR. 70 %
125 DISP.BRIGHT 100 %
200 SUBMENU CONF INVERTER
205 MAX. UNITS 6
210 INVERTER ALL
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. 50,0 Hz
250 MIN. FREQ 15,0 Hz
255 CONF. FMIN f->0
260 FMIN TIME 0 sec
265 BOOST 5 %
270 KNEE FREQ. 50,0 Hz
275 POWER RED. OFF
280 SEL.SW.FRQ. Auto
300 SUBMENU REGULATION
305 JOG Hz 3,5 bar
310 WINDOW 10 %
315 HYSTERESIS 80 %
320 REG. MODE normal
325 FRQ. LIFT 30,0 Hz
330 LIFT AMOUNT 0,0 %
400 SUBMENU SENSOR
405 DIMENS.UNIT bar
410 CONF SENSOR Sensor 1
415 SENSOR TYPE 4-20mA
420 SENS. RANGE 10.00 bar
425 SENS. CURVE linear
430 SENS1 CAL 0 0%=0,00 bar
435 SENS1 CAL X 0%=10,00 bar
440 SENS2 CAL 0 0%=0,00 bar
445 SENS2 CAL X 0%=10,00 bar
500 SUBMENU SEQUENCE CNTR
505 ACT.VAL.INC 0,35 bar
510 ACT.VAL.DEC 0,15 bar
515 ENABLE FREQ 48 Hz
520 ENABLE DLY 5 sec
525 SWITCH DLY 2 sec
530 DISABLE FRQ 30,0 Hz
535 DISABLE DLY 5 sec
540 DROP FREQ 42,0 Hz
545 OVERVALUE 0,00 bar
550 OVERVAL DLY 0,0 sec
555 SWITCH INTV 24 hours
560 SYNCH.LIM. 0,0 Hz
565 SYNCH.WIN. 2,0 Hz
570 MSTPRIORITY ON


600 SUBMENU ERRORS
605 MIN.THRESH. 0,00 bar
610 DELAY TIME 2 sec
615 ERROR RESET ON
700 SUBMENU OUTPUTS
705 ANALOG OUT1 Output frequency
710 ANALOG OUT2 Actual value
715 CONF REL 1 Running
720 CONF REL 2 Errors
800 SUBMENU REQUIRED VALUES
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 SUBMENU OFFSET
905 OFFS.INPUT OFF
910 LEVEL 1 0 %
915 LEVEL 2 0 %
920 INTENSITY 1 0 %
925 INTENSITY 2 0 %
1000 SUBMENU TESTRUN
1005 TESTRUN 100 hours
1010 TESTRUN FREQ. 30 Hz
1015 TESTR.BOOST 10 %
1020 TESTR.TIME 5 sec
1025 SEL.DEVICE 01
1030 TESTRUN MAN
1100 SUBMENU SETUPS
1105 LOAD SETUP
1115 SW USERSET
1120 PASSWORD 2 0000
1125 CLR ERRORS
1200 SUBMENU RS485-INTERFACE
1205 ADDRESS 1
1210 BAUDRATE 9600
1215 FORMAT RTU N81
1220 PUMP ADDR 1

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