



Instruction manual

Pump-Controller MAI:

Pressure Regulation

Software Version: 5.11

Table of contents		Page
1.	Safety precautions	2
2.	General / Mode of operation	4
3.	Models	6
4.	Installation and Mounting	7
5.	Wiring / Connections	8
6.	Name of keys / Display	12
7.	Main menu – Operation data	13
8.	Start up / Changing parameters	14
9.	Protective functions / Trouble-Shooting	23
Appendix	Multiple pump operation	26
Appendix	Expert mode	27
Appendix	Standard specifications	29
Appendix	Index	30

1. Safety Precautions

Please read this manual carefully and all of the warning signs attached before installing or operating the equipment
Keep this manual handy for your reference.

Definitions of safety instructions

A safety instruction (message) is given with a signal word:

WARNING ! or CAUTION !

WARNING !

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION !

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product.

General

WARNING !

These instructions should be read and clearly understood before working on the system. This equipment should be installed, adjusted and serviced by trained and qualified electrical maintenance personnel. Failure to observe this precaution could result in bodily injury.

WARNING !

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, you may be exposed to components at or above the line potential. Extreme care should be taken to protect against shock. Dangerous voltage may exist after the power light is off.

Wait more than 5 minutes after turning off the power supply before performing maintenance or inspection. Hazard of electric shock. Disconnect incoming power before working on this unit.

WARNING !

Install an emergency stop key separately from the isolator. Rotating shafts can be hazardous.

WARNING!

This equipment has a high leakage current and must be permanently fixed to earth. The inverter should be protected separately against ground fault.

Observe the regional regulations for electrical installation!

WARNING!

Do not attach or remove wiring or connectors when the power is applied. Do not check signals during operation. When the power is turned on when the running command is on, the motor will start rotating. The stop key is only effective when the function is set. If there is a power failure and an operation instruction is given the unit may start automatically when the power is reinstated.

WARNING!

Make sure that the input voltage is correct. Be sure to install the unit in a room that is not exposed to direct sunlight and is well ventilated. Avoid environments which have a high ambient temperature, high humidity or excessive condensation. Avoid dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist and salt damage, etc.

WARNING !

Do not connect the power source to any terminals except power connectors.

WARNING !

If you want to operate at a frequency higher than standard setting value (50 Hz), be sure to check the speeds of the motor and the machine with each manufacturer. Voltage and insulation resistance tests are executed before the unit is shipped. Never perform test insulation resistance and voltage tests at the inverter. Do not stop operation by switching off the power supply.

CAUTION!

It is strongly recommended that all electrical equipment conforms to the National Electrical Codes and local regulations. Only qualified personnel should perform installation, alignment and maintenance. The manufacturer reserves the right to alter the technical data in order to make improvements or update information.

CAUTION!

Failure to observe these rules will render the guarantee invalid. The same applies to repair jobs and/or replacement.

CAUTION!

The manufacturer declines all responsibility in the event of damage or injury caused as a result of tampering with the equipment.

CAUTION!

Do not switch on/off power supply to run/stop the motor/system! Start the unit only by using run button or external run command.

2. General

2.1 Pressure Regulation System

Thank you for buying this high quality controller unit.

For the best results, read this manual carefully and note all warnings. Follow all the instructions exactly. Keep this manual handy for quick reference.

This controller operates fully automatically depending on the demand of water. It is able to regulate the output frequency (= revolutions per minute) of the pump continuously variable by an inverter-fed technology. The set pressure will be regulated nearly constant; as well at different/changing operation situations. The pressure transducer (sensor) is reading the actual pressure (feedback). The (PID-) Controller compares the feedback pressure and the target pressure and regulates the revolutions of the pump.

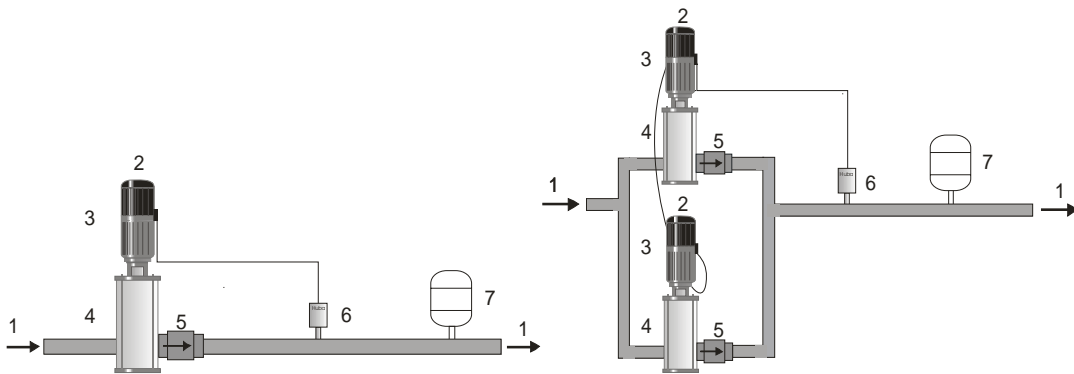
The Parameters of the inverter are programmable and can be adjusted to different system configurations. Parameter changes should only be done by qualified personnel or after consultation with the manufacturer. The system is factory set for most of all cases of operation mode – but some parameters have to be set for proper work. **The start-up is menu supported (see “Start up”).**

The Display shows all messages in clear text (English language).

2.2 Advantages of variable speed drives:

- Nearly constant pressure
- Continuous regulation of power/capacity of pump even when operation situation is changing
- Energy saving operation
- Low mechanical wear of pumps
- Quick amortization of higher purchase price

2.4 Description of a pressure regulation system:



Example: 1 pump panel

Example: 2 pump panel

1 Flow direction	5 Non-return valve
2 Controller	6 Pressure transducer
3 Motor	7 Pressure vessel
4 Pump	

Caution!

A non-return valve is **necessary** and should be installed in the pressure pipe. The pressure transducer **must** be installed in the pressure pipe **behind** the non-return valve!
 The pressure vessel is not necessary, but it is recommended to use a small one (4...18 litres).

Note: Using a pressure vessel!

If a pressure vessel is fitted it should be pre-charged with air and checked regularly. The pre-charge pressure results from system pressure minus 0,5 bar.

Example: system pressure: 4 bar
 pre-charge the vessel with air to: 3,5 bar

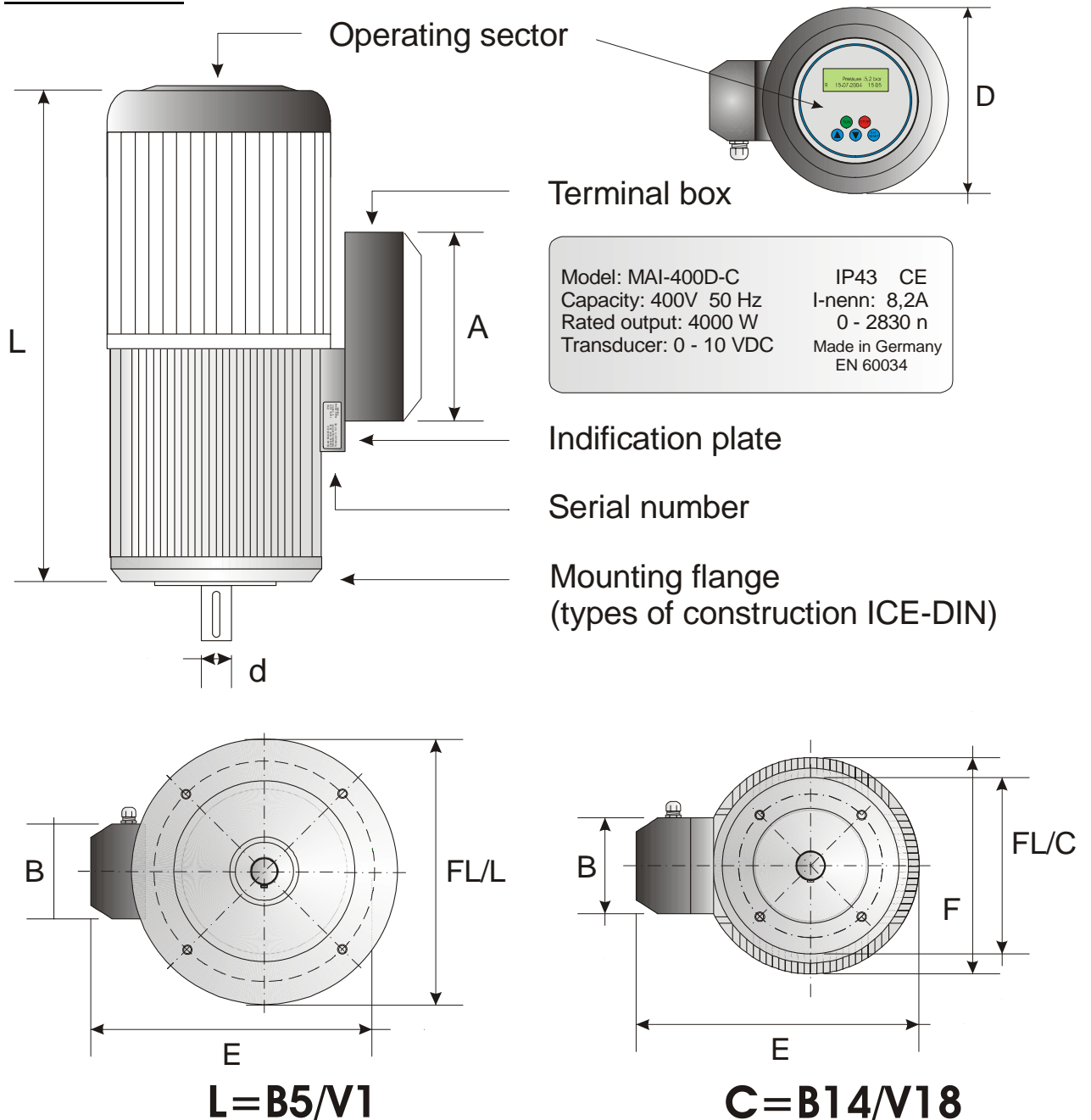
3. Models

3.1 Example:

MAI - 400D - C

- C** Mounting flange B 14 small
- L** Mounting flange B 5
- E** Single phase version 230V 1~
- D** Three phase version 400V 3~
- 400** (400 = 4 kW) capacity for each motor
- MAI** Pressure regulation system consisting of engine and frequency inverter

3.2 Construction:



3.3 Dimensions: (all measures in mm)

	A	B	D	E	F	L	FL/L	FL/C	d
MAI-075E	150	90	170	240	165	385	200	120	19
MAI-075D	150	90	170	240	165	385	200	120	19
MAI-110E	150	90	170	240	165	400	200	120	19
MAI-110D	150	90	170	240	165	400	200	120	19
MAI-150E	150	90	190	250	175	430	200	140	24
MAI-150D	150	90	190	250	175	430	200	140	24
MAI-220E	150	90	190	250	175	465	200	140	24
MAI-220D	150	90	190	250	175	465	200	140	24
MAI-300D	150	90	190	250	175	480	250	160	28
MAI-400D	150	90	190	250	175	500	250	160	28

4. Installation and mounting of the unit

Caution!

Place the unit with clearance of at least 15 cm around it to provide cooling airflow. Be sure to check the ambient temperature is within +5°C to +30°C. If there is hot equipment near the unit, keep the unit as far away as possible. Higher ambient temperature can cause shorter equipment life!

4.1 Mounting the unit



The engine automatic controller usually has a standard mounting flange, which can be developed on each suitable vertical pump for standard engines.

5. Wiring / Connections

WARNING!

Observe the warnings at the start of this manual before making any electrical connections.

WARNING!

Be sure to use the right voltage and to connect the wires to the right terminals!

WARNING!

This equipment has a high leakage current and must be permanently fixed to earth. The inverter should be protected separately against ground fault.

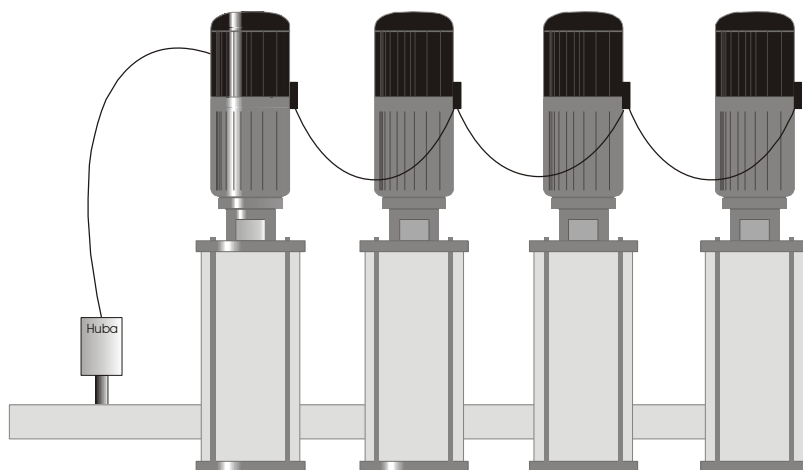
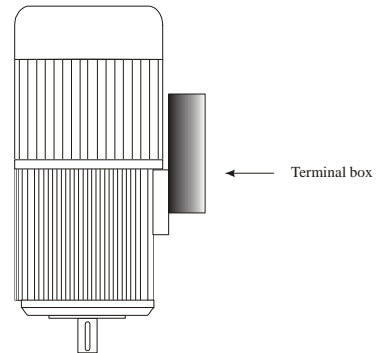
Observe the regional regulations for electrical installation!

5.1 Motor protection

The inverter protected against over current. An optional motor thermistor (PTC) is also available.

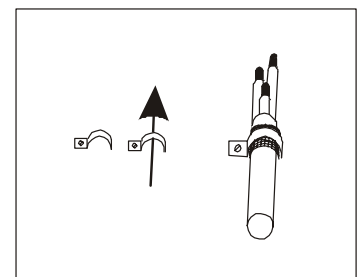
5.2 Connection of In-/Outputs

The pump-controller is connected to the mains according to standard by PG-thread in the terminal box. The earthing conductor, the external inputs and outputs can also attach them there.

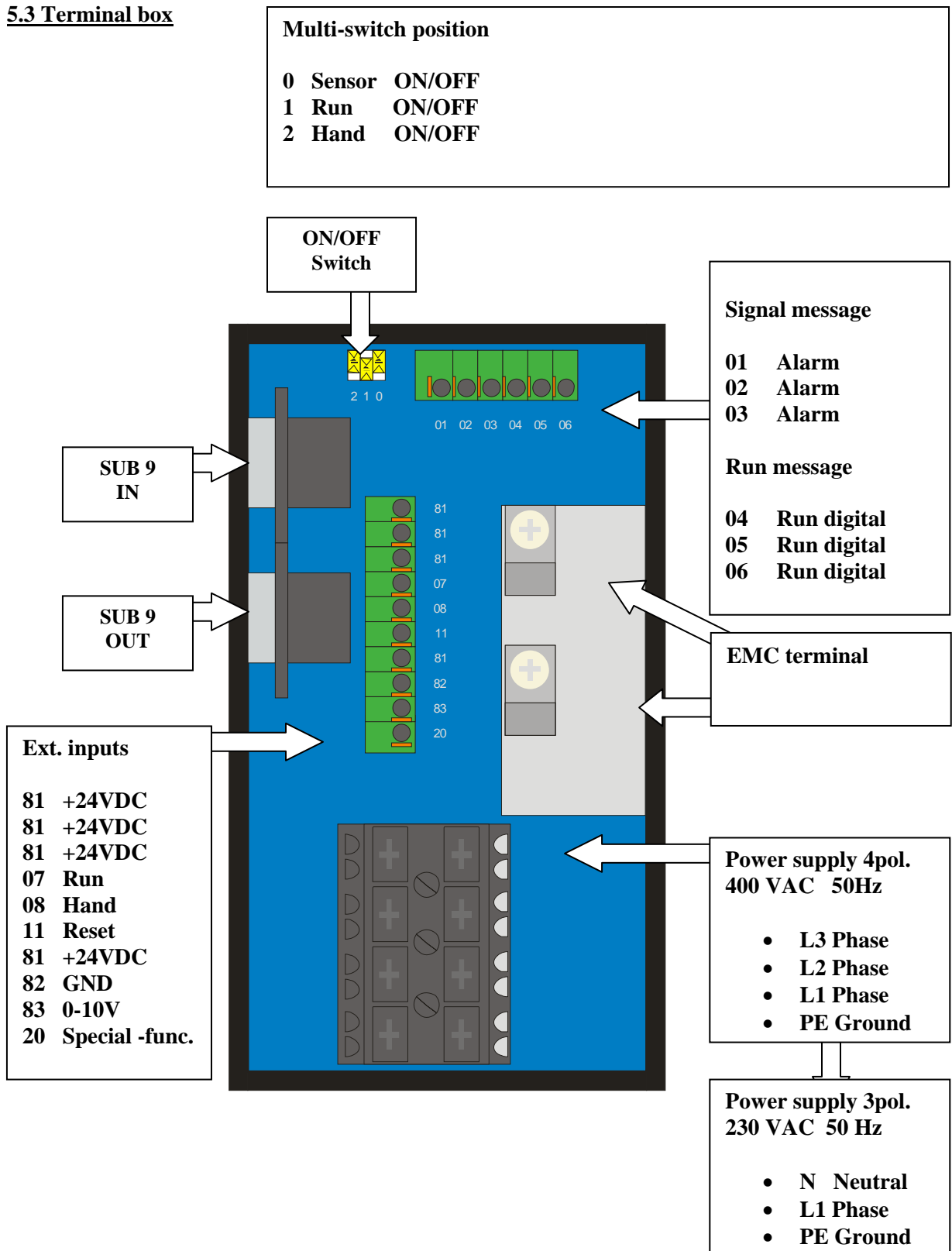


multiple pumps system
Up to 4 pump-controllers can be linked with one another.

Shielded wires must be used to connect pumps, sensor and external inputs and outputs. The shielding must be connected to the grounding clamp as shown in the figure.



5.3 Terminal box



5.4 Power supply (see t.-box)

Caution!

Before switching on power supply make sure that:

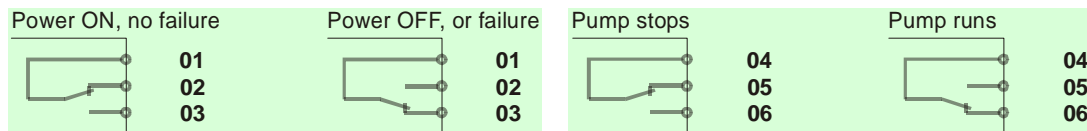
- Power supply, sensor and external inputs are connected to the right terminals
- The inverter is connected to ground
- All screws are fastened (clamps)

WARNING!

Be sure to use the right voltage and to connect the wires to the right terminals!

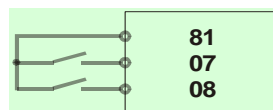
5.5 Connection of alarm relay (for each pump)

Clamp	Function	Description
01	Alarm relay	Alarm Al 0
02	230 VAC 1A	Alarm Al 1
03		Alarm Al 2



5.6 Connection of external inputs (each pump)

Clamp	Function	Description
81	External inputs	+24 V DC
07		Ext.1: external “Start”
08		Ext.2: external “Fix speed”
11		Ext.5: optional input
82		GND
83		0-10 V Signal
20		Special function



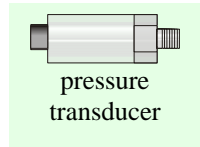
Clamp 07: Can be used for **external run command** (release, float switch, etc.). If connected with +24V (clamp 81) the running command is given. The unit can be started *either* with „Ext.1“ *or* with RUN button (activate by menu item “Running command”). Factory setting: RUN-button.

Clamp 08: Can be used for external command to switch to **fix speed running**.

Clamp 11: Can be used for an external failure signal to stop operation and get error message “external trip”.

5.7 Connection analogue pressure transducer

Clamp	Function	Description
81	transducer	+24VDC supply for transducer
82		GND (ground)
83		0..10 V analogue signal

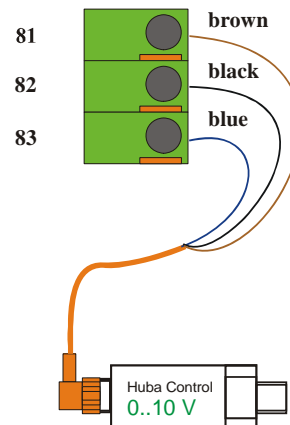


Use shielded wire only and connect it to the grounding clamp inside the terminal box!

Caution!
 Be sure to use the right terminals!
 Do not manipulate the analogue signal!
 Do not connect other devices to the +24 V terminal except sensor and external inputs!
 Only use the provided sensor!

Please check how the transducer has to be connected (depends on the used type of transducer).

For **multiple pumps system** one or several transducers are possible.



5.8 Frequent installation failures

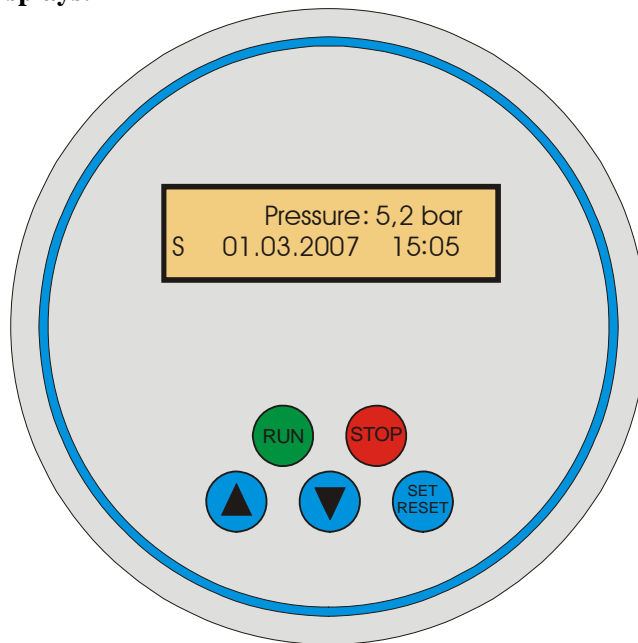
- *Sensor is connected wrong*
- *Sensor is not installed in the pressure pipe behind the non-return valve*
- *Non-return valve is not installed or not installed in the right direction*
- *Pipes/pumps are not ventilated*
- *Wrong running direction*

Please see also “Trouble shooting”

Before start operation check ones more whether all connections are right!

6. Name of keys / Display

For multiple pumps plant: Each pump has its own display. Parameter changes have be done to all pumps/displays.



Monitor (LCD display)

Multicolor text display shows pressure, parameters, etc.



RUN key

This key is used for starting. (When external start is used, this key does not work.)



STOP key

This key is used for stopping the pump operation and for escapes the parameter mode.



UP key, down key

These keys are used for changing data and parameters (to scroll).



SET/RESET key

Pressing this key after setting data and parameters will memorize the settings.
Also used for resetting error messages.

Main page of menu

R: Run/Operation
S: Stop
E: External run
command missing

Ⓡ PRESSURE: 5,2 bar
OUT FREQUENCY: 50 Hz

7. Main menu / Operation data

After switch on power supply the electronic (display unit) starts to communicate with the inverter to check internal stored data. During this procedure the display shows following message:

MAI-CONTROLLER
START COMMUNICAT

If automatic start command („auto start“) is selected the pump operation will start immediately:

CAUTION
AUTO START



Caution

If the function „auto start“ is selected, the pump may start running automatically after switch on main isolator (or power supply).

Main menu/ Main page

After a few seconds the communication is complete. The display shows the main menu. In the main menu are 6 menu pages: 4 user pages to monitor operation data and 2 expert pages with special data (further details are necessary to use these pages / see “expert mode”). From the main menu the “trip history monitor” can be selected to monitor the last 6 failures. **The first page in the main menu is the “main page”.** This main page appears always after power on or after setting parameters.

Main page

Pressure, Run signal,
Output frequency:

Speed, Motor current:

Date, Time:

1st Expert page

2nd Expert page

Hours run counter:
(maximum: 65000h)

Trip monitor:

R: Run/Operation
S: Stop
E: External run
command missing

Ⓜ PRESSURE: 5,2 bar
OUT FREQUENCY 50 Hz

SPEED: 2850
R MOTOR CURRENT 6,30 A

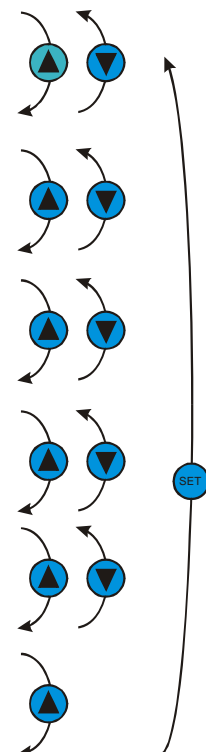
PRESSURE: 5,2 bar
R 15:05 01.03.2007



SZ 000 LF 80 / 26
R 0 3,5 DF 97 / 79



So 4,0 St 3,5 M
R 0 2,7 LF 80 DF 97


OPERATION HOURS:
R 00900 h


Er OVER LOAD
0 15:05 01.03.2007




To scroll between the pages use the up/down keys  and  .
All data of the main menu can be monitored – they cannot be changed.

To enter the **trip history monitor** press the  - key once while the „operation hours counter is displayed. From here press the  - key to get back to the main page.

To enter the **parameter mode** (to change parameters) press the  - key once while display shows the main page of the main menu. (see „changing parameters“).

To **start** pump operation press  - key. If you give the running command by an external signal this key is not used (see „Running command“)!

To **stop** pump operation press  - key. This key is also used to get back to the main menu after changing parameter.

7.1 How to reset the hours run counter


To **reset** the hours run counter to **00000** see the following description:

1. After switch on power supply the electronic (display unit) starts to communicate with the inverter. The display shows the message:



MAI-CONTROLLER
START COMMUNICAT

2. During this procedure press the  +  +  keys **at the same time** and **hold them** to reset the counter.



OPERATION HOURS
RESET

8. Start up / Changing parameters

Before start-up check following items:

- Pump/plant is installed to the pipe work?
- Pipes are ventilated?
- Electrical connections are done and checked. External inputs and outputs connected?

Be sure to use the right terminals for all connections!

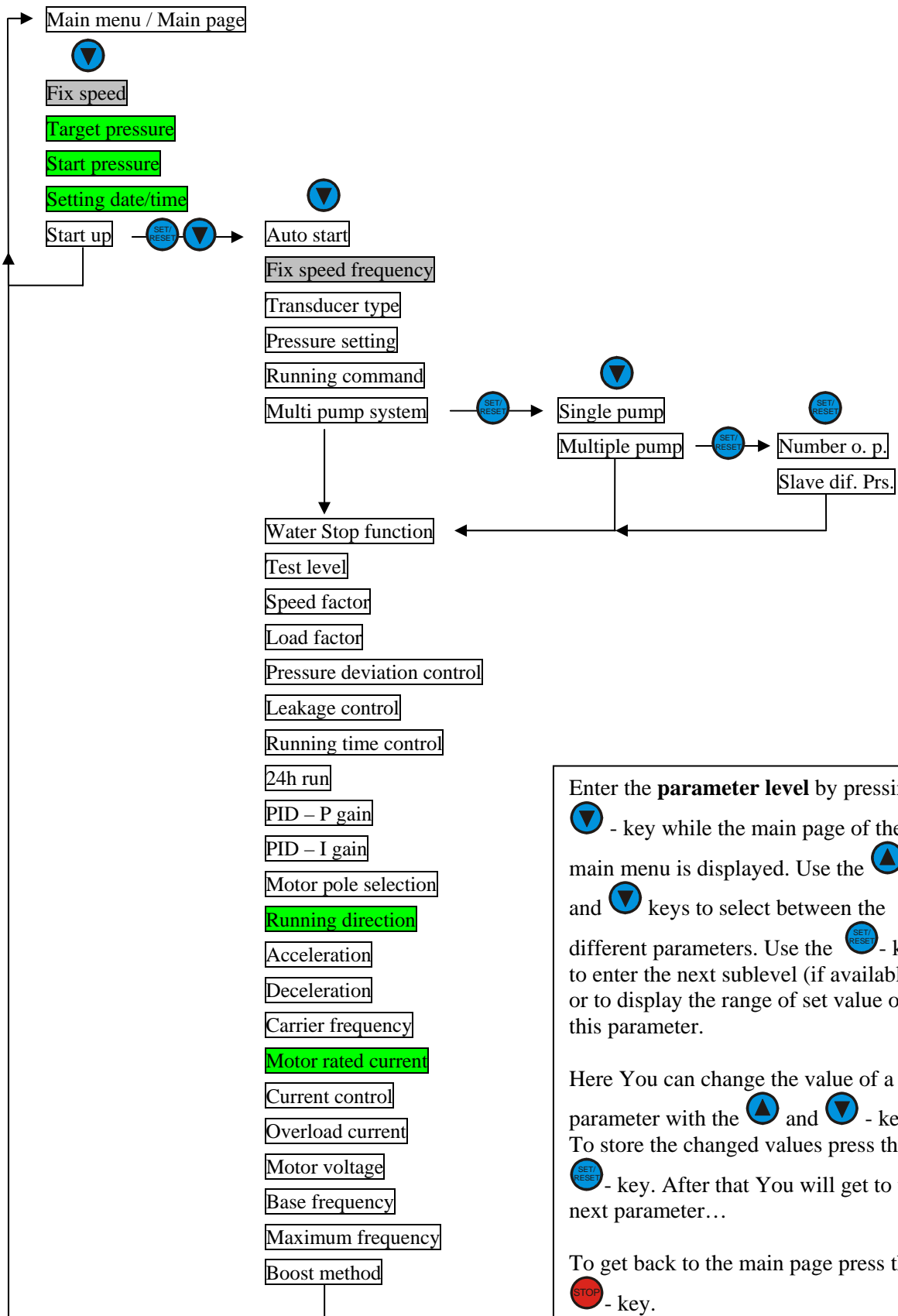


Caution!

Caution!

If the function „auto start“ is selected, the pump may start running automatically after switch on main isolator (or power supply).

Menu prompting



Enter the **parameter level** by pressing - key while the main page of the main menu is displayed. Use the and keys to select between the different parameters. Use the - key to enter the next sublevel (if available) or to display the range of set value of this parameter.

Here You can change the value of a parameter with the and - keys. To store the changed values press the - key. After that You will get to the next parameter...

To get back to the main page press the - key.

The Parameters of the inverter are programmable and can be adjusted to different system configurations. Parameter changes should only be done by qualified personnel or after consultation with the manufacturer. The system is factory set for most of all cases of operation modes – but some parameters have to be set for proper work. **The start-up is menu supported (see “Start up”)**. Each parameter or function can be selected by a menu item (as described). After entered the menu item there are either range of set value or options to select.





Descriptions of the menu items / parameters


Menu item	Range of set value	Factory setting
-----------	--------------------	-----------------


The first menu item appears after pressing  - key while the main page of the main menu is displayed:

FIX SPEED	 ON / OFF	OFF
-----------	--	-----


Fix Speed
e.g. if transducer has failed

Fix Speed: Sometimes it could be necessary to run the pump with fix speed (e.g. for service). To activate select the menu item „fix speed” and press the  - key; move the flashing cursor to “ON” or “OFF” with the  and  keys and set with  - key.

The pump will start after run command ( - key).

To deactivate the fix speed running press the  - key for 2 seconds.

Note: If the function „fix speed“ is used the automatically pump changeover does not work (only multiple pump sets).

If „fix speed“ is not activated (cursor of OFF) the next menu item appears after pressing  - key:

TARGET PRESSURE	 0 up to maximum	e.g. 5,0 bar
-----------------	---	--------------

Set the target pressure for the pump system.



START PRESSURE	 0 up to maximum	e.g. 3,5 bar
----------------	---	--------------




















Following characteristics can be reached by setting a „start pressure“:

- Pump motor reaches higher speed in a short time (important for submersible motor pumps).
- When the pressure decreases a little bit after pump has stopped the pump will not restart immediately.


The start pressure should be set to about 70% of the target pressure.


Using the “start pressure” can cause pressure fluctuation. To disable “start pressure” set the same value like “target pressure”.




Menu item	Range of set value	Factory setting
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">SETTING DATE / TIME</div>	 	hour min. day month year <div style="background-color: #d3d3d3; padding: 2px;">14 52 30 09 04</div>
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">START UP</div>	Press  while  is pressed and hold to enter next sublevel. Press only  to skip “Start up” menu and continue with (get back to) main page.	
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">AUTO START</div>	 YES / NO	<div style="background-color: #d3d3d3; padding: 2px;">NO</div>
If this function is used the system will start automatically after power supply is switched on. Caution: Pumps may start running even when it is not expected.		
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">FIX SPEED FREQUENCY</div>	 0 .. 50 Hz	<div style="background-color: #d3d3d3; padding: 2px;">35 Hz</div>
This frequency will be used for the function „Fix speed“.		
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">TRANSDUCER TYPE</div>	 0 .. 100 bar	<div style="background-color: #d3d3d3; padding: 2px;">depends on the used transducer</div>
Set the maximum pressure of the pressure transducer: e.g. 10 bar for 0..10-bar-transducer.		
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">PRESSURE SETTING</div>	 INTERN. / EXTERN.	<div style="background-color: #d3d3d3; padding: 2px;">INTERNAL</div>
Internal: Target pressure will be set by key pad (see “Target pressure”) External: Target pressure will be set by analogue input (optional clamps)		
		
<div style="border: 1px solid black; background-color: #d4edda; padding: 5px; display: inline-block;">RUNNING COMMAND</div>	 INTERN. / EXTERN.	<div style="background-color: #d3d3d3; padding: 2px;">INTERNAL</div>
Internal: Running command is given by  - key External: Running command (release) is given by external input (clamps) Ext. and Intern: Running command is given when  - key was pressed and external input is closed (e.g. float switch)		
		

Menu item	Range of set value	Factory setting
-----------	--------------------	-----------------

<div style="border: 1px solid black; background-color: #d4edda; padding: 2px; display: inline-block;">MULTI PUMP SYST.</div>	Enter the next sublevel by pressing  to choose between following operation modes:	
<ul style="list-style-type: none"> - Single pump systems - Multiple pump systems (2-, 3- or 4-pump panels) 		

Press  - key to continue with menu item “Water stop function”.





<div style="border: 1px solid black; background-color: #d4edda; padding: 2px; display: inline-block;">SINGLE PUMP SYST.</div>	Activate by pressing  - key	
Used for all pump systems with 1 single pump.		




<div style="border: 1px solid black; background-color: #d4edda; padding: 2px; display: inline-block;">MULTI PUMP SYST.</div>	Select this item if your pump system is made for 2, 3 or 4 pumps (all pumps with variable speed). On a multiple pump set the pump assignment changes every 5 working hours automatically to maintain equal wear on all pumps. See also appendix “Multiple pump operation“
--	---

Caution: Parameter changes have to done to all pumps/displays!









<div style="border: 1px solid black; background-color: #d4edda; padding: 2px; display: inline-block;">NUMBER OF PUMPS</div>	  02..04 pumps	<div style="background-color: #d4edda; padding: 2px; display: inline-block;">02 pumps</div>
Set the number of pumps for multiple pump systems.		



<div style="border: 1px solid black; background-color: #d4edda; padding: 2px; display: inline-block;">SLAVE DIF.</div>	 0,0..1,0 bar	<div style="background-color: #d4edda; padding: 2px; display: inline-block;">0,3</div>
Differential pressure to switch on or off the next pump (Slave).		



Menu item	Range of set value	Factory setting
-----------	--------------------	-----------------

 <div style="border: 1px solid black; background-color: #d9ead3; padding: 2px; display: inline-block;">WATER STOP FUNC.</div>	 normal / fast	<div style="background-color: #d9d9d9; padding: 2px; display: inline-block;">normal</div>
<p>This function is used to identify weather there is still a demand of water on the system or not. The standard setting is “normal”. To use the fast „Water stop function“ special knowledge and experience of the system is necessary. If the normal setting does not work properly (the pump does not switch into „stand-by“ mode after a few minutes when water demand is stopped) please contact your dealer.</p> <p>The menu items “Test level “, “Speed factor“ and “Load factor“ are only used for the fast “water stop function”. See also appendix “Expert mode”.</p>		
 <div style="border: 1px solid black; background-color: #d9ead3; padding: 2px; display: inline-block;">TEST LEVEL</div>	 0..100%	<div style="background-color: #d9d9d9; padding: 2px; display: inline-block;">50%</div>
 <div style="border: 1px solid black; background-color: #d9ead3; padding: 2px; display: inline-block;">SPEED FACTOR</div>	 0..100%	<div style="background-color: #d9d9d9; padding: 2px; display: inline-block;">50%</div>
 <div style="border: 1px solid black; background-color: #d9ead3; padding: 2px; display: inline-block;">LOAD FACTOR</div>	 0..100%	<div style="background-color: #d9d9d9; padding: 2px; display: inline-block;">50%</div>

<div style="border: 1px solid black; background-color: #d9ead3; padding: 2px; display: inline-block;">PRESSURE DEV. CONTR.</div>	 0..100% of target pressure	<div style="background-color: #d9d9d9; padding: 2px; display: inline-block;">50%</div>
--	---	--

Set an allowed pressure deviation to identify **dry running**: If the pressure fall below or exceed this range for more than 90 seconds the pump will stop and an error message will appear “Pressure deviation”.

Note: To enable this function the pressure (in the pipes) have to reach the target pressure once. By this characteristic the controller suppresses an error message while filling the pipe work the first time.



Menu item	Range of set value	Factory setting
-----------	--------------------	-----------------

LEAKAGE CONTROL	 OFF / ON (1..15)	OFF
-----------------	--	-----

Identification of leakage in the pipe work.

To enable this function set this menu item to „ON“ and select the numbers of allowed pump starts within 20 minutes; range: 01 ... 15 starts within 20 minutes (fix time).

Does the pump starts more often than an error message will appear „Leakage failure“.



RUN TIME CONTROL 000 min	 000 .. 750 min	000 min
-----------------------------	--	---------

Maximum allowed time of running. If pump runs longer than the set time it will stop and an error message will appear “Maximum running time”. If set to “OFF” this function is disabled.



24-h RUN	 OF / ON	OFF
----------	---	-----

If the pump has not started for 24 hours it will start for 60 seconds to protect against corrosion. The pump will run with the frequency stored as “fix speed”.



PID - P GAIN	 0,2 .. 5,0	1,0
--------------	--	-----

PID control: P gain



PID - I GAIN	 0,1 .. 60	1,0
--------------	---	-----

PID control: I gain



MOTOR POLE SELE .	 2, 4, 6, 8	2
-------------------	--	---

Motor pole selection; e.g.: Rated motor speed 3000 rpm (29xx) = 2 pole



RUNNING DIRECTION	 right / left	right
-------------------	--	-------

















The running direction is left or right when locking onto the motor shaft.



ACCELERATION TIME	 0 .. 50 seconds	1,0 sec.
-------------------	---	----------

Acceleration time of the pump.



Menu item		Range of set value	Factory setting
DECELERATION TIME		0 .. 50 seconds	2,0 sec.
Deceleration time of the pump.			
			
CARRIER FREQUENCY		0...15kHz	9,0
Carrier frequency of the inverter output – high carrier frequency causes high temperature on the inverter higher radio noise; lower carrier frequency causes higher motor noise and higher temperature in the motor.			
			
MATOR RATED CURRENT		0.0 up to maximum	depends on capacity
Set the motor rated current (see nameplate motor)			
			
CURRENT CONTROL		ON / OFF	ON
This function is used to prevent over current. If overload current is reached the frequency will decelerate the output current automatically. To come into service it is possible to disable this function temporary.			
			
OVERLOAD CURRENT		0.0 up to maximum	125% of motor rated current
When the output current has reached the overload current the inverter will reduce the output frequency to prevent overload. If the current exceeds this value the pump will stop and an error message will appear “Overload”.			
			
MOTOR VOLTAGE		380..480 V	400 V
			
BASE FREQUENCY		30..100 Hz	50 Hz
At this output frequency the maximum output voltage is reached.			
			
MAXIMUM FREQUENCY		30..100 Hz	50 Hz
Maximum output frequency.			
			

Menu item	Range of set value	Factory setting
-----------	--------------------	-----------------

BOOST METHOD	 manual / automatic	automatic
---------------------	--	------------------



The torque boost can improve the motor torque at low speed. If set to “automatic” torque boost the output voltage is adjusted automatically by the condition of the load.



BOOST FACTOR	 0 .. 20%	10,0%
---------------------	--	--------------


Level corresponding to output voltage for manual torque boost (% of maximum output voltage). This menu item does only appear when the „Boost method“ is set to „manual“.

End of menu


After pressing  or  the changed data will be transmitted and stored to the inverter. During this procedure the display shows the following message:

MAI-CONTROLLER
START COMMUNICAT

If automatic start command („auto start“) is selected the pump operation will start immediately:

Otherwise the running command will be given by the -key. The display will show the main page of the main menu. The operation data will be displayed.

Note:













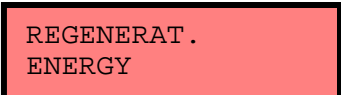

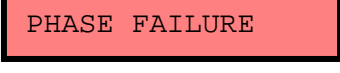
At any time it is possible to leave the menu and get back to the main menu with the -key.

9. Protecting functions / Trouble-shooting

9.1 Error messages on the display

In case of failure the pump will be stopped an error message appears on the display. The last 6 error messages are stored and can be displayed with date and time of failure (trip history monitor).

Use  -key to reset any error message.



Error message	possible reason / help	Code
	<ul style="list-style-type: none"> - Pressure transducer is not connected - Transducer cable is broken 	--
	<ul style="list-style-type: none"> - Burst pipe - Water shortage 	
<p>In case of transducer failure it is possible to run the pump with fix speed: press the  -key to activate the fix speed mode and use  - and  -key to start or stop. To inactivate the fix speed mode again press  -key for 2 seconds.</p>		
	<ul style="list-style-type: none"> - Check power supply 	E09
	<ul style="list-style-type: none"> - Motor thermal protection - Check/set motor rated current - Overload 	E05
	<ul style="list-style-type: none"> - Over current / pump overload 	E01
	<ul style="list-style-type: none"> - Over current while decelerate pump speed 	E02
	<ul style="list-style-type: none"> - Over current while accelerate pump speed 	E03
	<ul style="list-style-type: none"> - Over current while stand still - Earth leakage - Motor blocked 	E04 E14
	<ul style="list-style-type: none"> - Over voltage internal circuit - Operation as generator - Deceleration time to short 	E07
	<ul style="list-style-type: none"> - EEPROM failure - Check all parameters 	E08
	<ul style="list-style-type: none"> - Check power supply - Check fuses 	E24

Error message	possible reason / help	Code
POWER LOSS	- Check power supply - Any high electric consumer	E16
OVERHEATING	- Check ambient temperature - Check ventilation	E21
IGBT ERROR	- Output stage failure - Short circuit motor wires	E30
THERMISTOR ERROR	- Motor overload / over heat	E35
OVER VOLTAGE	- Check power supply	E15
EMERGENCY STOP	- External emergency stop (optional) is set	E13
EXTERNAL TRIP	- External trip (optional) is set	E12
CPU ERROR	- CPU error	E11 E22
PRESSURE	- Pressure have fallen below (or exceeded) allowed pressure range - Dry running	
LEAKAGE FAILURE	- Pump have started to often (leakage in the pipe work?)	
MAX RUNNING TIME	- Maximum running time is reached (see “running time”)	
STORAGE ERROR	- The changed parameters are not stored properly	
OTHER ERROR	- Error in communication between inverter and display	

9.2 Trip history monitor

To enter the „**trip history monitor**“ press  -key while the menu item „operation hours counter“ is displayed. Here you can see the last 6 error messages with time and date.



To scroll between the stored trips use the  and  keys.

From the trip history monitor use the  -key to get back to the **main menu**.

9.3 Trouble-Shooting

Monitor is dark

Power supply is on?

Check fuses!

Pump does not start running

Run command is not given?

“S” signal in the display

“E” signal in the display

If RUN key is used: press RUN button (see “R” in display).

If “07” is used: close “81” and “07”.

Pump does not start running but display shows “R” (running command)

Start pressure too low?

Pressure in pipe is higher than set target pressure?

Pump does not stop

Set target pressure is too high (pump can not reach pressure)?

Pipe work is not ventilated properly?

Non-return is not fitted in the pressure pipe between pump and pressure transducer.

Non-return is not leak proof?

If short pipes are used, it is recommended to use a pressure vessel behind the non-return valve (pre-charge pressure: system pressure minus 0.5 bar)!

Set “water stop identification“ to a higher value!

Pressure monitor does not show the right pressure

Factor for “transducer type” is wrong; depends on range of used transducer (e.g. 0.10 for 10-bar-transducer; 0.25 for 25-bar-transducer)?

Transducer plug is wet?

Cable of transducer is fault?

Panel becomes to warm

Check ambient temperature! Provide cooling airflow!

Set “carrier frequency” to a lower value!

Appendix Multiple pumps system

Multiple pumps system with variable speed for all pumps (2..4 pumps)

Multiple pump sets consists of several controllers. Each of them can operate self-sufficient. If one pump is stopped/switched off, the other pump(s) will still operate.

Some multiple pump panels have got several pressure transducers. The number of terminal clamps depends on the number of used transducers.

The pumps will be started or stopped depending on the requirements. The “target pressure” and the “slave differential pressure” have to be set to each display (for each pump). The system will calculate a pressure cascade that will start and stop the pumps.

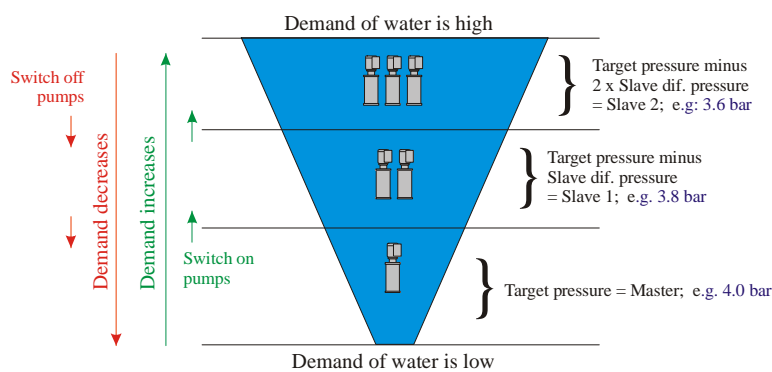


Figure: Pressure cascade with 3 pumps

Pump changeover

There is no assignment as to which pump is No. 1 or No. 2 etc. To maintain equal wear on all pumps the lead pump changes every 5 working hours. The user can manually change the lead pump by stopping the master (see below).

All controllers (inverters) of a multiple pump system are connected to each other to communicate. Is one of the pumps stopped (stop command or trip) the other will maintain the pump operation.



Note!

**The system will still operate even when one pump is switched off.
Parameter changes have to done to all pumps/panels!**

Manual pump changeover

It is possible to change the pump assignment of the pumps manually:

Stop the pump that operates as „Master“ (highest pressure threshold value; see also Appendix „expert mode“). The next pump will start to operate as “Master” after 30 seconds.



Note!

The pressure cascade will be interrupted by:

- Operating one pump with fix speed
- Parameter setting procedure is not complete
- Internal communication line is broken

The automatic pump changeover is disabled if the pressure cascade is interrupted!

Appendix Expert mode

Fast „Water Stop Function“

This function is used to identify weather there is still a demand of water on the system or not. The standard setting is “normal”. To use the **fast** „Water stop function“ special knowledge and experience of the system is necessary. If the normal setting does not work properly (the pump does not switch into „stand-by“ mode after a few minutes when water demand is stopped) please contact your dealer.

To change the following parameter select the menu item “Water Stop Func.”

Test level	0..100%	50%
Speed factor	0..100%	50%
Load factor	0..100%	50%

Test level: Electronic device to identify the demand of water (Target pressure is reached and water demand is very small or zero). The higher this value is set the better the system will identify the stop of water flow but the higher the pressure fluctuation can be.

Standard setting 50% is best for most of all pump sets

Setting >50% for short or non-elastic pipe work (without pressure vessel)

Setting <50% cause low pressure fluctuation but a pressure vessel is necessary!

Setting 0% electronic water stop function is disabled

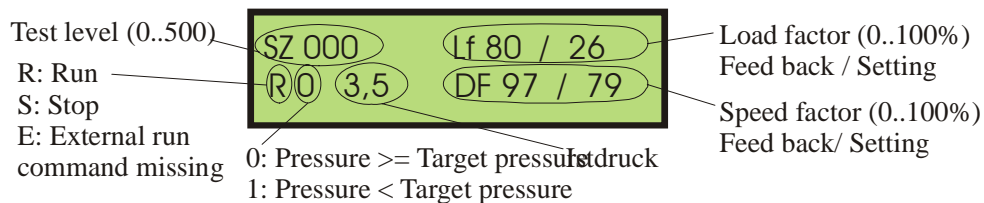
Speed factor: This factor depends on the motor speed while smallest water consumption of the pump plant. This factor has to be found for every single pump.

Load factor: This factor depends on load of pump motor. This factor has to be found for every single pump.

Expert menu pages

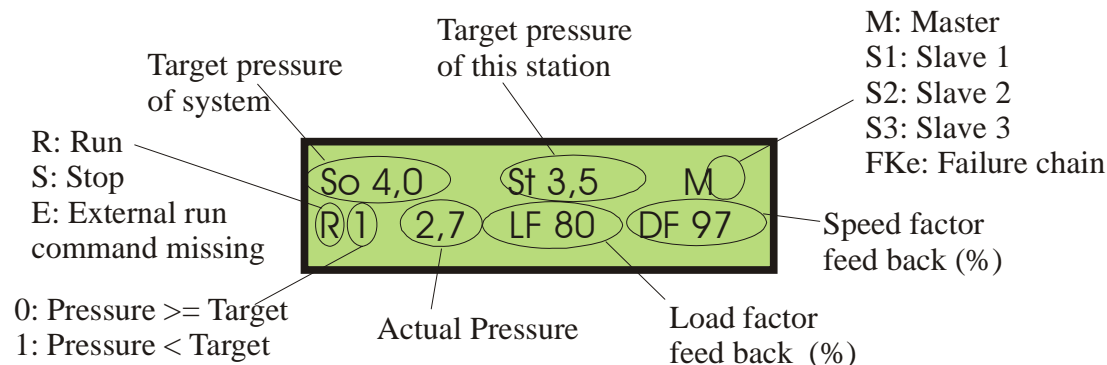
The 4th and 5th page of the main menu are used for detailed information of the operation (special knowledge and experience of the system is necessary).

The 1st expert page helps to find out the right settings for speed factor and load factor:



If the feed back value of LF **and** DF is lower than setting: pumps will stop
 If the feed back value of LF **or** DF is higher than setting: Test level is enabled
 If the feed back value of LF **and** DF is higher than setting: Test level is disabled

The 2nd expert page is used for multiple pumps system. It gives information about target pressure cascade and pump changeover:



Each controller/display (station) of a multiple pump system is connected to 2 other controllers to an electronic chain. Each controller gets a signal from a further controller and gives a signal to a next controller. One of the controllers is the „Master“ (highest target pressure); all other controllers are „Slave“ (e.g.: the target pressure of slaves 1 is system target pressure minus “slave differential pressure”). With of the controllers the „Master“ is will be set during switch on power supply (chance). A periodic pump changeover will give the master function to the next controller.

The momentary target pressure of a station/controller is displayed on the 2nd expert page. All momentary target pressures of all controllers together are the target pressure cascade. The difference between them is the “Slave differential pressure” (see also „Multiple pump systems”). If system is in RUN mode the pressure cascade will switch over every 5 working hours automatically. If the station/controller witch is running as “master” will be stopped or does it trip than it will give the master function to the next controller (after 30 seconds). This is to make sure that the master function will always be given to a controller that is in proper service condition.

So the switchover to the next controller can be done manually pressing stop key of this controller that is working as master. After 30 seconds the pressure cascade chain will switchover.

Following conditions will interrupt the pressure cascade chain:

- Fix speed mode is enabled at one controller
- Parameter programming procedure is not finished properly
- Communication line between the controller is disconnected

When the pressure cascade chain is interrupted it will be displayed on the 2nd expert page as „FKe“.

The automatic pump changeover is disabled if pressure chain is interrupted.

Appendix Technical data

Type	Engine rated output	Input voltage	Engine rated current	Rated speed
MAI-075E	0,75 kW	230 V 50/60 Hz	2,9 A	2850n
MAI-110E	1,1 kW	230 V 50/60 Hz	3,9 A	2800n
MAI-150E	1,5 kW	230 V 50/60 Hz	5,3 A	2890n
MAI-220E	2,2 kW	230 V 50/60 Hz	7,9 A	2850n
MAI-075D	0,75kW	400 V 50/60 Hz	1,7 A	2850n
MAI-110E	1,1 kW	400 V 50/60 Hz	2,3 A	2800n
MAI-150D	1,5 kW	400 V 50/60 Hz	3,0 A	2890n
MAI-220D	2,2 kW	400 V 50/60 Hz	4,6 A	2850n
MAI-300D	3,0 kW	400 V 50/60 Hz	6,1 A	2820n
MAI-400D	4,0 kW	400 V 50/60 Hz	8,2 A	2830n

protection standard:	IP 44
carrier frequency:	0,5 - 15 kHz; Faktory setting 9 kHz
V/F characteristics:	constant or reduced torque with any variable voltage/frequency
output frequency range:	0,5 - 360 Hz
frequency accuracy:	digital command: +/- 0,01 % of max. frequency analogue command: +/- 0,2 % of max. frequency
frequency setting resolution:	digital setting: 0,1 %, analogue setting: max. frequency divided 1000
overload current capacity:	150 % for 60 seconds (once in 10 minutes), max. 220 %
starting torque:	min. 100 %
DC injection braking:	min. frequency, braking time and braking force can be set
analogue input:	0..10V DC, input impedance 10 Kilo ohm (max. 12 V), 0..20mA, input impedance 100 ohm (max. 24mA), PTC input (option)
digital input:	2 inputs, 24V PNP logic, normal open or normal closed, re-programmable
digital output:	1volt free contact n.o. & n.c. , alarm signal (2 # as option)
protection functions:	over current, over voltage, under voltage, electronic thermal, temperature abnormality, ground fault upon starting, overload limit
other functions:	multi speed frequency, PID control, parameter lock, restart blocked, operating hours meter, RS 422 (option)
ambient temperature:	+5 to +30 °C
humidity:	20 - 90 % RH (no dew condensation)
vibration:	5,9 m/s ² (0,6 G) 10 - 55 Hz
ground leakage current (worst case):	up to 15kW <30mA (300mA); up to 30kW <30mA (550mA); up to 37kW <30mA (690mA); up to 55kW <30mA (750mA);
installation location:	1000 meter or less altitude, indoors
options:	engine throttle, sine filter, serial interface
standards:	CE-EMC (Electro Magnetic Compatibility) guideline (89/336/EG) in connection with integrated radio noise filter C1, CE-low-voltage guideline (73/23/EG)

Appendix Index

Headword	Page	Headword	Page
24 h run	20	Parameter	15
Acceleration time	20	PI(D) control	20
Ambient temperature	7	Power supply	2, 9, 13
Auto start	2, 13, 17	Pressure cascade	18, 26
Boost	22	Pressure deviation control	19
Capacity	29	Pressure display	13
Carrier frequency	21	Pressure regulation system	5
Clamps	9	Pressure setting / Target pressure	10, 16, 17
Communication start	13	Pressure transducer	10, 17, 26
Connections, electric	8	Pressure vessel	5
Current control	21	Pressure, actual	13
Current, input	13, 29	Pressure, Start pressure	16
Date	13, 17	Programming	14
Deceleration	21	PTC	8, 24
Display	12, 15	Pump changeover, automatic	26
Display functions	13	Reactor, AC	11
Dry running	19, 24	Reasons for failures	11, 25
Electrical connections	8	Regulation, pressure	4, 20
Error reset	12, 23	Relay intelligent output	9
Errors	23	Reset trip	12, 23
Expert mode	27	Restart automatic	2, 13, 17
External intelligent inputs	9	Run command	10, 12, 17
External intelligent output	9	Run indicator	13
Fix speed	16, 17	Running direction	20
Frequency, Base-	21	Running time control	20
Frequency, Maximum-	21	Shielding	8
Fuse	29	Single pump system	18
General of pump operation	4, 26	Slave	18, 26
Ground	3, 8	Speed	13
Ground leakage (protection)	3, 29	Speed factor	19, 27
Hours run Counter	13	Start up	14, 17
Installation	7, 8	Stop command	12, 13
Installation failure	11	Submersible pumps	4
Leakage control	20	Technical data	6, 29
Load factor	19, 27	Terminals	9
Main menu	13, 15	Test level	19, 27
Main page	13, 15, 22	Time	13, 17
Menu prompting	15	Transducer connection	10
Models	6	Transducer failure	23
Motor connection	11	Transducer type	17
Motor current	13, 21	Trip history monitor	13, 24
Motor pole selection	20	Trip reset	12, 23
Motor protection	8, 21, 23	Trips	23
Motor voltage	21	Trouble-shooting	25
Motor wire	11	Variable speed drive	4
Multiple pump systems	10, 18, 26	Voltage	2, 9, 13
Non-return-valve	5	Warning	2
Numbers of pumps	18	Warranty	3
Operation data	13	Water over load	21
Operation hours meter	13	Water-stop-function	19
Output frequency, Speed	13		
Over current	23		
Over load	21		