be **the first.**

VC 1800/180 TECH

Serial No.: 155632

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ENGEL

technical manual - machine

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GENERAL

You have decided on an ENGEL product which is produced and supplied under the most strict quality controls.
The instruction manual must be considered as part of the injection molding machine and is intended for those persons who are entrusted with activities on the plant. The instruction must be kept during the life of the product and be passed on to each following owner or user. Each obtained addition must be integrated into the instruction manual.

The instruction manual for the injection molding machine is divided into 3 manuals:

”Instruction manual” (Start-up, maintenance, spare parts)

”Operator manual” (Operation)

”Technical manual” (Elimination of faults)

The instruction manual is delivered in the following forms:

- in paper form (without Technical manual). One electric schematic is in the control cabinet.
- as online help on the control unit (without spare parts and schematics)
- on CD in PDF format

Messrs. ENGEL reserves the right to update the documentation.



WARNING!

Do not use the machine without relevant training.
Improper use of the plant can lead to considerable personal damage and damage to property.
Before you put the plant into operation, you are obliged in addition to read through the chapter Safety well and to get familiar with the safety equipment.

We recommend you the participation in trainings at one of Engel’s training centers.

This manual (Technical manual) includes technical information for the error diagnostics and repair.
Further descriptions of possibly used additional equipment can be found in the chapter Special equipment of the instruction manual).

1 USE AS DIRECTED

ENGEL products are constructed in keeping with the latest technological developments and the accepted safety standards.

The ENGEL injection molding machines must be used exclusively for the manufacture of molded parts of thermoplastics, thermosets and elastomers according with the instruction manual.
To these ends, the processing tips given by the material manufacturer must also be observed! (Improper processing could lead to personal injury or damage to the equipment!)

The installation, operation and maintenance of the plant may only be made by persons who have been trained for this activity on ENGEL machines.

Engel is not liable for damage due to improper use, not using the equipment as directed, not following the information in the instruction manual and operating while faulty.

In case of alterations on the machine the EC conformity declaration expires and the machine must not be put into operation!

1.1 APPLIED STANDARDS AND GUIDELINES

98/37 EWG	Machines guideline
73/23/EWG, 93/68 EWG	Low voltage guideline
89/336/EWG, 92/31 EWG, 93/68 EWG	EMV guideline electromagnetic compatibility
EN 12100-1	Safety of machines
EN 12100-2	Safety of machines
EN 294	Safety of machines, safety distances
EN 201	Safety information for injection molding machines
EN 418	Safety of machines, EMERGENCY STOP equipment
EN 60204-1	Safety of machines, electric equipment of machines
EN 61310-1	Safety of machines, mark and operate displays
EN 61310-2	Safety of machines, mark and operate displays
EN 775	Safety industrial robot

2 TEXT FORMATTINGS

For the clear creation of the manual and for especially important information you find the following text formattings:



DANGER!

Immediately impending dangers, which can lead to death or serious physical injuries!



WARNING!

Possible dangers, which can lead to death or serious physical injuries!



CAUTION!

Possible dangers which can entail medium or slight physical injury and/ or damage on the plant!

CAUTION!

Possible dangers which can lead to damage on the plant!



Note!

Application tips and useful information!

”xxx” Hint to a text on the screen or control panel
[xxx] Hint to a button on the screen or control panel



Example:

Practical examples for the better understanding.

1. Numbered sequence, procedure

■ Bullet sign (emphasis

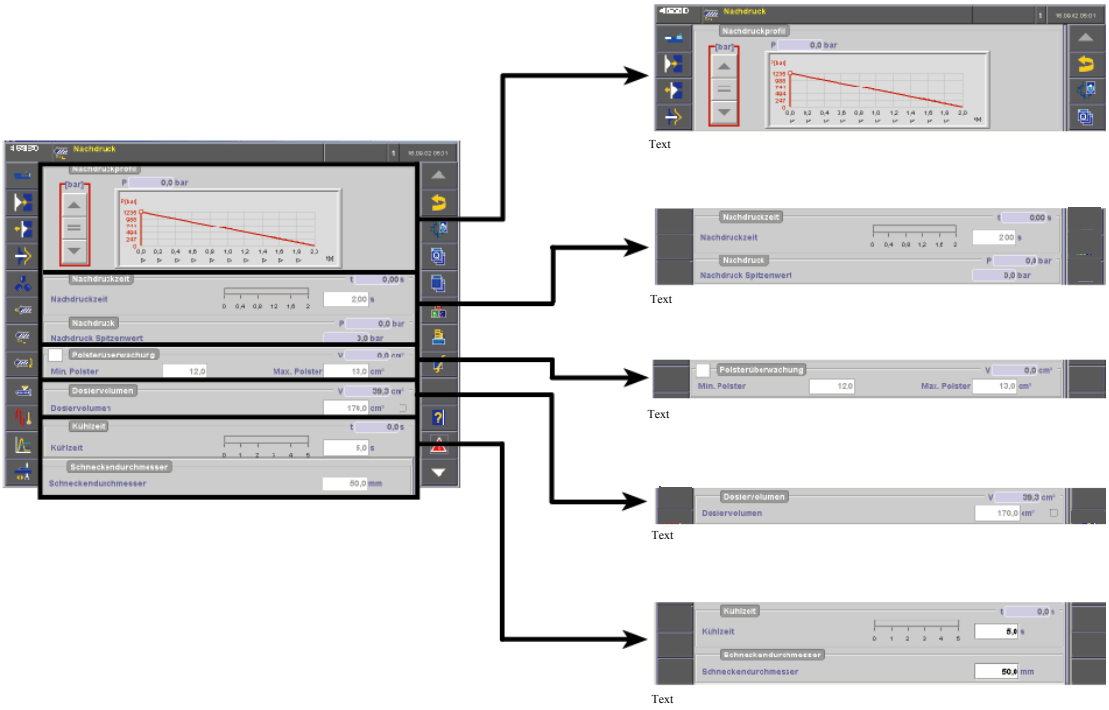
[1] Position description for drawings and pictures

”Alarms” and **”Messages”** are listed up in tabular form with symbol for alarm class as well as description for reason, effect and elimination.
In the manuals an alarm list is mentioned in the index directory under Symbols*

2.1 DIVISION OF SCREEN PAGES

The individual screen pages may vary in length depending on machine configuration. Some screen pages may have a scroll function. The screen pages are divided into blocks for functional description.

Screen pages



CAUTION!

The set parameters are purely accidental and do not serve as pattern for a machine setting.

3 INJECTION MOLDING

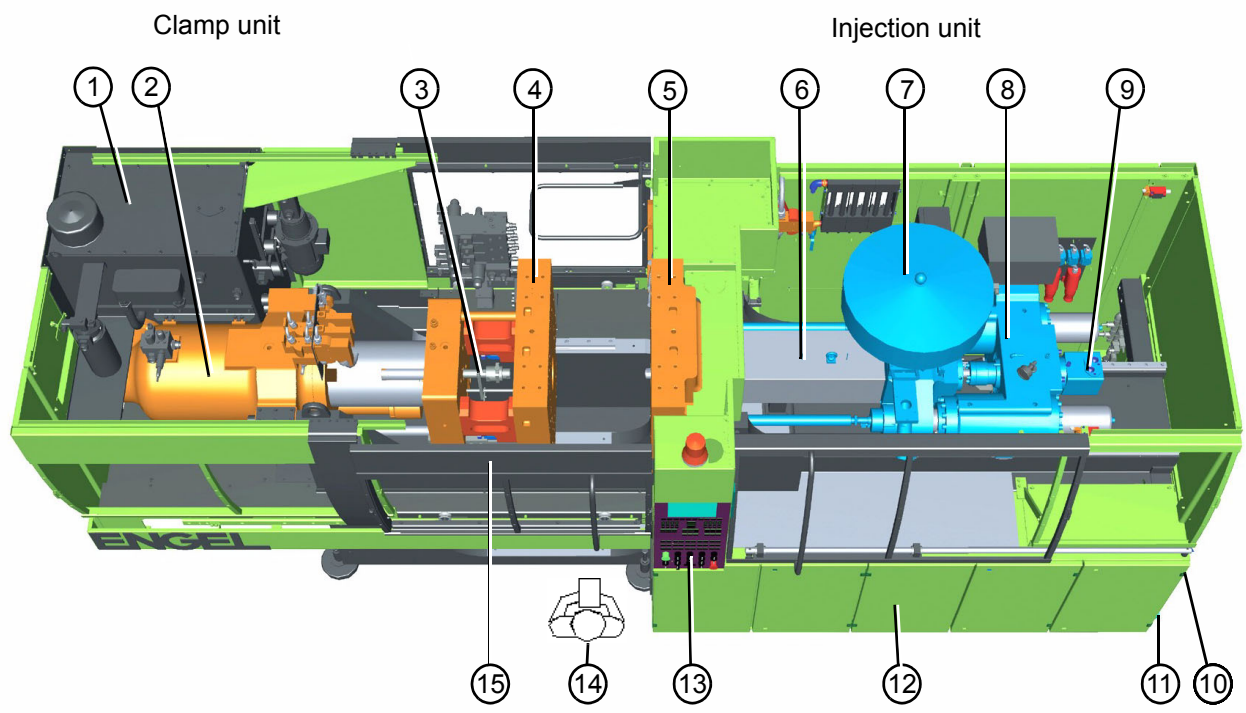
Injection molding is the most important process in the production of molded parts. Originally developed for thermoplastics, it can nowadays be applied to almost all plastics, also to

- Thermoset (PF molding compounds),
- Elastomer (e.g. rubber compounds),
- Foaming (e.g. on polystyrene basis),
- Unfilled and filled molding compounds.

In one cycle of the injection molding machine, the raw material is processed into a finished molded part. The raw material is usually available, to the processor, in powder or granular form. The liquid or plastic viscous material is injected into the mold under high pressure. This process results in molded parts with high dimensional accuracy.

3.1 MACHINE SURVEY VICTORY

Example: VC 650/150 POWER



[1] Hydraulic oil container
[2] Clamping cylinder
[3] Hydraulic ejector
[4] Moving platen
[5] Stationary platen
[6] Plasticizing barrel with nozzle
[7] Material hopper
[8] Injection unit
[9] Screw drive for plasticizing
[10] Main electical isolator
[11] main input
[12] Control cabinet
[13] Control panel with screen
[14] Operator position
[15] Moving safety gate clamping unit

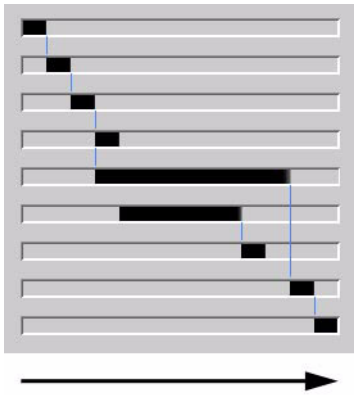
4 MOLDING CYCLE AND PRINCIPLES

4.1 MOLDING CYCLE OF AN INJECTION MOLDING MACHINE

An injection molding machine cycle is made up of a series of interrelated steps. Each step performs a specific task in the processing of the material to produce a finished part. The processor refers to this as a molding cycle.
The molding cycle is judged on the time required (cycle time) or after a number of cycles set on the production counter screen page (e.g. injection shot counter). Individual machine movements can overlap each other in time.

Example of an injection molding machine sequence

Mold closing
Nozzle contact
Injection
Hold pressure
Cooling time
Plasticizing
Retract nozzle
Mold opening
Demolding



Time

First step: Mold closing
The molding cycle starts with the closing of the mold halves. The mold is closed using a suitable speed and force profile, determined by the operator. The speed and force used should allow the mold halves to close without damage. If cores are required, they must be moved in after the mold has closed. When the mold is closed, the machine can build up the clamp force.

Second step: Nozzle contact
The injection unit nozzle is moved up to the mold, and the operator set contact pressure is built against the sprue bushing.

Third step: Injection and hold pressure
The screw injects the melt in the screw antechamber into the mold cavity under high pressure with adjustable speed profile. The pressure can be between 300 and 2500 bar depending on mold and molding compound. A mechanically closing non-return valve prevents the backflow of the melt into the screw channels.
The cooling time begins with the entry of the molten plastic into the mold. To prevent sink marks or voids in the part, the machine switches over to hold pressure after the mold has been filled, the hold pressure packs out the mold to compensate for material lost due to cooling until the sprue freezes off (gate sealing). A hold pressure profile and time can be set by the operator. After the hold pressure, the operator set cooling time begins.

Fourth step: Plasticizing
The plastic granules fall from the material hopper through the feed throat of the injection barrel into the feed section of the plasticizing screw. The screw turns and conveys the material forward towards the nozzle through the externally heated barrel. As the screw turns, the shear forces exerted on the material combined with the heat from the barrel cause the material to be melted and conveyed to the front of the screw. The accumulation of melted material in front of the screw pushes the screw back against an operator set counter pressure (back pressure).

The resistance to the backward movement of the screw promotes uniform melting and mixing of the material. When the desired volume of melted material is reached, usually determined by the distance that the screw is pushed back, then screw turning is stopped.
For relieving the melt compressed in the screw antechamber the machine retracts the screw afterwards (decompression). If necessary, a shut-off nozzle sees to it that no melt flows out from the nozzle.

Fifth step: Nozzle retraction
The nozzle must sometimes be retracted from the mold in order that

- the sprue shears off,
- to prevent too much heat transfer from the nozzle to the sprue bushing,
- to prevent the heated nozzle from being cooled down by the colder sprue bushing.

Sixth step: Ejection
At the end of cooling time, the mold opens with an operator set speed profile and the molded part is ejected. When the moving mold half reaches the set open position, the molded part is ejected. Ejector pins are moved through the moving mold half and push out the molded part. The cycle is finished with the expiry of the recycle time and the machine is now ready for a new cycle.

4.2 IMPORTANT PRINCIPLES AND NOTES

Several important prerequistes must be created to ensure optimal process control:

- The part and mold must be designed to suit the mechanical, thermal and flow properties of the plastic material used.
- Standardized checks on incoming material.
- Efficient machinery.
- Well designed machine sequence.
- Sequential quality test of the injection molding machine.
- Systematic mold proving trials.
- Optimization aids.

SAFETY

Due to their very operation, injection molding machines create PRESSURES - FORCES - TEMPERATURES, which can lead to dangers of accident for persons.
In order to protect persons against dangers of accident, ENGEL machines are equipped with corresponding safety devices.



DANGER!

Safety devices must not be changed or put out of function. Check the safety devices before the operation of the machine.

[See 'Function of the safety devices' on side 20.]

When a defect with the safety equipment is detected:

1. Stop the machine operation and switch off the motor.
2. Carry out no further activity on the injection molding machine.
3. Immediate message to a person who is competent and responsible for the safety of the plant at the factory.
4. Only after the serviceability of the safety equipment is guaranteed, the machine operation may be resumed.



DANGER!

The working and the stay below movable components are forbidden! During operation one must not enter and reach into the movement area of the machine by no means!



CAUTION!

During the set-up and operation of the machine it must most urgently be paid attention to that wrong settings can lead to damage on the plant. Settings must be compatible to the function of the machine, mold, material and peripheral units.

ENGEL is not liable in respect to operational errors.

Additional safety hints must be observed in the respective chapters of the instruction manual.



WARNING!

Maintenance and repair work on the plant may only be carried out by persons who have been trained for this activity on ENGEL injection molding machines!
You must have comprehensive knowledge of safety precautions and operating elements!

The activities and maintenance intervals described in the chapter Maintenance must be observed.
In addition, control period as well as control activity must be observed and/or carried out on all safety devices for the protection of persons and things according to the safety regulations fixed in your country by the authorities.

Further work on the machine beyond the described activities may only be carried out by ENGEL service technicians.

1 ACCIDENT PREVENTION

- During work on the plant wear the prescribed, personal safety clothing (safety boots, safety gloves, safety goggles, ...). Observe the local safety regulations for the reliability in operation of injection molding lines!
- Keep the whole plant always clean. This considerably contributes to its serviceability and so biggest possible safety for the operating personnel.
- Do not remove any danger or information signs and markings from the machine or additional devices!
- The entering of the machine frame is forbidden during the machine operation!
- If for the filling of the processing material container a mounting aid is required, use such one which corresponds to the local safety regulations!
- Do not reach in or look into the feed throat of an operational injection unit!
- During work in the area of the heated-up components (material barrel, injection mold, ...) wear safety gloves and safety goggles!
- Always observe the processing guidelines and safety hints indicated by the material manufacturer!
- Use extractor fans when processing material types detrimental to health.
- Only use shut-off nozzles prescribed by the legislator!
- During all work in the movement area of the machine switch off motors!
- Before required activities near the gate of the injection mold (e.g.: Maintenance and cleaning work, removal of processing material particles/rests, disassembly of mold inserts etc.) observe by all means:
  - Injection unit or units must be moved away from the mold! There must be no connection between injection unit nozzle and mold!
  - There is danger of burning by possible loosening of the cold material slug and following flowout of hot material from the injection mold feed point!
  - Wear suitable, protective clothing, gloves and safety goggles!
- Do not enter or reach into the part ejection area!
- Do not reach into the clamping mechanism, ejector and mold area during the machine operation!
- During the operation no maintenance work may be carried out!
- Protect all pipings against harmful influences such as acids and mechanical effects.
- Check all pipings for their work-safe state. Switch off the plant immediately when detecting a leakage, damage or break of a piping.
- Only specially marked areas on the injection molding machine may be used as work areas!
- Unauthorized personnel are not allowed to work on the injection molding machine!

2 PICTOGRAPHS

Meaning of the pictographs which can be attached on the plant as danger hint:



BEWARE of hot surface!



DANGER by electric current!



BEWARE of hand injuries!



DANGER by floating loads!



Admittance for authorized persons only!



Keep off the area!



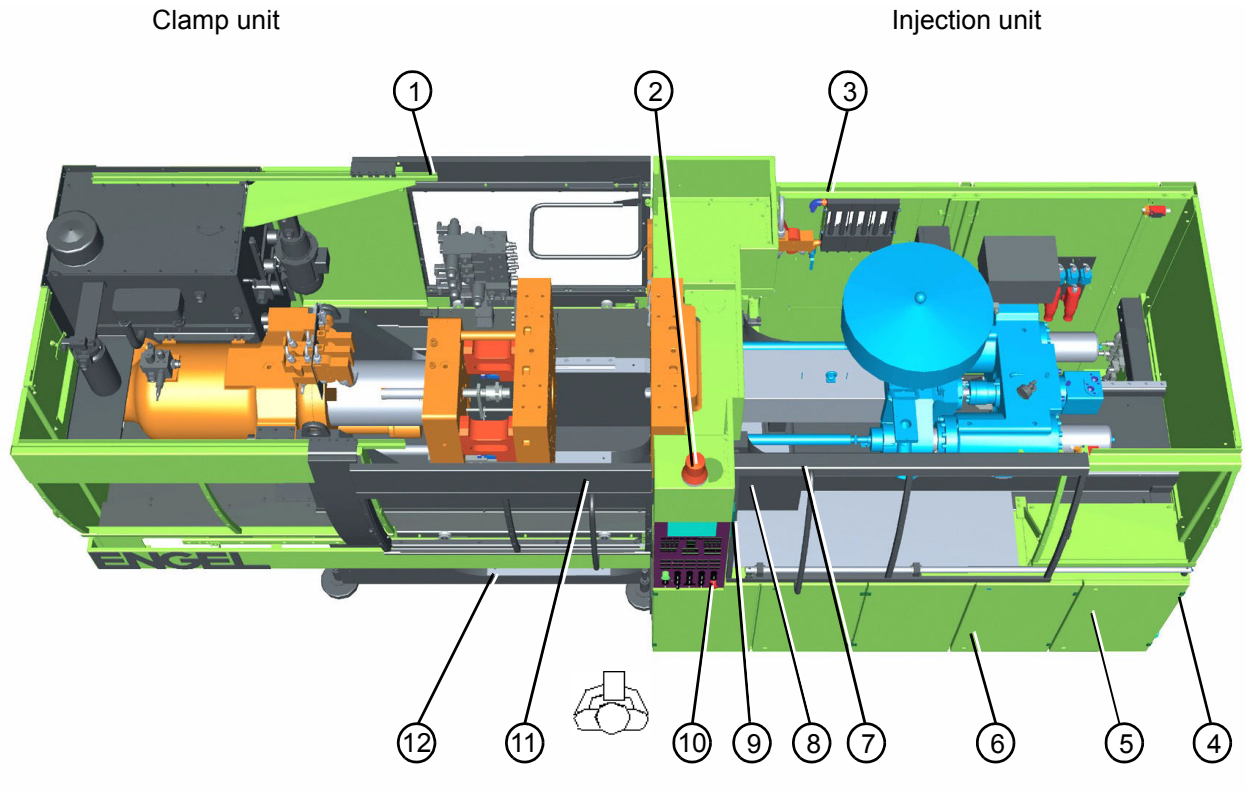
No admittance for persons with cardiac pacemaker!



The working and the stay below movable components are forbidden!

3 SURVEY SAFETY DEVICES - VICTORY

Example: VC650/150 POWER



[1] Moving safety cover clamping unit at the back
[2] Alarm lamp (flashes in case of alarm)
[3] Safety cover injection unit at the back
[4] Main switch and machine type plate
[5] Rating plate on the inside of the control cabinet door
[6] Control cabinet with danger signs **"Danger from electric current"**
[7] Front safety gate - injection unit
[8] Danger sign **"Hot machine parts"** (Plasticizing barrel)
[9] **"Mnemonic phrases for working on injection molding machines"**
[10] EMERGENCY STOP button red
[11] Moving safety cover clamping unit in front
[12] Cover delivery chute for injection molded parts

4 FUNCTION OF THE SAFETY DEVICES

By the actuation of an EMERGENCY STOP button the whole injection molding line with robot must switch off. When opening a safety gate, all dangerous movements must stop. On the screen the respective alarm messages appear.

4.1 EMERGENCY STOP BUTTONS FOR THE PLANT SHUTDOWN

The EMERGENCY STOP buttons are on the control panel of the injection molding machine and depending on the execution for example:

- on the rear side of the injection molding machine
- on the hand control device of the robot
- at the safety gate of a safety guarding
- within a safety guarding

In case of an EMERGENCY STOP actuation the drive motors of the injection molding line are switched off immediately. Message:

	”EMERGENCY STOP”
Reason	An EMERGENCY STOP function is active, e.g. EMERGENCY STOP button is pressed, rear safety gate is open
Effect	The alarm lamp flashes, cycle and motor are stopped immediately. All dangerous movements are blocked immediately.

Re-start-up after EMERGENCY STOP

1. Convince yourselves that no danger situation exists any longer.
2. Relief of the EMERGENCY STOP button by turning clockwise.
3. Acknowledge alarm with program interruption switch
4. Switch on motors

Note!

The EMERGENCY STOP equipment is active in each mode of operation!

4.2 SAFETY GATES INJECTION MOLDING MACHINE

When opening a safety gate, all dangerous movements are blocked and a respective message appears on the screen.

	”Safety gate x clamping unit open”
Reason	Safety gate has been opened
Effect	All machine movements are blocked.
Reset	Close the safety gate.

The opening of the rear safety gate on the clamping unit causes an EMERGENCY STOP switching-off depending on protection execution or has the same function as the safety gate on the operator side.

	”Nozzle safety gate/purge guard open”
Reason	Injection unit safety gate is open
Effect	All injection unit movements are blocked and the cycle stops.
Reset	Close the injection unit safety gate/purge guard

TECHNICAL MACHINE FUNCTIONS

The chapter technical machine functions explains all important functions and movements. It is mainly gone into the sequence of the movements on the basis of pressures, speeds and times. The appertaining variables can be seen in the variables monitor in lists of variables and can be set with a corresponding password.
A Tooltip on the screen flags for digital inputs and outputs displays to which electronic module the device is connected. With it a clear connection is made for continuing to pursue the signal in the electric schematic.
All digital inputs and outputs can also be found in the variables monitor at the corresponding groups of variables(di_xxxxx, do_xxxxx).

1 POWER SUPPLY

The main switch may only be switched on after ensuring the network connection.

Sequence after switching on the control voltage:

1. Lighting-up of the control voltage switch
2. Run-up of the control panel computer and making a connection to the modules.
3. Run-up of the individual modules (green flashing status LEDs)
4. In the correct state on each module the status LEDs light green and via the Watchdog relay the majority of the voltages for valves and limit switches is switched on. (24VK, 24VK1, 24VKN, 24VE, 24VC)
5. When the safety gate is closed, further voltages for valves switch on. (24VKS, 24VKS1)
6. The Watchdog tests the whole system and sequence program and in the error case the cut-off relay reacts.
7. Lighting-up of the active inputs and outputs (green and red LEDs).
8. Heating and motor start possible.

2 MOTOR START

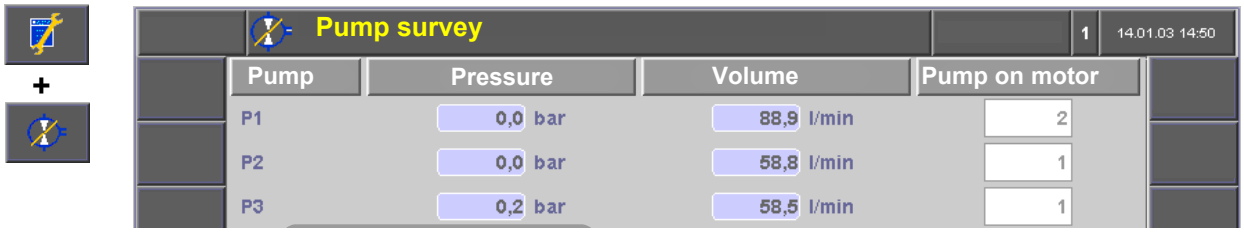
Without hydraulic oil filling you cannot switch on the motor!
Only after run-up and enabling signal of the control unit it is possible to start the pump motors with closed safety covers.
Now you must check the direction of rotation of the motor by all means as follows:

- Switch the motor briefly on and off again with the key **[Motor on/off]** on the switch panel.
- Observe, or a second person, the direction of rotation of the motor.
- Does the fan blade turn into the direction of the arrow on the motor housing?
- Everything okay. Ignore the next items.
- Not okay. Switch off the machine again immediately.
- Interrupt the power supply (interrupt the connection to the electric network).
- Have the connection wires exchanged by an electric expert.
- Check the direction of rotation of the motor anew (like described above)

Motor start sequence:

1. Filter/cooling motor (not on small machines)

2. By start impulse of the control unit the pump motor starts with 'Stand-by output' (e.g. pressure 30bar, volume 30%)
   Several motors always start in succession.
   Pumps of started motors must be on stand-by pressure. Pumps of motors to be started must be below the max. pressure for motor start.
3. The lighting motor start button signals that all motors run on delta.
4. After the starting circuit of the motor has switched over from star to delta, the stand-by operation begins or when the oil temperature is too low, the oil preheating program.



Volume display only at certain machine types.

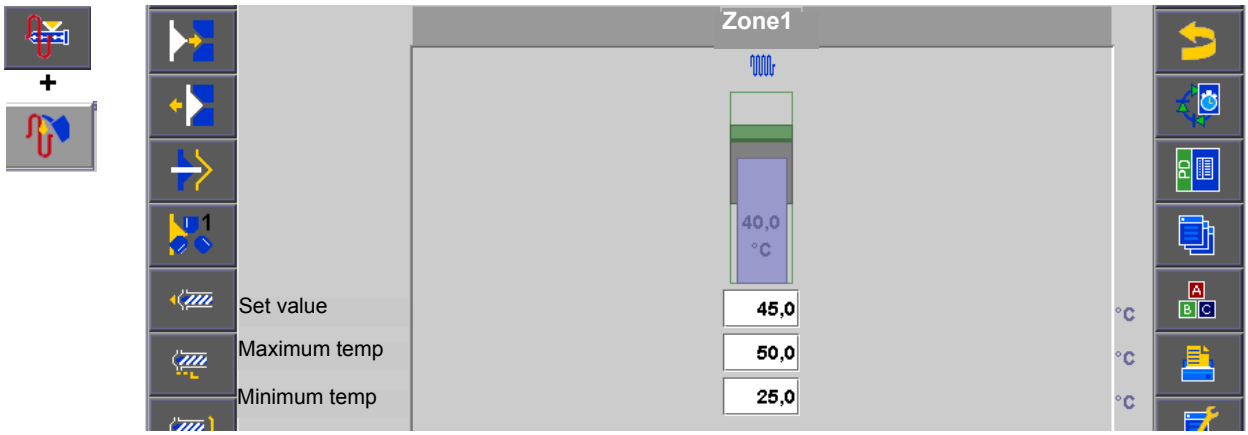
Note!

When actuating a pushbutton, without waiting for the delta run of the motors, the motors stop again.

Parameters: Group of variables Motor1

2.1 OIL PREHEATING

When the oil temperature with running motors lies or falls under the adjustable minimum temperature, an oil preheating program starts automatically.



The set value of the oil temperature should always be 40 - 45 °C! When reaching this value the oil preheating stops.

Here the set settings for the oil preheating are output.





On large machines a directional valve for the oil preheating is mounted (do_OilPreHeating).

Movements in manual and set-up mode are possible. The oil preheating program is interrupted and starts again after finishing the movement. The changeover to automatic mode is blocked, however! It is only enabled when the minimum temperature is exceeded.

	**”Oil temperature too low for automatic mode”**
Reason	The hydraulic oil temperature is too low.
Effect	Blocks changeover to automatic mode; when the motor is running and no hand control key is actuated, the action oil preheating occurs, nevertheless it can be run normally in the manual program.
Reset	Wait with switched-on motor until the hydraulic oil temperature is reached; possibly set the minimum temperature for the oil temperature lower on the screen page Oil temperature control.

When the oil temperature lies between minimum temperature and the set value minus hysteresis when switching on the control unit, the oil preheating is also started. The changeover to Automatic is not blocked, however.

You find variables (hysteresis, limiting values,...) in the variables monitor in the group OilHeating and/or in the selection of variables OilHeating. [See ’Monitor of variables’ on side 110.]

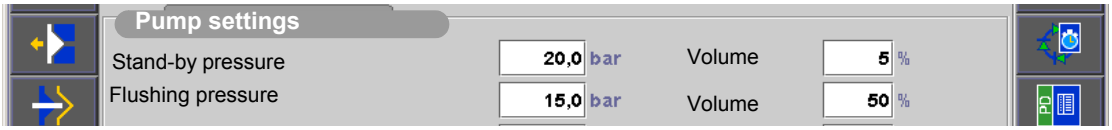
	**”Oil temperature too high”**
Reason	The hydraulic oil has exceeded the set maximum temperature.
Effect	The machine finishes the current cycle, no next cycle start, the oil cooling remains switched on, the alarm lamp flashes. If the temperature **”Maximum oil temperature with motor stop”** Variable in the variables monitor „OilHeating” should be reached, the motor and the cooling water valve switch off.
Reset	Turn on the cooling water, check the cooling water inlet and the cooling water valve, possibly clean the oil cooler.

	**”No oil temperature change”**
Reason	The oil temperature has not risen despite switched-on oil preheating program. The temperature must rise within a period (variable in the variables monitor „OilHeating”) of approx. 6min by 2°C.
Effect	Motor stops
Reset	Check the thermocouple and the hydraulic system

2.2 FLUSHING - STAND-BY

For cooling the pumps with running motor without machine movement a flushing circuit is active with a certain material throughput. When a machine movement occurs in Manual or Automatic, the flushing program stops. After finishing the movements the stand-by operation starts and after a delay time the flushing process starts again.





2.2.1 TRANSFER BETWEEN MOVEMENTS

In order to handle the transitions between the movements without jerks, there are several variants. Transfer stands here for the process that the pump output is transferred from the premovement to another value. The transfer can be defined for each movement.

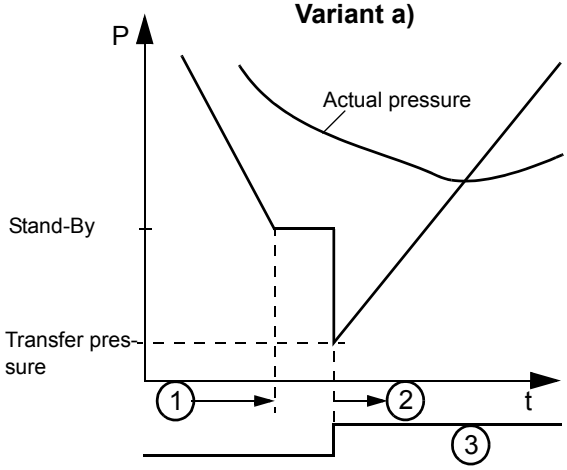
Transfer of the output before the start of the movement:
This setting acts on the output before the movement.
The transfer before is also needed for the interconnection of the pumps in order to bring them on a common transfer value.

Transfer after the end of a movement:
After the end of a movement the pump can also be run on the transfer value again.
But this kind of transfer is not used in standard.

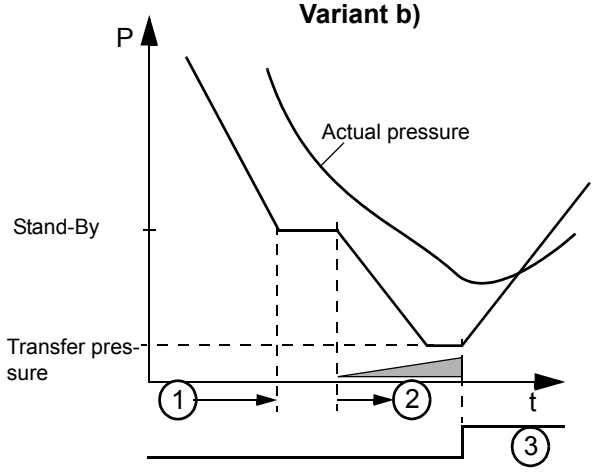
There are 5 possibilities of the transfer:

none Variant a)	The transfer is finished immediately. The next movement is started immediately.
time Variant b)	The transfer is finished after the set **"Transfer time"**.
actual value smaller Variant c)	The transfer is finished when the actual pressure lies under the **"Switching pressure"**.
set value reached Variant d)	The transfer is finished after the ramp has reached the **"Transfer pressure"**.
actual value greater	The transfer is finished when the actual pressure lies over the defined switching pressure, e.g. for accu pressure This switching pressure must be linked in the software with a variable and may therefore only be set by ENGEL.

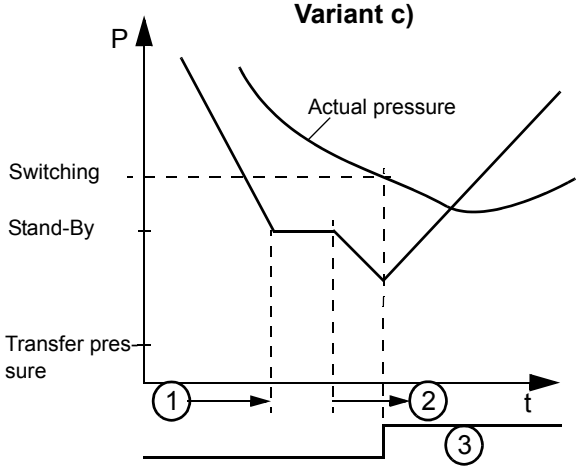
Variant a)



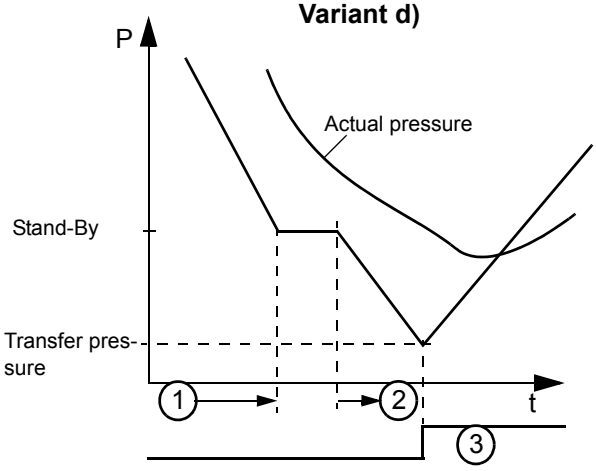
Variant b)



Variant c)



Variant d)



[1] preceding movement

[2] new movement

[3] Directional valve / volume/flow control valve

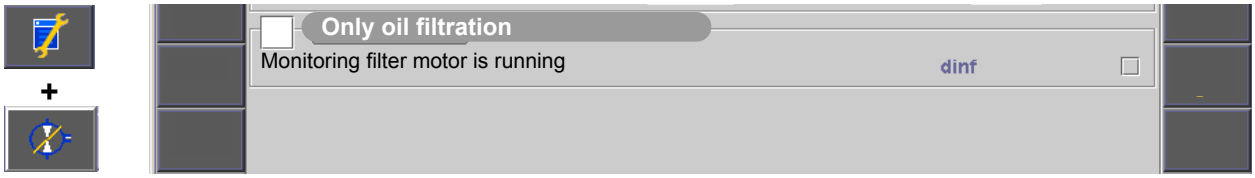
Example:

Sequence plasticizing - mold opening:

1. Stand-by outputs active
2. Minimum outputs for plasticizing on pump 1.
3. Delay in order that pump pressure reduces and (plasticizing) movement starts softly.
   Standard transfer: actual value smaller
4. Introduce plasticizing (Activate directional valve);
   Outputs corresponding to plasticizing profile on pump 1
5. Cooling time end
   (Mold opening before end plasticizing)
6. Output of stand-by
7. Start of mold opening, only when the set transitions for start mold opening fulfilled.
   Standard transfer: actual value smaller

2.3 PARTIAL FLOW FILTRATION

Filtration and cooling of the hydraulic oil occur in this case not in the main stream, but in a separate cooling circuit with a separate pump.
The filtration is always active with running pump motor, but can also be started alone, for the filtration of fresh oil.



Only oil filtration:
The program must be switched on manually and/or switches on automatically when the oil level is too low. Message:

	”Oil filtration active”
Reason:	The program switch **”Filtration”** is switched on and the partial flow filtration is active.
Effect:	Main motor does not start.
Reset:	Possibly refill oil, filter oil correspondingly long, switch off **”Filtration”**.

Filtration of fresh oil:

1. Choose screen page **”Hydraulic survey”**.
2. Switch on program **”Only oil filtration”**.
3. Switch on motors (only filter motor starts).
4. Have filtration run for at least 3 hours.
5. Switch off program **”Only oil filtration”** again.
6. Filter motor stops.

7. Acknowledge with **”Program interruption switch”**.
8. At the next motor switching-on all motors start again

2.4 HYDRAULIC MONITORINGS

The control unit monitors tank shutting clacks, oil filters and the oil level. During the oil preheating the oil filter monitorings are suppressed until reaching the set set value.

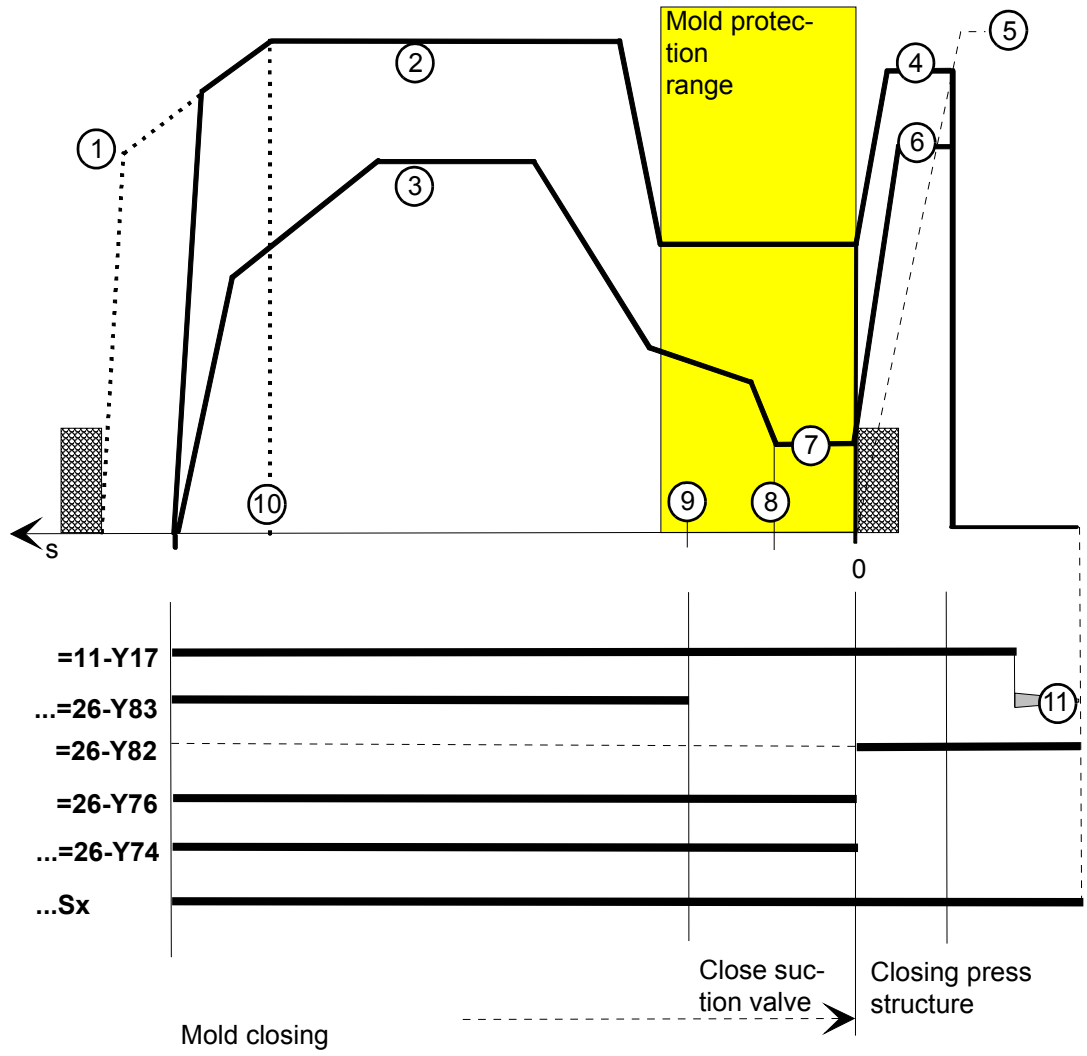
	**”Tank shutting clack(s) closed”**
Reason	A shut-off flap in the pump suction line is not open. Digital input F1 does not lie on +24VE.
Effect	Motor switches off, heatings reduce, the alarm lamp flashes.
Reset	Open the shutting clacks, if the message does not go out, check the limit switches.

	**”Oil level too low”**
Reason	The hydraulic oil level is too low.
Effect	Machine finishes the current cycle and stops, alarm lamp is set. Motor stop delayed, heatings reduce delayed.
Reset	Refill oil and possibly eliminate the leaks.

	**”No oil filtration”, ”Check oil filter”, ”Check high-pressure filter” or ”Check return filter”**
Reason	The digital input F2 does not lie on +24VE because either the partial flow motor is switched off or the oil filter is soiled.
Effect	Machine finishes the current cycle and stops, motors are switched off, heatings reduce, the alarm lamp flashes.
Reset	Check the filter and possibly exchange it and/or also check the filter motor.

3 MOLD CLOSING

Pressure and speed diagram



[1] Reduced start pressure during closing (only acts at large opening strokes).

[2] Pressure profile, acts on the variable displacement pump.

[3] Speed profile, acts on the proportional valve and on the variable displacement pump at the same time.

[4] corrected clamping pressure

[5] current clamping pressure

[6] Volume high pressure build-up

[7] minimum closing speed

[8] Braking position before Mold closed

[9] Mold position close suction valve

[10] Stroke with reduced start pressure

[11] Delay between deactuation closing solenoid and high pressure build-up solenoid

=11-Y17	Mold closing (Machines under 130t)
Sx	Pump stage (=26-Y62, =26-Y63)
=26-Y83	Suction valves opening
=26-Y84	Build up clamping force
=26-Y74	High speed cylinder (Machines from 130t)
=26-Y76	Differential connection during closing (Machines under 130t).

Profile setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Mold closing and/or in the variables selection Mold1. [See 'Monitor of variables' on side 110.]

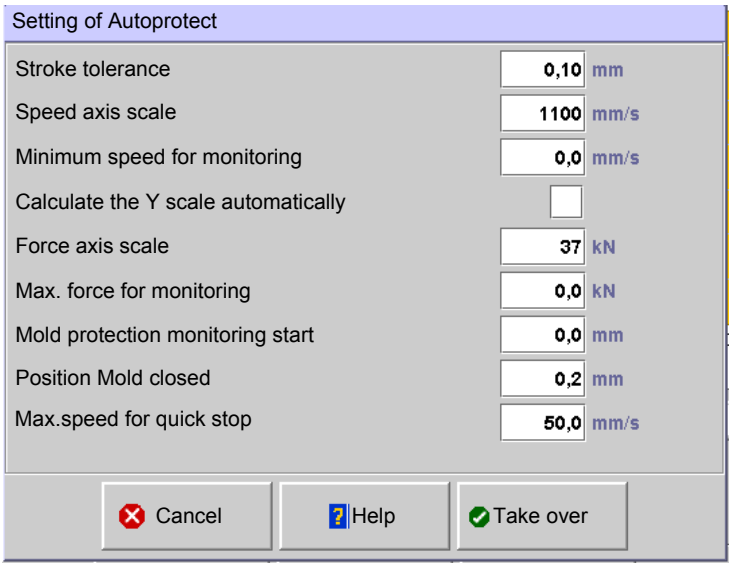
3.1 CLOSING INTERLOCK

When the digital input Fu.di_ExtClosingBlock is not active, the mold closing is blocked.

Extension with existing option Freely programmable in/outputs
By the parameter **"Use of external inhibiting input"** another freely available input can be used. see description Freely programmable in/outputs in the operator's manual

The setting of the closing interlock occurs in the variables monitor in the group ExtClosingBlock [See 'Monitor of variables' on side 110.]

3.2 AUTOPROTECT SETTINGS



Stroke tolerance
Tolerance for measuring accuracy of the stroke transducer in order that no alarm is released by measuring errors.

Scale of the speed or force axis
If not the automatic scaling is activated, representation of the speed axis with the scale indicated here.

Min. speed and max. force for monitoring
These values must not be exceeded/remain under during initialization, cyclic initialization and during monitoring. The maximum force must be set bigger than the necessary force during mold closing as otherwise a mold protection error appears immediately during initialization.

Standard settings:
Maximum force 80% of the max. mold protection force
Minimum speed 0.1 mm/sec

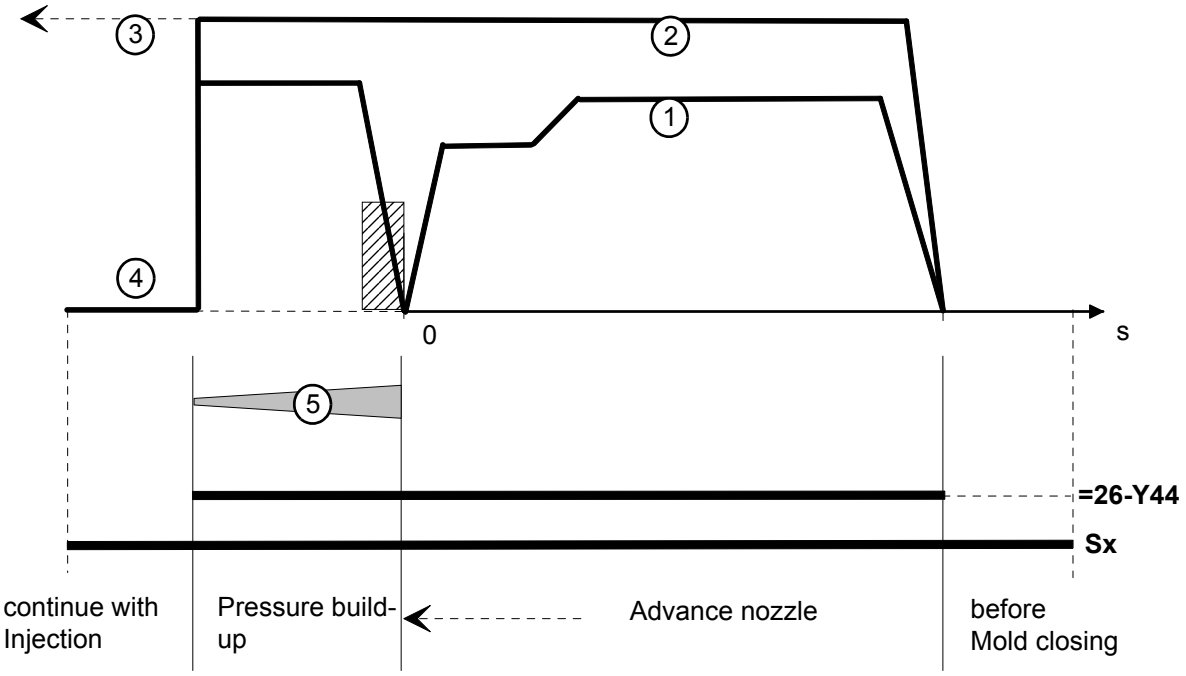
The set mold protection pressure acts as limitation for the system pressure at the same time.

Calculate the scale automatically
Automatic determination of the scale.

Max. speed for quick stop
When the current speed is over this value, the speed with the ramp „Soft stop delay" is brought on this value. Afterwards an immediate stop of the movement occurs.

4 ADVANCE CARRIAGE UNIT

Pressure and speed diagram



[1] Speed profile
[2] Pressure profile
[3] Manual mode, =26-Y44 and =26-Y62 (machines with Bosch hydraulics) active as long as **[Nozzle forward]** remains pressed
[4] Automatic mode
[5] Force build-up time

=26-Y44	Advance carriage unit
Sx	1. Pump stage

During the movement the stroke transducer is checked for correct function. The signal must lie within the calibrated min - max values. In the error case immediate stop and alarm message. [See '"Component x stroke transducer defective (min, max, offset)"' on side 134.]

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Nozzle and/ or under the selection Nozzle1. [See 'Monitor of variables' on side 110.]

4.1 AUTOMATIC NOZZLE CONTACT POINT DETERMINATION

Determination and storage of the nozzle contact point in each operating state.

Nozzle contact point is not yet determined:
Erasure from the nozzle contact point when switching on the control voltage and when switching over to set-up mode. The nozzle advances with decreased speed and with reduced pressure. After approx. 2 sec standstill recognition time on the contact point the screen flag **"Nozzle contact point reached"** lights up. This position is considered as 0 point for the stroke scale of the nozzle movement.
Nozzle contact point has already been determined:
Despite already determined nozzle contact point at each nozzle forward movement in the manual mode and in the first automatic cycle a new determination occurs. In order to prevent that after a mechanical change of the nozzle stroke, e.g. insertion of a shorter nozzle tip, the machine switches to contact pressure before the nozzle is still applied. It is run with normal profile and the contact point is determined like above.

Note!

It is very adviseable to switch over to set-up mode after a mechanical change of the nozzle stroke or to switch off/on the control voltage in order to cause an erasing and thus a new determination of the contact point in the following.

4.2 CONTACT PRESSURE BUILD-UP

The pressure build-up can be switched over in the variables monitor:

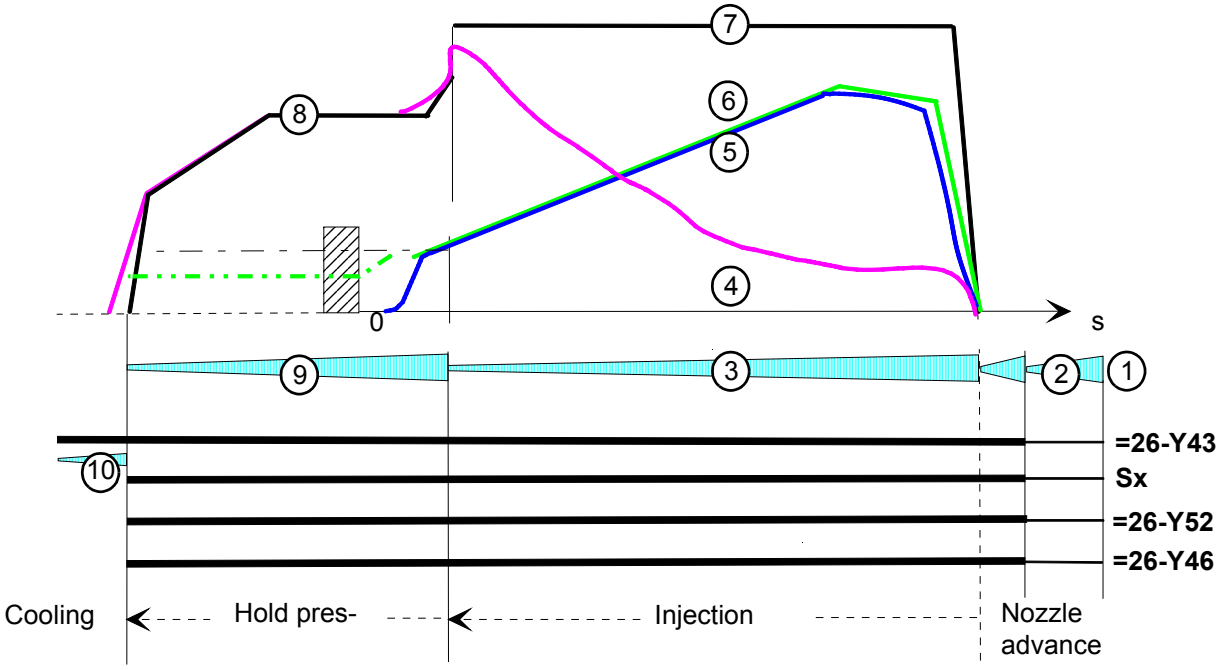
- Pressure build-up via time (0)
- Pressure build-up via pressure (1)

Contact pressure build-up time

As soon as the pos. J is reached at the advance of the nozzle, the pressure build-up time starts. This time can be set on the screen in seconds. During this time a decreased speed and a reduced pressure are output. The pressure build-up time is not effective in the manual mode.

5 INJECTION AND HOLDING PRESSURE

Injection and post injection pressure without servovalve

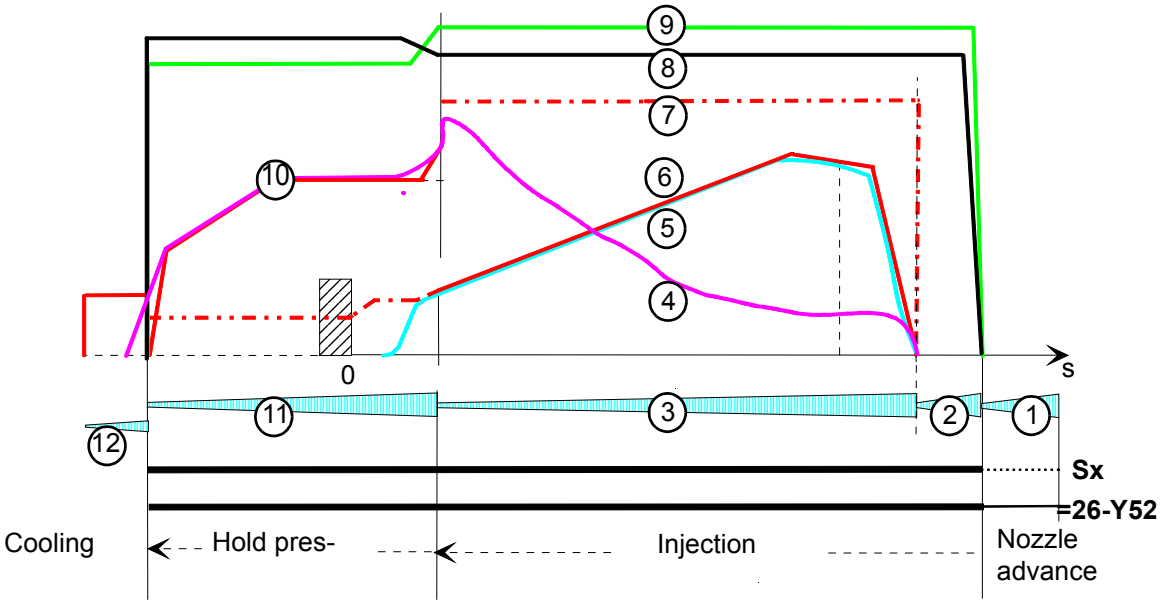


[1] Injection delay (only in the automatic mode)
[2] Delay analog/digital
[3] Injection time
[4] Pressure actual value
[5] Actual value speed
[6] Set value speed
[7] Injection pressure limit
[8] Hold pressure
[9] Hold pressure time
[10] De-energizing delay =26-Y43

=26-Y43	Injection.
Sx	Pump stage
=26-Y52	Differential connection (without increased injection pressure) from injection unit 650
=26-Y46	Differential connection (without increased injection pressure) Continuous piston rod up to injection unit 500

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Injection and/or under the selection InjectionUnit1. [See 'Monitor of variables' on side 110.]

Injection and post injection pressure with servovalve



[1] Injection delay (only in the automatic mode)
[2] Start delay controller
[3] Injection time
[4] Pressure actual value
[5] Speed actual value
[6] Speed set value
[7] Injection pressure limit
[8] System Press
[9] Volume
[10] Hold pressure
[11] Hold pressure time
[12] Time servo output after injection hold pressure

Sx	Pump stage
=26-Y52	Differential connection (without increased injection pressure) from injection unit 650

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Injection and/ or under the selection InjectionUnit1. [See 'Monitor of variables' on side 110.]

5.1 SPEED OPEN LOOP CONTROL IN THE POST INJECTION PRESSURE PHASE

Stroke-dependent continuation of the speed profile during the post injection pressure phase and the corresponding speed flag remains actuated. Output of a constant speed value only when the screw is on stop.

5.2 INCREASED INJECTION PRESSURE

The increased injection pressure must be switched on with **''Increased injection pressure Yes/No''** here a recalibration of the speed values occurs.

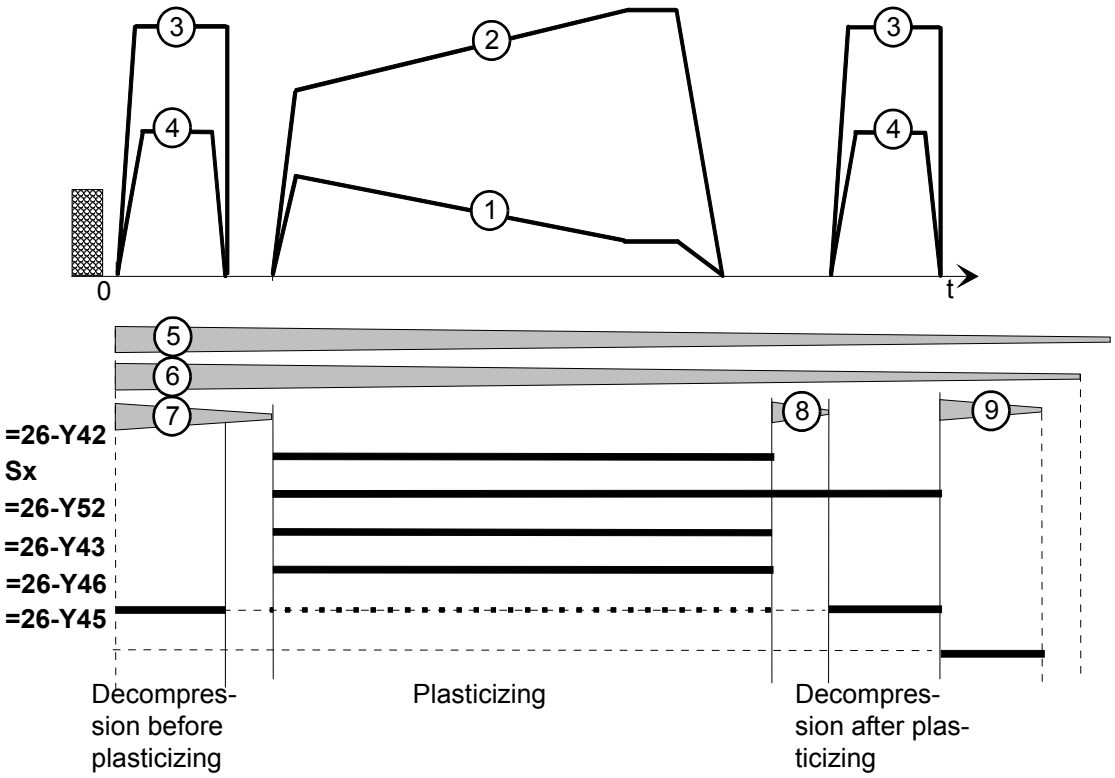
Depending on unit used solenoid for the differential connection:

- =26-Y52
- =26-Y46 (continuous piston rod)

In the normal program, i.e. without increased injection pressure, with injection solenoid =26-Y43 the differential solenoid =26-Y52 energizes. So the injection movement occurs faster by oil return and as a result with decreased pressure.

6 PLASTICIZING AND DECOMPRESSION

Pressure and speed diagram



[1] Specific back pressure
[2] Plasticizing speed
[3] Pressure screw retraction
[4] Decompression speed
[5] Cooling time
[6] Delay time retraction
[7] Plasticizing delay time
[8] Delay time between plasticizing and decompression
[9] Force build-up time for nozzle

=26-Y42	Plasticizing
Sx	Pump stage
=26-Y52	Decompression
=26-Y43	Differential system
=26-Y46	Injection solenoid
=26-Y45	Pressure reduction nozzle

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Injection and Decompression and/or under the selection InjectionUnit1. [See 'Monitor of variables' on side 110.]

6.1 SPECIFIC BACK PRESSURE

Back pressure switching-off

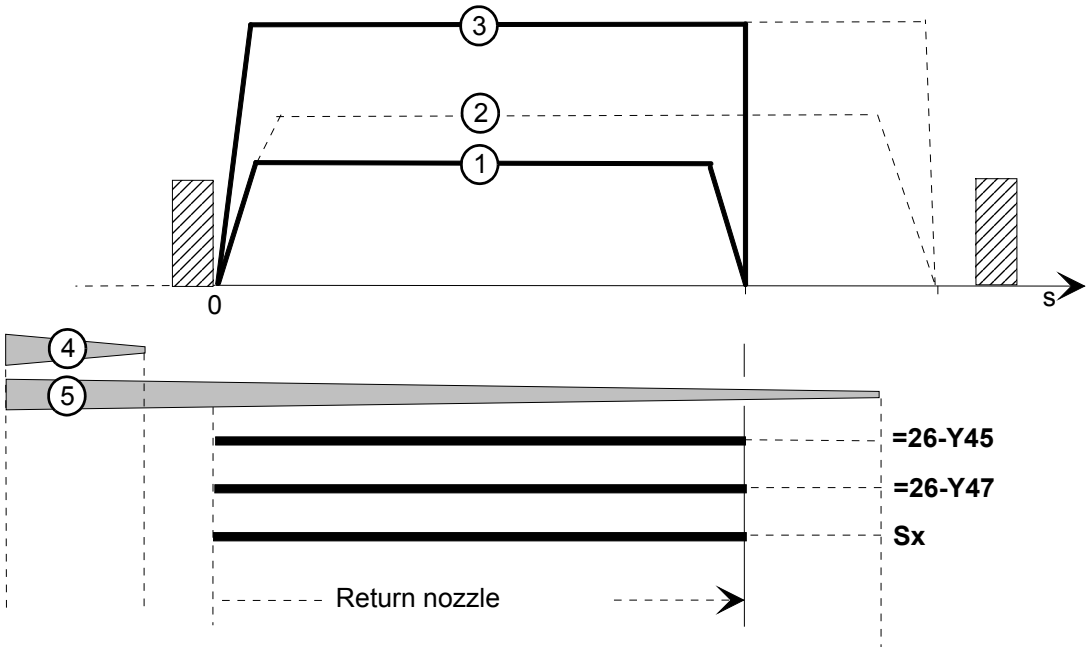
When in the manual mode at the moment of the key actuation for **”Plasticizing”** the key-operated switch **”SIT”** is actuated, as back pressure set value, regardless of the back pressure values set on the screen, 0 bar is output.

Active back pressure

It is possible to switch the servovalve from the last holding pressure stage on the first back pressure stage. Thus, when the plasticizing shall begin immediately after holding pressure, a jumping back of the screw shall be prevented.

7 RETURN CARRIAGE UNIT

Pressure and speed diagram



[1] Speed nozzle return in Automatic
[2] Speed nozzle return in Manual
[3] Pressure nozzle return
[4] Delay time retraction
[5] Cooling time

=26-Y45	Carriage unit backward
=26-Y47	Contact pressure reduction
Sx	Pump stage

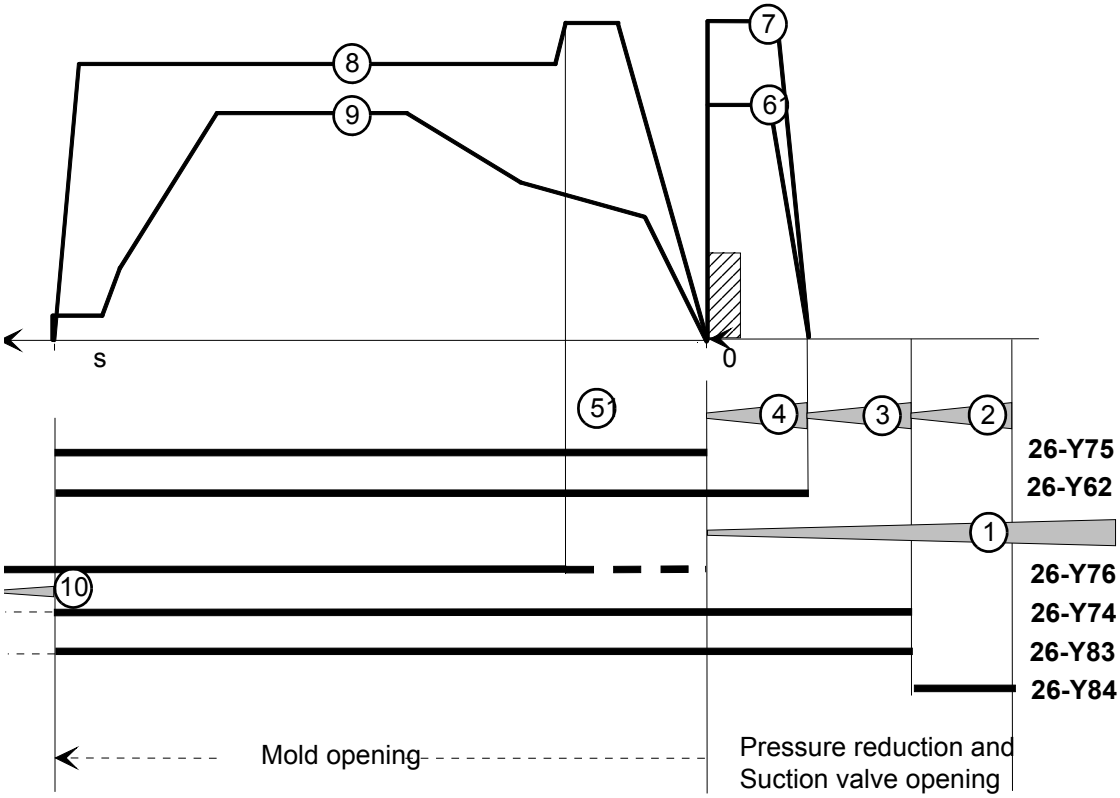
Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Nozzle and/ or under the selection Nozzle1. [See 'Monitor of variables' on side 110.]

7.1 CONTACT PRESSURE REDUCTION

Before the retraction of the carriage unit and/or mold opening the contact pressure must be reduced. The setting occurs with the set value **"Holding force during demolding"** on the screen page Nozzle.

From suction valves opening no parallel movement is allowed as from this moment the valve actuation for suction valve opening is effective.
As for the clamping pressure reduction only an electric actuation of the reduction solenoid is required, this occurs in parallel to plasticizing or screw retraction.

8 MOLD OPENING

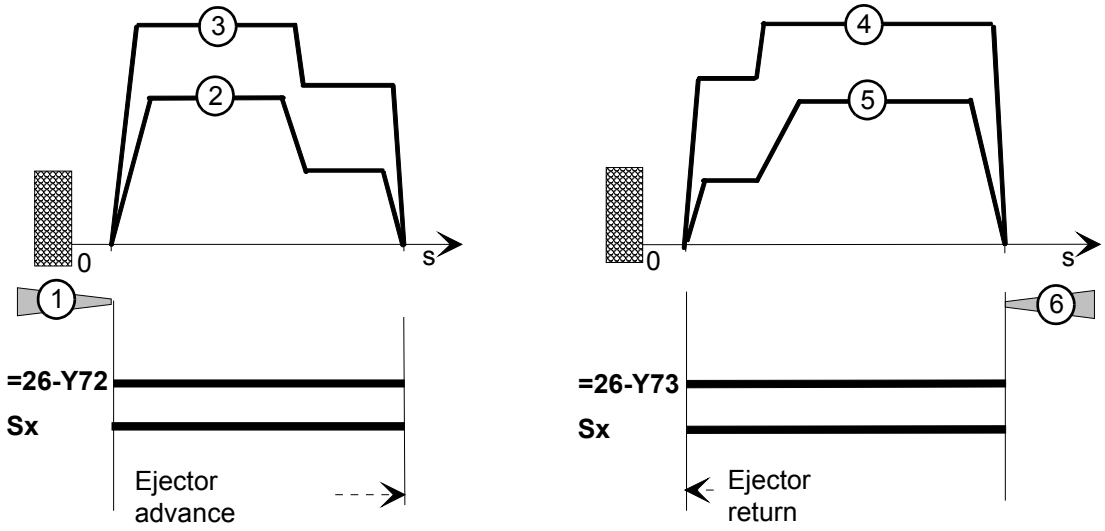


[1] Cooling time
[2] Clamping force reduction time
[3] Analog output delay after setting the suction valve solenoid
[4] Duration suction valve opening
[5] Increased opening force upto position
[6] Volume suction valve opening
[7] Pressure suction valve opening
[8] Pressure mold opening
[9] Speed mold opening
[10] Deactuation delay of differential solenoid

=26-Y75	Mold opening, only at HV1
=26-Y62	Pump stage 1
=26-Y76	Differential system
=26-Y83	Open suction valves. Remain open in automatic mode until mould is closed again.
=26-Y84	Pressure reduction
=26-Y74	High speed switching-off from HV2, remains energized in Automatic, until mold has closed on G2 again.

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Mouldopening and/or under the selection Mould1. [See 'Monitor of variables' on side 110.]

9 ADVANCE AND RETURN EJECTOR



[1] Ejector forward delay
[2] Speed ejector forward
[3] Pressure ejector forward
[4] Pressure ejector return
[5] Speed ejector return
[6] Ejector return delay

=26-Y73	Ejector forward
=26-Y72	ejector retracted
Sx	Pump stage 1

Ramp setting [See 'Ramp setting' on side 127.]
Variables (times, positions,...) can be found in the variables monitor in the group Ejector and/or under the selection Ejector1. [See 'Monitor of variables' on side 110.]

9.1 EJECTION MONITORING

By means of digital input the evaluation of a contact of a check weigher, delivery flap or light beam guard occurs.
The ejected part must actuate and make the delivery detector free again (impulse) in order to start the next cycle.
The polarity of the detector signal can be influenced in the variables monitor.

	**"Ejection monitoring"**
Reason	An injection molded part has not been ejected, the ejection monitoring (additional equipment) has reacted.
Effect	The alarm lamp flashes, no new cycle starts.
Reset	Eject the injection molded part.

9.2 SET-UP MODE EJECTOR

Speed:
The set-up volume is fixed by a variable, if the screen value for volume is set smaller than the fixed set-up volume, however, the smallest set value is output.

Pressure:
The set-up pressure is fixed by a variable, if the screen value for the pressure is set smaller than the fixed set-up pressure, however, the smallest set value is output.

10 2. EHV PUMP

10.1 PARALLEL MOVEMENTS

On machines which are equipped with two pumps the main movements are supplied via the main pump and the secondary movements from the second pump.
Because of that the possbility results to actuate all movements which are supplied by different pumps in parallel.

Main movements:

- Mold opening
- Mold closing
- Injection
- Plasticizing
- Screw retraction

Secondary movements:

- Ejector
- Nozzle
- Cores

It must be observed at parallel operation that the pumping capacity is divided up and so mold closing and mold opening can no longer occur with maximum speed if a parallel movement is wanted.

Before the start of pressure-sensitive movements it is checked whether the pressure in the system lies under an adjustable level. If this is not the case, on the pump a transfer pressure is output until the set pressure level is reached. Only then the corresponding movement is started.

Thus a jerky start (not corresponding to the setting) of the movement shall be avoided by high remaining pressures in the system.

This pressure reduction can basically be set at each movement.

Delay clamping high pressure build-up - injection:
By the possible parallel movements at certain settings it can arise that on the main pump the injection movement will start the build-up without delay. By the high remaining pressure in the system the injection movement will start by jerks and jolts. Therefore also during injection it is tranferred pressure-dependent.
This means if the pressure is too high, at first the pump is moved on the transfer pressure before the injection is started.

10.2 PUMP INTERCONNECTION

When the interconnection of pumps is activated, the second pump is connected with the solenoid =42-Y14.2.

Interconnection of pumps during injection
The analog actuation of the second pump occurs during the whole injection process (pre-injection and post injection pressure) in the following way:
The volumes and the pressure actuation of the second pump are run along with the first one.
The software closed loop control of the injection speed and of the pressure limit is exclusively made via the first pump.

Interconnection of pumps in the post injection pressure
It can be configured that with beginning post injection pressure the second pump is disconnected.

Pump interconnection at plasticizing
The analog actuation of the second pump occurs then with the same actuations as the main pump.
With activated interconnection parallel movements of carriage unit, cores and ejector to the plasticizing are not possible.

Interconnection of pumps on the clamping unit
When the interconnection of pumps on the clamping unit is activated, the pumps are interconnected during closing and opening in order to reach a higher maximum closing speed. This interconnection does not occur in each case, however, but only then when this is required (due to the set speeds) and/or possible (due to the secondary movements possibly running in parallel).
Here the following criteria are checked:

- Speeds:
  When the maximally set speed on opening and/or closing does not exceed the value which can also be reached with one pump, it is basically run with one pump in the

respective direction.
Only when a speed is set which can no longer be reached with a pump, it is switched over to 2-pump operation if the 2nd pump is not needed for parallel movements.

- Position opening stroke - start ejector forward testing:
  In order to prevent that the ejector is switched to parallel operation unintentionally by setting e.g. the opening stroke bigger, but then it is forgotten to write the pos. start ejector forward also high, it is checked when changing the opening stroke whether the pos.start ejector forward has been set equal to the opening stroke before. When this has been the case, the pos. start ejector forward is pulled along with the opening stroke automatically.

The connection and disconnection of the second pump occurs dynamically. This means the opening can e.g. start with both pumps, then the core needs the second pump. Now the volume output of the second pump is run down and the pumps are separated in order that the core can run. Afterwards the pumps, if it is still required, are interconnected again and the second pump supports the opening again.

	**” Unit x output No.x error at the pump interconnection”**
Reason	An error has appeared at the pump interconnection. The pumps have not been brought on the same pressure. Either a pressure transducer is defective or a wrong setting exists. After 0.5 seconds the pumps have been interconnected despite unequal pressure.
Effect	The production is not switched off or stopped.
Reset	The error is deleted with the program interruption key. It shall be searched for the problem, however.

HARDWARE

In this chapter it is gone into the whole hardware (electronic components). It is a survey of the properties of the individual modules, but also of the whole system structure. With it the error diagnostics or a maintenance work shall be facilitated strongly.

1 GENERAL

In order to correspond to the respective functional requirements, the system is conceived modularly. It essentially consists of a control panel computer and of control modules. It is possible to arrange the modules separated mechanically from each other. The modules are constructed with EMV shielding and designed for the mechanical protection as cassettes. The adaptation to different interfaces is realized by inserting slide-in modules.



WARNING!

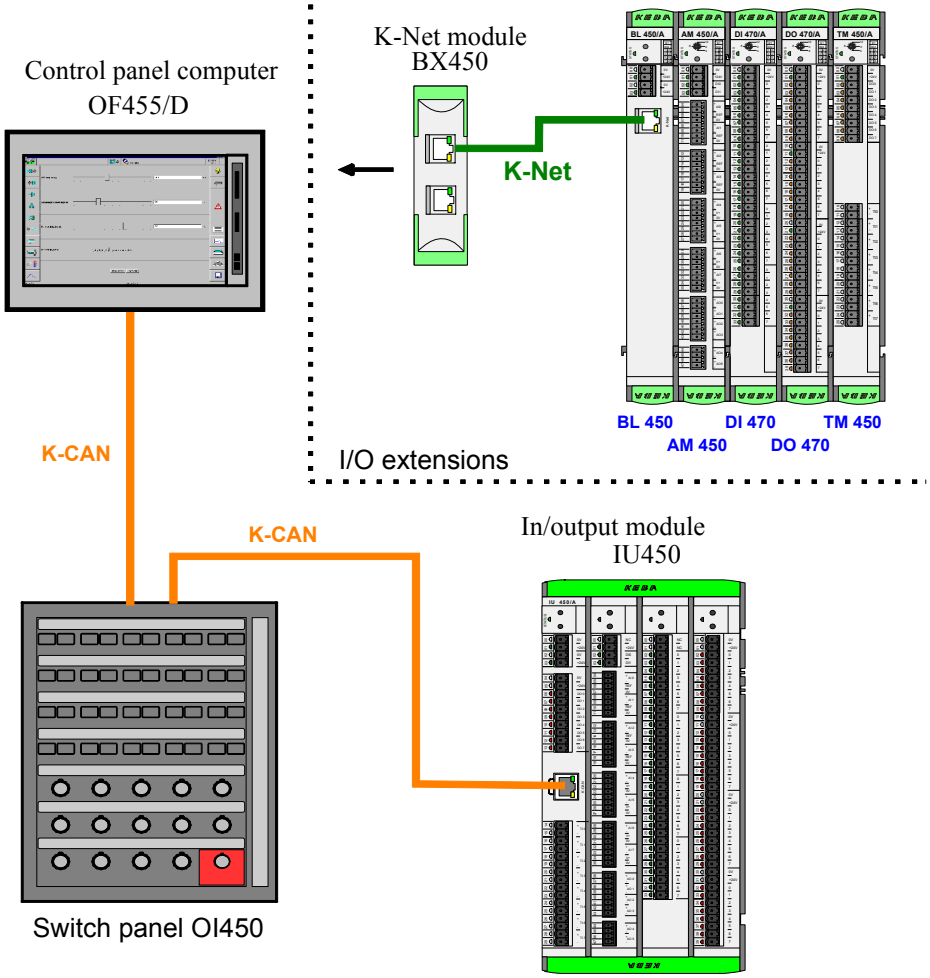
Each manipulation on the control unit under voltage must not be carried out. The individual modules must not be pulled out from and/or inserted into the rack under voltage as because of that undefined signal states present themselves and as a result damage of the operator and of the whole equipment can arise.
In the removed state electronic elements are sensitive against electrostatic charge. Before the manipulation with the modules an electric discharge must be carried out by touching a metallic, grounded object. Components on the modules should be touched as little as possible.

1.1 ELECTROMAGNETIC COMPATIBILITY

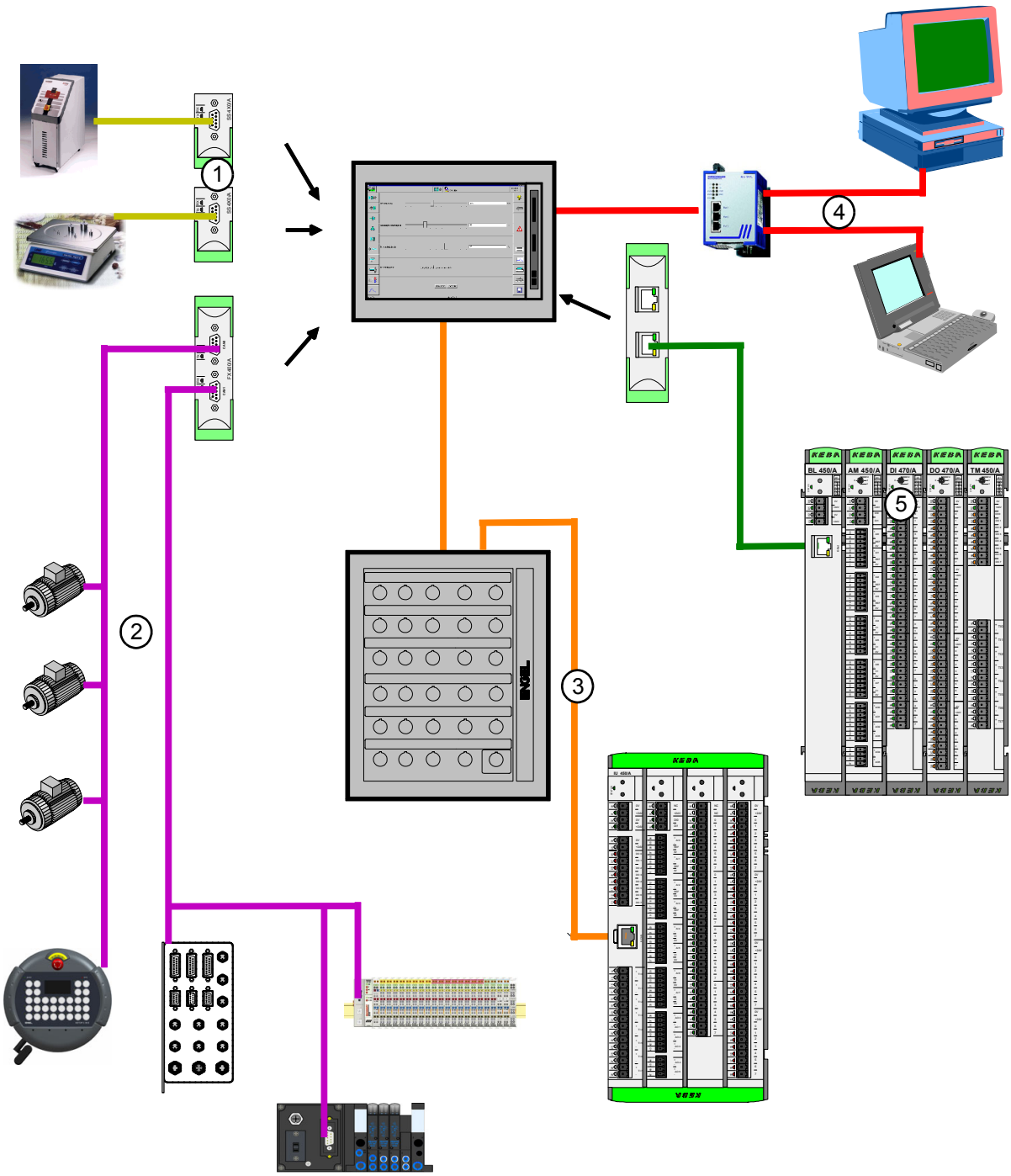
The components correspond to the EMV standard (EN 50081-2 and EN 50082-2)
Also for this reason changes and extensions on the control units must be left with authorized, correspondingly instructed personnel.

2 SYSTEM CONFIGURATION

Example of a system configuration Basic0



Extension possibilities Basic0



[1] Extension peripheral unit with interface modules (Balance, temperature control unit,...)

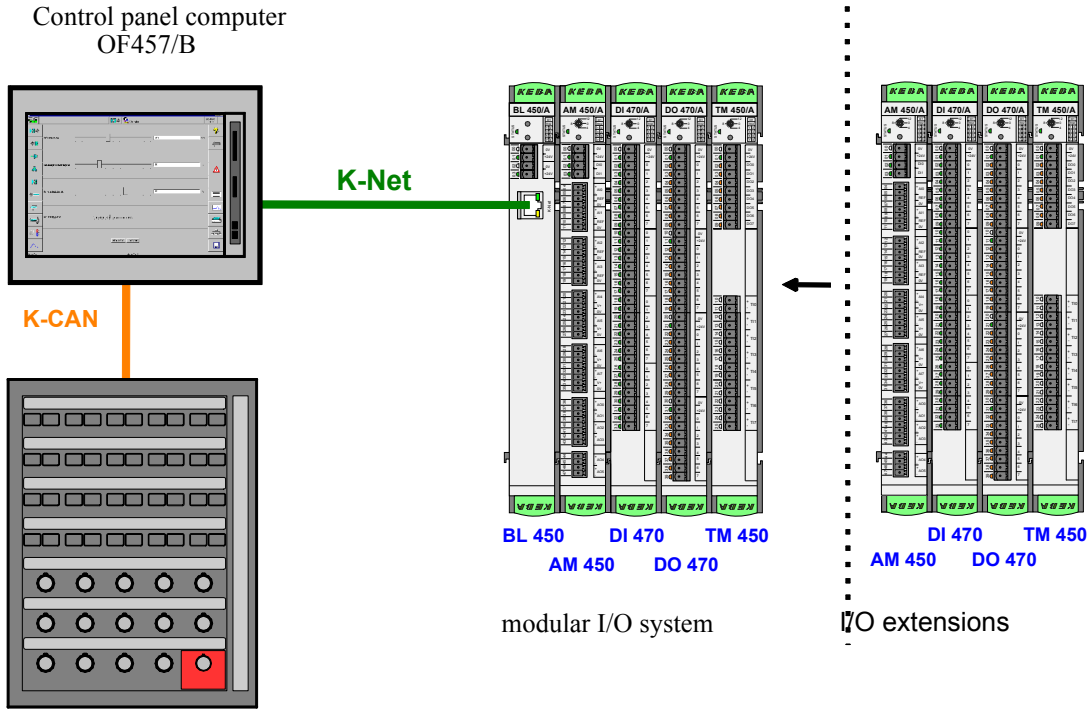
[2] Extension robotics with interface module FX400

[3] Standard configuration with OF455/D, OI450 and IU450

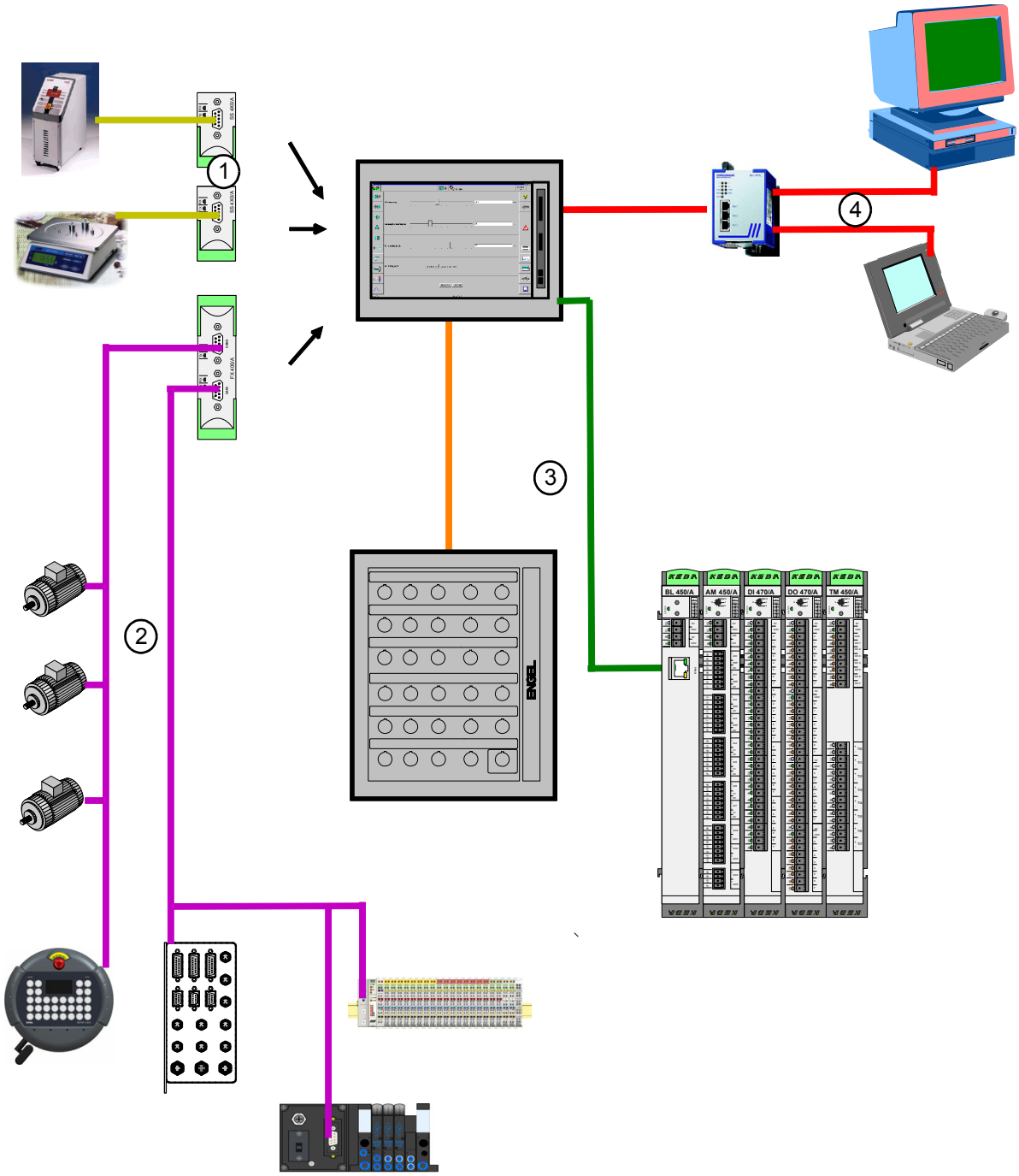
[4] Network

[5] IO extension with interface module BX450

Example of a system configuration Standard



Extension possibilities standard



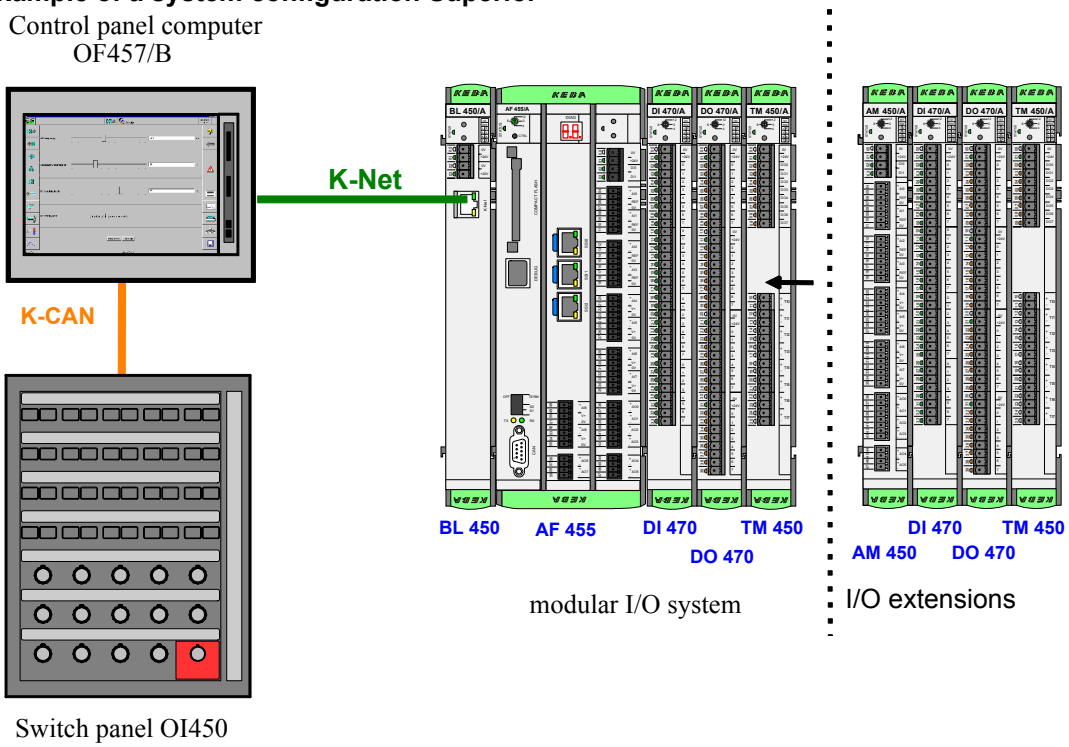
[1] Extension peripheral unit with interface modules (Balance, temperature control unit,...)

[2] Extension robotics with interface module FX400

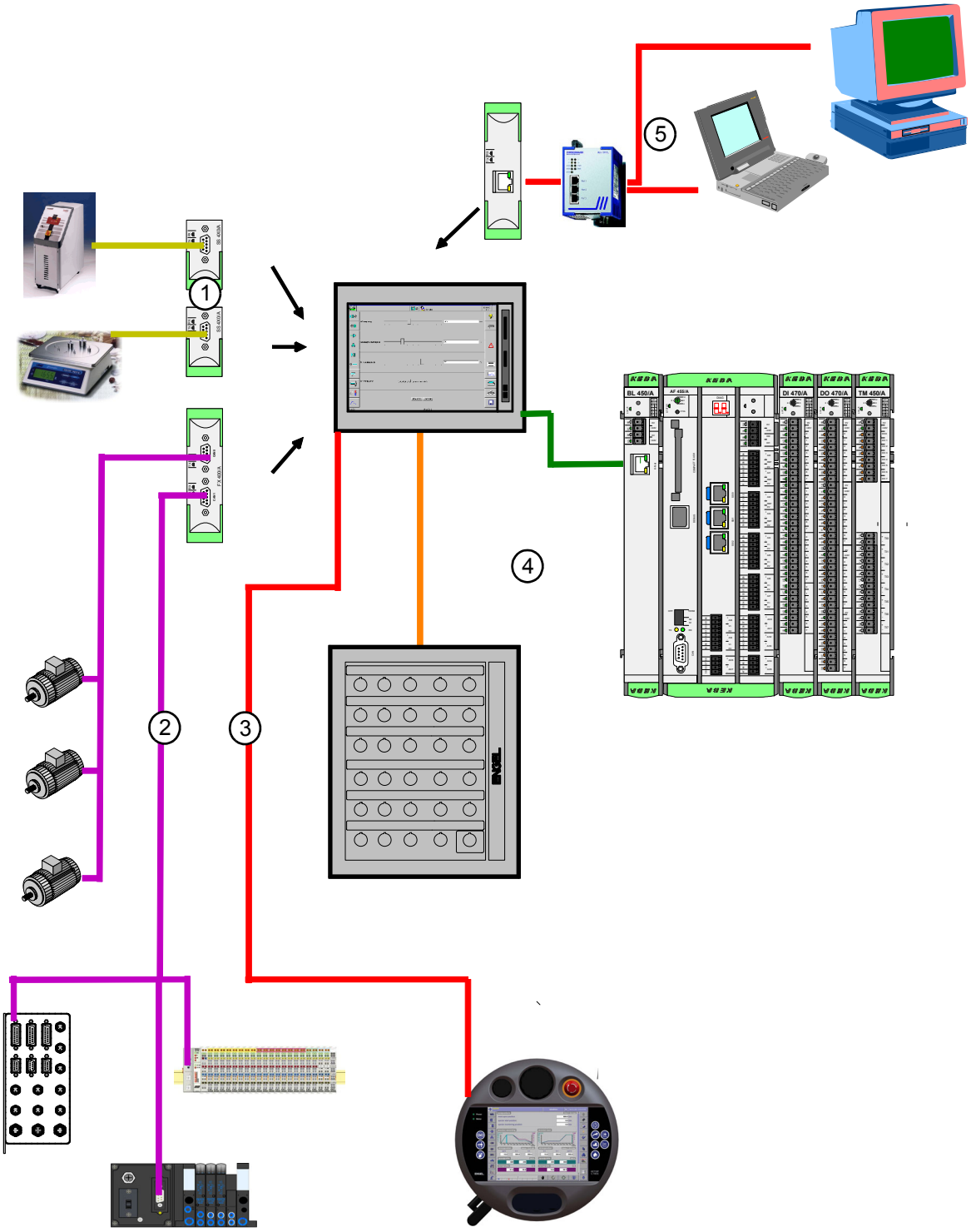
[3] Standard configuration with OF457B, OI450 and stack of modules

[4] Network

Example of a system configuration Superior



Extension possibilities Superior



[1] Extension peripheral unit with interface modules (Balance, temperature control unit,...)

[2] Extension robotics with interface module FX400

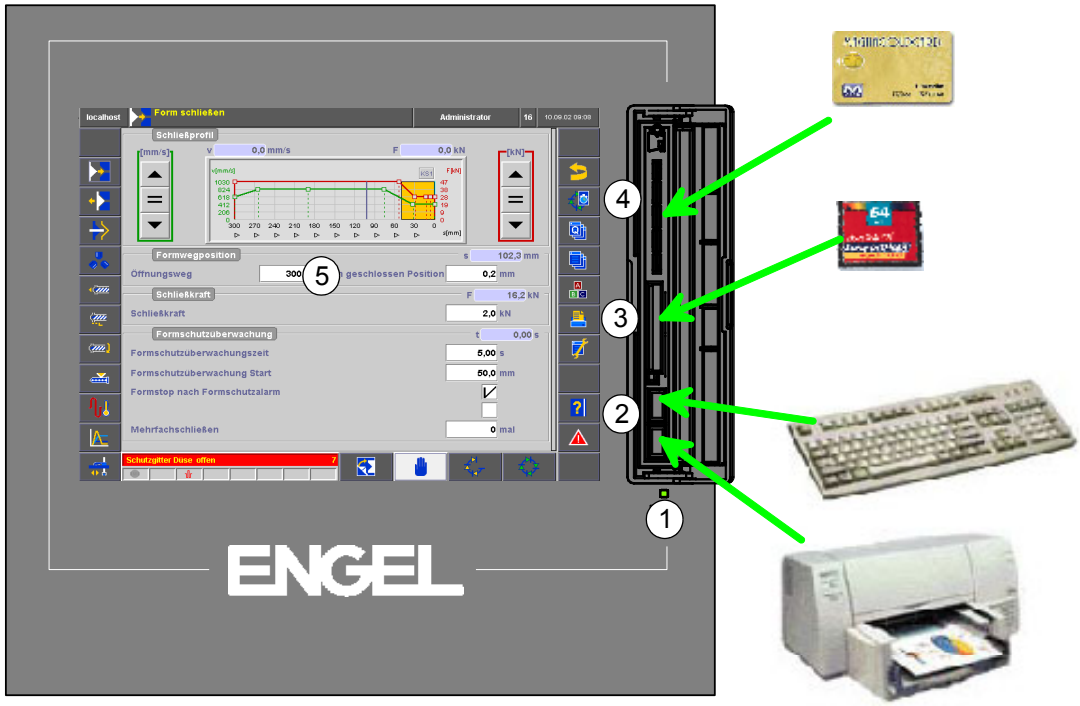
[3] Ketop C100 (Connection via Ethernet)

[4] Standard configuration with OF457/B, OI450 and stack of modules incl. AF455

[5] Network with interface module NX450

3 CONTROL PANEL COMPUTER OF 455/D AND 457/B

The control panel computer OF 450 is the central unit of the CC200 control system. The computer handles the tasks of open and closed loop machine control and the display of the interactive GUI screen pages..
Computer unit, TFT display with touch screen, CompactFlash for reading or writing data to or from the control unit and magnetic card reader for access authorization are accommodated in a compact metal housing.



[1] Power LED for power supply
unlit: no 24 V supply or power pack defective
green: Power pack OK.

[2] 2 USB interfaces for external devices

[3] Compact Flash as a reading or writing medium for parts and machine data

[4] Magnetic card for access authorization

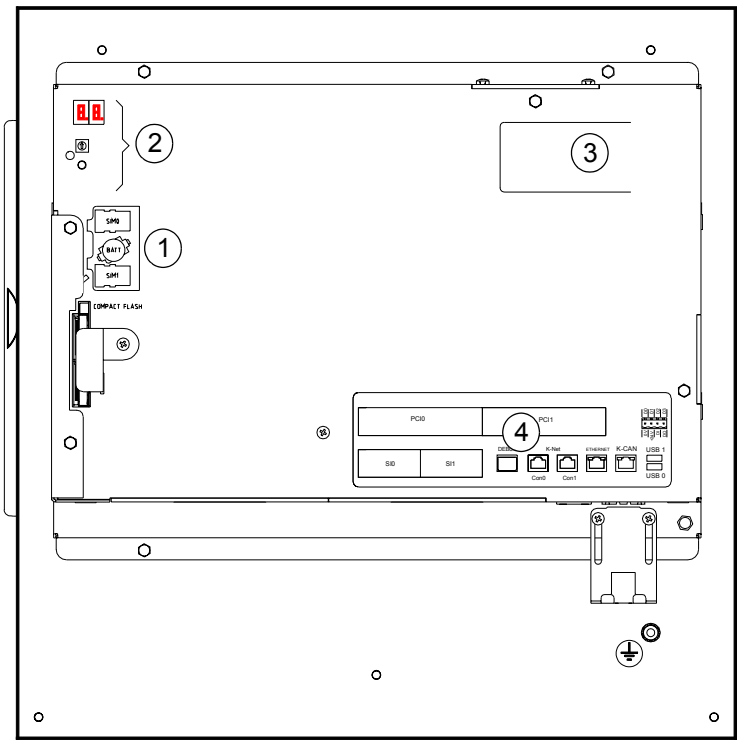
[5] TFT display with touch screen 12,1

WARNING!

The touch screen must not be operated with pointed, sharp, metallic objects and not with ball-point pens or pencils either.

Cleaning:

The cleaning of the surface shall occur with a wet, clean, soft cloth and with a glass cleaner. Spray the glass cleaner if possible on the cloth and not directly on the surface.
Rear



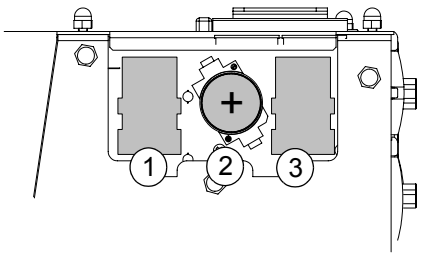
[1] Sticker for position of the Sim cards and of the battery laterally

[2] Operating and display elements

[3] Type plate with order and serial number

[4] Sticker for interface arrangement on the underside

Battery and SIM card holder



[1] SIM0 Storage of machine-firm data and software licensing

[2] Buffer battery for the real time clock and special data (e.g. shot counter).

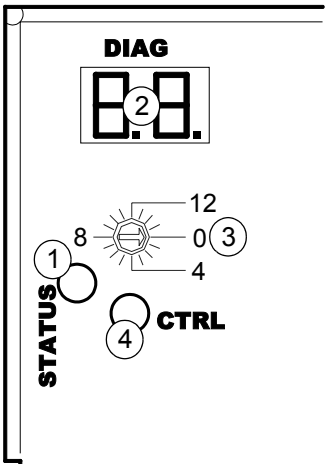
[3] SIM1 KEBA software components

	**”SIM card cannot be read”** **”Shadow date on SIM card not found”** **”Application data on SIM card not found”** **”Component n does not exist -> application data on sim card are not correct ”** **”Machine number not found on SIM card”**
Reason	The SIM card is defective, cannot be read or includes wrong data.
Effect	The watchdog is released [See ’Reset / Watchdog’ on side 59.]
Reset	Control voltage off/on Contact service

	**”Wrong machine number”**
Reason	The SIM card is defective, cannot be read, includes wrong data or a wrong software has been read in.
Effect	The watchdog is released [See ’Reset / Watchdog’ on side 59.]
Reset	Control voltage off/on Contact service

	**”Fast Retain data lost - check battery”**
Reason	The buffer battery is empty.
Effect	Data such as the shot counter actual value can have got lost.
Reset	Until the acknowledgement by the user the automatic mode is blocked. Change the buffer battery [See ’Change battery’ on side 60.]

Operating and display elements



[1] Status LED

[2] 7 Segment display for the running-up-to-speed status

[3] Address switch for the K-Net address

[4] Program loading key

Status display master modules
The three-colored status display is at all control panel computers (OF 4xx) on the device rear side and at all K-Net-Master modules (AF 4xx and CP 4xx) on the module front side.

unlit	internal power supply of the module is missing
yellow	Run-up - initialization phase
flashing green	Module run-up completed, status OK
red	fatal module error - the module is out of order

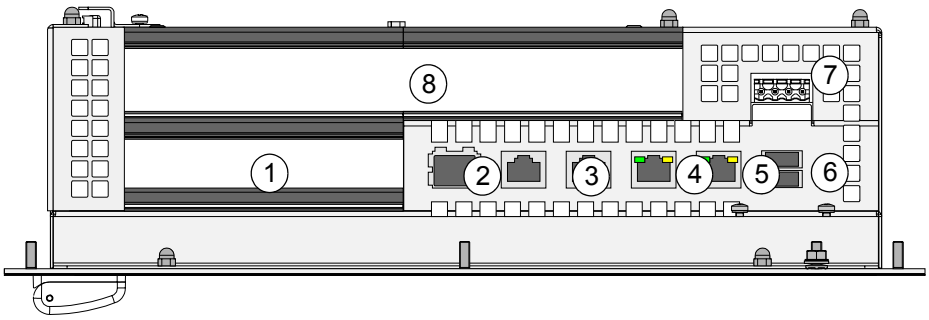
Diagnostics display master modules
The diagnostics display serves the display of the run-up status.

The diagnostics display is at all control panel computers (OF 4xx) on the device rear side and at all K-Net-Master modules (AF 4xx and CP 4xx) on the module front side.



- The first digit indicates in which section of the run-up the OF 45x is.
- The second digit indicates which step is just processed.
- The first decimal point displays whether in the respective mode to the CTRL key a functionality is assigned.

Underside

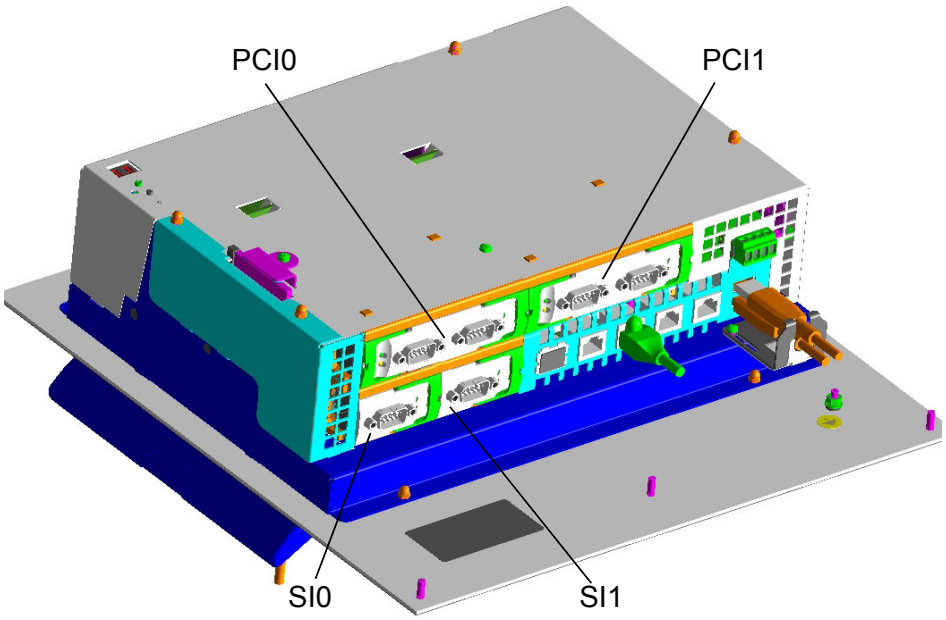


[1] Two slide-in shafts for serial interface modules
[2] Debug interface (diagnostics interface for service)
[3] K-NET interface (not at OF455/D)
[4] Ethernet interface
[5] K-CAN interface
[6] 2 USB interfaces (incl. pull relief)
[7] Contacts for power supply, Digin and Digout (Output for Watchdog relay)
[8] Plug-in chutes for two KEBA-PCI interface modules

Status display interfaces
Also on the RJ45 plugs (interfaces) are two status LEDS each (yellow and green).

green	lights briefly at the reception of data
yellow	lights briefly at the transmission of data

Use of interface modules

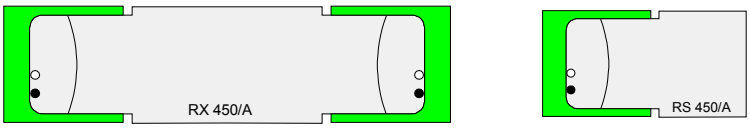


On the underside of the OF 450 there are two compact PCI slots (PCI0 and PCI1) and two slots for the serial interface modules (SI0 and SI1).
On the PCI and the serial slots you can employ modules from the KEMRO-K2 range.

Note!

Provide not used slots always with reactance modules as overheatings of the device can arise due to thermal short circuit.

Reactance modules



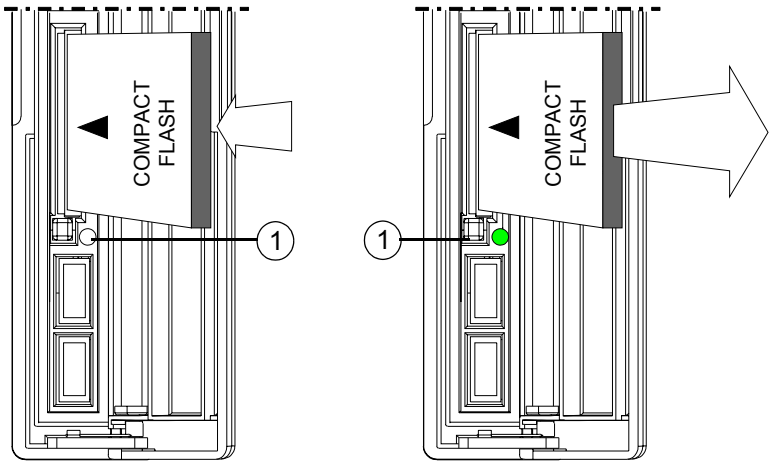
Module mounting:

1. Push the module in the correct position in on the provided position. A guide prevents an inadvertent plug-in in the wrong position.
2. Engage the locking mechanism.
3. Lower the strap.

Module removal:

1. Lift the strap.
2. Loosen the locking
3. Pull the module from the chute.

Insertion/removal of the Compact Flash card on the front side



[1] Drive LED

[2] Ejection key



WARNING!

The Compact Flash card may only be taken out from the plug-in chute when the drive LED does not light. Otherwise there is the danger of data loss.

Insert the Compact Flash card like represented in the drawing below with the arrow ahead. By wrong plug-in contact pins can be damaged.

Measures of precaution when dealing with Compact Flash cards:

- Do NOT introduce the card into the plug-in chute forcibly. It is designed so that it can be introduced into the device only in one direction. The card should glide into the slot easily.
- Keep the card away from humidity, heat and direct sunlight.
- Keep the card away from electrostatic sources or magnetic fields.
- Do not let the card fall and do not bend it.
- Do not remove the card or switch off the device while it writes on the card.

3.1 OPERATION BEHAVIOUR

Run-up of the master modules

During the step-by-step run-up the diagnostics display of all master modules (AF 4xx and CP 4xx) and of the control panel computer (OF 4xx) displays the operating status.

The run-up is divided into:

- BIOS start
- Boot system run-up
- Application run-up

BIOS start:
Depending on the module and hardware equipment the BIOS start varies.
The status of the BIOS start is displayed by means of the letters[n, u, o, r, i, h] (1 digit of the diagnostics display) and numbers[0..8] (2 digits diagnostics display).
If this start phase is not finished, the error elimination can only be carried out by the producer.

Boot system run-up:
Status h0..h9
Here the boot system is loaded, started and afterwards the firmware is loaded and started.
If this start phase is not finished, it is possible to replace the rear Flash by a new one. If also with a new Flash no improvement has been achieved, the problem lies at the control panel computer and the error elimination can only be carried out by the producer.

Application run-up:
Status H0..H8
Here the operating system and the running time systems (SPS, HMI, KEOPS) are started.

If this start phase is not finished or the visualization does not start, the Flash or the software is damaged. Remedy by replacing the Flash or by a new software.

3.2 RESET / WATCHDOG

If the Watchdog of the control panel computer is not serviced within 2 ms (program or communication error), a NMI (Non Maskable Interrupt) is generated. From then for the software 100 ms are available for a data protection.
After these 100 ms the reset becomes active and with it also the DigOut is reset (on the control panel computer) and so the watchdog relay is released.

- Analog outputs (e.g. on the AM 450) are laid on approx. 0 V (max. ±100 mV).
- Digital outputs go on 0.

	**”Watchdog”**
Reason	A fatal program or communication error has appeared
Effect	Opening of the watchdog relay and resetting of the analog and digital outputs
Reset	Control voltage off/on Contact service

3.3 REPAIR AND MAINTENANCE WORK OF THE CONTROL PANEL COMPUTER

At the design of the device special attention has been paid to the easy maintainability. All service work can be executed with a simple standard tool.

Needed mold

- Box wrench with 5.5 mm wrench width
- Screwdriver, Phillips size 1 and 2, magnetic

Required place of work:
ESD-protected place of work with 2 ESD mats (approx. 1 m² work surface for depositing the device parts)



WARNING!

The device may only be opened by instructed qualified personnel and only the maintenance work expressly allowed by KEBA may be done. Other manipulations on the device entail the loss of the guarantee.

Permitted repair and maintenance work

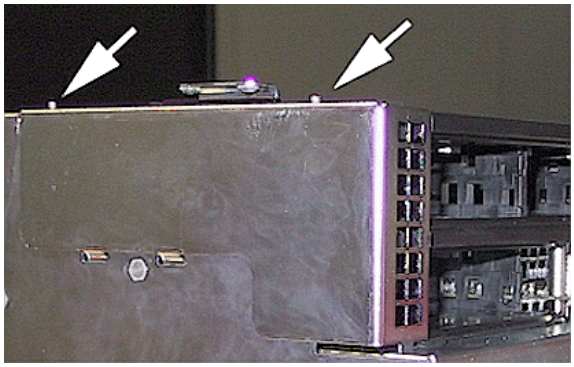
- Insert SIM cards
- Battery change
- Fan change

- Exchange of the total device
- Touch screen change
- Exchange of the display background lighting
- Display change

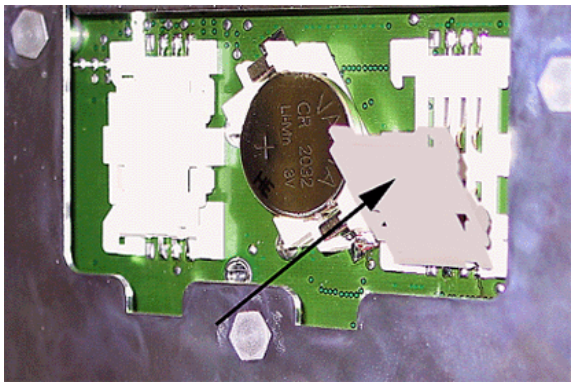
Insert SIM cards

Construction without opening of the device.

1. Remove the service cover by loosening the two nuts (Arrows).



2. Push the flap of the SIM card holder downwards and afterwards to the front. (Arrow)



3. Push in the SIM card.
4. Snap shut the card holder and push it upwards for locking.
5. Put on the service cover and screw it in again.

Change battery

Replace the buffer battery which is on the side of the device only by a battery of the same type. Battery type: CR2032 (Lithium-Mn, 3 V/220 mAh).

1. Remove the service cover. [See 'Insert SIM cards' on side 60.]
2. Loosen the old battery from the upper bracket.
3. Insert the new battery at first on the lower side with plus pole to the outside and press it on lightly above until it engages.
4. Put on the service cover and screw it in again.

Note!

At the disposal of batteries the regulations for special waste must be observed!

WARNING!

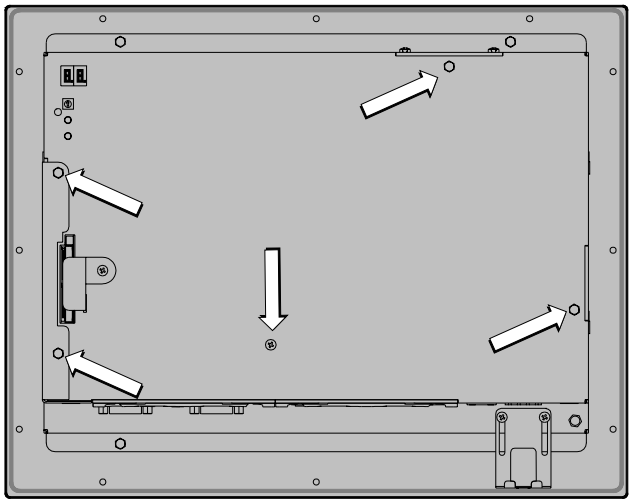
Do not use any force!
There is the danger that otherwise the holder is separated.

Opening the device for the maintenance work:

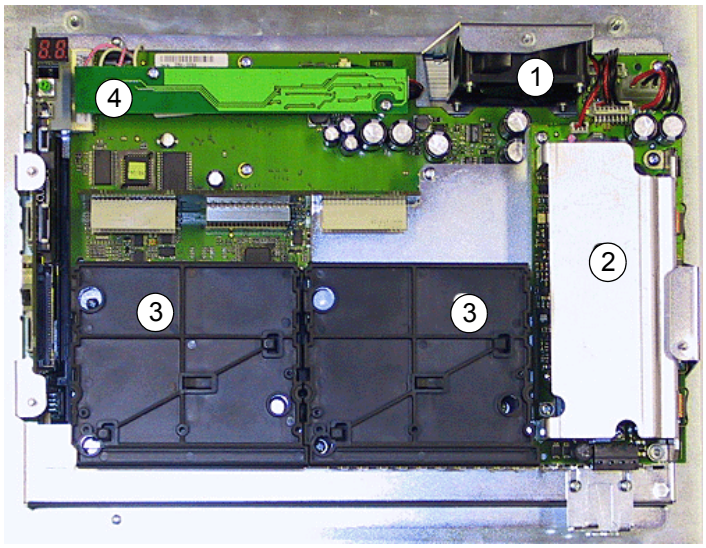
- Change fan
- Change touch panel
- Change display-background lighting

Process:

1. Disconnect all cables before the opening.
2. Remove the chip card and all Compact Flash.
3. Loosen four nuts and a recessed head screw.



4. Remove the service cover and the covering cap.



[1] fan
[2] Power pack
[3] PCI slide-in unit chutes
[4] Backlight converter

Change fan

The employed fans have in case of continuous operation and a temperature of 40°C a statistical life of 70 000 hours (approx. 8 years). The exchange of the fan is problem-free, but must occur in time in order to guarantee the reliability in operation of the control system.

Procedure:

1. Open the device [See 'Opening the device for the maintenance work:' on side 61.]
2. Disconnect the connection plug of the fan.
3. Loosen the four mounting screws of the fan and take it out.
4. Built in the new fan.
5. Connect the connection plug.
6. Assemble the device in the reverse order.

Note!

Observe the installation direction!
The fan must be built in again so that it sucks the air from the housing and blows it to the outside.

	”Warning limit CPU temperature is °C”
Reason	The temperature on the CPU has exceeded 80°C
Effect	Alarm lamp flashes.
Reset	Check and/or exchange ventilator and filter of the control cabinet. Check and/or exchange ventilator of the CPU.

	”CPU temperature is °C -> cycle stop”
Reason	The temperature on the CPU has exceeded 85°C
Effect	At the next cycle the machine stops
Reset	Check and/or exchange ventilator and filter of the control cabinet. Check and/or exchange ventilator of the CPU.

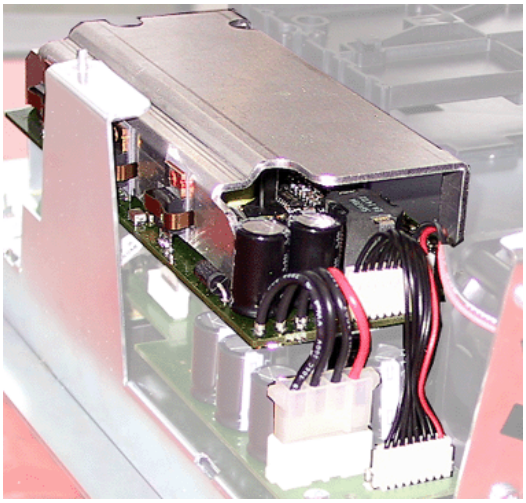
	”CPU temperature too high”
Reason	The temperature on the CPU has exceeded 90°C
Effect	The system switches off.
Reset	Check and/or exchange ventilator and filter of the control cabinet. Check and/or exchange ventilator of the CPU.

Change touch panel

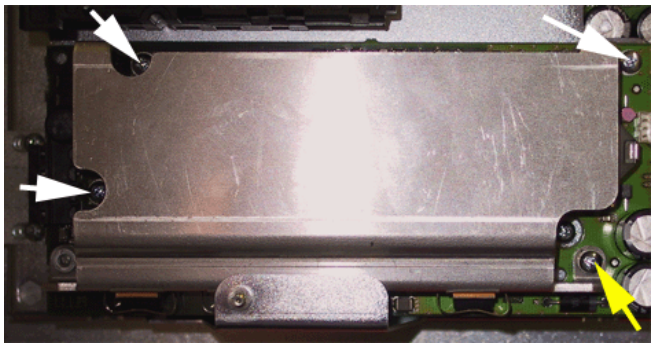
Procedure:

1. Open the device [See 'Opening the device for the maintenance work:' on side 61.]
2. Dismount the power pack

2.1. Disconnect all connection plugs of the power pack.

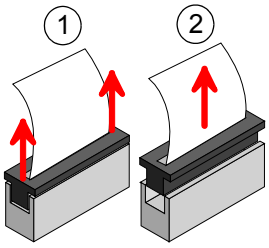


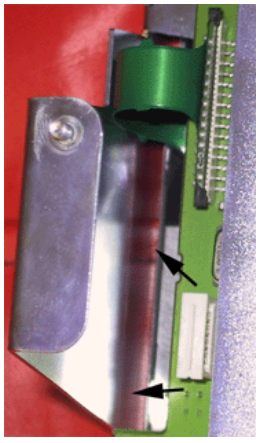
2.2. Loosen the four screws and remove the power pack.



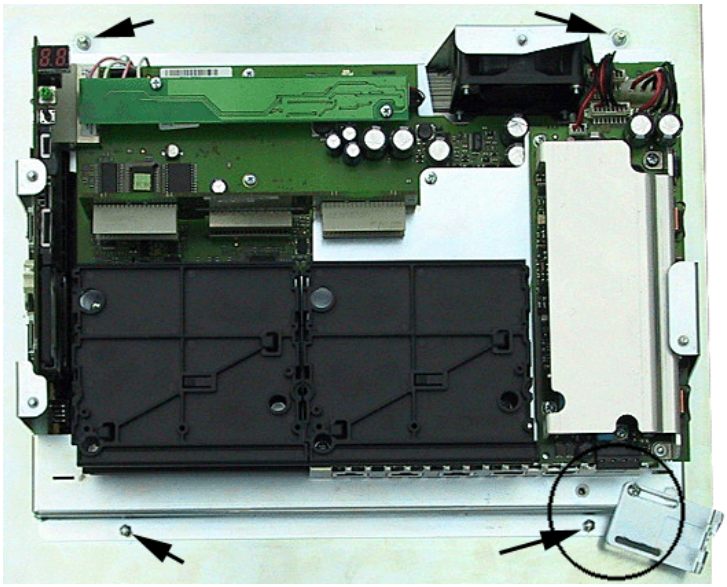
3. Dismount the touch panel.

3.1. Loosen the zero force plug for ribbon cable of the touch panel by pulling up the locking **[1]** and then pull out the ribbon cable vertically **[2]**.





3.2. Loosen the four cap nuts on the housing (Arrows).
For loosening the cap nut, below the pull relief for the USB interface, the pull relief must be swivelled aside by removing a screw (Circuit)

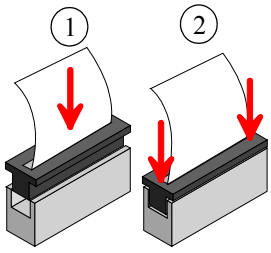


3.3. Lift the electronic part from the touch panel. The touch panel is exchanged as whole unit.

4. Mount the touch panel.

4.1. Thread the ribbon cable through the gap, put the touch panel on the mounting screws.

4.2. Push the ribbon cable into the unlocked zero force plug **[1]** and arrest the locking of the plug by pressing in the collar **[2]**.



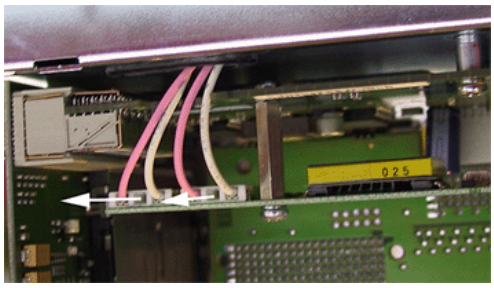
5. Assemble the device in the reverse order.

Change display-background lighting

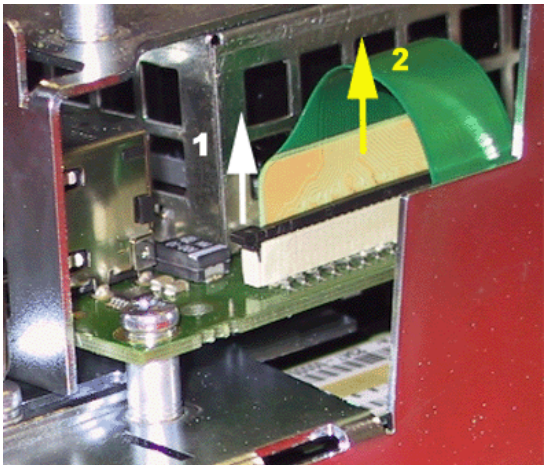
The background lighting has an average life of 50 000 hours (approx. 5.7 years) in case of continuous operation. According to this definition the luminance has fallen to the half. Due to the activated screen saver about the double life of the lighting can be expected.

1. Dismount the touch panel [See 'Change touch panel' on side 64.]

2. Pull the two plugs of the backlight converter (Power supply for the background lighting)



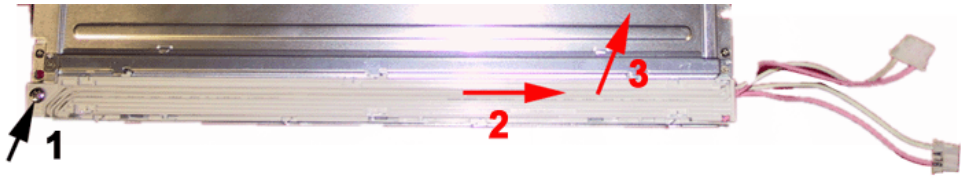
3. Unlock the zero force plug for display-Flexprint **[1]** and pull out the display-Flexprint **[2]**.



4. Loosen the four screws of the display fixing and lift the display.



5. Turn round the display
6. Loosen the mounting screw of the background lighting **[1]**, pull the background lighting somewhat aside **[2]** and swivel this out **[3]**.



7. Exchange the background lighting.
8. Assemble the device in the reverse order.

Exchange of the total device

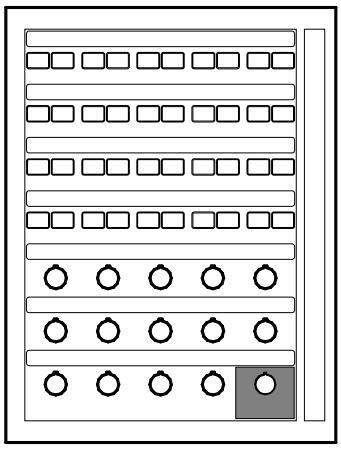
When changing of the whole unit, the following must be observed:

- Take off the SIM cards and the Flash cards from the old device and insert them into the new one. [See 'Insert SIM cards' on side 60.]
- Set the K-Net address.
- Set the IP address (at Ethernet application).

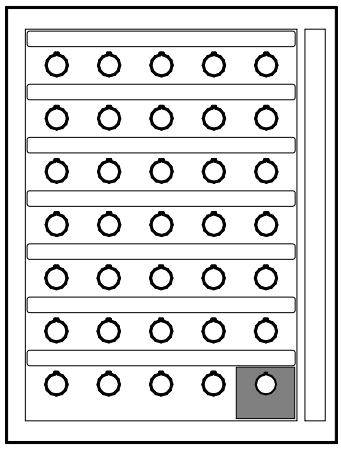
4 OI 450 SWITCH PANEL

The switch panels of the type OI 450 are system components for accommodating touch-sensitive keyboards and/or circuit elements. The components OI 450A/B include evaluation electronics, which is connected to the control panel computer via a K-CAN bus line.

OI 450/A

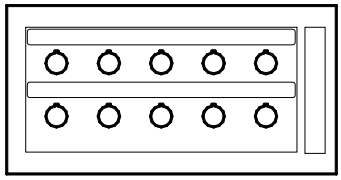


OI 450/B

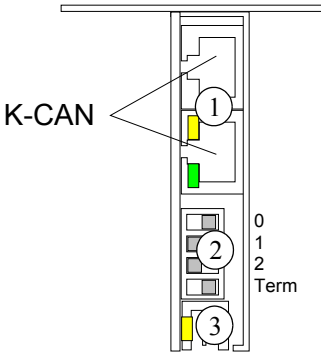


OI 450/C

Additional module without evaluation electronics



Position of the address and bus terminal switch



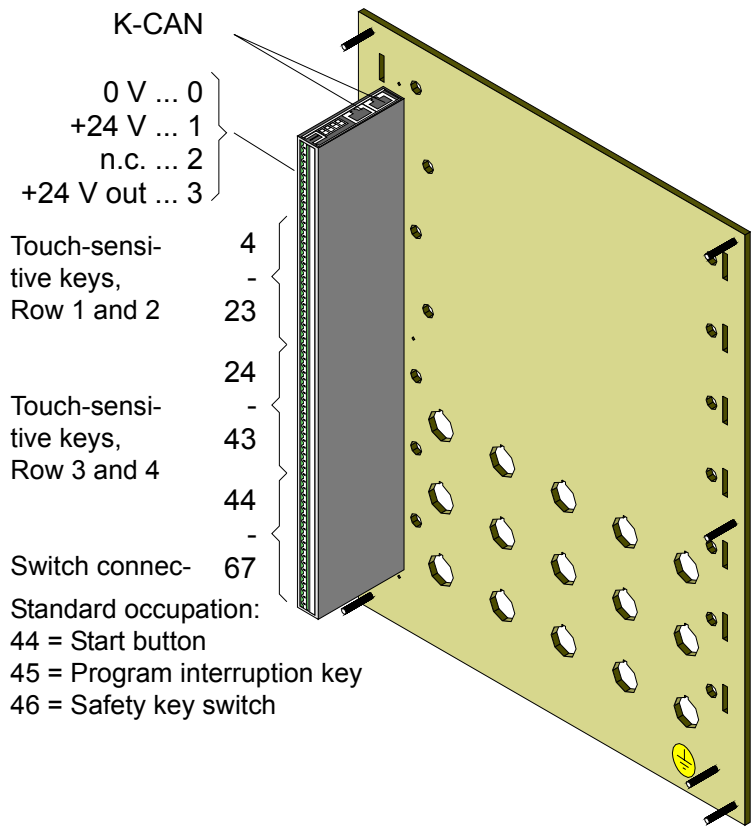
[1] K-CAN connections

[2] binary address switches and bus connection

[3] Status LED

The design allows the exchange of the evaluation electronics without disassembly of the panel.

Connections, wiring

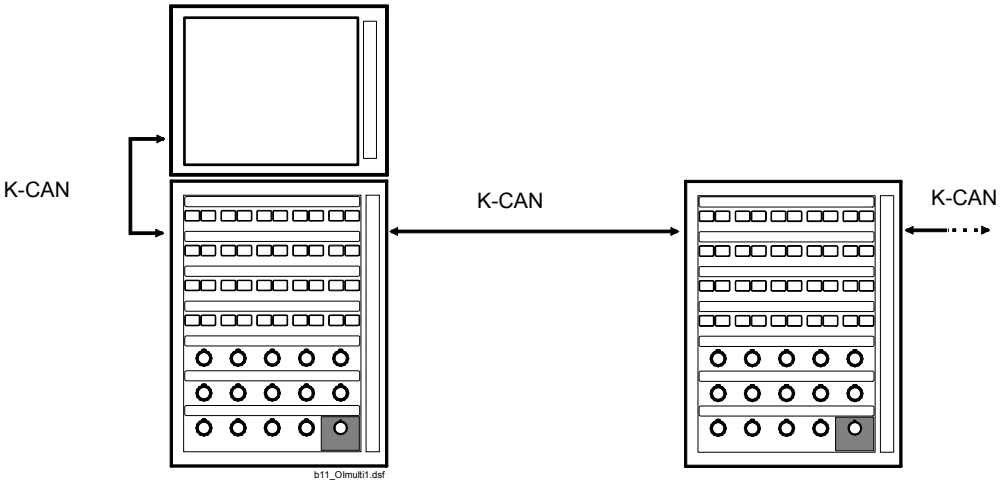


	”OI450 defective %1n %2n %1s”
Reason	In the module an error has appeared To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

4.1 CONTROL KEYS SWITCHOVER

At another switch panel a bus connection (at many pushbuttons) or a wiring of the pusbhuttons on digital inputs can be selected.

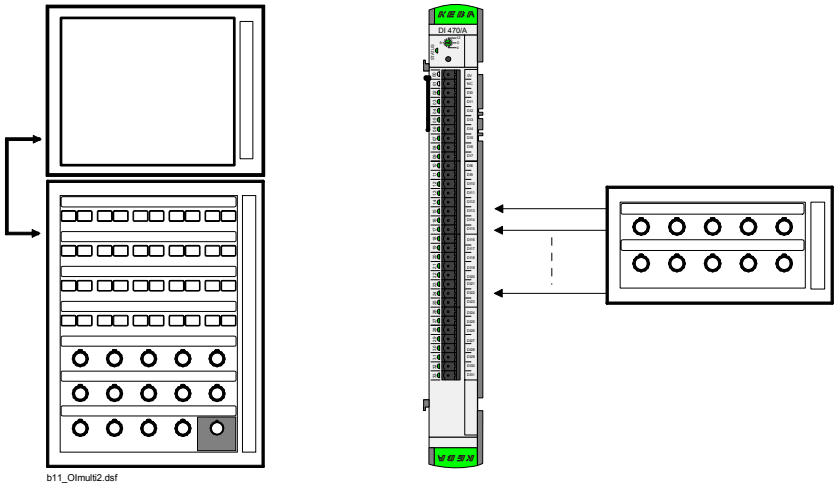
Example with another OI450/A (K-CAN connection)



Main unit with visualization and OI450/A

OI450/A

Example with an OI450/C and digital inputs



Main unit with visualization and OI450/A

DI470/A

OI450/C

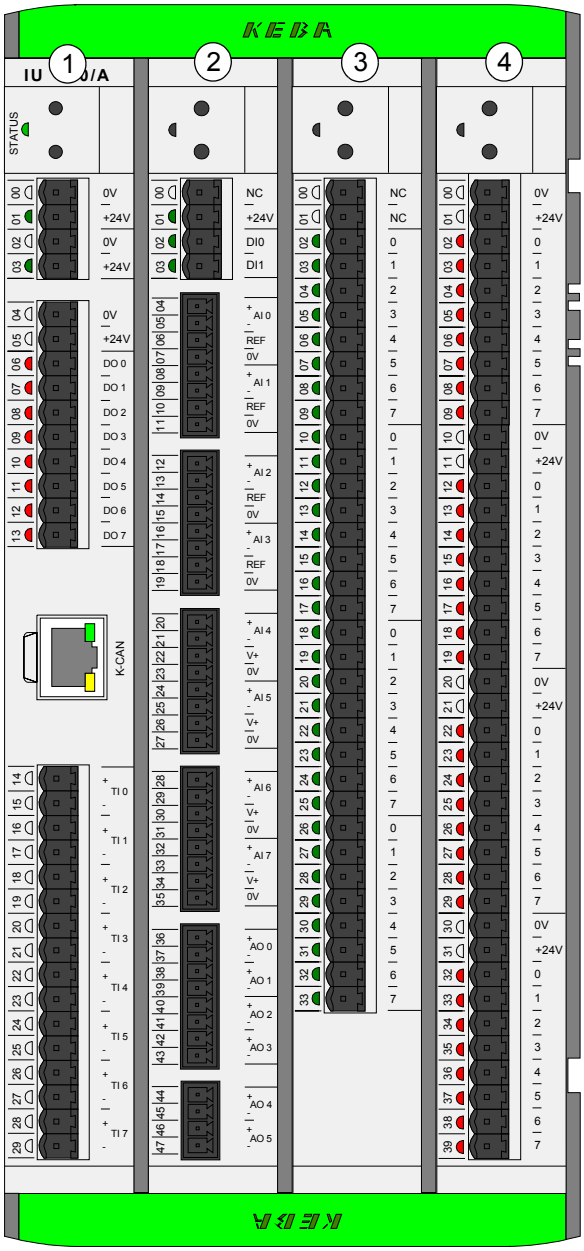
Please take the exact wiring from the electric schematic.

Semi and fully automatic mode

A changeover to another control panel has no impact on the current automatic cycle.

5 COMBINED I/O MODULE IU450/A

The IU 450 is a combined I/O module with the function of individual input/output modules



[1] Temperature module with power supply and K-CAN connection

[2] Analog in/output module

[3] Digital input module

[4] Digital output module

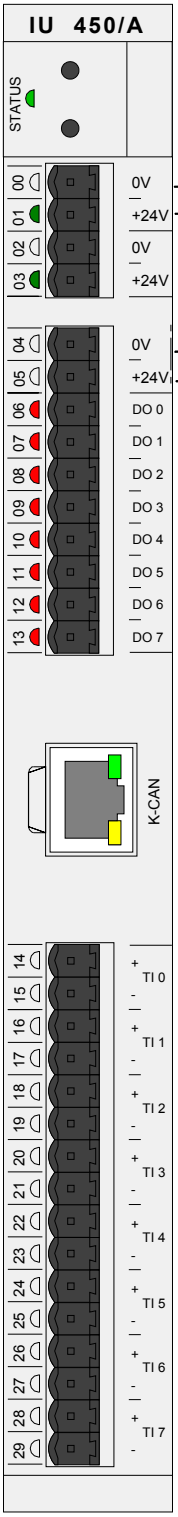
- per system only one IU 450 possible
- no addressing necessary (set fixed)
- Attachment on the back via two parallel mounting rails

	**”IU450 defective %1n %2n %1s”**
Reason	In the module an error has appeared To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

5.1 TEMPERATURE MODULE

The temperature module serves to measure and actuate heating and cooling circuits such as cylinder heaters, mold heatings, oil cooling, feed throat cooling etc.

Cutout from IU 450



- 8 pulse-width modulated, digital outputs
- Nominal current 1A, nominal voltage 24V DC
- Switching state display by red LEDs
- Overload-proof
  - individual outputs are switched off
  - Resetting by switching the control voltage off/ on

+24VC
0V

Occupation example, for the actual occupation see the electric

0V
+24VC
Hydraulic oil cooling
Barrel heating 1
Barrel heating 2
Barrel heating 3
Barrel heating 4
Barrel heating 5
Reserve
Feed throat cooling

Electric K-CAN connection.

Hydraulic oil temperature
Barrel heating 1
Barrel heating 2
Barrel heating 3
Barrel heating 4
Barrel heating 5
Reserve
Feed throat cooling

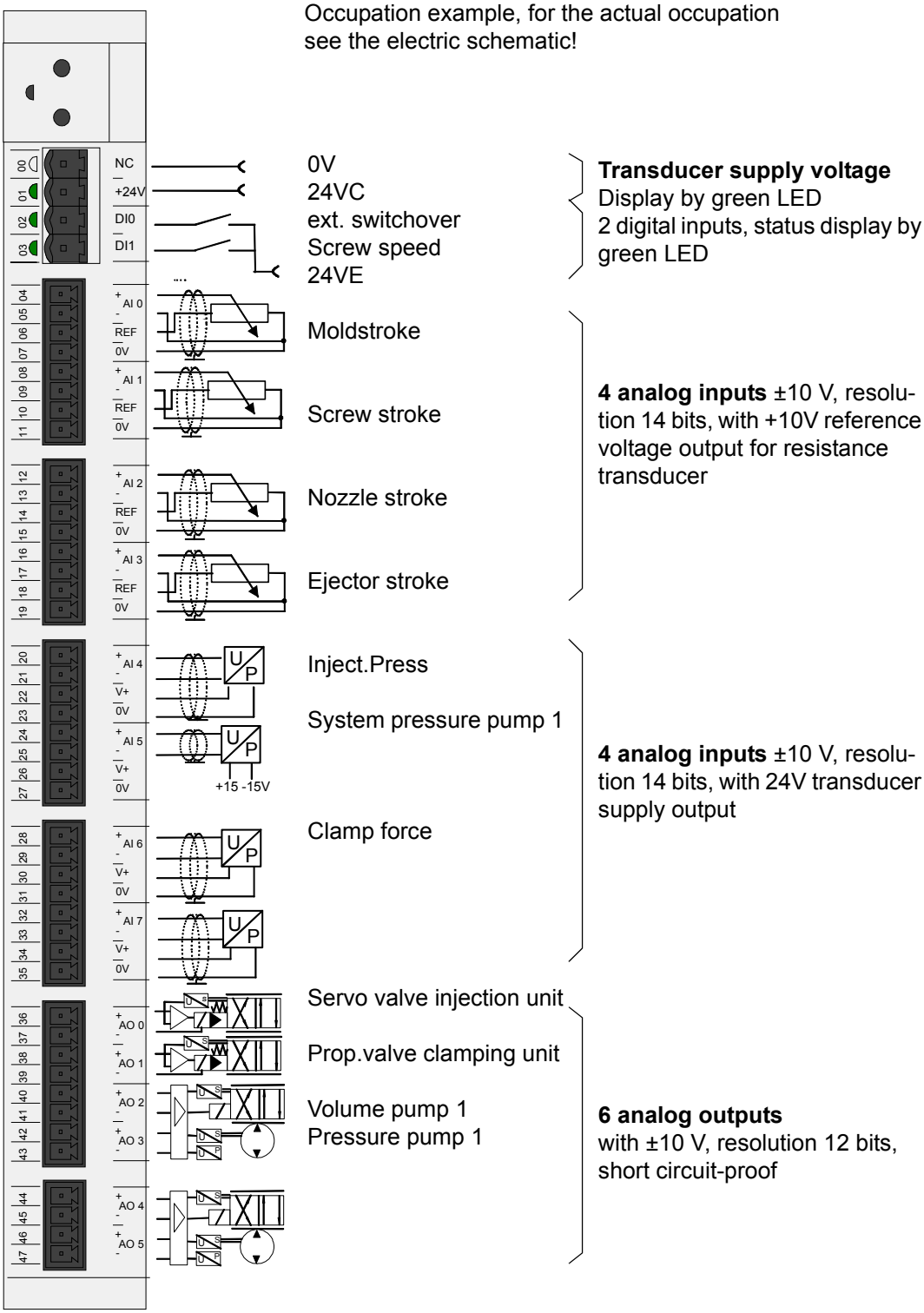
- 8 physically separated thermoelement inputs

[See message:"'Heating output of the zone x is defective" "Cooling output of the zone x is defective"']
[See message:"'Heating x zone x defective"']
[See message:"'Couple break x in group x zone x Emergency service - couple break x in group x zone x"']

5.2 ANALOG IN/OUTPUT MODULE

The input/output module serves to measure and/or to control speeds, pressures, forces and positions of the machine.

Cutout from IU 450

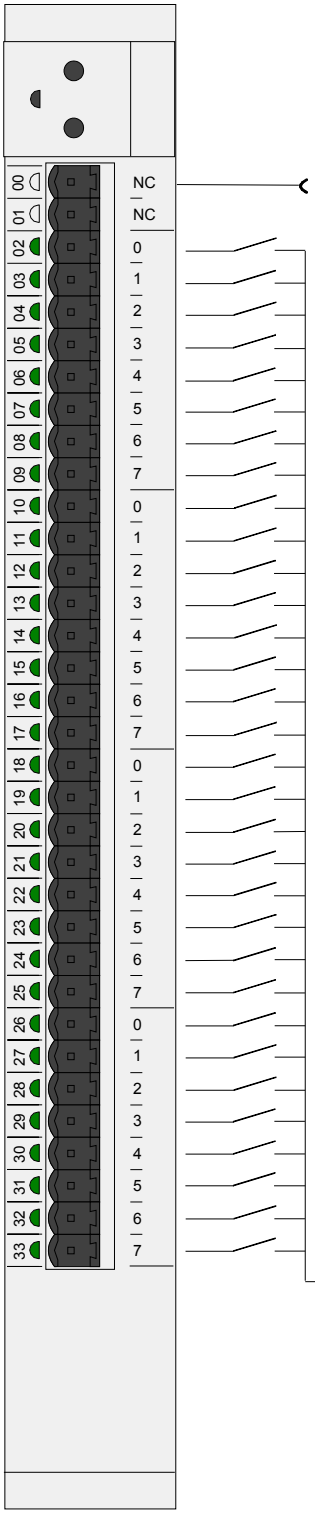


Defect of inputs and/or outputs [See message:"'Analog output for x defective" "Analog input x defective (user protocol)"']

5.3 DIGITAL INPUT MODULE

The digital input module serves to read in the digital signals of sensors, initiators, switches, buttons, relay contacts.

Cutout from IU 450



Occupation example, for the actual occupation see the electric schematic!
Meaning when signal carries + 24V,

0 V, reference potential for the digital inputs

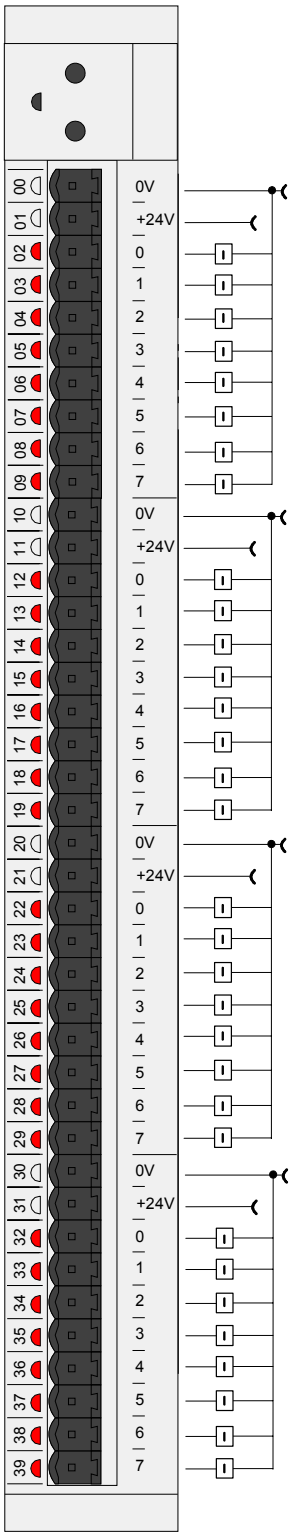
EMERGENCY STOP circuit ok
Safety gate 1 closed
Safety valve 1 safety cover open
Nozzle protection closed (1)
Core-pull 1 moved out
Core-pull 1 moved in
Core-pull 2 moved out
Core-pull 2 moved in
Core-pull safety 1
Charge amplifier 1, rejects message (1)
Ejection safety 1
Motor 1 runs on delta
Throttle valve (1)
Oil filter 1 (1)
Injection unit turn in (1)
Barrel heatings on (1)
Mold heating on
Safety gate 1 open
Safety valve 1 safety cover closed
Nozzle guard open (1)
Oil level
Core-pull safety 2
Monitoring filter motor
Release mold closing 1
High pressure build-up suppression 1
Safety gate 1 open (Closing safety)
Mold dismounted 1 moving platen
Mold dismounted 1 stationary platen
Mold mounted 1 moving platen
Control card EHV pump 1 ok (1)
Control card EHV pump 2 ok (1)
Mold mounted 1 stationary platen
+24VE

- 32 potential-free inputs with common ground potential
- Switching state display by green LEDs
- Voltage range for logic „1”: 15 up to 30 V

5.4 DIGITAL OUTPUT MODULE

The digital output module serves to actuate automation components such as contactors, solenoid valves, relays.

Cutout from IU 450



Occupation example, for the actual occupation see the electri

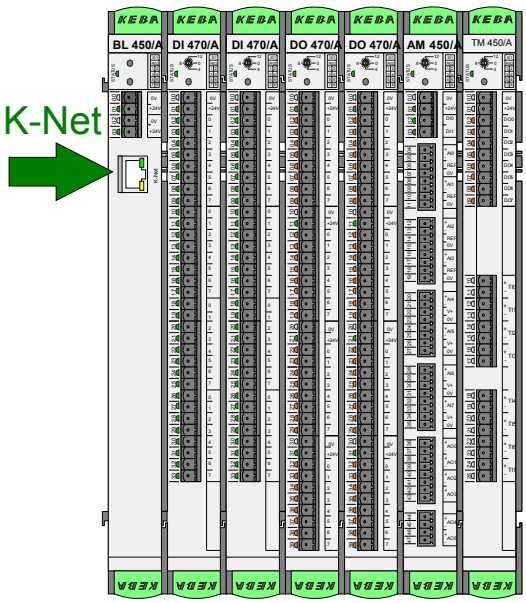
- 32 potential-free outputs (4 groups to each 8)
- Nominal voltage 24V DC,
  Nominal current group 1-3 2A group 4 1A
- Switching state display by red LEDs

0V
+24VK1S
Mold closing
Mold opening
Plasticizing (1)
Injection (1)
Advance nozzle (1)
Motor start impulse
Advance ejector 1
Return ejector 1
0V
+24VK1
Return nozzle (1)
Pump 1
Pump 2
Reject 1
Signal release motor
Injection rapid
Screw retraction (1)
Contact pressure reduction (1)
0V
+24VKS
Clamping pressure reduction 1
Safety solenoid 1 (closing safety)
Clamping high pressure
Suction valve opening
Open shut-off nozzle 1
Air valve 1 on
Open shut-off nozzle 2
Differential solenoid clamping unit
0V
+24VKN
Signal manual mode 1
Signal (semi) automatic mode 1
Signal release heatings (1)
Alarm lamp 1
Signal mold open 1
Signal Ejector 1 rear
Signal Ejector 1 in front
Signal Mold closed 1

Short circuit recognition

- concerned output is switched off
- [See message:"'Short circuit %1n %2n %1s"']

6 MODULE STACK CONNECTED VIA THE K-NET

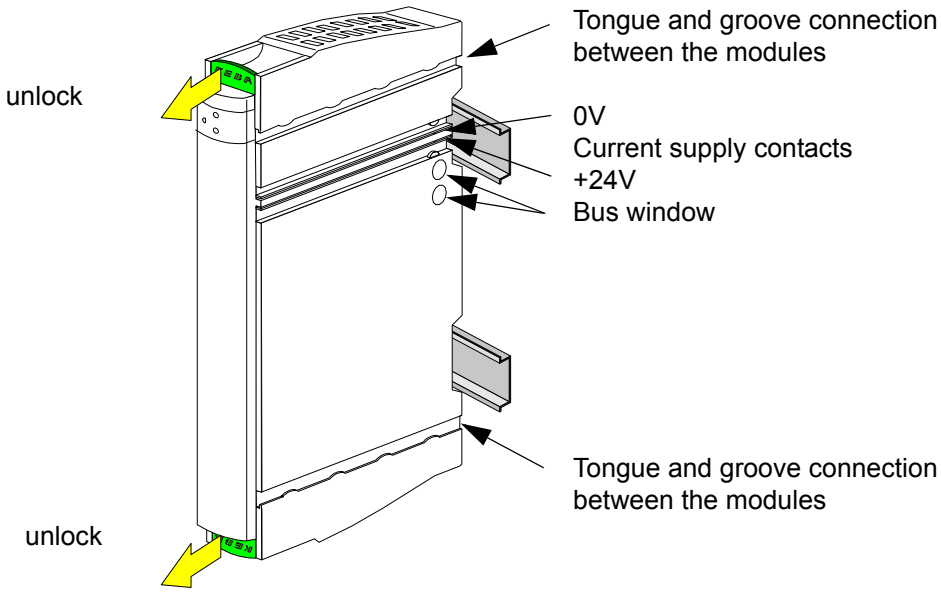


Survey: Modules

AF 455/A	Analog control module
AM 450/B	Analog in/output module
BL 450/A	Bus coupling module (K-Net connection to the right)
DI 470/A	Digital input module
DO 470/A	Digital output module
TM 450/A	Temperature measuring and output module with 8 thermo-couple inputs and 8 digital outputs

Arrangement of the modules

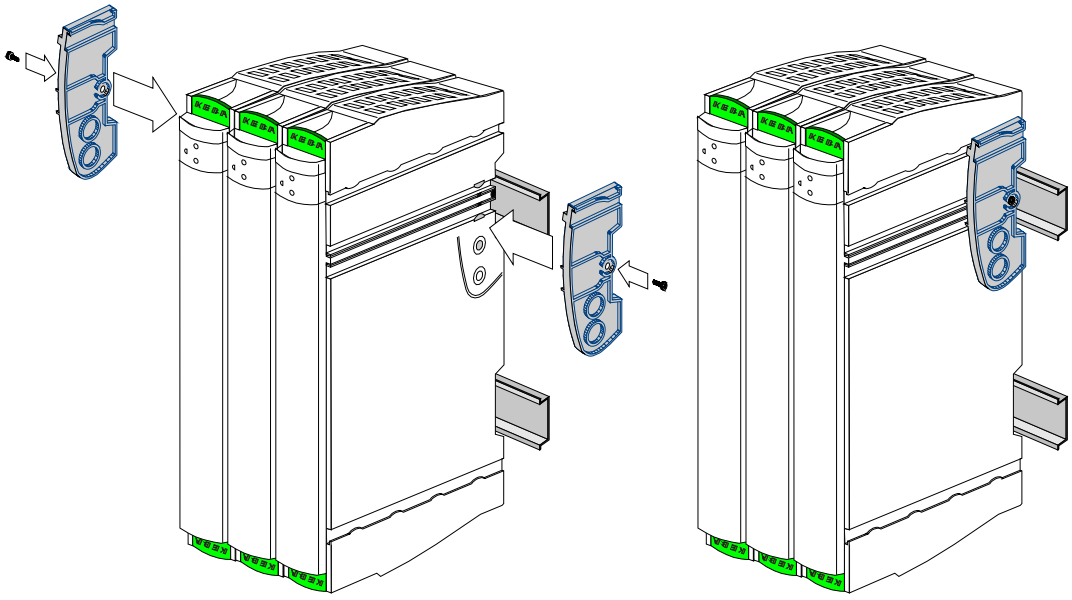
- in optional order next to one another
- Attachment on the back via two parallel mounting rails
- corresponding side guides via tongue and groove connections
- side contacts for the power supply
- side optical bus window for data transmission



Note!

Pay attention during assembly of the modules so that they are completely engaged onto the top hat rail and in the guide of the next module.
The guides must be slid into the guide slots of the neighbouring module in order that the side mounted power supply contacts and the transmission/reception windows of the K-Net are positioned correctly.

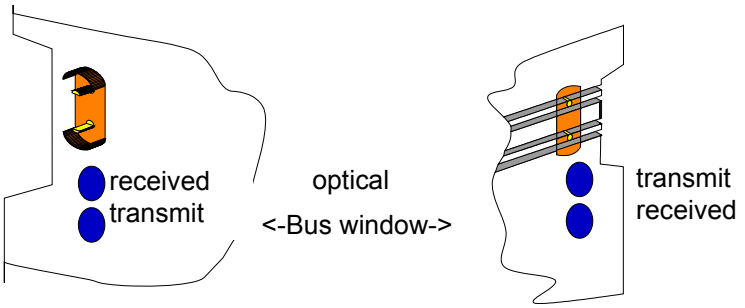
End plates fastening
For the protection of the supply contacts and of the optical bus interface on the extreme left and extreme right module end plates must be fastened. The fastening occurs with the screws enclosed in the end plates set.



K-NET

The K-NET is a serial bus for the transmission of data between the modules

- electric connection between control panel computer and I/O groups
- optical signal transmission between adjoining modules of a stack



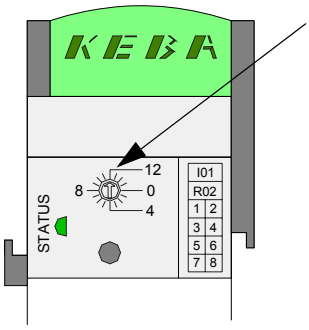
Module view from the left Module view from the right

WARNING!

In order to avoid cloudiness of the bus windows:
á do not clean with acetone or similar.
not come into contact with carbonated liquids, organic greases and oils (e.g. rape oil).
á do not subject to intensive UV radiation over a longer period of time.

Setting of the module address

Addressing of the modules in the system via an address switch with 16 positions. With it a maximum of 16 modules of the same kind can be within one bus circuit. The address switch is on the module front



Address switch
Address switch positions within one bus circuit must only exist once for modules of the same kind. Different modules (e.g. DI 470 and DO 470) may show the same address switch positions

Example for addressings:
DI470 cards 1-16 / addresses 0-15
DO470 cards 1-16 / addresses 0-15
TM450 cards 1-16 / addresses 0-15
AF455 cards 1-7 / addresses 1-7 attention: Address 0 is assigned for the control panel computer!
AM450 cards 1-8 / addresses 8-15 attention: Addressing begins at 8!

When of a card type more than shown above is used in construction, another PCI lane must be used.

	**”Address switch of two cards equal to %1n Nr.%2n %1s”**
Reason	Two cards of the same type have been provided with the same address. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the defective device.
Effect	The control unit does not run up completely.
Reset	Change address of a card Control voltage off/on Contact service

Status display slave modules
The operating state of a slave module (AM 4xx, DI 4xx, DO 4xx, TM 4xx) is displayed on the multi-colored LED on the front panel (inscription STATUS).
Exceptions: BL 450, PI 450 and slide-in modules.

unlit	internal power supply of the module is missing
flashing green	Initialization phase of the K-Net
green	operation
yellow	No K-Net connection
flashing red	Module error (such as overload, line interruption,...)
red	fatal module error - the module is out of order

Run-up of the slave modules

Order of the run-up phase of all slave modules:

- Initialization (Status led lights yellow)
- Communication is built up (Status led flashes green)
- Run-up-to-speed compl.:
  - without error (status led lights green) -> ready for operation
  - with error (status led lights red) -> reset is released by Watchdog

6.1 POWER SUPPLY AND BUS COUPLE MODULES

The bus couple modules serve besides the conversion of the electric K-Net data transfer to the optical bus also for feeding the power supply. The 24V DC operating voltage is led on via contacts from module to module.

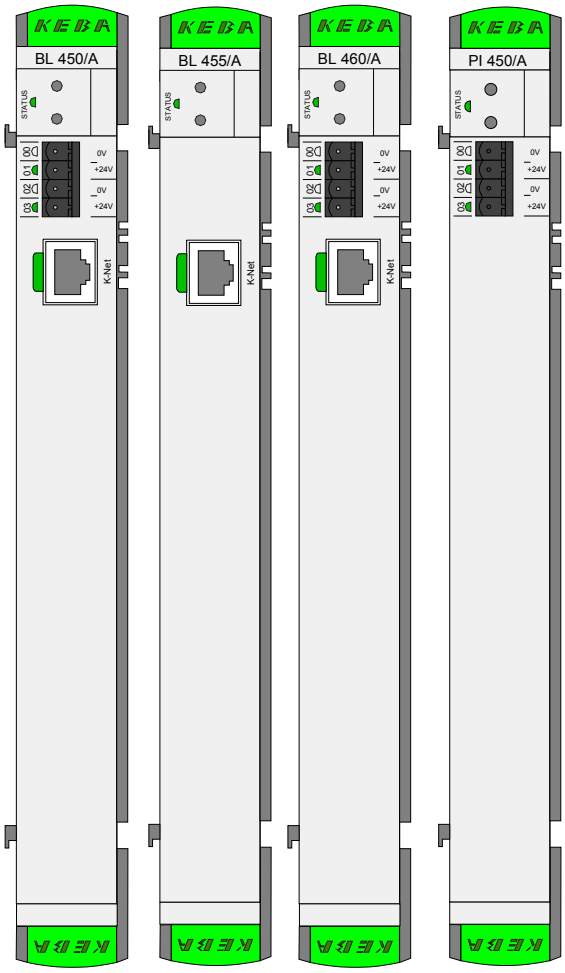
The bus couple and feeding modules are delivered in different variants.

BL 450: Optical K-Net interface to the right
The BL 450 is used for feeding the power supply and for coupling in the optical K-Net without repeater function. (max. line length of the K-Net cable: 30 m)

BL 460: Optical K-Net interface to the right
The BL 460 is used for feeding the power supply and for coupling in the optical K-Net with repeater function. (max. line length of the K-Net cable: 50 m)

BL 455: Optical K-Net interface to the left
The BL 455 is used for coupling out the optical K-Net with repeater function (see the following figure.)
This module has no voltage feeding

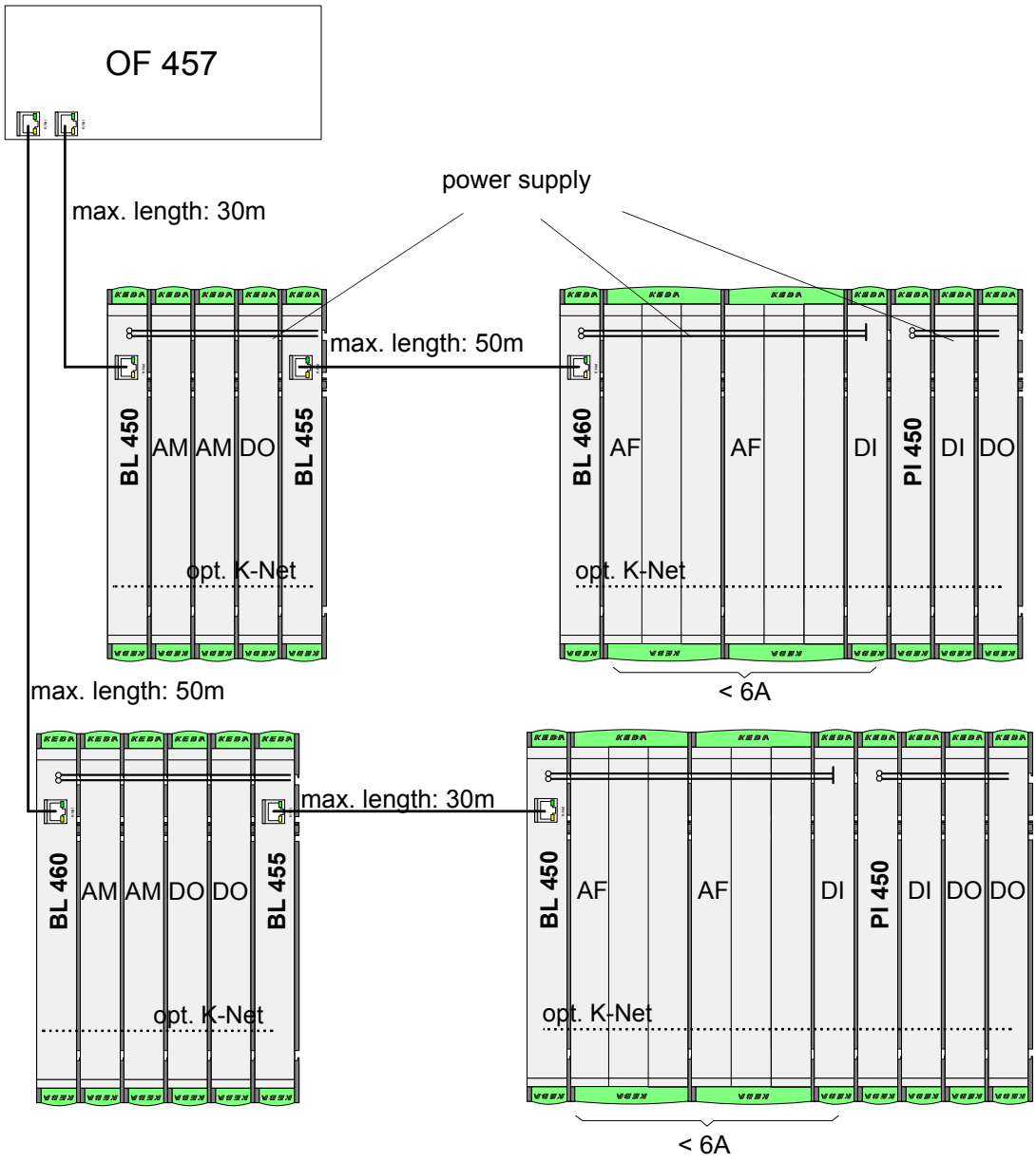
PI 450: Feeding module, K-Net is looped through passively.
Use: When the sum current of all modules exceeds the maximum limit of 6A.



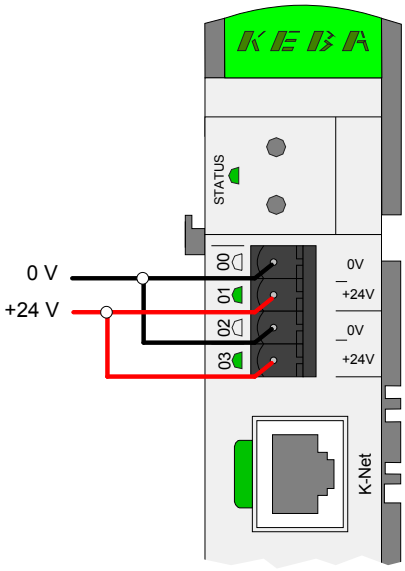
power supply

electric K-Net connection

Application example:



Connections:



Always connect both terminals in parallel.
When using only one pair of terminals a thermal overload of the contacts can arise.

Status display BL450 / BL460 / PI450:

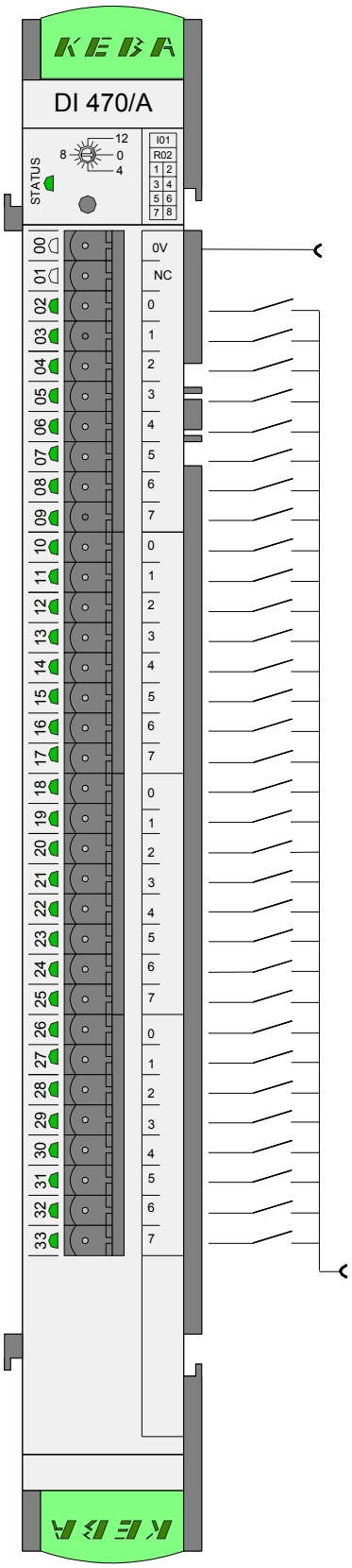
unlit:	Module not supplied
red:	Voltage on the bus smaller than 17.5V
orange:	Voltage on the bus between 17.5V and 18V
green:	Voltage on the bus bigger than 18V

Status display BL455:

unlit:	Module not supplied
green:	Voltage on the bus bigger than 18V

6.2 DIGITAL INPUT MODULE DI470/A

The module DI470 reads the digital signals of sensors, initiators, switches, buttons and relay contacts.



- 32 potential-free inputs with common ground potential
- Switching state display by green LEDs
- Voltage range for logic „1”: 15 up to 30 V

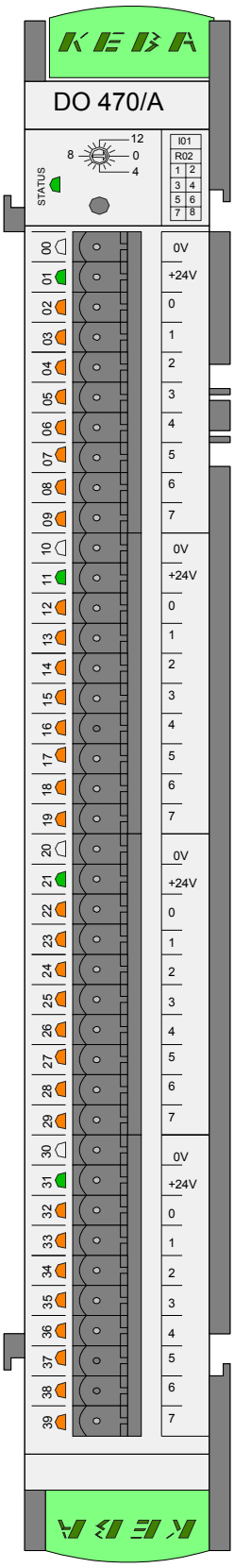
Occupation example, for the actual occupation see the electric schematic!
Meaning when signal carries + 24V,

0 V, reference potential for the digital inputs

EMERGENCY STOP circuit ok
Safety gate 1 closed
Safety valve 1 safety cover open
Nozzle protection closed (1)
Core-pull 1 moved out
Core-pull 1 moved in
Core-pull 2 moved out
Core-pull 2 moved in
Core-pull safety 1
Charge amplifier 1, rejects message (1)
Ejection safety 1
Motor 1 runs on delta
Throttle valve (1)
Oil filter 1 (1)
Injection unit turn in (1)
Barrel heatings on (1)
Mold heating on
Safety gate 1 open
Safety valve 1 safety cover closed
Nozzle guard open (1)
Oil level
Core-pull safety 2
Monitoring filter motor
Release mold closing 1
High pressure build-up suppression 1
Safety gate 1 open (Closing safety)
Mold dismounted 1 moving platen
Mold dismounted 1 stationary platen
Mold mounted 1 moving platen
Control card EHV pump 1 ok (1)
Control card EHV pump 2 ok (1)
Mold mounted 1 stationary platen
+24VE

6.3 DIGITAL OUTPUT MODULE DO470/A

The module DO 470 actuates automation components, such as contactors, solenoid valves, relays.



- 32 potential-free outputs (4 groups to each 8)
- Nominal current 2A, nominal voltage 24V DC
- Switching state display by red LEDs

Occupation example, for the actual occupation see the electric schematic!
Meaning when signal carries + 24V

0V
+24VK1S
Mold closing
Mold opening
Plasticizing (1)
Injection (1)
Advance nozzle (1)
Motor start impulse
Advance ejector 1
Return ejector 1
0V
+24VK1
Return nozzle (1)
Pump 1
Pump 2
Reject 1
Signal release motor
Injection rapid
Screw retraction (1)
Contact pressure reduction (1)
0V
+24VKN
Signal manual mode 1
Signal (semi) automatic mode 1
Signal release heatings (1)
Alarm lamp 1
Watch-Dog
Signal Ejector 1 rear
Signal Ejector 1 in front
Signal Mold closed 1
0V
+24VKS
Clamping pressure reduction 1
Safety solenoid 1 (closing safety)
Clamping high pressure
Suction valve opening
Open shut-off nozzle 1
Air valve 1 on
Open shut-off nozzle 2
Differential solenoid clamping unit

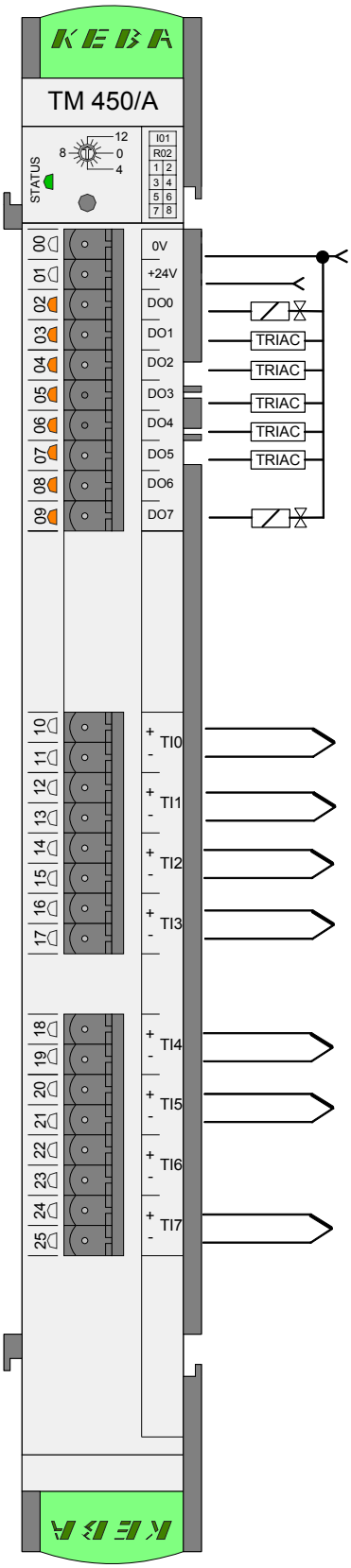
Short circuit recognition

- concerned output is switched off
- Error message on the screen

	**”Short circuit %1n %2n %1s”**
Reason	A short circuit has appeared. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand, which indicates the exact place of the short circuit.
Effect	The short circuit zone(s) is (are) switched off immediately. The motor switches off delayed, the alarm lamp lights. The machine stops immediately
Reset	Examine connections between card(s). The cards themselves are sustained short circuit-proof and need only be exchanged if there’s any doubt.

6.4 TEMPERATURE MEASURING AND OUTPUT MODULE TM450/A

The module TM 450 measures and actuates the heating and cooling circuits, such as barrel heating, mold heating, oil cooling, feed throat cooling etc.



- 8 pulse-width modulated, digital outputs
- Nominal current 1A, nominal voltage 24V DC
- Switching state display by red LEDs
- Overload-proof *)

Occupation example, for the actual occupation see the electric s

0V
+24VC
Hydraulic oil cooling
Barrel heating 1
Barrel heating 2
Barrel heating 3
Barrel heating 4
Barrel heating 5
Reserve
Feed throat cooling

- 8 physically separated thermoelement inputs
- Thermocouple break monitoring:
  - Error message on the screen

Hydraulic oil temperature
Barrel heating 1
Barrel heating 2
Barrel heating 3
Barrel heating 4
Barrel heating 5
Reserve
Feed throat cooling

*)

- individual outputs are switched off
- Error message on the screen
- Resetting by switching the control voltage off/on

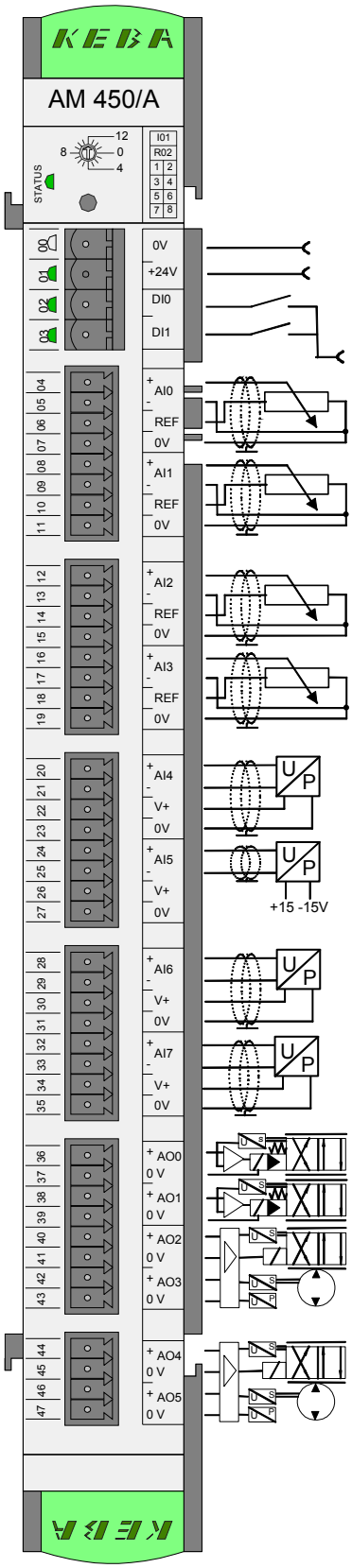
	**”Heating output of the zone x is defective” ”Cooling output of the zone x is defective”**
Reason	On digital outputs of a temperature card too high current has been measured --> short circuit possible. The concerned zone(s) is (are) shown via the display field(s).
Effect	The short circuit zones are switched off immediately, the remaining ones are lowered delayed, the motor switches off delayed, the alarm lamp lights.
Reset	Examine connections between temperature card(s) and triac(s). The cards themselves are sustained short circuit-proof and need here only be exchanged if there’s any doubt.

	**”Heating x zone x defective”**
Reason	It occurs no temperature increase despite actuation of a heating zone. This error case is recognized by examining a temperature difference of 2 degrees centigrade over an adjustable space of time. With switching off the cylinder heating switch on the control panel this message is suppressed.
Effect	Current cycle finished, no new cycle start possible, alarm lamp set, motor switches off delayed, heatings switch off immediately (HZA de-energizes).
Reset	Check fuses, heater bands, connections and triacs.

	**”Couple break x in group x zone x Emergency service - couple break x in group x zone x”**
Reason	A thermocouple is defective or the connection of a thermocouple to the temperature card is interrupted.
Effect	Without program ’Emergency service’: The machine finishes the cycle and stops then. The alarm lamp flashes, the motor switches off delayed, the heatings switch off immediately. With program ’Emergency service’: The machine continues to run with the heating capacity (actuator operation) with which the zone controller has worked before the thermocouple break.
Reset	Check thermocouples, thermolines and contact points.

6.5 ANALOG IN/OUTPUT MODULE AM450/B

The module AM 450 measures and/or controls the of speeds, pressures, forces and positions of the machine.



Occupation example, for the actual occupation see the electric schematic!

In case of a break of an analog transducer error message on the screen

0V
24VC
ext. switchover
Screw speed
24VE

Transducer supply voltage
Display by green LED
2 digital inputs, status display by green LED

Moldstroke

Screw stroke

Nozzle stroke

Ejector stroke

4 analog inputs ±10 V, resolution 14 bits, with +10V reference voltage output for resistance transducer

Inject.Press

System pressure pump 1

Clamp force

4 analog inputs ±10 V, resolution 14 bits, with 24V transducer supply output

Servo valve injection unit

Prop.valve clamping unit

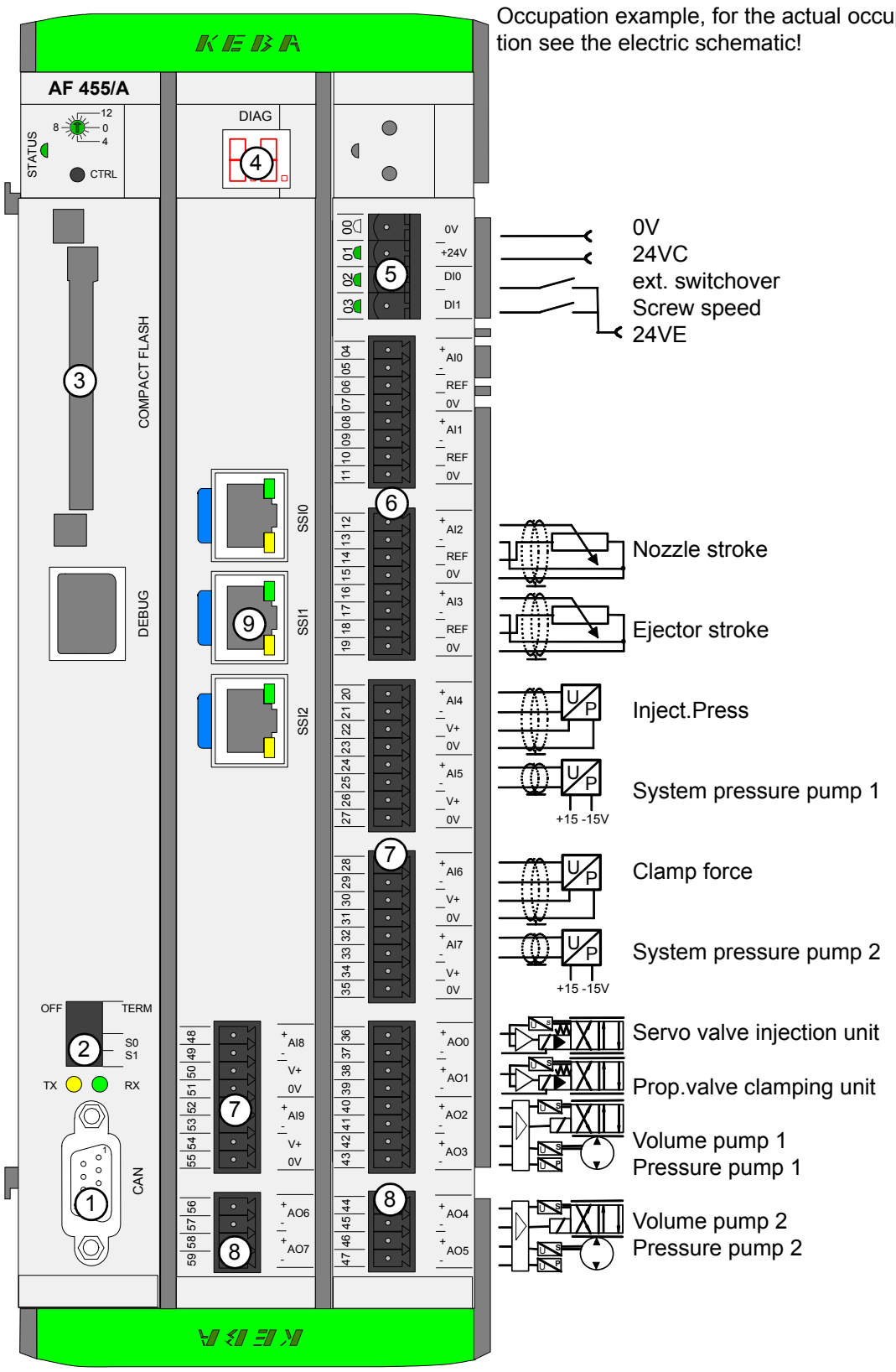
Volume pump 1
Pressure pump 1

6 analog outputs
with ±10 V, resolution 12 bits, short circuit-proof

	**”Analog output for x defective”** **”Analog input x defective (user protocol)”**
Reason	An analog input and/or output is defective. The error text can change a bit by a more exact specification.
Effect	The machine is not capable to run.
Reset	Check module Exchange module Contact service

6.6 ANALOG IN/OUTPUT MODULE AF455/A

The module AF455 serves to measure and/or control speeds, pressures, forces and positions of the machine.



[1] CAN interface

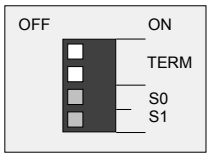
[2] CAN bus terminal
[3] Compact Flash Slot
[4] Diagnostics display
[5] Transducer supply voltage and 2 digital inputs
[6] 4 analog inputs ±10 V, resolution 14 bits, with +10V reference voltage output for resistor transducer
[7] 6 analog inputs ±10 V, resolution 14 bits, with 24V transducer supply output for pressure transducer
[8] 8 analog outputs with ±10 V, resolution 12 bits, short circuit-proof
[9] 3 SSI interfaces for Si010

Defect of inputs and/or outputs [See message:"'Analog output for x defective" "Analog input x defective (user protocol)"']

	**"AF455 defective %1n %2n %1s"**
Reason	In the module an error has appeared To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

6.6.1 CAN BUS TERMINAL

The DIP switch for activating the bus terminal (Term) is on the module in front above the CAN interface.



The switches S0 and S1 do not have any function.

Note!

Always both TERM switches must be in the same position.
A different switch position yields an unallowed termination and the communication does not function.

6.6.2 STATUS DISPLAYS

On the module are several status displays

2 green LEDs for the signal state display on the digital inputs
lighting at 24V input signal

1 multi-colored LED for the status display (Module status led)
[See 'Status display master modules' on side 55.]

CAN-Bus status LEDs

- TX: yellow LED -> lights, at the transmission of data
- RX: green LED -> lights, at the reception of data

SSI Status LEDs

- green: Supply for transducer is applied on the plug
- yellow: Data are received

Diagnostics display
The diagnostics serves to display the running-up-to-speed status.

6.6.3 COMPACT FLASH

For the operation of the AF 455 a Compact Flash card with the system software and the application must be inserted in the Compact Flash.

Taking out of the CF card

1. Remove the screws of the metal guard bow.
2. Take off the metal guard bow.
3. Remove the Compact Flash card.

Insertion of the CF card

1. Insert the Compact Flash card.
2. Attach the metal protection strap again.
3. Mount the screws of the metal protection strap.

Measures of precaution when dealing with Compact Flash cards:

- Do NOT introduce the card into the plug-in chute forcibly. It is designed so that it can be introduced into the device only in one direction. The card should glide into the slot easily.
- Keep the card away from humidity, heat and direct sunlight.
- Keep the card away from electrostatic sources or magnetic fields.
- Do not let the card fall and do not bend it.
- Do not remove the card or switch off the device while it writes on the card.

6.6.4 MAINTENANCE HINTS

WARNING!

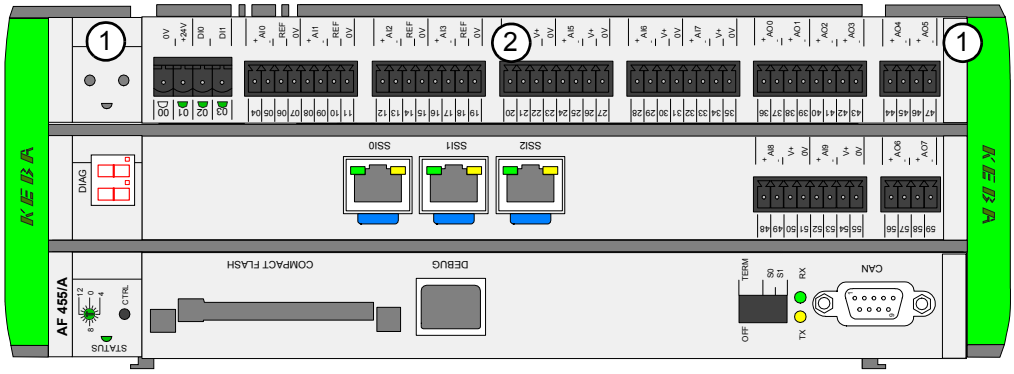
The device may only be opened by instructed qualified personnel and only the expressly allowed maintenance work may be done. Other manipulations on the device entail the loss of the guarantee.

Change fan

The employed fans have in case of continuous operation and a temperature of 40°C a statistical life of 70 000 hours (approx. 8 years). The exchange of the fan is problem-free, but must occur in time in order to guarantee the reliability in operation of the control system.

Procedure:

1. Disconnect all front panel plugs.
2. At first lift the two small front panel elements **[1]**, and afterwards the main front cover **[2]**



by means of screwdriver.

Hint: The front covers of the central and of the left part need not be removed.

3. Open the right side wall after loosening the five quick-action clamps.



4. Disconnect the connection plug of the fans to be exchanged.

5. Press fastening of the fan away from the fan by means of screwdriver and take out fan.
6. Build in new fan:
   Press fastening of the fan away from the fan by means of screwdriver and insert fan.
7. Plug the connection plug straight on.
8. Assemble the device again in the reverse order.



Note!

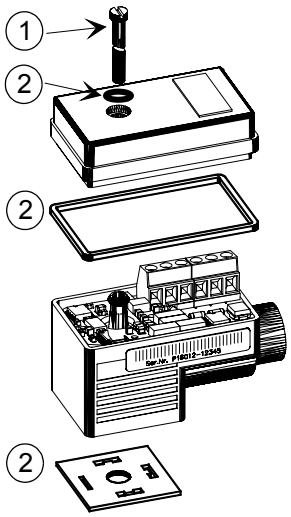
Observe the installation direction!
The fan must be built in again so that it sucks the air from the housing and blows it to the outside.

6.7 ANALOG/DIGITAL ADAPTER SE010

The analog/digital adapter SE 010 is inserted directly on a resistance stroke transducer.

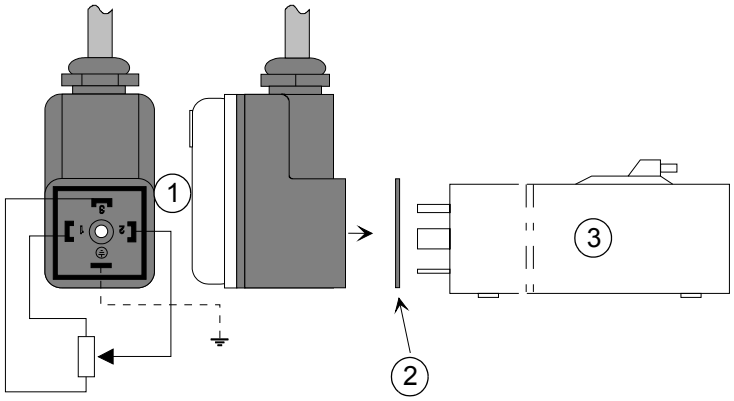
The stroke position is digitalized with 16 bits resolution and transmitted serially via the SSI interface. The SSI connecting cable to the AF 455 is clamped on a 6-pole terminal screw.

A green LED displays that the 24 V supply voltage is applied on the SE 010.



[1] Fastening screw
[2] Seals

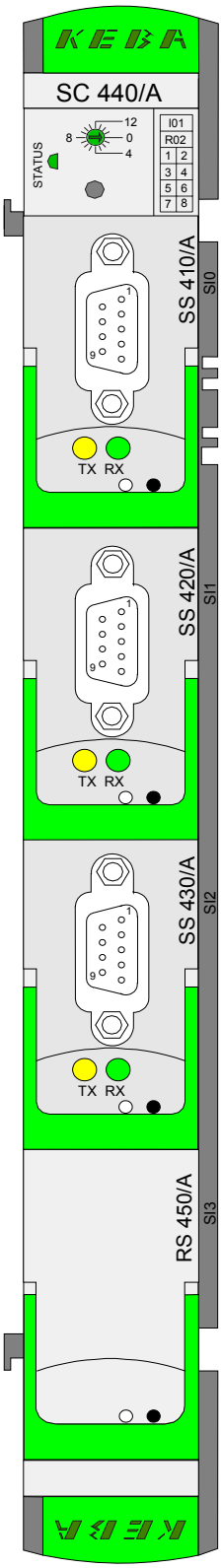
Assembly on the stroke transducer



[1] Analog/Digital Adapter SE010
[2] Gasket
[3] Stroke transducer

6.8 CARRIER MODULE FOR SERIAL SUBMODULES SC 440/A

The module SC 440 serves to receive up to 4 serial interface submodules.



Submodules in the slots SI0 and SI2 can be operated with max. 115 kBauds, submodules in the slots SI1 and SI3 with max. 57.6 kBauds.

With full occupation it is possible (depending on the multitude of data) that impairments can arise at transmissions with the above mentioned baud rates.

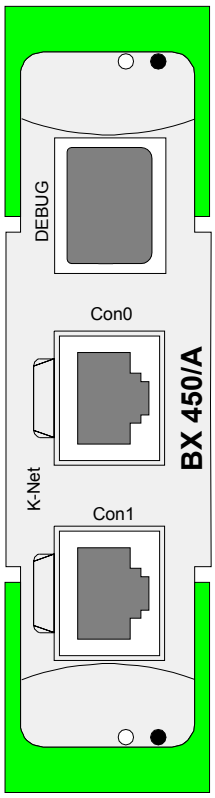
In order to guarantee a sufficient protection against accidental contact, you must provide the shafts which are not used with blind modules. [See 'Reactance modules' on side 57.]

7 INTERFACES

7.1 K-NET INTERFACE MODULE BX450/A

The BX450 module is a K-NET interface and serves the communication with a bus couple card.

It is executed as plug-in module and is inserted into the control panel computer if required.
[See 'Use of interface modules' on side 56.]



The module is configured and activated by the host

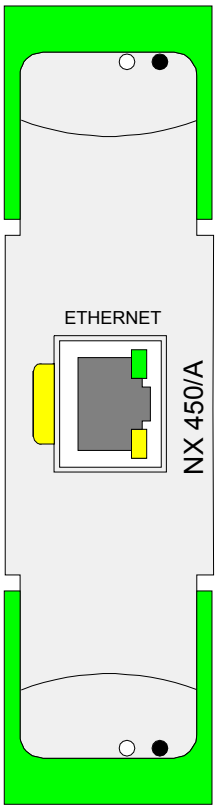
The host can release a reset without going into the reset itself.

In the case of an error an error code is displayed by the status LEDs.

7.2 ETHERNET INTERFACE MODULE NX 450/A

On the front side a RJ-45 connection is available for the connection to an Ethernet network. The NX450 Ethernet module can be included in a 10Mbit/s as well as 100Mbit/s Ethernet.

It is executed as plug-in module and is inserted into the control panel computer if required.
[See 'Use of interface modules' on side 56.]



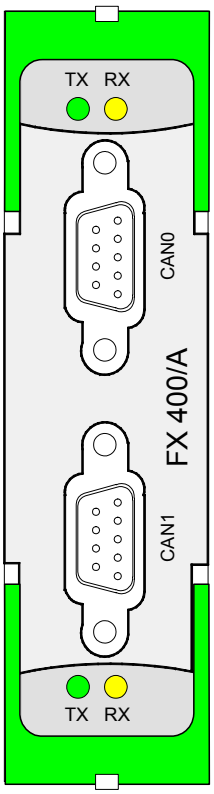
On the Ethernet bush (RJ-45) is a Link status led (green) and an Activity led (yellow).

green: lights as soon as an Ethernet connection exists.
yellow: lights at the transmission and reception of data.

7.3 CAN INTERFACE MODULE FX 400/A

The FX 400 module is a CAN-bus interface with two indpendent CAN circuits.
It is executed as plug-in module and is inserted into the control panel computer if required.
[See 'Use of interface modules' on side 56.]

This module provides the communication of the control panel computer with external control elements (robot, external hydraulic unit,...).



- Submodule, plug-in on PCI interface
  (33 MHz, 32 Bit, 5V)
- 2 CAN interfaces (CAN0, CAN1)
  with up to 1 Mbit/s data transmission rate
- CAN specification: CAN 2.0A, CAN 2.0B passive

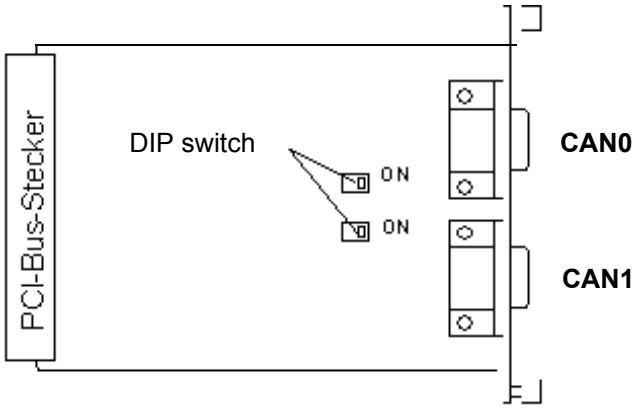
The module has per channel two status LEDs.

They have the following meaning:
green LED (TX): lights when transmitting
yellow LED (RX): lights when reading

If a module error occurs, the four status LEDs display an error code.

- Error messages on the screen

At the beginning and at the end of a bus a terminal resistance must be set, which is set here by means of DIP switch on the printed board assembly.

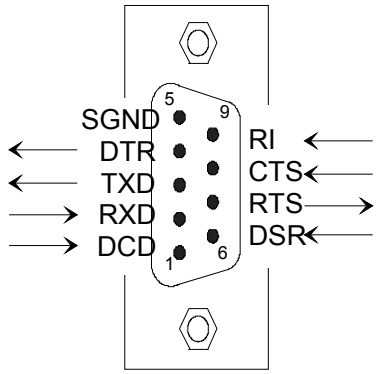


	”FX400 defective %1n %2n %1s”
Reason	In the module an error has appeared To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

7.4 RS-232 INTERFACE MODULE SS410/A

- RS-232 interface according to PC standard
- Transmission rate up to 115200 kbits/s
- max. line length 15m

DSUB plug connection from the front

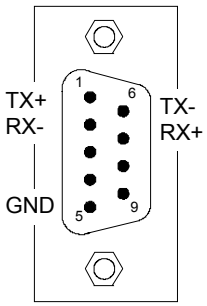


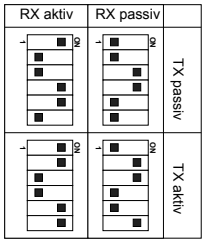
	Signal designation	**Pin-no.**	**In/output**
DCD	Data Carrier Detect	1	Input
RXD	Receive Data	2	Input
TXD	Transmit Data	3	Output
DTR	Data Terminal Ready	4	Output
SGND	Signal Ground	5	
DSR	Data Set Ready	6	Input
RTS	Request To Send	7	Output
CTS	Clear To Send	8	Input
RI	Ring indicator	9	Input

7.5 CURRENT LOOP INTERFACE MODULE SS420/A

- 20 mA Transmitter/receiver Current Loop interface

- Transmission rate up to 9600 kbits/s
- max. line length 1000m





	Signal designation	Pin No.	Source of current / lower
TX+	Transmitter	1	Source (active and passive)
TX-	Transmitter	6	Depression (active and passive
RX-	Receiver	2	Source (active and passive
RX+	Receiver	7	Depression (active and passive
GND	screen earth	5	---

Loop currents and voltages

- Loop current at „0” 0mA at „1” 20mA
- Loop voltage approx. 17V
- Voltage drop receiver <=3V transmitter <=2V

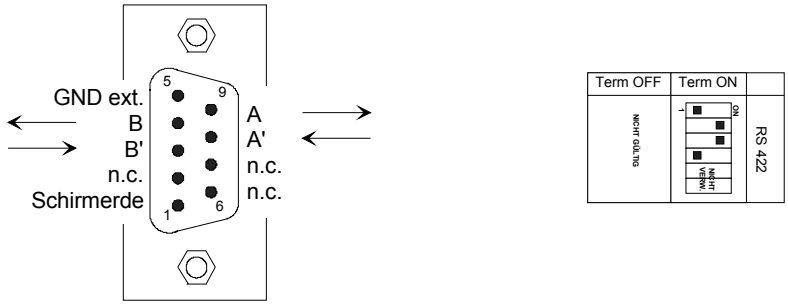
The sum of the voltage drops must not be bigger than the loop voltage!

7.6 RS-485/422 INTERFACE MODULE SS430/A

RS-485/422 interface up to 115200 bauds

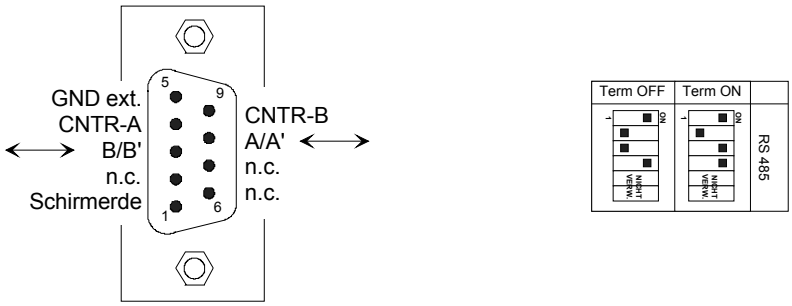
- Transmission rate up to 115200 kbits/s
- max. line length 1200m

RS-422, DSUB plug connection from the front



RS422	Signal designation	Pin-no.	Input/output
A	Transmit -	9	Output
A’	Receive -	8	Input
B	Transmit -	4	Output
B’	Receive +	3	Input
GND ext	Signal ground	5	

RS-485, DSUB plug connection from the front



RS485	Signal designation	Pin-no.	Input/output
A / A’	Transmit / receive	8	In or output
B / B’	Transmit / receive	3	In or output
CNTR-A	Data flow control for Repeater	4	Output
CNTR-B	Data flow control for Repeater	9	Output
GND ext	Signal ground	5	

Screen earth pin 1
This connection is provided on the plug, but should only be used then when it is not possible to contact the screen directly via a conductible DSUB bush housing.

If the module is at one end of the line, the terminal resistor must be activated (Term OFF)

8 GENERAL ERROR MESSAGES

	**”System Error (Details in the Infolog)”**
Reason	A sequence system error has appeared. This error can be specified more exactly in the Infolog.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

	**”General System Error component %1n %2n %1s”**
Reason	A hardware error has appeared which cannot be localized more closely. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Contact service

	**”Invalid calibration data %1n No.%2n %1s”**
Reason	An input and/or output is defective. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the error.
Effect	The machine stops immediately and goes into the reset state.
Reset	Exchange card(s) Contact service

	**”Device defective %1n No.%2n %1s”**
Reason	A device (module) is defective. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the defective device.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Exchange card(s) Contact service

	**”Device on KCAN is defective %1n No.%2n %1s”**
Reason	A device (module) in the KCAN circuit is defective. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the defective device.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Exchange card(s) Contact service

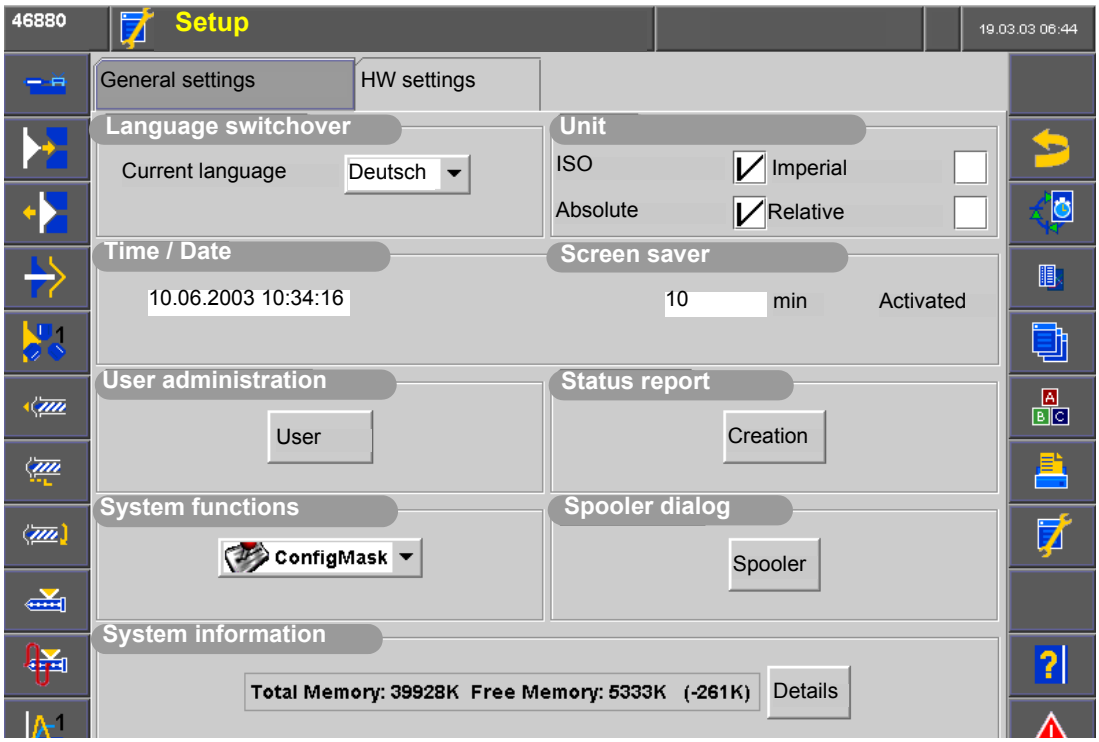
	**”KNET defective %1n No.%2n %1s”**
Reason	A device (module) in the KNET circuit or the KNET bus itself is defective. To this error two numbers (%1n %2n) must be read off which are helpful for the more exact localization of the error reason, above all when you make use of our customer service by telephone. As %1s a hardware path can stand which indicates the exact place of the defective device.
Effect	The machine stops immediately and goes into the reset state.
Reset	Control voltage off/on Exchange card(s) Contact service

SERVICE TOOLS

The chapter Servicetool includes the programs which are necessary for the general settings such as network settings.
The programs for diagnostics, administration of variables, writing/reading of machine data sets and the ramp settings are also treated in this chapter.

1 SETUP

On the **"Setup"**page basic control settings are possible. In the operator's manual, chapter **OPERATION CC200**, CONTROL SETTINGS, global user settings, such as language switchover, switchover of units, time/date are described. For service purposes still further settings are possible.



1.1 SCREEN SAVER

In the Combobox the time after which the screen shall switch dark for sparing can be chosen. The time always starts at the end of an operation process. With **"Activated"** general switching-off or -on.

Note!

The background lighting has a limited life. This can be extended by activating the screen saver.

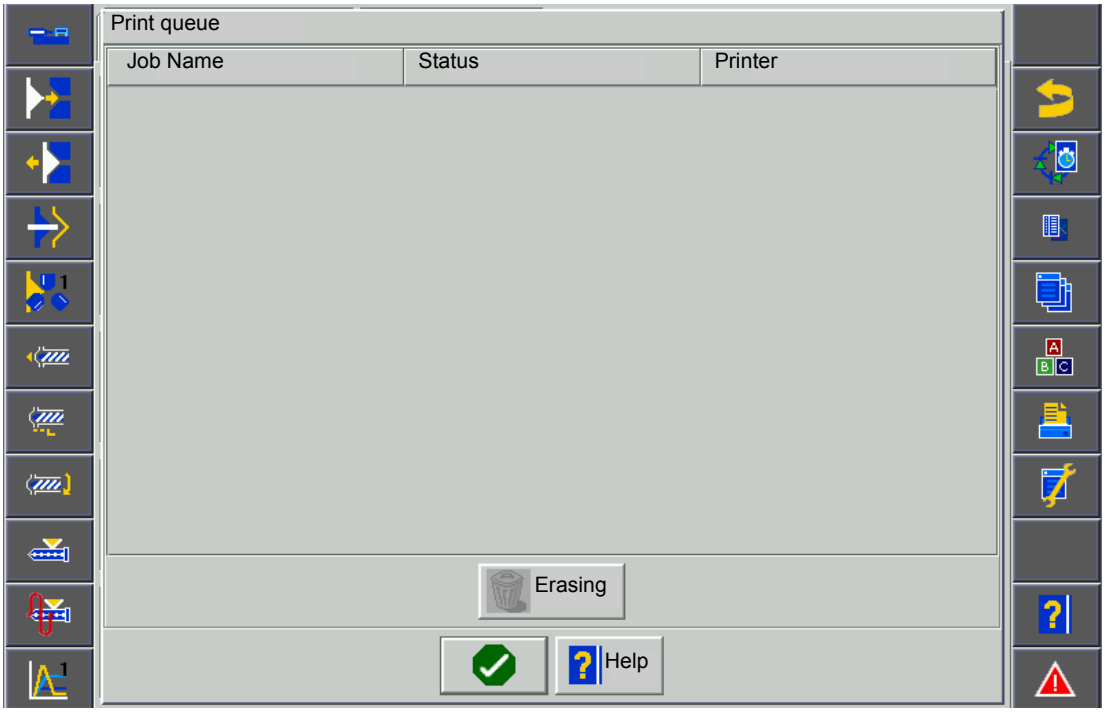
1.2 STATUS REPORT

The status report makes snapshots of machine situations with malfunction message protocol as well as machine and parts data set.
By pressing Creation it is written on the front Flash.

The report serves the software technician to localize errors, user changes, data set changes.

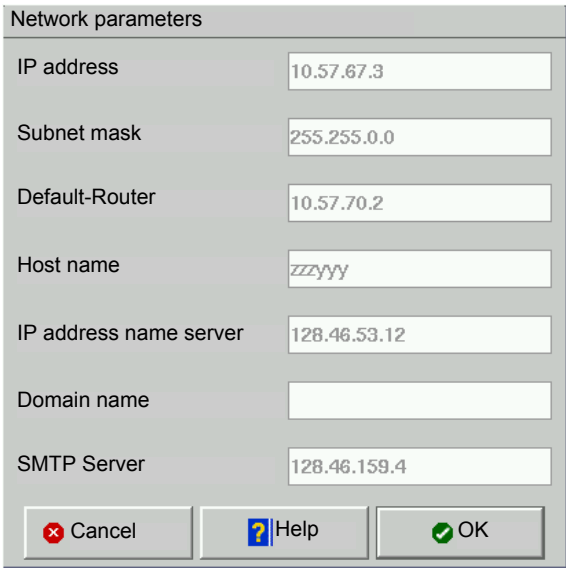
1.3 SPOOLER DIALOG

In this dialog the existing printing orders and those in work are displayed.
With **[Delete]** each existing printing order can be removed again.



1.4 NETWORK PARAMETERS

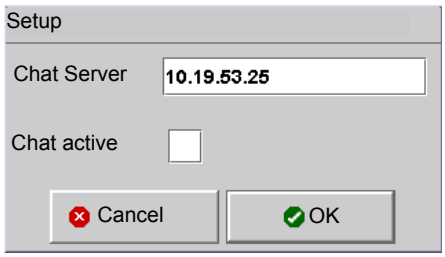
For the comfortable storage of data sets on the company network, sending out of E-mails, chat, etc. under the tab HW settings **[Network parameters]** must be set. You get to know the values from your network administrator.



Chat settings

As the program Chat only functions via the network, also here settings must be made.

Simply press the button Setup in the program Chat

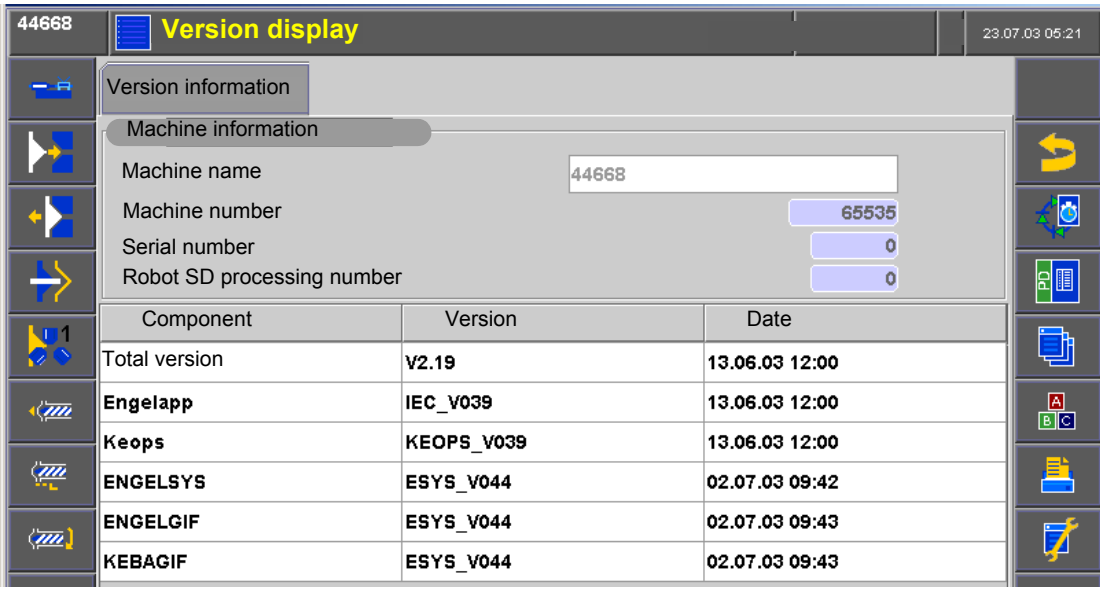


Simply select a computer or a machine which shall serve as Chat Server.
Enter afterwards the IP address of the selected „Chat Server" as Chat Server into all machines.
As soon as the switch **"Chat active"** is switched on, the Chat function functions.

1.5 SYSTEM FUNCTIONS

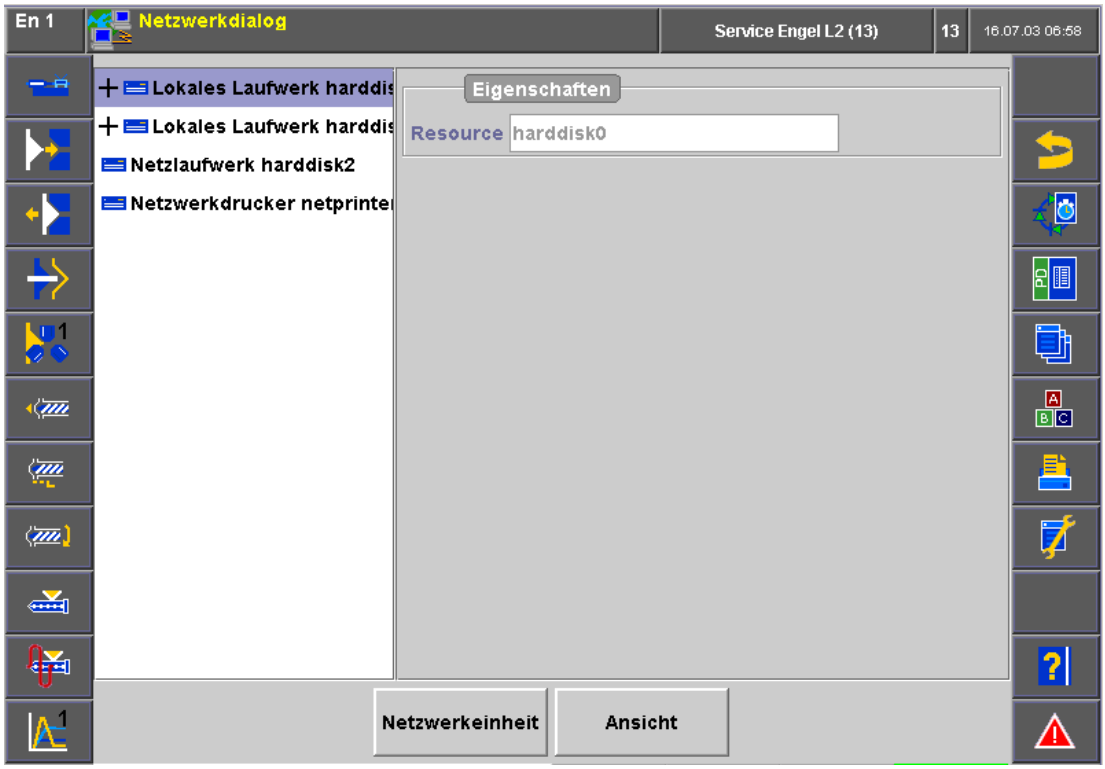
1.5.1 VERSION DISPLAY

Includes the most important machine and software information.



1.5.2 NETWORK DIALOG

The network dialog serves to administer and/or to configure local drives, network drives and printers in the network.



Release local drives
In order to be able to address local drives also from external (network,...), they must be released.

Procedure of a drive release:

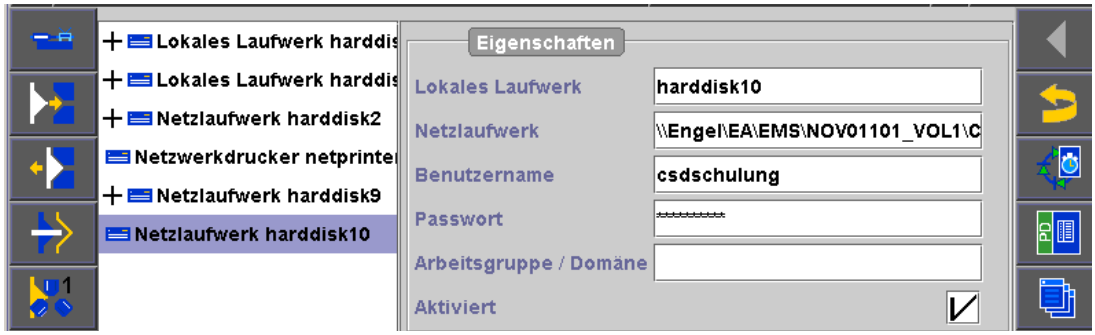
1. select local drive.
2. Press **[Network unit]** and **[Release]**.
3. give a name for the release and confirm.

Addition of network drives or network printers

1. Press **[Network unit]** and **[Add]** .
2. Selection via network drive or network printer



3. Make corresponding settings.



- **"Local drive"** Name of the network drive on the machine
- **"Network drive"** Path of the network drive
- **"User name"** User name for the authorization of the network drive
- **"Password"** Password for the authorization of the network drive

At the network printer still the printer language must be indicated in addition, e.g. PS.

With the key **"Load newly"** the data stored last are loaded newly and the current changes are rejected.

Note!

All changes only become valid after the storage and after a new start of the control unit!

2 MONITOR OF VARIABLES

The monitor of variables serves to change and display machine variables. For the adjustment of the function units certain variables are summarized in groups.
It is also possible to create new groups (Favorites) . A search function supports the finding of individual variables.

Structure example of a variable (Output definition mold closing) **''sv_OutDefCIP''**

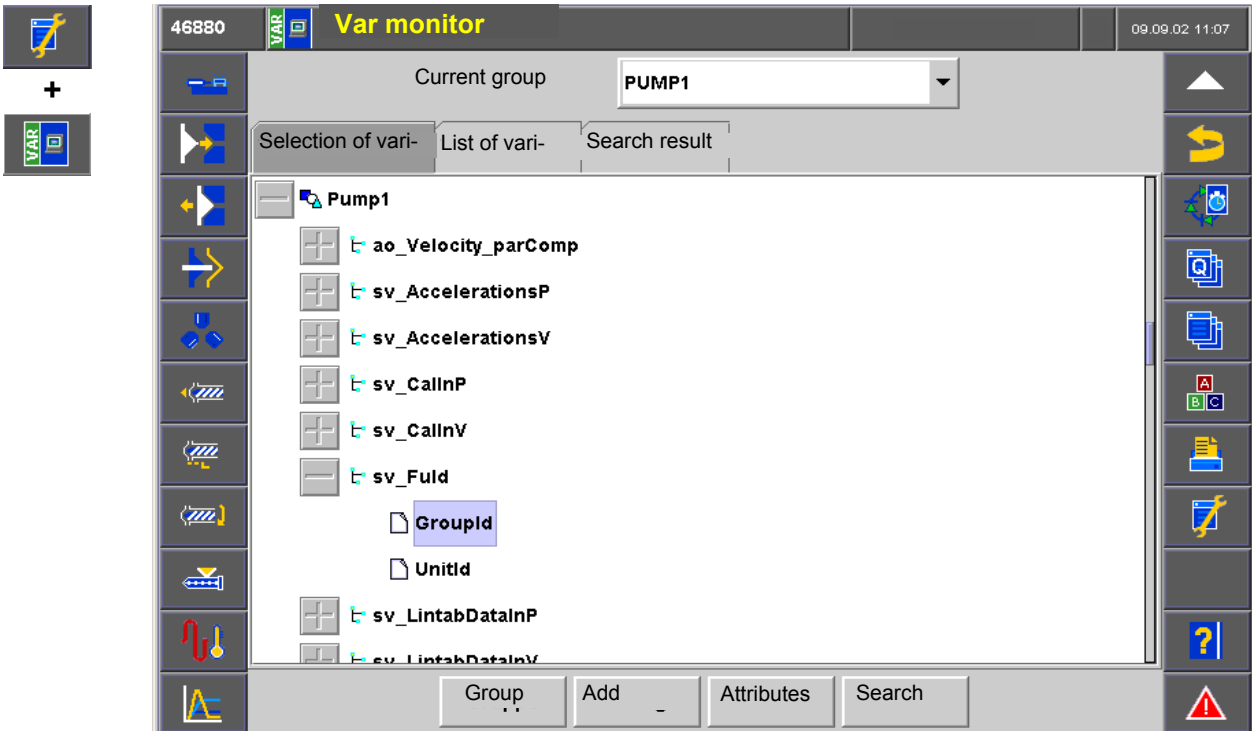
sv_	System variable
. . . OutDef	Output definition
. CI	Mold closing
. . . . . P	Pressure

Examples of naming

di_		digital input
do_		digital output
ai_		analog input
er_		Error signal
sv_		System variables
	b	boolean variable
	c	Constant
	i	Integer variable
	u	unsigned integer variable
	r	real variable
	d	Date and time variable
	s	String variable

2.1 SELECTION OF VARIABLES

All variables are structured and have to be searched here in a tree structure.



closed group of variables

open group of variables

Variable

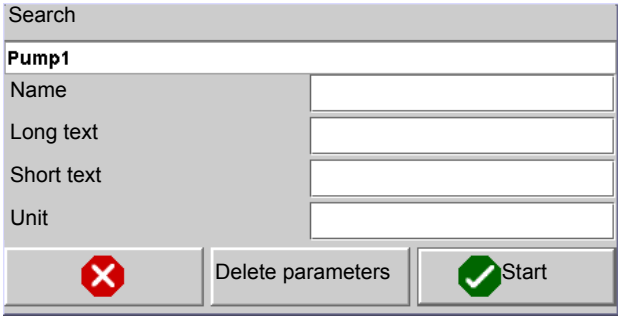
sv_bAdminRead

Variable marked

sv_AnaCoordMode

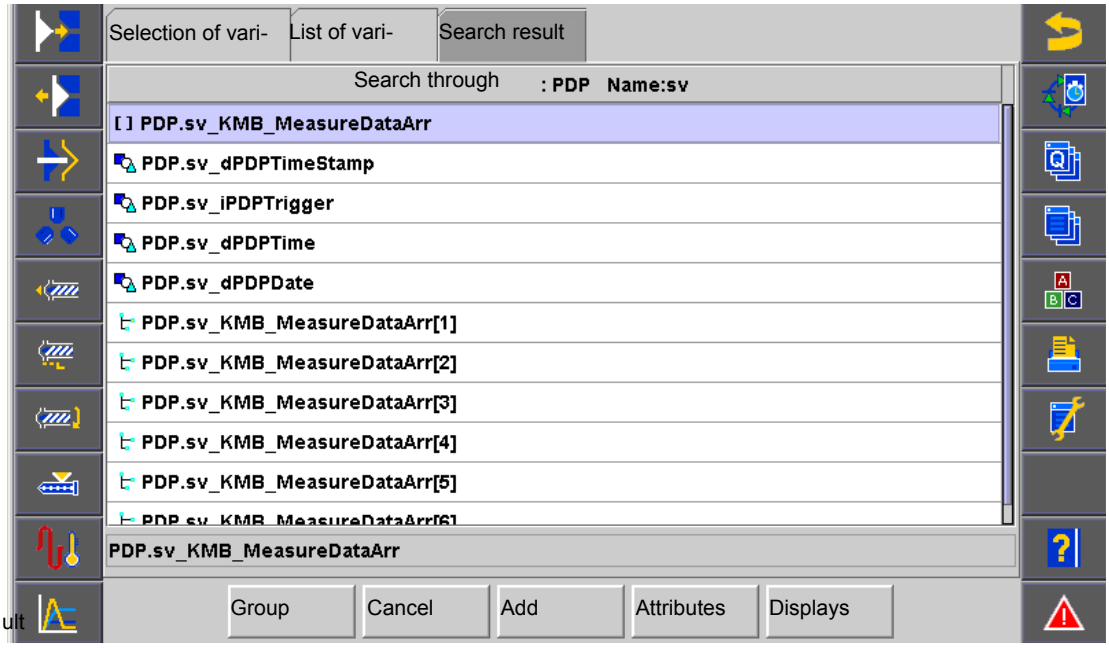
Search

As soon as the name of a group of variables is marked, it is possible to use the search function **[Search]**.



Name of groups of variables
Name of variables
Written-out name
Short name, e.g. SSx
Unit e.g. %, s, ...

The text must only stand in one field.
It is also possible to search for text parts.
After the search the search result window is opened immediately.
Here all variables and directories are mentioned which have been found at the search.

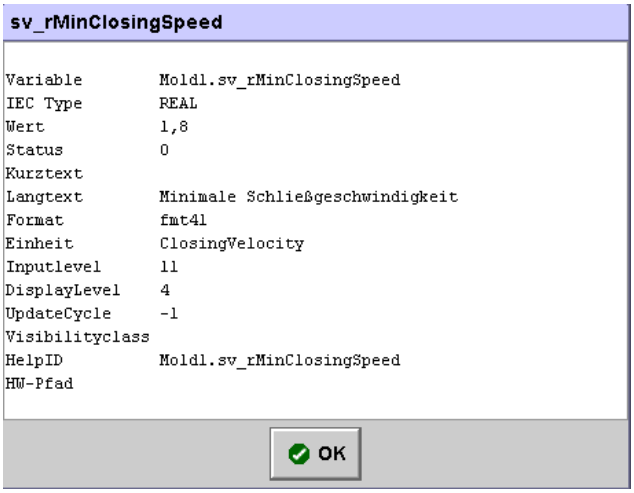


You can interrupt the current search with **[Interrupt]**.
When more than 100 variables are found, you can switch on with **[Continue]** .
At found directories it is possible to jump with **[Displays]** into the directory tree.

Attributes
Shows the details of a variable

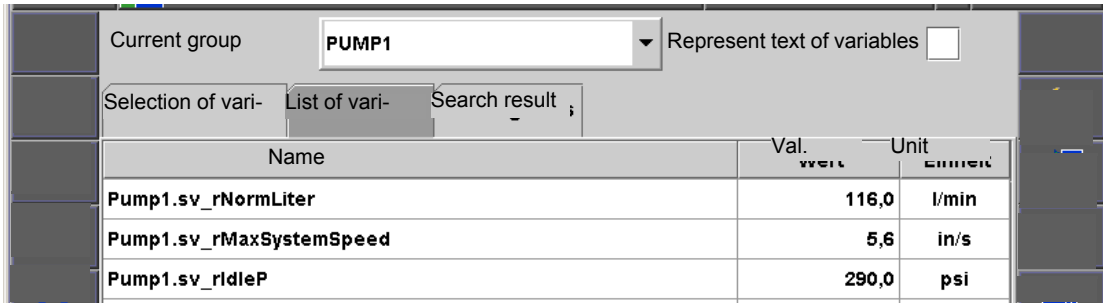
1. Select variable
2. Opening of the attribute window with **[Attributes]**

Example:



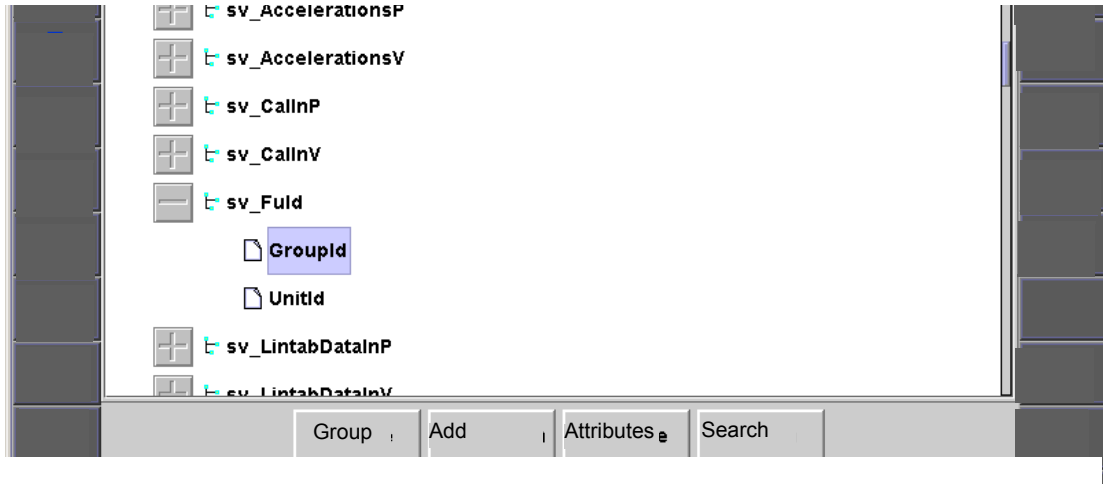
2.2 LIST OF VARIABLES

Representation of the selected group. The value of a variable can only be changed in the list of variables. For adjusting the individual function units already groups of variables are predefined.
For the better understandability the text of variables can be switched over to long text with the switch **"Represent text of variables"** .



Creation of a group:

1. Press **[Group]** and **[New]**
2. Fix name
3. Select (mark)needed variable in the tree structure



4. Inclusion in the group by pressing **[Add]**.
5. Press **[Group]** and **[Store]** . Because of that the variable remains in the group also afer a page change.

When adding a variable select at first an existing group and afterwards continue with item 3.

By pressing **[Group]** and **[Delete]** the current whole group is deleted.

Change of a variable

1. Select a variable (mark).
2. Press on the value.
   The input window opens
3. Make the change.

Removal of a variable from a group

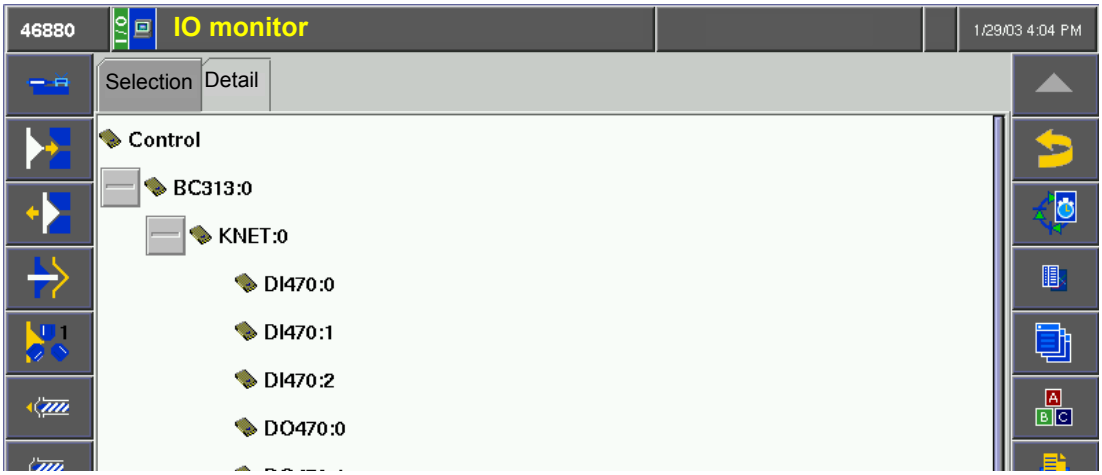
1. Open the list of variables of the group.
2. Mark the variable.
3. Press **[Delete variable]**.
   [Delete everything] deletes all variables of the group
4. Press **[Group]** and **[Store]** .

Print list of variables 

3 I/O MONITOR

The I/O monitor offers the possibility to display and to set analog and digital inputs and outputs. The representation of the hardware modules provided in the software occurs hierarchically in a tree structure, corresponding to the inclusion in the system.



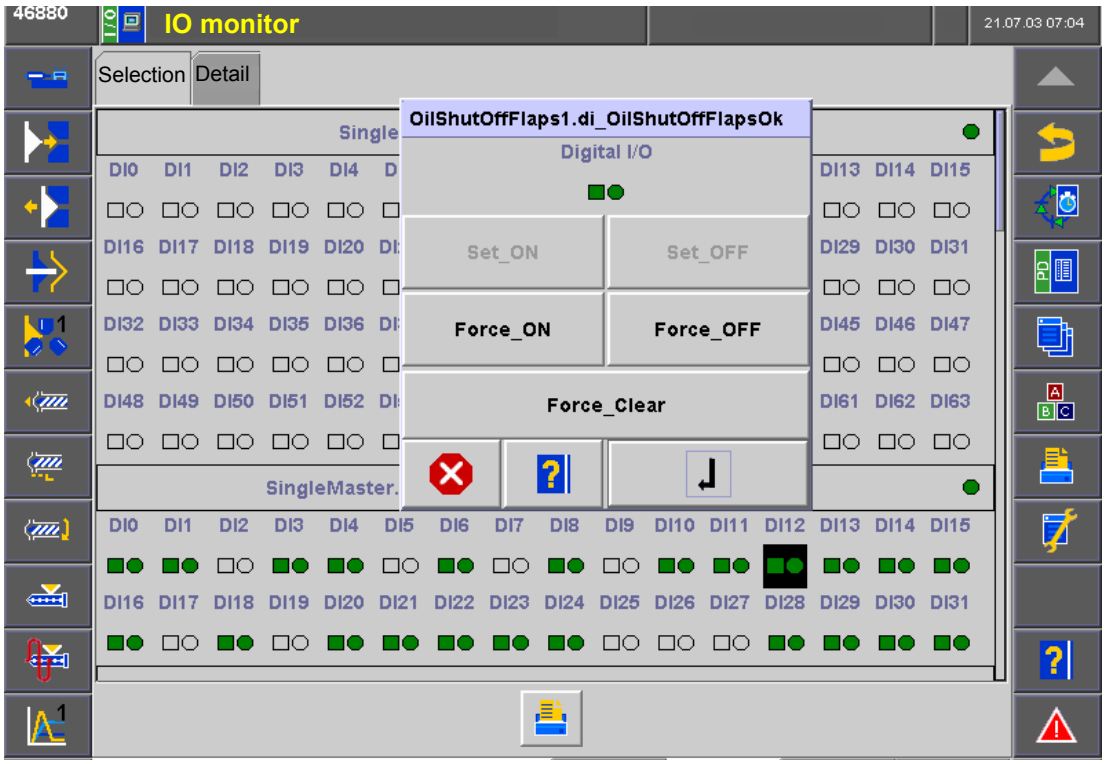


Functions:

- Total representation of the modules included in the software
- Possibility of the selection from one or several modules
- Display of the state of the digital inputs and outputs (green = active)
- Display of the actual value in mV at analog inputs and outputs
- Display of the temperature at temperature inputs
- Display of the power in percent at temperature outputs

Procedure when setting an output or input:

1. Select the requested hardware modules. These are then represented bordered red. Touching an already chosen module lightly cancels the selection again.
2. Change into the detail representation by touching the card rider **[Detail]**lightly.
   The control unit displays for each selected HW module the current values of the inputs and outputs.
   A tag in the headline at the right above at each module shows the status of the card
   - green: Communication with the hardware module functions
   - red: Communication with the hardware module does not function
3. At the digital inputs and outputs the circuit represents the actual state of the terminal, the square that valid for the control unit (green = active).

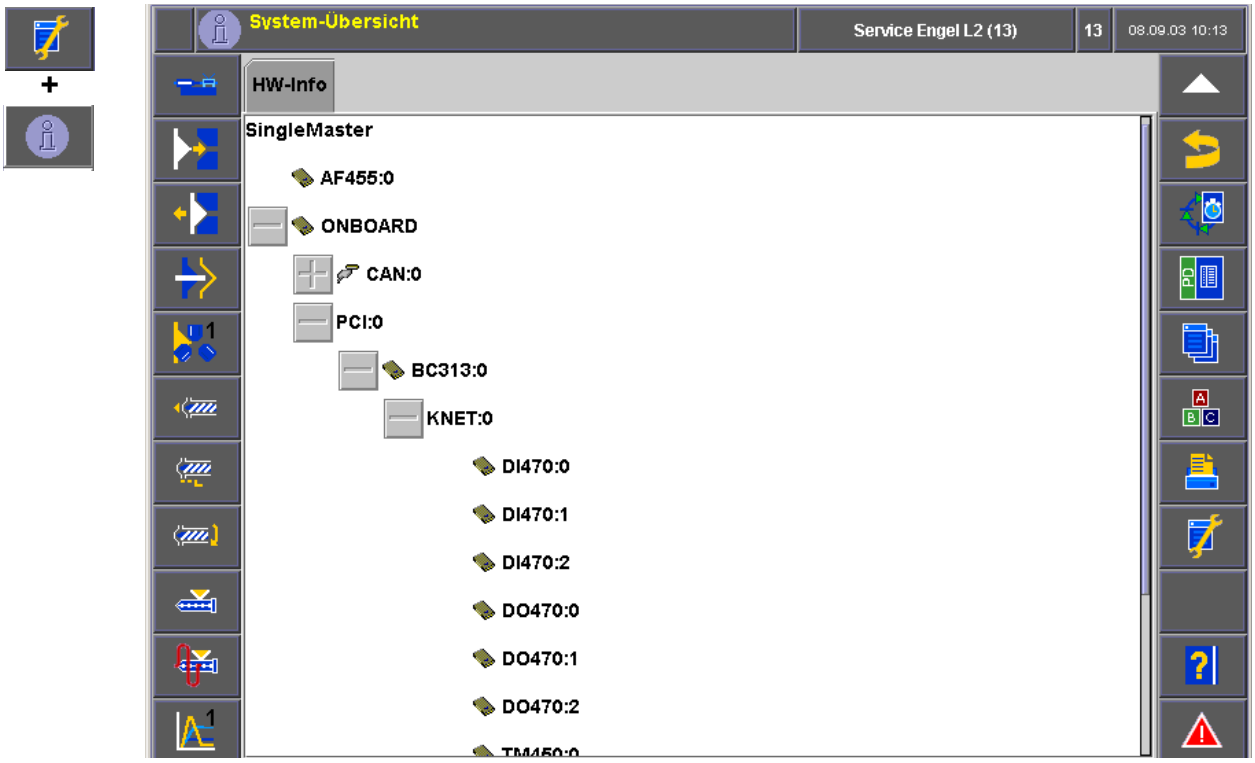


4. Press on an output or input.
   A dialog field with the input possibilities opens.
5. Set the requested value. The input and/or output is then bordered red.

Set_ON	Set signal to 1. The sequence program can change the signal again, however. Only for digital outputs.
Set_OFF	Set signal to 0. The sequence program can change the signal again, however. Only for digital outputs.
Force_ON	Fix signal on 1. Control voltage off/on cancels the fixing.
Force_OFF	Fix signal on 0. Control voltage off/on cancels the fixing.
Force Clear	Cancel fixing again

4 SYSTEM SURVEY

In the system survey it is possible to call up detail information to each electronic module.



By pressing on an electronic module the following information appears:

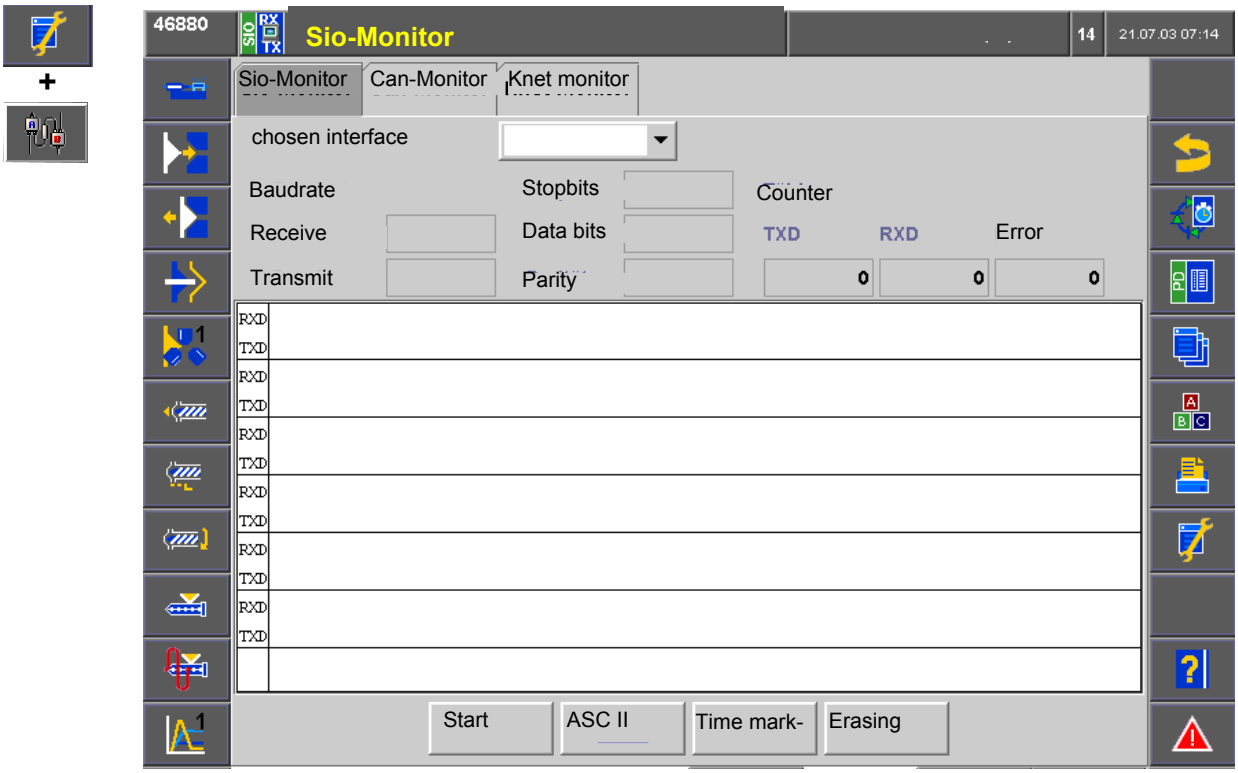
- Printed board assembly number
- Function variant
- Serial number
- Material number
- HW revision
- Device number
- Start-up date
- Hour counter

5 INTERFACE MONITOR

The interface monitor serves to monitor data which are sent via the interfaces.

It includes 3 areas:

- Sio monitor: for serial interfaces
- CAN monitor: for CAN circuits
- K-Net monitor: for the system bus of the system



5.1 SIO MONITOR

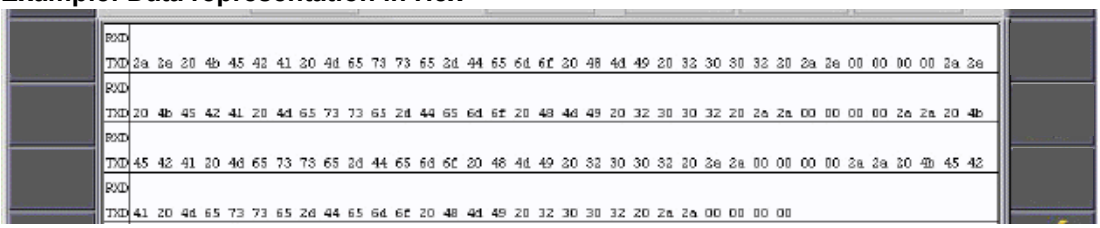
The Sio monitor is used for the display of data and settings of the serial interfaces.

- From the configured interfaces one can be selected.
- Baud rate for reception and transmission page
- Number of stop bits, data bits, set parity
- Counter for transmitted (TXD) and received (RXD) characters and appeared errors
- received and transmitted data and, when selected, time markers

Start
With this button you can start and stop the recording

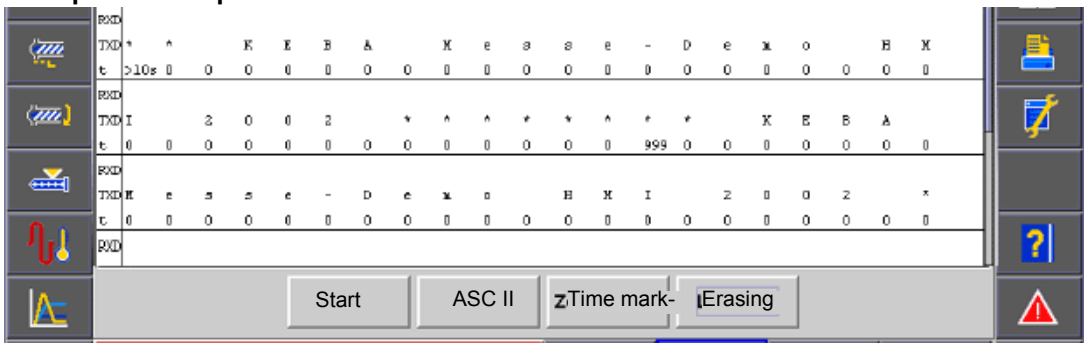
ASCII
Here it is possible that you switch over between ASCII and Hex representation

Example: Data representation in Hex



Time markers
Fading-in of time markers

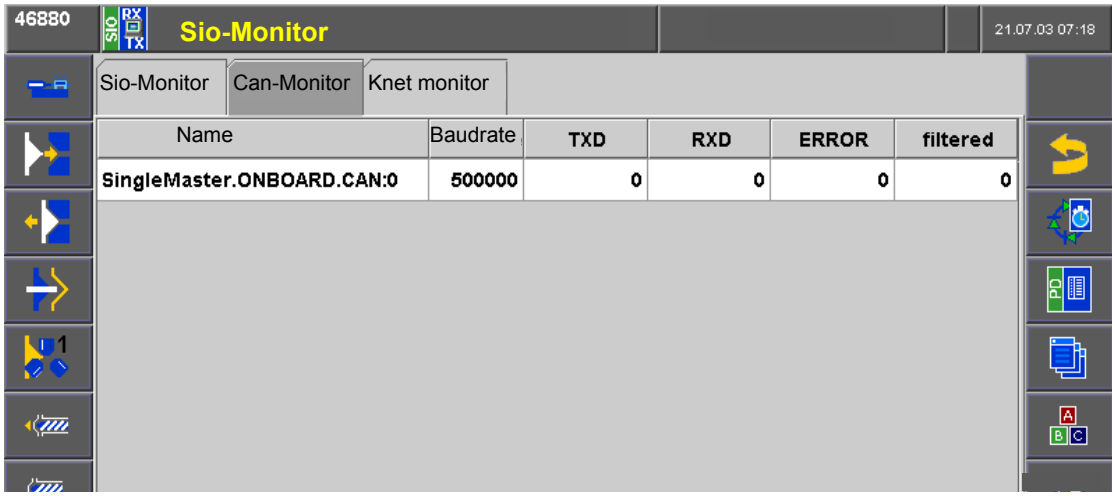
Example: Data representation in ASCII and time markers



Erasing
The whole data field is deleted.

5.2 CAN MONITOR

The CAN monitor serves the check of the configured CAN circuits.

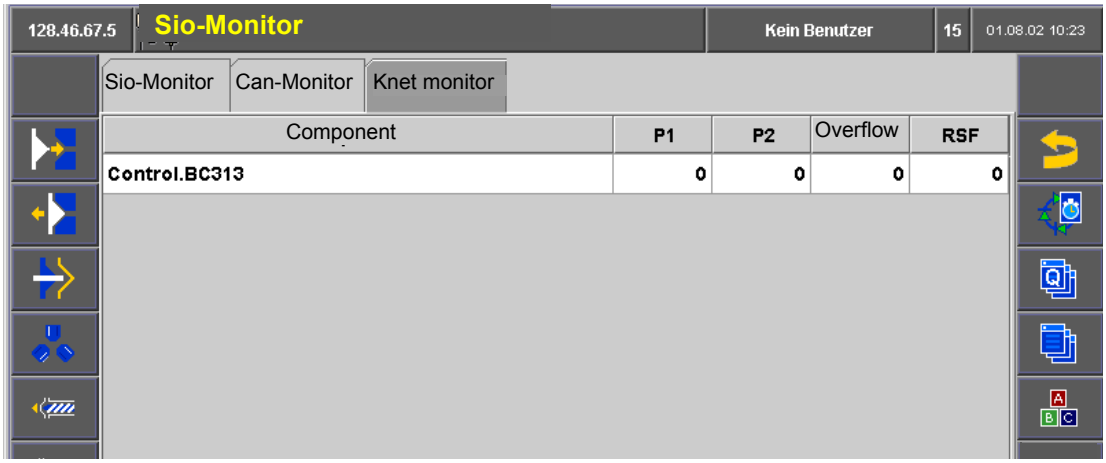


Name	Designation of the CAN circuit
Baudrate	Baud rate in bit/s

TXD	Number of the sent CAN messages
RXD	Number of the received CAN messages
ERROR	Number of the faulty received CAN messages
filtered	Number of the received CAN messages, which have been intended for this Controller.
Start/Stop	Starts and/or stops the recording When leaving the monitor the recording is stopped automatically.

5.3 K-NET MONITOR

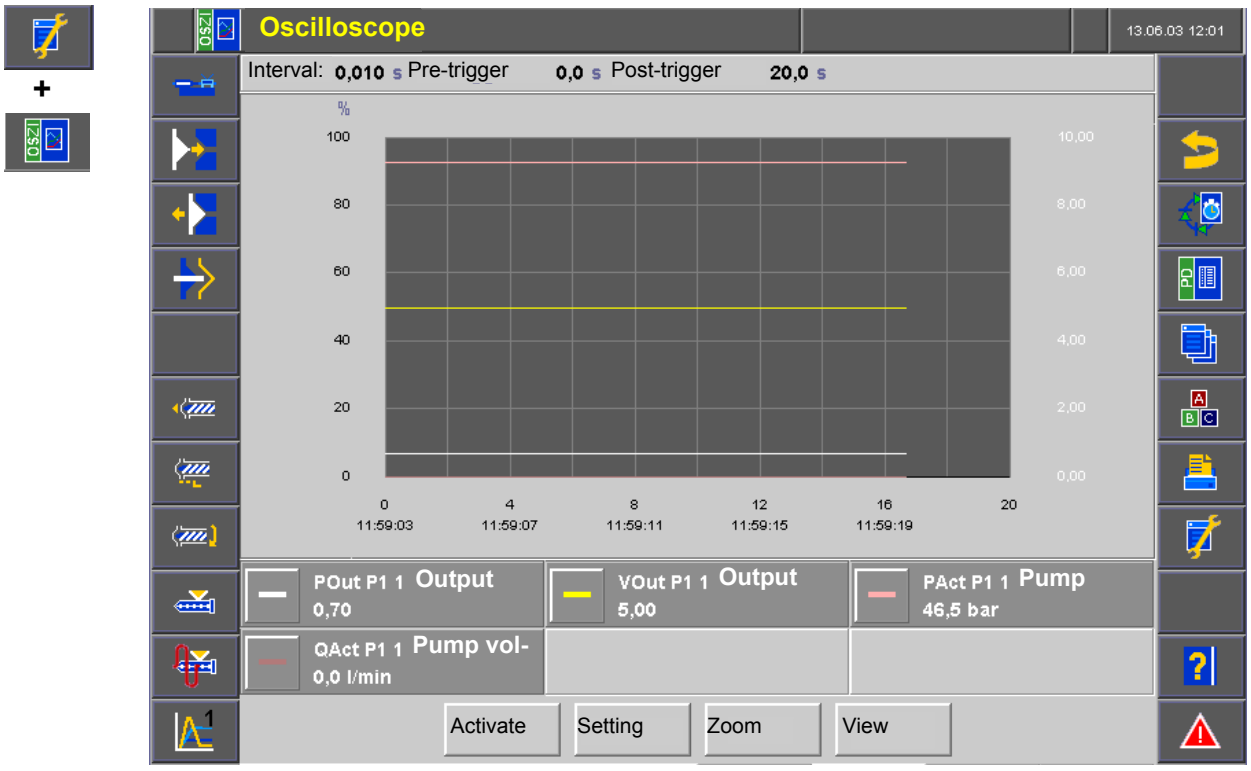
The K-Net-Monitor serves to check the K-Net interface.



Component	Designation of the Knet circuit
P1	Number of the frames on the Knet port1.
P2	Number of the frames on the Knet port2.
Overflow	Number of the bus overflows
RSF	Number of the repeated service frames

6 OSCILLOSCOPE

An oscilloscope integrated into the control unit represents in the service case a comfortable aid for measuring different machine signals.
Recordings can be stored and be displayed again at a later moment or on another system. A recording can also be stored in textual format and so be displayed in another application (e.g. MS Excel).



A maximum of 12 curves can be selected and/or recorded and displayed at the same time.
By pressing a legend element (area) the corresponding curve can be faded out and/or in. Via the button of a legend element the legend dialog can be reached by setting the line color, upper and lower limit of the scale and the visibility of the scale.

Types of measurement:

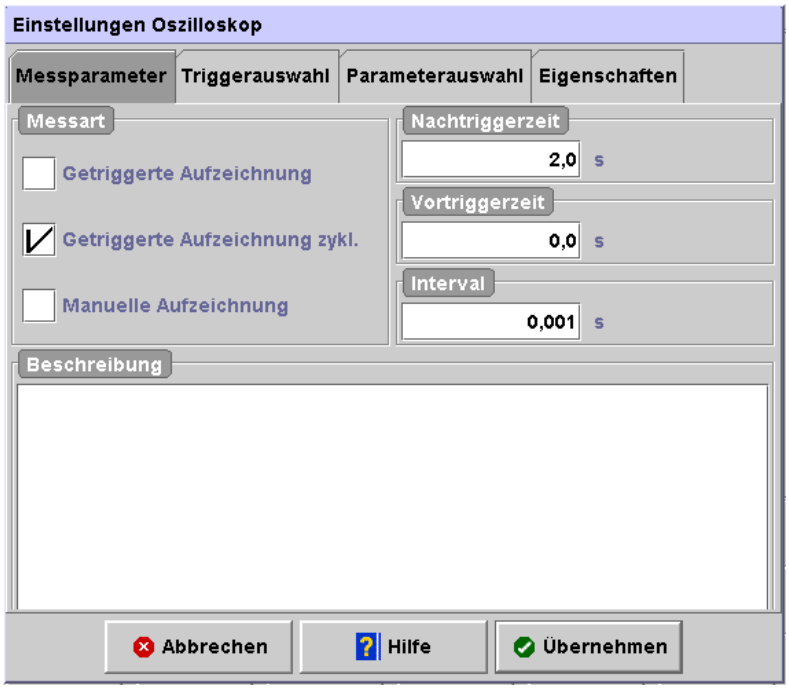
- Manual recording:
  By pressing Start the recording is started.
  Setting of measuring interval, measuring duration
  When as measuring duration the value 0 is set, it is a continuous measurement, which can only be stopped by pressing the Stop button.

- Triggered recording:
  The measurement is started at the first trigger impulse
  Setting of measuring interval, pretrigger time and posttrigger time

- Triggered recording cyclical:
  The measurement is started at each recurring trigger impulse.
  Setting of measuring interval, pretrigger time and posttrigger time

Note!

At not appropiate settings the set times are corrected automatically.



As trigger events system variables, system events and system alarms are available whereby system events and system alarms are exclusively intended for the software service.

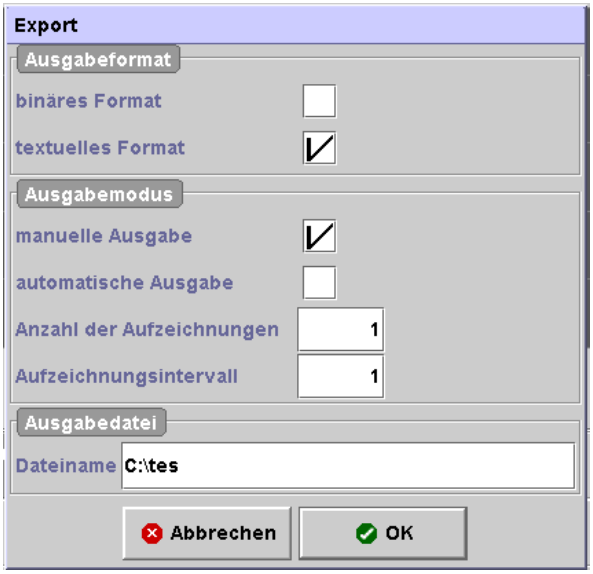
Parameter trigger
All groups and their variables, which have been created in the variables monitor, are available in the software oscilloscope in the same grouping.

For a numerical variable, which has been selected as trigger, a trigger threshold value must be entered as well as an exceeding / not-reaching must be indicated at which the recording shall be started.
For a boolean variable the flank must be selected.



”Representation prehistory”
It determines the range by which it is scrolled with fully drawn graphics. Up to X division = 0 means a displacement of the graphics by the whole display range, up to X division = 2 means a displacement by half the range, up to X division = 4 by a quarter etc.

Export settings



In the group Output format the selection between binary format (later import possible for view) and textual format (Excel importable) occurs).

In the group Output mode it can be chosen between manual and automatic output. Manual output means that when actuating the ”Start Export” key the current, complete recording is output into the specified file once whereby a possibly existing file with the same name is overwritten.

Automatic output means that at the start of the next recording the data are written into the specified file in the selected format. The export can either be finished explicitely by the user or is finished by reaching the end criterion (number of the recordings).

By specifying a recording interval > 1 recordings can be omitted selectively.
At binary recording in the automatic mode for an order always exactly one file is produced (indication under file name), which is provided by the system automatically with a continuous number before the file extension (e.g.: MyExportFile000.bin, MyExportFile001.bin, ...).
An existing series of measurements with the same name is deleted completely before the start of the new recording - after hint to the user -.
The data at the textual export are always added to the existing file, which is created newly at the beginning of the recording.

Store settings
Stores the whole settings such as measuring duration, trigger, parameters and properties

Load recordings
Exported curves in the binary format can be read in.

Load settings
Loading of formerly stored settings.

7 DATA DIALOG SERVICE FUNCTIONS

The data dialog includes under the menu item **[Extras]** some service functions

7.1 BACK-UP FLASH CARD

This function enables the copying of the rear Flash card (H0) on an available network drive or on the front Flash card.



Procedure (from user level 11):

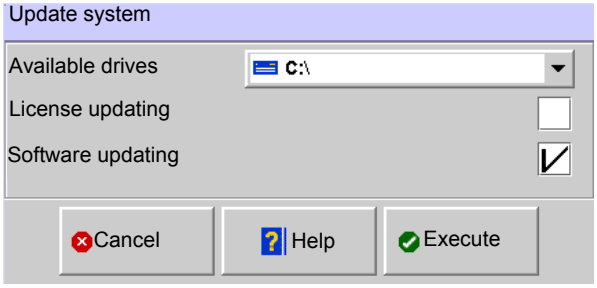
1. Press **[Extras]** and **[Protect Flash card]**.
   It appears the dialog window **”Store Flash card”**.
2. Choose an available drive in order to store into the network, or activate the program switch **”Store on front Flash card”** (H1).
3. Actuate the key **[Store]**in order to start the process.

Note!

Pay attentiion to the available memory capacity of the front Flash card. This should at least correspond to the capacity of the rear Flash card.

7.2 SYSTEM UPDATING

Menu function for reading in license files and software upgrades.



Procedure (from user level 12):

1. Press **[Extras]** and **[System updating]**.
   It appears the dialog window **"Update system"**.
2. Choose the drive on which the license file and/or the software upgrade is.
3. Mark the corresponding program switch and confirm with **[Execute]**.
4. In order to complete the updating switch the control voltage off and on.

	"no valid license ID"
Reason	The indicated license is not valid
Effect	The Watchdog is set. [See 'Reset / Watchdog' on side 59.]
Reset	Control voltage off/on Contact service

7.3 READ ENGEL PARTS DATA

At this process the parts data set which has been written at the delivery is read from the rear Flash card (H0). This is equivalent to a resetting of the data to factory setting (from user level 7).

1. Press **[Extras]** and **[Restore ENGEL parts data]**.
   The delivery state is read and is afterwards ready for processing.

7.4 WRITE PARTS DATA AS ENGEL STANDARD

This function overwrites the ENGEL parts data set (delivery state) on the rear Flash card (H0). In order to prevent a data loss, it is recommended to protect the Flash card before.
If an equipment is retrofitted, this process should be carried out in order to also enable the possibly later reading of the ENGEL parts data set.
Procedure (from user level 11):

1. Press **[Extras]** and **[Write parts data as ENGEL standard]**.
   It appears the dialog window **"Change ENGEL parts data really?"**.
2. The writing is only started after the confirmation of the dialog.

Note!

The delivery data are overwritten irrevocably. In order to be able to execute this function, the current project must be in the execution state.

7.5 READ ENGEL MACHINE DATA

The ENGEL machine data set includes all machine-dependent machine settings such as fixed pressures, fixed speeds, offsets, calibrations, etc.
If calibrations, optimizations or machine-dependent data are changed inadvertently, it is possible to read in the machine data.
Hint: The reading of the correct data presupposes that the machine data set has been written at each change of machine-dependent data.

Procedure when reading a machine data set (from user level 11):

1. Select the data carrier in the selection window.
2. Select the machine data set (Global) in the selection tree.
3. Press **[Extras]** and **[Read ENGEL machine data]**.
   The machine data set is read in.

7.6 WRITE ENGEL MACHINE DATA

After each calibration, optimization or change of machine-dependent data the machine data set should be written in order to enable a later read-in.

Procedure when writing a machine data set
(from user level 11):

1. Press **[Extras]** and **[Write ENGEL machine data]**.
   It appears the dialog window **”Write ENGEL machine data on”**.
2. Select a drive and confirm with **[Writing]**.
   The machine data set is written with the name **”GLOBAL”**.

7.7 DISPLAY MACHINE DATA

The function displays the **”Data set attributes”** (date, creator,...) of the current machine data set.
Procedure (from user level 11):

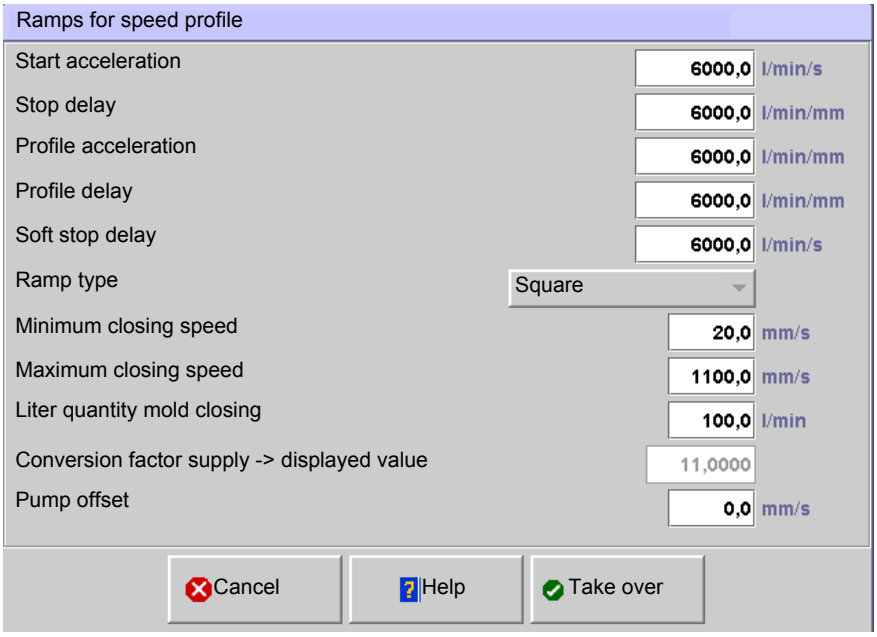
1. Press **[Extras]** and **[Display machine data]**.
2. Choose the key **”Active parts data set”** (at the right above) in order to return into the execution state.

8 SET VALUE GRAPHICS

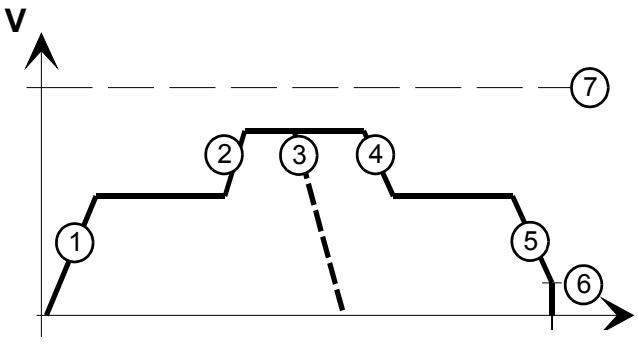
8.1 RAMP SETTING

Ramp means passing, not abrupt change of an adjustable (pressure and/or speed). Basically one distinguishes between stroke and time ramps. All ramps within a profile are stroke ramps. The start-up movement and soft stop delay are time ramps.
The ramps and also the most important speed- and pressure-relevant parameters can be changed under **[Profile]**, **[Ramps for speed]** and **[Ramps for force]** in the service mode.

Example: Ramps for speed profile mold closing



Example: Speed profile mold closing

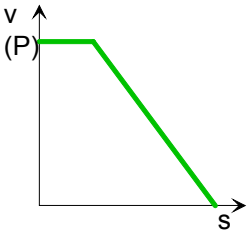


[1] Maximum **”Start acceleration”**
[2] Maximum **”Profile acceleration”**
[3] At a movement interruption **”Soft stop delay”** is effective in all modes of operation
[4] Maximum **”Profile delay”**
[5] Maximum **”Stop delay”**
[6] **”Minimum speed”**

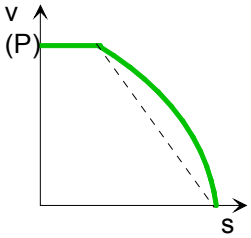
[7] ”Maximum speed”

”Ramp type”
Selection possibility on linear, square and sine square ramps.

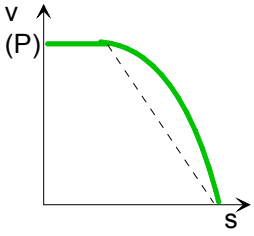
Linear:



Square:



Sine square:



- Linear is used for actuations without proportional valve, and pressure outputs
- Square is used for actuations with proportional valve
- Sine square is used for electric drives

”flow rate”
Required pump liter quantity in order to reach **”Maximum speed”**

”Conversion factor supply -> displayed value ”
Multiplication factor for the conversion from l/min to mm/sec.
The factor is calculated from maximum closing speed and maximum liter quantity for mold closing.
Example **”Maximum closing speed”**: 1030 mm/s / 116 l/min = 8.88
So because of that the really acting ramp can be calculated.
Example **”Start acceleration”**: 1000 l/min/s * 8.88 = 8880 mm/s

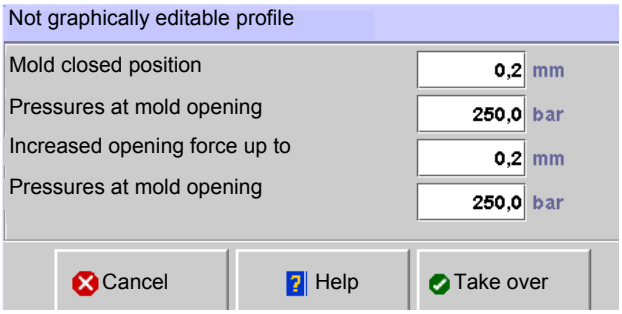
”Pump offset” (only at speed profile)
Increase of the pump actuation as compared with proportional valve actuation

All movements which do not have any stroke transducer (e.g. high speed mold mounting device, core-pulls) run via time ramps.

Soft stop in case of EMERGENCY STOP, for the clamping unit:
In order that also in case of an ”EMERGENCY STOP” and/or with safety gate opening a soft stop for the clamping unit can become effective, diaphragms are built in in the pilot control part of the proportional valve.

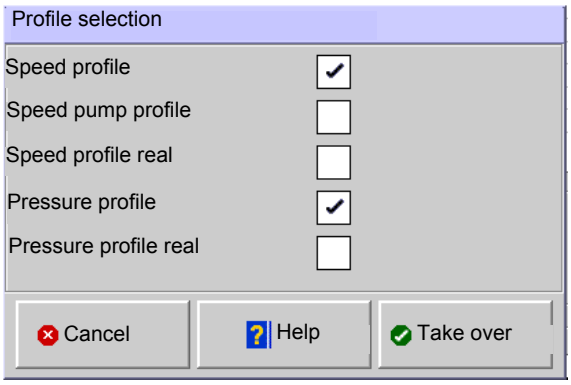
8.2 NOT GRAPHICALLY EDITABLE PROFILE

Setting possibility for not graphically editable profiles with **[Profile]** and **[Constant profile]**



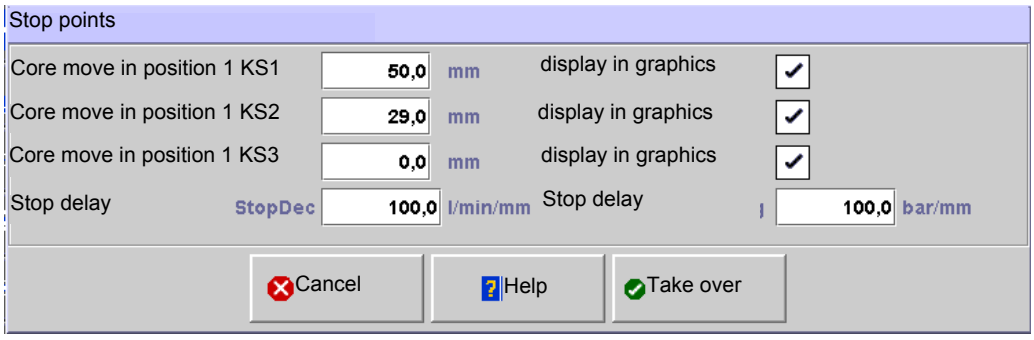
8.3 PROFILE SELECTION

Selection of curves possibility with **[Profile]** and **[Displays]**.



8.4 STOP POINTS

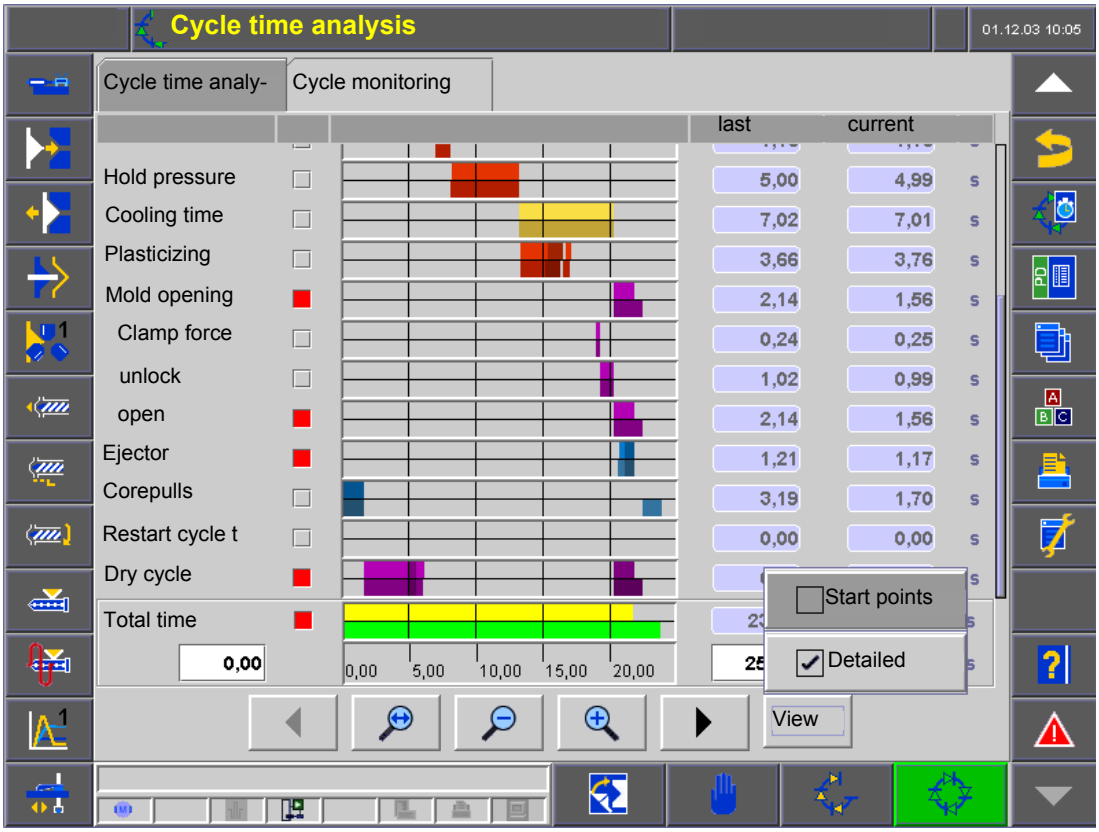
With switched-on switch the control unit displays the respective stop point in the set value graphics. The ramp settings are valid for all stop points. Selection via **[View]** and **[Stop points]**.



9 CYCLE TIME ANALYSIS EXTENDED

With the extension of the cycle time analysis it is possible from Level 12 to fade in detail times for the mold opening and mold closing as well as a dry cycle time.
This serves e.g. for optimization purposes and quality assurance measurements.

Example:



With the menu key **[View]** and checking off the field **[Detailed]** the additional times must be faded in.

For the movements Mold opening and Mold closing now additional lines for the partial movements are faded in. Example Mold opening: the partial movements Clamping force reduction, unlocking and (high speed) opening are inserted.
The dry cycle time, according to EUROMAP 6, can be seen as last but one line.

CALIBRATIONS AND CLOSED LOOP CONTROLS

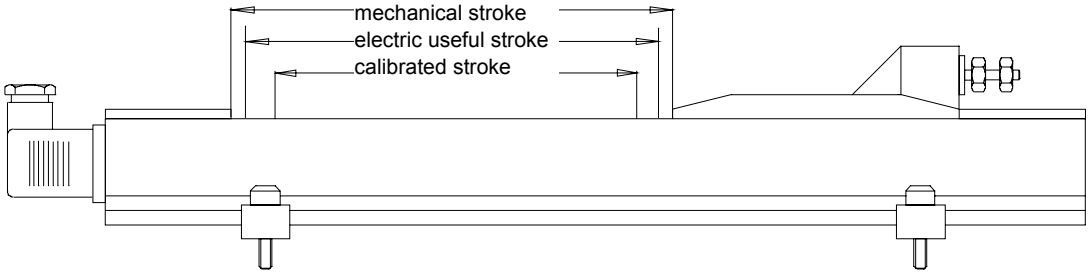
For the open and closed loop control of positions, pressures, forces, speeds and temperatures analogously working components are employed. For the tuning to the machine and control unit therefore different calibrations and adjustments are required.

1 STROKE TRANSDUCER

1.1 OHMIC STROKE TRANSDUCERS

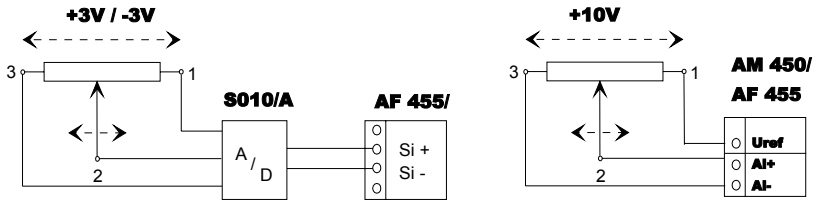
For the measurement of the strokes ohmic stroke transducers are used. These transducers are distinguished by a good resolution (0.01mm) and by a good linearity.

Ohmic stroke transducer:



Transmission possibilites of the transducer signal:

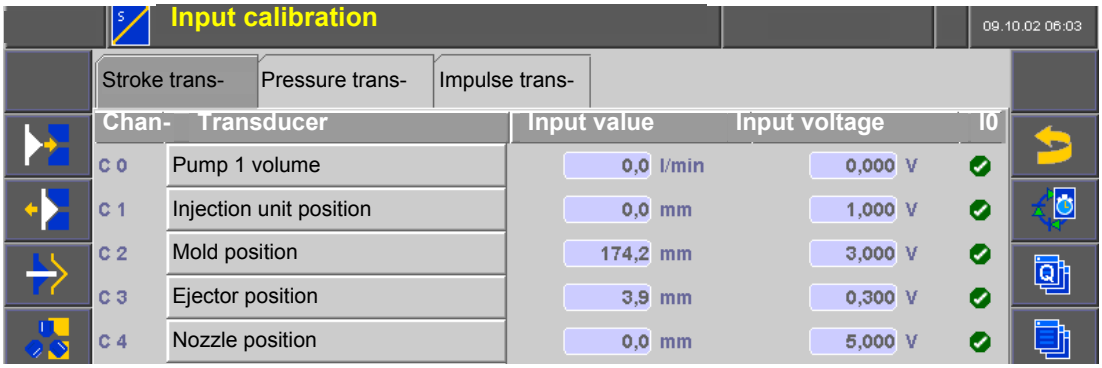
Connections, power supply for stroke transducer:



- Serial interface: Supply of the stroke transducers via the transducer SE010/A (integrated into plug on the stroke transducer) with a voltage of +3/-3V. Measuring signal transmission serial to the AF455.
- Analog interface: Supply of the stroke transducers with a voltage of +10V. Measuring signal transmission analogously to the AM450 and/or AF455.

Survey of the stroke transducers with their actual values and selection possibility of a detailed view for the respective transducer:

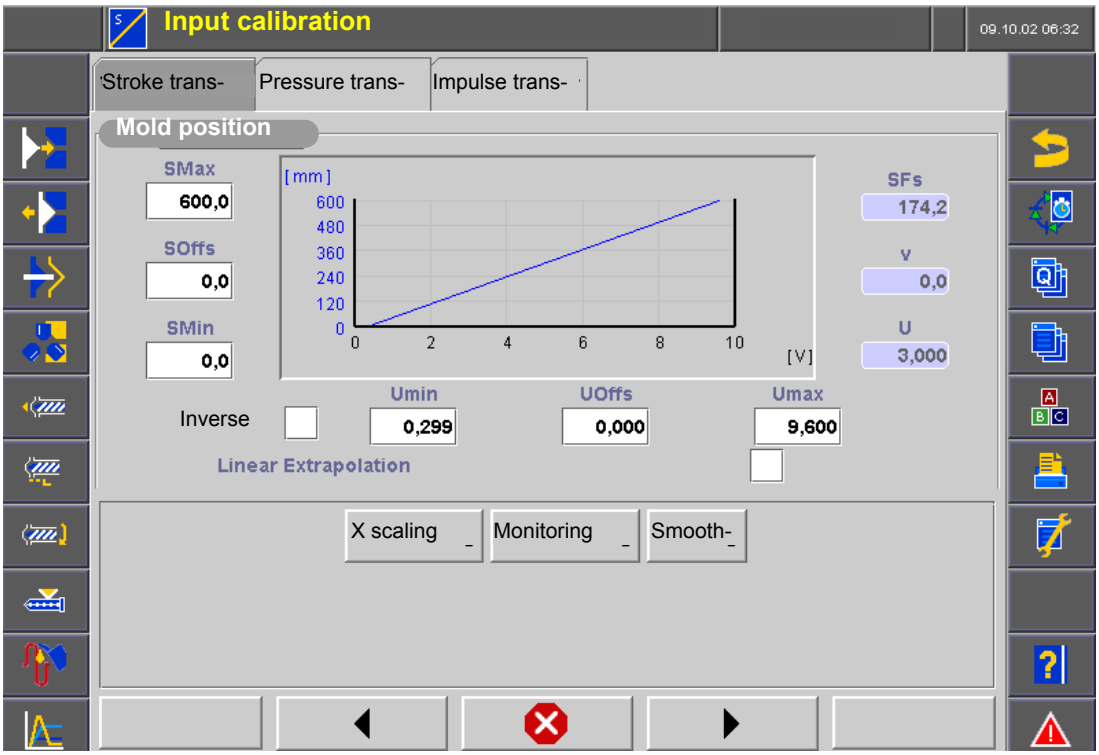




Display that the transducer is okay

Display that a min., max. or offset monitoring has reacted.
[See 'Monitoring' on side 133.]

Detailled view with graphics

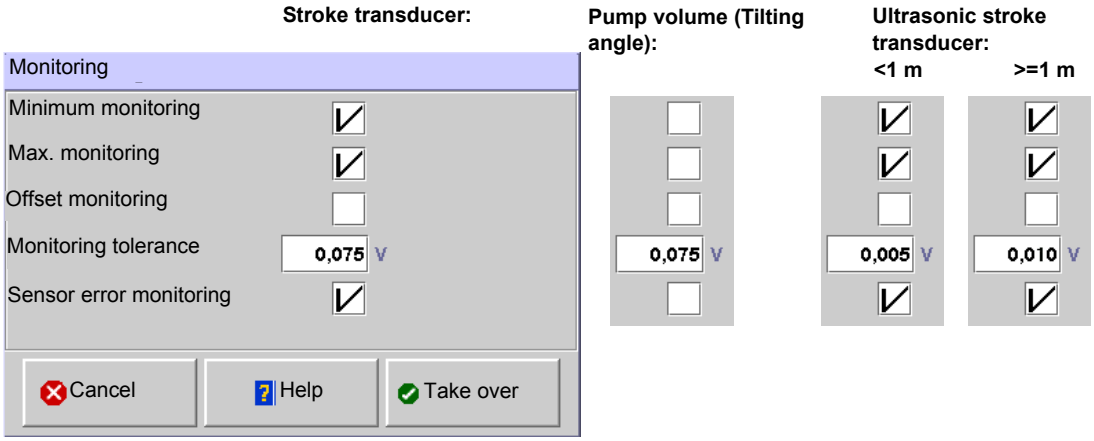


Explanation of the abbreviatons:

”sMin”/”sMax”	Minimum stroke / maximum stroke of the movement
”Umin”	Zero stroke calibrated in Volt. This voltage the stroke transducer delivers at position ”0”.
”UMax”	When reaching the maximum stroke this voltage has beeen measured and stored.
”UOffs”	determined offset voltage (e.g. nozzle zero point)
”SFs”	Display of the stroke in mm
”v”	Display of the current speed of the respective movement
”U”	Display of the current stroke transducer voltage, in Millivolt
”Inverse”	Stroke transducer voltage commutated
”Linear extrapolation”	For measuring values outside min/max
”X scaling”	Change of the X-axis calibration possible
”Monitoring”	Selection of monitorings (min, max, offset)
”Smoothing”	Setting of the smoothing time for stroke measurement and speed measurement.

1.2 MONITORING

The monitoring of the individual stroke transducers can be configured.
Selection with **”Input calibrations”** / **”Stroke transducer”** / **”Stroke x”** / **[Monitoring]**:



”Minimum monitoring” Activation of the monitoring; whether minimum (Umin) is not reached.
”Max. monitoring” Activation of the monitoring; whether maximum (Umax) is exceeded.
”Offset monitoring”Activation of the monitoring; whether offset (Umin+Uoffs) is not reached.
”Monitoring tolerance” Tolerance for monitorings Min/Max and offset monitoring.
”Sensor error monitoring” Activation of the monitoring for cable break.

At some transducers this dialog can include another parameter (e.g. tolerance for position monitoring). The set value indicates by how much the movement may move without actuation.
[See message:”’Component x stroke monitoring”’]

	**”Component x stroke transducer defective (min, max, offset)”**
Reason	By the control unit a position has been measured which is not possible according to the calibrated minimum and maximum positions.
Effect	The automatic cycle and the respective movement stop.
Reset	Check stroke transducer and its fastening and clean it and/or possibly exchange it. Check cable for wire break and/or short circuit. Check the transducer voltage on the detailled view of the input calibration. The input voltage must lie between **”Umin”** and **”Umax”**.

If a component moves without actuation, the control unit shows the message:

	**”Component x stroke monitoring”**
Reason	Position stroke monitoring has reacted because the component has moved around the set tolerance stroke without actuation.
Effect	Motor stops immediately, the alarm lamp flashes.
Reset	Check of the drive for the component. Check the set tolerance stroke.

1.3 CARRY OUT THE STROKE CALIBRATION

A calibration is necessary then when an exchange of a transducer or a position change has occurred.
It serves to record the maximum strokes of the individual function units and to transmit to the control unit.

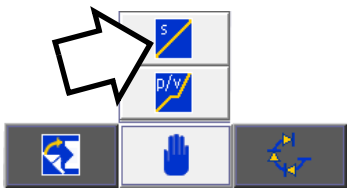
Note!

In order to enable the moving over the whole stroke, no injection mold may be mounted (only at analog stroke transducers).

WARNING!

The ejector can be run during calibration in each mold position!

Changeover of the operating state



Procedure:

1. Set machine to manual mode and establish the conditions for the respective movements.
2. Switching on of the calibration by changeover of the operating state from Manual to input calibration.
   One function unit each can now be run with the hand control keys. The movements occur with separate pressure and speed outputs.
3. With the hand control keys move the unit on maximum stroke. On the screen watch the actual value displays. They must show a rising profile during the movement.
4. After the unit has run on maximum stroke (mechanical stop of the hydraulic cylinder), have the hand control key still actuated until **”sMax”** and **”Umax”** take over the actual values. Now the maximum stroke is calibrated.
5. With the hand control key actuate the unit in the other direction, the actual values are falling.
6. When reaching the zero point (mechanical stop of the hydraulic cylinder) have the hand control key still actuated until **”sMin”** and **”Umin”** take over the actual values.
7. Afterwards run in the other direction again. The actual value now corresponds exactly to the run stroke.
8. Switching-off of the calibration by changeover of the operating state from input calibration to Manual.
9. Store these data now as ENGEL machine data set whereby it must be considered that also all other machine constants and calibration tables are transmitted.

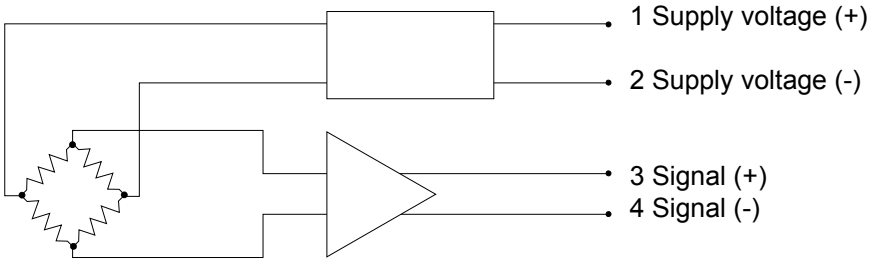
2 PRESSURE TRANSDUCER

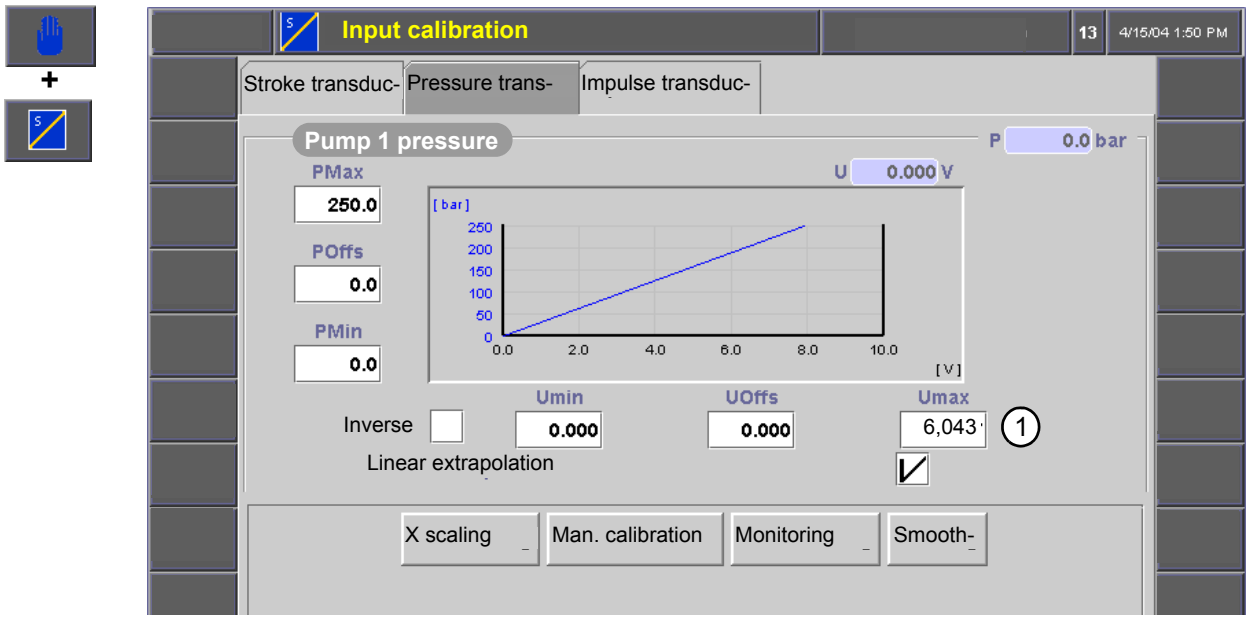
For the measurement of pressures, depending on the machine construction, a different number of pressure transducers is employed.

Example pressure transducer Dynisco: Offset +200mV, sensitivity 24.17mV/bar



Electric connection





[1] **”Umax”**:
Pressure transducer Dynisco ... 6,043 V
Pump pressure transducer HM16 ... 7,937 V

Explanation of the abbreviatons:

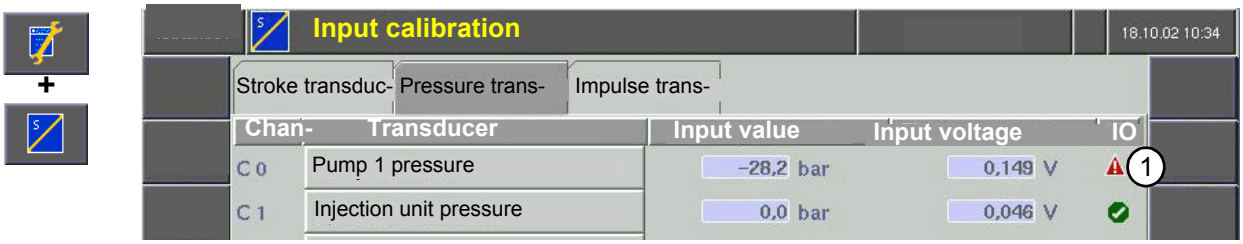
”PMin”/”PMax”	Minimum pressure / maximum pressure
”Umin”/”UMax”	Voltage of the minimum pressure/maximum pressure
”POffs”	Offset pressure (determined automatically or entered manually)
”UOffs”	Offset voltage (determined automatically or entered manually)
”P”	Pressure reading in bar
”U”	Current pressure transducer voltage, in millivolts
”Inverse”	Pressure transducer voltage changed poles
”Linear extrapolation”	For measuring values outside min/max
[X scaling]	Change of the X-axis calibration possible
[Man. calibration]	Setting of the linear curve (0 and max)
[Monitoring]	Selection of monitorings (min, max, offset)
[Smoothing]	Setting of the smoothing time for pressure measurement

2.1 AUTOMATIC OFFSET DETERMINATION

The control unit determines for each pressure transducer the offset voltage automatically when the motor is switched off for about 10-20 minutes (Hydraulic system pressureless). At the pressure transducer on the clamping unit the mold must be open in addition.
When the voltage lies between **”Min Offset”** and **”Max Offset”**, the input voltage is entered as offset.
When the value lies outside the offset area, appears the message:

	**”x offset pressure transducer outside the tolerance”**
Reason	Pressure transducer offset outside allowed area.
Effect	The alarm lamp flashes, the motors cannot be started and the heatings reduce delayed.
Reset	Check pressure transducer, cabling. A readjustment is possible at some types with an adjusting screw. Manuel setting at **”UOffs”** possible.

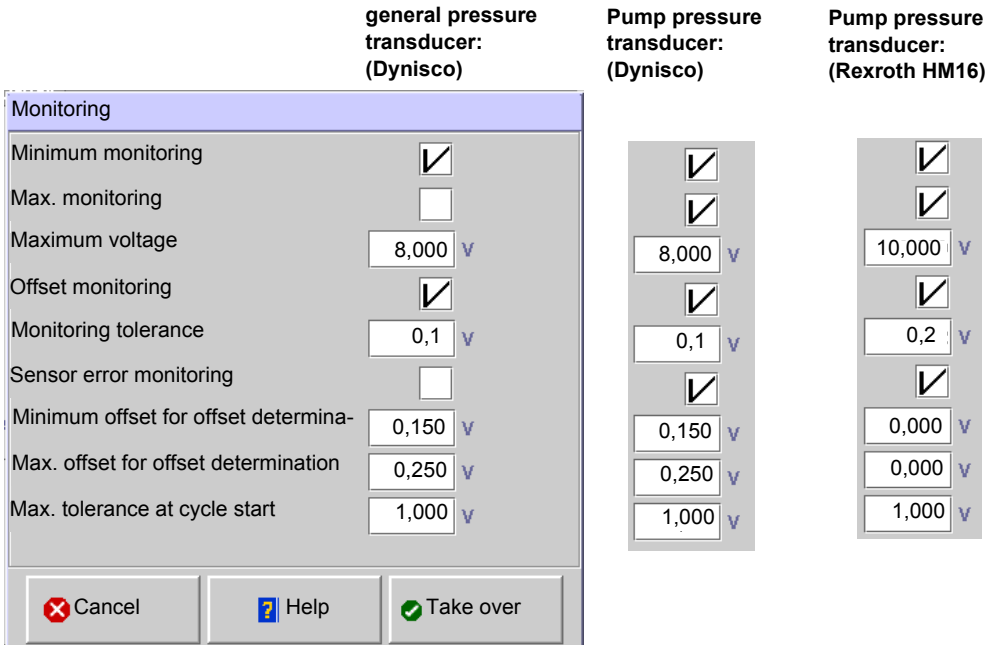
In addition, an error icon displays the corresponding pressure transducer on screen page **”Input calibrations”** / **”Pressure transducer”** :



[1] Error icon

2.2 MONITORING

The monitoring of the individual pressure transducers can be configured.
Selection with **"Input calibrations"** / **"Pressure transducer"** / **"Pressure x"** / **[Monitoring]**:



"Minimum monitoring" Activation of the monitoring; whether minimum (Umin) is not reached.
"Max. monitoring" Activation of the monitoring whether maximum (Umax) is exceeded. Is always switched on at pump pressure transducer for the protection of the pumps.
"Maximum voltage" In order that voltage peaks do not output an error immediately, here a maximally allowed voltage can be entered.
"Offset monitoring"Activation of the monitoring; whether offset (Umin+Uoffs) is not reached.
"Monitoring tolerance" Tolerance for monitorings Min/Max and offset monitoring.
"Sensor error monitoring" Activation of the monitoring for cable break and/or sensor defect
"Minimum offset for offset determination" Minimum limit at offset determination.
"Max. offset for offset determination (0=off) " Maximum limit during offset determination. With the value **"0"** the offset determination is switched off.
"Max. tolerance at cycle start" Tolerance for exceeding of Umax at cycle start.

With switched-on monitoring the control unit checks the transducer voltage permanently. When the voltage is not between Umin + Uoffs and Umax +/-tolerance, appears the message:

	**"x pressure transducer defective (min, max, offset)"**
Effect	The automatic cycle, the respective movement and the motor stop, the alarm lamp flashes, changeover to manual mode. Error icon on the screen page **"Input calibrations"** / **"Pressure transducer"**
Reset	Check pressure transducer and cable (short circuit, wire break, supply voltage). Check the transducer voltage on screen page Input calibration.

Monitoring of the pump pressure at motor start

Pumps of started motors must be on stand-by pressure, pumps of motors still to be started must be under the maximum pressure for motor start.

	**”Pump pressure x too high to switch on motor”**
Reason	Pump pressure for motor start too high (Setting see list of variables Motor)
Effect	The alarm lamp flashes, the motors cannot be started and the heatings reduce delayed.
Reset	Check pressure transducer, cabling, pump configuration (pump x on motor x), pump interconnection (solenoids, check valves), pump x.

Monitoring of the minimum pressure of the pumps

If the minimum pump pressure is not reached longer than the allowed time, the motors are switched off delayed.

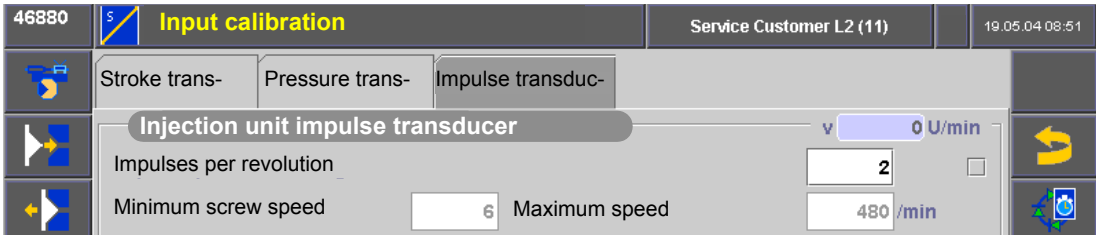
	**”Pump pressure x too low”**
Reason	Pump pressure smaller than minimum pressure variable displacement pump.
Effect	The alarm lamp flashes, movements are stopped, the motors switch off delayed and the heatings reduce delayed.
Reset	Check pressure transducer, cabling, pump input/output calibration pump x.

Monitoring of the injection pressure

For safeguarding the barrel the hydraulic pressure in the injection cylinder is monitored.
If the injection pressure exceeds the biggest set injection pressure and post injection pressure value, the following error is displayed.

	**”Injection pressure x exceeded”**
Reason	The injection pressure has exceeded the biggest set injection pressure and post injection pressure value by an adjustable tolerance longer than the devibration time.
Effect	The injection process stops, the cycle is still finished, the alarm lamp flashes, the motors switch off delayed and the heatings reduce delayed.
Reset	Check pressure transducer, cabling, pump/servo valve

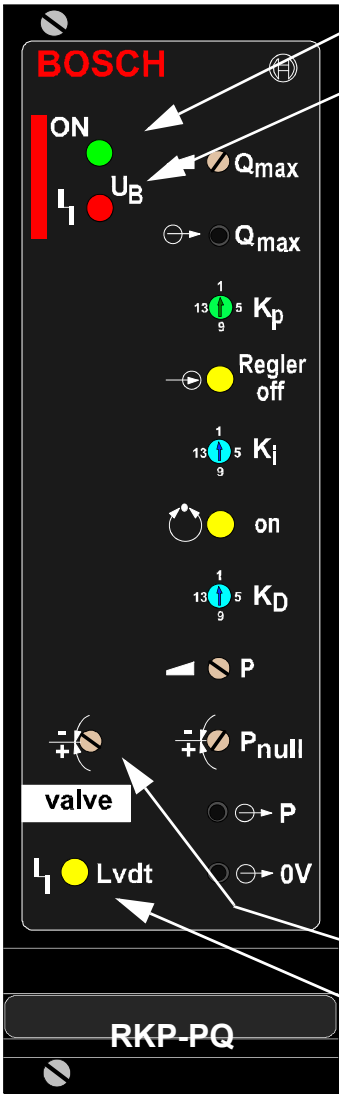
3 IMPULSE TRANSDUCER FOR SPEED



An inductive switch at the screw drive delivers impulses per revolution. The basic settings for recording the speed are given here.

4 BOSCH CONTROL MODULE

Amplifier module for radial piston pumps with electrohydraulic adjustment for pressure and throughput closed loop control



BR11 025

LED green ”Card release”
lights when pin z16 lies on 24V (Card release)

LED red ”Supply voltage too low”
lights when the supply voltage drops under 21V

Potentiometer ”Amplification volume”

Test jack volume

Hexcode switch for fine adjustment of the proportional share of the pressure closed loop control

LED yellow ”Pressure controller off”, lights when the pressure closed loop control is deactivated

Hexcode switch for fine adjustment of the integral share of the pressure closed loop control

LED yellow ”Pressure controller active”, lights when the pressure has reached the set value

Hexcode switch for fine adjustment of the differential share of the pressure closed loop control

Potentiometer ”Amplification pressure”

Potentiometer ”Zero point pressure”

Test jack pressure

Test jack 0V

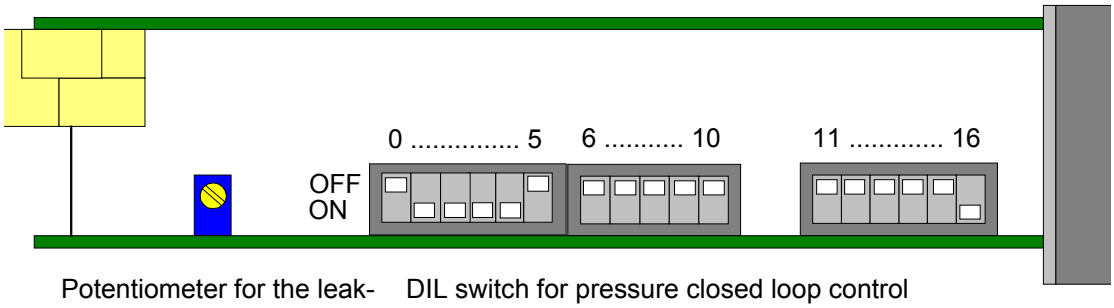
Potentiometer ”Zero point volume”

LED yellow ”Cable break stroke transducer”, lights in case of cable break of the stroke transducer

- Actuation with ± from the analog card.
- Depending on valve type the card outputs max. 2.7A (NG6) or max. 3.7A (NG10).

- All outputs are short circuit-proof.
- Adjustment of the individual controller shares on the card with DIL switches (rough adjustment) and with Hexcode switches (fine adjustment).
- Further, the card is equipped with a waste oil compensation, which is adjusted via a potentiometer directly on the card. The aim is to reach approximately the same volume throughput with different pressures.

Setting example of Hexcode and DIL switch:
Kp=3, Ki=4, Kd=8



Potentiometer for the leakage oil compensation

DIL switch for pressure closed loop control and pressure sensor

Error signals:

- Cable break pressure transducer (LED controllers off and on flash), DIL3
- Cable break stroke transducer (LED Lvdt)
- Supply voltage too low (LED UB)

	"Control card x defective"
Reason	The control card for pressure and volume of the EHV pump is defective or the monitoring input on the control unit for this card does not lie on +24V.
Effect	The alarm lamp flashes, the motors switch off and the heatings reduce. Renewed motor start is prevented.
Reset	Check the supply voltage and seat of the VT card in the holders. Also the connecting lines from control unit to the control card. Possibly exchange the card and adjust this newly. The settings can be read off and transmitted from the pulled-off card.

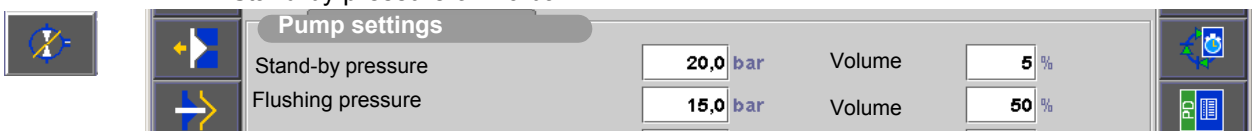
4.1 SETTING OF THE BOSCH VARIABLE DISPLACEMENT PUMP

Note!

As during the card adjustment various variables (constants) are adjusted, it is recommended to protect the current machine data.
[See 'Write ENGEL machine data' on side 126.]

Setting pump 1 before the motor start

1. Make the presetting of the control card according to setting protocol of the respective machine type.
   DIL 0 up to DIL 16 directly on the amplifier card; KP, KI and KD on the front panel.
2. Turn the potentiometer for leakage current compensation to the left on stop in order that the leakage current compensation is switched off. One recognizes the stop by faint clicking of the potentiometer.
3. Switch off the control voltage and insert the card with an external card holder.
4. Switch the control voltage on again.
5. Set the pump 1 P calibration to 0 up to +10V.
   [See 'Valve calibration' on side 144.]
6. Set the pump 1 V calibration to 0 up to +10V.
   [See 'Valve calibration' on side 144.]
7. Check or correct the following values:
   Flushing volume to 50%
   Flushing pressure to 15bar
   Stand-by volume on 10%
   Stand-by pressure on 20 bar



8. Tune the zero point of the pressure control circuit with the potentiometer on the front panel so that on the measuring sockets P and 0V approx. 0V can be measured.
9. If your machine has an accu, block this up and deactivate it in addition on the part of the software.
10. If your machine has a servovalve on the injection unit, set the closed loop control to Pump closed loop controlled. [See 'Closed loop control via servovalve' on side 158.]

Pressure setting pump1 after the motor start:

1. Set the variable **"Maximum injection pressure"** (setting limitation for the injection pressure limit) to the system pressure and switch on the motor. Switch off **"Stop molding at pressure limit"** and the pressure limit closed loop control in addition. [See 'Pressure limit injection pump' on side 156.]
2. Set Pmin: Set the time-dependent changeover and a long injection time. Move the screw on mechanical stop and set the injection pressure limit to 10 bar.
   Press injection together with the key-operated switch (in order to switch off the pressure limitation) and align with potentiometer Pzero the actual pressure to the set pressure.
3. Set Pmax: Set the injection pressure limit to maximum and press injection together with the key-operated switch, adjusting the actual value with potentiometer **"P"** to the set set value.
4. Repeat the two preceding items under the control of the pressure set values with the actual values (e.g. 10, 50, 100, ... 250 bar).
5. Afterwards reset the variable **"Maximum injection pressure"** (setting limitation for the injection pressure limit) and **"Stop molding at pressure limit"** to the original value.
6. When necessary, check the safety valve (e.g. after exchange), switching off DIL4 and pressing Molding. (~280 - 300 bar)

Speed setting for pump 1

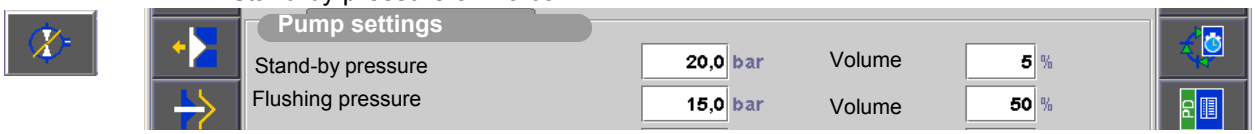
1. Switch off the speed closed loop control in the software, afterwards set the [See 'Injection speed pump' on side 156.]**"Injection pressure limit"** to maximum. On

machines with 2 pumps and ACCU for the volume setting of the main pump the set value setting for volume and pressure of pump 2 must be set to 0 for a short time as otherwise the pump 2 conveys the oil to the main pump.

2. Set minimum speed: Set the injection speed to 10 mm/sec. and press injection together with the key-operated switch, adjusting the actual value with potentiometer valve to the set set value.
3. Set maximum speed: Set the metering stroke and the injection speed to maximum. Press injection together with the key-operated switch, adjusting the actual value with potentiometer Qmax to the set set value.
4. Repeat the two preceding items under the control of the speed set values with the actual values.
5. At 2-pump hydraulics reset the volume and pressure output for pump 2 into the original state again
6. Waste oil compensation with material: Set the waste oil potentiometer in the middle and adjust the current injection speed to the set value setting during production.
   Hint: The more pressure is needed during injection, the more the leakage oil losses make themselves felt and the more exactly the compensation can be adjusted.
7. Switch the speed closed loop control on again and reset the injection pressure limit to the original value again. On accu machines open the stop valve for the accu again and activate it again on the screen page Injection.

Setting pump 2 before the motor start

1. Make the presetting of the control card according to setting protocol of the respective machine type.
   DIL 0 up to DIL 16 directly on the amplifier card; KP, KI and KD on the front panel.
2. Turn the potentiometer for leakage current compensation to the left on stop in order that the leakage current compensation is switched off. One recognizes the stop by faint clicking of the potentiometer.
3. Switch off the control voltage and insert the card with an external card holder.
4. Switch the control voltage on again.
5. Set the pump 1 P calibration to 0 up to +10V.
   [See 'Valve calibration' on side 144.]
6. Set the pump 1 V calibration to 0 up to +10V.
   [See 'Valve calibration' on side 144.]
7. Check or correct the following values:
   Flushing volume to 50%
   Flushing pressure to 15bar
   Stand-by volume on 10%
   Stand-by pressure on 20 bar



8. Tune the zero point of the pressure control circuit with the potentiometer on the front panel so that on the measuring sockets P and 0V approx. 0V can be measured.
9. If your machine has an accu, block this up and deactivate it in addition on the part of the software.

Pressure setting pump2 after the motor start:

1. Move the ejector approx. in the middle in order that no ramps are active during the setting and disconnect the two ejector slides. Set the pressure **"max. pressure ejector**

forward” to the system pressure and afterwards the force for ejector forward to maximum and the force for ejector return to 10% of the maximum force.

2. Set Pmin: Press Ejector return and set with potentiometer Pzero 10% of the maximum pressure.
3. Set Pmax: Press Ejector forward and set with potentiometer P the maximum pressure for 2nd pump (max. pressure see Calibration curve).
4. Repeat the two preceding items until you have reached the values and then reset the **”max. pressure ejector forward”** again.
5. When necessary, check the safety valve (e.g. after exchange), switching off DIL4 and pressing ejector forward. (~280 - 300 bar)
6. Connect the two ejector solenoids again.

Speed setting for pump 2

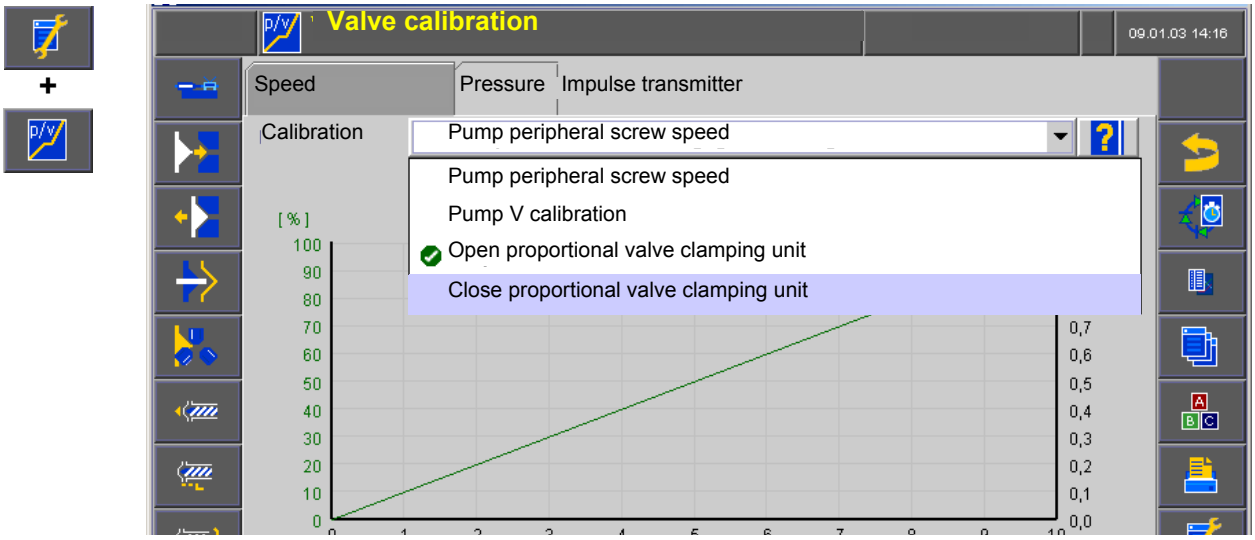
1. Close the mold in order to build up the clamping pressure. Advance carriage unit and determine J (in order that pressure is not reduced).
   Set the contact pressure and the nozzle speed forward from 20mm to maximum and the nozzle speed between 0mm and 20mm to 5% of the maximum speed.
   After the settings return the carriage unit.
2. Set Vmin: Set the analog output for volume pump 2 (A04) to 0.5V and activate the measurement of the pump2 V calibration. With potentiometer set valve to 10% of the maximum speed (e.g. 100% = 129 > 10% = 13 mm / sec.).
3. Set Vmax: Set the analog output for volume pump 2 (A04) to 5V and activate the measurement of the pump2 V calibration. Press Carriage forward and adjust with potentiometer Qmax the actual speed to the maximum speed (max. speed see data sheet and/or valve calibration pump 2, e.g. 100% = 129 mm/sec).
4. Repeat the two preceding items and reset the analog output for volume pump 2.
5. Turn the potentiometer waste oil compensation pump 2 into the same position as at pump 1.
6. At accu machines open the stopcock for the accu again and activate it again on the screen page Injection

Note!

When in the wake of the above described putting into operation the pump or servovalve closed loop control has been switched off or program switches have been switched over, the basic settings must be made again after completing the putting into operation.

5 VALVE CALIBRATION

Recording of the characteristic lines of the proportional valves and of the servovalve. Voltage values are given by the control unit and the reactions of the valve to be calibrated are recorded as actual values and stored in tables. At the output of set values then the computer accesses to the corresponding table value.
Protection of these data at the end of the start-up together with all other machine parameters as ENGEL machine data. If these data get lost for defect reasons, one reads in the ENGEL machine data anew. [See ’Write ENGEL machine data’ on side 126.]



Means that it has already been calibrated successfully.

When further valves are mounted which need a calibration, these appear on the menu.

Distinction into different calibration types:

a) Linear output:

- Only setting of the 0 point and max. point. The connection (explicitly the output on the valve) occurs with a straight line between these points.
- The setting of the points (rotation of the initialized straight line) occurs with the cursor keys.

b) Speed calibration / Pressure calibration:

- The computer sets voltage value to the valve in an automatic calibration cycle and measures the real extent of the movement. At first it determines the 0 point of the movement and then rises with constant voltage steps until no increase of the sped is recognized any longer. It enters the measured data into a table to which it can access later at the set value setting.

c) Screw speed calibration:

- Analogously to the speed calibration.

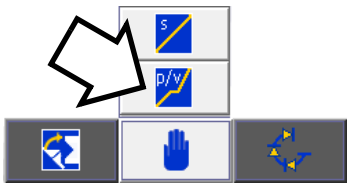
valves	Calibration type	by means of
Volume central, 1 pump	a)	without movement
Volume central, 2 pumps	a)	without movement
RPM	c)	Screw rotation
Servo valve injection	b)	Injection movement
Close proportional valve	a)	Closing movement
Open proportional valve	a)	Opening movement
Prop. for ejector and core-pull	a)	Ejector movement

Preparations:

1. Set machine to manual mode
2. Switch on motor, wait for delta run

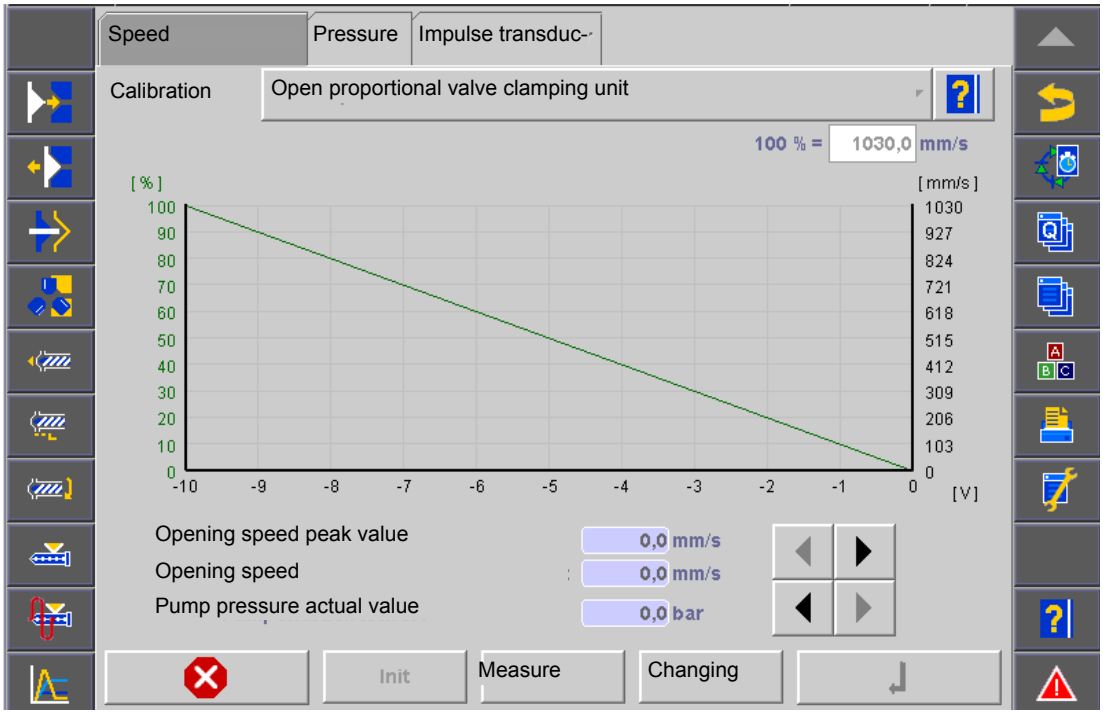
3. Bring hydraulic oil temperature to 40 up to 45 degrees centigrade (possibly start the oil preheating program)
4. Establish the conditions for the individual movements:
   - Close safety cover clamping unit
   - Close safety cover nozzle
   - Unit must not be swivelled out
   - Establish the conditions for screw movement and retract the nozzle from a possibly built-in mould
   - For the movements the safety conditions must be fulfilled

Changeover of the operating state



5.1 LINEAR OUTPUT

Only setting of the 0 point and max. point. The connection (explicitly the output on the valve) occurs with a straight line between these points.
The setting of the points (rotation of the initialized straight line) happens with the cursor key or numerically.



On this screen page the calibrated curve of the valve is represented on a percent axis from 0 to 100% and a voltage axis from 0 to +10V.

Initialization

By pressing **[Init]** a distance of 0%,OV to 100%,(-)+10V is drawn (linear values for presetting the proportional amplifiers).

Measurement
By pressing **[Measuring]** the actual values for current speed, peak value and pump pressure appear.

0-point determination:

1. Enter for the respective mold movment the speed values of 1% of the maximum value.
2. Carry out the movement.
3. Set with the cursor keys (left/right) the straight line on the graphics so that the mold still moves.

Set maximum value

1. Enter for the respective mold movement the speed values of 100% of the maximum value.
2. Carry out the movement watching the two actual values.
3. Set with the cursor keys (left/right) the straight line on the graphics so that the maximum value of the speed is just reached.

Note!

Do not forget to take over change!

Changing
The microprocessor gives during calibration certain voltage stages as actuation on the concerned valve and then stores the reached value. Between the individual stages it calculates a linear characteristic line, but when a valve between the individual stages is especially unlinear, it is possible to recorrect each individual percent stage with **[CHANGE]**.

Note!

Do not forget to take over change!

5.2 SPEED CALIBRATION

The computer gives in an automatic calibration cycle voltage values to the valve and measures the real extent of the movement. At first it determines the 0 point of the movement and then rises with constant voltage steps until the maximum speed (100%) is reached. It enters the measured data into a table to which it can access later at the set value setting.

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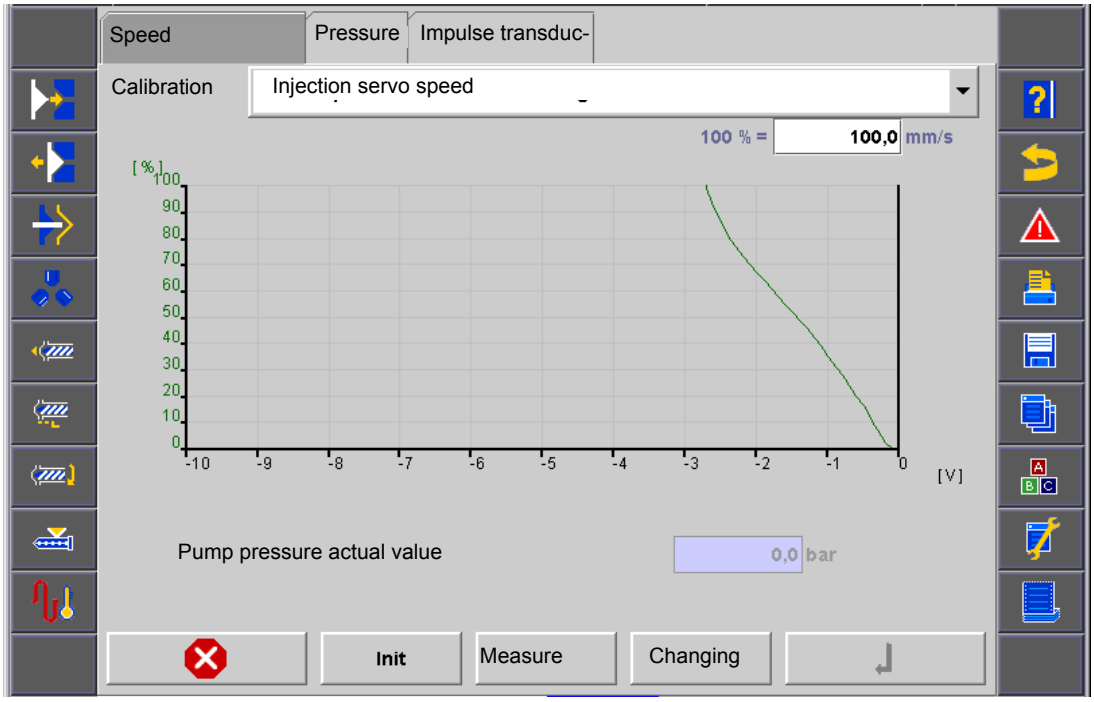


As output curve the graphics show the curve stored at the last calibration on a percent axis of 0 to 100% and on a voltage axis of -10V to 0V.
When it is not yet calibrated, a linear curve of 0%,0V to 100%,-10V is represented.
A distance of 0%,OV up to 100%,(-)+10V is drawn (linear values for presetting the proportional amplifiers).

Initialization
By pressing **[Init]** a distance of 0%,OV to 100%,(-)+10V is drawn (linear values for presetting the proportional amplifiers).

Measurement
By this instruction the calibration is started and the valve is actuated in steps.

- For the measurement the screw returns entirely and the valve is actuated with a mean value.
- The voltage value (adjustable) is increased so long until the screw moves, then the voltage value is taken back again until the screw stands still again: Zero point
- Now the voltage value increases by 0.1V and the injection speed is measured and displayed. Then the screw returns again and the process is repeated until the max. speed is reached.

The characteristic line is drawn in per cent of the max. value.

Note!

Do not forget to take over change!

The characteristic line determined last (dotted) is taken over into the memory (continuous line).

Changing
The microprocessor gives during calibration certain voltage stages as actuation on the concerned valve and then stores the reached value. Between the individual stages it calculates a linear characteristic line, but when a valve between the individual stages is especially unlinear, it is possible to recorrect each individual percent stage with **[CHANGE]**.

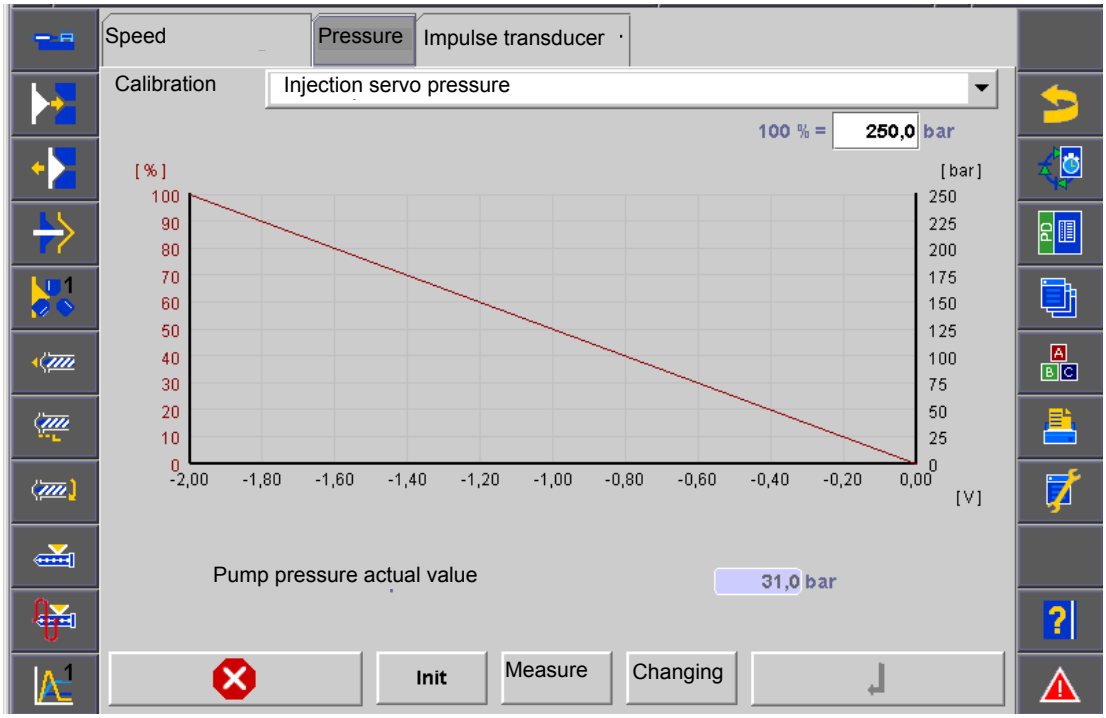
Note!

Do not forget to take over change!

5.3 PRESSURE CALIBRATION

For the pressure calibration there are two variants to make the calibration.

- Manual
- Automatic



Initialization
By pressing **[Init]** a distance of 0%,OV to 100%,(-)+10V is drawn (linear values for presetting the proportional amplifiers).

Measurement
Selection via automatic or manual calibration

- **Manual calibration**
  For the measurement the screw moves at first entirely forward. Then the voltage value for the pressure valve is increased step-by-step. At each increase the pressure actual value must be entered manually. The pressure actual value can be watched on the manometer and/or on the screen by the actual value display.
- **Automatic calibration**
  For the measurement the screw moves at first entirely forward. Then the voltage value

for the pressure valve is increased step-by-step and the actual value is entered automatically..

Note!

Do not forget to take over change!

The characteristic line determined last (dotted) is taken over into the memory (continuous line).

Changing
The microprocessor gives during calibration certain voltage stages as actuation on the concerned valve and then stores the reached value. Between the individual stages it calculates a linear characteristic line, but when a valve between the individual stages is especially unlinear, it is possible to recorrect each individual percent stage with **[CHANGE]**.

Note!

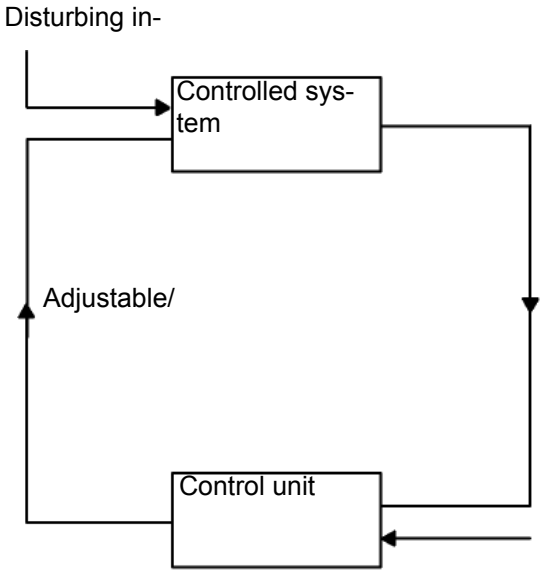
Do not forget to take over change!

5.4 SPEED CALIBRATION

Analogously to the speed calibration. The hydraulic motor for the screw drive is actuated.

6 SET CLOSED LOOP CONTROLS

Closed loop control principle

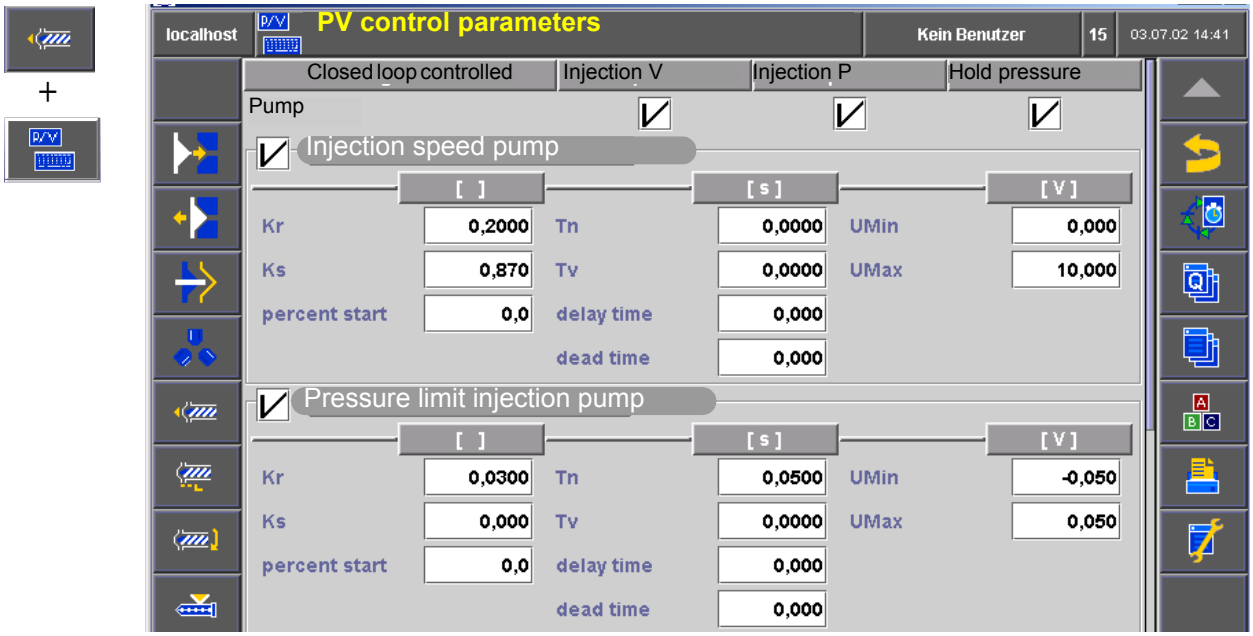


The reproducibility of each mold filling operation depends on the repeatability of the required injection speed, of the post injection pressure and of the back pressure.
In a control circuit basically a set-actual value comparison occurs whereby the difference is amplified correspondingly and is output as correction value according to special calculation alogithms.

By the employment of the variable displacement pump the volume throughput and the pressure are adapted to the machine cycle automatically, through which a minimum of energy consumption is guaranteed.

The pressure gradient via the throttle valve is kept constant, through which flow/throughput variations are compensated as a function of the consumer pressure.

In order to reach the request for observing most exacting tolerances and avoiding each re-machining, it is possble to complete the system by a speed and/or pressure closed loop control on the injection unit.



Kr	Reinforcement controller branch, P share yields a proportional output to the difference **increase:** quicker increase, better eliminatiion of malfunctions, higher tendency to oscillate **decrease:** slower increase, slower elimination of malfunctions, low tendency to oscillate
Ks	Pilot control value control branch The output value is fetched from the calibration and multiplied by Ks
percent start	Start point in percent of the controller 80 means that at 80% of the reached set value the controller is activated.
Tn	Reset time in sec, I share Corresponding to the difference set value - actual value a value is added up on the output permanently; the smaller Tn, the higher is the control effect **increase:** slow elimination of the difference to the set value **decrease:** quicker elimination of the difference to the set value
Tv	Rate time in sec, D share Change of the actual value is subtracted from the output (prevents e.g. the overshoot at pressure closed loop control) **increase:** stronger reaction at actual value changes, lower stability **decrease:** less reaction at actual value changes, stability increase

delay time	Controller employment delay The integrator is only put on after the delay time
dead time	Dead time Is only used at the position controller in order to compensate the dead time of the system.
r.p.m	Minimum output value of the controller
UMax	Maximum output value of the controller
UStart	Start voltage at back pressure controller

Prerequisites for setting the control parameters

- Volume and pressure calibrations must be carried out
- Differential system/switch on accu (if existing)
- Machine must be soaked (1/2 h automatic operation)
- Setting of the output limits of the controller (UMin/UMax - see presetting of the respective controller)

6.1 SETTING OF THE SPEED CLOSED LOOP CONTROL

The speed closed loop control is realized via a position controller. The position controller closed loop controls by means of set/actual position of the screw and delivers an adjustable in volt.
In the acceleration phase (during delay time) the output occurs without closed loop control according to the characteristic line of the valve.
With it one reaches that in the start phase the set speed is approximately reached, but the speed difference appearing during the start phase between set value and actual value does not lead to an overshoot as the position controller would attempt to make this up.
With the factor Ks a so-called precontrol value (also control circuit amplification) can be set, which acts as basic value for the controller output and stems directly from the calibration table. With Ks of e.g.: 0.9 the open loop controlled output is given to 90%. The rest is compensated by the controller.

At the position speed controller only the parameters Ks, Kr and dead time must be set.

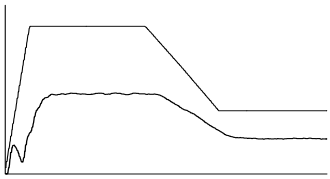
Without material set Kr as high as possible so that just no oscillations appear in order that the closed loop control with material reacts sufficiently quickly (At small speeds without material short oscillations can appear).

——— Speed set value [mm/s]
——— Speed actual value [mm/s]

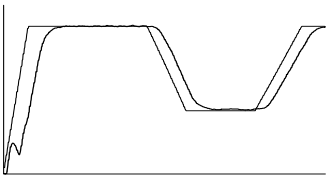
1. Presetting Kr, Tv and Tn = 0

2. Setting Ks

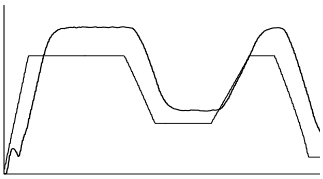
Ks too low
Set value is not reached



Ks ok

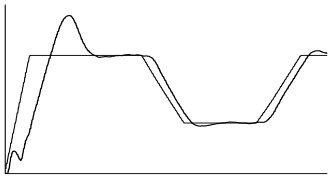


Ks too high
Set value is exceeded

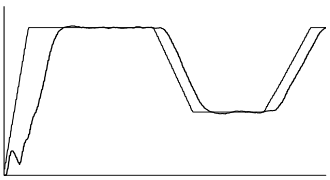


3. Setting delay time: Set Kr to 0.2 and enter the time between start injection and increase of the speed curve to 80% of the set value as delay time

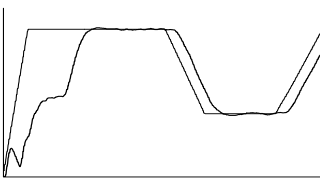
delay time too low,
Overshoot after start



delay time ok

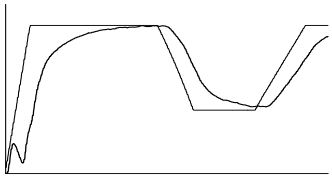


delay time too high,
Set value is reached too late

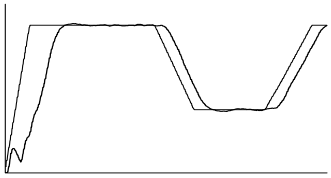


4. Setting parameter Kr (for setting the further parameters halve Ks)

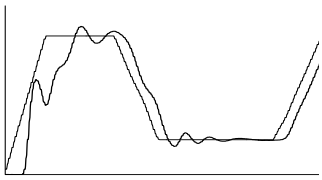
Kr too low
Set value is reached slowly



Kr ok



Kr too high
Oscillate



5. 5. Set parameter Ks to determined value again (double it)

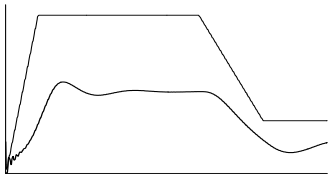
6.2 SETTING OF A PRESSURE CLOSED LOOP CONTROL

The pressure closed loop control is realized via a PID controller. If a characteristic line exists, set the amplfication of the control branch Ks to 1.0. As a result a voltage value is output without intervention of the controller via the characteristic line, through which the controller becomes more stable.
In order to compensate set/actual value deviations, Tn (I share) must be set. In order that overshoot is prevented, set also Tv (D share).

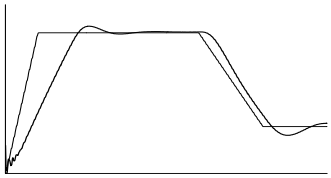
——— Pressure set value [bar]
——— Pressure actual value [bar]

1. 1. Presetting of the parameters Kr = smallest possible value bigger than 0, Tv = 0, Tn = 5
2. 2. Setting parameter Ks

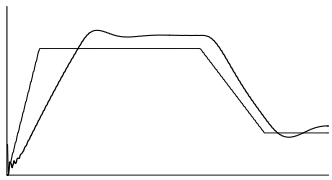
Ks too low
Set value is not reached



Ks ok

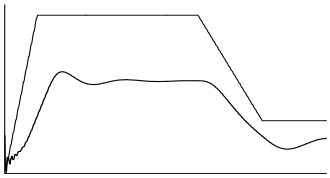


Ks too high
Set value is exceeded

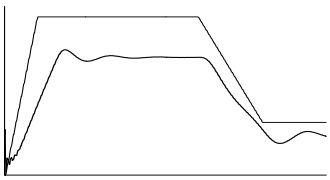


3. 3. Setting parameter Kr (for setting the further parameters halve Ks)

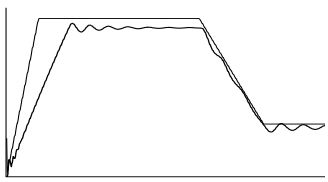
Kr too low
Set value is not reached



Kr ok set value is not reached
as tn setting (I share) is missing

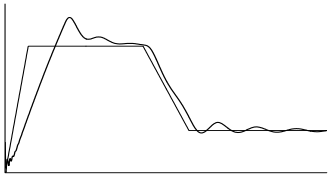


Kr too high
Oscillation

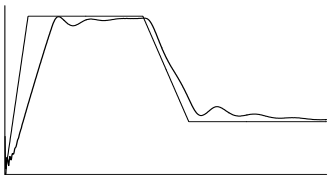


4. 4. Setting parameter Tn

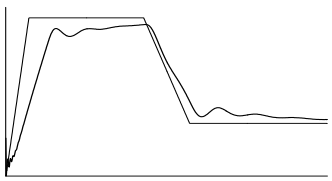
tn too low
Oscillate



tn ok

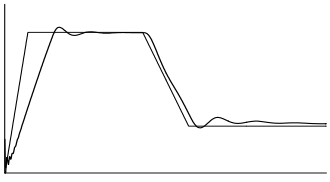


Tn too high
Set value is not reached

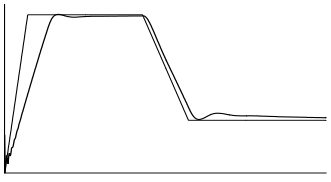


5. 5. Setting parameter Tv

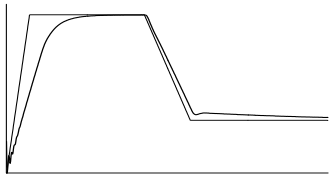
tv too low
slight overshoot



tv ok

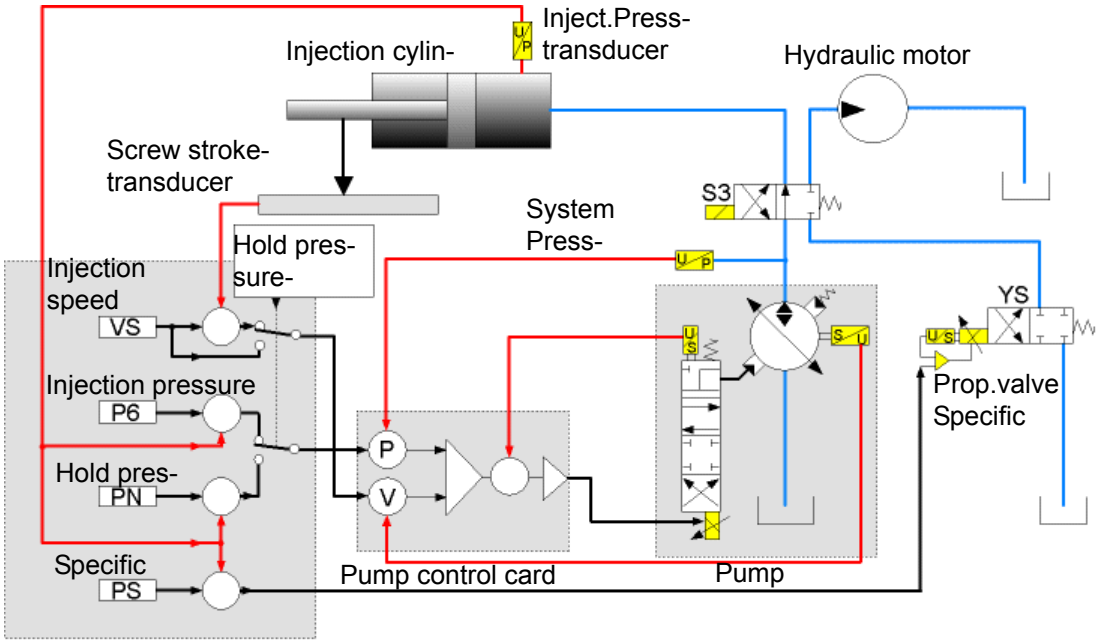


tv too high
Set value is reached slowly



6. 6. Set parameter Ks to determined value again (double it)

6.3 CLOSED LOOP CONTROL VIA PUMP



6.3.1 INJECTION SPEED PUMP

The injection speed is closed loop controlled via the set value setting of the pump. The speed profile for injection is processed by means of position closed loop control.

Standard values of the speed closed loop control

Parameters	Setting	
Kr	0,2	
Ks	0,95	
percent start	0	
Tn	0	s
Tv	0	s
delay time	0,1	s
dead time	0,05	s
r.p.m	0	V
UMax	10	V

6.3.2 PRESSURE LIMIT INJECTION PUMP

The pressure limit is closed loop controlled by the pumps electronics on the set value of the injection pressure limit with the system pressure transducer as measuring system.
Moreover, a software controller superimposes the hardware control circuit by influencing the injection pressure limit.
The set D share (Tv) is only effective in the pressure increase time. With reaching the pressure limit this is disconnected in order to get an improved control behaviour.

Standard values of the pressure limit closed loop control

Parameters	Setting	
Kr	0,01	
Ks	0	
percent start	0	
Tn	0,05	s
Tv	0,055	s
delay time	0	s
dead time	0	s
r.p.m	-1	V
UMax	0	V

6.3.3 POST INJECTION PRESSURE PUMP

In order to increase the accuracy of the closed loop pressure control, it is possible to connect to the pressure limit controller of the pump still a controller in series on the analog card. This measure compensates overdynamic processes and deviations, which can be caused by the open loop controlled setting.

The PID controller for the post injection pressure must be switched on on the screen page **"PV control parameters"** . It closed loop controls by means of pressure set/actual value and delivers an adjustable in volt.

Standard values of the post injection pressure closed loop control

Parameters	Setting	
Kr	0,003	
Ks	1.0	
percent start	80	
Tn	0	s
Tv	0,003	s
delay time	0	s
dead time	0	s
r.p.m	0,6	V
UMax	10	V

6.3.4 BACK PRESSURE

The back pressure controller is realized with a PID controller and delivers an adjustable in volts on the basis of pressure set/actual value difference.

Standard values of the back pressure closed loop control

Parameters	Setting	
Kr	0,05	
Ks	0	
percent start	0	
Tn	0,150	s
Tv	0	s
delay time	0	s
dead time	0	s
r.p.m	0,3	V
UMax	-0,4	V
UStart	7	V

Start value for the controller initialization:
On machines with a separate back pressure proportional valve for the controller a start value UStart can be entered. With it one dampens the overshooter at the beginning of the closed loop control process.
The start value corresponds to that voltage which the controller outputs when starting the closed loop control.

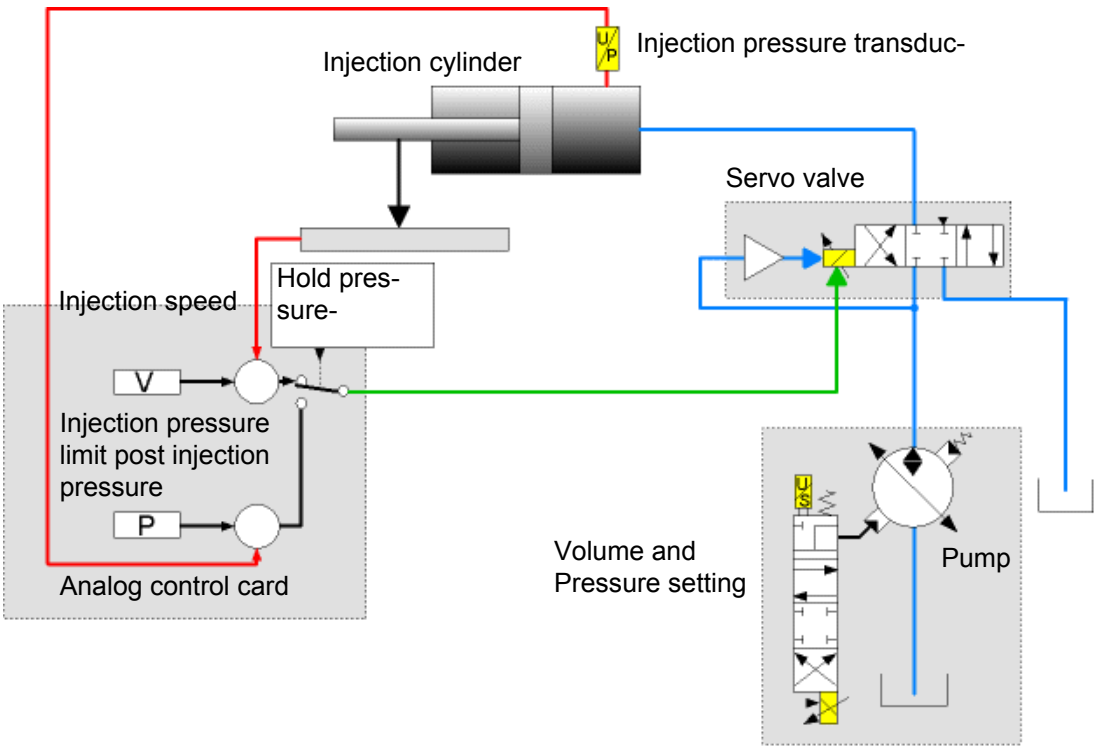
Start value for controller initialization at active back pressure:
When the active pressure transition from post injection pressure to back pressure is activated, the start value UStart must be set smaller as with too big start value the valve opens and the pressure is reduced immediately.

6.4 CLOSED LOOP CONTROL VIA SERVOVALVE

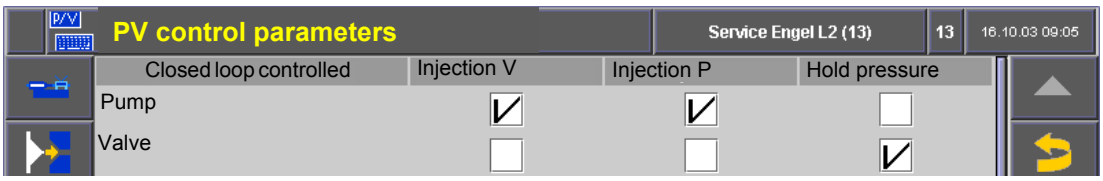
6.4.1 GENERAL

In order to be able to reach the best precise repeatability and tightest tolerances, in many application cases a servo valve is employed on the injection unit in order to closed loop control with this fast control element the injection speed, the holding and the back pressure.
During the mold filling phase a software position closed loop control occurs. The system observes the requested speed by setting calculated stroke positions. A pressure limit closed loop control starts when a maximum pressure given for sparing the mold (injection pressure limit) is reached. In the transition from mold filling to packing phase the changeover from position closed loop control to post injection pressure closed loop control occurs (Changeover point). Here a speed limit is defined which follows the speed profile setting up to the 10th profile point.

Principle of the closed loop control with servo valve

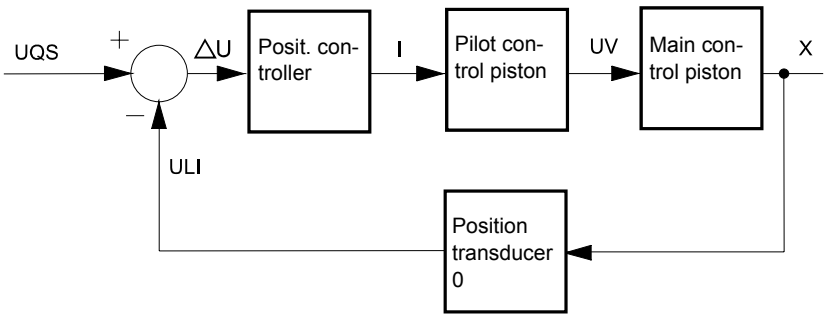


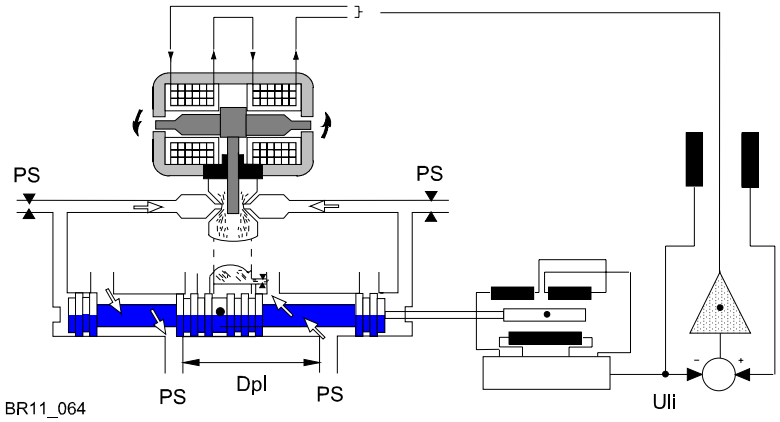
Selection of the type of closed loop control



By the configuration switches it can be selected whether it is closed loop controlled via the pump or via the valve.

Method of operation of electronically position-controlled valves:





The term ”Servo” quite generally says that a small input variable causes a big output variable. In electrohydraulic pressure and speed control circuits servovalves are employed because of their fast reaction.
For an exact conversion independent of disturbing influences if possible of the electric input signal in throughput or pressure the control piston is position closed loop controlled.
An electric input signal (set value UQS) is given on the position controller integrated in the valve, which drives current through the torque motor coils.
Like at the mechanically position-controlled valves this causes a pressure difference on the faces of the control piston and causes its displacement.
The position transducer fed via an oscillator measures the position of the control piston (Actual value ULI). This actual value rectified by a demodulator is led back to the position controller, which compares it with the set value UQS. The position controller actuates the torque motor so long until set and actual value are the same. Because of that the position of the control piston is proportional to the electric set value. Simplifying the position set value is called throughput set value. The actual throughput from the valve to the consumer is dependent on the valve pressure drop.

The following SERVO VALVES are employed:

- Two-stage MOOG SERVOVALVES with electronic position control
- Three-stage MOOG SERVO VALVES with electronic closed loop position control
- BOSCH SERVO VALVES

Detailed documents about functioning and/or sectional drawings can be had at ENGEL after-sales service for service cases.

6.4.2 INJECTION SPEED VALVE

The speed profile for injection is processed by means of position closed loop control. A parameter (Kr = P share) must be adjusted. The position controller closed loop controls by means of set/actual position of the screw and delivers an adjustable in volt.

Standard values of the speed closed loop control

Parameters	Setting	
Kr	0,28	
Ks	1.0	
percent start	0	
Tn	0	s
Tv	0	s
delay time	0,1	s
dead time	0,05	s
r.p.m	-10	V
UMax	10	V

Starting from the basic setting the controller can still be optimized:
Set (increase) the amplification kr so that a minimum overshoot can be reproduced. Max. overshooter of 5mm/s (at a set value of 80mm/s) allowed. When braking to a small speed the undershooter must not be more than 5mm/s. After 200ms at the latest the transient effect must be finished. A decrease of Ks brings more of controller employment, i.e. the control circuit amplification kr must be increased.

Closed loop control employment delay:
As at the closed loop control via a servovalve the delay of the pump at start injection shall not shrink, the pump is actuated by a time earlier before the controller becomes active on the servovalve.

6.4.3 PRESSURE LIMIT INJECTION VALVE

By the closed loop control of the pressure limit with servovalve on the set value setting injection pressure limit the pressure limit can be closed loop controlled regardless of the speed controller.
The always active pump controller runs with set value injection pressure limit plus an adjustable tolerance range.
The pressure limit closed loop control occurs via a PID controller algorithm and acts on the speed set value setting at servo valve closed loop control.
Before reaching the pressure limit a PD controller acts without I share (Tn). After reaching the injection pressure limit a PI controller becomes active without D share (Tv), through which in the pressure control phase larger stability is reached.

The stroke point of the first exceeding is marked with a red line in the set value graphics for injection.

Standard values of the pressure limit closed loop control

Parameters	Setting	
Kr	0,015	
Ks	0	
percent start	0	
Tn	0,09	s
Tv	0,035	s
delay time	0	s
dead time	0	s
r.p.m	0	V
UMax	10	V

Increase Kr so long until first tendencies to oscillate arise, afterwards increase Tv with a Kr without tendencies to osciallate so long until the overshooter falls on an acceptable value without that the system begins to oscillate.
The pressure limit closed loop control should best be set to material cushion. If this is not possible, one can set the closed loop control also to stop, but must consider that with material the behaviour could worsen.
For the setting to stop a pressure value of 90% of the maximum injection pressure shall be set.
Start position for the control of the pressure limit closed loop control is always the front screw position (ssx = 0.0mm)

6.4.4 INJECTION HOLD PRESSURE VALVE

After switching over to holding pressure the PI holding pressure controller gets active.
As post injection pressure controller a PI controller is provided. It closed loop controls by means of pressure set/actual value and delivers an adjustable in volt.

Standard values of the post injection pressure closed loop control

Parameters	Setting	
Kr	0,05	
Ks	0	
percent start	0	
Tn	0,15	s
Tv	0	s
delay time	0	s
dead time	0	s
r.p.m	-5	V
UMax	1	V

Increase Kr so long until first tendencies to oscillate arise, afterwards decrease Tn with a Kr without tendencies to oscillate so long until the transient effect can be accepted.
In order to avoid a too large overswing, also the correcting variable limitations can be adjusted.

Waste oil compensation:
On machines with Moog valve the overlapping of the valve can be compensated by means of a waste oil compensation. For this purpose it is necessary to record a calibration of the pressure via the valve. The value from the calibration table * Ks (correction factor) is then added to the determined adjustable.
With leakage oil compensation a part of the integral share is covered by means of compensation, thus the I share of the PI controller can decrease.
Another advantage of the waste oil compensation lies in the fact that at the changeover to post injection pressure the controller is based on the controlled value immediately and because of that an undershoot can be avoided.

6.4.5 SPECIFIC BACK PRESSURE

The back pressure controller is run via a PI controller and delivers an adjustable in volt by means of pressure set/actual value difference.

Standard values of the back pressure closed loop control

Parameters	Setting	
Kr	0,05	
Ks	0	
percent start	0	
Tn	0,15	s
Tv	0	s
delay time	0	s
dead time	0	s
r.p.m	-0,4	V
UMax	7	V
UStart	7	V

Increase Kr so long until first tendencies to oscillate arise, afterwards decrease Tn with a Kr without tendencies to oscillate so long until the transient effect can be accepted.
In order to avoid a too large overswing, also the correcting variable limitations can be adjusted.

7 TEMPERATURE CONTROL PARAMETERS

7.1 MONITORING

Per zone on the screen one switch is available, which in the position ☑ includes the concerned zone into the start-up safety, the zone actual value having to have reached the appertaining negative tolerance in order to be able to run all screw movements.



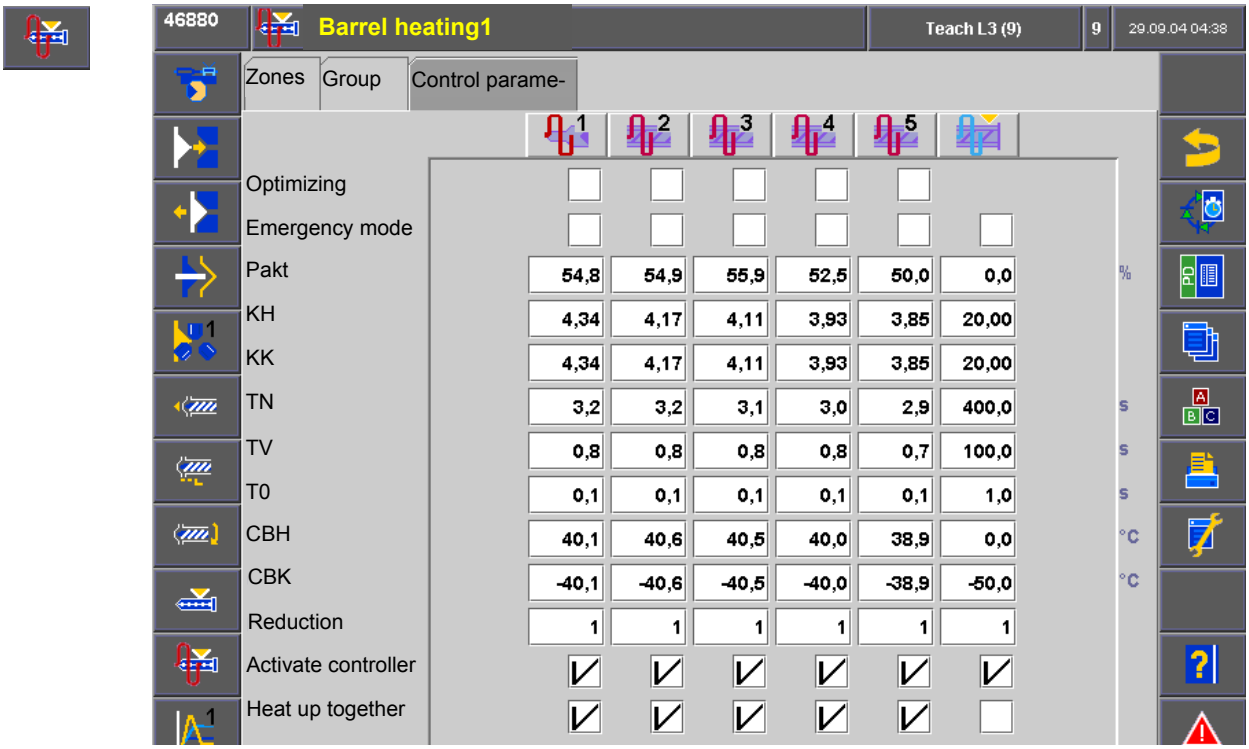
Note!

When the monitoring is switched off, this can lead to a fracture of the screw tip.

When the monitoring is switched off and the set value remains under the negative tolerance, the following message appears:

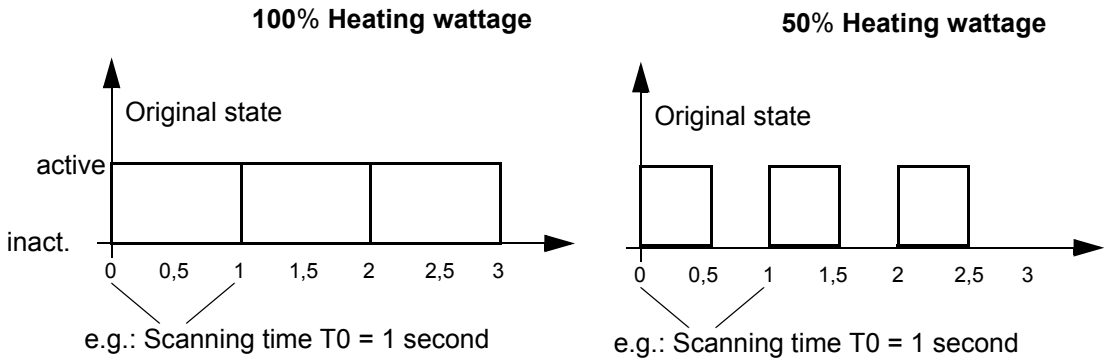
	”Plasticizing force of cylinder heater x reduced”
Reason	The movement Plasticizing has been started while the min. monitoring of a zone is switched off and the actual temperature of this zone does not lie within the negative tolerance.
Effect	The plasticizing force is reduced to approx. 50%.
Reset	In order to get full metering performance again, the zone must be heated up again until the temperature is in tolerance again and the soaking time has been waited for.

7.2 CONTROL PARAMETERS



7.2.1 PARAMETERS

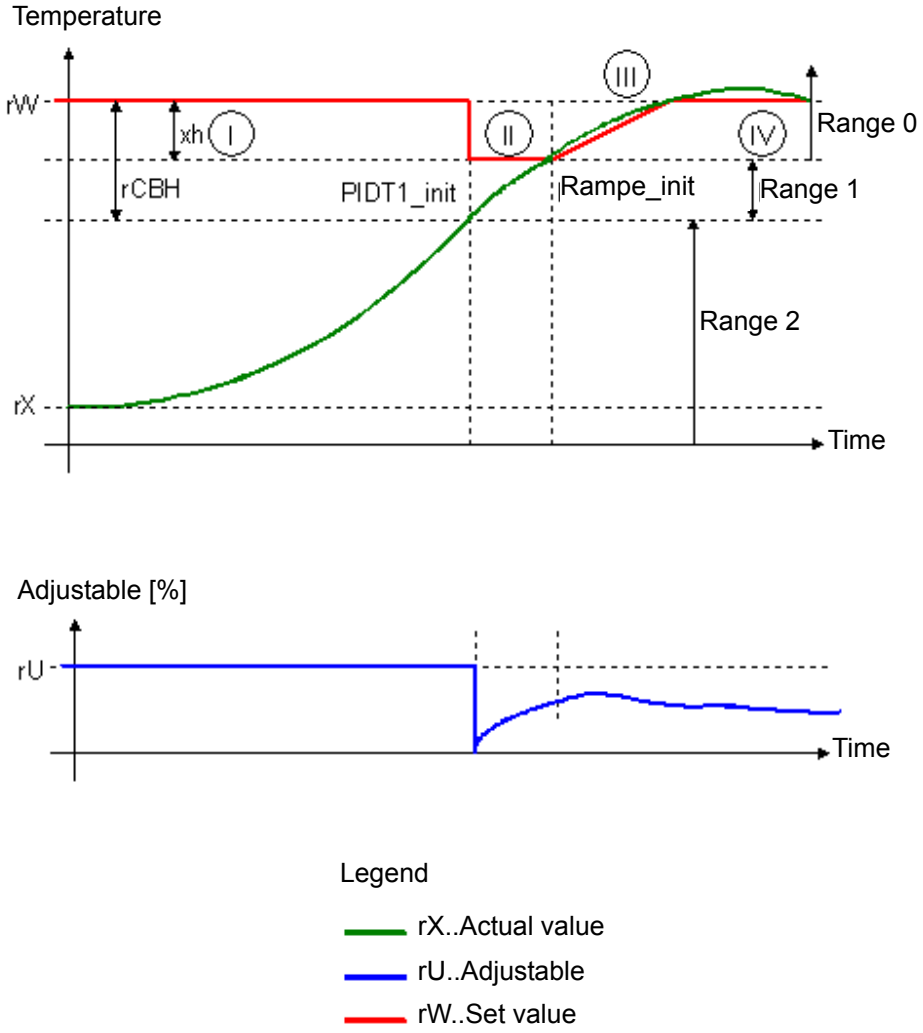
"Pakt"
Heating capacity display in %, range -100...+100%
The On/Off ratio of the controller output within one cycle represents the raised heating and/or cooling capacity. 100% corresponds to always switched on.



”KH”
Proportional amplification for heating (Conversion from the CC100 KH=1000/Xph)

Operation behaviour

The heating-up process is implemented as follows:



In the phase (I) it is heated up with 100 % until the Cutback value is reached. (Temp. range 2)
In phase (II) the PIDT1 controller is active, the set value is reduced to rW-xh. xh is determined automatically from the controller amplification. xh = rCBH - rMaxY / rKH with the condition xh >= 0.0.
In phase (III) the set value is pulled up to the given set value by means of a ramp. The ramp increase is either calculated automatically
rDY = dT0 /dTN * 16° (at dTN > 0.0, otherwise rDY = 0.0).
In the phase (IV) the PIDT1 is active, the set value corresponds to the handed over (normal controller operation) (Range 0).

”KK”
Proportional reinforcement for cooling. During optimization KH and KK are written the same. Increase for an increased cooling capacity KK.

”TN”
Reset time (Integral share)

TN can be maximally 255 times T0. For bigger TN T0 must be enlarged. The smaller TN, the stronger the I share acts. For TN = 0 the I share is switched off.

”TV”
Rate time (Differential share)
TV can be maximally 255 times T0. For bigger TV T0 must be enlarged. The bigger TV, the stronger the D share acts. For TV = 0 the D share is switched off.

”T0”
Scanning time
As guide time the time within which the temperature rises by 1 °C with full heating capacity can be used. It occurs maximally a switching operation on the final control element per cycle time (controller cycle).

”CBH”
Cub back heating
With CBH that difference to the temperature set value is fixed at which the controller switches over from full heating capacity to PID closed loop control during the heating-up. With correct setting CBH prevents the overshoot during heating up. The value is calculated automatically during the heating-up optimization and can, when bad transient response appears, be readjusted manually.

”CBK”
Cut back cooling
With CBK that difference to the temperature set value is fixed at which the controller switches over from full heating capacity to PID closed loop control during the cooling. With correct setting CBK prevents the overshoot during cooling down.

”Reduction”
The reduction serves to reduce the number of the switching processes of the respective cooling output for sparing the valves.
Normally an output is actuated within a controller cycle (T0) once corresponding to the calculated switching-on time. A setting of e.g. 10 during the reduction would mean that after 10 controller cycles the calculated switching-on times are added and the cooling output is then only actuated once.

”Activate controller”
In order to switch off individual zones for a short time, here the controller can be activated and/ or deactivated.

”Heat up together”
When these switches are switched on, the zones heat up together within the group.
When a zone of the group reaches a too big distance to another zone of the group, this stops the heating-up until the distance lies in the range again.

7.2.2 OPTIMIZING

Automatic determination of the parameters for the controlled system
Here the machine heats up with 100% heating capacity up to a certain value and switches off the heating afterwards. After a cooling phase the calculation of the optimum control parameters begins.

Heating-up optimization
Prerequisites and procedure:

1. Bring zones to room temperature.
2. Switch off heating switch on the switch panel.

3. Set set values at least 50°C over the actual temperature.
   Hint: In order to reach an optimum determination, set the values to the later operating temperature.
4. Set the pos. and neg. temperature deviation large enough.
   Hint: On 50°C and/or 30°C in order that the monitoring function does not react.
5. Switch on the cooling stretches used in operation (e.g. feed throat cooling) by all means as also such influence the parameter determination.
6. Switch off half-wave circuit.
7. Set controller mode to PID_2PT (Two-step controller).
8. Make control parameter basic setting in order to prevent extreme settings:

	KH	TN	TV	T0	KK	CBH
Nozzle	25,0	100,0	25,0	5,0	25,0	0,0
Barrel	10,0	600,0	200,0	10,0	10,0	0,0
Mold heating	10,0	600,0	200,0	10,0	10,0	0,0
Hot runners	50,0	50,0	15,0	0,5	50,0	0,0

9. Switch on **"Optimization"** for the corresponding zones.
10. Switch on the heats at the control panel.
11. The self-determination begins and lasts between 1 minute and 2 hours.
12. The determination is represented by means of flag.
13. The optimization is completed when the flag of the selected zones has gone out.

After the overwriting of the parameters the machine switches over to closed loop control operation and begins with the heating-up to the set set values.
A manual follow-up of the self-optimized control parameters after completing the automatic determination is possible.



Note!

The set zone set temperature can be exceeded at the heating-up attempt. Therefore carry out the heating-up attempt without material. Because of that arising errors in the determination are minimum and can therefore be neglected.

When a thermocouple break appears during the determination, this is interrupted. The switch **<Optimization>** is set to **<OFF>**.

The heating-up monitoring is not active during the self-determination.

Standard parameters for oil cooling and feed throat cooling

T0 = 20s	TN = 0	TV = 0	KK = 1000
CBH = 0,0	CBK = -50,0		

Operating point optimization

For a better oscillation behaviour in the working point it is possible to re-optimize the parameters determined before in the automatic mode.

Procedure:

1. Current optimizations must be completed (= all optimization switches are OFF).

2. All temperatures must be steady in their working points. Actual values ~ set values.
3. Half-wave circuit must not be active.
4. The maximum negative temperature deviation shall not be set too small (approx. 30°C)
5. Do not switch on neighboring zones simultaneously to the working point optimization.
6. Switching-on of the optimization switches individually or not neightboring ones
   e.g. 1 + 3 +... after completion 2 + 4 +...
   Re-optimize mold heating zones individually, specially when the mutual influence of the heatings is not known exactly.

The optimization undertakes a cooling phase by 8 °C.
Attention in the automatic mode:
After reaching the difference of 8°C from the actual value in the start moment, the re-optimization is completed, the set value is limited again. The optimization switch goes on OFF.

OPTIONS

1 CONVEYING UNIT OR COLORING EQUIPMENT

This interface serves to actuate a conveying unit or coloring equipment.

At variable MatConveyor1.sv_iMatConveyorActuation the position **"Impulse signal"** is used for conveying units or coloring equipment which wait for an impulse signal. By repeated interruption of a plasticizing process such a device would be triggered several times and possibly be started several times.

The variables are in the group of variables: MaterialConveyer

Variables

MatConveyor1.sv_iMatConveyorActuation (Actuation type conveying unit)	Position **"Permanent signal"**: Parallel signal to plasticizing Position **"Impulse signal"**: Parallel output to plasticizing without actuation after plasticizing interruption
MatConveyor1.sv_iMatConvOnInjUnit	Conveying unit is mounted on unit x

2 CORE-PULL SAFETY

The digital inputs CoreSafetyx.di_CoreSafety fulfill the following tasks depending on the setting:

The digital inputs monitor the **"Ejector position at the back"**.
If the ejector is not returned completely, in each case the core move in movements are blocked.

Additional interlocks:

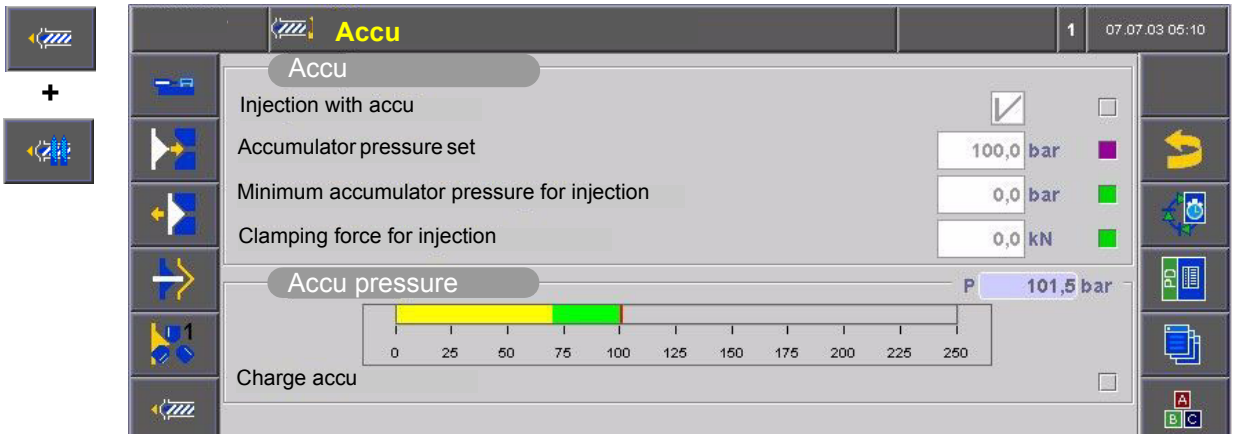
- **"Block mold closing via core safety"** also the mold closing is blocked
- **"Block move out core via core safety"** also the core moving-out is blocked

Extension with existing option Freely programmable in/outputs
By the parameter **"Use of external inhibiting input"** another freely available input can be used. see description Freely programmable in/outputs in the operator's manual

The setting of the core safety occurs in the variables monitor in the group CoreSafety [See 'Monitor of variables' on side 110.]

3 ACCU FOR INJECTION

With beginning injection the accu is connected in order to make available bigger amounts of oil for the injection movement, which the pump cannot deliver. The accu must be charged at beginning injection. The accu pressure is monitored with a pressure transducer. In case of too low pressure the pump recharges if the corresponding pumps are available.



3.1 CHARGE ACCU

The accu is only charged when the following conditions are fulfilled:

- When an accu stopcock exists, this must be opened manually.
- The motors must run.
- The screen switch **"Injection with accu"** must be switched on.
- The **"Accu pressure set value"** must be set bigger than 0.
- The pumps must be available.
  And/or in the holding pressure accu charging occurs in parallel to the holding pressure. At the injection already when braking the screw in front of the stop and/or with falling speed profile the accu can be charged.
- Injection must be switched on.
- When a voltage supply relay is mounted, this must not be defective (only at small machines).
- All conditions on the injection unit (e.g. unit swivelled in) must be fulfilled.

The accu charging is started when the accu pressure actual value does not reach the set value by more than the hysteresis (parameter), or when at cycle start the accu pressure set value is not reached.
The charging at the cycle start has the purpose that the accu is always equally full at start injection.

It is always charged with the maximally available number of pumps.

Pressure and volume settings for accu charging can be set via the respective pumps with parameters provided for this purpose.

The accu charging is stopped when the accu pressure set value is reached, or one of the conditions for accu charging is omitted.

The charging of the accu occurs -
- with constant volume:
(AccuInjection1.svPowerControlPumpV.bOnOff = 0)

The volume setting on the pumps occurs here in Manual with: AccuInjection1.sv_rPumpVManual
in Automatic with: AccuInjection1.sv_rPumpVAuto

3.2 DISCHARGE ACCU

When the program **"Injection with accu"** is switched off, or the motors are not switched on (input **"Motors on delta"** deactive), or the conditions on the injection unit (e.g. unit swivelled in) are not okay, the **"Safety solenoid accu"** is switched off and so the accu is emptied.
Moveover, the safety solenoid is switched off when the accu pressure set value is exceeded by more than the maximum accu pressure set value exceeding. (sv_rAccuPressureMaxDiff)

3.3 INJECTION WITH ACCU

The injection speed is closed loop controlled by the servo valve also with switched-on accu.

Injection with accu + charging pump(s):
AccuInjection1.sv_bInjectWithoutPumps = 0.

At the injection the pumps are actuated with accu charging volume, i.e. regardless of the set injection speed the biggest possible amount conveyed is taken off from the pumps. Because of that the accu discharge and hence also the accu charging time are kept as little as possible. Furthermore, for the further reduction of the accu charging time the accu charging solenoid is already set at the injection. So the accu can already be charged when braking the screw in front of the stop and/or with falling speed profile.
During the post injection (holding) pressure time the accu is also charged.

Injection with accu without charging pump(s):
AccuInjection1.sv_bInjectWithoutPumps =1.

Here the injection occurs purely from the accu.
This setting is required then when the accu charging pump(s) is (are) needed for parallel movements.

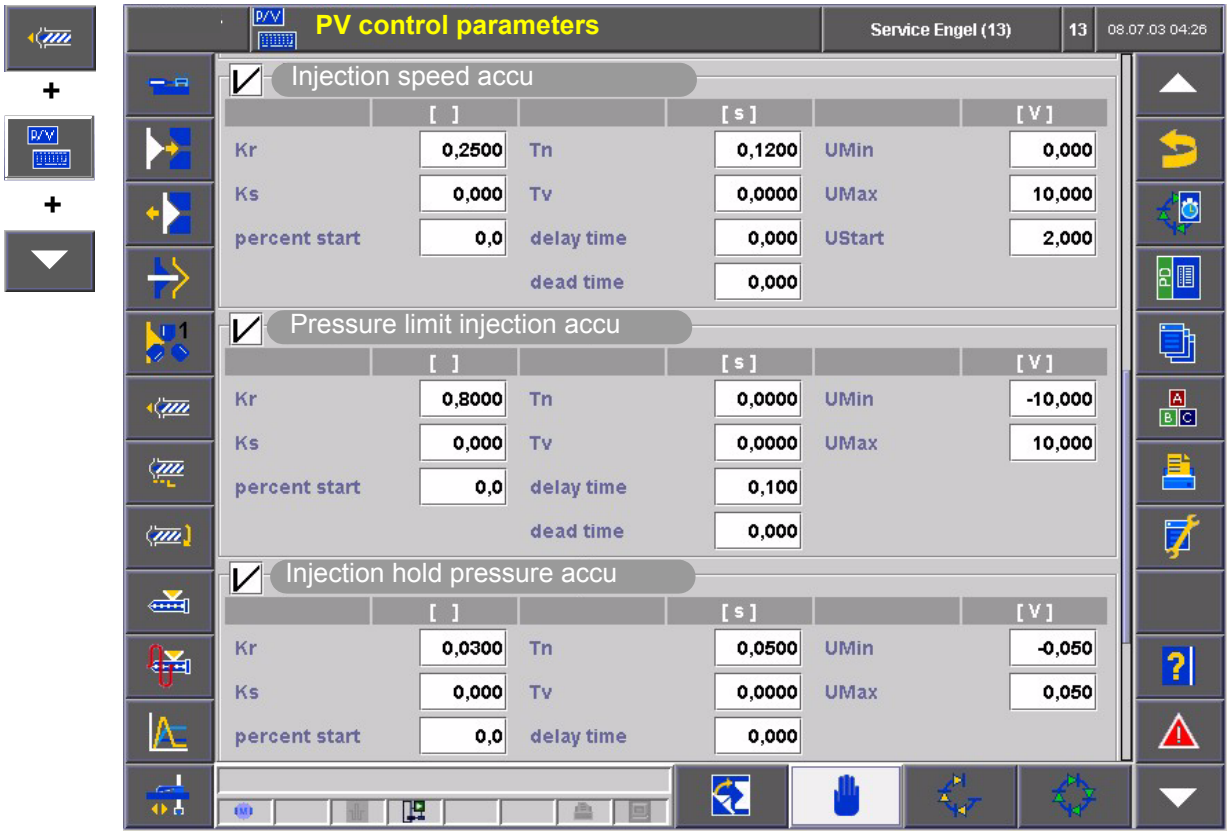
Only at check valve hydraulics:
At first the pumps are activated;
When the pump pressure actual pressure reaches the Leadover value (AccuInjection1.sv_rLeadoverPressurePump), then the accu is connected by means of directional valve and the servovalve is actuated.

When the nozzle is not advanced (nozzle contact point not reached), it is injected with reduced, constant speed. (Nozzle1.sv_rOutputVInjNotSwiv).

When the mold is not closed, it is injected with reduced, constant speed. (Mold1.sv_rOutputVInjMldNotCl).

Closed loop injection control:

The injection closed loop control exclusively occurs via the servovalve.
At **"Injection with accu"** there are separate control parameter sets for the operation with accu.



Monitoring of the min. operating pressure:

During the injection process it is checked permanently whether the accu pressure actual value lies over the min. operating pressure. (sv_rAccuMinOperationPressure)

In the error case the injection is stopped.

	**”Minimum accu pressure reached”**
Reason	During injection the minimum operating pressure of the accu has not been reached. This could also be a hint to that the accu unit does not suffice for the set injection stroke.
Effect	Injection is stopped, motor switches off delayed, heatings reduce delayed, the alarm lamp flashes.
Reset	Check accu equipment! Increase accu charging pressure or decrease injection stroke.

3.4 LINEARIZATION / CALIBRATION

The speed linearization of the servovalve occurs with accu.
For this purpose the screen switch **”Injection with accu”** must be switched on and the **”Accu pressure set value”** must be set bigger than 0;
otherwise:

	”Switch on accu”
Reason	A calibration is started, at which an accu is required and this is not switched on.
Effect	Calibration not possible
Reset	Switch on program switch Injection with accu and write accu pressure set value on maximum value

On accu machines no **”Differential system”**, i.e. without increased injection pressure is provided.

The calibration of the accu pressure transducer occurs on the page **”Input calibration pressure transducer”**.

	”Switch off accu”
Reason	A calibration is started at which no accu is required and/or the accu must not be switched on.
Effect	Calibration not possible
Reset	Program switch for switching off accu

3.5 PARAMETERS, INPUTS, OUTPUTS

Parameters:

Group of variables: AccuInjection1		
sv_iMainPump	[ ]	Main pump
sv_iExtraPump1	[ ]	Additional pump 1
sv_iExtraPump2	[ ]	Additional pump 2
sv_PowerControlPumpV.bOnOff	[ ]	Power control main pump accu charging on/off
sv_PowerControlPumpVExtra.bOnOff	[ ]	Power control additional pumps accu charging on/off
sv_PowerControlPumpV.rPower	[kW]	Power of the motor
sv_PowerControlPumpVExtra.rPower	[kW]	Power of the motor
sv_PowerControlPumpV.rEfficiency	[%]	Efficiency of motor
sv_PowerControlPumpVExtra.rEfficiency	[%]	Efficiency of motor
sv_PowerControlPumpV.dSmoothTime	[s]	Pressure smoothing actual value

Parameters:

sv_PowerControlPumpVExtra.dSmoothTime	[s]	Pressure smoothing actual value
sv_bInjWithoutPumps	[]	Injection with accu without pumps
sv_bAccuChargeWithMoldClosing	[]	Accu charging during mold closing
sv_bExtraOutputOnExtraPumps	[]	Separate outputs on additional pumps
sv_rAccuMax24Vk	[bar]	Max. accu pressure for motor start in case of error 24VK
sv_rAccuMinOpPress	[bar]	minimum operating pressure accu
sv_rAccuPressureMaxDiff	[bar]	maximum accu pressure set value exceeding
sv_rMaxAccuPressure	[bar]	Max. accu pressure
sv_rPressureHysteresis	[bar]	Accu pressure negative hysteresis
sv_rPumpP	[bar]	Pressure accu charging pump
sv_rPumpPExtra	[bar]	Pressure accu charging additional pumps
sv_rLeadoverPressurePump	[bar]	Leadover pump pressure for injection
sv_rPumpVAuto	[%]	Volume accu charging pump Automatic
sv_rPumpVAutoExtra	[%]	Volume accu charging additional pumps Automatic
sv_rPumpVManual	[%]	Volume accu charging pumps Manual
sv_rPumpVManualExtra	[%]	Volume accu charging additional pumps Manual
sv_dPumpDelay	[s]	Pumps delayed after accu off
sv_rAccuStopBeforeEndOfCooling	[s]	Time stop accu charging before end cooling time
sv_bPumpControlWithoutAccu	[s]	Pump closed loop control without accu
system.sv_bDividePumpsAt0Pressure	[s]	Separate pumps after leadover (Yes)

inputs:

Signal number:	Designation:	Function:	
=2x-Sxx	AccuInjection1.di_24vk_high	Power supply monitoring +24V with active M1	Option!
=2x-Sxx	AccuInjection1.di_24vk_low	Power supply monitoring 0V with active M1	Option!

outputs:

Signal number:	Designation:	Function:	

outputs:

do87	AccuInjection1.do_AccuInject	Accu injection	Option!
do15	AccuInjection1.do_AccuChargeMainPump	Accu charging main pump	Option!
do15	AccuInjection1.do_AccuChargeExtraPump1	Accu charging additional pump1	Option!
do15	AccuInjection1.do_AccuChargeExtraPump2	Accu charging additional pump2	Option!
do14x	AccuInjection1.do_AccuSafety	Accu safety solenoid	

Analog inputs:

Signal number:	Designation:	Function:
ai8	AccuInjection1.ai_Pressure	Accu pressure

3.6 ERROR SIGNAL

	**”Proportional valve supply interrupted”**
Reason	The limit switches of the power supply monitoring relay (+24VK) have been actuated at the same time longer than one second. The error state is preserved until the deliberate error acknowledgement.
Effect	Motor stops immediately, the alarm lamp flashes.
Reset	Power supply monitoring relay (+24VK) must be checked for diametrically opposed switch position
Resetting	At least one error-free switching function of the power supply monitoring relay by motor on/off, afterwards program interruption switch on/off

3.7 START INJECTION STARTING FROM CLAMPING FORCE

In order to use this program **”Start injection from clamping force”** , in the sequence editor the closing sequence 19 and the injection sequence 19 must be used.
On the screen page **”Accu”** the **”Clamping force for injection”** can be set.



With switched-on program in the automatic program the injection process is started from the **”Clamping force for injection”**when the following conditions are fulfilled in addition:

- Nozzle contact point determined
- Plasticizing finished
- set minimum accu pressure for injection reached

Note!

When this program is switched on, the set clamping force is not monitored like in the standard as the clamping force is not yet reached at beginning injection.
Further, it is not waited until the set contact pressure build-up time has expired.

Nozzle forward in parallel to mould closing:

- Occurs in standard!

Parameters:

Group of variables: Mold1		
sv_rClmpForceDiffInj	[kN	Minus tolerance of the clamping force for injection

3.8 GENERAL

During injection with accu the molding is only started when the **"Minimum accu pressure for injection"** is reached. Adjustable on the screen page **"Accu"**.
The injection speed is closed loop controlled by the servo valve also with switched-on accu.

Only at check valve hydraulics:
At first the pumps are activated;
When the pump pressure actual pressure reaches the accu charging pressure set value minus a tolerance, the accu is connected by means of directional valve and the servovalve is actuated. (AccuInjection1.sv_rLeadoverPressurePump)

3.9 INJECTION WITH ACCU WITHOUT PUMPS

This function is executed at equipment with parallel compression and is activated via the parameter AccuInjection1.sv_bInjWithoutPumps.

The injection then only occurs via the accu.
Also the post injection pressure is only kept via the accu.

The accu and the pumps are separated from each other by the activated directional valve **"Injection with accu without pumps"**.

outputs:

Signal number:	Designation:	Function:	
do88	AccuInjection1.do_InjWithoutPumps	Injection with accu without pumps	Option!

3.10 SCREW RETRACTION WITH ACCU

When a servovalve is mounted and directional valve **"Accu injection"** does not exist, also the screw retraction from the accu occurs.

3.11 ACCU SHUT-OFF

For increased safety an accu shut-off solenoid (DO_AccuOff) is switched into the accu main piping. The existing manual shut-off is omitted. The solenoid is connected through in the normal accu operation. A deactuation separates the accu equipment from the hydraulic system.

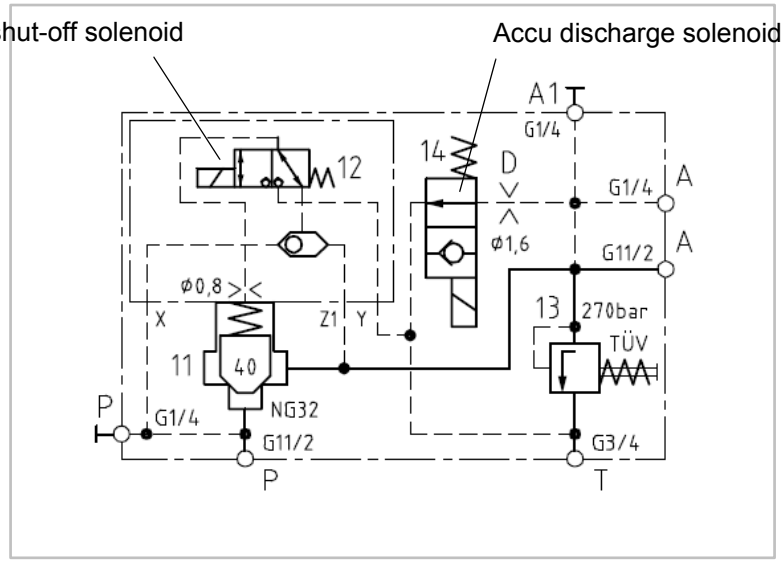
The accu shut-off solenoid de-energizes in the following situations:

SW	HW	Situation
x	x	Control voltage switched off
x	x	emergency stop
x		Motor switched off
x		Accu program switched off
x	x	Safety cover on the clamping unit open
x	x	Safety cover on the injection unit open
x	x	Unit swivelled out

SW = software interlock, the digital output de-energizes.
HW = electric interruption, the electric feed line to the solenoid is interrupted with a contactor contact.

The function of the accu discharge solenoid SSP remains uninfluenced.

Accu safety block



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