HNP Mikrosysteme

Operation manual for micro annular gear pump
mzr-11557, mzr-11558, mzr-11558X1

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Impressum

Original instructions

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This manual has been prepared with care. HNP Mikrosysteme does assume no liability for any errors in this manual and resulting consequences. Likewise, no liability is assumed direct or subsequent damages arising from an incorrect use of the devices.

While using micro annular gear pumps, the relevant standards regarding the specifications of this manual have to be followed.

Subject to change without notice.

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1 General Information

This operating manual contains basic instructions to be followed during integration, operation and maintenance of an mzr® micro annular gear pump. For this reason it is necessary to read it carefully before any handling of the device. The present manual should always be kept at the operation site of the micro annular gear pump.

In case assistance is needed, please indicate the pump type visible on the housing.

1.1 Application scope of the pumps

The micro annular gear pumps described in this manual are suitable for continuous delivery and discrete dosage of watery solutions, solvents, methanol, oils, lubricating liquids, paints and varnishes as well as many other liquids.

If you intend to treat any aggressive, poisonous, or radioactive liquids, you must conform to safety measures as according to the regulations in force. Any project concerning handling of corrosive liquids should be previously discussed with the pump manufacturer.

The micro annular gear pumps *must not* be used for invasive medical applications, in which the liquid having had contact with the pump is re-introduced to the body.

Micro annular gear pumps exclusively are provided for use in the industrial area. A private use is excluded.

The micro annular gear pumps *must not* be used in aircrafts and spacecrafts or other vehicles without prior consent of the manufacturer.

Data concerning resistance of the pumps to the manipulated liquids have been elaborated according to the best of HNPM's knowledge. However, operating parameters varying from one application case to another, no warranty for this information can be given.

Information given in this manual does not release the customer from the personal obligation to check the integrity, correct choice and suitability of the pump for the intended use. The use of the micro annular gear pumps should be conform with technical norms and regulations in force.

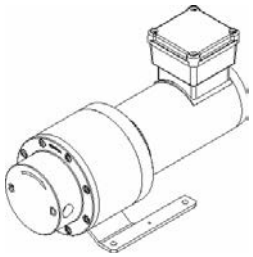
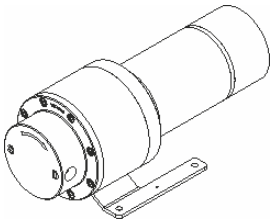
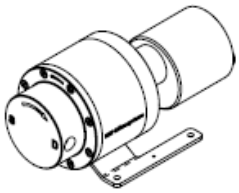
If you wish to receive more information than comprised in this operating manual please contact directly HNP Mikrosysteme.

1.2 Pump Model Designation

This manual is valid for the micro annular gear pumps mzr-11557 and mzr-11558, manufactured by HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin, Germany.

The bottom line of this manual shows the issue and date of issue of this operating instruction.

1.3 Technical data of the micro annular gear pumps

	mzr-11557	mzr-11558	mzr-11558X1
View			
Constructive Specifications			
Displacement volume	192 µl	192 µl	192 µl
Measurements (L x W x H)	291 x 130 x 171 mm	301 x 130 x 129 mm	301 x 130 x 129 mm
Weight	approx. 11 kg	approx. 11 kg	approx. 10 kg
Internal volume	8,5 ml		
Material pump case	alloy C22 (2.4602), optional: stainless steel 316L		
Material rotors	partially stabilized ZrO_2, optional: tungsten carbide Ni-based; Titaniumcarbide Alumina Zirconia Ceramics (TAZ)		
Material shaft	sintered silicon carbide (SSiC)		
Material bearing	Al_2O_3 ceramics		
Material wetted functional parts	Al_2O_3 ceramics		
Shaft seal	FFPM (Kalrez® Spectrum™ 6375), optional: FPM, EPDM		
Fluid connections	3/8" NPT internal thread, lateral		
Technical data			
Flow rate	29 – 1152 ml/min (= 69,1 l/h)	0,192 – 1152 ml/min (= 69,1 l/h)	0,192 – 768 ml/min (= 46,08 l/h)
Smallest dosage volume	100 µl	30 µl	30 µl
Max. system pressure	60 bar (870 psi) (inlet pressure+differential pressure)		
Differential pressure range	0 – 20 bar (290 psi) with 1 mPas 0 – 40 bar (580 psi) with 16 mPas The data are dependent on media and viscosity.		
Viscosity range	0,3 – 1.000 mPas		
Precision	< 1 %		
Pulsation	6 % (theoretical)		
Operating temperature	-5 … +60 °C -20 … +100 °C * (-dcx) -20 … +150 °C * (-hx)		
Ambient temperature	-5 … +50 °C		
Store temperature	5 … +40 °C		

caption: * Differing specifications on request

table 1 Technical data of the micro annular gear pump head mzr-11557, mzr-11558 and mzr-11558X1

Warning The material properties of a liquid (e.g. viscosity, lubricating property, particle content, corrosiveness) impacts the technical data and the lifetime of pumps. Under appropriate conditions the characteristic values may be increased or decreased.

Warning

If you intend to operate the pump out of the range of the above given specification, please consult the manufacturer. Modifications may be necessary to ensure successful operation. Otherwise the pump or the system may be damaged seriously.

1.4 Measurements

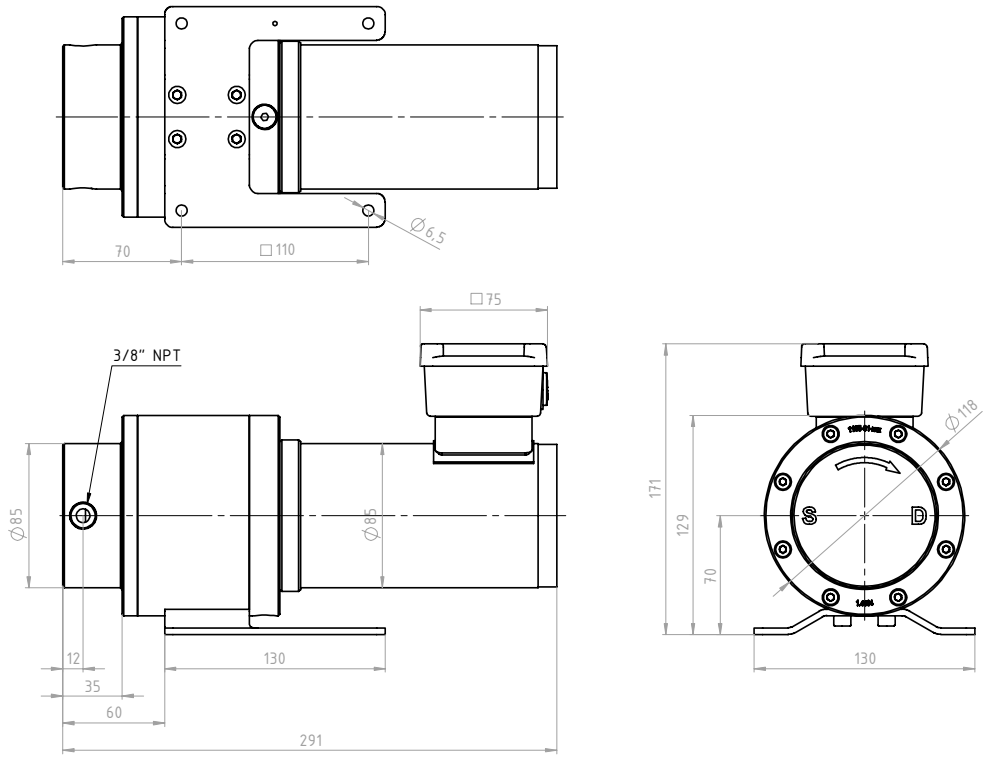


figure 1 Dimensions of the micro annular gear pump mzr-11557

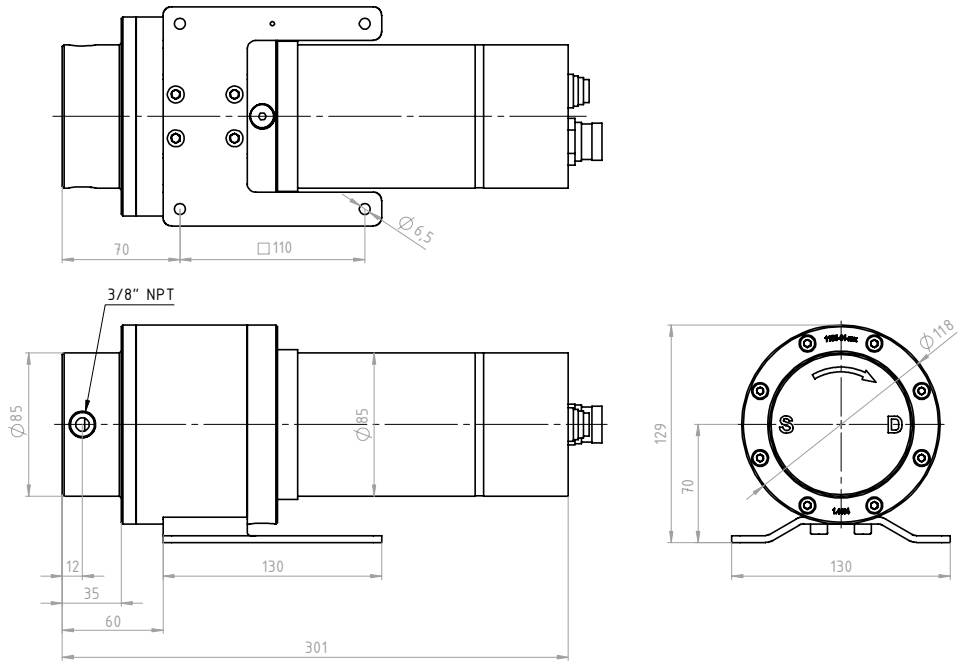


figure 2 Dimensions of the micro annular gear pump mzr-11558

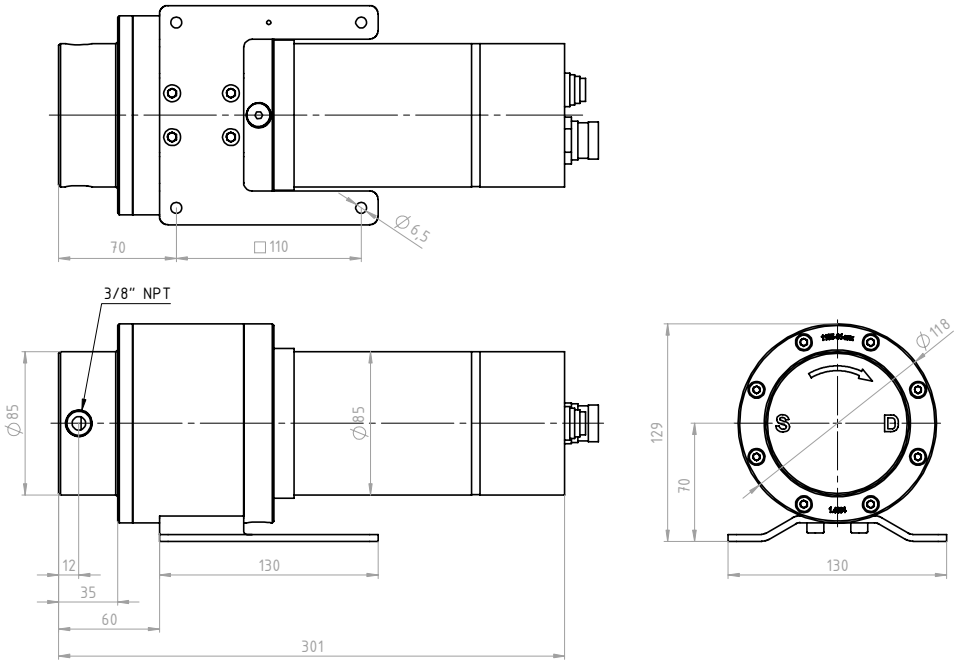
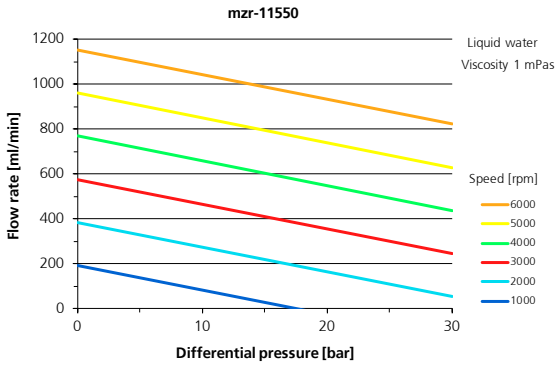


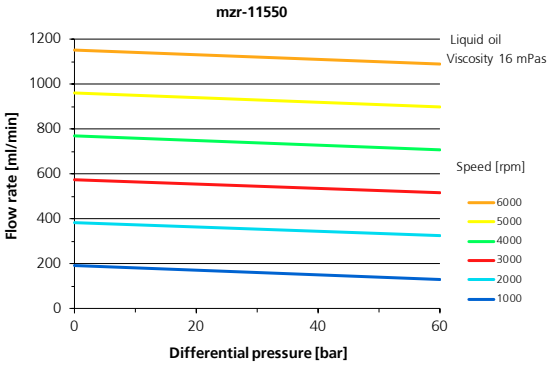
figure 3 Dimensions of the micro annular gear pump mzr-11558X1

1.5 Flow charts

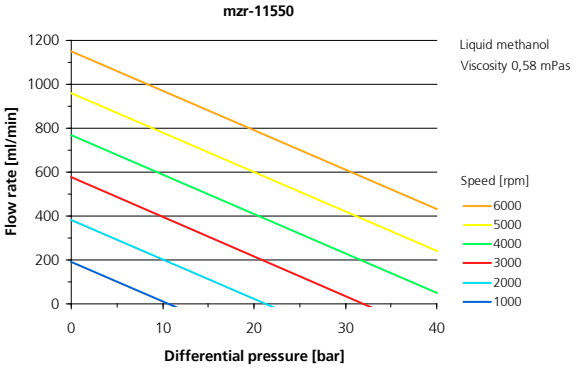
Liquid water



Liquid oil 16 mPas



Liquid methanol



Liquid oil 100 mPas

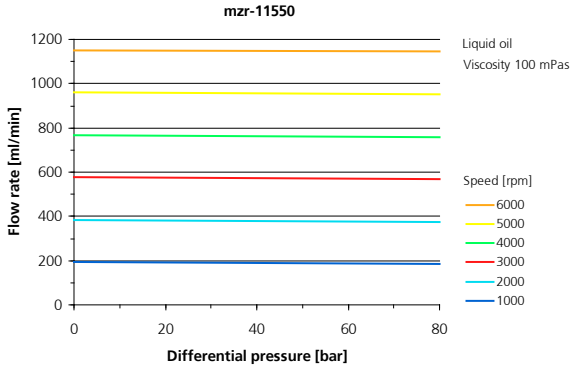


figure 4 Flow charts of the micro annular gear pumps

1.6 Technical data of the motor of mzr-11557

The micro annular gear pump mzr-11557 is provided with a 4 poles asynchronous servo motor with high dynamic. The connection of the motor to a frequency converter is simple.

Data of capacity	**SDSGAXX 056-22**	
Rated power	240	W
Max. Stall torque	0,81	Nm
Rated continuous current	0,86	A
Rated voltage	390	V
Rated frequency	100	Hz
Rated speed	2790	rpm
Max speed	6000	rpm
Rated power factor cos φ	0,71	
moment of inertia	1,404	kgcm²
Protection class	IP 55	
Weight	4	kg

table 2 Technical data of the motor

1.7 Technical data of the motor of mzr-11558

The micro annular gear pump mzr-11558 is provided with an actuator equipped with a 2-pole brushless DC-motor. The DC motor uses a high dynamic and is recommendable for programmed dosage operations of the micro annular gear pump. With a control unit it is possible to manage lower speed ranges down to 1 RPM. The accuracy of dosage can be achieved better than 0.5 %. The connection of the motor to a control unit is simple.

Data of capacity	
Nominal voltage	42 V DC
Max. continuous current	10 A
Assigned power rating	386 W
Max. Stall torque	500 mNm
Encoder	HP, Typ HEDL 5640
Cycles per revolution and channel	500
Operation range	1 – 6.000 rpm
Max speed by 24 V	4.000 rpm
operation range 42 V	7.000 rpm
Terminal inductance, phase-phase	275 µH
Protection class	IP 54
Weight	3,1 kg
Male socket for motor supply	Binder series 623 Type: 99-4637-20-06
Female cable connector for motor supply	Binder series 623 Type: 99-4636-00-06
Male socket for Encoder/Hall sensor	Lumberg Typ: SFV 120
Female cable connector for Encoder/Hall sensor	Binder series 423 Type: 99-5130-15-12
length of the cable	3 m lengthen to max. 10 m

table 3 Technical data of the motor

Pin	**Description**
1	motor phase A
2	n.c.
3	motor phase B
4	n.c.
5	motor phase C
6	n.c.

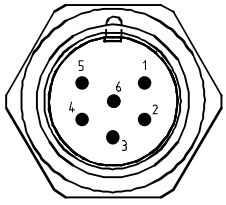


table 4 Pin configuration of the motor supply

Pin	Description
A	Encoder voltage +5 V
B	Encoder/Hall sensor GND
C	Encoder channel A
D	Encoder channel A neg.
E	Encoder channel B
F	Encoder channel B neg.
G	Encoder channel I
H	Encoder channel I neg.
J	Hall sensor voltage +5 V
K	Hall sensor A
L	Hall sensor B
M	Hall sensor C

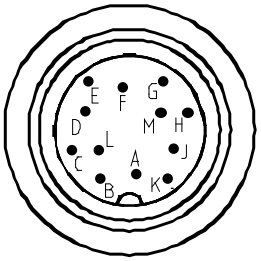


table 5 Pin configuration of the motor connector (Encoder/Hall)

wire color	Description
brown	motor phase A
green	motor phase B
white	motor phase C
black	screen (optional)

table 6 Motor supply cable 3 poles

wire color	Description	Pin controller S-HV
red	Encoder voltage +5 V	6
pink	Hall sensors voltage +5 V	6
yellow	Encoder channel B	7
green	Encoder channel A	8
blue	Encoder/Hall sensor GND	9
brown	Hall sensor A	10
grey	Hall sensor B	11
white	Hall sensor C	12
black	screen	earth screw

table 7 Encoder/Hall sensors cable 8 poles with controller S-HV

The encoder channel A and B are change together on the controller S-HV!

1.8 Technical data of the motor of mzr-11558X1

The micro annular gear pump mzr-11558X1 can alternatively be driven with a brushless DC-motor with analog hall sensors. It is characterized by higher dimensions and a wider speed range, which covers entirely the speed range of the micro annular gear pump and shows a longer service life than a brushed DC-motor.

Performance parameters	
Nominal voltage	36 V
Max. continuous torque	191,9 mNm
Power	201 W
No-load speed at 9 V	10,450 rpm
Max. continuous current	6.29 A
Terminal resistance, phase-phase	0.445 Ω
Terminal inductance, phase-phase	143 µH
Speed	1 – 5000 rpm
Ambient temperature	-30 … +125 °C
Male socket for motor windings	Binder Series 623 Type: 99-4637-20-06
Female cable connector for motor windings	Binder Series 623 Type: 99-4636-00-06
Male socket for Hall sensor cable	Lumberg Type: SFV 50/6
Female cable connector for Hall sensor	Binder Serie 423 Type: 99-5114-09-05
Type of Hall effect sensor	analog
Length connection cable	2 m

table 8 Technical data of the brushless DC-motor

pin	**Description**
1	motor phase A
2	n.c.
3	motor phase B
4	n.c.
5	motor phase C
6	n.c.

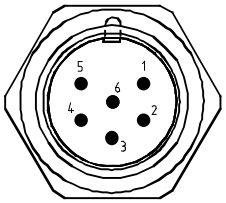


table 9 Pin configuration of the motor supply

wire colour	**Description**
brown	motor phase A
green	motor phase B
white	motor phase C

table 10 Cable 3 poles of the motor supply

pin	Description
A	Hall sensor GND
B	Hall sensor sensor voltage +5 V
C	Hall sensor A
D	Hall sensor B
E	Hall sensor C

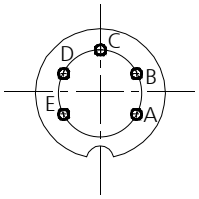


table 11 Pin configuration of the hall sensor connector

2 Safety

Comply with the general safety instructions listed in this safety section and also with the special safety instructions listed under the other main sections.

2.1 Labelling of instructions in the operating manual

The safety instructions are listed in this operating manual which, if not complied with, can cause danger, are specially labelled by

Danger symbol		Non-compliance poses danger for persons.
High voltage symbol		Non-compliance poses danger of electrical shock.
Warning symbol	Warning	Non-compliance poses a risk to the machines

The name plate mounted on the pump must be complied with and be maintained in a clearly readable condition.

2.2 Staff qualification and training

The operational, maintenance, inspection and assembly staff must evidence the appropriate qualifications for these works. Areas of responsibility, competencies and monitoring of the staff must be precisely regulated by the operator. If the personnel do not have the necessary knowledge, they must be trained and instructed accordingly. This can be implemented, if necessary, by the manufacturer / supplier on behalf of the machine operator. In addition, the operator must ensure that the content of this operating manual is fully understood by the personnel.

2.3 Dangers from non-compliance with safety instructions

Non-compliance with safety instructions can pose a danger not just to personnel, but also to the environment and machinery. Non-compliance with the safety instructions can lead to the loss of all claims for compensation.

In detail, non-compliance can cause the following dangers (examples):

- Failure of important machine/system functions
- Failure of prescribed methods for maintenance and servicing
- Danger to persons from electrical, mechanical and chemical effects
- Danger to the environment from escaping hazardous substances

2.4 Safety-conscious work

The safety instructions listed in this operating manual, the applicable national regulations for accident prevents and all internal working, operating and safety regulations of the operator must be complied with.

2.5 Safety instructions for the operator

- If hot or cold machine parts pose any danger, these parts must be protected on site against contact.
- Leaks (e.g. from the shaft seal) of dangerous conveyed goods (e.g. explosive, toxic, hot) must be guided away in such a manner that no danger is present for persons and the environment. Legal requirements must be complied with.
- Danger posed by electrical energy must be excluded

2.6 Safety instructions for maintenance, inspection and assembly work

The operator must ensure that all maintenance, inspection and assembly work is carried out by authorised and qualified specialist personnel, who are sufficiently familiar with this operating manual.

In general, work on the machine should only be implemented when it is at a standstill. The procedure described in this operating manual to stop the machine must be complied with in full.

Pumps or aggregates that convey media hazardous to health must be decontaminated. Immediately after work is complete, all safety and protection equipment must be remounted/restarted.

Before commissioning, the points listed in the Initial start-up section must be noted.

2.7 Unauthorised conversions and spare parts manufacturer

Conversions or modifications to the machine are only permitted following consultation with the manufacturer. Original spare parts and accessories authorised by the manufacturer ensure safety. The use of other parts may annul the liability for any resulting consequences.

2.8 Improper modes of Operation

The operating safety of the delivered machine is only ensured by its correct use as per chapter 1 in this operating manual. The limit values given in the manual must not be exceeded in any case.

2.9 General safety instructions

Skilled personnel may only do *mounting* and *initial operating* of micro annular gear pumps.

The pump can achieve *high pressures*. Use only the fluidic connections included in the delivery and be sure, that *fittings* and *tubes* are *permissible* and *specified* for these pressures.

In order to decrease the pressure, provide the system with a *pressure control valve* directing the excess liquid to the storage tank or back to the suction side. In the case of blockage of the pressure side the operating pressure can multiply, this can lead to the damage of downstream components.

The micro annular gear pump is highly precise manufactured. Any kind of contamination on the inside of the pump can cause damages. Therefore, we may ask you, to ensure yourself, that all fluidic leading parts are absolutely free from any kind of dirt, dust or any other particles, as these impurities may affect the function of the pump.

For operating of the micro annular gear pump, the use of filters with a pore size of 10 µm or smaller is required.

Warning

To connect the tubes of the pump remove the transport plugs and adapt them to the fittings, which are found in the delivery volume (see: assembly instructions for fluidic connections).

Pay attention to the *correct assembly* of your *fluidic connections* on the micro annular gear pump head, to keep up the indicated *flow direction*. Should you intend to use the pump in reverse operation modus, we may ask you to contact one of our Applications Consultants at HNP Mikrosysteme, as this kind of operation is not possible in every range of application.

If you intend to use *aggressive, corrosive or poisonous*, etc. *pumping media*, you are obligated to take care of the appropriate safety precautions in accordance of law and regulations.

Information about *media constancy* is given by best knowledge of HNP Mikrosysteme. According to the variations of parameter referring to the variety applications, we are *not able* to take a *warranty* upon these specifications.

The *rotary shaft seals* used in the micro annular gear pump avoid in standard operation the leaking of media from the micro annular gear pump. Micro annular gear pumps are »technically sealed«, but *not hermetic sealed*, so that gases may escape from the pump or lead into the pump.

Take measures of precaution to avoid damages on close by equipment and avoid pollution of the environment, in case of disengagement.
Be careful to assemble the micro annular gear pump, so that disengaging fluidic media may not leak into the motor or the control unit in case of malfunction.

In standstill, the medium in the pump may float in direction of the drop of pressure through the pump. If necessary provide *back pressure valves* (see: accessories).

Warning

Avoid in any case *dry running* of your *micro annular gear pump* as this may especially damage the seals. A short phase of dry running when setting the pump into operation is negligible.

Warning

Do not disassemble the micro annular gear pump in case of malfunction; contact our service personnel of HNP Mikrosysteme immediately to be helped.

Protect the micro annular gear pump and the electric actuator from *shock and at zero impact.*

The actuators may be protected against *moisture, dust and perspiration*.

The *permitted electrical data* of the actuators may *not be exceeded*. Notice that especially *the accurate set polarity* of the distribution voltage is required, if not the control unit can be destroyed.

Warning The *surface temperature* of the *actuators* can exceed 60°C (140°F) in *full load*. You might want to *provide protection* to *avoid accidental contact*, which will cause burns on your skin.

3 Transportation and Storage

3.1 Shipping

The pumps are shipped from the factory in such a manner that they are protected against corrosion and against shocks.

In addition, inlets and outlets are plugged with protective plugs. This measure is necessary to securely prevent foreign bodies from penetrating into the pump's interior.

3.2 Transportation

To avoid transport damage, the transport packaging must be protected against shocks.

HNP Mikrosysteme guarantees that the shipped goods are in perfect condition at the time of delivery. The pumps must be immediately checked for transport damage once the pumps have been received. If damage is noted, the shipper responsible and the pump manufacturer must be informed immediately.

3.3 Interim storage

The following points must be obeyed for storing the pumps:

- Do not store the pumps in wet or damp rooms
- Protective plugs must be left screwed in
- Store temperature see according section 1.3 of this manual

4 Description of the micro annular gear pump

4.1 Operating principle of the micro annular gear pump

Micro annular gear pumps are positive displacement pumps. They contain two rotors, bearing slightly eccentrically to each other; an externally toothed internal rotor and an annular, internally toothed external rotor (see figure 5). Due to their cycloid indenting, the rotors remain interlocked at any time, forming during rotation a system of several sealed pumping chambers. As the rotors revolve around their offset axis, the pumping chambers increase on the induction (suction) side and simultaneously decrease on the delivery side of the pump (see figure 6). A homogenous flow is generated between the kidney-like inlet and outlet.

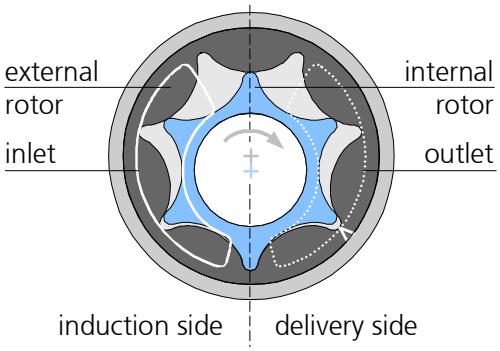


figure 5 Principle of the micro annular gear pump

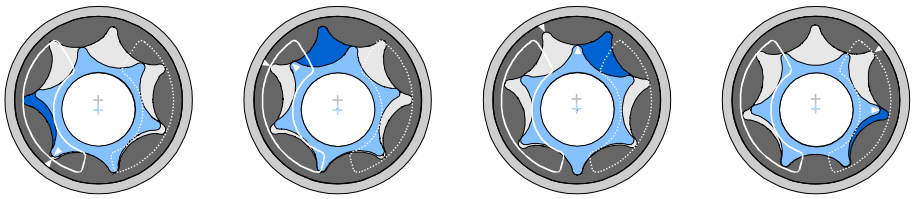


figure 6 Operating principle of the micro annular gear pump

Reciprocating and rotary pumps have a direct allocation to the fed amount of the displacement volume V_g of the pump and its actuator's number of revolutions n. The displacement volume describes the volume, which is theoretically fed with each revolution. The coherence of the flow rate referring to the formula (= volumetric flow rate) Q of the pump is:

$$Q = \eta_{Vol} \cdot V_g \cdot n$$

The volumetric efficiency η_{Vol} shows the relationship between the actual and the theoretical flow rate. The existing differences result from internal movement of the liquid during the operation.

Example: The pump head mzr-11550 has a displacement volume of 192 µl. On the assumption that the volumetric efficiency is 100%, the flow rate at a speed of 3000 RPM would be 576 ml/min, according to the above formula. The table 12 shows theoretical flow rate values depending on speed expressed in ml/min and l/h.

RPM	**Q** [ml/min]	**Q** [l/h]
100	19,2	1,15
500	96	5,76
1000	192	11,52
2000	384	23,04
3000	567	34,02
4000	768	46,08
5000	960	57,60
6000	1152	69,12

table 12 Theoretical flow rate of the micro annular gear pump mzr-11558

The pressure, which the pump has to generate, is given by the construction of the fluidic system and the results of the hydrostatic pressure and the hydraulic resistants (given by tubes, contractions etc.).

The viscosity of the pumping medium has an important influence on the volumetric efficiency. The volumetric efficiency increases with higher viscosity according to the smaller disengagement through the gaps of the pump.

Cavitation is an effect, which can result in a specific ceiling speed. The reason for this is the static pressure reaching the steam pressure of the liquid in the inlet port of the pump. In this state an increase of speed does not result in an increased flow rate. The formation of gas prevents a sufficient feeding of the pump. With increasing viscosity of the liquid (e.g.> 10.000 mPas), the ceiling speed is lower.

The specific feature of the mzr-pumps is their highly precise design, as well as the guarantee of high accumulator pressure and high accuracy in flow rate and dosage. Therefore, space width and transverse space width of the rotors as well as the interspace to the adjacent case parts are in the range of just a few micrometers. This precision is the condition to achieve a volumetric efficiency in the range of approx. 100 %.

4.2 Construction

The micro annular gear pump consist of the pump head, coupling assembly, motor and bracket (see figure 7).

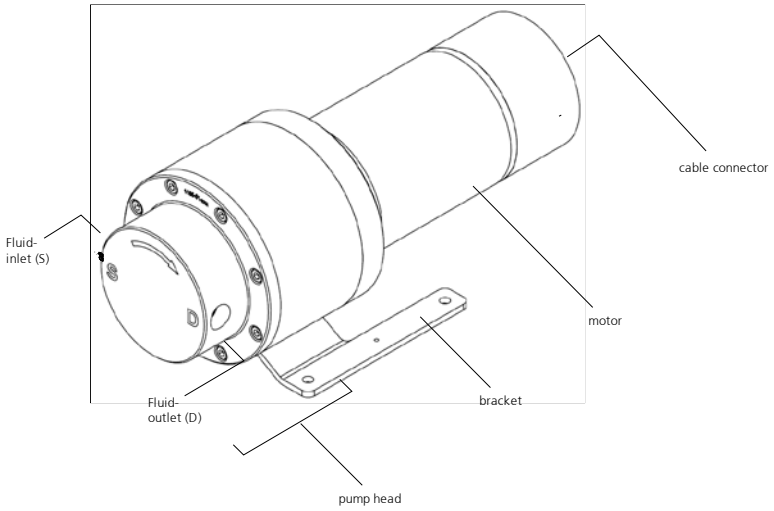


figure 7 Design of the micro annular gear pump mzr-11558

4.3 Construction materials

Wetted parts	mzr-1155x-dcy	mzr-1155x-dcs
Rotor materials	Titaniumcarbide Alumina Zirconia Ceramics (TAZ)	Titaniumcarbide Alumina Zirconia Ceramics (TAZ)
Control plates	Al2O3 ceramics	Al2O3 ceramics
Pump case material	alloy C22 (2.4602)	stainless steel 316 L
bearing material	Al2O3 ceramics	Al2O3 ceramics
shaft material	sintered silicon carbide (SSiC)	sintered silicon carbide (SSiC)
Static sealing material	FFPM (Kalrez® Spectrum™ 6375), EPDM	FFPM (Kalrez® Spectrum™ 6375), EPDM
Distance washer	PTFE	PTFE

table Construction materials of the wetted parts, rotor Titaniumcarbide Alumina Zirconia Ceramics (TAZ)

Wetted parts	**mzr-1155x-hy**	**mzr-1155x-hs**
Rotor materials	tungsten carbide Ni-based	tungsten carbide Ni-based
Control plates	tungsten carbide Ni-based	tungsten carbide Ni-based
Pump case material	alloy C22 (2.4602)	stainless steel 316 L
bearing material	tungsten carbide Ni-based	tungsten carbide Ni-based
shaft material	tungsten carbide Ni-based	tungsten carbide Ni-based
Static sealing material	FFPM (Kalrez® Spectrum™ 6375), EPDM	FKM optional: EPDM, FFPM (Kalrez® Spectrum™ 6375)
Distance washer	PTFE	PTFE

table 13 Construction materials of the wetted parts, rotor material tungsten carbide

The resistance of the construction materials to the delivered liquids should be verified by the operator for each individual application.

The resistance of the construction materials to the delivered liquids should be verified by the operator for each individual application. Pumps handling non-lubricating liquids have shorter service lives.

Other seal materials are available upon request.

4.4 Fluidic connectors

The micro annular gear pump head has an inscription on the front side (see figure 8). The liquid inlet connection is marked with the letter »S«, the liquid outlet connection with the letter »D«. An arrow indicates the inherent turning direction of the shaft.

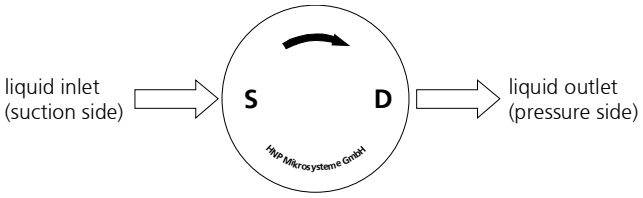


figure 8 Indication of the turning direction and fluidic connections on the front of the micro annular gear pump

The pump head has two inner threads for the connection of tube fittings. The pump head is available either in a version for lateral connections with 3/8" NPT fittings.

Sealing plugs are inserted into the holes for the fluidic connections as protection against contamination during delivery. The sealing plugs have to be removed before assembly of the fluidic connectors. If the fluidic connectors are disassembled, please re-seal the threads with the cleaned sealing plugs as protection against particles.

5 Optional modules

The spectrum of applications of the high performance micro annular gear pump series may be expanded by using different additional modules. The modules allow for special applications, which could otherwise not be accomplished with a standard pump version. The modules may be combined with each other and with almost all available pump heads and motor versions.

– *Heat insulation module* extends the operating temperature range of the pump by protecting the motor from overheating
– *Integrated inner canal system for fluidic tempering* to regulate the temperature of the fluid-containing parts of the pump

The configuration of a given pump version should in each case be discussed with consideration to the specific requirements of the application. *Additional* customized modules may be designed on demand.

5.1 Heat insulation module

The heat insulation module enables to deliver hot liquids up to temperatures of 150° C (248 °C). It comprises thermally insulating coupling components made of plastic (PEEK) located between the pump and the drive. The drive should not be exposed to overheating. For this reason the heat transfer from the pump to the drive should be limited. An additional thermal barrier is provided by the plastic motor housing. If the surrounding temperature rises, the pump is working over a longer period or the manipulated liquid features a high temperature, convection cooling of the motor is recommended.

5.2 Integrated inner canal system for fluidic tempering

The integrated inner canal system for fluidic tempering permits active tempering of the pump head in the operating temperature range from -20 °C (-4 °F) to a maximum of 150 °C (302 °F). The module consists of a double casing covering the pump head and a thermoelectric couple type J, whose mode of integration varies depending on the pump size. Oil, water or adapted cooling liquids may be used as thermal liquids. If you are not sure, which heat transfer liquid is the best adapted in your case, HNP Mikrosysteme will help you find the suitable one. The thermal liquid ports 2 x 1/8" NPT inside are displaced by 90°. The inlet for the heat transfer liquid is situated at the suction side and the outlet is on the delivery side (see figure 9).

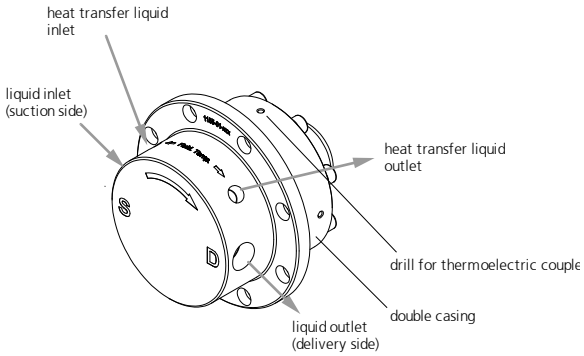


figure 9 Micro annular gear pump head integrated inner canal system for fluidic tempering

This heating module is not certified for use in areas exposed to explosion hazards!

Before connecting the liquid supply, please observe the following technical data! The maximal pressure of the heat transfer liquid should not exceed 15 bar.

Note that a pump head with integrated inner channel system can not be mounted on a drive system for standard pump head.

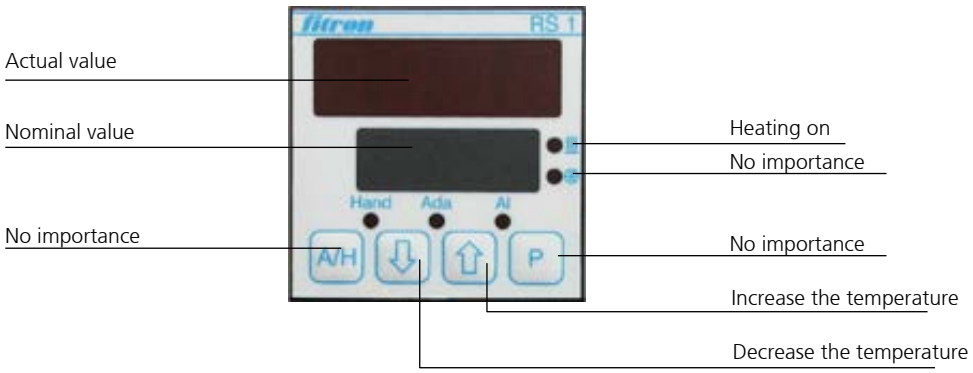
Thermal element	
Type	MT-1.5
Thermal element	Type L (Fe-CuNi DIN 43710)
Temperature measuring range	0 to 400 °C
Diameter of the sensing device	1.5 mm
Material	1.4541

	mzr-11558
Double jacket material	stainless steel 302
Inlet	2 x 1/8" NPT inside (90° distance)
Operating temperature range	-20 to 150 °C
Max. pressure	max. 15 bar

table 14 Technical data of the integrated inner canal system for fluidic tempering

5.3 Heating device „*JET*micro“

The heating device „*JET*micro“ has been designed for use with the heating module.



Hand: Blinks during temperature set in the manual input mode

Ada: Ada display blinks during the automatic control adjustment

AL: Alarm display – not configured, no importance

Actual value display:

OPEN = sensor failure

cLLɔ = sensor reverse polarity

With ⇩ or ⇧ the nominal temperature may be set.

Power supply

90-230 VAC, Shock-proof plug, 3 m long

Electrical connection

10-pole bush insert, 16 A/250 V

	Heating		Sensor	
	L	N	+	-
Zone 1	1	6	2	7
Zone 2 (Option)	4	9	5	10

table 15 Pin configuration of the heating device

6 System integration

6.1 Check before installation

Inspect the pumps for potential damage during the shipment (see chapter 3.2).

Please check, if the right pump type has been delivered, as according to the following points:

- Compatibility with the delivered liquid
- Viscosity range
- Pump performance (displacement volume, dosage volumes, operating pressures)
- Operating temperature range

If you notice any difference between the required and the delivered pump type, please contact HNP Mikrosysteme. Do not put the pump into operation without prior approval.

6.2 Mounting of the micro annular gear pump

The micro annular gear pump is mounted on an angle support with M5 screws. The favored mounting position of the micro annular gear pump is horizontal. However, if the pump has to be operated vertically, the motor must be located above the pump head in order to prevent the liquid from entering into the motor.

Warning

Install the pump in such a way that in case of failure no liquid can enter the motor or controller.

Take precautions that in case of leakage no surrounding objects or environment will be damaged.

Install the micro annular gear pump only in places that fulfill the required conditions for safe pump operation.

The motor must be protected against humidity, dust or sweat.

6.3 General instructions for the assembly of the liquid supply network

Please always cut the tubing at a right angle with an adapted hose cutter. If metal tubes are used, an intensive cleansing procedure will be necessary. After machining the tubing has to be cleansed and flushed throughoutly. The smallest piece of swarf within the liquid delivery system may cause failure of the micro annular gear pump.

Please note that correct integration of the tubing with the pump head is a necessary condition to ensure the right direction of flow. If you wish to operate the pump in a reverse direction, please contact HNP Mikrosysteme, since it is not possible in every case.

In order to protect the interior of the pump from pollution, the pump heads are delivered with protective plugs. They should be put on when the pump is at a standstill.

For the best performance the suction tube should be as short as possible and have a large internal diameter.

Warning

In most cases the pump should be operated with a filter featuring pores that do not exceed 10 µm. The filter protects the pump from particles and dirt.

6.4 Assembly instruction for tubing and accessories

Particles or soiling can block or impair the function of the micro annular gear pump.

Warning

Please check that all wetted parts of the fluidic system are clean. Clean these parts in case before mounting the pump.
Please check whether there are swarfs in the screw connections, pollution remaining in reservoirs or soiling in valves, pipe work or filters.

Assembly of the tubing and piping system

1. Please cut the tubing rectangular with a hose cutter. If metal pipes are used an intensive cleaning procedure is necessary. After machining the pipes have to be cleaned and flushed very carefully. Smallest swarfs within the fluidic system can cause failure of the micro annular gear pump.

2. Connect the fittings with the tubing respectively the pipe work according to the attached installation instruction.

Please note that the correct assembly of tubes respectively pipes with the pump head is a necessary condition to secure the right direction of flow. When you want to operate the pump in reverse direction please contact HNP Mikrosysteme since this is not possible in any application.

3. The thread of the fitting should be wrapped with 2-3 layers of PTFE tape and screwed in the NPT thread (see table 16). First manually, then tightened with ½ to ¾ wrench turns.

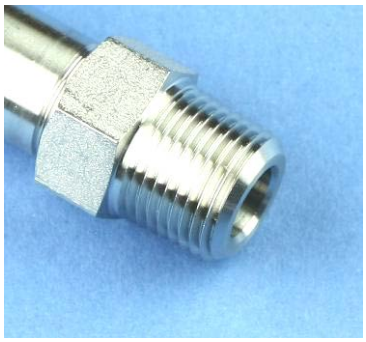
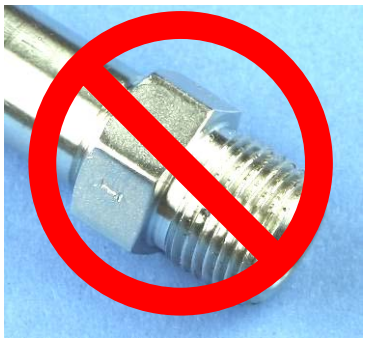
		
Clean the internal and external screw threads leaving no residues.	Make sure the internal and external screw threads are not dented or deformed.	Wrap the PTFE tape around the screw thread clockwise beginning with the second pitch of screw thread..
The PTFE tape should be wrapped tightly around the screw thread approx. 3 - 4 times.	Cut the PTFE tape off and wind the end of the tape tightly around the screw thread.	The PTFE tape should not stick out over screw thread because pieces can be cut off and get into the system.

table 16 Use of PTFE Tape

4. The suction line should be installed ascending to the pump for better degassing. The suction line should be designed as short as possible. The inner diameter of the suction line should be large to guarantee good priming of the liquid. At the planning of the pipe system take care of possibilities for degassing.

5. Operate the micro annular gear pump always with a filter with a pore size of 10 µm or smaller. The filter prevents that particles or solids penetrate into the pump what can cause major damage.

6. Avoid dry running of the pump. Make sure that the liquid flow is not interrupted.

6.5 Filter selection and use

In majority of cases it is recommended to integrate a filter on the suction side of the micro annular gear pump to ensure its secure operation. The recommended filter pores or mesh size should not exceed 10 µm. The penetration of particles or swarf that could cause a blockage or damage to the pump can only be avoided by using an adapted filter.

HNP Mikrosysteme offers a choice of standard filters covering a broad spectrum of applications. You may count on our assistance for the selection of the most suitable one.

In order to select the best adapted filter, such operating parameters as flow rate, viscosity and degree of pollution of the liquid will be needed. An increase in at least one of the mentioned terms will require the use of a bigger filtering element or the pressurization of the delivered liquid. In case no suitable filter for high viscosity liquid can be found, it is possible to use a filter with slightly larger pore size. Prior discussion with HNP Mikrosysteme is here recommended. A filter with larger pores is still better than no filter at all. Alternatively an already filtered liquid may be used.

Warning Because filters have a large internal volume, it is recommended to fill in the filter and the suction tube with already filtered liquid in order to avoid dry operation of the pump during the startup.

Warning Please control regularly the filtering elements for pollution. Cleanse regularly the filter or replace it with a new one. A polluted filter may considerably decrease the volumetric efficiency of a pump. Furthermore, because of the cavitation effects dosage imprecision and even pump damage may occur.

Warning A too small filter (too little filtering surface) may considerably decrease the volumetric efficiency of the micro annular gear pump. What is more, because of the cavitation effects dosage imprecision and even pump damage may occur.

7 Motion Controller

Without a motion control unit you cannot start the micro annular gear pumps!

7.1 Operation with frequency inverter for mzr-11557

The motor of the micro annular gear pump mzr-11557 is a 4 poles asynchronous motor. For the operation of the pump a frequency inverter must be used.

In the case the micro annular gear pump was delivered together with a frequency inverter this is predefined already on a motor speed range of approx. 300 to 6000 rpm.

Please observe al instructions to the frequency inverter e.g. »Operation instructions« and »Mounting instructions«. A no observance of these instructions can destructed of the micro annular gear pump and the frequency inverter.

Warning

You adjust the parameters of the frequency converter to the assessment parameters of the motor. If you not observe the assessment parameters can lead to a destruction of the motor!

General indications for initial operation:

- Read the mounting Instructions and operating instructions before you start working!
- Please observe all safety information given!
- Please observe the technical data!
- When working on live controllers, the valid national regulations for the prevention of accidents (e. g. VBG 4) must be observed.
- The electrical installation must be carried out in compliance with the corresponding regulations (e.g. cable cross-sections, fuses, PE connection). Additional notes and information can be obtained from the corresponding Instructions.
- Please observe the maximum permissible motor cable length!
- Connect the internal motor thermal contact (NC)!
- The motor has to be attached into delta connection at the use of a one phases frequency inverter!
- All operations must be carried out only by qualified and skilled personnel when the low-voltage machine is at standstill and when the machine is de-energized and protected against unintentional restart. This also applies to auxiliary circuits (e.g. brake, encoder, separate fan). Check safe isolation from the supply!
- Take the frequency inverter into operation!
- Parameterize the frequency inverter with the permitted parameter of the micro annular gear pump!
- Set the max. output frequency to 200 Hz
- Set the V/f-rated frequency 100 Hz.
- Save all changed parameter!
- Enable the controller!
- Set point selection e.g., changes the speed of the micro annular gear pump via potentiometer at terminals.

– If unknown faults appear or an uncertainty arises from appearing faults in the working with the pump, immediately shut down the micro annular gear pump at first!

7.2 Operation with Controller S-HV for mzr-11558

We deliver the micro annular gear pump mzr-11558 with the controller S-HV. Over this controller can be control the speed of the motor and the flow rate of the pump.

Electrical parameter of the controller S-HV			
Power supply	U_B	48 (11 – 70)	V
Max. continuous Current	I_{cont}	10*)	A
Max. peak Current	I_{max}	20*)	A
Velocity Range		50...6000*)	rpm
Inputs			
Set value	Input resistor	20	kΩ
	Voltage signal	± 10	V
Encoder signals	Channel	A, B	
	Logic level	TTL	
	Frequency range	max. 100	kHz
Enable	Logic level	low 0...0,5/high 8...30	
	Enable	high active	
Display	2-colour LED	green: Ready, red: Error	
Outputs			
Current monitor „Monitor I"	Output voltage range	± 10	V
	proportional factor	0,5	V/A
	Output resistor	10	kΩ
Speed monitor „monitor n"	Output voltage range	± 10	V
	proportional factor	0,5	V/A
	Output resistor	10	kΩ
Supervision output Ready	Input voltage range	max. 30	V
	current	< 20	mA
Technical Data			
Temperature range	operation	-10 … +45 °C	
	storage	-10 … +80 °C	
Humidity range	non condensing	20 … 80 % rel. hum.	
Dimensions	L x B x H	180 x 100 x 40 mm	

*) Values are different for each pump type

table 17 Technical Data of the controller S-HV

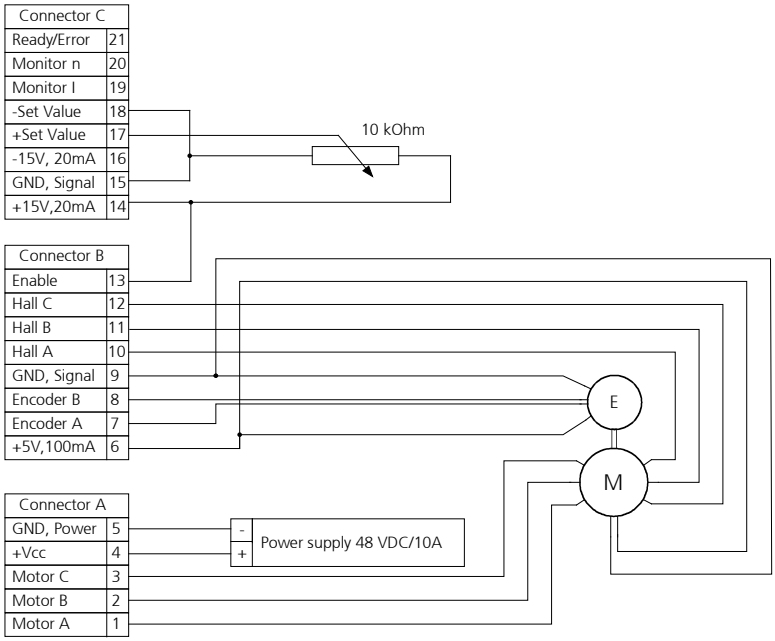


Figure 10 Connection plan with controller S-HV and micro annular gear pump mzr-11558

Initial operation procedure

1. Connect the motor cables with a motor control unit (see Figure 10).

2. Connect the DC- power supply with 48 V to the control unit. Check for correct polarity. False connecting may cause severe malfunction or even destroy the electronic of the motor.

3. Insert the jumper J5, J6 and J7 for the encoder mode.

4. Check the adjustment of the internal potentiometer.

potentiometer	function	potentiometer position
P1	Gain course	5 %
P2	Gain fine	0 %
P3	maximum speed at set value of 10 V	100 %
P4	Current limitation	100 %
P5	Offset	50 %

table 18 Internal potentiometer position

5. To avoid in any case dry running of the micro annular gear pump we recommend ensuring steady media supply.

6. Programming the control unit or turn the potentiometer in 0 position that the pump not rotate (0 rpm)

7. Switch on in the DC-power supply and start the micro annular gear pump.

Notice:

By an installation with the control unit SCA-B4-70-10 please read the operating instruction of the control unit! The speed range can change with the jumper on the control unit. The motor of the micro annular gear pump mzr-11558 have 2 pols! You can configure the control unit to control the speed with external potentiometer! You can configure the control unit to control the speed with external potentiometer! The speed range is to be set by jumper J10 and J11. One of four speed ranges is to be set.

Jumper(s)	**max. speed**
J10 and J11	5000 rpm
J10	10000 rpm
J11	20000 rpm (not recommended)
-	40000 rpm (not recommended)

table 19 Speed range

Skilled personnel may only do *mounting* and *initial operating* of micro annular gear pumps.

Check for correct polarity. False connecting may cause severe malfunction or even destroy the electronic of the motor.

Avoid in any case *dry running* of your *micro annular gear pump* as this may especially damage the seals.

Filling the pump with liquid before you start the pump!

For filling use a syringe!

7.3 Operation with Controller S-HP-E for mzr-11558

We deliver the micro annular gear pump mzr-11558 with the controller S-HP-E. This programmable control unit enables to adjust speed for constant flow rates or the position of the motor for the dosage of constant amounts of liquid.

Electrical parameter of the controller S-HP-E			
Power supply	U_B	48 (20 – 55)	V
Max. continuous Current	I_{dauer}	10*)	mA
Max. peak Current	I_{max}	20 (< 1s)*)	mA
Speed range		30...6,000*)	rpm
Max. motor power		800*)	W
Interface RS-232	after RS-232 standard	9600 Baud, 8 Bit, 1 Stop-Bit, RxD, TxD, GND (keine Handshake Signale)	
Interface CAN	after DSP 301, DSP 402		
Software	Composer, Elmo Studio		
Input			
Digitale Eingänge	programmable	10	
	Voltage signal	12 – 24 (High)	V
Analoge Eingänge	Input resistor	2	
	programmable	± 10, 14 bit Auflösung	V
Encodersignale	Voltage signal	A, /A, B, /B, I, /I	
	Channel	max. 5	MHz
Hallsignale	Frequency range	A, B, C	
	Channel	0 – 1 (Low) 2,5 – 5 (high)	V
Output			
Digital output	programmable	5	
Voltage +5 V Encoder	Voltage	5	V
	Max. Current	200	mA
Voltage +5 V Hall sensors	Voltage	5	V
	Max. Current	30	mA
Voltage +5 V Auxiliary	Voltage	5	V
	Max. Current	200	mA
Technical Data			
Temperature range	operation	0 … +40 °C	
	storage	-20 … +85 °C	
Humidity range	non condensing	20 … 90 % rel. hum.	
Dimensions	L x B x H	150 x 105 x 25.4 mm	
Weight		IP20	
Temperature range		640 g	

*) Values limited in the control unit with corresponding software

table 20 Technical Data of the controller S-HP-E

The control unit S-HP-E permits an easy startup of the pump with following interfaces:

- Power supply over connector
- Interface RS-232 over connector alternative CAN Bus over separate connector
- Prepared separate cable for the motor and the encoder/hall sensor with electrical connectors (useful for initial setup and an example for installation in control cabinet)
- Status display over LED.

Warning When commissioning with the controller S-HP-E note the attached technical descriptions!

Warning Follow the enclosed instructions!

Warning Without a motion controller is the micro annular gear pump not set in operation!

Make sure that the polarity of the supplied direct current is correct, otherwise electronics will be damaged.

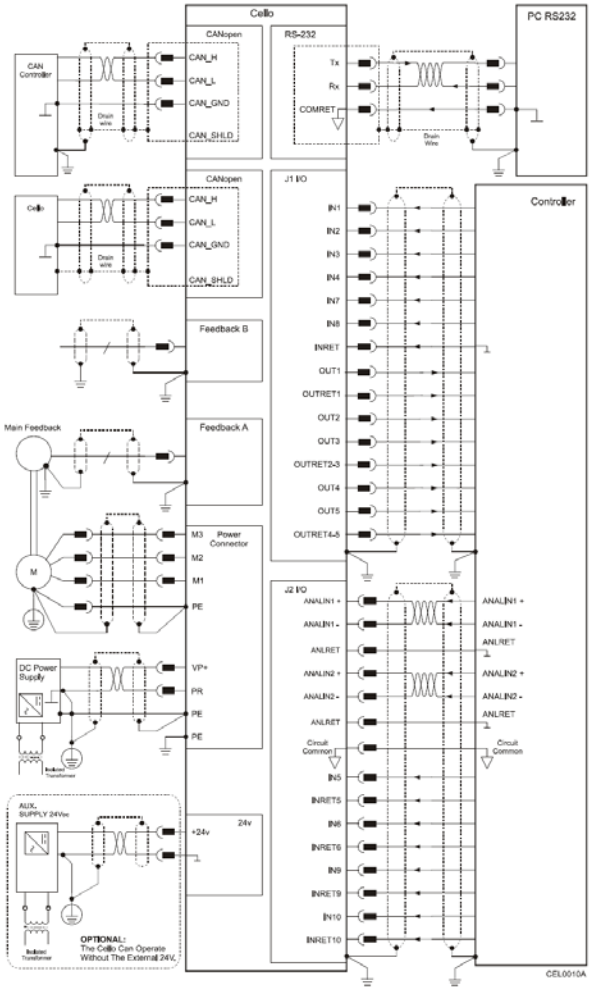


figure 11 Connection plan with controller S-HP-E

Initial operation

1. Connect the power cables with a motor control unit.

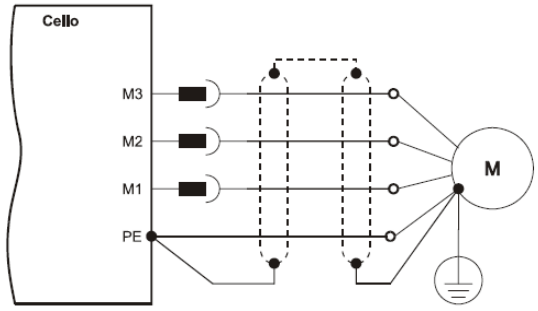


figure 12 Connection plan power cable

Connector Power & Motor S-HP-E	Cable LIY(C)Y 3 x 1,5 mm²	Description	Connector 6 poles motor
M1	brown	Phase A	1
M2	green	Phase B	3
M3	white	Phase C	5
	yellow/green	screen	

table 21 Power cable

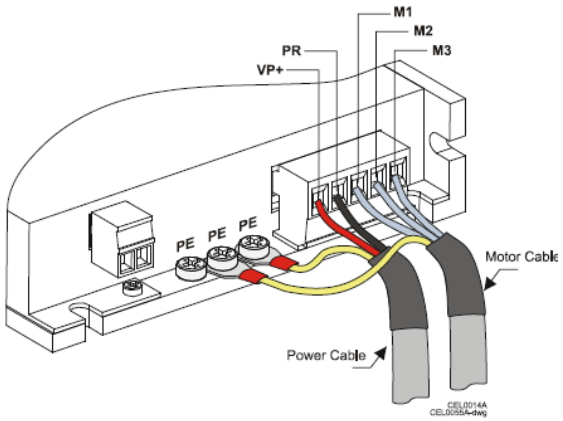


figure 13 Connecting the power cable

Cable version (green) as of January 2019

Connector Feedback S-HP-E PIN	Feedback Cable CBL-DFDBK	Cable LIY(C)Y 12 x 0,14 mm²	Description	Connector 12 pole Motor
1	green	white	Hall sensor C	M
2	white / yellow	brown	Hall sensor A	K
3	white	blue	GND	B
4	grey	red/pink	+5 V (Hall/Encoder)	A / J
5	orange	black	Encoder Channel A neg.	D
6	red	green	Encoder Channel A	C
7	blue	red/blue	Encoder Channel I neg.	H
8	purple	grey / pink	Encoder Channel I	G
10	yellow	grey	Hall sensor B	L
14	black	purple	Encoder Channel B neg.	F
15	brown	yellow	Encoder Channel B	E
	grey	n.c.	no function	n.c.

table 22 Feedback Cable CBL-DFDBK-DE-XX (green cable Helu Tobgeber 512 PUR, as of 2019)

Connector J1 S-HP-E PIN	Elmo I/O Kabel CBL-CELIO1-DE-XX	Signal	Description
1	red	IN1	Programmable Input 1, IN1
2	orange	IN2	Programmable Input 2, IN2
3	brown	IN3	Programmable Input 3, IN3
8	white / brown	IN8	Programmable Input 8, IN8
4	white / orange	OUT2	Programmable output 2, OUT2
5	white / yellow	OUT3	Programmable output 3, OUT3
6	black	IN4	Programmable Input 4, IN4
7	grey	IN7	Programmable Input 7, IN7
9	white	INRET	General Input Return, INRET
10	purple	OUTRET2-3	Programmierbarer Ausgang Return 2 + 3, OUTRET2-3
11	white / green	OUT4	Programmable output 4, OUT4
13	green	OUT5	Programmable output 5, OUT5
12	blue	OUTRET4-5	Programmable output Return 4 + 5, OUTRET4-5
14	white / rot	OUT1	Programmable output 1, OUT1
15	white / black	OUTRET1	Programmable output Return 1, OUTRET1
housing	screen	screen/PE	Screen / PE

table 23 I/O Cable CBL-CELIO1-DE-XX (green cable Helu Tobgeber 512 PUR, as of 2019)

Connector J2 S-HP-E PIN	Elmo I/O Kabel CBL-CELIO2	Signal	Description
1	purple	IN5	Programmable Input 5
6	green	IN5RET	Programmable Input 5, Return
2	blue	IN6	Programmable Input 6
7	yellow	IN6RET	Programmable Input 6, Return
3	red	IN9	Programmable Input 9
8	brown	IN9RET	Programmable Input 9, Return
4	orange	IN10	Programmable Input 10
9	black	IN10RET	Programmable Input 10, Return
5	white / orange	ANALOG1+	Analog Input 1 +
10	white / red	ANALOG1-	Analog Input 1 -
11	white / green	ANALOG2+	Analog Input 2 +
12	white / yellow	ANALOG2-	Analog Input 2 -
13	white / black	ANARET	Analog Return
14	grey	ANARET	Analog Return
15	white	SUPRET	Supply Return
housing	screen	screen /PE	screen / PE

table 24 I/O Kabel CBL-CELIO2-DE-XX (green Cable Helu Tobgeber 512 PUR, as of 2019)

Cable version (grey) until December 2018

Connector Feedback S-HP-E PIN	Feedback Cable CBL-DFDBK	Cable LIY(C)Y 12 x 0,14 mm²	Description	Connector 12 poles motor
1	green	white	Hall sensor C	M
10	yellow	grey	Hall sensor B	L
2	pink	brown	Hall sensor A	K
3	white	blue	GND	B
4	brown	red/pink	+5 V (Hall/Encoder)	A / J
5	orange	black	Encoder Channel A neg.	D
6	light-blue	green	Encoder Channel A	C
7	blue	red/blue	Encoder Channel I neg.	H
8	red	grey/pink	Encoder Channel I	G
14	black	purple	Encoder Channel B neg.	F
15	purple	yellow	Encoder Channel B	E
	grey	n.c.	no function	n.c.

table 25 Feedback Cable

Connector J1 S-HP-E PIN	Elmo I/O cable CBL-CELIO1	Signal	Function
1	orange	IN1	Programmable Input 1
2	light-blue	IN2	Programmable Input 2
3	purple	IN3	Programmable Input 3
8	black	IN8	Programmable Input 8
4	grey	OUT2	Programmable Output 2
5	pink	OUT3	Programmable Output 3
6	blue	IN4	Programmable Input 4
7	red	IN7	Programmable Input 7
9	white / yellow	INRET	General Input Return
10	white / red	OUTRET2-3	Programmable Output Return 2 + 3
11	yellow	OUT4	Programmable Output 4
13	green	OUT5	Programmable Output 5
12	white /black	OUTRET4-5	Programmable Output Return 4 + 5
14	brown	OUT1	Programmable Output 1
15	white	OUTRET1	Programmable Output Return 1

table 26 I/O cable J1

2. Connect the RS-232 port of the controller with a free serial interface of a PC. For this purpose use the delivered adapter cable.

3. To avoid in any case dry running of the micro annular gear pump we recommend ensuring steady media supply.

4. Connect the power supply of 48 VDC on the connector Power & Motor. False connecting may cause severe malfunction or even destroy the electronic of the controller! After switch on of the power supply during the initial phase of the S-HP-E the green LED "power" light on.

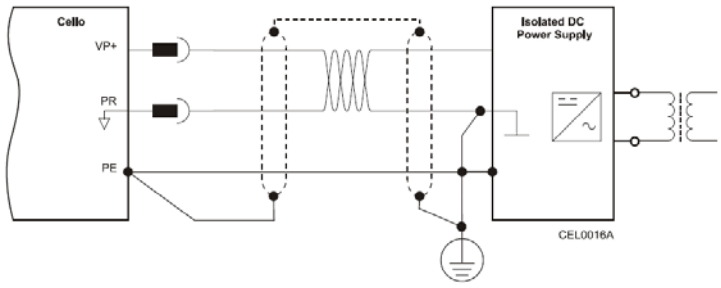


figure 14 Main power supply connection diagram

The power supply of the controller S-HP-E should be 48 VDC. With this power supply can be operated the micro annular gear pump with the entire speed range (see chapters 1.3 and 7.3).

5. You may now install the delivered software » Composer « as described in the chapter 9.

7.4 Operation with Controller S-BL for mzr-11558X1

The micro annular gear pump mzr-11558X1 with brushless DC motor and analog hall sensors as drive be delivered with the S-BL control unit. This programmable control unit enables to adjust speed for constant flow rates or the position of the motor for the dosage of constant amounts of liquid. On the delivered diskettes or CDs you will find a PC-program operating under Windows that enables to program such parameters as speed, acceleration and current consumption. The delivery package comprises also a null-modem cable for connection to a serial interface of a PC.

S-BL control unit			
Type of control unit		4-Q servo amplifier	
Nominal voltage	U	24	V
Power supply	U_B	12 - 30	V
Residual ripple		≤ 2 %	
Max. continuous output current	$I_{continuous}$	4500*)	mA
Max. peak output current	I_{max}	6000*)	mA
Speed range		10...5900*)	rpm
Input No. 1	input resistance	5	kΩ
Nominal analog speed	voltage range	± 10	V
Nominal digital speed	PWM signal	low 0...0.5 / high 4...30	V
	frequency range	100...2000	Hz
Output/Input No. 2	Error state	max. U_B / 30 mA	
	no error	switched to GND	
	programmed as input	low 0...0.5 / high 3,5... U_B	V
Input No. 3	TTL - logic level	low 0...0.5 / high 3,5...30	V
	PLC - logic level	low 0...7 / high 12,5...30	V
Program memory		6,6	kBytes

*) Values limited in the control unit with corresponding software

table 27 Technical data of the S-ND control unit

The control unit permits an easy startup of the pump with:

- the possibility to connect the voltage supply to the delivered DIN socket
- the possibility to connect the voltage supply with screw clamps
- a 8-pole screw clamps connector assembly for the motor cable
- speed set with potentiometer
- analog voltage signal 0-10 V for speed control at the screw clamps
- 9-pole connection plug for the RS-232 interface
- error output with status LED, programmable also as trigger input with screw connections
- tumbler switch S1 for the connection of digital input No. 3 of the motor control unit

Startup of the micro annular gear pump with the S-BL control unit

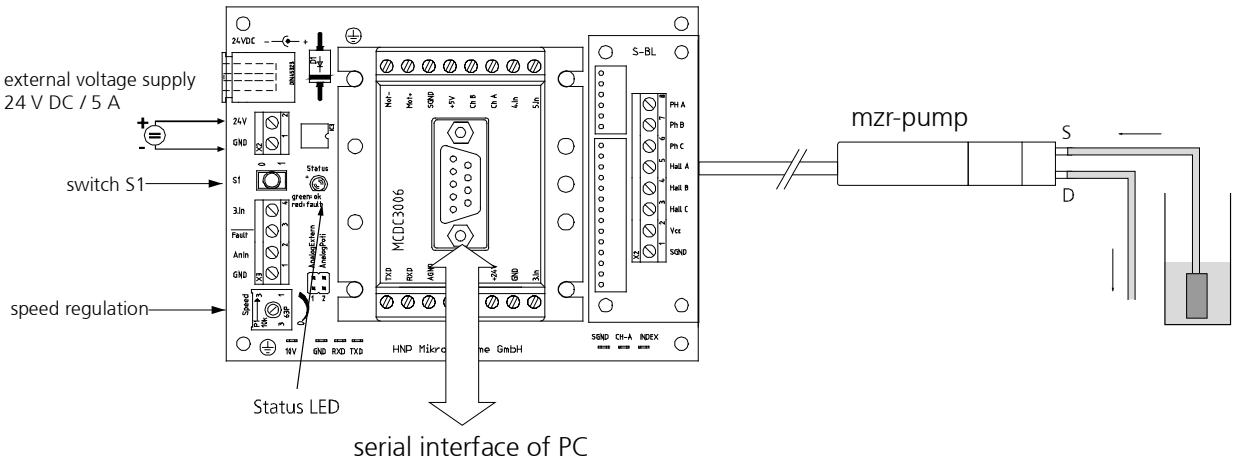


figure 15 Connection of the micro annular gear pump mzr-11558X1 and the S-BL control unit

1. Connect the motor cable to the 6-pole connector of the S-BL control unit. The pin configuration is indicated in table 10 and table 11.

2. Connect the RS-232 port of the MCBL3006 with a free serial interface of a PC. For this purpose use the delivered 9-pole null-modem cable.

3. Put the potentiometer of the S-BL control unit to zero position by turning it clockwise to the limit stop.

4. Connect the voltage supply 24 VDC. This can be done with the integrated DIN connector or, alternatively the 2-pole screw clamp (24 V = »+«; GND = »-«). Pay attention to the correct polarity.

5. You may now install the delivered software »Motion Manager« as described in the chapter 11.

While connecting the DC voltage pay attention to the correct polarity, otherwise electronics may be damaged.

Remarks:

- It is possible to adjust speed of the micro annular gear pump with the potentiometer without the need to connect the serial interface.
- With the analog nominal value input (connection clamps »AnIN« and »GND«) it is possible to adjust speed of the pump with a standard signal 0-10°V. For this purpose it is necessary to plug the jumper on the S-BL control unit from the »AnalogPoti« to the »AnalogExtern«. The serial interface does not need to be connected.
- In case of an overcurrent error the green status LED on the S-BL control unit turns red
- The standard programs memorized in the motor control unit may be started with the tumbler switch S1. Basic sample programs are shown in the chapter 9. For more advanced programs please refer to the user manual for Motion Controller MCBL3006.

8 Start Up / Shut Down

8.1 Preparing for operation

After the liquid supply system had been completed, please check once again the operating conditions of the micro annular gear pump as according to the following points:

- Are the inlet and outlet tubes correctly connected?
- Is the entire liquid supply system clean - that means free of particles, foreign bodies, pollution or swarf?
- Has a filter been installed on the suction side?
- Has a sufficient amount of the right liquid been supplied?
- The pump does not run the risk of a dry operation?
- The entire liquid supply system has been checked for leakage?
- Is it possible to stop the pump by an emergency switch if an unexpected malfunction occurs at the startup?

8.2 Startup of the micro annular gear pump

Switch on the voltage supply. The micro annular gear pump can now be put into operation by turning on the potentiometer knob or by sending a nominal external voltage signal.

Start the filling in of the pump at low or middle speed (1000 - 3000 rpm).

Warning

Starting the pump in dry condition might lead to damage of functional components of the pump. Therefore, it is necessary to have the pump primed (prefilled), and also in further operation please ensure a continuous supply of liquid. Dry running of the pump has to be avoided.

The user is liable for damages caused by, any consequence with the non-compliance of this instruction.

8.3 Flushing procedure after use

After each service the micro annular gear pump should be carefully flushed with a non-corrosive, filtered and particle-free flushing liquid (see table 28 and table 29). During flushing procedure the pump should operate at a speed of about 3000 rpm and if possible against a low pressure (that can be obtained by using a restrictor, a capillary or similar). The flushing liquid must be compatible with the delivered liquid and suitable for solving the remaining liquid rests. Depending on the application for example water, or isopropanol may be used. If you have doubts whether a particular liquid is suitable for this function or not, please ask the manufacturer of the liquid or HNP Mikrosysteme.

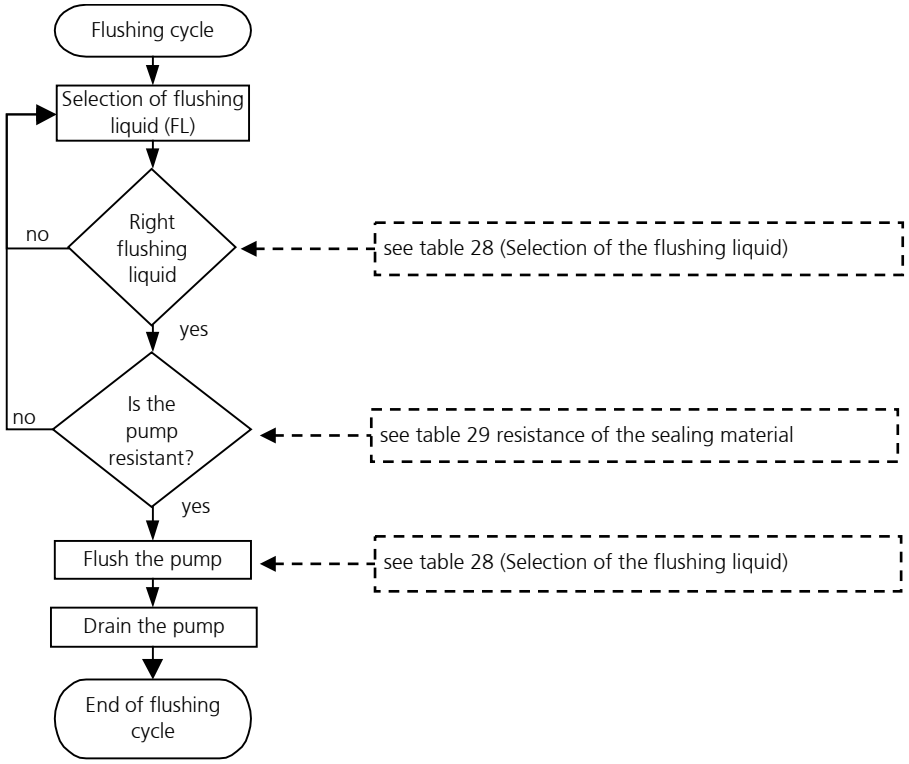


figure 16 Diagram of the flushing procedure

Warning Liquids that remain in the pump may crystallize, coagulate or lead to corrosion and as a consequence impair the work of the micro annular gear pump.

Warning Please make sure that the pump components and particularly O-rings and sealing are resistant to the employed flushing liquid. (see table 29).

Warning The flushing liquid (solvent) and the recommended duration of the flushing procedure depend on the delivered liquid (see table 29). The indicated flushing liquids are simple recommendations and should therefore be checked by the user as to their compatibility and suitability.

Regulations concerning use of substances dangerous to health should be followed!

	Nature of the delivered liquid	Flushing time [min]	Suitable flushing liquid
1	Oils, fats, plastifierss	15-20	isopropanol, ethanol, acetone, benzine/petroleum ether
2	Solvents (polar + nonpolar)	5-10	isopropanol, ethanol
3	Other organic liquids	10-15	isopropanol , ethanol
4	Refrigerating and cooling agents	15-20	isopropanol, ethanol
5	Neutral water/y solutions	20-25	isopropanol, ethanol
6	Basic solutions	25-30	DI-water (deionized water)
7	Organic acids	30-40	isopropanol, ethanol
8	Weak mineral acids	25-30	DI- water
9	Strong mineral acids	35-45	DI- water
10	Strong oxidizing liquids	35-45	DI- water
11	Paints, varnishes, adhesives	50-60	not specified - for further information please contact HNP Mikrosysteme.

table 28 Selection of the flushing liquid (solvent) and the duration of the flushing procedure depending on the delivered liquid.

Warning Please make sure that the pump components and particularly O-rings and sealing are resistant to the employed flushing liquid (see table 29).

	Shaft sealing		O-ring material		
Flushing liquid	PTFE (Teflon®), graphite-reinforced	UHMWPE	FPM (Viton®)	EPDM	FFPM
acetone	0	0	3	0	0
benzene	0	3	1	3	0
benzyl alcohol	0	-	0	2	0
butanol	0	-	1	0	0
dimethyl sulfoxide (DMSO)	0	0	3	0	0
ethanol	0	0	0	0	0
isopropanol	0	0	0	0	0
methanol	0	0	2	0	0
methylethylketone (MEK)	0	0	3	1	0
styrene	0	-	1	3	1
toluene	0	1	2	3	0
water	0	0	0	0	0
xylene	0	1	2	3	0
benzine/petroleum ether	0	0	0	3	0
oil / fine mechanics oil	0	0	0	3	0

Legend: 0 ... good suitability 1 ... suitability 2 ... conditional suitability 3 ... labile - ... not specified

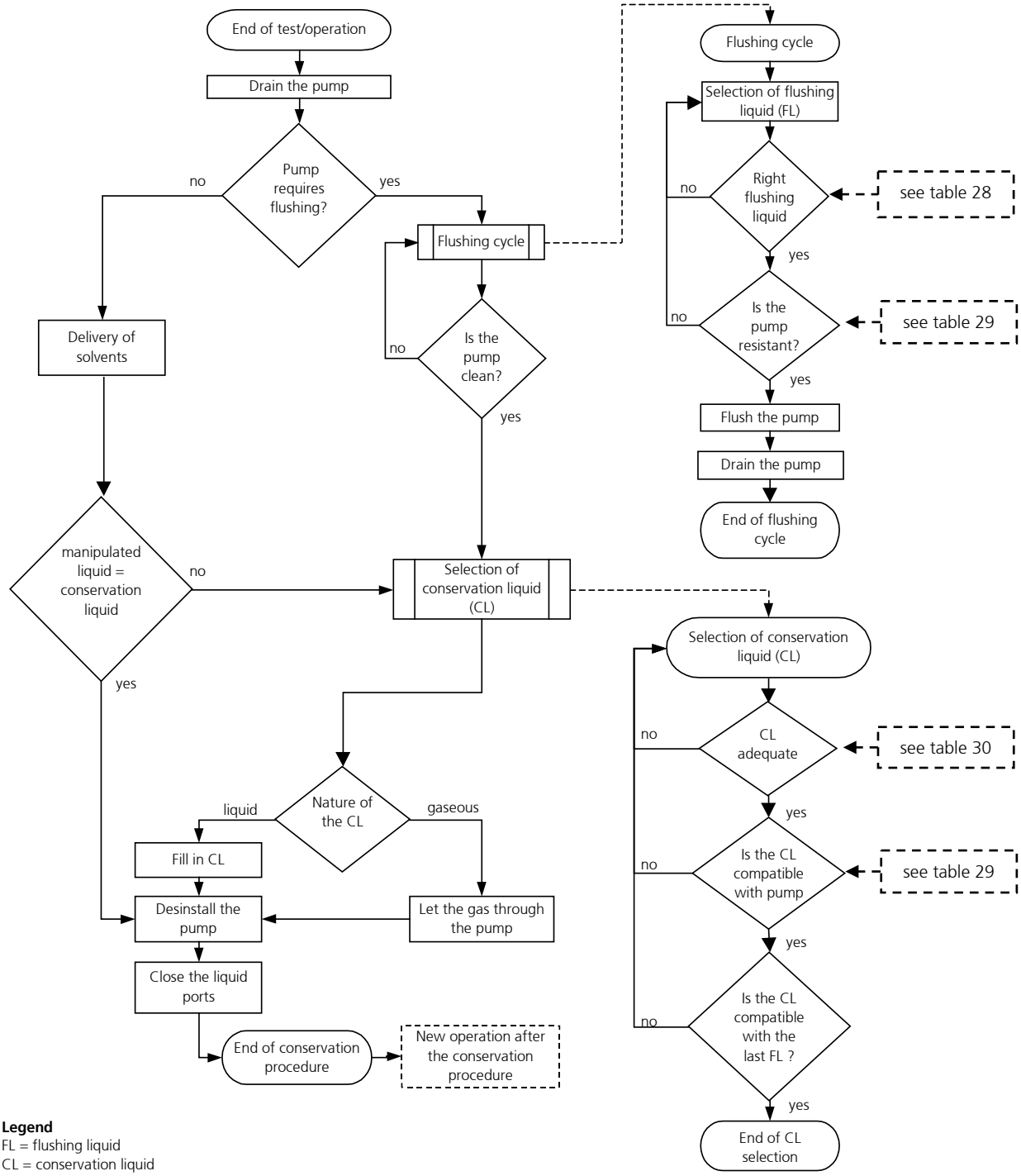
table 29 Resistance of the sealing materials depending on the flushing liquid (solvent)

8.4 Shutdown of the micro annular gear pump

In order to shut down a mzr-pump the following steps should be followed:

- Flush the pump with a filtered and particle-free flushing liquid (solvent) as described in the chapter 8.3.
- After the flushing procedure decrease speed of the pump to 0 rpm
- Fill the pump with a suitable conservation liquid (see chapter 8.4.1)
- Remove the pump from the system (see chapter 8.4.2)

By proceeding as shown in the diagram (see figure 18) you may prepare the pump for a longer standstill.



Legend
FL = flushing liquid
CL = conservation liquid

figure 17 Diagram of the shutdown procedure

8.4.1 Conservation

If the micro annular gear pump operates at irregular intervals or for other reasons should be put out of operation for a longer period, it should, after service and flushing procedure (see chapter 8.3), be filled in with a suitable conservation liquid.

The conservation liquid may be selected from the table 30 depending on the duration of the standstill and the resistance of the pump to the manipulated liquid. The indicated conservation liquids are simple recommendations and should therefore be checked by the user as to their compatibility and suitability. The figure 18 presents a diagram of conservation agent selection.

Remark: This diagram is repeated as a part of the figure 17 (shutdown procedure of the micro annular gear pump).

After the cleansing procedure the pump should be filled with a suitable conservation agent. You will find a choice of possible conservation agents in the table 30.

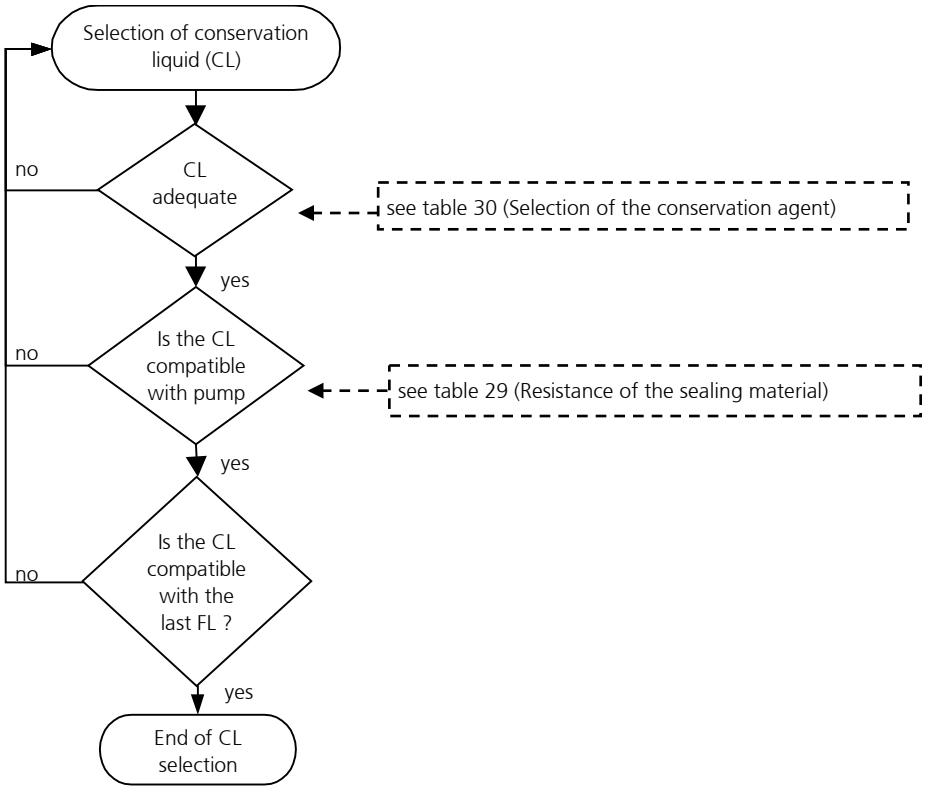


figure 18 Diagram - selection of conservation liquid (CL)

Liquids	Solubility in water	Compatibility with the delivered liquid	Duration of storage	Breakaway torque	Toxicology	Viscosity	Description
isopropanol	+	+	o	o	o	+	solvent for organic compounds, cosmetics, essential oils waxes, and esters, antifreezers, antiseptic agents
acetone	+	+	o	o	o	+	solvent for a number of organic compounds, unlimited solubility in water, dissolves natural and synthetic resins, fats, oils and commonly used plastifiers
ethanol	+	+	o	o	o	+	solvent for organic compounds, fats, oils and resins
fine mechanics oil	-	-	+	+	+	+	cleansing and protective action (dissolves fats, tar, rubber or adhesive substances, protects against corrosion).
hydraulic oil	-	-	+	+	+	-	lubricating and preserving properties (*Warning*: may resinate or deteriorate with time)
nitrogen	-	+	+	+	o	+	is not a solvent, may leave deposits after drying out
air / compressed air		+	+	+	+	+	is not a solvent, may leave deposits after drying out

Legend: + ... good/suitable o ... satisfactory; - ... bad/inadequate

table 30 Selection of the conservation agent

In order to prevent dust particles and foreign bodies from penetrating into the pump or the conservation agent from leaking out, please secure the liquid input and output openings with the delivered protective plugs or screws.

Warning Water or DI-water should not be used as conservative liquids. They germinate already after a few days and build a biofilm which can later block the pump.

8.4.2 Dismantling of the system

– Put the drive out of operation by turning down speed to 0 rpm and by switching off the voltage supply. Make sure that the procedure described in the chapter 8.3 has been completed.
– Now that the pump has been stopped you may remove it from the system.
– Protect the inlet and outlet openings of the pump with adapted protective plugs or screws.

8.5 Trouble shooting

If the pump stops operating abruptly or has difficulties with starting operation, please undertake the following steps:

Try to liberate the micro annular gear pump:

- by turning the potentiometer knob back and forth or by connecting an analog voltage
- via the control software
- by pressing with a syringe a suitable flushing liquid (see table 28 and table 29) through the micro annular gear pump
- by changing the operating direction of the pump.

If these measures turn out to be ineffective, please contact the service staff of HNP Mikrosysteme (see chapter 19) and send the pump back to the manufacturer for inspection.

Warning

You should under no condition try to disassemble the pump by yourself. This may cause damage to the pump components and consequently annul your warranty claims.

8.6 Return of the micro annular gear pump to the manufacturer

For the return of a micro annular gear pump and components that have already been employed, please follow the instructions:

- drain any remaining rests of the delivered liquid from the pump
- flush the pump with an adapted solvent
- remove the filter elements from integrated or loosely delivered filters
- protect all openings against dust with the delivered protective plugs or screws
- return the pump in its original packing

The service personnel which carries out the repair should be informed about the condition of the already used micro annular gear pump. This is done by means of the "Declaration of media in contact with the micro annular gear pump and its components" (see chapter 16). This form may also be downloaded from the web site *https://www.hnp-mikrosysteme.de/service/download-center.html*.

The "Declaration of liquids in contact with the micro annular gear pump and its components" must imperatively be filled in. The nature of liquid which entered into contact with the micro annular gear pump and its components must be specified.
In case of non-compliance, the sender will be liable for any resulting injure to persons or any object damage.

9 Software »Composer« and »Elmo Studio« (Option for S-HP-E)

The » Composer « software enables operation and configuration of the drive and offers a possibility of an online graphic analysis of the operating data. The software is delivered on CD. The program may be installed on a PC running under Windows 2000®, Windows XP® and Vista® operating systems.

Install the software » Composer « by starting the program »Setup« on the CD.

After the installation the » Composer « program may be started from the folder from the Windows start menu.

In order to program the drive the micro annular gear pump should be put into operation. The drive and the PC should be connected with the delivered "RS232-COM cable".

All chapters described below are explained very detailed in the documentations of the controller manufacturer.

9.1 Use application of CD

Load the application contained on the CD with the default parameters of the micro annular gear pump.

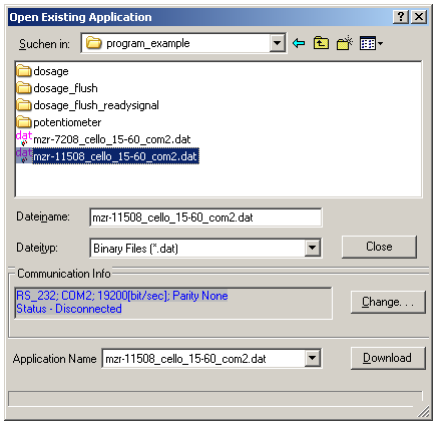


Figure 19 Open Existing Application

The serial port RS-232 can change with button »Charge«.

The communication opens via button "Download". The program in the EEPROM of the controller is deleted after a prior notice.

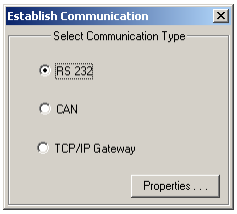


Figure 20 Select Communication Type

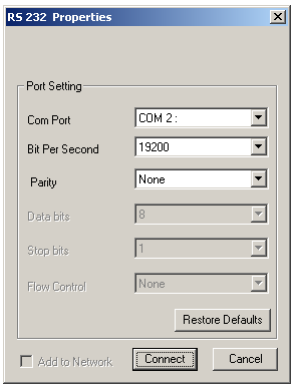


Figure 21 RS-232 interface properties

9.2 Creating a new application

Following windows are to go through to create a new application.

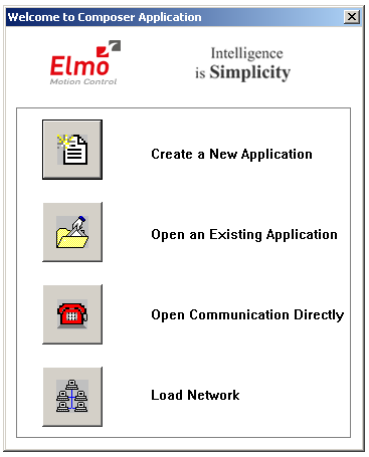


Figure 22 Welcome windows to Composer applications

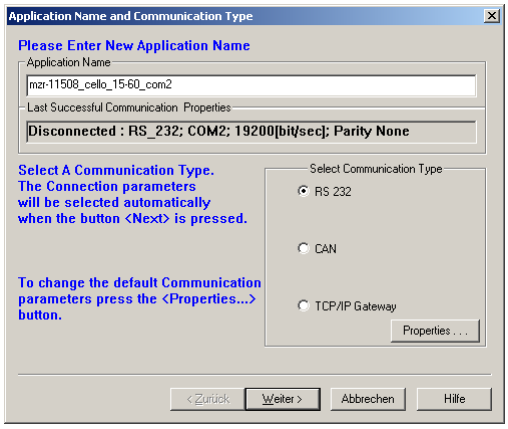


Figure 23 New Application name

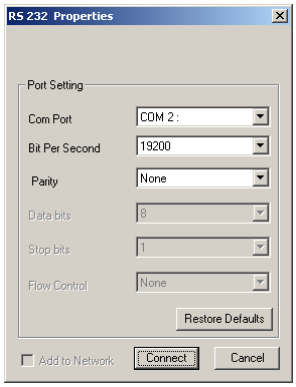


Figure 24 Selection of the relevant interface

Subsequently run the automatic scan of the serial port.

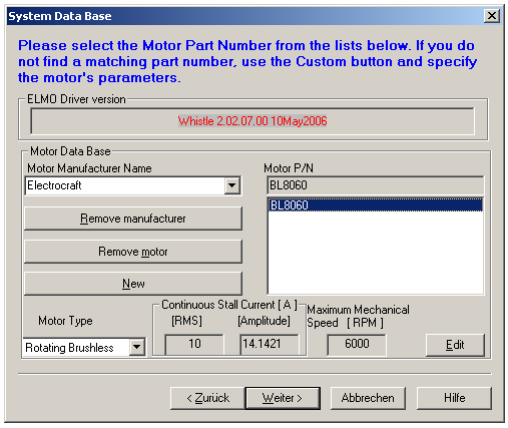


Figure 25 Adjustment of the motor data

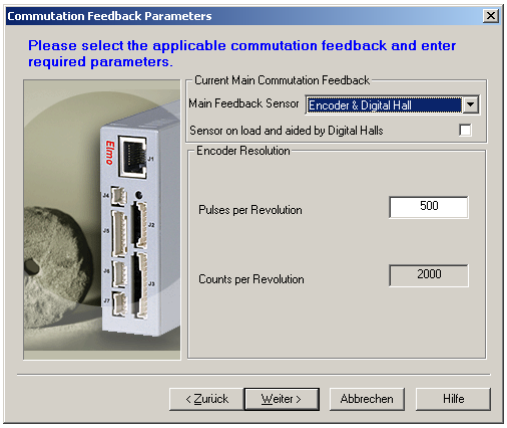


Figure 26 Adjustment of the encoder data

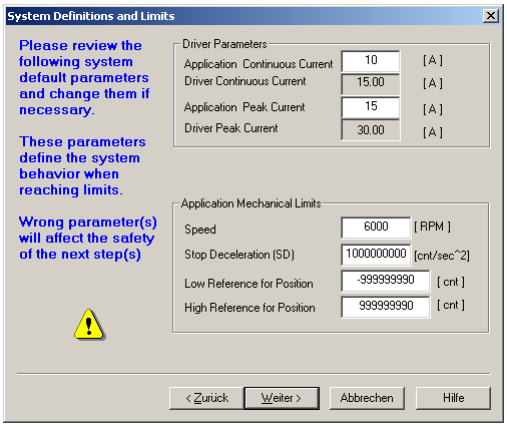


Figure 27 Adjustment of the driver parameter

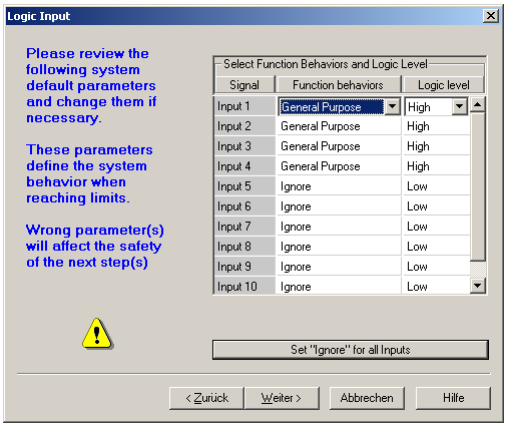


Figure 28 Adjustment of the digital inputs

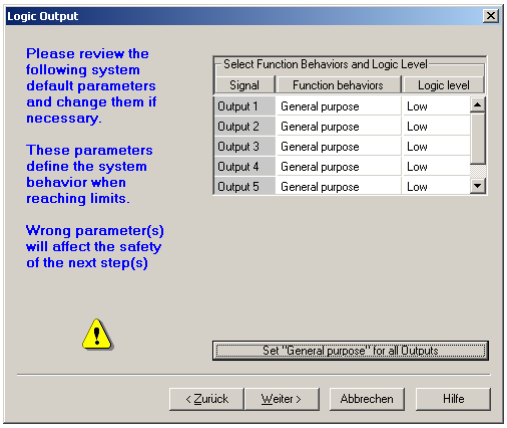


Figure 29 Adjustment of the digital outputs

9.3 Adjustment of controller parameter

The controller parameters of the controller must be set for the operation of micro annular gear pump. If the controller settings are noted with an uneven running of the motor tuning of the controller, a further optimization will be carried out.

The controller settings can be easily implemented on the following window.

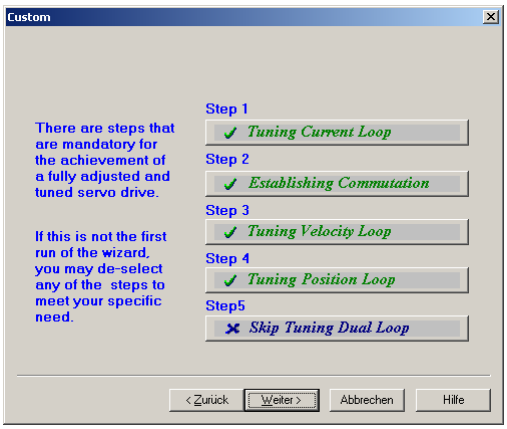


Figure 30 Adjustment of controller parameter

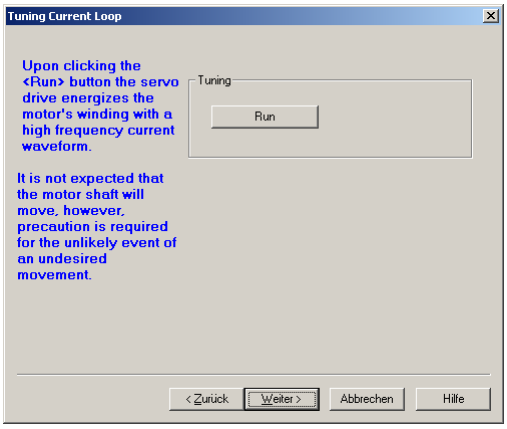


Figure 31 Start Autotuning

Figure 32 Start commutation test

Figure 33 Advice turning the motor shaft

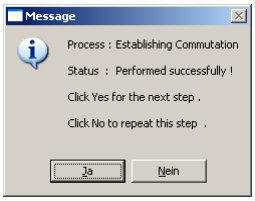


Figure 34 Message with status

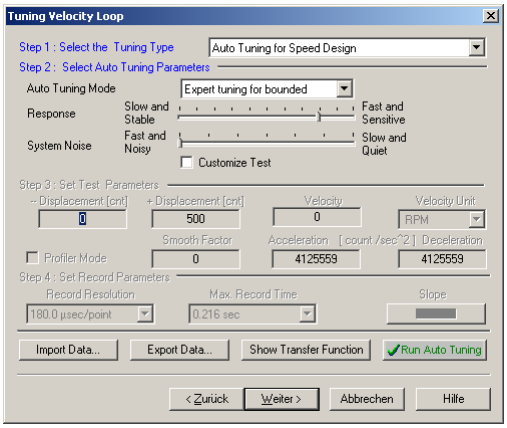


Figure 35 Tuning parameter of velocity loop

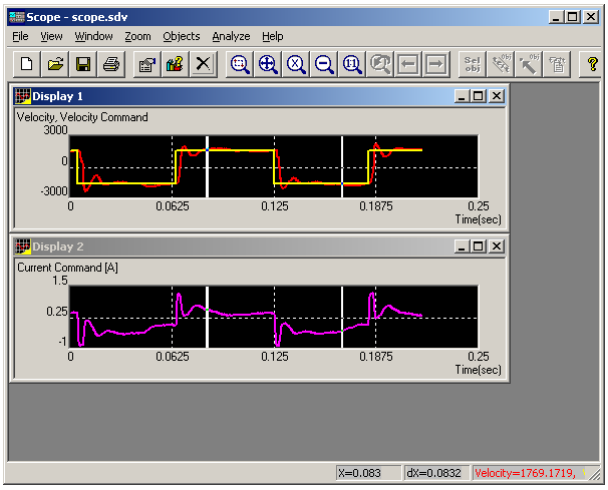


Figure 36 Windows scope motor velocity

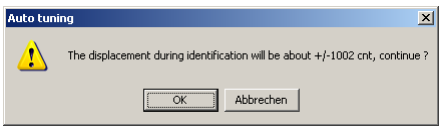


Figure 37 Advice window of motor rotation

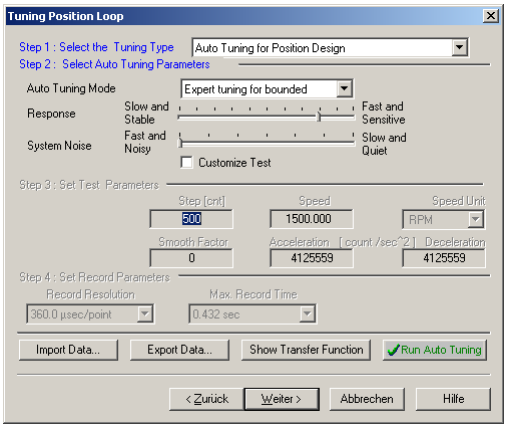


Figure 38 Tuning parameter of position loop

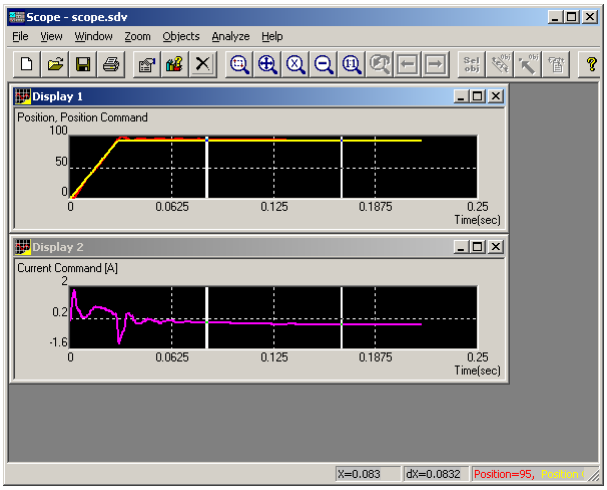


Figure 39 Windows scope motor positioning

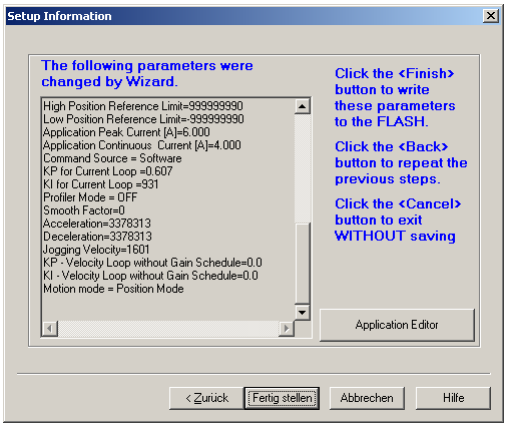


Figure 40 Setup Information

After adjustment of controller parameters, all parameters are saving with *parameter/Save all parameters*.

9.4 Operation of micro annular gear pump with RS-232 interface

In the *velosity mode*, the velocity of the pump motor speed is adjustable.

An example for continuous delivery

Command	Description
1000	Rotation speed of 1000 rpm
3000	Rotation speed of 3000 rpm
0	Standstill of the pump (speed 0 rpm)

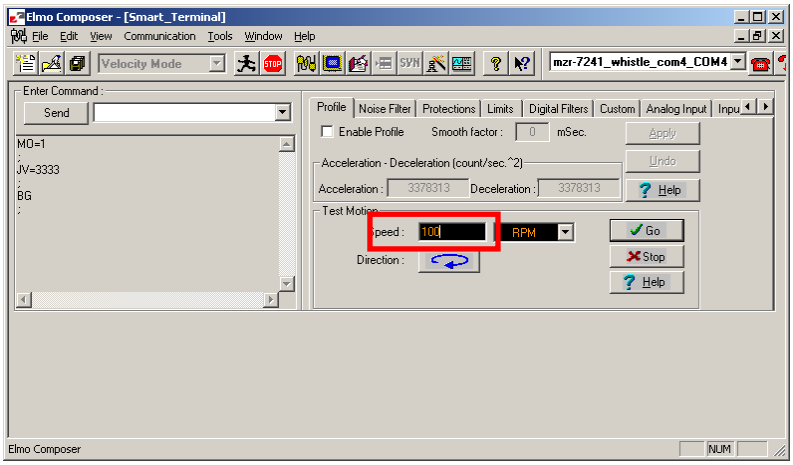


Figure 41 Speed adjustment

9.5 Operation of micro annular gear pump as stand alone application

With the software "Elmo Studio" sequence programs are permanently save in the controller. The programs start automatically when the supply voltage.

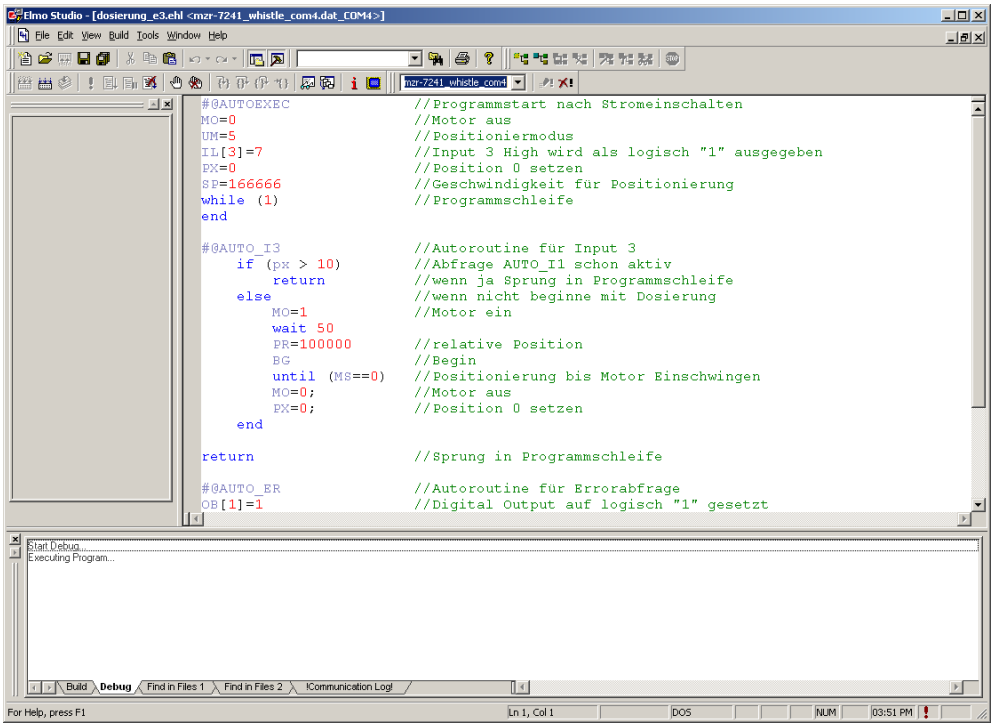


Figure 42 Software Elmo Studio

Programming is described in detail in the documentation of the motion control manufacturer explained. Some example programs for dispensing with the micro annular gear pump are included on the CD

9.6 Problems and their removal with controller S-HP-E

Error	Possible cause of error	Action
LED does not light up	No power supply	Check all power switches
LED lights	Motor does not rotate	Using the software for error check of the controller
Control is not responding	Wrong interface	Überprüfen, ob am PC die richtige Schnittsteller verwendet wird, ggf. umstecken oder EPOS die richtige Schnittstelle mitteilen
	wrong cable assignment	Check the wiring, correct if necessary
Motor hums whistles, or swinging	Controller parameters are not optimal	Controller parameters to check (see "Regulation tuning") in the separate manual control

table 31 Excerpt error control S-HP-E

If a disturbance that has not been mentioned in the above list, or that makes the use of the micro annular gear pump unsafe appears, please stop the operation of the pump without delay and contact the manufacturer.

10 Software »mzr-pump controller«

Install the delivered software »mzr-pump controller« from both diskettes by starting the program »Setup« on the diskette »Disk 1«. The delivered software is compatible with Windows 2000®, Windows XP® and Windows 7®.

After a successful installation the program »mzr-pump controller« can be found in the start menu under »Programs - HNP Mikrosysteme«. After the program has been initiated, data such as the pump type »mzr-2505«, »mzr-2905«, »mzr-4605«, »mzr-7205« and the gear reduction should be set.

The program enables to coordinate metering or continuous delivery tasks. The operating parameters of the micro annular gear pump are set via included user interface.

The »Dosage« operating mode (see figure 43) enables to set constant volumes in units such as ml, mg or rpm as well as pauses for a fixed number of sequences or for continuous operation. Each metering procedure will be configured according to the speed profile which is set for such values as »Max. velocity« and the »Acceleration«. The allowable speed values extend from 1 to 6000 rpm and the acceleration values from 1 to 2000 rotation/s².

The metering procedure can be initiated with the »Start« button or by pressing the enter key. The task may be stopped either with the »Stop« button or by pressing once again the enter key.

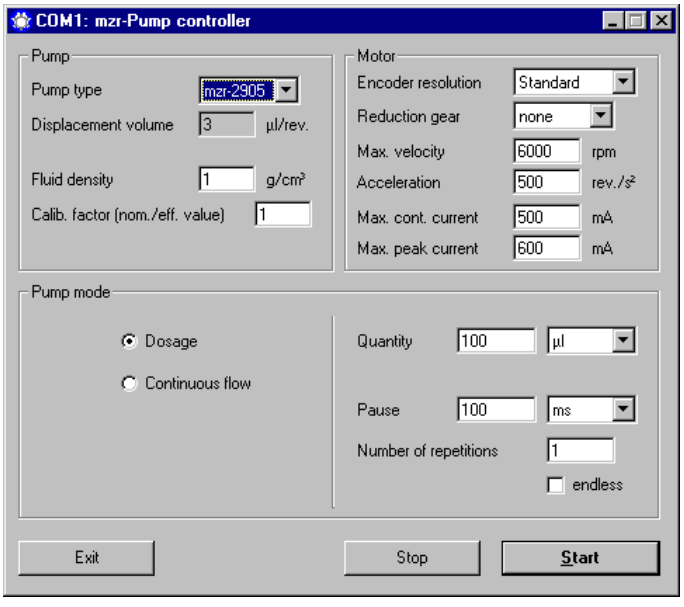


figure 43 Setup window of the »Dosage« operating mode

In the »Continuous flow« operating mode (see figure 44) continuous flow rates in units such as ml/min, g/min and rpm may be set. Operation of the micro

annular gear pump may be initiated with the »Start« button or by pressing the enter key for the indicated »Duration« value. Checking of the »endless« box will put the pump to continuous operation. The »Stop« button or pressing of the enter key once again will stop the delivery. If you check the »Potentiometer« box, speed may be set by turning the potentiometer knob in the front of the control module or on the terminal box.

The input of the »Fluid density« enables to convert units of weight to the given volumes or to the given flow rates expressed in volume units. *Remark*: if you are only working with volumes, the indication of the fluid density will not be necessary and the standard value »1« can be left.

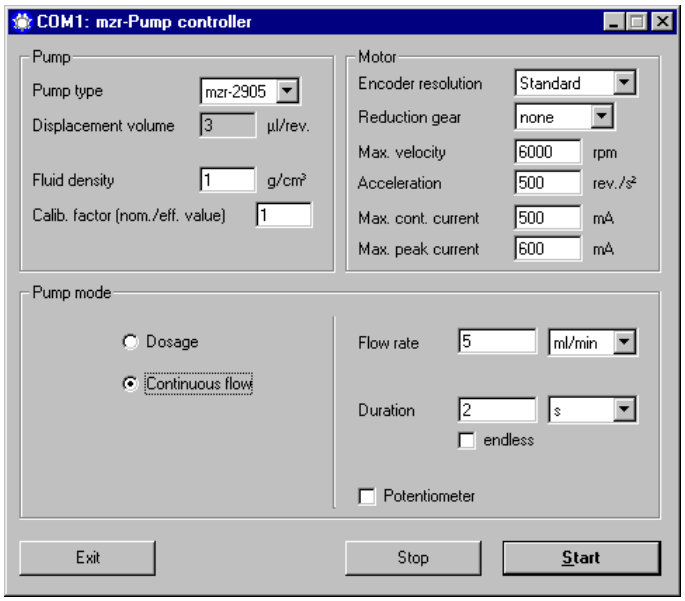


figure 44 Setup window of the »Continuous flow« operating mode

The »Calibration factor« enables to find the relation between the actually delivered quantities or flow rates (= actual value) and the set up quantities or flow rates (=nominal value). The calibration factor is specific to every pump and each application case and therefore should be determined by the user as according to the volume or weight of the delivered fluid. The calibration factor may be calculated according to the following formula:

$$\text{Calibration factor} = \frac{\text{Desired quantity}}{\text{Actual quantity}} = \frac{\text{Desired delivery value}}{\text{Actual delivery value}}$$

In practice, due to the high precision of the system the calibration factor value will only slightly exceed 1.

11 »Motion Manager« software

The »Motion Manager« software enables operation and configuration of the drive and offers a possibility of an online graphic analysis of the operating data. The software is delivered on CD. The program may be installed on a PC running under Windows 7®, Windows 8 or Windows 8.1® operating systems.

Install the software »Motion Manager« by starting the program »Setup« from the CD.

If the CD are not available you may still download this program from the web site http://www.hnp-mikrosysteme.de/download-center.html or the web site www.faulhaber.com (menu support - download). Here, the latest version is always available in English and German.

After the installation the »Motion Manager« program may be loaded from the »Faulhaber Motors« folder from the Windows start menu.

In order to program the drive, the micro annular gear pump should be put into operation. The drive should be connected to the PC with the delivered null-modem cable.

11.1 Direct drive control

In the »Motion Manager« software the input commands may be sent directly to the drive. This enables to execute the movement commands and to modify the drive parameters.

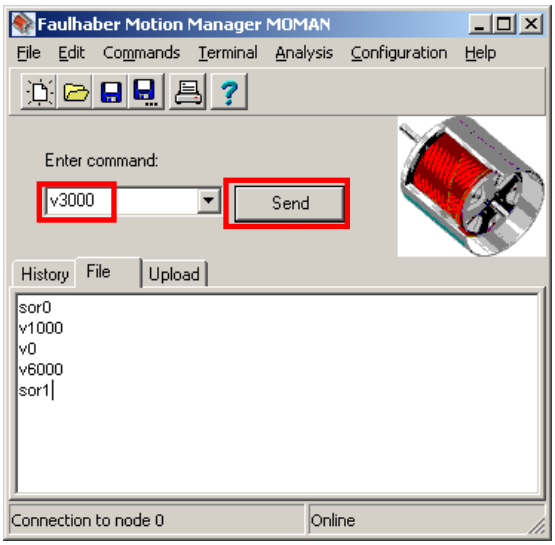


figure 45 Motion Manager software for direct control of the drive

The commands are entered in the field »Enter command:«. The button »Send« will send the command to the drive for execution (see figure 45). The commands may be given alternatively in capital letters or low case. The drive will ignore excess space characters.

An example for continuous delivery

Commands	Description
SOR0	Operating mode RS-232: Set the nominal speed via the RS-232 interface
V1000	Rotation speed of 1000 rpm
V0	Standstill of the pump (speed 0 rpm)
V6000	Speed value 6000 rpm
SOR1	Analog input of the operating mode: setup of the nominal speed with the potentiometer knob or by connecting an external voltage signal to the analog input

An example for discrete dosage

Command	Description
SOR0	Operating mode RS-232: set the position via RS-232 interface
LR10000	Load a relative position of 10000 to the control unit 10,000 = 10 rotations (*Remark: 1000 steps = 1 rotation)*
M	Execute the task / start positioning
LR20000	Load a relative position of 20000 to the control unit 20,000 = 20 rotations
M	Execute the task / start positioning
SOR1	Analog input operating mode: Set nominal speed with potentiometer or by connecting a voltage signal to the analog input

In case of the mzr-11558X1 micro annular gear pumps 1 revolution of the rotor corresponds to 1000 steps. The gear reduction is to be considered while using a gear reduction module.

For more details concerning the operation of the Motion Manager, please read the online program help.

Programming of the control

The control of the micro annular gear pump may be adapted by the user to a specific task by means of an easy programming language. The program files are available in the ASCII code and have by default the »mcl« extension which stands for "*m*otion *c*ontroller *l*anguage". Various parameters of the drive such as the maximal speed, the acceleration, the number of rotations, the allowable current load and the parameters of the PI-controller may be programmed with this language. Furthermore, it is possible to program short movement sequences which will be saved in the internal memory of the drive and then autonomously executed.

11.1.1 Transfer of a mcl file to the drive

The existing mcl files may be loaded to the file editor window using the menu command *File - Open…* (in the program window).

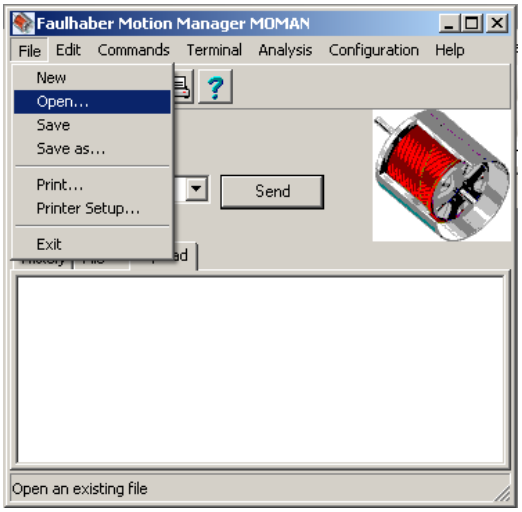


figure 46 Menu file- open

The required mcl file may be selected and loaded via the file selection window (see figure 46). By using the menu command *Terminal - Transfer configuration file* the mcl file will be transferred to the drive (see figure 47).

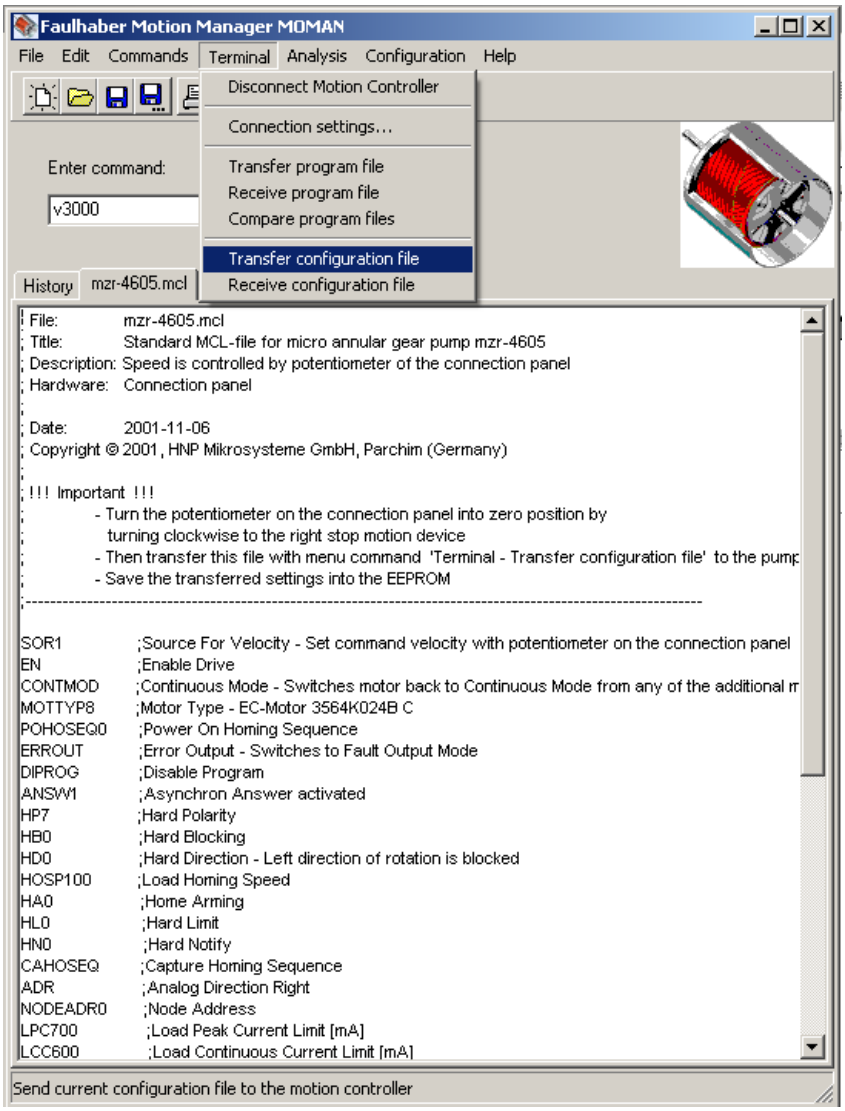


figure 47 Transfer of the mcl files as parameter data

When a window appears with the enquiry if the mcl files should be transferred to the »Motion-Controller«, answer by clicking on the »Yes« button.

In order to save the configuration and the programmed operation files in the EEPROM, confirm the dialogue window with »OK« (see figure 48). By this confirmation the program will be saved in the memory with a resident status and will be available for future operation.

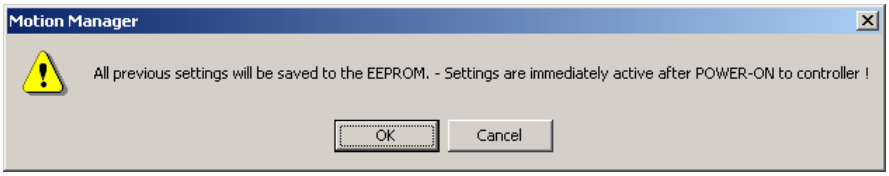


figure 48 Storage confirmation

A diskette with sample mcl programms is delivered along with the Motion Manager. At the delivery the pump has a standard program configuration. Moreover, a sample program that may be started with an external switch is available for discrete dosage tasks.

Pump type	Standard program	Sample program for dosage tasks
mzr-11558X1	mzr-11558_S.mcl	switchdosage_11558_e3_S.mcl

table 32 Overview of mcl sample programs

12 Problems and their removal

Error	Possible cause of error	Action
1 No function	No power supply	Check all power switches
2 Pump does not dose	No dosage liquid in the tank	Fill the liquid tank
	Motor error	Check motor Status of the pump with the software Motion Manager
	Dosage needle blocked	Check and clean the dosage needle
	Back-pressure valve does not work	Check the back-pressure valve
	No signal for start dosage	Check the start signal of the central control unit (PLC)
	Pump error	Replace pump and send the pump to the manufacturer
3 Pump does not prime during bringing the dosage system into service	Pump does not suck	Check of the installation
	-„-	Check air pressure on tank
	-„-	Back-pressure valve does not open, Check the back-pressure valve!
	-„-	Air bubbles in fluid system (tubings, valves)
	Tubings leak	Change the tubings
4 Motor works but pump does not pump	No liquid in pump	Prime the pump
	Air bubbles in fluid system (tubings, valves)	Prime the pump and the fluid system
	Valve not open	Flush the valve
	Dosage needle blocked	Clean, flush or change the dosage needle
	Coupling of the connection motor –pump is loose	Replace pump and send the pump to the manufacturer
	Pump shaft is broken	Replace pump and send the pump to the manufacturer
5 Pump does not pump but is filled with liquid	Particle in dosage liquid or pump blocked	Check Status of the pump with the software Motion Manager Try to get free the pump with negative prime speed (-500 rpm) for only 1 s
	-„-	Don't change the parameter of the motor with command »FCONFIG«, »LPC«, »LCC«!
	-„-	Flush the pump with the syringe
	Back-pressure valve not open	Flush the valve
	Dosage needle blockade	Clean or flush the needle
	Air bubbles in fluid system (tubings, valves)	Fill/Prime the pump and the fluid system
6 Dosage volume does not correspond with the datasheet or calculation	Air bubbles in fluid system and pump	Flush the fluid system and check the fluid system for opening connections
	Filter dirty	Change the filter
	Back-pressure valve not open	Flush the back-pressure valve
7 Liquid leaks out of the dosage needle (dosage needle drops)	Back-pressure valve not closed	Flush the back-pressure valve
	Pressure at process liquid tank	Disconnect the pressure connection of the process liquid tank
8 Liquid leaks out of the sealing liquid needle	Pressure at sealing liquid tank	Disconnect the pressure connection of the sealing liquid tank
9 Dosage volume reduces over the time	Filter dirty	Change the filter
	Dirt or deposition in the pump	Flush the pump or send the pump to the manufacturer for cleaning
10 Leak at the pump body	Seal out of order	Send the pump to inspection to the

Error	Possible cause of error	Action
		manufacturer
11 Leak of the fluid connections	Flangeless ferrules leak	Change the flangeless ferrules
12 Status of the pump cannot be checked or calibrated	No contact/connection to the pump	Check the power supply of the pump
	-„-	Check the connection of the zero modem cable between PC and dosage system or try to use a new cable
	Motor control out of order	Switch the power supply for a short time OFF and then ON to start the motor control again
13 Over temperature	Pump surface dirty	Clean the pump surface
	Pump works heavy	Flush the pump
14 Over current	Pump works heavy	Dosage needle damage, replace the needle
	-„-	Dosage needle blockade, clean or flush the needle
	Back-pressure valve not open	Flush the back-pressure valve
	Particle in dosage liquid	Flush the pump
15 Under voltage	Supply voltage < 12 VDC	Check the power supply voltage
16 Over voltage	Supply voltage > 28 VDC	Check the power supply voltage

table 33 Trouble shooting guide

If a disturbance that has not been mentioned in the above list, or that makes the use of the micro annular gear pump unsafe appears, please stop the operation of the pump without delay and contact the manufacturer.

13 Accessories for microfluidic systems

The accessory range for the liquid delivery systems of HNP Mikrosysteme comprises complementary equipment such as hoses, tubes, fluid fittings, filters and non-return valves that are best adapted to your micro annular gear pump. We will eagerly share our long date experience as far as component selection is concerned.

14 Non-liability clause

HNP Mikrosysteme GmbH shall not be liable any damage resulting form the non-respect of instructions comprised in this operating manual.

It belongs to the user to check the integrity, the correct choice and the suitability of the product for the intended use.

It remains at the responsibility of the user to conform to all laws, rules and regulations in force. This applies above all to the treatment of aggressive, poisonous, corrosive and other dangerous liquids.

15 Service and maintenance

For service and maintenance, you have the possibility to send your micro annular gear pump to HNP Mikrosysteme (the address is found on the cover of this manual). In measures of the service package, seals and other parts subject to wear are exchanged.

16 EU Directive

A Directive or EU Directive is a legal instrument of the European Community addressing at the member states and forcing them to implement specific regulations or targets. Leastwise, micro annular gear pumps are covered, by the scope of application of the following Directives: The following directives are of importance for the user of the described micro annular gear pumps:

Low-Voltage Directive (2014/35/EU)

The Low-Voltage Directive is not relevant for micro annular gear pumps described in this manual, because the supply voltage is limited to a maximum of 30 VDC.

Machinery Directive (2006/42/EU)

A micro annular gear pump is a machine and is consequently covered by this Directive. However, it may be a part of a machine or installation.

EMC Directive (2014/30/EU)

The Directive on Electromagnetic Compatibility (EMC) applies to all electronic and electrical devices, installations and systems. Consequently, the Motion Controller of the micro annular gear pump is covered by the EMC Directive.

RoHS Directive (2011/65/EU)

To our knowledge our products delivered to you do not contain substances or applications in concentrations that are forbidden by this directive. No substances contain our products delivered to you after our current knowledge in concentrations or application, the placing on the market in products according to the valid requirements forbade to the Directive.

WEEE Directive (2002/96/EU)

Disposal of micro annular gear pumps has to be environmentally sound.

All materials and liquids haveto be recycled in accordance with the relevant regulations. Electrical parts can not be disposed of as household waste. They have to be delivered to designated collection points.

REACH regulation (EU) No. 1907/2006

HNP Mikrosysteme is not a manufacturer or importer of chemical substances subjected to registration, but in terms of regulation, a downstream user. As downstream user, we conduct the necessary communication with our suppliers to ensure future deliveries of all components necessary to us. We will notify you of all relevant, changes in our products, their availability and the quality of parts/products delivered by us within our business and coordinate the appropriate action in individual cases with you. Previous inspection did not show any limitation in the supply of material from our upstream suppliers.

16.1 Electromagnetic Compatibility (EMC)

Electromagnetic compatibility is defined as the ability of a electric or electronic device to function satisfactorily as intended in its electromagnetic environment without introducing intolerable electromagnetic disturbances in that environment.

16.1.1 EMC Directive and Standards for controller S-BL

Comformity was proven by proof of compliance with the following harmonized standards by the company Dr. Fritz Faulhaber:

– EN 61000-6-4 (10/01): Generic standards – Emission standard for industrial environments
– EN 61000-6-2 (10/01): Generic standards – Immunity for industrial environments

These standards prescribe certain standardised tests for the emitted-interference and interference-immunity tests. The following tests are required due to the connections on the controller:

Generic Standard on Emitted Interference:	**Description**
EN 55011 (05/98)+A1(08/99)+A2(09/02):	Radio disturbance characteristics
Generic Standard on Interference Immunity	
EN 61000-4-2 (05/95)+A1(4/98)+A2(02/01):	Electrostatic discharge immunity test
EN 61000-4-3 (04/02)+A1(10/02):	Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4 (09/04):	Electrical fast transient/burst immunity test
EN 61000-4-5 (03/95)+A1(02/01	Surge immunity test
EN 61000-4-6 (07/96)+A1(02/01):	Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8 (09/93)+A1(02/01):	Power frequency magnetic field immunity test

Table 1 Standards Summary

All tests were conducted successfully.

16.1.2 Information on use as intended

For micro annular gear pumps, note the following:
Requirement for the intended operation is the operation according to the technical data and the manual.

Restrictions

If the micro annular gear pumps are used at home, in business or in commerce or in small businesses, appropriate measures must be taken to ensure that emitted interferences are below the permitted limit a values!

17 Declarations of conformity

The delivered micro annular gear pump falls within scope of the following EU directives:

– Machinery Directive (2006/42/EU)

You may request the declarations of conformity for the micro annular gear pumps from us separately.

HNP Mikrosysteme

EU-manufacturer's certificate (following Machinery Directive 2006/42/EU)

We hereby declare that the following micro annular gear pumps of the high performance series:

mzr-11557

are intended for installation into another machinery/plant and that start of operation is forbidden until it is identified that the machinery/plant into which these micro annular gear pumps shall be installed corresponds to the regulations of the EU guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– Machinery Directive (2006/42/EU)

Applied standards are particularly

DIN EN 809	DIN EN 60204-1	DIN EN 294
DIN EN ISO 12100 part 1		DIN EN 953
DIN EN ISO 12100 part 2		UVV

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Mr. Lutz Nowotka, HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin is authorised to compile the technical file according to Annex VII A.

Date: December 30, 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

HNP Mikrosysteme

EU-manufacturer's certificate (following Machinery Directive 2006/42/EU)

We hereby declare that the following micro annular gear pumps of the high performance series:

mzr-11558

are intended for installation into another machinery/plant and that start of operation is forbidden until it is identified that the machinery/plant into which these micro annular gear pumps shall be installed corresponds to the regulations of the EU guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– Machinery Directive (2006/42/EU)

Applied standards are particularly

DIN EN 809	DIN EN 60204-1	DIN EN 294
DIN EN ISO 12100 part 1		DIN EN 953
DIN EN ISO 12100 part 2		UVV

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Mr. Lutz Nowotka, HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin is authorised to compile the technical file according to Annex VII A.

Date: December 30, 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

HNP Mikrosysteme

EU-manufacturer's certificate (following Machinery Directive 2006/42/EU)

We hereby declare that the following micro annular gear pumps of the high performance series:

mzr-11558X1

are intended for installation into another machinery/plant and that start of operation is forbidden until it is identified that the machinery/plant into which these micro annular gear pumps shall be installed corresponds to the regulations of the EU guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– Machinery Directive (2006/42/EU)

Applied standards are particularly

DIN EN 809	DIN EN 60204-1	DIN EN 294
DIN EN ISO 12100 part 1		DIN EN 953
DIN EN ISO 12100 part 2		UVV

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Mr. Lutz Nowotka, HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin is authorised to compile the technical file according to Annex VII A.

Date: December 30, 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

18 Service, maintenance and warranty.

The maintenance of the micro annular gear pump should be carried out depending on the delivered liquid

– *for lubricating liquids* after 12,000 h working hours, but not later than 24 months after the initial operation

– *for non-lubricating liquids, crystallizing liquids or liquids containing particles,* after 5000 h working hours but not later than 12 months after the initial operation. If during the first inspection no substantial wearout of the pump is observed, the following inspection under the same working conditions should be performed after 8000 h working hours, yet not later than 15 months following to the last inspection.

If during the first inspection the pump shows a particularly strong wearout, the maintenance intervals should be readapted to the operating parameters.

In order to prevent a strong wearout of the pump, the pump should be shut down properly after every application as described in the chapter 8.4. A supplementary flushing procedure with a neutral flushing liquid (see chapter 8.3) also slows down the wearout process of the pump.

It is not allowed to open the micro annular gear pumps. The warranty extincts with the expiry of the legal warranty period or with the opening of the pump. Furthermore HNP Mikrosysteme cannot give any warranty of exchange for parts whose damage result from incorrect use.

For service and maintenance please return your micro annular gear pump to HNP Mikrosysteme (You will find the address on the cover of the present operating manual).

The declaration of liquids having had contact with the micro annular gear pump and components must imperatively be completed. The nature of the liquids must be specified. In case of non-compliance the sender will be liable for any resulting injure to persons or any object damage.

Sealings, rotors and shaft are parts that undergo wear and will be replaced by HNP Mikrosysteme GmbH during maintenance depending on their degree of wear.

19 Contact persons

Development and application assistance , service and accessories

Mr. Sven Reimann
Phone +49| (0) 385|52190-349

Service and maintenance

Mr. Steffen Edler
Phone +49| (0) 385|52190-307

Drive and control technology

Mr. Lutz Nowotka
Phone +49| (0) 385|52190-346

20 Legal information

Marks

mzr® is a registered German trademark of HNP Mikrosysteme GmbH.

MoDoS® is a registered German trademark of HNP Mikrosysteme GmbH.

µ-Clamp® is a registered German trademark of HNP Mikrosysteme GmbH.

HNPM® is a registered German trademark of HNP Mikrosysteme GmbH.

Teflon® is a registered trademark of DuPont.

Viton® is a registered trademark of DuPont Dow Elastomers.

Kalrez® Spectrum™ is a registered trademark of DuPont.

PEEK™ is a registered trademark of Victrex plc.

HASTELLOY® is a registered trademark of Haynes International, Inc.

Aflas® is a registered trademark of ASAHI Glass Ltd.

Microsoft®, Windows® are registered trademarks of Microsoft Corporation in the USA and in the other countries.

Cavro® is a registered trademark of Tecan Systems, Inc.

Other product names or descriptions not mentioned above are possibly registered trademarks of related companies.

Patents

Micro annular gear pumps (and housings) are protected by assigned patents: EP 1115979 B1, US 6,520,757 B1, EP 852674 B1, US 6,179,596 B1, EP 1354135, US 7,698,818 B2. Patents pending DE 10 2011 001 041.6, PCT/IB2011/055108, EP 11 81 3388.3, US 13/884,088, CN 2011 8006 5051.7, HK 13 11 2934.9, DE 10 2011 051 486.4, PCT/EP2012/061514, EP 12 728264.8, US 9,404,492 B2, CN 2012 8003 8326.2. In the US, Europe and China additional patents are pending.

21 Safety information for the return of already employed micro annular gear pumps and components

21.1 General information

The operator carries the responsibility for health and safety of his/her employees. The responsibility extends also to employees not belonging to the company that have a direct contact with the micro annular gear pump and its components during repair or maintenance works. The nature of media (liquids) coming into contact with the micro annular gear pump and its components must be specified in the corresponding declaration form.

21.2 Declaration of liquids in contact with the micro annular gear pump

The staff performing the repair or maintenance works must be informed about the condition of the micro annular gear pump before starting any work on the device. The »Declaration of media in contact with the micro annular gear pump« should be filled in for this purpose.

The declaration should be sent directly to the supplier or to the company designated by the supplier. A second copy of the declaration must be attached to the shipment documents.

21.3 Shipment

The following instructions should be observed for the shipment of the micro annular gear pump.

- drain any remaining liquid from the pump
- flush the pump with an adapted flushing liquid
- remove the filter elements from the integrated or loosely delivered filters
- all the openings should be air-tight plugged
- return the pump in the original packing

22 Declaration of media in contact with the micro annular gear pump and its components

Type of the device

Pump type/article no.: _____

Serial number: _____

Operating hours/running time: _____

Reason of return: _____

_____

_____

Contact with media (liquids)

The micro annular gear pump was in contact with:

_____

and has been rinsed with:

_____

Product info sheet / Material Safety Data Sheet: ☐ yes* ☐ no

* Please attach file

or is available on the following web site: www. _____

If a pump which had contact with dangerous substances could not be properly cleansed prior to shipment, we reserve the right to entrust a specialized company with cleansing of the device. The return of the pump in original packing is advisable. It is necessary in order to protect the employees and delivery staff.

Nature of media contact:

☐ explosive	☐ oxidizing	☐ sensitive to moisture
☐ toxic (toxic byproducts)	☐ radioactive	pH-value: approx. ____ to ____
☐ carcinogenic	☐ microbiological	other: _____
☐ irritant	☐ corrosive	_____

Hazard (H-statements): _____ Precautionary (P-statements): _____

Declaration

Hereby I/we affirm that the stated information is complete and correct. Micro annular gear pump and accessories are shipped in conformity with the applicable regulations.

company: _____ ☐ Mrs ☐ Mr title: _____

division: _____ name: _____

street, no.: _____ phone: _____

ZIP/city: _____ e-mail: _____

country: _____

city, date: _____ authorized signature / company stamp:

23 Supplement

- Drawings
- Manual of the motion controller S-HV
- Manual of the motion controller S-HP-E (optional)
- Manual of the motion controller S-HP-M (optional)