LasGAR Plus

Laser gas control valve with Piezo activation and upstream gas valves
LGRP type series analog and EtherCAT

Operating instructions

Version 01

ID no.: **PS09586A**

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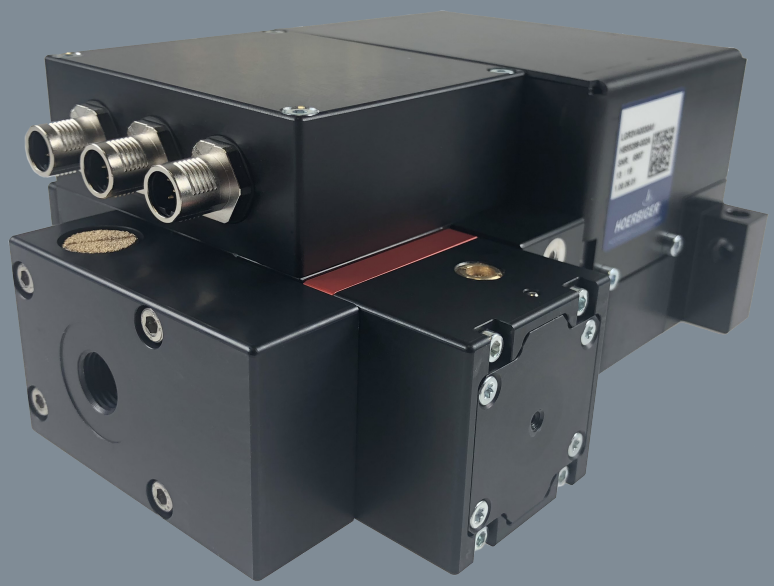
because performance counts



Version: 01
Date: 2019

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1 Notes about using the operating instructions

1.1 About these instructions

These operating instructions serve to explain how to transport, assemble, and put the LasGAR Plus into service, to prevent personal injury and property damage, guarantee fault-free operation, and not to damage the environment. In addition, the operating instructions contain information for the operator of the machine in which the LasGAR Plus is installed.

1. The operating instructions are part of the product. Keep the operating instructions carefully.
2. Transfer the operating instructions to any subsequent owner or user.

For additional information, contact the manufacturer at the following address:

HOERBIGER Flow Control GmbH
Südliche Römerstraße 15
86972 Altenstadt
Germany

Information on the Internet: www.hoerbiger.com

1.2 Warnings used

Warnings warn about dangers that can occur when handling the product. There are four danger levels with the following signal words:

Signal word	Meaning
DANGER	Identifies a danger with high risk that can cause death or severe injury.
WARNING	Identifies a danger with a medium risk that can cause death or severe injury.
CAUTION	Identifies a danger with a low risk that can cause slight or moderate injury.
NOTICE	Identifies a danger that can cause property damage.

1.3 Symbols

This symbol indicates useful and important information.

✓ This symbol stands for a prerequisite that must be fulfilled before performing an action.

⇨ This symbol stands for an individual action to be performed.

1. Numbers indicate several steps to be performed in an action instruction: Step 1
2. Step 2
   ↳ This symbol stands for the intermediate result of an action.
   ↳ This symbol stands for the result of an entire action instruction.

1.4 Abbreviations

Term / Abbreviation	Explanation
PDO	Process data object

2 Basic safety instructions

2.1 Intended use

The LasGAR Plus serves to control the cutting gas pressure for switching laser welding gases on and off when laser cutting. The device may only be used within the specified power limits, for specification, see chapter *Technical data, page 14*.

- ✓ All requirements for the safety of the device are fulfilled, see chapter *Technical requirements, page 9*.
- ✓ All legal requirements are fulfilled for the machine in which the device is installed.
- ✓ All safety equipment is properly installed and functional.
- ✓ The operating personnel have received initial training from the machine manufacturer.

1. Ensure that employees working on the device have the required qualification.
2. Only use the device in connection with laser cutting equipment.
3. Only operate the device with the specified media, see chapter *Pneumatic Characteristics, page 15*.
4. Only operate the device with dry, dust- and particle-free, pure gases, see chapter *Pneumatic Characteristics, page 15*.
5. Do not reconfigure the device or change it in any way.

2.2 Personnel qualification

Unqualified personnel cannot detect risks and is therefore subject to greater dangers.

1. Only commission qualified personnel with the activities described in these instructions.
2. Make sure that the personnel adheres to the locally valid regulations and rules for safe and danger-conscious work.

The following target groups are addressed in these instructions:

Trained person: A trained person is somebody who has been trained extensively by the operator in his tasks in connection with the safe operation of the valves.

Training is conducted by specialized personnel.

Qualified person: A qualified person is somebody who, based on his technical training and/or extensive experience, can detect risks and prevent hazards that can arise during his activity.

Electrically-qualified person: An electrically-qualified person is somebody who, based on his specialized training, knowledge, and experience, as well as knowledge of the applicable regulations, can judge and perform the work with which he is commissioned and detect possible hazards independently.

Pneumatically-qualified person: A pneumatically-qualified person is somebody who, based on his specialized training, knowledge, and experience with respect to pneumatic components and systems as well as knowledge of the applicable regulations, can judge and perform the work with which he is commissioned and detect possible hazards – especially with respect to interactions between pneumatic, mechanical, electrical, and control-technical components – independently.

Activity	Authorization
■ Assembly ■ Start-up	■ Trained person ■ Qualified person
■ Installation incl. electrical connection	■ Electrically-qualified person
■ Work on the pneumatic systems	■ Pneumatically-qualified person
■ Operation	■ Trained person
■ Service ■ Troubleshooting ■ Elimination of faults ■ Taking out of service	■ Qualified person

2.3 Duties of the machine manufacturer

2.3.1 Technical requirements

Damage due to carbon dust

Carbon dust from compressed air compressor can damage the valve.

- Avoid carbon dust.

1. For adherence to the media quality for cutting gases and control air prescribed in chapter *Technical data, page 15*, suitable filters, compressed air dryers, and oil separators must be provided; if possible near the connections of the valve.
2. Use screw connections with O-rings to connect pipes. **NOTICE! PTFE seals and liquid seals may not be used since parts can loosen and contaminate the valve.**
3. Flush or pig compressed air and gas lines for the device before installation in order to remove all particles and deposits in the line completely, see chapter *Connecting gases, page 26*.
4. Do not use the device as a safety valve for pressure limitation.
5. Ensure that the construction surrounding the device can safely absorb the static and dynamic forces arising during operation.
6. After assembly of the device, perform a sound measurement and take suitable sound protection measures if necessary.
7. Set up the main switch and EMERGENCY STOP switch on the superior controller of the machine.
8. Provide gas supply, gas lines, and connections according to the device's requirements; see chapter *Gas installation, page 24*.
9. Make sure that the media pressures on the device do not cause any hazard, see chapter *Pneumatic Characteristics, page 15*.
10. Only use suitable pressure lines.
11. Adhere to the storage and operation duration for the line specified by the manufacturer of the pressure line.

2.3.2 Responsibility with regard to the operator

1. Complete operating instructions according to the results of the risk assessment and the safety measures taken.
2. Determine the relevant content of the operating instructions for the operator and transfer the operating instructions to the operator of the machine.

2.4 Responsibility of the operator

The assumed duties of the operator are:

1. Adherence to operational safety regulations.
2. Adherence to the valid national occupational safety regulations.
3. Adherence to the intended use of the valve.

2.5 Duties of the personnel

1. Carefully read and understand operating instructions before assembly and starting up the device.
2. Heed and follow all safety instructions, notes, requirements, and information.
3. Keep operating instructions in the immediate area during installation and start-up.

2.6 Behavior in case of emergency

1. Switch off main switch of the machine in order to de-energize the machine.
2. Switch off gas supply.
3. Secure machine against unintentional switching on.
4. Command all people to leave the danger zone.
5. Secure the danger zone.
6. Inform responsible supervisor.
7. Rescue injured persons from the danger zone as soon as it is possible to do this without endangering yourself.

2.7 Personal protective equipment

Flying parts, escaping liquids, and sharp edges can cause severe and life-threatening injuries.

1. When working on pneumatic systems, wear eye protection according to EN 166.
2. Wear work gloves according to EN 388.

3 Product description

3.1 Description

The LasGAR Plus is a control and regulation device for cutting gases for laser cutting.

The LasGAR Plus consists of the following components:

1. Control and communication electronics for precise, dynamic cutting gas regulation and analog or digital communication with the machine control.
2. Input filter unit to protect the device against coarse dirt particles from the supply line. Only present in the model LasGAR Plus Filter.
3. Upstream valve unit with 2 or 3 upstream valves for gas selection of the cutting gases.
4. Control valve electronically controlled to regulate cutting pressure during the cutting process.

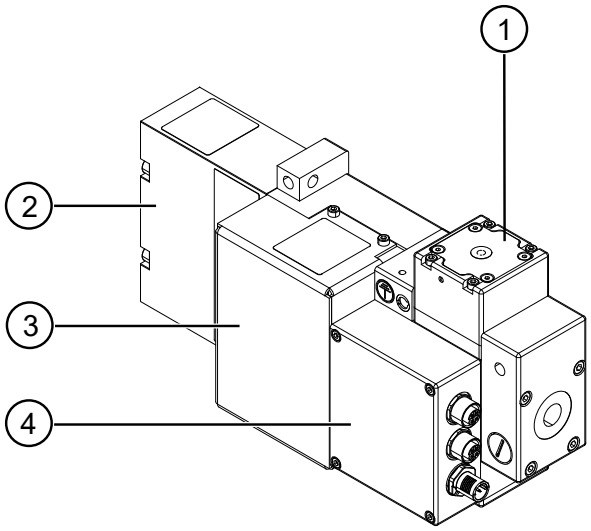


Fig. 1: Components of the LasGAR Plus

1	Control valve	3	Upstream valve unit
2	Input filter unit	4	Control and communication electronics

The compact, ready-to-use unit can be installed in laser cutting machines and connected using gas and electric connections.

3.2 Function

The LasGAR Plus switches the cutting gases required for the cutting process on and off, e.g. nitrogen, oxygen, compressed air, or argon, and provides the selected gas to the laser cutting head controlled via the unit's output.

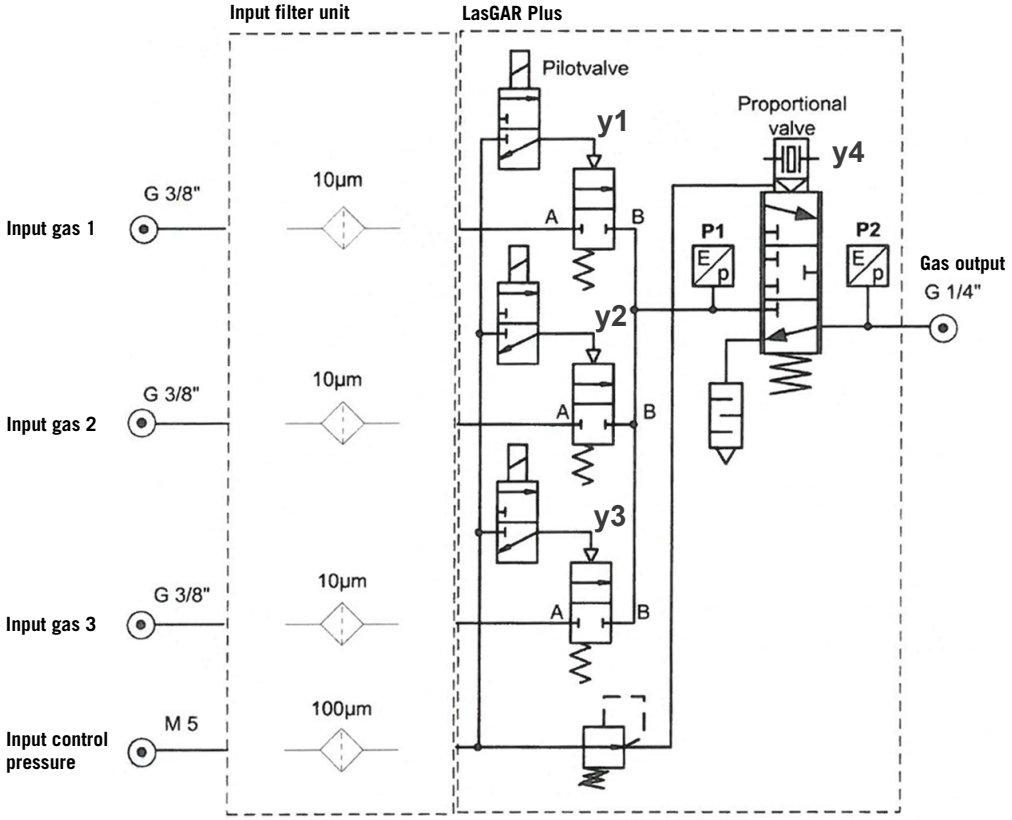


Fig. 2: Pneumatic circuit diagram, 3-gas version (input filter unit only for LGRPF variant)

3.2.1 Cutting gas selection

The cutting gases applied to the input of the upstream valve unit are fed with the switching of one of the integrated 2/2-way valves Y1, Y2 or Y3 to the input of the control valve Y4. Here, only one cutting gas can be selected; the other valves are locked electronically. The upstream vales are made to be back pressure-proof so that there can be no gas mixture.

3.2.2 Cutting gas control

The control valve Y4 regulates the output pressure according to the target value specified by the machine control and provides the pressure to the laser cutting head.

The pressure sensor P1 measures the input pressure of the control valve. The current value is output as analog signal for processing by the machine control.

The following functions are possible:

- Check whether the current pressure at the control valve input is higher than the selected pressure target value.
- Securing against gas mixing for cutting gas switching. The switching occurs only when the pressure P1 is lower than the pressure of the newly selected gas.

In addition, for the “digital communication” model, warnings are output if the input pressure is too low.

The pressure sensor P2 handles the electronic control for recording of actual pressure. The value is also output as an electric signal.

For quick pressure reduction, the control valve is able to ventilate the pressure at the output via integrated ventilation holes.

3.2.3 Communication

Depending on the model, the communication with the machine control is handled in analog (0 – 10 V) or digital fashion (EtherCAT).

3.2.4 Input filter unit

The optional input filter unit is a particle filter with 2 or 3 filter cartridges (10 µm apiece) on the cutting gas inputs and a filter screen (100 µm) at the control pressure input. The filter cartridges protect the upstream valves and the control valve against large dirt particles and can be changed out.

3.3 Scope of delivery

The scope of delivery includes:

- Laser gas valve: LasGAR Plus (LGRP type variant) or
- Laser gas valve with input filter unit: LasGAR Plus filter (LGRPF type variant)
  - Analog (ID number according to type plate) or
  - EtherCAT (ID number according to type plate)
- Brief operating instructions

Gas lines and connections are not included in the scope of delivery.

The detailed operating instructions can be downloaded from the Internet at www.hoerbiger.com.

3.4 Technical data

General technical data

Designation	LasGAR Plus (types LGRP and LGRPF)
Models	■ 2 or 3 upstream valves ■ Analog or EtherCAT communication ■ With and without input filter unit
Function type Pressure control valve	Piezoelectric upstream 3-way proportional pressure controller, electronically controlled
Function type Upstream valves	Magnetic indirectly controlled 2/2-way switching valves, back pressure-proof
Fastening type	M6 screws
Connection sizes	
Gas inputs	G⅜
Gas output	G¼
Control air input	M5
Weights	
Type LGRP2V 2-gas model	2.25 kg
Type LGRP3V 3-gas model	2.4 kg
Type LGRPF2V 2-gas model with input filter unit	3.05 kg
Type LGRPF3V 3-gas model with input filter unit	3.2 kg
Installation position	Vertical
Storage temperature	-20 to +70 °C
Ambient temperature	-5 to +45 °C
Medium temperature	-10 to +50 °C
Rel. humidity	5 % to 95 % (non-condensing)
Materials	Aluminum, brass, spring steel, plastic, elastomer
Protection type	IP 50 (DIN EN 60529 A1:2000) [1)]
Max. permissible accelerations	
Positioning	30 m/s^2 (total)

Designation	LasGAR Plus (types LGRP and LGRPF)
Cutting (x/y axis)	20 m/s^2 (total)
Shock	30 m/s^2
Behavior in case of power failure	Cutting gas inputs are closed, gutting gas output ventilated
Input filter unit (only for LGRPF version)	
Mesh size filter elements Gas inputs	10 µm
Mesh size filter elements Control pressure input	100 µm

[1] Only with properly mounted plug connectors, gas, and compressed air connections

Pneumatic characteristics

Cutting gas media with input pressure ranges [1]	
Compressed air	0 to 40 bar
Oxygen	0 to 15 bar
Nitrogen	0 to 40 bar
Argon	0 to 40 bar
Medium quality	According to ISO 8573-1:2010 (3:2:2)
Cutting gas output	
Output pressure	0.4 to 30 bar
Output pressure precision analog version [2]	
Control range 0.4 to 10 bar	± 0.06 bar (with ambient temperature 5 to 45° C)
	± 0.1 bar (with ambient temperature < 5 °C)
Control range > 10 bar	± 0.5 bar (with ambient temperature – 5 to 45 °C)
Output pressure precision digital version [2]	
Control range 0.4 to 10 bar	± 0.03 bar (with ambient temperature - 5 to 45 °C)
	± 0.1 bar (with ambient temperature < 5 °C)
Control range > 10 bar	± 0.5 bar (with ambient temperature – 5 to 45 °C)

Gas throughput (Q) (with p1 = 6 bar and p2 = 0 bar)	
LRGP type (without input filter unit)	1,600 l/min
LRGPF type (without input filter unit)	1,450 l/min
Control air media with input pressure range	
Compressed air	4.5 to 7 bar
Nitrogen	4.5 to 7 bar
Medium quality	According to ISO 8573-1:2010 (6:3:3)

[1)] Assignment of the cutting gases to the inputs 1, 2, and 3 is arbitrary.

[2)] Only applies with use of the calibration mode according to chapter *Calibration and function check, page 37*.

Electric characteristics

General electrical characteristics	
Supply	
Nominal voltage (U_N)	24 V DC ± 10 %
Nominal voltage (P_N)	8 W
Ripple (U_N)	≤ 10 %
Current consumption (I_N)	300 mA

Analog model (type LGRPx-xx-A00)	
Target value input	
Target value (W)	0 to 10 V
Resolution	0.333 V/bar
Input resistance (R_E)	≥ 80 kΩ
Actual value output monitoring input pressure p1	
Output voltage (U_X)	0 to 10 V
Resolution	0.333 V/bar
Max. output current (I_X)	1 mA (short circuit-proof)
Actual value output pressure p2	
Output voltage (U_X)	0 to 10 V
Resolution	0.333 V/bar
Max. output current (I_X)	1 mA (short circuit-proof)
Inputs selection upstream valves gas 1, 2, and 3	
Switching voltage “OFF” (U_{OFF})	0 V
Switching voltage “ON” (U_{ON})	24 V ± 10 %
Input resistance (R_E)	≥ 1 kΩ

EtherCATmodel (type LGRPx-xx-DE)	
Communication	EtherCAT
Electromagnetic compatibility [1)]	
Immunity to interference	EN 61000-6-2
Emitted interference	EN 61000-6-4

[1)] Use of screened connection cable required

3.5 Type code

Fields of the type code:

Field		1	2	3	4	5
ID no.	LGR	xx	xx	xx	xx	xx
Example	LGR	PF	3V	A00	30	00

Tab. 1: Type code fields

Possible values for fields of the type code:

Field		Model	Note
1	Device variant	■ P = Plus ■ PF = Plus + Filter	
2	Number of upstream valves	■ 2V = 2 upstream valves ■ 3V = 3 upstream valves	
3	Electrical control	■ A00 = analog ■ DE = digital EtherCAT	
4	Pressure range	■ 30 = max. output pressure	
5	Device model	■ 00 = standard model ■ Sxxx = customer-specific special model	These operating instructions are not valid for devices with order code Sxx. The operating instructions must be requested from the manufacturer specifying the type code and the ident. no.

Tab. 2: Type code values

3.6 Type plate

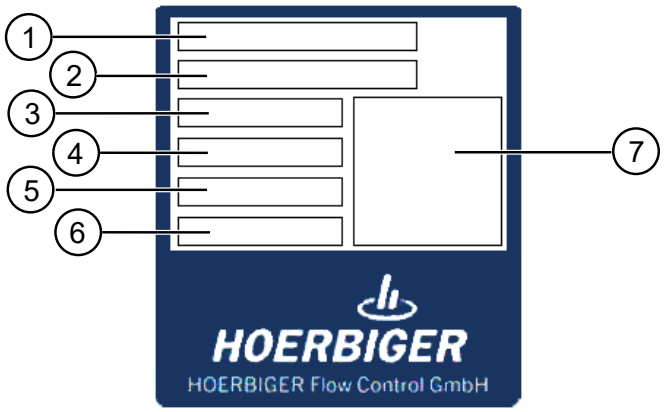


Fig. 3: Type plate

1	Product name	5	Date of manufacture (ww/yy)
2	Type designation	6	Software version number
3	ID number	7	Data matrix code The data matrix code includes the content of the type plate.
4	Serial number		

4 Transport and storage

Damage due to missing packaging!

The device can be damaged due to packaging missing during transport and storage.

- Only transport and store the device in the original packaging.

The LasGAR Plus is packed in a carton. The device can be moved by hand.

1. Transport the device to the installation location and unpack it immediately prior to installation.
2. Place the packaging materials in the recycling container.
3. The pneumatic connections are secured with a protective film against dirt penetration. Only remove this protective film immediately before connecting the pneumatic lines.

5 Assembly and installation

5.1 Assembly

⚠ DANGER

Mortal danger due to flying parts!

Improperly fastened parts can fly around and cause life-threatening injuries.

- Ensure that the construction surrounding the device can safely absorb the static and dynamic forces arising during operation.
- Fasten the device as specified using 2 fastening holes at the rear or 3 fastening holes on the side.
- Use screw locking to fasten the device.
- Adhere to tightening torques.

⚠ CAUTION

Personal injury or property damage due to incorrect installation position!

Incorrect installation position can cause disturbances in the valve function. Personal injury and property damage can result.

- Be sure to heed the vertical installation position according to the following figures.

⚠ CAUTION

Personal injury or property damage due to covered ventilation openings!

Covered ventilation openings can cause severe injuries and damage to the valve.

- Make sure that the distance between the ventilation openings (marked as “y” in Fig. *Ventilation openings, page 23*) and the surrounding parts is at least equal to the opening diameter.

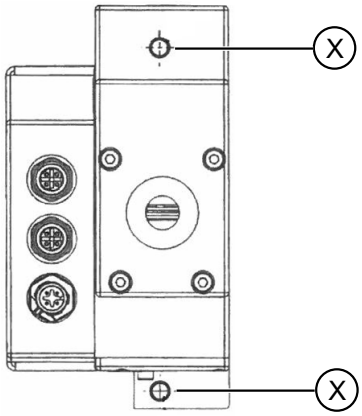


Fig. 4: LGRP fastening rear

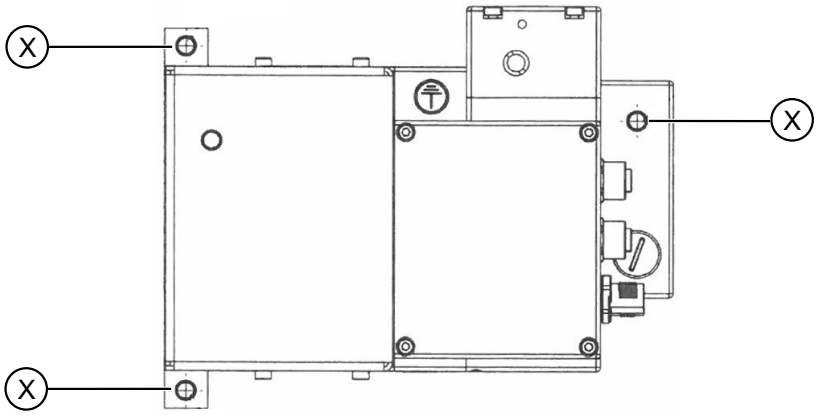


Fig. 5: LGRP fastening side

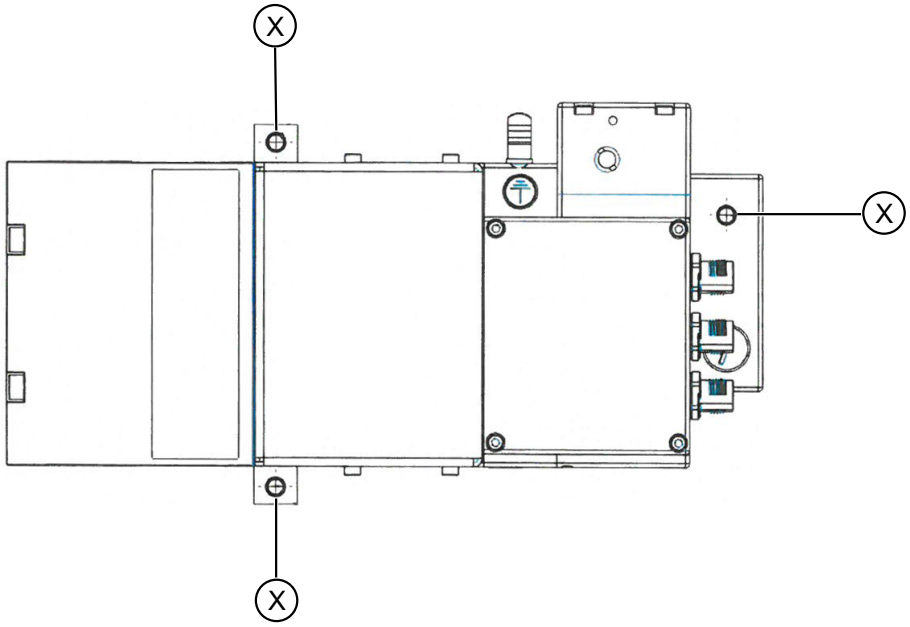


Fig. 6: LGRPF fastening side

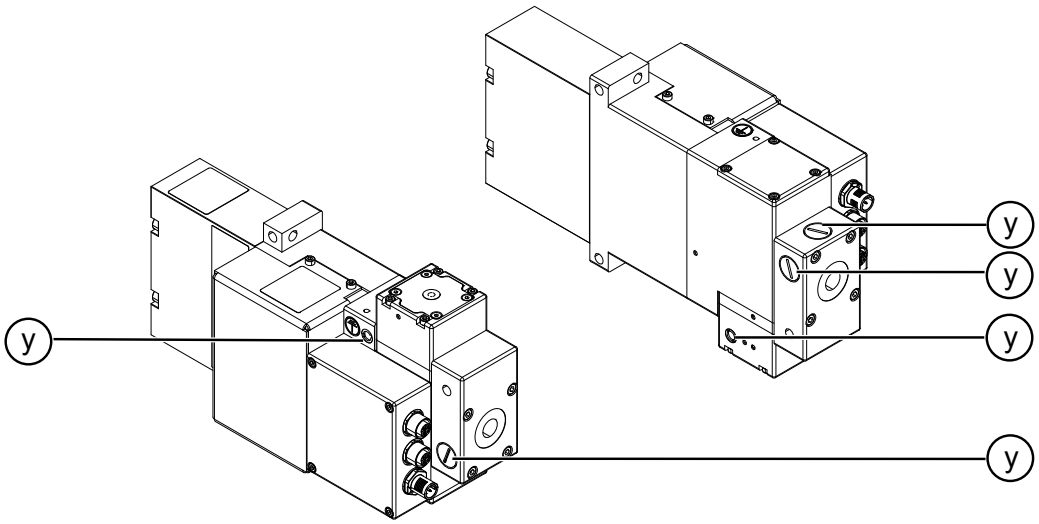


Fig. 7: Ventilation openings

1. Screw device to a carrier plate with M6 screws. Here, you can choose one of the following fastening types:
   ↳ Fasten device at the rear using 2 fastening holes (X) (see Fig. *LGRP fastening rear, page 21*) or
   ↳ Fasten device on the side using 3 fastening holes (X) (see Fig. *LGRP fastening side, page 22* and Fig. *LGRPF fastening side, page 22*).
2. Use screw locks.
3. Heed the tightening torque of 9.5 ± 0.5 Nm.
4. Make sure that the distance between the ventilation openings (y) and the surrounding parts is at least equal to the opening diameter (see Fig. *Ventilation openings, page 23*).

Mounting turned by 180° is possible.

5.2 Gas installation

5.2.1 Gas connections

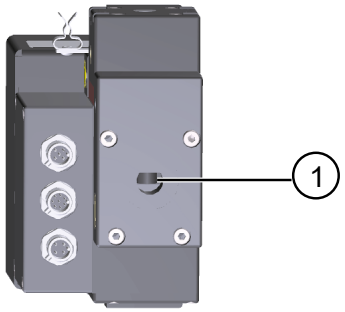


Fig. 8: Gas connections front side

1	Cutting gas output G¼		

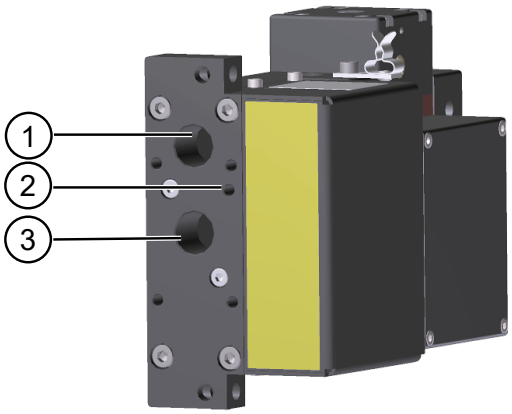


Fig. 9: LGRP2V gas connections rear

1	Input cutting gas 2 G⅜	3	Input cutting gas 1 G⅜
2	Input control air M5		

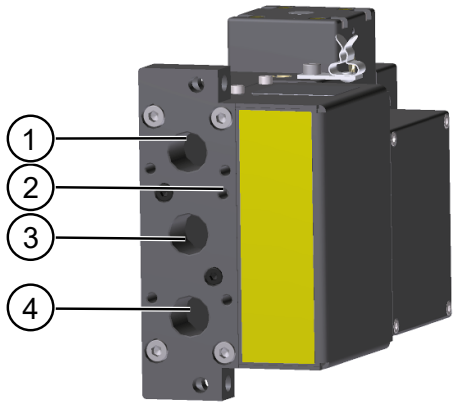


Fig. 10: LGRP3V gas connections rear

1	Input cutting gas 3 G⅜	3	Input cutting gas 2 G⅜
2	Input control air M5	4	Input cutting gas 1 G⅜

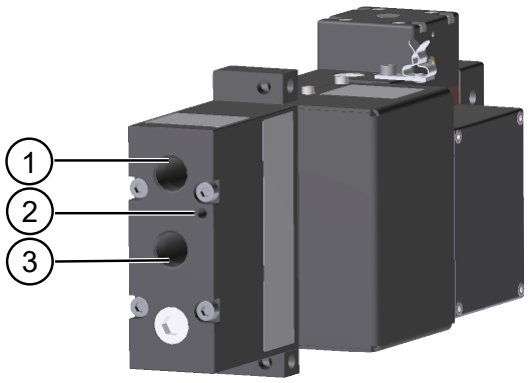


Fig. 11: LGRPF2V gas connections rear

1	Input cutting gas 2 G⅜	3	Input cutting gas 1 G⅜
2	Input control air M5		

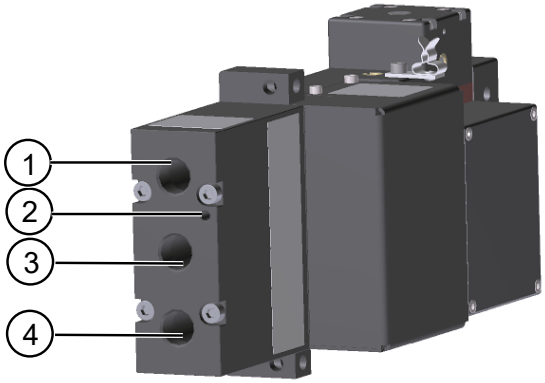


Fig. 12: LGRPF3V gas connections rear

1	Input cutting gas 3 G⅜	3	Input cutting gas 2 G⅜
2	Input control air M5	4	Input cutting gas 1 G⅜

5.2.2 Connecting gases

⚠ DANGER

Mortal danger due to improperly connected pressure lines!

The pressure lines are under high pressure. Improperly connected lines can loosen under pressure, whip around, and cause life-threatening injuries.

- Only have the device started up by trained personnel.
- Only have faults on the device eliminated by trained personnel.
- Before start-up and troubleshooting, check the connections.
- Only have compressed air supply and cutting gases connected by trained personnel.
- Before installation, depressurize all lines and lock against switching on again.
- Only operate the device within the prescribed power limits, see *Technical data, page 14*.
- Do not use any grease when mounting the lines (e.g. threaded connections).

⚠ DANGER

Mortal danger with use of oxygen as cutting gas!

Using oxygen as a cutting gas can cause life-threatening injuries and damage to the device.

- Heed maximum pressure, see *Technical data, page 14*.
- During filter cartridge change in the input filter unit, only use greases that are suitable for oxygen.

⚠ WARNING

Personal injury and property damage due to undefined machine states!

Undefined machine states can cause severe injuries and damage to the valve.

- Wear prescribed protective equipment.

⚠ CAUTION

Personal injuries and property damage due to soiled compressed air or gas lines!

Soiled compressed air or gas lines can cause injuries and damage to the valve.

- Only use dry, clean compressed air and gases. Adhere to the media quality, see chapter *Pneumatic Characteristics, page 15*.
- Before each gas connection, place a filter with max. 5 µm mesh size upstream. Do not use filters based on sintering material.
- Only supply compressed air and gases through clean, particle- and dust-free lines.
- Flush compressed air and gas lines before connection to the valve or clean them with a brush (cleaning scraper) in order to remove particles and deposits (see Fig. *Cleaning the gas line with cleaning scraper, page 27* below).
- Only use O-ring seals for compressed air and gas connections (see Fig. *Screwing with O-ring seal, page 27* below); do not use PTFE sealing tape, pastes, adhesive threaded seals, or hemp.

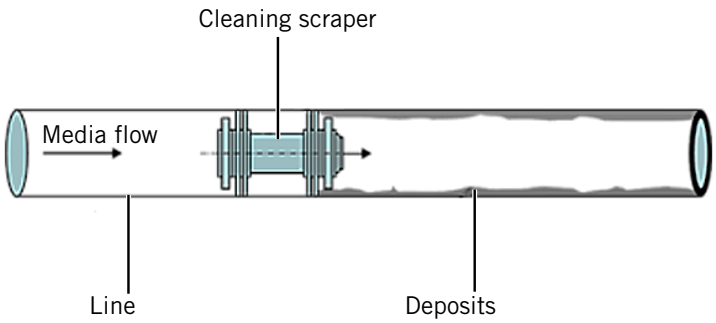


Fig. 13: Cleaning the gas line with cleaning scraper

Fig. 14: Screwing with O-ring seal

1. Remove protective films from the connections.
2. Connect gas lines according to drawings in chapter *Gas connections, page 24*.
3. Connect control air supply to the control air connection.
4. Connect argon, compressed air, oxygen, or nitrogen supply to the connections Gas 1, Gas 2, or Gas 3.
5. Check connections for tight fit and leaks.

5.3 Electrical installation

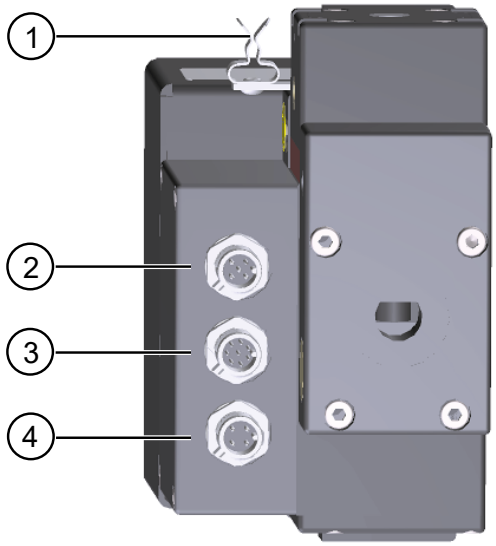


Fig. 15: Electrical connections

1	Screening clamps (only for analog device variant) and PE connection	3	Plug connection X2
2	Plug connection X3	4	Plug connection X1

If necessary, the screening clamps can be moved to the opposite housing side.

5.3.1 Analog device variant

1. Connect the 24 V power supply to X1. **NOTICE! Do not connect pins 2 and 4!**
2. Connect the cable for the control signals to X2.
3. Connect the cable for gas selection to X3.
4. Check plug connection for correct fit.
5. Connect screen of the connection lines (X1 – X3) to the machine ground.
6. To improve the EMC interference resistance, strip cable to plug connection X2 approx. 150 mm away from the plug to approx. 20 mm and fasten in the screen clamps (1).
7. To improve the EMC interference resistance, connect the valve via one of the two grounding connections on the housing to the machine body (2) using a line with as large a cross section as possible.

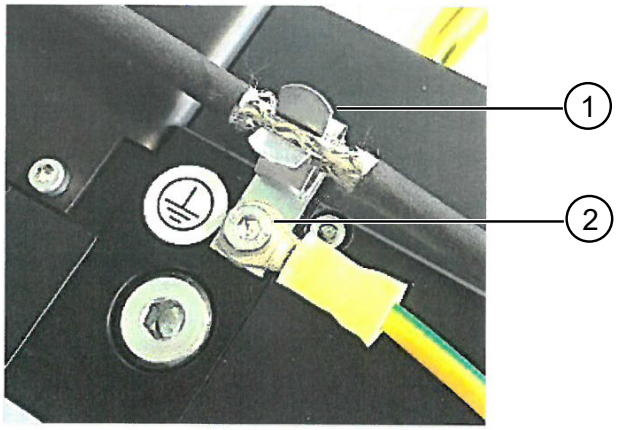
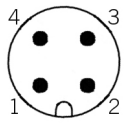
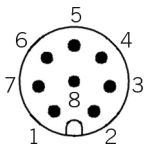
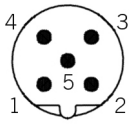


Fig. 16: Connection of cable screen

1	Screen line to connection X2 (only for analog model)	2	Connection to machine body

Plug connection	Connection	Pin assignment
X1	Power supply M12x1 A-coded 4-pin plug  	1: 24 V 2: Do not connect! 3: GND (connected to housing) 4: Do not connect!
X2	Control signals M12x1 A-coded 8-pin plug  	1: +Target value (0 to 10 V / input) 2: –Target value (GND/input) 3: GND 4: Input pressure P1 (0 to 10 V = 0 to 30 bar / output) 5: Output pressure P2 (0 to 10 V = 0 to 30 bar output) 6: Digital_IO1 (Ready [0/24 V output]) 7: Digital_IO2 (pressure reached [0/24 V output]) 8: Digital_IO3 (Calibration [0/24 V input])

Plug connection	Connection	Pin assignment
X3	Gas selection M12x1 B-coded 5-pin plug 	1: Gas 1 (0/24 V input) [1)] 2: Gas 2 (0/24 V input) [1)] 3: GND 4: Gas 3 (0/24 V input) [1)]; only for variant 3 upstream valves 5: n.c.

Tab. 3: Analog connections

[1)] Place inputs not used on GND.

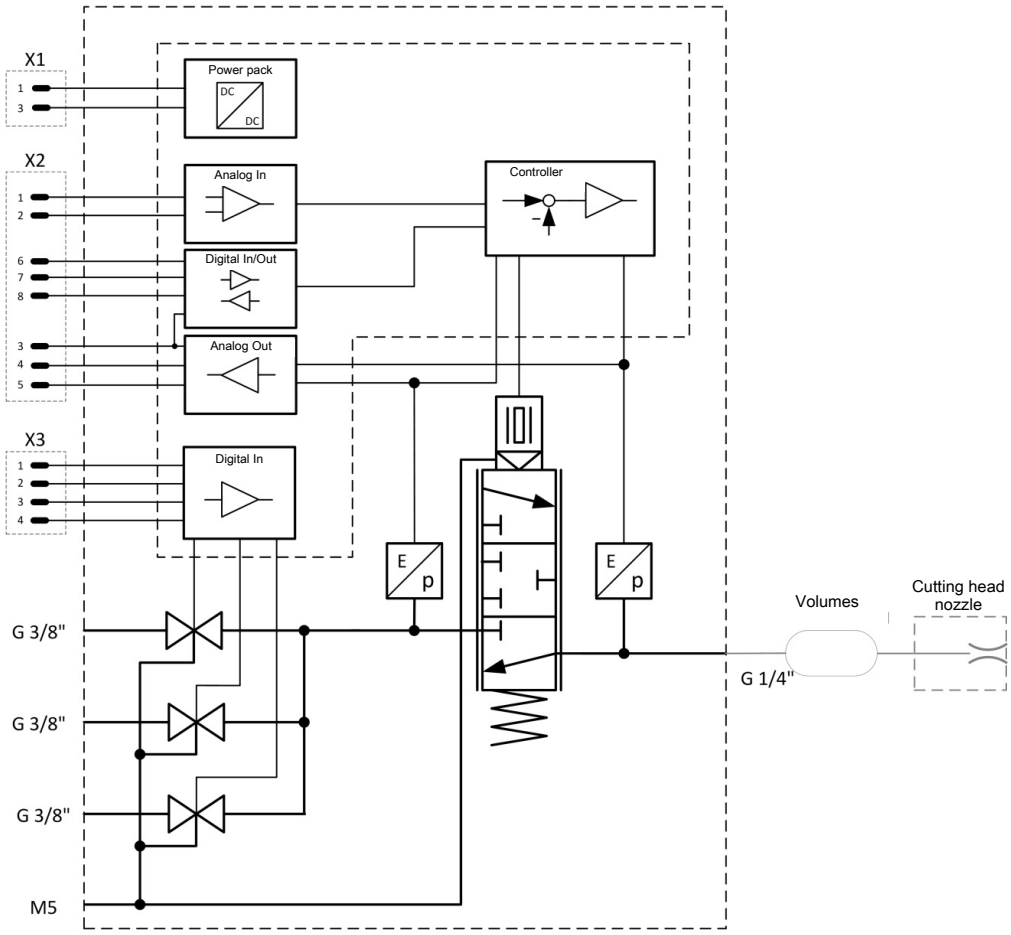
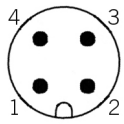
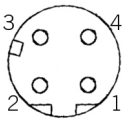
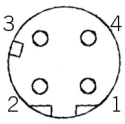


Fig. 17: Block diagram, analog – variants

5.3.2 Digital device variant

1. Connect to X1 24 V power supply. **NOTICE! Do not connect pins 2 and 4!**
2. Connect input cable to X2 EtherCAT.
3. Connect output cable to X3 EtherCAT.
4. Check plug connection for correct fit.
5. Connect screen of the connection lines (X1 – X3) to the machine ground.
6. In order to improve the EMC interference resistance, strip the insulation from the cable on the plug side and fasten cable screen to the machine ground with a grounding clip.

Plug connection	Connection	Pin assignment
X1	Power supply M12x1 A-coded 4-pin plug 	1: 24 V 2: Do not connect! 3: GND (connected to housing) 4: Do not connect!
X2	EtherCAT input M12x1 D-coded 4-pin socket 	1: Tx + 2: Rx + 3: Tx - 4: Rx -
X3	EtherCAT output M12x1 D-coded 4-pin socket 	1: Tx + 2: Rx + 3: Tx - 4: Rx -

Tab. 4: EtherCAT connections

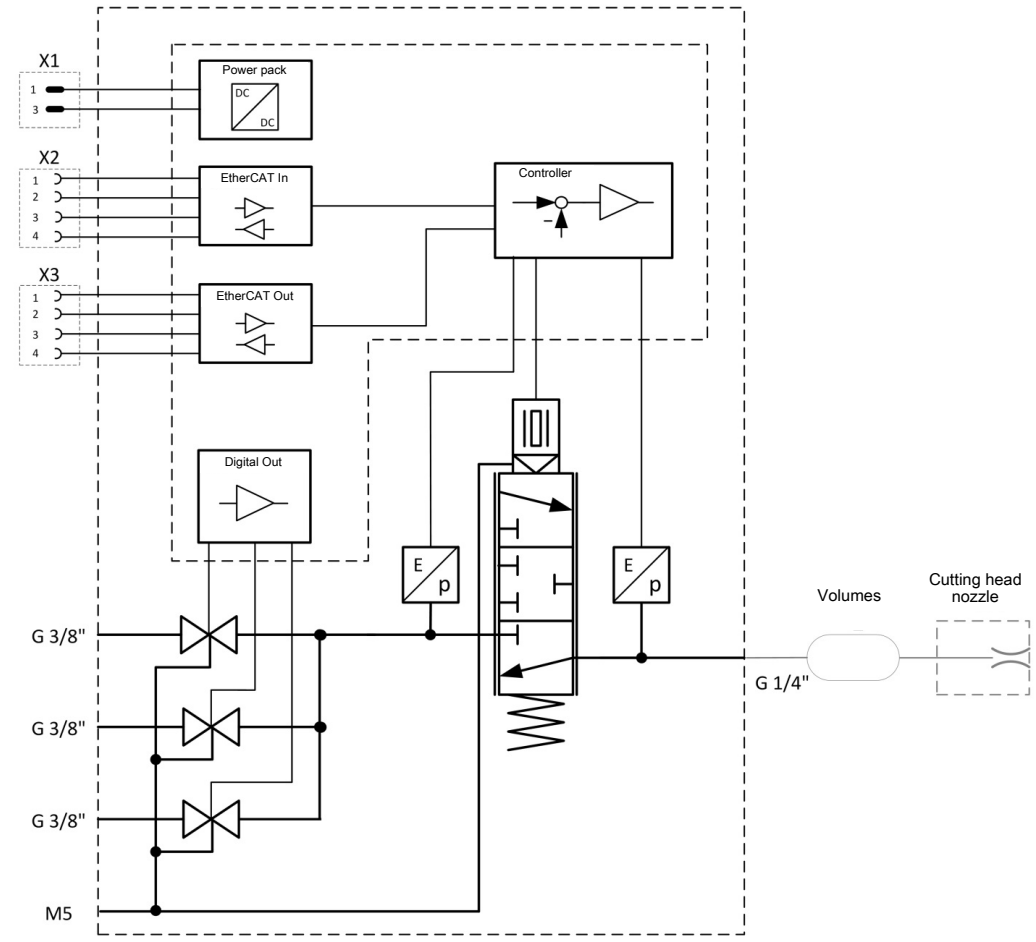


Fig. 18: Block diagram, EtherCAT

6 Start-up

6.1 Start-up

⚠ DANGER

Mortal danger due to improperly connected pressure lines!

The pressure lines are under a pressure of up to 30 bar. Improperly connected lines can loosen under pressure, whip around, and cause life-threatening injuries.

- Only have the device started up by trained personnel.
- Only have faults on the device eliminated by trained personnel.
- Before start-up and troubleshooting, check the connections.
- Only have compressed air supply and cutting gases connected by trained personnel.
- Before installation, depressurize all lines and lock against switching on again.
- Only operate the device within the prescribed power limits, see *Technical data, page 14*.
- Do not use any grease when mounting the lines (e.g. threaded connections).

⚠ WARNING

Personal injury and property damage due to undefined machine states!

Undefined machine states can cause severe injuries and damage to the valve.

- Wear prescribed protective equipment.

1. Check whether electrical cables and gas lines are connected correctly, see chapter *Gas installation, page 24* and *Electrical installation, page 28*.
2. Connect compressed air supply, control air, and cutting gases to superior air and gas supply.
3. Switch on 24 V voltage supply.

7 Operation

7.1 Switching on

⇨ Switch on the 24 V power supply on the device.
↳ Self-calibration starts.
↳ After approx. 15 seconds, the device is ready for operation and goes into the operating state specified by the input signals:
– Analog device variant: Connection X2, digital output “Ready”
– Device variant EtherCAT: via PDO `GAS_STA` Bit 1

7.2 Switching off

⇨ Switch off 24 V power supply of the device.
↳ The cutting gas output of the device is ventilated.

7.3 Selecting cutting gas input

The gas input is selected via the upstream valve-controlled Gas 1 / Gas 2 / Gas 3.
The upstream valve is activated electropneumatically via a pilot valve.

1. Analog device variant: Connect the desired upstream valve to connection X3 via digital input, see chapter *Analog device variant, page 28*.
2. EtherCAT device variant: With PDO `GAS_SEL`, set the appropriate bit for the desired upstream valve, see chapter *Digital device variant, page 31*.

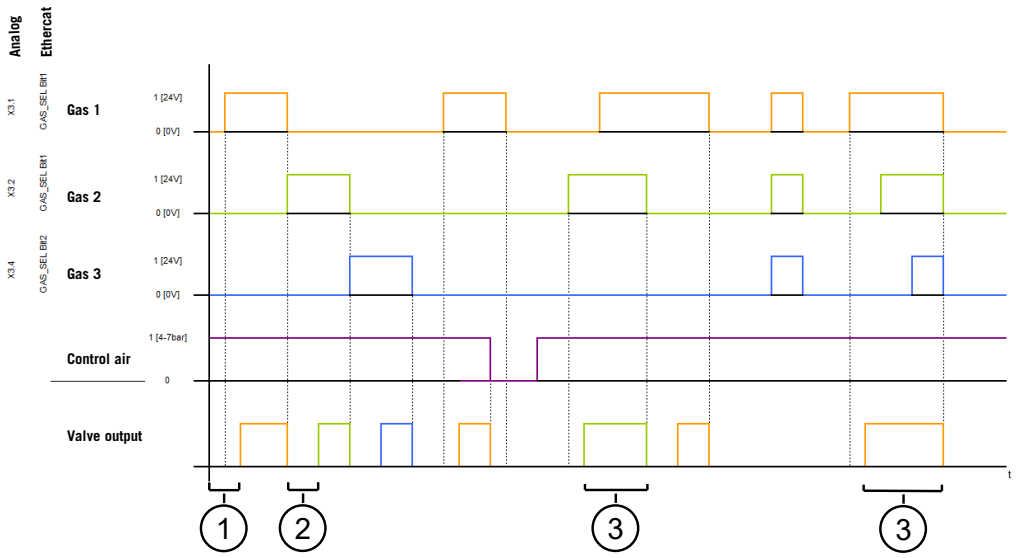


Fig. 19: Activation logic of upstream valves – valve output

1	Switch-on time cutting gases t_{ON}: approx. 80 ms[1)]	3	Electric control inputs interlocking [3)]
2	Switching time for cutting gases in case of gas change t_{CHANGE}: approx. 230 ms [1) 2)]		

1) The time from switching on the upstream valve until gas is available at the input of the control valve.

2) After switching off a gas, all control inputs for the gas selection are locked for 150 ms (t_{LOCK}). As soon as the time has elapsed, the inputs are active again, that is, with delay-free switching of the gases, the selected gas is available at the output after 230 ms.

3) To protect against the simultaneous selection of several gases, the electric control inputs for gas selection are interlocked.

7.4 Output target value

The proportional valve is activated by the control electronics via a piezoelectric pilot valve. The actual value of the pressure is compared constantly to the pressure target value via a pressure sensor.

The control electronics controls the piezo pilot valve so that the difference between target value and actual value is 0. In this state, the output pressure is controlled correctly.

⇨ Analog device variant: Output target value to connection X2 via analog input as voltage.

⇨ EtherCAT device variant: Output target value with PDO `P_SOLL`.

7.5 Changing cutting gas

The type of installation behind the cutting gas output of the valve is crucial for the selection of a time-optimal procedure for the cutting gas change.

If necessary, the optimal procedure must be determined via tests.

The use of the pressure sensors for input and output pressure allows quick gas change times.

With use of a large cutting nozzle or a small hose and cutting head volume:

Variant 1

From low output pressure to higher output pressure (e.g. gas 1: 0.6 bar to gas 2: 10 bar).

1. Switch off active upstream valve through control signals of the machine.
2. Set target value to P2max (analog version: 10 V DC, EtherCAT version: 30000).
   ↳ The input pressure on the proportional valve is reduced via the still-present target value.
3. Switch on upstream valve for the desired cutting gas, see chapter *Selecting cutting gas input, page 34*.

Variant 2

From high output pressure to lower output pressure (e.g. gas 1: 10 bar to gas 2: 0.6 bar).

1. Switch off active upstream valve through control signals of the machine.
2. Set target value to P2max (analog version: 10 V DC, EtherCAT version: 30000).
   ↳ The input pressure on the proportional valve is reduced via the still-present target value
3. Wait until the value of the input sensor on the device is lower than the bottle pressure of the new desired gas.
4. Switch on upstream valve for the desired cutting gas, see chapter *Selecting cutting gas input, page 34*.
5. Specify new target value through control signals of the machine.

Change cutting gas with use of a small cutting nozzle or a large hose/cutting head volume

Variant 1

From low output pressure to higher output pressure (e.g. gas 1: 0.6 bar to gas 2: 10 bar).

1. Switch off active upstream valve through control signals of the machine.
2. Set target value to 0 bar (analog version: 0 V DC, EtherCAT version: 00000).
   ↳ The input pressure on the proportional valve is reduced via the ventilation connection of the valve.
3. Switch on upstream valve for the desired cutting gas, see chapter *Selecting cutting gas input, page 34*.

Variant 2

From high output pressure to lower output pressure (e.g. gas 1: 10 bar to gas 2: 0.6 bar).

1. Switch off active upstream valve through control signals of the machine.
2. Set target value to 0 bar (analog version: 0 V DC, EtherCAT version: 00000).
   ↳ The input pressure on the proportional valve is reduced via the still-present target value.
3. Wait until the value of the input sensor on the device is lower than the bottle pressure of the new desired gas.
4. Switch on upstream valve for the desired cutting gas, see chapter *Selecting cutting gas input, page 34*.
5. Specify new target value through control signals of the machine.

7.6 Calibration and function check

The valve has an electric “Calibration” input through which the following functions can be triggered:

- Self-calibration of the output pressure (compensates for temperature influences caused by control inaccuracies).
- Function check of the valve (the functionality of the control valve is checked).

It is recommended that you activate the “Calibration” function after each pallet change in order to achieve maximum precision of the cutting gas pressure and to guarantee the operational readiness of the valve.

The self-calibration of the output pressure can be triggered during operation (offset output pressure).

1. Switch off all upstream valves through control signal of the machine.
2. Output target value output pressure “0 bar.”
3. Output calibration signal:
   – Analog device variant: Set connection X2, digital input “Calibration”. As soon as the signal indicates “Ready” the value “0,” reset digital input “Calibration”.
   – EtherCAT device variant: Set PDO `GAS_SEL` Bit 3. As soon as PDO `GAS_STA` bit 1 indicates the value “0” or bit 4 the value “1”, reset PDO `GAS_SEL` bit 3.

After approx. 15 seconds, the self-calibration is complete. The LasGAR Plus reports operational readiness “Ready”. If the "Ready” signal does not come, there is a fault, see chapter *Troubleshooting, page 41*.

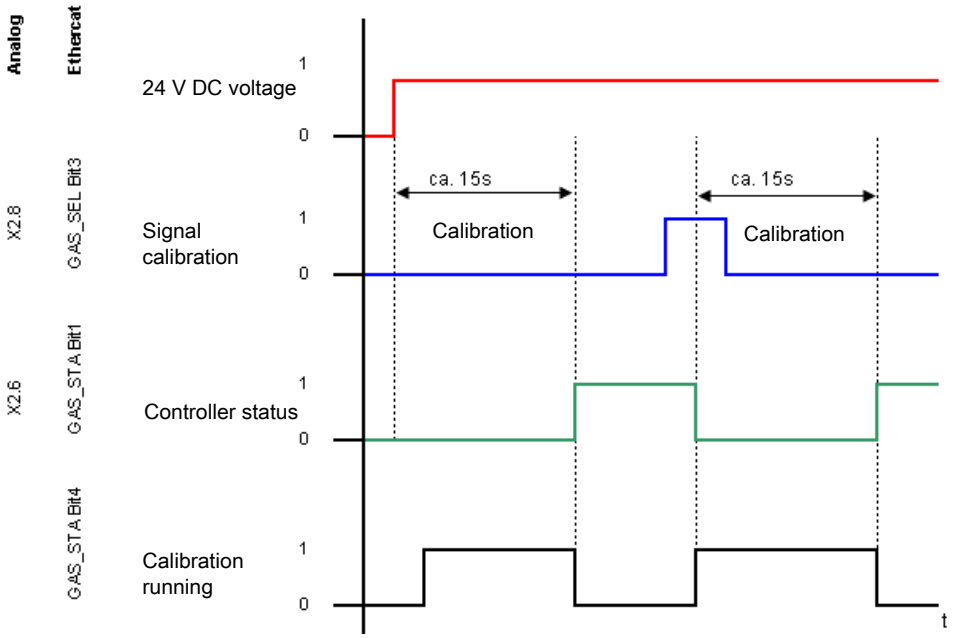


Fig. 20: Timing calibration offset pressure sensor P2

7.7 Additional functions

For the process logging and monitoring by a superior control, the following reports are available via the outputs of the valve:

- Input pressure p1 of the currently selected cutting gas, measured with pressure sensor P1
- Output pressure p2 of the currently selected cutting gas, measured with pressure sensor P2
- Output pressure reached, digital signal,
  switching condition for “ON” = pressure reached:
  (actual pressure-target pressure) < 4 % of pressure target value + 0.21 bar

Depending on the version, this information is available directly or via the digital interface, see chapter *Electrical installation, page 28*.

The following information is only available with the EtherCAT variant:

- Low input pressure < 1.1 * target value
- Low input pressure < 1.05 * target value
- Calibration report
- Parameterizing window “Pressure reached”

7.8 EtherCAT process data objects

Objects	I/O	Size		Description
P_Soll: target value	E	1 Word	Target value	Selection target value 0 to 30000 [mbar]
P_Ist: actual value	A	1 Word	Actual value	Response actual pressure 0 to 30000 [mbar]
PV_IST: pre-pressure	A	1 Word	Pre-pressure	Response pre-pressure 0 to 40000 [mbar]
REG_ST: set value D-controller	A	1 Word	Controller output pressure control circuit	Set value pressure control circuit 0 to 10000
SER_NR	A	1 Word	Serial number	Serial number device format: decimal 1 to 9999
SW_VER	A	1 Word	Software version	Software version format: hexadecimal Ex.: SW Ver. (dec.): 01.00.00.01 Corresponds to: 0x1001
DATA_1	A	1 Word	Reserve	No data content
DATA_2	A	1 Word	Reserve	No data content
DATA_3	A	1 Word	Reserve	No data content
PR_RE: Pressure Reached [%]	A	1 Word	Target value	Measurement window pressure reached Format: 0x0000
GAS_SEL: Gas selection	E	1 Word	Bit 0: Gas selection gas 2	Switch on/off gas 2 0/1
			Bit 1: Gas selection gas 1	Switch on/off gas 1 0/1
			Bit 2: Gas selection gas 3	Switch on/off gas 3 0/1
			Bit 3: Calibration request	Request self-calibration Offset output pressure

Objects	I/O	Size		Description
GAS_STA: Gas status	A	1 Word	Bit 0: Pressure reached	Response pressure reached 0/1
			Bit 1: Controller status	Response controller ready 0/1
			Bit 2: Gas warning	Response supply gas < 110 % * target 0/1
			Bit 3: Gas error	Response supply gas < 105 % * target 0/1
			Bit 4: Calibration running	Self-calibration (offset output pressure) is running
PR_RE: Pressure reached [%]	E	1 Word	Higher Byte (or 0xFF00)	0 to 17.0 % of target value Pressure reached above 0 to 170 (or 0xAA)
			Lower Byte (or 0x00FF)	0 to 17.0 % of target value Pressure reached below 0 to 170 (or 0xAA)

Tab. 5: EtherCAT process data objects

8 Troubleshooting

⚠ DANGER

Mortal danger due to improperly connected pressure lines!

The pressure lines are under a pressure of up to 30 bar. Improperly connected lines can loosen under pressure, whip around, and cause life-threatening injuries.

- Only have the device started up by trained personnel.
- Only have faults on the device eliminated by trained personnel.
- Before start-up and troubleshooting, check the connections.
- Only have compressed air supply and cutting gases connected by trained personnel.
- Before installation, depressurize all lines and lock against switching on again.
- Only operate the device within the prescribed power limits, see *Technical data, page 14*.
- Do not use any grease when mounting the lines (e.g. threaded connections).

⚠ DANGER

Mortal danger due to improper troubleshooting!

Improper elimination of faults can cause life-threatening injuries.

- Only eliminate faults that are described in the chapter *Troubleshooting, page 41*.
- For all other faults, contact HOERBIGER.

Fault/message	Possible cause	Remedy
No cutting gas pressure	Failure of the electrical or pneumatic power supply	⇨ See chapter *Restoring the power supply, page 44*.
	Soiling on the valve	1. Only supply dry and pure gases in clean, particle- and dust-free lines. 2. If necessary, replace device.
	Soiling of the input filter unit (only LGRPF model)	⇨ Change filter cartridges, see chapter *Filter change in the input filter unit, page 46*.
"Ready" signal does not come after switching on the 24 V power supply	Insufficient power supply	⇨ Check power supply.
	Pressure sensor fault	⇨ Replace device.

Fault/message	Possible cause	Remedy
"Ready" signal does not come after start of self-calibration	No or too low pneumatic control air pressure	⇨ Check control air supply. **NOTICE! Self-calibration was not completed.**
	Pressure sensor fault	⇨ Replace device.
"Ready" signal goes out during operation	Failure of the electrical supply or too high or too low supply voltage	⇨ Check power supply.
	Calibration activated and running	⇨ Wait until the calibration has ended.
	Calibration not completed successfully	1. Start calibration again. 2. Check control air pressure. 3. Replace device.
Output pressure lower than selected with target value or No "Pressure reached" signal	Control air pressure or cutting gas pressure too low	⇨ See chapter *Restoring the power supply, page 44*.
	Soiling on the valve	1. Only supply dry and pure gases in clean, particle- and dust-free lines. 2. If necessary, replace device.
	Tolerance window for "Pressure reached" signal set too low	⇨ Check tolerance window and set higher if necessary (only for "digital" version), see chapter *EtherCAT process data objects, page 39*.
	Soiling of the input filter unit (only LGRPF model)	⇨ Change filter cartridges, see chapter *Filter change in the input filter unit, page 46*.
Output pressure higher than selected with target value	Soiling on the valve	⇨ If necessary, replace device.

Fault/message	Possible cause	Remedy
Error message “gas warning” or gas error (only with “digital” version)	Control air pressure or cutting gas pressure too low	⇨ See chapter *Restoring the power supply, page 44*.
	Soiling on the valve	1. Only supply dry and pure gases in clean, particle- and dust-free lines. 2. If necessary, replace device.
	Soiling of the input filter unit (only LGRPF model)	⇨ Change filter cartridges, see chapter *Filter change in the input filter unit, page 46*.
Gas mixture after gas change	Gas change times too short	⇨ Adjust the gas change times, see chapter *Selecting cutting gas input, page 34*.
Gas mixture without gas change	Upstream valve soiled or defective	⇨ If necessary, replace device.
Cutting pressure not stable	Target value fluctuations	⇨ Check target value signal.
	Soiling on the valve	⇨ If necessary, replace device.

Tab. 6: Faults

8.1 Restoring the power supply

With failure of the electric or pneumatic power supply, the output of the device is ventilated within 200 ms in order to prevent an escape of the process gases. There is no pressure on the output and further gas escape on the output is prevented.

1. Switch control signals of the upstream valves and the target value of the gas output to “OFF”.
   ↳ With return of the pneumatic control air supply, the device goes into the operating state that is specified by the input signals.
2. As soon as the pneumatic control air supply is available again, activate control signals of the upstream valves and the target value of the gas output.
   ↳ After return of the electric power supply, the device automatically starts an initialization that takes 15 s. During this time, there is no pressure on the gas output. After that, the device goes into the operating state that is specified by the input signals.
3. As soon as the ready signal “ON” is indicated, activate control signals of the upstream valves and the target value of the gas output.

9 Service

⚠ WARNING

Personal injury and property damage due to improper servicing

Malfunctions can results.

- In case of fault, do NOT service the device.
- In case of fault, shut the device down immediately.
- Remove the complete valve and send it to the manufacturer's local agent for servicing.

9.1 Inspection and maintenance plan

Work to be performed	ir	d	w	¼ y	y	oh
■ Check compressed air and gas connections for leaks.				X		
■ Check electrical cable for cracks, kinks, and damage to the cable insulation. ■ Replace damaged cables.				X		
■ Check electrical plug connection and union nuts to ensure they are tight. ■ If necessary, tighten union nuts.				X		
■ Check fixed clamping of the screen on the screening clamp. ■ If necessary, fix or replace clamp.				X		
■ Check body connection between LGR and machine body. ■ If necessary, tighten screws.				X		
■ Check screws to ensure they are tight, tighten if necessary.				X		
■ Check type plates to ensure they are present, visible, legible, and complete; replace if necessary.					1	
■ Check filter cartridges in input filter unit for soiling and replace if necessary. (Only for LGRPF model)	ir				1	

Legend: ir= if required, d = daily, w = weekly , ¼ = quarterly, y = annually, oh = operating hours

9.2 Filter change in the input filter unit

⚠ DANGER

Mortal danger due to unsuitable components!

The use of unsuitable components can cause life-threatening injuries.

- Use only the manufacturer's filter sets since these are suitable for oxygen use.

⚠ DANGER

Mortal danger due to incorrect greases!

The O-rings of the filter elements are pre-greased with oxygen-suitable grease. The use of other greases can cause life-threatening injuries.

- Never re-grease O-rings.

A filter change can only be done for the LasGAR Plus in the LGRPF model and for the LASFIL Compact.

The input filter unit is equipped with one filter per gas input and one filter for the control air connection. Soiled filter elements can be changed out.

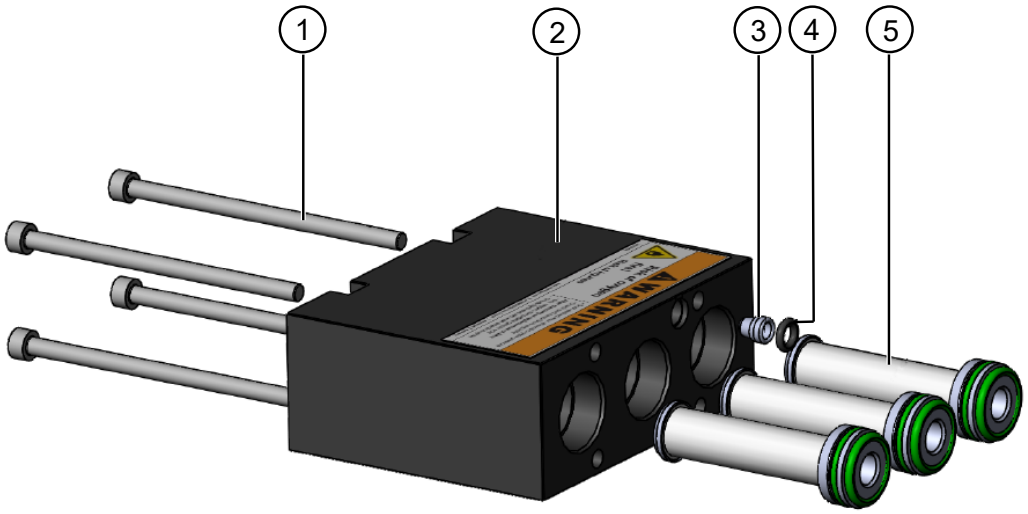


Fig. 21: Filter unit with replacement filters

1	Fastening screws	4	O-ring
2	Filter housing	5	Filter cartridge cutting gases
3	Filter use control air		

Replacement filters can be ordered using the following item numbers:

Filter	Item number	Scope of delivery
Filter set for cutting gas inputs	PS12739A	1 filter cartridge with O-rings mounted and pre-greased with oxygen grease
Filter set for control lift input	PS12740A	1 filter element 1 O-ring

Tab. 7: Replacement filter

9.2.1 Taking device out of service

⚠ DANGER

Mortal danger due to residual energies!

After switching off, there are residual electrical and pneumatic energies on the device that have to be reduced slowly and can cause life-threatening injuries if the device is touched.

- Disconnect the device from electrical and pneumatic power supplies before dismantling.
- Wait 10 seconds until residual energies in the system have been reduced completely.

⚠ WARNING

Risk of injury due to pressure

- Do not perform any work on the valve when it is pressurized.

1. De-energize and depressurize the device.
2. Lock and ventilate the gas and compressed air supply.
3. Wait 10 seconds until residual energies in the device have been reduced completely.
4. Check whether the gas and pressure supplies are depressurized.

9.2.2 Changing the gas filter

1. Loosen the 4 fastening screws (1) in order to loosen the filter unit from the LasGAR Plus or the connection plate.
2. Pull the filter cartridge (5) out of the filter housing (2) using an M8 screw.
3. In the filter housing (2), check the installation space of the filter cartridge (5) for soiling and clean if necessary.
4. Push the new filter cartridge into the filter housing (2) and press it in by hand up to the stop. In the process, heed the correct position of the two pre-mounted O-rings.
5. Screw the filter unit with 4 fastening screws (1) to the LasGAR Plus or the connection plate, tightening torque 6 Nm ± 0.5 Nm.

9.2.3 Changing the control air filter

1. Loosen the 4 fastening screws (1) in order to loosen the filter unit from the LasGAR Plus or the connection plate.
2. Remove O-ring (4) from the control air connection.
3. Remove the filter insert (3) from the filter housing (2).
4. In the filter housing (2), check the installation space of the filter insert (3) for soiling and clean if necessary.
5. Insert the new filter insert (3) into the filter housing (2).
6. Insert the O-ring (4).
7. Screw the filter unit with 4 fastening screws (1) to the LasGAR Plus or the connection plate, tightening torque 6 Nm ± 0.5 Nm.

10 Decommissioning and disposal

10.1 Decommissioning/dismantling

⚠ WARNING

Risk of injury due to pressure

- Do not perform any work on the valve when it is pressurized.

⚠ DANGER

Mortal danger due to residual energies!

After switching off, there are residual electrical and pneumatic energies on the device that have to be reduced slowly and can cause life-threatening injuries if the device is touched.

- Disconnect the device from electrical and pneumatic power supplies before dismantling.
- Wait 10 seconds until residual energies in the system have been reduced completely.

1. De-energize and depressurize the device.
2. Lock and ventilate the gas and compressed air supply.
3. Wait 10 seconds until residual energies in the device have been reduced completely.
4. Check whether the gas and pressure supplies are depressurized.
5. Loosen electrical cabling.
6. Loosen gas lines.
7. Take device components apart.
8. Dispose of components, see chapter *Disposal, page 49*.

10.2 Disposal

The disposal of the packaging and used parts is the customer's responsibility.

⇨ Dispose of the product according to the local regulations at approved collection points or have removed by approved disposal companies.

11 Appendix

11.1 Product observation

Our goal is continuous enhancement of our products and close cooperation with the customer. Please tell us about faults or problems with the valve.

11.2 Material defects and defects of title

These operating instructions and technical details with respect to the specifications and figures in these operating instructions are subject to change without notice.

The company HOERBIGER Flow Control GmbH makes no quality or durability guarantees, and also no guarantees about suitability for a particular purpose. These must be agreed upon expressly in writing. Public statements, promotions, and advertising do not constitute quality specifications for the product.

The operator's claims relating to material defects and defects of title assume that he presses this claim in writing immediately, at the latest within two working days. HOERBIGER Flow Control GmbH is in no case responsible for damage to the product itself or consequential damages caused by the product that are caused by improper handling of the product.

Insofar as HOERBIGER Flow Control GmbH is responsible for a defect, HOERBIGER Flow Control GmbH will, at its option, provide rectification of substitute performance.

Liability of HOERBIGER Flow Control GmbH – regardless of the legal justification – exists only in case of intention or gross negligence, negligent injury of life, body, health for defects that were fraudulently concealed or whose absence was guaranteed expressly in writing. Furthermore, according to the product liability law for personal injury or property damage to privately used objects.

In case of negligent injury of essential contract duties, HOERBIGER Flow Control GmbH is also liable, also in case of slight negligence, however limited to the contract-typical, foreseeable damages. Additional claims are excluded.

In case individual regulations of these operating instructions, the applicable legal regulations or other instructions of HOERBIGER Flow Control GmbH are disregarded, material defects and defects of title are terminated.

In particular, HOERBIGER Flow Control GmbH is not responsible for failures or faults that are caused by modifications by the customer or other persons. In such cases, the repair costs due will be invoiced. These will also be invoiced for the checking of the device if no fault could be found on the device.

There are no claims to the availability of previous versions and to the ability to refit devices delivered to the respective current series state.

11.3 Declaration of conformity

The current declaration of conformity is included in the scope of delivery and it can be found in the download area on the company's website:

http://www.hoerbiger.com/

HOERBIGER

because performance counts