

# Operation Manual

## Proportional Valve VP60 Series



**Before starting work read these instructions.**

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Manufacturer's Address:

Norgren GmbH

Stuttgarter Str. 120

D-70736 Fellbach

## 1. General

### 1.1 Information about these Instructions

These instructions will enable you to safely install, set up and operate the proportional valve VP60 in the analogue or IO-Link version. These instructions are an integral part of the product and must be accessible to personnel. Personnel must carefully read through and understand these instructions before starting work of any kind on the valves. Following all of the safety and handling instructions contained in this manual is a fundamental requirement for safe working.

### 1.2. Explanation of Symbols Safety Notice

#### **DANGER**

**This symbol and the word ,danger' indicates an immediately dangerous situation that may result in death or serious injury if not avoided.**

#### **Warning!**

**This symbol and the word 'warning' indicates a potentially dangerous situation that may result in death or serious injury if not avoided.**

#### **CAUTION!**

**This combination of symbol and signal word indicates a possibly hazardous situation that may result in damage to property or environmental damage if it is not avoided.**

Indicates tips and other useful information.

### Other Symbols

The following symbols are used to emphasise instructions, outcomes, lists, references and other elements in these instructions.

Other symbols	Meaning
1., 2., 3.,	Step-by-step instructions
•	Lists with no specific order

### 1.3. Specifications

The factory-set capacity ranges for the valve are also indicated on the nameplate of the respective device.

## 2. Liability

### 2.1. Liability

Physical modifications to the VP60 proportional valve may only be carried out by the manufacturer. If the valve requires repairs or maintenance beyond the activities described in these instructions, this work may only be carried out by the manufacturer of the proportional valve or by persons expressly authorised and trained by the manufacturer. Failure to comply with the above provisions will invalidate the warranty claims. The manufacturer accepts no liability for any damage incurred.

### 2.3. General Safety Instructions/ Proper Usage

#### Caution!

This product is for use in industrial compressed air systems only. It is to be used where the pressure and temperature ratings listed in the data sheet are not exceeded. Contact Norgren directly before using the product in non-industrial applications, in life support or other systems not covered in the published instructions.

Misuse, wear or malfunction can cause components used in pneumatic systems to fail in a variety of ways.

System designers are strongly advised to consider the failure modes of all component parts used in pneumatic systems and to take adequate safety precautions to prevent injury to personnel and damage to equipment in the event of such a failure.

**System designers are required to provide safety information to the end user in the operation of the system.**

### **3. Functional Safety**

#### **Note:**

The VP60 is **not a** design with design-related fail-safe properties.

Therefore, no safety-related properties can be guaranteed at valve level.

For machine controls (complex mechatronic systems) with the VP60, a risk analysis in accordance with e.g. EN-ISO12100 is urgently recommended.

Information on the current standard situation can be obtained from the VDMA or the BGIA.

#### **3.1. General Safety Instructions**

DANGER - Danger due to hazardous movement

Changes to the valve configuration can lead to unwanted movements or changes to connected consumers under air supply.

Please ensure a safe operating condition before changing the valve configuration. This also applies in particular to changes via the USB configuration interface or the IO-Link parameters.

Use suitable stop and vent valves in the supply lines and at the consumer connections for enabling.

#### **Warning! - Danger from compressed air**

Connections 2 & 4 can still be under pressure for a long time even after the pressure supply to connection 1 has been switched off!

Protect yourself and others by not removing any pressurised connections and wear suitable personal protective equipment when working!

Depressurise the system before carrying out any work

All work must be carried out by qualified pneumatics specialists

#### **Warning! - clogging of silencers**

Blockage of the silencers can lead to malfunction of the valve

Ensure appropriate air quality

#### **Warning! - Risk of injury due to noise**

Only operate the valve with suitable silencers

Always wear ear protection when working

#### **Warning! - Risk of injury due to insufficient qualification**

As the operator, ensure that work is only carried out by qualified personnel

Train the operating personnel comprehensively in safety issues

Have electrical installations carried out only by qualified electricians

## **4. Basic function**

### **4.1. General Description**

The VP60 is a 5/3-way proportional valve of nominal size 8.

The flow-optimised, metal-seated 5/3-way spool is adjusted as quickly as possible to the position corresponding to the setpoint by means of a moving coil and position sensor via a  $\mu$ P control loop.

In the production process, a setpoint / setpoint travel map is determined for each VP60 in such a way that a linear relationship between setpoint and flow results under constant pressure conditions. Device-specific manufacturing tolerances are compensated for by this procedure. The result is an idealised V-characteristic in the ratio of input setpoint to pneumatic flow. However, the sensitively adjustable, proportional zero-cut characteristic is maintained in any case. When de-energised or in the event of faults (see valve operating states), a spring presses the spool into the preferred position. The low-loss, digital electronics are integrated in the valve.

There are no user-serviceable parts in the valve assembly.

### **4.2. Application**

The VP60 represents a bi-directional, linearized variable throttle and enables, for example, the stepless, reversible speed control of double-acting cylinders or reversible pneumatic motors.

### **4.3. Function and Functional Types**

The VP60 represents a bi-directional, linearized variable throttle. Proportional to the input signal, the flow can be varied continuously between negative and positive maximum values. In the middle position, all ports are blocked. Setpoints above the middle open the passages 1 to 2 and 4 to 5. Setpoints below the middle open the paths 1 to 4 and 2 to 3. The latter are de-energized or, in the event of a fault, spring-loaded fully open. In the delivery state, the valve is set to mode (5/3-way).

#### **4.3.1. Function Type (5/3-way)**

Filtered compressed air (see technical features) is available at port 1.

The actuator (2.e. cylinder) is connected to ports 2 and 4. Ports 3 and 5 are used for venting. Silencers with low flow resistance should be connected here.

The reaction of the actuator (e.g.: retraction or extension of a cylinder) in the event of a fault (e.g. power failure) results from the connection diagram of the same to VP60 ports 2 and 4.

If no movement is desired in the event of a fault (see operating states of the valve), the responsible system designer should provide additional shut-off valves between the valve and actuator.

#### **4.3.2. Function Type (2/2-way)**

For consumers with constant air flow, which require only one supply connection and no venting (e.g.: nozzles or turbines). The following sub-functions result:

2/2 NC (normally closed): The air is connected to port 2. ports 3, 4 and 5 are closed.

Via VP-Tool\*, the entire setpoint range can be assigned to the 2/2 valve function with the effect of (opening/closing). If this is not done, the VP60 remains closed below the center. An exhausting effect can be adjusted above the middle. Middle = too, max. Set point = max. Flow

2/2 NO (normally open): The air is connected to connection 4. connections 2,3 and 5 are closed.

Via VP-Tool\*, the entire setpoint range can be assigned to the 2/2 valve function with any effect (opening/closing). If this is not done, the VP60 remains closed above the middle. An exhaust effect can be set below the middle. min. Input=max. Flow, Middle=to.

#### **Note:**

The accuracy of the valve remains unchanged by the use of the 2/2-way mode, which is only used for adaptation to the conditions and the purpose of use in your plant.

\*) In the IO-Link version, the function type must be set via the parameters described in the IO-Link. Details can also be found in the parameter description list in the appendix.

## 5. Pneumatic Connection

### 5.1 Block Diagram of the Valve Function (5/3 way)

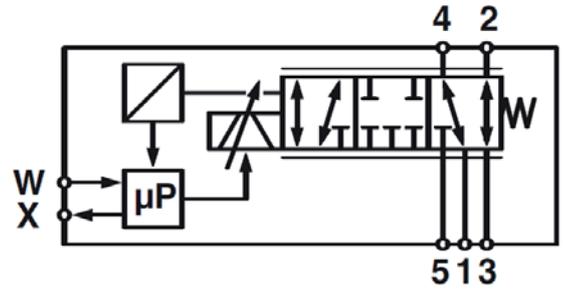
Port size 1: System pressure

Port size 2: Operation Connection

Port size 3: Venting working connection 2

Port size 4: Operation Connection

Port size 5: Venting working connection 4



### 5.2 Operating Medium

These units are designed for use with clean, dry, oil-free compressed air.

Compressed air shall be provided in accordance with ISO8573-1; grouping 2-3-1. A filtering of the supply air (<3 microns) is strongly recommended.

For flow-intensive applications, screw fittings with a straight outlet should be preferred in order to avoid possible pressure losses.

#### Caution!

**When using compressed air containing oil and water, the dynamics and the service life of the valve can be significantly reduced.**

The pneumatic connections for input and output pressure have a G1/4" or 1/4" NPT internal thread, a suitable screw fitting must be used.

#### Caution!

**Under no circumstances should Teflon sealing tape be used to seal the connections as this tends to break down into small particles. These can contaminate the valve mechanics and cause malfunctions.**

## 6. Electrical Connection

### 6.1 Pin Assignment

#### 6.1.1 Variant Analogue



Pin	Colour (Typ.)	Ref.	Port size
1	white	Iin	Setpoint input current 4..20 mA (load resistance 500R)
2	brown	fault	Error output (max.15mA to GND Vs)
3	green	-Ud	Setpoint input voltage difference negative (0..10V /-5-5V)
4	yellow	+Ud	Setpoint input voltage difference positive (0..10V /-5-5V)
5	grey	I out	Current output actual value 4..20mA (Vs GND potential)
6	pink	Ub	Supply voltage Vs +24V DC
7	blue	GND	Supply mass (Vs GND)
8	red	U out	Voltage output actual value 0..10V (Vs GND potential)

#### 6.1.2 Variant IO-Link



Pin	Colour (Typ.)	Ref.	Port size
4	yellow	+Ud	Setpoint input voltage difference positive (0..10V /-5-5V)
5	grey	I out	Current output actual value 4..20mA (Vs GND potential)
6	pink	Ub	Supply voltage Vs +24V DC
7	blue	GND	Versorgungsmasse (Vs GND)
8	red	U out	Voltage output actual value 0..10V (Vs GND potential)

Potentials VA & VB are galvanically isolated.

## 6.2 Power Supply

Nominally, the VP60 is supplied with 24 V DC between Vs and GND. The electronics are protected against incorrect polarity of the supply and will not be damaged.

The power supply must be isolated from the mains.

(PELV according to EN 60204-1, DIN VDE 0100-410, IEC 364-4-41, HD 384.4.41 S2, EN 60079-14).

### Note:

The device must be connected by a qualified person. The national and international regulations for the installation of electrical devices must be observed.

The valve body must always be integrated into the equipotential bonding of the plant (grounding).

**Note:**

The actuator system (= position controller of the valve spool) is activated from a supply voltage of 21 V. Although the average current consumption (at 24 V over 10 seconds is limited to 0.6 A and is reversibly reduced to 0.2 A if exceeded, peaks of up to 1.5 A can occur. This must be taken into account when designing the analogue supply.

In the IO-Link version, the supply voltage of the valve actuator is ensured via a second channel. The valve is therefore connected via port class B. This must be taken into account when selecting a suitable master.

**Note:**

Power supply units often have an electronic current limiter, the activation of which results in a reduction of the output voltage. As a result, the switch-off threshold of the actuator of the VP60 of 18 V can be undershot. Due to the then drastically reduced current requirement of the valve (~0.08 A), the power supply unit voltage rises again above the switch-on threshold. Possibly an undesired oscillation process is created in this way!

**Attention!****Supply voltages > 32 V DC can permanently damage the internal overvoltage protection.**

Since the VP60 enables the actuator from approx. 21 V, a voltage range of 21 to 32 V is specified. However, once the switch-on threshold has been exceeded, operation is guaranteed until the switch-off threshold of approx. 18 V is undershot.

This hysteresis (~3V) prevents the above mentioned oscillations if the power supply is designed correctly. Any ripples present (nominally 10%  $U_b$  = max. 2.4 V) must be smaller than this hysteresis in order for the VP60 to operate properly.

## 7. Assembly Instructions

### 7.1. General Safety Instructions

The installation of a filter <3 microns before the supply port (1) is required for maximum service life.

Further information can be found in the chapter "Pneumatic connection".

To maintain the linearity of the VP60 even at high flow rates, lines and additional valves should have a nominal size larger (> = NG10) than the VP60 (NG8) and be as short as possible.

#### Note:

For dynamic applications, it is recommended to install a buffer volume (the size of the actuator's working volume) after the filter and before port 1.

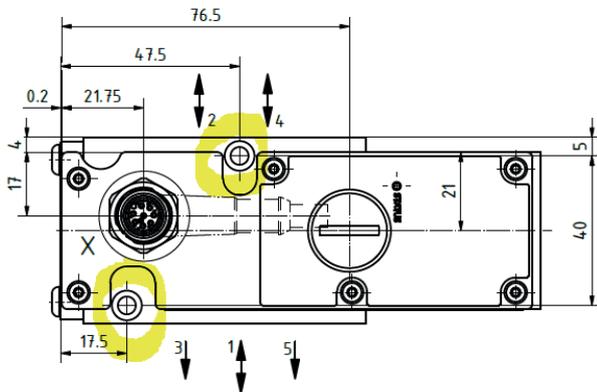
Before connecting the VP60, all lines should be cleaned of residues, e.g. by blowing them out. The entry of dirt particles and foreign bodies via the pressure line must be prevented.

In the case of moving mounting locations, the valve should be installed as far as possible at right angles to the main direction of movement. The VP60 can be mounted in any position. However, the preferred position is vertical, with the solenoid pointing upwards. This has a favourable effect with regard to the thermal load on the electronics and the mechanical forces on the slide.

### 7.2. Installation

Caution!

The valve may only be mounted through the two mounting holes of the valve mechanism.



### 7.3 Accessories:

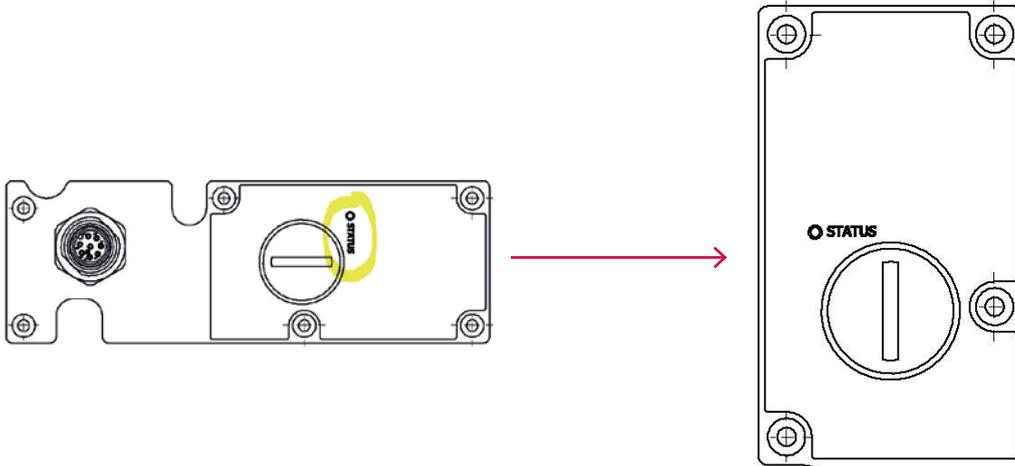
Detailed ordering information on available accessories can be found in the product data sheet or on our homepage:

<https://www.norgren.com>

## 8. Diagnostics and Troubleshooting

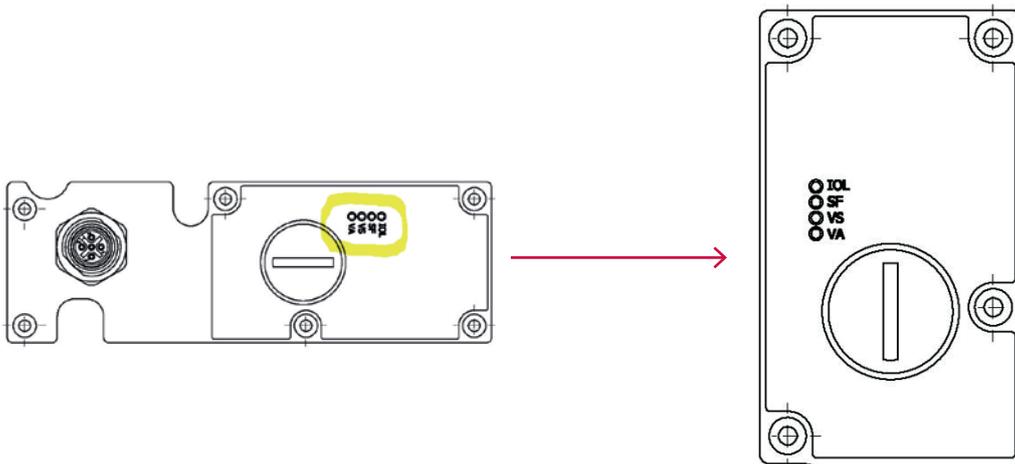
### 8.1. LED Function

#### 8.1.1. Analogue Version:



LED STATUS → **red**: Valve system fault -> check overvoltage at / if necessary.  
**green**: The position control of the valve piston is active.

#### 8.1.2. IO-Link Version:



IOL → Flashed **green**. IO-Link Communications established Lights up permanently **green** → IO-Link interrupted.  
 SF → Lights up **red**: → System error. Please run diagnostics or have unit serviced.  
 VB → **green** → Logic supply OK **red**: → Logic supply voltage not correct  
 VA → **green** → Supply logic OK **red**: → Supply voltage actuator missing / wrong

## 8.2. Status Byte

You can access the status via VPTool or via the IO-Link parameter Index 70 Sub Index 0, as well as in the IO-Link process data. Values in the status byte are signaled via the "STATUS" or the "SF" LED, depending on the variant.

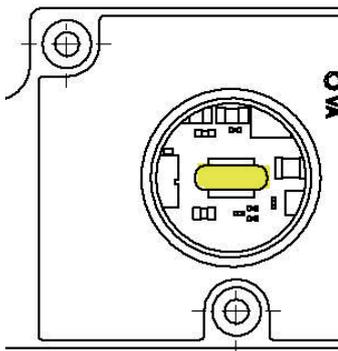
Status byte	Detailed device status	Error description	Recommended measure
0b00000001*	$V_A$ deviates strongly from nominal voltage.	Voltage supply VA deviates too much.	Check that a voltage > 18V is applied to VA.
0b00000010	Overcurrent in actuator	The current monitoring of the actuator unit has detected a too high current consumption.	The valve may be sluggish or dirty. Service required.
0b00000100	Position deviation too high.	The controlled position deviates strongly from the setpoint position. The short occurrence of the error bit during setpoint jumps is not a malfunction.	Dirt or malfunction of the valve mechanics. Supply current may be limited. Service if necessary.
0b00100000	$V_S$ deviates strongly from nominal voltage.	The permissible supply voltage is outside the nominal range.	Please check the supply voltage in the supply circuit (if necessary, current limiting active?).

Bit 1 only with Variante IO-Link

Bit 3,4,6,7 reserved for special applications

## 8.3 Diagnostic Interface

For parameterization and diagnostics, a USB-C interface is located under the dust protection cap centrally on the cover of the valve. The protection cap can be unscrewed counterclockwise using a suitable screwdriver.



This interface is connected to a Windows PC via VPTool.

### Note:

**Please note that the EMC conformity and the IP protection lose their validity when the cover is open and the interface is connected. This is only restored when the cover is closed.**

**8.4. Status Byte**

<b>Error/fault</b>	<b>Possible cause</b>	<b>Troubleshooting measure</b>
- Output flow too low or not proportional	- Connection cross section too small	- Check and enlarge if necessary
- no control / maximum flow only	- Supply voltage missing/too low	- Check voltage and ensure if necessary , check for current limitation
- no output flow	- no setpoint is present - no supply pressure - pneumatic connections clogged - pneumatic connection	- measure the input signals - check - check - check according to the book
- Fluctuations in the output flow	- Fluctuations in supply pressure	- Diagnosis of the pressure supply
- No reaction of the output flow when the setpoint value is changed	- Valve mechanics dirty / damaged	- Check filtering and send in device for maintenance
- Output flow is reached only sluggishly	- Use of compressed air that has not been cleaned or lubricated - Dirt in the valve causes friction	- use unlubricated compressed air and install oil filter or suitable FRL unit - Check filter
- Abrupt change of the flow	- Disturbances in the input signal or in the supply - Insufficient shielding of the setpoint signal or the ground connection	- Installation Improve / Shield - Improve ground wiring
- Flow rate at setpoint in middle position too high / not as expected	- Faulty mass connection when using the differential voltage input. - Internal leakage due to contamination	- Correct the wiring of the system - Have valve serviced

## 9. Transport and Storage

The individual packages are packed according to the expected transport conditions.

### 9.1. Transport

**Note:**

The valve and its components can be damaged by transport, corrosion or penetrating foreign bodies.

- Transport the valve in the delivery packaging
- Do not throw or drop packages
- Do not remove the valve from its packaging until immediately before assembly.

### 9.2. Storage

The valves are packed for immediate installation after delivery. Note in case of prolonged storage:

- Leave the valve in the packaging
- Store valve dry and dust-free
- Do not expose the valve to aggressive media (e.g. salty air).
- Protect from sunlight

## 10. Disposal

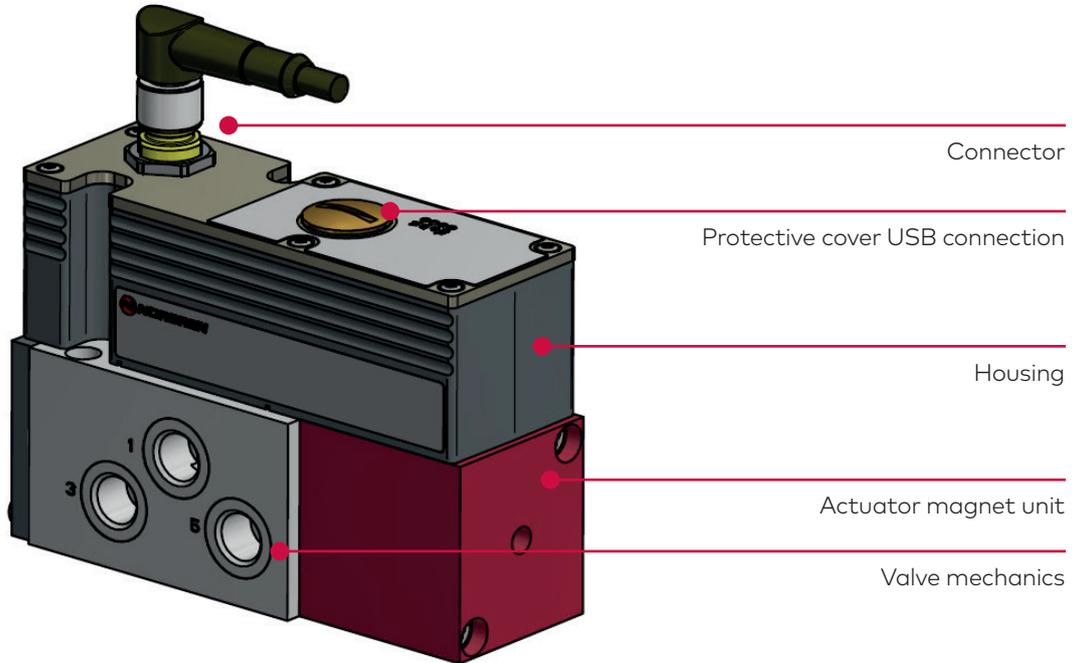
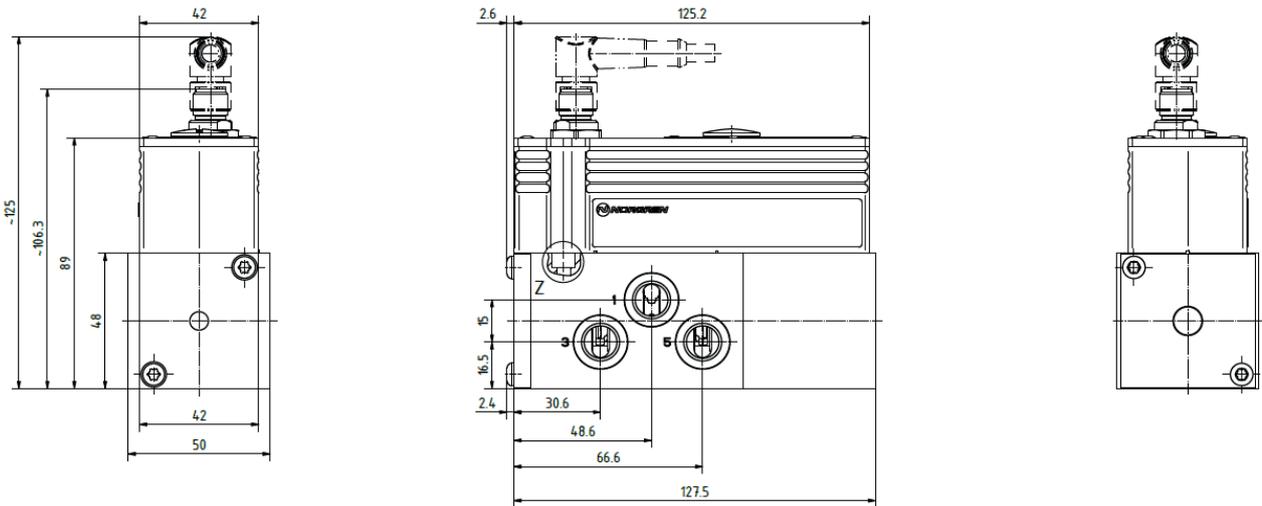
Dismantle the valves after decommissioning

Recycle the recyclable materials.

**Note:**

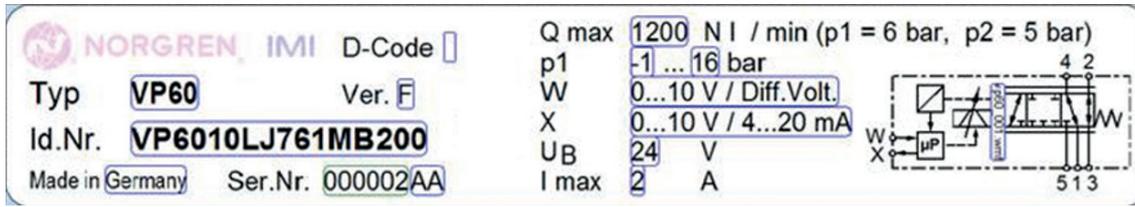
Incorrect disposal can be hazardous to the environment

If in doubt, contact your local authorities for information on environmentally safe disposal.

**11. Annex**
**11.1 Component View**

**11.2. Dimensions**


**11.3 Markings**

Nameplate exemplary:

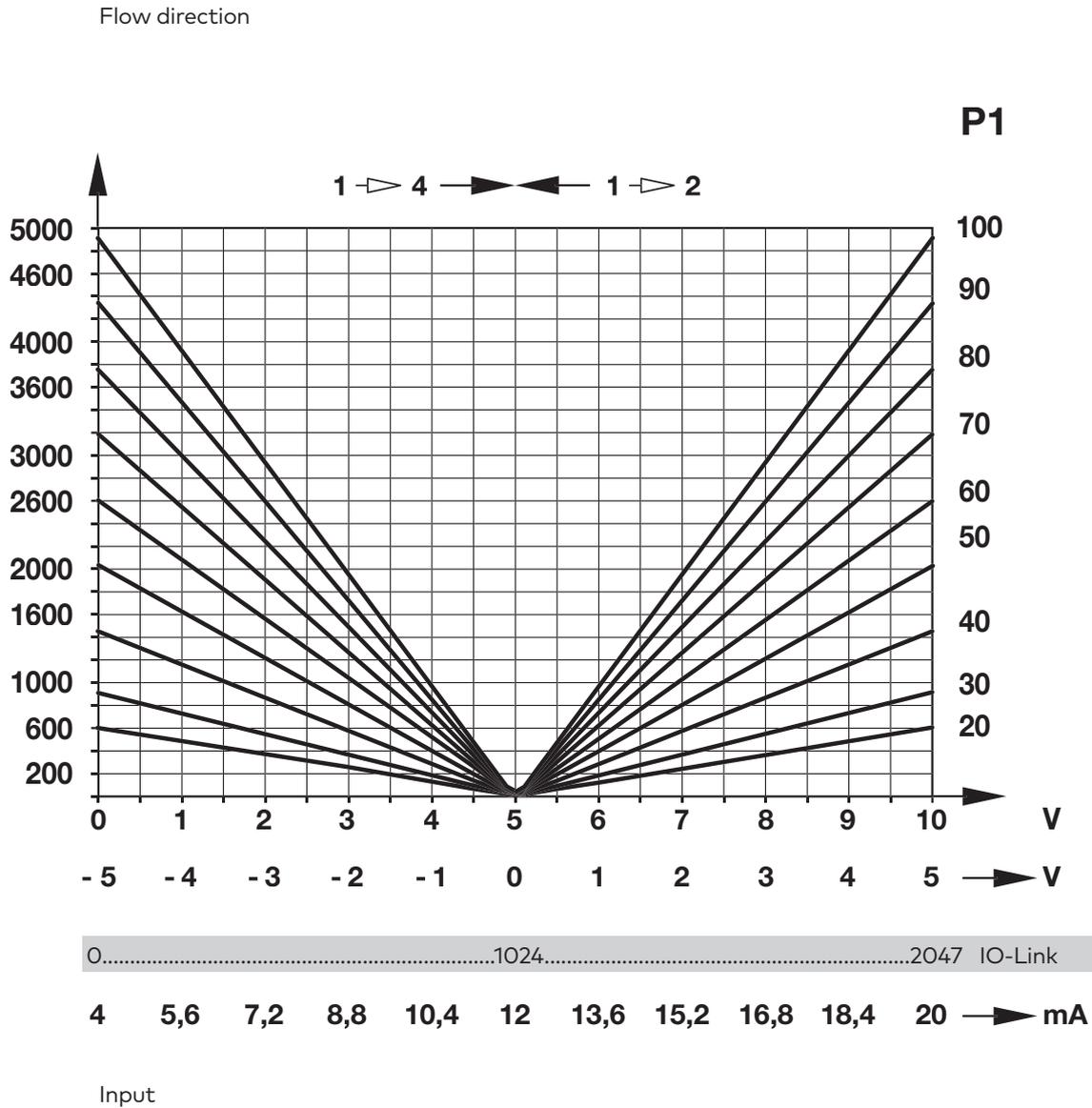


The nameplate contains the following information:

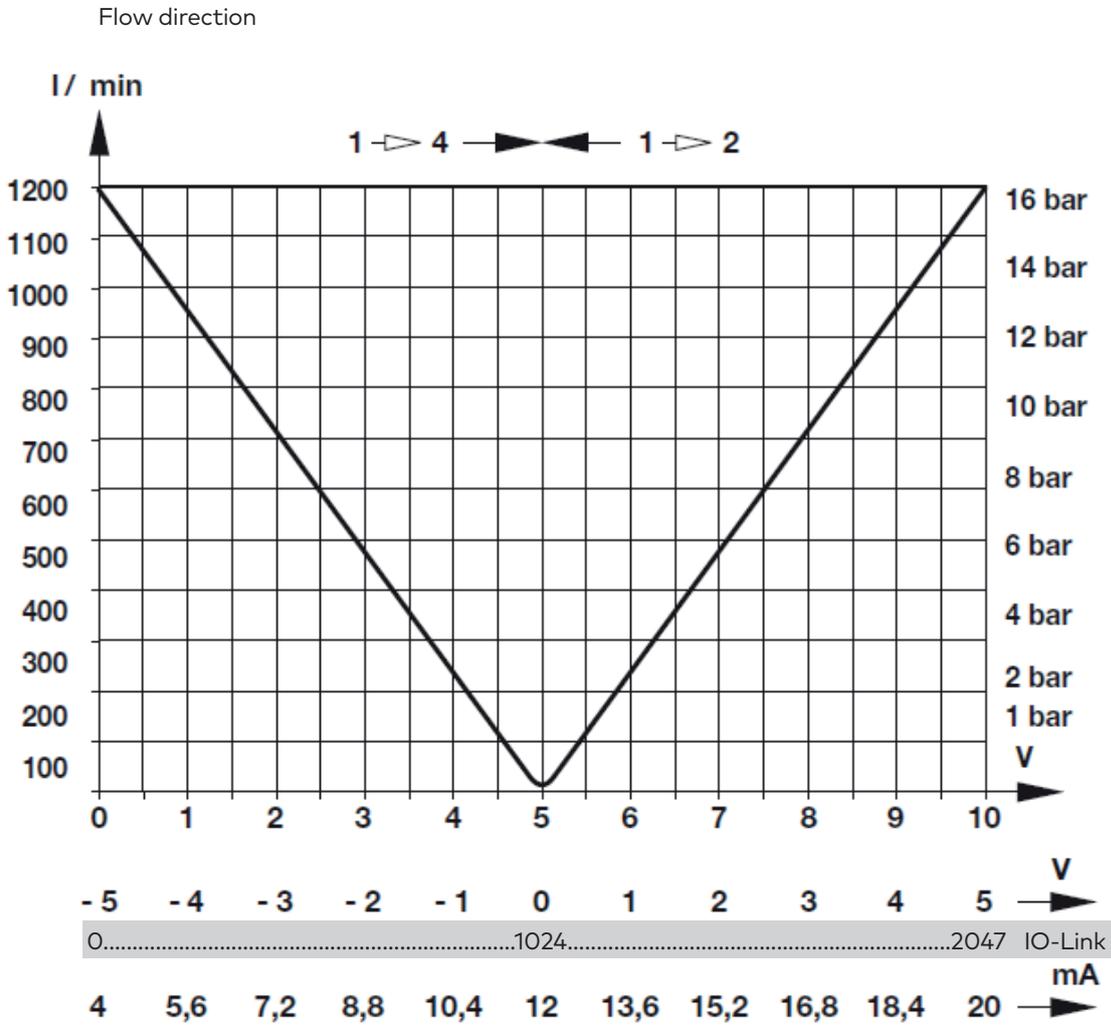
- Manufacturer
- Connection schemes
- Model Identification number with version
- Pressure range Inlet pressure p1
- Setpoint W / Actual value X
- Flow
- Supply voltage Ub
- Limit current I max
- Date code, five digits, year/week/day
  - Digit 1-2 Year of manufacture (2001=A1, 2010=B0, 2021=C1)
  - Position 3-4 Production week (KW)
  - Digit 5 Production day (Sunday=1, Monday=2)

**11.4.Characteristics**

Flow rate as a function of the set point and P1; P2, P4 = 0 bar (fei outflow):



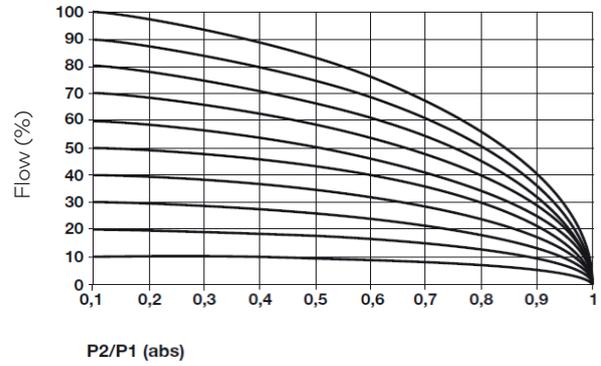
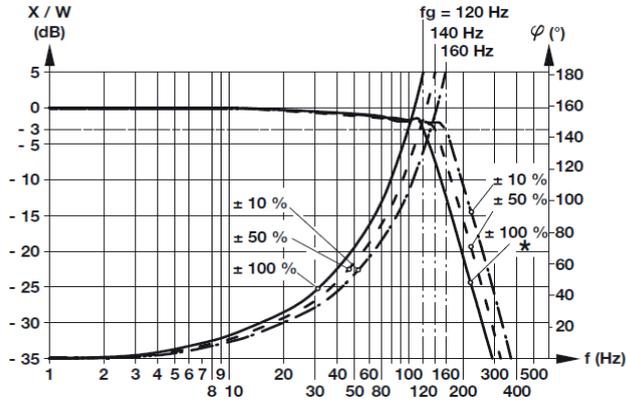
Flow rate as a function of the set point at constant pressure P1 = 6 bar; P2, P4 = 5 bar:



Input

Frequency response and phase of the slider position controller at 10, 50 and 100% setpoint:

Flow rate as a function of pressure ratio P2/P1 at set points 10, 20, to 100%:



Valve in Function 5/3. 0% corresponds to the middle position.

### 11.5. Technical Data

Please for Technical Data see Data Sheet

### 11.6 IO-Link General Information

This device is available with an IO-Link communication interface. An IO-Link-capable module (IO-Link master) is required for operation. The IO-Link interface enables direct access to the process and diagnostic data and provides the option of parameterizing the device during operation.

In addition, communication is possible via a point-to-point connection with a USB-C adapter cable. Access to the USB interface is gained after removing the cap on the connection lid.

Device-specific Information

The IODDs required for configuring the IO-Link unit and detailed information about the process data structure, diagnostic information and parameter addresses can be found at: <https://www.norgren.com/de/de/technical-service/software>

### 11.7 IO-Link Process Data

Name	Bitlength	Structure	Value Range
Process Data In	24 (3byte)	x = non significant X = significant	
→ Actual value	16	xxxx xxxx XXXX XXXX XXXX XXXX	0..2047 (1024 = Middle position)
→ Status byte*	8	XXXX XXXX xxxx xxxx xxxx xxxx	0..255
Process Data Out	16 (2byte)		
→ Input	16	XXXX XXXX XXXX XXXX	0..2048

\*Status byte description see chapter 8.4.

### 11.8. Important IO-Link Parameters

Param Block & Param Variable	Function/Description	Index	Sub Index	Model	Function
V_Function	Valve Mode	64	0	UIntegerT_16	Defines the valve mode 5/3-way, 2/2-way
V_BitLogic	Status bit Logic	65	0	BooleanT	Inverts the logic of the status bit.
V_ZeroOffset	Zero-Offset	66	0	IntegerT_16	Defines an offset to the zero point of the valve.
V_Hours	Operating Hours	67	0	UIntegerT_16	Operating hours of the valve (ro)
V_Strokes	Piston Strokes	68	0	UIntegerT_16	Schiko motion counter
V_ActorCurrent	Current/-/	69	0	UIntegerT_16	Current consumption of the actuator (mA)
V_Errorbytes	Error Bytes	70	0	UIntegerT_16	Status/Errorbyte Mirror (s. Prozessdaten PDIn)

Further parameter descriptions can be found in the IODD of the product at: <https://www.norgren.com/de/de/technical-service/software>

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OM\_IO-Link\_VP60 en/03/21

Incorporating

