

# Operation Manual

## Proportional Valve VP23 Series



**Before starting work read these instructions.**

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Our policy is one of continued research and development. We therefore reserve the right to amend, without notice, the specifications given in this document.

Order number 7503482000000050

Revision: 2

Manufacturer's Address:

Norgren GmbH  
Stuttgart St. 120  
D-70705 Fellbach

## 1. General

### 1.1 Information about these Instructions

These instructions allow you to safely set up and operate the proportional valve VP23 in the analogue or IO-Link version. It is an integral part of the product and must be accessible to the user. The user must carefully read and understand these instructions before starting any type of work. Following all safety and handling instructions in this manual is a prerequisite for safe operation.

### 1.2. Explanation of Symbols Safety Notice

#### **DANGER**

**This symbol and the signal word "Danger" indicate an imminent danger. If not avoided, death or serious injury will result.**

#### **Warning!**

**This symbol and the signal word "Warning" indicate a possible imminent danger. danger. If not avoided, death or serious injury can result.**

#### **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 VP23 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 authorized and trained by the manufacturer. Failure to comply with the above provisions will invalidate the warranty. The manufacturer accepts no liability for any damage caused.

### 2.3. General Safety Instructions/ Proper Usage

**Caution!** This product is to be used in industrial compressed air systems only. It is to be used where the pressure and temperature values listed in the data sheet are not exceeded. Before using the product in non-industrial applications, in life support or other systems not covered in the published instructions, please contact Norgren directly.

Due to misuse, wear, or malfunction, components used in pneumatic systems can 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 personal injury and equipment damage in the event of such a failure.

**System designers are required to include safety information for the end user in the operations manual if fault protection is not adequately provided.**

**System designers and end users are strongly advised to follow the safety instructions included with the products.**

### **3. Functional Safety**

#### **Note:**

The VP23 is **not** a design with inherent fail-safe characteristics.

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

For machine controls (complex mechatronic systems) with the VP23, a risk analysis according to e.g. EN-ISO12100 is strongly recommended.

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

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

##### **ANGER - Danger due to hazardous movement**

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

Please establish 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 disconnection.

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

After switching off the pressure supply, port 1 may still be under pressure for a longer period of time.

Protect yourself and others by not removing pressurized connections and wear appropriate personal protective equipment when working!

Depressurize the system before carrying out any work

Have all work carried out by Pneumatics specialists

##### **Warning! - Clogging of silencers**

Blockage of the silencers can lead to malfunction of the valve

Ensure appropriate air purity

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

Operate the valve only with suitable silencers

Always wear hearing protection when working

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

As the operator, make sure that work is only carried out by qualified specialist personnel

Train the operating personnel comprehensively in safety issues

Have electrical installations carried out by qualified electricians only

##### **CAUTION - Risk of burns due to hot surfaces**

After longer operating times or at high pressures, considerable heat may be generated at the solenoid. Danger of burns when touched

## **4. Basic function**

### **4.1. General Description**

The VP23 is a digital proportional pressure regulator that uses an electronic setpoint (analogue voltage/current or IO-Link process data) to control the valve output pressure. The pressure is kept constant even if the medium (compressed air or neutral gases) is consumed. The actual pressure value is reported back to the user as a voltage output and current output or as IO-Link process data.

### **4.2. Application**

The VP23 allows the stepless adjustment of a pneumatic pressure. This can be used to control or regulate the following processes: Speed, position, flow, force, control of pneumatically actuated control and metering valves.

### **4.3. Function**

The valve operates with a closed control loop in which the outlet pressure is constantly detected by the pressure sensor and compared with the specified setpoint. If the outlet pressure is lower than the pressure set by the set point or if a higher pressure is required, the force on the spool is increased via the electric proportional solenoid. A connection is made between port 1 (inlet pressure) and port 2 (outlet pressure) until the outlet pressure is equal to the specified set point. If the outlet pressure is higher than the pressure set by the set point or if a lower pressure is desired, the force on the spool is reduced by the electric proportional solenoid. A connection is made between port 2 (outlet pressure) and port 3 (vent) until the outlet pressure is equal to the specified set point. In addition, after switching off the supply voltage, the last set output pressure is vented down to 0 bar.

Option: The IO-Link interface allows the user to not only control the output of the device, but also to adjust operating parameters and monitor various performance feedback such as current output pressure and operating hours.

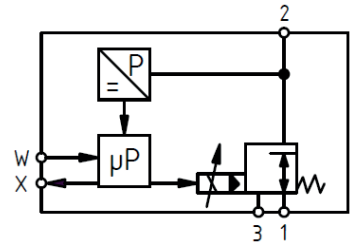
## 5. Pneumatic Connection

### 5.1 Block Diagram of the Valve Function (3/2 way)

Port 1: System (input) pressure

Port 2: Working port (outlet pressure)

Connection 3: Venting



The pneumatic connections are marked with numbers and preferably have the following function and flow direction: Flow direction: 1 => 2 (consumer pressure build-up), 2 => 3 (consumer pressure reduction, venting). Without current the pneumatic connection 2=> 3 is open.

Connection size: flange-mounted version with connecting plate G 1/4, G3/8, G1/2, G3/4

### 5.2 Operating Medium

Filtered, oil-free and lubricated condensate-free compressed air or neutral gases (non-flammable).

Filtering of the supply air (50 μm) is recommended. When using lubricated compressed air, the dynamics and service life can be influenced by lubricants and their additives.

Medium temperature: -5 ... 50°C ( 23 ... 122°F) (non-condensing)

To prevent parts from freezing, the compressed air must be free of moisture below 2°C ( 35 °F).

#### Caution!

When using lubricated compressed air, the dynamics and the service life can be influenced by the lubricants and their additives.

The maximum permissible inlet pressures depend on the pressure range:

| Set pressure P2    | Operating pressure P1 max. |
|--------------------|----------------------------|
| 0 (0,02) ... 2bar  | 7 bar                      |
| 0 (0,1) ... 10bar  | 12 bar                     |
| 0 (0,16) ... 16bar | 17 bar                     |

#### Caution!

Avoid sealing the screw connections on the connection plate with Teflon sealing tape or other sealing material. Otherwise sealing material residues could get into the valve body and lead to sluggishness and malfunction of the valve.

## 6. Electrical Connection

### 6.1 Pin Assignment

#### 6.1.1. Variant Analogue



| Pin | Colour (Typ.) | Port size                           |
|-----|---------------|-------------------------------------|
| 1   | white         | Setpoint input W(I) 0/4 ... 20mA    |
| 2   | brown         | Comparator output X(comp)           |
| 3   | green         | Signal ground GNDS                  |
| 4   | yellow        | Setpoint input W(U) 0 ... 10V       |
| 5   | grey          | Actual value output X(I) 4 ... 20mA |
| 6   | Pink          | Supply voltage 24 V DC              |
| 7   | blue          | Supply mass GND                     |
| 8   | red           | Actual value output X(U) 0 ... 10V  |

The ground connection of the enclosure should always be connected to achieve optimum continuous EMC protection.

##### 6.1.1.1. Analogue Input Signals

Signals of the pneumatic setpoint input (pressure, only one active, switchable):

Pressure setpoint W(U), GNDS related: Voltage signal 0 ... 10 V, input resistance  $R > 100k\Omega$

Pressure Setpoint W(I), GND referred: Current 0/4 ... 20 mA, load 500 Ohms

##### 6.1.1.2. Analogue Output Signals

Pneumatic output pressure signals (both active):

Pressure Actual value X(U), GNDS related: 0 to 10 V = 0 to max. P2, output current max. 1mA

Pressure Actual value X(I), GND related: Current (0)4 to 20 mA, load resistance 500 Ohm recommended

##### 6.1.1.3. Digital Output Signal

Comparator signal of the pneumatic pressure status, "pressure reached" referred to the setpoint with tolerance range (% max. P2) adjustable, default  $\pm 2\%$ .

X(comp) referred to GND:

Outlet pressure outside switching range ( $\text{abs}(X-W) \geq 2\%$ ) PLC level Low

Pressure reached ( $\text{abs}(X-W) < 2\%$ ) PLC level High - Output current max. 10mA

This output can alternatively be configured as a pressure switch with fixed pressure limits.

### 6.1.2. Variant IO-Link



| Pin | Colour (Typ.) | Port size                 |
|-----|---------------|---------------------------|
| 1   | brown         | Supply voltage 24V VS     |
| 2   | white         | Supply voltage 2L (VA)    |
| 3   | blue          | Supply mass (Vs GND)      |
| 4   | black         | IO-Link signal (C/Q)      |
| 5   | grey (gr/ge)  | Supply ground 2M (VA GND) |

(VA and VS are galvanically isolated)

This device has an optional IO-Link communication interface that requires an IO-Link-capable module (IO-Link master) for operation. The IO-Link interface enables direct access to the process and diagnostic data and provides the possibility to set the parameters of the unit during operation. In addition, communication is possible via a point-to-point connection with a USB adapter cable for parameterization purposes.

The IODDs required for configuring the IO-Link unit and detailed information about process data structure

### 6.2 Power Supply

Nominally the VP23 is supplied with 24V DC. The max. permissible supply range is between 18 and 32 V DC (incl. residual ripple). The electronics are protected against incorrect polarity of the supply and will not be damaged. However, higher voltages can destroy the electronics!

- Before connecting, make sure that the supply voltage is switched off.
- Connect the device as follows:  
Supply voltage UB or VA and VS with IO-Link: 24V nominal (18 to 32V DC)  
Residual ripple max.: 10%

Current consumption UB or VA with IO-Link:

Max. at 24 V DC: < 2,0 A approx.

Static at 24V DC, 25°C and balanced (X=W): < 0,7A approx.

Current consumption VS with IO-Link at 24V DC: approx. 50mA

The power supply of the proportional directional control valves may only be operated via a supply with safe isolation 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 equipment must be observed.

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

The actuator system (=valve solenoid) is activated from 18 V supply voltage. Although the current draw at 24V drops to < approx. after 1 sec. 0.7 A is limited, peaks of up to 2.0 A can occur. This must be taken into account when designing the system supply.

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

Power supplies often have electronic current limiting, the activation of which results in a reduction of the output voltage. This allows the switch-off threshold of the actuator of the VP23 of 18 V to be undershot. Due to the then drastically reduced current requirement of the valve (~0.08 A), the power supply voltage rises again above the switch-on threshold. This may cause an undesired oscillation process!

## **7. Assembly Instructions**

### **7.1. General Safety Instructions**

The valve series is suitable for use in enclosed spaces and normal industrial environments:

Ambient temperature: -5 ... +60°C (23 ... 140 °F)

Mounting position any, preferably vertical, solenoid upwards. Mounting location as close as possible to the consumer. For moving mounting locations, install the valve at right angles to the direction of acceleration.

#### **7.1.1. Pneumatic Connection**

If possible, the supply line to 1 should be larger than the nominal valve size. Working line at 2 if possible equal to or larger than the nominal valve size. Air at vent connection 3 must be discharged without pressure. Line cross-sections and length have an influence on the application (buffer volume, pressure drop).

The operating pressure must be higher than the maximum required outlet pressure at P2: Recommendation  $\geq 1\text{bar}$ .

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.

For further notes on the compressed air supply, see chapter 5 "Pneumatic connection".

#### **7.1.2. Electrical Connection**

When installing the valve, make sure that no damage occurs to the electrical connection. There should be enough space for the cable routing. Make sure that the cables are routed as follows: crush-free, stretch-free (no pull on the cable), kink-free. The torque when tightening the union nut should not exceed 0.3 Nm. For the electrical connection, use a cable as listed under accessories. The correct pin assignment and connection can be found in the operating instructions.

##### **7.1.2.1. Shielding (Analogue Version)**

If no listed accessory cable is used, use a shielded cable to avoid interference from electric fields. The shield must be connected to PE on the system side (see connection diagram).

##### **7.1.2.2. Cable Routing**

Supply and signal lines must not be laid parallel to power lines or high-voltage lines. Cable cross-section according to VDE 01134.

#### **7.1.3. Combination with other Devices**

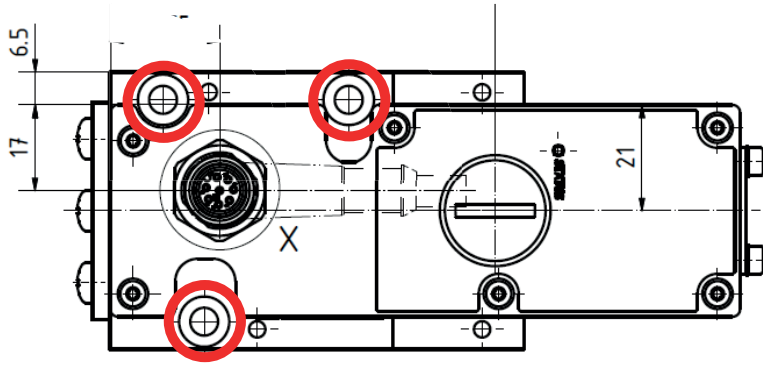
Upstream devices (e.g. pressure reducer) Flow rate greater than that of the proportional valve Downstream devices (e.g. switching valves) Flow rate equal to or greater than that of the proportional valve.

## 7.2. Installation

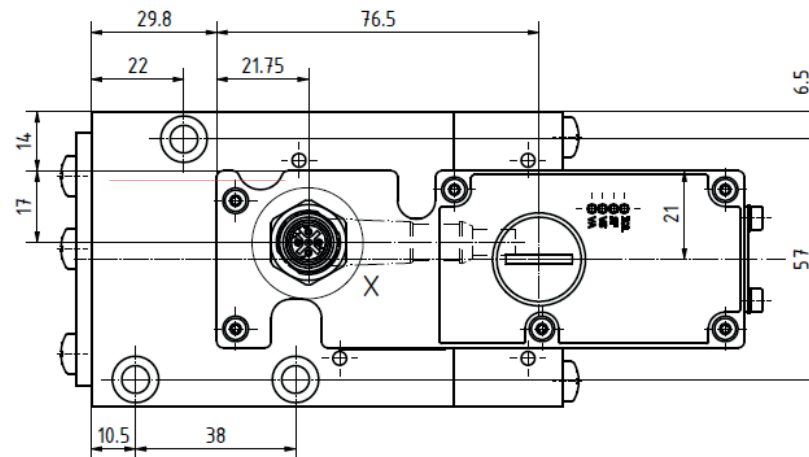
### Caution!

The valve may only be mounted through the three mounting holes of the valve mechanism:

Example VP23 analogue, NG8:



Example VP23 IO-Link, NG16:



### Caution!

Before mounting the valve, the pneumatic lines must be cleaned of mounting residues (e.g. by blowing them out).

## 7.3 Accessories

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

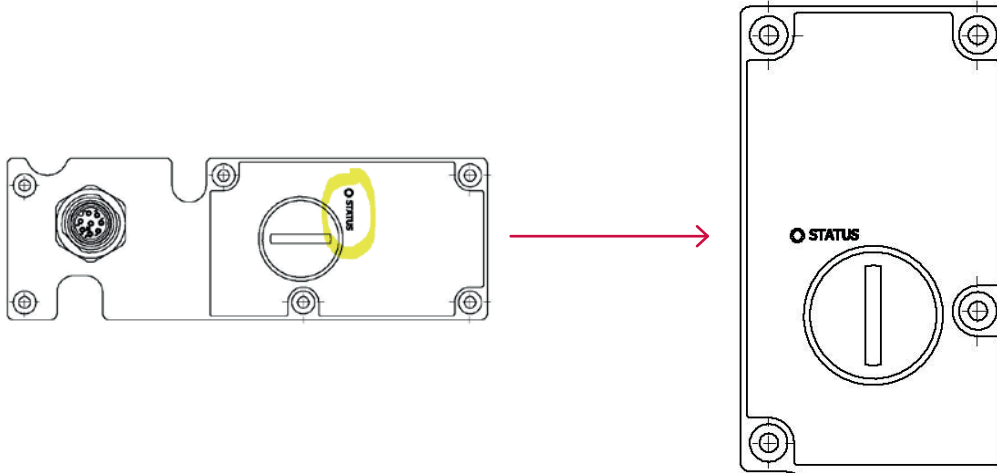
<https://www.norgren.com>

## 8. Diagnostics and Troubleshooting

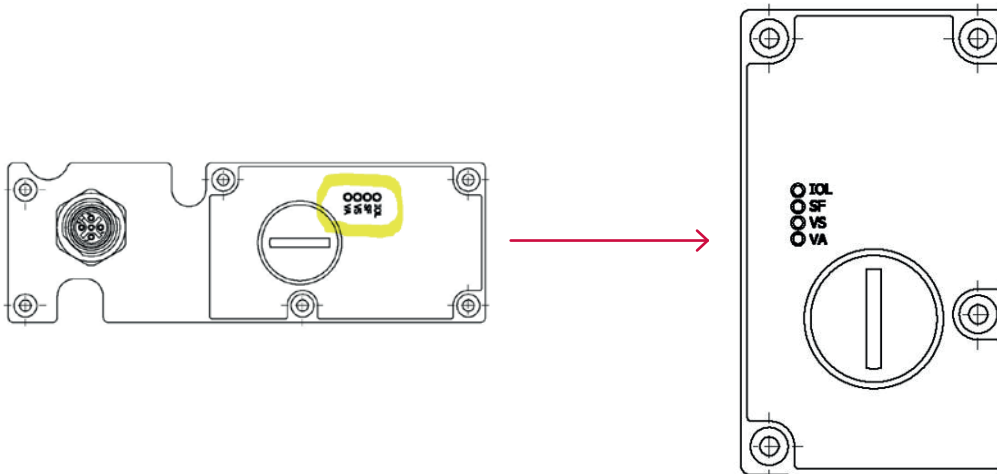
### 8.1. LED Function

#### 8.1.1. Analogue Version

This has a status LED



| LED          | Description                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------|
| Valve status | green: Status ok (status byte = 0);<br>red: error state (various triggers; see Table 8.2 Status byte below) |



| LEDs                    | Description                                                                                                                  |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1. IO-Link              | Flashes green when there is an IO-Link connection                                                                            |
| 2. SF<br>(valve status) | green: Status ok (status byte = 0);<br>red: error state (status byte > 0: various triggers; see Table 8.2 Status byte below) |
| 3. $V_s$                | green: Voltage ok;<br>red: voltage missing or too low                                                                        |
| 4. $V_A$                | green: Voltage ok;<br>red: voltage missing or too low                                                                        |

## 8.2. Status Byte

### 8.2.1. Analogue Version:

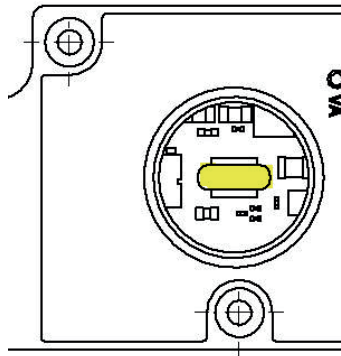
| Status byte | Detailed device status            | Error description                                                                                               | Recommended measure                                                         |
|-------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 0b00000001  | $U_B < \text{min.}$               | Power supply $U_B$ too low.                                                                                     | Ensure that a voltage $> 18V$ is present at $UB$ and is properly connected. |
| 0b00000100  | Reserved                          | -                                                                                                               | -                                                                           |
| 0b00000100  | Control deviation $> \text{max.}$ | Pressure is outside the set limits.                                                                             | Check that there is sufficient input pressure at P1.                        |
| 0b00001000  | Valve temperature $> \text{max.}$ | The max. permissible temperature has been exceeded.                                                             | Ensure a lower ambient resp. Fluid/Ambient temperature:                     |
| 0b00010000  | Solenoid current to max.          | The pressure regulator has the max. Valve flow reached without the actual pressure value reaching the setpoint. | Check that there is sufficient input pressure at P1.                        |

### 8.2.2. IO-Link Version

| Status byte<br>(process data) | Detailed device status            | Error description                                                                                               | Recommended measure                                                         |
|-------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 0b00000001                    | $V_S < \text{min.}$               | Voltage supply $V_S$ too low.                                                                                   | Ensure that a voltage $> 18V$ is present at $VS$ and is connected properly. |
| 0b00000010                    | Reserved                          | -                                                                                                               | -                                                                           |
| 0b00000100                    | Control deviation $> \text{max.}$ | Pressure is outside the set limits.                                                                             | Check that there is sufficient input pressure at P1.                        |
| 0b00001000                    | Valve temperature $> \text{max.}$ | The max. permissible temperature has been exceeded.                                                             | Ensure a lower ambient resp. Fluid/Ambient temperature:                     |
| 0b00010000                    | Solenoid current to max.          | The pressure regulator has the max. Valve flow reached without the actual pressure value reaching the setpoint. | Check that there is sufficient input pressure at P1.                        |
| 0b00100000                    | $V_A < \text{min.}$               | Power supply $V_A$ too low.                                                                                     | Ensure that voltage $> 18V$ to $VA$ is present and properly connected.      |

### 8.3 Diagnostic Interface

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



This interface is connected to a Windows PC via the VPTool software.

#### 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 by closing the lid.

### 8.4. Common Errors

| Status byte (process data)                                    | Detailed device status                                                | Recommended measure                           |
|---------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------|
| LED does not light up                                         | Power supply interrupted                                              | Check power supply                            |
| Valve does not respond to setpoint input                      | Setpoint input is not connected correctly                             | Check port configuration                      |
| Valve does not control despite correct setpoint specification | Pressure connections are not connected correctly                      | Check pressure connections                    |
| Valve does not reach the adjusted pressure value              | Inlet pressure is too low / Air extraction quantity is too high       | Set inlet pressure according to specification |
| Leakage between sub-base and valve                            | O-rings between sub-base and valve are damaged or incorrectly mounted | Check O-rings on connecting plate             |

## **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

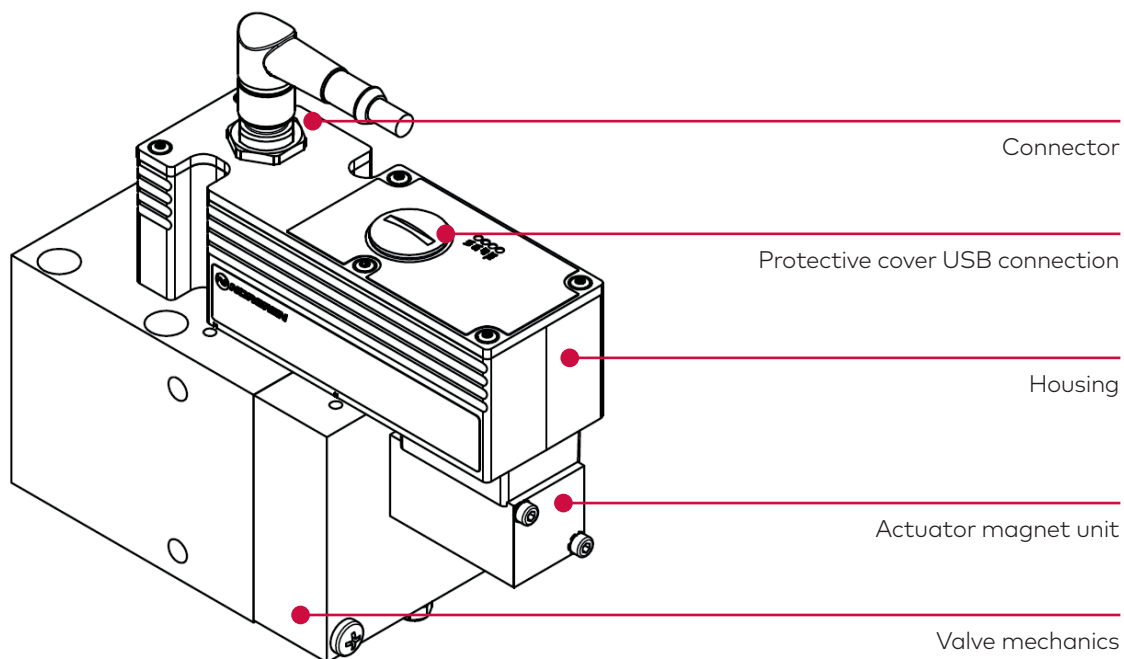
**Note:**

Incorrect disposal can cause hazards to the environment

In case of doubt, obtain information on environmentally safe disposal from the local authorities.

## 11. Annex

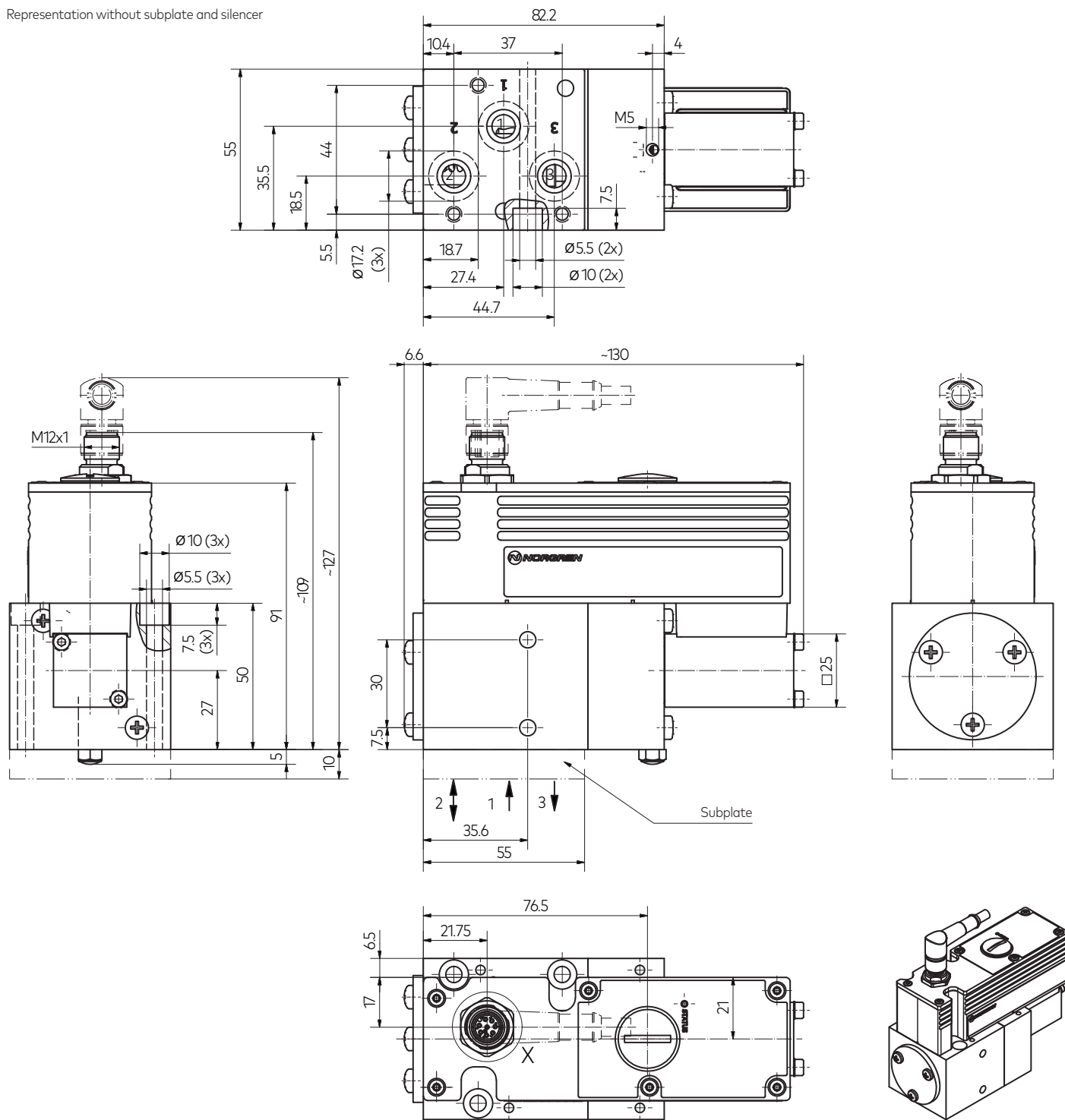
### 11.1. Component View



## 11.2. Dimensions

VP23 analogue NG8

Representation without subplate and silencer

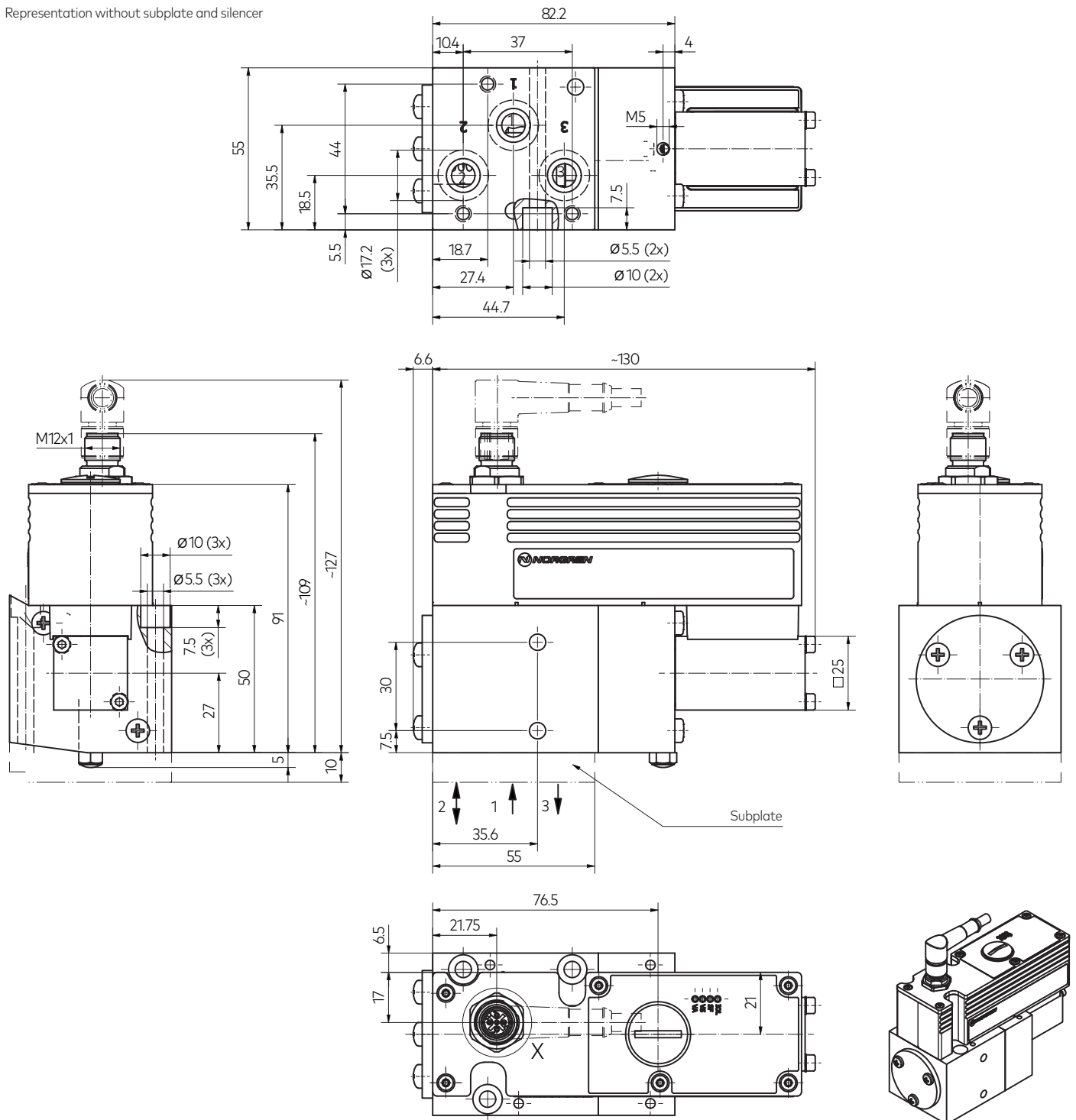


## Representation without subplate and silencer



**VP23 IO-Link, NG8**

Representation without subplate and silencer

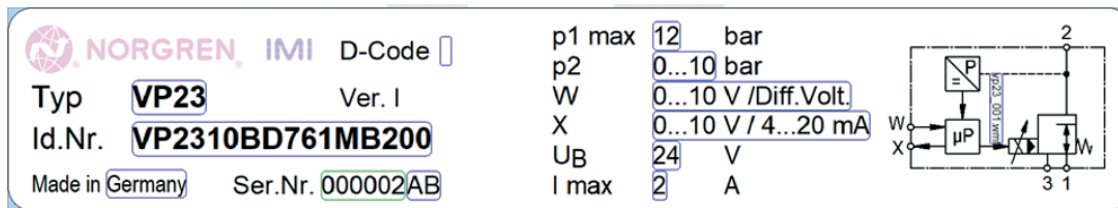


## Representation without subplate and silencer



### 11.3. Markings

Nameplate exemple:



The nameplate contains the following information:

- Manufacturer
- Connection schemes
- Model Identification number with version
- Pressure ranges inlet pressure p1max and outlet pressure p2
- Setpoint W / Actual value X
- 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

Please for flow characteristics see data sheet

#### 11.5. Technical Data

Please for technical data see data sheet

#### 11.6. General Information IO-Link

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 possibility to set the parameters of the unit during operation.

In addition, communication is possible via a point-to-point connection with a USB-C adapter cable for parameterization purposes. Access to the USB interface is gained by removing the cap on the connection cover.

#### 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  | Sub Index | Data Type   | Structure                                    | Value Range                                |
|-------------------------|------------|-----------|-------------|----------------------------------------------|--------------------------------------------|
| <b>Process Data In</b>  | 40 (5byte) |           | RecordT     | x = non significant X = significant          |                                            |
| Actual value X          | 32         | 1         | Float32T    | xxxx xxxx XXXX XXXX XXXX XXXX XXXX XXXX XXXX | 0...nominal pressure<br>(Pmax = 2, 10, 16) |
| Status byte             | 8          | 2         | UIntegerT_8 | XXXX XXXX xxxx xxxx xxxx xxxx xxxx xxxx      | 0...255                                    |
| <b>Process Data Out</b> | 32 (4byte) |           | RecordT     |                                              |                                            |
| Set point W             | 32         | 1         | Float32T    | XXXX XXXX XXXX XXXX                          | 0...nominal pressure<br>(Pmax = 2, 10, 16) |

Status byte error bits: see chapter 8.4

### 11.8. Important IO-Link Parameters

| Parameter Variable         | Index | Sub Index | Model       | Function                                                                                                                                                         |
|----------------------------|-------|-----------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V_ParamSet                 | 64    | 0         | IntegerT_16 | User Parameter Preset - Selection of preset controller parameters: User-Defined, VolumeSmall, VolumeMedium, VolumeLarge, NozzleSmall, NozzleMedium, NozzleLarge. |
| V_PressureUnit             | 65    | 0         | IntegerT_16 | Pressure Unit - Selection of the pressure unit used for pressure setpoint input and actual value feedback: Bar, MPa, PSI                                         |
| V_RampRateUp %/ms          | 66    | 0         | IntegerT_16 | Ramp_Rise_Rate %/ms - Max. ramp rise rate setting                                                                                                                |
| V_RampRateDwn %/ms         | 67    | 0         | IntegerT_16 | Ramp_Fall_Rate %/ms - Max. ramp fall rate setting                                                                                                                |
| V_KpUserDefined %          | 68    | 0         | IntegerT_16 | User_PID_Kp % - Adjustment of the control gain P component within the control algorithm. These settings should only be changed by experienced personnel (%).     |
| V_KiUserDefined %          | 69    | 0         | IntegerT_16 | User_PID_Ki % - Adjustment of the control gain I component within the control algorithm. These settings should only be changed by experienced personnel (%).     |
| V_DeadtimeUserDefinedpos % | 70    | 0         | IntegerT_16 | User_Integral_Rise_Deadtime % - I-portion dead time setting during a pressure rise (%)                                                                           |
| V_DeadtimeUserDefinedneg % | 71    | 0         | IntegerT_16 | User_Integral_Fall_Deadtime % - I-portion dead time setting during a pressure drop (%)                                                                           |

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

### 11.9. IO-Link Diagnostic Displays

| Diagnostics (Read-Only) Parameters | Index | Sub Index | Model       | Description                                                  |
|------------------------------------|-------|-----------|-------------|--------------------------------------------------------------|
| Operating Hours                    | 104   | 0         | IntegerT_32 | Number of hours the unit has been powered since manufacture. |
| Operating Minutes                  | 103   | 0         | IntegerT_16 | Total minutes since the last switch-on or Hourly Update.     |
| Parameter Address                  | 100   | 0         | IntegerT_16 | Reserved                                                     |
| Parameter Value                    | 101   | 0         | IntegerT_16 | Reserved                                                     |
| Parameter Operation                | 102   | 0         | UIntegerT_3 | Reserved                                                     |

Norgren operates four global centres of technical excellence and a sales and service network in 50 countries, as well as manufacturing capability in Brazil, China, Czech Republic, Germany, India, Mexico UK and the USA.

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