OPERATING INSTRUCTIONS

MKY45 M288

Table of contents

1 General Information

These operating instructions are intended to ensure the correct, effective, and safe use of the **MKY45 M288** from Wandfluh. The operating instructions include behavioral guidelines provided by Wandfluh, either as the manufacturer or through its resale organizations (Wandfluh sister companies or Wandfluh representatives), as part of their instructional duty.

For this purpose, the operating instructions mainly include:

- Information about the proper use, installation, and commissioning of the MKY45
- Information on safety in handling the control system

1.1 Application Area

Thanks to its flameproof enclosure, the MKY45 is suitable for use in potentially explosive atmospheres.

1.2 Product Identification

Nameplate on the side of the product:

- Type code
- Article number
- Production number
- Certifications
- Electrical specifications

Digital nameplate, accessible with the parameterization software PASO2 (see PASO2 22).

- Type code
- Article number
- Serial number
- Firmware version

1.3 Conformity

The MKY45 electronics has been developed and tested in accordance with the latest technical standards. In particular, the EMC directives EN 61000-6-2 (immunity) and EN 61000-6-4 (emission of interference) have been applied.

1.4 Manufacturer

Wandfluh AG
Postfach
CH-3714 Frutigen

sales@wandfluh.com
www.wandfluh.com

2 Safety Regulations

Attention

The MKY45 electronics monitor internal control functions and system operating conditions. However, uncontrolled movements or changes in force resulting from unforeseeable electronic faults cannot be prevented in all cases.

Therefore, personal hazard must be prevented by interrupting the operating voltage through the **emergency stop chain** on the system side.

2.1 Installation / Commissioning / Parameterization

- These operating instructions must be carefully studied beforehand, and their instructions must be followed.
- All supply voltages and other energy sources must be disconnected before installation.
- Installation/assembly must only be carried out by personnel with electrical knowledge.
- Precautions regarding electrostatic discharge-sensitive components on the control card must be observed.
- Incorrect operation by personnel cannot be prevented by the device.
- Before switching on the supply voltage, the fuse protection, correct wiring, and compliance of the supply voltage with the permissible supply voltage range must be checked.

3 Product Description

3.1 Type Code

The MKY45 lacks a dedicated type code. The specifications are integrated into the solenoid type code. Detailed information is available in the solenoid datasheet (supplement M288) on the Wandfluh product page at wandfluh.com.

3.2 Technical Data

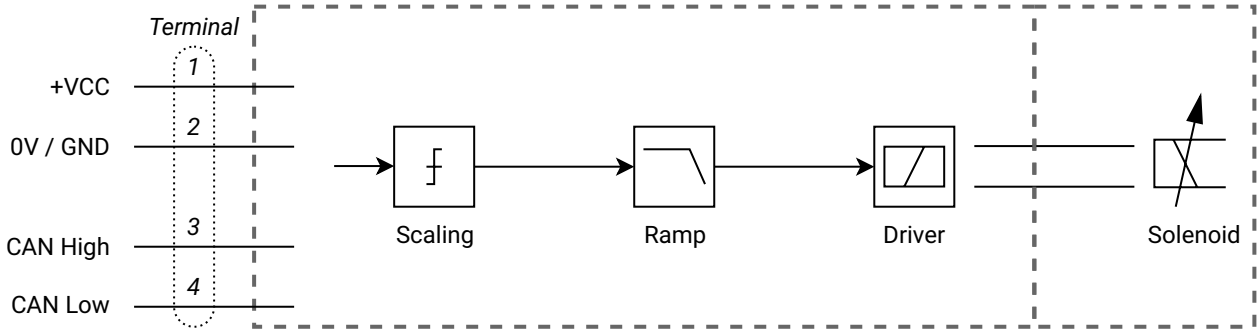
3.2.1 General Specifications

Description		Value
Design		Electronics mounted directly in the solenoid housing
Connections	Screw terminal	4-pin terminal, max. 1.5 mm^2
	Parameterization	via CAN (requires a USB-to-CAN adapter from PEAK)
Dimensions		see drawing 9
Ambient temperature	-25...+70 °C	Derating see Temperature Monitoring 10
Degree of protection		IP67 according to EN 60 529

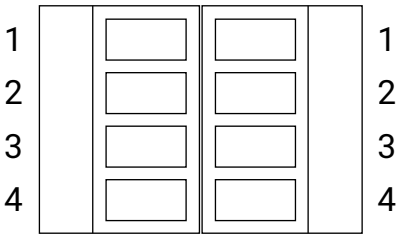
3.2.2 Electrical Specifications

Description		Value
Supply voltage +VCC		12/24 VDC + 10%
Fuse		The device must be protected by the user with a time-delay fuse
Temperature drift		< 1% at ΔT = 40° C
Quiescent current		approx. 20 mA
Maximum current consumption		Quiescent current + 1x max. solenoid current
CAN	Protocol	SAE J1939
	Baud rate	250 kbit/s
	Galvanic isolation	No, signals are referenced to GND
	Bus termination	must be terminated externally 120 Ω at both ends
Solenoid current	Minimum current (I_{min}) Factory setting	adjustable 50 mA
	Maximum current I_{max} Factory setting	adjustable depends on the variant
Dither	Adjustable frequency Factory setting	4 ... 500 Hz 70 Hz
	Adjustable level Factory setting	0 ... 400 mA 200 mA
EMC	Immunity	EN 61000-6-2
	Emissions	EN 61000-6-4

3.3 Block Diagram

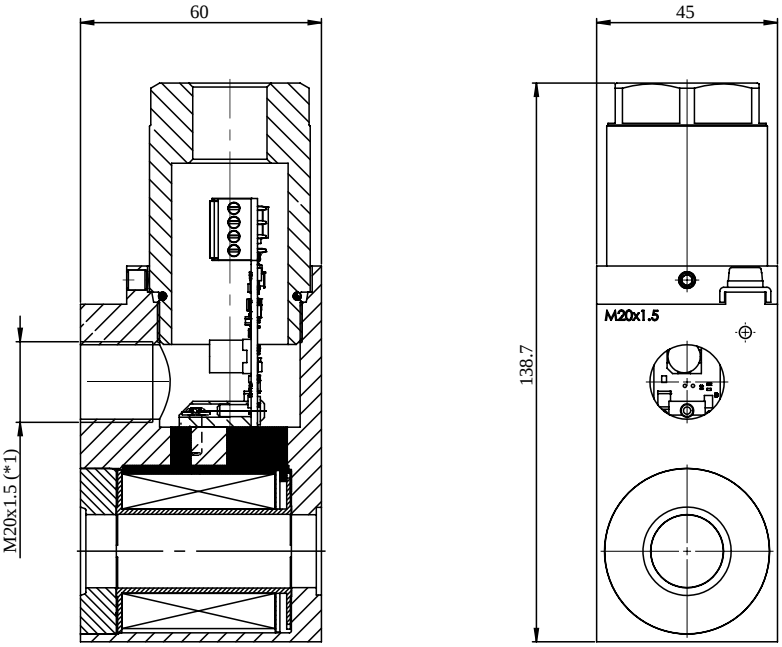


3.4 Pin Assignment



Pin	Signal
1	Supply voltage +VCC
2	Supply voltage 0 V / GND
3	CAN High
4	CAN Low

3.5 Dimensions



3.6 Inputs and Outputs

3.6.1 Supply Voltage

The MKY45 is operated with a minimal supply voltage of 18 VDC (see Electrical Specifications 8). If this voltage is undershot, the device goes into an error state.
If a brief drop in supply voltage is expected in the system (e.g., when starting a motor in a mobile machine), this error can also be automatically reset. To do this, the Supply Error Auto Reset 18 function must be activated in PASO2.

3.6.2 Fieldbus J1939

The setpoint can be specified and the device monitored via the CAN interface using the SAE J1939 protocol.
In addition, the MKY45 periodically transmits the actual solenoid current and the device status, including any errors and warnings.

The CAN interface is **not** galvanically isolated, the CAN signals are referenced to 0V / GND.

> **Info**
>
> The J1939 communication specification for the MKY45 is available online on the corresponding product page at wandfluh.com.

3.6.3 Solenoid Output

The solenoid output measures the actual solenoid current. This enables the MKY45 to regulate the solenoid current and compensate for temperature effects such as self-heating.
All relevant settings are adjustable via parameters (available settings see Function Description 16). This allows the behavior to be adapted to the valve.

3.6.3.1 Temperature Monitoring

The MKY45 has a factory-set internal temperature monitoring system that can limit the solenoid current to prevent overheating of the device.
This means that at high ambient temperatures and high solenoid temperatures, the full solenoid current may not be reached.

Above 110 °C of the internal electronics temperature, the set maximum solenoid current (I_{max}) is reduced depending on the temperature.
The temperature of the MKY45 electronics is visible in the parameterization software PASO2.

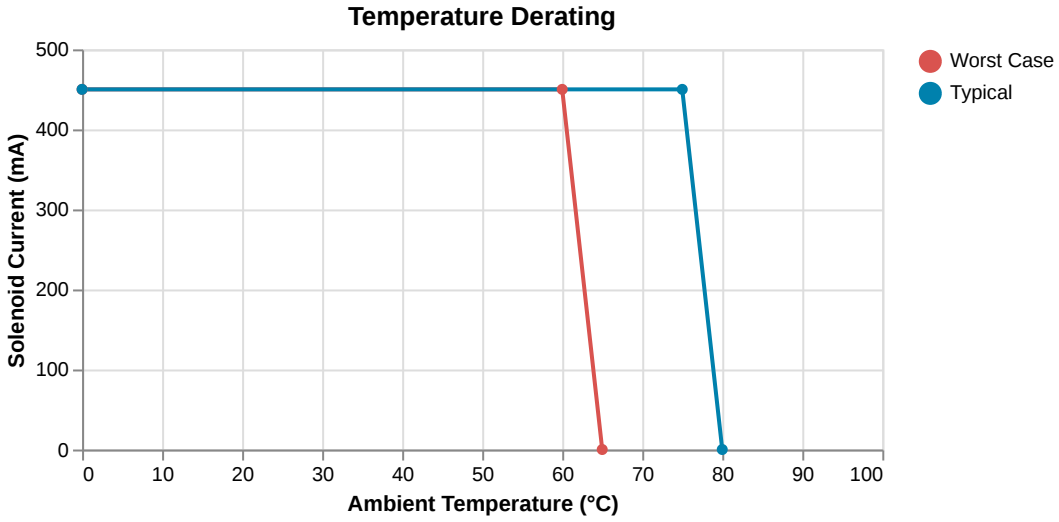
Since the self-heating of the solenoid significantly impacts the electronics temperature, this current limitation can reduce the temperature, allowing the device to operate with limited current even at higher ambient temperatures.
When this limitation, known as **derating**, is active, the solenoid current of the valve, and consequently the operating range of the valve, is restricted — the effect is similar to that of a restricted setpoint signal range (see valve data sheet).

Attention

If the monitored electronics temperature exceeds 115 °C, the MKY45 switches to an error mode.
The solenoid outputs are then locked to prevent permanent damage to the electronics.
After cooling down and resetting the error (see chapter Troubleshooting 25), the MKY45 can be activated again.

The derating/reduction of current depends on:

- Ambient temperature (lower temperature is better)
- Supply voltage (higher voltage is generally better)
- Solenoid type (smaller solenoid with lower power is generally better)
- Solenoid current (lower current is generally better)



Worst Case: Stacked assembly, both neighbour valves fully powered.
Typical: Device operating individually at full load.

4 Function Description

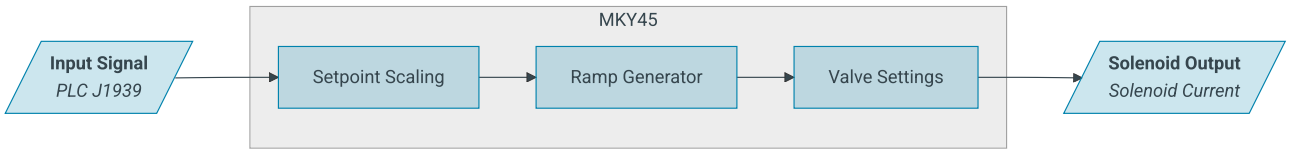
The MKY45 is an explosion-protected amplifier unit for controlling a hydraulic valve. The electronics are integrated directly into the housing.

Multiple devices can be connected in series using daisy-chain wiring, thereby reducing the amount of cabling required.

Thanks to the built-in ramp function, various monitoring functions, and other adjustable options, the functionality of the MKY45 can be individually customized.

The parameterizable solenoid drivers allow various types of valves to be controlled.

Simplified overview of the signal flow



The **function blocks** and their **parameters** are described below.

Info

The documentation is valid for the entire product family. Individual functions may not be available in all product variants.

This documentation is also available in the parameterization software PASO2 22.

4.1 Setpoint Scaling

This function block contains the settings for scaling the setpoint signal.
Both the source of the setpoint signal and its processing, such as scaling, can be configured.

The input signal is initially acquired as a raw value and then converted into a scaled setpoint according to the scaling parameters.

4.1.1 Signal Type

The desired signal type for the setpoint is specified here.
This setting determines which sources are available (see Source 13).

4.1.2 Source

The source to be used as the setpoint is selected here.

4.1.3 Cable Break Monitoring

Cable break detection for the input signal is enabled here.
Cable break detection monitors the raw value of the input signal.
The thresholds at which a cable break is detected are defined by the parameters
Lower Cable Break Threshold 13 and Upper Cable Break Threshold 13.

4.1.4 Lower Cable Break Limit

If the raw value falls below the Lower Cable Break Threshold 13, a cable break error is triggered.

4.1.5 Upper Cable Break Limit

If the raw value rises above the Upper Cable Break Threshold 13, a cable break error is triggered.

4.1.6 Lower Raw Value

The lower raw value defines the first reference point of the linear scaling.
At this raw value, the scaled setpoint corresponds to the Lower Scaling Value 13.

4.1.7 Upper Raw Value

The upper raw value defines the second reference point of the linear scaling.
At this raw value, the scaled setpoint corresponds to the Upper Scaling Value 13.

4.1.8 Lower Scaling Value

The Lower Raw Value 13 is scaled to this value.

If the raw value falls below the value defined by the Lower Raw Value 13 parameter, the setpoint is extrapolated linearly. As a result, the scaled setpoint may fall below the value specified here. If this is not desired, the scaled setpoint can be limited using the Limit Scaling 14 parameter.

4.1.9 Upper Scaling Value

The Upper Raw Value 13 is scaled to this value.

If the raw value rises above the value defined by the Upper Raw Value 13 parameter, the setpoint is extrapolated linearly. As a result, the scaled setpoint may rise above the value specified here. If this is not desired, the scaled setpoint can be limited using the Limit Scaling 14 parameter.

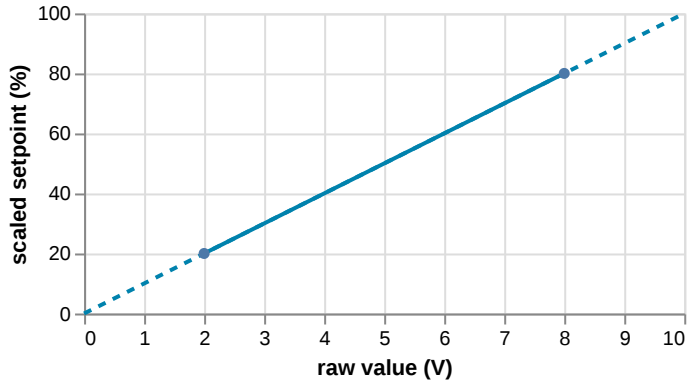
4.1.10 Limit Scaling

When this parameter is enabled, the setpoint is not extrapolated during scaling. Instead, the two scaling values are used as absolute limits.

Info

This diagram illustrates the relationship between the raw parameters (Lower Raw Value 13 at 2V and Upper Raw Value 13 at 8V) and their corresponding scaled outputs (Lower Scaling Value 13 at 20% and Upper Scaling Value 13 at 80%).

If the Limit Scaling 14 parameter is enabled, the scaled setpoint is limited to the lower or upper scaling value and is not extrapolated.



- The *solid line* represents the scaling between the two defined reference points.
- The *dashed lines* show the linear extrapolation outside this range.

4.1.11 Deadband

Prevents unintended valve activation caused by minimal signal changes around the center position of the setpoint transmitter (e.g., a joystick in its mechanical zero position).

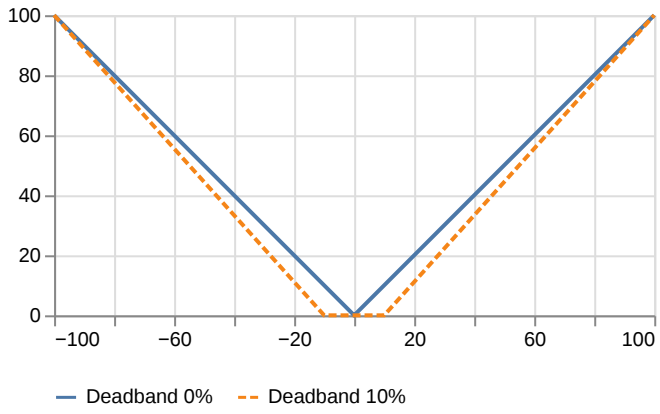
The function acts symmetrically around the zero point (0%) of the already scaled setpoint. If the absolute value of the scaled setpoint is lower than the configured threshold, a setpoint of 0% is output.

If the parameter is set to 0%, the deadband function is disabled.

Attention

The deadband function changes the scaling of the output value!

The output is scaled linearly from 0% to ±100% over the range between the deadband value and 100% (see diagram).



4.2 Ramp Generator

This function block is used to configure the settings for setpoint value changes (ramp-up and ramp-down speeds of the setpoint value).

In the event of a sudden change in the setpoint value, the internal setpoint value is gradually increased using the ramp. This can help prevent abrupt movements or pressure surges, for instance.

Info

When the enable signal changes from *inactive* to *active*, the ramp generator is restarted.

4.2.1 Ramp Up (positive)

The set ramp time refers to a setpoint jump from 0% to +100% for solenoid driver **1** (positive setpoint).

A value of 0 means the ramp is turned off at this point.

4.2.2 Ramp Down (positive)

The set ramp time refers to a setpoint jump from +100% to 0% for solenoid driver **1** (positive setpoint).

A value of 0 means the ramp is turned off at this point.

4.3 Solenoid Driver

This function block is used to configure solenoid (valve)-specific settings.

Info

The output of the solenoid driver will be deactivated, if there is an error in the Channel.

4.3.1 Output

Selection of which physical solenoid output is controlled by this solenoid driver.

4.3.2 Cable Break Monitoring

Activation of the cable break monitoring of the solenoid output.

4.3.3 Minimal Current (i_{min})

Minimum solenoid current, which flows at a setpoint > 0%.
This parameter corresponds to the opening point of the valve.

4.3.4 Maximal Current (i_{max})

Solenoid current that flows at a setpoint of 100%.
This parameter corresponds to the desired maximum actuation of the valve or the maximum allowable solenoid current for the solenoid being used.

4.3.5 Dither Amplitude

The ± level of the dither signal.

If no dither is desired, the level can be set to 0.

4.3.6 Dither Frequency

Selection of the desired dither frequency.

A lower dither frequency produces a stronger effect. However, if the frequency is too low, it may cause the valve to oscillate.

Info

The dither function overlays the solenoid current with a dither current of the desired amplitude[16] and frequency[16], causing the valve spool to oscillate slightly to break the static friction in the spool.

This can minimize the *stick-slip effect* and improve the valve's response.

Based on experience, 70 Hz / 200 mA is a good baseline setting for Wandfluh valves. Depending on the application (fast/slow valve, long hoses/short pipes, with/without accumulators, etc.), the settings can be further adjusted.

4.4 Channel Enable

The enable function allows the signal processing of the device and the solenoid outputs to be intentionally enabled or disabled.

Info

When the enable signal changes from *inactive* to *active*, all **errors** in the current channel **are reset**.

This also resets all device errors.

If the ramp generator is used, it will be restarted.

4.4.1 Enable

Determines whether and how the channel can be locked and enabled.

Possible settings:

Value	Explanation
Off	The channel is locked, i.e., no solenoid current will flow.
On	The channel is enabled, solenoid current can flow.
External	The enable signal is controlled with a digital high signal. The parameter Source[18] determines the source of the signal.
External inverted	The enable signal is controlled with a digital low signal. The parameter Source[18] determines the source of the signal.

4.4.2 Source

If `External` or `External inverted` is selected in the parameter Enable 17, this parameter selects the source of the enable signal.
The selected input activates or deactivates the enable signal accordingly.

4.5 Device Error

4.5.1 Supply Error Auto Reset

Setting whether an error due to the supply voltage will be automatically reset when the error condition is no longer present.

Info

This can be useful for mobile machines where the supply voltage temporarily drops during the startup process. Without the auto-reset function, the device would switch to error status and wait for manual reset via the enable input (or via PASO2).

4.6 Fieldbus J1939

The J1939 fieldbus settings are configured in this function block.

Attention

Changes to the parameters in this function block take effect only after the device has been restarted.

Info

The J1939 communication specification is available online on the Wandfluh product page.

4.6.1 Node ID

The address of the J1939 device on the bus.

4.7 Device Properties

4.7.1 Name

Display name for the device. Shown in the PASO2 device selection.

4.8 Additional Functions

Additional functions available:

- Display of Errors and Warnings
- Export and import of all settings
- Reset to factory settings
- Retrieve operating statistics data
- Retrieve device information

Info

If a special function is needed that is not available in the device, Wandfluh also offers custom developments.

sales@wandfluh.com

5 Commissioning

Attention

Please refer to the section Safety Regulations 6.

For **EMC-compliant connections**, the following points must be strictly observed:

- Signal cables must not be routed parallel to high-power cables.

Further notes:

- All signals must be connected via the 4-pin screw terminal.
- For daisy-chain wiring, the terminating resistor can be installed in the terminal of the last device.
- The PASO2 parameterization software for parameterization and diagnostics is connected via CAN. A USB-to-CAN adapter is required for this purpose (see Configuration (PASO2) 22).
- The tuning to the used valve must be done by the user.
- Further settings regarding the device's function must be made by the user.

Info

Wandfluh can create application-specific parameter files upon customer request.

5.1 Installation

The electronics module is permanently mounted inside the solenoid.

For the installation of the solenoid, see the mounting instructions M288 (Art. No. 990.8534).

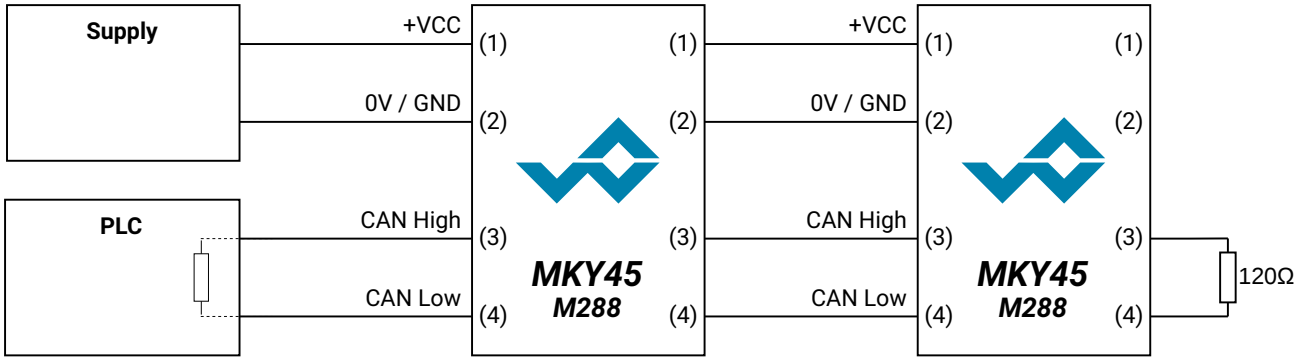
5.1.1 Accessories

A USB-to-CAN adapter is required for parameterization:

- USB-to-CAN adapter: PCAN-USB adapter from PEAK-System
  The adapter is not sold by Wandfluh.

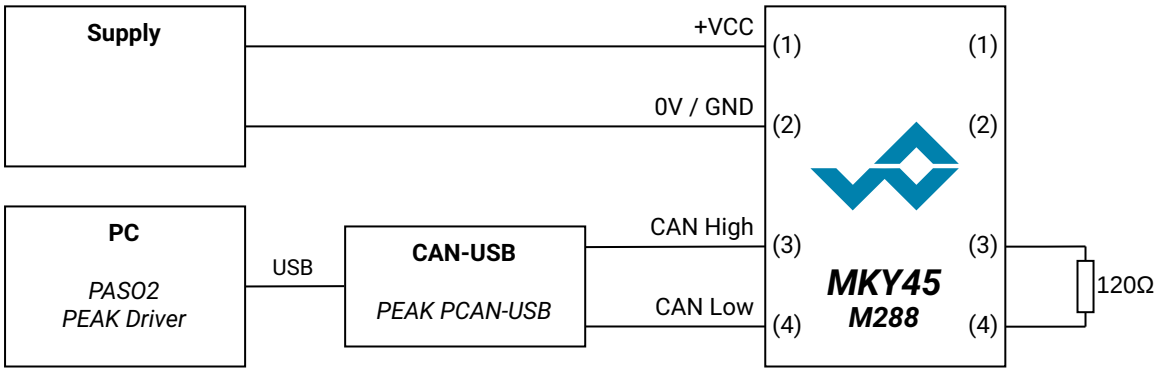
5.2 Connection Examples

5.2.1 Daisy Chain



Connection example with daisy-chain wiring and a terminating resistor on the last unit.

5.2.2 PASO2



Connection example for PASO2 using a USB-to-CAN adapter from PEAK-System.

6 Configuration (PASO2)

The parameterization and diagnostic software **PASO2** enables easy configuration of the MKY45. All settings can be made via the intuitive user interface.

The software offers the following key features:

- **Flowchart-Based Parameterization**
  Functions are clearly presented as functional blocks in the signal flow. Within each block, the available parameters are visible and can be directly edited.
- **Real-Time Analysis**
  The current values of inputs and outputs as well as the results of the functional blocks are displayed in real time within the signal flow. Changes to parameters are immediately traceable.
  Any device error or warning messages are shown directly and explained.
- **Parameter File Management**
  All device settings can be saved in a parameter file and transferred to other devices as needed.
  These files can be opened and edited even without a connected device. New files can also be created for any desired device.
- **Integrated Help**
  The software features a comprehensive help function that covers both the operation of PASO2 and the explanation of all functional blocks and parameters.

Beyond the listed features, PASO2 also offers additional options for simple and efficient commissioning of the MKY45 as well as optimal adaptation to the respective hydraulic system.

Download PASO2
https://www.wandfluh.com/en/software/

6.1 Installation

6.1.1 System Requirements

System Requirements	
Operating system	Windows 10 or later
CAN-to-USB adapter	PCAN-USB adapter from PEAK

Info

The software can be installed for a single user or globally for all users.
For a global installation, administrative rights are required depending on company policy.

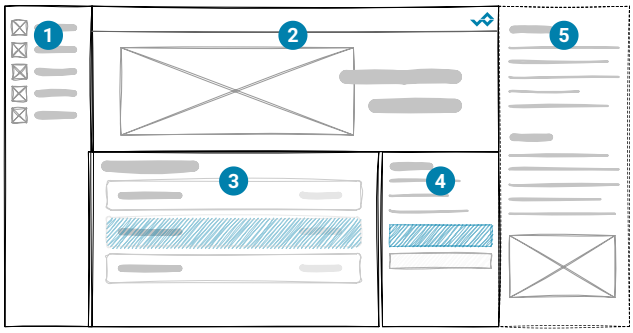
When connecting the MKY45 to PASO2 via the CAN bus using a PEAK PCAN-USB adapter, the appropriate PEAK adapter driver must be installed.

6.2 Layout

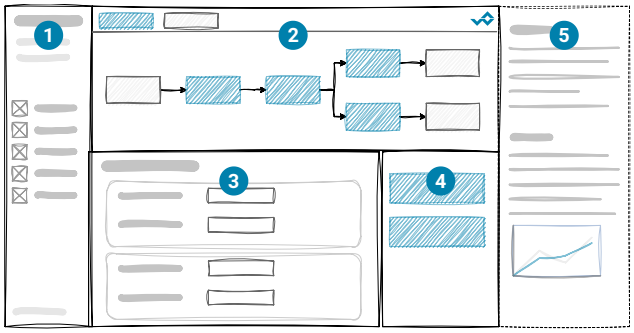
In PASO2, two main views can be distinguished, each of which is divided into five areas.

Various basic actions can be carried out in the *Start view*. The *Editing view* then allows you to edit parameters (of connected devices and parameter files).

Start view



Editing view



1. **Menu**
   The context menu is located here.
   Additional information about the device is displayed in the editing view.
2. **Graphic**
   In this area, the flowchart with function blocks is displayed in the editing view. The function blocks can be clicked to edit them. At the top, you can switch between channels.
3. **Setting**
   The connected devices are displayed here in the *Device Selection*. Under *New*, a Wandfluh device can be selected for which a parameter file is to be created.
   In the editing view, the parameters of a function block can be displayed and edited.
4. **Action**
   In the start view, a selected device can be opened/connected. A parameter file can also be written to connected devices.
   In the editing view, additional information such as the *Allocation List* appears in this area.

5. **Help**
   The optional help is displayed in this area. In the *Settings* area, the help for the current context can be called up by clicking on the help symbol (**?**).

6.3 Edit Parameters

Step-by-step instructions on how to modify a parameter on the device using PASO2.

The USB-to-CAN adapter must be connected to the PC, and the MKY45 must be connected to the adapter (see Connection Examples 21).

1. Open PASO2 and navigate to the *Device Selection* menu ❶ from the start view.
2. If the MKY45 is connected via the CAN bus, the desired USB-to-CAN adapter must first be connected by clicking *Bind Adapter* ❹.
3. Select the desired device from the list ❸ and click *Connect* ❹.
4. In the editing view that appears, click on *Disable Write Protection* ❶ to enable parameter changes.
5. Click the desired function block ❷ and enter the new value for the target parameter ❸.
   Confirm entry with Enter / ↵ or leave the field — the new value will be transferred to the device.
6. *(Optional)* Use *Save As ...* ❶ to store all parameters in a file — for reuse or documentation, for example.
7. Use *Disconnect* ❶ to end the connection to the device.

7 Troubleshooting

The device can detect fault conditions and report them as errors and warnings.

7.1 Display

7.1.1 PASO2

When the device is connected to PASO2, the error/warning icon in the channel is animated.

Under *Channel Error*, all active errors and warnings for the current channel are listed.

If an error is reported by a function block, a warning icon appears in the corresponding function block.

Device errors are additionally listed under *Device Error*.

7.1.2 Feldbus

Active errors and warnings are reported via J1939 in the `DM1` diagnostic message.
For details, refer to the *J1939 Specification* available online on the product page off the MKY45 at wandfluh.com.

7.2 Error

7.2.1 Power Supply Error

The supply voltage is below 18 VDC.
The error is also reported if a voltage dip (t > 250 ms) has occurred.

Notes:

- Is the supply power adequate?
- Is the AC component too high (see section Electrical Specifications 8)?
- Using the parameter Supply Error Autoreset 18, this error is reset automatically once the supply voltage returns to the allowed range.

7.2.2 Temperature

The device temperature is too high (above 115 °C).

Notes:

- The solenoid was operated at too high a current, causing the device to overheat, and/or the ambient temperature is too high.
- Check the ambient temperature and solenoid current settings, and allow the device to cool down.

7.2.3 Solenoid Output Short Circuit

A short circuit has occurred at the solenoid output.

Notes:

- Check the connections between the device and the valve (solenoid).

7.2.4 Solenoid Output Cable Break

A cable break has occurred at the solenoid output.

Notes:

- Check the connections between the device and the valve (solenoid).
- If the cable break function is not required, monitoring can be disabled via the parameter Cable Break Monitoring 16.

7.2.5 Internal Error

A severe internal error has occurred.

Connect the device to PASO2 and update the firmware. If the issue persists, contact support.

7.3 Warning

7.3.1 High Temperature

The device temperature has exceeded 110 °C.

Notes:

- The solenoid is being driven with too high a current, causing significant heating of the device, and/or the ambient temperature is too high.
- Check the ambient temperature and solenoid current settings.
- Prolonged exposure to high temperatures can reduce the devices' lifespan.

7.3.2 Derating

The device is in *derating* mode and reduces the maximum solenoid current based on the device temperature (see Temperature Monitoring 10).

Notes:

- The solenoid was operated with too high a current, causing significant heating of the devuce, and/or the ambient temperature is too high.
- Check the ambient temperature and solenoid current settings.
- Prolonged exposure to high temperatures can reduce the devices' lifespan.

7.4 Resetting Errors

When the fault condition has been resolved, the error must be reset.

In PASO2, errors can be reset per channel or for the entire device at the push of a button.

The errors can also be reset via the fieldbus.
For more information, refer to the product page off the MKY45 at wandfluh.com.

Info

Warnings are always reset automatically.

8 Disposal

- The MKY45 electronics must be disposed of in accordance with the general regulations of the country in which it is used.
- Electronic parts are recycled by specialized companies.