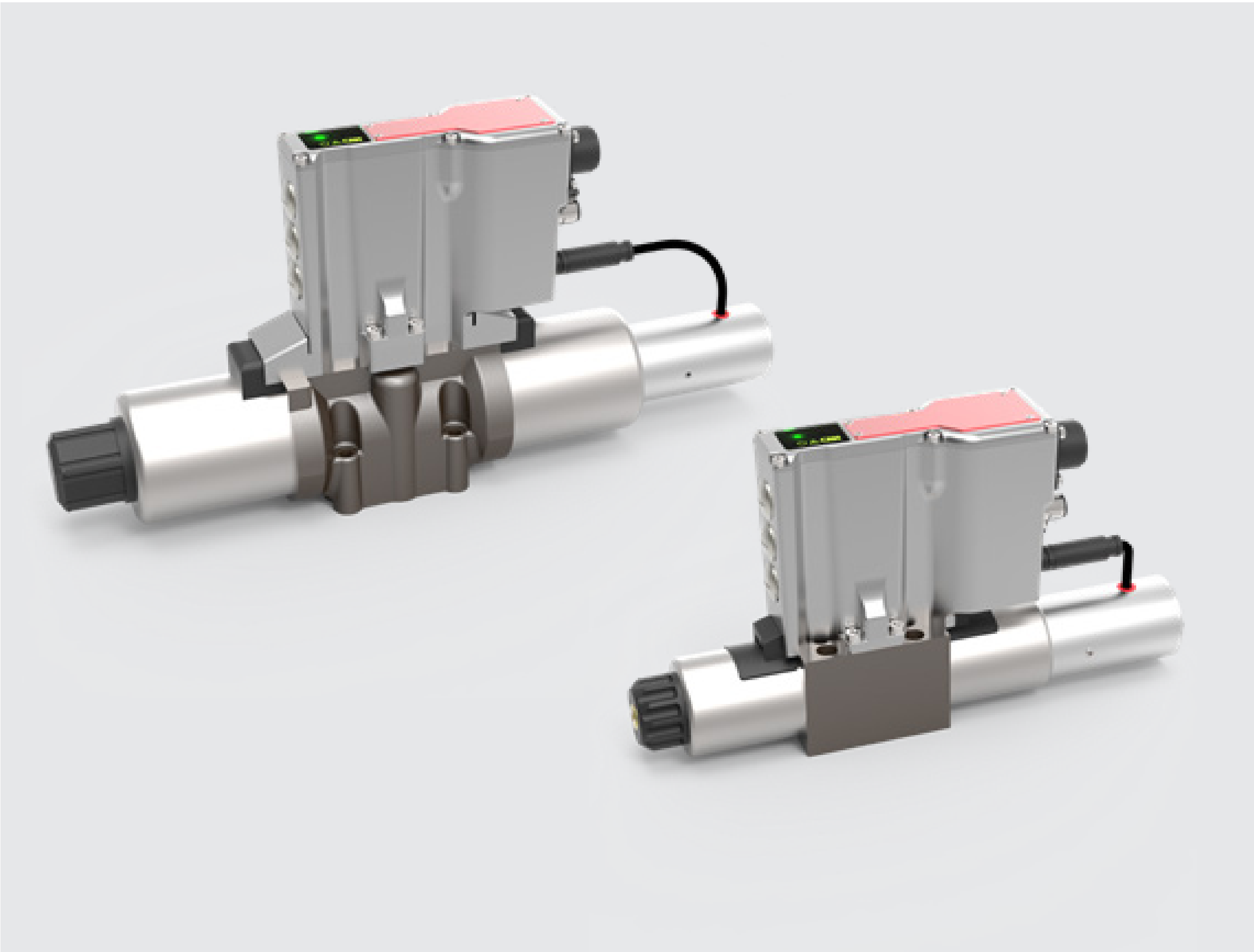
Manual

Proportional Valve PRM9



Safety and operating instructions

Read safety and operating instructions before use.

Note:
Illustrations do not always correspond exactly to the original.
Erroneous information does not constitute a legal claim. Design changes reserved.

If you have any questions, please contact:
ARGO-HYTOS s.r.o.
Dělnická 1306
54315 Vrchlabí

www.argo-hytos.com
info.cz@argo-hytos.com

User Manual

Content

1.1. Introduction

The proportional directional control valve PRM9 consists of a cast iron housing, a special control spool, two centering springs with supporting washers, one or two proportional solenoids, a position sensor and an on-board electronics with housing. The measurement system of the position sensor is based on a "linear variable differential transformer". The proportional directional control valve PRM9 is manufactured in 2 basic nominal sizes – Size 06 and Size 10

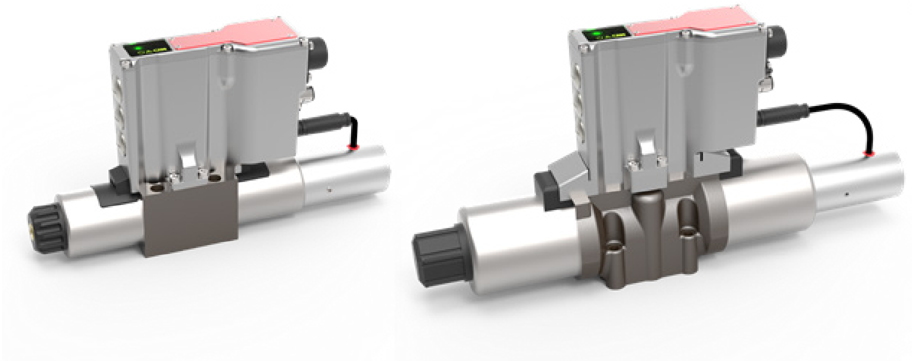


Figure 1-1: PRM9-06 and PRM9-10

The electronics are arranged centrally above the hydraulic housing and the coils are directly connected to the housing so that no external cabling of the coils is produced. The sensor for detecting the piston position is mounted at the end of a coil and is connected to the electronics via a cable. The MIL-C5015 (6 + PE) connection is used for the main connection of the digital electronics and connects the supply, command signal and monitor signal of the internal piston position. Further connection possibilities are directly related to the selected valve variant. These are, in detail, M12x1, 5-pin, for the bus connection in the standard version CANopen and also M12x1, 5-pin, for connecting an external sensor (of an external process variable).
The coil current is controlled by a PWM signal and can be modulated via a dither signal. Additional function parameters, such as ramp, offset, dead band, max. current etc., are adjustable by means of the parameterization software, The computer is connected to the valve via USB (USB-A (computer) <=> µ-USB (valve)The factory configuration of the valve depends on the design.
The factory configurations as well as the parameterization software and the necessary fieldbus data can be obtained via a download portal on the ARGO-HYTOS website.

1.2. Use of the directional control valves

The proportional directional control valves with integrated digital electronics are available in the following configurations (for further information see data sheet):
› E02S02 – proportional directional control valve with internal feedback
› E04S02 – proportional directional control valve with internal feedback and process feedback
In configuration E02S02, the proportional directional control valves can be used to control the flow direction and the volume flow (position or speed control). In configuration E04S02, the proportional directional control valves can be used directly for controlling external process variables, e.g. the position or speed (influencing variable: volume flow), or force or torque (influencing variable: pressure) of a suitable output.

1.3. Limited warranty

The operation of a proportional directional control valve in any installation must be in accordance with the instructions and recommendations of the manufacturer ARGO-HYTOS s.r.o. as well as the general safety regulations and further legal regulations of the respective country. The manufacturer is not liable for any property damage or injury to persons caused by the operation of hydraulic systems, which are equipped with a proportional directional control valve of the company ARGO-HYTOS. Failure to comply with the regulations, incorrect handling or misinterpretation will result in the user being held responsible and liable.

1.4. Used Symbols

This symbol warns that there is a danger for persons, machines, material or living environment.

This symbol calls attention to advice and information.

1.5. Caution

The directional control valve can be installed and put into operation only by a trained and authorized person

Some parts of the directional control valve may become hot during operation.

Some parts of the directional control valve may become hot during operation.
When using the directional control valves in applications with high safety requirements, it is necessary for a possible case of trouble to take measures for the immediate switching off of the supply or of the signal for the desired directional control valve value. When switched off, the valve moves into its natural spring-centered starting position. The resultant channel connection in the starting position depends on the valve piston, so it is necessary to check whether the selected piston is suitable for the application.

After switching on the electrical supply, the command signal is activated after a short dwell time (1-2 s). Care must be taken that the spontaneous application of a command signal does not cause any undesired function of the directional control valve.

1.6. Service, Maintenance, Repairs

If there is a defect in the valve, please contact ARGO-HYTOS. The opening of the valve by third parties is prohibited and leads to the expiry of complaints. In the event of a complaint, please state the type code, the SAP number and the serial number of the valve; thereby assuring an accelerated processing of the case. The repair or maintenance of the valves can only be carried out by trained personnel.

1.7. Basic Setting

The proportional directional control valves with digital OBE are – depending on the version – preconfigured or fully configured by the manufacturer, and are therefore suitable for immediate use. In configuration E02S02, the directional control valve is fully functional and essentially no intervention in the electronic parameters is necessary. In configuration E04S02, the user must make the necessary parameter settings, which describe the external sensor / the external process feedback and, in addition, adjust the control parameters to the system to be used in order to ensure a perfect functioning of the valve in use.

2. Technical Description

2.1. Basic Parts

Figure 2-1 shows the proportional directional control valve PRM9 and its basic parts.
The directional control valve consists of:

- the body with the inserted spool (1)
- proportional solenoids (2)
- the spool position sensor (3)
- the control digital electronics (4)

Basic parts are the same for all configurations offered by the producer but their application differs according to the respective configuration.

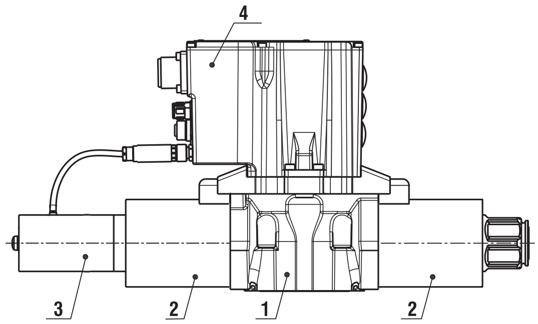


Figure 2-1: Proportional directional control valve PRM9

2.2. Technical Parameters

Basic directional control valve parameters			
Nominal size	Size	06	10
Connection dimensions		DIN 24 340 and ISO 4401)	
Maximum working pressure in ports P, A, B	bar (PSI)	350 (5100)	
Maximum working pressure in port T	bar (PSI)	160 (2320)	220 (3190)
Pressure liquid		Mineral oil (HM, HV) according to DIN 51524	
Fluid working temperature range (NBR/Viton)	°C (°F)	-30... +80 / -20 ... +80 (-22 ... +176 / -4 .... +176)	
Working viscosity range	mm²/s (SUS)	20 ... 400 (98 ... 1840)	
Specified fluid cleanliness level		Class 21/15 according to ISO 4406: 1987, recommended filter's filtering capability β10 ≥ 75.	
Nominal flow rate at Δp = 10 bar (145 PSI)	l/min	5, 8, 15, 30	30, 60
	(GPM)	(1.32 , 2.11, 3.96, 7.93)	(7.93, 15.85)
Basic electronics parameters			
Power supply voltage with protection against reversing of polarity	V DC	19.2…28 (residual ripple < 10%)	
Input: command signal		+/-10 V, 0...10 V, +/-10 mA, 4...20 mA, 0...20 mA, 12 +/- 8 mA, 0…Uref; Uref/2± Uref	
Output: spool position	V	0…5	
Input: external feedback		0...10 V, 4...20 mA, 0...20 mA	
Resolution of A/D transducers	bit	12	
PWM frequency	kHz	18	
Output: solenoid coils		Two final stages with pulse width modulation max. 4 A	
Cycle period of the controllers	μs	200	
Setting of parameters		Using PC (USB-A) and parametrization software PRM9	
CAN serial interface		CANopen M12x1.5-pin	
General information			
Ambient temperature	°C (°F)	-40 … +50 (-40 …. +122)	
IP protection class		IP65 & IP67	
Shock & vibration		Sinus 10 g, max. ampl. 0.75 mm, 10-2000 Hz Shock 30 g, half sinus 11ms	
Disturbance resistance	DIN EN 61000-4-2 Testing the immunity to static discharge DIN EN 61000-4-3 Testing the immunity to high-frequency electromagnetic fields DIN EN 61000-4-4 Testing of immunity against fast transient electrical disturbances DIN EN 61000-4-5 Testing the immunity against impact voltages DIN EN 61000-4-6 Interference immunity against conducted disturbances induced by high-frequency fields DIN EN 61000-4-8 Testing the immunity to magnetic fields with energy-related frequencies		

3. Design of Valves

3.1. Configuration E02S02 (Direct acting proportional directional control valve with internal spool position feedback)

The proportional directional control valve in configuration E02S02 (internal position feedback), see Figure 3-1, can be used to control the oil flow direction and quantity (position or speed control) as a function of the piston variant used. Due to the internal position feedback, the valve has a better dynamic response and has a low hysteresis and a higher sensitivity than a comparable valve without internal feedback.

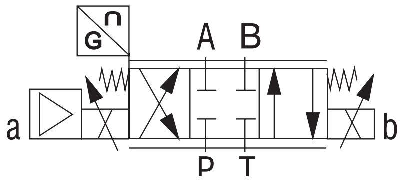


Figure 3-1: Proportional directional control valve with two coils in the configuration E02S02

3.2. Configuration E04S02 (Proportional directional control valve with internal spool position feedback and process feedback)

The proportional directional control valve in configuration E04S02 (internal spool position feedback and process feedback), see Figure 3-2, can be used directly for controlling external process variables, e.g. the location / position, volume flow / speed and pressure / force, or torque of a suitable output.
In addition to controlling the process variable using a cascade control, the internal position of the spool is also fed back. In addition to hysteresis and sensitivity, the dynamics can also be influenced. This must be matched with the application to be operated.

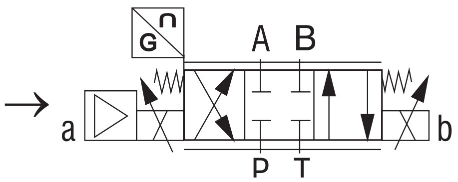


Figure 3-2: Proportional directional control valve with two coils in the configuration E04S02

4. Valve Assembly

Valves are designed for installation according to ISO 4401. Make the assembly according to the producer's instructions written in the documentation that is a part of each valve package.

5. Electrical Connection

The digital electronics are surrounded by an aluminum housing, which has positive properties with respect to the heat conduction. The coils are connected to the digital electronics by means of a break-proof plug-in connection in the electronics housing.
Supply as well as command and monitor signals are connected by means of a standard MIL plug, the other CANopen connections, as well as process feedback by means of an M12x1 socket. The connection to the parameterization software is made via a µ-USB - USB cable. If the valve is a fieldbuscapable
valve (standard: CANopen), both the baud rate and the address can be set by means of encoders, which are located behind the screw caps.
Furthermore, the electronics includes an optical feedback (LED) which, in particular, describes the operating state. The details can be found in Figure 5-1.

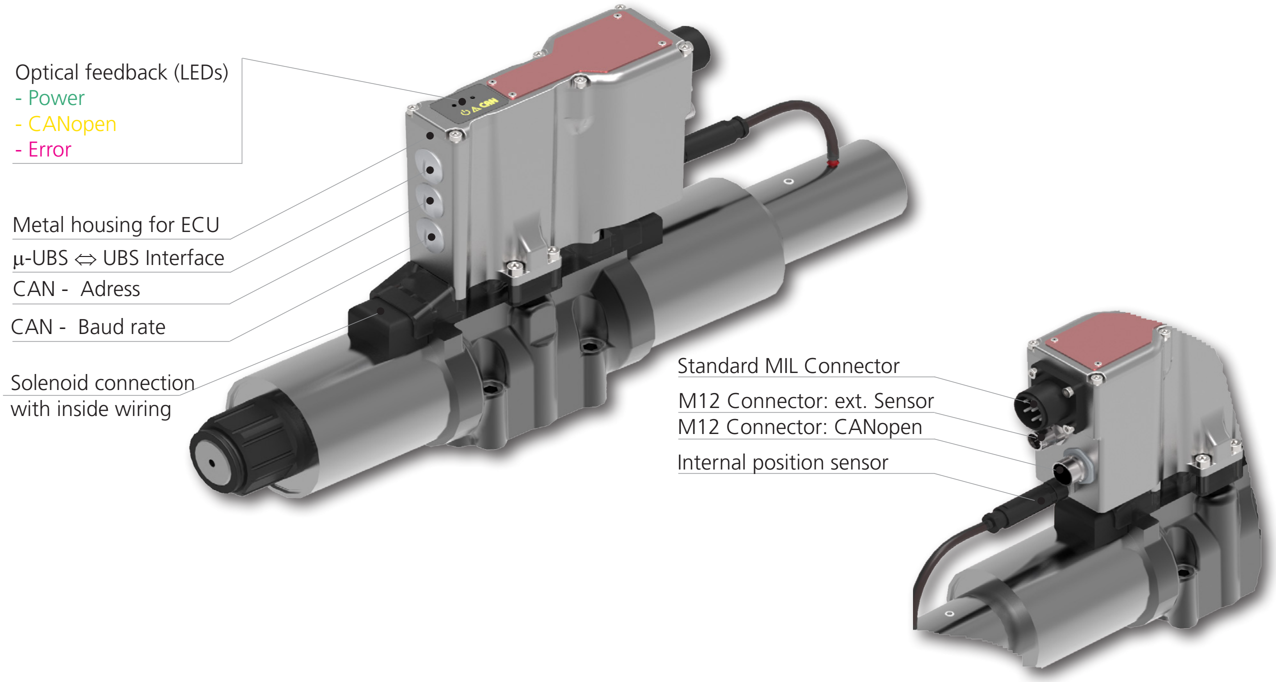
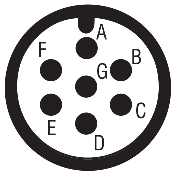


Figure 5-1: Electrical / Electronic connections of PRM9

5.1. Connection of Power Supply and Command Signal to the Valve Electronics

The supply voltage and the command signal are connected to the valve electronics via a 6 + PE MIL plug (EN 175201-804), which is shown in Figure 5-2. The MIL connector is not included in the scope of delivery of the proportional control valve. The pin assignment can be seen in Figure 5-3 (view on the electronics).

Figure 5-2: Connector



PIN	Technical data
A	Supply 24V
B	GND (Supply)
C	GND (Monitor)
D	INPUT
E	GND (Input)
F	Monitor
G	PE

Figure 5-3: PIN assignment (electronics)

Do not connect under voltage

The command signal input resistance:
Voltage signals ≅ 114 kΩ (±10 V, 0 ... 10 V, 0…Uref; Uref/2± Uref)
Current signals ≅ 133.5 Ω (±10 mA, 4...20 mA, 0...20 mA, 12 ±8 mA)

5.2. Connection of the valve electronics to and PC

The PC can be connected to the valve electronics via a standard Micro USB 2 <-> USB-A cable. A special driver is not necessary for operation, common operating systems[1] have already set up a suitable driver. The valve supports USB Class 03 h, Human Interface Device (HID). In order to ensure the correct functioning of the valve, the main power supply of the valve should first be switched on and then the USB cable must be connected. This connection allows parameterization of the valve with the help of the corresponding parameterization software available via the ARGO-HYTOS download portal. The cable is not included in the scope of delivery and must be ordered separately.

[1] Tested with Windows 7, Windows 10

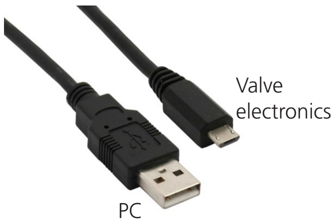
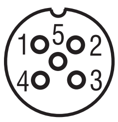


Figure 5-4: µ-USB <-> USB-A; Connection between valve electronics and PC

5.3. Connection of the External Feedback

The connection of the process feedback (only included in the configuration E04S02) is based on a 5-pole socket, A-coded, M12x1. The corresponding plug is shown as an example in Figure 5-5. In addition to the signal connection of the external sensor, the interface also provides the supply voltage. The plug with cable is not included in the scope of delivery and must therefore be ordered separately. The corresponding PIN assignment is shown in Figure 5-6.

Figure 5-5: Connector process feedback



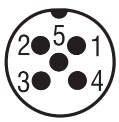
PIN	Technical data
1	Supply 24V
2	Signal
3	GND
4	n.c.
5	n.c.

Figure 5-6: assignment connector process feedback (electronics)

5.4. CANopen Connection

The fieldbus connection (only in configuration E02S02-CA and E04S02-CA) is done via a 5-pin connector, A coded, M12x1. The corresponding socket is shown by way of example in Figure 5-7. The socket with cable is not included in the scope of delivery and must therefore be ordered separately. The assignment of the socket is shown in Figure 5-8.
(The basic configuration baud rate and address can be preset at the hardware via the switches).

Figure 5-7: Connector CANopen



PIN	Technical data
1	n.c.
2	n.c.
3	CAN GND
4	CAN HIGH
5	CAN LOW

Figure 5-8: PIN-assignment connector CANopen (electronics)

5.5 Optical feedback via LED

In addition to the analog and digital interfaces, the PRM9 electronics also has an optical feedback signal, which codes the current operating state of the electronics or of the valve. Depending on the valve design, 2 or 3 LEDs are available.

1. LED1 Power
2. LED2 Error
3. LED3 CANopen

Figure 5-9: Optical feedback via LEDs

In Table 5-1 the possible displays of the LEDs and thus the states of the valve are described. Three message types / states of the message are distinguished:

- Fault: In the event of a fault, the valve moves into the natural spring-centered position until the fault is repaired. If the error is corrected during operation, the error message switches to the normal mode after approx. 10s.
- Warning and status: In the warning or status states, the function of the valve is continued, ie not interrupted, but an optical feedback signal is output

General LED displays

LED1 Colour RGB; Power	LED2 Colour RED; ERROR	LED3 Colour Orange; CAN/BUS (only if implemented)	Description	Message Type	Error Code CANopen (hex)
white	on	on	firmware is booting	status	-
green	off	off	no errors, normal operation, no bus active	status	-
green	off	according to normal operation	no errors, CANopen OPERATIONAL	status	0000
orange (gr+red)	off	according to normal operation	temperature >70°C	warning	0000
orange (gr+red) 2 Hz	on	according to normal operation	temperature >100°C	error	4211
blue	2 Hz	according to normal operation	solenoid A high current	error	5411
magenta (bl+red)	2 Hz	according to normal operation	solenoid B high current	error	5412
blue	1 Hz	according to normal operation	solenoid A open	error	5411
magenta (bl+red)	1 Hz	according to normal operation	solenoid B open	error	5412
2 Hz red	1 Hz	according to normal operation	analog input (AI) command signal error	error	3420
1 Hz red	1 Hz	according to normal operation	AI ext. sensor error	error	5230
1 Hz red	1 Hz	according to normal operation	AI int. pos. sensor error	error	7300
2 Hz red	on	according to normal operation	supply voltage error out of range	error	3410
red	on	according to normal operation	general error	error	1000

Table 5-1

LEDs in case of multiple errors

LED1 Color RGB; Power	LED2 Colour RED; ERROR	LED3 LED3 (Orange; CAN/BUS) (only if implemented)	Message Type
2Hz red	2Hz	according to normal operation	error
2Hz red	Off	according to normal operation	warning

Table 5-2

In addition to the optical feedback, the error messages can also be read out via the available parameterization software.

5.6. Commissioning

When the supply voltage is applied, the "Power" LED lights up white for approx. 2s. The valve electronics is booting. The LED then changes to green and thus to the normal operating mode. If this is not the case, a combination of the LEDs listed in 5.5 appears and signals the fault condition

⚠ When commissioning the proportional directional control valve, the necessary safety instructions must be strictly adhered to.
In order to avoid uncontrolled behavior of the system, all power and hydraulic circuits must be checked before connecting the supply voltage. All measures must be taken to enable the system to be shut down in an emergency

6. Integrated Digital Electronics

6.1. Electronics Block Diagram

The block diagram shows the basic structure of the digital onboard electronics. In addition, the interfaces to the outside and their nature can be taken from the representation. More details about the electrical connections can be found in Chapter 5 "Electrical connection".

Nr.	Technical data	Description		
1	Command signal	0...20 mA 4...20 mA ±10 mA 0...10 V ±10 V Ratiometric ±5 V	unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar	Resolution 12 bit
2	Internal spool position	4...20 mA		Resolution 12 bit
3	External feedback signal	0...20 mA 4...20 mA ±10 mA 0...10 V ±10 V Ratiometric ±5 V	unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar unipolar / bipolar	Resolution 12 bit
4	A/D transducer			
5	Overcurrent protection			
6	Final stage PWM		max. 4 A (f=18 kHz)	
7	Copy of spool position sensor signal		0 ... 5 V	
8	USB			

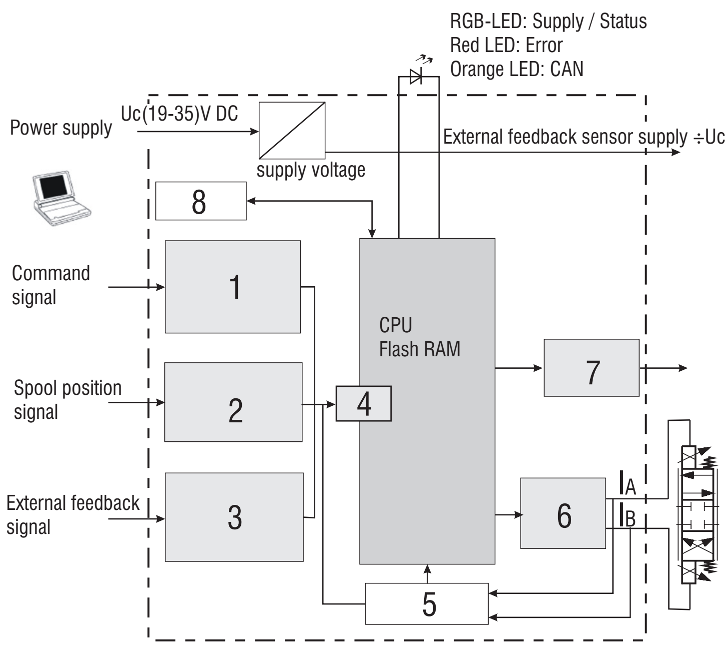


Figure 6-1: Block diagram of the digital onboard electronics

7. CANopen protocol

7.1. CAN communication

The CAN interface corresponds to the "CAN 2.0B Active Specification". The data packets correspond to the format shown in Table 7-1. The figure is only intended for visual purposes, the basic implementation corresponds to the CAN 2.0B specification. The valve supports a selection of transmission speeds on the CAN bus (see Table 7-1.).

By CiA recommended and by the valve supported data rates			
Data rate	Supported	CiA Draft 301	Bus length (according to CiA draft standard 301)
1 Mbit/s	yes	yes	25 m
800 kbit/s	yes	yes	50 m
500 kbit/s	yes	yes	100 m
250 kbit/s	yes	yes	250 m
125 kbit/s	yes	yes	500 m
50 kbit/s	yes	yes	1000 m
20 kbit/s	yes	yes	2500 m
10 kbit/s	no	yes	5000 m

Table 7-1: Supported bus speeds with CANopen communication and associated cable lengths

The electrical parameters of the CAN interface are listed in Table 7-2

Parameter	Size	Unit
Typ. response time for SDO requests	<10	ms
Max. Response time for SDO requests	150	ms
Supply voltage CAN transceiver	3,3	V
Scheduling integrated	Switchable	-

Table 7-2: Electrical parameters CAN interface

Electrical parameters CAN interface

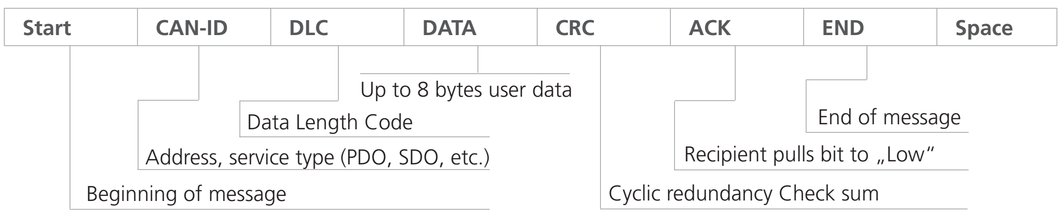


Figure 7-1: CAN message format

7.2. CANopen

CANopen defines the What, not the How something is described. The implemented methods are used to realize a distributed control network, which can connect participants from very simple to very complex controls without creating communication problems between the participants..

Properties of the CANopen protocol on the PRM9 valve:

- CANopen standard DS301
- Up to two receive PDOs
- Up to two transmit PDOs
- An SDO
- Heart Beat
- Emergency Object
- NODE ID can be set via SDO
- Baud-Rate can be set via SDO

The central concept of CANopen is the so-called Device Object Dictionary (OD), which is also used in other fieldbus systems.

7.2.1. „CANopen Object Dictionary" in general

The CANopen Object Dictionary (OD) is an object directory in which each object can be addressed with a 16-bit index. Each object can consist of several data elements, which can be addressed via an 8-bit subindex

The basic layout of the CANopen object directory is shown in Table 7-3

CANopen Object Dictionary	
Index (hex)	Object
0000	-
0001 - 009F	Different data types (Boolean, Integer)
00A0 - OFFF	Reserved
1000 - 1FFF	Communication profile area (e.g. device type, error register, supported PDOs,..)
2000 - 5FFF	Communication profile area (manufacturer-specific)
6000 - 9FFF	Device profile-specific device profile area (e.g. "DSP-408 device profile fluid power technology proportional valves and hydrostatic transmissions")
A000 - FFFF	Reserved

Table 7-3: General CANopen Object Dictionary Structure

7.2.2. CANopen Communication Objects

Communication objects transmitted in CANopen are described by services and protocols and are classified as follows:

- The Network Management (NMT) provides services for bus initialization, error handling, and node control
- Process Data Objects (PDOs) are used to transfer process data in real time
- Service Data Objects (SDOs) allow read and write access to the object directory of a node
- The Special Function Object Protocol allows node guarding, synchronization and emergency messages

The initialization of the network with a CANopen master and a valve is described below as an example.
Figure 7-2 shows the status diagram of the CANopen protocol on the PRM9. All transitions (1-14) in the diagram are triggered by external events.

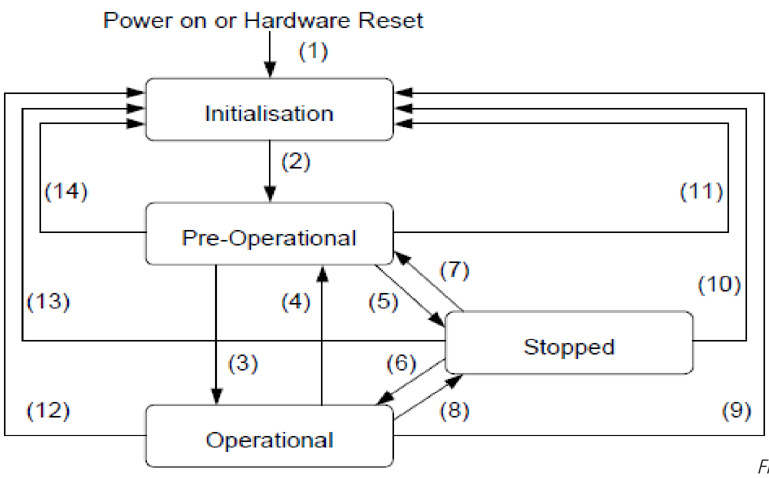


Figure 7-2: Status diagram of the CANopen protocol in the PRM9

After the current has been applied, the valve sends a boot up message within approx. 5 seconds. In the pre-operational state, only the heartbeat messages are sent by the valve, if configured accordingly (point A in Figure 7-3).

The valve can then be configured via SDOs; in most cases, this is not necessary since the communication parameters set once are automatically saved by the valve (see point B in Figure 7-3).
In order to put the valve into the operational state, a corresponding message can be sent either to all CANopen nodes or specifically to the valve.
In the operational state, the valve sends the supported PDOs according to its configuration either in periodic time intervals or synchronized messages (see point C in Figure 7-3)

A

Initialization, wait for boot-up / heart-beat from the valve →

B

Pre-operational, configuration of the valve, via SDO →

C

NMT to all nodes / to valves to go into operational mode

Figure 7-3: CANopen Bus initialization process

Depending on the state of the valve, various services of the CANopen protocol are available (see Table 7-4).

Availability of the services depending on the state				
Service / Communication object	Initializing	Pre-operational	Operational	Stopped
PDO			X	
SDO		X	X	
Synch		X	X	
BootUp	X			
NMT		X	X	X

Table 7-4: Available CANopen services in different states of the interface

7.2.3. Network Management (NMT)

The NMT serves to control the communication interface of the valve. For this purpose, a corresponding telegram (see Table 7-5) is sent to the network by the master of the CANopen network. The byte 1 (address) is assigned with Node ID of the target device or 0x00, depending on whether the message is addressed to a specific device or all devices.

COB-ID	Byte 0	Byte 1
0x000	Statement	Address

Table 7-5: Structure of the NMT telegram

Transitions in Figure 7-2	Instruction	Meaning according to Figure 7-2
(3), (6)	0x01	Change to operational
(5), (8)	0x02	Change to stopped
(2), (4), (7)	0x80	Change to pre-operational
(1)	0x81	Reset of the valve electronics
(9), (10), (11), (12), (13), (14)	0x82	Reset of the communication interface

Table 7-6: NMT instructions

7.2.4. Service Data Object (SDO)

Service Data Objects are used for write and read access to the object list of the valve. The SDOs are acknowledged in each case and the transfer takes place only between two participants, a so-called client / server model (see Figure 7-4).
The valve can only function as a server, thus only responds to SDO messages and does not send requests to other subscribers by itself. The SDO messages from the valve to the client have the NodeID + 0x580 as COB-ID (Communication Object Identifier). For requests from the client to the valve (server), the NodeID + 0x600 is expected as the COB ID for the SDO message.

The standard protocol for SDO transfer requires 4 bytes to encode the transmitter direction, the data type, the index and the subindex. Thus, 4 bytes remain from the 8 bytes of a CAN data field for the data content.

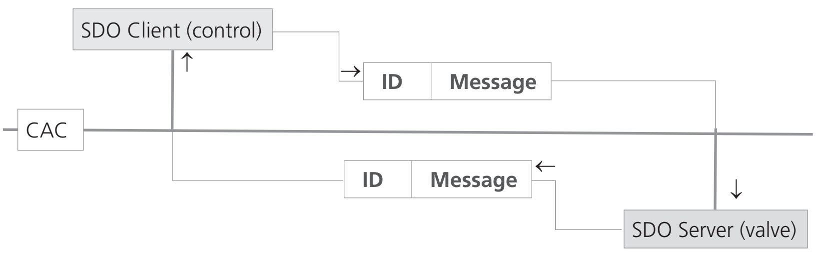


Figure 7-4: SDO client / server relationship

SDOs are designed to configure the valve via access to the object directory, to query infrequently required data or configuration values, or to download larger amounts of data. The SDO properties at a glance:

- All data in the object directory can be accessed
- Confirmed transmission
- Client / server relationship during communication

The control and user data of a non-segmented SDO standard message are distributed over the CAN message, as shown in Table 7-7. The user data of an SDO message is up to 4 bytes. Using the control data of an SDO message (Cmd, index, subindex), the access direction to the object directory and possibly the transferred data type are determined. For the exact specifications of the SDO protocol, the "CiA Draft Standard 301" should be consulted.

CAN	CAN-ID	DLC	User data CAN message							
			0	1	2	3	4	5	6	7
CANopen SDO	COB-ID 11 Bit	DLC	Cmd	Index		Subindex	User data CANopen SDO message			

Table 7-7: Structure of an SDO message

An example of a SDO query of the serial number of the valve from the object directory at index 0x1018, subindex 4, with data length 32 bits is shown in the following. The client (control) sends a read request to the valve with the ID "NodeID" (see Table 7-8).

CAN	CAN-ID	DLC	User data CAN message							
			0	1	2	3	4	5	6	7
CANopen	COB-ID 11 Bit	DLC	Cmd	Index		Subindex	User data SDO			
				1	0	0	3	2	1	0
Message from client to valve	0x600+ NodeID	0x08	0x40	0x18	0x10	0x04	dont care	dont care	dont care	dont care

Table 7-8: SDO upload request by the client to the server

The valve responds with a corresponding SDO message (see Table 7-9), in which the data type, index, subindex and the serial number of the valve are encoded, here, for example, the serial number 200123 (0x30DBB).

CAN	CAN-ID	DLC	User data CAN message							
			0	1	2	3	4	5	6	7
CANopen	COB-ID 11 Bit	DLC	Cmd	Index		Subindex	User data SDO			
				1	0	0	3	2	1	0
Message from valve to client	0x580+NodeID	0x08	0x43	0x18	0x10	0x04	0xBB	0x0D	0x30	0x00

Table 7-9: SDO upload response by the server to the client

An example for the download of data (heartbeat time) via SDO in the object list of the valve at index 0x1017 with data length 16 bits is shown below. The client (control) sends a write request to the valve with the ID "NodeID" (see table 7-10) to set the heartbeat time to 1000 ms (0x03E8).

CAN	CAN-ID	DLC	User data CAN message							
			0	1	2	3	4	5	6	7
CANopen	COB-ID 11 Bit	DLC	Cmd	Index		Subindex	User data SDO			
				1	0	0	3	2	1	0
Message from client to valve	0x600+NodeID	0x08	0x2B	0x17	0x10	0x00	0xE8	0x03	0	0

Table 7-10: SDO download request by the client to the server

The valve responds with a corresponding SDO message (see Table 7-11), which confirms that the access was successful and that the index and subindex to which the access was made are encoded

CAN	CAN-ID	DLC	User data CAN message							
			0	1	2	3	4	5	6	7
CANopen	COB-ID 11 Bit	DLC	Cmd	Index		Subindex	User data SDO			
				1	0	0	3	2	1	0
Message from valve to client	0x580+NodeID	0x08	0x60	0x17	0x10	0x00	0x00	0x00	0x00	0x00

Table 7-11: SDO download response by the server to the client

7.2.5. Process Data Object (PDO)

PDOs are one or more data records that are mirrored from the object directory into the up to 8 bytes of a CAN message in order to transfer data quickly and with as little time as possible from a "producer" to one or more "consumers" (see Figure 7-5). Each PDO has a unique COB-ID (Communication Object Identifier), is only sent by a single node, but can be received by several nodes and does not need to be acknowledged / confirmed.

PDOs are ideally suited to transfer data from sensors to the controller or from the controller data to actuators. PDO attributes of the valve at a glance:

- Valve supports up to two transmit PDOs (TPDOs), up to two receive PDOs (RPDOs)
- The mapping of the data in PDOs is fixed and cannot be changed
- COB-IDs for all PDOs can be selected freely.
- All PDOs can be transferred event / timer-triggered or cyclically triggered to SYNCH.

The valve supports two different PDO transmission methods.

1. In the event or timer-triggered method, the transmission is triggered by an internal timer or event
2. In the case of the SYNCH-triggered method, the transmission takes place in response to a SYNCH message (CAN message by a SYNCH producer without user data). The response with PDO occurs either with every received SYNCH or adjustable after all n-received SYNCH messages.

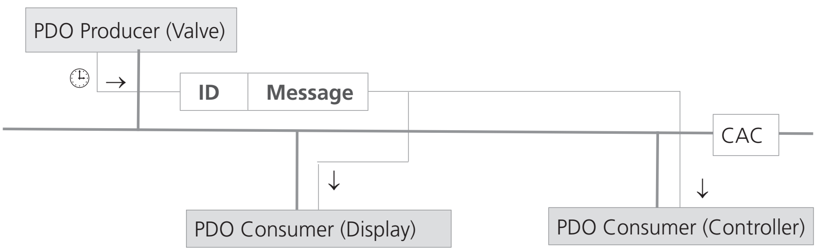


Figure 7-5: PDO Consumer / producer relationship

7.2.6. PDO Mapping

The valve supports up to two transmit PDOs (TPDOs) to enable the most efficient operation of the CAN bus. The valve does not support dynamic mapping of PDOs, the mapping parameters in the OD are read-only, but not writeable.
Figure 7-7 shows the principle of mappings of objects from the OD into a TPDO, it corresponds to the CiA DS-301, Chapter 8.5.4. The objects which are mapped in TPDO 1 to 2 can be determined in the OD at index 0x1A00 to 0x1A01. The mapping of the RPDOs is readable at index 0x1600 and 0x1601.
The structure of the PDO mappings is shown in Figure 7-6. In addition, each PDO has a description of the communication parameters, ie transmission type, COB-ID and, if applicable, event timers. The communication parameters for TPDO 1 to 2 are documented in OD at index 0x1800 to 0x1801. For RPDOs, the communication parameters can be read out at index 0x1400 to 0x1401.

Byte: MSB

Index (16 Bit)	Subindex (8 Bit)	Object length in bit (8 Bit) LSB

Figure 7-6: Basic structure of a PDO mapping entry

Depending on the control mode of the valve, the contents of the PDO mappings can change.

Complete OD, with mappable objects			
Index	Sub	Type	Object
....	....	....	....
6040 h	00	U16	Device Control Word
....	....	....	....
6041 h	00	U16	Device Status Word
....	....	....	....
6301 h	01	S16	Position Actual Value
....	....	....	....
6381 h	01	S16	Pressure Actual Value
....	....	....	....

TPDO1 mapping parameters in the OD, at index 0x1A00		
Sub	Type	Value
00	U8	02
04	U32	0x60410010
03	U32	0x63010110

TPDO1 communication parameter in the OD, at index 0x1800		
Sub	Type	Value
00	U8	Highest SubIndex
01	U32	COB-ID
02	U8	Transmission Type
03	-	n.a.
04	-	n.a.
05	U16	Event Timer

TPDO1	Status		Position					
Byte in CAN-Msg.	0	1	2	3	4	5	6	7

Figure 7-7: Principle of the mapping of multiple OD objects into a TPDO

The valve supports certain types of the TPDO (see Table 7-12), which can be entered for the respective communication parameters of the TPDOs (see Figure 7-7).

Valve-supported TPDO types					
Type	Supported	Cyclical	Not cyclical	Synchron	Asynchron
0	yes		X	X	
1-240	yes	X		X	
241-253	no				
254	yes				X
255	yes				X

Table 7-12: Description of the TPDO types

7.2.7. "CANopen Object Dictionary" in detail

Table 7-13 shows the communication-related part of the object directory. The here possible settings correspond to the CANopen standard as described in DS 301.
The appropriate EDS file for the valve is available on the homepage of www.ARGO-HYTOS.com.

Communication Profile Area						
Idx (hex)	Sub	Name	Type	Attr.	Default	Notes
1000	0	Device type	U32	ro	198h	
1001	0	Error register	U8	ro	00h	
1003		Predefined error field				
	0	Number of entries	U8	rw	0..xh	largest sub index
	x	Standard error field entry	U32	ro		
1005	0	COB_ID SYNC Message	U32	rw	0x80	=< 7FFh
1006	0	Communication cycle period	U32	rw		
1008	0	Manufacturer device name	String	ro	„PRM9“	
1009	0	Manufacturer HW version	String	ro	„1.00“	

100A	0	Manufacturer Software Version	string	ro	Depends on current firmware	e.g.: "1.01"
1017	0	Producer heartbeat time	U16	rw	3E8h	heartbeat time in ms
1018		Identity	record	ro		
	0	Number of entries	U8	ro	04h	largest sub index
	1	Vendor ID	U32	ro	000000E6h	Argo Hytos GmbH
	2	Product Code	U32	ro		Device dependent
	3	Revision Number	U32	ro		Device dependent
	4	Serial Number	U32	ro		
1F80	0	NMT Startup	U32	rw	2	2 = no auto operational 0 = auto operational
1400		Receive PDO1 Parameter	record			
	0	Number of entries	U8	ro	02h	largest sub index
	1	COB-ID	U32	rw	2^{30}+200h+NodeID	COB-ID used by PDO
	2	Transmission type	U8	ro	FFh	
1401		Receive PDO2 Parameter	record			
	0	Number of entries	U8	ro	02h	largest sub index
	1	COB-ID	U32	rw	2^{30}+300h+NodeID	COB-ID used by PDO
	2	Transmission type	U8	ro	FFh	
1600		RPDO1 Mapping parameter	record			
	0	Number of entries	U8	ro	02h	largest sub index
	1	Parameter 1	U32	ro	60400010h	Device Control Word
	2	Parameter 2	U32	ro	63000110h	In Control Mode 2
					63800110h	In Control Mode 4
1601		Receive PDO2 Parameter	record			
	0	Number of entries	U8	ro	01h	largest sub index
	1	Parameter 1	U32	ro	0x21000210	
1800		Transmit PDO1 Parameter	record			
	0	Number of entries	U8	ro	05h	largest sub index
	1	COB-ID	U32	rw	180h+NodeID	COB-ID used by PDO, range: 181h..1FFh, can be changed while not operational
	2	Transmission type	U8	rw	FFh	cyclic+synchronous, asynchronous values: 1-240, 254, 255
	5	Event Timer	U16	rw	1388h	event timer in ms for asynchronous TPDO1
1801		Transmit PDO2 Parameter	record			
	0	Number of entries	U8	ro	05h	largest sub index
	1	COB-ID	U32	rw	280h	
1A00		TPDO1 Mapping Parameter	record			
	0	Number of entries	U8	ro	02h	largest sub index
	1	1st app obj. to be mapped	U32	co	60410010h	Device Status Word
	2	2nd app obj. to be mapped	U32	co	63010110h	In Control Mode 2
					63810110h	In Control Mode 4
1A01		TPDO2 Mapping Parameter	record			
	0	Number of entries	U8	ro	02h	largest sub index
	1	1st app obj. to be mapped	U32	co	21000110h	External Sensor
	2	2nd app obj. to be mapped	U32	co	21000510h	External Sensor after linearization

Table 7-13: "Communication Profile Area", communication-related object list

All valve-specific objects are placed in the object directory starting at index 2000h and shown in table 7-14. This part of the object list maps valve-specific data and parameters. Furthermore, some configuration options are supported, which are not covered by the DS-408.

Idx (hex)	Sub	Name	Type	Attr.	Default	Notes
2000		Demand value generator characteristic compensation	array			
	0	Number of entries	U8	ro	09h	largest sub index
	1	Value XA	S16	rw	-16384..16384	
	…	Value XB..XH	S16	rw	-16384..16384	
	9	Value XI	S16	rw	-16384..16384	
2001		Demand value generator characteristic compensation	array			
	0	Number of entries	U8	ro	09h	largest sub index
	1	Value YA	S16	rw	-16384..16384	
	…	Value YB..YH	S16	rw	-16384..16384	
	9	Value YI	S16	rw	-16384..16384	
2002		Temperature Electronics	S8	ro		In °C

2003		Supply voltage	U16	ro		In mV
2004		Current limitation parameters	record			
	0	Number of entries	U8	ro	03h	largest sub index
	1	CURNORM	U16	ro	0..4000	In mA
	2	LIMIT A	U16	rw	0..CURNORM	In mA
	3	LIMIT B	U16	rw	0..CURNORM	In mA
2005		External sensor	record			
	0	Number of entries	U8	ro	04h	largest sub index
	1	Sensor signal input type	U16	rw	0..14	Refer to table 7-15
	2	Sensor signal inversion to	U8	rw	0	0 = off, 1 = on
	3	Offset for the sensor signal	S16	rw	-16384..16384	
	4	Gain for the sensor signal	U16	rw	16383..65535	
2006		External sensor characteristic compensation	array			
	0	Number of entries	U8	ro	09h	largest sub index
	1	Value XA	S16	rw	-16384..16384	
	…	Value XB..XH	S16	rw	-16384..16384	
	9	Value XI	S16	rw	-16384..16384	
2007		External sensor characteristic compensation	array			
	0	Number of entries	U8	ro	09h	largest sub index
	1	Value YA	S16	rw	-16384..16384	
	…	Value YB..YH	S16	rw	-16384..16384	
	9	Value YI	S16	rw	-16384..16384	
2008		External sensor characteristic compensation on/off	U8	rw		0 = off, 1 = on
2100		External sensor data	record			
	0	Number of entries	U8	ro	06h	largest sub index
	1	Sensor signal value	S16	ro	-16384..16384	
	2	Sensor signal input	S16	wo	-16384..16384	
	3	Sensor after inversion	S16	ro	-16384..16384	
	4	Sensor after Offset	S16	ro	-16384..16384	
	5	Sensor after Gain	S16	ro	-16384..16384	
	6	Sensor after linearization	S16	ro	-16384..16384	

Table 7-14: "Manufacturer-specific" part of the CANopen communication profile

The meaning of the settings for the external sensor input is given in Table 7-15.

Index / subindex	Description	Breakdown		
2005_h / 01_h	Sensor signal Input type	0	→	0..20 mA unipolar
		1	→	0..20 mA bipolar
		2	→	4..20 mA unipolar
		3	→	4..20 mA bipolar
		4	→	+/-10 mA unipolar
		5	→	+/-10 mA bipolar
		6	→	0..10 V unipolar
		7	→	0..10 V bipolar
		8	→	±10 V unipolar
		9	→	±10 V bipolar
		10	→	Ratiometric (U supply/2) unipolar
		11	→	Ratiometric (U supply/2) bipolar
		14	→	Value is accepted via CANopen 2100_h/02_h, or RPDO2

Table 7-15: Breakdown of input types for external sensor input

Table 7-16 provides an overview of the valve-specific entries of the object list, which are structured according to CiA DS 408.

Index (hex)	Sub (hex)	Name	Type	Std	Min	Max	Attr.	CiA 408 Ref.
6040	0	Device control word	U16				rw	7.2.2.1.1
6041	0	Device status word	U16				ro	7.2.2.1.2
6042	0	Device mode	S8				rw	7.2.2.1.3
6043	0	Device control mode	S8				rw	7.2.2.1.4
605F	0	Device capability	U32				ro	7.2.2.2.9
6300	0	Number of Entries	U8	1			ro	7.2.5.1.1
	1	Position (command value)	S16		-16384	16384	rw	7.2.5.1.1

6301	0	Number of Entries	U8	1			ro	7.2.5.1.2
	1	Position (actual value)	S16		-16384	16384	ro	7.2.5.1.2
6310	0	Number of Entries	U8	1			ro	7.2.5.1.4
	1	Demand value	S16		-16384	16384	ro	7.2.5.1.4
6330	0	ramp type	S8	3	3	3	rw	7.2.5.1.12
6332	0	Number of Entries	U8	1			ro	7.2.5.1.14
	1	Acceleration Time Positive	U16	0	0	40000	rw	7.2.5.1.14
6333	0	Number of Entries	U8	1			ro	7.2.6
	1	Acceleration Time Negative	U16	0	0	40000	rw	7.2.6
6335	0	Number of Entries	U8	1			ro	7.2.6.1.2
	1	Deceleration Time Positive	U16	0	0	40000	rw	7.2.6.1.2
6336	0	Number of Entries	U8	1			ro	7.2.6.1.3
	1	Deceleration Time Negative	U16	0	0	40000	rw	7.2.6.1.3
6340	0	Demand value generator directional dependent gain type	S8	-1	-1	-1	rw	7.2.6.1.4
6341	0	Demand value generator directional dependent gain factor	U32				rw	7.2.6.1.5
6342	0	Demand value generator dead band compensation type	S8	1	1	1	rw	7.2.6.1.6
6343	0	Number of Entries	U8	1			ro	7.2.6.1.7
	1	Dead band compensation, jump of positive signal	S16	0	0	16384	rw	7.2.6.1.7
6344	0	Number of Entries	U8	1			ro	7.2.6.1.8
	1	Dead band compensation, jump of negative signal	S16	0	0	16384	rw	7.2.6.1.8
6345	0	Number of Entries	U8	1			ro	7.2.6.1.9
	1	Dead band compensation, threshold	S16	0	0	16384	rw	7.2.6.1.9
6346	0	Demand value generator characteristic compensation type	S8	0	-1	0	rw	7.2.6.1.10
6350	0	Number of Entries	U8	1			ro	7.2.6.1.11
	1	Control deviation	S16		-16384	16384	ro	7.2.6.1.11
6351	0	Control monitoring type	S8	2	2	2	rw	7.2.6.1.12
6352	0	Number of Entries	U8	1			ro	7.2.6.1.13
	1	Control monitoring delay time in ms	U16	1000	0	5000	rw	7.2.6.1.13
6353	0	Number of Entries	U8	1			ro	7.2.6.1.14
	1	Control monitoring threshold	S16	1600	0	16384	rw	7.2.6.1.14
6360	0	Dither type	S8	1	1	1	rw	7.2.6.1.17
6361	0	Number of Entries	U8	1			ro	7.2.6.1.18
	1	Dither amplitude	U16		0	16384	rw	7.2.6.1.18
6362	0	Number of Entries	U8	1			ro	7.2.6.1.19
	1	Dither frequency	U16		0	65000	rw	7.2.6.1.19
6380	0	Number of Entries	U8	1			ro	7.2.6.2.1
	1	Command value in pressure or velocity closed loop control (vprc, dcs), control mode 4	S16		-16384	16384	rw	7.2.6.2.1
6381	0	Number of Entries	U8	1			ro	7.2.6.2.2
	1	Actual value on pressure closed loop control (vprc), control mode 4	S16		-16384	16384	ro	7.2.6.2.2

Table 7-16: Valve-related SDO Directory, CiA device profile 408

7.3 Addressing, baud rate, LED display

The Node ID of the valve and the CAN baud rate can be defined by software as well as by hardware. Two rotary switches with 16 positions are available for configuring the interface (CANopen / analog), baud rate and the node ID. Two LEDs are available for displaying the status information of the CANopen interface.

7.3.1. Addressing and baud rate via rotary switch

The function of the available rotary switch (see Figure 7-8) is described in detail in Table 7-17

Figure 7-8: Rotary switch arrangement and designation

Rotary switch	Value	Resulting effect	
Interface / baud rate	0	Setpoint is only accepted via analog local interface. CAN terminator is not active. This completely deactivates CANopen. This switch position is also used to configure the firmware for CAN-less operation / variant.	
	1	Reserved for future use (for the time being the same effect as position 0).	
	2	Setpoint is transmitted as standard via CANopen, but can be configured via 0x604F, see CiA 408: 7.2.2.1.6 Object 604Fh: Device local. CAN terminator is not active by default, but can be activated via USB command, see Chapter 8.7.	20 kbit/s
	3		50 kbit/s
	4		125 kbit/s
	5		250 kbit/s
	6		500 kbit/s
	7		800 kbit/s
	8		1000 kbit/s
	9	Setpoint is only accepted via CANopen. CAN-Terminator is active by default, but can be disabled via USB command, see Chapter 8.7.	20 kbit/s
	A		50 kbit/s
	B		125 kbit/s
	C		250 kbit/s
	D		500 kbit/s
	E		800 kbit/s
	F		1000 kbit/s
Node-ID	0	Node ID of the valve is defined by software. The Node ID can be set via USB, see Chapter 8.7.	
	1	LSS and Autobitrate is activated, the interface / baud rate rotary switch has no function when the CANopen is active. Standard value is transferred via CANopen, but can be configured via 0x604F, see CiA 408: 7.2.2.1.3 Object 6042h: Device mode. CAN terminator is not active by default, but can be activated via USB command, see Chapter 8.7.	
	2	Node-ID 10_d	
	3	Node-ID 15_d	
	4	Node-ID 20_d	
	5	Node-ID 25_d	
	6	Node-ID 30_d	
	7	Node-ID 35_d	
	8	Node-ID 40_d	
	9	Node-ID 45_d	
	A	Node-ID 50_d	
	B	Node-ID 55_d	
	C	Node-ID 60_d	
	D	Node-ID 65_d	
	E	Node-ID 70_d	
	F	Node-ID 75_d	

Table 7-17: Description of the rotary switch functionality

7.3.2. CANopen LED indicators

Based on CiA DS 303, Chapter 4.2, the flashing codes of the LED displays are defined according to Figure 7-9.

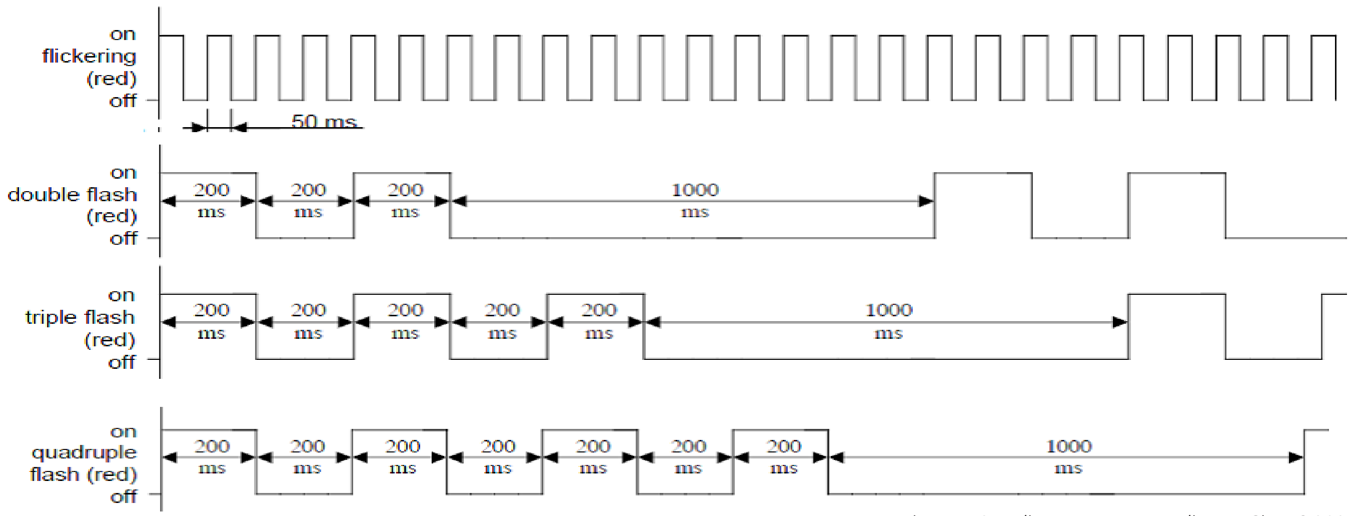
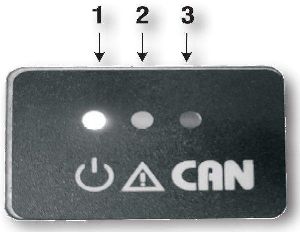


Figure 7-9: Indicator states according to CiA DS 303

The combination of the CANopen-related LED flashing codes is encoded according to Table 7-18. The assignment of the LED names is given in Figure 7-10. For multiple overlapping states / faults, see Table 5-2.



1. LED1 Power
2. LED2 Error
3. LED3 CANopen

Illustration 7-10: Description of LED indicators

LED1 RGB (PWR)	LED2 (RED;ERROR)	LED3 (Orange; CAN/BUS)	Description	Message type	Error code CANopen (hex)
green	off	2,5Hz	no errors, CANopen PRE-OPERATIONAL	status	0000
green	off	Single Flash	no errors, CANopen STOPPED	status	0000
green	off	on	no errors, CANopen OPERATIONAL	status	0000
green	off	Flickering	The auto-bitrate detection is in progress or LSS services are in progress	status	-
green	Single flash	Single Flash	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)	CANopen warning	8100
green	Double flash	Single Flash	A guard event (NMT-slave or NMTmaster) or a heartbeat event (heartbeat consumer) has occurred	CANopen Error control event	8100
green	Triple flash	Single Flash	The sync message has not been received within the configured communication cycle period time out (see object dictionary entry 0x1006)	CANopen Sync Error	8100
green	Quadruple flash	Single Flash	An expected PDO has not been received before the event-timer elapsed	CANopen Event-Timer Error	8100
green	on	Single Flash	The CAN controller is bus off	CANopen Bus Off	8100

Table 7-18: CANopen LED indicators

7.4. State machine valve

The internal states of the valve are implemented according to [VDMAPROP], Chapter 5.2, see Figure 7-11.

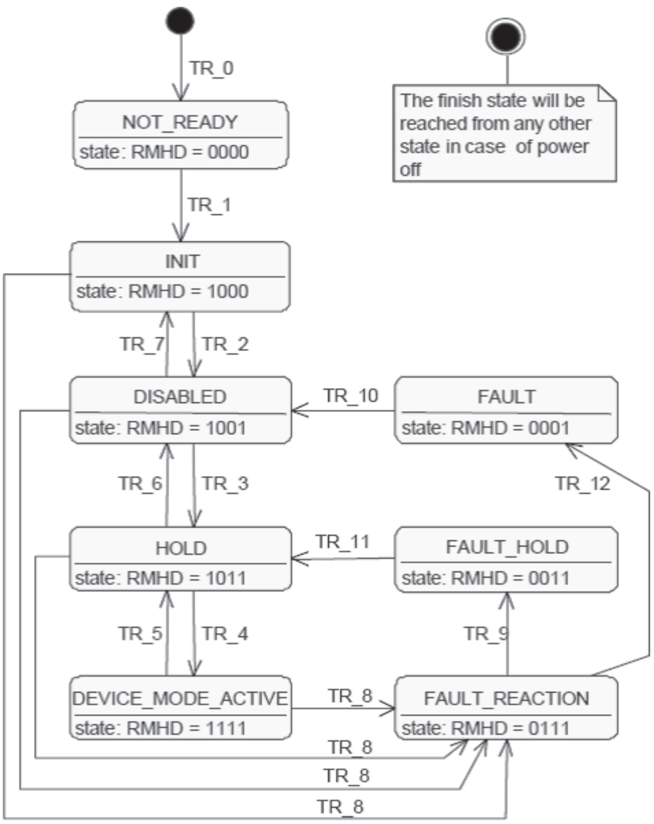


Figure 7-11: Internal states of the valve according to [VDMAPROP], Chapter 5.2

NOT READY:
- the electronic circuit has power
- self-test running
- device init running (e. g. communication interface, hardware, software)
- device function disabled

INIT:
- device parameters can be set
- initialization of device parameters with stored values (if available)
- device function disabled

DISABLED:
- device parameters can be set
- device function disabled

HOLD:
- device parameters can be set
- the preset hold setpoint is effective
- the setpoint generated in the state DEVICE MODE ACTIVE is not effective

DEVICE MODE ACTIVE:
- device parameters can be set
- the device mode defined by the device mode parameter is active
- in this state the change of device modes is not admitted (write access to the device mode parameter will be responded negatively)

FAULT HOLD:
- device parameters can be set
- the actual value presently effective is held or a preset hold setpoint is effective the setpoint generated in the state DEVICE MODE ACTIVE is not effective

FAULT:
- device parameters can be set
- device function disabled

FAULT REACTION: (This state is assumed when the device is no longer able to operate.)
- device parameters can be set
- a fault dependent vendor specific action is executed
- device function may be enabled

The transitions in the state machine of the valve are broken down in Table 7-20. The device control command is of type UINT16, the meaning of the individual bits is listed in Table 7-19, see [VDMAPROP], Chapter 5.3

Control Word Bits	15..	..4	3	2	1	0
Meaning	-	-	Reset Fault (R)	Device mode active enable (M)	Hold enable (H)	Disabled (D)

Table 7-19: Composition of Control Word,
(see [VDMAPROP], Chapter 5.3)

Transition	Trigger	Command / explanation	Device control command – bits					
			15..	..4	3	2	1	0
					R	M	H	D
0	Internal	Power up						
1	Internal	Device init successful						
2	External	Activate disable	X	X	X	X	X	1
3	External	Activate hold	X	X	X	X	1	1
4	External	Activate device mode	X	X	X	1	1	1
5	External	De-activate device mode	X	X	X	0	X	X
6	External	De-activate hold	X	X	X	0	0	X
7	External	De-activated disabled	X	X	X	0	0	0
8	Internal	Fault detected						
9	Internal	Fault reaction successful (fault hold)						
10	External	Reset fault (disabled)	X	X	0	X	0	X
			→					
			X	X	1	X	0	X
11	External	Reset fault (hold)	X	X	0	X	1	X
			→					
			X	X	1	X	1	X
12	Internal	Fault reaction successful (fault)						

Table 7-20: Transitions of the valve state machine and associated device control commands
(see [VDMAPROP], Chapter 5.2)

7.5. Relation of valve and communication state machine

The device state machine (see Chapter 7.4 of this document and [VDMAPROP], Chapter 5.2) is influenced by the CANopen communication machine (see Chapter 7.2.2 of this document and [CiA301], Chapter 8.4). These relationships are shown graphically in Figure 7-12 and tabularly in Table 7-21

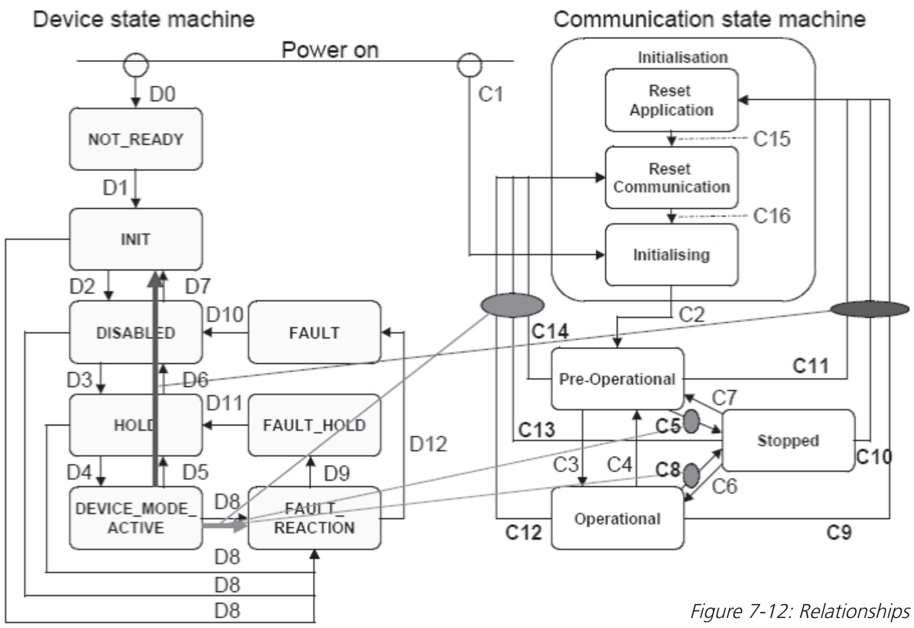


Figure 7-12: Relationships between valve and communication state machine,
see CiA 408, Chapter 4.3.2

Trigger	Effect
C5 and C8	D8, DEVICE_MODE_ACTIVE →FAULT_REACTION
C12, C13 and C14	D8, DEVICE_MODE_ACTIVE→ FAULT_REACTION
C9, C10 and C11	D5, D6, D7, DEVICE_MODE_ACTIVE →INIT

Table 7-21: Relationships between valve and communication state machine,
see CiA 408, Chapter 4.3.2

7.6. Commissioning of the valve with CANopen interface

For the commissioning of the valve with the CANopen protocol certain basic prerequisites with regard to baud rate and node ID have to be fulfilled and a start procedure must be followed.
The communication interface must be set correctly so that communication via CANopen is possible. For this, the baud rate must be selected for the existing network (all connected devices must communicate with the same baud rate, for example to 250 kbit/s). For setting the baud rate, see Chapter 7.3.1 and Chapter 8.7.
The Node ID of the valve must not be used by another device on the same network. For the setting of the Node ID, see Chapter 7.3.1 and Chapter 8.7.
After connecting the valve to the CANopen network, configurations can be made on the valve, for example, the TPDO and RPDO parameters of the valve can be adjusted.
For the start of the valve in CANopen environment, the communication interface of the valve must be set to the operational mode (see Chapter 7.2.2 and 7.2.3) after the configuration of the interface parameters.
As soon as the communication interface of the valve is in the operational mode, the state machine of the valve must be operated correspondingly in order to reach the DEVICE_MODE_ACTIVE state (see Chapter 7.4). For this, the R, D, H, M bits in the Device Control Word must be set to 1 in this order (this can be done via SDO or PDO). An example of the procedure with access via SDO is given in Figure 7-13 (message composition:

Write U16: 0x2B, COB-ID: 0x600+Node-ID, Index 0x6040, Subindex 0, Bits R, D, H, M, $08_h \rightarrow 09_h \rightarrow 0B_h \rightarrow 0F_h$ set to 1 in succession).

ID	Type	DLC	RTR	B0	B1	B2	B3	B4	B5	B6	B7
$060A	11bit	8	☐	$2B	$40	$60	$00	$08	$00	$00	$00
$060A	11bit	8	☐	$2B	$40	$60	$00	$09	$00	$00	$00
$060A	11bit	8	☐	$2B	$40	$60	$00	$0B	$00	$00	$00
$060A	11bit	8	☐	$2B	$40	$60	$00	$0F	$00	$00	$00

Figure 7-13: Setting of the valve state machine to the DEVICE_MODE_ACTIVE state via SDO access, Node ID of the valve: 0x0A

The specification of the setpoint is normally carried out via PDO. The prerequisite for the correct writing of the setpoint value to the valve via the PDO message is that the state machine of the valve is in mode DEVICE_MODE_ACTIVE and remains in this mode as well. The COB ID of the PDO message must match the settings of the valve. Two example messages for the actuation of the valve alternating in position + 50% and -50% are shown in Figure 7-14 message composition:

COB-ID RPDO: 0x200+Node-ID, Device Control Word U16: 0x000F, Set Point ca. +50% [8000_d = $1F40_{hex}$]; ca.-50% [-8000_d = $E0C0_{hex}$])

Name	Time	Gen	ID	Type	DLC	RTR	B0	B1	B2	B3	B4	B5	B6	B7
TPDO Pos +50%	1000 ms	☑	$020A	11bit	8	☐	$0F	$00	$40	$1F	$00	$00	$00	$00
TPDO Pos -50%	1000 ms	☑	$020A	11bit	8	☐	$0F	$00	$C0	$E0	$00	$00	$00	$00

Figure 7-14: Setting the setpoint to approx. +/-50% by PDO, Node-ID of the valve: 0x0A

7.7. Configuration interfaces and inputs on delivery

The default settings for the command signal, the external sensor input and the CAN interface are given in Table 7-22.

Type of valve	Setpoint	External sensor	Rotary switch	Node-ID rotary switch
PRM9-AABBBB/CC-24E02S02-CA	+/-10 V bipolar	-	6 = 500kbit/s, internal terminator disabled	2 = Node-ID: 10_d
PRM9-AABBBB/CC-24E04S02-CA	+/-10 V bipolar	+/-10 V bipolar	6 = 500kbit/s, internal terminator disabled	2 = Node-ID: 10_d

Table 7-22: Configuration of the setpoint inputs and the external sensor input in the delivery state

8. Configuration software

The contents of this chapter are the essential steps needed to implement the software for configuring a PRM9 digital onboard electronics, from the setup of the software to the parameterization of the valve.
Before the parameterization is carried out, it is advisable to read this manual and, if necessary, to consult ARGO-HYTOS. In addition, an appropriate professional qualification of the operator is a prerequisite.

8.1. General information

The PRM9.exe program allows you to configure the integrated digital electronics of the PRM9 valve series according to the respective application via a PC via a USB connection.
The following features of the software are to be mentioned:

- PRM9.exe is a directly executable file, without any installation effort
- Configuration of the parameters by means of a graphical or tabular interface.
- Storage of the configured operating parameters in a *.prm file.
- Possibility of a fast basic configuration using the type code
- Working in online (direct data transmission to the electronics "live") and off-line mode.
- Display of the signal values in online mode by means of oscilloscope function

8.2. Hardware requirements

Minimum hardware requirements:
Processor: AMD/Intel compatible 1GHz or faster
Main memory ≥ 2 GB
Free space on HD ≥100 MB
Screen contrast minimum 1024x768, optimal 1280x720
Operating Systems Windows 7, 10

8.3. Start

The software PRM9.exe can be downloaded from the download portal at www.ARGO-HYTOS.com. The download portal (see Chapter 9) is located in the area of the proportional valves.
After saving the file, it can be used immediately without further installation by performing 

PRM9.exe.

8.4. Basic configuration of the parameterization software

Figure 8-1 shows the basic structure of the program. Essentially, this is divided into the following areas.

- Menu bar (8.5)
- Toolbar (8.6)
- Main area (8.7)
- Status bar (8.8)

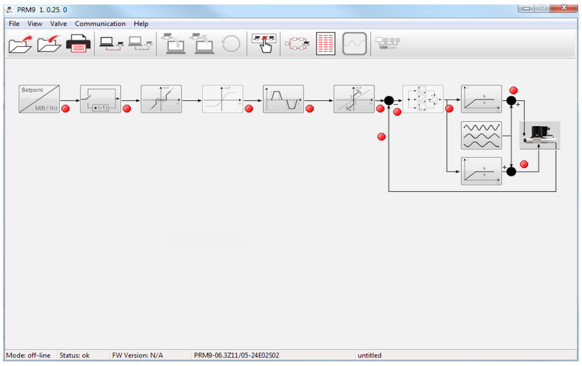


Figure: 8-1 Basic configuration

Most information / actions can be made redundantly over several paths. The following chapters describe the possibilities and contents of the software PRM9.EXE, divided in the areas listed above.

8.5. Menu bar

File View Valve Communication Help

Figure 8-2 Menu bar

The menu bar is located at the top of the program, as shown in Figure 8-2, and contains the following drop-down menus:

File The "File" sub-item essentially allows you to handle the records * .prm, containing the complete parameter data sets.
› Open : Allows you to load a parameter record *.prm
› Save: Allows you to save a parameter record *.prm
› Save as: Allows you to save a parameter record under another name
› Print: Prints the current parameter record
› Exit: Ends the software tool PRM9.exe

View The "View" sub-item allows you to change the views / display in the main area.
› Flow chart: Representation of the signal flow diagram of the respective valve type in the main area
› Parameter table: Direct table-shaped representation of all variable parameters in the main area
› Oscilloscope: Real-time representation of individual values / variables. Access only in online mode.
› Access level: Password-protected selection of access authorization basic or expert
  › Basic: Basic possibilities of the valve parameterization
  › Expert: Further possibilities of parameterization (Including controller and linearization)
› Change language: Selection of the program language German, English, Czech

Valve The sub-item "Valve" allows the exchange of information with the valve / valve electronics as well as basic valve configurations.
› Valve selection: Selection of a valve configuration using the type code
› Valve status: Returns the current state of the valve (on / off-line, type code, firmware version, serial number, error message)
› "Upload" to the valve:
Writing the data contained in the program into the valve electronics
› "Download" from the valve:
Reading out the parameter data contained in the valve electronics into the program
› Valve reboot:Restart of the valve electronics.
Only permitted at disconnected hydraulic circuit.

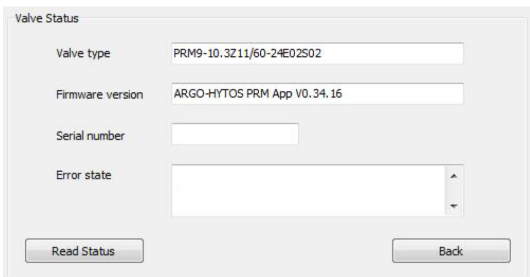


Figure 8-3 Message window of the valve status

Coommunication The sub-item "Communication" describes and enables the status change within the course of a communication

- › HID configuration: Displays the devices currently connected to the computer. If more than one valve is connected to the computer at the same time, the one used for communication can be defined.
- › Online Mode: Changing to online mode. In this way, the parameters in the valve electronics are directly accessible.
- › Offline Mode: Switching to offline mode. The software is decoupled by the valve electronics.

Help General Information

- › Help: Access to the operating manual
- › Homepage: If the internet connection is available: Direct access to the ARGO-HYTOS homepage
- › About: Manufacturer and contact information

8.6. Toolbar

Figure 8 4 Toolbar

The toolbar provides quick access to the essential functions, which are explained in more detail below.

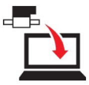
Loading a parameter record (* .prm)
See also menu bar: File / Open

Saving a parameter record (* .prm))
See also menu bar: File / Save

Printing the current parameter record
See also menu bar: File / Print

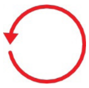
Switching to online mode
See also menu bar: Communication / online mode

Switching to offline mode
See also menu bar: Communication / offline mode

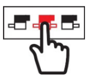


Reading out the data from the valve to the computer. Only possible in online mode.
See also menu bar: Valve / "Download" from the valve

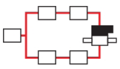
Writing the data to the valve from the computer. Only possible in online mode.
See also menu bar: Valve / "Upload" to the valve



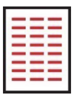
Rebooting the valve electronics. Only possible in online mode.



Valve selection. Selection of a standard valve variant using the type codes.
See also menu bar: Valve / valve selection.



Representation of the valve variant and access to the valve parameters using the signal flow chart in the main area.
See also menu bar: View / flow chart.



Listing of and access to the valve parameters by means of a table.
See also menu bar: View / parameter table.

Switching to the oscilloscope view. Single values can be seen in real time.
Access is only possible in online mode.

Switching to the CANopen configuration window.

8.7. Main area

In the main area of the configuration software, the following actions can be performed depending on the selection:

- › Valve selection according to standard configuration
- › Configuration of the valve parameters
  - › Flow Chart (graphically oriented approach)
  - › Table (listed parameter table)
- › Oscilloscope (representation of data in real time)

8.7.1. Valve selection

In the range of the valve selection, the basic parameter settings of different basic configurations can be selected. The designations contained herein correspond to the display in the type code of the valve, ie size, spool type, nominal volume flow, supply voltage, configuration (internal position feedback, external process variable, CANopen).
It should be noted that valve-specific information, e.g. calibration data, are not contained in this data set. An optimal use of a PRM9 with regard to the application is only possible with individual adjustment of parameters. The values generated by the valve selection can only be considered as general basic values.
If the individual parameters of the factory setting are required, it is recommended to save the data of the valve in a * .prm file before the first intervention. In addition, this information can be obtained at any time via the download portal.

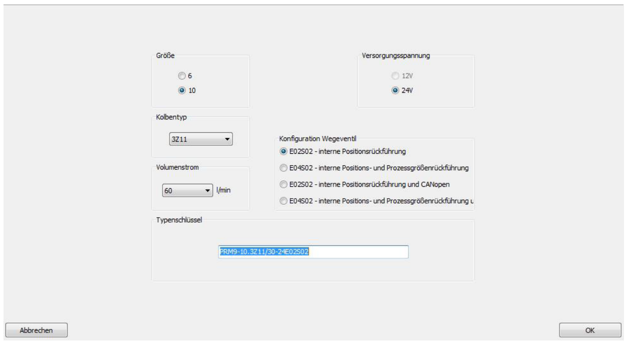


Figure 8-5 Valve selection

8.7.2. Configuration of the valve parameters

As already mentioned in the introduction, there are basically two possibilities to display and change the valve parameters. More graphically oriented, the signal flow diagram is reproduced as shown in Figure 8-6. Alternatively, the listed form is shown on a table as shown in Figure 8-18.

Signal flow plan

The two main signal flow diagrams of the standard variants E02 and E04 are explained in more detail below.
First, the similarities of the representation are discussed.
The red points in the signal flow plan are measuring points. If the valve is in online mode and one of these red dots is pressed, the main window changes to the oscilloscope display and the point of the tap is already selected and can thus be displayed in real time.
If icons in the signal flow chart are grayed out, you do not have the authorization level to change this data (see menu bar: View / access level).

Variant E02

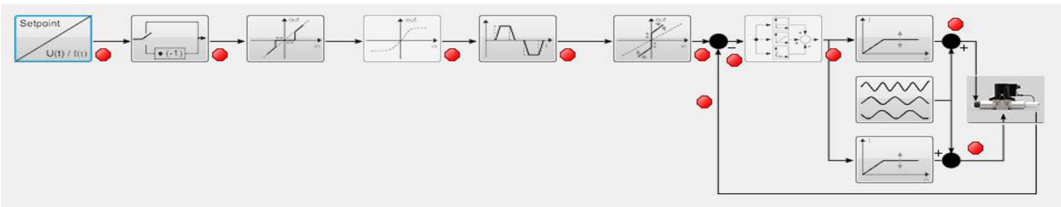
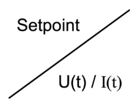
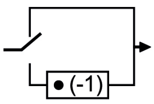
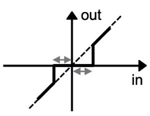
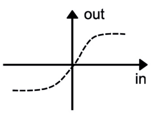


Figure 8-6 Display as flowchart using the example of an E02 (level: Basic)

Variant E02 corresponds to a direct acting proportional directional valve with internal position feedback. From the viewpoint of the design, there are 3 variants: with one coil on each side A & B, only with one coil on side A and only with one coil on side B.

However, the basic structure of the signal flow diagram is nearly the same and differs only in details of the icons and the windows behind it. The logic of the influencing parameters is, identical, thereforethe explanation below is given for the variant with 2 coils.

Symbol	List of parameters	Short description
	Command signal: Signal type	Selection of the signal type of the command signal: Voltage or current, bi- or unipolar.
	Command: Polarity	Setting the polarity of the command signal.
	Command signal: Threshold	Setting the threshold value. Above this value, the command signal is forwarded internally. It is essentially used for noise suppression around the zero value.
	Command signal: Linearization	The linearization of the command signal allows an influence on the characteristics of the valve, e.g. setting of a software-supported fine control range.

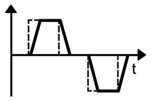
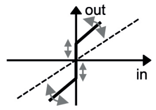
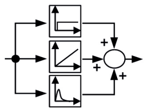
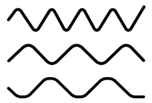
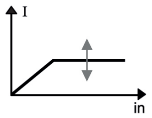
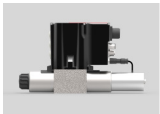
	Command signal: Ramp upwards Ramp downwards	The predetermined value corresponds to the linear delay of the forwarded signal to a command step by 100 % up or down.
	Gain; Offset	Offset in the forwarded signal corresponds to a constant share applied to the command signal (parallel signal shift). Amplification in the forwarded signal corresponds to a change by a constant factor of the command signal.
	Position sensor: P,I,D,T	P: Represents the proportional part of the position controller I: Represents the integral part of the position controller D: Represents the differential part of the position controller T: Represents the delay time
	Dither frequency Dither amplitude	Sets the amplitude / frequency of the excitation current of the coil superimposed to the direct current. They directly affect the sensitivity and hysteresis of the valve
	Coil A: Limit Coil B: Limit	Defines the maximum output current at the respective coil.
	-	Valve selection
	-	Measuring points

Table 8-1 Short description of the icons and naming of the parameter values E02

Variant E04

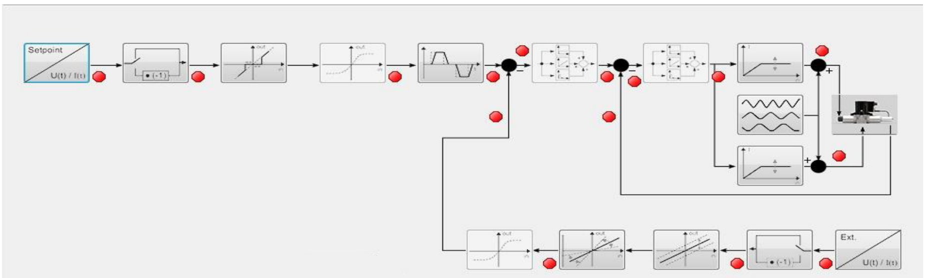
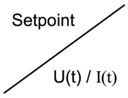
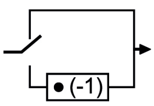
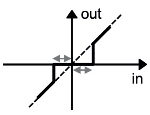
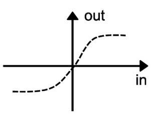


Figure 8-7: Display as flowchart using the example of an E04 (level: Basic)

:The variant E04 corresponds to a direct acting proportional directional control valve with internal position feedback and the possibility of connecting an external sensor / an external process variable directly to the and by this beeing able to generate a closed loop control independent of the higher-level system. As with version E02, there are 3 variants from the viewpoint of the structure, whereby only the variant with 2 coils is discussed in the following explanations.

Symbol	List of parameters	Short description
	Command signal: Signal type	Selection of the signal type of the command signal: Voltage or current, bi- or unipolar
	Command: Polarity	Setting the polarity of the command signal
	Command signal: Threshold	Setting the threshold value. Above this value, the command signal is forwarded internally. It is essentially used for noise suppression around the zero value
	Command signal: Linearization	The linearization of the command signal allows an influence on the characteristics of the valve, e.g. small changes of the input signal are followed by large changes of the position.

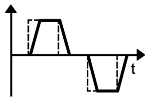
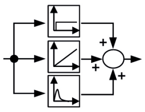
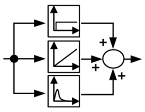
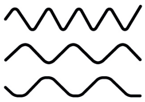
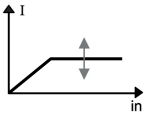
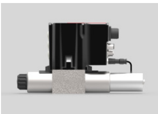
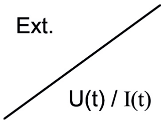
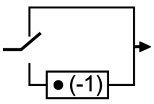
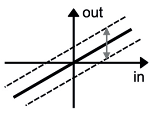
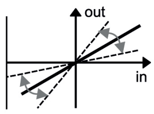
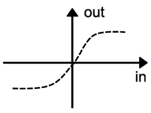
	Command signal: Ramp upwards Ramp downwards	The predetermined value corresponds to the linear delay of the forwarded signal to a command signal step
	External sensor: P, I, D, T	P: Represents the proportional part of the process variable controller I: Represents the integral part of the process variable controller D: Represents the differential part of the process variable controller T: Represents the delay time
	Position sensor: P, I, D, T	P: Represents the proportional part of the position controller I: Represents the integral part of the position controller D: Represents the differential part of the position controller T: Represents the delay time
	Dither frequency Dither amplitude	Sets the amplitude / frequency of the excitation current of the coil superimposed to the direct current. They directly affect the sensitivity and hysteresis of the valve
	Coil A: Limit Coil B: Limit	Defines the maximum output current at the respective coil
	-	Valve selection
	External sensor: Signal type	Selection of the signal type of the external sensor: Voltage or current, bi- or unipolar
	External sensor: Polarity	Setting the polarity of the external sensor signal
	External sensor: Offset	Offset in the forwarded signal corresponds to a constant share applied to the external sensor signal (parallel signal shift).
	External sensor: Amplification	Amplification in the forwarded signal corresponds to a change by a constant factor of the external sensor signal
	External sensor: Linearization	The linearization of the external sensor signal enables a compensation of possible non-linearities in the course of the sensor signal
	-	Measuring points

Table 8-2: Short description of the icons and naming of the parameter values E04

Variants CANopen
Valve variants that have a CANopen fieldbus interface can be fundamentally configured using the symbol shown in Table 8-3 below.

CANopen	CANopen:….	Access to CANopen parameters such as baud rate and address

Table 8-3: Short description of the CANopen access

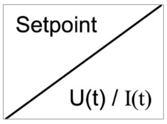
Detailed description of the basic configuration windows

After the short description of the signal flow diagram and its symbols with the help of the examples E02 and E04, this chapter describes the stored configuration possibilities in more detail and explains them in detail. In this explanation, reference is made to a valve with two coils and bipolar signal type respectively. Individual configuration windows can therefore deviate depending on the valve variant used, but the basic parameter description still remains valid.

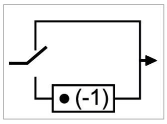
Signal type and polarity of the command signal

Symbol:

Signal type



Polarity



Configuration window:

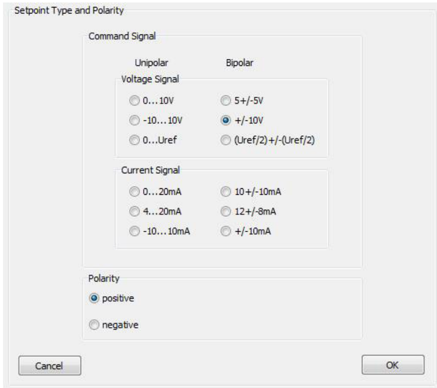


Figure 8-8: Signal type and polarity of the command signal

Within the scope of this configuration window (Figure 8-8), the signal type (current / voltage, bipolar / unipolar) of the command signal can be selected according to the application. Recommended settings can be found in Table 8-4.

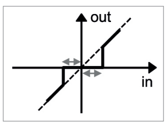
Signal type	Valve variant							
	E02		E04		E02-CA		E04-CA	
	Internal position feedback		Internal position and external feedback		Internal position feedback		Internal position and external feedback	
	1 Coil	2 Coils	1 Coil	2 Coils	1 Coil	2 Coils	1 Coil	2 Coils
±10 V		x	x	x	By using the analog command signal, refer to E02		By using the analog command signal, refer to E04	
0...10 V	x		x	x				
0...20 mA	x		x	x				
4...20 mA	x		x	x				
±10 mA		x	x	x				
12±8 mA		x	x	x				

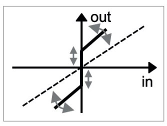
Table 8-4: Recommended setting of the command signal type

In addition, the polarity can be adjusted. The polarity describes which coil A or B is energized with positive / negative command signal. By default, with positive command signal and positive polarity, the coil A is energized. Finally, the polarity allows a change in the sign of the command signal and thus a reversal of the coil to be energized.

Threshold, amplification and offset of the command signal

Block symbol threshold, offset and gain
(only available with E02 variants)





Configuration window:

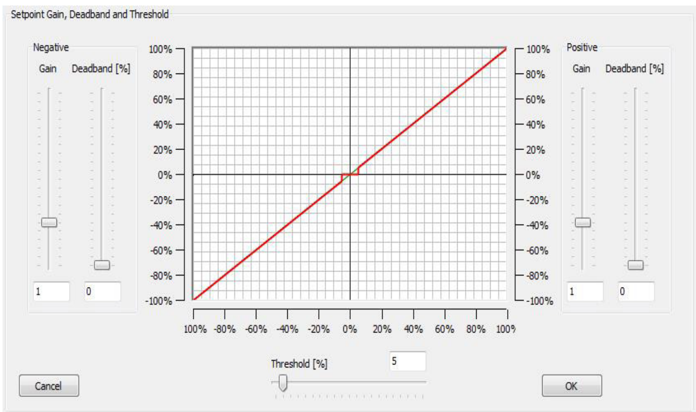
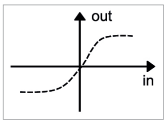


Figure 8-9: Threshold, gain and offset of the command signal

The threshold setting is used to suppress noise components around the zero point of the command signal. The threshold value is referenced as a percentage to the selected command signal type. Command signals which are smaller than the selected threshold value are not forwarded, what means that behind the threshold, there is a signal of zero. If the threshold value is exceeded, the command signal is forwarded 1:1. This suppresses a constant regulation around the zero point due to noise components. As shown in the example of Figure 8-9, the threshold is 5 %, which shows that all signals less than 5% are not passed on and that the signals larger than 5 % are passed on to the same scale.
In addition to the threshold value, the gain as well as the offset can be parameterized in this configuration window (but this applies only to the E02 variants).
By means of the gain, the ratio between the command signal variable and the coil current value can be parameterized. Finally as an example, this means that, with a 50 % command signal, 100 % of the coil current can already be present. Thus the amplification has a decisive influence on the sensitivity of the valve behavior.
The offset, often referred to as dead band compensation, is used to electronically reduce a positive overlap of the spool, by shifting the hydraulic -mechanical zero position in the direction of the control edges. This means, when changing from one edge to the other, the valve spool jumps within these limits. The limits should be chosen in such a way that the valve continues to remain within the positive overlap to avoid inadvertent displacement of the output. In the event of an electrical supply failure, however, the valve moves back into its naturally centered position (spring-centered).

Linearization of the command signal

Block symbol



Configuration window:

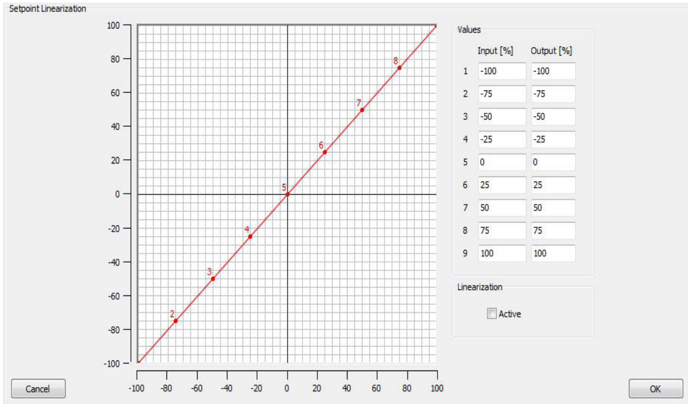
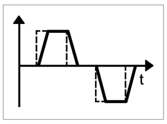


Figure 8-10: Linearization of the command signal

The linearization of the command signal offers the possibility of varying the valve characteristic over the entire command signal range. The only limitation of the variation is that the output signal above the command signal must be monotonically increasing. By means of the parameterization, e.g. a fine control range can be electronically implemented in the valve.

Ramp function

Block symbol



Configuration window:

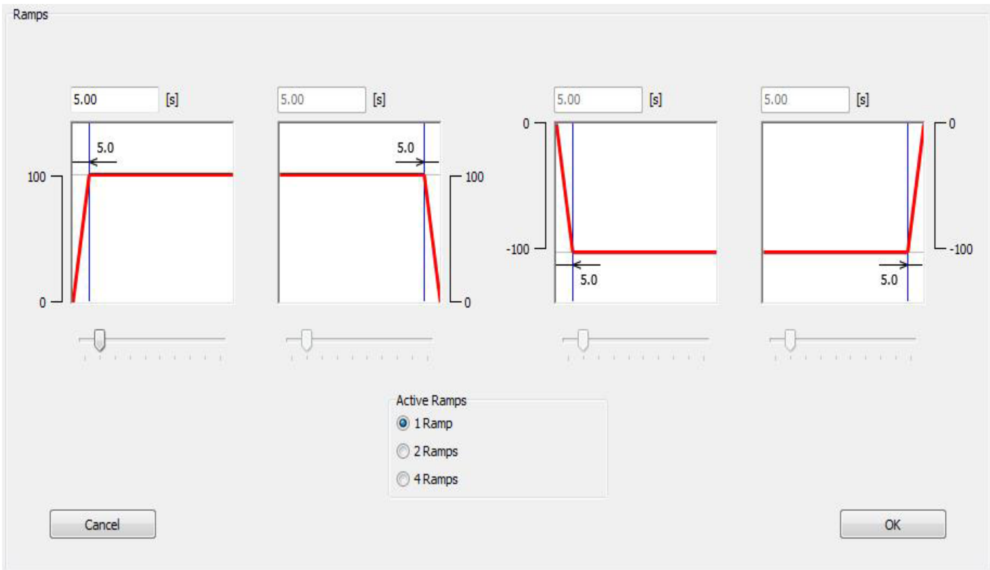
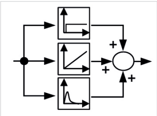


Figure 8-11: Configuration window of the ramp function

The ramp function makes it possible to establish a fixed, temporally linear relationship between a jump-shaped command signal change and ramp-shaped reaching of the command value. In essence, this function can be used to suppress jerky and discontinuous processes, thus avoiding e.g. hydraulic shocks within an application. In this case, all ramps can be influenced at the same time, or, depending on the access level, each ramp can also be individually controlled – ie the pick-up and fall times of the individual directions can be specified individually. The time value of the ramp setting is always related to a 100 % step of the command signal. Lower jump heights thus only yield partial ramp times. The direction of which ramp is assigned (example with 2 coils and bipolar signal: coil A/B ⇔ 0…100%; 0…-100%) depends essentially on the chosen polarity and is therefore the user's selected setting.

Controller

Block symbol



Configuration window: (E04 variants)

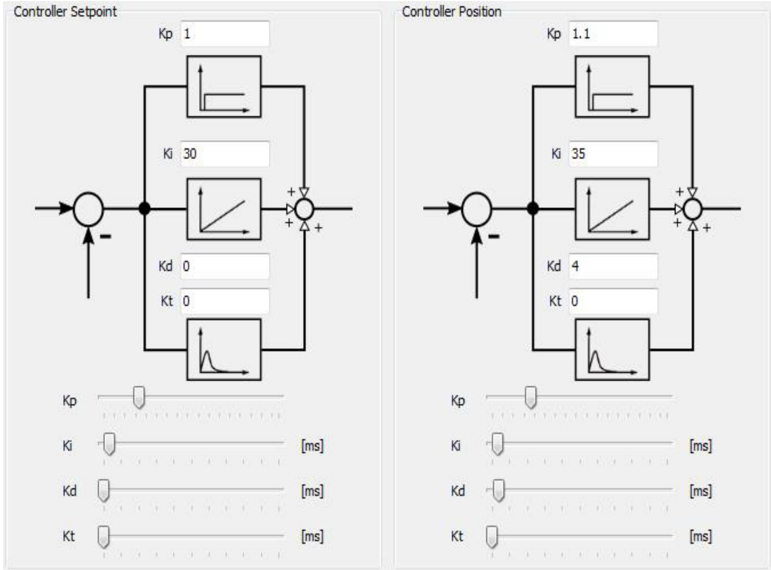


Figure 8-12: Configuration window controller with the example of an E04 variant (controller for position and external sensor)

A PIDT1 is used as a closed loop as controller for the position (variant E02 and E04) as well as for controlling the external sensor size (variant E04). The individual parameters proportional (Kp), integral part (Ki), differential (Kd) and delay time (Kt) can be set individually and can be adjusted numerically or graphically as shown in the configuration window.

The E02 valve variant represents a cascaded control circuit with 2 circuits, the current control being subordinated to the internal position control. In the case of the E04 valve variant, the current and position control is superimposed by a third control circuit, namely that of the external sensor variable.
Since this is a cascade-shaped control, it should be pointed out that the control circuits directly influence each other and can only be parameterized by qualified personnel. Therefore, free access to the control parameters via the access level is limited.

The basic principles of this PIDT1 controller and, in general, the cascade structure are sufficiently well-known and can therefore be taken from the technical literature. Therefore no further discussion should be made at this point.
In addition, the user is given a simple but practicable method to determine the controller parameters depending on the application. As written, this is a simple and practicable method which, however, has no claim to achieve the absolute optimum of the controller setting. Here, too, reference is made to the general literature.

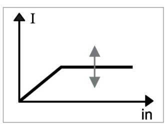
Simple method for setting the controller parameters:

- First, all the parameters Ki, Kd, Kt are set to zero and the proportional part is set to a small value.
- If the system is steady, a command jump is given and the response of the system is monitored. The selected controller setting should have the tendency to follow the command jump and therefore compensate for the deviation. If this is not the case, please check the polarity setting and / or the signal type or range.
- If there is a compensation for the deviation, the proportionality factor Kp is continuously increased further in the following, until the control variable overshoots. Then take the proportionality factor back to the last value before the control value is exceeded.
- Similarly, the integration constants Ki are followed. However here, a small overshoot of the controlled variable is permitted.
- The last factor is the differential factor. The procedure is the same as before. The D component should lead to the slight overshooting of the controlled variable due to the selected setting of Ki being canceled and thus a desired regulating behavior is achieved.
- If the process reproduced here has been reached, it is optionally possible to further reduce the control time by increasing the initial Kp and then Ki again.
- If, due to the D component, the overshoot due to the selected Ki component is significantly at the expense of the control time, it is recommended to reduce both Kp, Ki and Kd. Before this, it is also possible to influence the control time by means of the delay time Kt.

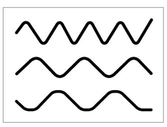
Current limitation and dither setting

Block symbol

Current limiter



Dither



Configuration window:

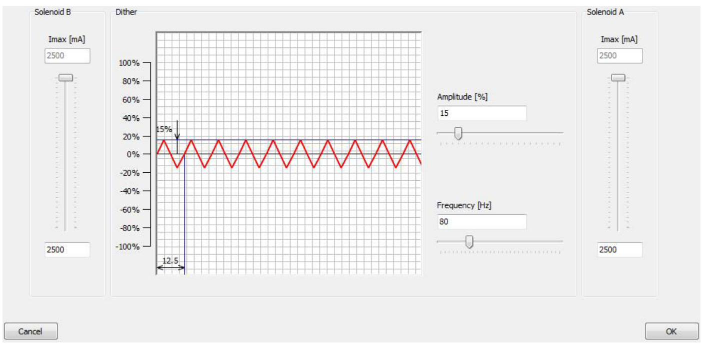


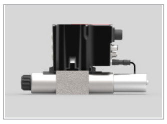
Figure 8-13: Current limitation and dither setting

By means of the current limitation, the maximum current can be preset at coil A and / or at coil B, within the scope of the application, as a function of the valve configuration. It should be noted that by reducing the maximum current value below the maximum permissible current value, the power limit of the valve is also reduced, and the dynamics of the valve are also influenced respectively.

The dither amplitude and frequency allow a micro-movement of the valve spool, which influences the friction and thus has an effect on the valve hysteresis and response sensitivity. When varying the values of amplitude and frequency, it should be taken into account that, at high amplitude and low frequency values, the valve performs a permanent oscillation which can cause vibrations in the hydraulic system. If, on the contrary, the amplitude is too low or the frequency is selected to be too high, the hysteresis increases and the response sensitivity decreases.

Valve selection

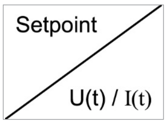
Block symbol

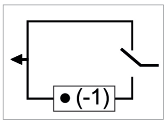


Configuration window: *See Chapter 8.7.1 Valve selection*

Signal type and polarity of the external sensor signal

Block symbol





Configuration window:

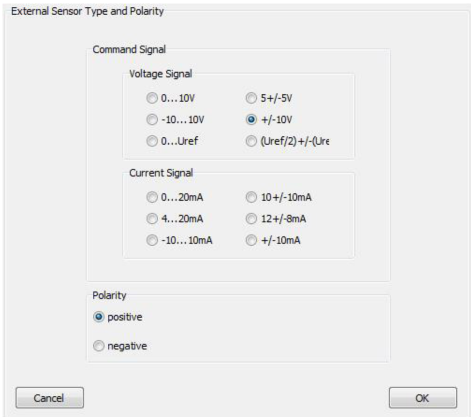


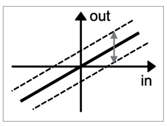
Figure 8-14: Configuration window signal type and polarity of the external sensor signal

Based on the signal type of the command signal, the signal type of the external sensor to be connected can also be selected for the valve variants E04. In this case, the polarity setting also influences the further course of the signal. If the polarity is positive, the input signal is looped through directly and the input signal is negated if the polarity is negative.

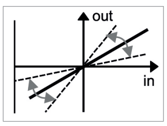
Offset and gain of the external sensor signal

Block symbol

Offset



Gain



Configuration window:

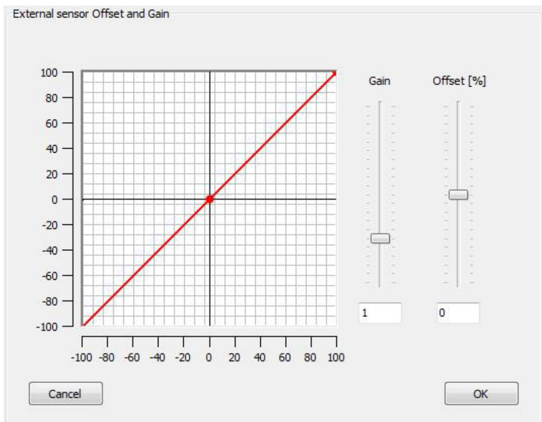
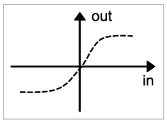


Figure 8-15: Configuration window offset and gain of the external sensor signal

The offset can be used to shift the external sensor signal in parallel. If e.g. the sensor has its own offset shift, this can be compensated for. The same applies to the gain. By means of the gain, the sensor signal can be scaled to correspond to the command signal of the controller input; when the command value is reached, the difference becomes zero.

Linearization of the external sensor signal

Block symbol



Configuration window:

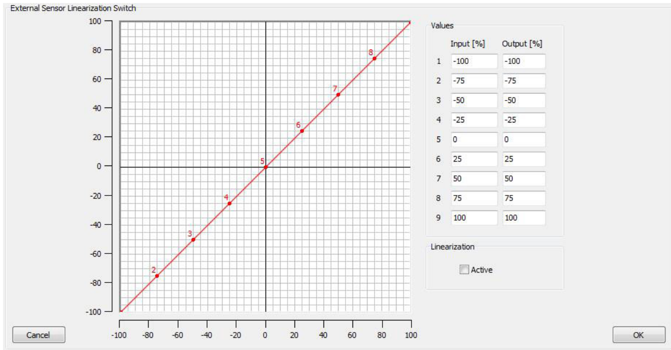


Figure 8-16: Configuration window linearization of the external sensor signal

Within the scope of the configuration window, as shown in Figure 8-16, the characteristic curve of the sensor signal can be influenced. If e.g. the sensor has its own nonlinear characteristic, this can be compensated for by means of the linearization function.

CANopen

Block symbol

CANopen

Configuration window:

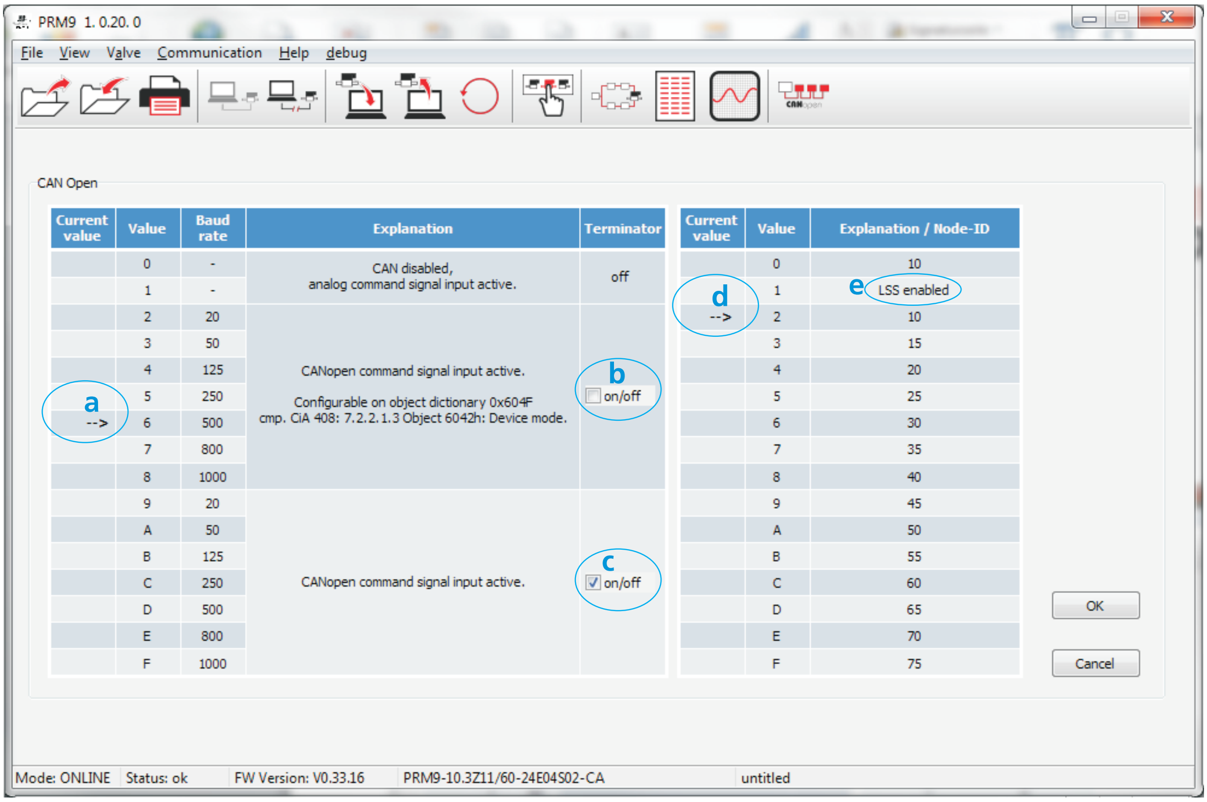
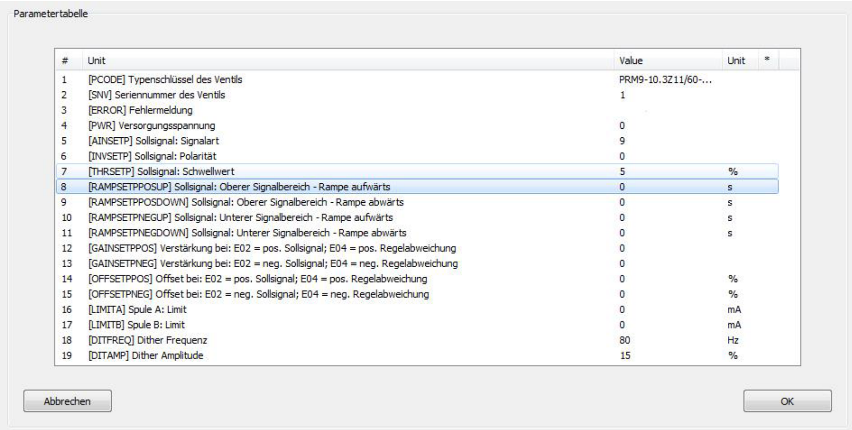


Figure 8-17: CANopen Configuration window, left table with rotary switch setting interface / baud rate, right table with setting of the rotary switch Node ID

Just as the valve-specific parameters can be adapted with regard to the valve characteristics via the parameterization software, the software offers a convenient way to check and set the basic parameters of the CANopen interface of the valve in addition to the general valve configuration. The CANopen configuration window offers two tabular overviews (see Figure 8-17) which shows the current settings of the rotary switches of the CAN interface. The display of the current rotary switch positions is read out by the valve once at startup and is not updated until the next restart. The table on the left in the figure above shows the currently selected setting of the rotary switch for interface / baud rate (*mark a*) and whether the CAN terminating resistor is switched on or off for rotary switch position 2_h to 8_h (*mark b* shows the switched off resistor) or for rotary switch position 9_h to F_h (*mark c* shows the resistor switched on).
The table on the right in the figure above shows the currently selected setting of the rotary switch for Node ID (*mark d*). Switch positions 2_h to F_h provide a selection of preset node IDs. Switch position 0_h allows the node ID to be defined from the CANopen range between 1_d and 127_d.
When you click on the area *marked with e*, a selection window appears as shown in Figure 9-19.

List of parameters



Parametertabelle

#	Unit	Value	Unit	*
1	[PCODE] Typenschlüssel des Ventils	PRM9-10.3Z11/60-...		
2	[SNV] Seriennummer des Ventils	1		
3	[ERROR] Fehlermeldung			
4	[PWR] Versorgungsspannung	0		
5	[AINSETP] Sollsignal: Signalart	9		
6	[INVSETP] Sollsignal: Polarität	0		
7	[THRSETP] Sollsignal: Schwellwert	5	%	
8	[RAMPSETPPOSUP] Sollsignal: Oberer Signalbereich - Rampe aufwärts	0	s	
9	[RAMPSETPPOSDOWN] Sollsignal: Oberer Signalbereich - Rampe abwärts	0	s	
10	[RAMPSETPNEGUP] Sollsignal: Unterer Signalbereich - Rampe aufwärts	0	s	
11	[RAMPSETPNEGDOWN] Sollsignal: Unterer Signalbereich - Rampe abwärts	0	s	
12	[GAINSETPPOS] Verstärkung bei: E02 = pos. Sollsignal; E04 = pos. Regelabweichung	0		
13	[GAINSETPNEG] Verstärkung bei: E02 = neg. Sollsignal; E04 = neg. Regelabweichung	0		
14	[OFFSETPPOS] Offset bei: E02 = pos. Sollsignal; E04 = pos. Regelabweichung	0	%	
15	[OFFSETPNEG] Offset bei: E02 = neg. Sollsignal; E04 = neg. Regelabweichung	0	%	
16	[LIMITA] Spule A: Limit	0	mA	
17	[LIMITB] Spule B: Limit	0	mA	
18	[DITFREQ] Dither Frequenz	80	Hz	
19	[DITAMP] Dither Amplitude	15	%	

Abbrechen OK

Figure 8-18: Display as a listed table using the example of an E02 (level: Basic)

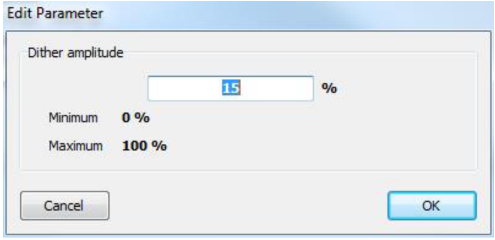


Figure 8-19: Parameterization window for single value using the example of the dither amplitude

The possibilities of parameterization presented in the context of the signal flow diagram can also be made in the parameter list. All parameters are listed according to the valve variant and the access level. When double-clicking on the desired parameter, a window appears which represents the limits of the parameter and has a selection field for setting the individual value.

Oscilloscope

Figure 8-20: Oscilloscope for displaying data in real time using the example E02, access level "Basic"

By means of the oscilloscope, internal valve data can be displayed in online mode. Access to the oscilloscope is obtained via the icon in the toolbar (see Chapter 8.6), via the menu bar (→ View / oscilloscope see Chapter 8.5), or directly in the signal flow plan when a measurement point is actuated (see for example, Figure 8-6); the selected size is also activated directly.
The oscilloscope itself is structured as follows: the playback window, the activation bar of the measuring points (right) and the control bar (bottom). The number of points to be observed at the same time is limited to 3, that is, 3 points can be selected from the activation bar. With regard to the representation, this can be controlled via the interval and the time window. The interval describes the update rate and the time window display the playback time. The recording is controlled via Start / Stop. Changes regarding the measuring points, intervals and time windows can only be carried out with stopped playback.

8.8. Status bar

Figure 8-21: Status bar"

The status bar shows the essential state information with regard to the following points: (In Figure 8-21 from left to right):

› Description of the communication mode
› Description of the state of the valve electronics
› Information about the implemented firmware version
› Information about the valve variant
› Information about the parameter data set used

Users of the PRM9 valve series can obtain both general and valve-specific information via the download portal at www.argo-hytos.com. To access this portal, the user must register once using the SAP and serial number of a PRM9 valve and then receives login data for further access to the portal.

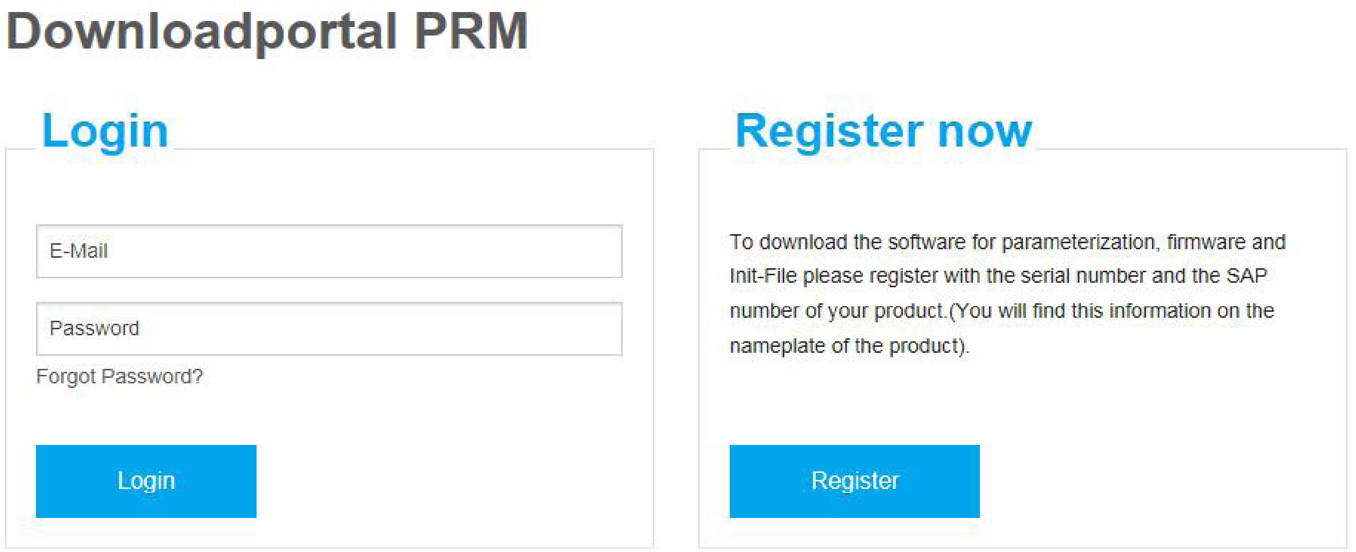
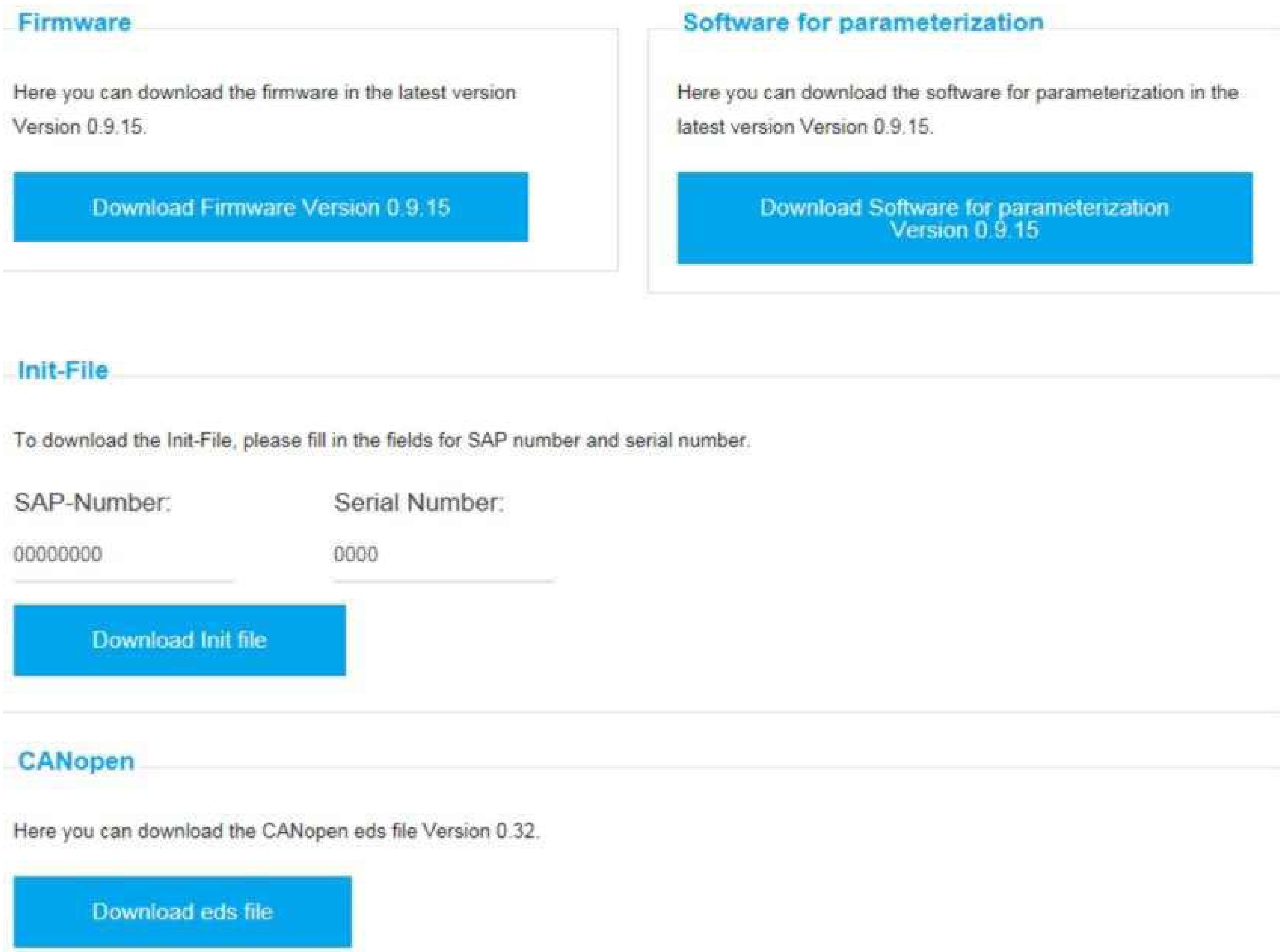


Figure 9-1: Login and registration area

After successful registration, the following information can be obtained via the portal at the most recent version:

› Firmware
› Parameterization software
› Init File - The init file is a valve-specific file and contains the parameter set with which the valve leaves the factory upon delivery. With the help of the valve identification via SAP and serial number, the factory setting of the valve can thus be restored at any time. Regardless of this, the user is recommended to save the valve-own data set directly from the valve before changing settings (see 8.5 Menu bar, ⇔ File / save as)
› CANopen - The eds file of the valves can be obtained under the CANopen selection.



International

ARGO-HYTOS worldwide

Benelux	ARGO-HYTOS B. V.	info.benelux@argo-hytos.com
Brazil	ARGO-HYTOS AT Fluid Systems Ltda.	info.br@argo-hytos.com
China	ARGO-HYTOS Fluid Power Systems (Yangzhou) Co., Ltd.	info.cn@argo-hytos.com
	ARGO-HYTOS Fluid Power Systems (Beijing) Co., Ltd.	info.cn@argo-hytos.com
	ARGO-HYTOS Hong Kong Ltd.	info.hk@argo-hytos.com
Czech Republic	ARGO-HYTOS s.r.o.	info.cz@ argo-hytos.com
	ARGO-HYTOS Protech s.r.o.	info.protech@argo-hytos.com
France	ARGO-HYTOS SARL	info.fr@argo-hytos.com
Germany	ARGO-HYTOS GMBH	info.de@argo-hytos.com
Great Britain	ARGO-HYTOS PVT. Ltd.	info.uk@argo-hytos.com
India	ARGO-HYTOS PVT. LTD.	info.in@argo-hytos.com
Italy	ARGO-HYTOS srl	info.it@argo-hytos.com
Poland	ARGO-HYTOS Polska sp. z o.o.	info.pl@argo-hytos.com
Russia	ARGO-HYTOS LLC	info.ru@argo-hytos.com
Scandinavia	ARGO-HYTOS Nordic AB	info.se@argo-hytos.com
Turkey	ARGO-HYTOS	info.tr@argo-hytos.com
USA	ARGO-HYTOS Inc.	info.us@argo-hytos.com

EN · 14888 · 0417