



Bulletin HY11-5715-603/UK

Operation Manual

Series PZD00A-40X

Design ≥ 40



Electronics for Command Signal Processing

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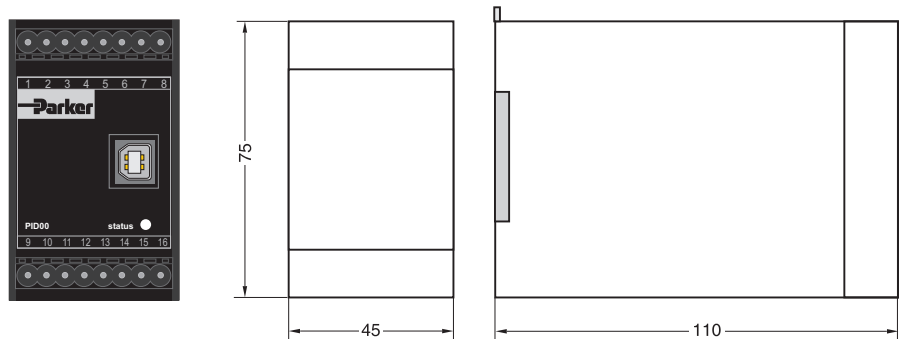
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1. Introduction

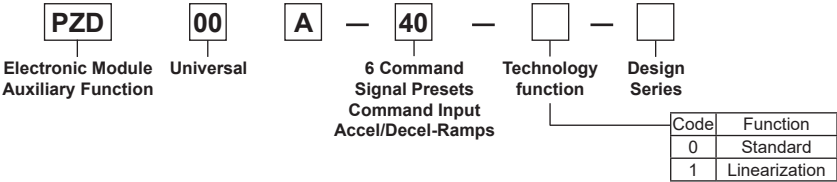
Parker electronic modules PZD00A-400 for rail mounting are compact, easy to install and provides time-saving wiring by disconnectable terminals. The digital design of the circuit results in good accuracy and optimal adaption for command sig-

nal processing by a comfortable interface program. The electronic unit may connected in series to proportional valves with onboard electronic as well as to amplifier modules P*D.

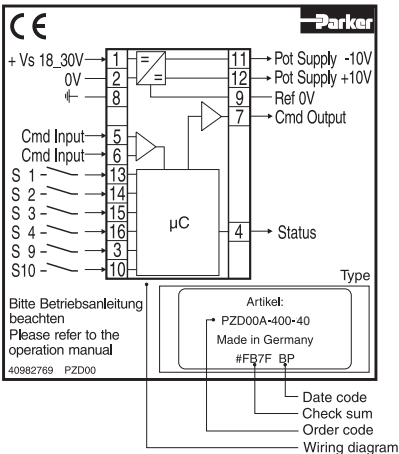
1.1 Front view / Dimensions



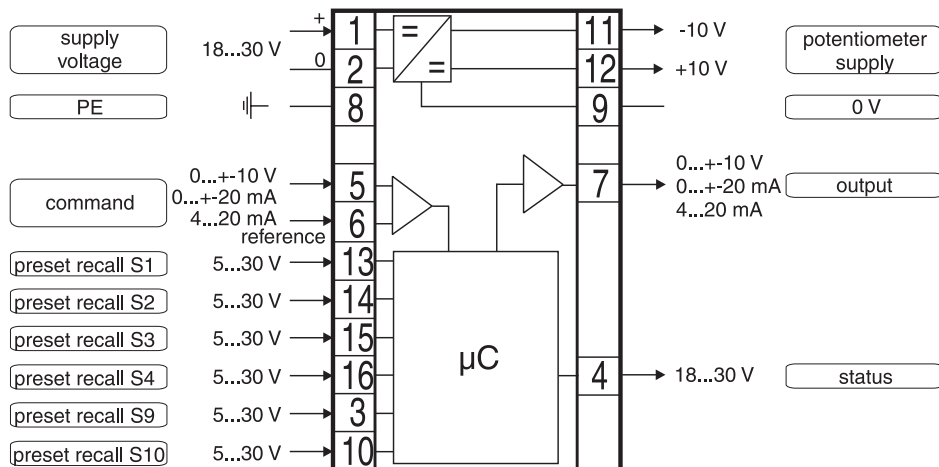
1.2 Ordering Code



1.3 Name Plate



1.4 Block Diagram



1.5 Characteristics of the control module

- Digital circuit design
- Six parametrizable preset recall channels with optional additive or priority dependent signal processing
- Output stage with different signal options
- Input stage with different signal options
- Status output
- Six parametrizable input command ramps as well as four quadrant ramp function
- Reference output for potentiometer supply
- Status indicator
- Parametering by USB interface
- Connection by disconnectable terminals
- Compatible to the relevant European EMC-standards
- Comfortable interface program
- Comfortable PC user software, free of charge: www.parker.com/isde - see "Support", or directly at www.parker.com/propxd.
- Optional technology function "linearization"

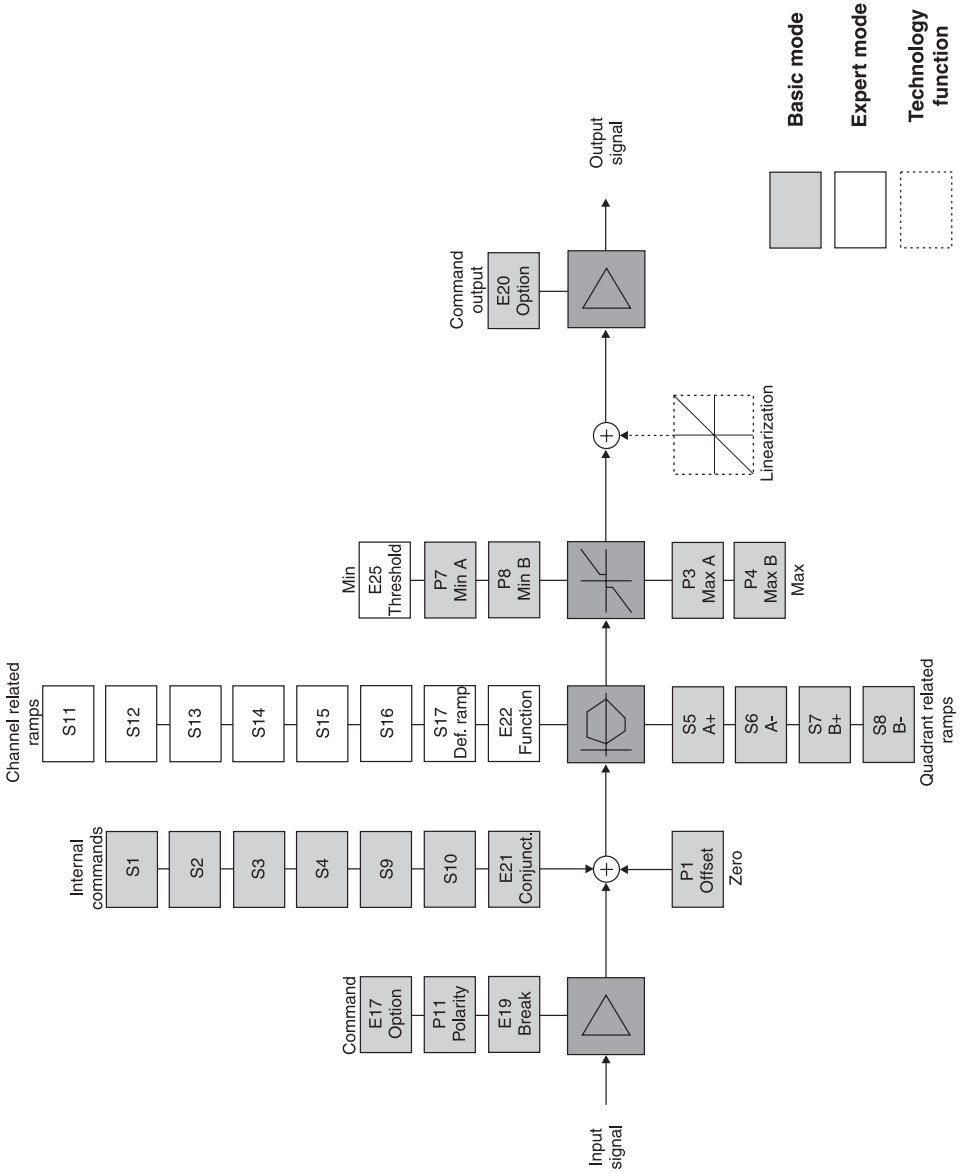


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1.6 Technical data

General		
Model		Module package for snap-on mounting on EN 50022 rail
Package material		Polycarbonate
Inflammability class		V0 according to UL 94
Installation position		Any
Amb. temperature range	[°C]	-20...+60
Protection class		IP 20 acc. EN 60529
Weight	[g]	160
Electrical		
Duty ratio	[%]	100
Supply voltage	[VDC]	18...30, ripple < 5% eff., surge free
Current consumption max.	[mA]	100
Pre-fusing	[mA]	500 medium lag
Command signal options	[V] [mA] [mA]	+10...0...-10, ripple < 0.01 % eff., surge free, Ri = 100 kOhm +20...0...-20, ripple < 0.01 % eff., surge free, Ri = < 250 Ohm 4...12...-20, ripple < 0.01 % eff., surge free, Ri = < 250 Ohm < 3.6 mA = output signal 0 V / 0 mA / 12 mA acc. to output option > 3.8 mA = output signal on (acc. NAMUR NE43)
Input signal resolution	[%]	0.025
Differential input max.	[V]	30 for terminals 5 and 6 against PE (terminal 8) 11 for terminals 5 and 6 against 0 V / terminal 2)
Channel recall signal	[V]	0...1.0: Off / 5...30: On / Ri = 100 kOhm
Status signal	[V]	0...0.5: Off / Us: On / rated max. 15 mA
Output signal options	[V] [mA] [mA]	+10...0...-10, rated max. 15 mA +20...0...-20, Ro < 500 Ohm 4...12...-20, Ro < 500 Ohm
Output signal resolution	[%]	0.025
Reference output	[V]	+10 / -10, 2 %, rated max. 15 mA
Adjustment ranges	Min Max Cmd channels Ramp Zero offset	[%] [%] [%] [s] [%]
		0...50 50...100 +100...-100 0...32.5 +100...-100
Interface		USB type B
EMC		EN IEC 61000-6-2, EN IEC 61000-6-4
Connection		Screw terminals 0.2...2.5 mm ² , disconnectable
Cable specification	[AWG]	20 = 0.5mm ² overall braid shield
Cable length	[m]	50
Options		
Technology function	Code1	Software adjustable transfer function with 10 compensation points for linearization of valve behaviour.

1.7 Signal flow diagram



2. Safety Instructions

Please read the operation manual before installation, startup, service, repair or stocking! Paying no attention may result in damaging the electronic or incorporated system parts.

2.1 Symbols

This manual uses symbols which have to be followed accordingly:



Instructions with regard to the warranty



Instructions with regard to possible damaging of the electronic or linked system components



Helpful additional instructions

2.2 Marking, Name Plates

Instructions applied on the electronic, i.e. wiring diagrams and name plates, must be observed and maintained legibly.

2.3 Work at the Electronic

Workings in the area of installation and commissioning of the electronic may only be allowed by qualified personnel. This means persons which have, because of education, experience and instruction, sufficient knowledge on relevant directives and approved technical rules.

3. Important Details

3.1 Intended Usage

This operation manual is valid for module electronics PZD00A-40X series. Any different or beyond it usage is deemed to be as not intended. The manufacturer is not liable for warranty claims resulting from this.

3.2 Common Instructions

We reserve the right for technical modifications of the described product. Illustrations and drawings within this manual are simplified representations. Due to further development, improvement and modification of the product the illustrations might not match precisely with the described valve. The technical specifications and dimensions are not binding. No claim may result out of it. Copyrights are reserved.

3.3 Liability

The manufacturer does not assume liability for damage due to the following failures:

- incorrect mounting / installation
- improper handling
- lack of maintenance
- operation outside the specifications



Do not disassemble the electronic! In case of suspicion for a defect please return the unit to the factory.

3.4 Storage

In case of temporary storage the electronic must be protected against contamination, atmospheric exposure and mechanical damages.

4. Mounting / Installation

4.1 Scope of Supply

Please check immediately after receiving the electronic, if the content is matching with the specified scope of supply. The delivery includes:

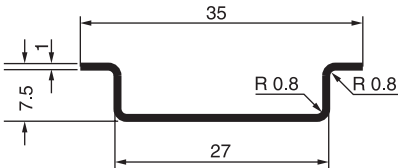
- module electronic
- operation manual

 Please check the delivery immediately after receiving the shipment for apparent damages due to shipping. Report shipment losses at once to the carrier, the insurance company and the supplier!

4.2 Mounting

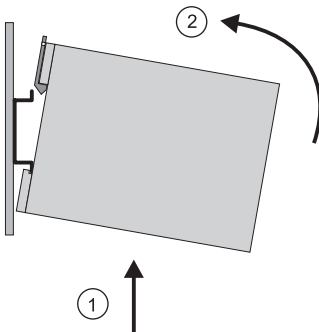
- compare electronic type (located on the name plate) with part list resp. circuit diagram
- the module may be mounted in any direction
- for mounting an assembly rail acc. EN 50022 is required

Dimensions

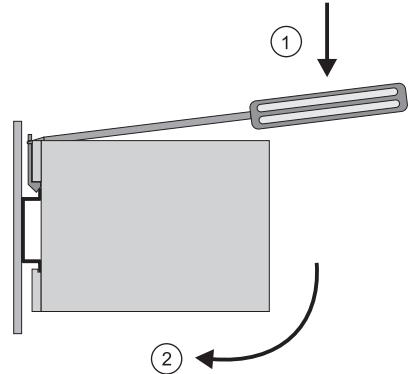


Work flow for module installation

- Mounting:
- (1) apply the module with the assembly rail guide at the lower edge of the rail
 - (2) engage the module upward



- Removing:
- (1) lift the metal socket lock with a suitable screwdriver (approx. 4 x 1 mm blade) against the spring force
 - (2) unmount the module at the top edge of the assembly rail



4.3 Operation Limits

The electronic may be operated within the determined limits only. Please refer to the "technical data" section.



Follow the environmental conditions! Unallowable temperatures, shock load, moisture exposure, radiation exposure, illegal electromagnetic emissions may result in operating trouble and may lead to failure! Follow the operating limits listed in the "specifications" table!

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4.4 Electrical Connection

The electrical connection of the module electronic takes place by disconnectable screw terminal blocks.

 This easy-to-install connection type allows a fast module replacement and a visible separation of the electrical connection. An additional folding unlocking lever allows simple removing of the terminal blocks and serves at once as shock hazard protection and marking strip.

The connecting wires have to comply to the following specification:

Wire type	hookup cable, stranded
Cross sections	min. AWG 20 / 0.5 mm ²
Wire length	max. 50 m

 For wire lengths > 50 m consult factory

Skinning lengths for the connecting wires



The screw terminals are designed to allow termination of all kinds of copper wires without the need for preparation. Copper made wire end sleeves may be usable as conductor stripping protection for the stranded wires.

 Soldering of the connection wires is permitted.

To ensure EMC-compatibility the wiring of the module has partly to be undertaken by shielded cables. Detailed information can be read from the chapter "Electrical Interfacing".

 The installation has to take place by qualified personnel! A short between individual conductors, loose wires as well as improper shield connection may result in malfunction and breakdown of the electronic!

 The earth ground wire from terminal 8 as well as the cable shields have to be tied to the protective earth terminal within the control unit. It is necessary to use a low ohmic potential connection between control unit and machine frame to prevent earth loops (cross section min. AWG 6 / 10 mm²).

4.5 Electrical Interfacing

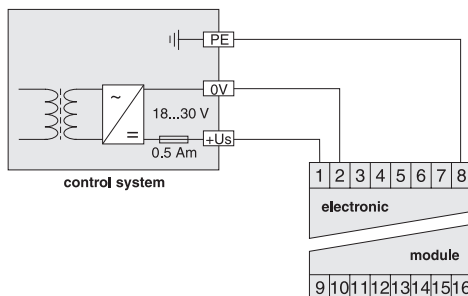
Supply Voltage:

The supply voltage for the electronic will be connected to the terminals 1 and 2 of the module electronic and has to cover the range of 18...30 V. The residual ripple may not exceed 5 % eff.

 The applied power supply must comply to the relevant regulations (DIN EN 61558) and must carry a CE-mark. The operating voltage for the electronic must be free of inductive surges. Do not exceed the maximum value of 30 V! Non-observance of this rule may result in permanent damaging of the electronic!

 The operation of the electronic is blocked if the supply voltage polarity is interchanged.

Wiring diagram of supply voltage



 Each electronic requires a separate pre-fuse of 0.5 Amp time lag. Non-observance of this instruction may create irreparable damage of electronic resp. incorporated system parts!

Input for external command signal:

The command signal to the valve will be connected to the terminals 5 and 6 of the difference signal input of the electronic. The connection has to be performed shielded.

The output signal behaves proportional to the command signal amplitude. Depending on the selected electronic parameters different versions of command signal processing are available, which are described below. For the function description terminal 6 is assumed as signal reference (0V).

Details are shown from the technical specifications.



The parameter options for the command signal input are described in the chapter "Operating Instructions".

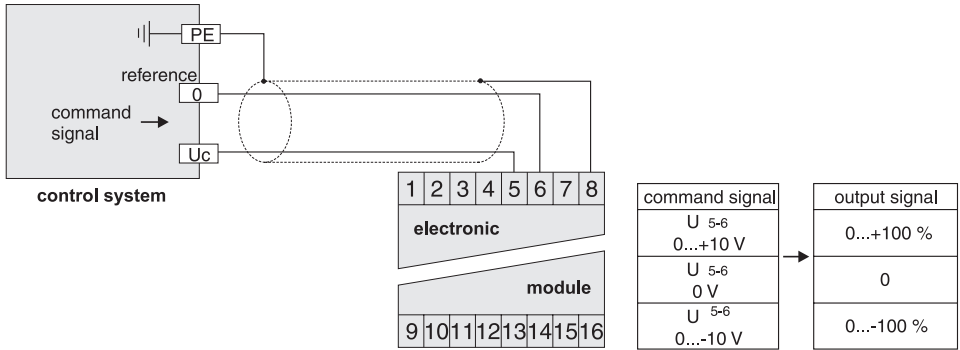
The command input signal needs to be filtered as well as free of inductive surges and modulations.

To prevent malfunctions a high signal quality is recommended.

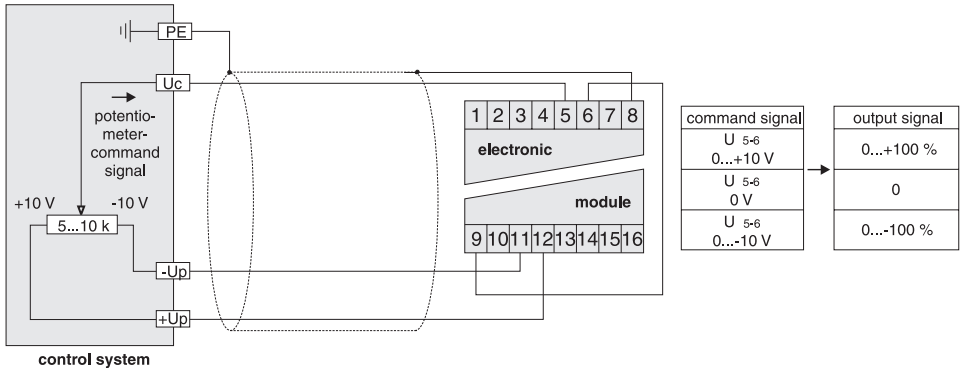


Incorrect signal amplitude levels may disturb the functionality and can damage the unit!

Wiring diagram of voltage command input +10...0...-10 V



Wiring diagram of voltage command input +10...0...-10 V via potentiometer

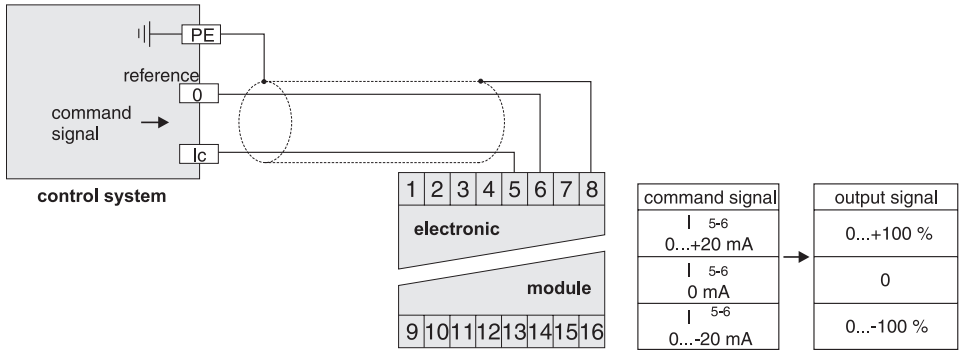


The external potentiometer is fed via the output "potentiometer supply". To prevent this output from overload, the resistance value of

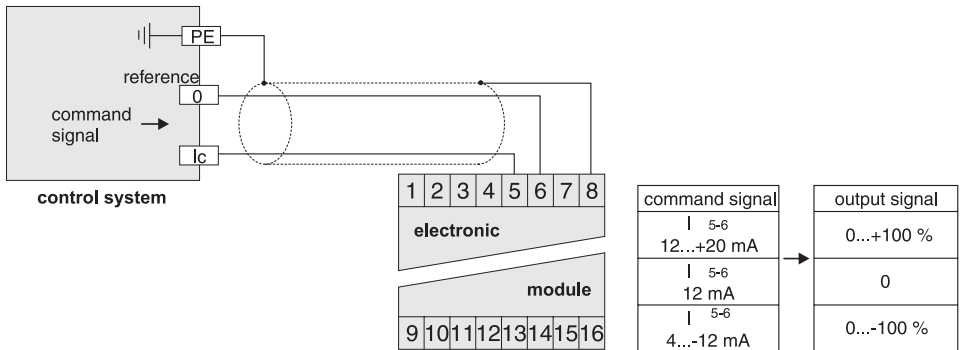
the potentiometer should be within a range of 5...10 kOhm. A nominal power rating of 0.1 W is sufficient.

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Wiring diagram of current command input +20...0...-20 mA



Wiring diagram of current command input 4...12...20 mA



☞ The option 4...20 mA uses the "0 mA" condition as breakdown-information. This means the presence of an evaluable failure information if the input signal line is interrupted. In this case the solenoid output will be switched off. The output will be switched on when the input signal

reaches a value of 3.8 mA, it switches off when the command falls below 3.6 mA. This determination follows the NAMUR - specification NE43. If necessary, the command signal cable break detection can be disabled by selecting the parameter E19.

Recall channels for internal command preset

Up to six corresponding inputs are provided for channel recall of internal command presets. The conjunction options of the internal command channels may be selectable via the parameter E21. The following options are provided:

- priority dependent
- additive

At priority dependent channel recall the channel with the lowest numerical designation has priority against other simultaneously addressed preset channels.

Example: Channels S1, S2, S3 are addressed. Channel S1 has priority, the corresponding internal command will be assessed as input signal.

The preset channels have priority against the analog signal input for the external command.

At additive channel recall the internal signal presets of the recall channels as well as a possible signal at the external signal input will be added. The sum of the signal values is limited at 100 %.

Example 1: Channel S1=+50 %, channel S2 =+20 %, external input signal = +5 V (= +50 %). The sum is +120 %, in this case +100 % input signal will be assessed.

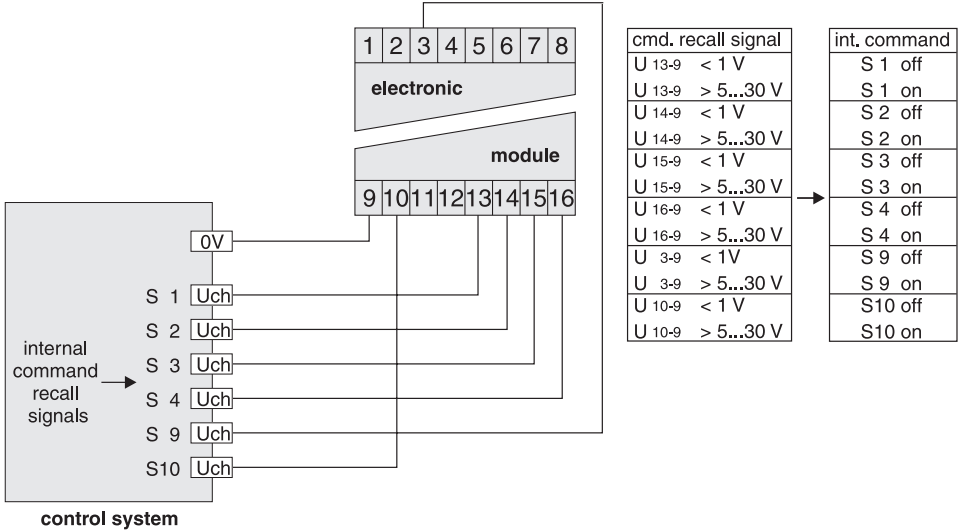
Example 2: Channel S1 = +50 %, channel S2 = +20 %, external input signal = -5 V (= -50 %). The sum is +20 %, in this case +20 % input signal will be assessed.

The preset channels are switched through during the signal trigger at the dedicated inputs.

More details are shown from the technical data.

△ The channel recall signals need to be filtered as well as free of inductive surges and modulations. To prevent malfunctions a high signal quality is recommended. Inputs must be coupled to defined potential, thus open channels has to be connected to 0 V level.

Wiring diagram of channel recall for internal signal presets



Instruction for ramp function

The function of the integrated ramp generator may be selected via the parameter E22. The following selections are available (valid for priority dependent as well as additive channel recall):

- quadrant dependent (set via the parameters S5...8) = standard operation, in this case the parameter adjustments S11...17 are without function. Any command signal segment consists of a dedicated ramp rate S5...8.

Example:

positive signal rise, positive signal fall, negative signal rise, negative signal fall.

- The defined ramp time will be effective between the “Min” an “Max” adjustment.
- internal command channel dependent (preset via the parameters S11...17) = special operation, in this case the parameter adjustments S5...8 are without function. Any internal command chan-

nel consists of a dedicated ramp rate S11...16, which affects the signal flow while the channel is switched on.

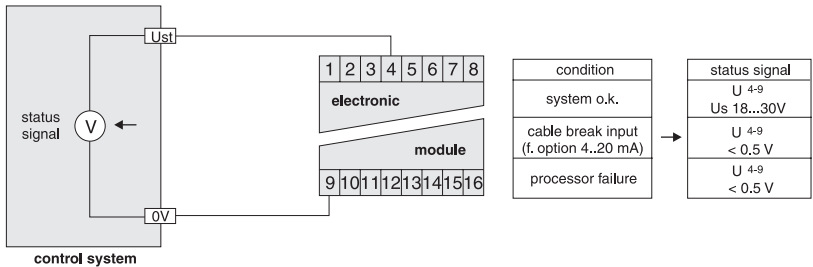
- For the operation mode “internal command channel dependent ramp preset” these rules applies:
- After recall channel switch-off the ramp rate S17 is active.
- At additive channel recall the ramp rate of the channel with the lowest numeric designation is active.

Status output:

The terminals 4 and 9 distributes a signal information about the status of the electronic. The following information is available:

- external command signal cable break (only for option 4...20 mA)
- internal processor fault
- The output may drive a load of max. 15 mA. Exceeding of this limit leads to malfunction.

Wiring diagram of status output

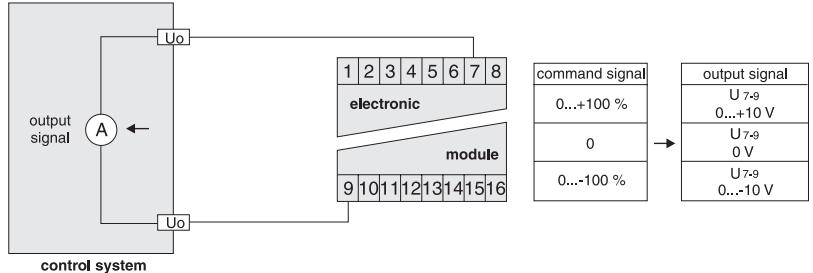


Signal output:

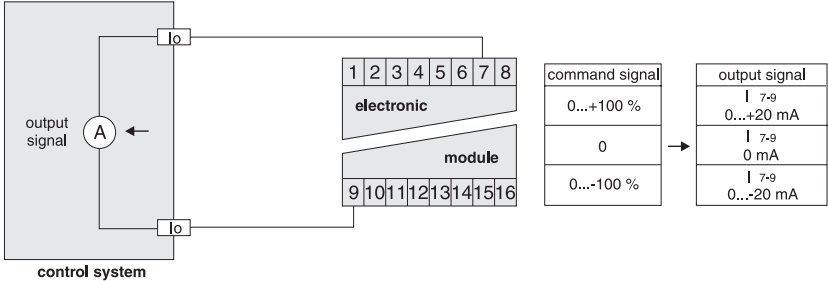
The terminals 7 and 9 provides the output signal, which may be used to control all external amplifier modules as well as integrated valve amplifiers. Different versions of output signal processing are available, which are described below.

⚠ The output signal option has to be selected according to the requirements of the downstreamed electronic.

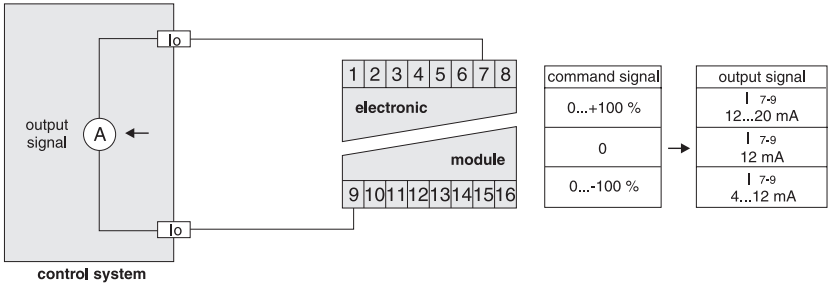
Wiring diagram of voltage output +10...0...-10 V



Wiring Diagram of current output +20...0...-20 mA



Wiring diagram of current output +4...12...20 mA

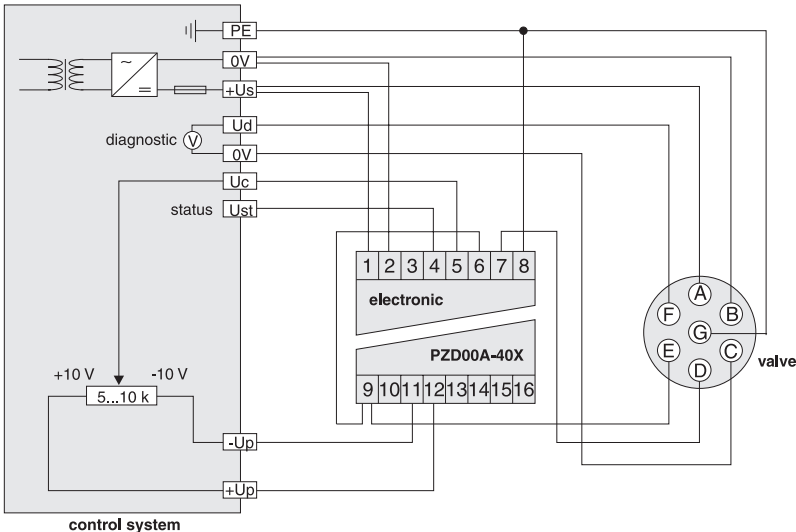


Wiring Examples:

Partially the wiring requires a shielded performance. For the sake of clarity the appropriate illustration is omitted.

Example 1:

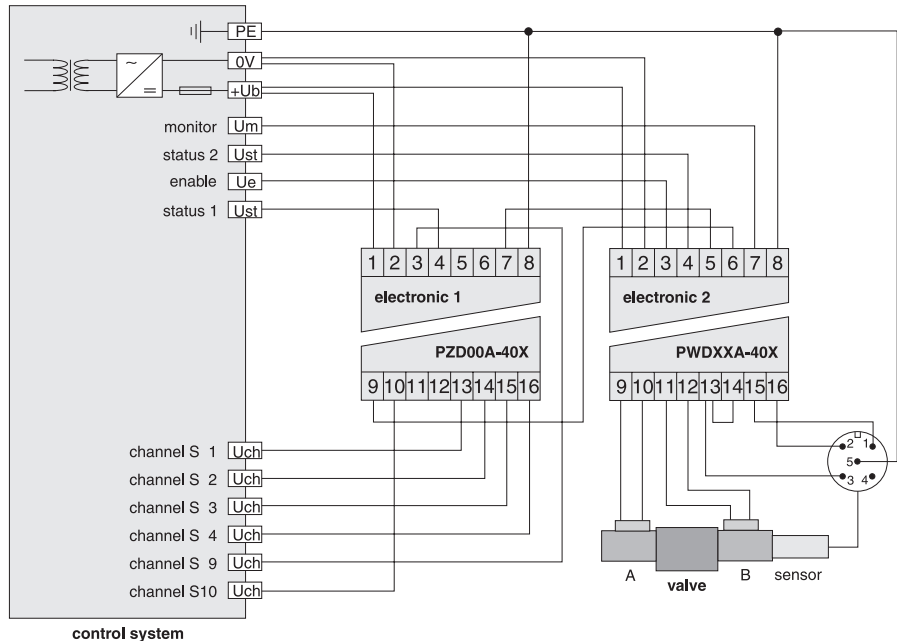
Command signal processing via PZD00A-40X to a proportional directional control valve with integrated electronic (D*FP). Voltage command input via potentiometer.



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Example 2:

Command signal processing via PZD00A-40X to an amplifier PWDXXA-40X with proportional directional control valve (D*FC, D**FS). Voltage command input via channel recall.



5. Operating Instructions

Basically the electronic performs the task of modulating resp. conditioning a command signal into the required form to be useful as command signal for a downstreamed valve amplifier.

ProPxD screenshot

5.1 Operating Software Program

ProPxD parameterizing software

The ProPxD software permits comfortable parameter setting for the module electronic. Via the clearly arranged entry mask the parameters can be noticed and modified. Storage of complete parameter sets is possible as well as printout or record as a text file for further documentation. Stored parameter sets may be loaded anytime and transmitted to the module electronic in the same manner as the basic parameters which are available for all usable valve series. Inside the electronic a nonvolatile memory stores the data with the option for recalling or modification.

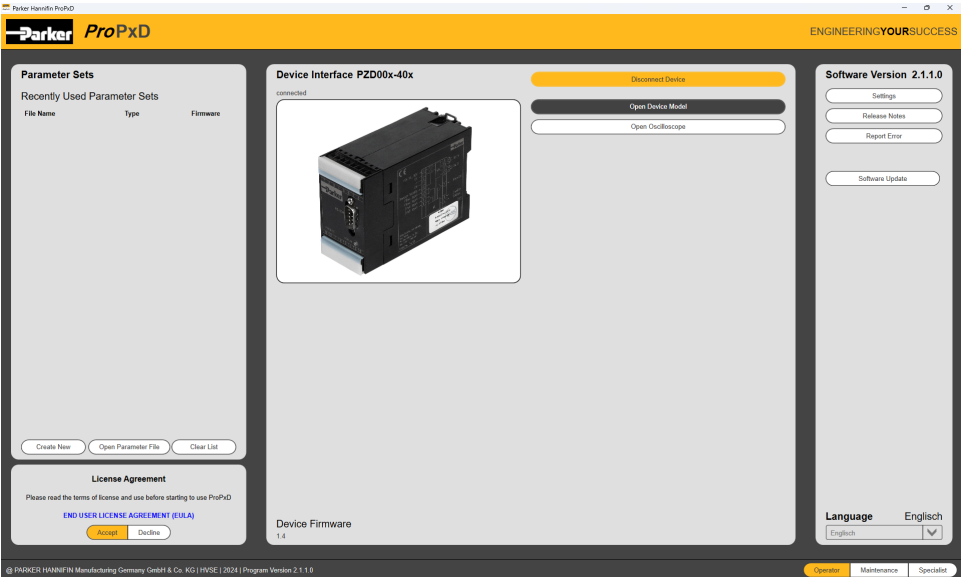
 The connected valve amplifier may not operated before loading an appropriate parameter set from the PC into the module electronic!

Features

- comfortable editing of all parameters
- depiction and documentation of parameter sets
- storage and loading of optimized parameter adjustments
- plain communication between PC and electronic via USB interface

The PC software can be downloaded free of charge at www.parker.com.

ProPxD screenshot



5.2 Software operating

 Incorrect settings may lead to malfunction!
In case of parameter changes shut the drive down!

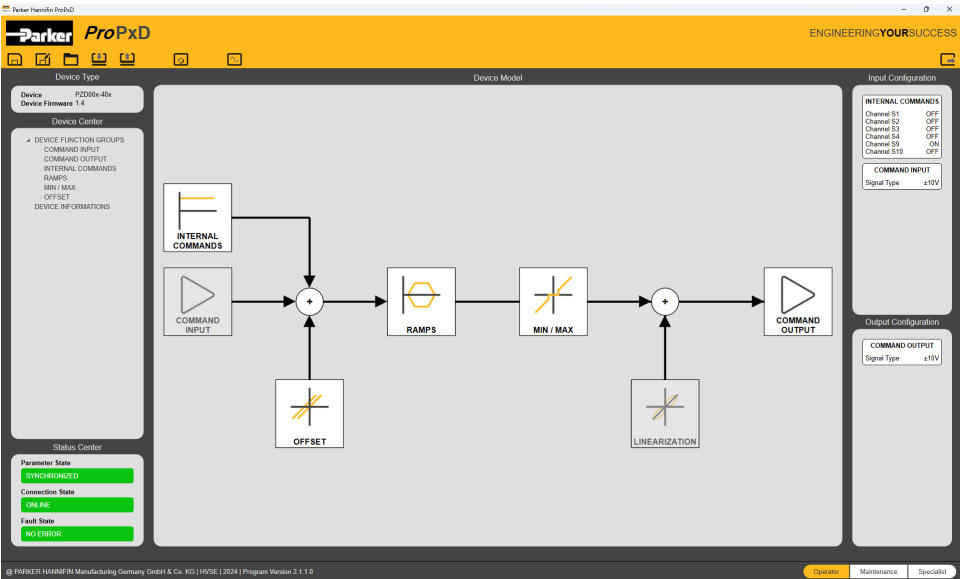
Brief instruction for first startup

-  **Step 1: Connect the module electronics to the supply voltage.**
Step 2: Connect the module to a PC via USB cable.
- Click on the ProPxD icon to start the operating program.
 - After displaying the program or database version, the „Device Interface“ program window opens.
 - Use the „Language“ menu to select the desired language version. The language can only be adjusted before searching for the device.
 - Identify the connected device by using the „Search for Device“ button. If there is no automatic identification, a manual search using the „Find Device“ button is required.
 - After selecting the device, connect to the device by using the “Connect Selected Device”.

- To set the parameters, open the device model.
- The parameter groups can be opened and changed via the device model or the device center.
- Save and download changed parameter sets to the device.
- The status center shows the device status including any errors..

 **If ProPxD does not connect to the device, the cause may be the lack of a driver for the USB interface on the module.**
The necessary driver can be downloaded from the following link.
VCP = Virtual Comport Driver
<https://ftdichip.com/drivers/vcp-drivers/>

Screen Shot ProPxD Device Model



Operation Manual

Extended functions

The user software is shared into 2 parameter ranges

- Operator-mode
- Maintenance-mode password „maintain“
- Specialist-mode Password will be given by special Parker modifications

For normal commissioning, the Operator mode is sufficient. It allows the setting of all application-specific parameters to adapt the controller function to the task at hand.

 Changing of Maintenance parameters is only permitted by qualified personnel.

To prevent unauthorized access to the „Maintenance“ mode, it is secured via a password request. The password is „maintain“ and cannot be changed.

5.3 Adjustment parameters

The available parameters may be divided into multiple groups and are characterized by different letters:

S-parameters: internal commands and ramps

P-parameters: operating parameters

E-parameters: extended parameters

Parameter overview for the operator mode

Parameter	Description	Unit	Parameter range		Default setting
			from	up to	
S1	internal command S1	%	-100.0	+100.0	0.0
S2	internal command S2	%	-100.0	+100.0	0.0
S3	internal command S3	%	-100.0	+100.0	0.0
S4	internal command S4	%	-100.0	+100.0	0.0
S5	ramp accel. -	ms	0	32500	0
S6	ramp decel. -	ms	0	32500	0
S7	ramp accel. +	ms	0	32500	0
S8	ramp decel. +	ms	0	32500	0
S9	internal command S9	%	-100.0	+100.0	0.0
S10	internal command S10	%	-100.0	+100.0	0.0
P1	zero	%	-100.0	+100.0	0.0
P3	MAX +	%	50.0	100.0	100.0
P4	MAX -	%	50.0	100.0	100.0
P7	MIN +	%	0.0	50.0	0.0
P8	MIN -	%	0.0	50.0	0.0
P11	polarity command	—	0	1	0
E17	option command	—	1 = ± 10 V 2 = ± 20 mA 3 = 4-20 mA		1 = ± 10 V
E19	cable break detection command	—	0	± 10 V: 0 ± 20 mA: 0 4-20 mA: 1	0
E20	option command output	—	1 = ± 10 V 2 = ± 20 mA 3 = 4-20 mA		1 = ± 10 V
E21	option internal command signal conjunction	—	0 = priority dependent 1 = additive		0 = priority dependent

Individual description of the parameter operator mode

S1 command signal S1	Adjustment of the internal command signal channel S1. To attenuate of an external accessible command signal.
S2 command signal S2	Adjustment of the internal command signal channel S2. To attenuate of an external accessible command signal.
S3 command signal S3	Adjustment of the internal command signal channel S3. To attenuate of an external accessible command signal.
S4 command signal S4	Adjustment of the internal command signal channel S4. To attenuate of an external accessible command signal.
S5 ramp accel. -	Adjustment of ramp rate for increasing of the negative signal polarity. To avoid switching noise.
S6 ramp decel. -	Adjustment of ramp rate for decreasing of the negative signal polarity. To avoid switching noise.
S7 ramp accel. +	Adjustment of ramp rate for increasing of the positive signal polarity. To avoid switching noise.
S8 ramp decel. +	Adjustment of ramp rate for decreasing of the positive signal polarity. To avoid switching noise.
S9 command signal S9	Adjustment of the internal command signal channel S9. To attenuate of an external accessible command signal.
S10 command signal S10	Adjustment of the internal command signal channel S10. To attenuate of an external accessible command signal.
P1 offset	Adjustment of zero position shifting (offset). To compensate for unbalances within the zero position of the valve.
P3 MAX +	Adjustment of maximum signal span for positive output signal. To match the command signal span to the valve operating range.
P4 MAX -	Adjustment of maximum signal span for negative output signal. To match the command signal span to the valve operating range.
P7 MIN +	Adjustment for positive output signal step at 0,1 % command signal. To compensate for the overlap of the valve spool.
P8 MIN -	Adjustment for negative output signal step at 0,1 % command signal. To compensate for the overlap of the valve spool.
P11 command signal polarity	Adjustment of the command signal polarity. To match the command signal polarity to the valve operating direction.
E17 type of command signal device	Adjustment of the command signal option. To match the command signal input to the input signal mode.
E19 cable break detection command	Adjustment of the operating mode for the command cable break detection. To turn on resp. off of the cable break detection of the command signal at a selected command signal option of 4...20 mA.
E20 type of command out signal device	Adjustment of the signal option for the command output. To match the command signal output to the input signal mode of a rear amplifier.
E21 internal command signal conjunction	Adjustment of conjunction for the internal command signals. To match the command signal logic.

Parameter overview for the maintain mode

Parameter	Description	Unit	Parameter range		Default setting
			from	up to	
S11	ramp for int. command S1	ms	0	32500	0
S12	ramp for int. command S2	ms	0	32500	0
S13	ramp for int. command S3	ms	0	32500	0
S14	ramp for int. command S4	ms	0	32500	0
S15	ramp for int. command S9	ms	0	32500	0
S16	ramp for int. command S10	ms	0	32500	0
S17	default ramp	ms	0	32500	0
E22	int. command signal ramp function	–	0 = quadrant depend. (S5...8) 1 = int. command depend. (S11...17)		0 = quadrant depend.
E25	MIN operating threshold	–	0 = 1 % 1 = 0.01 %		0 = 1 %

Individual description of the maintain mode parameter

S11 ramp for internal command signal 1	Adjustment of the ramp rate for the internal command signal channel S1. To avoid switching noise.
S12 ramp for internal command signal 2	Adjustment of the ramp rate for the internal command signal channel S2. To avoid switching noise.
S13 ramp for internal command signal 3	Adjustment of the ramp rate for the internal command signal channel S3. To avoid switching noise.
S14 ramp for internal command signal 4	Adjustment of the ramp rate for the internal command signal channel S4. To avoid switching noise.
S15 ramp for internal command signal 9	Adjustment of the ramp rate for the internal command signal channel S9. To avoid switching noise.
S16 ramp for internal command signal 10	Adjustment of the ramp rate for the internal command signal channel S10. To avoid switching noise.
S17 default ramp	Adjustment of the ramp rate for the default ramp. To avoid switching noise.
E22 internal command signal ramp function	Adjustment of the ramp function for the internal command signals. To match the ramp functionality.
E25 MIN operating threshold	Adjustment of the MIN operating threshold. To match the response sensitivity for the MIN-stroke step.

5.4 Error messages

Malfunctions when using the ProPxD software program will be indicated via appropriate failure messages.

Failure messages and corrective actions

Failure message	Description/corrective action
The Com Port is not available!	Terminate the other program, or quit the message and select another RS-232C port via the menu "Options > Port". Afterwards reconnect the null modem cable.
Unable to open COM port	Com port is not available. Quit the message and select another virtual COM port via the menu "Options > Port".
There is no module connected or the communication is disturbed!	No data exchange possible. Either the electronic has been removed, the port is mismatched, or the connection will be disturbed by strong electrical fields. Check if the Com port is set for "9600, 8, 1. none, none" via the menu "Options > Port".
Wrong password!	Retype the password, notice the exact spelling (case sensitivity).
Wrong input!	An invalid character or a value outside the permitted range has been used at parameter entry.
Keep the entered parameters?	During parameter loading from the electronic module memory the preset parameters from the left hand screen display may be rejected or maintained.
The chosen module isn't the same as the connected hardware!	In principle, parameters dedicated to a type which deviates from the connected electronic module may be edited. However, for data transmitting the correct module has to be connected. If parameters will be loaded from a module which deviates from the selected one, the parameters from the left hand side screen display of the program will be overwritten.
file name.pxd already exists. Do you want to replace the file?	The file name already exists within the indicated directory. Select another name, another directory or overwrite the existing file with "OK".

6. Maintenance

 Service work may only be carried out by qualified personnel. Detailed knowledge of the machine functions concerning switching on and off as well as of the required safety relevant technical tasks is required!

Periodical maintenance is essential for the longevity of the unit and guarantees reliability and availability. The following properties of the electronic has to be checked in continuous short time intervals:

- tight fit on the mounting rail
- tight fit of the disconnectable terminals
- tight fit of the terminal screws
- environmental temperature level
- supply voltage level
- cleanliness of the ambience

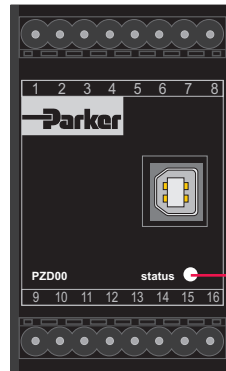
7. Troubleshooting

Basis of troubleshooting is always a systematic approach. At first the following questions have to be checked:

- are there practical experiences with similar failures?
- have system adjustments been changed?

 In either case the available diagnostic options should be used. The electronic permits a diagnostic of the valve function via the monitor output. The status output monitors the working condition of the electronic, an additional visual status results from an LED indicator.

Location of the status indicator



Statusanzeige

Function assignment

Operating condition	LED-display
no failure	green
no supply voltage	off
cable break command signal (only for option 4...20 mA)	red
internal processor fault	red

Afterwards starting of troubleshooting by means of a priority list of the most likely reasons.

malfunction at runtime of the connected amplifier					
- output signal absence - output signal oscillation - wrong output polarity - output signal too low - output signal too high - signal course too abrupt - output signal without input signal presence - no potentiometer supply					
	possible reasons for malfunction			corrective actions	
X	X		X	supply voltage absent or too low	keep supply voltage range
	X			supply voltage contains too much ripple	reduce ripple
X				missing electronic parameters	provide parameters
X	X	X	X	incorrect electronic parameters	check parameters
X	X	X		wiring sequence incorrect	correct wiring sequence
X			X	wiring interrupted	fix cable
		X	X	potentiometer supply overloaded	increase resistance up to min. 2kOhm
X		X		command input signal too low	increase command input signal
	X			command input signal contains too much ripple	reduce ripple
X			X	electronic terminals contaminated	clean terminals
	X			cables partly or totally without shielding	change cable grade
			X	electronic defective	keep characteristics, check wiring, replace electronic
X	X		X		

 Troubleshooting in a hydraulic system requires in either case a systematic approach. The work may exclusively be performed by qualified personnel, as it requires detailed knowledge about function and construction of the system. Reversals or disassemblies may not be taken imprudently! Prior to the works it has to be clarified, if the system has been operated properly until the failure occurred.