Bulletin MSG11-5715-695/UK

Operation Manual
Series DFplus

Design > 30

Proportional Directional Control Valve with freely configurable supervising Control Circuit

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WARNING — USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

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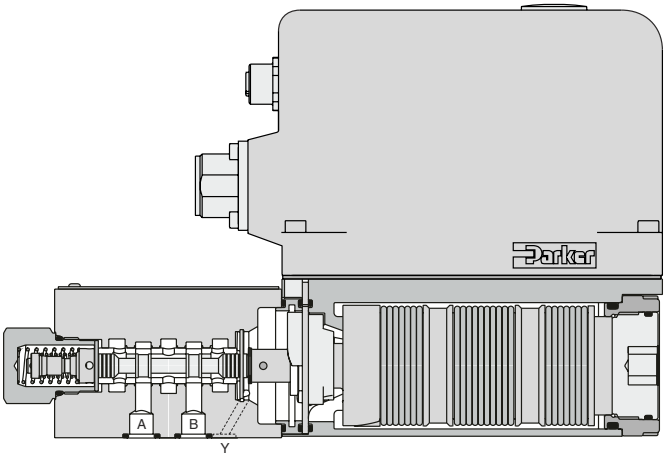
The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

1. Introduction

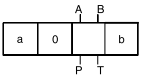
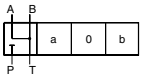
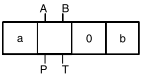
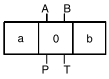
D*FP



Ordering code

D		F	P			9				D	
Direct. control valve	**Nominal size**			**Spool-type** (see catalogue)	**Spool position on power down** [1]	**Y-port plugged (resp. verify)** [2]	**Seal**	**Command-signal**	**Elec-tronics option**	**Freely config. super-vising control circuit**	**Design series** (not required for ordering)

Code	Nominal size
1	NG06 / CETOP 03
3	NG10 / CETOP 05

Code	Spool position on power down	Code	Spool position on power down
A [3]		H [5] [6]	
B [3]		J [5] [6]	
C [4]			

Code	Connection
0	6 + PE
5	11 + PE
7	6 + PE + Enable

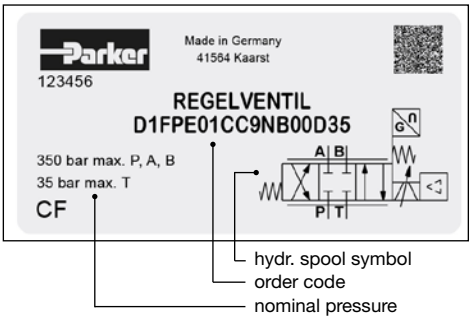
Code	Signal	Function
B	+/- 10 V	0...+10 V -> P-A
E	+/- 20 mA	0...+20 mA -> P-A
K	+/- 10 V	0...+10 V -> P-B
S	4...20 mA	12...20 mA -> P-A

Code	Seal
N	NBR
V	FPM
H	for HFC fluid

[1] On power down the spool moves in a defined position.
This cannot be guaranteed in case of single flow path on the control edge A – T resp. B – T with pressure drops above 120 bar or contamination in the hydraulic fluid.
[2] Needs to be removed at tank pressure >35 bar.
[3] Approx. 10 % opening, only zero lapped spools and underlap spools.
[4] Only for overlapped spools.
[5] D1FP: Flow for code M: 35 l/min at Δp 35 bar.
[6] Only D1FP

D_FP_D 5715-695 UK.indd 16.09.21

Name plate



Characteristics of valve driver

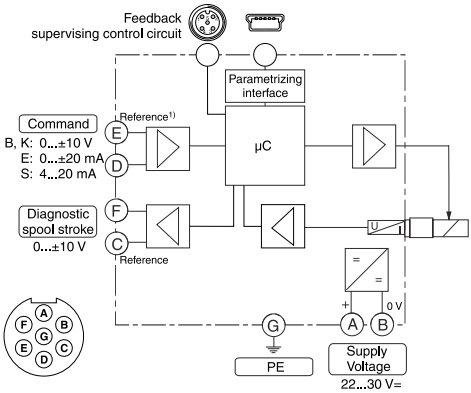
The integral electronic driver combines all functions for optimal operation of the valve. Thanks to its excellent dynamic the valve is deployable within closed loop control applications. The most important features are:

- freely configurable supervising control circuit
- high dynamic actuator with specially designed electronic driver
- closed loop controlled spool position
- constant current actuator control with overcurrent shutoff
- excellent properties for response sensitivity and temperature drift
- differential input stage with various command signal options
- diagnostic output for spool stroke / overcurrent state
- meets relevant European EMC-standards

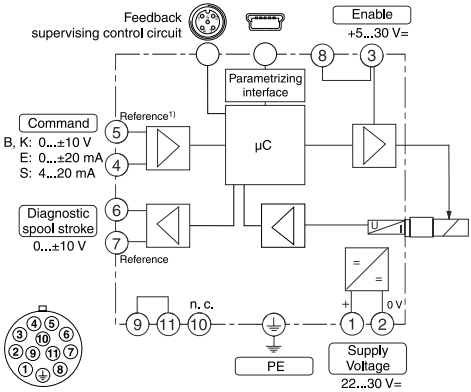
CE

Block diagram of onboard electronics

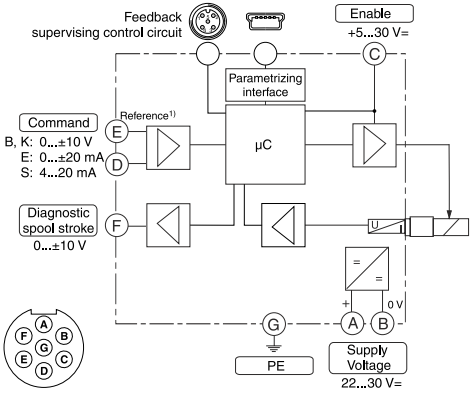
Code 0 (6+PE)



Code 5 (11+PE)



Code 7 (6+PE with enable)



1) Do not connect with supply voltage zero.

Technical data

General			
Model			Proportional directional control valve
Drive			VCD®-actuator
Mounting interface			NG06 (CETOP 03) / NG10 (CETOP 05)
Installation position			unrestricted
Sensitivity		[%]	< 0.03
Hysteresis		[%]	< 0.05
Temp. drift of center postion		[%/K]	< 0.025
Ambient temperature		[°C]	-20...+50
Vibration resistance		[G]	10 Sinus 5...2000 Hz acc. IEC 68-2-6 10 (RMS) Random noise 20...2000 Hz acc. IEC 68-2-36 15 Shock acc. IEC 68-2-27
Weight		[kg]	NG06: 3.6 / NG10: 6.5
Hydraulic			
Fluid			Hydraulic oil according to DIN 51524 ... 535, other on request
Fluid temperature		[°C]	Seal code: N: -25...+60, H, V: -20...+60
Viscosity permitted		[cSt]/ [mm^2/s]	20...400
recommended		[cSt]/ [mm^2/s]	30...80
Filtration			ISO 4406; 18/16/13
Operating pressure max.		[bar]	350 for ports P, A, B / max. 35 for port T at internal drain, 350 when using port Y / port Y max. 35 [1]
Electrical			
Duty ratio		[%]	100
Protection class			IP65 in accordance with EN 60529 (with correctly mounted plug-in connector)
Supply voltage / ripple		[V]	22...30, electric shut-off < 19, ripple < 5 % eff., surge free
Current consumption max.		[A]	3.5
Pre-fusing		[A]	4.0 A medium lag
Input signal	Code B, (K) voltage	[V]	+10...0...-10, ripple < 0.01 % eff., surge free, 0...+10 V P–>A (P–>B)
	Impedance	[kOhm]	100
	Code E current	[mA]	+20...0...-20, ripple < 0.01 % eff., surge free, 0...+20 mA P–>A
	Impedance	[Ohm]	<250
	Code S current	[mA]	4...12...20, ripple < 0.01 % eff., surge free, 12...20 mA P–>A
	Impedance	[Ohm]	<250
			< 3.6 mA = enable off, > 3.8 mA = enable on acc. NAMUR NE43
Input capacitance typ.		[nF]	1
Differential input voltage max.		[V]	30 for terminal D and E against PE (terminal G) 11 for terminal D and E against 0 V (terminal B)
	Code 0		
	Code 5	[V]	30 for terminal 4 and 5 against PE (terminal ⏚) 11 for terminal 4 and 5 against 0 V (terminal 2)
	Code 7	[V]	30 for terminal D and E against PE (terminal G) 11 for terminal D and E against 0 V (terminal B)
Enable signal	Code 5/7	[V]	5...30, Ri = > 8 kOhm
Diagnostic signal		[V]	+10...0...-10 / +12.5 error detection, rated max. 5 mA
EMC			EN 61000-6-2, EN 61000-6-4
Electrical connection			
	Code 0/7		6 + PE acc. EN 175201-804
	Code 5		11 + PE acc. EN 175201-804
Wiring min.	Code 0/7	[mm^2]	7 x 1.0 (AWG16) overall braid shield
	Code 5	[mm^2]	8 x 1.0 (AWG16) overall braid shield
Wiring length max.		[m]	50

[1] For applications with p_T>35 bar (max 350 bar) the Y-port has to be connected and the plug in the Y-port has to be removed.

2. Safety instructions

Please read the operation manual before installation, start-up, service, repair or stocking! Disregard may result in damaging the valve or incorporated system parts.

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 valve or linked system components

Helpful additional instructions

Service

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

3. Important details

Intended usage

This operation manual is valid for proportional directional control valves DFplus series. Any different or unintended usage is to be considered as not intended. The manufacturer is not liable for warranty claims resulting from this.

Common instructions

Parker reserves the right for technical modifications of the described product. Illustrations and drawings within this manual are simplified representations. Due to improvement or modification of the product the illustrations might not match precisely with the described valve. The technical specifications and dimensions are not binding. No claims can be derived of it. Copyrights are reserved.

Liability

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

- incorrect mounting / installation
- improper handling
- lack of maintenance
- unintended usage

Do not disassemble the valve! In case of suspicion for a defect please contact Parker.

Storage

In case of temporary storage the valve must be protected against contamination, atmospheric exposure and mechanical damages. Each valve has been factory tested with hydraulic oil, resulting in protection of the internal parts against corrosion. Yet this protection is only ensured under the following conditions:

Storage period	Storage requirements
12 months	constant humidity < 60 % as well as constant temperature < 25 °C
6 months	varying humidity as well as varying temperature < 35 °C

Outdoor storage or within sea and tropical climate will lead to corrosion and might disable the valve!

4. Mounting / Installation

Scope of supply

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

- valve
- operation manual

The central connector has to be ordered separately and is not included in the delivery.

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

Mounting

- Compare valve type (located on the name plate) with bill of materials respectively circuit diagram.
- The valve may be mounted fix or movable in any direction.
- Check mounting surface for the valve. Uneveness of 0.01 mm/100 mm, surface finish of 6.3 µm are tolerable values.

☞ Keep valve mounting surface and work environment clean!

- Remove protection plate from the valve mounting surface
- Check the proper position of the valve ports and the O-rings.
- Mounting bolts:
  D1FP: 4 pcs. M5x30
  D3FP: 4 pcs. M6x40
  use property class ISO 4762-12.9
- Bolt kits:
  D1FP: BK375
  D3FP: BK385
- Tighten the bolts crisscross with the following torque values:
  D1FP: 7.6 Nm
  D3FP: 13.2 Nm

⚠ Insufficient condition of the valve mounting surface might create malfunction!
Incorrect mounting resp. bolt torque may result in abrupt leakage of pressure fluid on the valve ports.

Limits of use

The valve may be operated within the determined limits only. Please refer to the “technical data“ section as well as to the “characteristic curves“ in the Parker catalogue HY11-3500/UK “Hydraulic Valves Industrial Standard”.

⚠ Follow the environmental conditions! Unallowable temperatures, shock load, aggresive chemicals exposure, radiation exposure, illegal electromagnetic emissions may result in operating trouble and may lead to failure! Follow the operating limits listed in the catalogue HY11-3500/UK “Hydraulic Valves Industrial Standard“, see technical data.

Pressure fluids

The following rules applies for the operation with various pressure fluids:

⚠ This above information serves for orientation and does not substitute user tests among the particular operating conditions. In particular, no liability for media compatibility may be derived out of it.

Mineral oil: usable without restriction.
HFC: choose the right seal option.

For operation with the following pressure fluids please consult Parker:

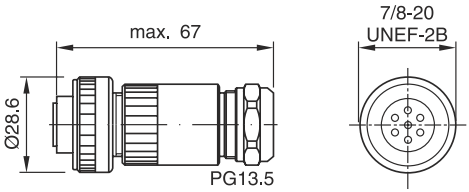
HFA	oil-in-water emulsion
HFB	water-in-oil emulsion
HFD	unhydrous fluids (Phosphor-Ester)

☞ For detailed information concerning pressure fluids note VDMA-document 24317 as well as DIN 51524 & 51502.

Electrical connection

The valve is connected electrically by one common cable and a central connector.

The connection codes 0 and 7 require a 6 + PE female connector EN 175201-804.



☞ The female connector can be ordered separately under article nr. 5004072.

⚠ In case third party connectors are used, accordance to the relevant EMC directives must be ensured.

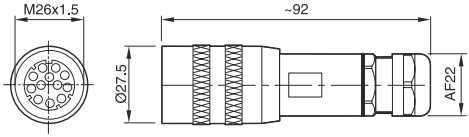
The connecting cable has to comply to the following specification:

Cable type	control cable, flexible, 7 conductors, overall braid shield
Cross section	min. AWG16
Outer dimension	8...12 mm
Cable length	max. 50 m

☞ For cable lengths > 50 m consult Parker.

The connection cable is coupled to the female connector by solder joints.
The shielding has to be assembled according the outline below.
Skinning lengths for the connecting cable:

The connection Code 5 requires a 11 + PE female connector EN 175201-804.



☞ The female connector has to be ordered separately under article nr. 5004711.

⚠ In case third party connectors are used, accordance to the relevant EMC directives must be ensured.

The connecting cable has to comply to the following specification:

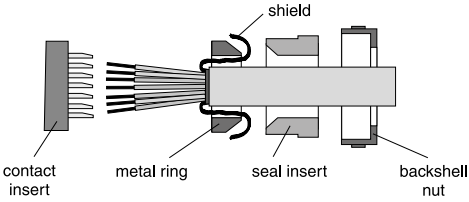
Cable type	control cable, flexible, 8 conductors, overall braid shield
Cross section	min. AWG16
Outer dimension	12...15 mm
Cable length	max. 50 m

☞ For cable lengths > 50 m consult factory.

The connection cable is coupled to the female connector by crimp contacts.
The shielding has to be assembled according the outline below.

Skinning lengths for the connecting cable:

⚠ Do not disconnect cable socket under voltage!



The backshell nut of the cable gland has to be tighten with a suitable tool. The target value for the tightening torque is 4 Nm. Tighten the cap nut with a torque of 5 Nm after attaching the female connector on the socket.

⚠ Incomplete tightening of backshell nut respectively cap nut may result in undesired release of the connection as well as degradation of the water tightness.

When using female connectors of other manufacturers, the relevant regulations must be observed.

⚠ The cable may only be connected to the female connector by authorized and qualified personnel. A short between individual conductors resp. to the connector housing , bad soldering as well as improper shield connection may result in malfunction and breakdown of the valve.

⚠ The mounting surface of the valve has to be connected to the earth grounded machine frame. The earth ground wire from the valve connecting cable as well as the cable shield 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 AWG 6).

Electrical interfacing

Supply voltage

The supply voltage for the valve has to cover the range of 22...30 V. Valve is de-energized below 19 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 valve must be free of inductive surges. Do not exceed the max. value of 30V! Higher voltage can lead to failure of the valve.

The increased inrush current of the valve should be considered when selecting the power supply. A stabilized power supply with overcurrent limiting feature should not be used. Due to the inrush current of the valve the current limit circuit may respond prematurely and create problems during energizing of the supply voltage.

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

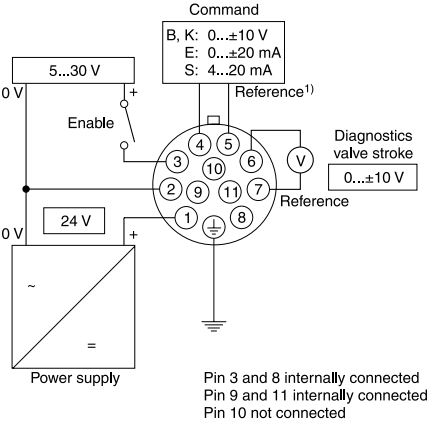
Each valve requires a separate pre-fuse of 4 Amp semi time-lag. Failure to observe this instruction may create irreparable damage of valve respectively incorporated system parts.

Enable input (only for Code 5 / 11+PE as well as code 7 / 6+PE)

A signal voltage enables the actuator drive of the valve. Continuous operation of the valve requires a permanent voltage 5...30 V (e.g. the supply voltage). In case of disabling the signal the valve will reach its power down position spring-actuated independently from the command signal value.

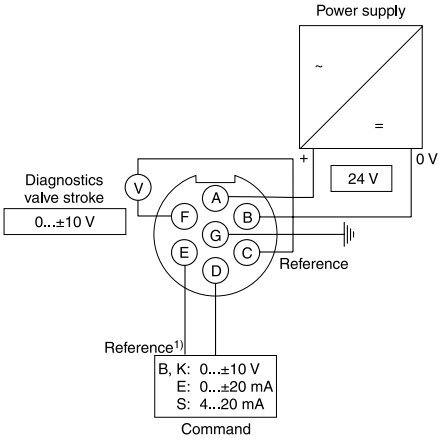
The enable function represents no safety arrangement against unwanted valve operation in terms of accident prevention regulations.

Code 5, 11 + PE acc. EN 175201-804

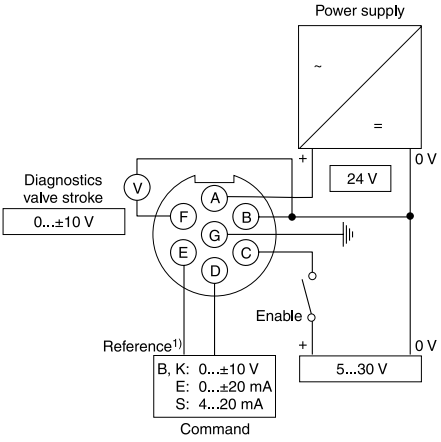


Wiring

Code 0, 6 + PE acc. EN 175201-804



Code 7, 6 + PE acc. EN 175201-804 + enable



1) Do not connect with supply voltage zero.

Command signal input

The spool stroke is proportional to the command signal amplitude.

⚠ The command input signal needs to be filtered as well as free of inductive surges and modulations. Due to the sensitivity of the valve a high signal quality is recommended. This will prevent malfunction.

☞ The option 4...20 mA uses the “3.6 mA“ condition as breakdown-information. If the input signal line is interrupted, an evaluable failure information is available. In this case the actuator drive will be switched off. The drive will switch 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.

Diagnostic output

A diagnostic signal is available. Its voltage represents the operating condition of the valve.

⚠ The output may drive a load of max. 5 mA. Exceeding of this limit leads to malfunction.

5. Operating instructions

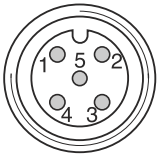
D3FP

Code command signal	Command signal	Function	VCD actuator	Diagnostic signal
B	0…+10 V		on	0…-10 V
	0…-10 V		on	0…+10 V
	Overload	 [1]	off	12.5 V
E	0…+20 mA		on	0…-10 V
	0…-20 mA		on	0…+10 V
	Overload	 [1]	off	12.5 V
K	0…+10 V		on	0…+10 V
	0…-10 V		on	0…-10 V
	Overload	 [1]	off	12.5 V
S	4…12 mA		on	0…+10 V
	12…20 mA		on	0…-10 V
	0…3.6 mA	 [1]	off	Cable break, 12.5 V
	Overload	 [1]	off	12.5 V

D1FP

Code command signal	Command signal	Function	VCD actuator	Diagnostic signal
B	0…+10 V		on	0…+10 V
	0…-10 V		on	0…-10 V
	Overload	 [1]	off	12.5 V
E	0…+20 mA		on	0…+10 V
	0…-20 mA		on	0…-10 V
	Overload	 [1]	off	12.5 V
K	0…+10 V		on	0…-10 V
	0…-10 V		on	0…+10 V
	Overload	 [1]	off	12.5 V
S	4…12 mA		on	0…-10 V
	12…20 mA		on	0…+10 V
	0…3.6 mA	 [1]	off	Cable break, 12.5 V
	Overload	 [1]	off	12.5 V

Pin assignment analog sensor, M12 socket



1: U_S
2: ±10 V
3: GND
4: 4 ... 20 mA +
5: 4 ... 20 mA -

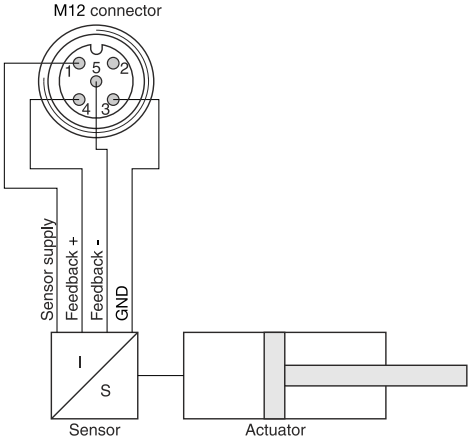
The M12 socket can be connected to voltage as well as current sensors.

[1] Diagnostic signal 12,5 V in error case. Spool moves in a defined postion, please see ordering code „spool position at power down“.

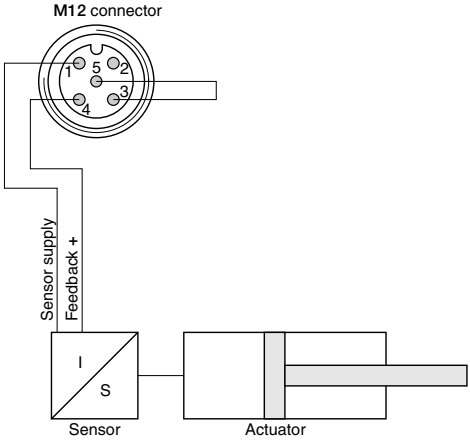
Examples position control

Current 4...12...20 mA contacts at the sensor input

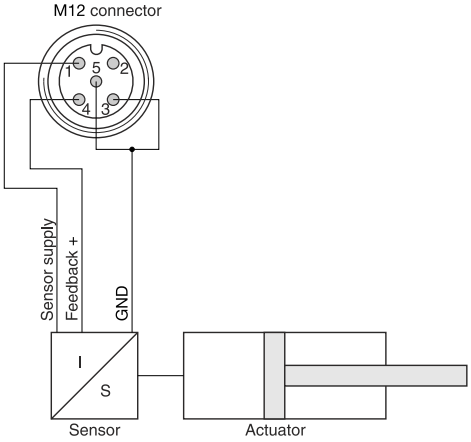
Wiring diagram four-wire



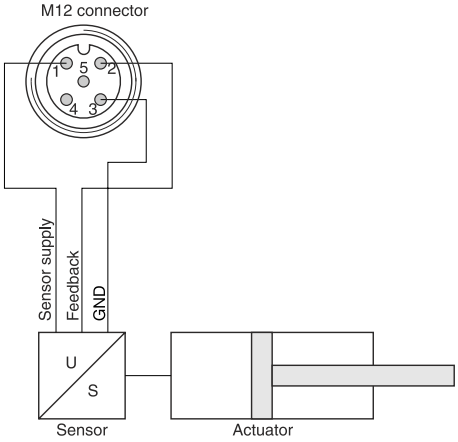
Wiring diagram two-wire



Wiring diagram three-wire



Voltage ±10 V (1...10 V)



The earth connection is achieved via the shilding.

⚠ The connection of a unsuitable sensor may create irreparable damage of the electronics.

Spool position at power down/center position

⚠ For valves with zero lap spools, distinction must be made between hydraulic neutral position and power-down position. Neutral position is taken at neutral input signal, corresponding to zero position of the hydraulic symbol. When the valve is switched off – no supply voltage, no enable, current signal (code S) < 3,8 mA – zero lap valves take the power down position (approximately 10 % opening) according to the ordering code. For valves with overlap spools, neutral position and power down position are the same (zero position).

Solenoid current monitoring

If the actuator current time interval exceeds 10 seconds, the actuator is switched off to prevent overheating. For normal operating conditions this state will not reached, but it may occur with a contaminated sluggish valve.

⚠ In this case the reason for the contamination should be rectified (hydraulic fluid exchange, filtration review, valve flushing).

The overcurrent shutoff condition may be resetted by the actions below:

Code 0: Temporary disconnection of the supply voltage.

Code 5: Temporary disconnection of the enable signal.

Code 7: Temporary disconnection of the enable signal.

☞ The shutoff of the VCD actuator due to overload will be indicated via the diagnostics output.

ProPxD parameterizing software

The ProPxD software permits comfortable parameter setting. 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.

The PC software can be downloaded free of charge at www.parker.com/isde – see page “Support” or directly at www.parker.com/propxd. Please check periodical whether the latest version is used.

Hardware requirements

- PC with operating system from Windows® XP upwards
- Interface RS232C
- display resolution at least 800 x 600
- connection cable between PC and electronic module
- memory requirement approximately 40 MB

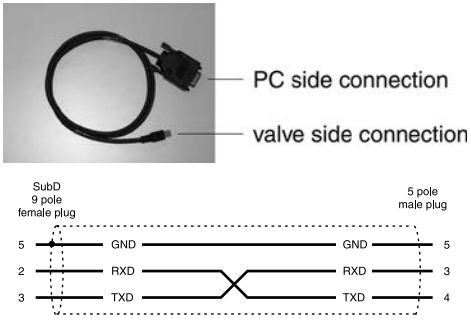
☞ If your PC has no serial interface according to RS232C standard you require in addition an USB-RS232C adapter.

Cable specification

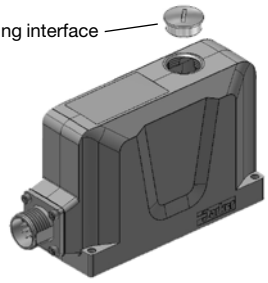
⚠ Attention! The valve electronic provides no USB interface, but can only be parametrized via an RS232C-connection. Therefore the usage of USB standard cables is not allowed and may result in damaging of valve respectively PC.

Parametrizing

Ordering code: 40982923



Parametering interface



⚠ The cover plug has to be re-installed after completion of the parametrizing work.

Program installation

Please check before installation if the above hardware requirements are met. If your PC has already stored an older version of the “ProPxD” program, it has to be deinstalled by using the Windows® - system control feature.

Program installation sequence:

- terminate the execution of other programs
- execute the file “setup.exe”
- follow the instructions on the screen

Answer the question, if an older version should be overwritten, with “ok”. During the installation you may change destination drive respectively installation path, if needed.

Please answer “ok” if at the end of the installation the program reports any system information. After successful installation the desktop display shows the ProPxD icon for starting the program.

Software operating

Brief instruction for first startup:

- Connect the valve electronic to the supply voltage.
- Connect the valve electronic to a PC via the parametrizing cable.
- Start the operating program.
- After displaying the program respectively data base version a program window opens and the connected valve will be automatically identified (possibly a manual identification via the button “Receive all” is necessary).
- Select the desired version via the menu “Options/Optionen” with the menu item “Language/ Sprache”.

- The valve specific default parameters are already available within the parameter table.
- Parameter changes are possible via mouse or the arrow buttons on the bottom left within the program screen, also the parameter values may be edited via the keyboard.
- Modified parameters will be stored via the “Enter” key or via the button “Update list”.
- Parameters have to be nonvolatile stored on the valve via the button “save parameter”.
- The chosen parameters may be optionally stored on the PC via the “File”-menu with the menu item “Save as”, data retrieving is always possible via the function “Load file”

Extended functions:

The user software is segmented into two parameter ranges:

- basic mode
- expert mode

For normal startup the basic mode is sufficient. It permits the setting of all application specific parameters to match the valve function with the task setting.

In case of special applications the valve parameters may be adapted via the expert mode. The operating mode may be selected from the “Options”- menu and remains after terminating and re-start of the program.

⚠ Changing of expert parameters is only permitted for qualified personnel. Incorrect settings may lead to malfunction! In case of parameter changes shut the drive down!

To prevent an unauthorized access for the expert mode, a password is requested. The name is “parker” and cannot be changed. Thus additionally to the button “Default” for loading of the default parameters, the button “Send parameter” appears in the “Expert”-operating mode. This button transmits only the setting of one single parameter to the connected valve. Thus a quick tuning of single parameters is permitted during the setup.

☞ A horizontal bar graph readout between the communication buttons shows the data transfer state.

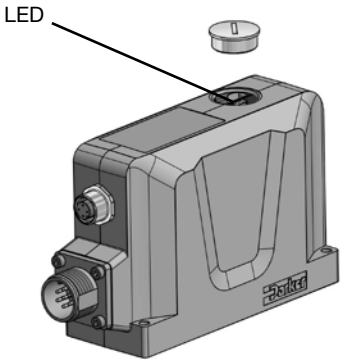
☞ Because the ProPxD program has also without connection to the valve functionality, a manual pre-selection of the parameters is possible. After selection of the valve type via the menu “Options” the parameters may be set and stored for later transmission.

Note the design series while selection of the valve!

The “File” menu provides the functions “Printer setup”, “Print preview” and “Print”. The print preview includes the option for parameter set storage as text file (format.txt) prior to further processing. The “Options” menu provides also the selection of the RS232C interface port via the menu item “Port”. Via the menu item “Load file” previously stored parameter sets may be loaded.

LED flashing signals of the valve electronics

enable valve OK: approx. 0.5 Hz (slowly, green)
disable valve OK: approx. 1 Hz (fast, green)
valve error: approx. 10 Hz (very fast, green)



Closer information can be can be displayed via the ProPxD parametrier software.

Error code

Error code (additive)	Error description
0	no errors
1	over current
2	cable break command signal
4	cable break feedback signal
8	undervoltage error
16	bus communication error
32	hardware failure

Error code read-out under task menu “Diagnosis/ condition monitoring information” and “Diagnosis/ receive Error codes”

Adjustment parameters

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

P-parameters operating parameters
E, J, K-parameters extended parameters
H-parameters supervising control parameters

Parameter overview for basic mode

Parameter	Description	Unit	Parameter Range ProPxD		Default Setting
			from	up to	
P1	Zero adjustment	%	-90.0	90.0	0.0
P3	MAX channel A	%	50.0	100.0	100.0
P4	MAX channel B	%	50.0	100.0	100.0
P7	MIN channel A	%	0.0	50.0	0.0
P8	MIN channel B	%	0.0	50.0	0.0
P11	Input signal inversion	–	0 = not inverted 1 = CMD inverted 2 = Diagnosis inverted 3 = both inverted		0
E17	Input signal (see installation instruction)	–	1 = ±10 V [1)] 2 = ±20 mA [1)] 3 = 4-20 mA [1)] 4 = 4-20 mA uni [2)] 5 = ±10 mA [1)]		1
E19	Input signal cable break detection (only 4...20 mA)	–	out = 0 on = 1		0

Individual description of basic parameters

P1	Adjustment of zero position displacement (offset). To compensate unbalances. Without 2nd control circuit (H21=0) for Pilot. With 2nd control circuit (H21 <> 0) for 2nd control circuit
P3	Adjustment of maximum signal span for positive output signal. To match the command signal span to the valve operating range.
P4	Adjustment of maximum signal span for negative output signal. To match the command signal span to the valve operating range.
P7	Adjustment of positive output signal step. To compensate for the valve overlap.
P8	Adjustment of negative output signal step. To compensate for the valve overlap.
P11	Adjustment of the command signal and diagnostic output signal polarity. To match the command signal polarity to the control system and downstream monitoring systems.
E17	Adjustment of the command signal input. To match the command signal input to the input signal mode.
E19	Adjustment of the operating mode for the command cable break detection. To turn on resp. off the cable break detection for the command signal at a selected command signal option of 4...20 mA.

[1)] -100 %...+100 %
[2)] 0 %...+100 %

Overview for additional expert mode parameter

Parameter	Description	Unit	Parameter Range ProPxD		Default Setting
			from	up to	
J8	Min supply voltage	V	17	28	18
J9	Delay supply voltage	ms	0	3000	1000
J12	Error handling	–	0 = no acknowledgment 255 = acknowledgment necessary 768 = no acknowledgment + diagnosis 1023 = acknowledgment + diagnosis		768
J16	4-20 mA diagnosis inversion	–	0 = not inverted 1 = Diagnosis 4-20 mA inverted		0
K17	Pilot zero adjustment		-20.000	20.000	0.000
H1	2nd control circuit P-amplification		0.00	100.00	0.00
H2	2nd control circuit P-part limitation	%	0.00	100.00	100.00
H17	2nd control circuit I-amplification		0.00	100.00	0.00
H18	2nd control circuit I-range		0.00	200.00	200.00
H19	2nd control circuit I-part limited	%	0.00	100.00	100.00
H20	2nd control circuit zero adjustment feedback		-30.000	30.000	0.000
H21	2nd control circuit feedback selection	–	0 = off 1 = main stage ±10 V [1] 2 = main stage 1-10 V [2] 3 = 4-20 mA [1] 5 = 4-20 mA uni [2]		0
H22	2nd control circuit feedback multiplicator / polarity	%	-300.00	300.00	100.00
H23	2nd control circuit feedback cable break detection	–	0 = off 1 = on		0
H24	2nd control circuit driven / controlled	–	0 = driven 1 = controlled		0
H25	2nd control circuit D Input ring buffer	–	0 = off 2 = 2 x 4 = 4 x 8 = 8 x		0
H26	2nd control circuit D-amplification		-100.00	100.00	0.00
H27	2nd control circuit D -lead time		0.00	100.00	0.00
H28	2nd control circuit D-part limitation	%	0.00	100.00	0.00

[1] -100 %...+100 %
[2] 0 %...+100 %

Individual description of additional expert parameters

J8	Adjustment of the minimal supply voltage below which the valve switches off with an error message.
J9	Adjustment of the minimum time the supply voltage should be above the set value of J8 for the valve to become ready for operation.
J12	Adjustment of error handling and report via diagnostic output: No acknowledgement necessary = fault will be deleted automatically as soon as the fault cause is solved (exception over current shotdown/ overload) Diagnosis => in fault case > +12.5 V voltage at the diagnosis output
J16	Polarity setting of the 4-20 mA diagnostic output. To match the downstream monitoring systems.
K17	Adjustment of zero position displacement (offset). To compensate unbalances.
H1	Adjustment of P-part for the controller. Basic configuration of the controller.
H2	Limitation of the P-part. To weighten the P-part in the correcting value.
H17	Adjustment of I-part for the controller. To reduce the control fault.
H18	Adjustment of the active range for the I-part regarding the control difference. To limit the I-part to a specific range.
H19	Limitation of the I-part. To weighten the I-part in the correcting value.
H20	Adjustment of the zero position displacement (offset). To compensate asymmetries in the sensor signal.
H21	Adjustment of the sensor-type. To match the feedback input to the sensor signal type
H22	Adjustment of feedback scaling and its polarity. To adapt the working range to the feedback-input range and the sensor signal polarity of the control system. E.g. H23 = -120 % / H21 = 1 => +5 V Input gets converted to -6 V.
H23	Adjustment of the operating mode for feedback cable break detection. To activate or deactivate the cable break detection of the sensor signal.
H24	Adjustment of the operating mode of the controller. To select the contol function.
H25	Adjustment of the D input ring buffer depth. To smoothen the feedback signal before differentiation.
H26	Adjustment of D-part for the controller. To improve the control dynamics.
H27	Adjustement of the lead time for the DT1-element of the controller. To dampen of the D-part in the controller.
H28	Limitation of the D-part. To weighten the D-part in the correcting value.

Application: Closed loop systems for position

Introduction

The electronics uses a feedback control loop which automatically adjusts the electrical input to the valve amplifier to move the drive to a commanded position. At the heart of this feedback loop is a digital controller which computes and updates the signal output (set value output) highly dynamic. The controller has adjustable coefficients, which must be set by the user for the particular application.
The controller provides a extended PID control capability plus extra features you can use to improve the performance beyond the limits of PID.

Basic information for the control algorithm
Why tuning?

The controller can be used with valves that vary greatly in flow capacity, frequency response, saturation and deadband, with different kinds of load, and with cylinders of any area and stroke. The user must adjust the control coefficients for the specific system. There are no fixed sets of values for the controller coefficients that will handle every situation well.
The electronics utilizes a "PID" controller for its basic control action. The name PID comes from the fact that the controller output is the sum of three terms, called proportional (P), integral (I) and derivative (D), each with a user adjustable coefficient.
The user software provides therefore the parameters H1 (P), H17 (I) and H26 (D).

P - H1

This term provides an immediate output signal, proportional to the error between commanded and measured position. If this parameter is set too high, sustained oscillations may occur. If it is set too low, accuracy and speed of response may be poor.
By using parameter H2 the setting of the variable is limited.

I - H17

This term causes the output to change at a rate proportional to the error in measured position over time (integration time), in a direction to drive the steady state error to zero. H17 is active within a window, which might be adjustable by parameter H18. H18 shall be adjusted in the way that the window lies near the final position or in the stationary range of the drive. A too higher value of H17 causes oscillations, in addition to which the selection of a too lower value may result in a slow action.
By using parameter H19 the setting of the variable can be limited.

D - H26

The D-term provides an output proportional to the rate of change of the measured drive position. Depending on the polarity of the parameter prefix, this term causes damping or acceleration. For hydraulic drives this term should be set to a low value.
By using parameter H27 lead time the rise can be damped.
By using parameter H28 the setting of the variable can be limited.

Simple tuning of a position control loop

Before trying anything complicated, you should adjust the proportional gain, accessible by H1. In many cases this coefficient will be all you need, and you will not have to bother with any of the other control features. If you do need the other features, you cannot adjust them properly without first adjusting the P-gain. Adjusting the P-gain is done by setting all the other control coefficients H2-H21 as well as H23-H28 to zero and increasing H1 to the highest value that does not result in sustained oscillations of the drive position.

Guarantee of control functionality

Before the tuning of the control loop may be commenced, the functionality of the control circuit must be ensured. As previously mentioned, the controller compares command and feedback signal and adjusts the electrical input to the valve amplifier to move the drive to the commanded position. To ensure this functionality, the polarities of command and feedback signal must be equal.

How can the functionality of the control loop be achieved?

At first you should set off the control loop (set parameter H24 to value 0 = open loop and transmit to the electronic) and cause the drive via manual control to the middle of the cylinder stroke. Afterwards adjust at first the control coefficients as described in chapter “Simple tuning of a position control loop” (H1 at 10 %) as well as the parameter H24 at 2 = external closed loop and transmit to the electronic. If this results in a rapid movement of the drive to an end position, the polarities are incorrect. Access now the parameter H22 = feedback signal polarity, change the value and transmit the data. The drive should be adjustable and remain in its position when you switch on the closed loop control via parameter H24. Now you should preset position commands and supervise the drive movement. If the drive even tough is running in closed loop mode, but the direction of the movement is not as required, you have to change the polarities of both command and feedback signal via the parameters P11 and H22. After that the drive is running as desired, you can continue with tuning of the loop.

Tuning of the closed loop control

1. Create a suitable tuning test profile – otherwise it may be difficult for you to tell how good the system response is. The test profile should programmed in a way to cause the drive to move from the start position to the required final position with the desired maximum acceleration and velocity. In the final position the drive should be commanded to dwell, that will give you enough time to watch the load position to see if it oscillates or remains stationary. This should be followed by returning the drive to the start position, where the dwell in position may also be evaluated.
2. Check once more to be sure that H17 and H26 are set to zero.
3. Adjust H1 to a low value, i.e. 10 %, and try the system on the test profile. Observe the result of the test. There are three possible outcomes:

- The drive oscillates continuously
  Stop the system quickly. Reduce the H1-value to ½ of the initial guess, and try again.
- The drive overshoots, but stops after one or two oscillations.
  Reduce the H1-value to ¾ of the initial guess, and try again.
- The drive reaches the commanded position with no overshoot.
  The system is usable with the estimated value of P-gain. You should experiment by increasing the H1-value stepwise to see how high a value the system will tolerate. Accuracy and response are improved by high values, but do not allow permanent oscillation!
  You have now completed the basic tuning for your control loop. The next step is to test the performance of the system to whether it meets your requirements. If not, the electronic has additional control features you can use to improve performance, as explained below.

The table below gives information which approaches may be embarked if typical problems with position control loops appear.

Problem	Solution
Positon error too large, when drive is stationary	Use parameter P17 – I-gain increase (only if P26 = 10 %)
Disappointingly low P-gain	Check the frequency response of the valve and positon transducer, or possibly the drive resonant frequency (s. item below)
Response too slow	Be sure H1 = P-gain is adjusted high enough (s. also previous items)
Unexplainable problems	Check the setting of all parameters

Improving system performance
Using the parameter H17 = I-gain

The integrator gain (abbreviated I) can be adjusted to reduce or eliminate the error between the commanded position and the position measured by the feedback transducer, subject to the command remaining constant. Higher values of I-gain will cause the response to be slower and more prone to oscillation with the combined effect of a reduced stationary error. Lower values will require a reduced time to reach zero steady state error. This parameter is only active if a window (5 – 20 %) is defined via H18.

Elimination of slow, small amplitude oscillation in position

Because of friction and other imperfections, use of the I-gain sometimes causes a slow, small amplitude oscillation in load position. This is an entirely different problem from the vigorous oscillations that occur when the P-gain is set too high. The electronics provides a “Window” feature (sometimes called “in-position-window”) to solve this problem. Select the parameter H18. Stepwise increasing of the window size to a large enough value will stop the slow oscillations.

Increasing load stiffness

“Load stiffness” is the term given to the resistance of the servo loop to deflection of the drive by external forces. Adjusting P-gain (H1) to the highest practical value is important.

Disappointing control loop function

The higher the value of P-gain is adjusted, the better is the static and dynamic performance of the system. You may not have any direct need for fast response, but may still need a high value of P to reduce static error, reduce following error or increase load stiffness. High values of P cause faster system response, whether you need it or not. As the system frequency response gets too close to the frequency response of one of your components, the system response becomes oscillatory.

- Valve
  The frequency response of the valve can be obtained from catalogue HY11-3500/UK “Hydraulic Valves Industrial Standard“ series D1FP/D3FP. As a first guess, it needs to be at least twice the system frequency response.
- Position transducer
  Some analog output transducers will present problems because of filtering intended to smooth the output. To ensure the best system dynamic, sensors with integrated D/A-converter should operate with a high sampling rate. Magnetostrictive transducers with digital output often have a low sampling rate, because of an interaction with the achievable resolution. Please obtain detailed information from the transducer supplier.
- Drive
  There is a mode of mechanical vibration created by the mass of the load and the compressibility of the hydraulic fluid in the whole system (cylinders, pipe, valve). This frequency is often surprisingly low when using long stroke cylinders.

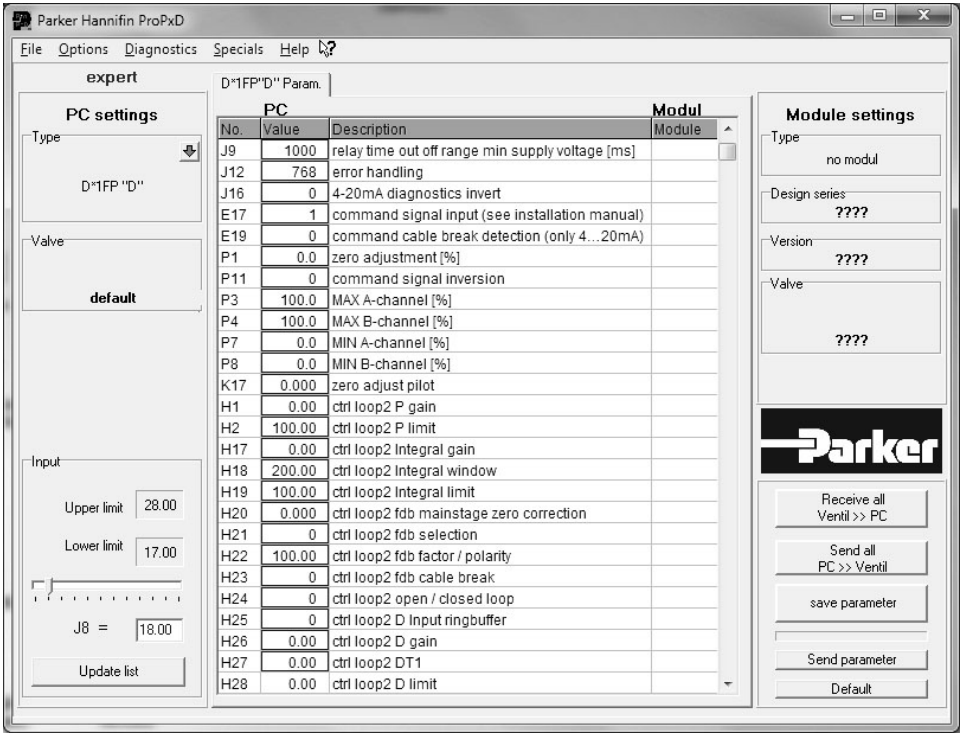
Sampling rate of the controller

The controller updates the electrical output to the valve at >1 kHz. This rate is fast enough to have negligible effect in almost all hydraulic applications, but it does set an absolute limit on the response of the system.

Position transducer accuracy and resolution

A control system cannot be better than its transducer.
Here are points to watch for:

- Absolute accuracy
  The controller positions the load as closely as possible to the position measured by the feedback transducer. The absolute accuracy of the measured position is determined by the transducer.
- Resolution
  The electronics cannot position the load more accurately than the resolution of the transducer. Be sure the resolution of your sensor is adequate. When using a true analog transducer (analog measurement principle and analog output), the resolution is limited by the utilized A/D-converter, which is 16 bit (1/4096 = 0.025 %).
- Installation
  The installation of the position transducer plays a most important rule for the proper functionality of the closed loop control. By all means it has to be secured, that the mounting of transducer and actuating device provides absolute freedom from vibration and clearance effects. This is most important even for the commonly expected velocities and accelerations. Also, the transducer has to be laid out for the dynamic requirements.



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 RS232C port via the menu “Options > Port”. Afterwards reconnect the parametrizing cable.
Unable to open COM port	Com port is not available. Quit the message and select another RS232C port via the menu “Options > Port”. Afterwards reconnect the parametrizing cable.
There is no module/valve connected or the communication is disturbed! Please check also the interface!	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 “115200, 8, 1. none, none” via the menu “Options > Port”.
Wrong password	Retype the password, notice the exact spelling (case sensitivity).
Wrong input	An unvalid character or a value outside the permitted range has been used at parameter entry.
The chosen module/valve isn´t the same as the connected hardware. Attention! Unsaved parameters will be lost.	In principle, parameters dedicated to a type which deviates from the connected valve may be edited. However, for data transmitting the correct valve has to be connected. If parameters will be loaded from a valve which deviates from the selected one, the parameters from the left hand side screen display of the program will be overwritten.
The chosen hardware isn´t the same as the connected module/valve.	The wrong valve type has been selected from the database, afterwards the function “send all” has been executed.
Attention! Factory settings will be changed! Transmit anyhow?	Default parameters has been read out from the database instead from the valve via the function “receive all”.
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”.
Further message	**Description**
Keep the entered parameters?	During parameter loading from the electronics memory the preset parameters from the left hand screen display may be rejected or maintained.

Air bleeding of hydraulic system

During initial startup, after an oil change as well as after the opening of lines or valves the hydraulic system must be air bleeded.

Filter

The function and lifetime of the valve are strongly affected by the cleanliness of the fluid.
Purity level class of 18/16/13 acc. ISO4406 is required.

Flushing

It is recommended to flush the pipelines by short circuiting the pressure and return lines. This prevents the installation dirt from entering the valve.

6. Trouble shooting

Basis of troubleshooting is always a systematic approach.

⚠ For suspect of a sluggish spool the valve may be flushed with clean pressure fluid.

⚠ Troubleshooting in a hydraulic system requires detailed knowledge about function and construction of the system. Therefore the work may exclusively be performed by qualified personnel.

malfunction at hydraulic load runtime - generally no function - high frequent oscillation - low frequent oscillation - one way operation only - speed variations at unchanging command - different speeds depending on travel direction - speed too low - drifting without command - poor dynamic										
									possible reasons for malfunction	**corrective actions**
X									hydraulic pump resp. motor defective	replace hydraulic pump resp. motor
X		X	X	X	X	X		X	drive overloaded	reduce pressure resp. speed, increase valve size
X		X	X	X	X	X	X	X	valve contaminated	clean pressure fluid, filter / flush valve
				X		X		X	hydraulic fluid too viscous / too cold	change fluid grade, provide operational temperature
X		X	X						too low oil level within tank	refill pressure fluid
				X	X	X			filter contaminated	replace filter
X		X				X	X		supply voltage too low	keep supply voltage range
	X								supply voltage carries too much ripple	reduce ripple
X			X			X			command signal too low	increase command signal
	X								command signal carries too much ripple	reduce ripple
			X		X				center position adjustment incorrect	check center position adjustment
X	X			X		X	X		contacts of central connector contaminated	clean contacts / replace plug
X									feed cable interrupted	fix feed cable
X	X	X	X	X		X	X		wiring sequence incorrect	correct wiring sequence
	X						X		feed cable without shielding	change cable grade
X									pilot pressure too low or failed	increase pilot pressure to min. 20 bar
		X				X	X		pilot pressure too low	increase pilot pressure to min. 20 bar
								X	pilot pressure too low	increase pilot pressure to min. 50 bar

7. Accessories / Spare parts

Accessories

The following accessories are available for the valve series DFplus:

Bolt kit

D1FP	ordering code BK 375
D3FP	ordering code BK 385

Female connection

Code 0: 6+PE	ordering code 5004072
Code 5: 11-PE	ordering code 5004711
Code 7: 6-PE	ordering code 5004072

Spare Parts

Seal kit NBR

D1FP	ordering code SK-D1FP
D3FP	ordering code SK-D3FP

Seal kit FPM

D1FP	ordering code SK-D1FP-V
D3FP	ordering code SK-D3FP-V

Seal kit HFC

D1FP	ordering code SK-D1FP-H
D3FP	ordering code SK-D3FP-H