WEST

Technical Documentation

PQ-132-U

p/Q-controller, pressure limiting controller for hydraulic axes

Electronics
Hydraulics meets
meets Hydraulics
Electronics

CONTENTS

1 General Information

1.1 Order number

PQ-132-U[1] - with programmable analogue output (±10 V differential output or 4… 20 mA) and analogue sensor interfaces

Extended versions

UHC-125-U-PDP - with programmable analogue output (±10 V differential output or 4… 20 mA) and analogue sensor interfaces, integrated **Profibus interface**

UHC-126-U-PFN - with programmable analogue output (±10 V differential output or 4… 20 mA) and analogue sensor interfaces, integrated **Profinet interface**

UHC-126-U-ETC - with programmable analogue output (±10 V differential output or 4… 20 mA) and analogue sensor interfaces, integrated **EtherCat interface**

1.2 Scope of supply

The scope of supply includes the module plus the terminal blocks which are part of the housing.
The Profibus plug, interface cables and further parts which may be required should be ordered separately.
This documentation can be downloaded as a PDF file from www.w-e-st.de.

1.3 Accessories

WPC-300 - Start-Up-Tool (downloadable from our homepage – products/software)

Any standard cable with USB-A and USB-B connector can be used as the programming cable.

[1] Compared with older versions (ordering code **A** for voltages output and **I** for current output) the code **U** (universal) is used for programmable outputs.

[2] The number of the version consists of the hardware version (first two digits) and the software version (last two digits). Because of the development of the products these numbers can vary. They are not strictly necessary for the order. We will always deliver the newest version.

1.4 Symbols used

General information

Safety-related information

1.5 Legal notice

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Date: 06.01.2025

1.6 Safety instructions

Please read this document and the safety instructions carefully. This document will help to define the product area of application and to put it into operation. Additional documents (WPC-300 for the start-up software) and knowledge of the application should be taken into account or be available.
General regulations and laws (depending on the country: e. g. accident prevention and environmental protection) must be complied with.

These modules are designed for hydraulic applications in open or closed-loop control circuits. Uncontrolled movements can be caused by device defects (in the hydraulic module or the components), application errors and electrical faults. Work on the drive or the electronics must only be carried out whilst the equipment is switched off and not under pressure.

This handbook describes the functions and the electrical connections for this electronic assembly. All technical documents which pertain to the system must be complied with when commissioning.

This device may only be connected and put into operation by trained specialist staff. The instruction manual must be read with care. The installation instructions and the commissioning instructions must be followed. Guarantee and liability claims are invalid if the instructions are not complied with and/or in case of incorrect installation or inappropriate use.

CAUTION!
All electronic modules are manufactured to a high quality. Malfunctions due to the failure of components cannot, however, be excluded. Despite extensive testing the same also applies for the software. If these devices are deployed in safety-relevant applications, suitable external measures must be taken to guarantee the necessary safety. The same applies for faults which affect safety. No liability can be assumed for possible damage.

Further instructions

- The module may only be operated in compliance with the national EMC regulations. It is the user's responsibility to adhere to these regulations.
- The device is only intended for use in the commercial sector.
- When not in use the module must be protected from the effects of the weather, contamination and mechanical damage.
- The module may not be used in an explosive environment.
- To ensure adequate cooling the ventilation slots must not be covered.
- The device must be disposed of in accordance with national statutory provisions.

2 Characteristics

This module was developed for controlling pressure and force of hydraulic drives, worked out as a classical p/Q controller (flow control with closed loop pressure limitation function). The command values are given by analogue input signals and the module is controlled by digital inputs. Furthermore some feedback values and status messages can be used there.

The output signal is available as an active differential output for direct connecting of control valves with integrated electronics. Alternatively a current output can be parameterized.

The control loop uses a control cycle time of 1 ms (adjustable). The controller is equipped with two sets of parameters, which can be switched in case of critical applications with different operating points.
The following control parameters are programmable: P (proportional), I (integrating), D (differential) with D_T1 (T1 filter) and I_ACT (activating of the integrator).
Internally the system is monitored for several errors. Data, command signal and sensor errors will be displayed via the READY output and the corresponding LED.

The parameterization (USB interface) is supported by our WPC-300 program. Various functions support the commissioning and troubleshooting. The operation is simple and problem-oriented, thus ensures a very short training time.

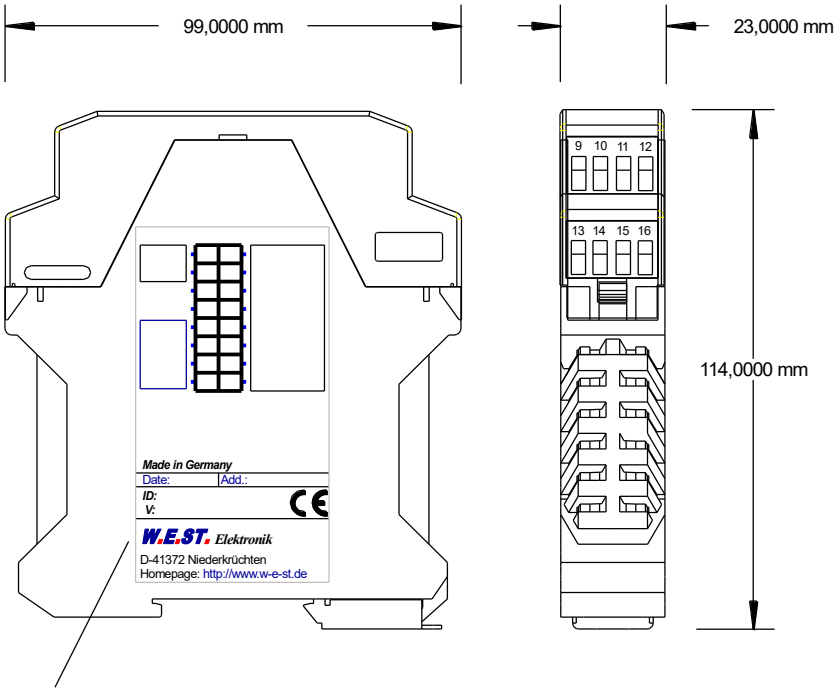
Typical applications: electronic 3way pressure control (down to zero bar), feed drives with definable max force as well as drives that have to follow an outline with constant force (polishing of surfaces).

Features

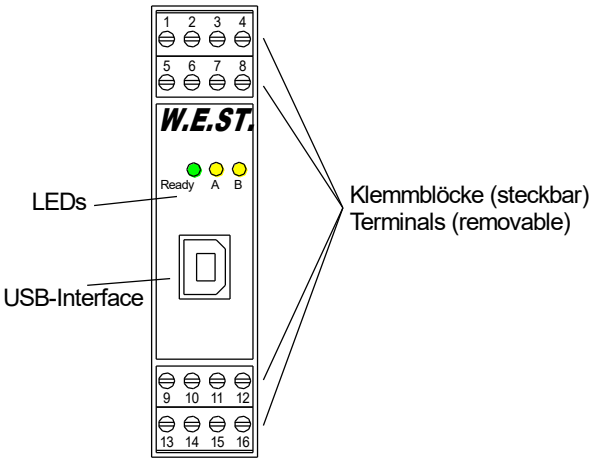
- **Analogue q– and p-command values**
- **Simple and intuitive scaling of the sensor**
- **Classical p/Q controller with pressure limitation (automatic switch over)**
- **PID-controller with switchable parameter set**
- **Data set for the pressure (force) in bar**
- **Ramps for pressure up and down**
- **Parameterset linked ramp times/detachable**
- **Force- / pressure controller with one sensor**
- **Differential pressure control with two pressure sensors**
- **Fault diagnosis and extended function checking**
- **Simplified parameterization with WPC-300 software**

2.1 Device description

Standard module



Typenschild und Anschlussbelegung
Type plate and terminal pin assignment



2.1 Installation instructions

- This module is designed for installation in a shielded EMC housing (control cabinet). All cables which lead outside must be screened; complete screening is required. It is also necessary to avoid strong electro-magnetic interference sources being installed nearby when using our open and closed loop control modules.

- **Typical installation location:** 24 V control signal area (close to PLC)
  The devices must be arranged in the control cabinet so that the power section and the signal section are separate from each other.
  Experience shows that the installation place close to the PLC (24 V area) is most suitable. All digital and analogue inputs and outputs are fitted with filters and surge absorbers in the device.

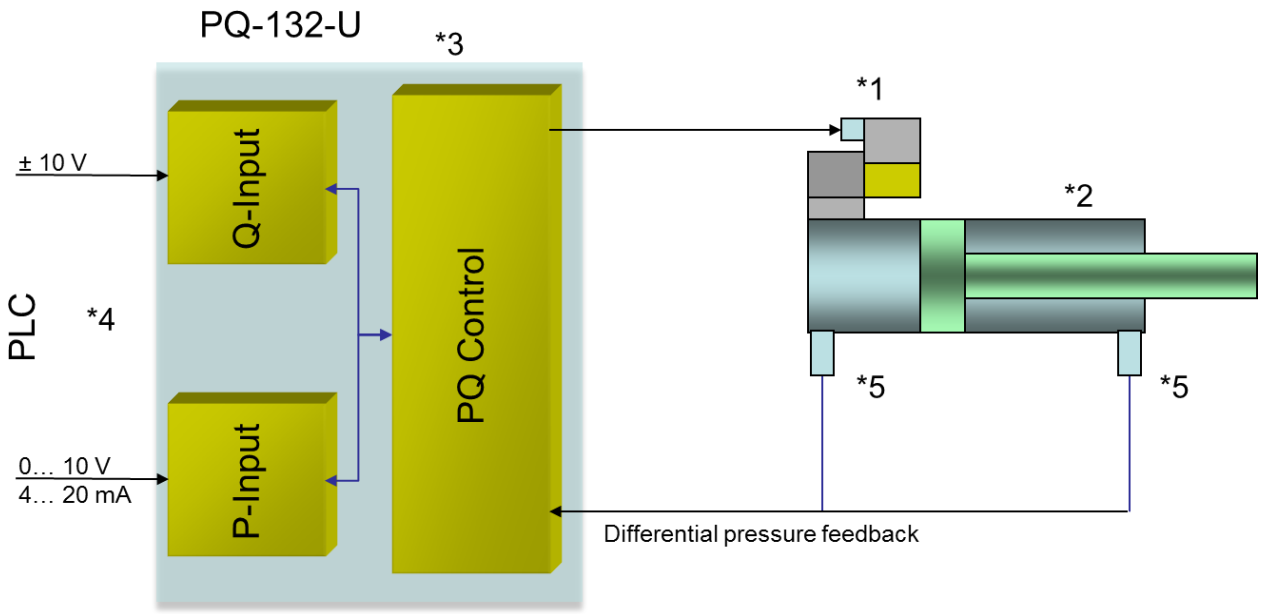
- The module should be installed and wired in accordance with the documentation bearing in mind EMC principles. If other consumers are operated with the same power supply, a star-shaped ground wiring scheme is recommended. The following points must be observed when wiring:
  - The signal cables must be laid separately from power cables.
  - Analogue signal cables **must be screened**.
  - All other cables must be screened if there are powerful interference sources (frequency converters, power contactors) and cable lengths > 3 m. Inexpensive SMD ferrites can be used with high-frequency radiation.
  - The screening should be connected to PE (PE terminal) as close to the module as possible. The local requirements for screening must be taken into account in all cases. The screening should be connected to at both ends. Equipotential bonding must be provided where there are differences between the connected electrical components.
  - If having longer lengths of cable (> 10 m), the diameters and screening measures should be checked by specialists (e. g. for possible interference, noise sources and voltage drop). Special care is required if using cables of over 40 m in length, and if necessary the manufacturer should be consulted if necessary.

- A low-resistance connection between PE and the mounting rail should be provided. Transient interference is transmitted from the module directly to the mounting rail and from there to the local earth.
- Power should be supplied by a regulated power supply unit (typically a PELV system complying with IEC364-4-4, secure low voltage). The low internal resistance of regulated power supplies gives better interference voltage dissipation, which improves the signal quality of high-resolution sensors in particular. Switched inductances (relays and valve coils) which are connected to the same power supply must always be provided with appropriate overvoltage protection directly at the coil.

2.2 Typical system structure

This minimal system consists of the following components:

(*1) Proportional valve (or control valve)
(*2) Hydraulic cylinder
(*3) Pressure/force sensor with analogue interface
(*4) control module PQ-132-U…
(*5) Interface to PLC with analogue and digital signals



2.3 Method of operation

2.3.1 General

Enable: This digital input signal initializes the application and error messages are deleted. The **READY** signal gets activated. The output signal to the control element is enabled. The drive can be controlled by the Q value or input.
Setting **RUN** will start the PID controller. The command signal input and the feedback signal inputs are evaluated now. Input **PIN5** provides additional functions depending on the parameter **PIN:5**. Either a switching between the two parameter sets is possible or the ramp function can be activated and deactivated with this input.

2.3.2 p/Q-pressure-control

This module serves to control pressures and forces on hydraulic actuators. The control structure is performed as a classical p/Q scheme (flow control with pressure limit control). A short cycle time provides an adequate reserve in dynamic requirements of the regulation.

Alternatively, it can be used with a pressure sensor or a force cell. Two pressure signal inputs can be used for the differential pressure control. The two setpoints (Q and p) provided as analogue variables, one for the volume current setpoint (trial of the cylinder) and one as the pressure setpoint. A ramp generator is connected in series with the pressure setpoint.

The output signal is available as a differential output for connection of control valves with integrated electronics.

2.3.3 Functionality

For p/Q control a dynamic zero-overlapped control valve is necessary. If the B-side of the cylinder cannot be relieved, pressure in both cylinder sides has to be measured.

The cylinder can be driven in both directions with the analogue Q command input value (± 10 V) and limits the max velocity. The pressure limitation control function is only active with a positive Q signal.

The p-command value pre-sets the max differential pressure. If this pressure (or force) is exceeded, the controller reduces the output signal to the valve (also in the negative range), so that the preset pressure will be kept. To go backwards for keeping the force is possible.

The pressure/force is determined via the analogue inputs X1 and X2. For differential pressure control the actual value is calculated (X1 – X2).

2.4 Commissioning

Step	Task
Installation	Install the device in accordance with the circuit diagram. Ensure it is wired correctly and that the signals are well shielded. The device must be installed in a protective housing (control cabinet or similar).
Switching on for the first time	Ensure that no unwanted movement is possible in the drive (e. g. switch off the hydraulics). Connect an ammeter and check the current consumed by the device. If it is higher than specified, there is an error in the wiring. Switch the device off immediately and check the wiring.
Setting up communication	Once the power input is correct, the PC (notebook) should be connected to the serial interface. Please see the WPC-300 program documentation for how to set up communication. Further commissioning and diagnosis are supported by the operating software.
Pre-parameterization	Now set up the following parameters (with reference to the system design and circuit diagrams): The SYS_RANGE, SENSOR SETTING, OUTPUT SIGNAL, PRESET:Q, RAMPs. Pre-parameterization are necessary to minimize the risk of uncontrolled movements. Parameterize specific settings for the control element. Reduce PRESET:Q and p to a value which is uncritical for the application.
Control signal	Check the control signal with voltmeter (ammeter). The control signal lies in the range of ± 10 V (4…20 mA). In the current state it should be 0. Alternatively, if current signals are used, approx. 0 mA should flow.
Switching on the hydraulics	The hydraulics can now be switched on. Since the module is not yet generating a signal, the drive should be at a standstill or drift slightly (leave its position at a slow speed).
Activating ENABLE	CAUTION! The drive can now leave its position and move to an end position at full speed. Take safety measures to prevent personal injury and damage. The drive stays in the current position. If the drive moves to an end position, the polarity is probably wrong.
Activating START	With the start signal (RUN), the controller is activated. On the intended pressure point is the Assembly control the pressure according to the setpoint.
Optimize controller	Now optimize the control parameters according to your application and your requirements.

3 Technical description

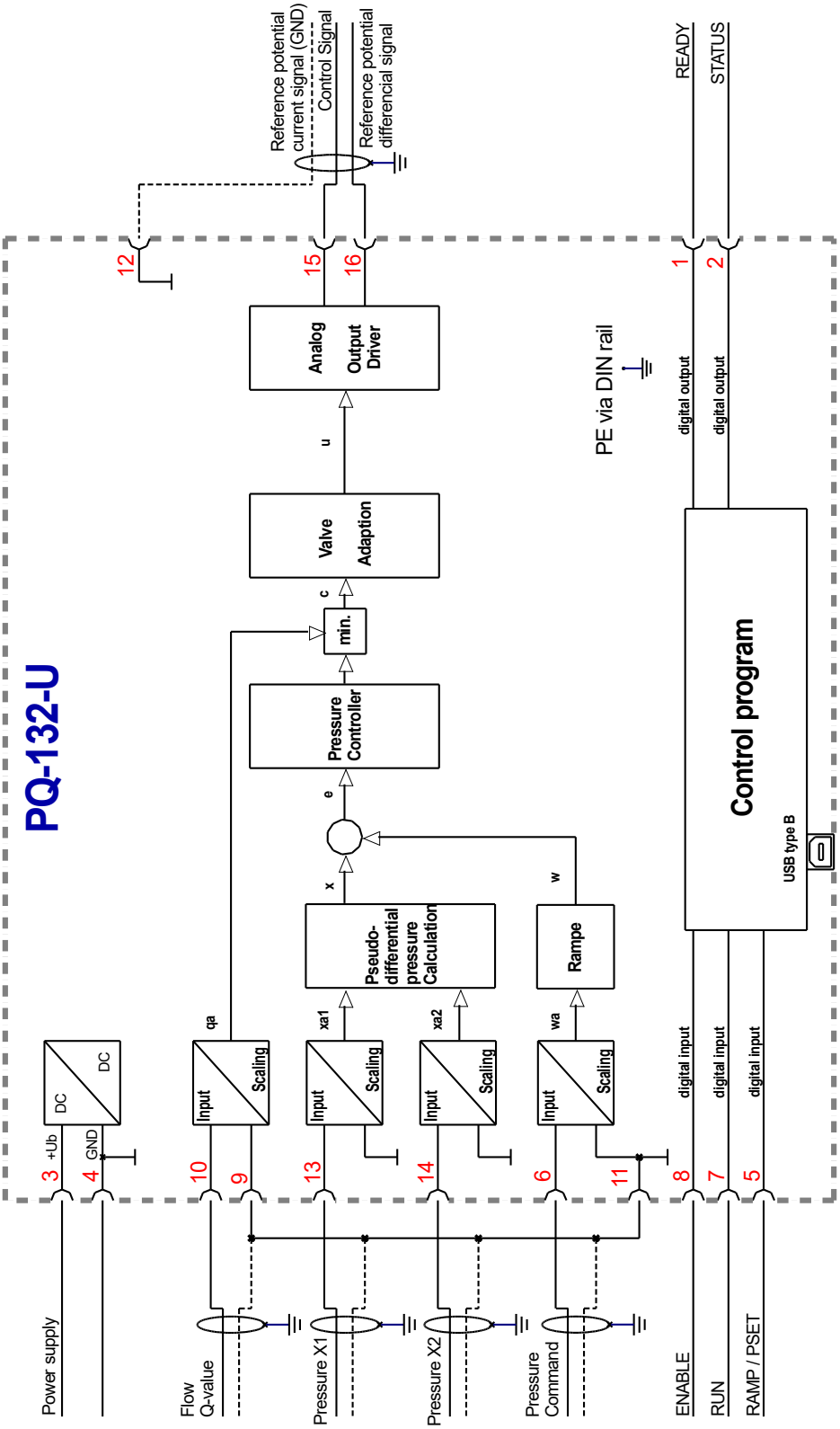
3.1 Input and output signals

Connection	Supply
PIN 3	Power supply (see technical data).
PIN 4	0 V (GND) connection.
Connection	**Analogue signals**
PIN 9 / 10	Q-value (QA), signal range ± 10V or 4…12…20 mA, scalable (SIGNAL:Q / AIN Q).
PIN 6	p-command value (WA), signal range 0…10V or 4… 20mA, scalable (SIGNAL:W / AIN W).
PIN 13	Pressure (force) feedback value (XA1), 0… 10 V or 4… 20 mA (SIGNAL:X1 / AIN X1).
PIN 14	Pressure (force) feedback value (XA2), 0… 10 V or 4… 20 mA (SIGNAL:X2 / AIN X2).
PIN 11	0 V (GND) connection for analogue input signals.
PIN 12	0 V (GND) connection for analogue output signals.
PIN 15 / 16 PIN 15 / 12	Valve control signal. Type of signal and polarity can be selected by the parameter SIGNAL:U.
Connection	**Digital inputs and outputs**
PIN 8	**Enable input:** General enabling of the application.!
PIN 7	**RUN:** **ON:** The controller is activated. **OFF:** Controller deactivated**.** The Q-value (PIN9/10) is placed on the output.
PIN 5	**RAMP/PSET:** Ramp for the pressure setpoint is activated. Alternatively can be switched over to a second set of parameters for the PID controller depending on PIN 5 parameter.
PIN 1	**READY output:** **ON**: The module is enabled; there are no discernable errors. **OFF:** Enable (PIN 8) is deactivated or a failure (current input or intern) has been detected (depending on the SENS command).
PIN 2	**STATUS output (error monitoring):** **ON:** The axis is within the pre-set monitoring range. **OFF:** The axis is without the pre-set monitoring range.

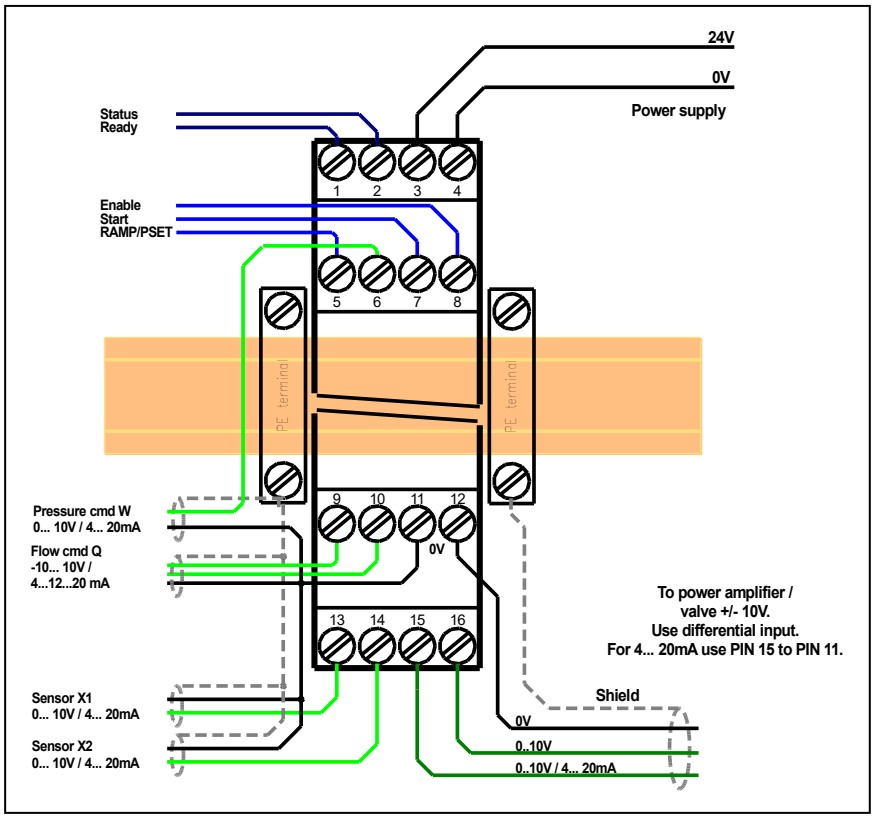
3.2 LED definitions

LEDs	Description of the LED function
GREEN	Identical to the READY output. OFF: No power supply or ENABLE is not activated ON: System is ready for peration **Flashing:** Error discovered Only active when SENS = ON
YELLOW A	Identical to the STATUS output. OFF: The axis is outside the monitoring window. ON: The axis is within the monitoring window.
GREEN + YELLOW A+B	1. **Chasing light (over all LEDs):** The bootloader is active. No normal functions are possible. 2. **All LEDs flash shortly every 6 s:** An internal data error was detected and corrected automatically! The module still works regularly. To acknowledge the error the module has to be cycle powered.
YELLOW A + YELLOW B	**Both yellow LEDs flash oppositely every 1 s:** The nonvolatile stored parameters are inconsistent! To acknowledge the error, the data have to be saved with the SAVE command or the corresponding button in the WPC. If the function of the module has changed via the FUNCTION parameter, all parameters are deleted purposely and set to default values. In this case the LEDs indicate no error, but a desired state. To acknowledge please save.

3.3 Block diagram

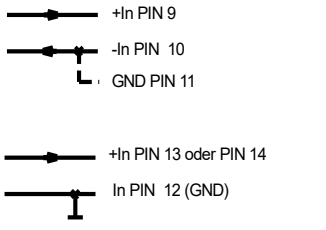


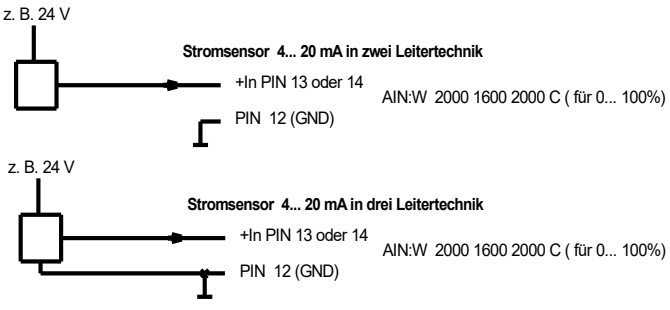
3.4 Typical wiring



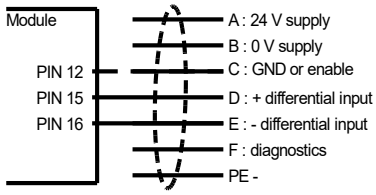
3.5 Connection examples

SPS / PLC 0... 10 V Sollwert, Sensor Spannungssignal





Valve (6 + PE plug) with OBE electronics



3.6 Technical data

Supply voltage (Ub)	**[VDC]**	12… 30 (incl. ripple)
Power consumption	**[W]**	max. 1,2
External protection	**[A]**	1 medium time lag
Digital inputs		
OFF	**[V]**	< 2
ON	**[V]**	> 10
Input resistance	**[kOhm]**	25
Digital outputs		
OFF	**[V]**	< 2
ON	**[V]**	max. Ub
Maximum current	**[mA]**	50
Analogue inputs		Unipolar / differential
Voltage	**[V]**	0… 10 / -10… 10
Input resistance	**[kOhm]**	min. 25
Signal resolution	**[%]**	0,003 incl. Oversampling
Current	**[mA]**	4… 20
Burden	**[Ohm]**	240
Signal resolution	**[%]**	0,006 incl. Oversampling
Analogue outputs		
Voltage	**[V]**	0… 10, +/- 10 differential
Maximum load	**[mA]**	10
Current	**[mA]**	4… 20
Maximum load	**[Ohm]**	390
Signal resolution	**[%]**	0,007
Controller cycle times		
Signal processing	**[ms]**	1
Serial interface	**-**	USB - virtual COM Port
Transmission rate	**[kBaud]**	9,6… 115,2
Housing		Snap -on module acc. EN 50022
Material	**-**	PA 6.6 polyamide
Flammability class	**-**	V0 (UL94)
Weight	**[kg]**	0,15
Protection class	**[IP]**	20
Temperature range	**[°C]**	-20… 60
Storage temperature	**[°C]**	-20… 70
Humidity	**[%]**	< 95 (non-condensing)
Connections		
Communication	**-**	USB type B
Plug connectors		4 x 4-pole terminal blocks
PE		via the DIN mounting rail
EMC	**-**	EN 61000-6-2: 8/2005 EN 61000-6-4: 6/2007 + A1:2011

4 Parameters

4.1 Parameter overview

Group	Command	Default	Unit	Description
Basic parameter				
	LG	EN	-	Changing language help texts
	MODE	STD	-	Parameter view
	SENS	ON	-	Malfunction monitor
	PIN:5	RAMP	-	Function of PIN 5
	CDWIN	2000	mbar	Size of the control deviation window
	EOUT	0	0,01 %	Output signal if not ready
Input signal adaption				
	SYS_RANGE	100	bar	System pressure
	ARATIO	1000	-	Area ratio of the cylinder
	PRESET:Q	0	0,01 %	Internal preset value
	F_OFFSET	0	mbar	Offset (force), is added to the actual value
Sensor scaling X1				
	SIGNAL:X1	U0-10	-	Type of input
	N_RANGE:X1	100	bar	Sensor nominal pressure
	OFFSET:X1	0	mbar	Sensor offset
Sensor scaling X2				
	SIGNAL:X2	U0-10	-	Type of input
	N_RANGE:X2	100	bar	Sensor nominal pressure
	OFFSET:X2	0	Mbar	Sensor offset
Command signal scaling				
	SIGNAL:W	U0-10	-	Type of input
	SIGNAL:Q	U+-10	-	Type of input

Group	Command	Default	Unit	Description
Ramp and PID control parameters				
Parameter set 1				
	RA1:UP	100	ms	Command signal ramp times
	RA1:DOWN	100	ms	
	C1:P	50	0,01	P gain
	C1:I	4000	0,01 ms	I gain
	C1:D	0	0,01 ms	D gain
	C1:T1	1	0,01 ms	D gain filter
	C1:I_ACT	5000	0,01%	Integrator activation threshold
Parameter set 2				
	RA2:UP	100	ms	Command signal ramp times
	RA2:DOWN	100	ms	
	C2:P	50	0,01	P gain
	C2:I	4000	0,01 ms	I gain
	C2:D	0	0,01 ms	D gain
	C2:T1	1	0,01 ms	D gain filter
	C2:I_ACT	5000	0,01%	Integrator activation threshold
Output signal adaptation				
	SIGNAL:U	U+-10	V|mA	Type and polarity of the output signal
Special commands				
Sample time				
	TS	10	0,1 ms	Control loop sample time
Scaling mode				
	AINMODE	EASY	-	Input scaling mode
	AIN:I X	i= X1|X2|W|Q	-	Free scaling of the analogue inputs. Gets activated when AINMODE is switched over to MATH.
		A: 1000	-	
		B: 1000	-	
		C: 0	0,01 %	
		X: V	-	

4.2 Basic parameters

4.2.1 LG (Changing the language)

Command		Parameters	Unit	Group
LG	x	x= DE|EN	-	**STD**

Either German or English can be selected for the help texts.

CAUTION: After changing the language settings, the ID button in the menu bar (WPC-300) must be pressed (module identification).

4.2.2 MODE (Parameter view)

Command		Parameters	Unit	Group
MODE	x	x= STD|EXP	-	**STD**

This command changes the operating mode. Various commands (defined via STD/EXP) are blanked out in Standard Mode. The commands in Expert Mode have a more significant influence on system behavior and should accordingly be changed with care.

4.2.3 SENS (Malfunction monitor)

Command		Parameters	Unit	Group
SENS	x	x= ON|OFF|AUTO	-	**STD**

This command is used to activate/deactivate the monitoring functions (4… 20 mA sensors, output current, signal range and internal failures) of the module.

ON: All monitoring functions are active. Detected failures can be reset by deactivating the ENABLE input.

OFF: No monitoring function is active.

AUTO: Auto reset mode. All monitoring functions are active. If the failure doesn't exist anymore, the module automatically resumes to work.

Normally the monitoring functions are always active because otherwise no errors are detectable via the READY output. Deactivating is possible mainly for troubleshooting.

4.2.4 PIN:5 (Function of Pin 5)

Command	Parameters	Unit	Group
PIN:5 x	x= RAMP|PSET	RAMP	**EXP**

With this command, the mode of action of the control pins can be set to terminal 15.

Command RAMP: With input signal on terminal 15, the ramps are activated. Without input signal, the ramps are disabled.

Command PSET: It can be switched to pin 5 between two parameter sets. It can also be switched between two ramp parameters.

4.2.5 CDWIN (Size of the control deviation window)

Command	Parameters	Unit	Group
CDWIN X	x= 100… 50000	mbar	**STD**

This parameter is entered in mbar.

The command defines a monitoring range for which a message is generated. The monitoring refers to the control deviation between the setpoint and actual value. If the control deviation is within the monitoring range, this is signalled via the status output or the STATUS LED. The control operation is not affected by this message.

4.2.6 EOUT (Output signal if not ready)

Command	Parameters	Unit	Group
EOUT X	x= -10000… 10000	0,01 %	**EXP**

Output value in case of a detected error or a deactive ENABLE input. A value (degree of valve opening) for use in the event of a sensor error (or the module is disabled) can be defined here. This function can be used if, for example, the drive is to move to one of the two end positions (at the specified speed) in case of a sensor error.

|EOUT| = 0 The output is switched off in the event of an error. This is normal behavior.

CAUTION! If the output signal is 4… 20 mA, the output is switched off when **|EOUT| = 0**. If a null value = 4 mA is to be output in the event of an error, EOUT must be set to 1[2].

The output value defined here is stored permanently (independently of the parameter set). The effects should be analyzed by the user for each application from the point of view of safety.

[2] This is necessary if using valves without error detection for signals lower than 4 mA. If the valve has an error detection it goes into a defined position after switching of the output.

4.3 Input signal adaptation

4.3.1 SYS_RANGE (System pressure)

Command	Parameters	Unit	Group
SYS_RANGE X	x= 10… 1000	bar	**STD**

This command defines the pressure, which corresponds to 100 % of the input signal. If the demand is set incorrectly, this leads to incorrect system settings, and the dependent parameters cannot be calculated correctly.

4.3.2 ARATIO (Cylinder area ratio)

Command	Parameters	Unit	Group
ARATIO X	x= 200… 5000	-	**EXP**

In order to limit the output force in either direction correctly the parameter ARATIO provides the ratio of the two surfaces of the cylinders piston. A divisor of 1000 for area B to set base.
Accordingly, a corresponding entry of the value A (ARATIO) of 1000 a ratio of A / B = 1000/1000

For example: surface ratio A/B = 2.08: ARATIO has to be set on 2080
surface ratio A/B = 0,5: ARATIO has to be set on 500
surface ratio A/B = 1: ARATIO has to be set on 1000

This parameter is used to calculate a pseudo differential pressure which, multiplied by the larger of the two surfaces, yields the resulting force. This value becomes negative for forces in direction "B".

4.3.3 PRESET:Q (Internal preset value)

Command	Parameters	Unit	Group
PRESET:Q	0… 10000	0,01%	**STD**

This parameter is entered in 0,01%.
Alternative to the analog input the flow can be specified as a parameter. When the analogue input is switched off with SIGNAL: Q = OFF, the configured value in PRESET: Q gets active.

4.3.4 F_OFFSET (Feedback offset)

Command	Parameters	Unit	Group
F_OFFSET X	x= -50000… 50000	mbar	**EXP**

This parameter is entered in mbar.
This parameter adds an offset value to the resulting feedback signal. For example, to compensate external power differences (suspended loads, spring forces ect.).

4.3.5 SIGNAL (Type of input signal)

Command	Parameters	Unit	Group
SIGNAL:I X SIGNAL:Q X	i= X1|X2|W x= OFF|U0-10|I4-20| U10-0|I20-4 x= OFF|U0-10|I4-12-20| U10-0|I20-12-4	- V|mA	**EASY**

This command can be used to change the type of input signal (voltages or current) and to define the direction of the signal. This command is available for all analogue inputs (X1, X2, W and Q).
OFF= Deactivation of the input.

4.3.6 N_RANGE (Nominal pressure of the sensor)

Command	Parameters	Unit	Group
N_RANGE:I X	i= X1|X2 x= 10… 1000	bar	**EASY**

This parameter is entered in bar.
N_RANGE is used to define the nominal value of the sensor. This value should be always higher than SYS_RANGE. The control parameter cannot be calculated correctly in case of wrong values.

4.3.7 OFFSET (Sensor offset)

Command	Parameters	Unit	Group
OFFSET:I X	i= X1|X2 x= -60000…60000	mbar	**EASY**

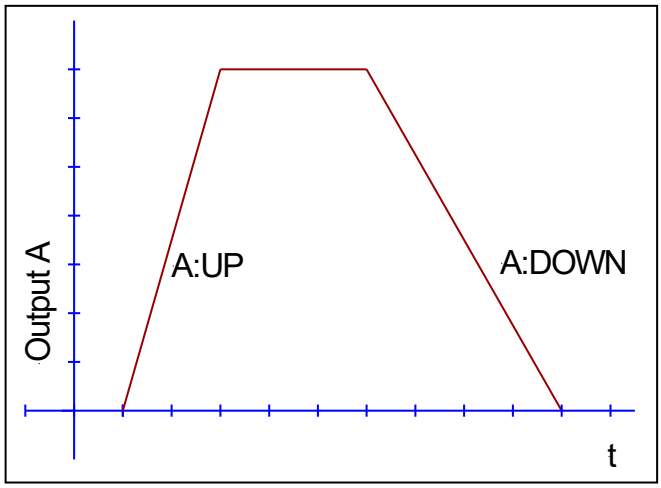
This parameter is entered in bar. Adjustment of zero point of the sensor is realized with it.
Xi(result) = Xi(analogue) – „OFFSET:Xi x“

4.4 Ramps and PID control parameters

4.4.1 RA (Command signal ramp time)

Command	Parameters	Unit	Group
RAp:i x	p= 1|2(Parameter set) i= UP|DOWN x= 1… 600000	**ms**	**STD**

The ramp times for the pressure command value are defined here in ms. Two separate time values are entered for increasing and decreasing pressure. They take effect on the command signal input (W).



4.4.2 C (PID control parameters)

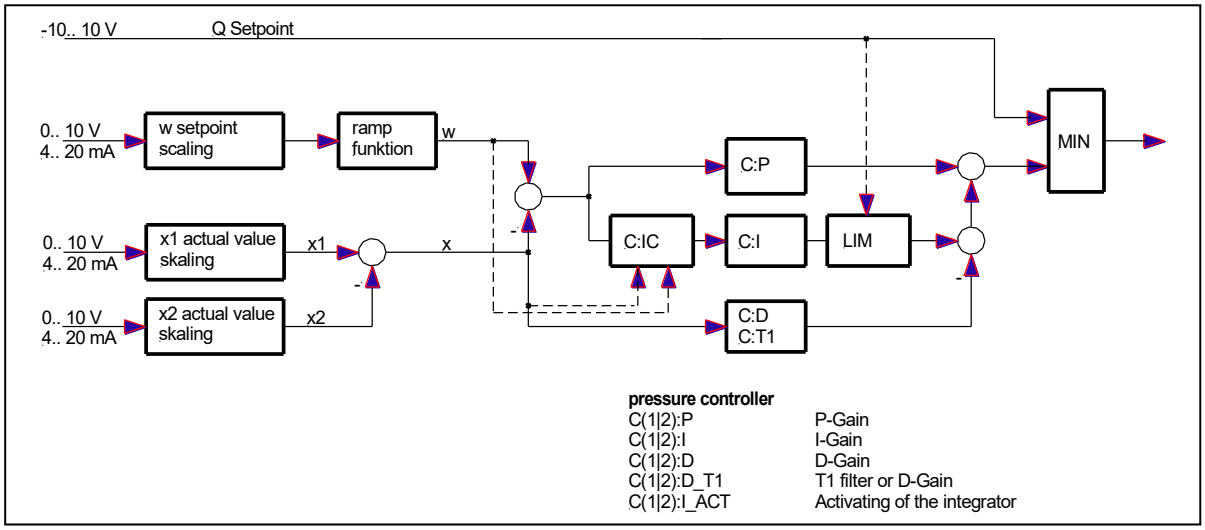
Command	Parameter	Unit	Group
Cp:i x	p= 1|2(Parametersatz) i= P|I|D|D_T1|I_ACT :P x= 1… 10000 :I x= 0… 30000 :D x= 0… 1200 :D_T1 x= 5… 1000 :I_ACT x= 0… 10000	 0,01 0,1 ms 0,1 ms 0,1 ms 0,01 %	**STD**

The control function will be parameterized via this command.

The P, I and D gain are similar to a standard PID controller. The T1 factor is used for the D-gain in order to suppress high-frequency noise.

I_ACT controls the integrator function. To reduce pressure overshoots, an activation point for the integrator can be programmed via the I_ACT value. The integrator is activated if the actual pressure is higher than the programmed threshold.

The integrator function of the controller can be disabled in special cases by setting **:I** to zero.



4.5 Output signal adaptation

4.5.1 SIGNAL:U (Type and polarity of the output signal)

Command	Parameter	Unit	Group
SIGNAL:U X	x= U+-10|I4-12-20| U-+10|I20-12-4|	V|mA	**STD**

This command defines the type of the output signal (current / voltage) and its polarity.

You can also choose between differential and unipolar output types.

- Differential voltage for +/- 100%
  - +-10V
  - -+10V

  Between PIN 15 and 16.

- Single ended current with zero point at 12mA for +/- 100%
  - 4-12-20mA
  - 20-12-4mA

  Between PIN 15 and 12.

An output current of < 4 mA indicates an error and the module is disabled. The current input of the proportional valves should be monitored by the valve. The valve have to be deactivated in case of < 4 mA input signal. Otherwise the EOUT command can be used to get a defined output signal.

4.6 Special commands

4.6.1 TS (Sample time)

Command	Parameters	Unit	Group
TS x	x= 5… 30	0,1 ms	**TERMINAL**

The control dynamics can be influenced with the sample time. Changes should only be made by persons who have sufficient knowledge of the dynamic system behavior.

CAUTION! After changing this value all time-dependent parameters must be checked and reset if necessary.

4.6.2 AINMODE (Input scaling mode)

Command	Parameter	Unit	Group
AINMODE x	x= EASY|MATH	-	**TERMINAL**

The command AINMODE is used to choose the input scaling method.

In the EASY mode (the default mode) the user may choose via the SIGNAL command from a variety of standard input signal types and polarities. The MATH mode, which is compatible to our older modules may be used to freely scale inputs with the AIN command.

Attention: This command does not show up in the parameter list in WPC. It has to be entered manually in the terminal window. After any change of AINMODE, module default data should be applied (by pressing the corresponding button in WPC-300)

4.6.3 AIN (Free analogue input scaling)

Command	Parameters	Unit	Group
AIN:i	i= X1|X2|W|Q		**MATH**
A	a= -10000… 10000	-	
B	b= -10000… 10000	-	
C	c= -10000… 10000	0,01 %	
X	x= V|C	-	

This command can be used to scale the individual inputs. The following linear equation is used for scaling.

$$Output = \frac{a}{b}(Input - c)$$

The ***"C" value*** is the offset (e.g. to compensate the 4 mA in case of a 4… 20 mA input signal).
The variables ***A*** and ***B*** are defining the gain factor with which the signal range is scaled up to 100 % (e.g. 1.25 if using 4… 20mA input signal, defined in default current settings by A = 1250 and B = 1000). The internal shunt for the current measuring is activated with switching the ***X*** value.

The gain factor is calculated by setting the usable range (***A***) in relation to the real used range (***B***) of the input signal. Usable are 0… 20mA, means (***A***) has the value **20**. Really used are 4… 20mA, means (***B***) has a value of **16** (20-4). Not used are 0… 4mA. In a range of 20mA this is an offset of 20%, means a value of **2000** for (***C***). Last but not least (***X***) has to be set to **C** choosing current signal.

In this case AIN command would look like this:

AIN:I 20 16 2000 C or AIN:I 1250 1000 2000 C

Typical settings:

Command	Input	Description
AIN:I 1000 1000 0 V	0… 10 V	Range: 0… 100 %
AIN:I 10 8 1000 V OR AIN:I 1000 800 1000 V	1… 9 V	Range: 0… 100 %; 1 V = 1000 used for the offset and gained by 10 / 8 (10 V divided by 8 V (9 V -1 V))
AIN:I 10 4 500 V OR AIN:I 1000 400 500 V	0,5… 4,5 V	Range: 0… 100 %; 0,5 V = 500 used for the offset and gained by 10 / 4 (10 V divided by 4 V (4,5 V -0,5 V))
AIN:I 20 16 2000 C OR AIN:I 2000 1600 2000 C OR AIN:I 1250 1000 2000 C	4… 20mA	Range: 0… 100 % The offset will be compensated on 20 % (4 mA) and the signal (16 mA = 20 mA – 4 mA) will be gained to 100 % (20 mA). Each of this parameterization for 4… 20 mA is setting the range to 0… 100 %.
AIN:Q 20 20 0 V OR AIN:Q 1000 1000 0 V	-10… 10 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**).
AIN:Q 20 10 0 V OR AIN:Q 2000 1000 0 V	-5… 5 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**). Really used are -5… 5V (10V).
AIN:X 20 8 5000 V OR AIN:X 2500 1000 5000 V	1… 5… 9 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**). Really used are *only 1*… 9V (8V) for **both solenoids** with **5V zero point** (5000) setting (e.g. for joystick use).
AIN:I 40 16 6000 C OR AIN:I 20 8 6000 C OR AIN:I 2500 1000 6000 C	4… 20 mA	Current input: *theoretically* usable range -20… 20mA (40mA) for a working range of -100… 100% (**two solenoids**). Really usable are *only* 4… 20mA (16mA) for both solenoids with 12mA zero point setting.

4.7 PROCESS DATA (Monitoring)

Command	Description	Unit
QA	Command signal flow (input signal)	%
WA	Command signal pressure (input signal)	bar
W	Command value (after ramp generator)	bar
X	Actual value (Pseudo – differential pressure)	bar
XA1	Feedback signal 1 (input signal)	bar
XA2	Feedback signal 2 (input signal)	bar
E	Control deviation	bar
C	Output signal of the controller	%
U	Output signal	%

The process data are the variables which can be observed continuously on the monitor or on the oscilloscope.

5 Appendix

5.1 Failure monitoring

Following possible error sources are monitored continuously when SENS = ON/AUTO:

Source	Fault	Characteristic
Command signal PIN 10 4... 20 mA	Out of range or broken wire	The output will be switched off.
Command signal PIN 6 4... 20 mA	Out of range or broken wire	The output will be switched off.
Feedback signal PIN 13 4… 20 mA	Out of range or broken wire	The output will be switched off.
Feedback signal PIN 14 4… 20 mA	Out of range or broken wire	The output will be switched off.
EEPROM (when switching on)	Data error	The output is deactivated. The module can only be activated by saving the parameters again!

CAUTION: Take care of the EOUT command. Changes will influence the behavior.

5.2 Troubleshooting

It is assumed that the device is in an operable state and there is communication between the module and the WPC-300. Furthermore, the valve control parameterization has been set with the assistance of the valve data sheets.

The RC in monitor mode can be used to analyze faults.

CAUTION: All safety aspects must be thoroughly checked when working with the RC (Remote Control) mode. In this mode the module is controlled directly and the machine control cannot influence the module.

FAULT	CAUSE / SOLUTION
ENABLE is active, the module does not respond and the READY LED is off.	There is presumably no power supply or the ENABLE signal (PIN 8) is not present. If there is no power supply, there is also no communication via our operating program. If a connection has been made to the WPC-300, then a power supply is also available.
ENABLE is active, the READY LED is flashing.	The flashing READY LED signals that a fault has been detected by the module. The fault could be: • A broken cable or no signal at the inputs, if 4…20 mA signals are parameterized. • Internal data error: press the command/SAVE button to delete the data error. The system reloads the DEFAULT data. With the WPC-300 operating program the fault can be localized directly via the monitor.
ENABLE is active; the READY LED is active; no output signal to the valve	To locate errors in the pressure-control-circuit, it is useful to start with the open loop pressure control (PIN 7 is not activated). In this case the flow can be adjusted • No pressure command input is available or the parameterization is incorrect. With the WPC-tool you can check if a command input is available. If not, you should check the wiring and/or the command set-point (in the PLC for example). • If the command input is correct, you have to check the output parameter. Check the correct setting of the output type. • Wrong configured pressure sensor. If the input-scaling is set to voltage (V) and the pressure sensor supplies a current signal (4... 20mA), the measured pressure value is always high. The output signal to the valve is therefore low.
ENABLE is active, the READY LED is active and the pressure is instable.	In many cases you may have a hydraulic problem. Electrical problems could be: • Electrical noise at the wire of the power supply. • Very long sensor cables (> 40 m) and sensor signal interference. • Incorrect parameterization of the pressure regulator.

5.3 Description of the command structure

The command structure:

[nnnn:i x] or
[nnnn x]

Meaning:

nnnn - used for an arbitrary command name
nnnn: - used for an arbitrary command name, expandable by an index.
Indexed commands are indicated by the sign ":"
i oder **I** - is a dummy for the index. E. g. an index can be „A" or „B", depending on the direction.
x - parameter value, in case of special commands more than one parameter are possible.

Examples:

MIN:A 2000 nnnn = "MIN", i = "A" and x = "2000"

OFFSET 50 nnnn = „OFFSET" and x = „50"

C:IC 2000 nnnn = "C", i = "IC" and x = "2000"

6 Notes