W.E.S.T. Elektronik GmbH

Technical Documentation

PID-131-U

Standard PID-Controller

CONTENTS

1 General Information

1.1 Order number

PID-131-U - with analog ±10 V differential output or 4… 20 mA output and analog sensor interface

1.2 Scope of supply

To the scope of supply belongs the module including 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.

1.4 Symbols used

General information

Safety-related information

1.5 Using this documentation

Structure of the documentation:

The standard product is described up to chapter 6. The extensions like POWER STAGE or SSI-INTERFACE are described in the chapters ADDITIONAL INFORMATION.

1.6 Legal notice

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The data and characteristics described herein serve only to describe the product. The user is required to evaluate this data and to check suitability for the particular application. General suitability cannot be inferred from this document. We reserve the right to make technical modifications due to further development of the product described in this manual. The technical information and dimensions are non-binding. No claims may be made based on them.

1.7 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 general controlling of dynamic systems. The controller structure is designed as a classic PID compensator with a short cycle time of 1ms.

It is possible to choose from different sensor and command signal types and polarities as 4… 20 mA, 0… 10 V or 10… 0V. More special input signals can be freely adapted via a mathematical scaling function.

The output signal is available as an active difference signal for the direct connection of valves with integrated electronics. Alternatively also single ended ones can be used.

The user may choose between two parameter sets by the use of Input S0 (pin 6)

Because of the easy handling a very short training period is guaranteed. A remote control function allows controlling the system without a higher level controller via the serial interface, e.g. for commissioning

The setup via USB is simple and easy to understand. A standard terminal program or our special windows application software (WPC-300, download from our homepage) can be used.

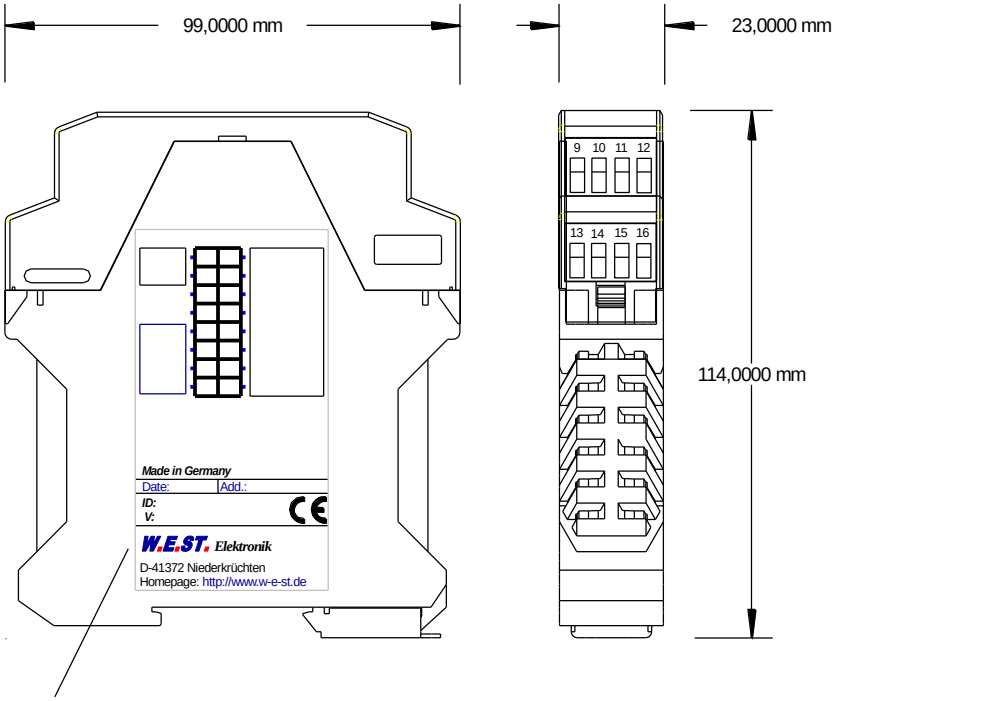
Typical applications: dynamic PID compensator for force, pressure and speed control.

Features

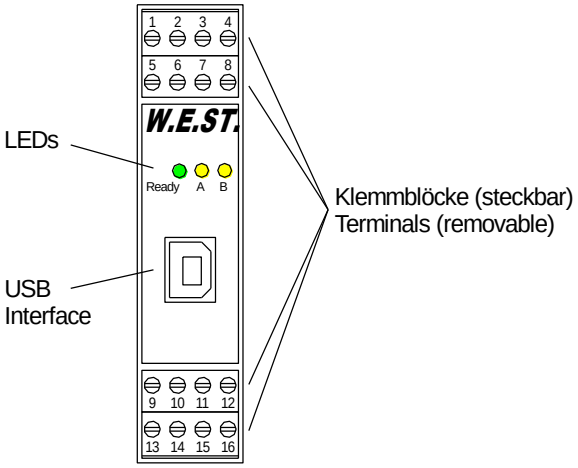
- **Analogue command and feedback values (0… 10 V or 4… 20 mA)**
- **Ramp function on the command value**
- **Universal controller structure**
- **Feedback value depending activation of the integrator by pre-set threshold value (automatically switching of the control structure)**
- **Application orientated parameter settings**
- **Universal output signal for control elements**

  0...10V, ± 10 V, 4… 20 mA or 4… 20mA with a virtual zero at 12mA
- **REMOTE CONTROL mode via serial interface**
- **Failure monitoring**
- **Adjustments via USB interface**

2.1 Device description



Typenschild und Anschlussbelegung
Type plate and terminal pin assignment



3 Use and application

3.1 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.

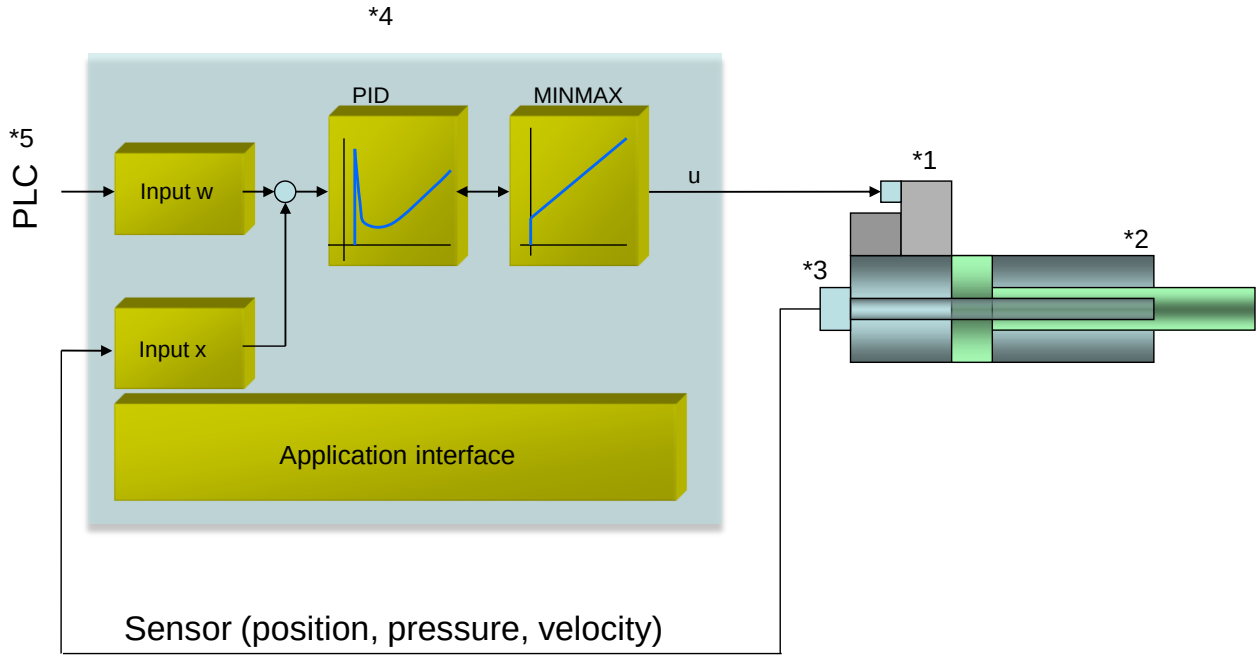
- The module should be installed and wired in accordance with the documentation bearing in mind EMC principles. If other consumers are operated with the same power supply, a star-shaped ground wiring scheme is recommended. The following points must be observed when wiring:
  - The signal cables must 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.

3.2 Typical system structure

This minimal system consists of the following components:

(*1) Proportional valve (or control valve) with integrated electronics
(*2) Hydraulic cylinder
(*3) Sensor for the regulation of positions, pressures or speeds
(*4) Electronic module PID-131
(*5) Interface to PLC with analogue and digital signals



3.3 Method of operation

This control module can be used in a wide variety of applications, as powe , pressure and speed or velocity control. The output signal suites any valves (with integrated electronics or external power amplifiers and power plugs).

Due to the high stability of the PID controller, the use is particularly recommended where open loop control would lead to poor reproducibility.

Typical use cases are pressure controlling fixed displacement pumps or remotely adjustable control pumps as well as force/torque controls for cylinders and motors.

ENABLE: This digital input signal initializes the application. Error messages are deleted, the output is switched on and the **READY** signal gets activated.

If the ENABLE input is deactivated the output gets switched off. **Attention:** Take care of the **EOUT** command.

Activating the **RUN** input starts the PID controller. Command and feedback input are evaluated now. The **S0** input provides using an alternative second set of parameters if activated.

The function of input **PIN5** depends on the parameterization. Either the ramp generator or the integrator can be switched on and off with this input.

3.4 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): SENSOR SETTINGS and OUTPUT SIGNAL. Parameterize specific settings for the control element (MIN, MAX and dither). Pre-parameterization is necessary to minimize the risk of uncontrolled movements.
Control signal	Check the control signal with a voltmeter. The control signal (PIN 15 to PIN16) is in the range of ±10 V. In the current state it should show 0 V. Alternatively, if using current signals, approximately 0 mA (PIN 15 to PIN 11) should flow.
Switching on the hydraulics	The hydraulics can now be switched on. The module is not yet generating a signal. Drives should be at a standstill or drift slightly (leave its position at a slow speed).
Activating ENABLE	The module is set in operating state. If no error occures the operating state is confirmed by the activated READY output and glowing green READY LED. With the feedforward value the drive can be moved.
Activating START	**Attention!** Drives can now leave their position with maximum speed. Take safety measures to prevent personal injury and damage. The control can now be driven by the anlogue inputs.
Optimize controller	Now optimize the controller parameters according to your application and your requirements.

4 Technical description

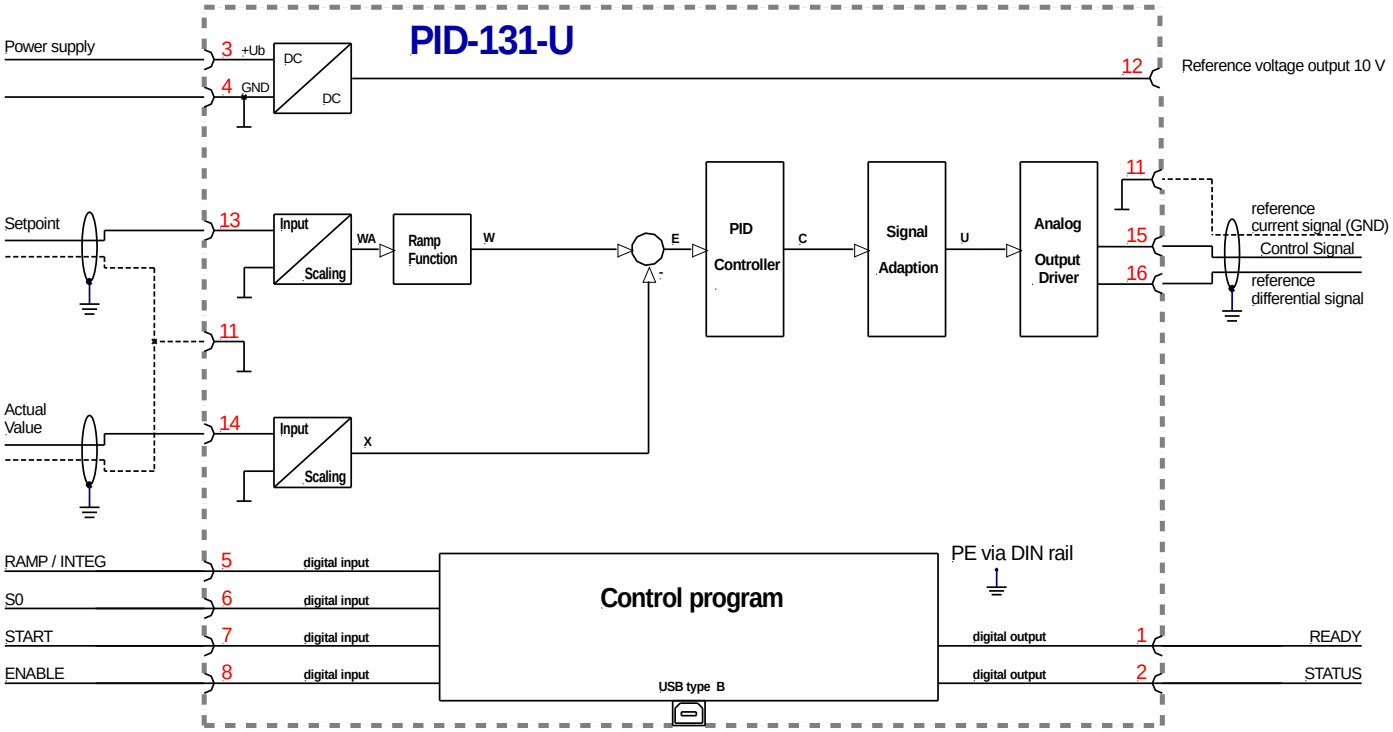
4.1 Input and output signals

Connection	**Supply**
PIN 3	Power supply (see technical data)
PIN 4	0 V (GND) connection.
Connection	**Analogue signals**
PIN 11	GND
PIN 12	10 V Reference voltage
PIN 13	Demand value (W), signal range 0… 10 V or 4… 20 mA, scalable
PIN 14	Actual value (X), signal range 0… 10 V or 4… 20 mA, scalable
PIN 15 / 16	Control signal. For current signal use output PIN 15 against 12, PIN16 is only for bipolar voltage 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	**START (RUN) input:** Activates the controler and sets control signal.
PIN 6	**S0 input**: Switching over between the parameter sets. S0 = OFF : parameter set 1 is active S0 = ON : parameter set 2 is active
PIN 5	**RAMP/INTEG input**: Activates the ramp- or the integrator function. Function is chosen with the parameter **PIN5**.
PIN 1	**READY output:** **ON:** The module is enabled; there are no known errors. **OFF:** Enable (PIN 8) is disabled or an error (current input or internal error) has been detected.
PIN 2	**STATUS output:** Monitoring of the control deviation depending on the CDWIN parameter, the status output will be deactivated, if the control deviation is higher than the adjusted permitted range. **ON:** control deviation is within the permitted range. **OFF:** control deviation is out of the permitted range.

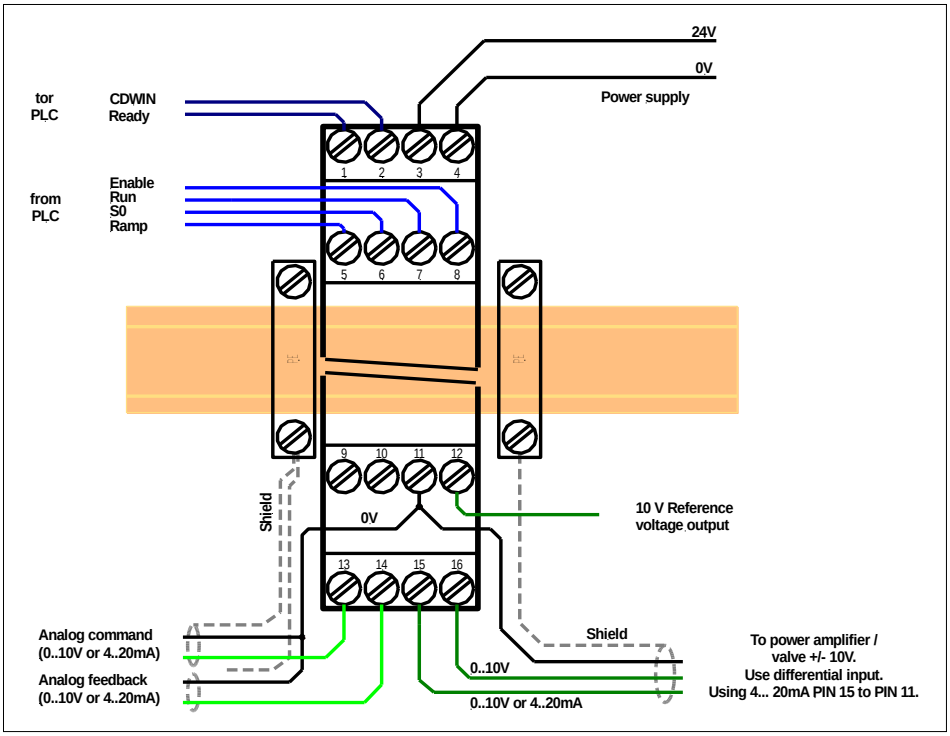
4.2 LED definitions

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 operation ***Flashing:*** Error discovered Only active when SENS = ON
YELLOW A	Identical to the STATUS output. OFF: Control deviation is higher than CDWIN value. ON: Control deviation is lower than CDWIN value.
GREEN + YELLOW A+B	1. **Chasing light (over all LEDs):** The boot loader 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 non-volatile stored parameters are inconsistent! To acknowledge the error, data has to be saved with the SAVE command or the corresponding button in the WPC

4.3 Block diagram



4.4 Typical wiring



4.5 Connection examples

SPS / PLC 0... 10 V command input signal

+In PIN 13

-In PIN 11

z. B. 24 V

PLC or sensor with 4... 20 mA (two wire connection)

+In PIN 13 or 14

PIN 11 (GND)

AIN:W 2000 1600 2000 C (für 0... 100%)

SPS / PLC 0... 10 V feedback input signal

+In PIN 14

In PIN 11 (GND)

z. B. 24 V

PLC or sensor with 4... 20 mA (three wire connection)

+In PIN 13 or 14

PIN 11 (GND)

AIN:W 2000 1600 2000 C (für 0... 100%)

Valve (6 + PE plug) with OBE electronics, voltage signal 0-10V or +/- 10V

Module

PIN 12

PIN 15

PIN 16

A : 24 V supply

B : 0 V supply

C : GND or enable

D : + differential input

E : - differential input

F : diagnostics

PE -

Valve (6 + PE plug) with OBE elektronics, current signal 4-20 mA oder 4-12-20 mA

PIN 12

PIN 15

PIN 16

A : 24 V supply

B : 0 V supply

C : GND or enable

D : + input control signal

E : - reference control signal

F : diagnostics

PE -

4.6 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

5 Parameters

5.1 Parameter overview

Group	Command	Default	Unit	Description
Basic parameters				
	LG	EN	-	Changing language help texts
	MODE	STD	-	Parameter view
	SENS	AUTO	-	Malfunction monitor
	PIN:5	RAMP	-	Function of pin 5
	CDWIN	200	0,01%	Size of the control deviation window
	EOUT	0	0,01 %	Output signal if not ready
Input signal adaptation				
Sensor scaling				
	SIGNAL:X	U0-10		Type of input
	N_RANGE:X	100	%	Range of sensor in relation to working range
	OFFSET:X	0	0,01%	Sensor offset
Command Input scaling				
	SIGNAL:W	U0-10	-	Type of input.
Ramp and PID control parameters				
	INTEG	FAST	-	Integrator speed range
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	0,1 ms	I gain
	C1:D	0	0,1 ms	D gain
	C1:D_T1	500	0,1 ms	D gain filter
	C1:FF	0	0,01 %	Feed forward
	C1:I_LIM	2500	0,01 %	Integrator limitation
	C1:I_ACT	2500	0,01 %	Integrator activation threshold
	C1:PT1_P	0	0,01 %	PT1 gain
	C1:PT1_T1	50	0,1 ms	PT1 time constant
Parameter set 2				
	RA2:UP	100	ms	Command signal ramp time
	RA2:DOWN	100	ms	
	C2:P	50	0,01 %	P gain
	C2:I	4000	0,1 ms	I gain
	C2:D	0	0,1 ms	D gain
	C2:D_T1	500	0,1 ms	D gain filter
	C2:FF	0	0,01 %	Feed forward
	C2:I_LIM	2500	0,01 %	Integrator limitation
	C2:I_ACT	2500	0,01 %	Integrator activation threshold
	C2:PT1_P	0	0,01 %	PT1 gain
	C2:PT1_T1	50	0,1 ms	PT1 time constant

Group	Command	Default	Unit	Description
Output signal adaptation				
	MIN:A **MIN:B**	0 0	0,01 % 0,01 %	Dead band compensation
	MAX:A **MAX:B**	10000 10000	0,01 % 0,01 %	Output scaling
	TRIGGER	200	0,01 %	Dead band compensation trigger point
	SIGNAL:U	U+-10	-	Type of output signal and polarity
Special commands				
Sample time				
	TS	10	0,1 ms	Sample time of the control loop
Scaling mode				
	AINMODE	EASY	-	Input scaling mode
	AIN:X **AIN:W**	A: 1000 B: 1000 C: 0 X: V	- - 0,01 % -	Free scaling of the analogue inputs. Gets activated when AINMODE is switched over to MATH.

5.2 Basic parameters

5.2.1 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 (SPEED BUTTON) in the menu bar (WPC-300) must be pressed (module identification).

5.2.2 MODE (Switching between parameter groups)

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.

5.2.3 SENS (monitoring of the modul functions)

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

This command is used to activate/deactivate the monitoring functions (4… 20 mA inputs 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 does not 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.

5.2.4 PIN5 (Function of PIN 5)

Command	Parameters	Unit	Group
PIN5 x	x= RAMP|INTEG	-	**STD**

With this command the function of PIN 5 can be defined.
RAMP: With input PIN 5 the ramp can be (de-)activated.
INTEG: With input PIN 5 the integrator can be (de-)activated. Ramp generator is active.

5.2.5 CDWIN (Size of the control deviation window)

Command	Parameters	Unit	Group
CDWIN x	x= 0… 2000	0,01 %	**STD**

This parameter is entered in 0.01 % of the setpoint .
The CDWIN command defines a monitoring rangewindow for which the CDWIN message is generated. The monitoring window monitors the deviation between the setpoint and the actual feedback value. if the deviation is within the CDWIN window, this is signaled via the status output and the CDWIN LED. The control process is not influenced by this signal.

5.2.6 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 missing ENABLE signal. 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 shall 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[1].
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.

[1] 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.

5.3 Input signal adaptation

5.3.1 SIGNAL (Type of input)

Command	Parameter	Unit	Group
SIGNAL:i x	i= W|X x= OFF|U0-10|I4-20| U10-0|I20-4	V|mA	**EASY**

This command can be used to change the type of input signal (voltage or current) and to define the direction of the signal. This command is available for all analogue inputs (W, X).
OFF= Deactivation of the input[2].

5.3.2 N_RANGE:X (Nominal range of the sensor)

Command	Parameter	Unit	Group
N_RANGE:X x	x= 1… 10000	%	**EASY**

With this command, the measurement range of the sensor is defined. The format is a percentage figure in relation to the operating range of the system. Since this is a general PID controller, the working range of the system is defined as 100%. Incorrect specifications lead to a corrupted system and the dependent parameters cannot be calculated correctly.

N_RANGE normally should not be less than 100 %

5.3.3 OFFSET:X (Sensor offset)

Command	Parameter	Unit	Group
OFFSET:X x	x=-10000… 10000	0,01%	**EASY**

With this command, the zero point of the sensor is set. The format is a percentage figure in relation to the operating range of the system. Since this is a general PID controller, the working range of the system is defined as 100%

5.3.4 Using the commands SIGNAL:X, N_RANGE:X and OFFSET:X

With these commands, the feedback sensor is scaled. Example:

The system pressure is 350 bar, the pressure sensor has a 4-20mA current output.

The nominal pressure of the sensor is 600bar (20mA at 600bar); the sensor has an offset of 3bar (at 0bar real pressure 3bar are displayed)

To scale this sensor correctly the following settings should be made:

- SIGNAL:X I4-20
- N_RANGE:X 171% (for 600bar are 171% of 350bar)
- OFFSET:X -85 (because 3bar is representing 0.85 % of 350bar)

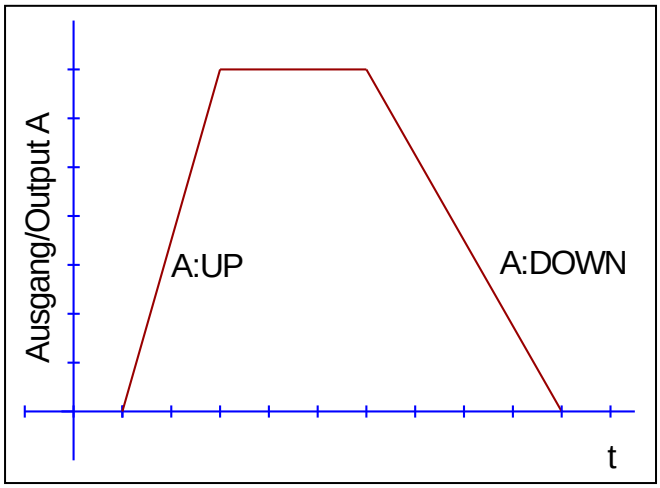
[2] The deactivation can be used to deactivate the velocity (speed) input PIN_9/10 (the VELO value is active).

5.4 Ramp and PID control parameters

5.4.1 RA (Command signal ramp times)

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

Ramp function for the 1st and 2nd quadrant.
The ramp time is adjusted separately for rising and falling input signals.



5.4.2 INTEG (Integrator Speed Range)

Command	Parameters	Unit	Group
INTEG x	x= FAST|SLOW	-	**EXP**

Depending on the dynamics of the control loop, the integrator's reset time must be set differently. This parameter can be used to extend the adjustment range in the direction of "slow", corresponding to high time constants.

In the standard setting "FAST", the time values entered at C1:I or C2:I are scaled according to the unit specified there in the comment text. Thus, if the maximum value of 30000 is entered, a reset time of 30000 x 0.1 ms = 3000 ms = 3 s can be realised.

If you want to specify longer times, set INTEG to "SLOW", which increases the setting tenfold. In this way, a range of 0 - 30 s is possible.

5.4.3 C (PID Control Settings)

Command	Parameters	Unit	Group
Cp:i x	p= 1|2 (parameter set) i= P|I|D|D_T1|FF|I_LIM|I_ACT|PT1_P|PT1_T1		**STD**
	:P x= 0… 10000	0,01 %	
	:I x= 0… 30000	0,1 ms	
	:D x= 0… 1200	0,1 ms	
	:D_T1 x= 0… 1000	0,1 ms	
	:FF x= 0… 10000	0,01 %	
	:I_LIM x= 0… 10000	0,01 %	
	:I_ACT x= 0… 10000	0,01 %	
	:PT1_P x= 0… 10000	0,01 %	
	:PT1_T1 x= 5… 1000	0,1 ms	

The control function will be parameterized via these commands.

The P, I and D gain are similar to a standard PID controller. The D_T1 factor is a filter for the D-gain in order to suppress high-frequency noise.

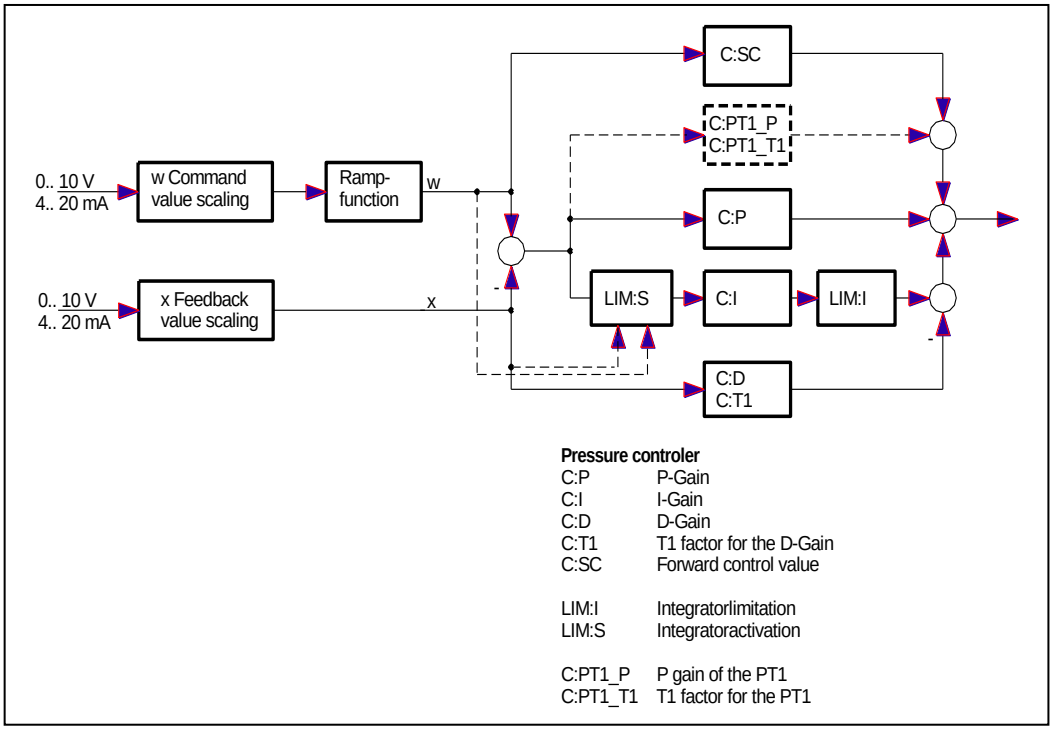
Via the FF value the command value is lead directly to the output. Because of that the controller only has to compensate the control deviation. This causes a solid type of control and a dynamic triggering.

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

I_LIM limits the working range of the integrator, so that the controller can quickly react to the process without any major overshoots. If the value is too small, it may have the effect that the non-linearity of the valve cannot be fully compensated.

The commands PT1_P and PT1_T1 set up an additional PT1 controller component parallel to the P component.

The low pass filtered P component can often be operated at higher gains than the direct P component. The stability is improved by the T1 value.



5.5 Output signal adaptation

5.5.1 MIN (Deadband compensation)

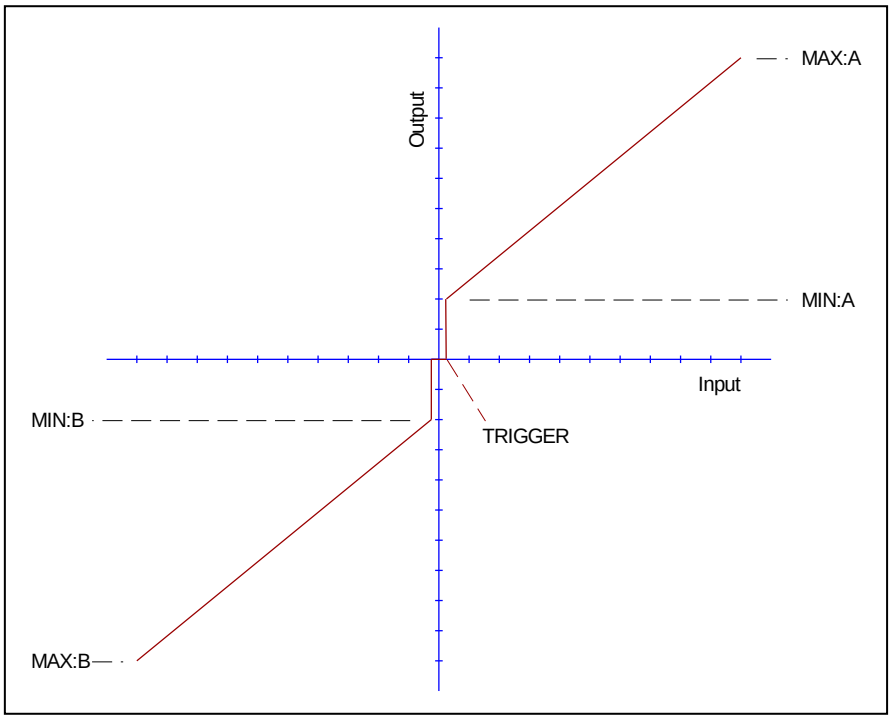
5.5.2 MAX (Output scaling)

5.5.3 TRIGGER (Deadband compensation trigger point)

Command	Parameters	Unit	Group
	i= A|B	-	**STD**
MIN:I x	x= 0… 6000	0,01 %	
MAX:I x	x= 3000… 10000	0,01 %	
TRIGGER x	x= 0… 4000	0,01 %	

With this command, the output signal is adjusted to the valve characteristics. With the MAX value the output signal (the maximum valve current) will be defined. With the MIN value the overlap (dead band of the valve) will be compensated. Via the TRIGGER the activation point of the MIN function is set and so a non-sensitive range around the zero-point can be specified.

ATTENTION: If the MIN value is set too high, it influences the minimal pressure, which cannot be adjusted any longer. In extreme case, this causes to an oscillating at small input values.



5.5.4 SIGNAL:U (Output type and polarity)

Command	Parameters	Unit	Group
SIGNAL:U x	x= U+-10|I4-12-20| U-+10|I20-12-4| U0-10|I4-20| U10-0|I20-4	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.
With differential outputs, the output voltage lies between terminals 15 and 16, single ended Output lies on terminal 15 with reference to terminal 11.

- Differential voltage
  - +-10V
  - -+10V
- Single ended voltage
  - 0-10V
  - 10-0V
- Single ended current with zero point at 12mA
  - 4-12-20mA
  - 20-12-4mA
- Single ended current with zero point at 4mA
  - 4-20mA
  - 20-4mA

An output current of less than 4 mA indicates that an error occurred or the module is not enabled. It is important to ensure that the connected valve closes at currents below 4mA. (If this is not the case, the EOUT command should be used to generate a defined output signal)

5.6 Special commands

5.6.1 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.

5.6.2 AINMODE (Input scaling mode)

Command	Parameters	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 WPC300)

5.6.3 AIN (Free analogue input scaling)

Command	Parameters	Unit	Group
AIN:i	i= W|X		MATH
a	a= -10000… 10000	-	
b	b= -10000… 10000	-	
c	c= -500… 10000	0.01%	
x	x= V|C	-	

This command offers a method to individualy scale an input. The following linear equation is used for the 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 (examples):

Command					Input signal	Description
AIN:x	1000	1000	0 V		0… 10 V	Range: 0… 100 %
AIN:x	10	8	1000 V	OR	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:x	1000	800	1000 V			
AIN:x	10	4	500 V	OR	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:x	1000	400	500 V			
AIN:x	20	16	2000 C	OR	4… 20 mA	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:x	2000	1600	2000 C	OR		
AIN:x	1250	1000	2000 C			

5.7 PROCESS DATA (Monitoring)

Command	Parameters	Unit
W	Command input signal	%
WA	Command value	%
X	Actual value	%
E	Control deviation	%
C	Controler output	%
U	Output control signal	%

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

6 Appendix

6.1 Failure monitoring

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

Source	Fault	Characteristic
Command signal PIN 13 4... 20 mA	Out of range.	The output will be switched off.
Feedback signal PIN 14 4… 20 mA	Out of range.	The output will be switched off.
EEPROM (at switching on)	Data error	The output is deactivated. The module can be activated by saving parameters again.

CAUTION: Take care of the EOUT command. Changes will influense the behaviour.

6.2 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 is been detected by the module. The fault could be: • A broken cable or no signal at the input (PIN 13 oder 14), 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 and RUN are active; the READY LED is on, the system moves to an end position.	The control circuit polarity is incorrect. The polarity can be changed with the SIGNAL:U command or by reversing the connections to PIN 15 and PIN 16.

6.3 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 or **I** - a dummy is 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"

7 Notes