WEST

Technical Documentation

PAM-195-P-S3

Power amplifier for directional valves with integrated power limitation function

Electronics
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Electronics

CONTENTS

1 General Information

1.1 Order Number

PAM-195-P-S3 - power amplifier for directional valves with integrated power limitation function

1.2 Scope of supply

The scope of supply includes the module plus the terminal blocks which are a 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 Legal notice

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Date: 07.01.2025

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 is used for the control of a directional valve with two solenoids or a pressure or throttle valve with one solenoid. Various adjustable parameters allow for an optimized adaptation to the respective valve. The integrated power amplifier with a short cycle time of 0,125 ms for the current loop is an inexpensive and space-saving solution.

Additionally to the amplifier function a power limitation functionality via an analogue input was implemented. Switching the direction was realized by a digital switching input. It is also possible to do it with an adapted scaling of the command input. Within that a simple unipolar output of a plc can control this amplifier. Controlling it with a bipolar signal from -10 to 10V is possible, too.

The output current is closed loop controlled and therefore independent from the power supply and the solenoid resistance. The output stage is monitored for cable breakdown, is short circuit proof and disables the power stage in case of an error.

RAMP, MIN and MAX, the DITHER (frequency and amplitude) and the PWM frequency are programmable.

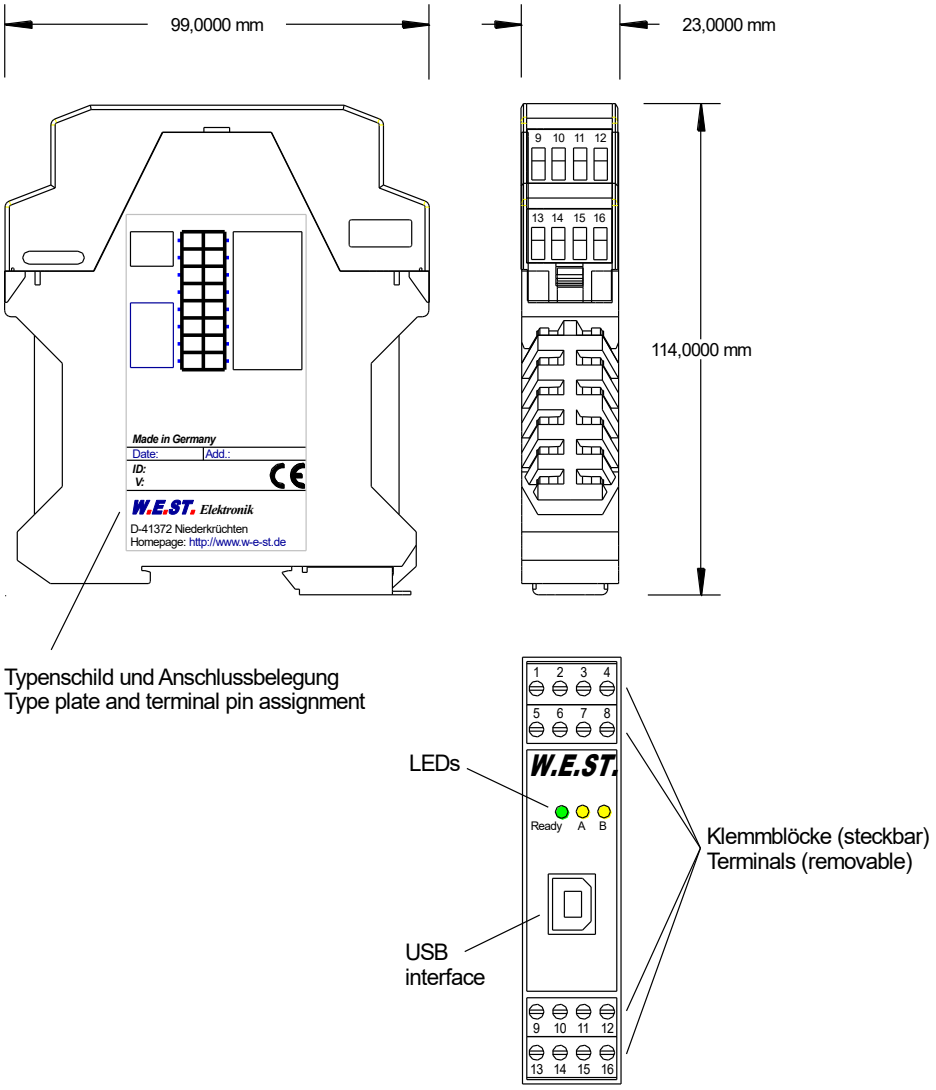
In addition, the valve characteristics can be linearized via 10 XY-points. For example: using pressure valves a linear behavior between input signal and pressure can be reached.

Typical applications: Control of directional, throttle and pressure valves, which need a flexible adaptation of the solenoid control. All typical proportional valves of the different manufactures (BOSCH REXROTH, BUCHER, DUPLOMATIC; PARKER...) can be controlled.

Features

- **Control of directional, pressure or throttle valves**
- **Compact housing**
- **Digital reproducible adjustments**
- **Free scaling of the analogue inputs**
- **Power limitation functionality via analogue input**
- **Unipolar controlling with direction switch**
- **Bipolar controlling via differential input**
- **Characteristics linearization via 10 XY-points per direction**
- **Free parameterization of RAMPS, MIN und MAX, output current, DITHER (frequency, amplitude)**
- **Nominal output current range: 0,5… 2,6 A**
- **Simple and application orientated parameter settings via WPC-software**
- **Failure monitoring and extended function check**

2.1 Device description



3 Use and application

3.1 Installation instruction

- 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 a requirement that no strong electro-magnetic interference sources are installed nearby when using our open and closed loop control modules.

- **Typical installation location:** 24V 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 space close to the PLC (24 V area) is most suitable. All digital and analogue inputs and outputs are fitted with filters and surge protection 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-connected 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 > 3m. 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.
  - With 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). Particular care is required with cables of over 40 m in length – 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 connected to the same power supply) must always be provided with appropriate overvoltage protection directly at the coil.

3.2 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. **CAUTION! Compared to older modules the standard baudrate of the interface was changed to 57600 Baud. Please set the WPC-300 to 57600 Baud or to the automatic baudrate recognition as described under OPTIONS/SETTINGS, point 6.3.1.** **ATTENTION!** A USB driver has to be installed and properly configured. See WPC-300 short guideline. Further commissioning and diagnosis are supported by the operating software. **ATTENTION!** The COMPORT (in WPC-300) has to be closed before the USB plug is to be disconnected. Otherwise the WPC-300 is going to be instable.
Pre-parameterization	Now set up the following parameters (with reference to the system design and circuit diagrams): The nominal output CURRENT and the typical valve parameters such as DITHER and MIN/MAX. Pre-parameterization is necessary to minimize the risk of uncontrolled movements.
Control signal	Check the control signal with an amp meter. The control signal (the current of the solenoid) is within the range of 0... 2, 6A. In the actual status it should show approximately 0 A. **ATTENTION!** You can monitor the current of the solenoids also in the WPC-300 program.
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) if it is a proportional valve.
Activating ENABLE	**CAUTION!** The drive can now leave its position and move to an end position with full speed or the pressure can reach maximum. Take safety measures to prevent personal injury and damage.

3.3 Range of applications

The amplifier described in this document provides a power limitation functionality. This can be used in different ways.

3.3.1 Limitation of the output power

Depending on the measured pressure in the application the volumetric flow will be reduced above a programmed threshold. This is a typical application which is the reason for displaying the feedback value also in bar.

3.3.2 Limitation of the input/common power

In this kind of use several devices get a signal for the power consumption of the whole system as feedback. So single valves can open without limitation. Even if the system reaches its borderline for overload, all valves will be limited uniformly.

4 Function modes and technical description

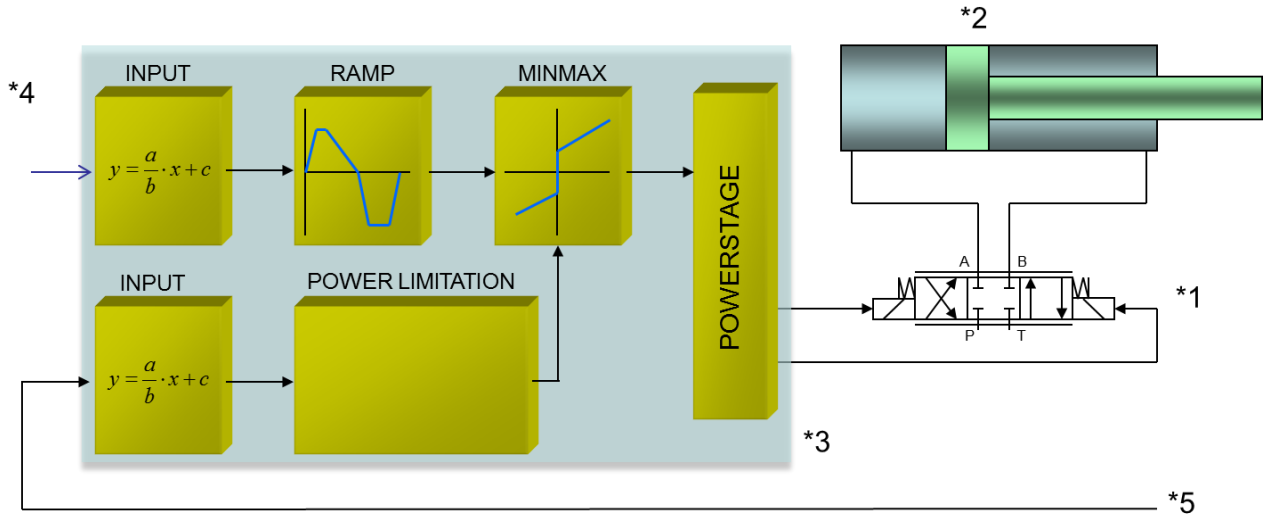
4.1 LED Indications

LEDs	Description of the LED function
GREEN + YELLOW	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 + YELLOW	**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.
GREEN	Identical to the READY output. **OFF:** No power supply or ENABLE is not activated **ON:** System is ready for operation **Flashing:** Error detected (e. g. valve solenoid or 4… 20 mA). Not active when SENS = OFF.
YELLOW	LED in the middle position = Current to the solenoid; the intensity is proportional to the actual output current. LED in the right position = Power limitation; the LED indicates, whether the device is in power limitation range or not.

4.2 Typical system structure

This minimal system consists of the following components:

(*1) proportional valve
(*2) hydraulic cylinder
(*3) power amplifier PAM-195-P-S3
(*4) interface to PLC with analogue and digital signals
(*5) power input, from pressure sensor or pump



4.3 Method of operation

This power amplifier is controlled by an analogue signal (from the PLC, from a joystick or a potentiometer). An ENABLE signal (typically 24V) activates the module and the READY output indicates this, if no internal or external error was detected.

The integrated standard functions will be configured via different parameters.

In case of a fault, the power output stage will be deactivated and the fault will be indicated through a deactivated READY output and a flashing READY LED.

The output current is closed loop controlled whereby a high accuracy and a good dynamic will be obtained. All custom proportional valves (up to 2,6A) may be controlled with this power amplifier.

This modified module is basically controlled by an unipolar command signal in the range of 0... 10V or 4... 20mA. A switching input is used for changing direction. By this way directional valves can be controlled via inexpensive unipolar plc outputs. Special feature of this module is the power limitation function. For that an upper limit for each direction can be preset. Due to reducing the flow rate depending on the actual pressure this limits will observed. Via this calculation for power limitation the output value (the flow) will be reduced:

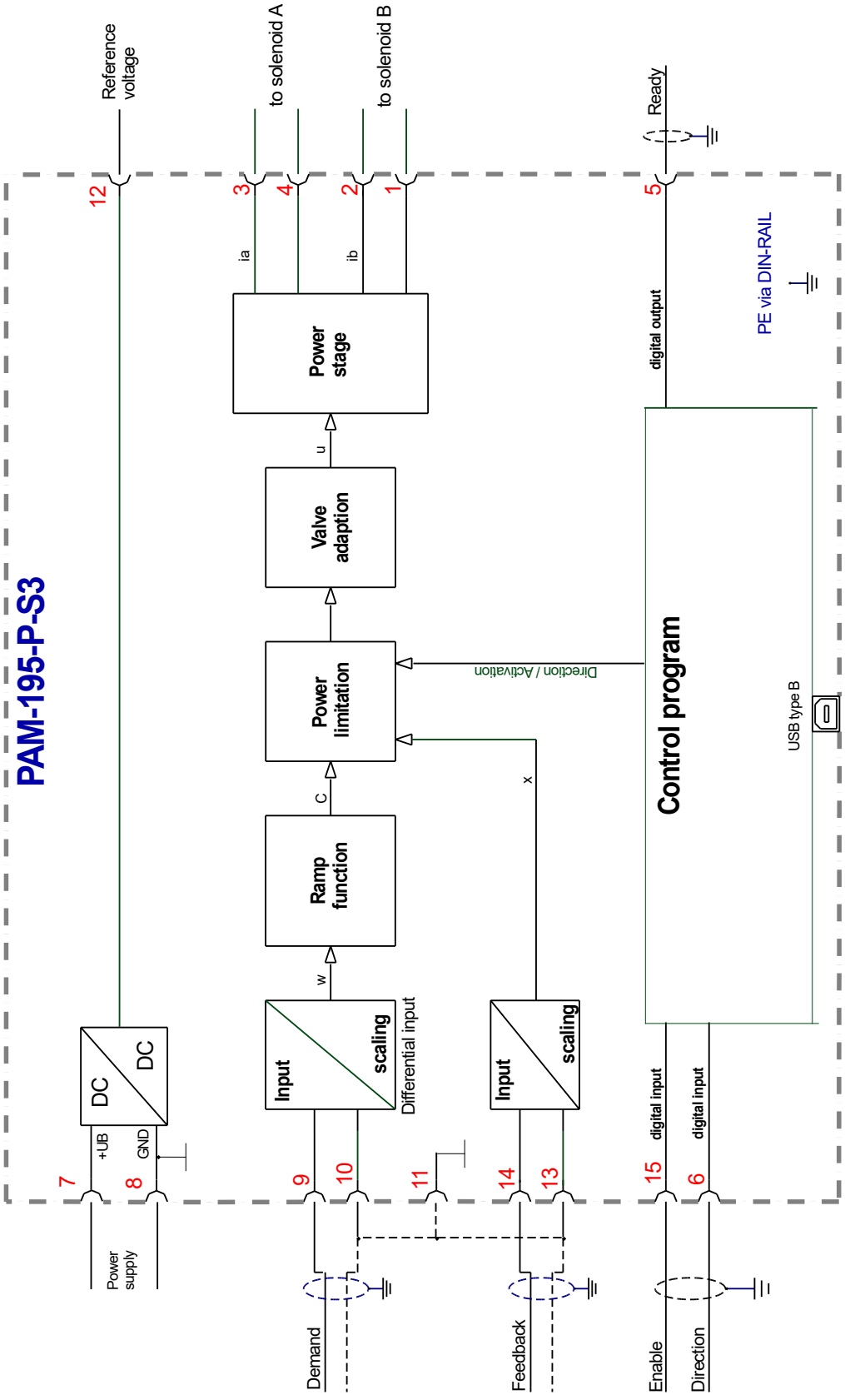
$$Output_{LIM} = \frac{PL_V \cdot 100\%}{INPUT_{Druck}}$$

INPUT means the measured signal for power limitation (e.g. the pressure) and PL_V (parameter PL:V) the power factor in % related to the maximum. The output signal will be limited down to the $OUTPUT_{LIM}$ value.

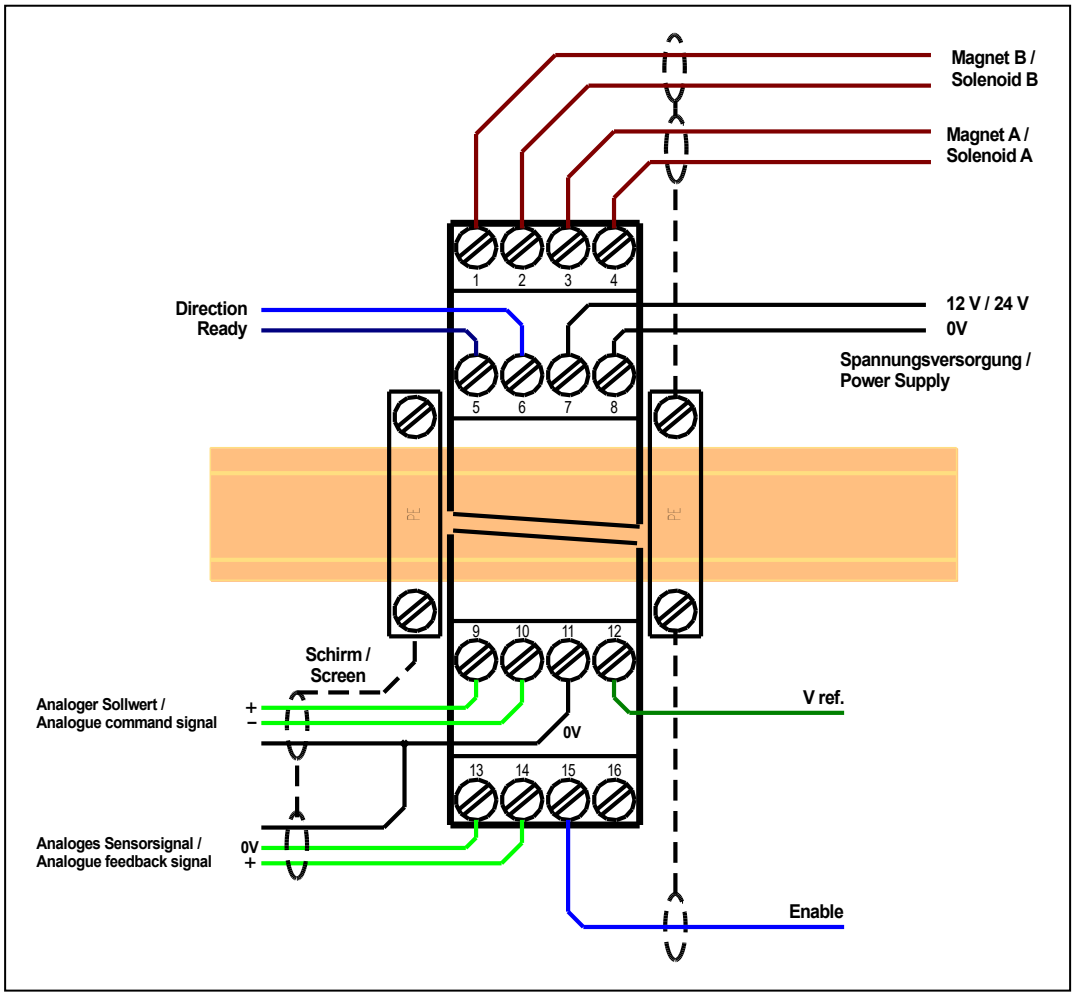
4.4 Input and output signals

Connection	Supply
PIN 7	Power supply (see technical data)
PIN 8	0 V (GND) Power supply (ground). **Attention**, PIN 8 and PIN 11 are connected internally. PIN 11 is used as the GND potential for the command and feedback signals.
Connection	**Reference voltages output**
PIN 12	Reference output voltage (8 V).
Connection	**PWM output**
PIN 3 / 4	Current controlled PWM outputs for solenoid A.
PIN 1 / 2	Current controlled PWM outputs for solenoid B.
Connection	**Analogue input signals**
PIN 9 / 10	Command (input) signal (W), range -100…100 % or 0… 100 % corresponds with 0…10 V or 4…20 mA. Other signal ranges can be scaled.
PIN 14 / 13	Feedback input (actual pressure), range 0… 10 V or 4… 20 mA corresponds with 0… 100 %.
PIN 11	0 V reference for the signal inputs.
Connection	**Digital inputs and outputs**
PIN 15	**Enable Input**: This digital input signal initializes the application. The output and the READY signal will be activated. By deactivating error signals are reset.
PIN 6	**Direction input:** Switching direction (changing solenoids).
PIN 5	**READY output**: **ON:** Module is ready, no errors are detected **OFF:** ENABLE (PIN 15) is deactivated or an error is detected.

4.5 Circuit diagram



4.6 Typical wiring

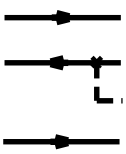


4.7 Input connection (examples)

SPS / PLC -10... 10 V / -100... 100%

AIN:W 1000 1000 0 V (-100... 100%)

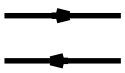
0... 10 V to +/- 100% with polarity switch



AIN:W 1000 1000 0 V (= 0... 100%)

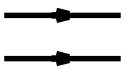
(=-0... -100%)

4... 20 mA input



AIN:W 1250 1000 2000 C (0... 100%)
AIN:W 2500 1000 6000 C (+/-100%)

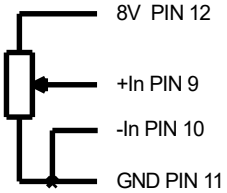
4... 20 mA input (with polarity switch)



AIN:W 1250 1000 2000 C (0... 100%)

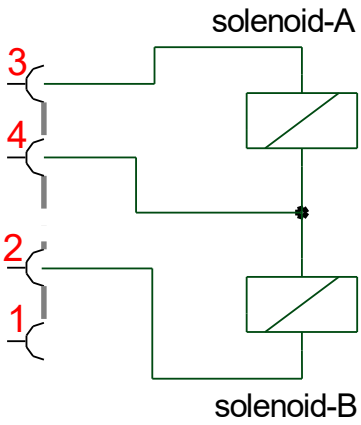
(0... -100%)

Potentiometer / Joystick



AIN:W 1000 800 0 V (0... 100%)
AIN:W 2000 800 4000 V (+/-100%)

3 wire connection e.g. for HAWE valves



4.8 Technical data

Power supply (U_b) Power consumption max. External fuse	**[VDC]** **[mA]** **[A]**	12… 30 (incl. ripple) 60 + solenoid current 3 medium time lag
Reference output Voltage Maximum load	 **[V]** **[mA]**	 8 25
Digital inputs OFF ON Input resistance	 **[V]** **[V]** **[kOhm]**	 < 2 > 10 25
Digital outputs OFF ON Maximum output current	 **[V]** **[V]** **[mA]**	 < 2 max. Ub 50
Analog inputs: Voltage Input resistance Current Burden Signal resolution	 **[V]** **[kOhm]** **[mA]** **[Ohm]** **[%]**	Unipolar/differential 0… 10 min. 90 4… 20 390 0,03
PWM power outputs Maximum output current Frequency	 **[A]** **[Hz]**	broken wire and short circuit monitored 2.6 61… 2604 selectable in steps
Sample times Current controller Analog inputs	 **[µs]** **[ms]**	 125 1
Serial interface Transmission rate	**-** **[kBaud]**	USB - virtual COM Port 9,6… 115,2
Housing Material Flammability	 **-** **[class]**	Snap-on module to EN 50022 PA 6.6 polyamide V0 (UL94)
Weight	**[kg]**	0,190
Connections Communication Plugs PE	**-**	 USB type B 4pol. screw terminals PE: direct via DIN rail
Protection class Temperature range Storage temperature Humidity Vibration	 **[°C]** **[°C]** **[%]** **-**	IP20 -20… 60 -20 …70 <95 (not condensing) IEC 60068-2-6 (category C)
EMC		EN 61000-6-2: 8/2005 EN 61000-6-4: 6/2007 ; A1:2011

5 Parameter

5.1 Parameter list

Group	Command	Default	Unit	Description
Basic parameters				
	LG	EN	-	Changing language help texts
	MODE	STD	-	Parameter view
	AINMODE	EASY	-	Input scaling mode
	SENS	AUTO	-	Malfunction monitor
	CCMODE	OFF	-	Activation and deactivation of the characteristic linearization
	SOLENOIDS	2	-	Number of solenoids
	POL	+	-	Output polarity
Input signal adaptation				
Command signal scaling				
	SIGNAL:W	U0-10	-	Type of input
	AIN:W	A: 1000 B: 1000 C: 0 X: V		Free scaling of the analogue command signal input. Gets activated when AINMODE is switched over to MATH.
	SYS_RANGE	100	bar	System pressure
Sensor signal scaling				
	SIGNAL:X	U0-10	-	Type of input
	AIN:X	A: 1000 B: 1000 C: 0 X: V		Free scaling of the analogue feedback input. Gets activated when AINMODE is switched over to MATH.
	N_RANGE:X	100	bar	Sensor nominal pressure
	OFFSET:X	0	mbar	Sensor offset
Ramp function				
	RA:1 **RA:2** **RA:3** **RA:4**	100 100 100 100	ms ms ms ms	Command signal four quadrant ramp times
Power limitation function				
	PLV:A **PLV:B**	10000 10000	0.01 % 0.01 %	Power limitation factor
	PLT1:A **PLT1:B**	5000 5000	0.1 ma 0.1 ms	Dynamic of the power limitation

Group	Command	Default	Unit	Description
Output signal adaptation				
	CC	-	xy	Free definable characteristic linearization
	MIN:A **MIN:B**	0 0	0.01 % 0.01 %	Deadband compensation
	MAX:A **MAX:B**	10000 10000	0.01 % 0.01 %	Output scaling
	TRIGGER	200	0.01 %	Deadband compensation trigger point
Parameters of the power stage				
	CURRENT	1000	mA	Rated solenoid current
	DAMPL	500	0.01 %	Dither amplitude
	DFREQ	121	Hz	Dither frequency
	PWM	2604	Hz	PWM frequency
	ACC	ON	-	Current loop auto adjustment
	PPWM **IPWM**	7 40	- -	P-Gain of the current loop I-Gain of the current loop

5.2 Basic parameters

5.2.1 LG (Changing the language for the help texts)

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

Either German or English can be selected for the help texts in the WPC-300 program.

CAUTION: After changing the language settings the parameter list has to be updated by pressing the speed button “ID”.

5.2.2 MODE (Switching between parameter groups)

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

This command changes the parameter mode. Various commands (defined via STD/EXP) are blanked out in standard mode. The several commands in expert mode have more significant influence on the system performance. Therefore they should be changed with care.

5.2.3 AINMODE (Mode of input scaling)

Command		Parameters	Unit	Group
AINMODE	X	x= EASY|MATH	-	EXP

This command allows switching the input scaling between a selection out of some standard signals (SIGNAL) and the free and individual mathematic scaling (AIN) for differing signal ranges.

For adapting the feedback input some more parameters are provided in EASY mode, helping to scale it to the chosen pressure range and display the parameter in Bar.

5.2.4 SENS (Failure monitoring)

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. This mode should be used in case of active enabling and monitoring by a PLC (READY signal).

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 especially for troubleshooting.

AUTO MODE: The module checks each second the actual failure status, which will (in case of a persistent error) trigger the LED and the READY output for a short time.

5.2.5 CCMODE (Activation of the characteristic linearization)

Command	Parameters	Unit	Group
CCMODE X	x= ON|OFF	-	EXP

This command will be used for activation or deactivation of the characteristics linearization (CC, CCA and CCB). Through deactivating this parameter a simple and quick estimation of the linearization is possible.

CAUTION: If CC command is used, parameters MIN, MAX and TRIGGER have to be considered. CC and those commands affect each other. Pay attention to that if it is necessary to use both kind of settings at the same time.

5.2.6 SOLENOIDS (One or two solenoids)

Command	Parameters	Unit	Group
SOLENOIDS X	x= 1|2	-	STD

This parameter allows you to adapt the amplifier to valves with one solenoid (e.g. pressure valves) or to such with two solenoids (directional valves).

5.2.7 POL (Output polarity)

Command	Parameters	Unit	Group
POL X	x= +|-	-	STD

Valves with one solenoid:

This command allows a switch over of the output signal direction (after the MIN-MAX function).

Example: POL:A + Input signal 0… 100 %, nominal output current 0… 100 %.
POL:A - Input signal 0… 100 % nominal output current 100… 0 %.

Directional valves:

This command allows a switch over of the output polarity.

5.3 Input signal adaption

5.3.1 SIGNAL (Switching the type of input signal)

Command	Parameters	Unit	Group
SIGNAL:W X SIGNAL:X X	X= U+-10|U-+10| I4-12-20|I20-12-4	-	AINMODE=EASY

By the use of this command some standard type of signals can be selected easily. Available are the voltage signals from 0...10 V or 10… 0 V just as the current ones from 4…20 mA and 20… 4 mA, used for 0… 100% demand value. This command is only active if AINMODE is set to EASY.

5.3.2 AIN (Analogue input scaling)

Command	Parameters	Unit	Group

`AIN:I a b c x`	`i = A|B`
	`a= -10000… 10000`
	`b= -10000… 10000`
	`c= -10000… 10000`
	`x= V|C`
		-
		-
		-
		0,01%
		-
			AINMODE=MATH

This command offers an individual scalable input. The following linear equation is used for the scaling.

$$Output = A/B \cdot (Input - C)$$

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):

AIN settings					Input signal	Description
`AIN:I`	`10`	`5`	`0 V`	OR	`0… 5 V`	Voltages input: Usable 0… 10V for a working range of 0… 100% (**one solenoid**). Really used are 0… 5V for 0… 100%.
`AIN:I`	`2000`	`1000`	`0 V`			
`AIN:I`	`10`	`8`	`1000 V`	OR	`1… 9 V`	Voltages input: Usable 0… 10V for a working range of 0… 100% (**one solenoid**). Really used are 1… 9V (8V) for 100% with 10% offset.
`AIN:I`	`1250`	`1000`	`1000 V`			
`AIN:I`	`20`	`16`	`2000 C`	OR	`4… 20 mA`	Current input: *theoretically* usable range 0… 20mA for a working range of 0… 100% (**one solenoids**). Really usable are 4… 20mA (16mA) with 20% offset (4mA) for 0… 100%.
`AIN:I`	`1250`	`1000`	`2000 C`			
`AIN:I`	`20`	`10`	`5000 V`	ODER	`0… 10 V`	Voltages input: 0… 10V for 0… 100% (**one solenoid**) will be expanded to +/- 100% (**two solenoids**) what normally would require 20V signal range. (50% offset).
`AIN:I`	`1000`	`500`	`5000 V`			
`AIN:I`	`40`	`16`	`6000 C`	ODER	`4… 12… 20 mA`	Current input: *theoretically* usable range 0… 20mA for a working range of 0… 100% (**one solenoids**). Expansion to +/- 100% would normally require 40mA signal range (60% offset for 12mA as zero position).
`AIN:I`	`2500`	`1000`	`6000 C`			
`AIN:I`	`20`	`10`	`0 V`	OR	`-5… 5 V`	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**). Really used are -5… 5V (10V). Multiplying factor 2.
`AIN:I`	`2000`	`1000`	`0 V`			

5.3.3 SYS_RANGE (Rated pressure of the system)

Command	Parameters	Unit	Group
SYS_RANGE X	x= 1… 600	bar	AINMODE=EASY

This parameter allows you to input the rated pressure value of the system. It is used as reference value for the sensor scaling and the displayed parameters.

5.3.4 N_RANGE:X (Nominal pressure of the sensor)

Command	Parameters	Unit	Group
N_RANGE:X X	x= 1… 600	bar	AINMODE=EASY

This parameter defines the working range of the pressure sensor. By inputting this value the controller is able to adapt the input scaling to the range of the rated pressure.

5.3.5 OFFSET:X (Zero point setting of the sensor)

Command	Parameters	Unit	Group
OFFSET:X X	x= -60000… 60000	mbar	AINMODE=EASY

Via this parameter an offset value for the pressure sensor can be preset. That means you can do a shift of the zero point of the feedback signal with it.

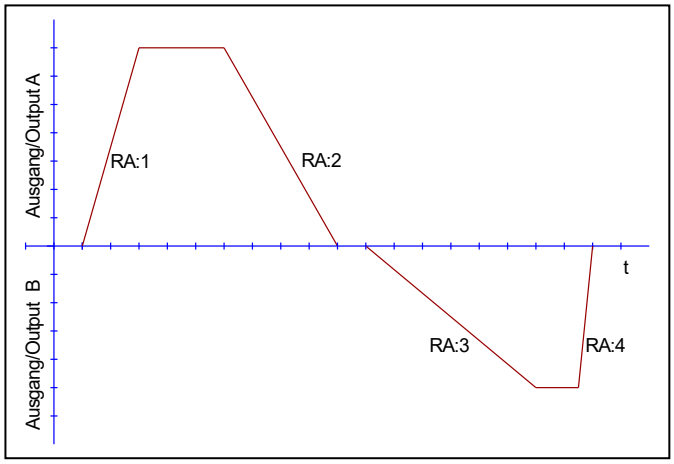
5.3.6 RA (Ramp function)

Command	Parameters	Unit	Group
RA:I X	i= 1… 4 x= 1… 120000	- ms	STD

Four quadrants ramp function.

The first quadrant means the acceleration ramp for solenoid A and the second one stands for the deceleration ramp of solenoid A. According to this the third quadrant represents the acceleration ramp for solenoid B so that the fourth quadrant remains for the deceleration ramp for solenoid B.

ATTENTION: Because of internal calculations rounding errors may be occur on the display.



5.4 Power limitation function

5.4.1 PL:V (Power limitation factor)

5.4.2 PL:T1 (Dynamic of the power limitation function)

Command	Parameters	Unit	Group
	I = A|B		STD
PLV:I X	x= 2000… 10000	0,01 %	
PLT1:I X	x= 10… 1000	0,1 ms	

The power limitation function is parameterized by these parameters.

PL:V defines the power factor according to the possible maximum power for each direction. The possible maximum is calculated by the maximum pressure and the displacement. It should be payed attention to the power loss.

PL:T1 defines the dynamic, means the speed of the power limitation function. Typical used values are in the range of 5… 50ms.

Attention: Because of internal calculations the value is parameterizable only stepwise. Always the next possible higher step is chosen.

5.5 Output signal adaption

5.5.1 CC (Characteristics linearization)

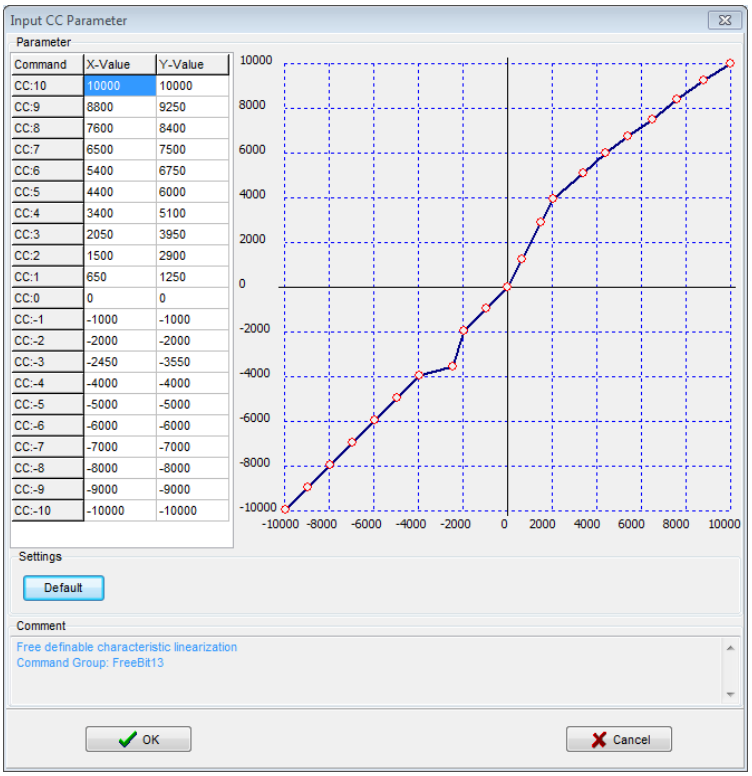
Command	Parameters	Unit	Group
CC:I X Y	i= -10… 10 x= -10000… 10000 y= -10000… 10000	- 0,01% 0,01%	CCMODE=ON

A user defined signal characteristic can be set by this function. For activating the parameter CCMODE has to be switched to ON.

The positive indexes stand for the solenoid A, the negative ones represent the solenoid B. The curve is calculated according to the equation of the linear interpolation: **y=(x-x1)*(y1-y0)/(x1-x0)+y1**.

The influence of the linearization can be estimated via the process data on the monitor or on the oscilloscope.

For the input of the characteristics linearization, the WPC-300 program provides a table and a graphic data input. The input signal is mapped on to the X-axis and the output signal is mapped on to the Y-axis.



5.5.2 MIN (Overlap compensation)

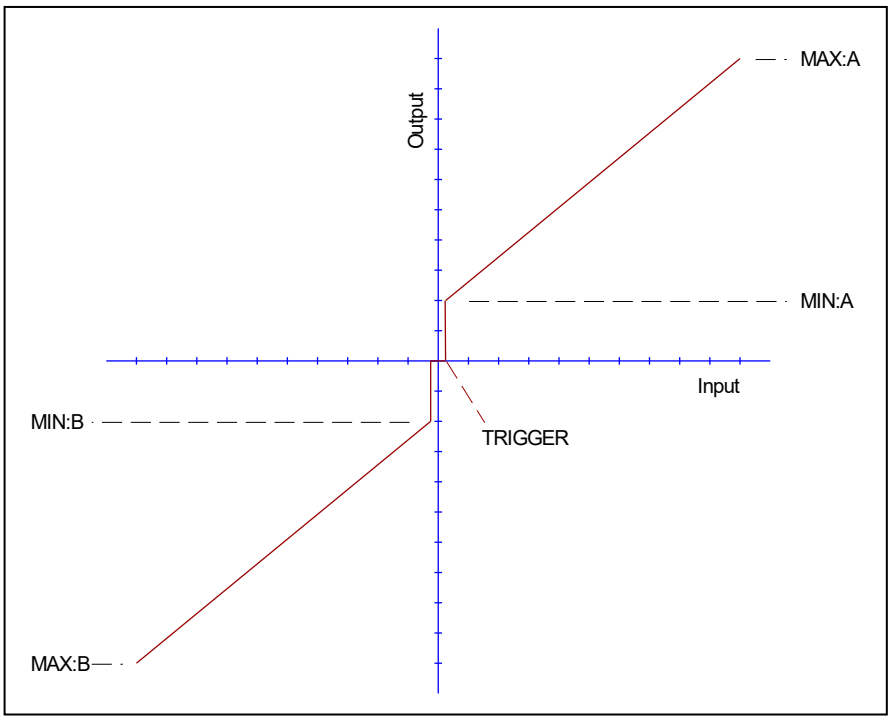
5.5.3 MAX (Output scaling)

5.5.4 TRIGGER (Threshold value of MIN function)

Command		Parameters	Unit	Group
		i= A|B	-	STD
MIN:I	X	x= 0… 6000	0,01%	
MAX:I	X	x= 5000… 10000	0,01%	
TRIGGER	X	x= 0… 3000	0,01%	

The output signal is adapted to the valve by these commands. 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[1] can be specified.

CAUTION: If the MIN value is set too high, it influences the minimal velocity, which cannot be adjusted any longer.



[1] This dead band is necessary, in order to avoid unrequested activations caused by small variations of the input signal. If this module is used in a position controls, the TRIGGER value should be reduced (typical: 1…10).

5.6 Parameters of the power stage

5.6.1 CURRENT (Nominal output current)

Command	Parameters	Unit	Group
CURRENT X	x= 500… 2600	mA	STD

The nominal solenoid current is set with this parameter. The DITHER and also the MIN/MAX parameter always refer to the selected current range.

5.6.2 DAMPL (Dither amplitude)

5.6.3 DFREQ (Dither frequency)

Command	Parameters	Unit	Group
DAMPL X	x= 0… 3000	0,01 %	STD
DFREQ X	x= 60… 400	Hz	

The dither[2] can be defined freely with this command. Different amplitudes or frequencies may be required depending on the respective valve. The dither amplitude is defined in % of the nominal current (see: CURRENT command). Depending on internal calculations the setting at higher frequencies is only possible in steps. Always the next higher step is chosen.

CAUTION: *The PPWM and IPWM parameters influence the effect of the dither setting. These parameters should not be changed again after the dither has been optimized.*

CAUTION*: If the PWM frequency is less than 500 Hz, the dither amplitude should be set to zero.*

[2] The DITHER is a superimposed signal to reduce the hysteresis. This function is defined by the amplitude and frequency. The DITHER frequency should not be confused with the PWM frequency. In some proportional valve documentations a mistake is done by the definition of the DITHER / PWM frequency. It is recognizable by missing information about the DITHER amplitude.

5.6.4 PWM (PWM frequency)

Command	Parameters	Unit	Group
PWM X	x= 61… 2604	Hz	EXP

The frequency can be changed in the defined steps (61 Hz, 72 Hz, 85 Hz, 100 Hz, 120 Hz, 150 Hz, 200 Hz, 269 Hz, 372 Hz, 488 Hz, 624 Hz, 781 Hz, 976 Hz, 1201 Hz, 1420 Hz, 1562 Hz, 1736 Hz, 1953 Hz, 2232 Hz and 2604 Hz). The optimum frequency depends on the valve.

Attention: *The PPWM and IPWM parameters should be adapted when using low PWM frequencies because of the longer dead times which forces a reduced stability of the closed loop control.*

5.6.5 ACC (Auto adaptation of the closed loop current controller)

Command	Parameters	Unit	Group
ACC x	x= ON|OFF	-	EXP

Operation mode of the closed loop current control.

ON: In automatic mode PPWM and IPWM are calculated depending on the preset PWM-frequency.

OFF: Manual adjustment.

5.6.6 PPWM (Solenoid current controller P gain)

5.6.7 IPWM (Solenoid current controller I gain)

Command		Parameters	Unit	Group
PPWM	X	x= 0… 30	-	ACC=OFF
IPWM	X	x= 1… 100	-	

The PI current controller for the solenoids is parameterized with these commands.

CAUTION: These parameters should not be changed without adequate measurement facilities and experiences.

Attention, if the parameter ACC is set to ON, these adjustments are done automatically.

If the PWM frequency is < 250 Hz, the dynamic of the current controller has to be decreased.
Typical values are: PPWM = 1… 3 and IPWM = 40… 80.

If the PWM frequency is > 1000 Hz, the default values of PPWM = 7 and IPWM = 40 should be chosen.

5.7 Process data (Monitoring)

Command	Description	Unit
W	Command value after input scaling	%
C	Command value after ramp function	%
X	Feedback value	%
XR	Feedback value real unit	%
U	Command value to current controller	bar
IA	Output current of solenoid A	mA
IB	Output current of solenoid B	mA

The process data are the variable values which can be continuously observed 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	Characteristics
Command signal PIN 9, 4...20mA	Out of range	The power stage is deactivated.
Feedback signal PIN 14, 4… 20mA	Out of range	The power stage is deactivated.
Solenoid A PIN 3 / 4 Solenoid B PIN 1 / 2	Broken wire	The power stage is deactivated.
EEPROM (monitored during power on procedure)	Data error	The power stage is deactivated. The module can be activated by saving new parameters (pressing of the SAVE Button).

6.2 Troubleshooting

Initial situation is an operable status of the device and existing communication between the module and the WPC-300 program. Furthermore, the parameterization of the valve control has to be done with the assistance of the valve data sheets.

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

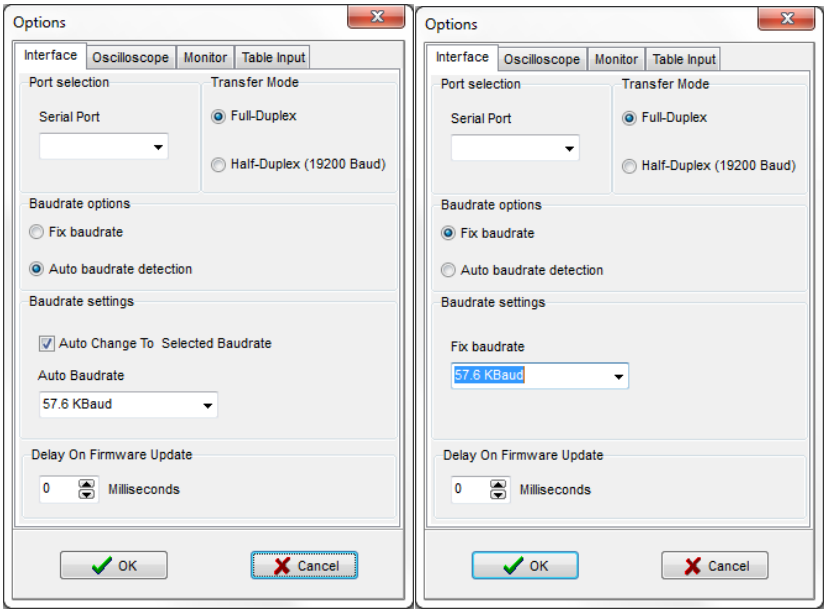
CAUTION: If using the RC (Remote Control) mode, all safety aspects have to be checked solidly. In this mode the module is actuated directly and the machine control has no influence on the module.

FAULT	CAUSE / SOLUTION
ENABLE is active, the module does not respond, and the READY LED is off.	Probably the power supply is disconnected or the ENABLE signal is not present. If there is no power supply there is also no communication via our operating program. If the connection to the WPC-300 exists, the power supply is also available. In this case the availability of the ENABLE signal can be checked via the monitor.
ENABLE is active, the READY LED is flashing.	The flashing READY LED indicates that a fault is detected by the module. The fault could be: • Failure detection in case of current input. Input signal below 3 mA. • A broken cable or incorrect wiring to the solenoids. • Internal data error: execute the command / press the button SAVE to delete the data error. The system reloads the DEFAULT data. With the WPC-300 operating program the failure can be localized directly via the monitor.

6.3 Differences to former product generations

6.3.1 Baudrate of the serial Interface

Attention, the new modules have a higher preset baudrate. In case of communication problems check the following settings. Both variants are possible; to maintain compatibility to older modules the „AUTO BAUDRATE DETECTION" should be preferred.



For updating the firmware the „Fix Baudrate" has to be set to 57.6 KBaud.

6.3.2 Output current adjustment / MIN_MAX / RCURR

The current command now needs the rated current value of the valve/solenoid. All parameters: MIN, MAX, DAMPL are in % and directly related to the rated current. The advantages are clear and simple adjustments, fix relationship of the dither amplitude and an exact output current adjustment.

6.4 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 - `i`=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