Technical Documentation

PROAM-21

Power amplifier for directional valves

Grundlage der Funktionsbeschreibung und zur Prüfung
der Module (keine Produktdokumentation).

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1 General Information

1.1 Order number

PROam21 - for directional valves (max output current: 0,8 A and 1,6 A)

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.

1.3 Accessories

1.4 Symbols used

General information

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Safety-related information

1.5 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.

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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.

11This 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.

11CAUTION!
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 proportional valves with one or two solenoids. Various adjustable parameters enable an optimized adaptation to the respective valve. This power amplifier is inexpensive and a space-saving solution.

The amplifier is controlled by different voltages or current input signals. The output current is closed loop controlled and therefore independent from the supply voltage and the solenoid resistance.

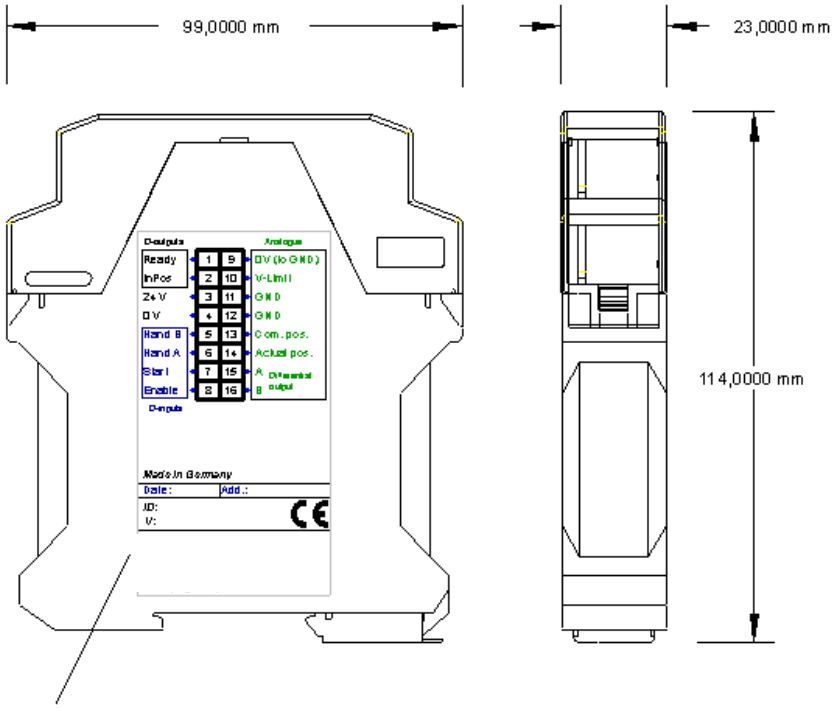
Ramps, MIN and MAX and PWM-frequency are adjustable via potentiometer

Typical applications: Control of proportional valves

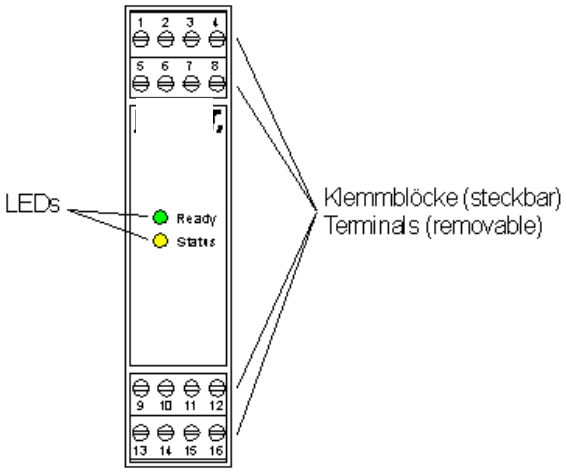
Features

- **Power amplifier for proportional directional valves**
- **Internal controlled by a modern microcontroller**
- **Compact housing**
- **Adjustment via potentiometer**
- **MIN-, MAX-, RAMP- and PWM-frequency adjustment via potentiometer**
- **Current range (per DIL switch): 0,8 A and 1,6 A**

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 a requirement that no strong electro-magnetic interference sources are 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 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.

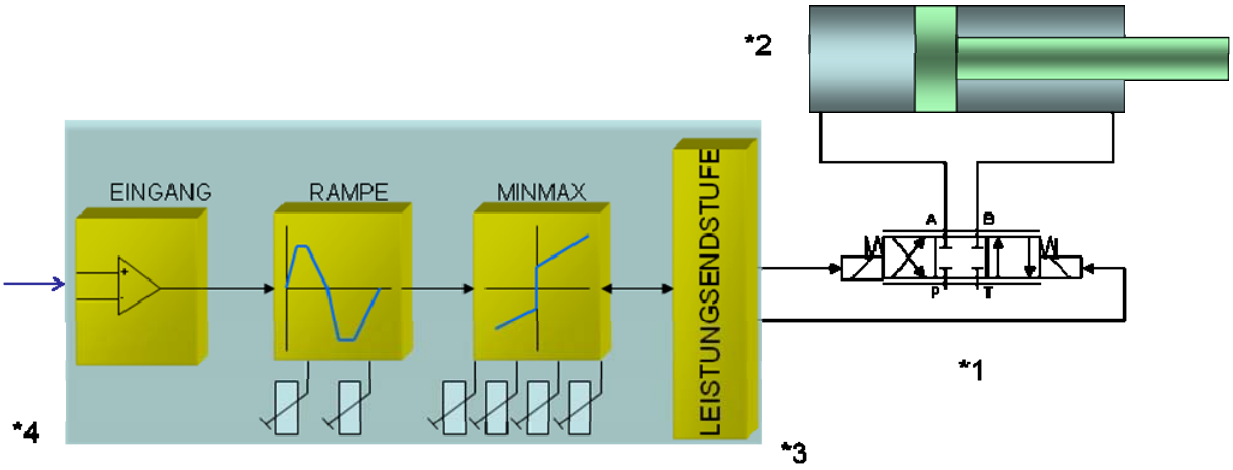
- The module should be installed and wired in accordance with the documentation bearing in mind EMC principles. If other consumers are operated with the same power supply, a star-connected ground wiring scheme is recommended. The following points must be observed when wiring:
  - The signal cables must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

This minimal system consists of the following components:

(*1) proportional valve
(*2) hydraulic cylinder
(*3) power amplifier PROam21
(*4) interface to PLC with analogue and digital signals



3.3 Method of operation

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 metal 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 cabling. Switch the device off immediately and check the cabling.
Pre-parameterization	Now set up the following parameters (with reference to the system design and circuit diagrams): The output current and the typical input function (DIL switches)
Control signal	Check the control signal with a voltmeter. The control signal (the current of the solenoid is within the range of 0... 1, 6 A). In the actual status it should have approximately 0 A.
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 hydraulic axis can be moved over the analogue input value.
Optimize controller	Now optimize the remaining parameters (MIN function and RAMP time) according to your application and your requirements.

4 Technical description

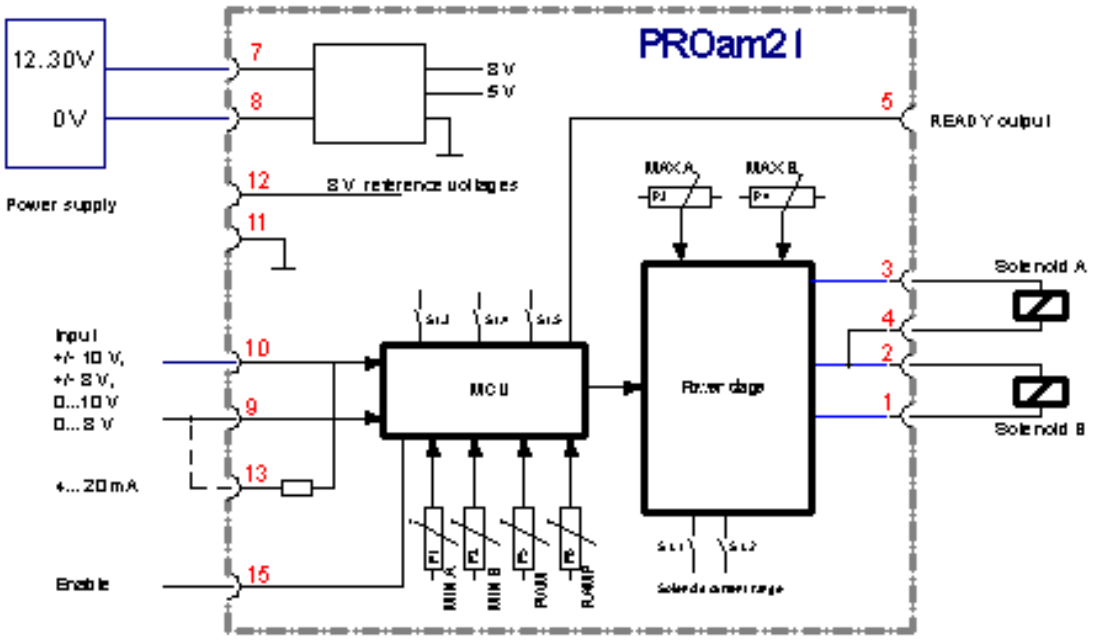
4.1 Input and output signals

Connection	Supply
PIN 7	Power supply (see technical data)
PIN 8	0 V (GND) Power supply (ground). **Attention**, PIN 8 is connected with PIN 11 internal. PIN 11 is used as the GND potential for the command and feedback signals.
Connection	**Analogue signals**
PIN 9/10	Command (input) signal (W), range +/-100 % corresponds with +/-10 V or 4… 20 mA.
PIN 13	Input resistor (500 Ohm) used for 4… 20 mA. PIN 13 have to be connected with PIN 9.
PIN 11	0 V (GND) for the signal inputs
PIN 12	Reference output voltage (8 V).
PIN 1/2 PIN 3/4	Current controlled PWM outputs for solenoid A and B.
Connection	**Digital inputs and outputs**
PIN 15	**Enable Input**: This digital input signal initializes the application, fault messages are reset. The output and the READY signal will be activated.
PIN 5	**READY output**: **ON:** No internal or external errors are detected **OFF:** ENABLE (PIN 15) is deactivated or an error is detected.

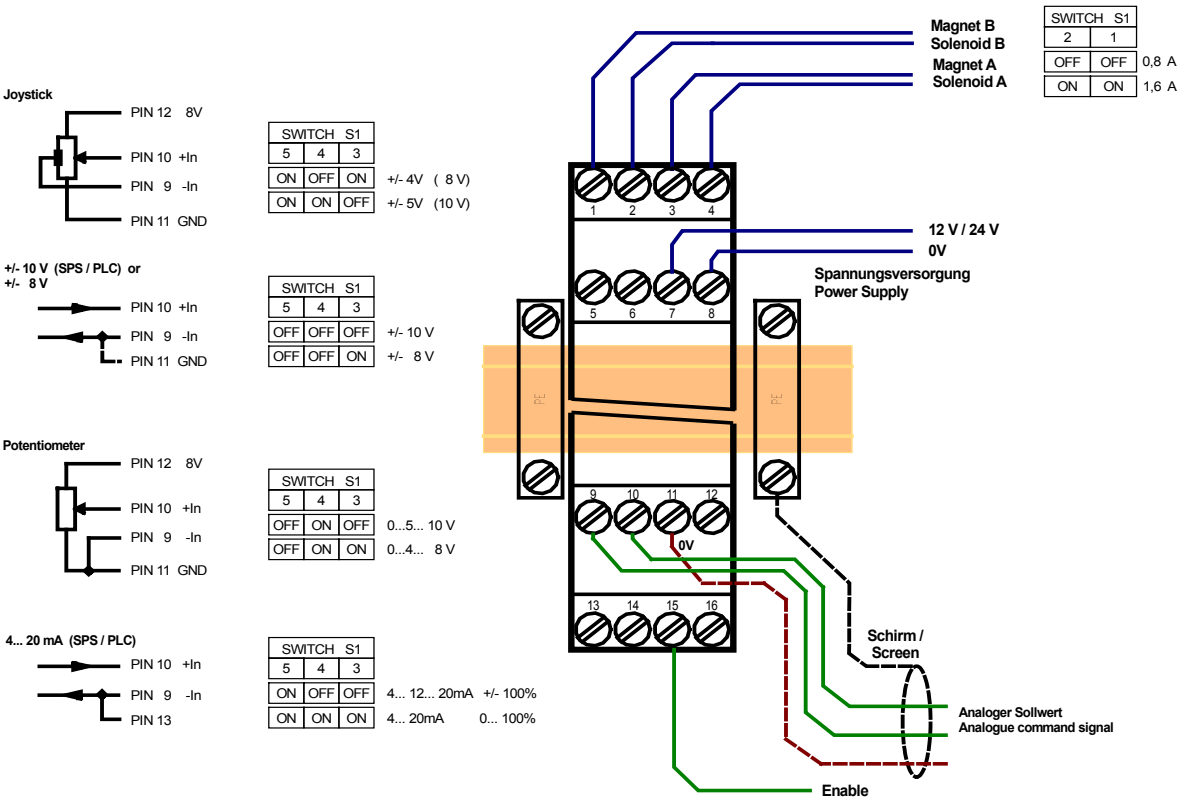
4.2 LED definitions

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 detected (e.g. valve solenoid or 4… 20 mA). Not active when SENS = OFF.
YELLOW A/B	**ON:**	related solenoid is activated.
	OFF:	solenoid not activated.

4.3 Circuit diagram



4.4 Typical cabling



4.5 Technical data

Power supply	**[VDC]**	12… 30 (incl. ripple)
Current consumption	**[mA]**	<100 + solenoid current
External fuse	**[A]**	3 medium time lag
Reference voltage	**[V]**	8 (maximum 10 mA)
Digital inputs	**[V]**	logic 0: <2
	[V]	logic 1: >10
Input resistance	**[kΩ]**	25
Digital outputs	**[V]**	logic 0: <2
	[V]	logic 1: >12 (50 mA)
Analogue inputs (sensor and command signals)	**[V]**	±10 / 0… 10; 90 kΩ
	[mA]	4...20; 390 Ω
Resolution	**[%]**	<0,025
PWM Output current	**[A]**	0,8 or 1,6; short cut protected.
PWM frequency	**[Hz]**	70...130
Sample time (pressure control)	**[ms]**	1
Sample time (solenoid current control)	**[ms]**	0,167
Adjustments		
MIN	**[%]**	0… 60 (0 = pre-adjusted)
MAX	**[A]**	0,7… 1,6
	[A]	0,4… 0,8 (pre-adjusted)
RAMP	**[s]**	0,05… 15 (0,05 = pre-adjusted)
PWM Frequency	**[Hz]**	70… 130 (130 = pre-adjusted)
Housing		Snap-On Module EN 50022 Polyamide PA 6.6 Combustibility class V0 (UL94)
Protection class	**[IP]**	20
Temperature range	**[°C]**	-20… 60
Storage temperature	**[°C]**	-20 …70
Humidity	**[%]**	<95 (not condensing)
Connections		4 x 4pol. screw terminals PE: direct via DIN rail
EMC		EN 61000-6-2: 8/2002 EN 61000-6-3: 6/2005

5 Adjustment

5.1 Elements

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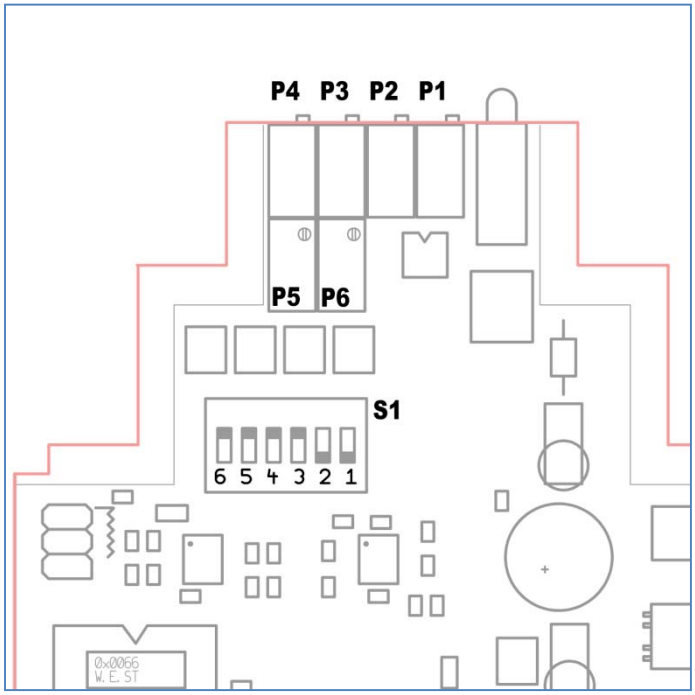
Location of the potentiometer



Front:

P1 = MINA
P2 = MINB
P3 = MAXA
P4 = MAXB

Elements inside the module:

P5 = PWM frequency
P6 = RAMP time

Input signal selection

DIL S1

S1.3 and S1.4 and S1.5

S1.5=OFF	**S1.4**=OFF	**S1.3**=OFF	±10 V input
S1.5=OFF	**S1.4**=OFF	**S1.3**=ON	±8 V input
S1.5=OFF	**S1.4**=ON	**S1.3**=OFF	0… 5… 10 V input (set in factory)
S1.5=OFF	**S1.4**=ON	**S1.3**=ON	0… 4… 8 V input
S1.5=ON	**S1.4**=OFF	**S1.3**=OFF	4… 12… 20 mA for ± 100%
S1.5=ON	**S1.4**=OFF	**S1.3**=ON	±4 V input (joystick)
S1.5=ON	**S1.4**=ON	**S1.3**=OFF	±5 V input (joystick)
S1.5=ON	**S1.4**=ON	**S1.3**=ON	4… 20 mA for 0… 100%

Solenoid current selection:
(both switches)

S1.1 = OFF, **S1.2** = OFF (up to 0,8 A)
S1.1 = ON, **S1.2** = ON (up to 1,6 A)

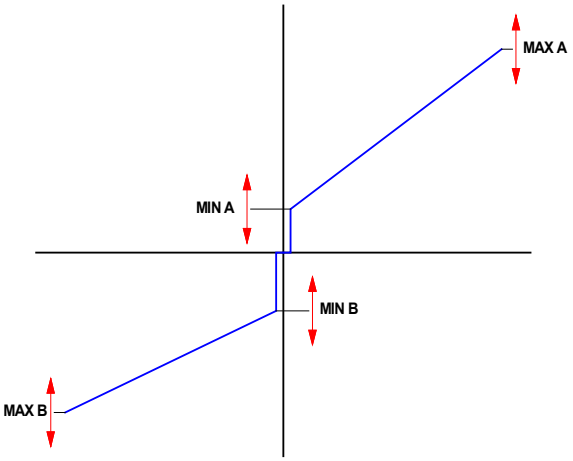
5.2 Start-up

Application with typical proportional valves.

Because of the type these valves have relatively great tolerances in comparison to the electronics. The adjustment can vary from valve to valve.

MAX: Maximal current adjustment. The presetting is 0,8 A and/or 1,6 A if the DIL switch S2 is ON. Preset an input signal of 100 % for the respective direction of the motion. By turning the MAX-potentiometers anti-clockwise the output current is reducing and the drive becomes slower. This can be carried out separately for the respective direction of the motion.
Caution: It is to be guaranteed that the maximum output current does not climb over the rated current of the valve.

MIN: Zero- / deadband adjustment. The MIN-adjustment should be carried out after the MAX-adjustment. The presetting is 0 (fully anti-clockwise). According to valve adjustments of approx. 15 % to 35 % of the rated current are necessary.
Preset a small input signal of approx. 3 % to 5 %. You increase the MIN value (rotate clockwise) continuously until the drive moves, from there you reduce the value (anti-clockwise) until the drive came to standstill again.
Caution: By changing of the MAX-adjustment also the MIN-adjustment changes.



RAMP: The ramp time is preset on approx. 50 ms (smallest value). It is prolonged by turning clockwise up to approx. 15 s. All ramp times are identical.
Caution Ramp times and simultaneously short cycle times (cycle time < ramp time) can result in a hardly understandable behaviour because all movements are carried out strongly.

PWM frequency: The PWM frequency is adjustable. Preset is 130 Hz (potentiometer fully clockwise). With the adjustment of the frequency (rotate anti clockwise) the valve hysteresis can be reduced clearly.
Caution: Too high dither amplitude can lead to an increased attrition.

General behaviour:

Power ON: After the power on the input signal is checked (4… 20 mA) and the system is than activated. When ENABLE is active (ENABLE directly connected with the supply voltage) the current is activated by an internally defined ramp (smooth starting) in order to drive onto the demand value with the pre-set ramp time.

ENABLE: With this switching-input the internal signal processing and the final stage are enabled. While activating the input the valve current will be driven the pre-set ramp. During the deactivation the current is disconnected immediately.

6 Appendix

6.1 Failure monitoring

Following possible error sources are monitored continuously:

Source	Fault	Characteristic
Command signal PIN 9/10 4...20 mA	Out of range	The power stage is deactivated.
Command signal PIN 9/10 LIM function	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 (at switching on)	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.

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CAUTION: If using the RC (Remote Control) mode, all safety aspects have to be checked solid. 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: - No signal at the input, if 4… 20 mA signal is chosen, or signal is out of range if the LIM monitoring is activated. - A broken cable or incorrect wiring to the solenoids. With the WPC-300 operating program the failure can be localized directly via the monitor.

History

Datum	Kurzzeichen	Bemerkung
25.10.2007	-	-
14.03.2012	UW	Neue Dokumentation für die Version PROam21
16.04.2012	UW	Fehler in der Dokumentation beseitigt.