

## Application Note: AN-106

### Commissioning of Power Amplifiers



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## 1 Symbols used



General information



Safety-related information

## 2 Safety instructions

Please read this document and the safety instructions carefully. This document will help you to put the device into operation. Additional documents (device documentation, 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.

### 3 Scope of application

This document describes the commissioning of power amplifiers using the PAM-199-P as an example. The basic procedure for other devices from our company is identical. Names of parameters or details of operation may differ.

This manual is intended as a supplement to the product documentation. There you will find a detailed description of all setting options and further information such as technical data and connection diagrams.

### 4 Requirements

#### 4.1 Wiring

The device must be correctly wired. Both the command signal and the valve to be controlled must be connected to the device (help in the corresponding AN).

#### 4.2 Operational readiness

The valve should be ready for operation. Ideally, the hydraulic system is also ready for operation and the valve can be actuated without causing any danger.

#### 4.3 Valve Data

The valve characteristics should be available. The data sheet of the valve with all necessary basic data is available. If this is not obtainable, at least the nominal current of the solenoid must be known. A corresponding figure is often embossed directly into the coil body.

#### 4.4 Tools / Accessories

A PC or laptop with the WPC-300 program is required for parameterization, which can be downloaded free of charge from the W.E.St. homepage.

The connection between the computer and the module to be parameterized is established via a USB cable, a type "B" socket is available on the device side.

A multimeter can be useful to check the operating voltage and, if necessary, the solenoid current.

A slotted screwdriver with max. 3.5 mm blade width is required for the screw terminals of the device.

The technical documentation of the device should be read in advance and available during commissioning.

## 5 Procedure

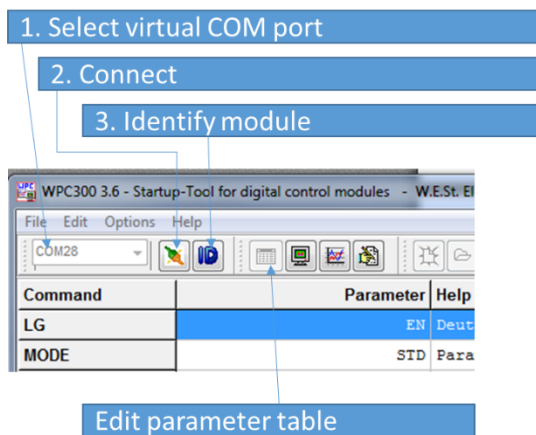
### 5.1 Before switching on the hydraulics

#### 5.1.1 To be checked

- Correct wiring according to circuit diagram and device description
- Safety measures to protect against uncontrolled movements during valve actuation
- Operating voltage is applied to the device.

#### 5.1.2 Pre-parametrization

Connect the computer to the module via USB.



Select device function

→ Parameter FUNCTION

Set language

→ Parameter LG

Data for the valve to be controlled:

Nominal current: from data sheet or embossing in coil

→ Parameter CURRENT

PWM frequency or dither from data sheet<sup>1</sup>

→ Parameter PWM / DAMPL / DFREQ

Setpoint signal: according to source

→ Parameter AIN

<sup>1</sup> There are two basic principles:

1. The coil is driven with the highest possible PWM frequency in the kHz range and an additional dither signal. This is the predominant variant in industrial hydraulics.
2. In the mobile sector, valves are mainly used which are controlled with a low PWM frequency. In this case no DITHER signal is used. It is not necessary to use the exact PWM frequency, therefore the input for our devices is done in steps by selecting from a table. The nearest setting should be selected.

Attention: The information in the data sheet on this subject is often incomplete or misleading, as the terminology is frequently confused. If there is only a frequency specification, the PWM setting is usually meant. If the DITHER signal is referred to, there is usually an indication of frequency and amplitude. If there are no instructions, it is recommended to use the factory settings.

## 5.1.3 Testing setpoint and enable signals

The monitor window of the WPC displays the external and internal signals of the connected amplifier.



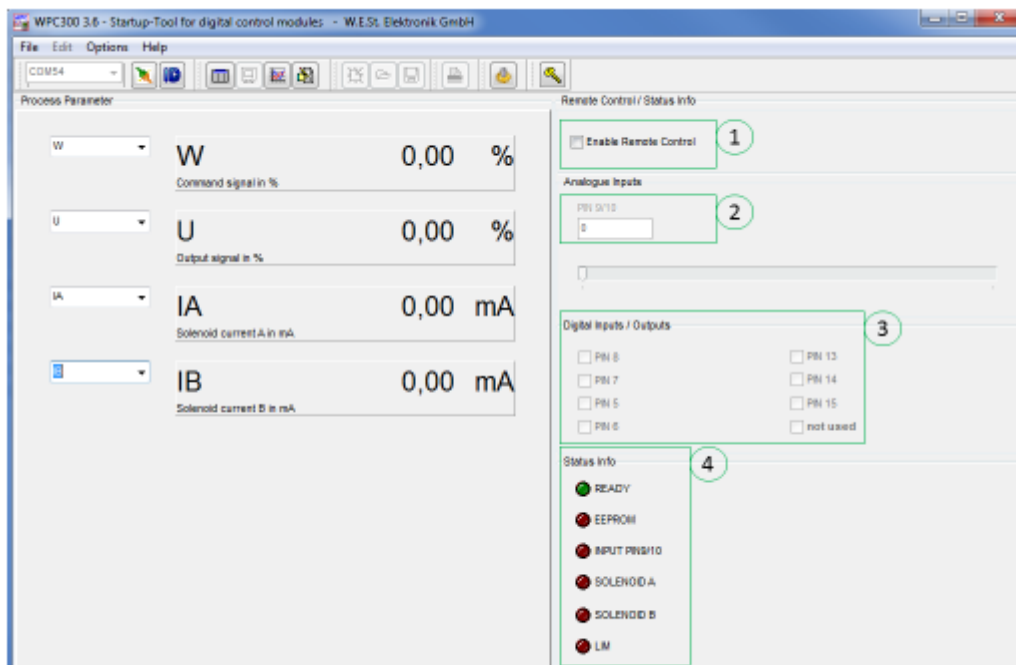
On the next page you can see the structure of this window.

Analog values are displayed on the left. The selection can be changed. In the example you see a meaningful arrangement for the PAM-199-P in the function "195" = directional valve control.

On the right side the digital input signals can be seen in box "3". If an external signal is present, this is indicated by a check mark in the corresponding checkbox.

Status information ("4") is shown below. Red LEDs symbolize errors. Help texts for these displays are shown when the mouse pointer is hovered over the labels.

First check whether the received setpoint (W) matches the output value of the source. If the function "196" = individual valves has been selected, two setpoints are read in, WA and WB.



Check whether the ENABLE signal can be set (PIN 15). In mode "196", parameter ENABLE\_B can be used to select whether the two channels are enabled together or independently. With independent enable, PIN6 for channel B must also be checked.

**Attention:** If a setpoint value is present during this test, the amplifier is activated and activates the valve. If you do not intend to do this, reset the analog command first!

The amplifier should be ready for operation when the "Enable" bit is set. This is indicated by the READY LED in the status info field and the display on the front of the device. If this display does not appear, there is an error which can be found with the help of the status info.

## 5.1.4 First activation

Now the device can be activated. The hydraulics should remain switched off for the time being.

It is possible to operate directly via the previously tested inputs or to use the "Remote Control Mode" of the amplifier to simulate the external control signals via WPC.



**Attention:** If the control is done via the remote control mode, the user has taken control of the device in this way, the external inputs are not evaluated.

To activate the Remote Control mode, activate the checkbox (1). After a safety query has been confirmed, analog setpoint inputs can be simulated via field "2". To do this, double-click in the number field (grey background appears) and either type in a number or adjust the value with the slider. Number entries are only accepted when the Enter key is pressed. A value of "10000" corresponds to 100%.

Digital input signals are controlled via the checkboxes (3).

Now it can be checked whether the output current of both channels can be regulated up to the rated current. The actual current is displayed on the left side (IA / IB). Of course, it is also possible to measure the current by looping an ammeter into the solenoid circuit. Please note that the value of interest is the arithmetic mean of the DC component. Different measuring and averaging methods can influence the accuracy, so that there may be deviations from the display in the WPC.



**Attention:** The magnetic circuit must not be opened during operation, otherwise voltage peaks may occur due to the coil inductance. These can destroy the amplifier!

A voltage measurement at the solenoid terminals of the amplifier does not provide any useful information, since due to the pulsed control (PWM) no meaningful measured value is to be expected.

Should the solenoid current fluctuate strongly ( $> \pm 10\%$  of  $I_{nom}$ ) during this test despite constant control, check whether the PWM frequency corresponds to the data sheet specification of the valve.

## 5.2 Settings with hydraulics running

The following steps are carried out while the hydraulics are in operation, as the behaviour of the overall system is now in the foreground.

### 5.2.1 Minimum control / overlap compensation

From the valve data sheet, a minimum actuation is indicated from which the valve opens. This theoretical value is entered for MIN:A / MIN:B in % of the nominal current. By carefully operating the valve with small setpoints, check in both directions whether this setting provides good behaviour:

- The movement starts with too high a speed, slow movements cannot be dosed: The MIN parameter in the relevant direction is too large and should be reduced.
  - The movement does not start until an appreciable setpoint value has been entered, the response threshold is too high: Increase the relevant MIN parameter.
- Both applies, the movement starts relatively late and is immediately too fast: First check the dither settings, see section 5.4.4.

### 5.2.2 Working range / maximum speed

It may be necessary to reduce the maximum control in one or both directions of movement. This can be done with the MAX parameters. In this way, for example, the different speeds on differential cylinders can be compensated so that the drive behaves identically in both directions.

### 5.2.3 Ramps

The ramp functions can be used to influence the behaviour during acceleration and deceleration.

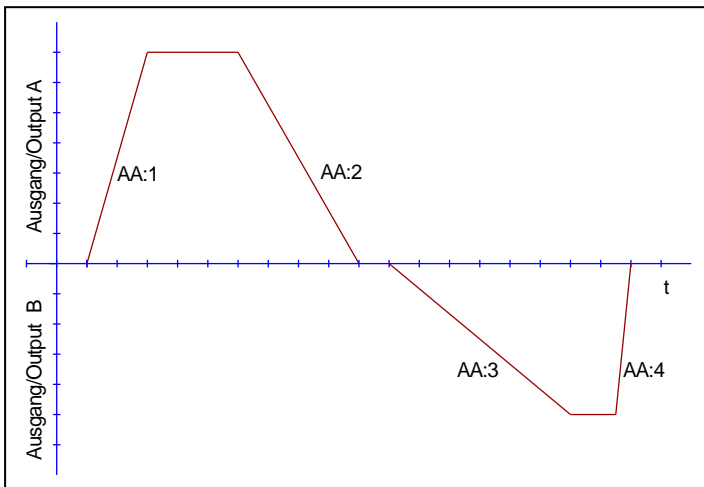
If the setpoint is changed abruptly (e.g. from a sequence controller), it is important to use the ramp function so that bumps do not occur. Ramps are also highly recommended for manual control of the setpoint, e.g. via a joystick. Particularly when braking larger masses, overloads of the system must be avoided as a result of the valve closing too quickly.

However, if the setpoint for the amplifier comes from a superimposed controller, ramps are usually undesirable. They can be switched off by setting the times to their minimum value.

Most times are set according to subjective criteria in the test: long time = sluggish, gentle behaviour, short time = fast, sharp reaction.



A so-called 4-quadrant ramp is available in **directional valve mode**. This means that there is a separate setting value for acceleration and braking in each direction:



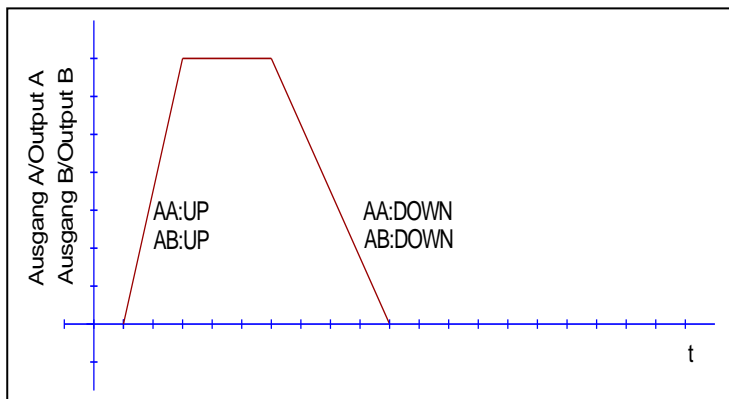
AA:1 – Movement in direction "A"  
Acceleration

AA:2 – Movement in direction "A"  
Deceleration

AA:3 – Movement in direction "B"  
Acceleration

AA:4 – Movement in direction "B"  
Deceleration

For **individual valves** (mode 196), there are two settings for each of the two channels, for increasing the signal and for decreasing it:



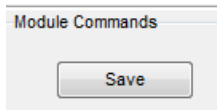
## 5.2.4 Frequencies / dither signal

If there were no irregularities or complaints in the previous tests, skip this point.

- Is the solenoid current unstable and cannot be precisely regulated?  
If you have set a PWM frequency according to the data sheet, change it to the maximum value and set this frequency as dither frequency (DFREQ) instead. The amplitude of the dither (DAMPL) can initially be set to 5% (setting value = 500).
- Can hysteresis effects be detected, i.e. the same control delivers different speeds when the signal is increased or reduced? Hysteresis also often leads to a start-up jump.
  - Low PWM frequency and DAMPL = 0 is set?  
➔ PWM – Decrease frequency.
  - PWM – frequency = max. and DFREQ / DAMPL is used?  
➔ DAMPL has to be increased. No effect? Reduce DFREQ.
- The valve hums noticeably, possibly even the pipes vibrate.
  - Low PWM frequency and DAMPL = 0 is set?  
➔ PWM – Increase frequency.
  - PWM – frequency = max. and DFREQ / DAMPL is used?  
➔ Reduce DAMPL.

## 5.3 Completion of work

Once all settings have been completed, save the settings in the non-volatile memory of the module using the SAVE command:



In addition, we recommend saving the parameters in a file:



This allows you to save the settings independently of the module and transfer them to other devices if necessary.

## 6 Further information and support

As mentioned at the beginning, all functional details are described in the technical product documentation of your device. If problems occur or additional functions are required, please read this document first.

Should further assistance be necessary, you can reach us under [technics@w-e-st.de](mailto:technics@w-e-st.de) or the telephone number given.

Please describe the circumstances of the case in an comprehensible way and attach:

- Set parameters as \*.wpc – file
- Screenshots of the WPC – monitor window and eventually of the oscilloscope view

Another very effective way of support is a remote access to your computer via the program TeamViewer. A free download link is available on our homepage.

## 7 Legal notice

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## 8 Notes