Rexroth
Bosch Group

Analog Closed Loop Control Electronics VT-PVAR-2-1X/...

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Commissioning Instructions

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1 Contents

2 Before You Start

This manual describes the commissioning of the electronic module PVAR-2-1X.. . The electronics can, in principle, be used for two different applications, namely:

- PVAR-2 as an analog position controller

and

- PVAR-2 as interface electronics between CNC and proportional valve.

The instructions are correspondingly split into two sections. **Chapter 3** contains the explanations on commissioning of the PVAR-2 as an **analog controller**.
Chapter 4 deals with the commissioning of the PVAR-2 as **interface electronics,** referred to hereafter in this manual as **intermediate electronics**.

3 Commissioning Instructions for the PVAR-2 as Control Electronics

3.1 System Layout

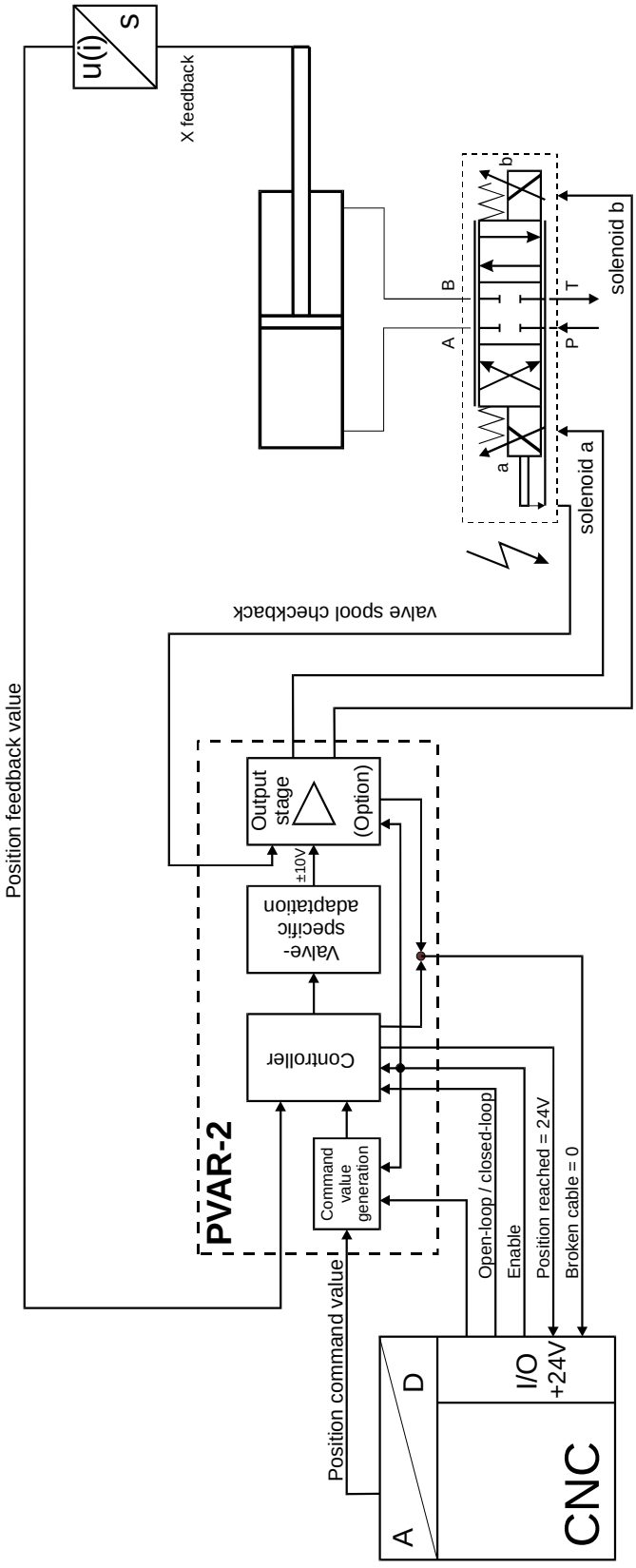


Figure 1: Layout diagram of the control electronics

3.2 Mechanical Installation

The PVAR-2 control electronics can be installed either in a 19" rack or in a dedicated card rack. For the "card rack" solution, Bosch Rexroth can supply the card rack Type VT 3002-2X (see RD 29 928) and the NE 30 power pack Type VT 19 083 (see RD 29 929).

3.2.1 Observe the following points during installation of the control electronics:

- Potential sources of electromagnetic interference, such as e.g. unearthed contactors, must not be located in the immediate vicinity of the control electronics.
- A distance of at least 1m must be maintained to radios and antenna cables.
- The laying of power-conducting cables in the vicinity of the electronics is not permitted.
- Command values may only be switched with appropriate contacts suitable for currents < 1 mA.
- Use only instruments with Ri > 100 kΩ for carrying out measurements.
- The terminals may only be connected or disconnected when deenergized.
- The electronics modules may only be inserted or removed when deenergized.
- Use low-capacitance cables conforming to the guidelines of the VDE. Cables should be laid without intermediate terminals wherever possible!
- The cable to the inductive position transducer and all signal lines must always be screened.
  Recommendation: Lay screen on the system open and connect to the corresponding terminal on the PVAR-2.
- Ensure that the permissible ambient temperature of 50 C is not exceeded.
- When using differential inputs, both inputs must always be connected and disconnected simultaneously.

3.3 Electrical Installation

3.3.1 Important Characteristics

Supply voltage	U	18V-35V DC
Max. power consumption	P	50W
Internally generated voltages	U U	±15V, max. 40 mA (externally loadable) ±10V, max. 10mA (externally loadable)
Supply voltage to switching inputs/outputs Switching inputs (from ext. controller/PLC)	U_{PLC} 0-Signal 1-Signal	24V, ±20% < 6V > 12V to U_{PLC} (input impedance >5kΩ)
Switching outputs (to ext. controller/PLC)	0-Signal 1-Signal	< 1V U_{PLC} - 2V, max. 15mA (short circuit-proof)
Differential inputs (command and feedback value)	U I	0 - 10V or ±10V / 50kΩ 4 - 20mA / load 100Ω
Differential inputs (ramp gradient from external source)	U	0 - 10V / 50kΩ
Impedance transformer input	U	0 - 10V (R_E in MΩ range)
Output signal for position feedback value	U	0 - 10V or ±10V max. 10mA (externally loadable)
Output signal for valve command value	U	± 10V / max. 10mA (externally loadable)
Type of connection		48-pin male connector, DIN 41 612, style F
Board dimensions		Euro-card 100 x 160mm, DIN 41 494 +1 clip-on board (KA5 / VTS0020) 80x60mm +1 clip-on board (optional) (PVE1 / VTS0021) 80x90mm
Front panel dimensions	Height	3 height modules (128.4mm)
	Width	8 depth modules (1module = 5.08mm)
Permissible ambient temperature	t	0° to 50°C
Storage temperature	t	-20°C to +70°C
Weight	m	0.3kg

3.3.2 Overview of Terminal Assignments

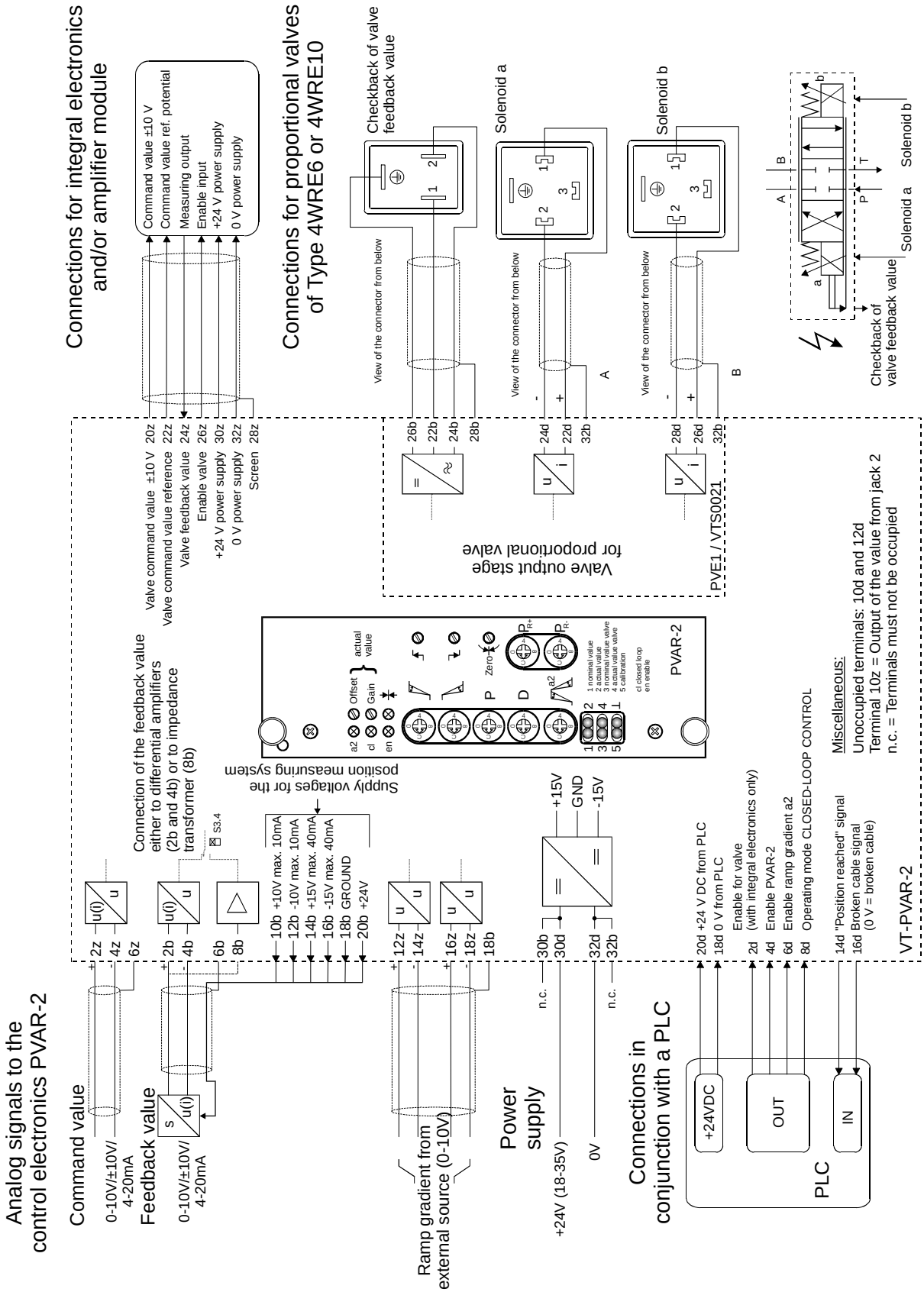


Figure 2: Terminal assignment of the control electronics

3.3.3 Voltage Supply to the Electronics

The PVAR-2 controller board requires a 24V DC power supply. If this voltage supply cannot be provided by the system, the NT30 / VT 19083 power pack to RD 29 929 from Bosch Rexroth can be used. As a power supply to the electronics, the 24V from the power pack is connected to terminal 30d and the 0Volt to terminal 32d.

3.3.4 Connection of the Position Command Value

The analog command value for the position is generally supplied by a PLC. The command value can be read in as a voltage or current signal and is connected to 2z (+) and 4z (reference). The screen of the cable can be connected to 6z of the PVAR-2 or to the signal source.

3.3.5 Connection of the Command Value "Ramp Gradient External" (optional)

The PVAR-2 electronics contains a ramp generator which allows the controller command value to be rounded via a time slope. Further details on the method of operation can be found in chapter 3.4.4, page 19.
The ramp gradient of the ramp generator can be influenced via two analog differential inputs. The voltage connected to 12z (+) and 14z (reference) determines the positive ramp gradient, the voltage at 16z (+) and 18z (reference) determines the negative ramp gradient. The ramp gradient can also be varied via rotary switches on the front panel ( ,  and 

) of the electronics. If the differential amplifiers are to be activated, jumpers X5 and X6 must be inserted to connect 2-3; if the rotary switches are to determine the ramp gradient, jumpers X5 and X6 must be inserted to connect 1-2.
These two differential inputs should only be connected when required.

3.3.6 Connection of the Position Feedback Value

The position of the axis to be controlled is signalled to the PVAR-2 as a feedback value. The feedback value can be read in as a voltage or current signal and is generally connected to terminals 2b (+) and 4b (reference). If the feedback value signal can only be loaded with high resistance, the feedback value can be connected to terminal 8b instead. Various voltages are available at terminals 10b to 20b as a power supply to the position measuring system (see Figure 2 on page 9).

3.3.7 Connection of a Proportional Valve (optional)

If ordered accordingly, the PVAR-2 contains the valve output stage for the proportional valves of Type 4WRE6 or 4WRE10. Three separate cables must be laid to this valve.
The cable is used for the valve spool position feedback signal. A cable of Type LiYCY 3x0.25mm² is recommended for this purpose.

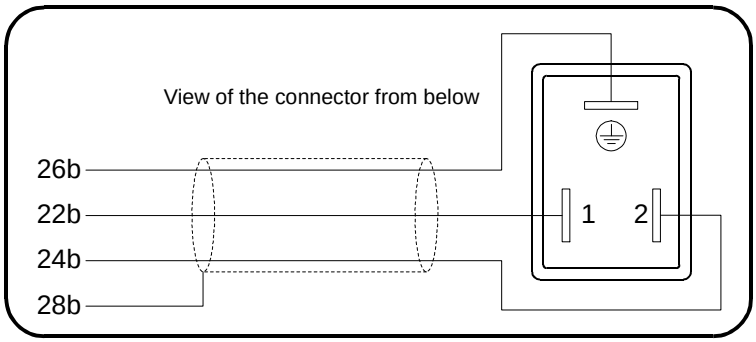


Figure 3: Connection of the feedback value pickup to the control electronics

The cables to the two solenoid valves should be laid separately from analog signal lines, in particular from the cable of the inductive position transducer. Screening of the solenoid cable is recommended. Cable type LiYCY 1.5 mm² up to 50 m length.

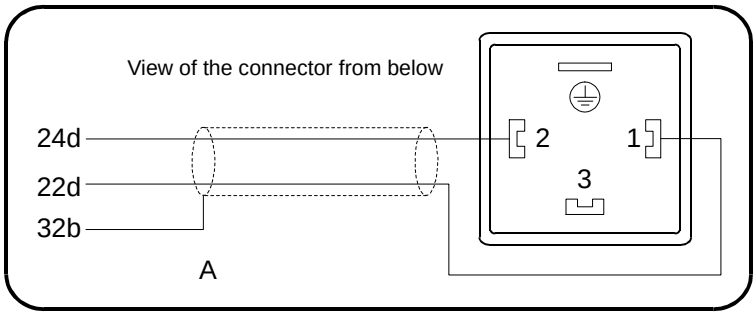


Figure 4: Connection of solenoid A to the control electronics

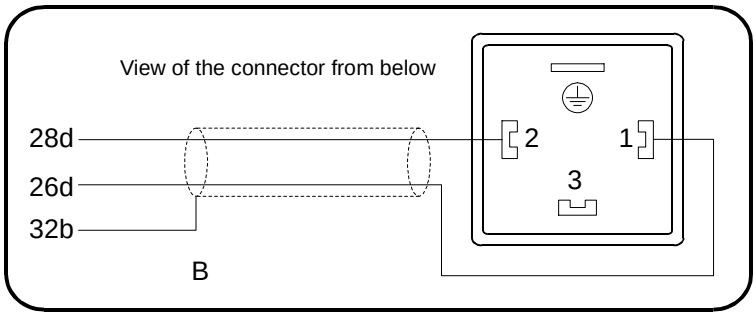


Figure 5: Connection of solenoid B to the control electronics

3.3.8 Connection of a Valve with Integral Electronics

Terminals 20z to 32z are available for connection of a valve with integral electronics.

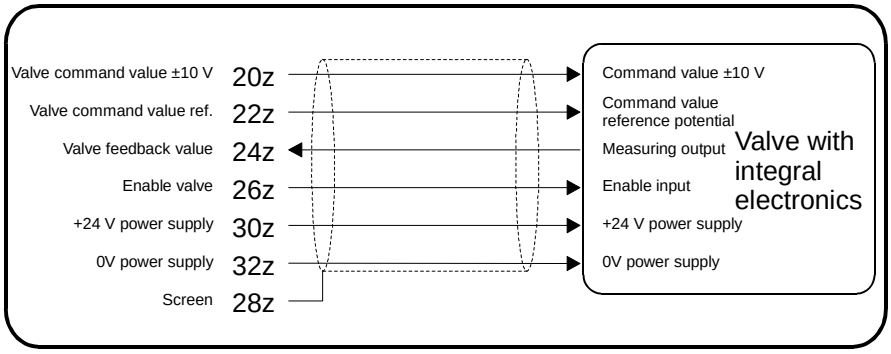


Figure 6: Connection of a valve with integral electronics to the control electronics

Note:
The voltage output (valve command value terminal 20z) must not be loaded with more than 10mA, i.e. the maximum load is 1kW.

3.3.9 Connections in Conjunction with a PLC

The connection to the PLC on the PVAR-2 is opto-decoupled, i.e. metallically separated. The voltage of the PLC must be used to supply the optocouplers. The voltage supply must be connected to terminal 20d (+24V from PLC) and 18d (0V from PLC).

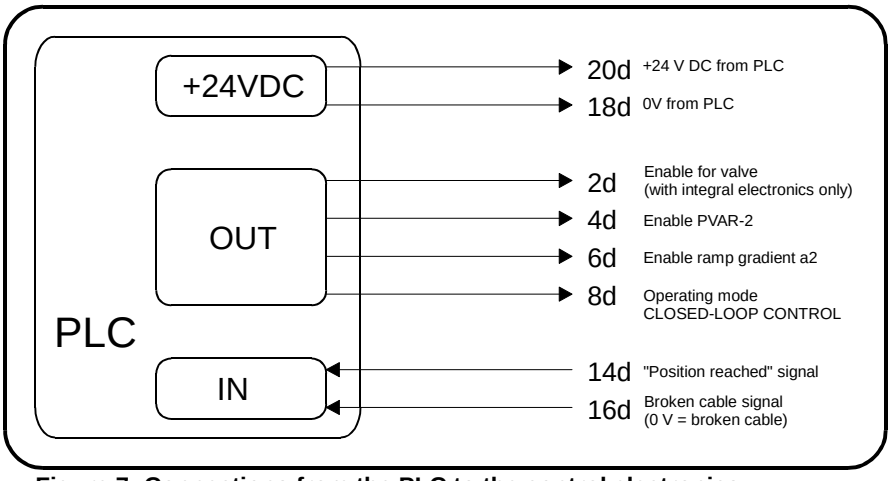


Figure 7: Connections from the PLC to the control electronics

3.3.10 Other Connections

The feedback value of the controller can be tapped at terminal 8z for evaluation or display purposes. The voltage output corresponds to the value from jack 2.

3.3.11 Layout Drawing of PVAR-2

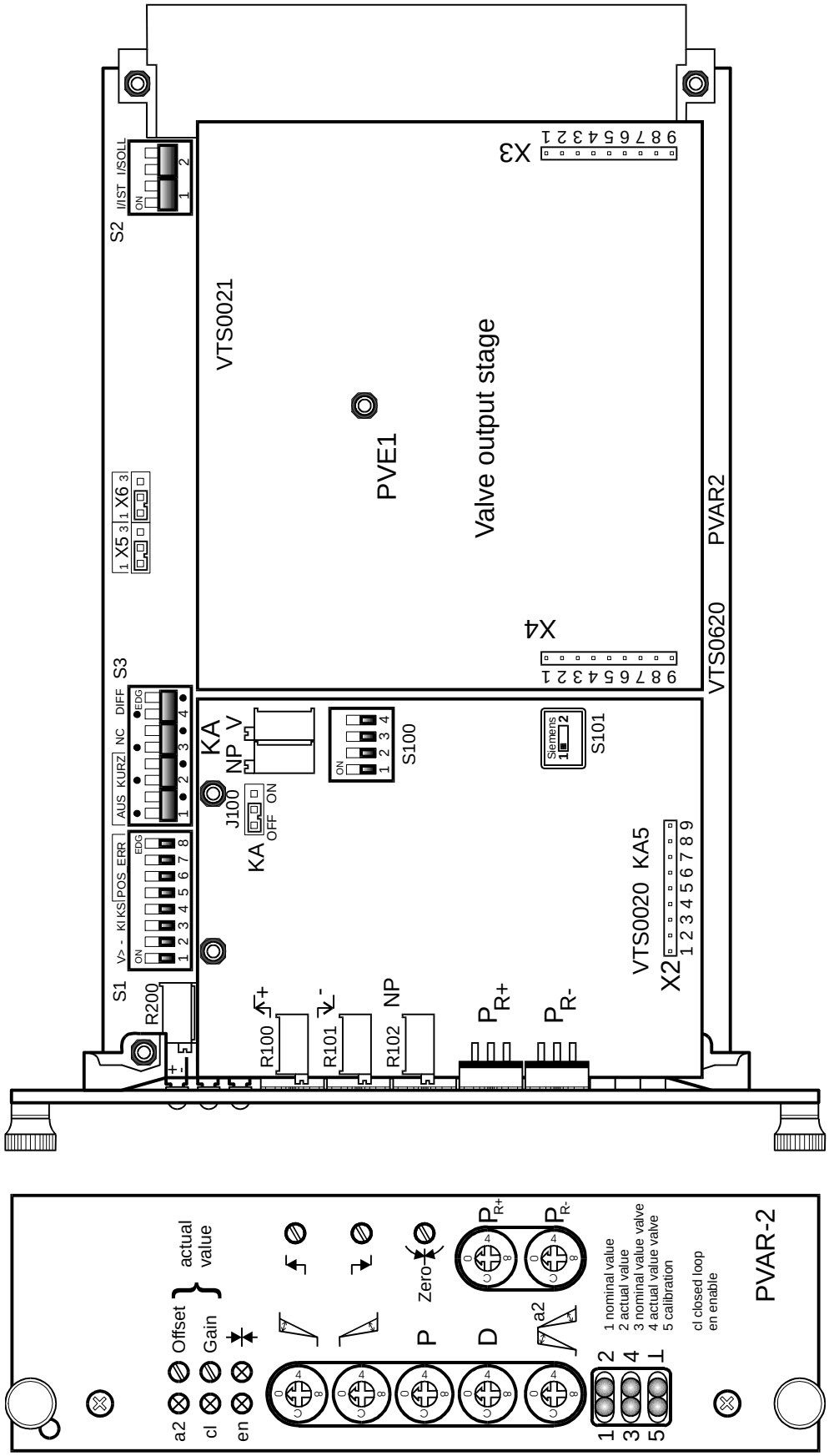


Figure 8: Layout diagram of the PVAR-2 as control electronics

3.3.12 Block Circuit Diagram of the PVAR-2

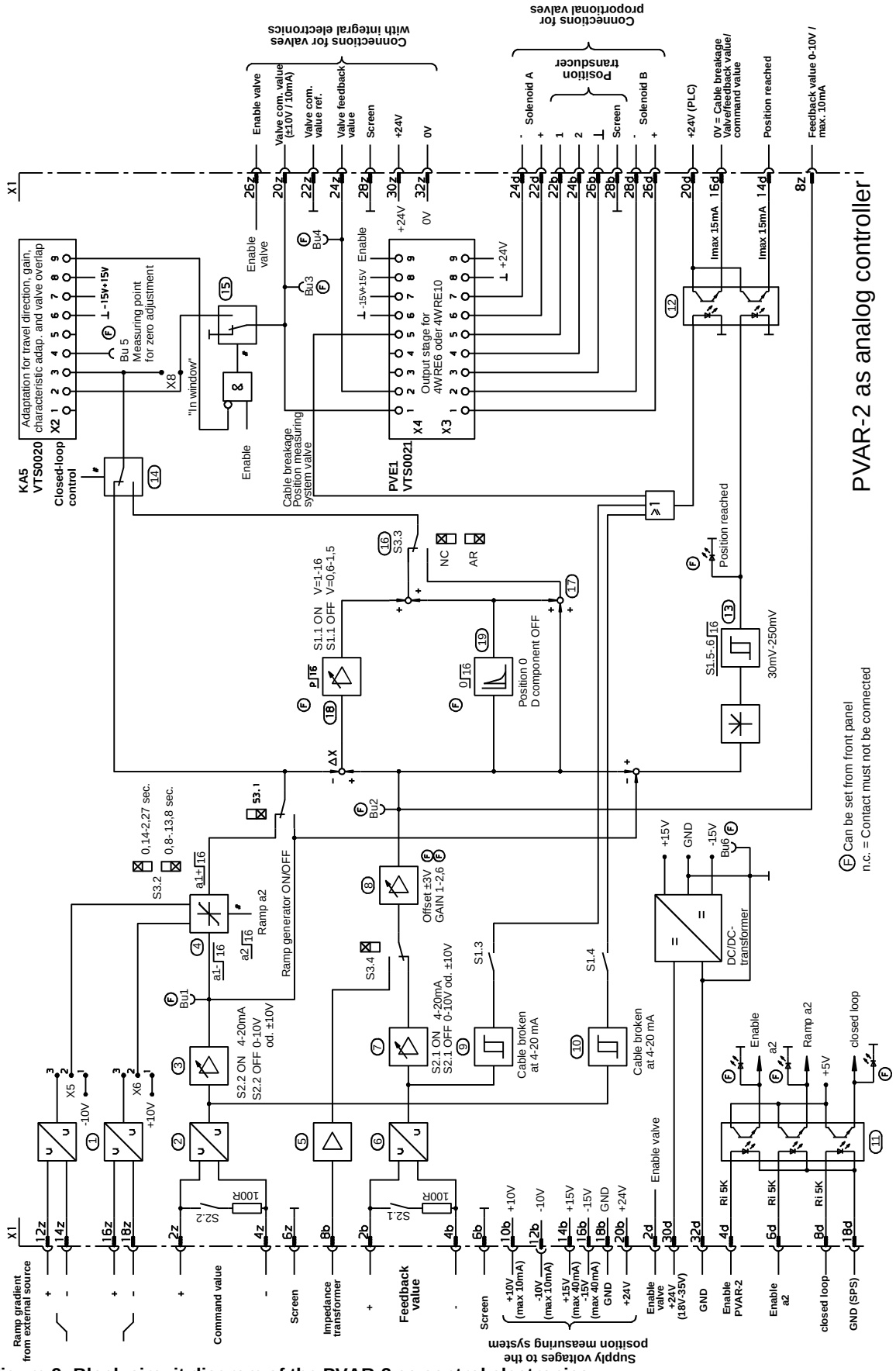


Figure 9: Block circuit diagram of the PVAR-2 as control electronics

3.4 Preconditions for Commissioning

3.4.1 General Information on Commissioning

- A precondition for the commissioning of the axis is the completion of the mechanical and electrical installation of the system.
- Check the terminal assignments.
- Carefully vent the hydraulic system and adjust the pressure of the system to the prescribed level.
- If, for safety reasons, the drives are initially started up at reduced pressure, note that final parametrisation of the controller can only be carried out when the system has been set to the final operating pressure.

3.4.2 Starting and Stopping Sequence

In order to avoid uncontrolled movements of the drive, the following sequence should be followed when starting and stopping the drive.

3.4.2.1 Starting

- Switch on the supply voltage to the PVAR-2 control electronics and to the position measuring system.
- Switch on the hydraulic oil supply.
- Enable the PVAR-2 control electronics (in the case of valves with integral electronics, connect an additional enable for the valve to terminal 2d).

3.4.2.2 Stopping

- Disable the PVAR-2 control electronics (in the case of valves with integral electronics, also disable the valves).
- Switch off the hydraulic oil supply.
- Switch off the supply voltage.

3.4.3 Basic Setting of the Board

Before switching on the voltage supply for the first time, all switches of the electronics must be moved to their basic position. Furthermore, no enables from the PLC should have been given.

3.4.3.1 Front Panel

– Move switches **P**, **D**, $\mathbf{P_{R+}}$ and $\mathbf{P_{R-}}$ to position 0.

– Move switches , and to position **F**. These switches are used for paramterisation of the ramp generator.

– Turn potentiometers , and **Gain** (actual value) completely to the left up against the internal mechanical stop.

Potentiometers **Offset** (actual value) and Zero are not checked at this point. The function of the individual switches is explained in more detail in section "Commissioning". The method of operation of the ramp generator is described in greater detail in section 3.4.4 page 19.

Note:
The potentiometers are 25-turn potentiometers, i.e. the internal mechanical stop of the potentiometer is reached after a maximum of 25 turns.

3.4.3.2 On the PVAR-2 Circuit Board

– **Switch S1** can always be turned to OFF at the start of commissioning.

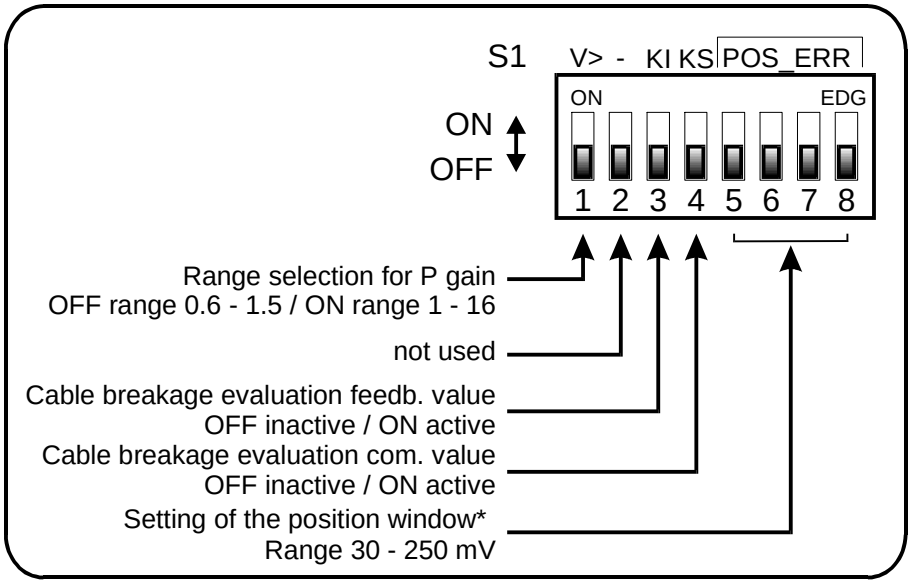


Figure 10: Switch S1 on the control electronics

*Table 6 (page 28) contains the possible setting of the position window

– The two differential inputs, command value and feedback value, for current signal or voltage signal are selected with **switch S2**.

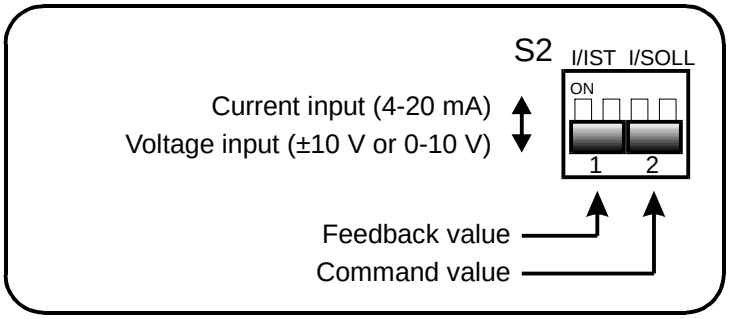


Figure 11: Switch S2 on the control electronics

– **Switch S3** is used for configuration
  - of the internal ramp generator (S3.1 and S3.2),
  - of the function of the PVAR-2 board as position controller (S3.3) and
  - of the feedback value input via the differential amplifier or the impedance transformer (S3.4)

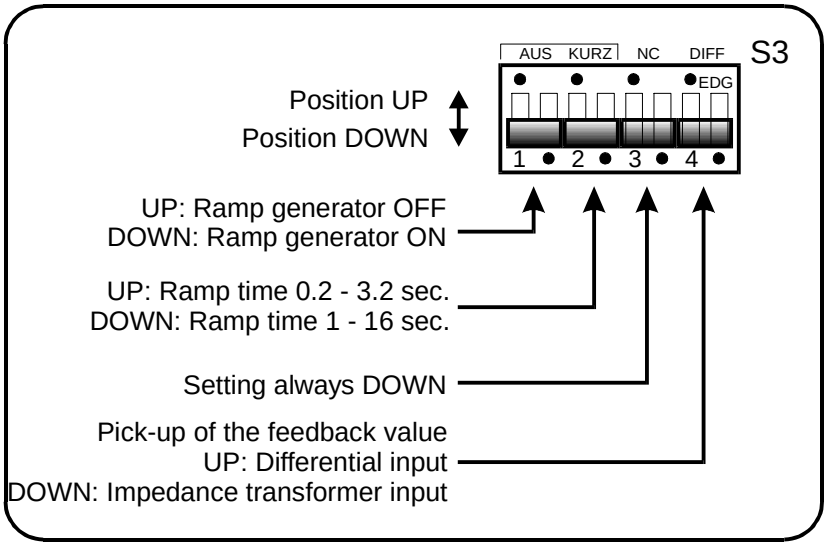


Figure 12: Switch S3 on the control electronics

– The ramp generator is configured with **jumpers X5 and X6**, whereby the gradient of the ramp generator is selected with the jumpers from
  – internal source (X5 and X6 position 1-2) or
  – external source (X5 and X6 position 2-3).

From internal source means that the ramp gradient is set with switches  and  or 

. From external source means that the ramp gradient is determined via 2 differential inputs, and thus with analog voltages (0-10V).

Note: If the ramp gradient is determined from an external source, ensure that switches  **,**  **and** 

are in position 0!

3.4.3.3 Auxiliary Board KA5

- Jumper **J100** is used to activate the conditioning for valves with progressive characteristic. Characteristic conditioning is deactivated in position OFF and activated in position ON. For valves of Type 4WRE.., the jumper must be inserted in position ON.
- The position of **switch S100.1** is only of significance when jumper 100 is in position ON. In the case of a valve of Type 4WRE6, the switch must be set to position OFF, n the case of a valve of Type 4WRE10 to position ON.
- **Switches S100.2 to S100.4** are responsible for the window logic. Using the window logic, actuating signals smaller than 40mV can be set to 0V. The window is activated by turning switch S100.2 to position ON.
  Switches S100.3 and S100.4 are used to set the window size. At the start of commissioning, the switches must be moved to position OFF.

  Selection of the window size:

Window size	Switch S100.3	Switch S100.4
10 mV	ON	ON
20 mV	OFF	ON
30 mV	ON	OFF
40 mV	OFF	OFF

Table 1: Window setting for valve command value deactivation

- **Switch S101** determines the method of overlapping compensation.
  At the start of commissioning, move this switch to position 1.

The locations of the switches can be seen in Figure 8 (page 13).

3.4.3.4 Auxiliary Board PVE1 (optional)

The valve output stage for the valve is located on auxiliary board PVE1. This board is only necessary for driving a proportional valve. No settings have to be carried out here.

3.4.4 Method of Operation of the Ramp Generator

3.4.4.1 General Information on the Use of the Ramp Generator

The command value for the position control circuit must be input by an external command value generator which either generates the complete command value profile or inputs the particular command value for a position as a jump.
In the former case, the ramp generator is not required and is switched off (switch S3.1 towards the edge of the board). The externally conditioned command value profile is now transmitted directly to the position controller.
In the latter case, the command value for a position is input as a jump, but via the ramp generator (switch S3.1 away from the edge of the board). Thanks to a time ramp which can be set in any travel direction, this command value can then be transmitted to the controller with the appropriate delay and thus generates a speed command value.

For a position control circuit it should be noted that with a command value jump input with downline time ramp, a position change over time takes place, i.e. a speed. An acceleration or deceleration cannot be generated by the command value, i.e. starting and braking of an axis is dependent on the system (weight, (Masse, natural frequency, P gain).

The ramp generator can be parametrised for the corresponding direction of travel with rotary switches  and  . If the PLC input a2 (terminal 6d) is switched, switch 

is activated for both directions of travel (example, see next page).

The ramp gradient can also be determined via two analog voltage inputs. The ramp gradient for increasing command values is determined by terminals 12z (+) and 14z (Ground), the gradient for decreasing command values by terminals 16z(+) and 18z (Ground).
The choice of input for the ramp gradient (from an external source via analog voltages or from an internal source with the rotary switches) is made with jumpers X5 and X6.

- Internal input: X5 and X6 position 1-2
- External input: X5 and X6 position 2-3

Note: If the ramp gradient is determined by analog voltages, the rotary switches for the ramp gradient must be turned to position 0.

In open-loop control mode, it is possible to set an acceleration phase and a deceleration phase separately via the ramp generator.

Note:
If the ramp generator is used for both open-loop and closed-loop modes, the following points must be observed:
When switching between the two operating modes, the PVAR-2 electronics must always be disabled beforehand.
The electronics must then remain disabled for at least 1 second!

3.4.4.2 Example of Use of the Ramp Generator

Example: Use of ramp generator in closed-loop mode:

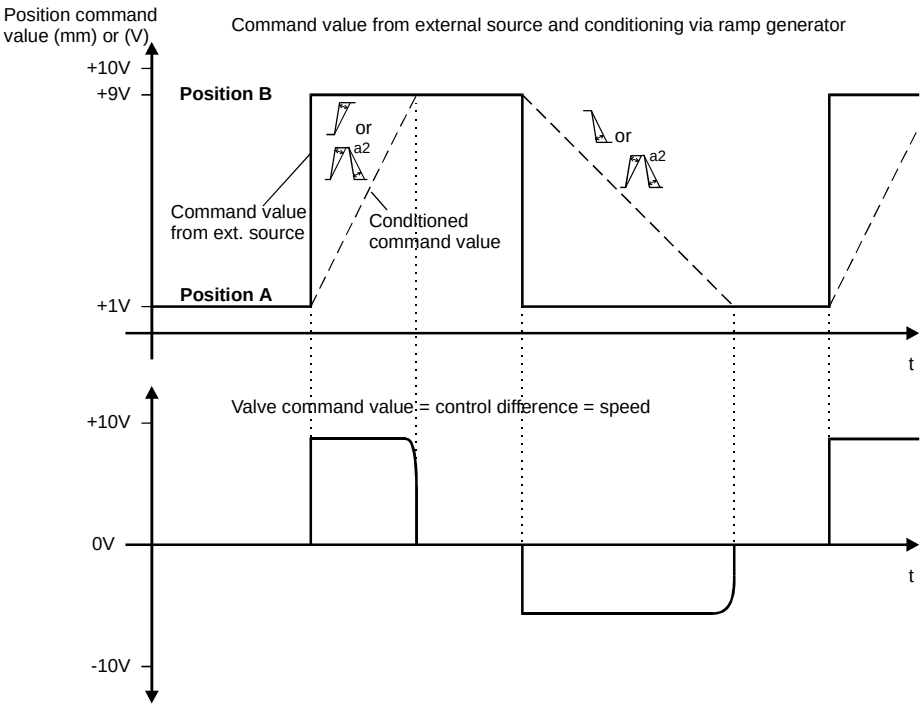


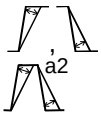
Figure 13: Functional example of the ramp generator in the control electronics

The feedback signal for a closed-loop controlled axis can come e.g. from a potentiometer or from an inductive position transducer from 0 to +10V.
Position A is at +1V, Position B at +9V.
If a command value jump from +1V to +9V is input, the ramp generator will be automatically activated, whereby ramp run time a1+ or a2 can be selected via PLC input -a2- (terminal 6d).
If the distance from +1V to +9V is 300mm, and a time range of 6 seconds was set for the selected ramp generator, then the travel speed is 3750 mm/min.

Calculation:	Travel distance:	300mm
	Travel time:	(6sec. / 10V) x 8V = 4.8sec.
	Speed:	(300mm / 4.8sec.) x 60 = 3750 mm/min

If a command value jump from +9V to +1V is input, the ramp generator will again be automatically activated. Here a choice can be made between the ramp run times a1- and a2. If a time range of 10 seconds was set for the activated a1-, then the travel speed is 2250 mm/min.

3.4.4.3 Setting the Ramp Time

Switch  and position	Switch S3.2 X5 and X6 jumper 1-2		Voltage at 12z /14z or 16z / 18z X5 and X6 jumper 2-3
	Short position	Long position	
0	0.14 sec.	0.8 sec.	10.20 V
1	0.28 sec.	1.6 sec.	5.10 V
2	0.42 sec.	2.5 sec.	3.45 V
3	0.56 sec.	3.3 sec.	2.59 V
4	0.72 sec.	4.3 sec.	2.00 V
5	0.86 sec.	5.2 sec.	1.67 V
6	1.0 sec.	6.0 sec.	1.45 V
7	1.13 sec.	6.8 sec.	1.27 V
8	1.28 sec.	7.6 sec.	1.13 V
9	1.41 sec.	8.4 sec.	1.02 V
A	1.54 sec.	9.2 sec.	0.93 V
B	1.68 sec.	10.0 sec.	0.85 V
C	1.87 sec.	10.8 sec.	0.78 V
D	1.97 sec.	12.0 sec.	0.72 V
E	2.12 sec.	12.6 sec.	0.68 V
F	2.27 sec.	13.8 sec.	0.64 V

The times shown apply to a ramp run time of 10V

Table 2: Setting of the ramp generator for the control electronics

The right-hand column of the table shows the analog voltage which would have to be connected to the two differential inputs to achieve the same ramp gradient as is achieved with the corresponding rotary switch and jumper positions.
If the ramp gradient is determined by analog voltages, the rotary switches for the ramp gradient must be turned to position 0.

3.5 Commissioning

3.5.1 Initial Operation of the Drive

Before the drive is operated in the position control circuit, the axis should first be driven only under open-loop control. Enable (PLC input 4d = +24V) the PVAR-2 in "OPEN-LOOP CONTROL" mode (PLC input 8d = 0V). Then input a small command value of approx. 1-2V and operate in both directions. The running behaviour at low speeds should be particularly closely checked.
If operation of the axis is not possible as described, the problem can be located using the troubleshooting guide (from page 29).
If the drive tends to run erratically (e.g. stick-slip phenomena) at the required minimum speed, the source of the problem must be eliminated before closing the control circuit.

The following are possible causes of this:

- Inadequately vented hydraulic system
- Unsuitable cylinder seals or excessive mechanical friction
- Elasticities between drive element and machine component
- Alignment errors
- Excessively long lines between drive and valve

3.5.2 Checking and Setting the Direction of Control

- Select operating mode "OPEN-LOOP CONTROL" (i.e. PLC input at terminal 8d = 0Volt) and "ENABLE" (PLC input 4d = +24 Volt).
- Operate the axis in this mode with command values of approx. 0.5 to 1 Volt. With a positive command value input (measured at jack 1), the voltage at the feedback value jack (measured at jack 2) should be smaller, with a negative command value input larger. If this is not the case, proceed as follows:

  - Case 1: Feedback value connected to differential input (terminal 2b/4b):
  The correct polarity of the feedback value can be achieved by reversing the connections at 2b and 4b.

  - Case 2: Feedback value connected to impedance transformer (terminal 8b):
  Connection to the impedance transformer is recommended for potentiometric position measuring systems without integral electronics. Only in this case can the voltage supply be reversed at the potentiometer.

In all cases:
In the closed control circuit, the polarity of command value and feedback value at the measuring jacks (jack 1 and jack 2) must always be reversed!

A change from positive to negative voltage corresponds to a decreasing feedback value.
A change from negative to positive voltage corresponds to an increasing feedback value.

3.5.3 Adaptation of the Feedback Value

The feedback value of the drive can be adapted with the two potentiometers "Offset" and "Gain" (actual value) on the front panel of the PVAR-2, so that the operating range can be set, for example, to the voltage range 0-10V.

The following procedure is recommended:

- First check that the potentiometer "Gain" is turned to the left-hand stop.
- Select operating mode "OPEN-LOOP CONTROL" (i.e. PLC input at terminal 8d = 0 Volt) and "ENABLE" (PLC input 4d = +24 Volt).
- Connect measuring instrument to jack 2 (=feedback value) (0V = ^)
- Procedure for feedback values in the range 0 to +10V or 0 to -10V:
  - Slowly move the axis up against the end stop at which the measuring instrument shows the smaller value (observe only the amount!).
  - Adjust the value to 0V with potentiometer "Offset".
  - Slowly move the axis up against the end stop at which the measuring instrument shows the larger value (amount!).
  - Turn potentiometer "Gain" in clockwise direction until the measuring instrument shows 10V.

    If the drive is to be moved under open-loop control between the two end positions, then the command values correspond to the values 0V and 10V.
- Procedure for feedback values in the range between -10V and +10V:
  - Move the axis to each end stop and note the voltages displayed on the measuring instrument in each of these positions.
  - Move the axis to the end position in which the larger noted value was obtained (observe only the amount of the values!)
  - Turn potentiometer "Gain" in clockwise direction until the measuring instrument shows 10V. The feedback value for this position is thus set to 10V.
  - Turn back to the other end stop again and note this new value.

    If the drive is to be moved under open-loop control between the two end positions, then the one command value corresponds to 10V, the other command value to the last value noted.
  - The potentiometer "Offset" is not moved during this adjustment!

3.5.4 Close Control Circuit and Set Gain

As described in section 3.4.4 page 19, the speed of the axis is determined by the time ramp on the board when this is activated. In order to optimise the axis, it is expedient to first travel the maximum stroke at a low speed (corresponding to a long ramp time).

Proceed as follows:

- Disable the PVAR-2 (4d = 0Volt).
- Check that switch S1.1 on the motherboard of the PVAR-2 is in position OFF; this means that the gain range of the P controller can be varied in the range from 0.6 to 1.5 with rotary switch P on the front panel.
- Select operating mode "CLOSED-LOOP CONTROL" (terminal 8d = +24 Volt)
- Set the command value roughly equal to the feedback value (ensure opposite polarity!!) so that the axis does not move when the electronics is enabled (control circuit!)
- Enable the PVAR-2 (terminal 4d = +24 Volt)
- Move the axis in both directions by inputting different position command values.
- If the axis moves without oscillation here, the gain can be gradually increased in small steps until the first noticeable oscillations of the axis become notice able in one or other of the directions of travel.
  The gain is first adjusted only by turning rotary switch "P" on the front panel: the larger the value, the greater the gain. If an even greater gain than step F is possible, the range of switch P must be changed. The change is made by turning switch S1.1 on the motherboard to position ON (range v = 1-16).
  The gain should be tested over the full speed range.

Note: Before moving switch S1.1 on the PVAR-2, switch "P" on the front panel must first be turned to position "0".

Switch P Position	Switch 1.1	
	Position v< (OFF)	Position v> (ON)
0	0.62	1.00
1	0.91	2.00
2	1.07	3.06
3	1.17	4.07
4	1.24	5.03
5	1.30	6.05
6	1.34	7.11
7	1.37	8.11
8	1.41	9.49
9	1.43	10.52
A	1.44	11.56
B	1.46	12.58
C	1.47	13.56
D	1.48	14.56
E	1.49	15.62
F	1.50	16.62

Table 3: Possible gain settings of the P controller

3.5.5 Travel Direction-Dependent Gain

When using differential cylinders, a travel direction-dependent adjustment of the gain may be necessary in some cases. This becomes noticeable when the axis moves smoothly in one direction, but exhibits oscillations in the other. The gain adjustment is performed such that the gain of the travel direction with a tendency to oscillate is reduced by P_{R+} or P_{R-}. The rotary switch to be adjusted is determined by the polarity at measuring jack 3 (= valve command value).

- Check that switches P_{R+} and P_{R-} are in position 0.
- Move the axis forward and back at maximum speed. Set the speed command value to the same level for both directions of travel.
- Note the highest voltage at jack 5 (+) and jack ⏚ (measuring zero) for both directions of travel.
- Compare the voltages and calculate the percentage of the smaller voltage in relation to the larger voltage. Set this calculated value at switch P_{R+} or P_{R-}. From the noted values it is now possible to determine which switch has to be adjusted. This is dictated by the sign of the smaller voltage (amount!).

  Example:

  - Noted voltages: +7 V and -8.6 V
  - Calculation of the percentages:
    Case 1: Characteristic conditioning is deactivated (J100 / OFF)
    (7V / 8.6V) x 100 = 81.4%

    Case 2: Characteristic conditioning is activated (J100 / ON)
    $(7V / 8.6V)^2$ x 100 = 66,2%
  - As the positive value noted is smaller from the point of view of amount, switch PR+ must be adjusted by the calculated percentage (see Table 4 page 25).
  - From the table we find the value -6- (J100 / OFF) / the value -A- (J100 / ON) for switch P_{R+}.
  - Switch P_{R-} remains in position 0.

Switch P_{R+} or P_{R-} Position	Setting in %
0	100%
1	97.8%
2	94.3%
3	91.1%
4	88.0%
5	84.6%
6	81.2%
7	78.0%
8	73.2%
9	69.9%
A	66.6%
B	63.2%
C	60.1%
D	56.8%
E	53.5%
F	50.2%

Table 4: Travel direction-dependent gain adjustment

3.5.6 D Component

Drive systems with a higher natural frequency of the hydraulic spring mass systems than that of the valve permit a further increase in the control circuit gain by adjusting the D component (switch D on the front panel).

- Carefully increase the gain until the axis starts to oscillate during movement. This setting again represents the limit of the drive stability.
- Turning rotary switch D on the front panel of the PVAR-2 in clockwise direction (starting position 0) activates the D component.
  The D component can now be increased until the axis is again in a stable operating range.
- In order to gradually reach an optimum setting it is expedient to now increase the gain setting again with rotary switch P up to the limit of stability and then further increase the D component to again obtain stable operating conditions.
- This procedure may have to be repeated several times.
- When a further increase in the D component no longer brings the drive back to stable operating conditions, no further increase in gain is possible. The limit of the drive stability is reached. At this point the gain should be reduced again by 20-25% in order to have a stability reserve.

3.5.7 Zero Balancing

Exact positioning of the axis is only possible when command value and feedback value have been balanced before the overlap compensation.

The following procedure is recommended:

- Select operating mode "CLOSED-LOOP CONTROL" (terminal 8d = +24 Volt)
- Move the axis to any position.
- Switch off the hydraulics!
- Measure the feedback value at jack 2.
- Measure the command value at command value jack 1 and set equal to the feedback value but with the opposite polarity.
- Measure the voltage at jack 5 and correct with balancing potentiometer 

so that 0 Volt is measured after the correction.

3.5.8 Overlap Compensation

As a rule the proportional valve for the PVAR-2 has a spool with positive overlap (approx. 10% dead zone around the centre position of the spool). This therefore means that due to the P controller on the PVAR-2, the position cannot be exactly reached initially. In order to ensure that the desired position is reached, however, an overlap compensation has to be set for each direction. This overlap compensation keeps the valve just open during braking to the nominal position until the control error has dropped to "ZERO".

In order to set the overlap compensation, proceed as follows:

– Check first that potentiometers ↑ and ↓ are both turned to the left-hand mechanical stop and that switch S101 on auxiliary board KA5 / VTS0020 is in position 1.

– Move the axis at low speed to any desired position. The axis then stops short of the nominal position.

– The positioning error can be measured with corresponding polarity at measuring jack 5. If it is positive, increase the positive overlap at potentiometer ↑ by turning in clockwise direction until the voltage at measuring jack 5 is 0V. If the voltage at measuring jack 5 is negative, the adjustment has to be carried out analogously at potentiometer ↓.

The adjustment procedure described above must be carried out several times for the positive and negative travel directions.

– A different method of overlap compensation can be selected at switch S101. This method provides a more dynamic positioning of the drive. However, the risk of overshooting during positioning is greater. Setting of the two potentiometers for the overlap must have been carried out as described above. The process is activated by turning switch S101 to position 2. The switch position can be changed at any time whilst the system is operating. The choice of the appropriate overlap compensation must be made individually for each axis.

– If the overlap compensation was set with the system cold, it must be checked and, if necessary, corrected with the system at operating temperature.

3.5.9 Window Logic

The window logic has to be activated at switches S100.2 to S100.4 (on auxiliary board KA5) only when the drive oscillates around its nominal position instead of remaining steady in its position.
This creates a defined zone around 0 Volt in which the valve command value is switched to 0 Volt when the selected window size is reached.
The window is activated by turning switch S100.2 to position ON.
Switches S100.3 and S100.4 are used to set the window size.

Selection of the window size:

Window size	Switch S100.3	Switch S100.4
10 mV	ON	ON
20 mV	OFF	ON
30 mV	ON	OFF
40 mV	OFF	OFF

Table 5: Window setting for valve command value deactivation

3.5.10 Window Position Reached

The display of the message "POSITION REACHED" in CLOSED-LOOP control mode indicates that the difference between command value and feedback value is smaller than a variable window size. This message is displayed on the front panel of the PVAR-2 (LED ⇕) and signalled with +24V via the PLC output to terminal 14d.
The window is set with switches S1.5 to S1.8.

S1	.5	.6	.7	.8	Threshold / mV
	ON	ON	ON	ON	44
	OFF	ON	ON	ON	60
	ON	OFF	ON	ON	72
	OFF	OFF	ON	ON	88
	ON	ON	OFF	ON	103
	OFF	ON	OFF	ON	118
	ON	OFF	OFF	ON	132
	OFF	OFF	OFF	ON	146
	ON	ON	ON	OFF	159
	OFF	ON	ON	OFF	173
	ON	OFF	ON	OFF	187
	OFF	OFF	ON	OFF	203
	ON	ON	OFF	OFF	218
	OFF	ON	OFF	OFF	233
	ON	OFF	OFF	OFF	247
	OFF	OFF	OFF	OFF	260

Table 6: Setting parameters for the message "Position reached"

The setting of the PVAR-2 as an analog control circuit is herewith completed!

3.6 Troubleshooting

The following faults are conceivable:

3.6.1 Drive does not move despite hydraulic oil supply, enable and command value input

- Check whether the control electronics has been enabled (the green LED "en" on the front panel of the PVAR-2 must be lit).
- Further troubleshooting depends on the selected operating mode:
- Case 1: "Open-loop control" mode:
  In "open-loop control" mode, the polarity of the command value determines the direction of travel and the level of the command value determines the travel speed of the drive. "Open-loop control" mode is recognisable from the fact that the LED "cl" on the front panel is **not** lit.
  Then check the following:
  - Input a command value of approx. 1-2 Volt.
  - If the axis is against the mechanical stop, reverse the polarity of the command value as a test (this should result in travel in the opposite direction).
  - If the axis still does not move, compare the value at jack 3 (valve command value) with the value at jack 4 (valve feedback value). The amount of the two values must be the same, but with opposite signs.
- Case 2: "Closed-loop control" mode:
  In "closed-loop control" mode, input a command value which is different from the feedback value. "closed-loop control" mode is recognisable from the fact that the LED "cl" on the front panel is lit.
  Then check the following:
  - Check the value at jack 3 (valve command value); if command value and feedback value are different, this value should be a voltage not equal to 0 V.
  - Compare the value at jack 3 (valve command value) with the value at jack 4 (valve feedback value). The amount of the two values must be the same, but with opposite signs.
    If the value at jack 4 is almost 0V, check the cable connection to the valve.
- In the case of valves with integral electronics, check that the voltage supply, enable and valve command value are OK.

3.6.2 Drive starts uncontrolled movement immediately after switching on the hydraulic oil supply with subsequent enable

This indicates a direct feedback in the control circuit. In this case, a constant +10V or -10V will be measured at measuring jack 4 (valve feedback value).
Check the following:

- Check the two solenoid plugs A and B for reversing
- Check the connection of the valve position transducer

3.6.3 During travel at low speed or during positioning, severe vibrations are noticeable at the drive

- The D component may be set too high. Slightly reduce the D component and observe whether the vibrations decrease, If necessary, then also reduce the P gain of the control circuit at rotary switch P.
- A lack of damping oil in the proportional valve can also cause vibrations in the drive. The valve must therefore be bled.
  - Unscrew the two 3 mm hexagon socket-head screws alongside the solenoid plugs A and B.
  - Using an oil can, pour hydraulic oil into the one screw bore until oil comes out of the other bore bubble-free..
  - Insert the screws again.
  - The tank line must be prevented from running dry as otherwise the valve will take in air again. If the installation space allows, install a pilot pressure insert. Pilot pressure 2-3 bar.
- Check whether command value, feedback value or position transducer lines of the proportional valve have been laid alongside power-transmitting cables.

4 Commissioning of the PVAR-2 as Intermediate Electronics

4.1 System Layout

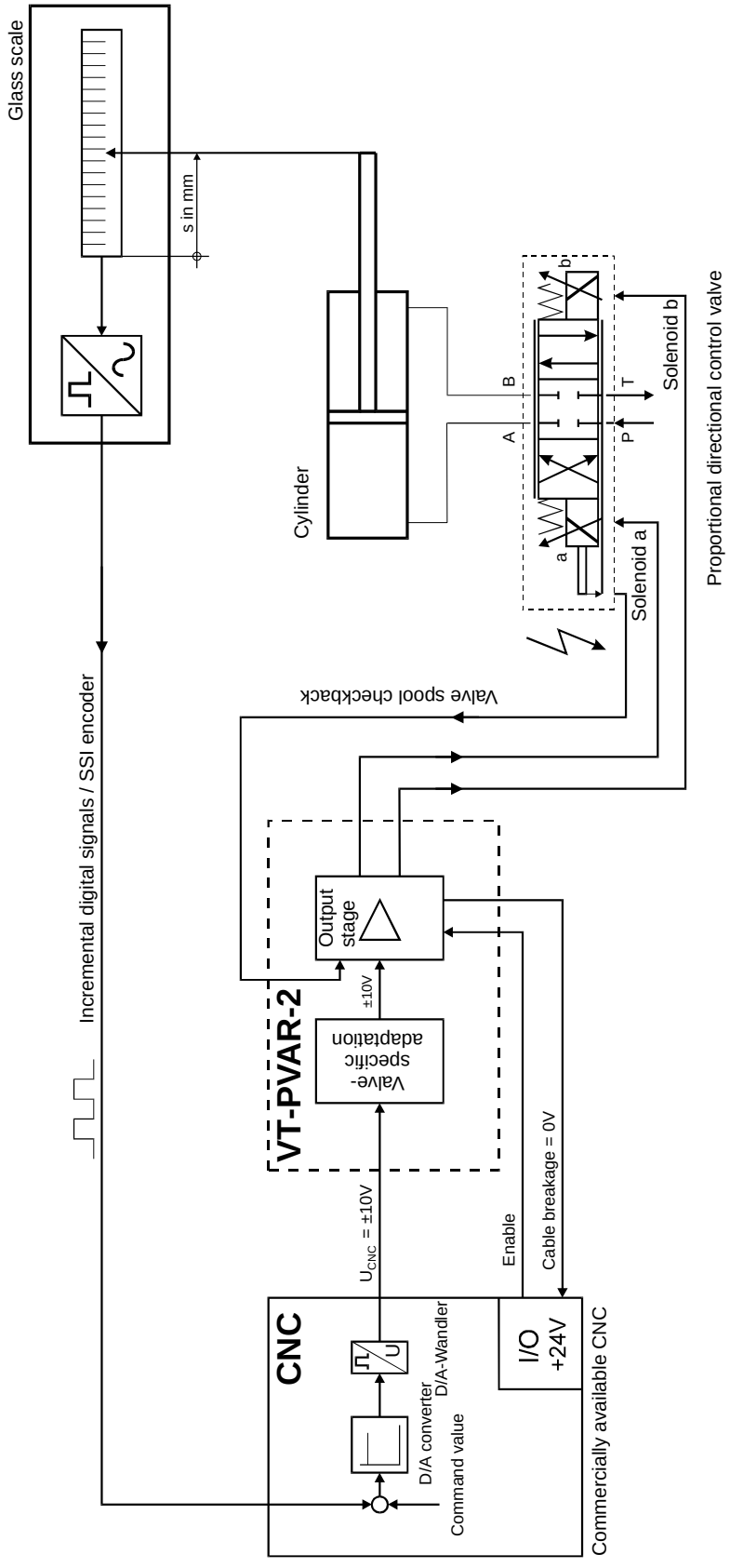


Figure 14: System layout of the intermediate electronics

4.2 Mechanical Installation

The PVAR-2 intermediate electronics can be installed either in a 19" rack or in a dedicated card rack. For the "card rack" solution, Bosch Rexroth can supply the card rack Type VT 3002-2X (see RD 29 928) and the NE 30 power pack Type VT 19 083 (see RD 29 929).

4.2.1 Observe the following points during installation of the intermediate electronics:

- Potential sources of electromagnetic interference, such as e.g. unearthed contactors, must not be located in the immediate vicinity of the control electronics.
- A distance of at least 1 m must be maintained to radios and antenna cables.
- The laying of power-conducting cables in the vicinity of the electronics is not permitted.
- Command values may only be switched with appropriate contacts suitable for currents < 1 mA.
- Use only instruments with Ri > 100 kΩ for carrying out measurements.
- The terminals may only be connected or disconnected when de-energized.
- The electronics modules may only be inserted or removed when de-energized.
- Use low-capacitance cables conforming to the guidelines of the VDE. Cables should be laid without intermediate terminals wherever possible!
- The cable to the inductive position transducer and all signal lines must always be screened.
  Recommendation: Lay screen on the system open and connect to the corresponding terminal on the PVAR-2. Screening of the command value input cable should be made at the CNC.
- Ensure that the permissible ambient temperature of 50° C is not exceeded.
- When using differential inputs, both inputs must always be connected and disconnected simultaneously.

4.3 Electrical Installation

4.3.1 Important Characteristics

Supply voltage	U	18V-35VDC
Max. power consumption	P	50W
Internally generated voltages	U U	±15 V, max. 40 mA (externally loadable) ±10 V, max. 10 mA (externally loadable)
Supply voltage to switching inputs/outputs Switching inputs (from ext. controller/PLC)	U_{PLC} 0-Signal 1-Signal	24V, ±20% < 6 V > 12 V to U_{PLC} (input impedance >5 kΩ)
Switching outputs (to ext. controller/PLC)	0-Signal 1-Signal	< 1V U_{PLC} - 2V, max. 15mA (short circuit-proof)
Differential input (command value)	U_{CNC}	±10V / 50kΩ
Output signal for valve command value	U	± 10V / max. 10mA (externally loadable)
Type of connection		48-pin male connector, DIN 41 612, style F
Board dimensions		Euro-card 100 x 160 mm, DIN 41 494 + 1 clip-on board (KA5 / VTS0020) 80x60 mm + 1 clip-on board (optional) (PVE1 / VTS0021) 80x90 mm
Front panel dimensions	Height	3 height modules (128.4 mm)
	Width	8 depth modules (1 module = 5.08mm)
Permissible ambient temperature	t	0° to 50°C
Storage temperature	t	-20°C to +70°C
Weight	m	0.3kg

4.3.2 Overview of Terminal Assignments

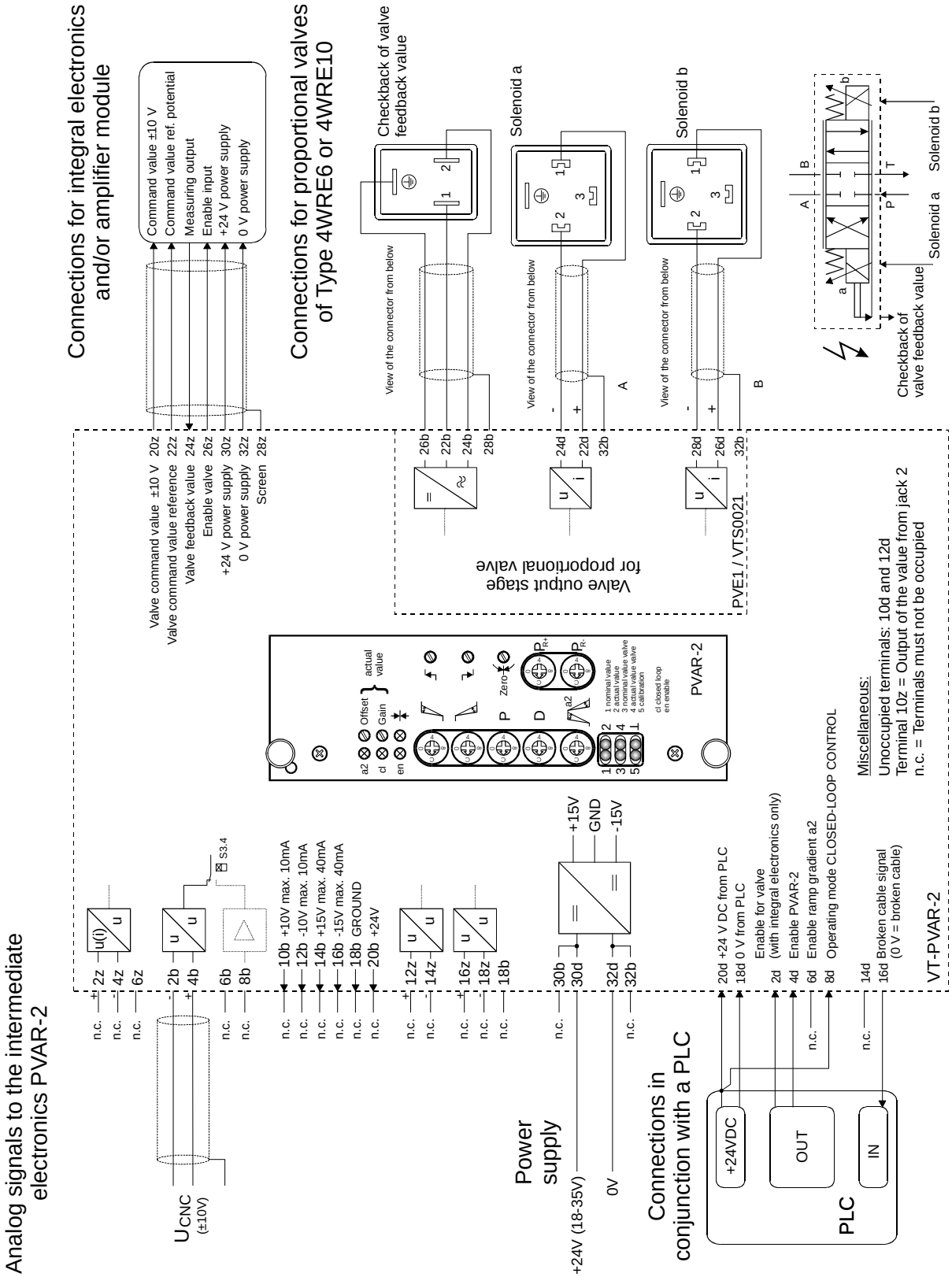


Figure 15: Terminal assignment of the intermediate electronics

4.3.3 Voltage Supply to the Electronics

The PVAR-2 intermediate electronics requires a 24V DC power supply. If this voltage supply cannot be provided by the system, the NT30 / VT 19083 power pack to RD 29 929 from Bosch Rexroth can be used. As a power supply to the electronics, the 24V from the power pack is connected to terminal 30d and the 0Volt to terminal 32d.

4.3.4 Connection of the CNC Output Signal

The analog output signal of the CNC (U_{CNC}) is connected to terminals 4b (+) and 2b (reference). The cable screen should be connected to the signal source, i.e. to the CNC.

4.3.5 Connection of a Proportional Valve (optional)

If ordered accordingly, the PVAR-2 contains the valve output stage for the proportional valves of Type 4WRE6 or 4WRE10. Three separate cables must be laid to this valve.
The cable is used for the valve spool position feedback signal. A cable of Type LiYCY 3x0.25mm² is recommended for this purpose.

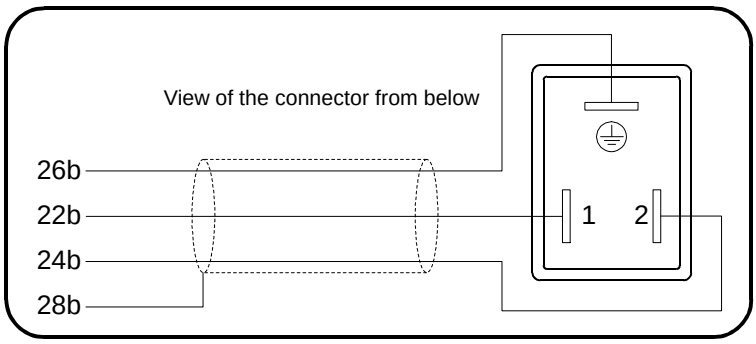


Figure 16: Connection of the feedback value pick-up to the intermediate electronics

The cables to the two solenoid valves should be laid separately from analog signal lines, in particular from the cable of the inductive position transducer. Screening of the solenoid cable is recommended.
Cable type LiYCY 1.5mm² up to 50m length.

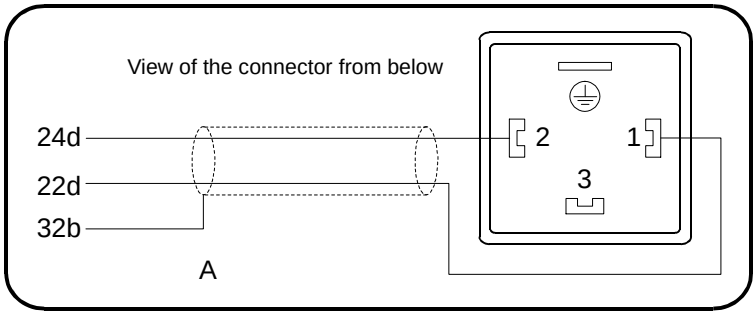


Figure 17: Connection of solenoid A to the intermediate electronics

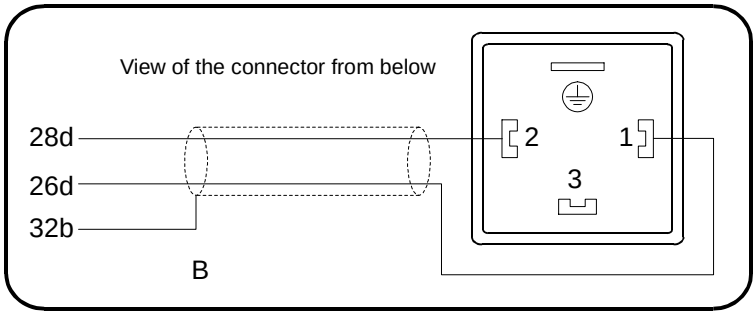


Figure 18: Connection of solenoid B to the intermediate electronics

4.3.6 Connection of a Valve with Integral Electronics

Terminals 20z to 32z are available for connection of a valve with integral electronics.

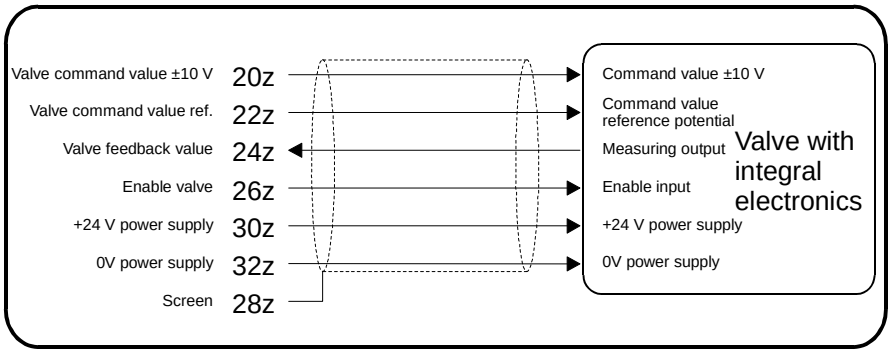


Figure 19: Connection of a valve with integral electronics to the intermediate electronics

Note:
The voltage output (valve command value terminal 20z) must not be loaded with more than 10mA, i.e. the maximum load is 1kW.

4.3.7 Connections in Conjunction with a PLC

The connection to the PLC on the PVAR-2 is opto-decoupled, i.e. metallically separated. The voltage of the PLC must be used to supply the optocouplers. The voltage supply must be connected to terminal 20d (+24V from PLC) and 18d (0V from PLC).

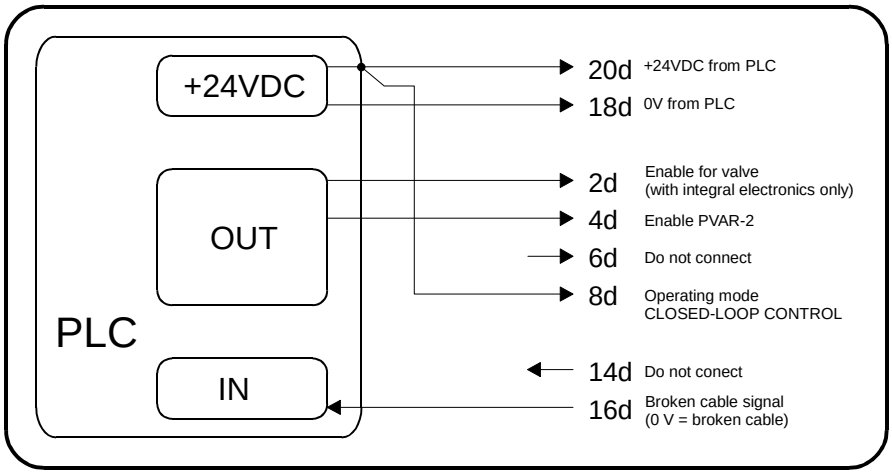


Figure 20: Connections from the PLC to the intermediate electronics

4.3.8 Other Connections

The feedback value of the controller can be tapped at terminal 8z for evaluation or display purposes. The voltage output corresponds to the value from jack 2.

4.3.9 Layout Drawing of PVAR-2

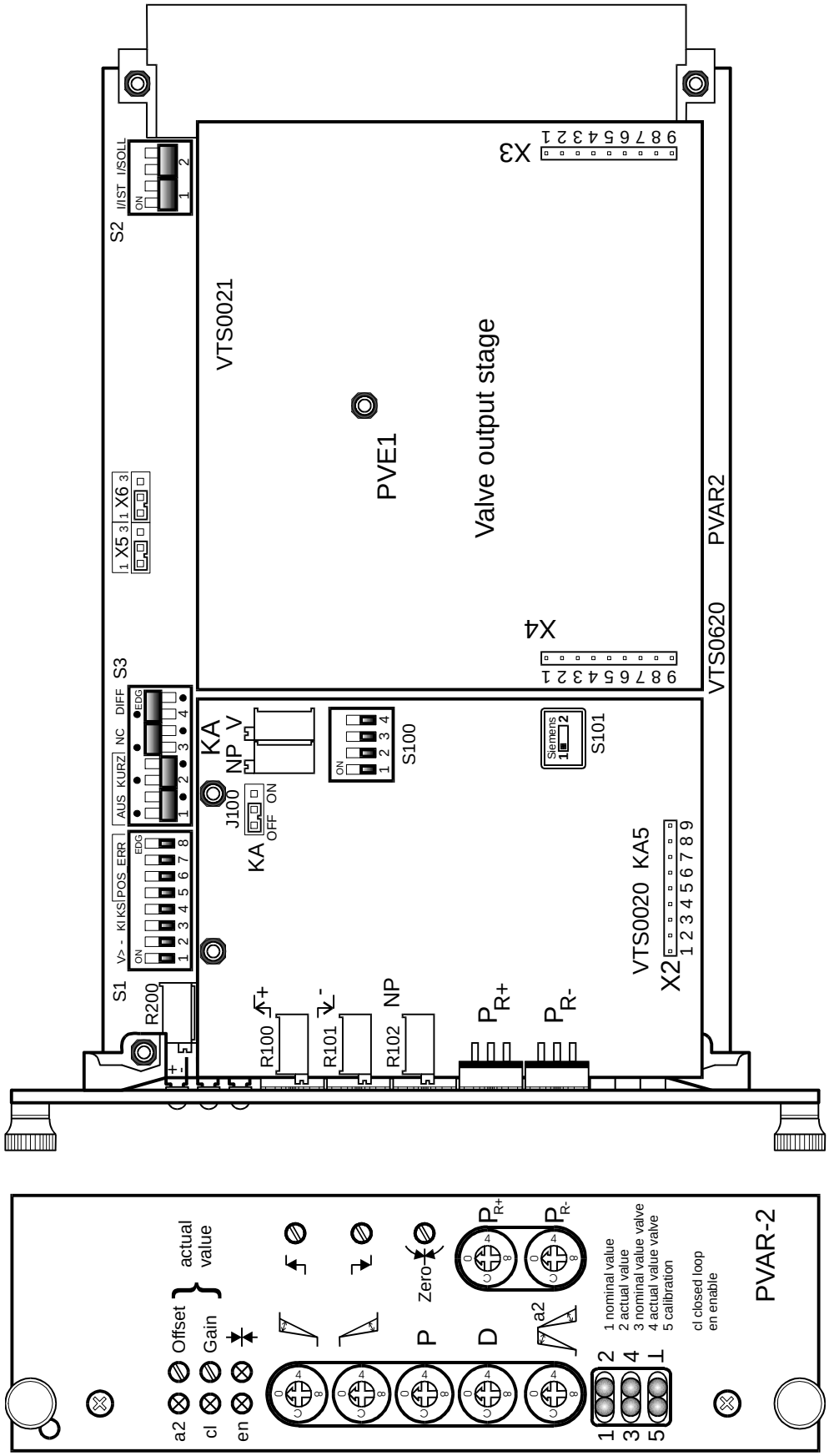


Figure 21: Layout diagram of the PVAR-2

4.3.10 Block Circuit Diagram of the PVAR-2

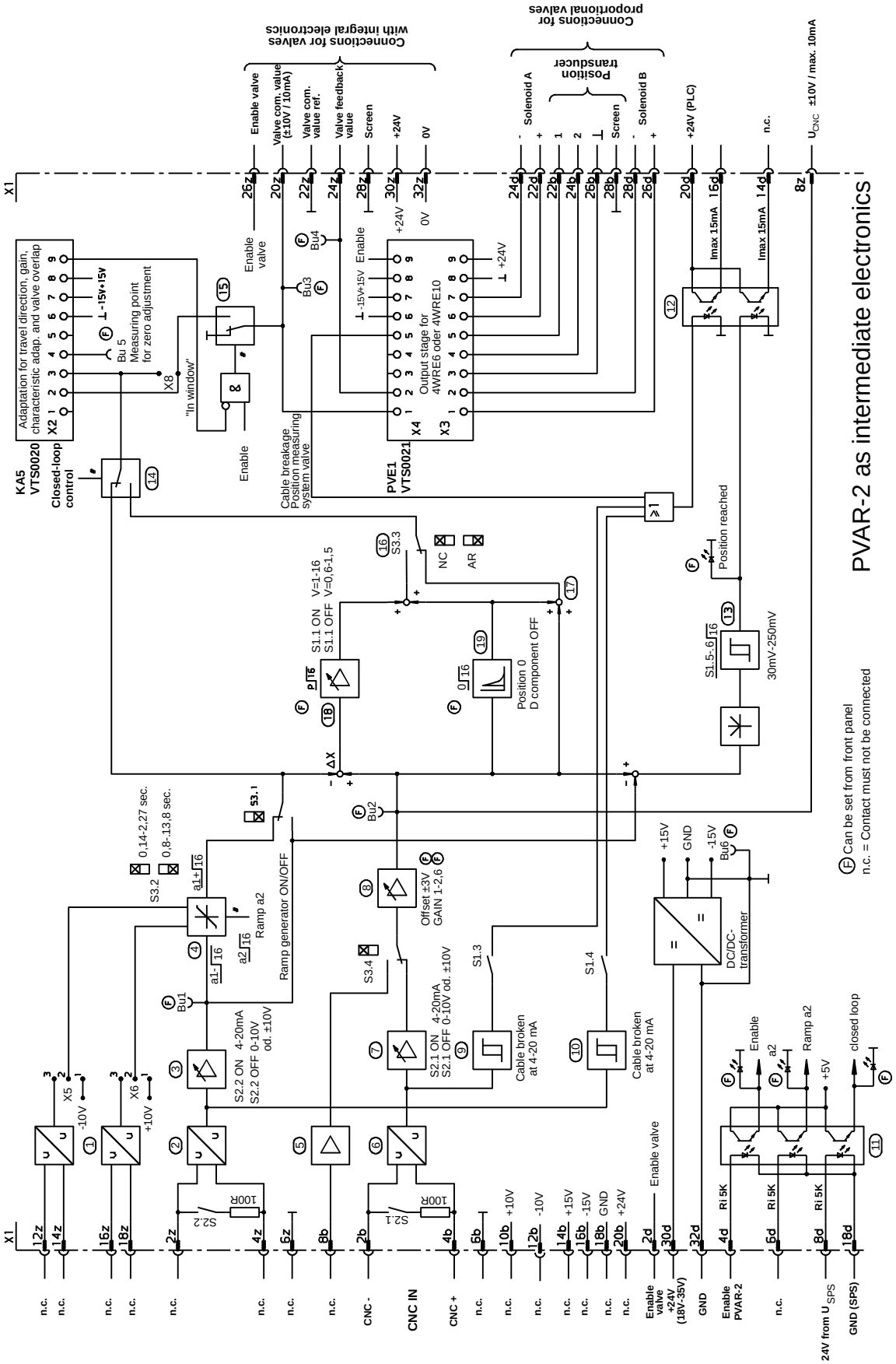


Figure 22: Block circuit diagram of the PVAR-2 as intermediate electronics

4.4 Preconditions for Commissioning

4.4.1 General Information on Commissioning

- A precondition for the commissioning of the axis is the completion of the mechanical and electrical installation of the system.
- Check the terminal assignments.
- Carefully vent the hydraulic system and adjust the pressure of the system to the prescribed level.
- If, for safety reasons, the drives are initially started up at reduced pressure, note that final parametrisation of the controller can only be carried out when the system has been set to the final operating pressure.

4.4.2 Starting and Stopping Sequence

In order to avoid uncontrolled movements of the drive, the following sequence should be followed when starting and stopping the drive.

4.4.2.1 Starting

- Switch on the supply voltage to the PVAR-2-intermediate electronics, position measuring system, PLC and CNC.
- Switch on the hydraulic oil supply.
- Enable the PVAR-2 intermediate electronics (in the case of valves with integral electronics, connect an additional enable for the valve to terminal 2d).
- Input the CNC command value.

4.4.2.2 Stopping

- Disable the PVAR-2 intermediate electronics (in the case of valves with integral electronics, also disable the valves).
- Switch off the hydraulic oil supply.
- Switch off the supply voltage.

4.4.3 Basic Setting of the Board

Before switching on the voltage supply for the first time, all switches of the electronics must be moved to their basic position. Furthermore, no enables from the PLC should have been given.

4.4.3.1 Front Panel

– Move switches **D**, $\mathbf{P_{R+}}$ and $\mathbf{P_{R-}}$ to position 0.

– Turn potentiometers , and **Gain** (actual value) completely to the left up to the internal mechanical stop.

– Switches **P**, , and on the front panel of the intermediate electronics have no function in this application and do not have to be configured.

– With the voltage supply switched on and the command value input 0 Volt from the CNC, measure the voltage at jack 2 against jack ⏚ and adjust to 0 Volt with the potentiometer Offset (actual value) on the front panel.

The is not checked at this point.
The function of the individual switches is described in more detail in section "Commissioning".

Note:
The potentiometers are 25-turn potentiometers, i.e. the internal mechanical stop of the potentiometer is reached after a maximum of 25 turns.

4.4.3.2 On the PVAR-2 Circuit Board

– **Switch S1** is turned to position OFF. The switch positions do not have to be altered during the commissioning.

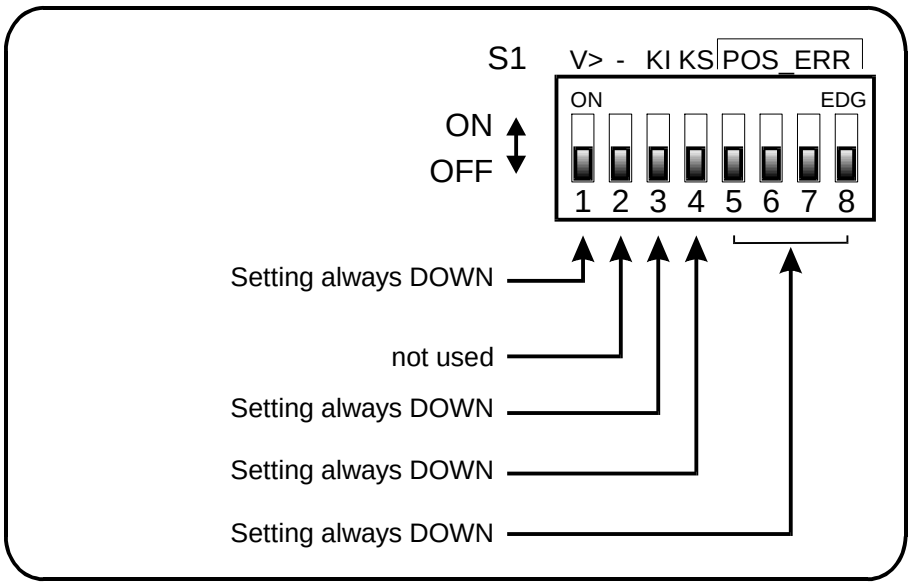


Figure 23: Switch S1 of the intermediate electronics

– Two differential inputs for current signal or voltage signal are configured with **switch S2**. If the PVAR-2 is used as intermediate electronics, both switches must always be turned to position OFF.

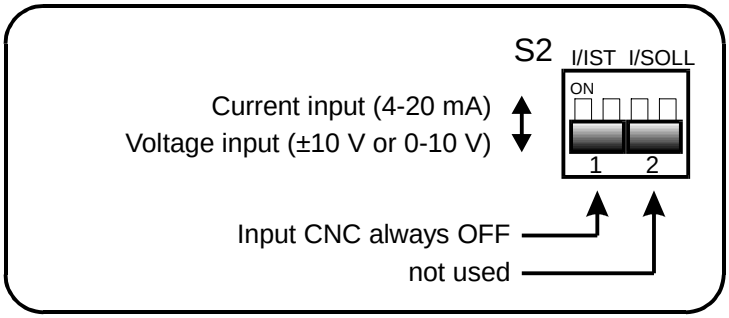


Figure 24: Switch S2 of the intermediate electronics

– **Switch S3** is used for configuration
  - of the function "intermediate electronics" (S3.3),
  - and of the voltage signal U_{CNC} (S3.4).

Switches S3.1 and S3.2 have no significance for the function "PVAR-2 as intermediate electronics".

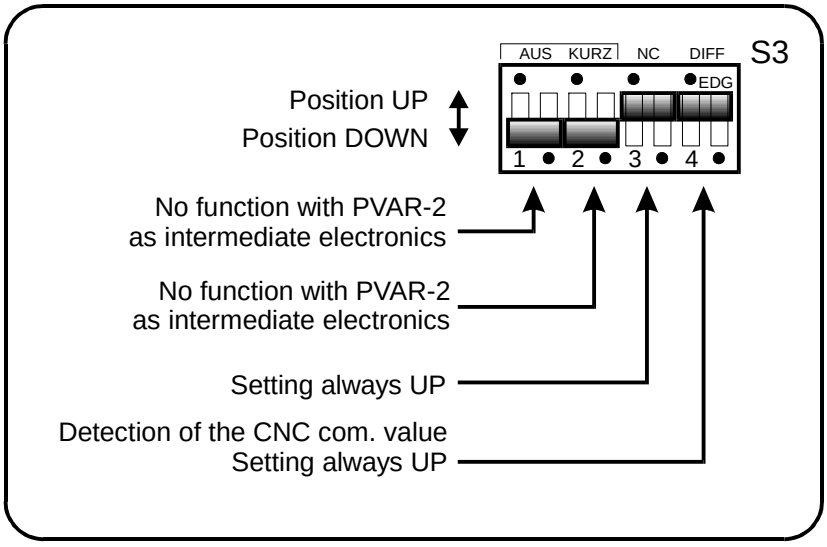


Figure 25: Switch S3 of the intermediate electronics

– **Jumpers X5 and X6** are not used for the "PVAR-2 as intermediate electronics" function. The jumpers should always be configured in position 1-2.

4.4.3.3 Auxiliary Board KA5

- Jumper **J100** is used to activate the conditioning for valves with progressive characteristic. Characteristic conditioning is deactivated in position OFF and activated in position ON. For valves of Type 4WRE.., the jumper must be inserted in position ON.
- The position of **switch S100.1** is only of significance when jumper 100 is in position ON. In the case of a valve of Type 4WRE6, the switch must be set to position OFF, n the case of a valve of Type 4WRE10 to position ON.
- **Switches S100.2 to S100.4** are responsible for the window logic. Using the window logic, actuating signals smaller than 40mV can be set to 0V. The window is activated by turning switch S100.2 to position ON.
  Switches S100.3 and S100.4 are used to set the window size. At the start of commissioning, the switches must be moved to position OFF.

  Selection of the window size:

Window size	Switch S100.3	Switch S100.4
10 mV	ON	ON
20 mV	OFF	ON
30 mV	ON	OFF
40 mV	OFF	OFF

Table 7: Window setting for valve command value deactivation

- **Switch S101** determines the method of overlapping compensation.
  At the start of commissioning, move this switch to position 1.

The locations of the switches can be seen in Figure 21 (page 40).

4.4.3.4 Auxiliary Board PVE1 (optional)

The valve output stage for the valve is located on auxiliary board PVE1. This board is only necessary for driving a proportional valve without integral electronics. No settings have to be carried out here.
.

4.5 Commissioning

4.5.1 Initial Operation of the Drive

Before the drive is operated in the control circuit, the axis should first be driven only under open-loop control. Enable the PVAR-2 (PLC input 4d = +24V). Instead of the CNC, a variable voltage source (e.g. battery charger) is connected to differential input 2b (-) / 4b (+).
Then input a small command value of approx. 1-2V and operate in both directions. When the polarity of the command value is reversed, the travel direction should also change. The running behaviour at low speeds should be particularly closely checked.
If operation of the axis is not possible as described, the problem can be located using the troubleshooting guide (from page 51).
If the drive tends to run erratically (e.g. stick-slip phenomena) at the required minimum speed, the source of the problem must be eliminated before closing the control circuit.

The following are possible causes of this:

- Inadequately vented hydraulic system
- Unsuitable cylinder seals or excessive mechanical friction
- Elasticities between drive element and machine component
- Alignment errors
- Excessively long lines between drive and valve

4.5.2 Checking and Setting the Direction of Control

The polarity output by the CNC system e.g. for the positive travel direction (machine coordinates) must also move the axis in positive direction.
Checking and setting of the correct control direction must be carried out before connecting the PVAR-2 intermediate electronics to the CNC as follows:

- Switch on the voltage supply to the PVAR-2 intermediate electronics and the CNC system.
- Switch on the hydraulic oil supply.
- "ENABLE" the PVAR-2 (PLC input 4d = +24 Volt). Additionally in the case of valves with integral electronics, enable the valve (terminal 26z)
- Connect DC voltmeter to the command value output of the CNC system **disconnected** from the PVAR-2 intermediate electronics.
- Supply a small **positive** voltage to 2b(-) / 4b(+)with the battery charger until the axis moves slowly.

The output voltage of the CNC position controller must rise **negatively** at the DC voltmeter. If this is the case, the control direction is correct and the PVAR-2 can be connected to the CNC output voltage with 2b(-) and 4b(+).

If a positive output voltage is obtained at the CNC, the control direction is not correct. In order to obtain the correct control direction, now connect the PVAR-2 to the CNC with 2b(+) and 4b(-) or reverse the polarity of the CNC.

4.5.3 Adaptation of the CNC Output Voltage to the Maximum Travel Speed

When using differential cylinders, the different working areas of the cylinders or in the case of drives with vertical operating directions (suspended load), a direction-dependent adaptation of the gain may be necessary.

Furthermore with the desired maximum speed of the drive, the output voltage at the CNC should be approx. 8V. This is expedient in order to utilise the full control range of the CNC.

Equally large output voltages in positive and negative travel direction also mean equally large following errors and thus also symmetrical operational gain K_V of the drive.

The adjustment is carried out as follows:

- Operate the drive forward and back at the desired maximum speed.
- Measure the voltage at jack 2 against jack ^ (measuring zero).
- For a positive measured voltage rotary switch P_{R+}, for a negative measured voltage rotary switch P_{R-} is required for the following adjustment.
- Turn the rotary switches from the zero position (0) in clockwise direction (but not further than position F) until the same voltage level is obtained for the programmed maximum speed for forward and reverse travel (i.e. + and -). The two measured voltages should preferably both be set to the same value in the vicinity of 8 V.

The CNC input voltage is reduced with the two rotary switches, depending on the polarity. The following table shows the setting range.

Switch P_{R+} or P_{R-} Position	Setting in %
0	100%
1	97.8%
2	94.3%
3	91.1%
4	88.0%
5	84.6%
6	81.2%
7	78.0%
8	73.2%
9	69.9%
A	66.6%
B	63.2%
C	60.1%
D	56.8%
E	53.5%
F	50.2%

Table 8: Travel direction-dependent gain adjustment

4.5.4 Gain of the Position Control Circuit

The gain of the complete position control circuit K_V must be carried out at the CNC system with the KV weighting.

Starting with a small K_V value, move the drive in the "Cycle" program towards + and - with approx. 50% of the maximum speed. If the drive runs smoothly, the gain setting at the CNC (K_V weighting) can be increased in small steps until the first undamped oscillations (chatter) occur in one or other of the travel directions.

This setting represents the limit of stability of the drive in question.

4.5.5 D Component

Drive systems with a higher natural frequency of the hydraulic spring mass systems than that of the valve permit a further increase in the control circuit gain by adjusting the D component (switch D on the front panel).

– Increase the gain at the CNC (K_V weighting) in small steps and operate the drive in the "Cycle" program until undamped oscillations (chatter) are observed at the axis.

  This setting again represents the limit of the drive system stability.

– Turning rotary switch D on the front panel of the PVAR-2 in clockwise direction (starting position 0) activates the D component.
  The D component can now be increased until the axis is again in a stable operating range.

– In order to gradually reach an optimum setting it is expedient to now increase the gain setting again with rotary switch P up to the limit of stability and then further increase the D component to again obtain stable operating conditions.

– This procedure may have to be repeated several times.

– When a further increase in the D component no longer brings the drive back to stable operating conditions, no further increase in gain is possible. The limit of the drive stability is reached. At this point the gain should be reduced again by 20-25% in order to have a stability reserve.

4.5.6 CNC Zero Balancing

Exact positioning of the drive system is only possible when a zero balance between CNC and PVAR-2 has been carried out before setting the overlap compensation
This means that at U_{CNC} = 0V (i.e. following error = 0V) the valve command value (jack 3) is also 0V.

The following procedure is recommended:

– Switch off the hydraulics.

– Set the following error of the CNC to 0 V.

– Measure the voltage at jack 2 (U_{CNC}) and correct with Potentiometer "Offset" (actual value) so that 0 Volt is measured after the correction.

– Measure the voltage at jack 5 and correct with balancing potentiometer Zero so that 0 Volt is measured after the correction.

4.5.7 Overlap Compensation

As a rule the proportional valve for the PVAR-2 has a spool with positive overlap (approx. 10% dead zone around the centre position of the spool). This therefore means that due to the P controller on the PVAR-2, the position cannot be exactly reached initially. In order to ensure that the desired position is reached, however, an overlap compensation has to be set for each direction. This overlap compensation keeps the valve just open during braking to the nominal position until the control error has dropped to "ZERO".

In order to set the overlap compensation, proceed as follows:

– Check first that potentiometers and are both turned to the left-hand mechanical stop and that switch S101 on auxiliary board KA5 / VTS0020 is in position 1.

– Move the axis at low speed in "jog" mode to any desired position. The axis then stops short of the nominal position.

– The positioning error can be measured with corresponding polarity at measuring jack 5. If it is positive, increase the positive overlap at potentiometer by turning in clockwise direction until the voltage at measuring jack 5 is 0V. If the voltage at measuring jack 5 is negative, the adjustment has to be carried out analogously at potentiometer .

The adjustment procedure described above must be carried out several times for the positive and negative travel directions.

– A different method of overlap compensation can be selected at switch S101. This method provides a more dynamic positioning of the drive. However, the risk of overshooting during positioning is greater. Setting of the two potentiometers for the overlap must have been carried out as described above. The more dynamic process is activated by turning switch S101 to position 2. The switch position can be changed at any time whilst the system is operating. Choice of the appropriate overlap compensation must be made individually for each drive system.

– If the overlap compensation was set with the system cold, it must be checked and, if necessary, corrected with the system at operating temperature.

4.5.8 Window Logic

The window logic has to be activated at switches S100.2 to S100.4 (on auxiliary board KA5) only when the drive oscillates around its nominal position instead of remaining steady in its position.
This creates a defined zone around 0 Volt in which the valve command value is switched to 0 Volt when the selected window size is reached.
The window is activated by turning switch S100.2 to position ON.
Switches S100.3 and S100.4 are used to set the window size.

Selection of the window size:

Window Size	Switch S100.3	Switch S100.4
10 mV	ON	ON
20 mV	OFF	ON
30 mV	ON	OFF
40 mV	OFF	OFF

Table 9: Window setting for valve command value deactivation

4.5.9 Window Position Reached

The display of the message "POSITION REACHED" is displayed when the CNC output voltage has reached a variable window around 0 V. This message is displayed on the front panel of the PVAR-2 (LED ⇕) and signalled with +24 V via the PLC output to terminal 14d. The message serves only for display purposes and has no influence on the function of the intermediate electronics.
The window is set with switches S1.5 to S1.8.

S1	.5	.6	.7	.8	Threshold / mV
	ON	ON	ON	ON	44
	OFF	ON	ON	ON	60
	ON	OFF	ON	ON	72
	OFF	OFF	ON	ON	88
	ON	ON	OFF	ON	103
	OFF	ON	OFF	ON	118
	ON	OFF	OFF	ON	132
	OFF	OFF	OFF	ON	146
	ON	ON	ON	OFF	159
	OFF	ON	ON	OFF	173
	ON	OFF	ON	OFF	187
	OFF	OFF	ON	OFF	203
	ON	ON	OFF	OFF	218
	OFF	ON	OFF	OFF	233
	ON	OFF	OFF	OFF	247
	OFF	OFF	OFF	OFF	260

Table 10: Setting parameters for the message "Position reached"

The setting of the PVAR-2 as intermediate electronics is herewith completed!

4.6 Troubleshooting

The following faults are conceivable:

4.6.1 Drive does not move despite hydraulic oil supply, enable and command value input

- Check whether the control electronics has been enabled (the green LED "en" on the front panel of the PVAR-2 must be lit).
- In the case of valves with integral electronics, check that the voltage supply, enable and valve command value are OK.
- Check the valve function:
  - Input any command value at 2b(-) / 4b(+).
  - Measure the voltage at jack 3 (valve command value) using a multi-meter. The voltage measured at jack 3 must also be measured at jack 4 (valve feedback value) with max. 200 mV deviation, but with opposite polarity.

    If, with a command value input, a voltage can be measured at jack 3, but practically 0 V is measured at jack 4, the cable connection between PVAR-2 and the valve must be checked.

4.6.2 Drive starts uncontrolled movement immediately after switching on the hydraulic oil supply with subsequent enable

This indicates a direct feedback in the control circuit. In this case, a constant +10V or -10V will be measured at measuring jack 4 (valve feedback value). Check the following:

- Check the two solenoid plugs A and B for reversing
- Check the connection of the valve position transducer

4.6.3 During travel at low speed or during positioning, severe vibrations are noticeable at the drive

- The D component may be set too high. Slightly reduce the D component and observe whether the vibrations decrease, If necessary, then also reduce the P gain of the control circuit at the CNC.
- A lack of damping oil in the proportional valve can also cause vibrations in the drive. The valve must therefore be bled.
  - Unscrew the two 3 mm hexagon socket-head screws alongside the solenoid plugs A and B.
  - Using an oil can, pour hydraulic oil into the one screw bore until oil comes out of the other bore bubble-free..
  - Insert the screws again.
  - The tank line must be prevented from running dry as otherwise the valve will take in air again. If the installation space allows, install a pilot pressure insert. Pilot pressure 2-3 bar.
- Check whether command value, feedback value or position transducer lines of the proportional valve have been laid alongside power-transmitting cables.

4.7 List of Figures and Tables

4.7.1 Figures

4.7.2 Tables

5 Notes

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