Digital PID-Controller U for hydraulic proportional valves BLS1

- 3 analog 12-bit inputs 0-10V / 4-20mA (set point, actual value 1, actual value 2)
- 10 digital inputs / 2 digital outputs (OC)
- 2 analog power outputs (pulse width modulated max.3A)
- 2 digital power outputs (max 3 A)
- sampling time 1.0 msec
- commamd value / feedback value range adjustable
- 2 ramp generators
- digital set point definition
- ON-LINE programming of parameters via PC software or manual terminal
- 2 programmable analog outputs (¹

(¹ = optional

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Introduction

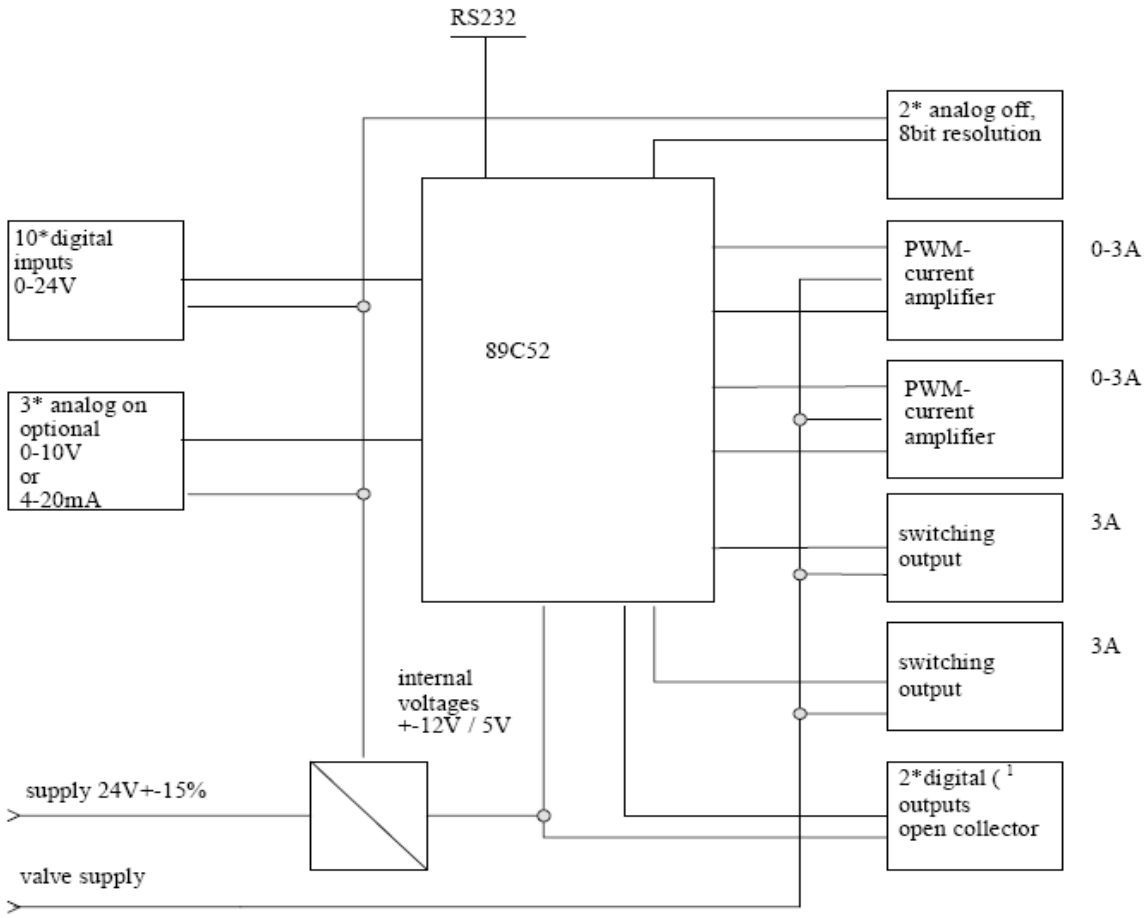


Fig. 1 : Block diagram of the card

The digital PID controller BLS1 is designed for the pilot control of hydraulic proportional valves. The use of a 24 Mhz. – clocked microcontroller and assembler programming permits to achieve computing times that are adequate to control highly dynamic hydraulic circuits.

Figure 1 shows the hardware arrangement of the card. In addition to the controller with PID characteristics and power amplifiers it is equipped with two power drivers for digital auxiliary functions. The digital inputs are also designed for extra functions such as e.g. direction of the 4/3-way valve combinations.

For the analog set point/actual value inputs separate reference voltage values can be set for the digitizer which permits to obtain an optimum resolution.

Programming of the functional setting and of the controller parameters is made by means of a PC or a manual terminal via a RS232 interface and the data are stored in a non-volatile memory (EEprom).

(¹ = optional

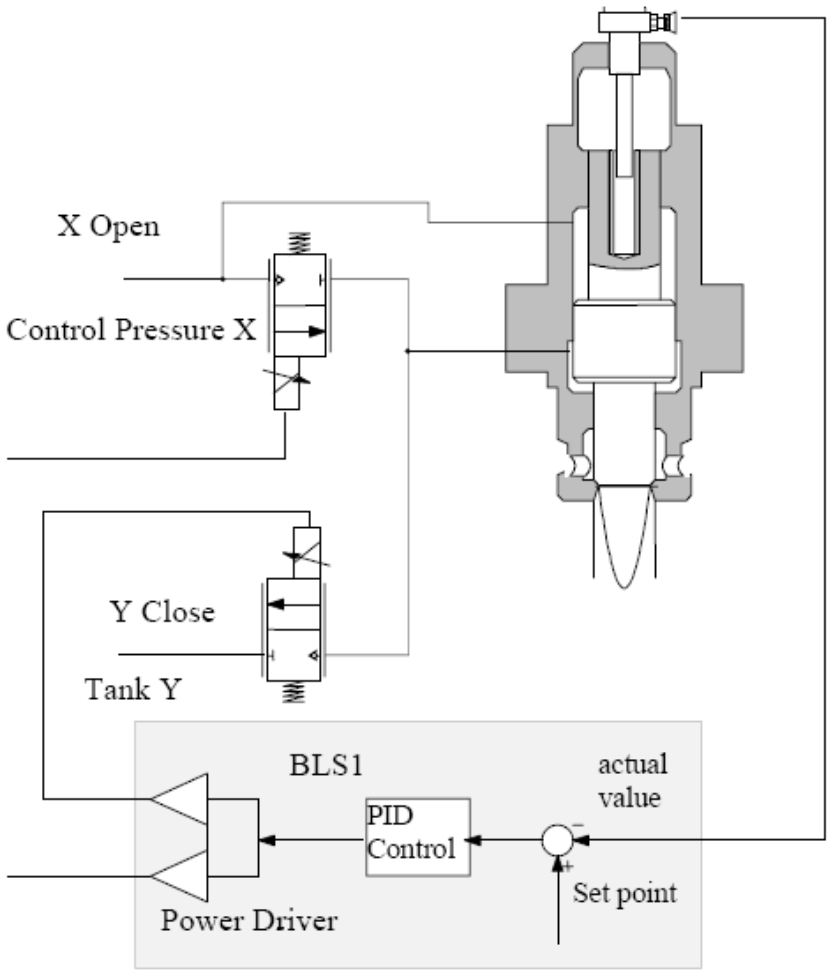


Fig. 2: Function of the card in the control circuit

Figure 2 shows a typical control circuit into which the card can be inserted. Further possibilities are given in **figure 3**.

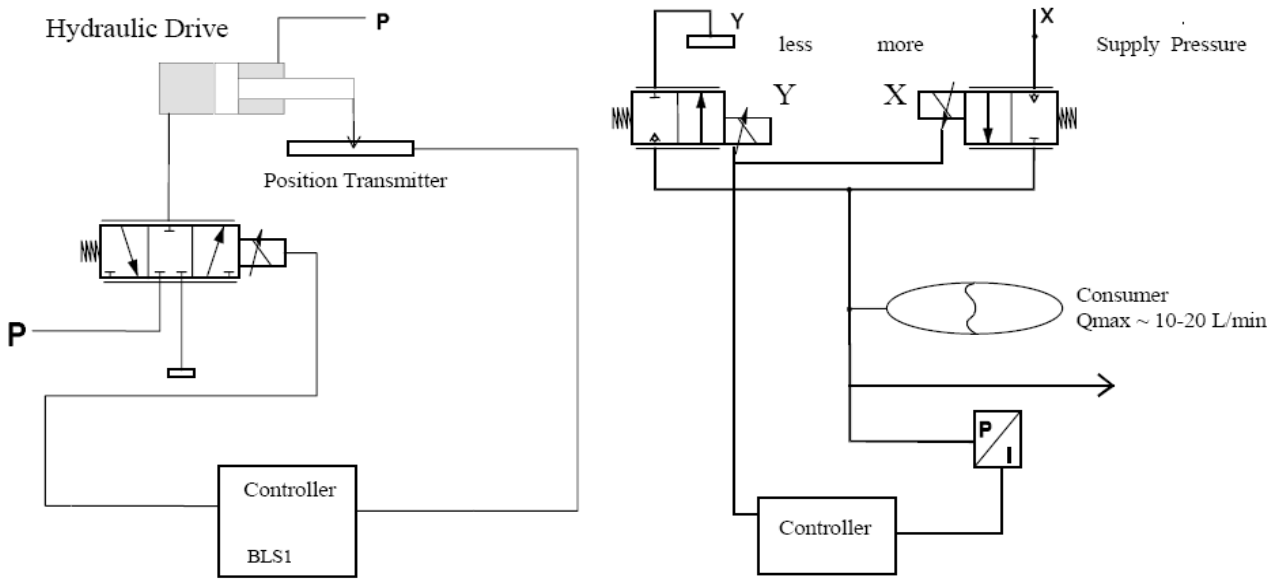


Fig. 3 : Further examples of possible control circuits

2. Technical Data

The supply voltage lines are protected against polarization errors. The power outputs are limited to a maximum of 6 Ampere, i.e. only in the event of a permanent short circuit can a damage occur due to the cooling body overheating. The power drivers should have a separate voltage supply line connected to supply voltage ground.

2.1. Electrical Data

Supply voltage UV

18-28V (typ.24V)

Intern. current (UV without solenoids)

100mA

Valve voltage UW

same as UV, valve current (max. 6A depending on solenoids)

Temperature range

-20 - +70 oC

Analog inputs

adjustable variants	
voltage	0-10V/Internal resistance 20KΩ
current	4-20mA working resistance 240Ω

Digital inputs

control inputs	0/24V max UV

Analog outputs

voltage	0-10V, max. current-carrying capacity 100mA (¹
power (PWM)	0-3A

Digital outputs

open collector	max. 100 mA (¹
power outputs	0/24V (max 3A)

Controller sampling

1.0 ms

2.2. Mechanical Dimensions

Printed circuit board

European standard size 100*160mm

Connector

48-pin to DIN 41612 type F

Width of front plate

8TE

2.3. Front Plate

Figure 4 shows the front plate. The front plate is provided with light-emitting diodes indicating the operating state and an interface connection for programming the card parameters.

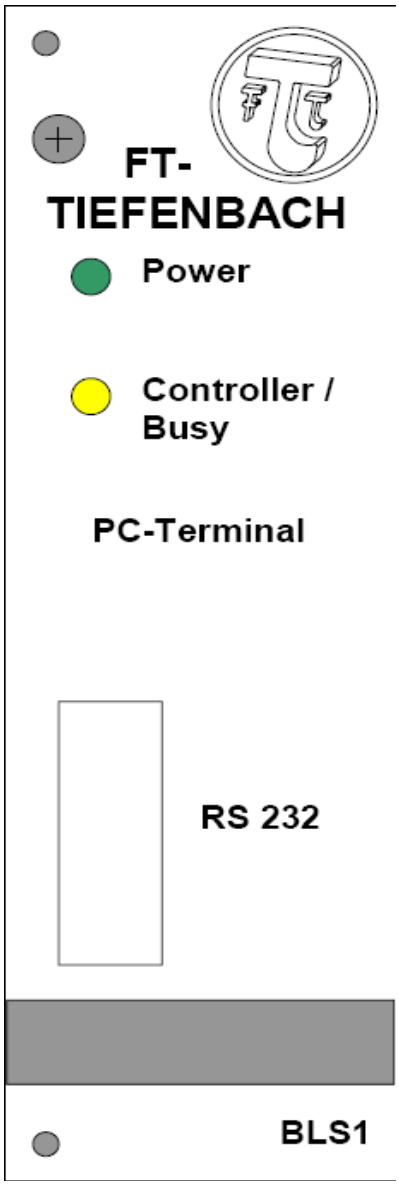


Fig.4:

2.3.1. LED Power

When operating voltage Uv is available this light-emitting diode is illuminated. The LED is independent of the computer.

2.3.2. LED Controller busy

LED

1. Sollwert/Command Value < 4 mA 2. Istwert1/Feedback1-Value < 4 mA
Subject to technical alterations
3. Istwert2/Feedback 2-Value < 4 mA

2.4. Connector Bracket

Figure 4 shows the location of the different inputs and outputs of the connector bracket at the rear.

	z	b	d
2	+24 V (Uv)	+24 V	+24 V
4	Ground SW	Set point 0-10V	Set point 4-20mA
6	Ground IW1	Actual value 1, 0-10V	Actual value 1, 4-20mA
8	Ground IW2	Actual value 2, 0-10V	Actual value 2, 4-20mA
10	Dig.In 0/Direction 2	Dig.In 1/Direction 1	Dig.In 9/ Set point 2
12	Dig.In 8/ Valve interlock	Dig.In 7/ Set point 1	Dig.In 6/ Set point 0
14	Dig.In 5	Dig.In 4	Dig.In 3/ 2. Pair of ramps
16	Dig.In 2/ ramps off	Dig.Out 1/ Iw-compar.	Dig.Out 2/ error
18	Prop solenoid X (-)	Analog 0 Out (¹	Analog 1 Out (¹
20	+12V	+12V	+12V
22	Ground	Ground	Ground
24	-12V	-12V	-12V
26		Ground SW-solenoid 1 (-)	SW-solenoid 1 (+)
28	+24 V (Uw)	Ground SW-solenoid 2 (-)	Prop solenoid Y (-)
30	Prop solenoid Y (+)	Prop solenoid X (+)	SW-solenoid 2 (+)
32	Ground	Ground	Ground

Fig. 4: Connector bracket configuration

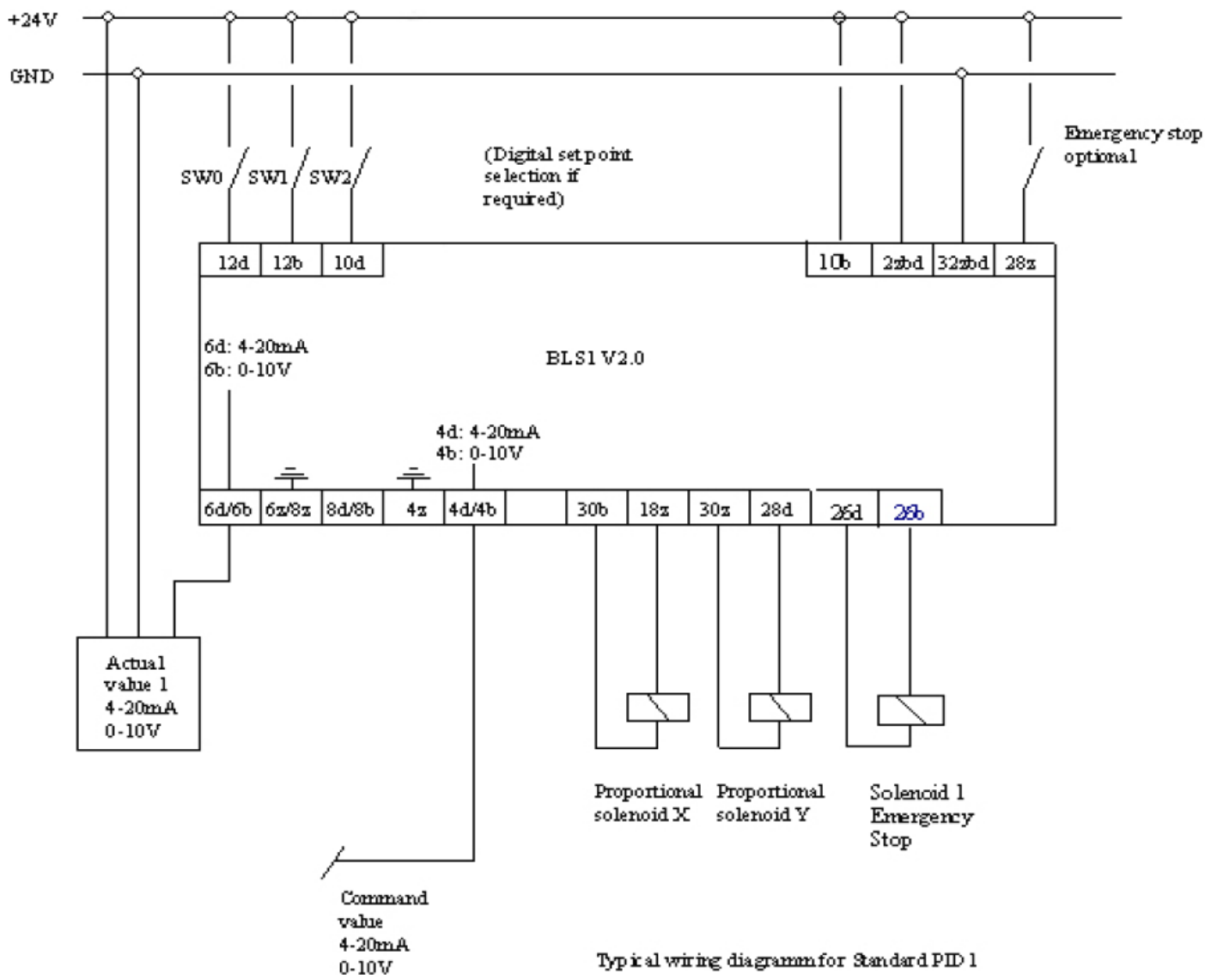
3.Installation of the Card in the Control Circuit

Safety information
Only trained personnel is allowed to change the settings on the card. An incorrect adjustment of the card may lead to the distruction of connected components.

For the function of the controller card in connection with a certain hydraulic configuration a guarantee will only be given after release.

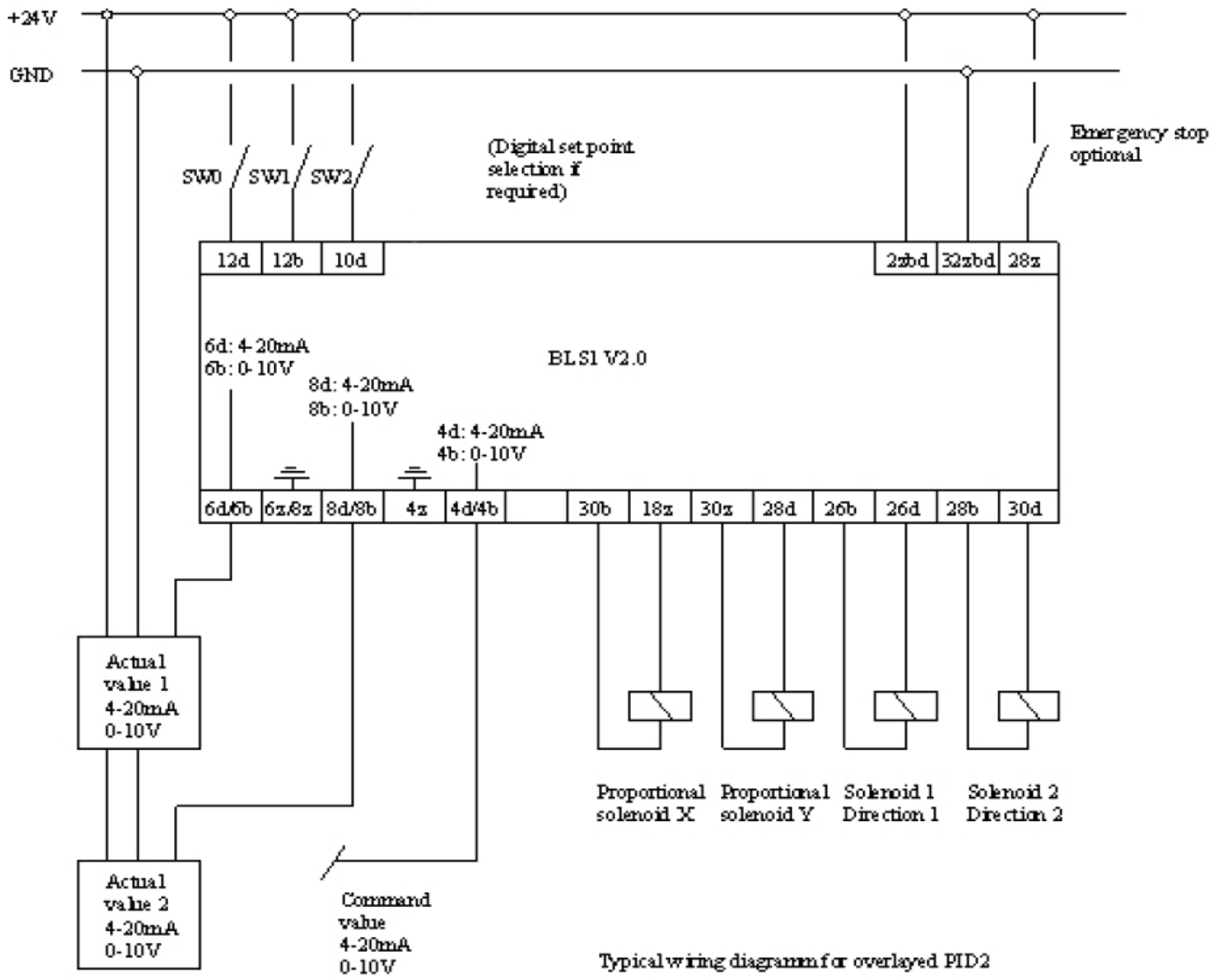
Fig 5 shows an example of how the card should be connected. The command value is an assumed pilot controller signal of 4-20mA. Such a signal may also come directly from the PLC control. The actual value transmitter is an assumed transmitter with 4-20mA signal output.

(¹ = optional



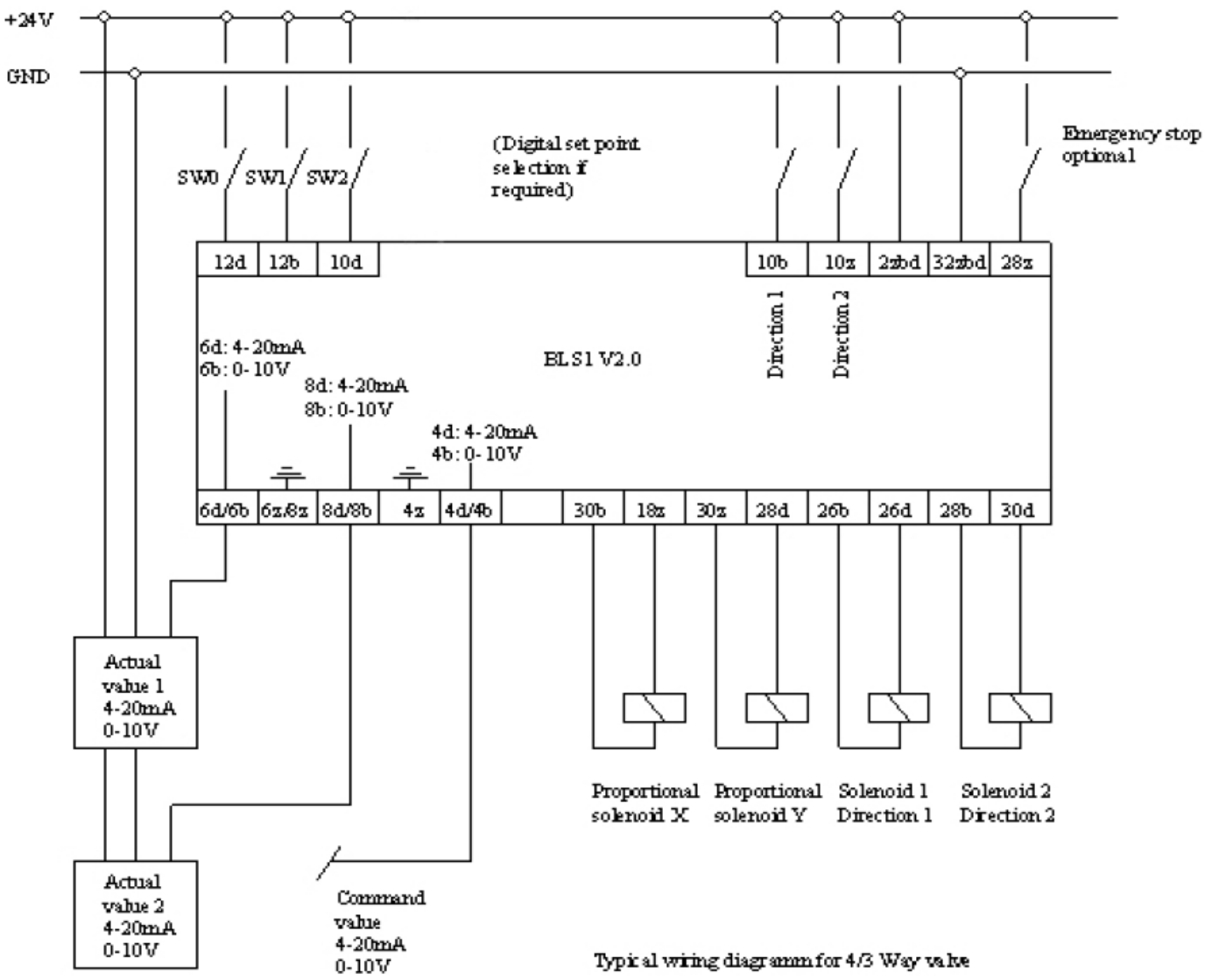
Typical wiring diagramm for Standard PID 1

Fig.5.1



Typical wiring diagramm for overlayed PID2

Fig. 5.2



Typical wiring diagramm for 4/3 Way valve

4. Setting of the Card

For programming the controller parameters the card is serially connected to a terminal (or PC). Parameter programming is menu-controlled. Parameter changes are taken over by the card without delay so that the results can be checked immediately on the controlled system.

4.1. Connection of the Computer with the Card

The computer is connected to the controller card by means of a serial cable. **Figure 6** shows various options. The construction of the cable is shown in the figure for the different options.

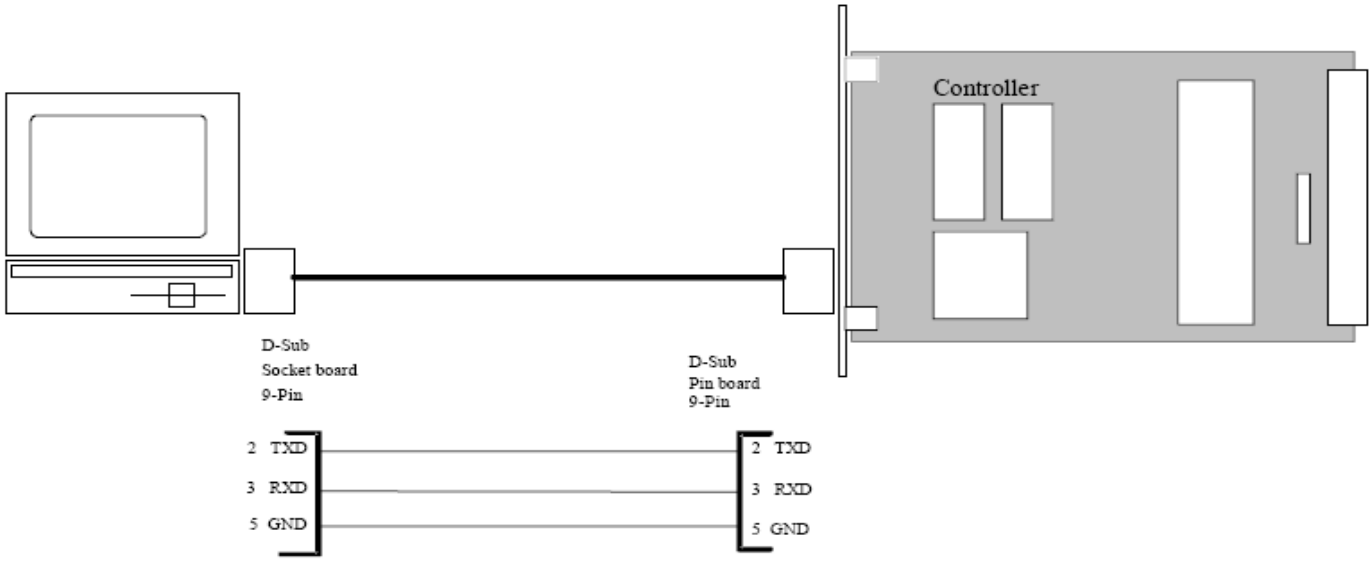


Fig. 5: Connection of the controller with a PC or a terminal

When using a standard PC, the program BLS1.EXE provided is used. A PC can be connected via COM1: or COM2:.

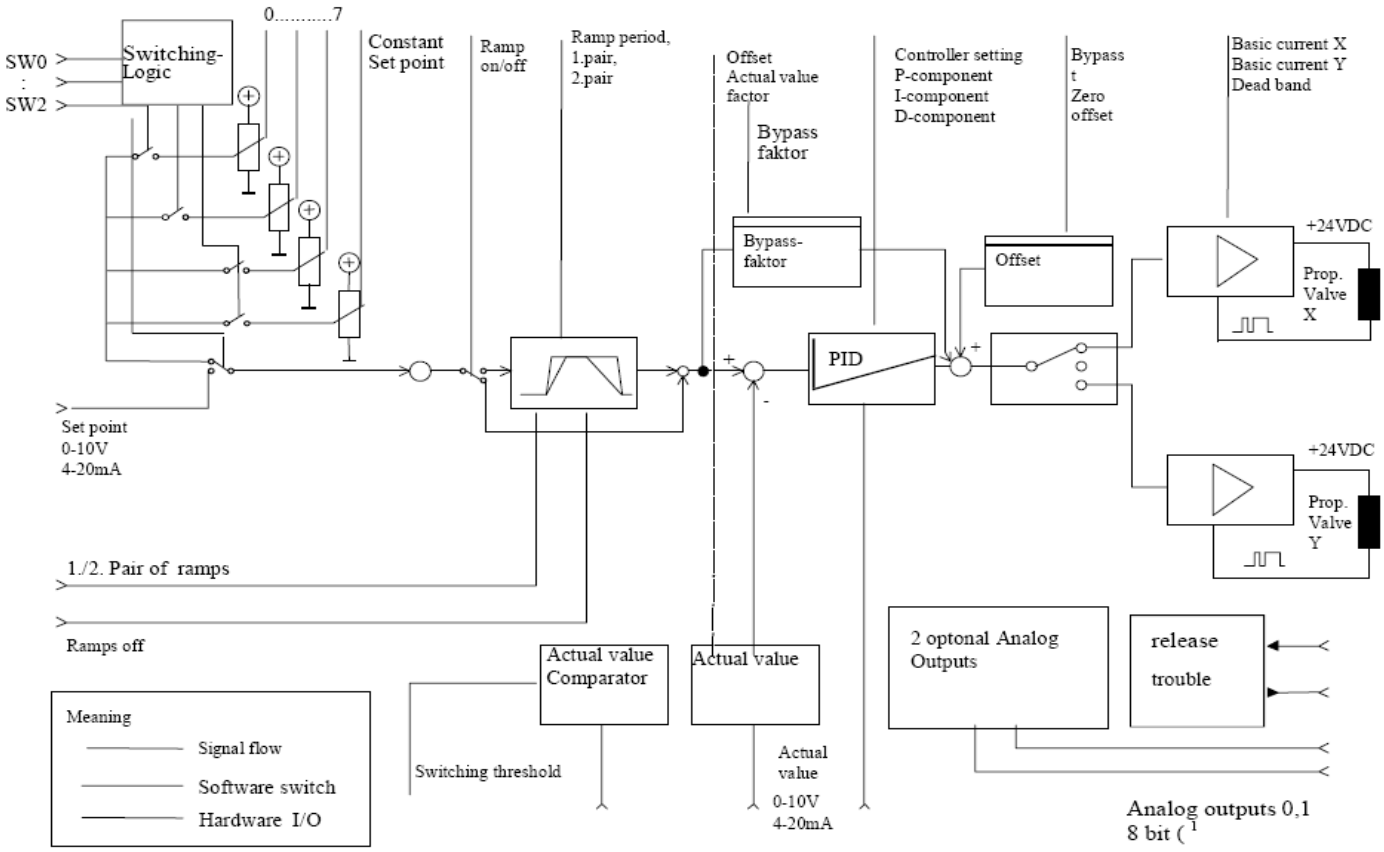


Fig. 6: Survey of adjustable parameters

The **basic current** is constantly admitted to the solenoids in order to ensure that the proportional solenoids react quickly. Only when the deviation is less than the preset **dead band** will the solenoid be switched off completely. This feature can be disabled. Via the proportional amplification (**P-amplification**)
the slope of the solenoid excitation curve is adjusted. It is possible to choose different basic currents for the two solenoids.

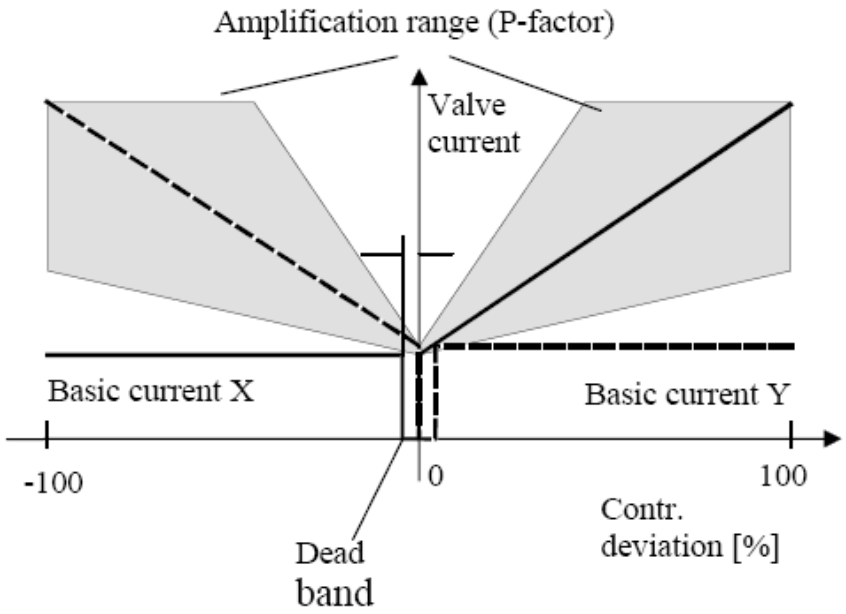


Fig. 7::Diagram deviation with respect to output current

4.1.1. Basic

The basic current is a constant current used to excite the respective solenoid so that the proportional band operates direct. The range of adjustment is 0 - ..100% of the maximum current depending on the solenoid connected. It is possible to set different values for solenoid X and solenoid Y.

4.1.2. Actual Value/Set Point Parameter

Here the upper and/or lower limit of the analog inputs is taken over. The respective limit value is programmed by operating the valve manually and then taken over.

4.1.3. Dead Band

The dead band is the maximum controlling difference around the zero position which does not yet cause the controller to respond. Othe

4.1.4. P-I-D Setting

With these menu items the amplification of the controller can be adjusted. First the proportional amplification should be adjusted such that the controlled system connected just not yet oscillates.Then the I- and D-components are used for correction. Experience has

4.1.4.1. Ramp Generator

The card is equipped with a ramp generator the signal pattern of which can be adjusted separately for positive and negative slopes (¹ . An external input permits to switch-over 2 pairs of ramps with different slopes.

(¹= Option

4.1.4.1.1. Constant Set Points

The software allows to define set points which are activated based on the position of external inputs. It is possible to define 7 set points. With digital inputs (SW0 – SW2) the respective constant set point is activated.

	Input (set point) 0 (12d)	Input (set point) 1 (12b)	Input (set point) 2 (10d)
Set Point 1	1	0	0
Set Point 2	0	1	0
Set Point 3	1	1	0
Set Point 4	0	0	1
Set Point 5	1	0	1
Set Point 6	0	1	1
Set Point 7	1	1	1

If none of the inputs is activated the controller will switch over to the analog set point signal.