

Electronic amplifier type EV22K2-12/24, EV22K3-12/24

for control of proportional valves

design of board with connector terminal strip to (DIN EN 60603-2)

1. General

1.1 Brief description

The amplifier board is equipped with two proportional amplifiers operating independently of each other with very good regulating accuracy. It enables 3/3 or 4/3 way proportional valves to be controlled simultaneously, each valve being equipped with a twin-proportional-solenoid or two individual proportional solenoids for alternating drive of the switch position a or b. Thus the amplifier board is primarily intended for electrical control of either two proportional directional control spool valves type PSL(V)... with E or E/A-actuation (see D 7700 ++) or type SWS 2...MP (acc. to D 7951) or type (N)SWP (acc. to D 7451 N)

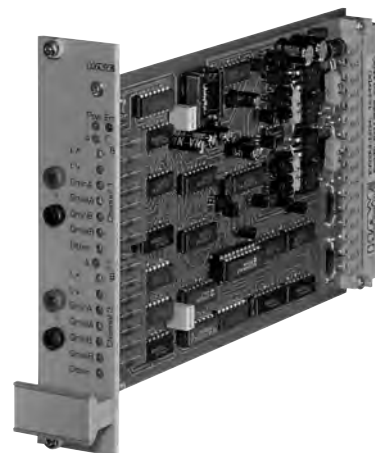
Control of lifting modules type HMC 2 and HMC 3 to D 7650 is likewise possible. Each of the two individual solenoids of the proportional flow control valves called upon alternately for lifting and lowering is connected to one half of the board, with the second remaining unused.

When there are two individual solenoids in stead of one twin solenoid, always one connection of each, e.g. PIN 1, should be jointly connected to one terminal (a10 resp. c10) on the terminal socket.

For remote operation, either two single axis joysticks or one double axis joystick (see D 7844) are suited as signal emitter for each amplifier board. Set point inputs can also be connected direct to an analogue output of an PLC, CNC or of a PC.

The amplifier board EV22K2-12/24 is regarding electrical characteristic and terminal layout upward compatible to the amplifier boards EV22K1-24 and EV22K1-12 (see D 7817). The dimensions are identical to a Europe-card width 6 HP (IEC 297-3).

Type EV22K3-12/24 has been specifically designed for use in control circuits, where a larger set point release range would interfere with a faultless operation.



Main components:

- Reverse voltage protected current supply unit for individual functional components and short circuit-protected voltage regulator for stabilized voltages $\pm 5V$ DC or $\pm 10V$ DC (selectable).
- Analogue adder for addition of set point voltages and subtraction of reference voltage.
- Linear ramp generators (integrators), with rise and fall times being set separately.
- Dither generators with adjustable dither amplitude.
- Current-regulated, PWM-controlled and short-circuit-protected final stages with wire interruption indication.
- Digital up to indicating, operating status, LED and error monitoring.

Main features:

- One amplifier board for supply voltage 12V DC and 24V DC
- Reverse voltage protection
- Two set point voltage range and stabilized voltage can be selected $\pm 5V$ and $\pm 10V$
- Mini. and maxi. current I_{min} (Q_{min}) and I_{max} (Q_{max}) precisely adjustable in both directions by means of multiplex potentiometer
- High accuracy current controls
- Dither signal is superimposed on output current
- Dither amplitude adjustable, dither frequency approx. 55 Hz
- Ramp times upwards and downwards can be adjusted separately by means of multiplex potentiometer.
- Outputs protected against short circuit and short to earth
- Wire interruption or short-circuits cause only a fault indication but no disable the functions, i.e. the complete electro hydraulic will work again immediately after the cause was solved, only the fault indication should be reset (see sect. 5.3, table 2)
- LED's on front panel clearly signal operating status of individual proportional amplifiers on board (if there is no fault status apparent)
- Signal output with (Open-Collector-Transistor) available, additional to Error-LED
- $\varnothing 2$ mm Test jacks on the control panel enabling measuring of the coil current by means of an ammeter without interruption of the connection leads. (The test jacks should be bridged after measurement to minimize losses)

Analogue inputs:

Set point device connection possible for uni-polar potentiometer with direction switch or bi-polar potentiometer

Real differential inputs, thus making possible safety circuit availability in the event of wire breakage with appropriate set point device (see section 6.1 example 1)

Second set point input allows if necessary for addition of a supplementary signal

Signal inputs (digital):

Ramp switch off, set point signal invert and enable function

Signal output (digital):

Parallel function of the visual Error (LED) on the front panel as well as with (Open-Collector-Transistor). A Pull-Up Resistor is available on board, which can be activated on demand. The front panel of the amplifier board is 3 U (128.4 mm) high and 6 HP (30.1 mm) wide. The depth is like with standard Europe card (160 mm) (IEC 297-3)

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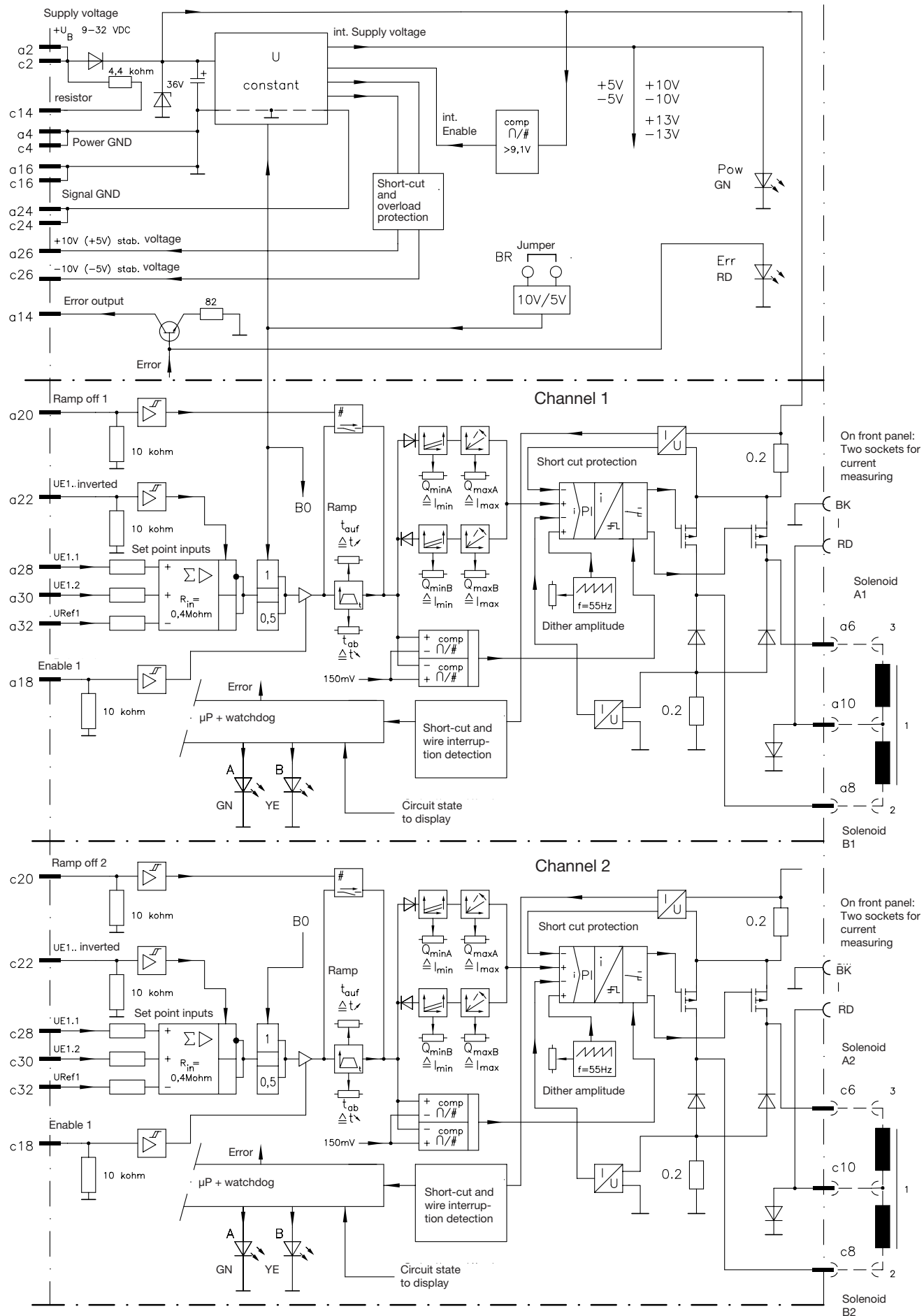
<http://www.hawe.de/en/products/by-category/electronics/>

Technical support

Phone: + 49 (0) 89 / 37 91 00 - 1256

E-mail: tech-support@hawe.de

1.2 Circuitry



2. Available versions, main data

2.1 Amplifier board

Order designation:
Electronic amplifier

EV 22 K . - 12/24

Basic type designation _____
Two twin or
a pair of two individual proportional solenoids, _____
controllable for alternating operation
(Plug-in) board version _____
2 Series _____
3 Version with specific release ranges
Supply voltage 12 or 24V DC (nominal value) _____

2.2 Assembly accessories

2.2.1 Card holder for amplifier board and snap-on foot for mounting rail

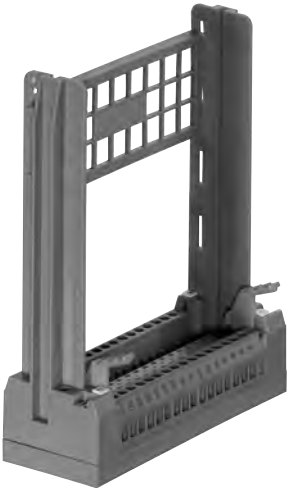
It consists of a frame with guide rails, a 32-pin socket strip conf. DIN 41 612 form D32 (DIN EN 60603-2) and one screw terminal socket. The card holder has been designed to fit an amplifier board. The board can easily be attached to the mounting plate by using the supplied screws M4; see also measurement drawings under 4.2. The snap-on foot must be attached at the floor of the card holder to enable the card holder to be clipped-in. This will enable the amplifier board to be easily installed onto a 35 mm-mounting rail, both in longitudinal as well as cross direction, within the control cabinets in accordance with DIN EN 60 715.

Order designation:

KH 7817 901

S 7817 902

KH = card holder
S = snap-on foot for mounting rail (no image) _____
Internal drawing number _____



2.2.2 Unit carrier for two to three amplifier boards

It consists of a screwed frame with three guide rails, a 32-pin socket strip conf. DIN 41 612 form D32 (DIN EN 60603-2) according to the maximum number of boards. The corresponding terminal sockets are attached on the side and are thus easily accessible. Connect solenoids at the upper terminal socket and inputs to the lower terminal socket. This will ensure that output currents will not hardly interfere with the inputs. A separate pair of sockets is provided with a downstream plug-in socket for vehicle blade-type fuses conf. DIN 72 581 T3 form C (max. 10A) to connect the supply voltage. In case the maximum number of permissible boards is not utilized, the empty slots at the front side can be covered over with dummy plates. These dummy plates are not included in our program.

Order designation:

BT 7817 950

BT = unit carrier for 3 boards _____
Internal drawing number _____



3. Further parameters

3.1 General information

Type	EV22K2-12/24	EV22K3-12/24
Nomenclature	Electronic amplifier	
Design	Plug-in board with 32-pin terminal strip conf. DIN 41 612 D32 (DIN EN 60603-2)	
Mounting	By means of board holder for one board or unit carrier.	
Installation position	Any	
Mass (weight)	approx. 200 g	
Protection EN 60529	IP 00	
Ambient temperature	-20° to +70°C	

3.2 Electrical data

Type		EV22K2-12/24	EV22K3-12/24
Power supply	U_B	9 ... 32V DC	
Max. perm. ripple factor (ripple)	w	10%	
Minimum filter capacitor necessary on supply voltage	C_B	2200 μ F every 1 A current at the solenoid	
Output voltage	U	$>U_B - 1.8$ V DC	
Power consumption	I_L	max. 110 mA (depending of supply voltage)	
PMW frequency of the power stage	f	≈ 1.9 kHz	
Output current (short circuit protected) I_A		max. 1.6 A	
Setting range	I_{\max}	0 ... 1.8 A	
	pre-set	0.6 A	1.4 A
	I_{\min}	0 ... 0.8 A	
	pre-set	0.25 A	0.75 A
Reference voltage	U_{ref}	-10 - 0 - +10V DC (BR off) ¹⁾	
Release range for I_{\min}	U	-5 - 0 - +5V DC (BR closed) ¹⁾ ± 300 mV (BR open) ¹⁾ ± 150 mV (BR closed) ¹⁾	(BR closed) not planned ± 15 mV (BR open) ¹⁾ (BR closed) not planned
Input impedance of set point inputs $U_{E..}$ to signal earth	R	≈ 400 k Ω	
Voltage range at reference inputs $U_{\text{Ref 1}}$ resp. $U_{\text{Ref 2}}$ related to signal earth	U	-10 - 0 - +10V DC (BR off) ¹⁾ -5 - 0 - +5V DC (BR closed) ¹⁾ (BR closed) not planned	
Input impedance of reference inputs $U_{\text{Ref 1}}$ resp. $U_{\text{Ref 2}}$ to signal earth	R	≈ 400 k Ω	

Circuit inputs (digital inputs):

Release inputs, ramp off inputs, inverting inputs

Input impedance to power earth	R	≈ 10 kΩ			
Input voltage level		BR off: ¹⁾	BR closed: ¹⁾	BR off:	BR closed:
Logic 0	U	0 ≤ U ≤ 4.5 V	0 ≤ U ≤ 1.3 V	0 ≤ U ≤ 4.5 V	not planned
Logic 1	U	9.5 ≤ U ≤ U _B	6 ≤ U ≤ U _B	9.5 ≤ U ≤ U _B	
Stabilized voltage for supply to set point potentiometer	U _{st}	± 10V DC (BR off) ¹⁾ ± 5V DC (BR closed) ¹⁾		± 10V DC (BR off) ¹⁾ (BR closed) not planned	
Short-circuit and over load protected					
Load capacity of stabilized voltage	I _{st}	max. 10 mA			
Ramp time (set separately related to full range of outout current)	t _R	0.1 ... 5 s, pre-set 0.1 s			
Ramp time with RAMP OFF circuit input controlled		< 0.1 s			
Dither frequency	f	≈ 55 Hz			
Dither amplitude, setting facility	I	100 ... 650 mA _{S-S}			
(Peak to peak)		pre-set ≈ 140 mA _{S-S}		approx. 90% of max.	

Output ports (digital output):

Error output

NPN-Transistor (Pin a14) with Open Collector:

Max. perm. voltage to ground	U_A	35 V
Max. perm. current	I_A	9 mA
Output short-circuit protector		
Pull-Up resistor (Pin c14)	R	4.4 k Ω

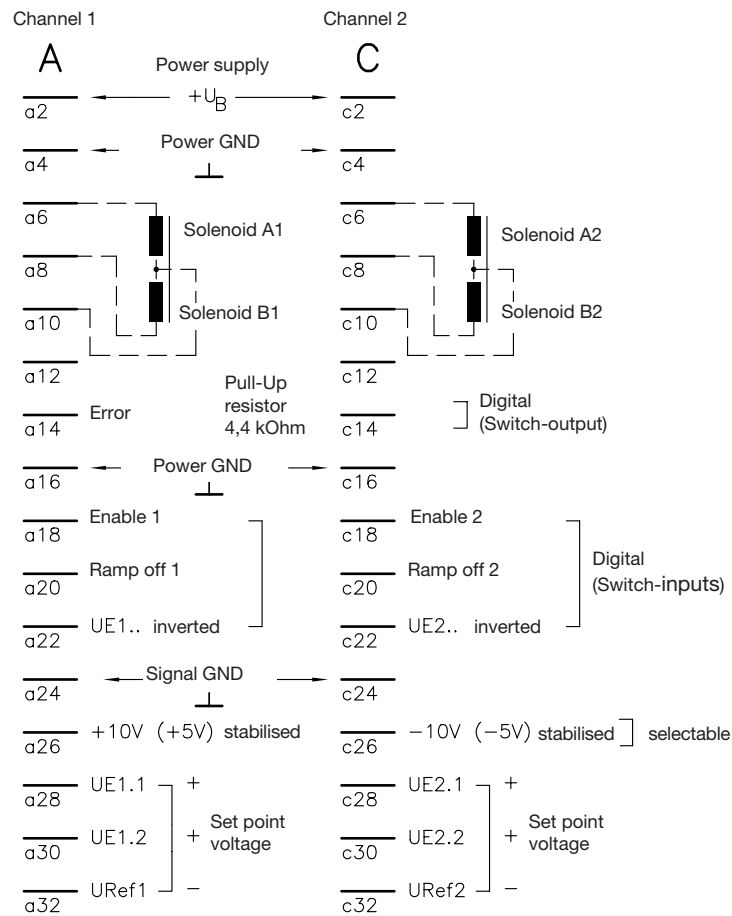
¹⁾ BR = Jumper on the board enabling selection of the reference voltage range (-10 ... +10V DC or -50 ... +5V DC) and the stabilized power supply (see unit dimensions in sect. 4). Function only planned for EV22K2-12/24..

3.3 Amplifier front panel and terminal strip

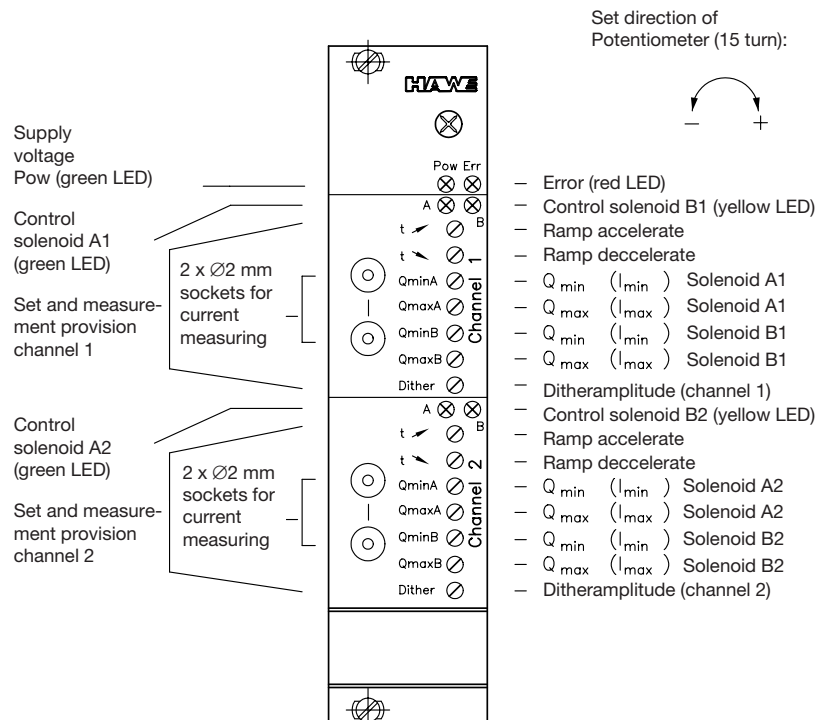
Terminal strip to DIN 41 612 D32 (DIN EN 60603-2)

Terminal rail

Connection

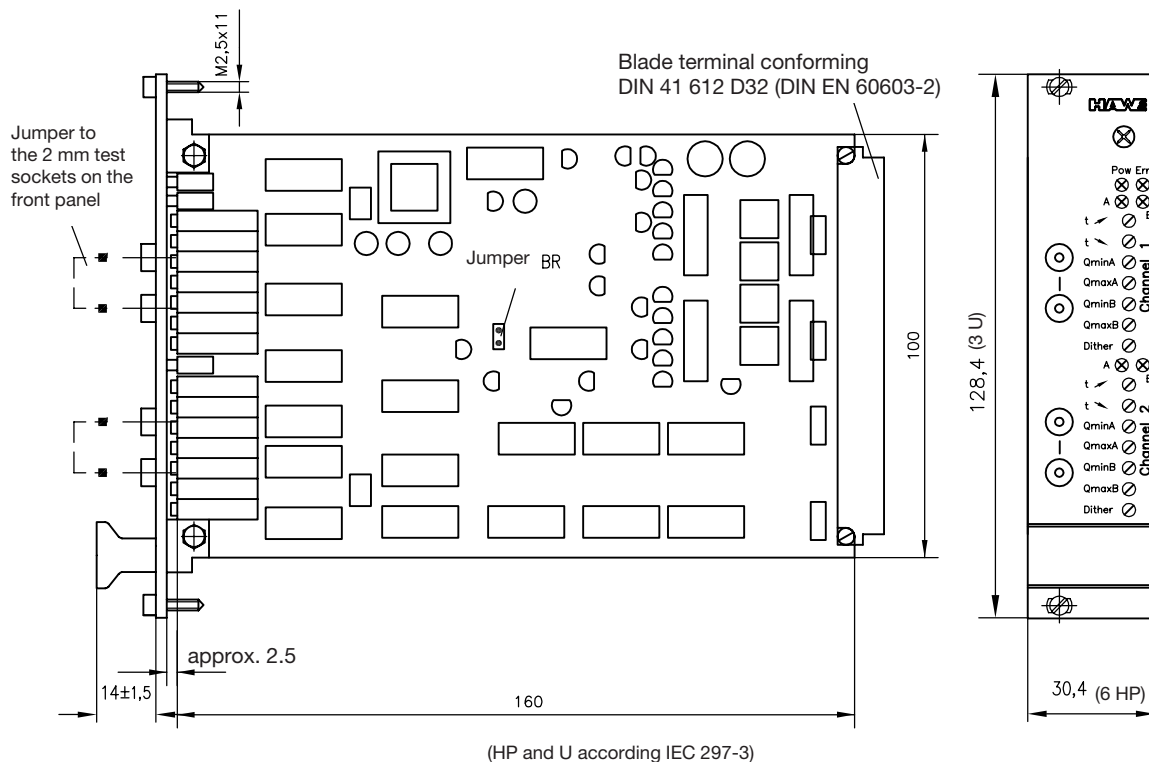


Front panel



4. Dimensions All dimensions are in mm, subject to change without notice!

4.1 Amplifier board EV22K2-12/24 and EV22K3-12/24



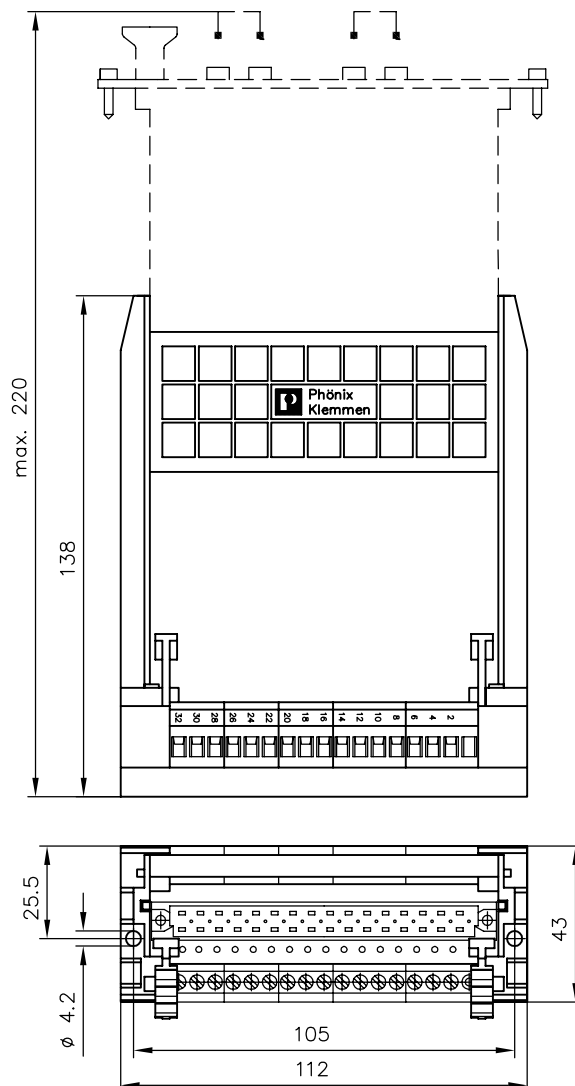
4.2 Assembly accessories

Card holder according to 2.2.1

Protection EN 60529 IP 00

Mass (weight) approx. 150 g

The snap-on foot must be attached at the floor of the card holder to enable the card holder to be clipped-in. This will enable the amplifier board to be easily installed onto a 35 mm-mounting rail, both in longitudinal as well as cross direction, within the control cabinets in accordance with DIN EN 60 715. The snap-on foot must be ordered separately.



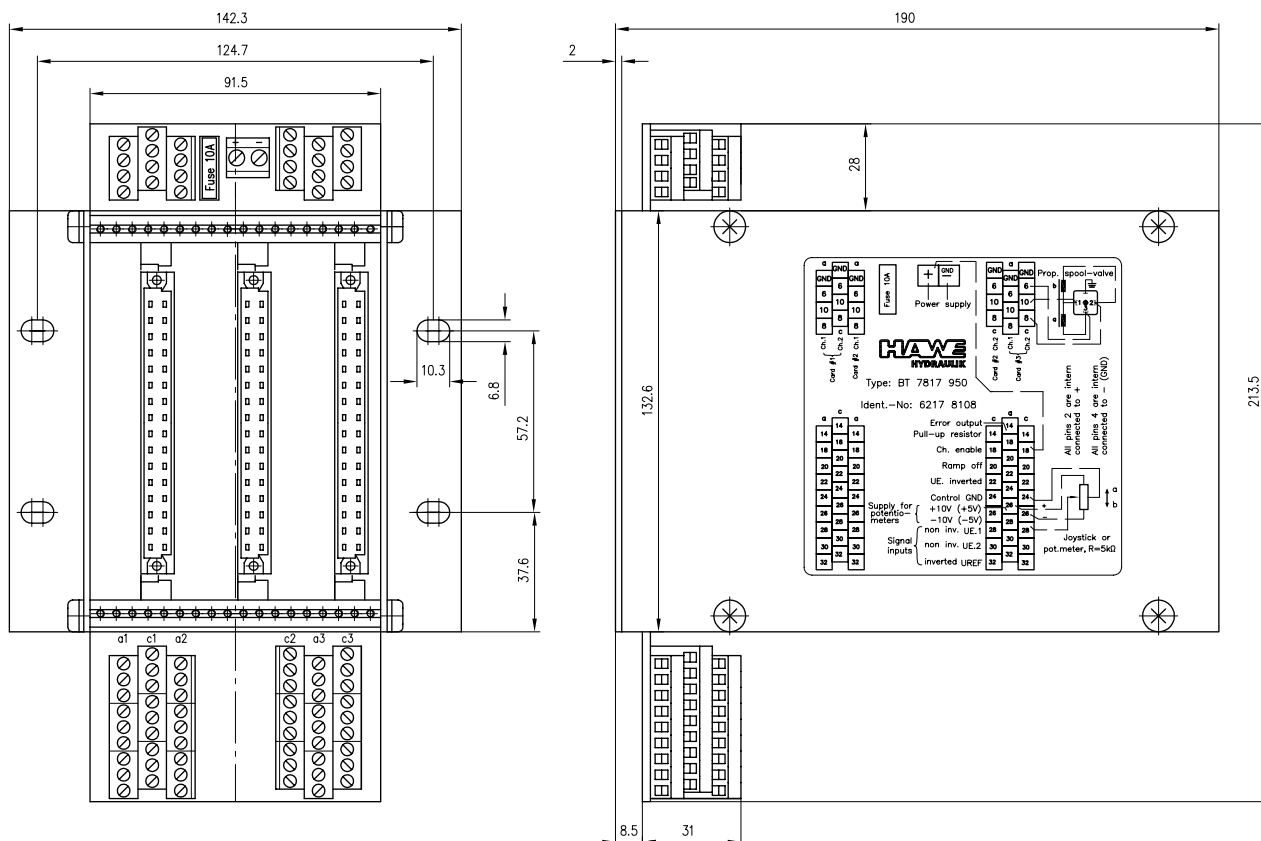
Unit carrier acc. to sect. 2.2.2

Protection EN 60529

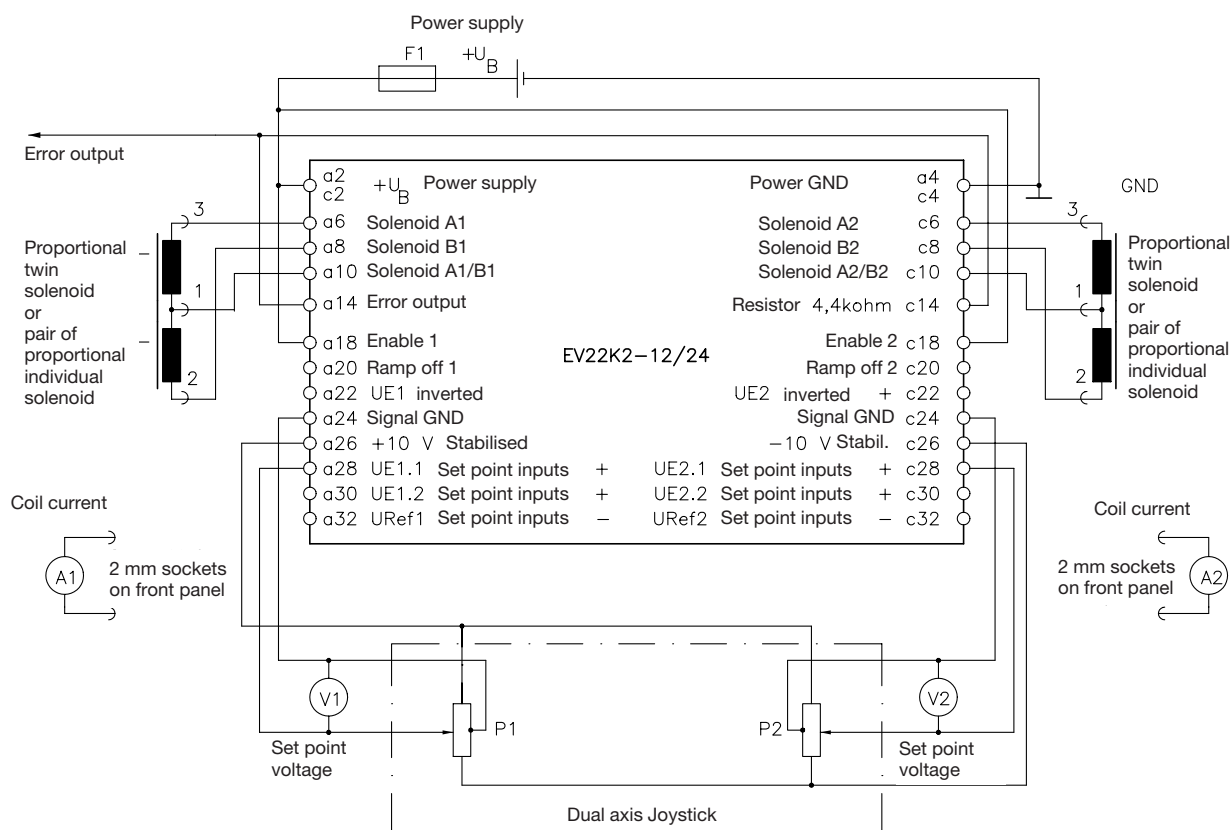
IP 00

Mass (weight)

approx. 700 g

**5. Operating instructions****5.1 Setting instructions**

Note: On delivery the amplifier board EV22K2-12/24 has been set up in such a way that it can be used, without further settings together with the proportional spool valve, type PSL and/or PSV in accordance with pamphlet D 7700 ++. On delivery the range of the output current of the amplifier board EV22K3-12/24 has been set to correspond with the proportional spool valve, type (N)SWP in accordance with pamphlet D 7451. One should only undertake more precise matching between the proportional valve and the proportional amplifier when specialist personnel and measuring equipment is available.



The arrangement on page 8 applies to the most used circuitry for EV22K2-12/24 where joy-sticks with wiper are used (see also example circuit 1 in sect. 6.1).

The cards are usually connected via a card holder or a unit carrier (see sect. 2.2). The codings of the terminals are similar to the one on the terminal rail (see sect. 3.3).

Where the length of connectors is over 3 m, connecting cables with wires twisted in pairs should be used, in order to minimize interference emission or increase interference resistance.

I_{\max} in the long term may not be above the I_{\lim} indicated for proportional solenoids.

F1 = Fuse 3.5 A (medium time lag)

a maximum of 3 boards may be protected by one fuse (10 A medium time lag)

V1, V2 = Check voltmeter for measurement of set point voltage, measurement range 0 to 10V DC

A1, A2 = Check amperemeter for measurement of winding current, measurement range 0 to 2 A DC

P1, P2 = Dual axis Joystick e.g. 1 x Type EJ2-10 acc. to pamphlet D 7844

- ① Adjust the ramp time to minimum (turn counter-clockwise until the wiper is lift away furthest from the front cover (visible trough the translucent housing)
- ② Amplifier and measuring equipment port in accordance with the circuitry example, check the position of bridge BR.
- ③ Switch on power. Only the green LED **Pow** should light up on the front panel. If the red LED **Err** lights up, there is a fault. Tables 1 and 2 are used for determining or eliminating the cause of a fault (see section 5.3). This applies to the entire setting procedure.

Setting channel 1 as example

- ④ Elevate joystick P1 as far as possible in one direction and leave it in this position until LED A lights up.

Read the voltage at voltmeter V1:

Approx. ± 300 mV for a reference voltage range of ± 10 V (bridge BR removed).

Adjust the min current $I_{\min A}$ for direction A with the respective potentiometer $Q_{\min A}$. The coil current will rise when turned clockwise (guideline for prop. directional spool valve type PSL/PSV with 24V DC solenoids is approx. 290 mA and approx. 580 mA with 12V DC solenoids. The coil current can be read from the ammeter A1.

- ⑤ Move the joystick in the other direction and keep it there until the LED **B** lights up and set the minimum current $I_{\min B}$ for direction **B** using the multiplex potentiometer $Q_{\min B}$ in accordance with section 4.
- ⑥ Move the joystick in direction **A** as far as the stop and keep it there (read off the relevant maximum set point voltage on voltmeter V1) and set the maximum current $I_{\max A}$ for direction **A** with the multiplex potentiometer $Q_{\max A}$. Moving the multiplex potentiometer clockwise causes the winding current to rise (guide figure for PSL or PSV proportional valves with 24 V solenoids approx. 600 mA, with 12 V solenoids approx. 1200 mA). Read off the winding current on ammeter A1.
- ⑦ Move joystick in direction **B** as far as stop and keep it there and set the maximum current $I_{\max B}$ for direction **B** in accordance with point 6 using the relevant multiplex potentiometer $Q_{\max B}$.
- ⑧ The dither amplitude should be set-up in a way that the hand levers (half-way position) of the prop. directional spool valve do already vibrate but no malfunctions can be detected at the hydraulic system (guideline for type PSL(V) acc. to D 7700-.. $U_N = 24$ V and with a coil current of 0,4 A approx. 140 mA_{S-S}. (These figures can be only taken with an Oscilloscope).
- ⑨ Set ramp time for acceleration on multiplex potentiometer t_{\uparrow} (arrow up). Set ramp time for braking on multiplex potentiometer t_{\downarrow} (arrow down). Ramp time is increased with clockwise movement.
- ⑩ Check settings Q_{\min} (I_{\min}), Q_{\max} (I_{\max}) and dither current and ramp time in both directional and if necessary repeat setting procedure.

Other notes:

An external set-point voltage must not exceed the set range of the reference voltage by more than 1 V (up- or down wards) for pro-longed periods. Otherwise it may cause malfunctions of the proportional amplifier.

If there are faults during the setting procedure or when starting up, check the power supply from mains; with a bridge-connected rectifier: is there an electrolyte filter capacitor of at least 2200 μ F/A winding current in circuit parallel with the supply voltage?

Is the supply voltage high enough for the proportional amplifier? Under load it should be at least approx. 1.8V DC higher than would be necessary for production of the set maximum current I_{\max} with a warm solenoid coil without proportional amplifier.

The used ammeter for the current measurement must not cause any higher voltage drop than 0.5 V, because otherwise the ampere reading, picked up from the test jacks, may be wrong.

For using the board as a simple proportional amplifier for control of individual proportional solenoids see section 6.2.

5.2 Radio interference suppression

In rare cases it can happen, that the prop. amplifier receives electromagnetic disturbances on site and switches over to „ERROR“ (e.g.. when not or insufficiently suppressed solenoid valves are actuated). It is recommended to retrofit a suppression to the on/off solenoid valves and/or to install a radio interference suppression coil in the power supply at the unit carrier (for mobile hydraulics e.g.: Suppressor coil with condenser; type: FN332-10A from Schaffner EMV GmbH in D-76185 Karlsruhe).

5.3 Notes to error indication

Two independent prop. amplifiers are integrated on this amplifier board. Each amplifier can actuate one twin solenoid or two individual solenoids. The operating states of the amplifiers are indicated by LED's on the front panel of the card, in case there is no malfunction. The green LED (Pow) indicates power supply for the card, whereas the red LED (Err) indicates an ERROR. In parallel to the red LED (Err) is a signal output (NPN-transistor with open-collector at pin a14) and a pull-up resistor 4,4 kΩ at pin c14. The red LED (Err) covers both amplifiers. Otherwise the handling of errors is handled completely separate for the two amplifiers i.e. when an error (e.g. No. 7, table 1) is indicated by the red LED (ERR), it may apply only to one amplifier on the card. The one channel where both LED's „A“ (green) and „B“ (yellow) are flashing simultaneously will have the malfunction. No. 6, table 1 is different because both amplifiers can't work as the power supply voltage is too low.

Both the error indication and signal do **not** harm the function of the amplifiers i.e. the behavior of the amplifier is completely independent from the error indication. The whole system will work again after the cause is eliminated, but the signal at error port (pin a14) and the error indication (LED's on the front panel) will be still apparent until the next acknowledgment.

Table 1: Operating status forms of proportional amplifier EV22K2-12/24 and EV22K3-12/24

No.	Light emitting diodes (LED , s)				Status	Mode of the OC-transistor at pin a14 (error output)	Diagnosis	Effect and recommended
	Power (green)	Err (red)	A (green)	B (yellow)				
1					Normal	off 1)	Operation, set point voltage $U_S=0$	Not necessary as normal operation
2							Operation, solenoid „B“ controlled	
3							Operation, solenoid „A“ controlled	
4							as No. 2 or 3, but „release is blocked, PIN 18 is at 0 V (0 logic level)	
5								
6					Error	off	Power supply voltage too low $U_B < 9,1 \text{ V}$	see item a in table 2
7					Error	on	Cable interrupted or short circuit in output (coil side) 3)	see item b in table 2

LED dark
 LED shines
 LED flashes

Table 2: Effects of fault status and elimination of fault

No.	Effect	Remedy Reset	Re-set of the error indication
a	Internal, total de-function of the card, all LED's are dark, all outputs deenergized	Increase supply voltage, if necessary check and improve smoothing	Automatic
b	Errors are indicated, but do not harm the function of the card, i.e. the card will perform flawless as soon as the short cut of line breakage is eliminated. Error indication has to be reset separately!	Check any solenoid coils and feed cables connected for short circuit or interruption and eliminate cause of fault	Only after cause of fault removed: switch on power again or produce positive flank on PIN 18 ²⁾ (ENABLE) of relevant amplifier

Note:

A fault status can only be perceived by the electronics if the winding currents on the drive have gone outside the permissible limits. Consequently, one cannot foresee a short circuit or cable breakage at output if the SET POINT VOLTAGE IS 0 or with the ENABLE BLOCKED (PIN 18). Such faults will only be reported shortly after drive is applied to the relevant side (end stage).

¹⁾ Error output pin a14 will emit an error signal for approx. 200 ms everytime the card is started up ($U_B > 9.1\text{V}$).

²⁾ The solenoid current will be cut off without delay when ENABLE (PIN 18) is blocked. The ramp function will be used when the ENABLE (PIN 18) is de-blocked again.

³⁾ Type EV22K3-12/24 only short circuit at the output

6. Examples of circuit

(non-binding suggestions)

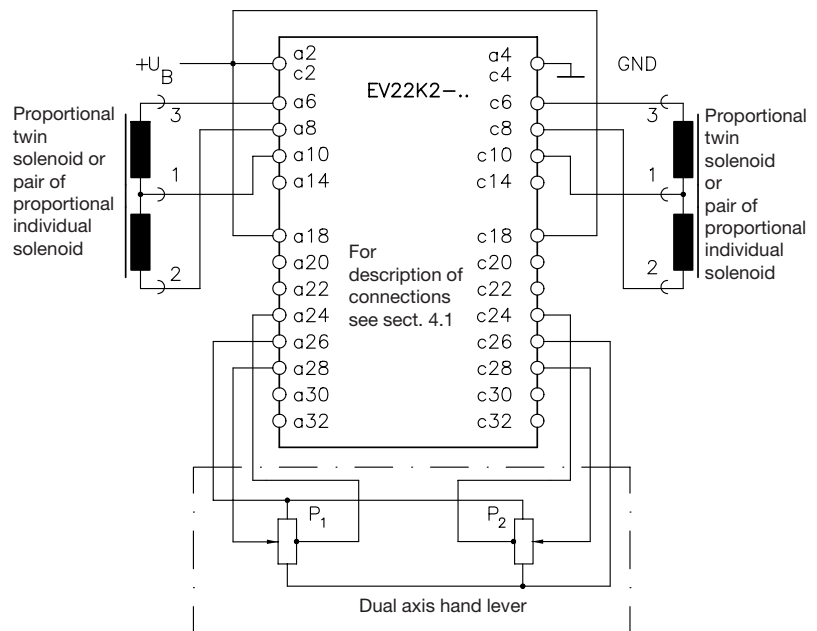
6.1 Control of hydraulic valves using either one twin or two individual proport. solenoids

Caution: These examples only apply to EV22K2-12/24!

Example 1:

The signal emitter connected consists of two potentiometers with central tap, e.g. two single axis joysticks or one double axis joystick. Set point voltage is bipolar. Joystick which can be used (example) type EJ1-10 acc. to D 7844

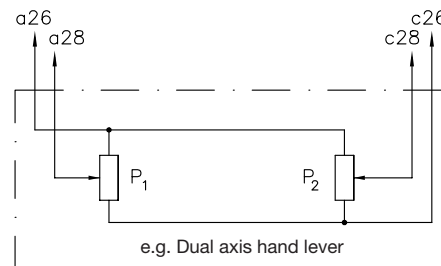
This basic wiring is protected against faulty connection of the un-activated twin prop. solenoid in the event of breakage of a wire at input (set point potentiometer). The un-activated proportional valve remains in the neutral position in the event of such wire breakage, as the set point voltage at input to the prop. amplifier remains zero.



Example 2:

Two single potentiometers with only three connections (without central tap) are used as signal emitter. The set point voltage is bipolar.

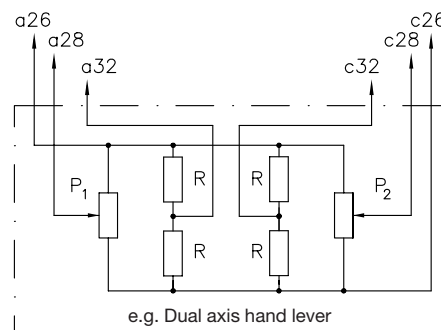
This very cheap version from the price aspect does have the disadvantage that, for example, if a supply connection from the set point potentiometer to the reference voltage +10 V (a 26) breaks, the reference voltage at input to the prop. amplifier immediately jumps to -10 V. This means that the prop. solenoid of the non-activated proportional valve is under drive and consequently the valve moves as far as the stop with unchecked movement and maximum velocity of the consumer item connected to it. Consequently, it is only reasonable to use such wiring if the signal emitter and the amplifier board are installed so closely together that it is unlikely that there will be any damage to the supply cables. Wiring in accordance with example 1 or example 3 is preferable for safety reasons.



Example 3:

As in example 2, two single potentiometers are used as signal emitter. The set point voltage is bipolar.

The absent central tap of the set point potentiometer is simulated in each case by two additional resistances approx. 5 ... 10 kΩ, 0.25 W. This avoids the safety disadvantages of example 2 and the same applies as in example 1.



Example 4:

Connection of a joystick switch with active set point emitter, set point voltage unipolar, e.g.: master switch with opto-electronic absolute value emitter.

Type: CSOVR 8P1.8P1 -2 OEG 010U

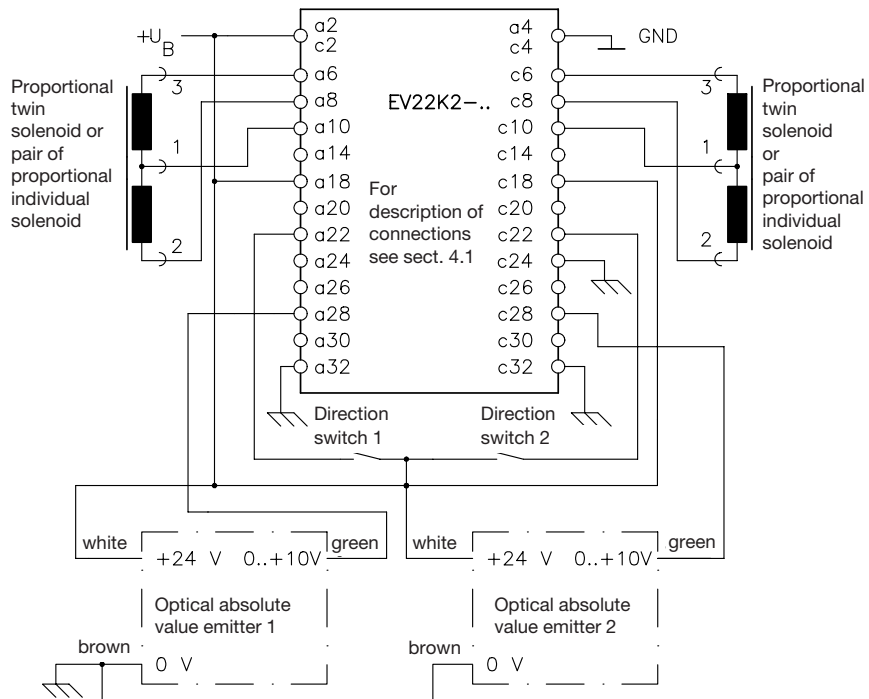
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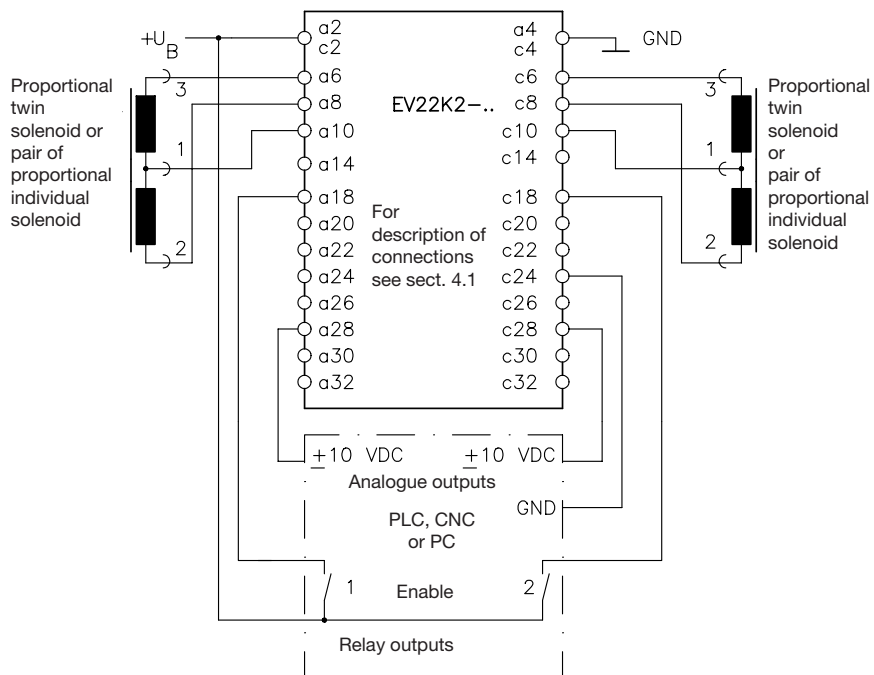
Direction switch coupled internally mechanically with absolute emitter:

Direction switch 1 - with optical absolute value emitter 1

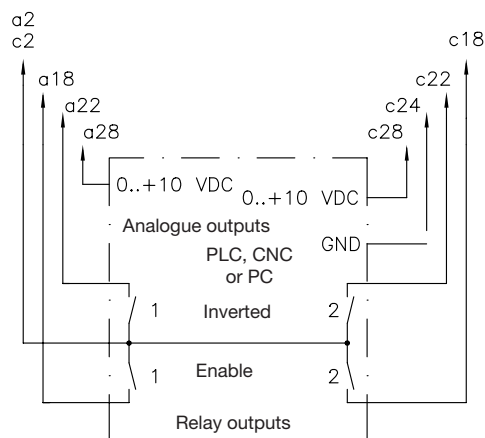
Direction switch 2 - with optical absolute value emitter 2

**Example 5:**

Connection to an PLC, CNC or PC, set point voltage bipolar.

**Example 6:**

Connection to an PLC, CNC or PC, set point voltage unipolar.



6.2 Control of hydraulic valves with one proportional solenoid

Caution: applies only to EV22K2-12/24

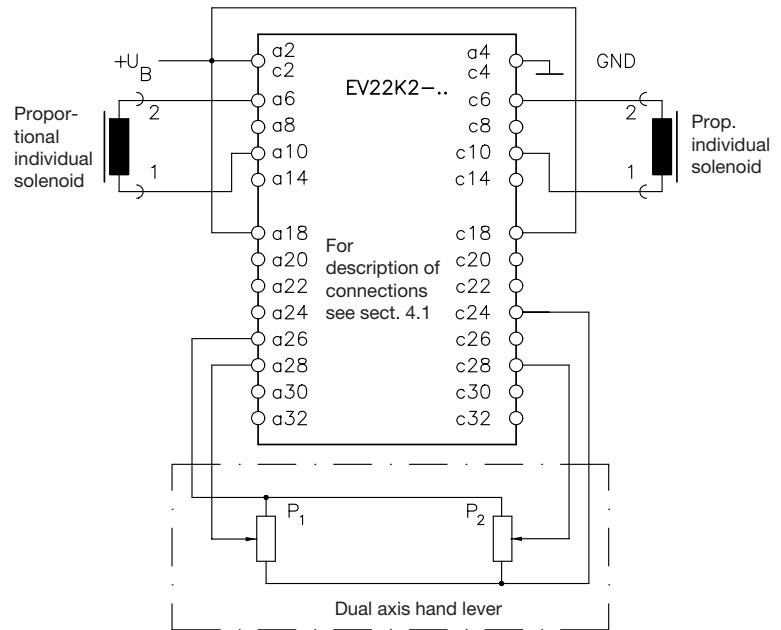
Example 7:

Use as single proportional amplifier.

Both single acting prop. solenoids should be connected to outputs a6 ... a10 or c6 ... c10 and a unipolar set-point voltage should be selected

Caution:

In the event of inversion (a22 or c22) or interchange or prefix or the set point voltage applies, the amplifier would go to fault status, because this would be equivalent to drive to the absent second coil and as connections a8 and c8 were unoccupied, it would be interpreted as wire breakage.



6.3 Type EV22K3-12/24

The amplifier board, type EV22K3-12/24, is designed only for used in closed circuits.