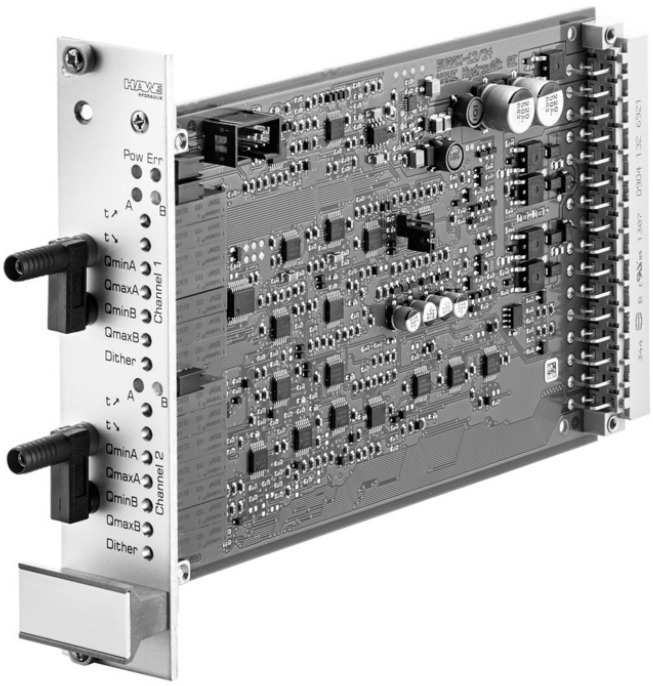
# Proportional amplifier type EV22K5

## Product documentation

Card design

| | |
|---|---|
| Supply voltage $U_B$: | 9 to 32 V DC |
| Output current $I_{max}$: | 1.8 A |

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HAWE HYDRAULIK

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# Table of Contents

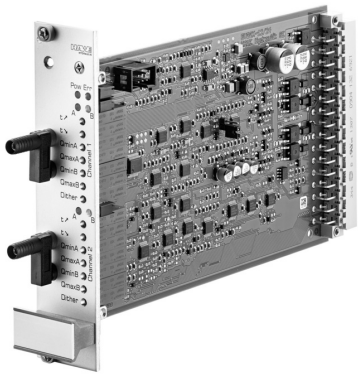
# 1 Overview of proportional amplifier type EV22K5

Proportional amplifiers actuate proportional solenoid valves by converting an input signal into a corresponding control current.

Thanks to the excellent control accuracy and highly precise feedback measurement, even challenging hydraulic applications can easily be realised.

A multi-turn potentiometer is used to configure the valve parameters such as the base and maximum current, dither and ramps. EV22K5 has two independent proportional amplifiers for mutual control of two twin solenoids or two sets of two single-action solenoids.

The amplifier module is mounted either on a mounting surface using an additional card holder or on a 35 mm standard support rail by means of a snap-on foot. It has the same dimensions as a Eurocard, with a front panel width of 6 HP.



*Proportional amplifiers Type EV22K5*

## Features and advantages

- Short-circuit-proof fixed voltage regulator ±5 V DC or ±10 V DC
- Compact design
- Easy commissioning
- Functions tailored to HAWE products
- LEDs for status monitoring

## Intended applications

- For controlling proportional valves
- Switch cabinet installation in an industrial environment

# 2 Available versions

## Amplifier module

**Ordering example**

| EV | 22 | K | 5 | 12/24 |
|---|---|---|---|---|

- 12/24 – Supply voltage 12 V DC / 24 V DC (nominal value)
- 5 – Design version
- K – Plug-in card version
- 22 – Two twin solenoids or two sets of two single proportional solenoids, alternately actuated
- EV – Basic type

## Assembly accessories

**BT 7817 950**

Module rack for two or three amplifier cards

The module rack consists of a screwed frame housing with 3 guide rails. The screw terminal strips are mounted on the side and are easy to reach. Unused slots can be sealed with blanking plates.

# 3 Parameters

## 3.1 General data

| | |
|---|---|
| **Designation** | Proportional amplifiers for 12 V DC to 24 V DC |
| **Version** | Card version with 32-pin terminal block according to DIN EN 60603-2 |
| **Installation position** | any |
| **Protection class** | IP 00 according to DIN VDE 0470, EN 60529 or IEC 529 |
| **Ambient temperature** | -20°C to +70°C |

## 3.2 Weight

- **Total: 750 g**
- PCB approx. 50 g
- Module rack approx. 700 g

## 3.3 Electrical data

| | |
|---|---|
| **Supply voltage $U_B$** | 9 to 32 V DC |
| **Max. current consumption** | 3.7 A |
| **Max. permissible ripple factor w** | 10% ripple |
| **Required filter capacitor $C_B$** | 2200 µF per 1 A coil current |
| **Output voltage $U_A$** | $U_B$ - 1.8 V DC |
| **Output current $I_A$** | max. 1.8 A continuous, short-circuit-proof per output group |
| **Adjustment areas** | ▪ $I_{min}$ = 0 to 0.8 A<br>default 0.25 A<br>▪ $I_{max}$ = 0 to 1.8 A<br>default 0.6 A |
| **Idle current $I_L$** | max. 110 mA (depending on voltage) |
| **Target value voltage $U_{nom}$** | ▪ -10 -0 ±10 V DC (no jumper) *<br>▪ -5 -0 ±5 V DC (jumper set) * |

| | |
|---|---|
| **Reference voltage $U_{St}$** | ▪ At $I_{st}$ 10 mA max.<br>– ±10 V DC (no jumper) *<br>– ±5 V DC (jumper set) *<br>▪ Short-circuit-proof and overload protected |
| **Input resistance $R_e$** | ≈ 400 kΩ |
| **Ramp time rise-fall $t_R$** | ▪ 0.1 to 5 s<br>▪ factory-set default 0.1 s |
| **Dither frequency f** | ≈ 55 Hz |
| **Dither amplitude I** | ▪ 100 to 600 $mA_{peak\ to\ peak}$<br>▪ Factory-set pre-setting ≈ 140 $mA_{peak\ to\ peak}$ |

* jumper = jumper on card for switching target value voltage ranges (-10 to +10 V DC or -5 to +5 V DC) and stabilised voltages (see Chapter 4, "Dimensions").

## 3.4 Specific parameters

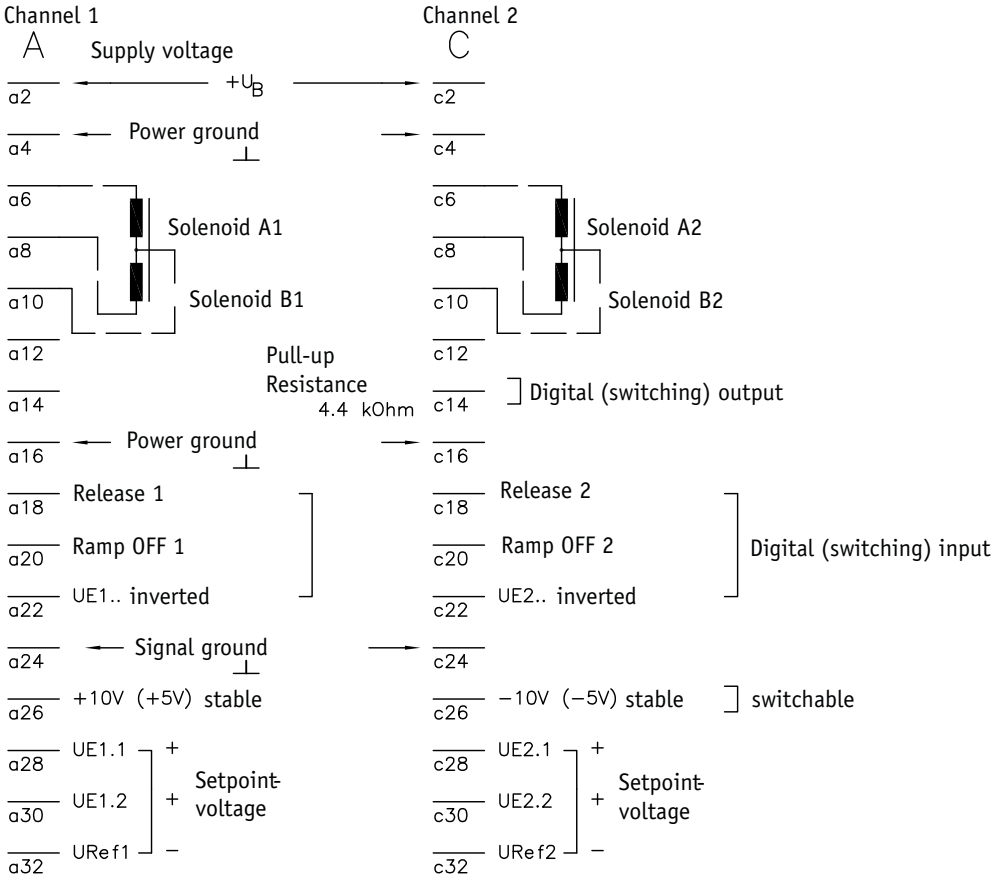
### Digital inputs

| | | | |
|---|---|---|---|
| **Release outputs** | TTL-compatible or to be activated via switching contact, output enabled when de-energised | | |
| **Ramp OFF inputs** | Ramp is off when energised | | |
| **Input resistance** | ≈ 10 kΩ | | |
| **Input voltage level** | | **BR open** | **BR set** |
| | logical 0 | 0 V ≤ U ≤ 4.5 V | 0 V ≤ U ≤ 1.3 V |
| | logical 1 | 9.5 V ≤ U ≤ UB | 6 V ≤ U ≤ UB |

### Digital output

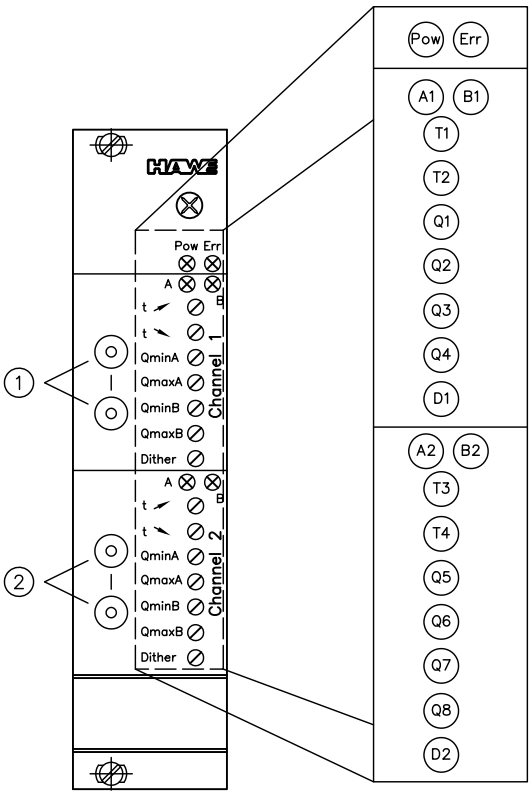
| | |
|---|---|
| **Output voltage $U_A$** | 35 V |
| **Output current $I_A$** | max. 9 mA |

## Amplifier front plate and terminal assignment of the terminal block




*Terminal block according to DIN EN 60603-2*

## Amplifier front plate




1 2x 2 mm sockets for current measurement (channel 1)

2 2x 2 mm sockets for current measurement (channel 2)

Adjustment direction of potentiometers (15-turn) – +

### General

Pow Supply voltage (green LED)

Err Fault (red LED)

### Channel 1

A1 Solenoid A1 control (green LED)

B1 Solenoid B1 control (yellow LED)

T1 Ramp rise time

T2 Ramp fall time

Q1 $Q_{min}$ ($I_{min}$) solenoid A1

Q2 $Q_{max}$ ($I_{max}$) solenoid A1

Q3 $Q_{min}$ ($I_{min}$) solenoid B1

Q4 $Q_{max}$ ($I_{max}$) solenoid B1

D1 Dither amplitude

### Channel 2

A2 Solenoid A2 control (green LED)

B2 Solenoid B2 control (yellow LED)

T3 Ramp rise time

T4 Ramp fall time

Q5 $Q_{min}$ ($I_{min}$) solenoid A2

Q6 $Q_{max}$ ($I_{max}$) solenoid A2

Q7 $Q_{min}$ ($I_{min}$) solenoid B2

Q8 $Q_{max}$ ($I_{max}$) solenoid B2

D2 Dither amplitude

## 3.5 Electromagnetic compatibility (EMC)

The EMC of the device was tested by an accredited testing laboratory (emitted interference according to DIN EN 61000-6-3 and immunity to interference according to DIN EN 61000-6-2 evaluation criterion “B”). The test set-ups only represent typical use. This EMC testing does not release the user from carrying out adequate prescribed EMC testing of their complete system (according to Directive 2014/30/EU). If the EMC of the complete system must be further amplified, the following measures can be tested and introduced:

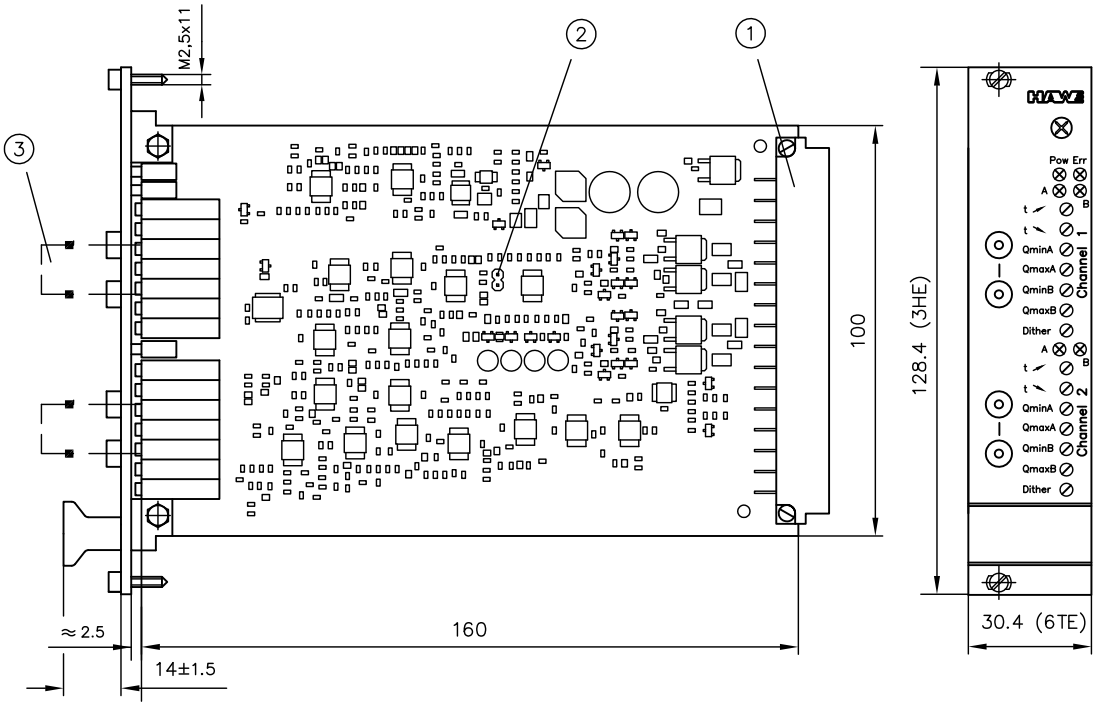
- The necessary smoothing capacitor according to Chapter 3.3, "Electrical data" is not only needed to ensure the device functions correctly, but also to guarantee compliance with EMC guidelines (conducted emitted interference).
- The device should be installed in a closed metal switch cabinet (shielding).
- Supply lines, such as inputs and outputs to and from the device, should be as short as possible. If necessary they should be shielded and twisted in pairs (to reduce the antennae-like effect for increasing the immunity to interference).

# 4 Dimensions

All dimensions in mm, subject to change.

## 4.1 Amplifier card

**EV22K5**

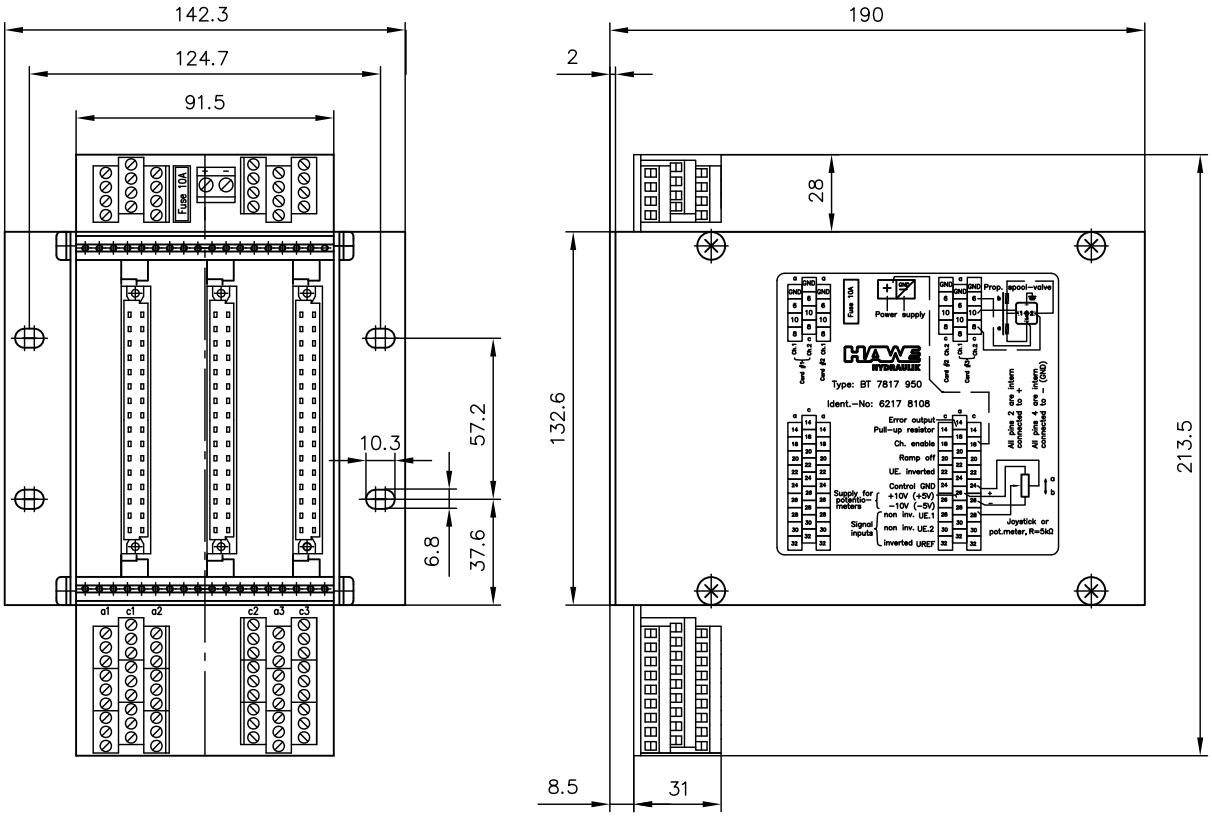



1 Female multipoint connector according to DIN EN 60603-2
2 Bridge BR
3 Short-circuit bridges for connection of 2 mm sockets to the front plate

Explanation of amplifier front plate (see Chapter 3.4, "Specific parameters")

## 4.2 Module rack

**BT 7817 950**



# 5 Installation, operation and maintenance information

## 5.1 Information on setting

**NOTICE**
When delivered, the proportional amplifier EV22K5-12/24 has been set up so that it can be used, without any further setting, together with the proportional spool valve type PSL or PSV according to publications D 7700 et sqq. More precise matching between the proportional spool valve and proportional amplifier should only be undertaken if the appropriate specialist personnel and measuring equipment are available.

The arrangement (see see Chapter 5.2, "Setting instructions") is considered a circuit for EV22K5-12/24 with a target value potentiometer with centre tap (see Chapter 6.1, "Actuation of hydraulic valves using one proportional twin solenoid each or two proportional single solenoids").

The card is connected using a card holder or module rack. The designation of the terminals corresponds to the designation of the terminal block (see Chapter 3.4, "Specific parameters").

Shielded connecting lines with wires braided in pairs should be used for connection lengths of more than 3 m to minimise emitted interference and/or to increase immunity to interference.

$I_{max}$ must not exceed the $I_{lim}$ value specified for the proportional solenoid for long periods. An external target value voltage must not exceed or fall below the set range of the reference voltages by more than 1 V for long periods. Otherwise this can lead to an incorrect reaction of the proportional amplifier. Application of the card as a single proportional amplifier for controlling single proportional solenoids (see Chapter 6.2, "Actuation of hydraulic valves using a proportional solenoid in each case").

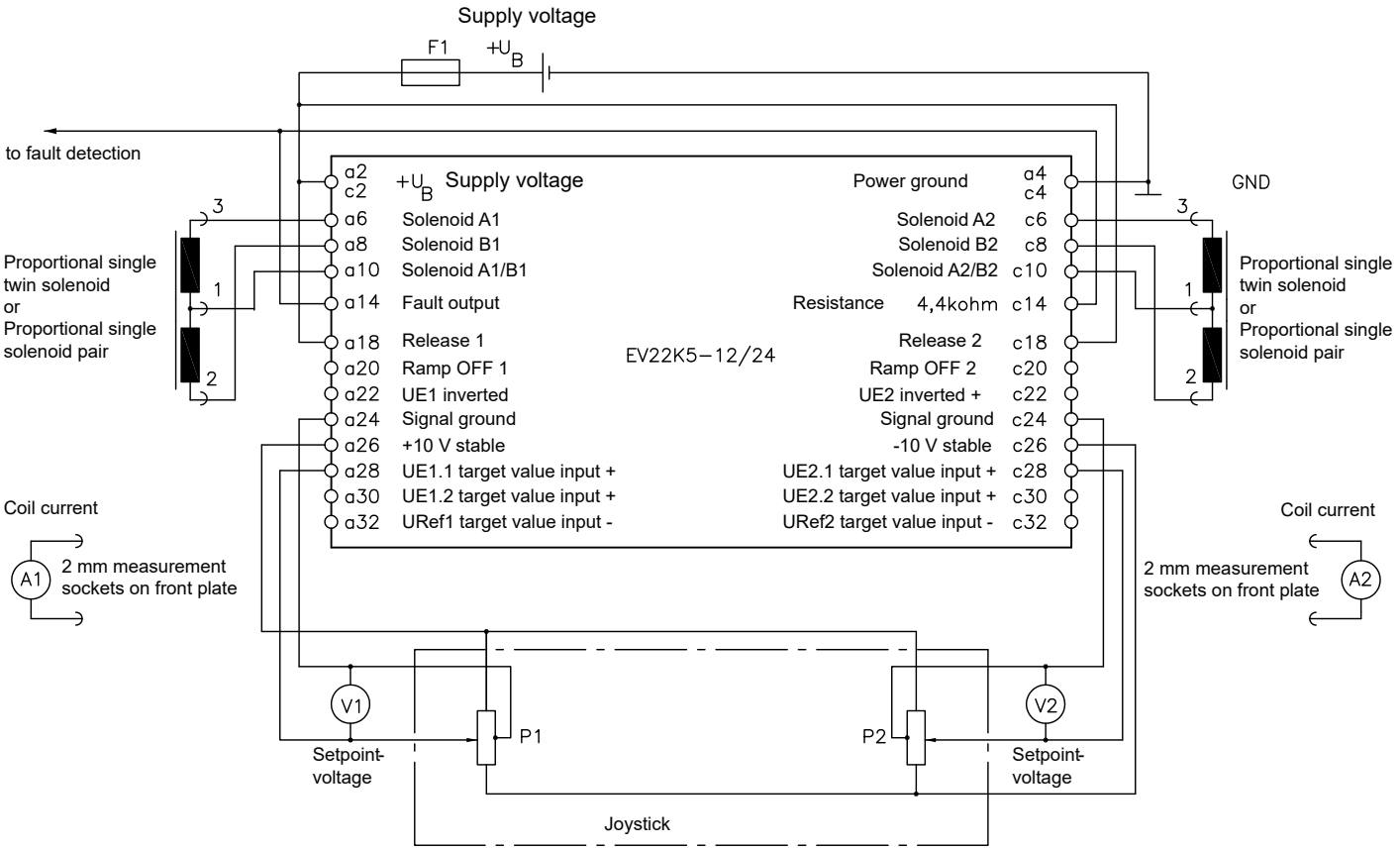
**NOTICE**
**Check the mains supply if any faults occur during the setting procedure, or during commissioning.**

The ammeter used for current measurement must not have a voltage drop of more than 0.5 V, otherwise the current measurement value displayed on the front plate via the measurement sockets can be wrong.

- For bridge rectification:
  Is an electrolyte filter capacitor of at least 2200 µF/A coil current connected in parallel to the supply voltage?
- Is the supply voltage for the proportional amplifier high enough? Under load, supply voltage should be at least 1.8 V DC higher than the voltage required to produce the set maximum current $I_{max}$ for a warm solenoid without proportional amplifier.

## 5.2 Setting instructions

### Connection pattern




- **F1:** 3.5 A fuse

> **NOTICE**
> Max. 3 cards may be protected with a single fuse (10 A).

- **V1, V2:** Control voltmeter for measuring the target value voltage, measuring range 0 to 10 V DC
- **A1, A2:** Control ammeter for measuring the coil currents, measuring range 0 to 2 A DC
- **P1, P2:** Joystick, e.g. 1x type EJ2-10 according to D 7844

### Preparing the module

1. Turn ramp potentiometer anti-clockwise.
   ✓ The wiper of the potentiometer in the transparent housing is furthest away from the front plate.
2. Connect the amplifier card and measurement devices according to the example circuit.
3. Check the position of the jumper.
4. Turn on power supply.
   ✓ The green LED on the front plate lights up.

> **NOTICE**
> If the red LED (Err) lights up, there is a fault. Diagnostics and fault elimination (see Chapter 5.4, "Error management")

## Setting the minimum current

1. Move and hold joystick P1 in one direction until LED A1 lights up.
2. Read voltage from voltmeter V1.
3. Use the multi-turn potentiometer $Q_{min}$ A1 to set the minimum current $I_{min}$ A for direction A. Turning it clockwise increases the coil current.

> **NOTICE**
> The indicative value for a PSL or PSV proportional spool valve with 24 V solenoids is approx. 290 mA, with 12 V solenoids approx. 580 mA

4. Read coil current from ammeter A1.
5. Move and hold joystick P1 in the opposite direction until LED B1 lights up.
6. Use the multi-turn potentiometer $Q_{min}$ B1 to set the minimum current $I_{min}$ B for direction B. Turning it clockwise increases the coil current.

## Setting the maximum current

1. Move joystick P1 in direction A as far as it will go and hold it there.
2. Read maximum target value voltage from voltmeter V1.
3. Use the corresponding multi-turn potentiometer $Q_{max}$ A1 to set the maximum current $I_{max}$ A for direction A. Turning it clockwise increases the coil current.

> **NOTICE**
> The indicative value for a PSL or PSV proportional spool valve with 24 V solenoids is approx. 600 mA, with 12 V solenoids approx. 1200 mA

4. Read coil current from ammeter A1.
5. Move joystick in direction B as far as it will go and hold it there.
6. Use the corresponding multi-turn potentiometer $Q_{max}$ B1 to set the maximum current $I_{max}$ B for direction B. Turning it clockwise increases the coil current.
7. Read coil current from ammeter B1.
8. Set the dither amplitude so that you feel a noticeable vibration when touching the lever of the proportional spool valve when the joystick is moved about half way. This must cause no interference in the hydraulic system.

> **NOTICE**
> Indicative values for type PSL(V) according to D 7700-.. UN = 24 V and with coil current 0.4 A approx. 140 mAS-S.
> Values for the dither amplitude can only be measured with an oscilloscope.

## Setting the ramp times

1. Set the ramp time for ramp up on multi-turn potentiometer t.
2. Set the ramp time for ramp down on multi-turn potentiometer t¯.
3. Turning clockwise extends ramp time.

## 5.3 Radio interference

In rare cases, it is possible for the proportional amplifier to go to fault status in the place where it is being used due to electromagnetic interference (e.g. where solenoid valves are being used which have no or inadequate interference suppression). In such cases, we recommend subsequent interference suppression of on/off solenoid valves and/or series incorporation of an EMC filter in the supply voltage on the module rack.

In mobile hydraulics e.g.: high-performance EMC filter type: FN332-10A from Schaffner EMV GmbH in 76185 Karlsruhe, Germany

## 5.4 Error management

- LEDs on the front plate indicate the operating states of the amplifier card.
- Green LED (Pow): Lights up when the supply voltage is connected.
- Red LED (Err): Lights up in the event of a fault status. The faulty channel is also indicated by simultaneous flashing of the green (A) and orange (B) channel-specific LEDs.
- In parallel to the red LED, a signal output (NPN transistor, pin a14) is present. Fault indication (red LED) and fault signal (pin a14) persist until acknowledged. However, the amplifier card functions once again as soon as the cause of the fault has been eliminated.

### Possible faults

| LED error code | | | | Possible cause | |
|---|---|---|---|---|---|
| Pow (green) | Err (red) | A (green) | B (yellow) | | |
| ● | ● | ● | ● | Supply voltage too low $U_B$ < 9.1 V | ► Increase supply voltage.<br>► Check smoothing and improve if necessary.<br>**Resetting the fault display**<br>► Automatic reset |
| ☼ | ☼ | ◑ | ◑ | Cable break or short-circuit at the output (coil side) | ► Check connected solenoids and supply lines for short-circuits.<br>► Check interruptions.<br>**Resetting the fault display**<br>► After fault elimination<br>► Switch supply voltage on again OR produce a positive flank on PIN 18 * (release) of the relevant amplifier. |

* When RELEASE is blocked (PIN 18), the solenoid current is switched off without delay, but switched back on when released again via the set ramp function.

● = LED remains off ☼ = LED lights up ◑ = LED flashes

**NOTICE**

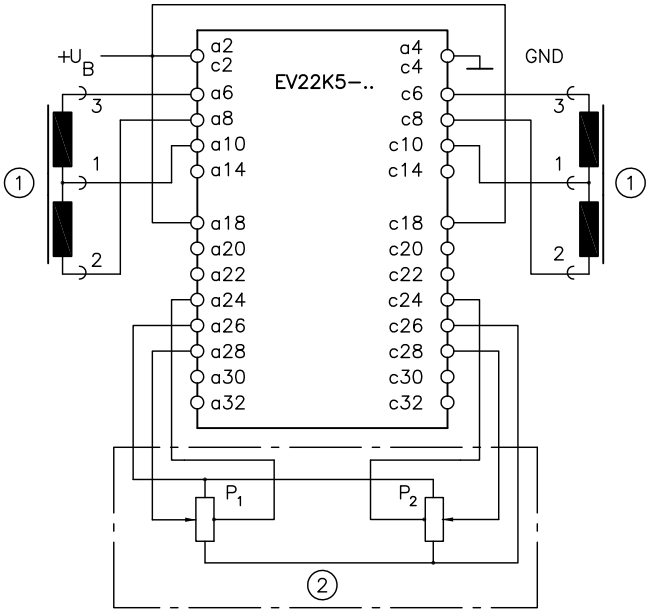
A fault status can only be detected by the electronics if the coil currents have exceeded the permissible limits on actuation. This means that no predictions are possible regarding short-circuits or cable breaks when TARGET VALUE VOLTAGE = 0 or RELEASE BLOCKED (PIN 18) is set. These faults will only be signalled just after activating the respective side (final stage).

# 6 Circuit examples

## 6.1 Actuation of hydraulic valves using one proportional twin solenoid each or two proportional single solenoids

Description of connections (see Chapter 3.4, "Specific parameters")

### Example 1

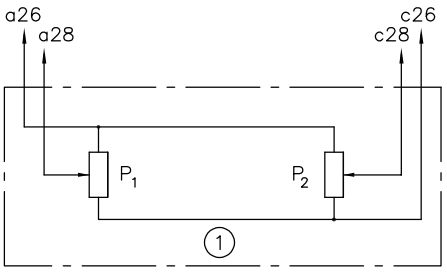



1 Proportional twin solenoid or proportional single solenoid

2 Joystick

The signal emitter connected consists of two potentiometers with centre tap, e.g. two single-axis joysticks or one dual-axis joystick. The target value voltage is bipolar.
This basic circuit is protected against malfunction of the non-activated proportional twin solenoid in the event of a wire break at the input (target value potentiometer). In the event of such a wire break, the non-activated proportional valve remains in the neutral position, as the target value voltage at the input of the proportional amplifier remains zero.

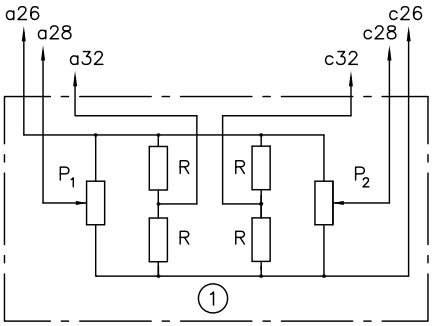
### Example 2




1 E.g. joystick

Two single potentiometers with only three connections (without centre tap) are used as signal emitters. The target value voltage is bipolar. This relatively cheap version does, however, have the drawback that if, for example, a supply line from the target value potentiometer to the reference voltage +10 V (a26) breaks, the target value voltage at the input of the proportional amplifier immediately jumps to -10 V. This means that the proportional solenoid of the non-activated proportional valve is fully activated and therefore the valve displaces to maximum with unchecked movement and max. speed of the consumer connected to it! Such a circuit should therefore only be considered if the signal emitter and amplifier card are installed so close to one another that any damage to the supply lines can be reasonably ruled out. The circuit according to example 1 or example 3 is preferable for safety reasons.

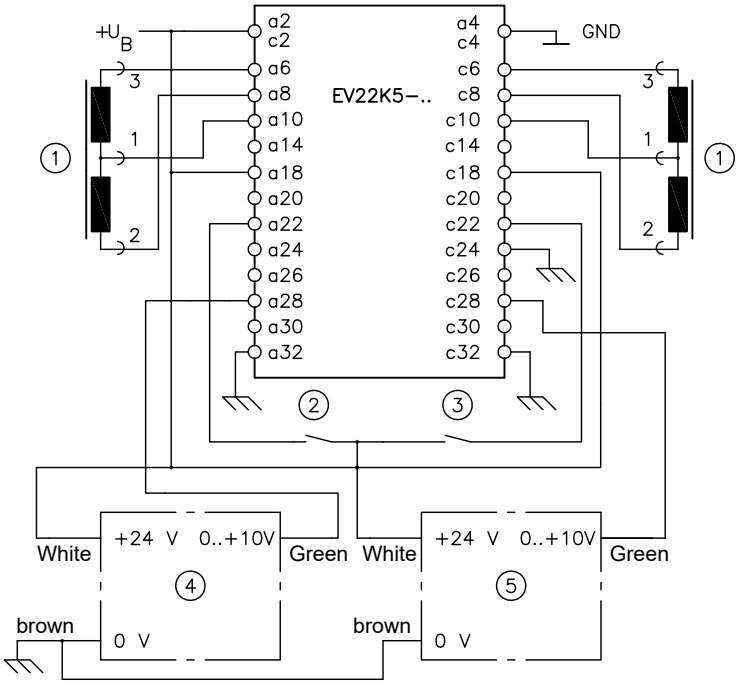
## Example 3




1 E.g. joystick

As in example 2, two single potentiometers are used as signal emitters. The target value voltage is bipolar. The absent centre tap of the target value potentiometers is simulated in each case by two additional resistances of the same size between 5 and 10 kΩ, 0.25 W. This avoids the safety disadvantages of example 2 and the same applies as in example 1.

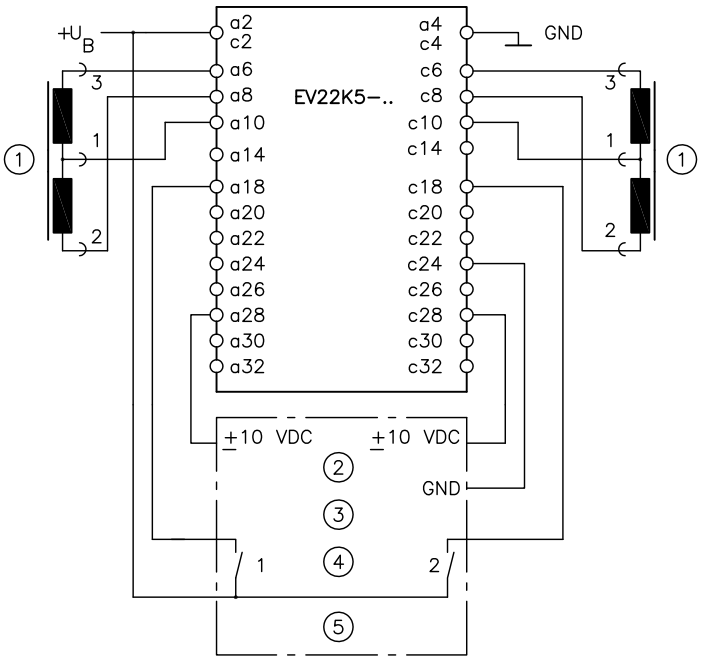
## Example 4




1 Proportional twin solenoid or proportional single solenoid
2 Reverser 1
3 Reverser 2
4 Optical absolute encoder 2
5 Optical absolute encoder 1

Connection of a joystick switch with active target value generator, target value voltage unipolar, e.g.: controller with opto-electronic absolute encoder
Type: CSOVR 8P1.8P1 -2 OEG 010U from Spohn und Burkhardt in D-89143 Blaubeuren
Reverser coupled internally mechanically with absolute encoder:
Reverser 1 – with optical absolute encoder 1.
Reverser 2 – with optical absolute encoder 2.

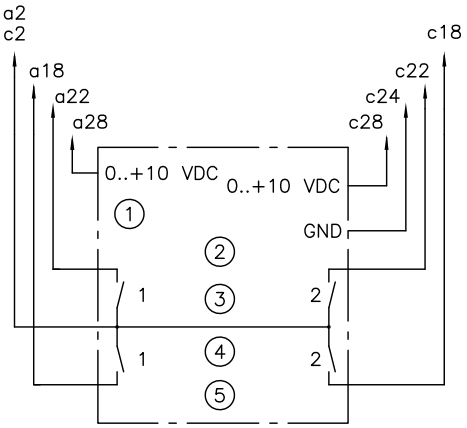
## Example 5




Connection to a PLC, CNC or PC, target value voltage bipolar

1 Proportional twin solenoid or proportional single solenoid
2 Analogue outputs
3 Release
4 Relay outputs

## Example 6



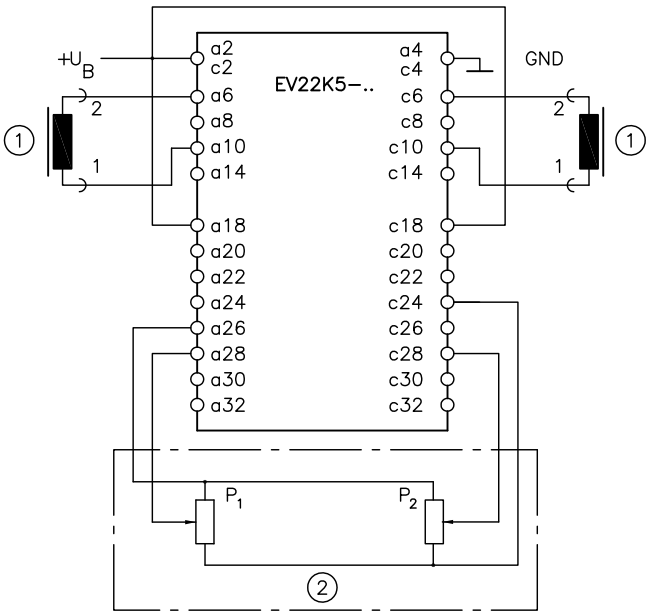

Connection to a PLC, CNC or PC, target value voltage unipolar

1 Analogue outputs
2 PLC, CNC or PC
3 Inverted
4 Release
5 Relay output

## 6.2 Actuation of hydraulic valves using a proportional solenoid in each case

Description of connections ("Specific parameters")

### Example 7




1 Proportional single solenoid
2 Joystick

Use as a proportional amplifier for two single solenoids. The two proportional solenoids should be connected to the ports a6 to a10 or c6 to c10 and a unipolar target value voltage should be selected.

**NOTICE**

In the event of inversion (a22 or c22) or a change in polarity of the target value voltage applied, the amplifier would go to fault status, because this would be equivalent to actuating the absent second coils and, as ports a8 and c8 were unoccupied, it would be interpreted as a wire break.

# References

## Additional versions

- Proportional amplifier type EV2S: D 7818/1
- Proportional amplifier type EV1M3: D 7831/2
- Proportional amplifier type EV1D: D 7831 D
- Valve control type CAN-IO 14+: D 7845-IO 14

## Application

- Proportional directional spool valves types PSL, PSV size 2: D 7700-2
- Proportional directional spool valves types PSL/PSV/PSM, size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Proportional directional spool valve banks type PSLF and PSVF size 7: D 7700-7F
- Proportional directional spool valve type PSLF, PSVF and SLF size 3: D 7700-3F
- Proportional directional spool valve type PSLF, PSVF and SLF size 5: D 7700-5F
- Proportional directional spool valve type EDL: D 8086
- Directional spool valve bank type SWS: D 7951



HAWE Hydraulik SE
Einsteinring 17 | 85609 Aschheim/Munich | P.O. Box 11 55 | 85605 Aschheim | Germany
Phone +49 89 379100-1000 | info@hawe.de | www.hawe.com

hawe.com/contact