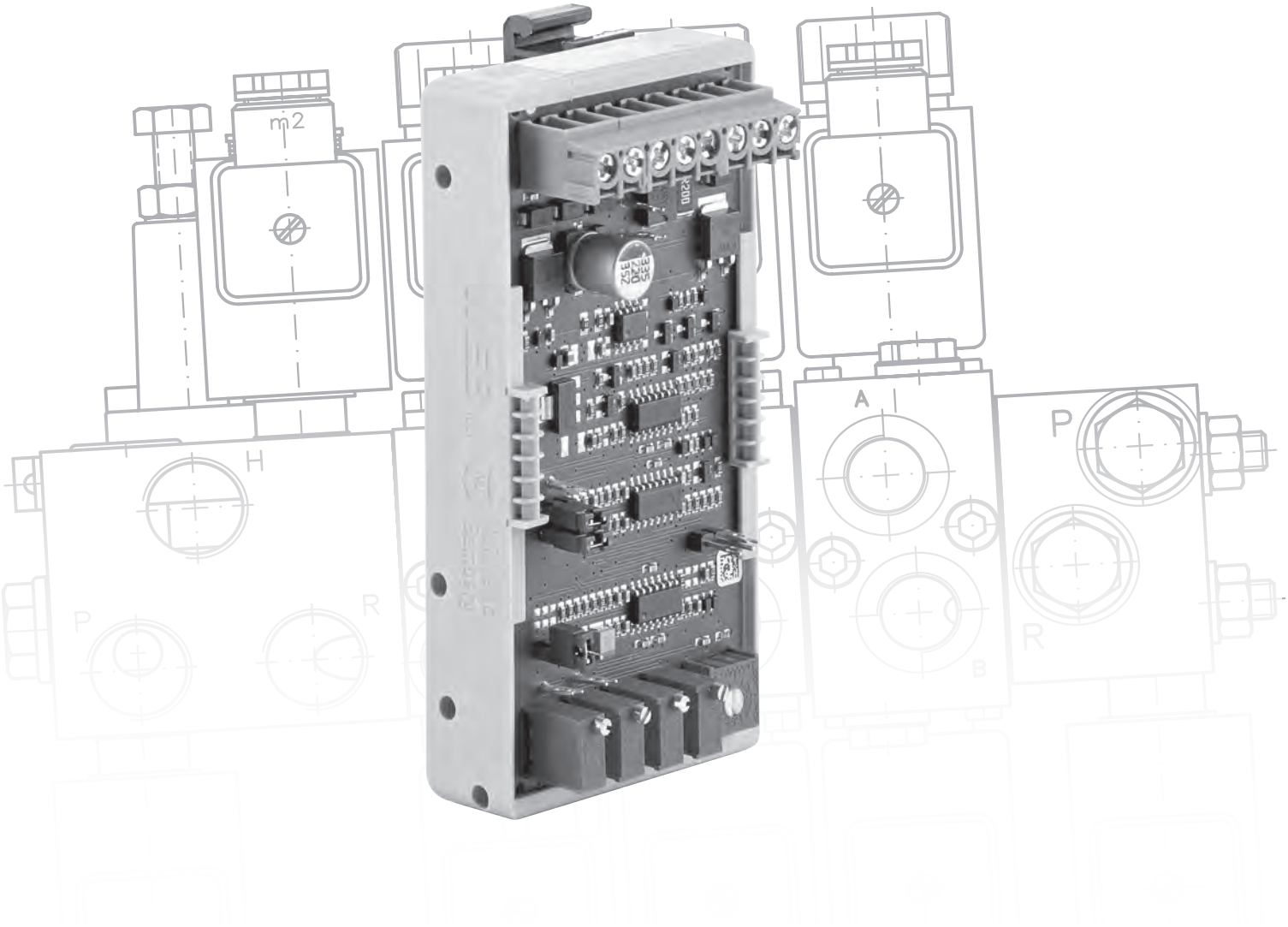
Proportional amplifier type EV1M3

for control of proportional valves, modular construction, connection with screw terminals

Power supply U_B:	9...32 V DC
Output voltage U_A:	U_B - 1.2 V DC
Output current I_A:	max. 2.4 A



Product documentation

D 7831/2

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Contents

1 Overview of proportional amplifier type EV1M3

Proportional amplifiers actuate proportional solenoid valves by converting an input signal into a corresponding control current.
The amplifier module EV1M3 can be assembled on a 32-mm or 35-mm DIN rail through the use of an additional card holder. Thanks to the excellent control accuracy and highly precise current 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.

Features and benefits:

- Compact design
- Easy commissioning
- Functions tailored to HAWE products

Intended applications:

- For actuation of proportional valves
- Installation in industrial switch cabinets

Figure 1: Proportional amplifier type EV1M3

2 Available versions, main data

Block diagram:

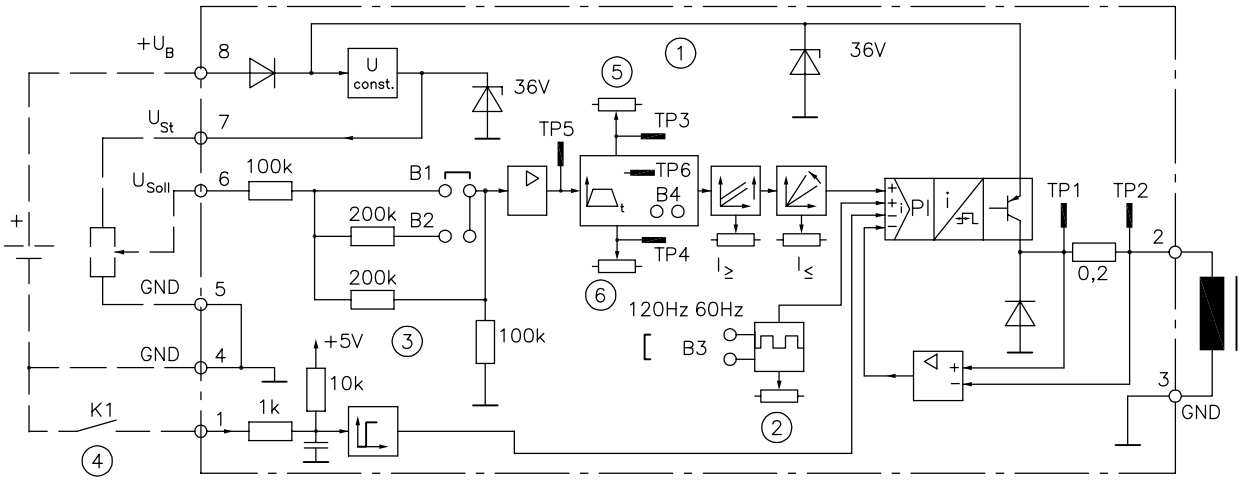

Figure 2: Block diagram EV1M3

1 Ramp
2 Dither amplitude
3 Intern
4 Enable / Disable
5 Up
6 Down

B4, TP3-TP6 are only in use when a coarse adjustment of the ramp times „rise“ and/or „fall“ on the multi-range-potentiometers is carried out by measuring the voltage (see Chapter 5.3, "Fast adjustment of ramp times").

TP1, TP2 test points for measuring the coil (inductive) current 100 mV & 0.5 A

The amplifier is suitable for use with all HAWE proportional valves up to 24 V. For the electro-hydraulic remote control of PSL(V) directional spool valves according to D 7770, due to the twin proportional solenoids for the switching positions A and B, it must be ensured that depending on the actuation direction, electric switching to the particular solenoid takes place automatically, e.g. by reverser (micro switch) in the remote control hand lever potentiometer, see Chapter 6.2, "Controlling hydraulic valves using one twin or two individual proportional solenoids for alternating operation".

Amplifier module

Order coding example:

EV	1	M	3	12/24

12/24 – Supply voltage 12/ 24V DC (rated value)

3 – Design and development status

M – Module with bolt-type terminal connections

1 – Single-action proportional solenoid

EV – Basic type

Accessories for assembly

Order coding example:

KM	7831 010

7831 010 – Internal drawing number

KM – Module card holder

3 Parameters

3.1 General

General data

Nomenclature	Proportional amplifier for 12 V DC to 24 V DC
Design	Board (module) with 8-pin screw terminal strip
Connection leads	max. 1.5 mm^2
Fastening	Only possible for 35-mm standard support rails or 32-mm support rails according to DIN EN 60715 in conjunction with a card holder (accessory)
Installation position	Any
Mass (weight)	■ **Total:** 80 g ■ Printed circuit board: 40 g ■ Card holder: 40 g
Type of protect. DIN VDE 0470, EN 60529 or IEC 529	IP 00
Ambient temperature	-20°C...+50°C (up to + 70°C at 75% of the max. output current I_A)

3.2 Electrical Data

Electrical data

Supply voltage	U_B	9...32 V DC
Max. permissible ripple factor	w	10% ripple
Required filter capacitor	C_B	2200 µF per 1 A of coil current
Output voltage	U_A	U_B - 1.2 V DC, pulse-width modulated
Output current	I_A	max. 2.4 A short circuit proof protect

Electrical data

Setting range	I_{min} = 0...1.6 A I_{max} = I_{min} + (0...2.4) A Factory default setting I_{min} = 0 A; I_{max} = 800 mA	**Note** I_{max} must never exceed 2.4 A!
No-load current	I_L	max. 20 mA (own consumption)
Voltage ranges	U_{nom}	Can be optionally set as 0...5 V DC, 0...10 V DC or 0...15 V DC Factory default setting 0...5 V DC
Reference voltage	U_{St}	5 V DC ±4%
Input resistance	R_e	>200 kΩ
Recommended potentiometer	P	2...10 kΩ
Ramp time rise-fall	t_R	0.1...10 s Ramp, linear rise time and fall time separately adjustable factory pre-setting: 0.1 s for both (minimum)
Enable/disable input		TTL compatible or can be triggered with a contact
Dither frequency	f	60 or 120 Hz switchable; factory pre-setting 60 Hz
Dither amplitude	I	0...750 mA (tip to tip), factory default setting 0 mA

3.3 Electro-magnetic compatibility (EMC)

The EMC of the device was tested using an accredited testing agency (emitted interference according to EN 61000-6-3 and immunity to interference according to 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 2004/108/EC). If the EMC of the complete system must be further amplified, the following measures can be tested and introduced:

- The required filter capacitor (see Chapter 3.2, "Electrical Data") is not only necessary for flawless performance of the device, but also to ensure compliance of the EMC (wire bound interference emission)
- The equipment should be installed in an metal 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 module

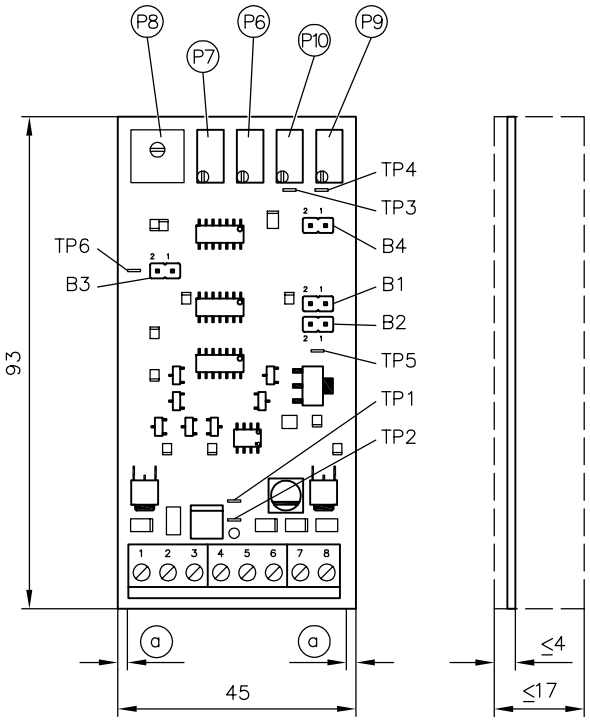

Figure 3: Overview of amplifier module

Bridges (Jumper)

	Jumper placed
	Jumper open

B1, B2 and B3 see Chapter 6.1, " Use of a proportional solenoid to control hydraulic valves" and Chapter 6.2, "Controlling hydraulic valves using one twin or two individual proportional solenoids for alternating operation".

Note

Leave the bridge (jumper) B4 open. Only change B4 to set the ramp time (see Chapter 5.3, "Fast adjustment of ramp times").

Potentiometer

P6	Potentiometer ramp down time t_d (25-turns)
P7	Potentiometer ramp up time t_u (25-turns)
P8	Potentiometer dither amplitude
P9	Potentiometer basic current I_{min} (25-turns)
P10	Potentiometer maximum current I_{max} (25-turns)

Direction of potentiometer rotation – +

Test points

TP1	Test point 1 (+) for current feedback measurement, 100 mV ≙ 0.5 A
TP2	Test point 2 (-) for current feedback measurement, 100 mV ≙ 0.5 A
TP3	Test point 3 to adjust ramp UP
TP4	Test point 4 to adjust ramp DOWN
TP5-6	Test point to adjust ramp times (see Chapter 5.3, "Fast adjustment of ramp times")

Mounting the printed circuit boards

a	max. 1.8 mm Range for securing and moving printed circuit (see Chapter 5.4, " Assembly of the amplifier module on the card holder")

Plan of terminal connections

1	Enable/disable inout
2	+ solenoid
3	0 V earth for solenoid
4	0 V power earth
5	0 V signal earth
6	Reference input
7	U_{ST} stabilized voltage (+5 V DC)
8	$+U_B$ supply voltage

4.2 Amplifier module assembled in the card holder

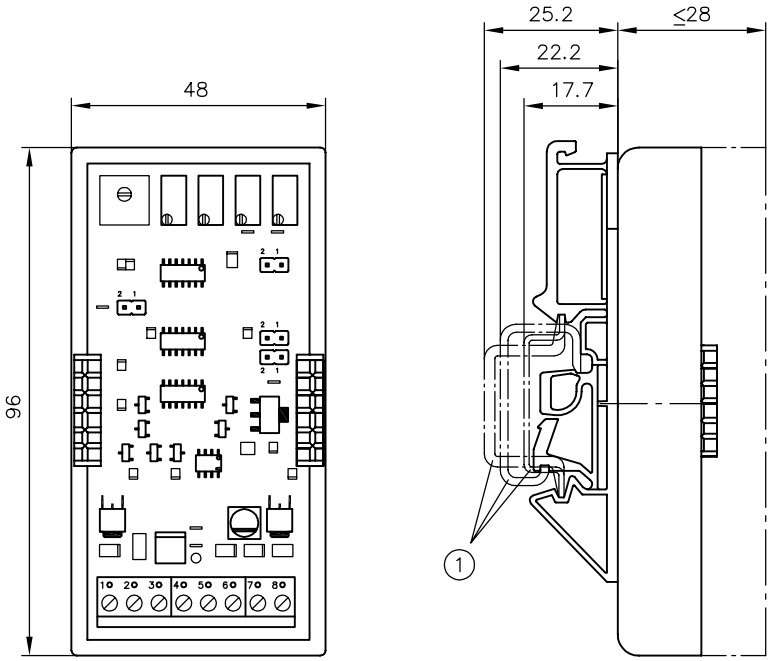

Figure 4: Dimensions of amplifier module assembled in the card holder

1 Standardized support bars

Description of the amplifier module see Chapter 4.1, "Amplifier module"

Assembly see Chapter 5.4, " Assembly of the amplifier module on the card holder".

5 Installation, operation and maintenance information

5.1 Information on setting

Note
These instructions apply to the target voltage range of 5V using internal stabilized voltage USt = 5 V. Bridges (jumpers) in position as delivered (for other, conceivable bridge positions see Chapter 6.1, " Use of a proportional solenoid to control hydraulic valves").

Assembly of the amplifier module on the card holder see Chapter 5.4, " Assembly of the amplifier module on the card holder" .

Note
An external target value voltage feed must not be negative! Negative voltage can lead to malfunction of and damage to the prop.-amplifier. If the maximum target value voltage is exceeded by 5, 10 or 15V DC according to bridge connection, the set current becomes I_{max} or $I_{max\ op.}$ ineffective, i.e., it increases beyond the set limit value.

When connecting wires more than 3 metres in length use wires with leads twisted in pairs in order to minimise interference (and therefore to enhace resistance to interference). Maximum coil voltage I_{max} set at the outlet may not in the long run exceed the I_{lim} limit specified for the proportional solenoid, since otherwise the solenoid would be subjected to a thermal overload and might break down.

It is also possible to introduce solenoids for 12 V in the case of power supply with nominal value of 24 V DC of the proportional amplifier. In this case, the power supply is converted through the timed output stage, automatically low-loss at a level of 12 V. .
Advantages: in the entire range of the power supply (e.g. from 12 to 32 V DC) the proportional valve operates and the reaction times of the solenoid become shorter; consequently the hydraulics become quicker.

Note
In the event of interference during the setting procedure or when commissioning, check mains supply.

- In the case of rectified bridge configuration:
  Check whether anelectrolyte filter capacitor of at least 2200 mF/A coil voltage is switched parallel to the supply voltage.
- Is the supply voltage for the proportional amplifier sufficient?
  Under load it should be at least approx. 2V DC higher than would be required to generate the maximum current set of I_{max} oper with a warm solenoid coil without a proportional amplifier.

5.2 Setting instructions

F1	Fuse 2.5 A mT
V1	Control voltmeter for measuring the coil current, 100 mV ≙ 0.5 A

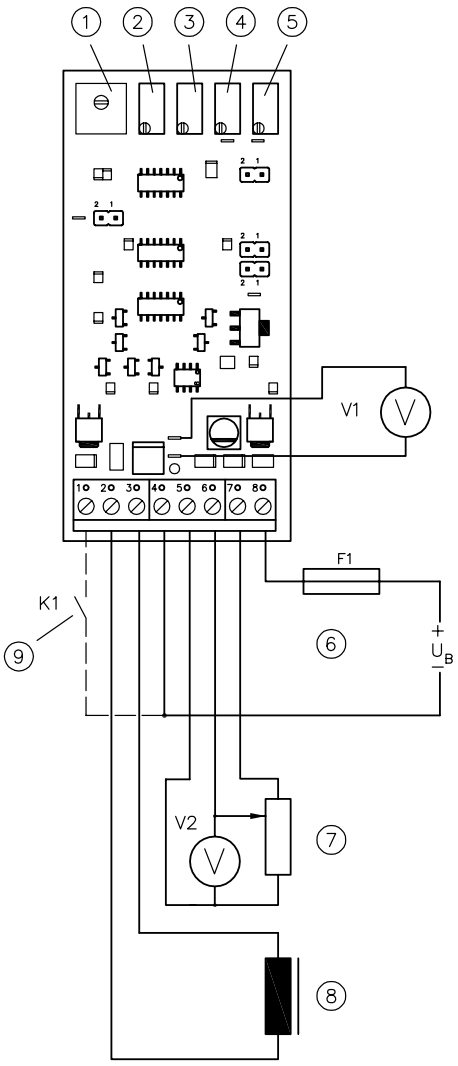

Figure 5: Setting instructions diagram

1 Potentiometer Ditheramplitude
2 Potentiometer Ramp up time t_u
3 Potentiometer Ramp down time t_d
4 Potentiometer max.current I_{max}
5 Potentiometer min. current I_{min}
6 Supply voltage
(e.g.: MNG 2,5-230/24 according to D 7835)
7 Target value potentiometer P1; 2 - 10 kΩ
(e.g. wire potentiometer 5 kΩ, 2 W)
8 Proportional solenoid
9 Enable / Disable

Requirement: The bridges of the amplifier module are provided as part of the delivery. (Other possible bridge settings see Chapter 6.1, " Use of a proportional solenoid to control hydraulic valves")

1. Amplifier connection:
Connect the proportional solenoid to terminals 2 and 3. Connect voltmeter V1 to test points TP1 and TP2 (to measure the coil (induction) current) . Connect the target value potentiometer (7) to terminals 5, 6 and 7. Connect the power supply to terminals 4 and 8.
2. Set the target value potentiometer to minimum (0V).
3. Preset dither amplitude using potentiometer dither amplitude (1).
4. Set ramp times $t_{up\ time}$ and $t_{down\ time}$ to minimum using potentiometer ramp up/down time (2) + (3) (turn anticlockwise until it stops).
5. Turn on power supply.
6. I_{min} to the minimum current $I_{min\ op.}$, to which, according to Q I or Δp I characteristic curve of the proportional valve, the desired functional end position below corresponds in operation. Adjustable I_{min} range see Chapter 3.2, "Electrical Data". To read $I_{min\ op.}$ voltmeter V1 positioned between test points TP1 and TP2 (current value see above).
7. Set target value potentiometer to max. Read target value voltage on the voltmeter V2 (approx. 5V).
8. I_{max} to the maximum current $I_{max\ op.}$, to which, according to Q I or Δp I characteristic curve of the proportional valve , the desired functional end position above corresponds in operation. Adjustable I_{max} range see Chapter 3.2, "Electrical Data".
9. Dither frequency f is factory set to 60 Hz via the open bridge B3. In most circumstances this is sufficient. By closing bridge B3 this can be increased to 120 Hz, which can be more suitable for prop. valves of smaller construction. Set the target value potentiometer to approx. 0.5 x I_{max} coil current. Set the dither amplitude (1) by turning the potentiometer dither amplitude clockwise to the right until vibration can just be felt on the proportional valve but does not interfere.
10. Set ramp times $t_{up\ time}$ and $t_{down\ time}$ to the desired time spans. The ramp times always extend beyond the overall range of the output current I_A. For briefer setting procedure see Chapter 5.3, "Fast adjustment of ramp times".
11. Controlling the set functional parameters $I_{min\ op.}$ (Step 6) for U_{target} = 0 V DC; $I_{max\ op.}$ (Step 8) for U_{target} = 5 V DC; dither amplitude (Step 10) and ramp times (Step 9). If necessary, repeat setting procedure.

5.3 Fast adjustment of ramp times

The ramp times are normally adjusted by trial-and-error. This is the simplest method of adjustment, but it is also very time consuming. The relationship between ramp times and the rotary motions of the trimming potentiometer (25-turn) is not linear. The ramp times can be adjusted accurately (*15%) using a digital voltmeter (minimum 100 kΩ/V input impedance) and in conjunct with the opposite diagram (refer also to Chapter 4.1, "Amplifier module" und Chapter 5.2, "Setting instructions"):

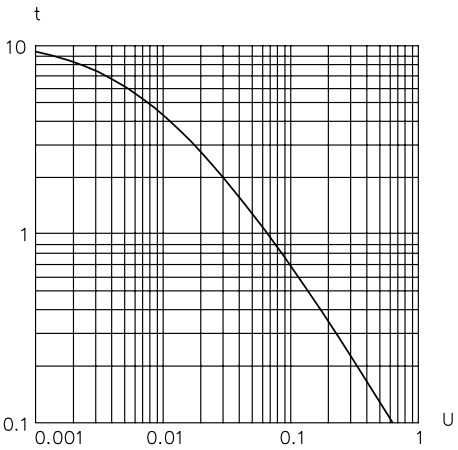

Figure 6: U voltage check voltmeter V1 (V), t ramp time (s)

1. Amplifier:
   Set jumber B4 and connect supply voltage to terminals 4 and 8
2. Adjusting ramp rise time:
   Connect TP5 with 5 V (terminal 7), connect voltmeter between TP6. and TP3 read the required voltage for the ramp rise time from the diagram, set voltmeter to this value using the potentiometer.
3. Adjusting the ramp fall time:
   Connect TP5 with 0 V (terminal 5). Connect voltmeter between TP6 and TP4. Determine the voltage for the required ramp fall time from the diagram and then set on the voltmeter using the ramp fall time potentiometer.
4. Set ramp times $t_{up\ time}$ and $t_{down\ time}$ to minimum (potentiometer ramp fall time/rise time anticlockwise until it stops, for a multi-turn potentiometer this is 25 turns)
5. Remove jumper B4

Note
The proportional amplifier does not operate if bridge B4 is set!

5.4 Assembly of the amplifier module on the card holder

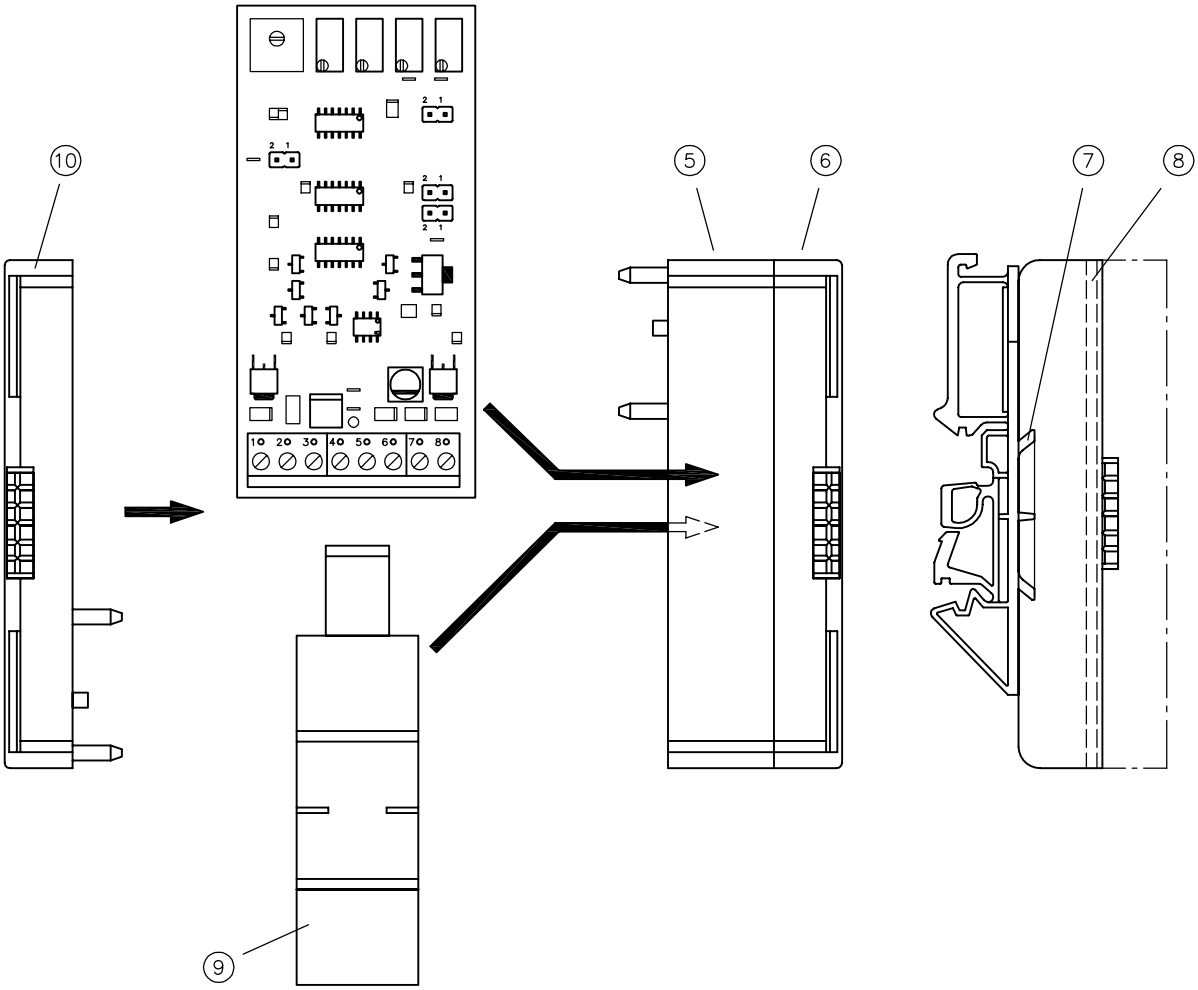

Figure 7: Assembly of the amplifier module on the card holder

5 Centrepiece
6 Card holder, right side
7 Rear trapezoid guid groove for support bar clamp
8 All-round holding groove for module (printed circuit)
9 Support bar clamp
10 Card holder, left side

Quick guide

1. Fit together centrepiece of card holder (5) and one of the two side pieces (6) + (10).
2. Insert support bar clamp (9) into trapezoid groove at the back (7).
3. Insert conductor plate into end of all-round holding grove (8).
4. Insert remaining card holder side piece (6) + (10).

6 Typical circuits

6.1 Use of a proportional solenoid to control hydraulic valves

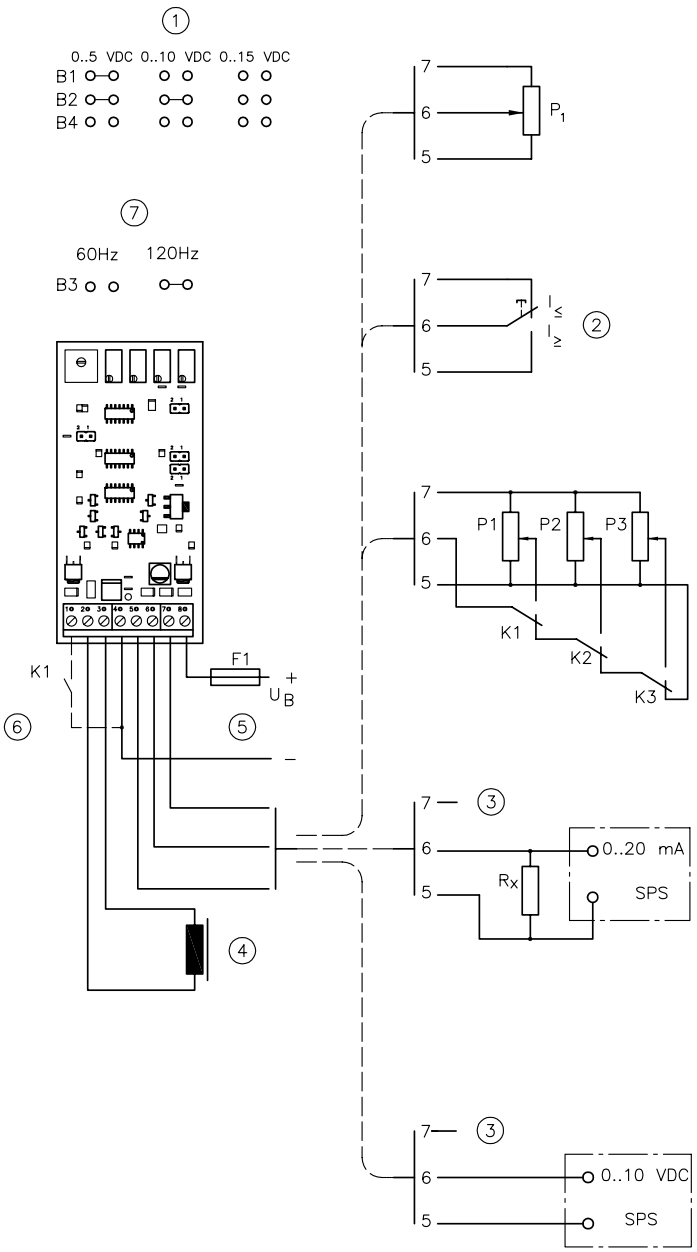

Figure 8: Diagram showing actuation of hydraulic valves with a proportional solenoid

1 Jumper position, Target voltage range
2 Operation
3 Not used
4 Supply
5 Proportional solenoid
6 Enable / Disable
7 Dither frequency

Example A	Operation with target value potentiometer F1 = medium-fast fuse; for nominal see Chapter 5.2, "Setting instructions" P1 = target value potentiometer 10 kΩ, min. 0.1 W. Jumpers B1 and B2 fitted
Example B	Opertation with a target value switch for the two target values set $I_{min\ oper}$ and $I_{max\ oper}$ F1 = see example a above, Jumper B1 and B2 closed
Example C	Operation with a priority-dependant target value switch for four target values (relay switch) Typical example of operation: Fast gear 1 - K 1 → P1 Fast gear 2 - K 2 → P2 Slow gear- K3 → P3 Stop - K1 → K2 → K3 → ⊥ F1 = see example a, Jumper B1 and B2 closed
Example D	Operation with external target value power source from SPS, CNC or PC **Note** Pay attention to the maximum load of the power source! F1 = see example a Rx = 250 Ω/ 0.5 W Jumper B1 and B2 closed
Example E	Operation with external target voltage from SPS, CNC or PC **Note** Whenever the maximum target value voltage of 10V DC (15V DC) is exceeded, the maximum current set will continue to increase! Accordingly, the coil might overheat under excesive power and break down! F1 = see example a, set Jumper B2 for 10V DC, do not set jumper for 15V DC voltage

6.2 Controlling hydraulic valves using one twin or two individual proportional solenoids for alternating operation

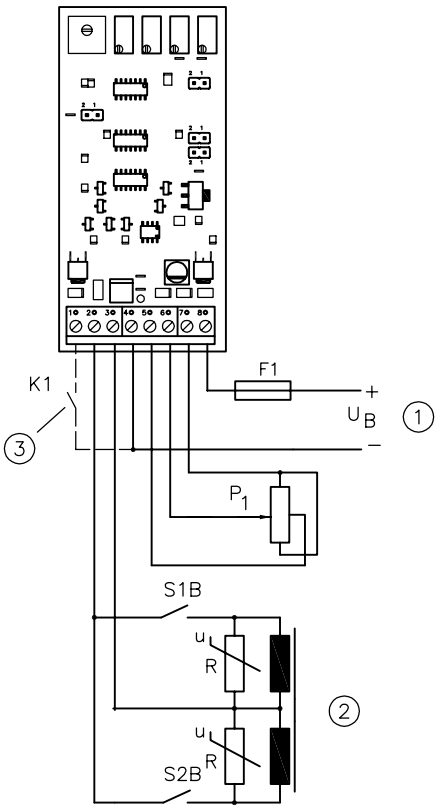

Figure 9: Diagram of actuation of hydraulic valves with twin or two individual proportional solenoids for alternating operation

1 Power supply
2 Proportional twin solenoid or pair of individual proportional solenoids
3 Enable / Disable

This mode of operation requires a remote-control potentiometer for central alignment and side recognition of two positively connected direct switches SB 1 and SB 2 for solenoid coils 1 and 2.

Example F: Controlling a proportional directional valve type PSL or PSV as specified in D 7700-ff.

F1	See examplel a
P1	Potentiometer with fixed central alignment, 2x5 kΩ
R	31V varistor, such as Siemens SIOV S05K25 or SIOV S10K25 (against radio inteference or excess voltage) Jumpers B1 and B2 (ref. voltage 5V DC) are placed, B3 open
S1B and S2B	Directional switches are included in the control gear for one axle

Additional versions

- Proportional amplifier type EV1D: D 7831 D
- Proportional amplifier type EV22K2: D 7817/1
- CAN node type CAN-IO: D 7845 IO
- Programmable logic valve control with Profibus type PLVC 21: D 7845-21
- Programmable logical valve control type PLVC 41: D 7845-41
- Programmable logic valve control type PLVC 8: D 7845 M

Use

- Proportional directional spool valve, type PSL and PSV size 2: D 7700-2
- Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Directional spool valve type NSWP 2: D 7451 N
- Clamping module type NSMD: D 7787
- Directional seated valve type EM and EMP: D 7490/1

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