

Proportional amplifier type EV1M3

Product documentation



Modular construction

Supply voltage U_B : 9...32 V DC

Output current I_A : max. 2.4 A



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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 feedback measurement, even challenging hydraulic applications can easily be realised. A multi-turn potentiometer is used to configure the valve parameters such as the minimum and maximum current, dither and ramps.

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Features and benefits:

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

Intended applications:

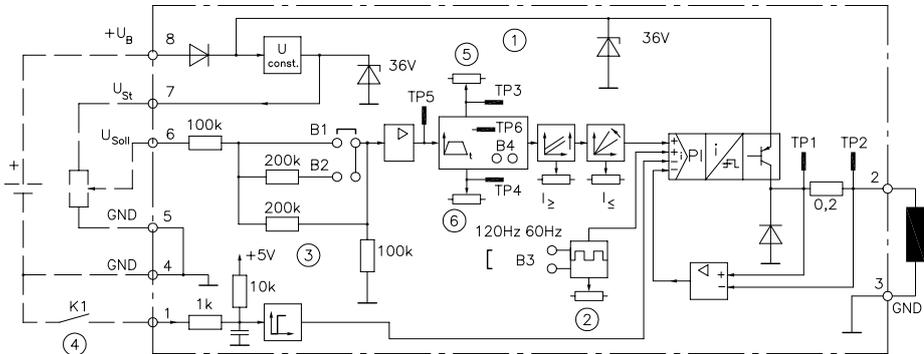
- For the actuation of proportional valves
- Switch cabinet installation in an industrial setting



Figure 1: Proportional amplifier type EV1M3

2 Available versions, main data

Block diagram:



- 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 control 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

Supply voltage 12/24 V DC
(nominal value)

Design and development status

Module with screw terminal connections

Single-acting prop. solenoid

Basic type

Assembly accessories

Order coding example:

KM 7831 010

Internal drawing number

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 block
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
Weight	<ul style="list-style-type: none"> ▪ 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 parameters

Setting range	$I_{\min} = 0 \dots 1.6 \text{ A}$	 Note I_{\max} must never exceed 2.4 A!
	$I_{\max} = I_{\min} + (0 \dots 2.4) \text{ A}$	
	Factory default setting $I_{\min} = 0 \text{ A}$; $I_{\max} = 800 \text{ mA}$	
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 $\pm 4\%$
Input resistance	R_e	>200 k Ω
Recommended potentiometer	P	2...10 k Ω
Ramp time rise-fall	t_r	0.1...10 s Increase and decrease time can be separately adjusted, factory default setting 0.1 s for both
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	l	0...750 mA (tip to tip), factory default setting 0 mA

3.3 Electro-magnetic compatibility (EMC)

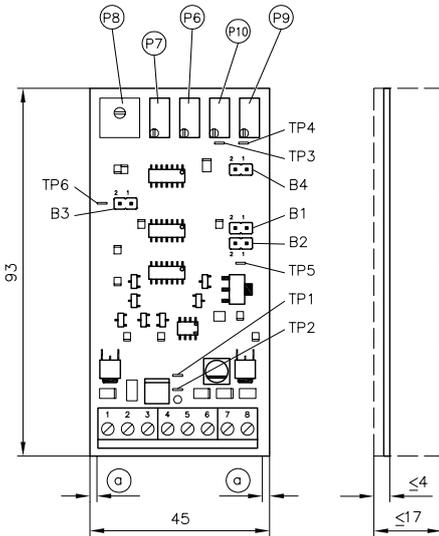
The EMC of the device was tested using an accredited testing laboratory (emitted interference according to EN 61000-6-3 and immunity to interference according to EN 61000-6-2 evaluation criterion "B"). The test set-ups only represent typical use. This EMC testing does not release the user from carrying 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 smoothing capacitor in accordance with [Chapter 3.2, "Electrical Data"](#) is not only needed to ensure the device functions correctly, but also to guarantee compliance with EMC guidelines (conducted emitted interference).
- The equipment should be installed in a 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



Bridges (Jumper)

-  Jumper placed
-  Jumper open

B1, B2 and B3 see [Chapter 6.1, "Actuation of hydraulic valves using a proportional solenoid"](#) and [Chapter 6.2, "Controlling hydraulic valves using one twin or two individual proportional solenoids for alternating operation"](#).

i Note

Leave the bridge (jumper) B4 open. Only change B4 to adjust 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 \pm 0.5 A
TP2	Test point 2 (-) for current feedback measurement, 100 mV \pm 0.5 A
TP3	Test point 3 to adjust ramp UP
TP4	Test point 4 to adjust ramp DOWN
TP5-6	Test points for adjusting the ramp time (see Chapter 5.3, "Fast adjustment of ramp times")

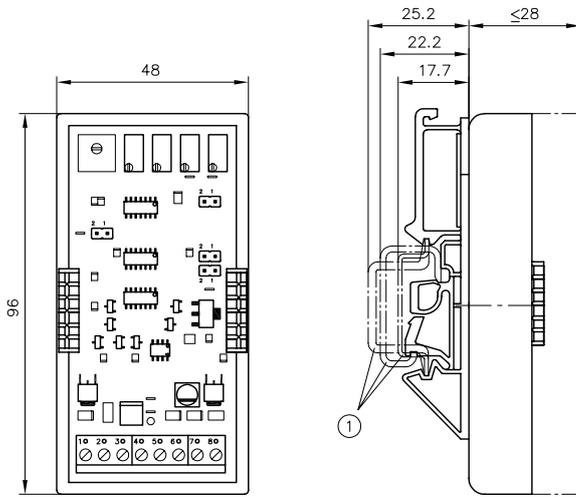
Mounting the printed circuit boards

- a max. 1.8 mm
Area for printed circuit board guide and holder (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



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"](#).

5.1 Information on setting**i Note**

These instructions apply to the target voltage range of 5V using internal stabilized voltage $U_{St} = 5\text{ V}$. Bridges (jumpers) in position as delivered (for other, conceivable bridge positions see [Chapter 6.1, "Actuation of hydraulic valves using a proportional solenoid"](#)).

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 malfunctions and the destruction of the proportional amplifier.
- If the maximum target value voltage of 5, 10 or 15 V DC depending on the bridge rectifier is exceeded, the set current I_{max} or $I_{max\ op.}$ becomes 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 enhance 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 supply voltage with nominal value of 24 V DC of the proportional amplifier. In this case, the supply voltage is converted through the timed output stage, automatically low-loss at a level of 12 V. Advantages: in the entire range of the supply voltage (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.

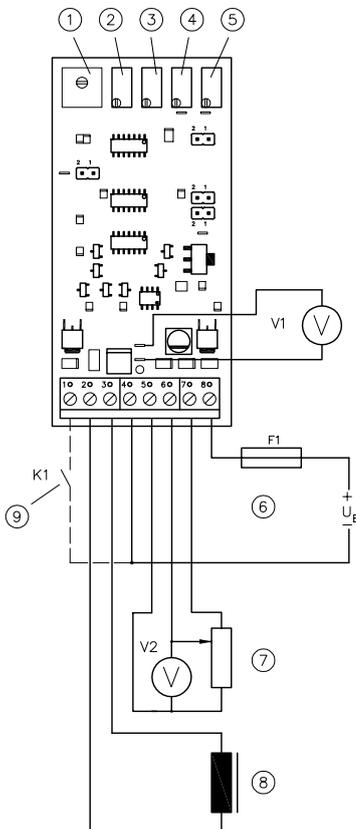
i Note

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

- In the case of rectified bridge configuration:
Check whether an electrolyte 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 $I_{max\ op.}$ 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 \pm 0.5 A



- 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 k Ω
(e.g. wire potentiometer 5 k Ω , 2 W)
- 8 Proportional solenoid
- 9 Enable / Disable

Precondition: The bridges of the amplifier module are provided as part of the delivery.

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 supply voltage 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 supply voltage.
6. I_{min} to the minimum current $I_{min\ op.}$, to which, according to the Q-I or Δp -I characteristic curve of the proportional valve, the desired bottom functional end position 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 the Q-I or Δp -I characteristic curve of the proportional valve, the desired top functional end position 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. $0.5 \times I_{max}$ 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} and t_{down} to the desired time spans. The ramp times always extend beyond the overall range of the output current I_A . For details of the shortened 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 k Ω /V input impedance) and in conjunct with the opposite diagram (refer also to [Chapter 4.1, "Amplifier module"](#) und [Chapter 5.2, "Setting instructions"](#)):

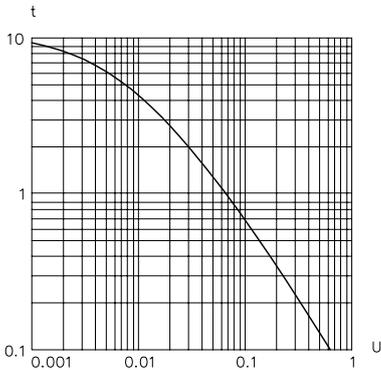


Figure 2: U voltage check voltmeter V1 (V), t ramp time (s)

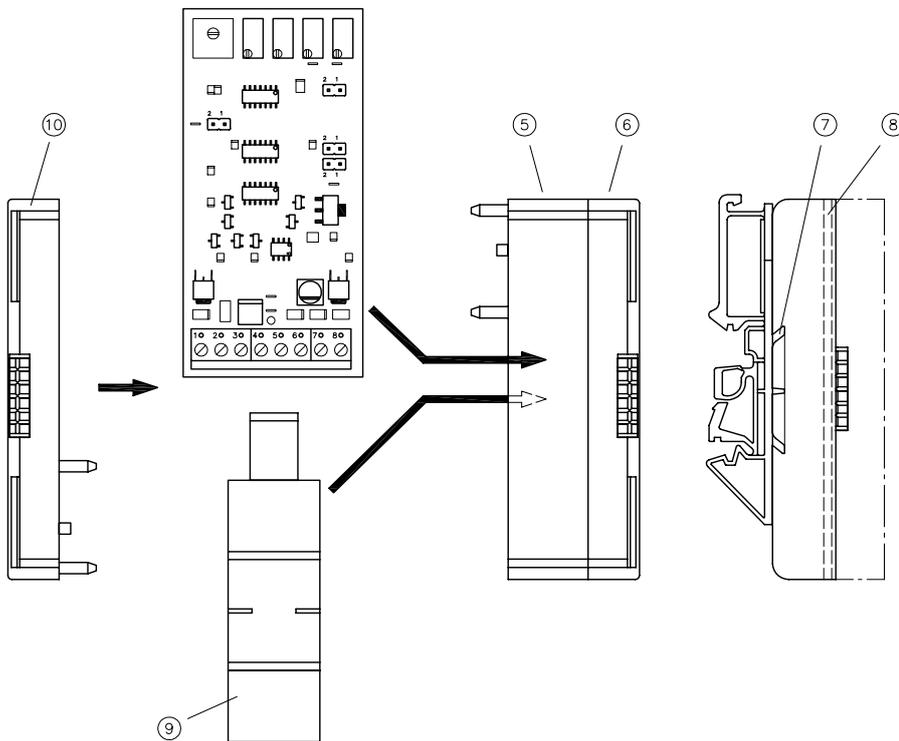
1. Amplifier:
Set jumper B4 and connect supply voltage to terminals 4 and 8
2. Adjusting ramp rise time:
Connect TP5 with 5 V (terminal 7), connect voltmeter between TP6. and TP3 read the required voltage for the ramp rise time from the diagram, set voltmeter to this value using the potentiometer.
3. 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 $t_{\text{up time}}$ and $t_{\text{down time}}$ 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



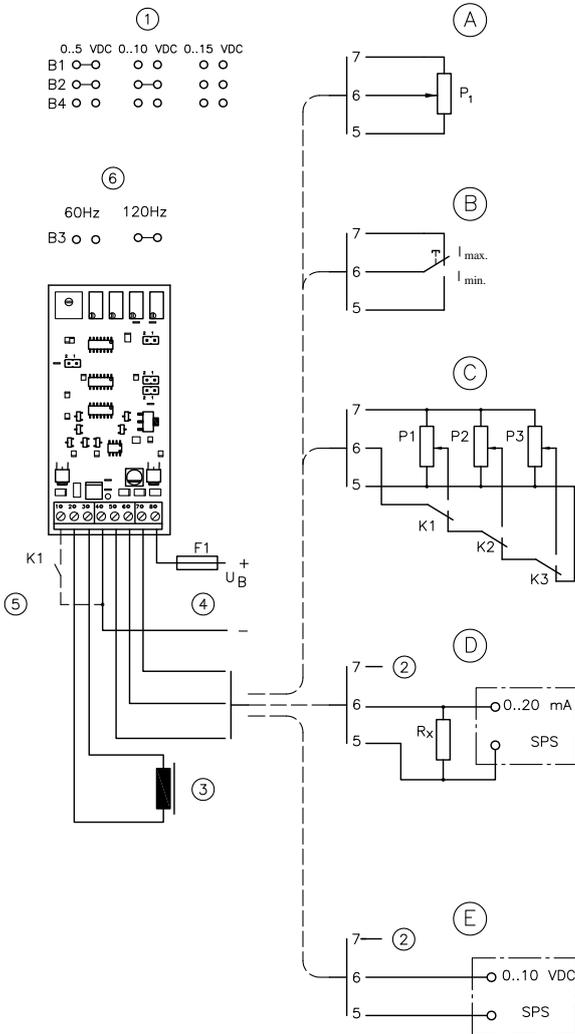
- 5 Centrepiece
- 6 Card holder, right side
- 7 Rear trapezoid guid groove for support bar clamp
- 8 All-round holding groove for module (printed circuit)
- 9 Support bar clamp
- 10 Card holder, left side

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 groove (8).
4. Insert remaining card holder side piece (6) + (10).

6 Typical circuits

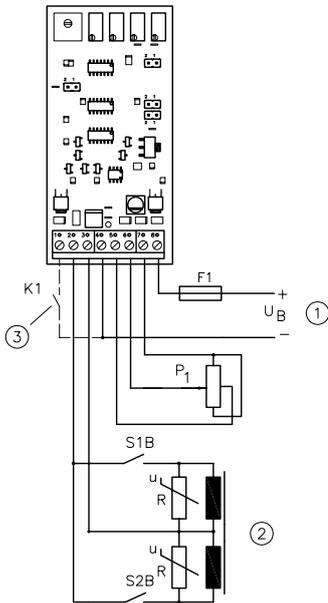
6.1 Actuation of hydraulic valves using a proportional solenoid



- 1 Bridge setting for target value voltage ranges
- 2 Not used
- 3 Proportional solenoid
- 4 Supply
- 5 Enable/block
- 6 Dither frequency

Example A	<p>Operation with target value potentiometer</p> <p>F1 = medium-fast fuse; for nominal see Chapter 5.2, "Setting instructions"</p> <p>P1 = target value potentiometer 10 kΩ, min. 0.1 W</p> <p>Jumpers B1 and B2 fitted</p>
Example B	<p>Operation with target value changeover switch for both configured target values I_{min} and I_{max}</p> <p>F1 = as in example A</p> <p>Bridges B1 and B2 set</p>
Example C	<p>Operation with a priority-dependant target value switch for four target values (relay switch)</p> <p>Typical example of operation:</p> <p>Fast gear 1 - K 1 → P1</p> <p>Fast gear 2 - K 2 → P2</p> <p>Slow gear- K3 → P3</p> <p>Stop - K1 → K2 → K3 → ⊥</p> <p>F1 = as in example A</p> <p>Jumper B1 and B2 closed</p>
Example D	<p>Operation with external target value power source from SPS, CNC or PC</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note Pay attention to the maximum load of the power source.</p> </div> <p>F1 = as in example A</p> <p>Rx = 250 Ω/ 0.5 W</p> <p>Jumper B1 and B2 closed</p>
Example E	<p>Operation with external target voltage from SPS, CNC or PC</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note Whenever the maximum target value voltage of 10V DC (15V DC) is exceeded, the maximum current set will continue to increase!</p> <p>Accordingly, the coil might overheat under excessive power and break down!</p> </div> <p>F1 = as in example A</p> <p>Jumper B2 for 10V DC, do not set jumper for 15V DC voltage</p>

6.2 Controlling hydraulic valves using one 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	As in example A
P1	Potentiometer with fixed central alignment, 2x5 kΩ
R	31V varistor, such as Siemens SIOV S05K25 or SIOV S10K25 (against radio interference 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

Further information

Additional versions

- Electronic 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

Application

- 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