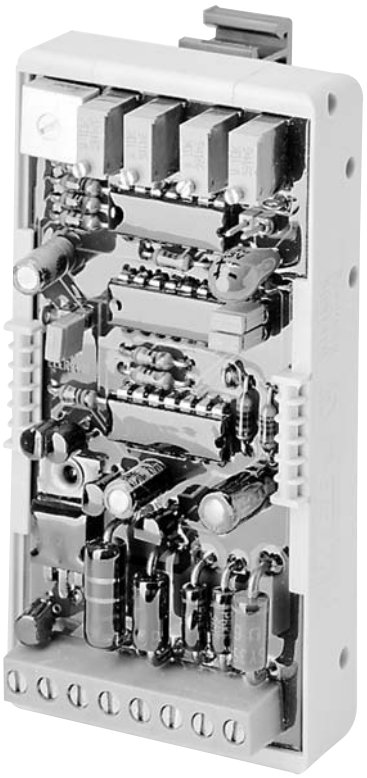
Electronic amplifier type EV1M2-12/24 and EV1M2-24/48

for controlling proportional valves
modular version to be connected via bolt-type terminals



1. General

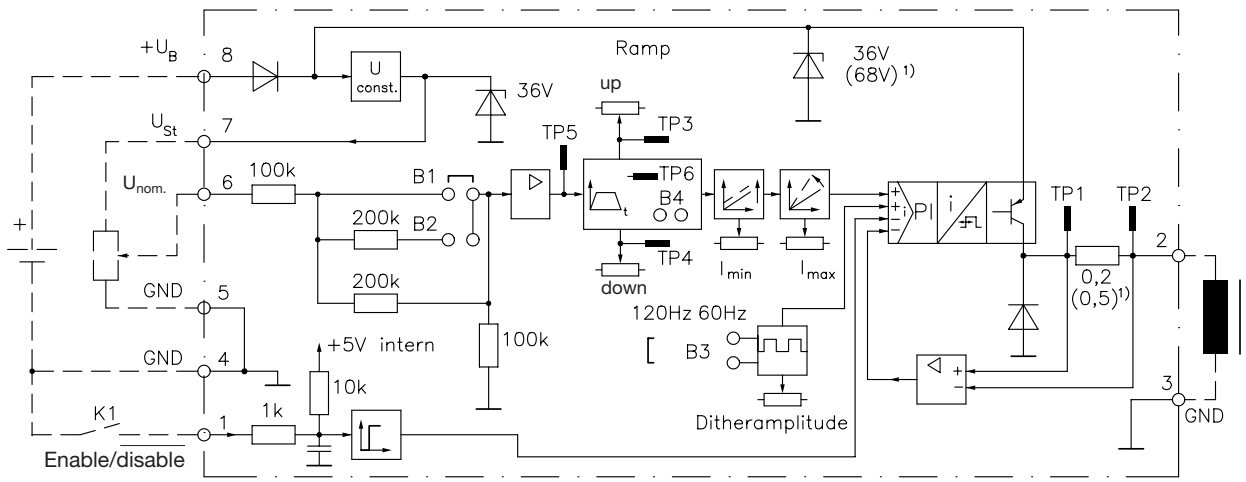
1.1 Brief description and block diagram

The amplifier has a very high control accuracy and can be used to control a proportional solenoid.
EV1M2-12/24 from 12V DC to 24V CD and EV1 M 2-24/48 from 24V DC to 48V DC.

Main components:
Permanent voltage regulator for generating 5V DC stabilized voltage
Linear ramp generator (integrator) with separate adjustment of rise and fall times
Dither oscillator
Current-controlled, chopped terminal stage

Main features:
I_{min} and I_{max} standard and maximum current may be precisely adjusted by multi-gear potentiometer.
Dither amplitude adjustable, dither frequency either 60 or 120 Hz.
Power supply secured against incorrect pole connection
Output protected against short cut and ground
Dither signal superimposed on current output
Enable/disable input (making the ramp ineffective)
Improved EMC (electromagnetic compatibility)
In conjunction with the card holder available as an accessory, this printed circuit with its compact dimensions fits conveniently on to 35 mm or 32 mm support rails in electric cabinets. Thanks to the modular design the connections on an 8-piece pin bar are clearly arranged and easily accessible from the front.

Block diagram



B 4, TP 3-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 sect. 4.2).

1) Values in brackets valid for EV1M2-24/48

TP 1, TP 2 test points for measuring the coil (inductive) current 100 mV ≙ 0.5 A (100 mV ≙ 0.2A)

This amplifier may be used for all HAWE proportional valves, see selection table in D 7810 Ü (over-view) . With electro-hydraulic remote control of PSL(V) directional valves as specified in D 7700-..., always make sure due to the twin proportional solenoids used for switch positions A and B that, depending on the direction of control and activation, there is an automatic, electric switchover to the respective solenoid, for example by a directional switch (micro-switch) in the remote control hand lever potentiometer, see typical circuit diagram in sect. 5.2.

2. Available versions , type coding

A card holder, as specified in sect. 2.2, must be ordered as an accessory for each module as specified in sect. 2.1, since this is essential to securely fasten the module on the 35 mm or 32 mm support bar. The module board is very compact, there for it does not feature any pre-drilled holes, etc. for any other kind of fastening (for example on bold rods).

2.1 Module

Order coding: **EV 1 M 2 -12 /.24.**

- Basic type
- Single-action proportional solenoid control
- Module with bolt-type terminal connections
- **12/24** Supply voltage 12/24 VDC (nominal)
- **24/48** Supply voltage 24/48 VDC (nominal)
- Design and development status (internal code)

2.2 Accessories for assembly

Order coding: **KM 7831 010**

- Module card holder
- Internal drawing number

2.3 Specifications

2.3.1 General data

Nomenclature	Electronic amplifier for 12V DC to 24V DC bzw. 24V DC to 48V DC
Design	Module with 8-pin bolt connection rail
Connection leads	max. 1.5 mm^2
Fastening	Only via card holder (accessory) on 35 mm standardized support bars to DIN EN 50 022 or 32 mm support bard to DIN EN 50 035
Installation position	Any
Mass (weight)	Module 45 g, card holder 40 g
Type of protect. IEC70(CO) 13	IP 00
Ambient temperature	-20... + 50°C (up to 70°C at 75% of the max. power output I_A)

2.3.2 Electrical data

		EV1M2-12/24	**EV1M2-24/48**
Supply voltage	U_B	9 ... 32V DC	18 ... 65V DC
max. perm. ripple factor	W	10%	
Required filter capacitor	C_B	2200 µF per 1 A induction current	
Output voltage	U_A	U_B -1.2V DC, pulse-width modulated	
Output current	I_A	max. 2.4 A short circuit proof protect.	max. 1.5 A
Setting range	I_{min}	0 ... 1.6 A	0 ... 1.5 A
	I_{max}	I_{min} + (0 .. 2.4) A	I_{min} + (0...1.5) A
		Pre-setting: I_{min} = 0 A; I_{max} = 1 A	
No-load current	I_L	max. 20 mA (own consumption)	
Voltage ranges	$U_{nom.}$	adjustable, select 0 ... 5V DC, 0 .. 10V DC or 0 ... 15V DC Pre-setting: 0...5VDC	
Reference voltage	U_{St}	5V DC±4%	
		load capacity max. 5 mA (stabilized voltage to supply potentiometer P 1)	
Input resistance	R	> 200 kΩ	
Recommended potentiom.	P	from 2 kΩ up tp 10 kΩ	
Ramp time rise-fall	t_R	0.1 .. 10s	
		Ramp, linear rise time and fall time separately adjustable factory pre-setting: 0.1s for both (minimum)	
Enable/$\overline{\text{disable}}$ input		TTL compatible or can be triggered with a contact (if blank release output)	
Dither frequency	f	60 or 120Hz switchable; factory pre-setting: 60 Hz	
Dither amolitude		0 ...750 mA (peak-to-peak)	

2.3.3 Electro-magnetic compatibility (EMC)

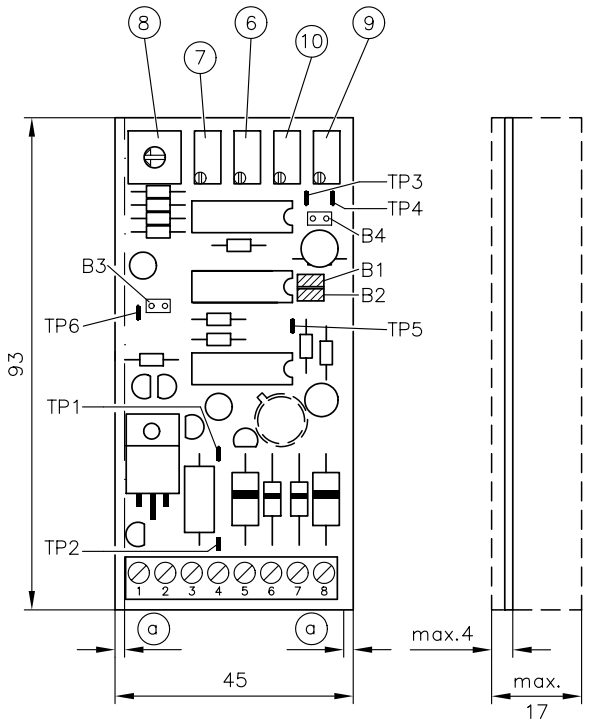
The electro-magnetic compatibility has been tested by an accredited approval institute (criteria "B": Interference emission acc. to EN 50 081 and interference immunity acc. to EN 50 082). This EMC test doesn't relieve the user from the proper execution of a specified EMC check for his complete system (accordingly to regulation 89/336/EWG), since the test assemblies represent only a typical application. The following measures should be checked, if the EMC of the complete system must be strengthened further:

- The required filter capacitor (see sect. 2.3.2) 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)
- All cables, leading in or out of the device should be kept as short as possible. The should be also be shielded and twisted in pairs. (This will reduce the antenna effect and increase the interference immunity).

3. Dimesions

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

3.1 Printed circuit



B1 - B4 bridges (jumpers)

Jumber placed

Jumber open

B 1, B2 and B3 see sect.5.1 and 5.2
B4 is only for adjusting the ramp time
(see section 4.2)
Attention: B4 must otherwise be kept open !

Direction of potentiometer rotation – +

(6) Potentiometer ramp down time t_{down} (25 turns)
(7) Potentiometer ramp up time t_{up} (25 turns)
(8) Potentiometer dither amplitude
(9) Potentiometer basic current I_{min} (25 turns)
(10) Potentiometer maximum current I_{max} (25 turns)

TP 1 + test point 1 for measuring current [1])
TP 2 - test point 2 for measuring current [1])
TP3 test point 3 to adjust ramp UP
TP 4 test point 4 to adjust ramp DOWN
TP 5-6 test points to adjust ramp times (see sect. 4.2)

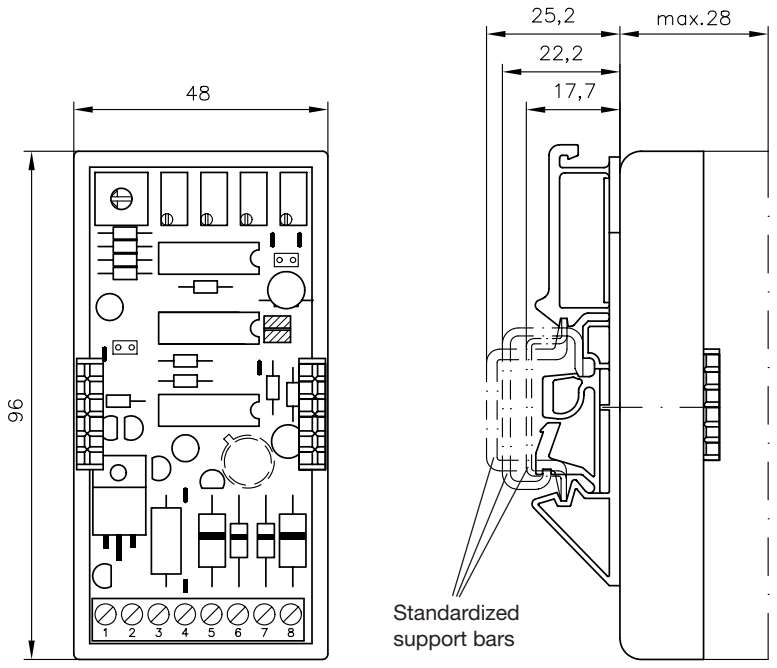
(a) max. 1.8 mm
Range for securing and moving printed circuit (see also sect. 6.1)

[1]) 100 mV ≙ 0.5 A for EV1M2-12/24
100 mV ≙ 0.2 A for EV1M2-24/48

Plan of terminal connections:

Kl. 1 enable/$\overline{\text{disable}}$ input
Kl. 2 solenoid
Kl. 3 zero Volt, ground for solenoid
Kl. 4 zero output, power
Kl. 5 zero Volt, signal ground
Kl. 6 reference input
Kl. 7 U_{St} stabilized voltage (+5VDC)
Kl. 8 $+U_B$ supply voltage

3.2 Printed circuit fitted in card holder



See above for description of printed circuit

Assembly of card holder see sect. 6

4. Instructions for assembly and installation

4.1 Instructions for installation

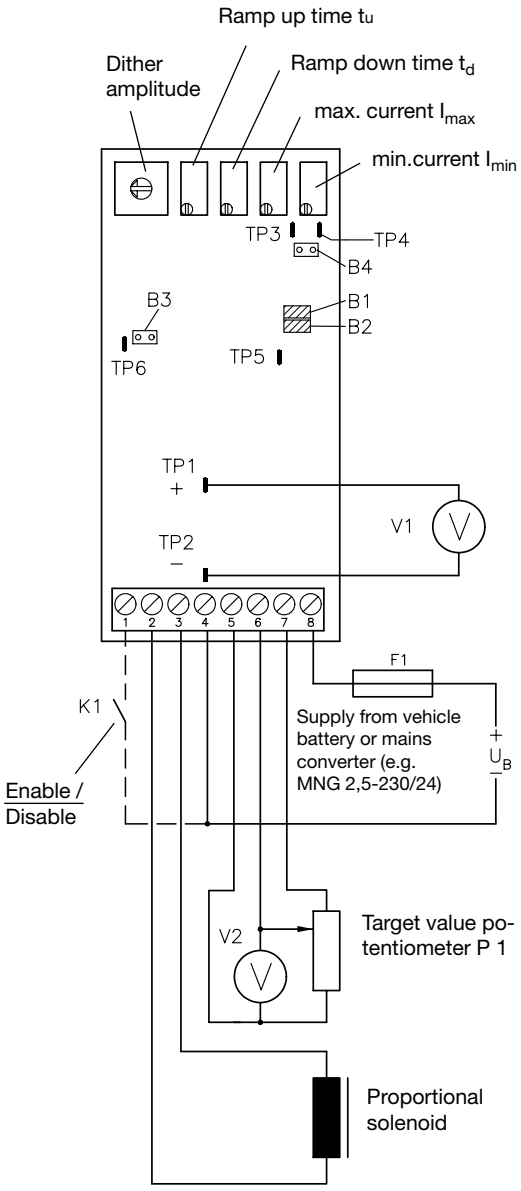
These instructions apply to the target voltage range of 5V using internal stabilized voltage U_{st} = 5V.

Bridges (jumpers) in position as delivered (for other, conceivable bridge positions see section 5.1)

For assembly of printed circuit on card holder see section 6.

Note: Any external target voltage fed into the system must not be or become negative. Negative voltage may lead to malfunction and destruction of the proportional amplifiers. When exceeding the maximum target voltage of 5, 10 or 15V DC, depending on the bridge circuit, the current set I_{max} or $I_{max\ oper}$ becomes ineffective, i.e. it increases beyond the threshold set.

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.



F1 = 2,5 A mT fuse
V 1 = Voltmeter for measuring coil current, 100 mV = 0.5 A (e.g. analogue or digital multimeter
TP 1 = Test point 1
TP2 = Test point 2
P1 = Target value potentiometer 0.5-10 kΩ (e.g.4 kΩ, 2 W wire potentiometer, BÜRKLIN model Nr: 72E 422)

(1) Amplifier connection:
Proportional solenoid to pins 2 and 3
Voltmeter V 1 to test points TP 1 and TP 2 (for measuring coil voltage)
Target value potentiometer to pins 5, 6 and 7
Supply voltage to pins 4 and 8

(2) Set target value potentiometer for setting procedure (6) to minimum (0V) (ground side; pins 3, 4 and 5 are interconnected internally within printed circuit)

(3) Pre-set dither amplitude (dither potentiometer in the middle)

(4) Set ramp times t_d and t_u to minimum (turn ramp potentiometer anti-clockwise until reaching the stop position. Multi-potentiometer (25 turns)

(5) Switch on supply voltage

(6) Set I_{min} potentiometer to minimum current Iminoper which, in accordance with the Q-I or Δp-I curve of the proportional valve, corresponds to its lower, desired terminal function point in operation. See sect. 2.3.2 for the adjustable I_{min} range. Read $I_{min\ oper}$ from voltmeter V1 connected between test points TP 1 and TP 2, applying a current scale of see above

(7) Set target value potentiometer for step (o) to max. Read target value voltage off voltmeter V 2 (env. 5V)

(8) Set I_{max} potentiometer to maximum current $I_{max\ oper}$ which, according to Q-I or Δp-I curve of the proportional valve, corresponds to its upper, desired terminal function point in operation. See section 2.3.2 for the adjustable I_{max} range

(9) Dither frequency f is set by the supplier to 55 Hz by means of open bridge B3. In most cases this is sufficient. However, it may be increased to 110 Hz by closing bridge B3, this setting being more appropriate for relatively small proportional valves (fitted, for example, with 25 ⌀ proportional solenoids)
Adjust potentiometer P 1 to 0.5 x I_{max} (inductance current). To determine the dither amplitude turn the ditherpotentiometer clockwise until vibrations on the proportional valve can just be felt but without it beginning to cause disturbances.

(10) Set ramp times tu and td to the periods desired. In all cases ramp times cover the entire range of output current I_A. To speed up the setting-up procedure see section 4.2

(11) Check the function parameters set: $I_{min\ oper}$ (item (6)) at U_{tar} = 0V DC; Imaxoper (item (8)) at U_{tar} = 5VDC, dither amplitude (item (9)) and ramp times (item (10)). If necessary, repeat setting procedures.

⑫ Further instructions
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 2200µF/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.

With the proportional amplifier operating at a supply voltage of 24V DC nominal, solenoid coils for 12V may also be used, in which case the supply voltage is automatically converted of the 12V level by the clocked terminal stage and with minimum loss. An important point to be observed in this case is that maximum permissible output current I_A tor the proportional amplifier and limit current I_{Lim} for the solenoid coil are not exceeded.
Advantages: The proportional valve remains operative throughout the entire supply voltage range (e.g. from 12-32V DC). In addition, the response times of the solenoid coil become shorter and the hydraulic system there-fore works more quickly.
For higher supply voltages (i.e. for a EV1M2-24/48) a solenoid coil for 24V DC should be used.

4.2 Fast adjustment of ramp times

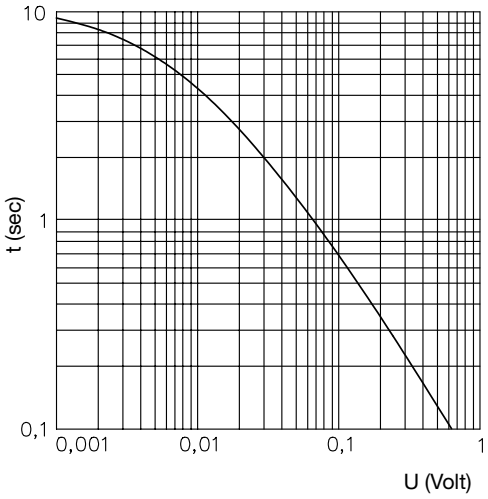
The ramp times are normally adjusted by trial-and-error. This is the simplest method of adjustment, but it is also very time consuming. The relationship between ramp times and the rotary motions of the trimming potentiometer (25-turn) is not linear.
The ramp times can be adjusted accurately (±15%) using a digital voltmeter (minimum 100 kΩ/V input impedance) and in conjunct. with the opposite diagram (refer also to sect. 3.1 and 4.1). The procedure is as follows:

a Amplifier:
Set jumber **B4** and connect supply voltage to terminals 4 and 8

b 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.

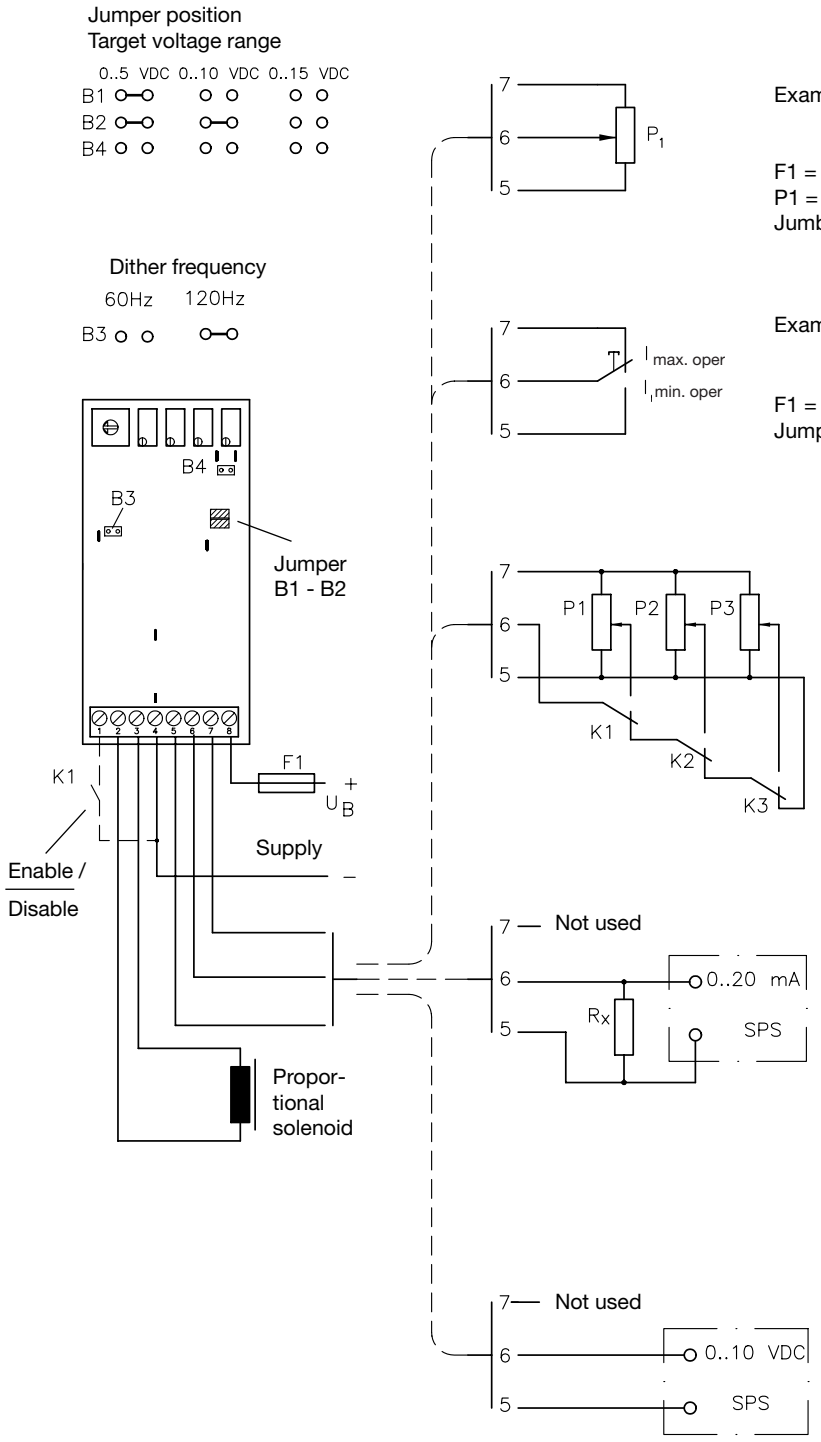
c Adjusting ramp fall time:
Connect **TP5** with 0 V (terminal 5), connect voltmeter between **TP6** and **TP4** , read the required voltage for the ramp fall time from the diagram set voltmeter to this value using the potentiometer.

d Remove jumper **B4** :
Caution: If **B4** jumper is set, the proportional amplifier will not work !



5. Typical circuits

5.1 Use of a proportional solenoid to control hydraulic valves



Example a: Operation with an external target value potentiometer

F1 = medium-fast fuse; for nominal see sect. 4.1 .
P1 = target value potentiometer 10 kΩ, min 0.1 W
Jumber B1 and B2 closed, other bridges open

Example b: Operation 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, other jumper open

Example c: Operation with a priority-dependant target value switch for four target values (relay switch)

Typical example of operation:

Fast gear 1 -	K1 → P1
Fast gear 2 -	K2 → P2
Slow gear -	K3 → P3
Stop -	K1 → K2 → K3 → ⊥

F1 = see example a above
Jumper B1 and B2 closed, other jumper open

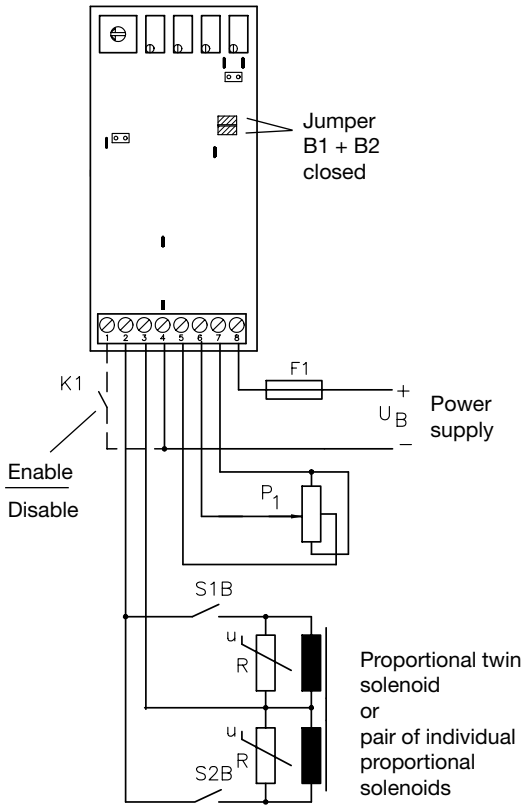
Example d: Operation with external target value power source from SPS, CNC or PC
Important: Note the maximum load all owedfor the power source

F1 = see example a above
Rx = 250 Ω/ 0.5 W
Jumper B1 and B2 closed, other jumper open

Example e: Operation with external target voltage from SPS, CNC or PC
Important: Whenever the maximum target value voltage of 10 VDC (15 VDC) is exceeded, the maximum current set will continue to increase. Accordingly, the coil might overheat under excessive power and break down.

F1 = see example a above
Set jumper B2 for 10V DC, do not set jumper for 15V DC voltage

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



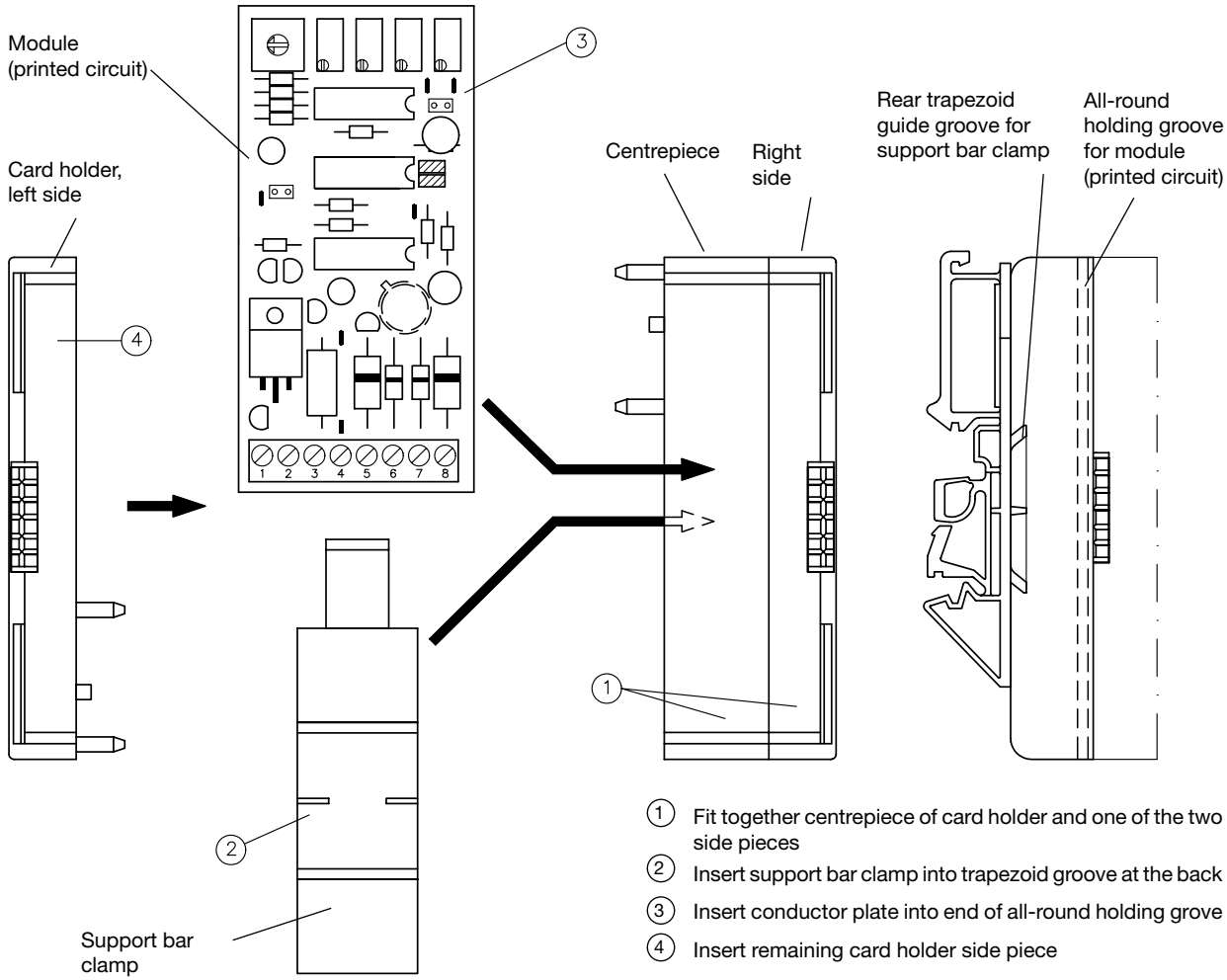
This mode of operation requires a remote-control potentiometer for central alignment and side recognition of two positively connected direct. switches SB 1 and SB 2 for solenoid coils 1 and 2

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

F1 = see example a above
P1 = Potentiometer with fixed central alignment, 2x5 kΩ
R = 31V varistor, such as a Siemens SIOV-S05K25 or SIOV-S10K25 (against radio interference or excess voltage)
Jumpers B1 and B2 (ref. voltage 5 VDC) are placed, B3 open
S1 B and S2 B = directional switches are included in the control gear for one axle

6. Appendix

6.1 Installation of printed circuit module on card holder



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