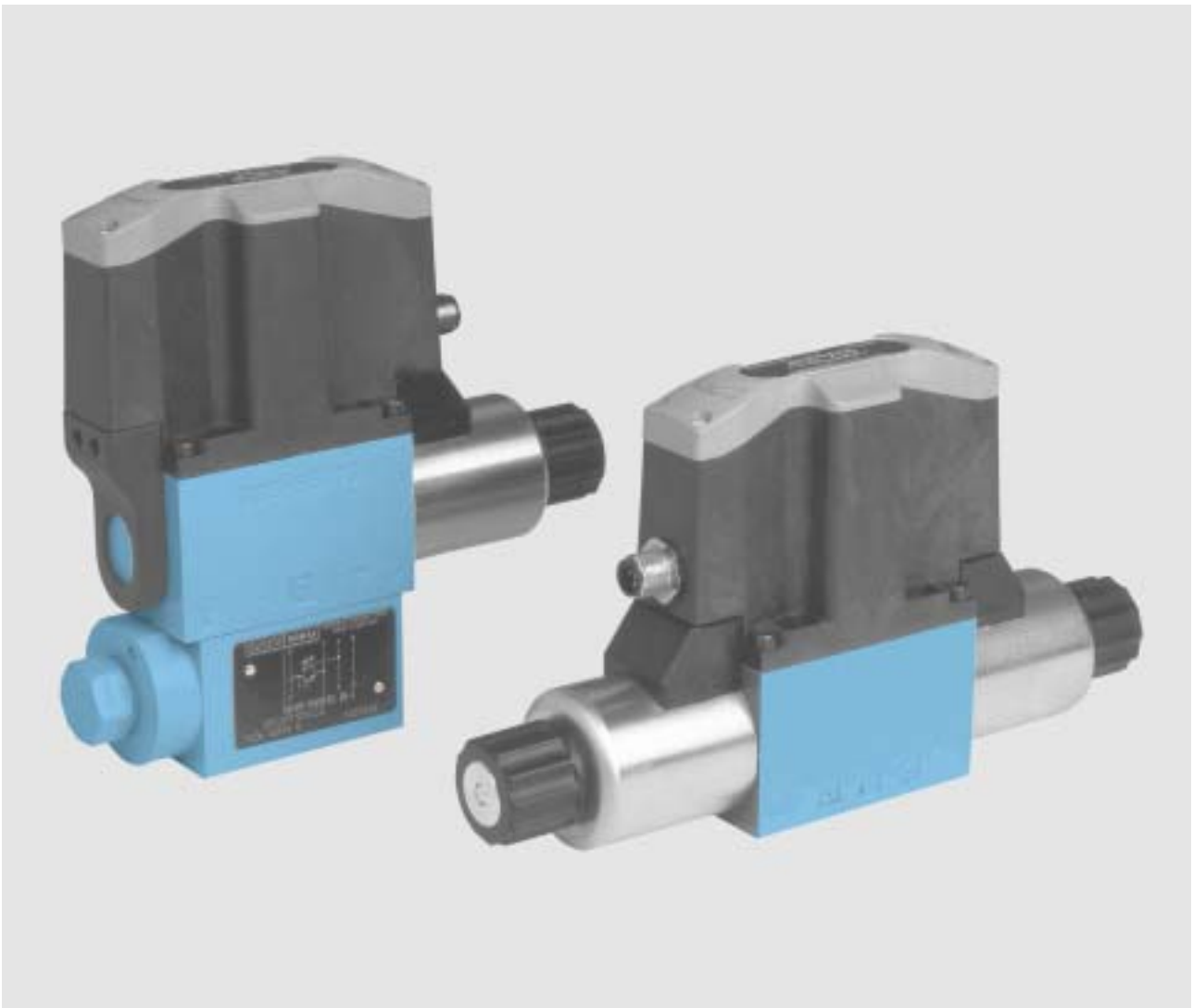
 www.khadamathydraulic.com
Tell: 021-55882749
Tell: 021-33488178
Fax: 021-33488105

DENISON HYDRAULICS

Proportional Directional Valves

Series 4DP01 with Onboard Electronics – Cetop 03



Publ. 4-EN 3160-A

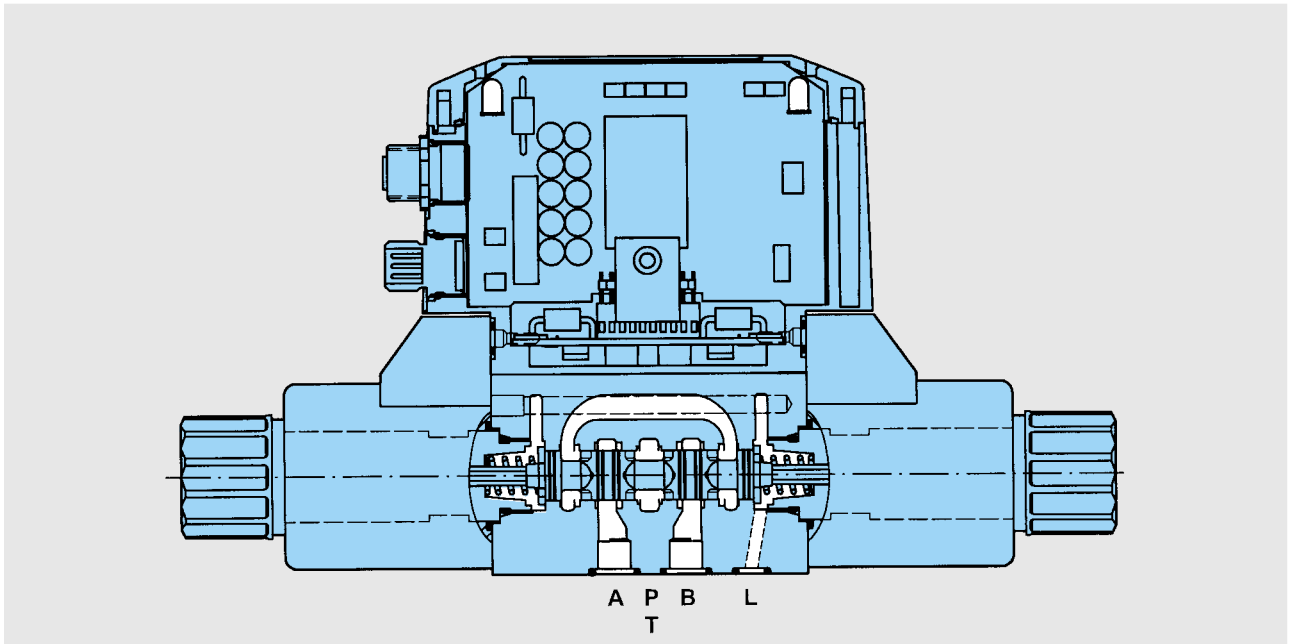
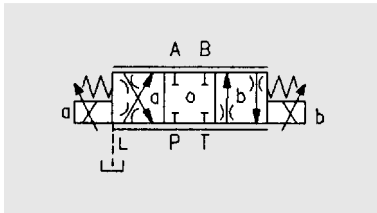
DENISON Hydraulics

FEATURES, SYMBOL, DOUBLE FLOW

FEATURES

- Onboard Electronics factory set for high grade of repeatability.
- Diagnostic lights as standard (three colour).
- Spools for various functions and flows to match precise system requirements.
- Also suitable for double flow operation (see below).
- Response time adjustable by integrated ramp time generators as standard.
- Electrical connection by standard M12 plug-in connectors, to be ordered separately (see page 13).
- Stackable 2- and 3-port pressure compensators offer constant flow independent of load induced pressure changes. Available in three different pressure drop ranges (see page 15).
- Mounting configuration conform to ISO 4401.
- World wide DENISON service.

SYMBOL (example)

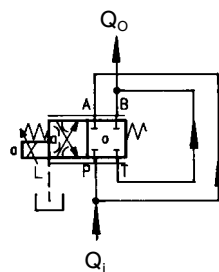


DOUBLE FLOW PATH

By splitting the flow between two spool edges, the 4DP01 proportional directional valve can control considerably higher flow than to be achieved by a single flow circuit.

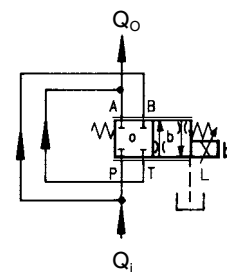
For this application, a body with drain port L must be used. In this case the maximum permissible operating pressure is the maximum permissible pressure in port T (210 bar).

Spool position 06



For spool 13 only

Spool position 05



	Flow at pressure drop Δp 5 bar Spool type 13
Single flow path	10, 20, 30 l/min
Double flow path	21, 33, 43 l/min

DESCRIPTION

GENERAL

The proportional directional valves, 4DP01 series, are direct operated by proportional solenoids and are, therefore, dynamically independent of pilot oil or supply pressure.

In the de-energised state, the spool is held in neutral position by springs. An electrical input signal (command-signal) changes the setting of the hydraulic output (flow). See diagram on page 6.

Energising the opposite solenoid reverses the flow direction.

The force of the proportional solenoid moves the spool against a spring. When the spring compresses sufficiently, the reaction force of the spring is equal to the solenoid force and a balance is reached between the two.

In proportion to each signal input, a certain balance point between the spring and solenoid force determines a particular spool stroke and spool position.

With each spool position, a certain throttling cross-section is given at the spool edges. The flow characteristics of different valves depend on the resistance profile of the throttle notches.

ONBOARD ELECTRONIC

The Onboard Electronic is tested and factory set in conjunction with a specific valve. It provides the full function of an amplifier card in a compact design on top of the valve. The factory setting of the electronics together with the valve ensures optimum interchangeability from valve to valve and minimises the setting requirement in the field. Diagnostic lights monitor three valve conditions.

DRAIN LINE

Where the T-port is exposed to pressures > 160 bar (see page 4) or where the return line flow causes large pressure peaks in the return line, body with port "L" must be selected and connected to tank. The valves should be mounted below the oil level of the tank. This ensures that the valve is at all times filled with oil.

Where it is necessary to mount the valve above the oil level of the tank, it is recommended that ports T and L are preloaded by means of a check valve with a back pressure spring of 1 ... 2 bar, mounted in the drain line.

PRESSURE COMPENSATORS

The flow of a proportional valve equates to $Q = f(\Delta p; A)$, the pressure differential Δp across the throttling orifice A.

Pressure compensators sense the Input and Output pressure of the proportional valve and maintain a constant pressure differential (Δp).

In combination with 2- or 3-port pressure compensators, proportional valves maintain flow or speed independent of load pressure changes.

TECHNICAL DATA

GENERAL AND HYDRAULIC CHARACTERISTICS

- Design Sliding spool valve, proportional controlled, without feedback
- Mounting position Optional but horizontal recommended (see also page 3)
- Type of mounting Subplate body according to ISO 4401
- Max. operating pressure

P, A, B	T	L
– drain port "L" connected	350 bar	210 bar 10 bar
– without drain port "L"	350 bar	160 bar
- Flow see curves page 7
- Nominal flow 10 / 20 / 30 l/min
(at $\Delta p = 5$ bar each metering edge)
- Fluid temperature range – 18... + 80 °C
- Ambient temperature range – 18... + 50 °C
- Viscosity range 10... 650 cSt; optimal 30 cSt
- Hysteresis $\leq 5\%$
(at $\Delta p = 100$ bar)
- Repeatability $\leq 3\%$
(at $\Delta p = 100$ bar)
- Min. response time

	1-connector version	2-connector version
	with min. ramp time setting	with ramp function switched off
– step signal 0... 100 %	125 ms	50 ms
– step signal 100... 0 %	100 ms	80 ms
– step signal $\pm 100\%$	160 ms	125 ms
- Fluid Mineral oil according to DIN 51524/25 (other fluids on request)
- Contamination level Fluid must be cleaned before and continuously during operation by filters that maintain a cleanliness level of NAS 1638 Class 8 (Class 9 for 15 Micron and smaller). This approximately corresponds to ISO 17/14. Better cleanliness levels will significantly extend the life of the components. As contaminant entrainment and contaminant generation may vary with each application, each must be analysed to determine proper filtration to maintain the required cleanliness level.

ELECTRIC CHARACTERISTICS

- Supply voltage (DC) 24 V
- Coil resistance

– cold start 20 °C	3.7 Ω
– warm value 50 °C	4.51 Ω
- Maximum current 2.2 A
- Max. coil temperature + 180 °C
(temperature class H)
- Type of protection (DIN 40050) IP 65
- Relative operating period 100 %

If the performance characteristics outlined above do not meet your own particular requirements, please consult your local DENISON Office.

ORDERING CODE

Model No.:

4DP01

-

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B

..

...

-

..

B

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-

...

..

-

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1 Series

01 = Cetop 03

2 Body

3 = Standard body
L = body with drain port "L"
(always connect "L" to tank
when T > 160 bar)

3 Control

B = solenoid operation with Onboard Electronics
without position feedback

4 Spool Type

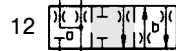
Spool position 03



Spool position 06



Spool position 05



5 Flow P-A; B-T or P-B; A-T

(at 5 bar Δp for each metering edge)
F10 = 10 l/min
F20 = 20 l/min
F30 = 30 l/min

6 Spool Position

03 = 3 (a, o, b), spring centered pos. "o"
05 = 2 (o, b), spring centered pos. "o", energised to "b"
06 = 2 (o, a), spring centered pos. "o", energised to "a"

7 Design Letter

8 Seal Class

1 = NBR seals
5 = FPM seals (Viton®)

9 Command Signal

4MA = 4...20 mA (single and double solenoid)
10V = 0...10 V (single solenoid), -10 V...+10 V (double solenoid)

10 Electrical Connector

CA = 1 connector M12 (standard)
CB = 2 connectors M12 (second connector for external emergency stop and ramp on/off function)
(Plug-in connectors must be ordered separately, see page 13)

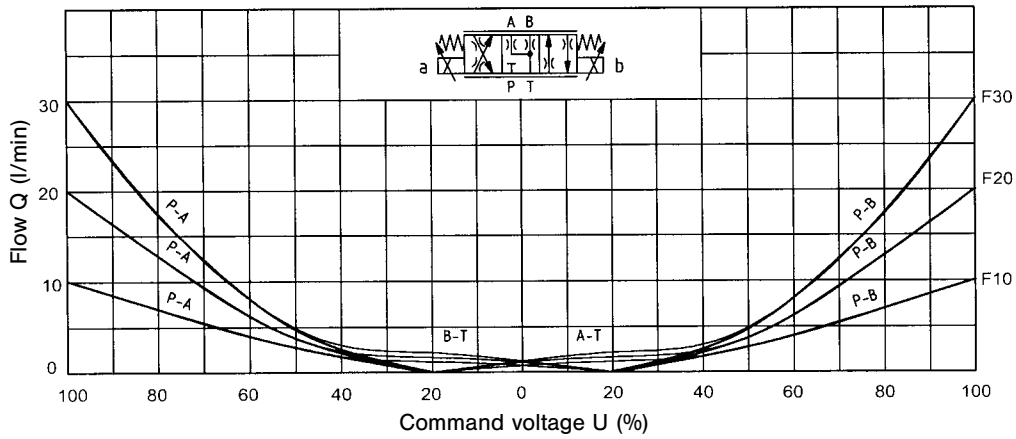
11 Modification

Note: For ordering information on Cetop 03 pressure compensators see page 15.

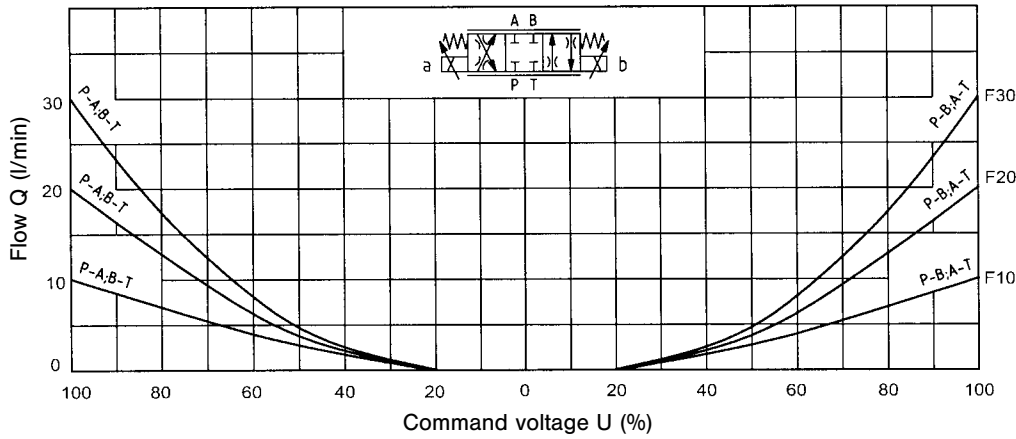
CURVES

Oil temperature 50 °C; viscosity 40 cSt.

Spool 02 ($\Delta p = 5$ bar for each metering edge)



Spool 43 ($\Delta p = 5$ bar for each metering edge)



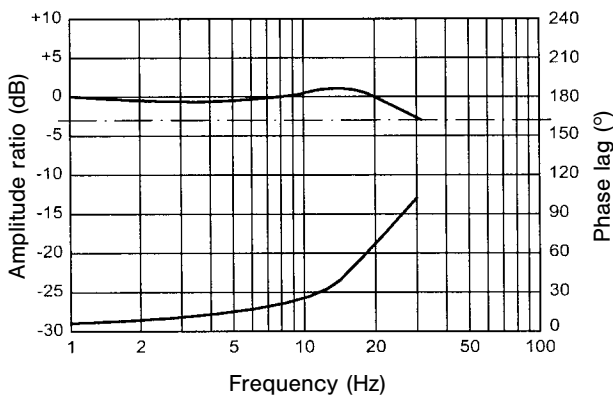
Nominal flow

In the case of a different pressure drop (e.g. in combination with a pressure compensator), the flow is altered as follows:

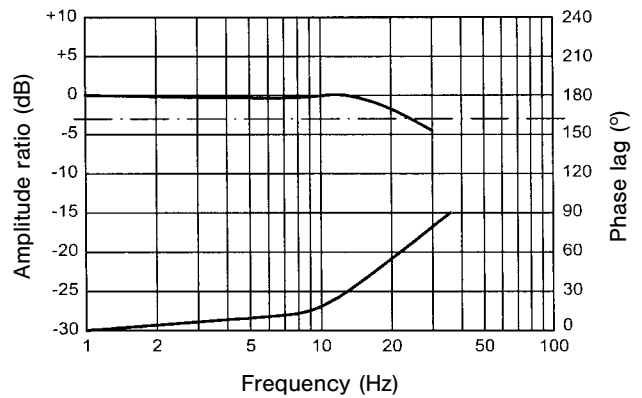
$$Q_x = Q_N \cdot \sqrt{\frac{\Delta p_x}{5}}$$

Attention: Q_{max} see page 7

Frequency characteristics (Signal 50% ± 25%)
double solenoid

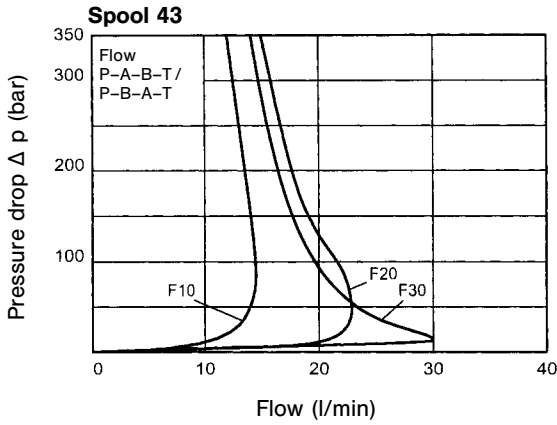
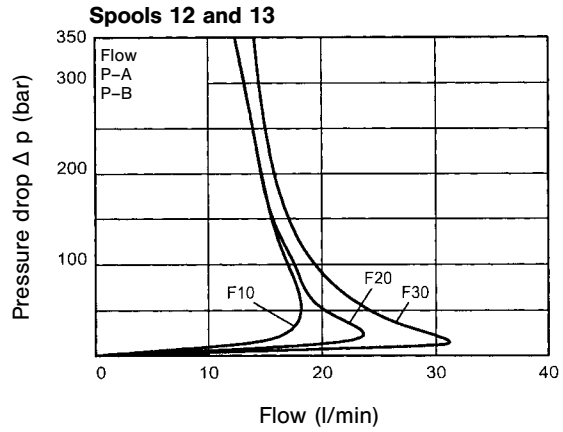
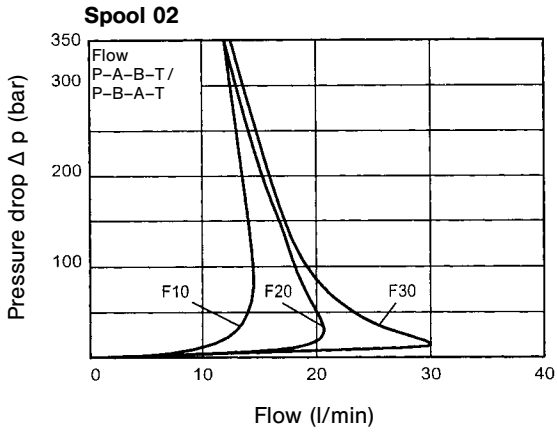


Frequency characteristics (Signal 50% ± 25%)
single solenoid



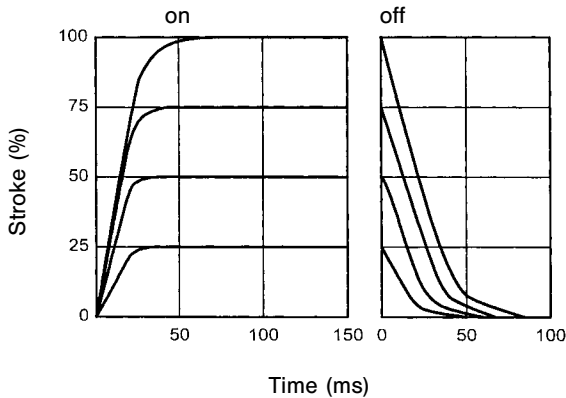
FUNCTIONAL LIMITS – STEP RESPONSE TIME

Oil temperature 50°C; viscosity 40 cSt.

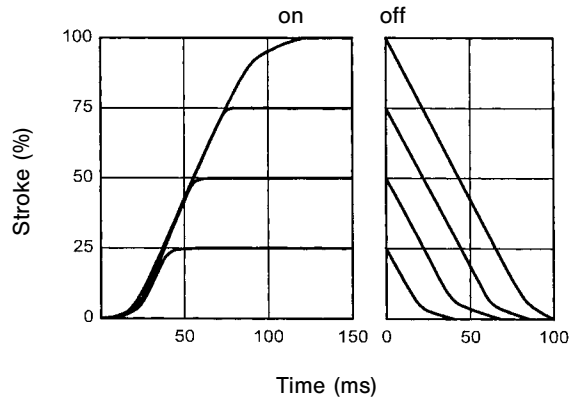


Step Response Time (at $\Delta p = 5$ bar each metering edge)

Ramp function switched off
(for electrical connector code CB only)



With min. ramp time

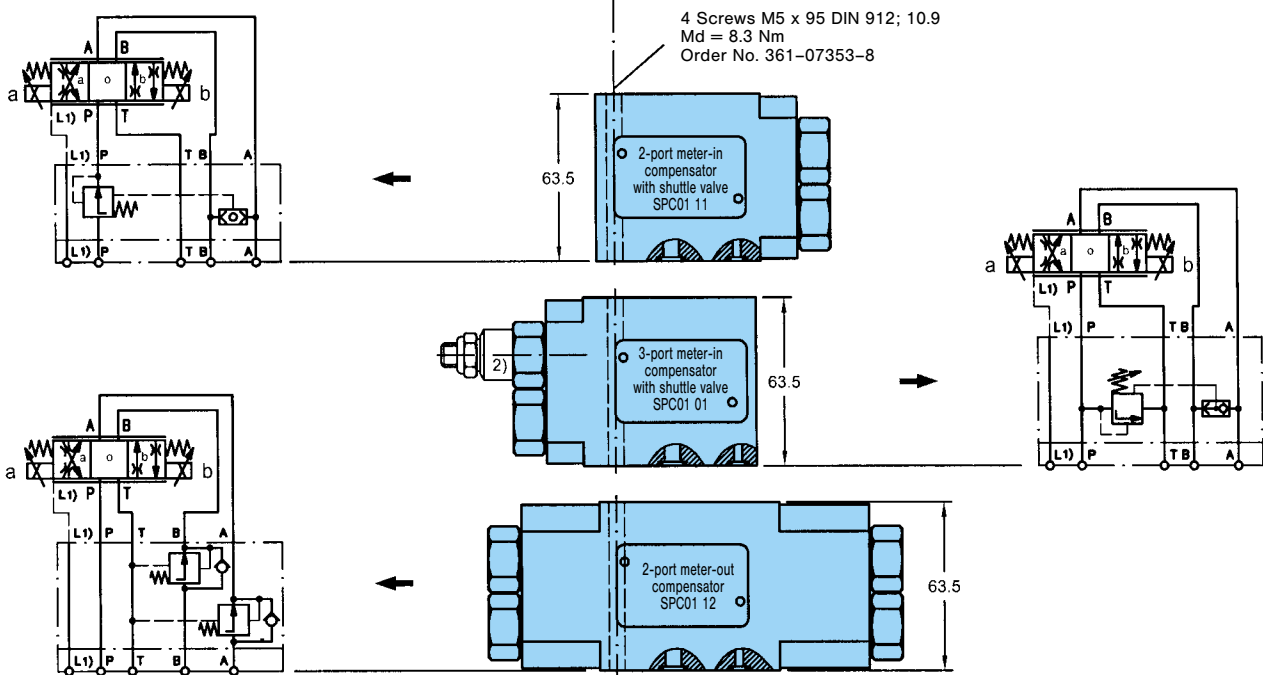
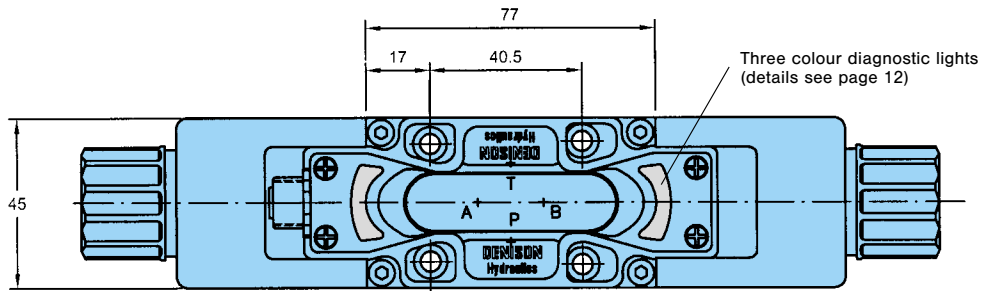
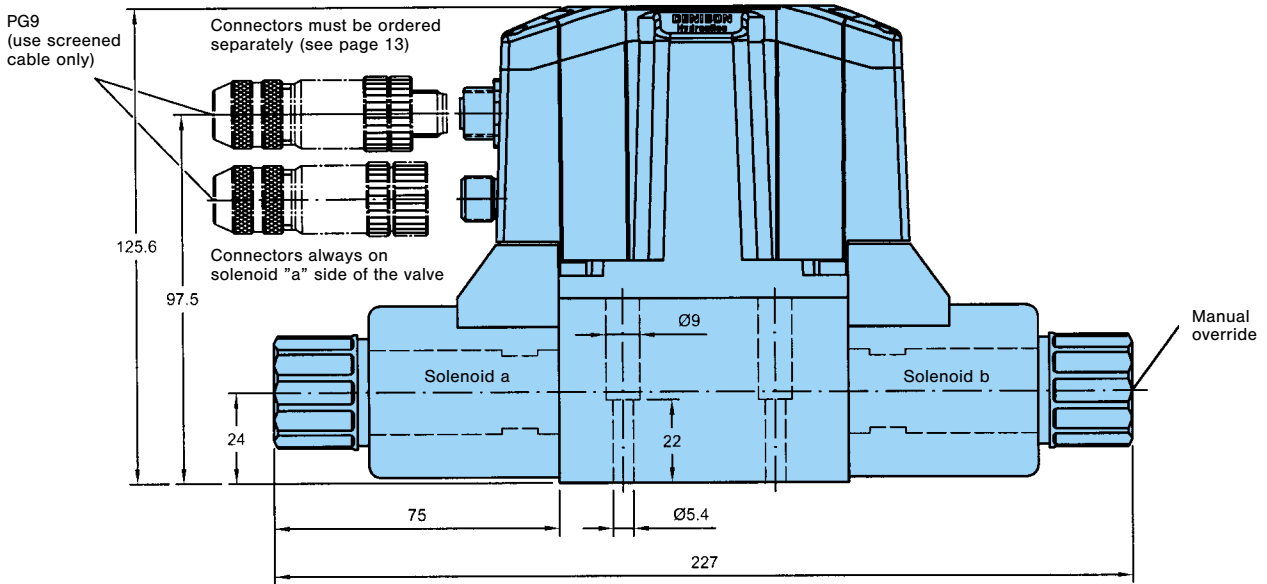


Note:

Adjustable ramp time functions are standard for all versions.

SPOOL POSITION 03

Weight: 2.5 kg



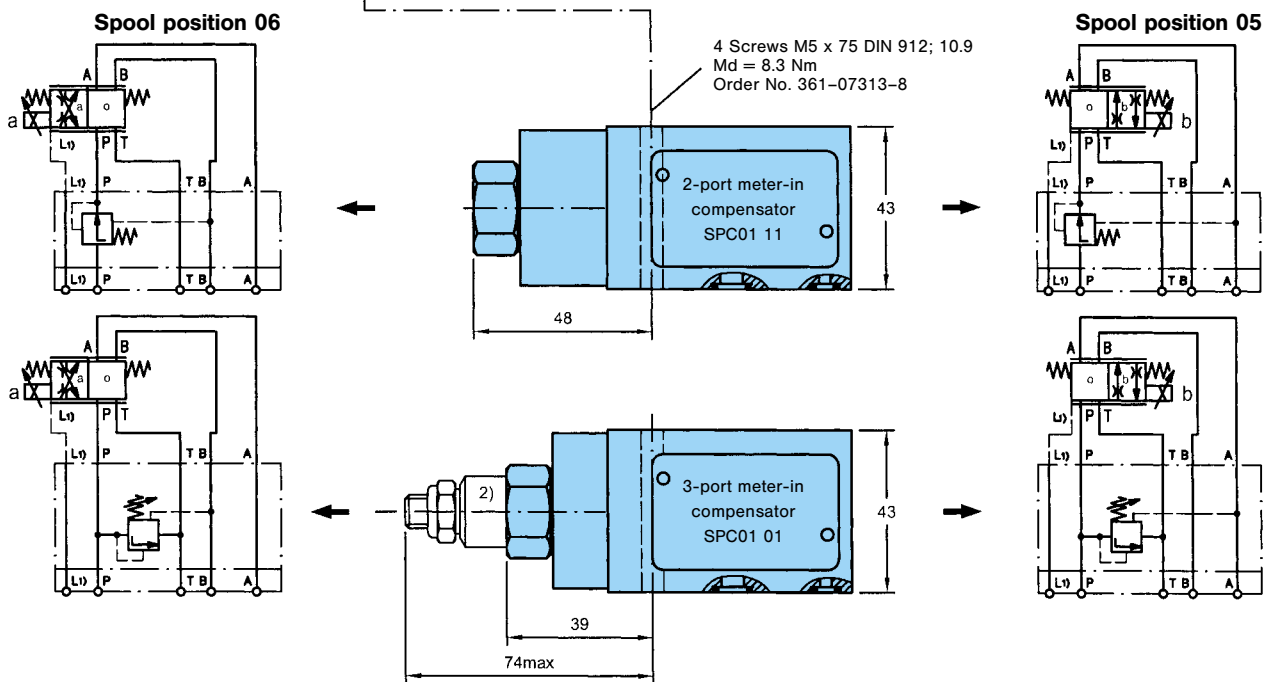
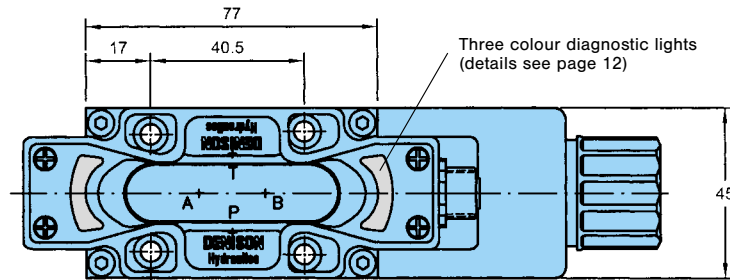
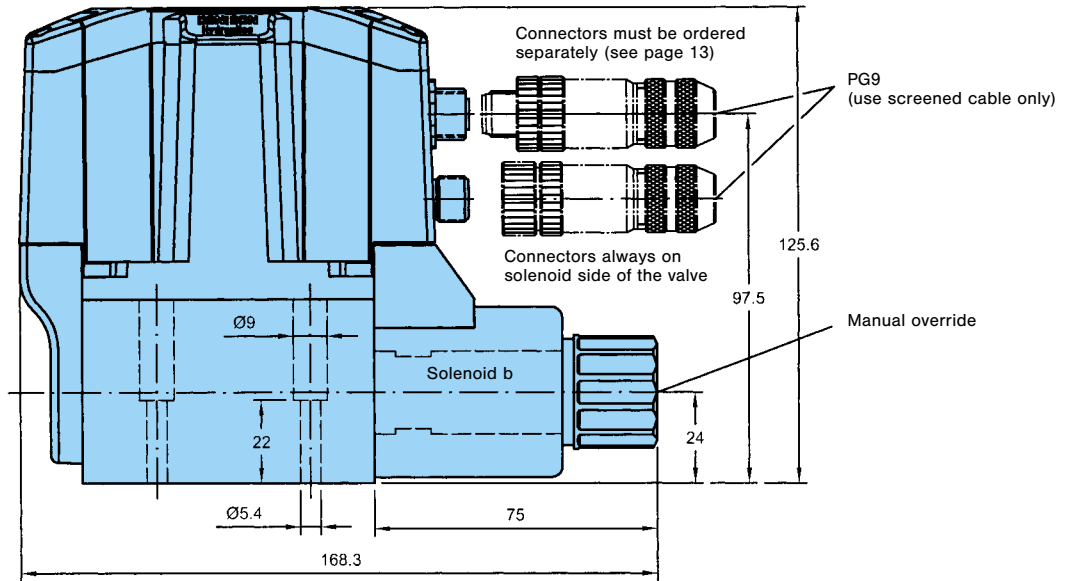
- 1) Always connect L to tank if T > 160 bar
- 2) Optional adjustment for SPC01 01

Note:
For order information on pressure compensators see page 15

SPOOL POSITIONS 05 & 06

Weight: 2.0 kg

4DP01-.B. ...-05

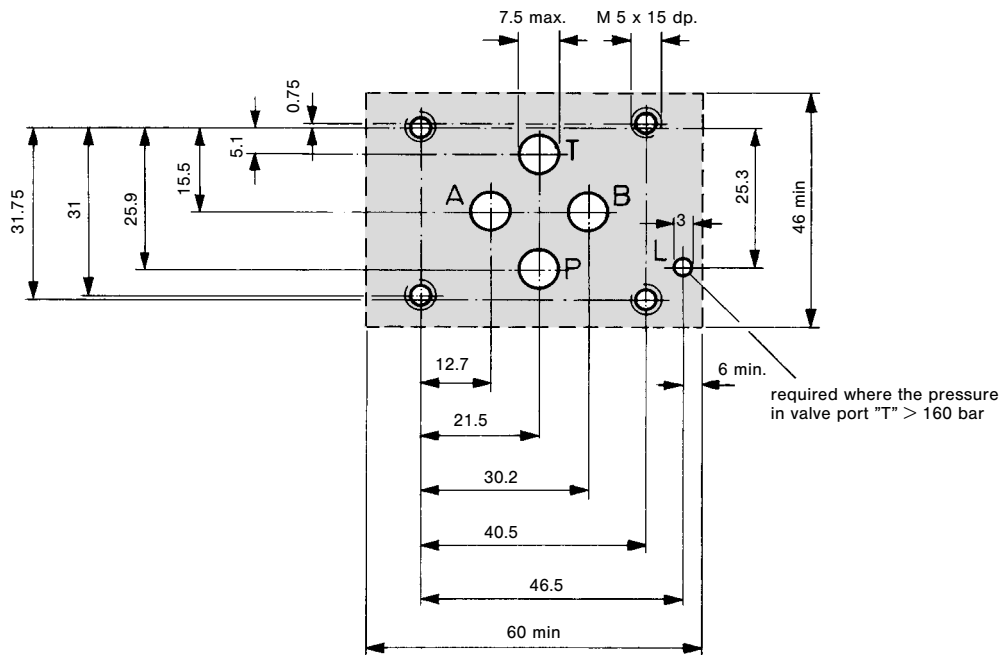


- 1) Always connect L to tank if T > 160 bar
- 2) Optional adjustment for SPC01 01

Note:
For order information on pressure compensators see page 15

MOUNTING CONFIGURATION

Conform to ISO 4401



Block mounting face

Flatness 0.01 mm / 100 mm length

Surface finish $\sqrt{0.8}$

For valves ordered without subplate, mounting screws must be ordered separately.

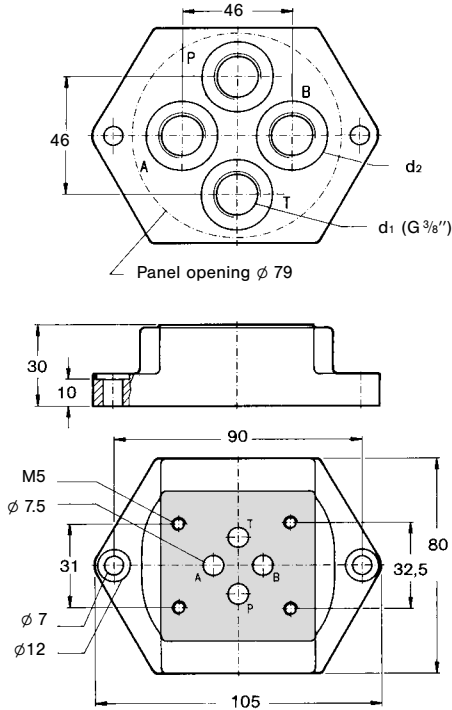
4-mounting screws	Order-No.
M 5 x 30, DIN 912; 10.9	700-70834-8

Torque 8.3 Nm

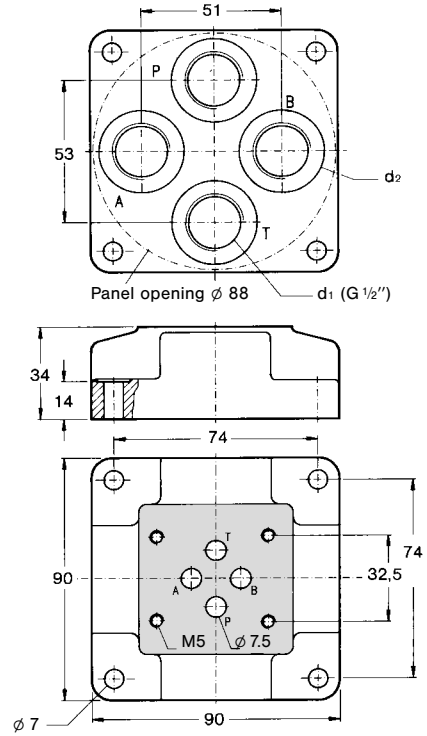
SUBPLATES

Mounting configuration conform to ISO 4401

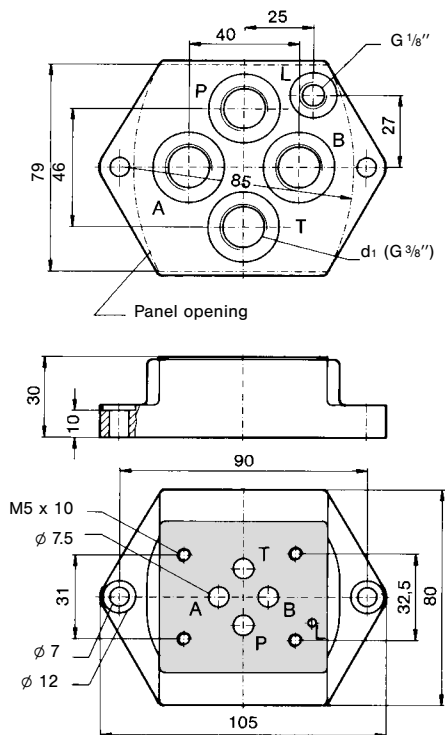
3/8" Subplate w/o L-port



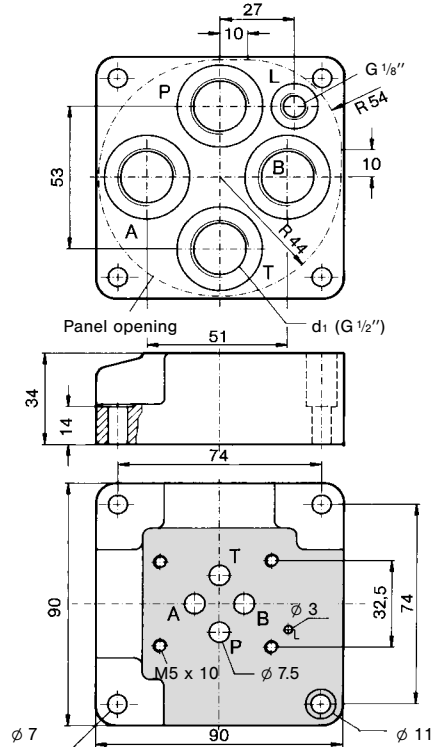
1/2" Subplate w/o L-port



3/8" Subplate with L-port



1/2" Subplate with L-port



Model No.	Order No.	Weight	d ₁ (A, B, P, T)	L-port	d ₂
SS-B-06-G 136	S26-32960-0	1.4 kg	G 3/8"	-	∅ 26 x 1
SS-B-08-G 136	S26-32961-0	1.7 kg	G 1/2"	-	∅ 31 x 1
SS-B-06-G 140	S26-34139-0	1.4 kg	G 3/8"	G 1/8"	∅ 26 x 1
SS-B-08-G 140	S26-34140-0	1.7 kg	G 1/2"	G 1/8"	∅ 31 x 1

Mounting screws are included in subplate order.

ONBOARD ELECTRONICS



Example:
4DP01 3B43F30 03

The proportional amplifier located on top of the valve is specially adapted to control proportional directional valves without position feedback type 4DP01. It proportionally converts electrical input signals into solenoid current.

The amplifier has a reverse polarity protection and one (or two) short circuit protected PWM-output stage(s) with max. current limit.

To operate single solenoid proportional valves only one of the output stages is fitted on the board.

Electronics for two different types of command signals are available – see ordering code on page 5 and below.

The ramp up/down potentiometers can be adjusted after removing the top cap (see page 13 for details).

The valves in combination with the electronics are factory set. For each valve the spool will be shifted to the edge of the mechanical overlap at 20% command signal, independent of the machining tolerances.

The main board is equipped with two diagnostic LEDs to display the operational condition, “power on”, “valve de-energised” and “fail-safe” – please see below.

Characteristics – Proportional Amplifiers

- Supply voltage
 - nominal 24 V DC
 - smoothed battery voltage 18...32 V DC
- Reference voltage ± 10 V ($\pm 0.5\%$) @ 10 mA stabilised, from amplifier
- Current consumption approx. 2.0 A at 100% command signal (140 mA quiescent)
- Short circuit protection for solenoid A and B
- Command signals
 - 0...+10 V, 100 Ω input impedance, for single solenoid valves
 - 10...0...+10 V, 100 Ω input impedance, for double solenoid valves
 - 4...20 mA, 100 Ω input impedance, for double and single solenoid valves

for single solenoid valves:
4...20 mA command = 0...100% current solenoid A

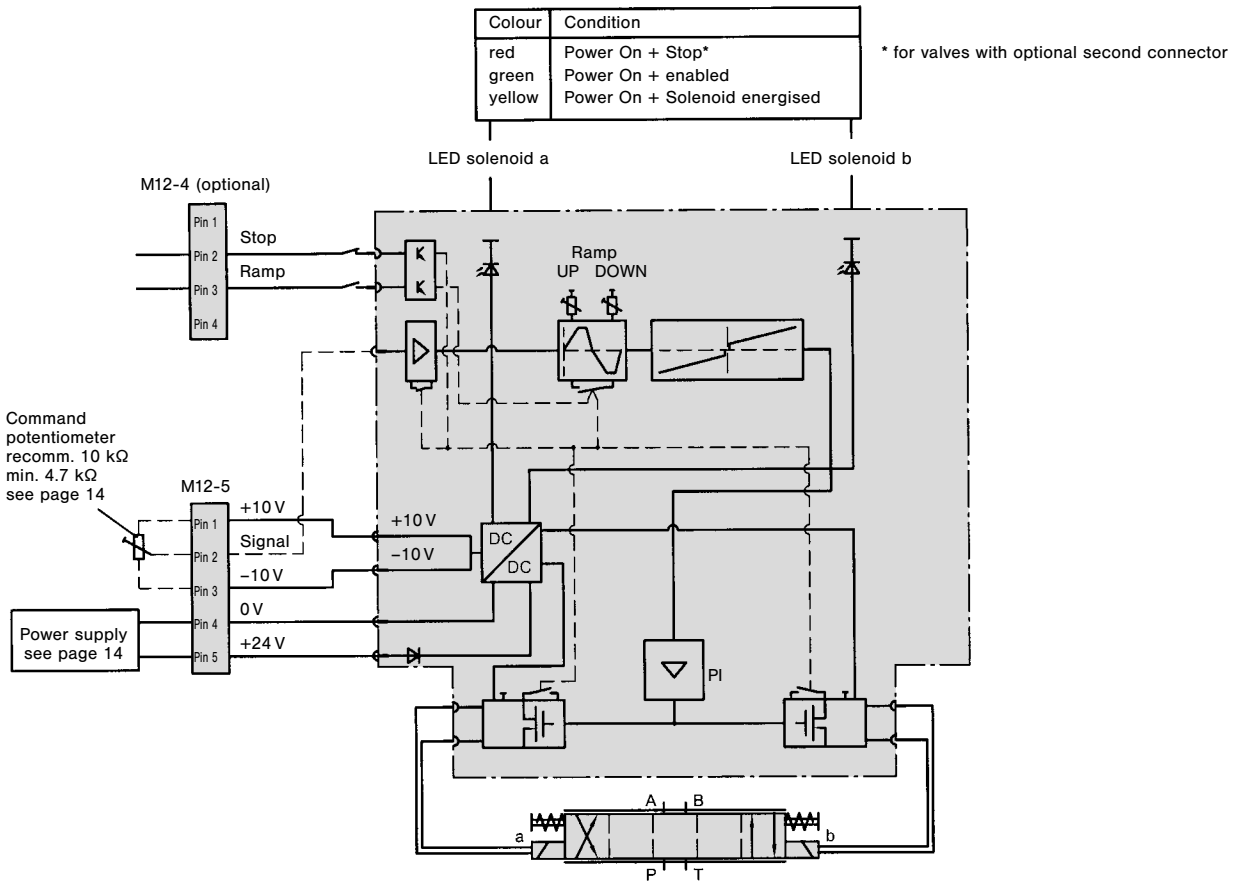
for double solenoid valves:
4...12 mA command = -100...0% current solenoid B
12...20 mA command = 0...100% current solenoid A
- Outputs (+) = solenoid A; (-) = solenoid B, for double solenoid version
(+) = solenoid A or B, for single solenoid version
- External stop (nominal 24 V) implement as NC (normally closed circuit) connection with an input voltage of 2.5...24 V DC; input impedance 22 k Ω (for electrical connector code CB only)
- Potentiometer for
 - ramp up up to 10s $\pm 20\%$ (1...50 V/s)
 - ramp down up to 10s $\pm 20\%$ (1...50 V/s)
- Ramp off (nominal 24 V) implement as NO (normally open circuit) connection with an input voltage of 4...32 V DC; input impedance 22 k Ω (for electrical connector code CB only)
- PWM 190 Hz $\pm 10\%$ for single solenoid valves
140 Hz $\pm 10\%$ for double solenoid valves
- Diagnostic LEDs
 - red: power on + fail safe with ext. emergency stop (valves with second connector)
 - green: power on + solenoid de-energised (command signal setting zero)
 - yellow: power on + solenoid energised (with increasing command signal)
- Wiring due to EMC shielded cables are required

Note:

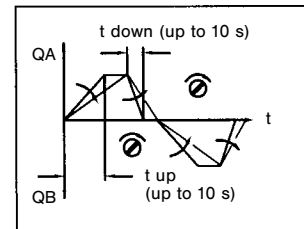
Power supply and potentiometer see page 14.

ONBOARD ELECTRONICS

Schematic block diagram and terminal assignment

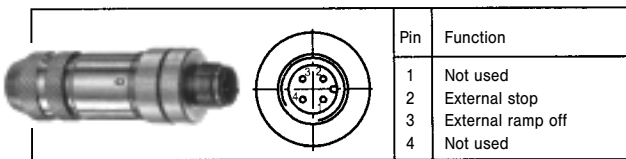


Ramp

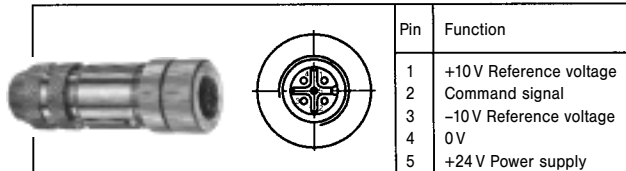


Details of potentiometers and connectors

Plug-in Connector B (male) Ordering No. 167-01116-8



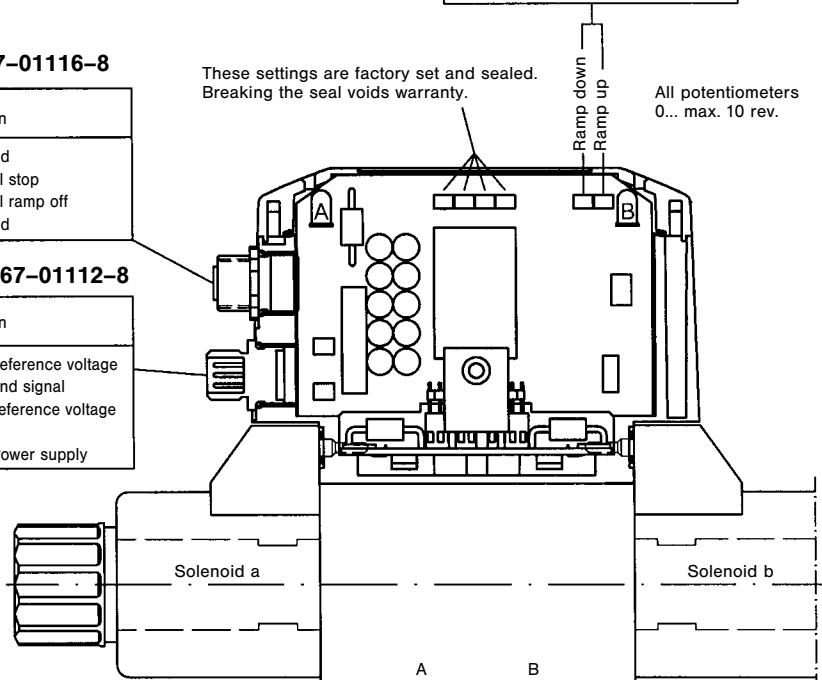
Plug-in Connector A (female) Ordering No. 167-01112-8



Note: use screened cable only!

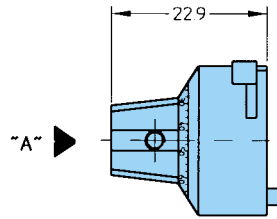
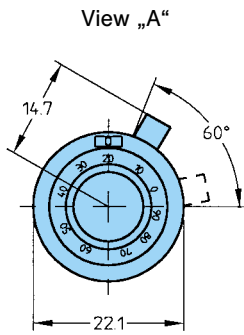
These settings are factory set and sealed. Breaking the seal voids warranty.

All potentiometers 0... max. 10 rev.

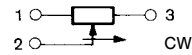
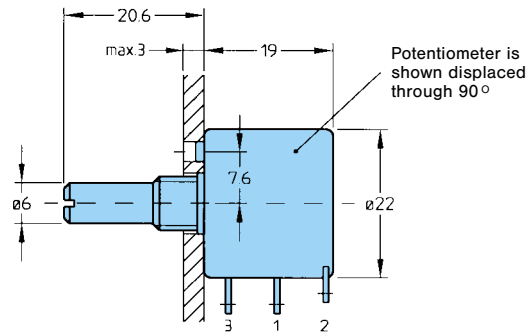


ACCESSORIES

Potentiometer-Adjusting knob Order No. 701-00014-8

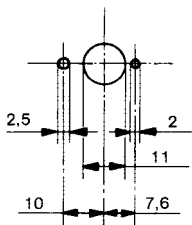


Potentiometer



Adjusting knob with scale 0...100 and with revolution counter. Adjustment is lockable.

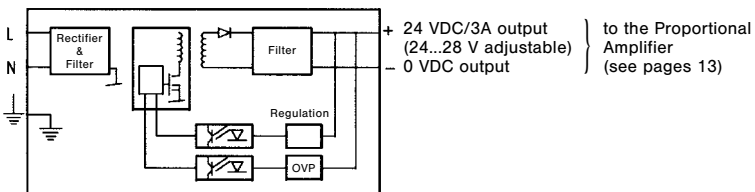
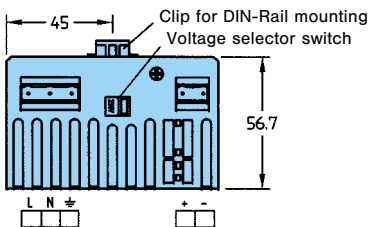
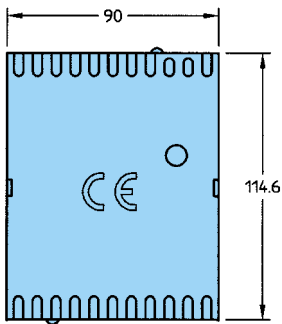
Panel opening



Potentiometer-Characteristics	Potentiometer Order No.	
	701-00012-8	701-00013-8
Angle of rotation	360°	3600°
Linearity	± 0.5%	± 0.25%
Resolution-Drift	0.11% of 360°	0.02% of 3600°

Power supply

Order No. 701-00023-8
Weight: 0.25 kg



L = Nominal frequency 50/60 Hz
Nominal voltage 230 VAC or 115 VAC (pay attention to voltage selector switch setting)
N = Neutral line

ORDER INFORMATION FOR PRESSURE COMPENSATORS

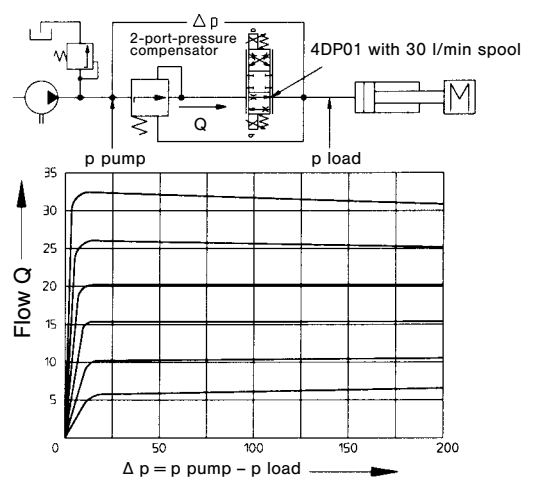
Model No.:

SPC 01 1 . . A

- | | | |
|--|---|---|
| <p>1 Series
SPC = Pressure compensator</p> <p>2 Size
01 = Cetop 03</p> <p>3 Function
01 = 3-port Meter-in Compensator
11 = 2-port Meter-in Compensator
12 = 2-port Meter-out Compensator ¹⁾
¹⁾ only with sensing port Code C</p> <p>4 Control Pressure Drop Range
04 = 2...5 bar adjustable
(only for 3-port compensator)
05 = 5 bar
10 = 10 bar (only for 3-port compensator)</p> | <p>5 Circuit Type
1 = single</p> <p>6 Load Sensing Port
A = in A
C = in A or B</p> <p>7 Body
3 = Aluminium (up to 210 bar)
5 = Steel (up to 350 bar)</p> <p>8 Design Letter</p> | <p>9 Seal Class
1 = NBR seals
5 = FPM seals (Viton')</p> |
|--|---|---|

		Model No.	Order No.	Weight
3-port Meter-in Compensators with shuttle valve P-A/B	Alu	SPC 01 01 041C3A	026 425800	0.8 kg
		SPC 01 01 051C3A	026 425810	
		SPC 01 01 101C3A	026 425820	
	Steel	SPC 01 01 041C5A	026 425830	1.6 kg
		SPC 01 01 051C5A	026 425840	
		SPC 01 01 101C5A	026 425850	
3-port Meter-in Compensators P-A	Alu	SPC 01 01 041A3A	026 425920	0.5 kg
		SPC 01 01 051A3A	026 425930	
		SPC 01 01 101A3A	026 425940	
	Steel	SPC 01 01 041A5A	026 425950	1.1 kg
		SPC 01 01 051A5A	026 425960	
		SPC 01 01 101A5A	026 425970	
2-port Meter-in Compensators with shuttle valve P-A/B	Alu	SPC 01 11 051C3A	026 425570	0.7 kg
	Steel	SPC 01 11 051C5A	026 425600	1.5 kg
2-port Meter-in Compensators P-A	Alu	SPC 01 11 051A3A	026 425690	0.6 kg
	Steel	SPC 01 11 051A5A	026 425720	1.3 kg
2-port Meter-out Compensators P-A/B	Alu	SPC 01 12 051C3A	026 426050	1.4 kg
	Steel	SPC 01 12 051C5A	026 426080	2.9 kg

Flow regulation
Example: 2-port Meter-in compensator



The product described is subject to continual development and the manufacturer reserves the right to change the specifications without notice.