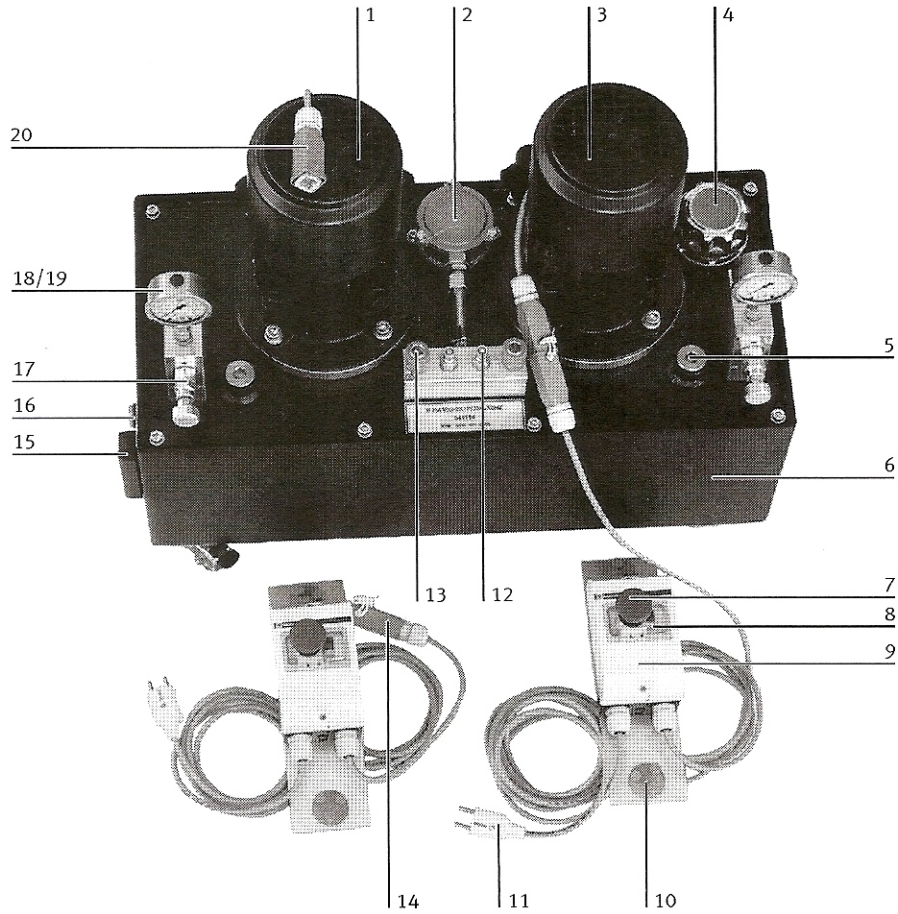
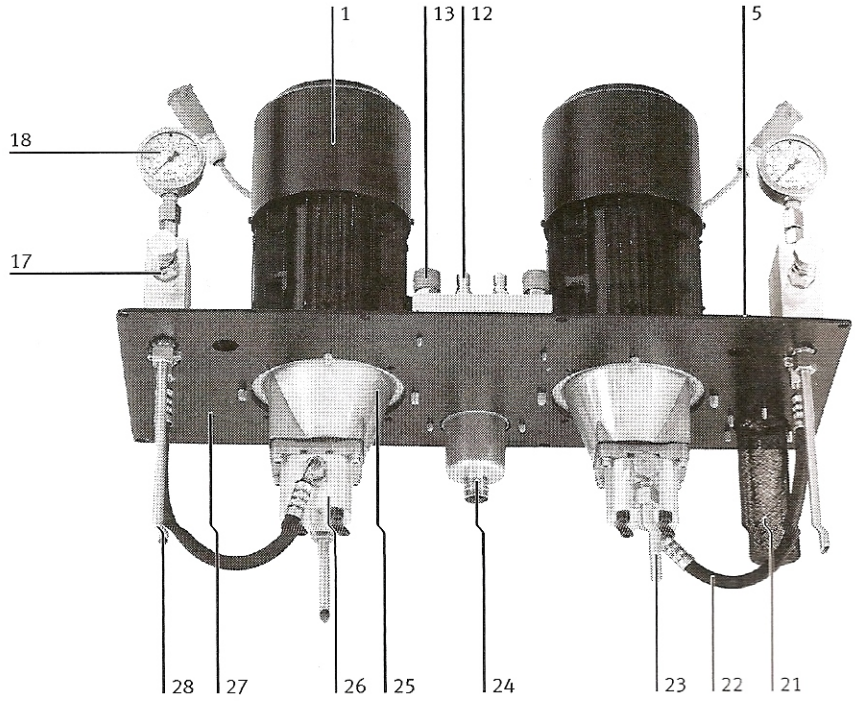
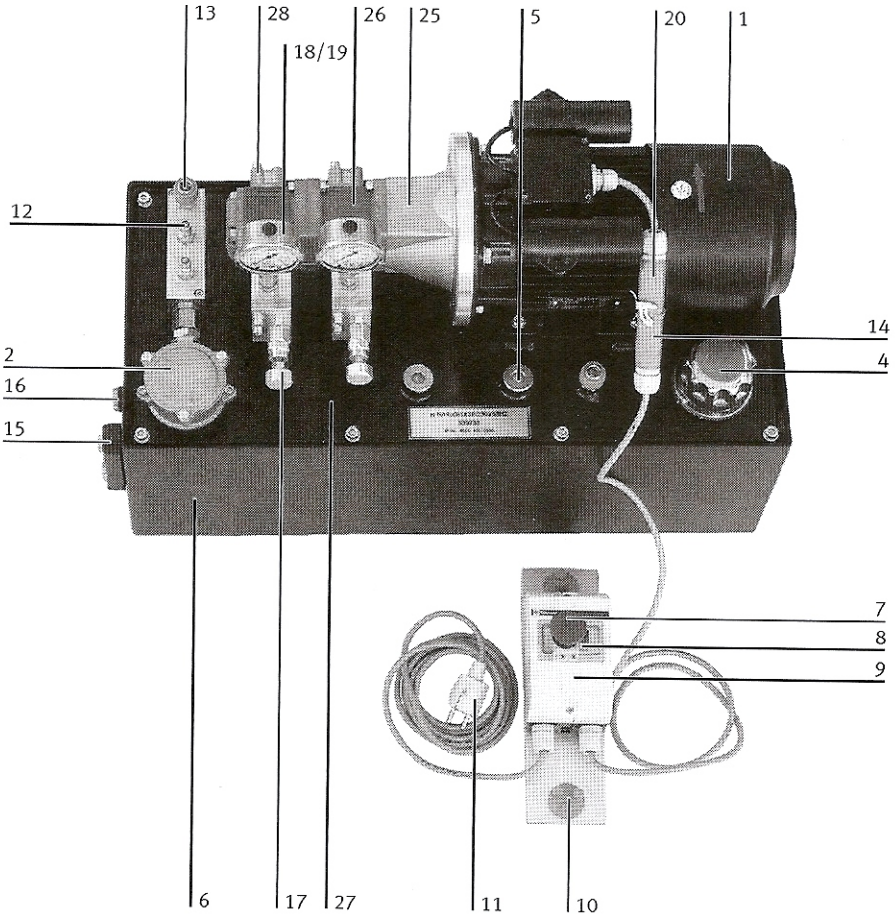
Hydraulic power unit with 40 litre tank

Power units with two motors
Order nos. 541117, 541118,
541114, 541116





Power units with one motor
Order nos. 186085, 186087, 541115, 539733



Structure

1 Electric motor
2 Return filter
3 Second electric motor
4 Ventilation filter
5 Connection for discharge measurement tank
6 Tank
7 OFF switch with mushroom actuator
8 ON switch
9 Console
10 Mounting system for console
11 Electrical flex with power supply plug
12 Tank connection fitting (T)
13 Connection for diaphragm accumulator of pressure-relief valve
14 Electrical connection to motor (quick coupling socket)
15 Oil level indicator with thermometer
16 Tank drain screw
17 Pressure-relief valve
18 Pressure gauge

19 Compressed air connection fitting (P)
20 Electrical connection from motor (quick coupling plug)
21 Filler strainer
22 Connecting tube from pump to pressure-relief valve
23 Suction pipe
24 Return filter drain
25 Pump holder
26 Pump
27 Tank cover plate
28 Tank connection of pressure-relief valve

Function

- The electric motor (1,3) drives the external gear pump (26). The pump (26) draws the oil from the tank (6) via a pump suction pipe (23). Depending on its design, the outlet of the pump is connected with the block of the pressure-relief valve either directly or via a tube (22).
- The pump delivers a virtually constant volume flow of oil. The quantity of oil not accepted by the consuming device must flow back into the tank without the maximum working pressure being exceeded. This is where the pressure-relief valve (17) comes into play. This valve is adjustable so that the maximum working pressure can be changed. In the case of pressure limitation, the oil flows back into the tank (6) via the pipe (28). The oil pressure given off is indicated by the pressure gauge (18).
- The return flow from the consuming device takes place via the quick connection couplings (12) on the common block. The blue quick coupling socket (13) is provided for relieving the pressure in the diaphragm accumulator and is not a connection for compressed air supply. The oil flows from the common block into the tank through the return filter (2).
- There are two further connections (5) directly on the tank. These are provided for connecting the discharge measurement container.
- The filling level and the oil temperature can be read at the sight glass (15).
- The ventilation filter (4) equalises the air pressure in the reservoir in the event of a fluctuating oil level. The air flow is filtered at the same time. The air filter is located in the removable lid. The lid is only removed to fill the power unit. Beneath the lid is a coarse strainer (21) that protects the power unit against the ingress of coarse particles while it is being filled.
- The oil in the tank can be drained at the tank drain screw (16).

Notes

- Incorrect operation and improper handling can result in failure of the device and injury to the user.
- No liability can be accepted for any damage that may occur as a result of non-intended use or incorrect handling.

Important

- The power unit is supplied without oil filling.
  Unlubricated operation of the pump is not permitted! Operating the power unit without oil filling will destroy the pump.

- The power unit must be stored and operated in horizontal position. Storage or operation in other positions may cause oil to leak out.
- The working pressure must not exceed max. 6 MPa (60 bar).
- Switch off the power unit when it is not in use to prevent unnecessary heating of the oil. If it is the case that you need warm oil, let the power unit run against the pressure-relief valve for a few minutes. The tank temperature can be read at the oil level sight glass.
- Check the filling level of the oil from time to time and top up if necessary.
- It is not permitted to tilt a power unit with oil filling when assembling the wheels.
- The motor features fuse protection against short circuit and overload. This will not, however, provide any protection if contact is made with live parts. We recommend operating the power unit in a network with a fault current detector (FI circuit breaker).
- Operation must be immediately discontinued if leaks occur. Any oil quantity that escapes must be immediately removed. The leak point must be repaired before the power unit is recommissioned. The information in the safety data sheets must be observed in the event of contact with the hydraulic oil. The safety data sheet must be requested from the hydraulic oil manufacturer (e.g. Exxon Mobil) in the respective country.
- Care must be taken when draining the oil to make sure that the capacity of the collecting basin is adequate.

Commissioning

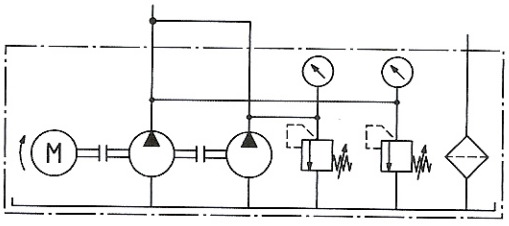
- **Installation in the Learnline lab trolley:**
  We recommend that you install the power unit before filling it with oil. The power unit is placed beside the drawer units on the two side members. The power unit is in the correct installation position when the control elements and indicators are facing the profile column. The threaded panels attached to the bottom of the tank ensure a secure fit. (See wheel set)
  Use in combination with the Learnline lab desk:
  The power unit can be placed directly on the ground. The use of a wheel set (order no.: 539734) is, however, recommended. The power unit can then be moved with ease, even when full.
- Fill mineral oil of the recommended type up to the maximum filling level. Filling takes place through the lid of the ventilation filter (4). Check the tank for tightness (visual inspection). Filling is made easier using a suitable funnel. Remove any oil that overflows immediately!
- Note also the following before connecting the power unit in accordance with the electrical diagram shown below: Check the electrical cables and connections for damage. Do not commission the power unit if the mains cable or plug is damaged. Check the mains voltage and frequency against the technical data or the rating plate of the motor.
- Check the direction of rotation of the electric motor. The direction of rotation is indicated by a red arrow on the fan housing. The direction of rotation of the motor can be observed at the fan. The wrong direction of rotation can result in damage and in addition prevent the build-up of pressure and cause bubbles to form in the tank.
- Lay the electrical cables in such a way that they cannot be accidentally pulled or tripped over. Use the plug when removing the mains cable from the plug socket.
- Remove the plug from the socket before cleaning.
- If you are not using a compressed air filter for your application, we recommend that you clean the mineral oil before starting your work. To do so, connect each pump outlet P to the port T using a hose line. The pumps use this hose line to feed the entire volume flow through the return filter. You should operate the pumps in this way for at least 15 minutes.
- If commissioning your entire equipment set for the first time, it is advisable to check the oil level more frequently as all hose lines are initially empty.
- When using the diaphragm accumulator (order no. 152859), replace the fitted drain hose with a longer drain hose (provided with the power unit). To do so, cut the hose to the correct length.
- Two connection options (5) are provided for the return hose of the discharge measurement container (order no. 162344 or order no. 535816). Replace the plugs with the connection pieces and secure the return hose using a hose clamp.

Special operation

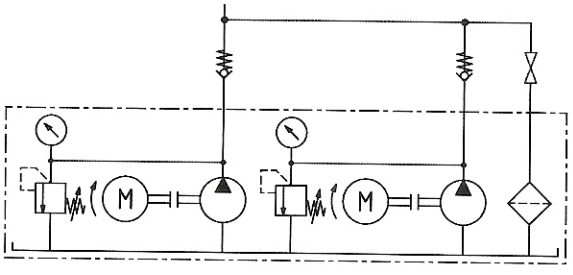
The volume flow can be doubled in power units with one motor and double pump by operating the two pumps in parallel.

Important

Cylinders can now be moved at double speed.

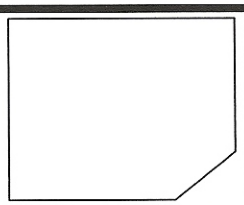
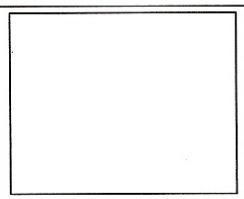


The following must be noted for power units with two motors: it is prohibited for a pump to rotate in the reverse direction. The pumps do not have a non-return valve at the outflow. Switching on the first pump will result in a second interlinked pump rotating in the reverse direction. The pump would then become the motor. Since simultaneous switching on and off via two separate switches is not safe, the pump must be protected by means of a suitable hydraulic circuit.

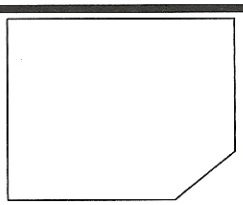
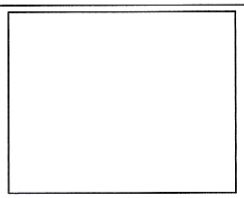


Trapped pressure can be relieved by means of the on-off valve.
Coupling under pressure is not permitted.

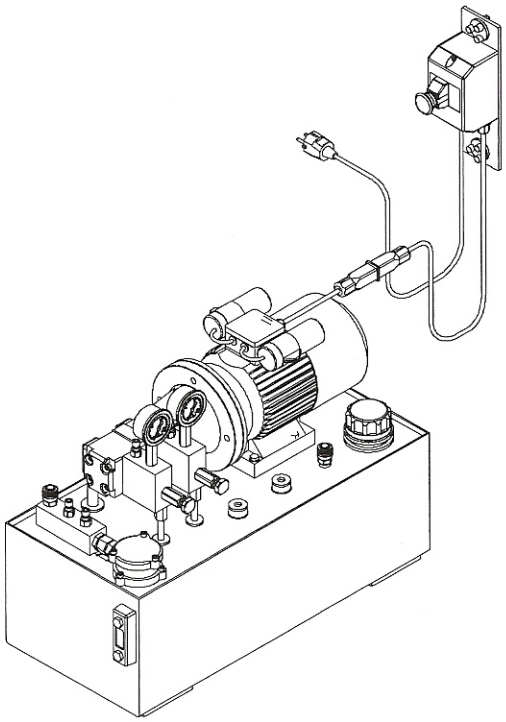
Technical data for power units with two motors

	Tank shape/cross-section	Order no. for 230 V	Order no. for 400/460 V
Power unit for Learnline up to 2004		541117	541118
Power unit for Learnline as of 2005		541114	541116
Hydraulic data	Dimensions	728 x 316 x 556 mm (length x width x height)	728 x 316 x 514 mm (length x width x height)
	Oil tank capacity	40 l	40 l
	Weight without oil filling	Approx. 72 kg	Approx. 72 kg
	Pump design	External gear pump	External gear pump
	Delivery rate	2 x 3.7 l/min	2 x 3.7 l/min (50 Hz) 2 x 4.4 l/min (60 Hz)
	Max. operating pressure	6 MPa (60 bar)	
	Hydraulic fluid	Mineral oil ISO VG 22 (19.8 – 24.2 cST at 40 °C)	
	Connections, per pump	One quick coupling socket for P and T, one quick coupling socket for the tank line of the diaphragm accumulator, one connecting thread for the discharge measurement tank	One quick coupling socket for P and T, one quick coupling socket for the tank line of the diaphragm accumulator, one connecting thread for the discharge measurement tank
Electrical data	Rotational speed	1415 rpm	1390 rpm (50 Hz) 1666 rpm (60 Hz)
	Power	2 x 0.55 kW	2 x 0.55 kW (50 Hz) 2 x 0.66 kW (60 Hz)
	Voltage	230 V, single-phase	400 V/460 V, triple-phase
	Frequency	50 Hz	50/60 Hz
	Duty cycle	100 %	100 %
	Fuse protection	Motor protection switch	Motor protection switch

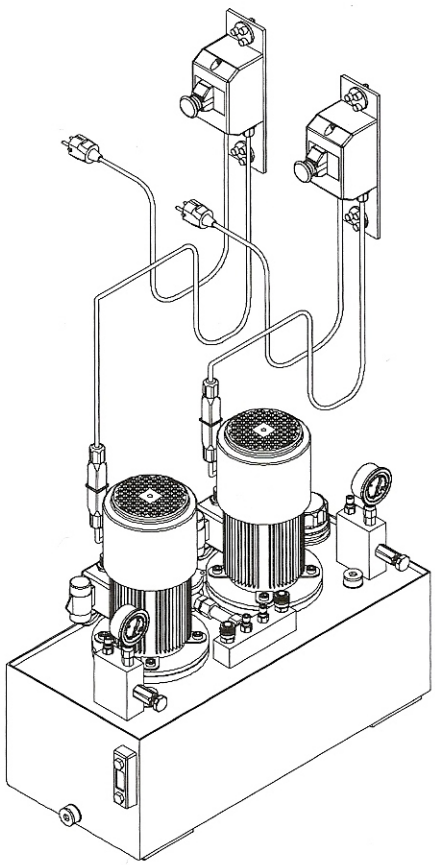
Technical data for power units with one motor

	Tank shape/cross-section	Order no. for 230 V	Order no. for 400/460 V
Power unit for Learnline up to 2004		186085	186087
Power unit for Learnline as of 2005		539733	541115
Hydraulic data	Dimensions	728 x 316 x 530 mm (length x width x height)	728 x 316 x 530 mm (length x width x height)
	Oil tank capacity	40 l	40 l
	Weight without oil filling	65 kg	65 kg
	Pump design	External gear pump	External gear pump
	Delivery rate	2 x 3.7 l/min	2 x 3.7 l/min (50 Hz) 2 x 4.4 l/min (60 Hz)
	Max. operating pressure	6 MPa (60 bar)	6 MPa (60 bar)
	Hydraulic fluid	Mineral oil ISO VG 22 (19.8 – 24.2 cST at 40 °C)	
	Connections, per pump	One quick coupling socket for P and T, one quick coupling socket for the tank line of the diaphragm accumulator, one connecting thread for the discharge measurement tank	One quick coupling socket for P and T, one quick coupling socket for the tank line of the diaphragm accumulator, one connecting thread for the discharge measurement tank
Electrical data	Rotational speed	1420 rpm	1400 rpm (50 Hz) 1680 rpm (60 Hz)
	Power	1.1 kW	1.1 kW/1.32 kW (60 Hz)
	Voltage	230 V, single-phase	400 V/460 V, triple-phase
	Frequency	50 Hz	50/60 Hz
	Duty cycle	100 %	100 %
	Fuse protection	Motor protection switch	Motor protection switch

Electrical connection plan
Order no. 186085, 539733

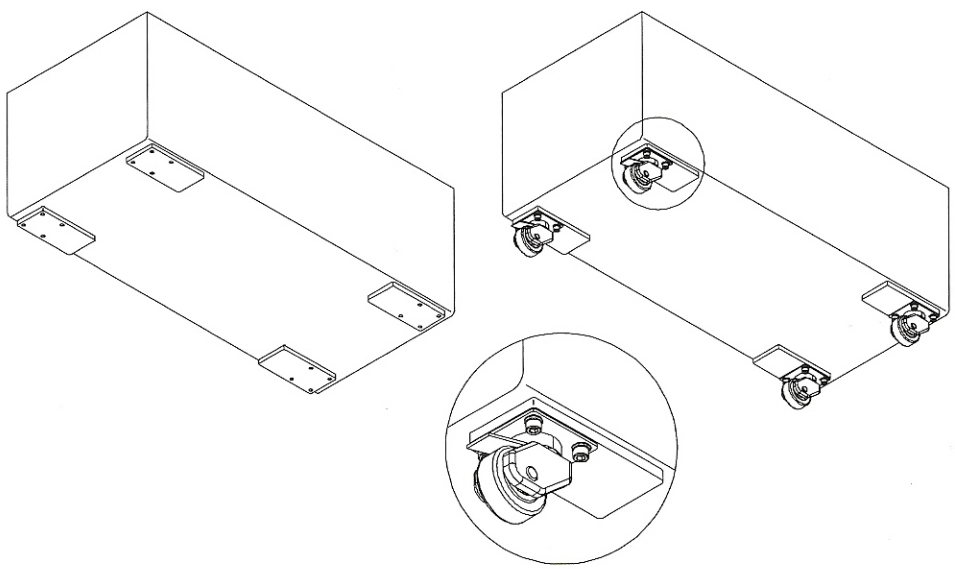


Electrical connection plan
Order no. 541114, 541117



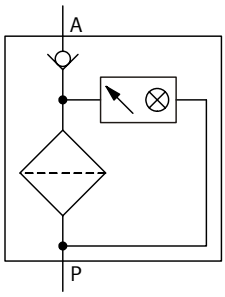
Wheel set
Order no.: 539734

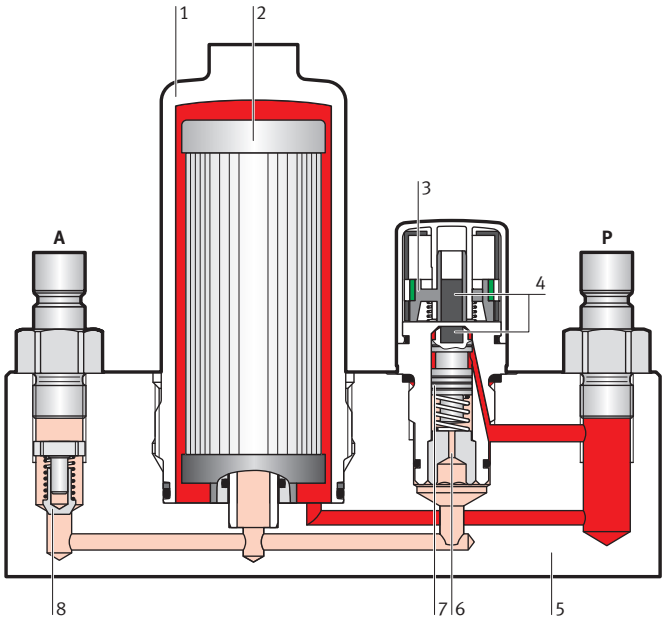
- The wheel set is only suitable for power units whose tank has a rectangular cross-section (order no.: 541114, 541116, 539733, 541115).
- The wheel set consists of four wheels, two of which are equipped with a lockable brake. Located on the underside of the power unit are panels with the hole pattern required for assembly of the wheels. Each wheel is secured using 4 screws.
- The power unit may only be tilted to assemble the wheels if the tank has first been drained.
- If possible, the wheels with lockable brake should be attached to the side that is most easily accessed.
- The lockable brake is not a transportation lock, nor is it suitable for securely parking the power unit on an inclined surface.



548609

Druckfilter Pressure filter Filtro de presión Filtre sous pression





Aufbau
Die Befestigung des Gerätes auf der Profilplatte erfolgt über das Rastsystem mit zwei blauen Hebeln (Befestigungsvariante "A").
Der Filter besteht aus:
Kappe (1), Filterelement (2), Verschmutzungsanzeige (3), Magnete (4), Gehäuse (5), Drosseldüse (6), Kolben (7), Rückschlagventil (8).

Design
The device is mounted on the profile plate using the locking system with two blue levers (mounting option "A").
The filter consists of:
Cap (1), Filter element (2), contamination indicator (3), Magnets (4), Housing (5), Flow control nozzle (6), Piston (7), Non-return valve (8).

Construcción
Para montar el aparato sobre la placa perfilada, se utiliza el sistema de enclavado, provisto de dos palancas azules (variante de montaje «A»).
El filtro está compuesto por:
tapa (1), elemento filtrante (2), indicador del grado de ensuciamiento (3), imanes (4), cuerpo (5), tobera de estrangulación (6), émbolo (7), válvula antirretorno (8).

Conception
L'appareil se fixe sur la plaque profilée par encliquetage du levier bleu (variante de fixation "A").
Le filtre se compose des éléments suivants :
coiffe (1), cartouche (2), voyant de colmatage (3), aimants (4), corps (5), buse d'étranglement (6), piston (7), clapet anti-retour (8).

Funktion

Die Aufgabe des Filters besteht darin, die im Öl schwebenden Feststoffe (Abrieb, Grate, Staub, ...) und Wasser zurückzuhalten. Vorzugsweise wird der Druckfilter gleich nach der Pumpe eingebaut, um alle nachfolgenden Hydraulikelemente schützen zu können.
Das Öl wird vom Anschluss P durch das Gehäuse (5) in die Kappe (1) geleitet. Dort durchdringt das Öl das Filterelement (6) von außen nach innen. Vom Innern des Filters geht es über das Rückschlagventil (8 zum Anschluss A. das Rückschlagventil (8) verhindert dass der Filter in umgekehrter Richtung durchströmt wird und ein Ausspülen der schon ausgefilterten Verschmutzungspartikel hervorruft. Der Druckabfall über dem Filterelement wird zur Überwachung des Verschmutzungs-grades herangezogen und optisch angezeigt (3).
Dazu wird der Kolben (7) von einer Seite von Anschluss P und auf der anderen Seite vom inneren des Filters mit Druckbeaufschlagt. Ist die aus der Druckdifferenz resultierende Kraft größer als die Federkraft und die Haltekraft des Magneten, so fährt der Kolben nach unten. Der Magnet der optischen Anzeige wird nun nicht mehr vom Magneten des Kolbens angezogen und wird nun von der Feder nach außen geschoben. Von außen ist nun statt des grünen Farbringes ein roter Ring zu sehen. Die Drosseldüse (6) verhindert ein unbeabsichtigtes auslösen der Verschmutzungsanzeige durch Volumenstromstöße.

Die Wirksamkeit des Filters wird durch das Verhältnis β der Partikelzahlen vor und nach dem Filter gekennzeichnet. Da

Function

The task of the filter is to retain the solids floating in the oil (abraded particles, burrs, dust etc.) and water. The pressure filter should preferably be installed immediately after the pump to protect all subsequent hydraulic components.
The oil is fed from the connection P through the housing (5) into the cap (1). Here, the oil penetrates the filter element (6) from the outside to the inside. From inside the filter it passes through the non-return valve (8) to connection A. The non-return valve (8) prevents a flow through the filter in the opposite direction and results in the contamination particles, which have been filtered out, to be flushed out. The pressure drop across the filter element is used to monitor the degree of contamination and is indicated visually (3).
To do this, pressure is applied to the piston (7) from connection P and, on the other side, from the inside of the filter. If the force resulting from the pressure difference is greater than the spring force and the retaining force of the magnet, the piston moves down. The magnet for the visual display is now no longer attracted by the magnet on the piston and it is pushed outwards by the spring. On the outside, a red ring can be seen instead of the green coloured ring. The flow control nozzle (6) prevents the contamination indicator from being inadvertently triggered by volumetric flow surges.
The efficiency of the filter is indicated by the ratio β of the number of particles upstream and downstream of the filter. Since its retention capacity is also dependent on particle size, these are classified. The retention value β indicates the particle size in the form of an

Funcionamiento

La tarea del filtro consiste en retener agua y sustancias sólidas contenidas en el aceite (virutas, polvo, etc.). El filtro deberá montarse preferentemente inmediatamente detrás de la bomba, con el fin de proteger todos los componentes hidráulicos.
El aceite fluye desde la conexión P hacia la tapa (1) a través del cuerpo (5). El aceite atraviesa el filtro (6) desde el exterior hacia el interior. Desde el interior del filtro fluye hacia la conexión A a través de la válvula antirretorno (8). Esta válvula (8) evita que el aceite fluya a través del filtro en sentido contrario.
Si sucediese, se produciría el desprendimiento de las partículas contenidas en el filtro. La caída de presión que provoca el filtro se aprovecha para controlar el grado de ensuciamiento del filtro. Este grado de ensuciamiento se muestra visiblemente (3).
Con ese fin, se aplica presión sobre el émbolo (7), por un lado desde la conexión P, y por el otro lado desde el interior del filtro. Si la fuerza que resulta de la diferencia de presión es superior a la fuerza del muelle y a la fuerza de sujeción de los imanes, el émbolo se desplaza hacia abajo. El imán del indicador óptico no es atraído por el imán del émbolo, por lo que de desplaza hacia el lado exterior debido a la fuerza que aplica el muelle. Desde fuera se puede apreciar un anillo de color rojo, en vez del anillo de color verde. La tobera de estrangulación (6) evita que se active el indicador del grado de suciedad debido a picos de caudal.

La eficiencia del filtro está determinada por la relación β entre la cantidad de partículas delante y detrás del filtro.

Fonction

Le filtre a pour mission de retenir les solides en suspension dans l'huile (particules détachées par abrasion, limailles, poussière, etc.) ainsi que l'eau. Le filtre se monte de préférence juste en aval de la pompe afin de pouvoir protéger tous les composants hydrauliques qui suivent.
L'huile est acheminée de l'orifice P à la coiffe (1), à travers le corps (5). L'huile y traverse la cartouche (6) de l'extérieur vers l'intérieur. Elle est évacuée de l'intérieur du filtre à l'orifice A par l'intermédiaire du clapet anti-retour (8). Ce dernier empêche que le filtre ne soit traversé en sens inverse,
ce qui entraînerait le détachement des particules déjà retenues. La perte de charge aux bornes de la cartouche est mise à profit pour surveiller le degré de colmatage et l'indiquer par un voyant (3).
Pour ce faire, le piston (7) est soumis, d'un côté, à la pression de l'orifice P et, de l'autre, à la pression régnant à l'intérieur du filtre. Quand la force résultant de la différence de pression est supérieure à la force du ressort et à la force de maintien de l'aimant, le piston remonte. L'aimant du voyant n'est plus alors attiré par celui du piston et est alors poussé vers l'extérieur par le ressort. De l'extérieur, on voit alors, au lieu de l'année de couleur verte, un anneau rouge. La buse d'étranglement (6) empêche le déclenchement intempestif du voyant de colmatage par des à-coups de débit.

L'efficacité du filtre se caractérise par le rapport β des nombres de particules en amont et en aval du filtre. Comme le pouvoir de rétention dépend aussi de la taille des

sich das Rückhaltevermögen auch nach der Partikelgröße richtet, werden die Partikel klassifiziert. Diese Partikelgröße erscheint im Rückhaltewert β als Index in µm, z.B. β_5 = Rückhaltewert bei Partikelgröße mit 5 µm.

index in µm, e.g. β_5 = retention value with a particle size of 5 µm.

Considerando que la capacidad de retención también depende del tamaño de las partículas, se procede a la clasificación de las partículas. El tamaño de las partículas aparece como índice en el valor de retención β, y se expresa en µm. Por ejemplo: β_5 = valor de retención con tamaño de partículas de 5 µm.

particules, on classifie les particules. Cette taille des particules apparaît dans le pouvoir de rétention β sous forme d'indice en µm, par rexmple β_5 = pouvoir de rétention des particules de 5 µm.

Hinweis
Normalerweise ist ein Rückschlagventil in Sperrrichtung absolut dicht. Damit ein sicheres und einfaches Aufkuppeln auf dieses Element möglich wird, muss in diesem Fall das Rückschlagventil eine gewisse Leckage haben. Die Leckage ist jedoch sehr klein.

Note
A non-return valve is normally completely tight in the reverse direction. To allow a secure and easy connection to this component, the non-return valve must have a certain amount of leakage. However, this leakage is minimal.

Note
Normalmente, una válvula de antirretorno cierra herméticamente en el sentido del bloqueo. Para que el acoplamiento en este componente sea fiable y sencillo, es necesario que, en este caso, la válvula antirretorno tenga fugas, aunque sean mínimas.

Note
Normalement, un clapet anti-retour est parfaitement étanche dans le sens de l'obturation. Pour assurer et simplifier le branchement à ce composant, il faut dans ce cas que le clapet anti-retour présente un certain taux de fuites. Ces fuites sont toutefois très faibles.

Multipass-Filterelement-Leistungsdaten nach ISO 4572 Multipass filter cartridge performance data to ISO 4572
Elemento filtrante Multipass. Datos del rendimiento según ISO 4572 Performances des cartouches au test multipass ISO 4572

Beta-Werte in Abhängigkeit vom Filterelement-Differenzdruck
Beta values as a function of filter cartridge differential pressure
Valores beta en función de la presión diferencial en el elemento filtrante
Valeurs de bêta en fonction de la pression différentielle de la cartouche

$$\beta_x = \frac{\text{Anzahl der Partikel mit der Abmessung} > x\ \mu m \text{ vor dem Filter}}{\text{Anzahl der Partikel mit der Abmessung} > x\ \mu m \text{ nach dem Filter}}$$

$$\beta_x = \frac{\text{Number of particles of size} > \text{x µm upstream of filter}}{\text{Number of particles of size} > \text{x µm downstream of filter}}$$

$$\beta_x = \frac{\text{Cantidad de partículas} > \text{x µm antes del filtro}}{\text{Cantidad de partículas} > \text{x µm detrás del filtro}}$$

$$\beta_x = \frac{\text{Nombre de particules de taille} > x\ \mu m \text{ en amont du filtre}}{\text{Nombre de particules de taille} > x\ \mu m \text{ en aval du filtre}}$$

Filterfeinheit **Degree of filtration** **Grado de filtración** **Finesse de filtration**	**Δp (bar)**	**β_2**	**β_3**	**β_5**	**β_{10}**
5 µm	2	12	40	300	>2000
5 µm	5	11	35	200	>2000

Randbedingungen
Die Wirksamkeit des Filters richtet sich aber auch nach folgenden Faktoren:
1. wird der gesamte

Parameters
The efficiency of the filter also depends on the following factors:
1. Whether the total flow is

Condiciones generales
La eficiencia del filtro también depende de los siguientes factores:
1. Si se filtra todo el caudal o

Autres critères
L'efficacité du filtre dépend aussi des facteurs suivants :
1. La filtration porte-t-elle sur l'intégralité ou une partie

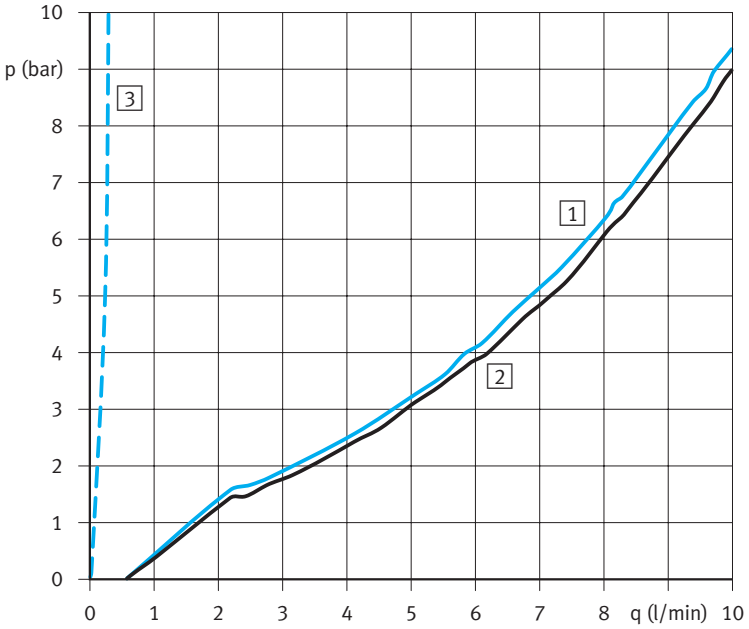
Volumenstrom gefiltert oder nur Teile (Volumenstrom des Druckbegrenzungsventils fließt ungefiltert ab),
2. wie oft durchströmt der gesamte Tankinhalt den Filter,
3. werden alle Leitungen und Elemente gespült,
4. wie hoch ist der erneute Verschmutzungseintrag des Systems (Staub, Kondenswasser, neue Ölbefüllung).

filtered, or only part of it (flow through pressure relief valve is discharged unfiltered)
2. How often the entire contents of the tank passes through the filter
3. Whether all tubes and components have been flushed
4. How high is the new system contamination entry (dust, condensation, new oil filling)

si solamente se filtra parte de él (evacuación sin filtrar del caudal proveniente de la válvula limitadora de presión).
2. Frecuencia con la que la totalidad del contenido del depósito atraviesa el filtro.
3. Suponiendo que se enjuagan todos los conductos y componentes:
4. Grado de renovación del ensuciamiento del sistema (partículas de polvo, condensado, relleno de aceite).

seulement du débit (le débit traversant le limiteur de pression n'étant pas filtré) ?
2. Combien de fois tout le contenu de la cuve traverse-t-il le filtre ?
3. Toutes les conduites et tous les composants sont-ils balayés ?
4. Quelle est l'ampleur de la recontamination du système (poussière, eau de condensation, nouveau remplissage d'huile) ?

Durchflusskennlinie mit und ohne Filterelement Flow-rate characteristics with and without filter cartridge
Línea característica del caudal, con y sin elemento filtrante Caractéristique de débit avec et sans cartouche



1 mit Filterpatrone
1 with filter cartridge
1 Con cartucho filtrante
1 avec cartouche

2 ohne Filterpatrone
2 without filter cartridge
2 Sin cartucho filtrante
2 sans cartouche

3 in Sperrrichtung
3 in reverse direction
3 En sentido de bloqueo
3 en sens d'obturation

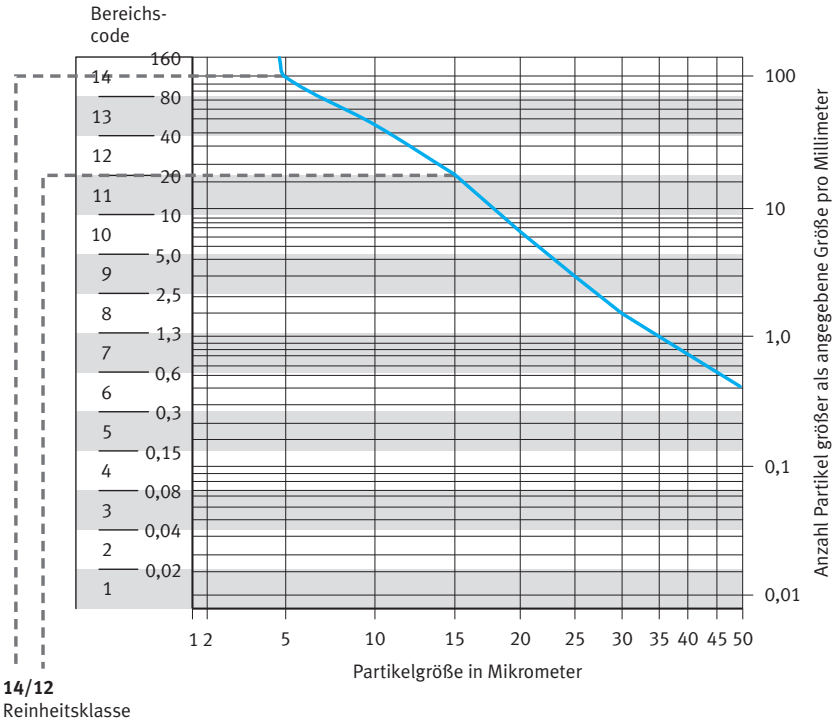
Reinheitsklasse
Zählt man die Zahl der Partikel in 1 ml Öl und schlüsselt diese noch nach ihrer Größe auf, so erhält man eine Aussage über die Verschmutzung bei der jeweiligen Partikelgröße. Die Anzahl der Partikel ist in Klassen aufgeteilt, den Reinheitsklassen.

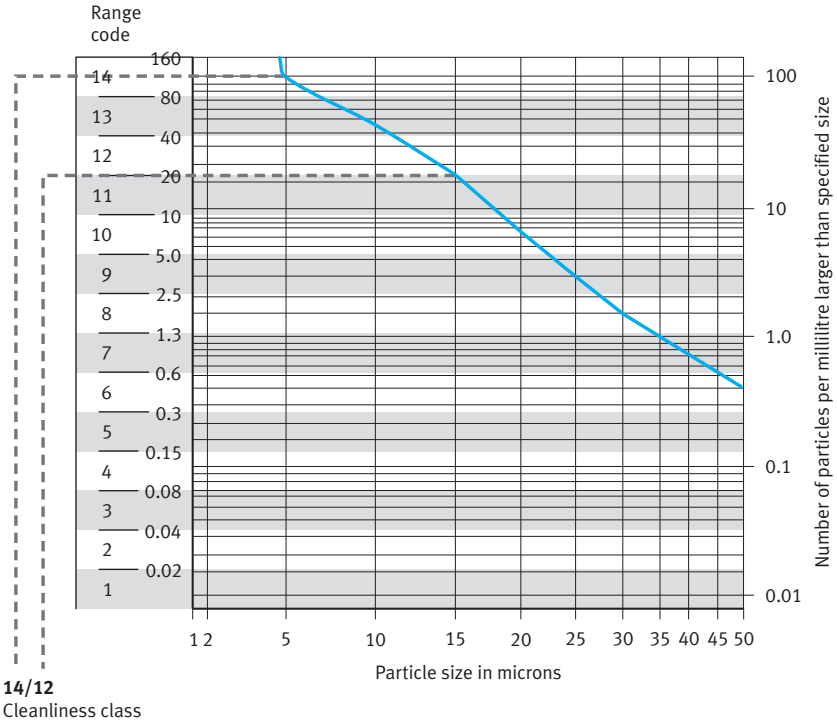
Cleanliness class
If we count the number of particles in 1 ml of oil and classify these according to their size, we can plot a graph showing the level of contamination that each particle size represents. The number of particles is divided into classes, the cleanliness classes.

Clase de pureza
Si se cuenta la cantidad de partículas contenidas en 1 ml de aceite y si, además, se clasifican dichas partículas según su tamaño, se obtiene una información sobre el grado de ensuciamiento considerando diversos tamaños de partículas. El tamaño de las partículas se clasifica según clases (clases de pureza).

Classe de propreté
En comptant le nombre de particules dans 1 ml d'huile et en les classant en fonction de leur taille, on peut indiquer quel est l'encrassement par des particules de chaque taille considérée. Les classes dans lesquelles sont réparties les particules sont appelées classes de propreté.

Reinheitsklassen-Diagramm Cleanliness class graph Diagrama de clases de pureza Diagramme des classes de propreté





Welche Reinheitsklasse erforderlich ist, richtet sich nach dem empfindlichsten Bauteil im System (siehe Tabelle).

The cleanliness class required is governed by the component within the system which is most sensitive to contamination (see table below).

La clase de pureza necesaria en cada caso depende del componente más sensible incluido en el sistema (consultar tabla).

La classe de propreté nécessaire dépend du composant le pus sensible au sein du système (voir tableau).

Empfehlung Recommendation Recomendaciones Recommandation

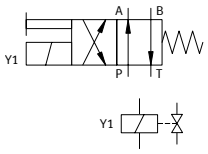
Element Component Componente Composant	**Reinheitsklasse nach ISO 4406 bei Teilchen von Cleanliness class to ISO 4406 for particles of Clase de pureza según ISO 4406 con partículas de Classe de propreté ISO 4406 pour particules de 5 µm/15 µm**
Zahnradpumpe Gear pump Bomba de engranajes Pompe à engrenage	18/15
Verstellpumpe (Kolben) Variable displacement pump (piston) Bomba de émbolo, regulable Pompe volumétrique (piston)	16/14
Wegeventil (Magnet) Solenoid-actuated directional control valve Válvula de vías (electroválvula) Électrodistributeur	18/15
Druckventil (regelnd Pressure valve (regulating function) Válvula reguladora de presión Régulateur de pression	17/14
Stromventil Flow control valve Válvula reguladora de caudal Régulateur de débit	17/14
Rückschlagventil Non-return valve Válvula antirretorno Clapet anti-retour	18/15
Proportional-Wege- und Druckventil Proportional directional control and pressure valves Válvula proporcional de vías, reguladora de presión Proportional directional control and pressure valves	16/13
Regelventil Regulator Válvula reguladora Régulateur	16/13
Zylinder Cylinder Cilindro Vérin	18/15
Hydraulikmotor Hydraulic motor Motor hidráulico Moteur hydraulique	18/15

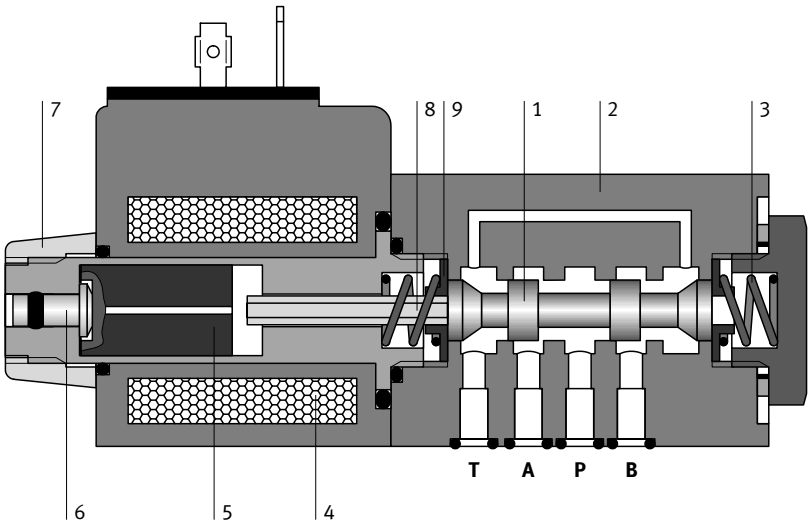
Technische Daten Technical data Datos técnicos Caractéristiques techniques

Hydraulik Hydraulics Hidráulica Hydraulique	
Medium Medium Fluido Fluide	Mineralöl, empfohlen Mineral oil, recommended viscosity Aceite mineral, recomendado Mineralöl, empfohlen Mineral oil, recommended viscosity
Maximal zulässiger Druck p_{max} Max. permissible pressure p_{max} Presión máxima admisible $p_{máx}$ Pression maximale admissible p_{max}	12 MPa (120 bar)
Porenweite Pore size Ancho de poros Porosité	5 µm
Erreichbare Reinheitsklasse Attainable cleanliness class Clase de pureza factible Attainable cleanliness class	15/12 – 17/14
Differenzdruck der Verschmutzungsanzeige Δp Differential pressure for contamination indicator Δp Presión diferencial Δp del indicador del grado de ensuciamiento Pression différentielle du voyant de colmatage Δp	5 bar 10 %
Anschluss Connections Conexión Raccordement	für 2 Kupplungsdosen Via 2 coupling sockets Para 2 acoplamiento tipo zócalo Via 2 coupling sockets via 2 raccords femelles
Ersatzpatrone für den Druckfilter Cartucho de recambio para el filtro Cartouche pour filtre sous pression Spare cartridge for the pressure filter	Best.-Nr. 236302 Referencia 236302 Referencia 236302 Réf. 236302
Änderungen vorbehalten Subject to change Reservado el derecho de modificación Sous réserve de modifications	

167082

4/2-way solenoid valve





Design

The 4/2-way solenoid valve is mounted on a function plate equipped with four quick coupling connectors. The component is fitted to the grid system of the slotted assembly board by means of the two blue levers (mounting variant “A”).

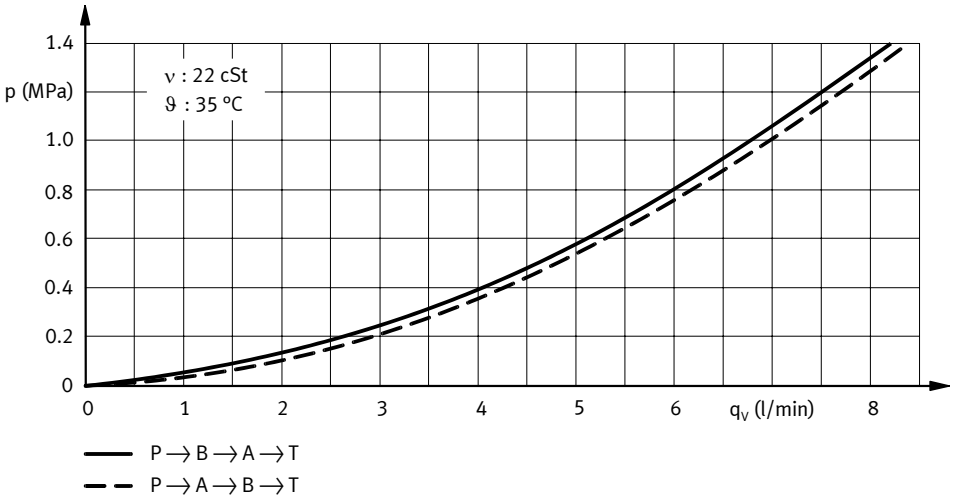
The valve consists of: Piston (1), housing (2), spring (3), solenoid coil (4), plunger (5), emergency manual override (6), nut (7), stem (8) spring disc (9).

167082

4/2-way solenoid valve

Function

This directional control valve comprises two switching positions for the control of flow rates. It is directly actuated via a DC solenoid coil. Characteristic of this valve is the spring return normal position.
The valve is shown in its normal position in the sectional view, whereby ports P and A as well as ports B and T are connected. The piston (1) is clamped in the housing between the springs and spring discs when the solenoid is de-energised. If voltage is applied to the solenoid coil Y1 (4), the plunger (5) presses the piston (1) against the opposite spring via the stem (8), thereby connecting port P to B and port A to T. The switching solenoid consists of a pressure tube, the push-on coil body is attached via the nut (7) and the stem (8). The electrical connection is effected via a valve plug socket.
An emergency manual override (9) facilitates actuation without electrical energy.



Pressure-drop/flow-rate characteristic

Note

The valve ports are identified by letters.

A, B Working ports
P Supply port
T Return-line port (tank connection)

The electrical connections are protected against overvoltage. The switching status is indicated by an LED.

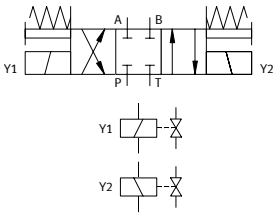
The manual override must not be actuated by means of sharped-edged objects (e.g. screwdrivers) so that its smooth operation and leak-proofness is maintained. A stiff manual override may result in malfunction of the solenoid valve.

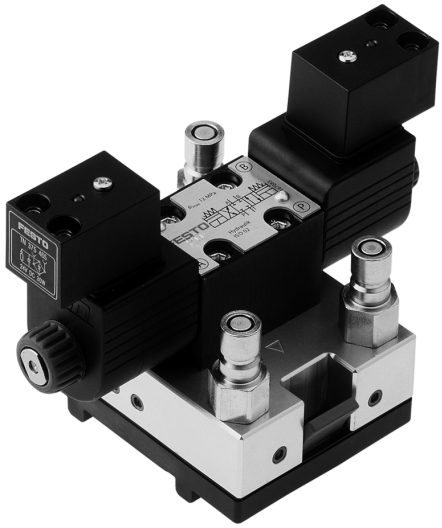
Technical data

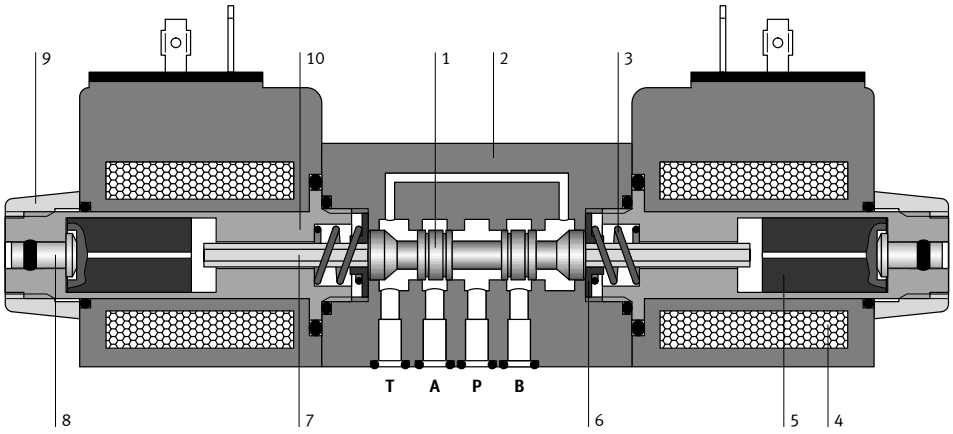
Hydraulic	
Medium	Mineral oil, recommended viscosity 22 cSt (mm^2/s)
Operating pressure p	60 bar (6 Mpa)
Max. permissible pressure p_{max}	120 bar (12 Mpa)
Voltage	24 V DC
Power rating	6.5 W
Actuation	Electrical
Connections, electrical	Via 4 mm safety connector plug
Connections, hydraulic	Via 4 coupling sockets

167083

4/3-way solenoid valve, closed in mid-position







Design

The 4/3-way solenoid valve is mounted on a function plate equipped with four quick coupling connectors. The component is fitted to the grid system of the slotted assembly board by means of the two blue levers (mounting variant “A”).

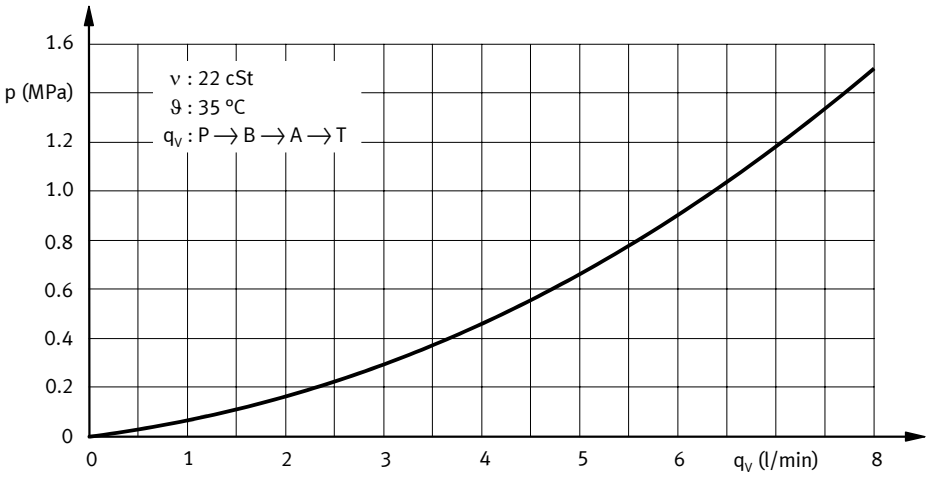
The valve consists of: Piston (1), housing (2), spring (3), solenoid coil (4), plunger (5), spring disc (6), stem (7), emergency manual override (8), nut (9), pressure tube (10).

167083

4/3-way solenoid valve, closed in mid-position

Function

This directional control valve comprises 3 switching positions for the control of flow rates and is directly actuated via DC solenoid coils. Characteristic of this valve is its mid-position, whereby ports A, B, P and T are closed.
The valve is shown in its mid-position in the sectional view. The valve assumes this position via the two compression springs, if neither of the two solenoids are energised (spring force). By applying voltage (energising) to the solenoid coil Y2 (4), the plunger (5) presses the piston (1) against the spring opposite via the stem. This causes port P to be connected to port A via the annular groove of the piston (1) and port B simultaneously to port T via the second annular groove.
By energising the solenoid coil Y1, the piston is pushed into the opposite direction. This causes port P to be connected to port B via the annular groove of the piston (1) and port A to port T via the second annular groove.
The switching solenoid consists of the pressure tube (10), the push-on coil body which is attached by means of the nut (9) and the stem (7). The electrical connection is effected via a valve plug socket.
An emergency manual override (8) also facilitates actuation without electrical energy.



Pressure-drop/flow-rate characteristic

Note

The valve ports are identified by letters.

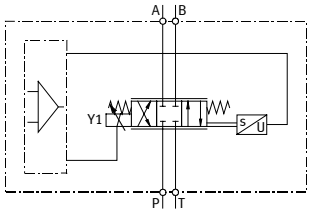
A, B Working ports
P Supply port
T Return-line port (tank connection)

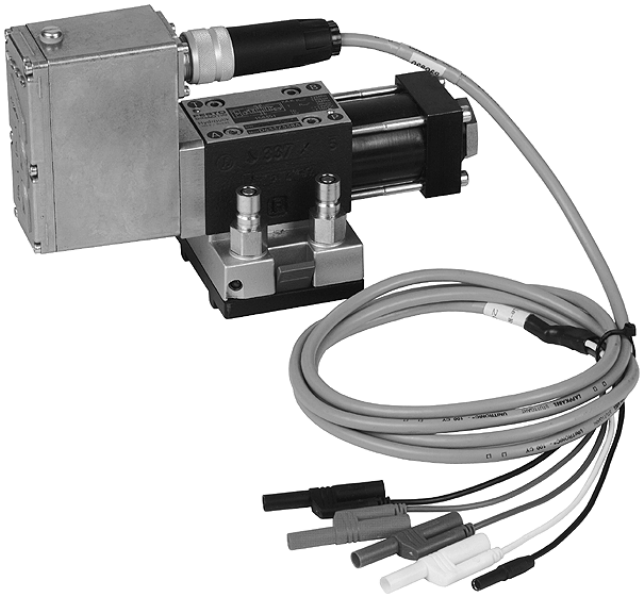
The electrical connections are protected against overvoltage. The switching status is indicated by an LED.

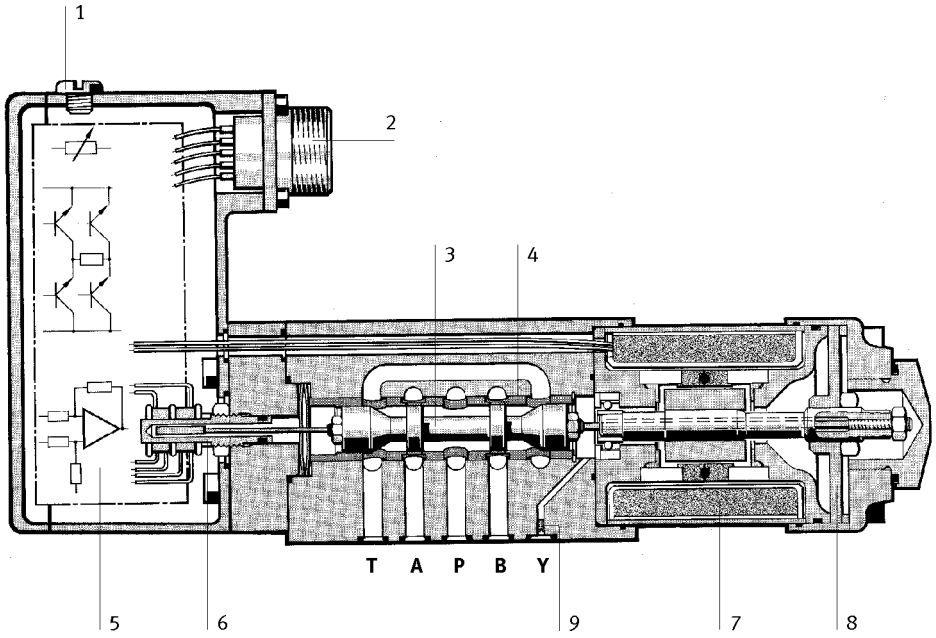
The emergency manual override must not be actuated by means of sharp-edged objects (e.g. screwdriver) so that its smooth operation and leak-proofness are maintained. A stiff manual override may result in malfunction of the solenoid valve.

Technical data

Hydraulic	
Medium	Mineral oil, recommended viscosity 22 cSt (mm^2/s)
Operating pressure p	60 bar (6 Mpa)
Max. permissible pressure p_{max}	120 bar (12 Mpa)
Voltage	24 V DC
Power rating	6.5 W
Actuation	Electrical
Connections, electrical	Via 4 mm safety connector plug
Connections, hydraulic	Via 4 coupling sockets







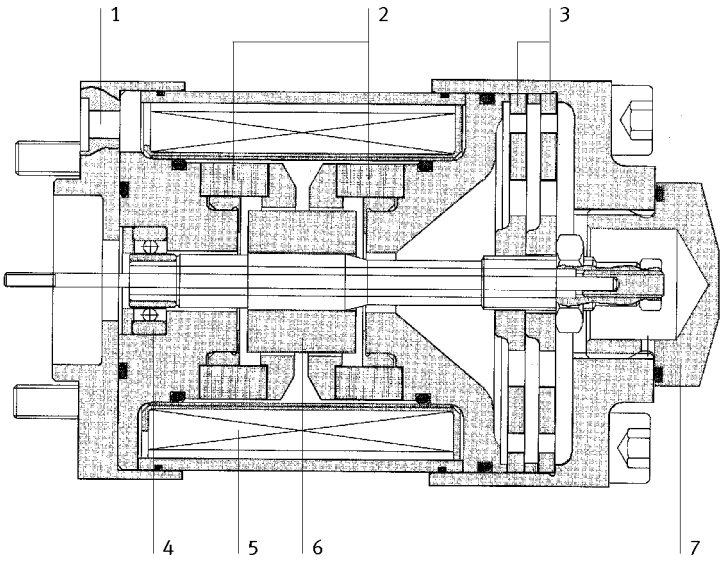
Construction of directional control valve

Plug screw for zero setting (1), Extension plug (2), Control sleeve (3), Control socket (4), Integrated electronics (5), Position encoder (6), Linear motor (7), Reset spring (8), Plug (9).

Function of directional control valve

An electrical control signal (in effect a control piston setpoint position value, but subsequently referred to as a setpoint volumetric flow rate value) is output to the integrated position controller, which drives the linear motor via the pulse-width modulated (PWM) driver electronics. The position encoder supplied via an oscillator measures the position of the control piston. This actual value signal is rectified via a

demodulator, returned to the position controller and compared with the setpoint value. The position controller now activates the linear motor until the setpoint and actual value are the same, whereby the position of the control piston is proportional to the electrical input signal. The actual flow rate q is, however, not only dependent on this electrical input signal, but also critically depends on the pressure drop Δp at individual control edges.



Construction of linear motor

Cable through hole (1), Permanent magnets (2), Reset springs (3), Bearing (4), Coil (5), Armature (6), Plug screw (7).

Function of linear motor

The linear motor is a differential motor energised via a permanent magnet. This means that part of the required magnetic force is already built-in. As a result of this, the current requirement of the linear motor is significantly less than that of comparable proportional magnets. The linear motor has a neutral mid-position and from this position is able to generate strokes and forces in both directions. These are proportional to the flow. Proportional solenoid systems, however require either two proportional solenoids with correspondingly complex wiring or operate unilaterally against a spring, whereby a reliable spring setting can only be achieved by means of overtravelling a power port (A or B). This can lead to uncontrollable movements on the drive unit. The linear motor does not draw any current in the spring centered position (mid or out of trim position). The high spring rigidity and the resulting reset force is overcome when advancing from the mid-position as are external forces, in-creased frictional forces due to contamination of the piston spool). When returning in the direction of zero position, the spring force is combined with the motor force, i.e. maximum force is always available when the piston spool closes.

Volumenstrom und Druckabfall

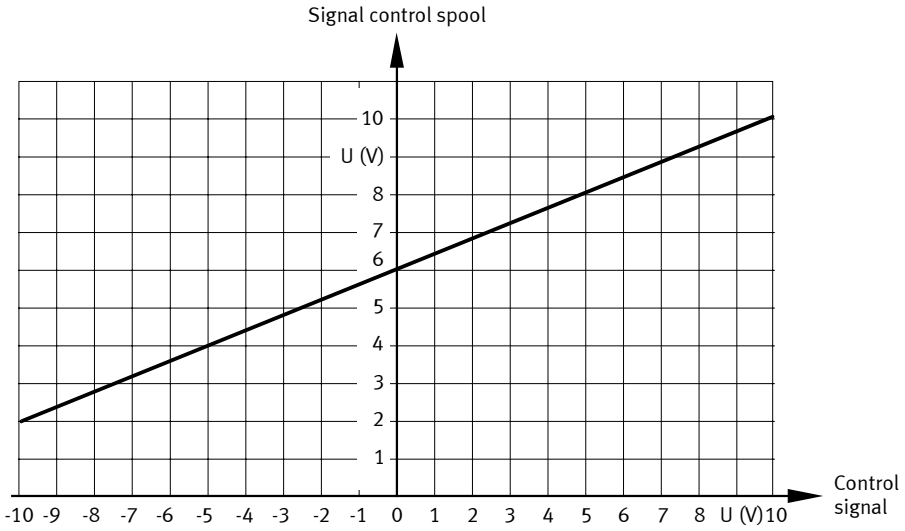
Volumetric flow rate and pressure drop A 100% setpoint input (e.g. +10 V DC = valve fully opened) and a nominal pressure drop Δp_N = 35 bar per control edge results in a nominal volumetric flow rate q_N per control edge. If the pressure drop is varied, the volumetric flow rate q also changes with the setpoint signal in accordance with the function below. The volumetric flow rate q thus calculated should not exceed an average flow velocity of 30 m/s at ports P, A, B and T.

Function for sharp-edged orifices (corresponds to control edges):

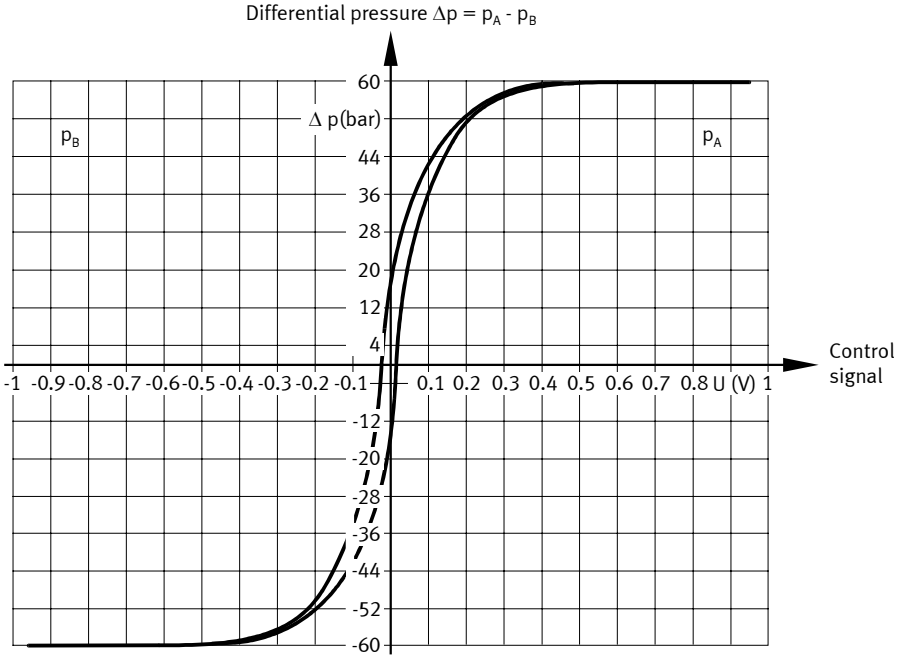
$$q = q_N \sqrt{\frac{\Delta p}{\Delta p_N}}$$

q (l/min) = Actual volumetric flow rate per control edge at Δp
q_N (l/min) = Nominal volumetric flow rate per control edge at p_N
Δp (bar) = Actual pressure drop per control edge
Δp_N (bar) = Nominal pressure drop per control edge

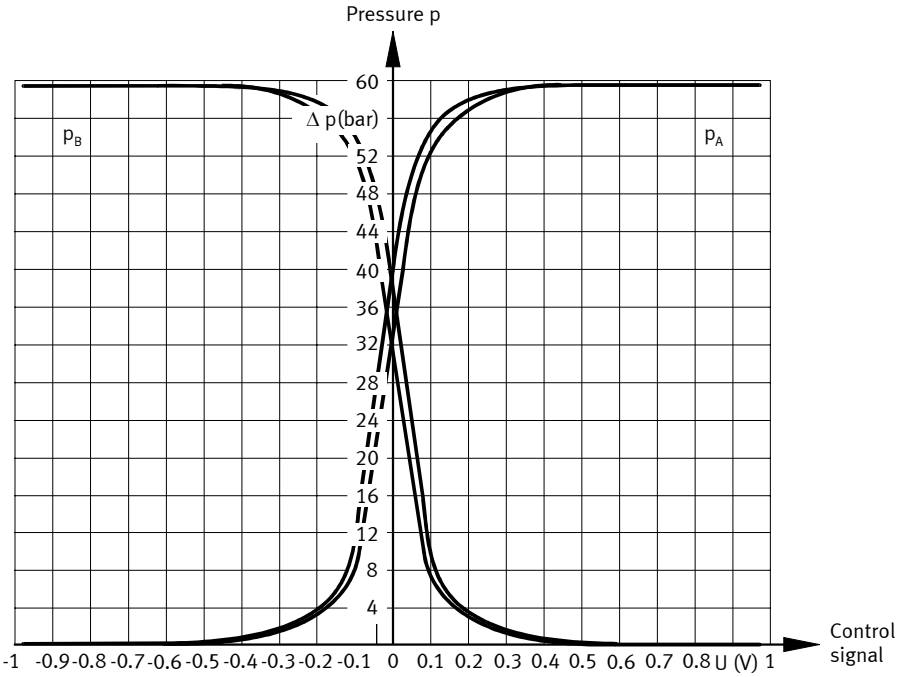
Static characteristics



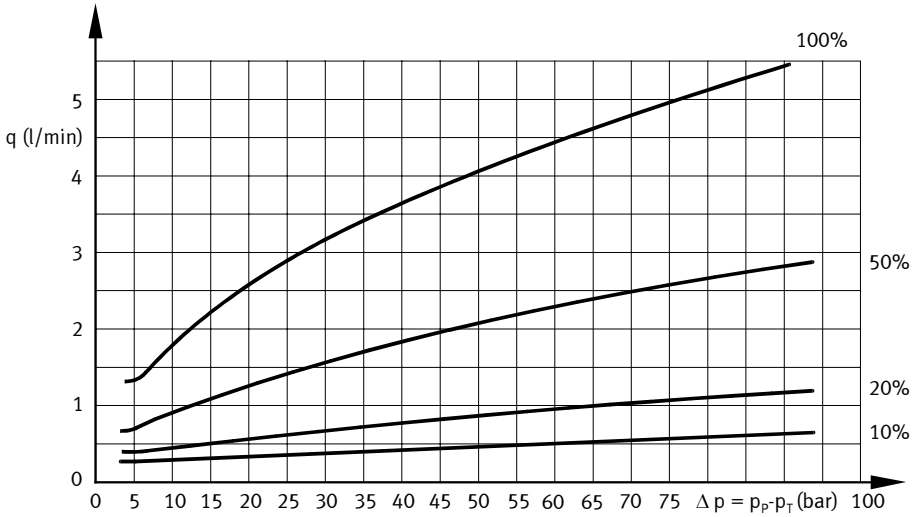
Control piston/signal characteristic curve



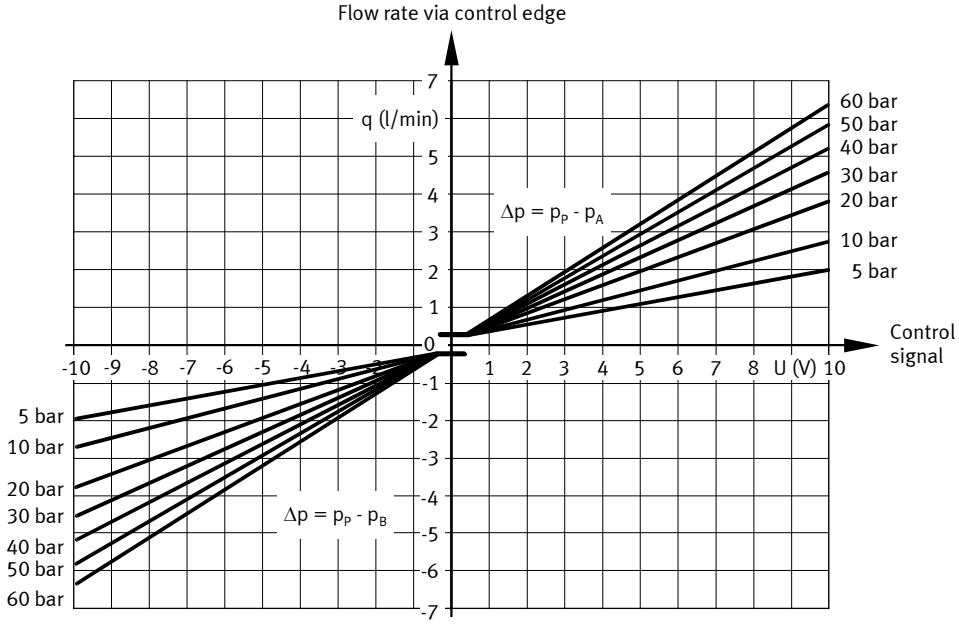
Pressure/signal characteristic curve



Pressure/signal characteristic curve



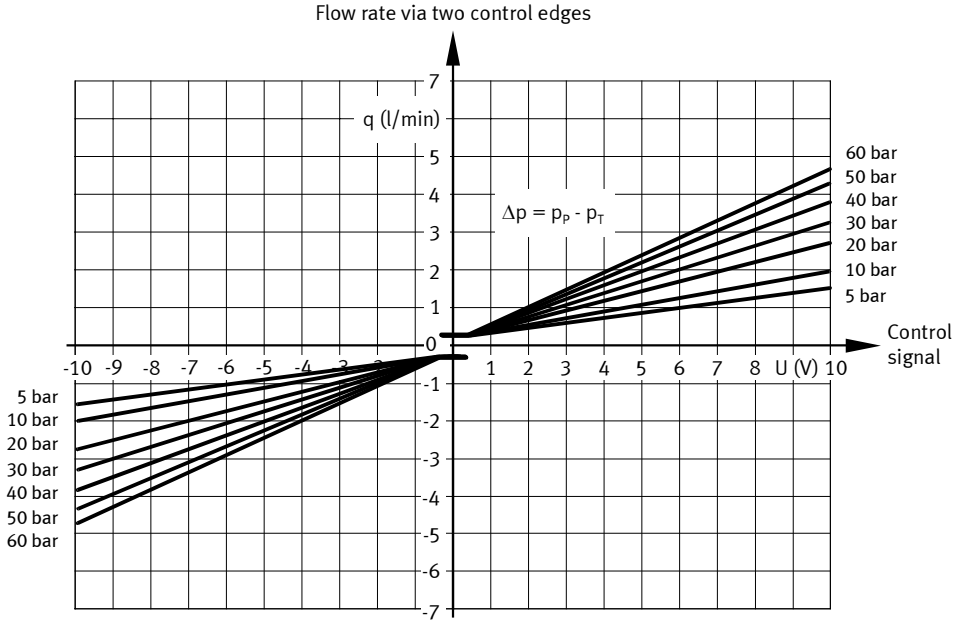
Flow rate/differentialpressure characteristic curve



Flow rate/signal characteristic curve

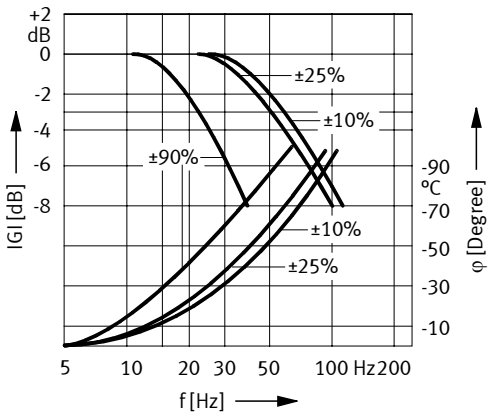
167088

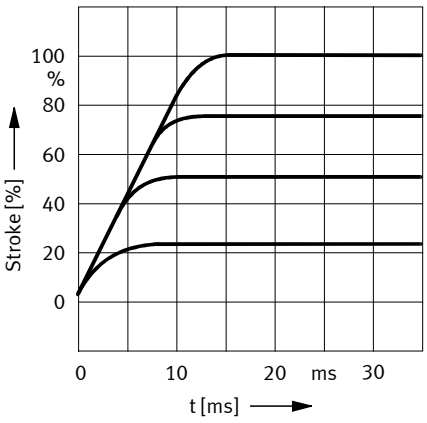
4/3-way regulating valve



Flow rate/signal characteristic curve

Dynamic characteristics

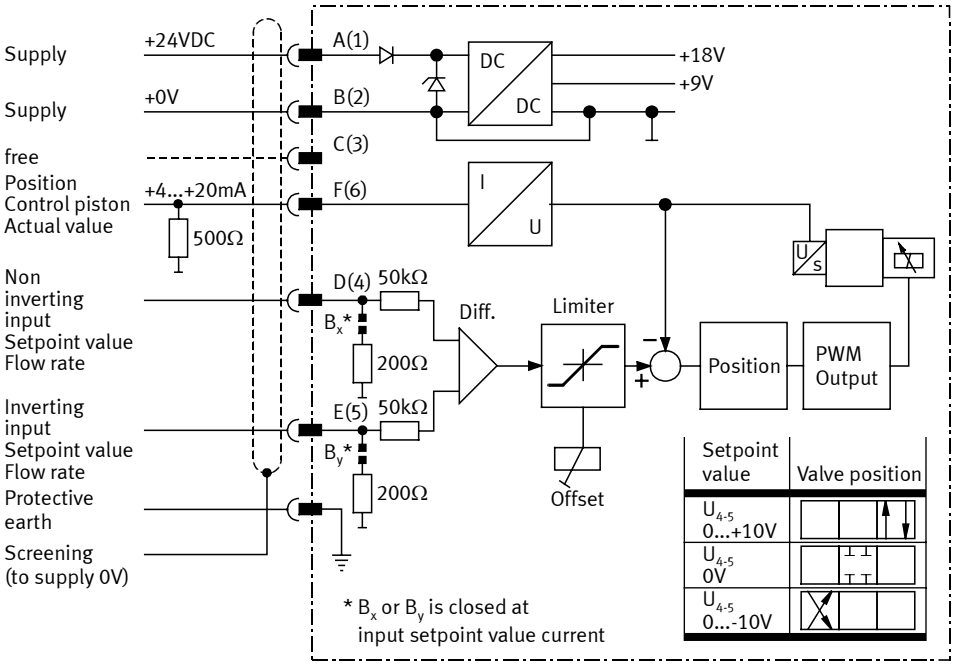




Pin assignment

Valve plug	Designation		Plug colour
A	Supply +	24 V	red
B	Supply –	0 V	blue
C			
D	Setpoint value +	0 – ±10 V	yellow
E	Setpoint value –	0 – ±10 V	green
F	Signal of control piston	4 – 20 mA	(coupling)

A resistor of 500 Ω has been soldered in between B and F resulting in a 2 to 10 V control piston signal.



Technical data

Hydraulic, Electrical	
Valve design	spool valve, single-stage with control sleeve
Actuation	direct via permanent magnet linear motor
Port pattern DIN 24340/ISO 4401/Cetop	Form A6/Cetop 3
Port diameter P, A, B, T	7.9 mm
Control oil supply	none
Leakage oil connection	blocked

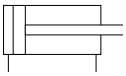
Technical data (continuation)

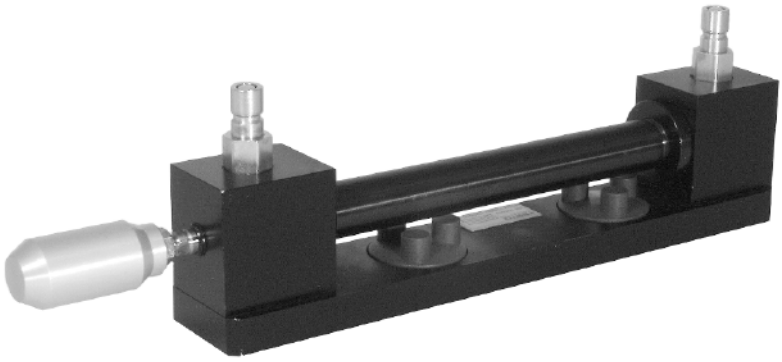
Hydraulic, Electrical	
Mounting position	any
Sealing material	NBR
Protection class DIN 40050, with assembled mating plug	IP 65
Nominal flow rate q_N	5 l/min at Δp_N = 35 bar (Tolerance ±10 %) 2 l/min at Δp_N = 5 bar (Tolerance ±10 %)
Leakage oil flow q_L	0.15 l/min at 140 bar
Max. operating pressure p_{max}, static	connections P, A, B: 350 bar connection T: 50 bar
Extension plug DIN 43563	6 + PE
Op. voltage supply of integrated electronics UB	+24 V DC
Op. voltage tolerance range min UB_{min}	+22 V DC
Op. voltage max UB_{max}	+28 V DC
Nominal current at UB = +24 V DC, Min. current IB_{min} at setpoint value zero	0.15 A
Max. current IB_{max} at setpoint value and 140 bar	1.2 A
Setpoint value signal	±10 V DC
Actual value signal	+4 – +20 mA
Relative duty cycle	100 % ED
Manipulating time signal step 0 – 100 %	< 12 ms
Inversion range	< 0,1 %
Hysteresis at 140 bar	< 0,2 %
Zero shift at ΔT = 55 K	< 1.5 %
Operating fluid DIN 51524	Mineral-based hydraulic oil
Oil temperature range	-20 – +80 °C
viscosity	recommended: 15 – 45 mm²/s permissible: 5 – 400 mm²/s
grade of filtration	recommended: x < 6 (6 µm absolut) permissible: x < 10 (10 µm absolut)
Contamination category	to NAS 1638 minimum: 6 to ISO 4406 minimum: 15/11
System filter	High pressure main flow filter, without bypass, but with contamination indicator

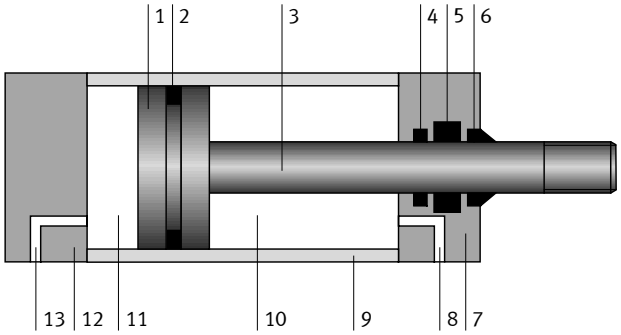
The maximum operating pressure of the valve sub-base and quick connection coupling is 120 bar.

152857, 184489, 184488

Cylinder 16/10/200, 16/10/300, 16/10/400







Design

This double-acting cylinder is equipped with a switching cam and two barbed fittings and is mounted on a mounting plate. The unit is secured to the profile panel by the twist-lock system using two blue finger nuts (mounting variant “B”).

The cylinder consists of: Piston (1), piston seal and guide (2), piston rod (3), piston rod bearing (4), piston rod seal (5), scraper ring (6), cylinder cap (7), connections (8 and 13), cylinder barrel (9), piston rod chamber (10), piston chamber (11), cylinder base (12).

Function

The piston chamber (11) is pressurised via connection (13). The action of the pressure on the piston surface produces a force which sets the piston in motion. This causes oil to be displaced from the piston rod chamber; the oil is discharged via connection (8). In order to retract the piston again, the piston rod chamber (10) is pressurised via connection (8). The displaced oil is discharged in this case via connection (13). The piston seal (2) acts as a divider between the two chambers, while the piston guide supports the piston. The piston rod seal (5) provides a seal between the piston rod chamber (10) and the surrounding environment. The scraper ring (6) keeps the rod seal (5) free of contamination. The piston rod bearing (4) guides and supports the piston rod.

152857, 184489, 184488

Cylinder 16/10/200, 16/10/300, 16/10/400

Note

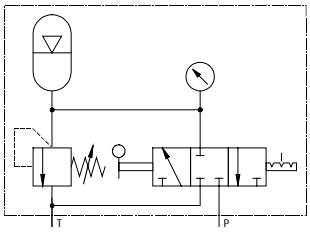
If the cylinder is used in conjunction with the weight (Order no. 152972), ensure that the cylinder is fully secured. For additional safety, the cover (Order no. 152973) can be used with the cylinder (Order no. 152857).

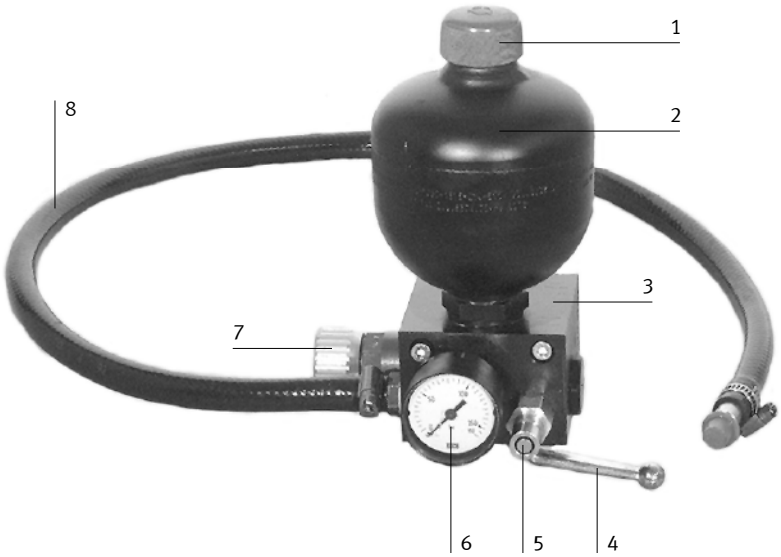
Technical data

Cylinder version (Order no.)	**152857**	**184489**	**184488**
Medium	Mineral oil, recommended viscosity 22 cSt (mm²/s)		
Piston diameter	16 mm		
Piston rod diameter	10 mm, with M 8		
Stroke	200 mm	300 mm	400 mm
Operating pressure p	6 MPa (60 bar)		
Max. permissible pressure p_{max}	12 MPa (120 bar)		
Connections	To accept 2 connector sockets		

152859

Diaphragm accumulator with shut-off block





Design

This accumulator is mounted on a block which contains the associated safety circuit. The component is fitted to the profile plate using cheese-head bolts and T-head nuts (mounting variant “C”).

The accumulator consists of: Gas valve (1), pressure vessel (2), shut-off block (3), supply port (4), 3/3-way valve with hand lever (shut-off valve) (5), pressure gauge (6), pressure relief valve (7), tank connection (8)

Function

The pressure vessel (2) is filled via port (4) with the shut-off valve (5) open. This causes the gas volume, separated from the hydraulic fluid by the accumulator diaphragm, to be compressed. As the pressure at port (4) falls, the previously-compressed gas volume expands and displaces the fluid stored in the pressure vessel. The volume of stored fluid corresponds to the change in gas volume between the minimum working pressure and the instantaneous pressure. The instantaneous working pressure is shown on the pressure gauge (6). The pressure relief valve (7) protects the accumulator against pressure overload. The gas valve (1) allows the gas filling pressure of the accumulator to be checked and corrected with the aid the filling and test device (Order no. 092491).

Before disconnecting the accumulator unit from a pressure system, open the shut-off valve (5) or drain the unit. Ensure that the return line (8) is connected up while the unit is in operation.

Use only NITROGEN to fill the accumulator (green cylinders)!!!

Never use oxygen. This would create in an EXPLOSION HAZARD!!!

152859

Diaphragm accumulator with shut-off block

Note concerning the filling of the accumulator

Gas filling pressure, general	$p_0 = 0.9 \cdot p_1$
Gas filling pressure, minimal	$p_{0min} = 0.25 \cdot p_2$
Gas filling pressure, maximal	$p_{0max} = 0.25 \cdot p_{max}$
Gas filling pressure, temperature-dependent	$p_{0temp} = p_0 \cdot \frac{\text{Filling temperature}}{\text{Operating temperature}}$

p_0 = Gas filling pressure
p_1 = Lower operating pressure
p_2 = Upper operating pressure
p_{max} = Max. permissible operating pressure

Example

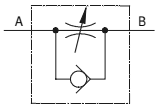
Lower operating pressure	$p_1 = 11$ bar
Upper operating pressure	$p_2 = 40$ bar
Max. permissible operating pressure	$p_{max} = 120$ bar
Gas filling pressure, general	$p_0 = 0.9 \cdot 11$ bar $= 10$ bar
Gas filling pressure, minimal	$p_{0min} = 0.25 \cdot 40$ bar $= 10$ bar
Gas filling pressure, maximal	$p_{0max} = 0.25 \cdot 120$ bar $= 30$ bar

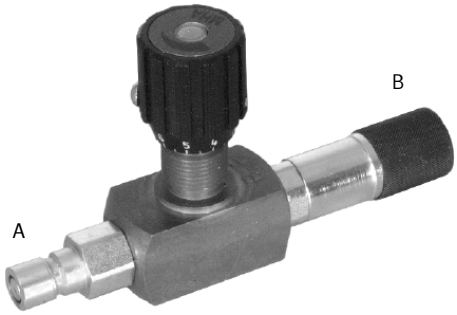
Technical data

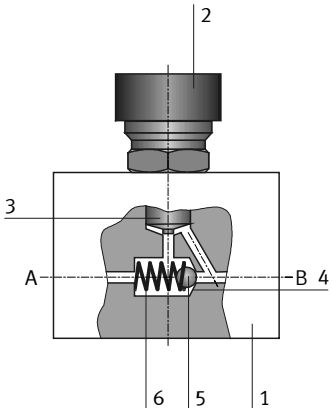
Hydraulic	
Medium	Gas: Nitrogen Fluid: Mineral oil, recommended viscosity 22 cSt (mm²/s)
Max. permissible pressure p_{max}	12 MPa (120 bar)
Gas filling pressure as supplied p_0	1 MPa (10 bar)
Nominal volume	0.32 dm³
Adjustment	Manual
Actuation	Hydraulic
Connections	For 1 quick-acting coupling (P) For 1 blue coupling socket (TS on hydraulic power pack)

152843

One-way flow control valve



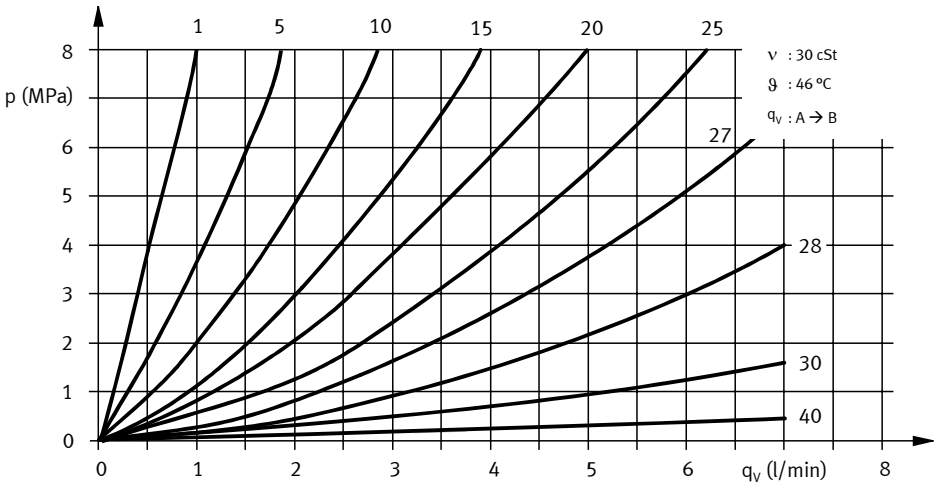




Design	Valve housing (1), rotary knob (2), throttle valve (3), valve seat (4), sealing ball (5), spring (6), nipple (A), socket (B).
Function	A one-way flow control valve is a combination of a throttle valve and non-return valve. In the flow direction from A to B, the hydraulic fluid flows only through the throttle point (3), the size of which is adjustable by means of the rotary knob (2). The valve seat (4) is closed by the sealing ball (5) and the spring (6). In the opposite direction, the non-return valve is open and the full flow cross-section is available.
Note	The valve ports identified by letters A and B are the working ports.

152843

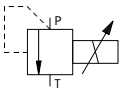
One-way flow control valve

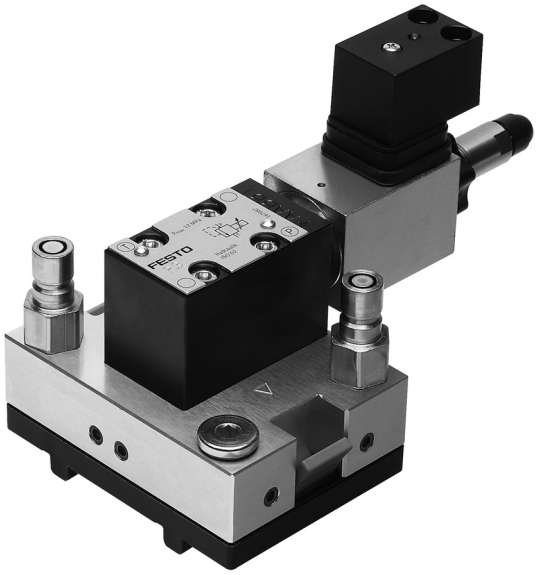


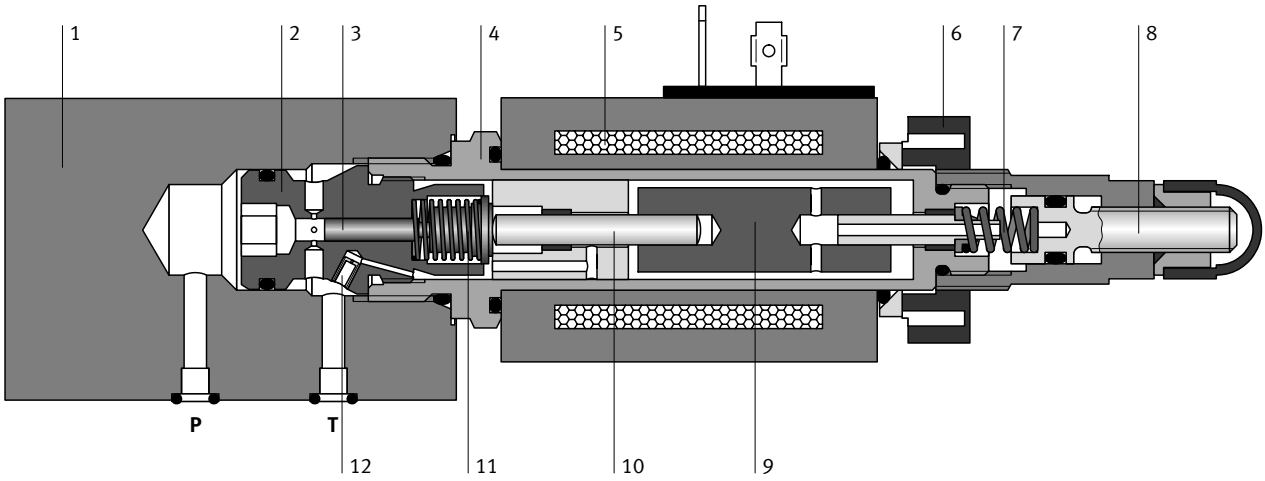
Pressure-drop/flow-rate characteristic for various rotary-knob settings

Technical data

Hydraulic	
Medium	Mineral oil, recommended viscosity 22 cSt (mm²/s)
Operating pressure p	6 MPa (60 bar)
Max. permissible pressure p_{max}	12 MPa (120 bar)
Nominal flow rate	9 l/min
Opening pressure	70 kPa (0.7 bar)
Actuation	Manual
Connections	For coupling nipple/socket







Design

This proportional pressure relief valve is mounted on a function plate equipped with two connection nipples. The electrical connection is equipped with a safety socket. The component is fitted to the grid system of the profile plate by means of the two blue levers (mounting variant “A”).

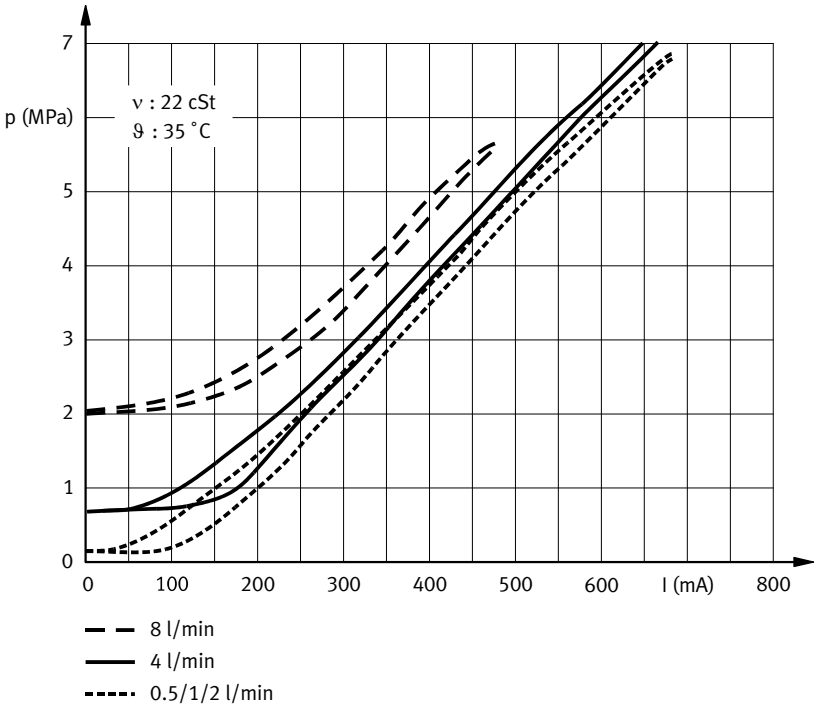
The valve consists of: Housing (1), cartridge housing (2), piston (3), solenoid tube (4), solenoid coil (5), knurled nut (6), spring (7), spindle (8), armature (9), stem (10), spring (11), nozzle (12).

167087

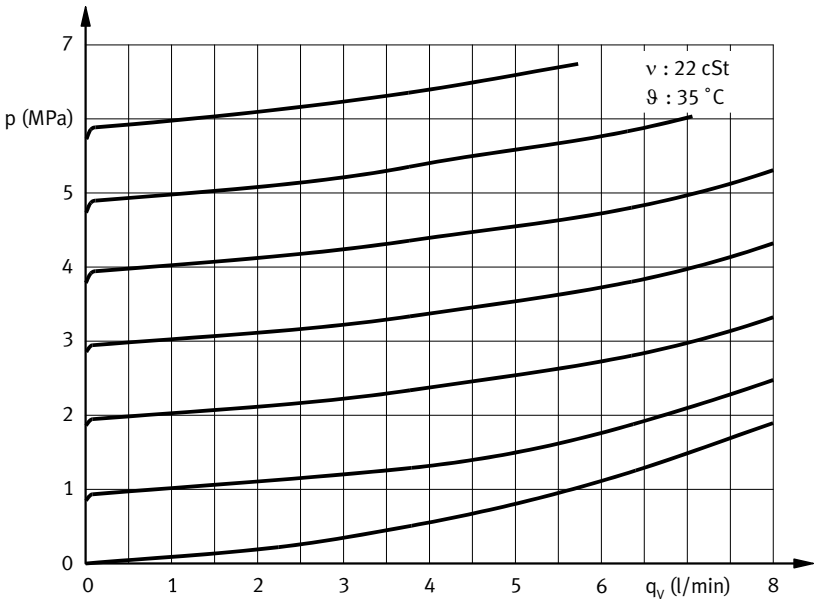
Proportional pressure relief valve

Function

The proportional pressure relief valve has a dynamic action and is electrically adjustable. The piston (3) has two opposing faces which are under pressure. The first face is pressurised via the supply port P, while the second is pressurised via port T. The passage from port T to the spring chamber is throttled by a nozzle (12). This cushions the valve action. When the solenoid is de-energised, the piston is fully retracted and allows full flow from port P to port T.
The proportional solenoid generates a force proportional to the solenoid current which acts on the armature (9). This force is applied via the stem (10) to the piston (3). The piston is displaced until an equilibrium is reached between the solenoid force on the one hand and on the other, the spring force and piston force resulting from the differential pressure on the piston multiplied by the piston area. During this movement, the cross-section of the connection between ports P and T is reduced or even closed completely. An intial tension is applied to the solenoid armature by the spindle (8) and spring (7). This allows the solenoid current to be adjusted relative to the resulting pressure.



Current/pressure characteristics



Flow-rate/pressure characteristics

Note

The valve ports are identified by letters:

P Supply port

T Tank (return) port

The electrical connections are protected against overvoltage. The operational status of the connections is displayed via an LED.

The intial spring tension on the spindle (8) and must not be changed.

167087

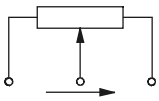
Proportional pressure relief valve

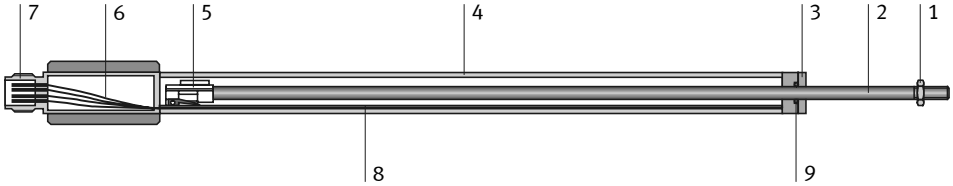
Technical data

Hydraulic	
Valve design	Directly-controlled poppet valve
Actuation	Proportional solenoid, pressure-tight, pushing action
Hydraulic port pattern	ISO/DIN 4401 size 02
Medium	Mineral oil, recommended viscosity 22 cSt (mm^2/s)
Recommended oil temperature	Up to 60 °C
Level of contamination	16/13 in accordance with ISO 4406 (7...8 in accordance with NAS 1638)
Max. operating pressure p_{max}, static	12 MPa (120 bar)
Max. pressure setting	6.3 MPa (63 bar) at 600 mA and 1 l/min.
Nominal flow rate q_N	5.5 l/min
Nominal voltage	24 V DC
Resolution	<1 mA
Repetition accuracy	<1.5 %
Electrical connection	4 mm safety plugs
Hydraulic connection	2 coupling sockets

167090, 525953

Linear potentiometer





Design

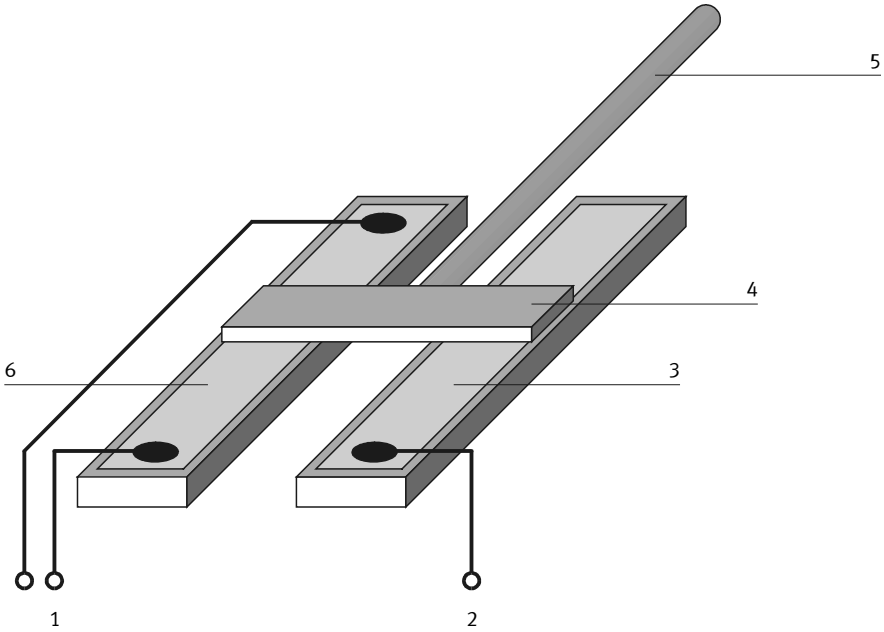
1 Attachment lock nut
2 Connecting rod
3 Cover cap with bearing
4 Light metal housing
5 Retainer for wiper
6 Electrical connection
7 Wiring box
8 Plastic film wiper track
9 Scraper ring

The linear potentiometer is mounted on to the hydraulic cylinder with the mounting kit.

Mounting kit (Order no.)	**120 778**	**525 955**	**525 952**
For cylinder (Order no.)	152 857	184 490	184 489

167090, 525953

Linear potentiometer



Function

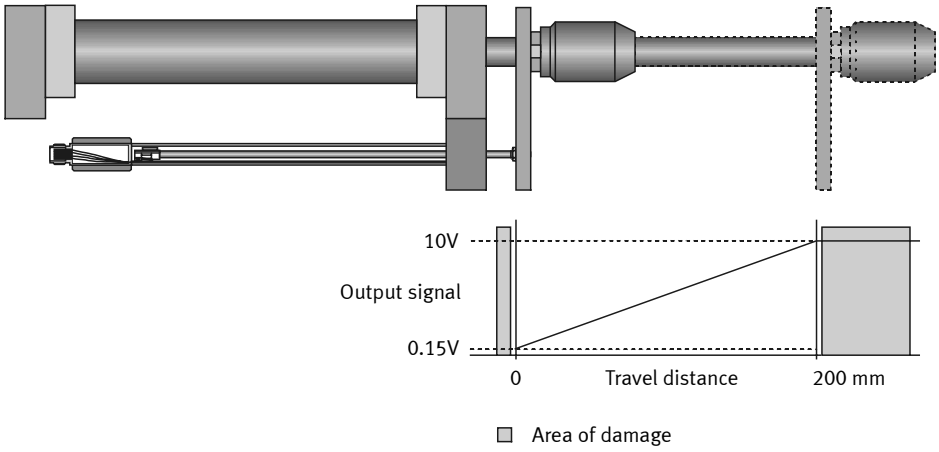
1 10 VDC
2 Signal output 0 – 10 V DC
3 Connecting rod
4 Wiper
5 Conductive track
6 Resistor track

Two plastic film wiper tracks are located along the inside of the light metal housing. One track represents the electrical resistor, the other acts as the conductive track. The wiper bridges the two tracks. The ends of the resistor track are connected electrically via a connection socket. A voltage is applied to these connections and subsequently drops via the resistor track. Depending on the position of the wiper or the connecting rod, a voltage is now tapped, which is proportional to the position.

Installation and connection of the displacement encoder

The linear potentiometer is connected by means of a special cable. This cable contains an electronic module, which protects the potentiometer from incorrect connection and from excessive electrical loads.
The displacement encoder is to be installed with the cylinder extended. The connecting rod is screwed into the drive plate of the cylinder and locked. Then, the potentiometer housing is pulled back up until the mechanical end stop has been reached. For the subsequent precision adjustment, it is necessary to connect the potentiometer electrically. The housing is then in the correct position when the output signal displays 9.99 V or just 10.00 V. (There are no output signal values greater than 10 V).
Now lightly clamp the housing. Then check the output voltage and the position of the housing in the retracted status of the cylinder. The position of the housing must not be moved during this and the output signal should not be below 150 mV. Now completely tighten the housing clamp.

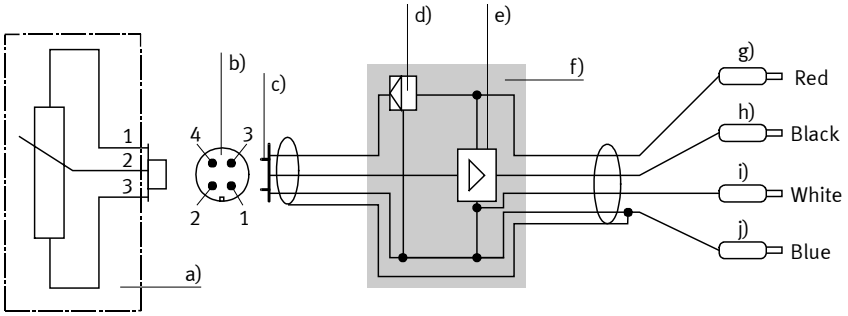
The potentiometer must be installed and secured with the greatest of care, as it may be damaged if the mechanical end stop is overtravelled. Therefore check that the stroke of the potentiometer is sufficient and that movements cannot exceed the mechanical end stop.



167090, 525953

Linear potentiometer

Electrical structure of the displacement encoder



a) Potentiometer
b) Pin assignment
c) Plug
d) Reference voltage supply
e) Impedance converter
f) Housing
g) Supply voltage
h) + Signal
i) – Signal
j) Supply earth

Technical data

Linear potentiometer (Order no.)	**167090**	**525953**
Connection cable		
Supply voltage	13 – 30 V DC	
Output voltage	0 – 10 V DC	
Potentiometer		
Measuring stroke	200 mm	300 mm
Mechanical stroke	201 mm	301 mm
Electrical resistance	10 kΩ ±20 %	22 kΩ ±20 %
Load carrying ability	4 W	6 W
Linearity tolerance	0.5 %	
Service life	25,000 000 Wiper cycles	
Max. wiper current	≤ 1 mA	
Max. pick-up speed	1.5 m/s	
Operating temperature range	-40 – +105 °C	
Protection class	IP 64	
Mechanical attachment of connecting rod	M4 thread	

525964

Pressure sensor

Construction

The analogue pressure sensor is screwed into a T connector. The electrical connection is established via the 4 mm safety connector plugs fitted to the connecting lead.

Function

A diaphragm inside the pressure sensor is distorted as a result of the measuring pressure applied. This distortion leads to a change in electrical resistance of the elements on the membrane (piezoresistive effect). This resistance change is electronically converted, temperature compensated and amplified.

Note

Please observe the polarity of the connected voltage during operation. The terminal plugs have been colour coded.

Terminal plugs		
Operating pressure	Positive terminal: Negative terminal:	red blue
Analogue output signals	Voltage:	black

525964

Pressure sensor

Technical data

Electrical	
Permissible operating voltage	15 – 30 V DC
Voltage output	0 – 10 V
Load resistance	≥4.7 kΩ
Measuring range	0 – 100 bar
Critical frequency	1 kHz
Ambient operating temperature	-10 – +70 °C
Temperature effect comp. range (-10 – +80 °C)	±0.2 % FSD*/10 K
Linearity	±0.5 % FSD*
Reproducibility	±0.1 % FSD*
Protection class (DIN 40 050)	IP 67
Weight	260 g
Connection	cable with 4 mm safety connector plugs

* FSD = full-scale deflection

525963

Temperature sensor

Construction

The analogue temperature sensor is screwed into a T connector. The electrical connection is established via the 4 mm safety connector plugs fitted to the connecting lead.

Function

Temperature is measured by a PT100 resistance thermometer, which operates on the principle that the electrical resistence of platinum varies in proportion to changes in temperature. Platinum has a positive temperature coefficient, i. e. its resistance increases as the temperature rises. This resistance change is electronically converted and amplified.

Note

Please observe the polarity of the connected voltage during operation. The terminal plugs have been colour coded.

Terminal plugs		
Operating pressure	Positive terminal: Negative terminal:	red blue
Analogue output signals	Voltage:	black

525963

Temperature sensor

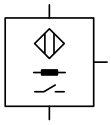
Technical data

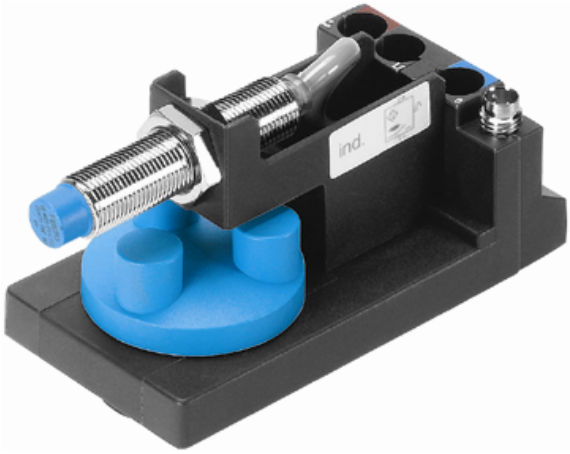
Electrical	
Permissible operating voltage	20 – 30 V DC
Voltage output	0 – 10 V
Load resistance	≥4.7 kΩ
Measuring range	0 – 100 °C
Ambient operating temperature	-10 – +100 °C
Linearity	<±0.5 % FSD*
Reproducibility	<±0.1 % FSD*
Protection class (DIN 40 050)	IP 67
Weight	260 g
Connection	cable with 4 mm safety connector plugs

* FSD = full-scale deflection

178574

Proximity sensor, inductive





Design

The inductive proximity sensor with LED and electrical connections is assembled on a polymer assembly base. The electrical connection is effected by means of safety connectors. The unit is mounted on the profile plate via a quick release detent system with blue triple grip nut (Mounting alternative “B”).

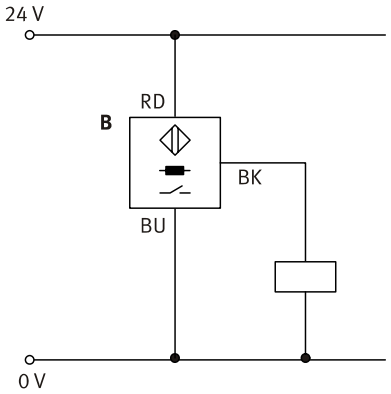
Function

The inductive proximity sensor consists of an oscillator circuit, which is made up of a parallel resonant circuit with coil and capacitor as well as an amplifier. The electromagnetic field is directed outwardly by means of a ferrite shell core. When a electrically conductive material is brought into the electromagnetic stray field, this creates eddy currents in the material in accordance with the law of induction, which attenuate the oscillator. Depending on the conductivity, the size and proximity of the conducting object, the oscillator may be attenuated so strongly that oscillation ceases. The attenuation of the oscillator is evaluated in the triggering stage which supplies an output signal.

The proximity sensor has a PNP output, i.e. the signal line is switched to a positive potential in the switched status. The switch is designed in the form of a normally open contact. The connection of the load takes place between the signal output of the proximity sensor and the load. The active surface can be identified by a blue polymer disc. The operating status is indicated via an LED display. The sensor is protected against polarity reversal, overload and short circuit.

178574

Proximity sensor, inductive



Note

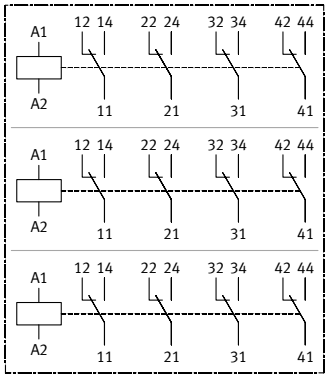
The correct polarity of the applied voltage is necessary for proper functioning. The connections for the operating voltage are colour coded as follows: red for positive, blue for negative and black for the signal output. The load is connected to the switching output and connected to the negative terminal of the current supply.

Technical data

Electrical	
Switching voltage	10 – 30 V DC
Residual ripple	maximum 10%
Nominal switching distance	4 mm
Switching frequence	maximum 800 Hz
Output function	normally open contact, positive switching
Output current	maximum 400 mA
Protection class	IP65
Connections	for 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN EN 500 81-1
Noise immunity	tested to EN 500 82-1

162241

Relay, 3-off

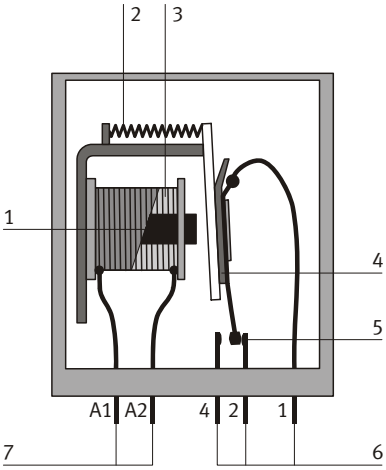


Design

This component consists of three relays with connections and two bus-bars for the power supply. All electrical connections are in the form of 4 mm sockets. The unit is mounted on the mounting frame or on the slotted assembly board using the set of plug-in adapters.

162241

Relay, 3-off

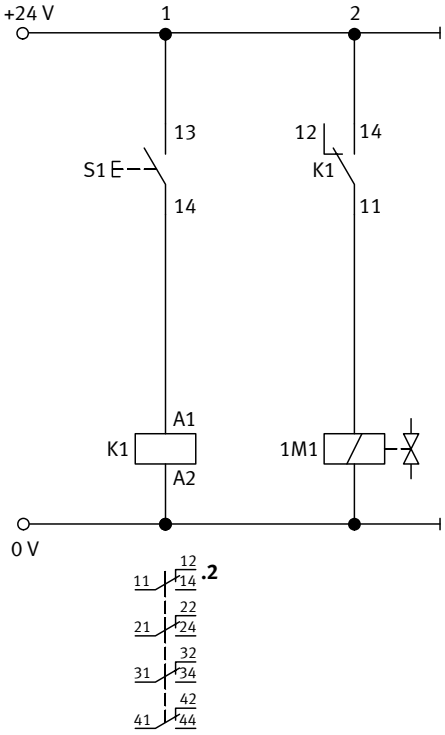


Function

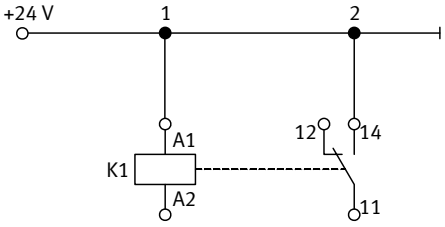
The relay consists of a coil with a core (1) and winding (3) with connection lugs (7), an armature (4), a return spring (2) and a contact assembly with four changeover contacts (5) and connection lugs (6). When power is applied to the coil connections, current flows through the winding, creating a magnetic field. The armature is pulled onto the coil core and the contact assembly is actuated. Electrical circuits are opened or closed via this assembly.
When the electrical current is removed, the magnetic field collapses and the armature and contact assembly are returned to their original position by a return spring.

Note

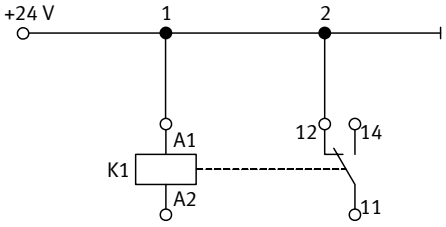
The switching status of the relays is indicated by LEDs, which are protected against incorrect polarity.
The four changeover contacts of the contact assembly can be used as normally-open contacts (1), normally-closed contacts (2) or changeover contacts (3).



Example of application: Circuit diagram, electrical



Changeover switch connected as normally-open contact



Changeover switch connected as normally-closed contact

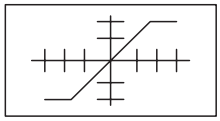
Normally-open contacts, normally-closed contacts: Allocation of contacts on relay plate

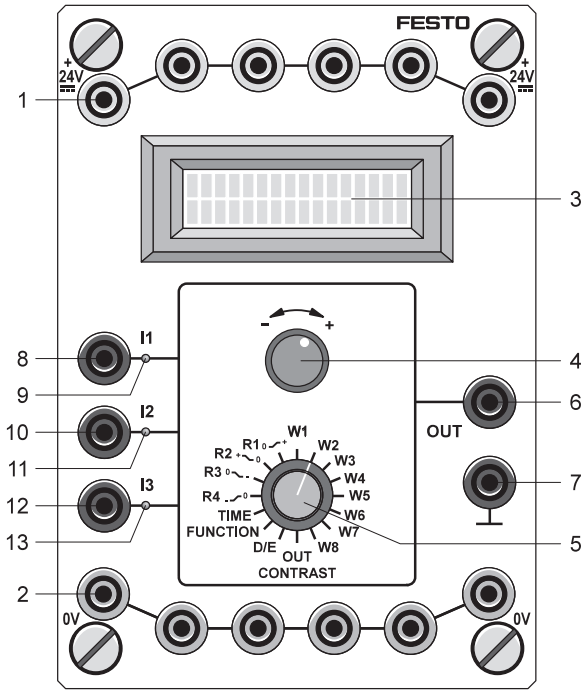
162241

Relay, 3-off

Technical data

Electrical	
Voltage	24 V DC
Contact assembly	4 changeover contacts
Contact rating	Max. 5 A
Contact interrupt rating	Max. 90 W
Pichup time	10 ms
Drop-off time	8 ms
Connections	For 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1





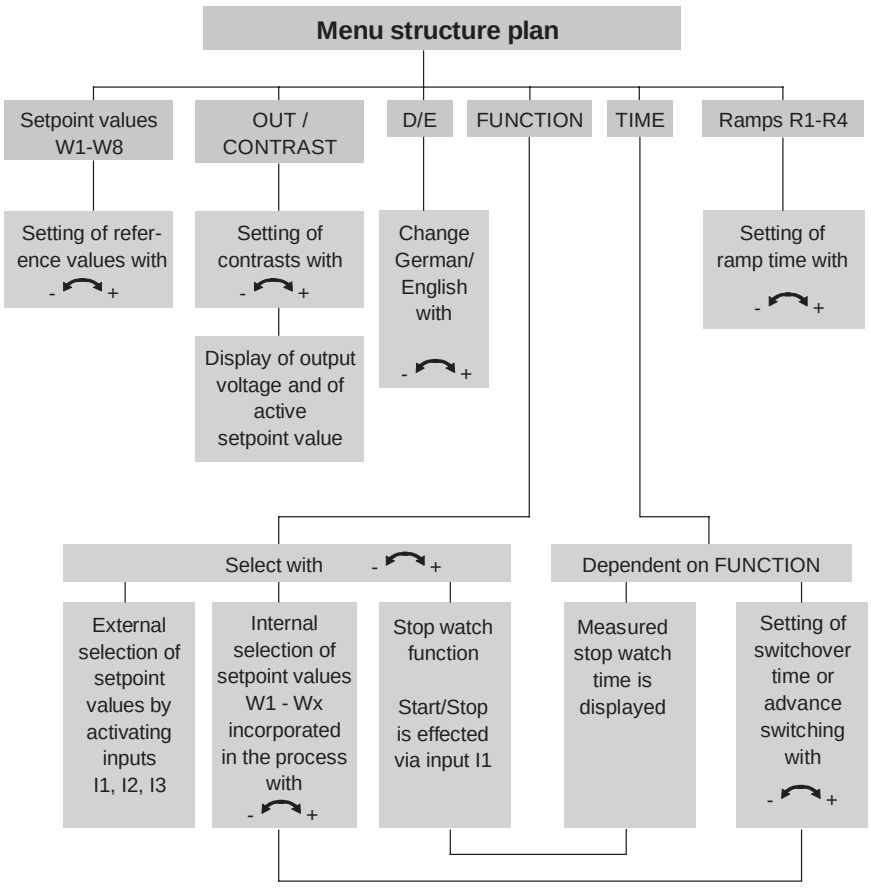
Front view

Control elements

1 Supply voltage: 24 VDC
2 Supply voltage: 0 VDC
3 Display
4 Turning knob
5 Selector switch
6 Setpoint signal +
7 Setpoint signal -
8 External binary input I1
9 LED
10 External binary input I2
11 LED I2
12 External binary input I3
13 LED I3

Design
The setpoint value card is housed inside a small ER unit. The signals and voltages can be accessed via 4 mm safety connectors. The unit is mounted in the cabinet frame of the laboratory workstation or on the profile plate by means of four plug-in adapters.

Function
The functions of the setpoint value card are as follows:
- programmable setpoint value generation
- programmable ramp generation
- cyclical sequence of setpoint values and ramps
- Stop watch



Menu structure plan

Storing
The set values are stored by means of further detenting of the selector switch.

Stop watch
The stop watch function is selected via the menu item “FUNCTION”. The measured time is displayed under the menu item “TIME”. The stop watch is started and stopped by means of setting at input I1. The maximum measuring time is 100 hours.

Setpoint values
Up to 8 setpoint values can be set between the voltage range of -10 V to +10 V. These can be activated internally or externally.
Internal activation is effected sequentially within the adjustable reversing time (0.01...50 sec.). The reversing time is identical for all setpoint values. The external control inputs I1, I2 and I3 are inactive.
With switchover times of less than 0.01 sec. or more than 50.0 sec., the operating mode “Advance switching setpoint values” is selected, where the internally selected setpoint values W1...Wx are continually advanced, once the actived setpoint value has reached its value.

Bit table of inputs			
I3	I2	I1	Setpoint value
0	0	0	W1
0	0	1	W2
0	1	0	W3
0	1	1	W4
1	0	0	W5
1	0	1	W6
1	1	0	W7
1	1	1	W8

Bit table

External activation is effected in any order according to the bit table via activation of the inputs I1, I2 and I3. The internal reversing time is inactive.

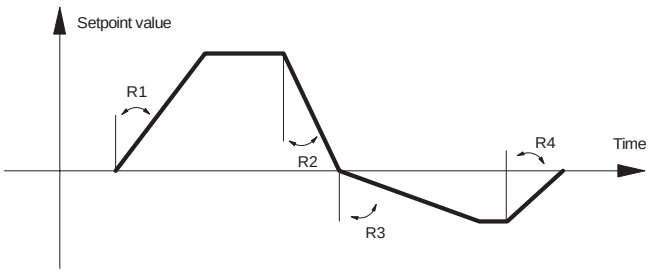
Ramps

The ramps are set as slope parameters (seconds / Volt), i.e.:

- low ramp value = large slope
- high ramp value = small slope

The ramps in the quadrants of the cartesian coordinate system are defined as follows:

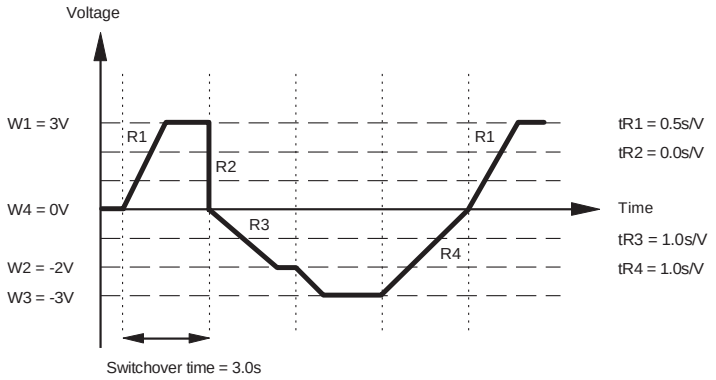
1. Quadrant: positive slope of 0 V
2. Quadrant: negative slope up to 0 V
3. Quadrant: negative slope of 0 V
4. Quadrant: positive slope up to 0 V



Supply voltage	24 V DC +/- 10%
Number of setpoint values	8
Output voltage range	-10V...+10V Tol. ± 5 mV (adjustable in steps of 0.1 V)
Number of ramps	4
Ramp times	0...10.0 s / 1V (adjustable in steps of 50 ms / 1V)
Activating voltage of inputs	min. 15 V
Output rate	1 kHz
Stop watch	Input I1 Measuring time 0...100 Std.
Connections	For 4 mm safety connector plug
Electromagnetic combatibility Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1
Subject to change	

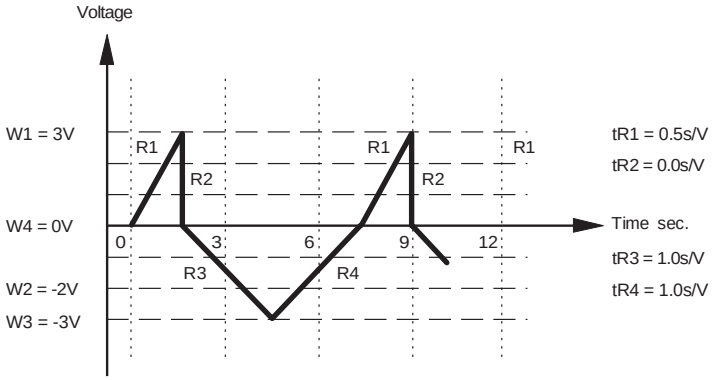
CE

Technical data



Example 1
Settings at setpoint value card:

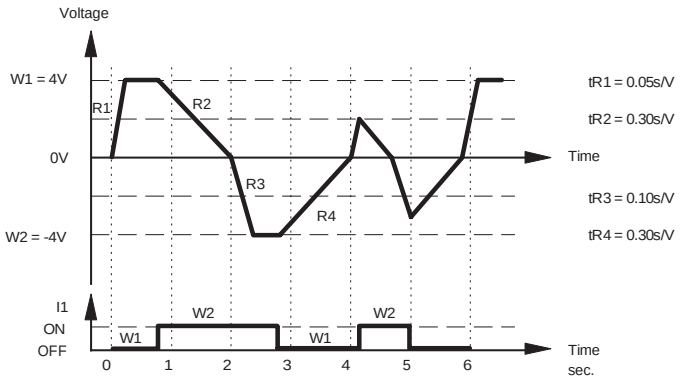
Function:	Internal selection: Setpoint values 1÷4
Time:	Switchover time t = 3.0s
Ramp times:	tR1 = 0.5s/V
	tR2 = 0.0s/V
	tR3 = 1.0s/V
	tR4 = 1.0s/V
Setpoint values:	W1 = 3.0V
	W2 = -2.0V
	W3 = -3.0V
	W4 = 0.0V



Example 2
Settings at setpoint value card:

Time: Advance switching setpoint values

All other settings identical to example 1.

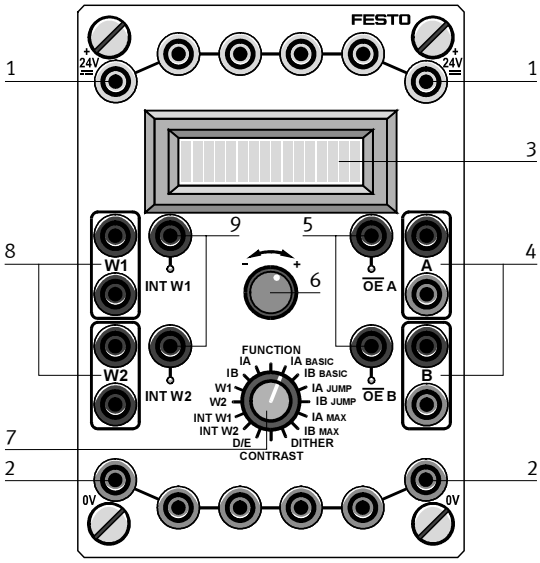


Example 3
External activation via input I1

Function:	Select setpoint values with I1, I2, I3
Ramp times:	tR1 = 0.05s/V
	tR2 = 0.30s/V
	tR3 = 0.10s/V
	tR4 = 0.30s/V
Setpoint values:	W1 = 4.0V
	W2 = -4.0V

162255

Control amplifier, two-channel



Control elements

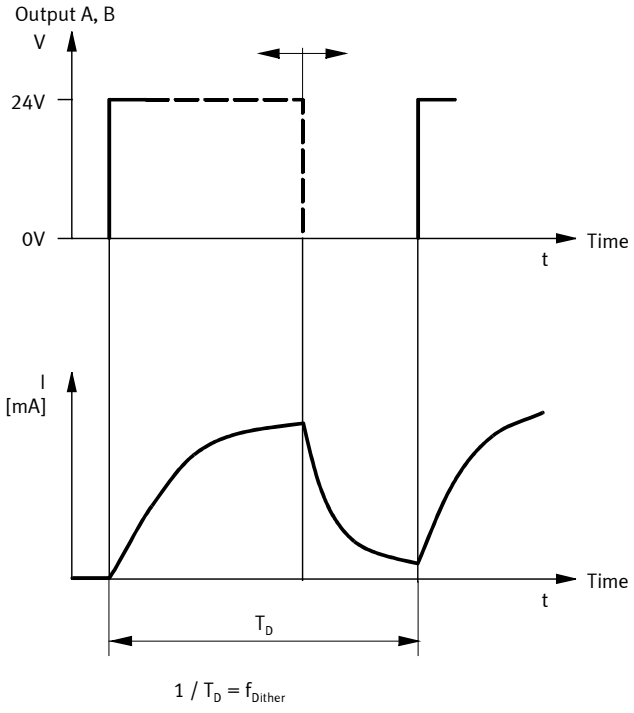
1 Supply voltage +24 V DC
2 Supply voltage 0 V
3 Display
4 Outputs A and B
5 Release of outputs A and B (output enable)
6 Rotary knob
7 Selector switch
8 Inputs for external setpoint values
9 Internal setpoint values

Design

The card of the proportional amplifier is housed inside a small electronic unit. The electrical connections are effected in the form of 4 mm safety connectors. The unit is mounted in the cabinet frame of the laboratory workstation or on the profile plate by means of four plug-in adapters

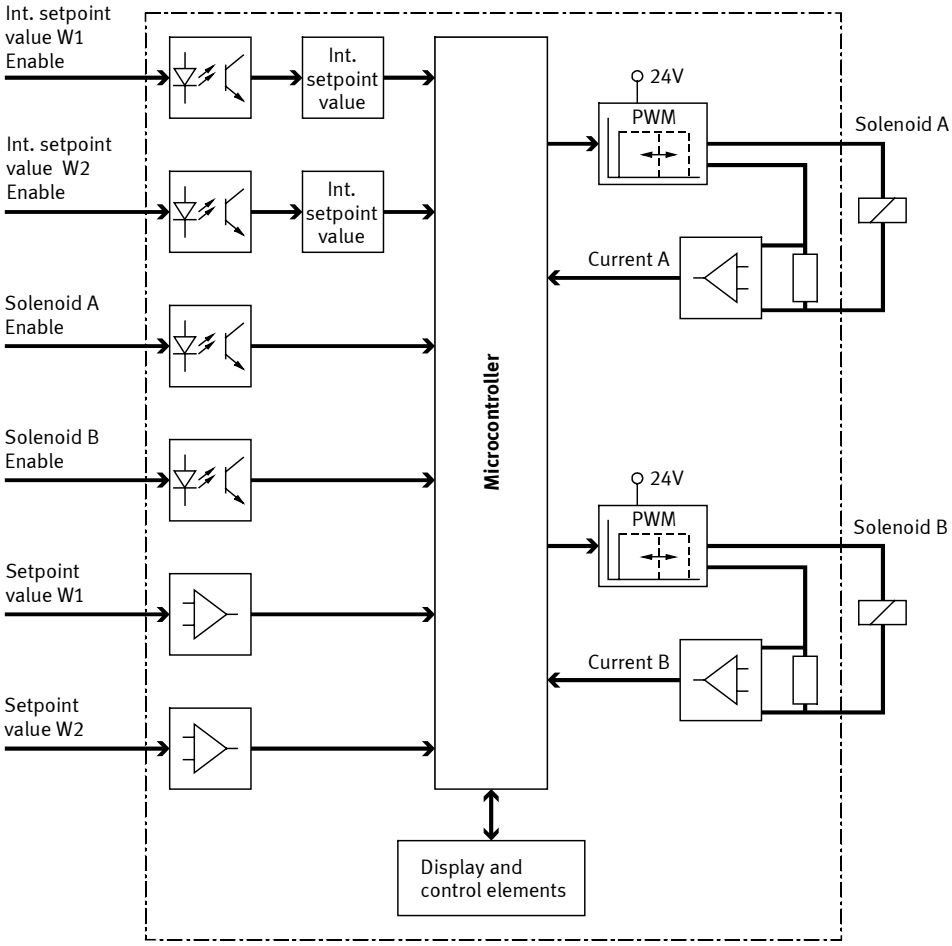
Function

The amplifier card is used for the actuation of proportional valves. The amplifier is designed in such a way that either two independent solenoids (1-channel) or one valve with two solenoids (2-channel), e.g. a 4/3-way proportional valve, can be actuated. The card operates optionally either in the same way as two 1-channel amplifiers or as a 2-channel amplifier.
For this purpose, setpoint values /voltage signals) are converted into the magnetizing current required for the proportional valves. This task is performed by two pulse-width modulated end stages. The function of the end stages may be compared to that of a switch. This is switched on for a period and switched off for a period. The sum total of the two periods remains the same. The ratio between On and Off is changed in relation to the setpoint value. The switch can remain switched on from zero time for the entire period. The longer the switch is set at On, the longer a current passes through the proportional solenoid. In the solenoid, the current rises according to the charge curve of a coil up to the maximum of the value specified by the voltage applied and the ohmic resistance, or limited by the time-related end. When switched to Off, the current drops according to the discharge curve. This results in a current pattern similar to a saw tooth.



Current flow

Since the resistance of the proportional solenoid coil changes with the temperature, the current is controlled. To do this, the current is conducted via a very small ohmic resistor. The voltage drop via this resistor is conducted toward the current controller. The end stages are fitted with an automatic fuse against overload.



Block diagram

Settings

All inputs are made via a selector switch and a rotary knob at the front of the card. Storage is effected by further switching of the selector switch. The variable data is shown on the display and secured against power failure.

FUNCTION	Two 1-channel amplifiers or one 2-channel amplifier
IA BASIC, IB BASIC	Basic current for output A, B
IA JUMP, IB JUMP	Jump current for output A, B
IA MAX, IB MAX	Maximum current for output A, B
DITHERFREQ.	Dither frequency
CONTRAST	Display contrast
D/E	Language options: German, English
INT W1, INT W2	Internal setpoint value W1, W2
W1, W2	Displays of external setpoint value W1, W2
IA, IB	Displays of magnetizing current at output A, B

The setpoint values can be specified externally or internally. The internal setpoint values are activated via the inputs INT W1 and INT W2. The active status is displayed via the LEDs next to the inputs.

Magnetizing current

There are three different magnetizing currents. The basic current, the jump current and the current dependent on the setpoint value.
The basic current is dependent on the setting at I Basic and not on the setpoint value.
The jump current is dependent on the polarity of the setpoint value. As far as the 2-channel amplifier is concerned, this means that a change of the positive setpoint value at output A leads to an abrupt rise in the current by the value set. Accordingly, a change to negative setpoint values leads to a jump current to channel B. The level of the setpoint value does not have any effect on the value of the jump current.
The correlation between setpoint value and magnetizing current depends on a number of factors. These factors are the maximum current I Max, the quiescent current I Basic, jump current I Jump and setpoint value.
The value of I Max refers to a setpoint value of 10 V. If no basic current and jump current is set, the amplification (V) is at:

$$V = \frac{\text{Value of I Max}}{10\,\text{V}}$$

Example

I Max = 800 mA

$$V = \frac{800\ \text{mA}}{10\,\text{V}} = 80\ \text{mA/V}$$

If a jump current or also a basic current is set, the amplification (V) is reduced. However, the maximum current remains at the value set with I Max.

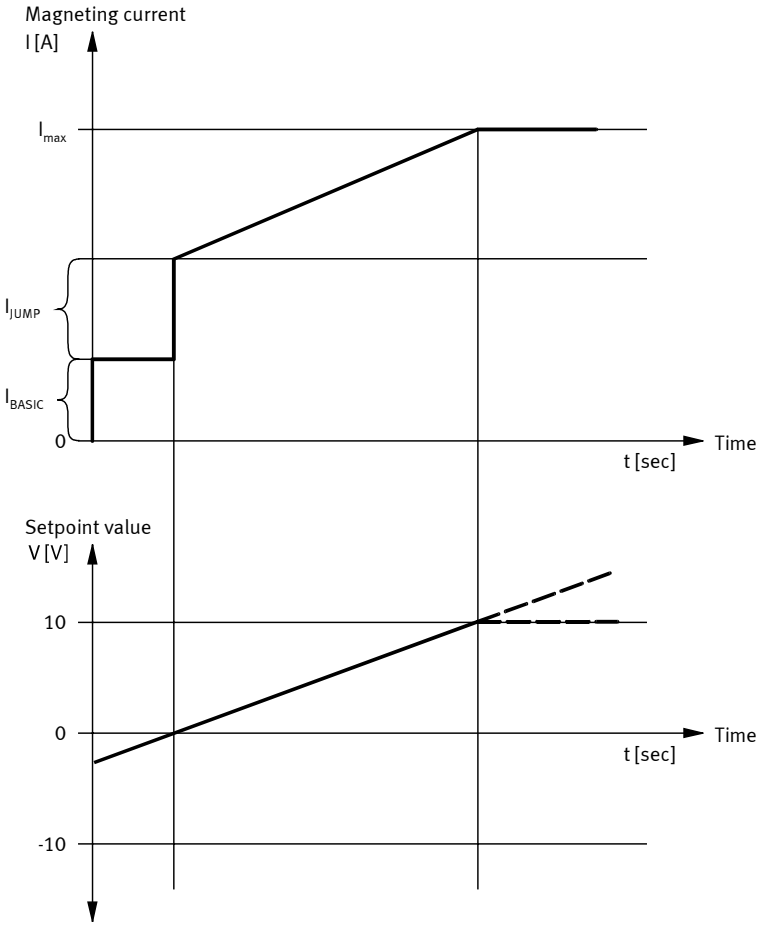
$$V = \frac{(I\ Max\ -\ I\ Basic\ -\ I\ Jump)}{10\,V}$$

Example

I Basic = 100 mA
I Jump = 200 mA
I Max = 800 mA

$$V = \frac{(800\ mA\ -\ 100\ mA\ -\ 200\ mA)}{10\,V} = \frac{500\ mA}{10\,V} = 50\ mA/V$$

Since the quiesent current and the jump current does not have to be set identically on both channels, this may result in a different amplification for channel A and channel B.



Magnetizing current settings

In addition, an enable may be switched via two PLC inputs. One enable signal each is available for the solenoid output A and B. One output is closed, if 24 V DC is applied at input OE A or OE B. The status is displayed via the LEDs next to the inputs.

Dither

In order to overcome the static friction of the valve spool, a frequency signal is superimposed on the magnetizing current. This is known as dither. This frequency is known at the same time as a pulse frequency for the end stages. The effect of the dither is greater with small frequencies. The choice of frequency is dependent on the hysteresis of the actuated valve and actuator and the acoustic interference. The set frequency applies to both solenoid outputs.

Setpoint specification

Setpoint values can be specified externally via two inputs or internally. If 24 V DC is applied to a control input INT W1 or INT W2, the internally set setpoint value applies and the LED is illuminated. The following applies for setpoint values W1 and W2:

1- channel-amplifier: Setpoint value W1, 0 – +10 V Output A
Setpoint value W2, 0 – +10 V Output B

2- channel-amplifier: Setpoint value W1, 0 – +10 V Output A
Setpoint value W1, 0 – -10 V Output B
Setpoint value W2 is not taken into consideration

Technical data

Electrical	
Supply voltage	24 V DC ±10 V, Residual ripple < 10 %
Setpoint values	±10 V DC, in steps of 100 mV
Switching signal for internal setpoint values	15 – 30 V DC
Solenoid outputs	PWM signal, 24 V, maximal 1 A
Enabling switching signal	15 – 30 V DC
Basic current	0 – 250 mA, in steps of 1 mA
Jump current	0 – 250 mA, in steps of 1 mA
Maximum current	100 mA – 1 A, in steps of 5 mA
Dither frequency	100 – 250 Hz, in steps of 1 Hz
Connections	For 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 82-1

The inputs are short-circuit protected or surge-proof up to 24 V.

162254

PID controller

PID

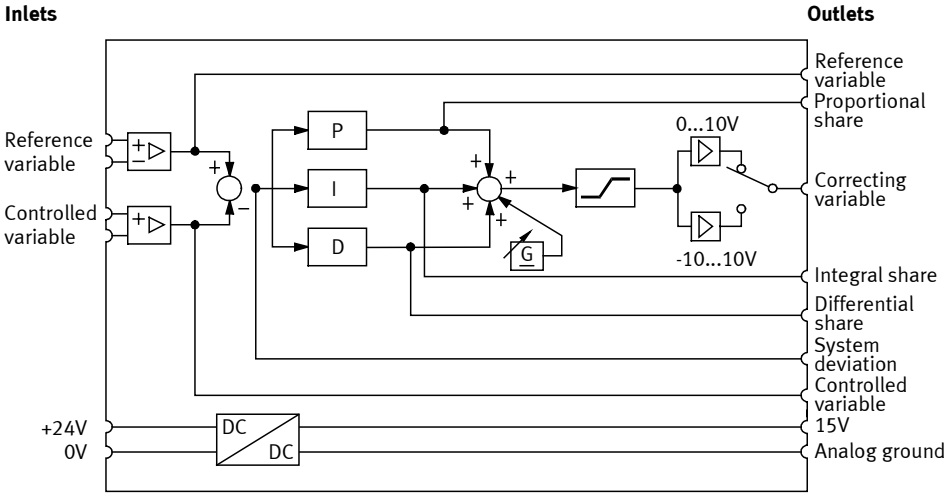
Design

The PID controller is made up of the following function areas:

- Power supply
- Differential inputs
- Comparator
- Controller components: Proportional component, Integral component, Differential component
- Correcting variable offset
- Summation point
- Limiter
- Output

Function

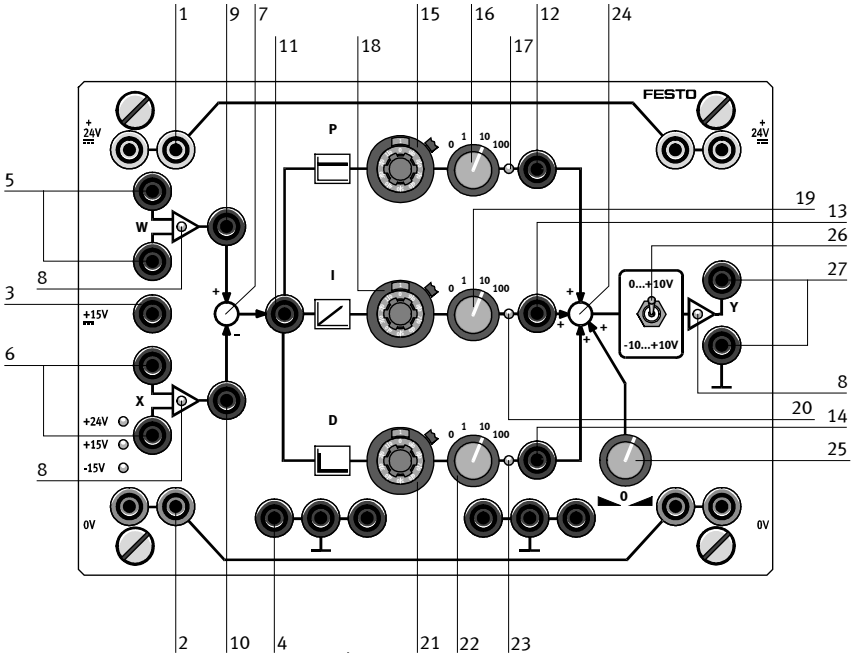
This PID controller can be used, among other things, as a controller for closed-loop pneumatic and hydraulic control circuits.



Representation in circuit diagram

162254

PID controller



Key to operator facilities

1	Power supply + 24 V
2	Power supply ground 0 V
3	Sensor power supply + 15 V
4	Sensor ground or analogue ground
5	Differential setpoint input
6	Differential actual-value input
7	Comparator
8	Overmodulation indicator
9	Test socket Setpoint
10	Test socket Actual value
11	Test socket System deviation
12	Test socket Proportional gain
13	Test socket Integral gain
14	Test socket Differential gain
15	Rotary potentiometer P component
16	Rotary switch P component
17	Power-on indicator P component
18	Rotary potentiometer I component
19	Rotary switch I component
20	Power-on indicator I component
21	Rotary potentiometer D component
22	Rotary switch D component
23	Power-on indicator D component
24	Summation point
25	Rotary potentiometer for correcting variable offset
26	Range selector switch
27	Correcting variable output

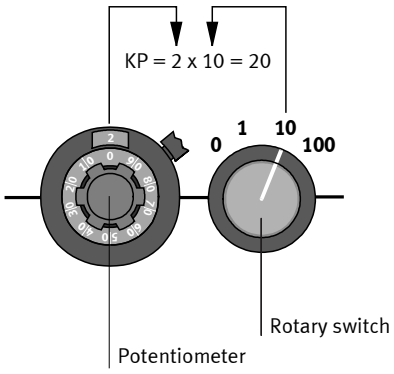
Power supply	The PID controller requires a power supply of 24 V. This voltage is converted internally to +/- 15 V and fed to the controller electronics. The voltages are electrically isolated from each other, i.e. the controller card has two zero potentials (analogue ground and power-supply ground (0 V)).
Note	The analogue ground and power-supply ground should never be connected together, since this may cause interference to signals. The 15 V should be used in conjunction with the analogue ground as the power supply for sensors in order to ensure that noise signals are kept to a minimum.
Differential inputs	A differential input is provided in each case on the PID controller for the setpoint and actual-value signals. The differential signal can be measured against analogue ground. The differential inputs are fitted with low-pass filters to suppress interference. Overmodulation of below -10 V or above +10 V is indicated by LEDs.
Comparator	The comparator is connected in series with the signal inputs and calculates the system deviation between the setpoint and actual value.
Controller components	The three controller components (P, I and D components) can be switched on and off separately, allowing different combinations to be used. The individual controller parameters are adjusted with the aid of potentiometers and rotary switches.
Correcting variable offset	The correcting variable offset can be used to impose constant voltages on the control signal in order, for example, to compensate for the zero-point shift of actuators.
Correcting-variable limiter	The correcting-variable limiter converts the controller signals to the working range required by the actuators. Any overmodulation of the output signal is indicated by an LED.
Output	The correcting variable can be tapped against analogue ground at the output.
Test sockets	Various test sockets allow signal voltages to be measured against analogue ground.

162254

PID controller

Setting the coefficients

The coefficients KP, KI and KD of the controller components are the product of the values set on the rotary potentiometer and rotary switch.



Technical data

Electrical	
Power supply	24 V DC +/-10 %
Overmodulation indicator	-10 > Ue > +10 V
Input voltage range	-13 V – +13 V
Position coefficient Kx	0 – 10
Speed coefficient K $\dot{x}$	0 – 100 ms
Acceleration coefficient K $\ddot{x}$	0 – 10 ms²
Overall gain P	0 – 1000
Output voltage limitation	[0 V – +10 V] [-10 V – +10 V]
Correcting variable offset	5 V ±3,5 V bei [0 V – +10 V] 0 V ±7 V bei [-10 V – +10 V]
Connection	for 4 mm safety connector plug
Electromagnetic compatibility	CE
Emitted interference	tested to EN 500 81-1
Noise immunity	tested to EN 500 81-1