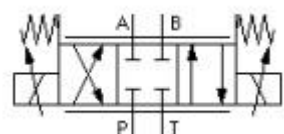


PNEUMATIKA I HIDRAULIKA

PROPORCIONALNA HIDRAULIKA

Prof. dr. sc. Željko Šitum



Laboratorij za automatiku i robotiku

Katedra za strojarsku
automatiku

Zavod za robotiku i
automatizaciju
proizvodnih sustava

Sadržaj predavanja

- **Klasična** hidraulika i pneumatika



- **Proporcionalna** hidraulika i pneumatika

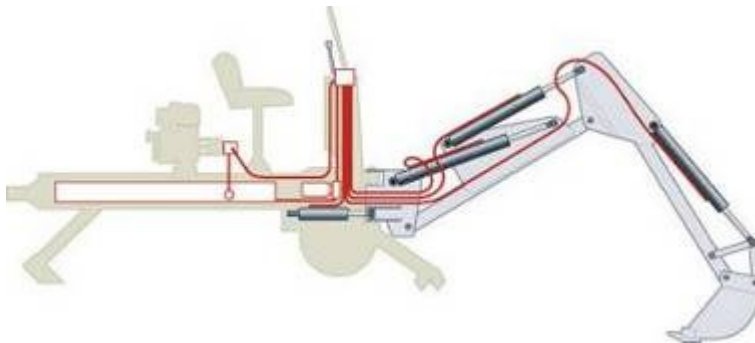


- Hidraulički i pneumatski **servosustavi**

- **Eksperimentalni rezultati** regulacije hidrauličkih i pneumatskih sustava



- **Pravci razvoja** suvremenih hidrauličkih i pneumatskih sustava



Hidraulički razvodnici

Dvopoložajni razvodnici

Uključno-isključni (on-off)
elektromagneti



Elektromagnetski razvodnik

**KLASIČNA
HIDRAULIKA**

Razvodnici s kontinuiranim djelovanjem

proporcionalni elektromagneti

elektromehanički pretvornik



Proporcionalni razvodnik

**PROPORCIONALNA
HIDRAULIKA**

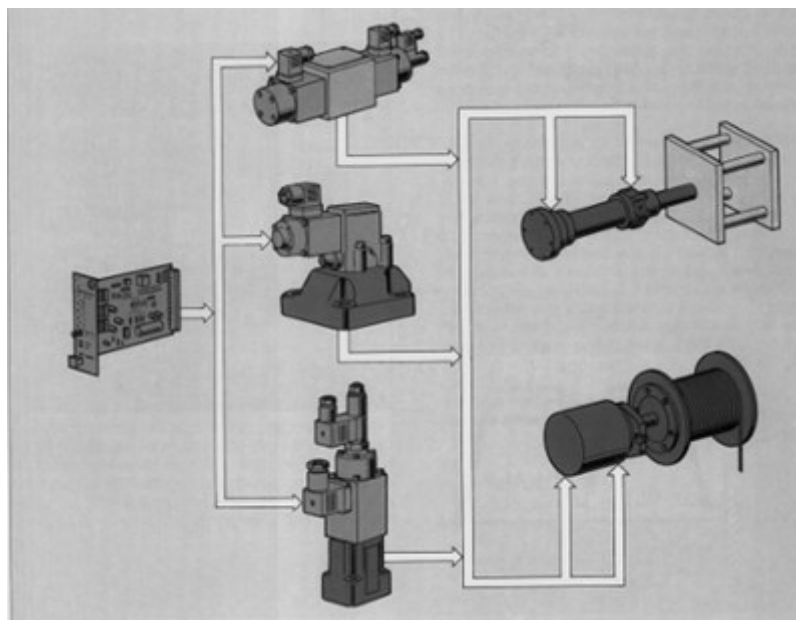
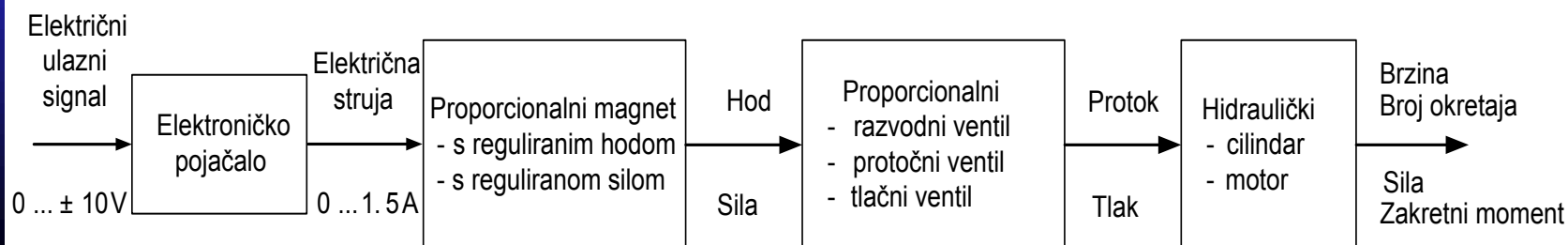


Servorazvodnik

SERVOHIDRAULIKA

PROPORCIONALNI VENTILI

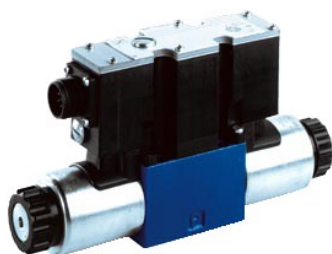
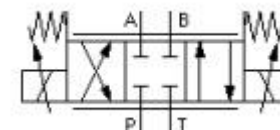
- Dolazi do objedinjavanja prednosti HIDRAULIKE s prednostima koje omogućuje ELEKTRONIKA (fleksibilnost, preciznost, prijenos i obrada signala i dr.).
- Popunjava “prazninu” između klasične hidraulike i servohidraulike



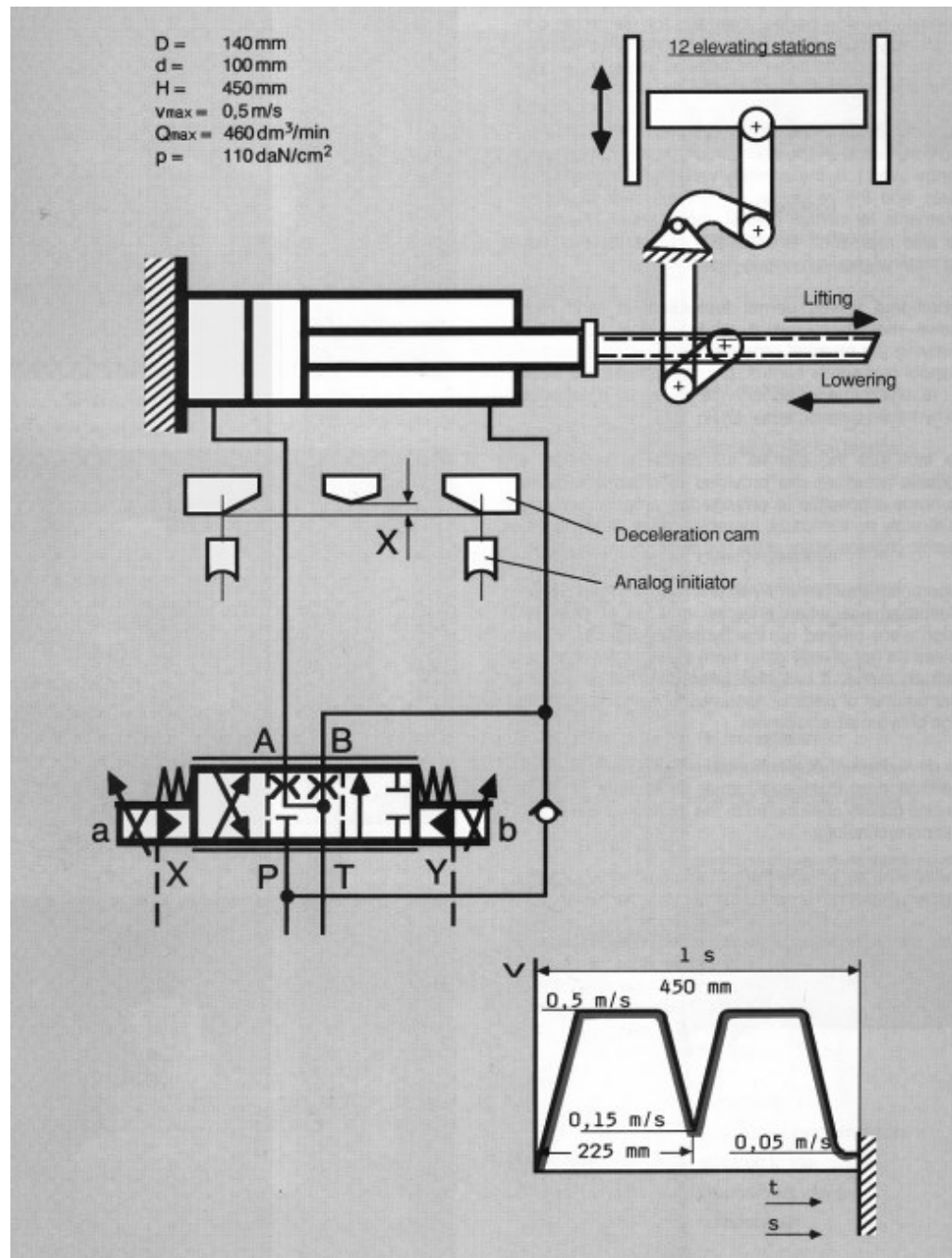
OTVORENI KRUG !

Tehničke prednosti proporcionalne hidraulike:

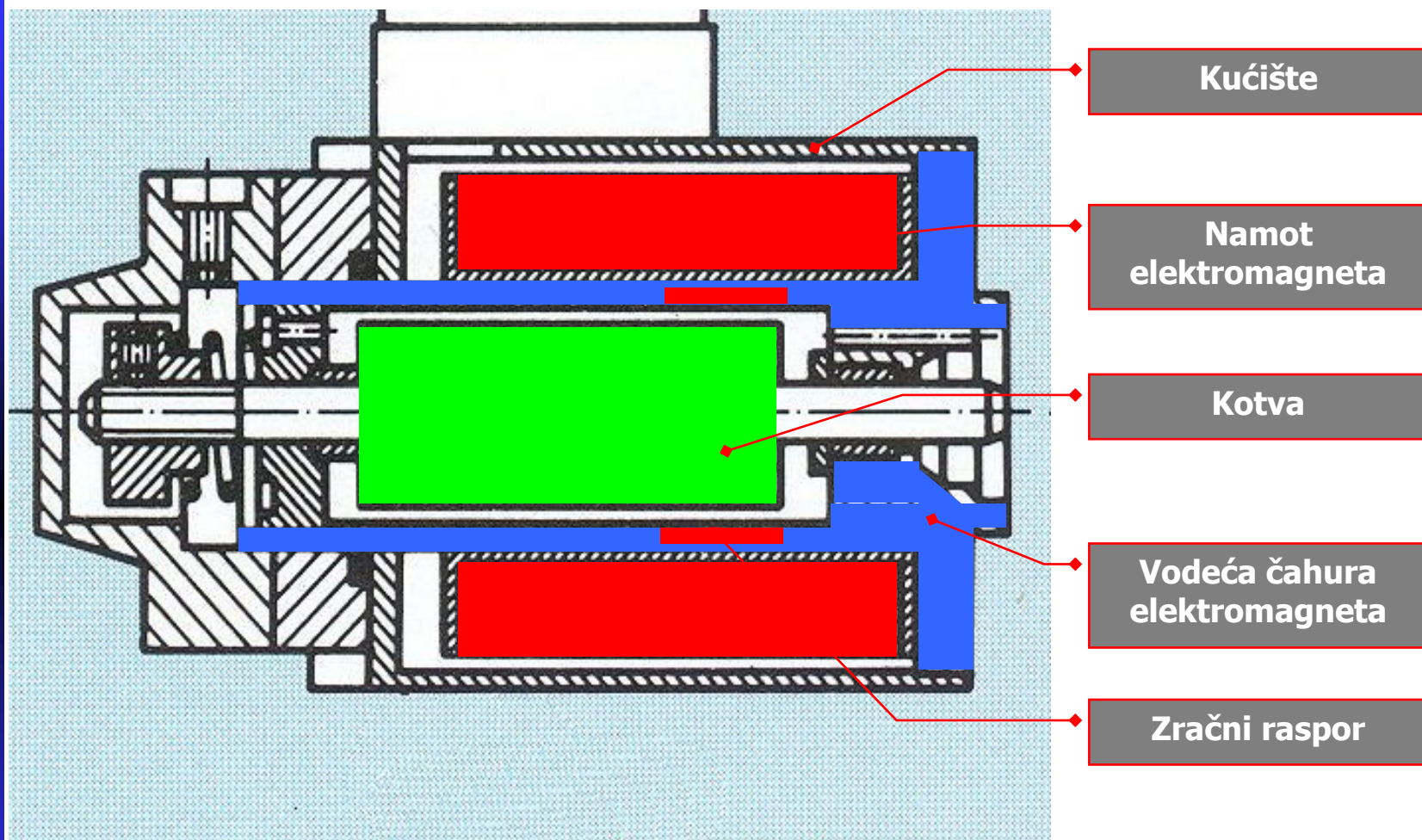
- Kontrolirani prijelazi između radnih položaja
- Kontinuirano upravljanje zadanom vrijednošću
- Smanjenje broja hidrauličkih komponenti – smanjenje troškova nabavke i održavanja
- Fleksibilnost sustava (mogućnost programskog upravljanja, daljinskog upravljanja...)
- Mogućnost korištenja senzorske tehnike u procesu upravljanja i regulacije
- Primjena elektroničkog pojačala
- Ugradnja proporcionalnog ventila neposredno na aktuator (cilindar, hidromotor)
- Povoljan utjecaj na okoliš: bolja energetska učinkovitost sustava
- Manji problemi s brtvljenjem, manja opasnost izljevanja hidrauličkog ulja u okoliš



Primjer: Zavarivanje dijelova karoserije automobila

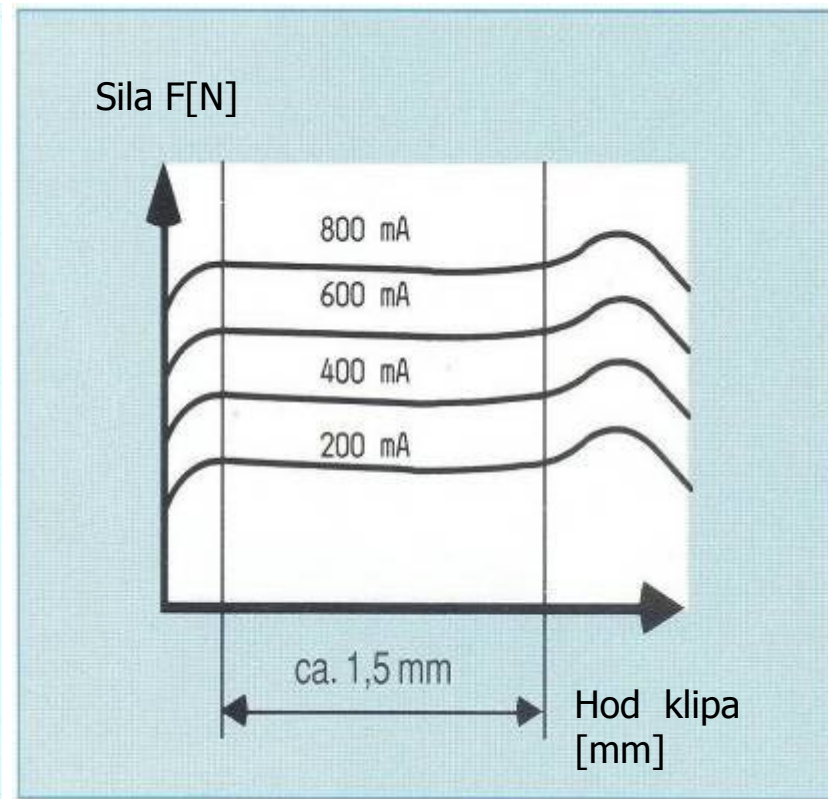
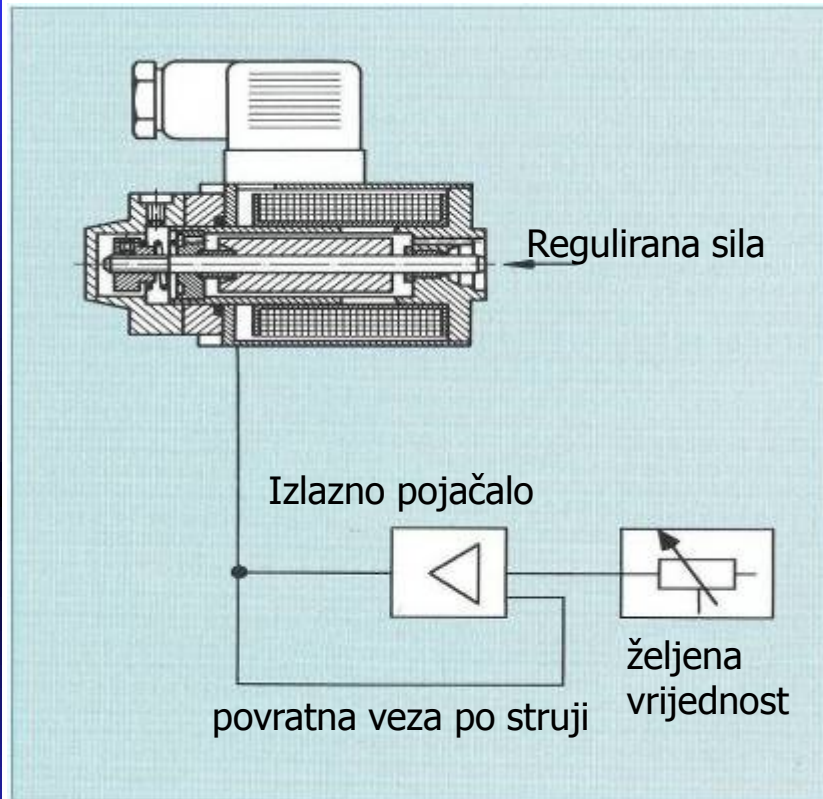


Koriste **proporcionalne magnete** kao elemente za povezivanje elektroničkog i hidrauličkog dijela.



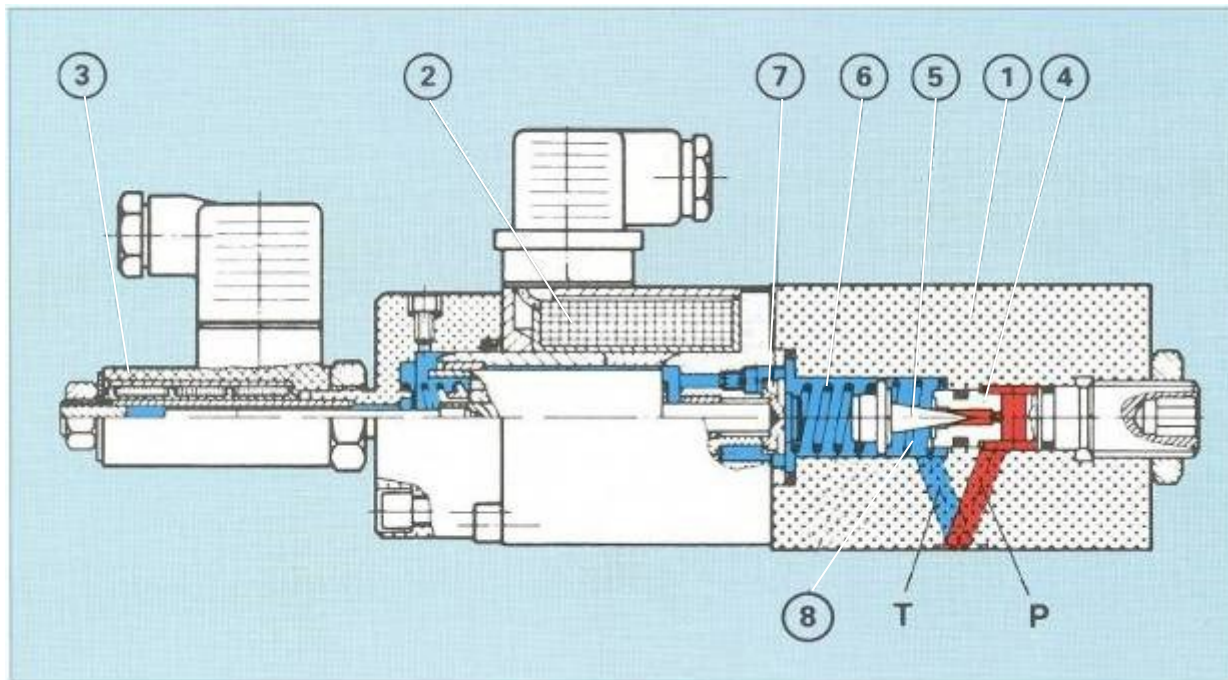
Glavni sastavni dijelovi

❖ proporcionalni magneti s reguliranom SILOM

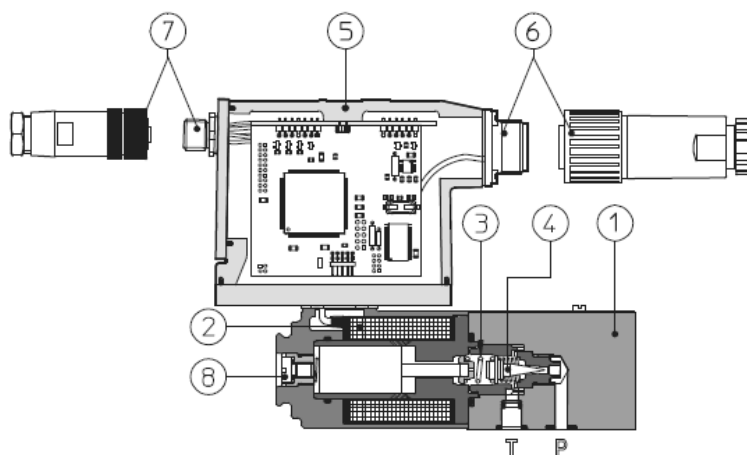


Područje primjene:

- proporcionalni TLAČNI ventili
- predupravljani proporcionalni razvodni ventili



- 1 – kućište ventila
- 2 – elektromagnet
- 3 – davač hoda
- 4 – sjedište ventila
- 5 – konus ventila
- 6 – tlačna opruga
- 7 – sjedište opruge
- 8 – opruga konusa

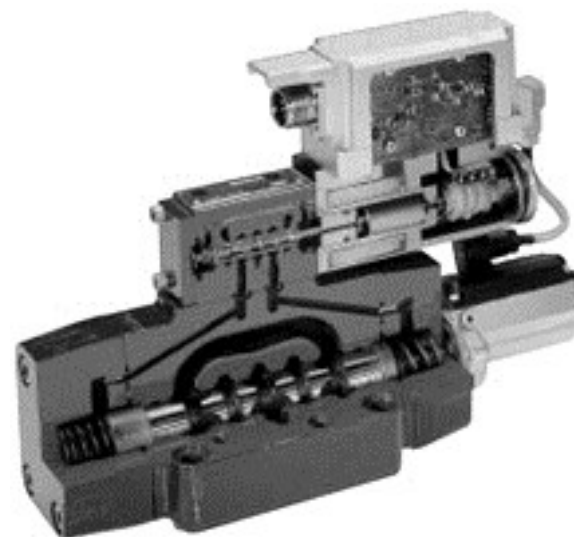
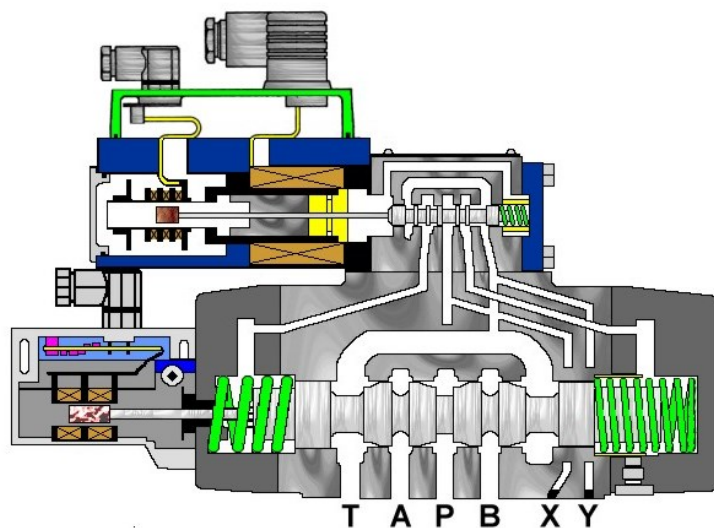
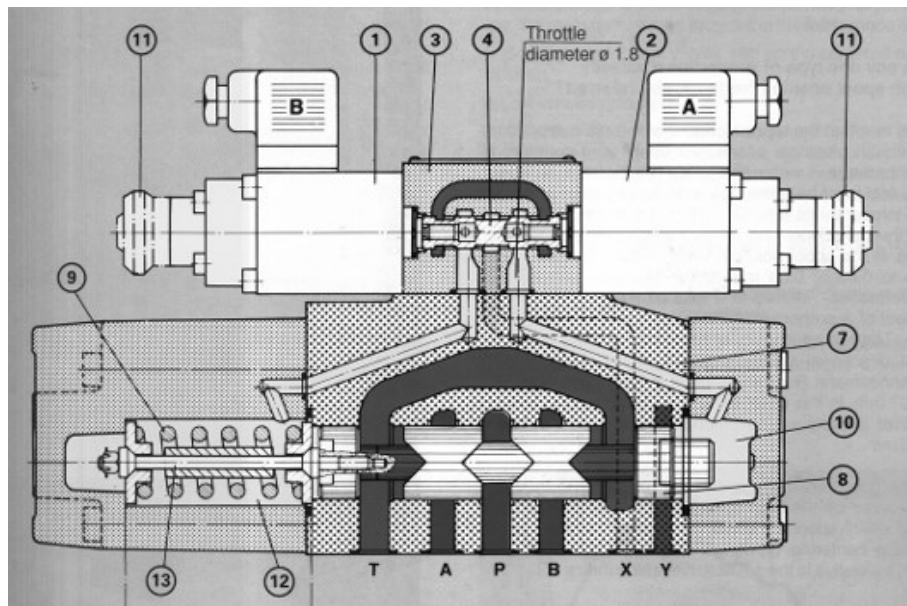


- 1 – kućište ventila, 2 – proporcionalni magnet, 3 – tlačna opruga,
- 4 – konus ventila, 5 – upravljačka elektronika, 6 – glavni konektor, 7 – konektor za komunikaciju, 8 – Vijak za ispust zraka

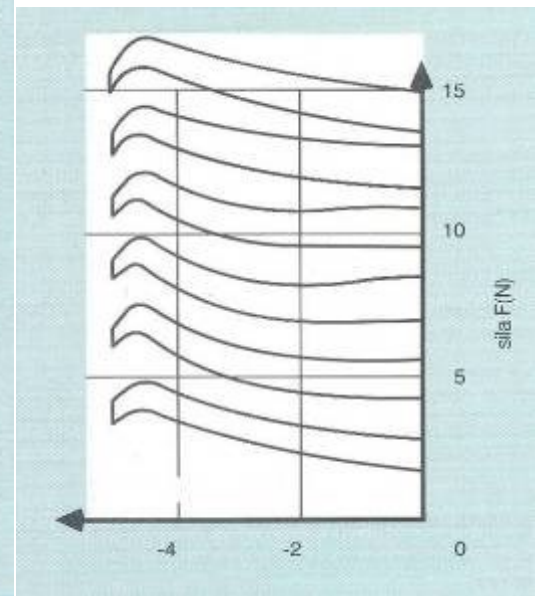
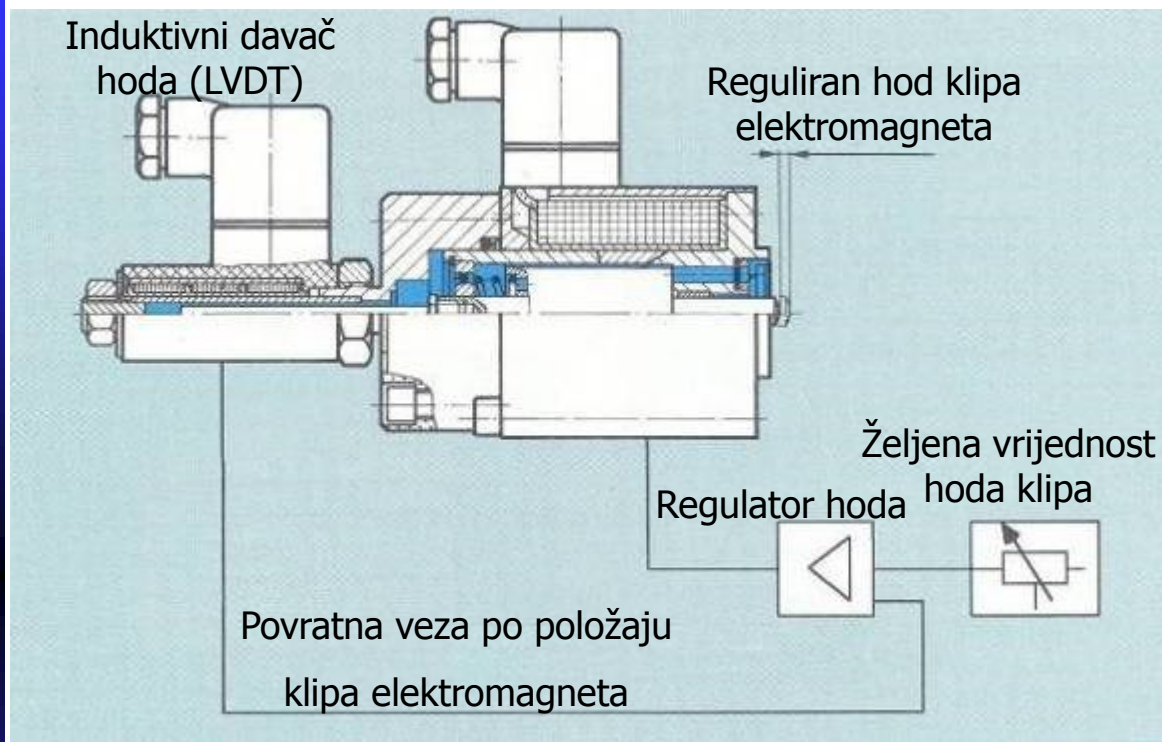
PROPORCIONALNI TLAČNI VENTIL ATOS RZMO-AE



PREDUPRAVLJANI proporcionalni razvodnik



❖ Proporcionalni magneti s **reguliranim HODOM**



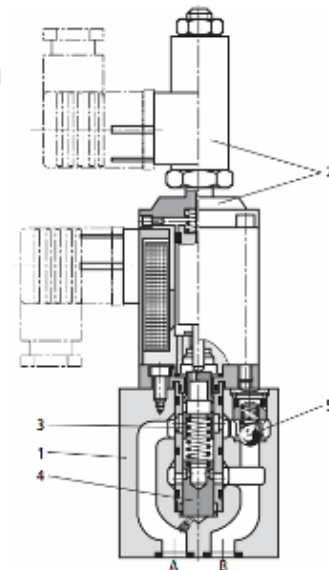
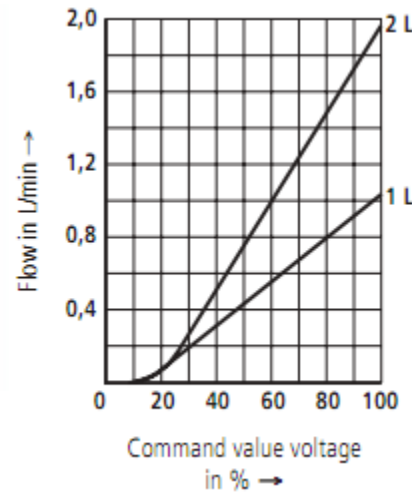
Područje primjene:

- proporcionalni RAZVODNI ventili
- proporcionalni PROTOČNI ventili

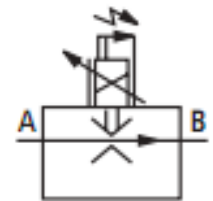
Proporcionalni **PROTOČNI** ventili



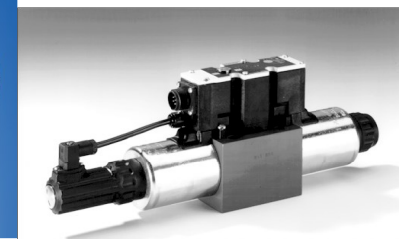
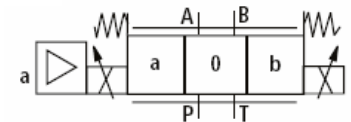
Zavisnost protoka
o upravljačkom signalu



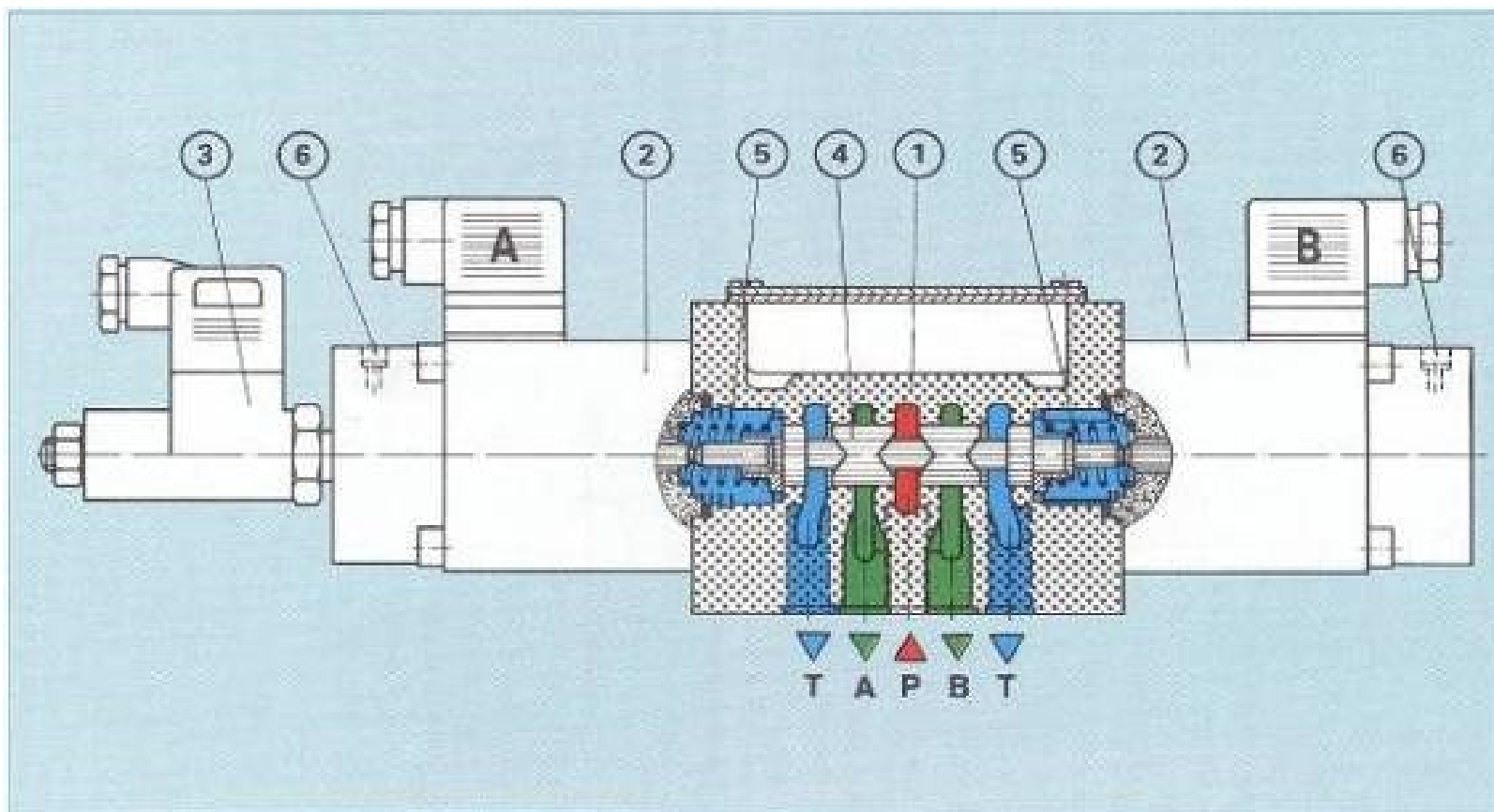
- 1 – kućište ventila
- 2 – induktivni davač hoda
- 3 – regulacijska prigušnica
- 4 – kompenzator tlaka
- 5 – nepovratni ventil



Proporcionalni **RAZVODNI** ventili



DIREKTNO UPRAVLJANI PROPORCIONALNI RAZVODNIK – Princip rada

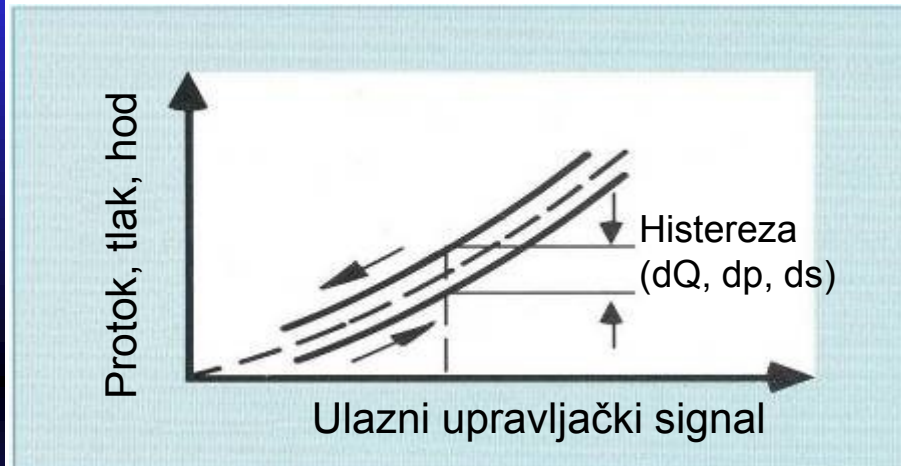


- 1 – kućište ventila
- 2 – elektromagnet
- 3 – mjerac hoda
- 4 – klip ventila
- 5 – opruga
- 6 – vijak za podešavanje

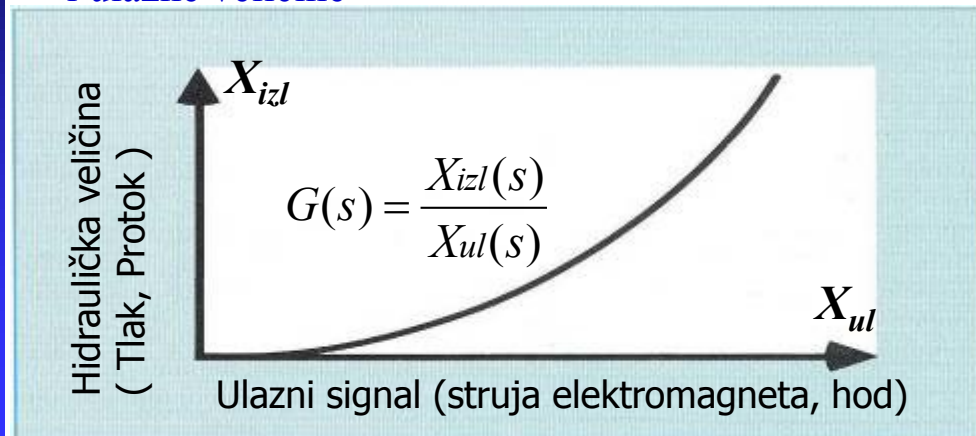


Karakteristike proporcionalnih ventila

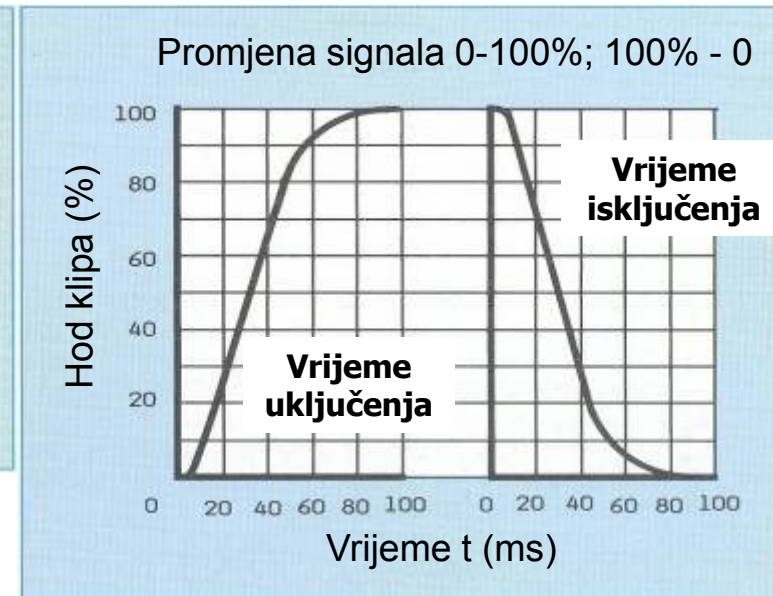
- ➡ Histereza – odstupanje od željene vrijednosti pri porastu i padu upravljačkog signala, mjereno pri istoj vrijednosti upravljačkog signala



- ➡ Prijenosna karakteristika – omjer izlazne i ulazne veličine

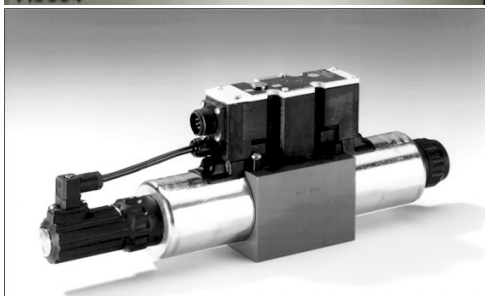
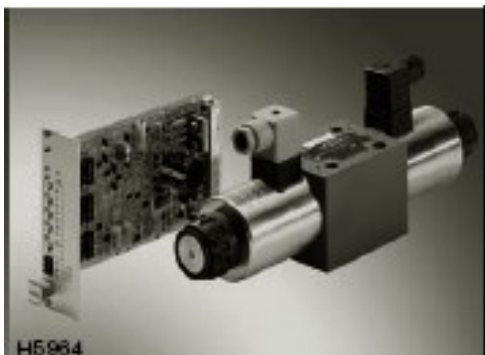
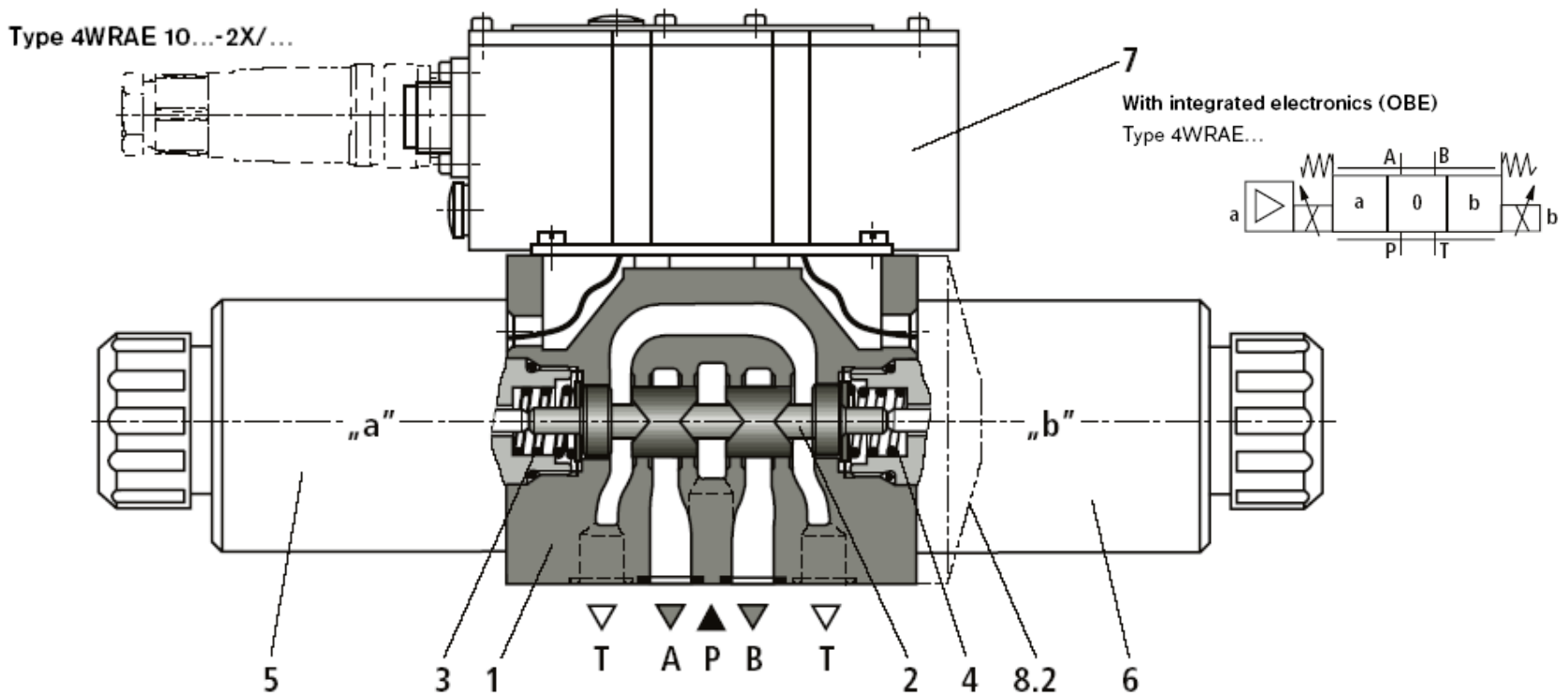


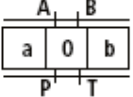


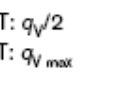
- ➡ Prijelazna karakteristika klipa proporcionalnog ventila pri skoku ulaznog signala – vrijeme uključivanja i isključivanja



- ➡ Točnost ponavljanja (ponovljivost) – razlika izlazne veličine pri ponovljenom postavljanju iste željene vrijednosti

Proportionalni direktno upravljani 4/3 razvodnik s integriranom elektronikom

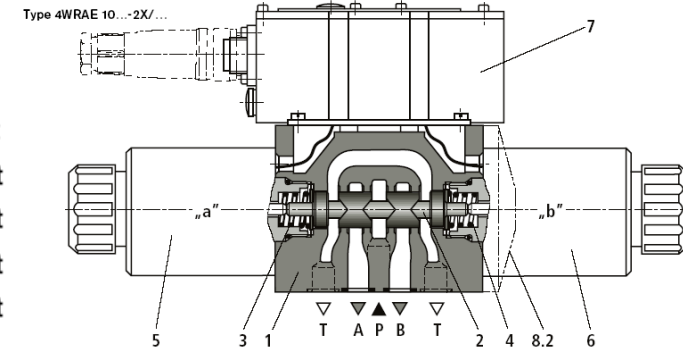
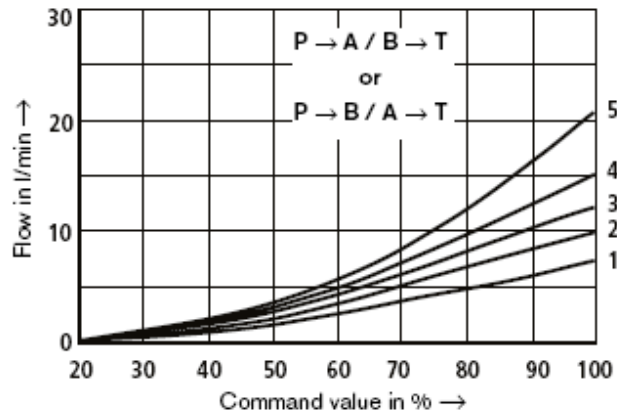


4WRA				-2X/ G24	/	V	*
Without integrated electronics (OBE)	= No code						Further details in clear text
With integrated electronics (OBE)	= E					V =	Seal material FKM seals, suitable for mineral oil (HL, HLP) to DIN 51524
Nominal size 6	= 6						Electronic interfaces A1 or F1 for 4WRAE
Nominal size 10	= 10					A1 = Command value input ± 10 V F1 = Command value input 4 to 20 mA	No code = For 4WRA
Spool symbols							Electrical connections
	= E E1-					K4 ²⁾ = Without plug-in connector, with component plug to DIN EN 175301-803 plug-in connector – separate order, see page 7	for 4WRA:
	= W W1-					K31 ²⁾ = Without plug-in connector, with component plug to DIN EN 175201-804 plug-in connector – separate order, see page 7	for 4WRAE:
	= EA					No code = Without special protection	Special protection
	= WA					J ¹⁾ = Sea water resistant (only for NS6) For details regarding the sea water resistant versions see RE 29055-M	
With spool symbols E1- and W1-: P → A: q _{V max} B → T: q _V /2 P → B: q _V /2 A → T: q _{V max}						G24 = Supply voltage 24 VDC	
Note: With spools W and WA, in the neutral position, there is a connection from A to T and B to T with approx. 3 % of the relevant nominal cross- section.						2X = Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions)	
						Nominal flow at a valve pressure differential Δp = 10 bar	
07 =						NS6	
15 =						7 l/min	
30 =						15 l/min	
						26 l/min	
30 =						NS10	
60 =						30 l/min	
						60 l/min	

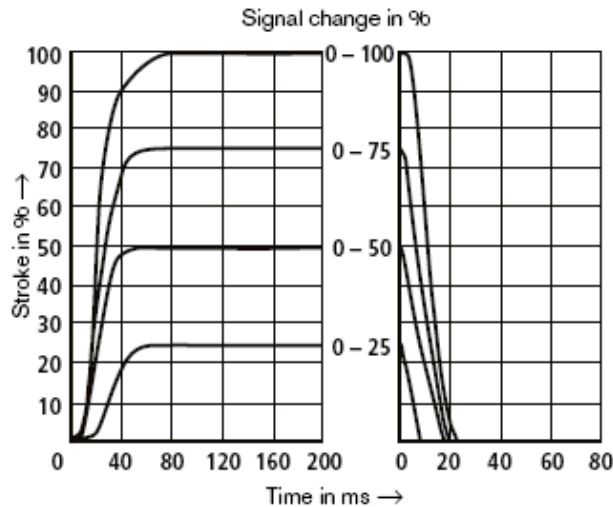
¹⁾ Other types of electrical protection on request

²⁾ Only for NS6: for version "J" = sea water resistant only state "K31"!

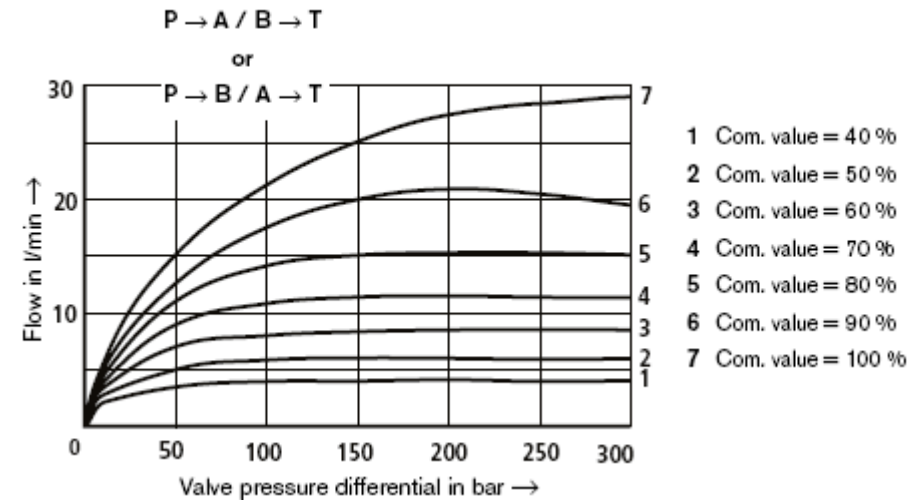
7 l/min nominal flow at 10 bar valve pressure differential



Types 4WRA and 4WRAE



Performance limit, nominal flow 7 l/min



Integrated electronics (OBE) for type WRAE

Pin allocation of the component plug



Integrated control electronics (see below)

Pin allocation	Contact	Signal
Supply voltage	A	24 VDC (19 to 35 VDC)
	B	GND
	C	n.c. ¹⁾
Differential amplifier input	D	Com. value (± 10 V / 4 to 20 mA)
	E	reference potential
	F	n.c.

Com. value: Positive command value (0 to 10 V or 12 to 20 mA) at D and reference potential to E causes flow from P to A and B to T.

Negative command value (0 to - 10 V or 12 to 4 mA) at D and reference potential to E causes flow from P to B and A to T.

For valves with a solenoid on side „A“ (spool variants EA and WA) a positive command value at D and reference potential to E (NS 6: 4 to 20 mA and NS 10: 12 to 20 mA) causes flow from P to B and A to T.

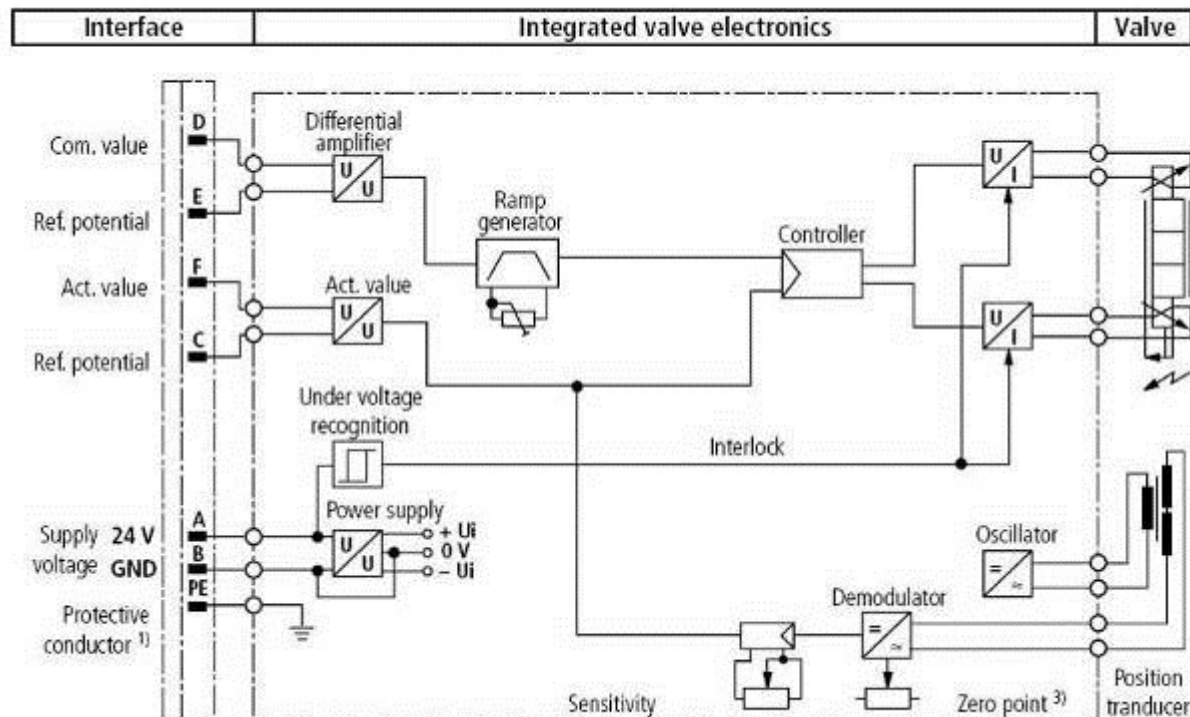
Connection cable: Recommendation: – up to 25 m cable length type LiYCY 5 x 0.75 mm²
– up to 50 m cable length type LiYCY 5 x 1.0 mm²

External diameter 6.5 to 11 mm

Connect screen to PE only on the supply side.

¹⁾ Contacts C and F must not be connected!

Block circuit diagram / connection allocation



Funkcionalna shema EHSS

