MANNESMANN REXROTH	**Electro-Hydraulic 4-Way Directional Servo Valve Model 4 WS 2 E.10… and 4 WSE 2 E. 10… (Series 4X)**	**RA 29 586/06.98**
	Size 10 (D 05) | **... 4600 PSI (315 bar)** | **... 20 GPM (75 L/min)**	**Replaces: 05.94**

Features:

– Servo valve for the closed loop control of position, force and velocity

– Two stage modular design for easy maintenance

– 1st stage is a flapper/nozzle design

– Mounts on standard ISO 4401-5, NFPA T3.5.1 M R1 and ANSI B 93.7 D 05 interface, with additional X1 port for external piloting

– For subplates, see RA 45 054

– Can be used in conjunction with several feedback devices

– Dry torque motor which is isolated and cannot be contaminated by the fluid

– May also be used as a 3-way valve

– 5 different coils available to meet your requirements

– Valve electronics
    • are available separately (standard plug-in Euro card design) or
    • integrated into the valve

– Valve with integrated electronics are adjusted and tested as a unit

K 4242-5
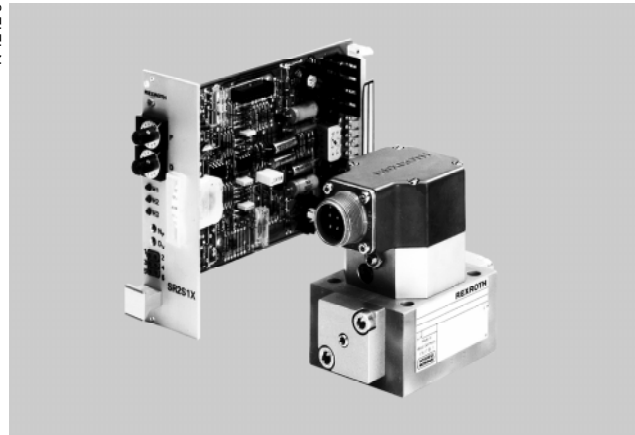
Model 4 WS 2 EM 10 -4X/..B...
with mechanical feedback, associated electronic amplifier card (ordered separately)

K 4246-3

Model 4 WSE 2 EE 10 -4X/..B...
with electronic feedback and integrated electronics

Table of contents

Note:

For service manual, request RDE 29 586-S
For complete parts list, request RDE 29 586-E!

Functional description

Valves Model 4 WS 2 E.10... and 4 WSE 2E.10... are electronically operated 2-stage servo valves. These valves are primarily used for closed loop control of position, force and velocity.

These valves consist of two stages, the 1st stage (2), has a magnetic torque motor (1) and is of flapper/nozzle type design. The 2nd stage (9) of the valve has a precision ground 4-way control spool and a feedback system which may be either mechanical, electrical or barometric as described below.

Pilot control (1st stage)

The 1st stage is a pilot valve which is electronically operated by a servo amplifier. The flapper/nozzle configuration functions like a "Hydraulic Amplifier".

The armature of the torque motor (1) is tilted from the neutral position by an electrical current, thereby offsetting the flapper (13) between the two orifices (3).

This change in flapper position creates a change in the flow area, in relation to the two fixed orifices, which therefore causes a differential pressure. This controls the spool (9) in the second stage of the valve.

The valve can be ordered in conjunction with a separate electronic amplifier card (Model 4 WS), or it can also be ordered with the electronics integrated into the valve (Model 4 WSE) depending on what is best for the application.

Model 4 WS, requires separate electronic amplifier

To control this valve an external electronic control (servo amplifier) is used, which amplifies the input signal to a level required for the output signal to the valve.

Depending on the specific application, several types of amplifiers are available.

Model 4WSE, integrated electronics

To control this valve, a specially tuned electronic control (16) is integrated in the valve, under the cover. This closed loop control, output stage and the oscillator/demodulator are molded into the cover.

The command value can either be a regulated voltage ($\pm$ 10 V), or a regulated current ($\pm$ 10 mA), causing the valve spool to move.

Mechanical feedback on the 2nd stage (Fig.1.1 and 1.2)

The control spool in the second stage (9) is physically connected to the torque motor (1) with the mechanical feedback linkage (5).

The torque tube (14) centers the armature (15) and the flapper (13) into the neutral "centered" position, when de-energized.

When a current is supplied to the torque motor (1) a magnetic field is generated which changes the position "tilts" the T bar (15), and therefore also the flapper (13) and feedback spring (5). This movement of the flapper, closer to one and farther from the other fixed orifices (3), causes a differential pressure which acts on the spool.

Due to the effects of the pressure differential, the control spool (9), is shifted and continues to move until the pressure is again equalized on both sides.

Therefore, the stroke of the control spool (9) within the sleeve (11) is directly proportional to input current from the electronic servo amplifier.

Electrical feedback on the 2nd stage (Fig. 2.1 and 2.2)

The control spool in the second stage (9) is physically connected to a rod (7) which is able to move in the inductive positional transducer (6). Spool movement is continually monitored and any change is sensed instantaneously. Dependant on spool position, different value voltage signals are fedback to the associated electronic amplifier, for comparison of actual vs. desired position and error correction if required.

When current is supplied to the torque motor (1) a magnetic field is generated which changes the position "tilts" the T bar (15) and therefore also the flapper (13). This movement of the flapper, closer to one and farther from the other fixed orifices (3), causes a differential pressure between the control chambers (8) & (10) which acts on the spool.

Due to the effects of the pressure differential, the control spool (9) and feedback rod (7) are shifted and continue to move until the actual feedback value agrees with the desired input signal value. Then the pressure is again equalized on both sides and the control signal is at zero.

Therefore, the stroke of the control spool (9) within the sleeve (11) is directly proportional to input current from the electronic servo amplifier.

Barometric feedback of the 2nd stage (Fig 3.1 and 3.2)

In the de-energized position the control spool in the second stage (9) is pressure balanced, and is held in the neutral or centered position by the contol springs (12).

When current is supplied to the torque motor (1) a magnetic field is generated which changes the position "tilts" the T bar (15) and therefore also the flapper (13). This movement of the flapper, closer to one and farther from the other fixed orifices (3), causes a differential pressure between the control chambers (8) & (10) which acts on the spool.

Due to the effects of the pressure differential, the control spool (9) is shifted and continues to move until control springs (12), flow forces and pressure is again in balance.

Since the control springs have a linear characteristic, the stroke of the control spool (9) within the sleeve (11) is directly proportional to input current from the electronic servo amplifier.

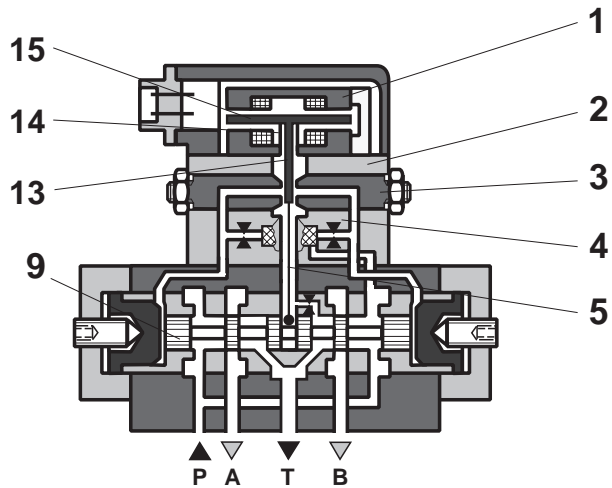| Valve with separate electronic amplifier	Valve with integrated electronics

Fig 1.1
Mechanical feedback
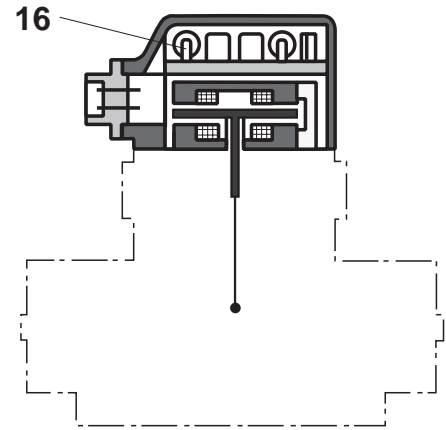(standard with external electronics)
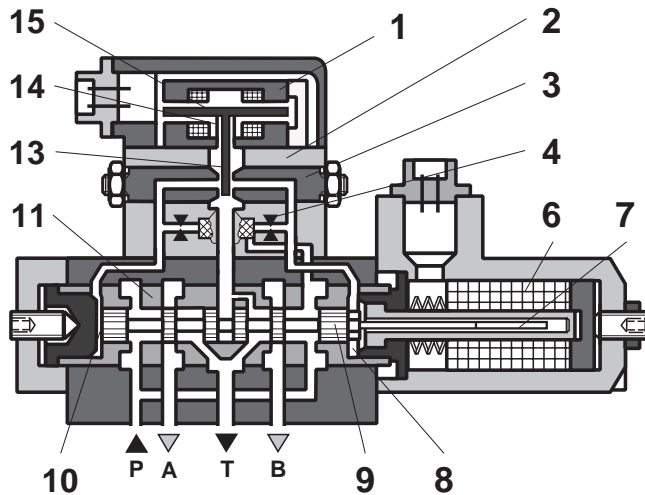
Fig 1.2
Mechanical feedback

Fig 2.1
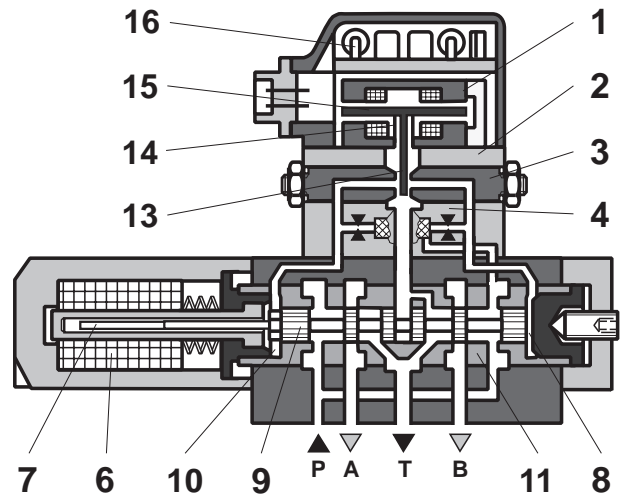**Electrical feedback**

Fig 2.2
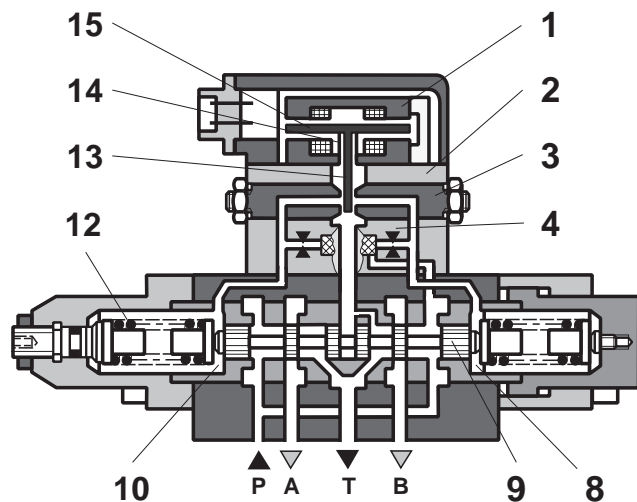**Electrical feedback**
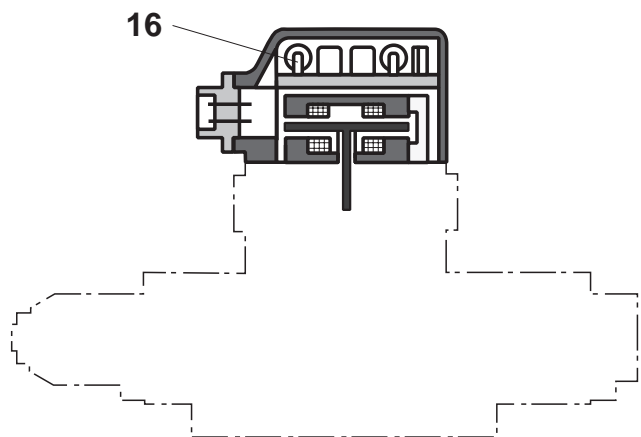(standard with integrated electronics)

Fig 3.1
Barometrical feedback

Fig 3.2
Barometrical feedback

Ordering code

		10 – 4X/	B							*

**Electrically operated
2-stage, 4-way servovalve:**
with **separate**
electronics   = 4 WS 2 E
with **integrated**
electronics   = 4 WSE 2 E

Mechanical feedback
(standard for valves with
separate electronic amplifier   = M
Electrical feedback
(standard for valves with
integrated electronics)   = E
Barometric feedback
(spring centered)   = B

Size 10 (NFPA/ANSI D 05)   = 10

Series 40 to 49   = 4X ❶
(40 to 49 externally interchangeable)

Flow
at a pressure drop across the valve of
p_V = 1000 PSI (70 bar)

0.53 GPM (2 L/min)	= 2
1.3 GPM (5 L/min)	= 5
2.65 GPM (10 L/min)	= 10
5.3 GPM (20 L/min)	= 20
8 GPM (30 L/min)	= 30
12 GPM (45 L/min)	= 45
16 GPM (60 L/min)	= 60
20 GPM (75 L/min)	= 75

(tolerance band for the flow vs. signal function
is shown on page 10) ❷

Valves with separate electronics:

Coil no. 1 5 mA / 500 Ohm per coil	= 1
Coil no. 2 30 mA / 40 Ohm per coil (Standard)	= 2
Coil no. 3 7.5 mA / 200 Ohm per coil	= 3
Coil no. 4 20 mA / 80 Ohm per coil	= 4
Coil no. 5 50 mA / 28 Ohm per coil	= 5

Valves with integrated electronics:
input signal: command value ± 10 mA / 1 kΩ   = 8
           command value ± 10 V / ≥ 50 kΩ (standard) . . = 9

Pilot supply and drain	Valve Model: 4 WS 2 EM… 4 WSE 2 EM… 4 WSE 2 EE…	4 WS 2 EE… 4 WS 2 EB… 4 WSE 2 EB…	
Externally piloted, externally drained	○	●	= –
Internally piloted, externally drained	○	●	= E
Externally piloted, internally drained	●	●	= T
Internally piloted, internally drained (standard)	●	●	= ET

● available; ○ = not available

Remarks:
Sandwich plate ($X_1 \rightarrow X$), must be ordered separately,
see page 16 item 19

Test unit for 4WSE (integrated electronics)
Model number VT-VET-1, Series 1X, data sheet RA 29 685
The test unit is used for the control and function monitoring of
integrated electronic valves.

❺   Further details
in clear text

M =	NBR seals suitable for petroleum oils (HM, HL, HLP)
V =	FPM seals suitable for phosphate ester fluids (HFD-R)

❹ **Spool overlap**

A =	0.5 to 1.5 % positive
B =	0.5 to 1.5 % negative
C =	3.0 to 5.0 % positive
D =	0 to 0.5 % positive
E =	0 to 0.5 % negative

Electrical connections
Valves with **separate** electronics:

K8 =   socket to size 14 S–2 S
without mating plug
without electric socket
mating connectors **RR00 002 460**
(order separately)

Valves with **integrated** electronics:
— electrical feedback:
K9 =   socket to size E 14 S–6 S
without mating plug
mating connectors **RR00 013 159**
(order separately)

❸   —mechanical or barometric feedback:
K13 =   socket to size E 14 S–5 S
without mating plug
mating connectors **RR00 011 921**
(order separately)

Input pressure range to the first stage
315 =   feedback mechanical
     145…4600 PSI (10…315 bar)

40 =		145…580 PSI (10…40 bar)
70 =	electric or	580…1000 PSI (40…70 bar)
140 =	barometrical	1000…2030 PSI (70…140 bar)
210 =	feedback	2030…3050 PSI (140…210 bar)
315 =		3050…4600 PSI (210…315 bar)

Test unit for 4WS2 (battery driven)
Part number for ordering RR00 010 573,
see data sheet RA 29 680
Note: Test unit
— only for valves with separate electronics.
— only for coil numbers 1, 2 and 3.
— with electrical feedback only the maximum
    flow will be signaled.

Explanation of ordering code

❶ Nominal flow

The nominal flow is the flow in GPM (L/min) at nominal current signal and at 1000 PSI (70 bar) pressure drop [500 PSI (35 bar) per control land]. Other values will necessarily produce a different flow rate.

The flow tolerance band and also the influences of saturation of flows equal to or above 16.0 GPM (60 L/min) must be noted (see page 10).

If required, servo valves can be supplied with special operating curves (with a subdued form, progressive, or with special spool overlaps). Any special characteristics or parameters must be very clearly specified.

❷ Coil electrical control data

The control signal must be generated from a current regulated output stage.

The standard coil for valves with separate electronics is spool number "**2**" (30 mA/40 Ω). With coil numbers 1, 3, 4 and 5, the closed loop electronic control (servo amplifier) must be custom matched with the valve.

With integrated electronic controls, the signal value can be supplied as a voltage signal – code "**9**", or for long distances [more than 82 ft (25 m) between the computer and the valve] as a current signal – code "**8**".

❸ Input pressure range to the 1st stage

The pilot pressure should be as constant as possible. Therefore, it is often best to externally pilot the valve via port X_1.

Mechanical feedback
Pilot pressure: 145 to 4600 PSI (10 to 315 bar)

The pilot pressure should not be less than 60% of the system pressure order to avoid reduction in the controllability, due to flow forces on the valves control spool.

Electric feedback

The pilot pressure should be kept within the pressure range where possible. In order to influence the dynamic response of the valve, it may be fed with a higher or lower pilot pressure. When the input pressure of $\leq$ 580 PSI (40 bar), it is always better to keep pilot pressure at port X_1 equal to the system pressure at port P.

Barometric feedback system

The pilot pressure can not be higher than the maximum pressure in the model code designation. The nominal flow refers to the mean pressure of the relevant pressure stage and changes with the pressure level.

❹ Spool overlap
The spool overlap given in % refers to the control spool stroke of 0.0315 inches (0.8 mm). For closed loop control, we recommend an overlap close to zero or slightly negative, like the "E" spool overlap.

Spool overlap "A"
This is the limit of the range for applications inclosed and open loop controls. The 0 position flow is much less than for "D".

Spool overlap "B"
Mostly applied at pressures less than 2320 PSI (140 bar). Suitable for position, force and pressure control in closed loop, it requires a higher degree of damping than with spool "D", and a greater 0 position flow is only of secondary importance.

Spool overlap "C"
Suitable for open loop or velocity control.

Spool overlap "D"
Suitable as a universal overlap for closed loop control of position, force and velocity with low 0 position flow, however with lower damping than that of spool "B".

Spool overlap "E"
Suitable for highly accurate applications with a somewhat higher 0 position flow than with spool "D". Main applications: control of pressure and force in a closed loop.

❺ Further details to be written in clear text

Special requirements should be specified here in clear text. After the receipt of an order, this will be checked by the factory and the valve code extended by an additional code when required.

Symbols (simplified)

Servo valve for separate electronics
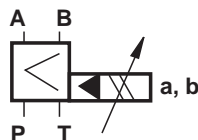
Servo valve with integrated electronics
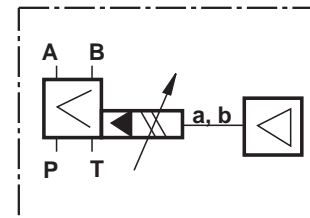
Mechanical feedback **M**	Electrical feedback **E**	Barometric feedback **B**

Technical data (For applications outside these parameters please consult us!)

General

Weight (approx.) lbs (kg)		
4 WS 2 EM 10 -4X/..	..with separate electronics	2.42 (1.1)
4 WS 2 EE 10-4X/		4.19 (1.9)
4 WS 2 EB 10-4X/..		3.53 (1.6)
4 WSE 2 EM 10 -4X/..	..with integrated electronics	2.65 (1.2)
4 WSE 2 EE 10 -4X/		4.41 (2.0)
4 WSE 2 EB 10 -4X/..		3.75 (1.7)
Additional items:		
Sandwich plate for external piloting		
(model "–", "T"), see page 15, item 16		0.66 (0.3)
Sandwich plate for external drain		
(model "–", "E"), see page 15		0.55 (0.25)
Flushing plate, see page 15		2.2 (1.0)
Cable connections 6-1/2 ft (2 m) long		
(for valves with separate electronics only) each cable		0.44 (0.2)

Mounting position	Optional, however, the pilot pressure must be ≥ 145 PSI (10 bar) before start-up
Ambient temperature range °F (°C)	–22 to +158 (–30 to +70) with external electronics –22 to +140 (–30 to +60) for 4 WSE 2 E.10 (with integrated electronics)

Hydraulic, measured at v = 149 SUS (32 mm²/s) and t = 104 °F (40 °C)

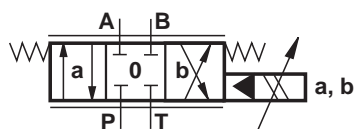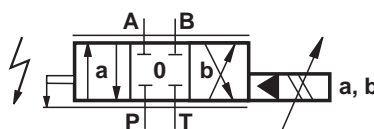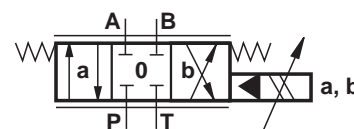| Feedback system	**Mechanical**	**Electrical** (V_p = 5) [1]	**Barometric**
Operating pressure range PSI (bar) ports A, B, P, X	145 to 4600 (10 to 315)	145 to 4600 (10 to 315) (note pressure range)	145 to 4600 (10 to 315) (note pressure range)
Return line pressure PSI (bar) ports T, Y	Pressure peaks <1450 (100) static <145 (10)	Pressure peaks <1450 (100) static <145 (10)	Pressure peaks <1450 (100) static <145 (10) (Return line pressure reduces spool stroke)
Hydraulic fluid	Petroleum oil (HM, HL, HLP) Phosphate ester fluids (HFD-R)		
Fluid cleanliness	Maximum allowable fluid cleanliness level – Class 16/13, according to ISO 4406. Therefore, we recommend a filter with a minimum retention rate of $ß_5 ≥ 100$ without bypass valve, with clogging indicator directly before the valve or as close as possible.		
Fluid temperature range °F (°C)	50 to +176 (10 to +80)		
Viscosity range SUS (mm²/s)	92 to 1760 (20 to 380); preferably 140 to 208 (30 to 45)		

Nominal flow (Q_N) GPM (L/min) ±10% at p_V = 1000 PSI (70 bar) [2]	0.53 (2)	1.3 (5)	2.65 (10)	5.3 (20)	8.0 (30)	12.0 (45)	16.0 (60)	20.0 (75)

Flow in center pos. [5] GPM (L/min) control fluid for pilot stage	$≈ 0.21\ GPM$ $\sqrt{\dfrac{p_V}{1015\ PSI\ (70\ bar)}}$ (0.8 L/min)	$≈ 0.21\ GPM$ (0.8 L/min)
Pilot leakage & leakage of whole valve [3], [4]	$\sqrt{\dfrac{p_V}{1015\ PSI\ (70\ bar)}}$ $\dfrac{0.21\ GPM\ (0.8\ L/min)}{+\ 0.04 • Q_N}$	$≈ 0.21\ GPM$ (0.8 L/min) $+ \sqrt{\dfrac{p}{1015\ PSI\ (70\ bar)}} • 0.04 • Q_N$

The centered position flow data is valid only without an overriding dither signal; it will increase if dither is applied.			
Hysteresis % (with dither optimized)	≤ 2.5	≤ 0.5	≤ 6 (pressure stage 40 and 70) ≤ 4 (pressure stages 140, 210, 315)
Reversal voltage %	≤1.0	≤ 0.4	≤ 3.0
Sensitivity %	≤ 0.5	≤ 0.2	≤ 1.5

Pressure gain	Spool overlap: A	≥ 50% of p for 1% spool stroke (from the hydraulic null point)
	Spool overlap: B, E	≥ 40% of p for 1% spool stroke (from the hydraulic null point)
	Spool overlap: D	≥ 75% of p for 1% spool stroke (from the hydraulic null point)

[1] V_p = electrical gain

[2] p_V = pressure drop across valve in PSI (bar)

[3] Q_N = Nominal flow in GPM (L/min)

[4] p = Operating pressure in PSI (bar)

[5] The zero flow data is valid without overlapping dither signal and increase with the dither part.

Technical Data (For applications outside these parameters please consult us!)

Electrical

Feedback type		**mechanical**		**electrical** (Vp = 5)		**barometric**	
Null compensation current	%	< 5, long term < 8				< 10, longterm < 15	
Null offset, starting with a nullpoint corrected valve with alteration of: Fluid temperature	%	< 2 / 68 °F (20 °C)				< 4 / 68 °F (20 °C)	
Ambient temperature	%	< 2 / 68 °F (20 °C)				< 4 / 68 °F (20 °C)	
System pressure (0.8 to 1.2) x p in bar	%	< 2		< 1		< 4	
Return line pressure (0 to 0.1) x p in bar	%	< 2		< 1		< 4	
Insulation		Exceeds NEMA class B – special installation on request					

Type of signal	analog							
Coil number		**1**	**2**	**3**	**4**	**5**	**8**	**9**
Associated amplifier (The amplifier card must be ordered separately)		**	*	**	**	**	integrated electronics	
		*With mechanical and barometric feedback use amplifier Model SR 2, see RA 29 980, or amplifier Model VT 1600, see RA 29 716. For electrical feedback use amplifier Model SR 1, see RA 29 979, or amplifier Model VT 1610, see RA 29 717. **Please consult us for electronics.					—	—
Nominal current per coil	mA	5	30	7.5	20	50	—	—
Resistance per coil	Ω	500	40	200	80	28	—	—
Inductivity at 60 Hz and 100% nominal current – Series circuit – Parallel circuit	H H	8.8 2.2	0.25 0.06	4.0 1.0	1.0 0.25	0.44 0.11	— —	— —
Recommended dither signal: f = 340 Hz		The amplitude of the dither depends on the hydraulic installation; maximum limit 10% of nominal current					—	—
Command value current regulated	mA	—	—	—	—	±10	—	
voltage regulated	V	—	—	—	—	—	±10	
Input resistance	kΩ	—	—	—	—	—	1	≥ 50
Supply voltage (± 3%)	V	—	—	—	—	—	±15	
Act. position value for spool setting at 100% command value	V	—	—	—	—	—	approx. ± 10 (only Model 4WSE2EE 10...)	

Electrical (inductive positional transducer) for external electronics

| Electrical measuring system		Differential transformer
Nominal spool stroke	inches (mm)	± 0.31 (0.8)
Sensitivity with 4.5 kHz carrier frequency	mV/V / in (mm)	1.7 (43)
Resolution (static)	continuous	
Feed voltage (V_{eff}) V	3.5	
Carrier frequency kHz	4.5	

## Plug-in connectors

For model 4WS2… (external electronics)
Plug-in connector – must be ordered separately
under part no. **RR00 002 460**;
For PIN allocation see below and
block circuit diagram on page 10

**2.36
(60)**

**0.79 A/F
(20)**

**Ø 1.10
(28)**

**4.09
(104)**
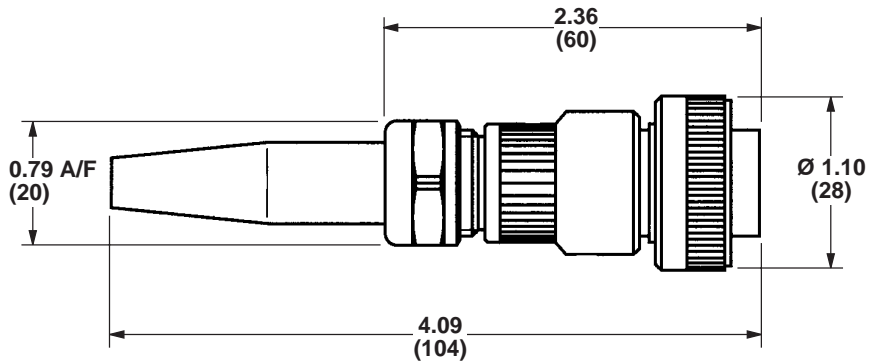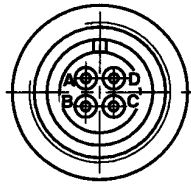
For model 4WSE2EM… and 4WSE2EB…
(integrated electronics) and **model 4WS2EE…**
(external electronics, inductive feedback)
Plug-in connector – must be ordered separately
part no. **RR00 011 921**;
For PIN allocation see below
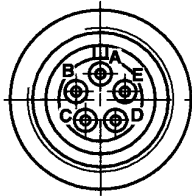
For model 4WSE2EE… (integrated electronics)
part no. **RR00 013 159**;
For PIN allocation see below
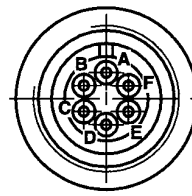
Electrical connections: Model 4 WS 2 E.10... (valves for external electronics)

Pilot control (1st stage)

Plug pin connections

blue
green

B   A
    D
  C
red
yellow
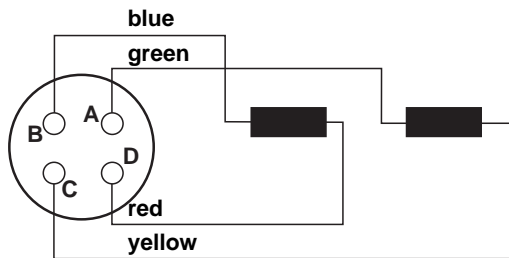
Positional transducer

Plug pin connections

green/yellow
blue

A
    E   red
B   D
  C
black
brown
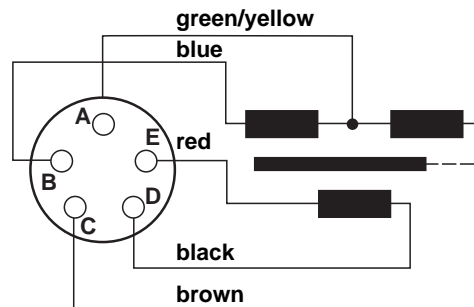
Electrical connections to the servo valve can be made either in parallel, or in series. For safety, due to the lower inductivity obtained, we recommend parallel connection.

Parallel connection: For plug connection, connect A to B and C to D.
                            For cable connection, connect yellow to brown,
                            and green to white.

Series connection: For plug connection, connect B to C.
                            For cable connection, connect brown to green.

An electrical input of A (+) to D (–) for plug connection, or yellow lead (+) to white lead (–) for cable connection, provides a flow direction in the 2nd stage of P to A and B to T.
Reversing the direction of the current reverses flow direction in the 2nd stage, to P to B and A to T.

Warning: Connection A at the plug, or the white wire in the cable must **not** be connected (due to radio interference effects).

Electrical connections and technical data: Model 4 WSE 2E. 10... (Valves with integrated electronics)

Models 4 WSE 2 EM 10.. and 4 WSE 2 EB 10.. (mechanical and barometric feedback)

Integrated electronics

	Terminal connection	Coil "8"	Coil "9"
Supply voltage in V ($\pm$ 3 %)	A	+ 15 V	+ 15 V
	B	− 15 V	− 15 V
	C	0 V	0 V
Command value	D	$\pm$ 10 mA	$\pm$ 10 V
	E	R_e = 1 kΩ	$R_e \geq$ 50 kΩ

	Terminal connection	Coil "8"	Coil "9"
Current required at plug connection	A	maximum 100 mA	maximum 100 mA
	B		
	D	$\pm$10 mA	$\leq$ 0.2 mA
	E		

Command value: Command value at plug connection D, negative polarity with respect to plug connection E gives a flow from P to B and A to T.
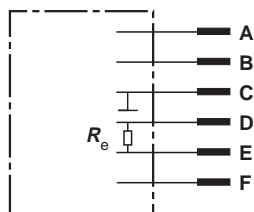
Command value at plug connection D, positive polarity with respect to plug connection E gives a flow from P to A and B to T.

Model 4 WSE 2 EE 10.. (electrical feedback)

Integrated electronics

	Terminal connection	Coil "8"	Coil "9"
Supply voltage in V ($\pm$ 3 %)	A	+ 15 V	+ 15 V
	B	− 15 V	− 15 V
	C	0 V	0 V
Command value	D	$\pm$ 10 mA	$\pm$ 10 V
	E	R_e = 1 kΩ	$R_e \geq$ 50 kΩ
Measured output for control spool	F	Nominal stroke corresponds to $\pm$10 V against 0 V; $R_i \approx$ 4.7 kΩ	

	Terminal connection	Coil "8"	Coil "9"
Current required at plug connection	A	maximum 200 mA	maximum 200 mA
	B		
	D	$\pm$10 mA	$\leq$ 0.2 mA
	E		

Command value: Command value at plug connection D, negative polarity with respect to plug connection E gives a flow from P to B and A to T.

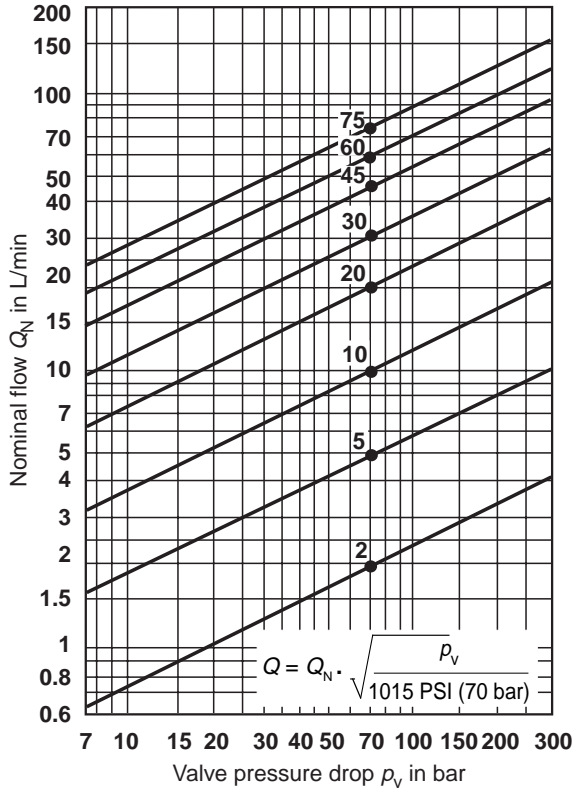Measured output F has a negative polarity with respect to earth ground 0 V.

Command value at plug connection D, positive polarity with respect to plug connection E gives a flow from P to A and B to T.

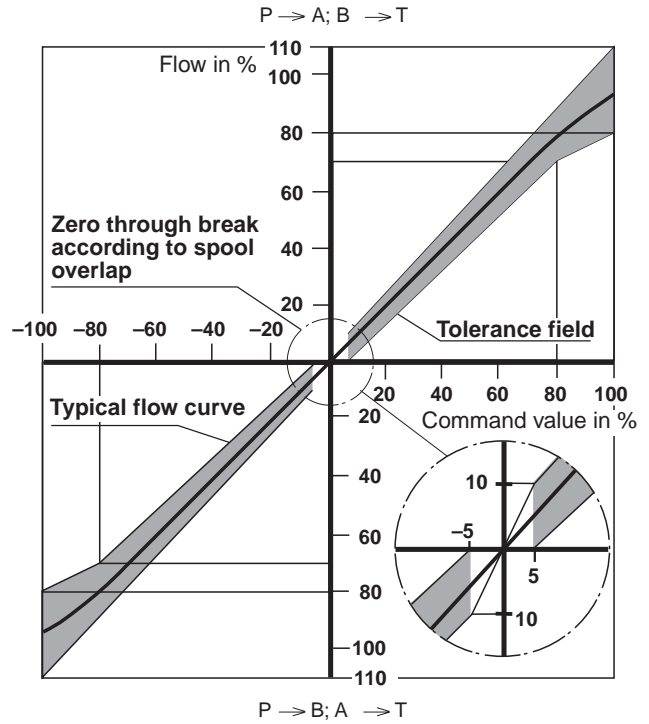Measured output F has a positive signal with regard to earth ground 0 V.

Operating curves: measured at v = 190 SUS (41 mm^2/s) and t = 122 °F (50 °C)

Flow vs. load function for all feedback systems
(Tolerance band ±10%) Note: Flows are calculated values

$$Q = Q_N \cdot \sqrt{\frac{p_v}{1015 \text{ PSI (70 bar)}}}$$

Valve pressure drop p_V in bar
Nominal flow Q_N in L/min

p_V = Valve pressure drop (input pressure minus return line pressure minus load induced pressure)

Tolerance zone for the flow-signal function

P ⟶ A; B ⟶ T

Flow in %

Zero through break according to spool overlap

Tolerance field

Typical flow curve

Command value in %

P ⟶ B; A ⟶ T

With flows of ≥ 16 GPM (60 L/min), the effects of flow saturation must be observed.

Frequency response curves: measured at v = 190 SUS (41 mm^2/s) and t = 122 °F (50 °C)
Model 4 WS 2 EB 10.. and 4 WSE 2 EB 10..

Barometric feedback

Nominal flow Q_N ≤ 8.0 GPM (30 L/min)
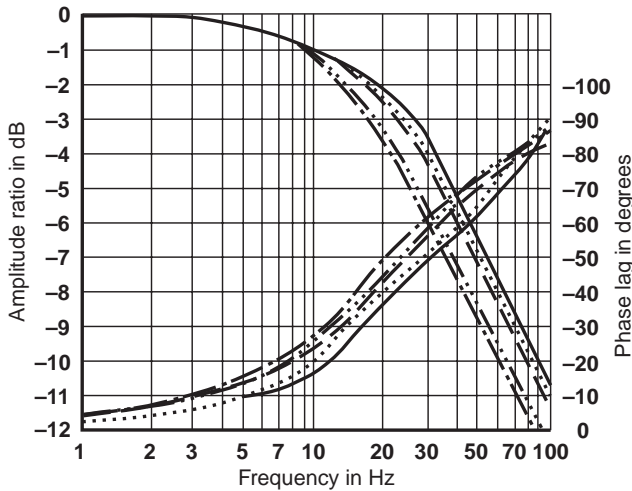
Amplitude ratio in dB — Phase lag in degrees — Frequency in Hz

Nominal flow Q_N ≥ 12 GPM (45 L/min)

Amplitude ratio in dB — Phase lag in degrees — Frequency in Hz
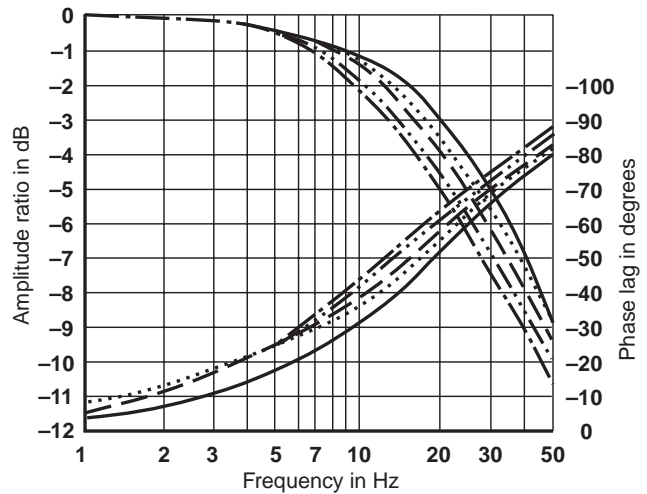
Pressure stage: = 580 PSI (40 bar); = 100 PSI (70 bar); = 2030 PSI (140 bar); = 3050 PSI (210 bar); = 4600 PSI (315 bar)

Operating curves, measured at v = 190 SUS (41 mm^2/s) and t = 122 °F (50 °C)
Model 4 WS 2 EM 10.. and 4 WSE 2 EM 10..

Mechanical feedback

Nominal flow $Q_N \leq$ 8 GPM (30 L/min)
Crossover functions
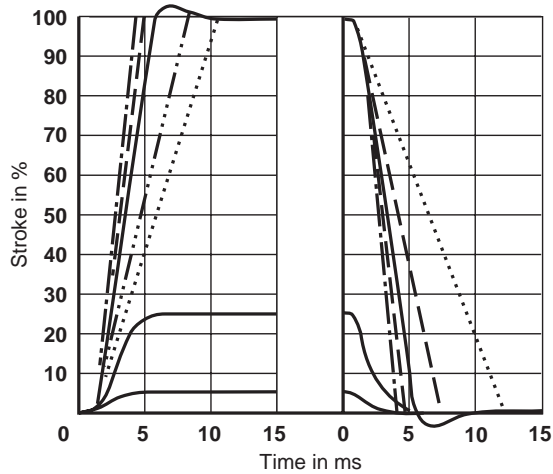
Nominal flow $Q_N \leq$ 12 GPM (45 L/min)
Crossover functions
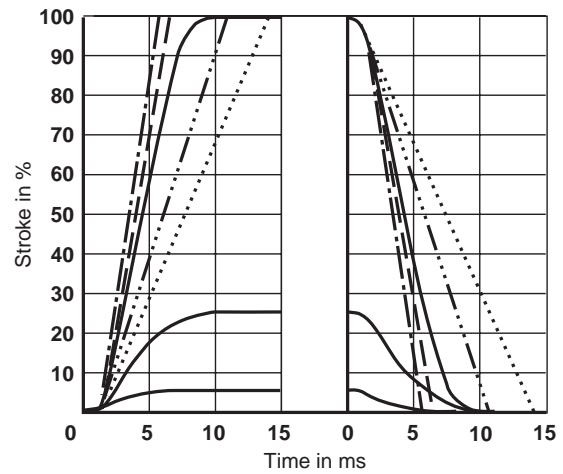
Pressure stage:	••••• = 580 PSI (40 bar)	—•••— = 100 PSI (70 bar)	—— = 2030 PSI (140 bar)	——— = 3050 PSI (210 bar)	—•— = 4600 PSI (315 bar)

Frequency response curves, operating pressure 2030 PSI (140 bar)
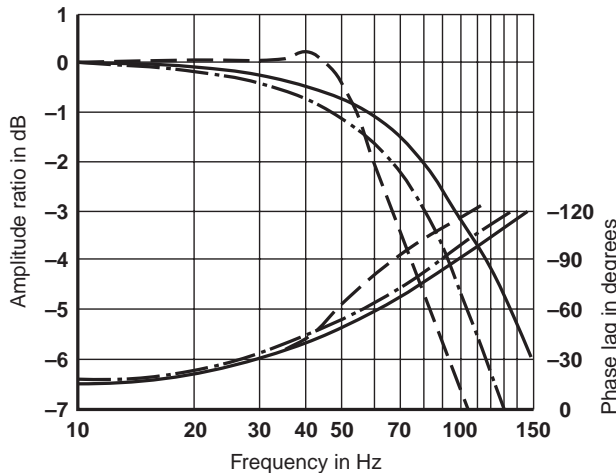
Frequency response curves, operating pressure 2030 PSI (140 bar)
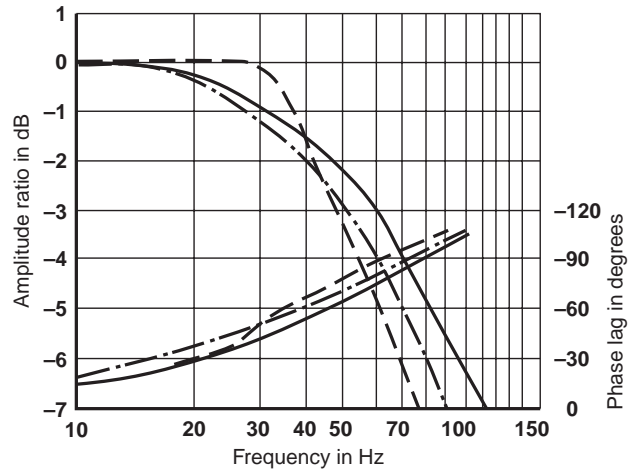
Signal: —•— = ±5%   —— = ±25%   ——— = ±100%

Associated dependency of frequency on operating pressure

Associated dependency of frequency on operating pressure
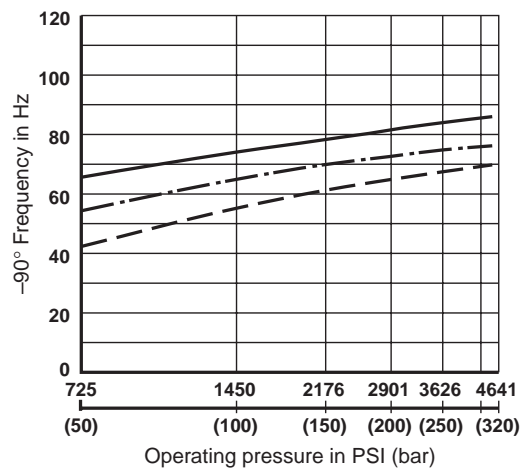
Signal: —•— = ±5%   —— = ±25%   ——— = ±100%

Operating curves: measured at v = 190 SUS (41 mm^2/s) and t = 122 °F (50°C)
Model 4 WS 2 EE 10.. and 4 WSE 2 EE 10..

Electrical feedback system

Nominal flow $Q_N \leq$ 8 GPM (30 L/min),
electrical gain (amplification) Vp = 5
Crossover functions

Stoke in %
Time in ms

Operating pressure ——— = 580, 1015, 2031 PSI (40, 70, 140 bar)   — — — = 3046 PSI (210 bar)   — • — = 4570 PSI (315 bar)

Frequency response curves, operating pressure 2030 PSI (140 bar), Vp = 5

Amplitude ratio in dB
Phase lad in degrees
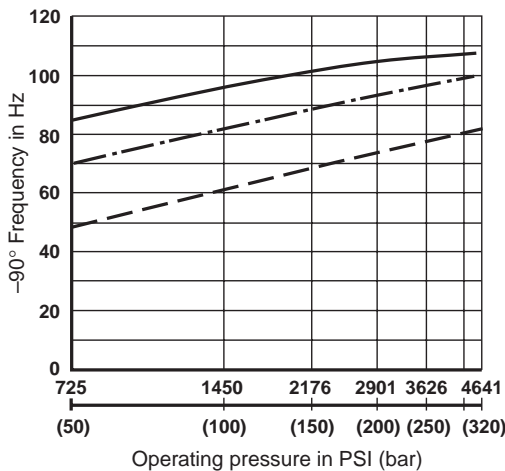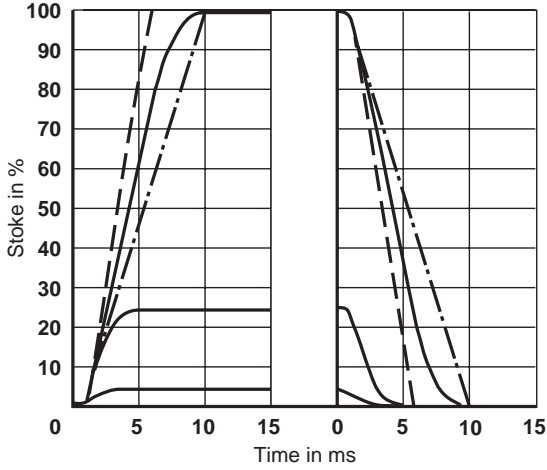Frequency in Hz

Signal: — • — = ± 5%   ——— = ± 25%   — — — = ± 100%

Associated dependency of frequency on operating pressure

−90° Frequency in Hz

| 145 | 580 | 1015 | 2031 | 3046 | 4600 |
| (10) | (40) | (70) | (140) | (210) | (315) |

Operating pressure in PSI (bar)

Nominal flow $Q_N \leq$ 12 GPM (45 L/min,
electrical gain (amplification) Vp = 5
Crossover functions

Stoke in %
Time in ms

Frequency response curves, operating pressure 2030 PSI (140 bar), Vp = 5

Amplitude ratio in dB
Phase lad in degrees
Frequency in Hz

Associated dependency of frequency on operating pressure

−90° Frequency in Hz

| 145 | 580 | 1000 | 2030 | 3051 | 4600 |
| (10) | (40) | (70) | (140) | (210) | (315) |

Operating pressure in PSI (bar)

Signal: — • — = ± 5%   ——— = ± 25%   — — — = ± 100%
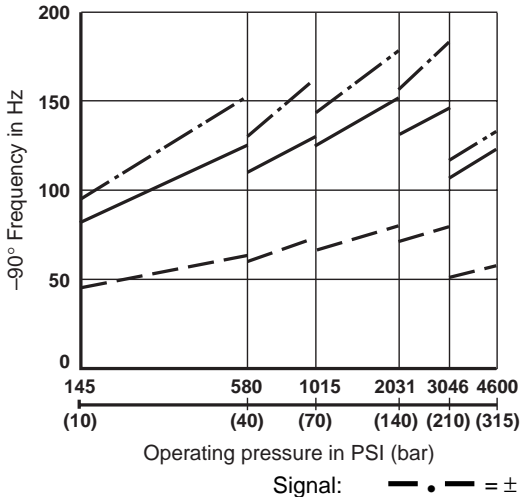
Unit dimensions: dimensions in inches (millimeters)

Mechanical feedback / with separate electronics
Model 4 WS 2 EM 10-4X/… (standard)

1 Zero point adjustment – remove plug (2.5 mm A/F) to access the potentiometer to set the zero point

2.1 Plug type MS 3106 E 14 S-2 S to non-integrated valve Ordering code: **RR00 002 460**

2.2 Plug type MS 3106 E 14 S-5 S to integrated valve Ordering code: **RR00 011 921**

3 Space required to remove plug

4 Adjustment on both sides for setting the "Null point" (centered position) of the valve (allen wrench 3 mm A/F)

5 Interchangeable filter element (10 mm A/F) part no. **RR00 306 842** (for NBR seals) part no. **RR00 306 843** (for FPM seals)

6 Valve mounting bolts, not included 4) socket head cap screws 1/4-20 UNC x 2" (M6 x 50) tightening torque = 7.67 lb-ft (10.4 Nm)

7 Nameplate

8 Top cover can be rotated 180°

9 Pilot stage (1st stage)

10 Second stage

11 O-ring (12 x 2 mm); Ports A, B, P, T

12 O-ring (7 x 1.5 mm); Port X_1

13 Optional port X_1 for external pilot oil supply Bore Ø 0.118 to 0.197 inches (3 mm to 5 mm) If port X is to be used, the sandwich plate must be used. (This plate must be ordered separately) **Warning!** Port X1 is connected to pressure. If port X instead of X1 is to be used a sandwich plate (order separately, see page 15)
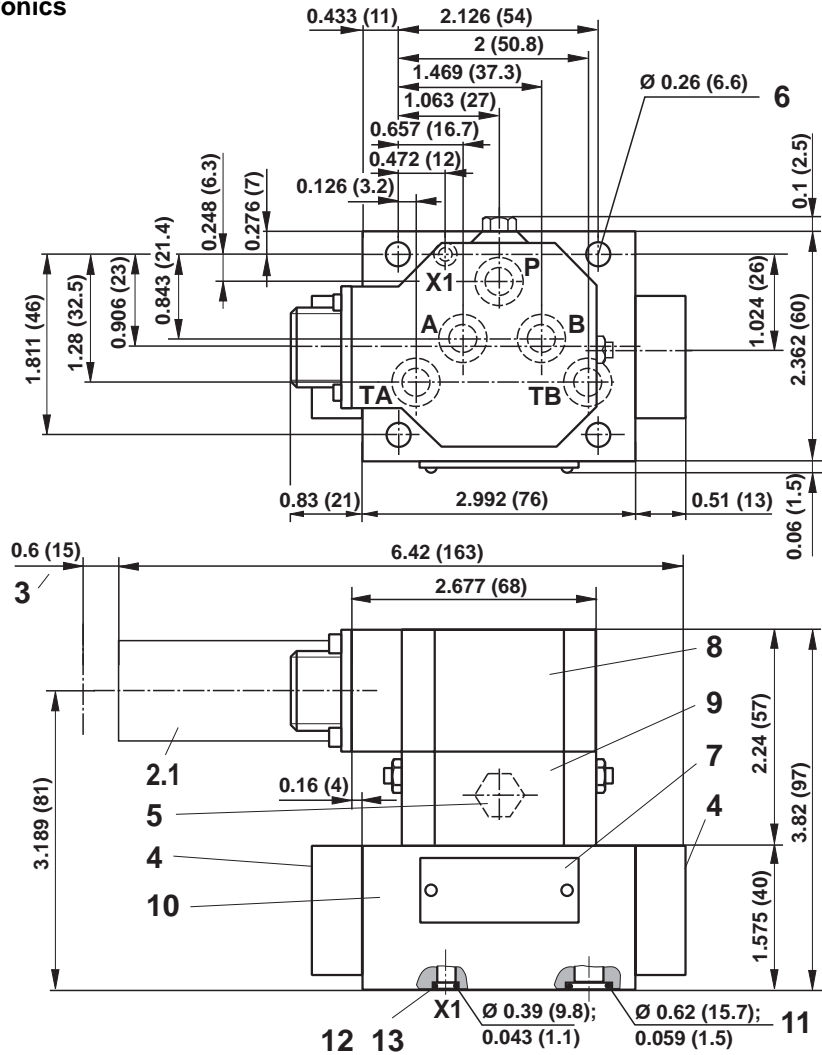
14 Cover with integrated electronics
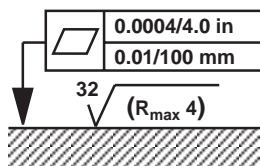
| 0.0004/4.0 in |
| 0.01/100 mm |

Required surface finish of interface when mounting the valve without our subplate

32 $(R_{max}\ 4)$

A/F = Across flats

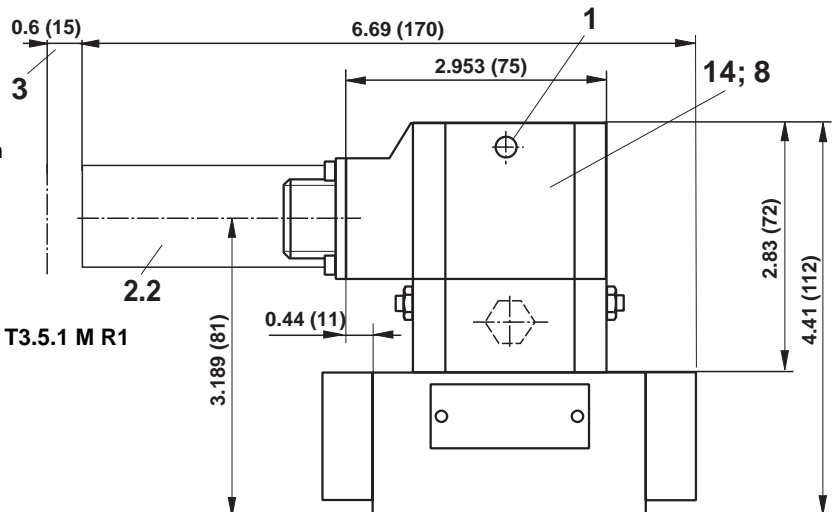**Valve Mounting interface to ISO 4401-5, NFPA T3.5.1 M R1 and ANSI B93.7 D 05 except for port X1.**

Subplates

G 66/12 (SAE-6; 9/16-18)
G 67/12 (SAE-8; 3/4-16)
G 534/12 (SAE-12; 1-1/16-12)
G 535/12 (SAE-12; 1-1/16-12) ⎱ with port X
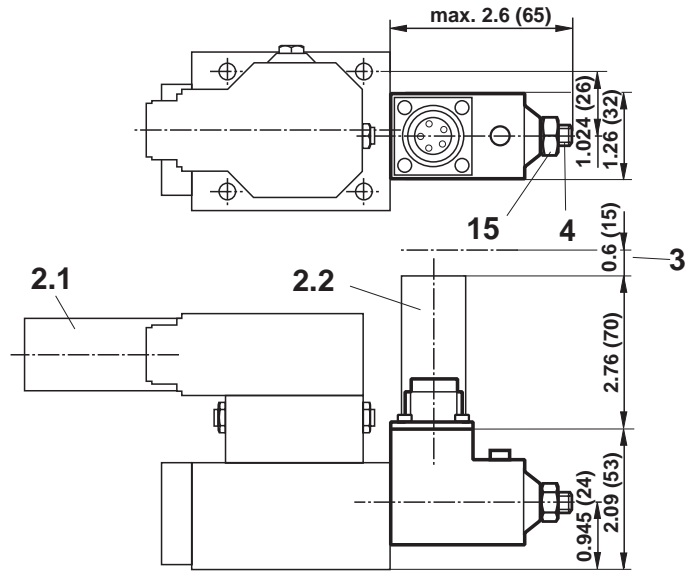G 536/12 (SAE-16; 1-5/16-12) ⎰

Subplates and valve mounting bolts must be ordered separately, see RA 45 054

Mechanical feedback / integrated electronics
### Model 4 WSE 2 EM 10-4X/…

Unit dimensions: dimensions in inches (millimeters)

**Electrical feedback / external electronic control
Model 4 WS 2 EE 10-4X/…**

**Electrical feedback / integral electronics
Model 4 WSE 2 EE 10-4X/…**

2.1 Plug compatible with Type MS 3106 E 14 S – 2 S
to non-integrated valve **RR00 002 460**

2.2 Plug compatible with Type MS 3106 E 14 S – 5 S
to non-integrated valve feedback **RR00 011 921**

2.3 Plug compatible with Type MS 3106 E 14 S – 6 S
to integrated electronics **RR00 013 159**
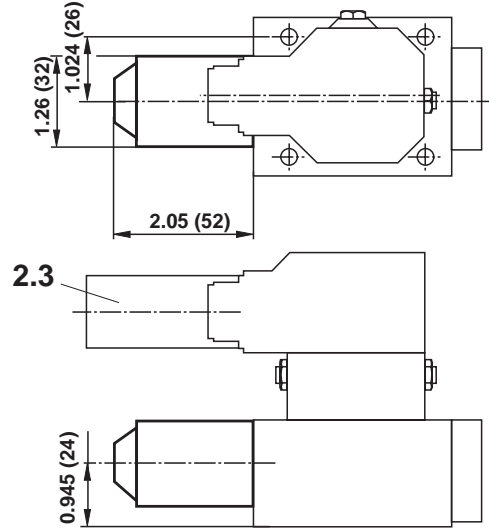
3 Space required to remove plug
(take care with the connecting cable)

4 Setting for hydraulic zero point
(allen key 3 A/F)

15 Lock nut 10 A/F

**Barometric feedback / external electronic control
Model 4 WS 2 EB 10-4X/…**

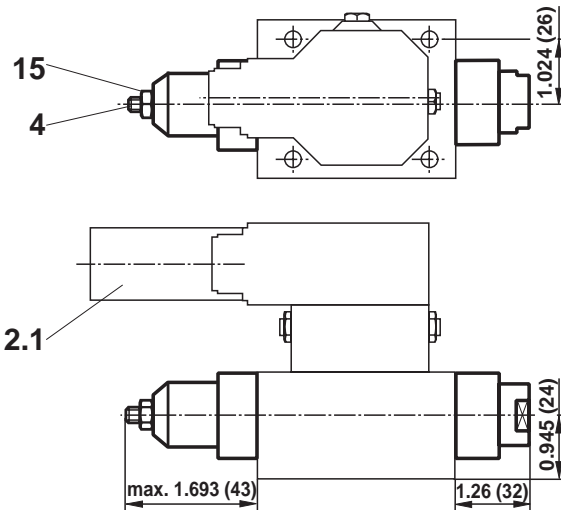**Barometric feedback / integral electronics
Model 4 WSE 2 EB 10-4X/…**

2.1 Plug compatible with Type MS 3106 E 14 S – 2 S
to non-integrated valve **RR00 002 460**
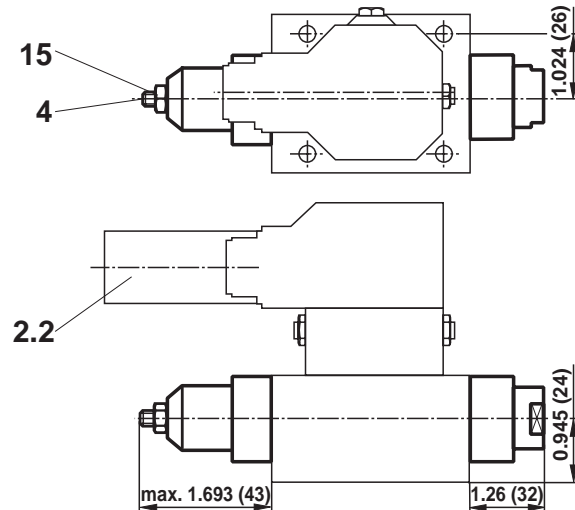
2.2 Plug compatible with Type MS 3106 E 14 S – 5 S
to integrated electronics **RR00 011 921**

4 Setting for hydraulic zero point (allen key 3 A/F)

15 Lock nut 10 A/F

Unit dimensions, Sandwich plates for external pilot oil feed: dimensions in inches (millimeters)

External pilot oil supply
(models "–" and "T")

The servo valve always has port X1.

If there is no X1 port on the mounting surface, the sandwich plate (16) must be used with external pilot oil feed is required.

Either port X or X2 may be used.

16 Sandwich plate with
NBR-seals, ordering code **RR00 319 482**
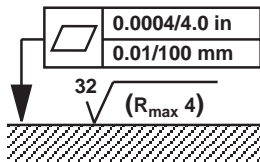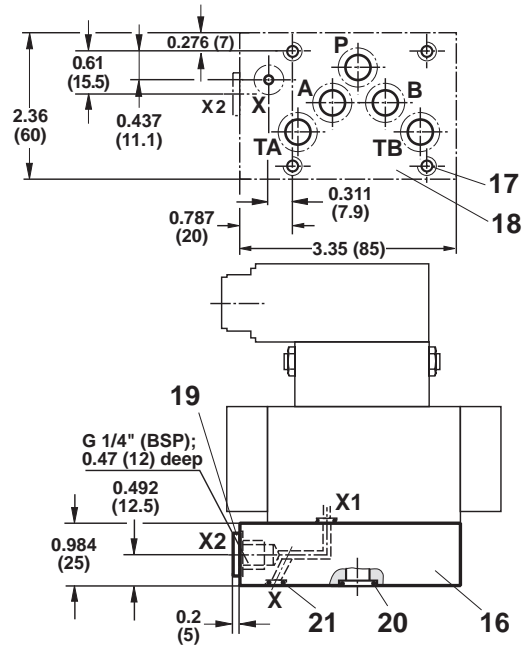FPM-seals, ordering code **RR00 319 483**

17 Valve mounting bolts
4) socket head cap screws
1/4-20 UNC x 3" (M6 x 75)
tightening torque = 7.67 lb-ft (10.4 Nm)

18 Mounting surface for the sandwich plate (16)

19 1/4" BSP plug, ordering code **RR00 001 973**
O-ring 14 mm x 2 mm

20 O-ring (12 x 2 mm); ports A, B, P, T

21 O-ring (10.82 x 1.78 mm); port X

Required surface finish of interface when mounting the valve without our subplate

External pilot oil drain
(models "–" and "E")

Sandwich plate (22) is **not** be used with mechanical feedback or electrical feedback with integrated electronics.

22 Sandwich plate included

23 For pilot oil feed Model "–", port X3 may be used instead of port X1 for the oil feed.

only in valve type:
4 WS 2 EE...
4 WS 2 EB...
4 WS E 2 EB...
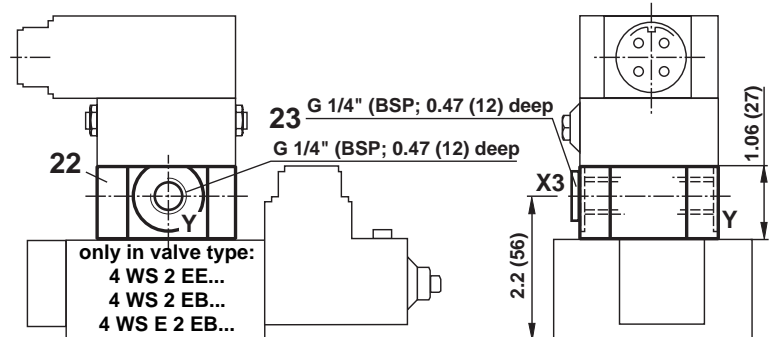
Unit dimensions, Flushing plate: dimensions in inches (millimeters)

Symbol

with NBR-seals
Ordering code RR00 308 492

19 O-ring (12 x 2 mm); ports A, B, P, T

20 O-ring (7 x 1.5 mm); port X

21 4) socket head cap screws
1/4-20 UNC x 2" (M6 x 50)
tightening torque = 11.4 lb-ft (15.5 Nm)

In order to guarantee the perfect functioning of servo valves, the installation must be flushed prior to start-up.

As a guide to the flushing time required, the following formula can be used:

$$t \geq \frac{V}{Q} \cdot 5$$

t = Flushing time in minutes
V = Tank contents in gallons (liters)
q_V = Pump flow in GPM (L/min)

When refilling more than 10% of the tank contents, the flushing process should be repeated.

Note: A directional control valve with mounting pattern according to ISO 4401-5, NFPA/ANSI D 05 is better than a flushing plate. Such a valve allows the actuator ports and lines to also be flushed. Refer to RA 07 700.
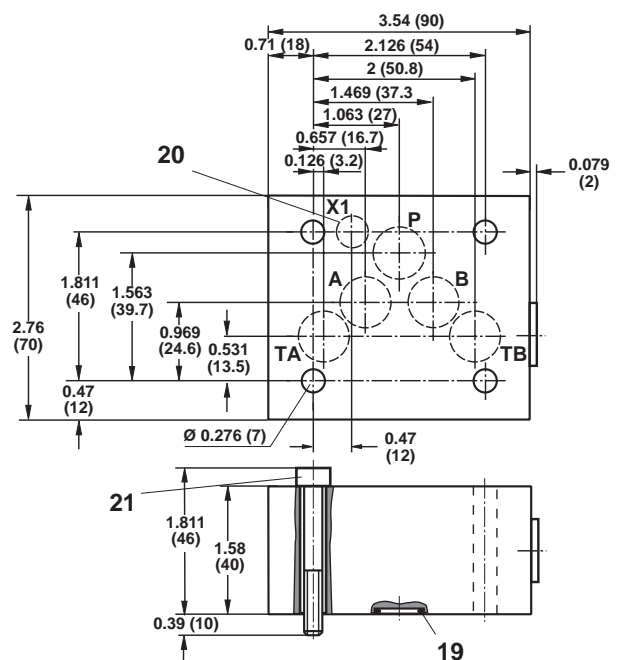
Control electronics for valve type 4WS2EM… and 4WS2EB…: servo amplifier SR 2 (must be ordered separately)

A external servo amplifier is used to control the valve. This changes the analogue input signal (command value) in such a way that a regulated current control of the servo valve can be effected using the output signal .

Technical data

Supply voltage	V : ± 22 to 28 V smoothed	– Height:	3 U (128.4 mm)
Max. output current	I_{max}: ± 60 mA	– Width conductor side:	1 HP (5.08 mm)
		– Width component side:	7 HP
Card dimensions:	Eurocard 100 x 160 mm, DIN 41 494		

For applications outside these parameters, please consult us!

Front plate dimensions

Detailed information: Data sheet RA 29 980

Terminal connections / block diagram
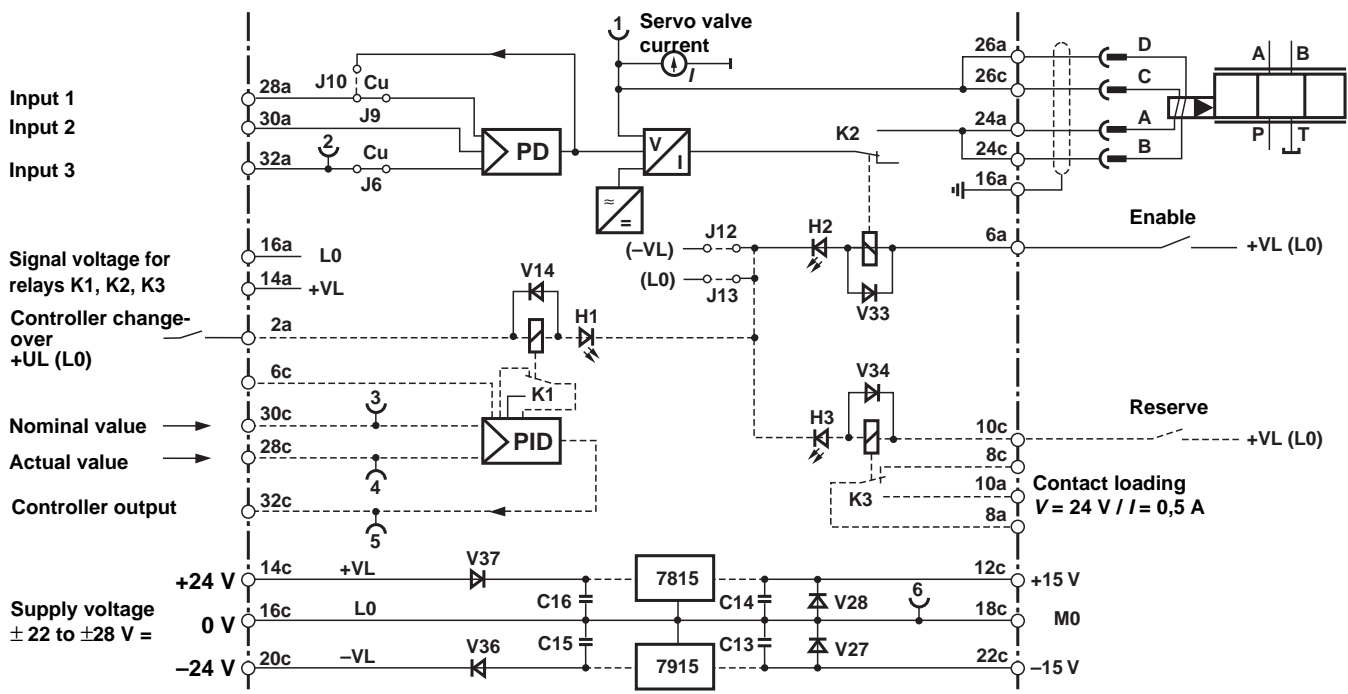
Relays K1 and K3 as well as the PID controller are special models and are identified by a VT number when ordering.

Positive command value at **port 30c** gives a flow at the servo valve from P to B.
Positive command value at **port 32a** gives a flow at the servo valve from P to A.

Ordering code

VT-SR 2	S	1X /	*

32-pin blade connector to DIN 41612 form D	**= S**	
(for installation in Euro-card racks and card holders)		
Series 10 to 19	**= 1X**	
(10 to 19: unchanged technical data and connection allocations)		

	Further details in clear text
0 =	without ± 15 V voltage regulator
1 =	with ± 15 V voltage regulator

Mannesmann Rexroth Corporation
Rexroth Hydraulics Div., Industrial, 2315 City Line Road, Bethlehem, PA 18017-2131 Tel. (610) 694-8300 Fax: (610) 694-8467
Rexroth Hydraulics Div., Mobile, 1700 Old Mansfield Road, Wooster, OH 44691-0394 Tel. (330) 263-3400 Fax: (330) 263-3333