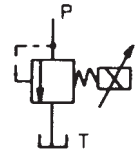


Photo	Type	Series	Description	Main Specifications
	Pressure Control	EPR	Electro-Hydraulic Proportional Pilot Relief Valve	0.3gpm, 5000psi
	Pressure Control	ER	Electro-Hydraulic Proportional Relief Valve	39.7 - 84.6gpm, 5000psi
	Pressure Control	EGB	Electro-Hydraulic Proportional Reducing and Relief Valve	13.2 - 26.4gpm, 3000psi
	Flow Control	ES	Electro-Hydraulic Proportional Flow Control Valve	0.08 - 132.1gpm, 3000psi
	Flow & Directional Control	ESD	Electro-Hydraulic Proportional Directional and Flow Control Valve	6.6 - 66.1gpm, 3571psi
NA	Pressure Control	EOG	Modular Type Electro-Hydraulic Proportional Reducing Valve	7.9gpm, 3571psi
	Flow Control	EOF	Modular Type Electro-Hydraulic Proportional Reducing Valve	0.08 - 6.6gpm, 3000psi
	Amplifier	EDA/EDC	Small Type Amplifier Series for Electro-Hydraulic Proportional Valve	NA

EPR Series Electro-hydraulic Proportional Pilot Relief Valve (EPR)



Features

This is a direct acting type relief valve based on a balance between the attraction force of a DC solenoid and a hydraulic force.

This valve can be utilized in a small capacity hydraulic system or connected to the vent-port of a balance piston type pressure control valve to

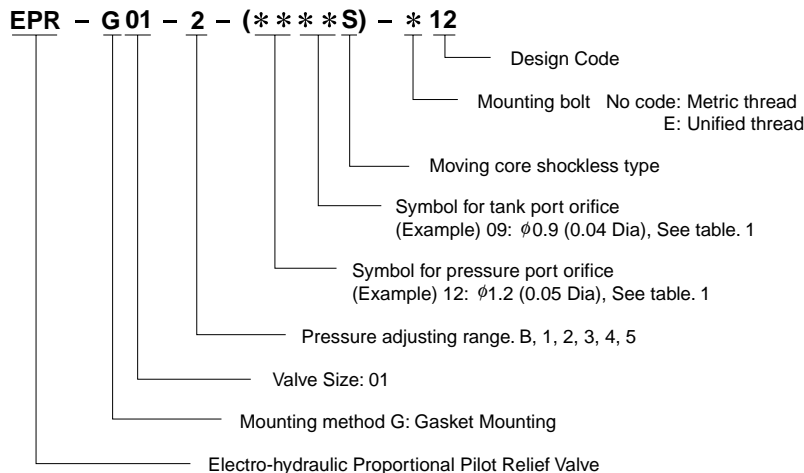
perform continuous control of the pressure in proportion to the input current.

Specifications

Item	Model	EPR-G01-*.****-*12
Rated flow	ℓ/min (gpm)	1.2 (0.3)
Pressure adjusting range	kgf/cm ² (psi)	B: 3 ~ 25 (43 ~ 357) 1: 7 ~ 70 (100 ~ 1000) 2: 10 ~ 140 (143 ~ 2000) 3: 15 ~ 210 (214 ~ 3000) 4: 15 ~ 280 (214 ~ 4000) 5: 20 ~ 350 (286 ~ 5000)
Rated current	mA	800
Coil resistance	Ω	20 (20°C) (68°F)
Hysteresis		3% or less Note 1).
Weight	kgf (lbs)	1.6 (3.5)

Note 1). This is the hysteresis value when Nachi amplifier is provided for the valve. (With dither)

Understanding Model Numbers



Number of Pressure port and Tank port orifice

Number	00	08	09	10	11	12	13
Orifice size	None	φ0.8 (0.031)	φ0.9 (0.035)	φ1.0 (0.039)	φ1.1 (0.043)	φ1.2 (0.047)	φ1.3 (0.051)

Unit = mm (inch)

Pressure range	Orifice number
B, 1 type	0013S
2, 3 type	0012S
4 type	1212S
5 type	1111S

Note) Standard size is as below.

● Handling

1 Air Bleeding

Loosen the air vent to bleed the air and fill the solenoid with oil at the start of operation to obtain good pressure control.

The position of the air vent can be changed by turning the cover.

2 Installation Method

The minimum pressure will become approximately 2kgf/cm² (29 psi) higher when this valve is attached on a vertical plane.

3 Manual Pressure Adjusting Screw

When there is no input current supplied to the valve as in the case of initial adjustment or due to an electrical fault, the valve pressure can be controlled temporarily by turning the manual adjusting screw. In normal operation, this manual adjusting screw must be retracted completely and fixed with the lock nut.

4 Minimum Relief Flow

Since the setting pressure may become unstable in case of low flow rate, use this valve at a flow rate of 0.3 ℓ / min (0.08 gpm) or more.

5 Load Capacity

When the circuit pressure is to be controlled directly by this valve, the load capacity must be 40cc (2.4 in³) or more.

6 Mounting Bolts

M5 x 45 ℓ (E: 10-24 UNC-3A x 1³/₄"), Grade 12.9 tightening torque = 50~70 kgf·cm (4~5 lbs·ft)

7 Subplate

When a subplate is required, specify the following type in the purchase order.

MSA-01Y-*10 (refer to dimensions in the figure below.)

8 Oil Temperature

-20°C~70°C (-4°F~158°F)

9 Oil Viscosity

12~400 cSt

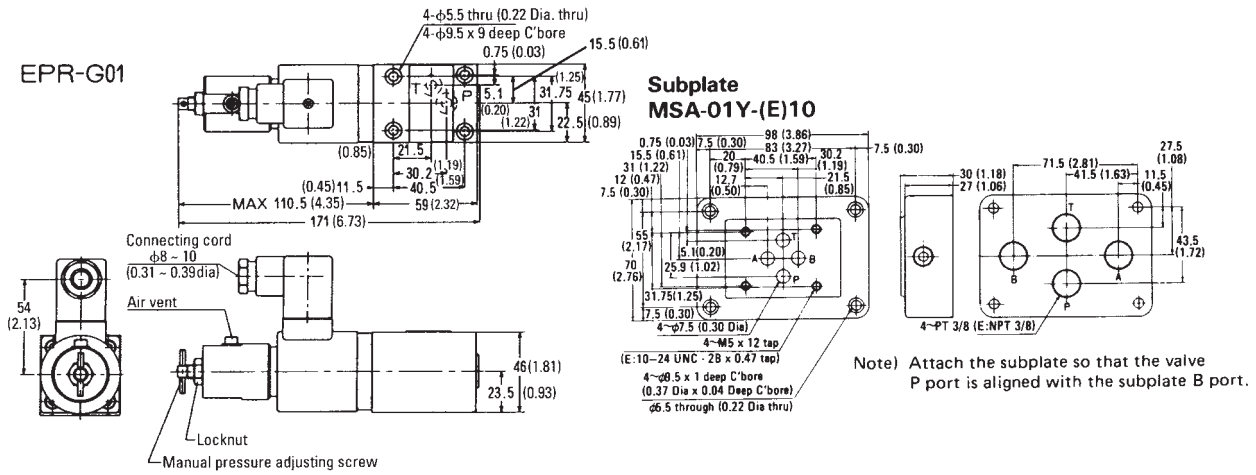
15~60 cSt is recommended.

10 Gasket Dimension

ISO 4401-03-02-0-94

Installation Dimensions

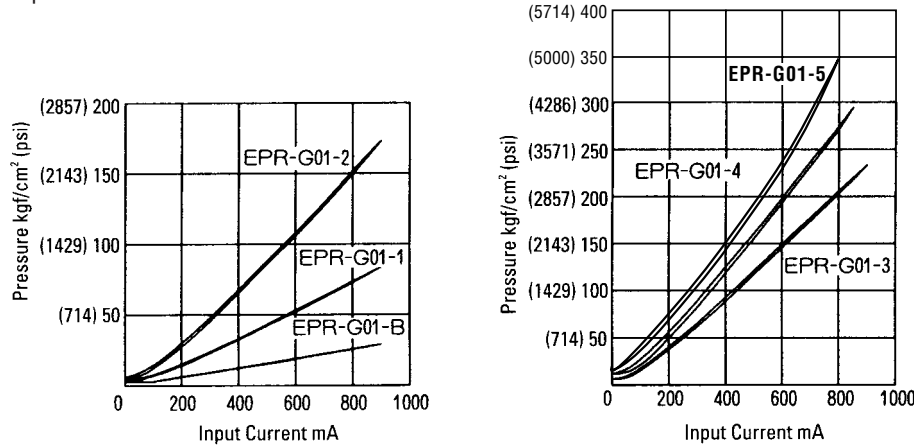
mm (inch)



Performance Curves

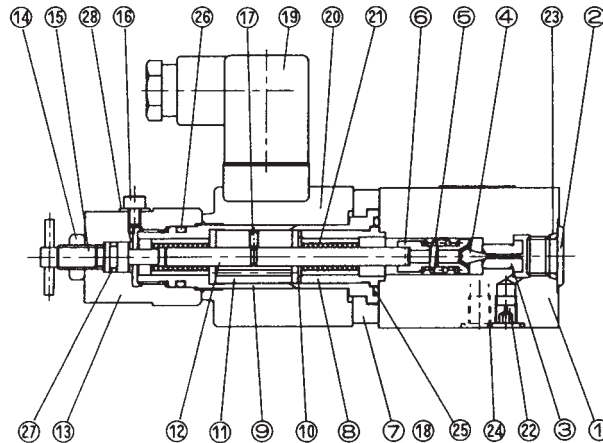
Oil viscosity = 32 cSt

Input Current-Pressure Characteristics



Cross Section Drawing

EPR-G01-*.****-*12

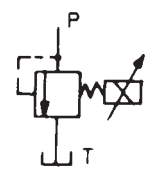


No.	Name of part
1	Body
2	Plug
3	Seat
4	Poppet
5	Spring
6	Retainer
7	Cover
8	Stopper
9	Guide
10	Shim
11	Plunger
12	Rod
13	Cover
14	Nut
15	Screw
16	Screw
17	Screw
18	Screw
19	Connector
20	Coil
21	Ballbush
22	Orifice
23	O ring
24	O ring
25	O ring
26	O ring
27	O ring
28	Seal

List of Seals

No.	Name of part	Number of part	Qty
23	O ring	RO-P11-90	1
24	O ring	RO-P9-90	2
25	O ring	RO-P22-90	1
26	O ring	RO-P16-90	1
27	O ring	RO-P7-90	1
28	Seal	DS-1-4	1

ER Series Electro-hydraulic Proportional Relief Valve (ER)



Features

This valve is a combination of the electro-hydraulic proportional pilot relief valve (EPR Series) and a balance piston type relief valve and is used to perform pressure control in proportion to the input current. Since the control pressure is affected very little by changes of flow rate or

oil temperature, even complicated pressure (power) control can be performed by an open loop system.

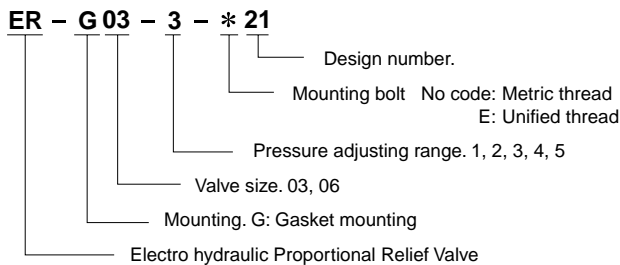
Specifications

Item	Model	ER-G03-*-*21	ER-G06-*-*21
Rated flow	ℓ/min (gpm)	150 (39.7)	320 (84.6)
Pressure adjusting range	kgf/cm ² (psi)	B: 3 ~ 25 (43 ~ 357) Note 1), 1: 7 ~ 70 (100 ~ 1000) 2: 10 ~ 140 (143 ~ 2000) 3: 15 ~ 210 (214 ~ 3000) 4: 15 ~ 250 (214 ~ 3571) 5: 20 ~ 350 (286 ~ 5000)	
Rated current	mA	800	
Coil resistance	Ω	20 (20°C) (68°F)	
Hysteresis		3% or less Note 2).	
Minimum relief flow	ℓ/min (gpm)	5 (1.3)	8 (2.1)
Weight	kgf (lbs)	6.0 (13.2)	7.1 (15.7)

Note 1). The G03 model only available. But the flow is restricted to 40 l/min (10.6 gpm).

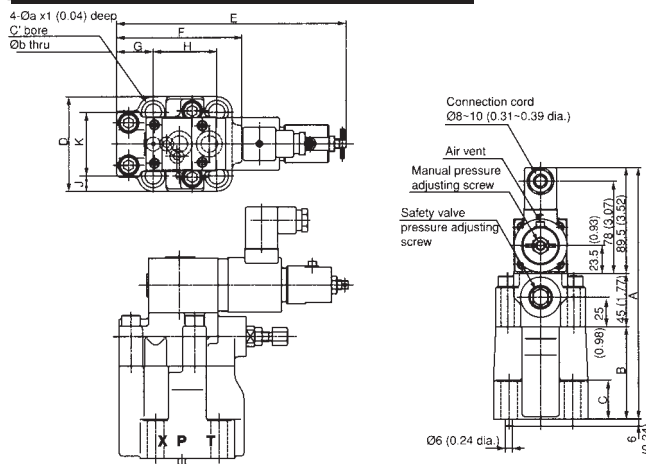
2). This is the hysteresis value when Nachi amplifier is provided for the valve. (With dither)

Understanding Model Numbers



Installation Dimensions

mm (inch)



Model	A	B	C	D	E	F	G	H	J	K	a	b
ER-G03	212.5 (8.37)	78 (3.07)	32 (1.26)	80 (3.15)	194.5 (7.66)	106 (4.17)	31 (1.22)	53.8 (2.12)	13.1 (0.52)	53.8 (2.12)	20 (0.79)	.14 (0.55)
ER-G06	217.5 (8.56)	83 (3.27)	36 (1.42)	100 (3.94)	203.5 (8.01)	119 (4.69)	37 (1.46)	66.7 (2.63)	15 (0.59)	70 (2.76)	25 (0.98)	18 (0.71)

● Handling

① Air Bleeding

Loosen the air vent to bleed the air thoroughly and fill oil in the solenoid at the start of operation to obtain good pressure control.

② Manual Pressure Adjusting Screw

When there is no input current supplied to the valve as in the case of initial adjustment or due to an electrical fault, the valve pressure can be controlled temporarily by turning the manual adjusting screw. In normal operation, this manual adjust screw must be retracted completely and fixed with the locknut.

③ Tank Port Back-Pressure

Use the valve with a tank port back-pressure which is as low as possible. 2 kgf/cm² (29 psi) or less is recommended.

④ Setting Pressure of Safety valve

The safety valve is set for a pressure that is 15~20 kgf/cm² (214~286 psi) above the maximum adjusting pressure. Adjust this safety valve setting in accordance with the pressure to be actually used.

⑤ Mounting Bolts

Grade = 12.9

Model	Bolt Size	Quantity	Tightening torque
ER-G03	M12 x 50ℓ (E: 1/2-13 UNCx2")	4	750 ~ 950 kgf cm (55 ~ 69 lbs·ft)
ER-G06	M16 x 80ℓ (E: 5/8-11 UNCx2 3/8")	4	1900 ~ 2350 kgf cm (138 ~ 170 lbs·ft)

⑥ Oil Temperature

-20°C~70°C (-4°F~158°F)

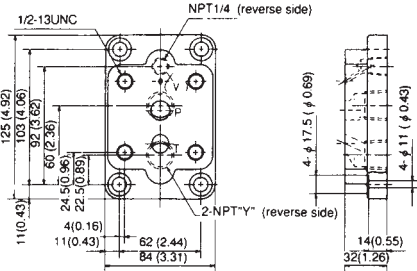
⑦ Oil Viscosity

12~400 cSt
15~60 cSt is recommended.

⑧ Gasket Dimension

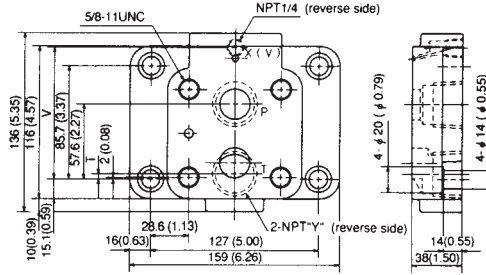
G03 = ISO 6264-AR-06-2-A
G06 = ISO 6264-AS-08-2-A

Subplate
MRI-03*-E10



Model	Y
MRI-03-E10	3/8
MRI-03X-E10	1/2

MRI-06*-E10

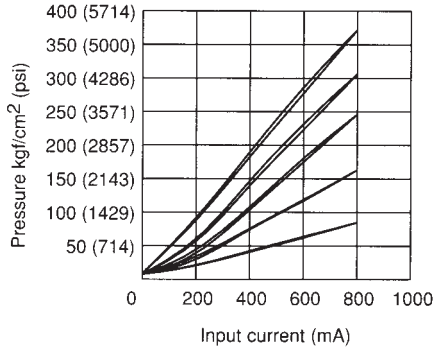


Model	Y	T	V
MRI-06-E10	3/4	13.2 (0.52)	92.5 (3.64)
MRI-06X-E10	1	4.7 (0.19)	100.7 (3.96)

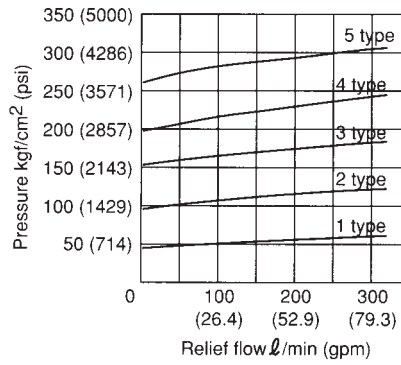
Performance Curves

Oil viscosity = 32 cSt

Input Current-Pressure Characteristics
ER-G06-*-21



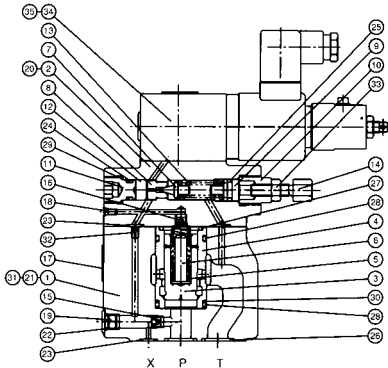
Pressure Override Characteristics
ER-G06-*-21



Cross Section Drawing

ER-G**-*-21

Combination with EPR Valve



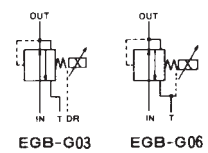
Model	Pilot valve model
ER-G03-B-21	EPR-G01-B-0011S-12
1	1-0011S-12
2	2-1313S-12
3	3-1313S-12
4	4-1212S-12
5	5-1212S-12
ER-G06-1-21	EPR-G01-1-0011S-12
2	2-1313S-12
3	3-1313S-12
4	4-1212S-12
5	5-1212S-12

No.	Name of part	No.	Name of part
1	Body	19	Plug
2	Cover	20	Screw
3	Poppet	21	Pin
4	Sleeve	22	O-ring
5	Spring	23	O-ring
6	Spacer	24	O-ring
7	Poppet	25	O-ring
8	Seat	26	O-ring
9	Plunger	27	O-ring
10	Retainer	28	O-ring
11	Plug	29	Backup ring
12	Collar	30	Backup ring
113	Spring	31	Screw
14	Knob	32	Orifice
15	Orifice	33	Nut
16	Orifice	34	Pilot relief valve
17	Plate	35	Screw
18	Plug		

List of Seals

No.	Name of part	Model / Number of part		Qty
		ER-G03-*-20	ER-G06-*-20	
22	O ring	RO-P8-90	RO-P8-90	2
23	O ring	RO-P9-90	RO-P9-90	3
24	O ring	RO-G10A-90	RO-G10A-90	1
25	O ring	RO-P11	RO-P11	1
26	O ring	RO-P18-90	RO-P28-90	2
27	O ring	RO-G25-90	RO-P28-90	1
28	O-ring	RO-G30-90	RO-P32-90	2
29	Backup ring	RBO-P10A	RBO-P10A	1
30	Backup ring	RBO-G30	RB-P32	1

EGB Series Electro-hydraulic Proportional Reducing and Relief Valve



Features

This is a combination of the electro-hydraulic proportional pilot relief valve (EPR Series) and a reducing valve with a relief and is used to perform pressure reducing control of the pres-

sure in a hydraulic system in proportion to the input current. Since a relief function is provided, the outlet side pressure can be maintained practically constant even when a reaction

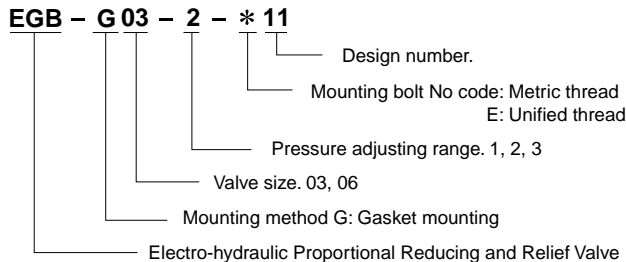
force acts on the valve outlet side. Owing to this feature, the response performance are very good.

Specifications

Item	Model	EGB-G03 *-11	EGB-G06 *-11
Max. operating pressure kgf/cm ² (psi)		210 (3000)	
Rated flow ℓ/min (gpm)		50 (13.2)	100 (26.4)
Pressure adjusting range kgf/cm ² (psi)		B: 3 ~ 25 (43 ~ 357) Note (1) 1: 7 ~ 70 (100 ~ 1000) 2: 9 ~ 140 (129 ~ 2000) 3: 15 ~ 210 (214 ~ 3000)	
Rated current (mA)		800	
Coil resistance (Ω)		20 (20°C) (68°F)	
Hysteresis		3% or less (Note 2)	
Weight kgf (lbs)		5.5 (12)	7.8 (17)

Note 1) The G03 model is only available, but the flow is restricted to 20 ℓ/min (5.3 gpm).
Note 2) This is the hysteresis value when NACHI's amplifier is provided for the valve. (With dither)

Understanding Model Numbers

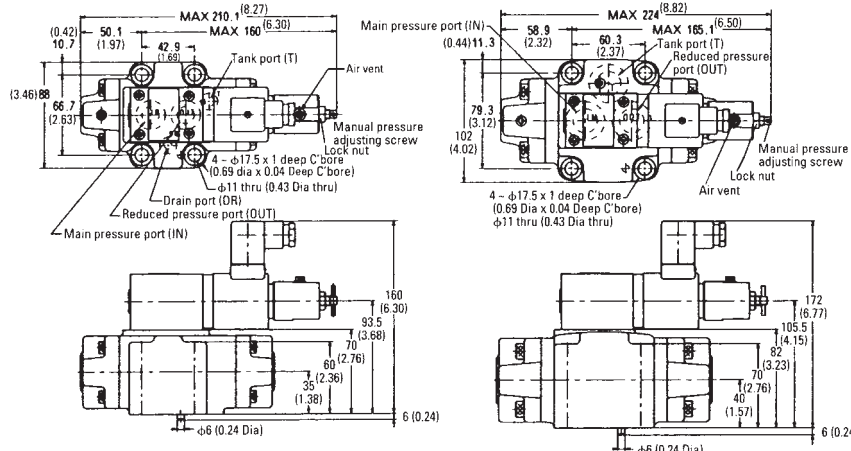


Installation Dimensions

mm (inch)

EGB-G03-*-11

EGB-G06-*-11



● Handling

1 Air Bleeding

Loosen the air vent to bleed the air thoroughly and fill oil in the solenoid at the start of operation to obtain good pressure control.

2 DR Port Piping

Please take care in piping so that the DR port (in case of G06 size T port) is always filled up with oil.

3 Manual Pressure Adjusting Screw

When there is no input current supplied to the valve as in the case of initial adjustment or due to an electrical fault, the valve pressure can be controlled temporarily by turning the manual adjusting screw. In normal operation, this manual adjusting screw must be retracted completely and fixed with the locknut.

4 Load Capacity

Use this valve with a load capacity (Valve outlet side capacity) or 5 ℓ (305 in³) or more.

5 Mounting Bolts

Grade = 12.9

Model	Bolt Size	Quantity	Tightening torque
EGB-G03	M10 x 75ℓ (E: 3/8-16 UNCx3")	4	450 ~ 550 kgf · cm (33 ~ 40 lbs · ft)
EGB-G06	M10 x 85ℓ (E: 3/8-16 UNCx3-3/8")	4	450 ~ 550 kgf · cm (33 ~ 40 lbs · ft)

6 Oil temperature

-20~70°C (-4°F~158°F)

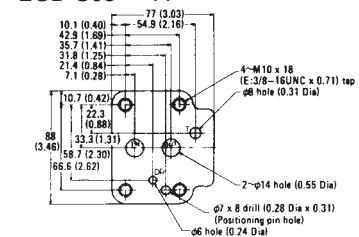
7 Oil viscosity

12~400 cSt

15~60 cSt is recommended.

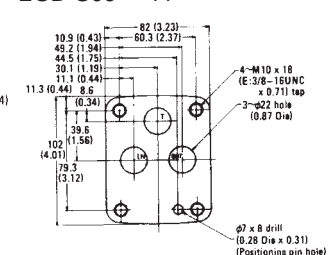
Installation Gasket Dimensions

EGB-G03-*-11



Installation Gasket Dimensions

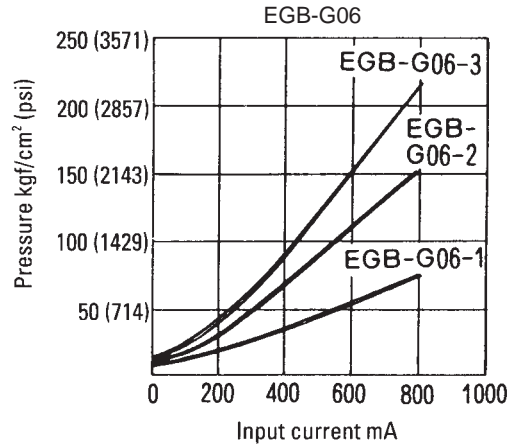
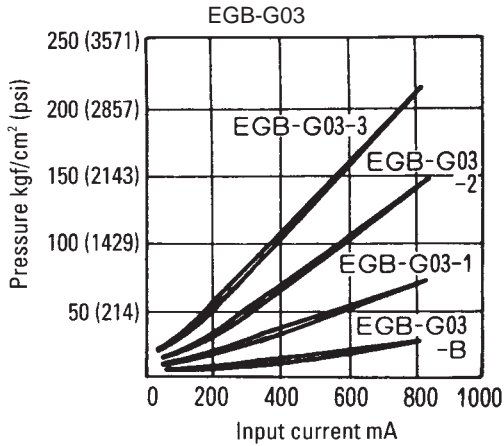
EGB-G06-*-11



Performance Curves

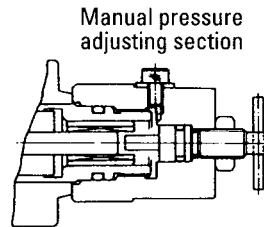
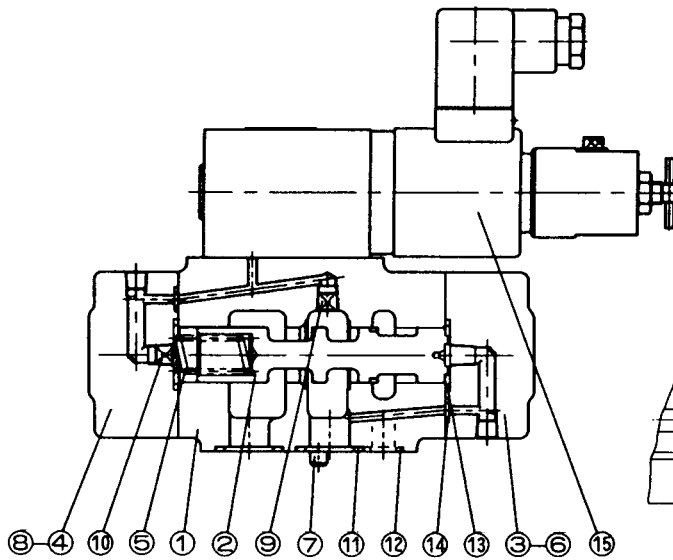
Oil viscosity = 32 cSt

Input current-Pressure Characteristics



Cross Section Drawing

EGB-G**-*-11



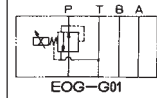
Combination with EPR Valve

Model	EPR valve model
EGB-G03-B-11	EPR-G01-B-0000-12
EGB-G03-1-11	1-0013-12
EGB-G03-2-11	2-0012-12
EGB-G03-3-11	3-0011-12
EGB-G06-1-11	EPR-G01-1-0013-12
EGB-G06-2-11	2-0012-12
EGB-G06-3-11	3-0012-12

List of Seals

No.	Name of part	ER-G03-**-11		ER-G06-**-11	
		Number of part	Q'ty	Number of part	Q'ty
11	O ring	RO-P20-90	2	RO-P26-90	3
12	O ring	RO-P10A-90	2	—	—
13	O ring	RO-P22-90	2	RO-G03-90	2
14	O ring	RO-P6-90	2	RO-P6-90	2

No.	Name of part
1	Body
2	Piston
3	Cover
4	Cover
5	Spring
6	Screw
7	Pin
8	Pin
9	Orifice
10	Orifice
11	O ring
12	O ring
13	O ring
14	O ring
15	Pilot relief valve



Features

This valve is the expansion of modular valve idea into electro-hydraulic proportional reducing valve, and it is used to perform pressure reducing control of the pressure in a hydraulic

system in proportion to the input current.

This valve is most suited for small hydraulic systems, such as continuous proportional control of the lathe's

work chuck pressure of machine tools. Since a relief function is provided, the response performance to the pressure is very good.

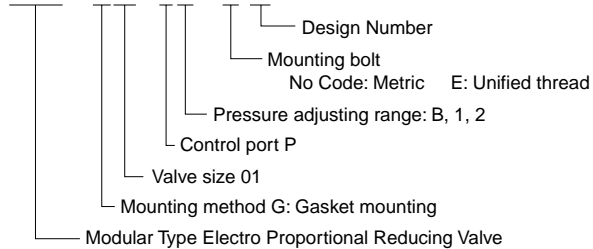
Specifications

Item	Model	EOG-G01-P*-*11
Max. operating pressure	kgf/cm ² (psi)	250 (3571)
Rated flow	ℓ/min (gpm)	30 (7.9)
Pressure adjusting ranges	kgf/cm ² (psi)	B: 3 ~ 25 (43 ~ 357) 1: 4 ~ 70 (58 ~ 1000) 2: 6 ~ 140 (86 ~ 2000)
Allowable back pressure of T-port	kgf/cm ² (psi)	Less than 25 (357)
Rated current	(mA)	850
Coil resistance	(Ω)	20 (20°C) (68°F)
Hysteresis	(%)	Less than 3 Note (1)
Weight	kgf (lbs)	3.6 (7.9)

Note 1) This is the hysteresis value when NACHI's amplifier is provided for the valve. (with dither)

Understanding Model Numbers

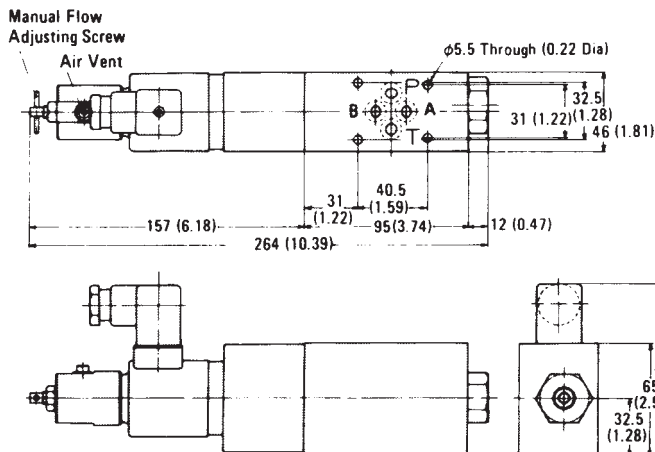
EOG - G01 - P1 - * 11



Installation Dimensions

mm (inch)

EOG-G01-P*



● Handling

1 Air Bleeding

Loosen the air vent to bleed the air thoroughly and fill oil in the solenoid at the start of operation to obtain good pressure control.

2 Manual Pressure Adjusting Screw

When there is no input current supplied to the valve as in the case of initial adjustment or due to an electrical fault, the valve pressure can be controlled temporarily by turning the manual adjusting screw. In normal operation, this manual adjusting screw must be retracted completely and fixed with the clocknut.

3 T-Port Back Pressure

Since this is the internal drain system, keep the valve T-port back pressure less than 25 kgf/cm² (357 psi).

4 Load capacity

Please make load capacity (outside piping capacity) more than 0.5 ℓ (0.13 gallon).

5 Oil Temperature

-20~70°C (-4°F~158°F)

6 Oil Viscosity

12~400 cSt
15~60 cSt is recommended.

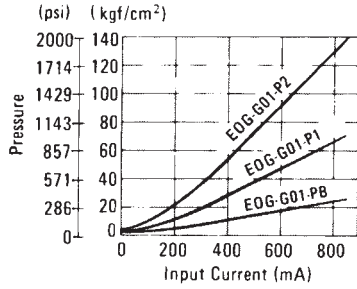
7 Gasket Dimension

ISO 4401-03-02-0-94

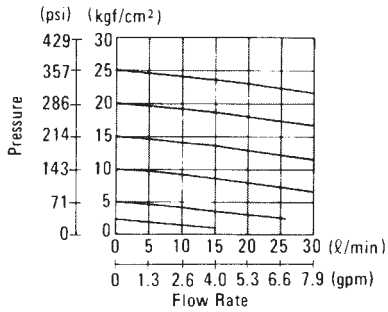
Performance Curves

Oil viscosity 32 cSt

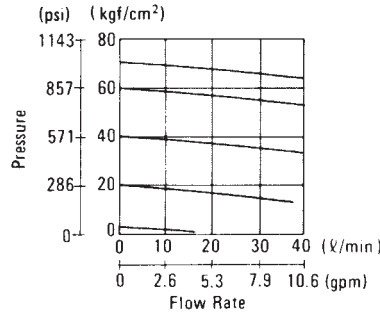
Input Current-Pressure Characteristics EOG-G01



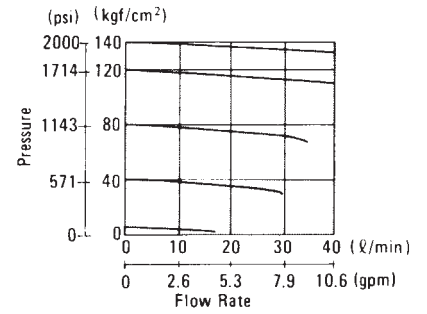
Flow Rate-Pressure Characteristics EOG-G01-PB



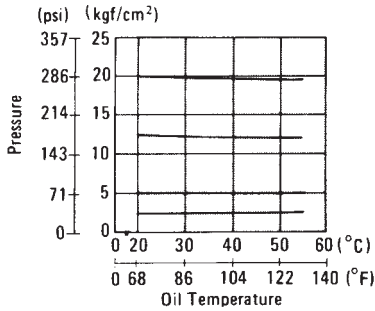
EOG-G01-P1



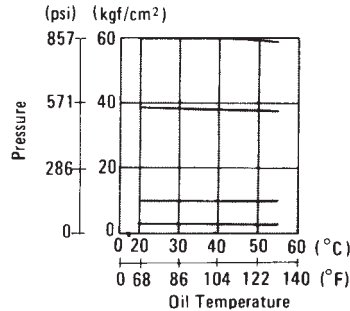
EOG-G01-P2



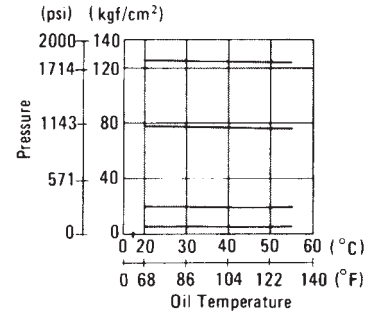
Oil Temperature Characteristics EOG-G01-PB



EOG-G01-P1

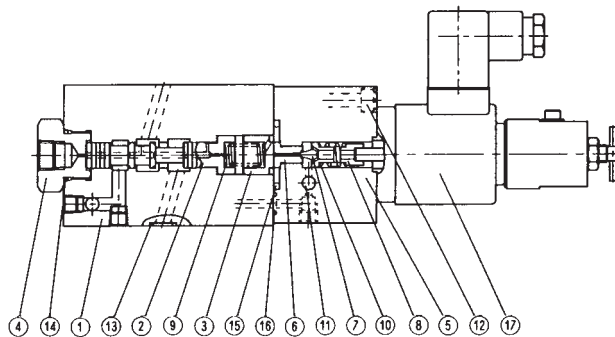


EOG-G01-P2

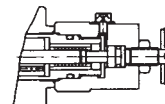


Cross Section Drawings

EOG-G01-P*-11



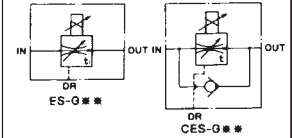
Manual adjusting section



No.	Name of part	Number of part	Qty
13	O ring	RO-P9-90	4
14	O ring	RO-P20-90	1
15	O ring	RO-G26-90	1
16	O ring	RO-P7-90	1

No.	Name of part
1	Body
2	Spool
3	Retainer
4	Plug
5	Cover
6	Seat
7	Poppet
8	Retainer
9	Spring
10	Spring
11	Orifice
12	Screw
13	O ring
14	O ring
15	O ring
16	O ring
17	Proportional solenoid

ES Series Electro-hydraulic Proportional Flow Control Valve (ES)



Features

The actuator speed can be controlled optionally according to the input current. Since the setting flow rate is affected

very little by changes of the pressure or oil temperature, high accuracy speed control is possible. This valve is most suited for acceleration and

deceleration control of the actuator and remote control.

Specifications

Item	Model	(C)ES-G02 -10/30-(F)-*12	ES-G03 -60/125-(F)-*12	(C)ES-G06 -250-*11	ES-G10 -500-(F)-*11
Max. operating pressure kgf/cm ² (psi)		210 (3000)			
Metered flow range ℓ/min (gpm)		0.3~10 (0.08~2.6)/ 0.3~30 (0.08~7.9)	1~60 (0.3~15.9)/ 1~125 (0.3~33.0)	3~250 (0.8~66.1)	5~500 (1.3~132.1)
Min. required differential pressure kgf/cm ² (psi)		10 (143) (Note 1)	13 (186) (Note 1)	15 (214) (Note 1)	20 (286) (Note 1)
Reverse free flow ℓ/min (gpm) (Only with check valve)		50 (13.2)	(125)(33.0) (Note 3)	200 (52.8)	—
Hysteresis		3% or less (Note 2)	3% or less (Note 2)	3% or less (Note 2)	3% or less (Note 2)
Rated current (mA)		800			
Coil resistance (Ω)		20 (20°C) (68°F)			
Weight kgf (lbs)		8.5 (19)	13 (29)	25 (55)	55 (121)

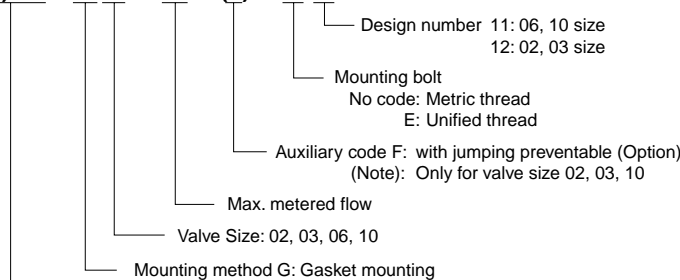
Note 1) This is the differential pressure between the valve inlet and outlet by which a good pressure compensation effect can be obtained.

Note 2) This is the hysteresis value when NACHI's amplifier is provided for the valve. (with dither)

Note 3) Although the ES-G03 does not include a built-in check valve type, a check valve auxiliary plate (Model MCF-03-D-22) is available.

Understanding Model Numbers

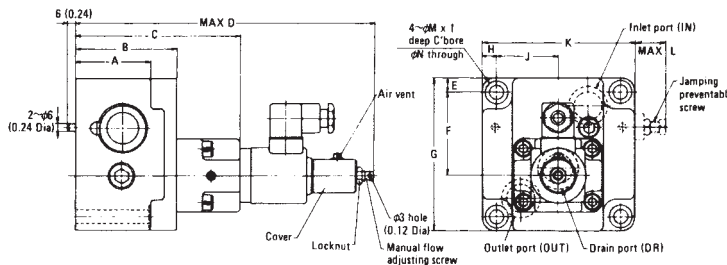
(C)ES - G02 - 30 - (F) - *12



CES: Electro-hydraulic Proportional Flow Control Valve with check valve. Only 02. and 06.
ES: Electro-hydraulic Proportional Flow Control Valve

Installation Dimensions

mm (inch)



Model	A	B	C	D	E	F	G	H	J	K	L	M	N
(C)ES-G02	66 (2.60)	80 (3.15)	132 (5.20)	242.5 (9.55)	9.7 (0.38)	48 (1.89)	102 (4.02)	9.4 (0.37)	38.1 (1.50)	95 (3.74)	23 (0.91)	14 (0.55)	8.8 (0.35)
ES-G03	61 (2.40)	82.5 (3.25)	134.5 (5.30)	245 (9.65)	11.2 (0.44)	67.8 (2.67)	124 (4.88)	11.2 (0.44)	50.8 (2.00)	124 (4.88)	26 (1.02)	17.5 (0.69)	11 (0.43)
(C)ES-G06	115 (4.53)	130 (5.12)	182 (7.17)	292.5 (11.52)	168.8 (6.66)	104.8 (4.13)	167 (6.57)	17 (0.67)	73 (2.87)	180 (7.09)	—	26 (1.02)	18 (0.71)
ES-G10	137 (5.39)	160 (6.30)	215 (8.46)	326 (12.83)	25 (0.98)	148 (5.83)	228 (8.98)	23.5 (0.93)	98.5 (3.88)	24.4 (0.96)	18 (0.71)	32 (1.26)	22 (0.87)

• Handling

1 Air Bleeding

Loosen the air vent and bleed the air thoroughly and fill oil in the solenoid at the start of operation to obtain stable flow control.

The position of the air vent be changed by turning the cover.

2 Manual Flow Adjusting Screw

When there is no input current supplies to the valve as in the case of initial adjustment or due to an electrical fault, the flow can be adjusted by turning the manual adjusting screw. In normal operation, this adjusting screw must be retracted completely and fixed by the locknut.

3 Drain Port

Connect the drain port directly to the oil tank so that the back-pressure will be 2 kgf/cm² (29 psi) or less.

4 Mounting Bolts

Grade = 12.9

Model	Bolt Size	Quantity	Tightening torque
(C)ES-G02	M8 x 80 ^z (E: 5/16-18 UNCx3-1/8")	4	200 ~ 250 kgf · cm (15 ~ 18 lbs · ft)
ES-G03	M10 x 75 ^z (E: 3/8-16 UNCx3")	4	450 ~ 550 kgf · cm (33 ~ 40 lbs · ft)
(C)ES-G06	M16 x 135 ^z (E: 5/8-11 UNCx5-5/16")	4	1900 ~ 2350 kgf · cm (138 ~ 170 lbs · ft)
ES-G06	M20 x 160 ^z (E: 3/4-10 UNCx6-5/16")	4	3700 ~ 4600 kgf · cm (268 ~ 333 lbs · ft)

5 If the distance between the flow control valve and the actuator is long (Piping volume is large.), resonance of the load system and the control valve may occur in some cases.

6 Subplate

Refer to page 8 for details.

7 Oil Temperature

-20~70°C (-4°F~158°F)

8 Oil Viscosity

12~400 cSt
15~60 cSt is recommended.

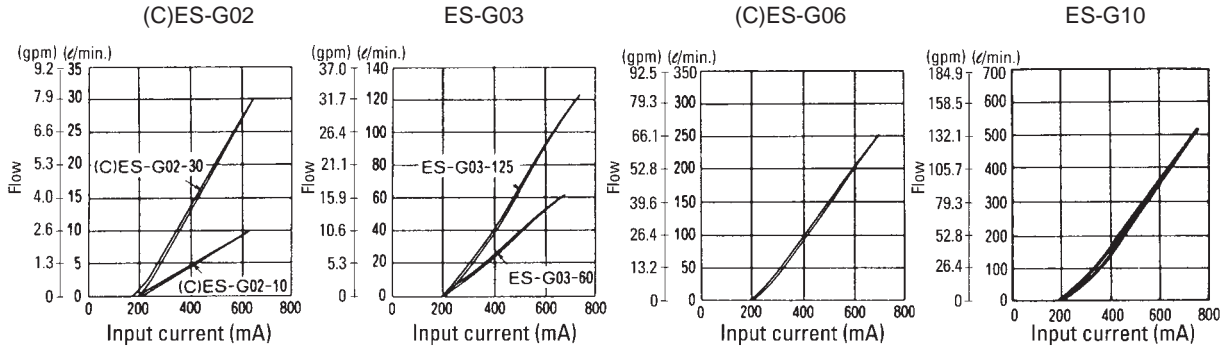
9 Gasket Dimension

(C)ES-G02 = ISO 6263-06-05-97

ES-G03 = ISO 6263-07-09-97

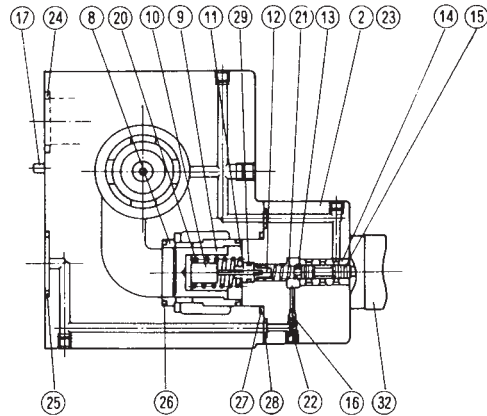
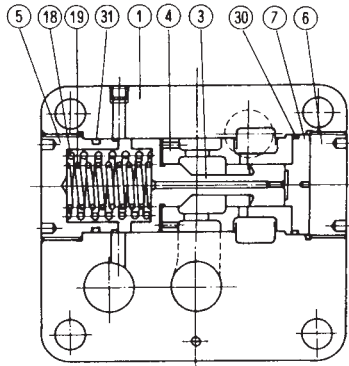
(C)ES-G06 = ISO 6263-08-13-97

Performance Curves



Cross Section Drawings

ES-G**-*-11(12)



No.	Name of part	No.	Name of part
1	Body	17	Pin
2	Cover	18	Spring
3	Piston	19	Spring
4	Sleeve	20	Spring
5	Plug	21	Spring
6	Plug	22	Spring
7	Retainer	23	Screw
8	Sleeve	24	O ring
9	Spool	25	O ring
10	Guide	26	O ring
11	Sleeve	27	O ring
12	Retainer	28	O ring
13	Retainer	29	O ring
14	Sleeve	30	O ring
15	Piston	31	O ring
16	Ball	32	Proportional solenoid

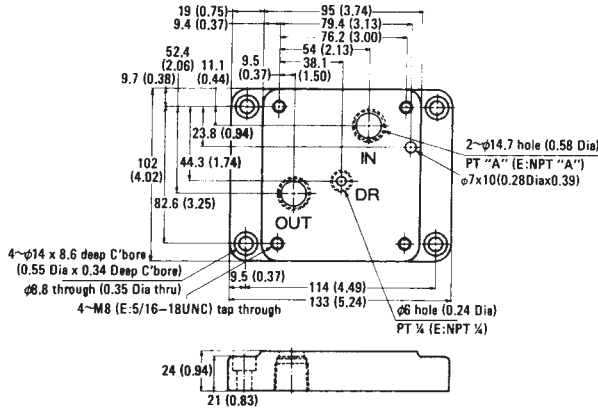
List of Seals

No.	Name of part	(C)ES-G02		ES-G03		(C)ES-G06		ES-G10	
		Number of part	Q'ty	Number of part	Q'ty	Number of part	Q'ty	Number of part	Q'ty
24	O ring	RO-P18-90	2	RO-P26-90	2	RO-G35-90	2	RO-P48-90	2
25	O ring	RO-P24-90	1	RO-P28-90	1	RO-G35-90	1	RO-P48-90	1
26	O ring	—	—	—	—	RO-G35-90	2	RO-G50-90	2
27	O ring	RO-P29-90	1	RO-P29-90	1	RO-G45-90	1	RO-G60-90	1
28	O ring	RO-P5-90	4	RO-P5-90	4	RO-P8-90	3	RO-P9-90	3
29	O ring	RO-P9-90	1	RO-P9-90	1	RO-P9-90	1	RP-P9-90	1
30	O ring	RO-P12-90	1	RO-P20-90	1	RO-G55-90	1	RO-G75-90	2
31	O ring	RO-P30-90	1	RO-P38-90	1	RO-P50-90	1	RO-G75-90	1

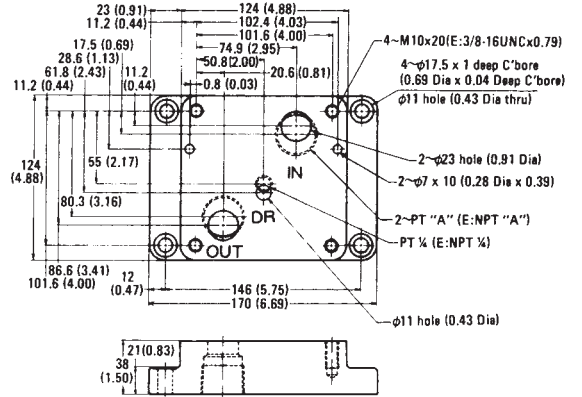
Subplate for Electro-hydraulic Proportional Flow Control Valves (ES)
MES-02*(E)10

MES-03*(E)10

Model	A
MES-02X-(E)10	3/8
MES-02Y-(E)10	1/2

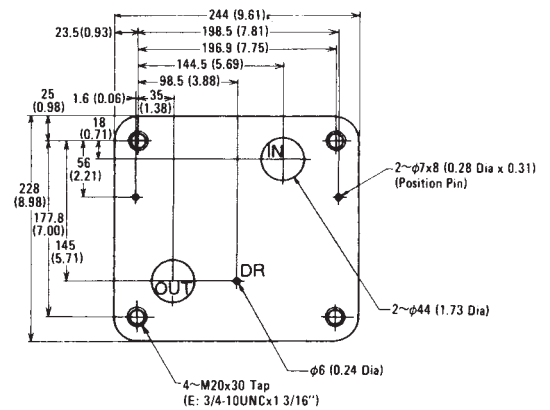
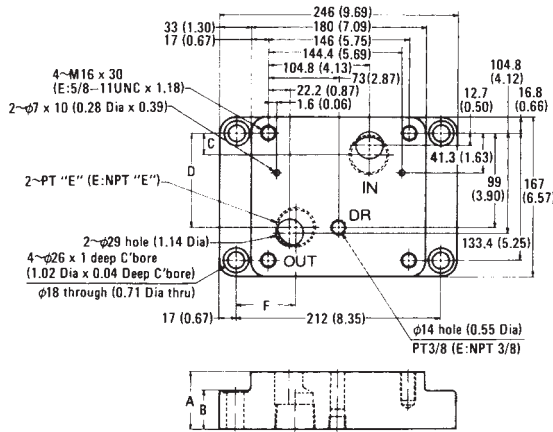


Model	A
MES-03Y-(E)10	3/4
MES-03Z-(E)10	1



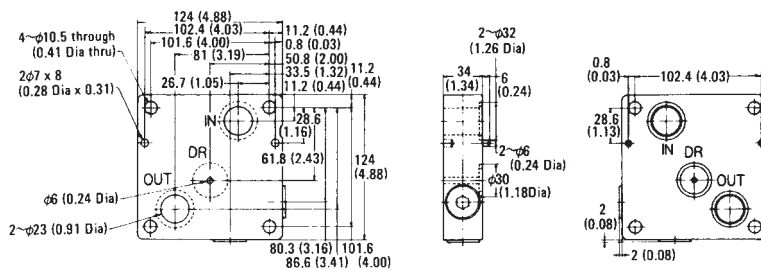
MES-06*(E)10

Gasket Mounting Dimensions
ES-G10

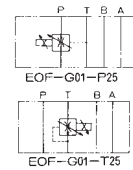


Model	mm (inch)					
	A	B	C	D	E	F
MES-06X-(E)10	45 (1.77)	25 (0.98)	16 (0.63)	104.8 (4.13)	1	55.2 (2.17)
MES-06Y-(E)10	60 (2.36)	40 (1.57)	23 (0.91)	99 (3.90)	1 1/4	62 (2.44)

Auxiliary Plate with Check Valve
MCF-03-D-22



Mounting bolts M10x110ℓ(E:3/8-16 UNCx4 3/8") 4 pcs



Features

This valve was made by modulating the combination of the Electro-Hydraulic Throttle Valve plus Pressure Compensating Valve, and has 2 types; one is the Meter-In Control Valve (EOF-G01-P) and the

other is Meter-Out Control Valve (EOF-G01-T). Since the setting flow rate is affected very little by changes of the pressure or oil temperature, this valve is most suited for electro-proportionating the

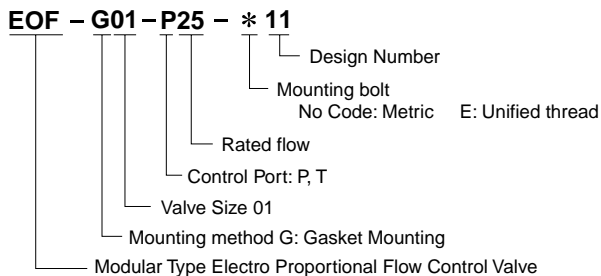
small oil hydraulic systems, such as the high speed shockless control or remote control of APC, ATC in the machine tools.

Specifications

Item	Model	EOF-G01-P/T25-*11
Max. operating pressure	kgf/cm ² (psi)	210 (3000)
Rated flow	ℓ/min (gpm)	0.3 ~ 25 (0.08 ~ 6.6)
Flow control port		EOF-G01-P: P-Port EOF-G01-T: T-Port
Allowable back-pressure of T-port	kgf/cm ² (psi)	Less than 25 (357)
Hysteresis	(%)	Less than 3 Note (1)
Resistance time	(sec)	0.05
Rated current (mA)	(mA)	800
Coil resistance	(Ω)	20 (20°C) (68°F)
Weight	kgf (lbs)	3.7 (8.2)

Note 1) This is the hysteresis value when NACHI's amplifier is provided for the valve. (with dither)

Understanding Model Numbers

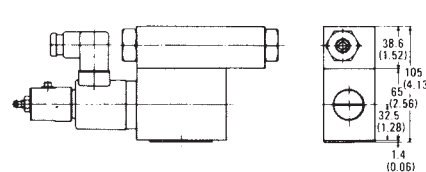
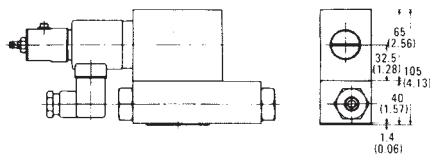
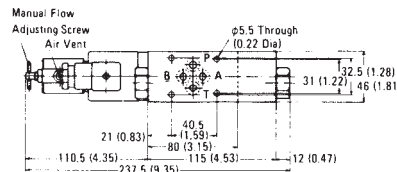
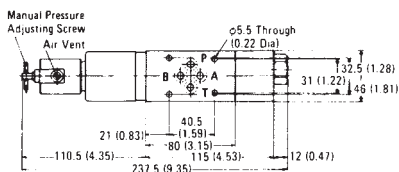


Installation Dimensions

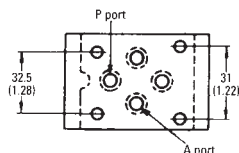
mm (inch)

EOF-G01-P25

EOF-G01-T25



O ring plate



Note: Notch side is A port.

● Handling

1 Air Bleeding

Loosen the air vent to bleed the air thoroughly and fill oil in the solenoid at the start of operation to obtain good flow control. The position of the air vent is changed by turning the cover.

2 Manual Flow Adjusting Screw

When there is no input current supplied to the valve as in the case of initial adjustment or due to an electrical fault, the flow can be adjusted by turning the Manual Adjusting Screw. In normal operation, this adjusting screw must be retracted completely and fixed by the lock-nut.

3 T-Port Back-Pressure

Since this is the internal drain system, keep the valve T-Port Back Pressure less than 25kgf/cm² (357 psi)

4 Oil Temperature

-20°C~70°C (-4°F~158°F)

5 Oil Viscosity

12~400 cSt
15~60 cSt is recommended.

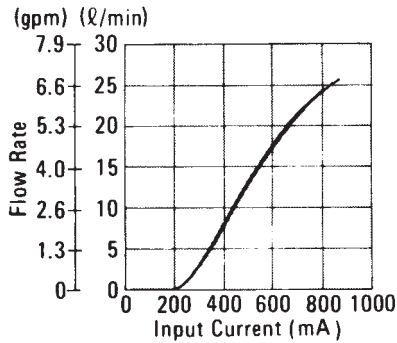
6 Gasket Dimension

ISO 4401-03-02-0-94

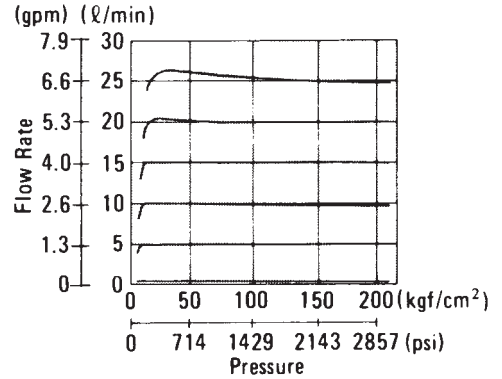
Performance Curves

Oil viscosity = 32 cSt

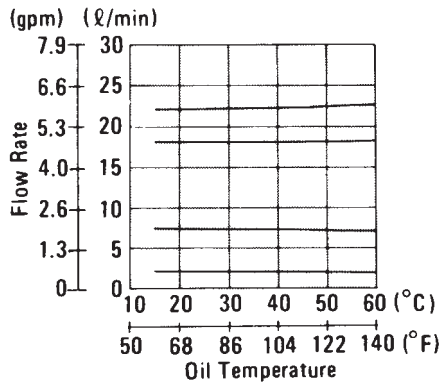
Input Current-Pressure Characteristics
EOG-G01



Pressure-Flow Rate Characteristics
EOG-G01

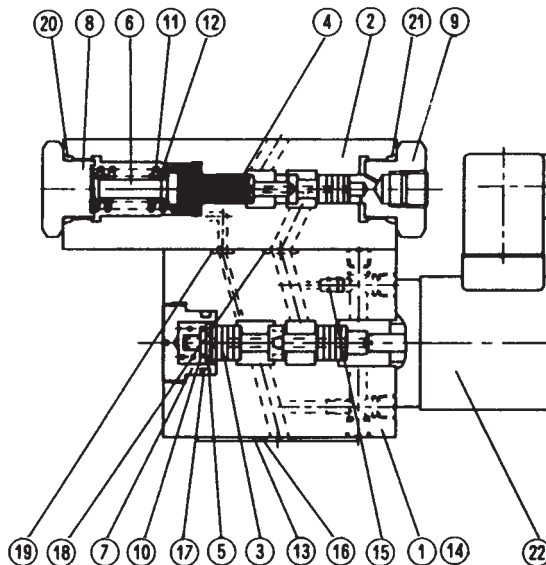


Oil Temperature Characteristics
EOG-G01-PB



Cross Section Drawings

EOF-G01-T25

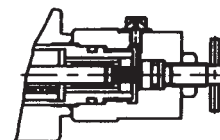


No.	Name of part
1	Body
2	Body
3	Spool
4	Piston
5	Retainer
6	Retainer
7	Plug
8	Plug
9	Plug
10	Spring
11	Spring
12	Spring
13	Plate
14	Screw
15	Screw
16	O ring
17	O ring
18	O ring
19	O ring
20	O ring
21	O ring
22	Proportional solenoid

List of Seals

No.	Name of part	Number of part	Qty
16	O ring	RO-P9-90	4
17	O ring	RO-P18-90	1
18	O ring	RO-P9-90	4
19	O ring	RO-P5-90	1
20	O ring	RO-P20-90	1
21	O ring	RO-P20-90	1

Manual adjusting section



ESD Series Electro-hydraulic Proportional Directional and Flow Control Valve (ESD)



Features

This is electro-hydraulic proportional control valve which is composed of DC proportional solenoids in addition to the conventional 4-way solenoid valve to provide both directional control and flow control functions. The available sizes are 01 size of the direct acting system and the 03 and 06 sizes of the pilot system. Directional control is performed by

applying an input current on one of the two proportional solenoids. And the flow volume is controlled by changing the magnitude of the input current.

Remote control and shockless acceleration and deceleration control are possible and the hydraulic circuit can be simplified.

Specifications

Item	Model	ESD-G01 -**-10-12	ESD-G03 -**-40-**-12 80-**-12	ESD-G06 -**-125-**-13 250-**-13
Max. operating pressure kgf/cm ² (psi)		250 (3571)		
Rated flow ℓ/min (gpm)		10/20 (2.6/5.3) (Note 1)	40/80(10.6/21.1) (Note 1)	125/250(33.0/66.1) (Note 1)
Max. flow ℓ/min (gpm)		25 (6.6) (Note 2)	100 (26.4) (Note 2)	250 (66.1) (Note 2)
Pilot pressure kgf/cm ² (psi)		—	10 (143) or more (Note 3)	
Pilot flow ℓ/min (gpm)		—	2(0.5) or more (Note 4)	5(1.3) or more (Note 4)
Allowable back-pressure of T port kgf/cm ² (psi)		25 (357)	25 (357) (Internal drain) 210 (3000) (External drain)	
Rated current (mA)		850		
Coil resistance (Ω)		20 (20°C) (68°F)		
Hysteresis (%)		5 or less (Note 5)		
Response time (sec)		0.04 (Note 6)	0.05 (Note 6)	0.1 (Note 6)
Weight kgf (lbs)		2.2 (4.9)	7 (15)	15 (33)

Note 1) This is the value when the P→A or P→B pressure drop ΔP = 10 kgf/cm² (143 psi).

Note 2) This value indicates the maximum flow between respective ports.

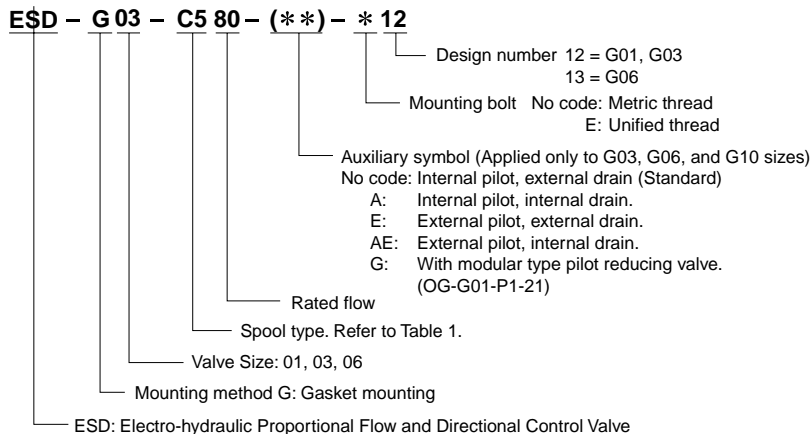
Note 3) This value indicates the difference between the pilot port and tank port or between the pilot port and drain port.

Note 4) This is the value when the response time from zero to rated current is assumed to be 0.1 sec. (0.3 sec. in case of G10 size)

Note 5) This is the hysteresis when NACHI's amplifier is provided for the valve.

Note 6) Response time is measured at 140 kgf/cm² (2000 psi), Oil temp. 40°C (104°C), Oil Viscosity 40cSt.

Understanding Model Numbers



Spool Type	Hydraulic Symbol		
	ESD-G01	ESD-G03	ESD-G06
C5			
C6S			

Note 1) Only in case of ESD-G03, the SOL symbol will be as indicated in ().

NOTE: ESD SERIES VALVES ARE METER IN / METER OUR DESIGN.

● Handling

1 Air Bleeding

Loosen the air vent and bleed the air thoroughly at the start of operation to obtain stable control operation.

2 T-port Piping

Provide piping so that the T-port (Pilot valve T-port in case of G03, G06) is always full of oil.

3 Manual Adjusting Screw

When there is no input current supplied to the valve in the case of initial adjustment or due to an electrical fault, the valve can be operated temporarily by turning the manual adjusting screw. In normal operation, the manual adjusting screw must be completely retracted to its original position.

4 Mounting Position of Valve

Mount the valve in proper position so that the spool axis will be horizontal.

5 Combination with Pressure Compensation Valve

Combined use with a pressure compensation valve (option) is recommended when flow control of higher accuracy is required or when it is to be used at high pressure. NACHI'S pressure reducing type pressure compensation valves listed in the page PV-20 are available for this purpose.

6 Pilot Pressure (ESD-G03, G06)

When the pilot pressure exceeds 90 kgf/cm² (1286 psi), use the modular type P-port pressure reducing valve (OG-G01-P1-21), and set pressure 20 kgf/cm² (286 psi).

7 Provide a counter balance valve in case of a system that requires a large brake force for deceleration or system which uses a vertical type cylinder.

8 Mounting Bolt

Valve Model	Bolt Size	Quantity
ESD-G01	M5x45ℓ (E: 10-24UNCx1 3/4")	4
ESD-G03	M6x35ℓ (E: 1/4-20UNCx1 3/8")	4
ESD-G06	M12x60ℓ (E: 1/2-13UNCx2 3/8")	6

9 Tightening Torque

Valve Model	Tightening Torque
ESD-G01	50 ~ 70 kgf-cm (3.6 ~ 5.1 lbs-ft)
ESD-G03	100 ~ 130 kgf-cm (7.2 ~ 9.4 lbs-ft)
ESD-G06	600 ~ 700 kgf-cm (43 ~ 51 lbs-ft)

10 Please maintain oil cleanliness class equal to NAS 9 or better.

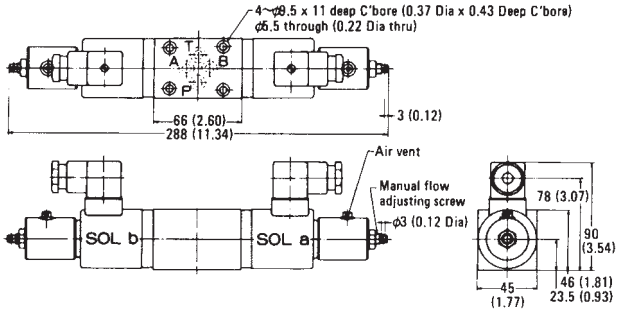
11 Oil Temperature
-20°C~70°C (-4°F~158°F)

12 Oil Viscosity
12~400 cSt
15~60 cSt is recommended.

Installation Dimensions

mm (inch)

ESD-G01



Gasket dimension

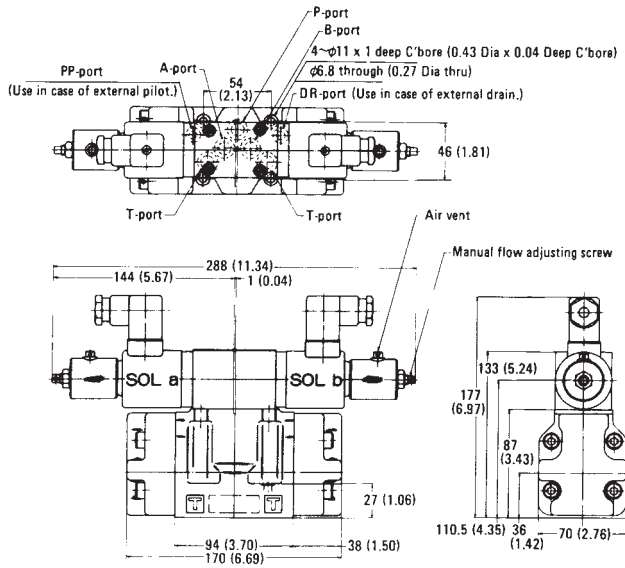
ESD-G01 = ISO 4401-03-02-0-94

ESD-G03 = ISO 4401-05-0-94

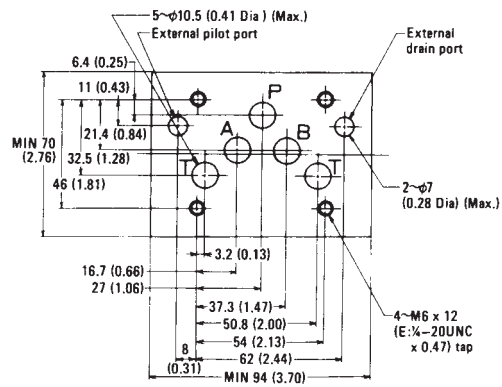
ESD-G06 = ISO 4401-08-07-0-94

Refer to MSA-01Y-(E)10 on page 3 for details of subplate.

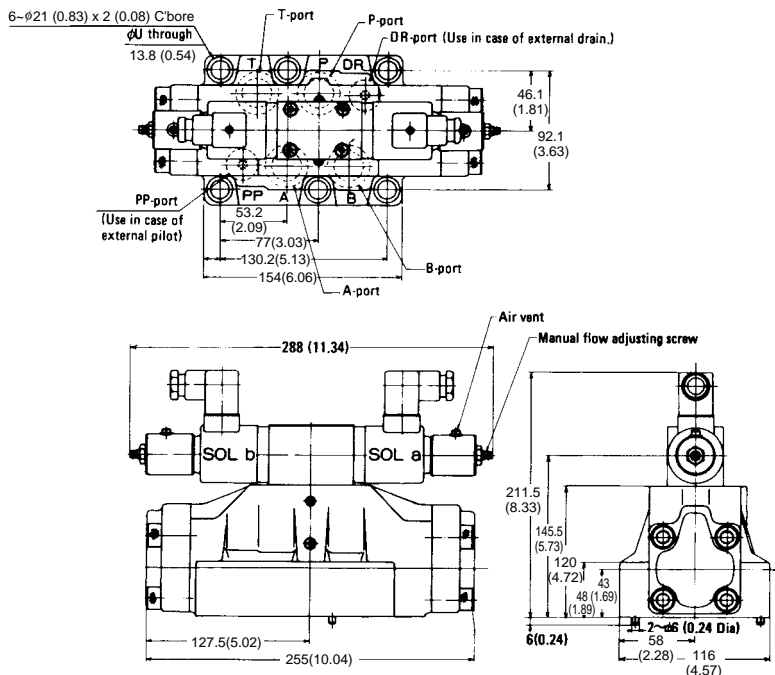
ESD-G03



ESD-G03 Mounting Gasket Dimensions



ESD-G06



Performance Curves

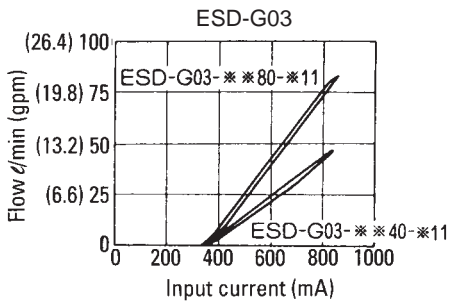
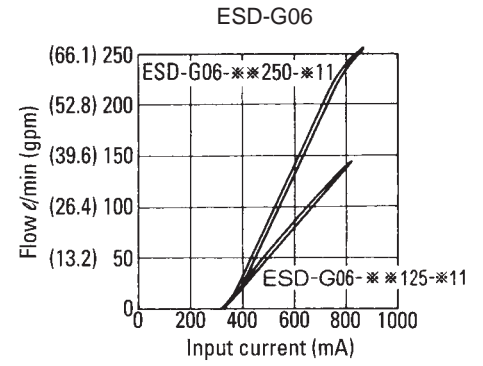
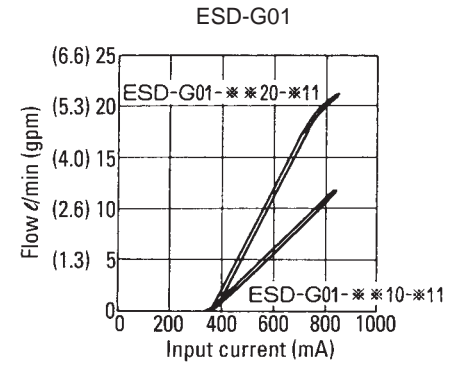
Oil viscosity = 32 cSt

The input current - flow rate characteristics are the characteristics when the control valve pressure drop ΔP of P→A or P→B is 10 kgf/cm² (143 psi) ($\Delta P = 10 \text{ kgf/cm}^2$ (143 psi)). The valve differential pressure represent-

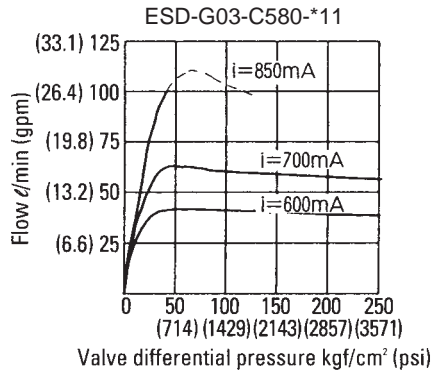
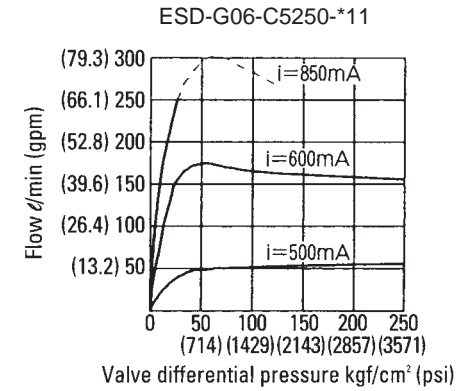
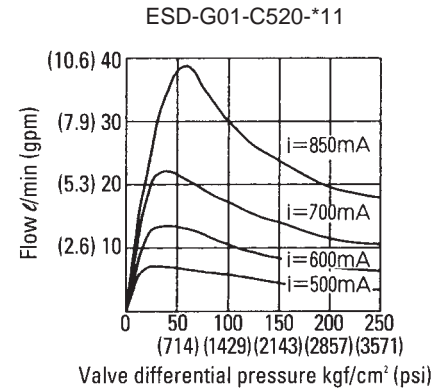
ed by the abscissa in the pressure - flow performance curve indicates the overall pressure drop of the control valve (pressure drop of B-A-B-T). The flow rate is measured by an oil motor.

Input Current -
Flow Rate Characteristics

NOTE: ESD VALVE SERIES
ARE METER IN/
METER OUT
DESIGN

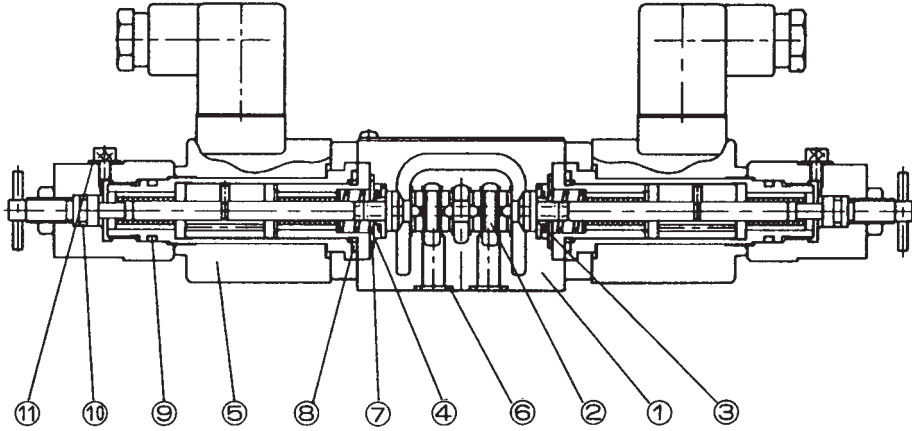


Pressure -
Flow Rate Characteristics



Cross Section Drawings

ESD-G01-****-12

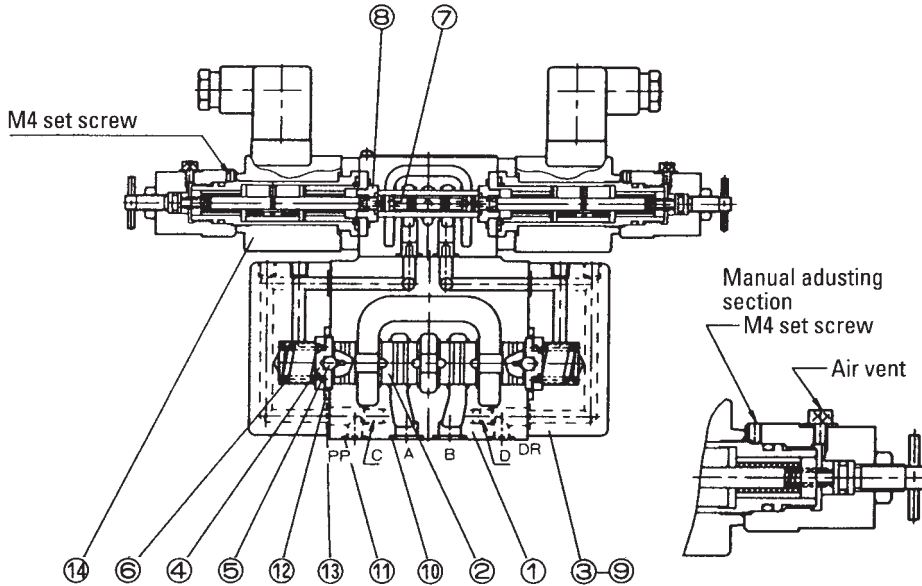


No.	Name of part
1	Body
2	Spool
3	Retainer
4	Spring
5	Coil
6	O ring
7	O ring
8	O ring
9	O ring
10	O ring
11	Seal

List of Seals

No.	Name of part	Number of part	Qty
6	O ring	RO-P9-90	4
7	O ring	ROA-019-90	2
8	O ring	RO-P22-90	2
9	O ring	RO-P16-90	2
10	O ring	RO-P7-90	2
11	Seal	DS-1-4	2

ESD-G03-****-(**)-12



No.	Name of part
1	Body
2	Spool
3	Cover
4	Retainer
5	Ball
6	Spring
7	Pilot spool
8	Stopper
9	Screw
10	O ring
11	O ring
12	O ring
13	O ring
14	Proportional solenoid

List of Seals

No.	Name of part	Number of part	Qty
10	O ring	RO-P12-90	5
11	O ring	RO-09-90	2
12	O ring	RO-P28-90	2
13	O ring	RO-P9-90	6

Note 1). There is a set screw on coil cover. Please loosen it when you change position of air vent.

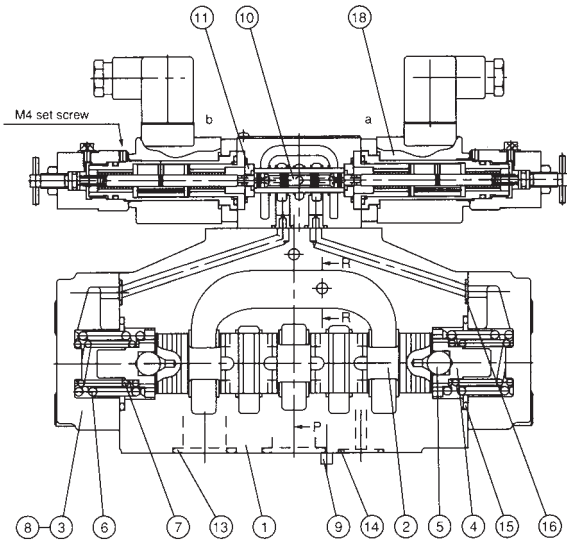
2). Method of modifying pilot of drain (Standard = internal pilot, external drain)

① To modify the internal pilot to the external one, remove the hexagonal socket plug from PP and mount it on C.

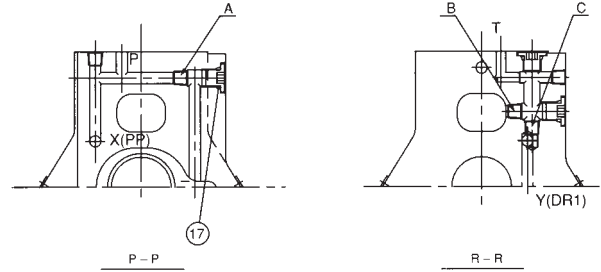
② To modify the external drain to the internal drain type, remove the hexagonal socket head plug from D and mount it on DR.

Cross Section Drawing

ESD-G06-****-13



Note) There is a set screw on coil cover. Please loosen it when you change position of air vent.



Note) Method of modifying pilot or drain (Standard = internal pilot, external drain.)

1. To modify the external pilot type to the internal one, remove the hexagonal socket head plug from (A).
2. To modify the internal pilot type to the external one, mount the hexagonal socket head plug on (A).
3. To modify the external drain type to the internal drain type, remove the hexagonal socket head plug from (B) and mount it on (C).
4. To modify the internal drain type to the external drain type, remove the hexagonal socket head plug from (C) and mount it on (B).

No.	Name of part	Number of part	
		ESD-G06-**-13	Qty
13	O ring	RO-P28-90	4
14	O ring	RO-P20-90	2
15	O ring	RO-G45-90	2
16	O ring	RO-P10-90	2
17	O ring	RO-P8-90	3

No.	Name of part	No.	Name of part
1	Body	10	Pin
2	Spool	11	Pilot spool
3	Cover	12	Stopper
4	Retainer	13	O ring
5	Ball	14	O ring
6	Stopper	15	O ring
7	Spring	16	O ring
8	Spirng	17	O ring
9	Screw	18	Proportional solenoid

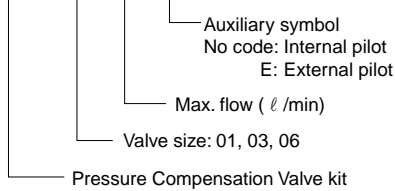
ESD Series Pressure Compensation Valve Kit

Specifications

Item	Model	JHF-01027	JHF-03040(E)	JHF-03080(E)	JHF-06170(E)
Max. operating pressure	kgf/cm ² (psi)	210 (3000)	250 (3571)	250 (3571)	210 (3000)
Differential pressure for compensation	kgf/cm ² (psi)	10 (143)	6 (86)	14 (200)	8 (114)
Max. flow	ℓ/min(gpm)	27 (7.1)	40 (10.6)	80 (21.2)	170 (44.9)
Weight	kgf (lbs)	1.5 (3.3)	4.7 (10.4)	5.0 (11.0)	12 (26.5)

Understanding Model Numbers

JHF - 03 040 (E)

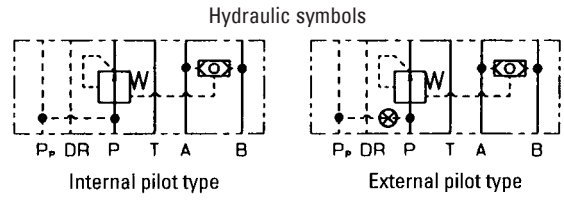
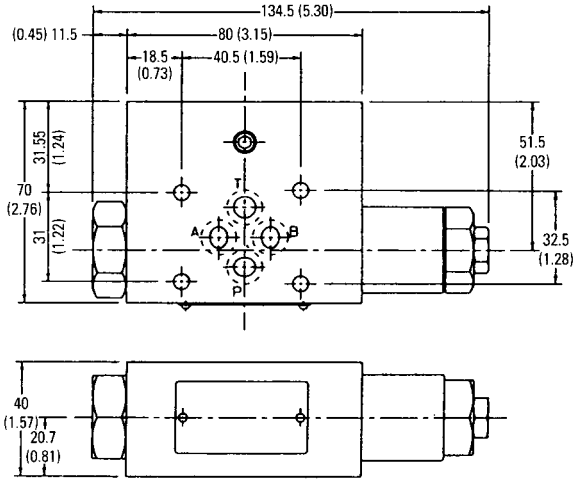


● Handling

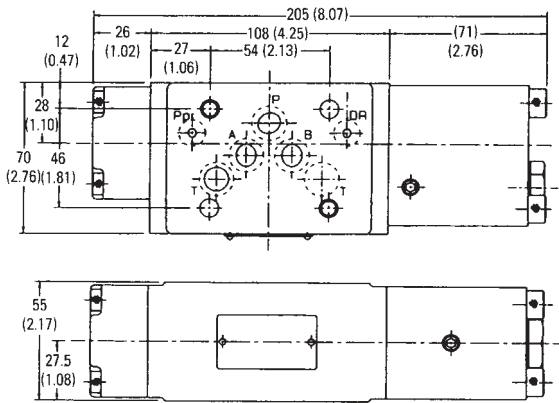
- 1 Use external pilot style ESD valve for this Pressure Compensation Valve kit.
- 2 Internal pilot type Pressure Compensation Valve Kit is used when there is no pilot port on manifold, and you have to supply pilot flow from P port.
- 3 External pilot type Pressure Compensation Valve kit is used when there is external pilot port on manifold.

Cross Section Drawings

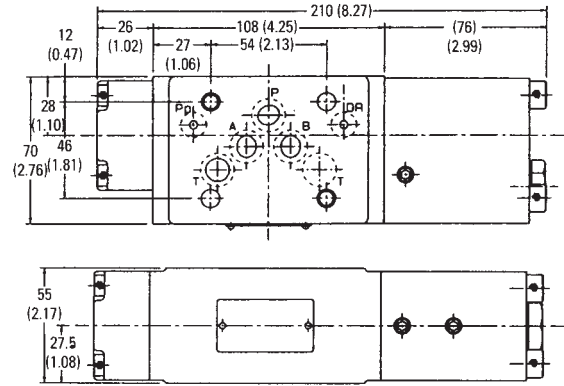
JHF-01027



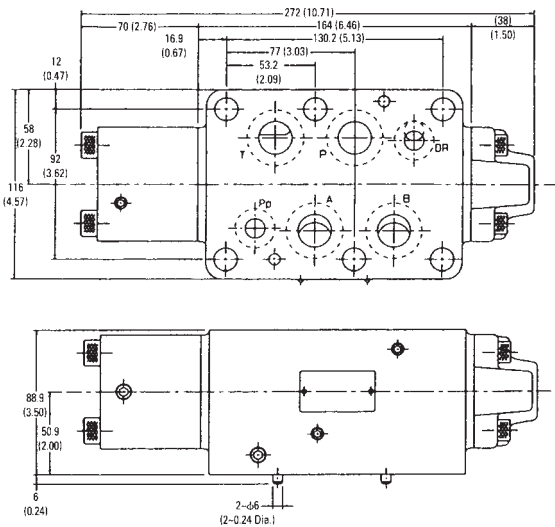
JHF-03040(E)



JHF-03080(E)



JHF-06170(E)





Features

These are compact and multi-function power amplifiers using high-technology of HIC (Hybrid IC).

- Compact and Space Saving
Less than 1/2 of old model.
- High Reliability
All functions are concentrated in a printed circuit board without any internal wiring.
- Multi function
 - This amplifier can operate 2 valves at a time.
 - Controller has also amplifier function. (EDC-PC6-AWZ-D2-20)
 - Dither frequency is adjustable.

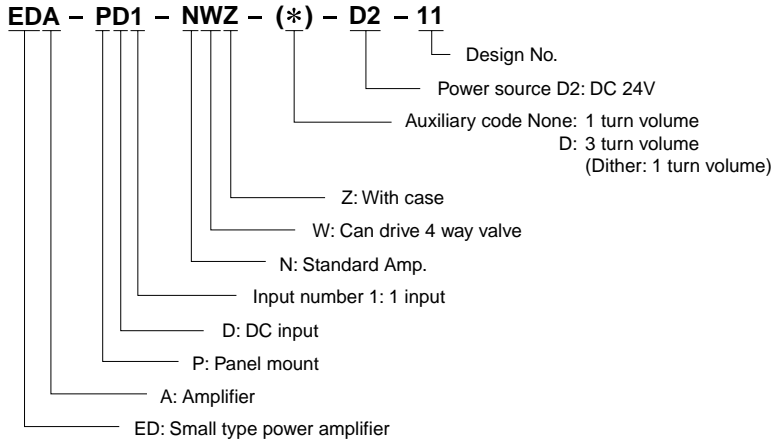
Specifications

Items	Models	EDA-PD1-NWZ-D2-11	EDC-PC6-AWZ-D2-20
Function		Amp. type	Amp. / Controller type
Input Number		1 DC input	2 DC input / 6 channel input
Max. output current		900mA (20Ω solenoid)	
Input voltage		-10 ~ +10VDC	0 ~ +10VDC
Input impedance		50kΩ	50kΩ
External setting variable resistor		10kΩ	10kΩ
Driven solenoid		SOL a, SOL b	SOL 1, SOL 2
Zero point adjust (NULL)		0 ~ 900mA	
Gain adjust (GAIN)		0 ~ $\frac{900mA}{2.5V}$	0 ~ $\frac{900mA}{2.5V}$
External supply power		+5VDC (5mA) -5VDC (5mA)	+5VDC (10mA)
Time lag (LAG)		0 ~ 2 sec	
Dither frequency (DITHER)		80 ~ 250 Hz	
Electric power source		DC24V (DC24 ~ 30V)	
Power consumption		30VA	60VA
Permissible ambient temperature		0 ~ 50°C	
Temperature drift		0.2mA/°C	
Weight		0.3kg (0.7 lbs)	0.4kg (0.9 lbs)
Driven valve		Pressure / Flow / Directional and flow control valve	

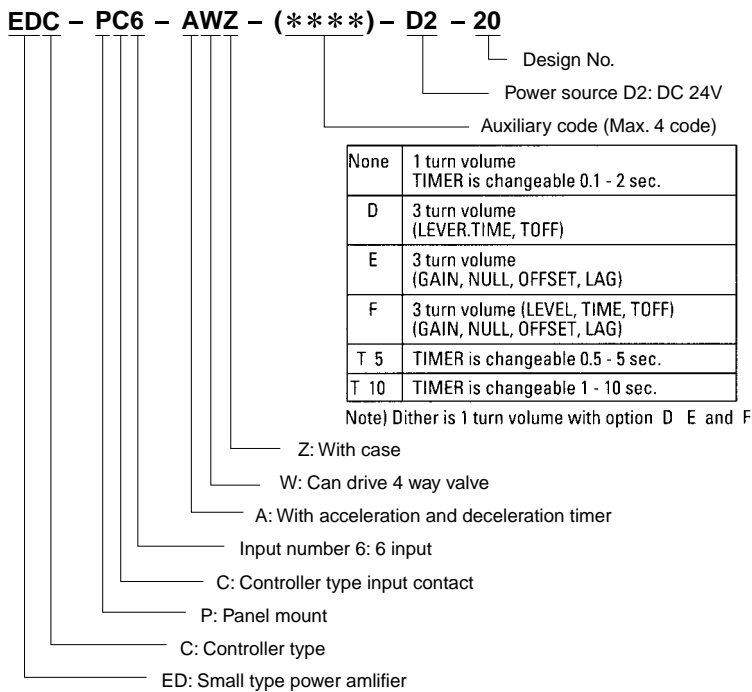
- Handling
 - 1 Select an installation place where the power amplifier will not be exposed to high temperature or high humidity and where there is minimal vibration and dust.
 - 2 Use shielded wire for the analog signal and valve output signal lines.
 - 3 Luminous diode, which changes the brightness according to the volume of output current, is installed.

Understanding Model Numbers

(1) Amplifier Type



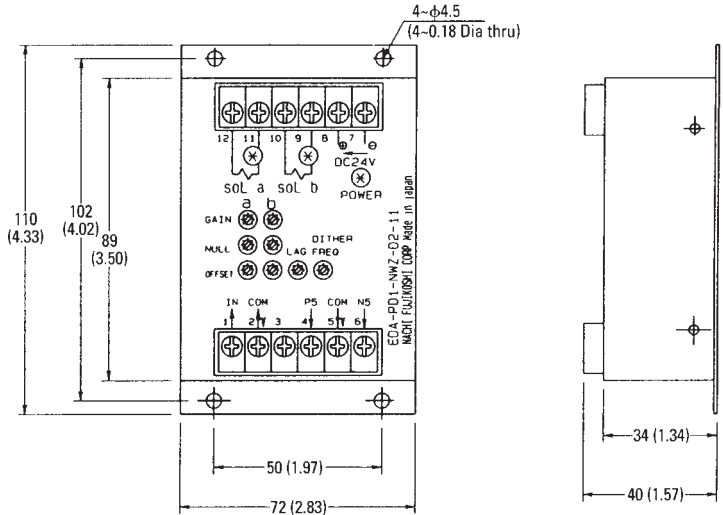
(2) Amplifier/Controller type



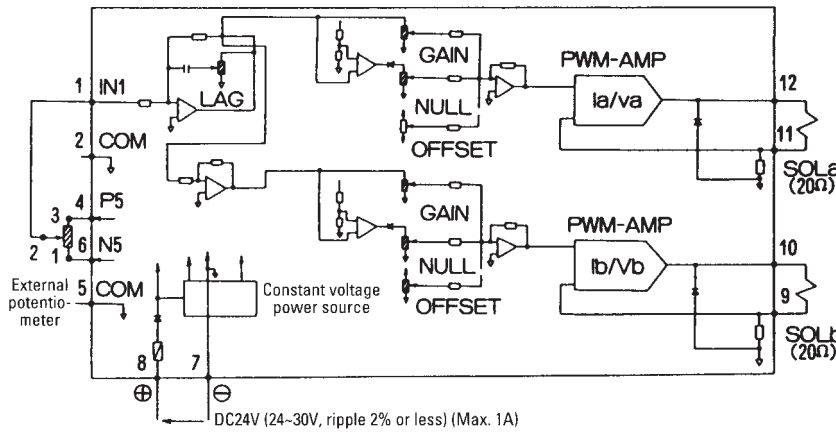
Installation Dimensions

EDA-PD1-NWZ-D2-11

No.	Terminal	No.	Terminal
1	Input signal terminal IN 1	7	- DC24V
2	Input signal terminal COM	8	+ DC24V
3		9	Output terminal for valve SOL B
4	Power supply for external use P5	10	
5	Input signal terminal COM	11	Output terminal for valve SOL a
6	Power supply for external use N5	12	

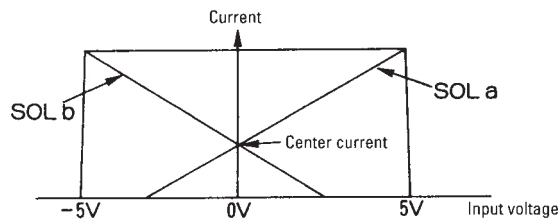


Block Diagram



Example of directions

1. Push-Pull drive method for special proportional valve.
 - a) Over-lap type ESD valve ESD-G01-C5₂₀¹⁰-6333B...300mA (Center current)
 - b) Zero-lap type ESD valve ESD-G01-C5₂₀¹⁰-6586A...200A (Center current)



Adjusting method:

1. Turn the volume of NULL, GAIN, OFFSET and LAG (total 7 volumes) to the end of counterclockwise.
2. Adjust output current by using OFFSET volume as below. (Terminal No. 1 and No. 2 must be free.)
 - { Sol. a...300mA (200mA)
 - { Sol. b...300mA (200mA)
3. Supply +5V to terminal (connect No. 1 and No. 4 terminal), and adjust the output current by using Sol. a GAIN volume as below.
 - { Sol. a...850mA
 - { Sol. b...300mA (Sol. b current does not change)
4. Supply -5V to No. 1 terminal (connect No. 1 and No. 6 terminal), and adjust the output current by using Sol. b GAIN volume as

- Amplifier supplies output to Sol. a when input voltage is plus, and supplies output to Sol. b when input voltage is minus. Amplifier can drive only 1 coil at a time.
- Push-pull drive is available.
- Measuring method for the current of solenoid coil:
 - Measure the voltage between No. 5 and No. 11 terminal for Sol. a.
 - Measure the voltage between No. 5 and No. 9 terminal for Sol. b.
 - The current is 1A at 0.5V as the resistance for current detecting is 0.5Ω.
 - Use tester with input impedance of 1MΩ or more.
- If only Sol. a is used, connect No. 1 terminal of external potentiometer to No. 2 terminal, and make the input 0~5V. (ex. ER, ES valve)
- By Push-Pull control, the response at zero point can be improved by driving Sol. a and Sol. b one at a time.

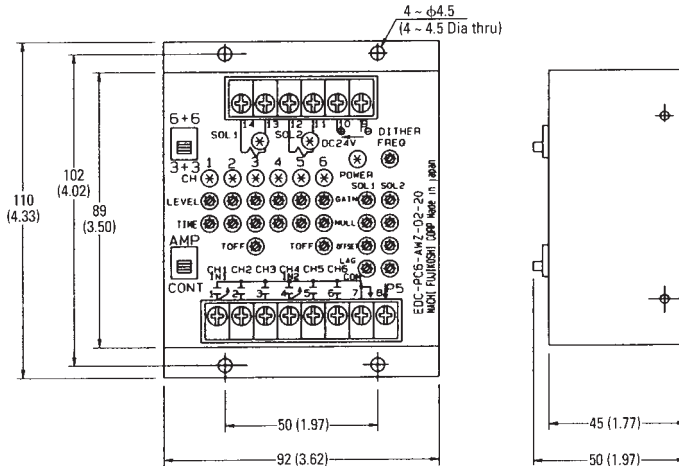
below

- { Sol. a...0mA
- { Sol. b...850mA

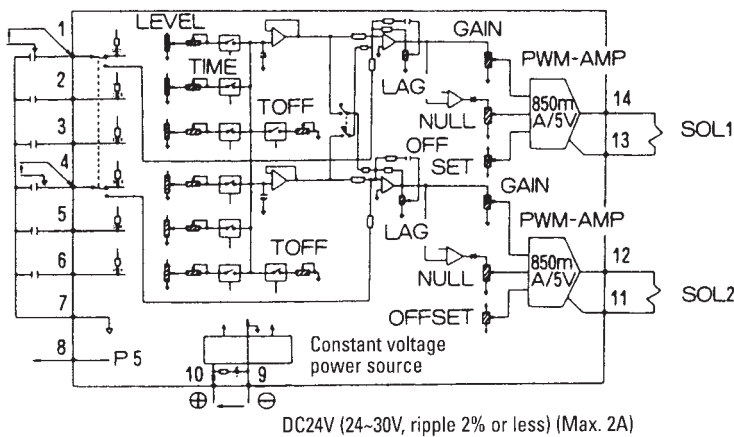
All settings are completed by this operation.

- LAG, NULL are not needed to adjust.

No.	Terminal	No.	Terminal
1	CH1 Selection terminal Input signal terminal	7	COM
2	CH2 Selection terminal	8	Power supply for external use P5
3	CH3 Selection terminal	9	- DC24V
4	CH4 Selection terminal Input signal terminal	10	+ DC24V
5	CH5 Selection terminal	11	Output terminal for valve
6	CH6 Selection terminal	12	SOL 2
		13	Output terminal for valve
		14	SOL 1



Block Diagram



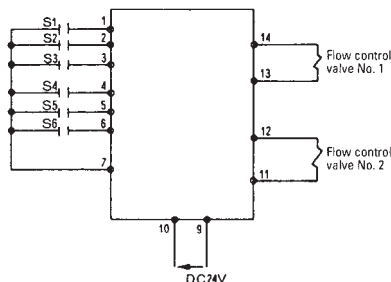
- Sol. 1 and Sol. 2 can be controlled individually one at a time.
- Measuring method for the current of solenoid coil:
Measure the voltage between No. 7 and No. 13 terminal for Sol. 1. Measure the voltage between No. 7 and No. 11 terminal for Sol. 2. The current is 1A at 0.5V as the resistance for current detecting 0.5Ω. Use tester with input impedance of 1MΩ or more.

- Synchronized control of two flow control valves (three speeds):
As shown left, while turning on CH1 and CH4, control the speed of No. 1 valve with the LEVEL resistor of CH1 and control the speed of No. 2 valve with the LEVEL resistor CH4. Then, set the resistor so that the speed of No. 1 valve is equal to that of No. 2 valve. Combining CH1 to CH3 and CH4 to CH6 allows synchronized control in three speeds.

Example of Directions

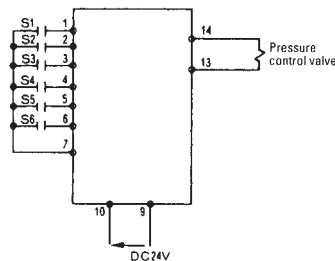
1) Switch positions

- CONT
- 3 + 3



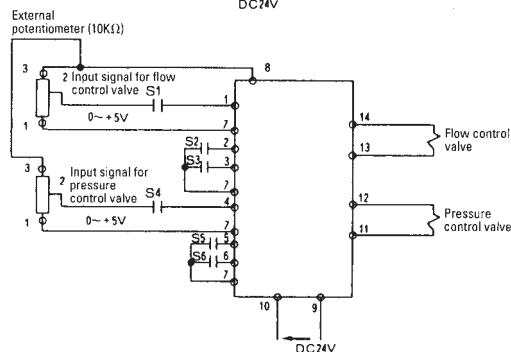
2) Switch positions

- CONT
- 6 + 6



3) Switch positions

- AMP
- 3 + 3



- 6-CH controller mode with one pressure control valve:
As shown left, the module controller can be used as the 6-CH controller for one pressure control valve. Use the OFFSET resistor to set minimum pressure. The NULL resistor cannot be set when channels are not selected.

- Two output amplifiers for simultaneous pressure and flow control of power match system:
As shown left, input voltage of 0 to 5V is added to the sum of the output from CH2 or CH3, and output to flow control valve. Input voltage of 0 to 5V is added to the sum of the output from CH5 or CH6, and output to pressure control valve.