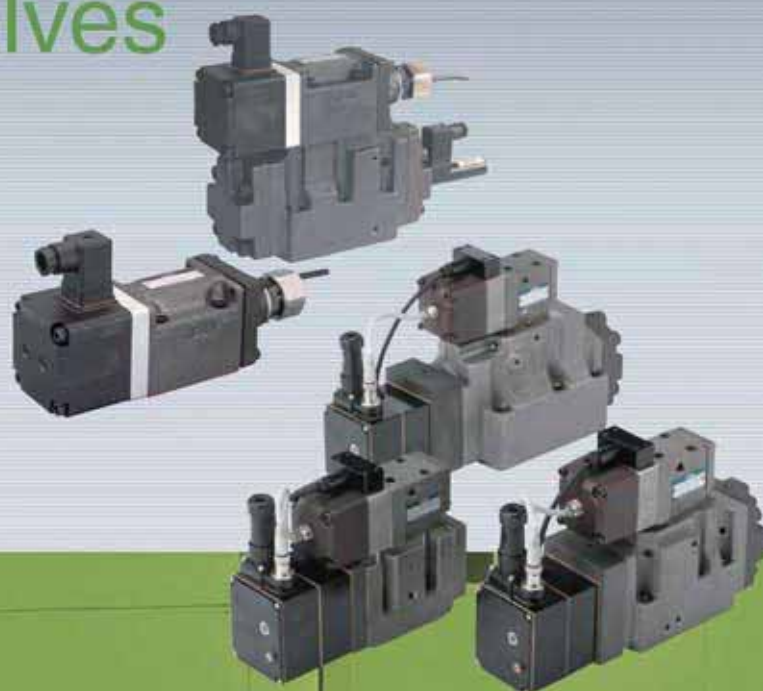


High-Speed Linear Servo Valves

OBE (On-Board Electronic) Type Linear Servo Valves



Hydraulic Fluids

Fluids Types

The fluid types below can be used for Yuken's linear servo valves.

Petroleum-Based Fluids	Use fluids equivalent to ISO VG 32 or 46.
Synthetic Fluids	Use phosphate ester-based or fatty acid ester-based fluids. Specify a valve model number with "F-" at its beginning if you wish to use valves with phosphate ester-based fluids; such valves require special seals (fluorinated rubber).
Water-Based Fluids	Use water-glycol fluids.

Note) Consult us for using fluids other than the above.

Recommended Fluid Viscosity and Temperature

To use the fluids above, ensure that the following conditions of fluid viscosity and temperature are met.

Viscosity	Fluid Temperature
15~400 mm ² /s	-15~+60°C

Contamination Control

Keep the hydraulic fluid clean and provide a line filter so that contamination of the fluid will not obstruct proper valve operation. To assure long life of linear servo valves, it is recommended to improve fluid cleanliness before use.

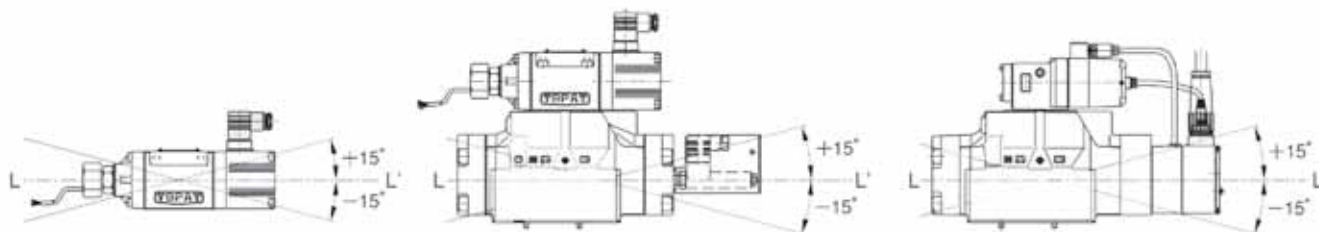
Contamination Level	Line Filter
NAS1638 Class 10 ISO4406-21/19/15	Absolute 20 µm

Instructions

Mounting

Mount the valve with the angle of the axis line L-L' within about $\pm 15^\circ$ from the horizontal plane, as shown below.

The valve must be mounted in such a way that the spool axis direction is not matched with the main vibration direction; otherwise, an external force may cause the spool to malfunction.



■ Installation Requirements

Avoid installing the valve in a strong magnetic field. Especially, the position sensor for detecting the spool position is affected by the magnetic field. Keep the valve away from devices that generate magnetic fields, such as solenoid operated directional valves. At the same time, a magnetic field generated by the valve may affect other devices; any device vulnerable to magnetic fields must not be installed near the valve.

■ Drain Piping (LSVG: Y Port/LSVHG: DR Port)

LSVG/LSVHG series high-speed linear servo valves have a diaphragm mechanism that keeps the inside of the linear motor dry in order to meet the requirements below.

1) Keeping response characteristics almost unchanged when fluid viscosity varies (the response characteristics of existing proportional/servo valves vary with changes in fluid viscosity).

2) Protecting moving coils from iron powder or moisture in hydraulic fluids.

A special drain port is provided to define the upper limit of pressure for the diaphragm, if any, so that the valve performance is maintained. For valve installation, provide a drain line by taking into account the following piping considerations.

- ① Back pressure at the drain port should be 0.05 MPa or less and not be a negative pressure.
- ② The drain line should be open to the air (the line end must not contact the fluid).
- ★ There are two types of pilot valves available: a dry type good in response characteristics and a wet type that eliminates drain (DR) port to improve usability.

■ Cable Length for I/O Signals

1) High-speed linear servo valves (amplifier-separated type)

Use a cable of up to 30 m length.

Consult us for customized products (Model: LSVG-03/LSVHG-04, 06) that allow the use of a cable of up to 200 m length.

2) OBE (on-board electronic) type linear servo valves

The maximum cable length depends on the I/O signal type. See the table below.

I/O Signal Type	Valve Model Number	Max. Cable Length
±10 V	LSVHG-**-EH-**-**-A*/D*-10	50 m*
4~20 mA	LSVHG-**-EH-**-**-B*/E*-10	300 m
±10 mA	LSVHG-**-EH-**-**-C*/F*-10	

★ Consult us when the cable length exceeds 50 m.

For both valve types in 1) and 2), pay attention to ensure that the power cable resistance is within 1 Ω and is as low as possible.

■ Electrical Failure and Safety Measures for Startup

Provide a separate safety circuit (e.g. uninterruptible power supply), if required, to securely continue/stop the operation of the hydraulic actuator for safety in case of electrical failure (power failure, cable disconnection, etc.) or upon startup.

■ Supply Pressure

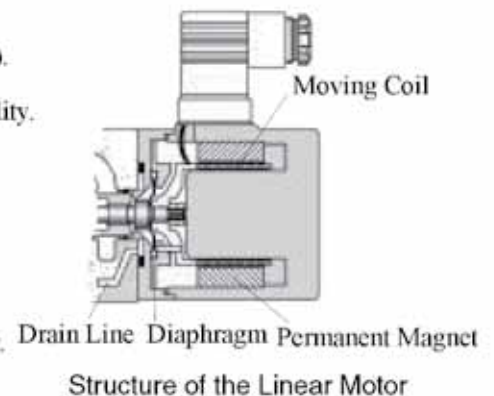
The servo valves are designed to operate at constant supply pressure; variations in supply pressure should be avoided as much as possible. Especially, for systems requiring high accuracy, the circuit must be designed to keep the supply pressure constant. Ideally, an accumulator will be installed in the supply pressure line near the servo valve to avoid supply pressure fluctuations during pressure transients.

■ Pressure at the Return Port

The return port of the servo valve may be subject to a considerably high pressure depending on the circuit type. However, it should be used at atmospheric pressure or similar pressure as much as possible. The pressure at the return port should be equal to or below actual supply pressure.

■ Disassembly/Reassembly

Linear servo valves consist of high precision components. You are prohibited from disassembling or reassembling the valves; otherwise, the designed valve performance may be degraded.



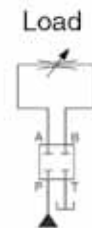
Valve Pressure Difference/Load Pressure Difference

This catalog uses two terms related to pressure differences: "valve pressure difference" (used for the range of flow control and no-load flow characteristics) and "load pressure difference" (used for load flow characteristics). The terms are described below.

Valve Pressure Difference

Suppose that, in the circuit shown on the right, the fluid flows from P to A and from B to T. In this case, the sum of the pressure difference between P and A and that between B and T is the pressure difference of this valve. For this four-way valve, the valve pressure difference " ΔP " is:

$$\text{Valve Pressure Difference} = [(\text{Pres. at P}) - (\text{Pres. at A})] + [(\text{Pres. at B}) - (\text{Pres. at T})]$$



In relation to the flow rate, an increase in the flow through the valve with a constant valve opening leads to an increase in the valve pressure difference due to increased flow resistance at the control part.

Load Pressure Difference

In the circuit above, the absolute pressure difference between A and B is the load pressure difference.

$$\text{Load Pressure Difference} = |(\text{Pres. at A}) - (\text{Pres. at B})|$$

If the resistance of piping, etc. is ignored, the difference between the supply pressure and the load pressure difference is the valve pressure difference of the linear servo valve. Therefore, a smaller load pressure difference means a larger valve pressure difference, allowing increasing the flow rate through the valve.

Flow Rate

In this catalog, the rated flow tolerance is $\pm 10\%$.

The flow rate depends on the viscosity and specific gravity of each hydraulic fluid.

- Multiply each viscosity by the corresponding coefficient in the table below.

Viscosity mm^2/s	15	20	30	40	50	60	70	80	90	100
Coefficient	1.19	1.11	1.00	0.93	0.88	0.84	0.81	0.78	0.76	0.74

- Use the following formula to obtain the flow rate corresponding to a specific gravity.

$$Q' = Q \sqrt{(0.85/G')}$$

- Use the following formula to obtain the relationship between the flow rate and the pressure for a servo valve.

$$Q_x = Q_{\text{rate}} \sqrt{\frac{\Delta P_x}{7}}$$

where Q_x : Flow rate to be determined;
 Q_{rate} : Rated flow rate (at $\Delta P = 7 \text{ MPa}$); and
 ΔP_x : Valve pressure difference in the actual circuit.

Direct type High-Speed Linear Servo Valves

These valves use a small, high-power linear motor as actuator and have an extremely simple structure that connects the motor moving coil, the spool, and the position sensor in series.

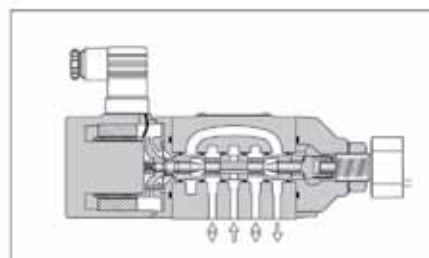


High accuracy

These valves have a low hysteresis of 0.1 % or less, achieving high accuracy. They allow the main unit to operate with much higher repeatability.

High response characteristics

The valves provide significantly high levels of step and frequency responses, which are typically used as measures of response characteristics; the step response is 2 ms (0↔100 %), and the frequency response is 450 Hz/ - 90° (± 25 % amplitude). Thus, the valves ensure that the main unit can achieve unprecedented high response. (★:Representative values)



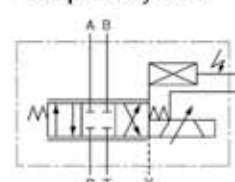
Excellent vibration-proof characteristics

With a simple structure, the valves offer high vibration resistance.

Excellent contamination resistance

The valves are also featured by excellent contamination resistance since they have a simple structure that directly connects the linear motor moving coil, the spool, and the position sensor. Compared to conventional servo valves for which the permissible contamination level is up to NAS 1638 class 7, the direct type linear servo valves can accept the contamination level of up to NAS 1638 class 10. These valves can contribute to greatly reducing the cost of fluid management.

Graphic Symbol



Model Number Designation

F—	LSVG	—03	—40	—R	—10
Fluid Type	Series Number	Valve Size	Rated Flow at $\Delta P = 7 \text{ MPa}$	Cable Departure Direction	Design Number
F : Required only if a phosphate ester-based fluid is used.	LSVG : Direct Type High-Speed Linear Servo Valves	03	4 : 4 L/min 10 : 10 L/min 20 : 20 L/min 40 : 40 L/min 60 : 60 L/min	(From the linear motor side) None: Upper (Standard) R: Right L: Left	10

Exclusive Amplifiers

To ensure stable performance, it is recommended to use Yuken's AMLS series of linear servo amplifiers.

Valve Model Number	Amplifier Model
LSVG-03-4/10/20/40	AMLS-A-D*-*-10
LSVG-03-60	AMLS-B-D*-*-10

Attachment

Mounting Bolt	Bolt Tightening Torque
Hex. Soc. Head Cap Screw: M8×65L...4 Pieces	30.8—37.7 Nm

Specifications

The specifications below are for use with a 48 V DC type exclusive amplifier; for use with a 24 V DC type amplifier, see the values in parentheses.

Item		Model Number	LSVG-03-4/10/20/40	LSVG-03-60
Rated Flow (at $\Delta P = 7$ MPa) ⁽¹⁾			4, 10, 20, 40 L/min	60 L/min
Max. Operating Pres.			35 MPa	
Proof Pres. at Return Port			35 MPa	
DR Port (Y) Permissible Back Pres. ⁽²⁾			0.05 MPa	
Internal Leak ($P_s=14$ MPa) (Viscosity: 30 mm ² /s)			1.7 L/min or less	
Hysteresis			0.1 % or less	
Step Response (0↔100 %) (Typical) ⁽³⁾			2 ms (3 ms)	3 ms (4 ms)
Frequency Response (± 25 % Amplitude) (Typical) ⁽³⁾	Gain: -3 dB		350 Hz (300 Hz)	330 Hz (240 Hz)
	Phase: -90°		450 Hz (370 Hz)	410 Hz (330 Hz)
Vibration Proof ⁽⁴⁾			Frequency: 10 – 60 Hz, Amplitude: 4 mm, Acceleration: 7.8 – 282 m/s ² Frequency: 61 – 2000 Hz, Amplitude: 4 – 0.0038 mm, Acceleration: 294 m/s ²	
Protection			Equivalent to IP64	
Ambient Temperature			-15 – +60°C	
Spool Type			Neutral/Zero Lap	
Spool Stroke to Stops			±0.5 mm	±0.75 mm
Polarity			See the description about I/O signal characteristics on page 18.	
Linear Motor Specification	Current		2 A [Max.6 A]	
	Coil Resistance		4.5 Ω [20°C]	
Mass			5 kg	

Note (1) Use the valves so that the relationship between the valve pressure difference and the flow rate, as specified below in “Range of Flow Control,” is met.

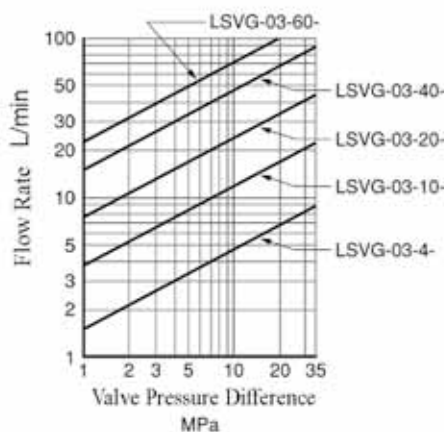
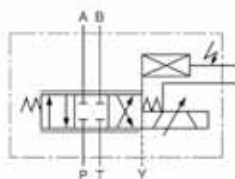
(2) Back pressure at the drain port (Y) should be 0.05 MPa or less and not be a negative pressure.

(3) This value is measured for each valve; it may differ depending on the actual circuit.

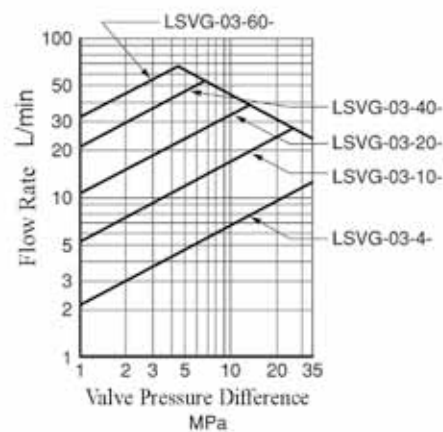
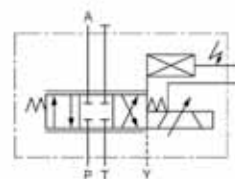
(4) There are restrictions on the mounting position; refer to the instructions for use.

Range of Flow Control

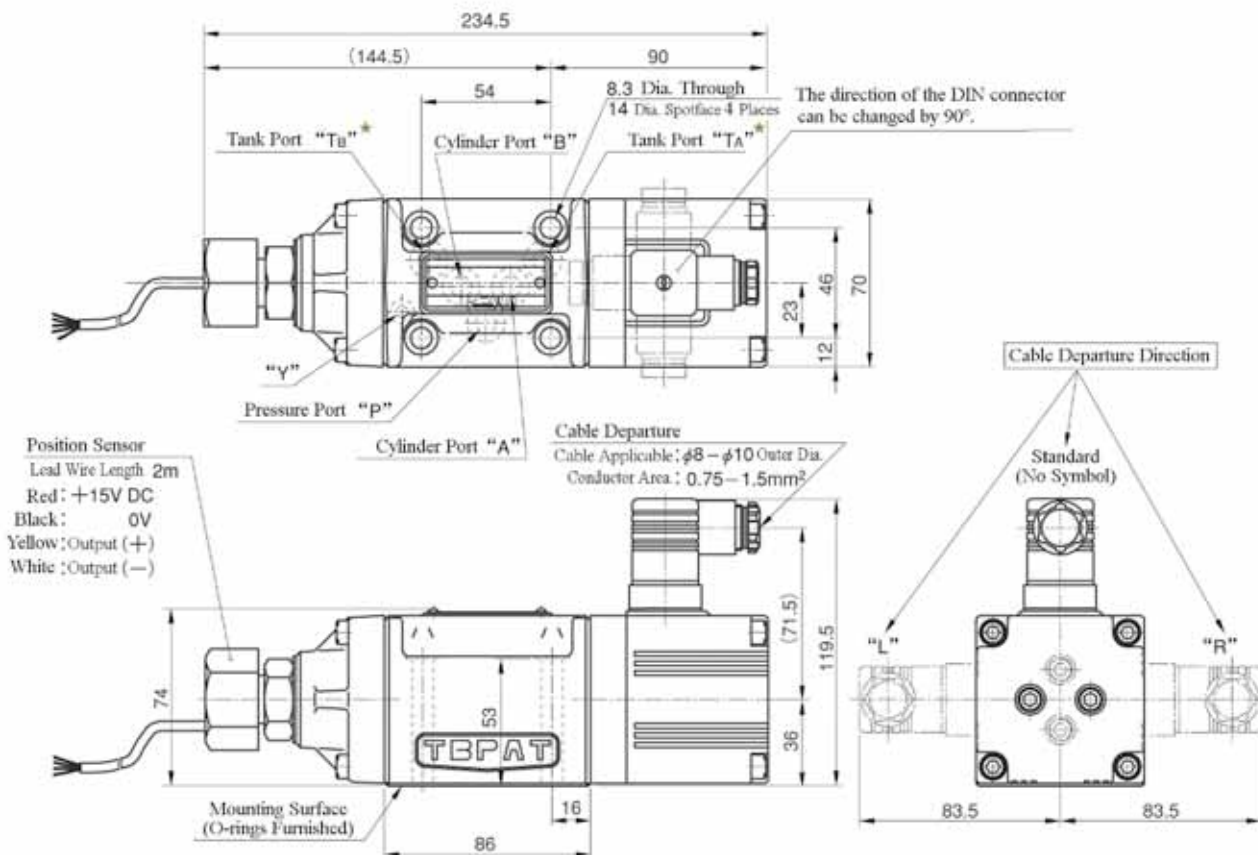
● Control Method: 4-Way Valve



● Control Method: 3-Way Valve



LSVG-03



NOTE) Refer to wiring diagram in page 20 for detailed connection between DIN-connector/position sensor and amplifier.

O-rings for the Ports

Port	O ring Size	Qty.
P, A, B, T	AS568-014 (NBR,Hs90)	5
Y	SO-NB-P7	1

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

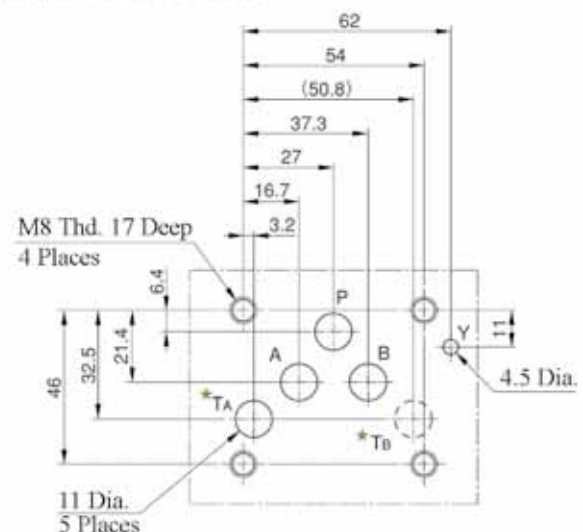
Mounting Surface

Prepare a mounting surface shown on the right. Basically, the dimensions of the mounting surface conform to ISO 4401-AC-05-4-A-84, but the specifications for valve mounting screws are different as follows.

Consult us for valves available with M6 mounting screws.

	ISO 4401-AC-05-4-B-84	Mounting Surface for LSVG-03
Valve Mounting Screw	M6	M8

The mounting surface should have a good machined finish.



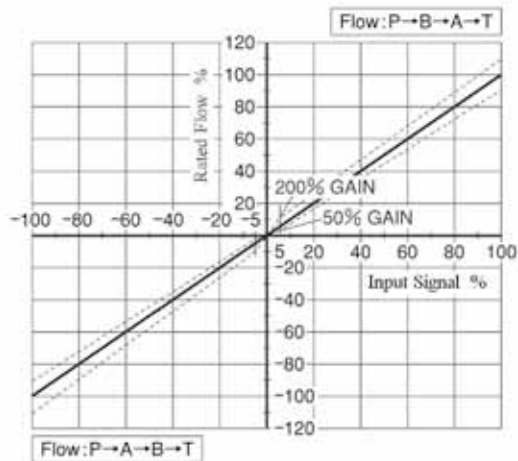
★ There are two tank ports "T_A" and "T_B" however, "T_A" may be used alone.

Characteristics of LSVG-03-4/10/20/40/60 (Fluid Viscosity 30mm²/S)

No-Load Flow Characteristics

<Conditions>

- Valve Pressure Difference : 7 MPa

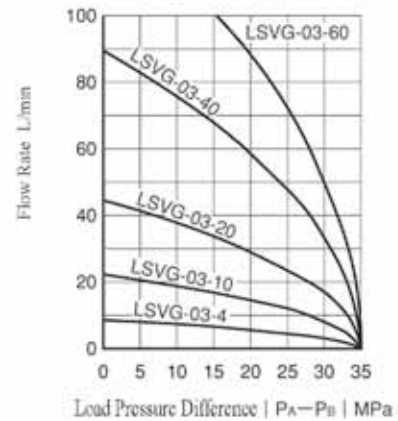


Load Flow Characteristics

<Conditions>

- Input Signal : 100%

Note) Tolerance of Load Flow : ±10 %



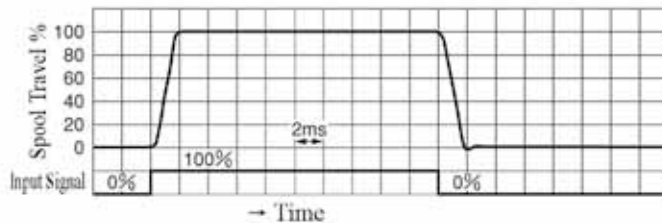
Step Response

<Conditions>

- Input Amplitude : 0 ⇔ 100 %
- Supply Pressure : 14 MPa

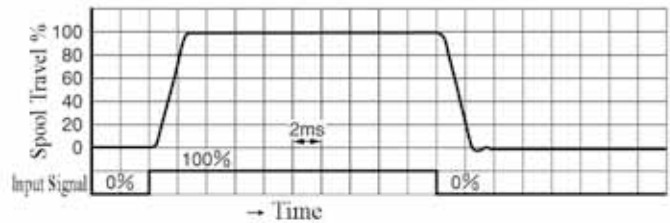
LSVG-03-4/10/20/40-10

Amplifier : AMLS-A-D48- * -10 (Power Supply : 48 V DC)

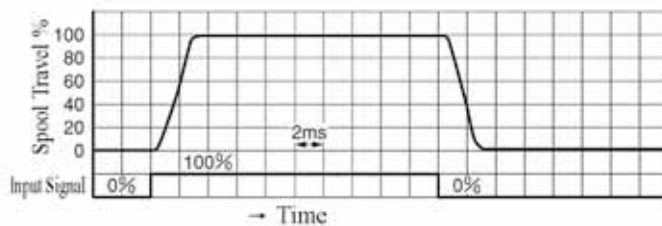


LSVG-03-60-10

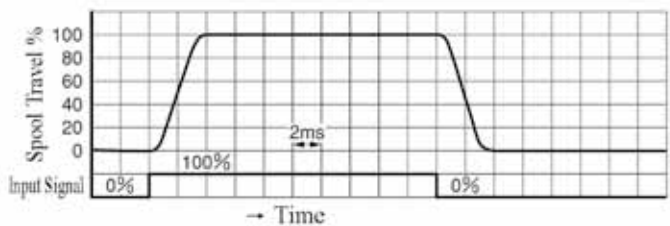
Amplifier : AMLS-B-D48- * -10 (Power Supply : 48 V DC)



Amplifier : AMLS-A-D24- * -10 (Power Supply : 24 V DC)



Amplifier : AMLS-B-D24- * -10 (Power Supply : 24 V DC)



Frequency Response

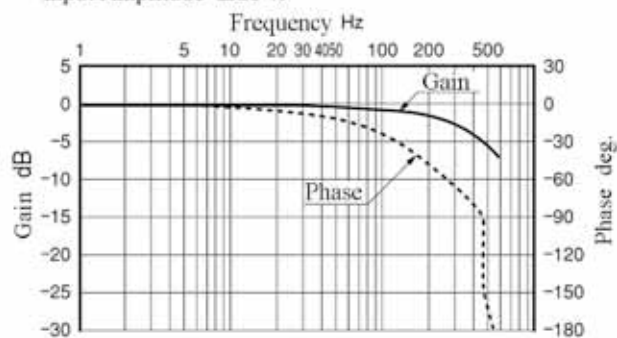
<Conditions>

● Hydraulic Circuit: Port A/B Closed ● Supply Pressure : 14 MPa

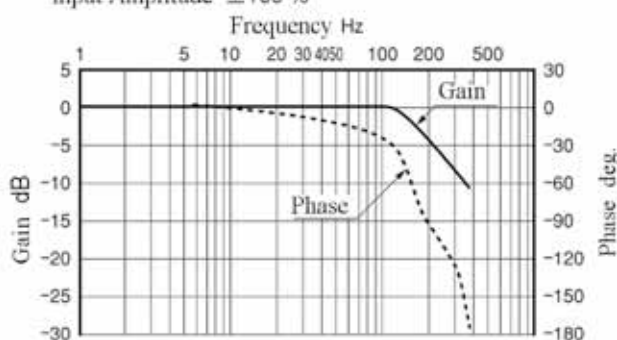
LSVG-03-4/10/20/40-10

Amplifier : AMLS-A-D48- * -10(Power Supply : 48 V DC)

Input Amplitude $\pm 25\%$

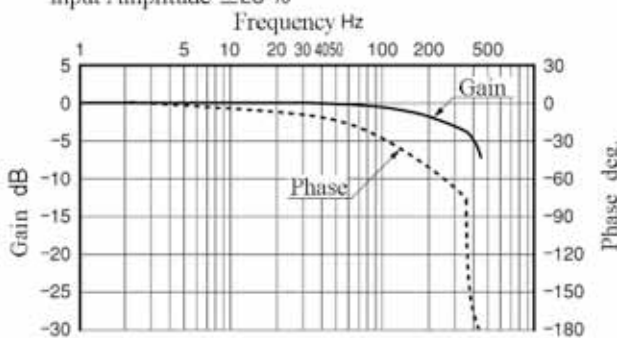


Input Amplitude $\pm 100\%$

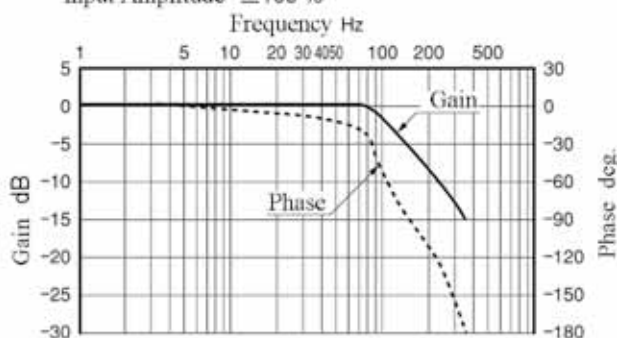


Amplifier : AMLS-A-D24- * -10(Power Supply : 24 V DC)

Input Amplitude $\pm 25\%$



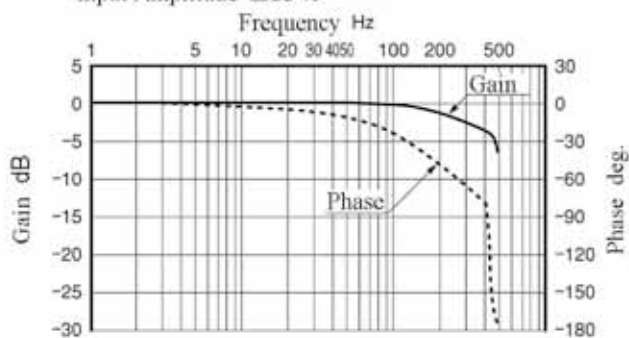
Input Amplitude $\pm 100\%$



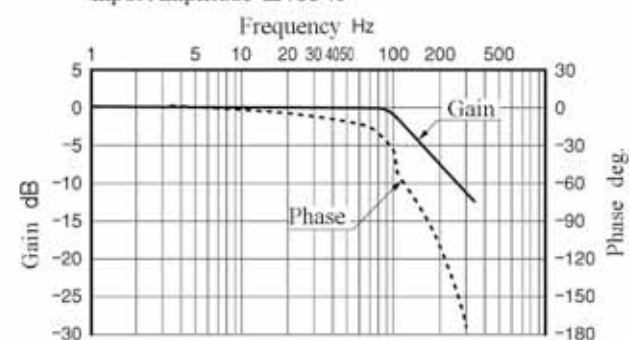
LSVG-03-60-10

Amplifier : AMLS-B-D48- * -10(Power Supply : 48 V DC)

Input Amplitude $\pm 25\%$

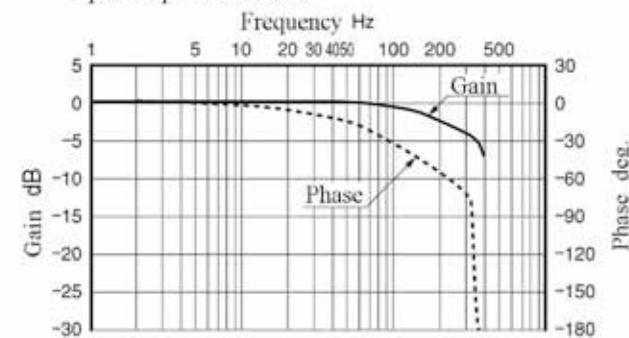


Input Amplitude $\pm 100\%$

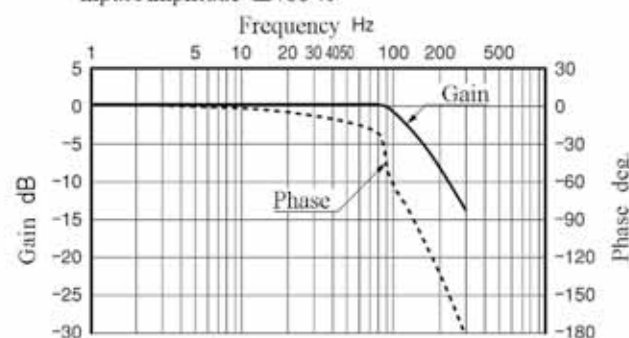


Amplifier : AMLS-B-D24- * -10(Power Supply : 24 V DC)

Input Amplitude $\pm 25\%$



Input Amplitude $\pm 100\%$



Two Stage Type High-Speed Linear Servo Valves

Two stage type linear servo valves are a type of high-flow servo valve that has a direct type high-speed linear servo valve in its pilot stage to drive the main spool.

These valves control the positions of the pilot and main spools with electrical feedback, achieving high accuracy and response.

- **High flow**

The valves consist of two stages to provide a high flow rate (Rated flow: 750-3800 L/min (at $\Delta P=7$ MPa)).

- **High accuracy**

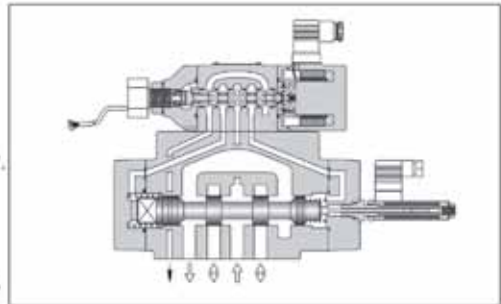
The valves have a low hysteresis of 0.1 % or less, achieving high accuracy. They allow the main unit to operate with much higher repeatability.

- **High response characteristics**

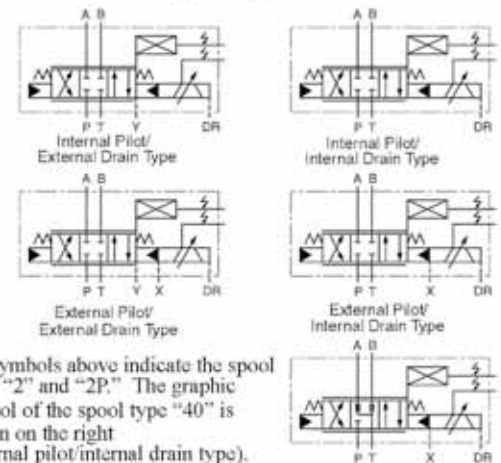
The valves provide significantly high levels of step and frequency responses, which are typically used as measures of response characteristics; the step response is 8 ms (0 $\rightarrow$ 100 %), and the frequency response is 105 Hz/- 90° (± 25 % amplitude) (Representative values for LSVHG-06-900). Thus, the valves ensure the achievement of unprecedented high response.

- **Excellent contamination resistance**

As is the case with the direct type linear servo valves, the permissible level of fluid contamination for these valves is up to NAS 1638 class 10.



Graphic Symbols



Note) The symbols above indicate the spool types "2" and "2P." The graphic symbol of the spool type "40" is shown on the right (external pilot/internal drain type).

Model Number Designation

F—	LSVHG	—06	—900	—2P	—E	T	—R	—A	—10
Fluid Type	Series Number	Valve Size	Rated Flow at $\Delta P = 7$ MPa	Spool Type	Pilot Type	Drain Type	Cable Departure Direction	Fail-safe Function	Design Number
F : Required only if a phosphate ester-based fluid is used.	LSVHG : Two Stage Type High-Speed Linear Servo Valves	04	750 : 750 L/min	2 : 10% Overlap 	None: Internal Pilot E: External Pilot	None: External Drain T : Internal Drain	(From the linear motor side) None: Upper (Standard) R : Right L : Left	None: PART Position Valve Opening: Full A : PART Position Valve Opening: Full	10 20
		06	900 : 900 L/min 1300 : 1300 L/min	40 : A, B, T Connection 					
		10	3800 : 3800 L/min	2P : Zero Lap (Dual Flow Gain)					

Exclusive Amplifiers

To ensure stable performance, it is recommended to use Yuken's AMLS series of linear servo amplifiers.

Valve Model Number	Amplifier Model
LSVHG-04-750	AMLS-C2-D※-※-10
LSVHG-06-900	AMLS-C-D※-※-10
LSVHG-06-1300 LSVHG-10-3800	AMLS-D-D※-※-10

Attachment

Model Number	Mounting Bolt	Qty.	Bolt Tightening Torque
LSVHG-04	Hex. Soc. Head Cap Screw : M 6 × 55L	2	12.9 ~ 15.9 Nm
	Hex. Soc. Head Cap Screw : M10 × 60L	4	60.6 ~ 74.1 Nm
LSVHG-06	Hex. Soc. Head Cap Screw : M12 × 85L	6	104 ~ 127 Nm
LSVHG-10	Hex. Soc. Head Cap Screw : M20 × 90L	6	494 ~ 603 Nm

Specifications

The specifications below are for use with a 48 V DC type exclusive amplifier; for use with a 24 V DC type amplifier, see the values in parentheses.

Item		Model Number			LSVHG-04-750			LSVHG-06-900			LSVHG-06-1300			LSVHG-10-3800		
Rated Flow at ΔP = 7 MPa (4-Way Valve)					750 L/min			900 L/min			1300 L/min			3800 L/min		
Rated Flow at ΔP* = 0.5 MPa (per Land)					283 L/min			340 L/min			490 L/min			1440 L/min		
Max. Operating Pres.					35 MPa			35 MPa			31.5 MPa			35 MPa		
Proof Pres. at Return Port		External Drain			31.5 MPa			35 MPa			25 MPa			28 MPa		
		Internal Drain (1)			31.5 MPa			35 MPa			25 MPa			28 MPa		
DR Port Permissible Back Pressure (2)					0.05 MPa											
Pilot Pressure (3)					1.5–35 MPa									1.5–25 MPa		
Pilot Flow Rate (4)					27 L/min or more (22 L/min or more)			30 L/min or more (24 L/min or more)			34 L/min or more (27 L/min or more)			32 L/min or more (27 L/min or more)		
Pilot Valve Leak (Viscosity: 32 mm ² /s)		Ps=Pp=14 MPa			1.7 L/min or less											
Main Valve Leak (Viscosity: 32 mm ² /s)		Spool Type			-2-	-40-	-2P-	-2-	-40-	-2P-	-2-	-40-	-2P-	-2-	-40-	-2P-
		Max. Leak Rate (L/min)			0.8	1.6	6.8	0.9	1.8	7	1	2	8	3	6	10
Hysteresis					0.1% or less											
Step Response (0↔100 %) (Typical) (5)					8 ms (10ms)			8 ms (10ms)			10 ms (13ms)			15 ms (18ms)		
Frequency Response (± 25 % Amplitude) (Typical) (5)		Gain: -3 dB			150 Hz (140 Hz)			160 Hz (130 Hz)			150 Hz (110 Hz)			100 Hz (60 Hz)		
		Phase: -90°			110 Hz (100 Hz)			105 Hz (100 Hz)			100 Hz (100 Hz)			85 Hz (75 Hz)		
Vibration Proof (6)					Frequency : 10–60 Hz, Amplitude: 4 mm, Acceleration: 7.8–282 m/s ² Frequency : 61–2000 Hz, Amplitude: 4–0.0038 mm, Acceleration : 294 m/s ²											
Protection					Equivalent to IP64											
Ambient Temperature					-15 — +60 °C											
Spool Stroke to Stops					±5 mm			±5 mm			±7 mm			±7 mm		
Spool End Area					7.1 cm ²			8 cm ²			8 cm ²			11.3 cm ²		
Polarity					See the description about I/O signal characteristics on page 18.											
Linear Motor Specification		Current			2 A [Max.6 A]											
		Coil Resistance			4.5 Ω [at 20 °C]											
Mass					12 kg			20 kg			21 kg			78 kg		

Note ⁽¹⁾ Pressure at the return port should be at actual supply pressure or less.

⁽²⁾ Back pressure at the drain port should be 0.05 MPa or less and not be a negative pressure.

⁽³⁾ Supply pressure for the pilot valve should be 1.5–35 MPa (1.5–25 MPa for LSVHG-10) and should also be 60 % of actual supply pressure or more.

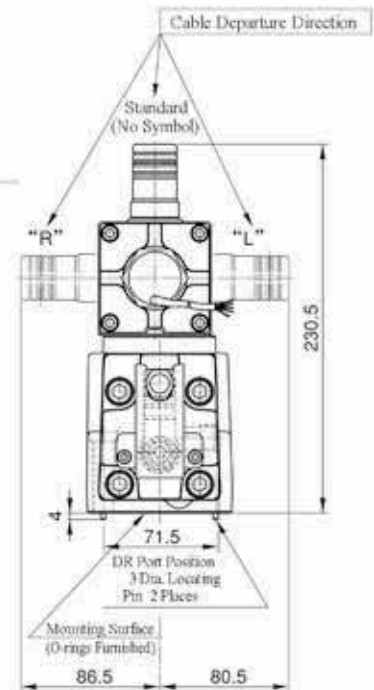
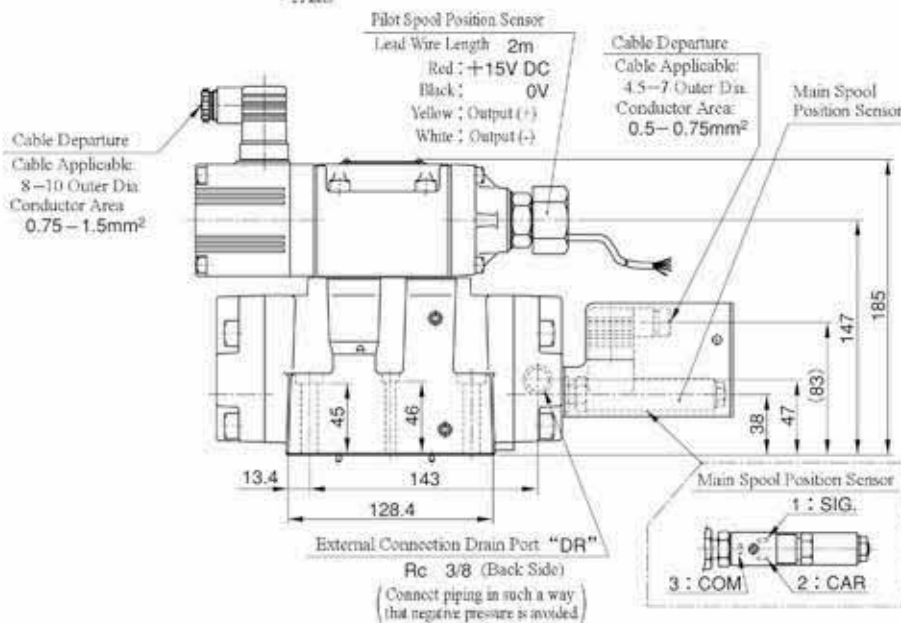
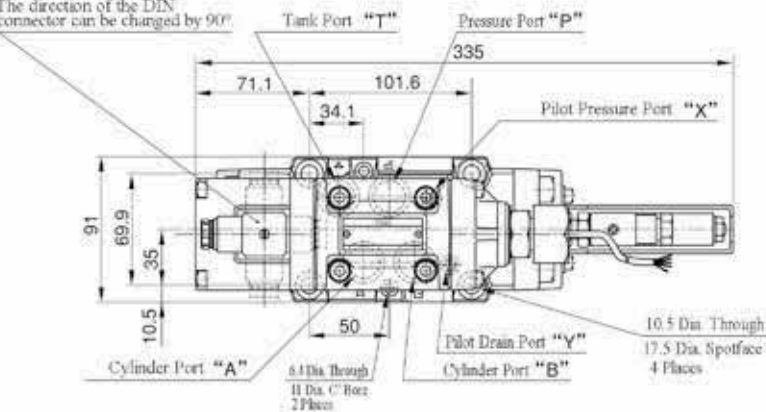
⁽⁴⁾ The pilot flow is calculated based on 14 MPa of pilot pressure and the above step response.

⁽⁵⁾ This value is measured for each valve based on 14 MPa of pilot pressure; it may differ depending on the actual circuit/operation conditions.

⁽⁶⁾ There are restrictions on the mounting position; refer to the instructions for use.

LSVHG-04

The direction of the DIN connector can be changed by 90°



NOTE) Refer to wiring diagram in page 20 for detailed connection from pilot valve DIN-connector and position sensors(pilot and main spool) to amplifier.

[Mounting Surface]

Prepare a mounting surface shown on the right. Basically, the dimensions of the mounting surface conform to ISO 4401-AD-07-4-A-80, but the specifications for the ports P, A, B, and T are different as follows.

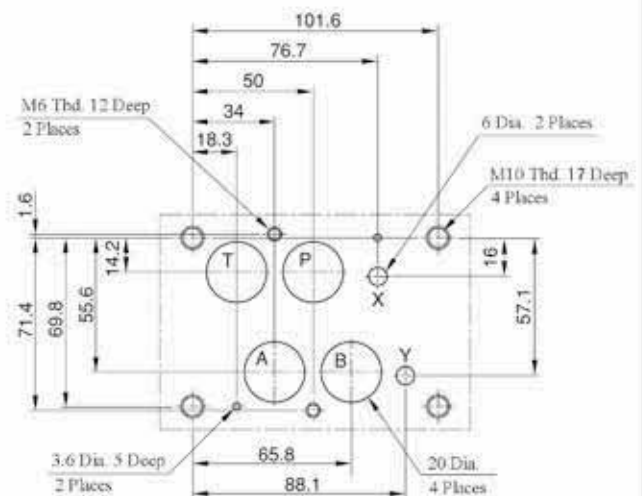
	ISO 4401-AD-07-4-A-80	Mounting Surface for LSVHG-04
	ISO 4401-07-06-0-94	
Dia. of Port P, A, B, T	17.5	20

The mounting surface should have a good machined finish.

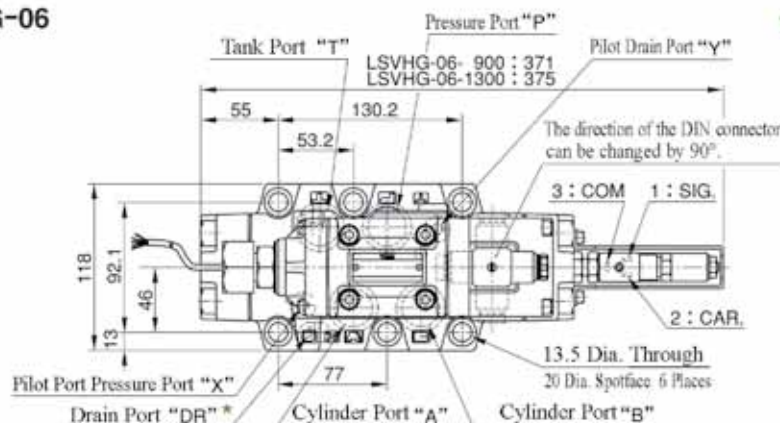
● O-rings for the Ports

Port	O-ring Size	Qty.
P, A, B, T	SO-NB-P22	4
X, Y	AS568-012 (NBR, Hs90)	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids

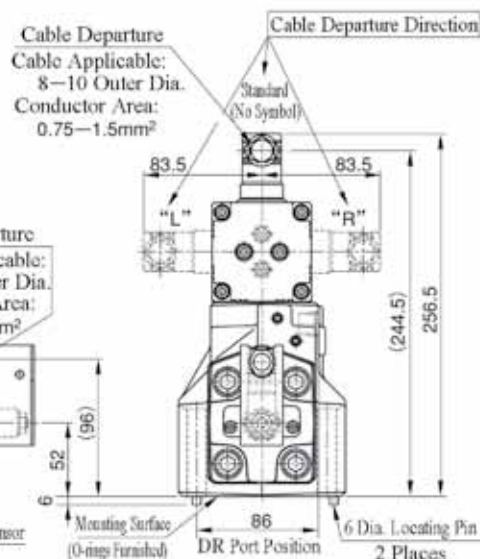
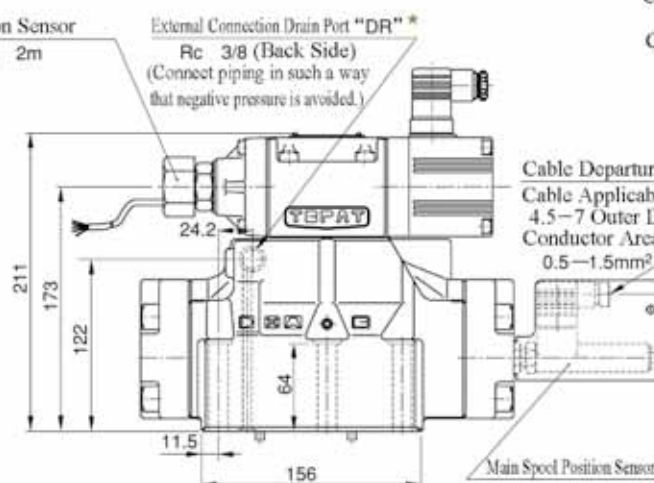


LSVHG-06



★ The valve has two "DR" ports: one for external connection and the other on the mounting surface. Use either one of the drain ports

Pilot Spool Position Sensor
Lead Wire Length 2m
Red: +15V DC
Black: 0V
Yellow: Output (+)
White: Output (-)



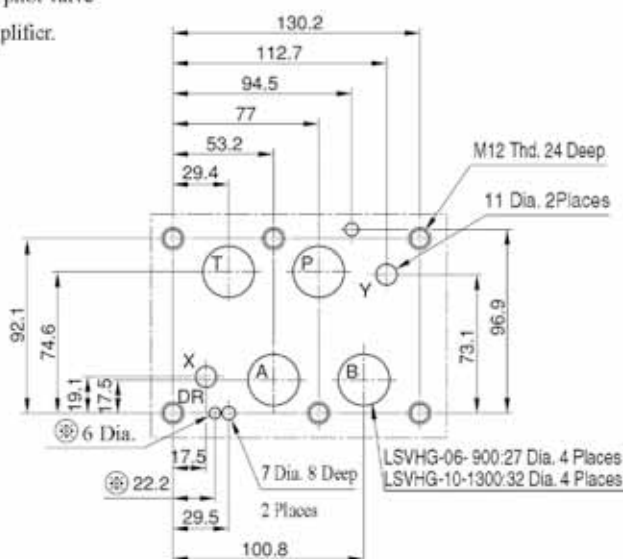
NOTE) Refer to wiring diagram in page 20 for detailed connection from pilot valve
DIN-connector and position sensors(pilot and main spool) to amplifier.

[Mounting Surface]

Prepare a mounting surface shown on the right. Basically, the dimensions of the mounting surface conform to ISO 4401-AD-07-4-A-80, but the specifications for the ports P, A, B, and T are different as follows.

	ISO 4401-AE-08-4-A-80	Mounting Surface for LSVHG-06-900	Mounting Surface for LSVHG-06-1300
Dia. of Port P, A, B, T	23.4	27	32
Drain Port "DR"	None	Available (6 Dia.)	

The mounting surface should have a good machined finish.



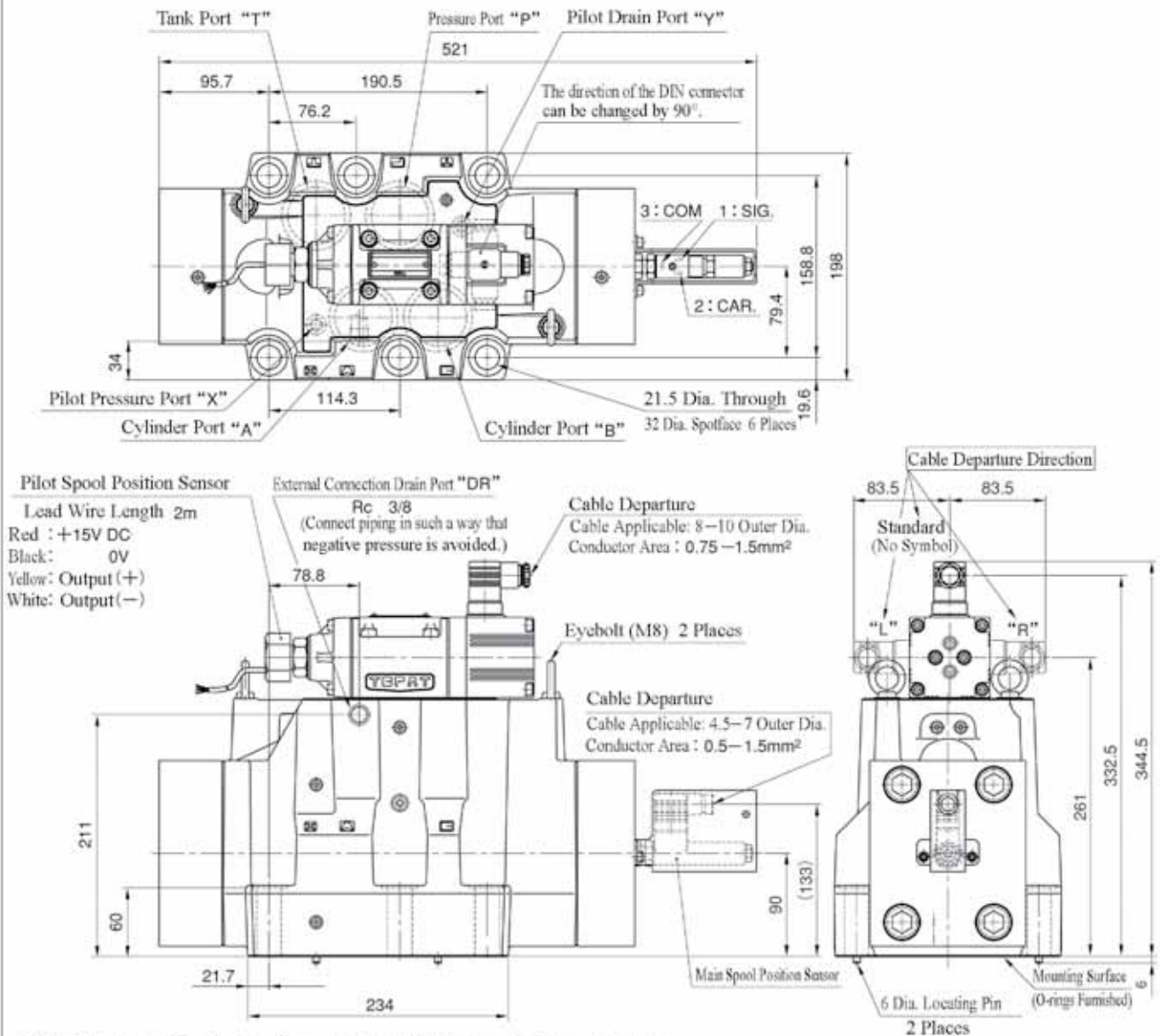
Note) Not required if the external connection drain port is used.

O-rings for the Ports

Port	O-ring Size		Qty.
	LSVHG-06-900	LSVHG-06-1300	
P, A, B, T	AS568-123 (NBR, Hs90)	AS568-126 (NBR, Hs90)	4
X, Y	SO-NB-P14		2
DR	AS568-016 (NBR, Hs90)		1

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

LSVHG-10



NOTE) Refer to wiring diagram in page 20 for detailed connection from pilot valve DIN-connector and position sensors(pilot and main spool) to amplifier.

[Mounting Surface]

Prepare a mounting surface shown on the right. Basically, the dimensions of the mounting surface conform to ISO 4401-AF-10-4-A-80 (ISO 4401-10-08-0-94). Consult us if a sub-plate is required.

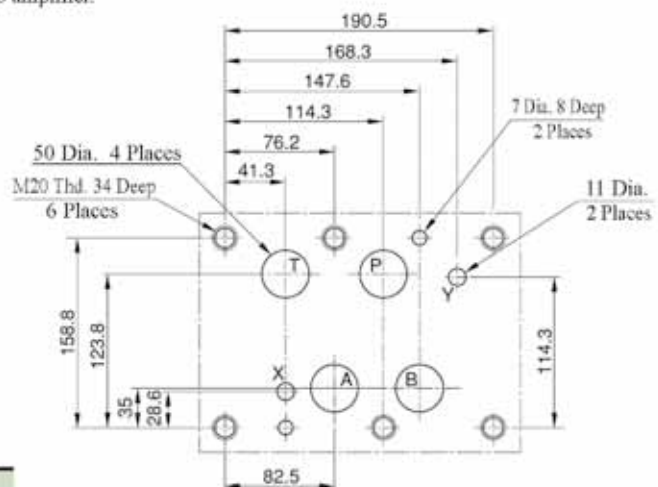
	ISO 4401-AF-10-4-A-80	Mounting Surface for ISO 4401-10-08-0-94
Dia. of Port P, A, B, T	36	50

The mounting surface should have a good machined finish.

● O-rings for the Ports

Port	O-ring Size	Qty.
P, A, B, T	SO-NB-P42	4
X, Y	SO-NB-P20	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

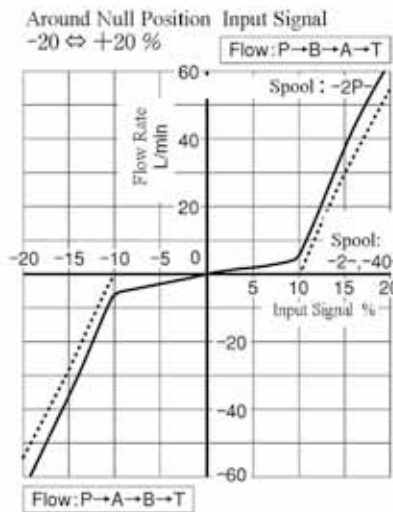
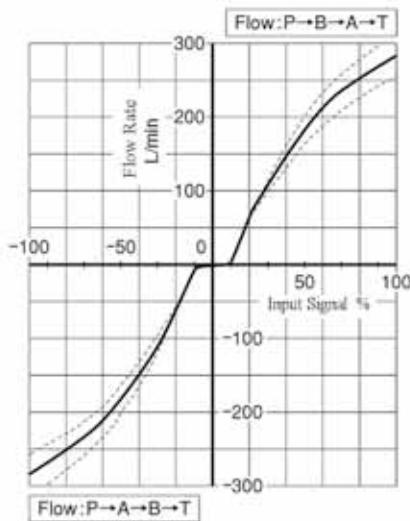


Characteristics of LSVHG-04-750 (Fluid Viscosity : 30mm²/S)

No-Load Flow Characteristics

<Conditions>

Valve Pressure Difference: 1MPa (Pressure Difference per Land: 0.5MPa)



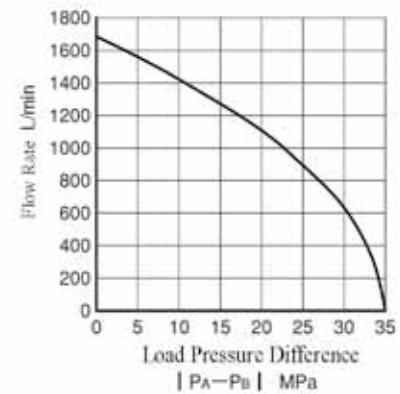
Load Flow Characteristics

<Conditions>

● Input Signal : 100%

Note)

Tolerance of Load Flow : ±10 %

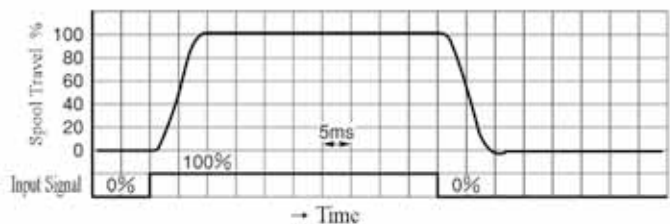
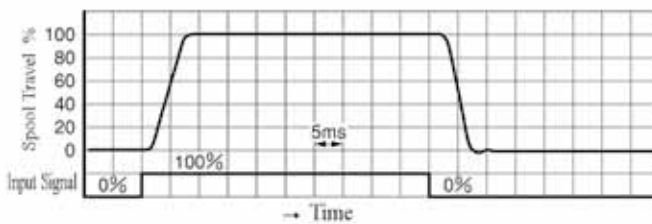


Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Amplifier : AMLS-C2-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C2-D24- * -10 (Power Supply : 24 V DC)

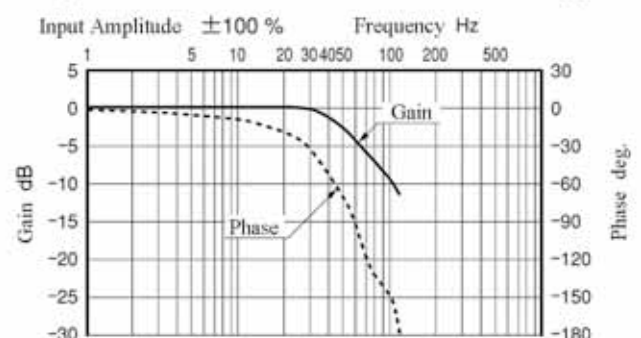
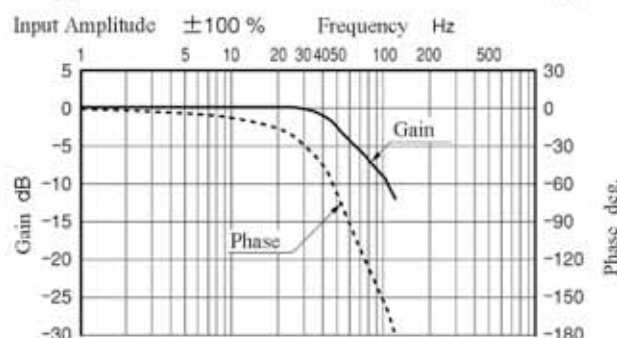
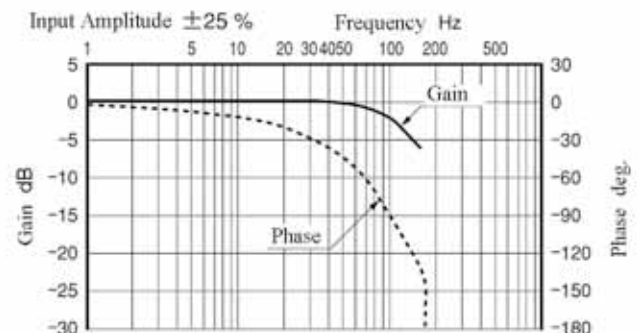
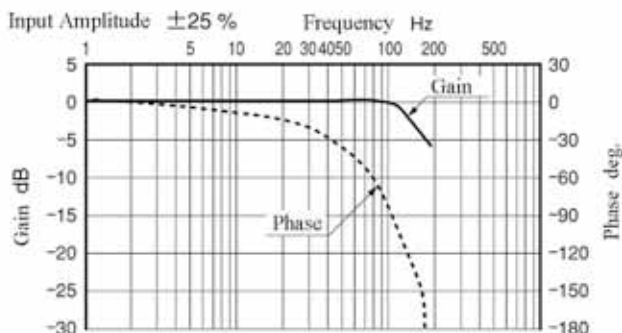


Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply Pressure : 14 MPa

Amplifier : AMLS-C2-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C2-D24- * -10 (Power Supply : 24 V DC)

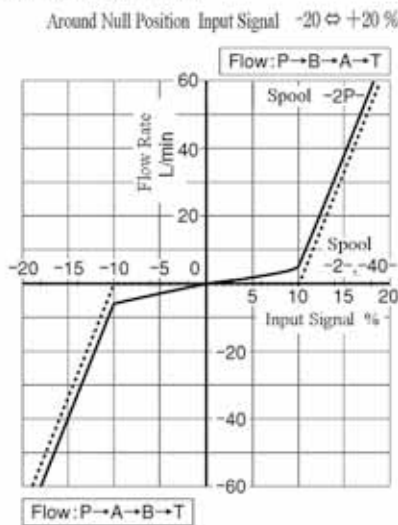
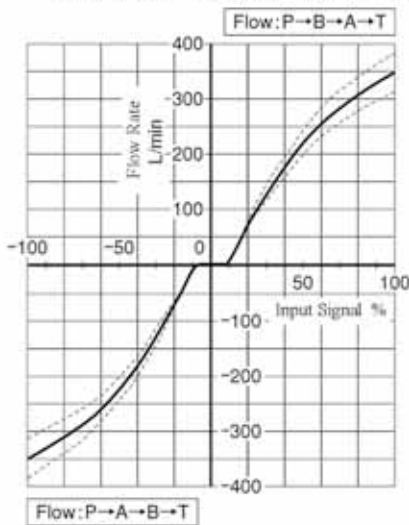


Characteristics of LSVHG-06-900 (Fluid Viscosity : 30mm²/S)

No-Load Flow Characteristics

<Conditions>

Valve Pressure Difference: 1MPa (Pressure Difference per Land: 0.5MPa)

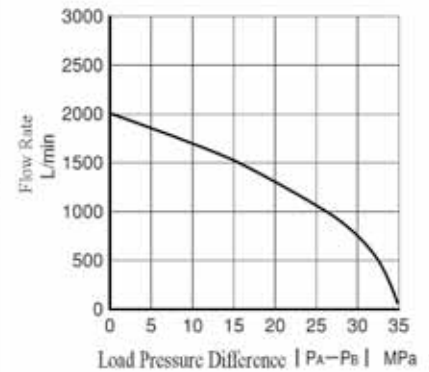


Load Flow Characteristics

<Conditions>

● Input Signal : 100%

Note) Tolerance of Load Flow : ±10 %

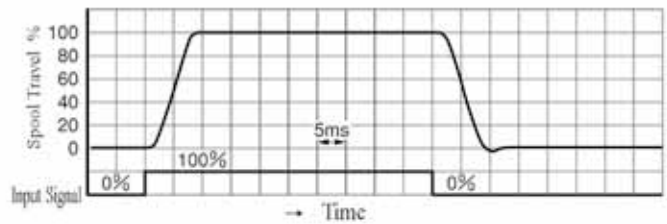
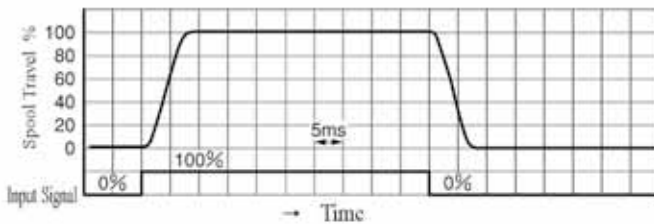


Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Amplifier : AMLS-C2-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C2-D24- * -10 (Power Supply : 24 V DC)

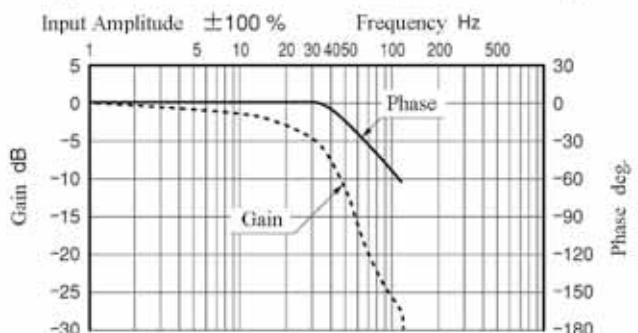
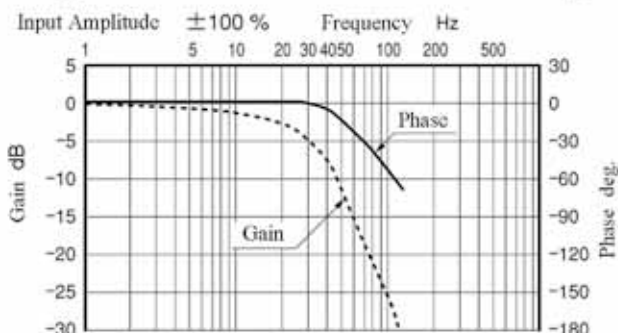
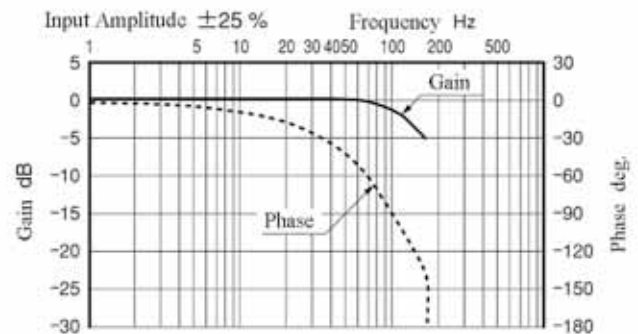
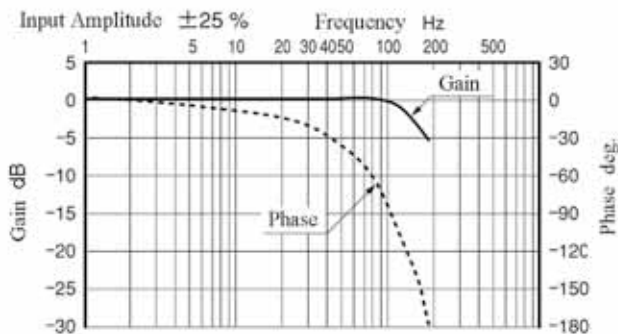


Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply Pressure : 14 MPa

Amplifier : AMLS-C2-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C2-D24- * -10 (Power Supply : 24 V DC)

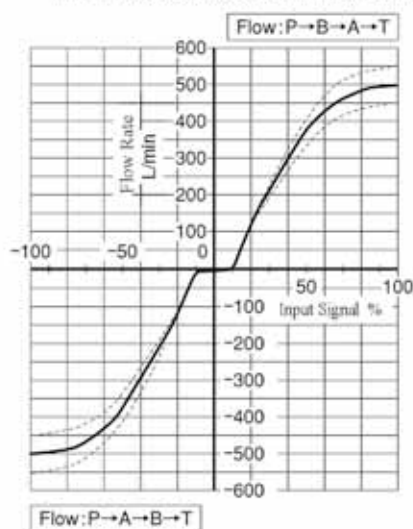


Characteristics of LSVHG-06-1300 (Fluid Viscosity : 30mm²/S)

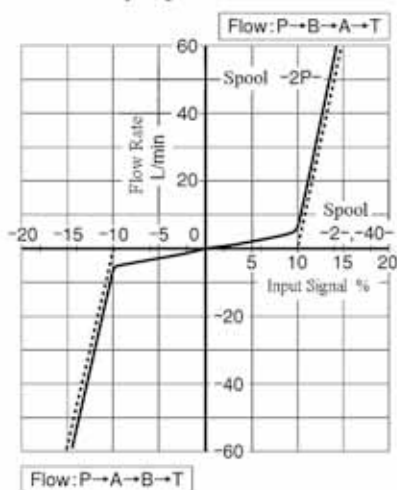
No-Load Flow Characteristics

<Conditions>

Valve Pressure Difference: 1MPa (Pressure Difference per Land: 0.5MPa)



Around Null Position Input Signal -20 ⇔ +20 %

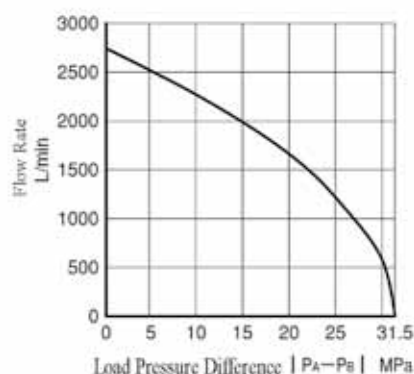


Load Flow Characteristics

<Conditions>

● Input Signal : 100%

Note) Tolerance of Load Flow : ±10 %

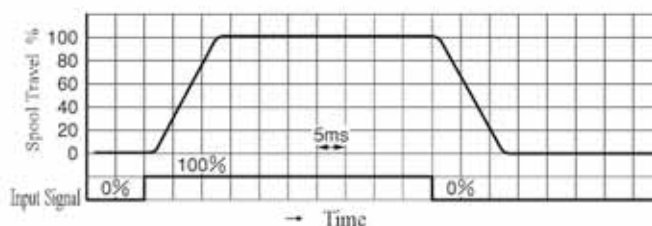
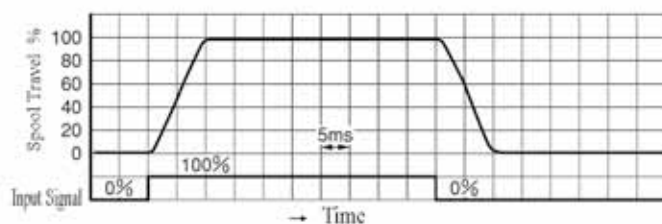


Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Amplifier : AMLS-C-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C-D24- * -10 (Power Supply : 24 V DC)

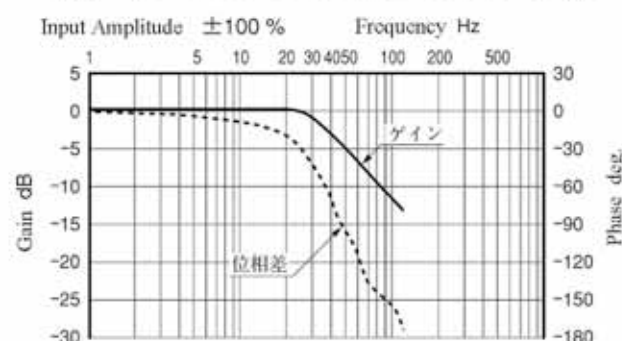
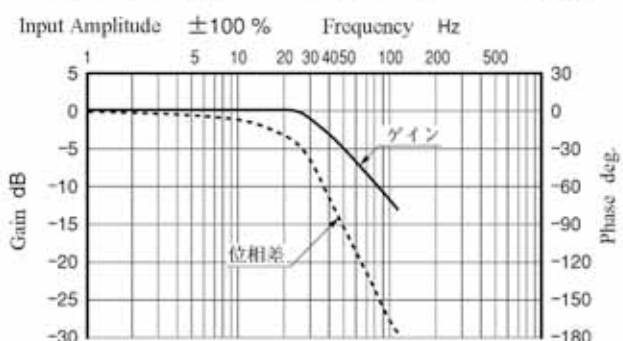
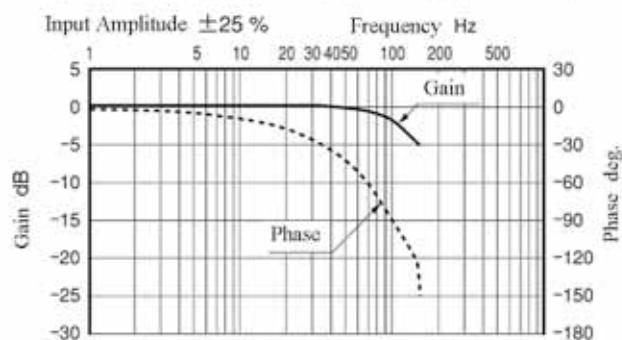
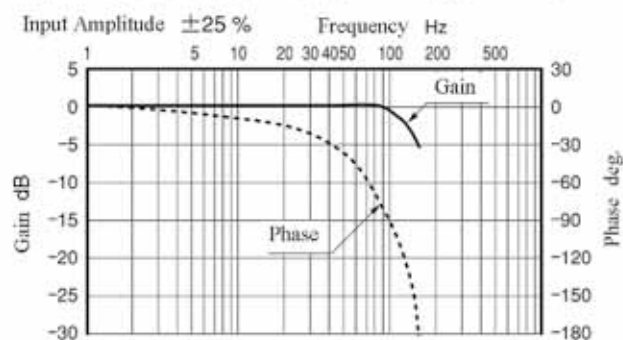


Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply Pressure : 14 MPa

Amplifier : AMLS-C-D48- * -10 (Power Supply : 48 V DC)

Amplifier : AMLS-C-D24- * -10 (Power Supply : 24 V DC)

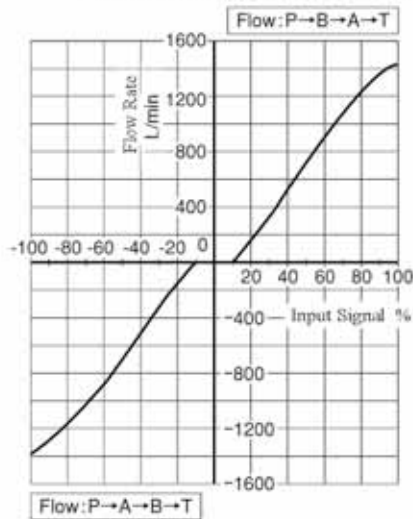


Characteristics of LSVHG-10-3800 (Fluid Viscosity : 30mm²/S)

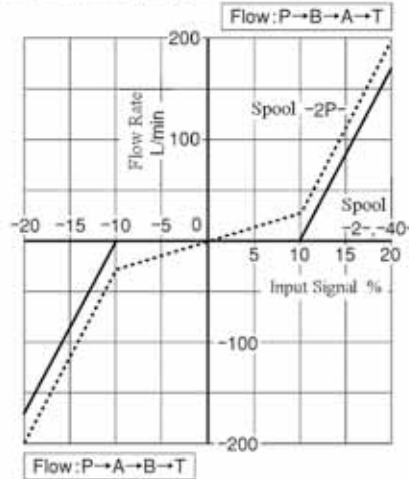
No-Load Flow Characteristics

<Conditions>

Valve Pressure Difference: 1MPa (Pressure Difference per Land: 0.5MPa)



Around Null Position Input Signal -20 ↔ +20 %

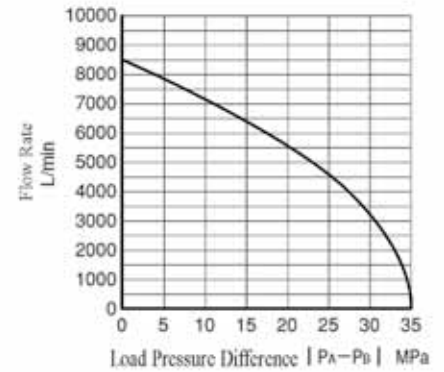


Load Flow Characteristics

<Conditions>

● Input Signal : 100%

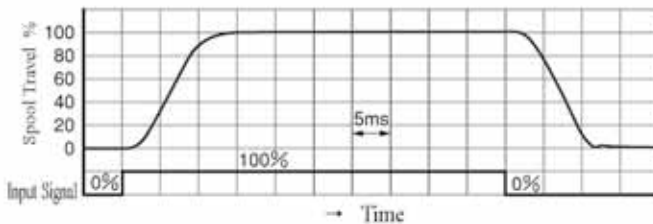
Note) Tolerance of Load Flow : ±10 %



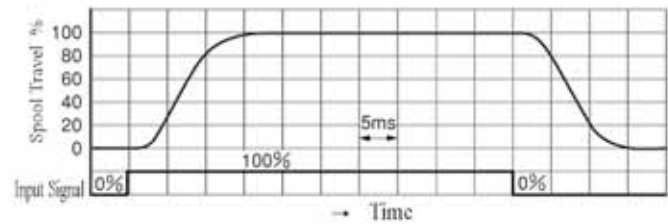
Step Response

<Conditions> ● Input Signal : 0 ↔ 100 % ● Supply/Pilot Pressure : 14 MPa

Amplifier : AMLS-D-D48- * -10 (Power Supply : 48 V DC)



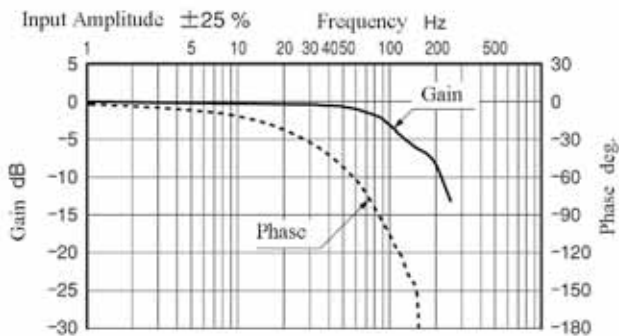
Amplifier : AMLS-D-D24- * -10 (Power Supply : 24 V DC)



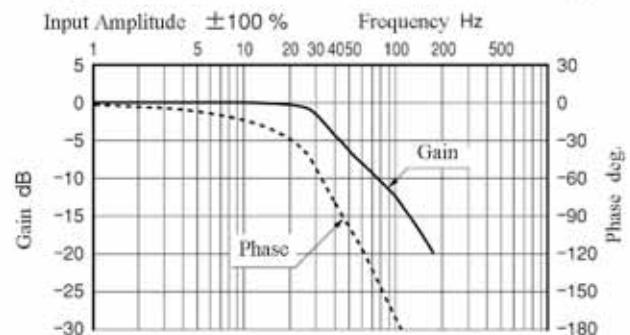
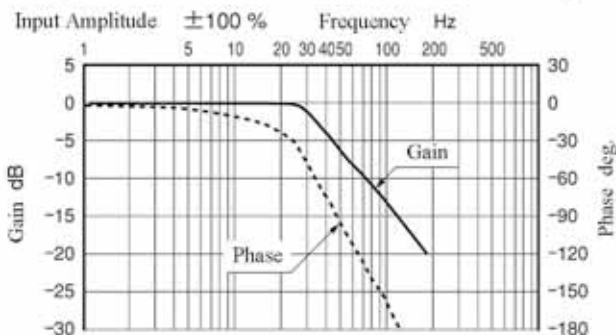
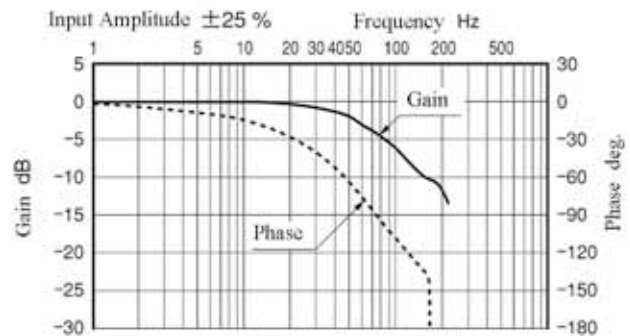
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply Pressure : 14 MPa

Amplifier : AMLS-D-D48- * -10 (Power Supply : 48 V DC)



Amplifier : AMLS-D-D24- * -10 (Power Supply : 24 V DC)



Linear Servo Amplifier

This amplifier is used to drive LSVG/LSVHG series high-speed linear servo valves.

With an optimal design for the servo valves, the amplifier can maximize the valve performance.



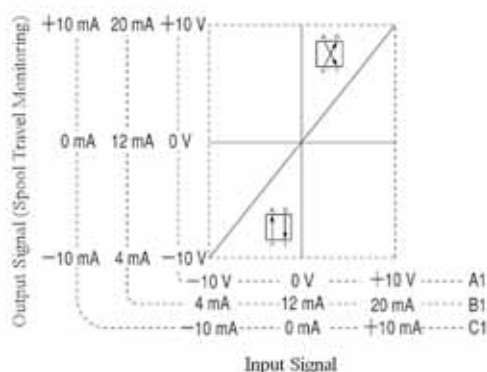
Specifications

Item	Model Number	AMLS- *-D48- *-10	AMLS- *-D24- *-10
Power Supply		48 ± 2.4 VDC (200 VA or more)	24 ± 1.2 VDC (100 VA or more)
Rated Output Current		Continuous ±2 A (4 A Peak)	Continuous ±2 A (3 A Peak)
Input/Output Signal		Output Signal = Spool Travel Monitoring	
	AMLS- *-D48/D24-A1-	Voltage Signal ±10 V (R _i = 100 kΩ, R _L ≥ 10 kΩ)	
	AMLS- *-D48/D24-B1-	Current Signal 4 — 20 mA (R _i = 200 Ω, R _L = 100—500 Ω)	
	AMLS- *-D48/D24-C1-	Current Signal ±10 mA (R _i = 200 Ω, R _L = 100—500 Ω)	
Control Input/Output Signal		a) Servo "ON" Input/Alarm Reset Input : Photocoupler Input Voltage : +15 — +28 VDC, Input Impedance : 2.2 kΩ b) Overcurrent Output (CURR.AL.) / Deviation Alarm Output (CRTLAL.) : Photocoupler Output Voltage: 50 VDC, Current: Max. 30 mA	
Ambient Temperature		0 — 50 °C	
Ambient Humidity		20 — 90 %Rh (No Condensation)	
Mass		1.8 kg	

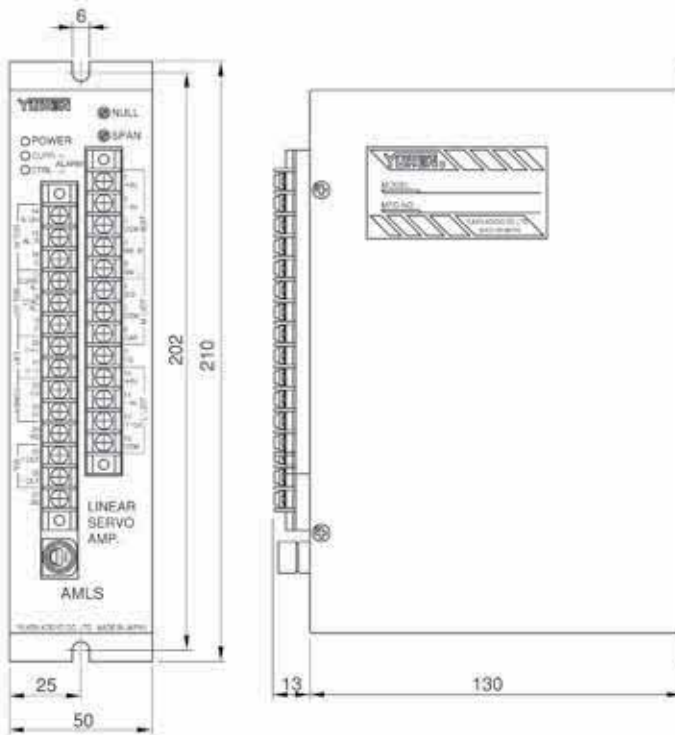
Model Number Designation

AMLS	—A	—D48	—A1	—10
Series Number	Applicable Valve Type	Supply Voltage	Input Signal/ Spool Travel Monitoring	Design Number
AMLS : Linear Servo Amplifier	A : LSVG-03-4/10/20/40 B : LSVG-03-60 C : LSVHG-06-900 C2 : LSVHG-04 D : LSVHG-06-1300 LSVHG-10-3800	D48 : DC 48 V D24 : DC 24 V	A1 : Voltage Signal ± 10 V B1 : Current Signal 4—20 mA C1 : Current Signal ± 10 mA	10

I/O Signal Characteristics



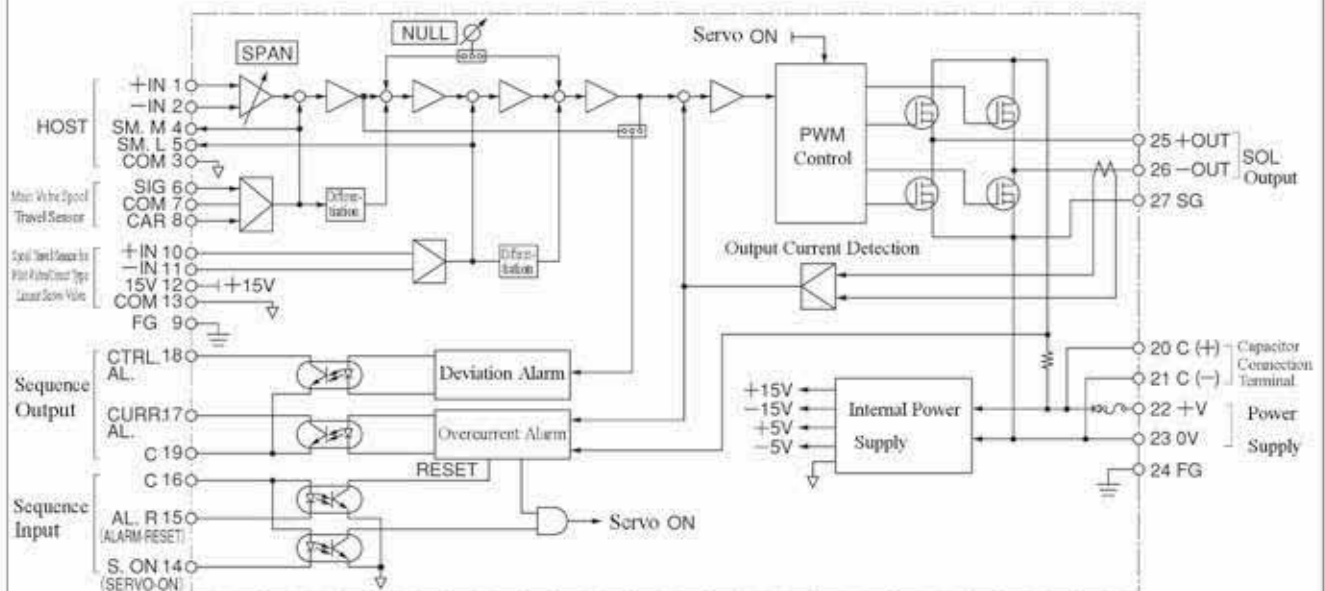
Appearance/Terminal Name



Terminal Name

No.	Terminal Name	
1	Input Signal	+IN
2		-IN
3	Common	COM
4	Sensor	Main Valve Spool
5		Pilot Valve/Direct Type Linear Servo Valve
6	Main Valve Spool Travel Sensor	SIG
7		COM
8		CAR
9	Frame Grounding	FG
10	Spool Travel Sensor for Pilot Valve	+IN
11		-IN
12	Direct Type Linear Servo Valve	+15V
13		COM
14	Sequence Input	Servo ON
15		Alarm Reset
16		Input Common
17	Sequence Output	Overcurrent Alarm
18		Deviation Alarm
19		Output Common
20	Capacitor Connection Terminal	Cap. (+)
21		Cap. (-)
22	Power Supply	+V
23		0V
24	Frame Grounding	FG
25	SOL Output	+OUT
26		-OUT
27	Signal Grounding	SG

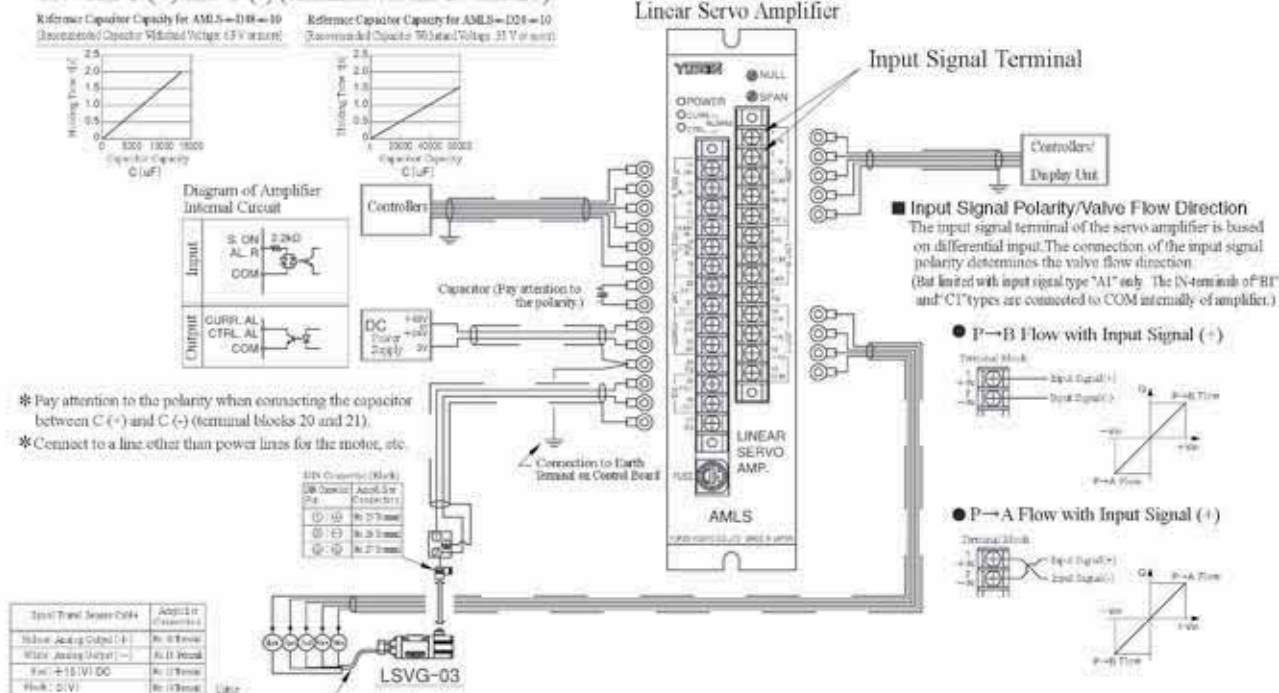
Block Diagram



■ Wiring Diagram

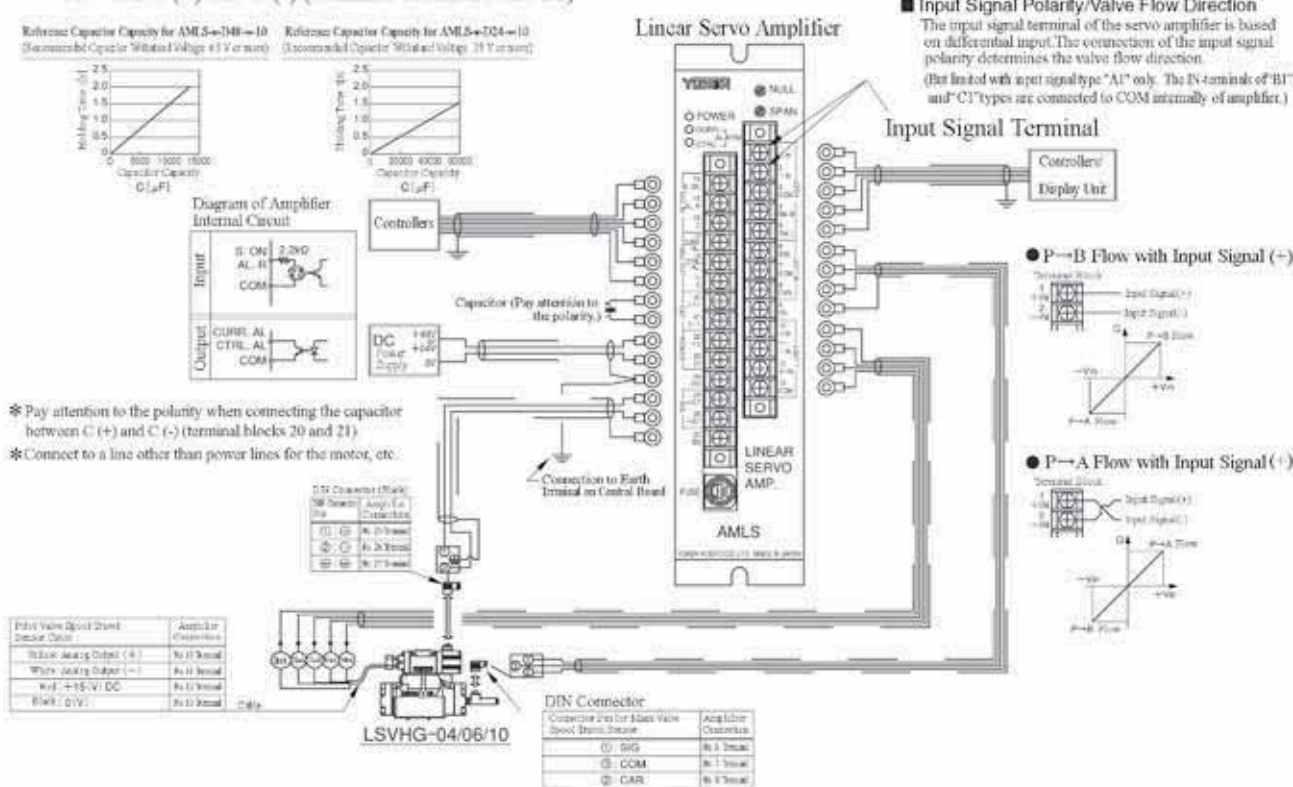
● AMLS-A, AMLS-B

* To hold the valve spool at the neutral position for a few seconds upon power failure or after power-off, connect the capacitor between C (+) and C (-) (terminal blocks 20 and 21).



● AMLS-C, AMLS-C2, AMLS-D

* To hold the valve spool at the neutral position for a few seconds upon power failure or after power-off, connect the capacitor between C (+) and C (-) (terminal blocks 20 and 21).



OBE(On-Board Electronic)type Linear Servo Valves(Std.Type)

OBE (on-board electronic) type linear servo valves have a small pilot valve (based on two stage type high-speed linear servo valves) and an exclusive power amplifier in a compact body. These servo valves provide "high accuracy, easiness to use, and great usability."

High accuracy

All of the OBE type linear servo valves have a low hysteresis of 0.1 % or less, achieving high accuracy; as is the case with the high-speed linear servo valves.

These valves allow the main unit to operate with much higher repeatability.

High response characteristics

Compared to other equivalent models, these valves provide higher levels of step and frequency responses, which are typically used as measures of response characteristics; the step response is 7 ms (0→100 %)*, and the frequency response is 125 Hz/± 3 dB(± 25 % amplitude)*

(*: Representative values for LSVHG-03EH).

Easiness to use

These valves can offer high accuracy for hydraulic control systems just with the power supply of 24 V DC and the input of command signals.

Six types of input signals in three input voltage/current ranges are available: 0→± 10 V, 0→± 10 mA, and 4→20 mA.

Great usability

The small amplifier in the valves has a fault indicator lamp. This lamp indicates an error when valve failure causes any deviation between the spool position commanded by the signal and the actual spool position. It facilitates you to immediately troubleshoot the failure of the valves, if any.

Two types of pilot valves available

There are two types of pilot valves available: a dry type good in response characteristics and a wet type that eliminates drain (DR) port to improve usability. They can be selected according to users' purposes.

Excellent contamination resistance

As similar to the high-speed linear servo valves, OBE type linear servo valves have a simple pilot valve structure, exhibiting excellent contamination resistance.

The permissible level of fluid contamination for these valves is up to NAS 1638 class 10.

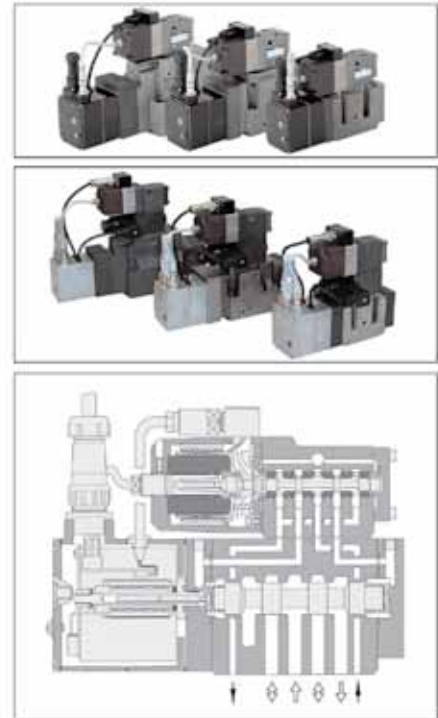
Direct Type OBE (On-Board Electronic) Type Linear Servo Valves

Direct type OBE (on-board electronic) type linear servo valves listed below are also available.

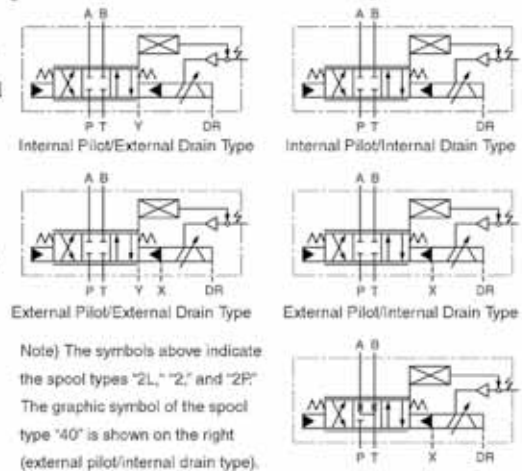
Contact us for further information.

● LSVG-01EH..... Rated flow rate: 4, 10, 20 L/min

● LSVG-03EH..... Rated flow rate: 40, 60 L/min



Graphic Symbols



Model Number Designation

F—	LSVHG	—06	EH	—900	—2P	—E	T	—W	A	—A	1	—20
Fluid Type	Series Number	Valve Size	Amplifier Type	Rated Flow at $\Delta P^* = 7 \text{ MPa}$	Spool Type #1	Pilot Type	Drain Type	DR Port and Permissible Back Pres.	Fail-safe #1 Function	Input Signal Spool Travel Monitoring	Connector Type	Design Number
F : Required only if a phosphate ester-based fluid is used.	LSVHG : Two Stage Type Linear Servo Valves	03	EH : OBE Type	230 : 230 L/min	2L : 2 % Overlap (Linear Flow Gain)	None: Internal Pilot	None: External Drain	None: With DR Port (Permissible Back Pres.: 0.05 MPa)	None: Position Valve Opening: Pull A: P→A→B→T Position Valve Opening: Pull when a fail-safe solenoid operated valve is encountered EA: With Solenoid Operated Valve P→A→B→T Position Valve Opening: 10 % EB: With Solenoid Operated Valve P→A→B→T Position Valve Opening: 10 % W: Without DR Port (Wet Type Pilot Valve)	A: Voltage Signal 0→V B: Flow with Input Signal (V) C: Current Signal 4→20 mA D: Flow with Input Signal (V) E: Voltage Signal 0→V F: Flow with Input Signal (V) G: Current Signal 4→20 mA H: Current Signal 12→20 mA I: Current Signal 12→20 mA J: Current Signal 12→20 mA K: Flow with Input Signal (V)	1: (6 + PE Pole)	20
				270 : 270 L/min	2: 10 % Overlap							
				750 : 750 L/min	40 : Open Centre A, B & T							
				900 : 900 L/min 1300 : 1300 L/min	2P : Zero Lap (Dual Flow Gain)							

*1. For the valves with a fail-safe solenoid operated valve, select "EC" if the spool type "2" or "40" is selected, and select "EA" or "EB" if the spool type "2L" or "2P" is selected.

*2. The valves with the model number "W" (without DR port) cannot use water-glycol fluids.

*3. For the valves with a fail-safe solenoid operated valve, select "T" only for the connector type.

Specification

A value in parentheses in the specification table below is applicable to the models of "LSVHG-*EH-*-*-*W*-*" (without DR port).

Model Number			LSVHG-03EH-230- *			LSVHG-03EH-270- *			LSVHG-04EH-750- *			LSVHG-06EH-900- *			LSVHG-06EH-1300- *		
Item																	
Spool Type			2 L			2	40	2P	2	40	2P	2	40	2P	2	40	2P
Rated Flow at ΔP = 7 MPa (4-Way Valve)			230 L/min			270 L/min			750 L/min			900 L/min			1300 L/min		
Rated Flow at ΔP = 0.5 MPa (per Land)			87 L/min			102 L/min			283 L/min			340 L/min			490 L/min		
Max. Operating Pres.			31.5 MPa						35 MPa			35 MPa			31.5 MPa		
Proof Pres. at Return Port (1)	External Drain	T Port	21 MPa (5)						31.5 MPa			35 MPa			25 MPa		
		Y Port	21 (7) MPa (5)						21 (7) MPa								
	Internal Drain	T & Y Port	21 (7) MPa (5)						21 (7) MPa								
DR Port Permissible Back Pres. (2)			0.05 MPa (The valves with the model number "W" have no DR port.)														
Pilot Pres. (3)			1.5 — 21 MPa														
Pilot Flow Rate (4)			9 (8) L/min or more						20 (17) L/min or more			22 (19) L/min or more			23 (19) L/min or more		
Pilot Valve Leak (Viscosity: 32 mm ² /s)		P _s -P _r =14MPa Max. Leak Rate (L/min)	0.8						1.2								
Main Valve Leak (Viscosity: 32 mm ² /s)			1.6	0.5	1	5.6	0.8	1.6	6.8	0.9	1.8	7	1	2	8		
Hysteresis			0.1 % or less														
Step Response (0↔100 %)(Typical) (6)			8 (10) ms			7 (9) ms			11 (13) ms			11 (13) ms			15 (18) ms		
Frequency Response (± 25 % Amplitude) (Typical) (6)	Gain: - 3 dB		120 (100) Hz			125 (110) Hz			100 (90) Hz			100 (90) Hz			75 (70) Hz		
	Phase: - 90°		110 (90) Hz			110 (100) Hz			90 (90) Hz			90 (90) Hz			70 (75) Hz		
Vibration Proof (7)			100 m/s ²														
Protection			Equivalent to IP 65														
Ambient Temperature			0 — +50 °C														
Spool Stroke to Stops			±4 mm			±3.5 mm			±5 mm			±5 mm			±7 mm		
Spool End Area			3 cm ²						7 cm ²			8 cm ²			8 cm ²		
Polarity			See the description about I/O signal characteristics on page 23.														
Linear Motor Specification		Current	Max. 2.1 A														
		Coil Resistance	9.6 Ω (at 20 °C)														
Approx. Mass			8.5 kg [11kg]						14 kg [16kg]			20 kg [24kg]			20 kg [24kg]		
Electric Connection			6 + PE / 11+ PE Connector														

Note

- (1) Pressure at the return port should be at actual supply pressure or less.
- (2) Back pressure at the drain port should be 0.05 MPa or less and not be a negative pressure.
- (3) Supply pressure for the pilot valve should be 1.5—21 MPa and should also be 60 % of actual supply pressure or more.
- (4) The pilot flow is calculated based on 14 MPa of pilot pressure and the above step response.
- (5) To use the external pilot types with supply pressure of 21 MPa or more, pressure at the port T/Y should be 7 MPa or less.
- (6) This value is measured for each valve based on 14 MPa of pilot pressure; it may differ depending on the actual circuit/operation conditions.
- (7) There are restrictions on the mounting position; refer to the instructions for use.
- (8) A value in brackets indicates the mass of a valve with a fail-safe solenoid operated valve.
- (9) For the effective range of the fail-safe function, see page 41.

Attachment

Mounting Bolt

Model Number	Mounting Bolt	Qty.	Bolt Tightening Torque
LSVHG-03EH	Hex. Soc. Head Cap Screw: M6×35L	4	12.9—15.9 Nm
LSVHG-04EH	Hex. Soc. Head Cap Screw: M6×55L	2	12.9—15.9 Nm
	Hex. Soc. Head Cap Screw: M10×60L	4	60.6—74.1 Nm
LSVHG-06EH	Hex. Soc. Head Cap Screw: M12×85L	6	104—127 Nm

Connector

Model Number	Connector	Qty.	Remarks
LSVHG-*EH -*-*1	6 + PE Electrical Plug	1	EN175201
LSVHG-*EH -*-*2	11 + PE Electrical Plug	1	PART804-Compatible.

Electric Specifications

6 + PE Connector



Valve Model		LSVHG- *EH- *-A1 LSVHG- *EH- *-D1	LSVHG- *EH- *-B1 LSVHG- *EH- *-E1	LSVHG- *EH- *-C1 LSVHG- *EH- *-F1
Pin				
Pin A	Power Supply	24 V DC (including 21.6– 26.4 V DC ripple), 50 VA or more		
Pin B		0 V		
Pin C	Signal Common	COM (0 V)		
Pin D	Input (+) (Differential) *1	0– ±10 V	4–20 mA	0– ±10 mA
Pin E	Input (-) (Differential) *1	$R_i = 100\text{ k}\Omega$	$R_i = 200\ \Omega$	$R_i = 200\ \Omega$
Pin F	Spool Travel Monitoring	0– ±10 V $R_L \geq 10\text{ k}\Omega$	4–20 mA $R_L = 100\text{--}500\ \Omega$ *2	0– ±10 mA $R_L = 100\text{--}500\ \Omega$ *2
Pin	Protective Earth	—		

11 + PE Connector



Valve Model		LSVHG- *EH- *-A2 LSVHG- *EH- *-D2	LSVHG- *EH- *-B2 LSVHG- *EH- *-E2	LSVHG- *EH- *-C2 LSVHG- *EH- *-F2
Pin				
Pin 1	Power Supply	24 V DC (including 21.6– 26.4 V DC ripple), 50 VA or more		
Pin 2		0 V		
Pin 3	Enable (Servo ON) Input	Input Current = 3–5 mA at 4.8–28 V DC		
Pin 4	Input (+) (Differential) *1	0– ±10 V	4–20 mA	0– ±10 mA
Pin 5	Input (-) (Differential) *1	$R_i = 100\text{ k}\Omega$	$R_i = 200\ \Omega$	$R_i = 200\ \Omega$
Pin 6	Spool Travel Monitoring	0– ±10 V $R_L \geq 10\text{ k}\Omega$	4–20 mA $R_L = 100\text{--}500\ \Omega$ *2	0– ±10 mA $R_L = 100\text{--}500\ \Omega$ *2
Pin 7	Signal Common	COM (0 V)		
Pin 8	Valve Ready Output	OPEN Collector Output Voltage: Max. 30V, Current: Max. 20 mA		
Pin 9 *3	Power Source (For Solenoid Operated Valve)	24 V DC (including 21.6– 26.4 V DC ripple), 14 VA Holding Current: 0.6 A		
Pin 10 *3		0 V		
Pin 11	Alarm Output	OPEN Collector Output Voltage: Max. 30V, Current: Max. 20 mA		
Pin	Protective Earth	—		

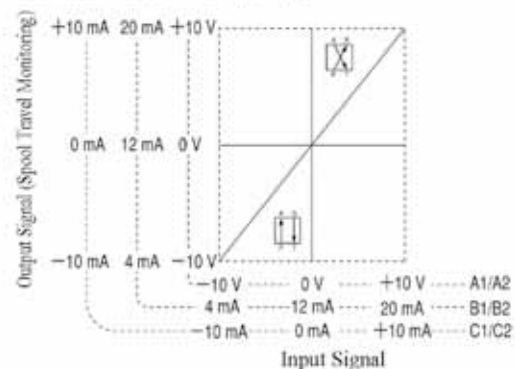
*1. Differential input signals can be used only for the valves with the voltage signal $\pm 10\text{ V}$ selected (LSVHG- *EH- A*/D*).

*2. The recommended load resistance is $200\ \Omega$.

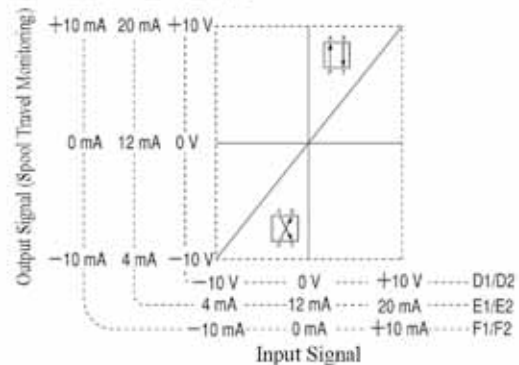
*3. Pins 9 and 10 are used only for the valves with a fail-safe solenoid operated valve mounted. In this case, use a separate power source of the solenoid operated valve from the power source of the amplifier (Pins 1 and 2).

I/O Signal Characteristics

• LSVHG- *EH- *-A*/B*/C*

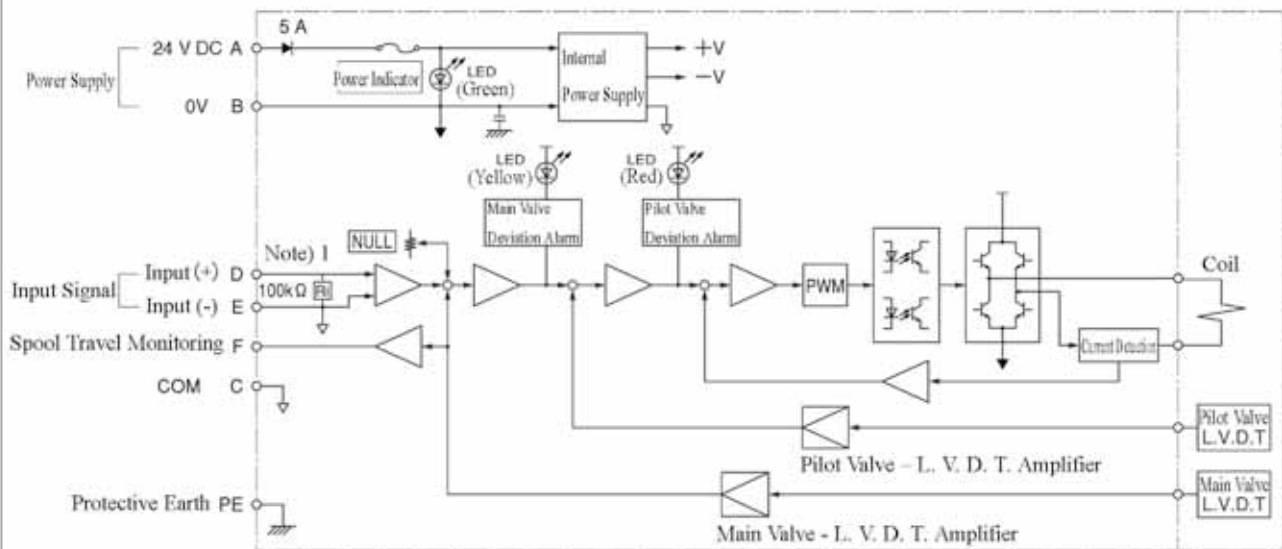


• LSVHG- *EH- *-D*/E*/F*

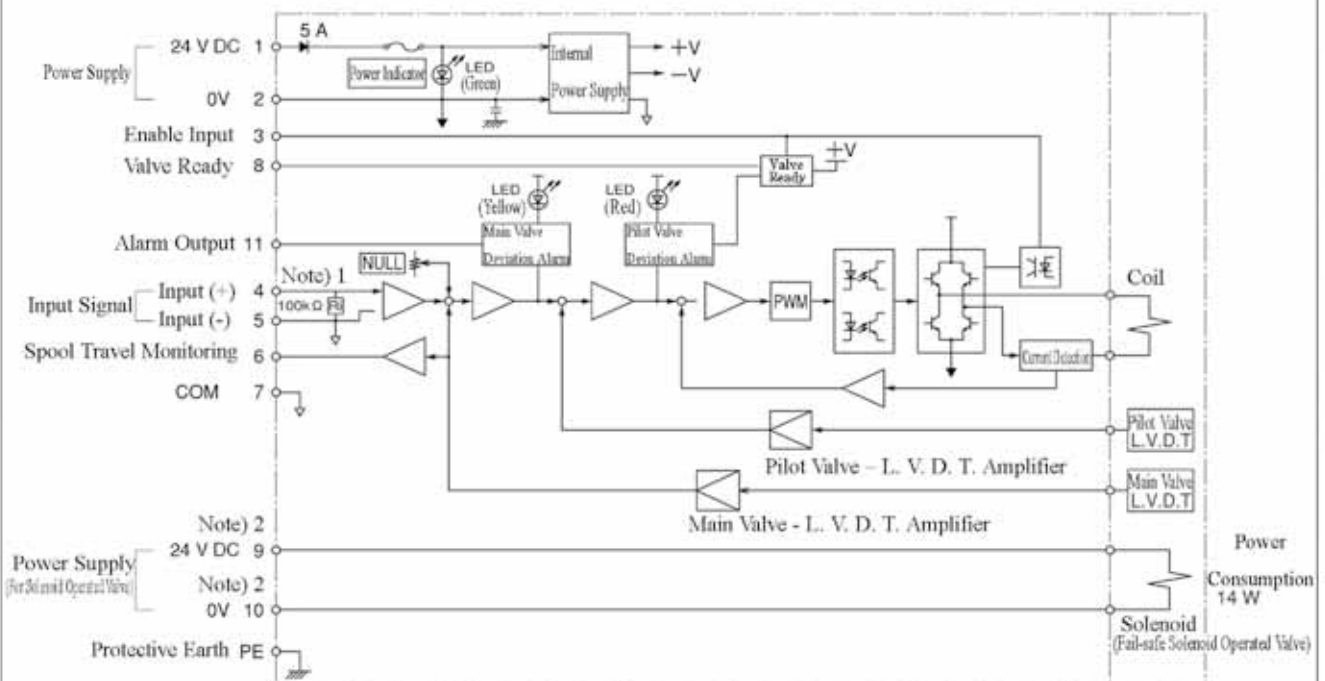


Block Diagram

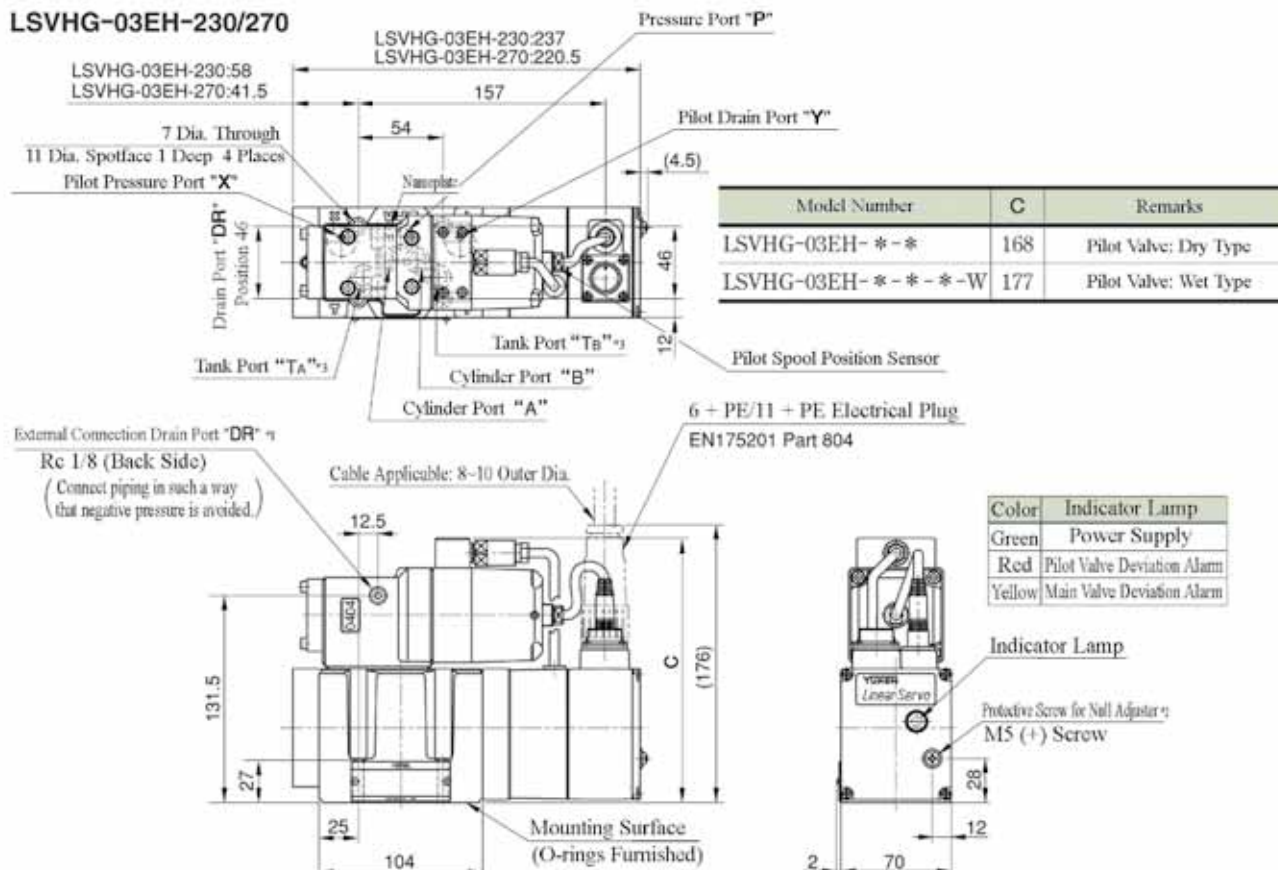
● LSVHG-*EH-*-A1/D1(6 + PE Connector)



● LSVHG-*EH-*-A2/D2(11 + PE Connector)



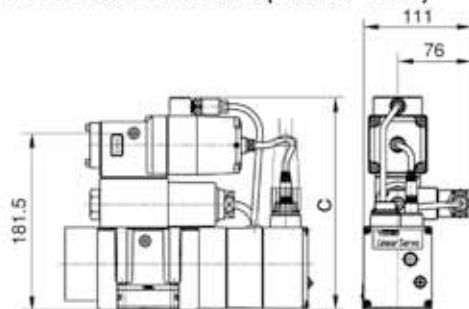
LSVHG-03EH-230/270



*1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.

*2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

LSVHG-03EH-230/270-**-**EA/EB/EC
(With Fail-safe Solenoid Operated Valve)



Model Number	C	Remarks
LSVHG-03EH- * - * -E *	218	Pilot Valve: Dry Type
LSVHG-03EH- * - * -WE *	227	Pilot Valve: Wet Type

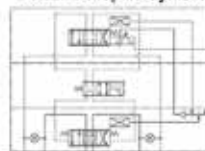
● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

- O-rings for the Ports

Port	O-ring Size	Qty.
P, A, B, T	AS568-014 (NBR, Hs90)	5
X, Y	AS568-016 (NBR, Hs90)	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

Detailed Graphic Symbol



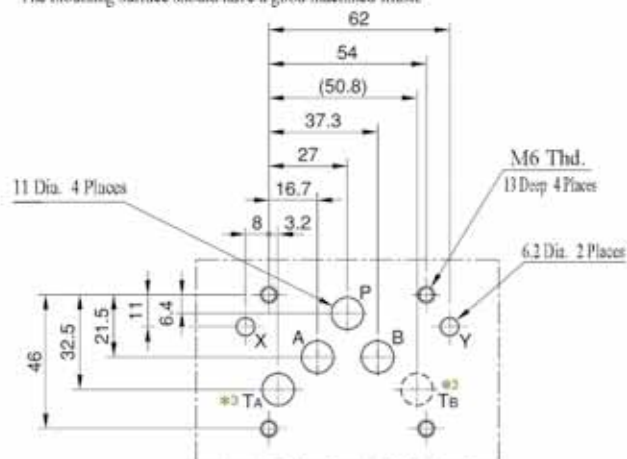
Note) The configuration in the shaded area varies with the selected spool type (corresponding to Graphic Symbols on page 21).

⊗:Plugs for selecting the pilot and drain types

[Mounting Surface]

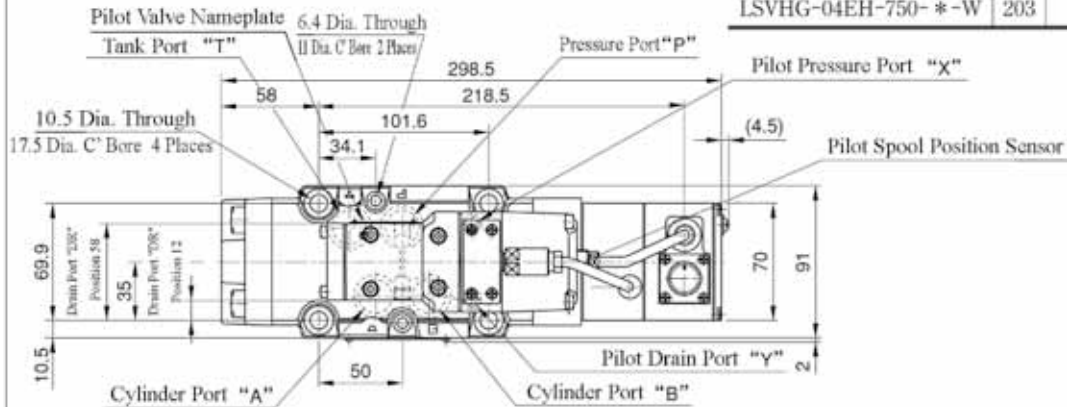
Prepare a mounting surface shown below. Basically, the dimensions of the mounting surface conform to ISO 4401-AC-05-4-A-80 (ISO 4401-05-05-0-94).

The mounting surface should have a good machined finish.



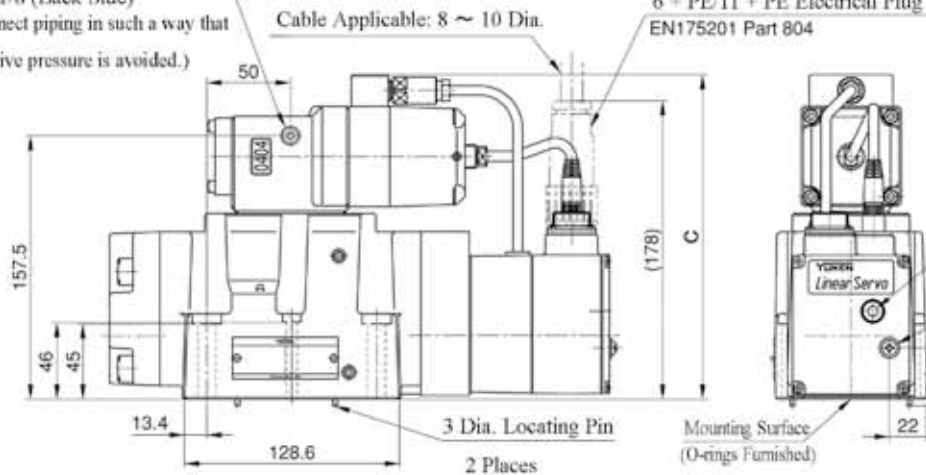
*3. There are two tank ports "TA" and "TIC" however, "TA" may be used alone.

LSVHG-04EH-750



Model Number	C	Remarks
LSVHG-04EH-750-*	194	Pilot Valve: Dry Type
LSVHG-04EH-750- *-W	203	Pilot Valve: Wet Type

External Connection Drain Port "DR" *1
Rc 1/8 (Back Side)
(Connect piping in such a way that negative pressure is avoided.)

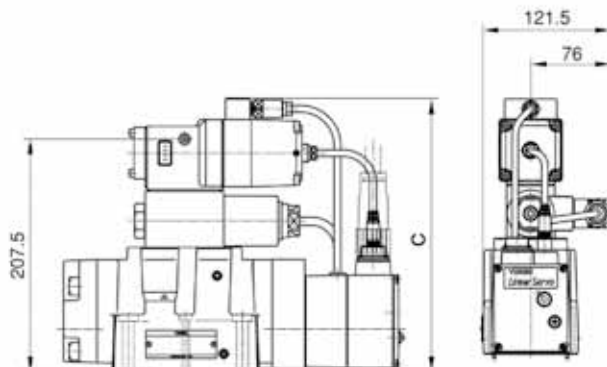


Color	Indicator Lamp
Green	Power Supply
Red	Pilot Valve Deviation Alarm
Yellow	Main Valve Deviation Alarm

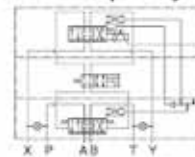
*1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.

*2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

LSVHG-04EH-750- *- * EA/EB/EC (With Fail-safe Solenoid Operated Valve)



Detailed Graphic Symbol



Note) The configuration in the shaded area varies with the selected spool type (corresponding to Graphic Symbols on page 21).

⊗: Plugs for selecting the pilot and drain types

Model Number	C	Remarks
LSVHG-04EH-750- *-E*	244	Pilot Valve: Dry Type
LSVHG-04EH-750- *-WE*	253	Pilot Valve: Wet Type

● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

[Mounting Surface]

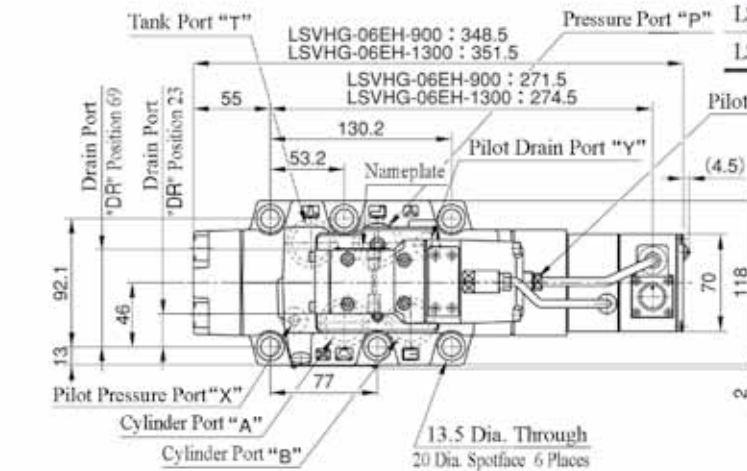
The dimensions of the mounting surface are the same as those of the models LSVHG-04 (page 11).

● O-rings for the Ports

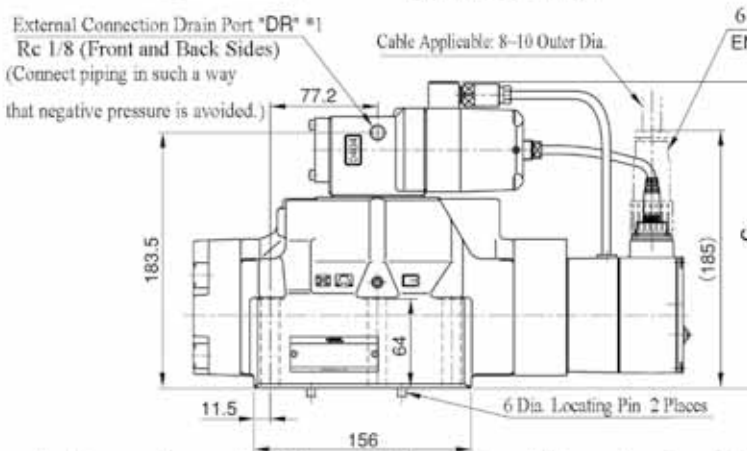
Port	O-ring Size	Qty.
P, A, B, T	SO-NB-P22	4
X, Y	AS568-012 (NBR, Hs90)	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

LSVHG-06EH-900/1300

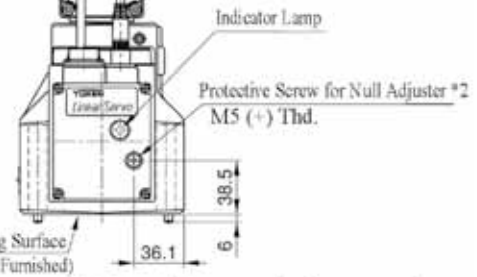


Model Number	C	Remarks
LSVHG-06EH- * - *	244	Pilot Valve: Dry Type
LSVHG-06EH- * - *-W	253	Pilot Valve: Wet Type



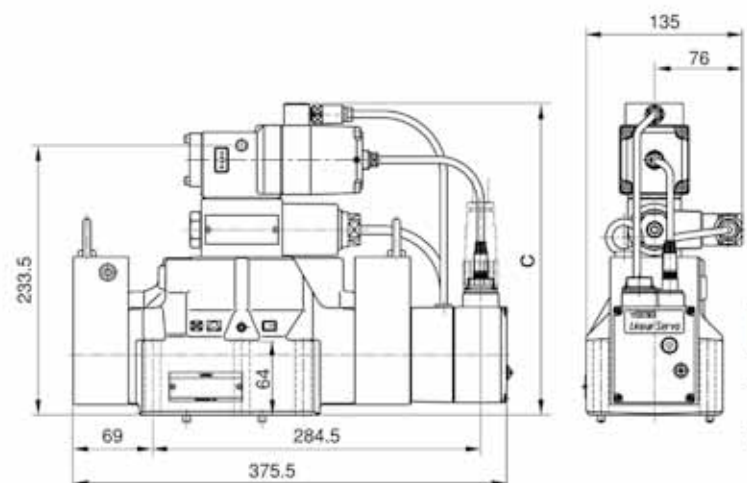
6 + PE/11 + PE Electrical Plug
EN175201 Part 804

Color	Indicator Lamp
Green	Power Supply
Red	Pilot Valve Deviation Alarm
Yellow	Main Valve Deviation Alarm

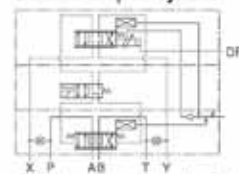


- *1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.
- *2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

LSVHG-06EH-900/1300- * - * EA/EB/EC (With Fail-safe Solenoid Operated Valve)



Detailed Graphic Symbol



⊗ : Plugs for selecting the pilot and drain types
Note) The configuration in the shaded area varies with the selected spool type (corresponding to Graphic Symbols on page 21).

Model Number	C	Remarks
LSVHG-06EH- * - *-E*	270	Pilot Valve: Dry Type
LSVHG-06EH- * - *-WE*	279	Pilot Valve: Wet Type

● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

● O-rings for the Ports

Port	O-ring Size		Qty.
	LSVHG-06EH-900	LSVHG-06EH-1300	
P, A, B, T	AS568-123 (NBR, Hs90)	AS568-126 (NBR, Hs90)	4
X, Y	SO-NB-P14		2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

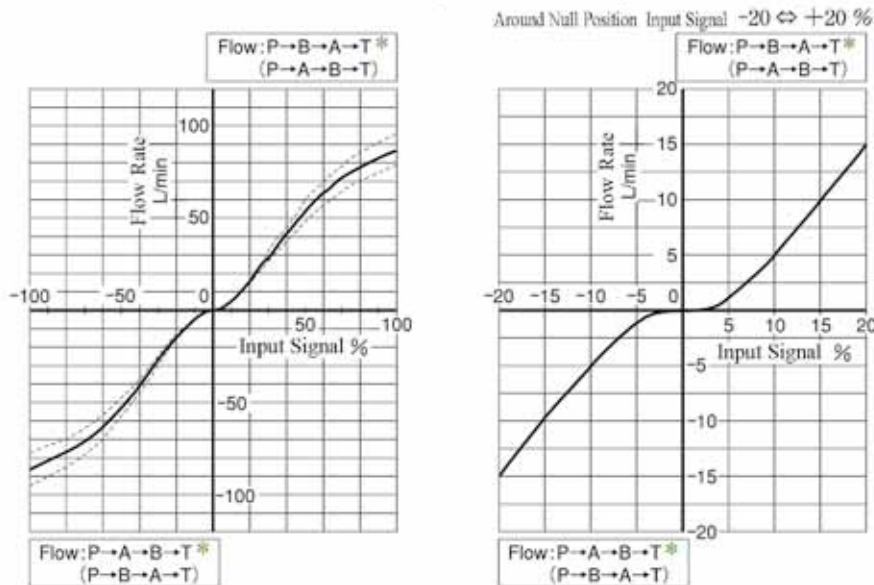
[Mounting Surface]

The dimensions of the mounting surface are the same as those of the models LSVHG-06 (page 12).

Characteristics of LSVHG-03EH-230 (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

<Conditions> Valve Pressure Difference: 1 MPa (Pressure Difference per Land: 0.5 MPa)

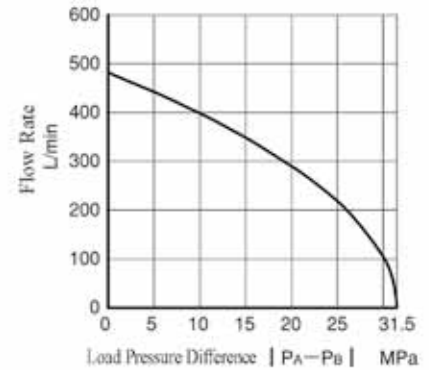


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow: ±10 %

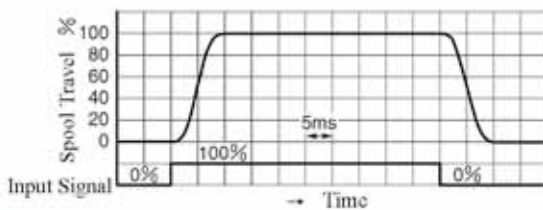


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

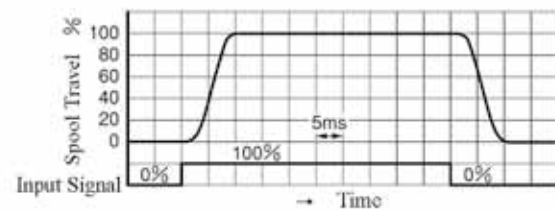
Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



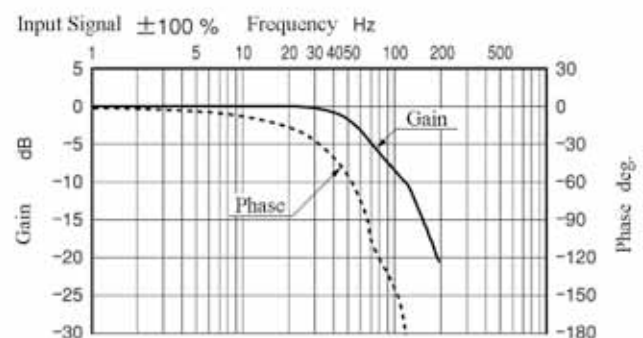
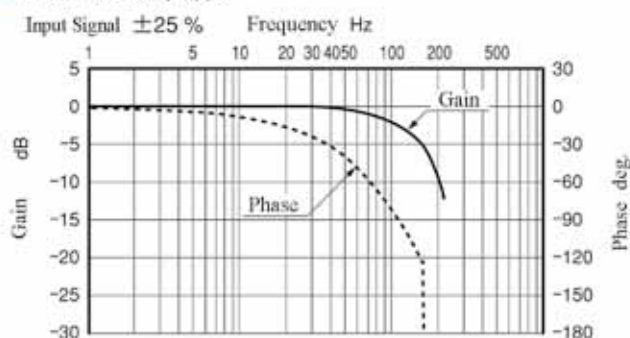
Pilot Valve: Wet Type



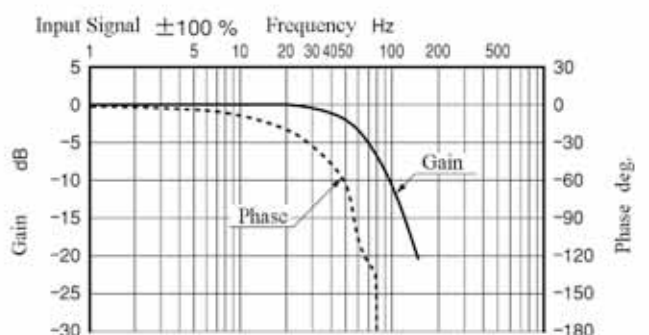
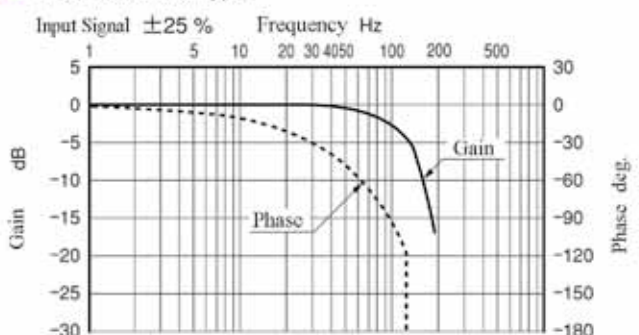
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



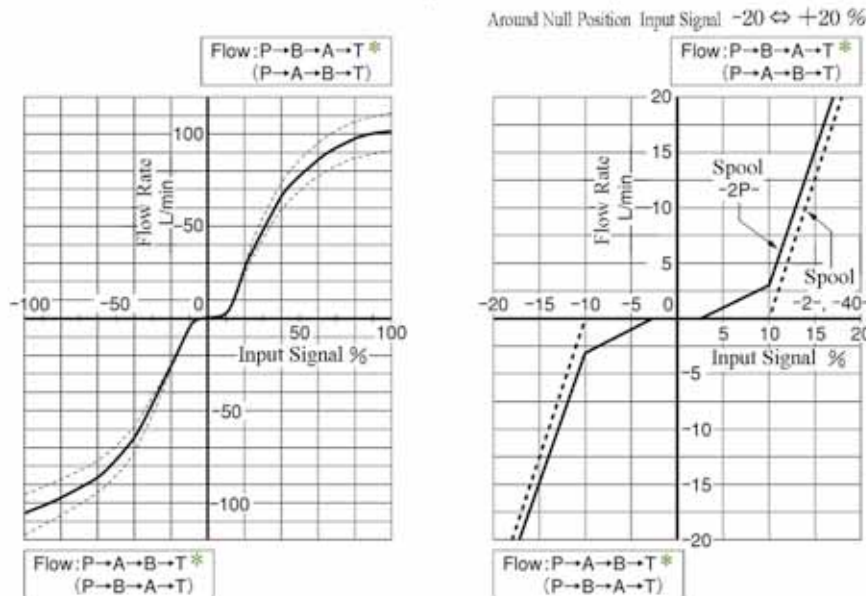
Pilot Valve: Wet Type



Characteristics of LSVHG-03EH-270 (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

<Conditions> Valve Pressure Difference: 1 MPa (Pressure Difference per Land: 0.5 MPa)

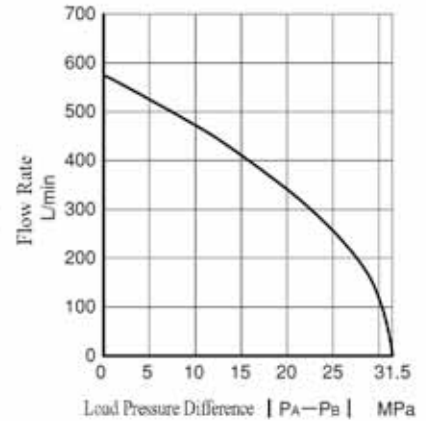


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow : ±10 %

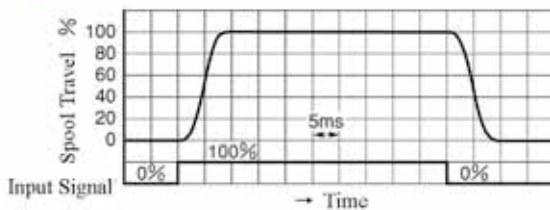


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

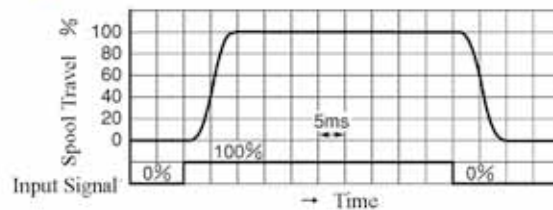
Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



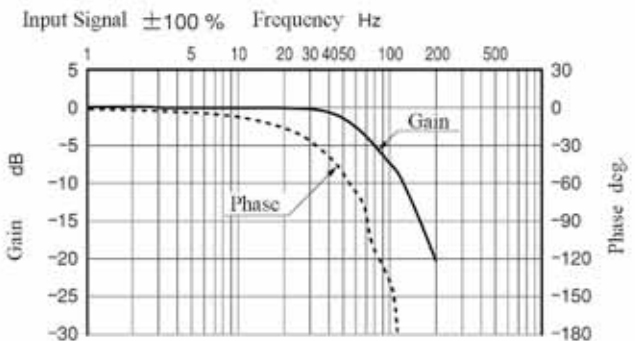
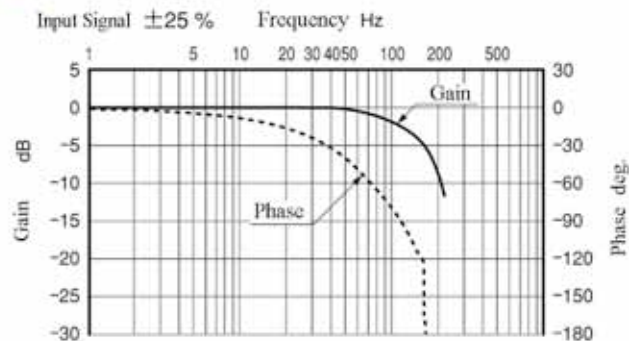
Pilot Valve: Wet Type



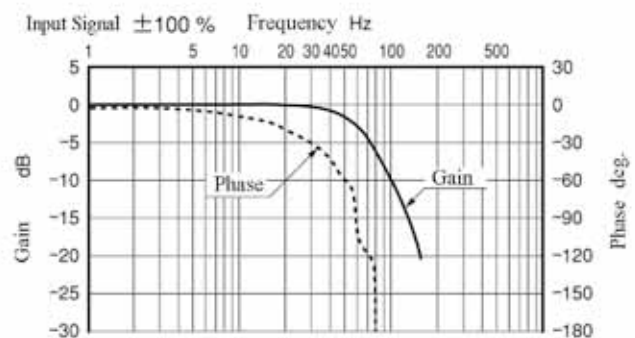
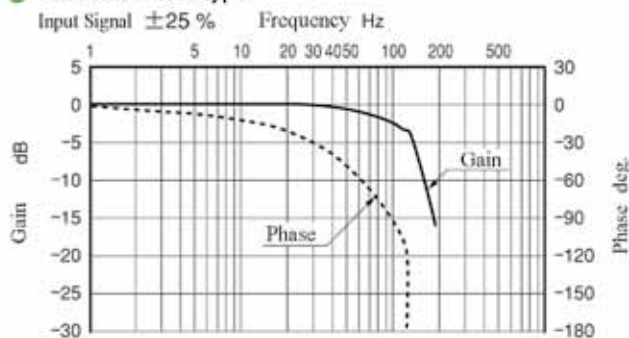
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



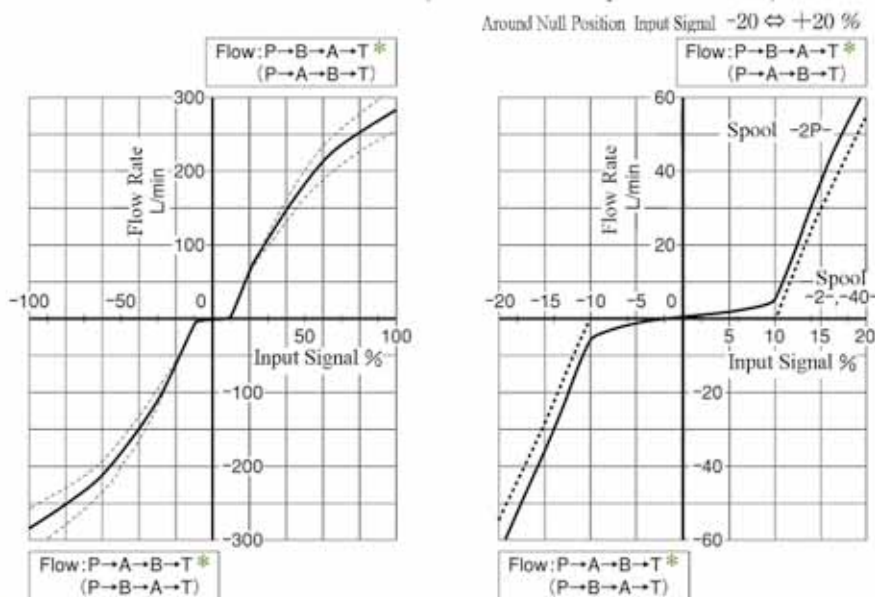
Pilot Valve: Wet Type



Characteristics of LSVHG-04EH-750 (Fluid Viscosity: 30mm²/S)

■ No-Load Flow Characteristics

<Conditions> Valve Pressure Difference: 1 MPa (Pressure Difference per Land: 0.5 MPa)

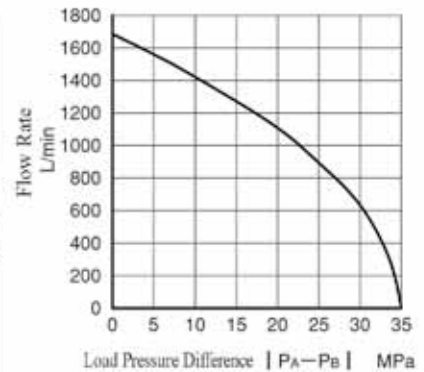


■ Load Flow Characteristics

<Conditions>

● Input Signal: 100 %

Note) Tolerance of Load Flow: $\pm 10\%$

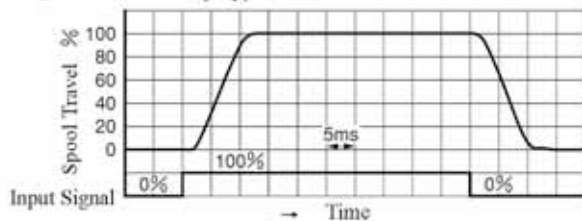


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

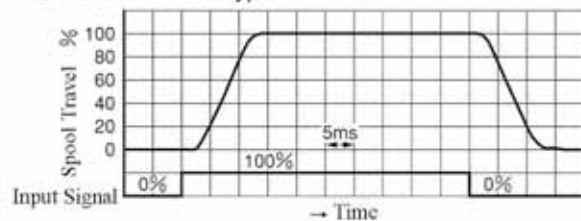
■ Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

- Pilot Valve: Dry Type



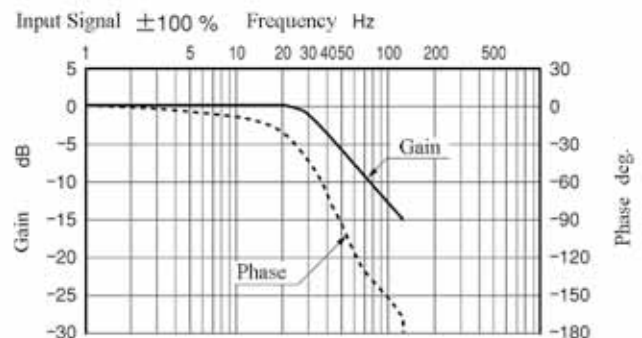
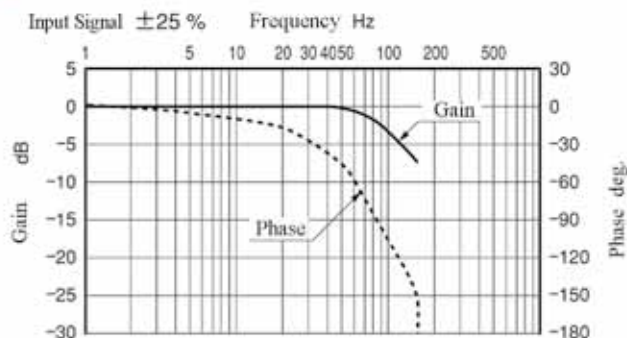
- Pilot Valve: Wet Type



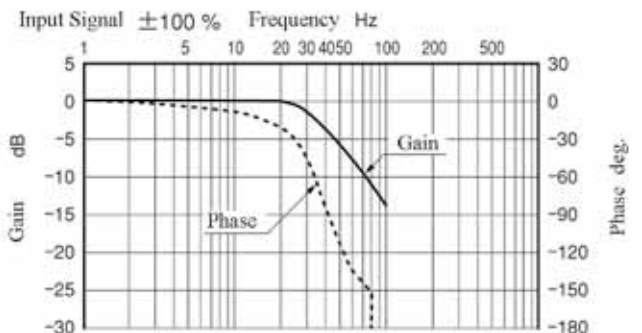
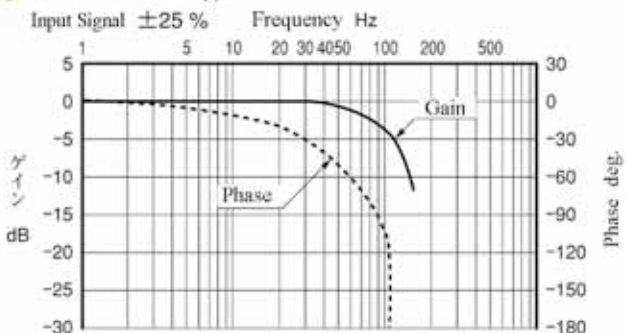
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

- **Pilot Valve: Dry Type**



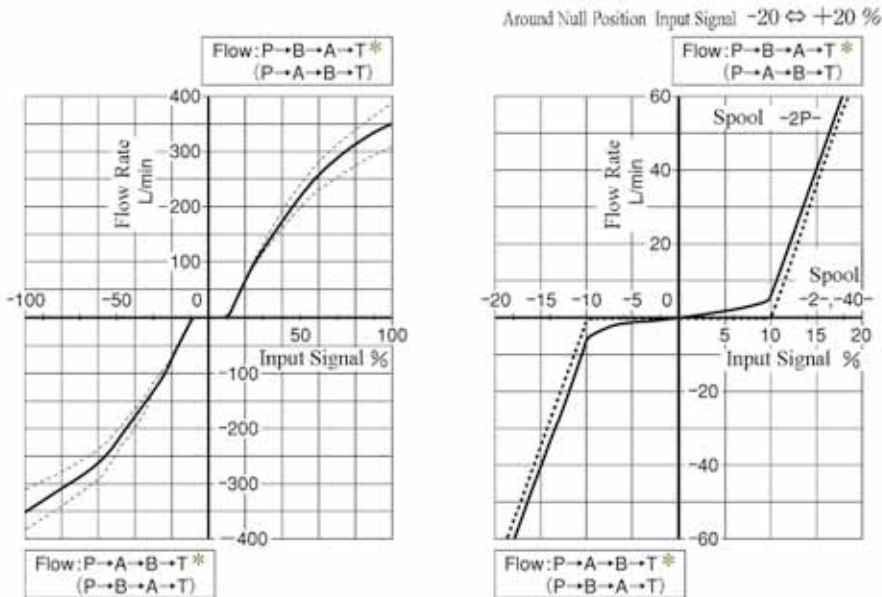
- **Pilot Valve: Wet Type**



Characteristics of LSVHG-06EH-900 (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

<Conditions> Valve Pressure Difference: 1 MPa (Pressure Difference per Land: 0.5 MPa)

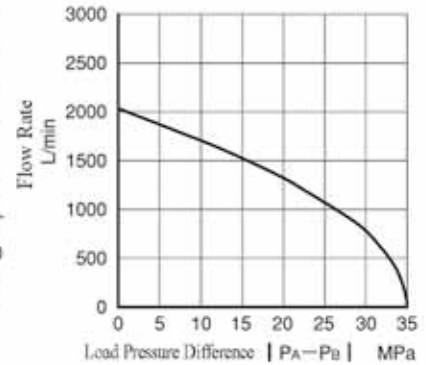


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow : ±10 %

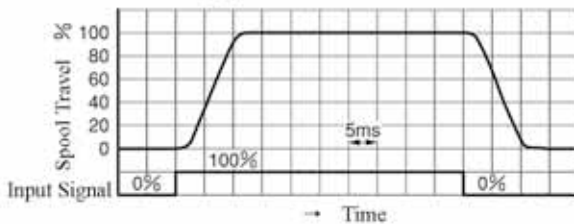


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

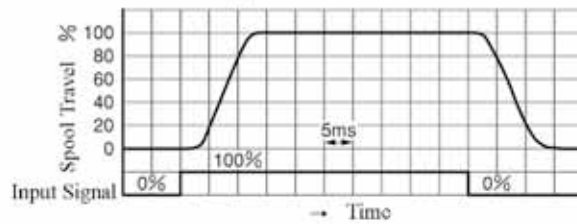
Step Response

<Conditions> ● Input Signal : 0 ↔ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



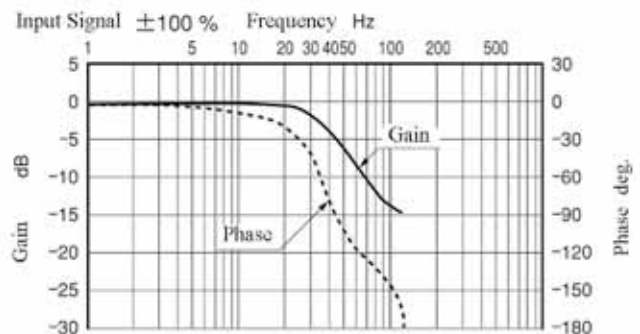
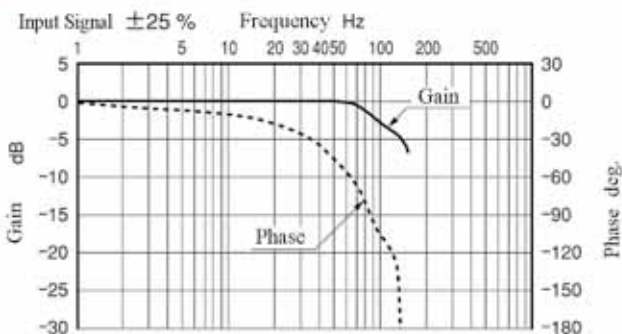
Pilot Valve: Wet Type



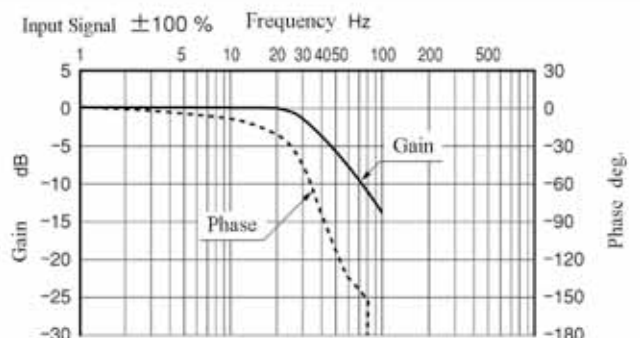
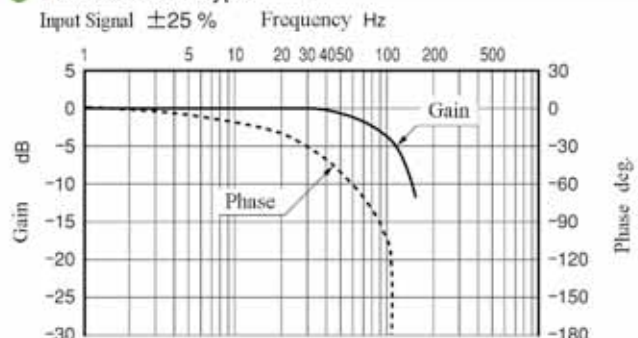
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



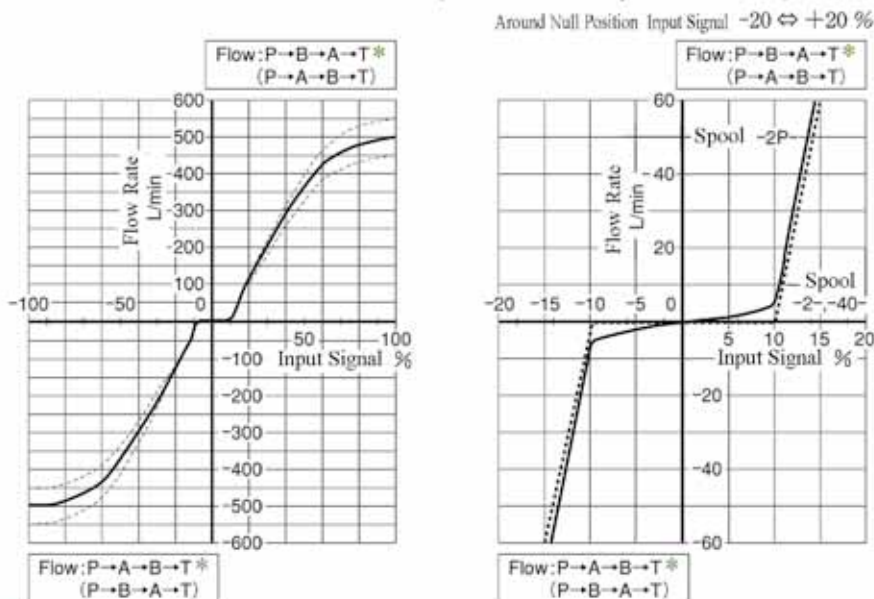
Pilot Valve: Wet Type



Characteristics of LSVHG-06EH-1300 (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

<Conditions> Valve Pressure Difference: 1 MPa (Pressure Difference per Land: 0.5 MPa)

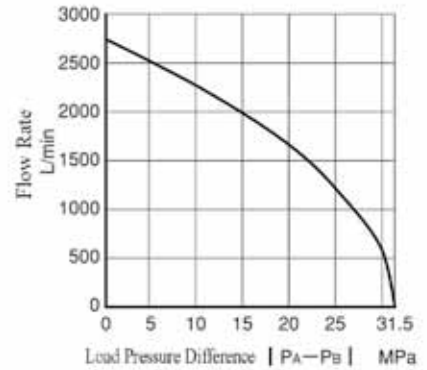


Load Flow Characteristics

<Conditions>

● Input Signal: 100 %

Note) Tolerance of Load Flow: ±10 %

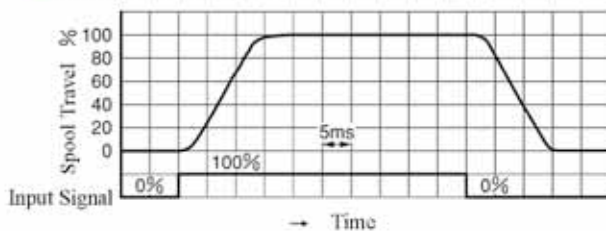


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

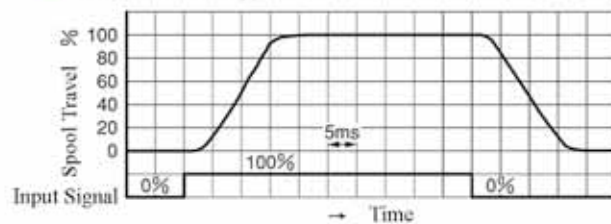
Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



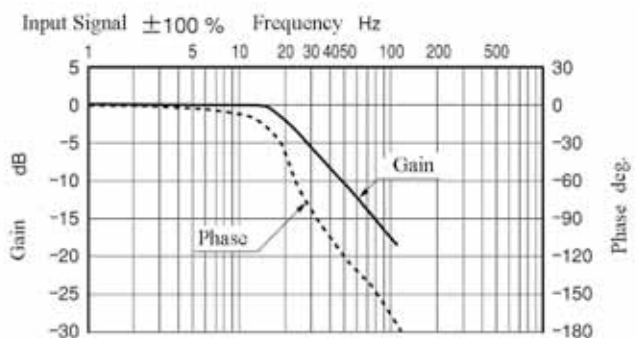
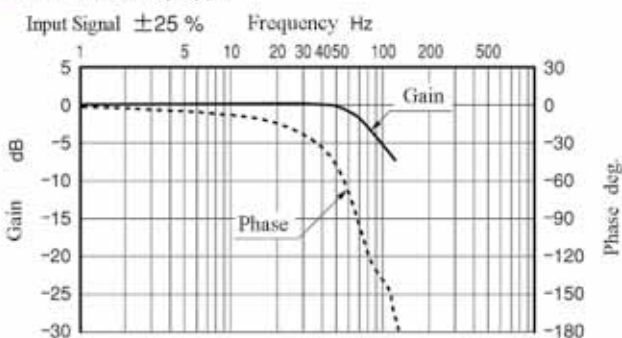
Pilot Valve: Wet Type



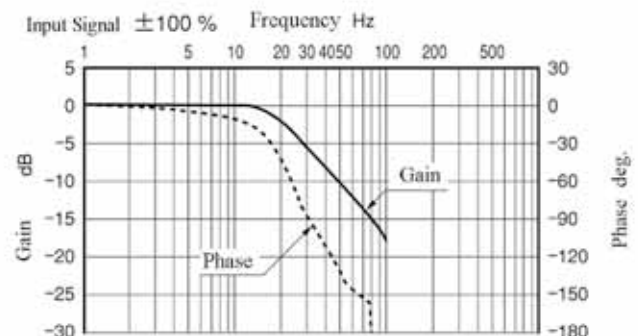
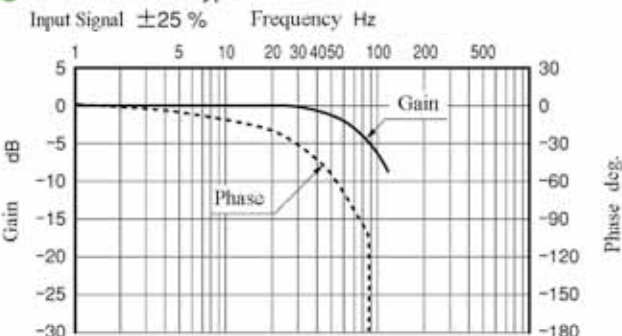
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



Pilot Valve: Wet Type



OBE(On-Board Electronic)type Linear Servo Valves (High Performance Type)

OBE (on-board electronic) type linear servo valves (high performance type) are produced for achieving higher accuracy and durability by incorporating a sleeve in the main stage of the OBE (on-board electronic) type linear servo valve (std. type), which has been well accepted for its "high accuracy, easiness to use, and great usability."

Since the spool and the sleeve are processed to fit well and properly keep 1 % overlap between one another, they are suited to be used for a system requiring high accuracy and durability.

High accuracy

As similar to the standard type valves, all of the high performance type valves have a hysteresis of 0.1 % or less, realizing high accuracy. These valves allow the main unit to operate with much higher repeatability.

High response characteristics

Compared to other equivalent models, these valves provide higher levels of step and frequency responses, which are typically used as measures of response characteristics; the step response is 7 ms (0→100 %)*, and the frequency response is 110 Hz/± 3 dB (± 25 % amplitude)* (*: Representative values for LSVHG-03EH-※S※).

Easiness to use

These valves can offer high accuracy for hydraulic control systems just with the power supply of 24 VDC and the input of command signals.

Six types of input signals in three input voltage/current ranges are available: 0—± 10 V, 0—± 10 mA, and 4—20 mA.

Great usability

The small amplifier in the valves has a fault indicator lamp. This lamp indicates an error when valve failure causes any deviation between the spool position commanded by the signal and the actual spool position. It facilitates you to immediately troubleshoot the failure of the valves, if any.

Excellent contamination resistance

As similar to the high-speed linear servo valves, OBE type linear servo valves have a simple pilot valve structure, exhibiting excellent contamination resistance. The permissible level of fluid contamination for these valves is up to NAS 1638 class 10.

Two types of pilot valves available

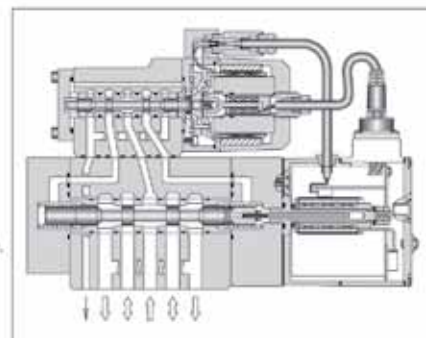
There are two types of pilot valves available: a dry type good in response characteristics and a wet type that eliminates drain (DR) port to improve usability. They can be selected according to users' purposes.

Model Number Designation

F—	LSVHG	—06	EH	—900	—S	4	—E	T	—W	A	—A	1	—20
Fluid Type	Series Number	Valve Size	Amplifier Type	Rated Flow at ΔP = 7 MPa	Spool Type	Control Method	Pilot Type	Drain Type	DR Port and Permissible Back Pres.	Fail-safe function	Input Signal/Spool Travel Monitoring	Connector Type	Design Number
F : Required only if a phosphate ester-based fluid is used.	LSVHG : Two Stage Type Linear Servo Valves	03	EH : OBE Type	60 : 60 L/min 100 : 100 L/min 160 : 160 L/min	S : 1% Overlap 	3 : 3-Way Valve *1 (Port A is used)	None Internal Pilot	None External Drain	None Back Pres.: 0.05 MPa W: Without DR Port *2 (Wet Type Pilot Valve)	None Position Valve Opening: Full A: P→A→B→T Position Valve Opening: Full Applicable only when a fail-safe solenoid operated valve is mounted EA: With Solenoid Operated Valve P→A→B→T Position Valve Opening: 10 % EB: With Solenoid Operated Valve P→B→A→T Position Valve Opening: 10 %	A: Voltage Signal 4-20 V ①→B→A→T Flow with Input Signal (+) ② B: Current Signal 4-20 mA ①→B→A→T Flow with Current Signal (1-20 mA) ②→B→A→T Flow with Input Signal (V) D: Voltage Signal 4-20 V ①→A→B→T Flow with Input Signal (+) ② E: Current Signal 4-20 mA ①→A→B→T Flow with Current Signal (1-20 mA) F: Current Signal 4-20 mA ①→A→B→T Flow with Input Signal (V)	1 : 6 + PE Pole 2 : 11 + PE Pole	20
		04		100 : 100 L/min 200 : 200 L/min 280 : 280 L/min 450 : 450 L/min									
		06		500 : 500 L/min 900 : 900 L/min									

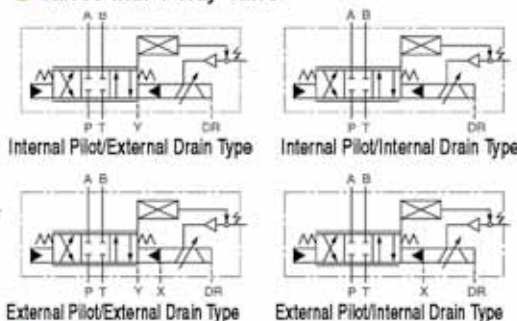
*1. For the valves with a 3-way valve and a fail-safe solenoid operated valve, select "EB" for the fail-safe function type and "D," "E," or "F" for the input signal/spool travel monitoring type.

*2. The valves with the model number "W" (without DR port) cannot use water-glycol fluids.

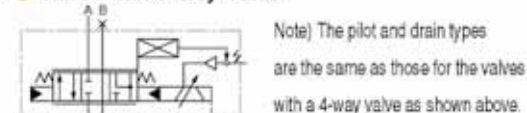


Graphic Symbols

Valves with 4-Way Valve



Valves with 3-Way Valve



Specification

A value in parentheses in the specification table below is applicable to models of "LSVHG-03EH-**-S*" (without DR port).

Model Number			LSVHG-03EH- *-S*						LSVHG-04EH- *-S*						LSVHG-06EH - *-S*							
Item			S4			S3			S4			S3			S4		S3					
Spool Type			S4		S3		S4		S3		S4		S3		S4		S3					
Rated Flow at ΔP = 7 MPa (4-Way Valve)			L/min	60	100	160	—	—	—	100	200	280	450	—	—	—	500	900	—	—		
Rated Flow at ΔP = 3.5 MPa (3-Way Valve)			L/min	—	—	—	60	100	160	—	—	—	—	100	200	280	450	—	—	500	900	
Max. Operating Pres.			MPa	31.5						35						35						
Proof Pres. at Return Port ⁽¹⁾	External	T Port	MPa	21						31.5						35						
	Drain	Y Port	MPa	21 ⁽²⁾ (7)						21 (7)						21 (7)						
	Internal Drain	T & Y Port	MPa	21 ⁽²⁾ (7)						21 (7)						21 (7)						
DR Port Permissible Back Pres. ⁽²⁾			MPa	0.05 (The valves with the model number “W” have no DR port.)																		
Pilot Pres. ⁽³⁾			MPa	1.5—21																		
Pilot Flow Rate ⁽⁴⁾			L/min	4 or more						6 or more						21 or more						
Pilot Valve Leak (Max.)	P _S -P _R =14MPa (Fluid Viscosity: 32 mm ² /s)	L/min	0.4																1.2			
Main Valve Leak (Max.)		L/min	0.6	1.1	2.1	0.3	0.6	1.1	0.9	1.7	2.5	5.0	0.5	0.9	1.3	2.5	1.9	4.8	1.0	2.4		
Hysteresis			%	0.1 or less																		
Step Response (0—100 %)(Representative Value) ⁽⁵⁾			ms	7 (8)						11 (12)						12 (13)						
Frequency Response (Representative Value) ⁽⁶⁾	Gain: -3 dB (± 25 % Amplitude)	Hz	110 (80)						100 (80)						100 (80)							
	Phase: -90° (± 25 % Amplitude)	Hz	110 (90)						100 (90)						95 (90)							
Vibration Proof ⁽⁷⁾			—	100 m/s ²																		
Protection			—	Equivalent to IP 65																		
Ambient Temperature			°C	0—+50																		
Spool Stroke to Stops			mm	±3.5						±3.5						±5						
Spool End Area			cm ²	1.3						3.1						8						
Linear Motor Specification	Current	A	Max. 2.1																			
	Coil Resistance at 20°C	Ω	9.6																			
Approx. Mass ⁽⁸⁾			kg	8.5 [11]						14 [16]						20 [24]						
Mounting Surface				ISO 4401-05-05-0-94						ISO 4401-07-06-0-94						ISO 4401-08-07-0-94						
Electric Connection				6 + PE/11 + PE Connector (EN175201 Part 804)																		

Note

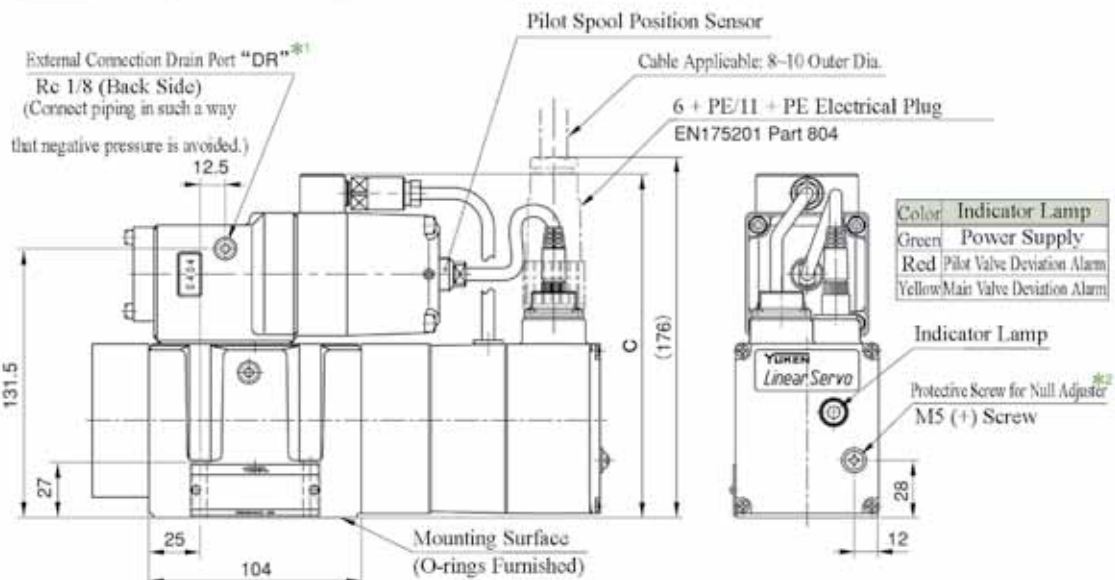
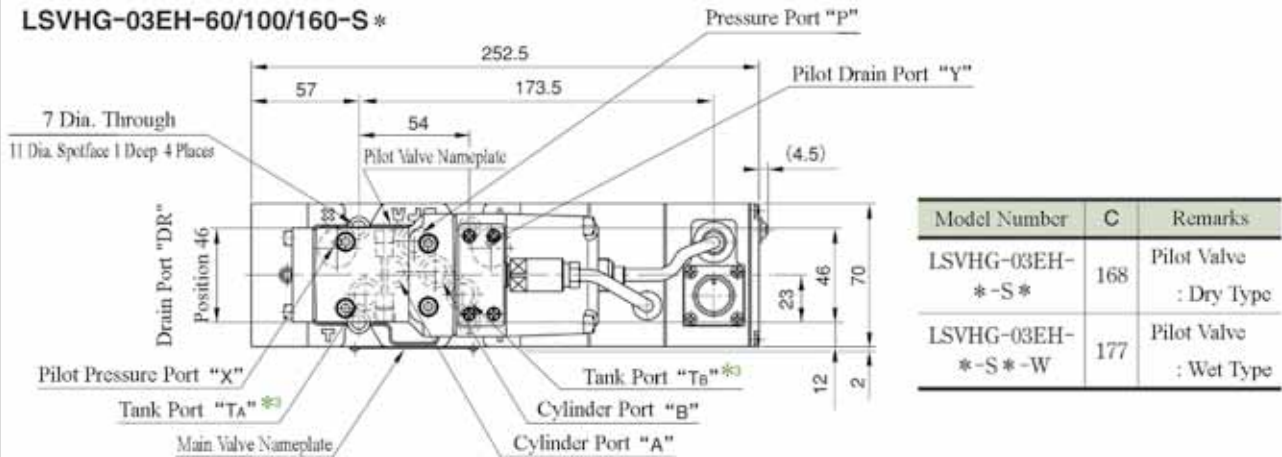
- (1) Pressure at the return port should be at actual supply pressure or less.
- (2) Back pressure at the drain port should be 0.05 MPa or less and not be a negative pressure. The valves with the model number "W" have no DR port.
- (3) Supply pressure for the pilot valve should be 1.5—21 MPa and should also be 60 % of actual supply pressure or more.
- (4) The pilot flow is calculated based on 14 MPa of pilot pressure and the above step response.
- (5) This value is measured for each valve based on 14 MPa of pilot pressure; it may differ depending on the actual circuit/operation conditions.
- (6) There are restrictions on the mounting position; refer to the instructions for use.
- (7) To use the external pilot types with supply pressure of 21 MPa or more, pressure at the port T/Y should be 7 MPa or less.
- (8) A value in brackets indicates the mass of a valve with a fail-safe solenoid operated valve.
- (9) For the effective range of the fail-safe function, see page 41.

Attachment, Electric Specifications, and Block Diagrams

These are the same as to those of the standard type. See the relevant pages.

Item	Page for reference
Attachment	22
Electric Specifications	23
Block Diagrams	24

LSVHG-03EH-60/100/160-S *



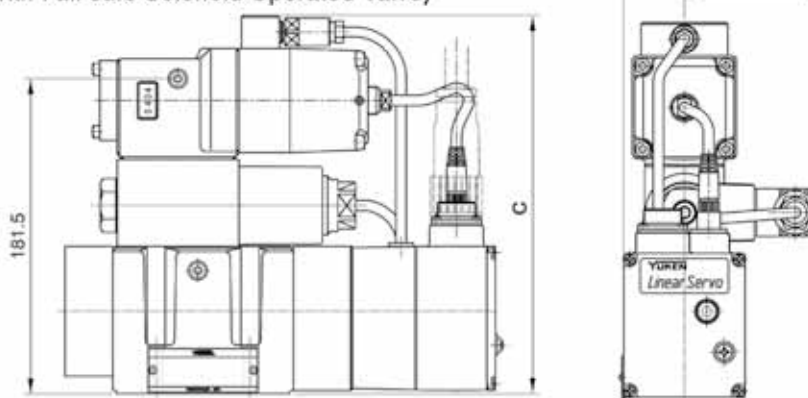
*1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.

*2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

*3. There are two tank ports "TA" and "TB" however, "TA" may be used alone.

LSVHG-03EH-60/100/160-S *-EA/EB

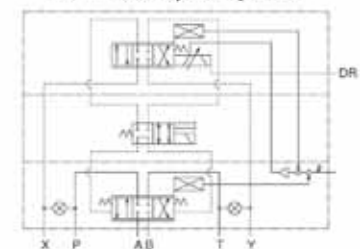
(With Fail-safe Solenoid Operated Valve)



[Mounting Surface]

The dimensions of the mounting surface are the same as those of the models LSVHG-03EH (page 25).

Detailed Graphic Symbol



⊗: Plugs for selecting the pilot and drain types

● O-rings for the Ports

Port	O-ring Size	Qty.
P, A, B, T	AS568-014 (NBR, Hs90)	5
X, Y	AS568-016 (NBR, Hs90)	2

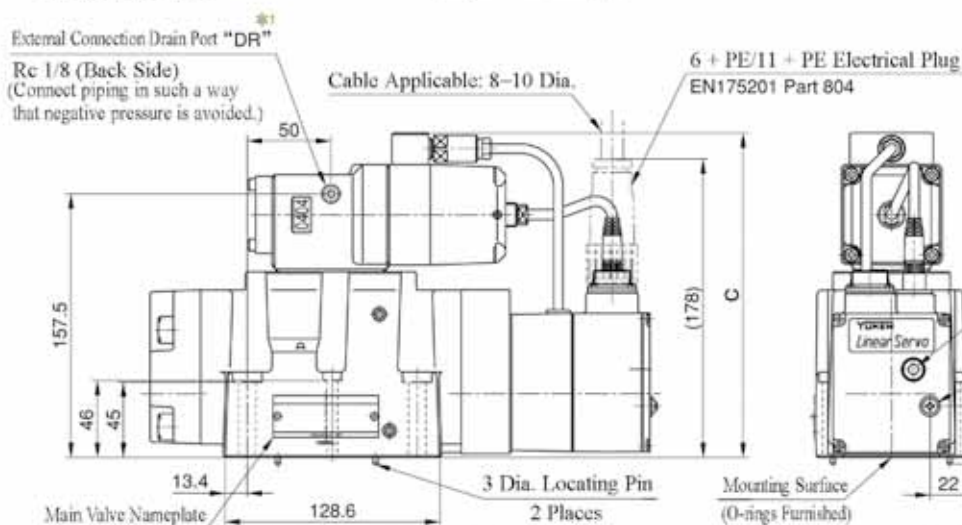
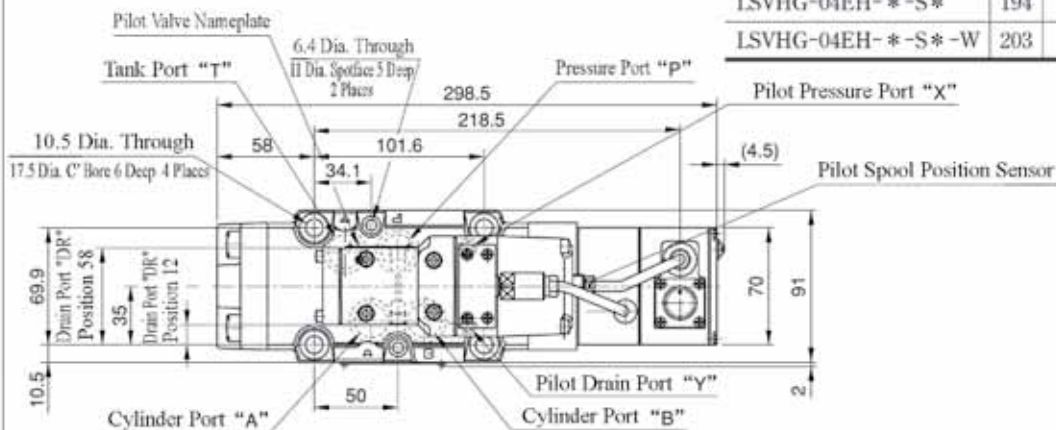
O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

Model Number	C	Remarks
LSVHG-03EH- *-S*-E*	218	Pilot Valve: Dry Type
LSVHG-03EH- *-S*-WE*	227	Pilot Valve: Wet Type

● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

LSVHG-04EH-100/200/280/450-S*

Model Number	C	Remarks
LSVHG-04EH-*-*S*	194	Pilot Valve: Dry Type
LSVHG-04EH-*-*S*-W	203	Pilot Valve: Wet Type



Color	Indicator Lamp
Green	Power Supply
Red	Pilot Valve Deviation Alarm
Yellow	Main Valve Deviation Alarm

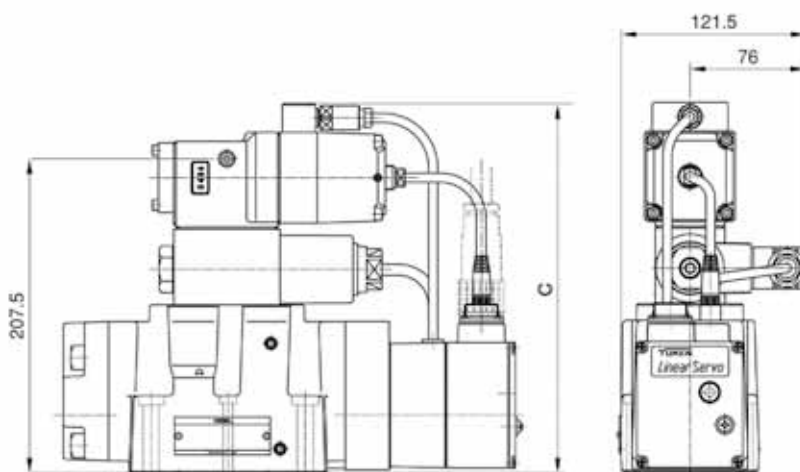
Indicator Lamp

M5 (+) Thd.

*1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.

*2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

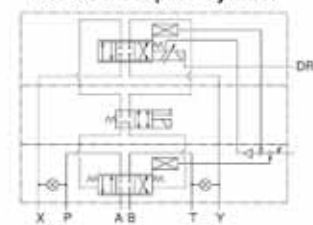
LSVHG-04EH-100/200/280/450- *S- *EA/EB (With Fail-safe Solenoid Operated Valve)



【Mounting Surface】

The dimensions of the mounting surface are the same as those of the models LSVHG-04 (page 11).

Detailed Graphic Symbol



⊗: Plugs for selecting the pilot and drain types

- O-rings for the Ports

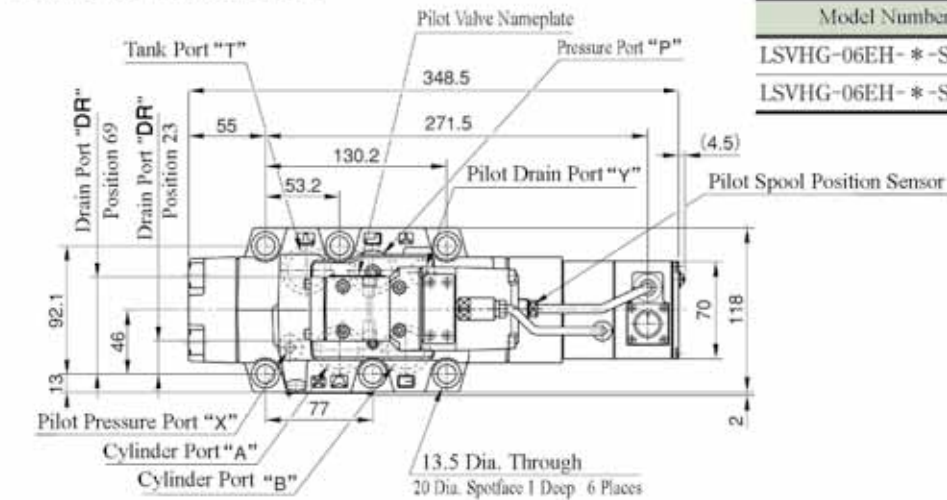
Port	O-ring Size	Qty.
P, A, B, T	SO-NB-P22	4
X, Y	AS568-012 (NBR, Hs90)	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

Model Number	C	Remarks
LSVHG-04EH- *-S *-E *	244	Pilot Valve: Dry Type
LSVHG-04EH- *-S *-WE*	253	Pilot Valve: Wet Type

● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

LSVHG-06EH-500/900-S*



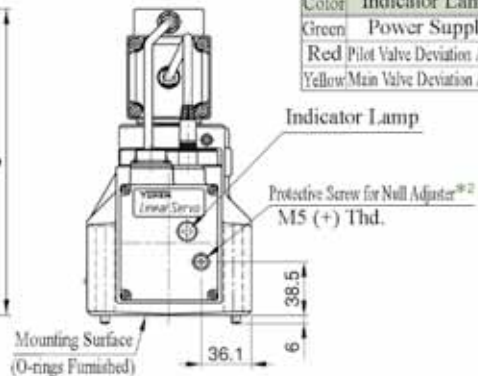
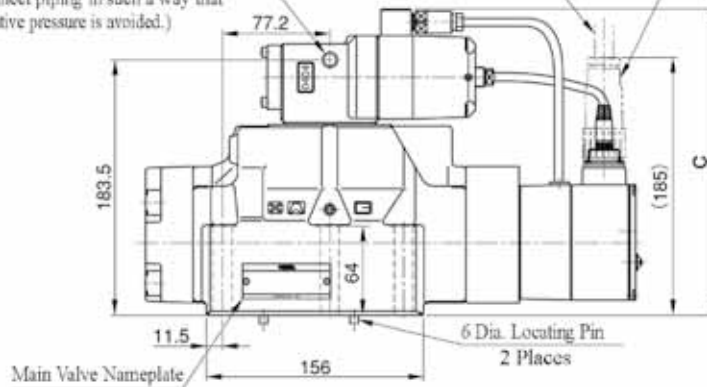
Model Number	C	Remarks
LSVHG-06EH- *-S*	220	Pilot Valve: Dry Type
LSVHG-06EH- *-S*-W	229	Pilot Valve: Wet Type

External Connection Drain Port "DR"^{*1}
Rc 1/8 (Front and Back Sides)
(Connect piping in such a way that
negative pressure is avoided.)

Cable Applicable: 8-16 Outer Dia.

6 + PE/11 + PE Electrical Plug
EN175201 Part 804

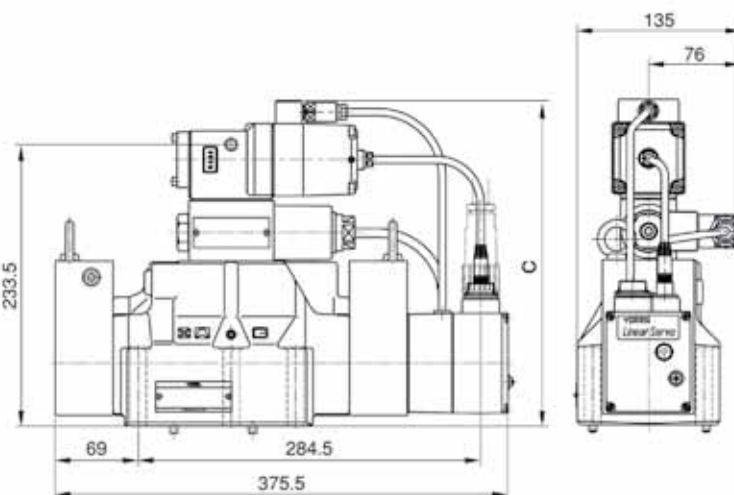
Color	Indicator Lamp
Green	Power Supply
Red	Pilot Valve Deviation Alarm
Yellow	Main Valve Deviation Alarm



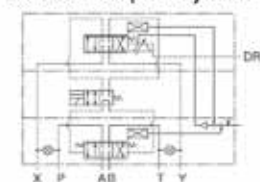
*1. The external connection drain port "DR" on the front side is usually plugged. To use the port on the front side, remove the hexagon socket head plug (5 Hex.) and plug the port on the back side.

*2. To adjust the null, remove the protective screw and turn the null trimmer. After adjustment, be sure to attach the protective screw.

LSVHG-06EH-500/900- *-S- *EA/EB (With Fail-safe Solenoid Operated Valve)



Detailed Graphic Symbol



⊗: Plugs for selecting the pilot and drain types

Model Number	C	Remarks
LSVHG-06EH- *-S- *-E*	270	Pilot Valve: Dry Type
LSVHG-06EH- *-S- *-WE*	279	Pilot Valve: Wet Type

● For other dimensions, see the figures above (the models without fail-safe solenoid operated valve).

● O-rings for the Ports

Port	O-ring Size	Qty.
P, A, B, T	AS568-123 (NBR, Hs90)	4
X, Y	SO-NB-P14	2

O-rings made of fluorinated rubber are required to use phosphate ester-based fluids.

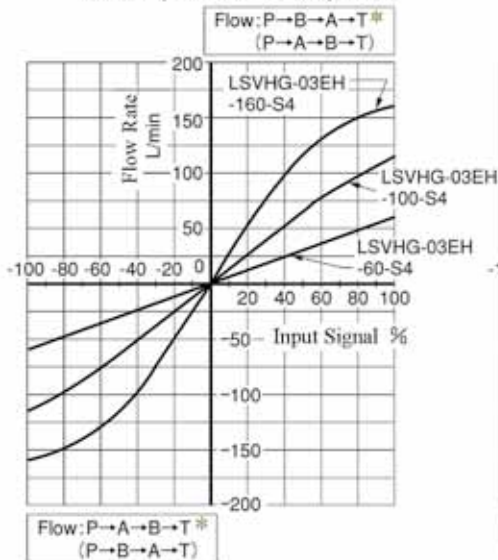
[Mounting Surface]

The dimensions of the mounting surface are the same as those of the models LSVHG-06-900 (page 12).

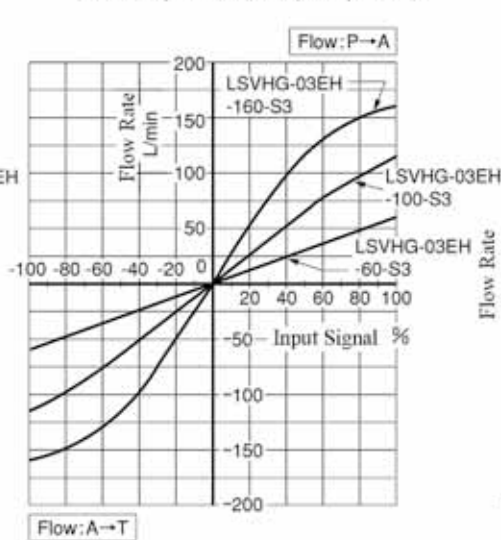
Characteristics of LSVHG-03EH-60/100/160-S (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

Valve Pressure Difference:
Constantly ΔP 7 MPa (4-Way Valve)



Valve Pressure Difference:
Constantly ΔP 3.5 MPa (3-Way Valve)

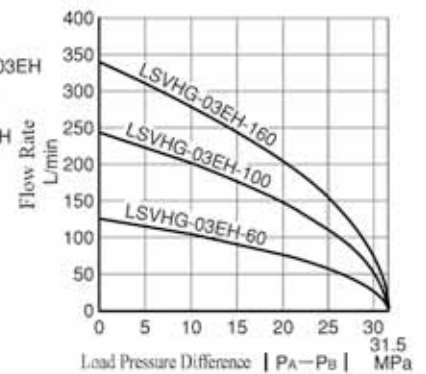


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow : ± 10 %

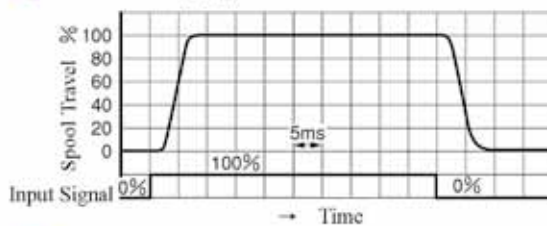


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

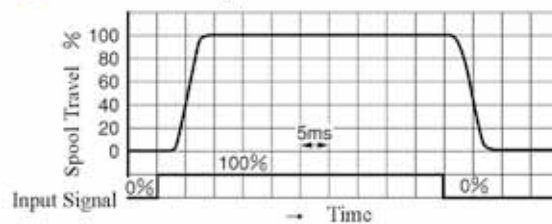
Step Response

<Conditions> ● Input Signal : 0 $\leftrightarrow$ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



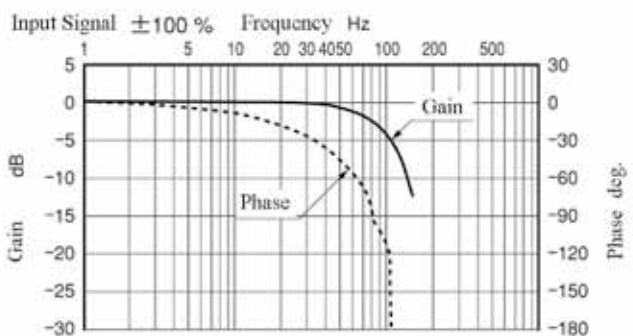
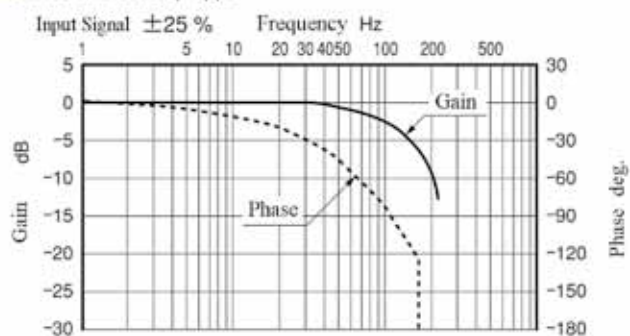
Pilot Valve: Wet Type



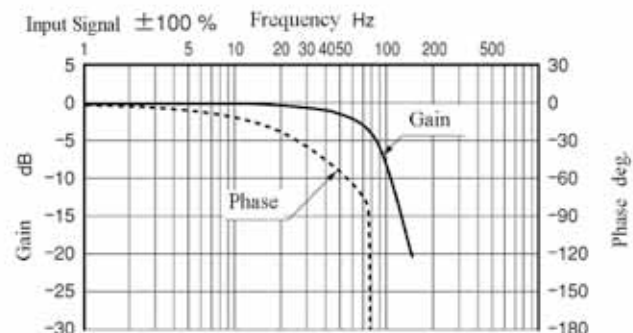
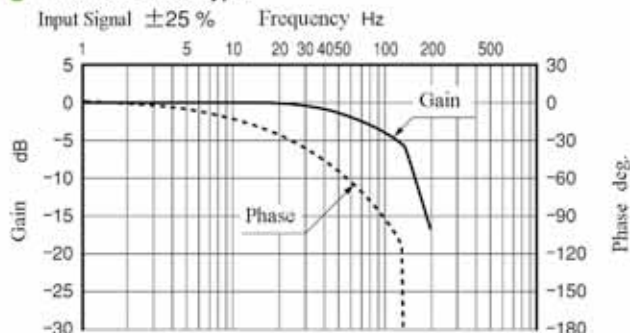
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



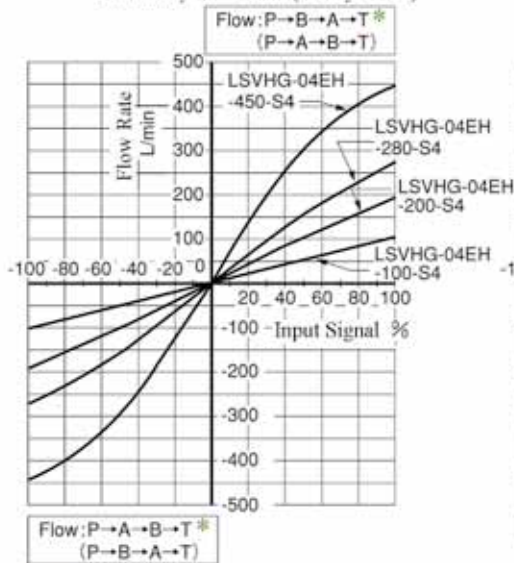
Pilot Valve: Wet Type



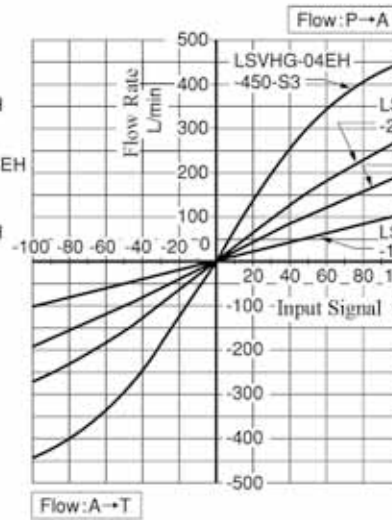
Characteristics of LSVHG-04EH-100/200/280/450-S (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

Valve Pressure Difference:
Constantly ΔP 7 MPa (4-Way Valve)



Valve Pressure Difference:
Constantly ΔP 3.5 MPa (3-Way Valve)

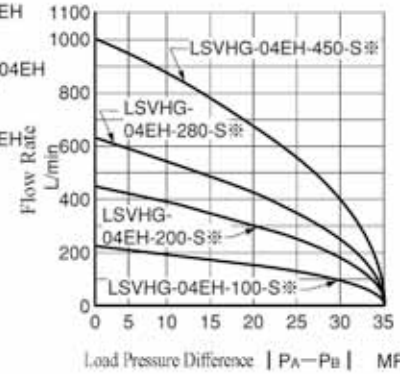


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow : ± 10 %

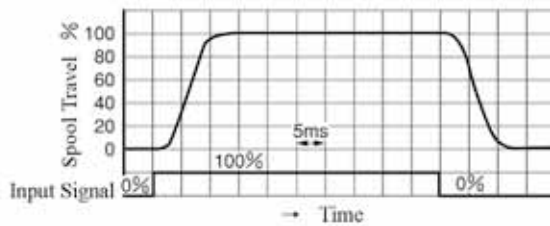


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

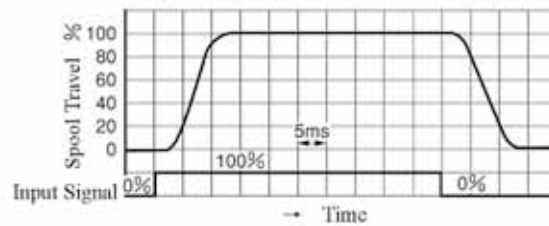
Step Response

<Conditions> ● Input Signal : 0 $\leftrightarrow$ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



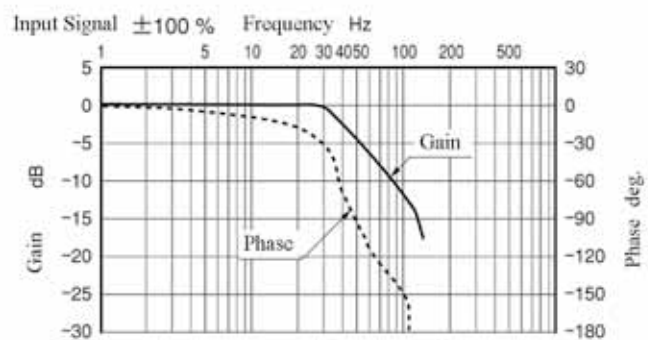
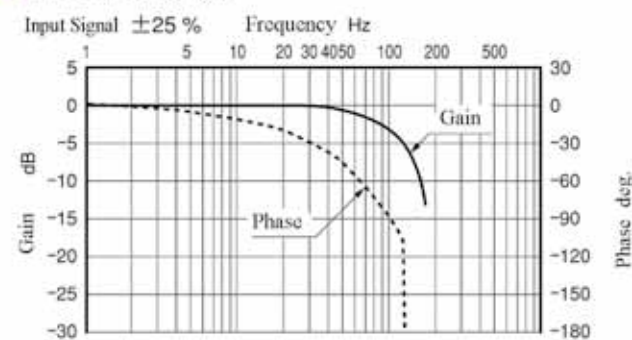
Pilot Valve: Wet Type



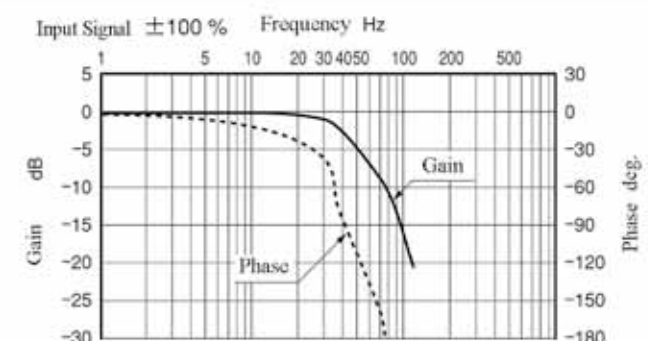
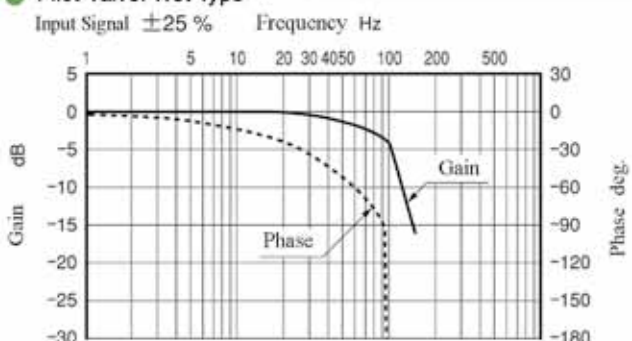
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



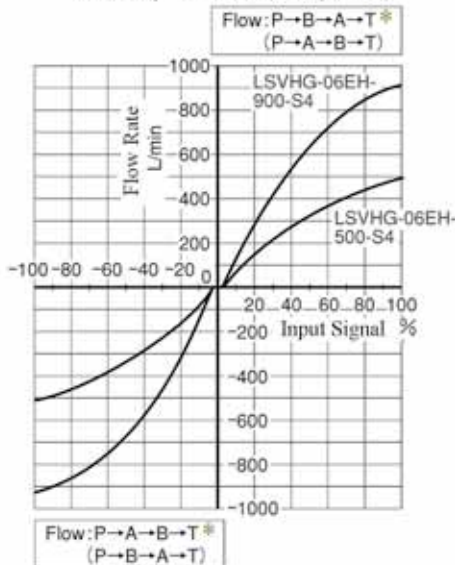
Pilot Valve: Wet Type



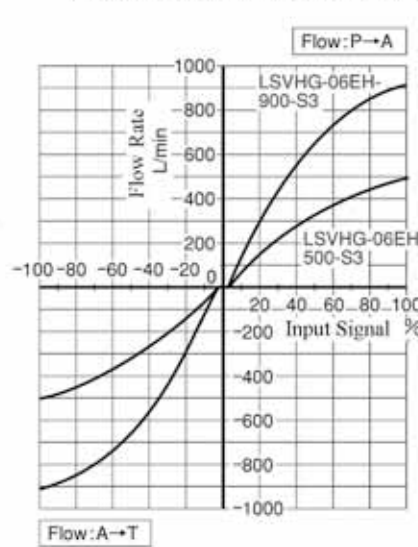
Characteristics of LSVHG-06EH-500/900-S (Fluid Viscosity: 30mm²/S)

No-Load Flow Characteristics

Valve Pressure Difference:
Constantly ΔP 7 MPa (4-Way Valve)



Valve Pressure Difference:
Constantly ΔP 3.5 MPa (3-Way Valve)

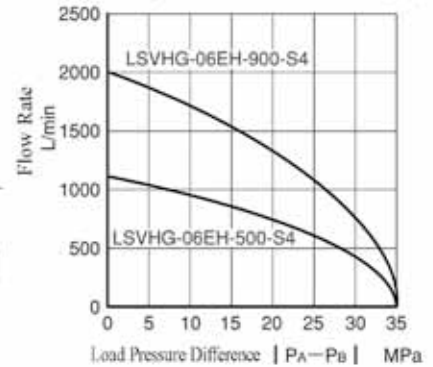


Load Flow Characteristics

<Conditions>

● Input Signal : 100 %

Note) Tolerance of Load Flow : ± 10 %

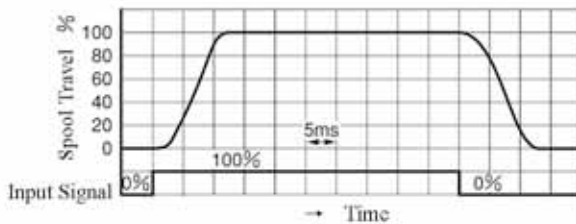


* The flow outside of parentheses is achieved when the input signal type "A," "B," or "C" is selected. The flow in parentheses is achieved when "D," "E," or "F" is selected.

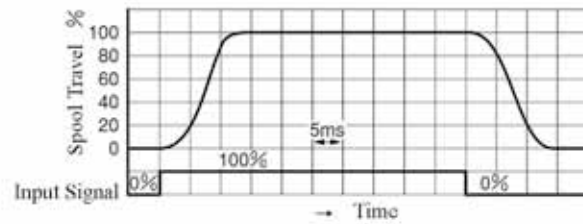
Step Response

<Conditions> ● Input Signal : 0 ⇔ 100 % ● Supply/Pilot Pressure : 14 MPa

Pilot Valve: Dry Type



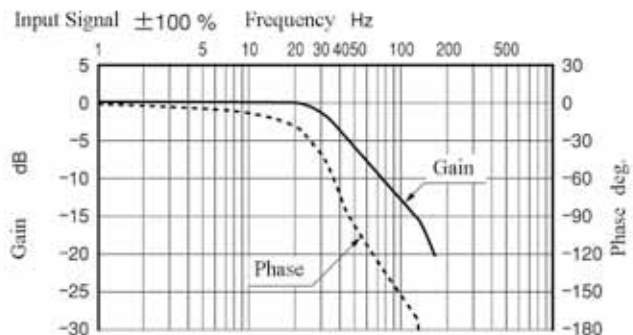
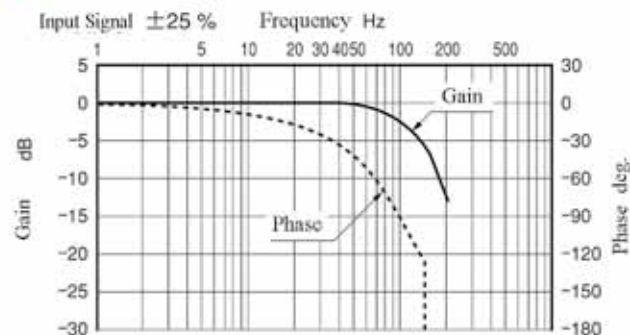
Pilot Valve: Wet Type



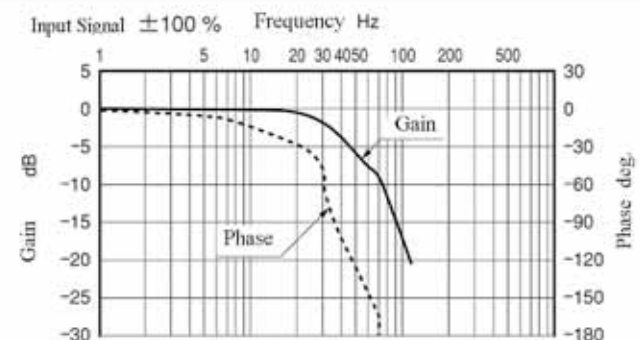
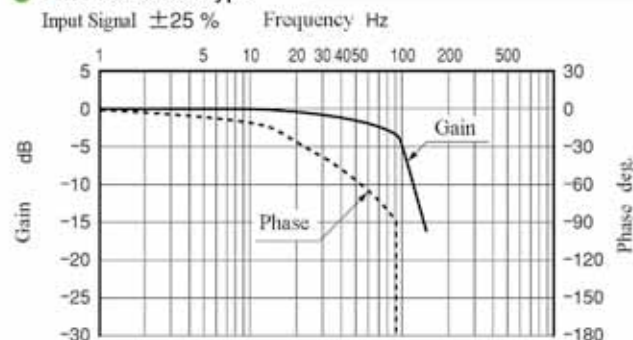
Frequency Response

<Conditions> ● Hydraulic Circuit: Port A/B Closed ● Supply/Pilot Pressure: 14 MPa

Pilot Valve: Dry Type



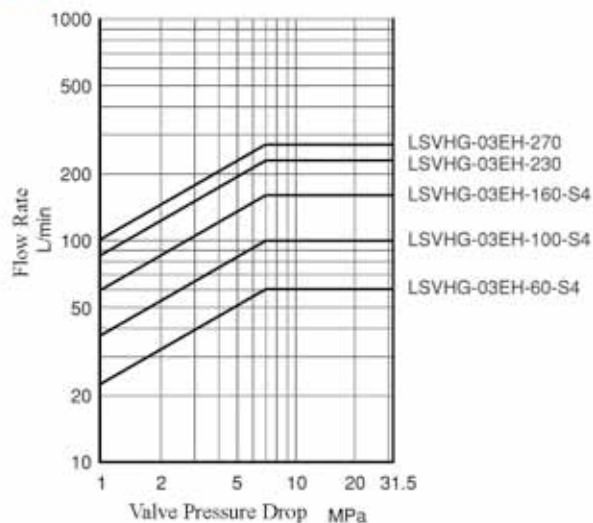
Pilot Valve: Wet Type



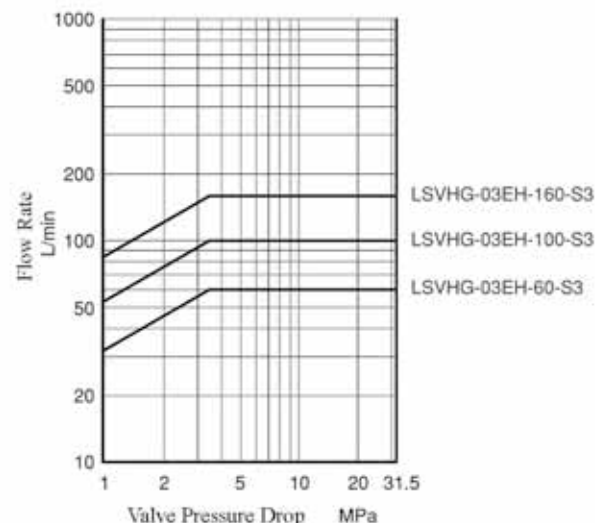
Effective Ranges of the Fail-safe Function for OBE (On-Board Electronic) Type Linear Servo Valves

● LSVHG-03EH-230/270-

● LSVHG-03EH-60/100/160-S4-

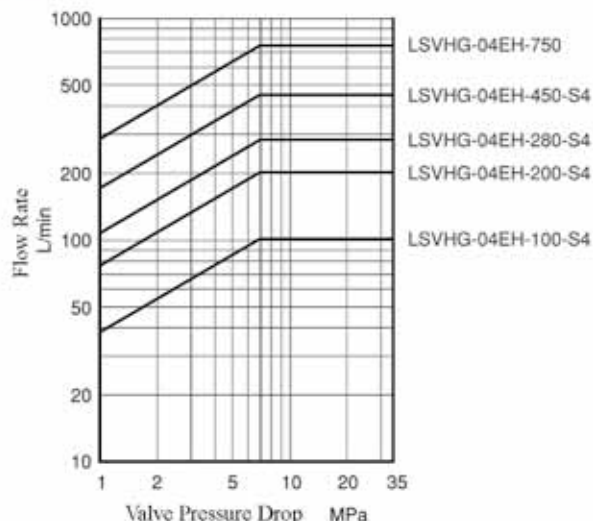


● LSVHG-03EH-60/100/160-S3-

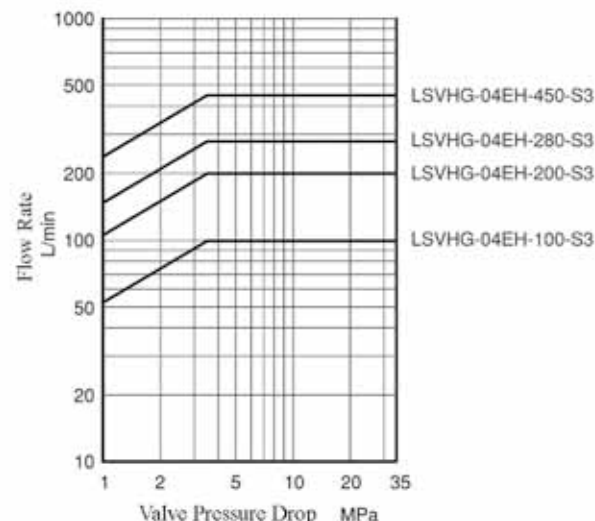


● LSVHG-04EH-750-

● LSVHG-04EH-100/200/280/450-S4-

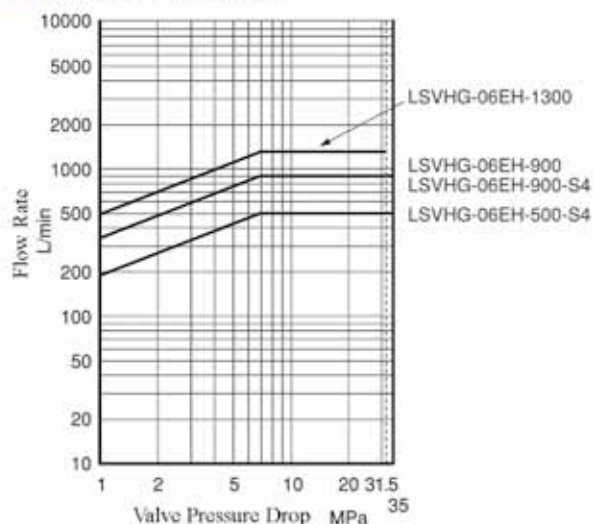


● LSVHG-04EH-100/200/280/450-S3-

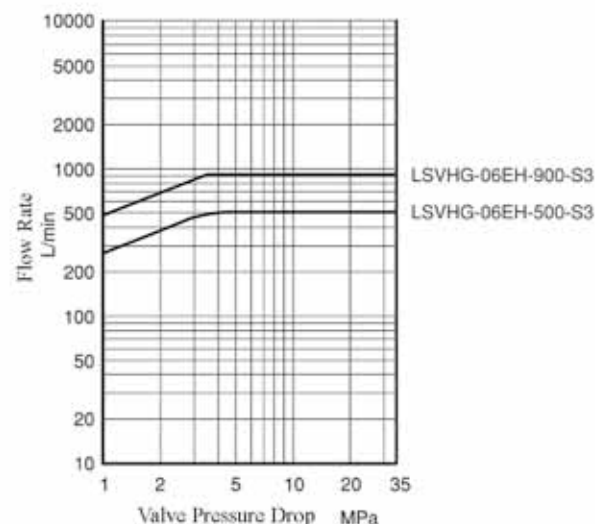


● LSVHG-06EH-900/1300

● LSVHG-06EH-500/900-S4-



● LSVHG-06EH-500/900-S3-



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