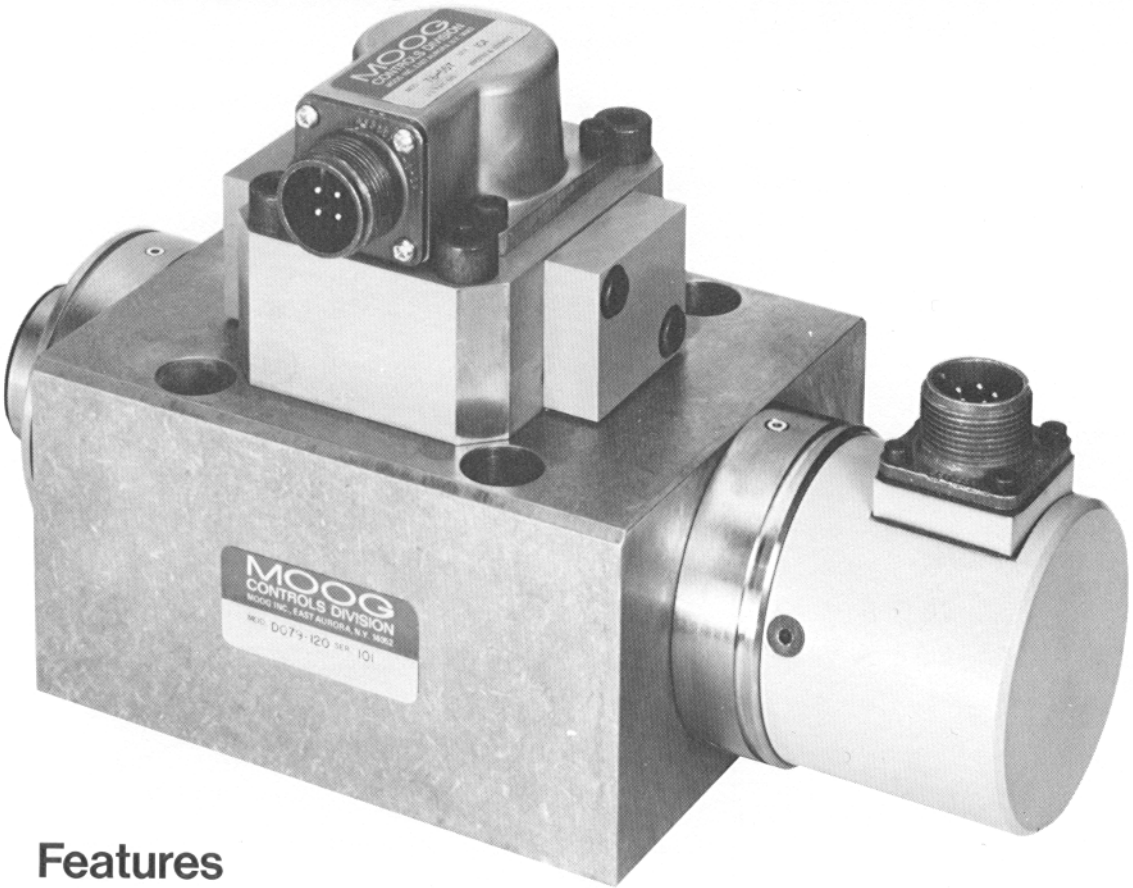
MOOG®

Models DO79-120 and 121
High Response Flow Control Servovalves



Features

- same manifold mounting as Moog 72 Series servovalve
- modular pilot valve
- optional five-port and six-port configurations available to isolate pilot supply
- typical dynamic response $<\pm 2$ db to 100 Hz
- optional 4000 psi configuration available
- electrical feedback allows convenient change in rated flow to help optimize system performance
- spool position LVDT electrically isolated from hydraulic fluid
- long life, hardened CRES spool and sleeve

These three-stage servovalves provide high dynamic response for precision control of position, velocity, or force in systems requiring about 15 hp to 75 hp. Maximum rated flow for the two models is 30 gpm and 60 gpm at 1000 psi drop. Operating supply pressure can be as high as 4000 psi (3000 psi maximum is standard).

The two-stage pilot valve is a special, high response Series 76 servovalve. Electrical feedback of third-stage spool position is provided by an LVDT. A separate oscillator, demodulator and servoamplifier are necessary to close the spool position servoloop.

Performance

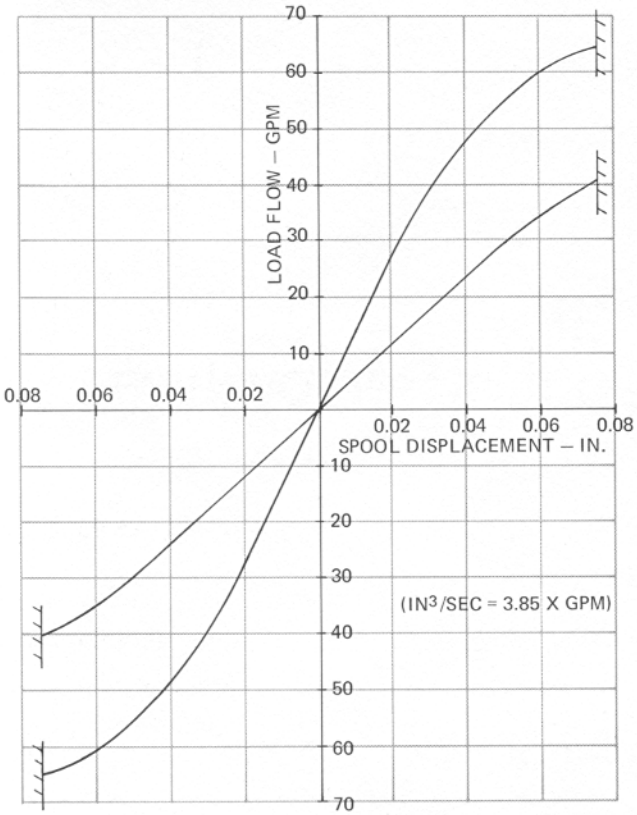


Fig. 1 Power Valve Flow Gain @ 1000 PSI Valve Drop

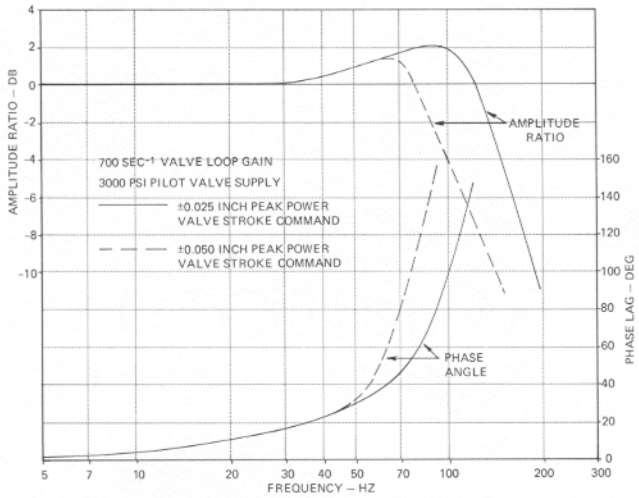


Fig. 2 Large Amplitude Frequency Response At Constant Loop Gain

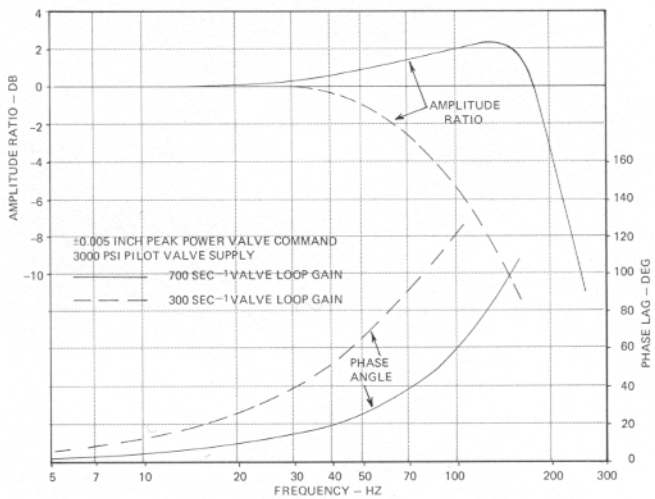


Fig. 3 Small Amplitude Frequency Response

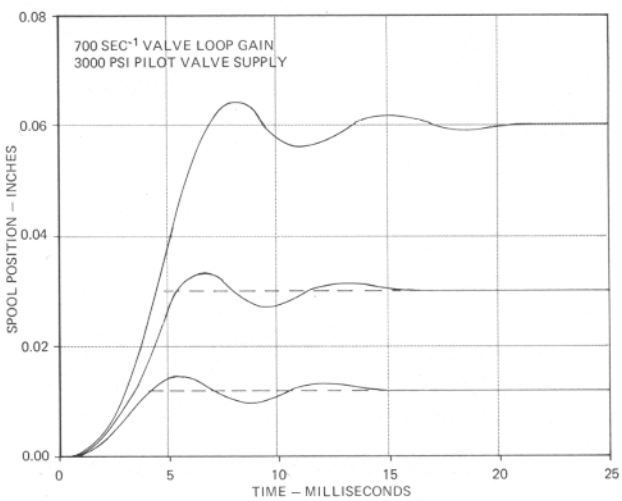


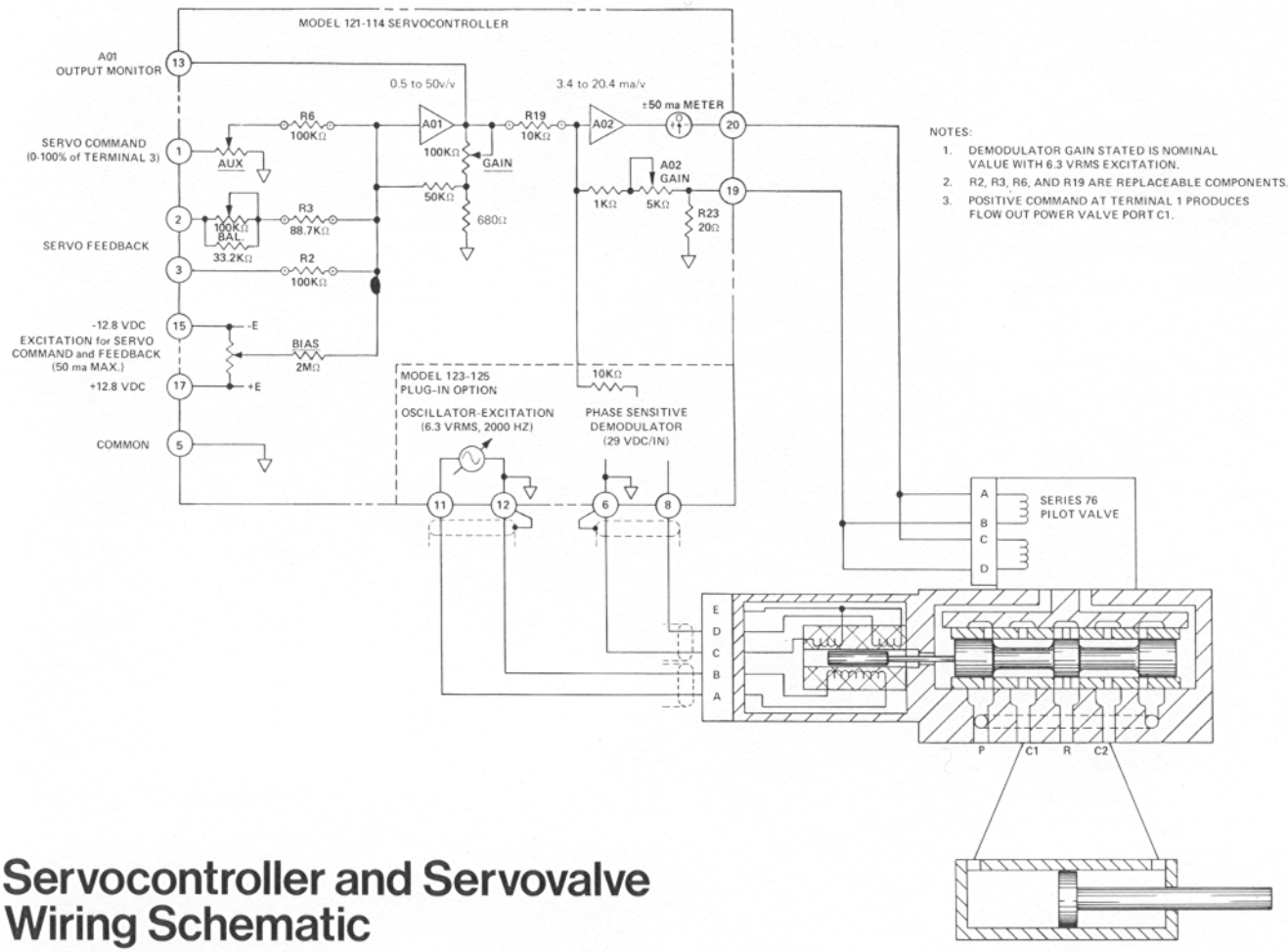
Fig. 4 Step Response

PILOT VALVE SPECIFICATIONS

Model Number	76-557
Rated Flow at 1000 psi	2.5 gpm
Rated Input	
series coils	±20 ma
parallel coils	±40 ma
Coil Resistance at +25°C	80Ω each (±10%)
Approximate Coil Inductance	
series coils	0.66 Henrys
parallel coils	0.18 Henrys

POWER VALVE SPECIFICATIONS

Spool End Area	0.44 in^2
Spool Flow Gain at 1000 psi (in linear region)	
D079-120	2.31 x 10^3 $\frac{in^3/sec}{inch}$
D079-121	5.48 x 10^3 $\frac{in^3/sec}{inch}$
Approximate Spool Stroke to stops	±0.075 inch



Servocontroller and Servovalve Wiring Schematic

SPOOL POSITION TRANSDUCER SPECIFICATIONS

Type	LVDT*
Excitation Frequency	
minimum	400 Hz
maximum	5000 Hz
recommended	2000 to 4000 Hz
Maximum Excitation Voltage	15 vrms
Approximate Excitation Power (at 2000 Hz)	6.5×10^{-4} va/volt
Recommended Load Impedance	≥ 50 K Ω
Output Sensitivity and Phase Shift	See Figure 5

*linear variable differential transformer

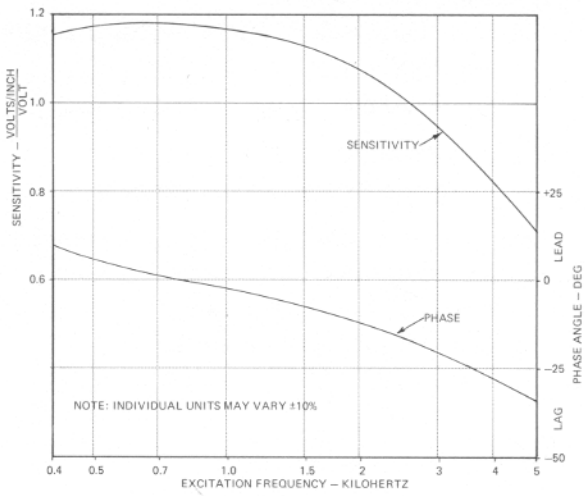


Fig. 5 Nominal LVDT Output Characteristics

Set-up and Operation

SERVOAMPLIFIER

The Model 121-114 is a convenient servoamplifier for use with the D079-120 and 121 servovalves. An optional plug-in circuit card, the Model 123-125, contains an oscillator and demodulator for operation of the spool position LVDT.

The ac excitation is nominally 6.3 vrms (adjustable) and the carrier frequency is 2000 Hz. The 2000 Hz frequency is recommended to achieve best servovalve response, however a lower frequency may be necessary if a long cable run is required.

With the nominal excitation of 6.3 vrms at 2000 Hz, the spool position LVDT will have a sensitivity of (from Figure 5) 1.07 x 6.3 = 6.74 vrms/inch. The demodulator gain of the Model 123-125 circuit card is 4.3 vdc/vrms.

SERVOVALVE LOOP GAIN

The inner loop gain of the D079-120 servovalve when operating with 3000 psi pilot supply pressure and with the coils of the pilot valve in parallel is determined by:

$$K_{IL} = \frac{K_A K_{PV} K_D K_X}{A_S}$$

where

K_{IL} = servovalve inner loop gain sec^{-1}

K_A = servoamplifier gain ma/vdc

K_{PV} = pilot valve gain

$$= \frac{2.5 \text{ gpm} \times 3.85 \frac{\text{in}^3/\text{sec}}{\text{gpm}} \sqrt{\frac{3000 \text{ psi}}{1000 \text{ psi}}}}{40 \text{ ma}}$$

$$= 0.42 \frac{\text{in}^3/\text{sec}}{\text{ma}}$$

K_D = demodulator gain = 4.3 vdc/vrms

K_X = LVDT gain = 6.74 vrms/inch

A_S = power spool end area = 0.44 in^2

For the recommended maximum inner loop gain of 700 sec^{-1}:

$$K_A = \frac{700 \times 0.44}{0.42 \times 4.3 \times 6.74} = 25.3 \text{ ma/vdc}$$

LOOP GAIN SET-UP

- Connect amplifier terminals 19 and 20 to the pilot valve electrical connector per the schematic on Page 3.
- Monitor terminal 13 (output of A_{01}) and adjust the BIAS pot on the front panel to obtain first +1.0 vdc, then −1.0 vdc.
- Monitor the valve current by either reading the front panel meter (±50 ma full scale) or by measuring the voltage drop across the 20Ω sensing resistor R23 (terminal 19 to terminal 5). The latter is the more accurate method.
- Adjust the A_{02} GAIN pot located on the back of the servocontroller board to obtain the desired amplifier gain. Note that 25.3 ma/vdc is a maximum recommended value. It is recommended that the amplifier gain be turned down the first time supply pressure is applied. It may not be possible to operate with satisfactory valve stability at the maximum amplifier gain as both the pilot valve and LVDT have about ±10% gain tolerances.

OUTER SERVOLOOP GAIN

The nominal gain of the D079-120 or D079-121 for the outer loop will be:

$$K_{VAL} = \frac{K_S}{K_D K_X}$$

where K_{VAL} = overall valve gain $\frac{\text{in}^3/\text{sec}}{\text{vdc}}$

K_S = power spool flow gain (see Specifications, Page 2)

K_D = demodulator gain vdc/vrms

K_X = LVDT gain vrms/inch

$$K_{VAL} = \frac{K_S}{4.3 \times 6.74} = \frac{K_S}{29} \frac{\text{in}^3/\text{sec}}{\text{vdc}}$$

Note that the power spool flow gain is specified for operation at 1000 psi supply. This gain must be corrected for operation at other supply pressures by multiplying by the square root of the ratio of supply pressures.

The input amplifier, A_{01}, of the Model 121-114 can be used for summing the load servo command and feedback signals. The A_{01} GAIN control (accessible on the front panel) provides a convenient loop gain adjustment.

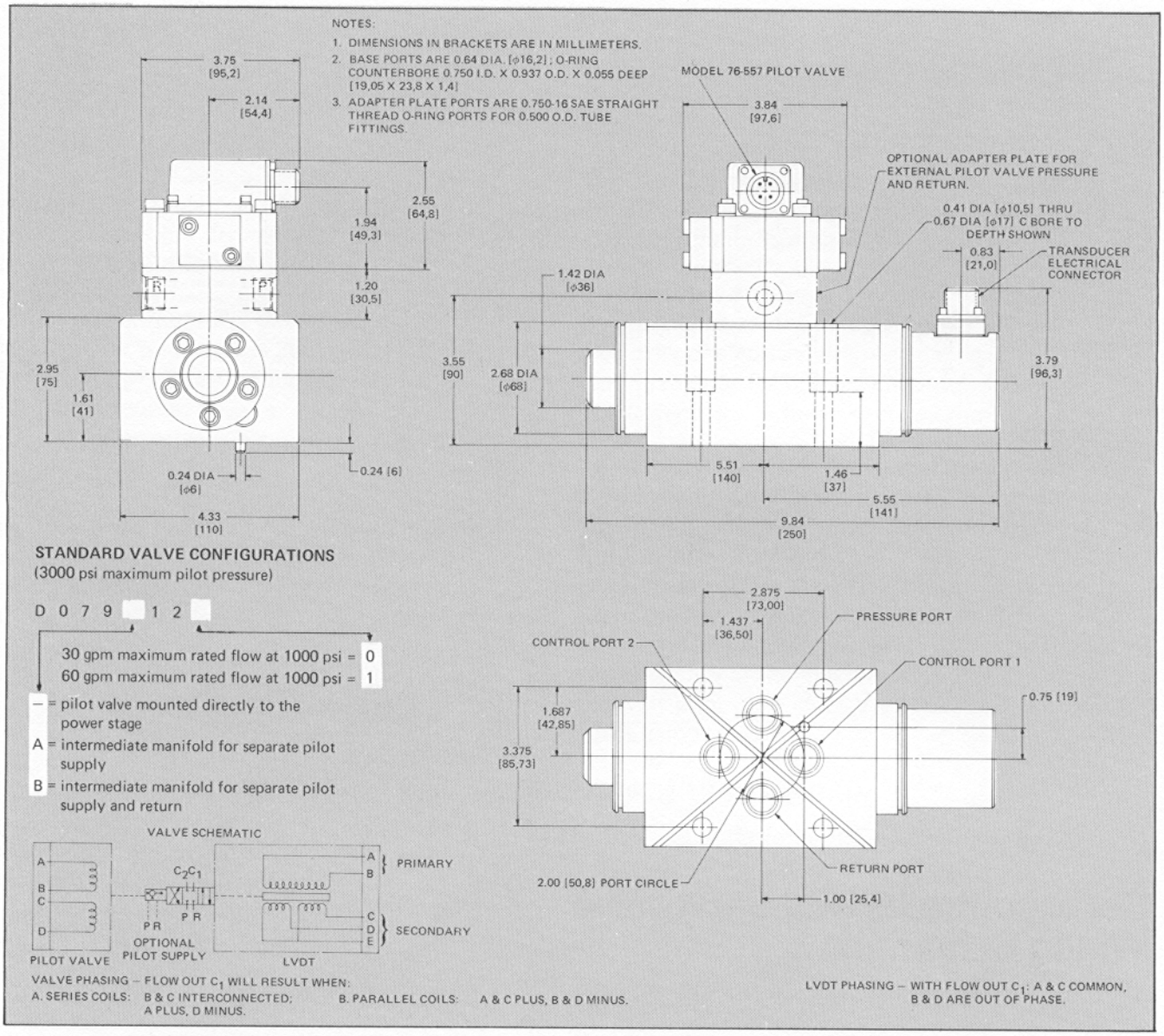
Specifications

	MODEL	
	D079-120	D079-121
Nominal rated flow at 1000 psi valve drop	30 gpm	60 gpm
Internal leakage at 1000 psi supply	<0.8 gpm	<1.6 gpm
Recommended supply pressures		
Pilot valve	1000 psi minimum 3000 psi max. standard 4000 psi special order	
Third-stage power valve	4000 psi max. standard	
Operating temperature	–20°C to +80°C	
Fluids	petroleum base 60 to 450 SUS @ 100°F (10 to 97 cSt @ 38°C)	
Buna N seals standard; Viton A and EPR seals available on special order		
Recommended supply filtration	10μ nominal, 25μ absolute, or better	
Weight (without optional pilot porting)	24 pounds	

Performance Summary

(with 3000 psi Pilot Pressure and Valve Loop Gain of 700 sec^{-1})

	servoloop scaled for full power valve output at:	
	±0.025 inch spool stroke	±0.050 inch spool stroke
Flow at 1000 psi supply		
D079-120	15 gpm	30 gpm
D079-121	35 gpm	55 gpm
Linearity	See Figure 1	
Flow symmetry	<±5%	
Flow gain at null (within ±5% of rated input)	50% to 200% of nominal	
Typical blocked load pressure gain at null	15% to 20% P_s/.001 inch spool travel	
Hysteresis	< 1%	
Threshold	< 0.5%	
Null Shift		
with 500 psi change in pilot supply pressure	< ±4%	< ±2%
with 500 psi change in pilot return pressure	< ±4%	< ±2%
with 50°C change in fluid temperature	< ±5%	< ±2.5%
Dynamic response at ±100% input amplitude		
< ±2 db amplitude ratio	to 125 Hz	to 90 Hz
approximate frequency for 90° phase lag	90 Hz	70 Hz



Accessories

	Part Number
Mounting Manifold	
4 ports (SAE 1-5/8 – 12 UN straight thread ports) for 1-1/4 dia. tubing	
for 3000 psi	100-22236-1
for 4000 psi	100-22236-3
Flushing Block (interconnects the four power stage ports)	100-23720
Replacement O-rings (Buna N 90 durometer)	
power stage base (4 required)	080-45122-40
pilot stage base (4 required)	080-45122-22
optional pilot supply manifold	
3 required	080-45122-22
1 required	080-45122-8
Mating Electrical Connectors	
pilot valve (MS 3106F14S-2S)	061-49054F14S-2S
LVDT (MS 3106F14S-5S)	061-49054F14S-5S