

SUB MINIATURE SERVO VALVES

PILOT OPERATED FLOW
AND PRESSURE CONTROL
E024 B & LB SERIES P, Q AND S



Rev 3. -, October 2015

HIGH PERFORMANCE TWO-STAGE DESIGN
FOR HIGH VIBRATION AND HIGH TEMPERATURE
ENVIRONMENTS

Essential technologies with a long and successful pedigree never die but get reinvented. This is true of the Moog nozzle flapper servo valve where in recent years Moog has created the E024 series for miniature applications; probably the smallest and most robust servo valve in the world.

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This catalogue is for users with a technical knowledge. To ensure the necessary characteristics of the system for function and safety, the user is required to check the suitability of the products described herein. The products described herein are subject to change without notice. Please note that this catalogue describes characteristics for the E024 B and LB series only. The characteristics of previous versions may be slightly different compared to the data published here. Please consult the appropriate catalogue. In case of doubt, please contact Moog.

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E024 SERIES PRODUCT OVERVIEW AND GENERAL TECHNICAL DATA

Pedigree and Typical Application

E024 Series valves have been developed from the proven 30 Series aerospace range which is widely used in civil and military aircraft applications.

Compared to the 30 Series, the E024 is significantly reduced in size and weight being only 95 g (not including the cable at 22 g/m) but retaining a flow capability ranging from 0.3 up to 7.5 lpm which, along with extended environmental tolerance, makes it perfectly suited to F1 motorsport and other applications where compact and rugged solutions are required.

E024 Product Improvements; B & LB Series

Recent product design improvement activities to increase the vibration and thermal capability have resulted in the LB series which from August 2014 onwards will supersede the previous LA series.

P, Q and S Versions

E024 Series valves are available in three versions and 6 types targeted at specific applications:

1. Linear flow control (Q-O); used for general purpose bi-directional motion control.
Dual Gain flow control (Q-Y); where a combination of high flow and precise motion control accuracy is required
2. Pressure control (P-B) and (P-U); used in 3 port applications where the chamber pressure can be set as a function of the input signal
3. Proportional Switching (S-P) and (S-R); where a degree of proportional control is required but the final position of the actuator is determined by external constraints (e.g. a mechanical detent system)

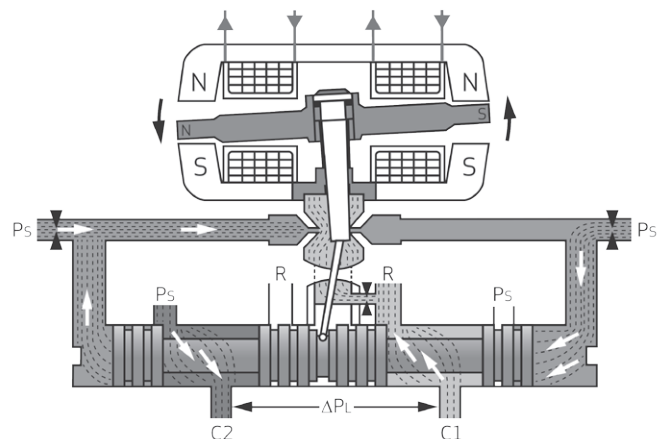
E024 Series Standard Options Overview (At 210 bar Operating Pressure)

Option	Q – Flow Control Linear (O)	Q – Flow Control Dual Gain (Y)	P – Pressure Control (B, U)	S – Proportional Switching (P, R)
Input Range	+/-100%	+/-100%	-40, +10 to +100%	+/-100%
Flow Rate (lpm)	0.3, 1.0, 1.5, 2.0, 3.8, 5.0, 7.5 Full signal no load flow rate at 70 bar drop	3.8, 7.0 Full signal no load flow rate at 70 bar drop. Dual gain ratio 1:2.5 at 25% signal	0.3, 0.8, 1.3, 1.9 Maximum leakage flow (occurring at 50% of 210 bar max control pressure (see data))	P: 7.2, High control port pressures at null R: 5.0, Low control port pressures at null
Response G, F	High / Low	High / Low	High / Low	High / Low
Bias, M, A, B, C	-15%>0>+15%	-15%>0>+15%	-15%>0>+15%	None
Header A, C	Moog / Custom	Moog / Custom	Moog / Custom	Moog / Custom
Orientation	P, R; Lead C1, C2	P, R; Lead C1, C2	P, R; Lead C1, C2	P, R; Lead C1, C2
Current (Parallel)	+/-10 mA	+/-10 mA	+/-10 mA	+/-10 mA

Note: This data presented in this catalogue assumes parallel connection; however the data is also applicable for +/-5mA serial connection (see installation information).

Operational Characteristics for E024 Series P, Q and S Versions

Supply Pressure	140 - 280 bar
Return Line	2 - 5 bar (typical)
Temperature Range	Operational (to specification); 0 - 135 °C Survivability; -40 °C to 165 °C
Fluid Viscosity	> 4 c.St
Vibration	Survivability: 50 g shock in any direction. AV valve mounting is recommended. Contact Moog for advice
Filtration	NAS 1638 Class 3 / ISO 4406 14/12/9 or better
Valve Proximity	Valves mounted in close proximity may experience magnetic interaction. It is recommended that the valves are mounted at least 2 mm apart to minimise this effect
Water Ingress	IP65



E024 SERIES P, Q & S; STATIC & DYNAMIC PERFORMANCE AT 210 BAR

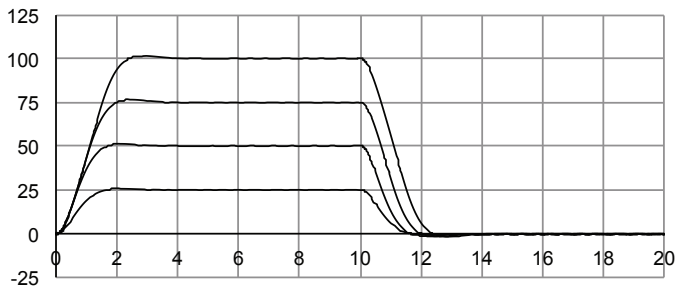
Response Types:		G (High)	F (Low)
Pilot Leakage Flow Rate (Qt)	(lpm)	0.28	0.15
Hysteresis (at spool)	(%)	< 3	< 3
Threshold (at spool)	(%)	< 0.5 [0.2]*	< 0.5 [0.2]*
Null Shift with 100 bar change	(%)	< 3	< 3
Null Shift with 100 °C change	(%)	< 5	< 5
Response Time (100% slew)	(ms)	< 1.8	< 2.6

Note: Test data is produced using Shell Tellus 32 at 40 °C and 210 bar supply pressure
 Note: [*] is the null threshold using dual gain (Q-Y) valves

Typical Spool Step Response Characteristics at 210 bar; 25, 50, 75, 100%

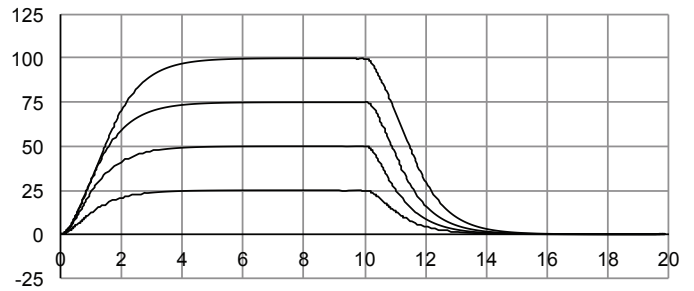
High Response (G)

Step Response (% v ms); G Pilot @ 210 bar



Low Response (F)

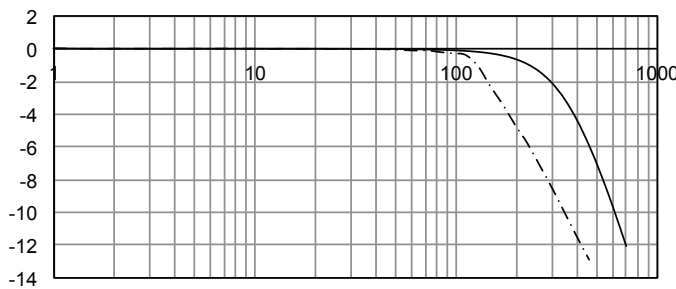
Step Response (% v ms); F Pilot @ 210 bar



Typical Spool Frequency Response at 210 bar; Amplitude +/-25% (solid line), +/-100% (dashed line)

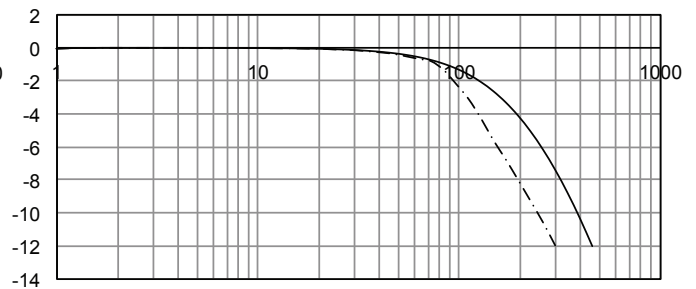
High Response (G)

dB Response (dB v Hz); G Pilot @ 210 bar

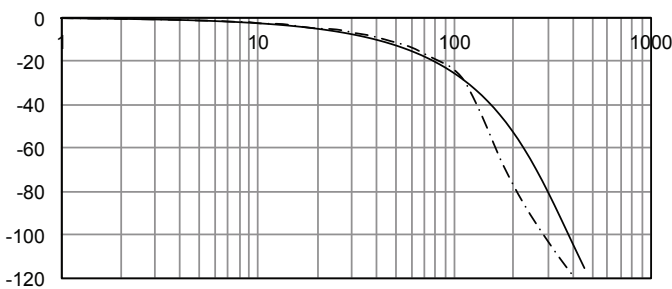


Low Response (F)

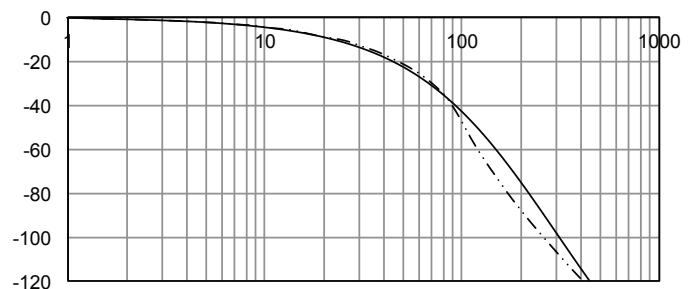
dB Response (dB v Hz); F Pilot @ 210 bar



Phase Response (deg v Hz); G Pilot @ 210 bar



Phase Response (deg v Hz); F Pilot @ 210 bar



E024 SERIES – Q; FLOW CONTROL VALVE APPLICATION AND CHARACTERISTICS

E024-Q; Flow Control Valve Application

O Type Spools

With an axis-cut (zero dead-band) spool and linear flow, are intended for closed loop servo control of position force or pressure. The 4 port format has both C1 and C2 ports active and may be used with either single or double ended actuators.

Y Type Spools

With a dual gain flow characteristic are also axis-cut, but in addition provide both high flow rate and improved resolution around null.

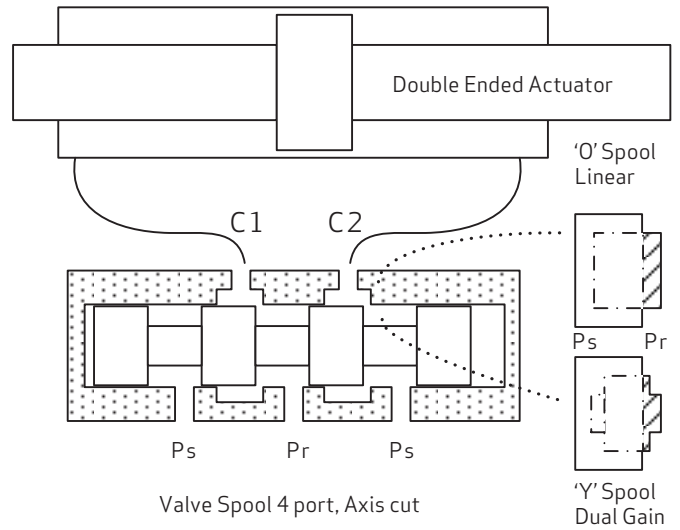
Typical characteristics are:

- Gain ratio 1:2.5 (for low v high signals)
- Gain breakpoint at +/-25% current

This gives a number of benefits including:

- Improved null accuracy
- Reduced null leakage

Note: Correction for the dual gain effect should be included in the controller.



E024-Q; Flow Characteristics at 70bar Drop (4-way control, no load)

Linear 'O' Spool (solid line)

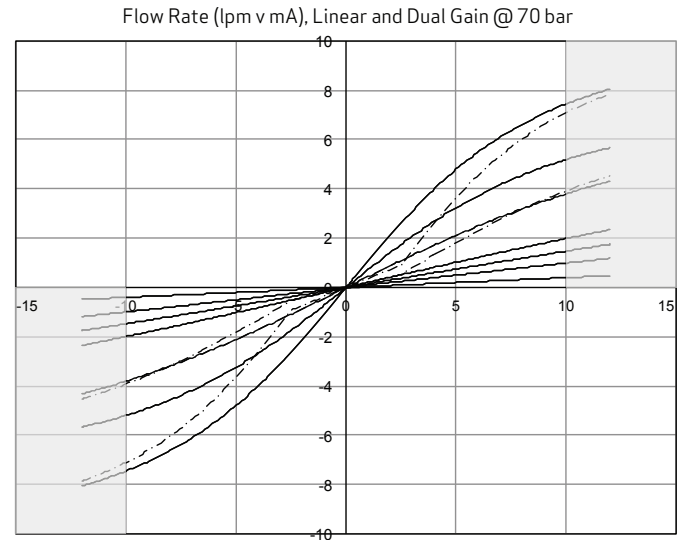
Flow Size **Qr (lpm)** @ 70 bar drop

Q03,	0.3 @ 10 mA
Q10,	1.0 @ 10 mA
Q15,	1.5 @ 10 mA
Q20,	2.0 @ 10 mA
Q38,	3.8 @ 10 mA
Q50,	5.0 @ 10 mA
Q75,	7.5 @ 10 mA

Dual Gain 'Y' Spool (dash dot)

Flow Size **Qr (lpm)** @ 70 bar drop

Q38,	3.8 @ 10 mA
Q70,	7.0 @ 10 mA



Note: Results with valve ports C1 and C2 connected together & 70 bar drop

Null Leakage

O Spool Null Leakage < 5% of Qr

Y Spool Null Leakage < 2% of Qr

Note: Assuming Shell Tellus 32 at 40 °C and 210 bar supply pressure

Bias M, A or B

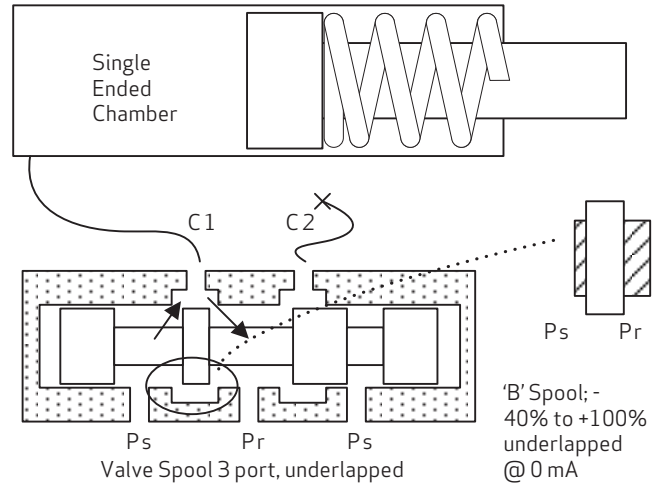
Bias M, 0% is shown in the figure. Preferred Bias A is 15% P > C1, and Bias B is 15% P > C2. Consult Moog Engineering for other bias options up to 15%.

E024 SERIES – P; PRESSURE CONTROL VALVE APPLICATION AND CHARACTERISTICS

E024-P; Pressure Control Valve Application

Pressure Control Spools

Provide an alternative to closed loop pressure control by shaping the spool slots for 3 port underlap (i.e. open loop) operation. The P > C1 and C1 > R port lands behave as a 'potential divider' giving a variable control port pressure between Pr and Ps over the valve operating range.



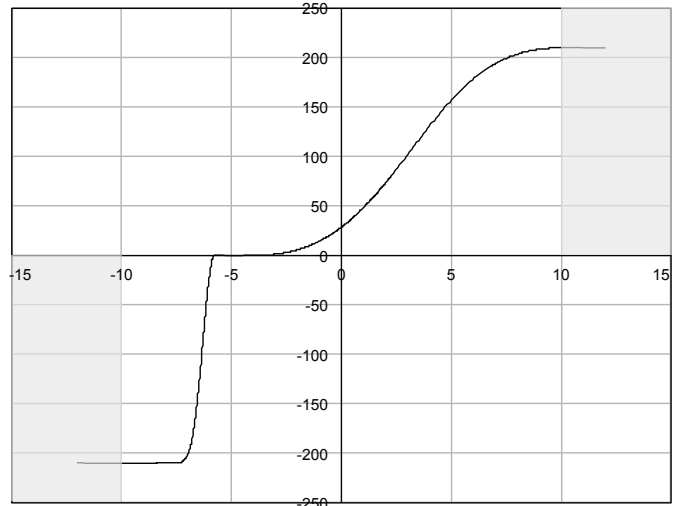
B Type Spool

The B spool (at 210 bar) modulates pressure for +ve and -ve currents; providing an unbiased centre pressure of around 26 bar for a zero input signal and pressure regulation at the C1 port for input signals from -40% to +100%.

(The unused C2 port offers an optional switching function at -70% signal).

Note: The thumbnail sketch shows a typical pressure versus current characteristic (see over for more details)

Blocked Port Pressure (bar v mA), All Flow Rates @ 210 bar



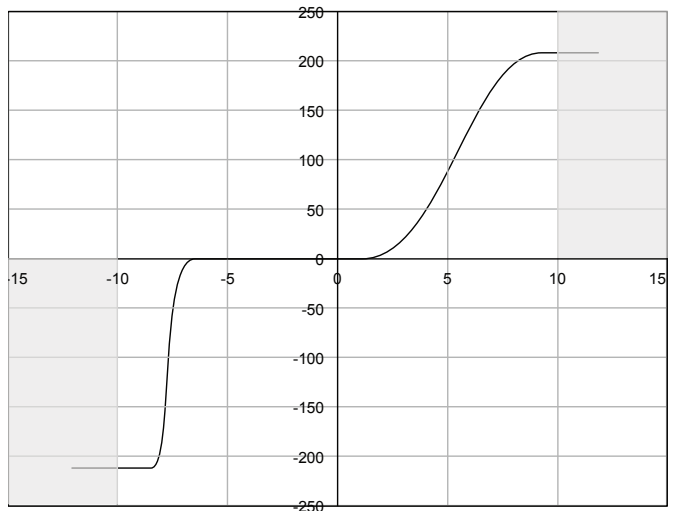
U Type Spool

The U spool (at 210 bar) provides an unbiased zero pressure with around 10% of overlap for zero input signal. Pressure regulation at the C1 port from zero to full system pressure occurs over a 10 to 100% operating range.

(The unused C2 port offers an optional switching function at -70% signal).

Note: The thumbnail sketch shows a typical pressure versus current characteristic (see over for more details)

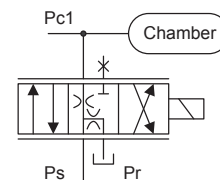
Blocked Port Pressure (bar v mA), All Flow Rates @ 210 bar



Note: The underlapped nature of the spool design creates a port leakage which should be considered. See data given overleaf.

Typical P Valve Installation

The following C1 port pressure and leakage characteristics relate to the preferred (3 -way) installation arrangement as shown here.



E024-P; B Type Spool; Pressure Control Characteristics at 210 bar Supply

Bipolar 'B' Spool (underlapped)

Flow Size Ql (lpm) @ 210 bar

P03,	0.3 @ 3 mA
P08,	0.8 @ 3 mA
P13,	1.3 @ 3 mA
P19,	1.9 @ 3 mA

Active port C1
Optional port C2

C1 port pressure range:
0 bar @ -4 mA to 210 bar @ +10 mA

C2 port pressure range:
P & R axis cut (0 to 210 bar) at -7 mA

The optional C2 port is normally not active; however, it can be used to provide a high flow switching function at an input signal of -70%

Note: Results with blocked ports at 210bar supply pressure

Bias C; 10 to 60 bar at 0mA

Bias C defines the valve C1 port pressure in bar at 0mA. Pressures may be selected between 10 and 60 bar (for a supply pressure of 210 bar). Consult Moog Engineering for other bias options. The M, A and B bias options (i.e. defined in terms of spool% shift) are not recommended.

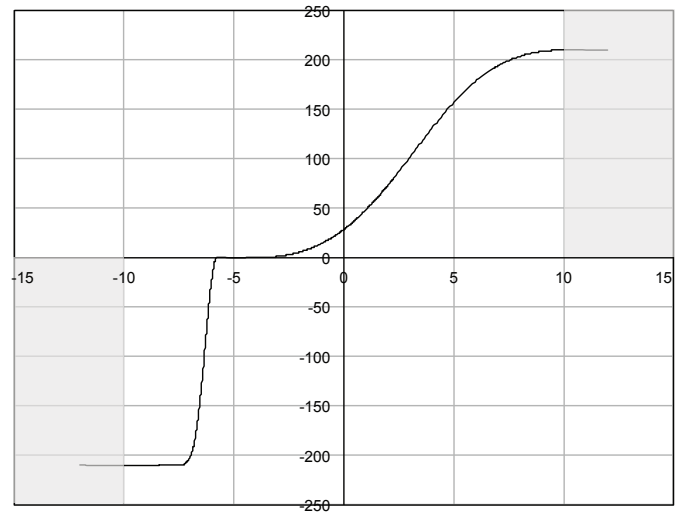
Leakage

The B Spool Leakage (unbiased) is maximum at 30% signal and defined by the flow size. See options (03, 08 etc.).

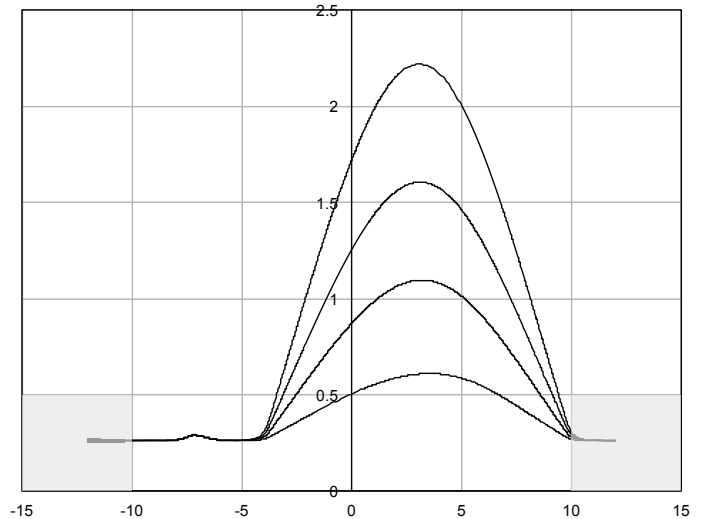
Spool flow size is expressed as the maximum spool leakage flow rate (Ql) across the active port not including the pilot flow. The shown leakage characteristics are with the valve port C1 blocked and Ps set to 210 bar.

Note: The figure shown is unbiased and also includes the G pilot leakage for 210 bar operation.

Blocked Port Pressure (bar v mA), All Flow Rates @ 210 bar



Blocked Port Leakage (lpm v mA) @ 210 bar



E024-P; U Type Spool; Pressure Control Characteristics at 210 bar Supply

Unipolar 'U' Spool (underlapped)

Flow Size Ql (lpm) @ 210 bar

- P03, 0.3 @ 5.5 mA
- P08, 0.8 @ 5.5 mA
- P13, 1.3 @ 5.5 mA
- P19, 1.9 @ 5.5 mA

Active port C1
Optional port C2

C1 port pressure range:
0 bar @ +1 mA to 210 bar @ +10 mA

C2 port pressure range:
P & R axis cut (0 to 210 bar) at -7 mA

The optional C2 port is normally not active; however, it can be used to provide a high flow switching function at an input signal of -70%

Note: Results with blocked ports at 210bar supply pressure

Bias M, A or B

Bias M, 0% is shown in the figure (and results in around 10% overlap of the C1 pressure port). Bias A up to 15% P>C1, or bias B up to 15% P>C2 are available via the box car selection options. For example 10% P>C2 (option B10) gives 20% of P overlap.

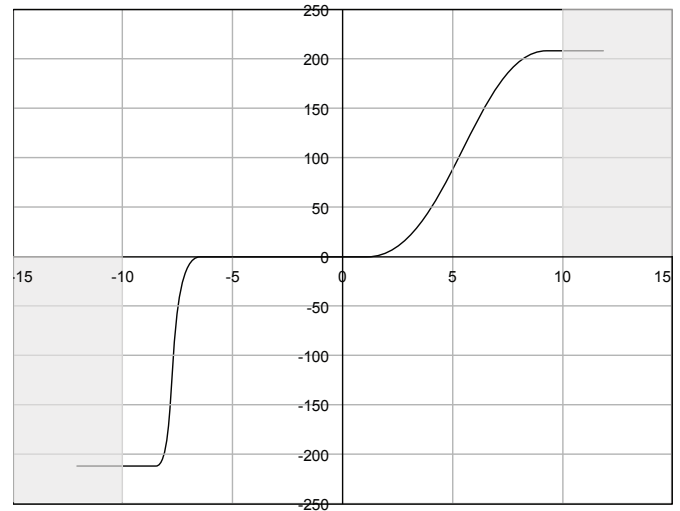
Leakage

The U Spool Leakage (unbiased) is maximum at 55% signal and defined by the flow size. See options.

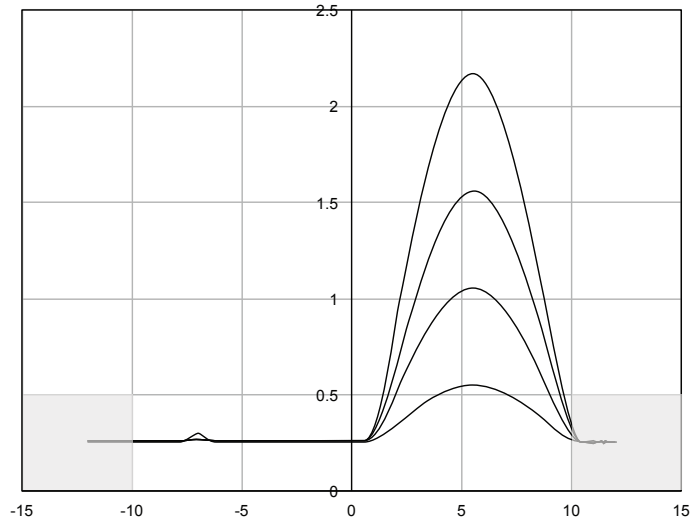
Spool flow size is expressed as the maximum spool leakage flow rate (Ql) across the active port not including the pilot flow. The shown leakage characteristics are with the valve port C1 blocked and Ps set to 210 bar.

Note: The figure shown is unbiased and also includes the G pilot leakage for 210 bar operation.

Blocked Port Pressure (bar v mA), All Flow Rates @ 210 bar



Blocked Port Leakage (lpm v mA) @ 210 bar



E024 SERIES - S; SWITCHING VALVE APPLICATION AND CHARACTERISTICS

E024-S; Proportional Switching Valves

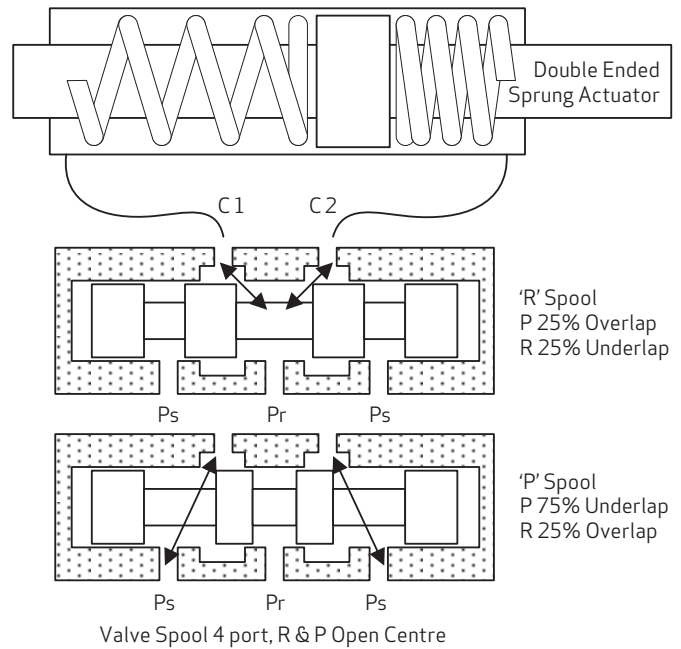
S type valves are for positioning applications where high transient speeds are required but the final position is determined externally (e.g. via a mechanical detent). Consequently, the valve is designed to have no control authority near its centre position. This allows the target actuator position to be governed by centring / detent springs.

R Type Spools

Connect both C1 and C2 ports to return pressure when the valve has zero input signal.

P Type Spools

Achieve the same effect, but with both C1 and C2 ports connected to supply pressure when the valve has zero input signal.



E024-S; Characteristics at 70 bar Drop (4-way control, no load)

High Centre Pressure 'P' Spool (solid line)

Flow Size **Q_r (lpm) @ 70 bar drop**
S72, 7.2 @ 10 mA

The P version has both pressure ports underlapped by 75% signal and the return ports overlapped by 25% signal.

Low Centre Pressure 'R' Spool (dash dot)

Flow Size **Q_r (lpm) @ 70 bar drop**
S50, 5.0 @ 10 mA

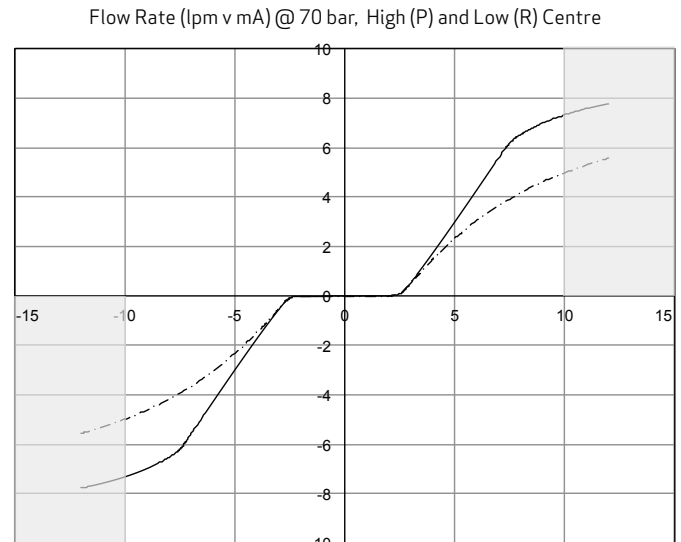
The R version has both return ports underlapped by 25% signal and the pressure ports overlapped by 25% signal.

Note: Results with valve ports C1 and C2 connected together and 70 bar drop

Leakage

The P type spool has significant port leakage flow (between P and R) for spool openings between 25% and 75% signal.

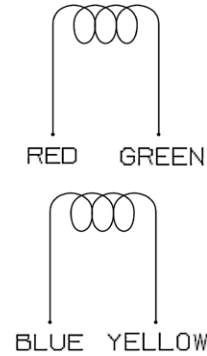
Bias M; No bias is allowed.



ELECTRICAL AND INSTALLATION DATA

Electrical Installation and Characteristics

- Wiring: Red/Green and Blue/Yellow individual coils
- Parallel Connection: Red/Blue and Green/Yellow;
Rated +/-10mA
Resistance 360 Ohm, Inductance 1.4 H
- Series Connection: Red and Green/Blue and Yellow;
Rated +/-5mA
Resistance 1440 Ohm, Inductance 5.2 H
- Current Overdrive: 20% overdrive is permissible
- Valve Phasing: Red/Blue +, Green/Yellow - for flow from P to C1
- Amplifier Requirements: Current feedback drive amplifier > 3 kHz bandwidth



Installation Details (dimensions in mm, consult Moog for a full installation drawing)

- Mounting Surface: Finish Ra < 0.8 um, flat within 10 um
- Manifold Port Diameter: 3.4/3.6 mm
- Base Mounting Seals: 'O' ring; 0.04" section, 0.210" id, Viton B, 90D (4off)
Moog part number -42082-188

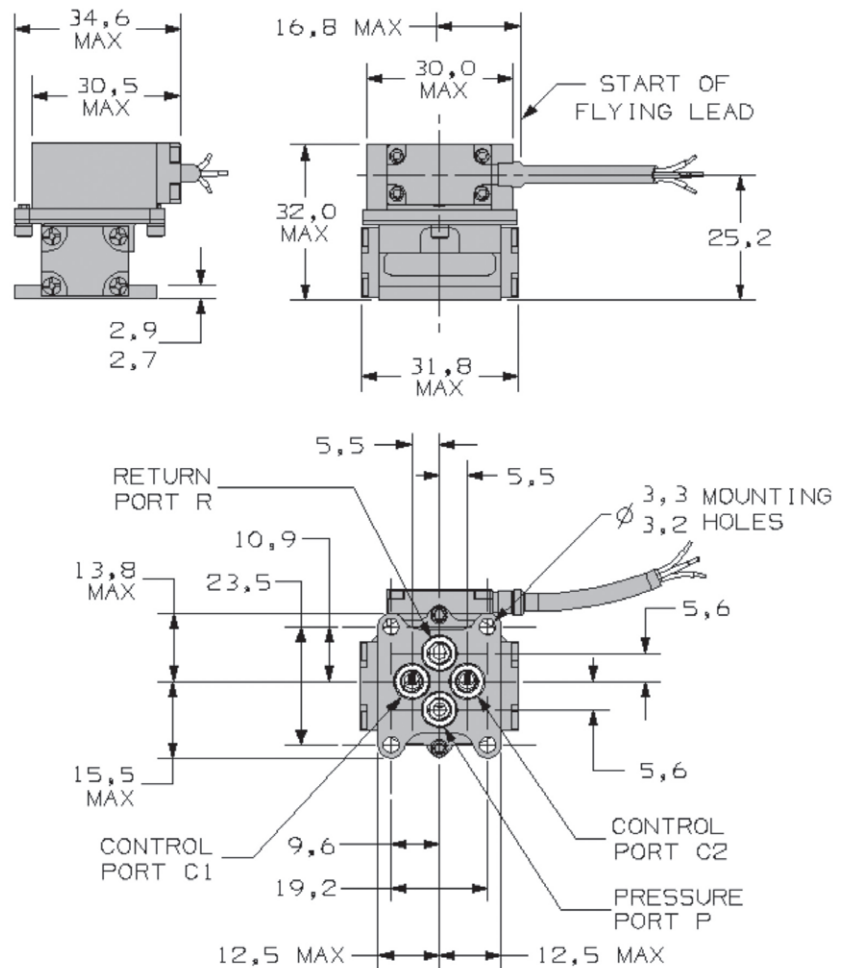
Bolt Down Recommendations:

- Torque; 1.5 Nm
- Screw Type; M3x0.5 SHCS
- Material; A2 or A4-80 St. Steel
- Moog part numbers; A75032-030-008 (8 mm length)
A75032-030-010 (10 mm length)

Note: Thread engagement length to be determined by the user depending on the manifold material.

Header Plate, Cable Exit and Cable Length:

- The motor cap cable exit header plate can be over the P or R ports and the cable exit in the direction of C1 or C2
- Minimum cable length 1300mm



E024 SERIES FLOW AND RESPONSE CALCULATIONS

The supplied technical data gives response, leakage and the P control valve details at 210 bar supply. Q and S valve types have flow rate information published for 70 bar drop and no load. Operational characteristics for other valve running conditions may be determined approximately by manual calculations or by dynamic simulation.

Manual Calculation

The following guidelines are offered:

Flow Control Valve Flow Rates

Are governed by supply (P_s), return (P_r) and load pressure (dP) conditions. See figure. For a given valve rated flow Q_r (at 70 bar drop) the maximum flow rate is given by:

$$Q = Q_r \sqrt{\left(\frac{P_s - P_r - dP}{70}\right)}$$

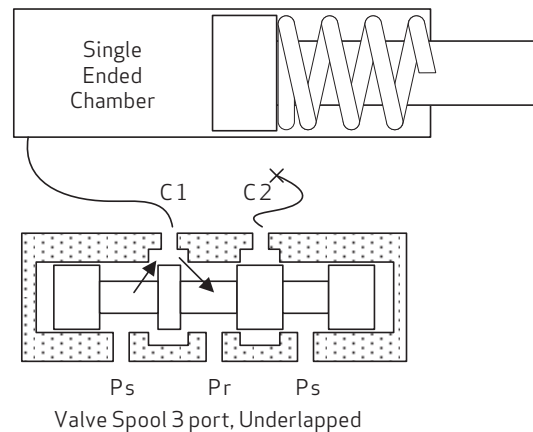
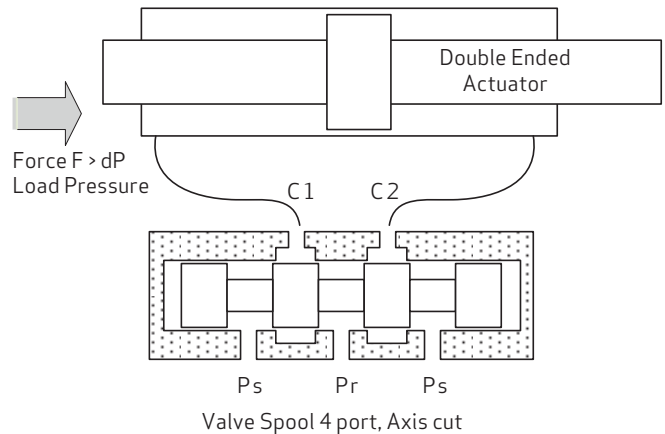
Pressure Control Valve Leakage and Actuation Flow Rates

May be calculated in a similar manner as a square root function of the actual supply pressure referenced to the quoted test pressure at 210 bar.

The maximum operational control flow to the system, e.g. at 50% pressure; is 2x the quoted maximum leakage flow of the valve. This also varies as a square root function of the supply pressure.

Dynamic Simulation (Consult Moog for more details)

The published dynamic performance (response) data is generated using validated simulation models. These are in some cases also available for distribution. Consult Moog Engineering for more details.



E024 SERIES - Q; FLOW CONTROL VALVE ORDERING INFORMATION

E 0 2 4	-		1	2	3	4	5	6	7	8	9	10	
Model Designation & Revision		Assigned by Factory										10 Signal Input/Output	
												Y ±10mA Parallel	
1 Valve Version		Q Flow Control										9 Connector Orientation	
2 'O' Spool Flow (lpm) @ 70 bar drop												P1 Header over P, lead towards C1	
03 0.3												P2 Header over P, lead towards C2	
10 1.0												R1 Header over R, lead towards C1	
15 1.5		2 'Y' Spool Flow (lpm)										R2 Header over R, lead towards C2	
20 2.0													
38 3.8		38 3.8											
50 5.0													
75 7.5		70 7.0											
3 Maximum Operating Pressure (bar)												8 Header	
H {21} 280 {Operating pressure Ps/10}												A Standard (straight)	
												C Customer supplied plate	
4 Spool Type												7 Seals	
O Linear Flow – Axis Cut												V Viton	
Y Dual Flow Gain – Axis Cut													
5 5 Pilot Stage Design												6 Spool Position without electrical signal (bias)	
F Low Response												M {00} Mid position	
G High Response												A {15} P → C1 and C2 → R, 15% [Bias offset %]	
												B {15} P → C2 and C1 → R, 15% [Bias offset %]	

Code 1 – Valve Version:

Identifies the type of valve, the performance of which is uniquely defined by the following box car codes and in accordance with the valve configuration details specified by Moog Engineering. Code 'Q' identifies the valve as being a flow control version.

Code 2 – Rated Flow:

A flow control valve (Q) may be axis cut linear (O spool) or dual gain (Y spool). Each spool type has its own "Rated Flow" defined as the no load flow rate (between C1 and C2) at 70 bar pressure drop between pressure and return. The Code 2 number is the rated flow x10.

Code 3 – Operating Pressure:

The full code here is for example "H21" meaning that the valve is capable of having a 280 bar supply pressure (i.e. code H) but the customer selected operating pressure is in this case set to be 210 bar (i.e. 21x10). Consult Moog Engineering for options other than 210 bar.

Code 4 – Spool Type:

In the case of flow control (type Q) valves, the 'Y' dual gain spool is available for applications requiring both high flow rate and good null sensitivity. See the supplied technical data for more details.

Code 5 – Pilot Stage Design:

High and low response options are available – see the supplied technical data for the step and frequency responses for each option.

Code 6 – Spool Position; without electrical signal (bias):

Shift from the 'M' position in the A or B directions may be customer selected but no higher than +/-15% (recommended bias). This information is carried in the code; e.g. "A10" means 10% bias P>C1. Consult Moog for bias other than +/-15%.

Code 7 – Seals:

Consult Moog Engineering for other options.

Code 8 – Header:

The detail of customer designed headers (option C) has to be specifically agreed with Moog.

Code 9 – Connector Orientation:

No comment.

Code 10 – Signal Input/Output:

Consult Moog Engineering for other options.

E024 SERIES - P; PRESSURE CONTROL VALVE ORDERING INFORMATION

E 0 2 4	-		1	2	3	4	5	6	7	8	9	10
			P									
Model Designation & Revision												
Assigned by Factory												10
												Signal Input/Output
												Y
												±10mA Parallel
												9
												Connector Orientation
												P1
												Header over P, lead towards C1
												P2
												Header over P, lead towards C2
												R1
												Header over R, lead towards C1
												R2
												Header over R, lead towards C2
												8
												Header
												A
												Standard (straight)
												C
												Customer supplied plate
												7
												Seals
												V
												Viton
												6
												Spool Position without electrical signal (bias)
												M{00}
												Mid position (U and B spool)
												A {15}
												P → C1 and C2 → R, ≤15% bias offset (U spool only)
												B {15}
												P → C2 and C1 → R, ≤15% bias offset (U spool only)
												C {30}
												Pc Set @ 0mA {Pc pressure in bar} (B spool only)

Code 1 – Valve Version:

Identifies the type of valve, the performance of which is uniquely defined by the following box car codes and in accordance with the valve configuration details specified by Moog Engineering. Code 'P' identifies the valve as being a pressure control version.

Code 2 – Max Leakage:

Pressure control valves (P) are designed to regulate flow from the C1 port by leakage via underlap between P>C1 and C1>R. The amount of leakage at the worst case operating point is governed by the spool size with options defined by Code 2. The code number is the maximum spool leakage flow x10 for 210 bar operating pressure. The 'shape' of the pressure characteristic is defined by Code 4. See the supplied technical data for more details.

Code 3 – Operating Pressure:

The full code here is for example "H21" meaning that the valve is capable of having a 280 bar supply pressure (i.e. code H) but the customer selected operating pressure is in this case set to be 210 bar (i.e. 21x10). Consult Moog Engineering for options other than 210 bar.

Code 4 – Spool Type:

In the case of pressure control valves (type P), the 'B' spool C1 slots are designed to be 40% open to Ps and 100% open to R at the spool centre position. This gives regulation of pressure from Pr to Ps over the input range -40% to +100%. The alternative 'U' spool gives a similar characteristic over the range +10% to +100%. See the supplied technical data for more details.

Code 5 – Pilot Stage Design:

High and low response options are available – see the supplied technical data for the step and frequency responses for each option.

Code 6 – Spool Position; without electrical signal (bias):

For the 'B' spool; shift from the 'M' mid-position is defined by code C{nn} which sets the bias to give a defined pressure at 0 mA. E.g. C30 indicates a set pressure of 30 bar for a supply pressure determined by Code 3. (The A and B bias shift notation is allowed but non-preferred). For the 'U' spool the bias options are M (no shift), A (P>C1) or B (P>C2). The amount of shift should be less than 15% (preferred) and designated via the numeric {} notation; e.g. "B10" means 10% bias P>C2.

Code 7 – Seals:

Consult Moog Engineering for other options.

Code 8 – Header:

The detail of customer designed headers (option C) has to be specifically agreed with Moog.

Code 9 – Connector Orientation:

No comment.

Code 10 – Signal Input/Output:

Consult Moog Engineering for other options.

E024 SERIES - S; SWITCHING VALVE ORDERING INFORMATION

E 0 2 4	-		1	2	3	4	5	6	7	8	9	10
			S									

Model Designation & Revision		Assigned by Factory	
1	Valve Version	S Proportional Switching	
2	Rated Flow (lpm) @ 70 bar drop	50 5.0 (Only available as an 'R' spool) 72 7.2 (Only available as a 'P' spool)	
3	Maximum Operating Pressure (bar)	H{21} 280 {Operating pressure Ps/10}	
4	Spool Type (Pressure operating range)	P Pressure Open Centre (see code 2) R Return Open Centre (see code 2)	
5	5 Pilot Stage Design	F Low Response G High Response	

10	Signal Input/Output	Y	±10mA Parallel
9	Connector Orientation	P1	Header over P, lead towards C1
		P2	Header over P, lead towards C2
		R1	Header over R, lead towards C1
		R2	Header over R, lead towards C2
8	Header	A	Standard (straight)
		C	Customer supplied plate
7	Seals	V	Viton
6	Spool Position without electrical signal (bias)	M{00}	Mid position

Code 1 – Valve Version:

Identifies the type of valve, the performance of which is uniquely defined by the following box car codes and in accordance with the valve configuration details specified by Moog Engineering. Code 'S' identifies the valve as being a proportional switching version; i.e. the valve is designed to be switched +/-100% from the centre position but may also be used for a degree of regulation between those limits. The centre position itself is designed to have the C1 and C2 ports connected together either at system pressure Ps or return pressure Pr.

Code 2 – Rated Flow:

A Proportional Switching Valve (S) may be designed as spool type 'P' or 'R'; i.e. an open centre connected to supply or return pressure respectively. In each case the no load flow rate (between C1 and C2) at 70 bar pressure drop is determined by Code 2. The code number is the rated flow x10.

Code 3 – Operating Pressure:

The full code here is for example "H21" meaning that the valve is capable of having a 280 bar supply pressure (i.e. code H) but the customer selected operating pressure is in this case set to be 210 bar (i.e. 21x10). Consult Moog Engineering for options other than 210 bar.

Code 4 – Spool Type:

In the case of proportional switching control (type S) valves, the 'P' spool is designed such that at the spool centre position the C1 and C2 ports are open by 75% to the supply pressure Ps and the return ports are closed by 25%. The 'R' spool is designed such that at the spool centre position the C1 and C2 ports are open by 25% to the return pressure Pr and closed to the supply pressure port by 25%. See the supplied technical data for more details.

Code 5 – Pilot Stage Design:

High and low response options are available – see the supplied technical data for the step and frequency responses for each option.

Code 6 – Spool Position; without electrical signal (bias):

Shift from the 'M' unbiased centre position is not allowed. For consistency the code here is M00.

Code 7 – Seals:

Consult Moog Engineering for other options.

Code 8 – Header:

The detail of customer designed headers (option C) has to be specifically agreed with Moog.

Code 9 – Connector Orientation:

No comment.

Code 10 – Signal Input/Output:

Consult Moog Engineering for other options.

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