Sun FLeX Series Solenoid Valves

**HIGH RELIABILITY**
Designed & tested to exceed 10-million operational cycles at full rated pressure

**LOW INTERNAL LEAKAGE**
Less than one drop per minute

**USES 740 & 747 SERIES DC COILS**
Low-power, high-power & hazardous location coils

**FPB***
3000 & 5000 psi (210 & 350 bar)
T-162A cavity

**PILOT-OPERATED ELECTRO-PROPORTIONAL THROTTLE VALVES**

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sunhydraulics.com/model/FPB*
PILOT-OPERATED ELECTRO-PROPORTIONAL THROTTLE VALVE

The 2/2 proportional poppet valves are pilot operated. They comprise a hex body (3), solenoid with coil (2), poppet (5), dart (4), coil nut (1), ball (6), pin (7), and two springs (8) for the FPBG and FPBF, and one spring (8) for the FPBJ and FPBI.

NORMALLY CLOSED
FPBG, FPBF, FPBD, and FPBE
Function: When de-energized, the dart (4) rests on the poppet (5) which in turn rests on the sleeve seat (9). In this condition, flow is blocked from 2 to 1 but will free flow from 1 to 2. When energized, the dart lifts from the poppet proportional to the coil current. The poppet then follows the dart and lifts from the seat, opening flow from 2 to 1.

If the FPBF or FPBD is open and flow is routed 1 to 2, the valve may auto close and only pilot flow will pass from 1 to 2. For the FPBG or FPBE, the check valve (6 & 7) at the nose of the poppet will allow free flow 1 to 2 whether the valve is open or closed.

NORMALLY OPEN
FPBJ, FPBI, FPBM and FPBN
Function: When de-energized, the dart (4) and poppet (5) are held away from the sleeve seat (9) by the spring (8), opening flow from 2 to 1. When energized, the dart pushes into the poppet seat proportional to the coil current. As the dart pushes against the spring, the poppet pushes into the sleeve seat, closing the valve. Flow is then blocked from 2 to 1 but can free flow from 1 to 2.

If the FPBI or FPBM is open and flow is routed from 1 to 2, the valve may auto close and only pilot flow will pass from 1 to 2. For the FPBJ or FPBN, the check valve (6 & 7) at the nose of the poppet will allow free flow 1 to 2 whether the valve is open or closed.

All FLeX Series valves incorporate the Sun floating-style construction to minimize the possibility of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.

FLeX Series proportional valves are fully compatible with the XMD Expandable Mobile Drivers from Sun.

Designed and tested to 10-million operational cycles at full rated pressure.

Exceeds the new NFPA test standard T2.6.1 R2014 for fatigue and burst pressure ratings.

Improved linearity and resolution over similar competing valves.

Designed using CFD fluid simulation for optimized geometries.

For optimum performance, an amplifier with current feedback and adjustable dither (80 - 250 Hz) should be used. Capacities rated at 200-psi (14-bar) differential and maximum rated coil current.

Depending on circuit requirements, a reverse free flow check bypassing the compensator may be needed when using an FPB* with an external compensator.

Zinc-nickel plating standard for 1000-hour salt fog protection.

The 5000 psi (350 bar) valves can be used with 740 Series high-power and 747 Series hazardous location coils.

The 3000 psi (210 bar) valves can be used with 740 Series low-power and 747 Series hazardous location coils.

A wide variety of coil termination and voltage options are available, with and without surge protection. See the CONFIGURATION section.

Coil connector options offer ratings up to IP69K. See individual coil product pages for details.
## FLeX Series CONFIGURATIONS

### MODEL CODE EXPLANATION
Sun cartridges have a base seven-digit part number. Each of the digits in the sequence has significance as shown in the model code explanation below. Available options and modifiers for specific cartridges, manifolds, and valve packages are shown on the individual product pages and data sheets. Not all modifiers are applicable for every model.

### COMPATIBLE FLeX SERIES COILS

#### Low-Power (17-W)* & High-Power (25-W) Coils

<table>
<thead>
<tr>
<th>Voltage</th>
<th>DIN 43650 Form A (IP65/IP67)</th>
<th>Deutsch DT04-2P (IP69K)</th>
<th>Resistance @20°C (ohms) ±10% (with diode*)</th>
<th>TVS Diode (Nominal) Breakdown Voltage (with diode*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Vdc</td>
<td>M20 x 1.5 180°</td>
<td>M20 x 1.5 90°</td>
<td>1/2” NPT 180°</td>
<td>1/2” NPT 90°</td>
</tr>
<tr>
<td>14 Vdc</td>
<td>740-212L</td>
<td>740-912LD</td>
<td>5.8 Ω</td>
<td>8.5 Ω</td>
</tr>
<tr>
<td>24 Vdc</td>
<td>740-214L</td>
<td>740-914LD</td>
<td>7.8 Ω</td>
<td>11.5 Ω</td>
</tr>
<tr>
<td>28 Vdc</td>
<td>740-224L</td>
<td>740-924LD</td>
<td>23.0 Ω</td>
<td>33.9 Ω</td>
</tr>
</tbody>
</table>

* The low-power coils are for use with the 3000 psi (210 bar) valves only.
** Above model codes are shown without transient voltage suppression (TVS) diodes. To order 740 Series coils with a TVS diode, append model code with "D" (Example: 740-212LD).

#### Hazardous Location, Explosion-Proof (30-W) Coils

<table>
<thead>
<tr>
<th>Voltage</th>
<th>M20 x 1.5 180°</th>
<th>M20 x 1.5 90°</th>
<th>1/2” NPT 180°</th>
<th>1/2” NPT 90°</th>
<th>Wattage @ 20°C</th>
<th>Circuitry</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Vdc</td>
<td>747-JM12BD</td>
<td>747-JM12CD</td>
<td>747-JN12BD</td>
<td>747-JN12CD</td>
<td>29.6 W</td>
<td>With diode</td>
</tr>
</tbody>
</table>
### TECHNICAL SPECIFICATIONS

**FLeX Series**

**PILLOT-OPERATED ELECTRO-PROPORTIONAL THROTTLE VALVE**

**SERIES 0, CAVITY: T-162A**

<table>
<thead>
<tr>
<th>TECHNICAL SPECIFICATIONS</th>
<th>FPBF, FPBG, FPBI, FPBJ</th>
<th>FPBD, FPBE, FPBM, FPBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Operating Pressure</td>
<td>5000 psi (350 bar)</td>
<td>3000 psi (210 bar)</td>
</tr>
<tr>
<td>Sun Cavity</td>
<td>T-162A</td>
<td></td>
</tr>
<tr>
<td>Sun Cartridge Series</td>
<td>Series 0</td>
<td></td>
</tr>
<tr>
<td>Nominal Flow Rate/Capacity</td>
<td>5 gpm (18.9 L/min)*</td>
<td></td>
</tr>
<tr>
<td>Check Cracking Pressure - Typical</td>
<td>100 psi (6.9 bar)</td>
<td></td>
</tr>
<tr>
<td>Response Time - Typical</td>
<td>50 ms (open &amp; close)</td>
<td></td>
</tr>
<tr>
<td>Maximum Internal Leakage at 110 SUS (24 cSt) at 5000 psi (350 bar)</td>
<td>0.004 in³ (0.07 cm³)/min (1 drop/min)</td>
<td></td>
</tr>
<tr>
<td>Switching Frequency (Maximum)</td>
<td>4.17 Hz (15,000 cycles/hour)</td>
<td></td>
</tr>
<tr>
<td>Recommended Dither Frequency</td>
<td>140 Hz**</td>
<td></td>
</tr>
<tr>
<td>Hysteresis (at Recommended Dither)</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Linearity (at Recommended Dither)</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Repeatability (at Recommended Dither)</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Deadband, Nominal (as Percent of Coil Current)</td>
<td>48%</td>
<td></td>
</tr>
<tr>
<td>Manual Override Option</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Viscosity Range</td>
<td>2,8 to 380 cSt or 35 to 2000 SUS</td>
<td></td>
</tr>
<tr>
<td>Filtration</td>
<td>Minimum cleanliness (ISO 4406 1999, 4/6/14 μm) 18/16/13</td>
<td></td>
</tr>
<tr>
<td>Valve Hex Size</td>
<td>0.75 in (19.1 mm)</td>
<td></td>
</tr>
<tr>
<td>Valve Installation Torque</td>
<td>20-25 lbf ft (27-34 N·m)</td>
<td></td>
</tr>
<tr>
<td>Mounting Position</td>
<td>No restrictions</td>
<td></td>
</tr>
<tr>
<td>Valve Weight (excluding coil)</td>
<td>5.6 oz (159 g)</td>
<td></td>
</tr>
<tr>
<td>Seal Kit - Viton</td>
<td>990-608-006</td>
<td></td>
</tr>
<tr>
<td>Seal Kit - Buna</td>
<td>990-608-007</td>
<td></td>
</tr>
</tbody>
</table>

* See performance curves for more details.

**We recommend a 140-Hz dither frequency be used as a starting point when tuning the amplifier and valve in a system.**
FLeX Series

PERFORMANCE CURVES

TYPICAL FLOW VS. COMMAND - 5000 psi (350 bar) Valves

FPBF
(Normally closed)

FPBI
(Normally open)

FPBG
(Normally closed)

FPBJ
(Normally open)

TYPICAL PRESSURE DIFFERENTIAL VS. FLOW - 5000 psi (350 bar) Valves

FPBF
(Normally closed)

FPBI
(Normally open)

FPBG
(Normally closed)

FPBJ
(Normally open)
PERFORMANCE CURVES

TYPICAL FLOW VS. COMMAND - 3000 psi (210 bar) Valves

TYPICAL PRESSURE DIFFERENTIAL VS. FLOW - 3000 psi (210 bar) Valves
**FLeX Series**

**DIMENSIONAL DRAWINGS**

**FPB* FAMILY WITH 740 SERIES LOW- & HIGH-POWER COILS**

NOTE: Please verify cartridge clearance requirements when choosing a Sun manifold. Different valve controls and coils require different clearances. An additional minimum 2.0 in. (50.8 mm) beyond the valve extension is needed for coil installation and removal.

**747 SERIES HAZARDOUS LOCATION COILS**
NOTE: For cavity tooling, see table below.

For full cavity detail, download the latest drawings from our website.

www.sunhydraulics.com/cavity/T-162A

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>HIGH-SPEED STEEL</th>
<th>TITANIUM COATED</th>
</tr>
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<tbody>
<tr>
<td>M16 X 1.5-6H tap, straight shank</td>
<td>998991</td>
<td>9989911101</td>
</tr>
<tr>
<td>Series 0 deep hex socket</td>
<td>998100005</td>
<td></td>
</tr>
<tr>
<td>T-162A cavity form drill, morse taper</td>
<td>994162001</td>
<td>994162101</td>
</tr>
<tr>
<td>T-162A cavity form drill, straight shank</td>
<td>994162102</td>
<td></td>
</tr>
<tr>
<td>T-162A cavity form reamer, morse taper</td>
<td>995162001</td>
<td>995162101</td>
</tr>
<tr>
<td>T-162A cavity form reamer, straight shank</td>
<td>995162102</td>
<td></td>
</tr>
</tbody>
</table>

XMD Single- and Dual-Output Drivers

The XMD is a single- or dual-output driver used with solenoid-operated electro-proportional valves for the mobile and industrial hydraulic industries. The driver can be mounted on a manifold using the standard mount clip or directly to the 740 Series low- and high-power coils using an optional coil-mount clip.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-output PWM driver w/ standard mounting bracket</td>
<td>XMD-01</td>
</tr>
<tr>
<td>Dual-output PWM driver w/ standard mounting bracket</td>
<td>XMD-02</td>
</tr>
</tbody>
</table>

Wire Harnesses

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire harness, 2-pin Deutsch-to-Metri-Pack Conversion</td>
<td>991-717</td>
</tr>
<tr>
<td>Wire harness, 2-pin Deutsch-to-Amp Jr Timer Conversion</td>
<td>991-718</td>
</tr>
<tr>
<td>Wire harness, 2-pin Deutsch-to-Twin-Lead Conversion</td>
<td>991-719</td>
</tr>
</tbody>
</table>