Pilot Controlled Directional Cartridges

Sun directional spool type valves (DR** and DP**) are pilot controlled, 2-way and 3-way switching devices. There are both direct acting and pilot operated versions that shift when a predetermined, user settable pressure has been sensed. They can be considered as directional sequence valves and are not bistable, i.e. they will modulate when the pilot pressure remains close to the set point.

There are also pilot operated versions with integral control cavities (DV**) that shift by either venting or de-venting, depending on the choice of the pilot valve. With these valves, the internal 100 psi (7 bar) bias spring pressure differential is the only pilot pressure requirement to be considered.

Applications

Sun pilot controlled directional valves can be used individually or as control interlocks to operate other valves. They can open or close pilot operated check valves or vent/de-vent ventable type relief, sequence, reducing/relieving, and unloading valves. They can also be used to shift larger pilot operated directional valves or logic elements.

The available pressure adjustment range for the pilot pressure signal is 50-4500 psi (3,5-315 bar), depending on the control range selected. The direct acting versions (DR**) are available in Series 1 only, and are rated at 7 gpm (28 L/min). The pilot operated versions (DP**), as well as the ventable valves (DV**), are available in Series 1 and Series 2 frame sizes, and are rated up to 15 gpm (60 L/min). All versions of these cartridges are offered in both 3 port and 4 port configurations. With the 4 port versions, the port 4 drain connection allows back pressure at port 3 that will not add to the pressure setting. However, if there is back pressure at port 4, it will also add to the pressure setting. (If desired, the valve can be made insensitive to the pilot pressure and will not be allowed to shift by blocking port 4.)

There are nine valve functions currently available:

- 2-way, three port, normally open
- 2-way, three port, normally closed
- 2-way, four port, normally open
- 2-way, four port, normally closed
- 3-way, three port, 1 blocked, 2 to 3 open
- 3-way, three port, 3 blocked, 1 to 2 open
- 3-way, four port, 1 blocked, 2 to 3 open
- 3-way, four port, 3 blocked, 1 to 2 open
- 3-way, four port, 2 blocked, 3 to 4open

2-Way Cartridges

All Sun 2-way pilot controlled cartridges use port 1 as the piloting port, with port 2 normally open to port 3 in the normally open valves, and port 2 open to port 3 when the normally closed version is actuated. With all three port cartridges, the spring chamber drains to port 3, so any back pressure on port 3 has to be considered. A four port version is preferred if port 3 back pressure is anticipated. (All four port cartridges use port 4 as the drain connection.)

- Normally open 2-way, three port cartridges are primarily used for unloading functions in the absence of a remote pressure signal. (See Figures 1 and 2.)
- Normally open 2-way, four port cartridges are typically used for blocking functions at a predetermined remote pressure signal, with port 3 seeing system pressure. (Be aware that any pressure at drain port 4 will add to the pressure setting.) (See Figure 3.)
- Normally closed 2-way, three port cartridges are primarily used for unloading functions at some predetermined remote pressure signal. (See Figures 4, 5 and 6.)
- Normally closed 2-way, four port cartridges are primarily used for blocking functions in the absence of a remote pressure. signal. (See Figure 7.)

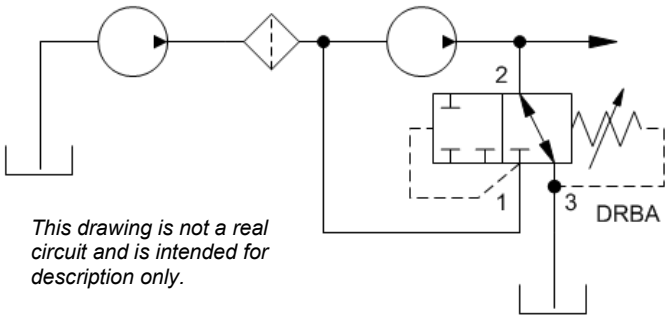


Figure 1.
Using a DRBA (or DP*A) to unload the main pump if low charge pressure is detected.

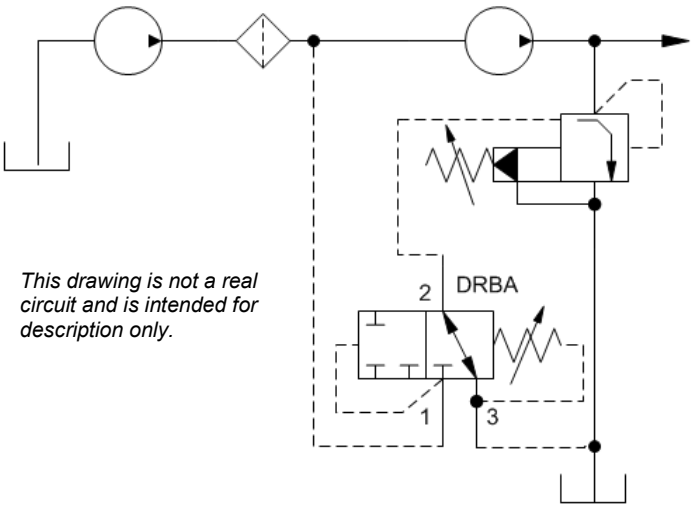


Figure 2.
With the addition of a ventable relief valve, system relief protection and high flow capacity can be achieved with the DRBA (or DP*A) being used as a pilot valve to unload the main pump if low charge pressure is detected.

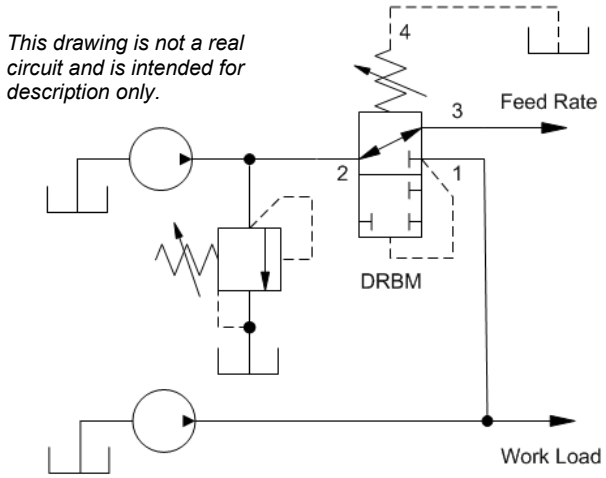


Figure 3.
In this variable feed rate circuit, when the work load pressure reaches the setting of the DRBM (or DP*M), the valve starts to close. As the valve restricts flow from the feed pump, the feed rate will slow or stop.

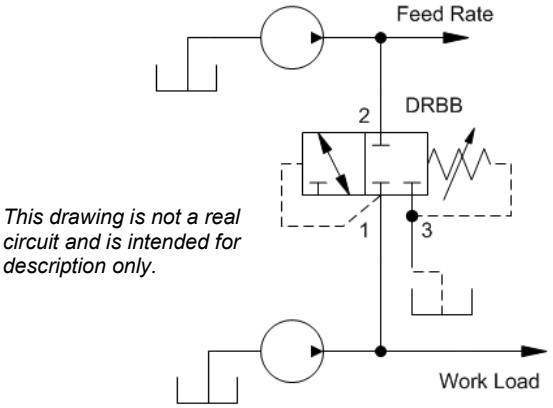


Figure 4.
This variable feed rate circuit is similar to that shown in Figure 3, except when the work load pressure reaches the setting of the DRBB (or DP*B), the valve bleeds off flow from the feed pump, slowing or stopping the feed rate.

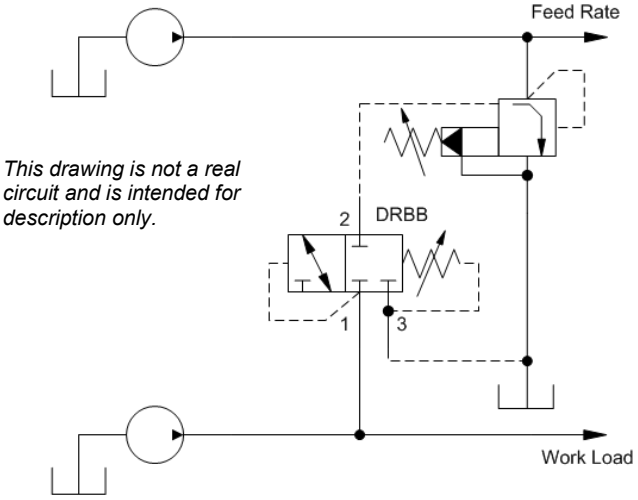


Figure 5.
Adding a ventable relief valve to the circuit shown in Figure 4, allows for higher flow plus system relief protection.

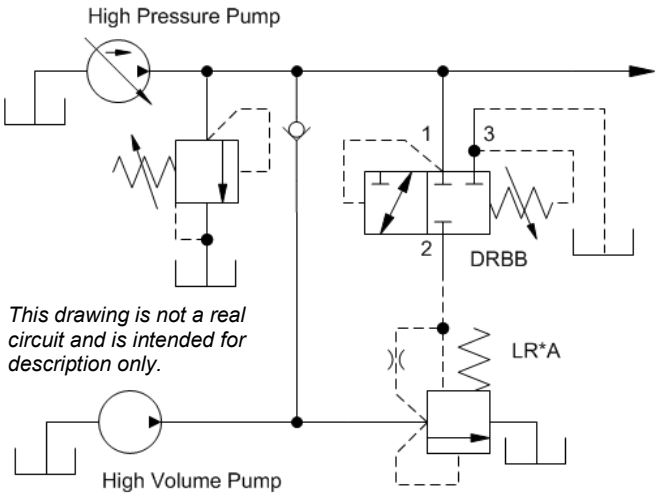


Figure 6.
Here a DRBB (or DP*B) is used to control an LR*A normally closed modulating logic cartridge, to unload the high volume pump in a higher flow “Hi-Lo” circuit.

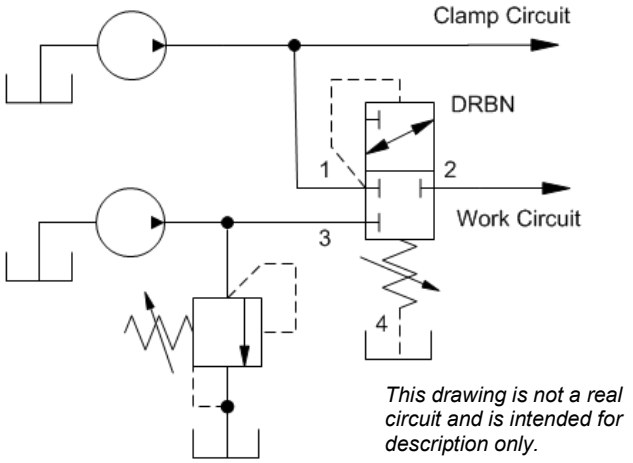
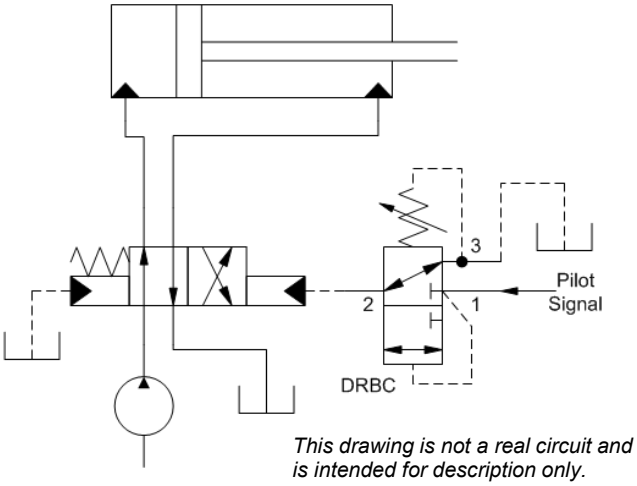


Figure 7.
This circuit is a clamp-work, dual power source, interlock system. If the clamping force falls below the DRBN (or DP*N) pressure setting, the work circuit will not function.

3-Way Cartridges

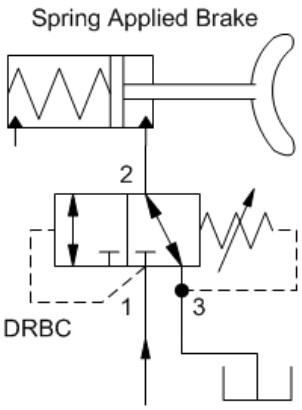
All Sun 3-way pilot controlled cartridges use port 1 as the piloting port. Port 1 is also used as one of the work ports on most 3-way cartridges. Available at-rest circuit variations include: port 1 blocked with 2 to 3 open, port 3 blocked with 1 to 2 open, port 2 blocked with 3 to 4 open (DRBR four port cartridges). As with the three port, 2-way cartridges, the spring chamber drains to port 3, therefore back pressure on port 3 has to be considered. A four port version should be selected if port 3 back pressure is present. (All four port cartridges use port 4 as the drain connection.)

Some typical applications for 3-way cartridges include: controlled piloting of pilot operated directional valves (See Figure 8), and controlled pressure release of spring applied brakes (See Figures 9 and 10).



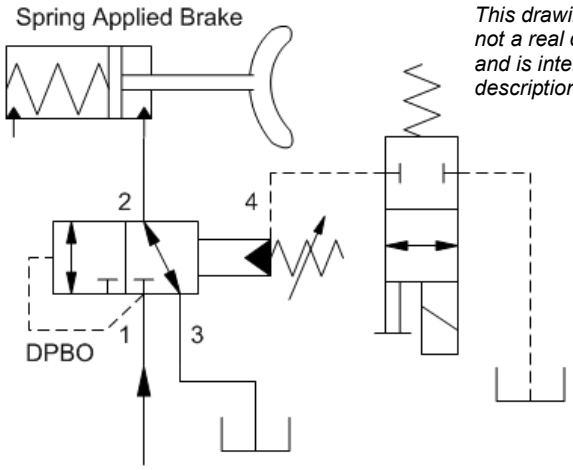
This drawing is not a real circuit and is intended for description only.

Figure 8.
Here, a DRBC (or DP*C) is used to control the shift point of a 2-position pilot operated directional valve.



This drawing is not a real circuit and is intended for description only.

Figure 9.
A DRBC (or DP*C) can be used to release a spring applied brake when a pre-determined work pressure is reached.



This drawing is not a real circuit and is intended for description only.

Figure 10.
Connecting a 2-way solenoid valve to port 4 of a pilot operated DPBO creates a brake release safety interlock circuit. The valve will NOT shift and release the brake with port 4 blocked.

Design Concepts and Features

*Three and Four Port Direct Acting Cartridges— DR***

Performance parameters include:

- Valves will shift when the pressure differential between port 1 and port 3 (or port 4) exceeds the pressure setting of the valve.
- The direct acting design features low internal leakage and no pilot flow consumption
- Direct acting versions are available in Series 1 size only.

*Three and Four Port Pilot Operated Cartridges– DP***

Performance parameters include:

- Valve shift when the pressure differential between port 1 and port 3 (or port 4) exceeds the pressure setting of the valve.
- Control pilot flow equals 7-10 in^3/min (0,11 – 0,16 L/min)
- Pilot operated versions are available in both Series 1 and Series 2.

*Three and Four Port Vent-to-Operate Cartridges– DV***

Sun three and four port, vent-to-operate, DV** cartridges are similar to DP** cartridges except they incorporate an integral T-8A control cavity in lieu of the pressure adjustment mechanism. These valves shift when flow is initiated through the pilot control cartridge in the T-8A cavity. Performance parameters include:

- In all cases, there must be a pressure source at port 1, relative to port 3 or 4, in order to shift the valve.
- Valve will shift when the pressure differential, via the pilot control cartridge, reaches the 100 psi (7 bar) internal bias spring pressure.
- All DP** valve circuit functions are available.
- The pilot control valves are sold separately and include solenoid, air pilot, manual, and hydraulic pilot operation.
- Control pilot flow equals 7-10 in^3/min (0,11 – 0,16 L/min).
- As with DP** versions, DV** cartridges are available in Series 1 and Series 2.

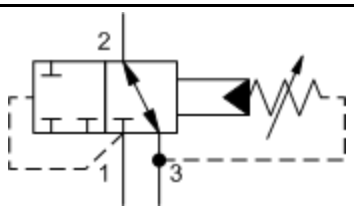
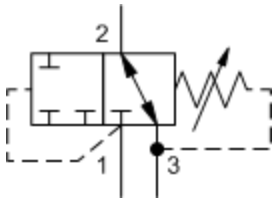
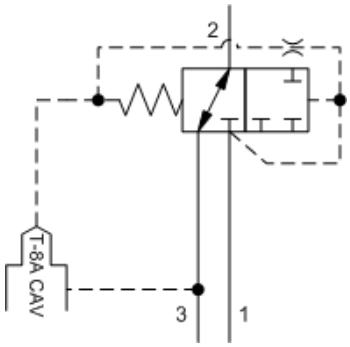
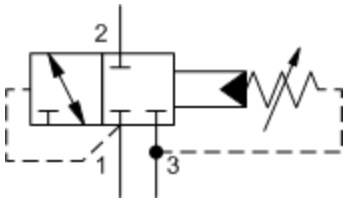
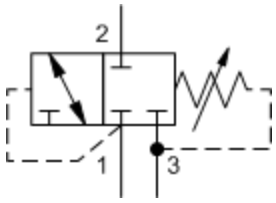
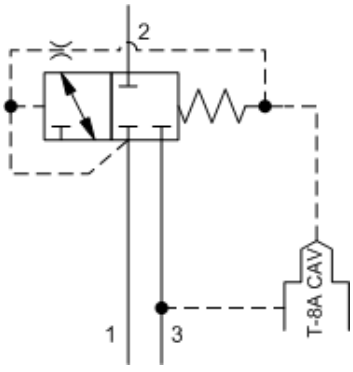
Directional Pilot and Control Cartridge Variations

Four Port Direct Acting Pilot Operated Directional Cartridges – DRAX and DRAY

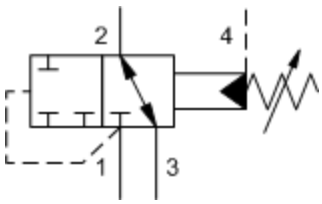
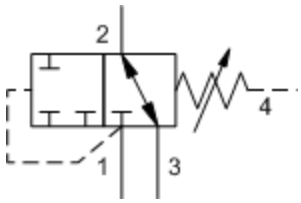
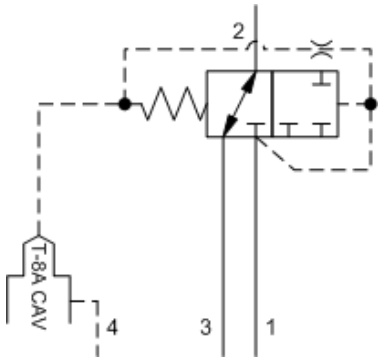
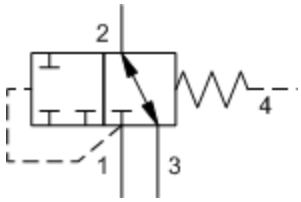
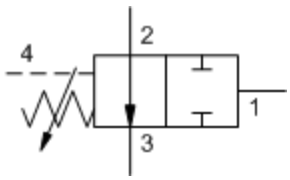
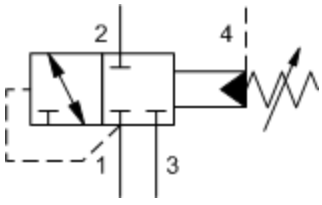
Sun four port DRAX (normally closed) and DRAY (normally open) direct acting, pilot controlled 2-way cartridges are unique two position, non-modulating, low-flow switching cartridges. When pressure at port 1 exceeds the pressure setting, the valve will fully shift. Performance parameters include:

- The nominal flow capacity is 0.5 gpm (2 L/min).
- The valve is designed to *not* modulate and is the equivalent of a hydraulic pressure switch.
- The pilot area (port 1) and the spring chamber drain (port 4) are positively sealed.
- Two pressure adjustment ranges are available; 1000-3000 psi (70-210 bar), and 2000-6000 psi (140-420 bar).

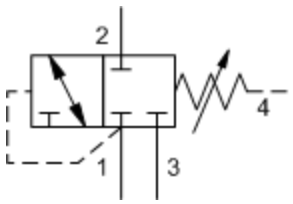
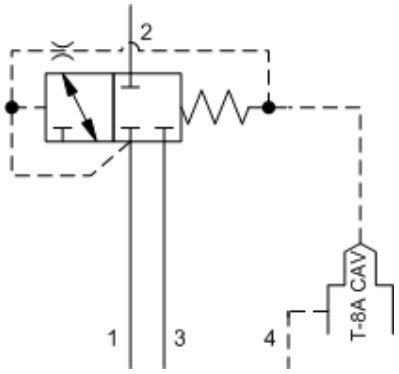
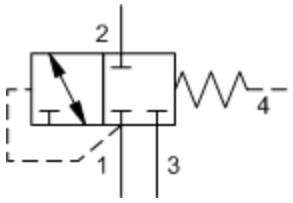
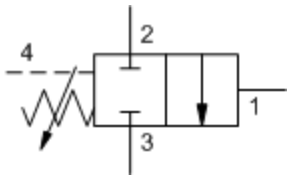
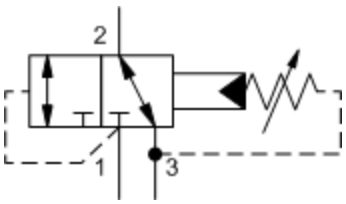
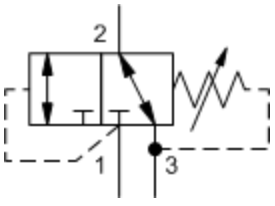
Pilot Controlled Directional Cartridge Valves Overview

Function	Description	Nominal Capacity	Model	Cavity	Symbol
2 Way - 3 Port - Normally Open	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBA DPCA	T-11A T-2A	
2 Way - 3 Port - Normally Open	Direct Acting	7 gpm (28 L/min.)	DRBA	T-11A	
2 Way - 3 Port - Normally Open	Integral T-8A Control-Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBA DVCA	T-11A T-2A	
2 Way - 3 Port - Normally Closed	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBB DPCB	T-11A T-2A	
2 Way - 3 Port - Normally Closed	Direct Acting	7 gpm (28 L/min.)	DRBB	T-11A	
2 Way - 3 Port - Normally Closed	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBB DVCB	T-11A T-2A	

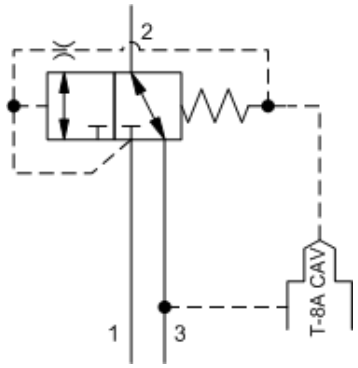
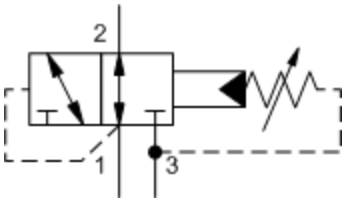
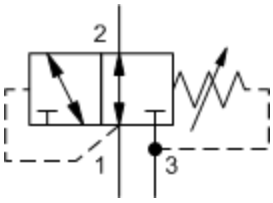
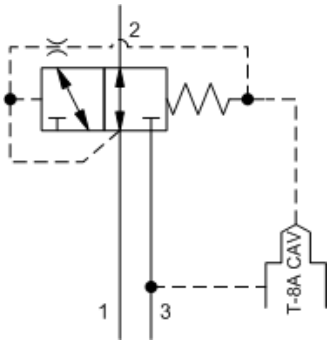
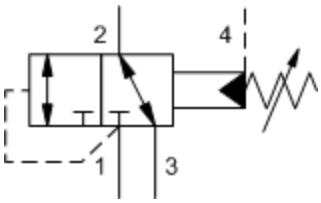
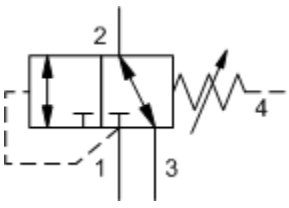
Pilot Controlled Directional Cartridge Valves Overview (continued)

Function	Description	Nominal Capacity	Model	Cavity	Symbol
2 Way - 4 Port - Normally Open	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBM DPCM	T-21A T-22A	
2 Way - 4 Port - Normally Open	Direct Acting	7 gpm (28 L/min.)	DRBM	T-21A	
2 Way - 4 Port - Normally Open	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBM DVCM	T-21A T-22A	
2 Way - 4 Port - Normally Open	Direct Acting - Fixed Setting	7 gpm (28 L/min.)	DRBMX	T-21A	
2 Way - 4 Port - Normally Open	Direct Acting – Sealed Pilot	0.5 gpm (2 L/min.)	DRAY	T-21A	
2 Way - 4 Port - Normally Closed	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBN DPCN	T-21A T-22A	

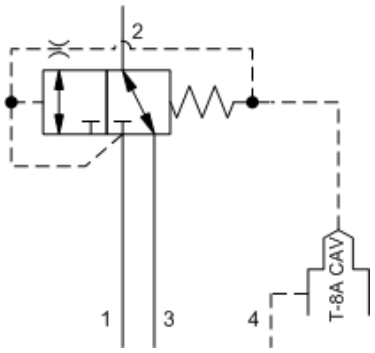
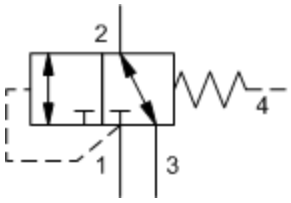
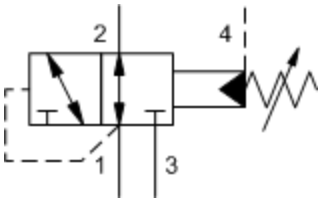
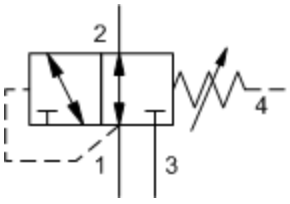
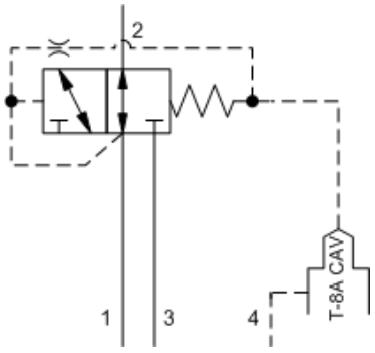
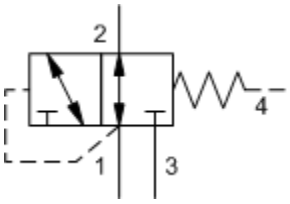
Pilot Controlled Directional Cartridge Valves Overview (continued)

Function	Description	Nominal Capacity	Model	Cavity	Symbol
2 Way - 4 Port - Normally Closed	Direct Acting	7 gpm (28 L/min.)	DRBN	T-21A	
2 Way - 4 Port - Normally Closed	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBN DVCN	T-21A T-22A	
2 Way - 4 Port - Normally Closed	Direct Acting - Fixed Setting	7 gpm (28 L/min.)	DRBNX	T-21A	
2 Way - 4 Port - Normally Closed	Direct Acting – Sealed Pilot	0.5 gpm (2 L/min.)	DRAX	T-21A	
3 Way - 3 Port - 1 Blocked, 2 to 3 Open	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBC DPCC	T-11A T-2A	
3 Way - 3 Port - 1 Blocked, 2 to 3 Open	Direct Acting	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DRBC DRCC	T-21A T-22A	

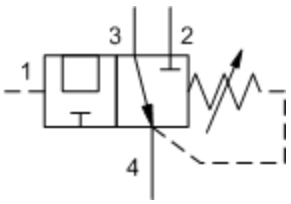
Pilot Controlled Directional Cartridge Valves Overview (continued)

Function	Description	Nominal Capacity	Model	Cavity	Symbol
3 Way - 3 Port - 1 Blocked, 2 to 3 Open	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBC DVCC	T-11A T-2A	
3 Way - 3 Port - 1 to 2 Open, 3 Blocked	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBD DPCD	T-11A T-2A	
3 Way - 3 Port - 1 to 2 Open, 3 Blocked	Direct Acting	7 gpm (28 L/min.)	DRBD	T-11A	
3 Way - 3 Port - 1 to 2 Open, 3 Blocked	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBD DVCD	T-11A T-2A	
3 Way - 4 Port - 1 Blocked, 2 to 3 Open	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBO DPCO	T-21A T-22A	
3 Way - 4 Port - 1 Blocked, 2 to 3 Open	Direct Acting	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DRBO DRCO	T-21A T-22A	

Pilot Controlled Directional Cartridge Valves Overview (continued)

Function	Description	Nominal Capacity	Model	Cavity	Symbol
3 Way - 4 Port - 1 Blocked, 2 to 3 Open	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBO DVCO	T-21A T-22A	
3 Way - 4 Port - 1 Blocked, 2 to 3 Open	Direct Acting - Fixed Setting	7 gpm (28 L/min.)	DRBOX	T-21A	
3 Way - 4 Port - 1 to 2 Open, 3 Blocked	Pilot Operated	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DPBP DPCP	T-21A T-22A	
3 Way - 4 Port - 1 to 2 Open, 3 Blocked	Direct Acting	7 gpm (28 L/min.)	DRBP	T-21A	
3 Way - 4 Port - 1 to 2 Open, 3 Blocked	Integral T-8A Control Cavity	7 gpm (28 L/min.) 15 gpm (60 L/min.)	DVBP DVCP	T-21A T-22A	
3 Way - 4 Port - 1 to 2 Open, 3 Blocked	Direct Acting - Fixed Setting	7 gpm (28 L/min.)	DRBPX	T-21A	

Pilot Controlled Directional Cartridge Valves Overview (continued)

Function	Description	Nominal Capacity	Model	Cavity	Symbol
3 Way - 4 Port - 3 to 4 Open, Port 2 Blocked	Direct Acting	7 gpm (28 L/min.)	DRBR	T-21A	
3 Way - 4 Port - 3 to 4 Open, Port 2 Blocked	Direct Acting - Fixed Setting	7 gpm (28 L/min.)	DRBRX	T-21A