



## The Smart Use of Logic Elements

*Logic elements, also known as differential-pressure sensing elements, have been around for a long time, yet they are the best-kept secret for simplifying circuits and creating compact hydraulic integrated circuits (HICs).*

Effective use of logic elements is a key to designing cost-effective circuits, and is limited only by the imagination of the designer. Most experienced hydraulic circuit designers know and understand the many ways to apply logic elements. Those who are less familiar with logic elements but are always looking for the next best solution will benefit from this article. It focuses on two popular Comatrol logic elements - the new HLE10-CPC and HLE10-OPO, and the new PSV12-34 proportional directional valves.

### Compensation and Unloading:

Adding a logic element upstream to a proportional flow control or proportional directional valve, and a shuttle valve downstream, can provide a simple load-independent, compensated flow control to a cylinder or motor. The red line (with compensation) on the included compensation curve shows how the flow does not change with the increase in pressure, or load. Without compensation, the flow would decrease as the load on the actuator increased, thus slowing down the cylinder or motor and reducing vehicle performance. The benefit is repeatable, precise proportional performance, regardless of the load on the actuator.

Unloading is another key feature of these logic elements. When using a fixed gear pump, it is always a good practice to unload the flow from the circuit when there is no actuation, thus minimizing power loss through the HIC.

“A logic element will not replace a load sense (LS) pump, but a fixed displacement pump in combination with a bypass logic element can cover most of the benefits of an LS pump, with a lower cost,” says Mark Mahony, product application engineer. “As fuel prices go up, customers cannot afford to have un-optimized systems. Using logic element technology allows our customers to optimize efficiency and precision on the high running functions, and optimize cost on functions used less frequently.”

### Schematic Examples:

The two schematics shown are proportional directional control circuits, both with compensation and unloading functionality, and a relief valve for over-pressure protection. The left circuit is using the HLE10-CPC as an unloading compensator, managing both functions in one valve - a simple, cost-effective solution. This circuit works well when operating one actuator at a time.

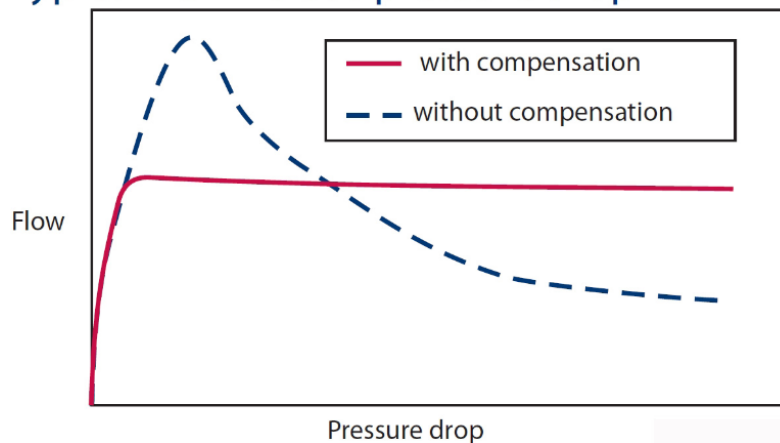
The right schematic is using the HLE10-OPO as a pre-compensator for each of the actuators, and using the HLE10-CPC as the unloading valve for the complete circuit. This is a common solution that provides

load-independent, proportional directional control of multiple motors and/or cylinders on a vehicle. The example shown has two actuators, but more can be added as long as there is enough flow provided by the gear pump for all the functions.

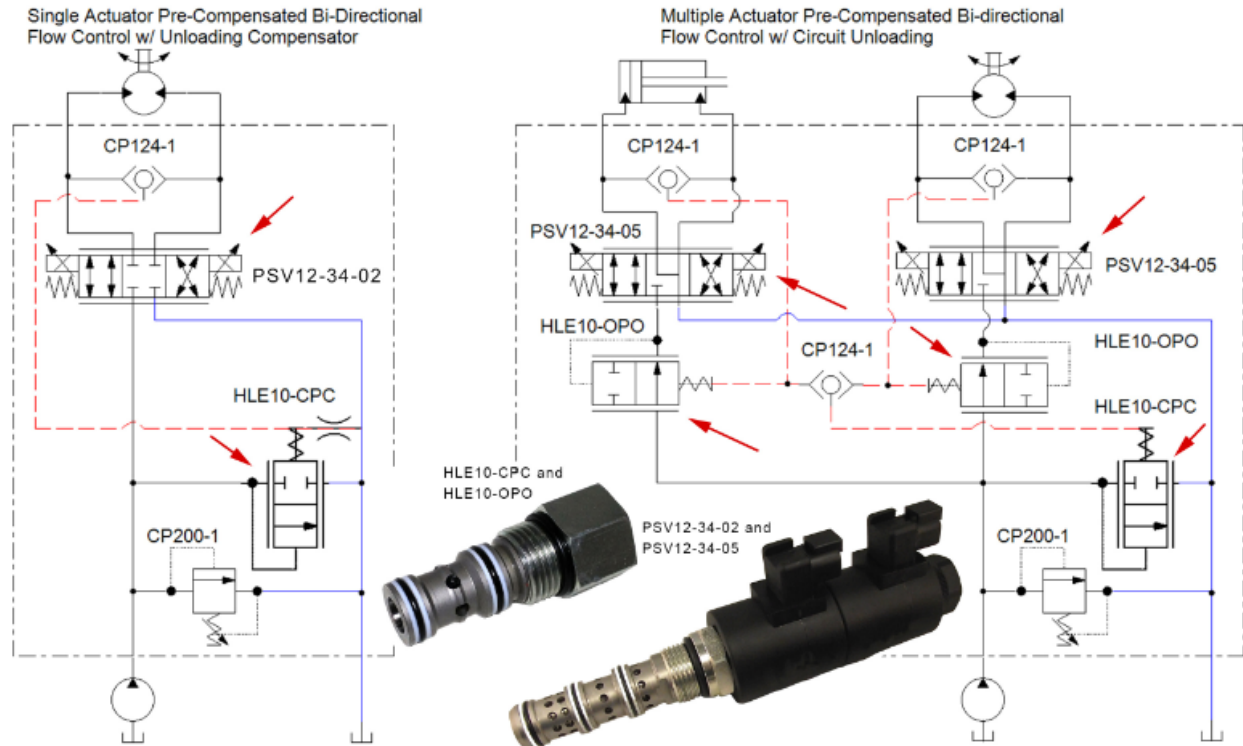
#### Product Overview:

The HLE10-CPC is a high pressure logic element (350 bar / 5075 psi), normally closed, pilot to close and features a rated flow of 80 LPM (21.1 GPM). The HLE10-OPO is a high pressure logic element (350 bar / 5075 psi), normally open, pilot to open and offers a flow rating of 60 LPM (15.8 GPM). The PSV12-34 is a proportional, non-compensated, 3-position, 4-way, directional flow control solenoid valve, with closed- or float-center spools. This valve is designed for directional control of hydraulic cylinders and motors, with flow rating up to 60 LPM (15.8 GPM) and pressures to 260 bar (3770 psi).

### Typical flow versus pressure drop



*Using a logic element as a pressure compensator provides load-independent control of the motor or cylinder.*



*Example pre-compensated, bi-directional flow control circuits with unloading using new HLE10 and PSV12-34 cartridge valves.*

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