WHITEPAPER

Evolution MOTION SOLUTIONS

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# The Building Block Principle



## A Technical Examination of Modular High-Flow Control with LC/LFA Cartridge Valves

**As hydraulic system power density increases, the demand for compact, efficient, and reliable high-flow control solutions has grown. This whitepaper examines the technical principles and advantages of the Bosch Rexroth LC/LFA 2-way cartridge valve system, a modular design philosophy that has become an industry standard.**

We will detail how the separation of the power section (the LC cartridge) from the control section (the LFA cover) allows for unparalleled functional versatility within a standardized ISO 7368 cavity. This analysis covers the pressure-actuated function of the cartridge, the variety of hydraulic functions achievable through different control covers, and the resulting benefits in system design, including reduced complexity, lower costs, and enhanced reliability for flows up to 25,000 l/min.

## THE CARTRIDGE VALVE PRINCIPLE

Separating Muscle from Brain The core innovation of the LC/LFA system is the physical and functional separation of the power-handling element from its control logic.

- **The Power Section (Type LC):** The LC cartridge is a simple, pressure-actuated 2-way valve element (poppet or spool) designed to fit into an ISO 7368-standardized cavity. Its primary function is to open or close a flow path. With a robust design available in sizes from NG16 to NG160, it is capable of handling extreme flows and pressures. The cartridge's state (open or closed) is determined by the pressure balance acting on its internal areas ($A_1$, $A_2$, $A_3$), which are controlled by the LFA cover.
- **The Control Section (Type LFA):** The LFA control cover bolts over the LC cartridge and serves as the interface for pilot control signals. It contains the pilot channels and, depending on the model, integrated pilot valves, orifices, or mounting surfaces for external pilot valves. It is the LFA cover that defines the complete function of the assembly.

## FUNCTIONAL VERSATILITY THROUGH MODULAR COVERS

By combining a single LC cartridge type with various LFA covers, a multitude of functions can be achieved in the same manifold cavity. This is the essence of the building block principle.

- **Directional Function (e.g., LFA...WEA):** By mounting a standard ISO 4401 directional spool valve (e.g., 4WE 6) onto the LFA cover, the assembly functions as a high-flow, 2-way, pilot-operated directional valve.
- **Pressure Relief Function (e.g., LFA...DB):** An LFA cover with an integrated pressure relief pilot valve transforms the cartridge into a high-capacity pressure relief valve
- **Logic Functions (e.g., LFA...GWA):** Covers with integrated shuttle valves allow the main cartridge to be controlled by the higher of two different pressure signals, enabling the creation of compact logic circuits (e.g., AND/OR functions).

## SYSTEM-LEVEL ADVANTAGES OF THE BUILDING BLOCK APPROACH

- **Reduced Leak Points & Manifold Size:** Integrating multiple functions into a single, compact manifold block drastically reduces the number of external connections, hoses, and potential leak points.
- **Cost-Effective Design:** Standardization on ISO 7368 cavities allows for efficient manifold manufacturing. The ability to use a small, inexpensive pilot valve to control a very high-flow main stage is inherently cost-effective.
- **Proven Reliability and Simplified Maintenance:** The LC/LFA system is one of the most field-proven hydraulic technologies. Its simple, robust design ensures a long service life. In the event of a failure, a cartridge can be quickly replaced without disturbing manifold plumbing, minimizing downtime.

**The Bosch Rexroth LC/LFA cartridge valve system is a prime example of a design philosophy that delivers both high performance and elegant simplicity. By providing a standardized, modular set of powerful and reliable "building blocks," it empowers hydraulic system designers to create compact, cost-effective, and highly functional high-flow circuits.**

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