WHITEPAPER

Evolution MOTION SOLUTIONS

rexroth
A Bosch Company

Decentralizing Intelligence



The Technical Advantages of Valve-Integrated Axis Control

This whitepaper explores the architectural shift from traditional, centralized hydraulic motion control to a decentralized model using valve-integrated axis controllers (IAC). Using the Bosch Rexroth 4WRPDH with IAC-Multi-Ethernet as a case study, we will analyze the technical benefits of embedding best-in-class motion control logic directly onto a direct operated, servo quality, control valve with a spool sleeve design.

Key topics include the reduction of system complexity and cost, the improvement of signal integrity and control performance through on-axis loop closure, the flexibility offered by Multi-Ethernet communication protocols, and the simplification of the engineering workflow via unified software tools like IndraWorks DS.

THE TRADITIONAL ARCHITECTURE AND ITS LIMITATIONS

A conventional hydraulic axis requires a motion control module in a central PLC, connected via analog command signals to an external amplifier, which in turn drives the valve. This architecture suffers from several drawbacks: high component count, extensive and noise-sensitive analog wiring, and significant cabinet space requirements.

THE INTEGRATED AXIS CONTROLLER (IAC) ARCHITECTURE

The 4WRPDH with IAC fundamentally changes this by collapsing the control chain. The valve, digital amplifier, and a powerful motion controller capable of position, pressure/force, and flow control are housed in a single, robust IP65 unit. This decentralized approach replaces long cables for analog wiring and feedback devices. This directly translates to reduced hardware costs, smaller electrical cabinets, and simplified machine assembly.

THE MULTI-ETHERNET ADVANTAGE: OPEN COMMUNICATION

A critical enabler for decentralized control is open, real-time communication. The IAC-Multi-Ethernet platform natively supports all major industrial Ethernet standards: Sercos, EtherCAT, PROFINET RT, and Ethernet/IP. For urgent or prototype applications, the system integrator can take a stocked IAC with Ethernet/IP and change it to EtherCAT using our Indraworks DS software. This allows machine builders unprecedented flexibility and simplifying standardization across their product lines.

PERFORMANCE GAINS FROM ON-AXIS LOOP CLOSURE

By placing the axis controller directly on the valve, analog control loops for pressure or load are closed at the point of action. The IAC processes digital feedback from high-resolution position transducers (SSI/EnDat). This eliminates noise issues and latency inherent in sending feedback signals back to a central PLC, resulting in higher dynamic response, improved control accuracy, and more stable machine operation. Complex functions like alternating pressure/flow control can be executed with greater precision.

END-TO-END SIMPLICITY WITH UNIFIED ENGINEERING TOOLS

The final piece of the puzzle is a simplified engineering workflow. The Bosch Rexroth IndraWorks DS software provides a single, intuitive environment for commissioning, parameterizing, and diagnosing the our “Hydraulic Drive” as well as supporting our “Electric Drives” frequently going into state-of-the-art fluid power systems. Features like a guided “Easy Startup Mode,” with online oscilloscope function for real-time signal tracing, and well-organized parameter lists dramatically reduce commissioning time, and supports maintenance personnel.

The 4WRPDH with Integrated Axis Controller represents a significant leap forward in hydraulic motion control. By decentralizing intelligence, embracing open communication standards, and simplifying the engineering process, it delivers a solution that is not only higher performing but also less complex and more cost-effective to implement and maintain. It successfully combines the high power density of hydraulics with the plug-and-play simplicity of modern electric drives.

Bosch Rexroth Corporation
Website: www.boschrexroth-us.com
Telephone: (800) REXROTH
(800) 739-7684
Email: info@boschrexroth-us.com

Evolution Motion Solutions
13835 Senlac Dr, Farmers Branch, TX 75234
800-569-9801
info@**evolution**motion.com
www.**evolution**motion.com

facebook.com/BoschRexrothUS
x.com/BoschRexrothUS
youtube.com/BoschRexrothUS
linkedin.com/company/bosch-rexroth-us/

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