

The DPO Series 2X Digital Injection Process Controller

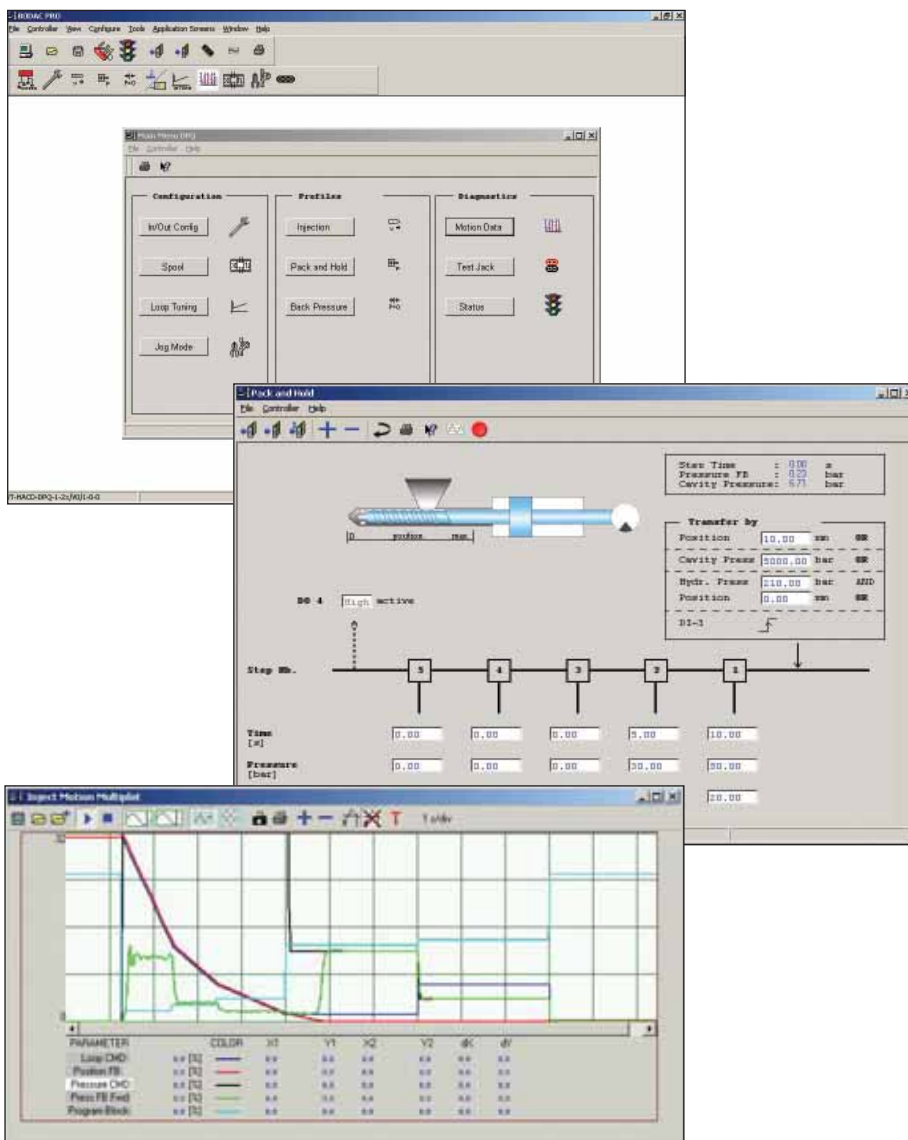
The Drive & Control Company



The Injection Process – Perfect Control with Precision Reproducibility

With the VT-HACD-DPQ the correct closed loop control electronics for the injection process are now available from Rexroth: perfect process control and the highest repetitive accuracy for maximum economic efficiency.

The positioning and control card VT-HACD-DPQ is easily integrated into the machine control system either by analog or fieldbus interfaces.



The injection process

As soon as both halves of the mold are closed, the most important part of the process begins – the injection of plastic.

Not only volume, but also the accurate flow rate of the extruded plastic is essential for the quality of the molded parts. Being able to define and guarantee material flow according to the design of the mold cavity so that the resulting control of the injection speed is accurate and remains independent of all other process variables, demands the highest level of closed loop control technology.

Know-how in the development, design and application of control axes is based on decades of experience working on hydraulic axis controllers. Rexroth has applied this know-how to design critical process steps, such as the transition from velocity into pressure control (hold pressure) without variation and with repetitive accuracy.

Pressure control with repetitive accuracy within the range of



fractions of a percent is necessary to maintain the dimensional stability of the injected part as well as the mechanical integrity of the machine. The VT-HACD-DPQ from Rexroth, now the most comprehensive control package in the field of plastics processing machinery, possesses this capability.

Rexroth offers a complete system consisting of easy-to-integrate hydraulic components and matched electronics for the highest quality closed loop process control.

Reduced cycle time

- Efficient control of injection velocity and pressure.
- Special controller design for highly repeatable accuracy.

Reduced costs

- Controls the overall injection process.
- High efficiency for old and new molding machines minimizes waste thanks to repetitively accurate motion sequences.

- Leakage caused by hydraulic pressure spikes and shocks are eliminated.

Improved process control

- Versatile profile and set-up options permit complete closed loop control of complex motion sequences.
- Repeatable transition from injection-velocity profile to pressure profile based on cylinder position, pressure, mold pressure or external event.
- Multiple steps for mold fill, hold, and back pressure profiles.
- Control of recovery volume and screw decompression.

Increased flexibility

- Adaptable to any machine control, PLC or PC.
- Configuration options support types of proportionally controlled hydraulic circuits.
- Control the process using either an analog command profile, or store a complete injection profile "on board" and trigger

individual sequences via either discreet signals or fieldbus.

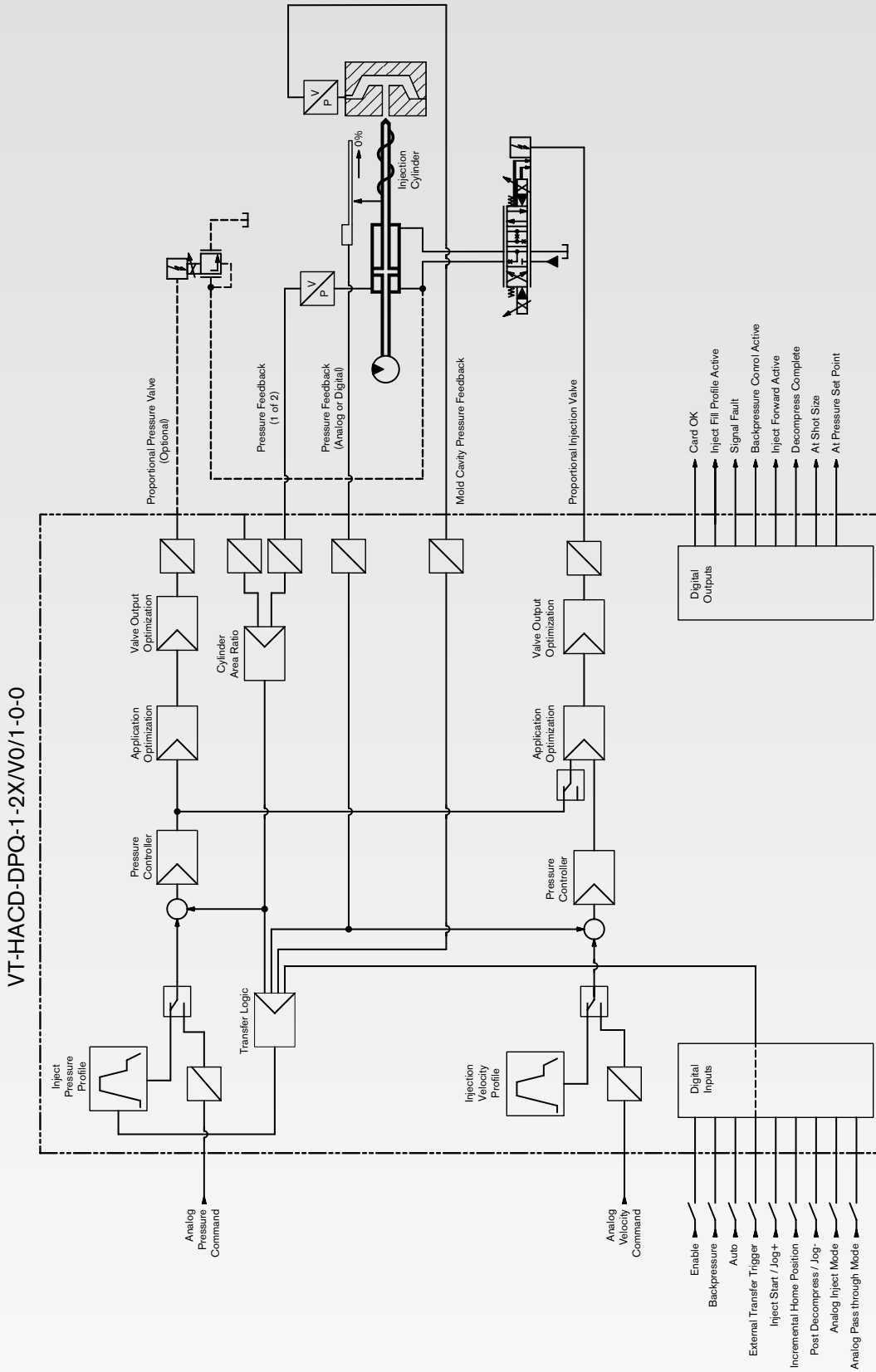
- Stored profiles greatly reduce part to part change-over time.
- Control the injection process for up to six different parts in sequence from a single injection unit and a single material.

Improved process monitoring

- Fieldbus interfaces permit access to all parameters.
- Acquisition and storage of critical process data during the operating cycle improves process monitoring.

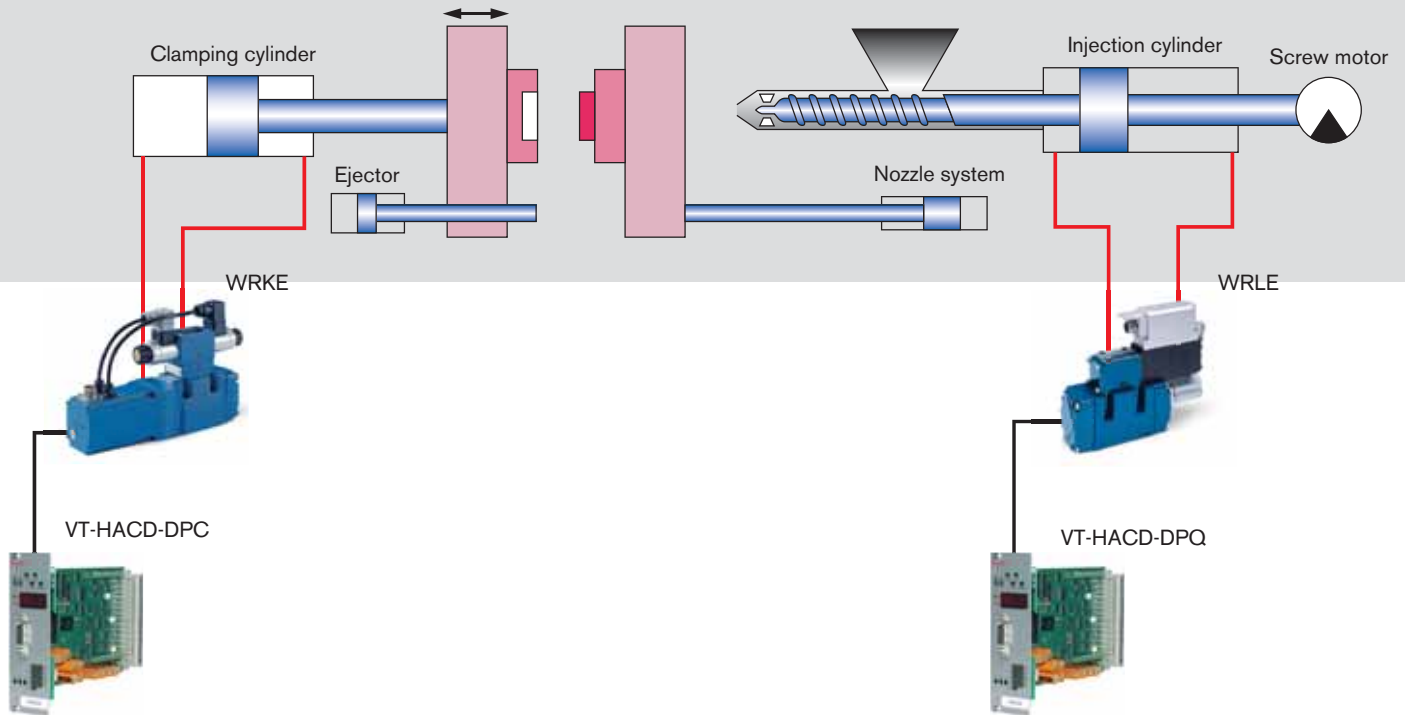
Simple set-up and adjustment of profile

- Special closed loop control solutions for hydraulic systems are more efficient than conventional machine controls and simplify set-up.
- Stored parameters for description of Rexroth valve characteristics makes for easier commissioning.
- Powerful software tool with graphic real-time display accelerates set-up.



This is a typical injection circuit using one valve for closed loop control of both velocity and pressure. In this application, the VT-HACD-DPO is controlling closed loop mold fill velocity, hold pressure, back pressure, and screw decompression with a single proportional injection valve.

One Card, Two Applications



With new market and application specific control cards, Rexroth opens up additional machine design freedom through simple implementation of robust industrial controller technology in de-centralized control structures. The separation between automation and hydraulic axis control hardware reaches a new level of quality with the VT-HACD family. Bosch Rexroth has paved the way for increased productivity of injection molding machines with this new series of configurable digital controllers. Specific process critical movements in a plastics

machine are controlled by fieldbus capable control cards: VT-HACD-DPQ for all injection phases and VT-HACD-DPC for clamp motion. Both use internal profiles that are totally independent of the scan times of the machine control.

The VT-HACD-DPC is used as an application specific solution for all the requirements of a clamp in a plastics machine. It is optimized for protection of the mold, repeatability, and exact control of force, as well as very accurate velocity control.

The VT-HACD-DPQ controls the injection process in injection molding machines with parameterization of all of the process phases. Specific functions are exact dosage and correct injection velocity, as well as bumpless transfer from velocity control to pressure control.

Results are Measurable

A typical example of a rebuild project was a mid 1980s 700 ton injection molding machine. This machine was rebuilt with a PLC using a DeviceNet™ network and the new VT-HACD-DPQ and VT-HACD-DPC to control all of the major machine functions.

The machine hydraulic system was upgraded with a new Bosch Rexroth high performance proportional valve for the injection cylinder. The existing clamp cylinder and ejector cylinder control valves were retained; both are open loop proportional valves without spool position feedback. Due to the performance advantages available

by using the new controllers, it was determined that these low cost valves would be adequate for closed loop control of the clamp and ejector cylinders. A clamp safety valve was added to meet new ANSI safety standards for plastic machinery, and an additional fixed displacement pump was added to increase the injection and clamp speed.

The criteria for the project to be considered a success was to meet "World Class Standards" for injection machine performance as defined by a third party corporation that manufactures test and measurement equipment for the injection molding process. The

manufacturing plant's third party measuring equipment accumulated data for the first month of production after the rebuild. Data supplied to Bosch Rexroth indicates the post rebuild numbers are impressive.

In six categories that were measured before the rebuild only Ejector Repeatability could pass the world class test; after the rebuild all of them exceeded world class standards. Examples of improvements from the original OEM "closed loop" control system include the following:

Measurement Criteria	Before Rebuild	After Rebuild
Hydraulic Injection Pressure Response Seconds required for pressure to settle after a 1000 PSI pressure change	Pressure never stable enough to measure	Better than World Class
Injection Speed Linearity % difference from velocity set point	Not World Class	Better than World Class Over 300% improvement
Injection Load Compensation % change in velocity per 1000 PSI change in load	Not World Class	Better than World Class Over 1400% improvement
Injection Decompression Repeatability Cubic Centimeters of injection volume variation	Not Repeatable enough to measure	Better than World Class
Clamp Repeatability Millimeters variation at open stop position	Not World Class	Better than World Class Over 400% improvement
Ejector Repeatability Millimeters variation at extended position	World Class	Better than World Class Over 700% improvement

In addition to the "World Class Standard" measuring criteria, production numbers show that this plant has an average scrap rate of 3% (percentage of parts produced that are of unacceptable quality). The rebuilt machine is running at 0.3% scrap rate, so the number of good parts produced per hour is higher than expected. Also, the calculated cycle time for the molded part is 40 seconds but this machine is producing the same part at a cycle time of 38 seconds. The reduced scrap and faster cycle time translates into additional annual plant savings of approximately \$38,000!

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Rexroth offers a unique and comprehensive range of products and services across technologies in its six fields of technology and service areas – strong in high-quality individual technologies, combined with highest application-specific competence in system packages with integrated complete solutions.

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Motion and
Assembly
Technologies

Pneumatics

Service



Rely on service across technologies

Rexroth integrates all services for the entire product spectrum in the field of factory and industrial automation into a single organization: from immediate support, spare parts service, field and repair service, retrofit/modernization through to training.

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