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Digital Electrohydraulics with Distributed Intelligence

Marco Agostani
Electronic Division
www.atos.com

Abstract

As a result of a five-years R&D project, Atos can now present its whole range of electrohydraulic proportional components with on board electronics in digital execution.
These products enable new funcionalities within the conventional control architectures and represent the foundamental premise to realize new compact machines with high technological contents.
The digital electronics integrate several logic and control functions *(distributed intelligence)* and make it feasible and inexpensive the introduction of the most modern fieldbus communication systems.

Advantages of Digital

The introduction of the digital control technology on board of proportional electrohydraulic components leads to some immediate improvements;
the possibility of implementing many functions in a reduced space allows to increase the number of settings of the components, to fit its behaviour to the peculiarities of the application.
The numerical management of these settings ensure its full repeatibility and thanks to the presence of permanent memories, the settings are saved into the electronics itself.
The digital components' testing guarantees repeatitive settings of all functional parameters and the new control technologies improve the static and dynamic performances of the proportional valves .

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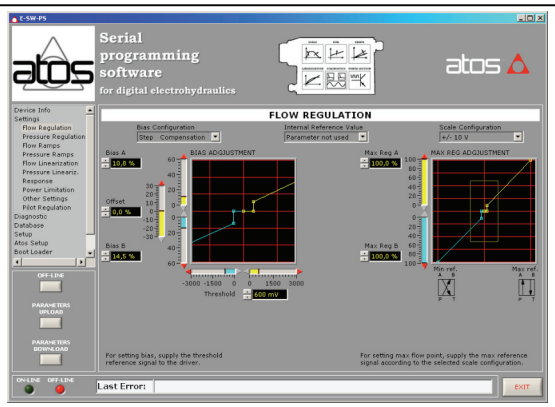

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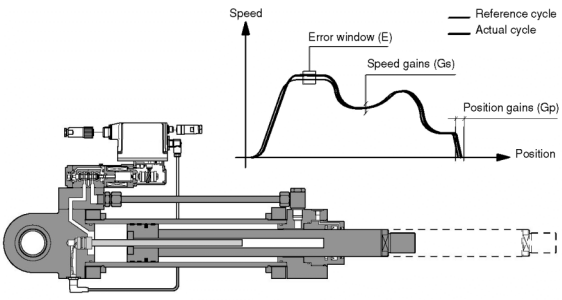

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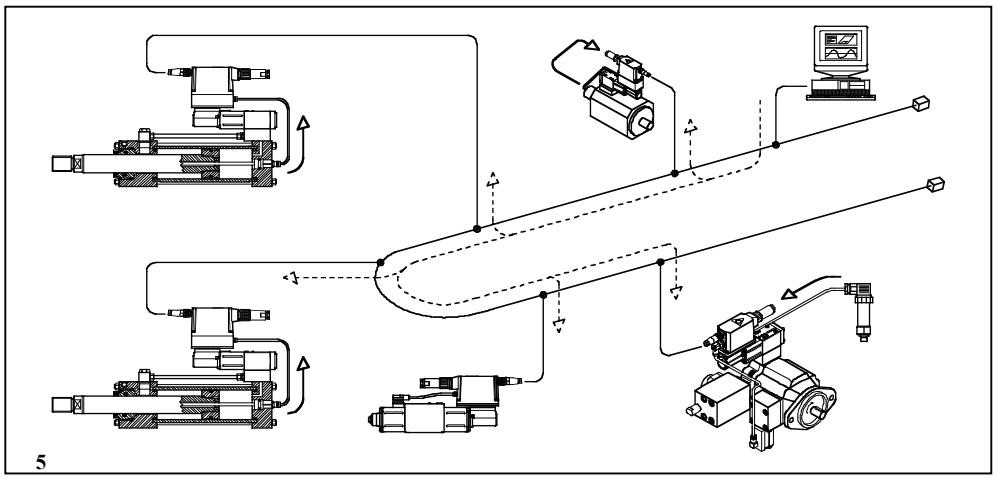
PS Execution

In the basic PS execution (fig.1), the new digital electronics are equipped with a standard RS232 interface, to be coupled to an user-friendly PC software (E-SW-PS fig.2), allowing the management of the functional parameters.
On board drivers in PS execution are available for valves without transducer (E-RI-AES), with position transducer (E-RI-TES) or pressure transducer (E-RI-TERS), and for pilot operated valves with double control loop (E-RI-LES).
The main feature of these electronics is the full interchangeability with the corresponding analog executions: reference and feedback signals are analogically supplied, whereas the programming interface allows the management of diagnostics and the configuration of the valve to fit its behaviour to the application's requirements
This approach enables a gradual introduction of the advantages of digital technology, without perturbing the whole application/machine's structure.
The main possible settings are:
- the digital setting of *bias and scale*
- the *linearization* of the regulation curve, allowing to obtain, by choice, both linear and non-linear behavior.
- the *ramps*, numerically set, correspond to the transition time from 0% to 100% of the regulation
- the regulation of the components' *dynamic response* to the system requirements.
Furthermore, a number of detailed diagnostics information permits a complete analysis of the component and of its eventual malfunctioning reasons.



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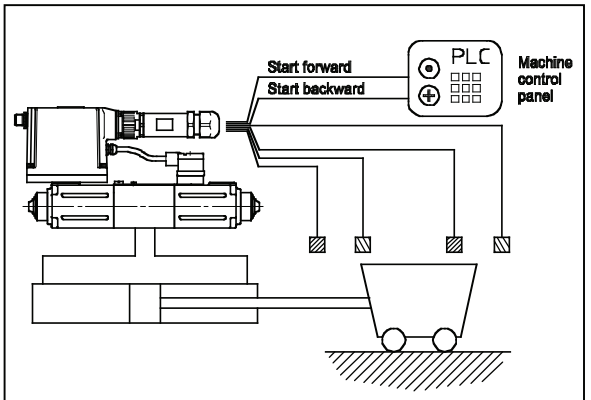
Fieldbus Executions

The availability of digital electronics is the foundamental basis for the realization of drivers with fieldbus interfaces (fig. 5).
The fieldbus presents remarkable advantages:
- immunity from electromagnetic disturbancies
- standardization of the communication protocols
- reduced wiring costs
- diagnostic and remote assistance of the system

Both the two most common standards are available on the whole range of Atos drivers:
- BC versions allow the connection with CANBus (CanOpen DS408 v1.5 protocol)
- BP versions allow the connection with Profibus-DP (Fluid Power Technology protocol)

Servoactuators

The new drivers' most advanced executions, see also the www.atos.com 'New solution' section, integrate several control functions within the driver itself, thus realizing truly compact electrohydraulic motion units.
E-RI-TEZ drivers for AZC servocylinders (fig.3-4), besides controlling the valve on which they are on board, perform a position, speed and/or force control of the actuator itself.
For the end user, the main advantages of this kind of servosystems are:



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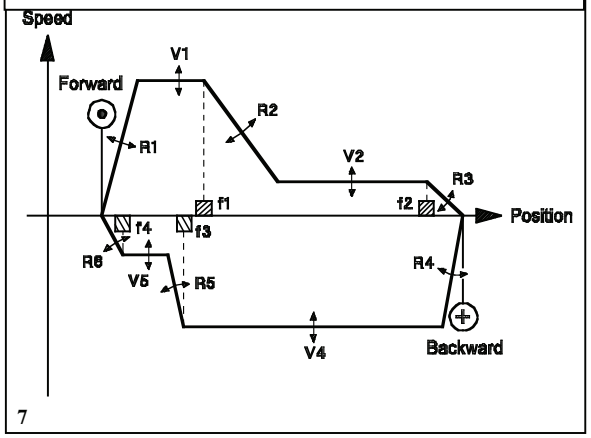

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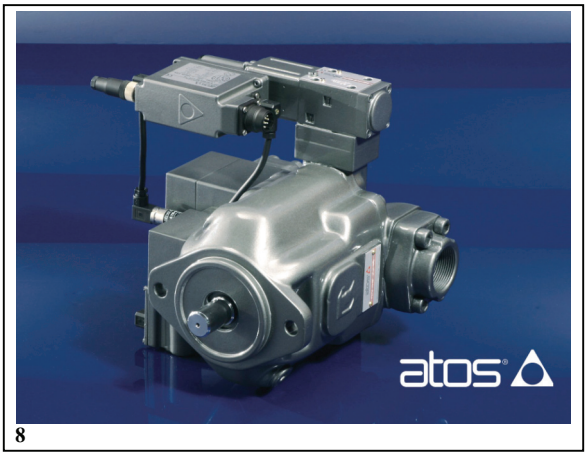

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- the self management of the mouvement control, with no need of using external axis cards
- the reduced number of wirings, thanks to the direct connection of the electronics to the peripherial sensors.
- the best possible performances achievable in fieldbus systems, both in terms of number of connected motion controls and of communication speed.

For what concerns the optimization to be obtained on bus systems, it is important to remark that the concept of distributed intelligence permits to locally manage the "fast" signals required to close the control loops (fig.5), avoiding to unnecessarily overload the communication line.

Easy Servosystems

In its easiest form, the concept of distributed intelligence is applied to drivers type E-RI-AEG (fig. 6-7).
These electronics autonomously manage up to five inductive proximity sensors and realize open loop "fast-slow" positioning cycles.
For any of the cycle phases it is possible to set speed and acceleration (ramps).

New Functionalities

The possibility of setting the control parameters together with the more compact dimensions of digital drivers also allow to realize new functionalities:
- E-RI-TES drivers in /ZP execution realize the combined P/Q (pressure/flow) control function on directional control valves
- E-RI-PES drivers for variable displacement axial piston pumps (fig.8) integrate the digital P/Q control with the electronic power limitation.

Further developments

Among the many possible developments, we like to recall:
- sincronysm algorythms
- self-tuning algorythms for the automatic optimization of the dynamic behaviour .
- the drivers pre-arrangement to remote assistance in fieldbus systems.