Digital electrohydraulics

1 DIGITAL TECHNOLOGY FOR PROPORTIONAL VALVES

Modern world is driven by digital electronics: computers, automation systems, cars and missiles, telecomunications and advanced network are all based on digital technology… …thanks to its typical benefits in comparison with analog: fast and powerful data processing, easy programmability, high immunity to electromagnetic noise, process parameters and data storage.

In electrohydraulics, digital electronics gives important advantages:
- better performances of electrohydraulic components: hysteresis, response time, linearity;
- numerical software setting of hydraulic parameters (scale, bias, ramp, compensation of non-linearities) for full repeteability and easy data storage
- diagnostic (fault, monitor) and computer assisted maintenance of machines and systems;
- direct interfacing to field-bus networks.

Atos, leader in pioneering proportional electrohydraulics, is active from years on digital electrohydraulics including: simulation models of valves and systems, research and testing of new DSP microcontrolles, R&D of new solutions.

New digital electrohydraulics with on board electronics 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 in the hydraulic system of the most modern fieldbus communication networks.

Atos digital driver's range replicate the analogue one:
- **E-RI-AES** for valves without transducer
- **E-RI-TES/LES** for valves with single/double LVDT transducer
- **E-RI-TERS** for valves with pressure transducer

2 COMMUNICATION INTERFACES

The communication interface is the channel trough which the valve receives commands and/or setting parameters and it returns information to the fieldbus controller.
Atos digital proportional valves are available with 3 optional communication interfaces:
- basic **-PS**: standard RS232 interface, to be coupled to an user-friendly PC software (E-SW-PS) optimized with grafic interface, for the management of all the functional parameters, see tab. G500.

  The main feature of this basic version is the full interchangeability with the corresponding analog executions, in fact the reference and the monitor signals are analog, whereas the serial interface allows to manage the diagnostics and to set the best configuration of the valve for the application's requirements.
  This approach enables a gradual introduction of the advantages of digital technology, without perturbing the whole application/machine's structure.
- option **-BC:** CANBus (CanOpen DS408 v1.5 protocol)
- option **-BP:** Profibus-DP (Fluid Power Technology protocol).

The valves with option -BC and -BP can be connected to the fieldbus network and thus digitally operated by the machine control unit.
The functional parameters can be set via fieldbus using the standard communication protocol implemented by Atos, or alternatively using the PC graphic software E-SW-PS with the relevant USB interface supplied with the software KIT (see fig. 2 and tab. G500). For start-up or maintenance operations, the valves with -BC or -BP interfaces can be operated with analogue signals via the 7 (or 12) pins power supply connector.

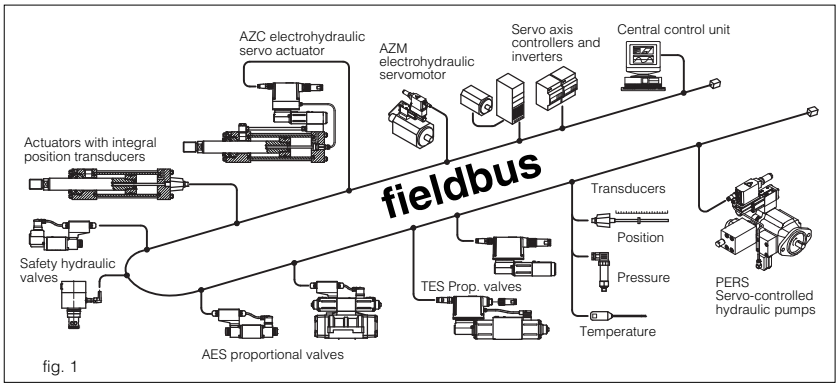
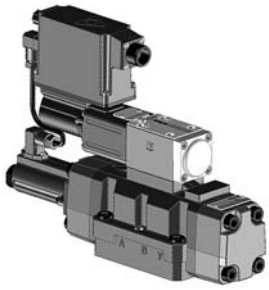


fig. 1

DKZOR-AES

AGMZO-TERS



DPZO-TES

LIQZO-LES

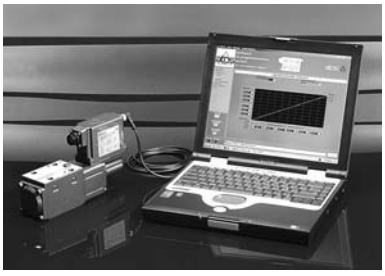


fig. 2 software setting of digital proportionals

3 DIGITAL SETTINGS AND DIAGNOSTICS

A large number of the functional parameters of the valve can be numerically set trough the communication interface, as:

- the bias and scale (fig. 4)
- the ramps, corresponding to the transition time from 0% to 100% of the valve's regulation (fig. 5)
- the linearization of the regulation curve, allows to modify the hydraulic regulation of any valve, as linearizing the characteristic of pressure control valve or change from linear to progressive the characteristic of a directional control valve (fig. 6).

Many other regulations are available like: customized configuration of the reference signal (standard ± 10 V), internal static self generation of the reference signal, dither signal, PID parameters for dynamic behaviour, alarm setting of the high/low limits of the electronics temperature, etc.

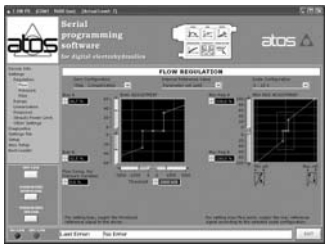


fig. 3 Software graphic interface

SCALE AND BIAS

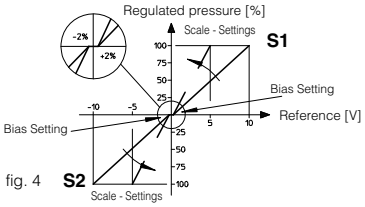


fig. 4

UP AND DOWN RAMPS

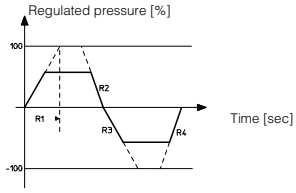


fig. 5

LINEARIZATION

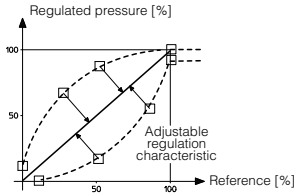


fig. 6

Detailed diagnostics information can be checked through the communication interface. They allow a complete analysis of the component state and of its eventual malfunctionings, as for example:

- real time monitoring of the reference signal, of the feedback signals and of the electronics temperature
- alarm in case one of the above parameters overcome the set limits
- alarm in case of interruption of the feedback cable

4 COMBINED P/Q CONTROLS FOR DIRECTIONAL VALVES AND PUMPS

The high computing capability of Atos digital electrohydraulic and its great flexibility allow to realize new functionalities:

- new drivers E-RI-TES with /SP and /ZP options perform the combined pressure and flow control on directional control valves. A remote pressure transducer must be installed on the system where is required the max pressure control and its feedback has to be interfaced to the valve. If the real value of the pressure in the system (measured by the pressure transducer) remains below the relevant reference signal, provided by the machine controller, then the digital driver regulates in closed loop the valve's spool position, according to the flow reference signal. When the real pressure become close to the relevant reference signal, the driver automatically performs the closed loop control of the pressure. This option allows to realize accurate dynamic pressure profiles. A multiple set of PID parameters can be real time selected during the axis motion via on-off signal to the 12 poles connector (option /SP) or through the - BC or -BP interfaces (option /ZP), to optimize the control performances in the different phases of the machine cycle.
- new drivers E-RI-PES for variable displacement axial piston pumps (see fig. 7), integrate the digital combined pressure and flow control (see above) with an electronic max power limitation. A multiple set of PID parameters can be real time selected during the axis motion via the 12 pin connector (option /S) or through the -BC or -BP interfaces (option /Z), to optimize the P/Q control performances.

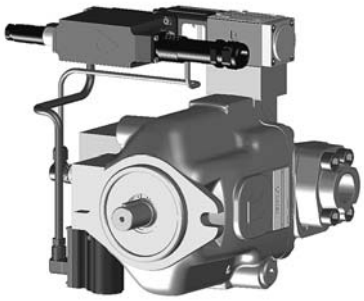


fig. 7

5 DIGITAL SOLUTIONS FOR BASIC SERVOSYSTEMS

The concept of distributed intelligence is applied in its easiest form to the drivers type E-RI-AEG, see fig. 8 and tab. G120.
This controller self-manages open loop "fast-slow" positioning cycles, interfacing up to five inductive proximity sensors.
For any of the cycle phases it is possible to set speed and ramps.
This solution has been developped for applications with repetitive cycles. The complete cycle is managed by the valve itself without auxiliary axis controller.

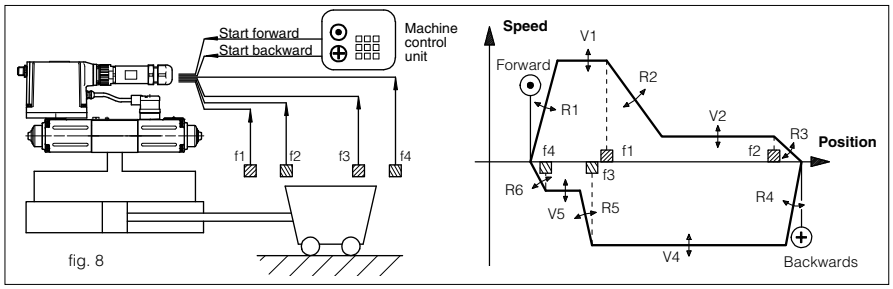


fig. 8

6 DIGITAL SERVOACTUATORS

Servoactuators integrate several control functions within the driver itself, thus realizing truly compact electrohydraulic motion units.

E-RI-TEZ drivers for servoactuators, see fig. 9, besides driving the valve on which they are integrated, also perform a position, speed and/or force control on the actuator itself.

For the end user, the main advantages of this kind of servosystems are:

- the self management of the motion 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 distributed intelligence permits to locally manage the "fast" signals required by high performances closed loop controls, avoiding to unnecessarily overload the fieldbus communication line.

Application of such servoactuator solutions takes place for example:

- for closed loop speed/position and pressure control of the injection phase in plastic presses
- for speed and force control of the moulds closing in plastic presses
- for parison control is blow moulding machines
- for master/slave syncronism in wood machines and bending presses.

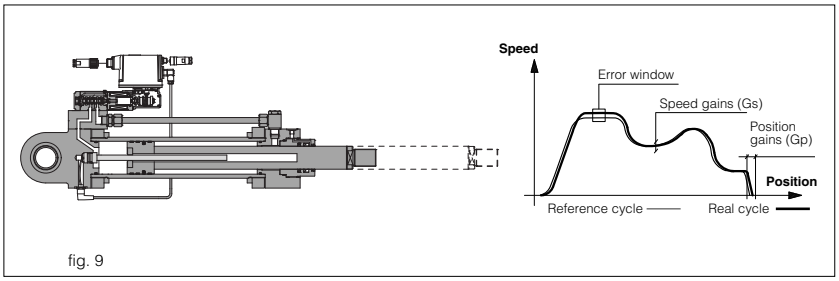


fig. 9