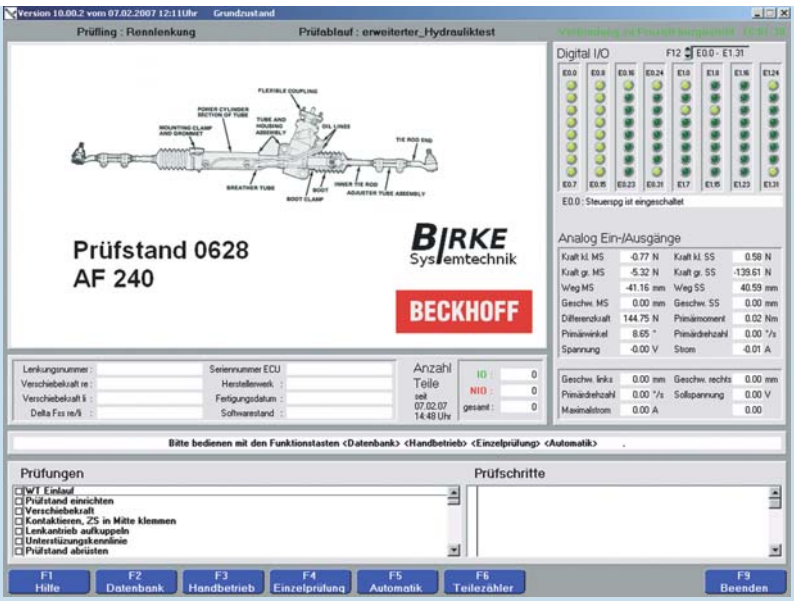
EtherCAT checks electric and hydraulic auto steering systems

High-resolution analog I/O for ultra fast control

The company Birke Systemtechnik GmbH, based in Erlangen, Germany, has been dealing with test rig software for automotive testing and setting up steering systems for 25 years. In the latest generation of software, TwinCAT and EtherCAT ensure fast sampling of actual values and optimum control with extremely short response times.



The test rig software from Birke can be used for testing and setting up hydraulic or electric steering systems and the associated control valves and sensors. It can be used for toothed rack or recirculating ball steering systems. Realistic driving conditions are simulated on a test rig. One of Birke's long-standing customers is Mercedes Benz Lenkungen GmbH, which in 2005 was taken over by ThyssenKrupp Technologies. Birke initially supplied a DOS-based test rig software to the company. Since 1999 the software has been Windows-based and features its own real-time system.

The parameterizable software can be adapted to the respective test task in terms of procedure and function without programming effort. Comprehensive diagnostic options offer support for exposing technical faults. In addition, Birke offers its own solutions for PDA and CAQ applications. The test rig software is suitable for laboratory rigs (and for very precise and time-consuming measurements) and for production rigs with cycle times of 30 seconds. The following parameters can be analyzed and controlled:

- Steering angle, accuracy 65,000 increments/90°
- Toothed rack distance, accuracy 1/10 µm (correct)
- Toothed rack speed between 10 µm/s and 100 mm/s, max. following error ±10 µm at ±10 kN load
- Volume flows with an accuracy of ±0.05 l/min up to a delivery rate of 20 l/min via proportional valves or directly via pump control lines
- Torque values

EtherCAT – convincing speed and flexibility

Commercially available hydraulic control systems are too slow, too inaccurate and too inflexible for controlling and analyzing these processes. What's more, these controls represent an additional system that has to be programmed, parameterized and integrated into the terminal computer via a defined interface, which leads to additional overhead and potentially significant costs for the required hardware and its integration into the terminal computer.

Birke Systemtechnik therefore decided to use a software-based solution from Beckhoff: TwinCAT PLC with a cycle time of 500 µs. Also, EtherCAT periphery ensures very fast sampling of the actual values and enables high-quality control.

The control system is integrated in the terminal computer, which makes it highly flexible. The digital and analog I/Os for the test rig control system are connected to the EtherCAT terminal system. The customer benefits from a high degree of flexibility with regard to system expansion (hardware and software). The fast, high-resolution analog inputs required for the tests are monitored via EL3102 input terminals (-10...+10 V) and via EL5101 incremental encoder interfaces.

The test software accesses the PLC via TwinCAT ADS. The real-time system from Beckhoff and the 500 µs cycle causes less than 5 % load on the PC.

"Overall we have achieved a very homogeneous, compact and cost-effective solution", said Christian Birke, managing director of Birke Systemtechnik. "We have already built several test rigs for EPAS (Electric Power Assisted Steering), the steering system of the future. In this system, steering power support is not provided hydraulically, but the required torque/force support comes from an electric motor that is integrated directly into the steering system." While car manufacturers expect production benefits from electric servo steering in the form of reduced model variety, drivers should experience lower fuel consumption and increased comfort.