

Webasto AG:  
Beckhoff automation and measurement technology for quality assurance of parking heaters

## High degrees of freedom in hardware and software for test bench engineering

Webasto develops and produces parking and auxiliary heaters for cars and semi-trailer trucks. In order to meet the high-quality standards of the automotive industry, Webasto subjects its devices to stringent tests before series production starts. In its next generation test facility, Webasto uses PC- and EtherCAT-based control and measurement technology from Beckhoff.



Webasto is one of the leading manufacturers of mobile heating systems worldwide. The devices are produced in advanced assembly facilities and highly automated production lines at the Webasto plant in Neubrandenburg, Germany.

Anyone who has experienced the convenience of not having to scrape ice off vehicle windows in the winter will appreciate how helpful a fuel-fired parking heater can be. In addition to enhanced comfort and safety through improved visibility, pre-warmed engines are less prone to wear and have lower emissions. In contrast to parking heaters, auxiliary heaters only work when the engine is running. They are becoming increasingly popular in diesel cars and trucks, because the heat dissipation from high-efficiency modern diesel engines is often not sufficient to heat the interior.

### Quality assurance has top priority

Webasto AG is one of the leading manufacturers of mobile heating systems worldwide. The devices are produced in advanced assembly facilities and highly automated production lines at the Webasto plant in Neubrandenburg, Germany. Quality assurance is a top priority for Webasto.

Before a new heater generation is produced in a series it is subjected to stringent testing and approval algorithms. Rigorous testing already starts during prototype development at the Webasto facility in Gilching, Bavaria. Testing of pre-series devices and re-validation of series devices takes place at Neubrandenburg.

### Heating systems on the test bench

The tests include environmental impact assessments, endurance runs and cold start tests, as well as a wide range of individual tests. During the endurance and stress tests, for example, the parking heaters are repeatedly switched on and off under practice-oriented conditions, in order to simulate loads and behavior over the complete service life.

Two climatic chambers are available for the cold start tests. In a salt/humidity/rain test heaters are sprayed with a saline solution for several days in order to test their corrosion resistance. A vibration table is used to test shock resistance under simulated road conditions. The devices must work with any fuel type and additive so they are tested accordingly.

"The tests are not only carried out with individual devices, but with several dozen identical types in parallel," said Reinhard Pansch, Webasto Engineering Manager for testing and development. Car manufacturers who install Webasto heaters require specific loading tests, which are precisely defined in a specification document, to be carried out and documented. During the test phase the various test scenarios have to be automatically activated and controlled. The procedures are programmed and stored in a parameterization database. On the other hand, the measurement readings must be logged and documented reliably in the measurement database. The whole facility can be controlled and visually monitored from a central place.

### Modernization of the endurance test facility

Due to the complexity of the test scenarios, Webasto has its own test bench construction facility, which was developed and constructed in close cooperation with automation & software Günther Tausch GmbH, based in Neubrandenburg. As early as 2003 Falk Bertermann, Project Manager at automation & software, and his team discussed the development of

## Webasto AG

The Webasto group, with headquarters in Stockdorf near Munich, has been a family-owned enterprise since it was established in 1901. The group now has more than 50 international locations (of which more than 30 are production locations) and operates in the business segments of roof and thermo systems. Webasto is one of the 100 largest suppliers to the automotive industry worldwide. In 2010 the group generated a sales volume of 2 billion euros with more than 8,500 staff. Core competencies include development, production and distribution of complete roof and convertible roof systems, heating, cooling and ventilation system for cars, motor homes, boats, as well as commercial and special-purpose vehicles.



The Thermo Top Evo heaters from Webasto represent the next generation of car parking heaters. They ensure rapid de-icing of windshields and a pleasant temperature inside the car.

a second generation of test installations with Reinhard Pansch. New specimens and modified test procedures had resulted in continuously increasing demands that the existing technology was no longer able to meet in some cases. In a comparison of automation solutions from different suppliers the Beckhoff solution emerged as the winner.

The test bench concept was modified significantly: Reinhard Pansch said: "We decided to divide the configuration into measuring tables and racks: This makes the whole facility much more flexible, since we can combine measuring tables and racks as required."

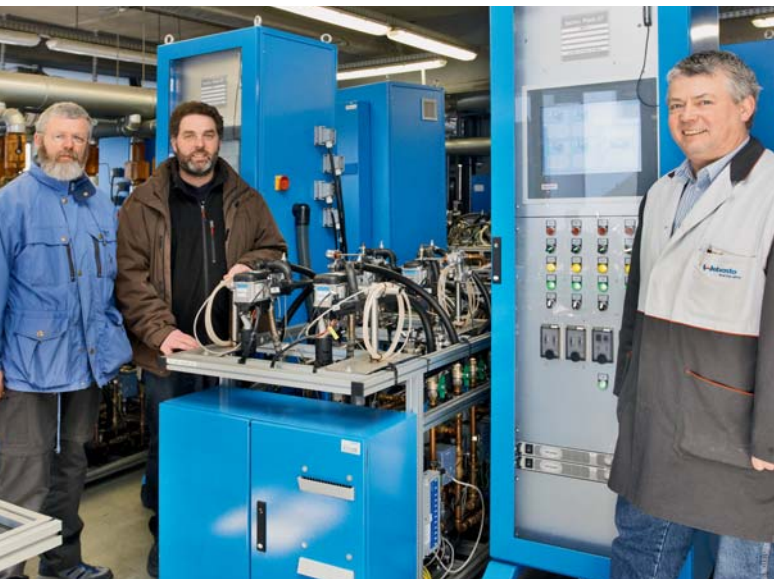
The measuring and control racks of the second generation and additional new component test stations are equipped with Beckhoff technology (see topology diagram).



In the control room, the centerpiece of the endurance test facility, all measurement values from the test processes are logged at high speed and visualized.

## automation & software Günther Tausch GmbH

automation & software GmbH was founded in 1993 as an engineering office by Günther Tausch and specializes in complete custom solutions for automation applications and special purpose machine construction. The core competencies of the company include development and construction of test installations. Test benches developed by automation & software can be found throughout the production halls and R&D departments of numerous automotive suppliers.



Software developer Jörg Schinke and Project Manager Falk Bertermann from automation & software Günther Tausch, with Reinhard Pansch, Test Engineering Manager at Webasto Neu-brandenburg, at one of the new endurance test stations for heating systems (from left to right)

### All in one: automation, measurement and safety technology in a single system

The data from the measuring sensors are logged via the Beckhoff EtherCAT Terminal system. In addition to digital I/Os, a wide range of analog measuring terminals are used for logging the high-precision measurement values and forwarding them to the respective Embedded PC. For multi-purpose measuring tasks some test benches are equipped with EL3681 digital multimeter terminals. These measuring channels are not tied to certain sensor types, which enhances the flexibility of the system even further. Temperature modules are integrated into the EtherCAT system via serial RS485 terminals.

In addition to measuring tasks, Beckhoff technology also deals with the line monitoring system, which communicates with the measurement technology. Boundary parameters such as air pressure and air temperature, which are required for assessing the burner behavior, for example, are logged centrally. The measurement values of the weather station and the safety system are made available to all measuring racks via TwinCAT-ADS. The communication between the Industrial PCs and Embedded PCs (CX1020 and CX1030) also takes place via TwinCAT-ADS. "ADS communication is a very elegant solution for exchanging signals between TwinCAT controllers. This was a further important criterion in our decision in favor of Beckhoff," said Reinhard Pansch.

### EtherCAT Hot Connect for variable topologies: coupling and decoupling of test benches during operation

Webasto uses EtherCAT at the fieldbus level, from the central PLC right down to each individual test bench. An important criterion in favor of EtherCAT was the hot connect functionality. The test benches can be coupled and decoupled during operation without affecting system stability. Falk Bertermann explains: "Via hot connect IDs, the controller detects which bench is connected and configures it automatically. This saves a lot of conversion and manual interventions in the data management." These variable topologies require EtherCAT couplers of the EK1101 type. In contrast to the standard couplers the EK1101 has an ID switch, which it can use to assign an ID to a group of EtherCAT components.

The old device generation read data every minute or so, in the new generation the cycle has been reduced down to the order of seconds. A further boost in performance is achieved with the eXtreme Fast Control technology (XFC) terminals from the EtherCAT I/O system. The EL3702 oversampling terminals, in conjunction with TwinCAT Scope 2 can be used to speed up data logging significantly in certain cases. Moreover, analysis of highly dynamic processes is improved.

### Modular control hardware and software offers high degrees of freedom

One of the big advantages of Beckhoff technology is that it offers high degrees of freedom for programming and control. "In test engineering we continuously face new challenges," said Falk Bertermann. "The software must be able to respond very flexibly to new devices and device features. Over the years we integrated numerous options for device developers

## TwinCAT Database Server: interface between PLC and SQL database

The TwinCAT database server enables direct data exchange between databases and the TwinCAT system. The TwinCAT database server is ideal for TwinCAT applications requiring many degrees of freedom. Webasto's central parameter database, for example, contains four categories of parameters:

- | Recipes with test cycle data
- | Normalization parameters for the connected sensors
- | Parameters with the required specifications of the boundary conditions for the test
- | Measuring channel parameters with warning and error limits

The database parameters are maintained via a Windows front end in the database and made available to the TwinCAT systems in real-time via a specially-developed download management application.

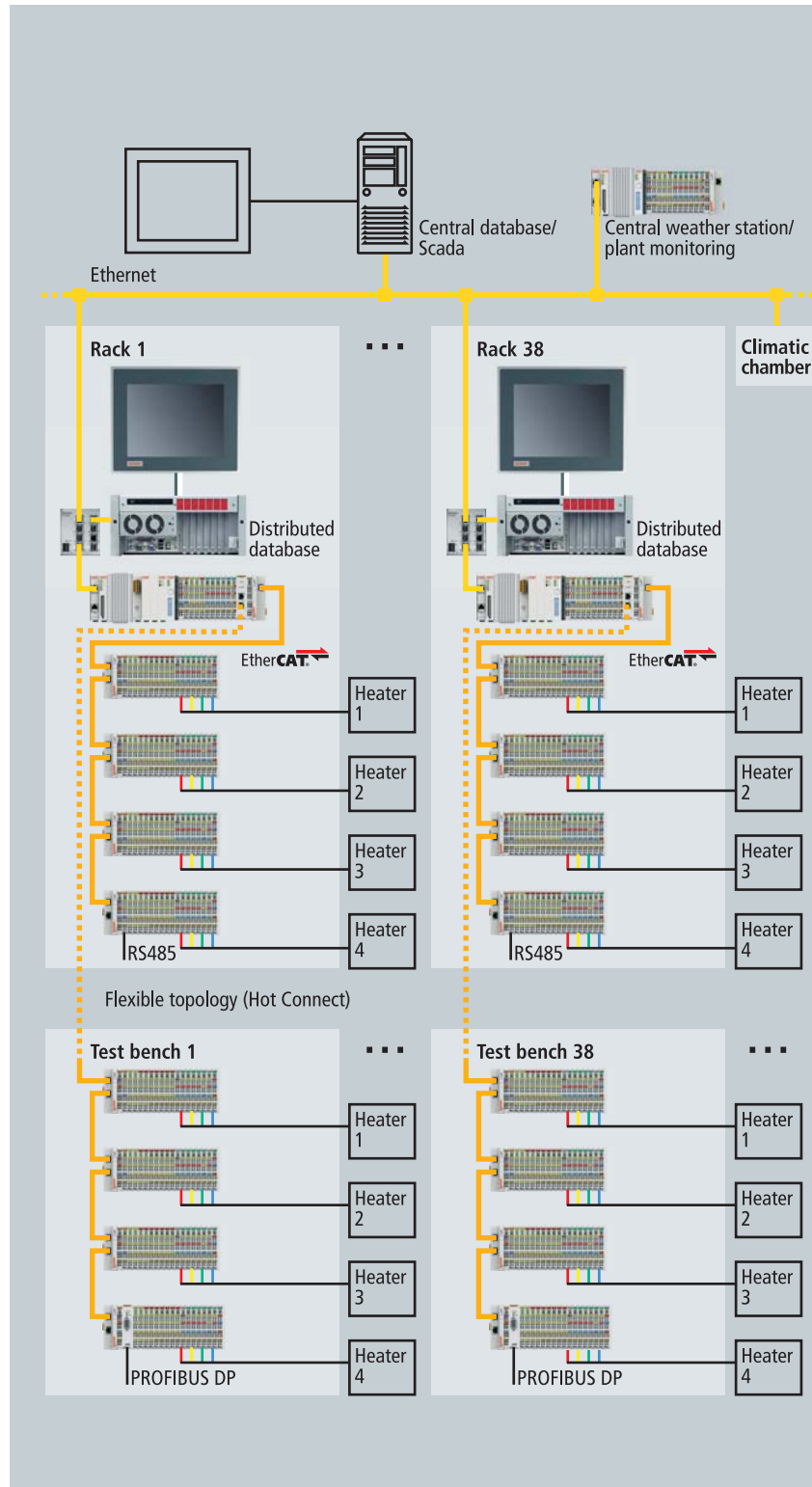
in TwinCAT software, which can be used to realize a wide range of test configurations without intervention from software developers. Device developers can use a convenient special parameter editor on their Windows PCs, from where all database parameters can be accessed.”

“Our software is based on a strictly modular design,” said Jörg Schinke, who is responsible for TwinCAT management and programming at automation & software. “The TwinCAT PLC libraries can be quickly configured to form a modular system as required for implementing projects.”

### Convincing technology

On the question of what other factors spoke for the Beckhoff solution, Reinhard Pansch, Falk Bertermann and Jörg Schinke came up with a number of reasons that led to the introduction of the new control technology as the standard: “Compact component design, very good run-time stability, plenty of scope for hardware configuration during installation and configuration of the systems, the real-time capability of EtherCAT, easy to realize communication between the controllers, the option of comprehensive remote maintenance, impressive price-to-performance ratio, customer-oriented and fast service, innovation capabilities and future viability of solutions, high availability of replacement components and transparent discontinuation management.”

Beckhoff technology has been introduced step by step at Webasto, and this development is continuing. Beckhoff technology is now also used in quality monitoring during production. The test facilities of the first generation systems at the Neubrandenburg site are being replaced with the new standard.



The measuring and control racks of the second test bench generation and additional new component test stations are equipped with Beckhoff technology throughout.