

Volkswagen Motorsport uses PC- and EtherCAT-based engine test bench technology

Optimized engine technology leads to VW victory at 2010 Dakar Rally



At Volkswagen, commitment to motor sports has a long tradition. The latest example is the triple success for the racing version of the VW Touareg at the 2010 Dakar Rally. At the VW test center in Hanover, Germany the engines are prepared for extreme stress: State-of-the-art measuring and control systems, designed and installed by the company RTW B. Nossol, controls the medium conditioning systems of the two engine test benches and the air-conditioning of the test chambers. Beckhoff supplied the PC- and EtherCAT-based automation platform.

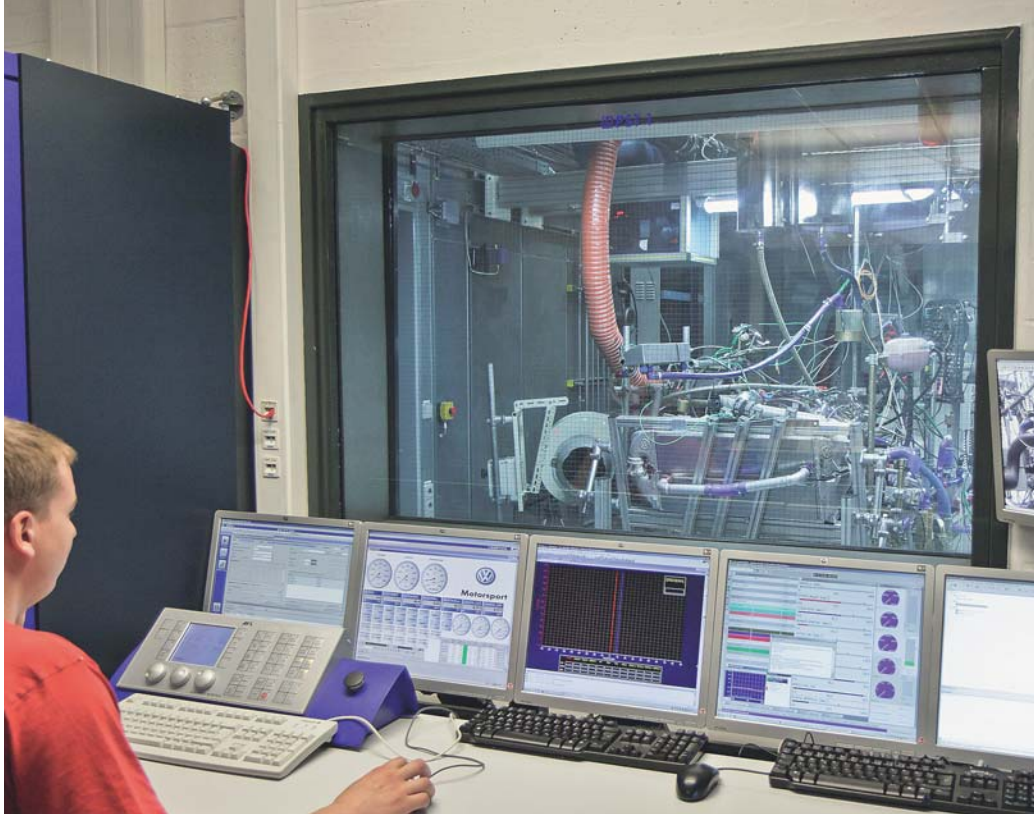
Nearly all Volkswagen racing engines are tested at the in-house test center in Hanover, which has around 130 staff. The high-performance diesel, gas and petrol engines are used in a range of competitions: the Dakar Rally, Formula 3, the 24-hour race at Nürburgring in Germany, the STCC (Swedish Touring Car Championship), the Scirocco Cup, Formula ADAC, the Jetta Cup USA, etc.

Extensive test procedures are required for these high-performance engines. "Our work starts with the basic development of the combustion techniques and includes numerous steps up to the final simulation of driving profiles, which we use to optimally adapt the engines to each individual race," said Johannes Brandt von Fackh, who is responsible for the engine test benches at Volkswagen motor sport. The units are

subjected to extreme stresses. "A test run can occasionally last up to 150 hours," said the engine expert.

Relaunch of the measuring and control systems

When Volkswagen Motorsport made the decision last year to modernize its engine test benches, the measuring and control systems for the building services and media conditioning were also going to be included in the update. Their main purpose is conditioning of the cooling systems for water, oil, charge air and the combustion air for the engines on the test benches. In addition they control the air-conditioning system for the test rooms and the control station. "In the past these functions ran via a relatively complex interface consisting of many analog signal cables



The engine experts from Volkswagen used TwinCAT HMI CE visualization software from Beckhoff to keep an eye on the processes.

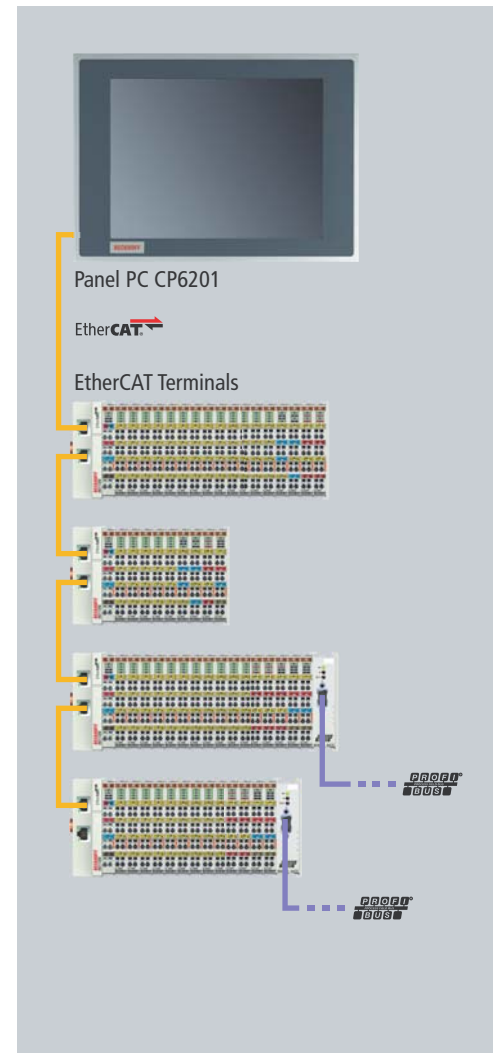
and a hardly used PROFIBUS, with different configurations for each test chamber," said Johannes Brandt von Fackh.

Communication via EtherCAT

Volkswagen Motorsport commissioned the company RTW B. Nossol GmbH, based in Neuenkirchen near Soltau, Germany, to modernize the measuring and control systems. This system integration company, which specializes in switchgear, automation and building management, has 20 years of experience in this field. "Our cutting-edge switchgear and controlgear production facilities enabled us to achieve the proposed alterations of the test bench within the specified time frame," said Timor Rickert, project manager at RTW-B. Nossol. "When it came to designing

the new IT infrastructure, we decided to use Beckhoff automation components with EtherCAT as the data bus. Key advantages of EtherCAT are its flexibility and capacity reserves for integration with other fieldbuses, and the comparatively low system costs."

The centerpiece of the new IT infrastructure for the media conditioning of the engine test benches and the air-conditioning of the test chambers is a Beckhoff CP6201 Panel PC with 1.8 GHz Intel® Pentium® processor and TwinCAT automation software. Four EtherCAT I/O stations with a total of 61 EtherCAT Terminals, which are housed in a control cabinet, are used for controlling the 360 I/Os. The EtherCAT network communicates with the higher-level test bench system via PROFIBUS terminals that are integrated in the EtherCAT Terminal system.



A Beckhoff CP6201 Panel PC with TwinCAT automation software is used for the media conditioning of the engine test benches and the air-conditioning of the test chambers. Four EtherCAT I/O stations with a total of 61 EtherCAT Terminals control a total of 360 I/Os.



Four decades of motor sport tradition

Volkswagen has been setting standards in motor sport for more than 40 years. It all started in 1966 with Formula V (the "V" stood for Volkswagen), which boasted 58 PS and robust beetle technology and offered new recruits a cost-effective route into Formula racing. No fewer than four subsequent Formula 1 World Champions, Jochen Rindt, Keke Rosberg, Nelson Piquet and Niki Lauda, emerged from this racing class. Between 1979 and 1994 Volkswagen won 55 international competitions as manufacturer of Formula 3 motors, with Michael Schumacher, Bernd Schneider and Joachim Winkelhock, among others. In addition, Volkswagen has shaped touring car racing for more than three decades with brand cups such as Scirocco, Golf and Polo. Moreover, Volkswagen was also successful in endurance races for touring cars, starting in 1997 with the 24-hours race at the Nürburgring. Since 2003 Volkswagen has been focusing on marathon rally sports. The first big success came with the victory at the 1980 Dakar Rally, followed by further victories in this classic offroad race, and culminating in the triple success in 2010.

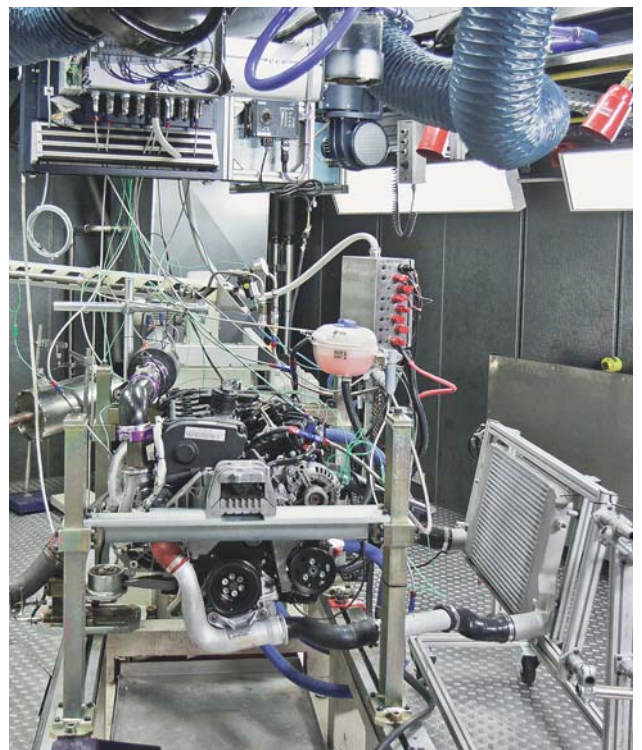
Standard TwinCAT libraries and function blocks simplify design and installation

During the test runs the motor data are logged and analyzed by the test bench system provided by AVL, a company that specializes in engine measurement technology. At the same time both the ambient temperature and the oil and cooling water temperature can be controlled via the EtherCAT network. The TwinCAT PLC HVAC library from Beckhoff permitted complex measuring and control systems for the media conditioning of the engine test benches and the air-conditioning of the test chambers. It also allowed the control station to be mapped in ready-made macros and function blocks. "This was very helpful for the engineering process and made the installation straightforward. All we had to do on-site was to connect the I/Os with the actuators and sensors," said Timor Rickert, summarizing the benefits of the TwinCAT PLC library.

The engine experts from Volkswagen used the TwinCAT HMI CE visualization software from Beckhoff to keep an eye on the processes. The software can also be used to change certain parameters such as the



The heating and cooling circuits with pumps for the media conditioning



operating state of the fans. "The PC- and EtherCAT-based systems from Beckhoff enabled us to implement all the requirements for the new measuring and control systems," said Johannes Brandt von Fackh. To-date the complete installation has been very reliable, just like the racing engines in the VW Touaregs at this year's Dakar Rally.

Volkswagen Motorsport www.volkswagen-motorsport.com
 RTW-B. Nossol GmbH www.rtw-nossol.de
 AVL Deutschland GmbH www.avl.com