Fieldbus-based Measurement Technology for Digital Transmission of Torque and Rotational Speed in Test Benches

Energy efficiency is a hot topic in the automotive industry. The focus is increasingly on engines and rolling resistance. Optimizing these two parameters requires new, more efficient vehicle designs, which demand the use of increasingly accurate measurements. Consequently, the demands being placed on test benches and test and measurement equipment used to determine torque and rotational speed are increasing steadily. Digital torque transducers have been standard for a long time. Not surprisingly, the number of modern Fieldbus-based systems has also grown due to their application flexibility, precision results, and real-time measurement capabilities.

Flexibility and Modularity

The HBM T40B and T40FM digital torque transducers meet the automotive industry's stringent requirements. In addition to familiar output signals such as frequency and voltage, they feature a TMC (Torque Measurement Communication) digital interface on the stator for outputting torque signals. In addition, these torque transducers can now be upgraded with the new, highly flexible TIM-EC interface module, which can enhance their performance and expand their potential applications significantly. As a result, they can be integrated into automation and control systems via both traditional signals and modern Ethernet-based Fieldbus technology such as EtherCAT.

TIM-EC is a two-channel interface module. In addition to the TMC digital torque signal, RS-422-compatible rotational speed signals from series T40 torque transducers can be connected. The following process data and measured values are provided via the EtherCAT bus:

- Torque
- Rotational speed
- Angle of rotation
- Power

Torque and rotational speed signals are also available through the module's 10+2 backplane bus. This offers extreme flexibility and modularity, which is a real plus, particularly for integration into higher-level control and automation systems. A single transducer can be operated on two separate TIM-EC units that are connected to each other via the backplane bus. All settings (for example, signal conditioning) can be changed independently from each other and without any secondary effects. As a result, control and automation levels can operate in an optimal way and react flexibly to the requirements of the tasks at hand. The system’s modular architecture allows it to be upgraded at any time.

Fast Control Based on Current Values

Controlling increasingly efficient and complex engines from a growing number of test bench engine management functions is more demanding than ever, particularly in terms of flexibility, data throughput, and speed. The EtherCAT real-time environment allows highly dynamic, top-quality test bench control, thanks to the low message transmission latency and very low jitter of the system. In addition, the powerful TIM-EC interface module supports update rates/bus cycle times of up to ≤20 kHz. Direct digital processing and output of the torque signal via the TMC signal on the stator, in combination with optimized hardware and signal conditioning in the TIM-EC interface module, make possible group delays of just 100 µs. Therefore, TIM-EC makes it possible to enhance the quality and stability of the test bench-based control loop.

Diagnostics and Parameterization

In addition to comprehensive diagnostics data via EtherCAT, TIM-EC has an Ethernet TCP/IP service interface. The integrated web server allows visualizing diagnostics data for the interface module and the connected torque transducer (“traffic light” presentation). Plain-text diagnostics and status information allows for further analyses. For example, users can retrieve on-site diagnostics data conveniently. The entire measuring chain or the TIM-EC can be tested quickly and easily.

The modern integrated web server simplifies visualizing TIM-EC functions. The interface module can be conveniently connected, tested, analyzed, and parameterized with a standard PC with Ethernet card. No complex software installation is required.

The measurement system is well suited for use in test benches and offers an ideal solution for applications such as testing dual-mass flywheels. In this application scenario, torque (angle) can be determined quickly and reliably using the angular signal.

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