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. Optimization of these two parameters requires new vehicle designs whose efficiency is the result of ever more accurate measurements. Consequently, demands on test benches and test and measurement equipment used for determining torque and rotational speed are steadily increasing. Digital torque transducers have long since become standard. The number of modern fieldbus-based systems also has increased. This comes as no surprise considering that they offer flexible use, provide precise results and allow real-time measurement.

Flexibility and modularity

HBM's T40B et T40FM digital torque transducers meet the automotive industry's high requirements. In addition to classical output signals such as frequency and voltage they feature a TMC (Torque Measurement Communication) digital interface on the stator. Moreover, the torque transducers can now be upgraded with the new highly flexible TIM-EC interface module to significantly enhance their performance and field of applications. They can thus be integrated into automation and control systems via both classical signals and modern Ethernet-based fieldbus technology such as EtherCAT.

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

- Torque
- Rotational speed
- Angle of rotation
- Power

Torque and rotational speed signal are also available on the module's 10+2 backplane bus. This offers extreme flexibility and modularity. 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 connected to each other via the backplane bus. All settings, e.g., signal conditioning can be changed independent of each other and without any secondary effects. The control and automation levels can thus operate in an optimal way and flexibly react to the requirements of the tasks at hand. Thanks to its modularity the system can be upgraded at any time.

Fast control based on current values

Controlling increasingly efficient and complex engines via a growing number of test bench engine management functions is becoming ever more demanding - particularly in terms of flexibility, data throughput, and speed. The EtherCAT real-time environment allows highly dynamic, top-quality test bench control. This is possible thanks to low-latency message transmission and the system's very low jitter. The powerful TIM-EC furthermore 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 enables group delays of approximately 100 µs. TIM-EC thus enables the quality and stability of the test bench-based control loop to be enhanced.

Diagnostics and parameterization

In addition to comprehensive diagnostics data via EtherCAT, TIM-EC has an Ethernet TCP/IP service interface. Diagnostics data are clearly visualized for the interface module and the connected torque transducer ('traffic light' presentation) on the integrated web server. Diagnostics and status information in plain text allow further analyses. For example, users can conveniently retrieve on-site diagnostics data. Fast testing of the entire measuring chain or the TIM-EC is as easy as possible.

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

The measurement system can be used in test benches and is the ideal solution, for example, for testing dual-mass flywheels. In this application scenario, torque (angle) can be quickly and reliably determined using the angular signal.

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