

Measurement Technology for the Analysis of Electrified Engines



Current & Voltage Measurement

To optimize efficiency and driving comfort, a German car manufacturer focuses on electrified gasoline engines. Key component of this technology is the integrated starter generator (ISG). For its best possible application, fast current and voltage measurements are indispensable.



Background

The ISG is a powerful electric motor mounted between the flywheel of the engine and the transmission. In coming vehicle generations, the ISG will replace starter motor and alternator and provide hybrid functions such as boosting, recuperation, load point shifting, coasting, start/stop, etc. The

ISG starts the engine so silently, that only a glance at the tachometer would reveal that the engine is currently active. Current and voltage measurements at the input of the inverter are required in order to obtain the optimum parameters for the starting operation.



Challenge

Although the on-board supply voltage has been increased to 48V, currents up to 300A still occur. In particular situations, e.g. engine start-up, there are even higher current peaks. Such extreme current

peaks can seriously damage the 48V battery. It is thus not only important to precisely measure the current but also those peaks lasting only for some microseconds.

The CSM Measurement Solution

To this aim, CSM provides a package solution consisting of an **AD4 OG1000** measurement module, an **XCP-Gateway** and the **CSM LEM LF-310 S Sensor Package**. To perform measurements as close to the inverter as possible, the current sensor is mounted between the back-up fuse and the ISG. Measurement module and gateway are placed in the footwell of the passenger seat.

The curve of the current measured is displayed in Fig. 1. The power electronics of the ISG also contains a current sensor whose output signal too is shown in the figure (white curve). That integrated sensor is checked via CAN bus. The comparison clearly shows that the internal sensor is operated at a considerably lower sampling rate. In addition, there is a distinctive signal delay due to the lower bus performance.

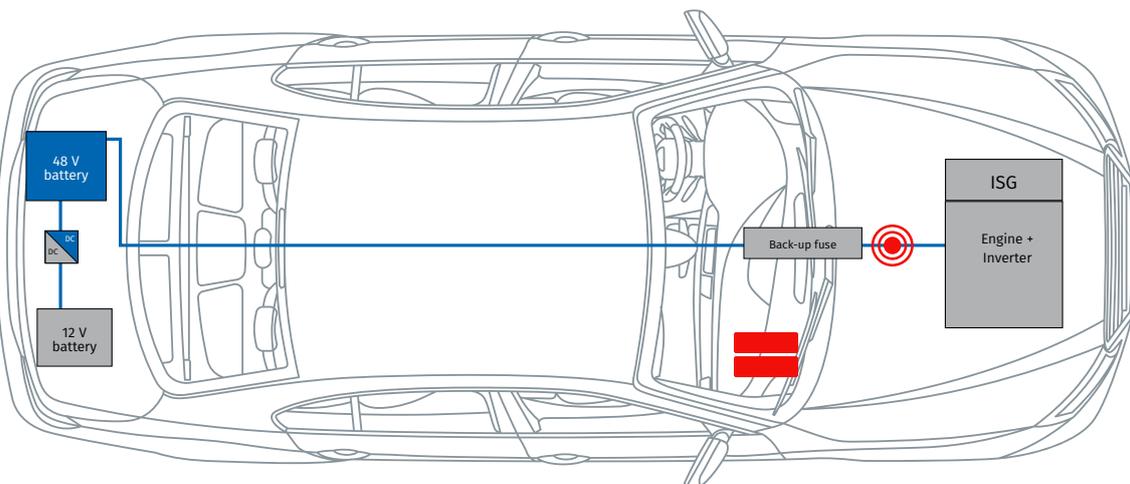


Fig. 1:  Point of measurement Sensor Package
 Measurement module

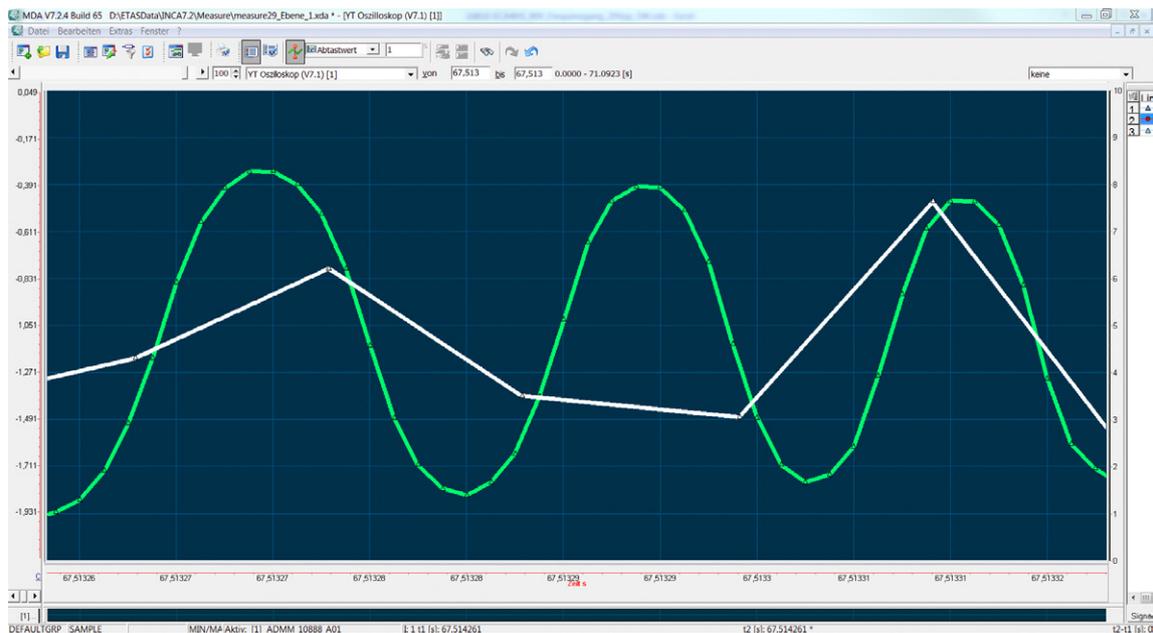


Fig. 2: The green curve describes the measurement using the CSM Sensor Package. The curve of the integrated sensor is highlighted in white.

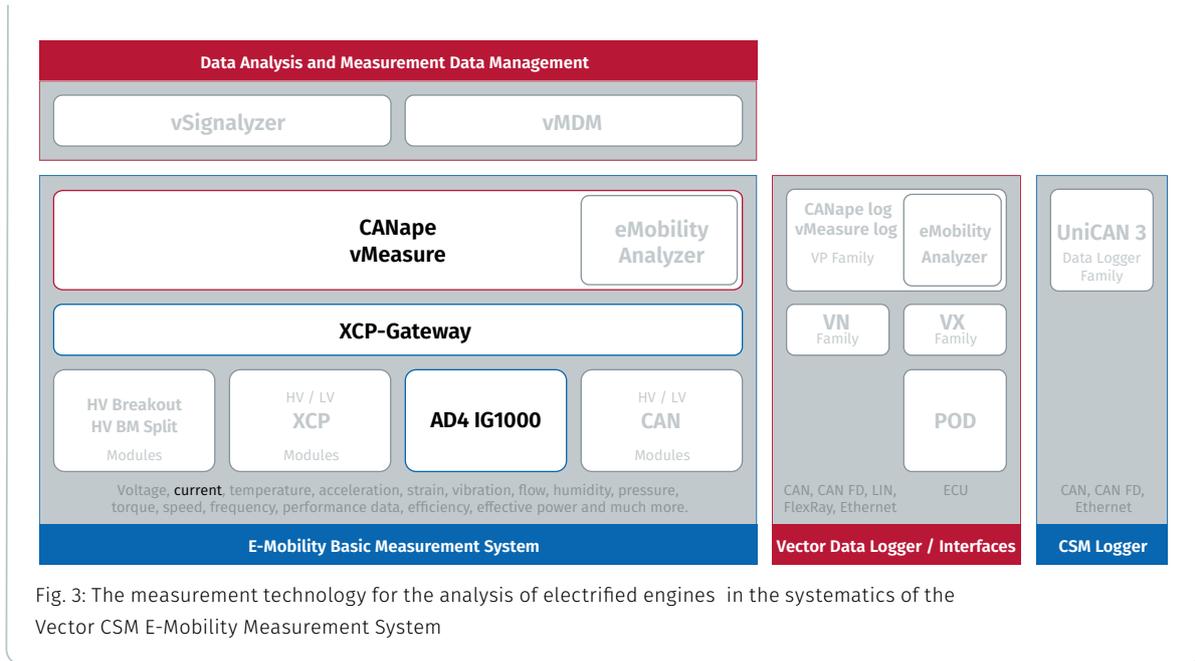


Fig. 3: The measurement technology for the analysis of electrified engines in the systematics of the Vector CSM E-Mobility Measurement System

Benefits

The LEM LF 310-S Sensor Package provides a measurement range of $\pm 500\text{A}$. Due to an high bandwidth of 100 kHz, current peaks can be converted into high-resolution voltage signals.

Contrary to conventional current sensors, e.g. shunts, the measurement technology of the Hall effect-based CSM Sensor Package is inherently galvanically isolated from the measurement setup which means that there is no risk of short circuit. The AD4 OG1000 allows signal sampling with frequencies up to 1000 kHz which makes it possible to display and analyze even very short current peaks in detail. The 10-fold sampling of the sensor eliminates aliasing effects. An optimum synchronicity of the individual channels additionally provides the

option to calculate the power curve based on the recorded voltage and current curves.

The XCP-Gateway converts signals into the standard protocol XCP-on-Ethernet which allows the acquisition of measurement signals via standard DAQ tools like CANape®. It is thus possible to perfectly integrate the system into the customer's already existing tool chain. Since time stamps are assigned to the data, it is possible to establish time relations to other previously recorded measured quantities, for example CAN signals from various ECUs the customer is recording via CANape®. Due to their ruggedness, CSM measurement modules can be mounted directly in the engine compartment and they are perfectly suited for long-term test drives.



Featured Products

AD4 ECAT MM Series – Type OG1000

CSM's AD4 ECAT OG1000 measurement module is ideally suited for the most accurate analysis of high-frequency signals with measurement data rates of up to 1 MHz per channel. It offers a high-precision, unipolar and channel-wise adjustable sensor excitation from ± 5 to ± 15 V DC for a variety of sensors.



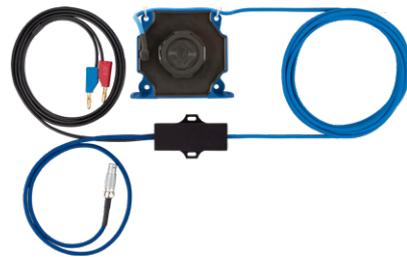
XCP-Gateway Series

CSM's XCP-Gateway Series protocol converters were specially developed for CSM EtherCAT® measurement modules and for measurement tasks with multiple measurement channels and high measurement data rates. The XCP-Gateway is available in "Basic" and "pro" versions. The "pro" version has two CAN interfaces via which CAN-based CSM measurement modules can be connected and integrated into the XCP-on-Ethernet measurement data protocol. In the "pro" version, temperature data from the HV Breakout Modules can also be transferred directly via EtherCAT®.



LEM Sensor Packages

CSM's LEM Sensor Packages allow fast and synchronous current measurements. Highly dynamic current measurements (e.g., on all three phases on the inverter, as well) with a threshold frequency of up to 200 kHz in a measurement range of up to $\pm 1,250$ A can be carried out with this Sensor Package along with the EtherCAT®-based measurement modules of the AD4 ECAT Series.



Complete solutions from a single source:

CSM provides you with comprehensive complete packages consisting of measurement modules, sensors, connecting cables and software - customized to your individual needs.

Further information on our products are available on our website at www.csm.de or via e-mail sales@csm.de.



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