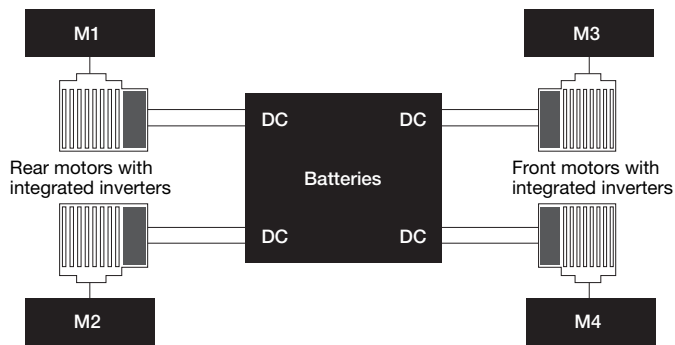
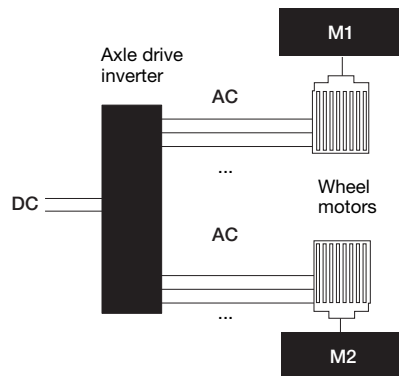


Application note

Overall efficiency of electric vehicles



Modern drive systems with integrated inverters do not allow access to the AC signals. Here one of the main measurement tasks is the overall drive train efficiency from DC to mechanical power. The example shows 4 DC measurements (1 to 4) with the corresponding 4 mechanical power measurements (M1 to M4)



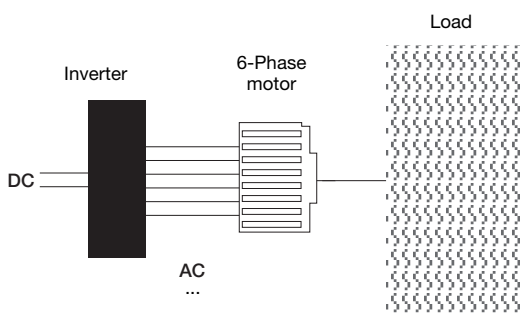
Example of an axle power efficiency measurement from DC (7) to dual 3-phase AC (1 to 3 and 4 to 6) plus dual mechanical power (M1 and M2)

Overview

From R&D to manufacturing and compliance testing, measurement of powertrain efficiency, harmonic content, battery charge/discharge process and ECU communication buses not only require progressively greater accuracies but also consistency in measurement over the specified ranges and conditions.

Key requirements

- Measurements from 6 phases for battery, inverter and 3 phase out put to motor
- Evaluation of motor characteristics such as torque, rotation speed & direction, slip etc.
- Harmonic evaluations of inverter signals due to superimpositions from switching circuits.



Example of an axle power efficiency measurement from DC (7) to dual 3-phase AC (1 to 3 and 4 to 6) plus dual mechanical power (M1 and M2)

The WT5000 advantage

7 input elements – Up to 7 power channels with user swappable inputs make it easy to evaluate the electrical, mechanical, total power and efficiency of electrical vehicle powertrains. Each input has filtering options to enable wideband and narrow band power analysis while eliminating aliasing and harmonic leakages.

Up to 4 motors evaluation

A single [WT5000](#) is capable of 2 sets of torque & A/B/Z phases or 4 sets of torque & rotation speed. Line filter can be set for pulse signal of motor torque and speed to reject noise.

Harmonics and dual harmonics

With 18 bit, 10 MS/s measurements and up to 5MHz bandwidth, the WT5000 supports harmonic analysis at various motor rotation speeds (0.1Hz to 300kHz fundamental) going up to the 500th order. Measure and compare distortion factor, THD, fundamental and harmonic components from two different inputs.

Battery charge/discharge measurements

The WT5000 enables the integration of current (Ah), apparent power (VAh), reactive power (varh), as well as the effective power integration (Wh) in charge/discharge modes. Furthermore, a user defined function makes it possible to calculate the average active power within the integrated period.