TORQUE AS A KEY VARIABLE
IN AUTOMOTIVE POWERTRAIN TESTING

Contactless torque measurement under real operating conditions
precise, reproducible and robust

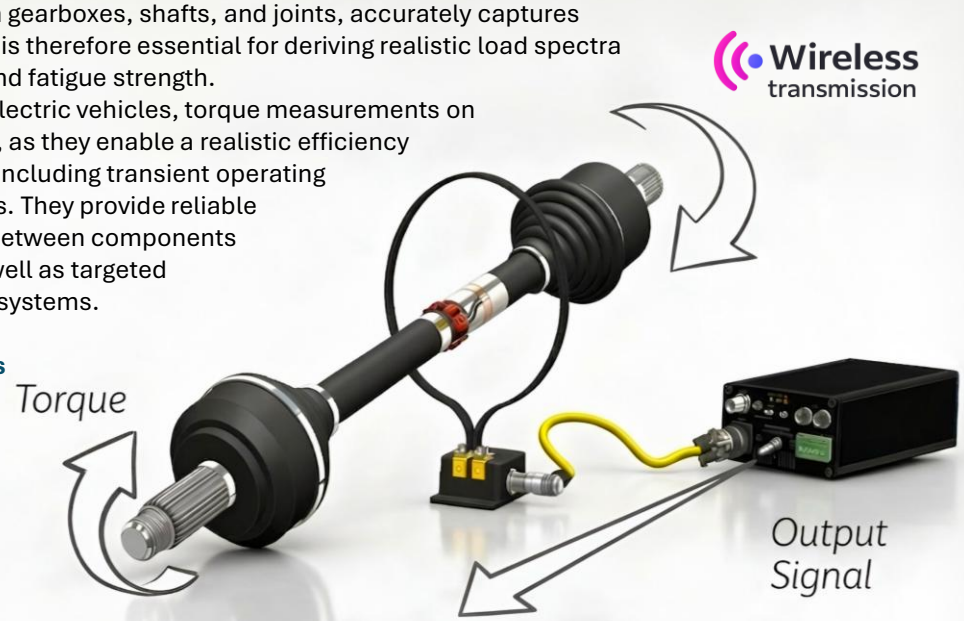
- Direct measurement on the shaft without mechanical modification of the drivetrain
- High data quality for validation and efficiency analysis of modern powertrain systems
- Reliable signal transmission under thermal, mechanical and electromagnetic loads

Challenges and Contactless Solutions under Extreme Conditions

Engineers in vehicle development and on test benches are faced with the challenge of measuring torque directly on rotating components such as drive shafts, gearboxes, or electric motors with high precision and reproducibility. Conventional systems reach their limits in terms of rotational speed capability, maintenance effort, installation space, and demanding environmental conditions such as oil, temperature, humidity, and contamination.
In contrast to slip ring-based systems, modern contactless telemetry systems overcome these limitations through wear-free power transmission and robust, fully digital signal processing. This enables stable, high-resolution measurement data to be reliably acquired and evaluated even under real operating conditions. At the same time, integration into existing test benches and vehicles is simplified, while the long-term stability of the measurement chain is significantly improved.

Torque Measurement in the Context of Modern Powertrain Testing

In modern powertrains, torque is increasingly regarded as the **primary reference variable**: it directly reflects the load acting on gearboxes, shafts, and joints, accurately captures load changes and peak values, and is therefore essential for deriving realistic load spectra as well as for validating durability and fatigue strength.
Particularly in the development of electric vehicles, torque measurements on drive shafts are gaining importance, as they enable a realistic efficiency evaluation of the entire drivetrain – including transient operating conditions and recuperation phases. They provide reliable insights into dynamic interactions between components and support the precise design as well as targeted optimization of modern powertrain systems.



Preferred Measurement Locations in the vehicle:

- Side shafts
- Prop shafts
- Transmission outputs
- Intermediate shafts

Torque Measurement under Real Operating Conditions

The application of telemetry systems on drive shafts requires precise coordination between mechanical integration, system robustness, and stable signal transmission. Limited installation space within the vehicle necessitates compact, adaptable solutions with minimal impact on the dynamic behavior of the rotating system. At the same time, the measurement location is exposed to combined mechanical, thermal, and electromagnetic influences that can directly affect measurement quality.

To ensure reliable measurement results, a telemetry system is required that is mechanically robust, provides a continuously stable power supply, and maintains reliable signal transmission even under interference. Key factors include immediate signal processing on the rotating structure and interference-resistant digital data transmission.

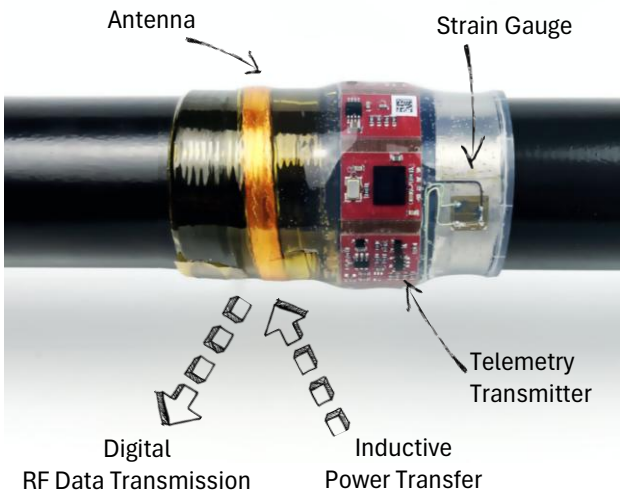
Telemetry systems designed accordingly enable long-term stable and reproducible data acquisition even under real operating conditions with high dynamic and electromagnetic loads.

Maintenance-free | **Oil- and water-resistant** | **Temperature-stable** | **16-bit precision** | **Long transmission distances** | **Connectivity**

Functional Principle of a Torque Measurement Shaft

A telemetry system for torque measurement on rotating drive shafts is based on strain gauges, which are directly applied to the shaft and convert mechanical loads into electrical signals. An integrated telemetry transmitter acquires these signals, processes them locally, and converts them into a digital data stream. Power is supplied contactlessly via inductive coupling, enabling wear-free operation.

In addition to the actual measurement data, modern telemetry systems also transmit operating parameters such as the supply condition and the temperature on the shaft, allowing extended condition monitoring and real-time assessment of measurement quality.



Robust Telemetry as the Foundation for Reliable Torque Data

Reliable torque measurements on drive shafts require a consistently robust design of the entire measurement chain. On-shaft digitization of strain gauge signals, combined with inductive, wear-free power and data transmission, enhances signal stability and reduces susceptibility to interference.

In addition, transmitted operating parameters such as inductive power status and rotor temperature enable continuous assessment of measurement conditions and ensure reproducible results both in the vehicle and on the test bench.

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