



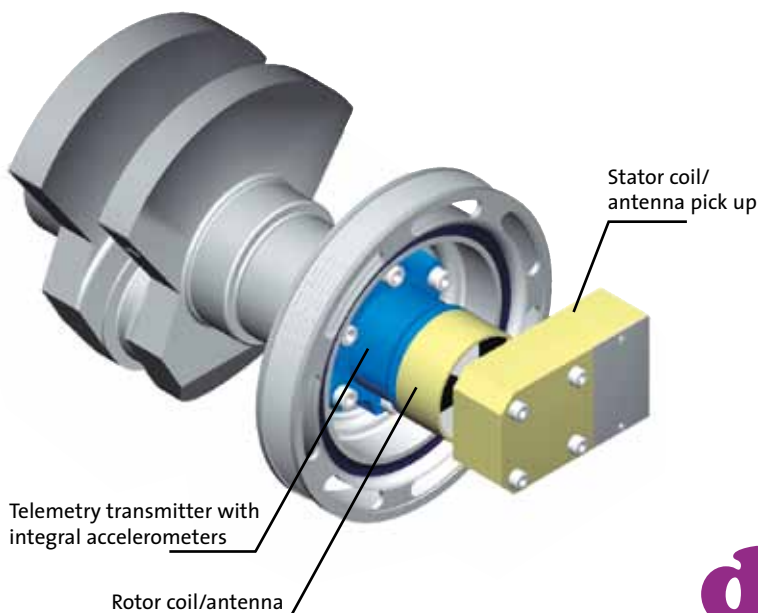
Advanced Telemetry Systems for Automotive Testing



New measurement instrumentation technologies are rapidly reducing vehicle development program schedules by offering efficient tools to measure and record data in component test stands and dynamometers as well as test track applications.

For many years wear-susceptible slip-rings and very basic, user unfriendly telemetry systems were the standard instruments for taking measured data from rotating vehicle components. Today an advanced wireless telemetry technology, combined with expert application engineering and after sales service, is available from datatel and is leaving the traditional solutions far behind with regard to reliability, wear, reproducibility, accuracy and ease of use.

Application Example:
Testing of torsional vibration dampers.
Measurement of torsional, axial and radial vibration modes.



datatel
TELEMETRY

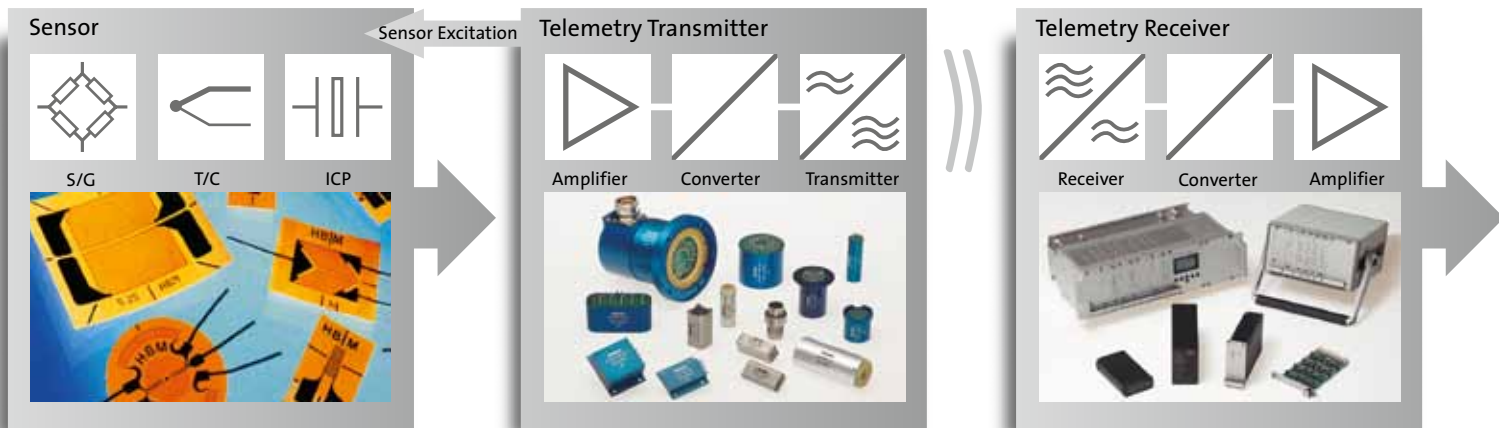
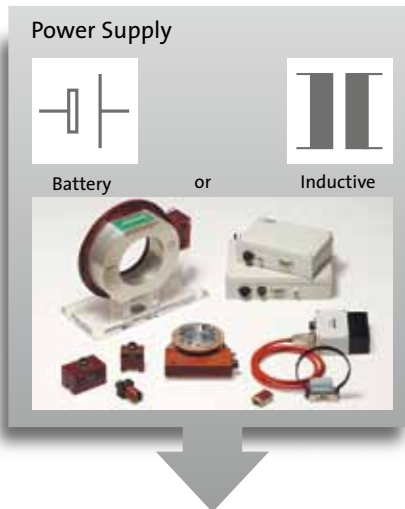
Advanced Telemetry Systems for Automotive Testing

Product Profile

datatel telemetry products are the result of more than twentyfive years of continuous user-oriented development and cover a wide range of rotating and reciprocating applications including automotive, test stand, transmission, railroad, process industry, turbomachinery and aerospace installations. Systems have been delivered with capacities ranging from a single channel to several hundred channels in one installation. Miniaturized telemetry transmitters are available for all standard measurement sensors for static and dynamic strain, torque, force, temperature, pressure, acceleration, vibration, displacement etc. However, datatel is always ready to develop or modify a special transmitter for the customer's requirement, together with the associated receiver and signal conditioning.

Datatel telemetry uses state-of-the-art analog and digital technology. Even highly dynamic signals up to 50 kHz frequency response can be measured and transferred with excellent quality and accuracy. The data from each individual transmitter are transferred to the telemetry receiver unit at a selected radio frequency in the MHz range. The final accuracy of the data is also, of course, dependent upon the performance of the sensors being used, but with datatel telemetry a measurement accuracy of $\pm 0.1\%$ FS can be achieved. In addition these modern telemetry systems feature helpful tools such as remotely controlled instrumentation diagnostic functions (e.g. online strain gage shunt calibration and auto-zero function, thermocouple 'open' detection, programmable gain and transmitter power supply monitoring) to check out the condition of the sensor and the complete measuring chain.

As a result of SMD, COB and Hybrid technology combined with special module packaging and potting methods these telemetry transmitters can accept operation in harsh conditions such as -40°C to $+125^{\circ}\text{C}$, g-loads more than 100,000g, shock, vibration, oily and gaseous environments.





Transmitter carriers for installation on different shaft diameters

Telemetry receivers are available with analog or digital output and can be connected directly to the preferred data acquisition system. Output signals are already filtered, amplified and calibrated. No additional signal processing of the measured data is needed.

To meet even the limited space requirement of test vehicle applications, receiver units are available as compact, self-sufficient units. They are rugged and can be powered by on-board 10 to 36 VDC. Alternatively for test stands and laboratory installations, receivers in modular 19" rack technology with mains power supply are standard.

All datatel telemetry transmitters can be powered either by battery or inductively. This dual power concept ensures the highest level of flexibility for a wide range of applications.

Battery supply can be used under the following conditions:

- Short operating times (several hours to a few days)
- Good accessibility
- Sufficient space
- Suitable for rotating or freely moving test objects.

Inductive power supply is maintenance-free and can be used under the following conditions:

- Long-term measurements (over weeks, months or years)
- Poor accessibility
- Limited space requirements
- Suitable for rotating test objects even for very high rotating speed.

An inductive power supply works like a transformer and has a stationary and a rotating coil. The coil system is fed by a power generator. The antenna system for the data transmission is built into the rotor and stator coils. datatel can supply a wide range of ready-to-install standard or customer specified coils set.

Customized Turnkey Solutions

datatel telemetry is based upon a highly-developed, modular electronics technology, supported by all the skills and resources necessary to design, manufacture and integrate complete, turnkey solutions to customer measurement requirements. This includes the design and fabrication of all special hardware needed for the application, plus the modifica-

tion of test components and the application of sensors (eg. strain gaging services). Particularly important are custom transmitter carriers and inductive power coil/ antenna assemblies, produced to suit the special requirements of any application. Hence the telemetry components are not merely 'tacked-on' to the machine under test but are fully integrated into the mechanical design so as to ensure secure, prolonged operation. For major test stands this provides virtually a permanent installation. Final system assembly, checkout and test is carried out at the datatel plant whenever possible, but on-site support is always available.



Custom design telemetry transmitter for strain measurement in a gear wheel

The result is targeted custom-designed turnkey telemetry systems from a single source. The unusually wide range of services and technical support provided is beneficial for the test program and guarantees success even for the most sophisticated telemetry projects.

Automotive Testing Applications

The versatility of datatel telemetry is a door-opener for a variety of new applications and makes it indeed a powerful tool for vehicle testing engineers. Some examples will demonstrate the flexibility and efficiency of these advanced wireless measuring devices:



1: Torque measurement on a truck cardan shaft

1 Drivetrain Torque Measurement

A standard requirement in vehicle testing is torque measurement on drivetrain components like half-shafts and cardan shafts. For short-term measurements battery powered telemetry transmitters can be easily attached with a strain gage to the rotating shafts. The measured torque data is transmitted via radio frequency to the receiver unit inside the vehicle cabin. It is beneficial that no external mounting device as familiar with

sliprings is required and the system can be used in public traffic. Moreover the installation can be performed within minutes.

For permanent torque monitoring the battery can be replaced by a maintenance free inductive power supply (see Photo 1). The telemetry transmitter and the rotor induction pick up is completely sealed in a clamp-on carrier device and is protected against dust, water splash or snow. The wide stator induction loop allows sufficient freedom of motion of the cardan shaft.

- 5 Engine
 - Piston temperature
 - Conrod force
 - Bearing temperature
 - Torque and strain on crankshaft
 - Torque on camshaft

Turbocharger
Blade vibrations
Temperature

Alternator
Winding temperature

Fuel Injection Pump
Torque
Force

Damper
Vibration
Temperature

Flex Plate
Engine torque

Clutch
Temperature
Force

2 **Automotive**
Torque
Temperature
Oil pressure

Gear Box
Torque
Tooth force

4 **Brake Disc**
Temperature

Tire
Temperature
Pressure



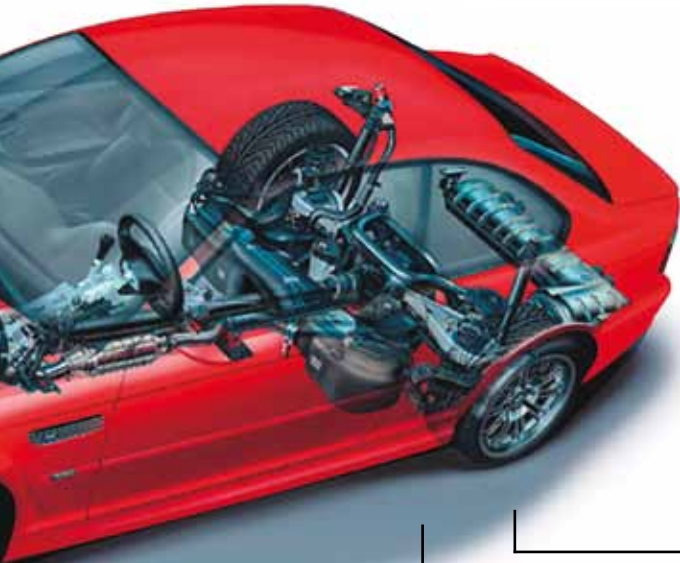
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2: Temperature measurement in an automatic transmission

A/C Compressor
Torque

Steering System
Steering torque
Steering force



3 Wheel/Rim
Wheel forces
Wheel moments

1 Drive Shaft
Torque

1 Cardan Shaft
Torque
Torsional vibration

2 Temperature Measurement in Automatic Transmissions

Photo 2 shows a telemetry application to measure temperature in an automatic transmission. With the given space limitations and the severe operating conditions it is almost impossible to integrate a standard slipping or telemetry system components. A custom designed 8 channel telemetry transmitter with thermocouple input was developed to meet the requirements. A flat, ring-shaped transmitter carrier and rotor induction coil assembly is mounted on a modified reverse clutch hub with the stator coil attached to the pump plate. The sealed telemetry electronics withstands the aggressive transmission oil operating temperature of up to +125°C and reliably measures accurate temperature data from the friction plates for months. Further applications inside transmission and gear drive components are eg. telemetric temperature, force, torque and oil pressure measurements.

3 Telemetry Systems for Road Load Data Acquisition

A detailed knowledge of the dynamic forces input to a roadwheel during operational usage plays an important role in both the design and validation processes of a new vehicle. With multi-axial wheel force transducers it is possible to acquire road load data such as longitudinal, lateral and vertical forces and the respective moments introduced into the rolling wheel under operational conditions.

An 8 channel telemetry system is used to transmit the signals from the strain gage based wheel force transducer (see Photo 3). Moreover the telemetry system handles online the processing of the measured data.

The telemetry transmitter features integral rotation angle measurement, two additional spare channels for brake or tire temperature



3: 6-component wheel force transducer with telemetric data transmission

measurement, a special sensor connector interface to ease the assembly and connection with the wheel force transducer instrumentation and on-board sensor calibration circuitry.



4: Temperature measurement on a brake test stand

4 Temperature Measurement on Brake Test Stands

Telemetry solutions for automotive component test stands are of interest to replace conventional slipping installations to improve the performance regarding reliability, signal quality and accuracy for long term test programs.

A typical example is temperature measurement on brake test stands (see Photo 4). An inductively powered multi-channel telemetry system is mounted on the shaft of the test rig using a customized split transmitter carrier for easy clamp-on installation. Upgrades for existing test stands are available. The telemetry transmitter is

equipped with a screw terminal interface for thermocouple hook-up, no soldering is required. The integral thermocouple "open" detection reliably indicates broken sensor wires.

5 Camshaft Torque Measurement

Photo 5 shows a telemetry installation on a camshaft test stand. Torque and rotation angle are measured on both camshafts by



5: Torque measurement on a camshaft test stand

special strain gage based torque transducers and angle transducers. The transducer/telemetry assembly is attached to the shaft end and a radially mounted inductive coil/antenna system picks up the transmitted torque data.

Company Background

6 Piston Temperature and Conrod Force Measurement

The knowledge of piston temperatures during fired engine operation represents important information for the development of modern combustion engines. In order to provide this data a special telemetry system was developed to enable online piston temperature measurements. A telemetry transmitter with a miniature power conditioning/storage system and a rotor coil/antenna pickup is attached to the conrod (see Photo 6). The transferred RF signals are picked up by a stator power coil/antenna mounted on the engine block.

With this system temperature measurements under all operating conditions of engine speed and load are possible. Moreover, other parameters like pressure, pistonring displacement and forces on the conrod can be measured with a similar technology.



6: Piston temperature measurement

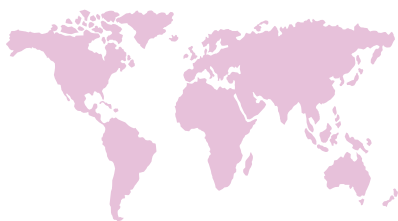


Telemetrie Elektronik GmbH (datatel) was founded in Hannover, Germany in 1976. The philosophy of providing expert advice to our customers coupled with the high performance, reliability and ease of use of the products have made the company into one of the leading manufacturers of telemetry systems Worldwide.

datatel telemetry systems have been setting new standards for the link between rotating or moving sensors and stationary data acquisition systems. The team of 40 experienced employees is specialized in the design, development and manufacture of innovative turnkey solutions for telemetric measurements of all kinds. In addition, a wide range of service and support activities is provided.

datatel is represented internationally with a network of service and sales partners in Europe, Asia and North America.

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