



Advanced Telemetry Systems for Aerospace Testing



New measurement instrumentation technologies are rapidly reducing aerospace research and development program schedules by offering efficient tools to measure and record data eg. from aero-engine rotors, aircraft propellers, helicopter rotors, landing gears, rocket fuel pumps and in component test rigs as well as fully operational engines or systems.

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

Based on the urgent requirements of the aerospace industry datatel has developed totally new telemetry systems with state-of-the-art electrical and mechanical performance to meet the current and future demands of next generation test instrumentation.



datatel
TELEMETRY

Advanced Telemetry Systems for Aerospace Testing

Product Profile

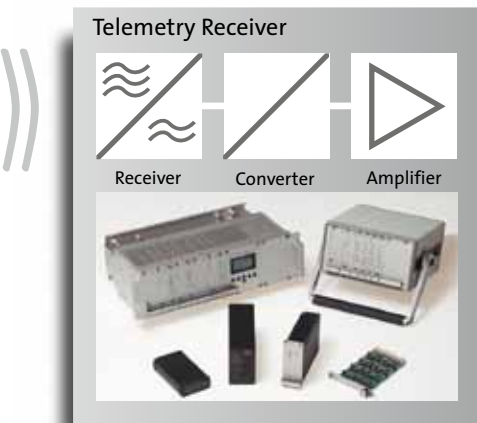
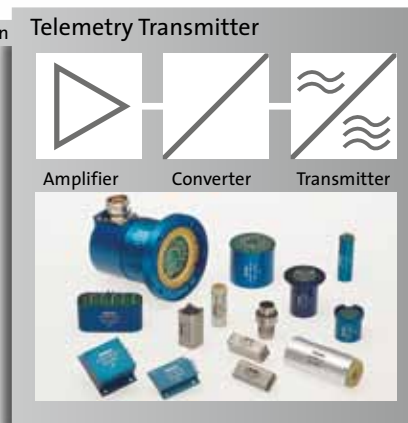
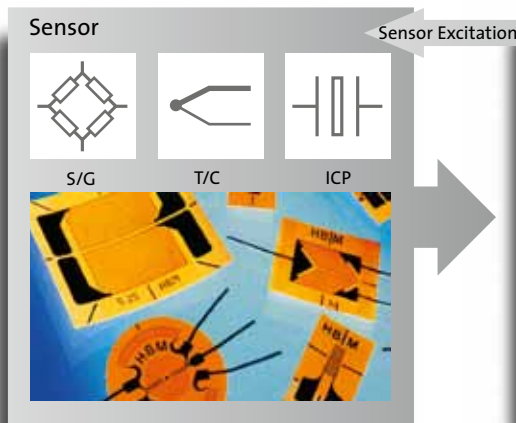
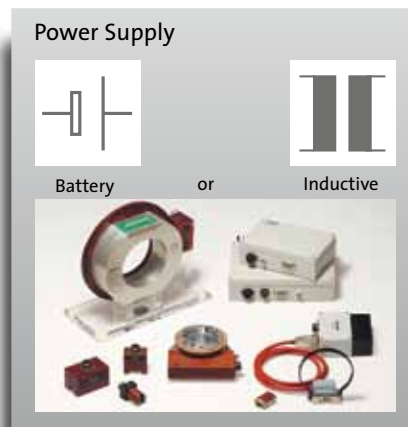
datatel telemetry products are the result of more than twentyfive years of continuous user-oriented development and cover a wide range of rotating and reciprocating applications including aero- and industrial turbomachinery, aerospace, diesel engine, automotive, test stand, railroad and process industry installations. Systems have been delivered with capacities ranging from a single channel to several hundred channels in one installation.

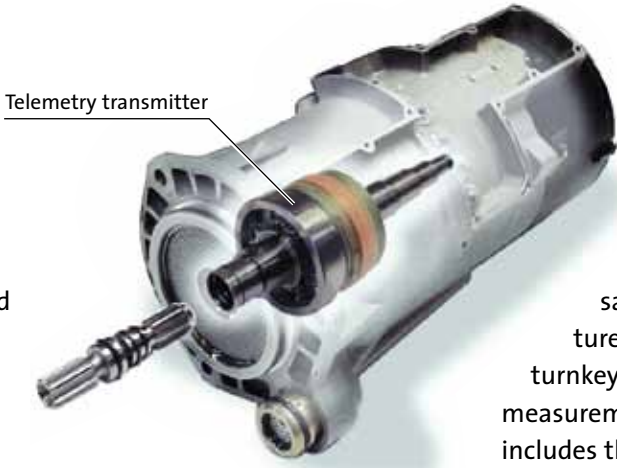
Miniaturized telemetry transmitters are available for all standard measurement sensors for static and dynamic strain, torque, force, temperature, pressure, acceleration, vibration, displacement etc. However, datatel is always ready to develop or modify a special transmitter for the customer's requirement, 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 signal 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, sensor 'open and short' detection, programmable gain, transmitter power supply and operating temperature monitoring) to check out in-situ the integrity of sensors, the associated wiring and the telemetry 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. For operation in higher environmental temperature cooling features are available.





Custom design telemetry system for investigation of dynamic torque and bending load on a DC generator drive spline at 27,000 rpm

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 flight test applications, receiver units are available as compact, self-sufficient units. They are rugged and can be powered by on-board AC or DC power supply. 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 neces-

sary 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 modification of test components and the application of sensors (e. g. 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.

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.

Aerospace 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 Aero Propulsion Testing

Standard requirements in aero-engine testing applications are blade vibration, dynamic or static pressure and temperature surveys on LP and HP compressor and turbine rotors in component test rigs or fully operational turbofan engines. datatel has a long record in designing high performance turnkey telemetry solutions for this kind of applications and special telemetry modules are available which meets the specific demands of aero propulsion testing.



Photo 1 shows a telemetry installation to measure 32 channels of dynamic strain and 8 channels of temperature in the LP compressor of a jet engine. The multichannel telemetry transmitters are mounted in a module carrier behind the nose cone.

A typical telemetry system for dynamic strain and temperature measurement in the HP section of a turbofan engine is shown on Photo 2.



Photo 2: Telemetry system assembly for taking measured data from HP compressor and turbine rotor (42 ch. dyn. S/G and 24 ch. T/C)



Photo 1: Telemetry installation for LP compressor test on El200 engine

The modular design features miniaturized transmitter modules with sensor connector interface, titanium transmitter carrier and Kevlar reinforced rotor coil/antenna system. The system was successfully operated at 21,000 rpm.



Photo 3: Telemetry transmitter unit mounted on propeller hub

2 Aircraft Propeller Testing

Multichannel telemetry systems are also available to measure static and dynamic strain on aircraft propeller blades. The systems are designed to suit flight test conditions as well as test stand applications. The data transmission is performed directly from the propeller to the data acquisition system in the aircraft cabin. The power supply of the rotating transmitter electronics is either by battery, anti-icing slip ring or inductive power system. Photo 3 shows a 16 channel telemetry system installation on the propeller hub. Integrated sensor connector interface, strain gage bridge completion and patch panel help to simplify the sensor hookup and the setup of the wireless test system in field operation.



Photo 4: Propeller model with strain gage balance and telemetric data transmission

3 Telemetry Systems for Wind Tunnel Model Testing

To acquire thrust, torque and force data from a propeller model in an aerodynamic wind tunnel laboratory, telemetry is applied to transmit signals with high accuracy from a rotating strain gage balance (see Photo 4). The customized telemetry transmitters are an integral part of the balance design (see Photo 5) and feature 4 strain gage channels and 2 additional RTD channels to provide offline temperature compensation capability. The rotating transmitter modules are powered by an inductive coil system which is also incorporated into the reduced scale propeller model operating at 15,000 rpm.



Photo 5: Strain gage balance with integrated transmitter modules

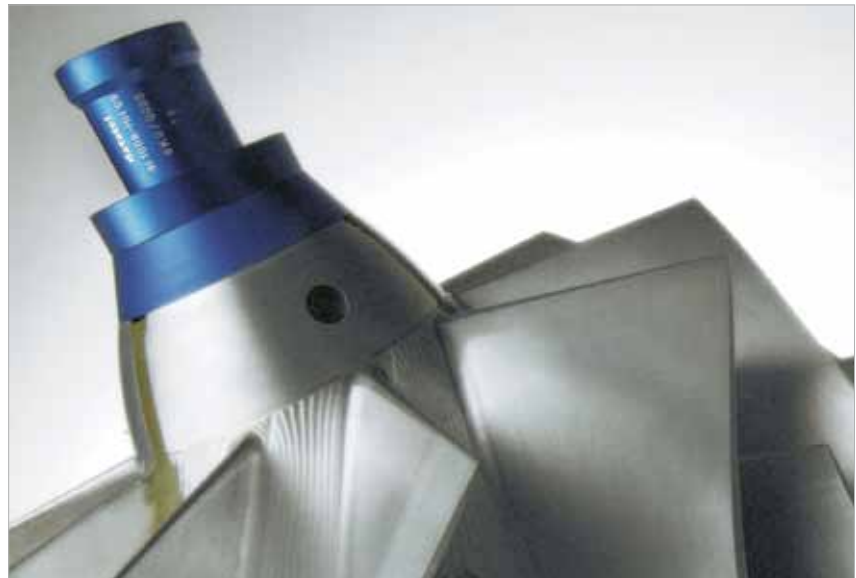
4 Wireless Telemetry Slipping Replacement Solutions

Individual wireless “Telemetry Slipping” solutions for centerline installations can now be designed. Photo 6 shows an example of a telemetry system replacing conventional multi-channel instrumentation slippings on high-speed test facilities. The device can be used to measure temperature or strain at up to 80,000 rpm operating speed on spin testers, aero bearing and seal test rigs or any other application with accessible rotor shaft end. A similar type of telemetry system is available for dynamic strain and temperature surveys on centrifugal compressors (see Photo 7). A centerline adapter with connector interface makes sensor hookup and mounting on the shaft end easy. The light weight, compact telemetry unit is attached directly to the test stand’s rotor shaft and does not require any complicated bearing assembly or lubrication as usually needed for traditional slippings.



Photo 6: Telemetry transmitter for centerline installation on high-speed shafts replacing traditional instrumentation slippings

Photo 7: Centrifugal compressor testing made easy by telemetry



datatel telemetry systems are used successfully for various rotating component tests, such as strain measurement on gear wheels, generator testing or PTO shaft torque measurement etc.



Company Background

5 Aerospace Component Testing

Some additional typical aerospace component testing applications where datatel's technology is successfully used are:

- Torque measurement on PTO shafts, reduction gear boxes, landing gears etc.
- Temperature measurement on aircraft carbon brake test rigs or tire test rigs
- Temperature and heat flow measurement in aero-bearing test rigs
- Dynamic strain measurement on APUs
- Strain and temperature measurement in AC and DC generators
- Strain measurement on helicopter rotor blades and rotor shafts etc.

Benefit from our extensive experience and get in touch. We look forward to discussing telemetry solutions for your special measurement requirements.



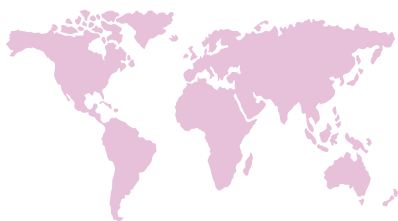
Telemetrie Elektronik GmbH (datatel) was founded in Hannover, Germany in 1976. The philosophy of providing expert advice to our customers coupled with the high performance, reliability and ease of use of the products have made the company into one of the leading manufacturers of telemetry systems Worldwide.

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.

www.datatel-telemetry.com



Telemetrie Elektronik GmbH
Berliner Allee 42
D-30855 Langenhagen · Germany
Tel. +49(0) 511 97 83 96-0
Fax. +49(0) 511 97 83 96-16
sales@datatel-telemetry.de