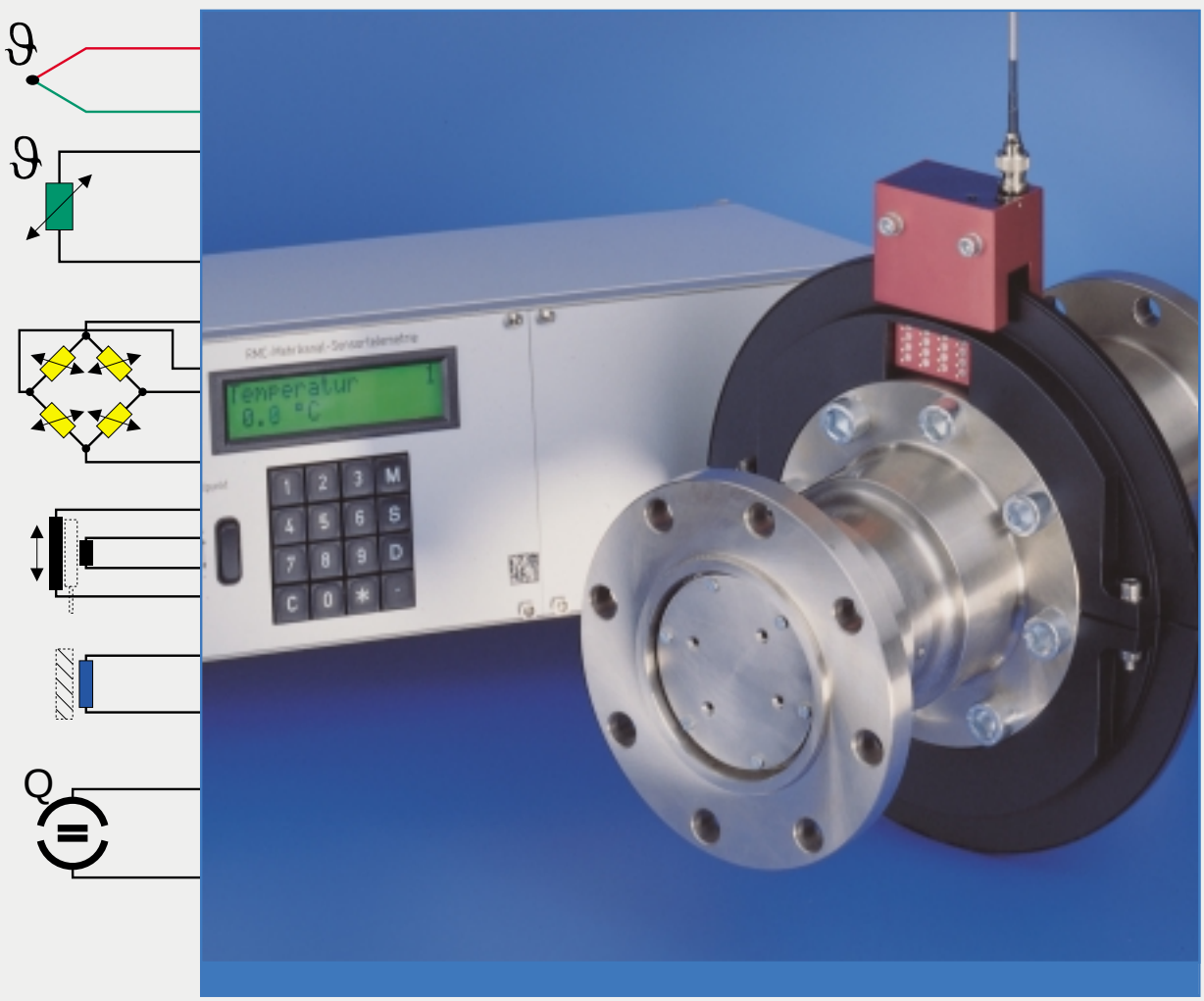
MULTIPLEX
SENSOR TELEMETRY



MANNER®
Sensortelemetrie

Sensor Telemetry – Compact and Consistent

The MANNER multiplex system product family was developed especially for the non-contact (telemetric) transmission of measurement data on moving objects in mechanical engineering, particularly rotating shafts.

The objective of sensor telemetry is to eliminate the usual problems involved with slip-rings, e.g. wear and tear, maintenance, signal interference and EMV instability. Furthermore, miniaturized sensor signal amplifiers and rotor electronics (8 channel 10 x 32 x 22 mm, 10 g) have made it possible to realize entirely new problem scenarios. Transmission via an interference-proof code guarantees the highest freedom from interference.

- **Digital transmission PCM (time division multiplex)**
- **FM transmission (time division multiplex)**
- **Antenna multiplex**

For Test-Stand and Series Applications

The product program from MANNER provides ready-made solutions for almost all areas of application, regardless of whether signals are sensed radially or axially. The consistently designed concept of sensor signal amplifiers and transmission elements (antenna) makes the telemetering system from MANNER particularly user-friendly.

The extensive standard program – which also includes components of miniature design – provides flexibility for virtually all applications in sensor telemetry.

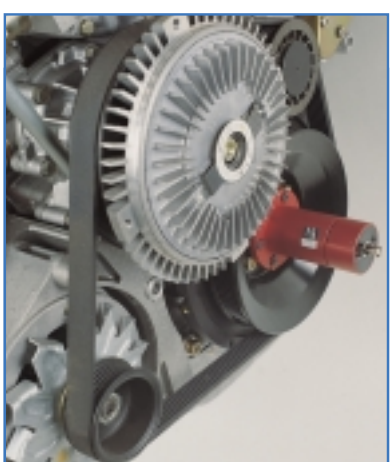
Power supply for the transducer and the rotor electronics takes place inductively. No batteries are used.

From Engineering to the Application

If the standard components for your measuring task need to be altered or are not even suitable, our engineering group is at your service to work out an application-specific solution. It will give you advice on the measuring task and make our extensive know-how about the entire spectrum of sensor telemetry available to you.

- Consultation
- Project planning
- Selection of optimal transducers
- DMS application
- Assistance during measurement
- Training in how to utilize the telemetry installation
- Implementation of complete measuring orders
- Manufacture and packaging of custom-built telemetry installations

Sensor Telemetry for Vehicle Measuring



Sensor Telemetry for Stress Analysis

Sensor Telemetry for Test Applications

The Areas of Application

Because of the modular program, sensor telemetry from MANNER is suitable for the most varied types of application:

- laboratory measuring technology
- vehicle measuring technology
- construction machinery
- hoisting plants in mining
- gear and motor measuring technology
- test-stand technology
- helicopter rotors
- wind generators
- turboblowers
- process technology
- machine monitoring
- process monitoring
- slip-ring replacement

The Measurable Variables

Typical physical measurable variables are:

- torque
- power
- strain
- acceleration
- linear or longitudinal deformation
- distance
- temperature
- pressure

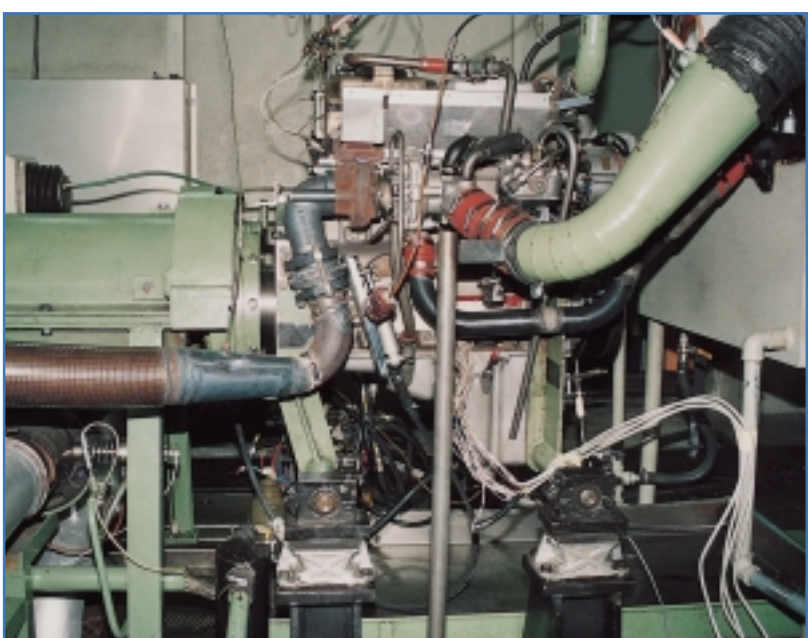
The System

- sensor signal amplifier (rotor electronics)
- evaluation unit (receiver)
- reception antenna pick-up
- rotor induction loop

The Features

- **maintenance-free via inductive energy-coupling for sensor and sensor signal amplifier (no batteries)**
- **digital transmission (digitalization in rotor electronics, PCM), FM technology or antenna multiplex**
- **remote-controlled measuring range selection and automatic zero point line-up in rotor electronics (during measuring operation)**
- **very easy handling and assembly, with minimal space requirements**
- **high transmission accuracy (zero point drift 0.003% Centigrade)**
- **measuring signal bandwidth 0 - 10 kHz**
- **scanning rate up to 100,000 samples/sec**
- **remote-controlled metering point changeover switch**
- **high environmental stability (IP 67); high immunity to interference**
- **ambient temperature from -30 °C to +125 °C (optionally to 150 °C)**
- **for commercially available sensors**
- **any shaft diameter from 0 to 2,000 mm, no free shaft end necessary**
- **integrated engine speed measurement (optional)**
- **integrated remote calibration function**

Sensor Telemetry for Test-Stand Applications

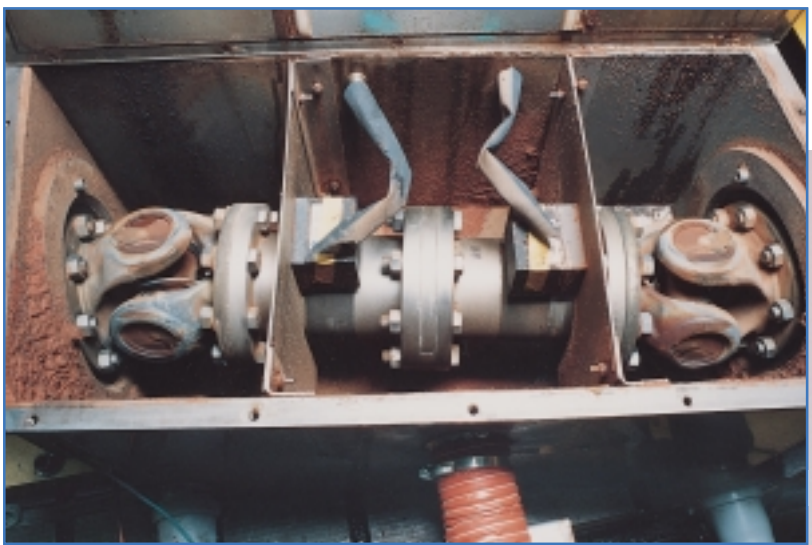


MANNER® Sensortelemetrie

For Use Even in the Toughest Environments

Application of telemetry depends to a great extent on environmental stability. The systems from MANNER have been specially developed for use in tough environments and are distinctive for the following characteristics:

- extremely sturdy (massive terminal pins)
- generally oil-proof
- supplied with protection type IP 67
- extremely resistant to acceleration (optionally up to 100,000 g)
- temperature-stable from -25 °C to +125 °C (optionally from -40 °C to +150 °C)
- minimal weight



Drive shaft test-stand with water and silica-sand rinse

The Decisive Advantage: Immunity to Interference

The decisive advantage of MANNER Sensor Telemetry as opposed to slip rings lies in immunity to interference. The systems from MANNER can be utilized even when EMV load is high.

Operation in close proximity to frequency converters is problem-free.

Even installation of the system in GTO-controlled large motors with 50 megawatt performance delivers interference-free signals (see photo, right).

Rotor temperature monitoring on GTO-controlled 50-megawatt motor

Miniature Designs

Sensor telemetry on gear input shaft

The units are of increasingly compact design. Component reserves are getting smaller all the time and verification of component load is becoming ever more important. The amount of space taken up by a measuring amplifier in the unit is usually very critical. Alterations in serial parts are often ruled out. The installability of rotor electronics depends to a great extent on their dimensions.

The miniature designs from MANNER were developed especially for gear and motor applications. Despite their massive design they are extremely lightweight, need very little space for insertion, and can be used in ambient temperatures of up to +150 °C.

This product series functions according to the tried and tested FM modulation method with time division multiplex. The eight-channel module, for instance, measures only 22 x 10 x 32 mm and weighs a mere 15 g.

Advantages over Slip-Ring Transmitters

Sensor telemetry for vibration analysis on turboblower via DMS

- high signal quality – no signal interruptions
- no wear and tear, bearing-free, no extra torque
- high EMV interference immunity via galvanic separation between rotor and stator
- high EMV security via amplification of the measuring signal in the rotor
- integrated measuring amplifier
- no constructional limitations with regard to mounting

MANNER® Sensortelemetrie

The Sensors

The preamplifiers are already integrated into the rotor electronics. All the usual commercial sensors can be connected directly to the sensor signal amplifier, without the need for any extra amplifiers.

The rotor electronics also ensure that the sensors are powered (no batteries).

- DMS sensors
- (quarter, half and full bridge)
- thermoelements NiCr-Ni, FeCo
- PT100 sensors
- pressure sensors
- piezosensors (optional)
- inductive sensors (LVDT's) (optional)
- eddy current sensors (optional)
- angle potentiometers
- special sensors

Piezoelectric Sensors

The rotor electronics can be optionally delivered with original Kistler charge amplifier modules. The outstanding characteristics of these charge amplifiers enable quasi-static pressure or power measurements.

The integrated remote-reset function allows defined, remote-controlled resetting even during operation.

Inductive Sensors (LVDT)

For LVDT sensors, a special transducer module is available for the rotor electronics. It generates a sinusoidal distribution voltage with a choice of 5, 10 or 20 kHz. The sensor signal is converted into an analog voltage signal.

The Importance of Accuracy

The value of any telemetry is determined by the accuracy of the input measuring amplifier. Here, because of the large fluctuations in ambient temperature and the small measuring signals, a decisive amount depends on the drift and noise characteristics of the input measuring amplifier. Even a transmission technology with 16-bit resolution is worthless if the characteristics of the input measuring amplifier are bad. Good anti-alaising filters (Butterworth-type) are also necessary here, of course, in order to avoid scanning errors.

The RMC sensor telemetry system is distinctive for its high degree of accuracy. The systems are available in four zero drift classes:

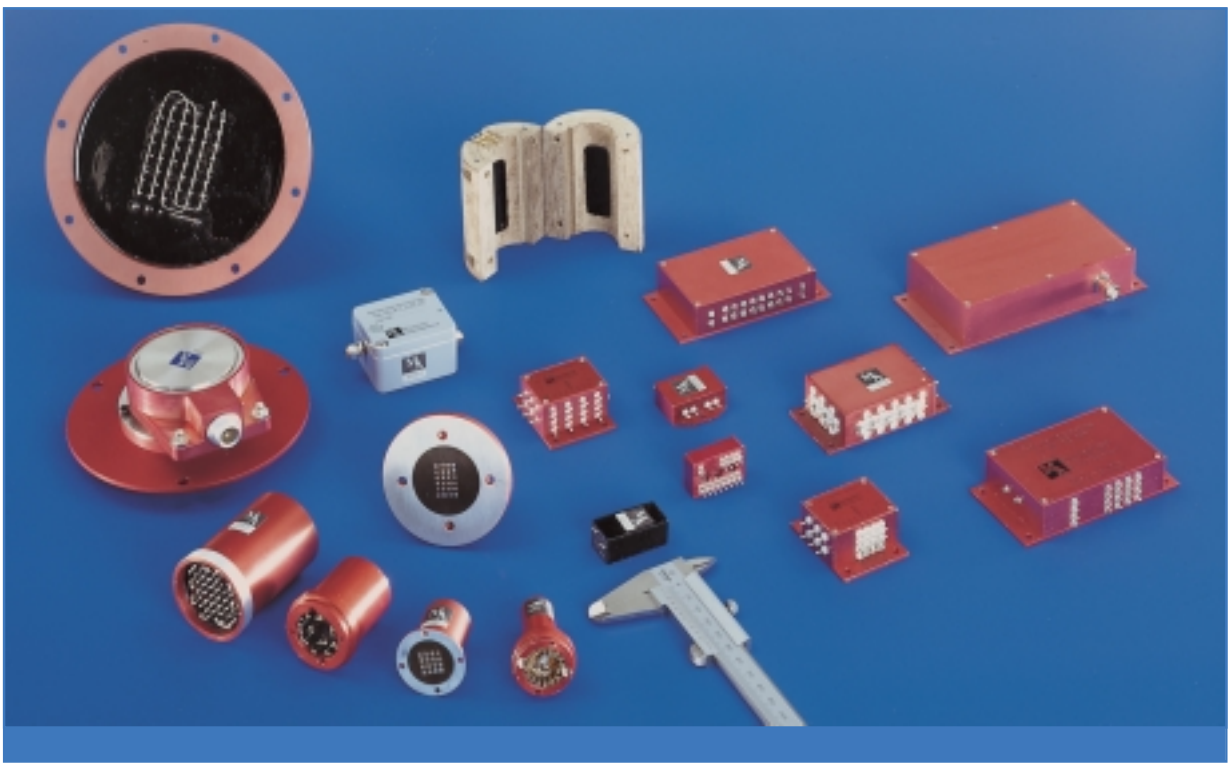
- 0,02 %/°C
- 0,01 %/°C
- 0,003 %/°C (optional)
- 0,001 %/°C (optional)

Automobile drive shaft

High-precision Torque Data Collection on Serial Parts via Additional Temperature Measurement

When torque data is collected on serial parts to determine their efficiency, temperature compensation for E-module and zero point is often extremely expensive. With the aid of additional temperature measurement at the measuring point, temperature-related errors in the measuring computer can be corrected. For this purpose a 2-channel multiplex telemetry is utilized, whereby the driving torque channel is permanently active (cutoff frequency up to 10 kHz / -3dB) and the temperature at the measuring point is scanned on a regular basis.

The Multiplex Sensor Telemetry Product Program



The standard product range comprises a modular system, enabling value-for-money solutions for the most varied applications. Standard interfaces guarantee compatibility between the modules and ensure later extendibility.

The system contains an extensive range of standard rotor electronics (sensor signal amplifiers) in various housings and evaluation units (receivers).

The systems are available with:

- digital transmission technology (PCM, time division multiplex)
- FM technology (time division multiplex)
- antenna multiplex

Systems can be delivered with:

- channel numbers from 2 - 32
- various shapes of housings
- miniature 8-channel versions (22 x 10 x 34 mm), weight 15 g
- versions for use in environmental extremes (ambient temperatures of up to +150 °C)
- protection type up to IP 67

and various antenna couplings:

- radial or axial sensing
- shaft diameter of up to 3000 mm
- antennas for axial sensing integrated into the rotor electronics
- cardan shafts with high freedom of movement up to ± 100 mm in all directions

plus receivers

- in 19“ technology (test-stand technology)
- plug-in cards
- compact designs
- PC plug-in cards

... also in miniaturized versions

Digital Transmission PCM or FM Transmission?

Both methods have their strengths and weaknesses. MANNER Sensor Telemetry is of modular design and – depending on the respective application – features both transmission methods.

Which of the two methods is more suitable depends on the problem in hand. FM modulation (FM technology) is without a doubt the most interference-free form of transmission. In digital transmission even one bit error can falsify the total measuring value by 100%. There again, digital transmission technology provides higher resolution, simpler further processing in the receiver, and the respective transfer to the measuring data collection system, since the need for any transducer is eliminated.

In the case of applications where space is at a real premium (piston telemetry, gear applications and environmental extremes with ambient temperatures of up to +150 °C), FM technology is producing better results at present. A digital conversion process requires more electronics, and the components necessary can only be used in a maximum temperature of approximately 120 °C. Larger space requirements and limited application temperatures are thus required. Moreover, the reliability of the rotor electronics is very dependent on the number of components that are needed. Rotor electronics with 8 measuring channels in a 10 x 22 x 32 mm housing and featuring PCM technology cannot yet be realized by today's technology.

Digital Transmission PCM

On the "PCM technology" version, the amplified and time division multiplex sensor signal is digitalized, encoded and then transmitted via the inductive bidirectional line using an A/D transducer. On systems with higher resolution each sensor signal is digitalized and the resulting digital datastreams are multiplexed. The digitalized sensor signal is either taken over digitally by the measuring computer (RS 232/RS 485 or optical link) or is available as an analog measuring signal (0 - +10 volts) at the receiver output.

FM Transmission

On the "PCM technology" version, the amplified and time division multiplex sensor signal is converted using a U/F transducer with 14-bit resolution into a frequency proportional to the measuring value and transmitted via the inductive bidirectional line. The amplified frequency-modulated sensor signal is either available as an analog measuring signal (0 - +10 volts) at the receiver output, or can be directly taken over by the measuring computer via the RS 232/RS 485 optional interfaces.

Antenna Multiplex

On the "antenna multiplex" sensor telemetry version, each amplified sensor signal is converted into a frequency proportional to the measuring value via a U/F transducer with 14-bit resolution and transmitted via the inductive bidirectional line. Each measuring channel has its own bidirectional line. The space requirements per bidirectional line are 10 mm, so 4 transmission channels would therefore require 40 mm of shaft. With antenna multiplex up to 40 kHz bandwidth per channel can be realized.

Non-Contact ...

Transmission of the measuring signal takes place inductively, using an antenna pick-up and an induction loop around the shaft. The length of the induction loop can amount to 3000 mm, depending on the respective type. The rotor ring (induction loop with turn) is wrapped around the shaft. It provides a continuous guarantee of inductive energy supply and measuring data transmission.

The rotor ring can...

- be mounted by the customer
- be obtained from MANNER by the meter in various different profiles
- be obtained from MANNER as a custom-built massive ring (for long-term application)

For drive shaft applications the inductive coupler is equipped with two induction loops (stator and rotor one wind each). The distance between the rotor ring and the stator ring can amount to a maximum of 100 mm. The loops also come in massive ring versions.

Trigger mark option

When measuring tasks are carried out on rotating shafts, the turning angle is often required so that the measuring signal can be assigned. A reference mark in the form of a defined pulse can be generated by the system without extra external components.

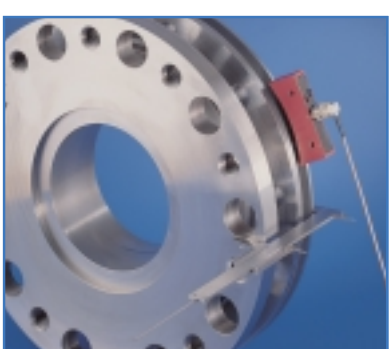
Easy-mount Rotor Induction Loop

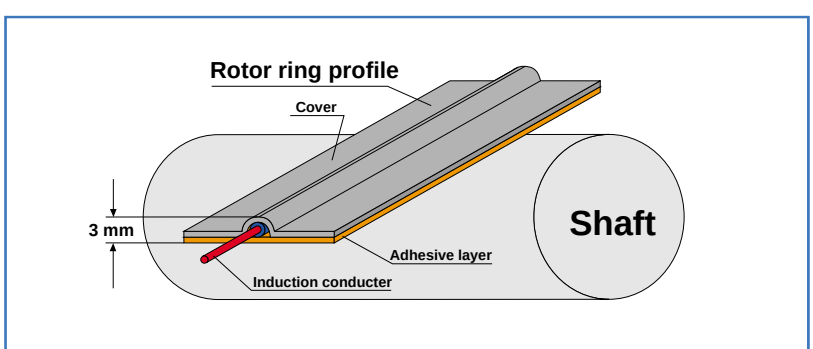
For universal measuring tasks a surface-mountable rotor ring profile is available by the meter. For assembly a section is cut from the roll that corresponds to the respective shaft diameter; the protective foil is then removed from the adhesive layer and stuck around the shaft. The ends are led to the sensor signal amplifier and soldered on. Alignment of any kind is unnecessary. The installation is thus operational within a very short time indeed, without any time limitation or the need for any batteries.

The profile consists of the rotor induction loop with base material and the adhesive layer. It is only 3 mm high, and a mere 30 mm wide.

For test-stands

For fatigue-strength installations, divisible rotor rings in massive design are available. The rotor rings are custom manufactured at the factory to suit the shaft diameter. The two shells are screwed down for subsequent assembly. The rotor electronics module can also be optionally mounted into the rotor ring.





RMC Technology

New RMC technology (remote-controlled measuring range selection and zero adjustment) is also available for multiplex systems.

What are the benefits of RMC technology?

You must certainly have been faced by measuring situations where the measuring range chosen was either too small or too large. Subsequent alteration of the measuring range can often involve high assembly costs. In cases like these, a rotor electronics measuring range that is adjustable via the receiver is extremely useful.

Or what about a measuring situation with a low input signal that is amplified accordingly and has no thermal zero drift compensation whatsoever (e.g. quarter bridge circuit)? Via the change in ambient temperature the measuring value slowly but surely leaves the measuring range. The measurement would then be over. With RMC technology it is possible during operation to correct the zero point by up to 1000% in the most sensitive measuring range.

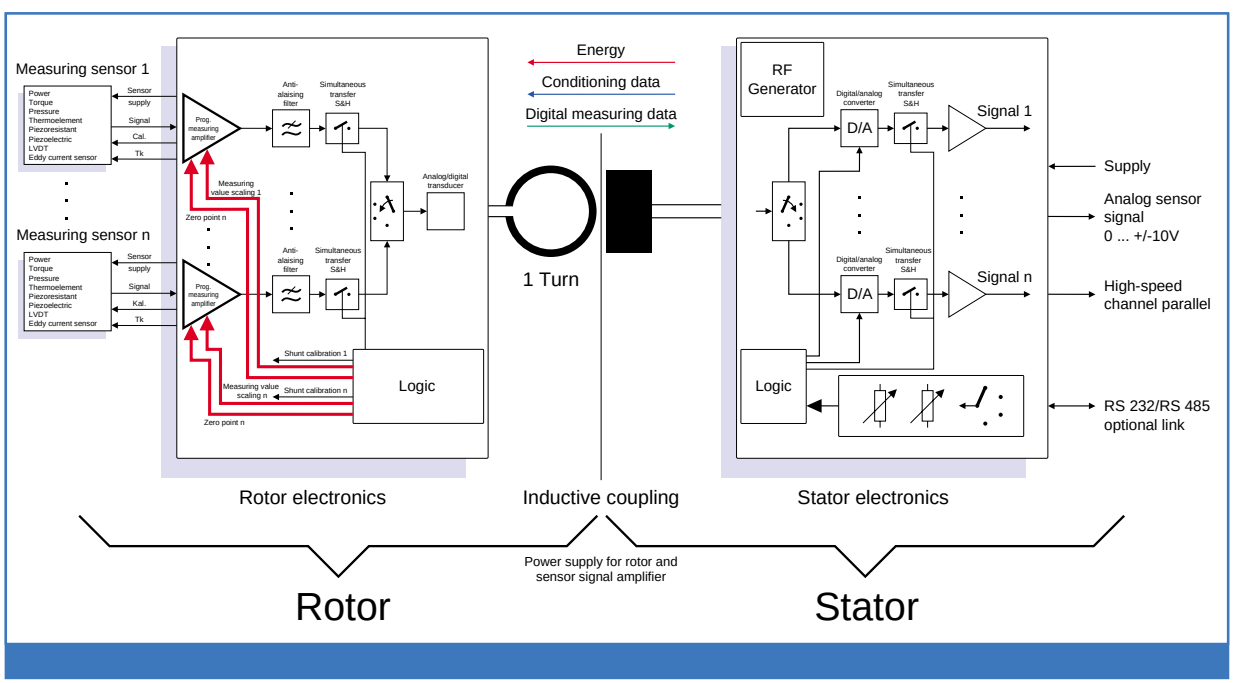
Setting the zero point with soldering resistance can be very hard work indeed in the case of classic telemetering installations, especially where major amplifications are involved. Where numerous measuring channels are involved, zero setting is an extremely expensive procedure. With RMC technology zero setting is totally eliminated. The measuring bridge is attached and checked for any connection faults. Defined zero point displacements can naturally also be set. All these functions are available online.

Documenting the conditioning parameters!

The conditioning parameters (zero point and measuring range) of all measuring channels can be called up via the serial interface and also programmed as downloads.

What are the distinctive characteristics of RMC technology?

- Amplification (measuring range) can be set from 0.0625 mV/V to 8 mV/V. The respective graduation is factor 2.
- Depending on the measuring range, the zero point can be corrected by up to 1000% of the measuring range.
- Measuring range selection and zero point adjustment take place in the rotor electronics (input measuring amplifier).
- The individual measuring ranges are calibrated in mV/V and the zero point errors between the measuring ranges have been eliminated.
- Optimal adjustment of the measuring range means that high resolution and accuracy are guaranteed in every measuring situation.
- A processor in the rotor electronics coordinates all processes and monitors data transmission.

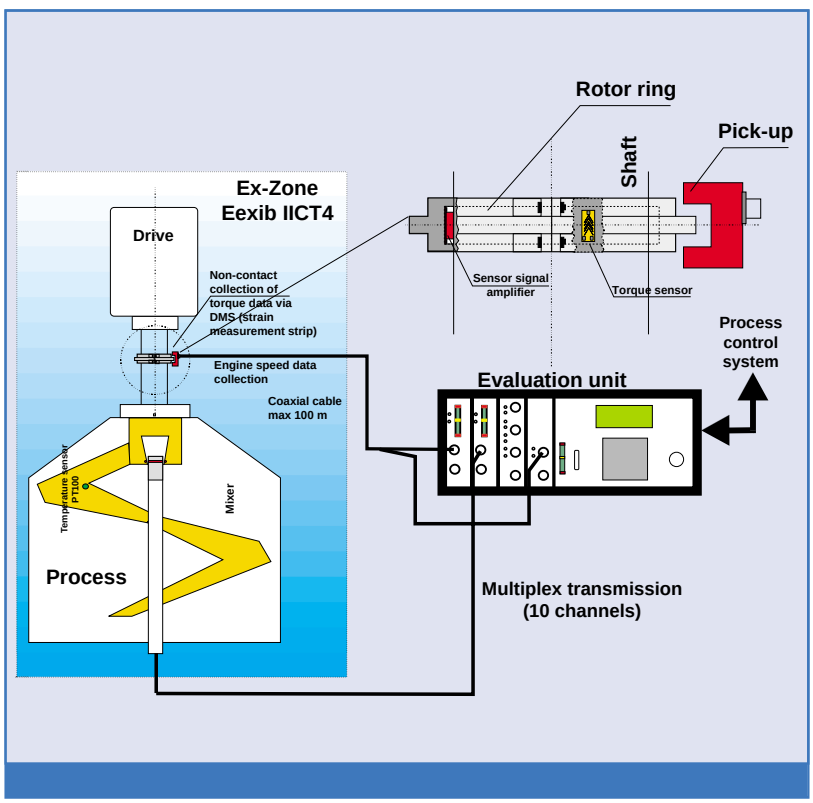


Wheel-turn Transmitters

Multiplex telemetry from MANNER is also available in the form of a wheel-turn transmitter in vehicle measuring technology, which transmits any required sensor signals from a turning wheel. These can be thermo-element signals, DMS signals or any other types of signals.

The wheel transmitter is suitable for trips through puddles (protection type IP 67). An engine speed impulse track with 360 pulses per revolution is also available. The number of channels can be 1, 4, 8 or 16. The transmitter is connected with the receiver via a thin coaxial cable. The sensor signals are available as analog output signals with 0 - ± 10V or as digital signals via the serial interface.

... and Further Sample Applications



Process control via sensor telemetry

Temperature data collection up to 150 °C ambient temperature on clutch thrust plate

Shear and torque measurement on drive shaft

Torque data collection with temperature measurement on gas turbine output shaft

Multiplex Sensor Telemetry – The Product Program

Multiplex sensor telemetry (product family)

Time division multiplex

System data	Digital transmission (PCM)			FM transmission			Antenna multiplex		
	Resolution	Channel numbers	Sensing rates	Signal dyn.	Channel numbers	Sensing rates	Signal dyn.	Channel numbers	Cutoff frequencies
	12 Bit	2 16	10 000 Samples/sec	66 dB	2 16	1 000 Samples/sec	66 dB	2 5	1 kHz (-3 dB)
	14 Bit*	4 24	25 000 Samples/sec		4 24	2 000 Samples/sec		3 6	10 kHz (-3 dB)
		8 32	50 000 Samples/sec		8 32	10 000 Samples/sec		4 7	40 kHz (-3 dB)
			100 000 Samples/sec			25 000 Samples/sec			
Accuracy class	Zero point and amplification drift at 1 mV/V 0.01 %/°C 0.003 %/°C			Zero point and amplification drift at 1 mV/V 0,02 %/°C 0,01 %/°C			Zero point and amplification drift at 1 mV/V 0,01 %/°C 0,003 %/°C 0,001 %/°C		
Ambient temperature range	- 10 ° ... + 85 °C - 25 ° ... + 125°C			- 10 ° ... + 85 °C - 25 ° ... + 125 °C - 40 ° ... + 150 °C			- 10 ° ... + 85 °C - 25 ° ... + 125 °C - 40 ° ... + 150 °C		
Acceleration stability	10 000 g 20 000 g			20 000 g 100 000 g			20 000 g 100 000 g		
Sensing	radial/axial			radial/axial			radial/axial		
Housing variants	• ALU cuboid • ALU cartridge			• ALU cuboid • Epoxy resin coated • ALU cartridge • Miniature			• Channel number + flat chip 15 x 8 x 32 mm		
RMC-option remote-controlled measuring range and zero point selec.	Measuring range 0.0625 mV/V ... 8 mV/V Zero point: 1000 % in smallest meas. range			Measuring range 0.0625 mV/V ... 8 mV/V Zero point: 1000 % in smallest meas. range			Measuring range 0.0625 mV/V ... 8 mV/V Zero point: 1000 % in smallest meas. range		
Trigger mark	Optional			Optional			–		
Data interface RS 232/RS 485 optional link	Optional			Optional in combination with RMC			Optional in combination with RMC		
Single-channel cut-in	–			remote-controlled meas. point selection switch			remote-controlled meas. point selection switch		
Simultaneous sensing	Optional			Optional			–		
Wheel-turn transmitter	–			Compact design (transmitter with bearings) engine speed output 360 pulses/rev. IP 67			–		

MANNER® Sensortelemetrie

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