USER MANUAL

STRAIN GAUGE BASED TORQUE SENSOR

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SAFETY PRECAUTIONS

WARNING! IN ORDER TO MINIMIZE RISKS, IT IS OF UTMOST IMPORTANCE TO RESPECT THE CURRENT SAFETY STANDARDS WHEN PLANNING, CONFIGURING AND OPERATING THE TORQUE SENSOR.

CAUTION: OPERATE THE TORQUE SENSOR WITH GREAT CAUTION! THE SENSOR MAY BE IRREVERSIBLY DAMAGED IF IMPACTED MECHANICALLY (FALL), CHEMI CALLY (ACIDS) OR THERMALLY (HOT AIR, VAPOR).

QUALIFIED PERSONNEL

Persons in charge of installing and operating the Torque sensor must have read and understood this user manual, paying extra close attention to all safety-related information. The EDR Torque sensor is a high-precision product integrating the most recent measurement techniques. The sensor can give rise to residual dangers if used and manipulated in a non-compliant way by unqualified personnel. This sensor must be handled by qualified personnel according to the technical requirements and the above-mentioned safety instructions. This is also true when using torque sensor accessories.

NOTICE

1. Periodically check all connections and attachments.
2. Always wear protective glasses when working close to rotating elements.
3. Never wear a necktie or baggy clothes when standing close to rotating elements.
4. Never stand too close or bend over the rotating drive chain.

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INTRODUCTION

Genaral Information

The Wireless Dynamic Torque Sensor is a shaft-mounted, flex-PCB-based measurement system that enables real-time monitoring of torque on rotating components. The system integrates precision strain gauges and onboard signal processing electronics into a flexible PCB, which is mounted directly on the rotating shaft.
The entire assembly is powered wirelessly via an inductive coil, removing the need for slip rings or wired power. Data is transmitted using BLE (Bluetooth Low Energy) to a host device for analysis or logging.
The electronics are encapsulated within a conformal coating for basic environmental protection. Flexibility in the PCB allows it to withstand dynamic bending during rotation, while ensuring signal integrity from the strain gauges.

PACKAGE CONTENTS

- Torque sensor assembly with mounted shaft and flex PCB
- Wireless power transmitter module
- Receiver module or PC interface
- USB cable (for receiver)
- Mounting accessories (optional)
- Quick Start Guide

Main Functions

The Wireless Torque Sensor performs the following functions:

1. Measurement of dynamic torque on a rotating shaft using bonded strain gauges.
2. Wireless power reception through inductive coupling, eliminating mechanical contact.
3. Wireless data transmission via BLE for real-time monitoring.
4. Temperature-compensated signal conditioning for reliable output across varying operating conditions.

The sensor's embedded electronics filter and amplify the signal from the strain gauges. The flex PCB design ensures minimal inertia contribution and seamless integration with rotating components.

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DATASHEET

Features

- Integrated torque conditioning
- Torque Range: from 0.5 N·m to 1 N·m
- Accuracy: < 1 %
- Overload Capacity: 500 %
- Breaking Limit: > 1000 %
- Low Speed Applications: up to 500 rpm
- Non-Contact (no sliprings)
- High Electrical Noise Immunity
- Aluminum Shaft
- EMI Susceptibility Conforms to European Standards

Description

The Wireless Dynamic Torque Sensor offers highly accurate real-time torque measurement for rotating shafts in dynamic applications. Designed with embedded strain gauges and onboard electronics, the sensor delivers precision measurements with wireless data transmission and wireless power reception—eliminating the need for physical connections such as slip rings.

The sensor integrates a signal conditioning circuit and BLE communication module on a compact, flexible PCB that is mounted directly on the shaft. This flex PCB design ensures minimal inertia, high mechanical compatibility, and robust signal integrity under rotational stress. Power is supplied via inductive coupling using a stationary transmitter and a coil integrated into the sensor's flex PCB.

The system provides a digital BLE output for torque data, enabling seamless integration with host systems for real-time monitoring and logging. The embedded electronics also include temperature compensation to ensure consistent performance across varying operating conditions.

To accommodate diverse application needs and budget constraints, the design emphasizes cost-effective components while maintaining performance. Each sensor assembly consists of a strain-gauge-instrumented shaft, a conformally coated flexible PCB with surface-mount components, and an inductive power interface. The system is well-suited for low-to-medium torque ranges and can be customized for various shaft diameters and use cases.

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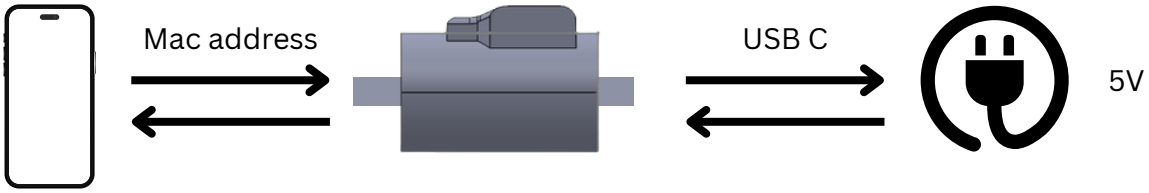
Applications

Applications of the Wireless Dynamic Torque Sensor

1. Rotating Machinery Monitoring
   - Real-time torque measurement in motors, turbines, pumps, and generators.
   - Detects performance degradation and mechanical faults.
2. Automotive Testing
   - Evaluation of drivetrain components (shafts, gearboxes, axles) under dynamic load.
   - Useful in electric vehicles (EVs) for monitoring motor output torque.
3. Robotics and Industrial Automation
   - Precise torque feedback in robotic joints or actuators for improved control and safety.
   - Monitoring of torque in automated assembly tools and torque-controlled machinery.

System Configuration



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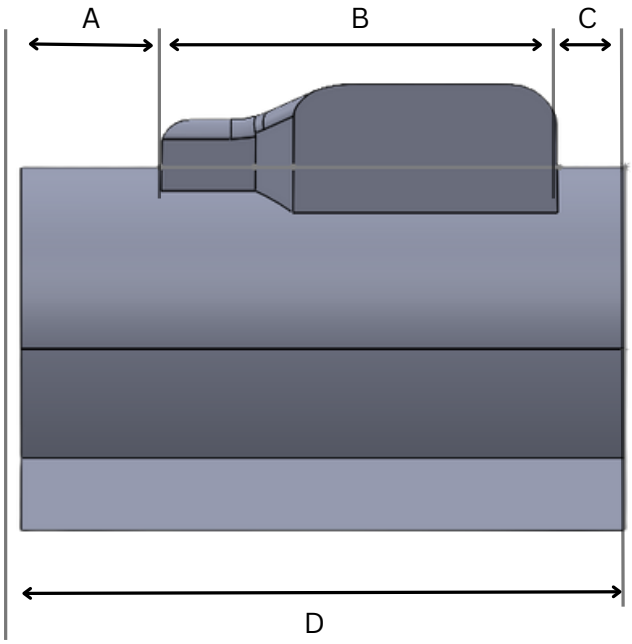
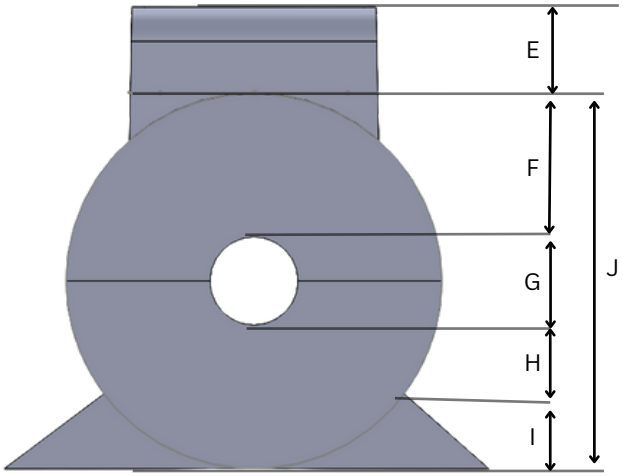
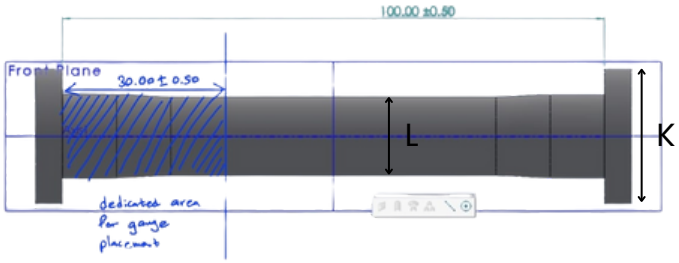
Enclosure Dimensions







	A	B	C	D	E	F	G	H	I	J	K	L
mm	30	70	30	130	80	25	25	15	15	75	25	14.6

SYSTEM OPTIONS AND ACCESSORIES

COUPLINGS

For optimal performance and longevity of the wireless torque sensor system, the use of precision couplings is recommended when integrating the sensor into a drive train. Since the sensor is primarily intended for low-speed applications, single-element couplings are generally sufficient. However, double-element couplings may also be used to further minimize any potential misalignment effects.
When selecting a suitable coupling for the torque sensor, the following criteria should be considered:

- High torsional spring rate for improved stiffness and torque transmission accuracy
- Strong and self-centering clamping mechanism to ensure reliable fixation and minimize slippage
- Speed compatibility with the intended operational range
- Good dynamic balancing to reduce vibrations and errors, especially in rotating setups
- Axial and angular misalignment tolerance to accommodate real-world mechanical deviations

Careful selection and installation of the coupling are essential to ensure accurate torque measurement, minimize mechanical stress on the sensor, and prevent premature wear or misalignment issues. The sensor's base-mounted design supports stable alignment, further simplifying coupling integration in most applications.

Brass Bearings

High-precision brass bearings are used at both ends of the torque sensor to interface with the coupling mechanisms. These bearings ensure low-friction rotation and are particularly suitable for measuring torque from small-diameter shafts. Their durable construction supports consistent alignment and minimizes measurement errors caused by mechanical play or vibration.

INSTALLATION / CONFIGURATION

Power Supply Configuration

The torque sensor operates on a stable 5V DC input supplied through a USB-C connection, making it highly convenient and portable. It can be powered using common sources such as a USB-C phone charger, a laptop USB-C port, or a standard power bank. The device requires at least 500 mA of current to function reliably. For best performance, ensure the power source delivers clean and consistent voltage. Avoid using fast chargers or USB Power Delivery (PD) adapters that exceed 5V, as this may damage the sensor or cause inaccurate readings.

Important Notes:

- ✅ Input Voltage: 5V DC only
- ✅ Minimum Current: 500 mA
- ✅ Connector: USB-C
- ⚠️ Do NOT use USB-PD or fast chargers with voltages above 5V

Mounting Possibilities

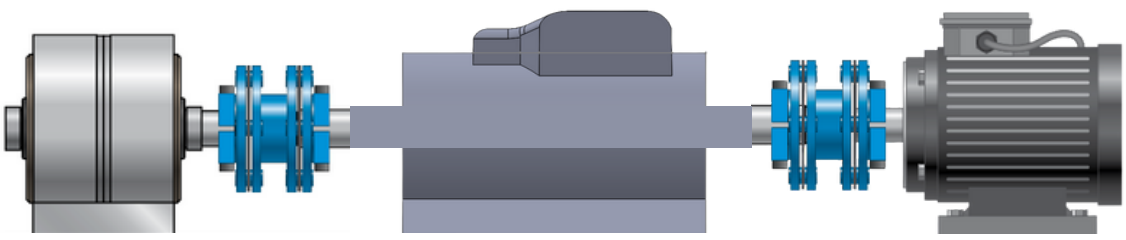
The wireless torque sensor is designed as a precision measuring instrument and should not be treated as a torque-transmitting mechanical component. Proper installation is crucial to maintain measurement accuracy and ensure long-term reliability of the internal components, especially the bearings and mounted electronics.

Our sensor supports a supported installation configuration, where the unit is securely mounted on a stable base. This setup minimizes mechanical stress, improves alignment stability, and protects sensitive internal elements from undue vibration or load.

Unlike suspended mounting configurations—which are suitable for limited use in low-speed setups—our supported mounting ensures optimal alignment and mechanical rigidity, which are essential for precise torque readings and enhanced operational lifespan.

Supported Installation

The measuring shaft is supported by the torque sensor housing, which itself is fixed to the test bench frame by means of a support unit. Here, couplings with two degrees of freedom must be used in or der to avoid hyperstatic mountings.



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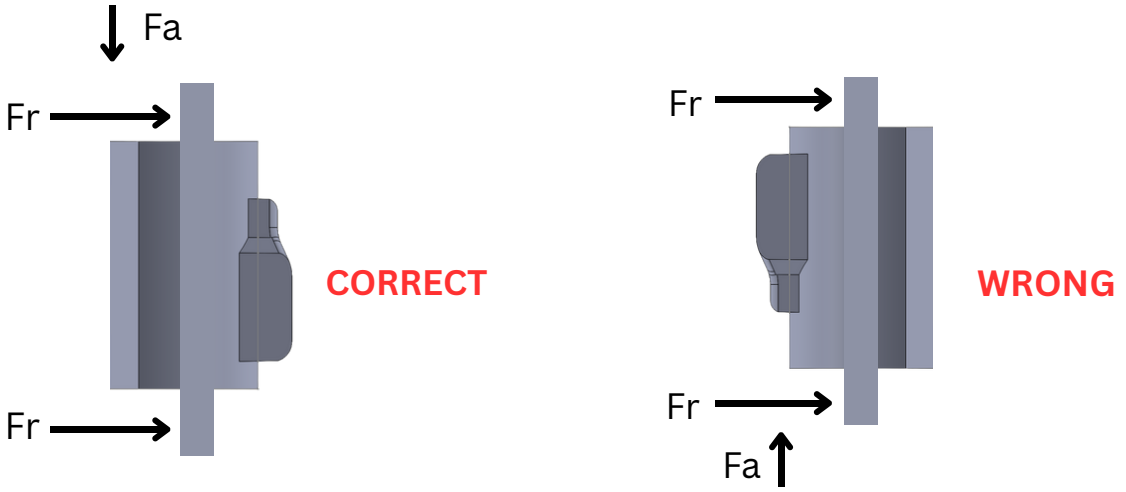
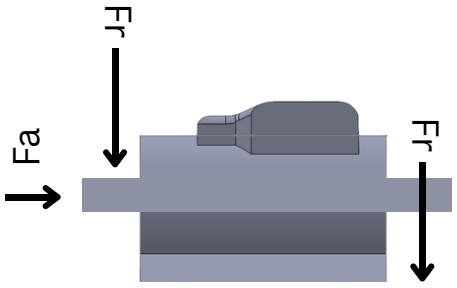
Vertical Installation



PARASITIC FORCES

Incorrectly mounted torque transducers can generate parasitic forces on the measuring shaft in radial (FR) and axial direction (FA)



Radial forces generate a bending momentum in the measuring shaft resulting in displace ment of its center of gravity. This disequilibrium will load the shaft periodically with a frequency proportion al to the speed of rotation. This effect is particularly noticeable at high speeds.

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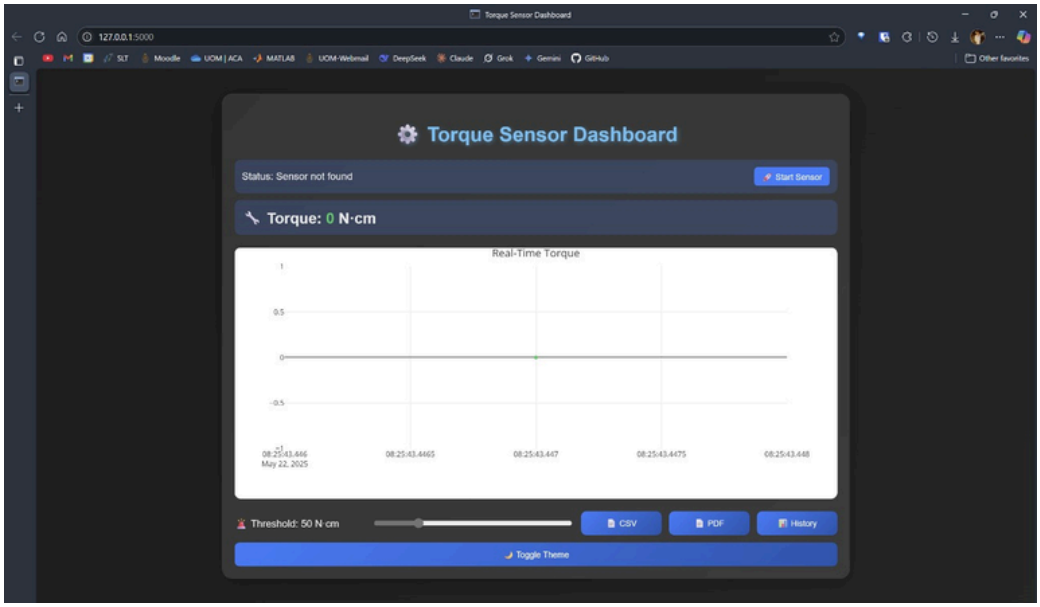
SOFTWARE SPECIFICATIONS

The torque sensor is paired with a custom-designed software application that enhances usability and enables real-time monitoring and data analysis. Key features of the software include:

- Automatic Bluetooth Connection:
- The software is configured to detect and connect to the torque sensor automatically using its unique Bluetooth MAC address. Users can scan for nearby devices, view available MAC addresses, and select the appropriate sensor for connection.
- Customizable Interface:
- The application provides a theme customization option, allowing users to switch between different visual modes for a more personalized experience.
- Real-Time Torque Visualization:
- A live plotting feature displays torque values in real time, providing immediate feedback for dynamic measurements.
- Data Export and Reporting:
- Users can export measured torque data in CSV or PDF formats for further analysis or record-keeping. This functionality supports both on-demand exports and automated session-based exports.
- History and Playback:
- The application maintains a history log of previous measurements, allowing users to revisit and analyze past data sessions.

This software is designed with simplicity, functionality, and performance in mind, enabling seamless integration with the wireless torque sensor and ensuring an efficient user experience.



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Repairs

Fault	Possible Causes	Solution
Shaft stiff to turn	Bearing failure due to: a) Torsional or flexural vibration b) High axial or radial loads c) Worn bearings d) Bent shaft	Return to factory
Zero shift less than 2%	Torsional vibration Torsional Shock	The zero reading may be re-adjusted at display
Zero shift between approx. 2 and 5% of full scale	Torque sensor has been overloaded Torsional vibration Torsional shock	The zero reading may be re-adjusted at the display
Zero shift more than 5%	Torque sensor overloaded by high alternating loads or torsional vibration	Return to factory
Hysteresis between clockwise and counter-clockwise torque	Torque sensor overloaded by high alternating loads or torsional vibration	Return to factory

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