TS SERIES
IN-LINE TORQUE SENSORS

FEATURES

- Integrated torque, speed and angle conditioning
- Torque Range: from 0.05 N·m to 10 N·m
- Integrated speed encoder with index
- Accuracy: < 0.1 %
- Overload Capacity: 200 %
- Overload Limit: 400 %
- Speed range: up to 15,000 rpm
- Torque Output: ±5 VDC (±10 VDC)
- USB interface & Analog Connection
- LED Operating Status Control
- Non-Contact (no sliprings)
- Single DC Power Supply: 12 - 32 VDC

DESCRIPTION

Magtrol’s In-Line TS Torque Transducers provide extremely accurate torque and speed measurement. Each model has an integrated conditioning electronic module providing a 0 VDC to ±10 VDC torque output through a 8 poles connectors, as well as a USB interface which can be directly connected to a computer. The sensor is delivered with a simple software allowing easy connection and data acquisition. A speed encoder provides 360 pulses per revolution, in Tacho A, Tacho B as well as Index Reference Z (1 per revolution). Magtrol Torque Transducers are very reliable, providing high overload protection, excellent long-term stability and high noise immunity. TS transducer models are strain gauges-based measuring system with imbedded telemetry signal transmission. 3LED’s inserted on the cover allow to any time check the sensor status by a color code (combination of the 3LED’s). The sensor is powered by 24 VDC (12 - 32 VDC) through its 8 poles connector. Tare & BITE (Built-In-Test) can be activated by either software or by a discrete input from the 8P connector. At first, the range covers 50 mN·m to 10 N·m in the same housing dimension. Extension in the upper range is foreseen at short term.

USB & ANALOG OUTPUT

The sensor offers an isolated USB interface in parallel to analog signals. Both signal can be used at the same time, for example for process control loop through computer via USB and in parallel fast data acquisition from the analog outputs; or an analog fast control loop and using USB link to acquire torque speed, angle, etc.

The refresh time of the continuous analog signals is 100 microseconds (10 kHz). The analog signal provides a 0...±5VDC output corresponding to the sensor nominal range, allowing 200% of measuring range (0...±10VDC). USB interface is a plug and play function not requiring any programming. It can easily be connected and used together with a LabVIEW™ based torque software delivered with the sensor.

APPLICATIONS

TS Series Torque Transducers provide dynamic torque and speed measurement of:
- Windshield wipers, electrical windows, starters, generators and brakes in automobile industry
- Pumps - water and oil
- Reduction gears and gearboxes
- Clutches
- Motorized valves & actuators
- Drills, pneumatic tools and other machine tools
- Torque & friction measurement by medical devices and watch industry
**ABSOLUT ENCODER INSIDE**

TS Torque sensors integrate a high-end encoder with 360 impulses on 2 traces (Tacho A, Tacho B) 90° shifted, giving an angle resolution of 0.25°. A third trace offers a 1 per revolution signal (Z), giving an angular reference. The sensor body is marked with “Encoder Side” to determine the encoder position. In low speed applications where the angle position/accuracy of the test object is important, the encoder side needs to be directly connected to the test object, such that the angle measurement is not influenced by the sensor deforming zone.

**OPERATING PRINCIPLES**

The measuring system is based on strain gauges directly applied on the sensor measuring section and connected in Wheatstone full bridge circuit. The strain gauges and its associated frontend amplifier are powered by a high frequency power transfer. Under an applied torque, the measuring section will elastically deform providing a strain in the measuring elements. A microprocessor conditions the signal from the amplifier and transfers the measured values to the stator contactless via telemetry data transfer. On board micro-controllers manage all the internal functions, such as power transfer, data collecting and filtering, calibration and set-up, tare and BITE (Build-In Test) functions, as well as the LED operating status control code. The sensor has to be supplied by a 24 VDC (12 - 32 VDC) from the analog connector. The signal cutoff frequency can be digitally selected and configured in a range from 2 Hz up to 1000 Hz.

**SYSTEM CONFIGURATION**

- External power supply
- USB
- Computer with Torque 7 Software
- TS Series Torque Transducer
- Fig. 2: When TS transducer is only use with USB connection, it must be supplied (12-32 VDC) through its analog connection.

**EASY OVERVIEW DEVICE STATUS**

A color code is given by the activation of 3 LED’s (Yellow, Green, Red) which are positioned on the top cover of the sensor. This color code constantly informs on the operating status of the sensor, such as measuring status, tare functions, offset value, BITE (Built-In Test), overload.

**ELECTRICAL CONFIGURATION**

- Power Supply (12 - 32 VDC)
- BITE / TARE
- Torque signal ±5 (±10) VDC
- Tacho A
- Tacho B
- Index
- Fig. 4: TS electrical input and output

**SUPPORTED & SUSPENDED INSTALLATIONS**

The device can be used in both supported and suspended versions. If possible, we advise you to use it as a supported version because it is the most suitable for the majority of situations (mandatory for high speed test).

The TS Series can also be installed without the base mount in a suspended configuration. This configuration is only allowed for low speed measurement. The benefit of this configuration is the use of a single element coupling, creating a shorter drive train.

- Computer with Torque 7 Software
- Programmable Controller
- External power supply
- & Signal
- Analog
- USB
- TS Series Torque Transducer
- POWER SUPPLY & SIGNAL
- ANALOG
- USB
- DSP 7000
- Programmable Controller
- Model 3411
- Torque Display
- DATA
- Fig. 3: In this situation the supply of the transducer is provided by the Model 3411 or the DSP 7000

- Model 3411
- Torque Display
- POWER SUPPLY & SIGNAL
- Fig. 5: Supported installation
- Mandatory for standard and high speed applications

- Model 3411
- Torque Display
- POWER SUPPLY & SIGNAL
- USB
- TS Series Torque Transducer
- Fig. 6: Suspended installation for low speed application only. Use single element coupling to create a shorter drive train.
### SPECIFICATIONS

#### MAIN FEATURES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>NOMINAL RATED TORQUE (RT)</th>
<th>DIAMETER AXE</th>
<th>MAX SPEED</th>
<th>TORSIONAL STIFFNESS</th>
<th>ANGULAR DEFORMATION</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N·m</td>
<td>mm</td>
<td>min⁻¹</td>
<td>N·m / rad</td>
<td>Degree</td>
<td>Kg</td>
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<td>TS 106</td>
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<td>10</td>
<td>9</td>
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<td>3'616</td>
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<td>9'617</td>
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<td>32</td>
<td>6'000</td>
<td>38'800</td>
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<td>TS 113</td>
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<td>62'845</td>
<td>0.456</td>
<td>1.7</td>
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</table>

#### TORQUE MEASUREMENT

- Rated torque: 0 to 100 % of RT
- Maximum Dynamic Torque Peak Value: 0 to 200 % of RT
- Resolution: 11'000 points
- Sampling Frequency: 16 bit at 10K sample / sec
- Maximum Dynamic Torque Without Damage: Up to 400 % of RT in the < 2 N·m range, 300 % RT in the > 2 N·m range
- Combined Error of Linearity and Hysteresis: < 0.1 % c)
- Noise: 2 ppm of RT / √ Hz . Typ b,c)
- Speed Influence on Zero Torque: < 0.015 % / 1000 rpm c)
- Power Supply Change Sensitivity: < 50 (ppm of RT / V) c)

#### SPEED & ANGLE MEASUREMENT

- Speed & Angle Measurement: Based on a 360 impulses, 2 traces, 90° phase shift + Index Optical encoder
  - Computed Speed accuracy (USB Output): < ±0.05% d)
  - Angle Resolution (USB): 0.25°
  - Absolute Accuracy: ± 0.25° Typ over 360°.
  - Thermal drift: unmeasurable

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a) These models are currently under development
b) Corresponds to < 0.05 % RT Peak to Peak over the whole 1kHz Bandwith
c) For TS 100 (50 mN·m) this parameter is degraded by a factor 2.
   Applicable to both Analog and USB output
d) Constant speed and based on the last 360 pulses

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**SPECIFICATIONS**

### ENVIRONMENT & MECHANICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>-40 °C to +85 °C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>+10 °C to +70 °C (-25 °C to +85 °C)*)</td>
</tr>
<tr>
<td>Temperature Influence on Zero / Sensitivity</td>
<td>&lt; ±0.1 % / 10 K in the 10 °C to 60 °C (Normal Temperature range) (c)</td>
</tr>
<tr>
<td></td>
<td>&lt; ±0.2 % / 10 K in the -25 °C to 80 °C (Extended Temperature range) (c)</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>IEC60068-2-27:2008 / Class B3</td>
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<tr>
<td>Vibration Sinusoidal</td>
<td>IEC60068-2-6:2007 / Class B3</td>
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<tr>
<td>Broadband random Vibration</td>
<td>IEC60068-2-35:2007 / Class B3</td>
</tr>
<tr>
<td>Protection Class</td>
<td>IP44 (DINEN60529)</td>
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<tr>
<td>EMC / EMI Compatibility</td>
<td>IEC61326-1 / IEC61321-2-3</td>
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<tr>
<td>Balancing Quality</td>
<td>G2.5 according to ISO 1940</td>
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<tr>
<td>Safety Standard</td>
<td>ISO 13849 / EN62061</td>
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<tr>
<td>Low voltage</td>
<td>IEC 61010-1</td>
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### ELECTRICAL CHARACTERISTICS & CONNECTION

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply (voltage range / max. power)</td>
<td>12 to 32 VDC / &lt; 2.2 W</td>
</tr>
<tr>
<td>Analog Torque Output (rated / max.)</td>
<td>±5 V / ±10 V; max. Output current: 2 mA</td>
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<tr>
<td>Torque Signal Bandwidth (-3dB)</td>
<td>1'000 Hz / 100 Hz / 50 Hz / 20 Hz/ 10 Hz/ 5 Hz / 2Hz</td>
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<tr>
<td>Settable by USB CONFIG cmd.</td>
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</table>

![Wiring diagram (Analogue)]

**ANALOG INPUT AND OUTPUT SIGNALS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tacho Outputs &amp; Index</td>
<td>2 Traces A + B 5 V TTL / 360 PPR / 100 kHz max frequency + Index 1/Rev; Max Output current : 5 mA</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>BITE (Calibration Control)</td>
<td>BITE Input pin grounded for more than 1 sec allows to get about + 60 % FSD shift at the O/P for 5 sec. (refer to manual to get more)</td>
</tr>
<tr>
<td>TARE</td>
<td>TARE Input pin pulled up to 12 V min / 32 V max for more than 1 sec allows to Tare the transducer. Depending how long this input is pulled-Up, the TARE is either memorized or not in NVRAM.</td>
</tr>
</tbody>
</table>

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*a) Extended temperature range
b) Cable shield connected to GND at user side
c) For TS 100 (50 mN·m) this paramter is degraded by a factor 2. Applicable to both Analog and USB output*
## TS 100-107 DIMENSIONS

**NOTE:** All dimensions are in metric units.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TORQUE [N·m]</th>
<th>øA g6</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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**NOTE:** 3D STEP files of most of our products are available on our website: www.magtrol.com; other files are available on request.
## TS 109-113 DIMENSIONS

**NOTE:** All dimensions are in metric units.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TORQUE [N·m]</th>
<th>øA</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<td>20</td>
<td>18 g6</td>
<td>27</td>
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<td>95</td>
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<th>M</th>
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<td>8 H9</td>
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<td>45(ø6 H9)</td>
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<td>TS 112 a)</td>
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</tbody>
</table>

a) **Notice:** These models are currently under development (subject to change)

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SYSTEM OPTIONS AND ACCESSORIES

COUPLINGS
When Magtrol TS Series Torque Transducers are to be mounted in a drive train, double-element miniature couplings are the ideal complement, although single-element couplings can be used for low speed applications. The criteria for selecting appropriate couplings for torque measurement is as follows:

▪ High torsional spring rate: Ensures a high torsional stiffness and angular precision
▪ Clamping quality (should be self-centering and of adequate strength)
▪ Speed range
▪ Balancing quality (according to speed range)
▪ Alignment capability

The higher the speed of the application, the more care is required in selecting the coupling and assembling (alignment and balancing) the drive train configuration. Magtrol provides a wide range of couplings suitable for torque measurement applications and can assist you in choosing the right coupling for your transducer.

TORQUE TRANSDUCER DISPLAYS
Magtrol offers the Model 3411 Torque Display which supplies the power to any TM/TMHS/TMB Transducer and displays torque, speed and mechanical power. Features include:

▪ Adjustable English, metric and SI torque units
▪ Large, easy-to-read vacuum fluorescent display
▪ Built-in self-diagnostic tests (BITE)
▪ Overload indication
▪ Tare function
▪ USB & Ethernet interface
▪ Torque and speed outputs
▪ Closed-box calibration
▪ Includes Magtrol's Torque 7 Software

TORQUE SPEED BOX
Magtrol's TSB Torque Speed Box allows data acquisition from two torque transducers simultaneously and provides the torque’s analog signal output and speed’s TTL signal output.

HIGH-SPEED PROGRAMMABLE CONTROLLER
Magtrol’s Model DSP 7000 High-Speed Programmable Dynamometer Controller employs state-of-the-art Digital Signal Processing Technology to provide superior motor testing capabilities. Designed for use with any Magtrol Hysteresis, Eddy-Current or Powder Brake Dynamometer, Magtrol In-Line Torque Transducer or auxiliary instrumentation, the DSP 7000 can provide complete PC control via IEEE-488 or USB interface. Standard Features:

▪ DSP 7001 Single Channel: Easy to use plug & play solution
▪ DSP 7002 Dual Channel: Enables the support of two testing instruments with independent or tandem configurations and two fully independent control loops
▪ Built-in Alarm System
▪ Speed & Torque Operating Modes
▪ Programmable Digital PID Values
▪ Built-in Current-Regulated Supply
▪ Adjustable Torque Units.

«TORQUE 7» SOFTWARE
Magtrol’s Torque 7 Software is an easy-to-use LabVIEW™ executable program, used to automatically collect torque, speed and mechanical power data. The data can be printed, displayed graphically or quickly saved as a Microsoft® Excel spreadsheet. Standard features of Torque 7 include: peak torque capture, multi-axes graphing, measured parameter vs. time, adjustable sampling rates and polynomial curve fitting.
SYSTEM OPTIONS AND ACCESSORIES

CABLE ASSEMBLIES (ANALOG & POWER SUPPLY / USB)

Each TS Series Torque transducer is delivered with a 3 meter cable for supply and analog signal (M12 straight connector and Pigtail wires) as well as a 2 meter USB cable (M12 mini-B / 2.0 USB-A).

Other lengths and cable configurations (e.g. with a 14 Pins connectors for use with 3411 Torque display or DSP 7000 Controller) are available on request.

ORDERING INFORMATION

Example: TS 109 In-line Torque Transducer would be ordered as : TS 109/XXX.