



TS SERIES IN-LINE TORQUE SENSORS

QUICK START GUIDE

1. INTRODUCTION

The TS Series In-Line Torque Sensor is a generation of high-precision torque sensors with integrated electronic processing circuitry, developed by Magtrol.

This sensor uses a non-contact measurement technology, integrates a conditioning electronic module providing a 0 to ± 10 VDC torque output and 3 TTL signals (Tach A, Tach B and Index), for speed and angle measurement.

2. WARNINGS & CAUTIONS

WARNING INDICATES A HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

- Make sure that all rotating parts are equipped with appropriate safety guards.
- Always wear protective glasses when working close to rotating elements.
- Never wear a necktie or baggy clothes when standing close to rotating elements.
- Never stand too close or bend over the rotating drive chain.

CAUTION INDICATES A HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN MINOR OR MODERATE INJURY.

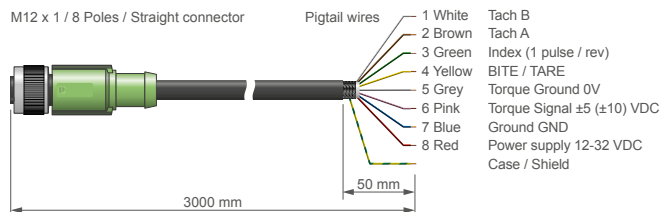
- Periodically check all connections and attachments.
- Make sure that all Magtrol electronic products are earth-grounded, to guarantee personal safety and proper operation.
- Check the power supply voltage from 12 to 32 VDC (24 VDC recommended) before operating the torque sensor.

3. DESCRIPTION & CONNECTIVITY

3.1 PARTS DESIGNATION



3.2 ATTACHED ANALOG CABLE

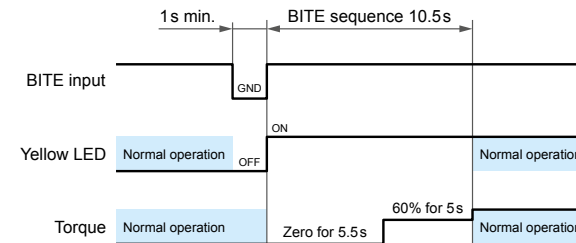


CAUTION CABLE SHIELD MUST BE CONNECTED TO GND AT USER'S SIDE.

4. B.I.T.E. SEQUENCE DESCRIPTION

The B.I.T.E. (Built-In Test Equipment) takes place at either «System Power Up» **OR** B.I.T.E. 8-pole (external line when pulled low for at least 1s) **OR** B.I.T.E. USB.

Its sequence is as follow:



The stator will turn ON power to the rotor. The first 5.5s of information will be used for rotor voltage measurement. Note during this time, the «analog output» and USB are set to zero.

After 5.5s, the signal from the rotor is available to the analog output and USB.

The B.I.T.E. signal is available on both the analog voltage output and USB in N·m. The B.I.T.E. level is about 60% of rated torque (RT). It is in addition to the torque applied to the sensor. One B.I.T.E. sequence is usually performed when no torque is applied.

5. TARE SEQUENCE DESCRIPTION

5.1 TARE - STATUS DESCRIPTION

TARE (external line) is pulled up to +24V line

1. *Activate and hold* TARE < 1.0s then ignore
2. *Activate and hold* TARE > 1.0s - 3.0s then the value is stored in RAM memory which will be reset to factory offset the next time the power is turned on
3. *Activate and hold* TARE > 3.0s - 6.0s then the value is stored in the NVM (Non-volatile Memory), then it will be saved when the power is turned off
4. *Activate and hold* TARE > 6.0s then the value in NVM is **RESET**

5.2 TARE - DESCRIPTION OF LED BEHAVIOR

When TARE is pressed, all three LEDs turn OFF.

- After 1s, **YELLOW** turns ON.
- After 4s, **YELLOW** and **GREEN** turn ON.
- After 6s, **YELLOW**, **GREEN** and **RED** turn ON.

6. USB FEATURES & COMMUNICATION

6.1 HARDWARE & SOFTWARE

A galvanic isolated USB interface is implemented. The maximum «common mode voltage» allowed between the sensor case and the computer GND is 33V.

TS Series Torque Sensor is delivered with software allowing communication between the sensor and a computer running Windows™ OS.

6.2 POWER SUPPLY

! The device is not powered by the USB. The sensor has to be powered through the 8-pole connector.

6.3 COMMAND SET

A set of commands are used for Configuration, Communication and System Function purposes. For instance:

- **Configuration commands** allow selection of: the FILTER cutoff frequency (2/5/10/20/50/100/1000Hz), the output power unit (hp, W, kW), the SPEED measurement algorithm (ΔT ; Gated; Index)
- **Communication commands** allow selection of measured values: TORQUE, SPEED, ANGLE, POWER
- **System function commands** allow activation of a sensor function: TARE, SAVE TARE, RESET TARE, B.I.T.E.

Refer to the User Manual to get the complete "command set" list.

7. TECHNICAL SPECIFICATIONS

TORQUE MEASUREMENT

Rated torque (RT)	0.05/0.1/0.2/1/2/5/10/20/50/100/200/500 N·m
Max. Dynamic Torque Peak Value	200 % of RT
Max. Static Torque Without Damage	300 % of RT
Resolution at RT	11 000 points
Sampling Frequency	16 bits at 10 000 sample/s
Combined Error of Linearity and Hysteresis	< 0.1 % ^{b)}
Noise Spectral Density	2 ppm of RT / $\sqrt{\text{Hz}}$. Typ ^{a,b)}
Speed Influence on Zero Torque	< 0.015 % / 1 000 rpm ^{c)}
Power Supply Change Sensitivity ^{d)}	< 50 (ppm of RT / V)

USB SPEED & ANGLE MEASUREMENT

Speed & Angle Measurement	<p>Tach A + B, 360 PPR, 100kHz max. frequency, Index 1 PPR^{e)}</p> <p>TTL, max. output current 5 mA</p>
	<p>Computed Speed accuracy (USB Output)</p> <p>< $\pm 0.05\%$^{f)}</p>
Angle Resolution (USB)	0.25°
Absolute Accuracy	$\pm 0.25^\circ$ over 360°
Thermal drift	< 50 ppm over temperature range

ELECTRICAL CHARACTERISTICS & CONNECTION

Power Supply (voltage range / max. power)	12 to 32VDC / < 2.2 W (24 VDC recommended)
Analog Torque Output (rated / max.)	$\pm 5\text{ V} / \pm 10\text{ V}$ (max. output current 2 mA)
Torque Signal Bandwidth (-3 dB) controlled by USB command.	2/5/10/20/50/100/1 000 Hz (50 Hz by default)

ENVIRONMENT & CERTIFICATIONS

Storage Temperature	-40 °C to +85 °C
Operating Temperature	-25 °C to +80 °C
Temperature Influence on Zero / Sensitivity	< $\pm 0.1\%$ / 10 °C for the range -25 °C to +80 °C ^{b)}
Mechanical Shock	IEC 60068-2-27:2008 / Class C3
Vibration Sinusoidal	IEC 60068-2-6:2007 / Class C3
Protection Class	IP44 (DIN EN 60529)
EMC / EMI Compatibility	IEC 61326-1 / IEC 61321-2-3
Balancing Quality	G2.5 according to ISO 1940

- a) Corresponds to 0.05% of RT peak to peak over the entire 1 kHz bandwidth
 b) For TS 100 (0.05 N·m) this parameter is degraded by a factor of 2. Applicable to both Analog and USB output
 c) For TS 100 (0.05 Nm) and TS 101 (0.1 Nm) this parameter is degraded by a factor of 2
 d) Torque Output change due to power supply change
 e) PPR means Pulse Per Revolution
 f) Constant speed and based on the last 360 pulses

8. INSTALLATION

Magtrol's TS Series In-Line Torque Sensors should be considered primarily as precision measuring instruments and not as torque transmission components. The model of the sensor and the accuracy of its drive train alignment strongly influence the measurement accuracy and lifetime of the sensor, especially of the bearings.



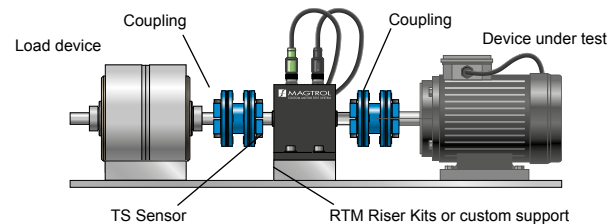
WARNING

IT IS CRITICAL TO USE A COUPLING DESIGNED FOR YOUR ASSEMBLY (e.g. FLEXIBLE COUPLINGS). NEVER MAKE A RIGID ASSEMBLY!

Magtrol provides a wide range of couplings suitable for torque measurement applications and can assist you in choosing the right coupling for your transducer. Please contact our technical service.

There are two main ways to mount the TS torque sensor: supported or suspended (for low speed applications only).

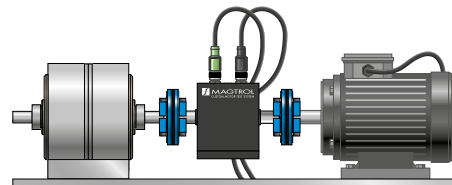
8.1 SUPPORTED INSTALLATION



SUPPORTED INSTALLATION mandatory for standard and high speed applications

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. Couplings with two degrees of freedom must be used in order to avoid hyperstatic mountings.

8.2 SUSPENDED INSTALLATION



SUSPENDED INSTALLATION for low speed applications only

Both the measuring shaft and torque transducer housing are supported by the drive and measuring unit shafts via couplings. In this configuration, couplings that offer only one degree of freedom are adequate to avoid a hyperstatic mounting.

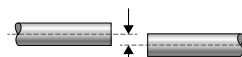


CAUTION

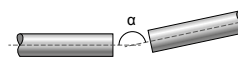
TS100-102 CANNOT BE USED IN SUSPENDED INSTALLATION AS THE WEIGHT OF THE SENSOR WILL DEGRADE THE ACCURACY OF THE MEASUREMENTS DUE TO RADIAL FORCES.

8.3 INSTALLATION PRECAUTIONS

ALIGNMENT: Be careful to install with an accuracy equal to or less than the following permissible installation errors.



Off-centering : 0.03 mm or less



Angular : max. 0.2° or less (or 1/10 of the value recommended by the coupling manufacturer)



Eccentricity : 0.03 mm or less

STARTING & STOPPING CONDITIONS: Ensure that the torque applied to the sensor never exceeds the product specifications when the system is started and/or stopped.

9. LED OVERVIEW OF DEVICE STATUS

A color code is given by the activation of 3 LED lights (Yellow, Green, Red) located on the top of the sensor. This color code continuously communicates the operating status of the sensor, such as measuring status, tare functions, offset value, B.I.T.E. (Built-In Test Equipment) and overload.

RED LED	
Flashing SLOW	Torque reading is above 100%
Flashing FAST	Torque reading is above 150%
Solid	Sensor failure; return to factory for repair
YELLOW LED	
Flashing FAST	TARE is in NVM
Flashing SLOW	TARE is in RAM
Solid	B.I.T.E. is active
GREEN LED	
Flashing SLOW	Torque reading is below 10%
Solid	Torque reading is above 10%

10. MAINTENANCE

Magtrol TS Series In-Line Torque Sensors are virtually maintenance-free. This is mainly due to the quality of its components and its design (non-contact signal transmission).

However, it may be necessary to change the bearings after extended use. The theoretical lifetime of the bearings is **5 000 hours** and Magtrol recommends replacing the bearings after this time.

The user must not attempt to change or repair the bearings or any other components himself. For all maintenance or repair operations, please return the sensor to Magtrol. Failure to comply may result in serious damage to the transducer or may invalidate the warranty.

11. CALIBRATION

To ensure correct operation of the sensor and long-term measurement consistency, it is recommended to calibrate the sensor regularly. Magtrol recommends a factory calibration (e.g. in Magtrol's ISO 17025 accredited laboratory) **every 12 months**.

Returning the sensor directly to the Magtrol factory is both advantageous and economical. We can guarantee a dedicated calibration for the sensor performed by one of our best specialists. In addition, any wear and tear requiring maintenance will be immediately taken care of by our after-sales service team.

12. PACKAGING

The sensor is delivered with packaging designed to store the sensor while not in use as well as to return the sensor to Magtrol for annual calibration. Please, keep the packaging!

For further information, please read the product datasheet or the user manual. Both are available to download on our website www.magtrol.com

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