MAGTROL

# TF SERIES
## TORQUE FLANGE SENSORS

# USER MANUAL

www.magtrol.com

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## PURCHASE RECORD

Please record all model numbers and serial numbers of your Magtrol equipment, along with the general purchase information. The model number and serial number can be found on either a silver identification plate or white label affixed to each unit. Refer to these numbers whenever you communicate with a Magtrol representative about this equipment.

Model Number : _____

Serial Number : _____

Purchase Date : _____

Purchased From : _____

3rd English Edition | Revision A | December 2021

# SAFETY PRECAUTIONS

**WARNING**

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

**CAUTION**

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

1. Make sure that all Magtrol electronic products are earth-grounded, to guarantee personal safety and proper operation.
2. Check line voltage before operating electronic equipment.
3. Make sure that all rotating parts are equipped with appropriate safety guards.

***NOTICE***

Detailed information regarding the safety guards or protective systems can be found *see section 2.7 - Protective Systems*.

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

## QUALIFIED PERSONNEL

Persons in charge of installing and operating the TF Series Torque Flange Sensor must have read and understood this user manual, paying extra close attention to all safety-related information.

The TF Series Torque Flange 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.

## RESIDUAL HAZARDS

Sensor performance is only one element in torque measurement. Safety is of equal importance. There are possible residual hazards when operating rotating test equipment and it is the responsibility of the designer, the manufacturer and the user to minimize these hazards.

In addition to general safety precautions, residual hazards are highlighted in this user manual by using safety symbols and sections (*see section - Conventions used in this manual*).

## PROPER USE

The use of TF Series Torque Flange Sensors is exclusively restricted to torque and rotational speed measuring tasks and directly-related control and regulating tasks. Any further use shall be deemed to be improper.

For safe operation, the TF Sensor and its accessories may only be used according to the data and specifications given in this User's Manual. Safe operation can be guaranteed only when the sensor is correctly transported, stored, installed, mounted and used.

## MODIFICATIONS

The TF Series Torque Flange Sensor and its accessories may not be modified without the express consent of Magtrol. Magtrol is not be liable for any consequential damages resulting from unauthorized modifications.

# TABLE OF CONTENT

# PREFACE

## PURPOSE OF THIS MANUAL

This manual contains all the information required for the setup, connection and general use of Magtrol's TF Series Torque Flange Sensor. To achieve maximum capability and ensure proper use, please read this manual in its entirety before operating the unit. Keep the manual in a safe place for quick reference whenever a question should arise.

## WHO SHOULD USE THIS MANUAL

This is written for operators installing a torque transducer as part of a test system that meausres the torque on transmission chains. The operator is assumed to have the necessary technical knowledge in electronics and mechanical engineering enabling him to install the TF Series Torque Flange Sensor without risk.

## MANUAL ORGANIZATION

This section gives an overview of the structure of the manual and the information contained within it. Some information has been deliberately repeated in different sections of the document to minimize cross-referencing and to facilitate understanding through reiteration.

The structure of the manual is as follows:

Chapter 1: INTRODUCTION – Contains the technical data sheets for Magtrol's TF Series Torque Flange Sensor, which describe the units and provide detailed technical characteristics.

Chapter 2: INSTALLATION / CONFIGURATION – Provides information needed for the setup and connection of the TF Torque Flange Sensor in a test system, and their integration with Magtrol electronic control units.

Chapter 3: STARTUP - Provides instructions to start the system and adjust the zero of the measuring chain.

Chapter 4: MEASURMENT CONSIDERATIONS - Defines and explains the limits of measures.

Chapter 5: OPERATING PRINCIPLES – Provides information on lubrication procedures and provides recommendations for the calibration and checking of the measuring current and voltage.

Chapter 6: TROUBLESHOOTING - provides explanations and procedures to solve some common issues that may be encountered when using the TF sensor

Chapter 7: MAINTENANCE, REPAIR & CALIBRATION – Provides information on maintenance, repair and calibration procedures, should the need arise.

Chapter 8: SERVICES INFORMATION - Information, contacts and addresses relative for repair and/or calibration.

## SEMANTICS

In this manual, different terminologies may be used to speak about the «TF Series Torque Flange Sensor». The primary purpose is to make this user manual useful and easy to read.

Below you will find different terminology used such as: «Torque Flange Sensor», «Torque Sensor», «Sensor», «Torque Flange Transducer», «Transducer» or «Torque Transducer» are synonyms; «TF XXX Series», «TF 3XX Series» or «TF Series» are all abreviations for «TF Series Torque Flange Sensor», etc.

The term «Series» stands for all the products of the series (e.g. TF 3XX Series refers to TF 300 - TF 399).

## CONVENTIONS USED IN THIS MANUAL

The following symbols and type styles may be used in this manual to highlight certain parts of the text:

**NOTICE**

Indicates information considered important but not hazard related.

This is intended to draw the operator's attention to complementary information or advice relating to the subject being treated. It introduces information enabling the correct and optimal function of the product.

**CAUTION**

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

THIS IS ALSO USED TO DRAW THE OPERATOR'S ATTENTION TO INFORMATION, DIRECTIVES, PROCEDURES, ETC. WHICH, IF IGNORED, MAY RESULT IN DAMAGE TO THE MATERIAL BEING USED. THE ASSOCIATED TEXT DESCRIBES THE NECESSARY PRECAUTIONS TO TAKE AND THE CONSEQUENCES THAT MAY ARISE IF THESE PRECAUTIONS ARE IGNORED.

**WARNING**

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

**THIS INTRODUCES DIRECTIVES, PROCEDURES, PRECAUTIONARY MEASURES, ETC. WHICH MUST BE EXECUTED OR FOLLOWED WITH THE UTMOST CARE AND ATTENTION, OTHERWISE THE PERSONAL SAFETY OF THE OPERATOR OR THIRD PARTY MAY BE AT RISK. THE READER MUST ABSOLUTELY TAKE NOTE OF THE ACCOMPANYING TEXT, AND ACT UPON IT, BEFORE PROCEEDING FURTHER.**

**DANGER**

**INDICATES A HAZARDOUS SITUATION THAT, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY. THE SIGNAL WORD «DANGER» IS TO BE LIMITED TO THE MOST EXTREME SITUATIONS.**

**THIS INTRODUCES DIRECTIVES, PROCEDURES, PRECAUTIONARY MEASURES, ETC. WHICH MUST BE EXECUTED OR FOLLOWED WITH THE UTMOST CARE AND ATTENTION, OTHERWISE THE PERSONAL SAFETY OF THE OPERATOR OR THIRD PARTY MAY BE AT RISK. THE READER MUST ABSOLUTELY TAKE NOTE OF THE ACCOMPANYING TEXT, AND ACT UPON IT, BEFORE PROCEEDING FURTHER.**

The safety symbol may subsequently vary depending on the source of the hazard. Below are examples:

Various safety pictograms according to ISO 7010

# 1. INTRODUCTION

## 1.1 GENERAL INFORMATION

The TF Series Torque Flange Sensors represent a generation of high-precision torque sensors developed by Magtrol. In addition to its rotating mechanical part, the TF Series sensor uses non-contact measurement technology. For this purpose, the TF Series sensor is always mounted together with an HF transmitter and a signal conditioning box.

The whole TF Series includes transducers with the following torque ratings: 20 N·m, 50 N·m, 100 N·m, 200 N·m, 500 N·m, 1 000 N·m, 2 000 N·m, 5 000 N·m, 10 000 N·m, 20 000 N·m, 50 000 N·m and 100 000 N·m.

The TF Series Torque Flange Transducers, together with Magtrol's TS Series Torque Sensors and Magtrol's TM Series In-Line Torque Transducers, offer a wide range of torque measurement requirements for the most demanding applications.

## 1.2 SYSTEM COMPONENTS

The whole range of TF Series Torque Measuring Systems are composed by the following four primary components: (1) Measuring Flange with Signal Amplifier, (2) HF Transmitter, (3) Signal Conditioner (here mounted on heatsink) and (4) Coaxial Cable

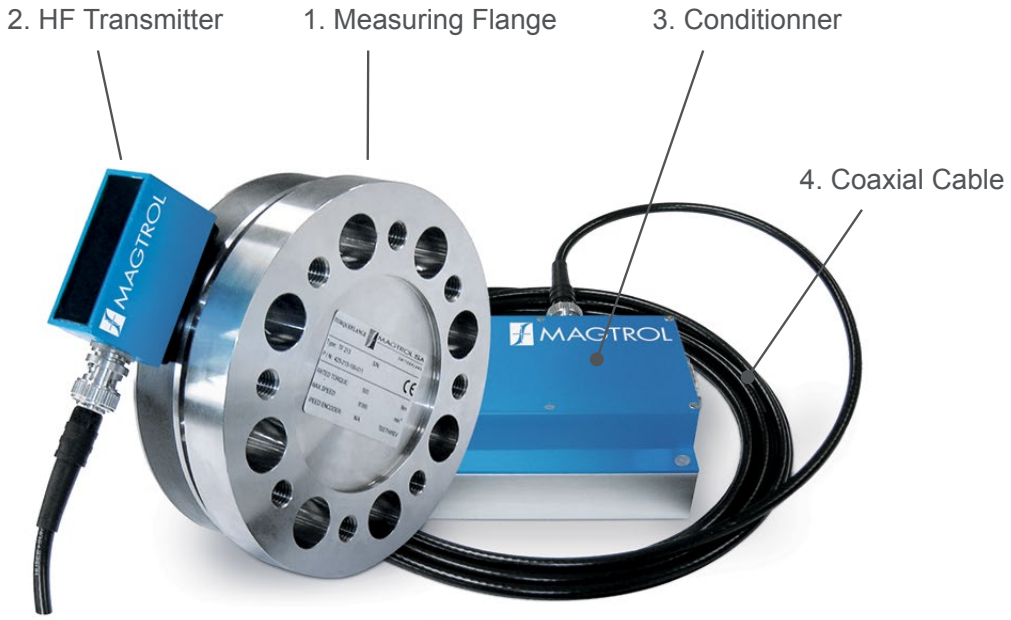



Fig.1-1 Complete Torque Measurement Systems TF Series

**NOTICE** System options often include a speed sensor and its signal conditioner or a torque display MODEL 3411

### 1.2.1 MEASURING FLANGE

The measuring flange represents the rotor part of the torque sensor. It is made of steel and contains 4 strain gauges in full-bridge configuration, an amplifier, a low-pass filter and an A/D converter. It is fitted with an electromagnetic track around its circumference which acts as an antenna for sending telemetric transmissions to the HF transmitter and, ultimately, the conditioner.

### 1.2.2 HF TRANSMITTER

The high-frequency transmitter represents the stator part of the transducer. This transmitter receives the signal from the measuring flange and relays it to the conditioner.

### 1.2.3 SIGNAL CONDITIONER

The torque conditioner supplies power to the measuring flange, via the HF transmitter, and collects the torque signal measured by the system. To display measured values, the conditioner must be connected to a MODEL 3411 Torque Display from Magtrol (*see section 1.2.6 - Signal Processor & Display Unit by Magtrol*) or similar device.

| MODEL | POWER | MOUNTING |
|---|---|---|
| TF 309 - 317 | 1.5 W | Mounted on heatsink for an optimal heat dissipation |
| TF 318 - 320 | 5 W | Mounting as an electronic module |

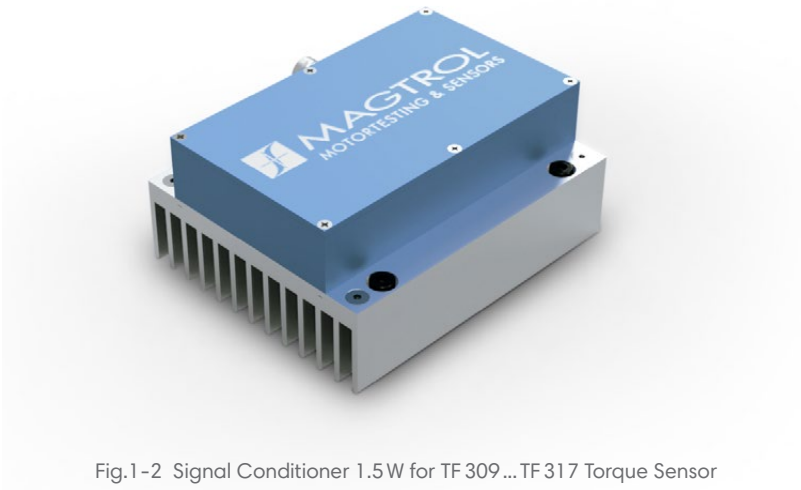



Fig.1-2 Signal Conditioner 1.5 W for TF 309 ... TF 317 Torque Sensor

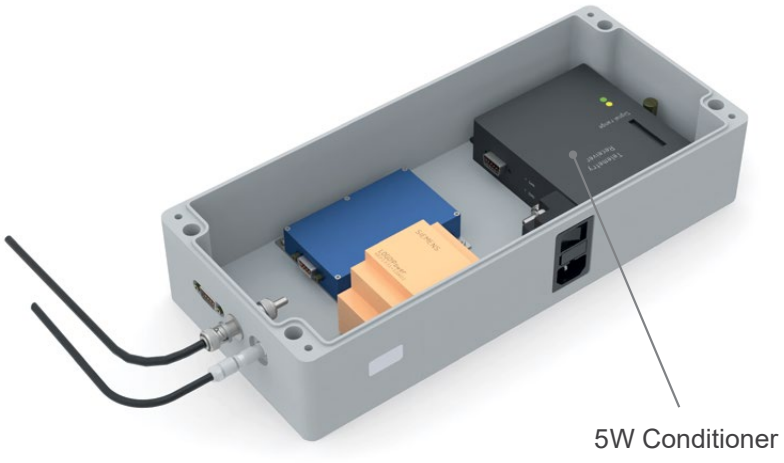



Fig.1-3 Signal Conditioner 5 W for TF 318 ... TF 320 Torque Sensors

### 1.2.4 COAXIAL CABLE

The shielded RG-58 coaxial cable between the HF transmitter and the conditioner has an impedance of 50 Ω and is 4 meters lenght (other lenght, 8 m, 12 m, 16 m and 20 m cables are available as an option).

### 1.2.5 SPEED MEASUREMENT (OPTION)

When ordered with the optional speed measurement capability, the TF Torque Sensor is fitted with a toothed rim with the speed sensor attached to the exterior (*see Fig.1-4*).

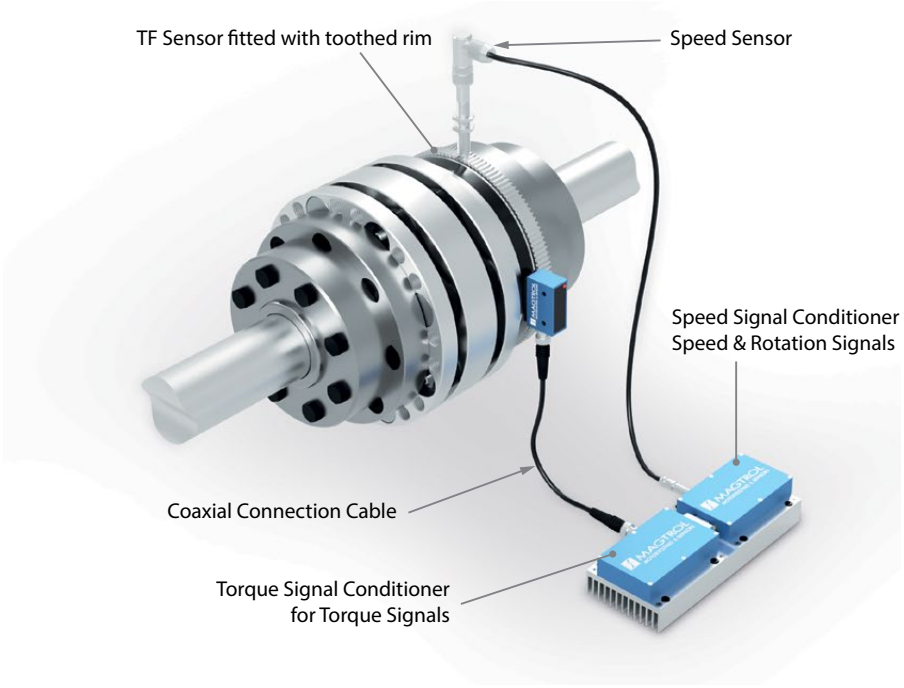



Fig.1-4 Mounted TF Torque Flange Sensor with Conditioner and Speed Measurement Option

### 1.2.6 SIGNAL PROCESSOR & DISPLAY UNIT BY MAGTROL

Available as a system option, Magtrol's MODEL 3411 Torque Display processes the torque and speed signals from the TF Sensor and displays the measured values and calculated power. For additional data processing, the unit has an Ethernet interface for connection to a PC and is delivered with Magtrol's «TORQUE Software».

TORQUE Software is a user-friendly Windows® executable program, developed under LabVIEW™, 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.


Fig.1-5 MODEL 3411 Torque Display

## 1.3 DATASHEET

# TF SERIES
## TORQUE FLANGE SENSORS

### FEATURES

- Complete torque measuring system including: measuring flange with signal amplifier, HF transmitter, conditioner and 4 m coaxial cable
- Contactless signal transmission: via telemetry
- Torque Range: 20 N·m ... 150 kN·m (higher torque on request)
- High Accuracy: 0.1 ... 0.2 % (0.05 % on request)
- Overload Capacity: up to 200 % (limit of adhesion)
- Measuring Range: 200 %
- Breaking Limit: >400%
- Compact, easy-to-mount design
- High torsional stiffness
- Bearingless: maintenance and wear-free
- Excellent noise immunity and shock resistance
- Protection class: IP 42 (IP 54 option)
- Integrated speed sensor and conditioner for rotational speed measurement (option)
- High temperature capability: up to 125 °C (option)

Fig. 1: Torque Flange Sensors TF 313 & TF 318 with HF Transmitter and Torque Signal Conditioner

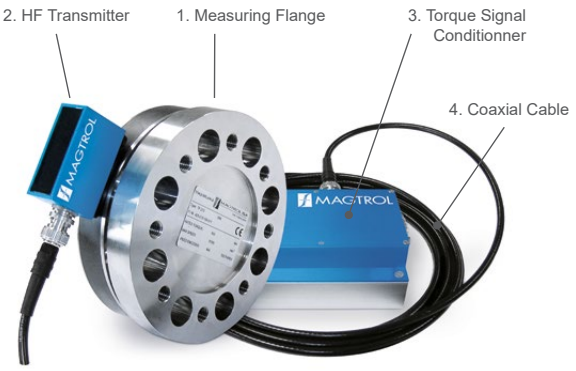
### DESCRIPTION

With its compact, bearingless, maintenance-free design, the TF Series Torque Flange Sensor from Magtrol brings many appealing advantages to torque measurement applications. The TF's high torsional rigidity supports direct mounting on the machine shaft or flange, avoiding the use of couplings on one side. This allows easy integration into a test system, shortens the overall length of the test bench and reduces costs.

Based on strain-gauge technology, the TF Series Sensor's precise telemetry system enables highly accurate signal transmission. A signal amplifier mounted in the measuring flange amplifies the measuring signal, modulates it to high frequency and transmits it inductively (via the HF transmitter) to the conditioner. In the signal conditioner, the digitized torque signal is transformed into an analog output signal of ±5 VDC. Rotational speed can be measured and converted to a TTL output signal with the optional speed sensor.

The contactless design of the Torque Flange Sensor permits a gap of up to 5 mm (typically 2 or 3 mm) between the rotor antenna and HF transmitter, which makes the signal acquisition insensitive to any axial or radial misalignment. Another advantage of this torque measurement system is its insusceptibility to signal interference due to the fact that, unlike other designs, the antenna does not need to be looped around the measuring flange. Additionally, a protective cover can be mounted close to the TF Series Torque Flange Sensor with no effect on the signal.

## ASSEMBLY

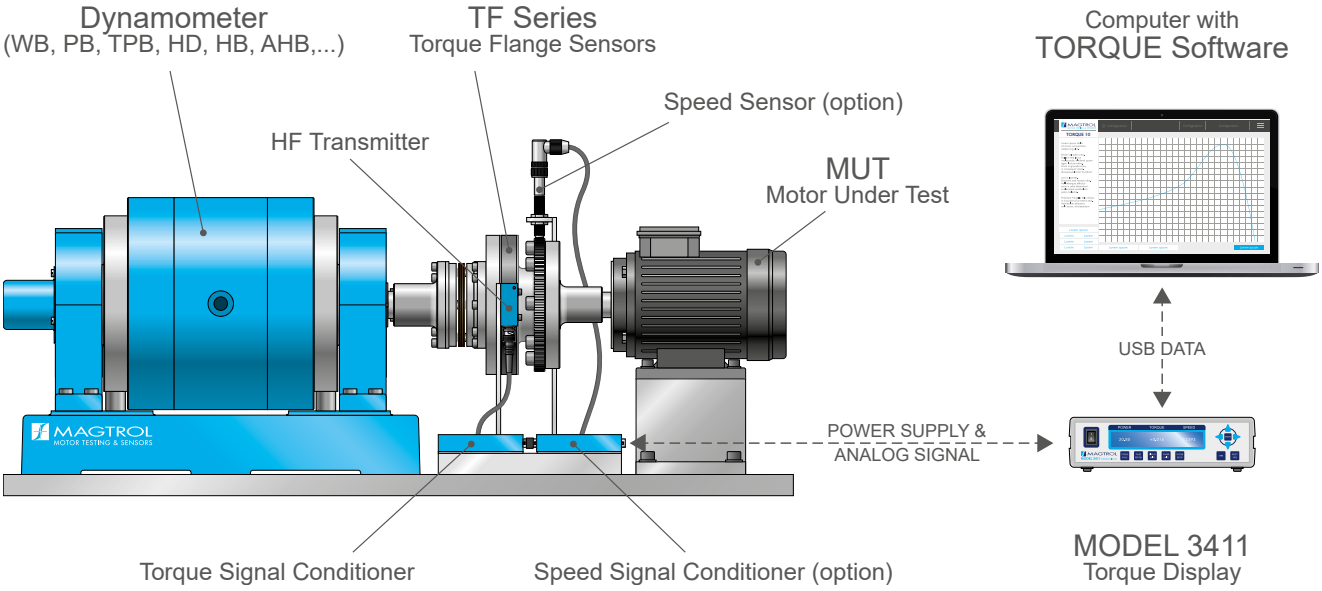



## APPLICATIONS

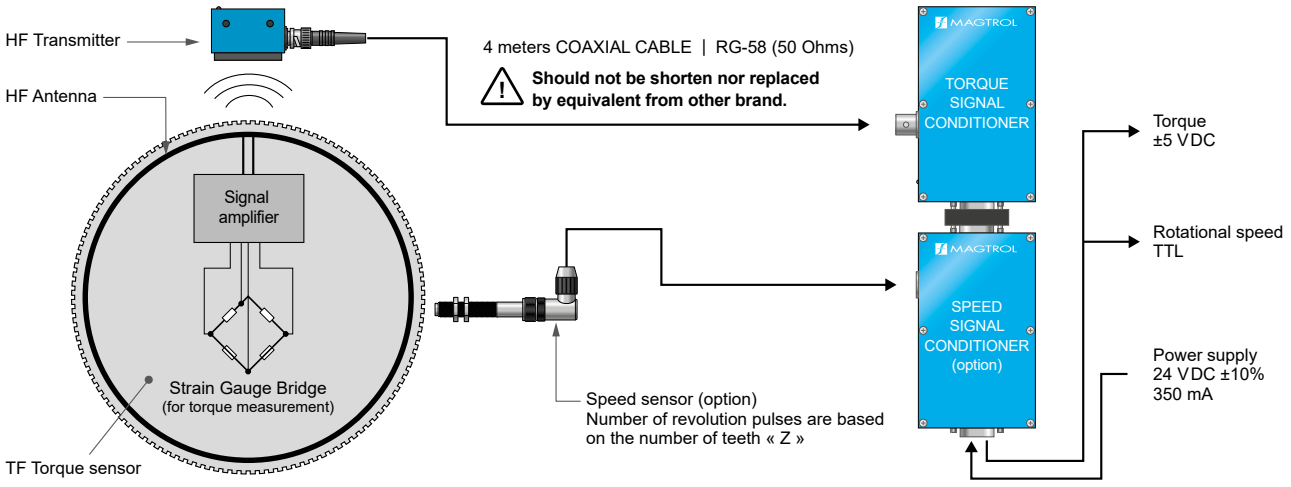
TF Series Torque Flange Sensors measure both static and dynamic torque on stationary and rotating shafts.

They are used in general combustion engine, electric motor and gearbox test benches; and can also be mounted inline for active torque monitoring of transmissions, powertrains, wind generators, gas turbines, boat engines, etc.

## SYSTEM CONFIGURATION




## ELECTRICAL CONFIGURATION



# TECHNICAL DATA

## MECHANICAL CHARACTERISTICS

| MODEL [a] | RATED TORQUE | OVERLOAD CAPACITY | ACCURACY CLASS | MAXIMUM SPEED | NUMBER OF THEETH [c] | TORSIONAL STIFFNESS | DEFORMATION ANGLE | SENSORS WEIGHT [d] | MOMENT OF INERTIA (X Axis) [f] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N·m | % of RT | | rpm | Z | kN·m / rad | ° | kg | kg·m² | lb·ft·s² |
| TF 309<br>TFHS 309 | 20 | 200 % | 0.1 % | 17 000<br>20 000 | 52 | 50 | 0.023 | 1.4 | 0.0022 | 0.0016 |
| TF 310<br>TFHS 310 | 50 | 200 % | 0.1 % | 17 000<br>20 000 | 52 | 72 | 0.040 | 1.5 | 0.0022 | 0.0017 |
| TF 311<br>TFHS 311 | 100 | 200 % | 0.1 % [b] | 17 000<br>20 000 | 52 | 86 | 0.067 | 1.5 | 0.0022 | 0.0017 |
| TF 312<br>TFHS 312 | 200 | 200 % | 0.1 % [b] | 17 000<br>20 000 | 52 | 106 | 0.108 | 1.5 | 0.0023 | 0.0017 |
| TF 313<br>TFHS 313 | 500 | 200 % | 0.1 % [b] | 15 000<br>20 000 | 59 | 850 | 0.034 | 1.9 | 0.0046 | 0.0034 |
| TF 314<br>TFHS 314 | 1 000 | 200 % | 0.1 % [b] | 15 000<br>20 000 | 59 | 1 285 | 0.045 | 2.0 | 0.0047 | 0.0035 |
| TF 315<br>TFHS 315 | 2 000 | 200 % | 0.1 % [b] | 12 000<br>15 000 | 79 | 2 476 | 0.046 | 3.2 | 0.0111 | 0.0082 |
| TF 316<br>TFHS 316 | 5 000 | 200 % | 0.1 % [b] | 10 000<br>12 000 | 95 | 5 573 | 0.051 | 5.0 | 0.0252 | 0.0186 |
| TF 317<br>TFHS 317 | 10 000 | 150 % [e] | 0.1 % [b] | 10 000<br>12 000 | 95 | 6 141 | 0.093 | 6.0 | 0.0276 | 0.0204 |
| TF 318 | 20 000 | 200 % | 0.1 - 0.2 % | 3 500 | 200 | 44 000 | 0.026 | 56.0 | 1.3430 | 0.9911 |
| TF 319 | 50 000 | 180 % [e] | 0.1 - 0.2 % | 3 500 | 200 | 74 700 | 0.038 | 59.0 | 1.3790 | 1.0177 |
| TF 320 | 100 000 | 180 % [e] | 0.1 - 0.2 % | 3 500 | 200 | 1 047 000 | 0.055 | 63.5 | 1.3970 | 1.0310 |

| | |
|---|---|
| Maximum Dynamique Torque without Damage (Overload Limit) | 400 % of Rated Torque |

## ENVIRONEMENT

| | |
|---|---|
| Rated Temperature Range | +10 °C ... +85 °C |
| Storage Temperature Range | -25 °C ... +85 °C |
| Extended Temperature Range (option) | -30 °C ... +125 °C |
| Temperature influence on zero | 0.01 % / °C |
| Protection class | IP 42 (option IP 54) |

## ELECTRICAL CHARACTERISTICS

| | |
|---|---|
| Power Supply | 24 V DC ±10 %, max 350 mA<br>TF 318, TF 319 & TF 320: 100 - 240 VAC |
| Torque Output Signal (rated / max.) | ±5 V DC / ±10 V DC |
| Filter Bandwith | 0 ... 1 kHz (-3 dB) / (option 5 kHz) |

## SPEED MEASUREMENT (OPTION)

| | |
|---|---|
| Number of Theeth | Dependending on TF size; refer to number of teeth |
| Speed Pick-Up Transducer | Magnetoresistive |
| Minimum Speed Detection | < 1 rpm |
| Speed Output | TTL (Pulse Per Revolution correspond with number of teeth) |

a) Torque up to 150 kN·m or higher, and high speed versions are available on request

b) Linearity- hysterese error 0.05 % is available on request

c) Inductive speed detection is available on request

d) Add 0.8 ... 2.8 kg to weight (dependending on configuration), for electronic devices attached to the sensor (HF transmitter, receiver, speed conditioner,...)

e) Dynamique torque peak values are due to force transmission limit of mounting screws.

f) The X axis of the moment of inertia represents the rotation axis of the torque transducer (see Fig. 2).

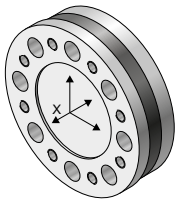
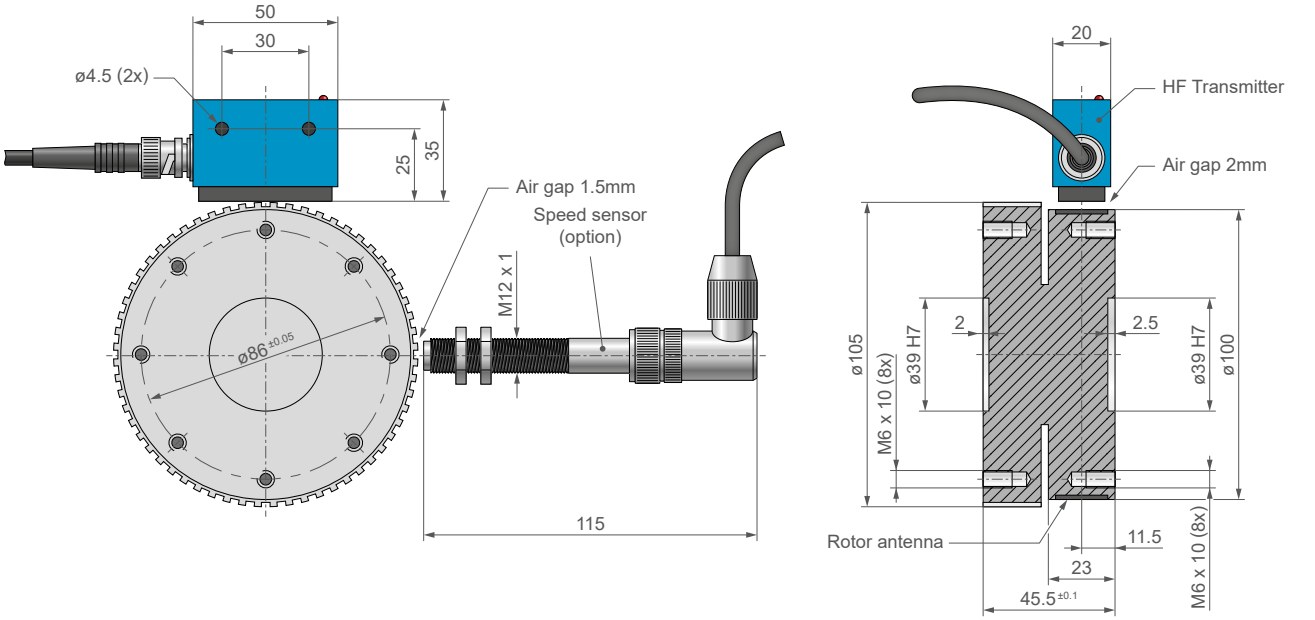
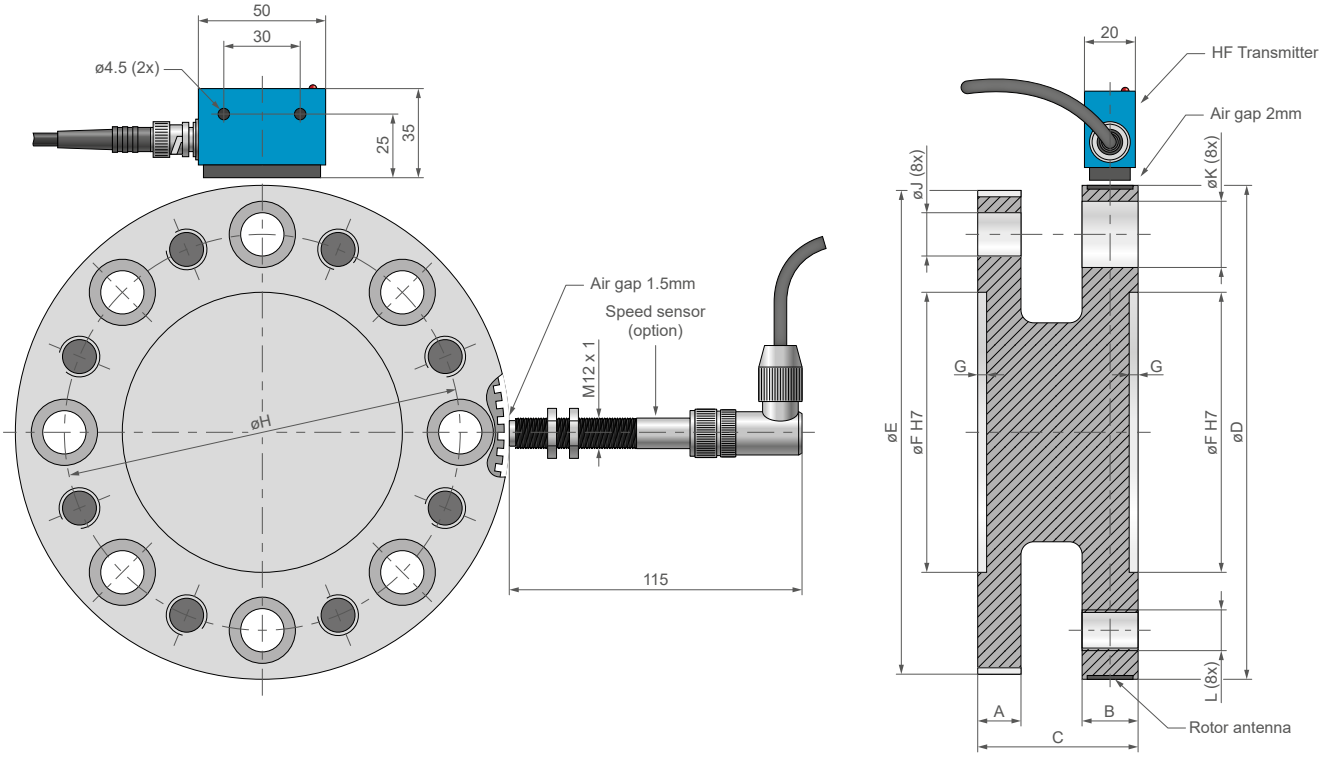



Fig. 2: Moment of Inertia (X Axis)

## DIMENSIONS TF & TFHS 309 - 312



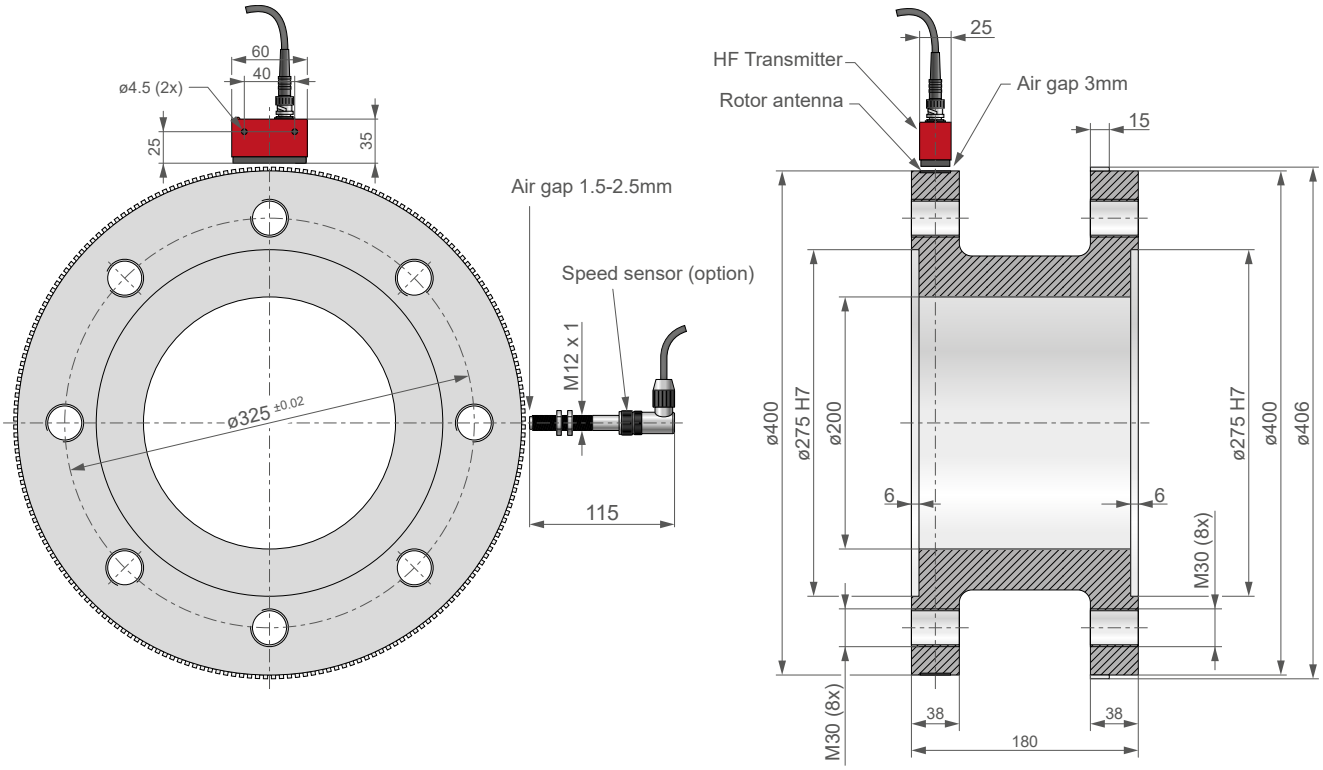

## DIMENSIONS TF & TFHS 313 - 317



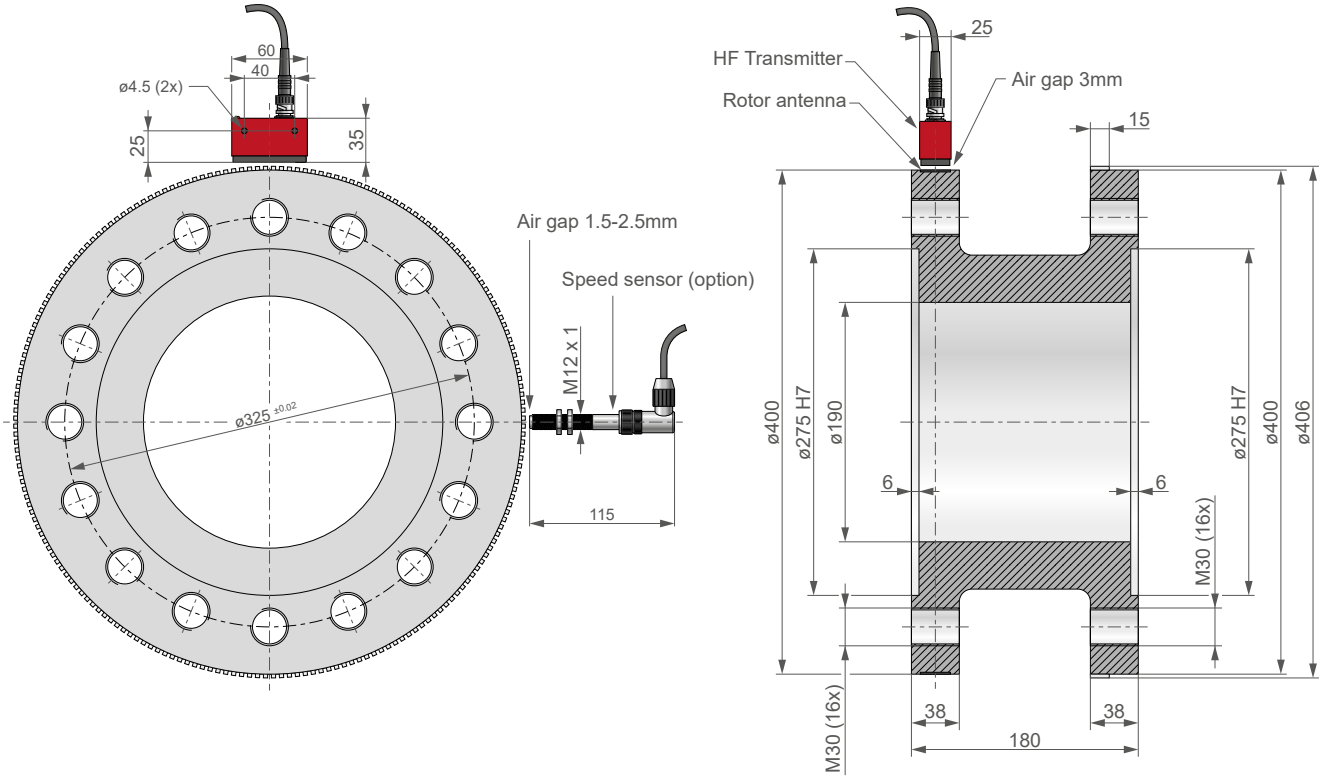

| MODEL | A | B | C | øD | øE | øF H7 | G | øH | øJ (8x) | øK (8x) | L (8x) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TF/TFHS 313 | 12 | 22 | 49 | 130 | 126 | 75 | 3.0 | 101.5 ±0.05 | 10.5 | 18 | M10 |
| TF/TFHS 314 | | | | | | | | | | | |
| TF/TFHS 315 | | | 53 | 164 | 156 | 90 | 3.5 | 130.0 ±0.05 | 12.5 | 20 | M12 |
| TF/TFHS 316 | 14 | | | 194 | 190 | 110 | 3.5 | 155.5 ±0.1 | 15.0 | 23 | M14 |
| TF/TFHS 317 | 17 | | 63 | | | | | | 17.0 | 26 | M16 |

**NOTE:** All dimensions are in metric units.
**NOTE:** 3D STEP files of most of our products are available on our website: www.magtrol.com ; other files are available on request.

## DIMENSIONS TF 318 - 319




## DIMENSIONS TF 320

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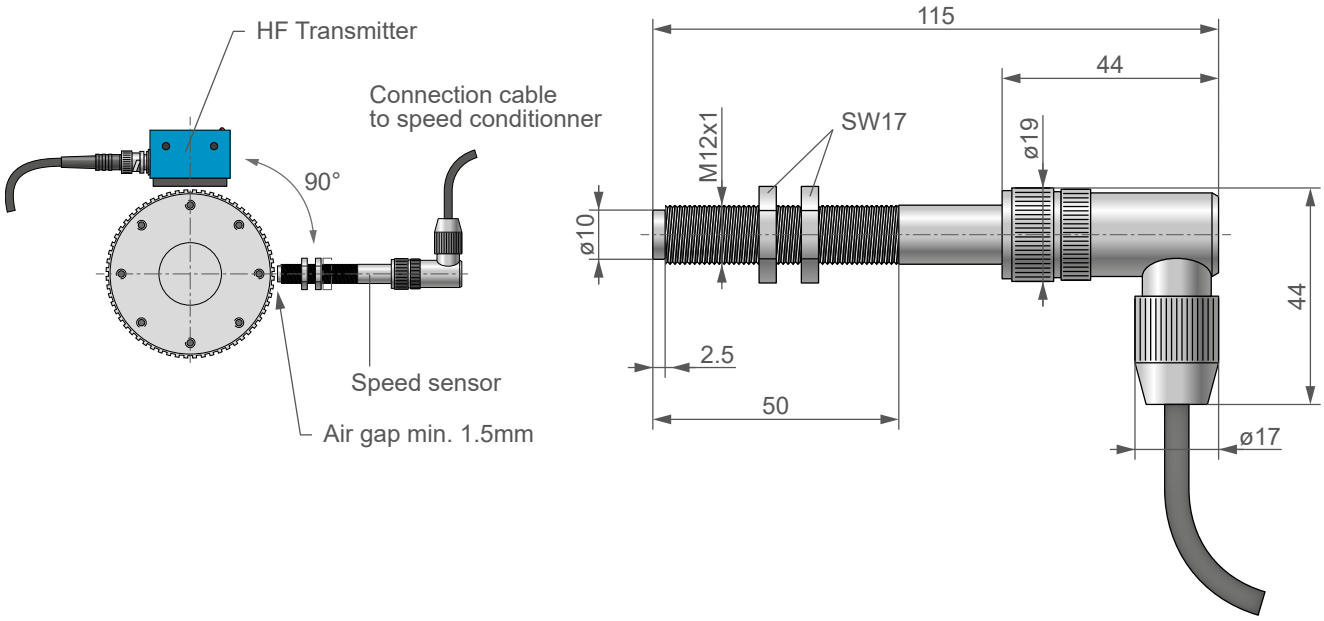
**NOTE:** 3D STEP files of most of our products are available on our website: www.magtrol.com ; other files are available on request.

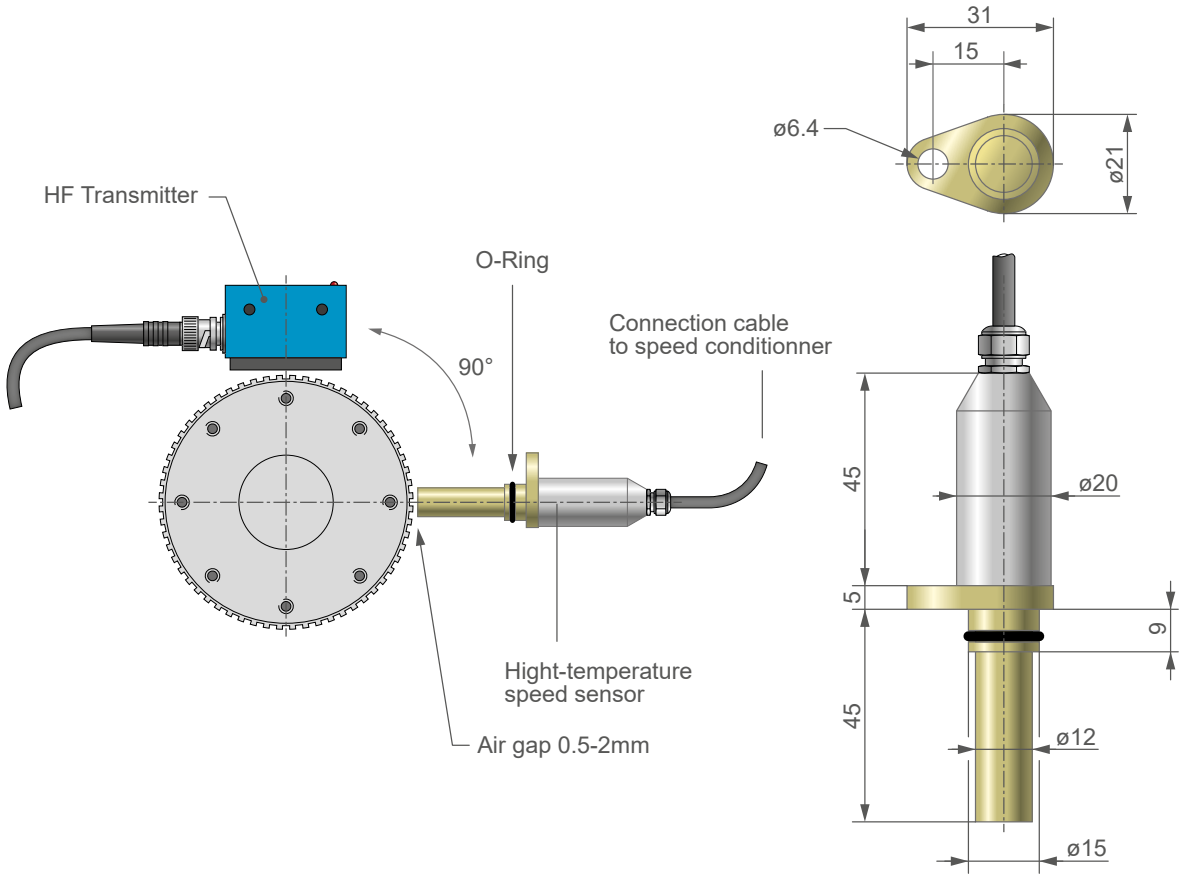
## STANDARD SPEED SENSOR

The standard speed sensor is delivered with TF Torque Flange Sensors ordered with the speed measurement option.




## HIGH TEMPERATURE SPEED SENSOR

The high-temperature speed sensor is delivered with TF Torque Flange Sensors ordered with both the speed measurement and extended temperature range options (125 °C).

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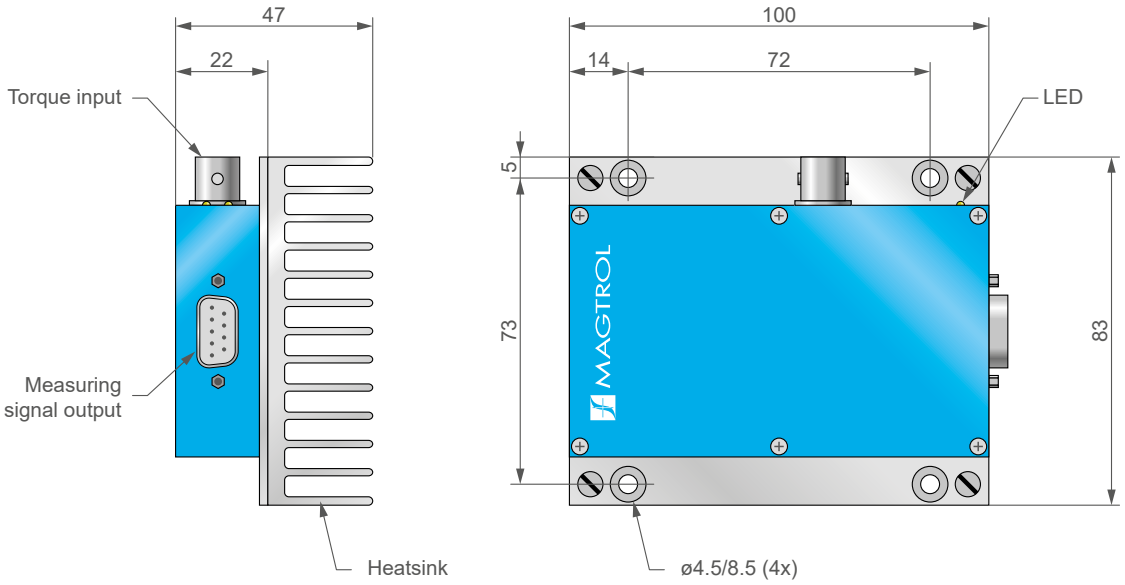
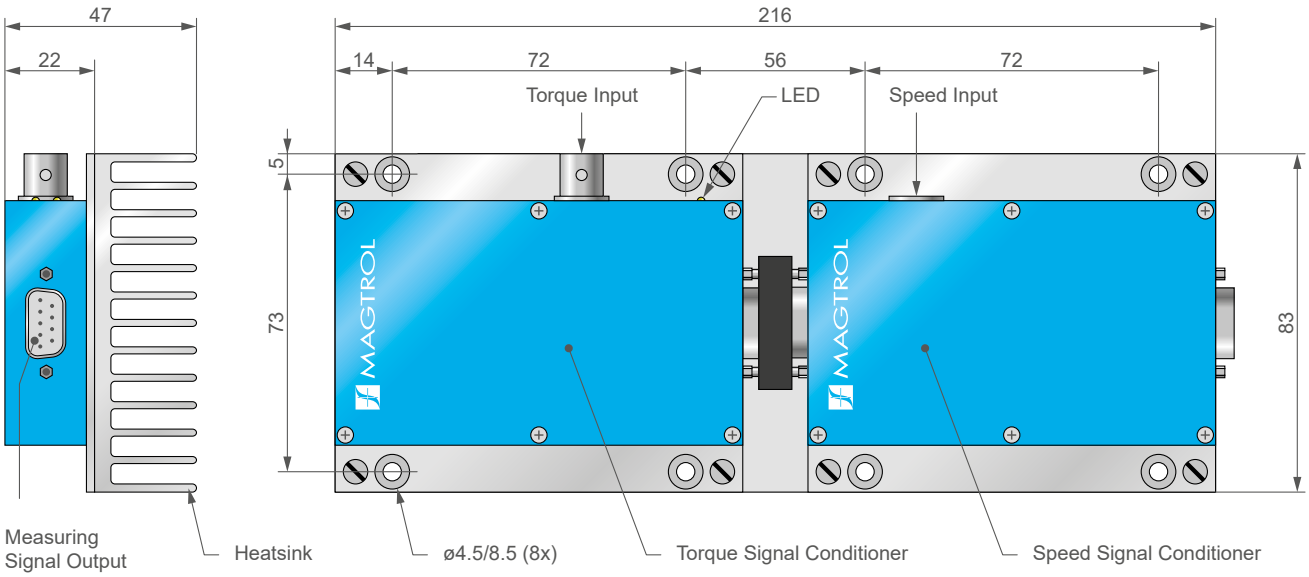
## TORQUE SIGNAL CONDITIONER

Conditioner (1.5 W) for TF 309 ... TF 317




## TORQUE SIGNAL CONDITIONER WITH SPEED OPTION

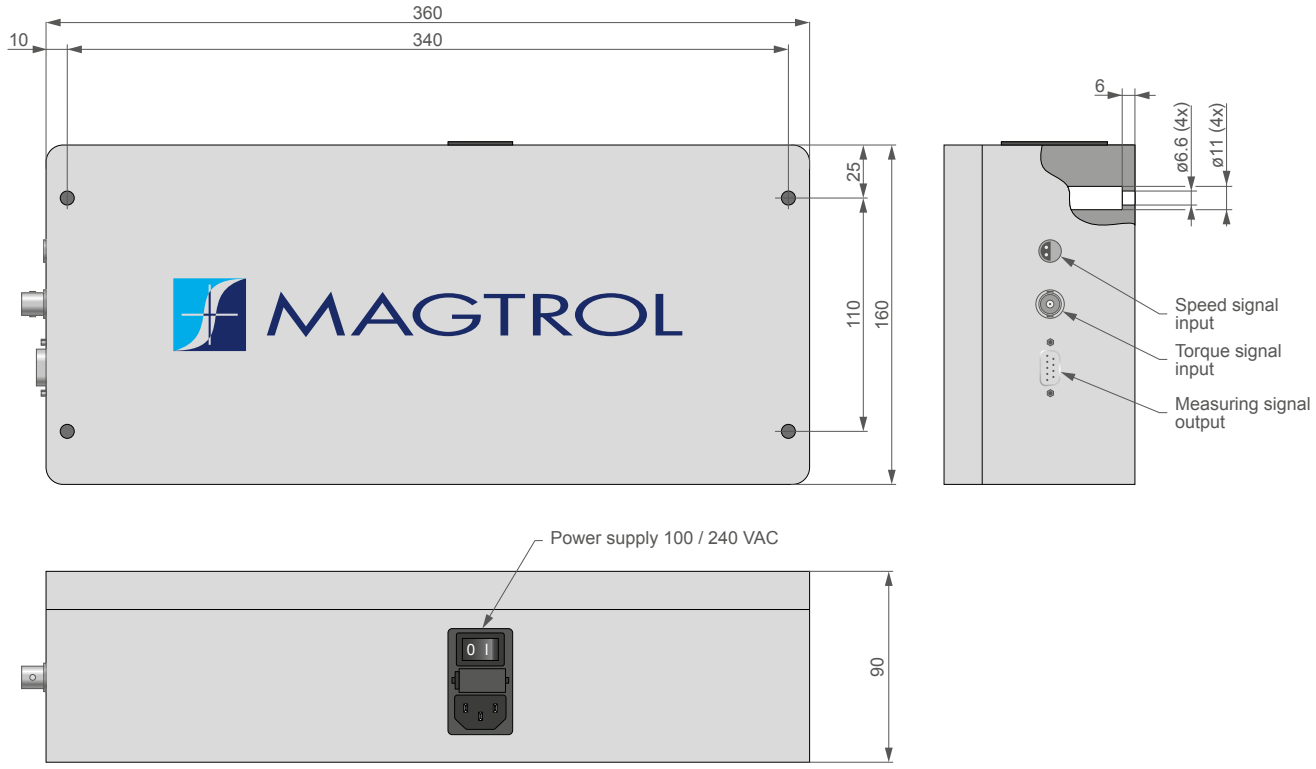
Conditioner (1.5 W) with speed option for TF 309 ... TF 317




**NOTE:** All dimensions are in metric units.
**NOTE:** 3D STEP files of most of our products are available on our website: www.magtrol.com ; other files are available on request.

## TORQUE SIGNAL CONDITIONER FOR TF 318-320

Conditioner with speed (5 W), for TF 318 ... TF 320




**NOTE:** All dimensions are in metric units.
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## SYSTEM OPTIONS

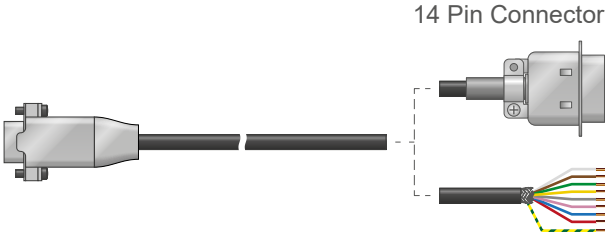
### MODEL 3411 - TORQUE DISPLAY

Fig. 3: MODEL 3411 | Torque Display

Magtrol offers the MODEL 3411 Torque Display which supplies power to any TF Sensor 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 (B.I.T.E.)
- Overload indication
- Tare function
- USB & Ethernet interface
- Torque and speed outputs
- Closed-box calibration
- Includes Magtrol's TORQUE Software

### CABLE ASSEMBLY



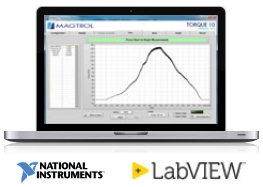

| ORDERING NUMBER | ER 1 | _ _ | - 0 | _ |
|---|---|---|---|---|

**16** : 14 Pin connector [a)]
**17** : Pigtail wires

**1 :** Cable lenght 5 m
**2 :** Cable lenght 10 m
**3** : Cable lenght 20 m

a) For use with MODEL 3411 Torque Display or DSP Controller

### «TORQUE» SOFTWARE




Magtrol's TORQUE Software is an easy-to-use Windows® 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 Magtrol's TORQUE Software include: peak torque capture, multi-axes graphing, measured parameter vs. time, adjustable sampling rates and polynomial curve fitting.

### COUPLINGS

For our TF Torque Flange Sensors, Magtrol offers specific couplings KTF Series (flexible disc) or BKC TF Series (below type). For more details, please contact your regional sales office.

Fig. 4: KTF Series | Flexible Disc Coupling

## ORDERING INFORMATIONS

| ORDERING NUMBER | TF | _ _ | _ _ _ | / 0 | _ | X |
|---|---|---|---|---|---|---|

**HS** : for High Speed version

**309, 310, ..., 320** : Model TF or TFHS

**1** : Basic
**2** : With Speed Measurement
**5** : High Temperature version (up to 125 °C)
**6** : Speed Measurement & Hight Temperature (up to 125 °C)

Example: TF 312 Torque Flange Sensor, high speed version, with speed measurement, would be ordered as: **TFHS 312 / 02X.**

# 2. INSTALLATION / CONFIGURATION

**CAUTION** BEFORE COMPLETING THE ASSEMBLY AND MOUNTING, IT IS ADVISED TO FIRST POWER UP THE SYSTEM (*SEE SECTION 3.1 - POWERING UP THE SYSTEM*) IN ORDER TO CHECK THE SIGNAL TRANSMISSION.

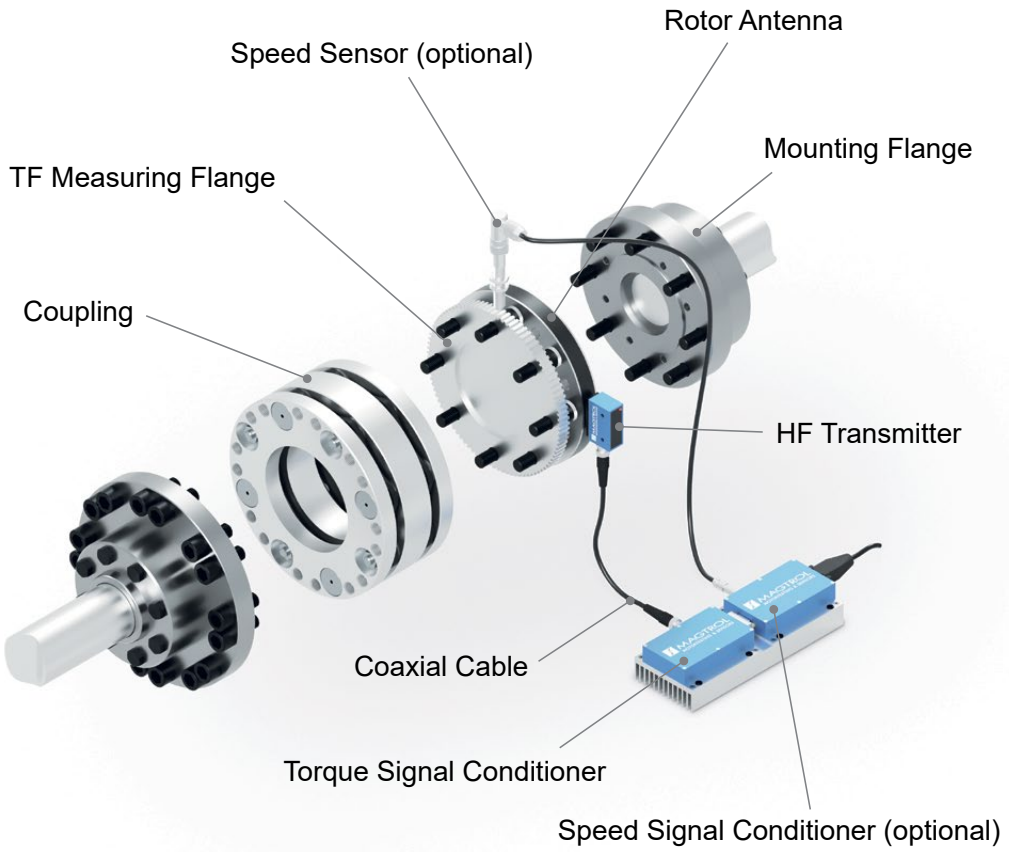



Fig.2-1 Installation Overview

## 2.1 INITIAL CLEANING

Prior to installing the TF Series Torque Flange Sensor, all contact surfaces including the measuring flange, coupling element and mounting flange must be carefully cleaned and degreased. This will guarantee optimal transmission of the measured torque signal.

Use a soft cloth lightly dampened with alcohol to avoid any abrasion. Be careful to prevent any alcohol from entering the flange or coming in contact with the rotor antenna during cleaning.

**CAUTION** AVOID ANY USE OF OVERLY AGGRESSIVE SOLVENTS. THESE CAN DAMAGE THE ROTOR ANTENNA WHILE CLEANING. IF NECESSARY, ACETONE MAY BE USED (INSTEAD OF ALCOHOL) TO REMOVE ENCRUSTED DEPOSITS.

It is advised to clean all flange and coupling contact surfaces each time the drive train is reconfigured.

# 2.2 SYSTEM CONSIDERATION

## 2.2.1 MOUNTING DIRECTION

Magtrol strongly recommends that the flexible coupling be mounted on the opposite side of the element to be measured. If the mounting cannot be done according to the above recommendations, proceed to the best of your ability. Magtrol Torque Flange work perfectly in all configurations, however, mounting as recommended (*see Fig.2-2*) can improve the quality of the measurement.

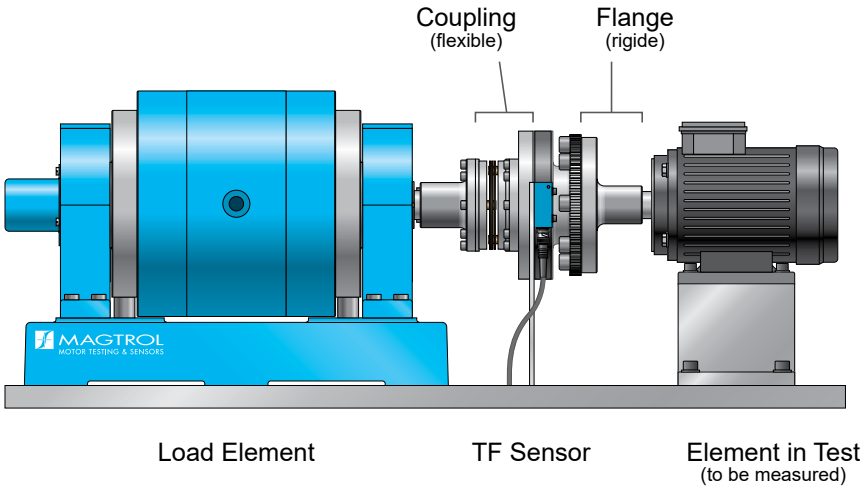



Fig.2-2 Recommanded Mounting direction

## 2.2.2 ALIGNMENT

The TF Series Torque Flange Sensors are easy to install by design. However, it is important to achieve the best possible alignment of the various components of the measurement drive train. Angular and radial misalignments (*see Fig.2-3*) must be avoided.

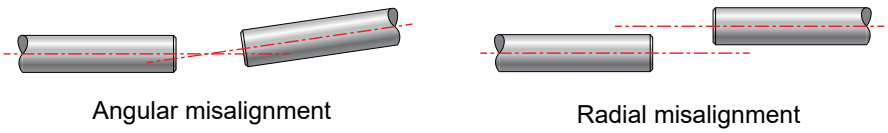



Fig.2-3 Angular and Radial Misalignment

The admissible angular and radial misalignment is 0.3° and 0.04 mm, respectively. By using proper couplings, modest misalignments can be compensated.

## 2.2.3 COUPLING SELECTION

To avoid excessive extraneous loads, do not couple the driving elements directly to the driven part of the measuring chain by means of the measuring flange. A coupling is necessary.

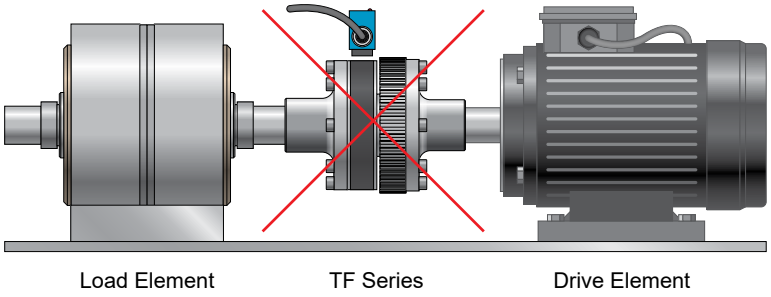



Fig.2-4 Incorrect (rigid mounting)

### 2.2.3.1 COUPLINGS FOR ANGULAR MISALIGNMENT

In case of a slight angular error, a one-piece lamella coupling, cardan shaft or bellows coupling may be used.

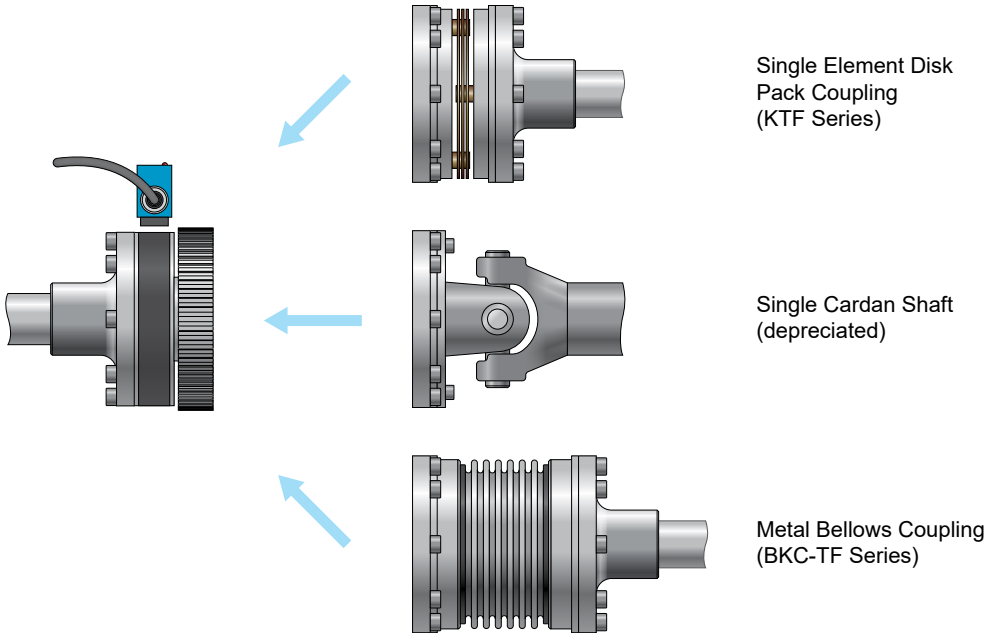



Fig.2-5 Coupling Options for Angular Misalignment Correction

### 2.2.3.2 COUPLINGS FOR RADIAL MISALIGNMENT

If the shaft mounting shows a slight radial misalignment, a two-piece lamella coupling, double cardan shaft or bellows coupling may be used. These elements provide the system with two degrees of freedom in order to compensate for a slight radial misalignment.

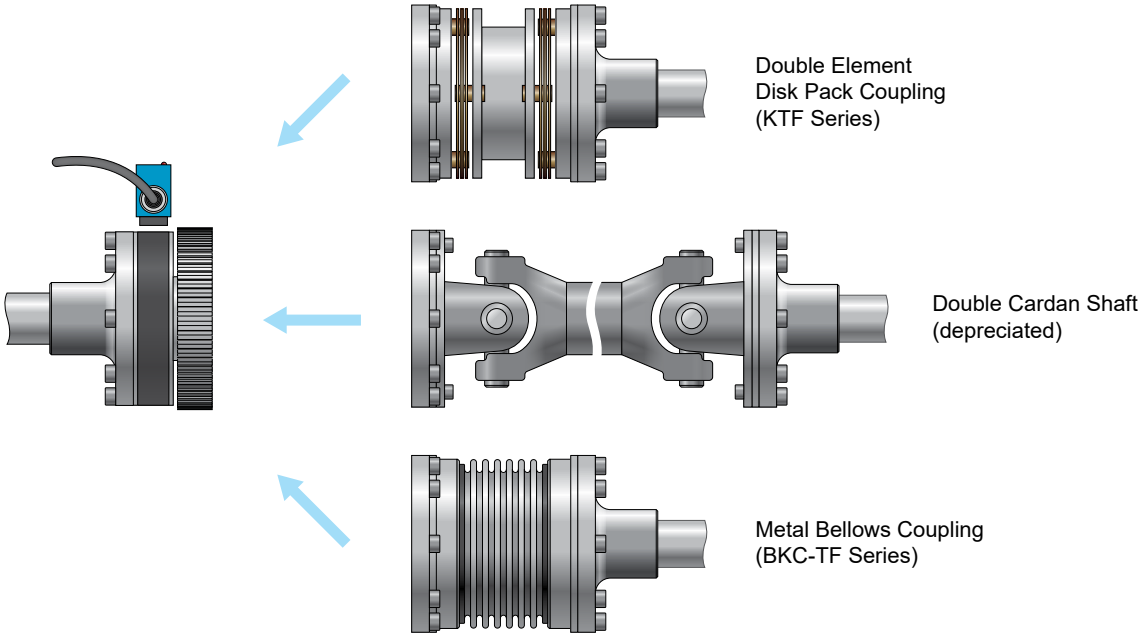



Fig.2-6 Coupling Options for Radial Misalignment Correction

## 2.2.4 MOUNTING CONSIDERATIONS

| MOUNTING FLANGE AND COUPLING SPECIFICATIONS | |
|---|---|
| Minimum Tensile Strength | 700 N/mm² |
| Minimum Hardness | 25 HRC |
| Roughness | Ra 1.6 |
| Minimum Face Flatness | 0.03 mm |
| Centering Tolerance ø | g6 |

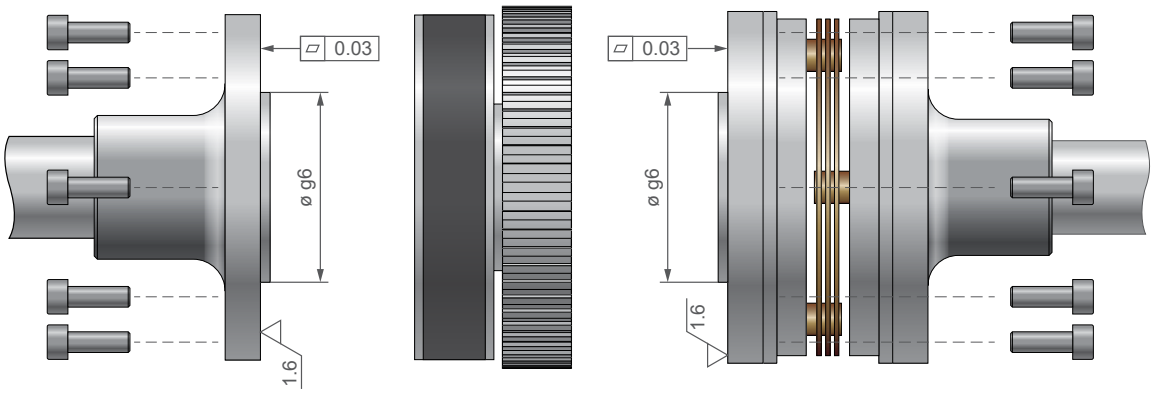



Fig.2-7 Mounting Flange and Coupling Specifications

- The mounting flange or coupling mounted on the same side as the rotor antenna must have a diameter equal to or smaller than the rotor antenna diameter.
- To achieve the best possible centering of the measuring flange, the mounting flanges and couplings should use a centering device with a «g6» tolerance on the outside diameter (*see Fig.2-7*).
- The measuring flange is fitted with a centering bore («H7» tolerance) on each face.

**NOTICE** If the mounting flange is also fitted with a centering bore, an intermediate centering washer may be used (*see Fig.2-9*).

- A minimum distance of 10 mm between the main body of the mounting flange and its center piece (*see Fig.2-8*) is necessary to avoid any disturbance when transmitting the HF telemetry signal.

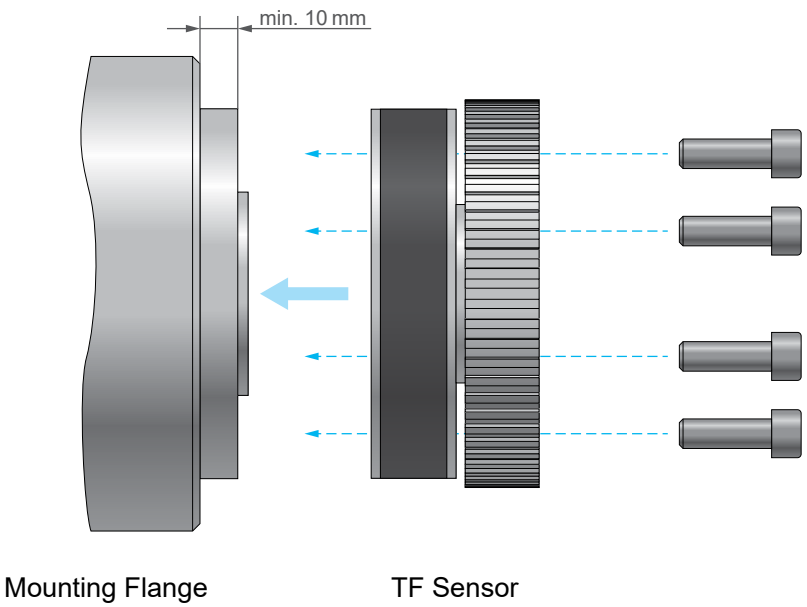



Fig.2-8 Measuring Flange Spacing

- Check the lengths of the screws and be sure to avoid any contact between the screws and the opposite part of the measuring flange (*see Fig.2-9*).
- Ensure 0.1 ... 0.2 mm of clearance between the centering hole of the measuring flange and the mounting flange centering washer.

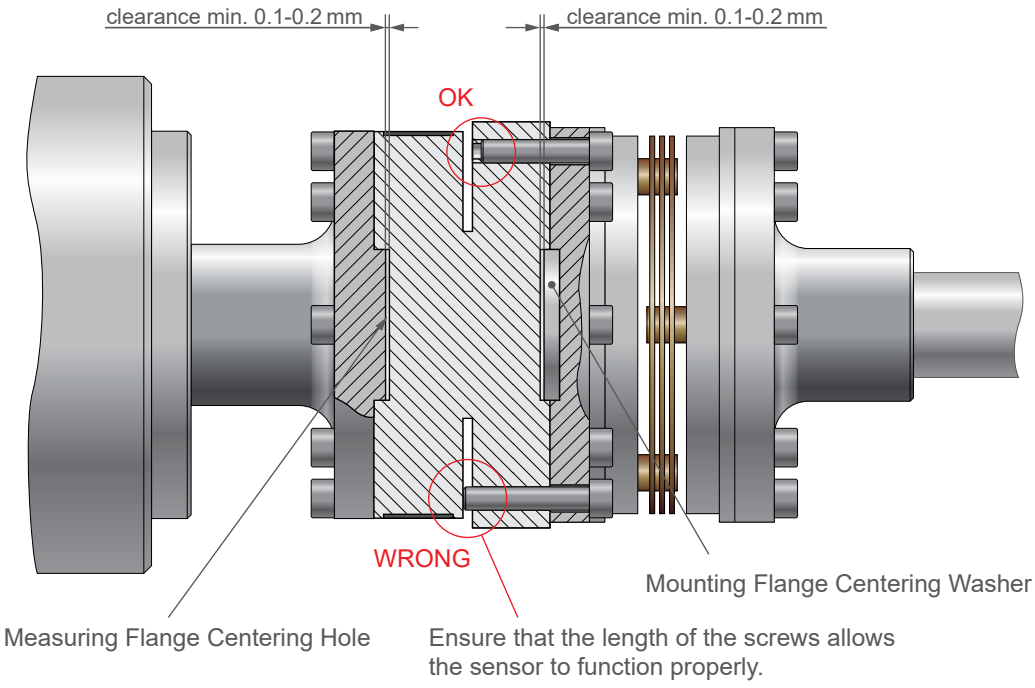



Fig.2-9 Mounting information regarding centering washers and the length of the screws

## 2.3 MOUNTING PROCEDURE

Depending on the model of TF Series, the mounting process will be different. When the TF Sensor can be mounted in either direction, Magtrol recommends that the TF Sensor be mounted on the fixed flange first (*see Fig.2-10*).

Although it is not always possible to follow the usual mounting procedure, Magtrol recommends that the TF Sensor be mounted in the following sequence (*see Fig.2-10*).

Magtrol Flange Torque Transducers work perfectly in all configurations, however, mounting according to the recommendations (*see section 2.2.1, 2.2.3 & Fig.2-10*) can improve the quality of the measurement.

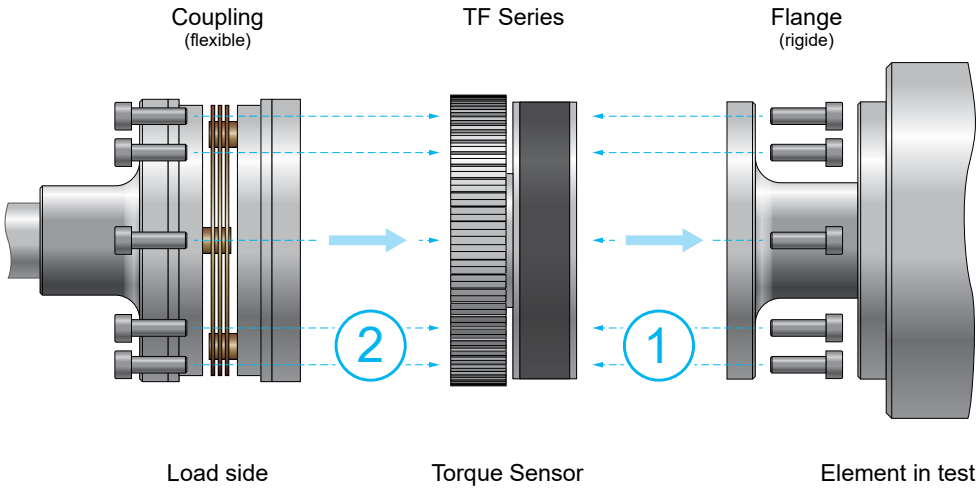



Fig.2-10 Recommended order of assembly of the elements

### 2.3.1 MOUNTING TF 309 - TF 312

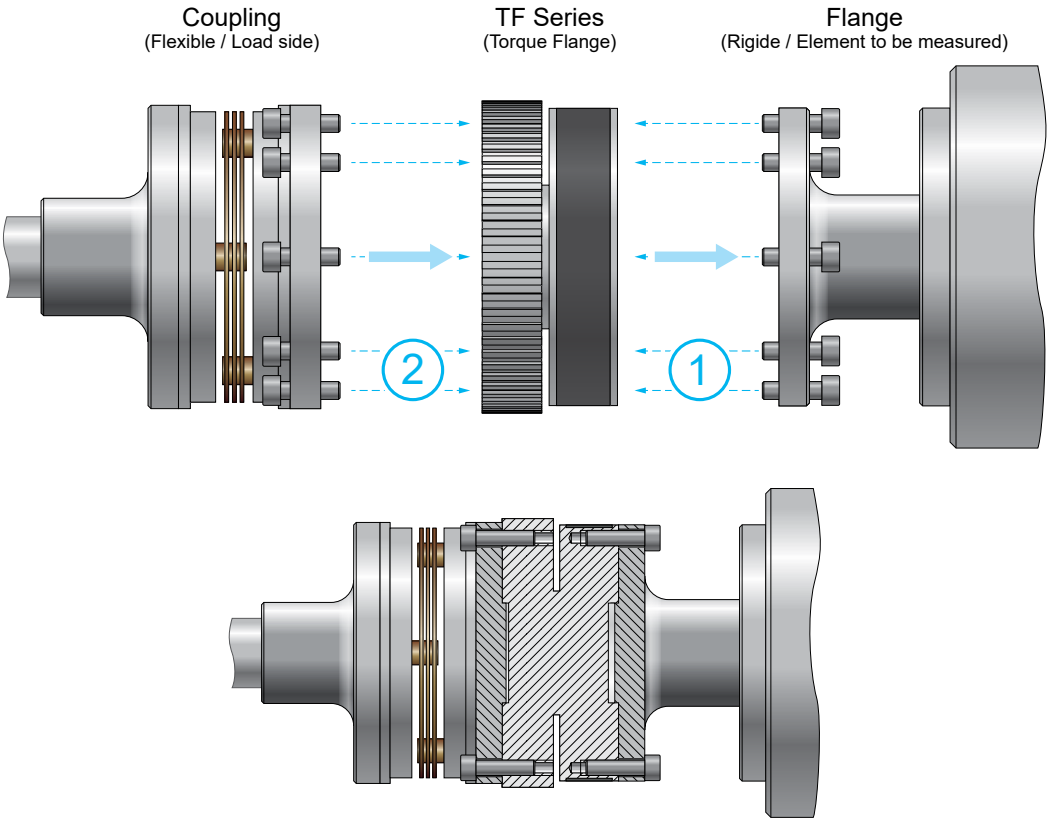



Fig.2-11 Recommended assembly process for TF 309 - TF 312

## 2.3.2 MOUNTING TF 313 - TF 317

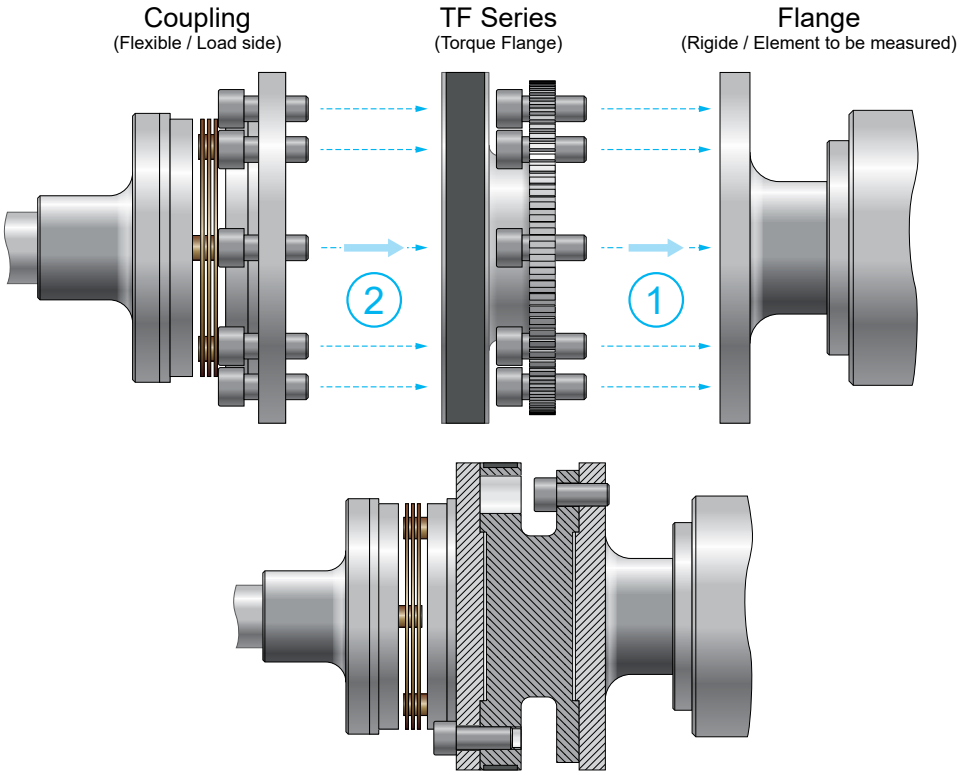



Fig.2-12 Recommended assembly process for TF 313 - TF 317

## 2.3.3 MOUNTING TF 318 - TF 320

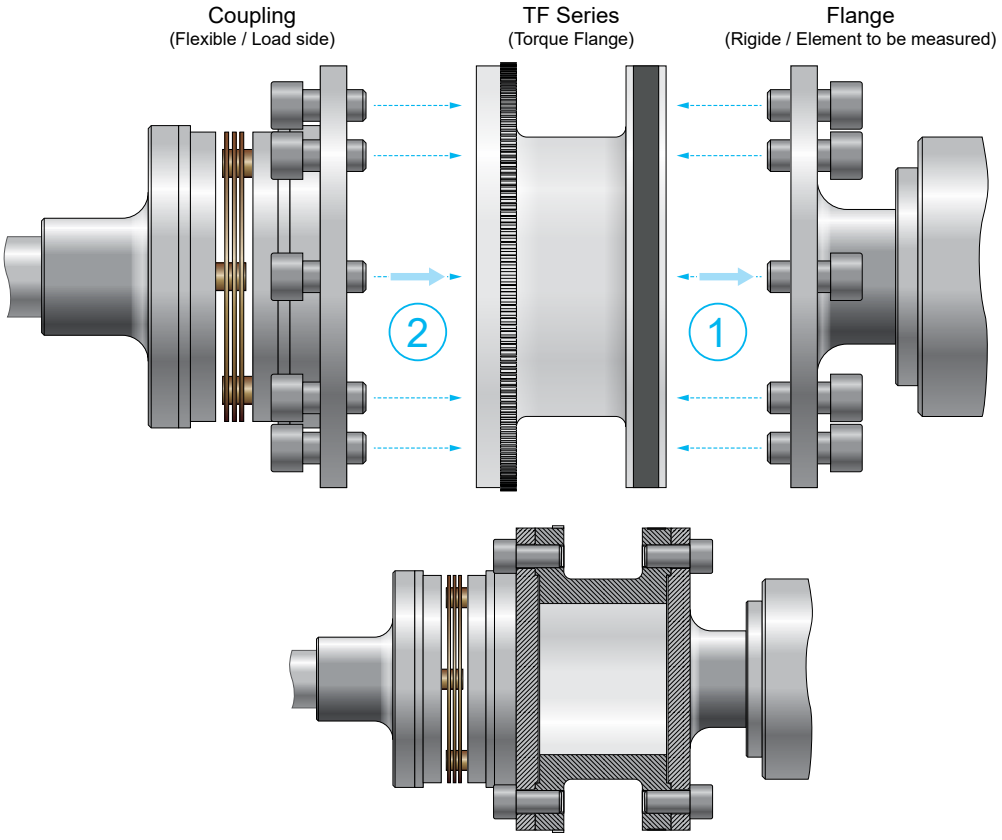



Fig.2-13 Recommended assembly process for TF 318 - TF 320

**NOTICE**

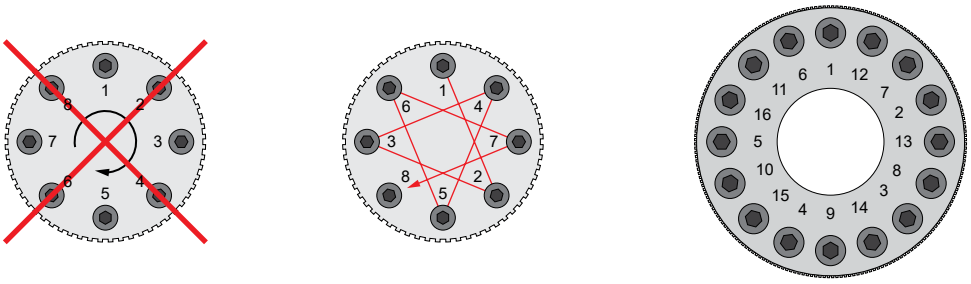
When using a cardan shaft, Magtrol recommends the latest generation of GKN Series 687 cardan shafts with limited weight. Do not use the over weighted old cardan shafts. Proper mounting position of the cardan shaft is neccessary to ensure proper balancing. Standard applications using a cardan shaft should not exceed 1500 ... 2000 rpm, depending on size and deflection angle.

## 2.3.4 MOUNTING SCREWS

The measuring flange must be mounted with 8.8/10.9/12.9 quality screws applying the specific fastening torque listed in the following table.

| MODEL | FASTENING SCREW SIZE | SCREW CLASS | FASTENING TORQUE [N·m] Friction Coefficient μ = 0.12 |
|---|---|---|---|
| TF 309 | M6 | 8.8 | 10.1 |
| TF 310 | | | |
| TF 311 | M6 | 10.9 | 14.9 |
| TF 312 | | | |
| TF 313 | M10 | 10.9 | 71.0 |
| TF 314 | | | |
| TF 315 | M12 | 10.9 | 123.0 |
| TF 316 | M14 | 12.9 | 229.0 |
| TF 317 | M16 | 12.9 | 354.0 |
| TF 318 | M30 | 10.9 | 2033.0 |
| TF 319 | | 12.9 | 2380.0 |
| TF 320 | | | |

The mounting screws must be tightened in the following order.




Wrong 8 Screws Version 16 Screws Version

Fig.2-14 Screw Tightening Order

**NOTICE**

When faced with alternating loads, secure the screws in their threads with thread locker in order to avoid any loss of preload. Be sure to prevent the thread locker from spilling over.

## 2.4 HF TRANSMITTER MOUNTING

Mount the HF transmitter according to the following specifications:

- The HF transmitter must be perfectly centered (laterally) with the rotor antenna and also aligned with the measuring flange axis.
- A gap of 2 mm for TF 309 ... TF 317 Sensors and 3 mm for TF 318 ... TF 320 Sensors must be maintained between the HF transmitter and rotor antenna in order to guarantee the best possible signal transmission.
- The HF transmitter must be mounted onto a support which can be easily adjusted both horizontally and vertically. To prevent any disturbance of the transmitted signal, the support must be at least 10 mm away from the HF transmitter rim (*see Fig.2-15*). The support must also be stable in order to prevent excessive vibrating of the HF transmitter and, consequently, avoid electromagnetic coupling problems between the rotor antenna and the HF transmitter.

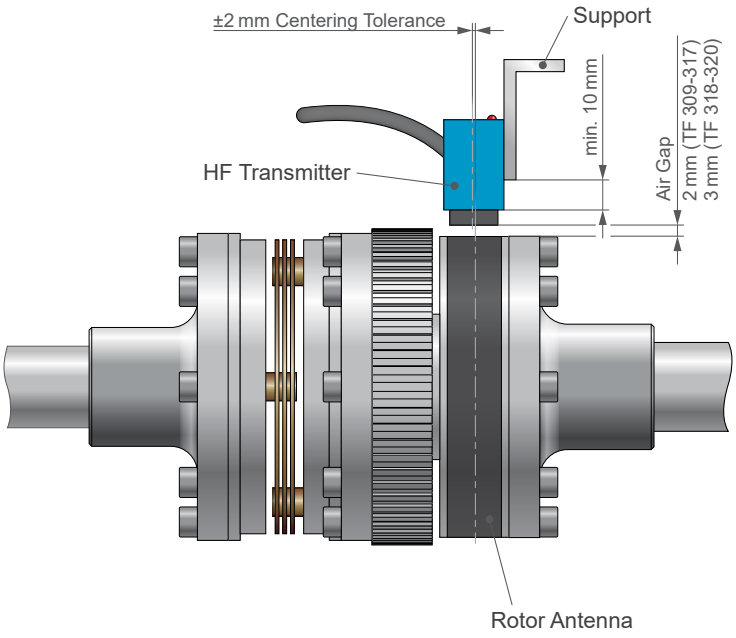



Fig.2-15 HF Transmitter Installation

## 2.5 SPEED SENSOR MOUNTING

If the TF Torque Flange Sensor is ordered with optional speed measurement capabilities, the HF Transmitter and the speed sensor must be mounted offset from each other with at least a 90° angle (*see Fig.2-16 & see Fig.2-17*).

### 2.5.1 STANDARD SPEED SENSORS

The speed sensor must be placed at a 1.5 mm distance from the measuring flange in order to optimize detection.

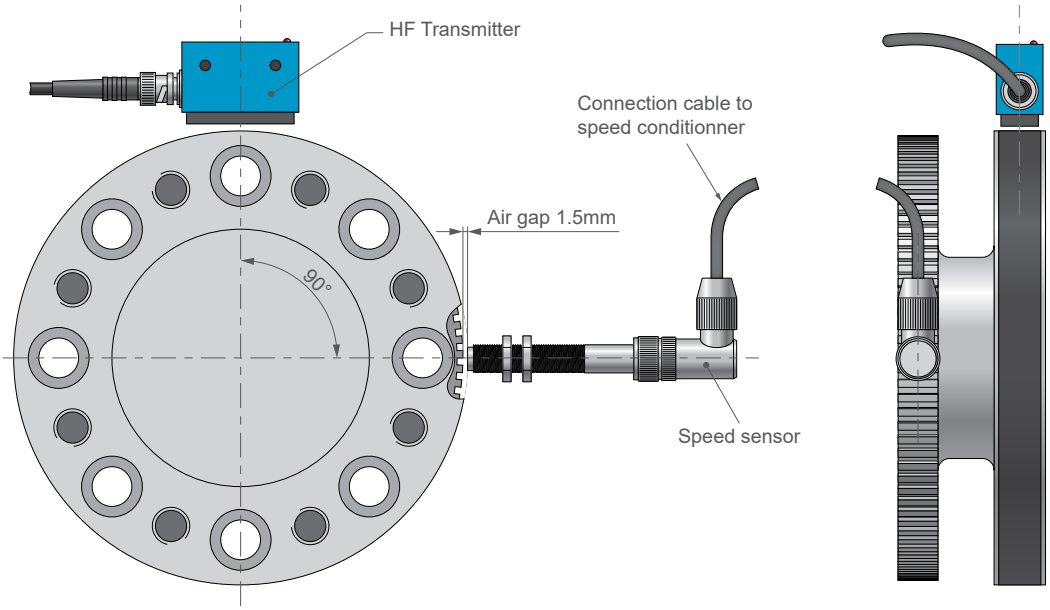



Fig.2-16 Standard Speed Sensor Installation

### 2.5.2 HIGH-TEMPERATURE SPEED SENSORS

The high-temperature speed sensor, delivered with TF Torque Flange Sensors ordered with extended temperature range (as an option), must be placed at a 0.5 ... 2 mm distance from the teeth with 10° angle to optimize the detection.

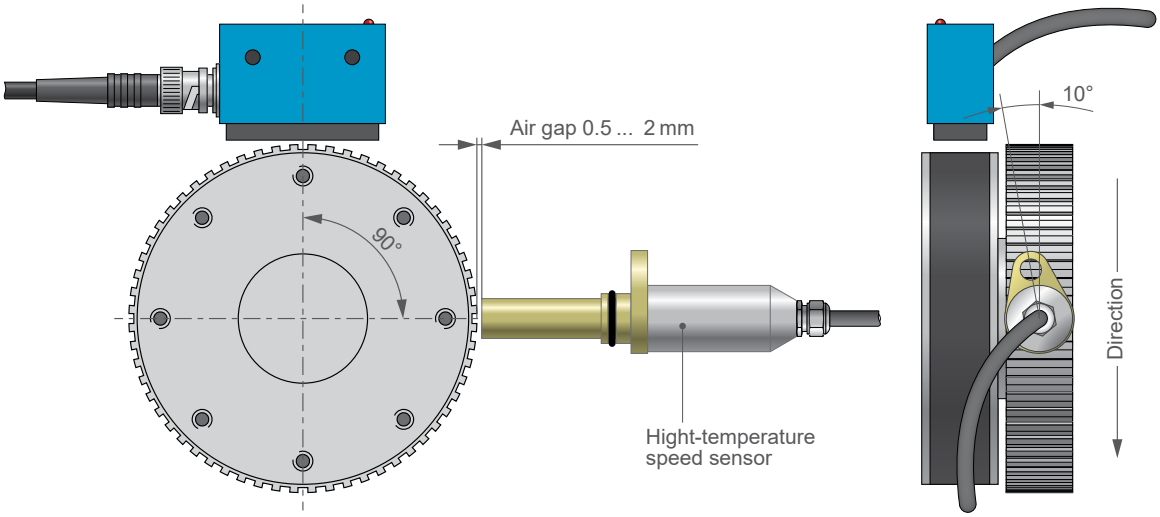



Fig.2-17 High-temperature Speed Sensor Installation

## 2.6 ELECTRICAL CONNECTIONS

Having installed the measuring flange and HF transmitter, only two electrical cables (three, with speed measurement option) need to be connected for the system to be operational.

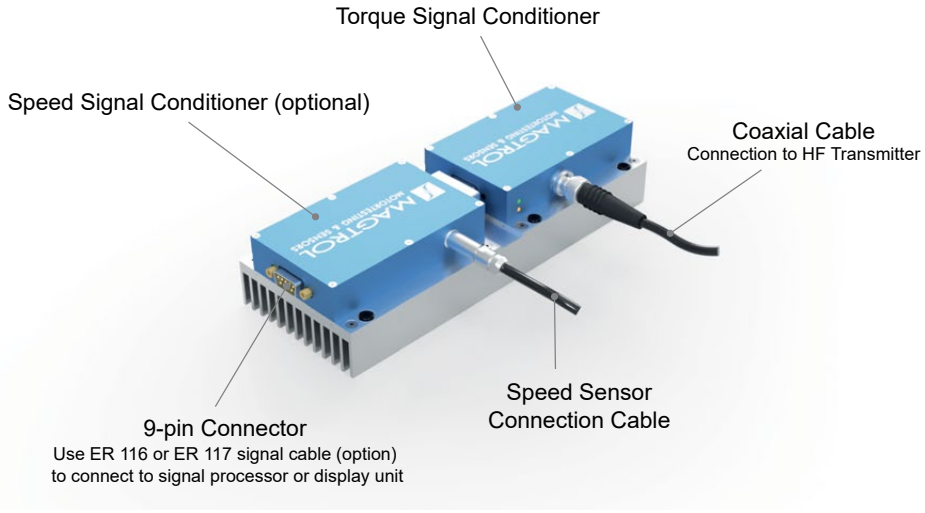



Fig.2-18 Signal Conditioner Connections

Avoid running the ER 116 or ER 117 signal cable, coaxial cable and speed sensor connection cable through an environment which may be perturbed by electromagnetic fields. These cables should also not be run close to transformers, electric motors or motor drives. If running these TF Torque Flange Sensor cables through such environments cannot be avoided, a minimum distance of 60 cm (~2 ft) from potentially perturbing components should be respected.

Ideally, these cables should be housed in steel conduit and connected to earth ground, to protect them as much as possible from electromagnetic perturbations.

### 2.6.1 CONNECTING THE HF TRANSMITTER TO THE TORQUE SIGNAL CONDITIONER

**CAUTION** NEVER SHORTEN THE COAXIAL CABLE. THE SYSTEM HAS BEEN TUNED IN ORDER TO OPTIMIZE THE HF TRANSMISSION USING THE COAXIAL CABLE'S ORIGINAL LENGTH (AS DELIVERED).

Connect the HF transmitter to the conditioner with the supplied coaxial cable, utilizing the dedicated connectors (*see Fig.2-18*).

### 2.6.2 CONNECTING THE SPEED SENSOR TO THE SPEED SIGNAL CONDITIONER

Connect the speed sensor (option) to the speed conditioner with the supplied connection cable, utilizing the dedicated connectors (*see Fig.2-18*).

## 2.6.3 CONNECTING THE CONDITIONER TO A SIGNAL PROCESSOR / DISPLAY UNIT

### 2.6.3.1 CONDITIONER CONNECTOR

For connection to a signal processor or display unit (such as a Magtrol's MODEL 3411 Torque Display or DSP 7001 Controller), the conditioner is equipped with the folowwing 9-pin D-sub connector.

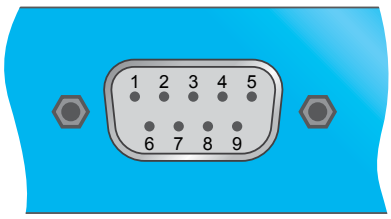
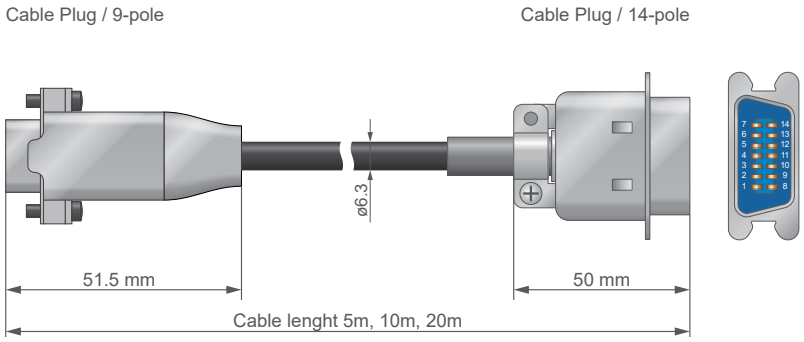



Fig.2-19 Conditioner Connector Pin Configuration

| PIN | DESIGNATION |
|---|---|
| 1 | Torque Signal ±5 (±10) VDC |
| 2 | Torque Signal GND |
| 3 | B.I.T.E. |
| 4 | N/C |
| 5 | Power Supply GND |
| 6 | TTL Speed Signal [a] |
| 7 | Power Supply 24 V DC [b] |
| 8 | N/C |
| 9 | N/C |

a) With Speed Measurement option
b) N/C for 5W Conditionner (TF 318 - TF 320)

### 2.6.3.2 CABLE ASSEMBLY ER 116 (14-PIN CONNECTOR)



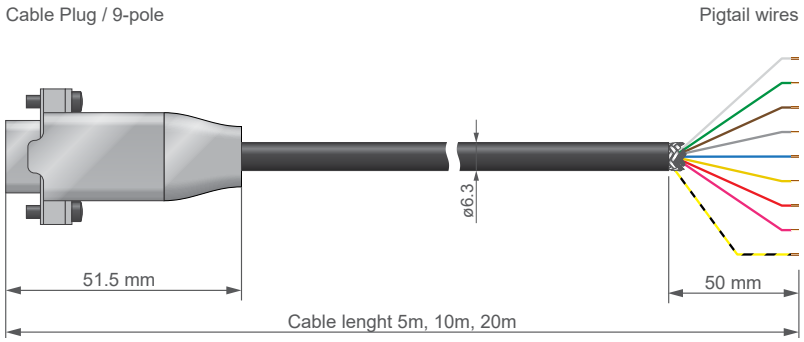

3 Power Supply 24 VDC [a]
4 Power Supply GND
5 Case / Shield
10 TTL Speed Signal [b]
12 B.I.T.E.
13 Torque Signal GND
14 Torque Signal ±5 (±10) VDC

[a] N/C for 5W Conditioner (TF 318 - TF 320)
[b] With Speed Measurement option

Fig.2-20 Cable ER 116 Pin Configuration

The ER 116 cable is used to connect the TF Series torque transducer signal conditioner to a torque display (MODEL 3411) or to a High-Speed Programmable Controller (DSP 7000). In order to use the dedicated TORQUE program, it is necessary to use a dedicated device such as the MODEL 3411 or DSP 7000.

### 2.6.3.3 CABLE ASSEMBLY ER 117 (PIGTAIL WIRES)




| | |
|---|---|
| 1 White | Torque Signal ±5 (±10) VDC |
| 2 Green | Torque Signal GND |
| 3 Brown | B.I.T.E. |
| Grey | N/C |
| 5 Blue | Power Supply GND |
| 6 Yellow | TTL Speed Signal [a] |
| 7 Red | Power Supply 24 VDC [b] |
| 8 Pink | N/C |
| | Case / Shield |

[a] With Speed Measurement option
[b] N/C for 5W Conditioner (TF 318 - TF 320)

Fig.2-21 Cable ER 117 Pin Configuration

Use the ER 117 cable to connects the TF Series Torque Transducer signal conditioner to a signal processor or display unit *(sold separately)*.

## 2.7 PROTECTIVE SYSTEMS

**DANGER** **ALL ROTATING PARTS MUST BE FITTED WITH A PROTECTIVE SYSTEM TO ENSURE THAT THE USER, AS WELL AS ALL OTHER SURROUNDING PEOPLE AND OBJECTS, WILL NOT BE INJURED OR DAMAGED AS A RESULT OF THE DRIVE ELEMENT BECOMING BLOCKED, A TORQUE OVERLOAD, OR ANY OTHER POTENTIAL PROBLEM.**

The following precautions concerning protective equipment of the drive train must be observed:

- Protective elements must prevent access to moving parts (during test).
- Protective elements must cover all parts which can cause crushing or cutting, and protect against projections of parts having become loose.
- Avoid attaching protective elements to rotating parts.
- Keep protective elements at a sufficient distance away from rotating parts. A minimum space of 12 mm should be maintained between rotating parts and protective elements (*see Fig.2-22*).

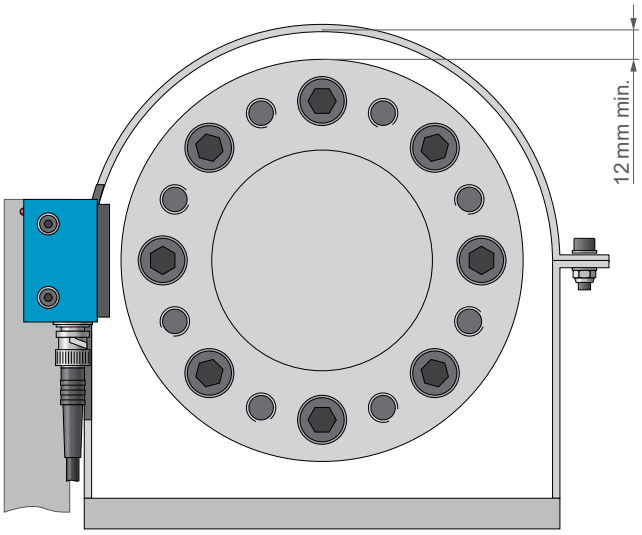



Fig.2-22 Spacing Between Flange and Guard

**WARNING** **THE ASSEMBLY AND INSTALLATION OF THE SYSTEMS MUST COMPLY WITH MACHINE SAFETY STANDARDS (ISO 12100 OR SIMILAR APPLICABLE STANDARDS).**

Below are examples of a protective system (*see Fig.2-23 to Fig.2-26*) commonly used for Test Bench (). All parts of the bench are accessible, but the covers prevent any risk to the user when closed.

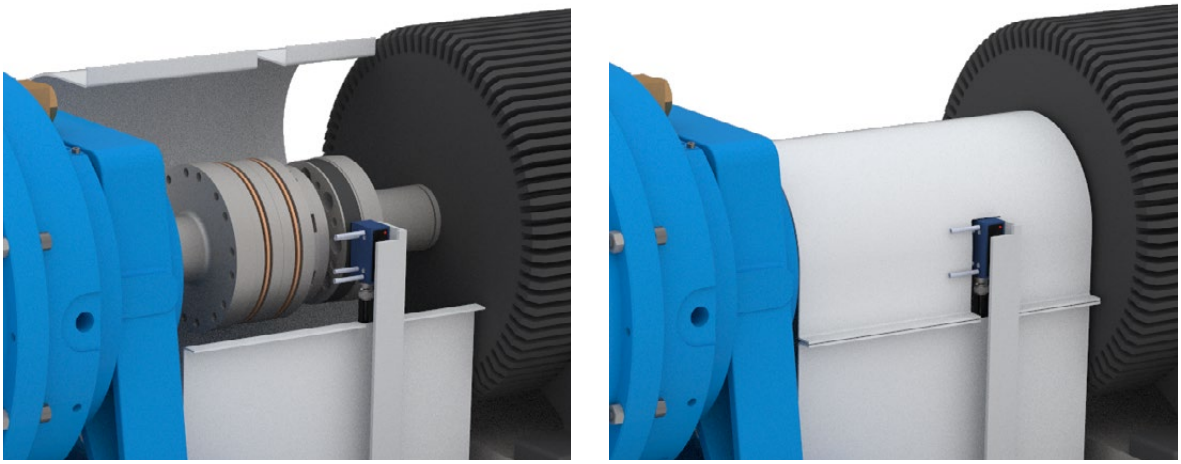


Fig.2-23 Example of specific protective system for TF Sensors

Fig.2-25 Turnkey customized test bench with retractable guard.



Fig.2-24 Test bench with fixed and movable metal guard with safety switch.

Fig.2-26 Custom motor test system with control rack and full safety protection all around the test table.

# 3. STARTUP

## 3.1 POWERING UP THE SYSTEM

1. Switch the system on (power up).
2. Check that all LEDs are illuminated. If this is not the case, please *see section 6.1 - LED Indicators*.

| LED | INDICATES |
|---|---|
| **CONDITIONER** | |
| Yellow | Conditioner is powered up. |
| Green | Conditioner receives a (return) signal. Data transmission is OK. |
| **HF TRANSMITTER** | |
| Red | HF transmitter is powered up. |

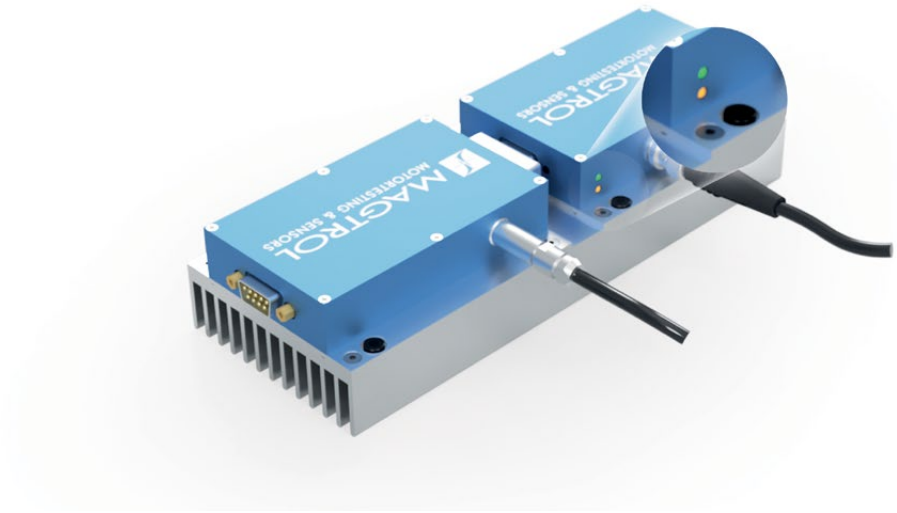



Fig.3-1 Green and Yellow LEDs on Torque Signal Conditioner


Fig.3-2 Red LED on HF Transmitter

## 3.2 OFFSET AND GAIN

Offset and Gain of TF Series Torque Flange Sensors are calibrated before delivery. However the zero (offset) may have drifted slightly after mounting the measuring flange (surface flatness, fastening torque of the screws, parasitic forces,...).

If necessary, proceed as follows:

1. Completely unload the measuring chain (no force should be applied to the TF Sensor).
2. Adjust the torque output signal by means of the "Offset" potentiometer placed inside the conditioner in order to obtain a zero value for the torque (0 N·m = 0.000 V).

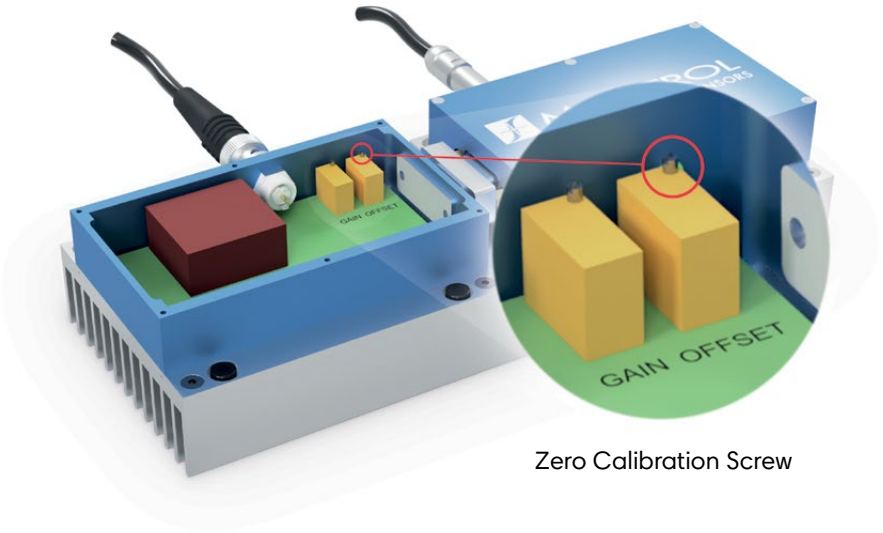



Fig.3-3 Zero Calibration of «1.5 W Conditioner» (TF 309 ... TF 317)


Fig.3-4 Zero Calibration of «5 W Conditioner» (TF 318 ... TF 320 Sensors)

**CAUTION** NEVER TOUCH THE "GAIN" ADJUSTMENT SCREW. IT IS ONLY USED AFTER A CONDITIONER REPLACEMENT OR REPAIR.

# 4. MEASURMENT CONSIDERATIONS

**CAUTION** WHEN PERFORMING STATIC MEASUREMENTS, IT IS POSSIBLE TO GO BEYOND NOMINAL TORQUE AND TOWARD THE TORQUE LIMIT WHICH CAUSES PLASTIC DEFORMATION. WHEN EXCEEDING THE NOMINAL TORQUE, ANY EXTRANEOUS LOADS SUCH AS AXIAL, SHEARING AND BENDING FORCES MUST BE AVOIDED.

## 4.1 DYNAMIC TORQUE

Static and dynamic measurements differ from one another by the evolution of torque over time. A constant torque produces static measurements, whereas varying torques can only be determined by dynamic measurement. TF Torque Flange Sensors have been designed to measure both static and dynamic torque.

## 4.2 DETERMINING THE NATURAL FREQUENCY OF A DRIVE TRAIN

**CAUTION** CRITICAL ROTATIONAL SPEEDS AS WELL AS NATURAL FREQUENCIES HAVE TO BE TAKEN INTO CONSIDERATION IN ORDER TO AVOID RESONANCES AND POSSIBLE OVERLOADING OF THE TF TORQUE FLANGE SENSOR.

In order to determine the dynamic torque and frequency response, and to prevent any damage to the system, it is necessary to calculate the natural frequency of the drive train's torsional oscillations.

The drive train is considered a combination of torsion springs with intermediate flywheel masses. In the TF Sensor, the deformation area of the measuring flange is the weakest link in the rotating measuring chain and is subject to torsional vibrations. A good approximation of the dominant torsional resonant frequency is given in the formula below:

***NOTICE*** For a detailed analysis of dynamic response, publications on structural mechanics should be consulted.

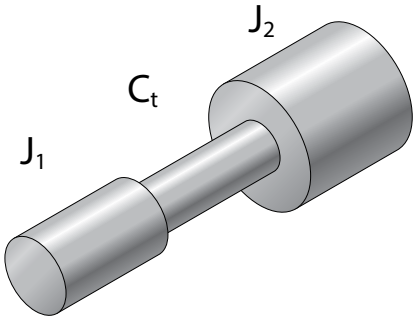



Fig.4-1 *Simplified Physical Drive Train Model*

- $f_0$ Natural frequency of system [Hz]
- $C_t$ Torsional stiffness of the flange [Nm/rad]
- $J_1$ Moment of inertia (driving element + mounting flange + ½ measuring flange) [kgm²]
- $J_2$ Moment of inertia (driven element + cardan shaft + ½ measuring flange) [kgm²]

A more detailed analysis of the dynamic system response may require the study of publications on structural mechanics. However, the following simplified model of a drive train can often be used.

$$f_0 = \frac{1}{2\pi}\sqrt{C_t \frac{J_1 + J_2}{J_1 \cdot J_2}}$$

**NOTICE** The natural torsional frequency of the drive train is lower due to the presence of the TF Torque Flange Sensor. The system's own natural frequency must then be recalculated to determine the influence of the TF Sensor.

The torsion spring describes the behavior of the measuring flange deformation zone. The torsional stiffness values ($C_t$) are indicated in the data sheet (*see section 1.3 - Datasheet*). Both moments of inertia ($J_1$ and $J_2$) are generated by the two deformation areas and can be calculated by adding the moment of inertia of each individual element. The moment of inertia of the flange is also indicated in the data sheet. Consult with the suppliers of the couplings, driving element(s) and driven element(s) in order to obtain details on moment of inertia of the other drive train components.

The natural torsional frequency ($f_0$) determines the response of the torque measuring system and helps to determine whether rapid variations may influence the measuring system or whether the torque is amplified or damped by the drive train dynamics. The transfer curve (*see Fig.4-2*) for various quality factor values (Q), depending on the torsional system damping factor. The graph charts the factor by which the torque will be amplified, depending on the frequency of the torsional oscillations.

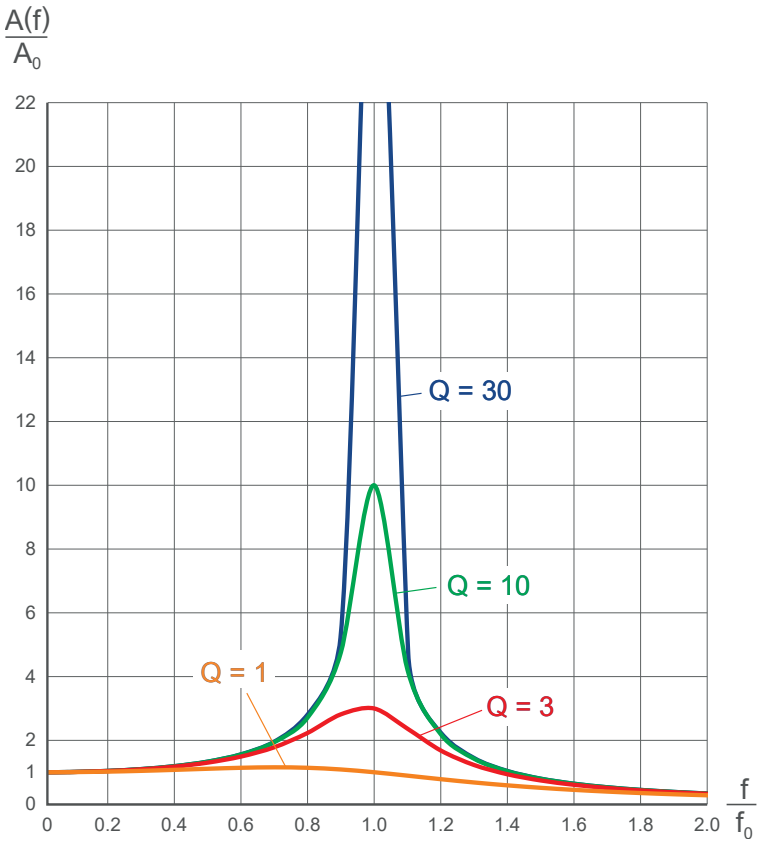



Fig.4-2 Drive Train Transfer Curve

Example Let us assume a natural frequency ($f_0$) of 1000 Hz and a quality factor Q=10. A dynamic torque around 900 Hz (close to the natural frequency) would be read by the TF torque flange sensor and amplified by a factor of approximately 6. It is important to note that this amplification is not electrical but mechanical. The risk of overloading the TF Sensor is therefore real.

**NOTICE** In practice, the system will be configured and used so as never to get close to the natural frequency of the measuring chain. The Q value must, if possible, be «1». For this reason, the drive train torsional oscillation frequency must be below ~0.5 $f_0$.

## 4.3 MAXIMUM DYNAMIC AMPLITUDE

The dynamic peak-to-peak amplitude must not exceed ±200 % of the nominal torque of the TF Torque Flange Sensor. This is even true with alternating loads. This amplitude must remain within -200 % $M_{nominal}$ and +200 % $M_{nominal}$ (*see Fig.4-3*).

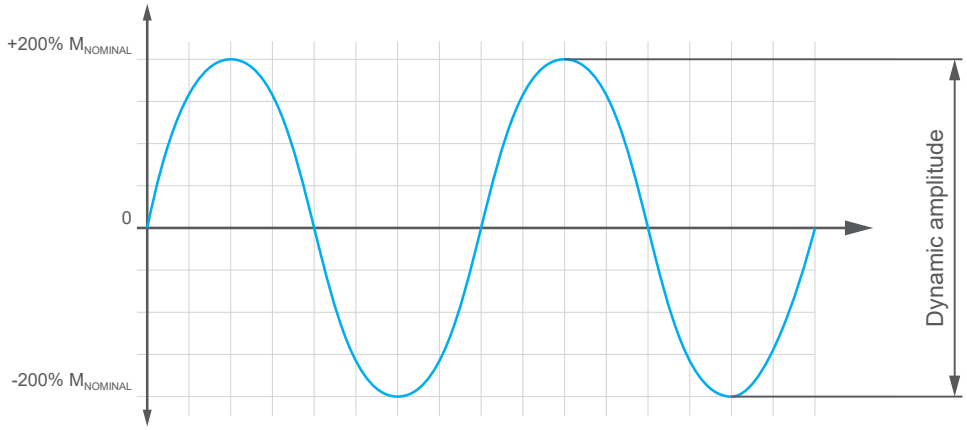



Fig.4-3 Admissible Dynamic Load

## 4.4 TEMPERATURE COMPENSATION

TF Series Torque Flange Sensors are temperature-compensated in their operating range 20 °C ... 85 °C in a balanced-temperature environment where the temperature on each face of the measuring flange is the same. When mounted between a warm and a cold element, the TF Sensor displays variations of measuring accuracy. Mounting the TF Sensor in an environment with a thermal gradient between the flange faces must be avoided.

## 4.5 PARASITIC FORCES

**CAUTION** NEVER EXCEED ADMISSIBLE LIMITS OF TORSIONAL MOMENTUM, AXIAL OR RADIAL FORCES. THE PARASITIC FORCES ARE TO BE AVOIDED AT MOST

If the TF Torque Flange Sensor is improperly installed, parasitic forces can act in both radial and axial directions on the sensor.

Radial forces generate torsional momentum on the TF Sensor which alters its center of gravity. The resulting imbalance will periodically load the TF sensor proportional to the rotational speed. The influence of this load increases with rotational speed.

Axial or radial forces, misalignment or unbalance will distort the measuring precision of the sensor. Modulation of axial or radial forces under rotation may cause an anticipated fatigue of the sensor and shorten its life time.

**NOTICE** The values provided in the table (*see Fig.4-4*) are dynamic limits. The dynamic limit could be much lower depending on the speed of application, balancing quality, alignment and vibrations.

The following table lists the admissible forces and torque which can be applied to the TF Series Torque Flange Sensors without damage.

| MODEL | Nominal Torque [N·m] | Limit Torque (150-200 % $M_{nominal}$) [N·m] | Rupture Torque (400 % $M_{nominal}$) [N·m] | Bending Torque [N·m] | Admissible Axial Force [N] | Admissible Radial Force [N] |
|---|---|---|---|---|---|---|
| TF 309 | 20 | 40 | 80 | 8 | 800 | 400 |
| TF 310 | 50 | 100 | 200 | 10 | 1 000 | 500 |
| TF 311 | 100 | 200 | 400 | 15 | 1 200 | 750 |
| TF 312 | 200 | 400 | 800 | 20 | 1 500 | 1 000 |
| TF 313 | 500 | 1 000 | 2 000 | 120 | 5 000 | 6 000 |
| TF 314 | 1 000 | 2 000 | 4 000 | 220 | 12 000 | 8 000 |
| TF 315 | 2 000 | 4 000 | 8 000 | 600 | 15 000 | 15 000 |
| TF 316 | 5 000 | 10 000 | 20 000 | 700 | 20 000 | 20 000 |
| TF 317 | 10 000 | 15 000 | 40 000 | 1 200 | 40 000 | 25 000 |
| TF 318 | 20 000 | 40 000 | 80 000 | 15 000 | 180 000 | 100 000 |
| TF 319 | 50 000 | 90 000 | 200 000 | 22 000 | 200 000 | 140 000 |
| TF 320 | 100 000 | 200 000 | 400 000 | 26 000 | 220 000 | 160 000 |

Fig.4-4 Table of admissible parasitics forces

# 5. OPERATING PRINCIPLES

## 5.1 TELEMETRY PRINCIPLE

Signal transmission between static and rotating components has always been plagued with technical problems. Magtrol's TF Series Torque Flange Sensors provide an interesting solution by using telemetry for signal transmission.

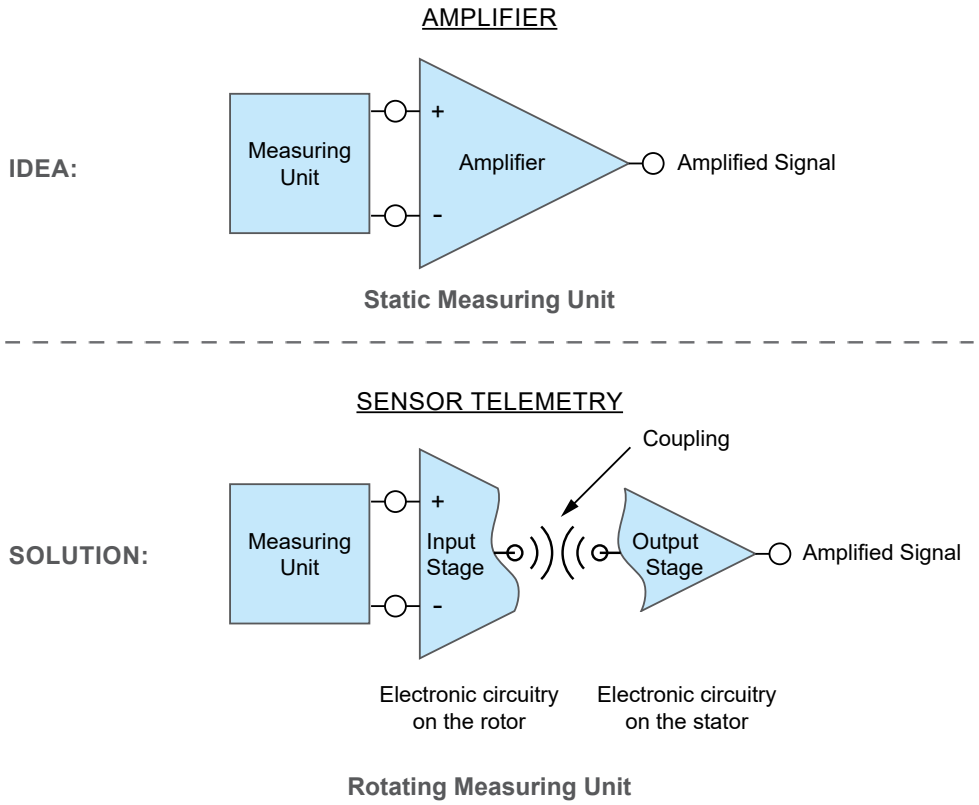



Fig.5-1 Telemetry Principle Applied to TF Torque Flange Sensors

## 5.2 SIGNAL TRANSMISSION

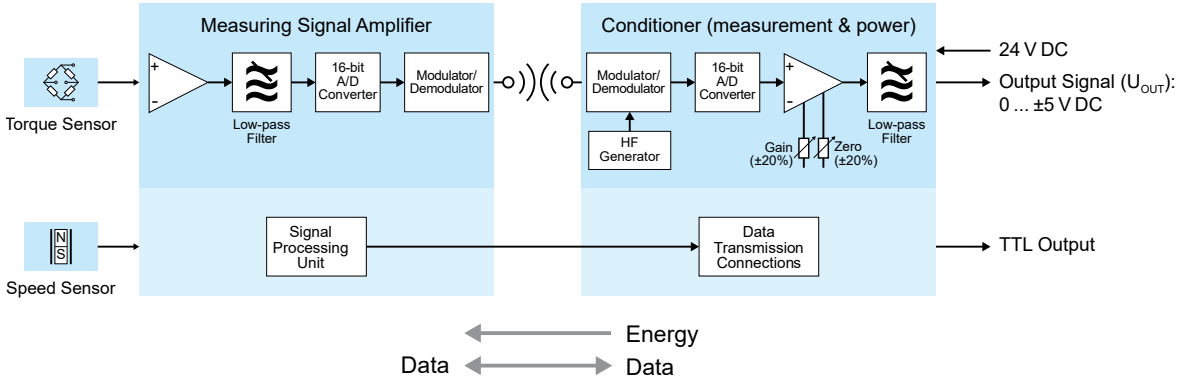



Fig.5-2 Signal Transmission Block Diagram

### 5.2.1 MEASURING FLANGE TO CONDITIONER

The torque signal is generated by strain gauges in a full-bridge configuration that are glued onto the inside of the measuring flange. This system has proven its efficiency and reliability over many decades with high measurement accuracy.

The signal delivered by the measuring flange is first amplified, and then sent to a low-pass filter before being digitalized with 16-bit resolution. Afterwards, the signal is modulated for transmission on an HF carrier wave (13.56 MHz). All this is carried out in the electronic module located inside the rotor. The measured signal is then transmitted by induction to the HF transmitter and finally demodulated by the conditioner.

### 5.2.2 CONDITIONER TO MEASURING FLANGE

A similar procedure is also used on the conditioner side which transmits the supply voltage (24 V) as well as the remote calibration signal to the rotor.

### 5.2.3 SPEED SENSOR TO SPEED CONDITIONER

Using the magnetoresistor principle, the (optional) speed sensor delivers a signal to the speed conditioner with a frequency proportional to the rotational speed.

# 6. TROUBLESHOOTING

## 6.1 LED INDICATORS

| LED COLOR | LED IS NOT ILLUMINATED | RECOMMENDATION |
|---|---|---|
| **CONDITIONNER HOUSING** | | |
| Yellow | Power supply problem. | Check conditioner power supply:<br>TF309-TF317: 24 VDC (stabilized) / 350 mA min.<br>TF318-TF320: 220 VAC |
| | The conditioner is defect. | Return conditioner to Magtrol. |
| Green | Signal transmission problem. | Check HF transmitter (*see section 2.4-HF Transmitter Mounting*). |
| | Measuring flange is defect. | Return entire torque flange sensor (with its conditioner and HF transmitter) to Magtrol. |
| **HF TRANSMITTER** | | |
| Red | HF transmitter power supply problem. | Check conditioner power supply, HF transmitter connectors and the cable. |
| | HF transmitter is defect. | Return HF transmitter to Magtrol. |

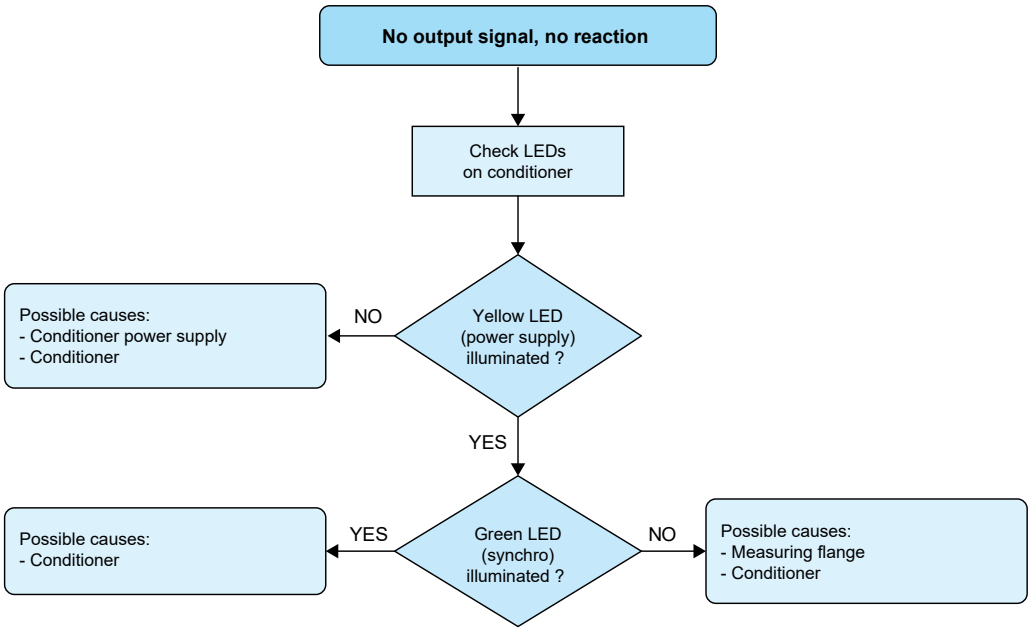
## 6.2 TROUBLESHOOTING

The following problems may occur with TF Series Torque Flange Sensors:

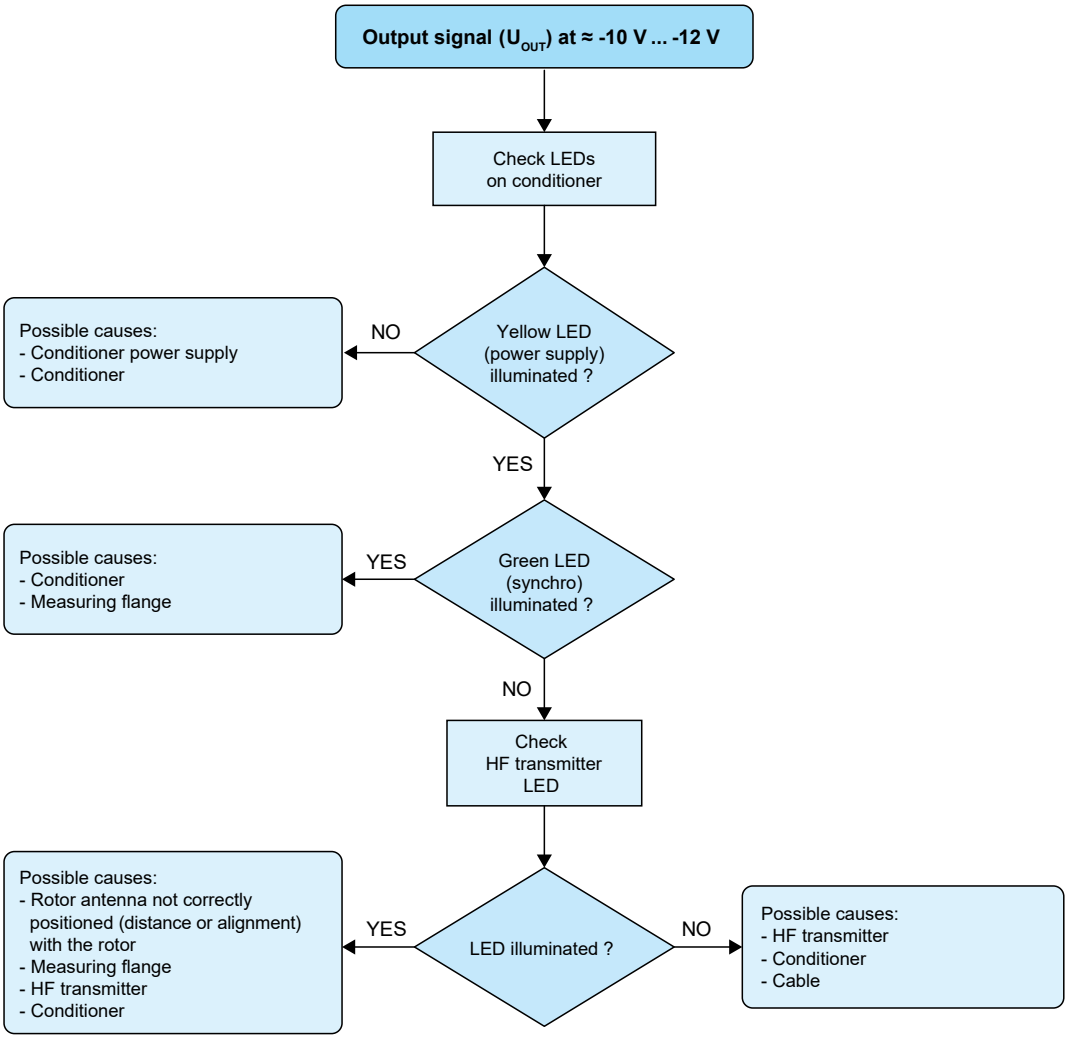
- No output signal / no reaction (*see section 6.2.1*).
- Output signal ($U_{out}$) remains between -10 V and -12 V (*see section 6.2.2*).
- «0» offset (signal behaves normally) (*see section 6.2.3*).
- Signal is at ¾ of its nominal value (calibration value) when the measuring flange is unloaded, or the signal varies according to the load (*see section 6.2.4*).
- Unstable signal (*see section 6.2.5*).

The possible causes of these problems are shown in the following flowcharts.

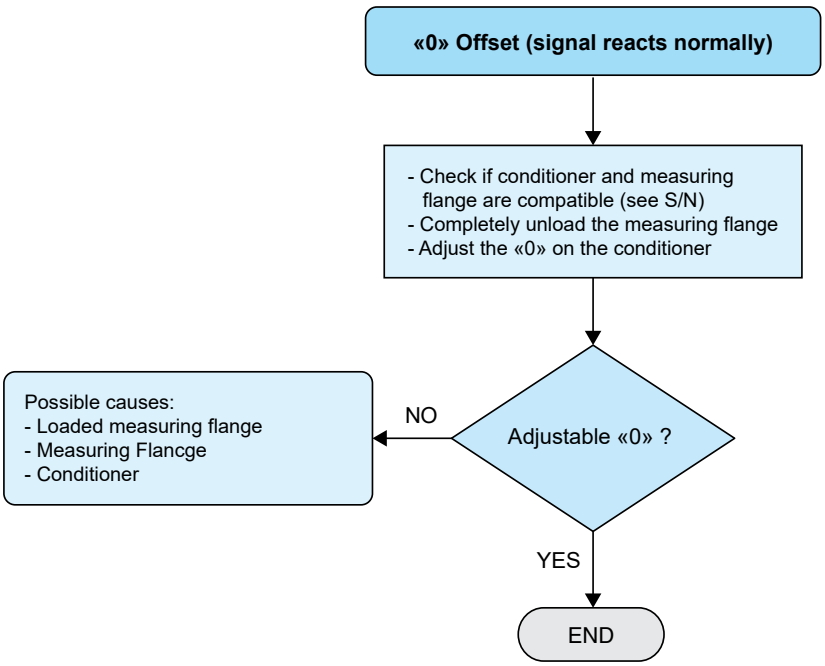
### 6.2.1 NO OUTPUT SIGNAL / NO REACTION



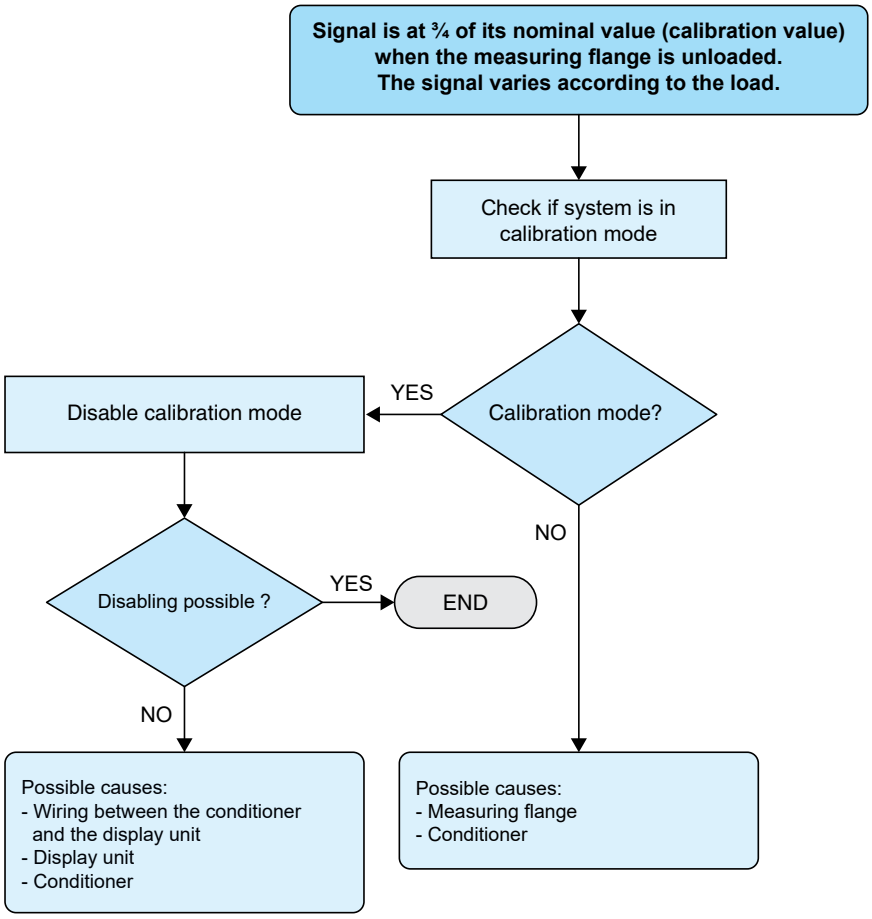
### 6.2.2 OUTPUT SIGNAL REMAINS BETWEEN -10 ... -12 V



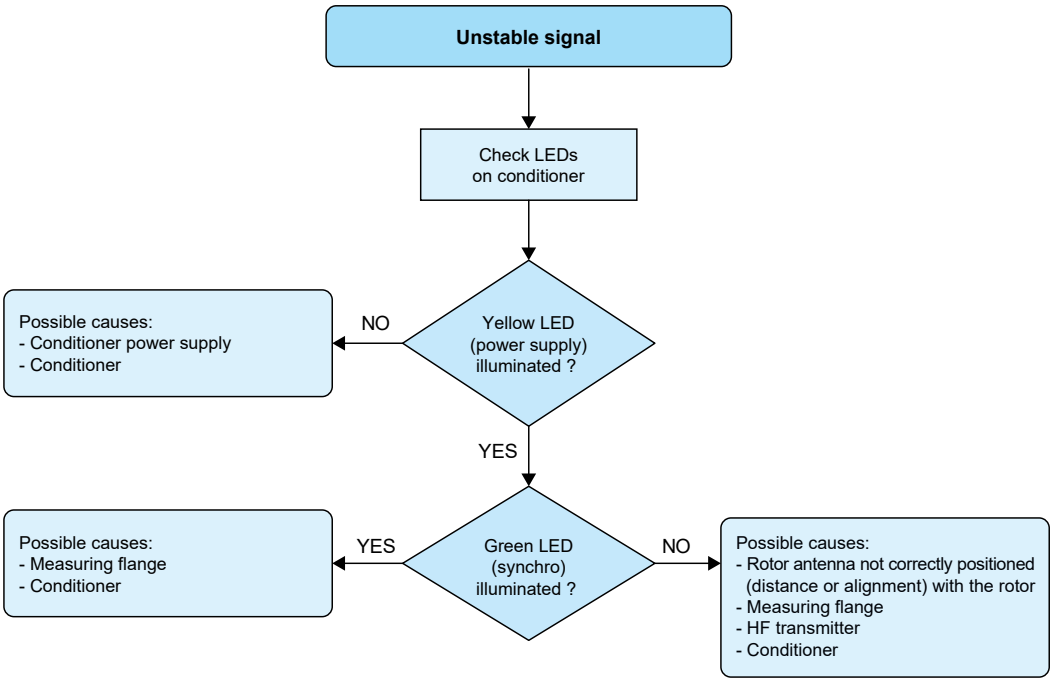

### 6.2.3 «0» OFFSET WITH NORMAL SIGNAL



### 6.2.4 SIGNAL AT ¾ OF ITS NOMINAL VALUE WHEN UNLOADED




### 6.2.5 UNSTABLE SIGNAL




**NOTICE** For additional assistance, please contact Magtrol Customer Service.

# 7. MAINTENANCE, REPAIR & CALIBRATION

## 7.1 MAINTENANCE

Magtrol TF Series Torque Flange Sensors are virtually maintenance-free. This is due to the following aspects of their construction:

- No bearings or other parts in contact.
- Transmission of the torque signal from the rotating measuring elements to the signal processing electronics by a process of induction rather than by using slip rings. This eliminates mechanical wear.

**CAUTION** THE USER MUST NOT ATTEMPT TO CHANGE OR REPAIR ANY COMPONENTS HIMSELF. FOR ALL MAINTENANCE OR REPAIR OPERATIONS, PLEASE RETURN THE SENSOR TO MAGTROL.

SIMILARLY, THE USER SHOULD NOT ATTEMPT TO CARRY OUT REVISIONS OR REPAIRS OF ANY KIND ON THE MECHANICAL OR ELECTRONIC COMPONENTS MAKING UP THE TRANSDUCER. IF A PROBLEM IS SUSPECTED, MAGTROL SHOULD BE CONTACTED SO THAT ARRANGEMENTS CAN BE MADE TO PERFORM ANY REPAIRS IN THE FACTORY.

FAILURE TO COMPLY MAY RESULT IN SERIOUS DAMAGE TO THE TRANSDUCER OR MAY INVALIDATE THE WARRANTY.

***NOTICE*** Any component of the TF Sensor measuring system **are sealed**. If there is any evidence that the housing has been opened and unauthorized modifications have been attempted, **the warranty will be invalidated.**

### 7.1.1 DISMOUNTING THE MEASURING FLANGE

When dismounting the measuring flange from the drive train, make sure that all mounting screws are removed including those which are not visible from outside.

**CAUTION** NEVER USE THE MEASURING FLANGE FOR LEVERAGE WHEN DISMOUNTING THE SENSOR.

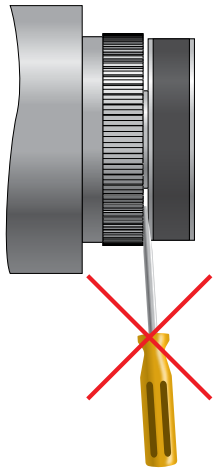


Fig.7-3 Improper Dismounting

## 7.2 REPAIR

In case of a defect, please *see chapter SERVICES INFORMATION* of this manual. Whether you are directed to ship your equipment back to MAGTROL INC. in the United States or MAGTROL S.A. in Switzerland, it is very important to include the following information with your return shipment:

1. Model number, part number, serial number, order number and date of acquisition
2. Description of the defect and the conditions in which it appeared
3. Description of the test bench (drawing, photographs, sketches, etc.)
4. Description of the tested object (drawing, photographs, sketches, etc.)
5. Description of the test cycle

**CAUTION** MAINTENANCE MUST BE PERFORMED BY MAGTROL IN ORDER TO GUARANTEE FUTURE MEASURING ACCURACY.

To allow MAGTROL to complete the work in the best possible time, carefully pack the torque transducer and follow the procedure outlined *see chapter SERVICES INFORMATION* of this manual.

## 7.3 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 Torque 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 specialists. In addition, any wear and tear requiring maintenance will be immediately taken care of by our after-sales service team.

# SERVICES INFORMATION

## RETURNING MAGTROL EQUIPMENT FOR REPAIR AND/OR CALIBRATION

When returning equipment to MAGTROL INC. (United States) or MAGTROL S.A. (Switzerland) for repair and/or calibration, a completed **Return Material Authorization (RMA) form is required.**

Please consult the «Services/Return and Calibration» section on our web site www.magtrol.com, in order to choose the most appropriate recipient for your needs.

Depending on where the equipment is located and which unit(s) will be returned, you will be directed to either ship your equipment back to MAGTROL, Inc. in the United States or MAGTROL S.A. in Switzerland.

## RETURNING EQUIPMENT TO MAGTROL INC. (UNITED STATES)

1. Visit the «Services/Return and Calibration» section of Magtrol's web site www.magtrol.com to initiate an RMA procedure. Complete the RMA form online and submit.
2. An RMA number will be issued to you via e-mail. Include this number on all return documentation.
3. Ship your equipment to: **MAGTROL, INC.**
   **70 Gardenville Parkway**
   **Buffalo, NY 14224 | USA**
   **Attn: Repair Department**
4. After Magtrol's Repair Department receives and analyzes your equipment, a quotation listing all the necessary parts and labor costs, if any, will be faxed or e-mailed to you.
5. After receiving your repair estimate, provide Magtrol with a P.O. number as soon as possible. A purchase order confirming the cost quoted is required before your equipment can be returned.

### CONTACT FOR AFTER SALES SERVICE AT MAGTROL INC.

After Sales, Repair & Calibration Services

phone +1 716 668 5555 ext. 115
fax +1 716 668 3162
e-mail service@magtrol.com

## RETURNING EQUIPMENT TO MAGTROL S.A. (SWITZERLAND)

1. Visit the «Services/Return and Calibration» section of Magtrol's web site www.magtrol.com to initiate an RMA procedure; complete the RMA form online and submit.
2. After your request has been reviewed, you will receive an email containing an RMA number and dedicated return instructions including specifics about shipping details. The RMA number will be a Magtrol SA internal repair order (SR-xxxx) reference.

   Any **shipment sent without an RMA risks delays and possible rejection,** so please wait until you receive the email with the details you will need to properly return your equipment.

   Any **equipment returned for credit must be approved** prior to return and is subject to a re-stocking fee.

### CONTACT FOR AFTER SALES SERVICE AT MAGTROL S.A.

After Sales, Repair & Calibration Services

phone +41 26 407 30 00
fax +41 26 407 30 01
e-mail repair@magtrol.ch

# REVISIONS TO THIS MANUAL

The contents of this manual are subject to change without prior notice. The latest updated versions of our manuals are available and downloadable at any time on Magtrol's website www.magtrol.com in the « SUPPORT » section.

To ensure that you have the latest version, compare the issue date (on the back of this manual) with the last updated document available on our website.

The table of revisions below lists the significant updates that have been made.

## REVISION DATES

| DATE | EDITION | CHANGE | SECTION(S) |
|---|---|---|---|
| Nov. 2021 | 3rd Edition - rev. A | Golbal update of the manual<br>Continued updates regarding the previous TF312 ... TF314 and TF317 ... TF320 updates.<br>Integration of the new TF 315 & TF 316 | All |
| Nov. 2014 | 2nd Edition - rev. H | Update Data Sheet | 1.2 |
| Oct. 2014 | 2nd Edition - rev. G | Remove TF209, TF210, TF211 and TF212<br>Add TF309, TF310, TF311 and TF312<br>All references to Torque 1.0 changed to Torque 7<br>All references to 3410 changed to MODEL 3411<br>Update Data Sheet | All |
| Apr. 2011 | 2nd Edition - rev. F | text concerning parasitic forces updated | 4.4 |
| Dec. 2009 | 2nd Edition - rev. E | New information about the cardan shaft was added in section 2.2.4.5.<br>New information about radial forces, axial forces and dynamic limit was added to section 4.4. | 2.2.4.5, 4.4 |
| June 2009 | 2nd Edition - rev. D | Changed values for TF 220 | 2.2.4.1 |
| Mar. 2009 | 2nd Edition - rev. C | Added (N/C for 5W conditioner) to pin 7 | 2.5.3.1 |
| Mar. 2009 | 2nd Edition - rev. B | 0.5 mm distance changed to 1.5 mm distance | 2.4.1 |
| Mar. 2008 | 2nd Edition - rev. A | New design for standard speed sensor | 1.2, 2.41 |
| Jan. 2008 | 2nd Edition | Added TF 209 | All |
| Oct. 2007 | 1st Edition - rev. A | Added high-temperature speed sensor information | 1.2, 2.4.2 |

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