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KISTLER
measure. analyze. innovate.

# Instruction Manual

## Mini-Smart Torque Sensor Type 4502A...

**Version Q**
(with standard square connections)

**Version H**
(with standard hexagon connections)

**Version QA/HA**
(with rotating angle measuring system)

**Version RA**
(with round shaft and rotation angle measurement)

4502A_002-407e-03.08

# Foreword

We thank you for choosing a Kistler quality product distinguished by technical innovation, precision and long life.

Information in this document is subject to change without notice. Kistler reserves the right to change or improve its products and make changes in the content without obligation to notify any person or organization of such changes or improvements.



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# Content



Total Pages 22

# 1. Introduction

Please take the time to thoroughly read this instruction manual. It will help you with the installation, maintenance, and use of this product.

Kistler offers a wide range of products for use in measuring technology:

- Piezoelectric sensors for measuring force, torque, strain, pressure, acceleration, shock, vibration and acoustic-emission
- Strain gage sensor systems for measuring force and moment
- Piezoresistive pressure sensors and transmitters
- Signal conditioners, indicators and calibrators
- Electronic control and monitoring systems as well as software for specific measurement applications
- Data transmission modules (telemetry)

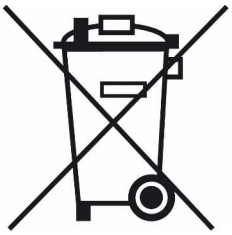
Kistler also develops and produces measuring solutions for the application fields engines, vehicles, manufacturing, plastics and biomechanics sectors.

Our product and application brochures will provide you with an overview of our product range. Detailed data sheets are available for almost all products.

If you need additional help beyond what can be found either on-line or in this manual, please contact Kistler's extensive support organization.

# 2. Important Information

## 2.1 Disposal Instructions for Electrical and Electronic Equipment



Do not discard old electronic instruments in municipal trash. For disposal at end of life, please return this product to an authorized local electronic waste disposal service or contact the nearest Kistler Instrument sales office for return instructions.

# 3. Application and Key Features

- Torque meter with strain gages measuring system
- Wear-resistant transmission of the measuring signal, integrated amplifier
- Measurement of constant and variable torques
- Torque measurement on the rotating shaft
- Integrated system for rotation angle measurement (only version QA/HA)
- Application in the laboratory, manufacture and quality control
- Ideal for use with power tools (version QA/HA) and test stand construction (version RA)
- Suitable for low and high speed ranges

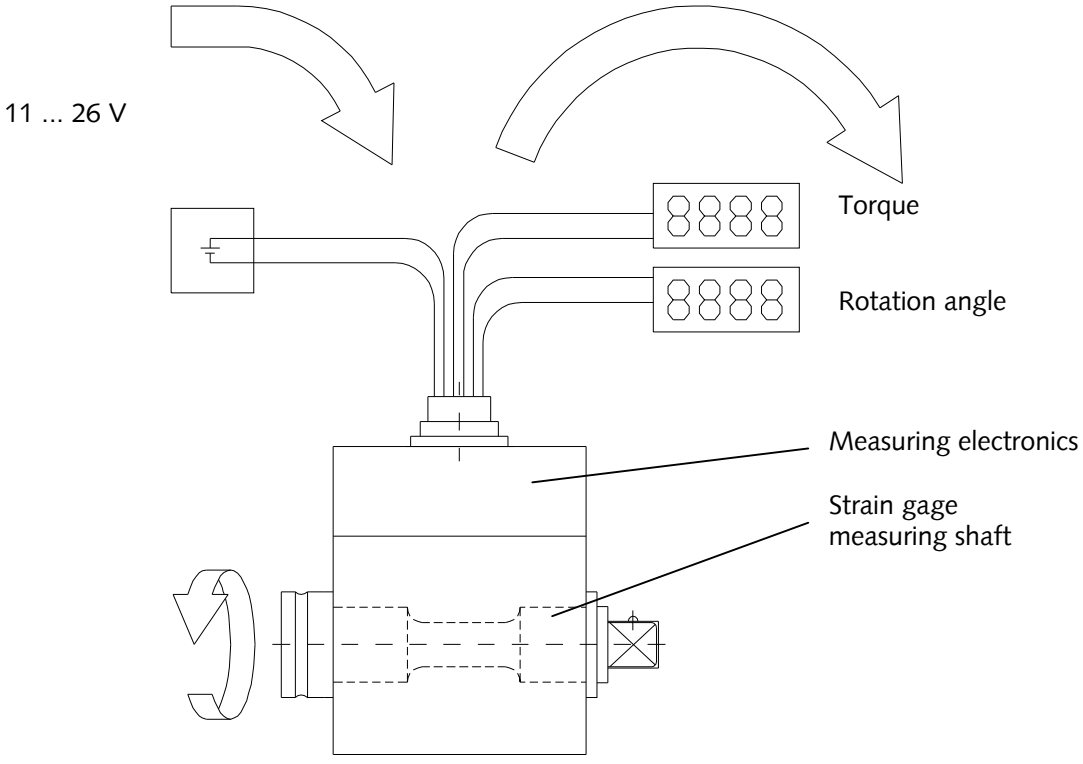



Fig. 1: Mini-Smart torque sensor

# 4. Description of the Measuring System

## 4.1 Mechanical Design

Torque Sensors type MS consist of a base body which contains the measuring shaft. The shaft ends are performed as standard square connections or standard hexagon ends.
On the measuring shaft there is a torsion distance with strain gauges and electronics with signal amplifier and A/D transformer.
The connection box of the base body contains the stationary electronics for the signal formation.
The base body of the Sensor offers different assembly possibilities (see chapter 5.2).

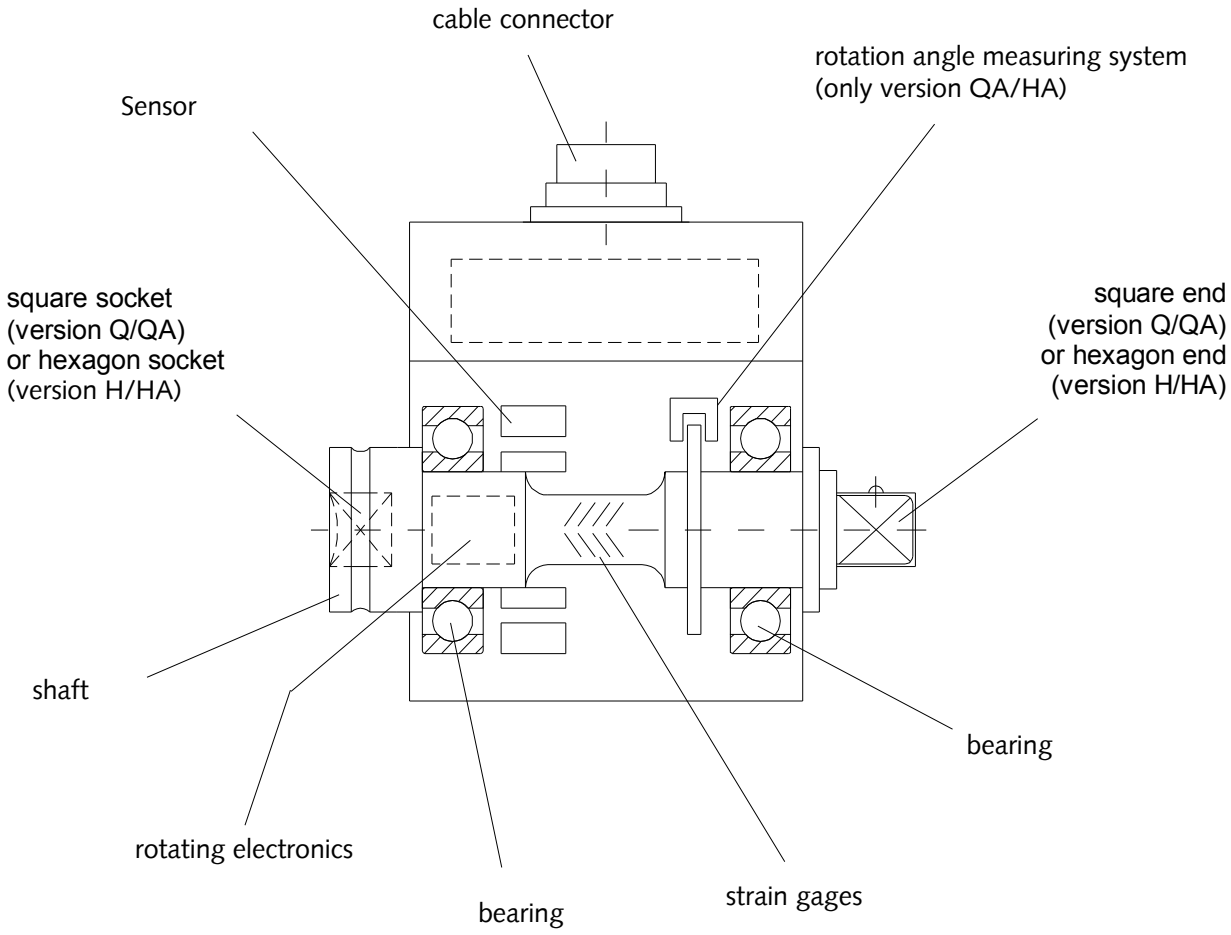



Fig. 2: Mechanical design Mini-Smart torque sensor Type 4502A...

## 4.2 Electrical Block Diagram

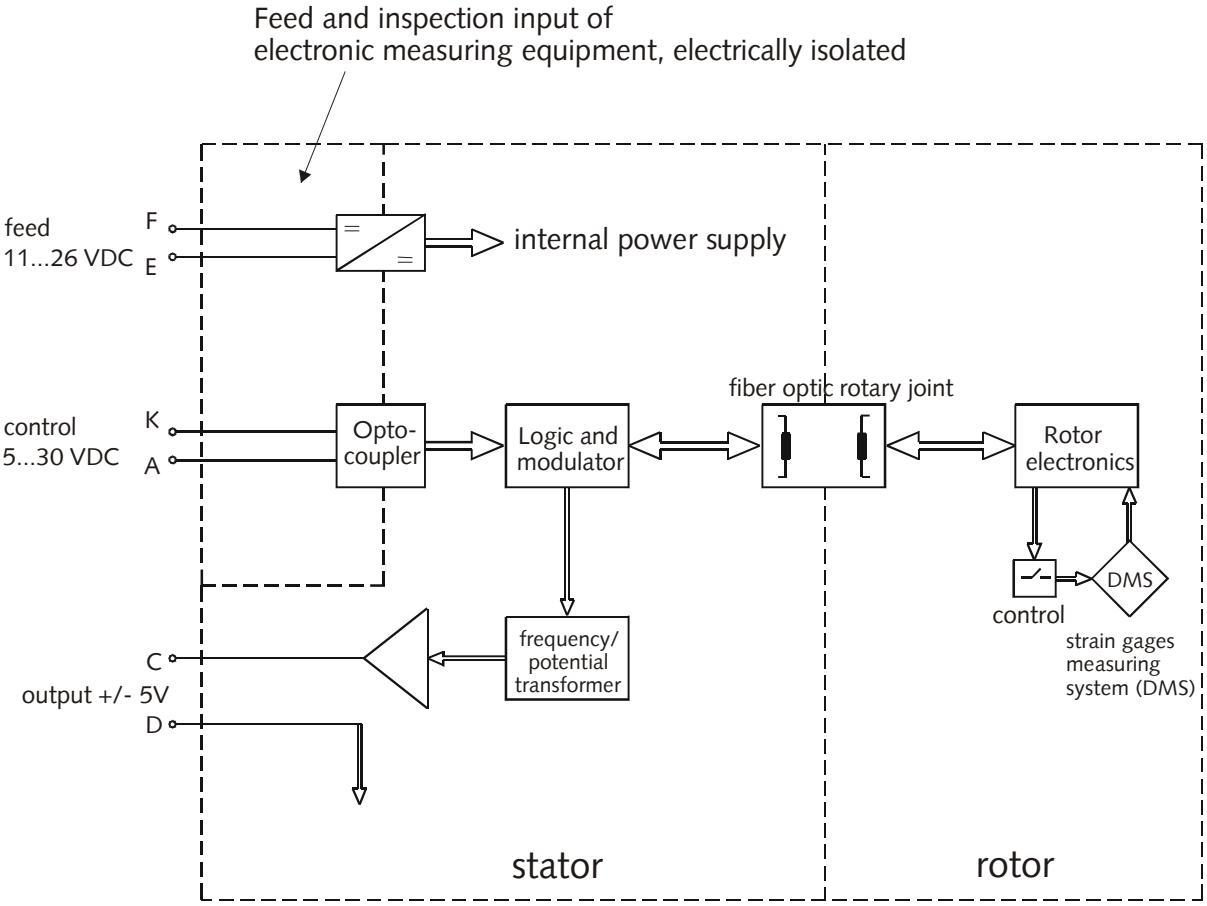



Fig. 3: Electrical block diagram

### 4.2.1 Examples of Application

Exactly use of electrical isolation for feed and measuring signal.

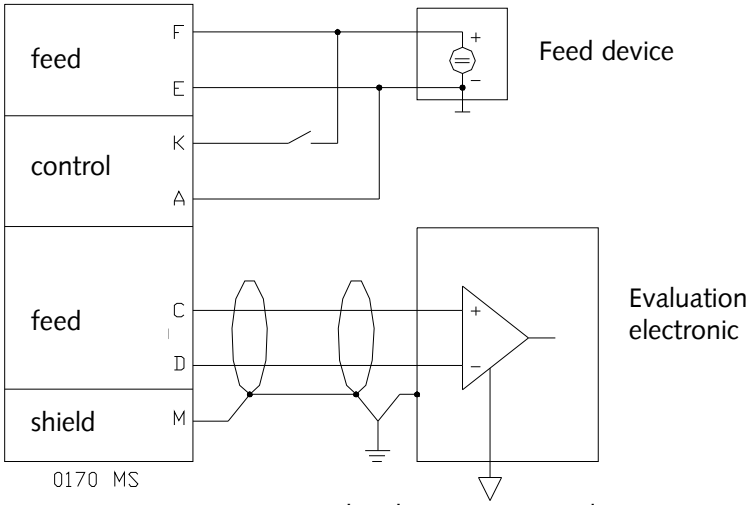



Fig. 4: Separate speed and measuring supply

Shared access measuring supply for feed and measuring supply.


Interlink the feed and measuring supply, evaluation electronic is to be made.

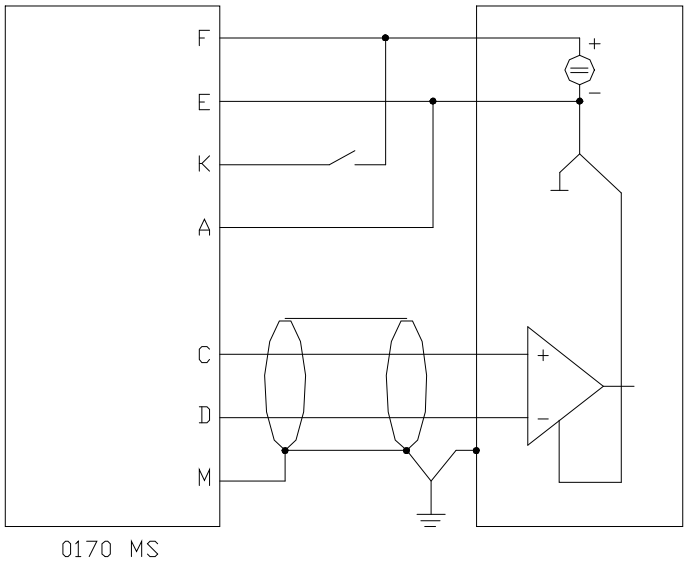



Fig. 5: feed and measuring supply in the evaluation electronic combined

## 4.3 Rotation Angle Measuring System (Version QA/HA and RA only)

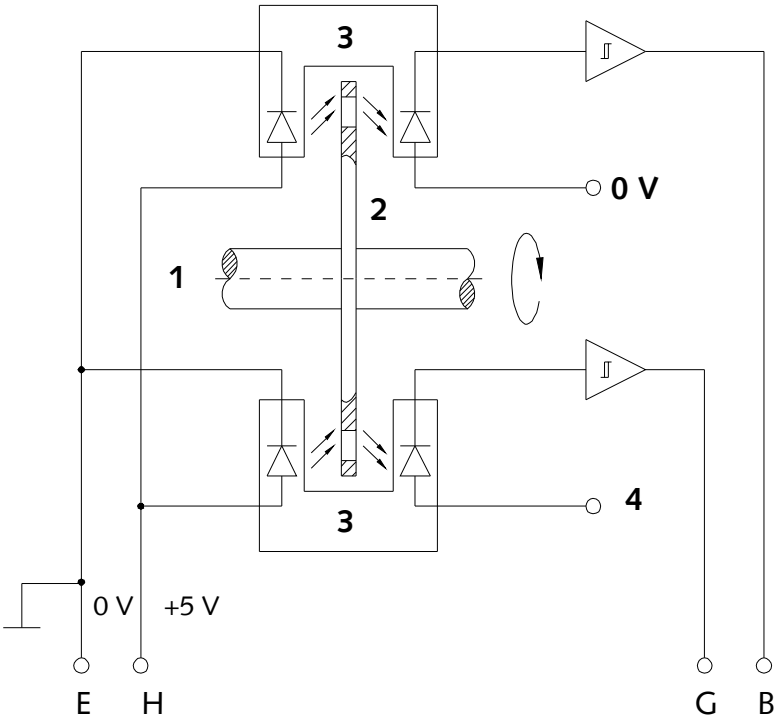



Fig. 6: Diagram showing the design of the rotation angle measuring system

1. Rotating shaft
2. Pulse disk
3. Forked light barrier with LED and photo diode
4. operation amplifier

**Features:**

- 360 light-dark stripes on the pulse disk
- Two forked light barriers shifted by phase angle 90°
- Pulse number proportional to the rotation angle

## 4.4 Adjustment for Angle-Pulse Output (Version QA/HA and RA only)

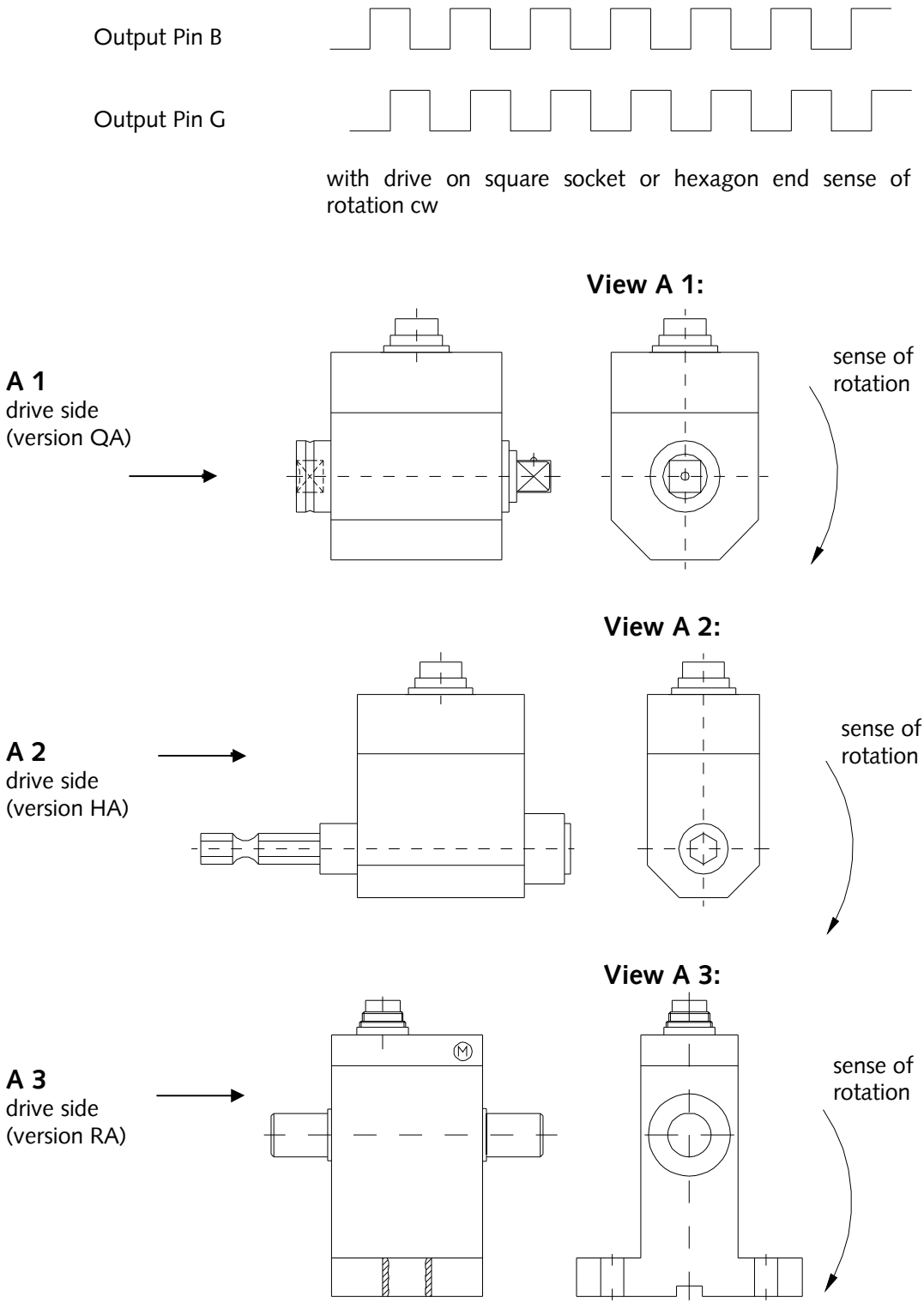



Fig. 7: Adjustment for angle-pulse output

# 5. Electrical Connections

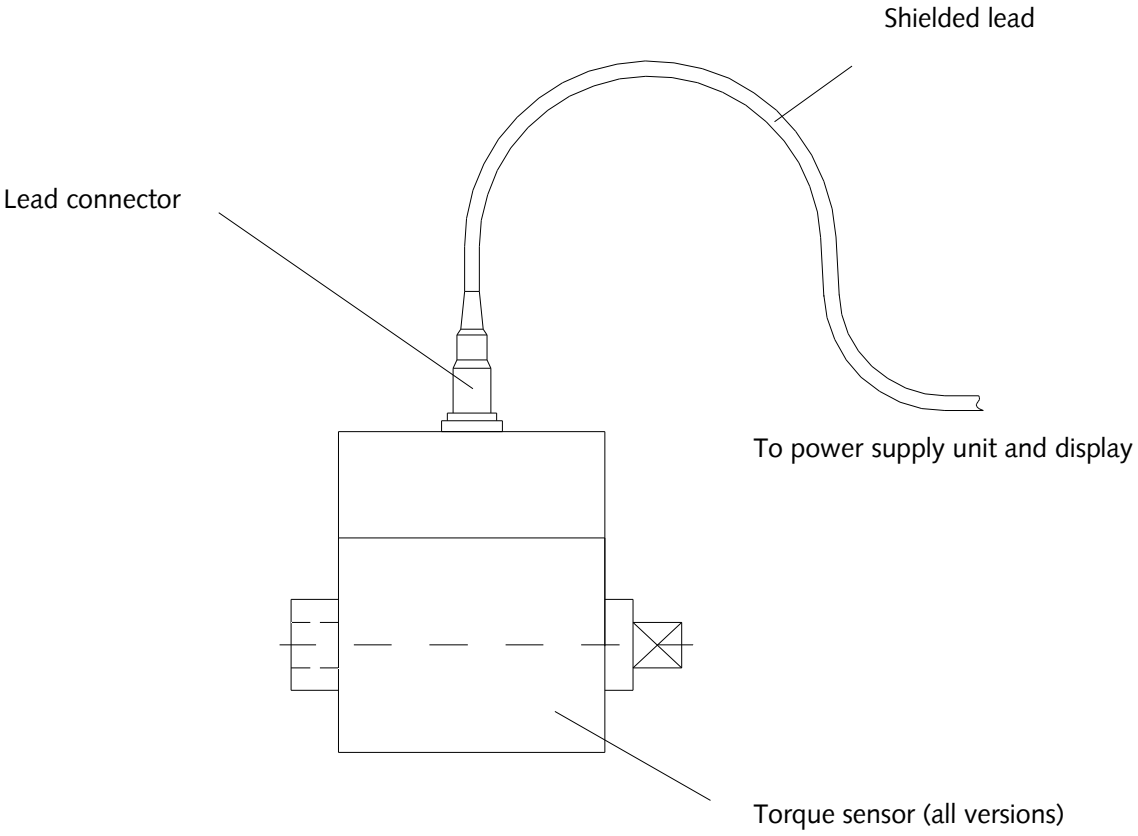


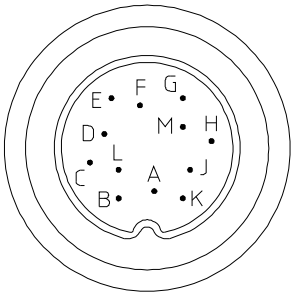

Fig. 8: Electrical connections

- Shielded lead of 0,14 mm² nominal cross section

## 5.1 Plug Connection (Tuchel, 12 pin)

| Function | Pin |
|---|---|
| GND electric calibration input signal | A |
| Angle 1, speed | B |
| Measuring signal $U_a$ ±5 VDC | C |
| GND measuring signal $U_a$ ±5 VDC | D |
| GND supply voltage $U_b$, angle, speed | E |
| Supply voltage $U_b$ +11 V ... +26 V, 1 W | F |
| Angle 2 (90° shifted to angle 1) | G |
| Supply angle +5 V | H |
| Torque range detection | J |
| El. Calibration input Kal. +5 V ... 30 VDC (activation generates a rated output voltage of +5 VDC) | K |
| GND torque range detection | L, option |
| Shield | M |

**Top view built-in plug**




### 5.1.1 Installing the Signal Lead

- Do not run the lead parallel to power cables or control circuits.
- Do not place the lead close to equipment producing strong electromagnetic fields,
- e.g. transformers, welders, contactors, electric motors, etc.
- If such situations cannot be avoided, run the lead inside earthed steel conduit.
- Make a loop in the lead when fixing it at the torque meter so that it is not damaged by vibration. If supply and evaluation unit are galvanically connected, a differential input must be used for the torque singal to prevent that the voltage drop on the 0 V-supply line affects the measured signal

## 5.2 Instruction for Electrical Installation

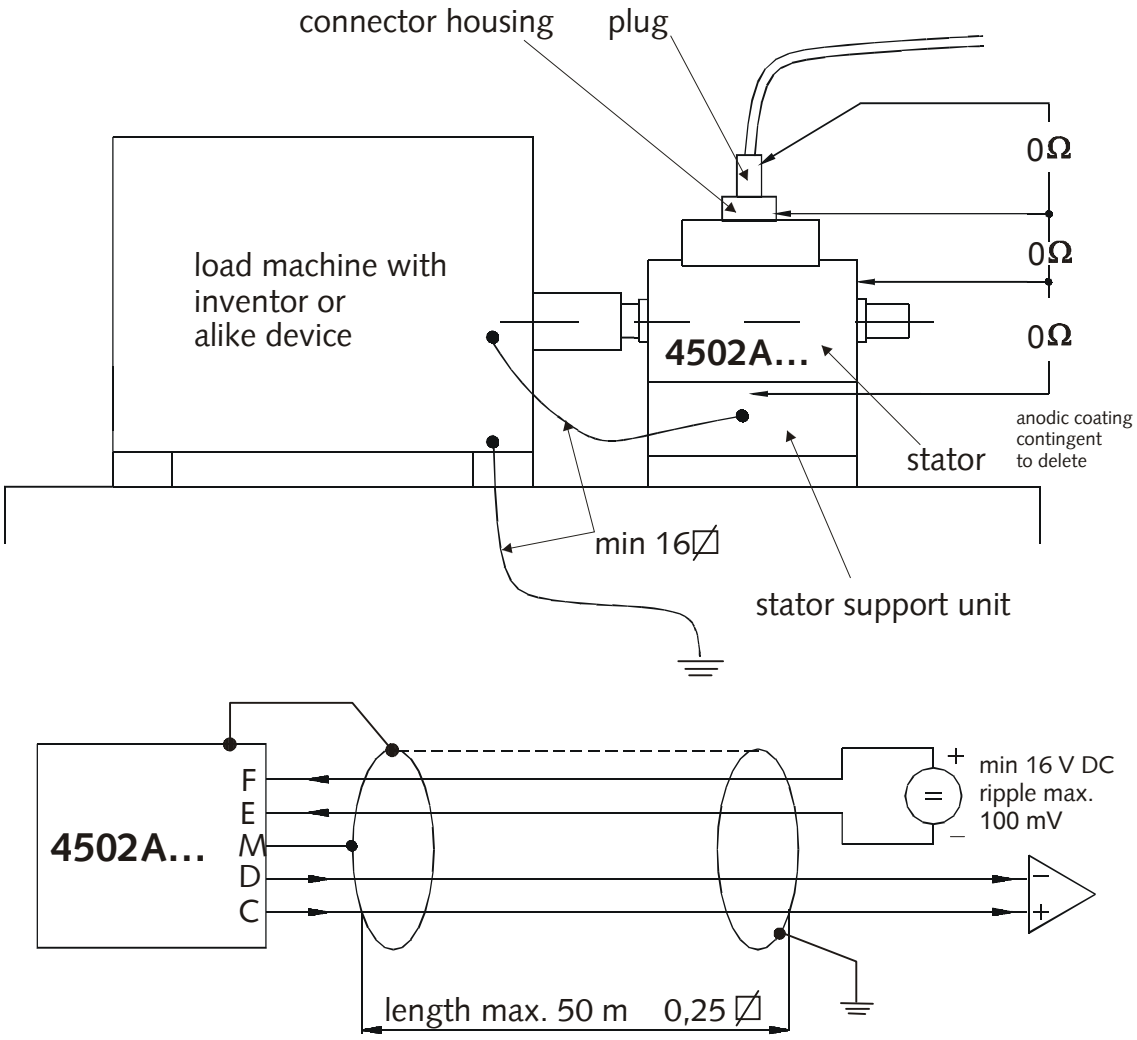
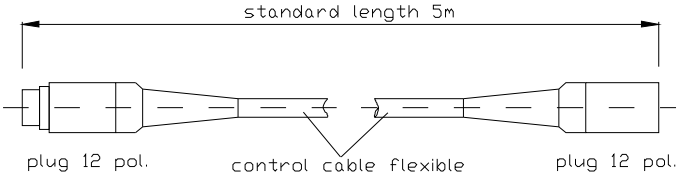



Fig. 9: Electrical installation

## 5.3 Connecting Cable

### 5.3.1 Cable Diagram with Plugs on Both Sides




wh= white
re= red
bl= black
blu= blue
pi= pink
gr= green
gr= grey
vi= violett

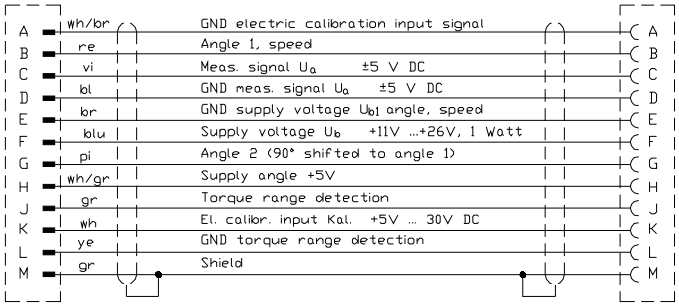



Fig. 10: Cable diagram with plugs on both sides

### 5.3.2 Cable Diagram, Plug (Sensor), Open Ends, Article-No.: 12497

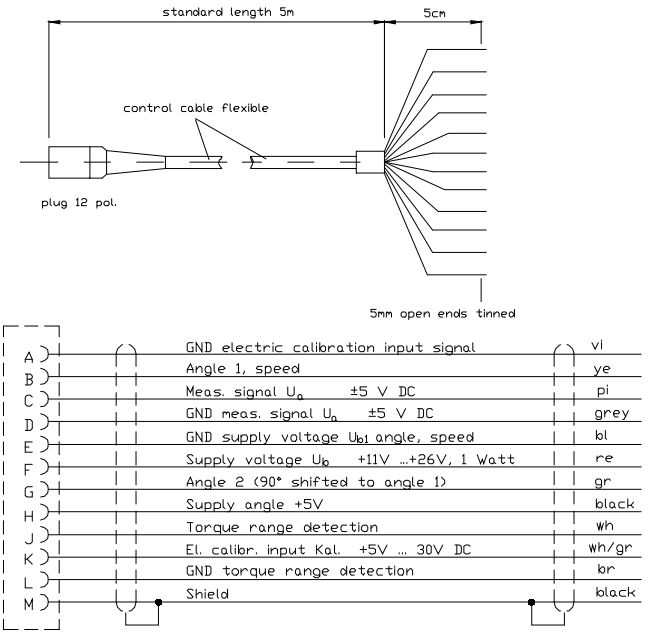



Fig. 11: Cable diagram, plug (sensor), open ends

# 6. Mechanical Application

## 6.1 Versions Q, QA, H and HA

- Torque meters of version Q and QA have square connections for plug-in tools acc. to DIN 3121
- Torque meters of version H and HA have hexagon connections acc. to DIN 3126, form E/F
- The torque meters are plugged on to the drive spindle as shown below

**Application examples:**

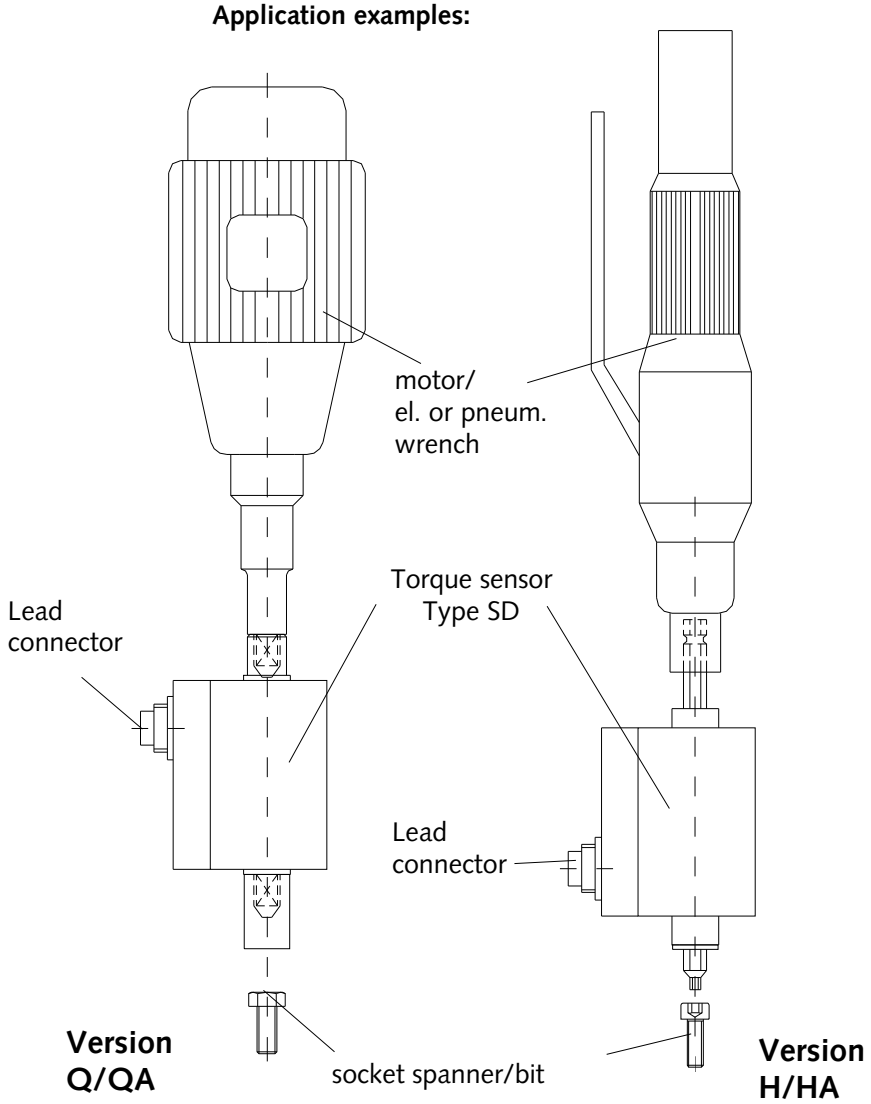



Fig. 12: Application examples versions Q/QA & H/HA

## 6.2 Torque Measuring Shaft Version RA

For the electric connection of measuring shaft and supply- and evaluation unit we recommend to use the shielded signal lead, art. no. 7203 with low capacity. Version VA 3600 is recommended as supply and evaluation unit.

The signal lead should not exceed a length of 30 meters. Do not run the lead parallel to power cables or control circuits.
The pin connection is explained in chapter 4.1 of this manual.

On each side of the torque measuring shaft there is a high quality bearing installed, and it contains an integrated housing base. The installation can have any position, however offset couplings must always be applied to balance geometrical false adjustments and like that keep false loads away from the torque measuring shaft.

**Radial, axial, diagonal and angular errors are compensated by:**

- Multi-disk couplings, e.g. data sheet 8301
- or diaphragma coupling
- or claw couplings

## 6.3 Possible Installation of Version RA

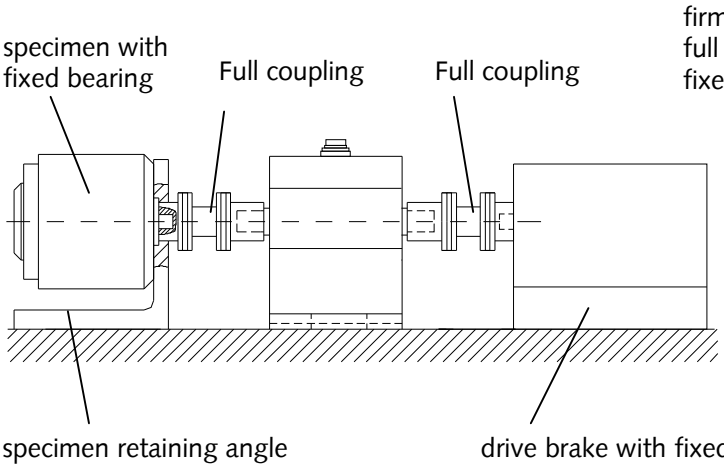



Fig. 13: Application example version R

Couplings compensate axial-radial and angular misalignment.

The connection of shaft and coupling hub is effected by a span device.
The measuring shaft is fastened with balancing class 6,5.
The torque measuring shaft is only a part of the shaft strang.
Radial and torsional vibrations may have a very bad impact on the performance of the torque shaft and the measuring signal.

For that reason the operating speed must not be near the critical speed, either it has to be far underneath or above it.

## 6.4 Supply Circuit and Evaluation

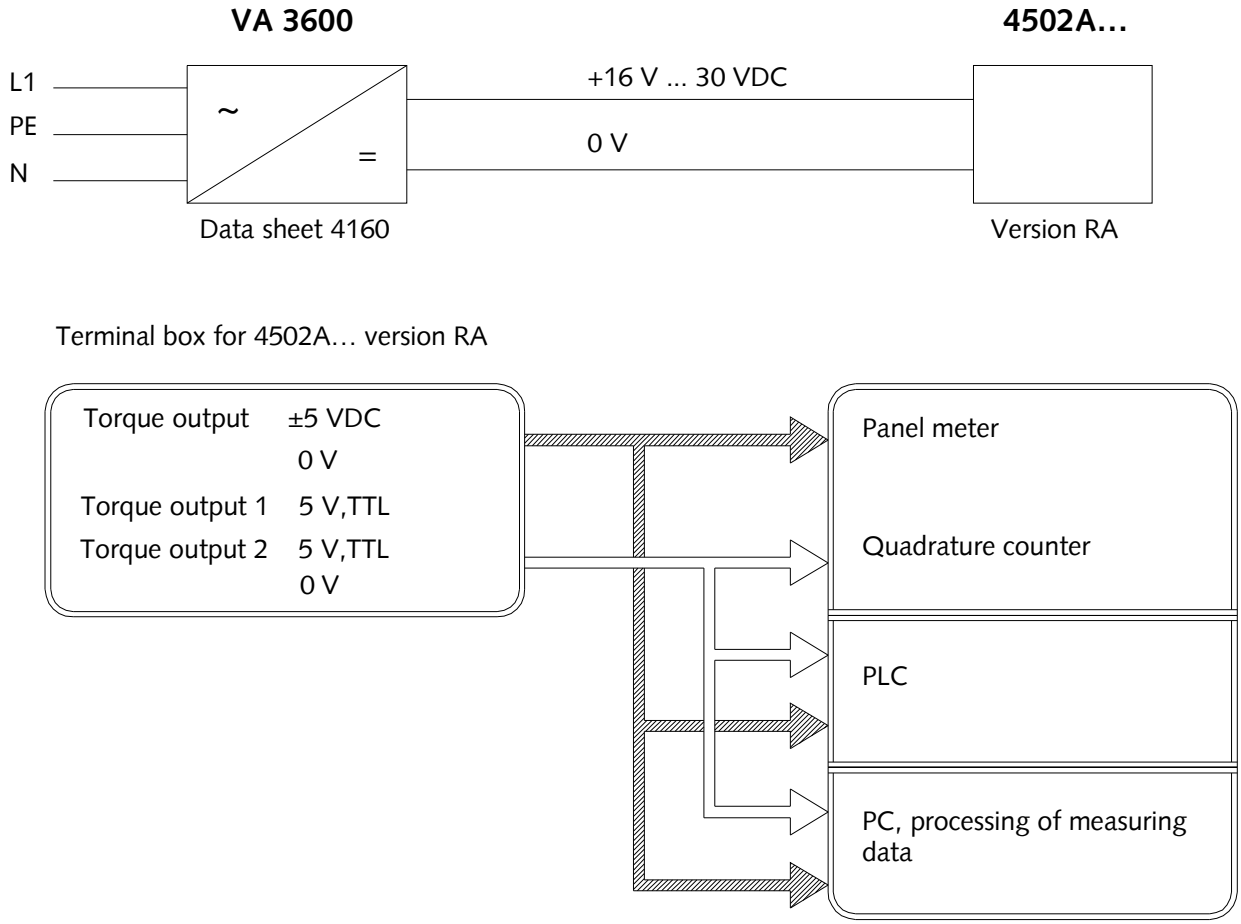



Fig. 14: Supply circuit and evaluation

# 7. Static Calibration

This procedure requires the use of a calibration device with a lever arm and weights for producing specific values of torque.

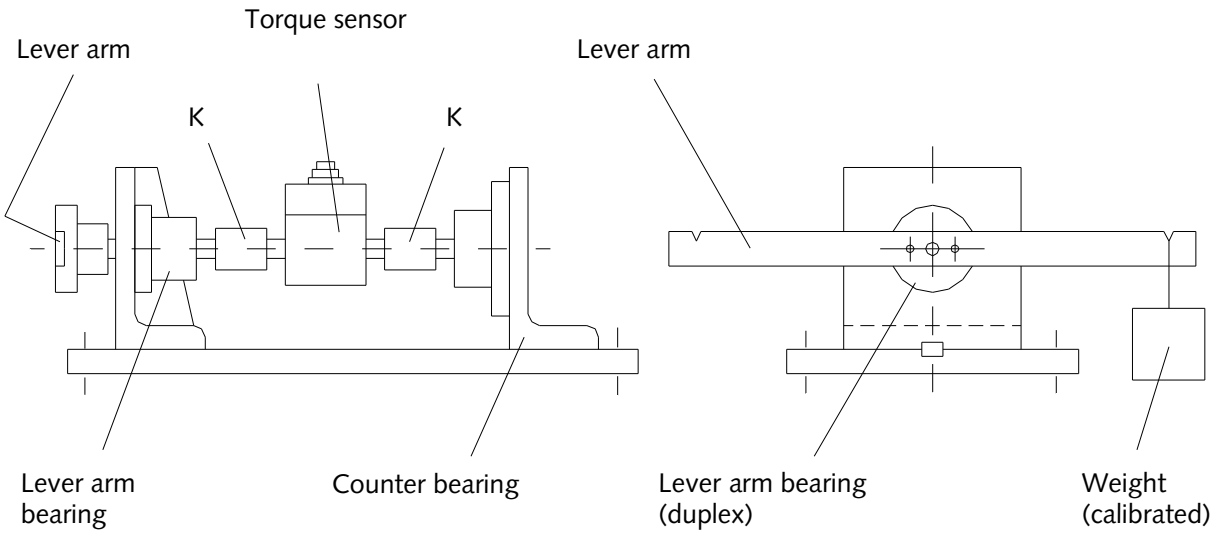
**The calibration procedure is as follows:**

- Apply the rated value of torque to the torque meter and then remove it again
- Adjust the zero reading accurately
- Apply a known value of torque to the torque meter
- Adjust the displayed reading to the corresponding value

**Plotting a calibration curve**

- Calibrate the torque meter as described above
- Apply torque in 1/10 steps up to the full rated value and then remove it again in the same way.
  A delay of at least 30 seconds must be allowed between the individual 1/10 steps so that each reading can stabilize before it is recorded

## 7.1 Construction of a Simple Calibration Device




K = Loose half-couplings

Fig. 15: Calibration device

## 7.2 Calculation Example for Lever Arm Length

$$L = \frac{M}{m \cdot g}$$, whereby

M = Torque
L = Length of lever arm required
m = Mass required
g = 9.80665 m/s²
(= standard gravity – varies with location)

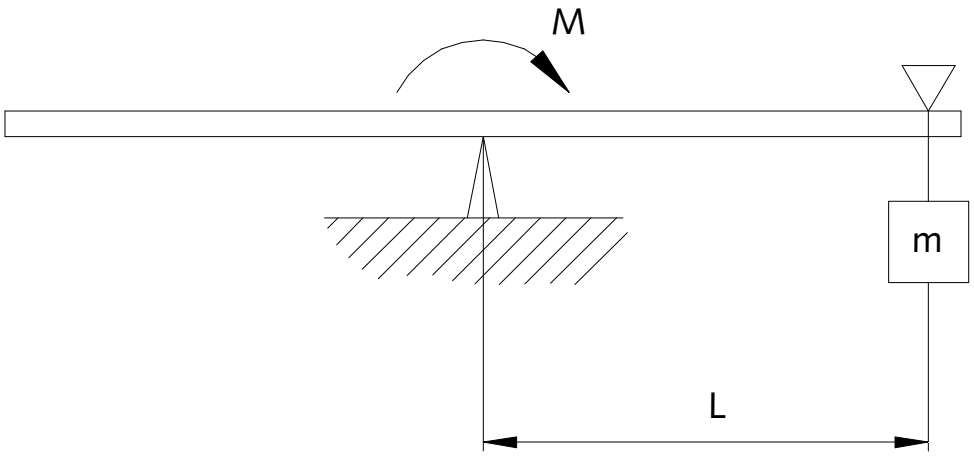



Fig. 14: Calculation of lever arm length

**Example:** m = 1 kg
M = 10 N·m

➔ $$L = \frac{10\ \text{N·m}\ \text{s}^2}{1\ \text{kg} \times 9{,}80665\ \text{m}} = 1{,}0197\ \text{m}$$

# 8. Maintenance

- Sensors of the MS series are almost maintenance-free
- Durability of bearings in rated temperature range is approx. 20 000 hours
- Durability of bearings in working temperature range is approx. 10 000 hours
- Renewal of bearings can only be effected at works
- Precision applications: Yearly calibration of Sensor (calibration at works or with adequate calibration device)
- Control correct cable plug position monthly
- Check cables for damages monthly

# 9. Repairs

| Fault | Cause | Remedy |
|---|---|---|
| Shaft stiff to turn | Bearing defect due to:<br>a) Torsional or flexural vibration<br>b) High axial or radial loads<br>c) Worn bearings<br>d) Bent shaft | Return to factory |
| Zero shift less than 2% | Torsional vibration<br>Torsional shock | The zero reading can be readjusted at the display |
| Zero shift between approx. 2 and 5% of full scale | Torque meter has been overloaded<br>Torsional vibration<br>Torsional shock | The zero reading can be readjusted once at the display |
| Hysteresis between clockwise and anticlockwise torque | Torque meter overloaded by high alternating loads or torsional vibration | Return to factory |
| Shaft stiff to turn | Bearing defect due to:<br>a) Torsional or flexural vibration<br>b) High axial or radial loads<br>c) Worn bearings<br>d) Bent shaft | Return to factory |
| Zero shift less than 2% | Torsional vibration<br>Torsional shock | The zero reading can be readjusted at the display |