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-01.14

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Foreword

This manual applies to the torque sensor Type 4502A… .

The instruction manual must be kept on hand for future use, and must be available at the site of implementation of the torque sensor, as needed.

The specifications in this manual can change at any time without prior notification. Kistler reserves the right to improve and to change the product for the purpose of technical progress without the obligation to inform persons and organizations as the result of such changes.

Original language of these operating instructions: German

Content

Total Pages 24

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 torque
- 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)
- Electromechanical NC joining modules and force-displacement monitors
- Test stand systems for electric motors and gear units for laboratory, manufacturing, and quality assurance

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 sensor 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

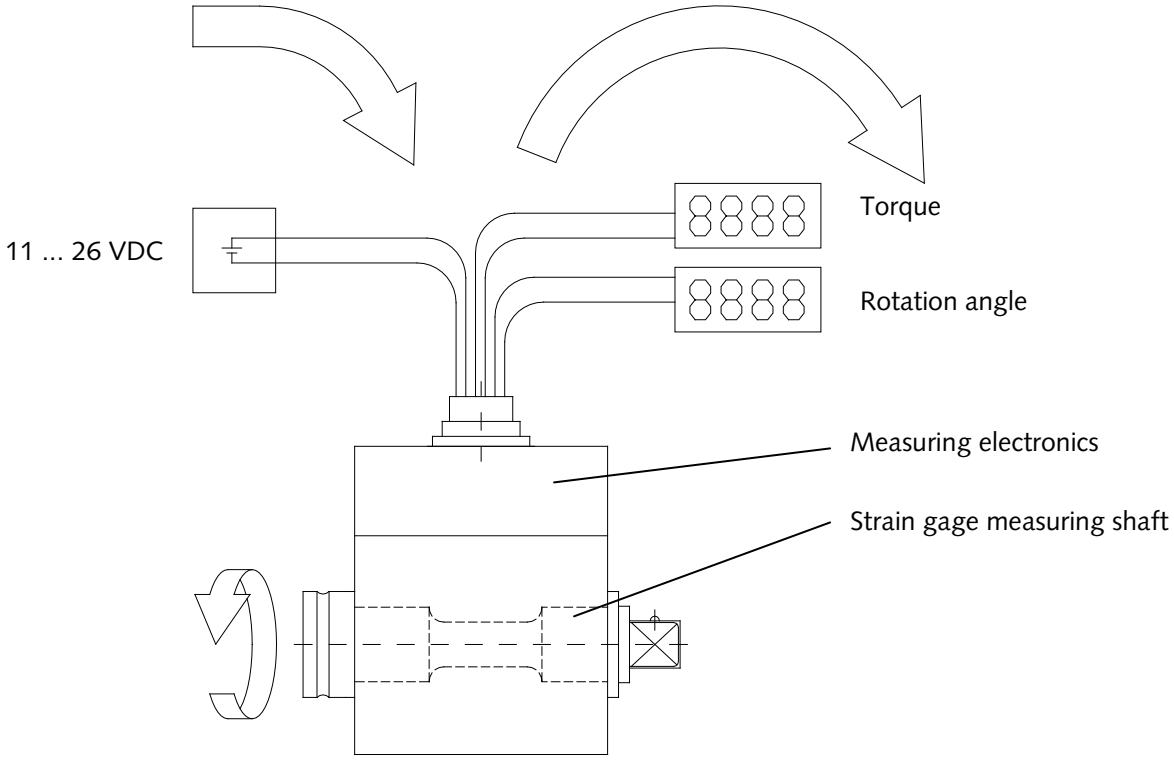


Fig. 1: Mini-Smart torque sensor Type 4502A…

4. Description of the Measuring System

4.1 Mechanical Design

Torque Sensors model Mini Smart 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 gages 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 "Mechanical Application").

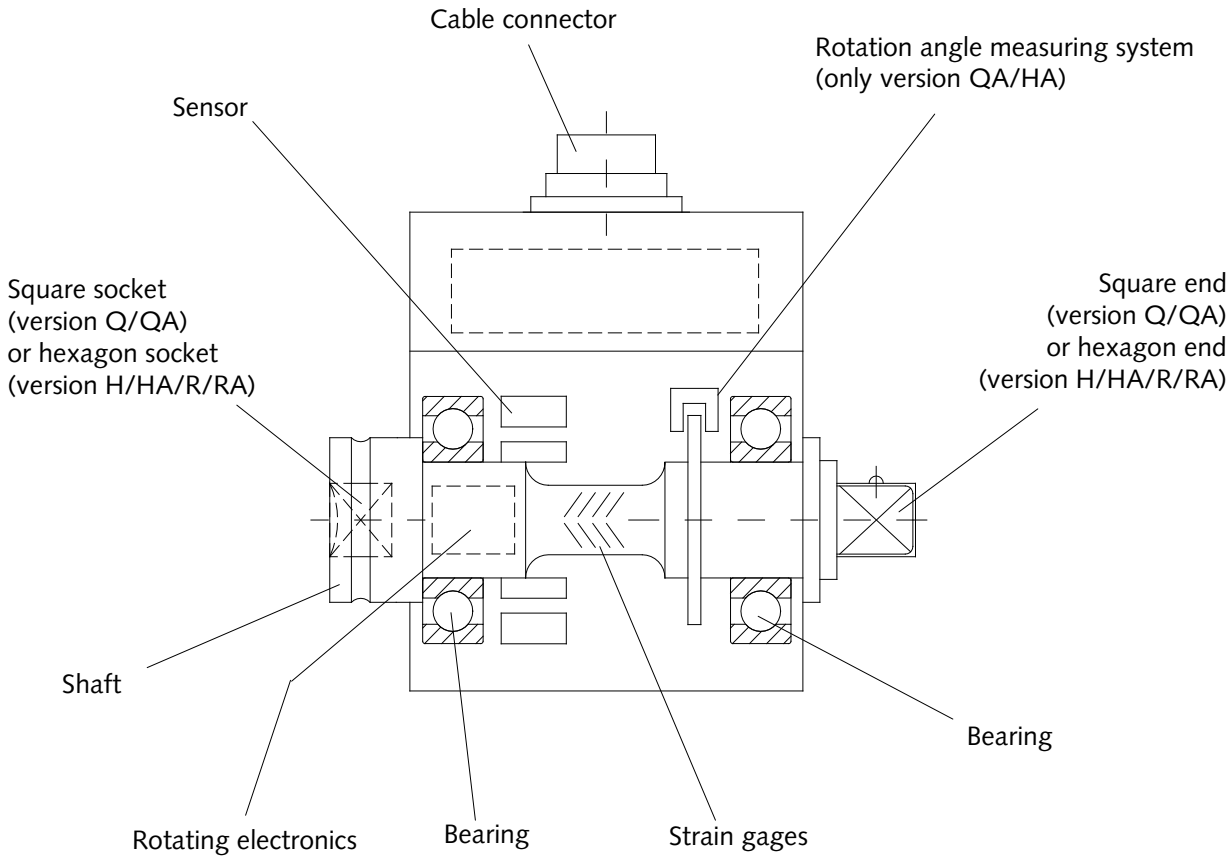


Fig. 2: Mechanical design Mini-Smart torque sensor Type 4502A...

4.2 Electrical Block Diagram

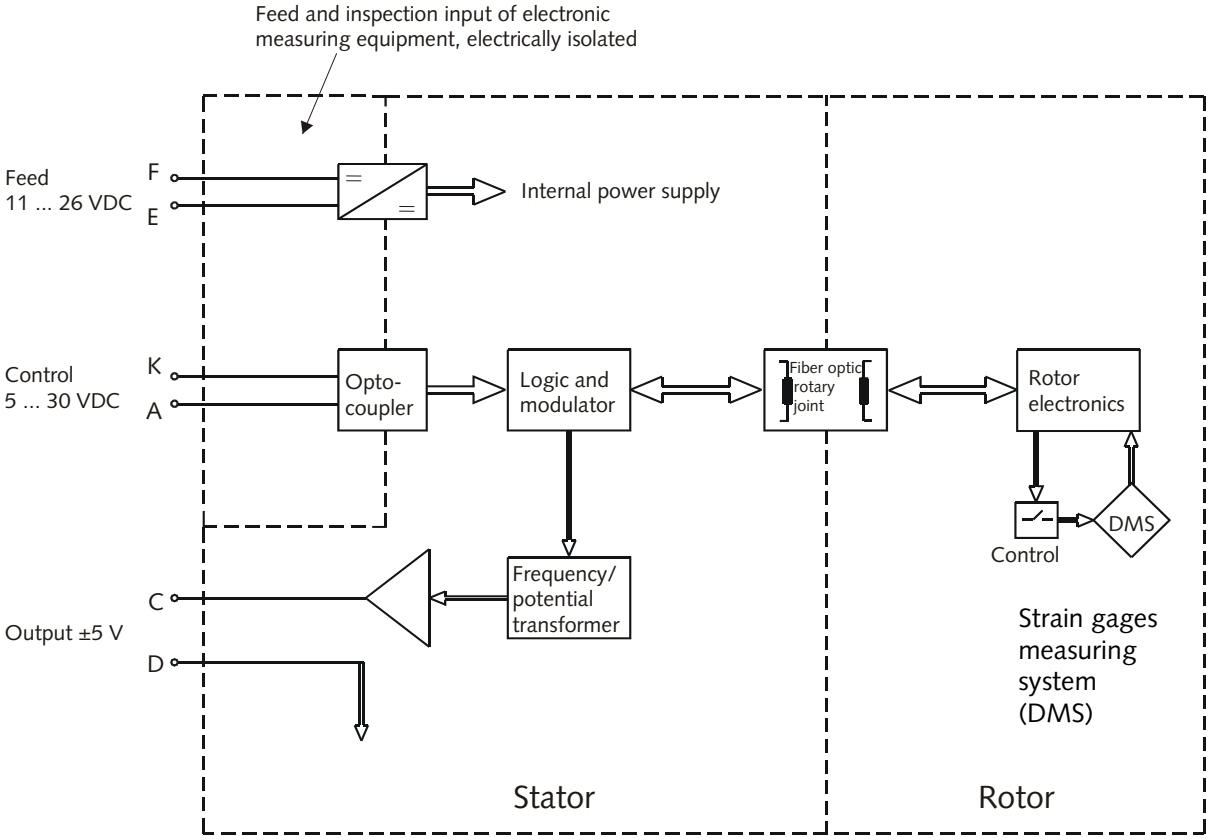


Fig. 3: Electrical block diagram

4.2.1 Examples of Application

Exactly use of electrical isolation for feed and measuring signal.

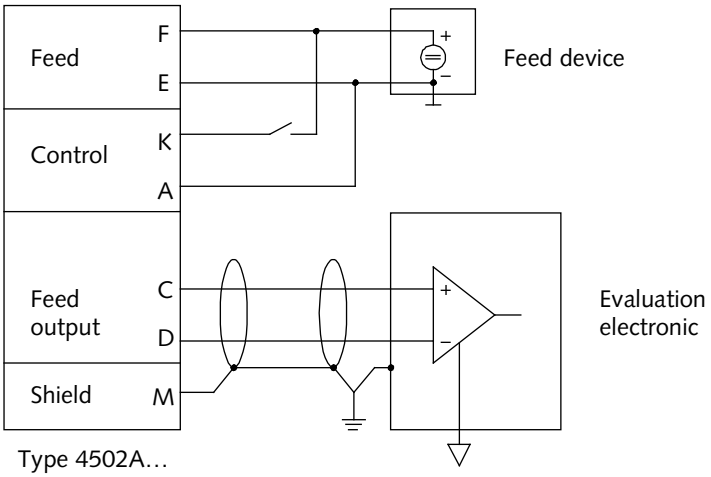


Fig. 4: Separate speed and measuring supply

Shared access measuring supply for feed and measuring supply.

NOTE

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

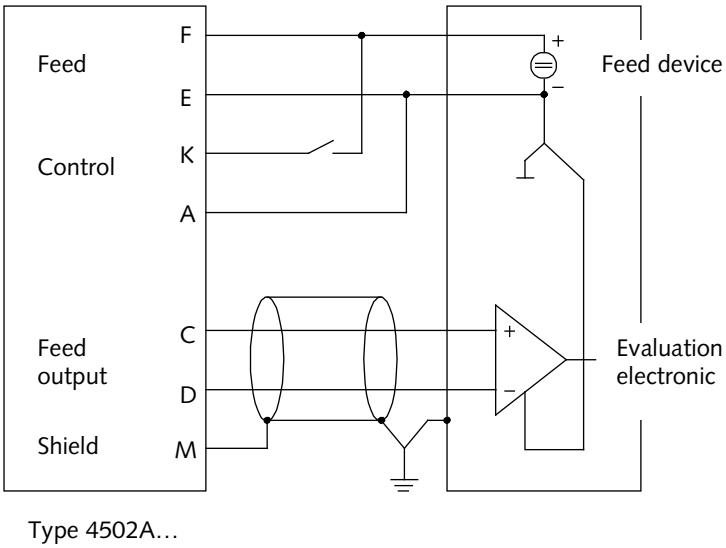


Fig. 5: Feed and measuring supply in the evaluation electronic combined

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

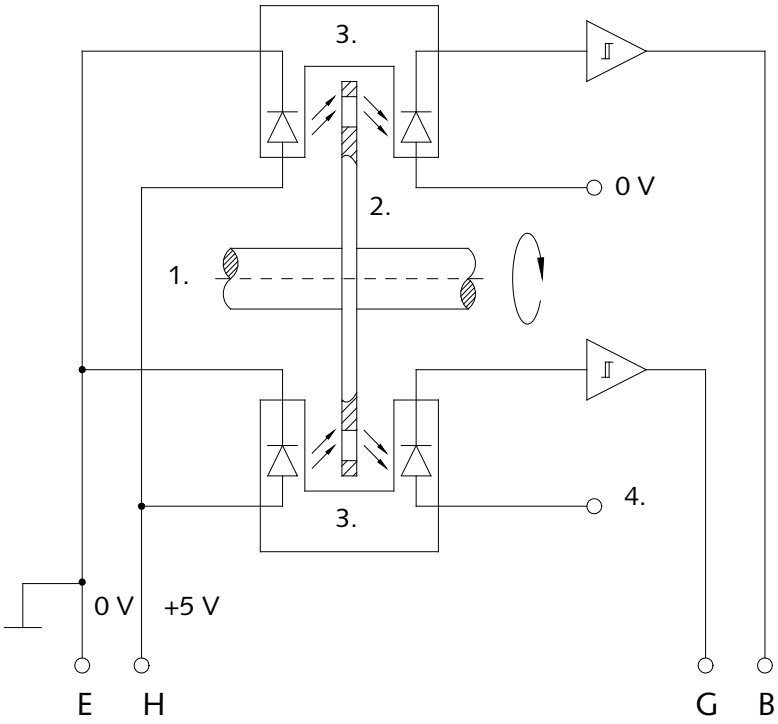


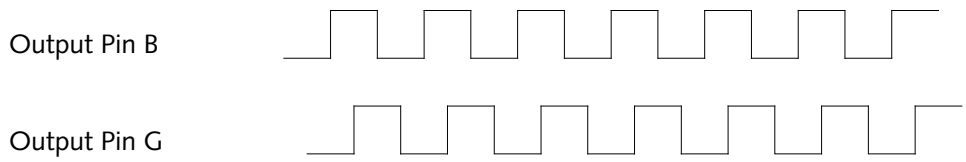
Fig. 6: Diagram showing the design of the rotation angle measuring system

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, RA only)



With drive on square socket or hexagon end sense of rotation cw.

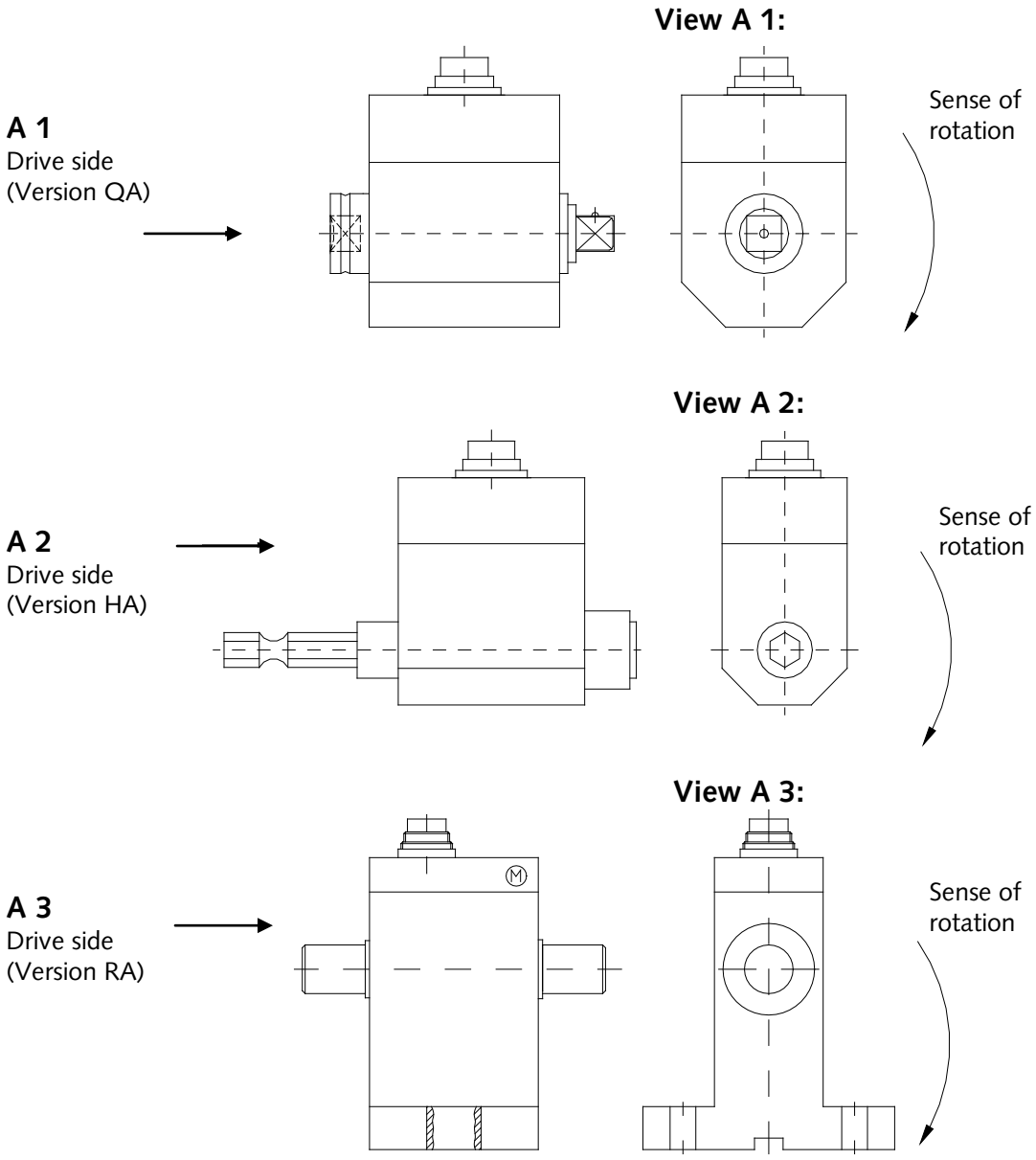


Fig. 7: Adjustment for angle-pulse output

5. Electrical Connections

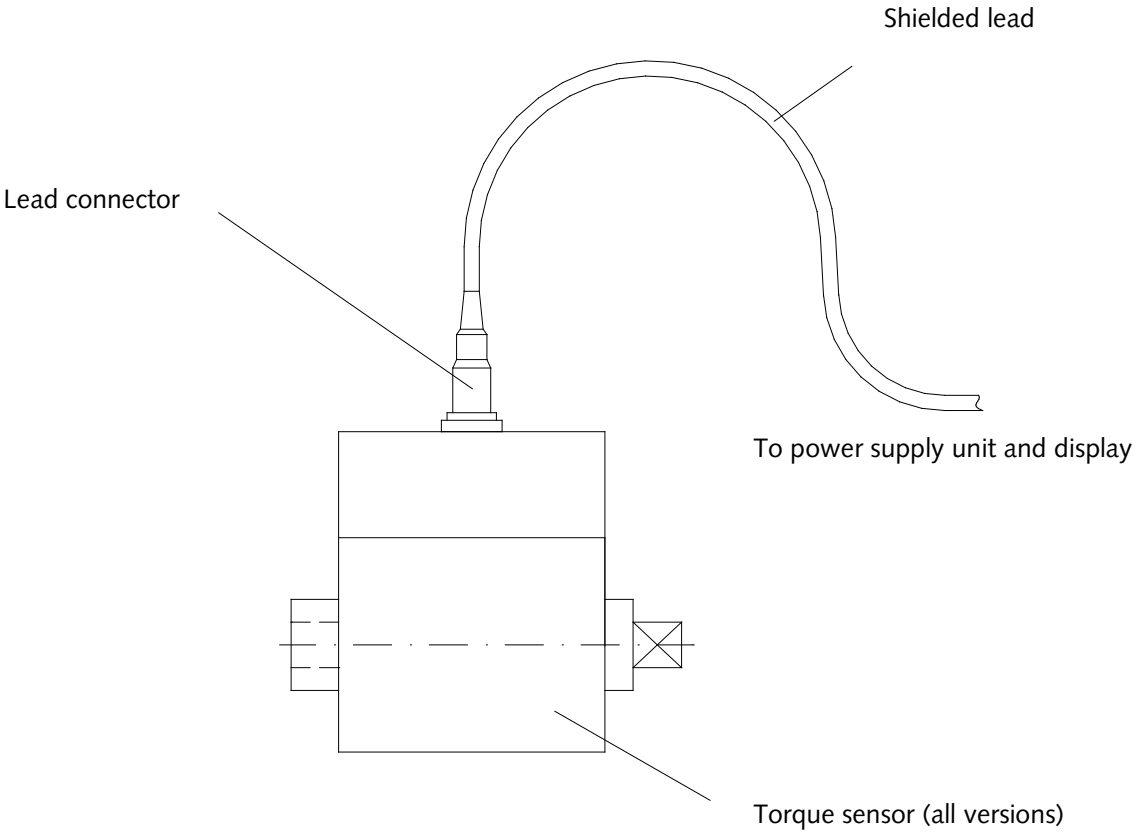
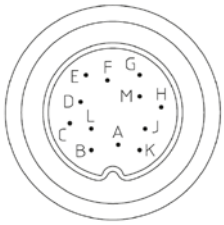


Fig. 8: Electrical connections

- Shielded lead of 0,14 mm² nominal cross section

5.1 Plug Connection (Tuchel, 12 pin)



Function	PIN		Description
Supply	F	$+U_B$	11 ... 26 VDC, power consumption <1 W
	E	GND	Ground relating to U_B and angle of rotation pulses
Shield	M		In sensor connected to housing
Torque output	C	U_A	±5 VDC bei M_{nom} at >2 kΩ 5 VDC at control signal activation $R_{i,C}$ = 10 Ω, output short circuit proof relating to AGND
	D	AGND	Ground relating to U_A
Angle of rotation sensor Supply Angle of rotation pulses	H	+UB	5 VDC
	B	Track A	Open collector output Internal 1 kΩ resistance to 5 VDC (pull up), TTL-level
	G	Track B	As Track A, 90° displaced
100 % control input	K	Control	Off: 0 ... 2 VDC On: 5 ... 30 VDC
	A	KGND	Ground relating to control input
	J		Not connected

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 sensor 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

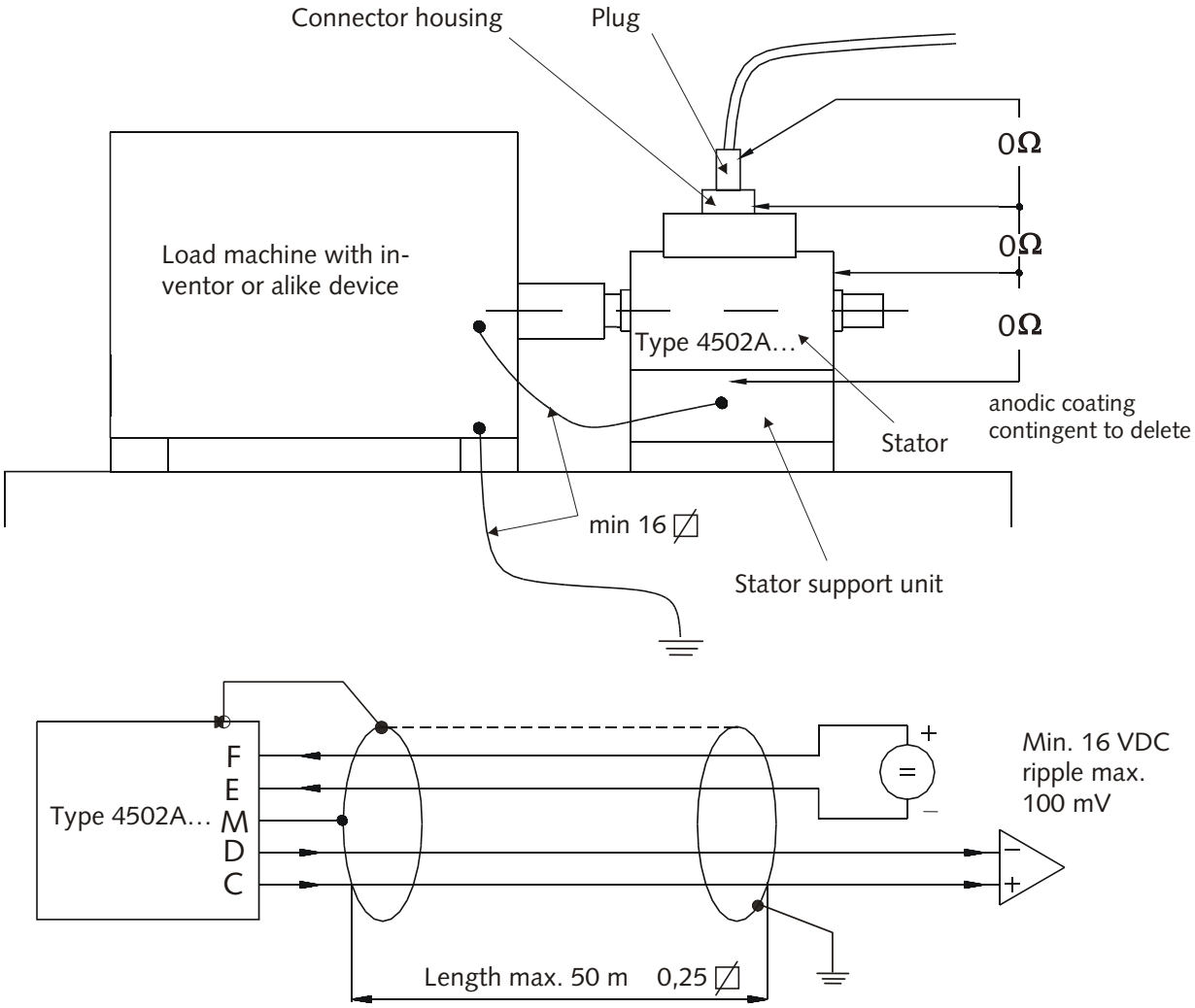
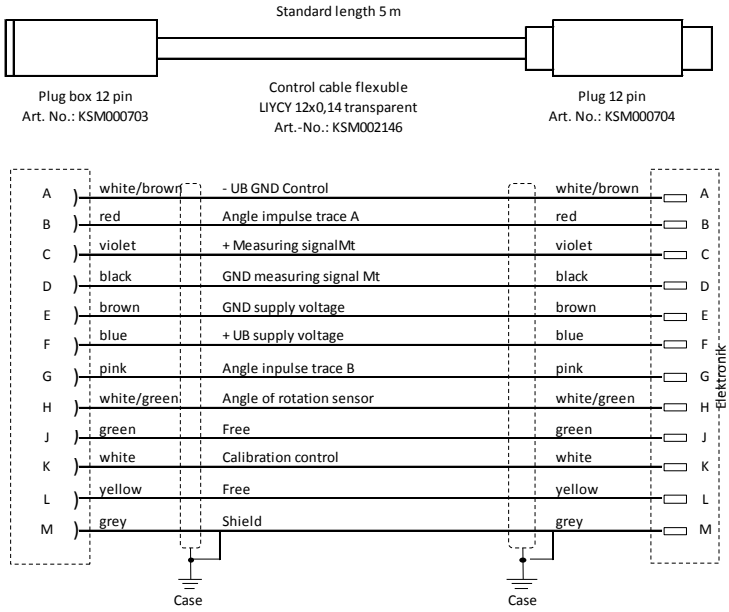


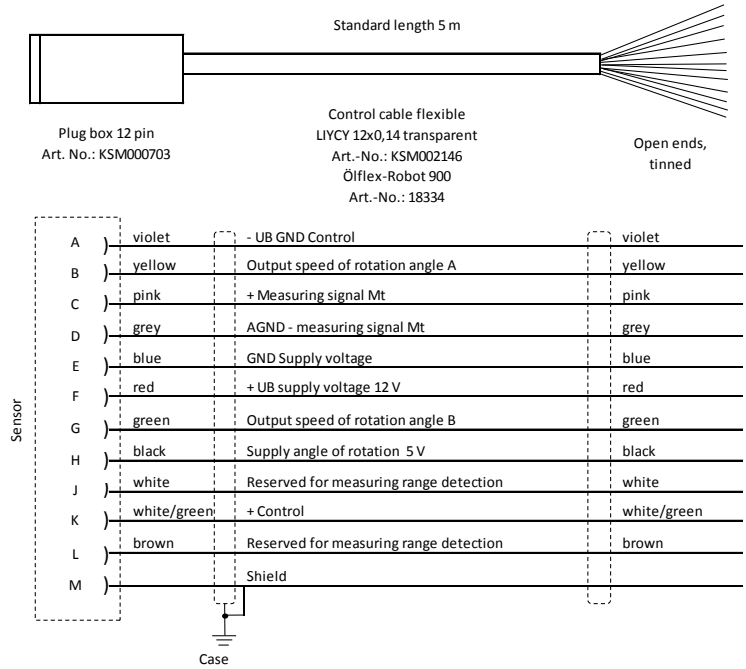
Fig. 9: Electrical installation

5.3 Connection Cable

Technical Data		Type KSM072030-5 Material-No.: 18008935
Connector		12 pin neg. – 12 pin pos.
Length	m	5 (other length on request)
Diameter	mm	6
Deg. of protection to IEC/EN 60529		IP40



Technical Data		Typ KSM0124970-5 Material-No.: 18008943
Connector		12 pin neg. – flying leads
Length	m	5 (other length on request)
Diameter	mm	6
Deg. of protection to IEC/EN 60529		IP40



6. Mechanical Application

6.1 Versions Q, QA, H and HA

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

Application examples:

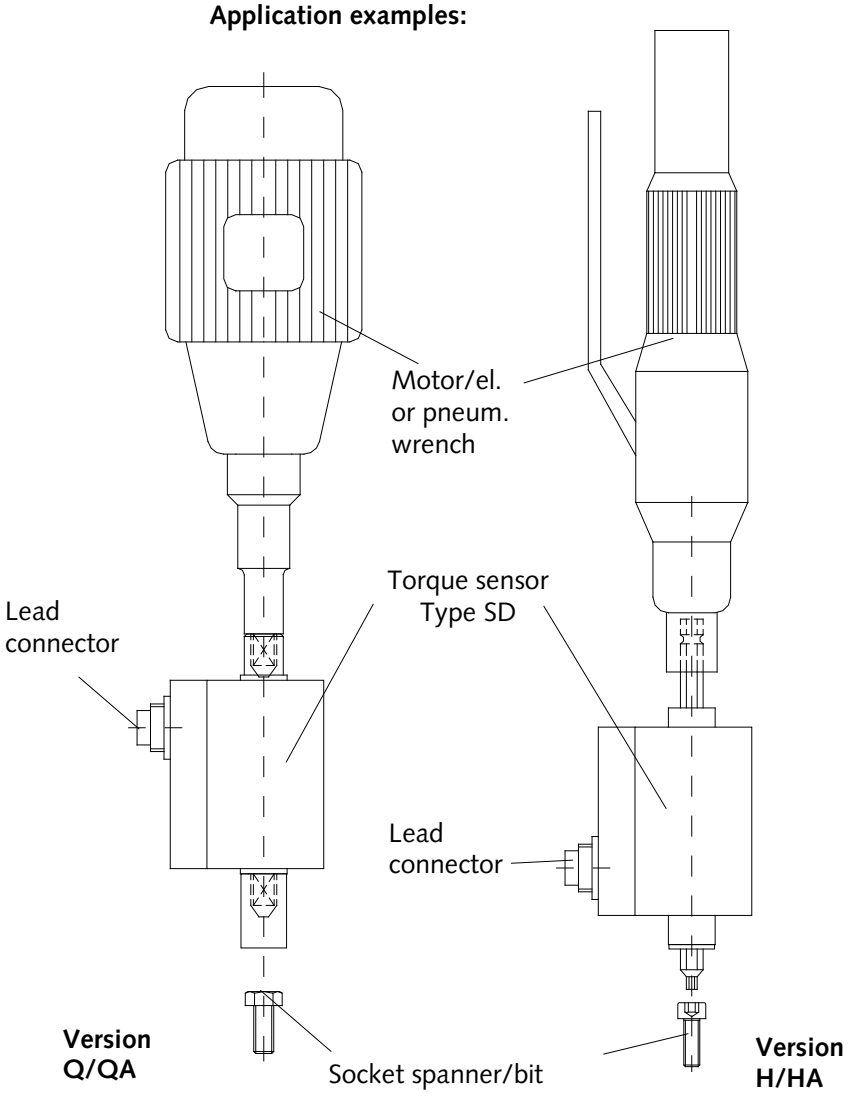
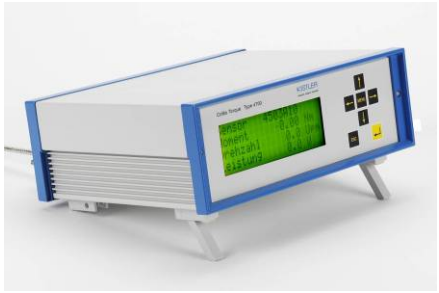


Fig. 10: Application examples versions Q/QA & H/HA

6.2 Torque Measuring Shaft Version RA



Type 4500B…

Type 4704A…

For the electric connection of measuring shaft and supply- and evaluation unit we recommend to use the shielded signal lead, Type KSM072030-5 with low capacity.

As supply and evaluation unit we suggest the Control Monitor CoMo Torque Type 4700B... .
The matching connection cable is Type KSM018538-2,5.

As an alternative solution the units Type 4704A…, model VA3600 without display can be used.
Assembly set Type KSM035681 as accessories for VA3600 for the connection of the torque measuring shaft Type 4520A… .

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 "Plug Connection" of this manual.

On each side of the torque measuring shaft there is a high quality bearing installed. The installation can have any position, however offset couplings must always be applied to balance geometrical errors and 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 000-672 Type 2303A…,
- or diaphragma coupling,
- or claw couplings.

6.3 Possible Installation of Version R/RA

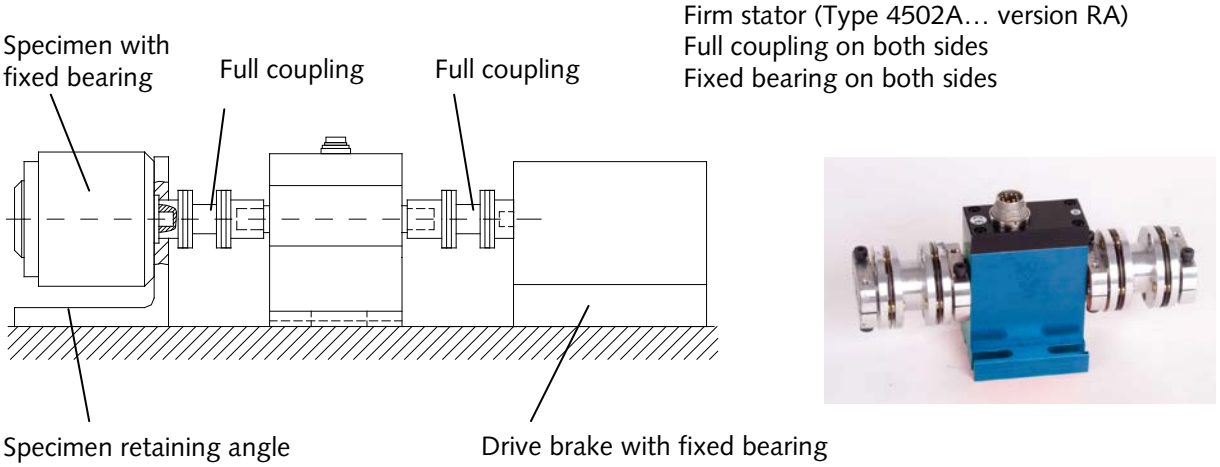


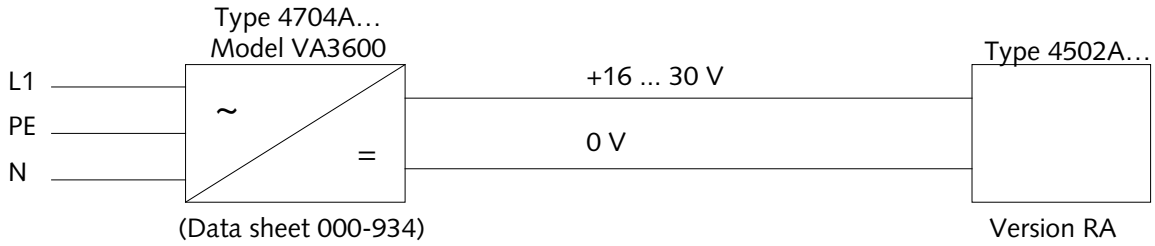
Fig. 11: Application example version RA

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



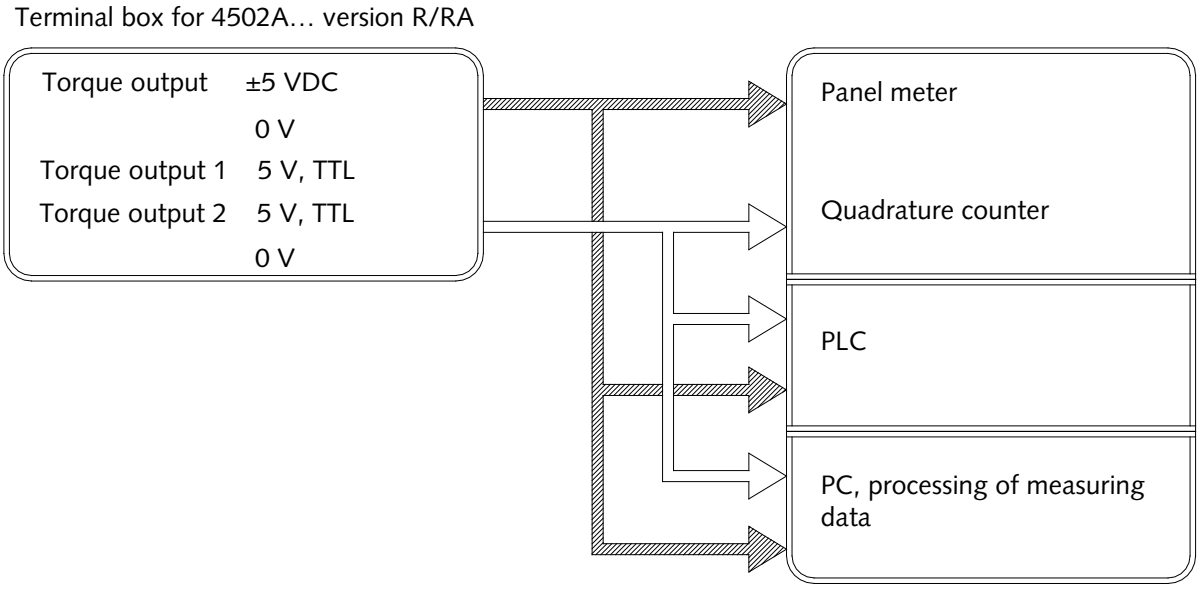


Fig. 12: Supply circuit and evaluation

7. Static Calibration

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

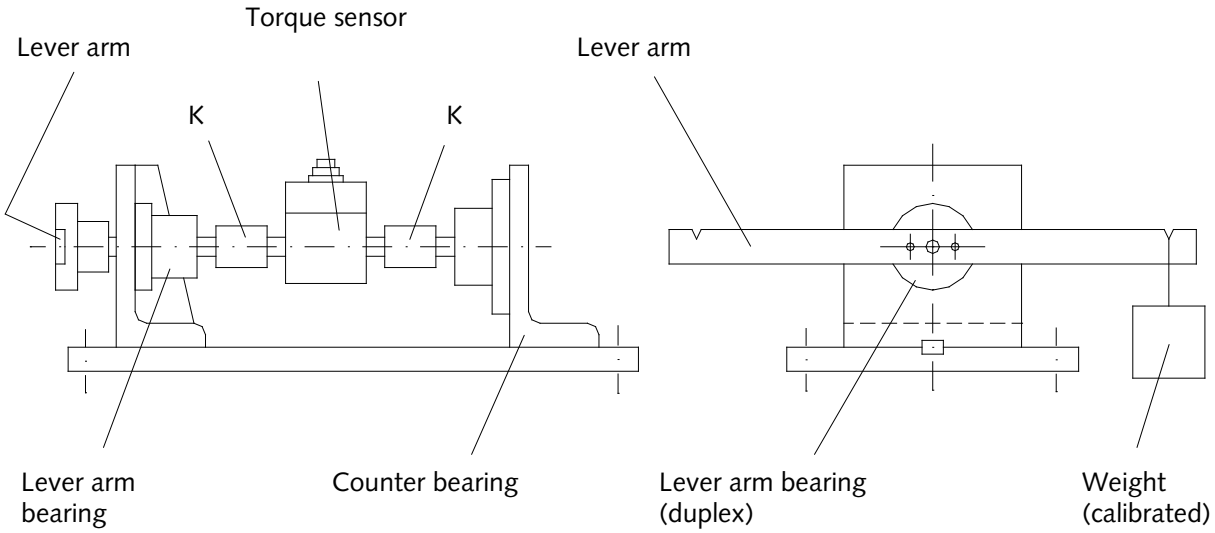
The calibration procedure is as follows

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

Plotting a calibration curve

- Calibrate the torque sensor 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. 13: 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)

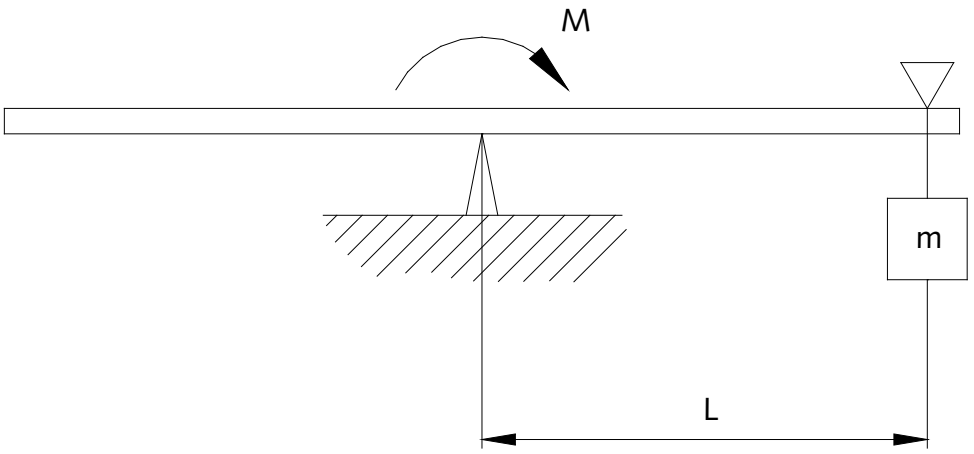


Fig. 14: Calculation of lever arm length

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 Type 4502A… 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: a) Torsional or flexural vibration b) High axial or radial loads c) Worn bearings d) Bent shaft	Return to factory
Zero shift less than 2 %	Torsional vibration Torsional shock	The zero reading can be readjusted at the display
Zero shift between approx. 2 and 5 % of full scale	Torque sensor has been overloaded Torsional vibration Torsional shock	The zero reading can be readjusted once at the display
Hysteresis between clockwise and anticlockwise torque	Torque sensor overloaded by high alternating loads or torsional vibration	Return to factory

10. Ordering Key

Type 4502A □□

Measuring Ranges in N·m/
Possible Versions

0,5	–	–	H	HA	–	–	–		**0,5**
1	–	–	H	HA	R	RA	RAU		**001**
2	–	–	H	HA	R	RA	RAU		**002**
5	–	–	–	–	R	RA	RAU		**005**
6	–	–	H	HA	–	–	–		**006**
10	–	–	–	–	R	RA	RAU		**010**
12	Q	QA	H	HA	–	–	–		**012**
18	Q	QA	H	HA	–	–	–		**018**
20	–	–	–	–	R	RA	RAU		**020**
50	Q	QA	–	–	R	RA	RAU		**050**
63	Q	QA	–	–	–	–	–		**063**
100	Q	QA	–	–	–	RA	–		**100**
150	Q	QA	–	–	–	–	–		**150**
160	Q	QA	–	–	–	–	–		**160**
200	–	–	–	–	–	RA	–		**200**
250	Q	QA	–	–	–	–	–		**250**
300	Q	QA	–	–	–	–	–		**300**
500	Q	QA	–	–	–	RA	–		**500**
1 000	Q	QA	–	–	–	RA	–		**1k0**

Versions
(Note Dependence with Measuring Range)

Square socket	**Q**
Square socket with rotational angle meas.	**QA**
1/4" hex socket	**H**
1/4" hex socket with rotational angle meas.	**HA**
Rotating shaft	**R**
Rotating shaft with rotational angle meas.	**RA**
Rotating shaft with rotational angle meas. and integral mounting base	**RAU**

Order example:

Type 4502A018HA

Torque sensor, rated torque 18 N·m: **018**, Version **HA**: 1/4" hex socket with angle measurement

11. Declaration of Conformity

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EC Declaration of Conformity
EG-Konformitätserklärung
Déclaration de conformité CE

Manufacturer Hersteller Fabricant	**Kistler Lorch GmbH** **73547 Lorch** **Germany**

declares that the product/erklärt, dass das Produkt/déclare que le produit

Name/Name/Nom	**Torque Sensor/Drehmomentsensor/Torque Capteur**
Type/Typ/Type	**4502A...**
Modules/Module/Modules	-
Options/Optionen/Options	**all/alle/toutes**

relates with the following standards/mit den folgenden Normen übereinstimmt/
est conforme aux normes suivantes

EMC Emission EMV Störaussendung Emission EMC	**EN 61000-6-4:2011-09**	**(Class A)**
EMC Immunity EMV Störfestigkeit Immunité EMC	**EN 61000-6-2:2006-03**	

Following the provisions of directive/Gemäss den Bestimmungen der Richtlinie/Conformément aux dispositions de directive

2004/108/EG **(EMC / EMV / EMC)**

Lorch, January 2014

Franz Winter
General Manager

12. Index