Technical Guidelines for Inductive Sensors LVDT / LVIT Product Series D… and W…

Technical Instructions for installation, use and maintenance of MESSOTRON transducers type D… / W… with core rod (excluding WP, WA, WE Series)

1. General information

Any person who is entrusted with the installation or operation of a transducer must have read and understood the instructions.

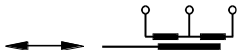
For transducers with integrated electronics (amplifier) the corresponding information / instructions are supplementary to note.

Please also refer to the connection instructions and notes in the operating instructions for the amplifier.

2. Measuring principle

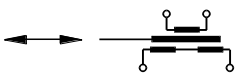
MESSOTRON offers three different measurement principles for inductive displacement measurement. The three techniques have in common the control / evaluation of a passive sensor by an internal (built-in) or external TF (carrier frequency) amplifier. An AC voltage (TF) stimulates an inductor system in the sensor. A movable ferro-magnetic (or aluminum) part of the sensor has an effect on the inductance in the coils. This change of the inductance will be evaluated by the amplifier and converted to a position-proportional direct voltage (DC) signal. This signal can be used for further evaluation and control functions.

Inductive half-bridge transducer LVIT (product series W…)



Electrically the LVIT transducers of MESSOTRON product series W… are Wheatstone half-bridges consisting of two measuring coils.
A ferro-magnetic core / core rod, which can be moved inside the coil, produces the same slip-resistant for both measuring coils if placed in the centre position. The bridge circuit is adjusted, and the measured voltage is zero.
If the core is moved away from its central position, the resistances of the two measuring coils change in opposite directions. The measured voltage increases within the measuring range proportional to the displacement.

Differential transformers LVDT (product series D…)



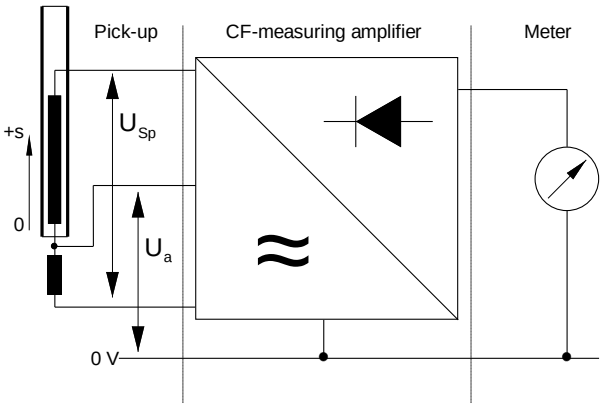
Differential transformers like all MESSOTRON D… series transducers consist of a primary and two secondary coils with a ferromagnetic core / core rod being linked according to the transformer principle.

Fed with an alternating voltage the primary coil induces a voltage to the secondary coils (electrical connection is shown). When the core is in the centre position the voltage is zero because the two secondary inductances are operated in the opposite way. If the core moves away from the centre, the measured voltage changes in proportion to the distance.

The ratio-metric evaluation with special carrier frequency amplifiers based on the ratio of the two secondary coils requires electrically separated secondary coils (6-wire LVDT) or an additional centre tap of the secondary side (5-wire LVDT). MESSOTRON offers several LVDT series optionally in 5 - or 6-wire version.

Long-stroke transducers (MESSOTRON series WP)

The displacement of the sleeved core inserted in a cylinder core rod is measured in an inductive way, based upon the eddy-current principle. The sleeved core influences a magnetic field induced by two coils in a half-bridge circuit. The variation of this magnetic field is picked up as a displacement proportional signal.
One of the two coils is simulated by a compact equivalent electronic circuitry. Thus, the natural zero is at the inner end position of the stroke (unlike other inductive systems with a default zero-value at stroke center).
An inductive transducer is operated using a carrier frequency (CF) amplifier. The device supplies an AC voltage U_{Sp}, amplifies the transducer amplitude-modulated output signal U_a and converts it to an easy-to-process DC signal (e.g. 0 ... 10 V).



3 Scope of delivery

Transducers are generally delivered including the core / core rod. Plug versions are delivered with the matching connector, unless otherwise agreed.

Transducer and core are paired for optimal characteristics. The cores of the transducers are therefore **not interchangeable** with another transducer.

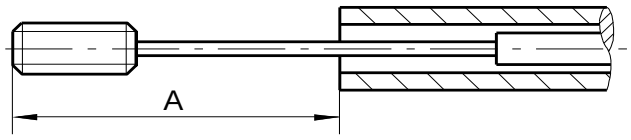
4 Mechanical design and installation

The housing of the transducer is made of high quality stainless steel. For the design of the electrical connection box aluminium may also be used. The entire electrical system is encapsulated in the housing. The transducers are designed for high vibration load and use in acid-free media. If the transducer is not explicitly specified as pressure resistant, it shall not be used in pressurized applications.

The outer dimensions of the transducer are shown in the dimensional drawing of the datasheet for standard versions, or otherwise specifically mentioned in the approval drawings.

Depending on the version, the transducers have a continuous core channel or core channel that is closed on one end. For a closed core channel it is necessary to make sure that the core does not strike against the end of the channel during installation.

The core rod should be mounted in a way that the mechanical dimension "A" is kept according to the value in the data sheet, making sure that the core is symmetrically placed from the middle position / zero position. A more accurate fine adjustment can be made electrically during the calibration of the amplifier.



Mounting restriction: Calibrated transducers e.g., to 80 mV/V nominal signal output with axial wires or cable connection may not be clamped 25 mm from the connection-end.

5 Connection

Connect the sensor to the amplifier using shielded, low-capacitance cable as follows:

Sensor			**Signal**	**MESSOTRON-measuring amplifier MBI 50.25.x**		**MESSOTRON-measuring amplifier MBI 46.31.xx**	
Braided wire	Cable	Connector		connector	terminal block	connector	terminal block
red	red	2 resp. B	Supply voltage	ac 2	16	ac4	15
blue	blue	3 resp. C	Supply voltage	ac 4	15	ac2	16
whithe+yellow	white	1 resp. A	output	ac 6	14	ac8	13
	black		not used				
	ground	---	ground	ac 10	12	ac12	11

Cable shielding should only be grounded on amplifier side, not on sensor side.

Precautions: Make sure that sensor cable is not routed parallel to other cables carrying high power or control signals. Avoid electromagnetic fields of motors, transformers or thyristor-systems. Take note of respective regulations for electric installations (in Germany: VDI/VDE 3551). A distance of up to 100m between sensor and amplifier is possible with appropriate cable routing.

Note that the sensors are not overload protected. Excessive voltages may destroy the transducer. Swapping of polarity will not cause damage to a displacement transducer without integrated amplifier, however, may cause a faulty or inverted signal.

6. Calibration

Perform all adjustments at operating temperature and, if possible, with the sensor installed.

Zero position / zeroing

The core centre position of a differential inductive sensor gives a zero output in the middle position. The simplest way to determine the correct zero position of the transducer is by setting the mechanical dimension "A" from the datasheet.

A more accurate approach is to remove the core and set amplifier output to 0V using the corresponding zero trimmer (or 12 mA with 4 ... 20 mA output). Once the 0V output without core is achieved, position the core inside the sensor such that the pre-set amplifier output of 0V is obtained again. Minor re-adjustment on zero trimmer is still possible.

For even higher accuracy, position the core in such way that an identical amplifier output signal is achieved with nominal and with interchanged supply lines. In this position, set the amplifier (zero-value trimmer) to 0 V resp. 12 mA.

Phase shift adjustment

A phase shift between the sensor excitation voltage and the output voltage is inherent of the LVDT design, typically ranging from 1-20 degree based on coil type and frequency used. If the amplifier provides a phase adjustment option, position the core at approx. 75% of the full stroke position on one side and set the output signal to its maximum with the help of the trimmer. Check the zero-value

setting again and re-adjust as necessary. Generally, most MESSOTRON half-bridge sensors show very small phase shift in the low single digit degrees, thus phase compensation may not be required.

Sensitivity setting
To adjust the sensitivity of the amplifier, the core / core rod is moved to its outer limit position and the gain setting of the amplifier is set to the desired maximum value (e.g. 10 V) using the sensitivity potentiometer.

Unless the sensor is specified as a calibrated version with set sensitivity such as 80mV/V do not use the datasheet value for sensitivity for setting of the gain, as these values are only approximations with fluctuation of +/-10%.

7. Maintenance and Installation

The displacement sensors operate based upon a non-contact measuring method and are therefore not subject to any significant wear if the core is not in touch with the body or internal lining. Routine maintenance work is therefore not required.

For versions with guided core and a core / plunger bearing such as all gauges or spring loaded LVDT and LVIT transducers the ease of movement of the plunger must be checked regularly based upon the working conditions. Clean the plunger and apply a minimum amount of high grade silicon oil if and when required.

Connection cables and plugs as well as protective parts e.g. sliding anchor sleeve, spring bellows must be checked regularly for damage and are to be replaced if necessary.

8. Troubleshooting

If a displacement transducer does not appear to be working properly, the electrical connection must be checked carefully. Measuring the resistance values between the connecting leads can indicate a possible problem. If the LVDT / LVIT provides a wrong signal of incorrect linearity, check whether the following settings have been performed correctly:

- Connection of the primary and secondary coil according to the datasheet values
- Amplifier setting to the correct carrier frequency as per the datasheet and test protocol
- Zero setting of the amplifier, so that the transducer is used around its electrical middle position
- Gain setting has been performed correctly at one of the transducers limit positions

9. Spare parts and repair

To guarantee smooth processing of replacement and follow-up deliveries, the nameplate with the serial number (F-Nr.) must not be removed from the transducer.

In any spare part or replacement requirement the serial number is required to identify the correct version, particularly for customized products.

Note that cores are matched with the sensors during the production and thus cannot be interchanged with other sensors. In case of spare / replacement it may be necessary to recalibrate the transducer and create a new test protocol.

It is usually not possible to repair the electrical system in the displacement transducer if the coils are damaged.