LVDT Sensors

Installation and Operation Manual

KEY FEATURES

- Rugged Construction
- Steel body
- Optional internal signal conditioner
- Excellent Linearity
- Non-contact internal design
- Optional Spring return

APPLICATIONS

- Control systems monitoring
- Structural Monitoring
- Precision small length measurement

Description

LVDT Displacement and position sensors are measuring systems which operate on the principle of the differential transformer. The high-resolution, contactless measuring method guarantees an almost unlimited service life, depending on the mechanical design. Furthermore, the proven technology ensures signal and measured value retention (true power on) even if the supply voltage is interrupted.

Contents

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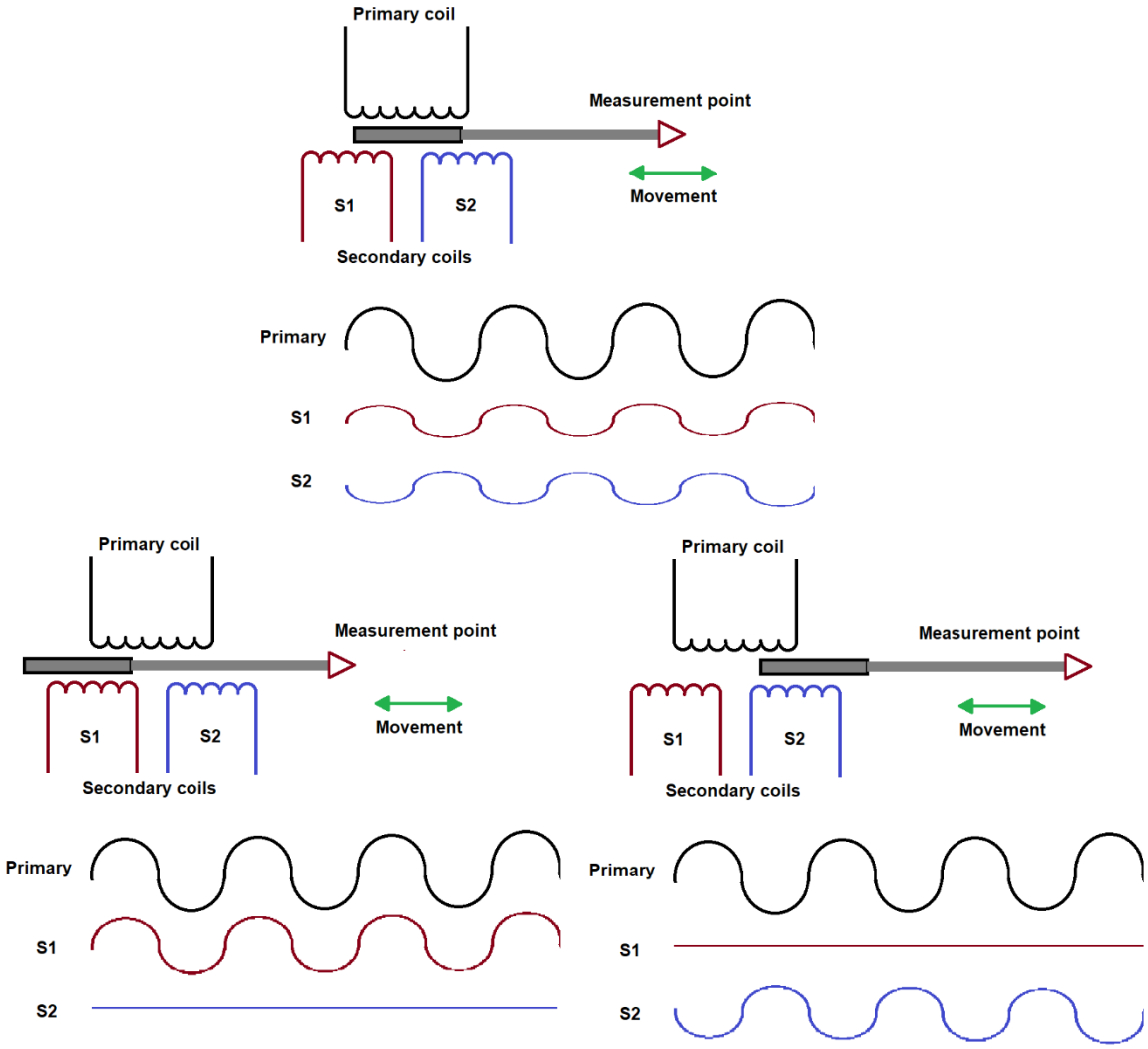
How an LVDT operates

LVDT sensors work on the transformer principle.

The primary coil is supplied typically with a 3V AC sine wave at a set frequency. This signal is transmitted to the secondary coils which form the output from the sensor.

The output is determined by the position of the moveable core. If the core is perfectly in the centre of the sensor, the transmission will be at the maximum value and in-phase. This is known as the "zero point" of the sensor. The core can then move in either direction, one being positive and the other being negative, and the transmission from the primary to the secondary coils will change in amplitude and phase accordingly.

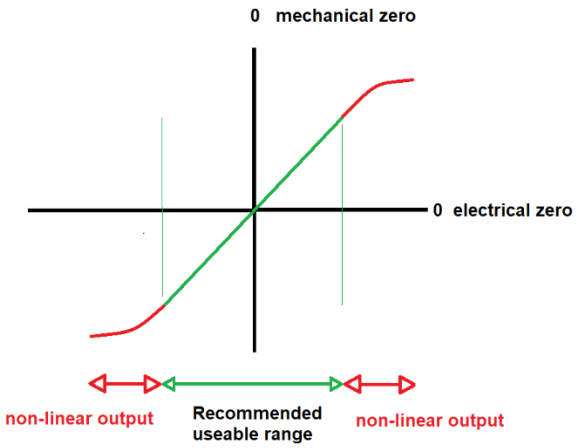
When wired as full-bridge, the sensor has two secondary coils and the acquisition system can monitor the signal in each secondary core. When wired as half-bridge, the two secondary cores are connected together which creates a single output.



As the coil moves either towards S1, or S2, the transmission will increase in that coil and decrease in the other. Therefore if you sum the waveform between the two secondary coils, you will know where the core is by the phase and amplitude of the waveform.

Mechanical Set up

- The *centre of travel* coincides with the mid-point of the output range. This is commonly known as the "zero point". In an AC output LVDT this is where the two secondary outputs are equal in amplitude but opposite in phase. Summing these gives a zero output. In a DC output LVDT, this is the mid-point of the output signal, therefore for a 0-10V output sensor, it will be 5V, or for a 4-20mA output sensor it will be 12mA.
- We always recommend setting the sensor to the zero point, or the centre of the range if possible and using the centre portion of the sensor range.
- *LVDT sensors vary in design.* Captive core versions have a mechanical limit to the sensor range, but this mechanical limit will be greater than the electrical range of the sensor. Free-core versions allow the core to be completely removed from the sensor. With the core removed, the reading from the sensor is meaningless.
- When the LVDT sensor has a captive core the end-stops are purely to prevent the core from coming away from the sensor. The end-stops are not designed to be used as a mechanical stop or limit to your measurement. We always recommend your design includes a mechanical stop to prevent the sensor being damaged.
- If the mechanical characteristics of the test need to allow movement further than the range of the sensor, there must be a mechanical disconnect between the sensor and the mechanical structure when the sensor range is exceeded. If a captive core sensor is pulled beyond its capability it will become irreparably damaged.
- Cable routing must be such that the cable does not become entangled with mechanical moving parts and must not cause the cable to be pulled tight. Incorrect cable management can result in cable failure / loss of signal.
- The LVDT sensors will often move mechanically beyond their electrical range. The stated range is given as the most linear part of the output curve, movement outside this range will give significantly less accurate readings as the linearity changes the further you move from the central point. Please see below graphic which shows the output behaviour of a typical LVDT sensor.



*Where an LVDT sensor has a built-in signal conditioner, the output is tailored to the linear section of the output curve of the LVDT. Outside this, the output of the signal conditioner will not change from either the maximum or minimum value.

Electrical Set up

Analogue Output.

- An Analogue output LVDT will connect directly to an acquisition system without the need for additional signal conditioning. Either 4-20mA or Voltage outputs are available and you can then easily set your sensor.
- The sensor will need a power supply (typically 24V) to power the internal signal conditioner, and then it will give the output via the signal wires.
- You will see the output change as you push the rod / core in and out of the sensor.

Connect as follows:

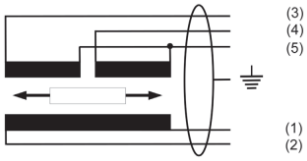
Brown	Power supply(typically 24V DC)
White	Signal GND
Green	Signal +
Grey	Power supply GND
For ±15V supply see below	
Brown	+15V DC
Yellow	-15V DC

AC output (without internal signal conditioner)

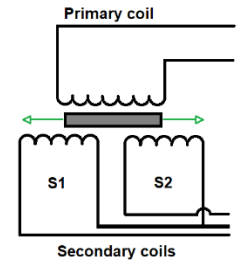
- Connection for AC output LVDT sensors requires either full bridge or half bridge connection
- LVDT compatible signal input will be required to connect the sensor
- Please ensure that you do not exceed the maximum rated primary excitation voltage and frequency
- Typical primary excitation voltage is 3V RMS

Connect as follows:

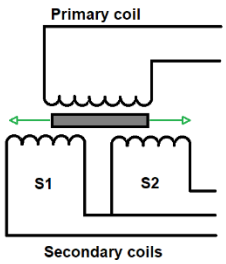
Red	Primary 1
Black	Primary 2
Orange	Secondary 1
Yellow	Secondary 2
White	Secondary 1,2 Centre
Shield	Housing



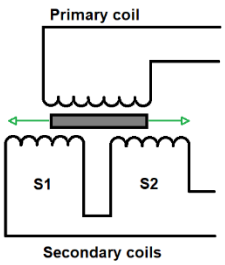
For general other wiring options for LVDT sensors, please see the below diagram.



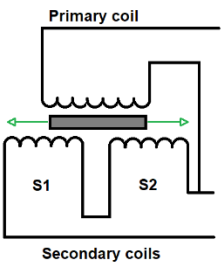
5 wire full-bridge wiring diagram 1



5 wire full-bridge wiring diagram 2



4 wire full-bridge wiring diagram



Half bridge 3 wire wiring diagram

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Spring / Pneumatic Advance Sensors

- LVDT sensors can be supplied with spring advance options and pneumatic advance.
- Spring advance sensors either have an internal or external spring and are designed to push against a reference surface
- Pneumatic advance sensors can be connected to an air-supply which when energised pushes the contact outwards from the sensor body. When the pneumatic system is de-energised the sensor retracts back to its shortest position. NOTE: to de-energise the air must be released from the system otherwise the sensor will remain pressurised and in its advanced position.
- The springs are strong enough to make a good contact with a surface even under vibration conditions.
- Note - standard spring return sensors do not have a varying electrical output in the first 1-2mm of travel, i.e. they will NOT detect the initial point of contact of tip. Custom units can be ordered to give immediate output on contact.

Example sensor with internal spring

Example of a pneumatic advance sensor

Example of sensor with external spring

Materials and IP rating:

- All the LVDT bodies are made from steel. Some are stainless steel and others are nickel plated steel. Please be sure that the material is compatible with your application.
- Most LVDT ranges can be specified as Stainless Steel if Nickel plated is the standard version with the exception of the ISDG/ISAG.
- In general all the LVDT ranges are available with IP65 protection. This allows them to be used where there is occasional water spray or a slightly damp condition environment.
- Some sensors can be upgraded to IP67 and a few to IP68. It is also recommended to upgrade to Stainless Steel body if not already available to give the highest protection. (the IP rating is for the electrical part of the sensor, not mechanical)
- Even IP68 sensors should be used with care in wet conditions. The moisture can carry with it debris and although the sensor will not be affected electrically by debris or silt build-up, internally this could impede the motion of the core.
- The nature of the operation of the LVDT relies on electrical transmission between the primary and secondary cores. This is done by using a ferrous core. The nature of the operation means that in certain high electro-magnetic fields, the sensor may suffer interference.
- Wherever possible we use cables with PUR sheath. PUR has superior qualities when exposed to sunlight, petrochemicals and solvents when compared to PVC or similar. We can also offer custom cables by request if there are specific features required.

Accessories:

Cable assemblies:

- **For sensors with M12 connectors we offer a full range of 5 pin cable assemblies.**

  CABLE-ASSY-066-000-L02M is our 2 metre cable assembly
  CABLE-ASSY-066-000-L10M is our 10 metre cable assembly
  We also offer cable assemblies custom made to your specifications.

Mounting blocks:

Mounting block for 20mm diameter sensors
20MM-MOUNTINGBLOCK

Mounting flange for 20mm diameter sensors
20MM-MOUNTING-FLANGE

Measuring contact:

Pneumatic connector:

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Signal Conditioners:

IMA2-LVDT

The IMA2 signal conditioner is designed to be supplied with your AC LVDT. The signal conditioner is matched to the LVDT and will give the output you require. The part number is devised depending on your specifications. It is uncommon to have solely the signal conditioner without an LVDT, but this can be supplied with the proviso that all the sensor and output requirements are confirmed.

IMK-LVDT and IMK-LVDT-OEM

The IMK-LVDT and IMK-LVDT-OEM are in-line signal conditioners for LVDT sensors. The IMK-LVDT is usually supplied paired with an LVDT sensor to optimise the output however the IMK-LVDT-OEM has customer-adjustable settings via dip-switches inside the housing.

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