LinACE with digital outputs vs. LVDT sensor

COMPACT DESIGN

DIGITAL OUTPUTS

HIGH ACCURACY

LinACE has a similar design to LVDT transducers. However, it is not an LVDT type transducer.

LVDT typically has three coils arranged around a tube. The center coil is the primary coil and the two outer coils are secondary coils. A ferromagnetic core slides along the axis. As the core moves, the connection between the primary coil and the two secondary coils changes, causing a change in the induced voltages. Difference in the induced voltage in secondary coils is transformed in position information. There is no measuring standard or scale in the LVDT.

LinACE is an encoder or readhead paired with a measuring standard or scale that encodes position. The measuring standard is a coded shaft. The LinACE readhead reads the encoded shaft and converts the encoded position to a digital signal. This is a true absolute encoder.

Reading the coded shaft offers several advantages over evaluating the change in position against the induced voltage.

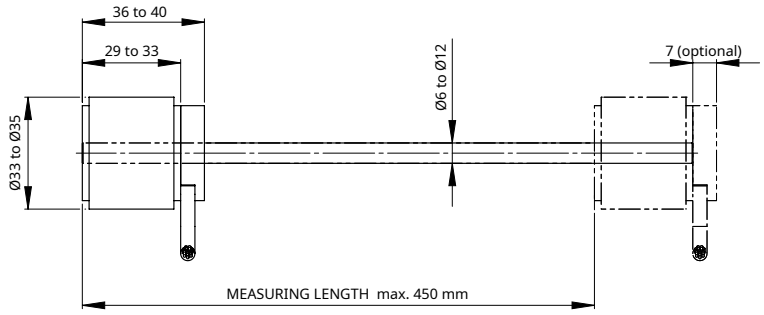
For more information on LinACE, visit the **LinACE website**.

Why choose LinACE instead of LVDT?

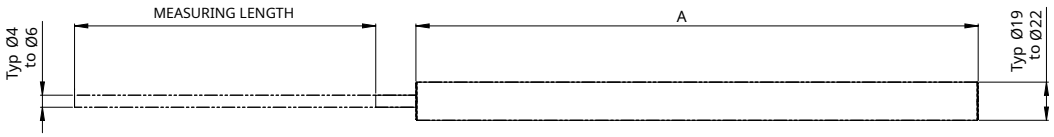
- Low weight (no heavy coils are needed)
- Compact design
- Digital output and high level of diagnostics and reliability
- High accuracy for measuring lengths 20 mm or more
- No pre- or post-travel

Compact design

Unlike LVDT, the length of the LinACE readhead does not depend on the measuring length. LinACE has a readhead length of 29 mm to max. 40 mm and a diameter of max. 35 mm.



LVDT transducers require coils length greater than the measuring length. Therefore, the sensor head length increases parallel to the measuring length.



LinACE vs. LVDT: readhead length and mass

Measuring length [mm]	20	100	150	300
LVDT length A[1] [mm]	140	230	280	450
LinACE readhead length[2] [mm]	29	29	29	29
LVDT mass[1] [g]	130	265	325	520
LinACE mass[2] [g]	94	111	122	144

[1] Estimated average value (with integrated processing electronics).
[2] With axial cable output, 1 m cable and 6 mm coded shaft diameter.

LVDT with a measuring length of 20 mm or more has a typical diameter of 19 mm or 22 mm.

LVDT can have integrated or separate processing electronics.

- In the case of integrated processing electronics, the sensor head length is even greater.
- If processing (signal conditioning) electronics is separate, it requires:
    - Additional cabling,
    - Space for installation and
    - Additional cost.

Digital output and high level of diagnostics and reliability

LinACE encoders are available in asynchronous serial, PWM, SSI and BiSS output versions and offer a range of selectable resolutions from 10 µm to 0.5 µm with speeds up to 5 m/s.

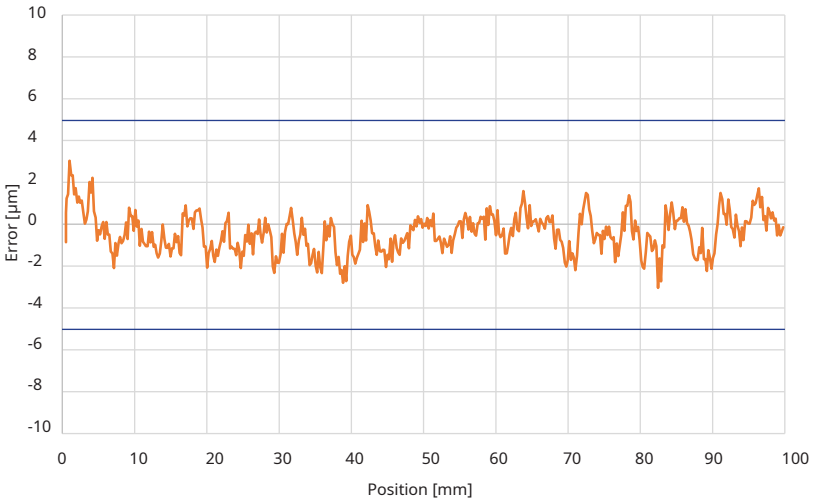
The LinACE encoder has a built-in advanced self-monitoring function that continuously checks several internal parameters. Error reports, warnings and other status signals are available on all digital interfaces.

General status	
b9	Error bit. If set, the position is not valid.
b8	Warning bit. If set, the encoder operational is close to its limits. The position is still valid, but the resolution and/or accuracy might be out of specification.
	The Error and Warning bits can be set at the same time, in this case the Error bit has priority. The general warning or error status is more closely defined by the Detailed status bits.
Detailed status	
b7	Warning - Signal amplitude too high. The readhead is too close to the shaft.
b6	Warning - Signal amplitude low. The distance between the readhead and the shaft is too large.
b5	Error - Signal lost. The readhead is too far away from the shaft.
b4	Warning - Temperature. The readhead temperature is out of specified range.
b3	Error - Power supply error. The readhead power supply voltage out of specified range.
b2	Error - System error. Malfunction inside the circuitry or inconsistent calibration data is detected. To reset the System error bit try to cycle the power supply while the rise time is shorter than 20 ms.
b1	Error - Wrong code. Shaft might be inserted in the wrong direction.
b0	Error - Acceleration error. The position data changed too fast. Shaft might be inserted in the wrong direction.

LVDT transducers normally have only analogue outputs and no status information. There are some manufacturers who can offer digital outputs, which they highlight as a unique selling point.

Accuracy for measuring lengths 20 mm or more

LinACE encoders are available with a resolution of 10 µm to 0.5 µm and an accuracy of ±100 µm to ±5 µm. An accuracy of ±5 µm is available up to a measuring length of 100 mm. And an accuracy of ±10 µm is available up to a measuring length of 450 mm.
Typical accuracy chart for measuring length 100 mm and accuracy ±5 µm:



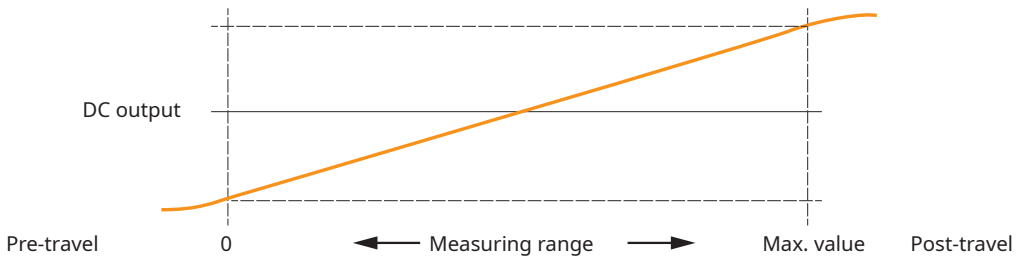
However, we have to take into account the temperature drift due to thermal expansion of the coded shaft and the aluminum housing.

LVDT transducers have a typical non-linearity of 0.1% to 0.5 %. The accuracy and resolution is therefore excellent up to a measuring range of 10 mm (±5 µm with ±5 mm travel with 0.1% non-linearity). With 100 mm travel, however, a non-linearity of 100 µm or more can be expected.

No pre- or post-travel

The LinACE encoder has no pre- or post-travel. The entire stroke from the beginning to the end of the coded shaft can be used without restrictions.
LVDT transducers have a very linear output over the specified range of core motion, but the sensor can be used over an extended range with reduced output linearity. This range is typically within a few mm.

- Pre-Travel: The mechanical movement from the fully outward position of the LVDT transducer (where the moving element is against a mechanical stop) to the beginning of the LVDT measurement range.
- Post-Travel: The mechanical movement from the end of the LVDT measurement range (inward) to the fully inward position where the moving element is against a mechanical stop.



Specifications comparison

	Transducer	
	LinACE	**LVDT**
Measuring length	From 20 mm to 450 mm	From 0.254 mm to 700 mm
Encoder length	Measuring length + 29 mm to 40 mm	Approx. measuring length × 2
Resolution	To 0.5 µm (>15 bit on 20 mm range)	<15 bit
Accuracy	To ±5 µm	
Non-linearity (% of full scale)	< 0.01 on 100 mm range	0.1 / 0.2 / 0.25 / 0.5
Repeatability	1 µm	0.01 % to 0.1 % (10 µm to 100 µm on 100 mm range)
Output bandwidth	2000 Hz	15 Hz to 500 Hz
Output	Asynchronous serial, PWM, SSI, BiSS	Analogue, RS485
Supply voltage	5 V	5 V to 12 V or 10 V to 30 V
Power consumption	Typ. 500 mW* Max. 600 mW*	300 mW to 700 mW
IP protection	40	40 to 68
Temperature	From –30 °C to +85 °C	Low: From –40 °C to 0 °C High: From +65 °C to +200 °C

* Without output load.

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