LION
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Technical Brief

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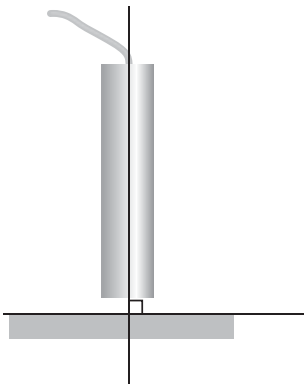
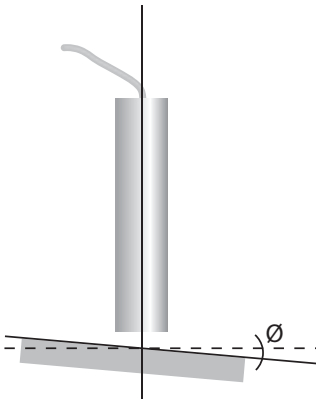
Error Sources: Probe/Target Angle





Applicable Equipment:

Capacitive Displacement Measurement Systems

Applications:

All Capacitive Displacement Measurement

Summary:

This Techical Brief describes the extent and nature of measurement errors as a result of a capacitive probe's sensing surface not being parallel to the target surface.

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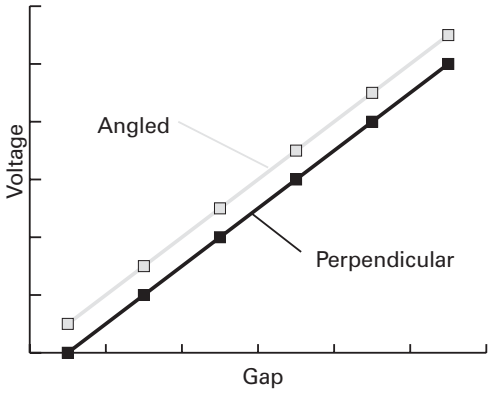

Measurement Error due to Probe Angle:

Nature of the Error:

Systems are calibrated with the probe perpendicular to the target surface. As that angle changes, the output will show a DC (offset) shift relative to the actual gap from the probe's center axis to the target.

- **Probe angle introduces a positive DC (offset) shift in the output causing the target to appear closer.**
- **Gain (scaling) error due to probe angle is insignificant in comparison to DC (offset) shift.**

Extent of the Error:

In addition to the Probe/Target angle, the magnitude of the error is dependent on:Sensor Radius,Probe/Target Gap,Sensor Geometry.

Error [m] is described by this function:

$$\text{Error} = \left(\frac{1 - \sqrt{1 - \left(\frac{r \bullet \theta}{d} \right)^2}}{2} \right) \bullet d \bullet k$$

Where:

r = radius [meters] of probe sensor area
d = probe/target gap, directly under the probe center axis [meters]
θ = probe/target angle [radians]

k = experimentally determined constant to account for field fringing errors

Typical k values are around 5.

Example 1: 0.5mm sensor radius, at 0.25mm gap, with a 0.0002 radian angle produces an error of approximately 0.05nm.

Example 2: 3mm sensor radius, at 0.75mm gap, with a 0.03 radian angle produces an error of approximately 13µm.