

2.1 Displacement Sensors

1. Introduction

- Displacement sensors measure the movement or position of an object.
- They can be used to measure linear or angular displacement.
- Common applications include industrial automation, robotics, automotive systems, and structural monitoring.

Types of Displacement Sensors

1. Linear Variable Differential Transformer (LVDT)
2. Rotary Variable Differential Transformer (RVDT)
3. Potentiometers
4. Capacitive Displacement Sensors
5. Inductive Displacement Sensors
6. Optical Displacement Sensors
7. Ultrasonic Displacement Sensors

1. Linear Variable Differential Transformer (LVDT)

Working Principle

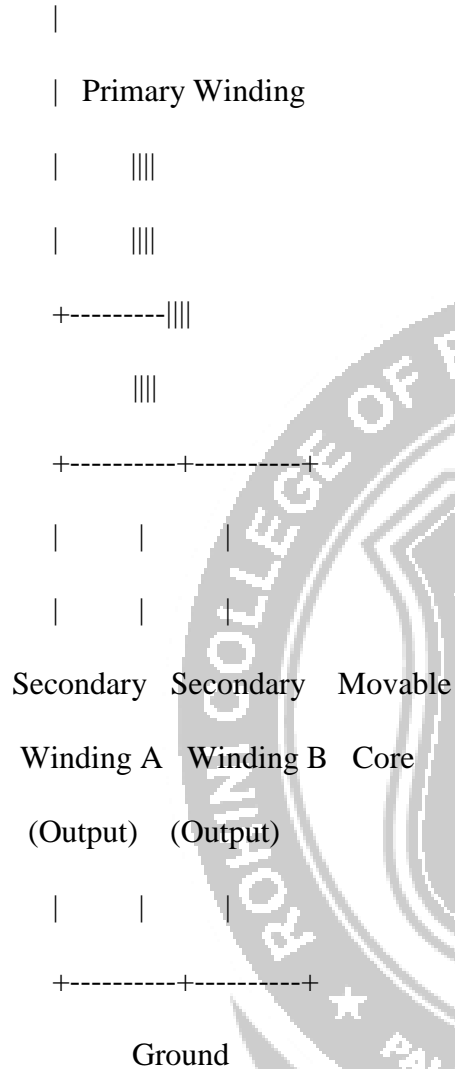
- Converts linear displacement into an electrical signal.
- Consists of a primary winding and two secondary windings.
- A movable core changes the mutual inductance between the primary and secondary windings.

Circuit Diagram

plaintext

Copy code

+V (AC Excitation)



2. Rotary Variable Differential Transformer (RVDT)

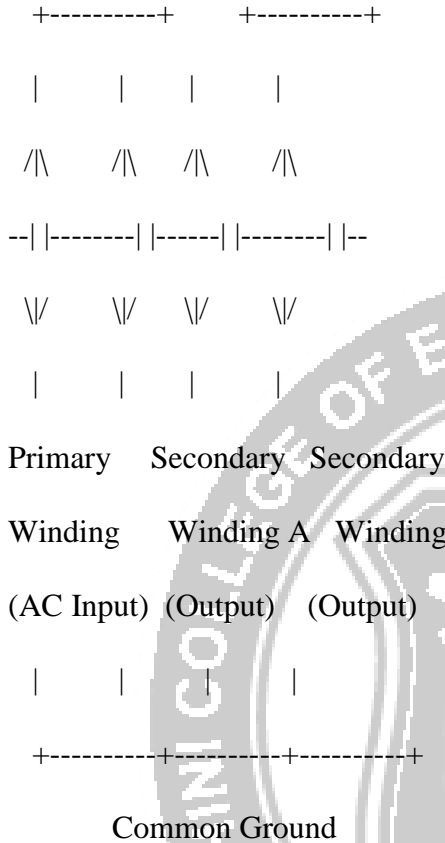
Working Principle

- Similar to LVDT but measures angular displacement.
- The core's rotation alters the magnetic coupling between the primary and secondary windings.

Circuit Diagram

plaintext

Copy code



3. Potentiometers

Working Principle

- A three-terminal resistor with a sliding or rotating contact.
- Used to create an adjustable voltage divider.

Circuit Diagram

plaintext

Copy code

+V (Input Voltage)

|

R1

|-----> Wiper (Output Voltage)



R2

|

Ground

4. Capacitive Displacement Sensors

Working Principle

- Measures changes in capacitance between two plates as displacement occurs.
- The capacitance varies with the distance or area of overlap between the plates.

Circuit Diagram

plaintext

Copy code

Plate 1 (Fixed)

|

+---+---+

| |

| |

(C) (C)

| |

+---+---+

|

Plate 2 (Movable)

5. Inductive Displacement Sensors

Working Principle

- Measures changes in inductance caused by the movement of a ferromagnetic target.

- The inductance changes with the distance between the sensor and the target.

Circuit Diagram

plaintext

Copy code

+V

|

Inductive Coil

|

|

+--- Ferromagnetic Target

|

Ground

6. Optical Displacement Sensors

Working Principle

- Uses a light source and a photo detector.
- Measures the change in light intensity or the position of a light spot.

Circuit Diagram

plaintext

Copy code

Light Source

|

|

[]

[]<-- Target

[]

|

|

Photo detector

7. Ultrasonic Displacement Sensors

Working Principle

- Uses ultrasonic waves to measure the distance to a target.
- The time taken for the echo to return is proportional to the distance.

Circuit Diagram

plaintext

Copy code

Ultrasonic Emitter

|

|----->

|

Ultrasonic Receiver

|

Ground

Applications

- Industrial Automation: Position feedback for machinery and robotic arms.
- Automotive Systems: Suspension systems, throttle position, and gear position.
- Robotics: Joint position sensing and movement tracking.

- Structural Monitoring: Measuring deformations and displacements in buildings and bridges.

Consumer Electronics: Touch screens and joysticks.

Advantages

- High accuracy and resolution.
- Non-contact options reduce wear and maintenance.
- Wide range of sensing technologies for different applications.

Disadvantages

- Can be affected by environmental factors like temperature and electromagnetic interference.
- Some types may require complex signal conditioning.
- Mechanical sensors like potentiometers can wear out over time.

Summary

Displacement sensors are critical components in a wide range of applications, providing precise measurement of linear and angular positions. Understanding the working principles and characteristics of different types of displacement sensors helps in selecting the right sensor for specific applications and ensuring accurate and reliable measurements.

