



ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY
AUTONOMOUS INSTITUTION
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 Anjugramam - Kanyakumari Main Road, Palkulam, Variyoor P.O. - 629 401, Kanyakumari District.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VII Semester

AU3008 Sensors and Actuators

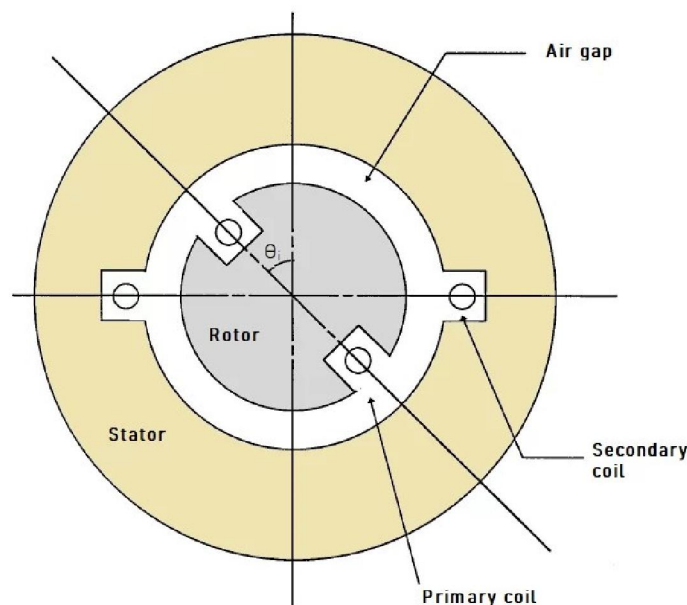
UNIT – 2 - Variable Resistance and Inductance Sensors

2.6 Inductive Potentiometer

An inductive potentiometer is a type of position sensor that uses electromagnetic induction to measure the angular displacement of a rotating shaft. Unlike traditional potentiometers that rely on sliding contacts, inductive potentiometers offer a contactless and wear-free operation.

Basic Components:

1. **Stator:** A fixed coil of wire that generates a magnetic field when energized.
2. **Rotor:** A movable coil of wire that rotates with the shaft.
3. **Excitation Source:** Provides an alternating current (AC) to the stator to create a magnetic field.



Inductive potentiometer

Principle of Operation:

1. **Magnetic Field Generation:** When the excitation source supplies AC to the stator, a magnetic field is generated around it.
2. **Rotor Interaction:** As the rotor rotates, its position in relation to the stator's magnetic field changes.
3. **Induced Voltage:** This change in position induces a voltage in the rotor coil.
4. **Output Signal:** The induced voltage is proportional to the angular displacement of the rotor, providing an output signal that represents the position of the shaft.

Key Advantages of Inductive Potentiometers:

- **Contactless Operation:** No sliding contacts, reducing wear and increasing lifespan.
- **High Accuracy:** Precise measurement of angular position.
- **Rugged Construction:** Suitable for harsh environments.
- **Wide Temperature Range:** Can operate in extreme temperatures.
- **Long-Term Reliability:** Minimal maintenance required.

Applications:

- **Industrial Automation:** Machine tools, robotics, and process control.
- **Aerospace and Defense:** Aircraft controls, missile guidance systems.
- **Medical Equipment:** Surgical instruments, diagnostic tools.

Working Principle of an Inductive Potentiometer:

The inductive potentiometer operates on the principle of **mutual inductance**, where the inductance between coils changes as a result of the relative position of the movable core.

1. **AC Excitation:** The primary winding is excited with an alternating current (AC) signal, which creates a magnetic field around the coil.

2. **Movement of the Core:** As the core (the movable ferromagnetic element) moves in response to linear or angular displacement, it affects the magnetic coupling between the primary and secondary windings.
3. **Change in Inductance:** The position of the core changes the mutual inductance between the primary and secondary coils. The inductance is proportional to the position of the core, meaning that as the core moves, the inductance changes predictably.
4. **Signal Output:** The change in inductance results in a variation of the induced voltage in the secondary coil. This variation is then processed by the associated electronic circuitry, converting it into an output signal that corresponds to the position of the core.

Applications:

- **Position Sensing:** Inductive potentiometers are used in industrial applications to measure linear or angular displacement in various machines.
- **Automotive Industry:** They are employed in throttle position sensors, steering angle sensors, and suspension systems.
- **Robotics:** Used for accurate position feedback in robotic arms or actuators.

Advantages:

- **Durability:** Since there are no physical contacts that wear out (unlike resistive potentiometers), inductive potentiometers are highly durable and suitable for harsh environments.
- **High Precision:** They offer precise measurements due to the sensitivity of inductance to movement.
- **Low Wear and Tear:** Since the operation is contactless, there is minimal mechanical wear, making these sensors reliable over long-term use.

Inductive potentiometers are favored in many high-precision applications, especially where mechanical wear is a concern or in environments where dirt and wear can damage traditional resistive potentiometers.