



# **SENSORS AND AUTOMATION**

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# Practical-3: Characterization of Strain Gauge

## Aim:

1. Plot the characteristics of Strain gauge.
2. Understand the effect of various parameters on the strain gauge performance.

## Theory:

Stress is the force generated inside an object in response to an applied external force. This internal force divided by the cross-sectional area of the object is called stress, which is expressed in Pa (Pascal) or N/m<sup>2</sup>. If the direction of the external force is vertical to the cross-sectional area, the stress is called vertical stress.

**Strain:** When a bar is pulled, it causes change in its length by  $\Delta L$ , making its new length =  $L$  (original length) +  $\Delta L$  (change in length). The ratio of this change in length  $\Delta L$ , to the original length,  $L$ , is called strain. The strain is expressed in  $\epsilon$  (epsilon):  $\epsilon = \Delta L / L$ . Strain in the same direction as the external force is called longitudinal strain. Each material has a certain ratio of lateral strain to longitudinal strain. This ratio is called Poisson's ratio.

## Gauge Factor:

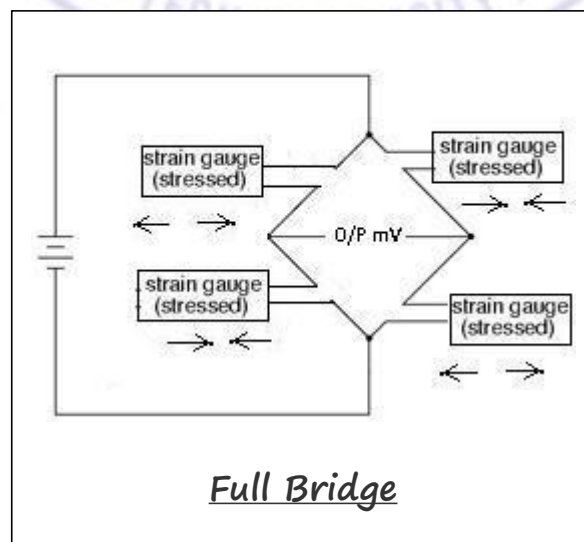
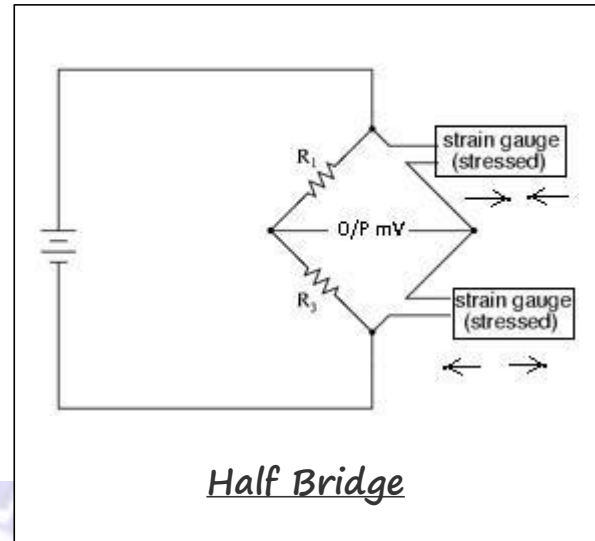
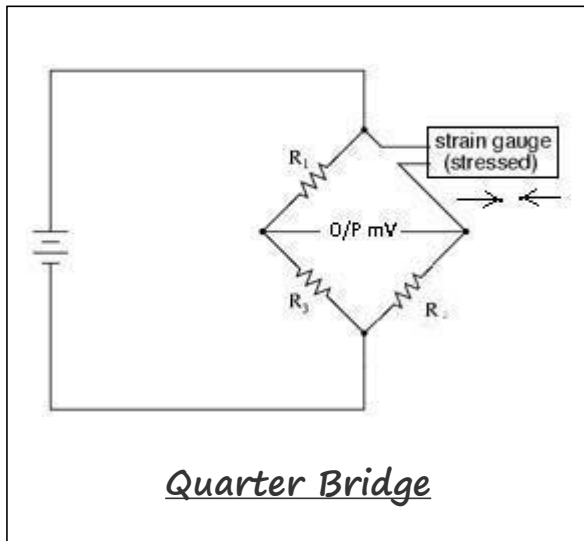
The characteristics of the strain gauges are described in terms of its sensitivity (gauge factor). Gauge factor is defined as unit change in resistance for per unit change in length of strain gauge wire given as

$$G.F. = (\Delta R / R_G) / \epsilon$$


where,  $\Delta R$  - the change in resistance caused by strain,  $R_G$  - is the resistance of the unreformed gauge, and  $\epsilon$  - is strain.

### Arrangement:

In certain applications where equal and opposite strains are known to exist it is possible to attach similar gauges in way that one gauge experiences positive strain and other negative strain. Depending on the number of gauges used the bridge, the circuit configurations are :



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### Characterize the Strain gauge sensor

**The ratio of stress upon strain is**

- ☐ a: Poisson's ratio
- ☒ b: Modulus of elasticity
- ☐ c: Modulus of stiffness
- ☐ d: None of these

**Young's Modulus describes the \_\_\_\_\_ of the material**

- ☐ a: Roughness
- ☒ b: Stiffness
- ☐ c: Ruggedness
- ☐ d: None of these

**Stress can be defined as**

- ☐ a: forces acting externally on the object
- ☐ b: deformation caused by acting forces
- ☒ c: Objects internal resisting force
- ☐ d: All of these

**The basic types of stress to which material can be subjected are:**

- ☒ a: Compression, shear, tensile
- ☐ b: Compression, shear, hardness
- ☐ c: Tensile, hardness, strain
- ☐ d: None of these

**The weighing balance works on the principle of comparing**

- ☒ a: forces
- ☐ b: moments
- ☐ c: acceleration
- ☐ d: None of these

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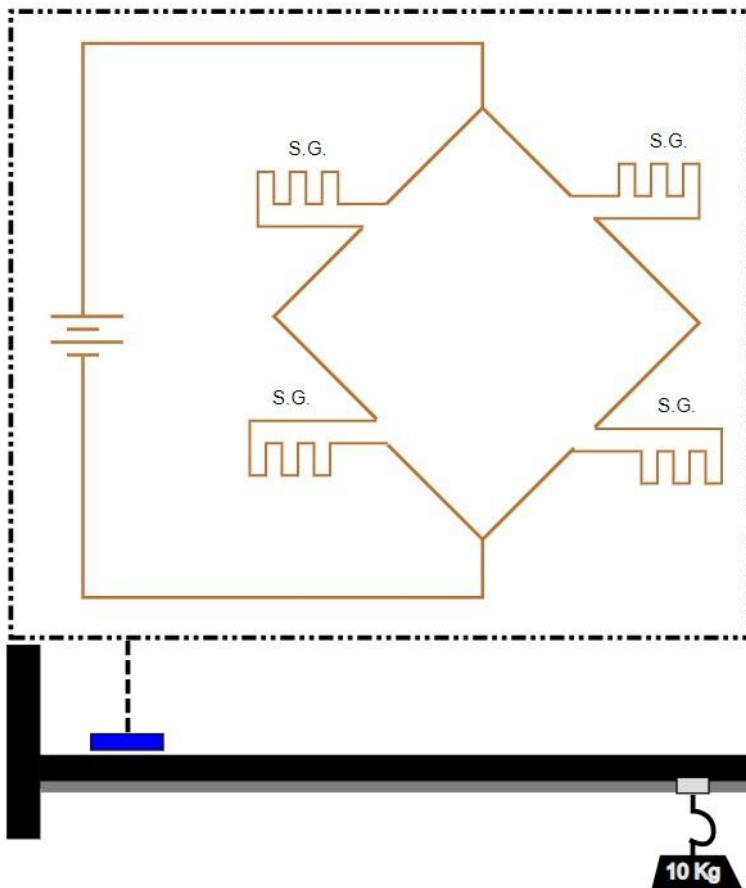
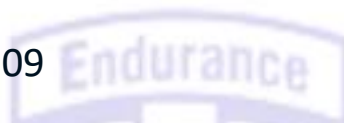
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### Selected Values:

1. Material:Copper
2. Input Voltage :10
3. Resistance :600
4. Gauge Factor :2
5. Configuration :Full Bridge
6. Weight : 4 Kg
7. Output Voltage : 20.09



### System Configuration

#### Level 1 - Measurement

Material

InputVoltage (V)

Resistance( $\Omega$ )

Configuration

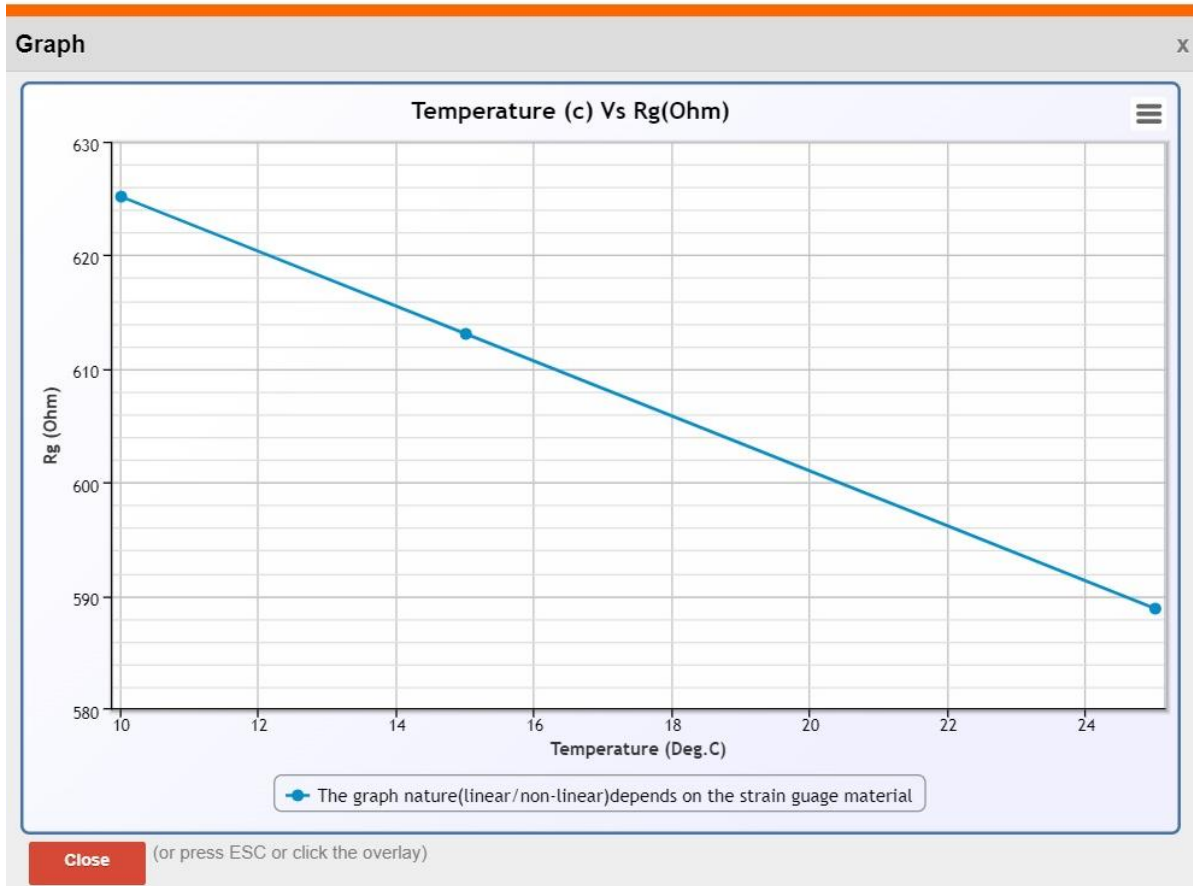
Gauge Factor

[configure](#)


## Characterize the Strain gauge sensor



## Characterize the Strain gauge sensor



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### Characterize the Strain gauge sensor

**Piezo-resistive strain gauge has**

- ☒ a: non-linear resistance characteristic
- ☐ b: has no relation with strain
- ☐ c: linear resistance characteristic
- ☐ d: All of these

**While mounting the strain gauge**

- ☐ a: strain gauge backing is responsible for the accuracy of measurement
- ☐ b: adhesive is responsible for the accuracy of measurement
- ☒ c: both are responsible for the accuracy of measurement
- ☐ d: None of these

**The characteristics of strain gauge is defined by**

- ☐ a: Poisson's ratio
- ☒ b: Gauge factor
- ☐ c: Young's modulus
- ☐ d: All of these

**Strain gauge cannot be used to measure**

- ☐ a: Force
- ☐ b: Flow
- ☐ c: Torque
- ☒ d: Level

**The strain gauges that don't need any bonding material**





- ☐ a: semiconductor strain gauges
- ☐ b: thin film strain gauges
- ☒ c: diffused semiconductor strain gauges
- ☐ d: None of these

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## Conclusion:

We studied characteristics of Strain Gauge and effects of various parameters on it's performance.