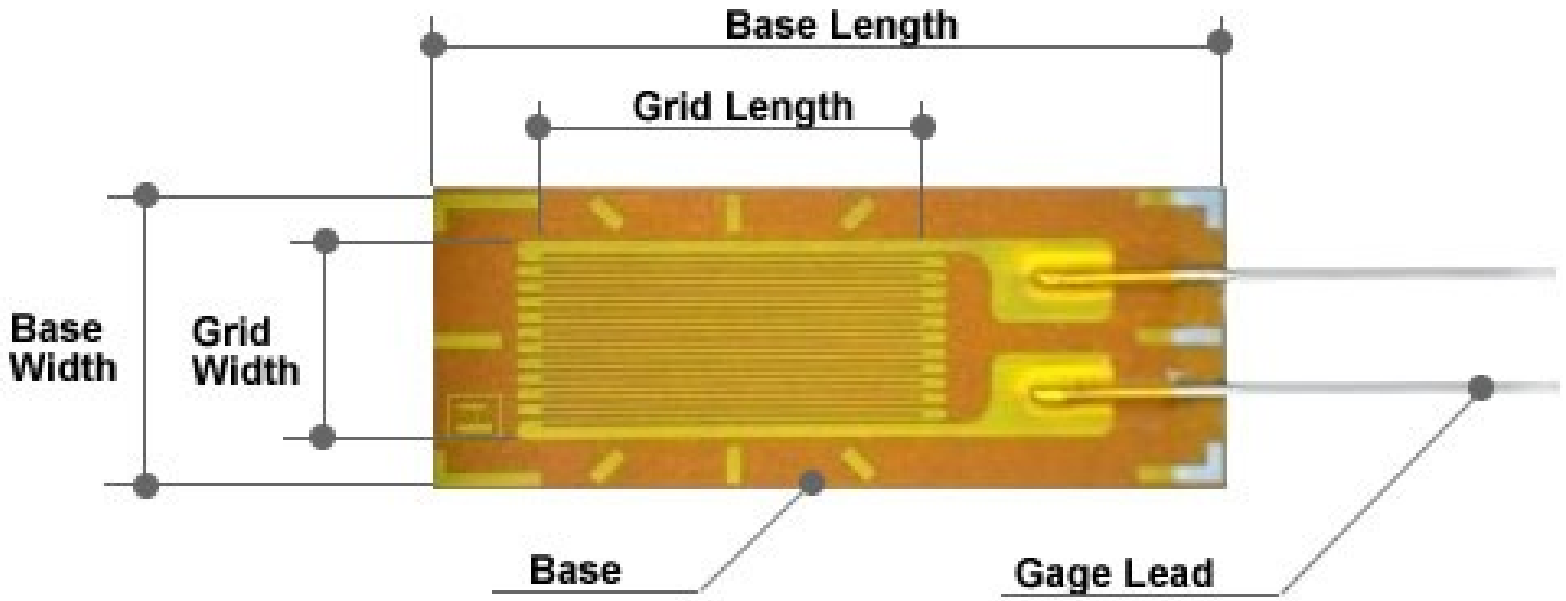
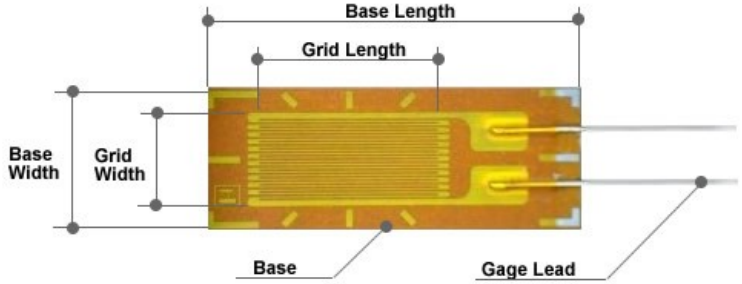
UNIT – 1

SCIENCE OF MEASUREMENT AND TRANSDUCERS

Bounded & Unbounded strain gauge

Strain gauge

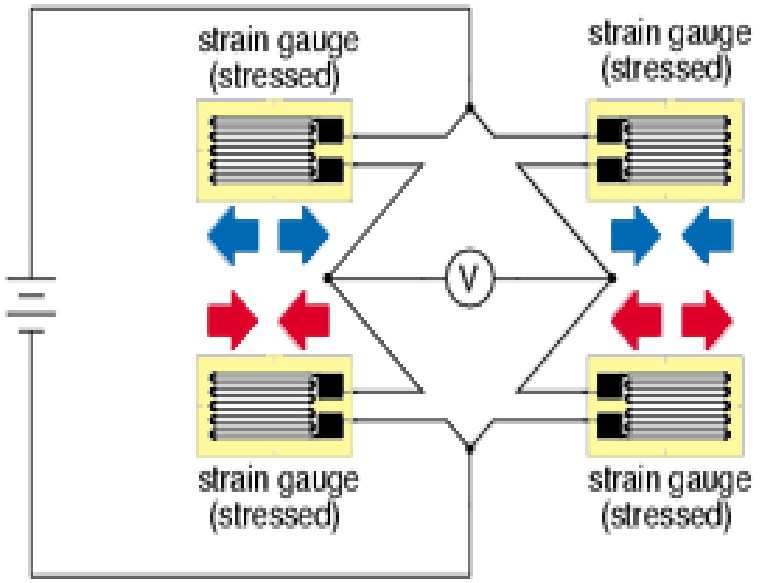




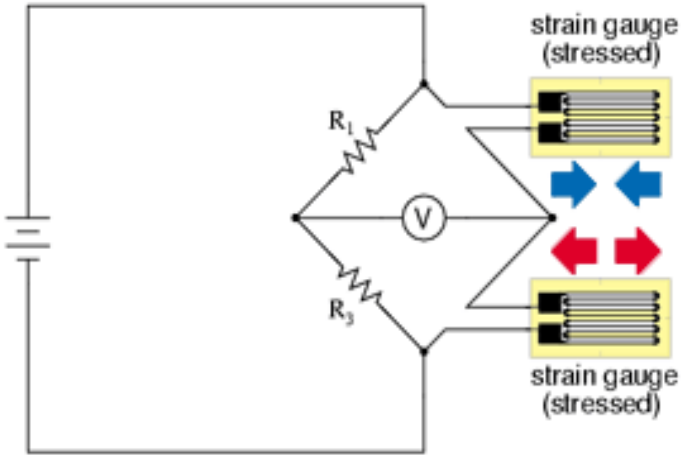
Specification	FA series	MA series	Unit and Note
Gage Length	0.3mm to 60mm	0.3mm to 60mm	standard
Gage Resistance	Within ±0.3% of the nominal resistance	Within ±0.3% of the nominal resistance	120Ω to 1000Ω
Foil Material	A : Cu-Ni Alloy	A : Cu-Ni Alloy	
Base Material	Polyester	Polyimide	
Gage Factor	2.00 (Nominal)	2.00 (Nominal)	1.90 to 2.10
Measurable Strain	2 to 4% maximum	2 to 4% maximum	Up to 10% with yielding strain
Temperature Range	- 30°C to + 80°C	- 30 to + 180°C	
Thermal Output	±2μst/°C(RT to + 80°C)	±2μst/°C(RT to + 160°C) ±5μst/°C(+ 160°C to higher)	Compensated temperature range
Gage Factor Change with Temperature	±0.015%/°C	±0.015%/°C	Refer to "Tech Information"
Fatigue Life	More than 1×10^5 reversals	More than 1×10^5 reversals	at $\pm1000\times10^6$ strain
Applicable Linear Expansion Coefficient	Common steel Stainless steel Aluminum alloy	Common steel Stainless steel Aluminum alloy	10.8ppm/°C 16.2ppm/°C 23.4ppm/°C

The strain gauge is connected into a Wheatstone Bridge circuit with a combination of :

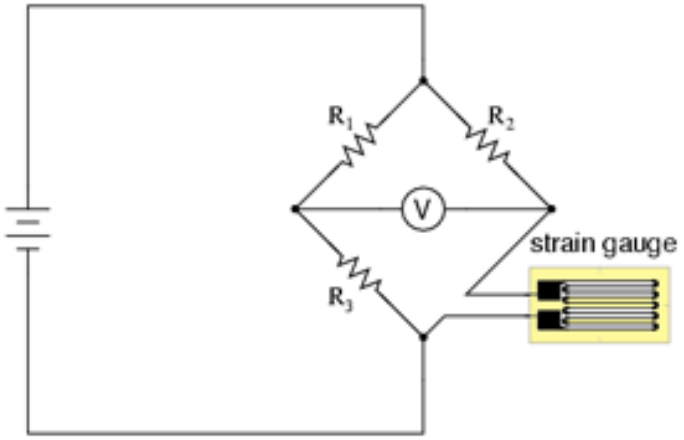
Full-bridge strain gauge circuit



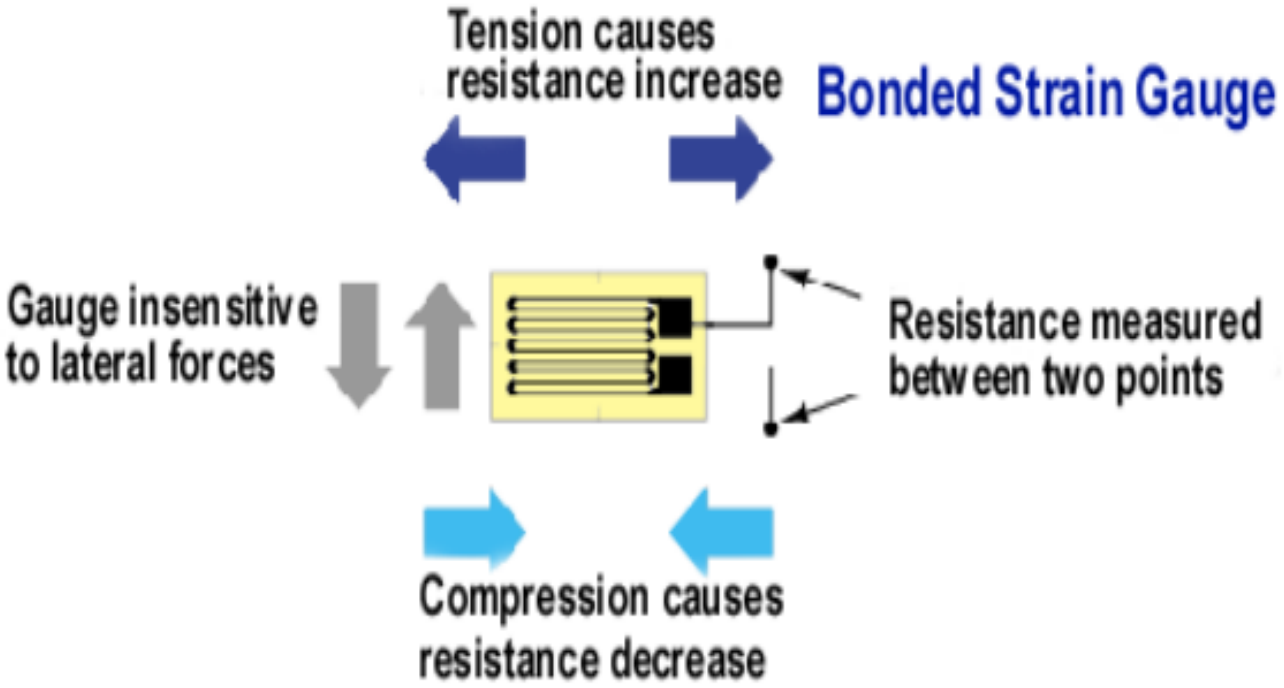
Half-bridge strain gauge circuit



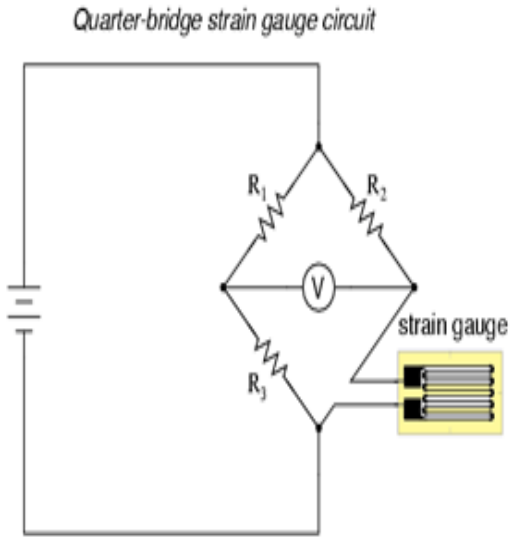
Quarter-bridge strain gauge circuit



The name "bonded gauge" is given to strain gauges that are glued to a larger structure under stress (called the test specimen)



Typical strain gauge resistances range from 30 Ohms to 3 kOhms (unstressed)



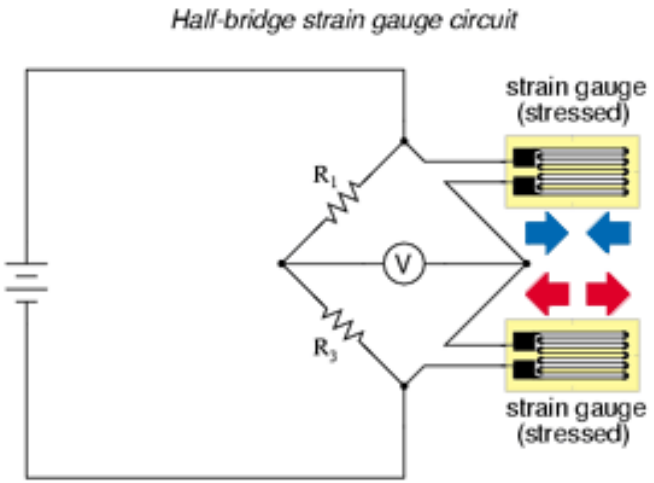
Typically, the rheostat arm of the bridge (R2 in the diagram) is set at a value equal to the strain gauge resistance with no force applied.

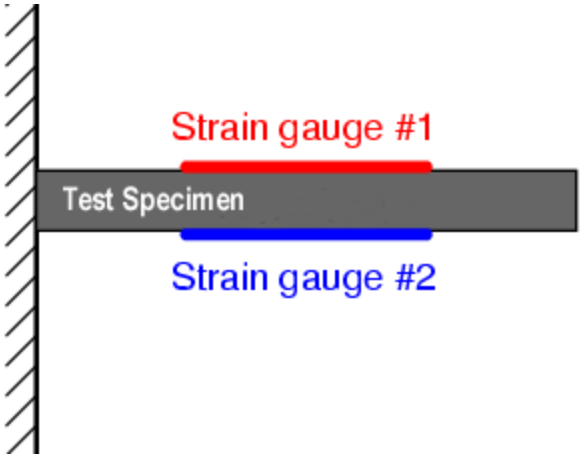
The two ratio arms of the bridge (R1 and R3) are set equal to each other.

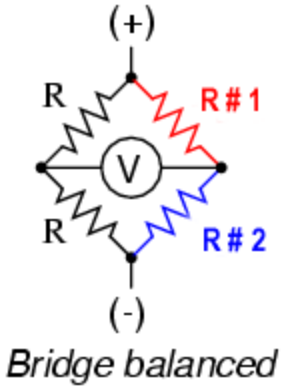
Thus, with no force applied to the strain gauge, the bridge will be symmetrically balanced and the voltmeter will indicate zero volts, representing zero force on the strain gauge.

As the strain gauge is either compressed or tensed, its resistance will decrease or increase, respectively, thus unbalancing the bridge and producing an indication at the voltmeter.

This arrangement, with a single element of the bridge changing resistance in response to the measured variable (mechanical force), is known as a quarter-bridge circuit.

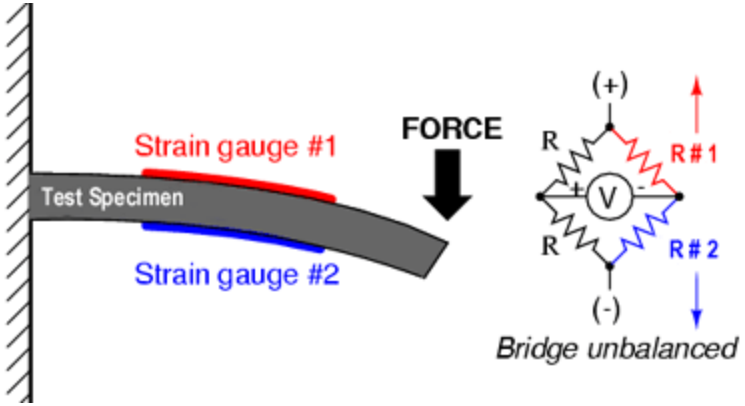






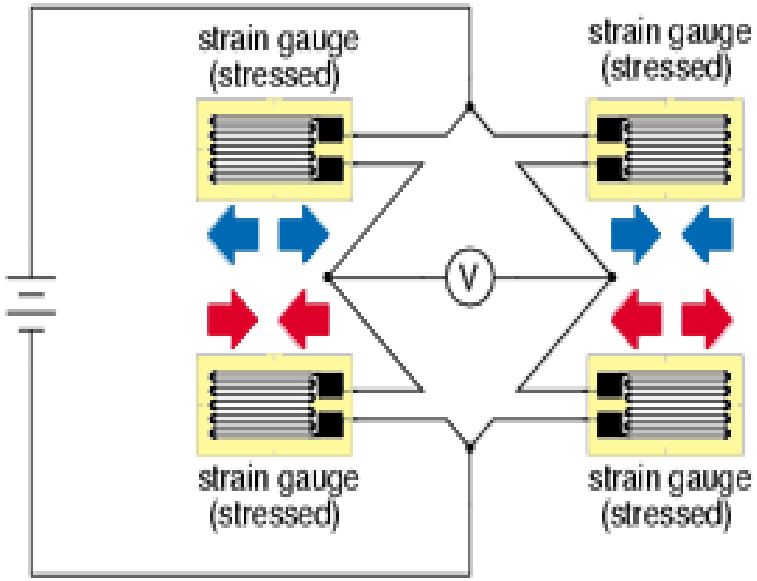
With no force applied to the test specimen, both strain gauges have equal resistance and the bridge circuit is balanced.

However, when a downward force is applied to the free end of the specimen, it will bend downward, stretching gauge #1 and compressing gauge #2 at the same time:



In applications where such complementary pairs of strain gauges can be bonded to the test specimen, it may be advantageous to make all four elements of the bridge "active" for even greater sensitivity. This is called a full-bridge circuit:

Full-bridge strain gauge circuit



Strain Gages Applications

They are often used in medical instruments like kidney dialysis machines and syringe pumps to help monitor fluid flow rates.

•Strain gages are also used in patient weighing and patient lift systems.

•Wireless strain gages can be found in CT scanners and mammography machines.

•Patient positioning systems used during radiation treatments

•In physical therapy applications, strain gage-based force sensors are used to measure forces on joints (shoulders, hips, knees, et al).

•Force feedback crutches aid patients undergoing orthopaedic therapy by detecting the amount of weight is being borne by the crutch