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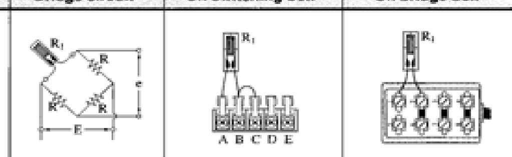
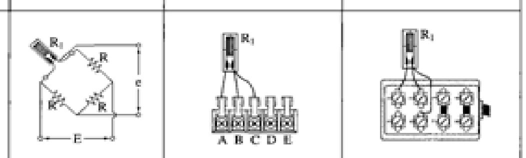
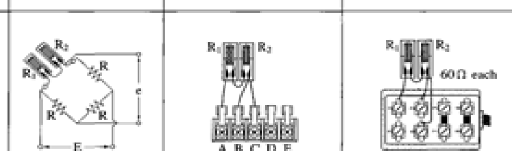
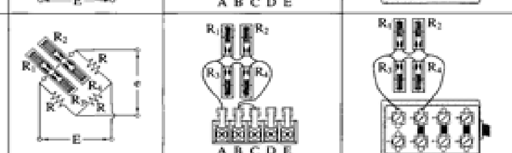
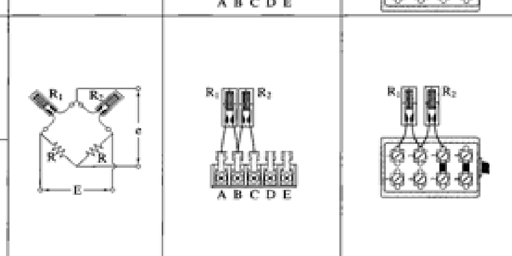
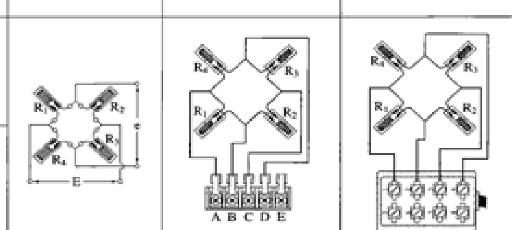
Strain Gage Connections and Bridge Circuits

Since the resistance change of strain gage is very small, it requires a Wheatstone bridge circuit to measure strain with strain gage. The simplest method is to place a strain gage into one arm of bridge circuit, while placing fixed resistors into other three arms. This method is called a quarter bridge method. If 3-cored lead wire is used for connecting a strain gage, influence of resistance change of lead wire due to temperature change is cancelled. This is called a quarter bridge 3-wire system. Half bridge is a method to place strain gages into two arms. This method has the advantage of doubling the output voltage or compensating the thermal output of strain gage, depending on the conditions of strain gage application. Full bridge method, in which all four arms are replaced by strain gages, yields redoubled output and compensation of temperature effect. TML strainmeters have functions of arranging bridge circuit, applying excitation voltage and amplifying and reading output voltage. Bridge circuit is completed by connecting strain gages and setting switches according to the specified manner of each strainmeter.

- Output voltage due to strain is based on the condition that output voltage before strain generation(e_0) is zero.
- Connection diagram may vary according to the type of strainmeter used.

Measuring mode	Bridge circuit	On switching box	On bridge box	Bridge output
Quarter bridge				E : Excitation voltage e : Output voltage Δe: Output voltage due to strain e_0 : Output voltage before strain generation R_0 : Resistance before strain generation ΔR: Resistance change due to strain ε : Strain K : Gauge factor
Quarter bridge with 3-wire system				$e = e_0 + \Delta e$ $R_1 = R_0 + \Delta R$ $R = R_0$ $\Delta e = \frac{E}{4} K\varepsilon$
Quarter bridge with double gauge and 3-wire system elimainatng bending strain				$R_1 = R_0 + \Delta R$ $R_2 = R_0 + \Delta R$ $R = 2R_0$ $\Delta e = \frac{E}{4} K\varepsilon$
Quarter bridge with 4 gauges				$R_1 = R_2 = R_3 = R_4 + \Delta e$ $R = R_0$ $\Delta e = \frac{E}{4} K\varepsilon$
Half bridge with 1-active and 1-dummy gauges				$R_1 = R_0 + \Delta R$ $R_2 = R_0 = R$ $\Delta e = \frac{E}{4} K\varepsilon$
Half bridge with 2-active gauges eliminating tensile strain				$R_1 = R_0 + \Delta R$ $R_2 = R_0 - \Delta R$ $R = R_0$ $\Delta e = \frac{E}{2} K\varepsilon$
Full bridge				$R_1 = R_3 = R_0 + \Delta R$ $R_2 = R_4 = R_0 - \nu \cdot \Delta R$ $\Delta e = \frac{E(1+\nu)}{2} K\varepsilon$ ν = Poisson's ratio
Full bridge				$R_1 = R_3 = R_0 + \Delta R$ $R_2 = R_4 = R_0 - \Delta R$ $\Delta e = EK\varepsilon$