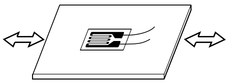
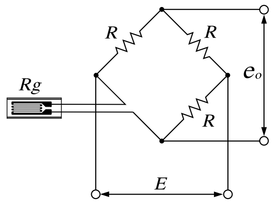
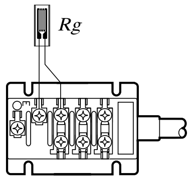
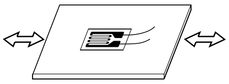
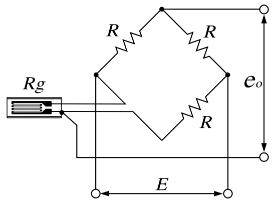
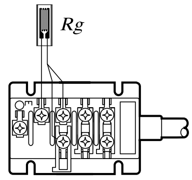
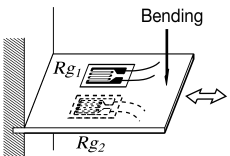
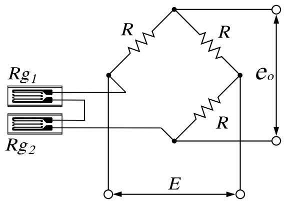
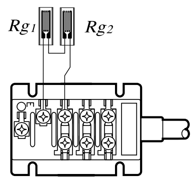
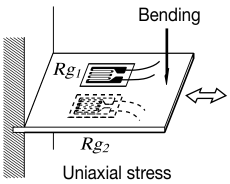
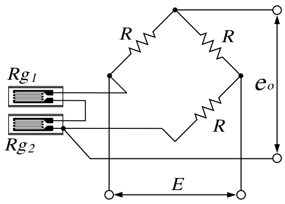
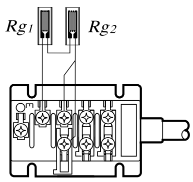
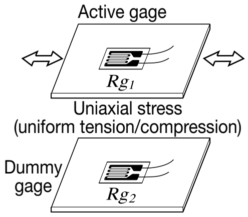
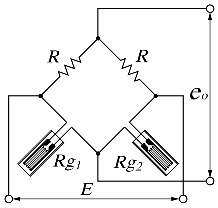
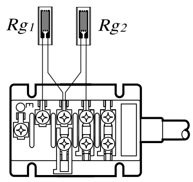
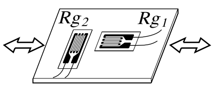
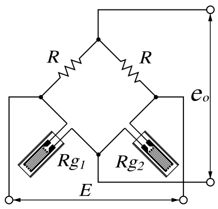
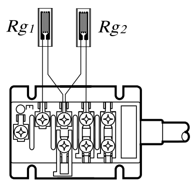
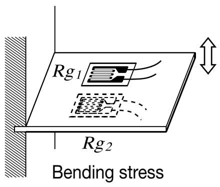
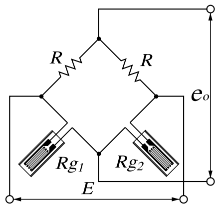
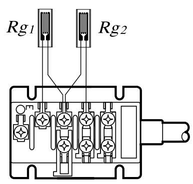
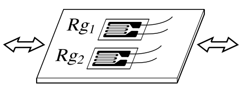
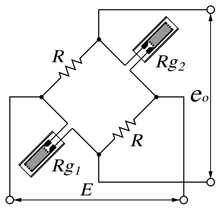
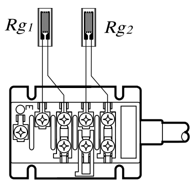
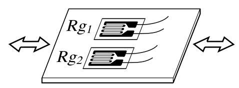
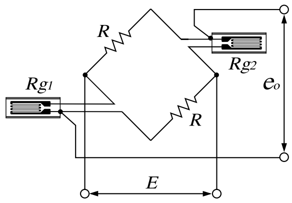
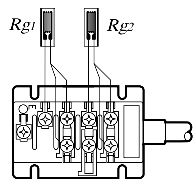
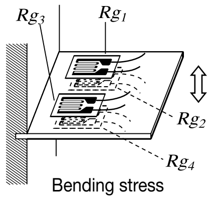
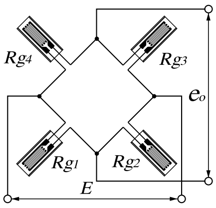
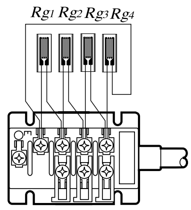
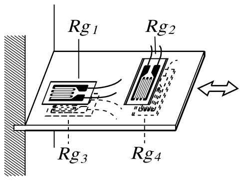
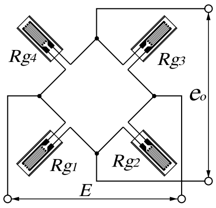
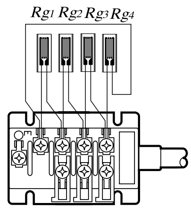
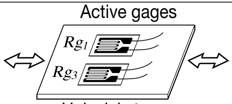
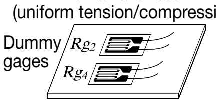
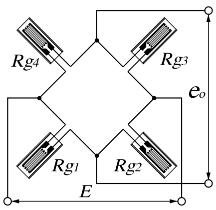
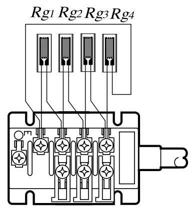
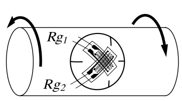
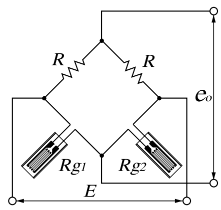
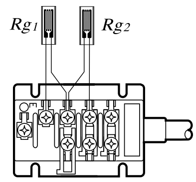
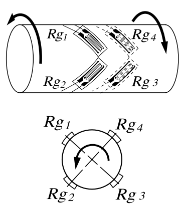
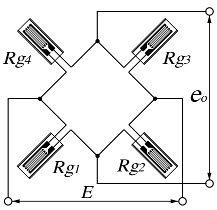
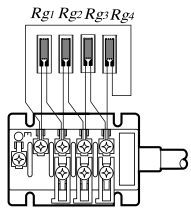
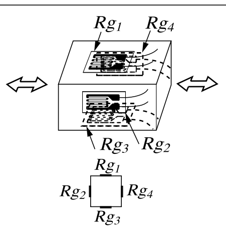
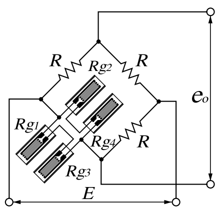
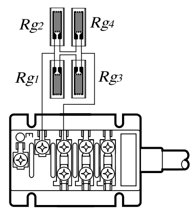
How to Form Strain-gage Bridges

No.	Name	Application Sample	Circuit	Output	Remarks	Bridge Box DB-120A/350A
1	1-active-gage 2-wire system Number of gages: 1	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$ K_s: Gage factor ε_o: Strain E: Bridge voltage e_o: Output voltage Rg: Gage resistance R: Fixed resistance	Suitable for use under environment of less ambient temerature changes; no temperature compensation. x1 output	
2	1-active-gage 3-wire system Number of gages: 1	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$	No temperature compensation; thermal effect of leadwires cancelled. x1 output	
3	Dual 1-active-gage 2-wire system in series (to cancel bending strain) Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$ Rg_1 ..... Strain: ε_1 Rg_2 ..... Strain: ε_2 $\varepsilon_o=\frac{\varepsilon_1+\varepsilon_2}{2}$ R: Fixed resistance $R=Rg_1+Rg_2$	No temperature compensation; bending strain cancelled. x1 output	
4	Dual 1-active-gage 3-wire system in series (to cancel bending strain) Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$ Rg_1 ..... Strain: ε_1 Rg_2 ..... Strain: ε_2 $\varepsilon_o=\frac{\varepsilon_1+\varepsilon_2}{2}$ R: Fixed resistance $R=Rg_1+Rg_2$	No temperature compensation; bending strain cancelled; thermal effect of leadwires cancelled. x1 output	
5	Active-dummy 2-gage system Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$ K_s: Gage factor ε_o: Strain E: Bridge voltage e_o: Output voltage Rg_1: Strain: ε_o R: Fixed resistance Rg_2..... Strain: 0	Temperature compensation; thermal effect of leadwires cancelled. x1 output	
6	Orthogonal 2-active-gage system Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{(1+\nu)E}{4}K_s\cdot\varepsilon_o$ ν: Poisson's ratio Rg_1, Rg_2: Gage resistance Rg_1 ..... Strain: ε_o Rg_2 ..... Strain: $-\nu\varepsilon_o$ R: Fixed resistance	Temperature compensation; thermal effect of leadwires cancelled. x(1+ν) output	
7	2-active-gage system (for bending strain measurement) Number of gages: 2	 Bending stress		$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ Rg_1 ..... Strain: ε_o Rg_2 ..... Strain: $-\varepsilon_o$ R: Fixed resistance	Temperature compensation; thermal effect of leadwires cancelled; compressive/tensile strain cancelled. x2 output	
8	Opposite side 2-active-gage 2-wire system Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ Rg_1 ..... Strain: ε_o Rg_2 ..... Strain: ε_o R: Fixed resistance	No temperature compensation; bending strain cancelled by bonding to the front and rear. x2 output	

No.	Name	Application Sample	Circuit	Output	Remarks	Bridge Box DB-120A/350A
9	Opposite side 2-active-gage 3-wire system Number of gages: 2	 Uniaxial stress (uniform tension/compression)		$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ Rg_1 ..... Strain: ε_o Rg_2 ..... Strain: ε_o R: Fixed resistance	No temperature compensation; thermal effect of leadwires cancelled; bending strain cancelled by bonding to the front and rear. x2 output	
10	4-active-gage system (for bending strain measurement) Number of gages: 4	 Bending stress		$e_o=K_s\cdot\varepsilon_o\cdot E$ Rg_1, Rg_3 ..... Bending strain: ε_o Rg_2, Rg_4 ..... Bending strain: $-\varepsilon_o$	Temperature compensation; thermal effect of leadwires cancelled; compressive/tensile strain cancelled. x4 output	
11	Orthogonal 4-active-gage system Number of gages: 4			$e_o=\frac{(1+\nu)E}{2}K_s\cdot\varepsilon_o$ ν: Poisson's ratio Rg_1, Rg_3 ..... Strain: ε_o Rg_2, Rg_4 ..... Strain: $-\nu\varepsilon_o$	Temperature compensation; thermal effect of leadwires cancelled. x2(1+ν) output	
12	Active-dummy 4-gage system Number of gages: 4	Active gages  Uniaxial stress (uniform tension/compression) 		$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ Rg_1, Rg_3 ..... Strain: ε_o Rg_2, Rg_4 ..... Strain: 0	Temperature compensation; thermal effect of leadwires cancelled; bending strain cancelled by bonding to the front and rear. x2 output	
13	2-active-gage system (for bending strain measurement) Number of gages: 2			$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ Rg_1 ..... Bending strain: ε_o Rg_2 ..... Bending strain: $-\varepsilon_o$ R: Fixed resistance	Temperature compensation; thermal effect of leadwires cancelled. x2 output	
14	4-active-gage system (for bending strain measurement) Number of gages: 4			$e_o=K_s\cdot\varepsilon_o\cdot E$ Rg_1, Rg_3 ..... Bending strain: ε_o Rg_2, Rg_4 ..... Bending strain: $-\varepsilon_o$	Temperature compensation; thermal effect of leadwires cancelled. x4 output	
15	4-active-1-gage system (for mean strain measurement) Number of gages: 4			$e_o=\frac{E}{2}K_s\cdot\varepsilon_o$ $\varepsilon_o=\frac{\varepsilon_1+\varepsilon_2+\varepsilon_3+\varepsilon_4}{4}$ R: Fixed resistance $Rg=R$ $R=Rg_1=Rg_2=Rg_3=Rg_4$	No temperature compensation; mean strain. x1 output	

●Relation between strain and voltage

The output of a strain-gage bridge is expressed as a strain quantity (με) or an output voltage (mV/V or μV/V) against the bridge voltage. The strain quantity and the output voltage have the following relation:

$$e_o=\frac{E}{4}K_s\cdot\varepsilon_o$$

If the bridge voltage E = 1V and the gage factor Ks = 2.00,

$$2e_o=\varepsilon_o.$$

Thus, a strain output is always 2 times larger than a bridge output voltage.

e.g. 3000με → 1500μV/V = 1.5mV/V