Strain Gages

1

Strain Gages

General Purpose

For Waterproof & Concrete Applications

For Composite Materials, PC Boards & Plastics

Ultra-small Strains for High, Low Temperature

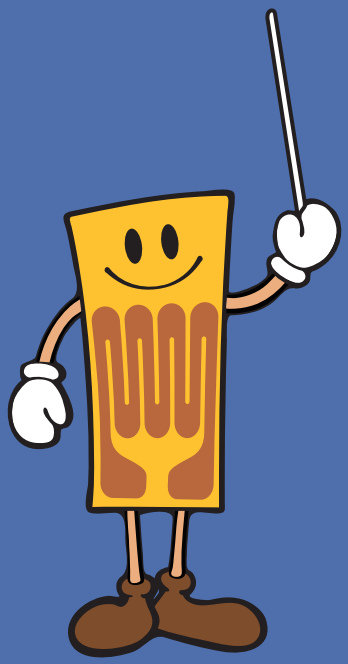
High Elongation & Bending Strain Gages

For Hydrogen Gas Environment

Gages with a Protector

Crack Gages

Adhesives & Coating Agents



Note
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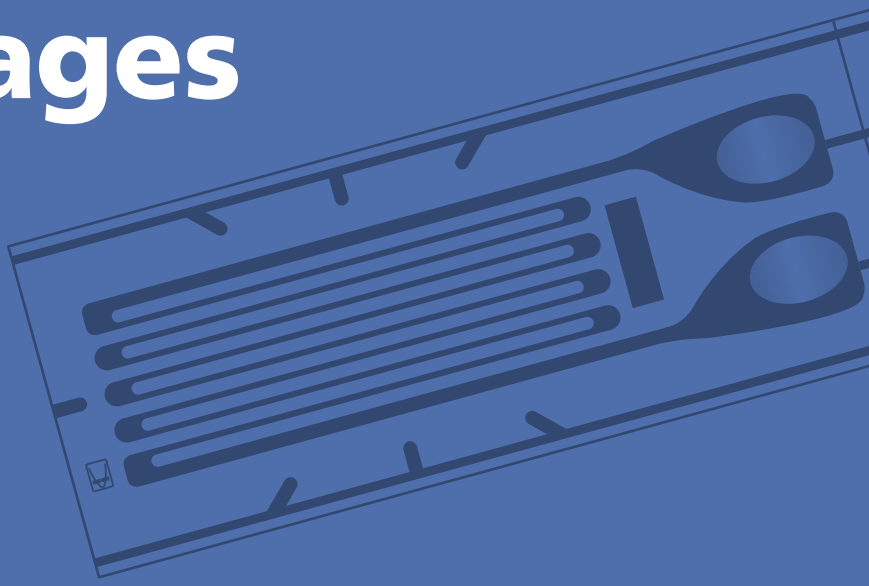
For prices and delivery date, contact us.

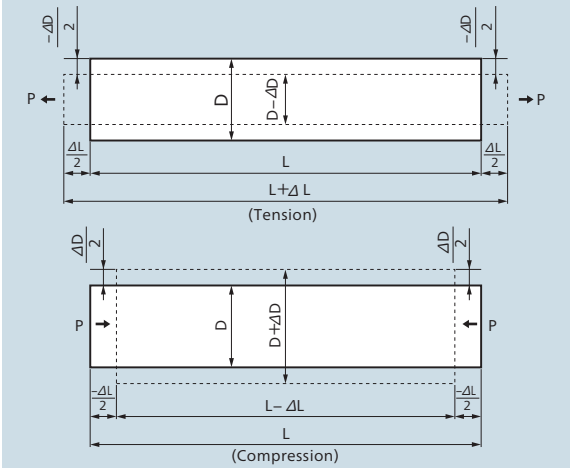
Strain Gages



■Strain, Stress, and Poisson's Ratio

When a material receives tensile force P, it has stress σ that corresponds to the applied force. In proportion to the stress, the cross section contracts and the length elongates by ΔL from the length L the material had before receiving the tensile force (See illustration in Fig. 1) below.

Fig. 1



The ratio of the elongation to the original length is called a tensile strain and is expressed as follows:

$$\varepsilon = \frac{\Delta L}{L}$$

ε: Strain
L: Original length
ΔL: Elongation

See the lower illustration in Fig. 1. If the material receives compressive force, it bears compressive strain expressed as follows:

$$\varepsilon = \frac{-\Delta L}{L}$$

For example, if tensile force makes 100 mm long material elongate by 0.01 mm, the strain initiated in the material is as follows:

$$\varepsilon = \frac{\Delta L}{L} = \frac{0.01}{100} = 0.0001 = 100\ \mu m/m$$

Thus, strain is an absolute number and is expressed with a numeric value with x10^{-6} strain, $\mu\varepsilon$ or μm/m suffixed.
Based on Hooke's law, the relation between stress and the strain initiated in a material by the applied force is expressed as follows:

$$\sigma = E\varepsilon$$

σ: Stress
E: Young's modulus
ε: Strain

Stress is thus obtained by multiplying strain by the Young's modulus. When a material receives tensile force P, it elongates in the axial direction while contracting in the transverse direction. Elongation in the axial direction is called longitudinal strain and contraction in the transverse direction, transverse strain. The absolute value of the ratio between the longitudinal strain and transverse one is called Poisson's ratio, which is expressed as follows:

$$\nu = \left| \frac{\varepsilon_2}{\varepsilon_1} \right|$$

ν: Poisson's ratio

ε_1: Longitudinal strain $\frac{\Delta L}{L}$ or $-\frac{\Delta L}{L}$ (See Fig. 1)

ε_2: Transverse strain $-\frac{\Delta D}{D}$ or $\frac{\Delta D}{D}$ (See Fig. 1)

Poisson's ratio differs depending on the material. For major industrial materials and their mechanical properties including Poisson's ratio, refer to page 9-1.

A strain gage detects a minute dimensional change (strain) as an electric signal. By measuring strain with the gage bonded to a material or structure, the strength or safety can be known. Thus, the strain gage is used in various industries including machinery, automobile, electric, civil engineering, medical, and food.

The strain gage is also adopted as a sensing element of force, pressure, acceleration, vibration, displacement, and torque transducers used for various purposes including measurement and control of production lines.

Kyowa produced the first Japanese-made strain gages in 1951, and based on the abundant experience and technology accumulated for these years, the company manufactures a variety of high-performance, environmentally friendly strain gages.

■Principle of Strain Gages

Each metal has its specific resistance. If external tensile force (compressive force) increases (decreases) the resistance by elongating (contracting) it. Suppose the original resistance is R and the strain-initiated change in resistance is ΔR. Then, the following relation is concluded:

$$\frac{\Delta R}{R} = Ks \cdot \frac{\Delta L}{L} = Ks \cdot \varepsilon$$

where, Ks is a gage factor, expressing the coefficient of strain gage sensitivity. General purpose strain gages use copper-nickel or nickel-chrome alloy for the resistive element, and the gage factor provided by these alloys is approximately 2.

■Types of Strain Gages

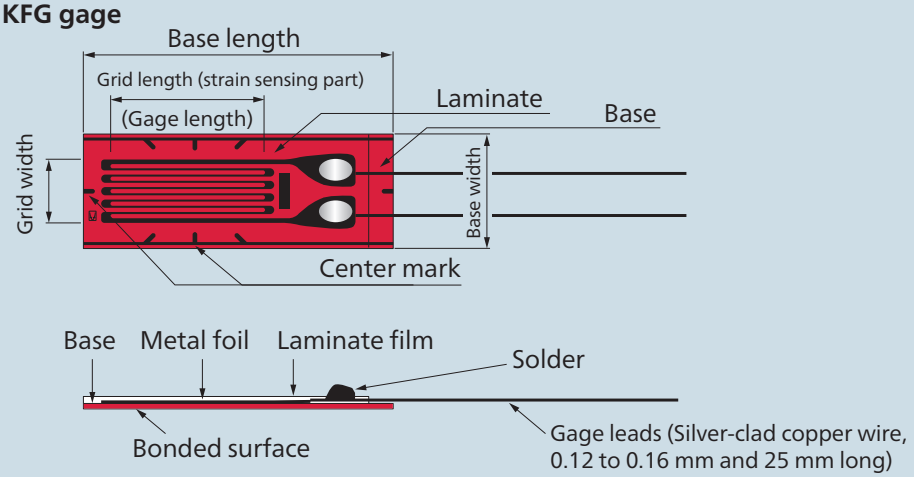
Types of strain gages include foil strain gage, wire strain gage, and semiconductor strain gage.

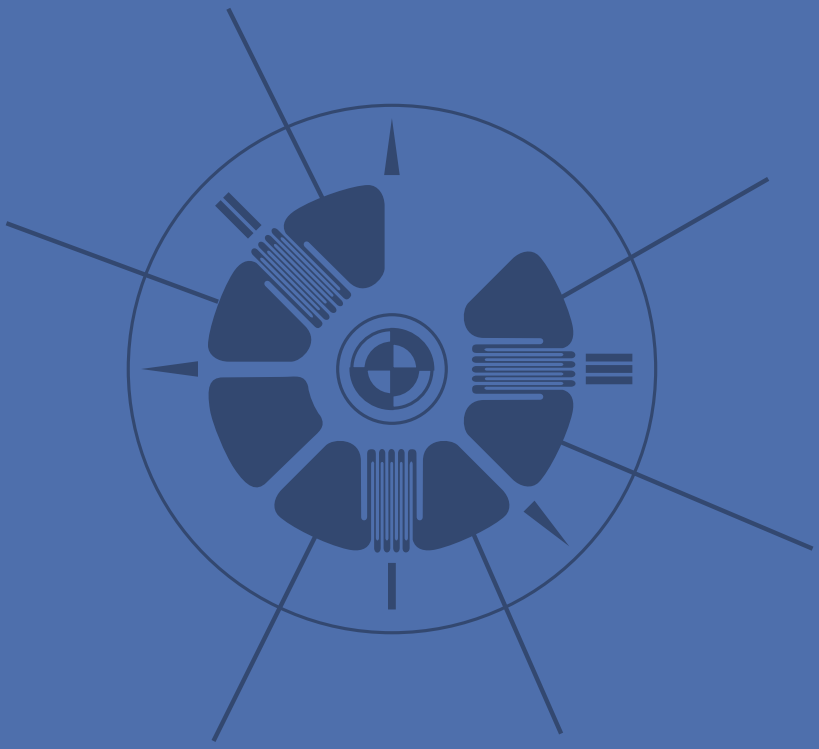
■Structure of Foil Strain Gage

The foil strain gage has metal foil photo-etched in a grid pattern on the electric insulator of the thin resin and gage leads attached, as shown in Fig. 2 below.

The strain gage is bonded to the measuring object with a dedicated adhesive. Strain occurring on the measuring site is transferred to the strain sensing element via the gage base. For accurate measurement, the strain gage and adhesive should match the measuring material and operating conditions including temperature. For the bonding method and dampproof treatment, refer to page 9-9.

Fig. 2 Example of KFG gage





■Principle of Strain Measurement

Strain initiated resistance change is extremely small. Thus, for strain measurement a Wheatstone bridge is formed to convert the resistance change to a voltage change. Suppose in Fig. 3 resistances (Ω) are R1, R2, R3 and R4 and the bridge voltage (V) is E. Then, the output voltage e_o (V) is obtained by the following equation:

$$e_0 = \frac{R_1R_3 - R_2R_4}{(R_1+R_2)(R_3+R_4)} \cdot E$$

Suppose the resistance R1 is a strain gage and it changes by ΔR due to strain. Then, the output voltage is,

$$e_0 = \frac{(R_1+\Delta R)R_3 - R_2R_4}{(R_1+\Delta R+R_2)(R_3+R_4)} \cdot E$$

If $R_1 = R_2 = R_3 = R_4 = R$ in the initial condition,

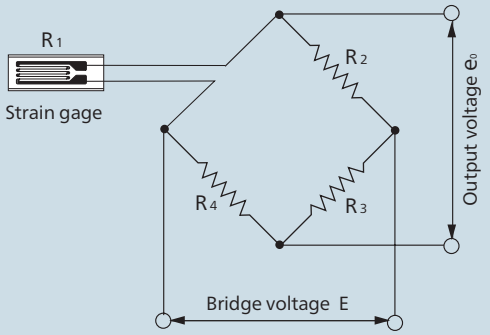
$$e_0 = \frac{R^2+R\Delta R-R^2}{(2R+\Delta R)2R} \cdot E$$

Since R may be regarded extremely larger than ΔR,

$$e_0 \fallingdotseq \frac{1}{4} \cdot \frac{\Delta R}{R} \cdot E = \frac{1}{4} \cdot Ks \cdot \varepsilon \cdot E$$

Thus obtained is an output voltage that is proportional to a change in resistance, i.e. a change in strain. This microscopic output voltage is amplified for analog recording or digital indication for strain measurement.

Fig. 3



■Strain Gage Wiring System

A strain gage Wheatstone bridge is configured with a quarter, half, or full bridge according to the measuring purpose. The typical wiring systems are shown in Figs. 4, 5 and 6. For varied strain gage bridge formation systems, refer to pages 9-7, 9-8.

●Quarter bridge system (1-gage system)

With the 1-gage system, a strain gage is connected to one side of the bridge and a fixed resistor is connected to each of the other 3 sides. This system can easily be configured, and thus it is widely used for general stress or strain measurement. The 1-gage 2-wire system shown in Fig. 4-1 is largely affected by leads. Therefore, if a big temperature change is expected or if the lead wire length is long, then the 1-gage 3-wire system shown in Fig. 4-2 must be used. For the 1-gage 3-wire system, refer to "Compensation Method of Temperature Effect of Lead Wires" (page 9-4).

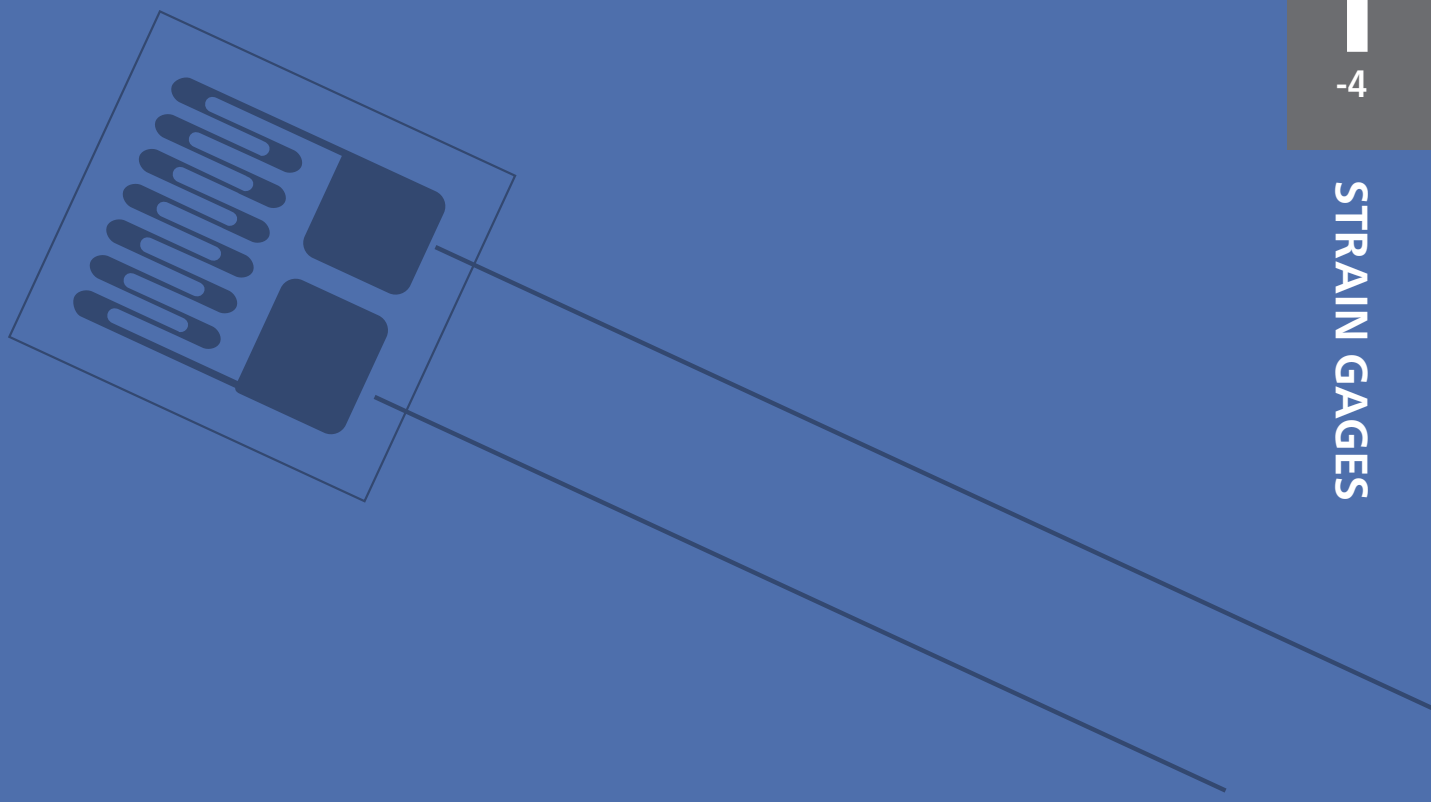


Fig. 4-1

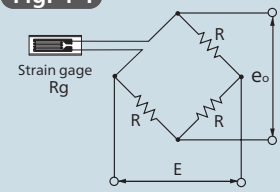
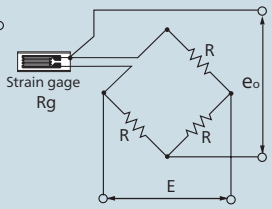
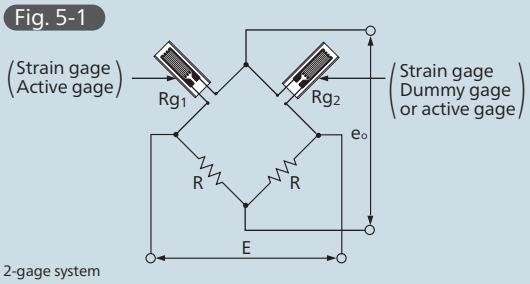


Fig. 4-2



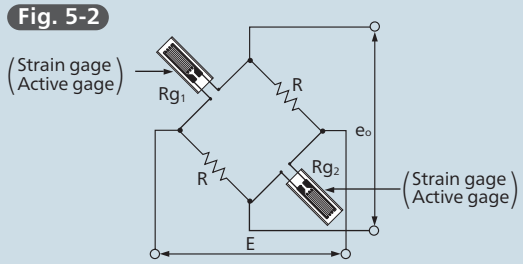
●Half bridge system (2-gage system)
With the 2-gage system, 2 strain gages are connected to the bridge, one each to adjacent or opposite sides with fixed resistor inserted in the other sides. See Figs. 5-1 and 5-2. There exist the active-dummy system, where one strain gage serves as a dummy gage for temperature compensation, and the active-active system, where both gages serve as active gages. The 2-gage system is used to eliminate strain components other than the target strain; according to the measuring purpose, 2 gages are connected to the bridge in different ways. For details, refer to "How to Form Strain Gage Bridges" (pages 9-7. 9-8).

Fig. 5-1



2-gage system

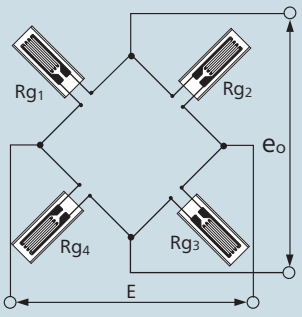
Fig. 5-2

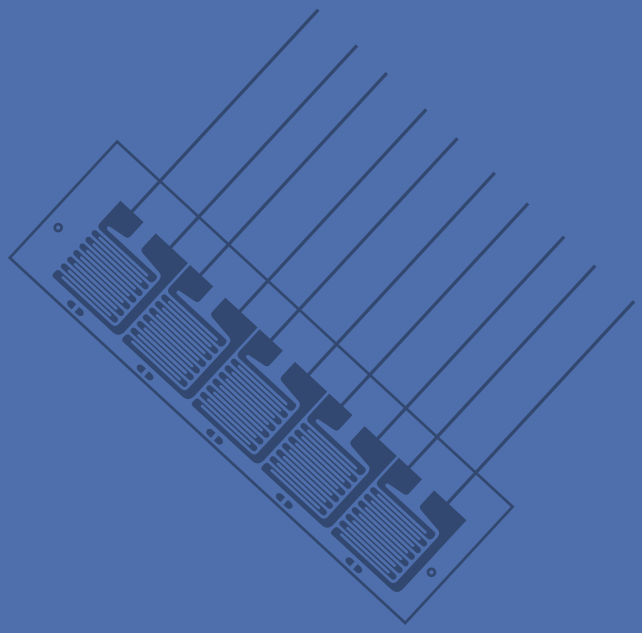


Opposite side 2-active-gage 2-wire system

●Full bridge system (4-gage system)
See Fig. 6. The 4-gage system has 4 strain gages connected one each to all 4 sides of the bridge. This circuit ensures large output of strain gage transducers and improves temperature compensation as well as eliminates strain components other than the target strain. For details, refer to "How to Form Strain Gage Bridges" (pages 9-7. 9-8).

Fig. 6





■Self-temperature-compensation Gages (SELCOM Gages)

When receiving a temperature change, a strain gage bonded to a measuring object generates an apparent strain due to a difference in linear expansion coefficient between the measuring object and the resistive element of the strain gage, and a thermally-induced resistance change of the gage element. The SELCOM gage has a resistance temperature coefficient of the resistive element adjusted to match with the measuring object, thereby minimizing the apparent strain.
Virtually all Kyowa's strain gages are SELCOM gages, and if bonded to suitable materials, the thermally-induced apparent strain is within 1.8 μm/m per ˚C in a temperature range of 10 to 80˚C. As shown in Fig. 7, the thermally-induced apparent strain of KFG gages is within μm/m per ˚C in a temperature range of 20 to 40˚C in which they are most frequently used. For the principle of SELCOM gages, refer to page 9-4. For the models and applicable materials, refer to page 1-6.

■Typical characteristic curve of thermally-induced apparent strain with KFG gage

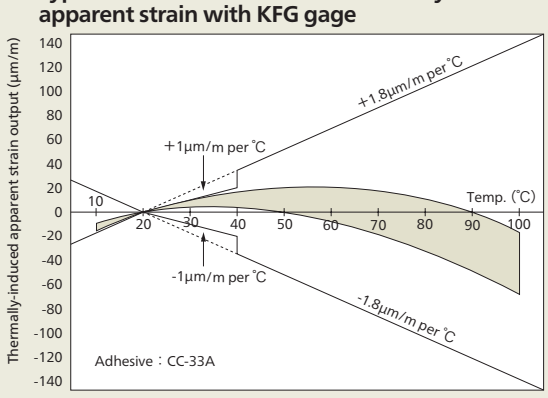
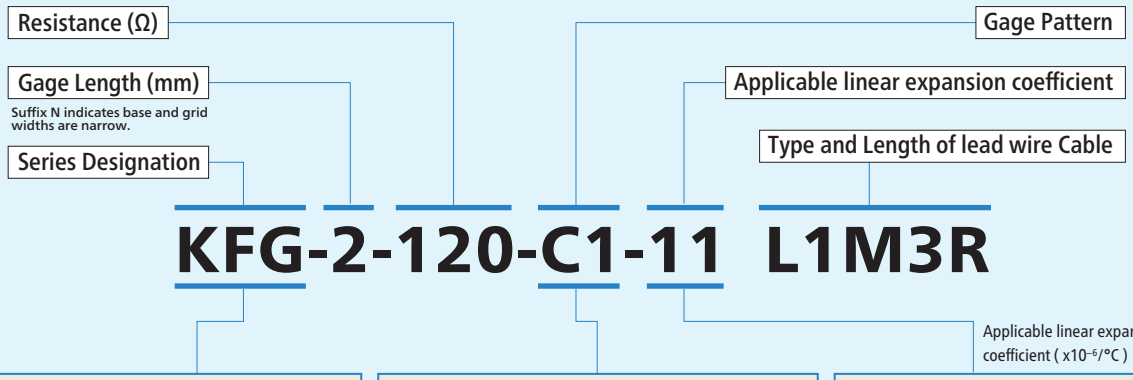


Fig. 7

■The following are described in Technical Notes(pages from 9-1)

- Mechanical properties of industrial materials
- Linear expansion coefficients of materials
- Examples of strain gage measurement
- Tensile and compressive stress measurement
- Bending stress measurement
- Equations to obtain strain on beams
- Torsional and shearing stress measurement
- Temperature effect of lead wires with 2-wire system
- Effect of insulation resistance
- Resistance change of strain gages bonded to curved surfaces
- Compensation of gage factors
- Misalignment effect
- Compensation of lead wire extension effect
- Compensation of nonlinearity of 1-gage system
- Method of obtaining the magnitude and direction of principal stress (Rosette analysis)
- Generating calibration values based on tip parallel resistance method.

■Strain Gage Model Name Coding System



KFG-2-120-C1-11 L1M3R

KFG: General-purpose Foil Strain Gages
KFGT: Foil Strain Gages with a Temperature Sensor
KFR: Foil Strain Gages
KFW: Waterproof Foil Strain Gages
KFWS: Small-sized Waterproof Foil Strain Gages
KCW: Weldable Waterproof Foil Strain Gages
KC: Wire Strain Gages
KM: Embedded Strain Gages
KMC: Concrete-embedded Strain Gages
KFRP: Foil Strain Gages for Composite Materials
KFRS Foil Strain Gages for Printed Boards
KFP: Foil Strain Gages for Plastics
KFML: Foil Strain Gages for low-elasticity Materials
KSP: Semiconductor Strain Gages
KSN: Self-temperature-compensation Semiconductor Strain Gages
KSPH: High-output Semiconductor Strain Gages
KSPL: Ultra Linear Semiconductor Strain Gages
KHCX: Encapsulated Strain Gages
KHCV: Encapsulated Strain Gages
KHCR: Encapsulated Strain Gages
KHCS: Encapsulated Strain Gages
KHCM: Encapsulated Strain Gages
KHC: Encapsulated Strain Gages
KFU: High-temperature Foil Strain Gages
KH: High-temperature Foil Strain Gages
KFH: High-temperature Foil Strain Gages
KFL: Low-temperature Foil Strain Gages
KFEM: Ultrahigh-elongation Foil Strain Gages
KFEL: High-elongation Foil Strain Gages
KFN: Non-inductive Foil Strain Gages
KFS: Shielded Foil Strain Gages
KFV: Foil Strain Gage for Hydrogen Gas Environment
KFF: Foil Strain Gages for Bending Strain Measurement
KCH: Foil Strain Gages with a Protector
KMP: Embedded Gage
KV: Crack Gage

A1: Uniaxial, leads at one end (KC, KTB gages)
C1: Uniaxial, leads at one end (Foil gage)
C2: Uniaxial 90°, lead at both ends
C3: Uniaxial 0°, lead at both ends
C9: Uniaxial, leads at one end (KFN gage)
C11: Uniaxial, 2-element, 1 mm thick (KFF gage)
C12: Uniaxial, 2-element, 2 mm thick (KFF gage)
C15: Uniaxial right 45°, for shearing strain, leads at one end
C16: Uniaxial left 45°, for shearing strain, leads at one end
C20: Uniaxial, leads at a side (For bolt axial tension)
D1: Biaxial 0/90°, lead at both ends
D2: Biaxial 0/90°, lead at both ends (For torque)
D3: Triaxial 0/90/45°, lead at both ends, plane arrangement
D4: Triaxial 0/120/240°, plane arrangement
D6: Quadraxial 0/30/90/150°, plane arrangement
D9: Uniaxial 5-element 90°
D16: Biaxial 0/90° stacked rosette, round base
D17: Triaxial 0/90/45° stacked rosette, round base
D19: Uniaxial 5-element 0°
D20: Biaxial 0/90° (KFN gage)
D22: Triaxial 0/90/45°, plane arrangement
D25: Triaxial 0/90/45°, plane arrangement
D28: Triaxial 0/135/90°, plane arrangement (For boring)
D31: Biaxial 0/90°, leads at one end (For torque)
D34: Biaxial 0/90°, plane arrangement
D35: Triaxial 0/90/45°, plane arrangement
D39: Biaxial 5-element 0/90°, stacked rosette
E3: Uniaxial, lead at both ends (semiconductor gage)
E4: Uniaxial, leads at one end (semiconductor gage)
E5: Uniaxial, lead at both ends with no base (semiconductor gage)
F2: Uniaxial 2-element (semiconductor gage)
F3: Biaxial 0/90° (semiconductor gage)
G4: Uniaxial, leads at one end (KH-G4)
G8: Uniaxial active-dummy 2-element, Inconel (For KHC)
G9: Uniaxial active-dummy 2-element, SUS (For KHC)
G10: Uniaxial (For KCW)
G12: Uniaxial active-dummy 2-element (For KHCS)
G13: Uniaxial active-dummy 2-element (For KHCX)
G15: Uniaxial active-dummy 2-element (For KHCM)
G16: Uniaxial active-dummy 2-element (For KHCR)
G17: Uniaxial active 1-element (For KHCV)
H1: Uniaxial (For KM-30)
H2: Uniaxial (For KM-120)
H3: Uniaxial (For KMC)
H4: Uniaxial with T thermocouple (For KMC)
J1: Uniaxial (For KFS)

Applicable linear expansion coefficient ($x10^{-6}$/°C)

1: Composite materials such as CFRP
Amber (1.1)
Diamond (1.2)

3: Composite materials such as GFRP
Silicon (2.3)
Sulfur (2.7)

5: Composite materials such as GFRP
Tungsten (4.5)
Lumber (5.0)
Molybdenum (5.2)
Zirconium (5.4)
Kobar (5.9)

6: Composite materials such as GFRP
28 Tantalum (6.6)

9: Composite materials such as CFRP, GFRP
Titanium alloy (8.5)
Platinum (8.9)
Soda-lime glass (9.2)

11: Common steel (11.7)
SUS631 (10.3)
SUS630 (10.6)
Cast iron (10.8)
Nickel-molybdenum steel (11.3)
Beryllium (11.5)
Inconel X (12.1)

13: Corrosion and heat-resistant alloys such as NCF
Nickel (13.3)
Printed board (13.0)

16: Stainless steel SUS304 (16.2)
Beryllium steel (16.7)
Copper (16.7)

23: 2014-T4 aluminum (23.4)
Brass (21.0)
Tin (23.0)
2024-T4 aluminum (23.2)

27: Magnesium alloy (27.0)
Composite material, GFRP (35.0)

65: Acrylic resin (65.0)
Polycarbonate (66.6)

For choosing strain gages, refer to pages 1-7, 1-8.
For special custom-made gage patterns, refer pages 1-52, 1-53.
Note: Combination of codes is limited and menu options cannot freely be selected.

Strain Gages Selection Chart

Selecting strain gage types matching to measurement purpose and environment.

KFG-2-120-

Series Designation

Series Designation

Selecting strain gage types matching the kind of material and the temperature of the environment.

E.g.

· Outdoor environment, measurement in underwater

KFW
Waterproof foil strain gages

· Measurement under high temperature

KFU
High-temperature foil strain gages

· Concrete internal strain measurement

KM
Embedded strain gages

Gage Length (mm)

Gage Length (mm)

Selecting gage length types matching the kind of material and the environment of space.

Main Application	Strain Gage Length (mm)
Strain measurement for mortar & concrete	30 to 120
Strain measurement for wood & glass	5 to 30
Strain measurement for common steel & acrylic	1 to 6
Concentrated stress measurement	0.15 to 2
Strain measurement in narrow space.	0.2 to 1
Strain measurement in fast phenomenon (Impact-shock, etc.)	0.2 to 1

Resistance (Ω)

Gage Resistance

Selecting strain gage resistance matching the measurement application.

Application	Resistance
Bending compensation	60Ω
General-purpose strain measurement	120Ω
For transducers	350 to 1000Ω

For special custom-made gage patterns, refer pages 1-52, 1-53.
Note: Combination of codes is limited and menu options cannot freely be selected.

C1-11 L1M3R

Gage Pattern

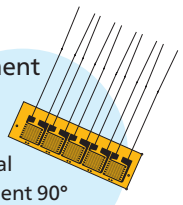
Pattern of strain gages

Selecting a pattern matching the measurement application.

E.g.

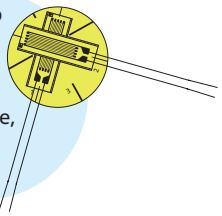
· Concentrated stress measurement

D9
Uniaxial
5-element 90°



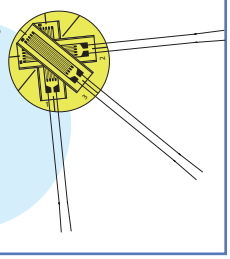
· Measurement of Poisson ratio

D16
Biaxial 0, 90°
stacked rosette,
round base.



· Stress analysis

D17
Triaxial 0, 90,
and 45°
stacked rosette,
round base.



Applicable Linear Expansion Coefficient

Linear expansion coefficient of strain gages

Selecting a pattern matching the measurement application.

E.g.

5 Wood (lumber)

11 Common steel

16 Stainless steel

23 Aluminum alloy

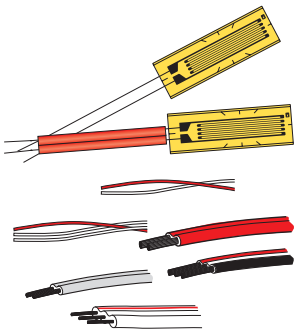
27 Magnesium alloy

65 Plastics

Type and Length of Lead Wire Type Cable

Lead wire cable of strain gage

Selecting a kind of lead wire cable matching the measuring condition under environments and temperature.



A strain gage with a lead wire for safe labor

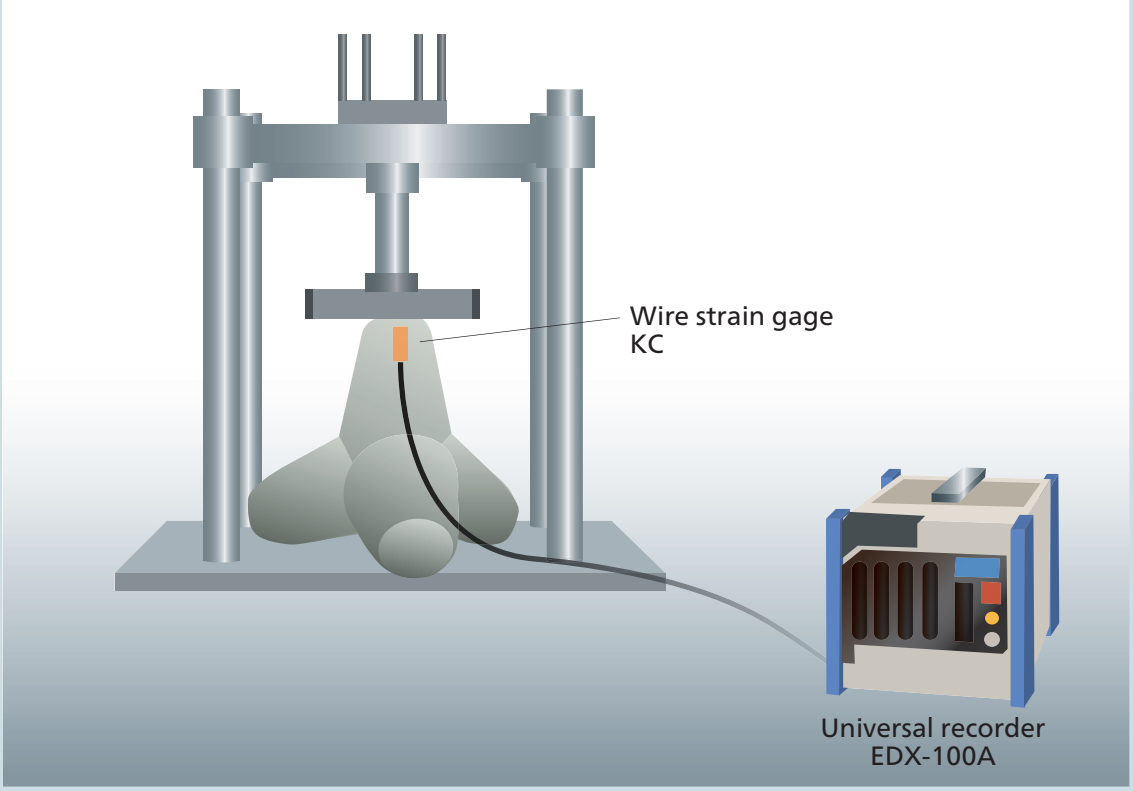
We supply these two types:

- Gages with leads only
- Gages connected to flat vinyl lead wires of required length

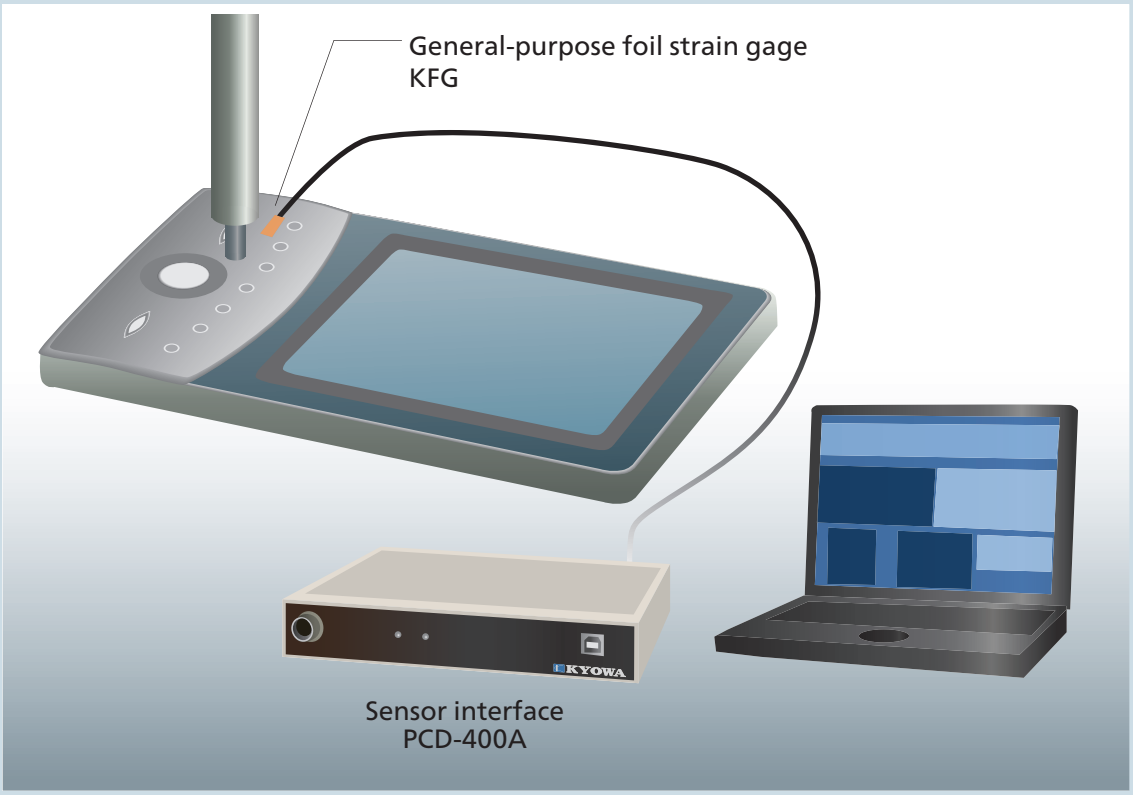
Gages connected to lead wires provide increases in speed and work required for adhesion. Refer to the pages for each gage for combinations of gages and lead wires.

Strain Gages Measurement Examples

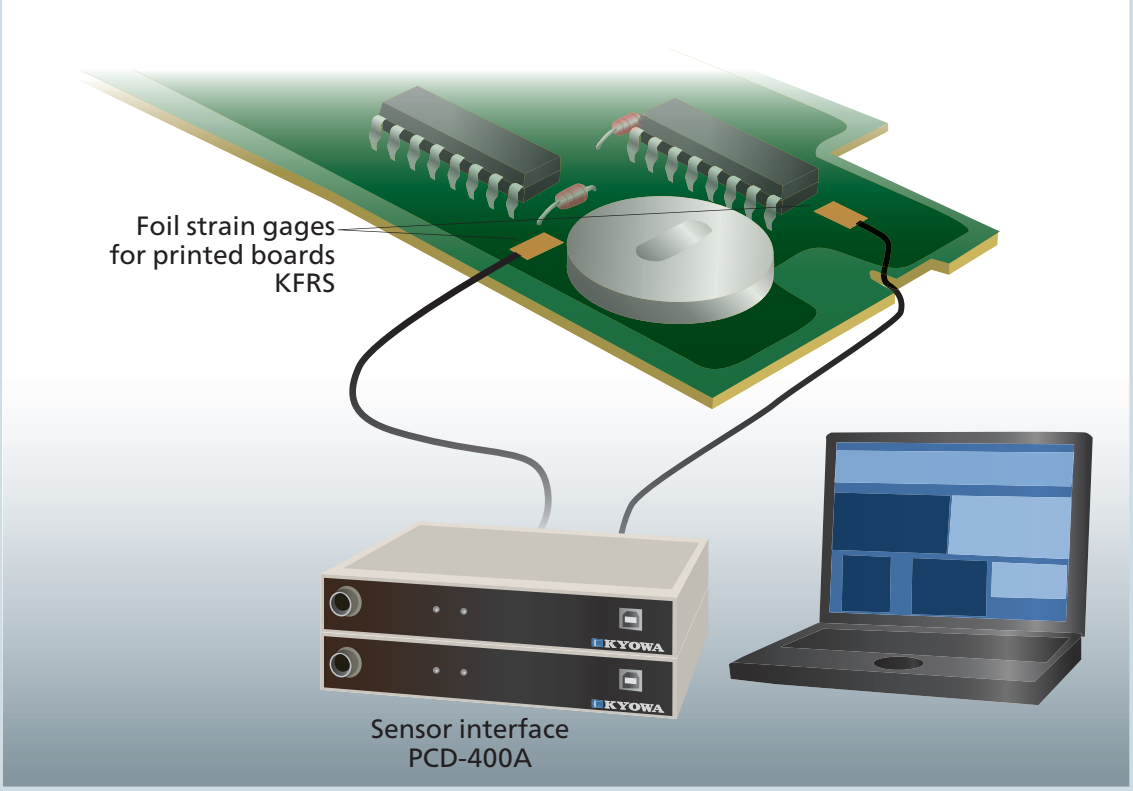
●Stress Measurement of precast concrete such as Tetrapods®



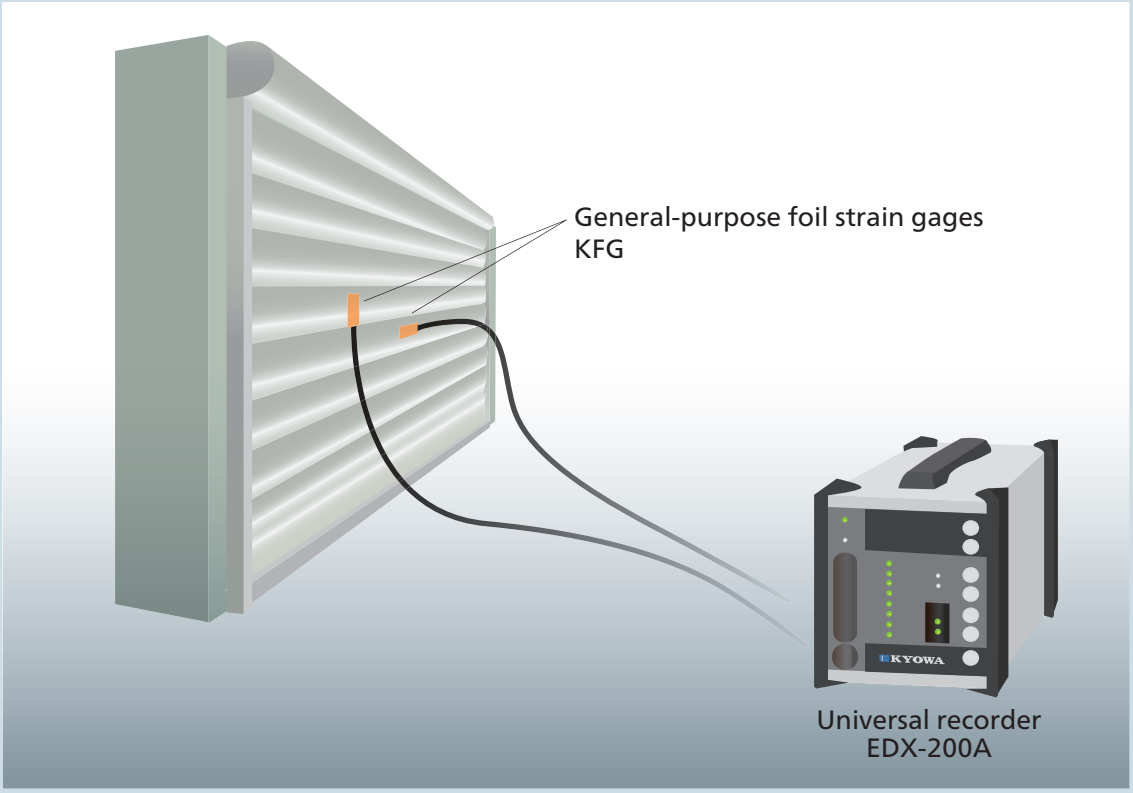
●Stress measurement of plastic parts



●Stress measurement when a PCB is mounted



●Stress measurement during strength testing of a shutter



Strain Gage Selection Chart for Each Measurement Application.

Metal

General Stress Measurement

Measurement Environment	Models	Pages
Under general environment	**KFG** General-purpose Foil Strain Gages	1-18
Max. elongation 5%	**KFG** General-purpose Foil Strain Gages	1-18
Usable at up to 150°C	**KFR** Foil Strain Gages	1-27
Less coating treatment required	**KFW** Waterproof Foil Strain Gages	1-29
Less coating treatment required	**KFWS** Small-sized Waterproof Foil Strain Gages	1-30
Simply waterproofed, long-term stability	**KCW** Weldable Waterproof Foil Strain Gages	1-30
Simply waterproofed, rugged	**KCH** Foil Strain Gages with a Protector	1-45

Applicable to Sensing Element of Transducers

Measurement Environment	Models	Pages
Uniaxial, High-resistance 350, 500, 1000 Ω	**KFG** General-purpose Foil Strain Gages	1-24
Uniaxial, for shearing strain	**KFG-C15, 16** General-purpose Foil Strain Gages	1-22
Biaxial, torque measurement	**KFG-D2, 31** General-purpose Foil Strain Gages	1-20 1-21

Residual Stress Measurement

Measurement Environment	Models	Pages
Installation by cutting method	**KFG T-F7** General-purpose Foil Strain Gages	1-25
Installation by boring method	**KFG-D28** General-purpose Foil Strain Gages	1-25

Measurement under hydrogen gas environment

Measurement Environment	Models	Pages
Measurement under high-pressure hydrogen gas environment	**KFV** Foil Strain Gage for Hydrogen Gas Environment	1-44

Internal Strain Measurement

Measurement Environment	Models	Pages
Applicable where a strain gage cannot be bonded inside a box structure	**KFF** Foil Strain Gages for Bending Strain Measurement	1-44

Crack Gages

Measurement Environment	Models	Pages
Measurement of the progress and propagation speed of crack	**KV** Crack Gages	1-46

Measurement at High-temperature

Measurement Environment	Models	Pages
Up to 950°C	**KHCX** Encapsulated Strain Gages	1-38
Up to 800°C	**KHCV** Encapsulated Strain Gages	1-38
Up to 750°C	**KHCR** Encapsulated Strain Gages	1-38
Up to 750°C	**KHCS** Encapsulated Strain Gages	1-38
Up to 650°C	**KHCM** Encapsulated Strain Gages	1-38
Up to 550°C	**KHC** Encapsulated Strain Gages	1-38
Up to 350°C	**KFU** High-temperature Foil Strain Gages	1-39
Up to 350°C	**KH** High-temperature Foil Strain Gages	1-39
Up to 250°C	**KFH** High-temperature Foil Strain Gages	1-40

Measurement at Low-temperature

Measurement Environment	Models	Pages
Measurement at LHe temperature (-269°C)	**KFL** Low-temperature Foil Strain Gages	1-41

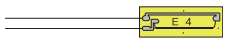
Measurement under High Electric Field

Measurement Environment	Models	Pages
Measurement under high electric field accompanying induction noise	**KFS** Shielded Foil Strain Gages	1-43

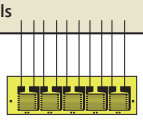
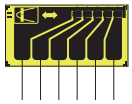
Applicable to Ultra-small Strain Measurement and Highly-Sensitive Element of Transducers

Measurement Environment	Models	Pages
Measurement of <100μm/m under less temperature change environment	**KSP** Semiconductor Strain Gages	1-36
Measurement of <100μm/m under less temperature change environment	**KSN** Self-temperature-compensation Semiconductor Strain Gages	1-36
Measurement of <100μm/m under less temperature change environment	**KSPL** Ultra Linear Semiconductor Strain Gages	1-37

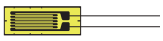
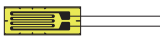
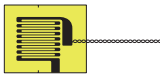
Impact Strain Measurement

Measurement Environment	Models	Pages
Enable measurement with no amplifier used	**KSPH**  High-output Semiconductor Strain Gages	1-37

Concentrated Stress Measurement

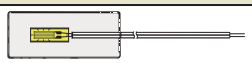
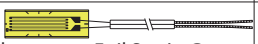
Measurement Environment	Models	Pages
Measurement of stress distribution at 8mm to 12mm intervals	**KFG-D9, 19, 39**  Pitch: 2mm or 3mm	1-22
Measurement of stress distribution at 2mm intervals	**KFR-D9, 19**  Pitch: 0.5mm	1-28

Measurement under High Magnetic Field

Measurement Environment	Models	Pages
Measurement under DC magnetic field at low temperature	**KFL**  Low-temperature Foil Strain Gages	1-41
Measurement under DC magnetic field at middle temperature	**KFR**  Foil Strain Gages	1-27
Measurement under DC magnetic field at high temperature	**KFH**  High-temperature Foil Strain Gages	1-40
Measurement under DC/AC magnetic field	**KFN** Non-inductive Foil Strain Gages 	1-43

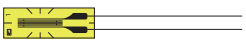
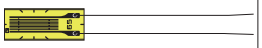
Concrete, Mortar, etc.

General stress Measurement

Measurement Environment	Models	Pages
Less coating treatment required	**KFW**  Waterproof Foil Strain Gages	1-29
Less coating treatment required	**KFWS**  Small-sized Waterproof Foil Strain Gages	1-30
Surface strain meas. (small aggregate)	**KFG**  General-purpose Foil Strain Gages Length: 10 to 20 mm	1-31
Surface strain meas. (large aggregate)	**KC**  Wire Strain Gages Length: 60 to 120 mm	1-31
Internal strain measurement	**KM**  Embedded Strain Gages	1-32
Self-shrinkage strain measurement	**KMC**  Concrete-embedded Strain Gages	1-32

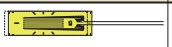
Composite Materials, Printed Boards, and Plastics

General Stress Measurement

Measurement Environment	Models	Pages
Applicable linear expansion coefficient 1 to 9×10^{-6}/°C	**KFRP**  Foil Strain Gages for composite Materials	1-33
Applicable linear expansion coefficient 13×10^{-6}/°C	**KFRS**  Foil Strain Gages for Printed Boards	1-34
Applicable linear expansion coefficient 65×10^{-6}/°C	**KFP**  Foil Strain Gages for Plastics	1-35
For polyurethane and rubber	**KFML**  Foil Strain Gages for Low-elasticity Materials	1-35
For strain measurement inside resin	**KMP**  Embedded Gage	1-45

Metal, Plastics, Lumber and Rubber

High-elongation Gages

Measurement Environment	Models	Pages
Max. elongation approx. 20%-30%	**KFEM**  Ultrahigh-elongation Foil Strain Gages	1-42
Max. elongation approx. 15%	**KFEL**  High-elongation Foil Strain Gages	1-42

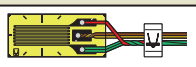
Wood (lumber), Plaster, Paper, etc.

General Stress Measurement

Measurement Environment	Models	Pages
Lumber (applicable linear expansion coefficient 5×10^{-6}/°C)	**KFG**  General-purpose Foil Strain Gages	1-19

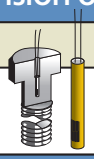
Various Materials

General Stress Measurement

Measurement Environment	Models	Pages
Simultaneous measurement of strain and temperature	**KFGT**  Foil Strain Gages with a Temperature Sensor	1-26

Metal Bolts

Measurement of Axial Tension of Bolts

Measurement Environment	Models	Pages
measuring tightening stress of bolts	**KFG-C20** General-purpose Foil Strain Gages 	1-25

Major Properties of Kyowa Strain Gages

	Models/ series designation		Materials: Resistive element	Materials: Base	Operating temperature ranges in combination with major adhesives after curing (℃) *1	Self-temperature-compensation range (℃)	Applicable linear expansion coefficient ($\times10^{-6}$/℃)	Strain limit at room temp. (Approx. %) *2	Fatigue life at room temp., approx. (Times) *3	Pages
For general stress measurement	General-purpose Foil Strain Gages KFG	For general purpose	CuNi alloy foil	Polyimide	CC-33A -196 to 120 CC-36 -30 to 100 EP-340 -55 to 150 PC-600 -196 to 150	10 to 100	5, 11, 16, 23, 27	5.0	1.2×10^7	1-18
		For sensing element of transducers			PC-600 -196 to 150 EP-340 -55 to 150	10 to 100	11, 16, 23, 27	5.0	1.2×10^7	1-20
		For concrete			CC-35 -30 to 120	10 to 100	11	5.0	1.2×10^7	1-31
		Concentrated stress measurement			CC-33A -196 to 120 CC-36 -30 to 100 EP-340 -55 to 150 PC-600 -196 to 150	10 to 100	11, 16, 23, 27	—	—	1-22
		Residual stress measurement			CC-33A -196 to 120 CC-36 -30 to 100 EP-340 -55 to 150 PC-600 -196 to 150	10 to 100	11, 16, 23, 27	—	—	1-25
		Bolt axial tension measurement			EP-180 Room temp. to 50	20 to 50	11	—	—	1-25
	Foil Strain Gages with a Temperature Sensor KFGT		CuNi alloy foil	Polyimide	CC-33A -10 to 120 CC-36 -10 to 100 EP-340 -10 to 120 PC-600 -10 to 120	10 to 100	11, 16, 23	3	1×10^6	1-26
	Foil Strain Gages KFR	Strain measurement at middle temperature; for transducers	NiCr alloy foil	Polyimide	PC-600 -196 to 150 CC-33A -196 to 120 EP-340 -55 to 150	0 to 150	11, 16, 23	2.2	1×10^6	1-27
		Concentrated stress measurement			PC-600 -196 to 150 CC-33A -196 to 120 EP-340 -55 to 150	0 to 150	11, 16, 23	—	—	1-28
	Waterproof Foil Strain Gages KFW		CuNi alloy foil	Paper base + phenol-epoxy	CC-33A -10 to 80 CC-36 -10 to 80 EP-180 -10 to 80	10 to 80	11, 16, 23	2.8	3×10^4	1-29
	Small-sized Waterproof Foil Strain Gages KFWS		CuNi alloy foil	Polyimide	CC-33A -10 to 80 EP-180 -10 to 80	10 to 80	11, 16, 23	5.0	3×10^4	1-30
	Weldable Waterproof Foil Strain Gages KCW		NiCr alloy foil	Stainless steel	(Spot welding) -20 to 100	10 to 90	11	0.9	*A 1×10^6	1-30
	Wire Strain Gages KC		CuNi alloy wire	Paper base + phenol-epoxy	CC-35 -30 to 120	10 to 60	11	1.8	1.5×10^5	1-31
	Embedded Strain Gages KM		CuNi alloy	Acrylate	(Embedment) -10 to 70	0 to 50	11	0.3	—	1-32
	Concrete-embedded Strain Gages KMC		CuNi alloy wire	Silicone	(Embedment) Room temp. to 70	—	—	0.3	—	1-32
For composite materials, plastics and rubber	Foil Strain Gages for Composite Materials KFRP		NiCr alloy foil	Polyimide	EP-34B -55 to 200 CC-33A -196 to 120	0 to 150	1, 3, 6, 9	2.2	1×10^6	1-33
	Foil Strain Gages for Printed Boards KFRS		NiCr alloy foil	Polyimide	CC-33A -196 to 120 PC-600 -196 to 150	-30 to 120	13	1.6	2×10^6	1-34
	Foil Strain Gages for Plastics KFP		CuNi alloy foil	Paper base + phenol-epoxy	EP-34B -20 to 80 CC-33A -20 to 80 CC-36 -20 to 80	10 to 80	65	3.0	1×10^6	1-35
	Foil Strain Gages for Low-elasticity Materials KFML		CuNi alloy foil	Phenol-epoxy	CC-33A 0 to 60	—	—	1.0	—	1-35
For ultra-small strain measurement	Semiconductor Strain Gages KSP	Ultra-small strain measurement	P type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	—	—	0.3	*A 2×10^6	1-36
		For sensing element of highly sensitive transducers	P type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	—	—	0.3	*A 2×10^6	1-36
		Ultra-small strain; 2-element, temperature-compensation type	P type Si N type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	20 to 70	11	0.3	*A 2×10^6	1-36
	Self-temperature-compensation Semiconductor Strain Gages KSN		N type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	20 to 70	11, 16	0.3	*A 2×10^6	1-36
	High-output Semiconductor Strain Gages KSPH		P type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	—	—	0.3	*A 2×10^6	1-37
	Ultra Linear Semiconductor Strain Gages KSPL		P type Si	Paper base + phenol-epoxy	CC-33A -50 to 120 CC-36 -30 to 100	—	—	0.3	*A 2×10^6	1-37

Notes

*1. Underlined adhesives are those used for strain limit tests at room temperature and for fatigue tests at room temperature.
*2. Typical values with uniaxial gages. Strain limit is the mechanical limit where a difference between the strain reading and mechanical strain initiated by applying tension load exceeds 10%.
*3. Typical values with uniaxial gages. Strain level: ±1500 μm/m ; *A: ±1000 μm/m; *B: ±500 μm/m, *C: ±100 μm/m.

	Models/ series designation	Materials		Operating temperature ranges in combination with major adhesives after curing (℃) *1	Self-temperature-compensation range (℃)	Applicable linear expansion coefficient (x10^{-6}/℃)	Strain limit at room temp. (Approx. %) *2	Fatigue life at room temp., approx. (Times) *3	Pages
		Resistive element	Base						
For high-temperature applications	Encapsulated Strain Gages KHCX	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to 950	25 to 950	11, 13	1.0 (950℃)	*C 1×10^6 (950℃)	1-38
	Encapsulated Strain Gages KHCV	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) 25 to 800	—	(Dynamic measurement)	1.0 (800℃)	*B 1×10^6 (800℃)	1-38
	Encapsulated Strain Gages KHCR	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) 25 to 750	25 to 750	11, 13, 16	1.0 (750℃)	*B 1×10^6 (750℃)	1-38
	Encapsulated Strain Gages KHCS	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to750	25 to 750	11, 13, 16	1.0 (750℃)	*B 1×10^6 (750℃)	1-38
	Encapsulated Strain Gages KHCM	Heat-resistant special alloy wire	Heat-resistant metal	(Spot welding) -196 to 650	25 to 650	11, 13, 16	1.0 (650℃)	*B 1×10^6 (650℃)	1-38
	Encapsulated Strain Gages KHC type 20	NiCr alloy wire	Heat-resistant metal	(Spot welding) -196 to 550	Room temp. to 500	11, 16	0.8	*A 4×10^5	1-38
	Encapsulated Strain Gages KHC type 10						0.5	*A 4×10^5	
	High-temperature Foil Strain Gages KFU	NiCr alloy foil	Polyimide	PI-32 -196 to 350	10 to 300	11, 16, 23	1.9	*A 1.5×10^5 (300℃)	1-39
	High-temperature Foil Strain Gages KH	NiCr alloy foil	Stainless steel	(Spot welding) -50 to 350	10 to 300	11, 16	0.5	*B 1×10^7	1-39
	High-temperature Foil Strain Gages KFH	NiCr alloy foil	Polyimide	PC-600 -196 to 250 EP-34B -55 to 200 PI-32 -196 to 250	10 to 250	11, 16, 23	2.1	2×10^5	1-40
For low temp.	Low-temperature Foil Strain Gages KFL	NiCr alloy foil	Polyimide	PC-600 -269 to 150 EP-270 -269 to 30 CC-33A -196 to 120	-196 to 50	5, 11, 16, 23	2.2	1×10^6	1-41
For large strain measurement	Ultrahigh-elongation Foil Strain Gages KFEM	CuNi alloy foil	Polyimide	CC-36 -20 to 80	—	—	20 to 30	—	1-42
	High-elongation Foil Strain Gages KFEL	CuNi alloy foil	Polyimide	CC-36 -10 to 80	—	—	15	1×10^6	1-42
For antimagnetic applications	Non-inductive Foil Strain Gages KFN	NiCr alloy foil	Polyimide	PC-600 -196 to 150 CC-33A -196 to 120	0 to 150	11, 16, 23	1	1×10^4	1-43
	Shielded Foil Strain Gages KFS	CuNi alloy foil (120) NiCr alloy foil (350)	Polyimide	PC-600 -196 to 150 CC-33A -196 to 120 EP-340 -55 to 150	10 to 100	11, 16	0.5	1×10^4	1-43
For Hi-pressure H2	Foil Strain Gage for Hydrogen Gas Environment KFV	FeCr alloy foil	Polyimide	PC-600 -30 to 80	—	—	—	—	1-44
Internal strain	Foil Strain Gages for Bending Strain Measurement KFF	CuNi alloy foil	Acrylate	CC-33A -50 to 80 EP-180 -50 to 80	20 to 60	11, 16, 23	0.2	*B 4×10^6	1-44
With protector	Foil Strain Gages with a Protector KCH	CuNi alloy foil	Polyimide	Protector: Stud bolt Strain gage EP-340, CC-33A -40 to 100	—	11	1	*A 1.2×10^6	1-45
Crack	Crack Gages KV	CuNi alloy foil	Paper base+ phenol-epoxy	CC-33A CC-36 PC-600	—	—	—	—	1-46

Notes

*1. Underlined adhesives are those used for strain limit tests at room temperature and for fatigue tests at room temperature.
*2. Typical values with uniaxial gages. Strain limit is the mechanical limit where a difference between the strain reading and mechanical strain initiated by applying tension load exceeds 10%.
*3. Typical values with uniaxial gages. Strain level: 1500 μm/m; *A: 1000 μm/m; *B: 500 μm/m, *C: 100 μm/m

Strain Gages with Pre-Attached Lead Cables

Virtually all Kyowa strain gages are delivered with a lead wire cable pre-attached to ensure labor saving in gage bonding works by eliminating the need for soldering. Types and lengths of the lead wire cable selectable for each gage are as follows.

When ordering, specify the model of the strain gage and the code of the lead wire cable with a space in between.

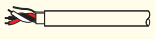
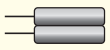
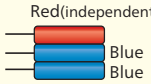
Model of Strain Gage / Code of lead wire Cable

e.g. **KFG-2-120-C1-11 L1M3R**

Applicable Models of Strain Gage		KFG, KFR, KFRP, KFP, KFL, KFEL, and KFEM		KFG, KFR, KFW, KFWS, KC, KFRP, KFP, KFEL, and KFEM			
Type of lead wire Cable		 Polyester-coated 2-wire copper cable -196 to 150°C	 Polyester-coated 3-wire copper cable -196 to 150°C	 Vinyl-coated flat 2-wire cable -10 to 80°C		 Vinyl-coated flat 3-wire cable -10 to 80°C	
				Uniaxial	Multiaxial	Uniaxial	Multiaxial
Length of lead wire cable (*)	15 cm	N15C2	N15C3	L15C2R	L15C2S	L15C3R	L15C3S
	30 cm	N30C2	N30C3	L30C2R	L30C2S	L30C3R	L30C3S
	1 m	N1M2	N1M3	L1M2R	L1M2S	L1M3R	L1M3S
	3 m			L3M2R	L3M2S	L3M3R	L3M3S
	5 m			L5M2R	L5M2S	L5M3R	L5M3S
Model, etc.		Twisted in the cases of 50 cm or longer		L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer	
Coating colors				 Red Red		 Red (independent) White White	

Note: KFEL and KFEM are available only with 2-wire system.

＊For other lead wire cable lengths, contact us.

Applicable Models of Strain Gage		KFG, KFR, KFRP, and KFL		KFN, KFS	KFRP, KFH, and KFL	KFU, KFH	
Type of lead wire cable		 Middle-temperature 2-wire cable -100 to 150°C	 Middle-temperature 3-wire cable -100 to 150°C	 Vinyl-coated low-noise 3-wire cable -10 to 80°C	 Vinyl-coated low-noise 3-wire cable -269 to 250°C	 High-temperature 3-wire cable -269 to 350°C	3 strand glass-coated Ni clad copper wire RT-280°C
Length of lead wire cable (*)	15 cm	R15C2	R15C3	J15C3	F15C3	H15C3	B15C3
	30 cm	R30C2	R30C3	J30C3	F30C3	H30C3	B30C3
	1 m	R1M2	R1M3	J1M3	F1M3	H1M3	B1M3
	3 m	R3M2	R3M3	J3M3	F3M3	H3M3	B3M3
	5 m	R5M2	R5M3	J5M3	F5M3	H5M3	B5M
Model, etc.		L-11	L-12	L-13	L-3	L-17	Contact us
Coating colors		 Grey Grey	 Red(independent) White Black	 Red(independent) White Black	 Red(independent) Blue Blue	 Black(independent) Yellow Green	 Red(independent) Blue White

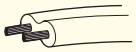
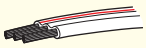
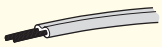
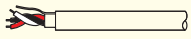
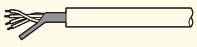
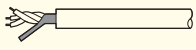
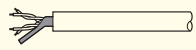
＊For other lead wire cable lengths, contact us.

●For concentrated stress measurement. KFR are provided standard with a lead wire cable 10 cm long.
●Encapsulated strain gages are provided standard with an MI cable 2 m long and a soft cable 50 cm long.

See page 1-30 for KCW. See page 1-32 for KM.
See page 1-34 for KFRS. See page 1-39 for KH.

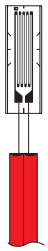
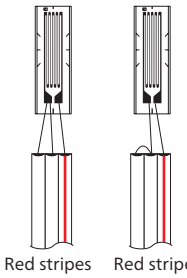
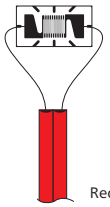
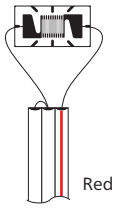
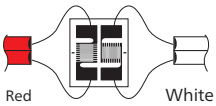
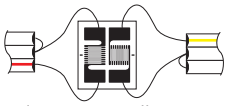
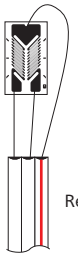
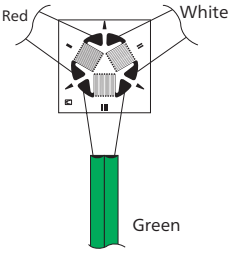
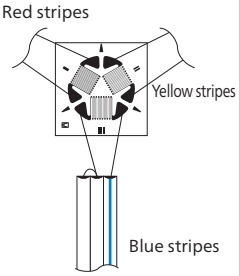
Lead Wire Cables

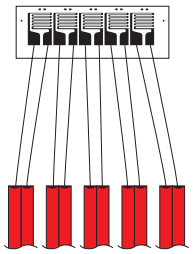
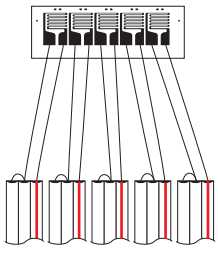
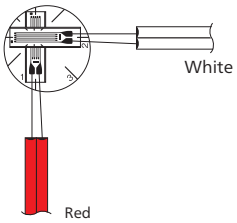
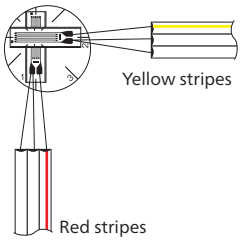
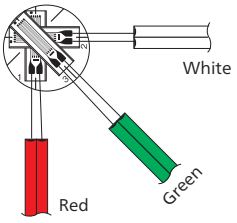
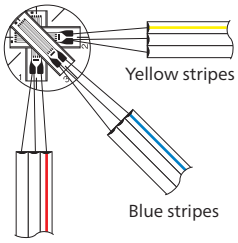
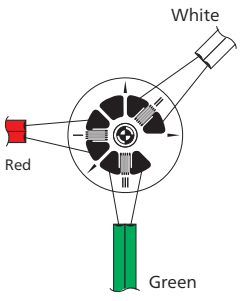
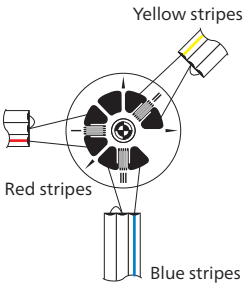
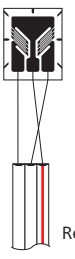
●L-type Lead Wire Cables

Operating Temperature Range	Models	Types	Conductor Material	Nominal Cross Section of Conductor (mm^2)	Number of Strands/ Wire Diam. (mm)	Reciprocating Resistance per Meter (Ω)	Coated Wire Diameter (mm)	Unit Length (m)
Room temp. to 350°C	L-1	High-temperature lead wire 	CuNi alloy	0.07	1/ϕ0.30	14.20	ϕ0.50	50
–10 to 80°C	L-2	Vinyl-coated flat 3-wire cable 	Copper	0.30	12/ϕ0.18	0.12	ϕ2.30	100
–269 to 250°C	L-3	Fluororesin-coated high/low-temp. 3-wire cable 	Silver-plated copper	0.14	7/ϕ0.16	0.28	ϕ0.98	50
Room temp. to 350°C	L-4	High-temperature lead wire cable 	Nickel-clad copper	0.20	1/ϕ0.50	0.18	ϕ0.70	30
–10 to 80°C	L-5	Vinyl-coated flat 2-wire cable 	Copper	0.50	20/ϕ0.18	0.07	ϕ2.50	100
–10 to 80°C	L-6 (*1)	Vinyl-coated flat 2-wire cable 	Copper	0.08	7/ϕ0.12	0.44	ϕ1.00	
–10 to 80°C	L-7 (*2)	Vinyl-coated flat 3-wire cable 	Copper	0.08	7/ϕ0.12	0.44	ϕ1.00	
–10 to 80°C	L-9 (*1)	Vinyl-coated flat 2-wire cable 	Copper	0.11	10/ϕ0.12	0.32	ϕ1.00	
–10 to 80°C	L-10 (*2)	Vinyl-coated flat 3-wire cable 	Copper	0.11	10/ϕ0.12	0.32	ϕ1.00	
–100 to 150°C	L-11	Middle-temperature 2-wire cable 	Silver-plated copper	0.08	7/ϕ0.12	0.44	ϕ0.86	
–100 to 150°C	L-12	Middle-temperature 3-wire cable 	Silver-plated copper	0.08	7/ϕ0.12	0.44	ϕ0.86	
–10 to 80°C	L-13	Vinyl-coated normal-temperature low-noise 3-wire cable 	Tin-plated copper	0.09	7/ϕ0.13	0.46	ϕ3.50	
–50 to 90°C	L-14	Chloroprene-coated normal-temperature low-noise 4-wire cable 	Tin-plated copper	0.08	7/ϕ0.12	0.48	ϕ4.00	
–269 to 250°C	L-15	Fluoroplastic-coated high/low-temp. low-noise 3-wire cable 	Silver-plated copper	0.08	7/ϕ0.12	0.48	ϕ2.50	10
–269 to 250°C	L-16	Fluoroplastic-coated high/low-temp. low-noise 4-wire cable 	Silver-plated copper	0.08	7/ϕ0.12	0.48	ϕ3.30	
–269 to 350°C	L-17	High/low-temperature 3-wire cable 	Nickel-plated copper	0.07	1/ϕ0.30	0.50	ϕ0.38	30

*1. These models have a suffix R, W, G, Y or B indicating the coating color; red, white, green, yellow or black. e.g. L-6B: Black vinyl coated.
*2. These models have a suffix WR, WL or WY indicating the stripe color; red, blue or yellow on white vinyl coating. e.g. L-7WR: Red stripes on white coating.

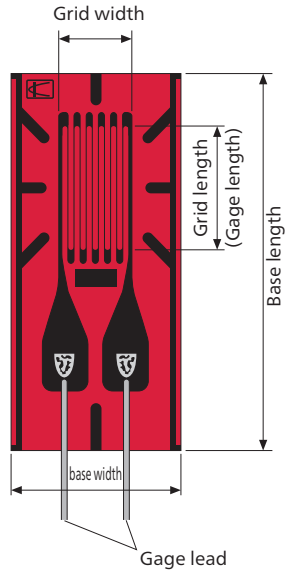
Examples of vinyl-coated flat wire to connect gages

Cord Types	2-wire	3-wire
C1		 2 kinds of connection depends on the length of gages. Same as D16 and D17
C2 or C3		
C15 or C16		
D1		
D2		
D4		

Cord Types	2-wire	3-wire
D9 or D19 or D39		
D16		
D17		
D28		
D31		

General-purpose Foil Strain Gages KFG

●General-purpose Foil Strain Gages in KFG Series



The KFG series gages use polyimide resin for the base approx. 13 µm thick, ensuring excellent flexibility. Besides indoor measurement, the outstanding moisture resistance lets them effectively perform outdoor measurement. Unless directly exposed to water drop, no coating treatment is required.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -196 to 120°C (–10 to 80°C with vinyl-coated cable attached)
CC-35: -30 to 120°C (–10 to 80°C with vinyl-coated cable attached)
CC-36: -30 to 100°C (–10 to 80°C with vinyl-coated cable attached)
EP-340: -55 to 150°C (–10 to 80°C with vinyl-coated cable attached)
PC-600: -196 to 150°C (–10 to 80°C with vinyl-coated cable attached)

Notes on pre-attached lead wire cables

- Standard color of the 2-wire cable pre-attached to uniaxial gages is red (R). If desired, a white, green, yellow or black cable can be pre-attached.
- Standard 3-wire cable pre-attached to uniaxial gages has red stripes. If desired, the red stripes can be changed to blue or yellow stripes.
- In the case of a triaxial gage, 2-wire cables are color-coded with red, white and green stripes for 0°, 90° and 45°, respectively and 3-wire cables, with red, yellow and blue stripes for 0°, 90° and 45°, respectively. The letter code is S in common.

■Types, lengths and codes of lead wire cables pre-attached to KFG series gages

Types / Length *	Polyester-coated 2-wire copper cable	Polyester-coated 3-wire copper cable	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable		Middle-temperature 2-wire cable	Middle-temperature 3-wire cable
	C1,C2,C3,C15, C16,D1,D2,D3, D4,D6,D9,D16, D17,D19,D28, D29 and D31	C1,C2,C3, C15,C16, D1,D4,D9, D16,D17,D19, D28 and D31	C1,C2,C3, C15,C16, D9 and D19	D1,D4, D16,D17, D28,D29, D39	C1,C2,C3, C15,C16, D2,D9,D19 and D31	D1,D4, D16,D17, D28 and D39	C1,C2,C3, C15,C16, D1,D4,D9, D16,D17,D19, D28 and D39	C1,C2,C3, C15,C16, D1,D2,D4,D9, D16,D17,D19, D28,D31 and D39
15 cm	N15C2	N15C3	L15C2R	L15C2S	L15C3R	L15C3S	R15C2	R15C3
30 cm	N30C2	N30C3	L30C2R	L30C2S	L30C3R	L30C3S	R30C2	R30C3
1 m	N1M2	N1M3	L1M2R	L1M2S	L1M3R	L1M3S	R1M2	R1M3
3 m			L3M2R	L3M2S	L3M3R	L3M3S	R3M2	R3M3
5 m			L5M2R	L5M2S	L5M3R	L5M3S	R5M2	R5M3
Oprg. temp. range**	–196 to 150°C		-10 to 80°C				-100 to 150°C	
Remarks	Twisted for 50 cm or longer (With some exception)		L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer		L-11	L-12

* For other lead wire cable lengths, contact us.
** Oprg. temp. range: Operating temperature range

When ordering, suffix the lead wire cable code to the model number with a space in between.

E.g.

KFG-5-120-C1-11 N10C3 for the gage with a polyester-coated 3-wire copper cable 15 cm long → KFG-5-120-C1-11 N15C3
KFG-5-120-C1-11 L5M2R for the gage with a vinyl-coated flat 2-wire cable 5 m long → KFG-5-120-C1-11 L5M2R
KFG-5-120-D17-11 L5M3S for the gage with a vinyl-coated flat 3-wire cable 5 m long → KFG-5-120-D17-11 L5M3S
KFG-5-120-C1-11 R5M3 for the gage with a middle-temperature 3-wire cable 5 m long → KFG-5-120-C1-11 R5M3
KFG-5-120-D17-11 R5M2 for the gage with a middle-temperature 2-wire cable 5 m long → KFG-5-120-D17-11 R5M2

If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long)

For the types of lead wire cables, refer to page 1-15 and 1-16.

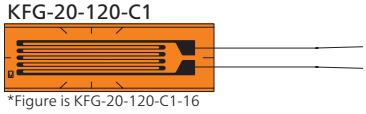
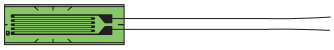
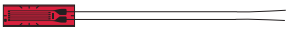
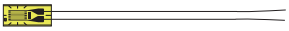
General-purpose Foil Strain Gages KFG

Uniaxial

Silver-clad copper gage leads 25mm long
Resistance: 120 Ω
Gage factor: Approx. 2.1

- Common steel
- Stainless steel
- Aluminum
- Magnesium alloy

(Linear expansion coefficient based on the base color to distinguish)

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material Base color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
KFG-30-120-C1  *Figure is KFG-30-120-C1-11	KFG-30-120-C1-11	●	30	3.3	37	5.2	
	KFG-30-120-C1-16	●					
	KFG-30-120-C1-23	●					
	KFG-30-120-C1-27	●					
KFG-20-120-C1  *Figure is KFG-20-120-C1-16	KFG-20-120-C1-11	●	20	5	28	8	
	KFG-20-120-C1-16	●					
	KFG-20-120-C1-23	●					
	KFG-20-120-C1-27	●					
KFG-10-120-C1  *Figure is KFG-10-120-C1-23	KFG-10-120-C1-11	●	10	3	16	5.2	
	KFG-10-120-C1-16	●					
	KFG-10-120-C1-23	●					
	KFG-10-120-C1-27	●					
KFG-6-120-C1  *Figure is KFG-6-120-C1-27	KFG-6-120-C1-11	●	6	1.7	10	3.4	
	KFG-6-120-C1-16	●					
	KFG-6-120-C1-23	●					
	KFG-6-120-C1-27	●					
KFG-5-120-C1  *Figure is KFG-5-120-C1-11	KFG-5-120-C1-5	●	5	1.4	9.4	2.8	For lumber
	KFG-5-120-C1-11	●					
	KFG-5-120-C1-16	●					
	KFG-5-120-C1-23	●					
	KFG-5-120-C1-27	●					
KFG-4N-120-C1 *Figure is KFG-4N-120-C1-16	KFG-4N-120-C1-11	●	4	0.7	8	1.4	
	KFG-4N-120-C1-16	●					
	KFG-4N-120-C1-23	●					
	KFG-4N-120-C1-27	●					
KFG-3-120-C1  *Figure is KFG-3-120-C1-23	KFG-3-120-C1-11	●	3	1.3	7.4	2.8	
	KFG-3-120-C1-16	●					
	KFG-3-120-C1-23	●					
	KFG-3-120-C1-27	●					
KFG-2-120-C1  *Figure is KFG-2-120-C1-27	KFG-2-120-C1-5	●	2	1.2	6.3	2.8	For lumber
	KFG-2-120-C1-11	●					
	KFG-2-120-C1-16	●					
	KFG-2-120-C1-23	●					
	KFG-2-120-C1-27	●					
KFG-2N-120-C1 *Figure is KFG-2N-120-C1-11	KFG-2N-120-C1-11	●	2	0.84	5.3	1.4	
	KFG-2N-120-C1-16	●					
	KFG-2N-120-C1-23	●					
	KFG-2N-120-C1-27	●					
KFG-1-120-C1  *Figure is KFG-1-120-C1-16	KFG-1-120-C1-11	●	1	1.1	4.8	2.4	
	KFG-1-120-C1-16	●					
	KFG-1-120-C1-23	●					
	KFG-1-120-C1-27	●					
KFG-1N-120-C1 *Figure is KFG-1N-120-C1-23	KFG-1N-120-C1-11	●	1	0.65	4.2	1.4	
	KFG-1N-120-C1-16	●					
	KFG-1N-120-C1-23	●					
	KFG-1N-120-C1-27	●					
KFG-03-120-C1  *Figure is KFG-03-120-C1-27	KFG-03-120-C1-11	●	0.3	1.4	3.5	2.4	
	KFG-03-120-C1-16	●					
	KFG-03-120-C1-23	●					
	KFG-03-120-C1-27	●					
KFG-02-120-C1  *Figure is KFG-02-120-C1-11	KFG-02-120-C1-11	●	0.2	1.4	3.3	2.4	
	KFG-02-120-C1-16	●					
	KFG-02-120-C1-23	●					
	KFG-02-120-C1-27	●					

A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material Base color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Biaxial, 0°/90°stacked rosette Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-10-120-D16-11	●	10	3	ϕ21		
	KFG-10-120-D16-16	●					
	KFG-10-120-D16-23	●					
	KFG-10-120-D16-27	●					
	KFG-5-120-D16-11	●	5	1.4	ϕ11		
	KFG-5-120-D16-16	●					
	KFG-5-120-D16-23	●					
	KFG-5-120-D16-27	●					
	KFG-3-120-D16-11	●	3	1.3	ϕ10		
	KFG-3-120-D16-16	●					
	KFG-3-120-D16-23	●					
	KFG-3-120-D16-27	●					
	KFG-2-120-D16-11	●	2	1.2	ϕ8		
	KFG-2-120-D16-16	●					
	KFG-2-120-D16-23	●					
	KFG-2-120-D16-27	●					
	KFG-1-120-D16-11	●	1	1.1	ϕ5		
	KFG-1-120-D16-16	●					
	KFG-1-120-D16-23	●					
	KFG-1-120-D16-27	●					
Triaxial, 0°/90°/45°stacked rosette for Stress Analysis Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-10-120-D17-11	●	10	3	ϕ21		
	KFG-10-120-D17-16	●					
	KFG-10-120-D17-23	●					
	KFG-10-120-D17-27	●					
	KFG-5-120-D17-11	●	5	1.4	ϕ11		
	KFG-5-120-D17-16	●					
	KFG-5-120-D17-23	●					
	KFG-5-120-D17-27	●					
	KFG-3-120-D17-11	●	3	1.3	ϕ10		
	KFG-3-120-D17-16	●					
	KFG-3-120-D17-23	●					
	KFG-3-120-D17-27	●					
	KFG-2-120-D17-11	●	2	1.2	ϕ8		
	KFG-2-120-D17-16	●					
	KFG-2-120-D17-23	●					
	KFG-2-120-D17-27	●					
	KFG-1-120-D17-11	●	1	1.1	ϕ5		
	KFG-1-120-D17-16	●					
	KFG-1-120-D17-23	●					
	KFG-1-120-D17-27	●					
Biaxial, 0°/90° plane arrangement Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D1-11	●	2	3.2	10	8.5	
	KFG-2-120-D1-16	●					
	KFG-2-120-D1-23	●					
	KFG-2-120-D1-27	●					
Biaxial, 0°/90° for Torque Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D2-11	●	2	3.4	12	7	
	KFG-2-120-D2-16	●					
	KFG-2-120-D2-23	●					
	KFG-2-120-D2-27	●					

*Figure is KFG-10-120-D16-11

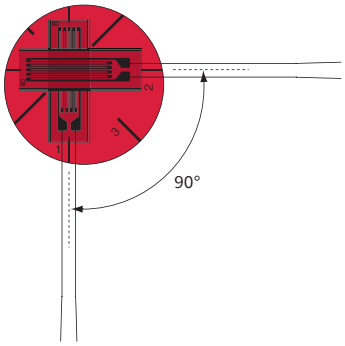


*Figure is KFG-10-120-D17-23

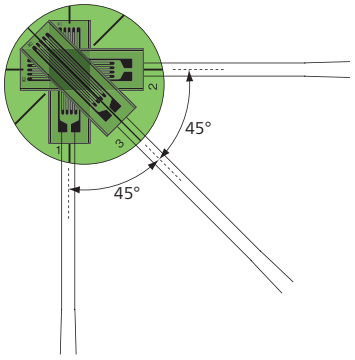


*Figure is KFG-2-120-D1-11

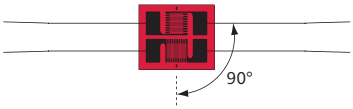
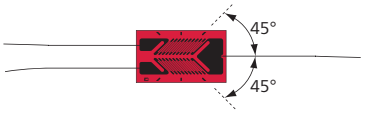
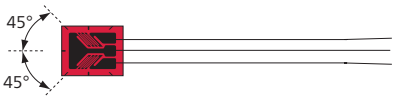
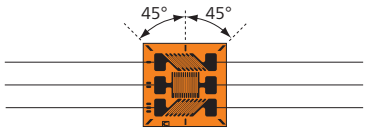
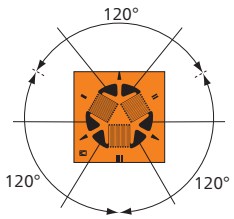
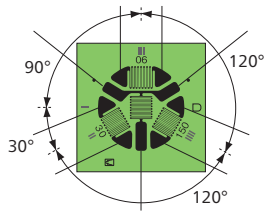


*Figure is KFG-2-120-D2-11



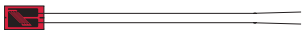
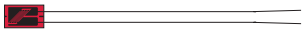
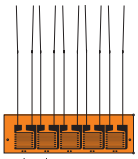
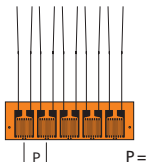
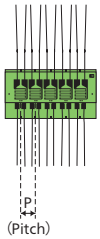
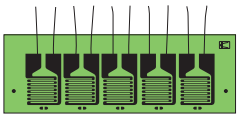
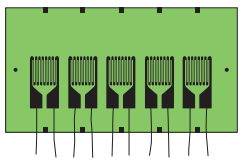
A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material End color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Biaxial, 0°/90° for Torque Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D31-11	●	2	1.2	8	6.5	
 *Figure is KFG-2-120-D31-11	KFG-2-120-D31-16	●					
	KFG-2-120-D31-23	●					
	KFG-2-120-D31-27	●					
Triaxial, 0°/90°/45° Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D3-11	●	2	3.6	11	11	
 *Figure is KFG-2-120-D3-16	KFG-2-120-D3-16	●					
	KFG-2-120-D3-23	●					
	KFG-2-120-D3-27	●					
Triaxial, 0°/120°/240° Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D4-11	●	2	3.4	12	12	
 *Figure is KFG-2-120-D4-16	KFG-2-120-D4-16	●					
	KFG-2-120-D4-23	●					
	KFG-2-120-D4-27	●					
	KFG-1-120-D4-11	●	1	1.7	7	7	
	KFG-1-120-D4-16	●					
	KFG-1-120-D4-23	●					
	KFG-1-120-D4-27	●					
Quadraxial, 0°/30°/90°/150° Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-2-120-D6-11	●	2	3.4	17	17	
 *Figure is KFG-2-120-D6-23	KFG-2-120-D6-16	●					
	KFG-2-120-D6-23	●					
	KFG-2-120-D6-27	●					
Uniaxial, with lead wires from both ends Resistance: 120 Ω Gage factor: Approx. 2.1	KFG-1-120-C2-11	●	1	1.8	5.6	3	
 *Figure is KFG-1-120-C2-27	KFG-1-120-C2-16	●					
	KFG-1-120-C2-23	●					
	KFG-1-120-C2-27	●					
 *Figure is KFG-1-120-C3-27	KFG-1-120-C3-11	●	1	1.8	5.5	2.7	
	KFG-1-120-C3-16	●					
	KFG-1-120-C3-23	●					
	KFG-1-120-C3-27	●					

A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material End color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Uniaxial, for shearing strain Resistance: 120 Ω Gage factor: Approx. 2.1							
	Torque measurement is possible by using C15 and C16 in combination.						
 *Figure is KFG-2-120-C15-11	KFG-2-120-C15-11 KFG-2-120-C15-16 KFG-2-120-C15-23 KFG-2-120-C15-27	● ● ● ●	2	0.8	5.2	3	
 *Figure is KFG-2-120-C16-11	KFG-2-120-C16-11 KFG-2-120-C16-16 KFG-2-120-C16-23 KFG-2-120-C16-27	● ● ● ●	2	0.8	5.2	3	
Uniaxial 5-element, for concentrated stress measurement Resistance: 120 Ω Gage factor: Approx. 2.1							
 P (Pitch) P = 3 mm for gage length 2 mm P = 2 mm for gage length 1 mm *Figure is KFG-2-120-D9-16 N10C2	KFG-2-120-D9-11 N10C2 KFG-2-120-D9-16 N10C2 KFG-2-120-D9-23 N10C2 KFG-2-120-D9-27 N10C2	● ● ● ●	2	2.2	17	5	A min. qty 5 PC.
	KFG-1-120-D9-11 N10C2 KFG-1-120-D9-16 N10C2 KFG-1-120-D9-23 N10C2 KFG-1-120-D9-27 N10C2	● ● ● ●	1	1.4	12	4	A min. qty 5 PC.
 P (Pitch) P = 3 mm for gage length 2 mm P = 2 mm for gage length 1 mm *Figure is KFG-2-120-D19-16 N10C2	KFG-2-120-D19-11 N10C2 KFG-2-120-D19-16 N10C2 KFG-2-120-D19-23 N10C2 KFG-2-120-D19-27 N10C2	● ● ● ●	2	2.5	17	5	A min. qty 5 PC.
	KFG-1-120-D19-11 N10C2 KFG-1-120-D19-16 N10C2 KFG-1-120-D19-23 N10C2 KFG-1-120-D19-27 N10C2	● ● ● ●	1	1.5	12	4	A min. qty 5 PC.
Biaxial 5 element stacked rosette (for stress concentration measurement) Resistance: 120 Ω Gage factor: Approx. 2.1							
 P (Pitch) P=2mm	 Upper side gage pattern  Lower side gage pattern						
*Figure is KFG-1-120-D39-23 N10C2	KFG-1-120-D39-11 N10C2 KFG-1-120-D39-16 N10C2 KFG-1-120-D39-23 N10C2 KFG-1-120-D39-27 N10C2	● ● ● ●	1	1.4 (1.5)	12	6.4	Figures in parentheses are for lower side gages. A min. qty 5 PC.
Uniaxial 60Ω gages Resistance: 60 Ω Gage factor: Approx. 2.1							
	Use 2 gages in parallel connection (bending compensation possible).						
 *Figure is KFG-5-60-C1-27	KFG-5-60-C1-11 KFG-5-60-C1-16 KFG-5-60-C1-23 KFG-5-60-C1-27	● ● ● ●	5	2	10	3.4	
	KFG-2-60-C1-11 KFG-2-60-C1-16 KFG-2-60-C1-23 KFG-2-60-C1-27	● ● ● ●	2	2.3	7.2	3.7	

A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

Uniaxial 350Ω gages

Resistance: 350 Ω
Gage factor: Approx. 2.1

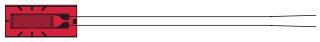


*Figure is KFG-5-350-C1-11

Models	Corresponds to the Material End color	Grid Length	Grid Width	Base Length	Base Width	Remarks
KFG-5-350-C1-11	●	5	2	9.4	4.2	
KFG-5-350-C1-16	●					
KFG-5-350-C1-23	●					
KFG-5-350-C1-27	●					
KFG-3-350-C1-11	●	3	2	7.4	4.2	
KFG-3-350-C1-16	●					
KFG-3-350-C1-23	●					
KFG-3-350-C1-27	●					
KFG-2-350-C1-11	●	2	2	6.3	4.2	
KFG-2-350-C1-16	●					
KFG-2-350-C1-23	●					
KFG-2-350-C1-27	●					
KFG-1-350-C1-11	●	1	2	4.8	3.4	
KFG-1-350-C1-16	●					
KFG-1-350-C1-23	●					
KFG-1-350-C1-27	●					

Biaxial 350Ω gages, 0°/90° stacked rosette

Resistance: 350 Ω
Gage factor: Approx. 2.1

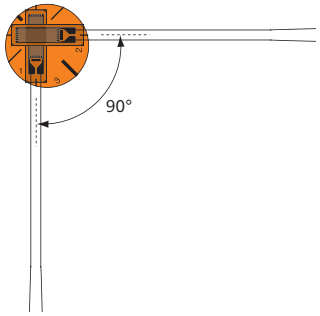


*Figure is KFG-5-350-D16-16

Models	Corresponds to the Material End color	Grid Length	Grid Width	Base	Remarks
KFG-5-350-D16-11	●	5	2	ϕ11	
KFG-5-350-D16-16	●				
KFG-5-350-D16-23	●				
KFG-5-350-D16-27	●				
KFG-3-350-D16-11	●	3	2	ϕ10	
KFG-3-350-D16-16	●				
KFG-3-350-D16-23	●				
KFG-3-350-D16-27	●				
KFG-2-350-D16-11	●	2	2	ϕ10	
KFG-2-350-D16-16	●				
KFG-2-350-D16-23	●				
KFG-2-350-D16-27	●				
KFG-1-350-D16-11	●	1	1.8	ϕ8	
KFG-1-350-D16-16	●				
KFG-1-350-D16-23	●				
KFG-1-350-D16-27	●				

Triaxial 350Ω gages, 0°/90°/45° stacked rosette

Resistance: 350 Ω
Gage factor: Approx. 2.1

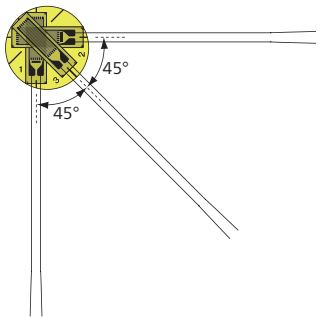
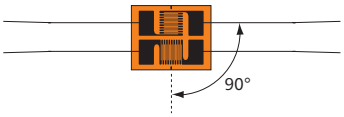
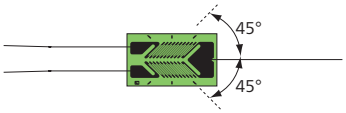
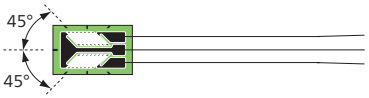


*Figure is KFG-5-350-D17-27

Models	Corresponds to the Material End color	Grid Length	Grid Width	Base	Remarks
KFG-5-350-D17-11	●	5	2	ϕ11	
KFG-5-350-D17-16	●				
KFG-5-350-D17-23	●				
KFG-5-350-D17-27	●				
KFG-3-350-D17-11	●	3	2	ϕ10	
KFG-3-350-D17-16	●				
KFG-3-350-D17-23	●				
KFG-3-350-D17-27	●				
KFG-2-350-D17-11	●	2	2	ϕ10	
KFG-2-350-D17-16	●				
KFG-2-350-D17-23	●				
KFG-2-350-D17-27	●				
KFG-1-350-D17-11	●	1	1.8	ϕ8	
KFG-1-350-D17-16	●				
KFG-1-350-D17-23	●				
KFG-1-350-D17-27	●				

A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material End color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Biaxial 350Ω gages, 0°/90° Resistance: 350 Ω Gage factor: Approx. 2.1							
 *Figure is KFG-2-350-D1-16	KFG-2-350-D1-11 KFG-2-350-D1-16 KFG-2-350-D1-23 KFG-2-350-D1-27	● ● ● ●	2	3	10	8.5	
Biaxial 350Ω gages for torque, 0°/90° Resistance: 350 Ω Gage factor: Approx. 2.1							
 *Figure is KFG-2-350-D2-23	KFG-2-350-D2-11 KFG-2-350-D2-16 KFG-2-350-D2-23 KFG-2-350-D2-27	● ● ● ●	2	4	12	6.8	
 *Figure is KFG-2-350-D2-23	KFG-2-350-D31-11 KFG-2-350-D31-16 KFG-2-350-D31-23 KFG-2-350-D31-27	● ● ● ●	2	3	10.5	6.5	
Uniaxial 500Ω gages for transducers Resistance: 500 Ω Gage factor: Approx. 2.1							
 *Figure is KFG-5-500-C1-27	KFG-5-500-C1-11 KFG-5-500-C1-16 KFG-5-500-C1-23 KFG-5-500-C1-27	● ● ● ●	5	3.5	11	4.9	
	KFG-2-500-C1-11 KFG-2-500-C1-16 KFG-2-500-C1-23 KFG-2-500-C1-27	● ● ● ●	2	2.6	7.5	4.4	
Uniaxial 1000Ω gages for transducers Resistance: 1000 Ω Gage factor: Approx. 2.1							
 *Figure is KFG-5-1K-C1-27	KFG-5-1K-C1-11 KFG-5-1K-C1-16 KFG-5-1K-C1-23 KFG-5-1K-C1-27	● ● ● ●	5	3.5	11	4.9	
	KFG-2-1K-C1-11 KFG-2-1K-C1-16 KFG-2-1K-C1-23 KFG-2-1K-C1-27	● ● ● ●	2	3	7.2	4.5	

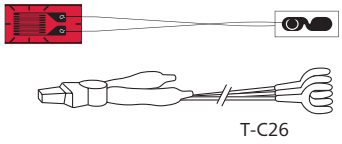
A min. qty 10 PC.

General-purpose Foil Strain Gages KFG

●KFG Series Foil Strain Gages with Gage Terminal

Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 2.1



(When the clip-equipped dedicated cable is used, the operating temperature range of each adhesive after curing is –10 to 80°C.)

*Figure is KFG-2-120-C1-11 T-F7

KFG gages equipped with a gage terminal enable one touch connection/disconnection of the lead wire cable. They are suitable for residual stress measurement with the cutting method. A clip equipped dedicated cable T-C26 (Vinyl-coated, 2 m long) is optionally available.

Applicable Adhesives and Operating Temperature Range after Curing

PC-600: -196 to 150°C
CC-33A: -196 to 120°C
CC-35: -30 to 120°C
CC-36: -30 to 100°C
EP-340: -55 to 150°C

Patterns, Gage Resistance, Gage Factor	Models	Corresponds to the Material End color	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Uniaxial	KFG-2-120-C1-11 T-F7	●	2	1.2	6.3	2.8	ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-2-120-C1-16 T-F7	●					
	KFG-2-120-C1-23 T-F7	●					
	KFG-1-120-C1-11 T-F7	●	1	1.1	4.8	2.4	ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-1-120-C1-16 T-F7	●					
	KFG-1-120-C1-23 T-F7	●					

Biaxial, 0°/90° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1

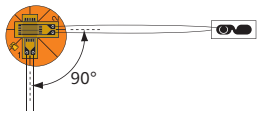


*Figure is KFG-2-120-D16-16 T-F7

Biaxial, 0°/90° stacked rosette	KFG-2-120-D16-11 T-F7	●	2	1.2	ϕ8		ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-2-120-D16-16 T-F7	●					
	KFG-2-120-D16-23 T-F7	●					
	KFG-1-120-D16-11 T-F7	●	1	1.1	ϕ5		ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-1-120-D16-16 T-F7	●					
	KFG-1-120-D16-23 T-F7	●					

Triaxial, 0°/90°/45° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1

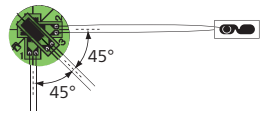


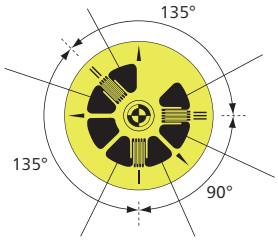
*Figure is KFG-2-120-D17-23 T-F7

Triaxial, 0°/90°/45° stacked rosette	KFG-2-120-D17-11 T-F7	●	2	1.2	ϕ8		ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-2-120-D17-16 T-F7	●					
	KFG-2-120-D17-23 T-F7	●					
	KFG-1-120-D17-11 T-F7	●	1	1.1	ϕ5		ϕ0.14 Polyester-coated copper cable 15 mm long
	KFG-1-120-D17-16 T-F7	●					
	KFG-1-120-D17-23 T-F7	●					

●KFG Series Foil Strain Gages for Boring Method

Triaxial, 0°/135°/90°

Resistance: 120 Ω
Gage factor: Approx. 2.1



For KFG gages with the lead wire cable pre-attached, refer to page 1-18.

*Figure is KFG-3-120-D28-27

Designed to measure residual stress released by the boring method.

Applicable Adhesives and Operating Temperature Range after Curing

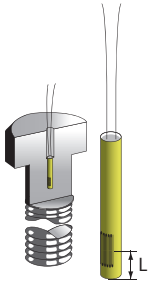
CC-33A: -196 to 120°C
CC-35: -30 to 120°C
CC-36: -30 to 100°C
EP-340: -55 to 150°C
PC-620: -196 to 150°C

Triaxial, 0°/135°/90°	KFG-3-120-D28-11	●	3	2	ϕ19.8		Gage center diameter 10.8
	KFG-3-120-D28-16	●					
	KFG-3-120-D28-23	●					
	KFG-3-120-D28-27	●					
	KFG-1.5-120-D28-11	●	1.5	1.3	ϕ12		Gage center diameter 5.5
	KFG-1.5-120-D28-16	●					
	KFG-1.5-120-D28-23	●					
	KFG-1.5-120-D28-27	●					

●KFG Series Foil Strain Gages for Measuring Axial Tension of Bolts

Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 1.9



Length from the tip of base to the center of grid

L	KFG-3 : 2.7mm
	KFG-1.5 : 1.75mm

If it is difficult to bond a strain gage to the surface of a bolt for measuring the tightening stress, these gages enable the measurement by embedding into a hole, 2 mm diameter, bored from the top head of the bolt. They are applicable to materials having a linear expansion coefficient of 11μm/m per °C.

ϕ0.14 Polyester-coated copper cable 5 mm long

Applicable Adhesives and Operating Temperature Range after Curing

EP-180 Normal temperature to 50°C

A min. qty 5 PC.

Options Dedicated gage terminal

Model	Dimensions	Base material	Conductor material	Remarks
T-F29	Outer: ϕ6 Inner: ϕ2.5	Glass epoxy	Copper foil	For bolt gages

T-F29

KFG-3-120-C20-11	3	app. 6	11.5	ϕ1.9	Bore diameter 2	
KFG-1.5-120-C20-11	1.5	app.6	5	ϕ1.9	Bore diameter 2	

A min. qty 10 PC.

General-purpose Foil Strain Gages KFGT

●KFGT Series Foil Strain Gages with A Temperature Sensor

Uniaxial 3-wire system

Polyester-coated copper lead wire 1 m long each
Resistance: 120 Ω
Gage factor: Approx. 2.1
Temperature sensor: T-type thermocouple
Accuracy: Within 1.5 °C

The KFGT gages are foil strain gages incorporating a T-type thermocouple for simultaneous measurement of strain and temperature. They ensure not only efficient strain measurement under environments where temperature change or temperature gradient requires simultaneous measurement of strain and temperature but also highly precise compensation of thermally-induced apparent strain. It is recommended to use Kyowa data logger UCAM-60B as a mating instrument.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -10 to 120°C CC-35: -10 to 120°C
CC-36: -10 to 100°C EP-340: -10 to 120°C

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
	KFGT-5-120-C1-11 N1M3	5	2.1	10	4.5	Standard accessories: lead wire stopper to prevent the gage from damaging Pre-attached lead wire 1-m long Extension lead wire are optionally available. A min. qty 5 PC.
	KFGT-5-120-C1-16 N1M3					
	KFGT-5-120-C1-23 N1M3					
	KFGT-5-120-C1-27 N1M3					
	KFGT-2-120-C1-11 N1M3	2	1.8	7	4.5	
	KFGT-2-120-C1-16 N1M3					
	KFGT-2-120-C1-23 N1M3					
	KFGT-2-120-C1-27 N1M3					

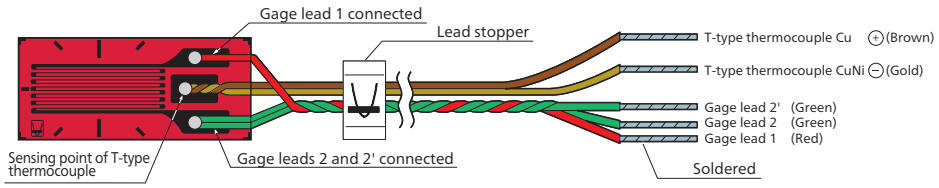


*Figure is KFGT-5-120-C1-11 N1M3

Options Extension Lead Wire Cables

Models	Dimensions (mm) Length	Width	Thickness	Qty per case	Remarks
NT-1M	1000	7.2	1.2	5	With gage terminal T-F25
NT-2M	2000				
NT-4M	4000				

General-purpose Foil Strain Gages KFR

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFR Series Foil Strain Gages

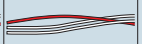
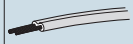
The KFR series foil strain gages are durable and easy-to-use high-grade strain gages. The gage element is sandwiched between heat-resistant polyimide base and cover, thereby letting them exhibit high performance in a wide temperature range.

Applicable Adhesives and Operating Temperature Range after Curing

PC-600: -196 to 150°C CC-33A: -196 to 120°C CC-35: -30 to 120°C
CC-36: -30 to 100°C EP-340: -55 to 150°C

■Types, lengths and codes of lead wire cables pre-attached to KFR gages

＊3-wire system is available only for gage lengths of 2 mm and 5mm

Types / Length	Polyester-coated 2-wire copper cable	Polyester-coated 3-wire copper cable＊	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable		Middle-temperature 2-wire cable	Middle-temperature 3-wire cable
								
	C1, D25		C1	D25	C1	D25	C1, D25	
15 cm	N15C2	N15C3	L15C2R	L15C2S	L15C3R	L15C3S	R15C2	R15C3
30 cm	N30C2	N30C3	L30C2R	L30C2S	L30C3R	L30C3S	R30C2	R30C3
1 m	N1M2	N1M3	L1M2R	L1M2S	L1M3R	L1M3S	R1M2	R1M3
3 m			L3M2R	L3M2S	L3M3R	L3M3S	R3M2	R3M3
5 m			L5M2R	L5M2S	L5M3R	L5M3S	R5M2	R5M3
Oprg. temp. range	-196 to 150°C		-10 to 80°C				-100 to 150°C	
Remarks	Twisted for 50 cm or longer		L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer		L-11	L-12

＊For other lead wire cable lead wire, contact us.

When ordering, suffix the lead wire cable code to the model number with a space in between. (Except for 02N, D9 & D19)

E.g. KFR-5-120-C1-11 for the gage with a polyester-coated 3-wire copper cable 30 cm long → KFR-5-120-C1-11 N30C3

KFR-5-120-D25-11 for the gage with a vinyl-coated flat 3-wire cable 5 m long → KFR-5-120-D25-11 L5M3S

If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long).

Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 2.1 (KFR 02N: Approx. 1.9)

Except for KFR-02N, these KFR series gages are also available with the gage resistance of 350Ω.
The size is slightly different from 120Ω gages.

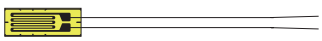


*Figure is KFR-5-120-C1-11

KFR-5-120-C1-11	5	2.5	10	3.7	
KFR-5-120-C1-16					
KFR-5-120-C1-23					
KFR-2-120-C1-11	2	2.5	6	3.7	
KFR-2-120-C1-16					
KFR-2-120-C1-23					
KFR-1-120-C1-11	1	1.5	4	2.7	
KFR-1-120-C1-16					
KFR-1-120-C1-23					
KFR-05-120-C1-11	0.5	1.4	3.3	2.7	
KFR-05-120-C1-16					
KFR-05-120-C1-23					
KFR-02-120-C1-11	0.2	1	2.5	2.2	
KFR-02-120-C1-16					
KFR-02-120-C1-23					
KFR-02N-120-C1-11 N10C2	0.2	0.9	1.6	1.2	With polyester-coated copper wires, 0.1 mm diameter by 10 cm long each
KFR-02N-120-C1-16 N10C2					
KFR-02N-120-C1-23 N10C2					

Triaxial 0°/90°/45°

Resistance: 120 Ω
Gage factor: Approx. 2.1

These KFR series gages are also available with the gage resistance of 350Ω.
The size is slightly different from 120Ω gages.

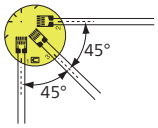


*Figure is KFR-1-120-D25-11

KFR-1-120-D25-11	1	1.5	ϕ8	A min. qty 5 PC.
KFR-1-120-D25-16				
KFR-1-120-D25-23				
KFR-05-120-D25-11	0.5	1.4	ϕ7.5	A min. qty 5 PC.
KFR-05-120-D25-16				
KFR-05-120-D25-23				

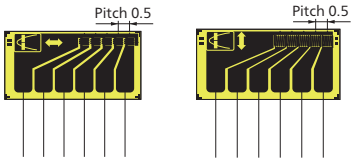
A min. qty 10 PC.

General-purpose Foil Strain Gages KFR

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm)				Remarks
		Grid		Base		
		Length	Width	Length	Width	

Uniaxial 5-element, for concentrated stress measurement

Resistance: 120 Ω
Gage factor: Approx. 1.95



D9 D19

*Figure is KFR-015-120-D9-11 N10C2 (Left)
*Figure is KFR-015-120-D19-11 N10C2(Right)

Note : When measuring with dynamic strain instruments and signal conditioners, this results in 1 measurement for each element. Measurement using 2 elements or more at the same time is not possible.
Note : Since the gage resistance is 120±15Ω (deviation among 5-element is 5Ω), each element requires an external resistor with the same resistance when connected to the measuring instrument.

KFR-015-120-D9-11 N10C2 KFR-015-120-D9-16 N10C2 KFR-015-120-D9-23 N10C2	0.15	0.34	6	3	P (Pitch) 0.5 mm A min. qty 5 PC.
KFR-015-120-D19-11 N10C2 KFR-015-120-D19-16 N10C2 KFR-015-120-D19-23 N10C2	0.15	0.45	6	3	P (Pitch) 0.5 mm A min. qty 5 PC.

Waterproof Strain Gages KFW

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm)				Remarks
		Grid		Base		
		Length	Width	Length	Width	

●KFW Series Waterproof Foil Strain Gages

The KFW series foil strain gages have the surface covered with a special resin for waterproof. The waterproof structure enables these gages to serve for outdoor or underwater measurement merely by being bonded to measuring objects. The insulation resistance shows virtually no deterioration even after 100 hours of use under an underwater pressure of approximately 10 MPa. In addition, the covering resin is flexible enough to enable easy bonding to curved surfaces.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -10 to 80°C　CC-36: -10 to 80°C　EP-180: -10 to 80°C

■Types, lengths and codes of lead wire cables pre-attached to KFW series gages

Types / Length	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable	
				
	C1	D16, D17	C1	D16, D17
15 cm	L15C2R	L15C2S	L15C3R	L15C3S
30 cm	L30C2R	L30C2S	L30C3R	L30C3S
1 m	L1M2R	L1M2S	L1M3R	L1M3S
3 m	L3M2R	L3M2S	L3M3R	L3M3S
5 m	L5M2R	L5M2S	L5M3R	L5M3S
Oprg. temp. range	−10 to 80°C			
Remarks	L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer	

＊For other lead wire cable lengths, contact us.

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

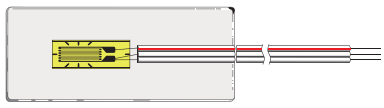
E.g.
KFW-5-120-C1-11 L2M2R
for the gage with a vinyl-coated flat 2-wire cable 2 m long
KFW-5-120-D17-11 L5M3S
for the gage with a vinyl-coated flat 3-wire cable 5 m long

These gages are also available with 350Ω resistance.

Notes on pre-attached lead wire cables
- Standard color of the 2-wire cable pre-attached to uniaxial gages is red (R). If desired, a white, green, yellow or black cable can be pre-attached.
- Standard 3-wire cable pre-attached to uniaxial gages has red stripes (R). If desired, the red stripes can be changed to blue or yellow stripes.
- In the case of a biaxial gage, 2-wire cables are color-coded with red and white stripes for 0° and 90°, respectively and 3-wire cables, with red and yellow stripes for 0° and 90°, respectively.
- In the case of a triaxial gage, 2-wire cables are color-coded with red, white and green stripes for 0°, 90°, and 45°, respectively and 3-wire cables, with red, yellow and blue stripes for 0°, 90°, and 45°, respectively.

Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 2.1

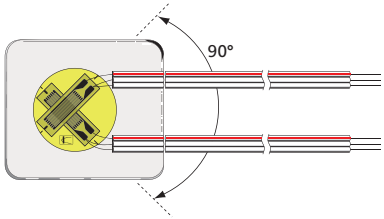


The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

KFW-5-120-C1-11 L1M3R	5	2	30	12	
KFW-5-120-C1-16 L1M3R					
KFW-5-120-C1-23 L1M3R					
KFW-2-120-C1-11 L1M3R	2	2.3	30	12	
KFW-2-120-C1-16 L1M3R					
KFW-2-120-C1-23 L1M3R					

Biaxial, 0°/90° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1

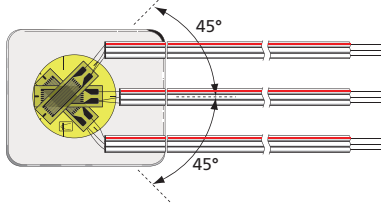


The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

KFW-5-120-D16-11 L1M3S	5	2	21	18	A min. qty 5 PC.
KFW-5-120-D16-16 L1M3S					
KFW-5-120-D16-23 L1M3S					
KFW-2-120-D16-11 L1M3S	2	1.4	21	18	A min. qty 5 PC.
KFW-2-120-D16-16 L1M3S					
KFW-2-120-D16-23 L1M3S					

Triaxial, 0°/90°/45° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1



The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

KFW-5-120-D17-11 L1M3S	5	2	21	18	A min. qty 5 PC.
KFW-5-120-D17-16 L1M3S					
KFW-5-120-D17-23 L1M3S					
KFW-2-120-D17-11 L1M3S	2	1.4	21	18	A min. qty 5 PC.
KFW-2-120-D17-16 L1M3S					
KFW-2-120-D17-23 L1M3S					

A min. qty 10 PC.

Waterproof Strain Gages KFWS & KCW

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFWS Series Small-Sized Waterproof Foil Strain Gages

The KFWS series foil strain gages are small-sized waterproof gages suitable for outdoor or underwater strain measurement where gage bonding space is limited. The waterproof resin is as thin as 1.3 mm, making them flexible enough to be bonded to a curved surface of 10 mm diameter.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -10 to 80°C CC-36: -10 to 80°C EP-180: -10 to 80°C

■Types, lengths and codes of lead wire cables pre-attached to KFWS series gages

Types / Length	Vinyl-coated flat 2-wire cable C1	Vinyl-coated flat 2-wire cable D16	Vinyl-coated flat 3-wire cable C1	Vinyl-coated flat 3-wire cable D16
15 cm	L15C2R	L15C2S	L15C3R	L15C3S
30 cm	L30C2R	L30C2S	L30C3R	L30C3S
1 m	L1M2R	L1M2S	L1M3R	L1M3S
3 m	L3M2R	L3M2S	L3M3R	L3M3S
5 m	L5M2R	L5M2S	L5M3R	L5M3S
Oprg. temp. range	–10 to 80°C			
Remarks	L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer	

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFWS-2N-120-C1-11 L3M2R
for the gage with a vinyl-coated flat 2-wire cable 3 m long

＊For other lead wire cable lengths, contact us.

Uniaxial

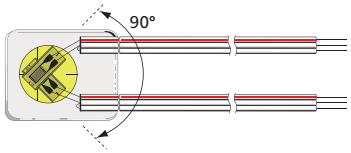
Resistance: 120 Ω
Gage factor: Approx. 2.1

The following models with the lead wire cable code L5M3R are delivered with a vinyl-coated flat 3-wire cable 5 m long pre-attached.

KFWS-2N-120-C1-11 L5M3R KFWS-2N-120-C1-16 L5M3R KFWS-2N-120-C1-23 L5M3R	2	0.84	15	6	

Biaxial, 0°/90° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1



The following models with the lead wire cable code L5M3S and delivered with a vinyl-coated flat 3-wire cable 5m long pre-attached.

KFWS-2-120-D16-11 L5M3S KFWS-2-120-D16-16 L5M3S KFWS-2-120-D16-23 L5M3S	2	1.2	15	12	10

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KCW Series Weldable Waterproof Foil Strain Gages

The KCW series foil strain gages are weldable gages, which do not require any coating treatment for use under high pressure or under water. They are available in 2 types: G10 with 1 gage and G14S with 4 gages. The G10 type endures a water pressure of approximately 10 MPa.

Mounting Method and Operating Temperature Range Spot welding –20 to 100°C

■Types, lengths and codes of lead wire cables pre-attached to KCW gages

Types / Length	3 strand chloroprene wire G10
15 cm	G15C3S
30 cm	G30C3S
1 m	G1M3S
3 m	G3M3S
5 m	G5M3S
Oprg. temp. range	-20 to 100°C

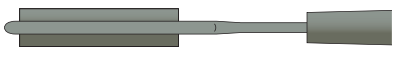
When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KCW-5-120-G10-11 G5M3S
If connecting 5 m of 3 strand chloroprene coated wire to KCW-5-120-G10-11

＊For other lead wire cable lengths, contact us.

Uniaxial 1 element With 3 strand chloroprene wire

Resistance: 120 Ω
Gage factor: Approx. 2.2



Material: SUS304

The following type is for 3 m of 3 strand chloroprene wire.

KCW-5-120-G10-11 G3M3S	5	–	21	5	Min. radius of curvature R20 A min. qty 2 PC.

A min. qty 10 PC.

Gages for Concrete KFG & KC

●KFG Series General-purpose Foil Strain Gages

*For the types and lengths of lead wire cables, refer to page 1-15 and 1-16.

Listed here are the KFG series gages with a suitable lead wire cable for strain measurement of concrete.

Applicable Adhesives and Operating Temperature Range after Curing (With vinyl-coated flat cable)
CC-35: -10 to 80°C

Notes on pre-attached lead wire cables
- Standard color of the 2-wire cable pre-attached to uniaxial gages is red (R). If desired, a white, green, yellow or black cable can be pre-attached.
- Standard 3-wire cable pre-attached to uniaxial gages has red stripes (R). If desired, the red stripes can be changed to blue or yellow stripes.
- In the case of a biaxial gage, 2-wire cables are color-coded with red and white stripes for 0° and 90°, respectively and 3-wire cables, with red and yellow stripes for 0° and 90°, respectively. Letter code is S in common.
- In the case of a triaxial gage, 2-wire cables are color-coded with red, white and green stripes for 0°, 90°, and 45°, respectively and 3-wire cables, with red, yellow and blue stripes for 0°, 90°, and 45°, respectively. Letter code is S in common.

Uniaxial

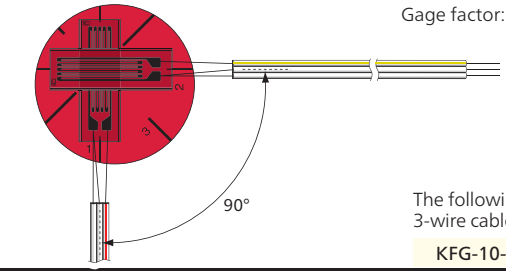
Resistance: 120 Ω
Gage factor: Approx. 2.1

The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
	KFG-30-120-C1-11 L1M3R	30	3.3	37	5.2	
	KFG-20-120-C1-11 L1M3R	20	5	28	8	
	KFG-10-120-C1-11 L1M3R	10	3	16	5.2	

Biaxial, 0°/90° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1

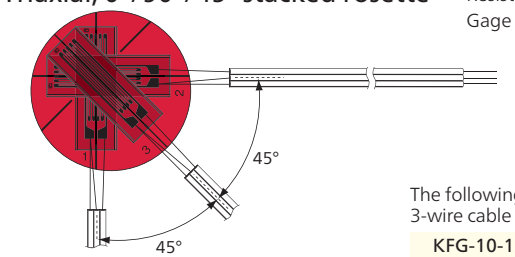


The following model with the lead wire cable code L1M3S is delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

Patterns, Gage Resistance, Gage Factor	Models	Grid Length	Grid Width	Base Length	Base Width	Remarks
	KFG-10-120-D16-11 L1M3S	10	3	ϕ21		

Triaxial, 0°/90°/45° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 2.1



The following model with the lead wire cable code L1M3S is delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

Patterns, Gage Resistance, Gage Factor	Models	Grid Length	Grid Width	Base Length	Base Width	Remarks
	KFG-10-120-D17-11 L1M3S	10	3	ϕ21		

●KC Series Wire Strain Gages

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KC-120-120-A1-11 L5M2R
for the gage with a vinyl-coated flat 2-wire cable 5 m long

If no lead wire cable code is suffixed, the gage is delivered with only gage leads (Silver-clad copper wires 25 mm long each).

Featuring a longer gage length, the KC series gages are wire strain gages suitable for mean strain measurement of concrete under test. Usually, a model with the gage length over 3 times longer than the maximum diameter of the aggregate is selected for the purpose.

Applicable Adhesives and Operating Temperature Range after Curing
CC-35: -30 to 120°C

■Types, lengths and codes of lead wire cables pre-attached to KC series gages

Types / Length	Vinyl-coated flat 2-wire cable	Vinyl-coated flat 3-wire cable
	A1	
15 cm	L15C2R	L15C3R
30 cm	L30C2R	L30C3R
1 m	L1M2R	L1M3R
3 m	L3M2R	L3M3R
5 m	L5M2R	L5M3R
Oprg. temp. range	-10 to 80°C	
Remarks	L-6, L-9 for 6 m or longer	L-7, L-10 for 6 m or longer

＊For other lead wire cable lengths, contact us.

Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 2.1

Patterns, Gage Resistance, Gage Factor	Models	Grid Length	Grid Width	Base Length	Base Width	Remarks
	KC-120-120-A1-11	120	0.6	132	6	
	KC-80-120-A1-11	84	0.6	95	8	
	KC-70-120-A1-11	67	0.6	80	7.5	
	KC-60-120-A1-11	60	0.6	74	8	

A min. qty 10 PC.

Gages for Concrete KM & KMC

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KM Series Embedded Strain Gages

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KM-120-120-H2-11 W5M3
for the gage with a vinyl-coated flat 3-wire cable 5 m long

The KM series gages are designed to be embedded in mortar or concrete for the purpose of measuring the internal stress. To ensure better adhesion to mortar or the like, the KM series gages feature a specially treated surface. They also provide suitable waterproofness and elastic modulus for the intended purpose.

Operating Temperature Range –10 to 70°C

■Types, lengths and codes of lead wire cables pre-attached to KM gages

Types / Length	KM-30 Vinyl-coated flat 2-wire cable	KM-120 Vinyl-coated flat 3-wire cable
	H1	H2
1 m	Y1M2	W1M3
3 m	Y3M2	W3M3
5 m	Y5M2	W5M3
Oprg. temp. range	-10 to 70°C	

＊For other lead wire cable lengths, contact us.

Uniaxial foil strain gages with vinyl-coated flat 2-wire cable

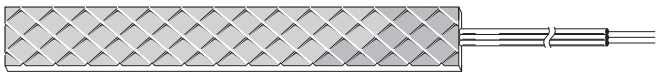
Resistance: 120 Ω
Gage factor: Approx. 1.8

The following model with the lead wire cable code Y1M2 is delivered with a vinyl-coated flat 2-wire cable 1 m long pre-attached.

KM-30-120-H1-11 Y1M2	30×9×3	A min. qty 1 PC.

Uniaxial foil strain gages with vinyl-coated flat 3-wire cable

Resistance: 120 Ω
Gage factor: Approx. 2.0.



The following model with the lead wire cable code W1M3 is delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.

KM-120-120-H2-11 W1M3	120×15×5	A min. qty 1 PC.

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KMC Series Concrete-Embedded Strain Gages

The KMC series gages are designed to measure self-shrinkage and self-stress of cemented materials. They enable measurement of the self-shrinkage and high-fluidity concrete immediately after placing. They are also used effectively to check for cracks of cemented materials. Usually, a T-type thermocouple is installed near the gage, while the KMC series gages of H4 type do not require such the installation since they are equipped with a built-in thermocouple.

Uniaxial wire strain gages with vinyl-coated flat 3-wire cable 3 m long

Resistance: 120 Ω

Normal temperature to 70°C A min. qty 1 PC.

The KMC series gages are available only with a vinyl-coated flat 3-wire cable 3 m long pre-attached.

KMC-70-120-H3	80×10×2	
KMC-70-120-H4	80×10×2	T-type thermocouple built in

Gages for Composite Materials & Plastics KFRP

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm)				Remarks
		Grid		Base		
		Length	Width	Length	Width	

●KFRP Series Foil Strain Gages for Composite Materials

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFRP-5-120-C1-1 N15C2
for the gage with polyester-coated 2-wire copper cable 15 cm long
KFRP-5-120-D22-3 L5M3S
for the gage with a vinyl-coated flat 3-wire cable 5 m long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long)

The KFRP series foil strain gages are self-temperature-compensation gages (SELCOM® gages) suitable for strain measurement of composite materials such as CFRP and GFRP. The special gage pattern minimizes the effect of self-heating due to gage current and the effect of reinforcement of low-elasticity materials.
To ensure accurate measurement by avoiding the self-heating effect of gage current, consider the following:

1. Select a lower bridge excitation voltage if the amplifier allows bridge voltage selection.
2. Active-dummy system
3. 350Ω strain gages

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -196 to 120°C CC-35: -30 to 120°C
CC-36: -30 to 100°C EP-34B: -55 to 200°C

■Types, lengths and codes of lead wire cables pre-attached to KFRP gages

Types / Length	2polyester-coated copper wires	3polyester-coated copper wires	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable		Middle-temperature 2-wire cable	Middle-temperature 3-wire cable	Fluoroplastic coated high/low-temp. 3-wire cable
	C1, D22		C1	D22	C1	D22	C1, D22		
15 cm	N15C2	N15C3	L15C2R	L15C2S	L15C3R	L15C3S	R15C2	R15C3	F15C3
30 cm	N30C2	N30C3	L30C2R	L30C2S	L30C3R	L30C3S	R30C2	R30C3	F30C3
1 m	N1M2	N1M3	L1M2R	L1M2S	L1M3R	L1M3S	R1M2	R1M3	F1M3
3 m			L3M2R	L3M2S	L3M3R	L3M3S	R3M2	R3M3	F3M3
5 m			L5M2R	L5M2S	L5M3R	L5M3S	R5M2	R5M3	F5M3
Oprg. temp. range	-196 to 150°C		-10 to 80°C				-100 to 150°C		-196 to 200°C
Remarks	Twisted for 50 cm or longer		L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer		L-11	L-12	L-3

＊For other lead wire cable lengths, contact us.

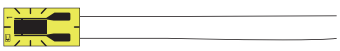
Uniaxial

Resistance: 120 Ω
Gage factor: Approx. 2.1

KFRP-5-120-C1-1	5	1.4	15	5
KFRP-5-120-C1-3				
KFRP-5-120-C1-6				
KFRP-5-120-C1-9				
KFRP-2-120-C1-1	2	1.2	10	5
KFRP-2-120-C1-3				
KFRP-2-120-C1-6				
KFRP-2-120-C1-9				

Uniaxial

Resistance: 350 Ω
Gage factor: Approx. 2.1

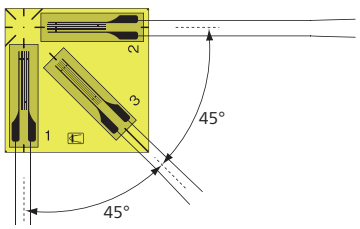


KFRP-5-350-C1-1	5	1.5	15	5
KFRP-5-350-C1-3				
KFRP-5-350-C1-6				
KFRP-5-350-C1-9				
KFRP-2-350-C1-1	2	2.2	10	5
KFRP-2-350-C1-3				
KFRP-2-350-C1-6				
KFRP-2-350-C1-9				

Triaxial, 0°/90°/45°

Resistance: 120 Ω
Gage factor: Approx. 2.1

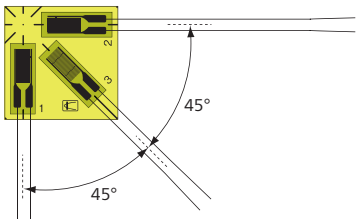
Each of 3 axis may be given a different linear expansion coefficient if requested.



KFRP-5-120-D22-1	5	1.4	19	19
KFRP-5-120-D22-3				
KFRP-5-120-D22-6				
KFRP-5-120-D22-9				
KFRP-2-120-D22-1	2	1.2	15	15
KFRP-2-120-D22-3				
KFRP-2-120-D22-6				
KFRP-2-120-D22-9				

A min. qty 10 PC.

Gages for Composite Materials & Plastic KFRP & KFRS

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Triaxial, 0°/90°/45° Resistance: 350 Ω Gage factor: Approx. 2.1	Each of 3 axis may be given a different linear expansion coefficient if requested.					
	KFRP-5-350-D22-1 KFRP-5-350-D22-3 KFRP-5-350-D22-6 KFRP-5-350-D22-9	5	1.5	19	19	
	KFRP-2-350-D22-1 KFRP-2-350-D22-3 KFRP-2-350-D22-6 KFRP-2-350-D22-9	2	2.2	15	15	

●KFRS Series Foil Strain Gages for Printed Boards

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.

KFRP-02-120-C1-13 N10C3

for the gage with a polyester-coated 3-wire copper cable 10-cm long pre-attached

KFRP-5-120-D35-13 L5M3S

for the gage with a vinyl-coated flat 3-wire cable 5 m long pre-attached

Printed boards are used for varieties of products including cellular phones, car navigation systems and digital cameras. To evaluate the mechanical and thermal characteristics of these printed boards, the KFRS gages were developed by integrating the advantageous features of KFG and KFR gages.

- Dimensions of gage base (bondable space to mounted components and narrow parts) 1.2 mm long by 1.1 mm wide (uniaxial), 2.5 mm long by 2.5 mm wide (biaxial or triaxial)
- Linear expansion coefficient of 13 x 10^{-6}/°C, suitable for component-mounted board
- Self-temperature-compensation range is made as wide as –30 to 120°C to satisfy thermal cyclic tests of printed boards

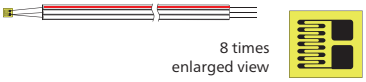
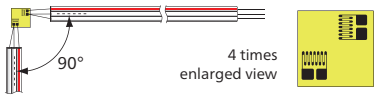
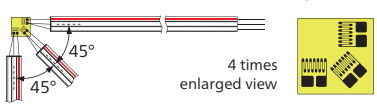
Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -196 to 120°C CC-36: -30 to 100°C PC-600: -196 to 150°C

■Types, lengths and codes of lead wire cables pre-attached to KFRS gages

Types / Length	Polyester-coated 2-wire copper cable	Polyester-coated 3-wire copper cable	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable		Middle-temperature 2-wire cable	Middle-temperature 3-wire cable
	C1, D34, and D35		C1	D34, D35	C1	D34, D35	C1, D34, and D35	
10 cm	N10C2	N10C3						
30 cm	N30C2	N30C3						
1 m			L1M2R	L1M2S	L1M3R	L1M3S	R1M2	R1M3
3 m			L3M2R	L3M2S	L3M3R	L3M3S	R3M2	R3M3
5 m			L5M2R	L5M2S	L5M3R	L5M3S	R5M2	R5M3
使用温度範囲	-196 to 150°C		-10 to 80°C				-100 to 150°C	
備　考			L-6		L-7		L-11	L-12

＊For other lead wire cable lengths, contact us.

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Uniaxial Resistance: 120 Ω Gage factor: Approx. 2.0	The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.					
	KFRS-1-120-C1-13 L1M3R	1	0.65	4	1.4	
	KFRS-02-120-C1-13 L1M3R	0.2	0.8	1.2	1.1	
Biaxial, 0°/90° Resistance: 120 Ω Gage factor: Approx. 2.0	The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.					
	KFRS-02-120-D34-13 L1M3S	0.2	0.8	2.5	2.5	A min. qty 5 PC.
Triaxial, 0°/90°/45° Resistance: 120 Ω Gage factor: Approx. 2.0	The following models with the lead wire cable code L1M3R are delivered with a vinyl-coated flat 3-wire cable 1 m long pre-attached.					
	KFRS-02-120-D35-13 L1M3S	0.2	0.8	2.5	2.5	A min. qty 5 PC.

A min. qty 10 PC.

Gages for Plastics KFP

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFP Series Foil Strain Gages for Plastics

The KFP series foil strain gages provide an applicable linear expansion coefficient of 65 x 10^{-6}/°C, which makes them suitable for strain measurement of plastics such as acrylic resin.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -20 to 80°C CC-35: -20 to 80°C
CC-36: -20 to 80°C EP-34B: -20 to 80°C

When bonding the KFP gage to a difficult-to-bond materials such as polyethylene with CC-33A, use S-9B surface treatment agent in combination.
For S-9B, contact us.

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

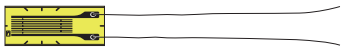
E.g.
KFP-5-120-C1-65 N10C3
for the gage with a polyester-coated 3-wire copper cable 10 cm long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long).

■Types, lengths and codes of lead wire cables pre-attached to KFP gages

Types / Length	Polyester-coated 2-wire copper cable	Polyester-coated 3-wire copper cable	Vinyl-coated flat 2-wire cable	Vinyl-coated flat 3-wire cable
	C1			
15 cm	N15C2	N15C3	L15C2R	L15C3R
30cm	N30C2	N30C3	L30C2R	L30C3R
1 m	N1M2	N1M3	L1M2R	L1M3R
3 m			L3M2R	L3M3R
5 m			L5M2R	L5M3R
Oprg. temp. range	-196 to 80°C		-10 to 80°C	
Remarks	Twisted for 50 cm or longer		L-6, L-9 for 6 m or longer	L-7, L-10 for 6 m or longer

＊For other lead wire cable lengths, contact us.

Uniaxial
Resistance: 120 Ω
Gage factor: Approx. 2.1



KFP-5-120-C1-65	5	2.5	13	5.2
KFP-2-120-C1-65	2	2	10	4.7

Uniaxial 350- gage
Resistance: 350 Ω
Gage factor: Approx. 2.1

KFP-5-350-C1-65	5	2.6	13	5.2
KFP-2-350-C1-65	2	2.4	10	5.2

Gage for Low-elasticity Materials KFML

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFML Foil Strain Gage for Low-elasticity Materials

The KFML foil strain gage uses a base with extremely low rigidity, enabling strain measurement of rubber or the similar materials with low Young's moduli.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: 0 to 60°C CC-36: 0 to 60°C

Uniaxial 350Ω gage
Resistance: 350 Ω
Gage factor: Approx. 2.0
(when bonded to metal)

KFML-5-350-C1	5	4	33	7

A min. qty 10 PC.

Gages for Ultra-small Strain Measurement KSP & KSN

●KSP Series Semiconductor Strain Gages

The KSP series gages are stable-performance semiconductor strain gages usable for general stress measurement and transducers. The F2 type has a half-bridge formed with 2-element, positive and negative, for self-temperature compensation and is suitable for strain measurement of steel products.

Applicable Adhesives and Operating Temperature Range after Curing
CC-33A: -50 to 120°C CC-36: -30 to 100°C

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Uniaxial Resistance: 120 Ω Gage factor: Approx. 120	KSP-2-120-E3	2	0.25	5	3	
Uniaxial Resistance: 120 Ω Gage factor: Approx. 120	KSP-2-120-E4	2	0.26	7.7	4	
Uniaxial 350Ω gage Resistance: 350 Ω Gage factor: Approx. 120	KSP-6-350-E4	6	0.27	13	5	
Uniaxial 350Ω gage Resistance: 350 Ω Gage factor: Approx. 150	KSP-1-350-E4	1	0.25	6.6	4	
Uniaxial 1000Ω gage Resistance: 1000 Ω Gage factor: Approx. 160	KSP-2-1K-E4	2	0.25	7.7	4	
Uniaxial, 2-element Resistance: 120 Ω Gage factor: Approx. 225	KSP-3-120-F2-11	3	n0.83 p0.47	10	4	A min. qty 2 PC.

●KSN Series Self-temperature-compensation Semiconductor Strain Gages

The KSN series gages use an n-type silicon for the resistive element to control the resistance temperature coefficient of the material according to the linear expansion coefficient of the measuring object. Thus, thermally-induced resistance change is minimized.

Applicable Adhesives and Operating Temperature Range after Curing
CC-33A: -50 to 120°C CC-36: -30 to 100°C

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
Uniaxial Resistance: 120 Ω Gage factor: Approx. –100	KSN-2-120-E3-11 KSN-2-120-E3-16	2	0.3	5	3	
Uniaxial Resistance: 120 Ω Gage factor: Approx. –100	KSN-2-120-E4-11 KSN-2-120-E4-16	2	0.3	7.7	4	A min. qty 4 PC.
Uniaxial Resistance: 120 Ω Gage factor: Approx. –110	KSN-2-120-E5-11 KSN-2-120-E5-16	2	0.3	–		Oxygen-free tin-plated copper wires 40 mm long each
Biaxial, 0°/90° Resistance: 120 Ω Gage factor: Approx. –100	KSN-2-120-F3-11 KSN-2-120-F3-16	2	0.3	ϕ11		A min. qty 2 PC.
Uniaxial 350Ω gages Resistance: 350 Ω Gage factor: Approx. –100	KSN-6-350-E4-11 KSN-6-350-E4-16	6	0.31	13	5	A min. qty 4 PC.

Gages for Ultra-small Strain Measurement KSPH & KSPL

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
●KSPH Series High-output Semiconductor Strain Gages						
Uniaxial 2000Ω gage Resistance: 2000 Ω Gage factor: Approx. 170	KSPH-4-2K-E4	4	0.73	11	4	
Uniaxial 10000Ω gage Resistance: 10000 Ω Gage factor: Approx. 170	KSPH-9-10K-E4	9	0.58	16	5	

The KSPH series gages have the resistance especially increased, thereby making high bridge voltage applicable to obtain high output voltage.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -50 to 120°C CC-36: -30 to 100°C

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
●KSPL Ultra Linear Semiconductor Gage						
Uniaxial 60Ω gage Resistance: 60 Ω Gage factor: Approx. 90	KSPL-7-60-E4	7	0.28	14	5	

The KSPL gage features a superior linearity of resistance change against strain in a comparatively wide range, thereby making it suitable as a sensing element of transducers.

Applicable Adhesives and Operating Temperature Range after Curing

CC-33A: -50 to 120°C CC-36: -30 to 100°C

A min. qty 4 PC.

Encapsulated Strain Gages

●Encapsulated Strain Gages

Hermetically sealed weldable strain gages are consist of sensing part and cable.

When ordering, specify the model together with code of the desired MI cable length, suffixed with a space in between. The suffix may include codes of the optional bridge adapter and compression fitting (See table below.) In all case, the length of soft cable is 50 cm (For extension, contact us).

MI Cable length codes and optional accessories

E.g. 1) KHCS-10-120-G12-11 C5M
for KHCS with 5 m long MI cable.
2) KHCS-10-120-G12-11 C2MV
for KHCS with 2 m long MI cable and a bridge adapter pre-attached.

MI cable length	Code of MI cable length	Bridge adapter pre-attached A	Compression fitting B	A & B
1m	C1M	C1MV	C1MF	C1MFV
2m (Std.)	C2M	C2MV	C2MF	C2MFV
3m	C3M	C3MV	C3MF	C3MFV
4m	C4M	C4MV	C4MF	C4MFV
5m	C5M	C5MV	C5MF	C5MFV
6m	C6M	C6MV	C6MF	C6MFV
8m	C8M	C8MV	C8MF	C8MFV
10m	C10M	C10MV	C10MF	C10MFV

Options

Bridge box DB-120A/L

Connect KHCV or KCW to form a Wheatstone bridge

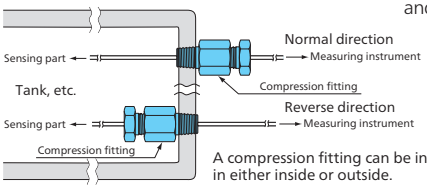
DB-120A

●DB-120A
Cable : Chloroprene-coated 5 m long, terminated a NDIS connector.
Dimensions: 60 x 42 x 25 mm
Weight: Approx. 600 g (including cable)

●DB-120L (Compact plug-in type)
Cable: Removable type 5 m long, terminated a NDIS connector.
Dimensions: 60 × 20 × 20 mm
Weight: Approx. 60 g (Excluding cable)

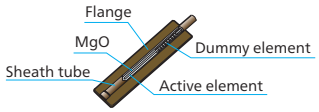
Compression fitting

For fixing MI cables.
When ordering, specify it.



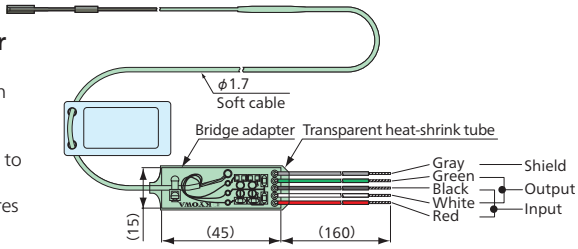
A compression fitting can be installed in either inside or outside.

Sensing part (2-element)



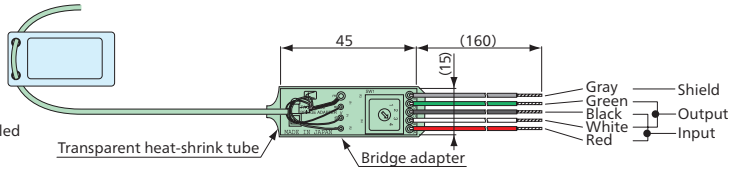
Half bridge adapter

Equipped with optimum temperature compensation resistors for the operating temperature range. When delivered, it is per-attached to the soft cable to prevent erroneous wring and ensures labor saving.

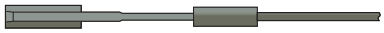


Quarter bridge adapter

A dedicated adapter to the KHCV, enables easy selection of the cutoff frequency (1.6, 7.23, 16 Hz, and flat) as well as easy connection to the measuring instrument to prevent erroneous wring.



Encapsulated Gages KHCX, KHCV, KHCR, KHCS, KHCM, and KHC

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Gage length		Flange Length	Flange Width	Remarks
950°C (Static/dynamic) ●KHCX Encapsulated Gage Uniaxial, 2-element, temperature-compensation type	Resistance: 120Ω. Gage factor (950°C): Approx. 1.5. Material: Inconel 600 (NCF 600) **Installation Method and Operating Temperature Range**: Spot welding: -196 to 950°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2m long and soft cable 0.5m long pre-attached					
	KHCX-10-120-G13-11 C2MV KHCX-10-120-G13-13 C2MV	10	–	20	3	Min. radius of curvature R75
800°C (Dynamic) ●KHCV Encapsulated Gage Uniaxial, 1-element active	Resistance: 120Ω. Gage factor (800°C): Approx. 1.2. Material: Inconel 600 (NCF 600) **Installation Method and Operating Temperature Range**: Spot welding: 25 to 800°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2m long and soft cable 0.5m long pre-attached					
	KHCV-5-120-G17 C2MV	5	–	10	3	Min. radius of curvature R15
750°C (Static/dynamic) ●KHCR Encapsulated Gage Uniaxial, 2-element, temperature-compensation type	Resistance: 120Ω. Gage factor (750°C): Approx. 1.2. Material: Inconel 600 (NCF 600) **Installation Method and Operating Temperature Range**: Spot welding: 25 to 750°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2m long and soft cable 0.5m long pre-attached					
	KHCR-5-120-G16-11 C2MV KHCR-5-120-G16-13 C2MV KHCR-5-120-G16-16 C2MV	5	–	10	3	Min. radius of curvature R15
Dynamic Strain Measurement at 750°C ●KHCS Series Encapsulated Gages for Static Uniaxial, 2-element, temperature-compensation type	Resistance: 120Ω. Gage factor (750°C): Approx. 1.8. Material: Inconel 600 (NCF 600) **Installation Method and Operating Temperature Range**: Spot welding: –196 to 750°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2 m long and soft cable 0.5 m long pre-attached.					
	KHCS-10-120-G12-11 C2MV KHCS-10-120-G12-13 C2MV KHCS-10-120-G12-16 C2MV	10	–	20	3	Min. radius of curvature R20
Dynamic Strain Measurement at 650°C ●KHCM Series Encapsulated Gages for Static Uniaxial, 2-element, temperature-compensation type	Resistance: 120Ω. Gage factor (650°C): Approx. 1.8 for gage length 10 mm, approx. 1.4 for gage length 5 mm. Material: Inconel 600 (NCF 600) **Installation Method and Operating Temperature Range**: Spot welding: –196 to 650°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2 m long and soft cable 0.5 m long pre-attached.					
	KHCM-5-120-G15-(11, 13, 16) C2MV	5	–	10	3	Min. radius of curvature R15
	KHCM-10-120-G15-(11, 13, 16) C2MV	10	–	20	3	Min. radius of curvature R20
550°C (Dynamic) 500°C(Static) ●KHC Encapsulated Gage Uniaxial, 2-element, temperature-compensation type Resistance: 120 Ω Gage factor (500°C) : Approx. 1.75 for gage length 20 mm Approx. 1.5 for gage length 10 mm Material: Inconel 600 (NCF 600)	**Installation Method and Operating Temperature Range**: Spot welding: –196 to 550°C The following models with the standard lead wire cable code C2M are delivered with MI cable 2 m long and soft cable 0.5 m long pre-attached.					
	KHC-20-120-G8-(11, 13, 16) C2MV	20	–	30	4	Min. radius of curvature R25
	KHC-10-120-G8-(11, 13, 16) C2MV	10	–	16.5	4	Min. radius of curvature R20
Uniaxial, 2-element, temperature-compensation type Resistance: 120 Ω Gage factor (500°C), approx. : 1.75 for gage length 20 mm, 1.5 for gage length 10 mm Material: SUS 321	The following models with the standard lead wire cable code C2M are delivered with MI cable 2 m long and soft cable 0.5 m long pre-attached.					
	KHC-20-120-G9-(11, 13, 16) C2MV	20	–	30	5	Min. radius of curvature R25
	KHC-10-120-G9-(11, 13, 16) C2MV	10		16.5	5	Min. radius of curvature R20

A min. qty 1 PC.

High-temperature Gages KFU & KH

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFU Series High-temperature Foil Strain Gages (350˚C)

The base is made of highly heat-resistant polyimide and the gage element is made of NiCr alloy foil, thereby letting the KFU series gage exhibit superior characteristics over a wide temperature range.

Note) Please use KFU for a short period test.
E.g. 72 hours or less at 350 °C, 360 hours or less at 300 °C,
adhesive PI-32 (It changes depending on the condition.)

Applicable Adhesives and Operating Temperature Range after Curing PI-32 –196 to 350°C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFU-5-120-C1-11 H5M3
for the gage with a high/low-temperature 3-wire cable 5 m long pre-attached
KFU-5-120-C1-11 B5M3
for the gage with a glass-coated Ni-clad 3-wire copper cable 5 m long pre-attached

If no lead wire cable code is suffixed, the gage is delivered with an Advanced ribbon cable only (25 mm long).

■Types, lengths and codes of lead wire cables pre-attached to KFU gages

Types / Length	High/low-temp. 3-wire cable	Glass-coated cable of 3 Ni-clad copper wires
	C1, D16, and D17	
15 cm	H15C3	B15C3
30 cm	H30C3	B30C3
1 m	H1M3	B1M3
3 m	H3M3	B3M3
5 m	H5M3	B5M3
Oprg. temp. range	-196 to 350°C	Normal temp. to 280°C
Remarks	L-17	Contact us

＊For other lead wire cable lengths, contact us.

Uniaxial

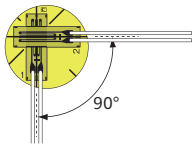
Resistance: 120 Ω
Gage factor: Approx. 1.85 (At 350 °C)

These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages

KFU-5-120-C1-11	5	2.5	10	3.7	
KFU-5-120-C1-16					
KFU-5-120-C1-23					
KFU-2-120-C1-11	2	2.5	6	3.7	
KFU-2-120-C1-16					
KFU-2-120-C1-23					

Biaxial, 0°/90° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 1.85 (At 350 °C)

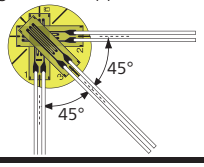


These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages

KFU-5-120-D16-11	5	1.4	ϕ11		
KFU-5-120-D16-16					
KFU-5-120-D16-23					
KFU-2-120-D16-11	2	1.2	ϕ8		
KFU-2-120-D16-16					
KFU-2-120-D16-23					

Triaxial, 0°/90°/45° stacked rosette

Resistance: 120 Ω
Gage factor: Approx. 1.85 (At 350 °C)



These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages

KFU-5-120-D17-11	5	1.4	ϕ11		
KFU-5-120-D17-16					
KFU-5-120-D17-23					
KFU-2-120-D17-11	2	1.2	ϕ8		
KFU-2-120-D17-16					
KFU-2-120-D17-23					

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KH Series High-temperature Foil Strain Gages (350˚C)

The metal base enables easy mounting with a compact spot welder.
Installation Method and Operating Temperature Range Spot welding –50 to 350°C
Time indicators (changes depending on usage conditions)
24 hours or less at 350 °C, 72 hours or less at 300 °C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KH-5-350-G4-11 D5M3
for the gage with a glass-coated cable of 3-twisted Ni-plated copper wire 5 m long pre-attached

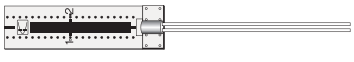
■Types, lengths and codes of lead wire cables pre-attached to KH gages

Types / Length	Glass-coated cable of 3 Ni-plated copper wires
	G4
15 cm	D15C3
30 cm	D30C3
1 m	D1M3
3 m	D3M3
5 m	D5M3
Oprg. temp. range	-50 to 350°C

＊For other lead wire cable lengths, contact us.

Uniaxial

Resistance: 350 Ω
Gage factor: Approx. 2.0 (At 350 °C)



If no cable code is suffixed, the gage is delivered with an Advanced ribbon cable only (25 mm long)

KH-5-350-G4-11	5	1	30	8	A min. qty 5 PC.
KH-5-350-G4-16					A min. qty 10 PC.

High-temperature Gages KFH

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFH Series High-temperature Foil Strain Gages (250°C)

The base is made of highly heat-resistant polyimide and the gage element is made of NiCr alloy foil, thereby ensuring less thermal output and excellent temperature characteristics.

Appropriate adhesives and operating temperature range, time/temp for curing.
(It changes depending on the condition.)

PC-600: -196 to 250°C
24 hours or less at 250 °C

EP-34B: -55 to 200°C
120 hours or less at 200 °C

PI-32: -196 to 250°C
24 hours or less at 250 °C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFH-5-120-C1-11 for the gage with a high/low-temperature 3-wire cable 5m long pre-attached.
→ KFH-5-120-C1-11 H5M3
If no lead wire cable code is suffixed, the gage is delivered with an advanced ribbon cable only(25mm long)

■Types, lengths and codes of lead wire cables pre-attached to KFH gages

Types / Length	High/low-temp. 3-wire cable	Glass-coated cable Ni-clad 3-wire copper cable	Fluoroplastic-coated high/low-temp. 3-wire cable
	C1, D25		
15 cm	H15C3	B15C3	F15C3
30 cm	H30C3	B30C3	F30C3
1 m	H1M3	B1M3	F1M3
3 m	H3M3	B3M3	F3M3
5 m	H5M3	B5M3	F5M3
Oprg. temp. range	-196 to 250°C	Normal temp. to 250°C	-196 to 250°C
Remarks	L-17	Contact us	L-3

＊For other lead wire cable lengths, contact us.

Uniaxial

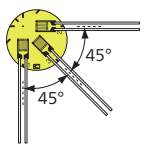
Resistance: 120 Ω
Gage factor: Approx. 1.9 (At 250 °C)

These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages.

KFH-5-120-C1-11	5	2.5	10	3.7	10
KFH-5-120-C1-16					
KFH-5-120-C1-23					
KFH-2-120-C1-11	2	2.5	6	3.7	10
KFH-2-120-C1-16					
KFH-2-120-C1-23					
KFH-1-120-C1-11	1	1.5	4	2.7	10
KFH-1-120-C1-16					
KFH-1-120-C1-23					
KFH-05-120-C1-11	0.5	1.4	3.3	2.7	10
KFH-05-120-C1-16					
KFH-05-120-C1-23					
KFH-02-120-C1-11	0.2	1	2.5	2.2	10
KFH-02-120-C1-16					
KFH-02-120-C1-23					

Triaxial, 0°/90°/45°

Resistance: 120 Ω
Gage factor: Approx. 1.9 (At 250 °C)



These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages.

KFH-1-120-D25-11	1	1.5	ϕ8	A min. qty 5 PC.
KFH-1-120-D25-16				
KFH-1-120-D25-23				
KFH-05-120-D25-11	0.5	1.4	ϕ7.5	A min. qty 5 PC.
KFH-05-120-D25-16				
KFH-05-120-D25-23				

A min. qty 10 PC.

Low-temperature Gages KFL

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFL Series Low-temperature Foil Strain Gages

The gage element is made of NiCr alloy, which exhibits excellent characteristics under low-temperature environments and is sandwiched between polyimide films. Thus, the KFL series gages are suitable for strain measurement of tanks and vessels containing low-temperature liquids such as LNG and LPG.

Applicable Adhesives and Operating Temperature Range after Curing
EP-270: –269 to 30 °C, PC-600: –269 to 150 °C, CC-33A: –196 to 120 °C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFL-5-120-C1-11 F5M3
for the gage with a fluororesin-coated high/low-temperature 3-wire cable 5 m long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long each).

■Types, lengths and codes of lead wire cables pre-attached to KFL series gages

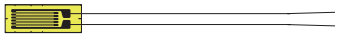
Types / Length	Polyester-coated 2-wire copper cable	Polyester-coated 3-wire copper cable	Middle-temperature. 2-wire cable	Middle-temperature. 3-wire cable	Fluoroplastic-coated high/low-temp. 3-wire cable
	C1, D25				
15 cm	N15C2	N15C3	R15C2	R15C3	F15C3
30 cm	N30C2	N30C3	R30C2	R30C3	F30C3
1 m	N1M2	N1M3	R1M2	R1M3	F1M3
3 m			R3M2	R3M3	F3M3
5 m			R5M2	R5M3	F5M3
Oprg. temp. range	–196 to 150°C		-100 to 150°C		-269 to 150°C
Remarks	Twisted for 50 cm or longer		L-11	L-12	L-3

＊For other lead wire cable lengths, contact us.

Uniaxial 350- gages
Resistance: 350 Ω
Gage factor: Approx. 2.1

KFL-30-350-C1-5	30	2.7	36	5.2	Mainly for lumber
KFL-30-350-C1-11					Mainly for concrete

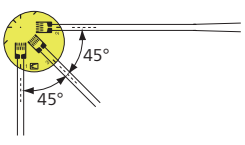
Uniaxial
Resistance: 120 Ω
Gage factor: Approx. 2.1



These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages.

KFL-5-120-C1-11	5	2.5	10	3.7
KFL-5-120-C1-16				
KFL-5-120-C1-23				
KFL-2-120-C1-11	2	2.5	6	3.7
KFL-2-120-C1-16				
KFL-2-120-C1-23				
KFL-1-120-C1-11	1	1.5	4	2.7
KFL-1-120-C1-16				
KFL-1-120-C1-23				
KFL-05-120-C1-11	0.5	1.4	3.3	2.7
KFL-05-120-C1-16				
KFL-05-120-C1-23				
KFL-02-120-C1-11	0.2	1	2.5	2.2
KFL-02-120-C1-16				
KFL-02-120-C1-23				

Triaxial, 0°/90°/45°
Resistance: 120 Ω
Gage factor: Approx. 2.1



These gages are also available with 350Ω gage resistance, with a slight difference in size from 120Ω gages.

KFL-1-120-D25-11	1	1.5	ϕ8	A min. qty 5 PC.
KFL-1-120-D25-16				
KFL-1-120-D25-23				
KFL-05-120-D25-11	0.5	1.4	ϕ7.5	A min. qty 5 PC.
KFL-05-120-D25-16				
KFL-05-120-D25-23				

A min. qty 10 PC.

High-elongation Gages KFEM & KFEL

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

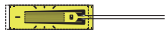
●KFEM Series High-elongation Foil Strain Gages

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFEM-5-120-C1 L10M2R
for the gage with a vinyl-coated flat 2-wire cable 10 m long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long each).

*Strain limit of 20% to 30% is ensured for simple tension applied to the gage bonded on stainless steel (SUS 304) or aluminum alloy (A1050) at normal temperature.
*Strain limit will be down under the following conditions.
- In case of bonding to hard-to bond materials such as aluminum alloy (A7075) and plastics(polypropylene)
- In case of the targets have discontinuous distortion, or any crack on its surface
- In case of measurement at High/low temperature.

Uniaxial
Resistance: 120 Ω
Gage factor: Approx. 2.0



KFEM series ultrahigh-elongation foil gages can measure strain in elastic to plastic region on structures and are suitable for large strain measurement or rupture tests of metals (Steel, stainless steel, aluminum) and plastics (polyethylene, polypropylene).

- Measurement of 20% to 30% material deformation possible
- Laminate protruded from the tip of gage base ensures improved adhesive property, making the gages hard to peel off.
- Foil material has an improved elongation property and is hard to disconnect.

Applicable Adhesive and Operating Temperature Range after Curing CC-36 –20 to 80°C

■Types, lengths and codes of lead wire cables pre-attached to KFEM gages

Types / Length	Polyester-coated 2-wire copper cable	Vinyl-coated flat 2-wire cable	Vinyl-coated flat 3-wire cable
	C1, D34, and D35	C1	
15 cm	N15C2	L15C2R	L15C3R
30 cm	N30C2	L30C2R	L30C3R
1 m	N1M2	L1M2R	L1M3R
3 m		L3M2R	L3M3R
5 m		L5M2R	L5M3R
Oprg. temp. range	-10 to 80°C	-10 to 80°C	
Remarks	Twisted for 50 cm or longer	L-6, L-9 for 6 m or longer	L-7, L-10 for 6 m or longer

＊For other lead wire cable lengths, contact us.

KFEM-10-120-C1	10.0	2.5	17.5	4.5
KFEM-5-120-C1	5.0	1.5	11.5	3.0
KFEM-2-120-C1	2.0	1.5	8.5	3.0
KFEM-1-120-C1	1.0	1.3	7.0	2.5

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks

●KFEL Series High-elongation Foil Strain Gages

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFEL-5-120-C1 L10M2R
for the gage with a fluororesin-coated flat 2-wire cable 10 m long pre-attached
KFEL-5-120-D35 L5M3S
for the gage with a vinyl-coated flat 3-wire cable 5 m long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with gage leads only (Silver-clad copper wires 25 mm long each).

Uniaxial
Resistance: 120 Ω
Gage factor: Approx. 2.1

Developed to measure strain in elastic to plastic region on structures, the KFEL series foil gages can measure strain as large as 10% to 15% with simple tension strain.

Applicable Adhesive and Operating Temperature Range after Curing CC-36 –10 to 80°C

■Types, lengths and codes of lead wire cables pre-attached to KFEL gages

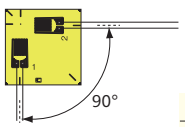
Types / Length	Polyester-coated 2-wire copper cable	Vinyl-coated flat 2-wire cable		Vinyl-coated flat 3-wire cable	
	C1, D34, and D35	C1	D34, D35	C1	D34, D35
15 cm	N15C2	L15C2R	L15C2S	L15C3R	L15C3S
30 cm	N30C2	L30C2R	L30C2S	L30C3R	L30C3S
1 m	N1M2	L1M2R	L1M2S	L1M3R	L1M3S
3 m		L3M2R	L3M2S	L3M3R	L3M3S
5 m		L5M2R	L5M2S	L5M3R	L5M3S
Oprg. temp. range	-10 to 80°C				
Remarks	Twisted for 50 cm or longer	L-6, L-9 for 6 m or longer		L-7, L-10 for 6 m or longer	

＊For other lead wire cable lengths, contact us.

Note: Besides the usual surface treatment with sandpaper, the gage bonding surface should be treated with the surface treatment agent S-9B if the gage is bonded to hard-to-bond plastics such as polyethylene and polypropylene. Then, bond the gage using the adhesive CC-36. For S-9B and bonding conditions for other special materials, contact us.

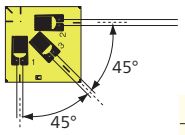
KFEL-5-120-C1	5	2.1	11	3.5
KFEL-2-120-C1	2	2.1	8	4

Biaxial, 0°/90°
Resistance: 120 Ω
Gage factor: Approx. 2.1



KFEL-5-120-D34	5	2.1	13	13
KFEL-2-120-D34	2	2.1	10	10

Triaxial, 0°/90°/45°
Resistance: 120 Ω
Gage factor: Approx. 2.1



KFEL-5-120-D35	5	2.1	13	13
KFEL-2-120-D35	2	2.1	10	10

A min. qty 10 PC.

Non-magnetoresistive Strain Gages KFN & KFS

●KFN Series Non-inductive Foil Strain Gages

The gage element is made of a special alloy which provides less magnetoresistant effect; also, the shape is designed to eliminate induction. Thus, the KFN series foil strain gages can accurately measure strain under AC magnetic environments.

Applicable Adhesives and Operating Temperature Range after Curing
PC-600: -196 to 150°C
CC-33A: -196 to 120°C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

E.g.
KFN-5-350-C9-11 J5M3
for the gage with a low-noise vinyl-coated 3-wire cable 5 m long pre-attached

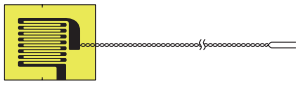
If no lead wire cable code is suffixed, the gage is delivered with 2 polyester-coated copper wires 10 cm long each.

■Types, lengths and codes of lead wire cables pre-attached to KFN gages

Types / Length	Vinyl-coated low-noise 3-wire cable
	C9, D20
15 cm	J15C3
30 cm	J30C3
1 m	J1M3
3 m	J3M3
5 m	J5M3
Oprg. temp. range	-10 to 80°C
Remarks	L-13

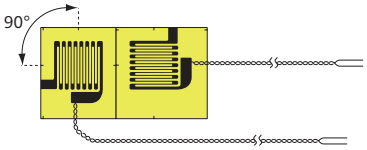
＊For other lead wire cable lengths, contact us.

Uniaxial 350Ω gages
Resistance: 350 Ω
Gage factor: Approx. 2.0



Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
KFN-5-350-C9-11	5	6.6	12	10	
KFN-5-350-C9-16					
KFN-5-350-C9-23					
KFN-2-350-C9-11	2	3.5	6	5	
KFN-2-350-C9-16					
KFN-2-350-C9-23					

Biaxial 350Ω gages. 0°/90°
Resistance: 350 Ω
Gage factor: Approx. 2.0



Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
KFN-5-350-D20-11	5	6.6	22	12	A min. qty 5 PC.
KFN-5-350-D20-16					
KFN-5-350-D20-23					
KFN-2-350-D20-11	2	3.5	11	6	A min. qty 5 PC.
KFN-2-350-D20-16					
KFN-2-350-D20-23					

●KFS Series Shielded Foil Strain Gages

The KFS series foil strain gages are shielded by the copper foil covering the whole body. Thus, if a large current flows to or around the gage bonding site, noise is prevented from entering the measuring circuit.

Applicable Adhesives and Operating Temperature Range after Curing
PC-600: -196 to 150°C
CC-33A: -196 to 120°C
EP-340: -55 to 150°C

When ordering, suffix the lead wire cable code (See table at the right) to the model number with a space in between.

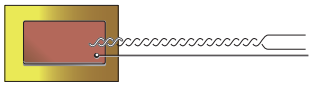
E.g.
KFS-5-120-J1 J5M3
for the gage with a low-noise vinyl-coated 3-wire cable 5 m long pre-attached
If no lead wire cable code is suffixed, the gage is delivered with 2 polyester-coated copper wires 25 mm long each.

■Types, lengths and codes of lead wire cables pre-attached to KFS gages

Types / Length	Vinyl-coated low-noise 3-wire cable
	J1
15 cm	J15C3
30 cm	J30C3
1 m	J1M3
3 m	J3M3
5 m	J5M3
Oprg. temp. range	-10 to 80°C
Remarks	L-13

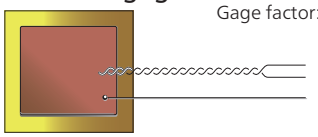
＊For other lead wire cable lengths, contact us.

Uniaxial
Resistance: 120 Ω
Gage factor: Approx. 2.1



Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
KFS-5-120-J1-11	5	1.4	15	10	Polyester-coated copper lead wires Shield wire 25 mm long
KFS-5-120-J1-16					
KFS-5-120-J1-23					

Triaxial 350Ω gage
Resistance: 350 Ω
Gage factor: Approx. 2.0

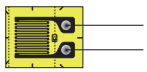


Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
KFS-5-350-J1-11	5	6.6	17	16	Polyester-coated copper lead wires Shield wire 25 mm long
KFS-5-350-J1-16					
KFS-5-350-J1-23					

A min. qty 10 PC.

Gages for High-pressure Hydrogen Gas Environment KFV

Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
●KFV Foil Strain Gage for Hydrogen Gas Environment NEW						
Uniaxial 350Ω gages Resistance: 350 Ω Gage factor: Approx. 2.5	KFV-2-350-C1	2	3.2	6	5	Polyester-coated copper lead wires A min. qty 2 PC.



KFV is a foil strain gage that enables stable strain measurement under high-pressure hydrogen gas environment. The metal foil of conventional foil strain gages has the electric resistance changed by receiving hydrogen effect, thereby disabling stable strain measurement. KFV strain gage receives less electric resistance change due to hydrogen, thereby enabling stable strain measurement.

Applicable Adhesives and Operating Temperature Range after Curing
PC-600: -30 to 80°C

To Ensure Safe Usage
Before using KFV strain gage, request the leaflet and read thoroughly the Safety Precautions described there.

Bending Strain Measuring Gages KFF

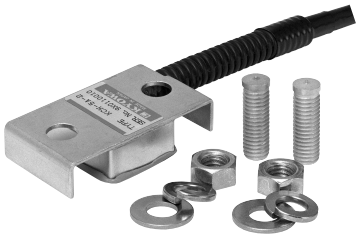
Patterns, Gage Resistance, Gage Factor	Models	Dimensions (mm) Grid Length	Grid Width	Base Length	Base Width	Remarks
●KFF Series Foil Strain Gages for Bending Strain Measurement						
Uniaxial 350Ω gages Resistance: 350 Ω Gage factor: Approx. 2.1	KFF-30-350-C11-11 KFF-30-350-C11-16 KFF-30-350-C11-23	30×7×1				A min. qty 5 PC.
	KFF-30-350-C12-11 KFF-30-350-C12-16 KFF-30-350-C12-23	30×7×2				A min. qty 5 PC.

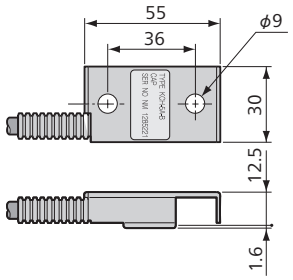
The KFF series foil strain gages have one each sensing element on both the upper and lower sides of the thick plastic base. Thus, if a gage cannot be bonded directly to the inside of the measuring object as in the case of measuring stress due to internal pressure in high-pressure vessels or stress measurement in box structures such as bridge girders, the KFF series gages can be bonded to the surface to obtain strain at the rear.

Applicable Adhesives and Operating Temperature Range after Curing
CC-33A: -50 to 80°C EP-180: -50 to 80°C

Gages with a Protector KCH

●KCH Series Foil Strain Gages with a protector





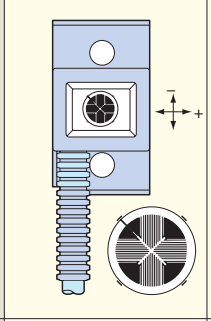
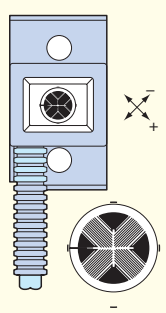
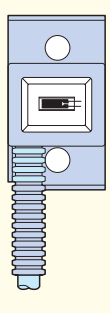
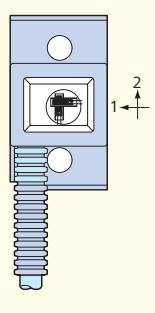
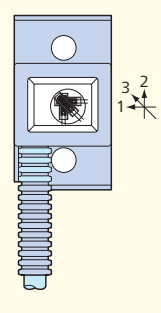
The unique design simplifies gage bonding, wiring and moisture-proofing work in the field. In addition, the metal case protects the strain gage and significantly improves reliability compared with conventional gages. Using stud bolts and adhesive, the gages can be mounted to the bottom and side plate of tank for strain measurement, to a hopper or tank for weight measurement, to the shaft of a truck for tare weight measurement or in any similar applications where the gages need to be protected against moisture, water or small stones. (Patented)

Applicable Adhesives and Operating Temperature Range after Curing

EP-340: –40 to 100°C　CC-33A: –40 to 100°C

●Relay Cables (for KCH-5A-BJ/SJ) (Option)

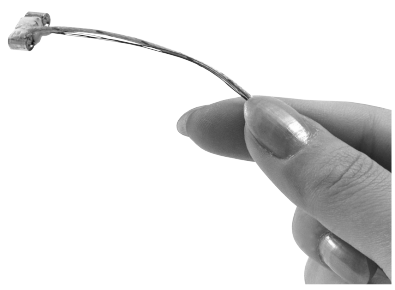
Models	TN-29	TN-30	TN-31	TN-32	TN-33
Cable length	2 m	3 m	7 m	10 m	12 m
Cable cover length	1.5 m	2.5 m	6.5 m	9.5 m	11.5 m
Remarks	With waterproof connector jack (R04-J6-F6.8); the other end is bared.				

Models	KCH-5A-B,KCH-5A-BJ	KCH-5A-S,KCH-5A-SJ	KCH-5A-1	KCH-5A-2	KCH-5A-3
Types	Bridge (for bending)	Bridge(for shearing)	Uniaxial	Biaxial, 0/90° stacked rosette	Triaxial, 0/90/45° stacked rosette
Gage Length	2 mm	2 mm	5 mm	5 mm	5 mm
Resistance	350 Ω	350 Ω	350 Ω	350 Ω	350 Ω
Gage Pattern					
System	4-gage system	4-gage system	3-wire system	3-wire system	2-wire system
Cable	KCH-5A-B and S come with special flexible vinyl-shielded 4-conductor (0.3 mm²) cable, 6.8-mm diameter by 10-m long, and bared at the tip; KCH-5A-BJ and SJ, with flexible vinyl-shielded 4-conductor (0.3 mm²) cable, 2 m long (cable cover 1.75 m long) by 6.3 mm diameter (that of cable cover 10.2 mm) and terminated with waterproof connector plug (R04-P6-M6.8). Relay cables TN-29 to 33 are separately sold.		Comes with special flexible vinyl-shielded 4-conductor (0.3 mm²) cable, 6.8 mm diameter by 10 m long, and bared at the tip.	Come with special flexible vinyl-shielded 6-conductor (0.3 mm²) cable, 6.8 mm diameter by 10 m long and bared at the tip.	

Embedded Gage KMP

●KMP Embedded Gage

Developed by Mitsubishi Electric Corp. and commercialized by Kyowa Electronic Instruments Co., Ltd.

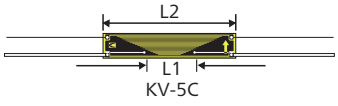


Embedded in resin, the KMP gage measures cure-shrinkage and internal strain. The compact design enables embedment in shaped resins and is suitable for internal stress measurement of products made by combining epoxy resin and metal.

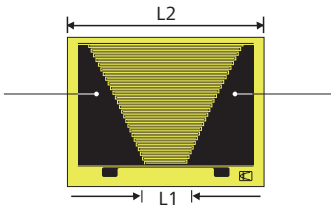
Model	KMP-8-H3-L100
Gage resistance	120Ω
Gage factor	Approx. 2.0
Length of sensing element	1 mm
Apparent Young modulus	Approx. 70 GPa (Approx. 7000 kgf/mm²)
Operating temperature range	20 to 150°C
Built-in thermocouple	K (ϕ 0.1 mm)

Crack Gages KV

●KV Series Crack Gages



KV-5C



KV-25B

Direction of crack

Bonded to a cracked or crack-expected part of structures and materials, the KV series gages measure the propagation length and velocity of the crack. Different from usual strain gages, the grid of the KV series gages is cut along with crack development, resulting in resistance change. (Utility model)

Features

- ●Progress and propagation velocity of a crack are electrically obtained.
- ●High response speed.
- ●Applicable to both flat and curved surfaces.
- ●Resistance change versus crack length is virtually linear.
- ●Dedicated adapter enables use of a conventional strain amplifier.
- ●Extremely simple and convenient compared with the conventional optical method.
- ●2 trigger wires each before and behind the grid (KV-5C) can be used for automation of measurement.

Specifications

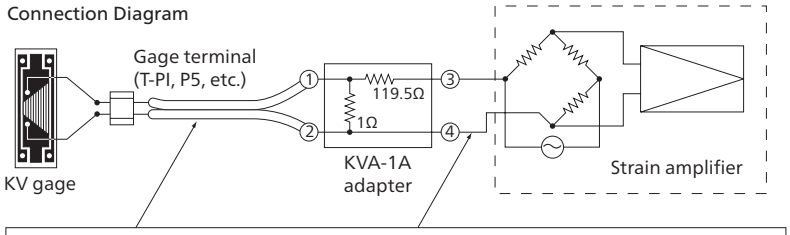
Models	Resistance (Ω)	Base size (mm)	Grid size (mm)				Qty of grids
			L1	L2	W	Pitch	
KV-5C	Approx.1	30×5	5.4	25.2	4.6	0.1	46
KV-25B	Approx.1	42×32	9	33.6	25.2	1	26

Applicable adhesives: CC-33A, CC-36, PC-600
Adapter: KVA-1A (option)
Dimensions: 35 x 20 x 15 mm

A min. qty 5 PC.

●**Adapter KVA-1A (option)**

Connection Diagram



Note : A lead-wire for connection to the adapter uses the one with a low resistance(0.1Ω or less)

Adhesives and Bonding Tools

To obtain good measurement results, the strain gage must be bonded completely to the measuring object. Thus, it is important to select a suitable adhesive for the materials of measuring object and gage base and for measuring requirements.

	Models	Types	Operating Temperature Range (°C)	Major Applicable Materials	Curing Requirements
	**CC-33A**	Instantaneous adhesive cured at normal temperature	-196 to 120	•Metals (Steel, stainless steel, copper, aluminum alloys A1050, A2024, etc.) •Plastics (acrylate, vinyl chloride, nylon, etc.) •Composite materials (CFRP, GFRP, printed board, etc.) •Rubber	Apply finger pressure (100 to 300 kPa) for 15 to 60 seconds. Then, leave the gage as it is for 1 hour. The finger pressure application time differs depending on temperature and humidity conditions. The lower the temperature and humidity, the longer the finger pressure application time required.
	**CC-35**	Instantaneous adhesive cured at normal temperature	-30 to 120	•Concrete •Mortar •Lumber	Apply finger pressure (100 to 300 kPa) for 30 to 60 seconds. Then, leave the gage as it is for 1 hour or more. The finger pressure application time differs depending on temperature and humidity conditions. The lower the temperature and humidity, the longer the finger pressure application time required.
	**CC-36**	Instantaneous adhesive cured at normal temperature	-30 to 100	•Metals (Steel, stainless steel, copper, aluminum alloys A1050, A2024, A7075, magnesium alloy, etc.) •Plastics (acrylate, vinyl chloride, nylon, polypropylene, etc.) •Composite materials (CFRP, GFRP, PCB, etc.) •Concrete •Mortar •Lumber •Rubber	Apply finger pressure (100 to 300 kPa) for 30 to 60 seconds. Then, leave the gage as it is for 1 hour or more. The finger pressure application time differs depending on temperature and humidity conditions. The lower the temperature and humidity, the longer the finger pressure application time required.
	**EP-270**	Cured at room temperature	-269 to 30	•Metals (Stainless steel, aluminum alloy, etc.)	Apply pressure (50±20 kPa) for 24 hours at approx. 25°C
	**EP-340**	Cured at normal temperature or by heating	-55 to 150	•Metals (Stainless steel, aluminum alloy, etc.)	Apply pressure (100±50 kPa) for 24 hours at approx. 25°C or for 2 hours at 80°C. Pressing is possible with tape.
	**EP-34B**	Cured at normal temperature or by heating	-55 to 200	•Metals (Steel, stainless steel, copper, aluminum alloy, etc.) •Plastics (acrylate, PVC, etc.) •Composite materials (CFRP, GFRP, printed board, etc.)	Apply pressure (30 to 50 kPa) for 24 hours at approx. 25°C or for 2 hours at 80°C. Pressing is possible with tape.
	**EP-180**	Cured at normal temperature or by heating	-50 to 100	•Metals (Steel, stainless steel, copper, aluminum alloy, etc.) •Plastics (acrylate, PVC, etc.)	Apply pressure (50 to 100 kPa) for 48 hours at approx. 25°C 12 hours at 40°C 3 hours at 80°C If used in bolt gages, then refer to the bolt gage instruction manual
	**PC-600**	Cured by heating	-269 to 250	•Metals (Steel, stainless steel, copper, aluminum alloy, etc.)	Apply Pressure (150 to 300 kPa) for 1 hour at 80°C, 2 hours at 13 0°C and then, 2 hours at 150°C
	**PI-32**	Cured by heating	-296 to 350	•Metals (Steel, stainless steel, copper, aluminum alloy, etc.)	Apply pressure (200 to 500 kPa) for 1 hour at 100°C, 2 hours at 200°C and then, heat for 2 hours at the operating temperature with the pressure removed. If it is difficult to heat to 200°C, 2 h at 200°C may be changed to 5 h at 160°C with all other conditions followed.

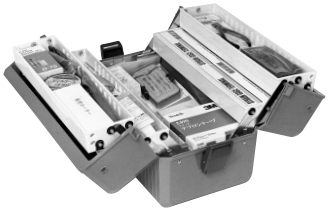
Note: The stated operating temperature range is for the adhesive only, and may differ depending on combinations with gages. When using, read the attached instruction manual carefully.

Export controlled product:
[Air transport prohibited]: Product which falls under the Aviation Law, and for which air transport is prohibited.

Ingredients	Capacity	Features	Major Applicable Gages
1 type of cyanoacrylate liquid	2g×1 or 2g×5	•Suitable for bonding general-purpose gages, such as KFG and KFR, which are used for general stress measurement at normal temperature of 20 to 80°C. •Quick curing time and stable bonding of various materials in a wide range of temperature and humidity ranges. •Quick curing ensures smooth bonding works. •Enables measurement in approximately 1 hour from bonding.	KFG, KFGT, KFR, KFW, KFRP, KFRS, KFP, KFML, KSP, KSN (excl. E5) KSPH, KSPL, KFL, KFN, KFS, KFF, KCH, KV
1 type of cyanoacrylate liquid	2g×1 or 2g×5	•High viscosity makes it suitable for bonding to porous materials such lumber and concrete. •Suitable for bonding a gage to porous materials such as concrete for general stress measurement at normal temperature of 20 to 80°C.	KFG, KFGT, KFR, KC, KFRP, KFP
1 type of cyanoacrylate liquid	2g×1 or 2g×5	•Suitable for bonding a high-elongation gage such as KFEM and KFEL at normal temperature of 20 to 80°C. •Suitable for bonding to hard-to bond materials such as aluminum alloy (A7075) and magnesium alloy. •High peeling resistance, high impact resistance and less aging deterioration of bonding strength	KFEM, KFEL, KFG, KFGT, KFR, KFW, KFWS, KFRP, KFRS, KFP, KFML, KSP, KSN (excl. E5), KSPH, KSPL, KFF, KV
2 types of liquid mixed,	50 g Main agent: 25 g Curing agent: 25 g	•Suitable for bonding gages for strain measurement at very low temperature.	KFL
2 types of liquid mixed,	30 g Main agent: 6 g x 4 Curing agent: 1.5 g x 4	•Suitable for bonding gages for strain measurement at middle temperature.	KFG, KFR, KFGT KFF, KFS
2 types of epoxy liquid mixed	30 g Main agent: 5.6 g x 4 Curing agent: 2.1 g x 4	•Suitable for strain measurement at middle temperature and for bonding gages for transducers.	KFRP, KFP, KFH
2 types of epoxy liquid mixed	30 g Main agent: 18 g Curing agent: 12 g	•Low viscosity makes it suitable for bonding gages (KFG-C20) embeddable in bolts.	KFG (C20), KFW, KFWS, KFF
1 heating type of phenol liquid	100 g	•Suitable for strain measurement at low, middle and high temperature and for bonding gages for transducers.	KFG, KFR, KFH KFL, KFN, KFS
1 heating type of polyimide liquid	20 g	•Suitable for bonding gages for strain measurement at high temperature.	KFU, KFH

■Gage Bonding Tool Kit

Note: * Strain gages and adhesives are not included. Please prepare them separately.



●GTK-77 Tool Kit

This kit includes almost all tools, gage terminals, solder and other expendables required for gage bonding work.

Contents
Tool box, screwdriver set, tweezers (2 PC.), nippers, radio pliers, tape measure (2 m), stainless steel scale, protractor, sandpaper (#100, #320, 3 PC. each), soldering iron tip cleaner, knife, utility knife, scriber, soldering iron (40 W), compasses, marking pencil, mending tape, pencils (4H, 6H, 2 PC. each), scissors, cotton swabs, clean paper, high-temperature solder, flux for high-temperature solder, heat-resistant glass tube, gage terminals (T-P1, T-P4, T-P5, T-P6, T-P7, T-P8, T-P9, T-P10, T-F2, T-F3, T-F7, T-F8, T-F10, T-F13, T-F17, T-F25, T-F28, T-H11, and T-R9), hair dryer (1200 W), insulation vinyl tape, table tap (2.5 m), soldering iron (ANTEX), silicon rubber (10 PC.), fluoroplastic sheet (10 PC.)

Note: The power supply about the electric goods is Japanese specification of 100 VAC.

●GTK-55 Tool Kit NEW

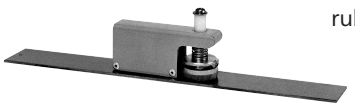
Portable and includes almost all items required for gage bonding work

Contents
Tool box, tweezers (2 PC.), nippers, radio pliers, stainless steel scale, sandpaper (#180, #320, #600, and #1000, 4 PC. each), utility knife, scriber, 4H pencils (3 PC.), tape, scissors, small scissors, cotton swabs, clean paper, gage terminals (T-F7, T-F17) vinyl tape, silicone rubber(10 PC.), fluoroplastic sheet (10 PC.), polyethylene sheet (SKF-28284, 100 PC.), gage presser (G-MATE-B, 1 PC.)

■Gage Pressers

●Gage Presser G-MATE

The G-MATE can apply pressure to a bonded strain gage continuously until the adhesive is cured. It consists of a frame equipped with a strong ferrite magnet to firmly fix the object under testing and a pressure disk equipped with silicon sponge rubber and coil spring to apply constant pressure to the strain gage.



G-MATE-B

Description	Models	Application
Gage Mate	G-MATE-B	For normal temperature (up to approx. 80 °C)
High-temperature Gage Mate	G-MATE-H	For high temperature (up to approx. 150 °C)

A min. qty 6 PC.

■Compact Spot Welder

●GW-3C Compact Spot Welder

Developed to mount encapsulated strain gages such as the KHCS and KHCD and to fix high-temperature lead wires and thermocouples, the GW-3C is an easy-to-use welder providing an increased welding capability and allowing continuously variable setting of welding energy.

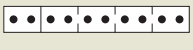
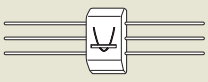
CE

Specifications	
Welding Energy	LOW: 0 to 25 Ws, continuously variable HIGH: 0 to 50 Ws, continuously variable
Welding Speed	1 Ws: 150 times/min., 5 Ws: 120 times/min., 10 Ws: 80 times/min., 20 Ws: 60 times/min., 50 Ws: 30 times/min.
Power Supply	Power Supply : AC line
Dimensions and Weight	183(W) x 153(H) x 313(D) mm (excluding protrusions), approx. 9 kg (mainframe)
EMC Directive	EN61326-1(Class A)
Low Voltage Directive	EN61010-1, EN61010-2-030 (Installation Category Ⅱ, Pollution Degree 2, Measurement Category O)
Accessories	Square welding head, grounding clip (With 1.3-m long cable), 2 electrodes (GW-02), metal file, fuse (5 A), hexagon wrench, Instruction Manual
Option	Aluminum trunk (GW-01)

Gage Terminals and Other Accessories

●T-type Gage Terminals

A gage terminal is applied to the connection between a strain gage and lead wire to protect the gage leads. It prevents the strain gage from receiving force and the gage leads from breaking or peeling off if the lead wire is pulled to some extent.

	Models		Dimensions (mm) (W x L x t)	Base Material	Conductor Material	Qty per Pack	Operating Temperature Range (°C)	Recommended Adhesive	Remarks
Foil type		T-F2B NEW	5-pole 14×55×0.1 1-pole 14×11×0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-34B	
		T-F3B NEW	5-pole 14×65×0.1 1-pole 14×13×0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-34B	For 3-wire system
		T-F13B NEW	5-pole 14×65×0.15 1-pole 14×13×0.15	Glass epoxy + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-F7B NEW	5-pole 6×25×0.1 1-pole 6×5×0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-34B	Compact
		T-F17B NEW	5-pole 6×25×0.15 1-pole 6×5×0.15	Glass epoxy + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-F8B NEW	5-pole 4×30×0.1 1-pole 4×6×0.1	Glass epoxy	Copper foil	20 sheets (5 poles/ sheet)	-196 to 120	CC-33A EP-34B	
		T-F10B NEW	15×50×0.1	Glass epoxy	Copper foil	10 sheets	-196 to 120	CC-33A EP-34B	Mainly for 5-element gages
		T-F23	5-pole 14×55×0.1 1-pole 14×11×0.1	Polyimide	Copper foil	20 sheets (5 poles/ sheet)	–196 to 200, –196 to 120 with CC-33A	CC-33A EP-34B	For high temperature, compact
		T-F24	5-pole 9×40×0.1 1-pole 9×8×0.1						
		T-F25	5-pole 6×25×0.1 1-pole 6×5×0.1						
		T-F26	5-pole 14×55×0.1 1-pole 14×11×0.1	Polyimide	Copper foil	20 sheets (5 poles/ sheet)	-196 to 350	PI-32	For high temperature
		T-F27	5-pole 9×40×0.1 1-pole 9×8×0.1						
		T-F28	5-pole 6×25×0.1 1-pole 6×5×0.1						
		T-F29 NEW	Outer: ϕ6 Inner: ϕ2.5	Glass epoxy	Copper foil	20 sheets	-196 to 120	EP-180, 340 CC-33A EP-34B	For measuring axial tension of bolts
Mold type		T-P1	14×10×4	Styrol	Tin-plated copper wire	20 PC.	-30 to 80	CC-33A	
		T-P4	14×10×4.5	Styrol + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P5	6×6×2	ABS	Tin-plated copper wire	20 PC.	-30 to 120	CC-33A	Compact
		T-P6	6×6×2.5	ABS + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P7	15×10×4	ABS	Tin-plated copper wire	40 PC.	-30 to 80	CC-33A	For 3-wire system
		T-P8	15×10×4.5	ABS + double-coated adhesive tape			-30 to 50	Not required	Self-bonding
		T-P9	6×5×4	Heat-resistant styrol	Tin-plated copper wire	40 PC.	-30 to 90	CC-33A	Compact
		T-P10	6×5×6	Heat-resistant styrol + rubber					Rubber on the rear

■Coating Agents

Coating agents are applied to gages and gage terminals to prevent gages from adsorbing moisture in outdoor or long-term measurement.

C-1B C-4 C-5 AK-22 VMTAP ARALDITE-T ARALDITE-C HAMATITE-Y KE-4898W

Models	C-1B	C-4	C-5	AK-22	VMTAP	ARALDITE-T,-C	HAMATITE-Y	KE-4898W
Type	Hot-melt type	Hot-melt type	Rubber solvent type	Special clay	Press-fitting rubber type	2-liquid type (1:1)	Rubber solvent type	Silicon solvent type
Operating Temp. Range	–30 to 40°C	–50 to 60°C	–269 to 60°C	–196 to 170°C	–30 to 80°C	–50 to 100°C	–20 to 70°C	–50 to 200°C
Curing Requirements	Heat-melted & cured at room temp.	Heat-melted & cured at room temp.	Melted & dried at room temp. 12 h.	Press-fitted	Press-fitted	24 h at room temp.	Melted & dried at room temp. 12 h.	Melted & dried at room temp. 12 h.
Moisture & Water-proofness	◎	◎	◎	◎	○	△	○	△
Mechanical Protection	△	△	△	△	△	◎	△	△
Oil Resistance	△	△	△	△	△	○	△	△
Alcohol Resistance	○	○	○	○	○	○	○	○
Toluene Resistance	×	×	×	×	×	○	×	×
Alkalescent Resistance	○	○	○	○	○	○	△	△
Weak-acid Resistance	○	○	○	○	○	○	△	△
Content	500 g	500 g	100 g	500 g	38mm×6m	T:170 g C:1.8 kg	1.5 kg	100 g
Material	Paraffin wax	Microcrystalline wax	Butyl rubber	Butyl rubber+ inorganic additive	Butyl rubber	Epoxy	Chloroprene rubber	Silicon
Color	White	White	Light yellow	Dark green	Black	Main agent: Light milk white Curing agent: Light yellow	Black	Milk white
Features	Can be applied with a brush after melting through heating. Suitable for underlayer of multilayer coating.	Excellent cohe-siveness makes it suitable for application to wall surface.	Minimal restriction in ultra-low temperature applications.	The clay-like shape ensures easy coating work. Operating temp. range is wide.	The tape shape facilitates coating work.	Highly effective mechanical protection makes it suitable for upper layer of multilayer coating.	Suitable for final finish of multi-layer coating.	Highly heat-resistant coating agent.
Product name	C-1B	C-4	C-5	AK 22	VMTAPE	ARALDITE	HAMATITE-Y	KE-4898-W

◎ : Excellent
○ : Rather excellent
△ : Rather inferior
× : Inferior

*When using, read the attached Instruction Manual carefully.

■Accessories for High-temperature Gages

●HTG Series Accessories for High-temperature Gages

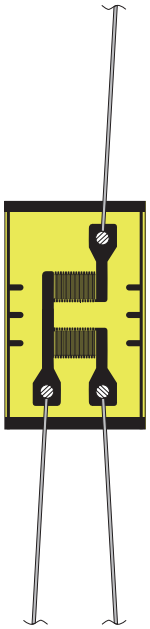
Description	Models	Specifications	Qty
High-temperature solder	HTG-S-B	Fusion temperature: 309°C Maximum operating temperature: 300°C	40 cm long bar x 2
Flux for high-temperature solder	HTG-S-F	Ingredients: Inorganic acid + alcohol	20 g
Heat-resistant glass tube	HTG-G-TUBE	Inner diameter: 1.5 mm Length: 1 m	10 PC.
Heat-resistant Teflon tape	HTG-T-TAPE	Heat resistance: 200°C Width: 12.7 mm	32.9 m long
Heat-resistant glass tape	HTG-G-TAPE	Heat resistance: 350°C Width: 25 mm	33 m long

*The heat resistance of 350°C for the heat-resistant glass tape are applied to a short-term operation.

Custom-designed Gages

Various custom-designed gage patterns and length are available to meet the need of customers' measurement. For details, please contact us.

Uniaxial 2-element half-bridge pattern

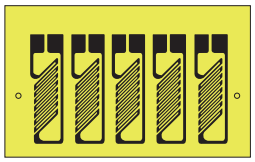


×3

Small uniaxial 2-end pattern

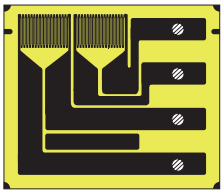
×12

5-element pattern for shearing strain test



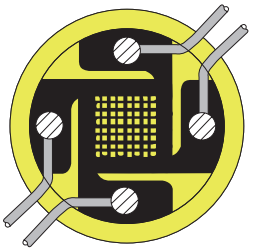
×3.5

Uniaxial 2-element pattern



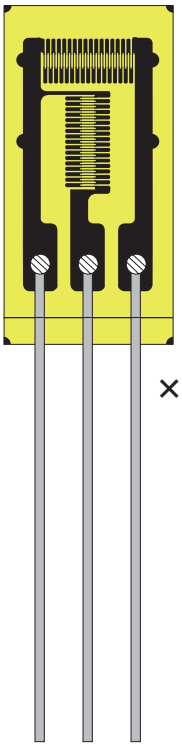
×3.5

Ultra-small biaxial 0°-90° crossed pattern



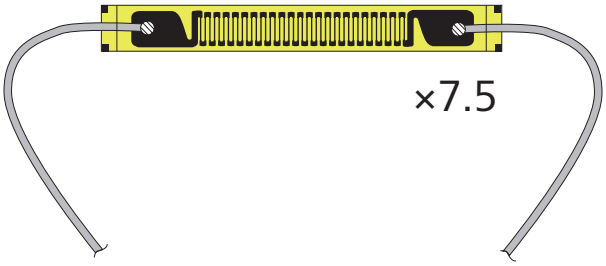
×12

Biaxial gages orthogonal half-bridge pattern



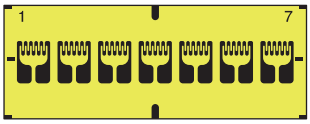
×9

Small uniaxial pattern with lead wires from both ends



×7.5

Multi-element pattern



×5

Custom-designed Gages for Transducers

■Strain Gages for Transducers

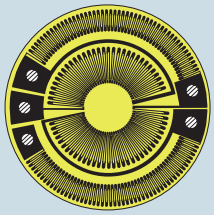
Being excellent in its nonlinearity & repeatability, strain gages not only can be used to test strain, but also be used to make transducers.
The strain gages have been used for making our strain gage transducers, therefore the transducers are high reliability.

We provide various strain gages for our customers to make their own transducers to test load, force, pressure, torque, etc.
The patterns below are some examples.
For details, please contact us.

Diaphragm pattern

Applicable transducers

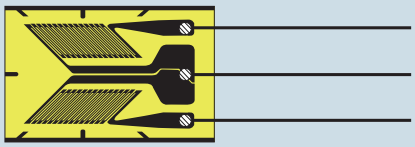
Pressure transducers



Biaxial shearing pattern

Applicable transducers

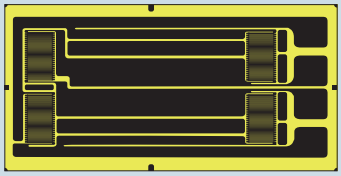
Torque transducers



Full-bridge pattern

Applicable transducers

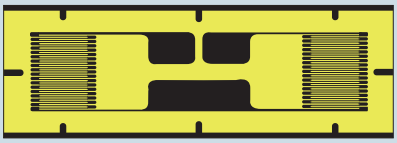
Load cells, & displacement transducers



Uniaxial 2-element half-bridge pattern

Applicable transducers

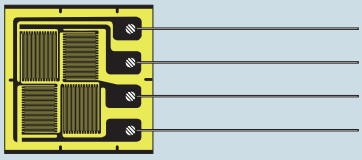
Load cells, & pressure transducers



Full-bridge pattern

Applicable transducers

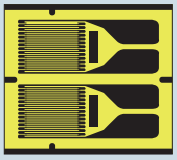
Load cells



Uniaxial 2-element pattern

Applicable transducers

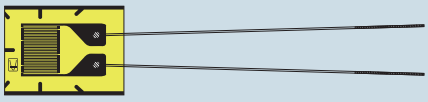
Load cells, & displacement transducers



Uniaxial

Applicable transducers

Load cells, pressure transducers, displacement transducers, & acceleration transducers



Biaxial half-bridge pattern

Applicable transducers

Load cells, & pressure transducers