



# STRAIN GAUGE EXTENSION LEADWIRES

Strain gauges are connected to strain measuring instruments using extension leadwires. We offer various types of leadwires to be selected depending on the usage conditions. In addition, most of strain gauges are available with extension leadwires preattached at our factory. Those leadwire-integrated strain gauges greatly save the leadwire connection works during the strain gauge installation. Please feel free to contact our company or local representative for the extension leadwires and the leadwire-integrated strain gauges.

## Standard leadwire length for leadwire-integrated strain gauges

Standard length of our integral leadwires is 1m, 3m and 5m except enamel leadwires. The standard length of enamel leadwires are 0.3m, 0.5m and 1m. Other lengths than the standard length may be available on request. The enamel leadwires are not available in a length more than 1m.

- OPTION -F Leadwire with CE marking
- Leadwire with CE marking (compliant to RoHS2 Directive)
- Identification code "-F" is appended to the type number of the leadwire.

## Leadwire selection

### ¶ Vinyl leadwires




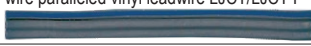
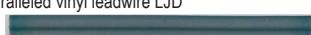
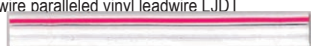







Vinyl leadwires are widely used as strain gauge leadwires, and are available in a variety of types. Because the vinyl insulation can be colored, these wires allow color-coding for rosette gauges. Stranded core wires are flexible and easy to handle, and allow easy wire connection and terminal attachment.

#### •Small diameter vinyl wires (Code to order -LH, -LHT)

These leadwires feature a thin vinyl insulated materials and small diameter core wires to achieve an outside diameter of 0.4mm. They are used for wiring in tight spaces. The stranded wires are flexible and minimize breakage due to repeated bending.

#### •Shielded vinyl wires (Code to order -LTSA, -LTSB)

These are 3-core wires with shield made of aluminium foil or braided copper wire. The outer insulation is made of vinyl. These leadwires offer a noise shielding function.

| Type number of leadwires<br>(Option code -F for CE marking)   | Core/Diameter<br>(cross section)<br>(mm) | Applicable<br>temperature | Total resistance<br>of lead<br>wire | Outer insulated<br>dimensions<br>(mm) | Length<br>per roll | Colors   |
|---|--|---------------------------|-------------------------------------|---------------------------------------|--------------------|--|
| 0.08mm <sup>2</sup> paralleled vinyl lead wire LJB/LJB-F<br>                   | 7/0.12<br>(0.08mm <sup>2</sup> )         | -20~+80°C                 | 0.44Ω/m                             | 1.1×2.2                               | 200m               | Red, White, Green, Black, Yellow<br>Blue, Red-White  |
| 0.08mm <sup>2</sup> 3-wire paralleled vinyl leadwire LJB/LJB-F<br>             | 7/0.12<br>(0.08mm <sup>2</sup> )         |                           |                                     | 1.1×3.3                               |                    | White wire and whichever color<br>Blue, Orange, Red, Green, Black or<br>Yellow stripe is selectable. (*) |
| 0.11mm <sup>2</sup> paralleled vinyl lead wire LJC/LJC-F<br>                   | 10/0.12<br>(0.11mm <sup>2</sup> )        | -20~+80°C                 | 0.32Ω/m                             | 1.4×2.8                               | 200m               | Grey   |
| 0.11mm <sup>2</sup> 3-wire paralleled vinyl leadwire LJC/LJC-F<br>             | 10/0.12<br>(0.11mm <sup>2</sup> )        |                           |                                     | 1.4×4.2                               |                    | Grey, One wire with Blue stripe (*)  |
| 0.3mm <sup>2</sup> paralleled vinyl leadwire LJD<br>                           | 12/0.18<br>(0.3mm <sup>2</sup> )         | -20~+80°C                 | 0.12Ω/m                             | 1.9×3.8                               | 200m               | Grey   |
| 0.3mm <sup>2</sup> 3-wire paralleled vinyl leadwire LJD<br>                    | 12/0.18<br>(0.3mm <sup>2</sup> )         |                           |                                     | 1.9×5.7                               |                    | White, One wire with Red stripe (*)  |
| 0.02mm <sup>2</sup> twisted vinyl leadwire LH<br>                              | 5/0.07<br>(0.02mm <sup>2</sup> )         | -20~+100°C                | 1.8Ω/m                              | Φ0.8                                  | —                  | Red, Green, White  |
| 0.02mm <sup>2</sup> 3-wire twisted vinyl leadwire LHT/LHT-F<br>                | 5/0.07<br>(0.02mm <sup>2</sup> )         |                           |                                     | Φ1.0                                  |                    | Red-Green-White  |
| 3.2mm-dia. 2-core shielded vinyl leadwire LS<br>                               | 7/0.12<br>(0.08mm <sup>2</sup> )         | -20~+80°C                 | 0.44Ω/m                             | Φ3.2                                  | 200m               | Outer : White<br>Core wire : Green-Green   |
| 3mm-dia. 3-core shielded vinyl leadwire LTSA<br>                               | 7/0.12<br>(0.08mm <sup>2</sup> )         | -20~+80°C                 | 0.44Ω/m                             | Φ3                                    | 200m               | Outer : Red, White or Green<br>Core wire : Red-Black-White   |
| 5mm-dia. 3-core shielded vinyl leadwire LTSB<br>                               | 7/0.26<br>(0.3mm <sup>2</sup> )          | -20~+80°C                 | 0.1Ω/m                              | Φ5                                    | 200m               | Outer : Black<br>Core wire : Red-Black-White   |
| 0.08mm <sup>2</sup> polypropylene 4-wire paralleled leadwire LQM/<br>LQM-F<br> | 7/0.12<br>(0.08mm <sup>2</sup> )         | -20~+100°C                | 0.44Ω/m                             | 0.9×4.0                               | 200m               | White, One wire with Red, Black, or<br>Blue stripe   |
| 3-wire paralleled special vinyl leadwire LXT/ LXT-F<br>                        | 7/0.12<br>(0.08mm <sup>2</sup> )         | -20~+150°C                | 0.44Ω/m                             | 0.9×2.7                               | 200m               | Red-Black-White  |

N.B.: \* Stripe is for distinction of independent wire in quarter bridge 3-wire connection.



# STRAIN GAUGE EXTENSION LEADWIRES

## ¶ Enamel leadwires

Enamel leadwires have a single core insulated with a resin. Heat resistance and handling methods vary depending on resin. Because the wire mass and diameter are small, enamel leadwires are used for strain measurement of rotating specimens and/or measurement of multiple points located in close proximity. Since the enamel leadwire contains one core covered with a thin resin, it must be handled with care.

## ·Polyurethane leadwires


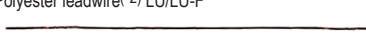

Polyurethane leadwires allow easy post-processing because the resin can be removed with a soldering iron. The resin is not strong, therefore, polyurethane wires must be handled with special care.

## ·Polyester leadwires

Polyester leadwires are harder than polyurethane wires. It cannot be removed with a soldering iron.

## ·Polyimide leadwires

Polyimide leadwires are harder than the polyester wire. A soldering iron cannot be used for post-processing.

| Leadwire type   | Core/Diameter <sup>(*)</sup> | Applicable temperature | Total resistance of leadwire | Outer insulated dimensions | Colors            |
|---|------------------------------|------------------------|------------------------------|----------------------------|-------------------|
| <br>Polyurethane leadwire <sup>(*)</sup> LP/LP-F | 1/0.14                       | -10~+120°C             | 2.5Ω/m                       | Φ0.16mm                    | Red, Brown, Green |
|   | 1/0.18                       |                        | 1.5Ω/m                       | Φ0.20mm                    |                   |
| <br>Polyester leadwire <sup>(*)</sup> LU/LU-F    | 1/0.14                       | -196~+200°C            | 2.5Ω/m                       | Φ0.16mm                    | Brown             |
|   | 1/0.18                       |                        | 1.5Ω/m                       | Φ0.20mm                    |                   |
| <br>Polyimide leadwire LE/LE-F                  | 1/0.14                       | -269~+300°C            | 2.5Ω/m                       | Φ0.16mm                    | Brown             |
|   | 1/0.18                       |                        | 1.5Ω/m                       | Φ0.20mm                    |                   |

N.B.: \*1: Two types with different core diameters, which are 0.14 mm and 0.18 mm, are available for each enamel wire.




\*2: Attachment of lead wire cannot be performed on stacked-type two-element or three-element gauges.

## ¶ Cross-linked Vinyl leadwires

The cross-linked vinyl insulation provides improved resistance against environmental elements. It is often used for underwater measurement in ordinary temperature.



## ¶ Cross-linked Polyethylene leadwires

The cross-linked polyethylene leadwire offers higher durability than the cross-linked vinyl leadwire. Cross-linked polyethylene leadwires can be used in steam, warm water and concrete with virtually no insulation degradation.

| Leadwire type  | Core/Diameter (Cross section)     | Applicable temperature | Total resistance of leadwire | Outer insulated dimensions | Length per roll | Colors  |
|--|-----------------------------------|------------------------|------------------------------|----------------------------|-----------------|---|
| <br>2-wire twisted cross-linked vinyl leadwire LJRA         | 7/0.16<br>(0.14mm <sup>2</sup> )  | -20~+100°C             | 0.24Ω/m                      | Φ3.0mm                     | —               | White   |
| <br>3-wire twisted cross-linked vinyl leadwire LJRTA        | 7/0.127<br>(0.09mm <sup>2</sup> ) | -20~+100°C             | 0.4Ω/m                       | Φ2.0mm                     | 200m            | Red-Green-Black   |
| <br>3-wire twisted cross-linked polyethylene leadwire LJQTA | 7/0.127<br>(0.09mm <sup>2</sup> ) | -65~+125°C             | 0.4Ω/m                       | Φ2.0mm                     | —               | Red-Yellow-Black<br>Red-Yellow-White<br>Red-Yellow-Blue |

## ¶ Special leadwire for temperature-integrated gauge







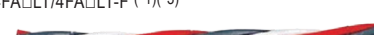
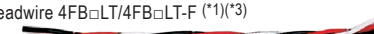
Special leadwire for temperature-integrated gauge consists of 2-core copper and 1-core constantan. To extend this wire, the exclusive leadwire should be applied properly.

| Leadwire type  | Core/Diameter<br>(Cross section) | Applicable<br>temperature | Total resistance of<br>leadwire | Outer insulated<br>dimensions | Length<br>per roll | Colors         |
|--|----------------------------------|---------------------------|---------------------------------|-------------------------------|--------------------|----------------|
| Temperature-integrated 3-wire paralleled vinyl leadwire<br>TLJBT/TLJBT-F<br>                          | 7/0.12<br>(0.08mm <sup>2</sup> ) | -20~+80°C                 | 0.44Ω/m <sup>(*1)</sup>         | 1.2×3.6mm                     | —                  | Red-White-Blue |
| Temperature-integrated 3-wire twisted fluorinated resin<br>(FEP) leadwire 6FB□TLT <sup>(*2)</sup><br> | 1/0.2                            | -269~+200°C               | 1.2Ω/m <sup>(*1)</sup>          | Φ1.1mm                        | —                  | Red-White-Blue |

N.B.: \*1: Total resistance of copper wire per meter  
\*2: □ is filled with the lead wire length in meter  
\*: For the method of connection to a strainmeter, refer to the operation manual of the strainmeter.

## ¶ Fluorinated resin leadwire

With a fluorinated resin leadwires, these leadwires can be used in a wide range of temperature from extremely low to high temperatures. Fluorinated resin resists most chemicals. A surface treatment (tetra-etching) is not required by 6FAS\_LT(-F).

| Leadwire type  | Core/Diameter<br>(Cross section) | Applicable<br>temperature   | Total resistance<br>of leadwire | Outer insulated<br>dimensions | Length<br>per roll | Suffix code<br>of leadwire | Colors          |
|--|----------------------------------|-----------------------------|---------------------------------|-------------------------------|--------------------|----------------------------|-----------------|
| 3-wire twisted fluorinated resin (FEP) leadwire<br>6FA□LT/6FA□LT-F <sup>(*1)(*3)</sup><br>              | 7/0.18<br>(0.18mm <sup>2</sup> ) | -269~+200°C                 | 0.2Ω/m                          | Φ2.0mm                        | 100m               | -6FA_LT                    | Red-Green-Blue  |
| 3-wire twisted fluorinated resin (FEP) leadwire<br>6FAS□LT/6FAS□LT-F <sup>(*1)(*3)(*4)</sup><br>        | 7/0.18<br>(0.18mm <sup>2</sup> ) | -269~+200°C                 | 0.2Ω/m                          | Φ2.0mm                        | 100m               | -6FAS_LT                   | Red-Green-Blue  |
| 3-wire twisted fluorinated resin (FEP) single-core leadwire<br>6FB□LT/6FB□LT-F <sup>(*1)(*3)</sup><br>  | 1/0.2                            | -269~+200°C                 | 1.2Ω/m                          | Φ1.1mm                        | —                  | -6FB_LT                    | Red-Green-Blue  |
| 3-wire twisted fluorinated resin (FEP) leadwire<br>6FC□LT/6FC□LT-F <sup>(*1)(*3)</sup><br>              | 7/0.08<br>(0.04mm <sup>2</sup> ) | -269~+200°C                 | 1.1Ω/m                          | Φ1.0mm                        | —                  | -6FC_LT                    | Red-Black-White |
| 3-wire twisted fluorinated resin (FEP) leadwire<br>6FCS□LT/6FCS□LT-F <sup>(*1)(*3)(*4)</sup><br>        | 7/0.08<br>(0.04mm <sup>2</sup> ) | -269~+200°C                 | 1.1Ω/m                          | Φ1.0mm                        | —                  | -6FCS_LT                   | Red-Black-White |
| 3-wire twisted fluorinated resin (FEP) leadwire<br>6FD□LTS/6FD□LTS-F <sup>(*1)(*3)</sup><br>            | 7/0.08<br>(0.04mm <sup>2</sup> ) | -269~+200°C                 | 1.1Ω/m                          | Φ1.5mm                        | —                  | -6FD_LTS                   | Red-Black-White |
| 3-wire twisted fluorinated resin (PTFE) leadwire<br>4FA□LT/4FA□LT-F <sup>(*1)(*3)</sup><br>             | 7/0.16<br>(0.14mm <sup>2</sup> ) | -269~+260°C <sup>(*2)</sup> | 0.24Ω/m                         | Φ1.9mm                        | 100m               | -4FA_LT                    | Red-Grey-White  |
| 3-wire twisted fluorinated resin (PTFE) single-core<br>leadwire 4FB□LT/4FB□LT-F <sup>(*1)(*3)</sup><br> | 1/0.2                            | -269~+260°C <sup>(*2)</sup> | 1.05Ω/m                         | Φ1.1mm                        | —                  | -4FB_LT                    | Red-Black-White |

N.B.: \*1: □ is filled with the lead wire length in meter  
\*2: PTFE leadwire is available for use in 300°C for a short term  
\*3: Suffix code LT(CT) means connecting terminal joint, while LT(TA) means insulation with film  
\*4: for easy application of coating: Surface treatment (tetra-etching) is not required when applying coating



# HOW ARE INTEGRAL LEADWIRES JOINED

Most TML strain gauges are available with extension leadwires pre-attached for customer convenience. We have several methods for connecting leadwires to be chosen depending on conditions such as the type of strain gauge and leadwire, measurement environments and so on.

## Different joints

### ·Integral type

A vinyl leadwire is jointed to polyimide insulated gauge leads of a strain gauge. The solder joints are covered with the vinyl insulation of the leadwire. This is our standard method of integral leadwire attachment.

### ·Heat-shrinkable tubing

A soldered joint between gauge leads and leadwire is protected with a heat shrinkable tube. The heat shrinkable tubes are available in three ratings of temperature among 80°C, 200°C and 260°C.

### ·Connecting terminals joint type

Gauge leads and leadwires are jointed using foil shape connecting terminals. Measurement in high temperature is possible by using a high temperature solder with melting point of 300°C or more for the joint.

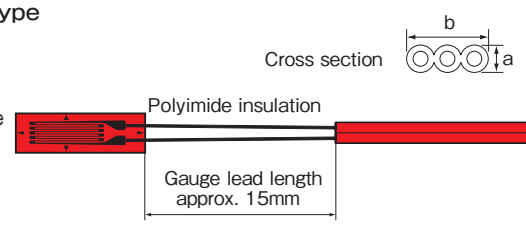

### ·Insulation film type

A soldered joint between gauge leads and leadwires is covered with an insulation film of glass cloth base. The film is resistive to heat up to 300°C, so this method is suited to measurement in high temperature.

### ·Direct type

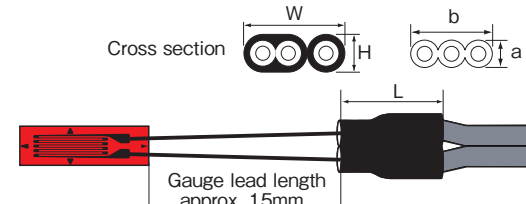




A vinyl leadwire is jointed directly to gauge leads, which are made of nickel plated copper. The solder joints are covered with vinyl insulation of a leadwire up to the end of the gauge base.

### Integral type

|                          | Cross section   | Leadwire          |           |     |             | Code to order |
|--------------------------|---|-------------------|-----------|-----|-------------|---------------|
|                          |   | Construction      | Dimension |     |             |               |
|                          |   |                   | a         | b   |             |               |
| Vinyl leadwire<br>2-wire |   | 2-wire paralleled | 7/0.12    | 1.1 | 2.2         | -LJB/-LJB-F   |
|                          |   | 10/0.12           | 1.4       | 2.8 | -LJC/-LJC-F |               |
|                          |   | 2-wire twisted    | 5/0.07    | 0.4 | -           | -LH           |
| Vinyl leadwire<br>3-wire |  | 3-wire paralleled | 7/0.12    | 1.1 | 3.3         | -LJBT/-LJBT-F |
|                          |   | 10/0.12           | 1.4       | 4.2 |             | -LJCT/-LJCT-F |

The option code "-F" appended to the leadwire code indicates that lead-free solder is used for the leadwire.

### Heat-shrinkable tubing

|  | Cross section   | Leadwire                                 |           |     |           | Heat-shrinkable tube |     |     | Code to order      |
|--|---|--|-----------|-----|-----------|----------------------|-----|-----|--------------------|
|  |   | Construction                             | Dimension |     | Dimension |                      |     |     |                    |
|  |   |  | a         | b   | L         | H                    | W   |     |                    |
| Vinyl leadwire<br>2-wire                     |  | 2-wire paralleled                        | 12/0.18   | 1.9 | 3.8       | 11                   | 3   | 6   | -LJD               |
| Vinyl leadwire<br>3-wire                     |  | 3-wire paralleled                        | 12/0.18   | 1.9 | 5.7       | 11                   | 3   | 7   | -LJDT              |
|  |   | 3-wire twisted                           | 5/0.07    | 0.4 | -         | 5                    | 0.8 | 1.6 | -LHT<br>-LHT-F     |
| Cross-linked Vinyl leadwire<br>2-wire        |  | Cross-linked vinyl 2-wire twisted        | 7/0.16    | 0.9 | -         | 11                   | 2   | 4   | -LJRA              |
| Cross-linked Vinyl leadwire<br>3-wire        |  | Cross-linked vinyl 3-wire twisted        | 7/0.127   | 1.1 | -         | 11                   | 2   | 4   | -LJRTA             |
| Cross-linked Polyethylene leadwire<br>3-wire |  | Cross-linked polyethylene 3-wire twisted | 7/0.12    | 0.8 | -         | 11                   | 2   | 4   | -LJQTA<br>-LJQTA-F |

The option code "-F" appended to the leadwire code indicates that lead-free solder is used for the leadwire.

| Heat-shrinkable tubing                                    |  | Leadwire   |           | Heat-shrinkable tube |      |     | Code to order |  |
|---|--|--|-----------|----------------------|------|-----|---------------|--|
|   |  | Construction   | Dimension | Dimension            |      |     |               |  |
|   |  |  |           | L                    | H    | W   |               |  |
| Gauge lead length approx. 15mm                            |  |  |           |                      |      |     |               |  |
| 3-core shielded Vinyl leadwire                            |  | 3-wire twisted   | 7/0.12    | Φ3                   | 10   | 2   | 4             | -LTSA<br>-LTSA-F                                 |
| 3-wire  |  |  | 7/0.26    | Φ5                   | 12.5 | 3   | 6             | -LTSB  |
| High temperature use<br>Fluorinated resin (FEP) leadwire  |  |  |           |                      |      |     |               |  |
| 3-wire  |  | FEP (Fluorinated-ethylene-propylene)<br>3-wire twisted | 1/0.2     | Φ1.1                 | 11   | 2   | 2             | -6FB <sub>o</sub> LT<br>-6FB <sub>o</sub> LT-F   |
| Gauge lead length approx. 15mm                            |  |  | 7/0.18    | Φ2                   | 11   | 3   | 4             | -6FAS <sub>o</sub> LT<br>-6FAS <sub>o</sub> LT-F |
| High temperature use<br>Fluorinated resin (PTFE) leadwire |  |  |           |                      |      |     |               |  |
| 3-wire  |  | PTFE (Polytetrafluoroethylene)<br>3-wire twisted       | 1/0.2     | Φ1.1                 | 11   | 2   | 2             | -4FB <sub>o</sub> LT<br>-4FB <sub>o</sub> LT-F   |
| Gauge lead length approx. 15mm                            |  |  | 7/0.16    | Φ1.9                 | 11   | 2.5 | 4             | -4FA <sub>o</sub> LT<br>-4FA <sub>o</sub> LT-F   |

| Connecting terminals joint type                           |  | Leadwire                                      |           | Code to order |  |
|---|--|---|-----------|---------------|--|
|   |  | Construction                                  | Dimension |               |  |
| Fluorinated resin (PTFE) leadwire<br>Special construction |  |   |           |               |  |
| 3-wire  |  | PTFE (Polytetrafluoroethylene) 3-wire twisted | 1/0.2     | Φ1.1          | -4FB <sub>o</sub> LT(CT)<br>-4FB <sub>o</sub> LT-F(CT) |
| Gauge lead length approx. 15mm                            |  |   |           |               |  |

| Insulation film type                                      |  | Leadwire                                      |           | Heat-shrinkable tube |    |     | Code to order |  |
|---|--|---|-----------|----------------------|----|-----|---------------|--|
|   |  | Construction                                  | Dimension | Dimension            |    |     |               |  |
|   |  |   |           | L                    | H  | W   |               |  |
| Fluorinated resin (PTFE) leadwire<br>Special construction |  |   |           |                      |    |     |               |  |
| 3-wire  |  | PTFE (Polytetrafluoroethylene) 3-wire twisted | 7/0.16    | Φ1.9                 | 13 | 1.5 | 4             | -4FA <sub>o</sub> LT(TA)<br>-4FA <sub>o</sub> LT-F(TA) |
| Gauge lead length approx. 15mm                            |  |   |           |                      |    |     |               |  |

N.B.:

Figures in Leadwire construction column show "Number of cores/ Diameter of one conductor leadwire in mm". For example, "7/0.12" represents "7core / 0.12mm diameter for one conductor leadwire". All dimensions of the Leadwire Heat-shrinkable tube and Film are approximate values in mm.

"o" in the "Code to order" is filled with the leadwire length in meter.