# RTD (Resistance Temperature Detector)

**RTD (Resistance Temperature Detector)** are sensors used to measure temperature by correlating the resistance of the RTD element with temperature. Most RTD elements consist of a length of fine coiled wire wrapped around a ceramic or glass core. The element is usually quite fragile, so it is often placed inside a sheathed probe to protect it. RTD element is made from a pure material whose resistance at various temperatures has been documented. The material has a predictable change in resistance as the temperature changes; it is this predictable change that is used to determine temperature.

Resistance elements include Platinum, Nickel, Copper, and other components. Platinum is the most popular and accurate type.

1. Platinum RTD
   a) Current: 5mA, 2mA, 1mA

      A grade: 2mA, 1mA

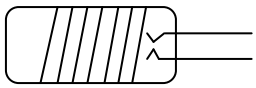
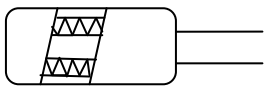
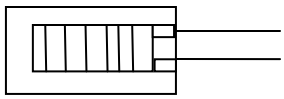
      JIS standard: 2mA, 1mA, 0.5mA

   b) Category

| Item | R100/RO value |
|---|---|
| Pt 100 | 1.3850 |
| JPt100 | 1.3916 |

- Pt100 means when the temperature is 0°C, the resistance for the element is 100 Ω
- JPt100 is Japanese stadnard

   c) Structure:

| Type | Temp. Range | Usage | Remark |
|---|---|---|---|
| Glass type  | -200 +/- 500 | Laboratory | Shock: withstand 100G's min. sine wave shock of 8 milliseconds duration |
| Ceramic type  | -700 +/- 750 | Industry | Shock: withstand 30G's min. sine wave shock of 8 milliseconds duration |
| Thin- Film type  | -50 +/- 350 | Surface temp. sensing | Less desirable for high speed measurements in the medical field as well as in environments that are corrosive or hostile. |

d) temperature range and accuracy: (d-1)

| Tolerances for Platinum Resistance Detectors to BS EN 60751:1996 / DIN 43760 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| °C | Class B | | Class A | | 1/3 DIN* | | 1/5 DIN* | | 1/10 DIN* | |
| | ±°C | ±Ω | ±°C | ±Ω | ±°C | ±Ω | ±°C | ±Ω | ±°C | ±Ω |
| -200 | 1.3 | 0.56 | 0.55 | 0.24 | 0.44 | 0.19 | 0.26 | 0.11 | 0.13 | 0.06 |
| -100 | 0.8 | 0.32 | 0.35 | 0.14 | 0.27 | 0.11 | 0.16 | 0.06 | 0.08 | 0.03 |
| 0 | 0.3 | 0.12 | 0.15 | 0.06 | 0.1 | 0.04 | 0.06 | 0.02 | 0.03 | 0.01 |
| 100 | 0.8 | 0.3 | 0.35 | 0.13 | 0.27 | 011 | 0.16 | 0.05 | 0.08 | 0.03 |
| 200 | 1.3 | 0.48 | 0.55 | 0.2 | 0.44 | 0.16 | 0.25 | 0.1 | 0.13 | 0.05 |
| 300 | 1.8 | 0.64 | 0.75 | 0.27 | 0.6 | 0.21 | 0.36 | 0.13 | 0.18 | 0.06 |
| 400 | 2.3 | 0.79 | 0.95 | 0.33 | 0.77 | 0.26 | 0.46 | 0.16 | 0.23 | 0.08 |
| 500 | 2.8 | 0.93 | 1.15 | 0.38 | 0.94 | 0.31 | 0.56 | 0.19 | 0.28 | 0.09 |
| 600 | 3.3 | 1.06 | 1.35 | 0.43 | 1.10 | 0.35 | 0.66 | 0.21 | 0.33 | 0.10 |
| 700 | 3.8 | 1.17 | - | - | - | - | - | - | - | - |
| 800 | 4.3 | 1.28 | - | - | - | - | - | - | - | - |

NOTE
According to DIN-ICE 751, BS1904, JIS C1604-1995 Standard.
Tolerances are calculated to 2 decimal points and are taken as a fraction of Class B.
* The tabulated values for close tolerance detectors 1/3rd, 1/5th and 1/10th DIN are interpolated and are for guidance only.

(d-2): Acceptable error tolerance calculation:

DIN Class A (JIS Class A): ± (0.15+0.002 |t|)°C

DIN Class B (JIS Class B): ± (0.30+0.005 |t|)°C

Class 1/3 DIN (±0.16%) (±0.004%) 0.10°C± 0.16t

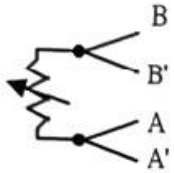
Class 1/5 DIN (±0.10%) (±0.024%) 0.06°C± 0.10t

Class 1/10 DIN (±0.05%) (±0.012%) 0.03°C± 0.05t

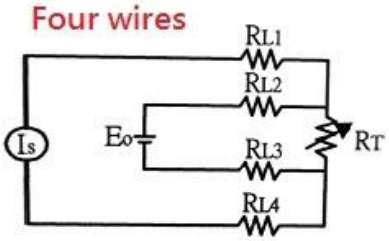
(e) Constant RTD element material:

| | Temp. Range(°C) | Description | Ω (at 0°C) | Ω/ Ω (at 0°C) |
|---|---|---|---|---|
| Platinum | -260 ~ 850 | Good stability<br>Good Linear | 100 Ω, 500 Ω, 1000 Ω | 0.00385 (DIN-IEC-751)<br>0.003916 (JIS-1604-1995) |
| Copper | -100 ~ 260 | Excellent Linear | 10 Ω (R=25°C) | 0.00427 |
| Nickel | -100 ~ 260 | High Sensitivity | 120 Ω | 0.00672 |
| RTD | -20 ~ 100 | Lower price<br>High Sensitivity | 5k Ω (R=25°C)<br>10K Ω(R=25°C) | By Maker |
| Note: 500 Ω and 1000 Ω resistance values are adopted by DIN-IEC-751 standard. | | | | |

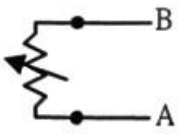
(f) RTD wire connection:



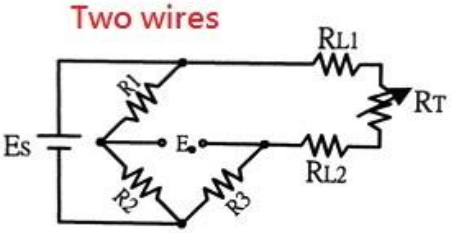

Four wires



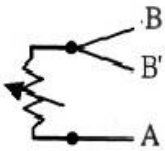

Four wires curcuit



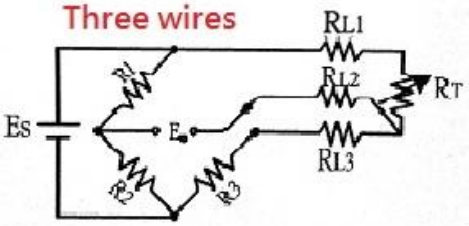

Two wires



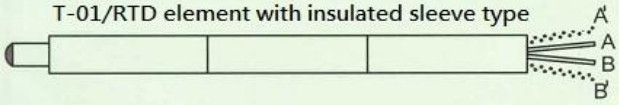
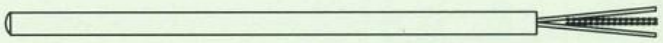
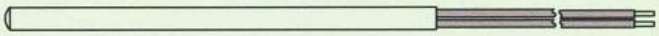
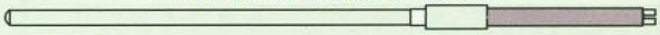
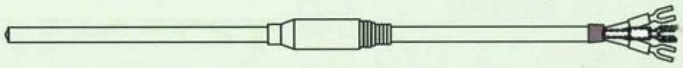
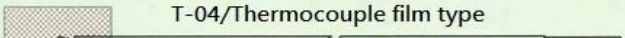
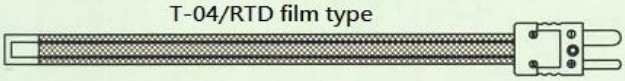
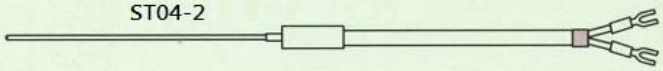
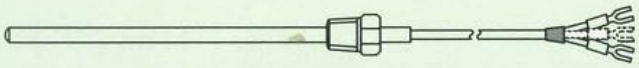
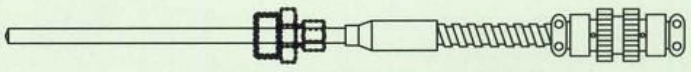
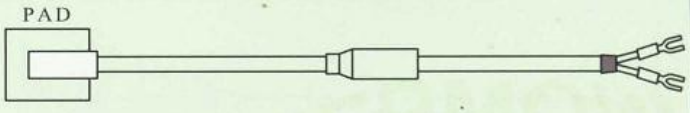

Two wires circuit

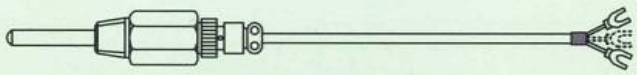
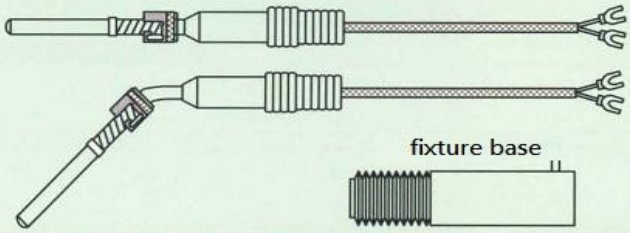
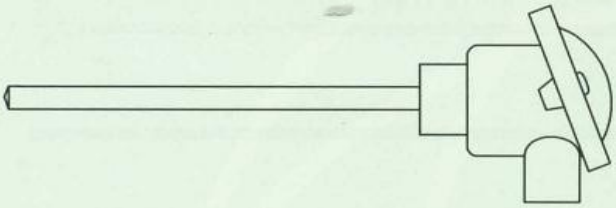
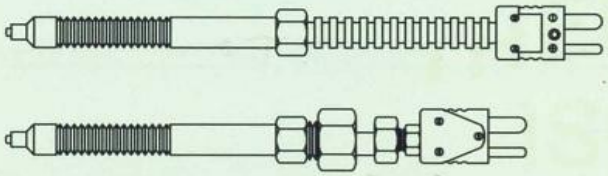
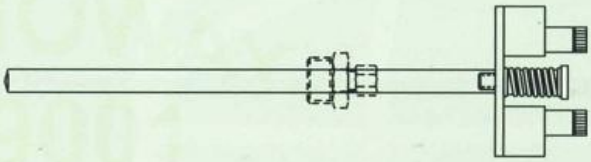
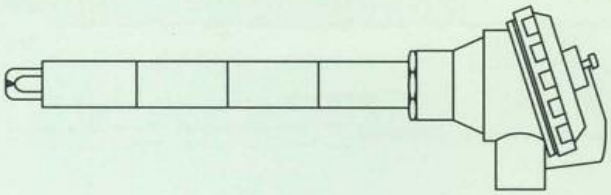
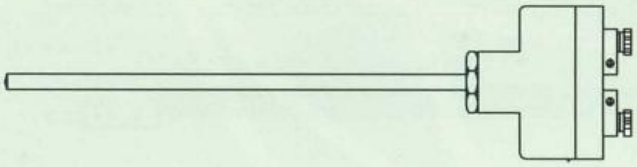
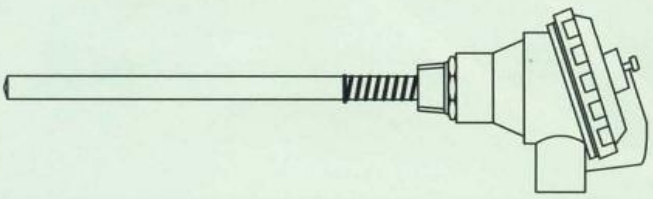
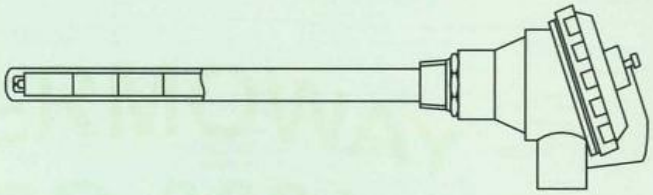
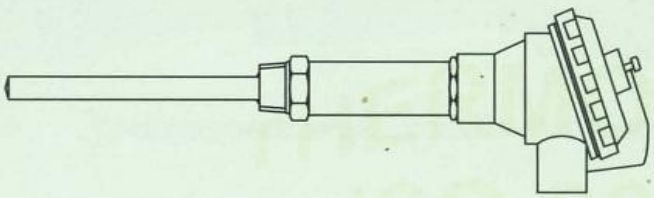



Three wires




Three wires circuit

| Model | Traditional Shape Appearance | Model | Metal Finished Shape Appearance |
|---|---|---|---|
| T-01 | Standard type | ST-01 | Standard type |
| | T-01/ thermocouple with insulated sleeve<br>  <br>T-01/RTD element with insulated sleeve type<br>  | |  |
| T-02 | Standard type with terminals | ST-02 | Basic type |
| | T02-1<br>  <br>  <br>T02-2<br> | |  <br>ST-02 with extended inductor<br>  |
| T-03 | Adjustable type with fixed screw | ST-03 | Transition joint fitting with spring |
| |  | |  |
| T-04 | Surface sensing type | ST-04 | Extra-thin type |
| | T-04/Thermocouple film type<br>  <br>T-04/RTD film type<br>  | | ST04-1<br>  <br>ST04-2<br>  |
| T-05 | Insertion Type with fix leads | ST-05 | Transition joint with E type connector |
| |  | |  |
| T-06 | Screw-fix surface sensing | ST-06 | Transition joint fitting with metal PDA pad |
| | T06-1<br>  <br>T06-2<br>  | | PAD<br>  <br>ST06-1 ST06-2 ST06-3<br>  |

| Model | Traditional Shape Appearance | Model | Metal Finished Shape Appearance |
|---|---|---|---|
| T-07 | Hex-screw type with E type connector | ST-07 | Pressure- resistance type with D type connector |
| |  | |  |
| T-08 | Spring type | ST-08 | Standard type with DIN wire box |
| |   | |  |
| T-09 | Immersion type | ST-09 | Stadnard type with DIN terminal board |
| |  | |  |
| T-10 | Terminal Type with wire box | ST-10 | Standard type with T type wire box |
| |  | |  |
| T-11 | Terminal type with metal tube protection | ST-11 | Screw-in with Spring |
| |  | |  |
| T-12 | Terminal type with metal tube protection screw-in | ST-12 | Hex-nipple type |
| |  | |  |