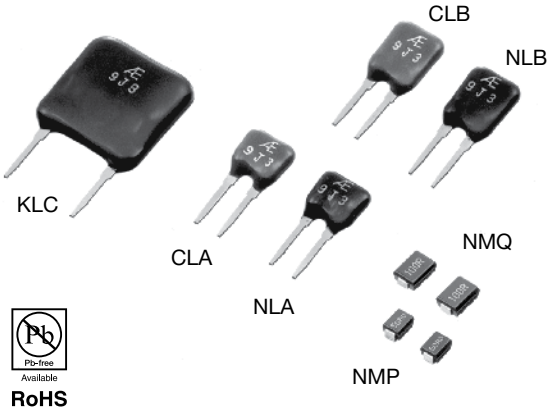
Ultra Precision Thermosensitive Resistor

This ultra precision thermosensitive resistor is a new type of resistor produced by the application of Alpha foil resistor technology. It is made of material only a few μm thick and responds rapidly to temperature changes. The metal foil that is used has a resistivity that varies linearly with temperature change. Strict control of foil composition maintains uniform quality without fluctuation of temperature characteristics of resistance. This thermosensitive resistor is produced by the same fine photo-etching technology used in the metal foil precision resistors. The pattern is ideally designed for temperature detection, providing small size and rapid response.

Characterisitics

❶ Since the resistance is provided by metal foil, the resistance is highly stable with little change over time
❷ Temperature characteristics of resistance are almost linear
❸ Response to temperature changes is rapid
❹ This thermosensitive resistor is small and low-priced
❺ Highly accurate with tolerance of resistance values ±0.5%
❻ Temperature characteristics can be freely adjusted (KLC type)



Pb-free Available
RoHS COMPLIANT

Main Applications

- Cold-junction reference for thermocouple
- Temperature-compensation in load cell
- Temperature-compensation device in semiconductor circuit
- Temperature-sensing device

COMPOSITION OF TYPE NUMBER

Example 1:
NLA 100R0 F
① ② ③

① Type
② Resistance Value*
③ Tolerance

Example 2:
KLC 3000-500R0 F
① ② ③ ④

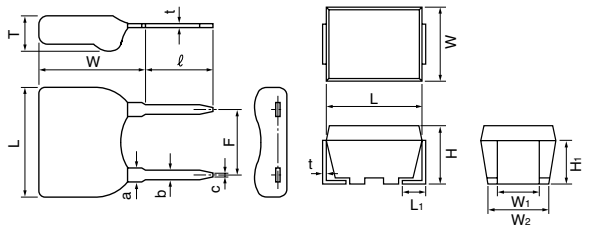
① Type
② TCR**
③ Resistance Value*
④ Tolerance

Example 3:
NMP 100R0 F L
① ② ③ ④

① Type
② Resistance Value*
③ Tolerance
④ Tape & Reel Package Required

*Resistance value, in ohm, is expressed by a series of five characters, four of which represent significant digits. R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of decimal point.
**Specify a desired TCR, following the type, in four-digit coding. The example “3000” means 3,000 ppm/°C while “0500” means 500 ppm/°C.

CONFIGURATION (DIMENSIONS IN mm)



Type	NLA, CLA	NLB, CLB	KLC
L	5.6±0.5		12.4±0.5
W	6.2±0.5	8.2±0.5	13.3±0.5
T	2.2±0.5		3.3±0.5
F	2.54±0.25		7.62±0.25
ℓ	5.0±1.0		
t	0.3±0.05		
a	1.0±0.05		
b	0.65±0.05		
c	0.4±0.05		

Type	NMP	NMQ
L	3.2±0.2	4.5±0.2
W	2.5±0.2	3.2±0.2
H	2.0±0.2	
L1	0.6±0.2	0.8±0.2
W1	1.4±0.3	
W2	2.3±0.2	3.0±0.2
H1	1.5±0.3	
t	0.15±0.05	

TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER

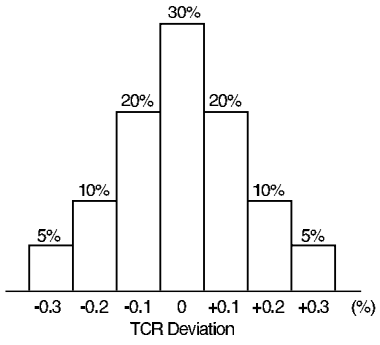
Type	TCR (ppm/°C)	Resistance Range (Ω)	Resistance Tolerance (%)* at 0°C	Rated Power (W) at 70°C
NMP	+6,060±2% (0 to 25°C) +6,260±2% (0 to 50°C) +6,660±2% (0 to 100°C)	5 to 250	±0.5 (D) ±1.0 (F) ±2.0 (G) ±5.0 (J)	0.1
NMQ		5 to 500		0.125
NLA	+6,060±1% (0 to 25°C) +6,260±1% (0 to 50°C) +6,660±1% (0 to 100°C)	5 to 500		0.125
NLB		5 to 1k		0.25
CLA	+4,250±1% (0 to 100°C)	5 to 100		0.125
CLB		5 to 200		0.25
KLC	See Fig.1 on next page			0.25

*Symbols parenthesized are for type number composition.

TAPE AND REEL PACKAGE (BASED ON EIA-481-1)

For details, refer to MP, MQ Series datasheet.

TCR SPREAD FROM NOMINAL AND DISTRIBUTION



TEMPERATURE CHARACTERISTICS OF RESISTANCE

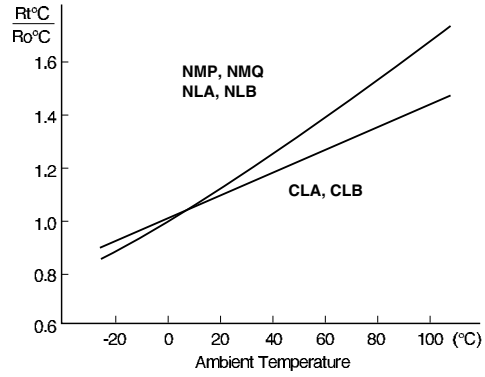
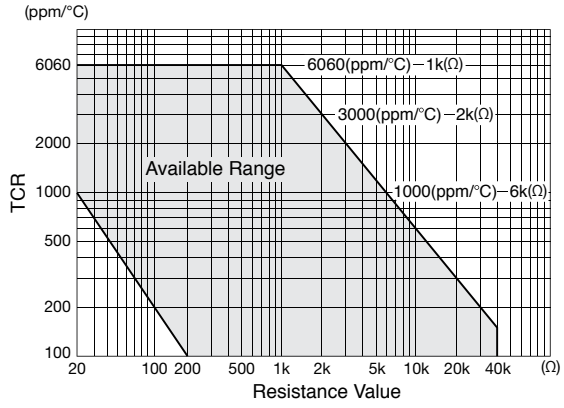
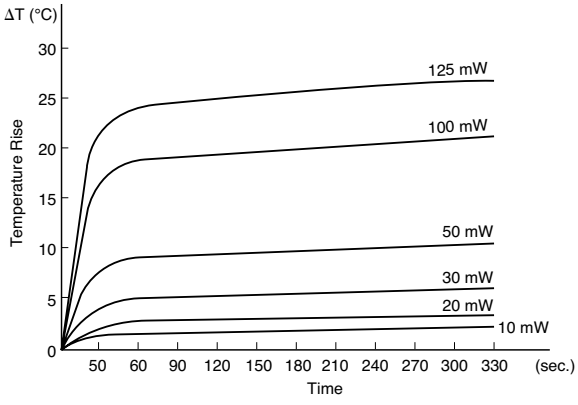


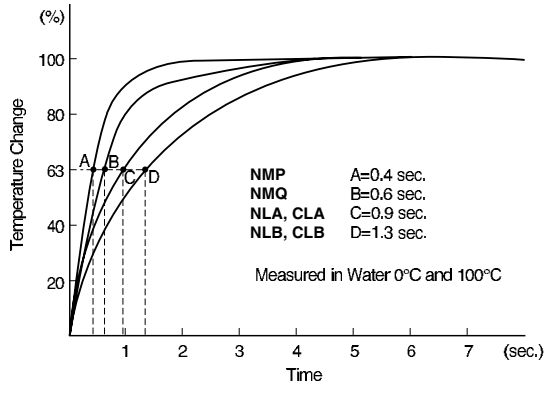
FIG. 1 TCR AND RESISTANCE AVAILABLE IN KLC TYPE



TEMPERATURE OF RESISTOR SURFACE



RESPONSE TIME TO TEMPERATURE CHANGE

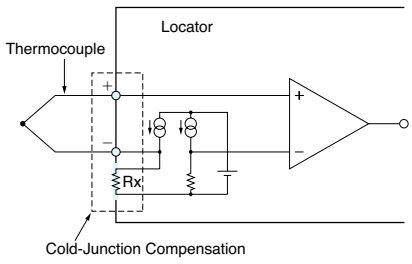


PERFORMANCE

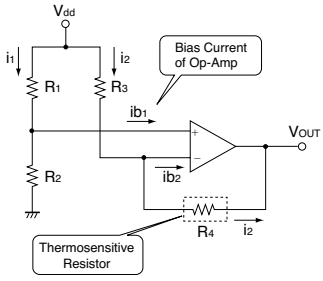
Parameters	Test Condition	ALPHA Specification	ALPHA Typical Test Data
Working Temperature Range **Max. Rated Operating Temp.** **Maximum Working Voltage**		–25°C to +125°C 70°C NMP: 50V; NMQ: 100V NLA, CLA: 250V; NLB, CLB, KLC: 300V	
Temperature Cycling **Overload**	–25°C/30 min., Room Temperature/5 min., +125°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.2% ±0.2%	±0.03% ±0.03%
Solderability **Resistance to Solvents**	235°C, 2 sec. ❶ Isopropyl Alcohol ❷ Trichloroethylene	over 75% coverage no damage	
Low Temperature Storage **Terminal Strength**	–25°C, No Load, 2 hrs. 0.908 kg (2 pounds),10 sec.	±0.2% ±0.2%	±0.03% ±0.03%
Dielectric Withstanding Voltage **Insulation Resistance** **Resistance to Soldering Heat** **Moisture Resistance**	Atmospheric: AC 300V, 1 min. DC 100V, 1 min. 350°C, 3 sec. +65°C to –10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.2% over 10,000 MΩ ±0.2% ±0.5%	±0.03% over 10,000 MΩ ±0.01% ±0.02%
Shock **Vibration**	50G, 11 ms, Half-Sine Wave, X, Y, Z, each 3 shocks 20G, 10 Hz to 55 Hz to 10 Hz, 1 min., X, Y, Z, each 2 hrs.	±0.2% ±0.2%	±0.03% ±0.03%
Life (Rated Load)	70°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.5%	±0.03%
Life (Moisture Load)	40°C, 90% RH to 95% RH, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.5%	±0.03%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.5%	±0.05%
High Temperature Exposure	125°C, No Load, 1,000 hrs.	±1.0 %	±0.1 %

APPLICATIONS OF THERMOSENSITIVE RESISTORS

Example: Cold-junction compensation for temperature measurement using thermocouple



Example: Temperature-sensing circuit



As shown in:

$$V_{OUT} = \left(\frac{R_2}{R_1+R_2} - \frac{R_1}{R_1+R_2} \times \frac{R_4}{R_3}\right) \times V_{dd}$$

Op-Amp output (V_{out}) becomes zero when R_1/R_2 and R_3/R_4 are balanced. So, output voltage ΔV_{out} is $\pm i_2 \times \Delta R_4$ when R_4 is changed to ΔR_4 from balanced point, $i_1=i_2$ and offset voltage is zero. The formula is as follows:

$$V_{OUT} = -\left(\frac{R_1}{R_1+R_2} \times \frac{1}{R_3}\right) \times \Delta R_4 \times V_{dd}$$

PRECAUTION IN USING NMP AND NMQ RESISTORS

1. Storage

Storage condition or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity. The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.

2. Caution in Soldering

❶ Hand Soldering

Hand soldering is applicable as shown at right.

Recommended

- Temperature of Iron Tip: 240°C to 270°C
- Power of Iron: 20W or less
- Diameter of Tip: Dia. 3 mm max.

❷ Solder Reflow in Furnace

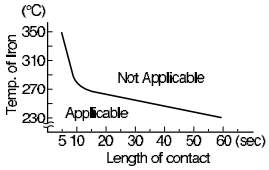
Recommended

- Peak Temperature: 250+0/-5°C
- Holding time: 10 sec. max.

❸ Dipping in Solder (Wave or Still)

Recommended

- Temp. of Solder: 260°C max.
- Length of Dipping: 10 sec. max.
- To cool gradually at room temperature



❹ Other

Corrosion-free flux, such as rosin, is recommended.

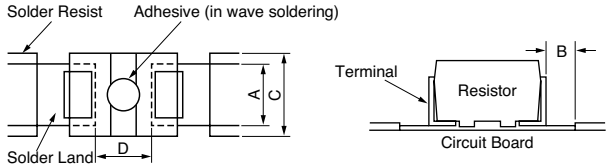
Do not apply pressure to the molded housing immediately after soldering.

3. Cleaning

Use volatile cleaner such as methylalcohol or propylalcohol.

4. Circuit Board Design

The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example below.



Type	A	B	C	D
NMP	1.6 to 2.0	0.5 to 1.5	2.2 to 2.6	1.8
NMQ				2.5

Dimensions in mm

When parts are mounted on a board in high density, solder can possibly attach to the resistors in an excessive amount to affect performance or reliability of the resistors. To prevent this effect, the use of solder resist is recommended to isolate solder lands.