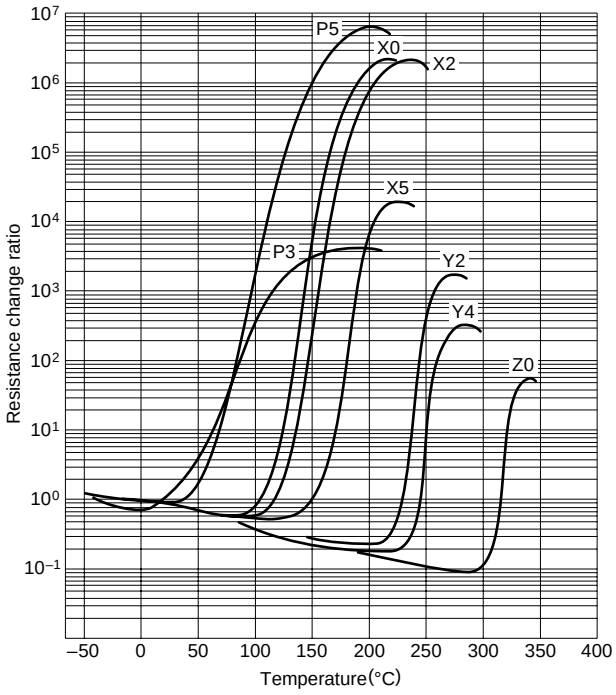
# Sensors

## Temperature Sensors
## PTC Thermistors

PTC (Positive Temperature Coefficient) thermistors are made of an oxide semiconductor ceramic with barium titanate as the main component. The switching temperature is determined by raw material composition. Above this temperature, the resistance rises rapidly. This property of PTC thermistors make them suitable for a wide range of applications, including constant temperature heaters, current limiting elements, and temperature sensors.

### FEATURES

- Switching temperatures are available in the range from +30 to +330°C, accommodating a wide variety of applications.




- Within any given size and shape, there is a wide range of available resistances at normal temperature. In the following formulas, ρ (specific resistivity at normal temperature) can have values in the range of 10Ω • m to 50kΩ • m with slight variations according to switching temperature. Resistance is calculated as follows:

Disc shape

$$R = \frac{t}{D^2} \times 12.7 \times \rho$$

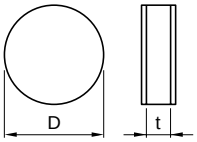
Rectangular shape

$$R = \frac{t}{L \bullet W} \times 10 \times \rho$$

R : Resistance at normal temperature(Ω)
D : PTC electrode diameter (mm)
L : PTC element length (mm)
W : PTC element width (mm)
t : PTC element thickness (mm)
ρ : Specific resistivity of PTC element's material at normal temperature (Ω • cm)

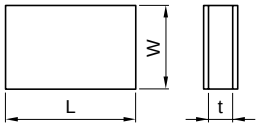
- Application of different shapes and resistances results in a wide range of rated voltages. Voltages may be AC or DC in the range of 12V to 240V.
- These thermistor elements enable contact-free circuit designs – no bimetals, relays, etc.
- Because the elements are made of ceramic material, it is possible to form units of various shapes and dimensions through the application of different molding methods.
- Various housing shapes can be produced to meet specific application requirements.

Disc type




D=ø5 to 35mm
t=1 to 5mm

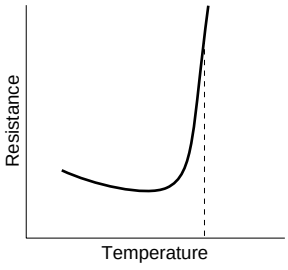
Square type




W=10 to 45mm
L=5 to 35mm
t=1 to 5mm

### FOR TEMPERATURE SENSING

The rapidly increasing resistance characteristics makes use of these thermistors a convenient method for detecting specific temperatures. Such applications also benefit from good sensitivity.




### FOR CURRENT LIMITING

- Current attenuation characteristics can be custom-tailored by controlling a combination of parameters: switching temperature, element volume, resistance value, and load impedance.
- The operating characteristics for overcurrent protection can be based on current increase, ambient temperature increase, or a combination of both.

# Sensors

## Temperature Sensors
## PTC Thermistors

### PTC THERMISTORS FOR DEGAUSSING COLOR CRT

### SHAPES AND DIMENSIONS

DIPPED TYPE (901 type)

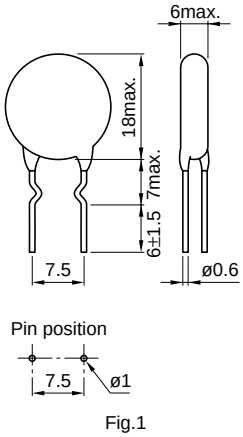



Fig.1

CASE TYPE (Single-PTC, 902 type)

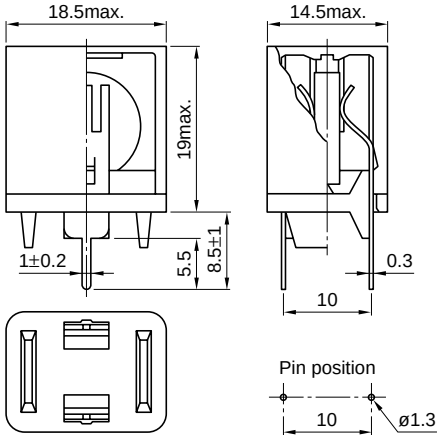



Fig.2

CASE TYPE (Double-PTC, 903 type)

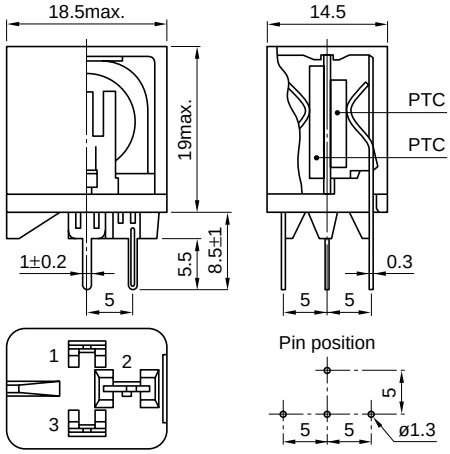



Fig.3

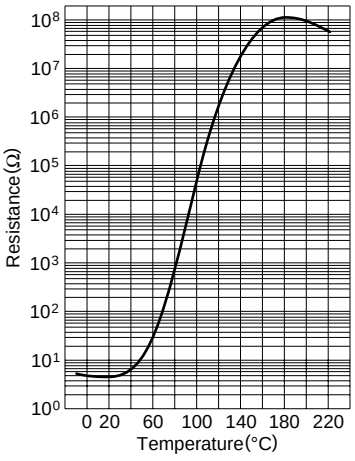
Dimensions in mm

### ELECTRICAL CHARACTERISTICS

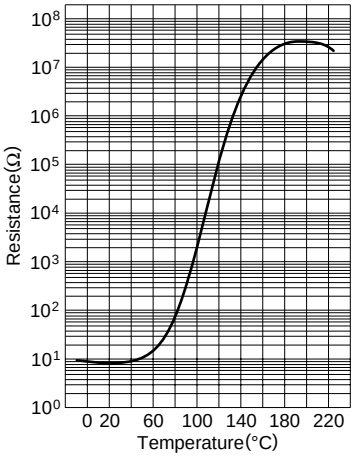
| Part No. | Initial resistance (Ω) | Rated voltage (V) | Maximum voltage (V) | Current attenuation characteristics Ep-p | | | Degaussing coil (Ω) | Fig. |
|---|---|---|---|---|---|---|---|---|
| | | | | Inrush (A)min. | After 3s (mA)max. | After 60s (mA)max. | | |
| 901P52E 050MP15 | 5±20% | 120 | 140 | 22 | 300 | 70 | 9.5 | 1 |
| 901P52E 070MP16 | 7±20% | 120 | 140 | 29 | 300 | 60 | 3.5 | 1 |
| 902P51D 030MN14 | 3±20% | 100 | 140 | 24 | 250 | 60 | 7.5 | 2 |
| 902P51D 050MN14 | 5±20% | 100 | 140 | 40 | 300 | 70 | 1 | 2 |
| 902P72E 090MR14 | 9±20% | 220 | 270 | 20 | 300 | 50 | 20 | 2 |
| 903P51D 030MN14 | 3±20% | 100 | 140 | 25 | 150 | 5 | 7.5 | 3 |
| 903P51D 050MN14 | 5±20% | 100 | 125 | 24 | 300 | 5 | 5.5 | 3 |
| 903P62E 090MR14 | 9±20% | 220 | 270 | 19 | 250 | 5 | 20 | 3 |
| 903P53E 120MR14 | 12±20% | 220 | 270 | 24 | 250 | 10 | 12 | 3 |
| 904P51D 1R5MN14 | 1.5±20% | 100 | 140 | 30 | 500 | 100 | 7 | 3 |
| 904P72E 4R5MR14 | 4.5±20% | 220 | 270 | 40 | 400 | 100 | 10 | 3 |

### RESISTANCE vs. TEMPERATURE CHARACTERISTICS

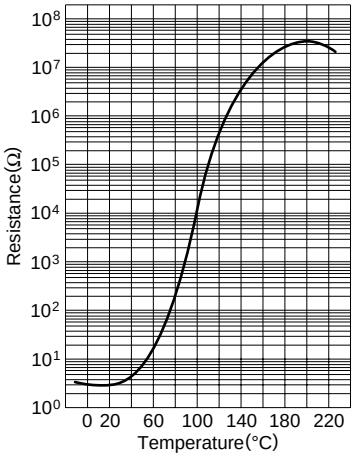
DIPPED TYPE(901 type)

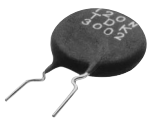



CASE TYPE(single-PTC, 902 type)




CASE TYPE(Double-PTC, 903 type)

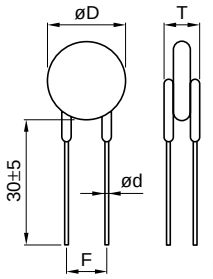


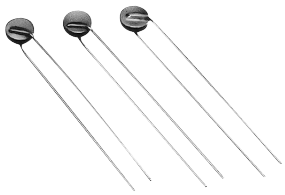



# Sensors

## Temperature Sensors
## PTC Thermistors

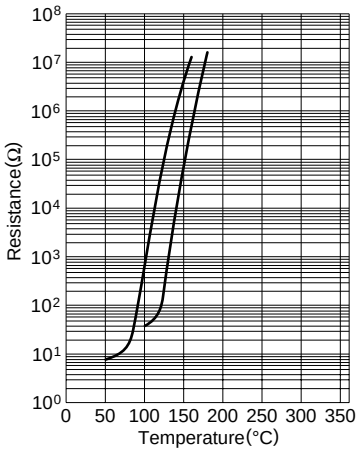
### PTC THERMISTORS FOR OVERCURRENT LIMITING
### SHAPES AND DIMENSIONS



Dimensions in mm

### RESISTANCE vs. TEMPERATURE CHARACTERISTICS




### ELECTRICAL CHARACTERISTICS

| Part No. | Switching temperature Ts (°C) | Rated voltage (V) | Initial resistance $R_{25}$(Ω) | Current on normal condition (mA) [at 25°C] | Maximum overcurrent (A) | Dimensions(mm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | øD max. | T max. | F | ød |
| 911X00C0R5MB15 | 100 | 16 | 0.5±20% | 900 | 5 | 15 | 4.5 | 10 | 0.6 |
| 911X01C010MB13 | 100 | 16 | 1±20% | 580 | 4 | 15 | 3.5 | 5 | 0.5 |
| 911X21D4R7MF10 | 120 | 35 | 4.7±20% | 320 | 1 | 9.6 | 5 | 5 | 0.6 |
| 911X21D070MJ07 | 120 | 60 | 7±20% | 220 | 1 | 8 | 4 | 5 | 0.6 |
| 911P81D100MN08 | 80 | 100 | 10±20% | 100 | 0.5 | 9 | 4 | 5 | 0.5 |
| 911P97E501YU10 | 90 | 400 | 500±40% | 20 | 0.2 | 11 | 7 | 5 | 0.65 |

• Coated products

## PTC THERMISTORS FOR MOTOR STARTING

### PRODUCT IDENTIFICATION

| 9 | 12 | X3 | 2 | E | 4R7 | N | Q | 18 | B1 |
|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |

(1) Product classification

| | |
|---|---|
| 9 | PTC thermistor |

(2) Applications/structures of the PTC thermistor

| | |
|---|---|
| 12 | For motor starting/element incorporated case type |
| 11 | For motor starting/element type single product |

(3) Switching temperature Ts

| | |
|---|---|
| X3 | 135°C (An approximate symbol is used for X3.) |
| X2 | 120°C |

(4) Specific resistance ρ

| | |
|---|---|
| 2 | less than 40 to 70 Ω • cm |
| 3 | less than 70 to 100 Ω • cm |
| 4 | less than 100 to 400 Ω • cm |
| 5 | less than 400 to 700 Ω • cm |
| 6 | less than 700 to 1000 Ω • cm |

(5) Resistance temperature coefficient α

| | |
|---|---|
| E | 22%/°C |
| D | 15%/°C |

(6) Nominal initial resistance $R_{25}$

R means the decimal point. The second and third digits in a symbol containing no R are significant figures respectively.
The first digit means the number of zero following the significant figure.

| | |
|---|---|
| 3R3 | 3.3Ω |
| 3R9 | 3.9Ω |
| 4R7 | 4.7Ω |
| 5R6 | 5.6Ω |
| 6R8 | 6.8Ω |
| 100 | 10Ω |
| 150 | 15Ω |
| 220 | 22Ω |
| 330 | 33Ω |
| 470 | 47Ω |
| 680 | 68Ω |

(7) Nominal initial resistance tolerance

| | |
|---|---|
| N | ±30% |
| M | ±20% |
| X | ±25% |
| Y | Special tolerance |

(8) Maximum rated voltage Erms

| | |
|---|---|
| Q | 200V(160 to 200V) |
| R | 240V(220 to 240V) |
| S | 300V(250 to 300V) |
| T | 360V(320 to 355V) |
| U | 400V |
| V | 500V(430 to 500V) |

(9) PTC element diameter

| | |
|---|---|
| 14 | ø14mm |
| 16 | ø16mm |
| 18 | ø17.5mm |
| 20 | ø20mm |

(10) Case type/circuit connection method symbol

| | |
|---|---|
| B0 | Plug-in case B type/CSIR |
| B1 | Plug-in case B type/RSIR |
| B2 | Plug-in case B type/RSCR |
| B3 | Plug-in case B type/CSR |
| C0 | Plug-in case C type/CSIR |
| C1 | Plug-in case C type/RSIR |
| C2 | Plug-in case C type/RSCR |
| C3 | Plug-in case C type/CSR |
| PS2 | Two-point fixed case type (Faston® tub terminal #187) |
| PS2A | Two-point fixed case type (Faston® tub terminal #250) |

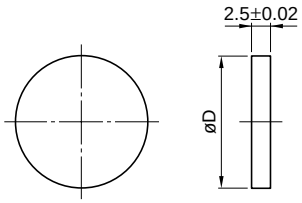
• Faston® is a registered trademark of AMP Incorporated.

# Sensors

## Temperature Sensors
## PTC Thermistors

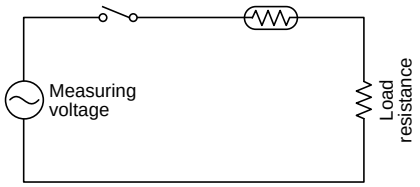
### PTC THERMISTORS FOR MOTOR STARTING

**SHAPES AND DIMENSIONS**




Dimensions in mm

**MEASURING CIRCUIT (at 25°C)**



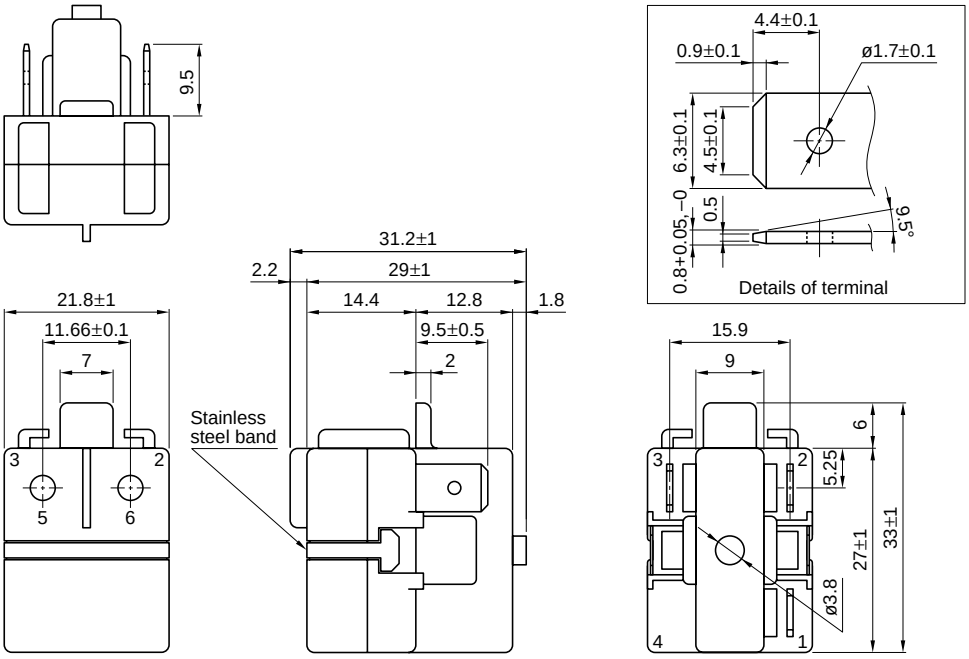

**UL FILE No., MAXIMUM RATED VOLTAGE AND MAXIMUM RATED CURRENT**

| Initial resistance | Switching temperature Ts | 135±10°C | | | | 120±10°C | |
|---|---|---|---|---|---|---|---|
| (Ω)±30% | øD±10% | 20mm | 17.5mm | 16mm | 14mm | 20mm | 17.5mm |
| | UL File No. | F20-3R3 | | | | E20-3R3 | |
| 3.3 | Max. rated voltage | 160V | | | | 160V | |
| | Max. rated current | 12A | | | | 12A | |
| | UL File No. | F20-3R9 | | | | E20-3R9 | |
| 3.9 | Max. rated voltage | 160V | | | | 160V | |
| | Max. rated current | 12A | | | | 12A | |
| | UL File No. | F20-4R7 | F18-4R7 | F16-4R7 | | E20-4R7 | E18-4R7 |
| 4.7 | Max. rated voltage | 180V | 180V | 160V | | 180V | 170V |
| | Max. rated current | 12A | 10A | 10A | | 12A | 12A |
| | UL File No. | F20-5R6 | F18-5R6 | F16-5R6 | | E20-5R6 | E18-5R6 |
| 5.6 | Max. rated voltage | 180V | 180V | 170V | | 180V | 190V |
| | Max. rated current | 12A | 10A | 10A | | 12A | 12A |
| | UL File No. | F20-6R8 | F18-6R8 | F16-6R8 | F14-6R8 | E20-6R8 | E18-6R8 |
| 6.8 | Max. rated voltage | 200V | 200V | 180V | 160V | 220V | 220V |
| | Max. rated current | 10A | 9A | 9A | 8A | 10A | 10A |
| | UL File No. | F20-100 | F18-100 | F16-100 | F14-100 | E20-100 | E18-100 |
| 10 | Max. rated voltage | 225V | 220V | 200V | 180V | 240V | 240V |
| | Max. rated current | 9A | 8A | 8A | 7A | 10A | 9A |
| | UL File No. | F20-150 | F18-150 | F16-150 | F14-150 | E20-150 | E18-150 |
| 15 | Max. rated voltage | 250V | 240V | 225V | 240V | 260V | 260V |
| | Max. rated current | 8A | 7A | 7A | 6A | 10A | 8A |
| | UL File No. | F20-220 | F18-220 | F16-220 | F14-220 | E20-220 | E18-220 |
| 22 | Max. rated voltage | 300V | 280V | 250V | 225V | 300V | 280V |
| | Max. rated current | 7A | 6A | 6A | 5A | 9A | 8A |
| | UL File No. | F20-330 | F18-330 | | F14-330 | E20-330 | E18-330 |
| 33 | Max. rated voltage | 355V | 320V | | 250V | 300V | 280V |
| | Max. rated current | 6A | 4A | | 4A | 9A | 7A |
| | UL File No. | F20-470 | F18-470 | | | E20-470 | E18-470 |
| 47 | Max. rated voltage | 400V | 350V | | | 300V | 300V |
| | Max. rated current | 5A | 4A | | | 9A | 6A |
| | UL File No. | F20-680 | F18-680 | | | E20-680 | E18-680 |
| 68 | Max. rated voltage | 430V | 400V | | | 320V | 300V |
| | Max. rated current | 4A | 4A | | | 9A | 5A |

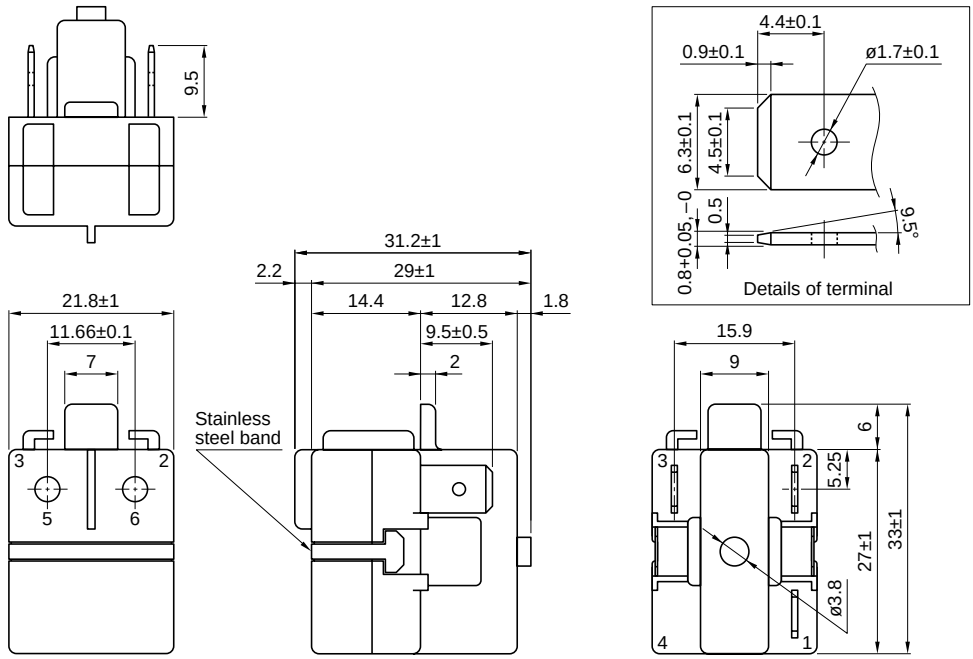
• Tolerances of initial resistance, switching temperature and product dimensions are UL recognized values.

**PTC THERMISTORS FOR MOTOR STARTING**
**PLUG-IN CASE, B AND C (Fail safe type) TYPES**
**SHAPES AND DIMENSIONS**

B TYPE




**C (Fail safe type) TYPE**




Dimensions in mm

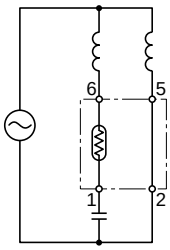
- Numbers of pin are differed from the starting style.

# Sensors

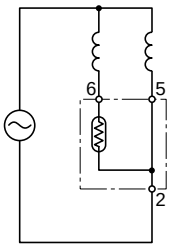
## Temperature Sensors
## PTC Thermistors

**PTC THERMISTORS FOR MOTOR STARTING**
**PLUG-IN CASE, B AND C (Fail safe type) TYPES**
**STARTING STYLES**

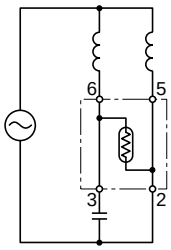
0:CSIR TYPE
Capacitor-start motor



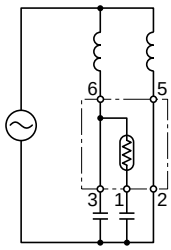

1:RSIR TYPE
Resistance-split-phase
Start motor




2:RSCR TYPE
Capacitor-drive



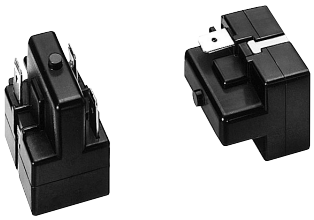

3:CSR TYPE
Capacitor-start-drive




**ELECTRICAL CHARACTERISTICS**
**SWITCHING TEMPERATURE Ts: 120°C(Ambient temperature 25°C)**

| Part No. | Initial resistance (Ω)±30% | Rated voltage Erms(V) | Withstand voltage*1 Erms(V) | Maximum rated current Irms(A) | Operating time (s)app. | Power consumption (W)max. | Resetting time (s)max. |
|---|---|---|---|---|---|---|---|
| 912X22E3R3NQ20-B*2X*3 | 3.3 | 160 | 240 | 12 | 0.6 | 3.2 | 120 |
| 912X22E3R9NQ20-BX | 3.9 | 160 | 240 | 12 | 0.6 | 3.2 | 120 |
| 912X22E4R7NQ20-BX | 4.7 | 180 | 270 | 12 | 0.6 | 3.2 | 120 |
| 912X22E5R6NQ20-BX | 5.6 | 180 | 270 | 12 | 0.6 | 3.2 | 120 |
| 912X23E6R8NQ20-BX | 6.8 | 220 | 330 | 10 | 0.6 | 3.2 | 120 |
| 912X24E100NR20-BX | 10 | 240 | 360 | 10 | 0.6 | 3.2 | 120 |
| 912X24E150NS20-BX | 15 | 260 | 390 | 10 | 0.6 | 3.2 | 120 |
| 912X24E220NS20-BX | 22 | 300 | 450 | 9 | 0.6 | 3.2 | 120 |
| 912X25E330NS20-BX | 33 | 300 | 450 | 9 | 0.6 | 3.2 | 120 |
| 912X25E470NS20-BX | 47 | 300 | 450 | 9 | 0.6 | 3.2 | 120 |
| 912X25E680NT20-BX | 68 | 320 | 480 | 9 | 0.6 | 3.2 | 120 |
| 912X22E4R7NQ18-BX | 4.7 | 170 | 255 | 12 | 0.4 | 3 | 100 |
| 912X22E5R6NQ18-BX | 5.6 | 190 | 285 | 12 | 0.4 | 3 | 100 |
| 912X22E6R8NQ18-BX | 6.8 | 220 | 330 | 10 | 0.4 | 3 | 100 |
| 912X23E100NQ18-BX | 10 | 240 | 360 | 9 | 0.4 | 3 | 100 |
| 912X24E150NR18-BX | 15 | 260 | 390 | 8 | 0.4 | 3 | 100 |
| 912X24E220NS18-BX | 22 | 280 | 420 | 8 | 0.4 | 3 | 100 |
| 912X24E330NS18-BX | 33 | 280 | 420 | 7 | 0.4 | 3 | 100 |
| 912X25E470NS18-BX | 47 | 300 | 450 | 6 | 0.4 | 3 | 100 |
| 912X25E680NS18-BX | 68 | 300 | 450 | 5 | 0.4 | 3 | 100 |

*1 Rated voltage×1.5, 1min
*2 Fail safe type:Please specify code C instead of B.
*3 Starting style code 0:CSIR/1:RSIR/2:RSCR/3:CSR



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**PLUG-IN CASE, B AND C (Fail safe type) TYPES**
**ELECTRICAL CHARATERISTICS**
**SWITCHING TEMPERATURE Ts: 135°C(Ambient temperature 25°C)**

| Part No. | Initial resistance (Ω)±30% | Rated voltage Erms(V) | Withstand voltage*1 Erms(V) | Maximum rated current Irms(A) | Operating time (s)app. | Power consumption (W)max. | Resetting time (s)max. |
|---|---|---|---|---|---|---|---|
| 912X32E3R3NQ20-B*2X*3 | 3.3 | 160 | 240 | 12 | 0.7 | 3.5 | 100 |
| 912X32E3R9NQ20-BX | 3.9 | 160 | 240 | 12 | 0.7 | 3.5 | 100 |
| 912X32E4R7NQ20-BX | 4.7 | 180 | 270 | 12 | 0.7 | 3.5 | 100 |
| 912X32E5R6NQ20-BX | 5.6 | 180 | 270 | 12 | 0.7 | 3.5 | 100 |
| 912X33E6R8NQ20-BX | 6.8 | 200 | 300 | 10 | 0.7 | 3.5 | 100 |
| 912X34E100NR20-BX | 10 | 225 | 340 | 9 | 0.7 | 3.5 | 100 |
| 912X34E150NS20-BX | 15 | 250 | 375 | 8 | 0.7 | 3.5 | 100 |
| 912X34E220NS20-BX | 22 | 300 | 450 | 7 | 0.7 | 3.5 | 100 |
| 912X35E330NT20-BX | 33 | 355 | 530 | 6 | 0.7 | 3.5 | 100 |
| 912X35E470NU20-BX | 47 | 400 | 600 | 5 | 0.7 | 3.5 | 100 |
| 912X36E680NV20-BX | 68 | 430 | 645 | 4 | 0.7 | 3.5 | 100 |
| 912X32E4R7NQ18-BX | 4.7 | 180 | 270 | 10 | 0.6 | 3.2 | 90 |
| 912X32E5R6NQ18-BX | 5.6 | 180 | 270 | 10 | 0.6 | 3.2 | 90 |
| 912X32E6R8NQ18-BX | 6.8 | 200 | 300 | 9 | 0.6 | 3.2 | 90 |
| 912X33E100NR18-BX | 10 | 220 | 330 | 8 | 0.6 | 3.2 | 90 |
| 912X34E150NR18-BX | 15 | 240 | 360 | 7 | 0.6 | 3.2 | 90 |
| 912X34E220NS18-BX | 22 | 280 | 420 | 6 | 0.6 | 3.2 | 90 |
| 912X34E330NT18-BX | 33 | 320 | 480 | 4 | 0.6 | 3.2 | 90 |
| 912X35E470NT18-BX | 47 | 350 | 525 | 4 | 0.6 | 3.2 | 90 |
| 912X35E680NU18-BX | 68 | 400 | 600 | 4 | 0.6 | 3.2 | 90 |
| 912X32E4R7NQ16-BX | 4.7 | 160 | 240 | 10 | 0.5 | 3 | 80 |
| 912X32E5R6NQ16-BX | 5.6 | 170 | 255 | 10 | 0.5 | 3 | 80 |
| 912X32E6R8NQ16-BX | 6.8 | 180 | 270 | 9 | 0.5 | 3 | 80 |
| 912X33E100NQ16-BX | 10 | 200 | 300 | 8 | 0.5 | 3 | 80 |
| 912X34E150NR16-BX | 15 | 225 | 340 | 7 | 0.5 | 3 | 80 |
| 912X34E220NS16-BX | 22 | 250 | 375 | 6 | 0.5 | 3 | 80 |
| 912X32E6R8NQ14-BX | 6.8 | 160 | 240 | 8 | 0.4 | 2.7 | 60 |
| 912X32E100NQ14-BX | 10 | 180 | 270 | 7 | 0.4 | 2.7 | 60 |
| 912X33E150NR14-BX | 15 | 240 | 340 | 6 | 0.4 | 2.7 | 60 |
| 912X34E220NR14-BX | 22 | 225 | 360 | 5 | 0.4 | 2.7 | 60 |
| 912X34E330NS14-BX | 33 | 250 | 375 | 4 | 0.4 | 2.7 | 60 |

*1 Rated voltage×1.5, 1min
*2 Fail safe type:Please specify code C instead of B.
*3 Starting style code 0:CSIR/1:RSIR/2:RSCR/3:CSR

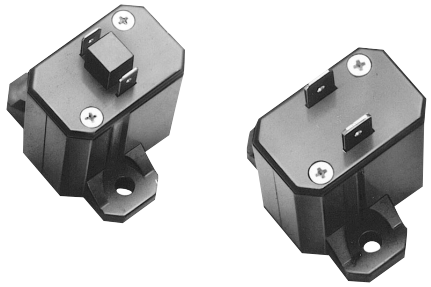
# Sensors

## Temperature Sensors
## PTC Thermistors

### PTC THERMISTORS FOR MOTOR STARTING

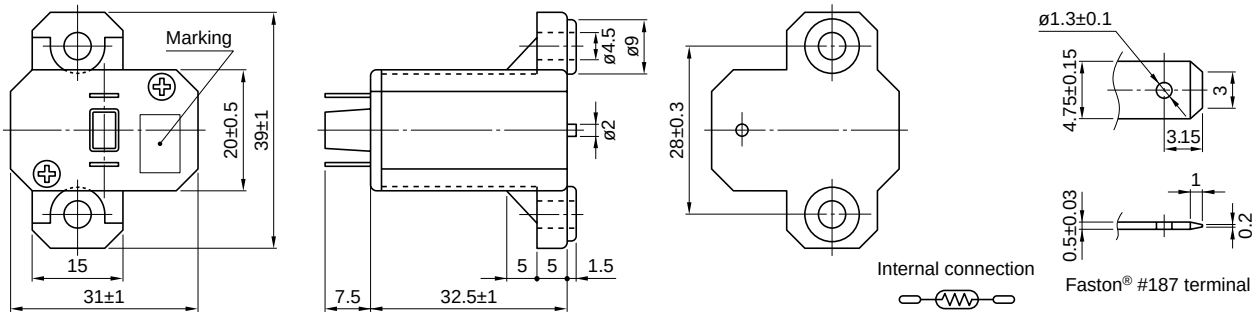
### FEATURES

- These are all UL recognized products (File No. E97354)
- They are available with all element types except the ø14mm type.

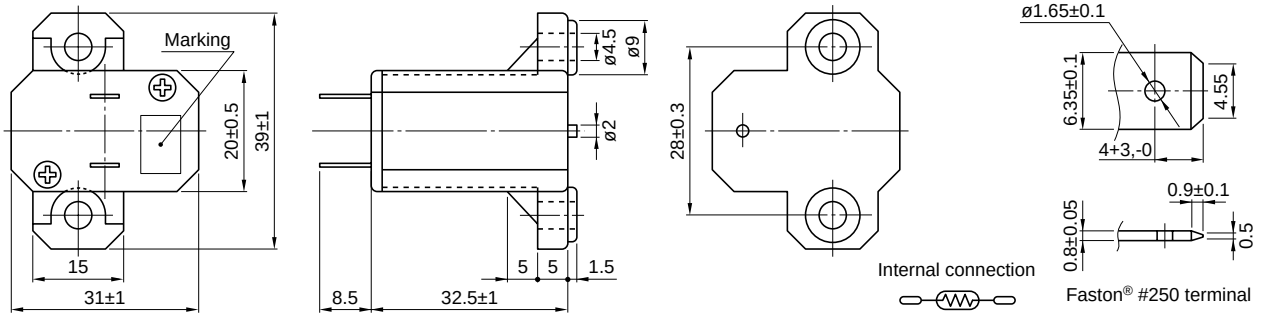


### SHAPES AND DIMENSIONS

**PS2**

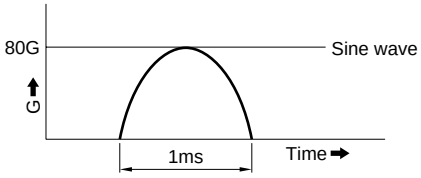



**PS2A**



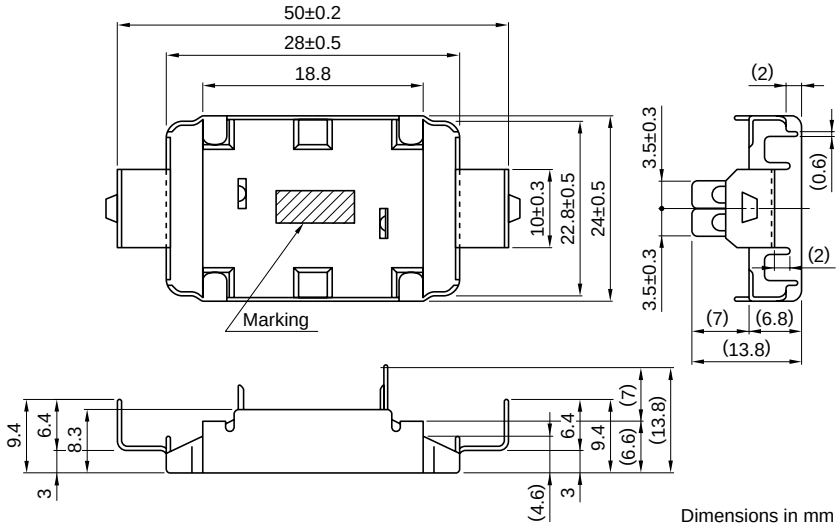

Dimensions in mm

### MECHANICAL CHARACTERISTICS

| Item | Test method | Specifications |
|---|---|---|
| Terminal part strength | Secure the sample and add the following pulling/pushing loads to each terminal for 10s.<br>Faston® tub terminal #187:98N (10kgf)<br>Faston® tub terminal #250:147N (15kgf) | Appearance: There shall be no structural abnormality such as lack of terminals. |
| Vibration resistance | Put a sample on the board steadily secured to the test machine in normal posture, and then apply cyclic up (30s) and down (30s) vibration of 3 mm/10 to 55Hz, in X, Y, and Z direction in the same manner as shown in the previous figure for 60min respectively. | Resistance change rate: ±10% max.<br>Appearance: There shall be no looseness, break, chipping, or cracking on each part. |
| Impact resistance | Secure a sample onto a mechanically strong fitting, and then apply 80G impulse (785m/s$^2$)* based on the below specifications upward/downward, left/right, and forward/backward respectively once (total 3 times).<br>*1G=9.80665m/s$^2$<br>  | Resistance change rate: ±10% max.<br>Appearance: There shall be no looseness, break, chipping, or cracking on each part. |

• Faston® is a registered trademark of AMP Incorporated.

**HEATERS FOR ELECTRONIC MOSQUITO KILLER (Example)**
**SHAPES AND DIMENSIONS**




Dimensions in mm

**Part No. 922Y17E152YR14-E**

**APPLICATION HEATERS FOR ELECTRONIC MOSQUITO KILLERS AND OTHER HEATERS**

**CHARACTERISTICS OF PTC THERMISTOR**

| | |
|---|---|
| Initial resistance value $R_{25}$ | 1 to 3kΩ[at 25°C] |
| Switching temperature | 210°C |

**CHARACTERISTICS**

| | |
|---|---|
| Resistance | 1 to 3kΩ[at 20°C] |
| Rated voltage Eac | 100V/240V 50/60Hz |
| Maximum current Irms | 0.6A[AC.110V], 1.5A[AC.240V] |
| Surface temperature | 163±5°C[at 25°C, AC.100V] |
| Power consumption | 4.5±1W |
| Safety standards | Electrical Appliance and Material Control Law, UL Certificated |

**RESISTANCE vs. TEMPERATURE CHARACTERISTICS**