

POWER THERMISTOR

The POWER THERMISTOR is a device for suppressing inrush current to an electric circuit. Circuits including electric bulbs or capacitors induce an inrush current more than 100 times the normal current when the circuit switch is turned on. The POWER THERMISTOR in the circuits protects electric equipments from being damaged by limiting the inrush current.

Application

The power thermistor will suppress inrush current which is caused by a capacitor, filament for a bulb, inverter for fluorescent lamp, a heater and etc., also will control fan motor speed of cooler for electric circuit.

It is developed to use for power supply of TV, VCR instead of cement resistor.

How to use the power thermistor



The most suitable power thermistor for the above circuit is required to fulfill the following terms and conditions.

1. The permissible current at ambient temperature of 55°C should be over 2A.
2. The thermistor resistance for suppressive current which becomes below 30A should be over 4.2 ohm from the under-mentioned formula.

$$\frac{\sqrt{2} V_E \times 1.1}{R_C + R_{25}} \leq 30$$

R_C : Internal resistance value in the circuit is 1 ohm (100V/100A)

R_{25} : Rated zero-power resistance at 25°C

3. Max. capacitance shall be over 2000 μ F at AC 100V.

Accordingly, suitable thermistors are 6D2-22, 5D2-18 and 8D2-18, and if we consider in the points of small time constant which means a small size and large effect for suppressive current which means large rated zero-power resistance, 8D2-18 is the most suitable one.

Use the following circuit in the power supply for 100V and 200V.



Thermal time constant

If ambient temperature of a thermistor is changed from T_1 to T_2 suddenly, temperature of the thermistor changes slowly.

The time constant means the time when temperature of the thermistor reaches 63% of the temperature difference.

Residual resistance

If current is flowed through a thermistor, any heat will be generated in the thermistor by which its resistance will be decreased, however, a decrease of a resistance will be stabilized at a saturation resistance value which is determined by impressed electric power and a dissipation constant. The residual resistance value means maximum saturation resistance value when the maximum permissible current is flowed through the thermistor.

Temperature coefficient α

The temperature coefficient of a thermistor is expressed by the following equation ;

$$\alpha = -\frac{B}{T^2} \times 100 (\%/^{\circ}\text{C})$$

Dissipation factor

If small voltage is applied to a thermistor, small current will flow which produce enough heat in the thermistor. Dissipation factor is electric power which make 1°C raise by heat in a thermistor.

$$\delta = \frac{P}{\Delta t} (\text{mW}/^{\circ}\text{C})$$

P is applied electric power.

Δt is risen temperature of the thermistor.

Maximum permissible current

If the maximum permissible current flows to a thermistor at 25°C, temperature of the thermistor rises to 200°C, (160°C). When ambient temperature is above 25°C, the maximum permissible current shall be over reduced as the maximum permissible current reduction curve.



Reliability tests

Version1

Dry heat test

Test sample is exposed in air at 160°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 15\%$

Damp heat test

Test sample is exposed in atmosphere of 95%RH at 40°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 15\%$

Load test

Test sample is applied the maximum rating current in air at 25°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 15\%$

Change of temperature

Test sample is given 10 times of the following temperature cycle,
 $\rightarrow -40^{\circ}\text{C}$ for 30 minutes \rightarrow room temperature for 5 minutes \rightarrow
 $\rightarrow 160^{\circ}\text{C}$ for 30 minutes \rightarrow room temperature for 5 minutes.
 $\Delta R_{25}/R_{25} \pm 15\%$

Version2

Dry heat test

Test sample is exposed in air at 150°C~200°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 20\%$

Damp heat test

Test sample is exposed in atmosphere of 95%RH at 40°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 15\%$

Load test

Test sample is applied the maximum rating current in air at 25°C for 1,000 hours. $\Delta R_{25}/R_{25} \pm 20\%$

Change of temperature

Test sample is given 10 times of the following temperature cycle,
 $\rightarrow -40^{\circ}\text{C}$ for 30 minutes \rightarrow room temperature for 5 minutes \rightarrow
 $\rightarrow 160^{\circ}\text{C}$ for 30 minutes \rightarrow room temperature for 5 minutes.
 $\Delta R_{25}/R_{25} \pm 15\%$

Part number



Applications

- Switching power supply
- Adapter
- LC, Plasma TV, DVD player
- AV, home electricity, Air-con
- OA, printer, PC
- etc.

Acquisition Standard

UL1434 File No. E92669



Specifications : D2 Series Version 1

| Part No. | Rated zero-power resistance (±15%) | Dissipation factor | Thermal time constant | Maximum current at 25°C | Residual resistance | Maximum permissible capacitance | | Category temperature range | |
|-------------|------------------------------------|--------------------|-----------------------|-------------------------|---------------------|---------------------------------|------|----------------------------|-----|
| | [Ω] | | | | | [mW/°C] | [S] | | [A] |
| 5D2-07 □ □ | 5.0 | (30) | (35) | 3.0 | 0.36 | 400 | 80 | -40~+160 | |
| 8D2-07 □ □ | 8.0 | | (41) | | | | | | |
| 10D2-07 □ □ | 10.0 | | (45) | 2.0 | 0.58 | 560 | 110 | | |
| 12D2-07 □ □ | 12.0 | | (41) | | | | | | |
| 16D2-07 □ □ | 16.0 | | (45) | 1.7 | 0.78 | 380 | 80 | | |
| 22D2-07 □ □ | 22.0 | | (50) | | | | | | |
| 2D2-10 □ □ | 2.0 | (32) | (50) | 5.0 | 0.15 | 1640 | 330 | | |
| 3D2-10 □ □ | 3.0 | | (53) | | | | | | |
| 5D2-10 □ □ | 5.0 | | (53) | | | | | | |
| 8D2-10 □ □ | 8.0 | | (70) | 4.0 | 0.22 | 1720 | 350 | | |
| 10D2-10 □ □ | 10.0 | | (75) | | | | | | |
| 12D2-10 □ □ | 12.0 | | (53) | | | | | | |
| 16D2-10 □ □ | 16.0 | | (70) | 3.0 | 0.52 | 1560 | 320 | | |
| 2D2-14 □ □ | 2.0 | | (90) | | | | | | |
| 3D2-14 □ □ | 3.0 | | (80) | | | | | | |
| 4D2-14 □ □ | 4.0 | | (36) | (95) | 5.0 | 0.20 | 3080 | | 630 |
| 5D2-14 □ □ | 5.0 | | | (110) | | | | | |
| 8D2-14 □ □ | 8.0 | | | (80) | | | | | |
| 10D2-14 □ □ | 10.0 | (95) | | 4.0 | 0.33 | 3600 | 740 | | |
| 12D2-14 □ □ | 12.0 | (105) | | | | | | | |
| 16D2-14 □ □ | 16.0 | (115) | | | | | | | |
| | | | | 2.5 | 0.47 | 1390 | 280 | | |
| | | | | 2.2 | 0.59 | 1790 | 370 | | |
| | | | | 2.0 | 0.71 | 2190 | 450 | | |
| | | | | 1.8 | 0.94 | 2790 | 570 | | |

*The rated values in "Dissipation factor" and "Thermal time constant" are for reference.

Specifications : D2 Series Version 2

| Part No. | Rated zero-power resistance (±15%) | Dissipation factor | Thermal time constant | Maximum current at 25°C | Residual resistance | Maximum permissible capacitance | | Category temperature range | Rated B-value (±5%) | |
|--------------|---------------------------------------|--------------------|-----------------------|-------------------------|---------------------|---------------------------------|---------|----------------------------|------------------------|----------|
| | [Ω] | [mW/°C] | [S] | [A] | [Ω] | AC.100V | AC.220V | (°C) | [K] | |
| 5D2-05 □ □ | 5.0 | (15) | (20) | 2.0 | 0.48 | 860 | 170 | -50~+150 | 2650 | |
| 10D2-05 □ □ | 10.0 | (7) | | 1.0 | 0.91 | | | | 2700 | |
| 20D2-05 □ □ | 20.0 | (1) | | 0.3 | 1.66 | | | | 2800 | |
| 5D2-08 □ □ | 5.0 | (22) | (35) | 3.0 | 0.35 | 1260 | 260 | -50~+170 | 2700 | |
| 10D2-08 □ □ | 10.0 | (17) | | 2.0 | 0.63 | | | | 2800 | |
| 15D2-08 □ □ | 15.0 | (26) | | | 1.0 | 0.94 | 2800 | | | |
| 20D2-08 □ □ | 20.0 | (8) | | 1.13 | | 2880 | 590 | | 2900 | |
| 2D2-11 □ □ | 2.0 | (26) | (40) | 5.0 | 0.15 | 2700 | 550 | -50~+170 | 2650 | |
| 3D2-11 □ □ | 3.0 | (24) | | 4.0 | 0.22 | 4830 | 990 | | 2650 | |
| 4D2-11 □ □ | 4.0 | (31) | | | | 0.28 | 2880 | | 590 | 2700 |
| 5D2-11 □ □ | 5.0 | (39) | | | | | 0.35 | | 2700 | 550 |
| 8D2-11 □ □ | 8.0 | (31) | | 3.0 | 0.50 | 2880 | 590 | | 2800 | |
| 10D2-11 □ □ | 10.0 | (42) | | 3.1 | 0.63 | | | | 2800 | |
| 12D2-11 □ □ | 12.0 | (21) | | 2.0 | 0.75 | 4030 | 830 | | 2800 | |
| 15D2-11 □ □ | 15.0 | (34) | | 2.5 | 0.80 | 2880 | 590 | | 2950 | |
| 16D2-11 □ □ | 16.0 | (37) | | | | | | | 0.86 | 2950 |
| 20D2-11 □ □ | 20.0 | (28) | | | | | | | 1.02 | 3000 |
| 1D2-13 □ □ | 1.0 | (12) | (55) | 6.0 | 0.06 | 860 | 170 | -50~+200 | 2650 | |
| 2D2-13 □ □ | 2.0 | (21) | | | 0.10 | | | | 2700 | |
| 4D2-13 □ □ | 4.0 | (24) | | | | | | | 5.0 | 0.18 |
| 4.7D2-13 □ □ | 4.7 | (26) | | 0.18 | 2900 | | | | | |
| 5D2-13 □ □ | 5.0 | (27) | | | 0.19 | 2900 | | | | |
| 8D2-13 □ □ | 8.0 | (25) | | 4.0 | 0.27 | 2880 | 590 | | 3000 | |
| 10D2-13 □ □ | 10.0 | (29) | | | 0.32 | | | | 3050 | |
| 12D2-13 □ □ | 12.0 | (37) | | | | 0.41 | 3000 | | | |
| 15D2-13 □ □ | 15.0 | (25) | | 3.0 | 0.48 | 4830 | 990 | | 3050 | |
| 16D2-13 □ □ | 16.0 | (26) | | | 0.51 | | | | 3050 | |
| 1D2-15 □ □ | 1.0 | (22) | (70) | | 8.0 | 0.06 | 6910 | 1420 | -50~+200 | 2650 |
| 1.5D2-15 □ □ | 1.5 | (29) | | 0.08 | | 2650 | | | | |
| 2D2-15 □ □ | 2.0 | (37) | | | | 0.10 | | | | 2700 |
| 3D2-15 □ □ | 3.0 | (36) | | 7.0 | 0.13 | 4030 | 830 | 2800 | | |
| 4D2-15 □ □ | 4.0 | (48) | | | 0.18 | | | 2800 | | |
| 4.7D2-15 □ □ | 4.7 | (37) | | 6.0 | | | | 0.18 | | 2900 |
| 5D2-15 □ □ | 5.0 | (39) | | | 0.19 | | | 2900 | | |
| 8D2-15 □ □ | 8.0 | (39) | | 5.0 | 0.27 | 5760 | 1190 | 3000 | | |
| 10D2-15 □ □ | 10.0 | (49) | | | 0.34 | | | 3000 | | |
| 12D2-15 □ □ | 12.0 | (54) | | | | | | 0.39 | | 3050 |
| 15D2-15 □ □ | 15.0 | (41) | | 4.0 | 0.45 | 5760 | 1190 | 3100 | | |
| 16D2-15 □ □ | 16.0 | (44) | | | 0.48 | | | 3100 | | |
| 4D2-18 □ □ | 4.0 | (59) | | | | | | 0.48 | | 3100 |
| 5D2-18 □ □ | 5.0 | (66) | | (90) | 8.0 | 0.16 | 6910 | 1420 | | -50~+200 |
| 8D2-18 □ □ | 8.0 | (53) | 6.0 | | 0.18 | 2950 | | | | |
| 10D2-18 □ □ | 10.0 | (62) | | | 0.26 | 3050 | | | | |
| 47D2-18 □ □ | 47.0 | (21) | 0.30 | | | 3100 | | | | |
| 3D2-22 □ □ | 3.0 | (48) | (130) | 8.0 | 0.94 | 12600 | 2610 | -50~+200 | 3450 | |
| 4D2-22 □ □ | 4.0 | (59) | | | 0.13 | | | | 2800 | |
| 6D2-22 □ □ | 6.0 | (43) | | | | | | | 0.16 | 2900 |
| | | | | 6.0 | 0.21 | | | | 3000 | |

Dimensions



①: Trade mark **S** ②: Part.No. (Notes 2) ③: Lot.No.

Notes1 : In case of adding strength to lead wire from the side, it may occur crack and fragment at a part of pants legs.

Notes2 : In case of D2-05, Marking is Resistance and D2. (example) 5D2-05... [5D2]

Dimensions Version 1

| Part No. | Dimensions [mm] | | | | | |
|--|-----------------|-----------|----------|---------|-----------|-----------|
| | D | H | T | d | H0 | lead wire |
| <input type="checkbox"/> D2-07 <input type="checkbox"/> <input type="checkbox"/> | max. 11.0 | max. 13.0 | max. 9.0 | 5.0±1.0 | max. 16.0 | (φ0.8) |
| <input type="checkbox"/> D2-10 <input type="checkbox"/> <input type="checkbox"/> | max. 13.0 | max. 17.0 | | | max. 19.5 | |
| <input type="checkbox"/> D2-14 <input type="checkbox"/> <input type="checkbox"/> | max. 17.0 | max. 21.0 | | 7.5±1.0 | max. 22.5 | |

Dimensions Version 2

| Part No. | Dimensions [mm] | | | | | |
|--|-----------------|----------|----------|----------|----------|-----------|
| | D | H | T | d | H0 | lead wire |
| <input type="checkbox"/> D2-05 <input type="checkbox"/> <input type="checkbox"/> | max 8.5 | max 11.5 | max. 7.0 | 5.0±1.0 | max 15.5 | (φ0.8) |
| <input type="checkbox"/> D2-08 <input type="checkbox"/> <input type="checkbox"/> | max 10.0 | max 13.0 | | | max 17.0 | |
| <input type="checkbox"/> D2-11 <input type="checkbox"/> <input type="checkbox"/> | max 11.5 | max 15.0 | | max. 8.0 | 7.5±1.0 | |
| <input type="checkbox"/> D2-13 <input type="checkbox"/> <input type="checkbox"/> | max 14.5 | max 18.0 | max 21.5 | | | |
| <input type="checkbox"/> D2-15 <input type="checkbox"/> <input type="checkbox"/> | max 16.5 | max 20.0 | 10.0±1.0 | | max 23.0 | (φ1.0) |
| <input type="checkbox"/> D2-18 <input type="checkbox"/> <input type="checkbox"/> | max 19.5 | max 23.0 | | | max 26.0 | |
| <input type="checkbox"/> D2-22 <input type="checkbox"/> <input type="checkbox"/> | max 23.0 | max 26.5 | max. 8.5 | max 29.5 | | |

Taping

Clinch type taping : T3C



Taping qty

version 1

| | |
|-------|-------------------|
| D2-07 | 1,000pcs/box |
| D2-10 | |
| D2-14 | (Part 500pcs/box) |

version 2

| | |
|-------|-------------------|
| D2-05 | 1,000pcs/box |
| D2-08 | |
| D2-11 | |
| D2-13 | (Part 500pcs/box) |

Straight type taping : T3D



Dimensions (Version 1)

Unit(mm)

| | P | P0 | P1 | W | W0 | W1 | W2 | H1 |
|-------|-----------|----------|----------|-----------|---------|---------|--------|----------|
| D2-07 | 15.0±1.0 | 15.0±3.0 | 5.0±0.7 | 17.5~19.0 | min5.0 | 9.0±0.5 | max3.0 | 16.0±0.5 |
| D2-10 | 15.0±1.0 | | | | | | | |
| D2-14 | 30.0±1.0 | | 3.75±0.7 | | | | | |
| | H2 | L | F1 | φD0 | t | t1 | Δh | |
| D2-07 | 19.0~21.5 | max1.0 | 5.0±0.5 | 4.0±0.2 | 0.6±0.3 | max1.5 | 0±2.0 | |
| D2-10 | | | | | | | | |
| D2-14 | | | 7.5±0.5 | | | | | |

Dimensions (Version 2)

| | P | P0 | P1 | W | W0 | W1 | W2 | H1 |
|-------|-----------|----------|----------|-----------|---------|---------|--------|----------|
| D2-05 | 15.0±1.0 | 15.0±3.0 | 5.0±0.7 | 17.5~19.0 | min5.0 | 9.0±0.5 | max3.0 | 16.0±0.5 |
| D2-08 | 15.0±1.0 | | | | | | | |
| D2-11 | 15.0±1.0 | | | | | | | |
| D2-13 | 30.0±1.0 | | 3.75±0.7 | | | | | |
| | H2 | L | F1 | φD0 | t | t1 | Δh | |
| D2-05 | 19.0~21.5 | max1.0 | 5.0±0.5 | 4.0±0.2 | 0.6±0.3 | max1.5 | 0±2.0 | |
| D2-08 | | | | | | | | |
| D2-11 | | | | | | | | |
| D2-13 | | | 7.5±0.5 | | | | | |

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