

# 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 2000μF 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 $\alpha$

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.

$\Delta t$  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,  
 → -40°C for 30 minutes → room temperature for 5 minutes →  
 → 160°C for 30 minutes → 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,  
 → -40°C for 30 minutes → room temperature for 5 minutes →  
 → 160°C for 30 minutes → 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]	
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		(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]
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)			0.94	2880	590		2800	
20D2-08 □ □	20.0	(8)		1.0	1.13				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	2700
8D2-11 □ □	8.0	(31)		3.0	0.50	2800				
10D2-11 □ □	10.0	(42)		3.1	0.63	2880	590		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)							2.0	1.02
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)							0.18	2800
4.7D2-13 □ □	4.7	(26)		5.0	0.18	2700	550		2900	
5D2-13 □ □	5.0	(27)			0.19				2900	
8D2-13 □ □	8.0	(25)			0.27	2880	590		3000	
10D2-13 □ □	10.0	(29)		4.0	0.32				3050	
12D2-13 □ □	12.0	(37)		3.0	0.41	4830	990		3000	
15D2-13 □ □	15.0	(25)			0.48				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	4030	830		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)	0.45					3100		
16D2-15 □ □	16.0	(44)	4.0	0.48	3100					
4D2-18 □ □	4.0	(59)	(90)	8.0	0.16	6910	1420	-50~+200	2900	
5D2-18 □ □	5.0	(66)			0.18				2950	
8D2-18 □ □	8.0	(53)		6.0					0.26	3050
10D2-18 □ □	10.0	(62)			0.30				3100	
47D2-18 □ □	47.0	(21)		2.0	0.94				3450	
3D2-22 □ □	3.0	(48)	(130)	8.0	0.13	12600	2610	-50~+200	2800	
4D2-22 □ □	4.0	(59)			0.16				2900	
6D2-22 □ □	6.0	(43)							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 18.5		
<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	max. 8.0	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	