聚鼎科技股份有限公司
TTC. POLYTRONICS TECHNOLOGY CORP.

PPTC Introduction

Sales & Marketing Division 2020

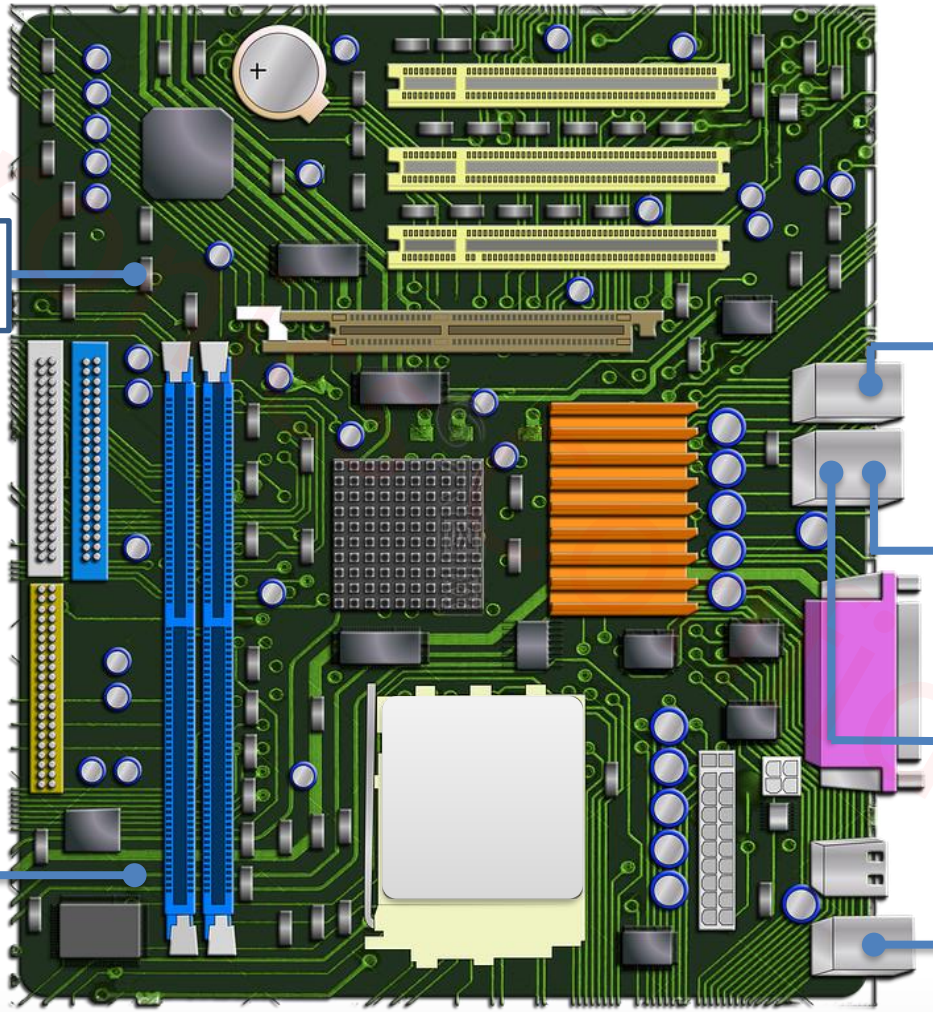
Polytronics Confidential

Why we need PPTC (AND/OR OCP OVP)

- **Safety regulation – Highly demand**
  - DC-in
  - Power supply

- **Risk prevention - Customary using**
  - Reverse connection
  - RJ45
  - I/O port

Safety regulation - Desktop Computer



LED RGB

DIMM

Graphics card

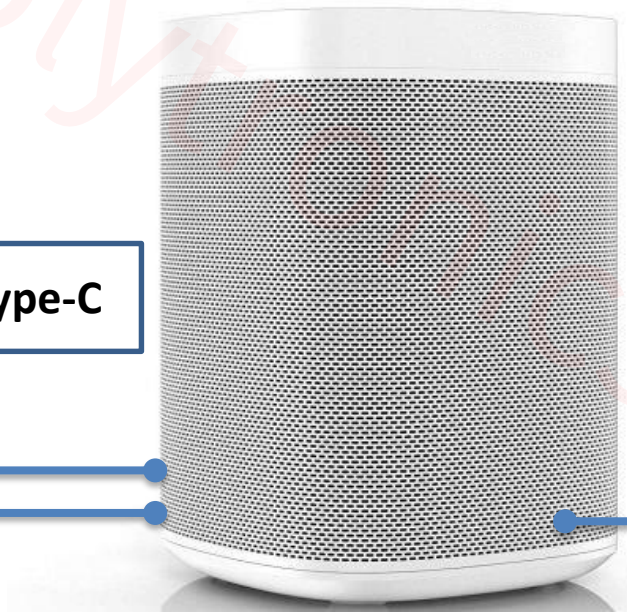
USB 2.0

USB 3.1 Gen 1

USB 3.1 Gen 2

PS/2

Safety regulation



USB, Type-C

DC-in

Battery Pack

Battery Pack

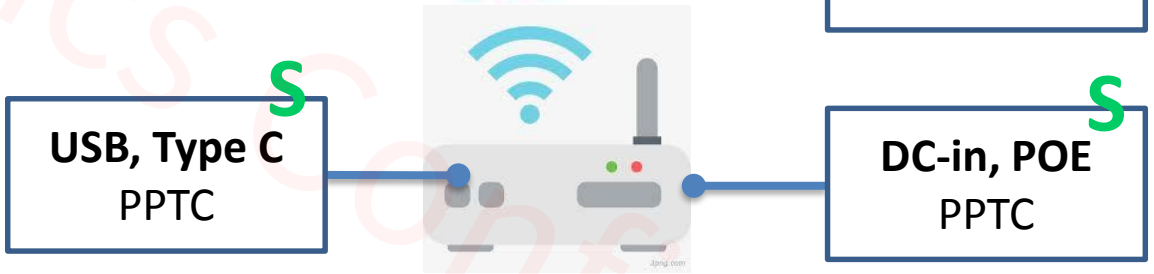
Cloud, Industry 4.0

S: Safety regulation

R: Risk prevention

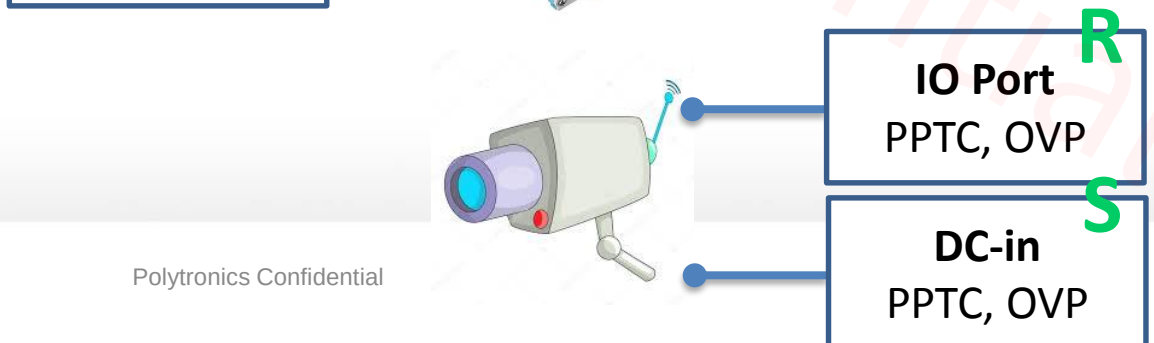
■Cloud and Server

■Netcom



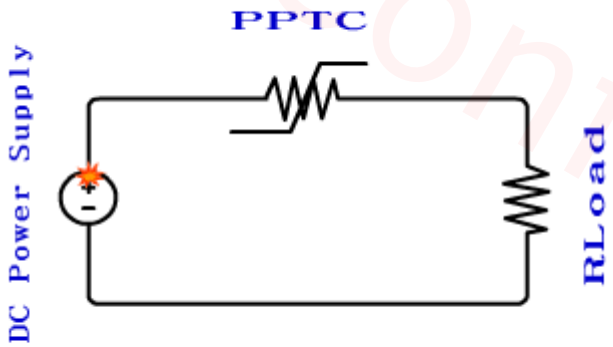
■IO HUB

■Sensor and CCTV



PPTC Theory

In generally, PPTC would place in series circuit of power supply source. During abnormal condition such as over current/ over load, PPTC resistance would increase from lower level to higher level. PPTC with higher resistance would limit the power supply.

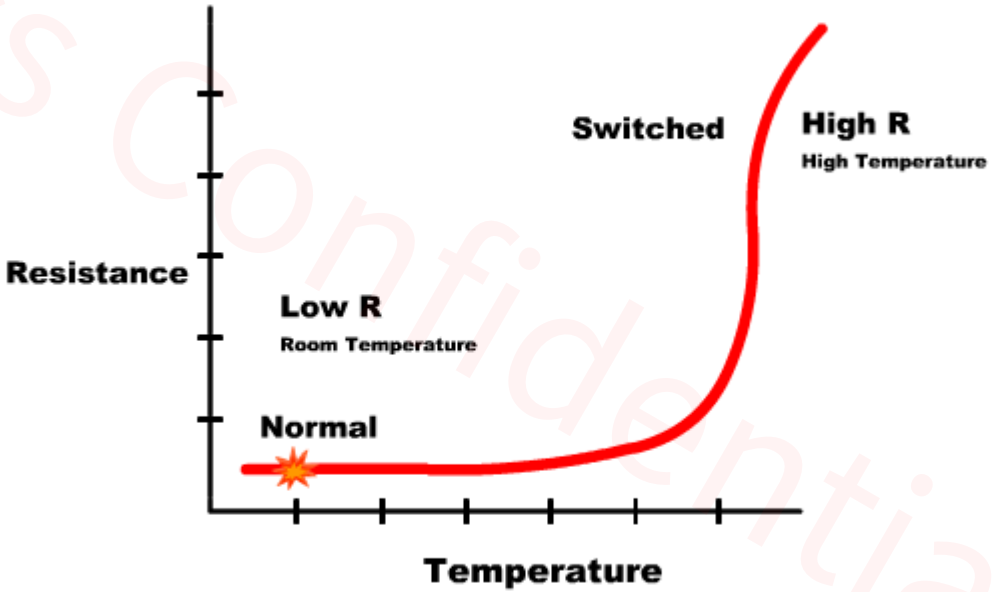


PPTC Theory

PPTC = Polymeric Positive Temperature Coefficient

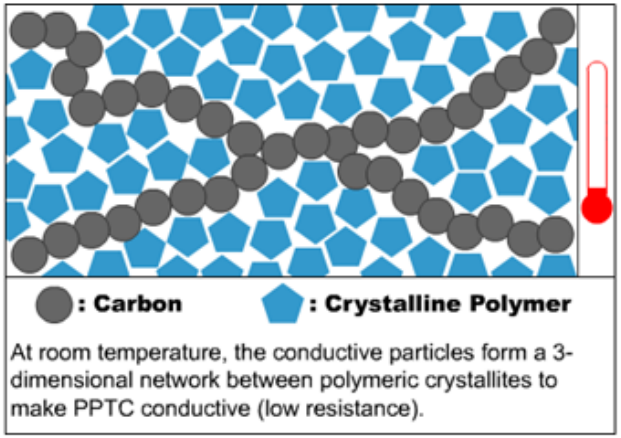
PPTC Theory

- Device resistance would increase as temperature increased.
- Device would be heat up by abnormal electrical current (I^2R) and/ or environment temperature. At that time, the PPTC resistance would increase rapidly to limit electrical current.

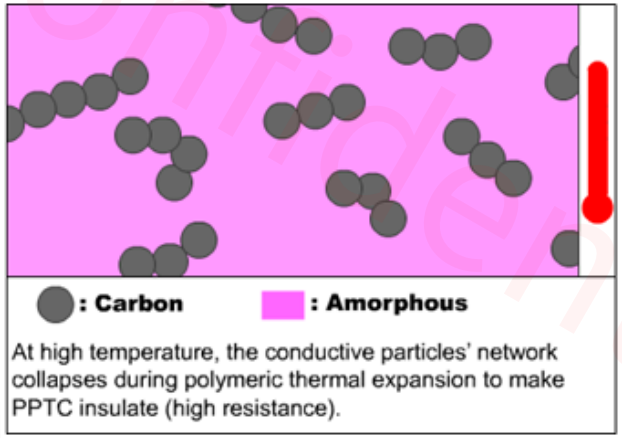


PPTC Theory

The PPTC material is containing with conductive filler and crystalline polymer. Under normal condition, conductive filler would compact together present with low resistance. When the temperature goes up into abnormal condition such as over current/ over load, the crystalline polymer would melt and expansion. The melting polymer would pull conductive filler apart. Losing compact conductive filler would present with higher resistance. After abnormal condition resolve, temperature decreased, the conductive filler would back together to present with lower resistance. Due to this mechanism, PPTC would also be named with resettable fuse.



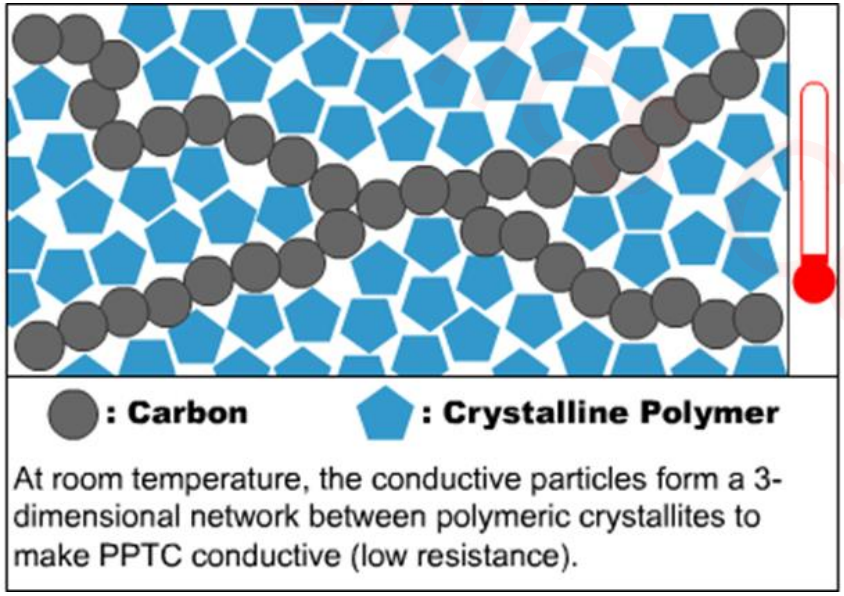
Normal



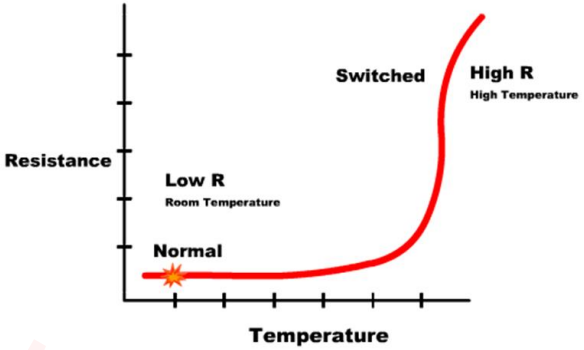
Over current/ over load

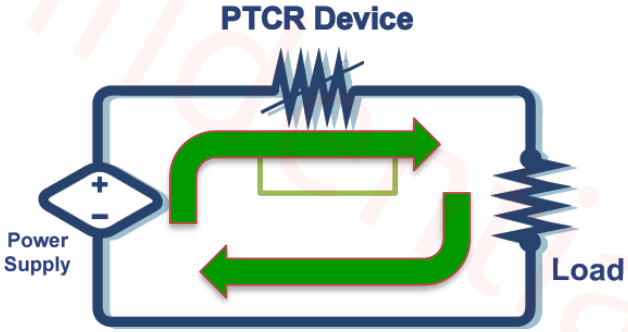
PTC Conductive Principle

Polymer structure at room temp.



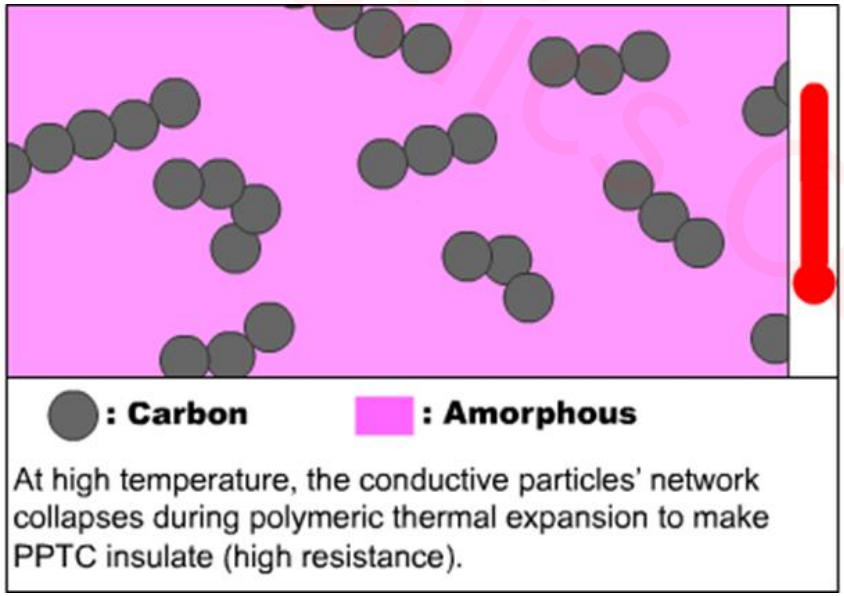
At room temperature, the conductive particles form a 3-dimensional network between polymeric crystallites to make PPTC conductive (low resistance).



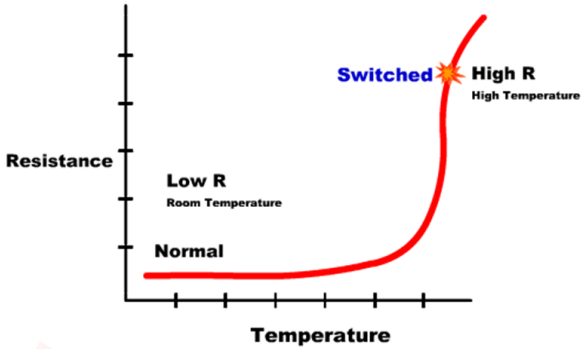


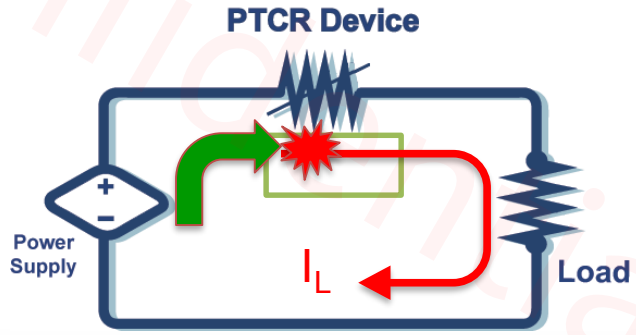
PTC Conductive Principle

Polymer structure at high temp.



At high temperature, the conductive particles' network collapses during polymeric thermal expansion to make PPTC insulate (high resistance).





Advanced Material

Low Temp. PTC (VTD,VLD)

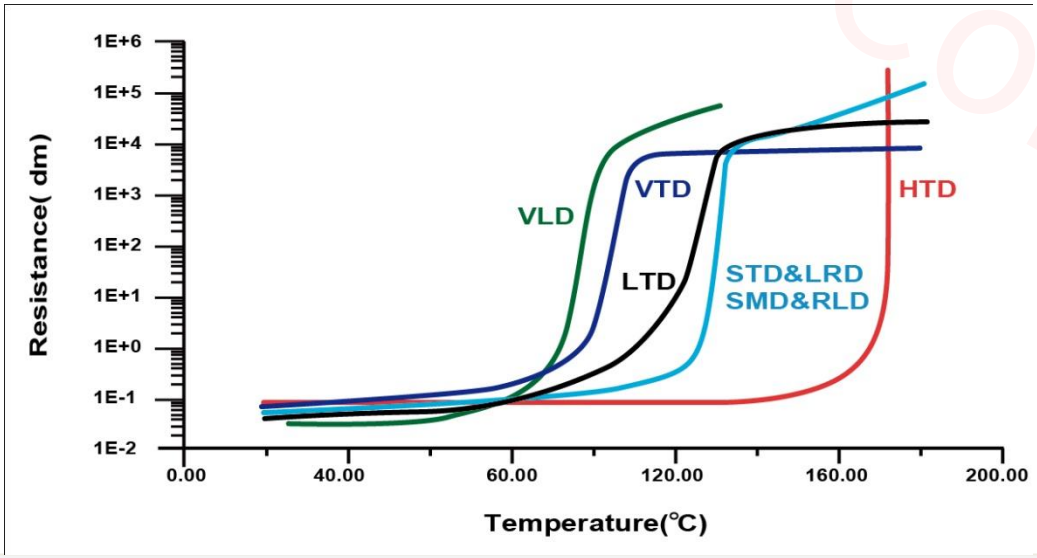
- Over-temperature & over-current protection
- **Low rho (<30mohm), high voltage (>16V), fast reaction**
- **Low trip temperature (<90°C)**

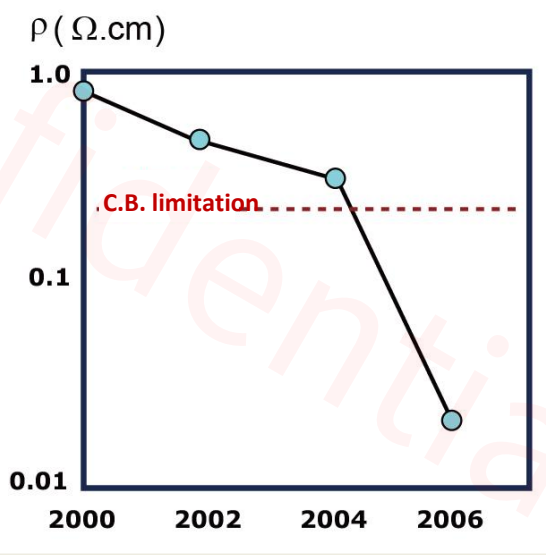
High Temp. PTC (HTD)

- Hold at high temp; trip when temperature lower
- **Terrific resistance recovering ability**
- **Ideal for vehicle motors**

Low Rho PTC (SLR, SMW, SLD)

- Breakthrough the conduct limitation of Carbon
- **Low rho, small size**
- **Metal oxidation conquered**
- **Volume resistance (r)<0.03 ohm.cm**





PPTC Characteristic

I_{hold} = Hold current

maximum current device will pass without tripping in 23ºC still air.

保持電流(工作電流)

在限定環境狀態下，可通過PPTC保險絲，且不會導致其跳動的最大電流。

Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)	cULus	
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

PPTC Characteristic

I_{trip} = Trip current

minimum current at which the device will trip in 23 ºC still air.

最小跳動電流

電流通過PPTC保險絲時，可使元件在限定狀態下跳動的最小電流。

Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)		
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

PPTC Characteristic

V_{max} = Maximum Voltage

最大電壓

在限定誤動作情況下，處於跳動狀態的PPTC保險絲能安全地承受跨於元件兩端的最高電壓。

Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)		
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

PPTC Characteristic

I_{max} = Maximum Current

最大電流

在限定狀態下，可安全使用之PPTC保險絲的最大誤動作電流。

Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)		
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

PPTC Characteristic

Maximum Time-to-Trip

最大跳動時間

指由誤動作電流導通至PPTC保險絲跳動所需的時間。
對PPTC保險絲而言，跳動時間視誤動作電流的大小與環境溫度而定。
誤動作電流愈大或溫度愈高，其跳動時間就愈短。

Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)		
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

PPTC Characteristic

R_{min}= Minimum resistance of device in initial (un-soldered) state.

是指安裝到電路中之前，在23℃的環境下，PPTC保險絲的阻值。
元件的製造是以阻值的範圍來分類。

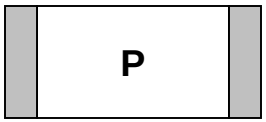
R_{1max} = Maximum resistance of device at 23 ºC measured one hour after tripping or reflow soldering of 260 ºC for 20 sec.

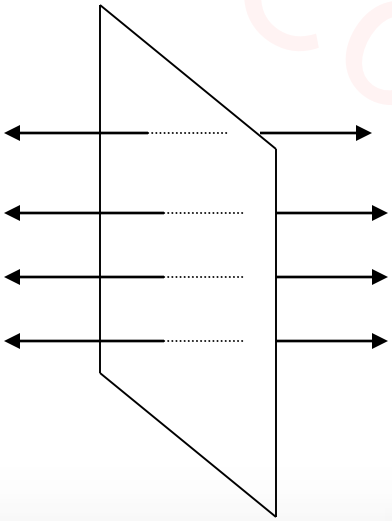
Part Number	I_{hold} (A)	I_{trip} (A)	V_{max} (Vdc)	I_{max} (A)	$P_{d\ typ}$ (W)	Maximum Time To Trip		Resistance		Agency Approval	
						Current (A)	Time (Sec.)	R_{min} (Ω)	R_{1max} (Ω)		
SMD1206P012TF	0.125	0.29	30	100	0.6	1.00	0.20	1.500	6.000	✓	✓
SMD1206P016TF	0.16	0.37	30	100	0.6	1.00	0.30	1.200	4.500	✓	✓
SMD1206P020TF/24	0.20	0.42	24	100	0.6	8.00	0.10	0.650	2.600	✓	✓
SMD1206P025TF	0.25	0.50	16	100	0.6	8.00	0.08	0.550	2.300	✓	✓
SMD1206P035TF/16	0.35	0.75	16	100	0.6	8.00	0.10	0.300	1.200	✓	✓
SMD1206P050TF	0.50	1.00	6	100	0.6	8.00	0.10	0.150	0.700	✓	✓
SMD1206P050TF/15	0.50	1.00	15	100	0.6	8.00	0.10	0.150	0.750	✓	✓
SMD1206P075TFT	0.75	1.50	8	100	0.6	8.00	0.20	0.090	0.290	✓	✓
SMD1206P075TF/13.2	0.75	1.50	13.2	100	0.6	8.00	0.20	0.090	0.350	✓	✓
SMD1206P110TFT	1.10	2.20	8	100	0.8	8.00	0.10	0.040	0.210	✓	✓
SMD1206P150TFT	1.50	3.00	8	100	0.8	8.00	0.30	0.040	0.120	✓	✓

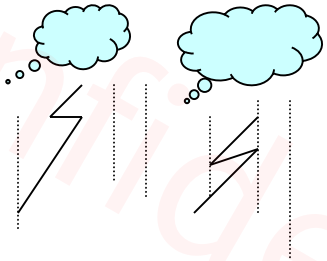
Heat Transfer & Electrical Prop. of PPTC

- PPTC devices are very sensitive to ambient temperature.
  - Their electrical properties, such as hold/trip current, power dissipation, time to trip, reflow resistance, are determined by device composition, structure and production processes under equilibrium condition of ambient temperatures

DEVICE PARAMETERS | HEAT TRANSFER | AMBIENT CONDITIONS





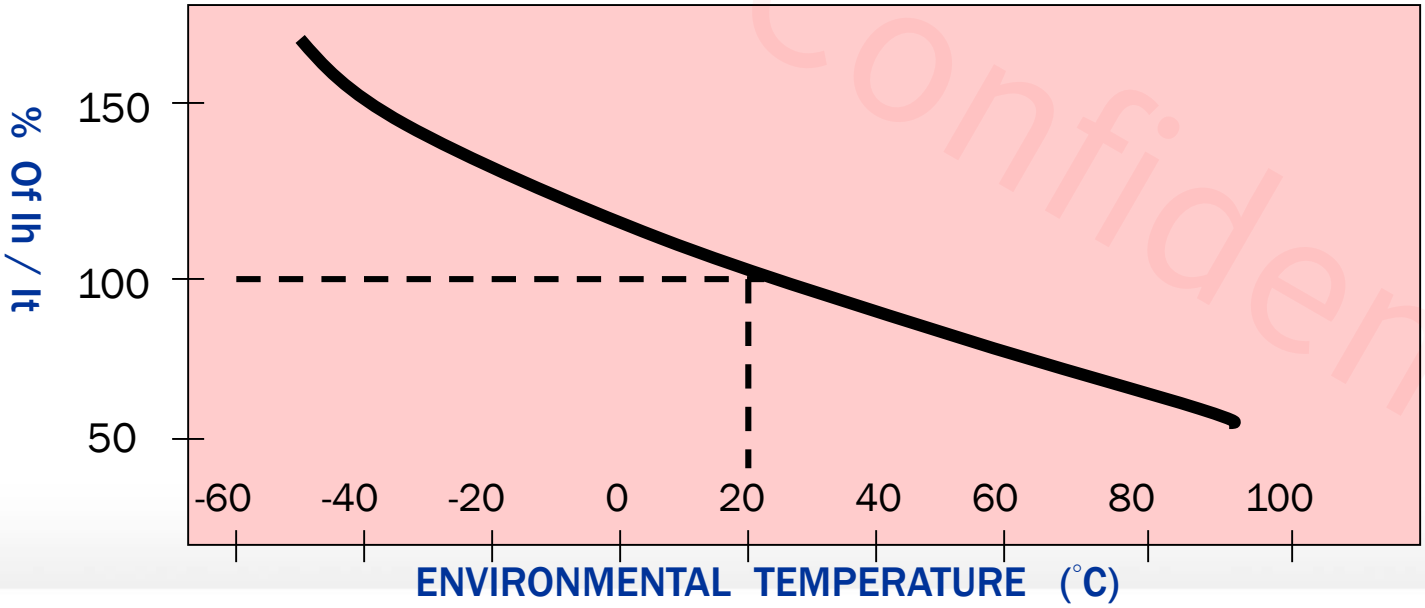


HOLD CURRENT (I-hold)
TRIP CURRENT (I-trip)
TIME TO TRIP (TtT)
POWER DISSIPATION (Pd)

*** AMBIENT TEMPERATURE**
*** AIR FLOW**
*** HEAT SINK**

Thermal Derating

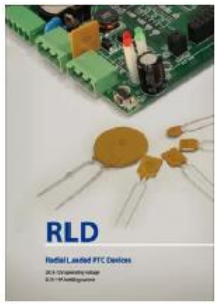
- As Ambient Operation Temperatures Increase, Heat Transfer Efficiency Become Slow.
- As Heat Transfer Efficiency Is Slow, Pd, T-to-T, IH, And IT All Decreases .
- A Proper PPTC Device Can Be Selected , ONLY When The Working Temperature Is Specified .



PPTC Selection Guide

- **Determine Operating Parameters of Circuits**
  - Normal operation current (I hold)
  - Maximum circuit voltage (V max)
  - Maximum interrupt current (I max)
  - Normal operating temperature surrounding device (min^{o}C/ max^{o}C)

- **Select the device form factor and dimension**
  - Surface mount device (SMD Series)
  - Axial leaded device (ALD Series)
  - Radial leaded device (RLD Series)
  - Customized device (Disc/ Chip/ terminal)



- **Confirmation**
  - Compare the maximum rating for Vmax and Imax of the PPTC device with the circuit in application and make sure the circuit's requirement does not exceed the device rating.
  - Check that PPTC device's trip time (time-to-trip) will protect the circuit.
  - Verify that the circuit operating temperature is within the PPTC device's normal operating temperature range.
  - Verify the performance and suitability of the chosen PPTC device in the application.