



**European Thermodynamics Limited**  
*Intelligent Thermal Management*

## Introduction to PTC Heaters

Positive Temperature Coefficient (PTC) heaters are a type of self-regulating electric heater that utilize the 'PTC' effect. These components are unique because their resistance increases as the temperature rises, resulting in a self-limiting heating effect. PTC heaters are widely used in various applications due to their safety, reliability, and efficiency.

### **Operating Principles**

The fundamental principle behind PTC heaters is the positive temperature coefficient effect. This means that as the temperature of the PTC material increases, its electrical resistance also increases. Here's a step-by-step breakdown of how they work:

**Initial Heating:** When an electric current passes through the PTC thermistor, it begins to heat up due to its electrical resistance.

**Resistance Increase:** As the temperature of the thermistor rises, its resistance increases exponentially. This increase in resistance reduces the current flow, causing the heating rate to decrease.

**Self-Regulation:** Eventually, the thermistor reaches a point where the heat generated by the electrical current balances with the heat dissipated to the surroundings. This equilibrium ensures that the heater maintains a stable temperature without overheating.

### **Types of PTC Materials**

PTC heaters are typically made from ceramic materials, such as barium titanate, which exhibit strong positive temperature coefficient properties. These materials are doped with various elements to achieve the desired electrical and thermal characteristics. The two main types of PTC materials are:

#### **European Thermodynamics Limited**

8 Priory Business Park, Kibworth  
Leicestershire LE8 0RX, UK

info@etdyn.com +44 (0)116 279 6899

[www.europanthermodynamics.com](http://www.europanthermodynamics.com)

Company registration number 4345086. Registered in England & Wales.  
VAT registration number 787 3265 86.  
Registered office: Unit C5, Welland Industrial Estate,  
Valley Way, Market Harborough LE16 7PS, UK.  
Directors N. Porter and K. Simpson





**European Thermodynamics Limited**  
*Intelligent Thermal Management*

**Polymer PTC (PPTC):** These are composite materials that combine polymers with conductive particles. They are often used in circuit protection devices.

**Ceramic PTC (CPTC):** These are ceramic-based materials, widely used in heating applications due to their stability and durability.

### Advantages of PTC Heaters

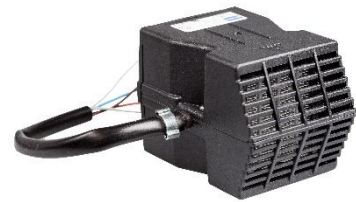
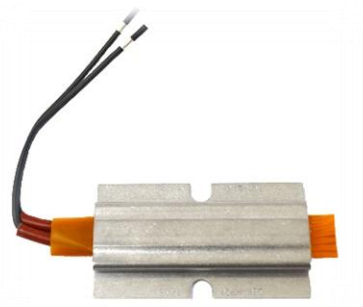
PTC heaters offer several benefits over traditional resistive heating elements:

**Safety:** The self-regulating nature of PTC heaters prevents them from overheating, reducing the risk of fire and damage.

**Efficiency:** They quickly reach their operating temperature and maintain it without the need for complex control systems.

**Reliability:** PTC heaters have a long lifespan and are less prone to failure compared to traditional heaters.

**Versatility:** They can be used in a wide range of applications, from automotive to household appliances.



[PTC Heaters Archives - European Thermodynamics Limited](#)

### European Thermodynamics Limited

8 Priory Business Park, Kibworth  
Leicestershire LE8 0RX, UK

info@etdyn.com +44 (0)116 279 6899

[www.europanthermodynamics.com](http://www.europanthermodynamics.com)

Company registration number 4345086. Registered in England & Wales.  
VAT registration number 787 3265 86.  
Registered office: Unit C5, Welland Industrial Estate,  
Valley Way, Market Harborough LE16 7PS, UK.  
Directors N. Porter and K. Simpson





**European Thermodynamics Limited**  
*Intelligent Thermal Management*

## Applications of PTC Heaters

PTC heaters are used in various industries and applications, including:

**Automotive:** PTC heaters are commonly used in electric vehicle (EV) battery thermal management systems, cabin heating, and seat warmers.

**Consumer Electronics:** They are used in devices like hair dryers, curling irons, and electric blankets for safe and consistent heating.

**Industrial Equipment:** PTC heaters are employed in dehumidifiers, air conditioners, and HVAC systems to provide efficient heating.

**Medical Devices:** They are used in equipment like blood analyzers and incubators, where precise temperature control is crucial.

## Design Considerations

When designing PTC heaters, several factors need to be considered:

**Temperature Range:** The PTC material should be selected based on the desired operating temperature range.

**Voltage and Current:** The electrical characteristics of the PTC heater must match the power supply and load requirements.

**Thermal Management:** Proper heat dissipation and thermal management are essential to maintain the heater's efficiency and longevity.

**Inrush curve:** See below document extract

## European Thermodynamics Limited

8 Priory Business Park, Kibworth  
Leicestershire LE8 0RX, UK

info@etdyn.com +44 (0)116 279 6899

[www.europanthermodynamics.com](http://www.europanthermodynamics.com)

Company registration number 4345086. Registered in England & Wales.  
VAT registration number 787 3265 86.  
Registered office: Unit C5, Welland Industrial Estate,  
Valley Way, Market Harborough LE16 7PS, UK.  
Directors N. Porter and K. Simpson

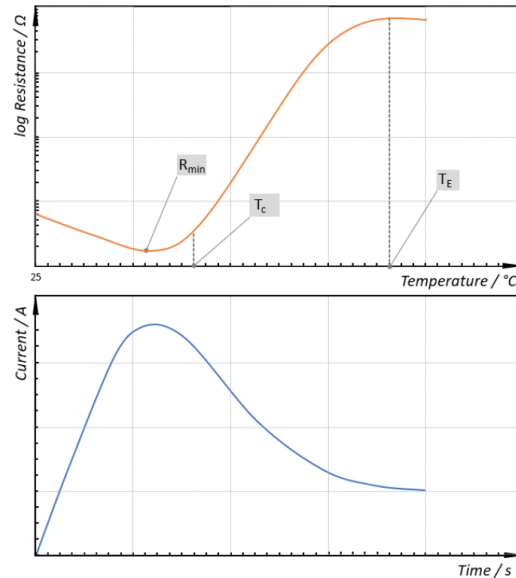




**European Thermodynamics Limited**  
Intelligent Thermal Management

## Characteristic PTC Curve

The typical resistance curve of a semiconductor as a function of temperature is called PTC curve. The initial resistance of the PTC first decreases slightly with increasing temperature until the lowest resistance value  $R_{min}$  is reached. Now the actual PTC behavior begins as the resistance increases non-linearly up to the nominal temperature  $T_c$ . At this point, also known as Curie temperature, the PTC's resistance increases significantly. The operating range of the PTC extends from the nominal temperature  $T_c$  to the maximum final temperature  $T_E$ , where hardly any current flows. The maximum temperature of a PTC depends on its ceramic composition and can therefore be determined in advance. Another characteristic of the PTC is its inrush current. As the resistance of the PTC is at its lowest value in  $R_{min}$ , a particularly large amount of current can flow there, causing it to undergo an increased inrush current for a few seconds each time it is switched on.



## Conclusion

PTC heaters are an innovative solution for various heating applications, offering safety, reliability, and efficiency. By leveraging the positive temperature coefficient effect, these heaters provide self-regulating, consistent heat output, making them ideal for a wide range of industries and applications.

For further technical details, compliance and tech-data, please look up the SKU of interest and download the attachments.

For design-in support, please send an email to [info@etdyn.com](mailto:info@etdyn.com).

## European Thermodynamics Limited

8 Priory Business Park, Kibworth  
Leicestershire LE8 0RX, UK

[info@etdyn.com](mailto:info@etdyn.com) +44 (0)116 279 6899

[www.europanthermodynamics.com](http://www.europanthermodynamics.com)

Company registration number 4345086. Registered in England & Wales.  
VAT registration number 787 3265 86.  
Registered office: Unit C5, Welland Industrial Estate,  
Valley Way, Market Harborough LE16 7PS, UK.  
Directors N. Porter and K. Simpson

