DuPont 7292

PTC CARBON RESISTOR

Technical Data Sheet

Product Description

Carbon-based PTC resistor paste DuPont 7292 can be used in self-regulating heating circuits that operate at <80ºC. The Positive Temperature Coefficient (PTC) of the cured film can be used to design circuits which heat up quickly to an equilibrium temperature and then stabilize at that temperature without external controls.

Product Benefits

- Self-thermostating temperature control
- Power reduction at operating temperature
- Fast warm-up to operating temperature
- Thermal stability at 90°C for 24hrs
- Power on/off cycling stability - with rapid plateau
- Adhesive compatibility – wide range/choice available

Self-Regulating Features

For heating/de-misting applications, the required heater resistance is designed around the approximate ~15KΩ/☐ paste by placing varying geometry resistors in series or parallel. Depending on the power applied and the ambient temperature when the circuit is powered up, it will rapidly heat and self-regulate at the designed operating temperature. At this point, a considerable increase in resistance will have occurred and a lower power consumption will result.

Processing

Substrates

125µm print treated and heat stabilized polyester

Screen Printing Equipment

Semi-automatic or manual

Ink residence time on screen

> 1 hr

Screen Types

Polyester, stainless steel

Termination

DuPont PE825, DuPont PE826, DuPont 5025 or DuPont 5064H polymer thick film silver inks

Typical Cure Conditions

Box oven: 130ºC for 10-20 minutes
Reel-to-reel: 140°C/2min

Typical Circuit Line Thickness Printed with 280 mesh Stainless Steel Screen

6-9 microns

Clean-up Solvent

Ethylene glycol diacetate

Table 1
Cured Properties

Test	Properties
Sheet Resistivity KΩ/sq	10.0 – 18.0
R Magnification Factor (25-85ºC)	8 – 10x
Adhesion/Tape Pull (3M Scotch Tape #600)	No Material Transfer

This table shows anticipated typical physical properties for DuPont 7292 based on specific controlled experiments in our labs and are not intended to represent the product specifications, details of which are available upon request.

Design Notes

While the chemical make-up of the DuPont composition 7292 is patented by DuPont, it is advisable to check that specific designs and applications do not infringe on any other patents. Heater circuits typically consist of DuPont 7292 carbon composition overprinted on a silver termination having inter-digitized tracks. The overprinted carbon composition forms a wide geometry resistor and the distance along the width (between the inter-digitized tracks) is generally used to target the final heater circuit resistance value. The gap (or spacing) between the silver tracks, determines the power density and consequently the heating characteristics of the circuit.

Applying Power

When the heater circuit is powered, it will rapidly heat and self- regulate/equilibrate at a designated temperature. This equilibrium temperature is influenced primarily by a very large increase in circuit resistance, see Figure 1. This is non-linear and generally referred to as Resistance Magnification (or PTC effect). In addition, the equilibrium temperature can be altered by the design and more specifically, the spacing between the silver tracks. An example is given, where 7 heater temperatures are plotted, with each having a termination spacing from 0.5mm through to 2.3mm, see Figure2. Within the first few power cycles, a permanent resistance shift is to be expected and the magnitude will be dependent, primarily on the maximum operating conditions. This has been found to be typically less than 10%. It may also result in a slight reduction in PTC performance consequently, it may be necessary to accommodate this shift within the initial design.

Better temperature stability can be expected from DuPont 7292, see figure 4. Improved stability can be seen though to 2000 cycles (Power on/off cycles) when comparing to its predecessor DuPont 7282.

Hysteresis effect

After the removal of power from a heater circuit, the polymer PTC composition exhibits a hysteresis effect. This is basically a “time lag” in the circuits’ ability to return to its original starting resistance. This does not affect the self-regulating performance but may result in erroneous resistance measurements.

Table 2
Physical Properties

Test	Properties
Viscosity (Pa.s) [Brookfield RVT UC&SP, 10 RPM, 25°C]	15 – 70
Thinner	DuPont 8270

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Compatibility of Adhesives

If an adhesive is used directly over the PTC composition, it is essential that the compatibility of the adhesive is tested to ensure that the performance of the heater is not compromised by any adhesive interactions. Adhesive incompatibility may result in erratic /excessive resistance shifts and/or significant changes in PTC characteristics. See Figure 3, for more details.

Printing

The composition should be thoroughly mixed before use. This is best achieved by slow, gentle, hand stirring with a clean burr-free spatula (flexible plastic or stainless steel) for 1-2 minutes. Care must be taken to avoid air entrapment. Printing should be performed in a clean and well-ventilated area.

Note: optimum printing characteristics are generally achieved in the room temperature range of 20ºC - 23ºC. It is therefore important that the material, in its container, is at this temperature prior to commencement of printing. Refer to - “Processing Conditions”.

Drying

Allow prints to level at room temperature, then dry in a well-ventilated oven or conveyor dryer. Refer to - “Processing Conditions”.

Storage and Shelf Life

Containers should be stored, tightly sealed, in a clean, stable environment at room temperature (<25°C). Shelf life of material in unopened containers is six months from date of shipment. Some settling of solids may occur and compositions should be thoroughly mixed prior to use.

Safety and Handling

For Safety and Handling information pertaining to this product, read the Material Safety Data Sheet (MSDS).

Figure 1:
Resistance Magnification (PTC Effect) vs Temperature

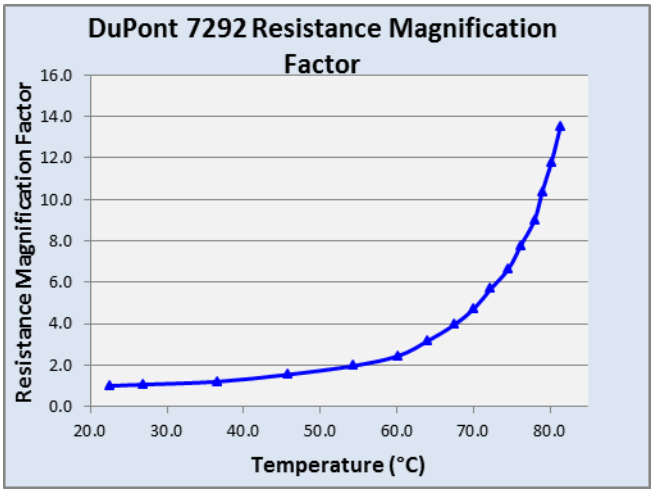


Figure 2:
Equilibrium Temp vs Ag Termination Spacing

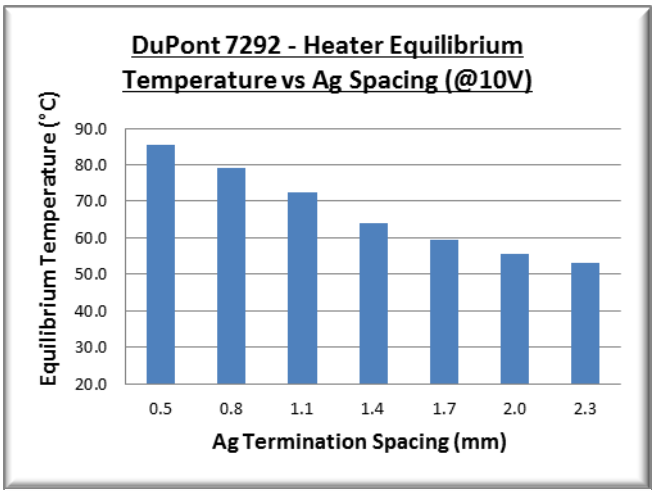
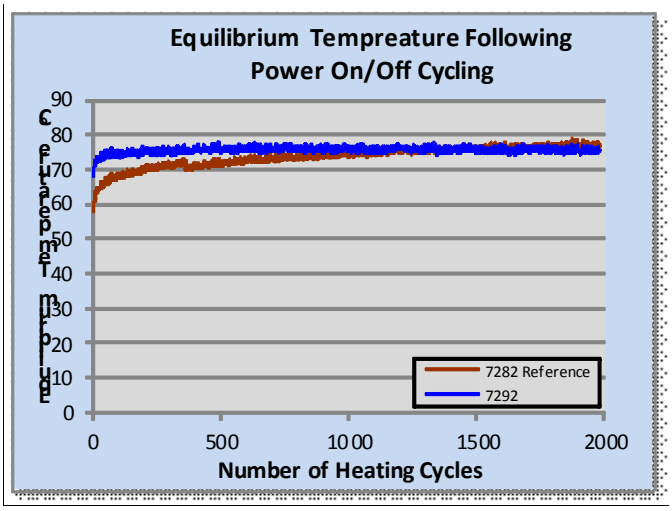


Figure 3
Adhesive Compatibility Check

Composition	Adhesive Type	Delta R - Post 85°C Heat Cycle
DuPont 7292	Lohmann DC249	0
	Mactac B2100	5%
	Arclads EL92734	5%
	Avery Dennison FT126	10%
	Avery Dennison HPA1902W	-5%

7292 has a more extensive range of compatible adhesives

Figure 4
Powered (12V) Cycling



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