DuPont 7400R Series Resistors

100mΩ/sq – 300mΩ/sq Surge Protection Resistors

Technical Data Sheet

Product Description

DuPont 7400R Series resistor composition are intended to be applied to ceramic substrates by screen printing and fired in a conveyor furnace in an air (oxidising) atmosphere, to form specific resistive elements. DuPont 7400R series resistors have been developed for applications where high voltage pulses must be dissipated. These materials have low resistivity and are intended for use in serpentine patterns

Product Benefits

- Outstanding stability to high voltage pulses
- Small changes in resistivity after encapsulation
- Thin, dense fired films
- Compatible 850°C firing encapsulant, suitable for laser trimming
- Suitable for encapsulation with low temperature overglaze
- Qualified at 20µm dried thickness
- Excellent stability after storage at 150°C and 85°C/85% rel humidity
- Lead, Cadmium, Phthalate, Nickel oxide free*

*Lead, Cadmium, Phthalate and Nickel oxide "free' as used herein means that cadmium, phthalate and nickel oxide are not intentional ingredients in and are not intentionally added to the referenced product. Trace amounts however may be present.

Terminations

7400R Series resistors can be used with a wide range of terminations. The reported properties are based on tests using QM21R Pd/Ag conductor composition as the termination material, pre-fired at 850°C.

Processing Summary

- **Drying**
  Allow prints to level for 5 – 10 minutes at room temperature, then dry for 10 -15 minutes at 150°C
- **Firing**
  850°C peak held for 10 minutes on 30 minute cycle in an air atmosphere. See Figure 1: Firing Profile

Compatibility

TABLE 1. TYPICAL PHYSICAL PROPERTIES

Viscosity (Pa.s.) (Brookfield HBT,10rpm, SC4-14/6R utility cup and spindle,25°C±0.2°C)	100 - 250
Coverage [cm²/g] Based on dried thickness of 20µm	90-110
Shrinkage [%]	see table 2
Thinner	4553
Shelf Life (months)	6

This table shows anticipated typical physical properties for DuPont 7400R based on specific controlled experiments in our labs and are not intended to represent the product specifications, details of which are available upon request.

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.

Substrates

Substrates of different compositions and from various manufacturers may result in variations in performance properties

Thinner

7400R composition is optimized for screen printing and thinning is not normally required. Use the DuPont recommended thinner for slight adjustments to viscosity or to replace evaporation losses. The use of too much thinner or the use of a non recommended thinner may affect the rheological behaviour of the material and its printing characteristics. Please refer to table 1.Typical Physical Properties'

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 about 1-2 minutes. Care must be taken to avoid air entrapment. Printing should be performed in a well ventilated area. Note: optimum printing characteristics are generally achieved in the room temperature range of 20°C-23°C. It is therefore important that the material, in its container, is at the temperature prior to commencement of printing. Class 10,000 printing area is recommended for building complex hybrids and multilayer circuits, otherwise severe yield losses could occur.

Drying

Allow prints to level at room temperature, then dry in a well ventilated oven or conveyor dryer. Refer to 'Processing Summary'.

Firing

Fire in well ventilated belt, conveyor furnace or static furnace. Air flows and extraction rates should be optimized to ensure that oxidizing conditions exist within the muffle and that no exhaust gases enter the room.

Encapsulation

Encapsulant composition DuPont 7401 has been specifically designed for compatibility with 7400R Series resistors and is recommended to obtain optimum pulse stability. 7401 is fired at peak temperature of 850°C using a 30 minute firing profile. Low temperature (500°C) firing encapsulant DuPont QQ550 or DuPont QQ620 (620°C) can also be used.

Laser Trimming

DuPont 7400 Series resistors can be trimmed successfully using a wide range of trimming conditions. When trimming through DuPont 7401 encapsulant relatively high power should be used. The following range of trim parameters have been used on production type YAG laser: bite size 4-5µm, pulse frequency 4-5kHz; average power 4.0 - 5.0 W, giving trim speeds of up to 25mm/s.

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Blend Behaviour

DuPont 7400 series resistivity and TCR blend characteristics are shown in Figure 2.

General

Yields and performance will depend to a large degree on the care exercised during processing, particularly in screen printing. Scrupulous care should be taken to keep the conductor composition, printing screens and other tools free of metal contamination.

Dust, lint and other particulate matter may also contribute to poor yields.

Safety and Handling

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

FIGURE 1. FIRING PROFILE

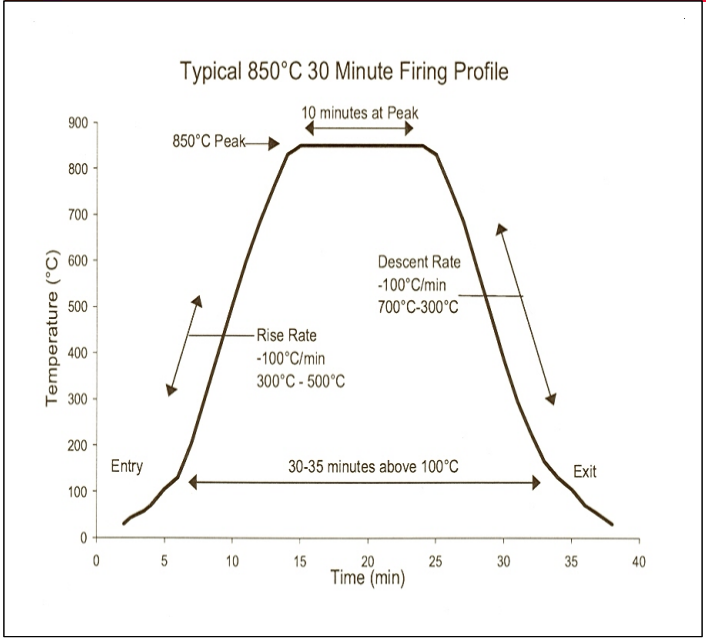

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TABLE 2. TYPICAL FIRED PROPERTIES[1]

Shrinkage (for guidance only)					
	7410R	7420R	7450R	7499R	744R
Wet/Dry (%)	50	49	44	42	40
Dry/Fired (%)	55	47	43	43	42
Typical Fired Properties[1]					
Resistivity mΩ/sq[2] Resistivity shipping specifications	100 ± 10%	200 ± 10%	500 ± 10%	1000 ± 20%	3000 ± 20%
HTCR ppm/°C[3] CTCR ppm/°C[4]	50 ± 25 75 ± 25	0 ± 25 50 ± 25	0 ± 25 50 ± 25	0 ± 25 50 ± 25	0 ± 25 50 ± 25
Resistance change after encapsulation					
7401 (850°C firing) QQ550 (500°C firing)	<5% <0.1%	<5% <0.1%	<5% <0.1%	<5% <0.1%	<10% <0.1%
Resistance change after pulse test[1,5]					
7401 encapsulant QQ550 encapsulant	<0.1% <0.1%	<0.1% <0.1%	<0.1% <0.5%	<0.1% <0.1%	<0.1% <0.1%
Resistance of test parts, Ω	20	40	100	200	600
Pulse peak voltage kV	1.5	1.9	2.6	3.2	4.7
Time to half peak voltage, μ s	340	400	500	575	640
Pulse energy, Joules	28	26	24	21	17
Resistance change after 1000 hours storage[6]					
150°C 85°C/85% RH		0.02% 0.01%	0.03% 0.1%	0.03% -0.01%	

1 Typical resistor properties based on laboratory tests using procedures as follows:

Pattern: 200 square serpentine with 0.9mm line width and 0.6mm spaces; Corners on pattern reinforced with DuPont QM21R conductor.

Printing: 325 mesh stainless steel screen, 8-12μm emulsion thickness to a dried resistor thickness of 20±3μm.

Firing: 30 minutes profile with a peak temperature of 850ºC held for 10 minutes.

Substrate: All tests performed on 96% alumina.

Termination DuPont QM21R Pd/Ag conductor

2 Resistivity values are normalized to 20μm dried thickness.

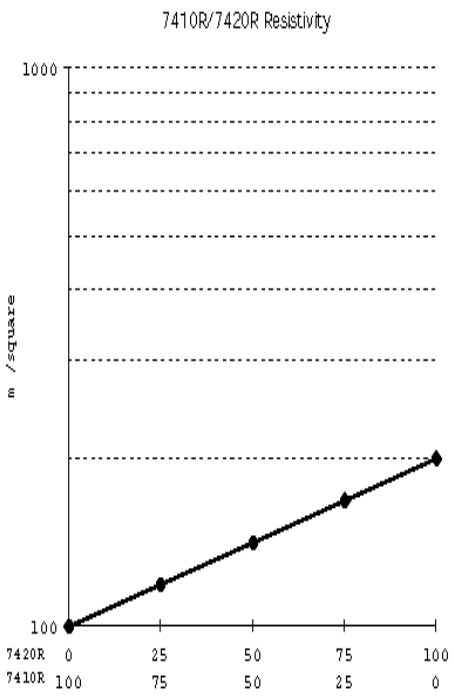
3 HTCR measured in the range +25ºC to 125ºC.

4 CTCR measured in the range -55ºC to 25ºC.

5 Resistors encapsulated at a fired encapsulant thickness of 10-12mm. Test equipment: Haefely P6T pulse tester with nominal 10/700ms pulse setting, (actual time to half peak shown in table). Resistance shift recorded after 10 pulses with 30 seconds between each pulse, at the pulse voltage indicated.

6 Resistors protected with DuPont 7401 encapsulant.

FIGURE 2. 7400R Series Resisitivity and TCR Blend Characteristics



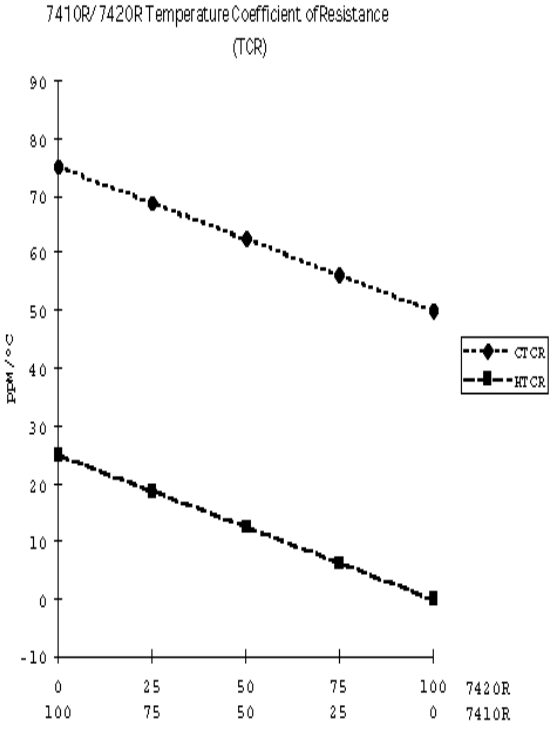


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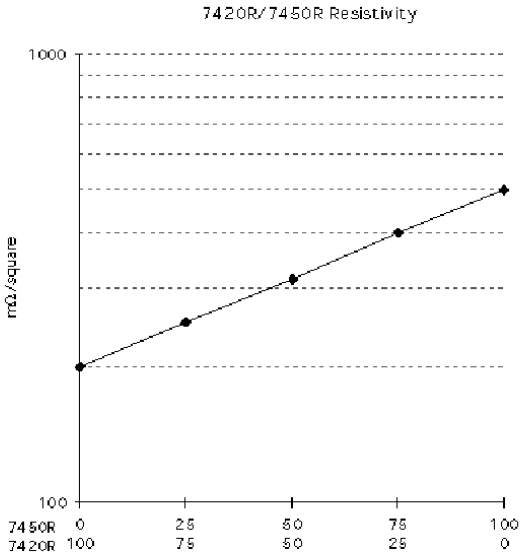
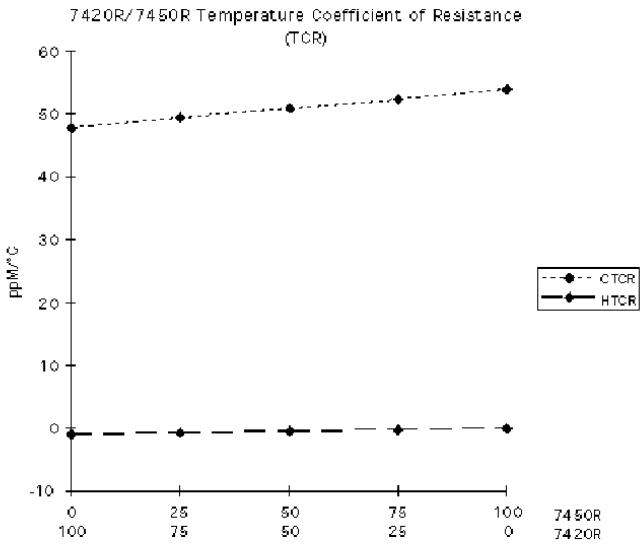
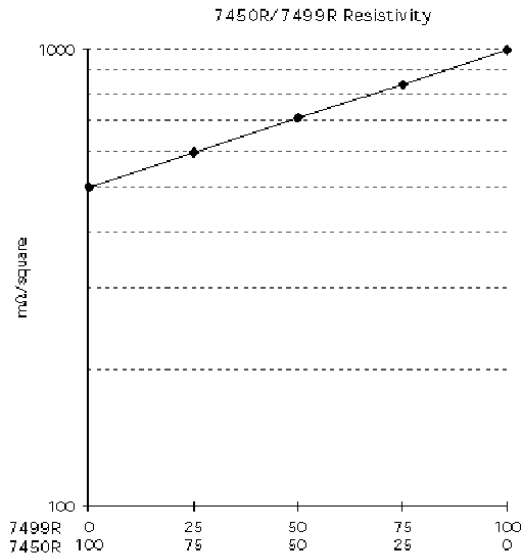
FIGURE 2. 7400R Series Resisitivity and TCR Blend Characteristics







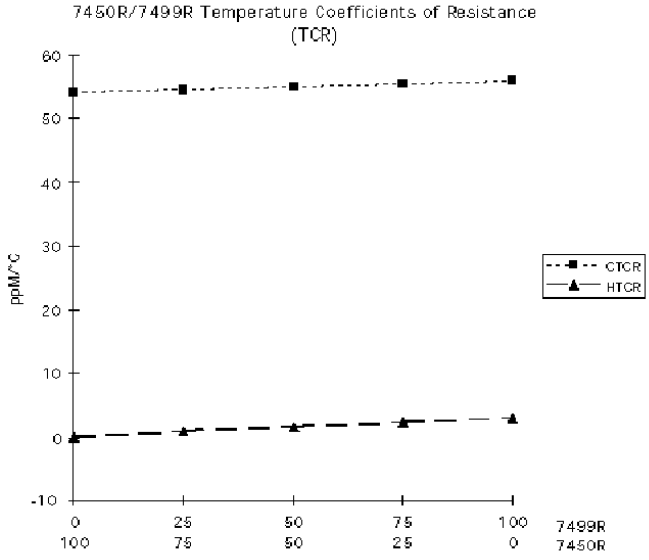


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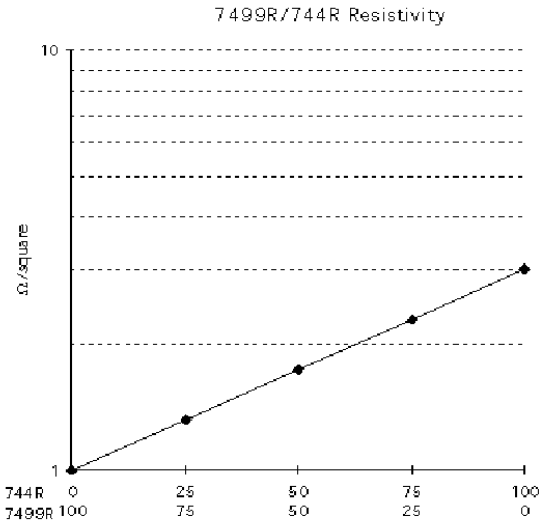
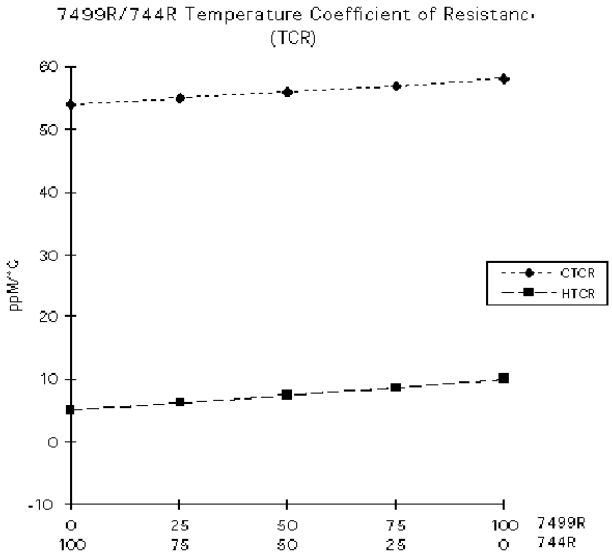
FIGURE 2. 7400R Series Resisitivity and TCR Blend Characteristics (cont.)





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