KOARTAN

MICROELECTRONIC INTERCONNECT MATERIALS

Mountain Ridge Business Park, Unit B12
1248 Sussex Turnpike, Randolph, New Jersey 07869-2908
Phone: 973.895-3600 Fax: 973.895-3617 www.koartan.com

REV. 111104

## Technical Information

# KOARMISTOR SERIES 7380

## BLENDABLE LASER-TRIMMABLE NTC THERMISTOR SYSTEM

The 7380 "Stacked" thick film NTC thermistor system is designed to offer greatly enhanced temperature sensitivity over the standard "planar" systems. It also allows passive incremental laser trimming. The stacked method is similar to the construction of thick film capacitors, where the terminations form two parallel plates. Electrical conduction through the thermistor is in the Z direction (see the figures in the Applications Notes section below). The 7380 series thermistors are not compatible with silver termination. Key features of the system include:

- Wide Resistivity Range
- Superior Temperature Sensitivity
- Blendability Across the Full Range.
- Firing in Standard 850°C Profile.
- Passivation with Low Temperature Overglaze or Polymer Encapsulant.

### TYPICAL FIRED FILM CHARACTERISTICS(1)

| | 7381 | 7382 | 7383 | 7384 | 7385 |
|---|---|---|---|---|---|
| **Resistance**(2) Ohms, 0.040"x0.040" pads | 10 ± 30% | 100 ± 30% | 1K± 30% | 10 K± 30% | 100 K ± 30% |
| **TCR** ppm/°C, + 25°C to +85°C | > 10,500 | > 12,500 | > 13,000 | > 14,000 | > 15,000 |
| **Beta Constant**(3) + 25°C to +85°C | > 1,800 | > 2,500 | > 2,900 | > 3,600 | > 4,300 |
| **TCR** ppm/°C, + 25°C to +125°C | > 7,000 | > 8,750 | > 9,200 | > 9,550 | > 9,775 |
| **Beta Constant** + 25°C to +125°C | > 1,600 | > 2,500 | > 3,000 | > 3,750 | > 4,500 |

(1) Typical properties are based on testing of several batches under various processing conditions. They are not intended as specification limits.

(2) The electrical results are based on three layers of 7380 series thermistors, and 0.040" x 0.040" termination pads fabricated with 4550 thin-print gold. Total fired thickness for three layers of thermistor 40 microns. All firing done in a standard 36 minute furnace profile with 10 minutes at 850°C.

(3) The Beta constant is defined as the natural logarithm of the ratio of the low temperature resistance to the high temperature resistance multiplied by the ratio of the product of the two temperatures to the difference in the temperatures. All temperatures are in degrees Kelvin. Absolute values of TCR and Beta are denoted in the table.

## COMPOSITION PROPERTIES

**Viscosity:** 150 ± 30 Kcps, when measured with Brookfield HBT, Spindle #14, utility cup, 10 RPM, 25°C.

**Specific Gravity:** 2.4 - 2.8 g/cm$^3$

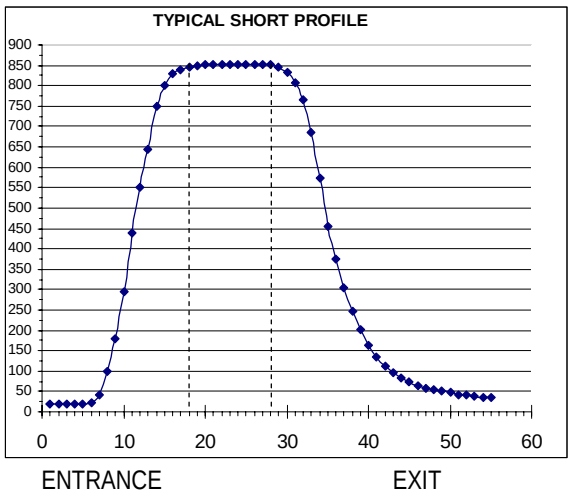
**Recommended Thinner:** KOARTAN A-1039

**Printing:** For best results, printing with a 250 mesh stainless steel screen with 10-15 µm emulsion and 45 degree angle is recommended. Three separate print and fired operations for a total fired thickness of 40 microns is recommended. Other mesh counts, 200-325, and emulsion thicknesses, 5-25 µm, may be used for special applications.

Coverage is approximately 100 cm$^2$ per layer, when utilizing a 250 mesh screen and a wet print thickness of about 38 micrometers.

**Drying:** Wet prints should be allowed to level for 5-10 minutes prior to drying. Dry for 10-15 minutes in a convection oven or belt dryer at 125°C-150°C.

**Firing:** Firing in air using a belt furnace and a 36-60 minute profile, with 10 minutes at a peak temperature of 850°C, is recommended. Air flow rates must be optimized to ensure that the products of binder burn-off discharge properly and create a fully oxidizing atmosphere in the muffle.




**Application Notes:** The 7380 series thermistor pastes are made of extremely high resistivity semiconducting ceramics. They are designed to provide a wide ranger of resistance and superior temperature sensitivity, when constructed as shown in schematic figure 1. In this figure "A" represents solder or wire bond pads and must be printed and fired first. Layers B and D are the termination, made of thin-print gold composition 4550. The 4550 is very dense and causes blistering if it is printed under another conductor. It must be printed on top of the solder or wire bond pads.

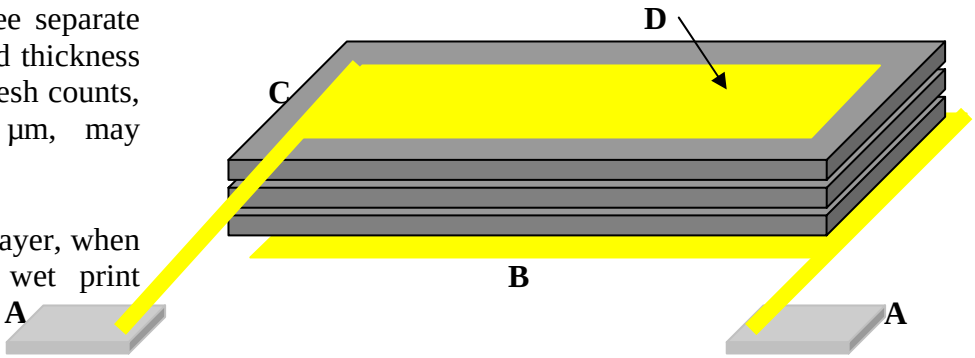



*Fig. 1*

The order of printing is from A to D. Each later of thermistor, C, must be separately fired.

If laser trimming is contemplated, a construction

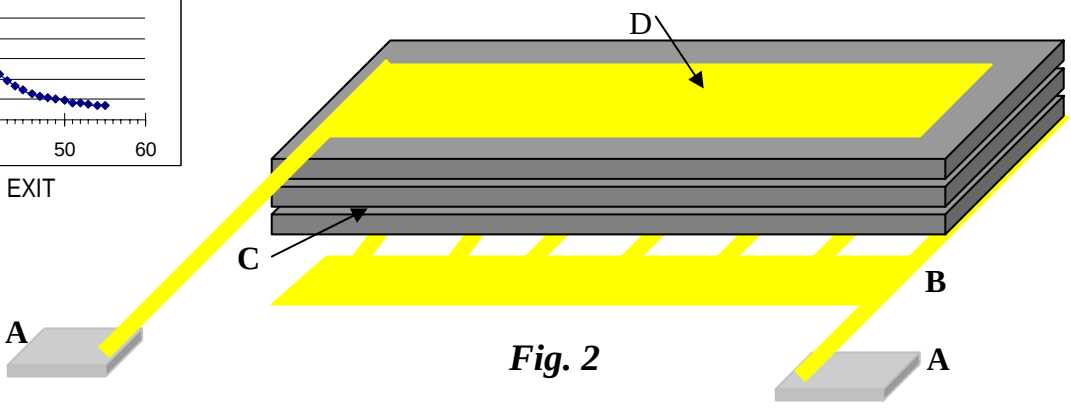



*Fig. 2*

scheme as shown in schematic figure 2 is recommended. The order of printing is the same as above, except that two layers of the bottom termination B is recommended for etching of fine lines. The minimum recommended line width is 2 mils. Three layers of the thermistor paste are printed and fired, followed by top termination D.

Figure 2 represents seven thermistors in parallel. Severing the lines of termination B with a laser beam will increase the resistance proportionally to the number of lines. The same general rule holds for thermistors without etched line, i.e., doubling the area of terminations reduces the resistance by about 50%, assuming the same thermistor thickness.

For a specific target value for the thermistor, one should use the maximum available area. The larger the area, the higher the resistivity of the blend paste to make it, thus the higher the TCR (Beta).

In addition to very high temperature response and laser trim capability, the 7380 series thermistors provide an additional beneficial feature. By placing a stacked thermistor in series or in parallel with an ordinary planar NTC, a regular resistor, or a PTC, one can form a couple that better matches resistance requirements at specific temperatures.

**Passivation:** Low temperature overglaze such as KOARTAN 5650, or polymer encapsulant is recommended. Glazing with the 5650 increases the resistance by about 5%. Please consult Koartan's technical staff for recommendation for your particular application.

**Storage and Shelf Life:** Store in tightly capped containers at room temperature. Shelf life is 6 months for unopened jars. Thorough mixing of the paste before each use is recommended. Under ordinary conditions of storage and use the product should not require thinning. However, solvent loss during extended printing runs may be corrected by incorporating up to 0.5% of Koartan A-1039 thinner.