DuPont Microcircuit Materials

S1X0 Series Resistors

10 Ω/sq - 1 MΩ/sq Resistor Compositions

Product Description

S1X0 Series Resistor System is specially formulated for use with the QM44 Multilayer System.

Product Benefits

- Tight TCR control.
- Low sensitivity to firing temperature and time
- Minimum length and thickness effects on resistivity and TCR
- Minimum shifts of resistivity and TCR on re-firing
- Thinner printing (20 µm dried thickness)
- Compatible with Ag and Ag/Pd termination metallurgies

Processing Conditions

Printing

Series S1X0 Resistor Compositions should be thoroughly mixed before use. This is best achieved by slow, gentle, hand stirring with a clean burr-free spatula (flexible plastic) for 1-2 minutes. Care must be taken to avoid air entrapment. Note: Optimum printing characteristics are generally achieved in the temperature range of 20°C-23°C. It is therefore important that material in its container is at this temperature prior to commencement of printing.

Specified properties are based on resistors printed to 20 ±2 µm dried print thickness. This is generally achieved using a 325-mesh stainless steel screen with 10-15 µm emulsion thickness. Print speeds of 10 to 20 cm/s may be used. Control and reproducibility of print thickness is essential to obtain predictable, reproducible fired resistor properties.

Typical Fired Resistor Properties [1]

	S110	S115	S120	S130	S140	S150	S160
Resistance [2], (Ω/sq)	10	50	100	1 K	10 K	100K	1M
Shipping Tolerance	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%
TCR [2]	± 100	± 100	± 100	± 100	± 100	± 100	± 100
STOL[3](V/mm)	6	13	20	70	160	400	630
SWV[4], V/mm	2.4	5.2	8	28	64	160	252
MRPD[5], mW/mm^2	411	387	381	467	248	160	45
Quan-tech Noise, dB	-25	-22	-18	-14	- 4	-1	+15
ESD(%ΔR) (5X@5000V)	-0.005	0.1	0.1	1.8	-1.0	-0.3	-0.3

[1] Typical fired properties are based on the following: Termination: QM22 Ag/Pd, Dried thickness of 20 ± 2 µm; Resistor geometry 1.0 x 1.0 mm, Firing - 30-min cycle 850°C peak for 10 minutes. Substrate: DuPont QM44.Resistance and TCR are measured on untrimmed resistors. STOL, SWV, MRPD, Quantech Noise, and ESD were measured on resistors trimmed to 1.5x the as-fired value.

[2] Temperature Coefficient of Resistance in PPM/C measured 25 to 125C (Hot TCR) and 25 to –55°C (Cold TCR)

[3] STOL: Short Time Overload Voltage (V/mm) 5 second pulse Voltage required to cause a 0.25% change in resistance of a resistor trimmed to 1.5x its as – fired value. Voltage/resistor length.

[4] SWV: Standard Working Voltage (V/mm) = 0.4 x STOL

[5] Maximum Rated Power Dissipation (mW/mm^2) = (SWV^2/Resistance(Ω) per Resistor area (mm^2)

Drying

Allow prints to level for 5-10 minutes at room temperature in a clean, environment, followed by drying for 10-15 minutes at 150°C.

Firing

Care must be taken to ensure that any gases/ vapors from other chemicals/materials (e.g. halogenated solvents) do not enter the furnace muffle. It is also essential that the air supply to the furnace is clean, dry and free of contaminants. Air flows and extraction rates should be optimized to ensure that oxidizing conditions exist within the muffle, and that no furnace exhaust gases enter the room.

Series S1X0 series resistors should be fired on a 30 minute firing cycle to a peak temperature of 850°C held for 10 minutes. Variations in the peak firing temperature and/or the time at the peak temperature may result in variations in the final fired properties. Resistor compositions must be fired in clean air; insufficient airflow or pollution of the air in the furnace may result in shifts of resistivity or TCR.

Encapsulation

Encapsulation is not required to meet published performance. For applications which require mechanical protection from extreme environments, low temperature encapsulant QQ550 or QQ600 is recommended prior to laser trimming.

Laser Trimming

Trim parameters should be selected to achieve a clean laser cut (kerf) and it is recommended to cut into the substrate by 5-7 µm.

The preferred range of laser trim parameters are as follows: bite size 0.12 to 0.17 mils, power 0.9-1.1 watts at a frequency of 3-4 KHZ.

Environment trim stability shown in Figure 2.

Blending

Adjacent members of the Series are blendable. The blend curve is shown in Figure 3.

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

DuPont thick film products are intended for industrial use by trained personnel. These products contain organic and inorganic ingredients. It is important for workers to avoid overexposure to chemicals contained in these products or that might become available when processing them. Overexposure to other materials used in the operation should also be avoided, for example, cleaning solvents and degreasing fluids.

Well-designed area and personal air sampling/ analysis can show if exposures are within required and recommended limits. Properly designed engineering controls, such as local ventilation and process enclosures, are effective in limiting employee exposure and to avoid the creation of hazardous conditions (e.g. forming an explosive vapor concentration). Engineering controls and procedures must comply with all applicable federal, state and local safety, health and environmental laws and regulations.

The following additional precautions should be taken when handling these products:

- Read the Material Safety Data Sheet (MSDS) and product labels before using the products;
- Use appropriate personal protective equipment (PPE) and practice good industrial hygiene. DO NOT INGEST! DANGEROUS IF SWALLOWED!
- Keep product container closed when not in use to prevent solvent evaporation and spilling hazards;
- If contact with skin occurs, wash affected area immediately with soap and water;
- Avoid prolonged breathing of vapors and dusts/particulates. Keep exposure levels within the required or recommended limits. Always use sufficient ventilation as noted above.

Figure 1. Typical Firing Profile

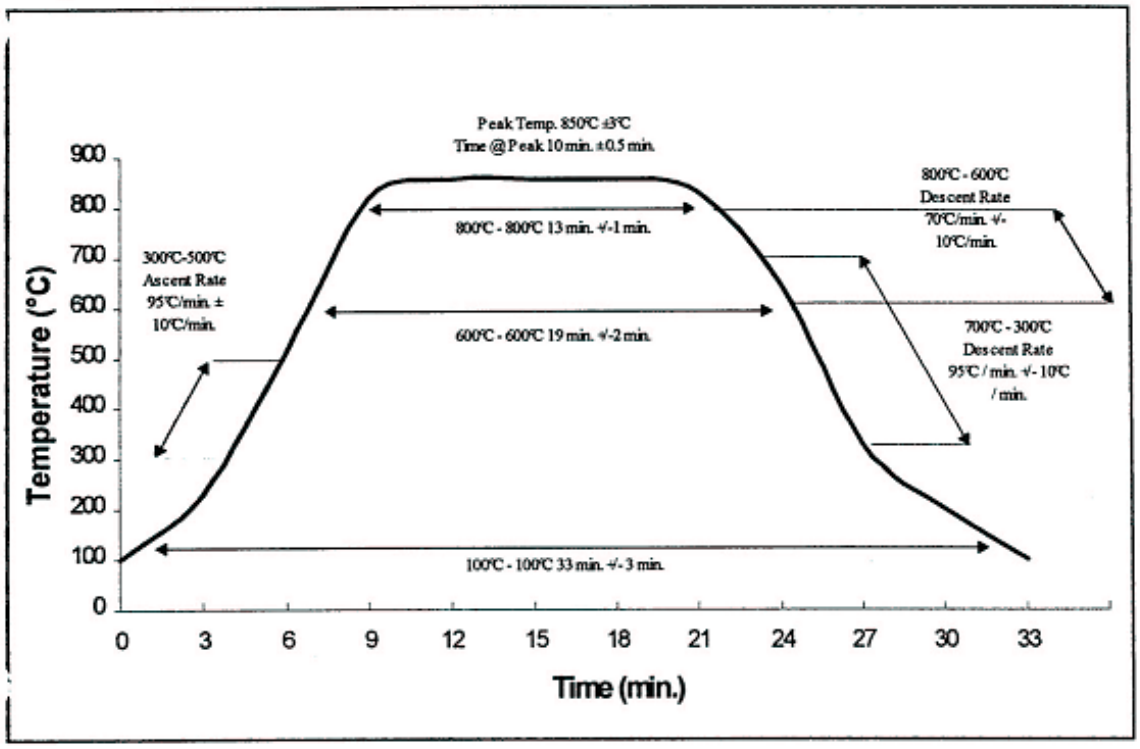
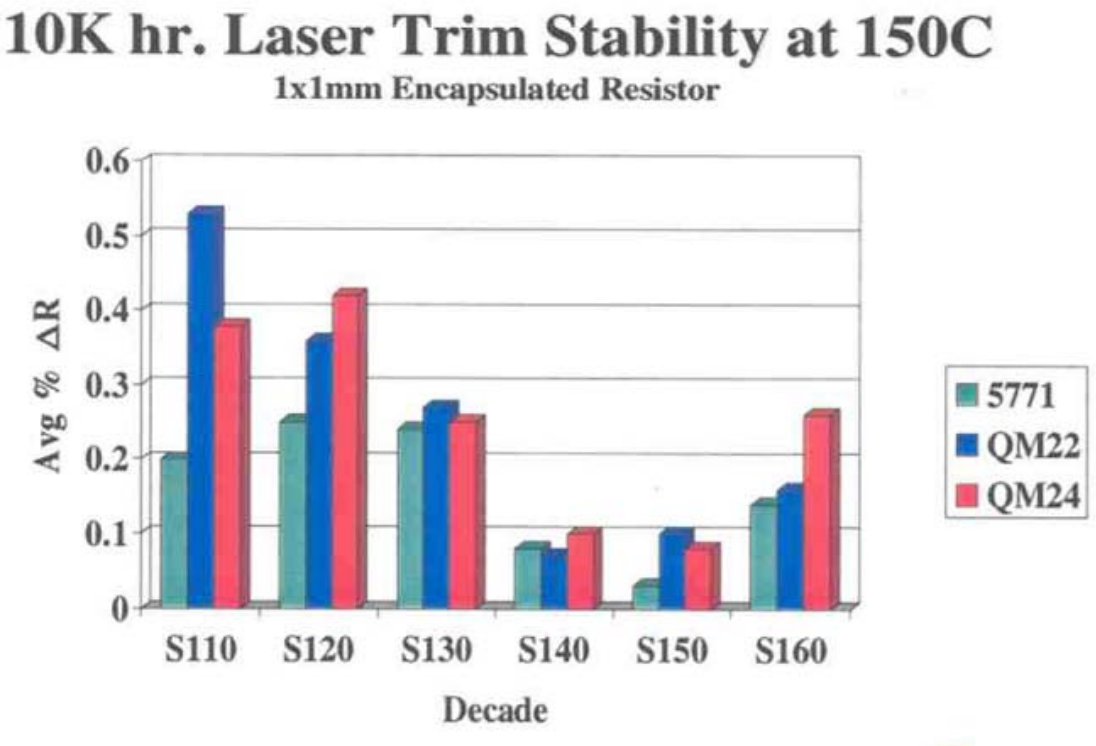
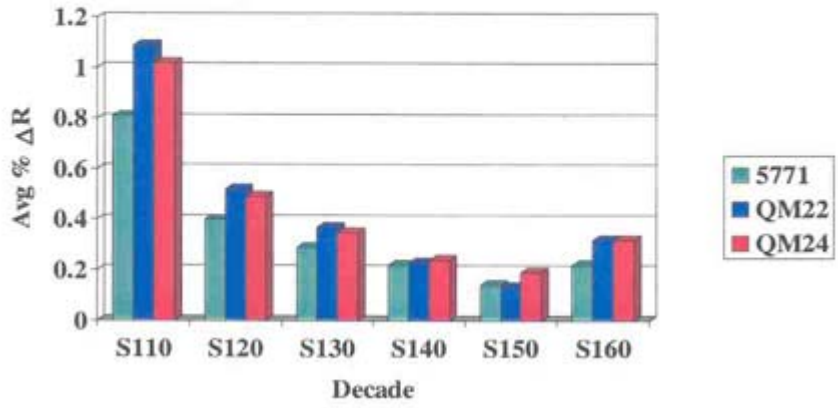


Figure 2



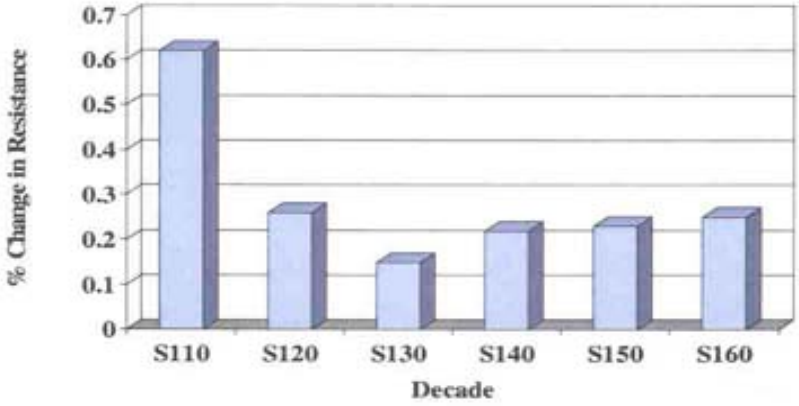
10K Hour Laser Trim Stability at 85C/ 85% R.H.

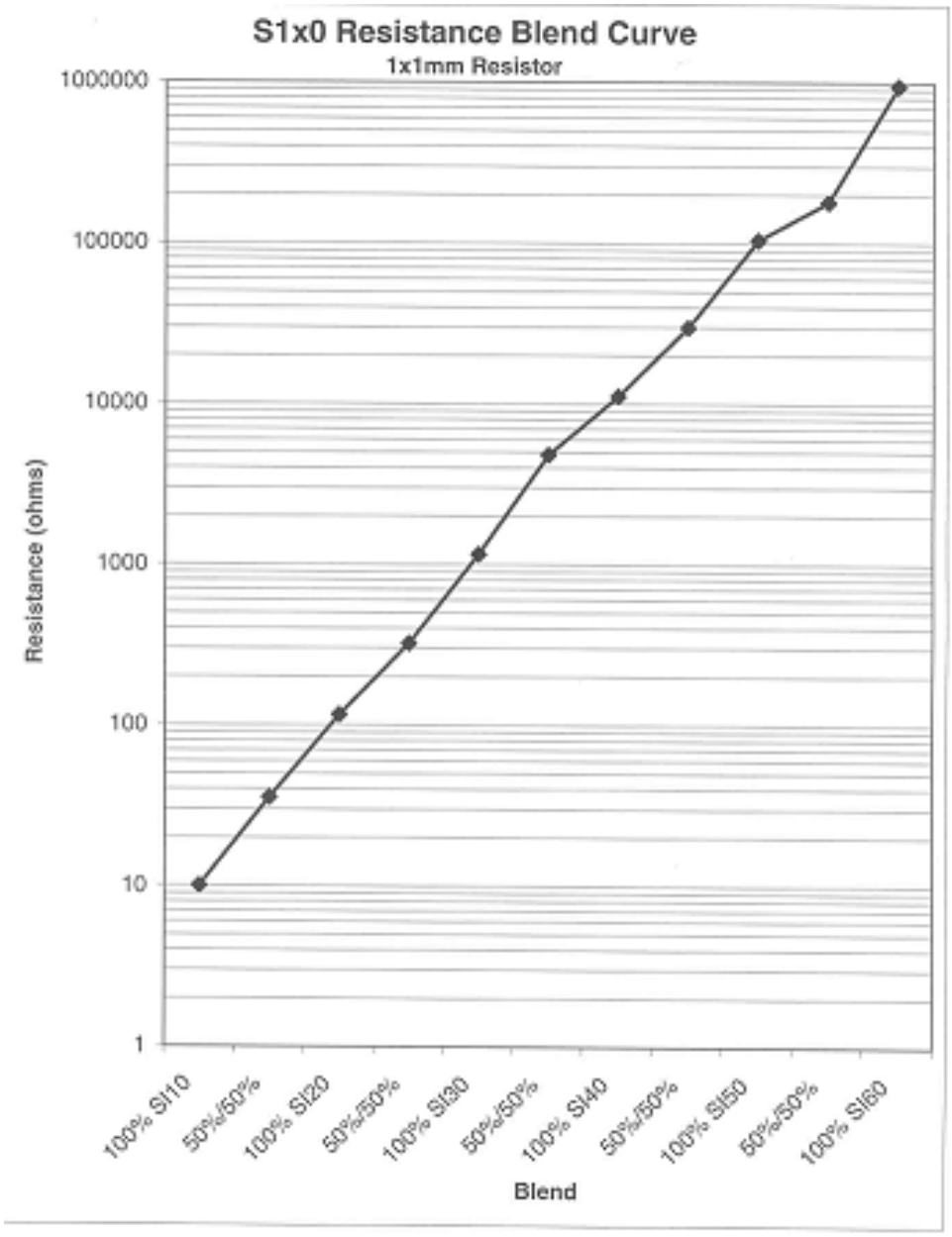
Encapsulated 1x1mm Resistor



Laser Trim Stability after 1000 Thermal Cycles +150°C to -50°C

(QM22 Termination)




S1x0 Resistance Blend Curve
1x1mm Resistor
Resistance (ohms)
1000000
100000
10000
1000
100
10
1
100% SI10
50%/50%
100% SI20
50%/50%
100% SI30
50%/50%
100% SI40
50%/50%
100% SI50
50%/50%
100% SI60
Blend

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MCMS1X0 (5/2008)

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