

Description: For many years, Ferro has been the leading supplier of thick film silver inks designed for making contact to the n-doped silicon front face of photovoltaic devices. Achieving good adhesion with an excellent ohmic contact to this shallow junction is critical in the production of high efficiency cells. Ferro Electronic Materials has produced a number of different formulations for this application.

33-473 is part of a specially designed silver conductor system that does not require drying. By eliminating the drying processes of conventional pastes, Hot Melt compositions offer higher throughput rates, increased productivity and improved yields. Hot Melt pastes are solid at room temperature, but when resistively heated above their melting point, the ink will screen print similarly to a conventional thick film paste. Unlike conventional pastes, once the

paste is transferred to the solar cell, the ink instantly resolidifies and is ready for the next printing sequence.

33-473 is a specially designed silver paste for contacting p/n⁺ type silicon solar cells passivated with SiN_x coatings with thicknesses between 750 Å – 900 Å.

When fired, this ink yields very low bulk and contact resistivity which results in high a Fill Factor and energy conversion efficiency. During the firing process the glasses and additives contained in the inks react with silicon nitride to form a low resistance contact while providing good adhesion to the wafer and excellent solderability.

Typical Properties

	33-473
Viscosity (poise) ¹ :	900 – 1300
Solids Content:	87.0 – 90.0%
Fineness of Grind:	< 14 / 11 μm
Dried Thickness:	30 – 45 μm
Fired Thickness:	15 – 25 μm
Resistivity ² (milliohms/square):	< 1.5
Drying Profile:	No drying required
Peak Firing Temp:	720 – 750°C
Time at Peak:	1 second

Notes:

¹Viscosity as measured on Brookfield model HBT cone/plate viscometer; 9.6 reciprocal seconds, 1.565”cone, 80°C.

²Milliohms/sq. at 25μm.

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Processing Recommendations

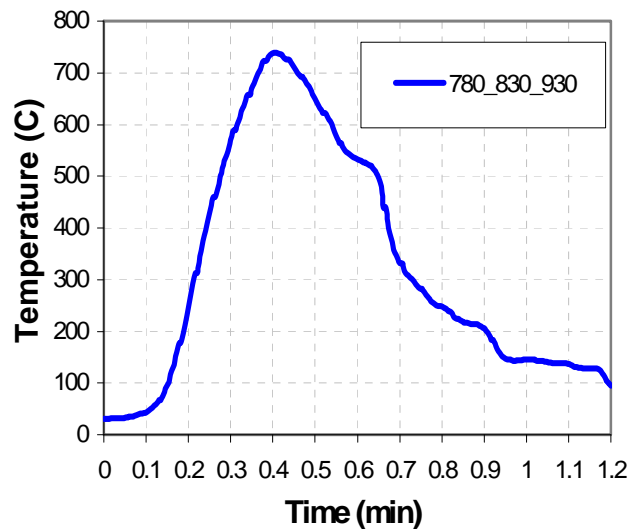
Printing: 250 – 325 mesh screen with a 20 μm – 25 μm emulsion thickness is recommended. The screen and squeegee need be heated to temperatures of 80 – 85°C prior to printing. The temperature of the stage or nest used to carry the silicon wafer should also be controlled to achieve optimum results.

Drying: No drying is required, the paste instantly resolidifies after transfer to the solar cell.

Firing: An Infrared furnace with belt speeds up to 120 IPM (inches per minute) is highly recommended. The front contact paste may be co-fired with the back contacts. The following furnace settings are suggested as a starting point:

Furnace:	Infrared
Heated Zone:	30 inches
Set Points:	Zone 1: 780 °C
	Zone 2: 830 °
	Zone 3: 930 °C
Belt Speed	120 IPM

These parameters yield the following profile as measured using a thermocouple:



Since the furnace configurations, furnace loading and the lamp power vary; the above furnace settings may be used as a starting point. It is highly recommended that a matrix of profiles be tried to optimize cell output and efficiency.

Thinning: Thinning is not recommended, since the paste is a solid at room temperature. The viscosity of the ink may be adjusted by controlling the temperature of the screen.

Paste Storage & Shelf Life: The paste should be stored in tightly capped containers, in a cool, dry place away from direct sunlight. Properly stored material will have a shelf life in excess of 6 months.

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