Voltera Conductive Ink (100102)

Description

Voltera Conductive Ink is highly conductive, durable, and solderable through both point soldering and reflow. It is specifically formulated for producing 1 or 2-layer circuit boards on bare or soldermask-coated FR4, but also has excellent adhesion and performance on a variety of substrates.

Application Notes

Soldering

Use SMD291 flux. For best results, burnish before soldering for 20[s] with supplied abrasive burnishing pad.

180-210°C – excellent solderability and rework.
>260°C – not recommended.

Curing

For best results, follow recommendation in Table 4. Shorter cure times (to 15 minutes) have shown good solderability and conductivity, but reduced adhesion.

For curing on the V-One, use automatic bake cycle. Invert the substrate on the baking ledges of the clamps. For a box oven, cure right-side up at $190°C$.

Recommended Substrates

- Fibreglass-epoxy or epoxy laminates (FR4, FR1), bare or soldermask-coated
- Polyimide ($125[\mu m]$)
- Glass (untreated, no coating)

Design recommendations

For circuit board applications with the standard $250\mu m$ nozzle, consider these design recommendations:

- Minimum IC pin-to-pin pitch: $0.65\ [mm]$
- Minimum 2-terminal package: 0402 (imperial)
- Minimum tracewidth: $8\ mil/200\ [\mu m]$ (recommend 10mil)
- Peak current depends on maximum temperature of the trace due to heat dissipation.
  Consult **Figure 1, Appendix B**.

Safety and Handling

See MSDS for safety, handling, and disposal information.

Table 1: Physical & Electrical Properties (Post-cure)

Test	Value
Sheet Resistance: ($80\mu m$ film thickness)	$12\ [m\Omega/sq]$
Resistivity (4-point-probe):	$9.5 \times 10^{-7}\ [\Omega.m]$
Typical cured film thickness:	$80\ [um]$
Film shrinkage, post-cure:	<30%
*Bend radius at fracture:	~ $0.5\ [cm]$
Joint strength (lbs force):	N/A
Adhesion (cross-hatch tape test):	No transfer

*Test fracture on 5mil polyimide

Table 2: Composition Properties

Test	Value
Viscosity recovery ratio: *1° Cone and plate, 25°C*	> 4.0 Appendix C.1
Recovery viscosity $[Pa.s]$: *1° Cone and plate, 25°C*	> 150 Appendix C.2
Viscosity target $[Pa.s]$: *1° Cone and plate, 25°C*	$> 275\ (1\ [1/s])$ $< 50\ (100\ [1/s])$ Appendix C.3
Density:	$3.7\ [g/mL]$
Clean-up solvent:	Isopropyl Alcohol (99%)

Table 3: Printing Properties (Printed on FR4)

Test	Value
Trace spread after print:	$< 20\%$
Recommended Nozzle ID:	$150 - 225\ [\mu m]$
Typical Line Width:	6-10 [mil] 150-250 [um]
** Typical Print Height:	$50 - 100\ [\mu m]$
** Typical Feedrate:	$300 - 500\ [mm/min]$
** Typical Kick:	$0.2\ [mm]$

**** V-One specific settings**

Table 4: Processing Parameters

Test	Value
Curing:	$30\ [min], 210°C$
Compatible solder:	$SnBiAg_1$ $SnBiAg_{0.4}$ $Sn_{62}Pb_{36}Ag_2$
Typical Print Height:	$50 - 100\ [\mu m]$
Typical shelf life:	6 months, unopened
Storage:	$4 - 10°C$, sealed container.

Appendix

A. Sheet Resistance

Sheet resistance should be measured by 4-point-probe. See MIL-STD-883H 3.8.11.1.3 for implementation details.

B. Temperature at Target Current

Thermal conductivity of conductive ink is lower than copper. Consult the chart in **Fig 1** for thermal considerations at desired target current $I\ [A]$, and select trace width based on thermal constraints of your specific application.

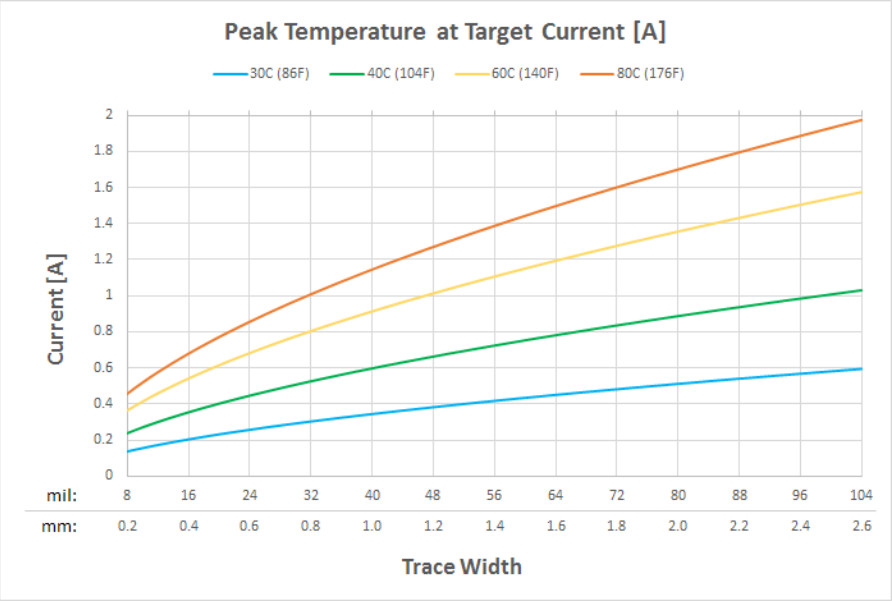

Figure 1: Peak temperature at target current. Measured at 2" trace length.

C. Viscosity Test Methods

Viscosity measurements are performed on a cone and plate rotational rheometer/viscometer, $1°$ cone geometry, $25°C$. **Retain all data for further analysis**. Report viscosity parameters from all tests to characterize the sample.

C.1 - Viscosity Recovery Ratio $\eta_{3/2}$

This test requires a rotational rheometer. Viscosity parameters are measured by Rotational Step Test (AKA 3-Interval Thixotropy Test, 3ITT; described by T. Mezger[1]). Test program is shown in **Table 5**. Example step test result shown in **Fig 2**. Allow sample to rest for $60[s]$ after loading.

Table 5: Step Test Program

Test	Interval	Start Shear [1/s]	End Shear [1/s]	Time [s]	#points	Total time [min]
3ITT	1	1	1	120	120	6
	2	100	100	120	120	
	3	1	1	120	120	

[1] Mezger, Thomas G. *The Rheology Handbook: For Users of Rotational and Oscillatory Rheometers*. Sec 11.2.3. Hannover: Vincentz Network, 2006.

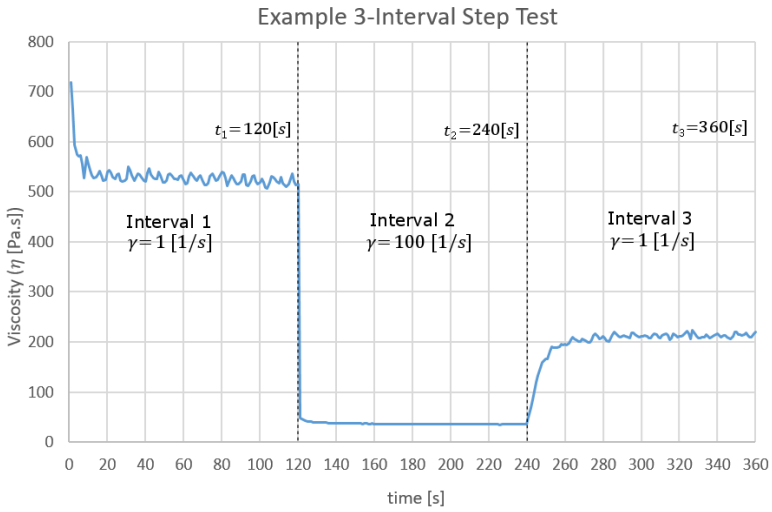

Figure 2: Example 3-Interval Step Test with intervals marked

Report **viscosity recovery ratio** $(\boldsymbol{\eta_{3/2}})$ as the ratio of viscosities at time 360[s] and time 240[s]:

$$\boldsymbol{\eta_{3/2} = \frac{\eta(t_3)}{\eta(t_2)} = \frac{\eta(t = 360[s])}{\eta(t = 240[s])}}$$

C.2 - Recovery Viscosity $\boldsymbol{\eta(t_2 + 20[s])}$

If test C.1 has been performed, report the viscosity at time 260[s] → $\eta(t_2 + 20[s])$.

If test C.1 cannot be performed, follow the program in **Table 6**. Allow sample to rest for 60 [s] after loading.

Table 6: Recovery Viscosity Test

Test	Interval	Start Shear Rate [1/s]	End Shear Rate [1/s]	Time [s]	Total time [min]
Viscometer	1	100	100	40	1
	2	1	1	20	

First, shear the sample at shear rate $100\ [1/s]$ for $40\ [s]$ to disrupt the sample structure. Immediately hold the sample at shear rate $1\ [1/s]$ for $20\ [s]$. Measure viscosity at end of this interval, preferably averaged over 5 [s].

C.3 - Viscosity Targets

If test C.1 has been performed, report the values $\eta(t_1)$ and $\eta(t_2)$.

If a programmable viscometer is not available to perform tests C.1 and/or C.2, this test should still be performed, using a fresh sample for each measurement. Allow samples to rest for 60 [s] after loading.

1. Shear sample at $1\ [1/s]$ for $10\ [s]$. Report viscosity $\eta(\dot{\gamma} = 1)$.
2. Shear sample at $100\ [1/s]$ for $10\ [s]$. Report viscosity $\eta(\dot{\gamma} = 100)$.