

VARIABLE RESISTIVE INKS (VRI)
ELECTRICALLY CONDUCTIVE SCREEN PRINTABLE INKS

VRI is a unique series of carbon or carbon/silver filled electrically conductive inks designed for screen printing on substrates such as FR-4, FR-3, and ceramic, CEM-1, CEM-3 and other inorganic and organic material used for printed circuit assemblies. These inks have excellent flexibility to allow for printing on thin polymer substrates as well. VRIs are extremely tough, one-component materials that exhibit outstanding abrasion resistance as well as high temperature stability, and resistance to humidity and solvents. Typical applications are potentiometers, rheostats, linear actuators and wherever stable electrical resistance at higher temperature and humidity exposure is required. The VRI product line is composed of several inks having different precision resistance values so custom blending for intermediate resistance values can be done on press. VRI inks can also be used to replace surface mount discrete component resistors. Printed patterns made with VRI inks can be trimmed using mechanical abrasion or lasers to maintain 1% electrical resistance linearity on substrates.

VRI Selection Guide by Resistivity Values

Product #	Ohms/sq. @ 0.6-0.7 mils	Ohms/sq./mil
VRI-AG	N/A	<0.05
VRI-1	0.9 -1.1	0.54 - 0.77
VRI-10	9 -11	5.4 - 7.7
VRI-24	21.6 – 26.4	13 – 18.5
VRI-100	90 - 110	54 - 77
VRI-1K	900 - 1100	540 - 770
VRI-10K	9K - 11K	5.4K - 7.7K
VRI-100K	90K - 110K	54K - 77K
VRI-1M	900K - 1.1 M	540K - 770K

Typical Properties

Appearance	Black paste
Viscosity Brookfield DV-III, SC4-14 spindle, 2 1/s	20,000 to 80,000 cps, depending on blend
Drying Schedule	< 5 minutes at 200° C with infrared 10 minutes at 130° plus 20 minutes at 200° C with convection
Density	Varies by product
Theoretical Coverage	130 to 300 cm ² /gram, depending on blend
Shelf Life (25° C)	1 year in unopened container
Total % NV Solids	Varies depending on blend
Hegman Gage	<20 μ
Solder Reflow Resistance Change 250° C, 8 seconds	No more than 5%
Thermal Aging Resistance Change 125° C, 1000 hours	No more than 5%

MORE INFORMATION ON REVERSE SIDE OF SHEET

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APPLICATION GUIDELINES

For screening, recommendation is to work in the range of a monofilament 196 polyester or a 200 stainless mesh with an emulsion thickness of 1.5 mils indirect or 0.5 mil direct. A polyurethane squeegee with a Shore 'A' durometer between 60 and 70 is recommended. Always mix ink thoroughly before using because carbon can settle over time. Be sure to mix individual inks thoroughly before combining as well.

For thinning and cleanup, carbitol acetate or butyl carbitol solvent is recommended. MEK may also be used for cleanup.

If solvent based inks are left on screens for any length of time, the ink will gradually thicken as solvent evaporates. If ink is to be left on an inactive press for any length of time, solvent evaporation can be minimized by pooling the ink into a small area instead of leaving it spread out over a large area. Pooling the ink reduces the surface area, thus slowing the drying process. Always check the viscosity of ink that has been recovered from a screen and add small amounts of solvent while mixing thoroughly to restore viscosity. Solvent can be added to reclaim thickened ink as long as the ink has not dried and hardened completely.

It is essential that all residual solvent be removed from this ink once it is applied. Incomplete drying will cause the ink to appear dry on the surface while trapping solvent underneath the surface. Over time, this trapped solvent will migrate out of the ink and can cause adhesion problems with any material such as dielectric layers or film laminates applied over the ink.

Completeness of drying of VRI materials can be checked by monitoring electrical resistance of a printed trace during subsequent passes through an oven, or after post baking.

The above properties are accurate to the best of our knowledge and Conductive Compounds, Inc. makes no guarantees for customer specifications established in applications where this product is used. Customer assumes responsibility for determining fitness of use in their particular application and the above guidelines are intended to provide a starting point for evaluation. Conductive Compounds, Inc. recognizes that each customer's manufacturing process is unique, and we are available to provide technical assistance to resolve your processing issues. Call us to discuss your application in more detail.