



ESL ELECTROSCIENCE

CERAMIC TAPES &
THICK-FILM MATERIALS

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CERMET RESISTOR SYSTEM

3100 Series

The ESL 3100 Series is a ruthenium based, thick film resistor paste system designed for use on Elpor II or similar insulated steel substrates. It is intended to be fired in the range of 600°C to 650°C. These materials are aimed at low cost; broader tolerance, commercial markets, and are ideal replacements for PC boards with 5 - 10% tolerance chip resistors. These materials should not be considered as direct replacements for higher precision thick film cermet circuits on high alumina substrates. Typical material characteristics are shown below.

	3100 - 0.65	3110	3111	3112	3113	3114	3115	3116
Nominal Resistivity (Ω/square) (1.25 x 1.25 mm resistor)	0.65*	1	10	100	1k	10k	100k	1M
Tolerance (%)	± 5	± 30	± 30	± 25	± 25	± 25	± 25	± 30
Average TCR (ppm/°C) (25°C to +125°C) and (25°C to -55°C)	≤ 1000	± 250	± 250	± 200	± 200	-50 \pm 200	-50 \pm 200	100 \pm 200
Heat Stability (%ΔR) (200°C, 24 hours)	N/A	± 1.0	± 1.0	± 1.0	± 1.0	± 1.0	± 1.0	± 1.0

* Tested using a nine square pattern

PROCESSING NOTES

Blending: Most of the ESL 3100 Series pastes are blendable. ESL 3110 and 3111 may be blended with one another but not with other members of the series. (Stir well before using)

Viscosity:
(Brookfield RVT, 10rpm, ABZ spindle, 25.5 \pm 0.5 °C) 225 \pm 25 Pa.s

Resistivity: ESL 9595-A platinum silver is used for terminations. Other ESL conductors such as 9996-B (Ag) or 593 (Ag) for low temperature firing may be used with slight resistance and TCR effects.

Substrates: Elpor II substrates are used for calibration. Other insulated steel substrates may be used although differences in fired properties may be observed.

ESL Europe (KOP) 3100 Series 9801-C

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See Caution and Disclaimer on other side.

PRINTING AND DRYING

Screen Mesh, Emulsion:	200 S/S, 20 μm
Levelling Time (at 20°C):	5 - 10 min
Drying Time (at 125°C):	10 -15 min
Dried Thickness:	25 \pm 3 μm

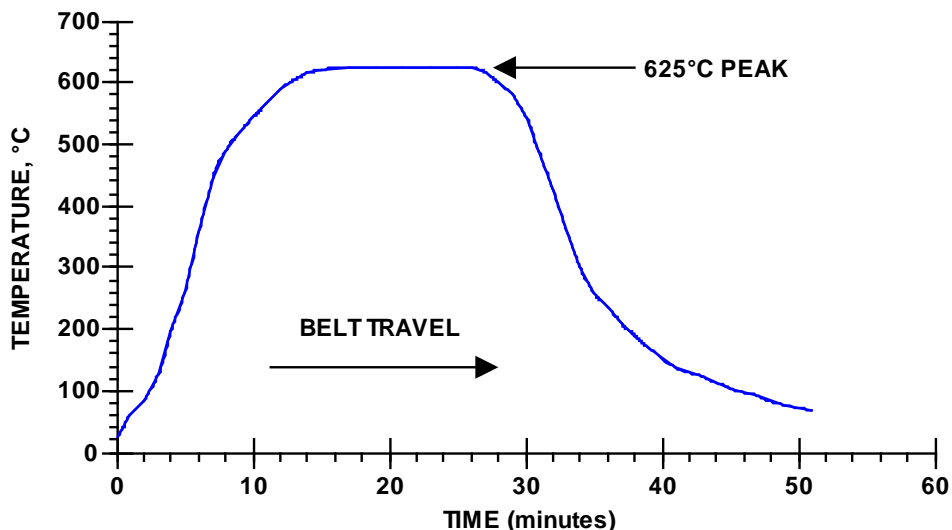
Note: The use of a 325 mesh screen will give a thinner dried thickness. A fired thickness range of 8 to 12 μm will trim more rapidly than thicker films, and will resist thermal expansion-contraction mismatch (strains between the steel, enamel and resistors during laser trimming) more readily than resistor films which are 13 to 18 μm thick. Thinner resistor films can be volatilized by a YAG laser at lower power and thus with less danger of cutting through the 125 to 150 μm thick enamel coating on the steel substrates. However, users should expect increases in sheet resistivity with thinner films.

Firing Temperature / Time:	625 °C / 10 - 12 min
Clean Air Exchange:	(minimum) 1-2 times / min
Total Firing Cycle:	45 min

Stabilisation:

For tolerances tighter than 5%, heat stabilization at 200°C to 450°C, prior to laser trimming has proven advantageous. Overglazing with ESL 4775 may stabilize, although firing temperature and time are critical. Expect changes of 5% to 10% due to overglazing or heat stabilization. Refiring resistors (normal profile) will cause changes (increasing with resistivity) of -5% to -30%. Use ESL 242-SB (epoxy overcoat) for post trim protection.

TYPICAL 625°C FIRING PROFILE



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CAUTION: Proper industrial safety precautions should be exercised in using these products. Use with adequate ventilation. Avoid prolonged contact with skin or inhalation of any vapours emitted during use or heating of these compositions. The use of safety eye goggles, gloves or hand protection creams is recommended. Wash hands or skin thoroughly with soap and water after using these products. Do not eat or smoke in areas where these materials are used. Refer to appropriate MSDS sheet.

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