



Electro-Science Laboratories, Inc.

416 East Church Road • King of Prussia, PA 19406-2625, U.S.A

610-272-8000 • Fax: 610-272-6759 • www.ElectroScience.com • Sales@ElectroScience.com

CERMET RESISTOR SYSTEM

3980 SERIES

- FOR HYBRID CIRCUITS & DISCRETE COMPONENTS
- HIGH PERFORMANCE
- LOW COST
- EASY PROCESSING
- OUTSTANDING VOLTAGE STABILITY
- EXCELLENT LASER TRIM STABILITY

The 3980 Resistor Series are ruthenium based resistor pastes designed for use in thick film hybrid microelectronic circuits and discrete components. They meet the most demanding telecommunication, aerospace, and medical applications and combine high performance, low cost, with ease of processing. The 3980 Resistor Series exhibits outstanding voltage, thermal, laser trim and load stability.

PASTE DATA

STIR WELL BEFORE USE

RHEOLOGY:

Thixotropic screen printable paste

VISCOSITY:

(Brookfield RVT, ABZ spindle, 10 RPM, 25.5°C±0.5°C)

225±25 Pa·s

SHELF LIFE:

6 months

PROCESSING

SCREEN MESH/EMULSION:

200/12.5 µm

LEVELING TIME: (25°C)

5-10 minutes

DRYING TIME: (125°C)

10-15 minutes

FIRING TEMPERATURE:

850°C

TIME AT PEAK:

10-12 minutes

TOTAL CYCLE:

45 minutes

TERMINATIONS:

9635-A

3980 Series 9807-B

ESL Affiliates

Japan: **ESL-Nippon Company, Ltd.** • Sukegawa Bldg. • 6th floor • 3-4 Yanagibashi 1-chome • Taito-ku • Tokyo 111, Japan • Tel: (011-81)-3-3864-8521 • Fax: (011-81)-3-3864-9270
NipponSales@ESLNippon.com

China: **Shanghai Agmet Electro-Science Laboratory Ltd.** • Second Floor Bldg. 12A1 • #223 North Fe Te Road • Waigaoqiao Free Trade Zone • Shanghai, China
Tel: (011-86)-21-5866-0497 • Fax: (011-86)-21-5866-0497 • ShanghaiSales@ShanghaiESL.com

Europe: **Agmet, Ltd.** • 8 Commercial Road • Reading, Berkshire, England RG2 0QZ • Tel: (011-44)-118-987-3139 • Fax: (011-44)-118-986-7331 • Sales@ESLEurope.co.uk

See Caution and Disclaimer on other side.

THINNER:

ESL 401

SUBSTRATE OF CALIBRATION:

96% alumina

3980 RESISTOR SERIES – TYPICAL PROPERTIES

PROPERTIES	3980	3981	3982	3983	3984	3985	3986	3987
Viscosity (Pa·s)	225±25							
Resistivity (Ω/sq.)	1	10	100	1 k	10 k	100 k	1 M	10 M
Tolerance(%)	±25%	±10%	±10%	±10%	±10%	±10%	±10%	±10%
Coefficient of Variation (%)	≤8	≤8	≤5	≤7	≤7	≤6	≤6	≤6
Dried Thickness	22.5±2.5μm							
Average TCR (ppm/°C)	150±100	±100	±100	±50	±50	±50	±100	-50±100
STOL (V/mm) ^a	--	5.91	23.6	78.7	217	492	--	--
Standard Working Voltage (V/mm) ^b	--	2.36	9.45	31.5	86.6	197	--	--
Maximum Rated Power (mW/mm ²) ^c	--	559	890	990	753	387	--	--
Noise (dB) ^d	--	-30	-20	-10	0	10	--	--
Laser Trim (%ΔR)	--	--	±0.3	±0.3	±0.3	±0.3	±0.3	±0.3

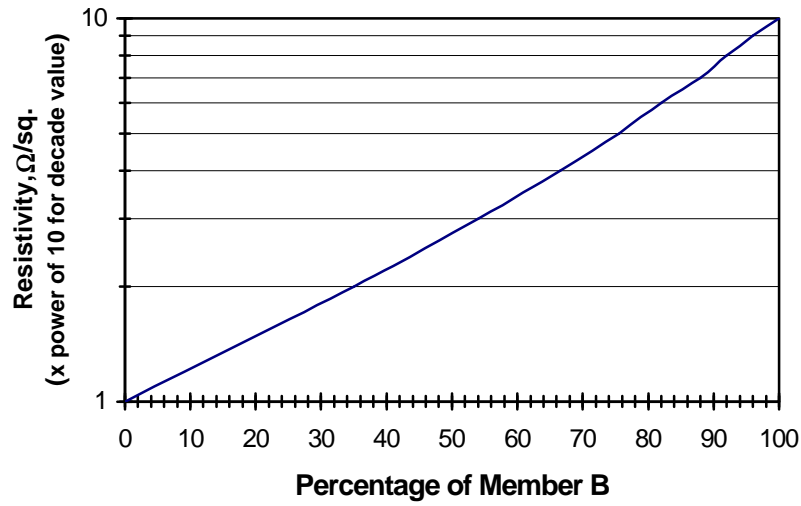
a. STOL: Voltage required, 5 seconds duration, to induce a resistance change of ±0.1% in a 1 mm x 1 mm resistor at 25°C; limited to 500 VDC.

b. Standard Working Voltage: 0.4 x STOL voltage.

c. Maximum Rated Power: (Standard Working Voltage)² / resistance.

d. Noise: Quan Tech noise measured on a 1.25 mm x 1.25 mm resistor.

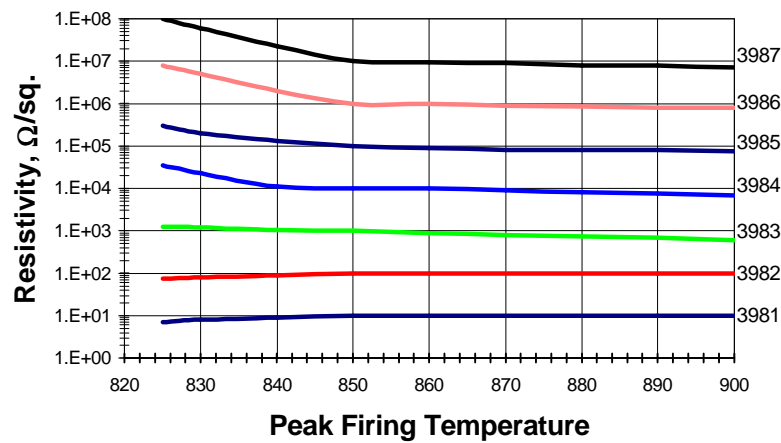
Typical Blending Curve -- 3980 Series



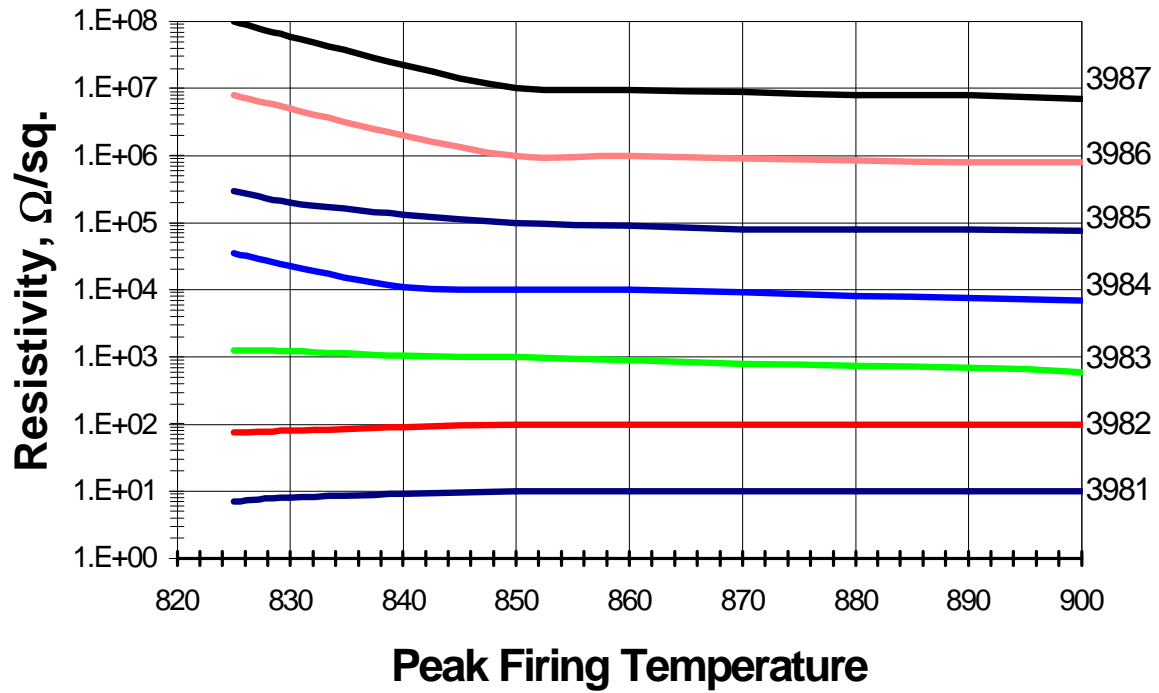
TYPICAL BLENDING OF ADJACENT DECADE VALUES

A	B
3981	3982
3982	3983
3983	3984
3984	3985
3985	3986

3980 Series --Typical Resistivity vs. Peak Firing Temperature



3980 Series –Typical Resistivity vs. Peak Firing Temperature





Electro-Science Laboratories, Inc.

416 East Church Road • King of Prussia, PA 19406-2625, U.S.A

610-272-8000 • Fax: 610-272-6759 • www.ElectroScience.com • Sales@ElectroScience.com

DIELECTRIC COMPOSITION

4909-MOD

ESL 4909-MOD is designed for printing over fired thick film thermal printhead resistors. It provides excellent thermal conductivity as well as a wear-resistant surface.

PASTE DATA

RHEOLOGY:

Thixotropic, screen printable paste

VISCOSITY:

(Brookfield RVT, ABZ Spindle, 10 rpm, 25.5°C±0.5°C)

70±15 Pa·s

COLOR:

(Fired)

White
Clear, transparent

SHELF LIFE:

(at 25°C)

6 months

PROCESSING

SCREEN MESH/EMULSION

150/25-40 microns

LEVELING TIME:

5-10 minutes

DRYING AT 125°C:

10-15 minutes

FIRING TEMPERATURE RANGE:

850°C

TIME AT TEMPERATURE:

10-12 minutes

SUBSTRATE FOR CALIBRATION:

96% alumina

THINNER:

ESL 401

TYPICAL PROPERTIES

FIRED FILM:

(Ra)

≤ 0.5 micron

4909-MOD 9607-B

ESL Affiliates

Japan: **ESL-Nippon Company, Ltd.** • Sukegawa Bldg. • 6th floor • 3-4 Yanagibashi 1-chome • Taito-ku • Tokyo 111, Japan • Tel: (011-81)-3-3864-8521 • Fax: (011-81)-3-3864-9270
NipponSales@ESLNippon.com

China: **Shanghai Agmet Electro-Science Laboratory Ltd.** • Second Floor Bldg. 12A1 • #223 North Fe Te Road • Waigaoqiao Free Trade Zone • Shanghai, China
Tel: (011-86)-21-5866-0497 • Fax: (011-86)-21-5866-0497 • ShanghaiSales@ShanghaiESL.com

Europe: **Agmet, Ltd.** • 8 Commercial Road • Reading, Berkshire, England RG2 0QZ • Tel: (011-44)-118-987-3139 • Fax: (011-44)-118-986-7331 • Sales@ESLEurope.co.uk

See Caution and Disclaimer on other side.

4909-MOD 9607-B

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 vapors 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.

DISCLAIMER: The product information and recommendations contained herein are based on data obtained by tests we believe to be accurate, but the accuracy and completeness thereof is not guaranteed. No warranty is expressed or implied regarding the accuracy of these data, the results obtained from the use hereof, or that any such use will not infringe any patent. Electro-Science assumes no liability for any injury, loss, or damage, direct or consequential arising out of its use by others. This information is furnished upon the condition that the person receiving it shall make their own tests to determine the suitability thereof for their particular use, before using it. User assumes all risk and liability whatsoever in connection with their intended use. Electro-Science's only obligation shall be to replace such quantity of the product proved defective.



Electro-Science Laboratories, Inc.

416 East Church Road • King of Prussia, PA 19406-2625, U.S.A

610-272-8000 • Fax: 610-272-6759 • www.ElectroScience.com • Sales@ElectroScience.com

DIELECTRIC GLAZE PASTE

CODE 129-C

CODE 129-C is a screen printable, smooth dielectric designed for thermal printhead underglaze and other high temperature glaze applications. Very smooth surfaces can be obtained by co-firing two layers in the temperature range of 1200°C-1350°C. CODE 129-C is designed to be used on 96% alumina substrates with minimum camber development (glass in compression).

PASTE DATA

RHEOLOGY:	Thixotropic screen printable paste
VISCOSITY: (Brookfield RVT, ABZ spindle, 10 rpm, 25.5°C±0.5°C)	150±25 Pa·s
COLOR:	Off White
SOLIDS CONTENT:	71-75%
SHELF LIFE: (25°C)	6 months

PROCESSING

SCREEN MESH/EMULSION:	200-325/37.5 µm
LEVELING TIME: (25°C)	5-10 minutes
DRYING AT 125°C:	10-15 minutes
FIRING TEMPERATURE/TIME AT PEAK:	1350°C/15 minutes
ALTERNATIVE FIRING TEMPERATURES/TIME AT PEAK:	1200°C-1250°C/1-3 hours
FIRING ATMOSPHERE:	Air
FLOW RATES:	10-60 liters/hour
FIRING PROFILES:	Shown on back
SUBSTRATE FOR CALIBRATION:	96% alumina
THINNER:	ESL 401

CODE 129C 9806-C

ESL Affiliates

Japan: **ESL-Nippon Company, Ltd.** • Sukegawa Bldg. • 6th floor • 3-4 Yanagibashi 1-chome • Taito-ku • Tokyo 111, Japan • Tel: (011-81)-3-3864-8521 • Fax: (011-81)-3-3864-9270
NipponSales@ESLNippon.com

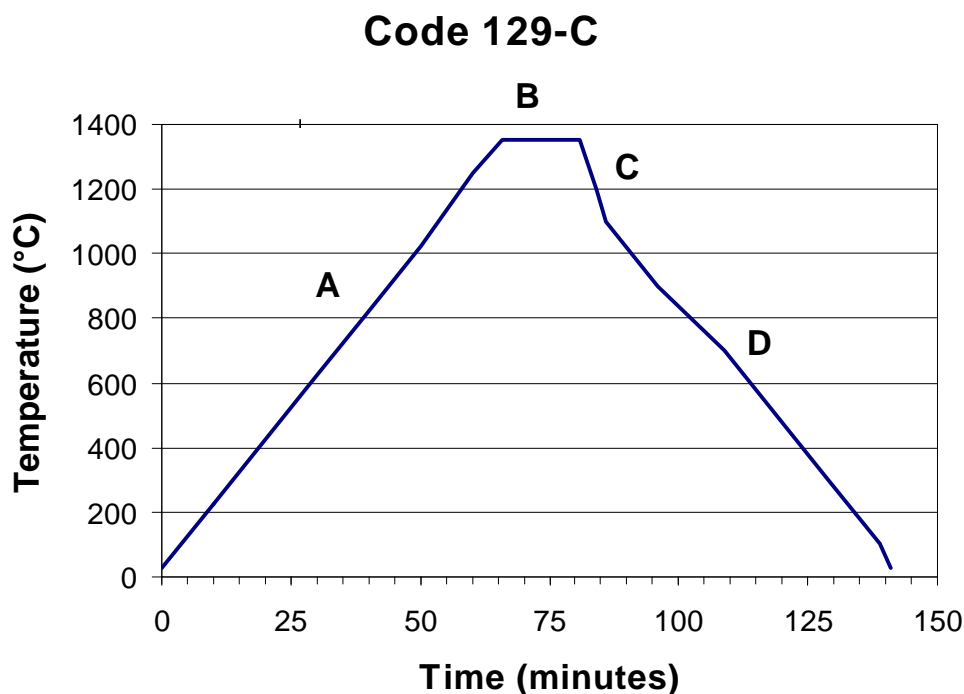
China: **Shanghai Agmet Electro-Science Laboratory Ltd.** • Second Floor Bldg. 12A1 • #223 North Fe Te Road • Waigaoqiao Free Trade Zone • Shanghai, China
Tel: (011-86)-21-5866-0497 • Fax: (011-86)-21-5866-0497 • ShanghaiSales@ShanghaiESL.com

Europe: **Agmet, Ltd.** • 8 Commercial Road • Reading, Berkshire, England RG2 0QZ • Tel: (011-44)-118-987-3139 • Fax: (011-44)-118-986-7331 • Sales@ESLEurope.co.uk

See Caution and Disclaimer on other side.

CHARACTERISTICS:

FIRED FILM THICKNESS: (two co-fired layers)	50 μm total
TCE: (25°C-400°C)	$69 \times 10^{-7} / ^\circ\text{C}$
GLASS TRANSITION POINT: (T_g)	703°C
DILATOMETRIC SOFTENING POINT:	761°C
SURFACE SMOOTHNESS (Fired Thickness = 50 μm):	RA = 0.04 μm , meniscus 5 μm
THERMAL CONDUCTIVITY, λ:	$\sim 0.8 \text{ W} \cdot \text{m}^{-1} \cdot \text{deg}^{-1} (\text{K})$
MEAN HEAT CAPACITY, C_p: (25°C-700°C)	$\sim 0.23 \text{ cal} \cdot \text{g}^{-1} \cdot \text{deg}^{-1} (\text{K})$
FIRED DENSITY, ρ:	3.2g/cm ³



CODE 129C 9806-C

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 vapors 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.

DISCLAIMER: The product information and recommendations contained herein are based on data obtained by tests we believe to be accurate, but the accuracy and completeness thereof is not guaranteed. No warranty is expressed or implied regarding the accuracy of these data, the results obtained from the use hereof, or that any such use will not infringe any patent. Electro-Science assumes no liability for any injury, loss, or damage, direct or consequential arising out of its use by others. This information is furnished upon the condition that the person receiving it shall make their own tests to determine the suitability thereof for their particular use, before using it. User assumes all risk and liability whatsoever in connection with their intended use. Electro-Science's only obligation shall be to replace such quantity of the product proved defective.

Primary Firing Schedule (Illustrated)

<u>Segment</u>	<u>Mode</u>	<u>Rate (°C/min.)</u>	<u>From (°C)</u>	<u>To (°C)</u>	<u>Time (min.)</u>
A	Heat	20	25	1,350	66
B	Isothermal	0	1,350	1,350	15
C	Cool	50	1,350	1,100	5
D	Cool	20	1,100	25	55

Alternative Firing Schedule (Example)

<u>Segment</u>	<u>Mode</u>	<u>Rate (°C/min.)</u>	<u>From (°C)</u>	<u>To (°C)</u>	<u>Time (min.)</u>
A	Heat	20	25	1,250	62
B	Isothermal	0	1,250	1,250	120
C	Cool	50	1,250	1,100	2-3
D	Cool	20	1,100	25	55