

Resistors

R 400 L Series

Low Ohmic Air Fired Surge Resistor Series

Description

R 400 L Series is a low range air-fired resistor system with a low Pd content. This Series is compatible with Heraeus Ag, Ag/Pt and Ag/Pd conductors.

Key Benefits

- It gives a dense fired film and was designed to give a very tight resistance distribution when cofiring the front and back side of circuits.
- Excellent print resolution for use in typical serpentine layouts.
- Laser trimmable
- Very good power handling and pulse stability
- Free of cadmium and nickel
- REACH⁷ and RoHS⁸ compliant

Processing

1. Spatulate well prior to processing. When stored in a refrigerator allow paste to come to room temperature prior to opening, to avoid condensation.
2. Print through a 200 – 325 mesh stainless steel screen. Total thickness 50 – 110µm.
3. Level at room temperature for 5 – 10 minutes.
4. Dry at 150 °C for 8 – 10 minutes
5. Fire at 850 °C (peak) for 10 minutes, and with a total firing cycle time of 30 – 60 minutes.

Thinner HVS 100

Compatibility

Ag C 1075 S (LPA 409-021)

AgPt C 1076 SD⁹
C 1076 SD (LPA 609-022)

AgPd C 1200 Series, C 2000 Series

Overglazes/Dielectrics IP 9209 H (600 °C)
IP 9117 D⁹ (850 °C)
IP 9117 E (850 °C)

Typical Properties (Paste)

Form: Thixotropic paste

Viscosity: 25 – 50 Pas (25 °C; D = 100 s⁻¹)

Solids: 75 % ± 1.5 %

Printing Speed: Up to 200 mm/s

Shelf Life: 6 month from date of shipment with correct storage (in a dry, cool (5 – 25 °C) and dark place with container tightly shut)

Typical Properties (Fired)¹

Sheet resistivity and TCR @18 µm dried film thickness

R 400 L Series ²	R 403 L	R 410 L	R 450 L	R 475 L
Rs [mΩ/□]	30 ± 15 %	100 ± 15 %	500 ± 15 %	750 ± 15 %
HTCR _{25-125 °C} [ppm/K]	365 - 400	365 - 400	365 - 400	365 - 400

Refire Stability with Overglaze

R 400 L Series	R 403 L	R 410 L	R 450 L	R 475 L
ΔR @ 850 °C	< - 2 %	< 5 %	< 5 %	< - 4 %
ΔR @ 600 °C	< - 2 %	< 5 %	< 5 %	< - 4 %
ΔR @ 850 °C + 500 °C	< - 4 %	< 5 %	< 5 %	< 5 %

Film Thickness Information³

R 400 L Series	R 403 L	R 410 L	R 450 L	R 475 L
Dried [microns]	14 - 18	16 - 20	17 - 20	17 - 20
Fired [microns]	11 - 15	11 - 15	12 - 16	12 - 16

Pulse Stability^{4,5}

R 400 L Series	R 403 L	R 410 L	R 450 L	R 475 L
ΔR < 0.5 %	500 V	670 V	870 V	1040 V
∅ Max. current ⁶	150 A	80 A	30 A	20 A
∅ Energy	25 Joule	25 Joule	18 Joule	16 Joule

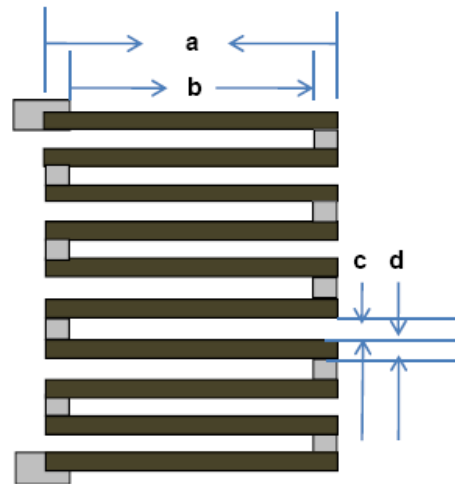
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- 1 Typical properties based on laboratory test methods. For optimum results all materials should be fired in a profiled furnace supplied by dried, hydrocarbon and other contaminant free air (PP-1).
- 2 Pastes are blendable to achieve desired resistivity. The resistivity should set by individual trials.
- 3 Measured after printing with a 325 mesh steel screen. Thickness of screen and emulsion combined was c. 75 µm, and the resultant printed track was 300 µm wide.
- 4 Measured on a 100 square serpentine pattern with a total length of 100 mm. The serpentine pattern contains 10 bars and each bar has a length of 10 mm with 1 mm line width, and 1 mm space between bars. To avoid the influence of the bends in the serpentine, the bars are connected with C 1076 SD AgPt (see Figure 1). Pulse stability testing was done using 10 pulses, overlazed with IP 9117 D.
- 5 Pulse shape: $Tr/Tf = 10\mu s/1000\mu s$
Tr: Rise time, Tf: Fall time to half of the peak voltage
- 6 @ max. voltage
- 7 REACH compliant according to the Annex XIV (Feb. 17, 2011) of Commission Regulation (EU) No 143/2011 to Regulation (EC) No 1907/2006 of the European Parliament and of the council on the Registration, Evaluation, Authorisation and Restriction of Chemicals ("REACH") by European Chemicals Agency; we define a material as REACH compliant, as long as substances used are not recorded in the Annex XIV.
- 8 RoHS compliant according to the Directives (European Union) No 2011/65/EC of Restriction of Hazardous Substances ("RoHS") and its subsequent amendments (including the exceptions No. 7.c. I of the EU Directive e.g. related to Pb)
- 9 Not REACH compliant – Sunset date of this product is Jan. 21, 2015 according to the Annex XIV (Feb. 17, 2011) of Commission Regulation (EU) No 143/2011 to Regulation (EC) No 1907/2006 of the European Parliament and of the council on the Registration, Evaluation, Authorisation and Restriction of Chemicals ("REACH") by European Chemicals Agency – Please ask for REACH compliant product(s).

Figure 1: Serpentine design used for pulse stability test



a: > b, depends on design of C1076 SD
 b: 10 mm = 10 □
 c = d: 1 mm
 □ : C 1076 SD
 ■ : R 400 L Series

The descriptions and engineering data shown here have been compiled by Heraeus using commonly-accepted procedures, in conjunction with modern testing equipment, and have been compiled as according to the latest factual knowledge in our possession. The information was up-to date on the date this document was printed (latest versions can always be supplied upon request). Although the data is considered accurate, we cannot guarantee accuracy, the results obtained from its use, or any patent infringement resulting from its use (unless this is contractually and explicitly agreed in writing, in advance). The data is supplied on the condition that the user shall conduct tests to determine materials suitability for a particular application.

Europe [TH]
 Heraeus Precious Metals GmbH & Co. KG
 Thick Film Materials Division
 Heraeusstr. 12 – 14
 63450 Hanau
 Germany
 Tel: +49 (6181) 35 - 5466
 E-Mail: th-info@heraeus.com
 Internet: www.heraeus-thickfilm.com

North America
 Heraeus Materials Technology LLC
 Thick Film Materials Division
 24 Union Hill Road
 W. Conshohocken, PA 19428
 USA
 Tel: +1 (610) 825 - 6050
 E-Mail: techservice@4cmd.com
 Internet: www.heraeus-thickfilm.com

Asia [TH]
 Heraeus Materials Technology Shanghai Ltd.
 No. 1 Guang Zhong Road
 Zhuanquiao Town, Minhang District
 201108 Shanghai
 People's Republic of China
 Tel: +86 (21) 3357 - 5688
 E-Mail: th.hmts@heraeus.com
 Internet: www.heraeus-thickfilm.com