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REGAL[™] CERMET RESISTOR SERIES

R-300-P SERIES

The REGAL R-300-P Resistor Series is an economical resistor paste designed for applications in high performance cermet trimmers and potentiometers.

The unique chemistry of the REGAL R-300-P Series provides excellent printing characteristics, nearly linear blending of adjacent members and minimal sensitivity towards wide variations in firing conditions. These advantageous features together with excellent fired resistor surface characteristics and low TCR's make this series a logical choice for exacting potentiometer requirements.

PASTE DATA

VISCOSITY:			
(Brookfield RVT, ABZ Spindle,	10 rpm, 25.5°C±0.5°C)	R-310-P & R-311-P	300±50 Pa- s
		R-312-P to R-316-P	225±50 Pa- s
THINNER:			ESL 435
PROCESSING	STIR WELL BEFORE USE		
PRINT THICKNESS:	A dry resistor film thickness ra for optimum performance of t calibrations, use of different pressures may require a differ performance with this resistor s	nge of 20 to 25 microns is he R-300-P series. With wiper metallurgies and/o rent dry film thickness to series.	s recommended respect to ESL or higher wiper obtain optimum
PRINTING AND DRYING:	A 200 mesh stainless steel scr is recommended. Allow wet p 15 minutes. Then dry at 125° (een with 12±3 microns em rints to level at room temp C for 10 to 15 minutes.	ulsion thickness perature for 5 to
SUBSTRATES:	The typical resistor performation alumina substrates (Kyocera / may result in variations in resisted)	nce data is based on te A476). Substrates of oth stor performance.	ests using 96% er compositions
R-300-P 9204-B			

ESL Affiliates

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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. FIRING: A continuous belt furnace with a total cycle time of 50 minutes and 11 minutes at a peak temperature of 850°C is recommended. See Figure 1. A dry, clean air atmosphere is required with a constant airflow of 20 liters per minute (for 10 cm wide belts) counter current to the substrate movement. The volume of air exchanged each minute should be approximately equal to the total volume of the furnace muffle. High production rates require increased airflows to keep vehicle burn-out products out of the peak firing zones. Avoid contamination of the air with vapors of halogenated solvents, residual compressor oil vapors and soldering flux furnes.

R-300-P SERIES

TERMINATIONS: Reported resistor properties are with ESL C-951 PtAg conductor composition prefired at 850°C using a resistor geometry 1 mm wide x 4 mm long. Potentiometer properties are reported on a 2 mm wide x 20 mm long resistor. This resistor series is compatible with other ESL conductive compositions such as silver, palladium-silver, platinum-gold, and gold. However, some shifts in resistivity and TCR may result with their usage.

FIGURE 1



R-300-P 9204-B

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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 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.

TYPICAL RESISTOR PROPERTIES^a

	<u>R-310-P</u>	<u>R-311-P</u>	<u>R-312-P</u>	<u>R-313-P</u>	<u>R-314-P</u>	<u>R-315-P</u>	<u>R-316-P</u>
RESISTIVITY (Ω/sq.):	1.5	10	100	1 k	10 k	100 k	1 M
SHIPPING TOLERANCE (%):	±20	±10	±10	±10	±10	±10	±10
TCR (ppm/°C):	±150	±100	±50	±50	±50	±50	±50
SHORT TIME OVERLOAD ^b (V/mm ²):	0.4	3	10	28	77	100	141
	TY	PICAL POTEN	TIOMETER PRO	PERTIES^c			
CRV:							
	< 1.0%	< 0.5%	< 0.3%	< 0.3%	< 0.3%	< 0.3%	< 0.3%
	< 1.0%	< 0.5%	< 0.3%	< 0.3%	< 0.3%	< 0.3%	< 0.3%
CONTACT NOISE:							
	< 1.0%	< 0.5%	< 0.3%	< 0.3%	< 0.3%	< 0.3%	< 0.3%
	< 1.0%	< 0.5%	< 0.3%	< 0.3%	< 0.3%	< 0.3%	< 0.3%
ROTATIONAL LIFE:							
	< 2.0%	< 1.0%	< 0.5%	< 0.2%	< 0.2%	< 0.2%	< 0.2%

a. Resistor Geometry: 1 mm width x 4 mm length. ESL C-951 PtAg terminations prefired at 850°C, 96% alumina substrate.

b. STOL: Voltage required, 5 seconds duration, to induce a resistance change of 0.5% at 25°C.

c. Ten finger Palliney 8 wiper, 10 grams/finger weight, 2 mm wide x 20 mm long resistor.

BLENDING CURVES FOR R-310-P / R-311-P





TCR VERSUS PERCENT BLEND



R-300-P 9204-B

BLENDING CURVES FOR R-311-P / R-312-P







BLENDING CURVES FOR R-312-P / R-313-P







BLENDING CURVES FOR R-313-P / R-314-P



RESISTANCE VERSUS PERCENT BLEND

TCR VERSUS PERCENT BLEND



BLENDING CURVES FOR R-314-P / R-315-P







BLENDING CURVES FOR R-315-P / R-316-P







TYPICAL FIRING SENSITIVITY R-311-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP						
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>850°C</u>		<u>870°C</u>		
		<u>R</u>	TCR	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	
C-951	60 MINUTES	0.913	150/55	0.972	113/8	0.989	92/-3	
C-951	30 MINUTES	0.824	177/88	0.848	158/61	0.823	166/79	
9695	60 MINUTES			0.985	109/4			
9695	50 MINUTES			1.031	84/-24			
	ESL CALIBRATION			1.000	87/-21			

NOTES:

- 1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = $10.54 \Omega/sq$. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.
- 2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 87/-21

TYPICAL FIRING SENSITIVITY R-312-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP						
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>85</u>	<u>850°C</u>		<u>0°C</u>	
		<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	
C-951	60 MINUTES	0.901	49/3	0.980	66/-13	1.057	82/23	
C-951	30 MINUTES	0.885	73/6	0.864	73/24	0.898	95/51	
9695	60 MINUTES			0.886	65/3			
9695	50 MINUTES			0.929	56/-13			
	ESL CALIBRATION			1.000	48/-20			

NOTES:

- 1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = 101.08 Ω /sq. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.
- 2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 48/-20

TYPICAL FIRING SENSITIVITY R-313-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP					
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>850°C</u>		<u>870</u>	<u>)°C</u>
		<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>
C-951	60 MINUTES	0.740	68/51	0.992	32/-1	1.197	6/-45
C-951	30 MINUTES	0.731	92/82	0.928	64/38	1.088	51/4
9695	60 MINUTES			0.971	37/5		
9695	50 MINUTES			1.107	33/-2		
	ESL CALIBRATION			1.000	31/-4		

NOTES:

- 1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = $1.039 \text{ k}\Omega/\text{sq}$. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.
- 2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 31/-4

TYPICAL FIRING SENSITIVITY R-314-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP					
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>85</u>	<u>0°C</u>	<u>87</u>	<u>0°C</u>
		<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>
C-951	60 MINUTES	0.857	62/42	1.002	47/24	1.208	35/1
C-951	30 MINUTES	0.992	76/62	1.080	65/36	1.186	70/46
9695	60 MINUTES			1.030	43/15		
9695	50 MINUTES			1.048	40/14		
	ESL CALIBRATION			1.000	43/19		

NOTES:

- 1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = 9.927 k Ω /sq. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.
- 2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 43/19

TYPICAL FIRING SENSITIVITY R-315-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP					
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>850°C</u>		<u>870°C</u>	
		<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>
C-951	60 MINUTES	1.069	22/-7	0.899	39/8	0.828	53/35
C-951	30 MINUTES	1.094	23/-6	0.937	41/21	0.809	81/79
9695	60 MINUTES			0.926	37/13		
9695	50 MINUTES			0.997	35/8		
	ESL CALIBRATION			1.000	31/-1		

NOTES:

1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = 93.33 k Ω /sq. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.

2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 31/-1

TYPICAL FIRING SENSITIVITY R-316-P

NORMALIZED RESISTIVITY AND TCR (ppm/°C, HOT AND COLD) (10 MINUTE SOAK TIME)

RESISTOR	RESISTOR FIRING	PEAK RESISTOR FIRING TEMP							
TERMINATIONS	CYCLE TIME	<u>830°C</u>		<u>830°C</u>		<u>85</u>	<u>0°C</u>	<u>87</u>	<u>0°C</u>
		<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>	<u>R</u>	<u>TCR</u>		
C-951	60 MINUTES	1.683	-24/-72	0.953	7/-22	0.600	35/18		
C-951	30 MINUTES	1.713	-34/-84	1.007	0/-35	0.591	26/12		
9695	60 MINUTES			1.056	9/-25				
9695	50 MINUTES			0.992	0/-29				
	ESL CALIBRATION			1.000	2/-28				

NOTES:

- 1. Normalizing Resistivity: (1 mm x 4 mm), 4 squares = $1.024 \text{ M}\Omega/\text{sq}$. ESL calibration: ESL C-951 PtAg terminations, 11 minute soak time, 850°C, 50 minutes firing cycle.
- 2. TCR, ESL calibration, (ppm/°C, Hot/Cold, +125°C/-55°C) = 2/-28