

## Technical Data Sheet



### THICK FILM MATERIALS

Product Type: Resistors

Product Name: R8900 Series

#### Air Fired Resistor System

##### Description

The Heraeus resistor R8900 Series materials is part of complete thick film materials system. Materials in this system are designed for production of high reliability, commercial and industrial hybrid microcircuit and resistor networks. The Series shows the following benefits:

##### Key Benefits

- Excellent noise and STOL values
- Compatible with C2000 Series (Ni and Cd-free)
- R8900 Series offers a range of  $10 \Omega/\square$  –  $1 \text{ M} \Omega/\square$
- Free of nickel, cadmium and phthalate
- REACH<sup>11</sup> and RoHS<sup>12</sup> compliant

##### Typical Fired Resistor Properties<sup>1</sup>

R8900 Series <sup>2, 3</sup>	R8911	R8921	R8931	R8935 L	R8935 HN <sup>10</sup>	R8941 N <sup>10</sup>	R8951 N <sup>10</sup>	R8961 N <sup>10</sup>
Resistivity <sup>4</sup> ( $\Omega/\square$ )	$10 \pm 10 \%$	$100 \pm 10 \%$	$1 \text{ k} \pm 10 \%$	$5 \text{ k} \pm 10 \%$	$5 \text{ k} \pm 10 \%$	$10 \text{ k} \pm 10 \%$	$100 \text{ k} \pm 10 \%$	$1 \text{ M} \pm 10 \%$
Temperature coefficient of resistance <sup>4</sup> TCR (ppm/K)	$0 \pm 100$	$0 \pm 100$	$0 \pm 100$	$0 \pm 100$	$0 \pm 100$	$0 \pm 100$	$0 \pm 100$	$0 \pm 150$
VCR <sup>5,13</sup> (ppm/V/mm)	-	-	-	-	-	- 50	-	-
Short term overload voltage <sup>6,13</sup> (V/mm)	9	28	87	155	180	238	497	524
Standard working voltage <sup>7, 13</sup> (V/mm)	3.6	11	35	62	72	95	199	209
Maximum rated power dissipation <sup>8, 13</sup> (mW/mm <sup>2</sup> )	1300	1280	1220	770	1040	910	395	44
Quan tech noise <sup>9,13</sup> (dB)	-	- 32	- 21	- 10	- 13	- 10	- 3	-

##### Legend

- 1) Typical properties based on laboratory test methods. For optimum results all materials should be fired in a profiled furnace supplied by dried, hydrocarbon-free and other contaminant-free air (PP-1).
- 2) Also available: R 8901 (Resistivity:  $1 \Omega/\square \pm 20 \%$ ; TCR:  $\pm 250$  ppm/K)<sup>3</sup>; other resistivity values available on request.
- 3) Processing conditions: **Termination**: Heraeus Silver / Palladium conductor composition C1214, prefired at 850 °C; **Substrate**: 96 % alumina (Ceramtec, Rubalit 708S); **Printing**: 200 mesh stainless steel screen with 30 – 40  $\mu\text{m}$  emulsion, to a dried thickness of  $22 \pm 3 \mu\text{m}$  (resistivity  $\leq 10 \Omega/\square$ ); **Firing**: 60 minute cycle (furnace entry to exit) to a peak temperature of 850 °C for 10 minutes.
- 4) Shipping specifications: Resistor geometry: 1.5 x 1.5 mm. Temperature coefficient of resistance: - 55 °C to + 25 °C and + 25 °C to + 125 °C.
- 5) Voltage coefficient of resistance: Resistor geometry: 1 x 1 mm laser trimmed with P-cut to 1.5 x fired value. VCR measured from 5 -50 VDC.
- 6) Short term overload (STOL) voltage: voltage required (5 seconds duration) to induce a resistance change of 0.1 % in a 1 x 1 mm resistor at 25 °C.

- 7) Standard working voltage: 0.4 x short term overload voltage.
- 8) Maximum rated power dissipation: (standard working voltage)<sup>2</sup>/resistance
- 9) Resistor geometry: 1 x 1 mm
- 10) Improved pastes with decreased firing sensitivities
- 11) REACH compliant according to the latest \*\* Annex XIV to Regulation (EC) of the European Parliament and of the council on the Registration, Evaluation, Authorisation and Restriction of Chemicals ("REACH") by European Chemicals Agency and its subsequent amendments: the material does not contain any substance listed in Annex XIV.
- 12) RoHS compliant according to the latest \* Directives (European Union) of Restriction of Hazardous Substances ("RoHS") and its subsequent amendments (including the exceptions related to Pb.
- 13) Test made with R 8900 Series non-REACH

\* See the data sheet issue date (DD/MM/YY) as reference of validity of latest edition which is available on request.

## Technical Data Sheet

### Air Fired Resistor System

#### 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 mesh stainless steel screen, 30 – 40 µm emulsion. Total screen thickness: 90 – 110 µm.
- 3) Level at room temperature for 5 – 10 minutes.
- 4) Dry at 150 °C for 10 minutes. Dried film thickness should be 24 ± 5 µm.
- 5) The electrical performance given in this data sheet refers to a 60 minutes firing cycle, with a peak temperature of 850 °C for 10 minutes.

#### Thinner

HVS 100

#### Typical Properties

Form	Pseudoplastic paste
Viscosity	20 – 50 Pas (25 °C, D = 100/s)
Coverage	80 – 110 cm <sup>2</sup> /g
Shelf Life	12 months from date of shipment with correct storage (in a dry, cool (5 – 25 °C) and dark place with container tightly shut).

#### Compatibility

Conductors, various standard terminations	
Ag	C 1075 S (LPA 409-021)
AgPd	C 2000 Series, C 1214
AgPt	C 1076 SD (LPA 609-022)
Au	C 5007
Overglazes	IP 9025 ST (500 °C) IP 9029 H (600 °C)
Dielectrics	IP 9117 Series IP 9227

#### Blend Break

- 1) Adjacent decades may be blended to yield intermediate values that conform to R 8900 Series specifications.
- 2) A blend break exists between R 8931 and R 8941 N which are not directly blendable, but for blending, two 5 kΩ/□ pastes are available, e.g. R 8935 L (compatible with the low-ohmic end R 8931 and R 8935 HN (compatible with the high-ohmic end R 8941 N).

#### Laser Trim Stability

All tests were performed on 1 x 1 mm resistors, not overglazed, and terminated with C 1214 (Ag/Pd).

#### Trimming Parameters

Trimming to 1.5 times the fired value with a Nd-YAG-laser with a single plunge cut

Trim Speed	10 – 30 mm/s
Q-Rate	2 – 5 kHz
Average Power	0.8 – 1.5 W

#### Trim Performance

Initial Accuracy	± 0.1 %
Low Term Stability (1000 hrs) 85 °C/ 85 % RH	± 0.2 %
150 °C aging	± 0.2 %

## Technical Data Sheet

### Air Fired Resistor System

#### Table of Annex Content\*\*\*

Content	Page
1. Effect of film thickness on resistivity	4
2. Effect of film thickness on TCR	5
3. Effect of resistor length on resistivity	6
4. Effect of resistor length on HTCR	7
5. Effect of peak temperature on resistivity	8
6. Effect of peak temperature on TCR	9
7. Blend curves - resistance and TCR	10
8. Print thickness – wet / dried / fired	12
9. Effect of termination on resistivity	13
10. Effect of firing on dielectric	13
11. Effect of firing cycle on resistivity	13
12. Re-firing shift – 850 °C / 10 min / 60 min	14
13. Stability with and without overglaze IP 9025 ST	14

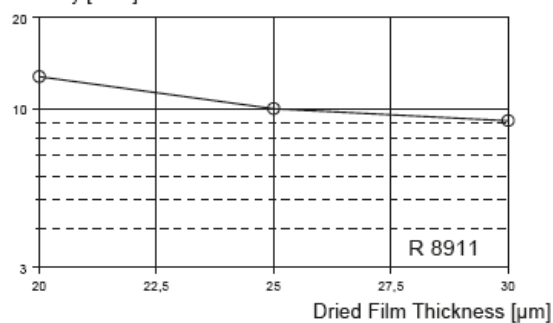
\*\*\* All following test results (Annex 1 to 13) are made with the non REACH compliant R 8990 Series. Since its inorganic components applied are identical as REACH compliant R 8900 Series, hence its results are also applicable for R 8900 REACH compliant.

## Technical Data Sheet

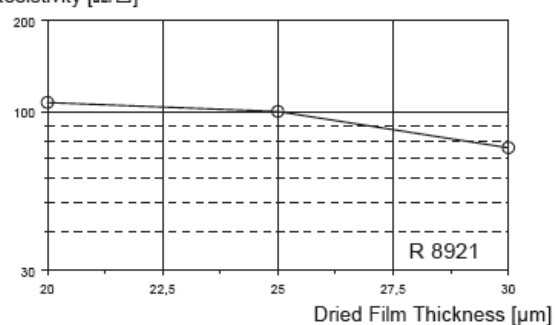
### Air Fired Resistor System

#### Annex 1: Effect of Film Thickness on Resistivity

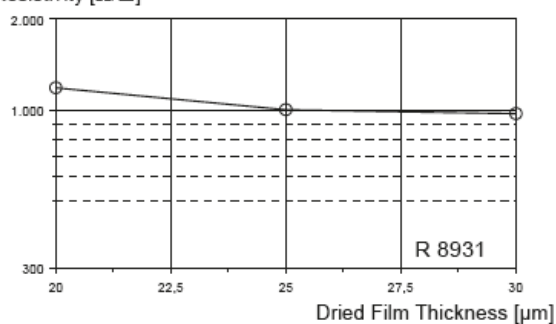
Resistivity [ $\Omega/\square$ ]



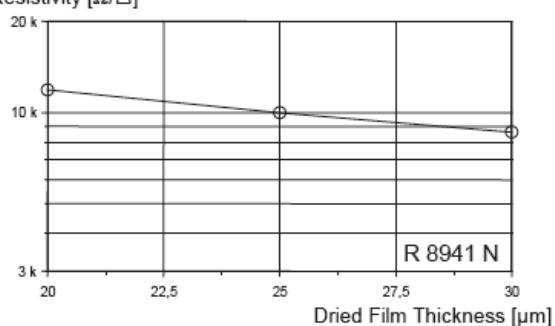
Resistivity [ $\Omega/\square$ ]



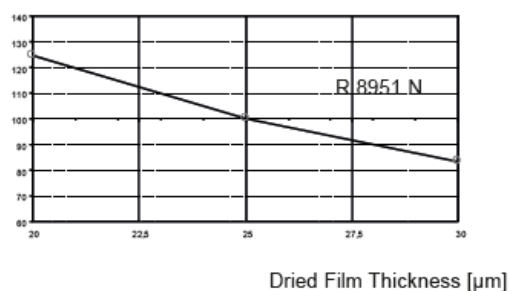
Resistivity [ $\Omega/\square$ ]



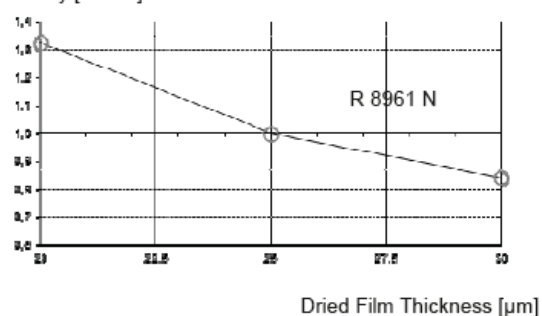
Resistivity [ $\Omega/\square$ ]



Resistivity [ $\text{k}\Omega/\square$ ]



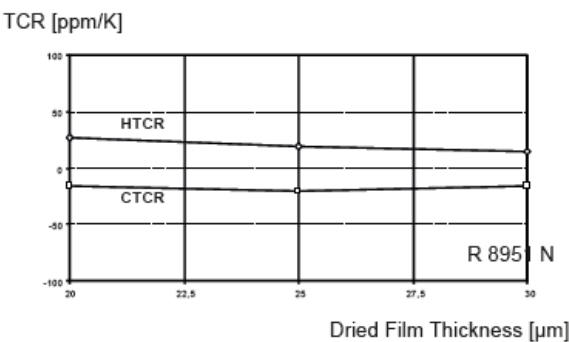
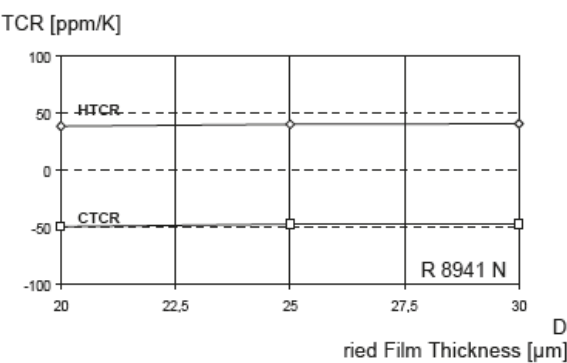
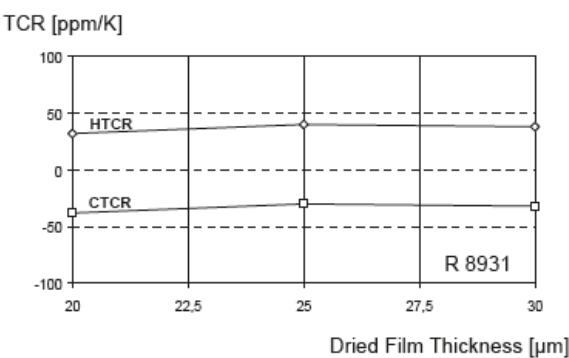
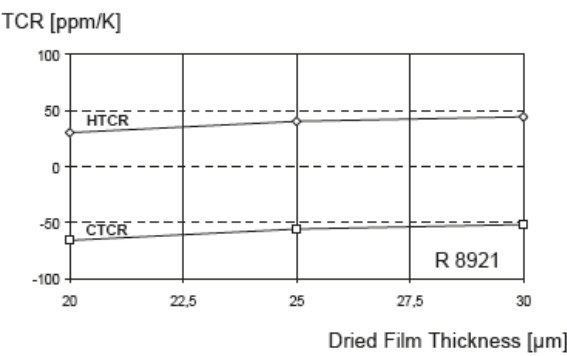
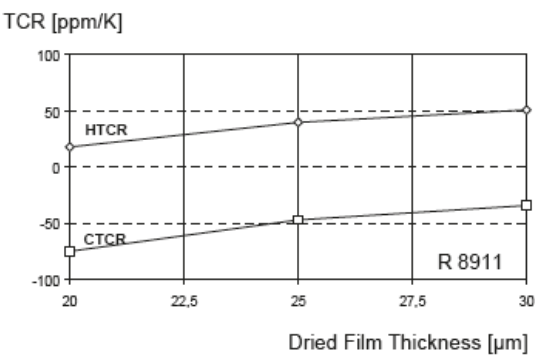
Resistivity [ $\text{M}\Omega/\square$ ]



Technical Data Sheet

Air Fired Resistor System

Annex 2: Effect of Film Thickness on TCR



## Technical Data Sheet

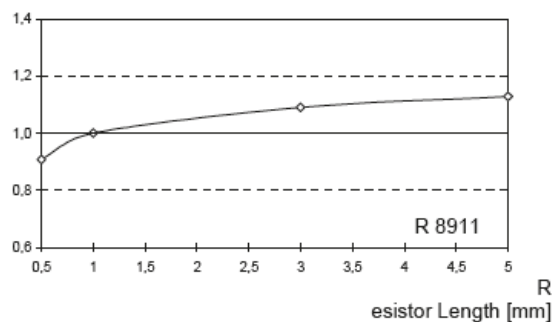
### Air Fired Resistor System

#### Annex 3: Effect of Resistor Length on Resistivity

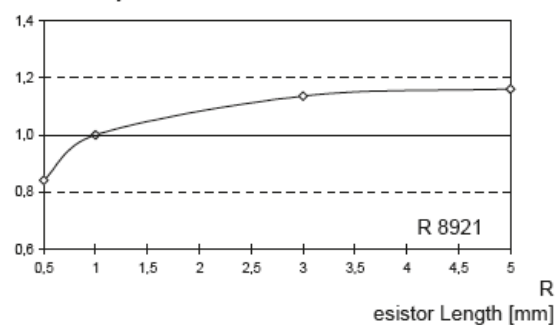
##### Annex 3. Effect of Resistor Length on Resistivity

Termination: C 1214 Ag/Pd ; Resistor width : 1.0 mm

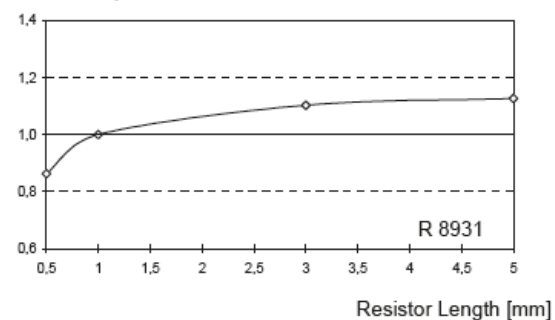
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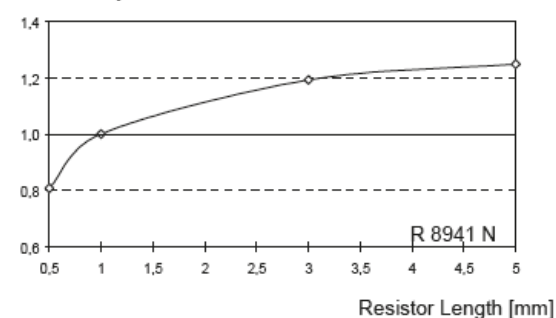
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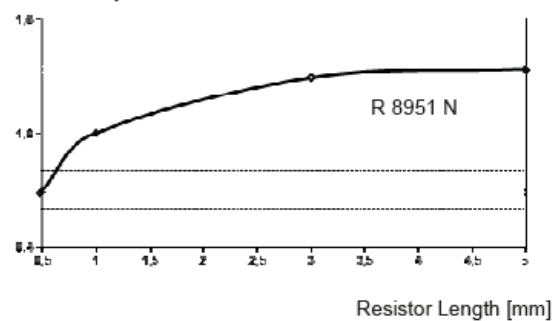
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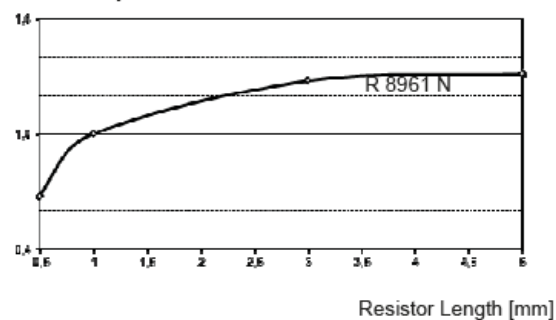
Rel. Resistivity



Rel. Resistivity



Rel. Resistivity



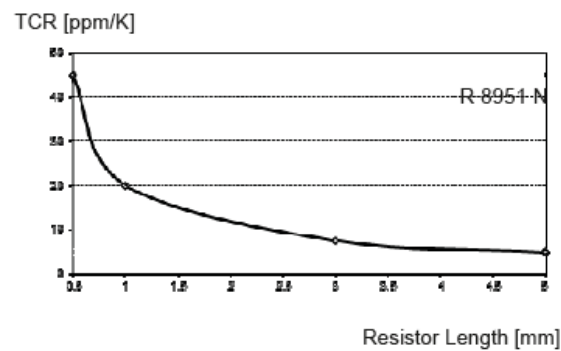
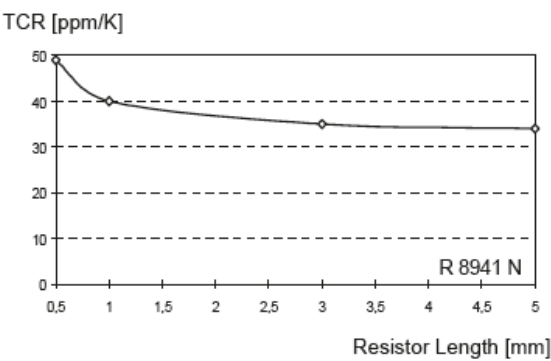
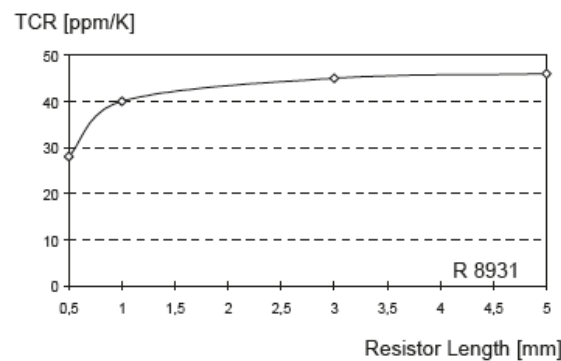
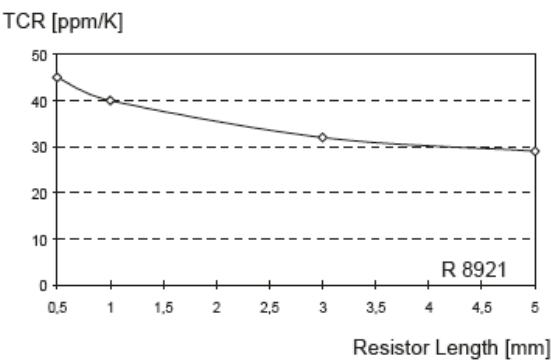
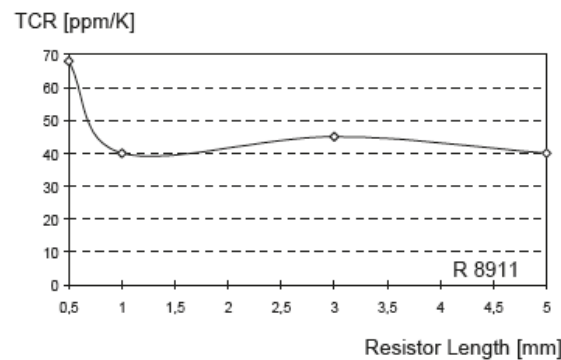
Technical Data Sheet

Air Fired Resistor System

Annex 4: Effect of Resistor Length on HTCR

Termination : C 1214 Ag/Pd ; Resistor width : 1.0 mm

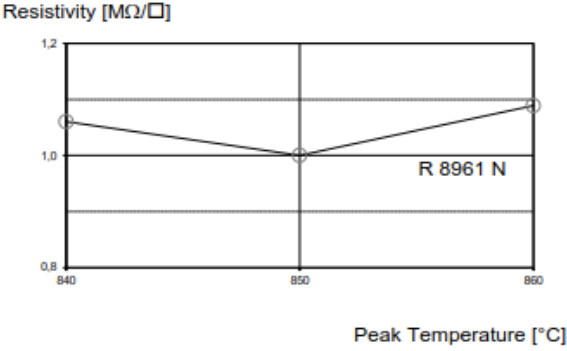
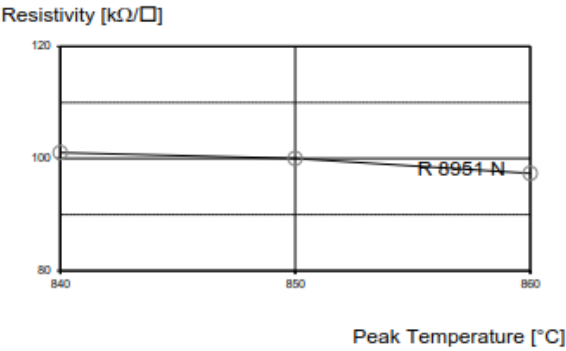
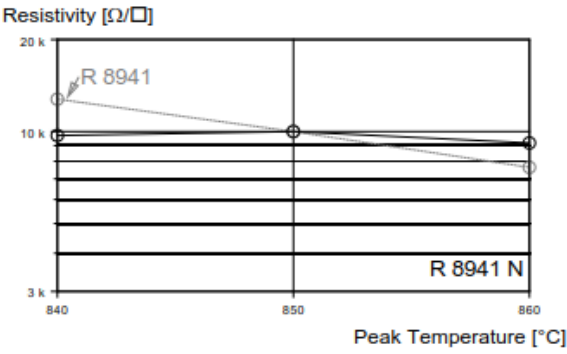
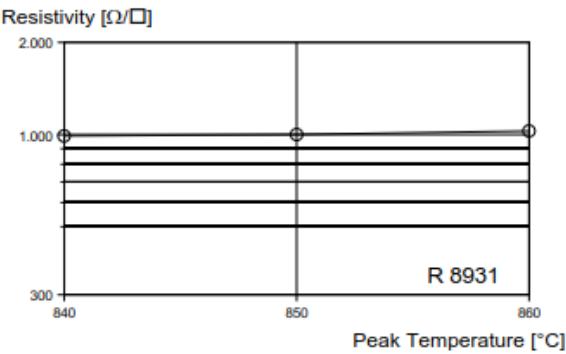
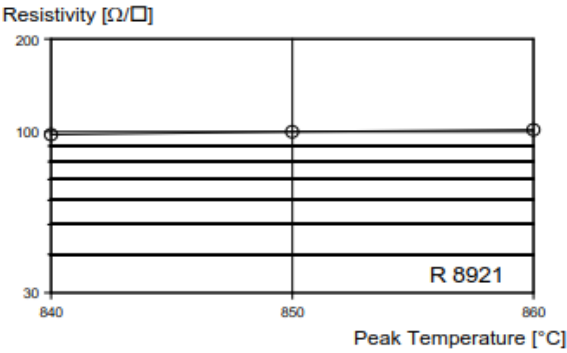
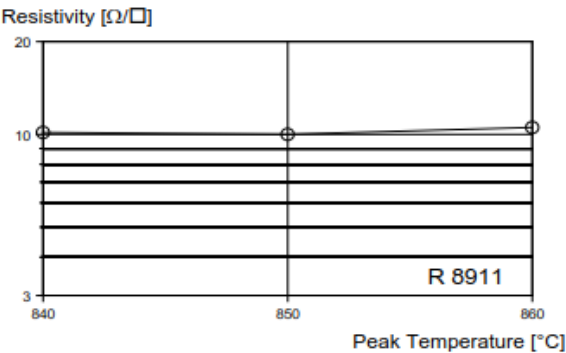
Annex 4. Effect of Resistor Length on HTCR



Technical Data Sheet

Air Fired Resistor System

Annex 5: Effect of Peak Temperature on Resistivity

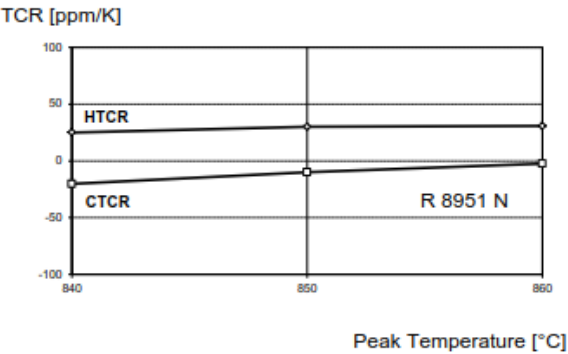
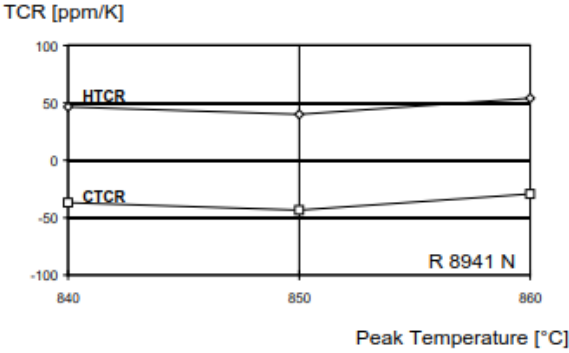
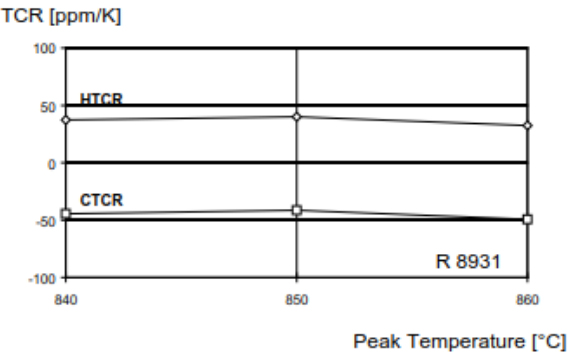
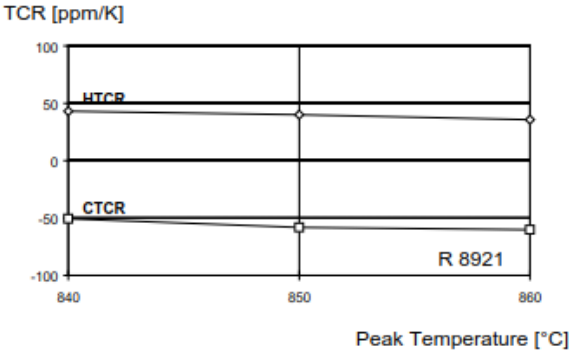
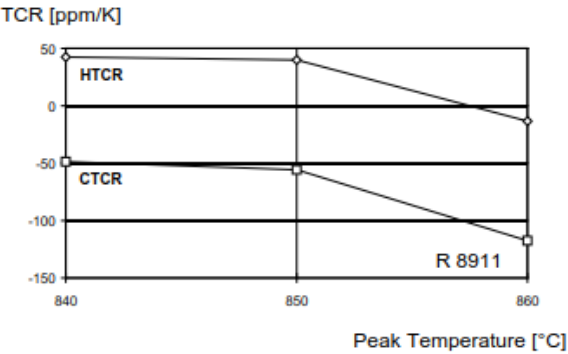




Technical Data Sheet

Air Fired Resistor System

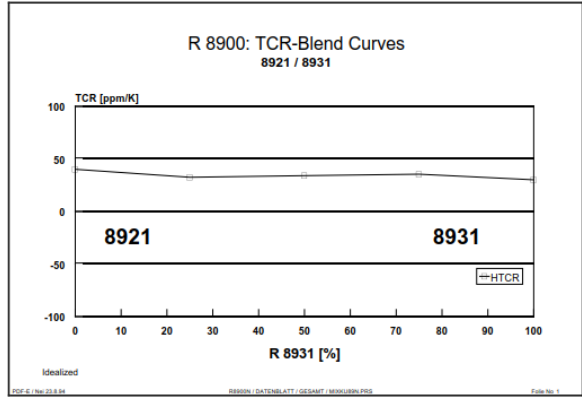
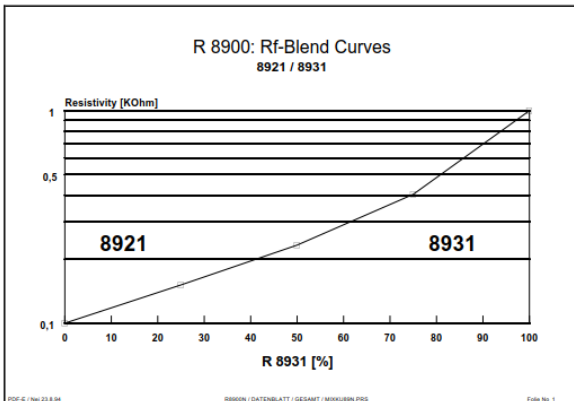
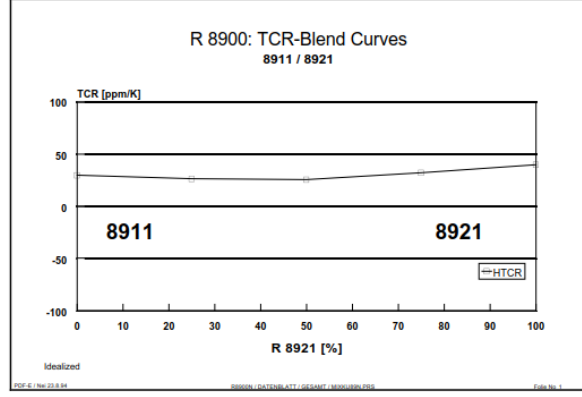
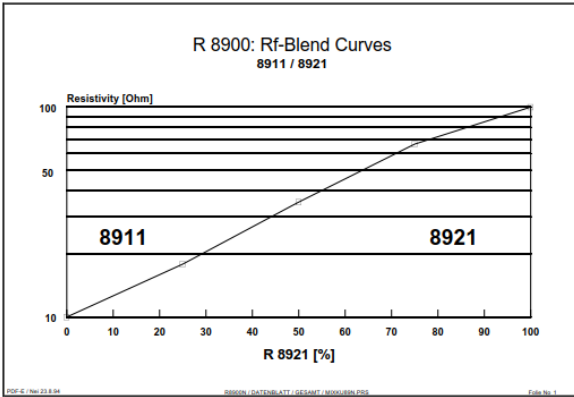
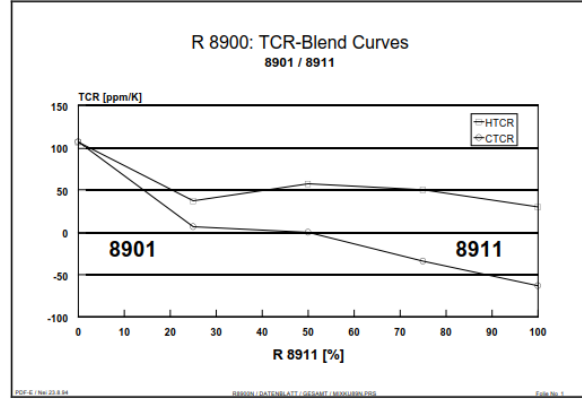
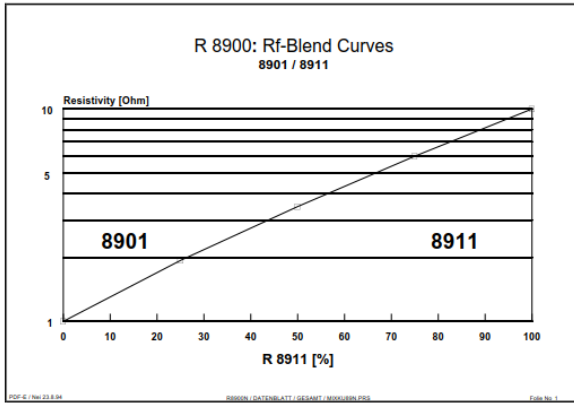
Annex 6: Effect of Peak Temperature on TCR



## Technical Data Sheet

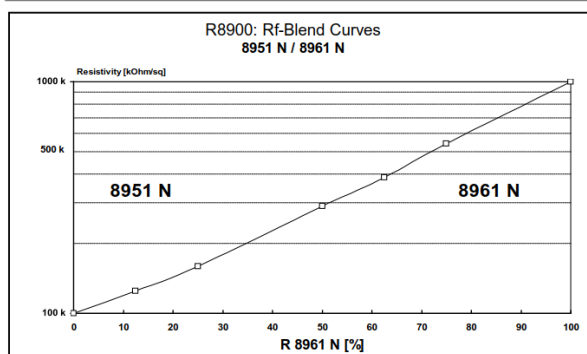
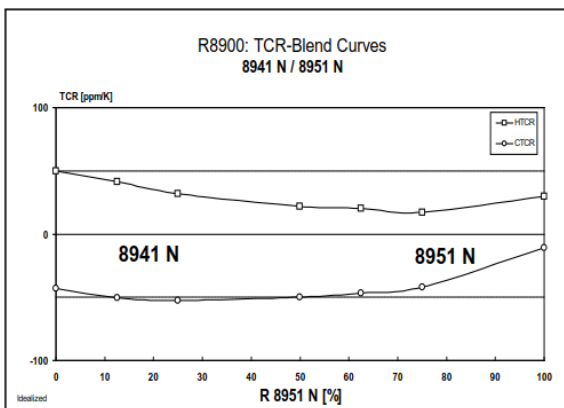
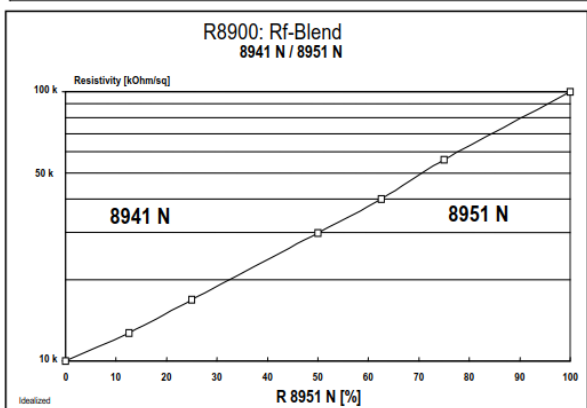
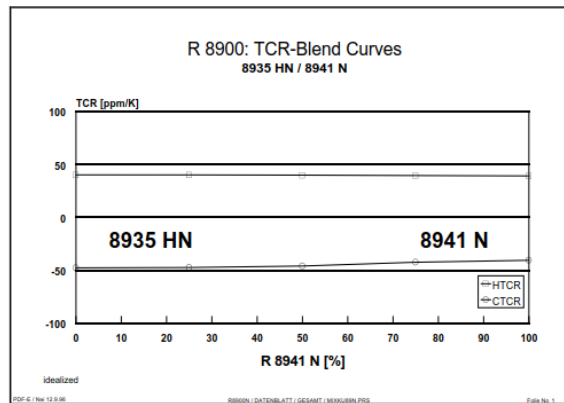
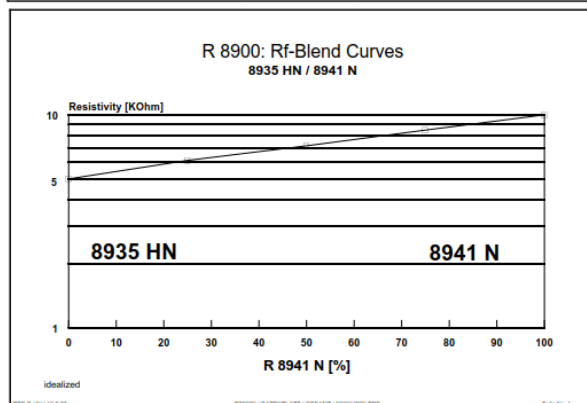
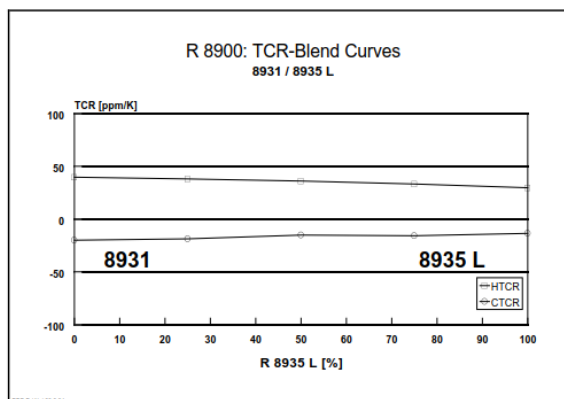
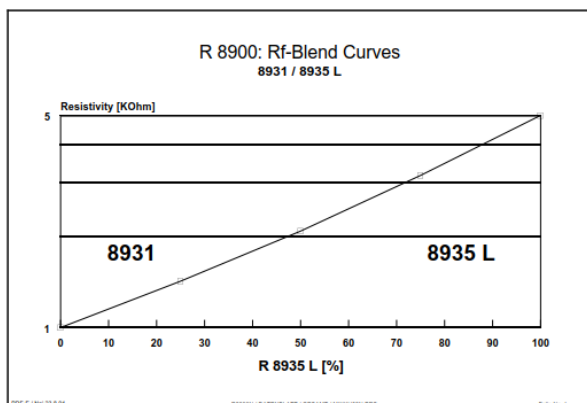
### Air Fired Resistor System

#### Annex 7: Blend Curves – Resistance and TCR



## Technical Data Sheet

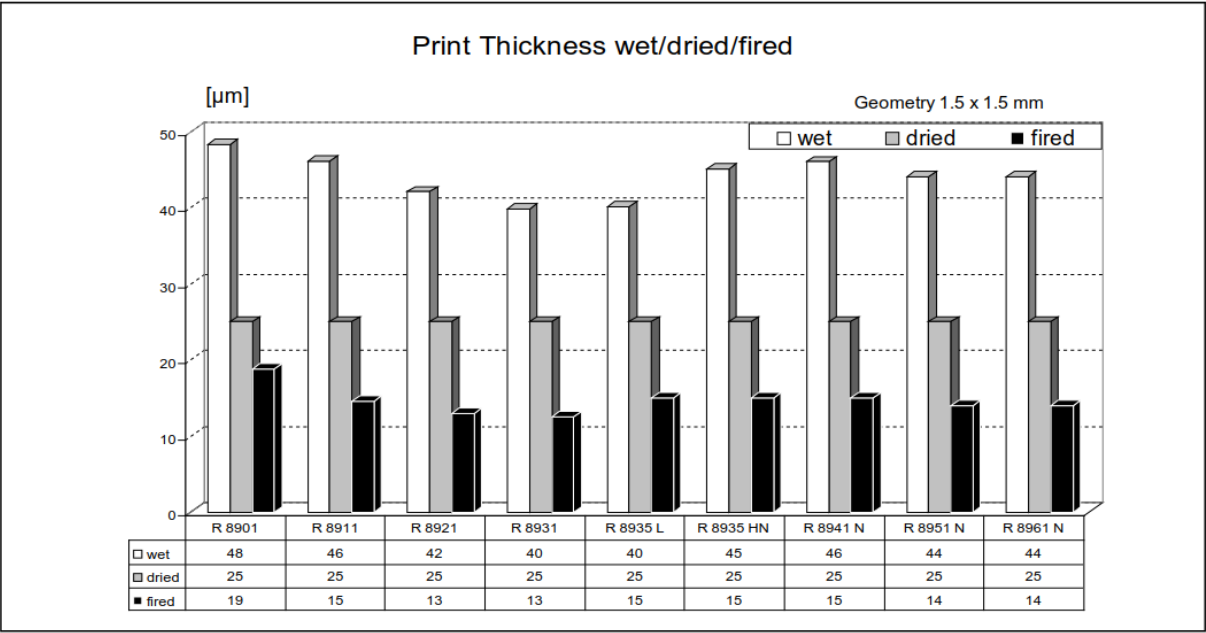
### Air Fired Resistor System



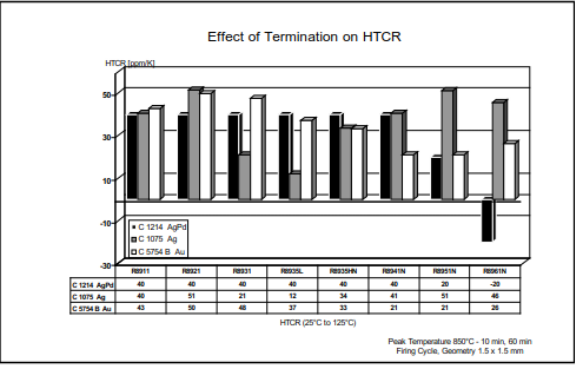
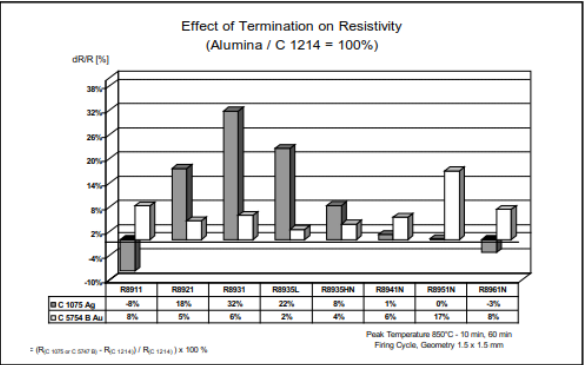
Technical Data Sheet

Air Fired Resistor System

Annex 8: Print Thickness – Wet / Dried / Fired



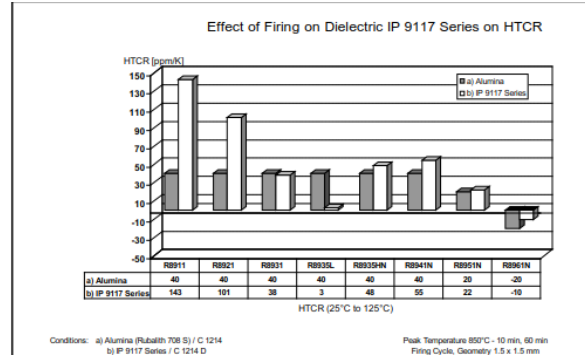
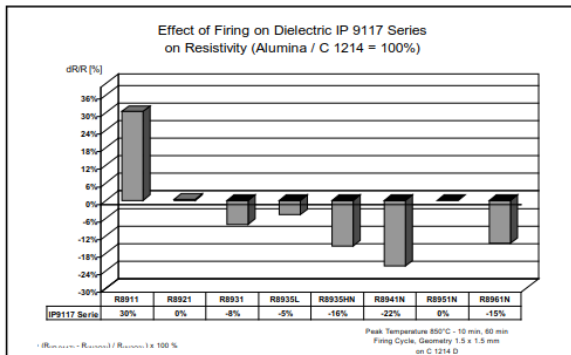
Annex 9: Effect of Termination on Resistivity



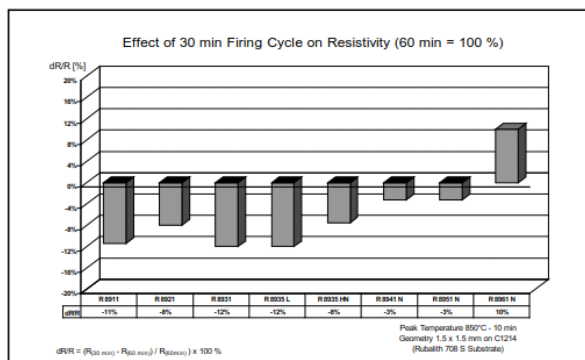
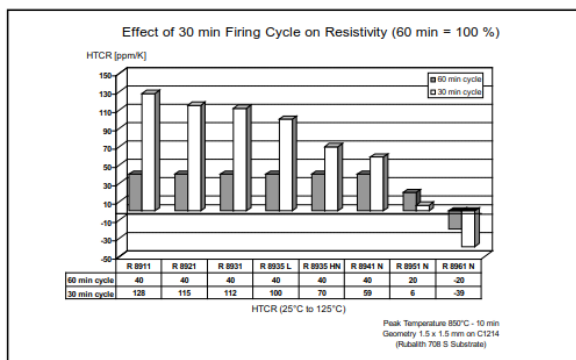
## Technical Data Sheet

### Air Fired Resistor System

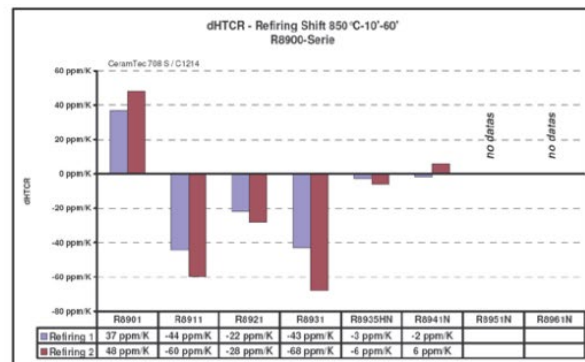
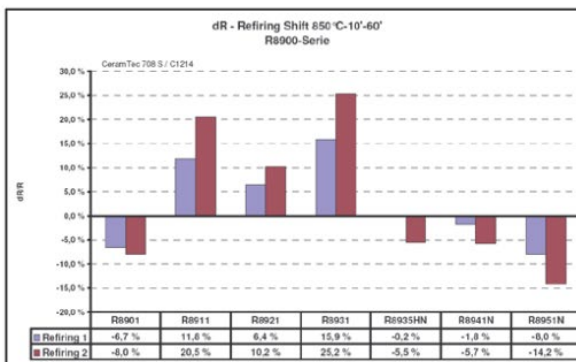
#### Annex 10: Effect of Firing on Dielectric



#### Annex 11: Effect of Firing Cycle on Resistivity



#### Annex 12: Re-firing Shift – 850 °C / 10 min / 60 min



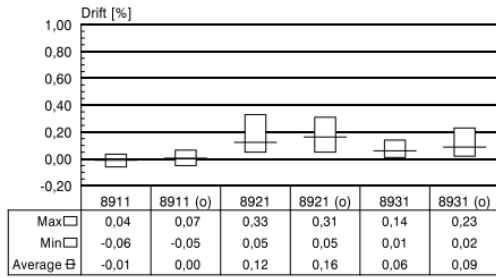
## Technical Data Sheet

### Air Fired Resistor System

#### Annex 13: Stability with and without overglaze IP 9025 ST

##### R 8900: Room Temp. Storage, 1000 h Data

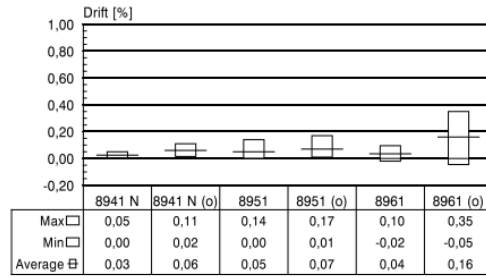
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

##### R 8900: Room Temp. Storage, 1000 h Data

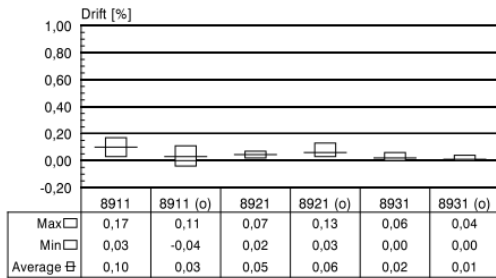
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

##### R 8900: 150 °C Storage, 1000 h Data

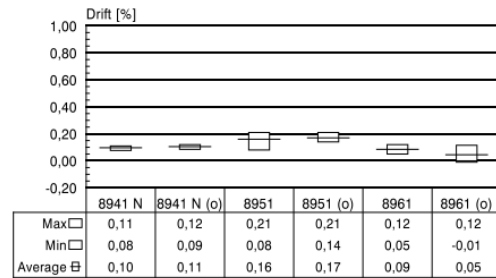
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

##### R 8900: 150 °C Storage, 1000 h Data

Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)

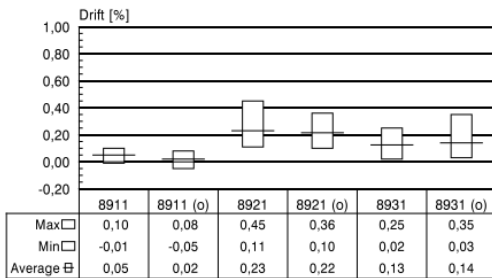


(o) = overglazed with IP 9025 ST

## Technical Data Sheet

### Air Fired Resistor System

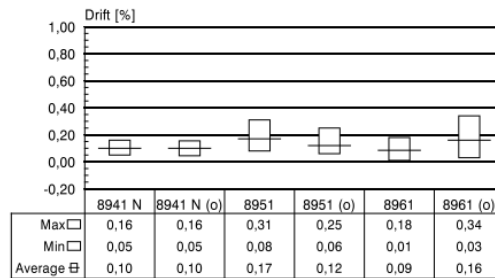
**R 8900: 85 °C/85 % RH Storage, 1000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

8911 / R8900N / Datenblatt / Gesamt / Lagerungen / 89RLAS02.PPS PDF-E / Neu Ausgegeben 0.11.06 / 3

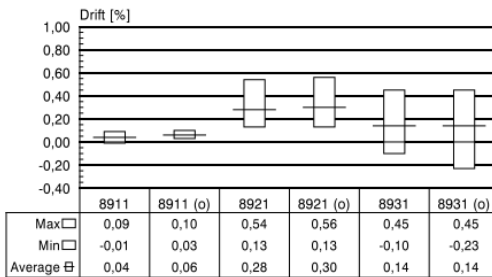
**R 8900: 85 °C/85 % RH Storage, 1000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

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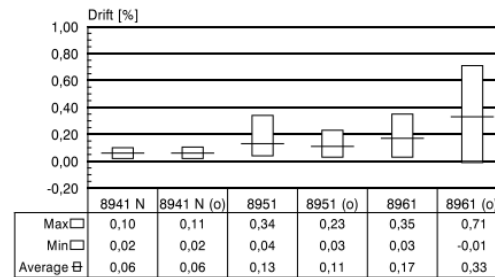
**R 8900: 40 °C/90 % RH Storage, 1000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



(o) = overglazed with IP 9025 ST

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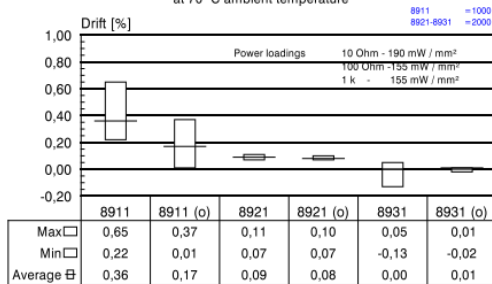
**R 8900: 40 °C/90 % RH Storage, 1000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)



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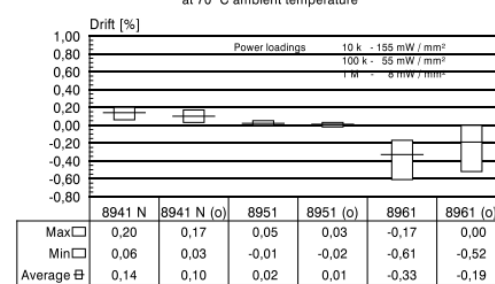
**R 8900: Load Life, 1000 h/2000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)  
at 70 °C ambient temperature



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**R 8900: Load Life, 1000 h Data**  
Resistance Drift after Laser Trimming  
(1 x 1 mm, plunge cut, 1.5 x fired value)  
at 70 °C ambient temperature

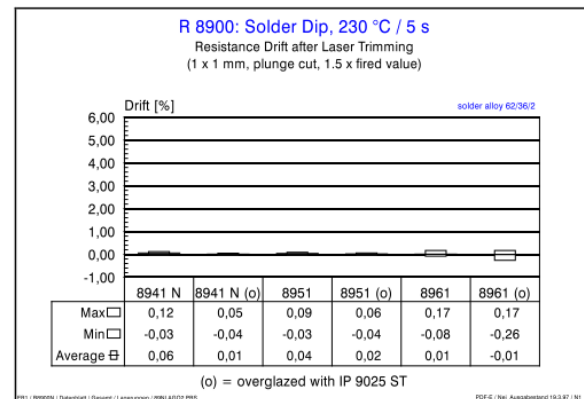
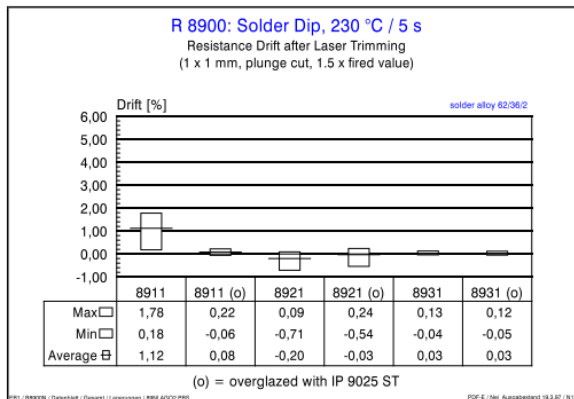
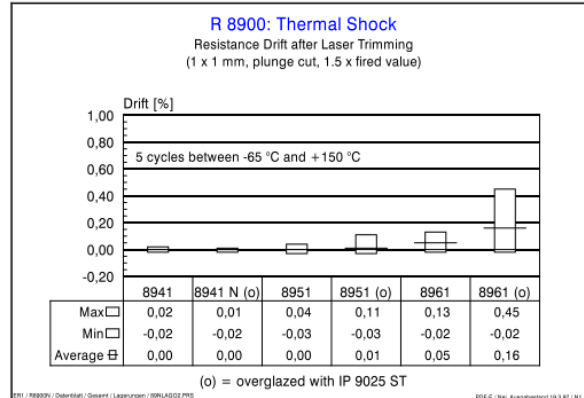
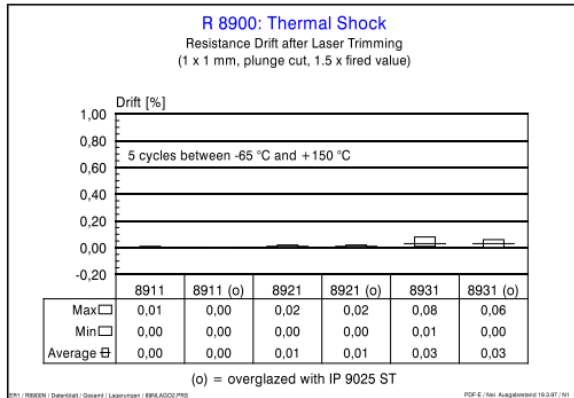


(o) = overglazed with IP 9025 ST

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## Technical Data Sheet

### Air Fired Resistor System



**Heraeus Electronics**  
Heraeus Deutschland GmbH & Co. KG  
Heraeusstraße 12 – 14  
63450 Hanau, Germany  
www.heraeus-electronics.com

**Americas**  
Phone +1 610 825 6050  
electronics.americas@heraeus.com

**Asia Pacific**  
Phone +65 6571 7649  
electronics.apac@heraeus.com

**China**  
Phone +86 53 5815 9601  
electronics.china@heraeus.com

**Europe, Middle East and Africa**  
Phone +49 6181 35 4370  
electronics.emea@heraeus.com