



**UNI-ROYAL**  
厚聲集團

# DATA SHEET

**Product Name** Ultra High Power Thick Film Chip Resistors

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**Part Name** SP Series

**File No.** SMD-SP-004

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## 1. Scope

- 1.1 This datasheet is the characteristics of Ultra High Power Thick Film Chip Resistors manufactured by UNI-ROYAL.  
 1.2 High power rating up to 6 watts  
 1.3 Suitable for both wave & re-flow soldering  
 1.4 Application LED lamps, Intelligent home appliances, Medical equipment, Kinds of industrial control devices & Industrial supplies.  
 1.5 AEC-Q200 qualified

## 2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1<sup>st</sup>~4<sup>th</sup> codes: Part name. E.g.: SP10、SP12、SP17、SP20、SP27

2.2 5<sup>th</sup>~6<sup>th</sup> codes: Power rating.

E.g.: W=Normal Size	“1~G” = “1~16”				
Wattage	2	3	4	5	6
Normal Size	2W	3W	4W	5W	6W

For power rating of 1W to 16W, the 5<sup>th</sup> digit will be a number or a letter code and the 6<sup>th</sup> digit will be the letters of W, S or U. E.g.: 2W=2W

2.3 7<sup>th</sup> code: Tolerance. E.g.: D=±0.5%      F=±1%      G=±2%      J=±5%      K= ±10%

2.4 8<sup>th</sup>~11<sup>th</sup> codes: Resistance Value.

2.4.1 If value belongs to standard value of E-24 series, the 8<sup>th</sup> code is zero, 9<sup>th</sup>~10<sup>th</sup> codes are the significant figures of resistance value, and the 11<sup>th</sup> code is the power of ten.

2.4.2 If value belongs to standard value of E-96 series, the 8<sup>th</sup>~10<sup>th</sup> codes are the significant figures of resistance value, and the 11<sup>th</sup> code is the power of ten.

2.4.3 11<sup>th</sup> codes listed as following:

0=10<sup>0</sup>    1=10<sup>1</sup>    2=10<sup>2</sup>    3=10<sup>3</sup>    4=10<sup>4</sup>    5=10<sup>5</sup>    6=10<sup>6</sup>    J=10<sup>-1</sup>    K=10<sup>-2</sup>    L=10<sup>-3</sup>    M=10<sup>-4</sup>

2.5 12<sup>th</sup>~14<sup>th</sup> codes.

2.5.1 12<sup>th</sup> code: Packaging Type. E.g.: C=Bulk      T=Tape/Reel

2.5.2 13<sup>th</sup> code: Standard Packing Quantity.

4=4,000pcs    5=5,000pcs    C=10,000pcs    D=20,000pcs    E=15,000pcs

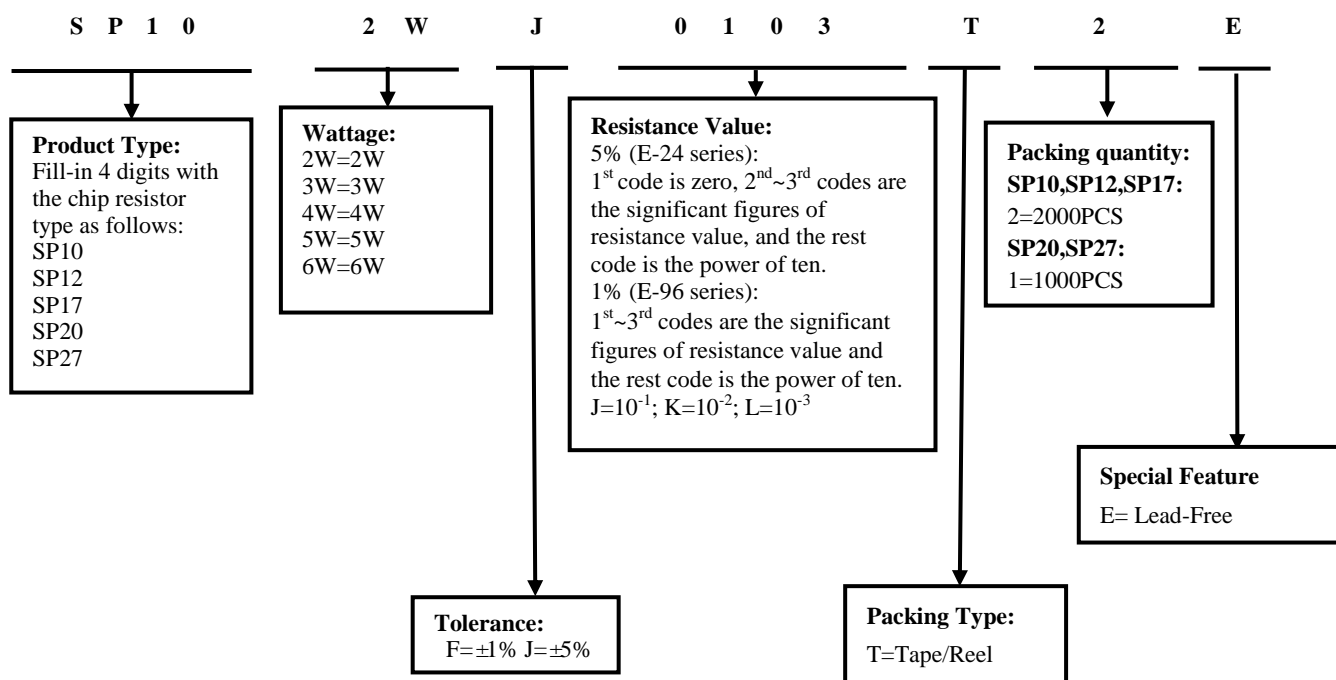
Chip Product: BD=B/B-20000pcs    TC=T/R-10000pcs

2.5.3 14<sup>th</sup> code: Special features.

E = Environmental Protection, Lead Free, or Standard type.

## 3. Ordering Procedure

(Example: SP10 2W ±5% 10KΩ T/R-2000)



#### 4. Marking

##### 4.1 $\pm 5\%$ tolerance products (E-24 series):

3 codes.

1<sup>st</sup>~2<sup>nd</sup> codes are the significant figures of resistance value,  
and the rest code is the power of ten.



333  $\rightarrow$  33K $\Omega$

##### 4.2 $\pm 1\%$ tolerance products (E-96 series):

4 codes.

1<sup>st</sup>~3<sup>rd</sup> codes are the significant figures of resistance value,  
and the rest code is the power of ten.

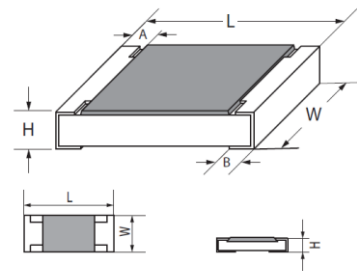
Letter "R" in mark means decimal point.



2701  $\rightarrow$  2.7K $\Omega$

#### 5. Dimension

Type	Dimension(mm)				
	L	W	H	A	B
SP10(2010)	5.00 $\pm$ 0.10	2.50 $\pm$ 0.15	1.10 $\pm$ 0.10	0.60 $\pm$ 0.25	0.50 $\pm$ 0.20
SP12(2512)	6.35 $\pm$ 0.10	3.20 $\pm$ 0.15	1.10 $\pm$ 0.10	0.60 $\pm$ 0.25	1.80 $\pm$ 0.20
SP17(2817)	7.10 $\pm$ 0.20	4.20 $\pm$ 0.20	1.10 $\pm$ 0.10	0.60 $\pm$ 0.20	1.80 $\pm$ 0.20
SP20(4320)	11.00 $\pm$ 0.30	5.00 $\pm$ 0.25	1.10 $\pm$ 0.10	0.80 $\pm$ 0.20	2.40 $\pm$ 0.20
SP27(4527)	11.60 $\pm$ 0.30	6.85 $\pm$ 0.25	1.10 $\pm$ 0.10	1.00 $\pm$ 0.20	2.50 $\pm$ 0.20

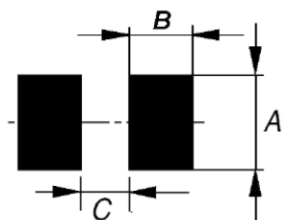


#### 6. Resistance Range

Type	Size	Power Rating	Resistance Range of 1% & 5%	Max. Working Voltage	Max. Overload Voltage	Dielectric withstanding Voltage	Operating Temperature
SP10	2010(5025)	2W	1 $\Omega$ ~10M	200V	500V	500V	-55 $^{\circ}$ C~155 $^{\circ}$ C
SP12	2512(6432)	3W	1 $\Omega$ ~10M	250V	500V	500V	-55 $^{\circ}$ C~155 $^{\circ}$ C
SP17	2817(7142)	4W	1 $\Omega$ ~10M	250V	500V	500V	-55 $^{\circ}$ C~155 $^{\circ}$ C
SP20	4320(1150)	5W	1 $\Omega$ ~10M	300V	600V	600V	-55 $^{\circ}$ C~155 $^{\circ}$ C
SP27	4527(1267)	6W	1 $\Omega$ ~10M	300V	600V	600V	-55 $^{\circ}$ C~155 $^{\circ}$ C

#### 7. Soldering pad size recommended

Unit:mm



Size	A	B	C
SP10	3.00	2.00	3.90
SP12	3.70	3.30	2.70
SP17	4.70	3.30	3.40
SP20	5.50	3.90	6.10
SP27	7.20	4.00	6.50

4 layers PCB specification:

1. Outside 2 layers (Top and Bottom) with copper foil thickness at 2 oz.
2. Inside 2 layers (Middle layers) with copper foil thickness at 4 oz.

#### 8. Derating Curve

Power rating will change based on continuous load at ambient temperature from -55 to 155 $^{\circ}$ C.

It is constant between -55 to 70 $^{\circ}$ C, and derate to zero when temperature rise from 70 to 155 $^{\circ}$ C.

Voltage rating:

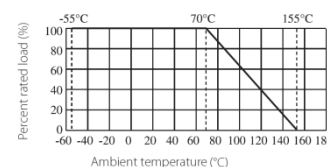
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$RCWV = \sqrt{P \times R}$$

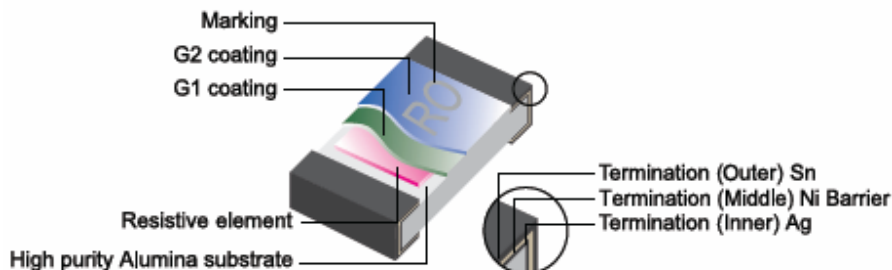
Remark: RCWV: Rating Continuous Working Voltage (Volt.) P: power rating (Watt) R: nominal resistance ( $\Omega$ )

In no case shall the rated DC or RMS AC continuous working voltage be greater than the applicable maximum value.

The overload voltage is 2.5 times RCWV or Max. Overload voltage whichever is lower.



## 9. Structure



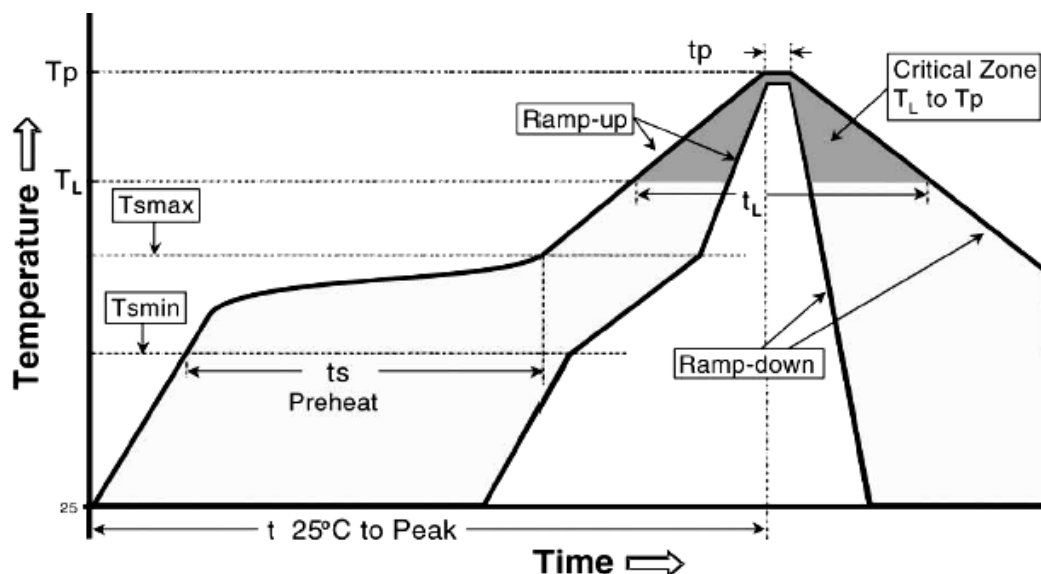
## 10. Performance Specification

Characteristic	Limits		Test Methods (GB/T5729&JIS-C-5201&IEC60115-1)
Temperature Coefficient	$1\Omega\sim 10\Omega: \leq 200\text{PPM}/^{\circ}\text{C}$ $10.1\Omega\sim 10\text{M}\Omega: \leq 100\text{PPM}/^{\circ}\text{C}$		4.8 Natural resistance changes per temp. Degree centigrade $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (PPM}/^{\circ}\text{C})$ $R_1$ : Resistance Value at room temperature ( $t_1$ ) ; $R_2$ : Resistance at test temperature ( $t_2$ ) $t_1$ : +25 °C or specified room temperature $t_2$ : Test temperature (-55 °C or 125 °C)
Short-time overload	$\pm 5\%$ $\pm 1\%$	$\pm(2.0\%+0.1\Omega)$ $\pm(1.0\%+0.1\Omega)$	4.13 Permanent resistance change after the application of 2.5 times RCWV or Max.Overload Votage whichever less for 5 seconds.
Dielectric withstanding voltage	No evidence of flashover mechanical damage, arcing or insulation breaks done.		4.7 Clamped in the trough of a 90 °C metallic v-block and shall be tested at ac potential respectively specified in the type for 60-70 seconds
Terminal bending	$\pm(1.0\%+0.05\Omega)$ Max		4.33 Twist of test board: Y/X = 3/90 mm for 60seconds
Soldering heat	Resistance change rate must be in $\pm(1.0\%+0.05\Omega)$ Max		4.18 Dipping the resistor into a solder bath having a temperature of $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and hold it for $10 \pm 1$ seconds
Solderability	Coverage must be over 95%.		4.17 The area covered with a new, smooth, clean, shiny and continuous surface free from concentrated pinholes. Temperature of solder: $245 \pm 3^{\circ}\text{C}$ ; Dwell time in solder: 2~3 seconds.
Rapid change of temperature	$\pm 5\%$ $\pm 1\%$	$\pm(1.0\%+0.1\Omega)$ $\pm(0.5\%+0.1\Omega)$	4.19 30 min at lower limit temperature and 30 min at upper limit temperature , 100 cycles.
Humidity ( steady state )	$\pm 5\%$ $\pm 1\%$	$\pm(3.0\%+0.1\Omega)$ $\pm(0.5\%+0.1\Omega)$	4.24 Temporary resistance change after 240 hours exposure in a humidity test chamber controlled at $40 \pm 2^{\circ}\text{C}$ and 90-95% relative humidity,
Load life in humidity	$\pm 5\%$ $\pm 1\%$	$\pm(3.0\%+0.1\Omega)$ $\pm(1.0\%+0.1\Omega)$	7.9 Resistance change after 1,000 hours (1.5 hours "ON", 0.5 hour "OFF") at RCWV or Max.Working Voltage whichever less in a humidity chamber controlled at $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 90 to 95% relative humidity.
Load life	$\pm 5\%$ $\pm 1\%$	$\pm(3.0\%+0.1\Omega)$ $\pm(1.0\%+0.1\Omega)$	4.25.1 Permanent resistance change after 1,000 hours operating at RCWV or Max.Working Voltage whichever less with duty cycle 1.5 hours "ON", 0.5 hour "OFF" at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ambient.
Low Temperature Storage	$\pm 5\%$ $\pm 1\%$	$\pm(3.0\%+0.1\Omega)$ $\pm(1.0\%+0.1\Omega)$	IEC 60068-2-1 (Aa) Lower limit temperature , for 2H.
High Temperature Exposure	$\pm 5\%$ $\pm 1\%$	$\pm(3.0\%+0.1\Omega)$ $\pm(1.0\%+0.1\Omega)$	MIL-STD-202 108A Upper limit temperature , for 1000H.
Leaching	No visible damage		J-STD-002 Test D Samples completely immersed for 30 sec in solder bath at $260^{\circ}\text{C}$ .

**11. Soldering Condition**

(This is for recommendation, please customer perform adjustment according to actual application)

11.1 Recommend Reflow Soldering Profile : (solder : Sn96.5 / Ag3 / Cu0.5)



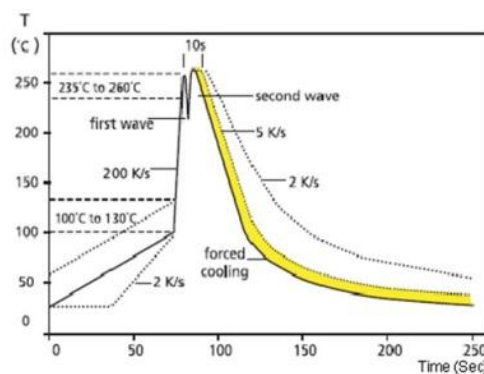
Profile Feature	Lead (Pb)-Free solder
Preheat: Temperature Min (Ts <sub>min</sub> ) Temperature Max (Ts <sub>max</sub> ) Time (Ts <sub>min</sub> to Ts <sub>max</sub> ) (ts)	150°C 200°C 60 -120 seconds
Average ramp-up rate: (Ts max to Tp)	3°C / second max.
Time maintained above : Temperature (T <sub>L</sub> ) Time (t <sub>L</sub> )	217°C 60-150 seconds
Peak Temperature (Tp)	260°C
Time within $\begin{smallmatrix} +0 \\ -5 \end{smallmatrix}$ °C of actual peak Temperature (tp) <sup>2</sup>	10 seconds
Ramp-down Rate	6°C/second max.
Time 25°C to Peak Temperature	8minutes max.

Allowed Re-flow times : 2 times

- Remark : To avoid discoloration phenomena of chip on terminal electrodes, please use N<sub>2</sub> Re-flow furnace . Height (F) of reflow shall be ≥25% (H)



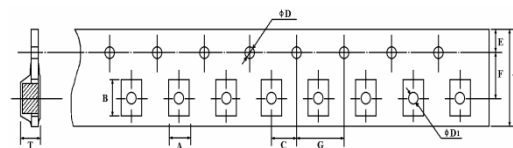
11.2 Recommend Wave Soldering Profile : (Apply to 0603 and above size)



## 12. Packing

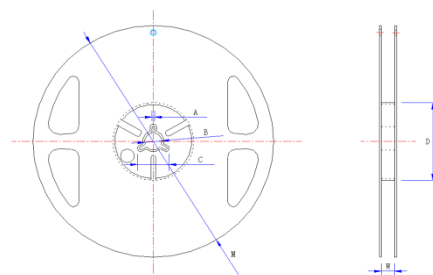
### 12.1 Dimension of plastic taping: (Unit: mm)

Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D_{-0}^{+0.1}$	$\Phi D1_{-0}^{+0.25}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
SP10	2.90	5.6	2.0	1.5	1.5	1.75	5.5	4.0	12	1.35
SP12	3.50	6.7	2.0	1.5	1.5	1.75	5.5	4.0	12	1.35
SP17	4.50	7.4	2.0	1.5	-	1.75	7.5	4.0	16	1.35
SP20	5.40	11.5	2.0	1.5	-	1.75	11.5	4.0	24	1.35
SP27	7.20	11.9	2.0	1.5	-	1.75	11.5	4.0	24	1.35



### 12.2 Dimension of Reel : (Unit: mm)

Type	Taping	Qty/Reel	A±0.5	B±0.5	C±0.5	$\Phi D \pm 1$	$\Phi L \pm 2$	W±1
SP10	Embossed	2,000pcs	2.0	13.0	21.0	60.0	178.0	13.5
SP12	Embossed	2,000pcs	2.0	13.0	21.0	60.0	178.0	13.5
SP17	Embossed	2,000pcs	2.0	13.0	21.0	60.0	178.0	17.5
SP20	Embossed	1,000pcs	2.0	13.0	21.0	60.0	178.0	25.5
SP27	Embossed	1,000pcs	2.0	13.0	21.0	60.0	178.0	25.5



## 13. Note

13.1. UNI-ROYAL recommend the storage condition temperature: 15℃~35℃, humidity :25%~75%.

(Put condition for individual product).Even under UNI-ROYAL recommended storage condition, solderability of products over 1 year old.

(Put condition for each product) may be degraded.

13.2. Store / transport cartons in the correct direction, which is indicated on a carton as a symbol.

Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

13.3. Product performance and soldered connections may deteriorate if the products are stored in the following places:

- Storage in high Electrostatic.
- Storage in direct sunshine 、rain and snow or condensation.
- Where the products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub>, Br, etc.

## 14. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~5	Feb.12, 2019	Haiyan Chen	Yuhua Xu
2	Modify the High Temperature Exposure conditions	7	July.29, 2019	Haiyan Chen	Yuhua Xu
3	Modify the reflow curve and add the wave soldering curve	5	Apr.29, 2020	Haiyan Chen	Yuhua Xu
4	1.Add the Soldering pad size recommended 2. Modify instructions for reflow soldering	3 5	Jun.25, 2020	Haiyan Chen	John Zhao
5	Modify the temperature coefficient test conditions	4	Oct.26, 2022	Haiyan Chen	Yuhua Xu

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