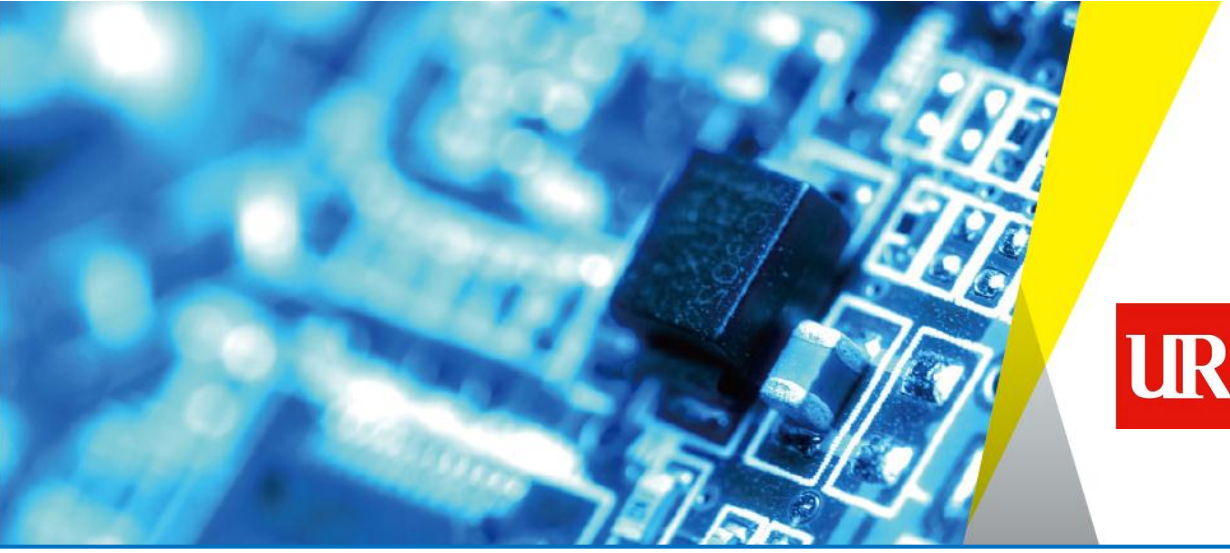

DATA SHEET

Product Name	**Ultra High Power Thick Film Chip Resistors**
Part Name	**SP Series**
File No.	**SMD-SP-004**

Uniroyal Electronics Global Co., Ltd.

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Manufacture Plant	Uniroyal Electronics Industry Co., Ltd.
	Aeon Technology Corporation
	Royal Electronic Factory (Thailand) Co., Ltd.
	Royal Technology (Thailand) Co., Ltd.

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
1.6 Compliant with RoHS directive.
1.7 Halogen free requirement.

2. Part No. System

Part No. includes 14 codes shown as below:
2.1 1st~4th codes: Part name. E.g.: SP10、SP12、SP17、SP20、SP27
2.2 5th~6th codes: Power rating.

E.g.: W=Normal Size "1~G" = "1~16"

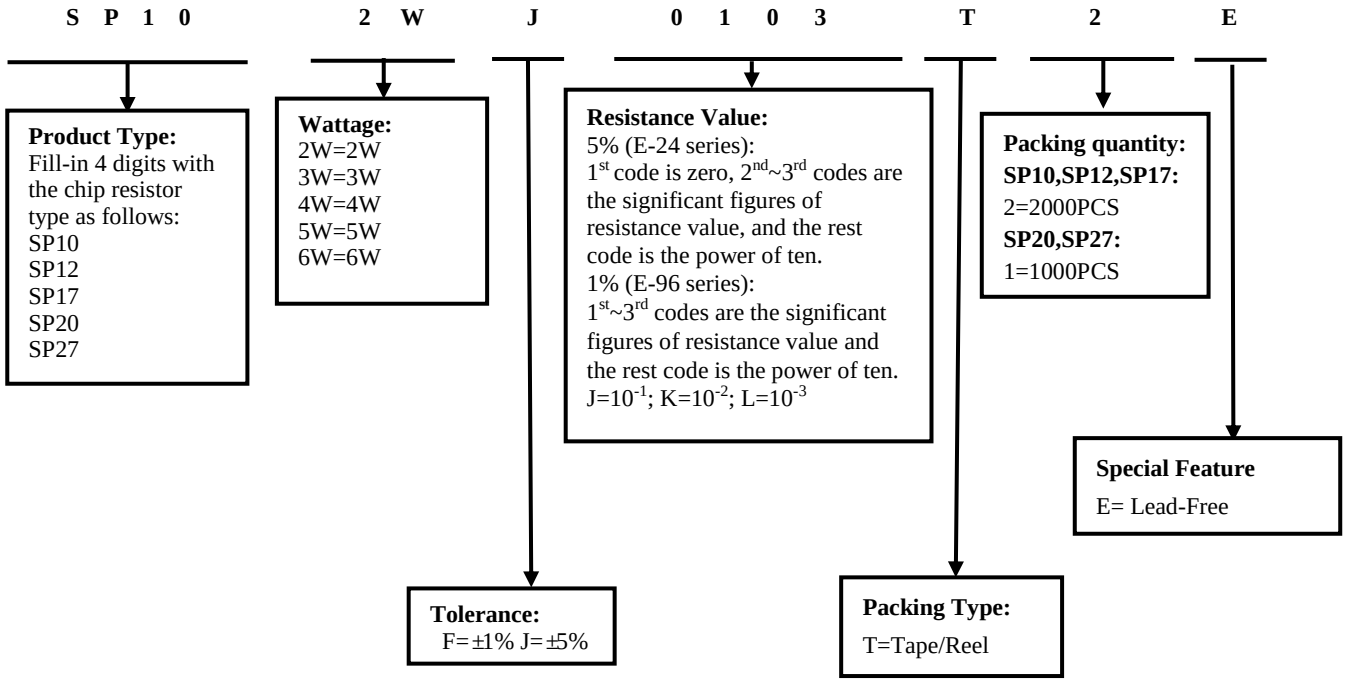
Wattage	2	3	4	5	6
Normal Size	2W	3W	4W	5W	6W

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

2.3 7th code: Tolerance. E.g.: D=±0.5% F=±1% G=±2% J=±5% K= ±10%
2.4 8th~11th codes: Resistance Value.
2.4.1 If value belongs to standard value of E-24 series, the 8th code is zero, 9th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.2 If value belongs to standard value of E-96 series, the 8th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.
2.4.311th codes listed as following:
0=10^0 1=10^1 2=10^2 3=10^3 4=10^4 5=10^5 6=10^6 J=10^{-1} K=10^{-2} L=10^{-3} M=10^{-4}
2.5 12th~14th codes.
2.5.1 12th code: Packaging Type. E.g.: C=Bulk T=Tape/Reel
2.5.2 13th 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 14th 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 ±5% tolerance products (E-24 series):

3 codes.

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

333 → 33KΩ

For ohmic values below 10 Ω, letter "R" is for decimal point.

9R1 → 9. 1Ω

4.2 ±1% tolerance products (E-96 series):

4 codes.

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

Letter "R" in mark means decimal point.

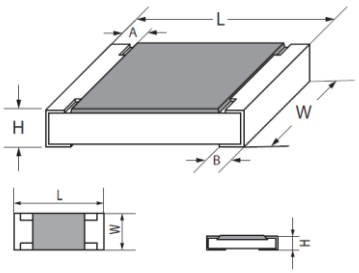
2701 → 2.7KΩ

For ohmic values below 100 Ω, letter "R" is for decimal point

1R80 → 1.8Ω

5. Dimension

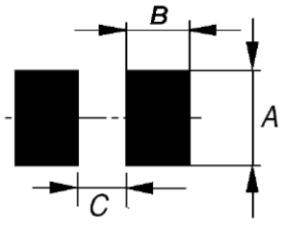
Type	Dimension(mm)				
	L	W	H	A	B
SP10(2010)	5.00±0.10	2.50±0.15	1.10±0.10	0.60±0.25	0.50±0.20
SP12(2512)	6.35±0.10	3.20±0.15	1.10±0.10	0.60±0.25	1.80±0.20
SP17(2817)	7.10±0.20	4.20±0.20	1.10±0.10	0.60±0.20	1.80±0.20
SP20(4320)	11.00±0.30	5.00±0.25	1.10±0.10	0.80±0.20	2.40±0.20
SP27(4527)	11.60±0.30	6.85±0.25	1.10±0.10	1.00±0.20	2.50±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	1Ω~10M	200V	500V	500V	-55℃~155℃
SP12	2512(6432)	3W	1Ω~10M	250V	500V	500V	-55℃~155℃
SP17	2817(7142)	4W	1Ω~10M	250V	500V	500V	-55℃~155℃
SP20	4320(1150)	5W	1Ω~10M	300V	600V	600V	-55℃~155℃
SP27	4527(1267)	6W	1Ω~10M	300V	600V	600V	-55℃~155℃

7. Soldering pad size recommended



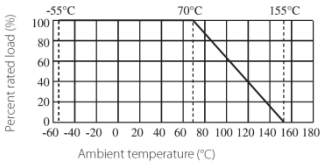
Unit:mm

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

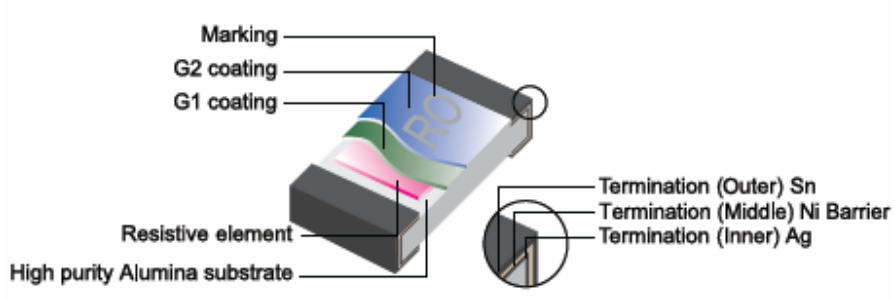


Power rating will change based on continuous load at ambient temperature from -55 to 155℃.
It is constant between -55 to 70℃, and derate to zero when temperature rise from 70 to 155℃.
Voltage rating:
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave 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 (Ω)
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

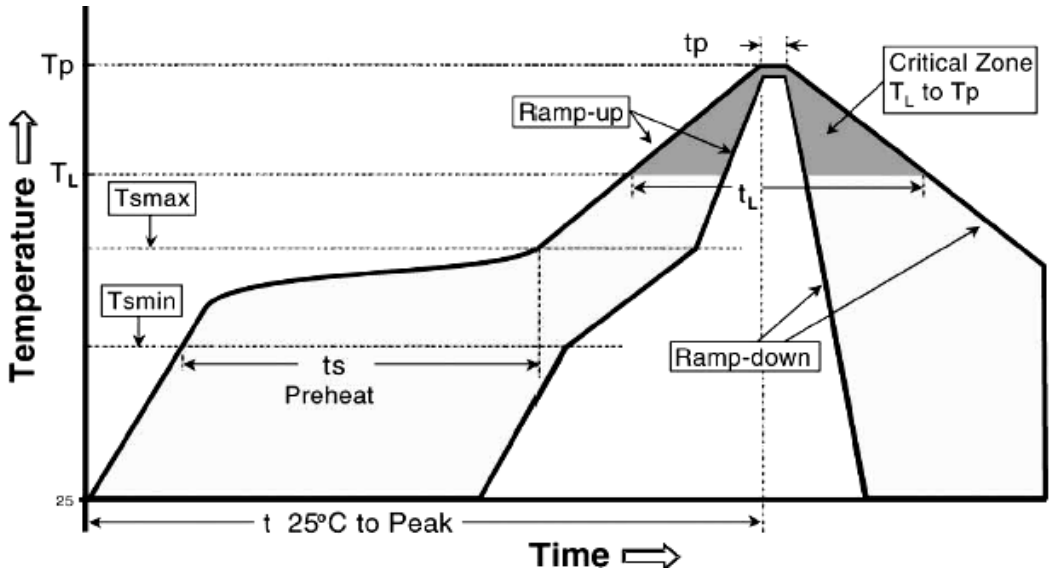
Characteristic	Limits	Ref. Standards	Test Method
Operational life	±1%: ±(1.0%+0.1Ω) ±5%: ±(3.0%+0.1Ω)	MIL-STD-202	1,000 hours at 125℃,36% power , derated voltage applied for 1.5 hours on,0.5 hour off, Measurement at 24±4hours after test conclusion.
Temperature Coefficient	1Ω~10Ω:≤±200PPM/℃ 10.1Ω~10MΩ:≤±100PPM/℃	User Spec	4.8 Natural resistance changes per temp. Degree centigrade $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6$ (PPM/℃) R_1: Resistance Value at room temperature （t_1）; R_2: Resistance at test temperature （t_2） t_1: +25 ℃ or specified room temperature t_2: Test temperature（-55℃or 125℃）
Short-time overload	±1%: ±(1.0%+0.1Ω) ±5%: ±(2.0%+0.1Ω)	JIS-C-5201	4.13 Permanent resistance change after the application of a potential of 2.5 times RCWV or Max. Overload Voltage whichever less for 5 seconds..
External Visual	No Mechanical Pamage	MIL-STD-883 Method 2009	Electrical test not required.Inspect device construction, marking and workmanship
Physical Dimension	Reference 5. Dimension Standards	JESD22 MH Method JB-100	Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers spec. Electrical test not required.
Resistance to Solvent	Marking Unsmeared	MIL-STD-202 Method 215	Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	Not broken	JIS-C-6429	Force of 17.7N for 60±1 seconds.

High Temperature Exposure (Storage)	±(1.0%+0.1Ω)	MIL-STD-202 Method 108	1000hrs. @T=155℃.Unpowered. Measurement at 24±2 hours after test conclusion.
Temperature Cycling	±1%: ±(0.5%+0.1Ω) ±5%: ±(2.0%+0.1Ω)	JESD22 Method JA-104	1000 Cycles (-55℃ to +155℃). Measurement at 24±2 hours after test conclusion.
Biased Humidity	±1%: ±(1.0%+0.1Ω) ±5%: ±(3.0%+0.1Ω)	MIL-STD-202 Method 103	1000 hours 85℃,85%RH. Note: Specified conditions: 10% of operating power. Measurement at 24±2 hours after test conclusion.
Mechanical Shock	±(1.0%+0.1Ω)	MIL-STD-202 Method 213	Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6ms,velocity 12.3ft/s 100Hz.
Vibration	±(1.0%+0.1Ω)	MIL-STD-202 Method 204	5g's for 20 min., 12cycle each of 3 orientations. Note: Use 8"*5"PCB. 031" thick 7 secure points onone long side and 2 secure points at corners of opposite sides. Parts mounted within 2' from any secure point. Test from 10-2000Hz.
ESD	±(1.0%+0.1Ω)	AEC-Q200-002	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of ±500V,±1KV, ±2KV, ±4KV, ±8KV, The electrometer reading shall be within ±10% for voltages from 500V to ≦800V.
Solderability	95% coverage Min.	J-STD-020E	For both leaded & SMD. Electrical test not required. Magnification 50X. Conditions: a) Method B 4hrs at 155℃ dry heat, the dip in bath with 245℃,5s. b) Method D: at 260℃, 30±0.5s.
Flammability	No ignition of the tissue paper or scorching or the pinewood board	UL-94	V-0 or V-1 are acceptable. Electrical test not required.
Board Flex	±(1.0%+0.05Ω)	JIS-C-6429	2mm for 60±5sec
Flame Retardance	No flame	AEC-Q200-001	Temperature sensing at 500℃, Voltage power subjected to 32VDC current clamped up to 500VDC and decreased in 1.0VDC/hour.
Resistance to Soldering Heat	±(1.0%+0.05Ω)	MIL-STD-202 Method 210	Condition B No per-heat of samples. Note: Single Wave Solder-Procedure 2 for SMD and Procedure 1 for Leaded with solder within 1.5mm of device body.

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)

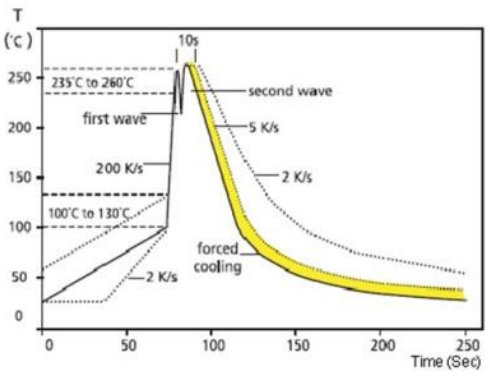


Profile Feature	Lead (Pb)-Free solder
Preheat： Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (Ts_{min} to Ts_{max}) (ts)	 150℃ 200℃ 60 -120 seconds
Average ramp-up rate： (Ts max to Tp)	 3℃ / second max.
Time maintained above : Temperature (T_L) Time (t_L)	 217℃ 60-150 seconds
Peak Temperature (Tp)	260℃
Time within $^{+0}_{-5}$℃ of actual peak Temperature (tp)[2]	10 seconds
Ramp-down Rate	6℃/second max.
Time 25℃ to Peak Temperature	8minutes max.

Allowed Re-flow times : 2 times

Remark : To avoid discoloration phenomena of chip on terminal electrodes, please use N_2 Re-flow furnace .

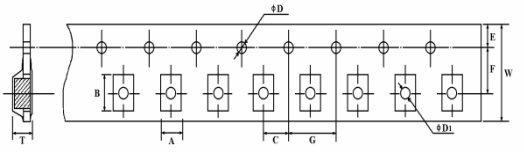
11.2 Recommend Wave Soldering Profile：(Apply to 0603 and above size)



12. Packing

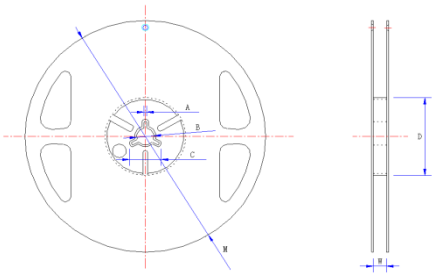
12.1 Dimension of plastic taping：(Unit: mm)

Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	$\Phi D1^{+0.25}_{-0}$	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	ΦD±1	ΦL±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:
a. Storage in high Electrostatic.
b. Storage in direct sunshine、rain and snow or condensation.
c. Where the products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, NO_2, 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
6	Modify performance in accordance with AEC-Q200 terms	4~5	Apr.09, 2024	Haiyan Chen	Yuhua Xu