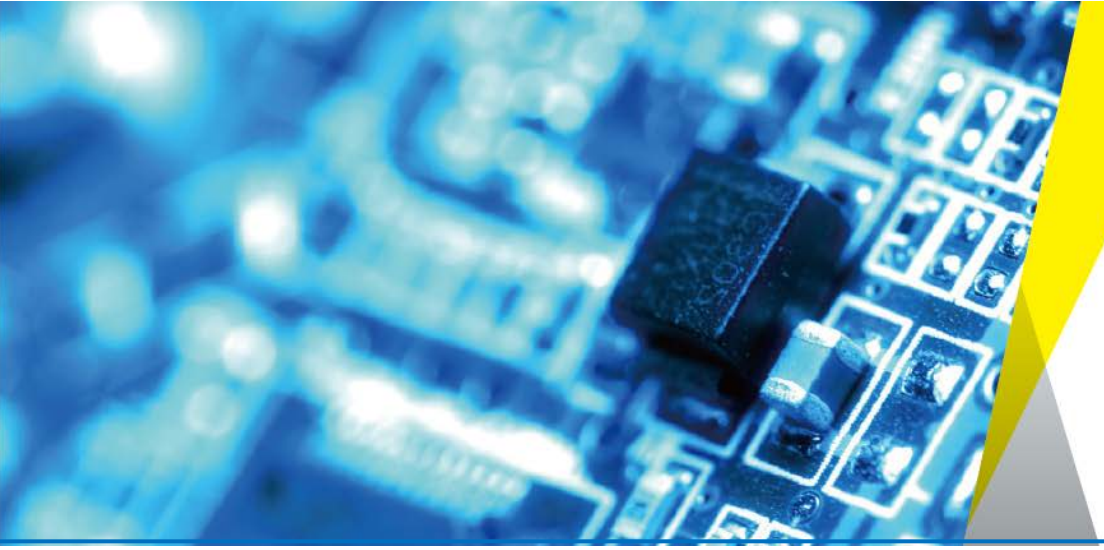

DATASHEET

Product Name	**Automotive Low Resistance Thick Film Chip Resistors**
Part Name	**CS Series**
File No.	**SMD-SP-020**

Uniroyal Electronics Global Co., Ltd.

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Email	marketing@uni-royal.cn
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 specification for approve relates to the Automotive Low Resistance Thick Film Chip Resistors manufactured by UNI-ROYAL.
1.2 Ultra-low Value
1.3 Low Temperature Coefficient
1.4 Suitable for reflow & wave soldering
1.5 Application：Power supply
1.6 The test items follow the test standard of AEC-Q200.
1.7 Compliant with RoHS directive.
1.8 Halogen free requirement.

2. Part No. System

Part No. includes 14 codes shown as below:
2.1 1st~4th codes: Part name. E.g.: CS02,CS03,CS05,CS06,CS07,CS10,CS11,CS12
2.2 5th~6th codes: Power rating.

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

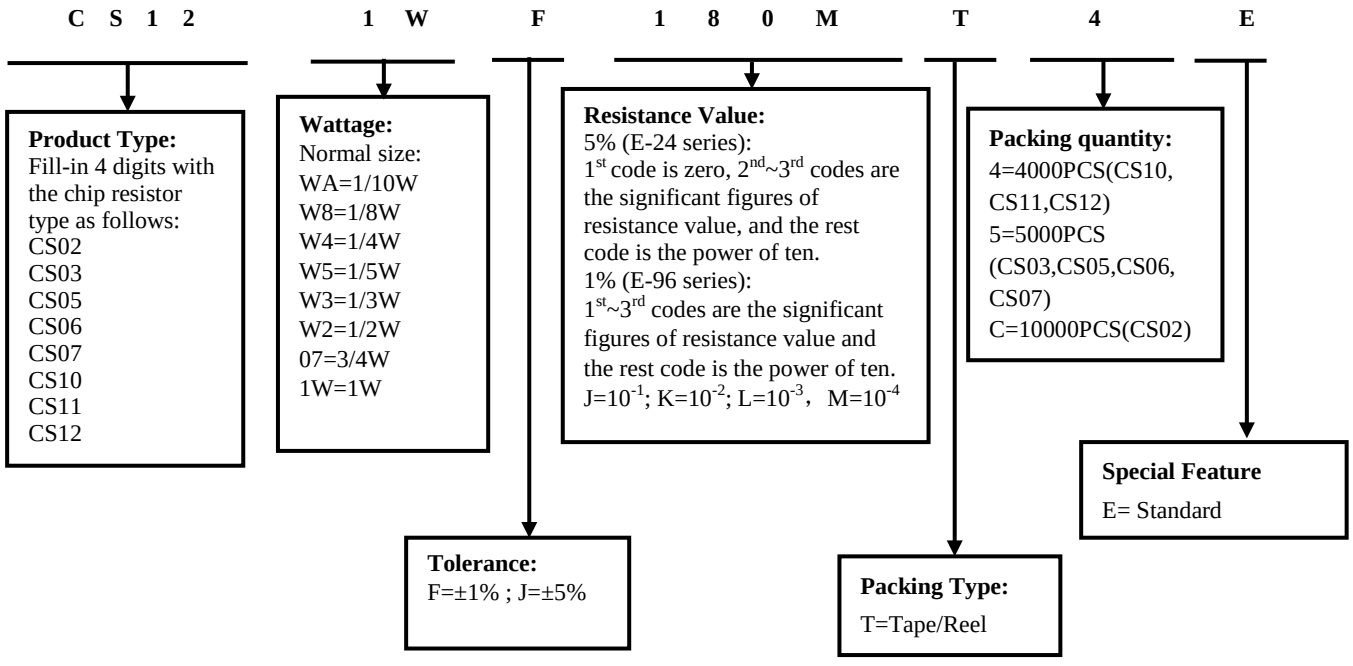
Wattage	3/4	1/2	1/3	1/4	1/5	1/8	1
Normal Size	07	W2	W3	W4	W5	W8	1W

If power rating is equal or lower than 1 watt, 5th code would be "W" and 6th code would be a number or letter.
E.g.: W8=1/8W W4=1/4W

2.3 7th code: Tolerance. E.g.: F=±1% J=±5%
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.: T=Tape/Reel
2.5.2 13th code: Standard Packing Quantity.
4=4,000pcs 5=5,000pcs C=10,000pcs
2.5.3 14th code: Special features.
E = Standard

3. Ordering Procedure

(Example: CS12 1W ±1% 0.018Ω T/R-4000)



4. Marking:

4.1 For CS02 size. Due to the very CS02 small size of the resistor's body, there is no marking on the body.

4.2 For CS03 size: Below 100mΩ (do not contain) product 3 digits of ±1%,±5%Tolerance , show as following：

056→ 0.056Ω

4.3 For CS03 size: Above(contain) 100mΩ product: 3 digits, the first digit is "R", which as decimal point, the 2nd & 3rd digits are significant.

R10→ 100mΩ

4.4 ±1%,±5%Tolerance: product below 1Ω show as following, the first digit is "R", which as decimal point.

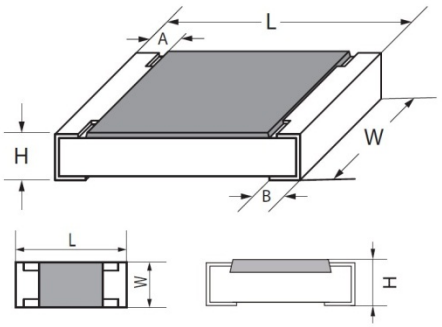
R050→50mΩ

4.5 ±1%,±5%Tolerance: product of 1Ω show as following, the first digit is "1", read alphabet "R"as decimal point.

1R00→ 1Ω

5. Dimension

Type	Dimension(mm)				
	L	W	H	A	B
CS02(0402)	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
CS03(0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20
CS05(0805)	2.00±0.15	1.25+0.15/-0.10	0.55±0.10	0.40±0.20	0.40±0.20
CS06(1206)	3.10±0.15	1.55+0.15/-0.10	0.55±0.10	0.45±0.20	0.45±0.20
CS07(1210)	3.10±0.10	2.50±0.15	0.55±0.10	0.50±0.25	0.50±0.20
CS10(2010)	5.00±0.10	2.50±0.20	0.55±0.10	0.60±0.25	0.50±0.20
CS11(1812)	4.50±0.20	3.20±0.20	0.55±0.20	0.50±0.20	0.80±0.30
CS12(2512)	6.35±0.10	3.20±0.20	0.55±0.10	0.60±0.25	0.80±0.30

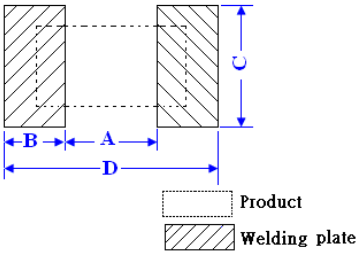


6. Resistance Range

Type	Power Rating	Dielectric withstanding Voltage	Resistance Range 1%&5%	Operating Temperature
CS02	1/8W	100V	50mΩ~1Ω	-55℃~155℃
CS03	1/5W	300V	10mΩ~1Ω	-55℃~155℃
CS05	1/4W	500V	10mΩ~1Ω	-55℃~155℃
CS06	1/3W	500V	10mΩ~1Ω	-55℃~155℃
CS07	1/2W	500V	10mΩ~1Ω	-55℃~155℃
CS10	3/4W	500V	10mΩ~1Ω	-55℃~155℃
CS11	3/4W	500V	10mΩ~1Ω	-55℃~155℃
CS12	1W	500V	10mΩ~1Ω	-55℃~155℃

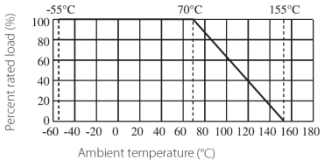
7. Soldering pad size recommended

Type	Dimension(mm)			
	A	B	C	D
CS02	0.5±0.05	0.5±0.05	0.6±0.05	1.5±0.05
CS03	0.8±0.05	1±0.05	0.9±0.05	2.7±0.05
CS05	1.0±0.1	1±0.1	1.4±0.1	3.4±0.1
CS06	2.0±0.1	1.1±0.1	1.8±0.1	4.2±0.1
CS07	2.0±0.1	1.1±0.1	2.9±0.1	4.2±0.1
CS10	3.6±0.1	1.4±0.1	3±0.1	6.4±0.1
CS11	2.9±0.1	1.5±0.1	3.7±0.1	5.9±0.1
CS12	4.4±0.1	2.1±0.1	3.7±0.1	8.6±0.1



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℃.

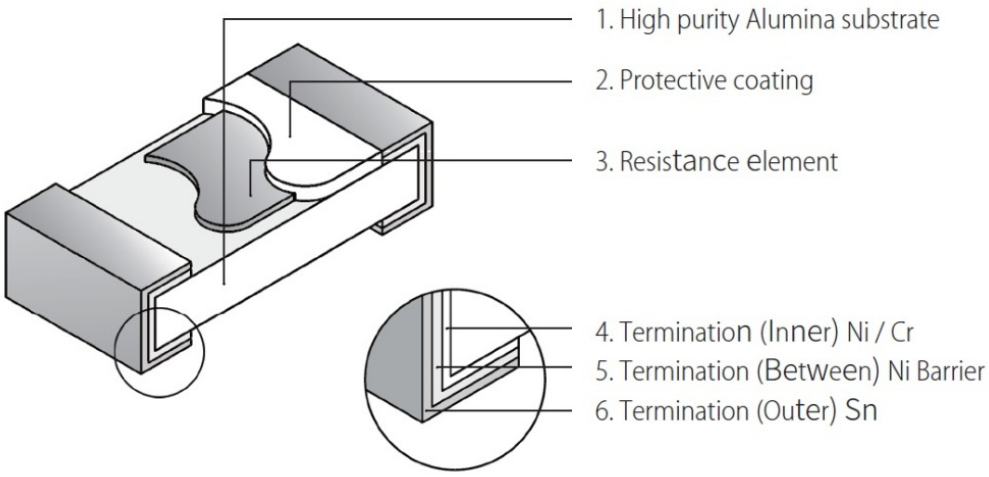


Voltage rating:
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following 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%+0.005Ω) Max. ±5%: ±(3.0%+0.005Ω) Max.	MIL-STD-202 Method 108	125℃, at 36% of operating power, 1000H(1.5 hours "ON", 0.5 hour "OFF"). Measurement at 24±4hours after test conclusion.
Electrical Characterization (T.C.R)	CS02: 50mΩ≤R<100mΩ: ±700 ppm/℃ 100mΩ≤R≤1Ω: ±200 ppm/℃ CS03: 10mΩ≤R<15mΩ: ±1500 ppm/℃ 15mΩ≤R<20mΩ: ±1000 ppm/℃ 20mΩ≤R<30mΩ: ±800 ppm/℃ 30mΩ≤R<33mΩ: ±600 ppm/℃ 33mΩ≤R≤50mΩ: ±400 ppm/℃ 50mΩ<R≤0.1Ω: ±300 ppm/℃ 0.1Ω<R≤1Ω: ±200 ppm/℃	GB/T 5729 4.8 JIS-C-5201 4.8 IEC 60115-1 6.2	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°C or specified room temperature t_2: Test temperature（+125℃）

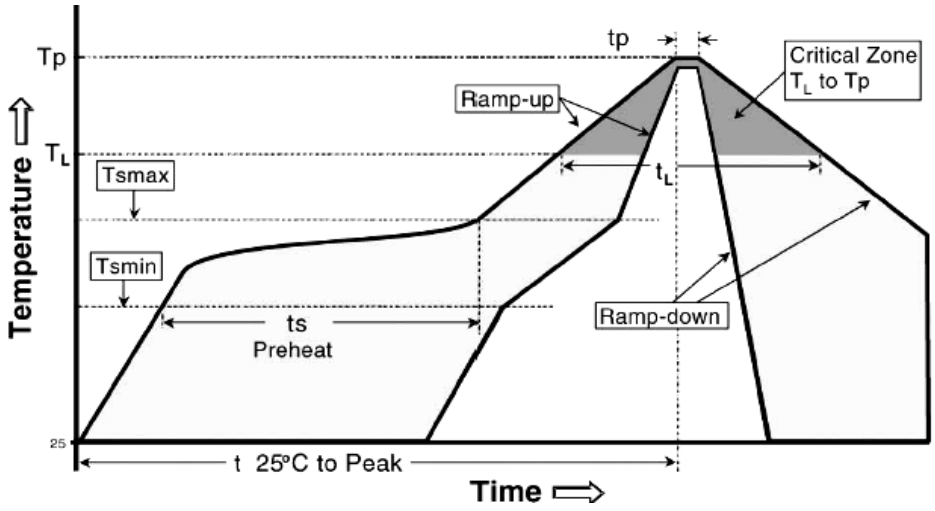
	CS05： 10mΩ≤R≤15mΩ: ±800 ppm/℃ 15mΩ<R≤25mΩ: ±600 ppm/℃ 25mΩ<R≤50mΩ: ±400 ppm/℃ 50mΩ<R≤0.2Ω: ±200 ppm/℃ 0.2Ω<R≤1Ω: ±100 ppm/℃ CS06： 10mΩ≤R＜15mΩ: ±700ppm/℃ 15mΩ≤R≤30mΩ: ±400ppm/℃ 30mΩ＜R≤50mΩ: ±300ppm/℃ 50mΩ＜R≤0.1Ω: ±200ppm/℃ 0.1Ω＜R≤1Ω: ±150ppm/℃ CS07： 10mΩ≤R＜15mΩ: ±500ppm/℃ 15mΩ≤R＜20mΩ: ±400ppm/℃ 20mΩ≤R≤50mΩ: ±300ppm/℃ 50mΩ＜R≤1Ω: ±100ppm/℃ CS10： 10mΩ≤R＜15mΩ: ±600ppm/℃ 15mΩ≤R＜20mΩ: ±500ppm/℃ 20mΩ≤R≤30mΩ: ±300ppm/℃ 30mΩ＜R≤50mΩ: ±200ppm/℃ 50mΩ＜R≤0.1Ω: ±150ppm/℃ 0.1Ω＜R≤1Ω: ±100ppm/℃ CS11： 10mΩ≤R＜20mΩ: ±500ppm/℃ 20mΩ≤R＜50mΩ: ±400ppm/℃ 50mΩ≤R≤0.1Ω: ±200ppm/℃ 0.1Ω＜R≤1Ω: ±100ppm/℃ CS12： 10mΩ≤R＜15mΩ: ±600ppm/℃ 15mΩ≤R＜20mΩ: ±400ppm/℃ 20mΩ≤R≤30mΩ: ±300ppm/℃ 30mΩ＜R≤50mΩ: ±200ppm/℃ 50mΩ＜R≤0.1Ω: ±150ppm/℃ 0.1Ω＜R≤1Ω: ±100ppm/℃		
Short-time overload	±1%: ±(1%+0.005Ω) ±5%: ±(2%+0.005Ω)	GB/T 5729 4.13 JIS-C-5201 4.13 IEC 60115-1 8.1.4.2	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	Marking Complete , no mechanical damage	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 Complete , no mechanical damage	MIL-STD-202 Method 215	Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.
Terminal Strength	Not broken	AEC-Q200-006	CS02:5N; others:17.7N, 60±1 seconds.
High Temperature Exposure (Storage)	±1%: ±(1.0%+0.005Ω) ±5%: ±(3.0%+0.005Ω)	MIL-STD-202 Method 108	1000hrs. @T=155℃.Unpowered. Measurement at 24±4 hours after test conclusion.
Temperature Cycling	±1%: ±(1.0%+0.005Ω) ±5%: ±(3.0%+0.005Ω)	JESD22 Method JA-104	1000 Cycles (-55℃ to +155℃). Measurement at 24±4 hours after test conclusion.
Biased Humidity	±1%: ±(1.0%+0.005Ω) ±5%: ±(3.0%+0.005Ω)	MIL-STD-202 Method 103	1000 hours 85℃,85%RH. Note: Specified conditions: 10% of operating power. Measurement at 24±4 hours after test conclusion.
Mechanical Shock	±(1.0%+0.005Ω)	MIL-STD-202 Method 213	Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.

Vibration	±(1.0%+0.005Ω)	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.
Soldrability	Coverage must be over 95%.	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%+0.005Ω)	AEC-Q200-005	Bending 2mm(min) for 60+5sec
Flame Retardance	No flame	AEC-Q200-001	Only requested, when voltage/power will increase the surface temp to 350℃.Apply voltage from 9V to 32V. No flame; No explosion.
Resistance to Soldering Heat	±(1.0%+0.005Ω)	MIL-STD-202 Method 210	Condition B No per-heat of samples. Dipping the resistor into a solder bath having a temperature of 260℃±5℃ and hold it for 10±1 seconds

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)

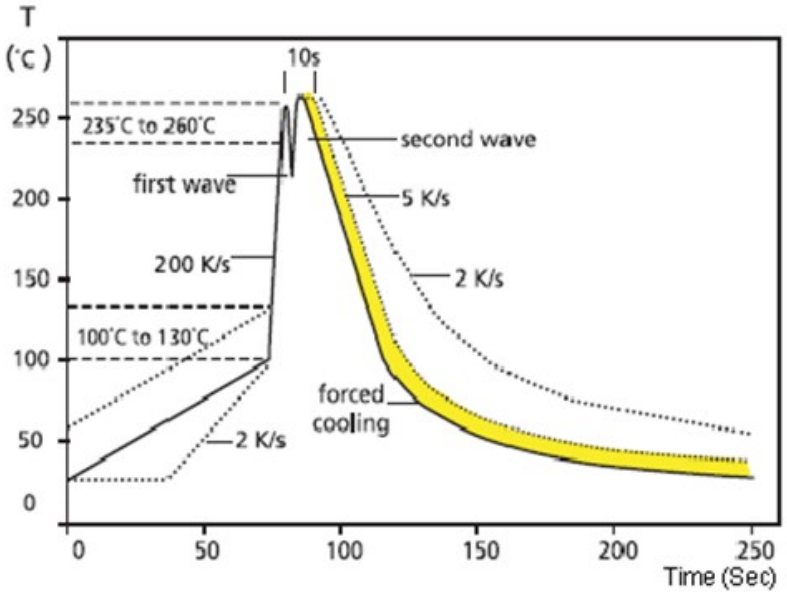


Profile Feature	Lead (Pb)-Free solder
Preheat： Temperature Min (Ts_{min}) Temperature Max (Ts_{max}) Time (Ts_{min} to Ts_{max}) (ts)	 150℃ 200℃ 60 -120seconds
Average ramp-up rate： (Ts max to Tp)	 3℃ / second max.
Time maintained above : Temperature (T_L) Time (t_L)	 217℃ 60-150 seconds
Peak Temperature (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, we suggest use N_2 Re-flow furnace .

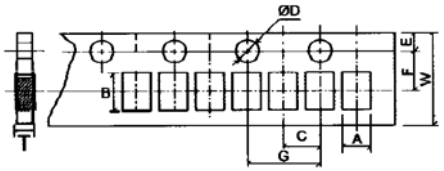
11.2 Recommend Wave Soldering Profile：(Apply to 0603 and above size)



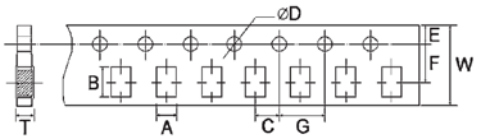
12. Packing

12.1 Dimension of Paper Taping :(Unit: mm)

Type	A	B	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.05
CS02	0.65±0.10	1.20±0.10	2.00	1.50	1.75	3.50	4.00	8.00	0.42

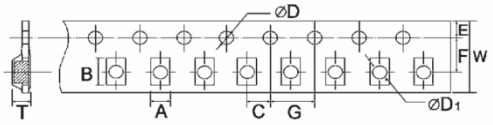


Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
CS03	1.10	1.90	2.00	1.50	1.75	3.50	4.00	8.00	0.67
CS05	1.65	2.40	2.00	1.50	1.75	3.50	4.00	8.00	0.81
CS06	2.00	3.60	2.00	1.50	1.75	3.50	4.00	8.00	0.81
CS07	2.80	3.50	2.00	1.50	1.75	3.50	4.00	8.00	0.75



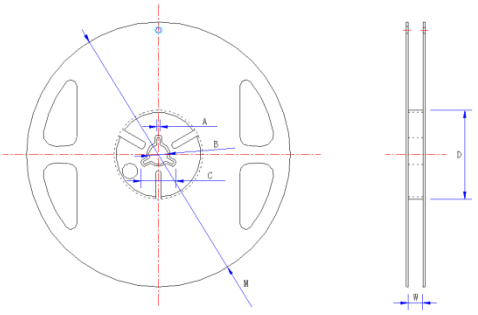
12.2 Dimension of Embossed Taping：(Unit: mm)

Type	A ±0.2	B ±0.2	C ±0.05	$\Phi D^{+0.1}_{-0}$	$\Phi D^{+0.25}_{-0}$	E ±0.1	F ±0.05	G ±0.1	W ±0.2	T ±0.1
CS10	2.90	5.60	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00
CS11	3.50	4.80	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00
CS12	3.50	6.70	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00



12.3 Dimension of Reel：(Unit: mm)

Type	Taping	Qty/Reel	A ±0.5	B ±0.5	C ±0.5	D ±1	M ±2	W ±1
CS02	Paper	10,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CS03	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CS05	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CS06	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CS07	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CS10	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8
CS11	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8
CS12	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8



13. Note

13.1. UNI-ROYAL recommend products store in warehouse with temperature between 15 to 35℃ under humidity between 25 to 75%RH. Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.

13.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.

13.3. Storage conditions as below are inappropriate:

a. Stored in high electrostatic environment

b. Stored in direct sunshine, rain, snow or condensation.

13.4 This product is used for automotive electronics. UNI-ROYAL will not be responsible for any damage, expense or loss caused by the use of this specification in any special environment. This series of products are suitable for automotive electronics applications, as shown below, If there are other applications, you need to confirm with UNI-ROYAL whether they are applicable:

a. Control unit for information, entertainment, navigation, audio;

b. Control unit for comfortable doors, windows, seat;

c. Control unit for internal lighting.

14. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~7	Mar.20, 2018	Haiyan Chen	Nana Chen
2	1.Modify the product name 2. Modify characteristic	1~7	Nov.22, 2018	Haiyan Chen	Nana Chen
3	Modify characteristic	5~6	Feb.16, 2019	Haiyan Chen	Yuhua Xu
4	1.Modify the reflow curve and add the wave soldering curve 2. Notes for improvement	6~7 8	Apr.30, 2020	Haiyan Chen	Yuhua Xu
5	3. Modify the "W" dimension of CS07	4	Apr.28, 2025	Haiyan Chen	Yuhua Xu