



# APPROVAL SHEET

**WW12C, WW08C, WW06C, WW04C,  
WW02C**

**±5%, ±1%**

Low ohm chip resistors ( power )

Size 1206, 0805, 0603, 0402, 0201

Anti-sulfuration ASTM B-809-95 Compliant

\*Contents in this sheet are subject to change without prior notice.



## FEATURE

1. High power rating and low range
2. High reliability and stability
3. Suitable for current sensing of small mobile devices
4. RoHS compliant & Lead free
5. Up side down mounting to minimize resistance drift after soldering
6. Anti-sulfur ASTM B-809-95 Compliant

## APPLICATION

- Game equipment
- Mobile phone
- Battery pack
- Power supply
- DSC
- HDD

## DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive paste that is applied to the top surface of the substrate. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to nominated value within tolerance which controlled by laser trimming of this resistive layer.

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For ease of soldering the outer layer of these end terminations is a Tin (lead free) alloy.



Fig 1. Construction of Chip-R

**QUICK REFERENCE DATA**

Item	General Specification				
Series No.	WW12C	WW08C	WW06C	WW04C	WW02C
Size code	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)	0201 (0603)
Resistance Tolerance	±5%, ±1%				±5%
Resistance Range	0.020Ω ~ 0.100Ω ( E24 +E96 )	0.010Ω ~ 0.100Ω ( E24 +E96 )	0.010Ω ~ 0.100Ω ( E24 +E96 )	0.025Ω ~ 0.100Ω ( E24 +E96 )	0.020Ω ~ 0.100Ω ( E24 +E96 )
TCR (ppm/°C)					
0.010Ω ~ 0.019Ω	N/A	0 ~ +250 ppm	0 ~ +350 ppm	N/A	N/A
0.020Ω ~ 0.030Ω	0 ~ +250 ppm	0 ~ +250 ppm	0 ~ +350 ppm	0 ~ +350 ppm	0 ~ +350 ppm
0.033Ω ~ 0.050Ω	±100 ppm	±150 ppm	0 ~ +250 ppm	0 ~ +350 ppm	0 ~ +350 ppm
0.051Ω ~ 0.100Ω	±100 ppm	±100 ppm	±150 ppm	±150 ppm	0 ~ +350 ppm
Max. dissipation at T <sub>amb</sub> =70°C	1/2W	1/3 W	1/4 W	1/8 W	1/10 W
Max. Operation Current (DC or RMS)	2.2 ~ 5.0A	1.8 ~ 5.7 A	1.5 ~ 5.0 A	1.1 ~ 2.2 A	1.0 ~ 2.2 A
Operation temperature	-55 ~ +125°C				

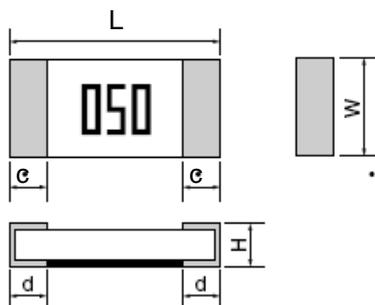
Note :

- This is the maximum current that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
- Max. Operation current : So called RCWC (Rated Continuous Working Current) is determined by  

$$RCWC = \sqrt{\text{Rated Power} / \text{Resistance Value}}$$

**MECHANICAL DATA(unit: mm)**

Symbol	WW12C	WW08C	WW06C	WW04C	WW02C
L	3.10 ± 0.20	2.00 ± 0.15	1.60 ± 0.10	1.00 ± 0.05	0.60 ± 0.03
W	1.60 ± 0.15	1.25 ± 0.10	0.80 +0.15 -0.05	0.50 ± 0.05	0.30 ± 0.03
H	0.60 ± 0.10	0.60 ± 0.10	0.50 ± 0.10	0.35 +0.05 -0.10	0.23 + 0.03 - 0.10
c	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.10	0.25 +0.05 -0.10	0.15 +0.05 -0.10
d	0.50 ± 0.25	0.40 ± 0.20 0.60 ± 0.20 ( < 0.02Ω )	0.30 ± 0.10 0.55 ± 0.10 ( < 0.02Ω )	0.25 +0.05 -0.10	0.15 ± 0.05





## MARKING

Each resistor is marked with a three-digit code on the substrate to designate the nominal resistance value. Please refer below table list! 0603, 0402 and 0201 sizes are no marking!

### ●Rated Resistance

Resistance	Code	Mark	Resistance	Code	Mark	Resistance	Code	Mark
20mΩ	R020	020	40mΩ	R040	040	68mΩ	R068	068
22mΩ	R022	022	43mΩ	R043	043	70mΩ	R070	070
24mΩ	R024	024	47mΩ	R047	047	75mΩ	R075	075
25mΩ	R025	025	50mΩ	R050	050	80mΩ	R080	080
27mΩ	R027	027	51mΩ	R051	051	82mΩ	R082	082
30mΩ	R030	030	56mΩ	R056	056	90mΩ	R090	090
33mΩ	R033	033	60mΩ	R060	060	91mΩ	R091	091
36mΩ	R036	036	62mΩ	R062	062	100mΩ	R100	R10
39mΩ	R039	039	65mΩ	R065	065			

Example: R10 = 0.100Ω  
050 = 0.050Ω



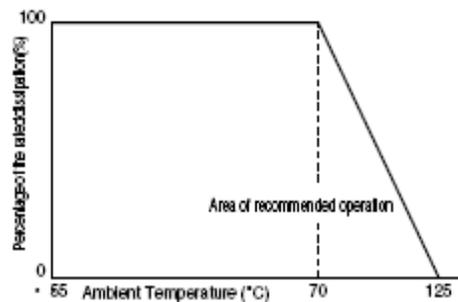
## FUNCTIONAL DESCRIPTION

### Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of ±5% & ±1%. The values of the E24/E96 series are in accordance with "IEC publication 60063".

### De-rating curve

The power that the resistor can dissipate depends on the operating temperature; see Fig.2



## MOUNTING

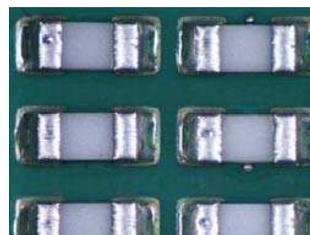
Due to their rectangular shapes and small tolerances, Surface Mountable Resistors are suitable for handling by automatic placement systems.

Chip placement can be on ceramic substrates and printed-circuit boards (PCBs).

Electrical connection to the circuit is by individual soldering condition.

The end terminations guarantee a reliable contact.

Resistive layer is on the bottom side as below !





### SOLDERING CONDITION

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 245°C during 3 seconds within lead-free solder bath. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.

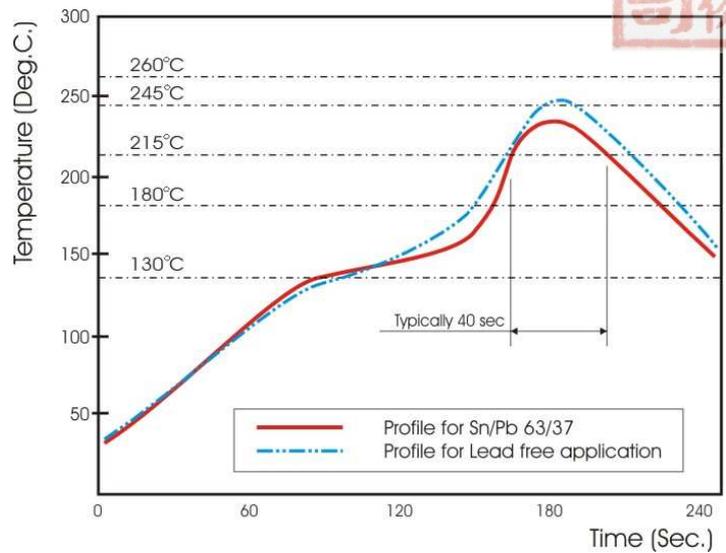


Fig 3. Infrared soldering profile for chip resistor

### CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WW04	C	R050	F	T	L
<b>Size code</b>	<b>Type code</b>	<b>Resistance code</b>	<b>Tolerance</b>	<b>Packaging code</b>	<b>Termination code</b>
WW02 : 0201	0201, 1/10W	E96 +E24:	J : ±5%	T : 7" Reel taping	L = Sn base (lead free)
WW04 : 0402	0402, 1/8W	R is first digit followed by 3 significant digits.	F : ±1%	A : 7" Reel taping 15Kpcs/reel	
WW06 : 0603	0603, 1/4W	0.020Ω = R020			
WW08 : 0805	0805, 1/3W	0.100Ω = R100			
WW12 : 1206	1206, 1/2W	0.025Ω = R025			

- Reeled tape packaging WW02C: 8mm width paper taping 2mm pitch, 15,000pcs per reel.
- Reeled tape packaging WW04C: 8mm width paper taping 2mm pitch, 10,000pcs per reel.
- Reeled tape packaging WW06C: 8mm width paper taping 4mm pitch, 5,000pcs per reel.
- Reeled tape packaging WW08C: 8mm width paper taping 4mm pitch, 5,000pcs per reel.
- Reeled tape packaging WW12C: 8mm width paper taping 4mm pitch, 5,000pcs per reel.

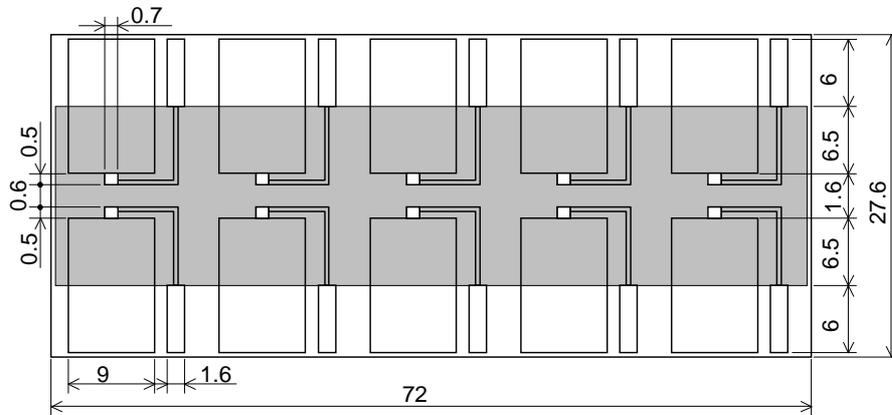


## TEST AND REQUIREMENTS

TEST	PROCEDURE	REQUIREMENT
Temperature Coefficient of Resistance ( TCR )	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ R <sub>1</sub> : Resistance at reference temperature R <sub>2</sub> : Resistance at test temperature t <sub>1</sub> : 25°C	Test temperature -55 ~ +125°C As defined in P.3
Short time overload ( STOL ) Sub-Clause 4.13	Permanent resistance change after 2 second application of a current 2.5 times RCWC specified.	ΔR/R max. ±1% no visible damage
Resistance to soldering heat Sub-clause 4.18	Un-mounted chips 10±0.5 seconds, 260±5°C	no visible damage Δ R/R max. ±1%
Solderability Sub-clause 4.17	Termination Sn base (lead free) : Un-mounted chip completely immersed in a lead free solder bath, 235°C±5°C, 2±0.5 sec	good tinning (>95% covered) no visible damage
Temperature cycling Sub-clause 4.19	1. 30 minutes at -55°C±3°C, 2. 2~3 minutes at room temperature, 3. 30 minutes at +125°C±3°C, 4. 2~3 minutes at room temperature, Total 5 continuous cycles	no visible damage ΔR/R max. ±1%
Load life (endurance) Sub-clause 4.25.1	70±2°C, 1000 hours, loaded with rated current, 1.5 hours on and 0.5 hours off	ΔR/R max. ±5% no visible damage
Steady state in Humidity Sub-clause 4.24	1000hrs without current applied in humidity chamber controller at 40°C±2°C and 90~95% relative humidity	ΔR/R max. ±5% no visible damage
Bending strength Sub-clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3 mm,	ΔR/R max. ±1% no visible damage
Adhesion Sub-clause 4.32	5N, 10±1s ( WW02C: 3N)	No visible damage



Test substrate



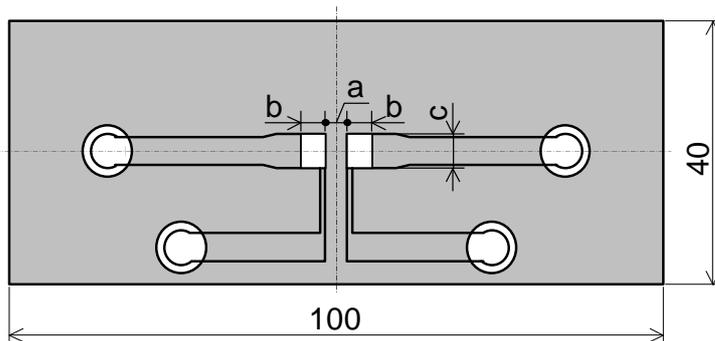
WW04C TEST SUBSTRATE Figure-3

Unit: mm

- :Copper clad
- :Solder resist

Remarks:

- 1). Material: Epoxy woven glass  
Thickness: 1.6mm Thickness of copper clad: 0.035mm
- 2). In the case of connection by connector, the connecting terminals are gold plated.  
However, the plating is not necessary when the connection is made by soldering.



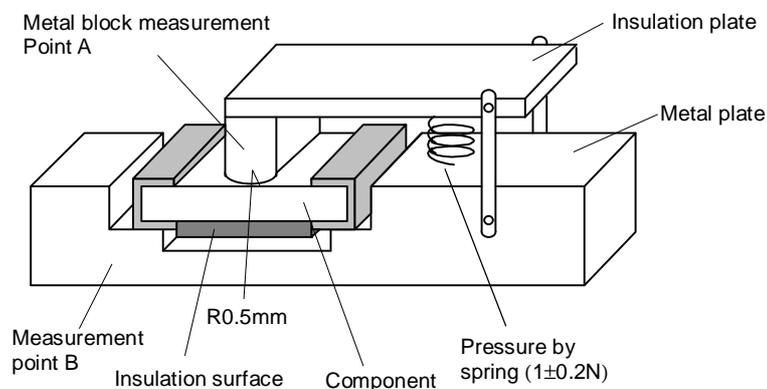
WW04C BOUND STRENGTH OF THE END FACE PLATING TEST SUBSTRATE  
Figure-4

Unit: mm

- :Copper clad
- :Solder resist

Style	a	b	c
WW04C	0.6	0.5	0.7

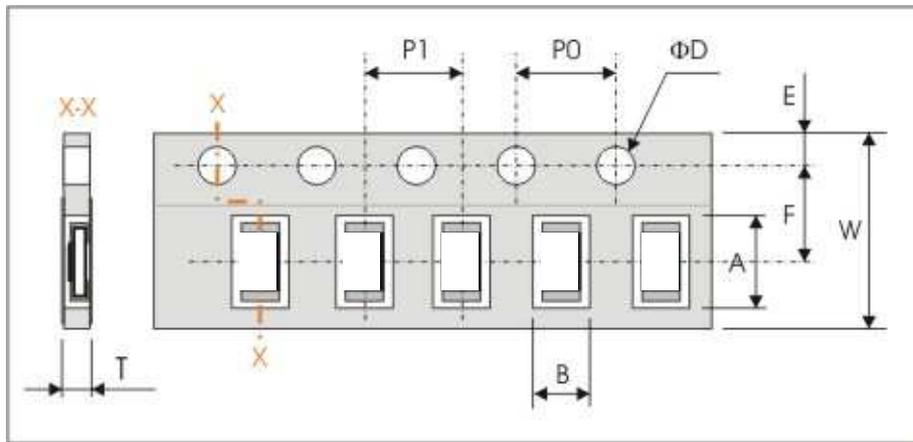
- Remark 1). Material: Epoxy woven glass  
Thickness: 1.6mm Thickness of copper clad: 0.035mm





**PACKAGING**

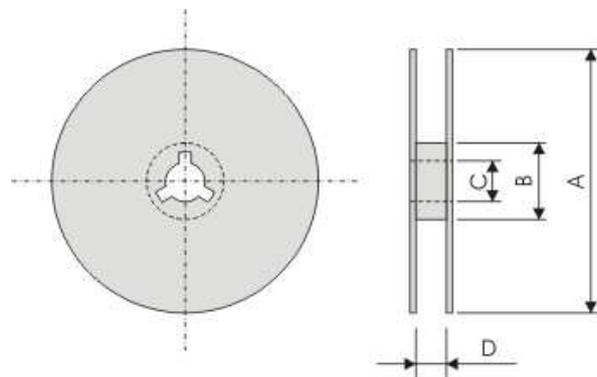
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WW02C	0.67±0.05	0.37±0.05	8.00±0.20	3.50±0.05	1.75±0.10
WW04C	1.15±0.10	0.65±0.10	8.00±0.20	3.50±0.05	1.75±0.10
WW06C	1.90±0.20	1.15±0.15	8.00±0.20	3.50±0.05	1.75±0.10
WW08C	2.50±0.20	1.65±0.15	8.00±0.20	3.50±0.05	1.75±0.10
WW12C	3.60±0.20	2.00±0.15	8.00±0.20	3.50±0.05	1.75±0.10

Series No.	P1	P0	ΦD	T
WW02C	2.00±0.05	4.00±0.05	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	0.45±0.05
WW04C	2.00±0.05	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 0.5
WW06C	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 0.8
WW08C	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.0
WW12C	4.00±0.10	4.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.0

**Reel dimensions**



Symbol	A	B	C	D
(unit : mm)	Φ180.0 -1.5	Φ60.0±1.0	13.0±0.2	9.0+1.0