

APPROVAL SHEET

**WW25W, WW20W, WW10W, WW12W,
WW08W, WW06W**

±1%, ±5%

Thick Film Normal Low Ohm Chip Resistors
Size 2512, 2010, 1210, 1206, 0805, 0603

Automotive Grade AEC Q200 Qualified

Anti-Sulfuration FOS 105°C 750hrs compliant

RoHS Exemption free and Lead free products
Halogen free

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

FEATURES

1. High power rating and low TCR
2. High reliability and stability
3. Reduced size of final equipment
4. RoHS exemption free and Lead free products
5. Anti-Sulfuration FOS 105°C 750hrs compliant
6. Automotive AEC Q200 Qualified

APPLICATIONS

- Power supply
- PDA
- Digital meter
- Computer
- Automotives
- Battery charger
- DC-DC power converter

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 Tin (lead free) alloy.

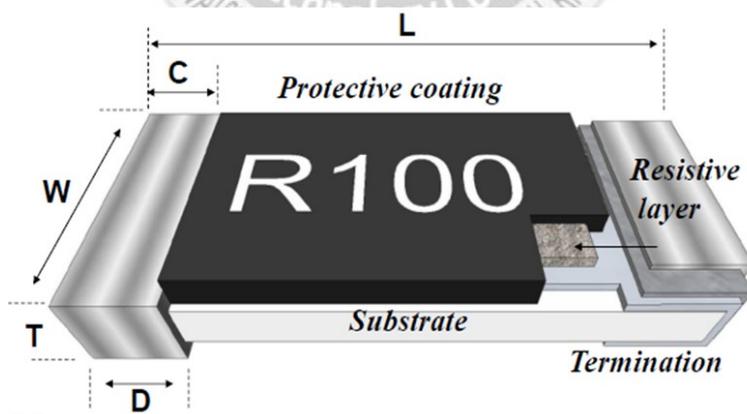


Fig 1. Construction of Chip-R

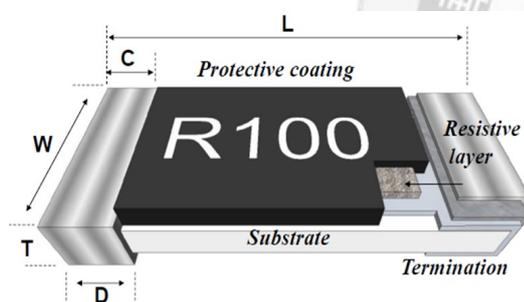
QUICK REFERENCE DATA

Item	General Specification					
Series No.	WW25W	WW20W	WW10W	WW12W	WW08W	WW06W
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)
Resistance Tolerance	±5%, ±1%					
Resistance Range	0.050Ω ~ 0.910Ω, E24					0.050Ω ~ 0.910Ω, E24
TCR (ppm/°C)	50 - 91mΩ: ±100 100 - 910mΩ: ±100	50 - 91mΩ: ±200 100 - 910mΩ: ±100				
Max. dissipation at T _{amb} =70°C	1 W	3/4W	2/3 W	1/3 W	1/4 W	1/8 W
Rated current	SQRT (Power / Resistance)					
Overload current	SQRT (5 x Power / Resistance)					
Operation temperature	-55 ~ +155°C					

Note:

Max. Working Current (A) = $\sqrt{P / R}$. P= Max. dissipation power at Tamb(W) , R=Resistance Value(Ω)

DIMENSIONS (unit : mm)



Symbol	WW25W	WW20W	WW10W	WW12W	WW08W	WW06W
L	6.30 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10
W	3.10 ± 0.20	2.50 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10
C	0.60 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
D	0.90 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20

CATALOGUE NUMBERS

The resistors have a catalogue number starting with:

WW12	W	R020	F	T	L	J
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code	Special code
WW25 : 2512	W : Thick film Power low ohm low TCR	0.020Ω = R020	J : ±5%	T : 7" Reel taping	L = Sn base (lead free)	J = Automotive ACE Q200 Qualified
WW20 : 2010		0.510Ω = R510	F : ±1%	Q : 10" Reel taping		
WW10 : 1210		0.025Ω = R025		G : 13" Reel taping		
WW12 : 1206						
WW08 : 0805						
WW06 : 0603						

Tape packaging WW10, WW12, WW08, WW06 : 8mm width paper taping
5,000pcs per 7" reel;
10,000pcs per 10" reel;
20,000pcs per 13" reel.

WW25, WW20: 12mm width emboss taping
4,000pcs per 7" reel;
8,000pcs per 10" reel;
16,000pcs per 13" reel.

MARKING

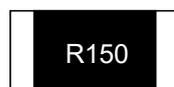
- **4 digits marking for 2512, 2010, 1210, 1206, 0805 size**

Each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value.

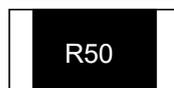
- **3 digits marking for 0603 size**

Each resistor is marked with a three -digit code on the protective coating to designate the nominal resistance value.

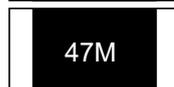
Resistance Marking (E-24 Series)



4 digit marking for ±1%, ±5% 0805, 1206, 1210, 2010, 2512
Examples: R150 = 150 mΩ, R020 = 20 mΩ



3 digit marking for ±1%, ±5% 0603
Examples: R12 = 120 mΩ, R50 = 500 mΩ



3 digit marking for ±1%, ±5% 0603 (47mΩ~91mΩ)
Examples: 20M = 20 mΩ, 47M = 47 mΩ

FUNCTIONAL DESCRIPTION

Product characterization

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

Derating curve

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

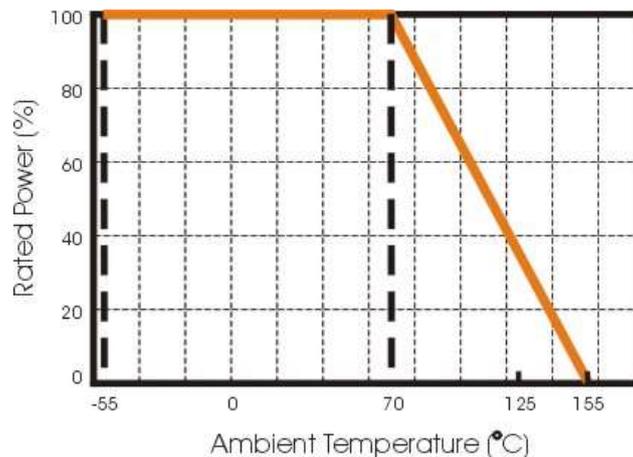


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
2. To store products with following condition:
 - Temperature :5 to 40°C
 - Humidity :20 to 70% relative humidity
3. Caution:
 - a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.
It may cause oxidization of electrode, which easily be resulted in poor soldering.
 - b. To store products on the shelf and avoid exposure to moisture.
 - c. Don't expose products to excessive shock, vibration, direct sunlight and so on

SOLDERING CONDITION follows J-STD-020D

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 235°C during 2 seconds. 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.

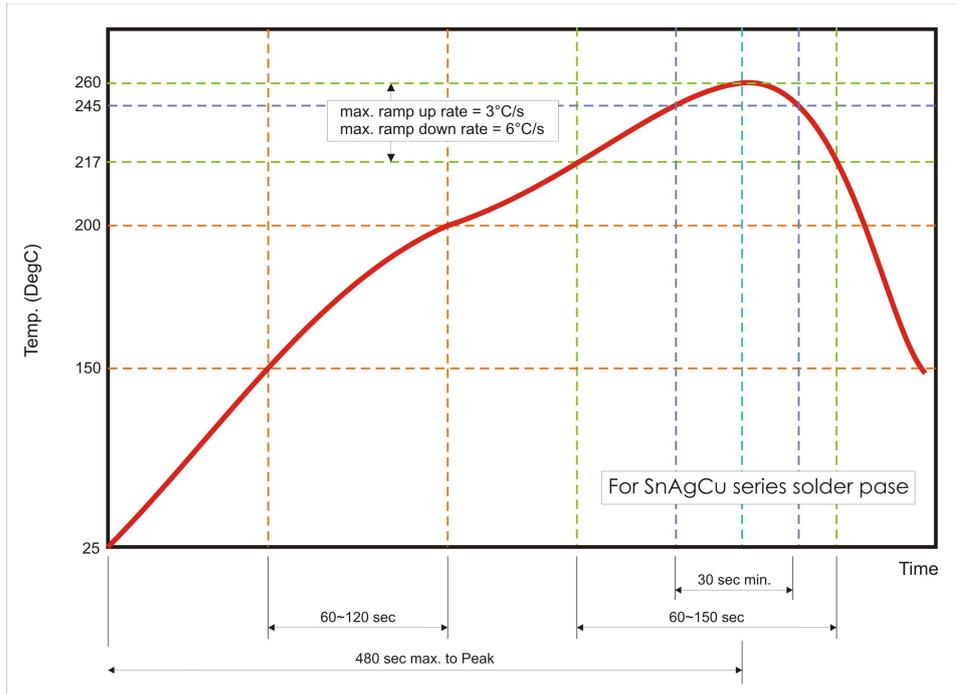
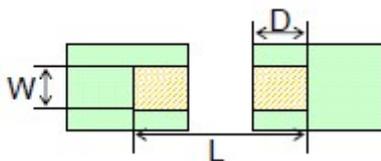


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

RECOMMENDED SOLDERING PAD

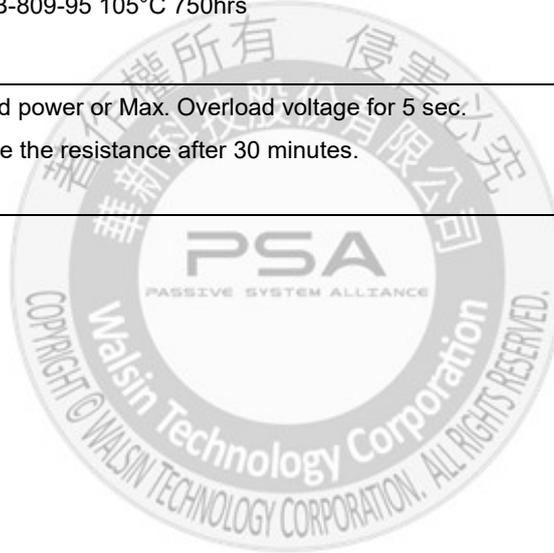


Symbol	WW25W	WW20W	WW10W	WW12W	WW08W	WW06W
W	3.70mm	3.00mm	3.00mm	1.80mm	1.30mm	0.90mm
D	1.60mm	1.50mm	1.30mm	1.30mm	1.15mm	1.00mm
L	7.60mm	6.80mm	4.70mm	4.70mm	3.50mm	3.00mm

TEST AND REQUIREMENTS(AEC Q200)

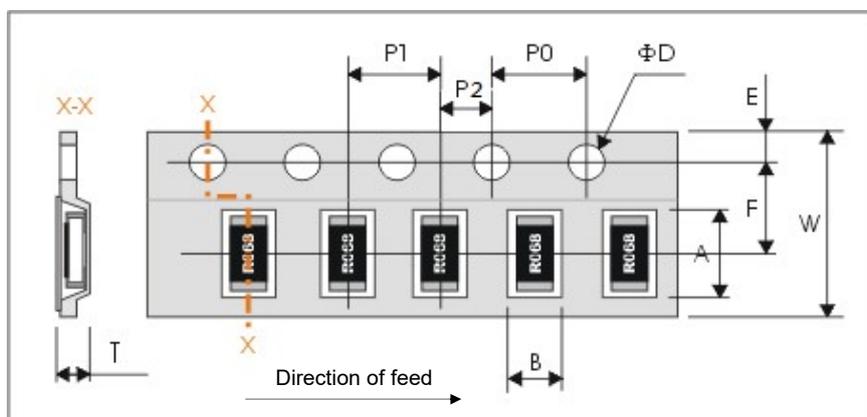
TEST	PROCEDURE	REQUIREMENT
Temperature Coefficient of Resistance(T.C.R) Clause 4.8	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ $t_1 : 25^\circ\text{C}$ R_1 : Resistance at reference temperature 25°C R_2 : Resistance at test temperature 155°C	Refer to "QUICK REFERENCE DATA"
High temperature exposure MIL-STD-202-Method 108	Test 1000 hrs./ @ $T=155^\circ\text{C}$ / Un-powered. Measurement at 24 ± 2 hours after test conclusion.	J: $\Delta R/R$ max. $\pm(3\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ no visible damage
Temperature cycling JESD22 Method JA-104	30 minutes at $-55^\circ\text{C} \pm 3^\circ\text{C}$, 2~3 minutes at $20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$, 30 minutes at $+125^\circ\text{C} \pm 3^\circ\text{C}$, 2~3 minutes at $20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$, 1000 cycles	J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$ no visible damage
Moisture resistance MIL-STD-202-Method 106	Test 65°C / 80~100%RH/ 10Cycles($t=24\text{hrs/cycle}$). Measurement at 24 ± 2 hours after test conclusion.	J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$ no visible damage
Bias Humidity MIL-STD-202-Method 103	Test 1000 hours/ @ 85°C /85% RH./ 10% of operation power. Measurement at 24 ± 2 hours after test conclusion.	J: $\Delta R/R$ max. $\pm(3\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ no visible damage
Operation life MIL-STD-202-Method 108	Test 1000 hrs./ $T_A=125^\circ\text{C}$ / 35% of operating power. Measurement at 24 ± 2 hours after test conclusion.	J: $\Delta R/R$ max. $\pm(3\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ no visible damage
External visual MIL-STD-883-Method 2009	Electrical test not required. Inspect device construction, marking and workmanship	no visible damage and marking follow spec
Physical dimensions JESD22 Method JB-100	The chip dimension (L, W, C, D, T) prescribed in the detail specification shall be checked by Protech 2.5D.	Within spec defined
Mechanic shock MIL-STD-202-Method 213	Test Peak value:100g's / Wave: Hail-sine / Duration:6ms / Velocity:12.3ft/sec.	no visible damage and within specified tolerance
Vibration MIL-STD-202-Method 204	Test 5g's for 20min., 12 cycles each of 3 orientations	J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$ no visible damage
Resistance to soldering heat(R.S.H) MIL-STD-202-Method 210	Un-mounted chips completely immersed for 10 ± 1 second in a SAC solder bath at $270^\circ\text{C} \pm 5^\circ\text{C}$	J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$ no visible damage
Thermal shock MIL-STD-202-Method 107	Test -55 to 155°C / dwell time 15min/ Max transfer time 20sec/ 300cycles	J: $\Delta R/R$ max. $\pm(1\%+0.5\text{m}\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5\text{m}\Omega)$ no visible damage

TEST	PROCEDURE	REQUIREMENT
ESD AEC Q200-002	Test contact 1KV(Min)	J: $\Delta R/R$ max. $\pm(1\%+0.5m\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5m\Omega)$ no visible damage
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4hrs/ solder dipping 235°C / 5sec. b) Steam the sample dwell time 8 hour/ solder dipping 215°C / 5sec. c) Steam the sample dwell time 8 hour/ solder dipping 260°C / 7sec.	good tinning (>95% covered) no visible damage
Board flex AEC Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3mm for 0603/0805, 2mm for 1206 and above sizes, once for 10 seconds	J: $\Delta R/R$ max. $\pm(1\%+0.5m\Omega)$ F: $\Delta R/R$ max. $\pm(0.5\%+0.5m\Omega)$ no visible damage
Terminal strength AEC Q200-005	Pressurizing force: 1.8Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations
Sulfuration test ASTM B-809-95	ASTM B-809-95 105°C 750hrs	$\Delta R/R$ max. $\pm(2\%+0.5m\Omega)$
Short time overload (S.T.O.L) Clause 4.13	5×Rated power or Max. Overload voltage for 5 sec. Measure the resistance after 30 minutes.	no visible damage $\Delta R/R$ max. $\pm(1\%+0.05m\Omega)$



PACKAGING

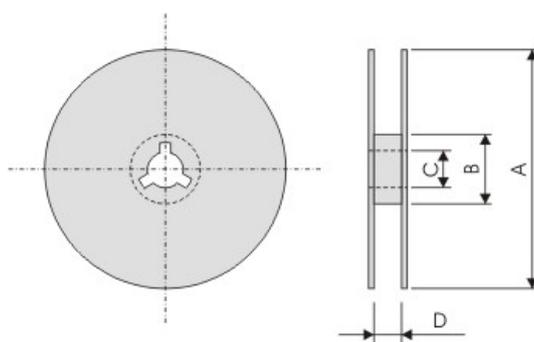
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WW25W	6.70±0.20	3.50±0.20	12.00±0.30	3.50±0.20	1.75±0.10
WW20W	5.50±0.20	2.80±0.20	12.00±0.30		
WW10W	3.60±0.20	3.00±0.20	8.00±0.30		
WW12W	3.60±0.20	2.00±0.20			
WW08W	2.40±0.20	1.65±0.20			
WW06W	1.90±0.20	1.10±0.20			

Series No.	P1	P0	P2	ΦD	T
WW25W	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	0.81±0.2
WW20W					0.81±0.1
WW10W					0.80±0.1
WW12W					0.80±0.1
WW08W					0.80±0.1
WW06W					0.70±0.05

Reel dimensions



Symbol	A	B	C	D
7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	10.0±1.5 (8mm tape)
10" reel	Φ254.0±2.0	Φ100.0±1.0		13.8±1.5 (12mm tape)
13" reel	Φ330.0±2.0	Φ100.0±1.0		