

APPROVAL SHEET

**WW25P_V, WW20P_V, WW10P_V, WW12P_V,
WW08P_V, WW06P_V, WW04P_V**

±1%, ±5% 100mΩ~976mΩ

Thick Film High Power Low Ohm Chip Resistors

**Size 2512 2W, 2010 1W, 1210 1/2W, 1206 1/2W
0805 1/4W ; 0603 1/8W, 0402 1/8W**

(Automotive & Anti-sulfuration)

**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 compact size
2. Automotive AEC Q-200 Compliant
3. RoHS Exemption free and Lead free products
4. Halogen free
5. Anti-sulfuration ASTM B-809-95 compliant

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

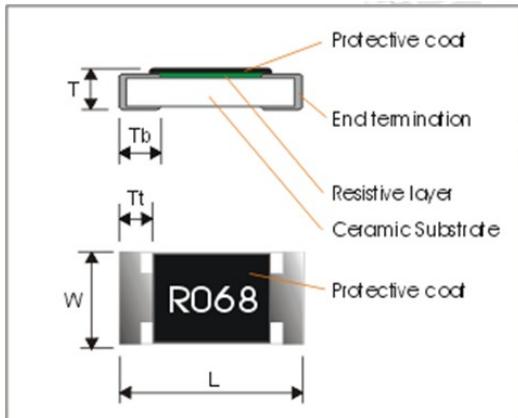
QUICK REFERENCE DATA

Item	General Specification						
Series No.	WW25P_V	WW20P_V	WW10P_V	WW12P_V	WW08P_V	WW06P_V	WW04P_V
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Tolerance	$\pm 1\% (E24+E96)$, $\pm 5\%$						
Resistance Range	$0.100\Omega \sim 0.976\Omega$						
TCR (ppm/ $^{\circ}\text{C}$) $0.100\Omega \sim 0.976\Omega$	$\pm 150\text{ppm}$				$\pm 200\text{ppm}$	$\pm 250\text{ppm}$	$\pm 300\text{ppm}$
Max. dissipation at $T_{\text{amb}}=70^{\circ}\text{C}$	2 W	1 W	1/2 W	1/2 W	1/4 W	1/8 W	1/8 W
Max. Operation Current (DC or RMS)	4.5~1.5A	3.2~1.0A	2.3~0.75A	2.2~0.7A	1.6~0.5A	1.1~0.35A	1.1~0.35A
Max. Overload Current (DC or RMS)	9.0~3.0A	6.4~2.0A	4.6~15A	4.4~1.4A	3.2~1.0A	2.2~0.7A	2.2~0.7A
Operation temperature	$-55 \sim +155^{\circ}\text{C}$						

Note :

1. 2W loading with total solder-pad and trace size of 300 mm^2
2. Resistance value will be changed by soldering condition and design of soldering pad, please design products in consideration of this change of resistance value

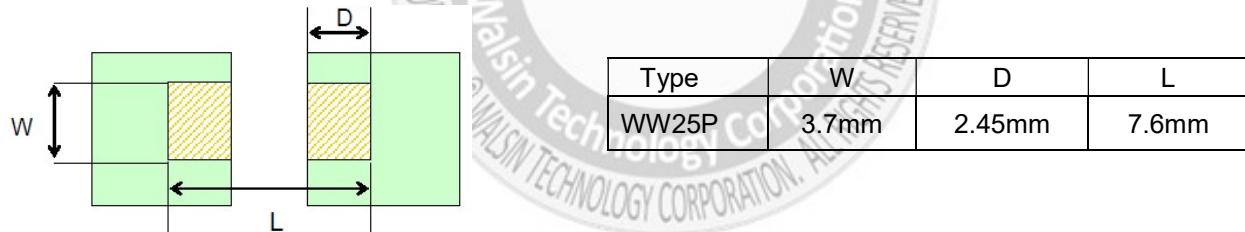
MECHANICAL DATA



(Unit: mm)

Symbol	WW25P	WW20P	WW10P	WW12P	WW08P	WW06P	WW04P
L	6.30 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	3.10 ± 0.15	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	3.10 ± 0.20	2.50 ± 0.20	2.50 ± 0.10	1.60 ± 0.15	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tt	0.60 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10
Tb	1.80 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10

Recommended Solder Pad Dimensions



CATALOGUE NUMBERS

The resistors have a catalogue number starting with.

WW25	P	R100	J	T	L	V
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code	Special code
WW25 : 2512	P : Power	E96 +E24: "R" is first digit followed by 3 significant digits. e.g.: 0.1ohm = R100 0.56ohm = R560	J : $\pm 5\%$ F : $\pm 1\%$	T : 7" Reel taping G : 13" Reel taping	L = Sn base (lead free)	V = 1. AEC Q200 Compliant 2. Anti-Sulfuration ASTM B-809-95 compliant 60°C x 480hrs 3. 100% CCD visual inspection
WW20 : 2010	2512 size = 2W					
WW10 : 1210	2010 size = 1W					
WW12 : 1206	1206 size = 1/2W					
WW08 : 0805	1210 size = 1/2W					
WW06 : 0603	0805 size = 1/4W					
WW04 : 0402	0603 size = 1/8W					
	0402 size = 1/8W					

Tape packaging WW12, WW10, WW08, WW06 : 8mm width paper taping 5,000pcs per reel.

WW04: 8mm width paper taping 10,000pcs per reel.

WW25, WW20: 12mm width plastic taping 4,000pcs per reel.

MARKING

- 0402 size series has no marking on the product overcoat for both 5% & 1%.

- 4-digit 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.



R510 = 0.510Ω (510mΩ)

- 3-digit marking for 0603 size

Rule	Series	Resistance Range	Example		Table
"R" followed by 2 significant digits if the 4th digit is "0"	E24	100mΩ ~910mΩ	R22	110mΩ= R10 220mΩ= R22 510mΩ= R51	Table-1
The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value : "Z"	E96	100mΩ ~976mΩ	25Z	178mΩ= 25Z 221mΩ= 34Z	Table-2
Others are no marking printed.	Out of E24 & E96	100mΩ ~976mΩ		400mΩ= No marking	-

■ Table-1 0603 E24 100mΩ ~910mΩ

Series	R value	Marking									
E24	100mΩ	R10	E24	200mΩ	R20	E24	390mΩ	R39	E24	680mΩ	R68
E24	110mΩ	R11	E24	220mΩ	R22	E24	430mΩ	R43	E24	750mΩ	R75
E24	120mΩ	R12	E24	240mΩ	R24	E24	470mΩ	R47	E24	820mΩ	R82
E24	130mΩ	R13	E24	270mΩ	R27	E24	500mΩ	R50	E24	910mΩ	R91
E24	150mΩ	R15	E24	300mΩ	R30	E24	510mΩ	R51			
E24	160mΩ	R16	E24	330mΩ	R33	E24	560mΩ	R56			
E24	180mΩ	R18	E24	360mΩ	R36	E24	620mΩ	R62			

■ Table-2 0603 E96 100mΩ ~976mΩ

Code	R value	Marking									
02	102mΩ	02Z	28	191mΩ	28Z	52	340mΩ	52Z	75	590mΩ	75Z
03	105mΩ	03Z	29	196mΩ	29Z	53	348mΩ	53Z	76	604mΩ	76Z
04	107mΩ	04Z	31	205mΩ	31Z	54	357mΩ	54Z	77	619mΩ	77Z
06	113mΩ	06Z	32	210mΩ	32Z	55	365mΩ	55Z	78	634mΩ	78Z
07	115mΩ	07Z	33	215mΩ	33Z	56	374mΩ	56Z	79	649mΩ	79Z
08	118mΩ	08Z	34	221mΩ	34Z	57	383mΩ	57Z	80	665mΩ	80Z
09	121mΩ	09Z	35	226mΩ	35Z	58	392mΩ	58Z	81	681mΩ	81Z
10	124mΩ	10Z	36	232mΩ	36Z	59	402mΩ	59Z	82	698mΩ	82Z
11	127mΩ	11Z	37	237mΩ	37Z	60	412mΩ	60Z	83	715mΩ	83Z
13	133mΩ	13Z	38	243mΩ	38Z	61	422mΩ	61Z	84	732mΩ	84Z
14	137mΩ	14Z	39	249mΩ	39Z	62	432mΩ	62Z	86	768mΩ	86Z
15	140mΩ	15Z	40	255mΩ	40Z	63	442mΩ	63Z	87	787mΩ	87Z
16	143mΩ	16Z	41	261mΩ	41Z	64	453mΩ	64Z	88	806mΩ	88Z
17	147mΩ	17Z	42	267mΩ	42Z	65	464mΩ	65Z	89	825mΩ	89Z
19	154mΩ	19Z	43	274mΩ	43Z	66	475mΩ	66Z	90	845mΩ	90Z
20	158mΩ	20Z	44	280mΩ	44Z	67	487mΩ	67Z	91	866mΩ	91Z
21	162mΩ	21Z	45	287mΩ	45Z	68	499mΩ	68Z	92	887mΩ	92Z
22	165mΩ	22Z	46	294mΩ	46Z	69	511mΩ	69Z	93	909mΩ	93Z
23	169mΩ	23Z	47	301mΩ	47Z	70	523mΩ	70Z	94	931mΩ	94Z
24	174mΩ	24Z	48	309mΩ	48Z	71	536mΩ	71Z	95	953mΩ	95Z
25	178mΩ	25Z	49	316mΩ	49Z	72	549mΩ	72Z	96	976mΩ	96Z
26	182mΩ	26Z	50	324mΩ	50Z	73	562mΩ	73Z			
27	187mΩ	27Z	51	332mΩ	51Z	74	576mΩ	74Z			

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of $\pm 5\%$ & $\pm 1\%$. The values of the E24/E96 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

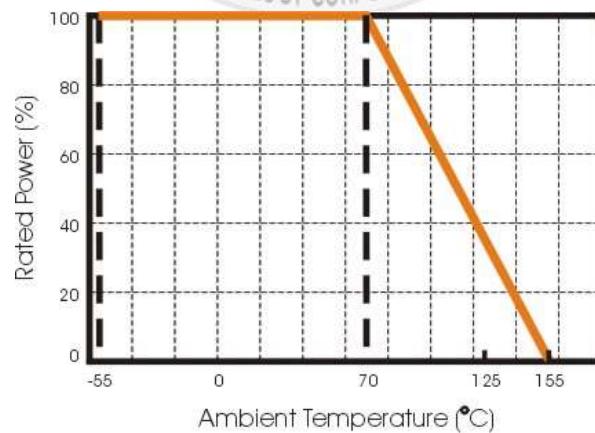


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

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 oxidation 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

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.

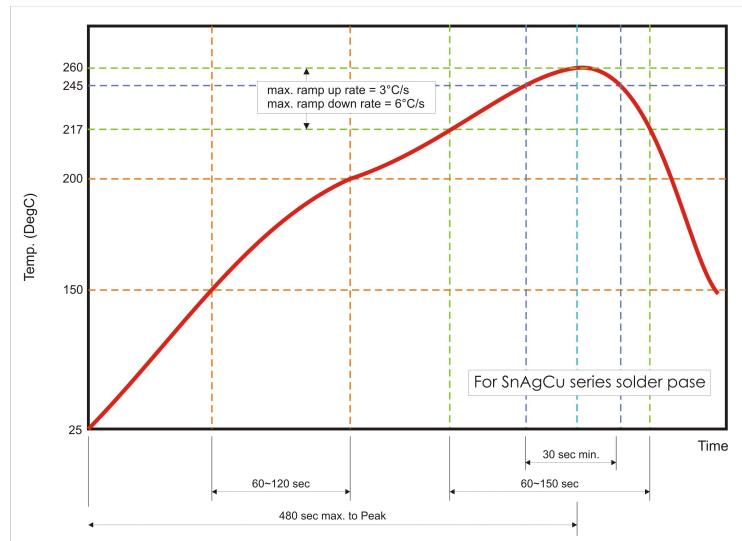


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste



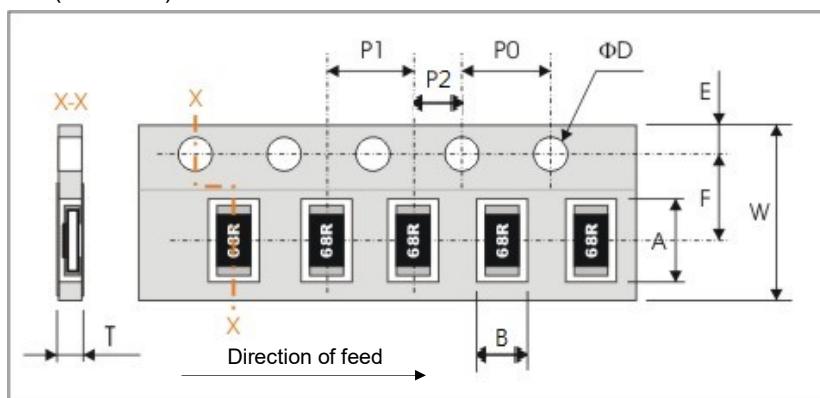
TEST AND REQUIREMENTS

TEST	PROCEDURE / TEST METHOD	REQUIREMENT
		Resistor
Electrical Characteristics JISC5201-1: 1998 Clause 4.8	<ul style="list-style-type: none"> - DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) <p>Natural resistance change per change in degree centigrade.</p> $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)} \quad t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ <p>R₁ : Resistance at reference temperature R₂ : Resistance at test temperature</p>	Within the specified tolerance Refer to "QUICK REFERENCE DATA"
Resistance to soldering heat(R.S.H) MIL-STD-202 method 210	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 270°C ±5°C	ΔR/R max. ±(1.0%+0.005Ω) no visible damage
Solderability J-STD-002	<ol style="list-style-type: none"> 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. 	95% coverage min., good tinning and no visible damage
Temperature cycling JESD22 Method JA-104	1000 cycles, -55°C ~ +155°C, dwell time 30min maximum.	ΔR/R max. ±(1.0%+0.005Ω) No visible damage
Moisture Resistance MIL-STD-202 method 106	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(1.0%+0.005Ω) No visible damage
Bias Humidity MIL-STD-202 method 103	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(2.0%+0.005Ω) No visible damage
Operational Life MIL-STD-202 method 108	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(2.0%+0.005Ω) No visible damage
High Temperature Exposure MIL-STD-202 Method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	ΔR/R max. ±(2%+0.005Ω) No visible damage
Board Flex AEC-Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4),bending once 2mm for 60sec.	ΔR/R max. ±(1.0%+0.005Ω) No visible damage
Terminal strength AEC-Q200-006	Pressurizing force: 1.8Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations
Thermal shock MIL-STD-202 method 107	Test -55 to 155°C / dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(1.0%+0.005Ω) No visible damage

TEST	PROCEDURE / TEST METHOD	REQUIREMENT
		Resistor
ESD AEC-Q200-002	Test contact 1KV (0.5KV for 0402 only)	ΔR/R max. ±(1.0%+0.005Ω) No visible damage
Short Time Overload JISC5201-1: 1998 Clause 4.13	2.5 times RCWV or max. overload voltage, for 5seconds	ΔR/R max. ±(2.0%+0.10Ω) No visible damage
Mechanical Shock MIL-STD-202 method 213	Test ½ Sine Pulse, Peak value: 100g, normal duration: 6ms, Velocity change:12.3ft/sec. Three shocks in each direction, total 18 shocks.	Within product specification tolerance and no visible damage.
Vibration MIL-STD-202 method 204	Test 5g's for 20 min., 12 cycles each of 3 orientations.	ΔR/R max. ±(0.5%+0.005Ω) and no visible damage.
Resistance to Solvents : MIL-STD-202 Method 215	Solvent is Isopropyl alcohol, immersion 3mins at 25°C and brush 10 strokes with a toothbrush with a handle made of a non-reactive material (wet bristle), immersion and brush 3 times and then air blow dry.	No superficial defect on marking, encapsulation, coating, appearance. Electrical characteristics within products specification and tolerance. Inspect at 3X max. for marking, inspect at 10X for part damage.
External Visual MIL-STD-883 method 2009	Electrical test not required. Inspect device construction, marking and workmanship	No visual damage and refer WTC marking code.
Physical Dimension JESD22 method JB-100	Verify physical dimensions(L, W, T, Tb, Tt)	Within the specified tolerance for WTC.
Sulfuration test ASTM B-809-95	ASTM B-809 60°C 480hrs	ΔR/R max. ±(2.0%+0.10Ω) No visible damage

PACKAGING

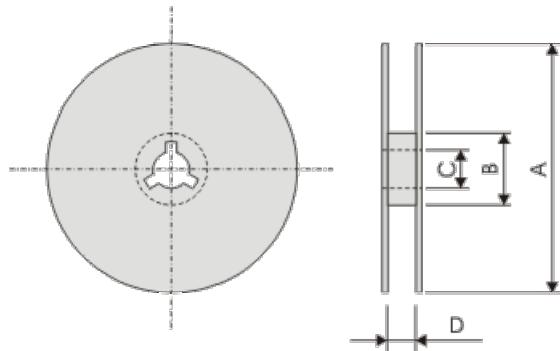
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WW25P	6.90±0.20	3.60±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WW20P	5.50±0.20	2.80±0.20			
WW10P	3.60±0.20	3.00±0.20			
WW12P	3.60±0.20	2.00±0.20			
WW08P	2.40±0.20	1.65±0.20			
WW06P	1.90±0.20	1.10±0.20			
WW04P	1.20±0.10	0.70±0.10			

Series No.	P1	P0	P2	ΦD	T
WW25P	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.2
WW20P					
WW10P	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
WW12P					
WW08P	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.65±0.05
WW06P					
WW04P	2.00±0.05	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.40±0.05

Reel dimensions



(unit : mm)

Reel / Tape	A	B	C	D
7" reel for 8mm tape	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	9.00 ± 0.50
7" reel for 12mm tape				12.4 ± 1.00
13" reel for 8mm tape	$\Phi 330.0 \pm 2.00$	$\Theta 100.0 \pm 1.00$	13.0 ± 0.2	9.00 ± 0.50

