

APPROVAL SHEET

**WW25X, WW18X, WW12X, WW08X,
WW06X**

±1%, ±5%

**Thick Film Current Sensing Chip Resistors
Size 2512, 1218, 1206, 0805, 0603
(Automotive)**

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

FEATURE

1. High power rating and compact size
2. Automotive AEC Q-200 Compliant
3. 100% CCD Visual inspection
4. RoHS compliant and Lead free products

APPLICATION

- 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 a lead free tin alloy.

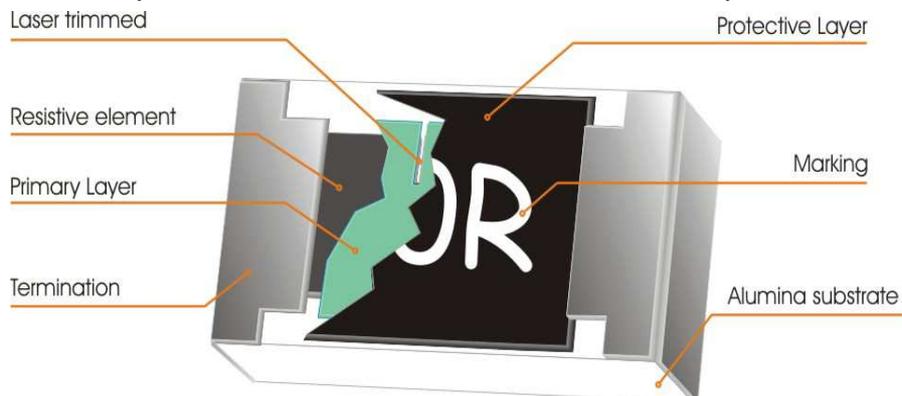


Fig 1. Construction of 2512, 1206, 0805, 0603 Chip-R

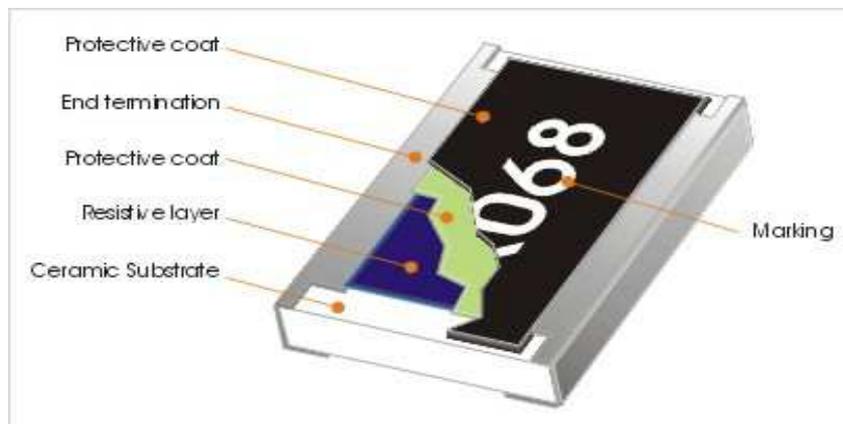


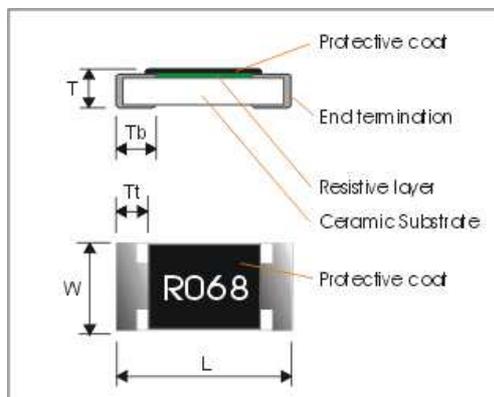
Fig 2. Construction of a 1218 Chip-R

QUICK REFERENCE DATA

| Item | General Specification | | | | |
|--|-----------------------|----------------|----------------|----------------|---------------|
| | WW25X | WW18X | WW12X | WW08X | WW06X |
| Series No. | 2512 (6432) | 1218 (3248) | 1206 (3216) | 0805 (2012) | 0603 (1608) |
| Resistance Tolerance | ±5%, ±1% (E24+E96) | | | | |
| Resistance Range | 0.02Ω ~ 0.976Ω | 0.02Ω ~ 0.976Ω | 0.02Ω ~ 0.976Ω | 0.02Ω ~ 0.976Ω | 0.1Ω ~ 0.976Ω |
| TCR (ppm/°C) | | | | | |
| 0.02Ω ≤ Rn < 0.05Ω | ≤ 2100 ppm/°C | ≤ 1500 ppm/°C | ≤ 2100 ppm/°C | ≤ 1500 ppm/°C | |
| 0.05Ω ≤ Rn < 0.10Ω | ≤ 1000 ppm/°C | ≤ 1000 ppm/°C | ≤ 1000 ppm/°C | ≤ 1000 ppm/°C | |
| 0.10Ω ≤ Rn < 0.50Ω | ≤ 500 ppm/°C | ≤ 500 ppm/°C | ≤ 500 ppm/°C | ≤ 500 ppm/°C | ≤ 500 ppm/°C |
| 0.50Ω ≤ Rn < 1Ω | ≤ 400 ppm/°C | ≤ 300 ppm/°C | ≤ 400 ppm/°C | ≤ 300 ppm/°C | ≤ 300 ppm/°C |
| Max. dissipation at T _{amb} =70°C | 1 W | 1 W | 1/4 W | 1/8 W | 1/10W |
| Max. Operation Current (DC or RMS) | 7.07 ~ 1.01A | 7.07 ~ 1.01A | 3.53 ~ 0.50A | 2.50 ~ 0.35A | 1.0 ~ 0.3A |
| Max. Overload Current (DC or RMS) | 14.14 ~ 2.02A | 14.14 ~ 2.02A | 7.06 ~ 1.0A | 5.00 ~ 0.70A | 2.0 ~ 0.6A |
| Operation Temperature | -55/+155°C | -55/+155°C | -55/+155°C | -55/+155°C | -55/+155°C |

MECHANICAL DATA (unit : mm)

| Dimension | WW25 | WW18 | WW12 | WW08 | WW06 |
|-----------|-----------|-----------|-------------|-------------|-------------|
| L | 6.40±0.20 | 3.05±0.15 | 3.10 ± 0.10 | 2.00 ± 0.10 | 1.60 ± 0.10 |
| W | 3.20±0.20 | 4.60±0.20 | 1.60 ± 0.10 | 1.25 ± 0.10 | 0.80 ± 0.10 |
| T | 0.60±0.10 | 0.55±0.10 | 0.60 ± 0.15 | 0.50 ± 0.15 | 0.45 ± 0.15 |
| Tt | 0.65±0.25 | 0.45±0.25 | 0.50 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.10 |
| Tb | 0.90±0.25 | 0.50±0.25 | 0.45 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.20 |



MARKING

For 0805 and above sizes, each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value.

Example:

$$R010 = 0.01\Omega$$

$$R510 = 0.51\Omega$$

For 0603 size, each resistor is marked with a three-digit code on the protective coating to designate the nominal resistance value.

Example:

$$R10 = 0.10\Omega$$

$$R51 = 0.51\Omega$$

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.3

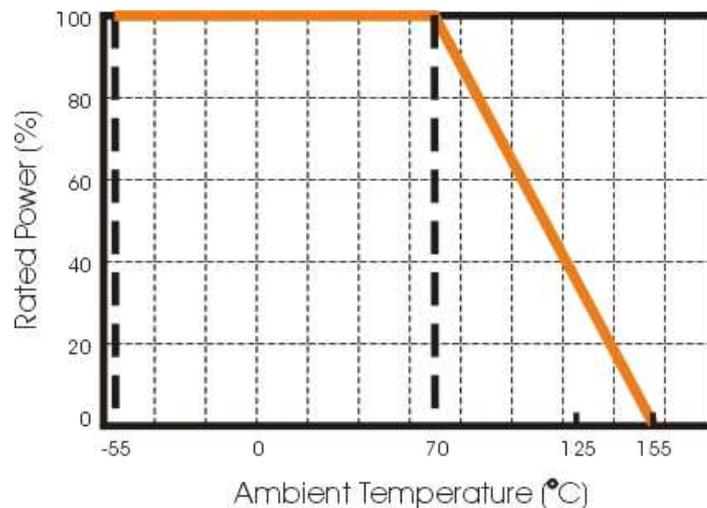


Fig 3. Max. dissipation in percentage of rated power as a function of the ambient temperature

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.

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 4.

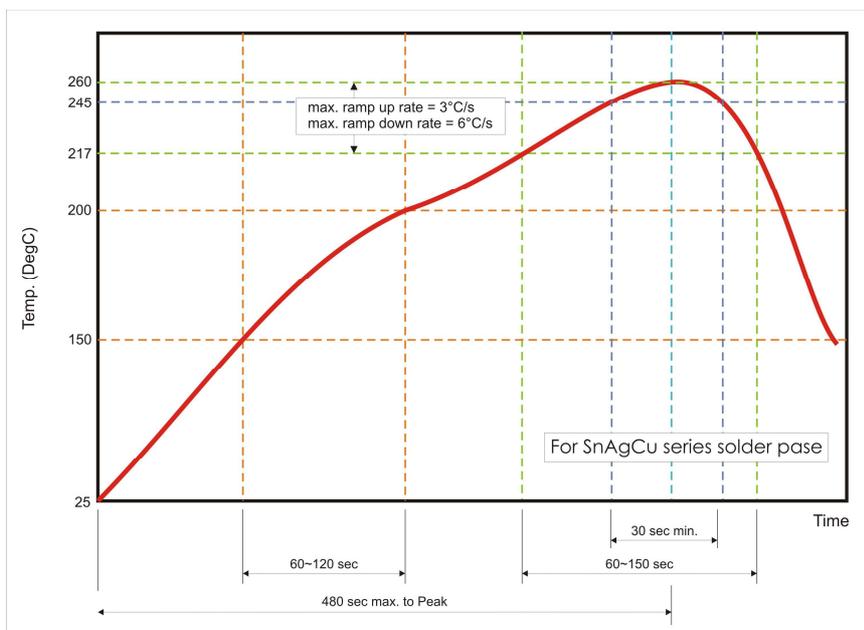


Fig 4. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

| WW25 | X | R020 | J | T | L | J |
|---|------------------|--|--------------------|-----------------------|-------------------------|--|
| Size code | Type code | Resistance code | Tolerance | Packaging code | Termination code | Special code |
| WW25 : 2512 WW18 : 1218 WW12 : 1206 WW08 : 0805 WW06 : 0603 | X : Normal | E96 +E24: R is first digit followed by 3 significant digits. 0.020Ω = R020 0.510Ω = R510 0.025Ω = R025 | J : ±5% F : ±1% | T : Reeled | L = Sn base (lead free) | J = Automotive grade AEC Q-200 compliant, 100% CCD visual inspection |

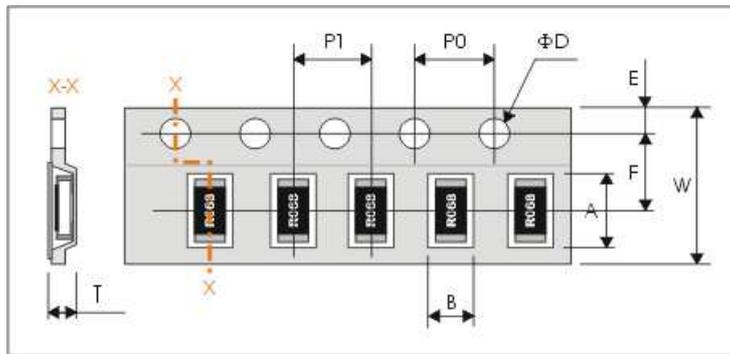
TEST AND REQUIREMENTS (AEC Q-200)

| TEST | PROCEDURE / TEST METHOD | REQUIREMENT |
|--|--|---|
| | | Resistor |
| Electrical Characteristics JISC5201-1: 1998 Clause 4.8 | - DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ $t_1 : 20^\circ\text{C}+5^\circ\text{C}-1^\circ\text{C}$ R_1 : Resistance at reference temperature R_2 : Resistance at test temperature | 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. ±(0.5%+0.005Ω) 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. | 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. ±(0.5%+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. ±(1.0%+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. ±(1.0%+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. ±(1%+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. ±(0.5%+0.005Ω) No visible damage |
| ESD AEC-Q200-002 | Test contact 25KV (air) | ΔR/R max. ±(1.0%+0.005Ω) 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. | $\Delta R/R$ max. $\pm(0.5\%+0.005\Omega)$ 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. |

PACKAGING

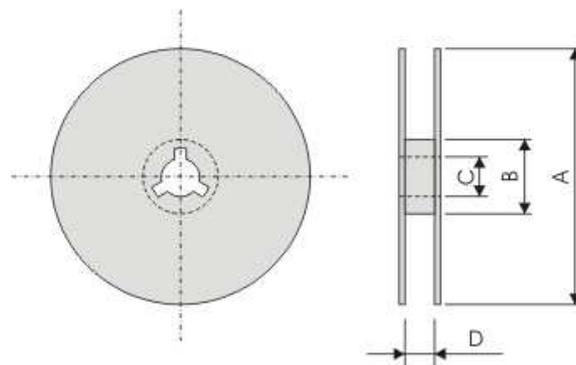
Plastic Tape specifications (unit: mm)



| Type | A | B | W | F | E |
|------|-----------|-----------|------------|----------|-----------|
| WW25 | 6.90±0.20 | 3.60±0.20 | 12.00±0.30 | 5.50±0.1 | 1.75±0.10 |
| WW18 | 4.90±0.20 | 3.55±0.30 | 12.00±0.30 | 5.50±0.1 | 1.75±0.10 |
| WW12 | 3.60±0.20 | 2.00±0.20 | 8.00±0.30 | 3.50±0.2 | 1.75±0.10 |
| WW08 | 2.40±0.20 | 1.65±0.20 | 8.00±0.30 | 3.50±0.2 | 1.75±0.10 |
| WW06 | 1.90±0.20 | 1.10±0.20 | 8.00±0.30 | 3.50±0.2 | 1.75±0.10 |

| Type | P1 | P0 | ΦD | T |
|------|-----------|-----------|---------------------------------------|-----------|
| WW25 | 4.00±0.10 | 4.00±0.10 | Φ1.50 ^{+0.1} _{-0.0} | Max. 1.2 |
| WW18 | 8.00±0.10 | 4.00±0.10 | | 1.30±0.20 |
| WW12 | 4.00±0.10 | 4.00±0.10 | | Max. 1.0 |
| WW08 | 4.00±0.10 | 4.00±0.10 | | Max. 1.0 |
| WW06 | 4.00±0.10 | 4.00±0.10 | | 0.65±0.05 |

Reel dimensions



| (unit : mm) | A | B | C | D |
|--------------|------------|-----------|----------|----------|
| WW25/ WW18 | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 14.0±0.2 |
| WW12/ 08/ 06 | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 9.0±0.5 |

Taping Quantity

- WW25 by plastic tape taping 4,000 pcs per reel.
- WW18 by plastic tape taping 3,000 pcs per reel
- WW12, WW08, WW06 by paper tape taping 5,000 pcs per reel