

APPROVAL SHEET

**SF25P, SF12P, SF10P, SF08P, SF06P,
SF04P**

±1%, ±5%

Thick Film High Power Chip Resistors

Size 2512, 1206, 1210, 0805, 0603, 0402

Automotive AECQ200 & Military Compliant

Anti-Sulfuration ASTM B-809 Compliant

RoHS 2 Compliant with exemption 7C-1

Halogen free

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

FEATURE

1. High reliability and stability $\pm 1\%$
2. Sulfuration resistant by Oil 105°C soaked with 3.5% sulphur 500hrs & ASTM B-809 105°C 1000hrs
3. Automotive grade AEC Q-200 & Military Compliant
4. 100% CCD inspection
5. RoHS 2 Compliant with exemption 7C-1 and Halogen free products

APPLICATION

- Automotive application
- Consumer electrical equipment
- EDP, Computer application
- Telecom application

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 extra protective metal film is added onto top side electrodes to protect termination from sulfuration. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to within tolerance by laser cutting 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.

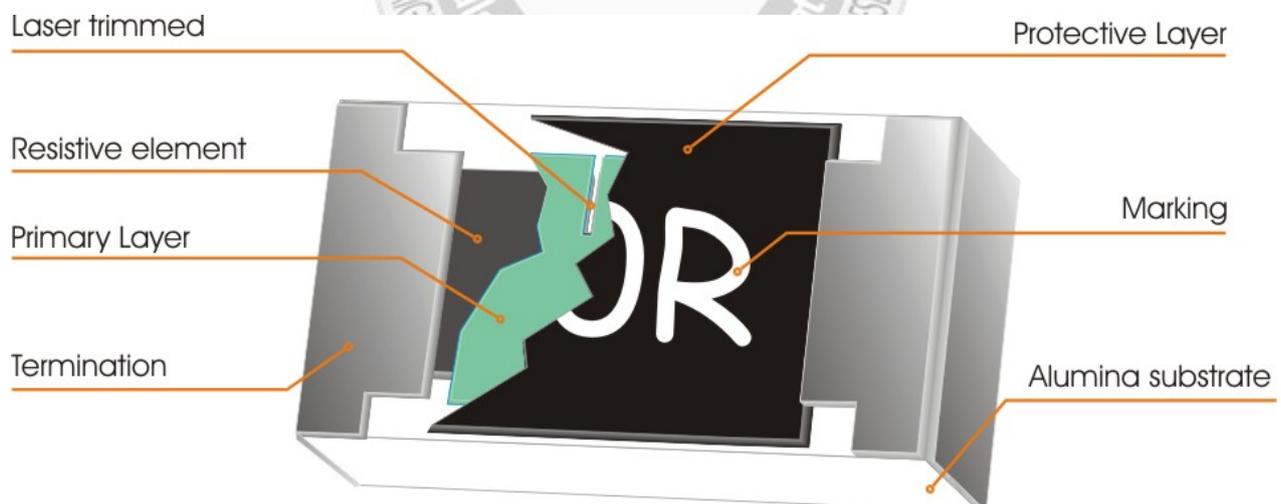


Fig 1. Construction of a Chip-R

QUICK REFERENCE DATA

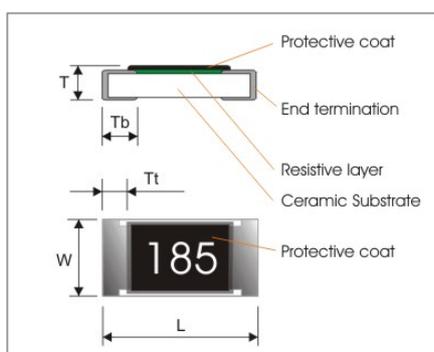
| Item | General Specification | | | | | |
|--|----------------------------|------------|------------|------------|------------|------------|
| | Series No. | SF25P | SF10P | SF12P | SF08P | SF06P |
| Size code | 2512(6432) | 1210(3225) | 1206(3216) | 0805(2012) | 0603(1608) | 0402(1005) |
| Resistance Range | 1Ω~1MΩ ,Jumper (0Ω) | | | | | |
| Resistance Tolerance | ± 1%, E96+E24 ± 5%, E24 | | | | | |
| TCR (ppm/°C) | | | | | | |
| 100Ω ~ 1MΩ | ≤ ± 100 | ≤ ± 100 | ≤ ± 100 | ≤ ± 100 | ≤ ± 100 | ≤ ± 100 |
| <100Ω | ≤ ± 200 | ≤ ± 200 | ≤ ± 200 | ≤ ± 200 | ≤ ± 200 | ≤ ± 200 |
| Max. dissipation @ T _{amb} =70°C | 2 W | 1/2W | 1/2 W | 1/4 W | 1/8 W | 1/8 W |
| Max. Operation Voltage | 250V | 200V | 200V | 150V | 75V | 50V |
| Max. Overload Voltage | 500V | 400V | 400V | 300V | 150V | 100V |
| Operation temperature | -55 ~ +155°C | | | | | |

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

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}} \text{ or Max. RCWV listed above, whichever is lower.}$$

DIMENSIONS (unit : mm)

| | SF25P | SF10P | SF12P | SF08P | SF06P | SF04P |
|-----------|-------------|------------------|------------------|---------------|-------------|-------------|
| L | 6.40 ± 0.20 | 3.20 + 0.15/-0.1 | 3.20 + 0.15/-0.1 | 2.00 ± 0.10 | 1.60 ± 0.10 | 1.00 ± 0.05 |
| W | 3.20 ± 0.20 | 2.49 ± 0.15 | 1.60 ± 0.15 | 1.25 ± 0.10 | 0.80 ± 0.10 | 0.50 ± 0.05 |
| T | 0.60 ± 0.10 | Max 0.71 | 0.605 ± 0.105 | 0.575 ± 0.075 | 0.45 ± 0.15 | 0.35 ± 0.05 |
| Tb | 0.90 ± 0.25 | 0.50 ± 0.25 | 0.50 ± 0.25 | 0.40 ± 0.25 | 0.30 ± 0.15 | 0.25 ± 0.10 |
| Tt | 0.65 ± 0.25 | 0.50 ± 0.25 | 0.50 ± 0.25 | 0.40 ± 0.25 | 0.30 ± 0.10 | 0.20 ± 0.10 |



MARKING

| | |
|---------------------------------------|--|
| Size \ Nr. Of digit of code/tolerance | $\pm 1\%$, $\pm 5\%$ |
| 2512/1210/1206/0805 | $\pm 1\%$: 4-digits marking; $\pm 5\%$: 3-digits marking |
| 0603 (1608) | 3-digits marking |
| 0402(1005) | NO MARKING |

3-digits marking (0603)

| Nominal resistance | Description | | | | | | | | | | | | | | | |
|--------------------|---|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|------|---------|--|
| E-96 series | The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value : $Y=10^{-2}$, $X=10^{-1}$, $A=10^0$, $B=10^1$, $C=10^2$, $D=10^3$, $E=10^4$, $F=10^5$ EX : 17.8 Ω =25X, 178 Ω =25A, 1K78 =25B 17K8=25C, 178K=25D, 1M78=25E | | | | | | | | | | | | | | | |
| 3. Remark | There is no marking for the items are not under E-24 and E-96 series | | | | | | | | | | | | | | | |
| CODE | R_value | CODE | R_value | CODE | R_value | CODE | R_value | CODE | R_value | CODE | R_value | CODE | R_value | CODE | R_value | |
| 01 | 100 | 13 | 133 | 25 | 178 | 37 | 237 | 49 | 316 | 61 | 422 | 73 | 562 | 85 | 750 | |
| 02 | 102 | 14 | 137 | 26 | 182 | 38 | 243 | 50 | 324 | 62 | 432 | 74 | 576 | 86 | 768 | |
| 03 | 105 | 15 | 140 | 27 | 187 | 39 | 249 | 51 | 332 | 63 | 442 | 75 | 590 | 87 | 787 | |
| 04 | 107 | 16 | 143 | 28 | 191 | 40 | 255 | 52 | 340 | 64 | 453 | 76 | 604 | 88 | 806 | |
| 05 | 110 | 17 | 147 | 29 | 196 | 41 | 261 | 53 | 348 | 65 | 464 | 77 | 619 | 89 | 825 | |
| 06 | 113 | 18 | 150 | 30 | 200 | 42 | 267 | 54 | 357 | 66 | 475 | 78 | 634 | 90 | 845 | |
| 07 | 115 | 19 | 154 | 31 | 205 | 43 | 274 | 55 | 365 | 67 | 487 | 79 | 649 | 91 | 866 | |
| 08 | 118 | 20 | 158 | 32 | 210 | 44 | 280 | 56 | 374 | 68 | 499 | 80 | 665 | 92 | 887 | |
| 09 | 121 | 21 | 162 | 33 | 215 | 45 | 287 | 57 | 383 | 69 | 511 | 81 | 681 | 93 | 909 | |
| 10 | 124 | 22 | 165 | 34 | 221 | 46 | 294 | 58 | 392 | 70 | 523 | 82 | 698 | 94 | 931 | |
| 11 | 127 | 23 | 169 | 35 | 226 | 47 | 301 | 59 | 402 | 71 | 536 | 83 | 715 | 95 | 953 | |
| 12 | 130 | 24 | 174 | 36 | 232 | 48 | 309 | 60 | 412 | 72 | 549 | 84 | 732 | 96 | 976 | |

4-digits marking (2512/1210/1206/0805)

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

Example

| RESISTANCE | 10 Ω | 12 Ω | 100 Ω | 6800 Ω | 47000 Ω |
|------------------|-------------|-------------|--------------|---------------|----------------|
| 4-digits marking | 10R0 | 12R0 | 1000 | 6801 | 4702 |

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24& E96 series for resistors with a tolerance of $\pm 0.5\%$, $\pm 0.1\%$. The values of the E24/E96 series are in accordance with "IEC publication 60063"

Derating

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

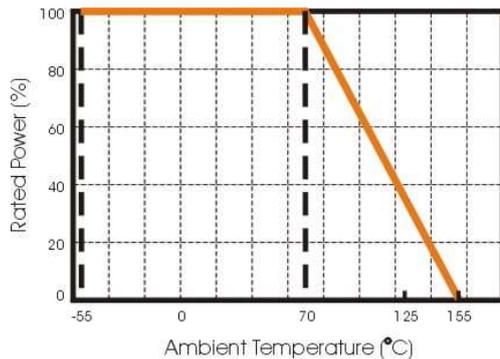


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

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.

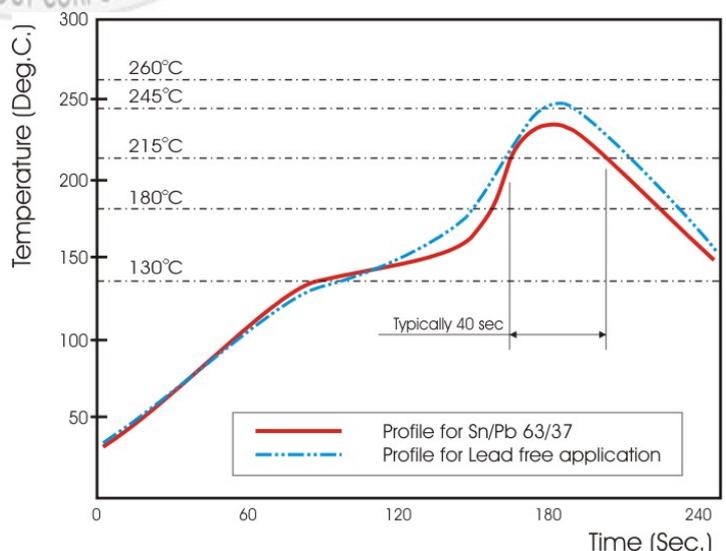


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

| SF12 | P | 1020 | F | T | P |
|---|--|---|----------------------------------|--|---|
| Automotive code | Type code | Resistance code | Tolerance | Packaging code | Termination code |
| SF25 ; 2512 SF10 : 1210 SF12 : 1206 SF08 : 0805 SF06 : 0603 SF04: 0402 | P : Power 0402 size = 1/8W 0603 size = 1/8W 0805 size = 1/4W 1206 size = 1/2W 1210 size = 1/2W 2512 size= 2W | 5%, E24: 2 significant digits followed by no. of zeros & a blank e.g.: 3ohm =3R0_ 10ohm =100_ 56Kohm =563_ (" " means a blank) 1%, E24+E96: 3 significant digits followed by No. of zeros 100Ω =1000 37.4KΩ =3742 | F : ±1% J : ±5% P : Jumper | T : 7" Reeled taping Q : 10" Reeled taping G : 13" Reeled taping B : Bulk | P = Anti-sulfur by Oil 105°C soaked with 3.5% sulphur 500hrs |

SF25:

1. Reeled tape packaging : 12mm width PC taping 4,000pcs per 7" reel

SF10, SF12, SF08, SF06:

1. Reeled tape packaging : 8mm width paper taping 5,000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging : 5,000pcs per poly-bag

SF04:

1. Reeled tape packaging : 8mm width paper taping 10,000pcs per reel,
2. Bulk packaging : 10,000pcs per poly-bag

TEST CONDITION FOR JUMPER (0Ω)

| Item | SF25P | SF10P | SF12P | SF08P | SF06P | SF04P |
|-----------------------|--------------|-------|-------|-------|-------|----------|
| Power Rating At 70°C | 2W | 1/2W | 1/2W | 1/4W | 1/8W | 1/8W |
| Resistance | MAX.20mΩ | | | | | MAX.50mΩ |
| Rated Current | 10A | 5A | 5A | 4A | 2A | 1.5A |
| Peak Current | 25A | 12.5A | 12.5A | 10A | 5A | 3.8A |
| Operating Temperature | -55 ~ +155°C | | | | | |

TEST AND REQUIREMENTS

Essentially all tests are carried out according to the schedule of IEC publication 115-8, category **LCT/UCT/56**(rated temperature range : **Lower Category Temperature, Upper Category Temperature**; damp heat, long term, 56 days). The testing also meets the requirements specified by EIA, EIAJ and JIS.

The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to IEC 60068-1, sub-clause 5.3. Unless otherwise specified, the following value supplied :

Temperature: 15°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

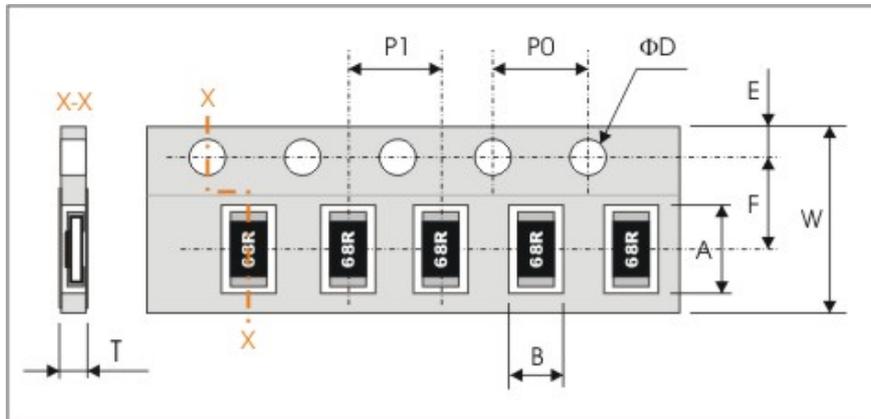
All soldering tests are performed with midly activated flux.

| TEST | PROCEDURE / TEST METHOD | REQUIREMENT | |
|---|--|---|-------|
| | | Resistor | 0Ω |
| 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%+0.05Ω) No visible damage | <50mΩ |
| 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 1 hour/ solder dipping 215°C/5sec. c) Steam the sample dwell time 1 hour/ solder dipping 260°C/ 7sec. | 95% coverage min., good tinning No visible damage | |
| Temperature cycling JESD22 method JA-104 | 1000 cycles, -55°C ~ +155°C, dwell time 5~10min | ΔR/R max. ±(0.5%+0.05Ω) No visible damage | <50mΩ |
| Moisture Resistance MIL-STD-202 method 106 | 65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle | ΔR/R max. ±(0.5%+0.05Ω) No visible damage | <50mΩ |
| Bias Humidity MIL-STD-202 method 103 | 1000+48/-0 hours; 85°C, 85% RH, 10% of operation power | ΔR/R max. ±(1.0%+0.05Ω) No visible damage | <50mΩ |
| Operational Life MIL-STD-202 method 108 | 1000+48/-0 hours; 35% of operation power, 125±2°C | ΔR/R max. ±(1.0%+0.05Ω) No visible damage | <50mΩ |

| TEST | PROCEDURE / TEST METHOD | REQUIREMENT | |
|---|---|---|-------|
| | | Resistor | 0Ω |
| 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%+0.05Ω) No visible damage | <50mΩ |
| Mechanical Shock MIL-STD-202 method 213 | 1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec | Within the specified tolerance No visible damage | <50mΩ |
| Board Flex AEC-Q200-005 | Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 10sec | ΔR/R max. ±(1.0%+0.05Ω). No visible damage | <50mΩ |
| Terminal strength AEC-Q200-006 | Pressurizing force: 1Kg, Test time: 60±1sec. | No remarkable damage or removal of the terminations | |
| Vibration MIL-STD-202 method 204 | Test 5g's for 20min., 12 cycles each of 3 orientations | ΔR/R max. ±(1.0%+0.05Ω) No visible damage | <50mΩ |
| 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%+0.05Ω) No visible damage | <50mΩ |
| ESD AEC-Q200-002 | Test contact 1.0KV (0.5KV for 0402 only) | ΔR/R max. ±(1.0%+0.05Ω) No visible damage | <50mΩ |
| Short Time Overload (STOL) JISC5201-1: 1998 Clause 4.13 | 5×Rated power or Max. Overload voltage for 5 sec. Measure the resistance after 30 minutes. | no visible damage ΔR/R max. ±(1%+0.05Ω) | <50mΩ |
| Sulfuration test | 1. Oil 105°C soaked with 3.5% sulphur , 500hrs 2. ASTM B-809 105°C 1000hrs | ΔR/R max. ±(1.0%+0.05Ω) No visible damage | <50mΩ |

PACKAGING

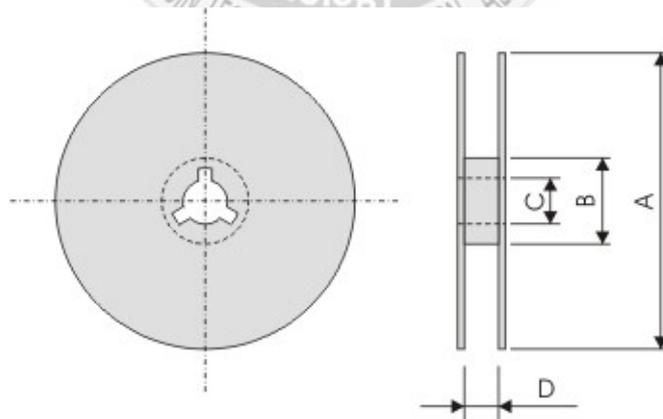
Tape specifications (unit :mm)



| Series No. | A | B | W | F | E |
|------------|-----------|-----------|------------|-----------|-----------|
| SF25P | 6.90±0.20 | 3.60±0.20 | 12.00±0.30 | 5.50±0.10 | 1.75±0.10 |
| SF10P | 3.60±0.20 | 3.00±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| SF12P | 3.60±0.20 | 2.00±0.20 | | | |
| SF08P | 2.40±0.20 | 1.65±0.20 | | | |
| SF06P | 1.90±0.20 | 1.10±0.20 | | | |
| SF04P | 1.20±0.10 | 0.70±0.10 | | | |

| Series No. | P1 | P0 | ΦD | T |
|-------------|-----------|-----------|---------------------------------------|-----------|
| SF25P | 4.00±0.10 | 4.00±0.10 | Φ1.50 ^{+0.1} _{-0.0} | Max. 1.2 |
| SF10/12/08P | | | | MAX. 1.0 |
| SF06P | | | | 0.65±0.05 |
| SF04P | | | | 0.40±0.05 |

Reel dimensions



| Symbol | A | B | C | D |
|------------|------------|-----------|----------|----------|
| 12 mm tape | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 12.4±1.0 |
| 8 mm tape | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 9.0±0.5 |