# APPROVAL SHEET

## SF25Z, SF20Z, SF10Z, SF12Z, SF08Z, SF06Z, SF04Z

## ±1.0%, ±0.5%, ±0.25%, ±0.1%, ±0.05%

## TC 5

Anti-Sulfuration Thin Film Chip Resistor

Size: 2512, 2010, 1210, 1206, 0805, 0603, 0402

RoHS Exemption free and Lead free products

Halogen free

PSA PASSIVE SYSTEM ALLIANCE
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RoHS COMPLIANT

Pb Pb-Free

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## FEATURES

1. SMD metal film resistor
2. High reliability and stability of 0.25% and below per customer request
3. High performance of TCR 5 ppm/°C and below per customer request
4. Low current noise
5. Sulfuration resistant against ASTM B-809
6. RoHS exemption free and Lead free product

## APPLICATIONS

- Medical equipment
- Measuring instrument
- Communication device
- Computer
- Printer

## 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 layer that is applied to the top surface of the substrate. The composition of the resistive layer 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 environmental soldering issue, the outer layer of these end terminations is a Lead-free solder .

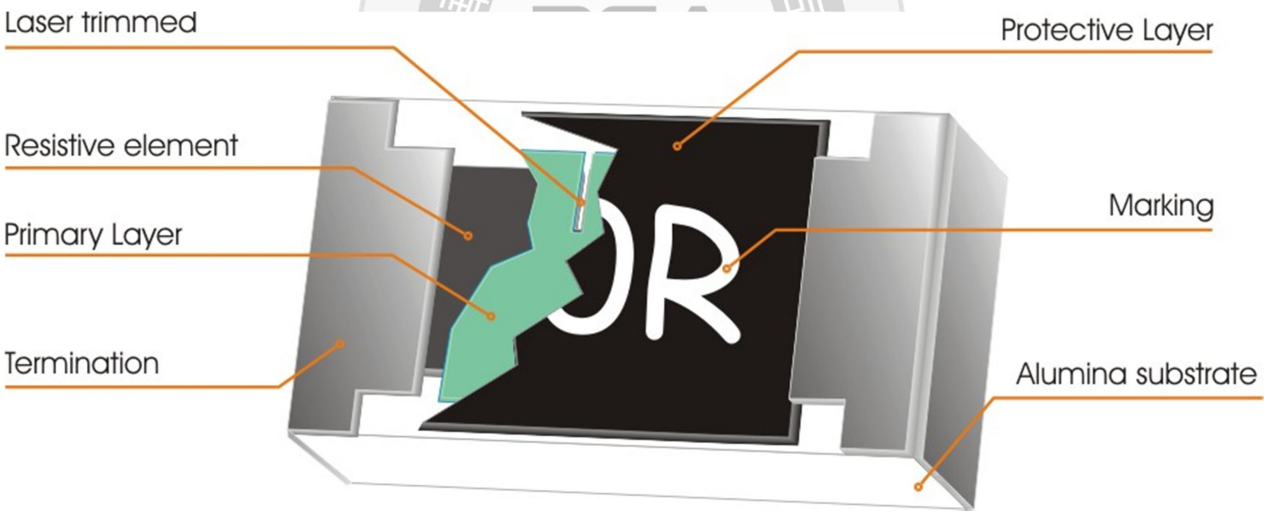



Fig 1. Construction of Chip-R SFxxZ


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## QUICK REFERENCE DATA

| Item | General Specification | | | | | | |
|---|---|---|---|---|---|---|---|
| Series No. | SF25Z | SF20Z | SF10Z | SF12Z | SF08Z | SF06Z | SF04Z |
| Size Code | 2512 (6432) | 2010 (5025) | 1210 (3225) | 1206 ( 3216 ) | 0805 ( 2012 ) | 0603 ( 1608 ) | 0402 ( 1005 ) |
| Resistance Tolerance | ±1.0%, ±0.5%, ±0.25%, ±0.1%, ±0.05% | | | | | | |
| Resistance Range | 4.7Ω ~ 600KΩ | 4.7Ω ~ 360KΩ | 4.7Ω ~ 150KΩ | 4.7Ω ~ 150KΩ | 4.7Ω ~ 100KΩ | 4.7Ω ~ 50KΩ | 10Ω ~ 10KΩ |
| TCR | ±5 ppm/°C | | | | | | |
| Max. Dissipation at $T_{amb}$=70°C | 3/4W | 1/2W | 1/4W | 1/8W | 1/10W | 1/16W | 1/16W |
| Max. Operating Voltage | 200V | 200V | 200V | 200V | 100V | 50V | 25V |
| Max. Overload Voltage | 400V | 400V | 400V | 400V | 200V | 100V | 50V |
| Operating Temperature | - 55~ +155°C | | | | | | |

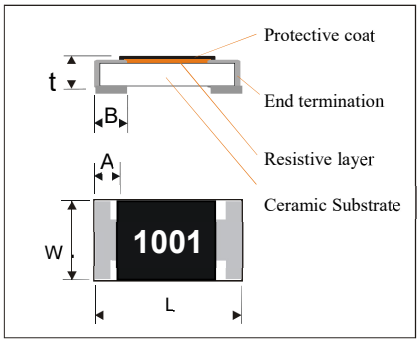
Note :

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

   $RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$ or Max. RCWV listed above, whichever is lower.
3. Tolerance : ±0.01% is upon requested

## DIMENSIONS: (unit:mm)

| Type | SF25Z | SF20Z | SF10Z | SF12Z | SF08Z | SF06Z | SF04Z |
|---|---|---|---|---|---|---|---|
| L | 6.35 ± 0.10 | 5.00 ± 0.10 | 3.10 ± 0.10 | 3.05 ± 0.15 | 2.00 ± 0.10 | 1.55 ± 0.10 | 1.00 ± 0.10 |
| W | 3.20 ± 0.15 | 2.50 ± 0.15 | 2.60 ± 0.15 | 1.55 ± 0.15 | 1.25 ± 0.10 | 0.80 ± 0.10 | 0.50 ± 0.05 |
| A | 0.60 ± 0.20 | 0.60 ± 0.20 | 0.50 ± 0.20 | 0.40 ± 0.20 | 0.25 ± 0.20 | 0.30 ± 0.15 | 0.30 ± 0.15 |
| B | 0.90 ± 0.25 | 0.60 ± 0.25 | 0.50 ± 0.20 | 0.40 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.15 | 0.30 ± 0.15 |
| t | 0.55 ± 0.10 | 0.55 ± 0.10 | 0.55 ± 0.10 | 0.55 ± 0.15 | 0.50 ± 0.15 | 0.45 ± 0.15 | 0.35 ± 0.05 |





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## CATALOGUES NUMBERS

The resistors have a catalogue number starting with .

| SF04 | Z | 1020 | D | T | L |
|---|---|---|---|---|---|
| **Size code**<br>SF25: 2512<br>SF20: 2010<br>SF10: 1210<br>SF12: 1206<br>SF08: 0805<br>SF06: 0603<br>SF04: 0402 | **Type code**<br>Z: TCR = ±5 ppm | **Resistance code**<br>E192+E24:<br>3 significant digits followed by no. of zeros<br>102Ω =1020<br>37.4KΩ =3742<br>220Ω =2200 | **Tolerance**<br>A : ±0.05%<br>B : ±0.10%<br>C : ±0.25%<br>D : ±0.50%<br>F : ±1.00% | **Packaging code**<br>T : 7" Taped & Reeled | **Termination code**<br>L : Sn base<br>(lead free) |

1. Reeled tape packaging: 8mm width paper taping.
   5,000pcs/reel for SF10, SF12, SF08, SF06
   10,000pcs/reel for SF04
2. Reeled tape packaging: 12mm width plastic taping
   4,000pcs/reel for SF25, SF20

## MARKING

- **No marking for 0402 size**
- **3 digits marking for 0603 size**

| Nominal resistance | Description |
|---|---|
| 1.E24 series | 2 significant digits followed by No. of zeros.<br>Example |

| RESISTANCE | 4.7Ω | 47Ω | 470Ω | 4K70 | 47K0 | 470K | 4M70 |
|---|---|---|---|---|---|---|---|
| 3 digits marking | 4R7 | 470 | 471 | 472 | 473 | 474 | 475 |

2.E96 series

The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value.
Repeat values between E24 and E96 series, whose marking are based on the E96 CODE table.

| Code | Z | Y | X | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|---|---|
| Multiplier | $10^{-3}$ | $10^{-2}$ | $10^{-1}$ | $10^{0}$ | $10^{1}$ | $10^{2}$ | $10^{3}$ | $10^{4}$ | $10^{5}$ | $10^{6}$ |

Example

| RESISTANCE | 1.78Ω | 17.8Ω | 178Ω | 1K78 | 17K8 | 178K | 1M78 |
|---|---|---|---|---|---|---|---|
| 3 digits marking | 25Y | 25X | 25A | 25B | 25C | 25D | 25E |

3. Remark: There is no marking for the items not under E24 and E96 series.

E96 CODE table:

| 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** |



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

For E24/E96 series, each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For values below 97Ω6 the R is used as a digit. For values of 100Ω or greater, the first 3 digits are significant, the fourth digit indicates the number of multiple to follow.

No marking for E192 series (non E24/E96 series)

**Example**

| **RESISTANCE** | 1Ω | 10Ω | 47Ω | 470Ω | 6800Ω | 47000Ω | 470000Ω | 1000000Ω |
|---|---|---|---|---|---|---|---|---|
| **4 digits marking** | 1R00 | 10R0 | 47R0 | 4700 | 6801 | 4702 | 4703 | 1004 |

# FUNCTIONAL DESCRIPTION

## Product characterization

Standard values of nominal resistance are taken from the E192 & E24 series for resistors with a tolerance of ±1.0%, ±0.5%, ±0.25%, ±0.1%, ±0.05%. The values of the E24/E192 series are in accordance with “IEC publication 60063”

## Derating

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

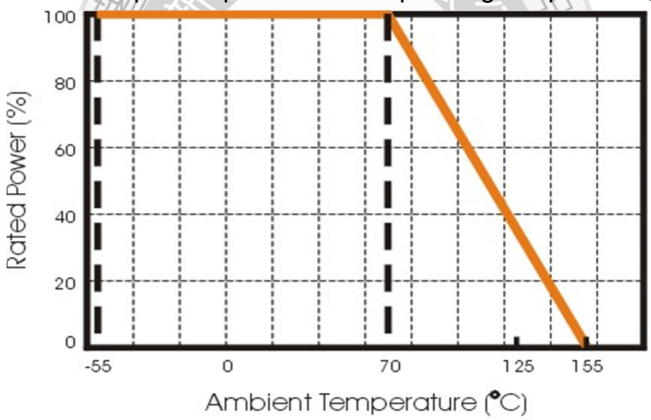



Fig.2 Maximum dissipation in percentage of rated power
As a function of the ambient temperature


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## 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 oxdization 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.

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## 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 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. Table 1.

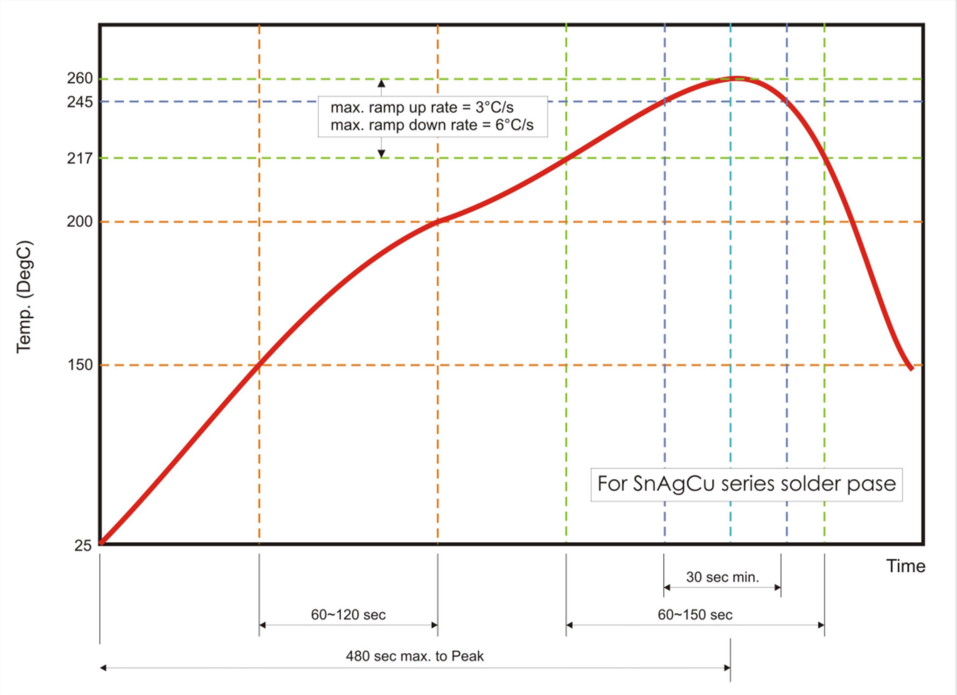



**Fig. 3 Infrared soldering profile for Chip Resistors**

**Table 1. Infrared soldering condition for Chip Resistors**

| Temperature Condition | Exposure Time |
|---|---|
| Average ramp-up rate (217°C to 260°C) | Less than 3°C/second |
| Between 150 and 200°C | Between 60-120 seconds |
| > 217°C | Between 60-150 seconds |
| Peak Temperature | 260ºC +0/-5°C |
| Time within 245°C | Min. 30 seconds |
| Ramp-down rate (Peak to 217°C) | Less than 6°C/second |
| Time from 25°C to Peak | No greater than 480 seconds |


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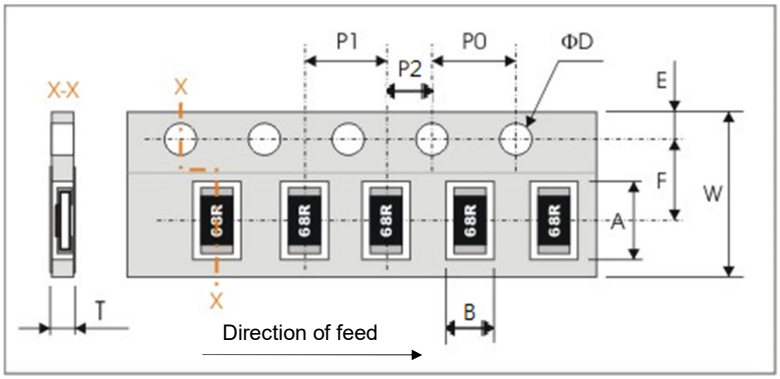
## TEST AND REQUIREMENTS(JIS C 5201-1 : 1998)

| TEST | PROCEDURE | REQUIREMENT |
|---|---|---|
| | | Resistor |
| DC resistance<br>**Clause 4.5** | DC resistance values measured at the test voltages specified below : | Within the specified tolerance |
| Temperature Coefficient of Resistance(T.C.R)<br>**Clause 4.8** | Natural resistance change per change in degree centigrade.<br>$\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C)<br>$R_1$ : Resistance at reference temperature<br>$R_2$ : Resistance at test temperature<br>$t_1$ : 20°C+5°C-1°C | Refer to " QUICK REFERENCE DATA" |
| Short time overload (S.T.O.L)<br>**Clause 4.13** | Permanent resistance change after a 5second application of a voltage 2.5 times RCWV or the maximum overload voltage specified in the above list, whichever is less. | ΔR/R max. ±(0.1%+0.05Ω) |
| Resistance to soldering heat(R.S.H)<br>**Clause 4.18** | Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260°C ±5°C | no visible damage<br>Δ R/R max. ±(0.1%+0.05Ω) |
| Solder ability<br>**Clause 4.17** | Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235°C±5°C | good tinning (>95% covered)<br>no visible damage |
| Temperature cycling<br>**Clause 4.19** | 30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C/-1°C, 30 minutes at +125°C±3°C, 2~3 minutes at 20°C+5°C/-1°C, total 5 continuous cycles | no visible damage<br>ΔR/R max. ±(0.25%+0.05Ω) |
| Load Life (Endurance)<br>**Clause 4.25** | 1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off | ΔR/R max. ±(0.25%+0.05Ω) |
| Humidity<br>**Clause 4.24** | 1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off | ΔR/R max. ±(0.25%+0.05Ω) |
| Bending strength<br>**Clause 4.33** | Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3 mm, once for 10 seconds. | ΔR/R max. ±(0.1%+0.05Ω) |
| Adhesion<br>**Clause 4.32** | Pressurizing force: 5N, Test time: 10±1sec. | No remarkable damage or removal of the terminations. |
| Insulation Resistance<br>**Clause 4.6** | Apply the maximum overload voltage (DC) for 1minute | R≧10GΩ |
| Dielectric Withstand Voltage<br>**Clause 4.7** | Apply the maximum overload voltage (AC) for 1 minute | No breakdown or flashover |
| Flower of Sulfur<br>**ASTM-B-809-95** | Sulfur 480 hours, 60°C, unpowered | ΔR/R max. ±(1.0%+0.05Ω) |


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## PACKAGING

**Tape specifications** (unit :mm)



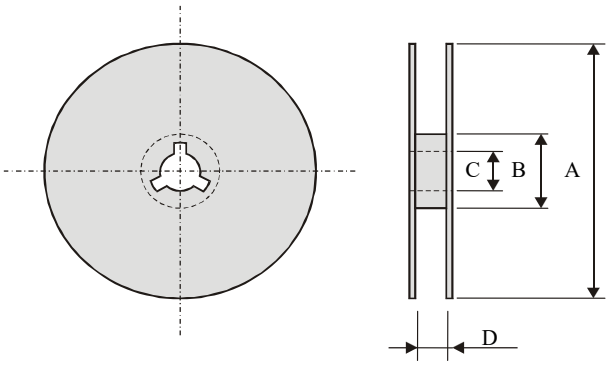

| Series No. | A | B | W | F | E |
|---|---|---|---|---|---|
| SF25 | 6.90±0.20 | 3.60±0.20 | 12.00±0.30 | 5.50±0.10 | 1.75±0.10 |
| SF20 | 5.50±0.20 | 2.80±0.20 | 12.00±0.30 | 5.50±0.10 | 1.75±0.10 |
| SF12 | 3.60±0.20 | 2.00±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| SF10 | 3.60±0.20 | 3.00±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| SF08 | 2.40±0.20 | 1.65±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| SF06 | 1.90±0.20 | 1.10±0.20 | 8.00±0.30 | 3.50±0.20 | 1.75±0.10 |
| SF04 | 1.20±0.10 | 0.7±0.10 | 8.00±0.20 | 3.50±0.05 | 1.75±0.10 |

PASSIVE SYSTEM ALLIANCE

| Series No. | P1 | P0 | P2 | ΦD | T |
|---|---|---|---|---|---|
| SF12 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | Max. 1.0 |
| SF25 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | Max 1.2 |
| SF20 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | Max 1.2 |
| SF10 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | Max. 1.0 |
| SF08 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | Max. 1.0 |
| SF06 | 4.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | 0.65±0.05 |
| SF04 | 2.00±0.10 | 4.00±0.10 | 2.00±0.10 | $\Phi 1.50^{+0.1}_{-0.0}$ | 0.45±0.05 |


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**Reel dimensions**




**SF25 , SF20**

| Symbol | A | B | C | D |
|---|---|---|---|---|
| (unit : mm) | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 14.0±0.5 |

**SF12 , SF10 , SF08 , SF06 , SF04**

| Symbol | A | B | C | D |
|---|---|---|---|---|
| (unit : mm) | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 9.0±0.5 |

**Taping quantity**

- Chip resistors 4,000 pcs per reel ( SF25, SF20 )
- Chip resistors 5,000 pcs per reel ( SF10, SF12, SF08, SF06 )
- Chip resistors 10,000 pcs per reel ( SF04 )

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