

# APPROVAL SHEET

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

**±1%, ±5%, Jumper**

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-I

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-I 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.

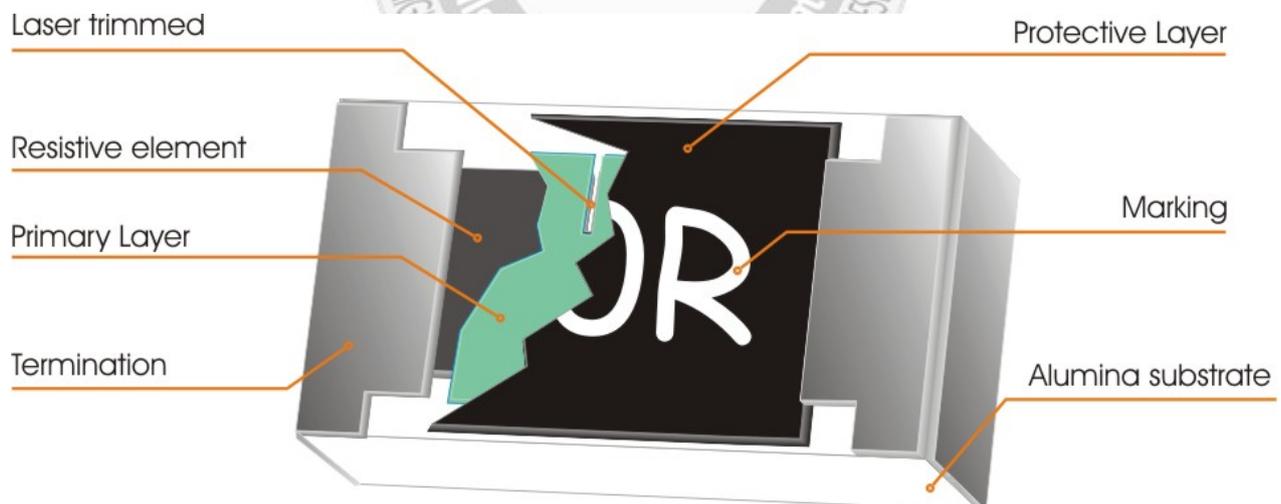


Fig 1. Construction of a Chip-R

## QUICK REFERENCE DATA

Item	General Specification					
Series No.	SF25P	SF10P	SF12P	SF08P	SF06P	SF04P
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 <sub>amb</sub> =70°C	2 W	1/2 W	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

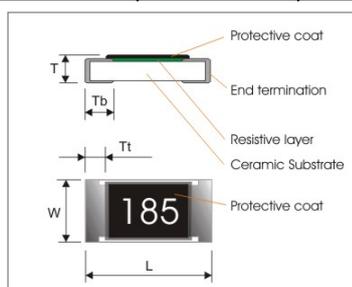
$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}} \text{ or Max. RCWV listed above, whichever is lower.}$$

### For Jumper (0Ω) :

Item	General Specification					
Series No.	SF25P	SF10P	SF12P	SF08P	SF06P	SF04P
Size code	2512(6432)	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	≤20mΩ					≤50mΩ
TCR (ppm/°C)	TCR is not applicable for Jumper product					
Max. dissipation @ T <sub>amb</sub> =70°C	2 W	1/2 W	1/2 W	1/4 W	1/8 W	1/8 W
Rated Current	10A	5A	5A	4A	2A	1.5A
Peak Current	25A	12.5A	12.5A	10A	5A	3.8A
Operation temperature	-55 ~ +155°C					

## DIMENSIONS (unit : mm)

	SF25P	SF10P	SF12P	SF08P	SF06P	SF04P
<b>L</b>	6.30 ± 0.20	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
<b>W</b>	3.10 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
<b>T</b>	0.60 ± 0.15	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.15	0.45 ± 0.10	0.35 ± 0.05
<b>Tt</b>	0.60 ± 0.25	0.50 ± 0.20	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.25 ± 0.10
<b>Tb</b>	1.80 ± 0.25	0.50 ± 0.20	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	0.20 ± 0.10



## CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

SF12	P	1020	F	T	P
<b>Automotive code</b>	<b>Type code</b>	<b>Resistance code</b>	<b>Tolerance</b>	<b>Packaging code</b>	<b>Termination code</b>
SF25 ; 2512	P : Power 2512 size= 2W	5%, E24: 2 significant digits followed by no. of zeros & a blank 3ohm =3R0_ 10ohm =100_ 56Kohm=563_ (" _ " means a blank)	F : ±1% J : ±5% P : Jumper	T :7" Reeled taping Q :10" Reeled taping G :13" Reeled taping H :13" reel 50Kpcs only for 0402 B :Bulk D :7" reel 20Kpcs only for 0402 A :7" reel 15Kpcs only for 0402	P = Anti-sulfur by Oil 105°C soaked with 3.5% sulphur 500hrs
SF10 : 1210	1210 size = 1/2W				
SF12 : 1206	1206 size = 1/2W				
SF08 : 0805	0805 size = 1/4W				
SF06 : 0603	0603 size = 1/8W				
SF04: 0402	0402 size = 1/8W	1%, E24+E96: 3 significant digits followed by No. of zeros 100Ω =1000 37.4KΩ =3742			

SF25:

1. Reeled tape packaging : 12mm width Plastic 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

## MARKING

Size \ Nr. Of digit of code\tolerance	± 1%, ±.5%
2512/1210/1206/0805	± 1%: 4 digits marking; ± 5%: 3 digits marking
0603	3 digits marking
0402	NO MARKING

Size \ Nr. Of digit of code\tolerance	Jumper (0Ω)
2512	4 digits marking
1210/1206/0805/0603	3 digits marking
0402	NO MARKING

### 3 digits marking ( ±5% 2512,1210,1206, 0805, 0603 )

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

### 3 digits marking ( ±1% 0603 )

Nominal resistance	Description																																																							
1.E24 series	2 significant digits followed by No. of zeros .As 0603 WR06X ±5% Example <table border="1"> <thead> <tr> <th>RESISTANCE</th> <th>4.7Ω</th> <th>47Ω</th> <th>470Ω</th> <th>4K70</th> <th>47K0</th> <th>470K</th> <th>4M70</th> </tr> </thead> <tbody> <tr> <td>3 digits marking</td> <td>4R7</td> <td>470</td> <td>471</td> <td>472</td> <td>473</td> <td>474</td> <td>475</td> </tr> </tbody> </table>	RESISTANCE	4.7Ω	47Ω	470Ω	4K70	47K0	470K	4M70	3 digits marking	4R7	470	471	472	473	474	475																																							
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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. <table border="1"> <thead> <tr> <th>Code</th> <th>Z</th> <th>Y</th> <th>X</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> </tr> <tr> <th>Multiplier</th> <th>10<sup>-3</sup></th> <th>10<sup>-2</sup></th> <th>10<sup>-1</sup></th> <th>10<sup>0</sup></th> <th>10<sup>1</sup></th> <th>10<sup>2</sup></th> <th>10<sup>3</sup></th> <th>10<sup>4</sup></th> <th>10<sup>5</sup></th> <th>10<sup>6</sup></th> </tr> </thead> <tbody> <tr> <td>Example</td> <td></td> </tr> <tr> <th>RESISTANCE</th> <td>1.78Ω</td> <td>17.8Ω</td> <td>178Ω</td> <td>1K78</td> <td>17K8</td> <td>178K</td> <td>1M78</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3 digits marking</td> <td>25Y</td> <td>25X</td> <td>25A</td> <td>25B</td> <td>25C</td> <td>25D</td> <td>25E</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Code	Z	Y	X	A	B	C	D	E	F	G	Multiplier	10 <sup>-3</sup>	10 <sup>-2</sup>	10 <sup>-1</sup>	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>	Example											RESISTANCE	1.78Ω	17.8Ω	178Ω	1K78	17K8	178K	1M78				3 digits marking	25Y	25X	25A	25B	25C	25D	25E			
Code	Z	Y	X	A	B	C	D	E	F	G																																														
Multiplier	10 <sup>-3</sup>	10 <sup>-2</sup>	10 <sup>-1</sup>	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>																																														
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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												
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 ( ±1% 2512,1210,1206, 0805 )

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

Example

RESISTANCE	Jumper (0Ω)	4.7Ω	10Ω	12Ω	100Ω	6800Ω	47000Ω	470000Ω
3 digits marking ±5% 2512,1210,1206, 0805, 0603 Jumper 1210,1206, 0805, 0603	000	4R7	100	120	101	682	473	474
4 digits marking ±1% 2512,1210,1206, 0805 Jumper 2512	0000	4R70	10R0	12R0	1000	6801	4702	4703

## FUNCTIONAL DESCRIPTION

### Product characterization

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

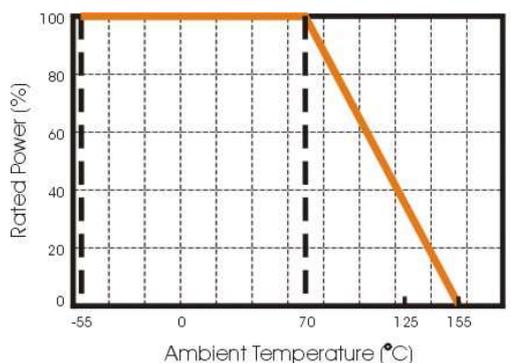


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

## 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.

### 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.

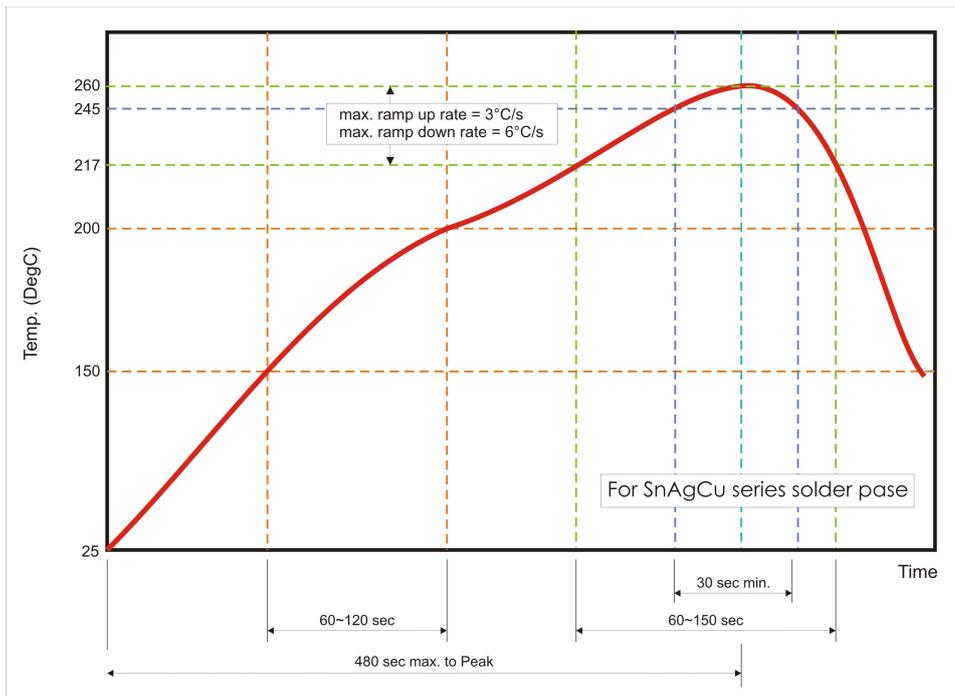


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

## TEST AND REQUIREMENTS

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).

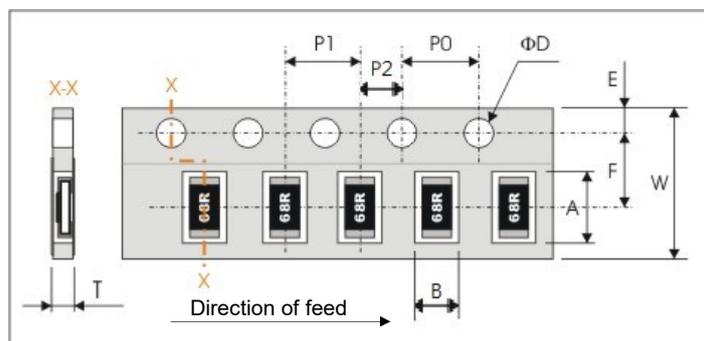
All soldering tests are performed with midly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Electrical Characteristics <b>JISC5201-1: 1998</b> Clause 4.8	- DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)} \quad t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ R <sub>1</sub> : Resistance at reference temperature R <sub>2</sub> : Resistance at test temperature	Within the specified tolerance Refer to “QUICK REFERENCE DATA”	
Resistance to soldering heat (R.S.H) <b>MIL-STD-202</b> <b>method 210</b>	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 <b>J-STD-002</b>	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 <b>JESD22</b> <b>method JA-104</b>	1000 cycles, -55°C ~ +155°C, dwell time 5~10min	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance <b>MIL-STD-202</b> <b>method 106</b>	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Bias Humidity <b>MIL-STD-202</b> <b>method 103</b>	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 <b>MIL-STD-202</b> <b>method 108</b>	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 <b>MIL-STD-202 method 108</b>	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 <b>MIL-STD-202 method 213</b>	1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec	Within the specified tolerance No visible damage	<50mΩ
Board Flex <b>AEC-Q200-005</b>	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 <b>AEC-Q200-006</b>	Pressurizing force: 1Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations	
Vibration <b>MIL-STD-202 method 204</b>	Test 5g's for 20min., 12 cycles each of 3 orientations	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Thermal shock <b>MIL-STD-202 method 107</b>	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 <b>AEC-Q200-002</b>	Test contact 1.0KV (0.5KV for 0402 only)	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Short Time Overload (STOL) <b>JISC5201-1: 1998 Clause 4.13</b>	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

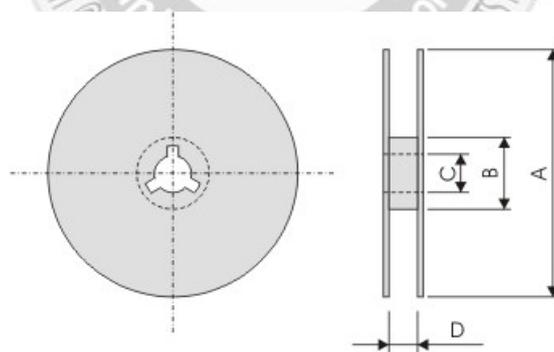
Tape specifications (unit :mm)



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	P2	ΦD	T
SF25P	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.2
SF10P/SF12P/SF08P					Max. 1.0
SF06P					0.65±0.05
SF04P					0.40±0.05

## Reel dimensions



Tape	Reel	A	B	C	D
12 mm plastic tape	7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	12.4.0±1.0
	10" reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	14.0±0.2
	13" reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	14.0±0.2
8 mm paper tape	7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5
	10" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5
	13" reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5