

# APPROVAL SHEET

**WF25A, WF20A, WF10A,  
WF12A, WF08A, WF06A, WF04A**

±1%, ±5%, Jumper

Thick Film Triple Power Chip Resistors

Size 2512 3W, 2010 1.5W, 1210 3/4W

1206 3/4W, 0805 1/2W, 0603 1/3W, 0402 1/5W

RoHS 2 Compliant with exemption 7C-I

Halogen free

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

## FEATURE

1. Small size and light weight
2. High reliability and stability
3. Reduced size of final equipment
4. High power
5. RoHS 2 Compliant with exemption 7C-I and Halogen free products
6. Flammability against UL94-V0
7. Automotive AECQ-200 Qualified

## APPLICATION

- High accuracy dc-power supply
- Digital multi-meter
- Telecommunication
- Computer
- Automotive industry
- Medical and military equipment

## 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 Tin (lead free) alloy.

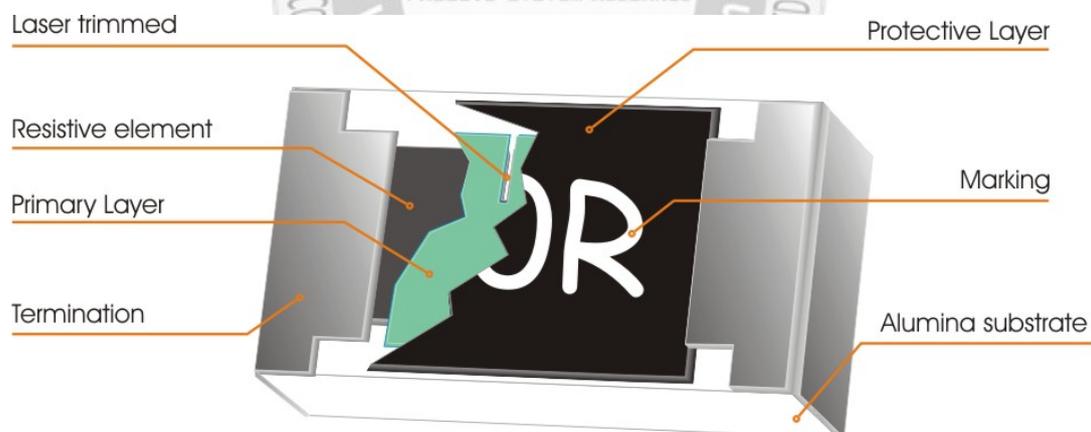


Fig 1. Construction of Chip-R

## QUICK REFERENCE DATA

Item	General Specification						
Series No.	WF25A	WF20A	WF10A	WF12A	WF08A	WF06A	WF04A
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Tolerance	±1% ( E24+E96) ±5% (E24)						
Resistance Range	1Ω ~ 1MΩ						10Ω ~ 1MΩ
TCR (ppm/°C)							
1% 10Ω~1M2Ω	±100	±100	±100	±100	±100	±100	±100
1% 1~9.76Ω	±100	±100	±100	±200	±150	±200	
TCR (ppm/°C)							
5% 1~1M2Ω	±200	±200	±200	±200	±200	±200	±100
Max. dissipation at T <sub>amb</sub> =70°C	3 W	1.5 W	3/4 W	3/4 W	1/2 W	1/3 W	1/5 W
Max. Operation Voltage	250V	250V	250V	250V	200V	75V	50V
Max. Overload Voltage	500V	500V	500V	500V	300V	125V	100V
Operation Temperature	- 55~+155°C						

Notes:

1. RCWV is Rated Voltage,  $V = \sqrt{P * R}$  or Max. Working Voltage whichever is lower.
2. V : Working Voltage(V) · P : Rated Power (W) · R : Resistance Value(Ω)
3. Please consider the resistance variance from soldering pad/trace/amount, and keep the surface temperature do not exceed 105°C when working.

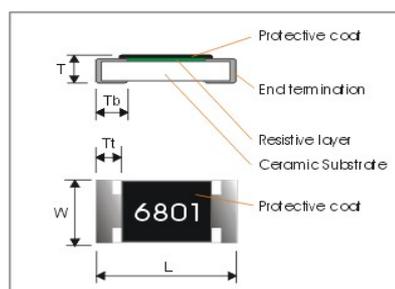
## High Current Power Jumpers (0Ω)

Item	General Specification						
Series No.	WF25A	WF20A	WF10A	WF12A	WF08A	WF06A	WF04A
Size code	2512 (6432)	2010 (5025)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)
Resistance Range	≤ 10mΩ	≤ 10mΩ	≤ 10mΩ	≤ 10mΩ	≤ 10mΩ	≤ 10mΩ	≤ 20mΩ
TCR (ppm/°C)	TCR is not applicable for Jumper product						
Max. dissipation @ T <sub>amb</sub> =70°C	3 W	1.5 W	3/4 W	3/4 W	1/2 W	1/3 W	1/5 W
Max Rated Current	14 A	12 A	9 A	9 A	7 A	6 A	3 A
Max Overload Current	28 A	24 A	18 A	18 A	14 A	12 A	6 A
Operation temperature	- 55~+155°C						

Notes:

Max.rated (Rated Current ) /Overload current (Peak Current) and resistance listed above, TCR is not applicable of Jumper products, and keep the surface temperature do not exceed 105°C when working.

## DIMENSIONS (unit : mm)



Series	WF25A	WF20A	WF10A	WF12A	WF08A	WF06A	WF04A
L	6.40 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	3.20 ± 0.25	2.50 ± 0.20	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	1.10 ± 0.20	0.60 ± 0.10	0.55 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10	0.35 ± 0.05
Tt	0.45 ± 0.25	0.65 ± 0.25	0.50 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20	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 ± 0.20	0.25 ± 0.10

## CATALOGUE NUMBERS

The resistors have a catalogue number starting with.

WF06	A	510_	J	T	L	J
<b>Size code</b>	<b>Type code</b>	<b>Resistance code</b>	<b>Tolerance</b>	<b>Packaging code</b>	<b>Termination code</b>	<b>Special code</b>
WF25: 2512 WF20: 2010 WF10: 1210 WF12: 1206 WF08: 0805 WF06: 0603 WF04: 0402	<b>A</b> : Triple Power 2512 = 3W 2010 = 1.5W 1210 = 3/4W 1206 = 3/4W 0805 = 1/2W 0603 = 1/3W 0402 = 1/5W	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	J : ±5% F : ±1% P : Jumper	T : 7" Reeled taping Z : 7" Reeled taping (WF25A)	L = Sn base (lead free)	J = AECQ-200 qualified

### ■ Reeled packaging

- WF25A 12mm width pc emboss taping 3,000pcs per 7" reel
- WF20A 12mm width pc emboss taping 4,000pcs per 7" reel
- WF10A, WF12A, WF08A, WF06A 8mm width paper taping 5,000pcs per 7" reel
- WF04A 8mm width paper taping 10,000pcs per 7" reel

## MARKING

Size \ Nr. Of digit of code\tolerance	$\pm 1\%, \pm 5\%$
2512/2010/1210/1206/0805	$\pm 1\%$ : 4 digits marking; $\pm 5\%$ : 3 digits marking
0603	3 digits marking
0402	No marking

Size \ Nr. Of digit of code\tolerance	Jumper (0 $\Omega$ )
2512/2010	4 digits marking
1210/1206/0805/0603	3 digits marking
0402	No marking

### 3 digits marking ( $\pm 5\%$ 2512,2010,1210,1206,0805,0603)

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

### 3 digits marking ( $\pm 1\%$ 0603)

Nominal resistance	Description																																						
1.E24 series	2 significant digits followed by No. of zeros .As 0603 WR06X $\pm 5\%$ Example <table border="1"> <thead> <tr> <th>RESISTANCE</th> <th>4.7<math>\Omega</math></th> <th>47<math>\Omega</math></th> <th>470<math>\Omega</math></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	4.7 $\Omega$	47 $\Omega$	470 $\Omega$	4K70	47K0	470K	4M70	3 digits marking	4R7	470	471	472	473	474	475																						
RESISTANCE	4.7 $\Omega$	47 $\Omega$	470 $\Omega$	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. <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> </thead> <tbody> <tr> <td>Multiplier</td> <td><math>10^{-3}</math></td> <td><math>10^{-2}</math></td> <td><math>10^{-1}</math></td> <td><math>10^0</math></td> <td><math>10^1</math></td> <td><math>10^2</math></td> <td><math>10^3</math></td> <td><math>10^4</math></td> <td><math>10^5</math></td> <td><math>10^6</math></td> </tr> </tbody> </table> Example <table border="1"> <thead> <tr> <th>RESISTANCE</th> <th>1.78<math>\Omega</math></th> <th>17.8<math>\Omega</math></th> <th>178<math>\Omega</math></th> <th>1K78</th> <th>17K8</th> <th>178K</th> <th>1M78</th> </tr> </thead> <tbody> <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> </tr> </tbody> </table>	Code	Z	Y	X	A	B	C	D	E	F	G	Multiplier	$10^{-3}$	$10^{-2}$	$10^{-1}$	$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$	RESISTANCE	1.78 $\Omega$	17.8 $\Omega$	178 $\Omega$	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	$10^{-3}$	$10^{-2}$	$10^{-1}$	$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$																													
RESISTANCE	1.78 $\Omega$	17.8 $\Omega$	178 $\Omega$	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												
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 ( $\pm 1\%$ 2512,2010,1210,1206,0805)

Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For values below 97.0 $\Omega$  the R is used as a digit. For values of 100 $\Omega$  or greater, the first 3 digits are significant, and the fourth digit indicates the number of multiple to follow.

#### Example

RESISTANCE	Jumper (0 $\Omega$ )	4.7 $\Omega$	10 $\Omega$	12 $\Omega$	100 $\Omega$	6800 $\Omega$	47000 $\Omega$	470000 $\Omega$
3 digits marking $\pm 5\%$ 2512,2010,1210,1206,0805,0603 Jumper 1210,1206,0805,0603	000	4R7	100	120	101	682	473	474
4 digits marking $\pm 1\%$ 2512,1210,1206,0805 Jumper 2512,2010	0000	4R70	10R0	12R0	1000	6801	4702	4703

## FUNCTIONAL DESCRIPTION

### Product characterization

Standard values of nominal resistance are taken from the E96&E24 series for resistors with a tolerance of  $\pm 1\%$ ,  $\pm 5\%$ . The values of the E96/E24 series are in accordance with "IEC publication 60063".

### Derating

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

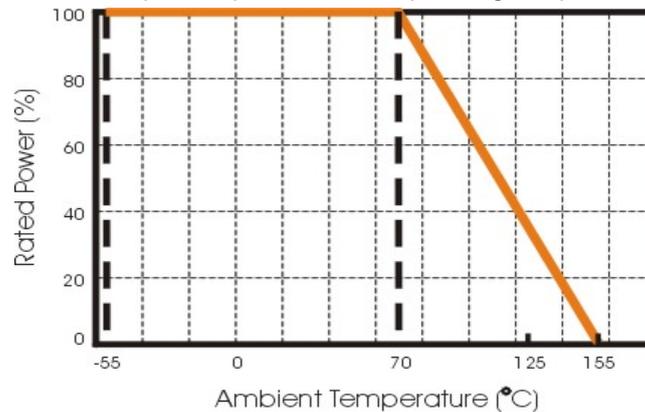


Fig.2 Maximum dissipation in percentage of rated power  
As a function of the ambient temperature

## 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.

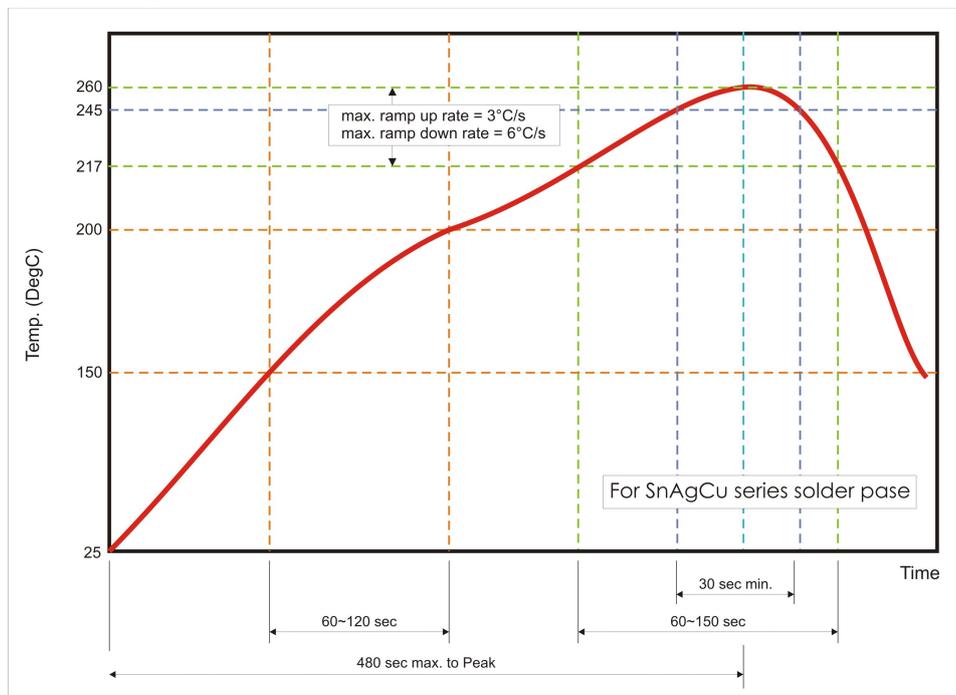
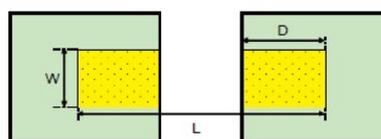


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

## RECOMMENDED SOLDERING PAD DIMENSIONS:

Series No.	W	D	L
WF25A	3.70	2.45	7.60
WF20A	3.00	1.50	6.80
WF10A	3.00	1.30	4.70
WF12A	1.80	1.30	4.70
WF08A	1.30	1.15	3.50
WF06A	0.90	1.00	3.00
WF04A	0.60	0.50	1.50

Unit: mm



## TEST AND REQUIREMENTS

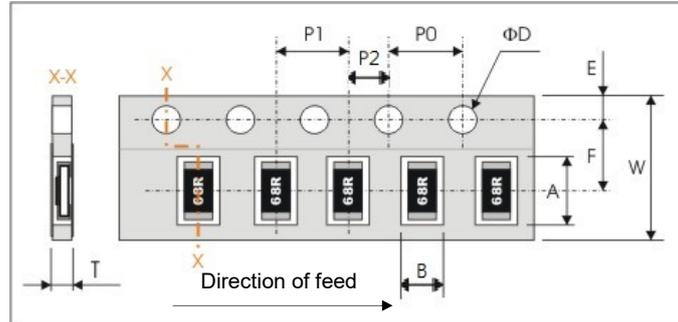
Basic Specification: AEC Q-200; IEC-60115

TEST	PROCEDURE	REQUIREMENT
<b>Clause 4.8</b> Temperature Coefficient of Resistance (TCR )	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ R <sub>1</sub> : Resistance at reference temperature R <sub>2</sub> : Resistance at test temperature t <sub>1</sub> : 25°C +1°C -1°C.	Refer to quick reference data for T.C.R specification
<b>AEC-Q200 TABLE 7.3</b> High Temperature Exposure	1000 hrs. @ T=155°C. Unpowered. Measurement at 24 ±2 hours after test conclusion.	No visible damage ΔR/R max. : ≤ ±(1%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.4</b> Temperature cycling	1000 Cycles (-55°C to +155°C). Measurement at 24±2 hours after test conclusion.	No visible damage ΔR/R max. : ≤ ±(0.5%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.</b> Moisture Resistance	Test 65°C /80~100%RH/10Cycles. Measurement at 24±2 hours after test conclusion. (t=24hrs/cycle).	No visible damage ΔR/R max. : ≤ ±(0.5%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.7</b> Bias Humidity	1000 hours 85 °C /85%RH. 10% of operating power. Measurement at 24 ±2 hours after test conclusion.	No visible damage ΔR/R max. : ≤ ±(1%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.8</b> Operation life (endurance)	Test 1000hr @ TA=125°C at specified rated power. Measurement at 24±2 hours after test conclusion.	No visible damage ΔR/R max. : ≤ ±(1%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.9</b> External Visual	Inspect device construction, marking and workmanship.	No visual damage and refer marking code.
<b>AEC-Q200 TABLE 7.10</b> Physical Dimension	Verify physical dimensions to the applicable device detail specification.	Within the spec.
<b>AEC-Q200 TABLE 7.13</b> Mechanical shock	Test Peak value:100g's,Wave:Hail-sine, Duration:6ms,Velocity:12.3ft/sec.	Within product specification tolerance and no visible damage.
<b>AEC-Q200 TABLE 7.14</b> Vibration	5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000 Hz.	No visible damage ΔR/R max. : ≤ ±(1%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ

TEST	PROCEDURE	REQUIREMENT
<b>AEC-Q200 TABLE 7.15</b> Resistance to soldering heat (R.S.H)	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 270°C ±5°C.	No visible damage ΔR/R max. : ≤ ±(0.5%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.16</b> Thermal shock	-55 to 155 °C / dwell time 15min/ Max transfer time 20sec/ 300cycles.	No visible damage ΔR/R max. : ≤ ±(0.5%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200-002</b> ESD	Test contact min. 1KV. (0.5KV for 0402 only)	No visible damage ΔR/R max. : ≤ ±(1%+0.1Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.18</b> Solderability	a)Baking 155°C 4H, dipping 235°C 5s b)Steam 8H, dipping 215°C 5s c)Steam 8H, dipping 260°C 7s.	Good tinning (>95% covered) No visible damage
<b>AEC-Q200 TABLE 7.20</b> Flammability	UL-94 V-0 or V-1 are acceptable	Refer UL-94.
<b>AEC-Q200 TABLE 7.21</b> Board flex	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending 2mm 2512.2010.1210.1206, 3mm 0805.0603,0402	No visible damage ΔR/R max. : ≤ ±(0.5%+0.05Ω) 0402 Jumper : ≤ 20mΩ Others Jumper : ≤ 10mΩ
<b>AEC-Q200 TABLE 7.22</b> Terminal strength	Force 1.8 Kg (0402 for 1.0kg) for 60 seconds.	No mechanical damage

## PACKAGING

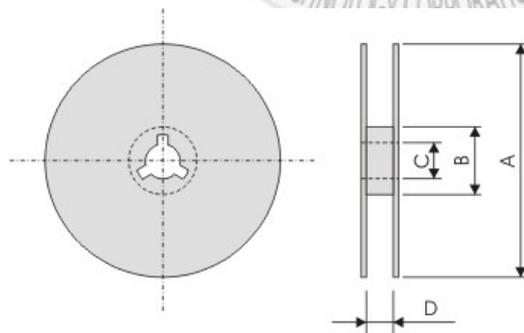
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WF25A	6.70±0.20	3.50±0.20	12.00±0.30	5.50±0.05	1.75±0.10
WF20A	5.50±0.20	2.80±0.20	12.00±0.30	5.50±0.05	1.75±0.10
WF10A	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.05	1.75±0.10
WF12A	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.05	1.75±0.10
WF08A	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.05	1.75±0.10
WF06A	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.05	1.75±0.10
WF04A	1.20±0.10	0.70±0.10	8.00±0.30	3.50±0.20	1.75±0.10

Series No.	P1	P0	P2	ΦD	T
WF25A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.50
WF20A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.00
WF10A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.00
WF12A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.00
WF08A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 1.00
WF06A	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	Max. 0.80
WF04A	2.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub>	0.40±0.05

## Reel dimensions



unit: mm

Symbol	A	B	C	D
7" 8mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0+1/-0
7" 12mm tape	Φ178.0±2.0	Φ60.0±1.0	13.0±0.5	13.8±1.5