

APPROVAL SHEET

WF12G, WF08G, WF06G, WF04G

$\pm 1\%$, $\pm 5\%$, $11\text{M}\Omega \sim 100\text{M}\Omega$

Thick Film High Ohm Chip Resistors
Size 1206, 0805, 0603, 0402

RoHS 2 Compliant with exemption 7C-I
Halogen free

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

FEATURES

1. Small size and light weight
2. High reliability and stability
3. Reduced size of final equipment
4. Higher component and equipment reliability
5. RoHS 2 compliant with exemption 7C-I and Halogen free products

APPLICATIONS

- Power supply
- PDA
- Digital meter
- Computer
- Palmtop computers

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 Tin (lead free) alloy.

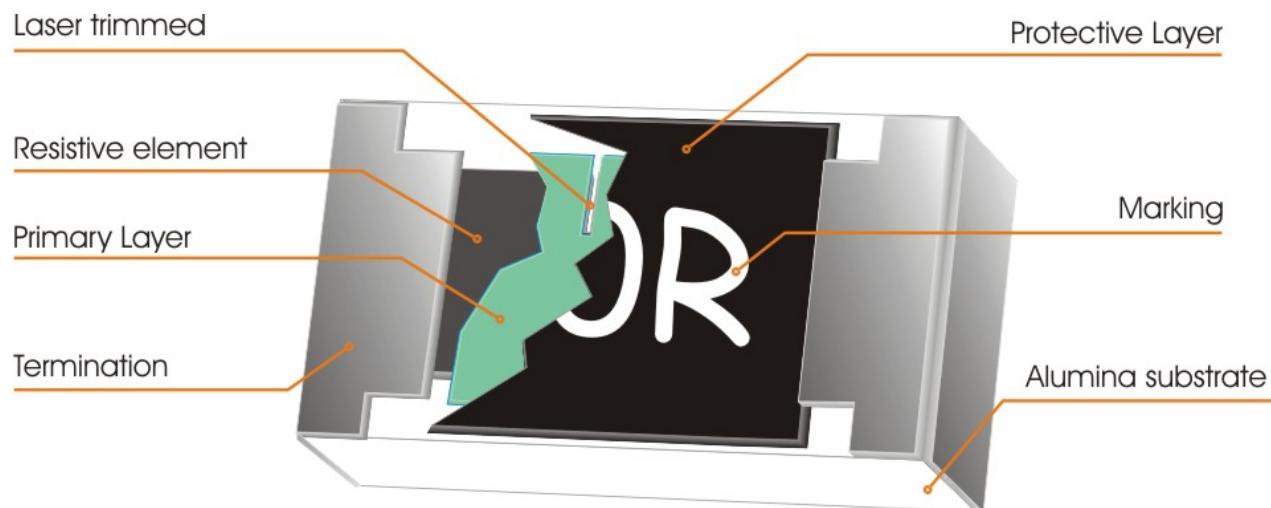


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification			
Series No.	WF12G	WF08G	WF06G	WF04G
Size code	1206 (3216)	0805 (2125)	0603 (1608)	0402 (1005)
Resistance Tolerance	$\pm 1\%$, $\pm 5\%$			
Resistance Range	$10M\Omega < R \leq 100M\Omega$		$10M\Omega < R \leq 30M\Omega$ (E24 series)	
TCR (ppm/ $^{\circ}$ C)	$\leq \pm 200$ ppm/ $^{\circ}$ C		$\leq \pm 300$ ppm/ $^{\circ}$ C	
Max. dissipation at $T_{amb}=70^{\circ}$ C	1/4 W	1/8 W	1/10 W	1/16W
Max. Operation Voltage (DC or RMS)	200V	150V	50V	50V
Climatic category (IEC 60068)	55/155/56			

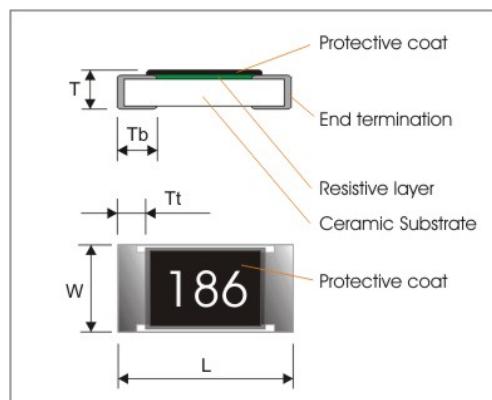
Note :

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

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

DIMENSIONS(unit : mm)

series	WF12G	WF08G	WF06G	WF04G
L	3.10 ± 0.15	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	1.60 ± 0.15	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
Tt	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10
Tb	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
T	0.55 ± 0.10	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05



CATALOGUE NUMBERS

The resistors have a catalogue number starting with :

WF06	G	226_	J	T	L
Size code WF12 : 1206 WF08 : 0805 WF06 : 0603 WF04 : 0402	Type code G : High ohmic >10MΩ	Resistance code 5% E24 : 2 significant digits followed by no. of zeros and a blank 11MΩ =116_ 22MΩ =226_ 30MΩ =306_ 100 MΩ =107_ (" " means a blank) 1%, E24+E96 : 3 significant digits followed by no. of zeros 11M0Ω =1105 15.8MΩ =1585 100 MΩ =1006	Tolerance J : ±5% F : ±1%	Packaging code T : 7" Reeled taping B : Bulk	Termination code L = Sn base (lead free)

1. Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel for 1206, 0805, 0603 (10,000pcs for 0402)
2. Bulk packaging : 5000pcs per polybag

MARKING

Size \ Nr. Of digit of code\tolerance	±5%	±1%
1206 (3216)	3 digits marking	4 digits marking
0805 (2012)	3 digits marking	4 digits marking
0603 (1608)	3 digits marking	3 digits marking
0402 (1005)	NO MARKING	

3 digits marking (±5% : 1206, 0805, 0603)

Each resistor is marked with a three digits code on the protective coating to designate the nominal resistance value.
2 significant digits followed by No. of zeros.

3 digits marking (±1% : 0603)

Nominal resistance	Description																																																					
1.E24 series	2 significant digits followed by No. of zeros . Example																																																					
	<table border="1"> <thead> <tr> <th>RESISTANCE</th><th>12MΩ</th><th>16MΩ</th><th>18MΩ</th><th>22MΩ</th><th>24MΩ</th><th>27MΩ</th><th>30MΩ</th><th>33MΩ</th><th>91MΩ</th></tr> </thead> <tbody> <tr> <td>3 digits marking</td><td>126</td><td>166</td><td>186</td><td>226</td><td>246</td><td>276</td><td>306</td><td>336</td><td>916</td></tr> </tbody> </table>										RESISTANCE	12MΩ	16MΩ	18MΩ	22MΩ	24MΩ	27MΩ	30MΩ	33MΩ	91MΩ	3 digits marking	126	166	186	226	246	276	306	336	916																								
RESISTANCE	12MΩ	16MΩ	18MΩ	22MΩ	24MΩ	27MΩ	30MΩ	33MΩ	91MΩ																																													
3 digits marking	126	166	186	226	246	276	306	336	916																																													
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^{-3}</th><th>10^{-2}</th><th>10^{-1}</th><th>10^0</th><th>10^1</th><th>10^2</th><th>10^3</th><th>10^4</th><th>10^5</th><th>10^6</th></tr> </thead> <tbody> <tr> <td>RESISTANCE</td><td>11MΩ</td><td>13MΩ</td><td>15.8MΩ</td><td>17.4MΩ</td><td>19.1MΩ</td><td>20MΩ</td><td>75MΩ</td><td>90.9MΩ</td><td>100MΩ</td><td></td></tr> <tr> <td>3 digits marking</td><td>05F</td><td>12F</td><td>20F</td><td>24F</td><td>28F</td><td>30F</td><td>85F</td><td>93F</td><td>01G</td><td></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	11MΩ	13MΩ	15.8MΩ	17.4MΩ	19.1MΩ	20MΩ	75MΩ	90.9MΩ	100MΩ		3 digits marking	05F	12F	20F	24F	28F	30F	85F	93F	01G	
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	11MΩ	13MΩ	15.8MΩ	17.4MΩ	19.1MΩ	20MΩ	75MΩ	90.9MΩ	100MΩ																																													
3 digits marking	05F	12F	20F	24F	28F	30F	85F	93F	01G																																													
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 ($\pm 1\%$: 1206,0805)

Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. The first 3 digits are significant, and the fourth digit indicates the number of multiple to follow.

Example

RESISTANCE		11MΩ	12MΩ	15.8MΩ	47MΩ	90.9MΩ	100MΩ
		11X10 ⁶ Ω	12X10 ⁶ Ω	15.8X10 ⁶ Ω	47X10 ⁶ Ω	90.9X10 ⁶ Ω	10X10 ⁷ Ω
		110X10 ⁵ Ω	120X10 ⁵ Ω	158X10 ⁵ Ω	470X10 ⁵ Ω	909X10 ⁵ Ω	100X10 ⁶ Ω
		11000000Ω	12000000Ω	15800000Ω	47000000Ω	90900000Ω	100000000Ω
±5% E24	3 digits marking (1206, 0805, 0603 ±5%)	116	126	-	476	-	107
±1% E24 & E96	4 digits marking (1206, 0805 ±1%)	1105	1205	1585	4705	9095	1006

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 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

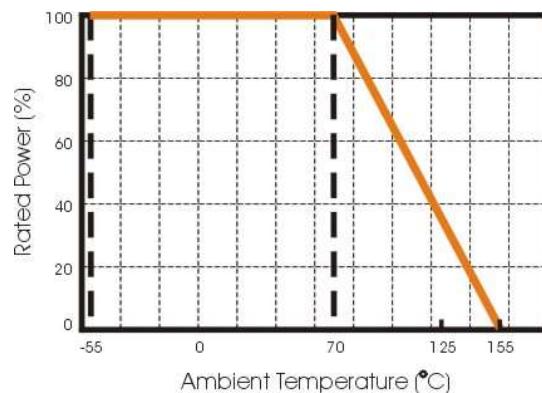


Figure 2. Maximum dissipation in percentage of rated power

As a function of the ambient temperature

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 below. WF04G is not guaranteed with wave soldering process due to its 0402 size.

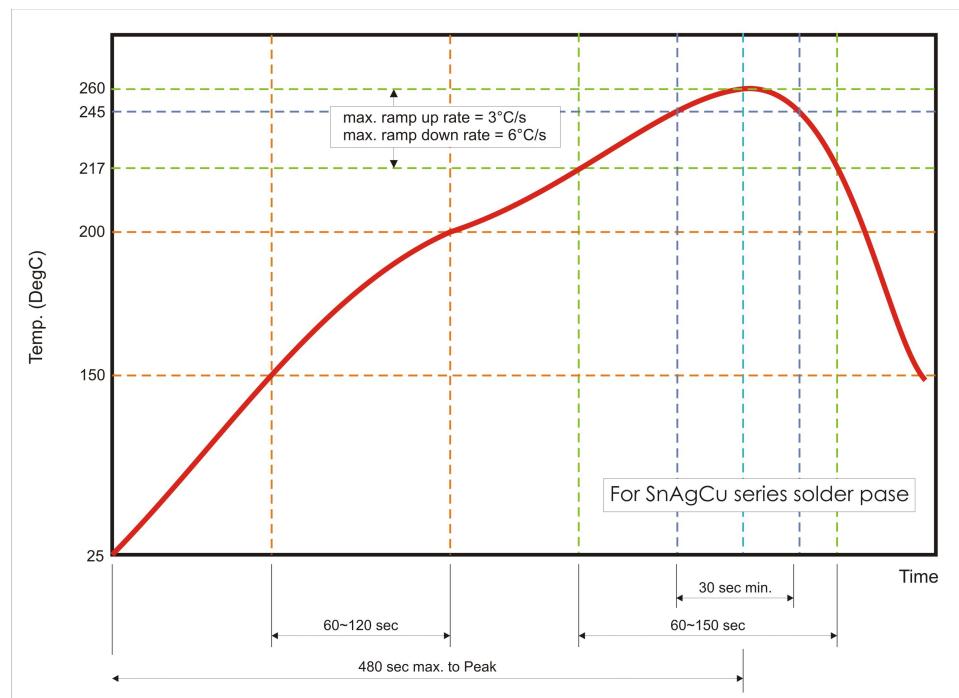


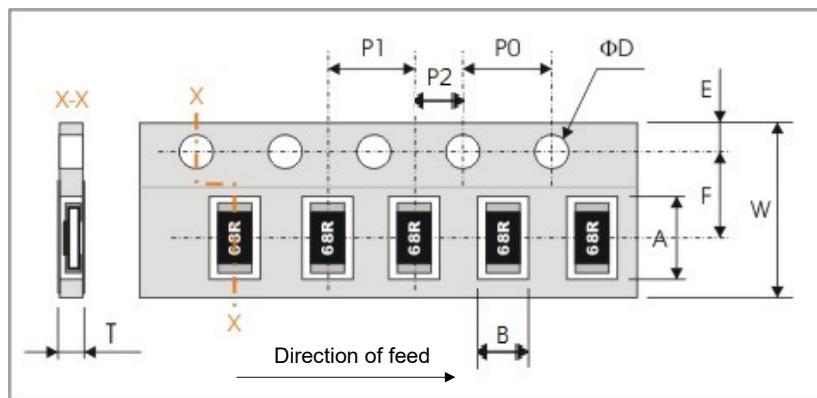
Fig 3. Recommended IR reflow soldering profile for
SMT process with SnAgCu series solder paste

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

TEST	PROCEDURE	REQUIREMENT
Temperature Coefficient of Resistance (T.C.R) Clause 4.8	<p>Natural resistance change per change in degree centigrade.</p> $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^{\circ}\text{C)}$ <p>R₁ : Resistance at reference temperature R₂ : Resistance at test temperature t₁ : 20°C+5°C-1°C t₂ : Test temperature.</p>	Refer to quick reference data for T.C.R specification.
Short time overload (S.T.O.L) Clause 4.13	Permanent resistance change after a 5 second application of a voltage 2.5xU _R or max. Overload voltage, whichever is less.	No visible damage. ΔR/R max. J: $\leq \pm(2\%+0.1\Omega)$ F: $\leq \pm(1\%+0.05\Omega)$
Solderability 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) no visible damage
Resistance to soldering heat(R.S.H) Clause 4.18	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260°C ±5°C	No visible damage. ΔR/R max. J: $\leq \pm(1\%+0.1\Omega)$ F: $\leq \pm(0.5\%+0.05\Omega)$
Temperature cycling Clause 4.19	<ol style="list-style-type: none"> 30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C-1°C, 30 minutes at +155°±3°C, 2~3 minutes at 20°C+5°C-1°C, <p>Total 5 continuous cycles.</p>	No visible damage. ΔR/R max. J: $\leq \pm(1\%+0.1\Omega)$ F: $\leq \pm(0.5\%+0.05\Omega)$
Load life (endurance) 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	No visible damage. ΔR/R max. J: $\leq \pm(3\%+0.1\Omega)$ F: $\leq \pm(1\%+0.05\Omega)$
Load life in Humidity 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	No visible damage. ΔR/R max. J: $\leq \pm(3\%+0.1\Omega)$ F: $\leq \pm(1\%+0.05\Omega)$
Bending strength Clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3 mm, once for 10 seconds	ΔR/R max. $\leq \pm(1\%+0.10\Omega)$
Adhesion Clause 4.32	Pressurizing force: 5N, Test time: 10±1sec.	No remarkable damage or removal of the terminations.
Insulation Resistance Clause 4.6	Apply the maximum overload voltage (DC) for 1minute	R: $\geq 10G\Omega$
Dielectric Withstand Voltage Clause 4.7	Apply the maximum overload voltage (AC) for 1 minute	No breakdown or flashover

PACKAGING

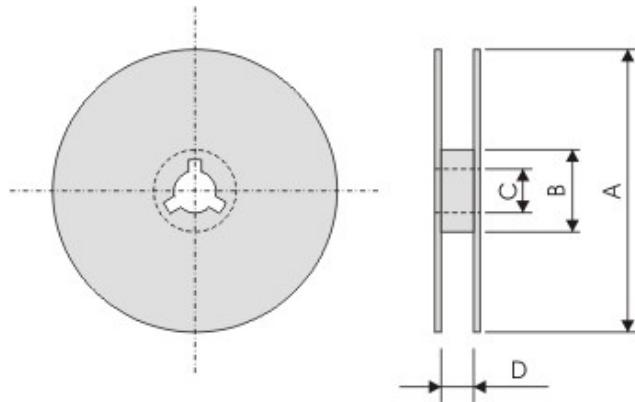
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WF12G	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.2	1.75±0.10
WF08G	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.2	1.75±0.10
WF06G	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.2	1.75±0.10
WF04G	1.20±0.10	0.70±0.10	8.00±0.30	3.50±0.2	1.75±0.10

Series No.	P1	P0	P2	ΦD	T
WF12G	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0 0.65±0.1 0.45±0.05
WF08G	4.00±0.10	4.00±0.10	2.00±0.10		
WF06G	4.00±0.10	4.00±0.10	2.00±0.10		
WF04G	2.00±0.10	4.00±0.10	2.00±0.10		

Reel dimensions



Symbol	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0±0.2	9.0±0.5

Taping quantity

- Chip resistors 5,000 pcs/reel for 1206, 0805, 0603 (10,000 pcs/reel for 0402)