APPROVAL SHEET

WF06P, WF08P, WF12P, WF10P, WF20P, WF25P

±1%, ±5% 0Ω, 1Ω~1MΩ

Thick film High Power Chip Resistors

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

(Automotive Grade)

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

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FEATURE

1. Automotive grade AEC Q-200 compliant
2. 100% CCD inspection
3. RoHS compliant and Lead free products
4. High power rating

APPLICATION

1. High accuracy dc-power supply
2. Digital multi-meter
3. Telecommunication
4. Computer
5. Automotive industry
6. 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.

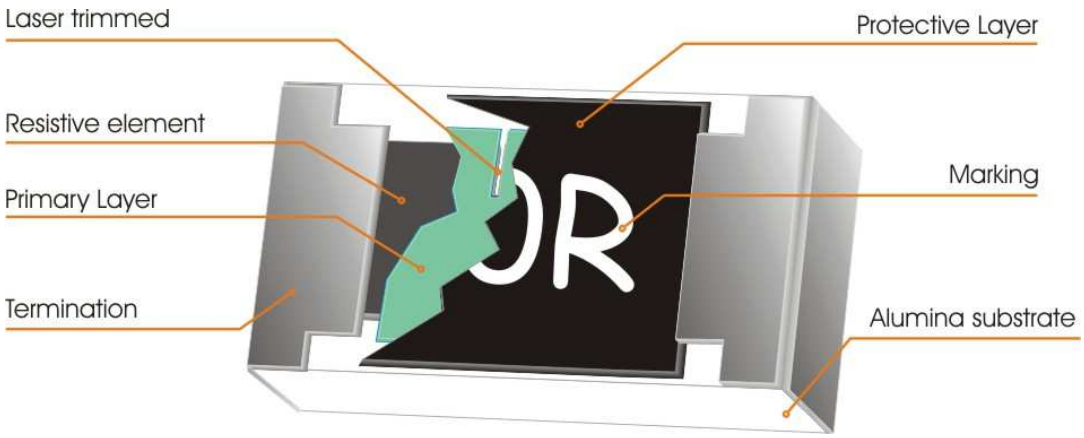


Fig 1. Construction of Chip-R

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QUICK REFERENCE DATA

Item	General Specification					
Series No.	WF06P	WF08P	WF12P	WF10P	WF20P	WF25P
Size code	0603 (1608)	0805 (2012)	1206 (3216)	1210 (3225)	2010 (5025)	2512 (6432)
Resistance Tolerance	±1%, ±5%					
Resistance Range	0Ω,1Ω~ 1MΩ (E96+E24 series)					
TCR (ppm/°C) 20°C ~ +155°C 10.2Ω ~ 1MΩ 1Ω ~ 10Ω TCR (ppm/°C) 20°C ~ - 55°C 10.2Ω ~ 1MΩ 1Ω ~ 10Ω	 ≤ ± 100 ≤ ± 100 ≤ ± 100 ≤ ± 150	 ≤ ± 100 ≤ ± 100 ≤ ± 100 ≤ ± 150	≤ ± 100	≤ ± 100 ≤ ± 200 ≤ ± 100 ≤ ± 200	≤ ± 100	
Max. dissipation at T_{amb}=70°C	1/8 W	1/4 W	1/2W	1/2W	1W	2W
Max. Operation Voltage	50V	150V	200V	200V	200V	300V
Max. Overload Voltage	100V	300V	400V	400V	400V	500V
Operation temperature	-55 ~ +155'C					

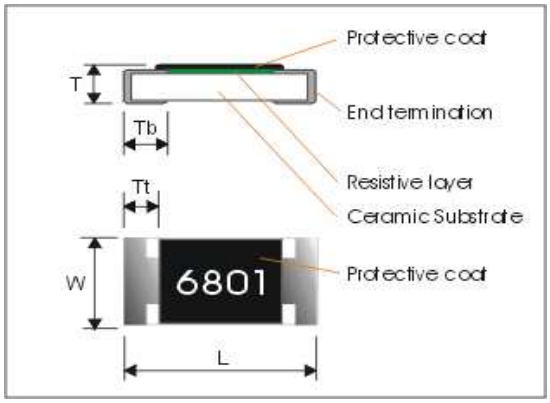
Note :

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.

DIMENSIONS (unit : mm)

Part No	WF06P	WF08P	WF12P	WF10P	WF20P	WF25P
L	1.60 ± 0.10	2.00 ± 0.10	3.10 ± 0.15	3.10 ± 0.10	5.00 ± 0.20	6.30 ± 0.20
W	0.80 ± 0.10	1.25 ± 0.10	1.60 ± 0.15	2.60 ± 0.10	2.50 ± 0.20	3.10 ± 0.20
T	0.45 ± 0.15	0.50 ± 0.15	0.55 ± 0.10	0.55 ± 0.10	0.60 ± 0.10	0.60 ± 0.15
Tt	0.30 ± 0.10	0.40 ± 0.20	0.50 ± 0.25	0.50 ± 0.20	0.60 ± 0.25	0.60 ± 0.25
Tb	0.30 ± 0.15	0.40 ± 0.20	0.50 ± 0.25	0.50 ± 0.20	0.60 ± 0.25	1.80 ± 0.25



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MARKING

Size \ Nr. Of digit of code\ tolerance	±5%	±1%
2512 (6432)	3-digits marking	4-digits marking
2010 (5025)	3-digits marking	4-digits marking
1210 (3225)	3-digits marking	4-digits marking
1206 (3216)	3-digits marking	4-digits marking
0805 (2012)	3-digits marking	4-digits marking
0603 (1608)	3-digits marking	3-digits marking

3-digits marking（±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（±1% : 0603）

Nominal resistance	Description
1.E-24 series	As *0603 WR06X* ±5%.
2.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 : 17.8Ω=25X，178Ω=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（±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.

Example

RESISTANCE	10Ω	12Ω	100Ω	6800Ω	47000Ω
3-digits marking（1206 & 0805 & 0603 ±5% ）	100	120	101	682	473
4-digits marking	10R0	12R0	1000	6801	4702

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FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96&E24 series for resistors with a tolerance of ±1%,±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

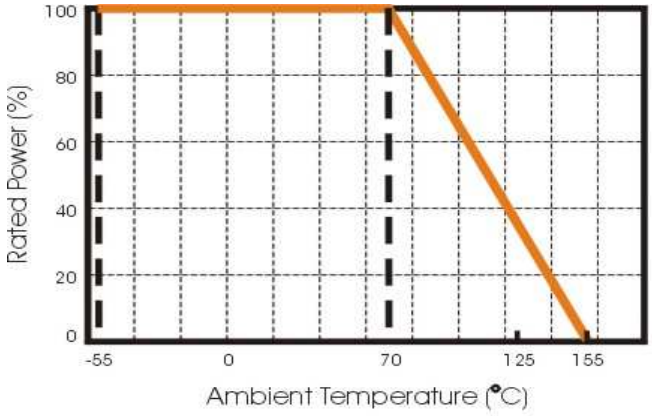


Fig.2 Maximum dissipation in percentage of rated power
As a function of the ambient temperature

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.

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.

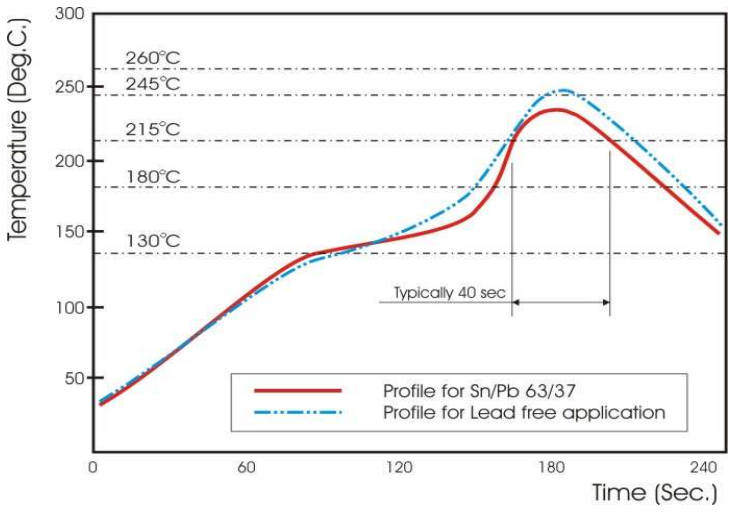


Fig 3. Infrared soldering profile for Chip Resistors

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CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WF08	P	1002	F	T	L	J
Size code WF06: 0603 WF08: 0805 WF12: 1206 WF10: 1210 WF20: 2010 WF25: 2512	**Type code** P :Power 0603 size = 1/8W 0805 size = 1/4W 1206 size = 1/2W 1210 size = 1/2W 2010 size = 1W 2512 size = 2W	Resistance code 5%, E24: 2 significant digits followed by No. of zeros e.g.: 3ohm =3R0 10ohm =100 56Kohm =563 1%, E24+E96: 3 significant digits followed by No. of zeros 100Ω =1000 37.4KΩ =3742	**Tolerance** J : ±5% F : ±1% P : Jumper	**Packaging code** T: 7" Reeled taping .	**Termination code** L = Sn base (lead free)	**Special code** **J =** Automotive grade and Anti-Sulfuration 10ppm x 240hrs

- Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel for 0603-1210 sizes.
- Reeled tape packaging : 12mm width plastic taping 4000pcs per 7" reel for 2010, 2512 sizes.

TEST CONDITIONS FOR JUMPER (0 Ω)

Item	WF25P	WF20P	WF12P	WF10P	WF08P	WF06P
Power Rating At 70°C	2W	1W	1/2W	1/2W	1/4W	1/8W
Resistance	Max. 20mΩ					
Rated Current	10A	7A	5A	5A	3.5A	2.5A
Peak Current	25A	17.5A	12.5A	12.5A	8.8A	6.2A
Operating Temperature	-55 ~ +155°C					

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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 : **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; 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, subclause 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
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20℃+5℃-1℃ 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℃±5°C	ΔR/R max. ±(1.0%+0.05Ω) no visible damage
Solderability **J-STD-002**	a) Bake the sample for 155℃ dwell time 4hrs/ solder dipping 235℃/ 5sec. b) Steam the sample dwell time 8 hour/ solder dipping 215℃/ 5sec. c) Steam the sample dwell time 8 hour/ solder dipping 260℃/ 7sec.	95% coverage min., good tinning and no visible damage
Temperature cycling **JESD22** **Method JA-104**	1000 cycles, -55℃ ~ +155℃, dwell time 30min maximum.	ΔR/R max. ±(1.0%+0.05Ω) No visible damage
Moisture Resistance **MIL-STD-202 method 106**	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(1.0%+0.05Ω) No visible damage
Bias Humidity **MIL-STD-202 method 103**	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(2.0%+0.10Ω) No visible damage
Operational Life **MIL-STD-202 method 108**	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(2.0%+0.1Ω) No visible damage
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. ±(2.0%+0.10Ω) No visible damage
Board Flex **AEC-Q200-005**	Resistors mounted on a 90mm glass epoxy resin PCB(FR4),bending once 2mm for 60sec.	ΔR/R max. ±(1.0%+0.05Ω) No visible damage

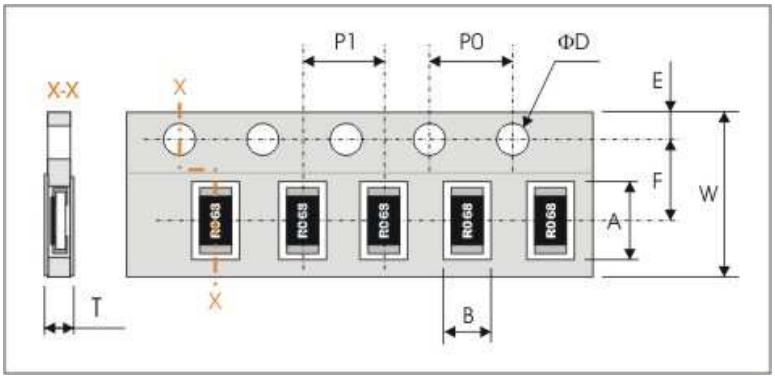
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Terminal strength **AEC-Q200-006**	Pressurizing force: 1Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations
Thermal shock **MIL-STD-202** **method 107**	Test –55 to 155℃/ dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(1.0%+0.05Ω) No visible damage
ESD **AEC-Q200-002**	Test contact 1.0KV (0.5KV for 0402 only)	ΔR/R max. ±(1.0%+0.05Ω) No visible damage
Mechanical Shock **MIL-STD-202** **method 213**	Test ½ Sine Pulse, Peak value: 100g, normal duration: 6ms, Velocity change:12.3ft/sec. Three shocks in each direction, total 18 shocks.	Within product specification tolerance and no visible damage.
Vibration **MIL-STD-202** **method 204**	Test 5g's for 20 min., 12 cycles each of 3 orientations.	△R/R max. ±(1%+0.05Ω) and no visible damage
Resistance to Solvents : **MIL-STD-202** **Method 215**	Solvent is Isopropyl alcohol, immersion 3mins at 25℃ and brush 10 strokes with a toothbrush with a handle made of a non-reactive material (wet bristle), immersion and brush 3 times and then air blow dry.	No superficial defect on marking, encapsulation, coating, appearance. Electrical characteristics within products specification and tolerance. Inspect at 3X max. for marking, inspect at 10X for part damage.
External Visual **MIL-STD-883** **method 2009**	Electrical test not required. Inspect device construction, marking and workmanship	No visual damage and refer WTC marking code.
Physical Dimension **JESD22** **method JB-100**	Verify physical dimensions(L, W, T, Tb, Tt)	Within the specified tolerance for WTC.

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PACKAGING

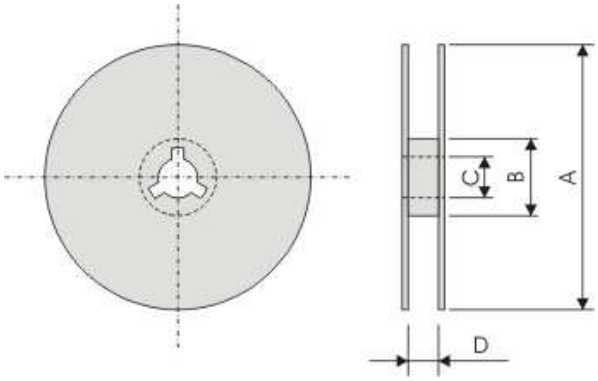
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WF25P	6.90±0.20	3.20±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WF20P	5.50±0.20	2.80±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WF10P	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF12P	3.60±0.20	2.00±0.20			
WF08P	2.40±0.20	1.65±0.20			
WF06P	1.90±0.20	1.10±0.20			

Series No.	P1	P0	ΦD	T
WF25P	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.2
WF20P				Max. 1.2
WF10P				Max. 1.0
WF12P				Max. 1.0
WF08P				Max. 1.0
WF06P				0.65±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

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