

APPROVAL SHEET

Thin Film High Precision Chip Resistors

WF Series

Size 2512, 2010, 1210, 1206, 0805, 0603, 0402, 0201

Tolerance $\pm 1\%$, $\pm 0.5\%$, $\pm 0.25\%$, $\pm 0.1\%$, $\pm 0.05\%$

TCR $\pm 50\text{ppm}$, $\pm 25\text{ppm}$, $\pm 15\text{ppm}$, $\pm 10\text{ppm}$, $\pm 5\text{ppm}$

RoHS Compliant

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

FEATURES

1. SMD metal film resistor
2. High reliability and stability of 0.1% per customer request
3. Full product range from 0201 ~ 2512 size
4. Full TCR range from 50 ~ 5ppm
5. Low current noise
6. $\pm 0.05\%$ is available upon the customer request.
7. RoHS compliant with complete lead free

APPLICATION

- Medical equipments
- Testing & Measuring instruments
- Communication devices Base station, AP Router,
- Power supply & Server
- High end audio system

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 .

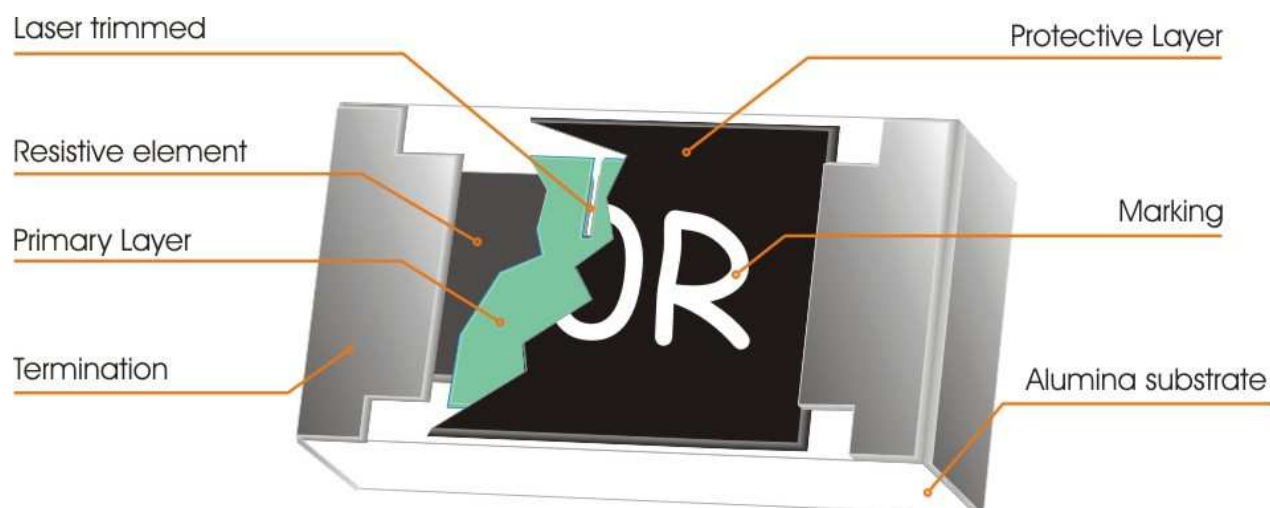


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

TYPE	Operation temperature	Rated power	MWV *1	MOV *2	DWV *3	TCR ppm/C	Resistance Range (E24+E192) & Tolerance				
							±0.05%	±0.1%	±0.25%	±0.5%	±1%
WF02 (0201)	-55 °C / +125°C	1/20W (±0.5%)	15V	30V	30V	±50	-	100-1K	-	47-10K	-
		1/30W (±0.1%)				±25	-	100-1K	-	47-5K	-
WF04 (0402)	-55 °C / +155°C	1/16W	25V	50V	50V	±50	10-100K	10-100K	10-100K	10-100K	10-100K
						±25	10-100K	10-100K	10-100K	10-100K	10-100K
						±15	25-20K	25-20K	25-20K	-	-
						±10	25-20K	25-20K	25-20K	-	-
						±5	25-8K	25-8K	25-8K	-	-
WF06 (0603)	-55 °C / +155°C	1/16W 1/10W Hi-power	50V 75V	100V 150V	100V 150V	±50	4.7-680K	4.7-680K	4.7-680K	4.7-680K	4.7-680K
						±25	4.7-680K	4.7-680K	4.7-680K	4.7-680K	4.7-680K
						±15	25-100K	25-100K	25-100K	-	-
						±10	25-100K	25-100K	25-100K	-	-
						±5	25-40K	25-40K	25-40K	-	-
WF08 (0805)	-55 °C / +155°C	1/10W 1/8W Hi-power	100V 150V	200V 300V	200V 300V	±50	4.7-1M	4.7-1M	4.7-1M	4.7-1M	4.7-1M
						±25	4.7-1M	4.7-1M	4.7-1M	4.7-1M	4.7-1M
						±15	25-200K	25-200K	25-200K	-	-
						±10	25-200K	25-200K	25-200K	-	-
						±5	25-80K	25-80K	25-80K	-	-
WF12 (1206)	-55 °C / +155°C	1/8W 1/4W Hi-power	200V	400V	400V	±50	4.7-1M	4.7-1M	4.7-1M	4.7-1M	4.7-1M
						±25	4.7-1M	4.7-1M	4.7-1M	4.7-1M	4.7-1M
						±15	25-300K	25-300K	25-300K	-	-
						±10	25-300K	25-300K	25-300K	-	-
						±5	25-120K	25-120K	25-120K	-	-
WF10 (1210)	-55 °C / +155°C	1/4W 2/5W Hi-power	200V	400V	400V	±50	10-1M	10-1M	10-1M	10-1M	10-1M
						±25	10-1M	10-1M	10-1M	10-1M	10-1M
WF20 (2010)	-55 °C / +155°C	1/2W 3/4W Hi-power	200V	400V	400V	±50	10-1.5M	10-1.5M	10-1.5M	10-1.5M	10-1.5M
						±25	10-1.5M	10-1.5M	10-1.5M	10-1.5M	10-1.5M
WF25 (2512)	-55 °C / +155°C	3/4W 1W Hi-power	200V	400V	400V	±50	10-1.5M	10-1.5M	10-1.5M	10-1.5M	10-1.5M
						±25	10-1.5M	10-1.5M	10-1.5M	10-1.5M	10-1.5M

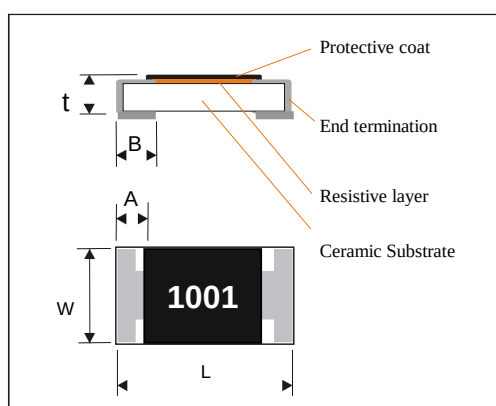
1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8" ! Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

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

2. *1 MWV = Max. Working Voltage; *2 MOV = Max. Overload Voltage; *3 DWV = Dielectric Withstand Voltage

DIMENSIONS:(unit:mm)

Type	SIZE	L	W	t	A	B
WF25	2512	6.35 ± 0.10	3.20 ± 0.15	0.55 ± 0.10	0.60 ± 0.20	0.50 ± 0.20
WF20	2010	5.00 ± 0.10	2.50 ± 0.15	0.55 ± 0.10	0.60 ± 0.20	0.50 ± 0.20
WF10	1210	3.10 ± 0.10	2.60 ± 0.15	0.55 ± 0.10	0.50 ± 0.20	0.50 ± 0.20
WF12	1206	3.10 ± 0.10	1.60 ± 0.10	0.60 ± 0.15	0.45 ± 0.20	0.45 ± 0.20
WF08	0805	2.00 ± 0.10	1.25 ± 0.10	0.50 ± 0.15	0.25 ± 0.20	0.40 ± 0.20
WF06	0603	1.55 ± 0.10	0.80 ± 0.10	0.45 ± 0.15	0.25 ± 0.15	0.30 ± 0.15
WF04	0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.25 ± 0.10
WF02	0201	0.60 ± 0.03	0.30 ± 0.03	0.23 ± 0.03	0.10 ± 0.05	0.15 ± 0.05



MARKING

- 3-digits marking for 0603 size**

WF has same marking rule as WR.

3-digits marking ($\pm 1\%$: 0603)

Nominal resistance				Description											
1.E-24 series				As 0603 WR06X $\pm 5\%$.											
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 : 17.8 Ω =25X, 178 Ω =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 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 non E24/E96 series, no marking is applied!

Example

RESISTANCE	10 Ω	12 Ω	100 Ω	6800 Ω	47000 Ω
4-digits marking	10R0	12R0	1000	6801	4702

- No marking code for 0402/ 0201 size**

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E192 & E24 series for resistors with a tolerance of $\pm 1\%$, $\pm 0.5\%$, $\pm 0.25\%$, $\pm 0.1\%$, $\pm 0.05\%$. 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

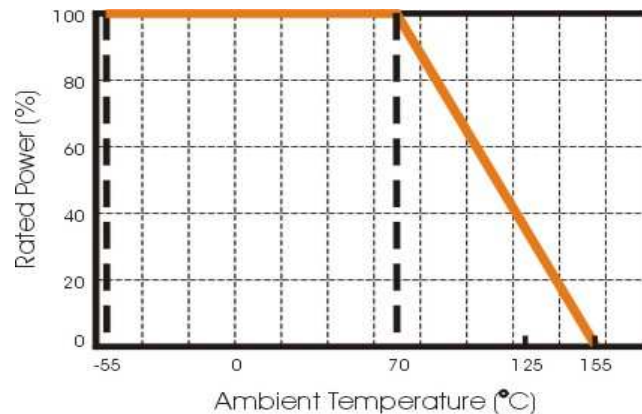
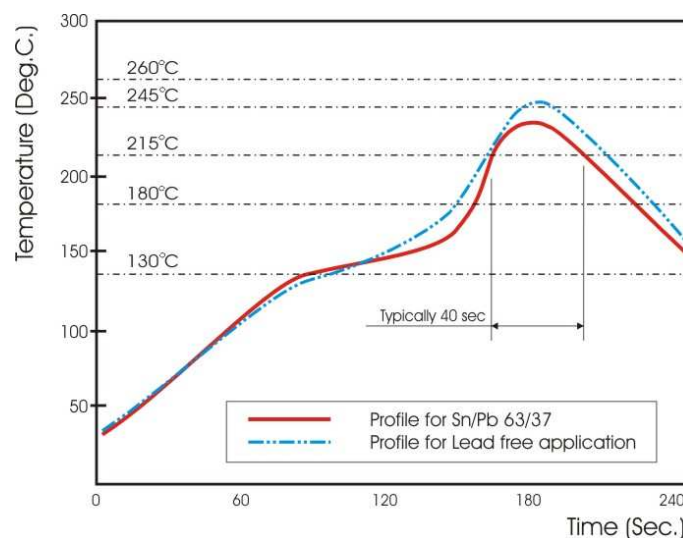


Fig.2 Maximum dissipation in percentage of rated power
As a function of the ambient temperature

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.



CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WF06	R	xxxx	B	T	L
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code
WF25: 2512	T: TCR 50	E192+E24:	F : $\pm 1.0\%$	T : 7" RL	L = Sn base (lead free)
WF20: 2010	Q: TCR 50	3 significant digits followed by no. of zeros	D : $\pm 0.5\%$	A : 7" RL	
WF10: 1210	Hi-power		C: $\pm 0.25\%$	15,000pcs/RL	
WF12: 1206	U: TCR 25	102 Ω =1020	B : $\pm 0.1\%$		
WF08: 0805	R: TCR 25:	37.4K Ω =3742	A : $\pm 0.05\%$		
WF06: 0603	Hi-power	220 Ω =2200			
WF04: 0402	F: TCR 15				
WF02: 0201	W: TCR 10				
	Z: TCR 5				

1. Reeled tape packaging: 8mm width paper taping.

5,000pcs/reel for WF10, WF12, WF08, WF06; 10,000pcs/reel for WF04; 15,000pcs/reel for WF02

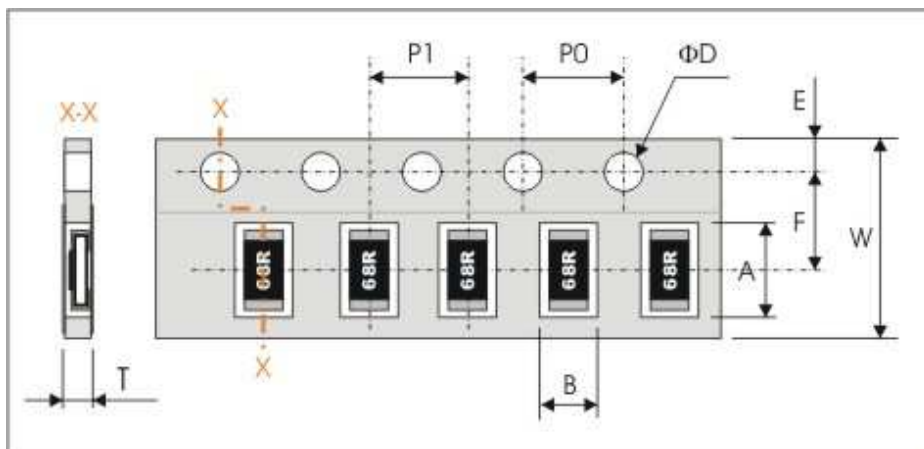
2. Reeled tape packaging : 12mm width plastic taping, 4,000pcs/reel for WF25, WF20

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

TEST	PROCEDURE	REQUIREMENT
		Resistor
DC resistance Clause 4.5	DC resistance values measured at the test voltages specified below : <10Ω@0.1V, <100Ω@0.3V, <1KΩ@1.0V, <10KΩ@3V, <100KΩ@10V, <1MΩ@25V, <10MΩ@30V	Within the specified tolerance
Temperature Coefficient of Resistance(T.C.R) Clause 4.8	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ R ₁ : Resistance at reference temperature R ₂ : Resistance at test temperature t ₁ : 20°C±5°C-1°C t ₂ : 125°C±5°C-1°C	Refer to "QUICK REFERENCE DATA"
Short time overload (S.T.O.L) 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.	For TCR50/25, ΔR/R max. ±(0.2%+0.05Ω) For TCR15/10/5, ΔR/R max. ±(0.1%+0.05Ω)
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 Δ R/R max. ±(0.1%+0.05Ω)
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
Temperature cycling Clause 4.19	30 minutes at -55°C±3°C, 2~3 minutes at 20°C±5°C-1°C, 30 minutes at +155°C±3°C, 2~3 minutes at 20°C±5°C-1°C, total 5 continuous cycles	no visible damage For TCR50/25, ΔR/R max. ±(0.2%+0.05Ω) For TCR15/10/5, ΔR/R max. ±(0.1%+0.05Ω)
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	For TCR50/25, ΔR/R max. ±(0.5%+0.05Ω) For TCR15/10/5, ΔR/R max. ±(0.25%+0.05Ω)
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	For TCR50/25, ΔR/R max. ±(0.5%+0.05Ω) For TCR15/10/5, ΔR/R max. ±(0.25%+0.05Ω)
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. ±(0.1%+0.05Ω)
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 ≥ 10GΩ
Dielectric Withstand Voltage Clause 4.7	Apply the maximum overload voltage (AC) for 1 minute	No breakdown or flashover

PACKAGING

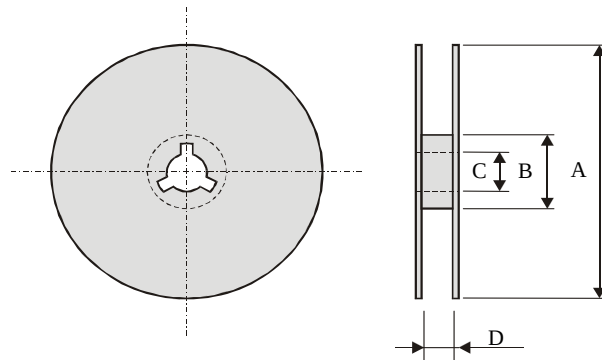
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WF25	6.90±0.20	3.60±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WF20	5.50±0.20	2.80±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WF10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF12	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF08	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF06	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF04	1.20±0.10	0.7±0.10	8.00±0.30	3.50±0.05	1.75±0.10
WF02	0.67±0.05	0.37±0.05	8.00±0.20	3.50±0.20	1.75±0.10

Series No.	P1	P0	ΦD	T
WF25	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	MAX1.2
WF20	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	MAX1.2
WF10	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	Max. 1.0
WF12	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	Max. 1.0
WF08	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	Max. 1.0
WF06	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	0.65±0.05
WF04	2.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	0.40±0.05
WF02	2.00±0.05	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	0.45±0.05

Remark: Plastic tape for WF25, WF20; Paper tape for WF10, WF12, WF08, WF06, WF04, WF02.



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 4,000 pcs per reel (WF25, WF20)
- Chip resistors 5,000 pcs per reel (WF10, WF12, WF08, WF06)
- Chip resistors 10,000 pcs per reel (WF04)
- Chip resistors 15,000 pcs per reel (WF02)
-