

APPROVAL SHEET

WR12, WR08, WR06, WR04, WR02

$\pm 1\%$, $\pm 5\%$

General purpose chip resistors

Size 1206, 0805, 0603, 0402, 0201

Customer : _____

Approval No : _____

Issue Date : _____

Customer Approval :



FEATURE

1. High reliability and stability
2. Reduced size of final equipment
3. Lower assembly costs
4. Higher component and equipment reliability
5. Lead free products upon customer requested

APPLICATION

- Consumer electrical equipment
- Automotive application
- 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 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 Lead-tin or Tin (lead free) alloy.

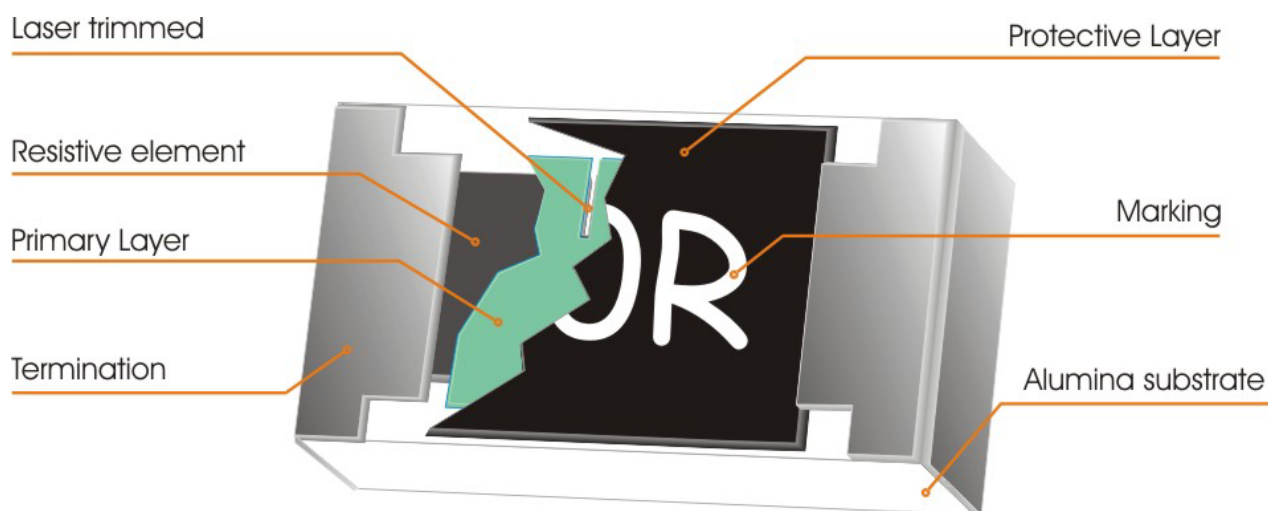


Fig 1. Construction of a Chip-R

**QUICK REFERENCE DATA**

Item	General Specification									
Series No.	WR12		WR08		WR06		WR04		WR02	
Size code	1206(3216)		0805(2012)		0603(1608)		0402(1005)		0201(0603)	
Resistance Range	1Ω~10MΩ(±5% tolerance),10Ω~1MΩ(±1% tolerance), Jumper									
Resistance Tolerance	±1% (E96)	±5% (E24)	±1% (E96)	±5% (E24)	±1% (E96)	±5% (E24)	±1% (E96)	±5% (E24)	±1% (E96)	±5% (E24)
TCR (ppm/°C)										
R≥1MΩ		≤ ± 200		≤ ± 200		≤ ± 200		-300~+500		
1MΩ > R > 10Ω	≤ ± 100	≤ ± 200	≤ ± 100	≤ ± 200	≤ ± 100	≤ ± 200	≤ ± 200	≤ ± 200	≤ ± 300	
R≤10Ω	-300~+500	-300~+500	-300~+500	-300~+500	-300~+500	-300~+500	-300~+500	-300~+500		
Max. dissipation @ T _{amb} =70°C	1/4 W		1/8 W		1/10 W		1/16 W		1/20 W	
Max. Operation Voltage (DC or RMS)	200V		150V		50V		50V		15V	
Max. Overload Voltage (DC or RMS)	400V		300V		100V		100V		30V	
Climatic category (IEC 60068)	55/155/56								55/125/56	

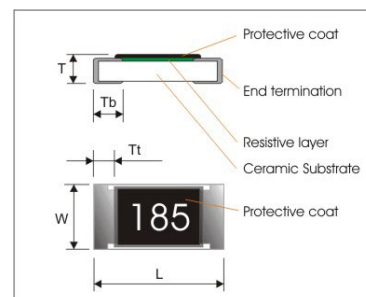
Note :

- 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

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}} \text{ or Max. RCWV listed above, whichever is lower.}$$
- The resistance range 1~10Ω and 1M ~10MΩ with 1% tolerance please refer to WR12W / WR08W / WR06W series.
- The resistance of Jumper is defined <0.05Ω.

DIMENSIONS (unit : mm)

	WR12	WR08	WR06	WR04	WR02
L	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05	0.60 ± 0.03
W	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05	0.30 ± 0.03
T	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05	0.25 ± 0.05
Tb	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10	0.15 ± 0.05
Tt	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10	0.15 ± 0.05



**MARKING**

Size \ Nr. Of digit of code\tolerance	$\pm 5\%$	$\pm 1\%$
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	
0201(0603)		

3-digits marking ($\pm 5\%$: 1206 & 0805 & 0603)

Each resistor is marked with a three digits code on the protective coating to designate the nominal resistance value. For values up to 91Ω the R is used as a decimal point. For values of 100Ω or greater the first 3 digits apply to the resistance value and fourth indicate the number of zeros to follow.

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 : $17.8\Omega=25X$, $178\Omega=25A$, $1K78=25B$ $17K8=25C$, $178K=25D$, $1M78=25E$											
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** ($\pm 1\%$: 1206/0805)

Each resistor is marked with a four digits code on the protective coating to designate the nominal resistance value. For values of $<97.6\Omega$ the R is used as a decimal point. For values of 100Ω or greater the first 3 digits are significant, the fourth indicates the number of zeros to follow.

Example

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

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.2.1~2.2

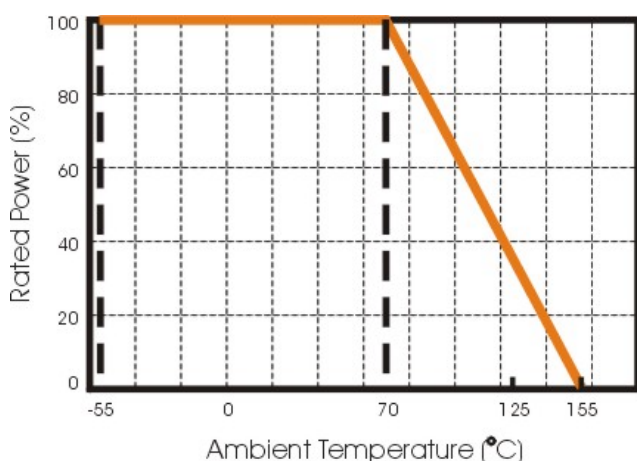


Figure 2.1 Maximum dissipation in percentage of rated power as a function of the ambient temperature for WR12X WR08X, WR06X, WR04X

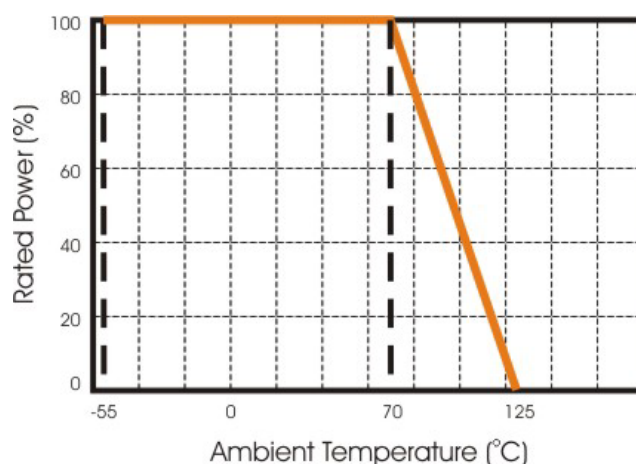


Figure 2.2 Maximum dissipation in percentage of rated power as a function of the ambient temperature for WR02X

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 one minute. 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 230°C during 2 seconds. The test condition for no leaching is 260°C for 60 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.

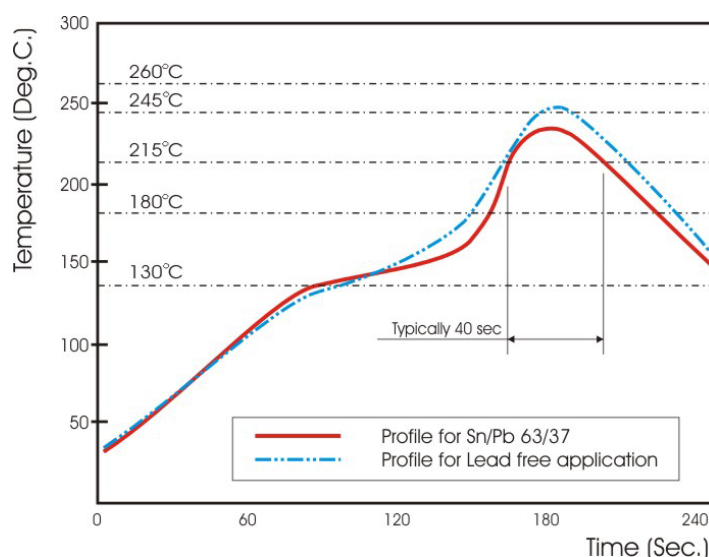


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WR12	X	472_	J	T	_
Size code	Type code	Resistance code	Tolerance	Packaging code	Termination code
WR12 : 1206	X : Normal	E24 : 2 significant digits followed by no. of zeros and a blank	F : $\pm 1\%$	T : 7" Reeled taping	_ = SnPb base (" " means a blank)
WR08 : 0805	F : Sputtering type	4.7 Ω =4R7_	J : $\pm 5\%$	Q : 10" Reeled taping	
WR06 : 0603		10 Ω =100_	P : Jumper	G : 13" Reeled taping	L = Sn base (lead free)
WR04 : 0402		220 Ω =221_		B : Bulk	
WR02 : 0201		Jumper =000_ (" " means a blank)			
		E96 : 3 significant digits followed by no. of zeros			
		102 Ω =1020			
		37.4K Ω =3742			

WR12,WR08,WR06:

1. Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging : 5000pcs per poly-bag

WR04:

1. Reeled tape packaging : 8mm width paper taping 10,000pcs per reel,
2. Bulk packaging : 10,000pcs per poly-bag

WR02:

1. Reeled tape packaging : 8mm width paper taping 10,000pcs per reel.

**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, 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 mildly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
DC resistance	JIS C 5202 5.1 / IEC 60115-1 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	<50mΩ
Temperature Coefficient of Resistance	JIS C 5202 5.2 / IEC 60115-1 4.8.4.2 $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ R ₁ : Resistance at reference temperature R ₂ : Resistance at test temperature t ₁ : room temperature; t ₂ : LCT or UCT	Within the specified TCR	N/a
Short Time Overload	JIS C 5202 5.5 / IEC 60115-1 4.13 Permanent resistance change after a 5sec application of a voltage 2.5xU _R or max. overload voltage, whichever is less.	ΔR/R max. ±(2%+0.10Ω)	<50mΩ
Resistance to Solder Heat	JIS C 5202 6.4 / IEC 60115-1 4.18 Unmounted chip with a solder bath, 260°C±5°C, 10±1 sec	ΔR/R max. ±(1%+0.05Ω)	<50mΩ
Solderability	JIS C 5202 6.5 / IEC 60115-1 4.17 Termination SnPb base : Unmounted chips completely immersed for 2±0.5 sec. in a solder bath at 230±5°C Termination Sn base (lead free) : Unmounted chip completely immersed in a lead free solder bath, 245°C±5°C, 3±1 sec	95% coverage min., good tinning and no visible damage	
Leaching Test	JIS C 5202 6.4 / IEC 60115-1 4.18 Unmounted chip with a solder bath, 260°C±5°C, 60±1 sec	Ditto	
Temperature Cycling	JIS C 5202 7.4 / IEC 60115-1 4.19 30min at LCT, 30min at UCT, 5 cycles	ΔR/R max. ±(1%+0.05Ω)	< 50mΩ
Damp Heat (Load life in humidity)	JIS C 5202 7.9 1000+48/-0 hours; 1.5hours ON, 0.5hours OFF at RCWV in a humidity chamber controlled 40±2°C, 90~95% RH	10Ω≤R<1MΩ : ΔR/R max. ±(3%+0.10Ω) R<10Ω, R≥1MΩ : ΔR/R max. ±(5%+0.10Ω)	< 50mΩ



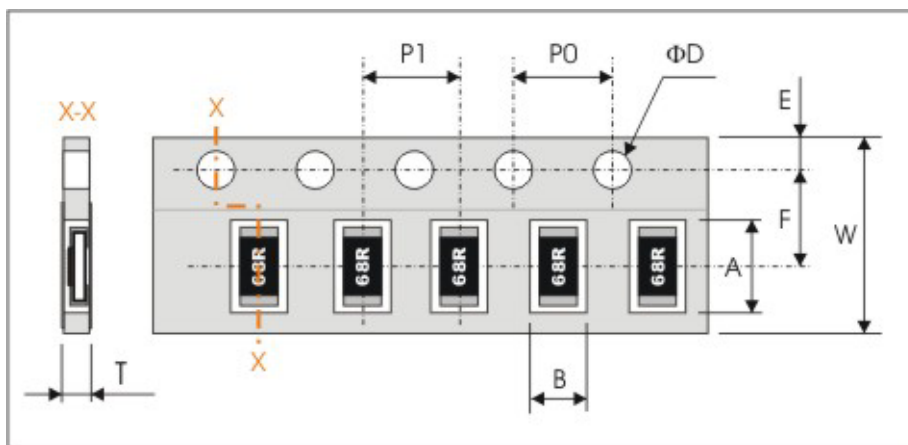
TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Load Life (Endurance)	JIS C 5202 7.10 / IEC 60115-1 4.25.1 1000+48/-0 hours; loaded with P_n or V_{max} ; 1.5 hours ON, 0.5 hours OFF	Ditto.	
Bending and Terminal Strength	JIS C 5202 6.1.4 / IEC 60115-1 4.33 Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 3mm for 10sec, 5mm for WR04,WR02 Pulling test : >500 grams	No visual damaged, $\Delta R/R$ max. $\pm(1\%+0.05\Omega)$	< 50mΩ

TEST CONDITION FOR JUMPER (0 Ω)

Item	WR12	WR08	WR06	WR04	WR02
Power Rating At 70°C	1/4W	1/8W	1/10W	1/16W	1/20W
Resistance	MAX.50mΩ				
Rated Current	2A	1.5A	1A	1A	0.5A
Peak Current	5A	3.5A	3A	1.5A	1A
Operating Temperature	-55~155°C				

PACKAGING

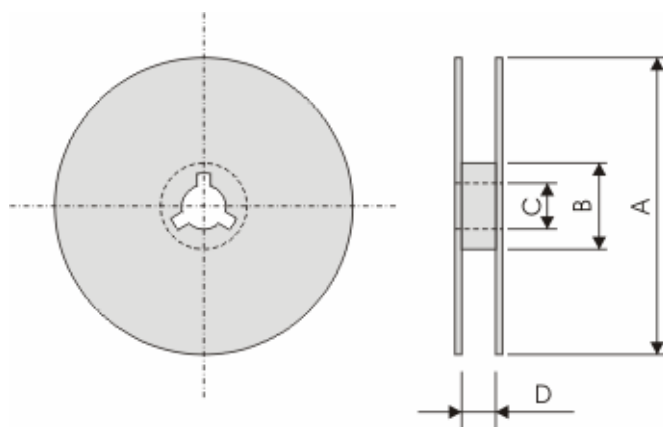
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WR12	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WR08	2.40±0.20	1.65±0.20			
WR06	1.90±0.20	1.10±0.20			
WR04	1.20±0.10	0.70±0.10			
WR02	0.70±0.05	0.40±0.05			

Series No.	P1	P0	ΦD	T
WR12 / WR08	4.00±0.10	4.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	Max. 1.0
WR06				0.65±0.05
WR04	2.00±0.10			0.40±0.05
WR02				0.30±0.05

7" Reel dimensions



Symbol	A	B	C	D
(unit : mm)	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5