APPROVAL SHEET

WR02X(W)

±5%, ±1%

Thick Film General purpose chip resistors

Size 0201

*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. Suitable for high density print circuit board assembly
5. Higher component and equipment reliability
6. Lead free product

APPLICATION

- Mobile phone
- PDA
- Camcorders
- Palmtop computers
- Hybrid module

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 pure Tin.

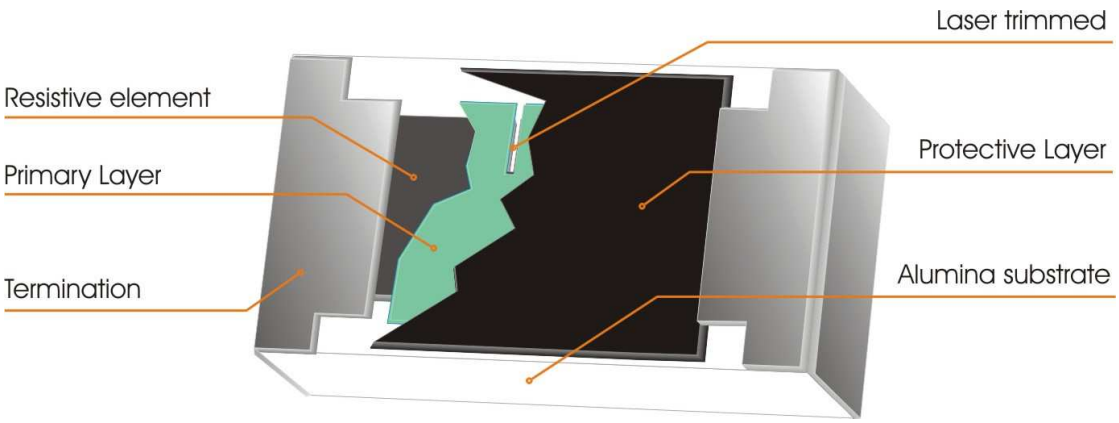


Fig 1. Construction of Chip-R WR02X

QUICK REFERENCE DATA

Item	General Specification	
Series No.	WR02X(W)	
Size code	0201(0603)	
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~ 10MΩ (±1% tolerance)	
Resistance Tolerance	±1% E96/E24	±5% E24
TCR (ppm/°C)	10Ω - 10MΩ, ≤±200 1 - 9.76Ω, +600~-200	
Max. dissipation @ T_{amb}=70°C	1/20 W	
Max. Operation Voltage (DC or RMS)	25V	
Max. Overload Voltage (DC or RMS)	50V	
Operation temperature	-55 ~ +125'C	

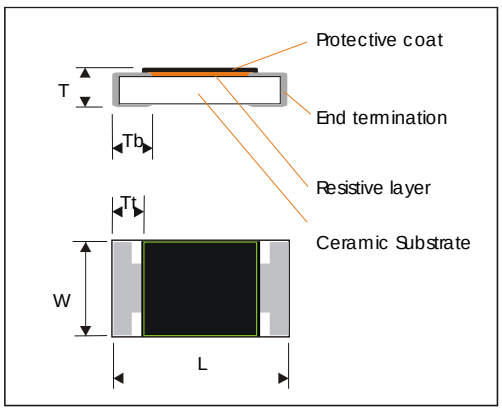
Note :

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

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

DIMENSION(unit : mm)

	WR02X(W)
L	0.60 ± 0.03
W	0.30 ± 0.03
T	0.23 ± 0.03
Tb	0.15 ± 0.05
Tt	0.10 ± 0.05



MARKING

WR02X(W) has no marking.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of ±5% & ±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

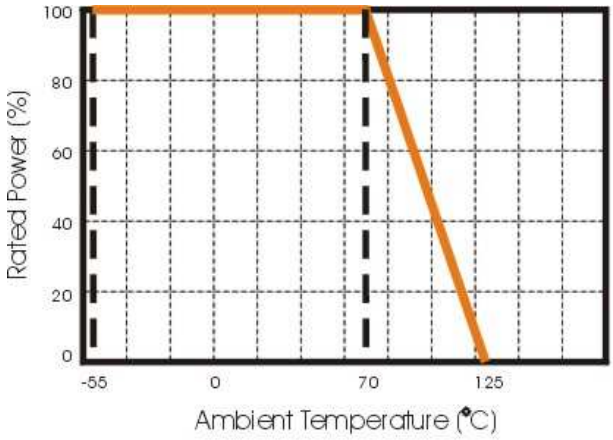


Figure 2. Maximum dissipation in percentage of rated power

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.

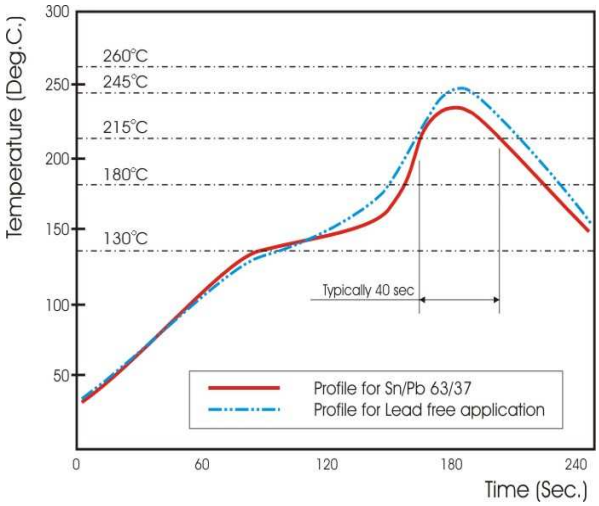


Fig 3. Infrared soldering profile for Chip Resistors WR02X(W)

CATALOGUE NUMBERS

The resistors have a catalogue number starting with :

WR02	X	472_	J	A	L
Size code WR02 : 0201	**Type code** X : Normal W : 1% For <10Ω and >1MΩ	**Resistance code** 5%, E24: 2 significant digits followed by no. of zeros and a blank 4.7Ω = 4R7_ 100Ω = 101_ 10KΩ = 103_ 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** A : 7” Reeled taping (15Kpcs/Reel) T : 7” Reeled taping (10Kpcs/Reel) D : 7” Reeled taping (20Kpcs/Reel) H : 13” Reeled taping (50Kpcs/Reel) G : 13” Reeled taping (70Kpcs/Reel)	**Termination code** L = Sn base (lead free)

TEST CONDITION FOR JUMPER (0 Ω)

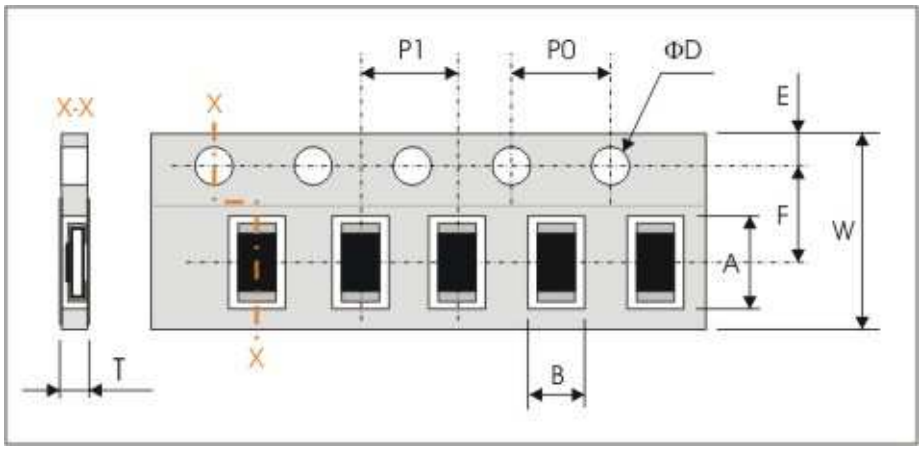
Item	WR02
Power Rating At 70°C	1/20W
Resistance	MAX.50mΩ
Rated Current	1A
Peak Current within 5 sec	2.5A
Operating Temperature	-55 ~ +125°C

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

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
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 (20℃+5℃/-1℃) R_2 : Resistance at test temperature (-55℃ or +125℃)	Within the specified tolerance Refer to "QUICK REFERENCE DATA"	<50mΩ
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.	ΔR/R max. ±(2%+0.10Ω)	<50mΩ
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℃±5°C	ΔR/R max. ±(1%+0.05Ω) no visible damage	<50mΩ
Solderability **Clause 4.17**	Un-mounted chips completely immersed for 2±0.8second in a SAC solder bath at 235℃±5℃	95% coverage min., good tinning and no visible damage	
Temperature cycling **Clause 4.19**	30 minutes at -55°C±3°C, 2~3 minutes at 20℃+5℃-1℃, 30 minutes at +125°C±3°C, 2~3 minutes at 20℃+5℃-1℃, total 5 continuous cycles	ΔR/R max. ±(1%+0.05Ω)	< 50mΩ
Damp Heat (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	10Ω≤R<1MΩ : ΔR/R max. ±(3%+0.10Ω) R<10Ω, R≥1MΩ : ΔR/R max. ±(5%+0.10Ω)	< 50mΩ
Load Life (Endurance) **Clause 4.25**	1000+48/-0 hours; loaded with RCWV or V_{max} in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off	Ditto.	
Bending strength **Clause 4.33**	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 5mm for 10sec.	No visual damaged, ΔR/R max. ±(1%+0.05Ω)	< 50mΩ
Adhesion **Clause 4.32**	Pressurizing force: 3N, Test time: 10±1sec.	No remarkable damage or removal of the terminations	

PACKAGING

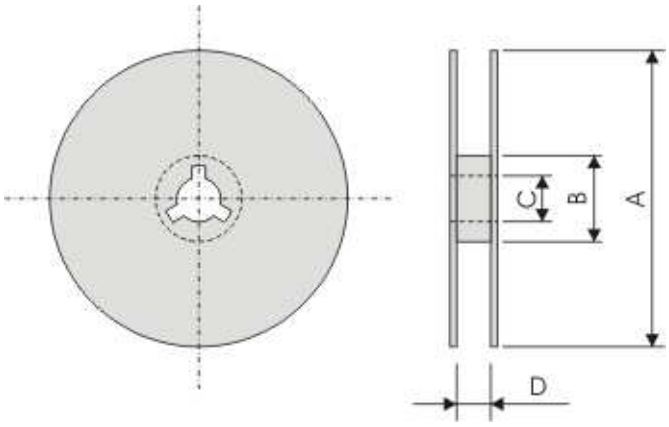
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WR02X	0.67±0.05	0.37±0.05	8.00±0.20	3.50±0.05	1.75±0.10

Series No.	P1	P0	ΦD	T
WR02X	2.00±0.05	4.00±0.05	$\Phi 1.50^{+0.1}_{-0.0}$	0.45±0.05

Reel dimensions



Symbol	A	B	C	D
7” Reel	Φ178.0±0.2	Φ60.0±1.0	13.0±0.2	9.0±0.5
10” Reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5
13” Reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5

Taping quantity and Tape material

- Chip resistors 10,000 / 15,000 / 20,000 pcs 7” Reel, Paper tape.
- Chip resistors 50,000 / 70,000 pcs 13” Reel, Paper tape.

APPROVAL SHEET

WR12, WR08, WR06, WR04

±1%, ±5%

Thick Film General Purpose Chip Resistors

Size 1206, 0805, 0603, 0402

RoHS 2 compliant & Halogen free

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

FEATURE

1. High reliability and stability
2. Reduced size of final equipment
3. Lower assembly costs
4. Higher component and equipment reliability
5. RoHS 2 compliant and Halogen free products

APPLICATION

- Consumer electrical equipment
- 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 Tin (lead free) alloy.

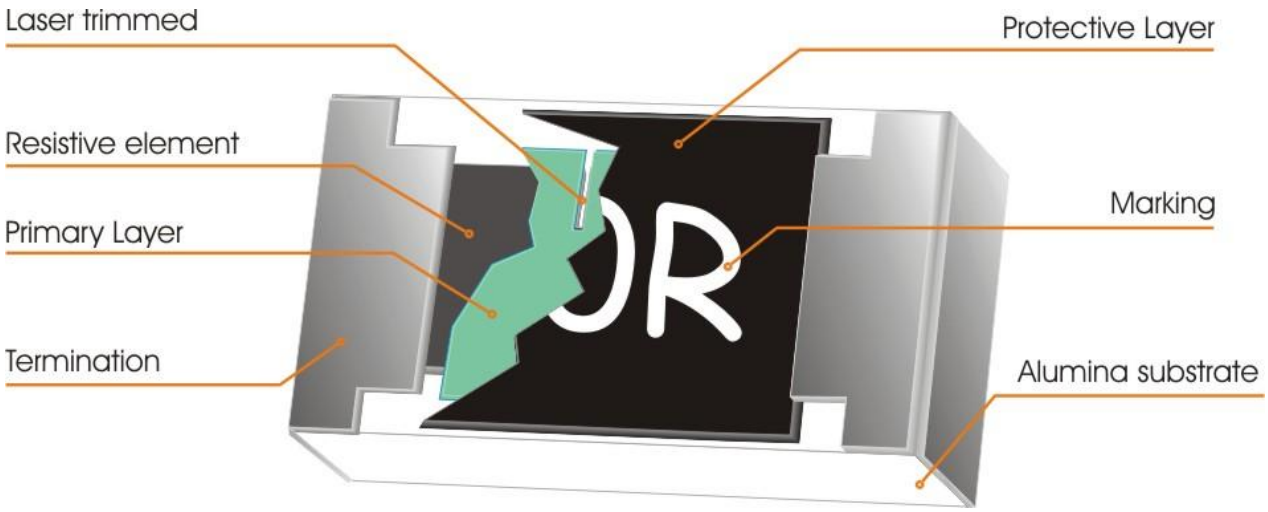


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification							
Series No.	WR12		WR08		WR06		WR04	
Size code	1206(3216)		0805(2012)		0603(1608)		0402(1005)	
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~10MΩ (±1% tolerance),							
Resistance Tolerance	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24	±1% E96/E24	±5% E24
TCR (ppm/°C) 10MΩ ≥R＞10Ω R≤10Ω	≤ ± 100 -200~+400							
Max. dissipation @ T_{amb}=70°C	1/4 W		1/8 W		1/10 W		1/16 W	
Max. Operation Voltage (DC or RMS)	200V		150V		75V		50V	
Max. Overload Voltage (DC or RMS)	400V		300V		150V		100V	
Climatic category	55/155/56							

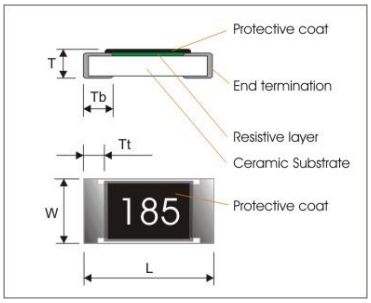
Note :

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

   $RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$ or Max. RCWV listed above, whichever is lower.
3. The resistance of Jumper is defined <0.05Ω.

DIMENSIONS (unit : mm)

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



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)	N0 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.

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% : 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

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ±5%, and E96 series for resistors with a tolerance of ±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

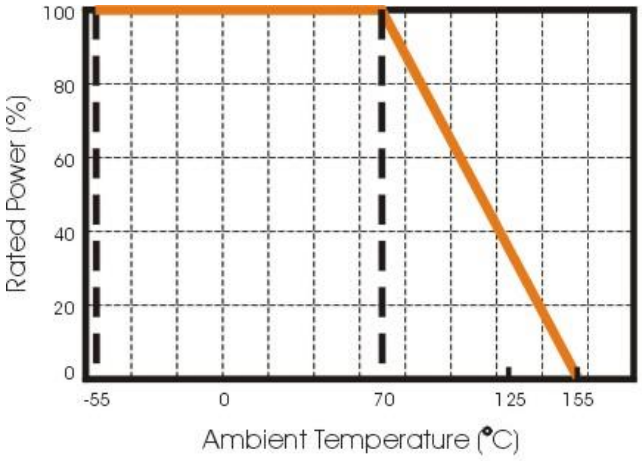


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature for WR12, WR08, WR06, WR04

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.

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℃

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 oxdization 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 follows J-STD-020D

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.

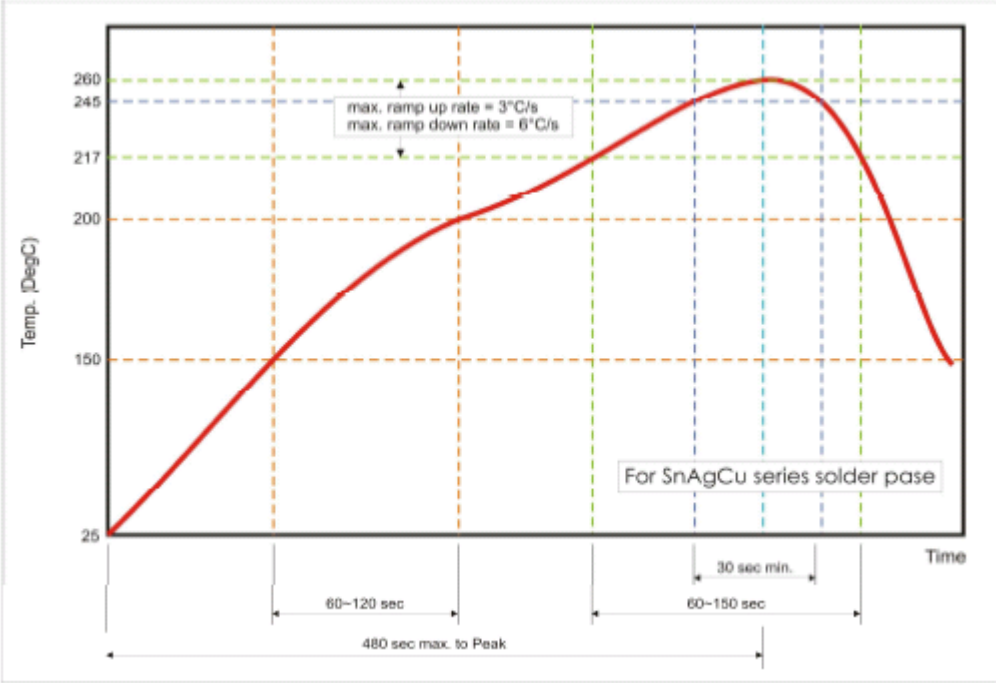


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with

WR12	X	472_	J	T	L
Size code WR12 : 1206 WR08 : 0805 WR06 : 0603 WR04: 0402	**Type code** **X :** Jumper ±5%, 1Ω ~ 10MΩ ±1%, 10Ω ~ 1MΩ **W** : ±1%, < 10Ω; >1MΩ	**Resistance code** ±5%, E24: 2 significant digits followed by no. of zeros and a blank 4.7Ω =4R7_ 10Ω =100_ 220Ω =221_ Jumper =000_ ("_" means a blank) ±1%, E24+E96: 3 significant digits followed by no. of zeros 102Ω =1020 37.4KΩ =3742	**Tolerance** F : ±1% J : ±5% P : Jumper	**Packaging code** T : 7" Reeled taping Q : 10" Reeled taping G : 13" Reeled taping H : 13" reel 50Kpcs only for 0402 B : Bulk D : 7" reel 20Kpcs only for 0402 A : 7" reel 15Kpcs only for 0402	**Termination code** L= Sn base (lead free)

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 7” reel, 20,000pcs per 10” reel. 70,000pcs per 13” reel.
2. Bulk packaging : 10,000pcs per poly-bag

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	0Ω
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°C+5°C-1°C; t_2 : -55°C or +155°C R_1 : Resistance at reference temperature (20°C+5°C/-1°C) R_2 : Resistance at test temperature (-55°C or +155°C)	Within the specified tolerance Refer to "QUICK REFERENCE DATA"	<50mΩ
Resistance to soldering heat(R.S.H) JISC5201-1:1998 Clause 4.18	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260℃±5°C	±5%:ΔR/Rmax.±(1%+0.05Ω) ±1%:ΔR/Rmax.±(0.5%+0.05Ω) no visible damage	<50mΩ
Solderability JISC5201-1: 1998 Clause 4.17	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235℃±5℃	95% coverage min., good tinning and no visible damage	
Temperature cycling JISC5201-1: 1998 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	±5%: ΔR/R max. ±(1%+0.05Ω) ±1%:ΔR/Rmax.±(0.5%+0.05Ω) No visible damage	<50mΩ
High Temperature Exposure MIL-STD-202 method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	±5%:ΔR/Rmax.±(2%+0.1Ω) ±1%:ΔR/Rmax.±(1%+0.1Ω) No visible damage	<50mΩ
Bending strength JISC5201-1: 1998 Clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 3mm for 10sec, 5mm for WR04	±5%:ΔR/Rmax.±(1%+0.05Ω) ±1%:ΔR/Rmax.±(1%+0.05Ω) No visual damaged	<50mΩ
Adhesion JISC5201-1: 1998 Clause 4.32	Pressurizing force: 5N, Test time: 10±1sec.	No remarkable damage or removal of the terminations	
Short Time Overload (STOL) JISC5201-1: 1998 Clause 4.13	2.5 times RCWV or max. overload voltage, for 5seconds	±5%: ΔR/R max. ±(2%+0.05Ω) ±1%: ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ

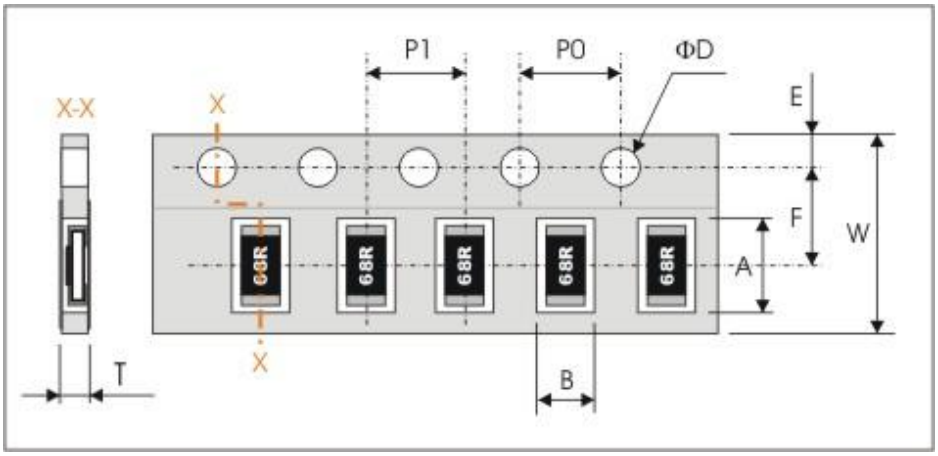
TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Load life in Humidity JISC5201-1: 1998 Clause 4.24	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off	±5%: ΔR/R max. ±(2%+0.1Ω) ±1%: ΔR/R max. ±(1%+0.1Ω) No visible damage	<50mΩ
Load life (endurance) JISC5201-1: 1998 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	±5%: ΔR/R max. ±(3%+0.1Ω) ±1%: ΔR/R max. ±(1%+0.1Ω) No visible damage	<50mΩ
Insulation Resistance JISC5201-1: 1998 Clause 4.6	Apply the maximum overload voltage (DC) for 1minute	R≧10GΩ	
Dielectric Withstand Voltage JISC5201-1: 1998 Clause 4.7	Apply the maximum overload voltage (AC) for 1 minute	No breakdown or flashover	

TEST CONDITION FOR JUMPER (0 Ω)

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

PACKAGING

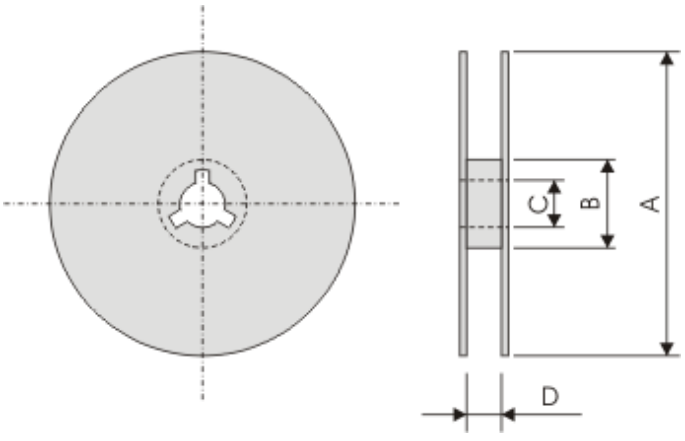
Paper Tape specifications (unit :mm)



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			

Series No.	P1	P0	ΦD	T
WR12 / WR08	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
WR06				0.65±0.05
WR04	2.00±0.10			0.40±0.05

7” Reel dimensions



Symbol	A	B	C	D
7” reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5
10” reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5
13” reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5

APPROVAL SHEET

WR10X(W)

±1%, ±5%

Thick film Technology

General purpose chip resistors

Size 1210

FEATURE

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

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 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.

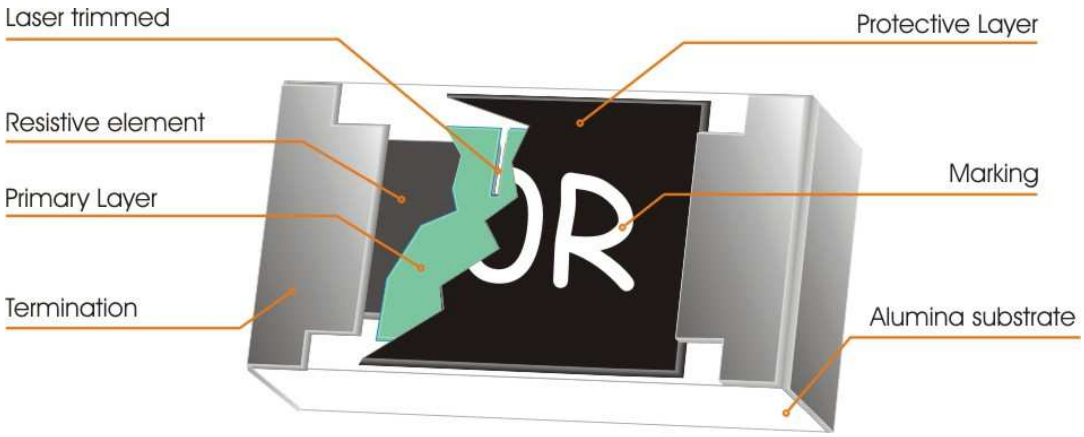


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification
Series No.	WR10X(W)
Size code	1210 (3225)
Resistance Tolerance	±1% (E96/E24), ±5% (E24)
Resistance Range	Jumper, 1Ω ~ 10MΩ (E96+E24 series)
TCR (ppm/°C) -55°C ~ +155°C	> 10R , ≤ ± 100 ppm/°C 1R ~ 10R, ≤ ± 200 ppm/°C
Max. dissipation at T_{amb}=70°C	1/3 W (0.33 W)
Max. Operation Voltage (DC or RMS)	200V
Max. Overload Voltage (DC or RMS)	400V
Climatic category	55/155/56

Type	WR10X
Power Rating At 70C	1/3 W
Resistance	Max. 50mR
Rated Current	2.5 A
Peak Current	6 A
Operating Temperature	-55C ~ 155C

Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see “IEC publication 60115-8”

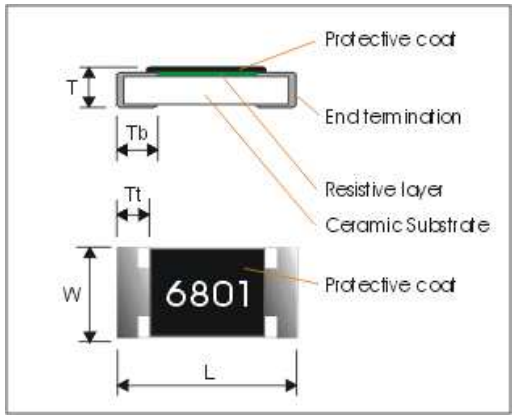
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

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

DIMENSIONS(unit : mm)

Part No	WR10X
L	3.10 ± 0.10
W	2.60 ± 0.10
Tt	0.50 ± 0.20
Tb	0.50 ± 0.20 *1
T	0.55 ± 0.10

*1 original 0.45+/-0.20



MARKING

3-digits marking（±5%）

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

4-digits marking（±1%）

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

Example

RESISTANCE	90Ω	100Ω	6800Ω	47000Ω
4-digits marking	90R0	1000	6801	4702
3-digits marking	-	101	682	473

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 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

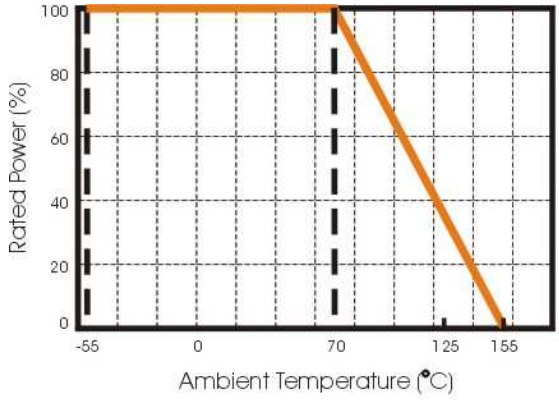


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

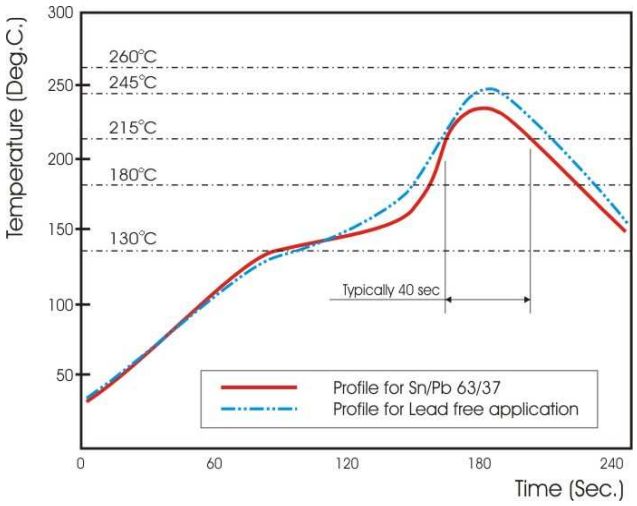


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WR10	X	4702	F	T	L
Size code **WR10: 1210**	**Type code** **X** : 5%: 1R ~ 10M 1%: 10R ~ 1M **W:** 1%: < 10R; > 1M0	**Resistance code** **5%, E24**: 2 significant digits followed by no. of zeros 100Ω = 101_ 10KΩ = 103 **1% E24+E96**: 3 significant digits followed by no. of zeros 102Ω =1020 37.4KΩ =3742 220Ω =2200	**Tolerance** **J: ± 5%** **F: ± 1%** **P: Jumper**	**Packaging code** **T: 7" Reeled taping**	**Termination code** **L =** Sn base (lead free)

■ **Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel.**

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

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 68-1, subclause 5.3, unless otherwise specified.

Temperature: 15ºC to 35ºC.

Relative humidity: 45% to 75%.

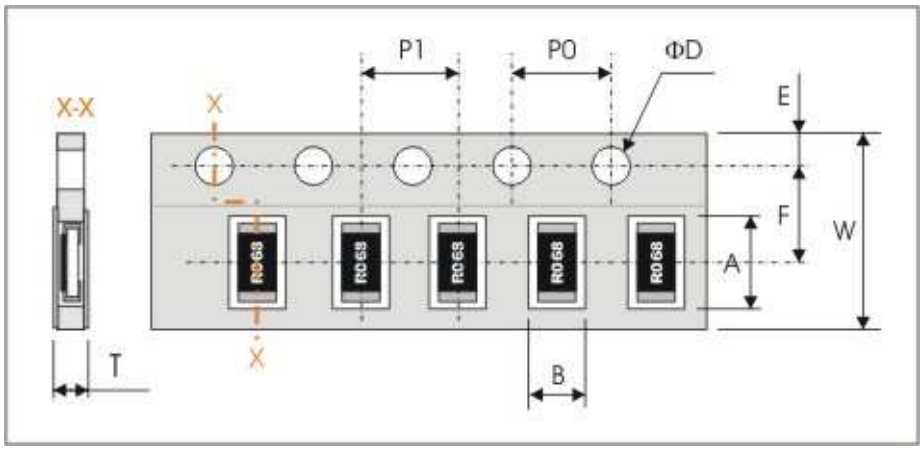
Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
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	<50mΩ
Temperature Coefficient of Resistance(T.C.R) **Clause 4.8**	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20℃+5℃-1℃ R_1 : Resistance at reference temperature R_2 : Resistance at test temperature	Refer to "QUICK REFERENCE DATA"	N/a
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.	ΔR/R max. ±(2%+0.10Ω)	<50mΩ
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℃±5°C	ΔR/R max. ±(1%+0.05Ω) no visible damage	<50mΩ
Solderability **Clause 4.17**	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235℃±5℃	95% coverage min., good tinning and no visible damage	
Temperature cycling **Clause 4.19**	30 minutes at -55°C±3°C, 2~3 minutes at 20℃+5℃-1℃, 30 minutes at +155°C±3°C, 2~3 minutes at 20℃+5℃-1℃, total 5 continuous cycles	ΔR/R max. ±(1%+0.05Ω)	< 50mΩ
Damp Heat (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	10Ω≤R<1MΩ : ΔR/R max. ±(3%+0.10Ω) R<10Ω, R≥1MΩ : ΔR/R max. ±(5%+0.10Ω)	< 50mΩ
Load Life (Endurance) **Clause 4.25**	1000+48/-0 hours; loaded with RCWV or V_{max} in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off	Ditto.	
Bending strength **Clause 4.33**	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 3mm for 10sec.	No visual damaged, ΔR/R max. ±(1%+0.05Ω)	< 50mΩ
Adhesion **Clause 4.32**	Pressurizing force: 5N, Test time: 10±1sec.	No remarkable damage or removal of the terminations	

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Insulation Resistance **Clause 4.6**	Apply the maximum overload voltage (DC) for 1minutes	R≧10GΩ	
Dielectric Withstand Voltage **Clause 4.7**	Apply the maximum overload voltage (AC) for 1 minutes	No breakdown or flashover	

PACKAGING

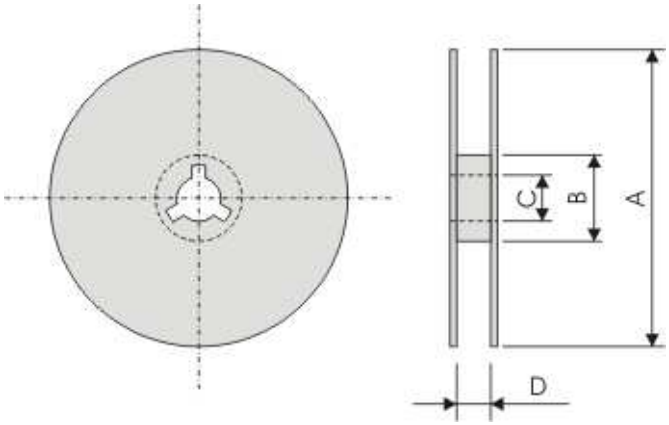
Paper Tape specifications (unit :mm)



Component Size / Series	W	F	E	P0	ΦD
WR10X	8.00±0.30	3.50±0.20	1.75±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$

Component Size / Series	A	B	P1	T
WR10X	3.60±0.20	3.00±0.20	4.00±0.10	Max. 1.0

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

Taping quantity

- Chip resistors 5,000 pcs/reel

APPROVAL SHEET

WR18X(W), WR20X(W), WR25X(W)

±1%, ±5%

Thick Film Power Chip Resistors

Size 1218,2010,2512

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

FEATURE

1. High power rating and compact size
2. High reliability and stability
3. Reduced size of final equipment
4. RoHS compliant and Lead free products

APPLICATION

- Power supply
- PDA
- Digital meter
- Computer
- Automotives
- Battery charger
- DC-DC power converter

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.

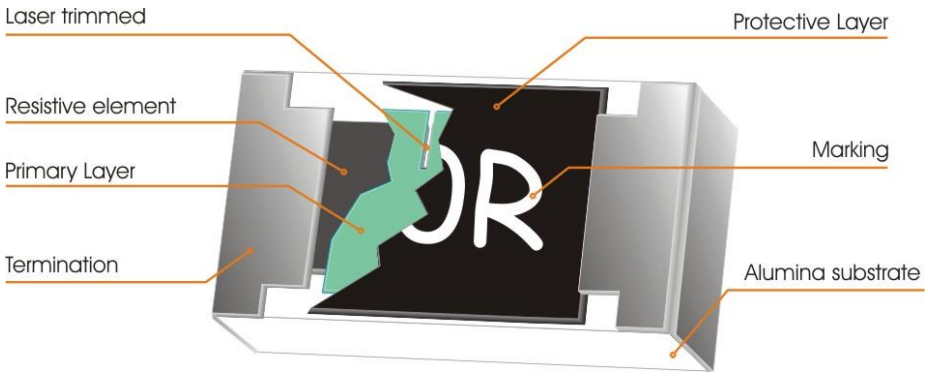


Fig 1. Construction of 2512, 2010 Chip-R

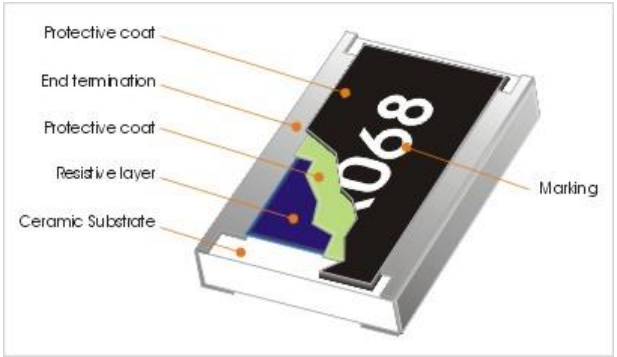


Fig 2. Construction of a 1218 Chip-R

QUICK REFERENCE DATA

Item	General Specification		
Series No.	WR18X(W)	WR20X(W)	WR25X(W)
Size code	1218(3248)	2010 (5025),	2512(6432)
Resistance Tolerance	±5% (E24); ±1% (E24+E96)		
Resistance Range	1Ω ~ 10MΩ, Jumper (0Ω)		
TCR (ppm/°C) : 10Ω< Rn ≤ 10MΩ	± 100 ppm/°C	± 100 ppm/°C	± 100 ppm/°C
1Ω≤ Rn ≤ 10Ω	± 200 ppm/°C	± 200 ppm/°C	± 200 ppm/°C
Max. dissipation at T_{amb}=70°C	1W	0.75 W	1W
Max. Operation Voltage (DC or RMS)	200V	200V	250V
Max. Overload Voltage (DC or RMS)	400V	400V	500V
Operation temperature	-55 ~ +155'C		
Storage temperature	5 ~ 40'C		

Test conditions for jumper (0 ohm)

Type	WR18X(W)	WR20X(W)	WR25X(W)
Power Rating At 70C	1 W	3/4 W	1 W
Resistance	Max. 50mR	Max. 50mR	Max. 50mR
Rated Current	4.5 A	3.8 A	4.5 A
Peak Current	11 A	9 A	11 A
Operating Temperature	-55C ~ 155C	-55C ~ 155C	-55C ~ 155C

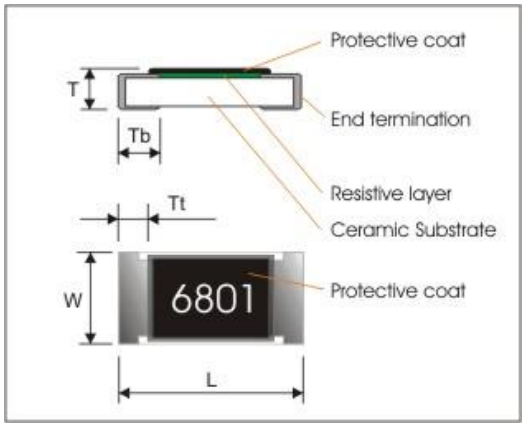
Note :

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

   $RCWV = \sqrt{Rated Power \times Resistance\ Value}$ or Max. RCWV listed above, whichever is lower.
3. Max. Operation Current : So called RCWC (Rated Continuous Working Current) is determined by
4. $RCWC = \sqrt{Rated\ Power / Resistance\ Value}$

MECHANICAL DATA (unit : mm)

TYPE	WR18	WR20	WR25
L	3.05±0.15	5.00±0.20	6.40±0.20
W	4.60±0.20	2.50±0.20	3.20±0.20
T	0.55±0.10	0.55±0.10	0.60±0.10
Tt	0.45±0.25	0.65±0.25	0.65±0.25
Tb	0.50±0.25	0.60±0.25	0.90±0.25



MARKING

Each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value.

Example:

1R00 = 1Ω
1001 = 1000Ω
0000 = 0Ω

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of ±5% & ±1%. The values of the E24/E96 series are in accordance with “IEC publication 60063”.

Derating curve

The power that the resistor can dissipate depends on the operating temperature; see Fig.3

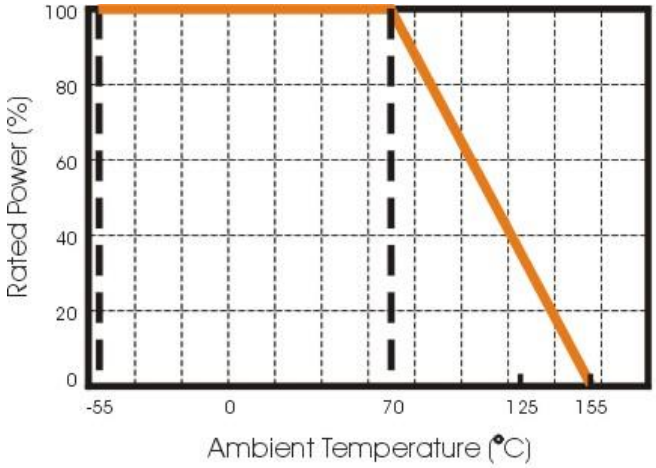


Figure 3. Maximum dissipation in percentage of rated power as a function of the ambient temperature.

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 below.

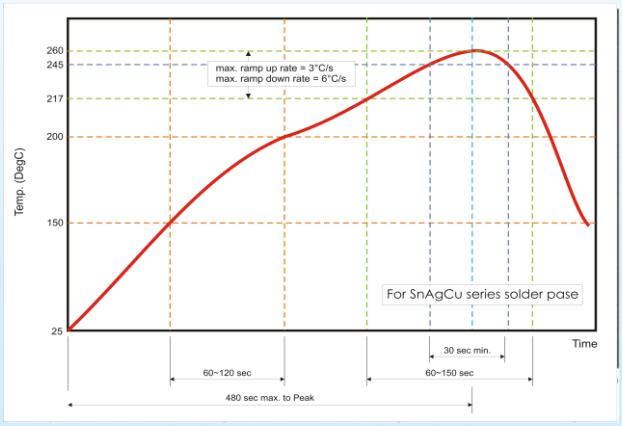


Fig. 1 Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste.

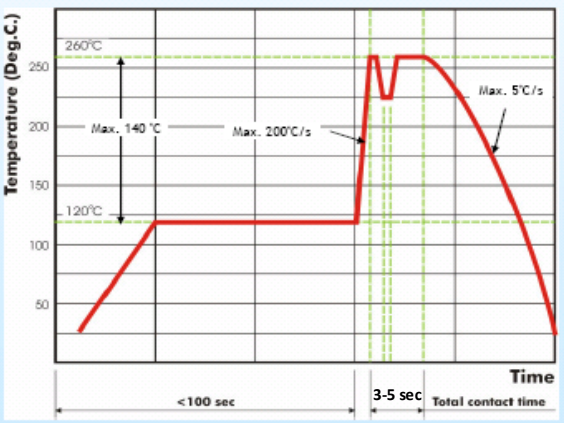


Fig. 2 Recommended wave soldering profile for SMT process with SnAgCu series solder.

The resistors have a catalogue number starting with .

WR20	X	472_	J	T	L
Size code WR25 : 2512 WR20 : 2010 WR18: 1218	**Type code** X : ±5%: 1Ω-10MΩ ±1%: 10Ω-1MΩ W : 1% : <10Ω or >1MΩ	**Resistance code** **5%** E24 : 2 significant digits followed by no. of zeros and a blank 4.7Ω =4R7_ 10Ω =100_ **1% E24+E96**: 3 significant digits followed by no. of zeros 102Ω =1020 37.4KΩ =3742	**Tolerance** J : ±5% F : ±1% P : Jumper	**Packaging code** T : 7” Reel taping (T:1218 10” Reel) Q : 10” Reel taping G : 13” Reel taping	**Termination code** L = Sn base (lead free)

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

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%.

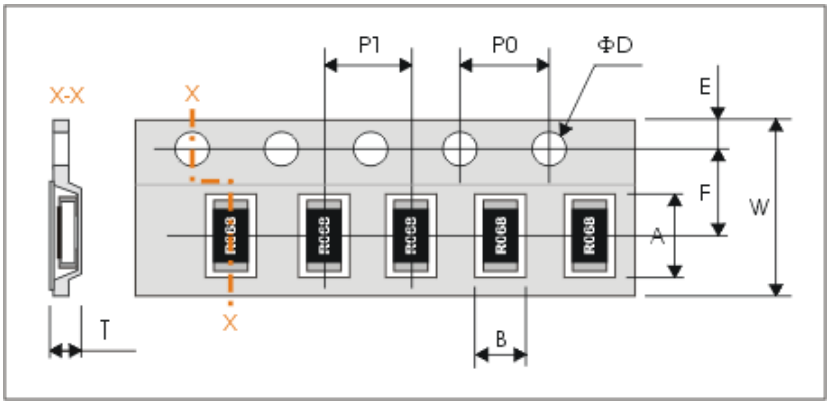
Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

All soldering tests are performed with midly activated flux.

TEST	PROCEDURE	REQUIREMENT
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20°C+5°C-1°C R_1 : Resistance at reference temperature R_2 : Resistance at test temperature	Refer to "QUICK REFERENCE DATA"
Short time overload (S.T.O.L) **Clause** **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.	ΔR/R max. ±(2%+0.1Ω)
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℃±5°C	no visible damage Δ R/R max. ±(1%+0.05Ω)
Solderability **Clause 4.17**	Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235℃±5℃	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 ΔR/R max. ±(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	ΔR/R max. ±(3%+0.1Ω)
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	ΔR/R max. ±(3%+0.1Ω)
Bending strength **Clause 4.33**	Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 2 mm, once for 10 seconds	ΔR/R max. ±(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

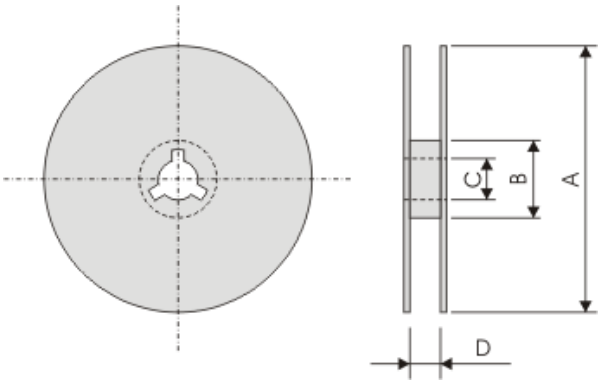
Plastic Tape specifications (unit :mm)



Type	A	B	W	F	E
WR18	4.90±0.20	3.55±0.30	12.00±0.30	5.50±0.10	1.75±0.10
WR20	5.50±0.20	2.80±0.20			
WR25	6.90±0.20	3.60±0.20			

Type	P1	P0	ΦD	T
WR18	8.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	1.30±0.20
WR20	4.00±0.10			MAX1.2
WR25				

Reel dimensions



(unit : mm)

Symbol	A	B	C	D
7” Reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	12.4.0±1.00
10” Reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	14.0±0.20
13” Reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	14.0±0.20

Taping quantity

WR20, WR25 by plastic tape taping 4,000 pcs per 7” reel; 8,000pcs per 10” reel; 16,000pcs per 13” reel !

WR18 by plastic tape taping 3,000 pcs per 10” reel