APPROVAL SHEET

WR25, WR20, WR18, WR10, WR12, WR08, WR06, WR04, WR02

±1%, ±5%, Jumper

Thick Film General Purpose Chip Resistors

Size 2512, 2010, 1218, 1210, 1206, 0805, 0603, 0402, 0201

RoHS 2 Compliant with exemption 7C-I
Halogen free

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FEATURES

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 with exemption 7C-I and Halogen free products
6. Flammability against UL94-V0

APPLICATIONS

- 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.

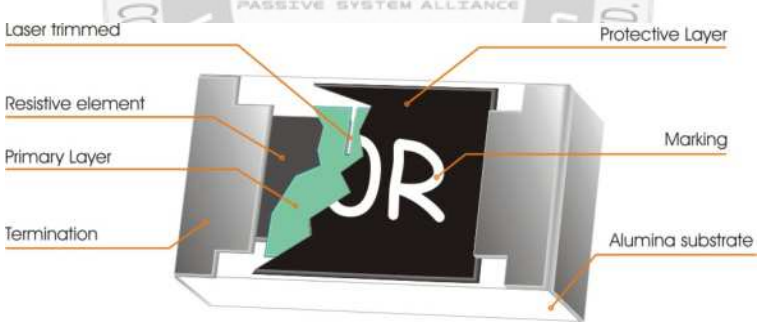


Fig 1.1. Construction of Chip-R

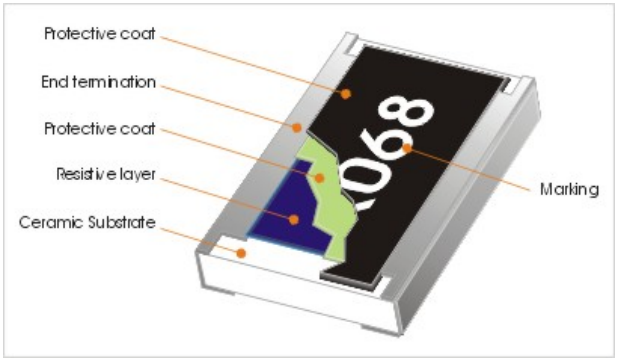


Fig 1.2. Construction of a 1218 Chip-R

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QUICK REFERENCE DATA

Item	General Specification								
Series No.	WR25X WR25W	WR20X WR20W	WR18 WR18W	WR10X WR10W	WR12X WR12W	WR08X WR08W	WR06X WR06W	WR04X WR04W	WR02X WR02W
Size code	2512 (6432)	2010 (5025)	1218 (3248)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)	0201 (0603)
Resistance Range	1Ω~10MΩ								
Resistance Tolerance	±1%, E96/E24, ±5%, E24								
TCR (ppm/°C)	10Ω< R≤ 10MΩ: ±100 R≤10Ω: ±200			10Ω< R≤ 10MΩ: ≤ ±100 R≤10Ω:-200~+400					10- 10MΩ: ±200 1- 9.76Ω: +600~-200
Max. dissipation @ T_{amb}=70°C	1W	3/4W	1W	1/2W	1/4W	1/8W	1/10W	1/16W	1/20W
Max. Operation Voltage	250V	200V	200V	200V	200V	150V	75V	50V	25V
Max. Overload Voltage	500V	400V	400V	400V	400V	300V	150V	100V	50V
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

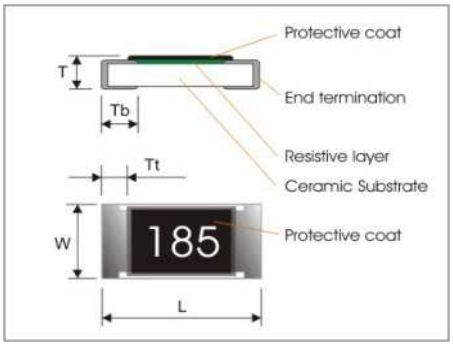
$$RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$$ or Max. RCWV listed above, whichever is lower.

For Jumper (0Ω) :

Item		General Specification								
Series No.		WR25X	WR20X	WR18	WR10X	WR12X	WR08X	WR06X	WR04X	WR02X
Size code		2512 (6432)	2010 (5025)	1218 (3248)	1210 (3225)	1206 (3216)	0805 (2012)	0603 (1608)	0402 (1005)	0201 (0603)
Resistance Range		≤50mΩ for P tolerance ≤30mΩ for F tolerance								
TCR (ppm/°C)		TCR is not applicable for Jumper product								
Max. dissipation @ T_{amb}=70°C		1W	3/4W	1W	1/2W	1/4W	1/8W	1/10W	1/16W	1/20W
P tol.	Rated Current	4.5A	3.8A	4.5A	3A	2A	1.6A	1A	1A	1A
	Peak Current	11A	9A	11A	7.5A	5A	3.2A	3A	2A	2.5A
F tol.	Rated Current	5.8A	5A	-	4A	2.9A	2A	1.8A	1A	1.25A
	Peak Current	14.5A	12.5A	-	10A	5.8A	4A	3.6A	2A	2.5A
Operation temperature		-55 ~ +155°C								

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DIMENSIONS (unit : mm)



Series	WR25	WR20	WR18	WR10	WR12	WR08	WR06	WR04	WR02
L	6.40±0.20	5.00±0.20	3.05±0.15	3.10±0.10	3.10±0.10	2.00±0.10	1.60±0.10	1.00±0.05	0.60±0.03
W	3.20±0.20	2.50±0.20	4.60±0.20	2.60±0.10	1.60±0.10	1.25±0.10	0.80±0.10	0.50±0.05	0.30±0.03
T	0.60±0.10	0.55±0.10	0.55±0.10	0.55±0.10	0.55±0.10	0.50±0.15	0.45±0.15	0.35±0.05	0.23±0.03
Tt	0.65±0.25	0.65±0.25	0.45±0.25	0.5 ±0.20	0.50±0.20	0.40±0.20	0.30±0.10	0.20±0.10	0.10±0.05
Tb	0.90±0.25	0.60±0.25	0.50±0.25	0.50±0.20	0.45±0.20	0.40±0.20	0.30±0.15	0.25±0.10	0.15±0.05

CATALOGUE NUMBERS

The resistors have a catalogue number starting with

WR12	X	472_	J	T	L
Size code WR25 :2512 WR20 :2010 WR18 :1218 WR10 :1210 WR12 :1206 WR08 :0805 WR06 :0603 WR04 :0402 WR02: 0201	**Type code** X : Jumper ±5%. 1Ω ~ 10MΩ ±1% 10Ω ~ 1MΩ W : ±1% 1Ω≤R<10Ω ±1% 1MΩ<R≤10MΩ	**Resistance code** ±5%,E24: 2 significant digits followed by no. of zeros and a blank 4.7Ω = 4R7_ 10Ω = 100_ 220Ω = 221_ Remark: "_" means a blank ±1%,E24+E96: 3 significant digits followed by no. of zeros 102Ω = 1020 37.4KΩ= 3742 82Ω = 82R0 For Jumper (0Ω) P tol. ≤ 50mΩ=000_ F tol. ≤ 30mΩ=0000 Remark: "_" means a blank	**Tolerance code** F : ±1% J : ±5% For Jumper (0Ω) P : ≤ 50mΩ F : ≤ 30mΩ	**Packaging code** T :7" Reeled taping Q :10" Reeled taping G :13" Reeled taping A :7" reel 15Kpcs only for 0402 & 0201 D :7" reel 20Kpcs only for 0402 & 0201 H :13" reel 50Kpcs only for 0402 & 0201 B :Bulk	**Termination code** L:Sn base (lead-free)

Tape packaging:

Size	Packaging tape	Packaging code						
		T: 7"reel	Q:10"reel	G:13"reel	A:7"reel	D:7"reel	H:13"reel	B: poly-bag
2512,2010	12mm width plastic tape	4,000pcs	8,000pcs	16,000pcs	-	-	-	5000pcs
1210,1206, 0805,0603	8mm width paper tape	5,000pcs	10,000pcs	20,000pcs	-	-	-	5000pcs
0402		10,000pcs	-	70,000pcs	15,000pcs	20,000pcs	50,000pcs	5000pcs
0201		10,000pcs	-	70,000pcs	15,000pcs	20,000pcs	50,000pcs	5000pcs

- 1218: 12mm width plastic taping 3,000 pcs per 10" reel with "T" taping code for standard tape packaging.

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MARKING

Size \ Nr. Of digit of code\tolerance	±5% & Jumper (0Ω)	±1%
2512, 2010, 1218	4 digits marking	4 digits marking
1210, 1206, 0805	3 digits marking	4 digits marking
0603	3 digits marking	3 digits marking
0402,0201	No marking	

- No marking for 0402 and 0201 size.
- Jumper (0Ω):
  2512, 2010,1218: 0000
  1210,1206, 0805, 0603 : 000
- 3 digits marking for ±5% 1210,1206, 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 for ±1% 0603 size:

Nominal resistance	Description
1.E24 series	2 significant digits followed by No. of zeros. Example

RESISTANCE	4.7Ω	47Ω	470Ω	4K70	47K0	470K	4M70
3 digits marking	4R7	470	471	472	473	474	475

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}

Example

RESISTANCE	1.78Ω	17.8Ω	178Ω	1K78	17K8	178K	1M78
3 digits marking	25Y	25X	25A	25B	25C	25D	25E

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.
3. Remark	There is no marking for the items not under E24 and E96 series.

E96 CODE table:

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 ±5% & ±1% 2512, 2010, 1218 size, for ±1% 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 values below 97Ω6 the R is used as a digit. For values of 100Ω or greater, the first 3 digits are significant, the fourth digit indicates the number of multiple to follow.

Example

RESISTANCE	Jumper (0Ω)	1Ω	10Ω	47Ω	470Ω	6800Ω	47000Ω	470000Ω	1000000Ω
3 digits marking	000	1R0	100	470	471	682	473	474	105
4 digits marking	0000	1R00	10R0	47R0	4700	6801	4702	4703	1004

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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 Curve

The power that the resistor can dissipate depends on the operating temperature; see Fig.2

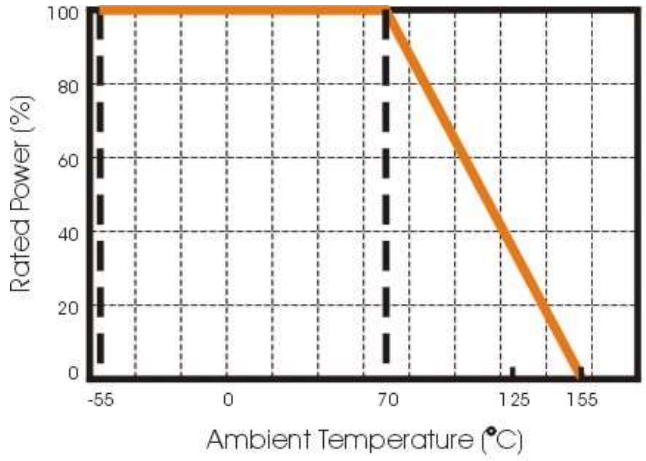


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

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 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

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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.

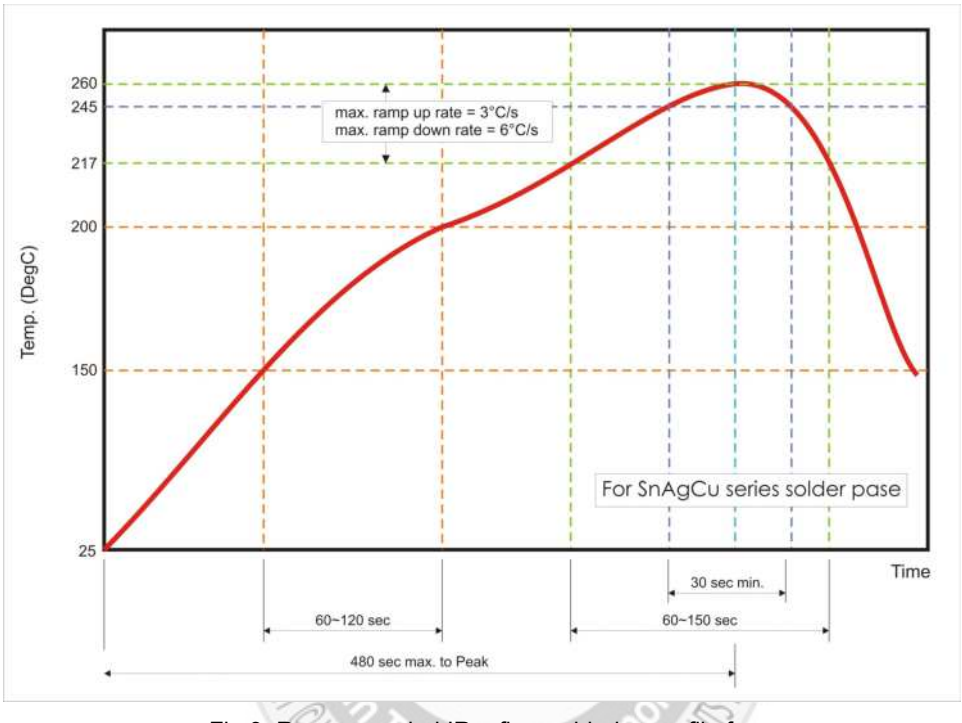


Fig 3. Recommended IR reflow soldering profile for SMT process with SnAgCu series solder paste

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TESTS 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	
		Resistance	Jumper
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"	
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°C ±5°C	Others: ±5%:ΔR/Rmax.±(1%+0.05Ω) ±1%:ΔR/Rmax.±(0.5%+0.05Ω) 2512,2010,1218: Δ R/R max. ±(1%+0.05Ω) 0201: ΔR/R max. ±(1%+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°C±5°C	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) 2512,2010,1218: ΔR/R max. ±(1%+0.05Ω) 0201: ΔR/R max. ±(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) 0201: ΔR/R max. ±(2%+0.1Ω) No visible damage	<50mΩ

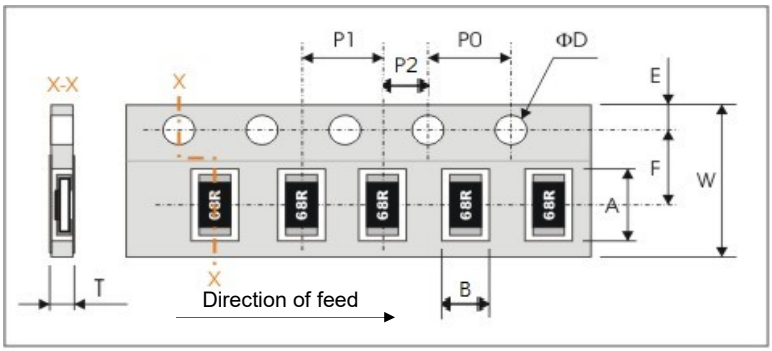
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TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistance	Jumper
Bending strength JISC5201-1:1998 Clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once for 10sec, 2mm for 2512,2010,1218 3mm for 1210,1206,0805,0603 5mm for 0402,0201	±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: 3N for 0201, 5N for others 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	Ohers: ±5%: ΔR/R max. ±(2%+0.05Ω) ±1%: ΔR/R max. ±(1%+0.05Ω) No visible damage 0201: ΔR/R max. ±(2%+0.10Ω) No visible damage	<50mΩ
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	Others: ±5%: ΔR/R max. ±(2%+0.1Ω) ±1%: ΔR/R max. ±(1%+0.1Ω) 2512,2010,1218: ΔR/R max. ±(3%+0.05Ω) 0201: 10Ω≤R<1MΩ : ΔR/R max. ±(3%+0.10Ω) R<10Ω, R≥1MΩ : ΔR/R max. ±(5%+0.10Ω)	<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) 2512,2010,1218: ΔR/R max. ±(3%+0.05Ω) 0201: 10Ω≤R<1MΩ : ΔR/R max. ±(3%+0.10Ω) R<10Ω, R≥1MΩ : ΔR/R max. ±(5%+0.10Ω)	<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	

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PACKAGING

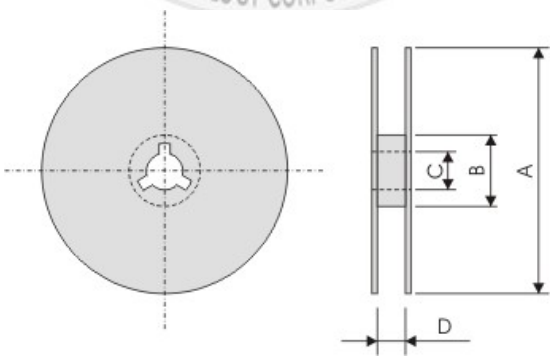
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WR25	6.90±0.20	3.60±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WR20	5.50±0.20	2.80±0.20			
WR18	4.90±0.20	3.55±0.30			
WR10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WR12	3.60±0.20	2.00±0.20			
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	0.67±0.05	0.37±0.05			

Series No.	P1	P0	P2	ΦD	T
WR25	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max.1.2
WR20					Max.1.2
WR18	8.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	1.30±0.20
WR10/12/08	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.80±0.10
WR06					0.70±0.05
WR04	2.00±0.05	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	0.50±0.05
WR02					0.45±0.05

Reel dimensions



Reel	A	B	C	D
7” reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	14.0±0.20 (12mm tape) 9.0±0.5 (8mm tape)
10” reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	
13” reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	

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