

# APPROVAL SHEET

**WR12, WR08, WR06, WR04**

**±1%, ±5%**

General purpose chip resistors

Size 1206, 0805, 0603, 0402

(Special Requirement)

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.

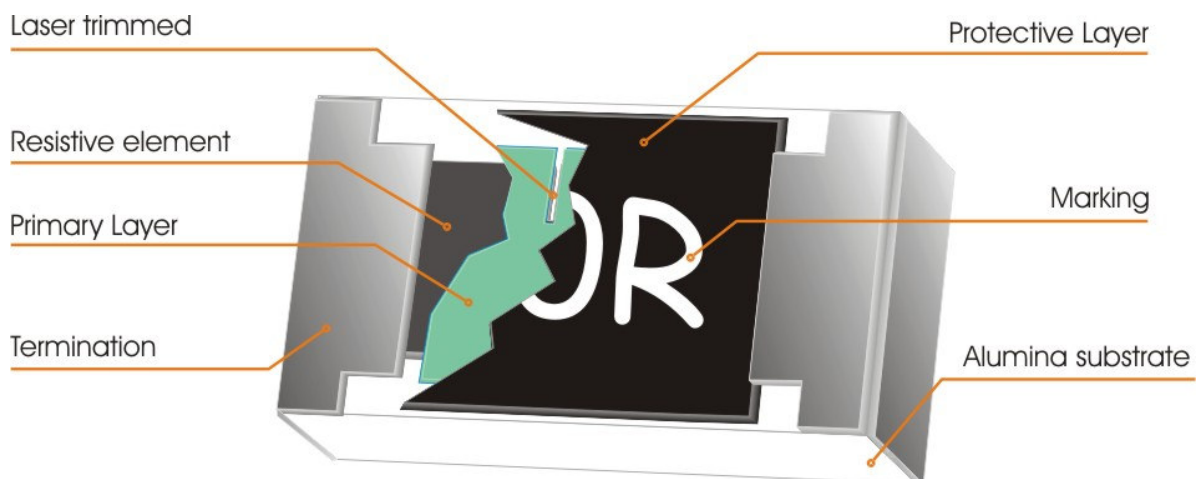


Fig 1. Construction of a Chip-R

## QUICK REFERENCE DATA

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

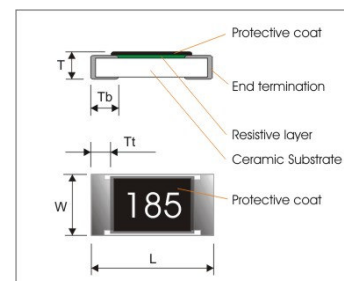
Note :

- 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  

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$$
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        |
|-----------|-------------|-------------|-------------|-------------|
| <b>L</b>  | 3.10 ± 0.10 | 2.00 ± 0.10 | 1.60 ± 0.10 | 1.00 ± 0.05 |
| <b>W</b>  | 1.60 ± 0.10 | 1.25 ± 0.10 | 0.80 ± 0.10 | 0.50 ± 0.05 |
| <b>T</b>  | 0.60 ± 0.15 | 0.50 ± 0.15 | 0.45 ± 0.15 | 0.35 ± 0.05 |
| <b>Tb</b> | 0.45 ± 0.20 | 0.40 ± 0.20 | 0.30 ± 0.15 | 0.25 ± 0.10 |
| <b>Tt</b> | 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%              |
|---------------------------------------|------------------|------------------|
| <b>1206 (3216)</b>                    | 3-digits marking | 4-digits marking |
| <b>0805 (2012)</b>                    | 3-digits marking | 4-digits marking |
| <b>0603 (1608)</b>                    | 3-digits marking | 3-digits marking |
| <b>0402(1005)</b>                     | NO 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. For values up to 9.1 the R is used as a decimal point. For values of 10.0 or greater the first 2 digits apply to the resistance value and third indicate the number of zeros to follow.

**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 :<br>$Y=10^{-2}$ , $X=10^{-1}$ , $A=10^0$ , $B=10^1$ , $C=10^2$ , $D=10^3$ , $E=10^4$ , $F=10^5$<br>EX : 17.8Ω=25X , 178Ω=25A , 1K78 =25B<br>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  $100\Omega$  or greater the first 3 digits are significant, the fourth indicates the number of zeros to follow.

#### Example

| RESISTANCE                                        | $10\Omega$ | $12\Omega$ | $100\Omega$ | $6800\Omega$ | $47000\Omega$ |
|---------------------------------------------------|------------|------------|-------------|--------------|---------------|
| 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

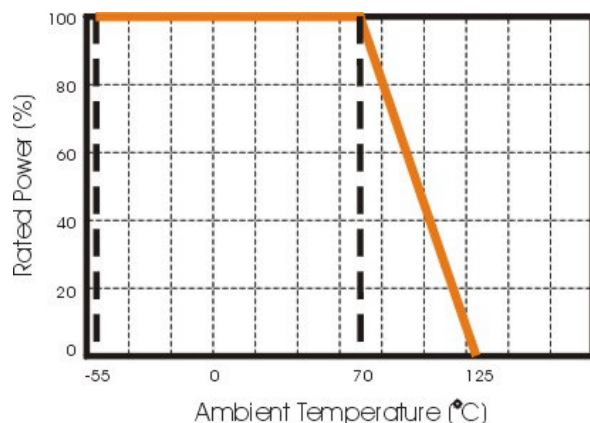


Figure 2.1 Maximum dissipation in percentage of rated power as a function of the ambient temperature for WR12X WR08X, WR06X, WR04X

## 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 245°C during 3 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.

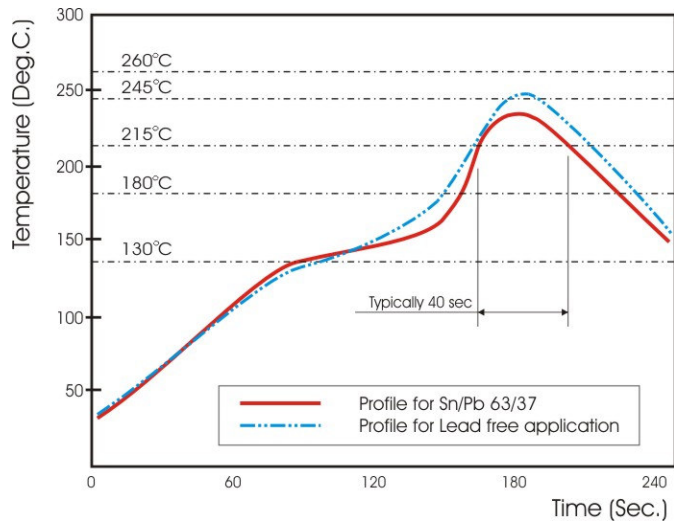


Fig 3. Infrared soldering profile for Chip Resistors

### CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

| WR12                                                     | X                | 472_                                                                                                                                                                                               | J                                | T                                                                                  | L                          | D                                   |
|----------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------|----------------------------|-------------------------------------|
| <b>Size code</b>                                         | <b>Type code</b> | <b>Resistance code</b>                                                                                                                                                                             | <b>Tolerance</b>                 | <b>Packaging code</b>                                                              | <b>Termination code</b>    | <b>Customer code</b>                |
| WR12 : 1206<br>WR08 : 0805<br>WR06 : 0603<br>WR04 : 0402 | X : Normal       | E24 : 2 significant digits<br>followed by no. of<br>zeros and a blank<br>220Ω =221_<br>("_" means a blank)<br>E96 : 3 significant digits<br>followed by no. of zeros<br>102Ω =1020<br>37.4KΩ =3742 | F : ±1%<br>J : ±5%<br>P : Jumper | T : 7" Reeled taping<br>Q : 10" Reeled taping<br>G : 13" Reeled taping<br>B : Bulk | L = Sn base<br>(lead free) | D = Special Customer<br>Requirement |

WR12xxxxFTLD is defined for Dell.

WR08xxxxFTLD is defined for Dell.

WR06xxxxFTLD is defined for Dell.

WR04xxxxFTLD is defined for Dell.

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

## 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<br><b>JISC5201-1:1998</b><br><b>Clause 4.5</b>                                | DC resistance values measured at the test voltages specified below :<br><10Ω@0.1V, <100Ω@0.3V, <1KΩ@1.0V,<br><10KΩ@3V, <100KΩ@10V, <1MΩ@25V, <10MΩ@30V                                                                                                                                                | Within the specified tolerance                                                              | <50mΩ |
| Temperature Coefficient of Resistance(T.C.R)<br><b>JISC5201-1:1998</b><br><b>Clause 4.8</b> | Natural resistance change per change in degree centigrade.<br>$\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)}$ $t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$<br>R <sub>1</sub> : Resistance at reference temperature<br>R <sub>2</sub> : Resistance at test temperature | Refer to "QUICK REFERENCE DATA"                                                             | N/A   |
| Short time overload (S.T.O.L)<br><b>JISC5201-1:1998</b><br><b>Clause 4.13</b>               | 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. Total one cycle.                                                                                                                  | ΔR/R max. ±(1%+0.05Ω) for F tol.<br>ΔR/R max. ±(2%+0.05Ω) for J tol.<br>No visible damage   | <50mΩ |
| Resistance to soldering heat(R.S.H)<br><b>IEC60068-2-58:2004</b>                            | Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 255°C±5°C                                                                                                                                                                                                                 | ΔR/R max. ±(0.5%+0.05Ω) for F tol.<br>ΔR/R max. ±(1%+0.05Ω) for J tol.<br>No visible damage | <50mΩ |
| Solderability<br><b>IEC60068-2-58:2004</b>                                                  | Un-mounted chips completely immersed for 3±0.3second in a SAC solder bath at 245°C±5°C                                                                                                                                                                                                                | 95% coverage min., good tinning<br>No visible damage                                        |       |
| Leaching Test<br><b>JIS C 0054: 1994</b><br><b>IEC 60068-2-58:2004</b>                      | Un-mounted chips completely immersed for 30±1second in a SnPb solder bath at 260°C±5°C                                                                                                                                                                                                                | Ditto                                                                                       |       |
| Insulation Resistance<br><b>JISC5201-1:1998</b><br><b>Clause 4.6</b>                        | Apply the maximum overload voltage (DC) for 1 minutes                                                                                                                                                                                                                                                 | R ≥ 10GΩ                                                                                    |       |
| Dielectric Withstand Voltage<br><b>JISC5201-1:1998</b><br><b>Clause 4.7</b>                 | Apply the maximum overload voltage (AC) for 1 minutes                                                                                                                                                                                                                                                 | No breakdown or flashover                                                                   |       |

| TEST                                                                                 | PROCEDURE / TEST METHOD                                                                                                                                                                   | REQUIREMENT                                                                                 |       |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------|
|                                                                                      |                                                                                                                                                                                           | Resistor                                                                                    | 0Ω    |
| Temperature cycling<br><b>JISC5201-1:1998</b><br><b>Clause 4.19</b>                  | 30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C-1°C,<br>30 minutes at +125°C±3°C, 2~3 minutes at 20°C+5°C-1°C,<br>total 5 continuous cycles                                              | ΔR/R max. ±(0.5%+0.05Ω) for F tol.<br>ΔR/R max. ±(1%+0.05Ω) for J tol.                      | <50mΩ |
| Damp Heat<br>(Load life in humidity)<br><b>JISC5201-1:1998</b><br><b>Clause 4.24</b> | 1000+48/-0 hours; 1.5hours ON, 0.5hours OFF at RCWV in a<br>humidity chamber controlled 40±2°C, 90~95% RH                                                                                 | ΔR/R max. ±(0.5%+0.05Ω) for tol.<br>ΔR/R max. ±(2%+0.05Ω) for J tol.<br>No visible damage   | <50mΩ |
| Load Life (Endurance)<br><b>JISC5201-1:1998</b><br><b>Clause 4.25</b>                | 1000+48/-0 hours; loaded with P <sub>n</sub> or V <sub>max</sub> ; 1.5 hours ON, 0.5 hours<br>OFF in a temperature chamber controlled 70±2°C                                              | ΔR/R max. ±(1%+0.05Ω) for F tol.<br>ΔR/R max. ±(3%+0.05Ω) for J tol.<br>No visible damage   | <50mΩ |
| Bending strength<br><b>JISC5201-1:1998</b><br><b>Clause 4.33</b>                     | Resistors mounted on a 90mm glass epoxy resin PCB(FR4),<br>bending once 5mm for 10sec                                                                                                     | ΔR/R max. ±(1%+0.05Ω) for F tol.<br>ΔR/R max. ±(1%+0.05Ω) for J tol.<br>No visible damage   | <50mΩ |
| Adhesion<br><b>JISC5201-1:1998</b><br><b>Clause 4.32</b>                             | Pressurizing force: 5N, Test time: 10±1sec.                                                                                                                                               | No remarkable damage or removal of the terminations                                         |       |
| Thermal shock<br><b>MIL-STD-202G 107G</b>                                            | Test condition F-1, -65(+0/-5)°C for 15min and +155(+3/-0)°C<br>for 15min, 25 cycles                                                                                                      | ΔR/R max. ±(0.5%+0.05Ω) for F tol.<br>ΔR/R max. ±(1%+0.05Ω) for J tol.<br>No visible damage | <50mΩ |
| Low Temperature<br>Operation<br><b>MIL-PRF-55342H 3.11</b>                           | -65(+0/-5)°C for 1 hour, RCWV applied for 45mins                                                                                                                                          | ΔR/R max. ±(0.5%+0.05Ω) for F tol.<br>ΔR/R max. ±(1%+0.05Ω) for J tol.<br>No visible damage | <50mΩ |
| Intermittent Overload<br><b>JISC5202</b><br><b>Clause 5.8</b>                        | Permanent resistance change after a 1 second ON and 25<br>seconds OFF application of a voltage 2.5 times RCWV or the<br>maximum overload voltage, whichever is less. Total 10,000 cycles. | ΔR/R max. ±(1%+0.05Ω) for F tol.<br>ΔR/R max. ±(2%+0.05Ω) for J tol.<br>No visible damage   | <50mΩ |
| Moisture Resistance<br>Heat<br><b>MIL-STD-202G 106G</b>                              | t=24 hours/cycle, 42 continuous cycles, total 1000 hours                                                                                                                                  | ΔR/R max. ±(0.5%+0.05Ω) for F tol.<br>ΔR/R max. ±(2%+0.05Ω) for J tol.<br>No visible damage | <50mΩ |

**TEST CONDITION FOR JUMPER (0 Ω)**

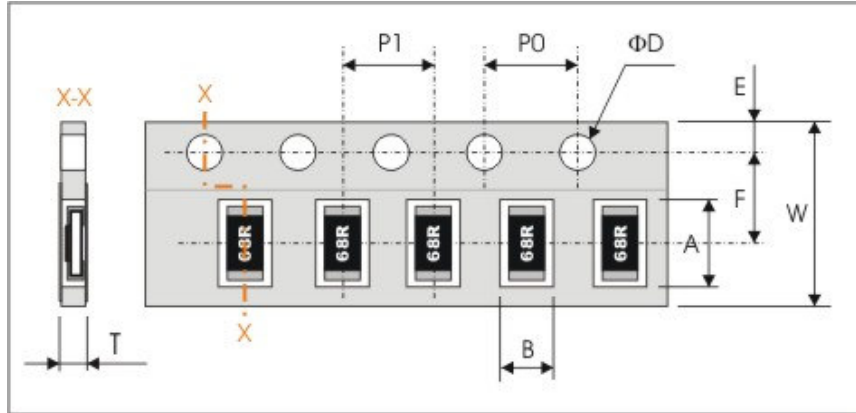
| Item                 | WR12     | WR08 | WR06  | WR04  |
|----------------------|----------|------|-------|-------|
| Power Rating At 70°C | 1/4W     | 1/8W | 1/10W | 1/16W |
| Resistance           | MAX.50mΩ |      |       |       |



|                       |           |    |    |    |
|-----------------------|-----------|----|----|----|
| Rated Current         | 2A        | 2A | 1A | 1A |
| Peak Current          | 10A       | 5A | 3A | 2A |
| Operating Temperature | -55~125°C |    |    |    |

**PACKAGING**

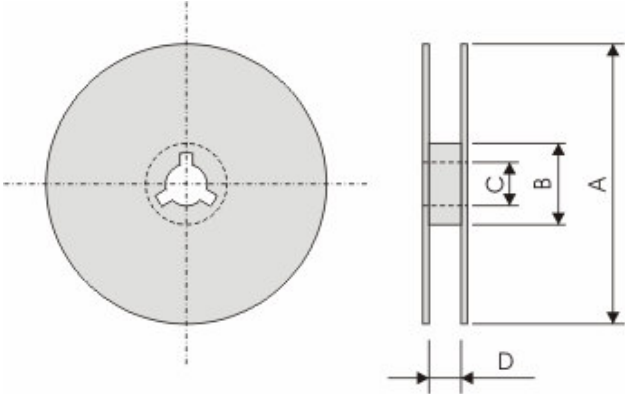
**Paper Tape specifications** (unit :mm)



| 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 | Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub> | Max. 1.0  |
| WR06        |           |           |                                       | 0.65±0.05 |
| WR04        |           |           |                                       | 0.40±0.05 |

**7" Reel dimensions**



| Symbol      | A                    | B                   | C              | D             |
|-------------|----------------------|---------------------|----------------|---------------|
| (unit : mm) | $\Phi 178.0 \pm 2.0$ | $\Phi 60.0 \pm 1.0$ | $13.0 \pm 0.2$ | $9.0 \pm 0.5$ |