

# APPROVAL SHEET

**WF20M / WF12M / WF08M / WF06M**

**0/-20% and 0/-30%**

Trimmable chip resistors

Size 2010, 1206, 0805, 0603

## FEATURE

1. Reduced size of final equipment
2. Lower assembly costs
3. Higher component and equipment reliability
4. Improved performance at high frequency
5. Low noise, when not trimmed
6. RoHS compliant and Lead free products

## APPLICATION

- Consumer electrical equipment
- Automotive application
- EDP, Computer application
- Telecom application

## DESCRIPTION

The resistors are constructed on a high-grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive paste, which is applied to the substrate. The composition of the paste is adjusted to give the approximate resistance required.

The resistive layer is covered with a transparent protective coating. Finally the two external end terminations are added. For case of soldering the outer of these end terminations is Tin (lead free) alloy.

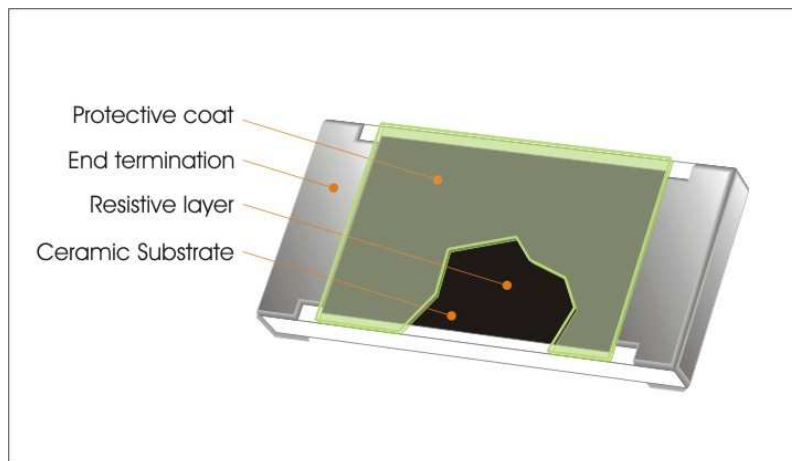


Fig 1. Construction of Trimmable Chip-R

## QUICK REFERENCE DATA

| Item                                       | General Specification                                         |             |             |             |
|--------------------------------------------|---------------------------------------------------------------|-------------|-------------|-------------|
| Series No.                                 | WF20M                                                         | WF12M       | WF08M       | WF06M       |
| Size code                                  | 2010 (5020)                                                   | 1206 (3216) | 0805 (2012) | 0603 (1608) |
| Resistance Range                           | 1Ω ~ 10MΩ Tolerance 0/-10% and 0/-20% and 0/-30% (E24 series) |             |             |             |
| TCR (ppm/°C)<br>≥10Ω<br><10Ω               | ≤ ± 200 ppm/°C<br>-300~+500 ppm/°C                            |             |             |             |
| Max. dissipation at T <sub>amb</sub> =70°C | 1/2W                                                          | 1/4 W       | 1/8W        | 1/10W       |
| Max. Operation Voltage (DC or RMS)         | 200V                                                          | 200V        | 100V        | 50V         |
| Max. Over Load Voltage (DC or RMS)         | 400V                                                          | 400V        | 200V        | 100V        |
| Climatic category (IEC 60068)              | 55/155/56                                                     |             |             |             |

Note :

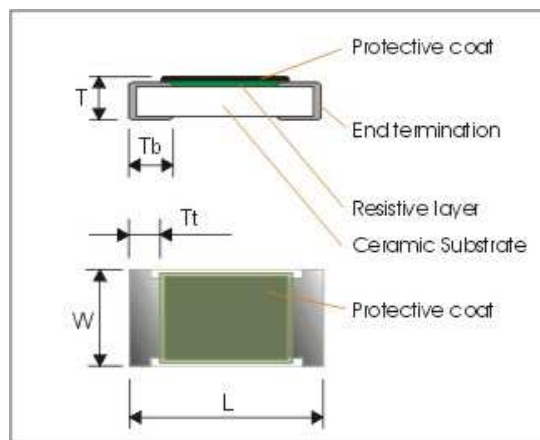
1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

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

## DIMENSIONS(unit : mm)

|           | WF20M       | WF12M       |
|-----------|-------------|-------------|
| <b>L</b>  | 5.00 ± 0.20 | 3.10 ± 0.10 |
| <b>W</b>  | 2.50 ± 0.20 | 1.60 ± 0.10 |
| <b>T</b>  | 0.55 ± 0.15 | 0.60 ± 0.15 |
| <b>Tb</b> | 0.65 ± 0.25 | 0.45 ± 0.20 |
| <b>Tt</b> | 0.60 ± 0.25 | 0.50 ± 0.20 |

|           | WF08M       | WF06M       |
|-----------|-------------|-------------|
| <b>L</b>  | 2.00 ± 0.10 | 1.60 ± 0.10 |
| <b>W</b>  | 1.25 ± 0.10 | 0.80 ± 0.10 |
| <b>T</b>  | 0.50 ± 0.15 | 0.45 ± 0.15 |
| <b>Tb</b> | 0.40 ± 0.20 | 0.30 ± 0.20 |
| <b>Tt</b> | 0.40 ± 0.20 | 0.30 ± 0.10 |



## MARKING

*No marking for Trimmable Chip Resistor*

## TRIMMING INTRODUCTIONS

Typical value for a YAG-laser;

cutting speed : 10-200 mm/sec,

laser power : 1-6 Watt,

bite size : 3~10 $\mu$ m ( = speed / Q\_rate , Bite Size is the distance each laser spot moving and influence the trimming accuracy)

maximum trimming length : 60% of resistive film width, minimum distance from end termination to trimming cut : 0.20mm, minimum distance between cuts (double-cut) : 0.5mm

### Protection of the laser cut

by epoxy-fenol lacquers, epoxy resins or silicon alkyd-resins.

This is necessary for humidity test and stability under loaded.

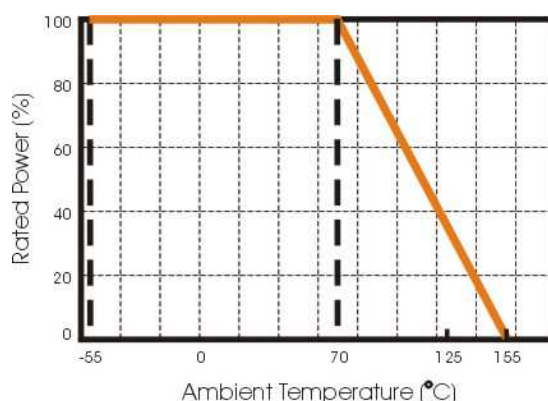
## FUNCTIONAL DESCRIPTION

### 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



**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.

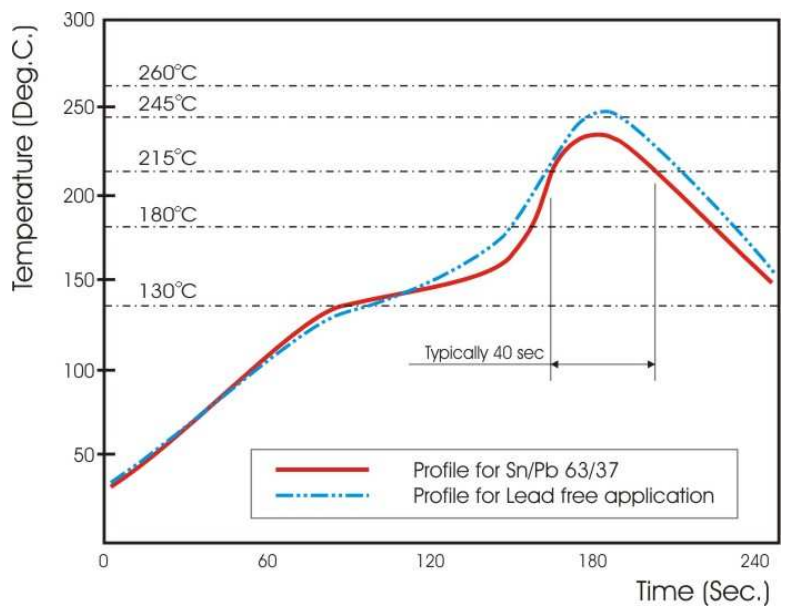


Fig 3. Infrared soldering profile for Chip Resistors

## CATALOGUE NUMBERS

The resistors have a catalogue number starting with :

| WF12        | M             | 472_                                                            | M          | T                    | L                       |
|-------------|---------------|-----------------------------------------------------------------|------------|----------------------|-------------------------|
| Size code   | Type code     | Resistance code                                                 | Tolerance  | Packaging code       | Termination code        |
| WF20 : 2010 | M : Trimmable | E24 : 2 significant digits followed by no. of zeros and a blank | X : 0/-30% | T : 7" Reeled taping | L = Sn base (lead free) |
| WF12 : 1206 |               |                                                                 | Y : 0/-20% | B : Bulk             |                         |
| WF08 : 0805 |               | 4.7Ω =4R7_                                                      | Z : 0/-10% |                      |                         |
| WF06 : 0603 |               | 10Ω =100_<br>220Ω =221_<br>(“_” means a blank)                  |            |                      |                         |

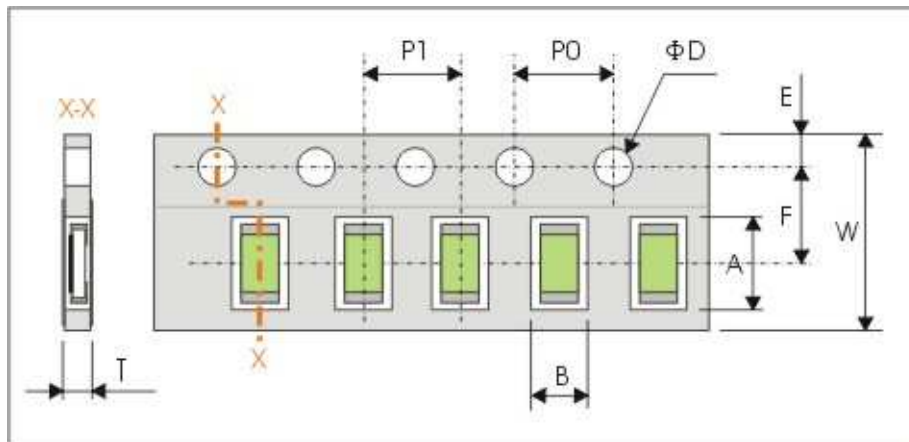
- Reeled tape packaging : WF12M / WF08M / WF06M - 8mm width paper taping 5000pcs per reel.  
: WF20M – 12mm width paper taping 4000pcs per reel.
- Bulk packaging : WF12M / WF08M / WF06M - 5000pcs per polybag  
: WF20M – 4000pcs per polybag

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

| TEST                                                              | PROCEDURE                                                                                                                                                                                                                    | REQUIREMENT                                          |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| DC resistance<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, <10KΩ@3V,<br><100KΩ@10V, <1MΩ@25V, <10MΩ@30V                                                                       | Within the specified tolerance                       |
| Temperature Coefficient of Resistance(T.C.R)<br><b>Clause 4.8</b> | Natural resistance change per change in degree centigrade.<br>$\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) ; t1 : 20°C+5°C-1°C<br>R1 : Resistance at reference temperature<br>R2 : Resistance at test temperature | Refer to<br>"QUICK REFERENCE DATA"                   |
| Short time overload (S.T.O.L)<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.                                                          | ΔR/R max. ±(2.0%+0.10Ω)                              |
| Resistance to soldering heat(R.S.H)<br><b>Clause 4.18</b>         | Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260°C±5°C                                                                                                                                        | no visible damage<br>ΔR/R max. ±(1.0%+0.05Ω)         |
| Solderability<br><b>Clause 4.17</b>                               | Un-mounted chips completely immersed for 2±0.5 second in a SAC solder bath at 235°C±5°C                                                                                                                                      | good tinning (>95% covered)<br>no visible damage     |
| Temperature cycling<br><b>Clause 4.19</b>                         | 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<br>ΔR/R max. ±(0.5%+0.05Ω)         |
| Load life (endurance)<br><b>Clause 4.25</b>                       | 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%+0.1Ω)                               |
| Load life in Humidity<br><b>Clause 4.24</b>                       | 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%+0.1Ω)                               |
| Bending strength<br><b>Clause 4.33</b>                            | Resistors mounted on a 90mm glass epoxy resin PCB(FR4); bending : 3 mm, once for 10 seconds. (only 2010: 2mm)                                                                                                                | no visible damage<br>ΔR/R max. ±(1%+0.05Ω)           |
| Adhesion<br><b>Clause 4.32</b>                                    | Pressurizing force: 5N, Test time: 10±1sec.                                                                                                                                                                                  | No remarkable damage or removal of the terminations. |
| Insulation Resistance<br><b>Clause 4.6</b>                        | Apply the maximum overload voltage (DC) for 1minute                                                                                                                                                                          | R ≥ 10G Ω                                            |
| Dielectric Withstand Voltage<br><b>Clause 4.7</b>                 | Apply the maximum overload voltage (AC) for 1 minute                                                                                                                                                                         | No breakdown or flashover                            |

## PACKAGING

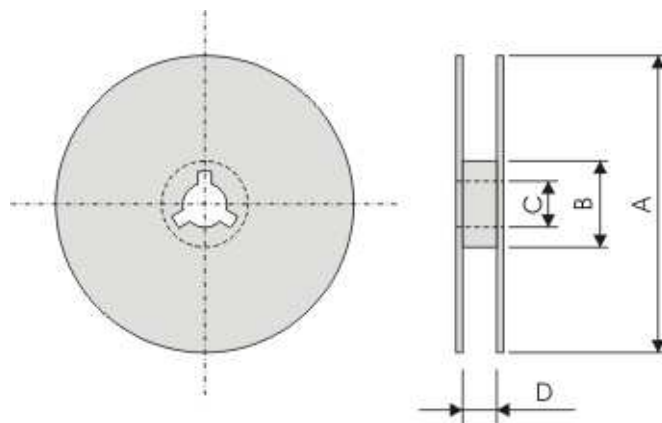
Paper Tape specifications (unit :mm)



| Series No. | A         | B         | W          | F         | E         |
|------------|-----------|-----------|------------|-----------|-----------|
| WF20M      | 5.50±0.20 | 2.80±0.20 | 12.00±0.30 | 5.50±0.1  | 1.75±0.10 |
| WF12M      | 3.60±0.20 | 2.00±0.20 | 8.00±0.30  | 3.50±0.20 | 1.75±0.10 |
| WF08M      | 2.40±0.20 | 1.65±0.20 |            |           |           |
| WF06M      | 1.90±0.20 | 1.10±0.20 |            |           |           |

| Series No.    | P1        | P0        | ΦD                                    | T         |
|---------------|-----------|-----------|---------------------------------------|-----------|
| WF20M         | 4.00±0.10 | 4.00±0.10 | Φ1.50 <sup>+0.1</sup> <sub>-0.0</sub> | Max. 1.2  |
| WF12M / WF08M |           |           |                                       | Max. 1.0  |
| WF06M         |           |           |                                       | 0.65±0.05 |

## Reel dimensions



| Symbol (unit : mm)   | A          | B         | C        | D        |
|----------------------|------------|-----------|----------|----------|
| WF12M / WF08M / WF06 | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 9.0±0.5  |
| WF20M                | Φ178.0±2.0 | Φ60.0±1.0 | 13.0±0.2 | 14.0±0.2 |