



## Features

- Surge withstand IEC 61000-4-5 1.2/50  $\mu$ s
- Low thermal resistant ceramic core
- E24 resistance values
- RoHS compliant\*
- Wide power range (1~8 W)
- Coating material meets UL 94V-0 requirements

## Applications

- Smart meters
- Renewable energy
- Industrial
- Power supplies/chargers
- Lighting
- Instruments/gauges
- White goods

# WS Series High Surge Withstand Wirewound Resistor

### Electrical Characteristics

|                               |                                     |
|-------------------------------|-------------------------------------|
| Resistance Range .....        | See Popular Resistance Values Table |
| Power Rating @ 70 °C          |                                     |
| WS1M, WS1A .....              | 1 W                                 |
| WS2M, WS2A .....              | 2 W                                 |
| WS3M, WS3A .....              | 3 W                                 |
| WS5M, WS5A .....              | 5 W                                 |
| WS7M, WS7A .....              | 7 W                                 |
| WS8M .....                    | 8 W                                 |
| Tolerance .....               | 5 %                                 |
| Operating Temperature .....   | -55 °C to +200 °C                   |
| Temperature Coefficient ..... | $\pm 200$ ppm/°C                    |
| Maximum Voltage .....         | $\sqrt{P \cdot R}$                  |

### Popular Resistance Values

| Code | R Value     |
|------|-------------|
| 15R0 | 15 $\Omega$ |
| 20R0 | 20 $\Omega$ |
| 22R0 | 22 $\Omega$ |
| 33R0 | 33 $\Omega$ |
| 47R0 | 47 $\Omega$ |

| Code | R Value       |
|------|---------------|
| 68R0 | 68 $\Omega$   |
| 1500 | 150 $\Omega$  |
| 1001 | 1K $\Omega$   |
| 3301 | 3.3K $\Omega$ |

Other E24 resistance values available upon request.

### Physical Characteristics

|                        |                                    |
|------------------------|------------------------------------|
| Resistor .....         | Low thermal resistant ceramic core |
| Lead Wire .....        | Tin-plated copper wire             |
| Coating Material ..... | Meets UL 94V-0 requirements        |

### Environmental Characteristics

| Test                      | Conditions                                                                                                                                     | Specification                            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Short Time Overload       | 10 times rated power for 5 seconds.                                                                                                            | $\Delta R \leq \pm(5\% \pm 0.05 \Omega)$ |
| Solderability             | 245 $\pm 3$ °C for 2.5 $\pm 0.5$ seconds.                                                                                                      | Over 95 % coverage                       |
| Resistance to Solder Heat | 260 $\pm 5$ °C for 10 $\pm 1$ seconds.                                                                                                         | $\Delta R \leq \pm(1\% + 0.05 \Omega)$   |
| Temperature Cycle         | 5 cycles, -55 °C $\pm 3$ °C for 30 minutes, Room temperature for 15 minutes, +155 $\pm 2$ °C for 30 minutes, Room temperature for 15 minutes   | $\Delta R \leq \pm(2\% + 0.05 \Omega)$   |
| Dielectric Strength       | Test voltage >500 Vrms for >1 minute.                                                                                                          | Pass                                     |
| Insulation Resistance     | Test voltage >500 Vrms for 1 minute.                                                                                                           | >10 $\Omega$                             |
| Load Life Humidity        | Rated continuous voltage for 1000 hours, 1.5 hours ON and 0.5 hours OFF at 90~95 % relative humidity and test temperature of 40 °C $\pm 2$ °C. | $\Delta R \leq \pm(5\% + 0.05 \Omega)$   |
| Load Life                 | Rated continuous voltage for 1000 hours, 1.5 hours ON and 0.5 hours OFF at a test temperature of 70 °C $\pm 2$ °C. 1000 hours at rated power.  | $\Delta R \leq \pm(5\% + 0.05 \Omega)$   |
| Surge                     | IEC 61000-4-5 1.2/50 $\mu$ s exponential.                                                                                                      | $\Delta R \leq \pm(5\% + 0.05 \Omega)$   |

### How to Order

|                                                   |                      |
|---------------------------------------------------|----------------------|
| Product Series                                    | <b>WS 3 M 22R0 J</b> |
| WS = Wirewound, High Surge Withstand              |                      |
| Power Rating                                      |                      |
| 1 = 1 Watt                                        |                      |
| 2 = 2 Watts                                       |                      |
| 3 = 3 Watts                                       |                      |
| 5 = 5 Watts                                       |                      |
| 7 = 7 Watts                                       |                      |
| 8 = 8 Watts                                       |                      |
| Pin Style                                         |                      |
| A = Axial Standard Version                        |                      |
| M = Axial Miniaturized Version                    |                      |
| Resistance Code                                   |                      |
| • R < 100 ohms:                                   |                      |
| "R" represents decimal point                      |                      |
| (example: 22R0 = 22 ohms)                         |                      |
| • R $\geq$ 100 ohms:                              |                      |
| First three digits are significant,               |                      |
| fourth digit represents number of zeros to follow |                      |
| (example: 1001 = 1K ohms)                         |                      |
| Resistance Tolerance                              |                      |
| J = $\pm 5\%$                                     |                      |

\*RoHS Directive 2002/95/EC Jan. 27, 2003 including annex and RoHS Recast 2011/65/EU June 8, 2011.

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The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time. Users should verify actual device performance in their specific applications.

# WS Series High Surge Withstand Wirewound Resistor

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## Product Dimensions



| Model | Dimensions                              |                                       |                                         |                                         |
|-------|-----------------------------------------|---------------------------------------|-----------------------------------------|-----------------------------------------|
|       | L*                                      | D                                     | W                                       | T                                       |
| WS1M  | $\frac{9.5 \pm 1.0}{(.374 \pm .004)}$   | $\frac{4.5 \pm 1.0}{(.177 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.65 \pm 0.05}{(.026 \pm .002)}$ |
| WS1A  | $\frac{11.5 \pm 1.0}{(.453 \pm .004)}$  | $\frac{5.0 \pm 1.0}{(.197 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.65 \pm 0.05}{(.026 \pm .002)}$ |
| WS2M  | $\frac{11.5 \pm 1.0}{(.453 \pm .004)}$  | $\frac{5.0 \pm 1.0}{(.197 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.65 \pm 0.05}{(.026 \pm .002)}$ |
| WS2A  | $\frac{15.5 \pm 1.0}{(.610 \pm .004)}$  | $\frac{5.5 \pm 1.0}{(.217 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS3M  | $\frac{15.5 \pm 1.0}{(.610 \pm .004)}$  | $\frac{5.5 \pm 1.0}{(.217 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS3A  | $\frac{17.5 \pm 1.0}{(.689 \pm .004)}$  | $\frac{6.5 \pm 1.0}{(.256 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS5M  | $\frac{17.5 \pm 1.0}{(.689 \pm .004)}$  | $\frac{6.5 \pm 1.0}{(.256 \pm .004)}$ | $\frac{28.0 \pm 3.0}{(1.102 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS5A  | $\frac{24.5 \pm 1.0}{(.965 \pm .004)}$  | $\frac{8.5 \pm 1.0}{(.335 \pm .004)}$ | $\frac{38.0 \pm 3.0}{(1.496 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS7M  | $\frac{24.5 \pm 1.0}{(.965 \pm .004)}$  | $\frac{8.5 \pm 1.0}{(.335 \pm .004)}$ | $\frac{38.0 \pm 3.0}{(1.496 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS7A  | $\frac{29.5 \pm 1.0}{(1.161 \pm .004)}$ | $\frac{8.5 \pm 1.0}{(.335 \pm .004)}$ | $\frac{38.0 \pm 3.0}{(1.496 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |
| WS8M  | $\frac{29.5 \pm 1.0}{(1.161 \pm .004)}$ | $\frac{8.5 \pm 1.0}{(.335 \pm .004)}$ | $\frac{38.0 \pm 3.0}{(1.496 \pm .118)}$ | $\frac{0.75 \pm 0.05}{(.030 \pm .002)}$ |

## Typical Part Marking

Resistors shall be marked with color coding. Colors shall be in accordance with JIS C 0802.



| Color  | 1st Band | 2nd Band | Multiplier | Tol.    |
|--------|----------|----------|------------|---------|
| Black  | 0        | 0        | 1 Ω        |         |
| Brown  | 1        | 1        | 10 Ω       | ±1 %    |
| Red    | 2        | 2        | 100 Ω      | ±2 %    |
| Orange | 3        | 3        | 1K Ω       |         |
| Yellow | 4        | 4        | 10K Ω      |         |
| Green  | 5        | 5        | 100K Ω     | ±0.5 %  |
| Blue   | 6        | 6        | 1M Ω       | ±0.25 % |
| Violet | 7        | 7        | 10M Ω      | ±0.10 % |
| Grey   | 8        | 8        |            | ±0.05 % |
| White  | 9        | 9        |            |         |
| Gold   |          |          | 0.1 Ω      | ±5 %    |
| Silver |          |          | 0.01 Ω     | ±10 %   |

## Power Derating Curve



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# WS Series High Surge Withstand Wirewound Resistor

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## Packaging Specifications



| Model      | O                                   | P                                    | A                                    | B                                    | C                                     | Pkg. Style | Min. Order Qty. (Pcs.) | Pcs./ Box  |
|------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|------------|------------------------|------------|
| WS1M       | $\frac{58 \pm 1}{(2.283 \pm .039)}$ | $\frac{5 \pm 0.3}{(.197 \pm .112)}$  | $\frac{75 \pm 5}{(2.953 \pm .197)}$  | $\frac{70 \pm 5}{(2.756 \pm .197)}$  | $\frac{255 \pm 5}{(10.039 \pm .197)}$ | Ammo Pack  | 5,000                  | 1,000 pcs. |
| WS1A, WS2M | $\frac{58 \pm 1}{(2.283 \pm .039)}$ | $\frac{5 \pm 0.3}{(.197 \pm .112)}$  | $\frac{80 \pm 5}{(3.150 \pm .197)}$  | $\frac{82 \pm 5}{(3.228 \pm .197)}$  | $\frac{255 \pm 5}{(10.039 \pm .197)}$ |            |                        |            |
| WS2A, WS3M | $\frac{65 \pm 5}{(2.559 \pm .197)}$ | $\frac{10 \pm 0.3}{(.393 \pm .112)}$ | $\frac{90 \pm 5}{(3.543 \pm .197)}$  | $\frac{119 \pm 5}{(4.685 \pm .197)}$ | $\frac{255 \pm 5}{(10.039 \pm .197)}$ |            |                        |            |
| WS3A, WS5M | $\frac{65 \pm 5}{(2.559 \pm .197)}$ | $\frac{10 \pm 0.3}{(.393 \pm .112)}$ | $\frac{90 \pm 5}{(3.543 \pm .197)}$  | $\frac{88 \pm 5}{(3.465 \pm .197)}$  | $\frac{255 \pm 5}{(10.039 \pm .197)}$ |            |                        |            |
| WS5A, WS7M | $\frac{90 \pm 5}{(3.543 \pm .197)}$ | $\frac{10 \pm 0.3}{(.393 \pm .112)}$ | $\frac{115 \pm 5}{(4.528 \pm .197)}$ | $\frac{124 \pm 5}{(4.882 \pm .197)}$ | $\frac{500 \pm 5}{(19.685 \pm .197)}$ |            | 2,000                  | 500 pcs.   |

For WS7A and WS8M packaging specifications, please contact factory.

## Surge Performance - 1.2/50 $\mu$ s Pulse Withstanding Curve



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