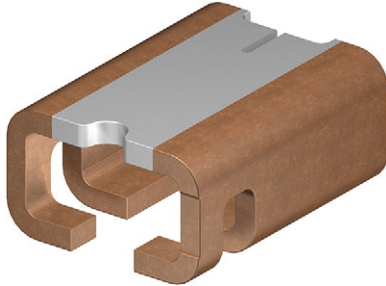


# Power Metal Strip® Resistors, Low Value, High Power, Surface-Mount, 4-Terminal



## LINKS TO ADDITIONAL RESOURCES



## FEATURES

- 4-terminal design allows for 1 % tolerance down to 0.0002 Ω
- High power-to-footprint print size ratio
- All welded Power Metal Strip® construction is ideal for all types of current sensing, voltage division and pulse applications
- Proprietary processing technique produces extremely low resistance values, down to 0.0002 Ω
- Sulfur resistance by construction that is unaffected by high sulfur environments
- Solid metal MnCu, MnCuSn, or NiCr alloy resistive element with low TCR (< 20 ppm/°C)
- Very low inductance < 1.5 nH
- Low thermal EMF (< 3 μV/°C)
- Maximum solder temperature up to 350 °C for 30 s
- AEC-Q200 qualified <sup>(1)</sup>
- PATENT(S): [www.vishay.com/patents](http://www.vishay.com/patents)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## Note

- <sup>(1)</sup> Flame retardance test may not be applicable to some resistor technologies

| STANDARD ELECTRICAL SPECIFICATIONS |      |  |                  |  |                                   |
|------------------------------------|------|--|------------------|--|-----------------------------------|
| GLOBAL MODEL                       | SIZE | POWER RATING <sup>(1)</sup><br>$P_{70^{\circ}\text{C}}$<br>W | TOLERANCE<br>± % | RESISTANCE VALUE RANGE <sup>(2)</sup><br>Ω | WEIGHT (typical)<br>g/1000 pieces |
| WSK1216                            | 1216 | 3.0  | 1.0              | 2m   | 60                                |
|                                    |      | 3.0  | 1.0              | 1m   | 60                                |
|                                    |      | 5.0  | 1.0              | 0.5m                                       | 60                                |
|                                    |      | 8.0  | 1.0              | 0.3m                                       | 60                                |
|                                    |      | 8.0  | 1.0              | 0.2m                                       | 60                                |

## Notes

- The full power rating of Power Metal Strip resistors are dependent upon the ability of the circuit board to dissipate the heat energy created in the resistance element. It is recommended to follow common design practices for power semiconductors that ensure the junction temperature is maintained within thermal limits by using large pad surfaces, thermal vias, heavier copper weights, internal layers as well as other thermal spreading features. The thermal resistance values provided function in the same manner as junction to terminal temperature
  - Qualified to AEC-Q200 rev. D
- <sup>(1)</sup> Terminal temperature power rating  
<sup>(2)</sup> Other values may be available, contact factory

| GLOBAL PART NUMBER INFORMATION  |   |   |   |   |   |   |   |  |   |   |   |   |   |   |  |  |
|---|---|---|---|---|---|---|---|--|---|---|---|---|---|---|--|--|
| Global Part Numbering Example: WSK12161L000FEA (WSK1216, 0.001 Ω, ± 1 %)                                      |   |   |   |   |   |   |   |  |   |   |   |   |   |   |  |  |
| (visit <a href="http://www.vishay.net">www.vishay.net</a> Vishay Dale parts numbering manual for all options) |   |   |   |   |   |   |   |  |   |   |   |   |   |   |  |  |
| W   | S | K | 1   | 2 | 1 | 6                                       | 1 | L  | 0 | 0 | 0   | F | E | A |  |  |
| GLOBAL MODEL (7 digits)<br><b>WSK1216</b>   |   |   | RESISTANCE VALUE (5 digits)<br>L = mΩ<br>1L000 = 0.0010 Ω<br>L5000 = 0.0005 Ω |   |   | TOLERANCE CODE (1 digit)<br>F = ± 1.0 % |   | PACKAGING CODE <sup>(1)</sup> (2 digits)<br>EA = lead (Pb)-free, tape / reel |   |   | SPECIAL <sup>(2)</sup> (2 digits)<br>(dash number) (up to 2 digits)<br>From 1 to 99 as applicable |   |   |   |  |  |

## Notes

- <sup>(1)</sup> Packaging code: EB (lead (Pb)-free) is a non-standard packaging code designating 1000 piece reels. The non-standard packaging code is identical to our standard EA (lead (Pb)-free), except that it has a package quantity of 1000 pieces
- <sup>(2)</sup> Follow link for customization capabilities: [www.vishay.com/doc?48163](http://www.vishay.com/doc?48163)

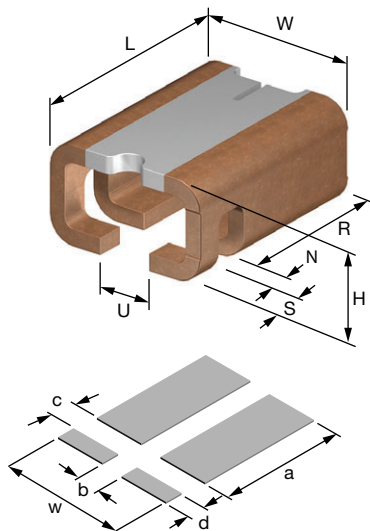
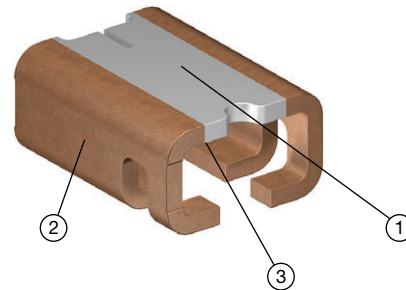
PATENT(S): [www.vishay.com/patents](http://www.vishay.com/patents)

This Vishay product is protected by one or more United States and international patents.

| TECHNICAL SPECIFICATIONS  |        |   |
|---|--------|---|
| PARAMETER   | UNIT   | WSK RESISTOR CHARACTERISTICS  |
| Component temperature coefficient (including terminal) <sup>(1)</sup> | ppm/°C | < 35 ppm, 0.2 mΩ and 0.3 mΩ<br>± 50 ppm, 1 mΩ and 2 mΩ<br>± 150 ppm, 0.5 mΩ |
| Element TCR <sup>(3)</sup>  | ppm/°C | < 20  |
| Operating temperature range   | °C     | -65 to +170   |
| Maximum working voltage <sup>(4)</sup>                                | V      | $(P \times R)^{1/2}$  |

**Notes**

- (1) Component TCR - total TCR that includes the TCR effects of the resistor element and the copper terminal; over temperature of 25 °C to +170 °C
- (2) Element TCR - only applies to the alloy used for the resistor element
- (3) Maximum working voltage - the WSL is not voltage sensitive, but is limited by power / energy dissipation and is also not ESD sensitive

**DIMENSIONS** in inches (millimeters)

**CONSTRUCTION OUTLINE**


- ① Resistive element: refer to table below for element material
- ② Terminal: solid copper
- ③ Terminal / element weld

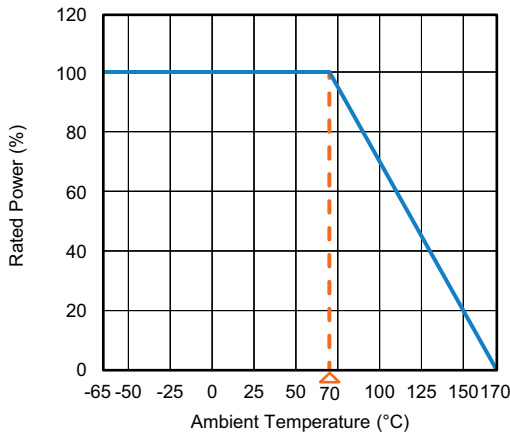
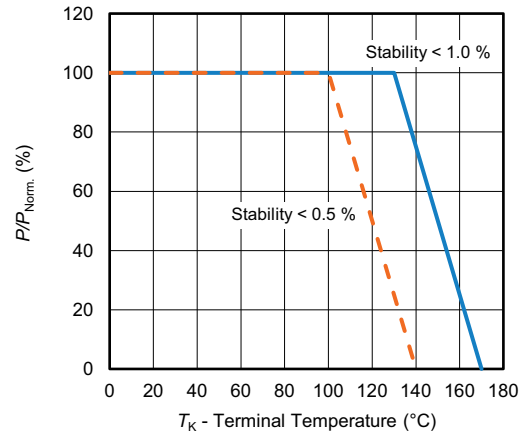
| MODEL   | DIMENSIONS in inches (millimeters) |                               |                               |                 |                              |                              |                               |
|---------|------------------------------------|-------------------------------|-------------------------------|-----------------|------------------------------|------------------------------|-------------------------------|
|         | W                                  | L                             | H                             | R (REF.)        | S                            | U                            | N                             |
| WSK1216 | 0.122 - 0.014<br>(3.1 - 0.35)      | 0.150 ± 0.012<br>(3.81 ± 0.3) | 0.075 - 0.014<br>(1.9 - 0.35) | 0.106<br>(2.70) | 0.020 ± 0.004<br>(0.5 ± 0.1) | 0.031 + 0.012<br>(0.8 + 0.3) | 0.024 ± 0.006<br>(0.6 ± 0.15) |

| MODEL   | SOLDER PAD DIMENSIONS |                 |                 |                 |                 |
|---------|-----------------------|-----------------|-----------------|-----------------|-----------------|
|         | a                     | b               | c               | d               | w               |
| WSK1216 | 0.116<br>(2.95)       | 0.024<br>(0.61) | 0.020<br>(0.50) | 0.028<br>(0.70) | 0.142<br>(3.60) |

| MODEL   | RESISTANCE VALUE (mΩ) | THERMAL RESISTANCE (°C/W) | ELEMENT MATERIAL |
|---------|-----------------------|---------------------------|------------------|
| WSK1216 | 0.2                   | 5.1                       | MnCuSn           |
|         | 0.3                   | 6.8                       | MnCuSn           |
|         | 0.5                   | 8.5                       | MnCuSn           |
|         | 1.0                   | 13.5                      | MnCu             |
|         | 2.0                   | 18.6                      | NiCr             |

**Notes**

- 3D models available: [www.vishay.com/doc?30334](http://www.vishay.com/doc?30334)
- Surface mount solder profile recommendations: [www.vishay.com/doc?31052](http://www.vishay.com/doc?31052)

**DERATING - AMBIENT TEMPERATURE**

**DERATING - TERMINAL TEMPERATURE**

 Example: WSK1216 0.001  $\Omega$ 
**PULSE CAPABILITY**

[www.vishay.com/en/resistors/joulewizard/](http://www.vishay.com/en/resistors/joulewizard/)

| PERFORMANCE               |   |             |
|---------------------------|---|-------------|
| TEST                      | CONDITIONS OF TEST  | TEST LIMITS |
| Thermal shock             | -55 °C to +150 °C, 2000 cycles, 15 min at each extreme  | ± 0.5 %     |
| Short time overload       | Refer to link for short time overload performance and pulse capability;<br><a href="http://www.vishay.com/en/resistors/power-metal-strip-calculator/">www.vishay.com/en/resistors/power-metal-strip-calculator/</a> | ± 0.5 %     |
| Low temperature operation | -65 °C for 24 h   | ± 0.5 %     |
| High temperature exposure | 2000 h at +170 °C   | ± 1.0 %     |
| Bias humidity             | +85 °C, 85 % RH, 10 % bias, 1000 h  | ± 0.5 %     |
| Mechanical shock          | 100 g's for 6 ms, 5 pulses  | ± 0.5 %     |
| Vibration                 | Frequency varied 10 Hz to 2000 Hz in 1 min, 3 directions, 12 h  | ± 0.5 %     |
| Load life                 | 2000 h at +70 °C, 1.5 h "ON", 0.5 h "OFF"   | ± 1.0 %     |
| Resistance to solder heat | 3 x at 250 °C ± 5 °C for 30 s ± 5 s   | ± 0.5 %     |
| Moisture resistance       | MIL-STD-202, method 106, 0 % power, 7b not required   | ± 0.5 %     |

**Note**

- Contact [ww2bresistors@vishay.com](mailto:ww2bresistors@vishay.com) for application specific performance requirements or qualification data. Typical performance is better than stated test limits

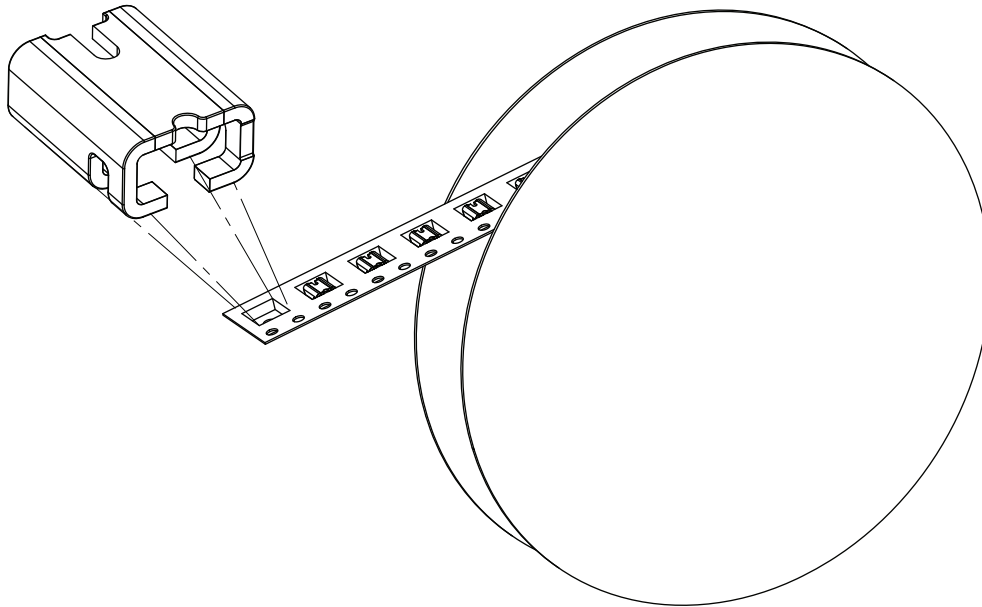


| PACKAGING (1) |                          |              |             |      |
|---------------|--------------------------|--------------|-------------|------|
| MODEL         | REEL                     |              |             |      |
|               | TAPE WIDTH               | DIAMETER     | PIECES/REEL | CODE |
| WSK1216       | 12 mm / embossed plastic | 330 mm / 13" | 2000        | EA   |

Notes

- Embossed carrier tape per EIA-481
- (1) Additional packaging details at [www.vishay.com/doc?20051](http://www.vishay.com/doc?20051)

REEL ORIENTATION



| LINKS TO RELATED DOCUMENTS                                |  |
|---|--|
| <b>SELECTOR GUIDE</b>                                     |  |
| Overview of Automotive Grade Products                     | <a href="http://www.vishay.com/doc?49924">www.vishay.com/doc?49924</a> |
| <b>TECHNICAL NOTES</b>                                    |  |
| SMD Current Sense: AEC-Q200 vs. Vishay Qualification      | <a href="http://www.vishay.com/doc?30416">www.vishay.com/doc?30416</a> |
| MIL-PRF vs. AEC-Q200: Do You Know What You Are Getting?   | <a href="http://www.vishay.com/doc?11000">www.vishay.com/doc?11000</a> |
| <b>WHITE PAPER</b>  |  |
| Thermal Management for Surface-Mount Devices              | <a href="http://www.vishay.com/doc?30380">www.vishay.com/doc?30380</a> |
| Temperature Coefficient of Resistance for Current Sensing | <a href="http://www.vishay.com/doc?30405">www.vishay.com/doc?30405</a> |



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