POWER METAL STRIP® RESISTORS

Optimized for Current Sensing

www.vishay.com
# High-CURRENT, Standard, Power Metal Strip® Resistors

<table>
<thead>
<tr>
<th>Product</th>
<th>Power Rating</th>
<th>Features</th>
<th>Dimensions</th>
<th>Application</th>
</tr>
</thead>
</table>
| WSR2   | 2.0 W        | • 0.001 Ω to 1.000 Ω  
          • ± 0.5 %, ± 1.0 %  
          • TCR down to ± 75 ppm/°C | L = 0.455 in. [11.56 mm]  
          W = 0.275 in. [6.98 mm]  
          H = 0.095 in. [2.41 mm] | • DC-DC converter in switching power supplies  
          • VRM’s in notebook/desktop PC’s  
          • Instrumentation  
          • Automotive controls for body and powertrain |
| WSL3921| 3.0 W        | • 0.0003 Ω to 0.004 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.394 in. [10.0 mm]  
          W = 0.205 in. [5.20 mm]  
          H = 0.037 in. [0.93 mm] | • DC-DC converter in switching power supplies  
          • VRM’s in notebook/desktop PC’s  
          • Instrumentation  
          • Automotive controls for EHPS/EPS/EPAS |
| WSL2726| 3.0 W        | • 0.0005 Ω to 0.003 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.272 in. [6.90 mm]  
          W = 0.260 in. [6.60 mm]  
          H = 0.117 in. [3.00 mm] | • DC-DC converter in switching power supplies  
          • Instrumentation  
          • Automotive controls for EHPS/EPS/EPAS |
| WSL4026| 3.0 W        | • 0.0005 Ω to 0.003 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.400 in. [10.10 mm]  
          W = 0.260 in. [6.60 mm]  
          H = 0.117 in. [3.00 mm] | • DC-DC converter in switching power supplies  
          • Instrumentation  
          • Automotive controls for EHPS/EPS/EPAS |
| WSR2-1 | 3.0 W        | • 0.0005 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.788 in. [20.02 mm]  
          W = 0.453 in [11.50 mm]  
          H = 0.026 in. [0.66 mm] | • Instrumentation  
          • Automotive controls for body and powertrain |
| WSR2-6 | 3.0 W        | • 0.0005 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.746 in. [18.95 mm]  
          W = 0.493 in [12.52 mm]  
          H = 0.086 in. [2.18 mm] | • Instrumentation  
          • Automotive controls for variable speed motor control |
| WSR2-14| 3.0 W        | • 0.002 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.455 in. [11.56 mm]  
          W = 0.216 in. [5.49 mm]  
          H = 0.011 in. [0.28 mm] | • Instrumentation  
          • Automotive controls for variable speed motor control |
| WSR3   | 3.0 W        | • 0.001 Ω to 0.200 Ω  
          • ± 0.5 %, ± 1.0 %  
          • TCR down to ± 75 ppm/°C | L = 0.455 in. [11.56 mm]  
          W = 0.275 in. [6.98 mm]  
          H = 0.095 in. [2.41 mm] | • DC-DC converter in switching power supplies  
          • VRM’s in notebook/desktop PC’s  
          • Instrumentation  
          • Automotive controls for body and powertrain |
| WSR5   | 5.0 W        | • 0.001 Ω to 0.300 Ω  
          • ± 0.5 %, ± 1.0 %  
          • TCR down to ± 75 ppm/°C | L = 0.455 in. [11.56 mm]  
          W = 0.275 in. [6.98 mm]  
          H = 0.095 in. [2.41 mm] | • DC-DC converter in switching power supplies  
          • VRM’s in notebook/desktop PC’s  
          • Instrumentation  
          • Automotive controls for body and powertrain |
| WSL5931| 5.0 W        | • 0.0002 Ω to 0.003 Ω  
          • ± 1.0 %  
          • Low TCR resistance element (< 20 ppm/°C) | L = 0.591 in. [15.0 mm]  
          W = 0.305 in. [7.75 mm]  
          H = 0.083 in. [2.10 mm] | • DC-DC converter in switching power supplies  
          • VRM’s in notebook/desktop PC’s  
          • Instrumentation  
          • Automotive controls for EHPS/EPS/EPAS |
**Introduction**

Vishay’s Power Metal Strip® resistors are optimized for current sensing in a wide range of electronic systems. Their low ohmic resistance, in combination with low rTC and low thermal EMF, makes Power Metal Strip products the resistor of choice for high-current and high-power applications in all market segments.

- Resistance from 0.0002 ohm to 1 ohm
- Resistance tolerance down to 0.5 %
- Very low inductance of < 5 nH
- Low thermal EMF (< 3 μV/°C)
- Lead (Pb)-free available
- Low rTC metal resistive element (< 20 ppm/ºC)
- Operating temperature range of – 65 ºC to + 275 ºC

In addition to the standard case sizes, Vishay offers nonstandard product sizes and terminal configurations to support emerging applications. This brochure provides an overview of Power Metal Strip product capabilities to support the needs of designers.

**Applications**

Current sensing Power Metal Strip resistors allow control circuitry to monitor the level of current in a circuit by translating current into a voltage that can be easily measured. The devices work by resisting the current flow in a circuit to a calibrated level, thus allowing a voltage drop to be detected and monitored by control circuitry. The low resistance of Power Metal Strip devices allow this function to be carried out with exceptional accuracy.

Current shunting is another application suitable for the low-ohmic Power Metal Strip resistor technology. When shunting, a resistor is used to divert most of the current in an electric circuit. Power shunts are used for electric motor starting, braking, and speed control. Loading, neutral grounding, preheating, and capacitor loading are applications in which a resistor shunts large amounts of current. A two- or four-terminal resistor with low ohmic resistance and high-current capability is the best solution for a shunt.

Current sensing and shunting are functions common to all market segments with many applications. Automotive electronics, industrial and medical equipment, mobile telecom, and notebook computers are among the diverse environments in which Power Metal Strip resistors deliver exceptional performance.

**Brushless DC Motor Control**

The use of brushless DC motors is increasing in motion control applications. The motor’s high efficiency and small size are important for automotive, industrial, military, aircraft, and communications equipment.

Automotive engine fan controls utilize brushless DC motors to improve engine temperature management. Accurate air flow and temperature control in the engine compartment are needed to allow the engine to run at a constant higher temperature for better fuel efficiency and lower emissions. The brushless DC motor cools the engine block or radiator to reduce temperature variation while high-power current sense resistors are used for fan speed control.

Electronic power steering and electric vehicle traction drives also use brushless DC motors. A current sense resistor is used to control the peak value of the motor winding current (load current). This is an application that requires low-inductance and high-current capabilities. See Figure A.
Automotive Battery Management

Accurate current sensing is becoming an increasingly important capability as the demands being placed on automotive batteries are growing. Electrical Hydraulic Power Steering (EHPS) / Electrical Power Steering (EPS) / Electrical Power Assistance Steering (EPAS), electronic-hydraulic braking, electric and hybrid vehicles, and power doors, all require the battery to provide additional current above and beyond what the alternator can deliver.

For proper battery management, a low-ohmic current sensing resistor is used to sense the amount of current flowing into the vehicle’s electrical system. The current sensing resistor must be capable of handling high currents (up to 1000 A) while offering a low temperature coefficient of resistance, low thermal EMF, and high stability in extreme environments. Resistance values of 50 µΩ to 100 µΩ are typically required for these applications.

For proper battery management, a low-ohmic current sensing resistor is used to sense the amount of current flowing into the vehicle’s electrical system. The current sensing resistor must be capable of handling high currents (up to 1000 A) while offering a low temperature coefficient of resistance, low thermal EMF, and high stability in extreme environments. Resistance values of 50 µΩ to 100 µΩ are typically required for these applications.

Figure C illustrates use of current sense resistor in a high-current battery management circuit.
Utility Power Meters Shunt

The utility industry is seeing a new generation of multifunction power meters. The new meters are more accurate in measuring and reporting actual utility usage and peak usage times, providing the power company with more accurate data to determine customer usage and to adjust billing terms.

In this application, a current sense resistor supports the microcontroller to determine power usage. A current shunt converts the current through the meter to a small, millivolt-level voltage. The voltage across the shunt must remain small to minimize the power dissipation by the shunt. A shunt with a resistance of 100 µΩ to 500 µΩ will provide a signal of less than 20 mV and still dissipate nearly 1 W of power at 40 A.

Figure D shows the current channel of an electric meter using a current shunt to convert the load current to a millivolt-level voltage.

![Diagram of current channel of an electric meter](current_channel_diagram.png)

Figure D
(Current Channel of an Electric Meter)

- **Load**
- **Line**
- **Current Sense Hi**
- **Current Sense Lo**
- **Typical $R_s = 350 \mu \Omega$**

- **$1 \ k\Omega$**
- **$1 \ k\Omega$**
- **$1 \ \mu F$**
New Product Application Sheet

Design Engineer: To help us support your new product requirements, please complete the information below.

Application Summary:  

Resistance Value =  

Resistance Tolerance = _________ %

Temperature Coefficient =  

Load Current:  

I_{peak} =  

Duration = _________ sec

I_{continuous} =  

Environmental Conditions:  

Temperature Range: _________ °C to _________ °C

Moisture: _________ °C at _________ % Rh

Other:  

Product Size:  

L = _________ mm  

W = _________ mm  

H = _________ mm

Product Sketch:  
(Please note current and voltage terminals)

Mounting Type:  

- Welded
- Bolted
- Soldered
- Terminal Coating __________

Project Timing:  

Initial Samples: _________ Month _________ Year

Design Validation: _________ Month _________ Year

Production Start: _________ Month _________ Year

Project EAU: _________ pcs  

Target Cost: _________ USD

Name:  

Title:  

Company:  

Email:  

Phone:  

Fax:  

Email this form to: ww2bresistors@vishay.com
## High-Current, Custom, Power Metal Strip® Resistors

<table>
<thead>
<tr>
<th>Product</th>
<th>Maximum Current</th>
<th>Features</th>
<th>Dimensions</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPR2068</td>
<td>10 A</td>
<td>0.012 Ω, ± 5 %, Multi-terminal</td>
<td>L = 4.550 in. [115.6 mm] W = 0.275 in. [6.98 mm] H = 0.175 in. [4.44 mm]</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>SPR0513</td>
<td>17.5 A</td>
<td>0.002 Ω to 0.01 Ω, ± 1 %, 4-terminal</td>
<td>L = 3.170 in. [80.52 mm] W = 0.030 in. [0.76 mm] H = 0.620 in. [15.8 mm]</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>SPR0755</td>
<td>31.6 A</td>
<td>0.001 Ω, ± 5 %</td>
<td>L = 1.920 in. [48.88 mm] W = 0.275 in. [6.98 mm] H = 0.235 in. [5.97 mm]</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>SPR4000</td>
<td>95 A</td>
<td>0.0007 Ω, ± 5 %, Multi-terminal</td>
<td>L = 0.708 in. [18 mm] W = 0.264 in. [6.7 mm] H = 0.732 in. [18.6 mm]</td>
<td>Automotive controls for EHPS/EPS/EPAS</td>
</tr>
<tr>
<td>SPR3001</td>
<td>100 A</td>
<td>0.0002 Ω, ± 5 %, Power Metal Strip®</td>
<td>L = 2.134 in. [54.2 mm] W = 0.268 in. [6.8 mm] H = 0.060 in. [1.5 mm]</td>
<td>Instrumentation, Power meters shunt</td>
</tr>
<tr>
<td>SPR3000</td>
<td>100 A</td>
<td>0.0007 Ω, ± 5 %, Power Metal Strip®</td>
<td>L = 2.075 in. [52.7 mm] W = 0.150 in. [3.8 mm] H = 0.040 in. [1.0 mm]</td>
<td>Instrumentation, Power meters shunt</td>
</tr>
<tr>
<td>SPR3004</td>
<td>100 A</td>
<td>0.00038 Ω, ± 5 %, Power Metal Strip®</td>
<td>L = 3.937 in. [100.0 mm] W = 0.787 in. [20.0 mm] H = 0.060 in. [1.5 mm]</td>
<td>Instrumentation, Automotive battery monitor shunt</td>
</tr>
<tr>
<td>WSL5931-xx</td>
<td>187 A</td>
<td>0.0002 Ω, ± 5 %, Power Metal Strip®</td>
<td>L = 0.590 in. [15.0 mm] W = 0.512 in. [13.0 mm] H = 0.049 in. [1.24 mm]</td>
<td>Instrumentation, Automotive controls for EHPS/EPS/EPAS</td>
</tr>
<tr>
<td>SPR4001</td>
<td>1000 A</td>
<td>0.00005 Ω, ± 5 %, Power Metal Strip®</td>
<td>L = 9.450 in. [240 mm] W= 3.937 in. [100 mm] H = 0.190 in. [4.7 mm]</td>
<td>High-current meter shunt</td>
</tr>
</tbody>
</table>
One of the World’s Largest Manufacturers
of Discrete Semiconductors and Passive Components

SEMICONDUCTORS:
Rectifiers • High-Power Diodes and Thyristors • Small-Signal Diodes • Zener and Suppressor Diodes
• FETs • RF Transistors • Optoelectronics • ICs • Modules and Assemblies

PASSIVE COMPONENTS:
Resistive Products • Magnetics • Capacitors • Strain Gage Transducers and Stress Analysis Systems