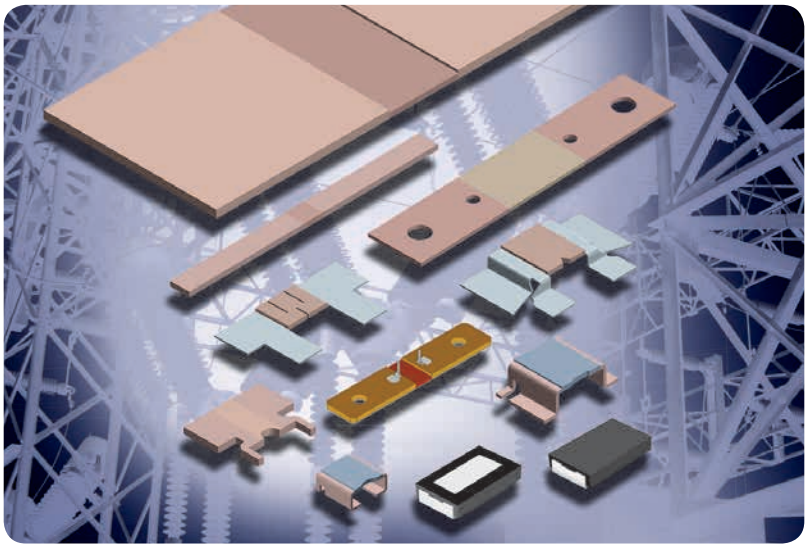
# POWER METAL STRIP® RESISTORS

Vishay Dale

## Power Metal Strip® Resistors Optimized for Current Sensing



## KEY BENEFITS

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 TCR and low thermal EMF, makes Power Metal Strip products the resistor of choice for hig current and high power applications in all market segments.

- Resistance from 0.00005 Ω to 1 Ω
- Resistance tolerance down to 0.1 %
- Very low inductance of < 5 nH
- Low thermal EMF down to < 1 µV/°C
- Lead (Pb)-free available
- Low TCR metal resistive element (< 20 ppm/°C)
- Operating temperature range of –65 °C to +275 °C

In addition to standard case sizes, Vishay offers non-standard 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.

## RESOURCES

- Technical Note: Components and Methods for Current Measurement
  www.vishay.com/docs/30304/currentmeasurement.pdf
- For technical questions contact ww2bresistors@vishay.com
- Sales Contacts: www.vishay.com/doc?99914

A WORLD OF SOLUTIONS

# POWER METAL STRIP® RESISTORS

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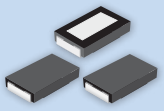
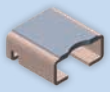
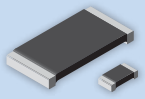
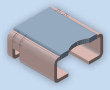
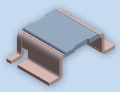
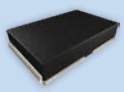
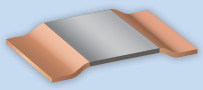
### High-Current, Standard, Power Metal Strip® Resistors

| Product | Power Rating | Features | | Dimensions | Application |
|---|---|---|---|---|---|
| WSR2, WSR3, WSR5  | 2.0 W | • 0.001 Ω to 1.000 Ω | • ± 0.5 %, ± 1.0 %<br>• TCR down to ± 75 ppm/°C | • L = 0.455 in [11.56 mm]<br>• W = 0.275 in [6.98 mm]<br>• H = 0.095 in [2.41 mm] | • DC/DC converter in switching power supplies<br>• VRMs in notebook / desktop PCs<br>• Instrumentation<br>• Automotive controls for body and powertrain |
| | 3.0 W | • 0.001 Ω to 0.200 Ω | | | |
| | 5.0 W | • 0.001 Ω to 0.300 Ω | | | |
| WSK1216  | 3.0 W | • 0.0005 Ω<br>• ± 1.0 %<br>• Low TCR resistance element (< 20 ppm/°C) | | • L = 0.150 in [3.81 mm]<br>• W = 0.122 in [3.1 mm]<br>• H = 0.075 in [1.9 mm] | • DC/DC converter in switching power supplies<br>• Inverter control for BLDC motor drives<br>• Automotive controls for EHPS / EPS / EPAS |
| WSLP  | 3.0 W | • 0.0005 Ω to 0.1 Ω<br>• ± 0.5 %<br>• Low TCR resistance element (< 20 ppm/°C) | | Available in standard sizes from 2512 to 0603 | • Automotive controls for body, powertrain<br>• Inverter control for BLDC motor drives<br>• Instrumentation |
| WSLF2512  | 6.0 W | • 0.0003 to 0.003 Ω<br>• ± 1.0 %<br>• Low TCR resistance element (< 20 ppm/°C) | | • L = 0.250 in [6.35 mm]<br>• W = 0.125 in [3.18 mm]<br>• H = 0.038 in [1.14 mm] | • DC/DC converter in switching power supplies<br>• Inverter control for BLDC motor drives<br>• Automotive controls for EHPS / EPS / EPAS |
| WSLP2726  | 7.0 W | • 0.0002 Ω to 0.005 Ω<br>• ± 1.0 %<br>• Low TCR resistance element (< 20 ppm/°C) | | • L = 0.272 in [6.90 mm]<br>• W = 0.260 in [6.60 mm]<br>• H = 0.117 in [3.00 mm] | • DC/DC converter in switching power supplies<br>• Instrumentation<br>• Automotive controls for EHPS / EPS / EPAS |
| WSLP4026  | 7.0 W | • 0.0002 Ω to 0.005 Ω<br>• ± 1.0 %<br>• Low TCR resistance element (< 20 ppm/°C) | | • L = 0.400 in [10.10 mm]<br>• W = 0.260 in [6.60 mm]<br>• H = 0.117 in [3.00 mm] | • DC/DC converter in switching power supplies<br>• Instrumentation<br>• Automotive controls for EHPS / EPS / EPAS |
| WSHM2818, WSHP2818  | 7.0 W | • 0.001 Ω to 0.2 Ω | • ± 0.5%<br>• Low TCR resistance element (< 20 ppm/°C) | • L = 0.280 in [7.1 mm]<br>• W = 0.180 in [4.6 mm]<br>• H = 0.059 in [1.5 mm] | • DC/DC converter in switching power supplies<br>• Inverter control for BLDC motor drives<br>• Automotive controls for EHPS / EPS / EPAS |
| | 10.0 W | • 0.001 Ω to 0.1 Ω | | | |
| WSLP3921, WSLP5931  | 9.0 W | • 0.0001 Ω to 0.004 Ω | • ± 1.0 %<br>• Low TCR resistance element (< 20 ppm/°C) | • L = 0.394 in [10.0 mm]<br>• W = 0.205 in [5.20 mm]<br>• H = see datasheet | • DC/DC converter in switching power supplies<br>• VRMs in notebook / desktop PCs<br>• Instrumentation<br>• Automotive controls for EHPS / EPS / EPAS |
| | 15.0 W | • 0.0001 Ω to 0.003 Ω | | | |

# POWER METAL STRIP® RESISTORS

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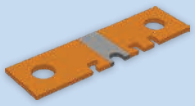
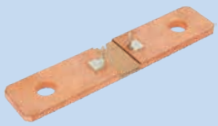
| High-Current, Custom, Power Metal Strip® Resistors | | | | |
|---|---|---|---|---|
| **Product** | **Maximum Current** | **Features** | **Dimensions** | **Application** |
| WSMS2908  | 175 A | • 50 µΩ to 1000 µΩ<br>• ± 5 %<br>• 3 W power<br>• Power Metal Strip construction | • L = 1.142 in [29.0 mm]<br>• W = 0.315 in [8.0 mm] | • Power meter shunt<br>• Instrumentation<br>• Power supplies |
| WSMS5515  | 175 A | • 50 µΩ to 1000 µΩ<br>• ± 5 %<br>• Up to 15 W power<br>• Power Metal Strip construction | • L = 2.165 in [55.0 mm]<br>• W = 0.590 in [15.0 mm]<br>• H = 0.059 in [1.5 mm] max | • Power meter shunt<br>• Instrumentation<br>• Power supplies |
| WSBS5216  | 345 A | • 100 µΩ<br>• ± 5 %<br>• 12 W power<br>• Power Metal Strip construction | • L = 2.047 in [52.0 mm]<br>• W = 0.630 in [16.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS5216-14  | 345 A | • 100 µΩ<br>• ± 5 %<br>• 12 W power<br>• Power Metal Strip construction<br>• Plated terminals | • L = 2.047 in [52.0 mm]<br>• W = 0.630 in [16.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS8518  | 600 A | • 50 µΩ to 250 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS8518-14  | 600 A | • 50 µΩ to 250 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction<br>• Plated terminals | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS8518-20  | 600 A | • 50 µΩ to 250 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction<br>• Sense pins for increased accuracy | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS8518-34  | 600 A | • 500 µΩ, 500 µΩ, and 1000 µΩ<br>• Patented NiCr element with terminal boot design for improved RTC<br>• Up to 36 W power<br>• Power Metal Strip construction<br>• Sense pins for increased accuracy | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |

# POWER METAL STRIP® RESISTORS

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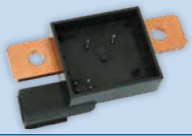
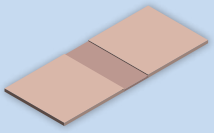
| High-Current, Custom, Power Metal Strip® Resistors | | | | |
|---|---|---|---|---|
| **Product** | **Maximum Current** | **Features** | **Dimensions** | **Application** |
| WSBS8518-40  | 600 A | • 50 µΩ to 125 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction<br>• Sense pins for increased accuracy | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBS8518-M3/M4  | 600 A | • 50 µΩ to 250 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction<br>• M3 or M4 tapped holes | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| WSBM8518  | 600 A | • 50 µΩ to 1000 µΩ<br>• ± 5 %<br>• 36 W power<br>• Power Metal Strip construction<br>• Molded enclosure allows for easy PCB connection | • L = 3.346 in [85.0 mm]<br>• W = 0.708 in [18.0 mm]<br>• H = 0.118 in [3.0 mm] | • Automotive / industrial battery monitor shunt<br>• Power supplies |
| SPR3004  | 100 A | • 0.00038 Ω<br>• ± 5 %<br>• Power Metal Strip construction<br>• Manganin element | • L = 3.937 in [100.0 mm]<br>• W = 0.787 in [20.0 mm]<br>• H = 0.060 in [1.5 mm] | • Instrumentation<br>• Automotive battery monitor shunt |
| SPR4001  | 1000 A | • 0.00005 Ω<br>• ± 5 %<br>• Power Metal Strip construction<br>• Manganin element | • L = 9.450 in [240 mm]<br>• W = 3.937 in [100 mm]<br>• H = 0.190 in [4.7 mm] | • High-current meter shunt |

## Additional Resources:

### Power Metal Strip Customization:

http://www.vishay.com/docs/48163/_capabilities_and_options_powermetalstrip_vmn-ms7460-1709.pdf

### Power Metal Strip Products:

https://www.vishay.com/resistors-fixed/power-metal-strip/

### Pulse Capability:

https://www.vishay.com/resistors/power-metal-strip-calculator/

## 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 allows 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.

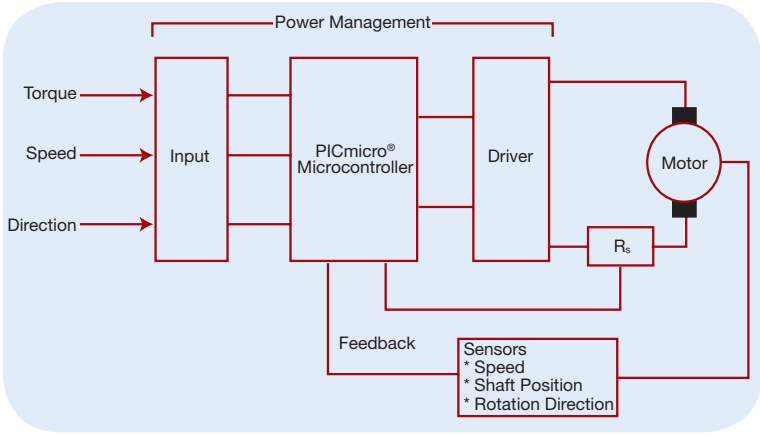
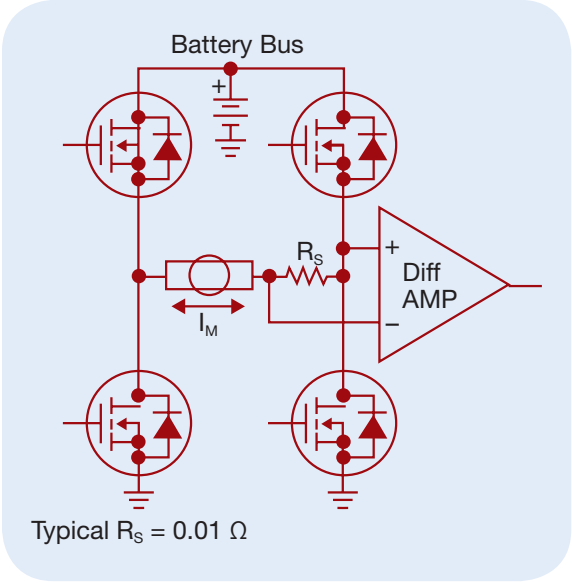



Figure A
(DC Motor Current Monitoring)




Electric 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).

Current sensing resistors are also used in the feedback circuit as replacements for Hall effect sensors. Figure B shows the use of current sense resistor "$R_s$" in an H-bridge motor control.

Figure B
(H-Bridge Current Monitoring)

## 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) / Electric Power Steering (EPS) / electric power-assisted 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 125 μΩ are typically required for these applications.

Figure C illustrates use of current sense resistor in a high current battery management circuit.

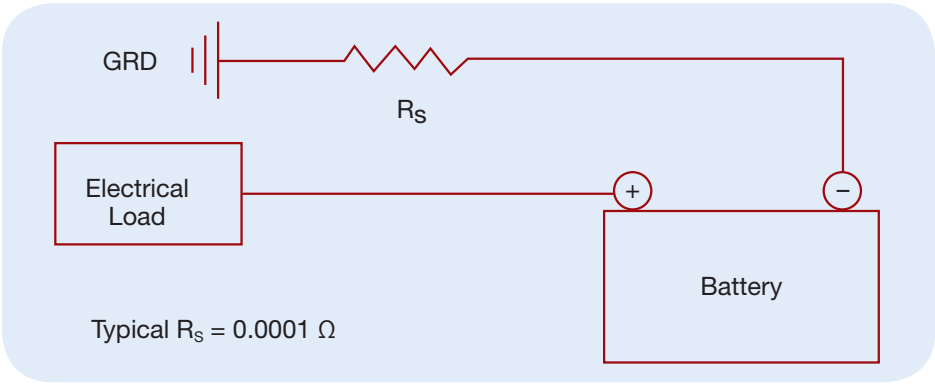



Figure C
(Automotive Battery Sensor)

## 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 will provide a signal of 20 mV and dissipate 1 W of power at 100 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.

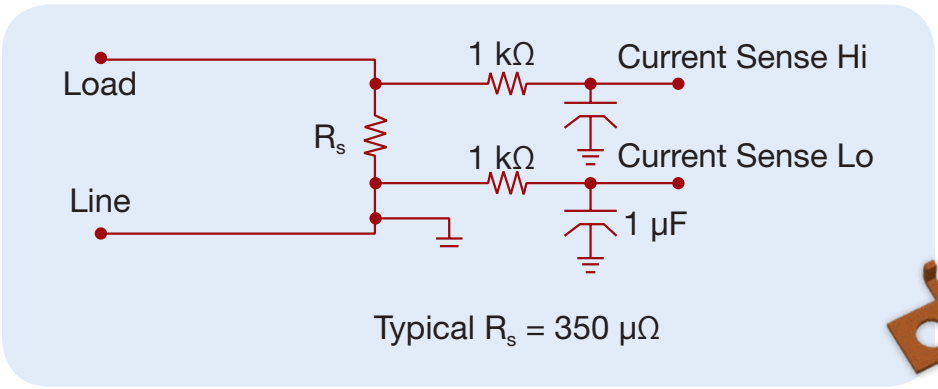
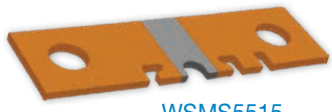
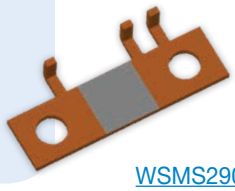



Figure D
(Current Channel of an Electric Meter)



WSMS5515



WSMS2908

# POWER METAL STRIP® RESISTORS

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## New Product Application Sheet

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

**Application Summary:** _____

**Resistance Value =** _____ Ohms **Resistance Tolerance =** _____ %

**Temperature Coefficient =** _____ ppm/°C

**Load Current:** $I_{peak}$ = _____ Amps Duration = _____ sec

$I_{continuous}$ = _____ Amps

**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:** _____ **Email:** _____

**Title:** _____ **Phone:** _____

**Company:** _____ **Fax:** _____

**Email this form to:** ww2bresistors@vishay.com