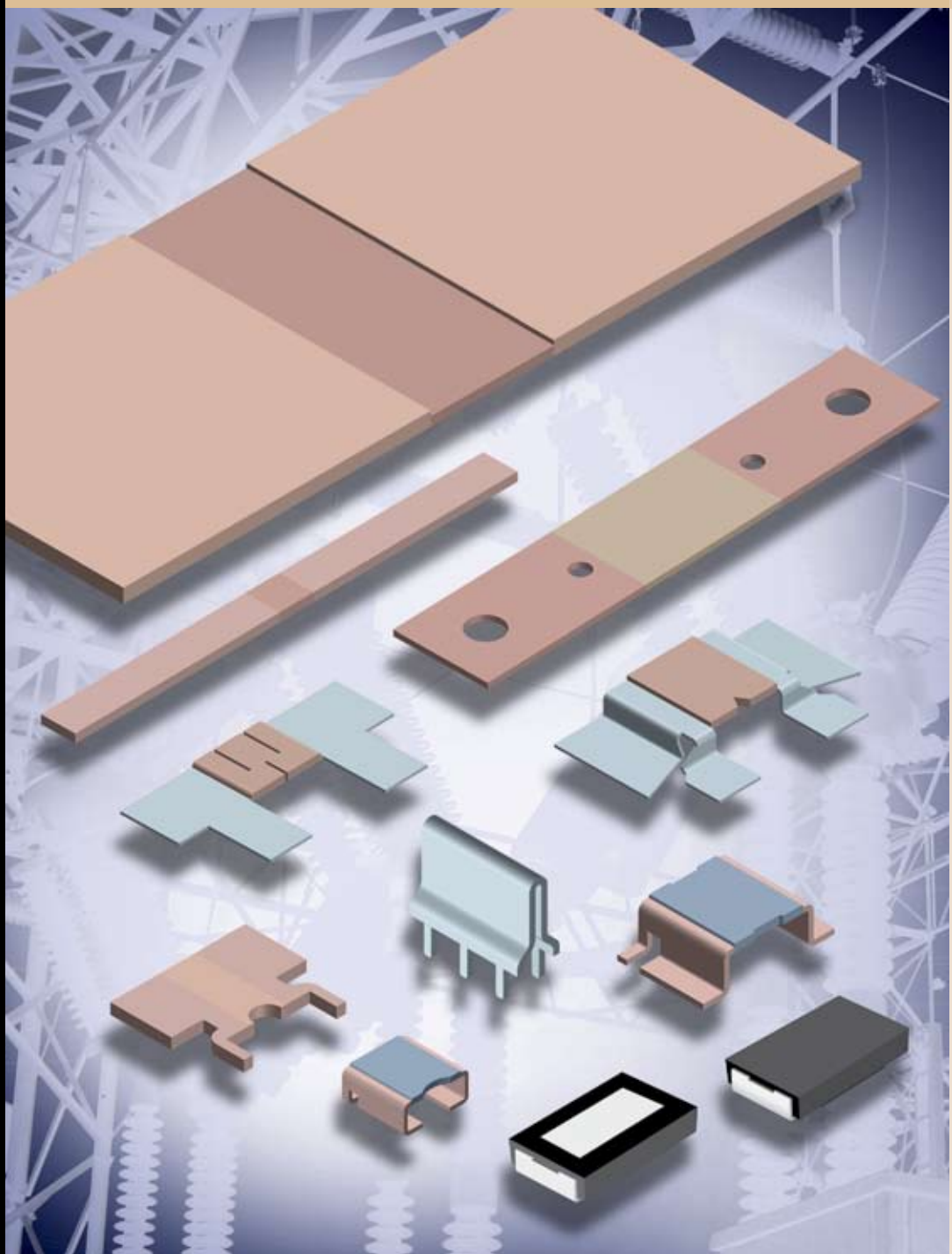
VISHAY INTERTECHNOLOGY, INC.

RESISTIVE PRODUCTS

POWER METAL STRIP® RESISTORS

Optimized for Current Sensing

CAPABILITIES



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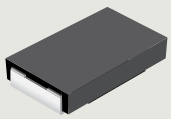
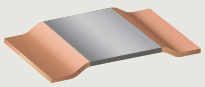
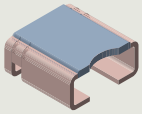
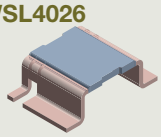
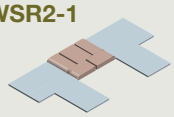
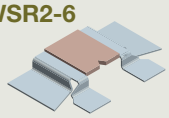
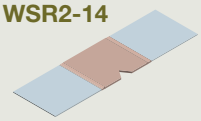
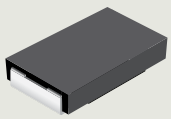
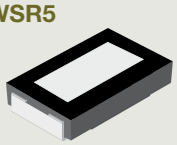
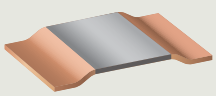
High-Current, Standard, Power Metal Strip® Resistors				
Product	**Power Rating**	**Features**	**Dimensions**	**Application**
WSR2 	2.0 W	• 0.001 Ω to 1.000 Ω • ± 0.5 %, ± 1.0 % • TCR down to ± 75 ppm/°C	L = 0.455 in. [11.56 mm] W = 0.275 in. [6.98 mm] H = 0.095 in. [2.41 mm]	• DC-DC converter in switching 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/°C)
- Operating temperature range of – 65 °C to + 275 °C

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.

Figure A
(DC Motor Current Monitoring)

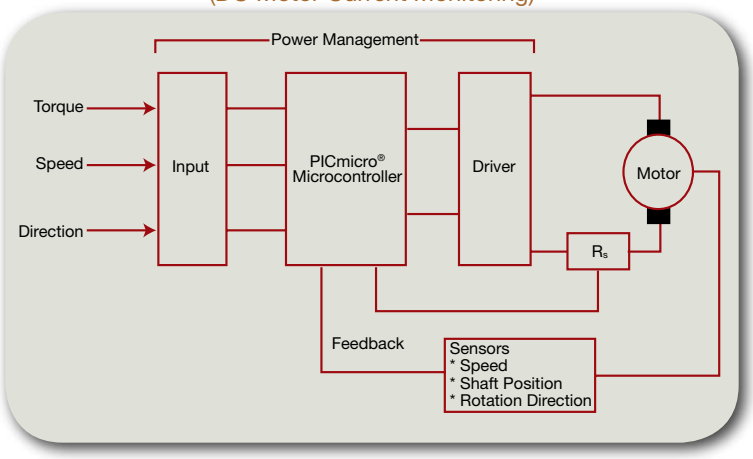
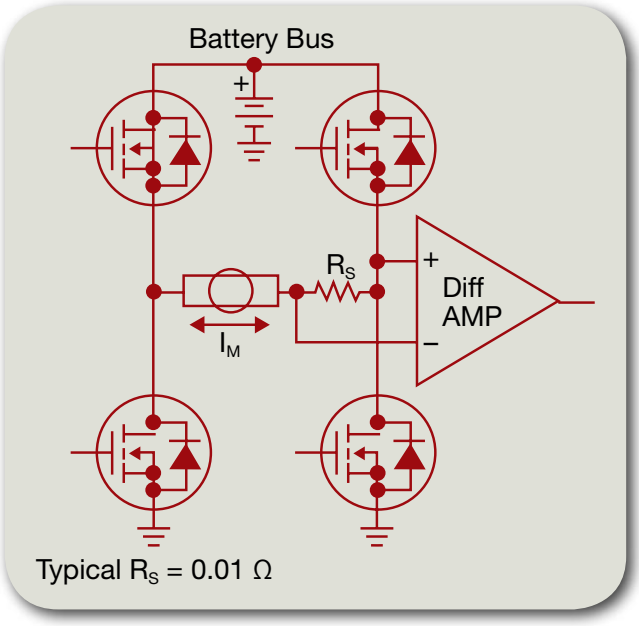


Figure B
(H-Bridge Current Monitoring)



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

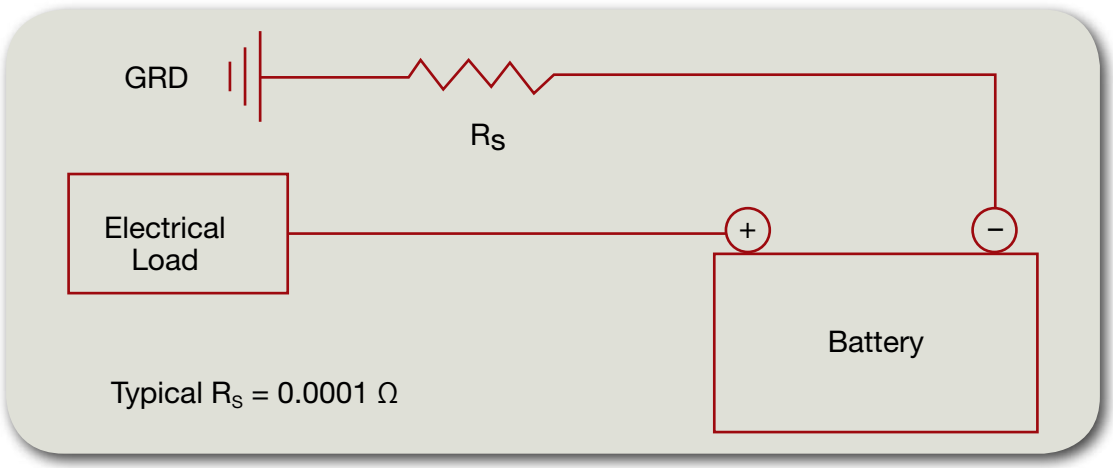
Automotive Battery Management

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.

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

Figure C
(Automotive Battery Sensor)



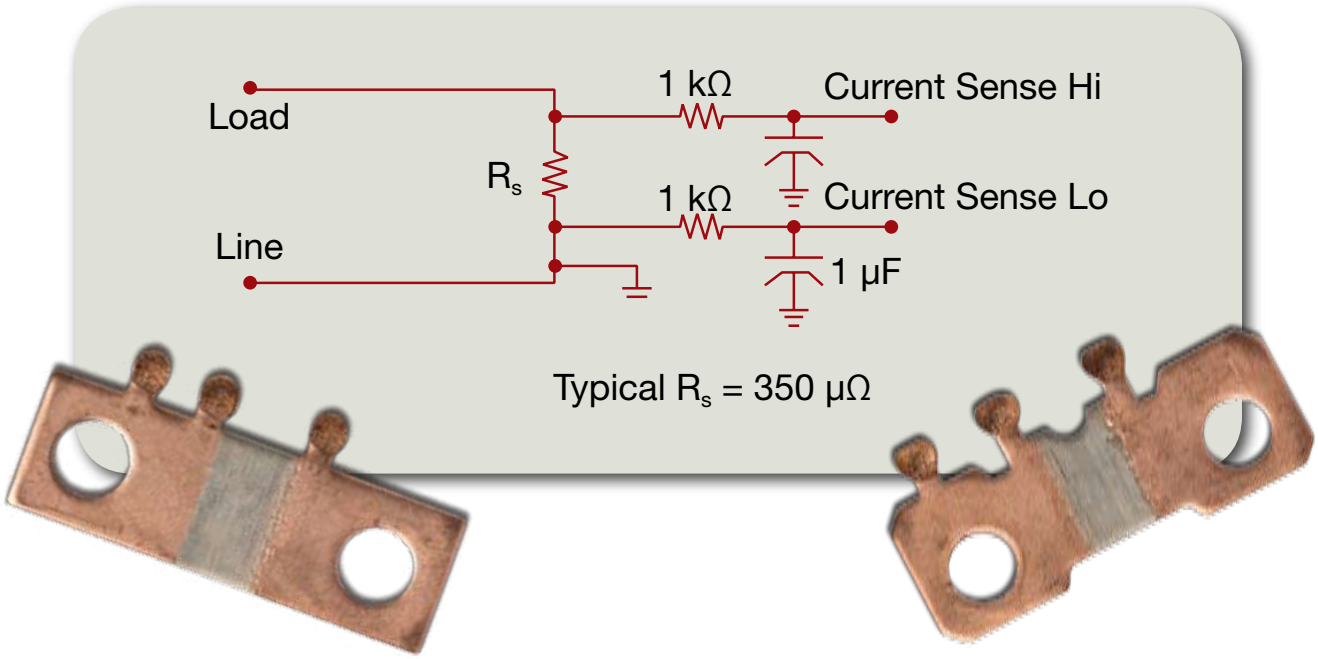
Utility Power Meters Shunt

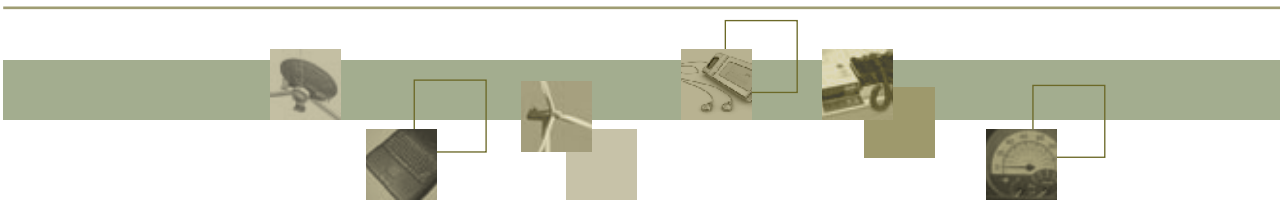
The utility industry is seeing a new generation of multifunction power meters. The new meters are more accurate in measuring and reporting actual utility usage and peak usage times, providing the power company with more accurate data to determine customer usage and to adjust billing terms.

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 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.

Figure D
(Current Channel of an Electric Meter)





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

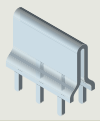
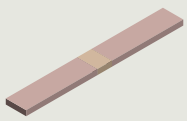
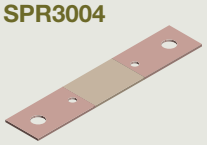
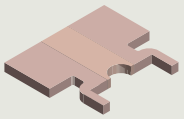
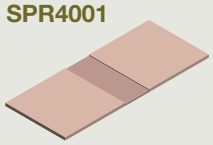
Production Start: _____ Month _____ Year

Project EAU: _____ pcs **Target Cost:** _____ USD

Name: _____ **Email:** _____
Title: _____ **Phone:** _____
Company: _____ **Fax:** _____

Email this form to: ww2bresistors@vishay.com

High-Current, Custom, Power Metal Strip® Resistors

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

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