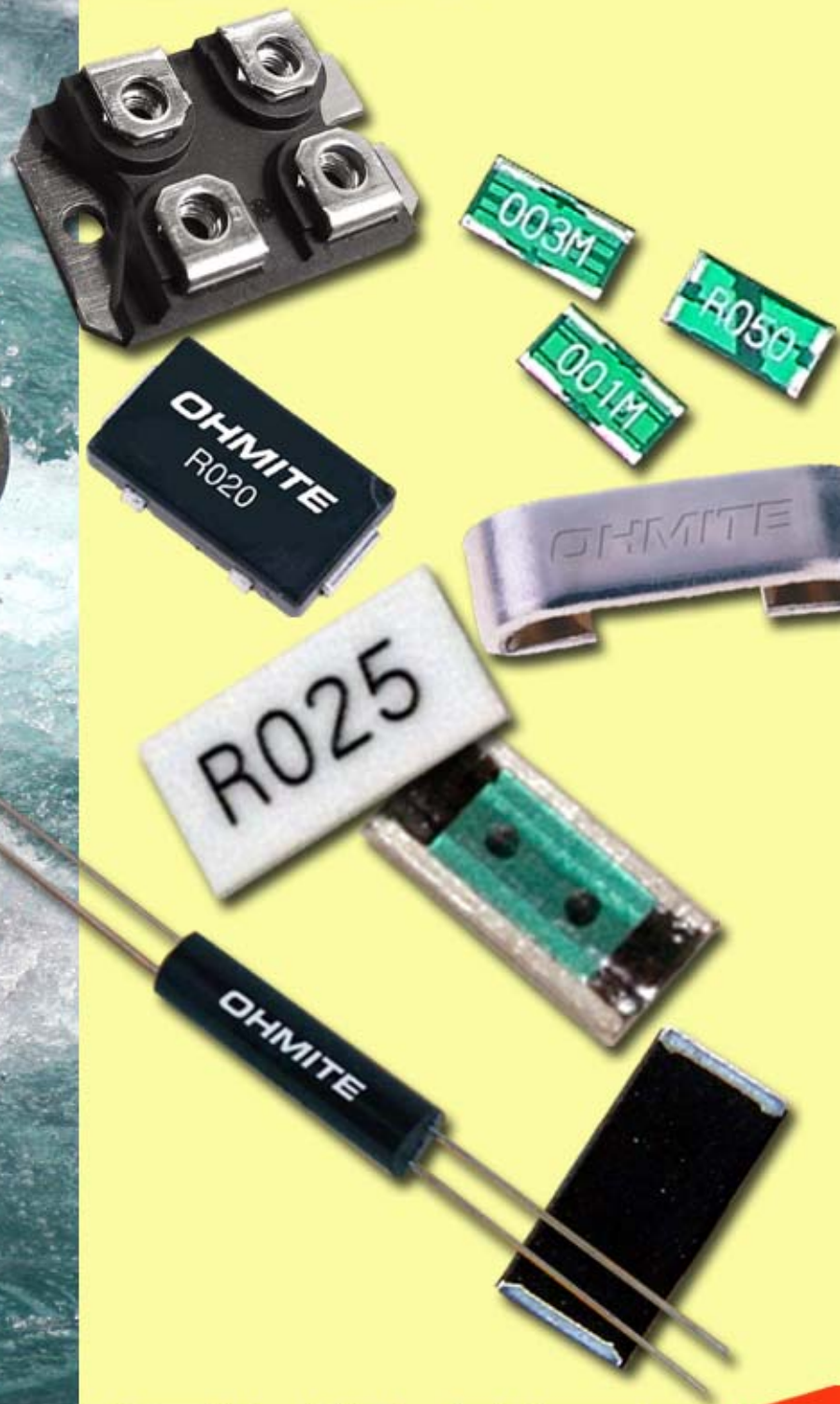


A GUIDE TO CURRENT SENSE RESISTORS



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When designing power supplies and regulated battery circuits, the aim is to eliminate the risk of short circuits or over current conditions which are likely to damage other components. Ohmite's current sense resistors are the simple and economic solution.

What is a current sensing resistor?

Current sensing products are established industry favorites among resistive products which, as with most passive products, the majority are surface mount. These resistors, often referred to as 'shunt' resistors, are used to monitor the current in a circuit and translate the amount of current in that circuit into a voltage that can be easily measured and monitored. Such resistors have very low resistance values, typically less than 50 milliohms (0.050 ohms) and often lower.

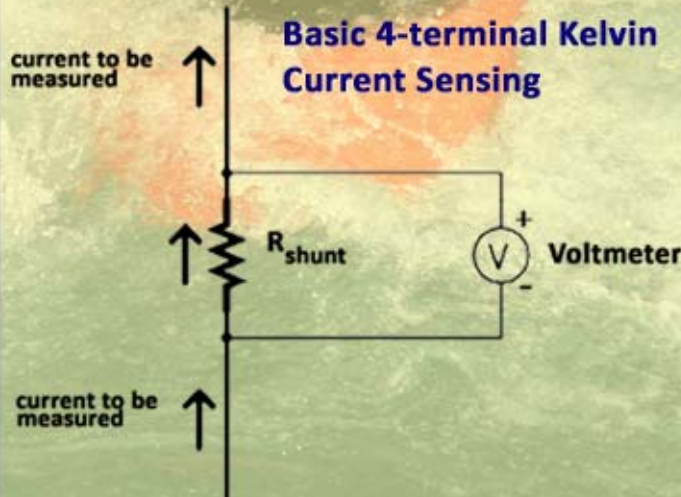
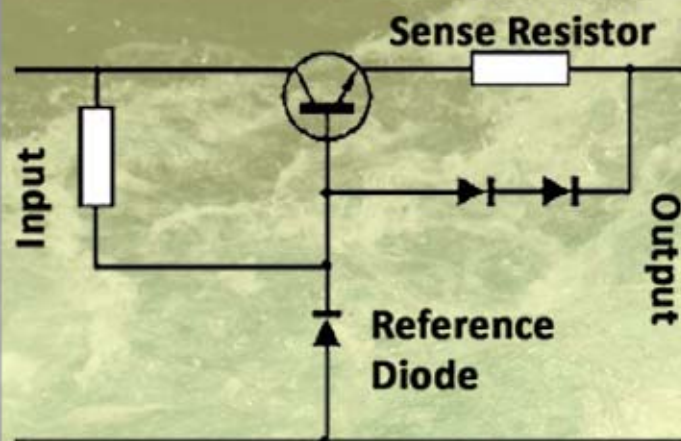
How do they work?

As stated by Ohm's Law, there is a voltage drop across any resistance when current is flowing. A current sensing resistor is designed for low resistance so as to minimize power consumption. As a result, the calibrated resistance senses the current flowing through it in the form of a voltage drop which is detected and monitored by the control circuitry.

What is a 'Kelvin' configuration?

A 'Kelvin' configuration resistor features four leads. These four terminal resistors enable a current to be applied through two opposite leads and a sensing voltage to be measured across the other two leads. The Kelvin configuration effectively eliminates the resistance and temperature coefficient of the leads. A Kelvin connection is essential for accurate current sensing.

Current measurement using a shunt resistor and voltmeter is particularly well-suited for applications involving particularly large magnitudes of current. In such applications, the shunt resistor's resistance will be in the order of milliohms or microohms, so that only a modest amount of voltage will be dropped at full current. Resistance this low is comparable to wire connection resistance, which means voltage measured across such a shunt must be done in such a way as to avoid detecting voltage dropped across the current carrying wire connections, in case huge measurement errors are induced. In order that the voltmeter only measures the voltage dropped by the shunt resistance itself, without any stray voltages originating from wire or connection resistance, shunts are usually equipped with four connection terminals



What does the future hold?

As the world becomes more and more technology driven, the uses for current sensing resistors will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The trend industry wide is smaller and smaller products, so look for an increasing number of new resistors to fill these requirements.



Where can they be used?

There are a multitude of uses for this product. Here are some applications already using current sensing products:

- **General Use** - Power supplies, disk drives, battery powermanagement, control of current detection or over-current detection, motor start, high voltage and precision applications.
- **Consumer Goods** - Power tools, thermostats, appliances, televisions, smoke detectors, and video cassette recorders.
- **Automotive** - Anti-lock brake systems, keyless entry systems, air bags, power steering, control systems, voltage regulators, power train, information centers as well as engine controls and modules.
- **Telecom** - Telephones, cell phones, pagers, mobile radios, hand-held devices and laptops.
- **Medical and Instrumentation** - Monitoring systems, pressure sensors, implant products, electronic scales, and a variety of diagnostic equipment.
- **Military and Aerospace** - Satellites, missiles, surveillance equipment, sonar, and avionic products.



Let's look at the wide range of Ohmite products designed for current sense applications

Ohmite's **10 Series** provides a current sensing option that provides higher accuracy and better temperature stability. The four terminal design offers lower Temperature Coefficients of Resistance (TCR), typically between 50 and 100 PPM/°C, and provides for lower self-heating drift which may be experienced on two-terminal resistors. The need to connect to the leads at precise test points is eliminated, allowing for tighter tolerance on the end application.

The **610 and 650 Series** four terminal bare element resistors provide ultra low resistance values (to 0.005 ohms) for relatively high current requirements. Combining the advantages of a radial Kelvin configuration and PCB mounting capability, the 610 has a power rating of 1Watt while the 650 Series can handle 5 Watts. Both feature a 1% tolerance standard and low inductance below 0.25 ohms. The 650 Series is capable of carrying up to 100 Amps of continuous current, while the 610 Series can handle up to 32 Amps.

MCS Series are available in 1 and 2 watt packages and are stocked in 1% tolerance and 11 popular resistance values. Using nickel-chromium and manganin-copper alloys, MCS Series offers low TCR, inductance, and thermo EMF benefits. Highly efficient manufacturing processes enable outstanding performance is coupled with a very competitive cost.

Our **14AFR Series** of axial leaded current sense resistors provide higher power densities than previously available. These 4 watt resistors are available in what would typically be a 3 watt package size due to the high temperature materials employed. Unlike conventional resistors of this type which are normally molded in costly silicone epoxy with a much lower maximum allowable temperature, Ohmite's three piece welded resistor elements are housed in high purity alumina oxide cylindrical shells, and then filled with alumina oxide powder for efficient heat transfer. 14AFR Series is available from stock in 9 standard resistance values, all at 1% tolerance.



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Ohmite's extended range of metal element, SMD, current sense resistors has been expanded with the **FCSL Series**.

These 2, 3, and 4 watt packages are available in six popular resistance values for each size. Using nickel-copper resistance elements bonded to high purity alumina substrates, the FCSL Series offers low TCR, inductance, and thermo EMF benefits. Electrodes situated on the long side of the rectangular chip facilitate heat evacuation and provide for increased power ratings on each size. Values as low as 0.001 ohms are available from stock

Ohmite offers 1% tolerance in the **LVC Series** current sense resistor family. Made with familiar thick film on alumina substrate technology, the LVC Series 1% resistor packages deliver reliable performance in a compact design. Industry standard 1206 and 2512 packages are rated at 0.5 and 1.0 watts respectively at 70°C ambient. Resistance values from 0.010 ohm to 1 ohm are available in 1% tolerance. LVC Series 1% resistors offer low tolerance to improve accuracy and repeatability for current sense applications that also require low profile, space saving, cost effective solutions. Low TCRs are provided down to 100 ppm. The operating temperature range is -55°C to 125°C. Nickel plated terminals prevent terminal breakdown under load, LVC resistors are also available in 5% tolerance.

The **RW1SOCK Series** of SMD Current Sense resistors are four terminal resistors offered in a resistance range from 0.005 ohms to 0.050 ohms. They are ideal for precision current sensing applications. Ohmite offer four stocked values as standard, off the shelf items in both 1% and 0.50% tolerances.

The **LVK** chip features the aforementioned four terminal 'Kelvin' configuration enabling the current to be applied through two opposite terminals and a sensing voltage to be measured across the other two terminals, eliminating the resistance and temperature coefficient of the terminals for a more accurate current measurement. Isolating the voltage and current terminals facilitates a very accurate current measurement and Ohmite's proprietary technology offers an excellent Temperature Coefficient of Resistance (TCR) even for very low resistance values. The resistive element consists of a durable, anti-corrosive metal alloy that combines reliable performance with the ability to withstand harsh environments.



The **CS3 Series** utilizes state of the art technology to achieve highly reliable non-inductive performance. Ideal for current monitoring and control applications, the CS3 uses the four terminal Kelvin configuration and offers values beginning at 1 miliohm



Ideal for many current monitoring and precision control applications, the **TGHG Series** is available in resistance values as low as 0.0005 ohms. The non inductive, thick film power resistors, when used with the appropriate heatsink, are equally suited to high power current monitoring up to 100W. Providing highly reliable, non inductive performance, the TGHG features a four terminal Kelvin connection to isolate measurement path from current flow path. The resistor has a nickel-plated copper heatsink, standard resistance values of 0.5m ohm to 1 ohm, while others are available on request. With resistance tolerances of 1%, the component can handle a pulse current up to 500A/0.5sec, depending on ohmic values.



The non-inductive, 3-piece welded element **60 Series** resistors offer a reliable low-cost alternative to conventional current sense products. With resistance values as low as 0.005Ω, and wattages from 0.1W to 3W, the **60 Series** offers a wide variety of design choices. Features include low inductance, wirewound performance and flameproof.



These bare metal element resistors are offered in 3 standard power ratings, 0.25, 0.50, and 1.0 watt, with a resistance range from 0.002 ohms to 0.008 ohms in standard 5% tolerance. **60S Series** extends Ohmite's extensive range of current sense resistors to ratings under 1 watt and values below 0.002 ohms.



When we launched the **TK**, it was the industry's first thin film power resistor in heatsinkable packaging. The TK offers major advantages, namely, low resistance values down to 0.03 ohms for current sense applications and low cost. The use of thin film technology enabled us to offer customers enhanced performance advantages such as being extremely stable (low TCR), low noise (parasitic capacitance and resistance), excellent high frequency performance and high accuracy (tight tolerances). The 15 and 20W heatsink dependent devices have resistance ranges of 4ohms to 10Kohms and 10mohms to 10Kohms and respectively. The Ryton case is fixed to a black anodized aluminium heatsink. Ohmite also provide a recommended heatsink.

The **WL Series** miniature moulded axial leaded wirewound resistors uses high purity (96% Alumina) ceramic cores with wire winding which are spot welded by CNC machine tools to ensure total operational consistency throughout. The resistors are also encapsulated with epoxy molding compound using advanced IC encapsulation mould/die technologies. The WL has ultra-low ohmic values for current sensing applications and has a very low inductance of <1nH @1MHz test. Available in 0.5, 1, and 2 Watt sizes ranging from 5.08 to 11.4mm in length and 2.54 to 6.86mm diameters, the components offer resistance values from 0.01 to 8.0Kohm.

Ohmite's **TBH25** TO220 style resistors are designed for a variety of uses that require intermediate heatsinkable power at an economical price. Engineered for industrial applications, these resistors deliver reliable performance to traditional high-quality Ohmite standards. Features include 25 Watts, @ 25°C case temperature, non-inductive performance and low thermal resistance. The resistance element is electrically insulated from the metal heat sink mounting tab. Ohmite also provide a recommended heatsink for this component

The **89 Series** is a high-performance axial type resistor. These molded-construction metal-housed resistors are available in higher power ratings than standard axial resistors and are better suited to withstanding vibration, shock and harsh environmental conditions. The 89 Series Metal-Mite® resistors are aluminum housed to maintain high stability during operation and to permit secure mounting to chassis surfaces. The metal housing also provides heat-sinking capabilities and can be fitted to our own heatsinks



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We hope that this introduction to Ohmite's range of current sense resistors is of use to you and gives you a brief view of our capabilities.

Please feel free to browse our other resistive component types which include:

- Surface Mount Resistors
- Wirewound Power Resistors
- Wirewound High Current
- Carbon and Ceramic Composition Resistors
- Thick Film Power Resistors
- Heat Sinkable Thick Film Power Resistors
- Thick Film, High Voltage, and Precision Resistors
- Heatsinks
- Potentiometers
- Control knobs
- Military Grade Resistors

For full technical specifications of all Ohmite products please visit our website.

Our distributors will be more than happy to assist you in choosing the right Ohmite current sense resistor for you applications. For contact details go to www.ohmite.com or call:

Phone: 847-258-0300

Fax: 847-574-7522

E-mail: sales@ohmite.com

International: +44 (0)1670 361 261

E-mail: ohmite@steadlands.com



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