VISHAY INTERTECHNOLOGY, INC.

POWER MANAGEMENT COMPONENTS

MARKET SOLUTIONS

www.vishay.com

SEMICONDUCTORS

RECTIFIERS
- Schottky (single, dual)
- Standard, Fast, and Ultra-Fast Recovery (single, dual)
- Bridge
- Superectifier®
- Sinterglass Avalanche Diodes

SMALL-SIGNAL DIODES
- Schottky and Switching (single, dual)
- Tuner/Capacitance (single, dual)
- Bandswitching
- PIN

ZENER AND SUPPRESSOR DIODES
- Zener (single, dual)
- TVS (TRANSZORB®, Automotive, ESD, Arrays)

MOSFETs
- Power MOSFETs
- JFETs

RF TRANSISTORS
- Bipolar Transistors (AF and RF)
- Dual Gate MOSFETs
- MOSMICs®

OPTOELECTRONICS
- IR Emitters and Detectors, and IR Receiver Modules
- Optocouplers and Solid-State Relays
- Optical Sensors
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

ICs
- Power ICs
- Analog Switches
- DC/DC Converters
- RF Transceivers
- ICs for Optoelectronics

PASSIVE COMPONENTS

RESISTIVE PRODUCTS
- Foil Resistors
- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
- Power Metal Strip® Resistors
- Chip Fuses
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
- Networks/Arrays
- Non-Linear Resistors
  - NTC Thermistors
  - PTC Thermistors
  - Varistors

MAGNETICS
- Inductors
- Transformers

CAPACITORS
- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Capacitors
- Silicon RF Capacitors

STRAIN GAGE TRANSDUCERS AND STRESS ANALYSIS SYSTEMS
- PhotoStress®
- Strain Gages
- Load Cells
- Force Transducers
- Instruments
- Weighing Systems
- Specialized Strain Gage Systems

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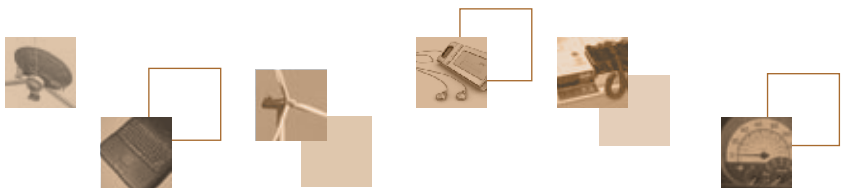
Contents

Power Management Components



Introduction

Vishay was founded in 1962 to manufacture and market foil resistors, an invention of physicist Dr. Felix Zandman, Chairman of the Board and founder. The Company began operations with foil resistors and strain gages as its initial product offerings. In 1985, having grown from a start-up into the world's leading manufacturer of these original products, Vishay began an ongoing series of strategic acquisitions to broaden its product portfolio.

Broad-Line Manufacturer, Global Presence

Today, Vishay is a broad-line manufacturer with a global presence. It is one of the world's largest manufacturers of discrete semiconductors and passive electronic components. Vishay's acquisitions include the infrared component business of Infineon and such top names as Siliconix, Dale, Draloric, Sprague, Vitramon, and BCcomponents (the former passive components business of Philips Electronics and Beyschlag).

Innovations in Technology

Over the years, Vishay's R&D efforts have led to a steady stream of technological breakthroughs and innovative products. These include packageless power MOSFETs, the industry's first silicon-based RF capacitors, dc-to-dc converter modules with all the active and passive components required for a complete power conversion solution, high-current IHLP inductors, Power Metal Strip® resistors, and many more.

Leading Industry Rankings

Vishay's global footprint includes manufacturing facilities in China and other Asian countries, Israel, Europe, and the Americas, as well as sales offices around the world. Vishay has market shares ranging from substantial to number-one for each of its products.

Discrete Semiconductors

Number 1 worldwide in low-voltage power MOSFETs
Number 1 worldwide in rectifiers
Number 1 worldwide in glass diodes
Number 1 worldwide in infrared components
...and others

Passive Components

Number 1 worldwide in wirewound and other power resistors
Number 1 worldwide in foil, MELF, thin film, and current sense resistors
Number 1 worldwide in wet tantalum capacitors
Number 1 worldwide in strain gage sensors and load cells
...and others

"One-Stop Shop" Service

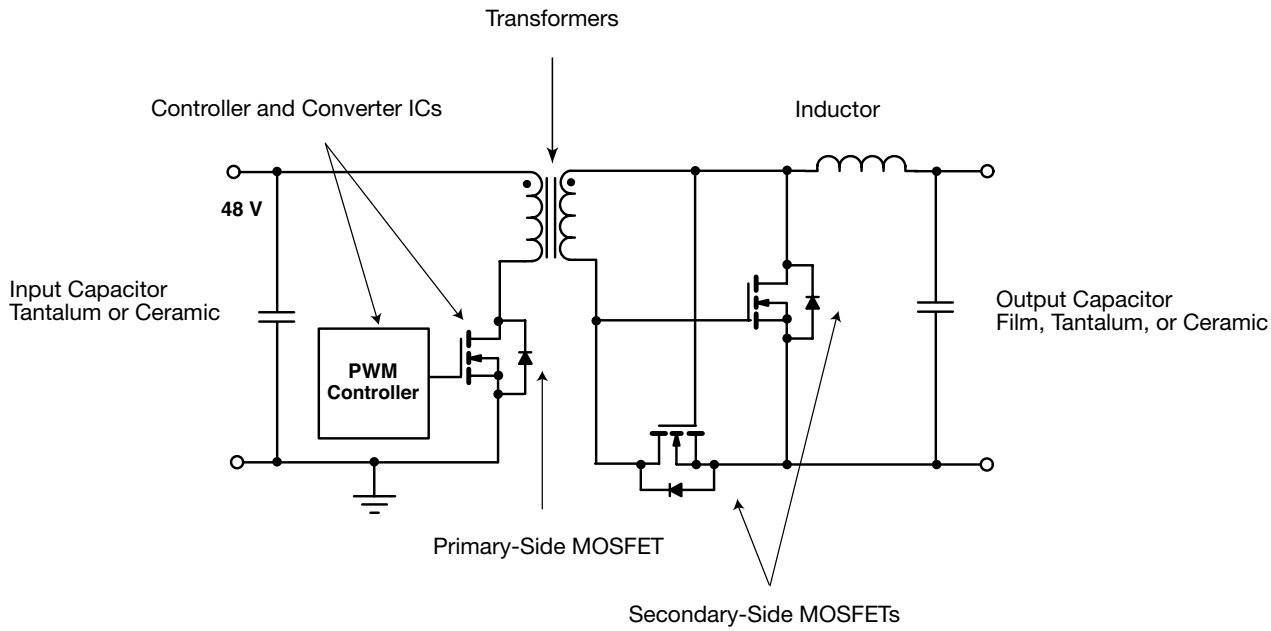
With Vishay's "one-stop shop" service, customers can send their bills of materials (BOMs) to Vishay and ask the Company to cross-reference Vishay products in all categories. This enables customers to order multiple components from one source—Vishay. In addition, Vishay's product sample service for design engineers provides free product samples worldwide. Quick turnaround time and a complete range of Vishay samples enable customers to rely on Vishay for discrete electronic component solutions. For more information about Vishay samples, please visit us on the Web at www.vishay.com or contact a local Vishay sales representative or office.

Power Management Components

Vishay offers one of the industry's broadest selections of semiconductor and passive components for power management applications. The Vishay product portfolio for power management includes power MOSFETs, power ICs, rectifiers, diodes, capacitors, resistors, and inductors. Within these product categories, Vishay offers many industry-first and industry-best devices, including Vishay Siliconix TrenchFET® power MOSFETs, Vishay Power Metal Strip® resistors, and Vishay Semiconductors Trench MOS Barrier Schottky (TMBS™) rectifiers.

Beyond delivering superior electrical performance, these devices encompass a range of packaging innovations that enable smaller and more thermally efficient circuit implementations. They include PolarPAK® power MOSFETs with double-sided cooling, SMPC rectifiers with current ratings up to 12 A in a tiny 4.7-mm by 6-mm footprint, and IHLP inductors with extraordinarily low height profiles and the industry's lowest DCR/µH for their respective package sizes.

With its broad product portfolio, Vishay is able to provide complete component solutions. For example, Vishay manufactures all the semiconductor and passive components shown in the circuit diagram below of a forward dc-to-dc converter. Vishay additionally offers a wide range of components for ac-to-dc and ac-to-ac conversion. Whether your application is power conversion, power switching, or power routing, Vishay has a power management solution to meet your needs.



Forward DC/DC Converter

Power MOSFETs

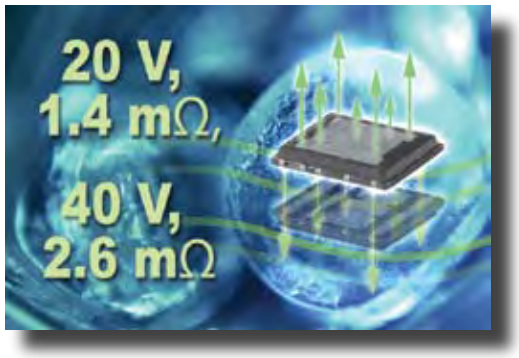
Vishay Siliconix leads the industry in the development of power MOS silicon and packaging technologies that boost power management and power conversion efficiency in computers, laptops, notebooks, PDAs, cellular phones, automotive electronics, consumer electronics, and many other systems—while greatly reducing the board area required for power components.

As miniaturization drives higher current densities in a wide range of electronic systems, designers are more aware than ever of the importance of thermally efficient packages for power semiconductor components. Vishay Siliconix package innovations addressing these demands include PolarPAK®, with dual top and bottom cooling, and several versions of PowerPAK®, each of which offers much better thermal performance than the standard package types with the same or similar footprint dimensions.

Vishay Siliconix continually innovates to meet the increasing demands of applications such as dc-to-dc conversion and load switching. For example, WFET® power MOSFETs combine the ultra low on-resistance capabilities of TrenchFET® technology with extraordinarily low gate-drain capacitance to maximize dc-to-dc converter efficiency. A complete new family of p-channel power MOSFETs, built on a patent-pending TrenchFET technology, offers a reduction in on-resistance up to 45 % compared with the previous state-of-the-art and signifies a new opportunity to reduce system power consumption through efficient load switching.

Recently introduced products

N-Channel PolarPAK® Power MOSFETs



- Up to 1/2 $r_{DS(on)}$ reduction with breakthrough double-sided-cooling package
- Dual heat dissipation paths double current density (>60 A)
- Fixed footprint and pad layout across family
- Easy handling provides high yield and reliability for high-volume production
- Designed for synchronous rectification, point-of-load converters, and OR-ing applications in telecom and data communications systems

WFET® Resolves Trade-Off Between On-Resistance and Switching Performance

- Record-breaking $r_{DS(on)}$ * Q_{gd} figures of merit (FOM) to improve dc-to-dc converter efficiency
- High-side MOSFET benefit: reduces C_{rss} and Q_{gd} with no impact on $r_{DS(on)}$
- Low-side MOSFET benefit: low Q_{gd}/Q_{gs} ratio ensures higher shoot-thru immunity
- Designed to maximize power MOSFET performance in such applications as dc-to-dc conversion and load switching

PowerPAK® ChipFET® Power MOSFETs

- Compact 3-mm by 1.8-mm footprint, pin-compatible with standard ChipFET package
- Replace power MOSFETs in SO-8 packages in point-of-load, synchronous rectification, and logic-level dc-to-dc conversion applications for low-power computer and fixed telecom systems
- Replace power MOSFETs in the TSOP-6 package used as load switches in portable electronic systems and notebook PCs
- Same 3-W maximum power dissipation as larger SO-8, enabling designs with higher power density

Advanced P-Channel TrenchFET Power MOSFETs

- Reduce device on-resistance by as much as 90 % compared with the previous state of the art, decreasing device power dissipation
- Offered in more than a dozen package types (single and dual) and with breakdown voltages from -12 V to -60 V
- Eliminate the need for level-shifting circuitry and maximize the power-saving benefits of low operating voltages in battery-operated systems
- Reduce board space requirements

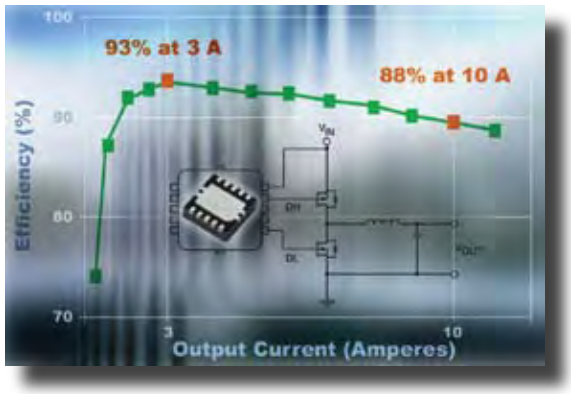
MICRO FOOT®: TSSOP-8 Performance in 1/5 the Space

- 81 % less footprint area than TSSOP-8 devices while providing industry-standard TSSOP-8 on-resistance based on chipscale package technology
- Smallest 20-V and 30-V common drain n-channel and 20-V common drain p-channel devices, ideal for Li-Ion and Li-Polymer battery pack protection applications in cell phones, PDAs, MP3 players, and digital cameras
- Compact 1.6-mm by 2.4-mm chipscale format with a 0.65-mm height profile

Power ICs

Vishay Siliconix power ICs include switchmode regulators, linear regulators, MOSFET drivers, and load switches with integrated slew-rate control. Switchmode regulator ICs include isolated and non-isolated controllers and converters for buck, boost, and buck-boost implementations. Applications for these devices address a wide range of end products, including computers, cell phones, consumer electronics, fixed telecom systems, and industrial systems.

Recently introduced products

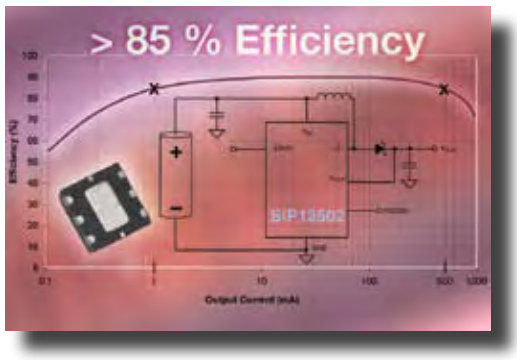


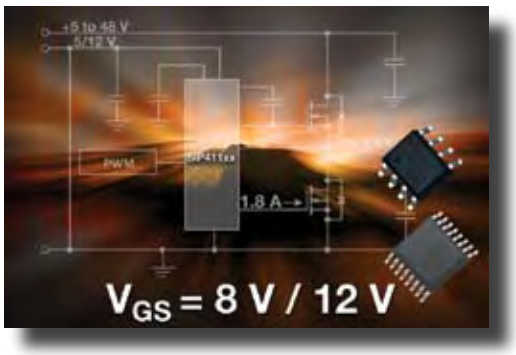
SiP12201 and SiP12202 10-A Synchronous Buck Step-Down Controller ICs

- Voltages converted with 93 % efficiency, prolonging battery life while lowering heat
- Available with input voltage ranges of 4.2 V to 26 V (SiP12201) or 2.7 V to 5.5 V (SiP12202)
- Produce output voltages as low as 0.6 V
- First devices on the market to combine this low output voltage with a 500-kHz operating frequency

SiP12502 and SiP12503 Boost Converter ICs Provide >85 % Efficiency at 500 mA Down to 1 mA

- Operation from input voltages of 0.85 V to 5 V
- Fixed 2-V, 3.3-V, and 5-V (SiP12502) or adjustable 2-V to 5-V (SiP12503) output voltages
- Integrated MOSFET rated for a low 0.24-Ω impedance at a 3.3-V output
- Designed to maximize the power available from single- or dual-cell NiMH or alkaline battery packs





SiP41108/9/10 1.8-A Half-Bridge N-Channel MOSFET Drivers for 5-V to 48-V Systems

- Provides selectable gate drive voltages of 8 V or 12 V to optimize efficiency, reduce component count, and minimize expense
- Optimized for high-frequency, high-current dc-to-dc synchronous rectifier buck power supplies

Si9122A 500-kHz Half-Bridge DC/DC Controller with Secondary Synchronous Rectification Drivers

- Input voltage of 28 V to 75 V
- >90 % efficiency, even for low output voltages
- Integrated ±1-A half-bridge primary drivers
- Secondary synchronous rectifier control with programmable deadtime delay
- Switching frequency from 250 kHz to 625 kHz set by external resistor

SiP4280A and SiP4282 P-Channel Load Switches

- Integrated slew-rate control reduces in-rush current when the device is turned on, allowing for the use of a small input capacitor, or no capacitor at all
- Shutdown load discharge circuit enables rapid turn-off of a load circuit when the switch is disabled
- Typical quiescent currents of 2.5 µA for the SiP4282 and 0.025 µA for the SiP4280A allow for longer on-times in battery-powered equipment

SiP21106, SiP21107, and SiP21108 Low-Dropout Voltage Regulators

- Ultra-low ground current in addition to a low dropout voltage of 135 mV helps to extend battery life in battery-operated power systems and portable electronics
- Advanced µCap design architecture allows stable operation with very small ceramic output capacitors, reducing board space and component cost
- 1 % output voltage accuracy at 25 °C
- Maintain regulation while delivering 330-mA peak current for systems with a high surge current upon turn-on
- For voltage regulation in PDAs, MP3 players, digital cameras, pagers, wireless handsets, wireless modems, medical handhelds, and more

Rectifiers

The expansive Vishay Semiconductors rectifier portfolio includes bridge, Schottky, ultrafast recovery, fast recovery, and standard recovery rectifiers in more than 20 package types with reverse voltage ratings from 20 V to 4000 V and forward current ratings from 0.6 A to 60 A. This product offering includes TMBS™ rectifiers, the industry's first Schottky barrier rectifiers built on Trench MOS technology. Useful as a rectification circuit or OR-ing diode in redundant switchmode power supplies, or to replace synchronous rectification solutions, TMBS™ devices feature the lowest forward voltage drop among Schottky rectifiers for their package types. Vishay Semiconductors rectifiers address applications including secondary rectification and freewheeling circuitry for ac-to-dc and dc-to-dc converters; output rectification for small and medium power adaptors; switchmode power supplies in consumer electronics such as computers, LCD monitors, and cell phones; flywheel and polarity protection for solenoid drive circuits in automotive and industry systems; and OR-ing diodes for telecommunication and industrial systems.

Recently introduced products

Industry-First High-Voltage 100-V TMBS™ (Trench MOS Barrier Schottky) Rectifiers

- Superior low V_F: 0.375 V at 5 A and 0.61 V at 20 A (VTS40100CT)
- Low-V_F, fast switching performance in switchmode power supplies and adapters for PCs and flat screen plasma and LCD TVs
- Low V_F reduces power loss and improves efficiency of the OR-ing diode in the high-voltage output of redundant switchmode power supplies

Rectifiers in New SMPC Package Enable High-Current-Density Performance up to 100 V and 12 A in Tiny 4-mm by 6.7-mm Footprint

- Special wide-bottom plate design improves heat dissipation compared to other miniaturized packages
- Enables current ratings up to 12 A for TMBS™ Trench MOS Barrier Schottky devices, up to 10 A for planar Schottky
- Uses industry-standard TO-277A outline
- For power conversion, power adapters, and power supplies

UH8JT and UHF8JT 8-A, 600-V Single High-Voltage Ultrafast Rectifiers

- Very fast reverse recovery time (t_{rr}) of 25 ns and forward recovery time (t_{fr}) of 150 ns
- Improved switching performance enables low switching power losses
- Offered in TO-220AC (UH8JT) and ITO-220AC (UHF8JT) versions
- For high-voltage continuous-current-mode power factor correction (CCM PFC) systems in consumer and computer products, high-voltage output for switchmode power supplies, secondary dc-to-dc rectification applications, and freewheeling diode applications

Capacitors

Vishay offers one of the industry's largest offerings of capacitors for power management applications, including devices built on aluminum, ceramic, film, and tantalum technologies in surface-mount and through-hole packages. Available capacitance and voltage ratings address the full range of power management applications from portable handheld devices to heavy industrial systems, with devices rated from 1 V to 40 kV.

Recently introduced products

TR3 Molded Tantalum Chip Capacitors

- Low ESR values allow for more efficient filtering in dc-to-dc conversion applications
- Ability to handle high currents is key in microprocessor bulk energy storage applications
- Availability in five molded case sizes enhances design flexibility
- Proven solid tantalum construction ensures long-term reliability
- Outstanding stability over time and temperature further enhances device performance and reliability

HDMKP Heavy-Duty, Metallized-Film Power Capacitors

- Feature low inductance of less than 50 nH
- Rated for high current up to 150 A
- Offer a high RMS current rating as a result of an advanced metallized film on the polypropylene dielectric
- Reduce ohmic losses with series resistance of less than 5 mΩ
- Offer high reliability and life expectancy in a compact design
- For dc and ac filtering and for dc linking in uninterruptible power supplies and in power converters for traction and industrial drives

GLI Metallized Film Power Capacitors

- Very low stray inductance
- Extremely low losses at high frequencies
- Low ESR
- Highest RMS current rating
- High impulse discharge current capability
- Resistance to heavy-duty shock and vibration
- High reliability and life expectancy
- Integrated flanges enable easy mounting
- For DC-linking, voltage conversion, frequency conversion, and impulse discharge applications

Power Metal Strip

Vishay Dale Power Metal Strip® current sensing resistors combine superior performance in high-temperature applications with a wide range of package sizes and a choice of resistance values from 0.0002 Ω to 1 Ω. These patented, state-of-the-art products deliver overload capabilities equivalent to wirewound devices and temperature coefficients as low as 30 ppm/°C.

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 monitored easily. 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 values of Power Metal Strip resistors allow this function to be carried out with exceptional efficiency. The low TCR of Vishay Power Metal Strip resistors minimizes the resistance change caused by self-heating and high-temperature environments.

MELF

Vishay's offering of MELF resistors includes thin film and metal film devices with TCRs as low as 5 ppm/°C and tolerances as low as ±0.02 % for ultra-precision performance. Power ratings range from 0.06 W to 1 W, with minimum and maximum resistance specifications ranging from 0.1 Ω to 15 MΩ respectively. Device options include MELF resistors with established reliability, the ability to withstand high pulse loads, and fusible cases.

Thick Film Power

The Vishay family of thick film power resistors includes 30-W, 50-W and 100-W devices in industry-standard TO220 and TO247 packages. These resistors use a ceramic package design (with no metal tab) for direct-mounting on heatsinks, and feature an exceptionally low inductance of less than 0.1 µH, suiting them for use in power conversion and control applications in a wide variety of industries.

Chip Fuses

Vishay chip fuses are available in a range of technology options, including thin film, metal film, carbon film, and wirewound and in case sizes ranging from 0002 to 2008.

Thermistors

Vishay's ceramic PTC thermistors are widely used in telecom infrastructure equipment as an over-current protection element. Their main function is to block too high or faulty line currents. Usually they operate together with overvoltage protection elements to form a resettable overload protection against all kinds of external disturbances. Ceramic PTCs have been the preferred choice for over-current protection in fixed telecom applications because of their ability to return to the original state after fault conditions and their robust and safe design.

The use of ceramic PTC technology confers high stability, fast response and recovery times, and the ability to sustain several trip cycles. This in turn allows the devices to conform to the more stringent requirements of the ITU K20-21-45 Edition 2003 specification for overvoltage and overcurrent protection for telecommunications equipment.

Recently introduced products

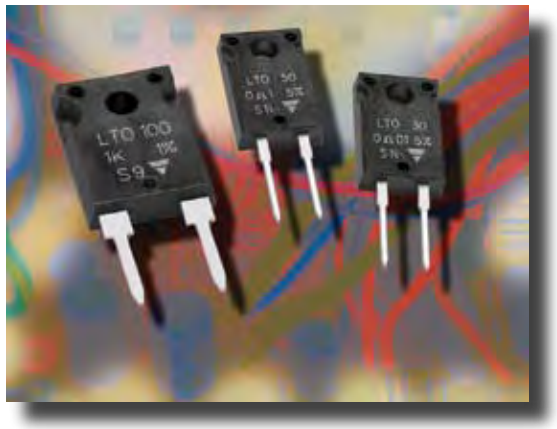
WSLS2512 Surface-Mount Power Metal Strip® Resistor

- Greater stability with maximum resistance change of 0.5 % through a 2000-hour workload
- Proprietary manufacturing techniques result in a very low 0.01-Ω to 0.1-Ω resistance value range
- Durable with all-welded construction and a solid metal nickel-chrome alloy resistive element
- For current sensing in high-temperature (+125 °C), tightened-stability applications that require precision current monitoring of sensitive circuits, such as automotive electronic controls including engine, transmission, and pollution controls

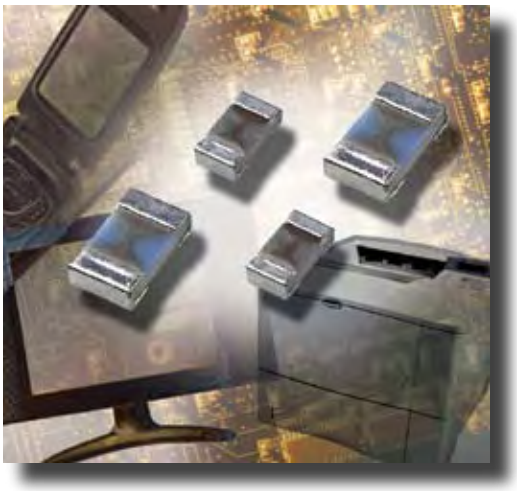
CMA 0204 and CMB0207 High Pulse Load MELF Resistors

- Advanced pulse load operation for protection of circuitry from surge pulses from signal and mains input lines
- Compatible with lead (Pb)-free and lead-containing soldering processes
- Lead (Pb)-free and RoHS compliant
- For automotive, telecom, industrial, and medical applications

LTO Thick Film Power Resistors



- 30-W, 50-W, and 100-W devices in industry-standard TO220 and TO247 packages
- Resistance values from 0.010 Ω to 550 kΩ for the LTO 30 and LTO 50 families, and from 0.015 Ω to 1 MΩ for the LTO 100
- Temperature coefficient of 150 ppm/°C for values above 0.5 Ω
- Ceramic package design (with no metal tab) for direct-mounting on heatsinks
- For power conversion and control applications in uninterruptible power supplies (UPS), power conversion for traction and industrial drives, and in medical, automotive, and industrial control environments



MFU 0402 Thin Film Flat Chip Fuses

- Feature rated current values up to 2.0 A with a breaking capacity of 50 A
- Compact RR 1005M metric case size [1.0 mm by .50 mm by .32 mm]
- Manufactured with quick-acting fuse characteristics for highly predictable performance even in sensitive electronic systems
- Feature a coating that protects against electrical, mechanical, and climatic hazards
- Provide secondary overcurrent protection for dc-to-dc converters, battery chargers, and low-voltage power supplies in mobile consumer electronics devices such as cell phones and portable media players

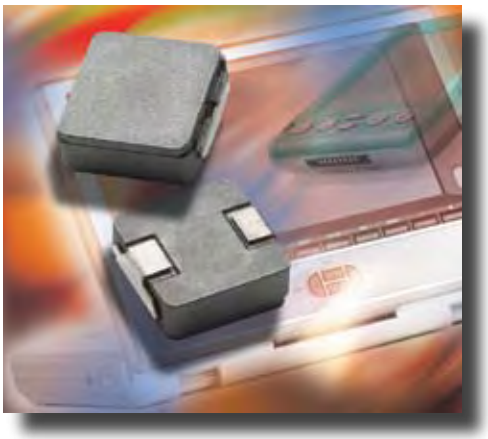
2322 673 Twin Vertical SMD PTC Thermistors

- Integrate two positive temperature coefficient (PTC) thermistors into a single surface-mount package
- Ceramic disc, reflow soldered to a lead-frame construction, results in a flat pick-up area of 30 mm^2 for automated assembly
- Reduce the board space required to implement overload protection in telecommunications applications by up to 65 %
- 240-V maximum voltage rating
- Available with maximum trip times between 1.2 s and 4.0 s and maximum current ratings ranging from 2.5 A to 4.0 A.

Inductors

Vishay Dale inductors are offered in both through-hole and surface-mount packages and include devices optimized for automotive, mobile phone, computer, consmer, fixed telecom, and industrial applications. The surface-mount range of Vishay Dale power inductors boasts a large selection of low-profile, high-current devices with typical DC ratings as high as 60 A. Power management applications served by these power inductor devices include high-current point-of-load converters, dc-to-dc converters in distributed power systems, dc-to-dc conversion for field-programmable gate arrays, and low-profile, high-current power supplies.

Recently introduced products



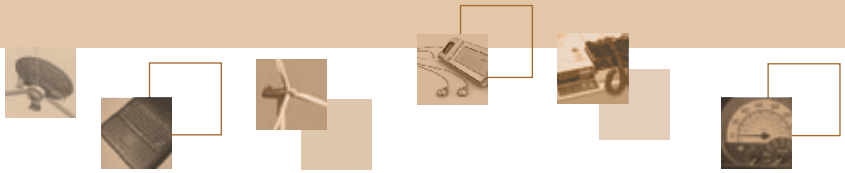
IHLP-4040DZ-01 and IHLP-4040DZ-11 Low-Profile, High-Current Inductors

- Feature high maximum frequencies of 1.0 MHz (IHLP-4040DZ-11) and 5.0 MHz (IHLP-4040DZ-01)
- High saturation currents of 46 A (IHLP-4040DZ-11) and 90 A (IHLP-4040DZ-01)
- Both devices offer inductance values down to 0.19 µH
- Compact dimensions of 0.405 in. by 0.453 in. [10.3 mm by 11.5 mm] and a very low height profile of 0.158 in. [4.0 mm]
- Handle high transient current spikes without hard saturation
- For voltage regulator module (VRM) and dc-to-dc converter applications in a broad range of electronic products.

New IHLP-1616AB-01, IHLP-1616AB-11, IHLP-1616BZ-01, and IHLP-1616BZ-11 Low-Profile, High-Current Inductors

- Feature high maximum frequencies of 1.0 MHz (IHLP-1616AB-11 and IHLP-1616BZ-11) and 5.0 MHz (IHLP-1616AB-01 and IHLP-1616BZ-01)
- Offer inductance ranges from 0.047 µH to 4.7 µH
- Compact dimensions of 0.160 in. by 0.175 in. [4.06 mm by 4.45 mm] in new 1616 footprint
- IHLP-1616AB-01 and IHLP-1616AB-11 feature very low height profiles of 0.047 in. [1.2 mm]
- IHLP-1616BZ-01 and IHLP-1616BZ-11 feature very low height profiles of 0.079 in. [2.0 mm]
- Handle high transient current spikes without hard saturation
- For voltage regulator module (VRM) and dc-to-dc converter applications in a broad range of electronic products.

Notes



SEMICONDUCTORS:
Rectifiers • Small-Signal Diodes • Zener and Suppressor Diodes • MOSFETs • RF Transistors • Optoelectronics • ICs

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

One of the World's Largest Manufacturers
of Discrete Semiconductors and Passive Components

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