WHAT ARE SMART LOAD SWITCHES?

Vishay Siliconix smart load switches are integrated low-resistance power switches with optimized features, as shown in Figure 1. The family provides improved controllability, safety, and compact sizes in designs for power distribution, sequencing, and protection.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Vin operation</td>
<td>The integrated gate driving circuit extends the minimum Vin range, bringing lower switch resistance and improved efficiency</td>
</tr>
<tr>
<td>Low-voltage GPIO enable</td>
<td>Low-voltage GPIO enable is simplified GPIO control that can be used to implement power distribution and sequencing of multiple sub-systems</td>
</tr>
<tr>
<td>Slew rate control</td>
<td>Load switches with slew rate control provide a controlled supply ramp, reducing inrush current</td>
</tr>
<tr>
<td>Quick output discharge</td>
<td>The output node has a defined decay with quick output discharge and does not leave the node floating</td>
</tr>
<tr>
<td>Fault protection and isolation</td>
<td>Load switches with fault protection and isolation can have integrated protection features such as reverse current, over temperature, current limiting, and short circuit for increased robustness</td>
</tr>
<tr>
<td>Small solution size</td>
<td>Integrated load switches in small package sizes use significantly less PCB area compared to a discrete implementation. Reduced BOM count translates into lower manufacturing costs</td>
</tr>
</tbody>
</table>

RESOURCES

- Product web page - www.vishay.com/power-ics
- For technical questions contact PowerICtechsupport@vishay.com
Load Management

In many applications, there is a repetition of power rails of the same voltage. Instead of using multiple DC/DC converters to generate the same voltage rails, load switches can be used to distribute the power from the DC/DC converter and sequence it in the appropriate order, reducing the board space required.

Power Saving

Functions not used at all times can be turned off using a load switch, reducing power consumption and prolonging battery life. This is more important for blocks with high power consumption, such as graphics, processors, radios, and memory in ultra-compact applications.

Vishay Siliconix offers smart load switches with resistance ranges from 100 mΩ down to 6.5 mΩ. For various circuit design considerations, they are offered as a series with feature options for turn-on slew rate, output discharge, reverse blocking, undervoltage lockout, logic high / low enable, and overcurrent protection. Parts are available in a variety of compact plastic packages as well as wafer-level chipscale package options. Vishay’s chipscale packages feature a unique top-side lamination to enhance mechanical ruggedness of the package, thus improving reliability during SMT handling.
SiP32458, SiP32459

The SiP32458/9 are 20 mΩ switches with superior low and flat $R_{\text{DS(ON)}}$ over a wide $V_{\text{IN}}$ range without compromising operating quiescent current. The parts incorporate an adaptive charge pump to drive the PMOS gate when turned on.

**FEATURES AND BENEFITS:**
- Wide operation voltage range: 1.5 V to 5.5 V
- 20 mΩ low and flat $R_{\text{DS(ON)}}$ over the full voltage range
- Low quiescent current of 2.8 µA at 3 V
- Low logic control EN with integrated pull-down resistor
- Reverse blocking functionality at turn-off

**APPLICATIONS:**
- Smartphones, PDAs, cell phones
- Handheld instrumentation and PCs
- Handheld POS
- Data storage

<table>
<thead>
<tr>
<th>Part Number</th>
<th>$R_{\text{ON}}$ (mΩ)</th>
<th>$T_{\text{ON}}$ (ns)</th>
<th>$T_{\text{OFF}}$ (µs)</th>
<th>$I_{\text{Q}}$ (µA)</th>
<th>Discharge</th>
<th>Reverse Blocking</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiP32458DB-T2-GE1</td>
<td>20</td>
<td>500</td>
<td>3</td>
<td>18</td>
<td>–</td>
<td>√</td>
</tr>
<tr>
<td>SiP32459DB-T2-GE1</td>
<td>20</td>
<td>500</td>
<td>3</td>
<td>18</td>
<td>√</td>
<td>–</td>
</tr>
</tbody>
</table>

SiP32101, SiP32102, SiP32103

**Ultra-Low-Resistance Bidirectional Switches**

The SiP32101, SiP32102, and SiP32103 offer the lowest resistance for bidirectional battery-isolated switches in compact 12-bump WCSP 1.3 mm by 1.7 mm packages, which enable a 91 % smaller PCB footprint over discrete solutions.

**FEATURES AND BENEFITS:**
- Ultra-low switch resistance: 6.5 mΩ at 3.3 V
- 5 A DC current capability
- Wide input voltage range: 2.3 V to 5.5 V
- Bidirectional ON and OFF switching
- Low quiescent current: 0.015 nA typical
- 1.4 V logic high for direct low-voltage control interface
- Slew rate control
- EN pin with integrated 500 KΩ pull resistor

**APPLICATIONS:**
- Smartphones and tablets
- Power bank and battery
- Portable meters and test instruments
- Communication devices with embedded batteries
- Portable medical and healthcare systems
- Data storage

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Control Logic</th>
<th>EN Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiP32101DB-T1-GE1</td>
<td>Low Enable</td>
<td>Pull Down</td>
</tr>
<tr>
<td>SiP32102DB-T1-GE1</td>
<td>High Enable</td>
<td>Pull Down</td>
</tr>
<tr>
<td>SiP32103DB-T1-GE1</td>
<td>Low Enable</td>
<td>Pull Up</td>
</tr>
</tbody>
</table>
SiP4282 and SiP32431 Series

Ultra-Low-Quiescent-Current Load Switches

The SiP32431 features 40 pA ultra-low quiescent current. They are of great advantage for those designs with limited battery size and long standby time.

FEATURES AND BENEFITS:
- Wide operation voltage range: 1.5 V to 5.5 V
- 100 μs and 1 ms slew rate options
- Low switch ON resistance: 100 mΩ
- Featuring output discharge, reverse blocking, and undervoltage lockout
- Compact TDFN4 1.2 mm by 1.6 mm package

APPLICATIONS:
- Portable instruments
- Healthcare devices
- Smartphones / cellular phones
- PMP, GPS, DSC
- Smart meters

SiP32419, SiP32429, SiP32430

Programmable Overcurrent Protection

The SiP32419, SiP32429, and SiP32430 smart load switches integrate multiple features that enhance controllability and safety. They provide settable overcurrent protection and soft start time for slew rate control. Their ultra-fast 1 μs short-circuit response and thermal shutdown provide enhanced levels of protection. The SiP32419 and SiP32429 offer current limit settings in the range of 750 mA to 3.5 A, and the SiP32430 offers current limit settings in the range of 150 mA to 1 A.

FEATURES AND BENEFITS:
- Wide operation voltage range: 6 V to 28 V
- Programmable switch turn-on
- Adjustable current limit
- < 1 μs short-circuit protection response time
- Over-temperature protection
- Input undervoltage lockout
- Convenient low-voltage control logic
- Power Good and Fault Flag outputs with blanking time
- Compact DFN10 3 mm by 3 mm package
- SiP32419 latches off on Fault
- SiP32429 and SiP32430 auto retry after 150 ms

APPLICATIONS:
- Industrial
- Telecommunication
- Data storage, HDD, SSD
- Portable equipment
- Motor drivers
- Digital cameras
- Computing
- Medical and healthcare equipment
- Smart meters
**Vishay Siliconix Smart Load Switch Product Offering**

Combining advanced process technology and circuit design, Vishay Siliconix offers best-in-class smart load switch products that include slew rate control load switches, current-limiting, and low-resistance bidirectional switches.

Vishay Siliconix offers smart load switches in both wafer-level chipscale packages and plastic package options.

### Slew Rate Control Load Switches

<table>
<thead>
<tr>
<th>Config</th>
<th>Part Number</th>
<th>Package</th>
<th>V_IN (min)</th>
<th>Rds (mΩ)</th>
<th>IQ</th>
<th>V_IN (max)</th>
<th>Rds (mΩ)</th>
<th>IQ</th>
<th>Continuous Current</th>
<th>Slew Rate</th>
<th>Output Discharge</th>
<th>Reverse Blocking</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>SIP32508DT</td>
<td>SOT23-6L 3.05 mm x 2.85 mm</td>
<td>1.1</td>
<td>48</td>
<td>10 µA</td>
<td>5.5</td>
<td>47</td>
<td>105 µA</td>
<td>3 A</td>
<td>2 ms</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>SIP32510DT</td>
<td>SOT23-6L 3.05 mm x 2.85 mm</td>
<td>1.5</td>
<td>395</td>
<td>&lt;1 nA</td>
<td>5.5</td>
<td>147</td>
<td>&lt;1 nA</td>
<td>1 A</td>
<td>100 µs</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>SIP32431DR3</td>
<td>SC70-6L 2 mm x 2 mm</td>
<td>1.5</td>
<td>350</td>
<td>&lt;1 nA</td>
<td>5.5</td>
<td>105</td>
<td>&lt;1 nA</td>
<td>1.2 A</td>
<td>100 µs</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>SIP32411DR</td>
<td>SC70-6L 2 mm x 2 mm</td>
<td>1.8</td>
<td>230</td>
<td>2.5 µA</td>
<td>5.5</td>
<td>2.5 µA</td>
<td>2.5 µA</td>
<td>1.2 A</td>
<td>100 µs</td>
<td>NA</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SIP32411DR</td>
<td>SC70-6L 2 mm x 2 mm</td>
<td>1.1</td>
<td>105</td>
<td>6.7 µA</td>
<td>5.5</td>
<td>101</td>
<td>71 µA</td>
<td>2 A</td>
<td>150 µs</td>
<td>NA</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SIP32408DNP</td>
<td>TDFN4 1.2 mm x 1.6 mm</td>
<td>1.5</td>
<td>350</td>
<td>&lt;1 nA</td>
<td>5.5</td>
<td>105</td>
<td>&lt;1 nA</td>
<td>1.2 A</td>
<td>100 µs</td>
<td>NA</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SIP32409DNP</td>
<td>TDFN4 1.2 mm x 1.6 mm</td>
<td>1.1</td>
<td>45</td>
<td>6.7 µA</td>
<td>5.5</td>
<td>62</td>
<td>71 µA</td>
<td>2 A</td>
<td>150 µs</td>
<td>NA</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SIP32448DNP</td>
<td>TDFN4 1.2 mm x 1.6 mm</td>
<td>1.8</td>
<td>38</td>
<td>10 µA</td>
<td>3.5</td>
<td>32</td>
<td>120 µA</td>
<td>4 A</td>
<td>2.7 ms</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>SIP32458DB</td>
<td>WCSP6 1.0 mm x 1.5 mm</td>
<td>1.5</td>
<td>38</td>
<td>2 µA</td>
<td>5.5</td>
<td>20</td>
<td>6 µA</td>
<td>3 A</td>
<td>2.7 ms</td>
<td>NA</td>
<td>√</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>SIP32459DB</td>
<td>WCSP6 1.0 mm x 1.5 mm</td>
<td>1.2</td>
<td>86</td>
<td>1.4 µA</td>
<td>5.5</td>
<td>46</td>
<td>5.8 µA</td>
<td>1.2 A</td>
<td>170 µs</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>SIP32472DNP</td>
<td>uDFN4, 1.1 mm x 1.1 mm</td>
<td>1.2</td>
<td>86</td>
<td>1.4 µA</td>
<td>5.5</td>
<td>46</td>
<td>5.8 µA</td>
<td>1.2 A</td>
<td>170 µs</td>
<td>NA</td>
<td>√</td>
<td>High</td>
</tr>
</tbody>
</table>

**POWER MANAGEMENT ICs**

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www.vishay.com
## Slew Rate Control Load Switches

<table>
<thead>
<tr>
<th>Config</th>
<th>Part Number</th>
<th>Package</th>
<th>VIN (min)</th>
<th>VIN (max)</th>
<th>Continuous Current</th>
<th>Slew Rate</th>
<th>Output Discharge</th>
<th>Reverse Blocking</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>SIP32460DB</td>
<td>WCSP4 0.8 mm x 0.8 mm</td>
<td>1.2</td>
<td>95</td>
<td>2 µA</td>
<td>5.5</td>
<td>50</td>
<td>4.5 µA</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>SIP32461DB</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>SIP32462DB</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>SIP32467DB</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>SIP32468DB</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>SIP32451DB</td>
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<tr>
<td></td>
<td>SIP32452DB</td>
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<tr>
<td></td>
<td>SIP32453DB</td>
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<tr>
<td></td>
<td>SIP32454DB</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIP32455DB</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual</td>
<td>(2 to 1)</td>
<td>TDFN8 2 mm x 2 mm</td>
<td>1.1</td>
<td>66</td>
<td>6.7 µA</td>
<td>5.5</td>
<td>62</td>
<td>71 µA</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>SIP32413DNP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SIP32414DNP</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>SIP32416DNP</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

## Current Limiting Switches

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>VIN (min)</th>
<th>VIN (max)</th>
<th>Rds (mΩ)</th>
<th>IQ (µA)</th>
<th>Current Limit Setting Range</th>
<th>Over-Current Response</th>
<th>Slew Rate</th>
<th>OTP</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIP32419</td>
<td>DFN10</td>
<td>6 V</td>
<td>28 V</td>
<td>56 mΩ</td>
<td>139 µA</td>
<td>0.75 A ~ 3.5 A</td>
<td>Off after 8 ms limit, switch latch at Off</td>
<td>Settatable</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td>SIP32429</td>
<td>DFN10</td>
<td>6 V</td>
<td>28 V</td>
<td>56 mΩ</td>
<td>139 µA</td>
<td>0.75 A ~ 3.5 A</td>
<td>Off after 8 ms limit, 150 ms auto retry after Off</td>
<td>Settatable</td>
<td>√</td>
<td>High</td>
</tr>
<tr>
<td>SIP32430</td>
<td>DFN10</td>
<td>6 V</td>
<td>28 V</td>
<td>56 mΩ</td>
<td>139 µA</td>
<td>0.15 A ~ 1 A</td>
<td>Off after 8 ms limit, 150 ms auto retry after Off</td>
<td>Settatable</td>
<td>√</td>
<td>High</td>
</tr>
</tbody>
</table>
## Smart Load Switches

### Bi-directional Switches

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>VIN (V)</th>
<th>Rds (mΩ)</th>
<th>IQ</th>
<th>Continuous Current (A)</th>
<th>Slew Rate</th>
<th>Reverse Blocking</th>
<th>Enable</th>
<th>EN Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiP32101</td>
<td>WCSP 1.3 mm x 1.7 mm</td>
<td>2.3</td>
<td>8</td>
<td>20 pA</td>
<td>5.5</td>
<td>5.1</td>
<td>30 pA</td>
<td>7</td>
<td>2.3 ms</td>
</tr>
<tr>
<td>SiP32102</td>
<td>WCSP 1.3 mm x 1.7 mm</td>
<td>2.3</td>
<td>8</td>
<td>20 pA</td>
<td>5.5</td>
<td>5.1</td>
<td>30 pA</td>
<td>7</td>
<td>2.3 ms</td>
</tr>
<tr>
<td>SiP32103</td>
<td>WCSP 1.3 mm x 1.7 mm</td>
<td>2.3</td>
<td>8</td>
<td>20 pA</td>
<td>5.5</td>
<td>5.1</td>
<td>30 pA</td>
<td>7</td>
<td>2.3 ms</td>
</tr>
<tr>
<td>SiP32460</td>
<td>WCSP 0.8 mm x 0.8 mm</td>
<td>1.2</td>
<td>95</td>
<td>1.2 µA</td>
<td>5.5</td>
<td>50</td>
<td>5.8 µA</td>
<td>1.2</td>
<td>170 µs</td>
</tr>
<tr>
<td>SiP32467</td>
<td>WCSP 0.8 mm x 0.8 mm</td>
<td>1.2</td>
<td>95</td>
<td>1.2 µA</td>
<td>5.5</td>
<td>50</td>
<td>5.8 µA</td>
<td>1.2</td>
<td>170 µs</td>
</tr>
</tbody>
</table>

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SEMICONDUCTORS

MOSFETs Segment

- Low-Voltage TrenchFET® Power MOSFETs
- Medium-Voltage Power MOSFETs
- High-Voltage Planar MOSFETs
- High-Voltage Superjunction MOSFETs
- Automotive-Grade MOSFETs

ICs

- VRPower® DrMOS Integrated Power Stages
- Power Management and Power Control ICs
- Smart Load Switches
- Analog Switches and Multiplexers

Diodes Segment

- Rectifiers
  - Schottky Rectifiers
  - Ultra-Fast Recovery Rectifiers
  - Standard and Fast Recovery Rectifiers
  - High-Power Rectifiers/Diodes
  - Bridge Rectifiers
- Small-Signal Diodes
  - Schottky and Switching Diodes
  - Zener Diodes
  - RF PIN Diodes
- Protection Diodes
  - TVS Diodes or TRANSZORB® (unidirectional, bidirectional)
  - ESD Protection Diodes (including arrays)
- Thyristors/SCRs
  - Phase-Control Thyristors
  - Fast Thyristors
- IGBTs
  - Field Stop Trench
  - Punch-Through Trench
- Power Modules
  - Input Modules (diodes and thyristors)
  - Output and Switching Modules (contain MOSFETs, IGBTs, and diodes)
  - Custom Modules

Optoelectronic Components Segment

- Infrared Emitter and Detectors
- Optical Sensors
  - Proximity
  - Ambient light
  - Light Index (RGBW, UV, IR)
  - Humidity
  - Quadrant Sensors
  - Transmissive
  - Reflective
- Infrared Remote Control Receivers
- Optocouplers
  - Phototransistor, Phototriac
  - Phototriac
  - High-Speed
  - IGBT and MOSFET Driver
- Solid-State Relays
- LEDs and 7-Segment Displays
- Infrared Data Transceiver Modules
- Custom Products

PASSIVE COMPONENTS

Resistors and Inductors Segment

- Film Resistors
  - Metal Film Resistors
  - Thin Film Resistors
  - Thick Film Resistors
  - Power Thick Film Resistors
  - Metal Oxide Film Resistors
  - Carbon Film Resistors
- Wirewound Resistors
  - Vitreous, Cemented, and Housed Resistors
  - Braking and Neutral Grounding Resistors
  - Custom Load Banks
- Power Metal Strip® Resistors
- Battery Management Shunts
- Crowbar and Steel Blade Resistors
- Thermo Fuses
- Chip Fuses
- Pyrotechnic Initiators / Igniters
- Variable Resistors
  - Cermet Variable Resistors
  - Wirewound Variable Resistors
  - Conductive Plastic Variable Resistors
  - Contactless Potentiometers
  - Hall Effect Position Sensors
  - Precision Magnetic Encoders

Capacitors Segment

- Tantalum Capacitors
  - Molded Chip Tantalum Capacitors
  - Molded Chip Polymer Tantalum Capacitors
  - Coated Chip Tantalum Capacitors
  - Solid Through-Hole Tantalum Capacitors
  - Wet Tantalum Capacitors
- Ceramic Capacitors
  - Multilayer Chip Capacitors
  - Disc Capacitors
  - Multilayer Chip RF Capacitors
  - Chip Antennas
  - Thin Film Capacitors
- Film Capacitors
- Power Capacitors
- Heavy-Current Capacitors
- Aluminum Electrolytic Capacitors
- ENYCAP™ Energy Storage Capacitors

Networks/Arrays
- NTC Thermistors
- PTC Thermistors
- Thin Film RTDs
- Varistors
- Magnetics
  - Inductors
  - Wireless Charging Coils
  - Planar Devices
  - Transformers
  - Custom Magnetics
- Connectors

Connectors

- Diodes Segment
- Rectifiers
- Small-Signal Diodes
- Protection Diodes
- Thyristors/SCRs
- IGBTs
- Power Modules
- Optoelectronic Components Segment
- Film Resistors
- Power Metal Strip® Resistors
- Power Management ICs
- Resistors and Inductors Segment