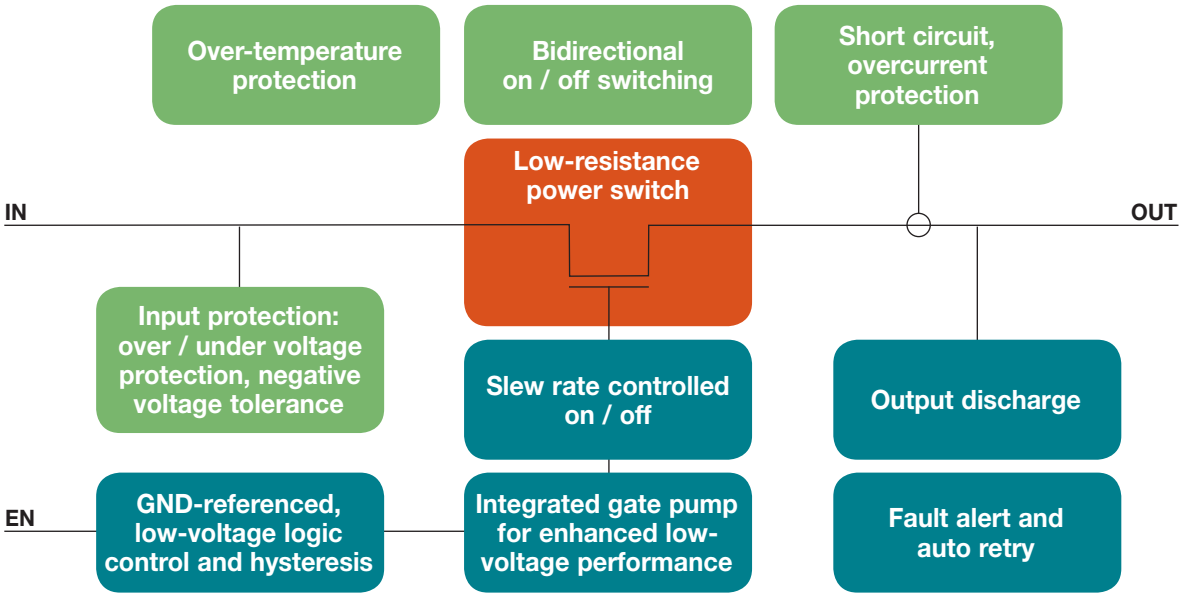
POWER MANAGEMENT ICs

Smart Load Switches

Smart Load Switch



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.

Features	Benefits
Low Vin operation	The integrated gate driving circuit extends the minimum Vin range, bringing lower switch resistance and improved efficiency
Low-voltage GPIO enable	Low-voltage GPIO enable is simplified GPIO control that can be used to implement power distribution and sequencing of multiple sub-systems
Slew rate control	Load switches with slew rate control provide a controlled supply ramp, reducing inrush current
Quick output discharge	The output node has a defined decay with quick output discharge and does not leave the node floating
Fault protection and isolation	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
Small solution size	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

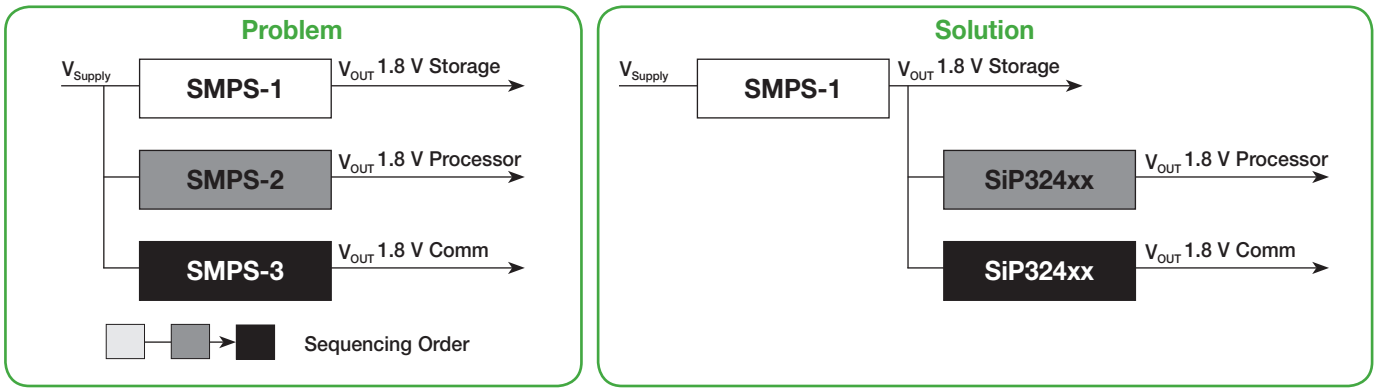
RESOURCES

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

A WORLD OF SOLUTIONS

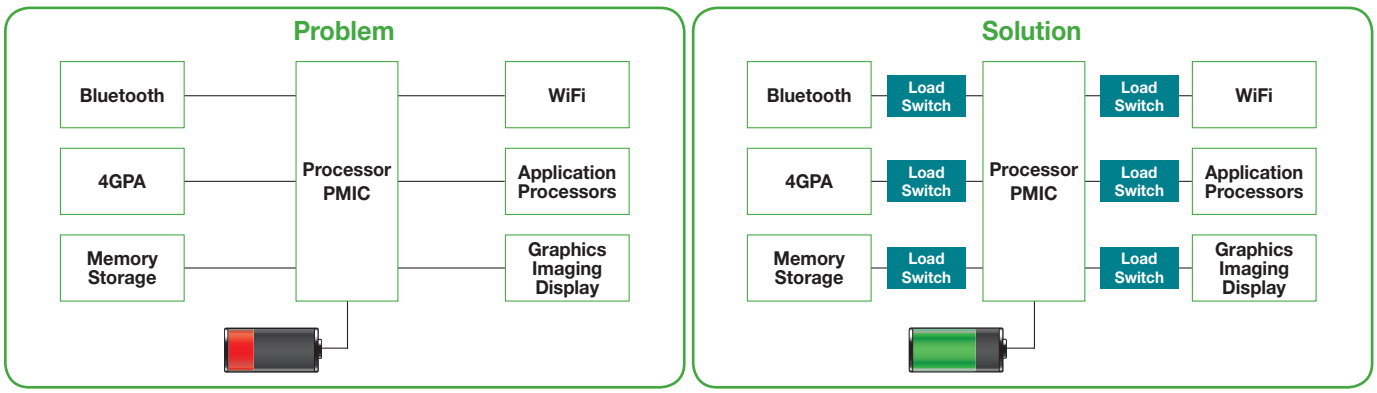
Load Management

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

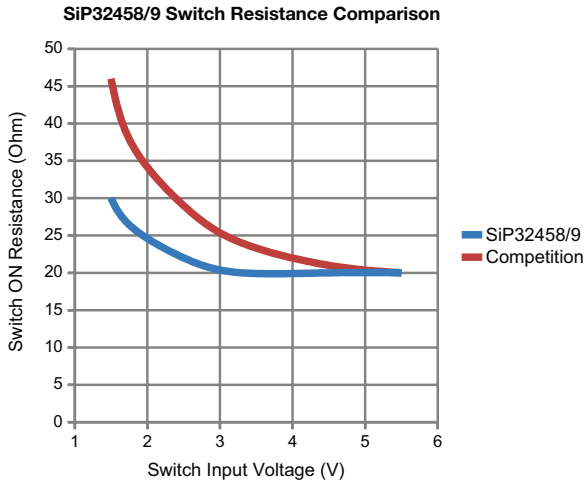
Functions not used at all times can be turned off using a load switch, reducing power consumption and prolonging battery life. This is more important for blocks with high power consumption, such as graphics, processors, radios, and memory in ultra-compact applications.



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 $R_{DS(ON)}$ over a wide Vin 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 $R_{DS(ON)}$ 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:

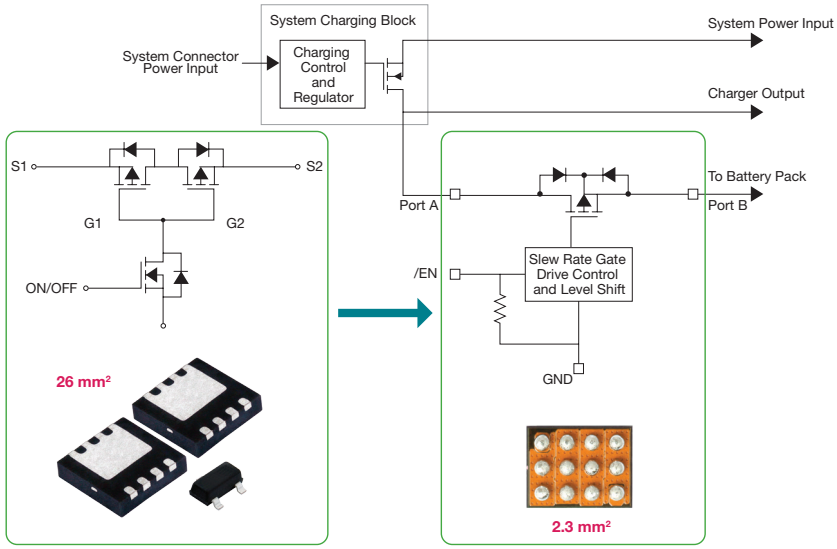
- Smartphones, PDAs, cell phones
- Handheld instrumentation and PCs
- Handheld POS
- Data storage

Part Number	R_{on} (mΩ)	$T_{D(on)}$ (ms)	T_R (ms)	$T_{D(oFF)}$ (µs)	Output Discharge	Reverse Blocking
SiP32458DB-T2-GE1	20	500	3	18	–	√
SiP32459DB-T2-GE1	20	500	3	18	√	–

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:

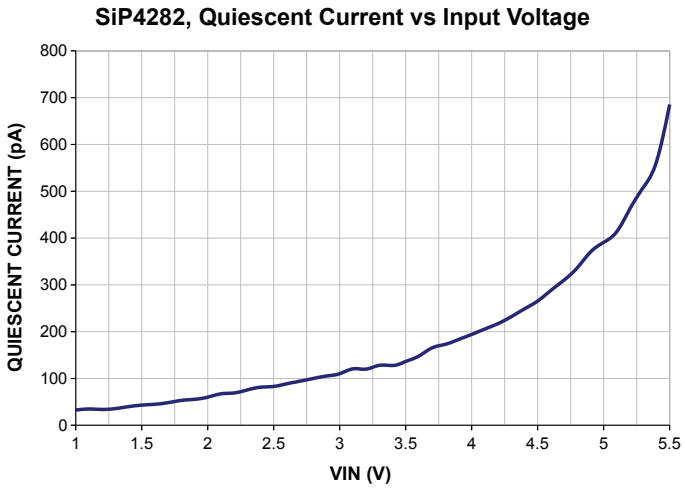
- Smartphones and tablets
- Power bank and battery
- Portable meters and test instruments
- Communication devices with embedded batteries
- Portable medical and healthcare systems
- Data storage

Part Number	Control Logic	EN Resistor
SiP32101DB-T1-GE1	Low Enable	Pull Down
SiP32102DB-T1-GE1	High Enable	Pull Down
SiP32103DB-T1-GE1	Low Enable	Pull Up

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

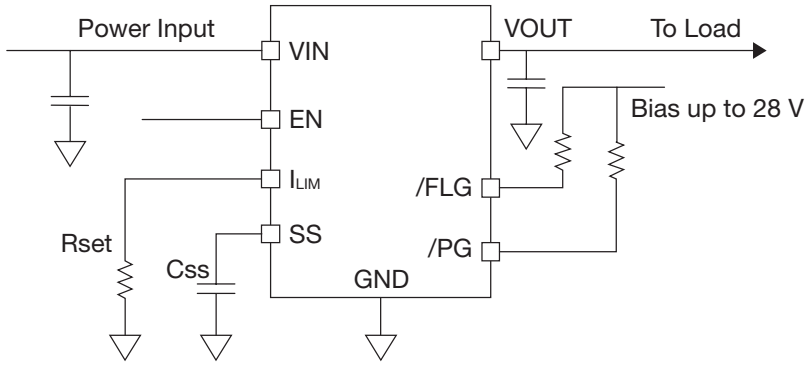
APPLICATIONS:

- 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

Config	Part Number	Package	V_{IN} (min)			V_{IN} (max)			Continuous Current	Slew Rate	Output Discharge	Reverse Blocking	Enable
			V_{IN} (V)	Rds (mΩ)	IQ	V_{IN} (V)	Rds (mΩ)	IQ					
Single	SiP32508DT	SOT23-6L 3.05 mm x 2.85 mm	1.1	48	10 µa	5.5	47	105 µA	3 A	2 ms	NA	√	High
	SiP32510DT									1.6 ms	√		High
	SiP32431DR3	SC70-6L 2 mm x 2 mm	1.5	395	<1 nA	5.5	147	<1 nA	1 A	100 µs	NA	√	High
	SiP32411DR		1.1	105	6.7 µa		101	71 µA	2 A	150 µs	√		
	SiP4282ADVP3	PPAK-SC75 1.6 mm x 1.6 mm	1.5	350	<1 nA	5.5	105	<1 nA	1.2 A	100 µs	√	NA	High
	SiP4282DVP3		1.8	230	2.5 µA			2.5 µA					
	SiP4282ADNP3	TDFN4 1.2 mm x 1.6 mm	1.5	350	<1 nA	5.5	105	<1 nA	1.2 A	100 µs	√	NA	High
	SiP32431DNP3										NA	√	
	SiP4282DNP3		1.8	230	2.5 µA			2.5 µA			√	NA	
	SiP32411DNP		1.1	66	6.7 µA		62	71 µA	2 A	150 µs		√	
	SiP32408DNP			45			44		3 A		NA		
	SiP32409DNP										√		
	SiP32448DNP		1.8	38	10 µA		32	120 µA	4 A		NA		
	SiP32458DB	WCSP6 1.0 mm x 1.5 mm	1.5	38	2 µA	5.5	20	6 µA	3 A	2.7 ms	NA	√	High
	SiP32459DB										√		
	SiP32472DNP	uDFN4, 1.1 mm x 1.1 mm	1.2	86	1.4 µA	5.5	46	5.8 µA	1.2 A	170 µs	√	√	High

Slew Rate Control Load Switches														
Config	Part Number	Package	VIN (min)			VIN (max)			Continuous Current	Slew Rate	Output Discharge	Reverse Blocking	Enable
			VIN (V)	Rds (mΩ)	IQ	VIN (V)	Rds (mΩ)	IQ					
Single	SiP32460DB	WCSP4 0.8 mm x 0.8 mm	1.2	95	2 µA	5.5	50	4.5 µA	2 A	140 µs	NA	√	High
	SiP32461DB										√		
	SiP32462DB									8.5 µs	NA		
	SiP32467DB									140	NA		Low
	SiP32468DB										√		
	SiP32451DB		0.9	56	10 µA	2.5	54	34 µA	1.2 A	25 µs	√		High
	SiP32452DB										NA		
	SiP32453DB										√		
	SiP32454DB		0.8	30	10 µA	2.5	28	34 µA	1.2 A	1.3 ms			
	SiP32455DB										NA		
Dual (2 to 1)	SiP32413DNP	TDFN8 2 mm x 2 mm	1.1	66	6.7 µA	5.5	62	71 µA	2 A	150 µs	NA	NA	High / Low
Dual	SiP32414DNP	TDFN8 2 mm x 2 mm	1.1	66	6.7 µA	5.5	62	71 µA	2 A	150 µs	√		High
	SiP32416DNP									2.5 ms			

Current Limiting Switches									
Part Number	Package	VIN (min)	VIN (max)	Rds	IQ	Current Limit Setting Range	Over-Current Response	Slew Rate	OTP	Enable
SiP32419	DFN10 3 mm x 3 mm	6 V	28 V	56 mΩ	139 µA	0.75 A ~ 3.5 A	Off after 8 ms limit, switch latch at Off	Settable	√	High
SiP32429	DFN10 3 mm x 3 mm	6 V	28 V	56 mΩ	139 µA	0.75 A ~ 3.5 A	Off after 8 ms limit, 150 ms auto retry after Off	Settable	√	High
SiP32430	DFN10 3 mm x 3 mm	6 V	28 V	56 mΩ	139 µA	0.15 A ~ 1 A	Off after 8 ms limit, 150 ms auto retry after Off	Settable	√	High

POWER MANAGEMENT ICs

Smart Load Switches

Bi-directional Switches

Part Number	Package	VIN (min)			VIN (max)			Continuous Current (A)	Slew Rate	Reverse Blocking	Enable	EN Resistor
		VIN (V)	Rds (mΩ)	IQ	VIN (V)	Rds (mΩ)	IQ					
SiP32101	WCSP 1.3 mm x 1.7 mm	2.3	8	20 pA	5.5	5.1	30 pA	7	2.3 ms	√	Low	Pull Down
SiP32102	WCSP 1.3 mm x 1.7 mm	2.3	8	20 pA	5.5	5.1	30 pA	7	2.3 ms	√	High	Pull Down
SiP32103	WCSP 1.3 mm x 1.7 mm	2.3	8	20 pA	5.5	5.1	30 pA	7	2.3 ms	√	Low	Pull Up
SiP32460	WCSP 0.8 mm x 0.8 mm	1.2	95	1.2 µA	5.5	50	5.8 µA	1.2	170 µs	√	High	Pull Down
SiP32467	WCSP 0.8 mm x 0.8 mm	1.2	95	1.2 µA	5.5	50	5.8 µA	1.2	170 µs	√	Low	Pull Down

POWER MANAGEMENT ICs

Smart Load Switches

SEMICONDUCTORS

MOSFETs Segment

MOSFETs
- 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 Emitters and Detectors

Optical Sensors
- Proximity
- Ambient light
- Light Index (RGBW, UV, IR)
- Humidity
- Quadrant Sensors
- Transmissive
- Reflective

Infrared Remote Control Receivers

Optocouplers
- Phototransistor, Photodarlington
- Linear
- 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

Networks/Arrays

Non-Linear Resistors
- NTC Thermistors
- PTC Thermistors
- Thin Film RTDs
- Varistors

Magnetics
- Inductors
- Wireless Charging Coils
- Planar Devices
- Transformers
- Custom Magnetics

Connectors

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