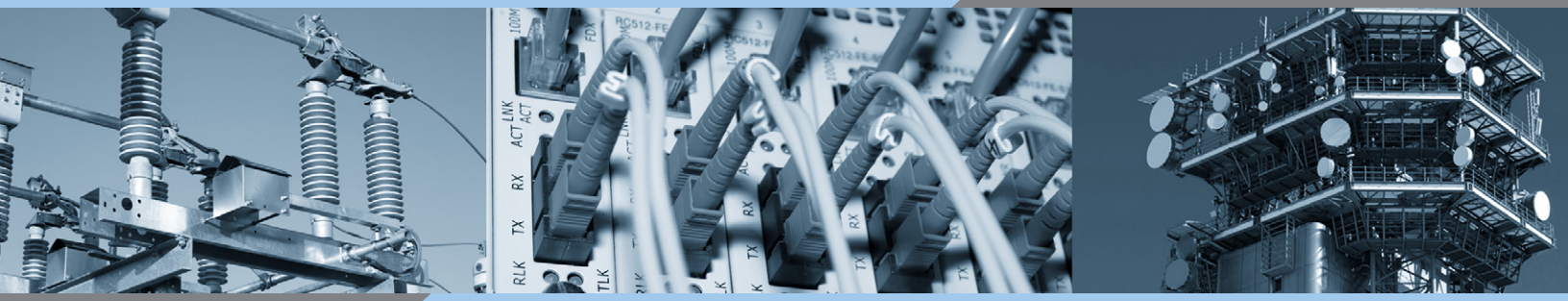
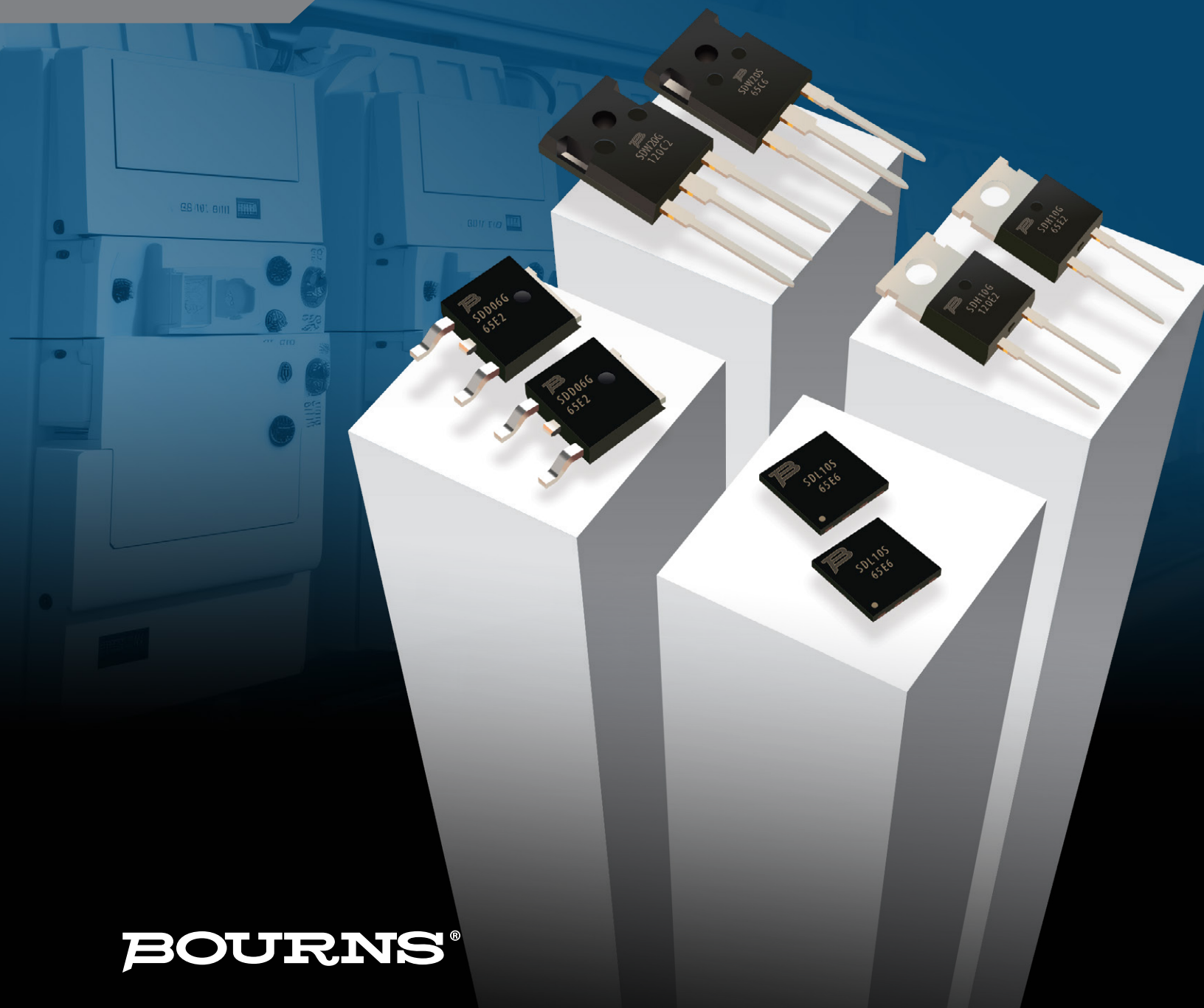
Bourns® Silicon Carbide (SiC) Schottky Barrier Diodes

BSD Series Brochure





BOURNS®

Introduction

Bourns® Silicon Carbide (SiC) Schottky Barrier Diodes

For diode applications, the ideal component would be one with no voltage drop during forward conduction and no leakage current when reverse biased. It would change instantly from conducting forward current to blocking reverse voltage. Compared to p-n junction silicon diodes, Schottky diodes provide reduced voltage drop with decreased reverse leakage current.

A Schottky diode is an electrical device used to convert alternating current (AC) which periodically reverses direction to direct current (DC) which flows in only one direction. Bourns *NOT ONLY* offers a wide variety of Silicon Schottky diode products *BUT ALSO* advanced Silicon Carbide Schottky diodes.

Silicon carbide is a type of semiconductor material that maintains its useful properties at much higher temperatures than the normally used doped silicon. Using SiC to construct Schottky diodes allows them to operate at higher temperatures, up to a 175 °C junction temperature, and permits the use of smaller heat sink designs so the thermal management is simplified.

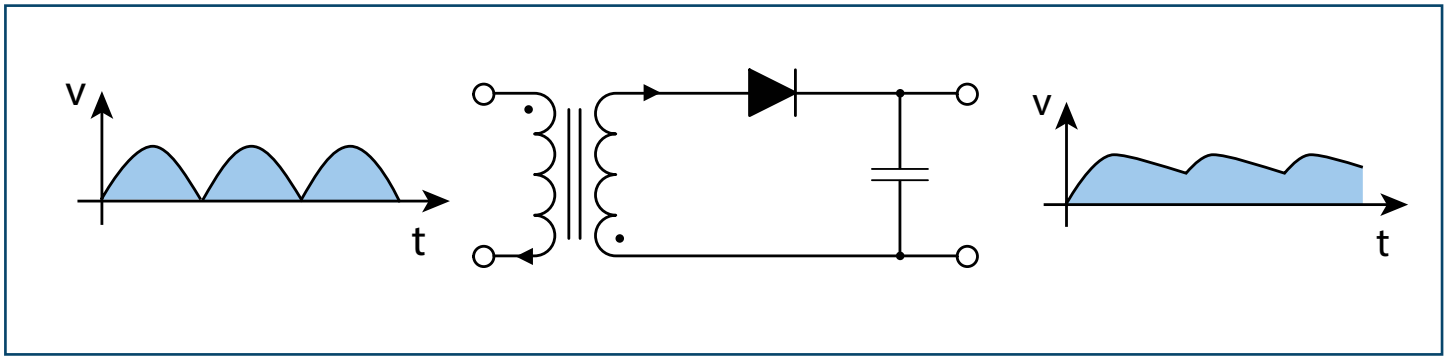
Similarly, a power system designed with SiC power semiconductors can operate at a 50 °C higher ambient temperature, which is higher than what can be achieved with a silicon semiconductor that features a junction rated at a maximum of 125 °C. This is an attractive feature that allows power systems to meet automotive and other harsh environmental application thermal performance requirements. Because SiC is a wide band gap (WBG) material, it can withstand higher voltage before breakdown and at an elevated temperature compared to silicon-based devices.

Bourns® Model BSD Series Silicon Carbide Schottky Diodes are designed for today's demanding high frequency and high current applications requiring increased peak forward surge capability, low forward voltage drop, reduced thermal resistance and low power loss. These advanced wide band gap components are ideal power conversion solutions to help increase reliability, switching performance and efficiency in applications such as DC-DC converters, Switched-Mode Power Supplies, photovoltaic inverters, motor drives and other rectification applications.

Bourns® Model BSD Series Product Offering

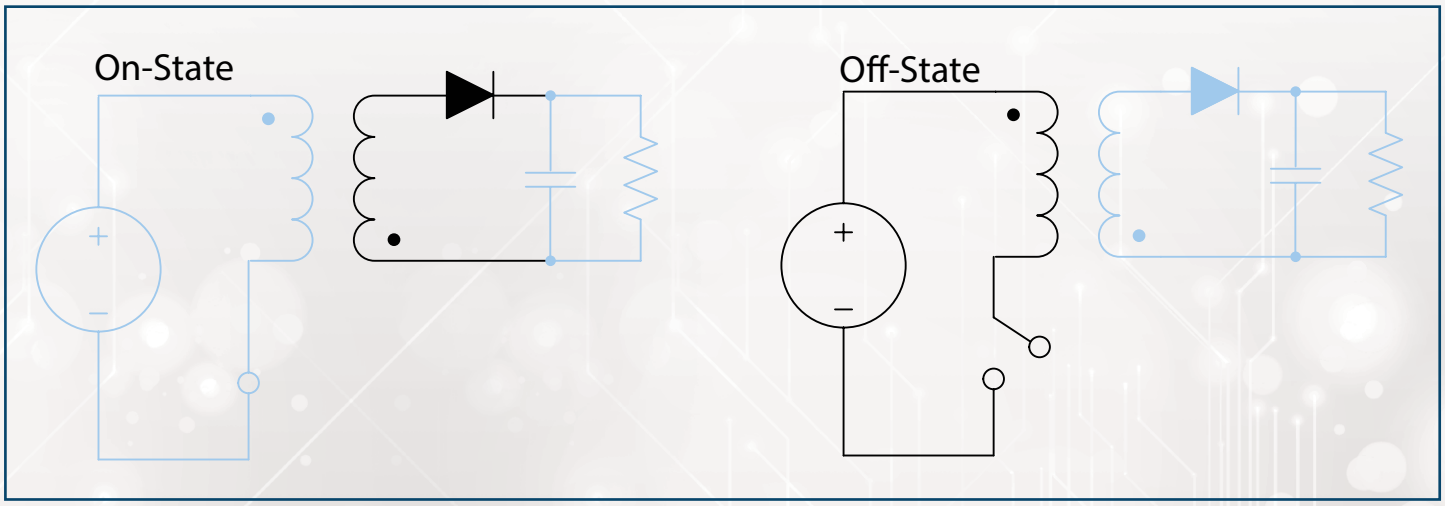
- **Single 650 V SiC Schottky Barrier Diodes**
- **Single 1200 V SiC Schottky Barrier Diodes**
- **Dual 650 V SiC Schottky Barrier Diodes**
- **Dual 1200 V SiC Schottky Barrier Diodes**

DC to DC Converter



Switched-mode DC to DC converters transform one DC voltage level to another, which may be higher (boost) or lower (buck), by storing the input energy temporarily and then releasing that energy to the output at a different voltage.

When the switch is in the on-state, the rectifier diode blocks the reverse current and the energy is transferred from the input voltage source to the transformer and the output capacitor supplies energy to the output load. When the switch is in the off-state, the energy is transferred from the transformer to the output load and the output capacitor.



Product Selection

General SiC Schottky Diode Parameters

Maximum Repetitive Peak Reverse Voltage (V_{RRM}) is the maximum voltage an SiC Schottky diode can withstand in the reverse direction without breaking down or avalanching, and SiC Schottky Barrier Diodes must have a peak inverse voltage rating higher than the maximum voltage being applied to them in the application.

Maximum Average Forward Rectified Current (I_F) is the maximum allowable average forward current in the normal operating temperature range.

Maximum Peak Forward Surge Current (I_{FSM}) is the maximum allowable non-repetitive single sine wave surge current with a pulse width of 10 milliseconds.

Forward Voltage (V_F) is the SiC Schottky Diode's forward voltage and low V_F SiC Schottky Barrier Diodes have less power dissipation in the forward direction to save energy.

Reverse Leakage Current (I_R) is the diode's reverse leakage current, and low I_R SiC Schottky Barrier Diodes have less power dissipation in the reverse direction for reduced power consumption.

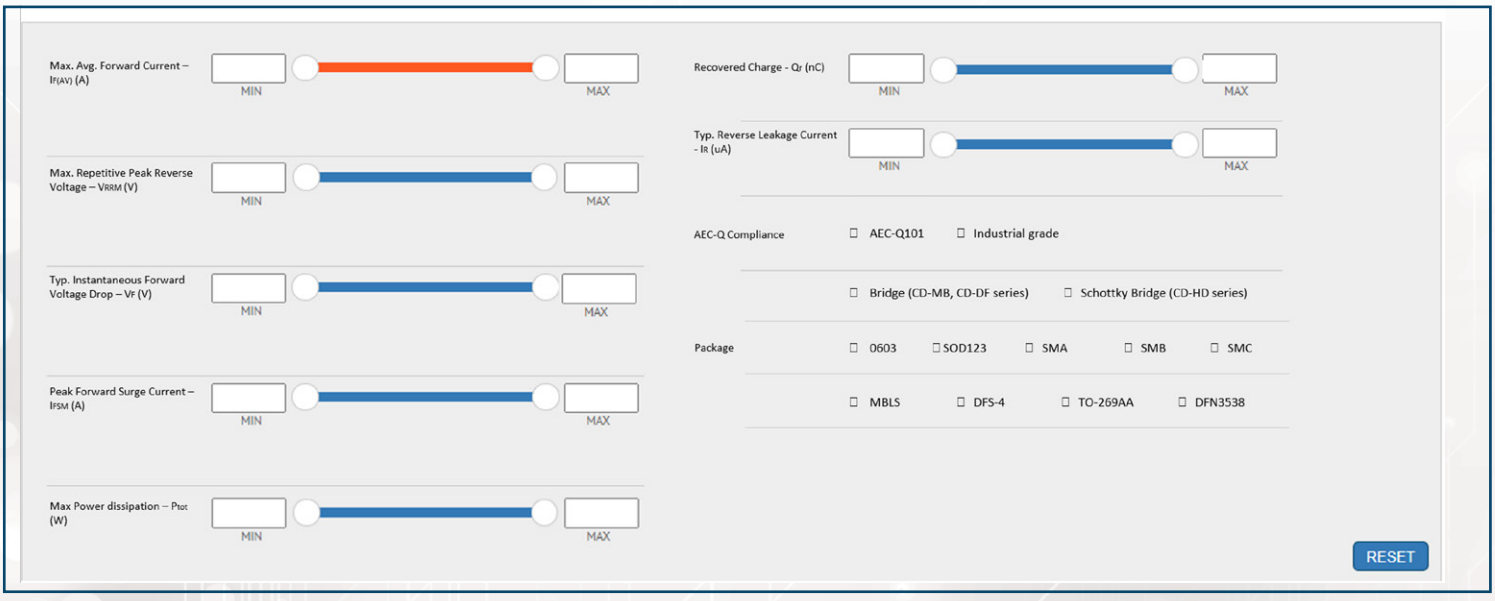
Symbol	Parameter	Unit	Description
V_{RRM}	Maximum Repetitive Peak Reverse Voltage	V	Maximum allowable repetitive instantaneous value of the diode's reverse voltage
I_F	Maximum Average Forward Rectified Current	A	Maximum allowable average forward current
I_{FSM}	Maximum Peak Forward Surge Current	A	Maximum allowable non-repetitive half-sine wave surge current
V_F	Forward Voltage	V	Voltage of the diode at I_F
I_R	Reverse Leakage Current	µA	Reverse leakage current at V_{RRM}
C_d	Diode Capacitance	pF	Junction capacitance of the diode
T_{rr}	Reverse Recovery Time	ns	Duration of time for diode to "turn off" when alternating current is switched from forward-bias to reverse-bias polarity
$R_{\Theta JA}$	Thermal Resistance to Air	°C/W	Temperature difference between junction and outside air per watt

Diode Capacitance (C_d) is the junction capacitance of the diode. Low diode capacitance SiC Schottky Barrier Diodes are used for high-speed switching converter applications.

Thermal Resistance to Air ($R_{\Theta JA}$) is the resistance to heat flow. Low thermal resistance SiC Schottky Barrier Diodes generate less heat, making them good quality insulators.

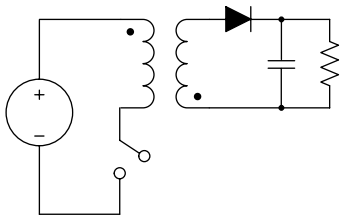
Bourns® Silicon Carbide (SiC) Schottky Barrier Diode Product Selection

Bourns offers a parametric search tool to assist in the selection of the appropriate product. The parametric search tool can be found on the Bourns website at: www.bourns.com/parametric-search



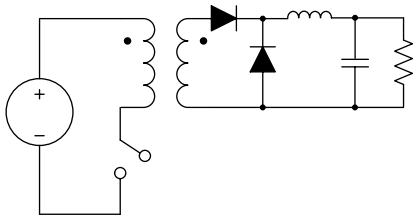
Rectifier Diode Applications

Flyback Converter Topology



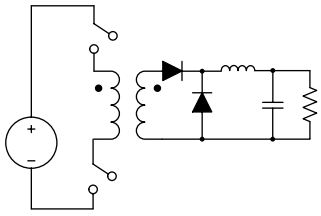
Isolation	Yes
Max. Power (W)	100
Strengths	Ground referenced switch, multiple outputs, fewer components
Weaknesses	Limited to 10 A output, high stress on diode, inefficient (use of ZVS converters improves losses)
Applications	AC-DC and DC-DC appliances, solar inverters, LED lighting, AC adaptors, E-meters, battery chargers, automotive, circuit breakers, TVs, STBs, PoE

Forward Topology



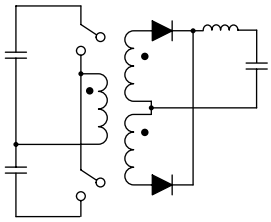
Isolation	Yes
Max. Power (W)	200
Strengths	Large step-down ratio
Weaknesses	High voltage on-switch increases power loss
Applications	AC-DC, DC-DC industrial controls

Two-Switch Forward Topology



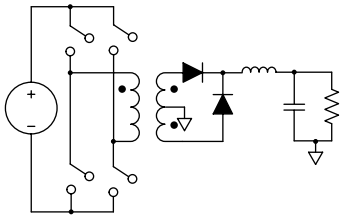
Isolation	Yes
Max. Power (W)	1000
Strengths	Very rugged circuit
Weaknesses	Noisy input
Applications	A AC-DC, DC-DC C/DC, DC/DC industrial controls

Half-Bridge Forward Topology



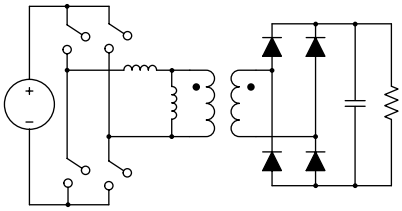
Isolation	Yes
Max. Power (W)	500
Strengths	Reduced core loss
Weaknesses	Does not work well with current mode, making it less than ideal for off-line power supplies
Applications	DC-DC industrial controls, telecom, data processing

Full-Bridge Forward Topology



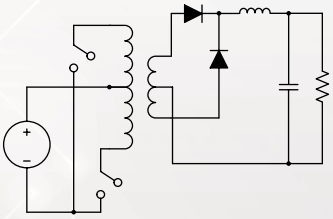
Isolation	Yes
Max. Power (W)	5000
Strengths	Clamped primary switch and minimal switching losses
Weaknesses	Requires experience to get functioning properly
Applications	AC-DC and DC-DC industrial controls, telecom, data processing, automotive HEV / EV

Full-Bridge Resonant Topology



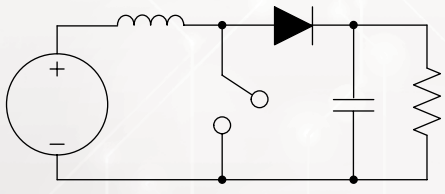
Isolation	Yes
Max. Power (W)	5000
Strengths	Soft switching
Weaknesses	Narrow input range
Applications	Lighting

Push-Pull Converter Topology



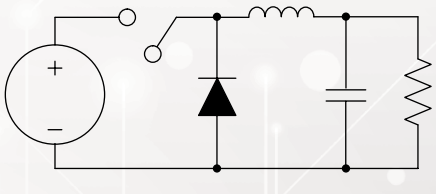
Isolation	Yes
Max. Power (W)	500
Strengths	Ground referenced switches
Weaknesses	Limited to low input voltages
Applications	DC-DC battery chargers, servers

Boost Converter Topology



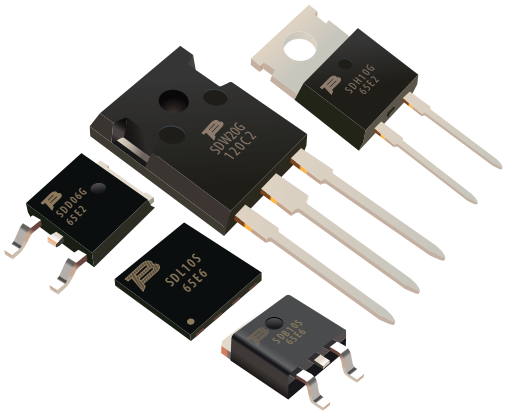
Isolation	No
Max. Power (W)	1000
Strengths	Low noise input
Weaknesses	Requires current mode control and has no isolation
Applications	AC-DC and DC-DC power factor correction circuits, automotive electric vehicles, motor drives (appliances)

Buck Converter Topology



Isolation	No
Max. Power (W)	1000
Strengths	Low noise output
Weaknesses	Optimum input/output ratio must be less than 10; no isolation
Applications	AC-DC and DC-DC notebooks, servers, graphic processors, automotive

SiC Schottky Barrier Diode Product Overview



FEATURES

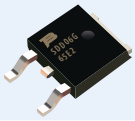
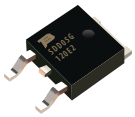
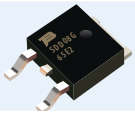
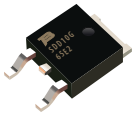
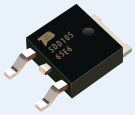
- Low power loss, high efficiency
- Low reverse leakage current
- High peak forward surge current (I_{FSM})
- Reduced EMI
- Negligible reverse leakage current
- Low forward voltage (V_F)
- Reduced heat dissipation
- Maximum operating temperature junction range (T_J) up to 175 °C
- Epoxy potting compound is flame retardant to the UL 94V-0 standard
- RoHS compliant*, Pb free and halogen free**

APPLICATIONS

- Switched-Mode Power Supplies (SMPS)
- Power Factor Correction (PFC)
- Photovoltaic inverters
- DC-DC, AC-DC converters
- Telecommunications
- Motor drives

**RoHS Directive 2015/863, Mar 31, 2015 and Annex.*
***Bourns considers a product to be "halogen free" if (a) the Bromine (Br) content is 900 ppm or less; (b) the Chlorine (Cl) content is 900 ppm or less; and (c) the total Bromine (Br) and Chlorine (Cl) content is 1500 ppm or less.*

TO-252 SMD

Model Number	Photo	Package	$I_{F(AV)}$ Max. (A)	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDD06G65E2		TO-252	6	175	650	9	1.45
BSDD05G120E2		TO-252	5	175	1200	11	1.42
BSDD08G65E2		TO-252	8	175	650	12	1.45
BSDD10G65E2		TO-252	10	175	650	14.5	1.45
BSDD10S65E6		TO-252	10	175	650	24	1.29

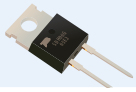
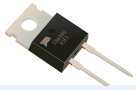
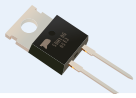
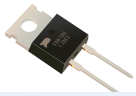
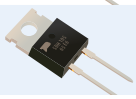
TO-263 SMD

Model Number	Photo	Package	$I_{F(AV)}$ Max. (A)	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDB10S65E6		TO-263	10	175	650	24	1.29

DFN8x8 SMD

Model Number	Photo	Package	$I_{F(AV)}$ Max. (A)	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDL10S65E6		DFN8x8	10	175	650	24	1.29

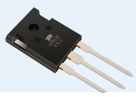
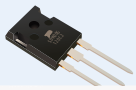
TO-220-2 SIP

Model Number	Photo	Package	$I_{F(AV)}$ Max. (A)	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDH06G65E2		TO-220-2	6	175	650	9	1.45
BSDH08G65E2		TO-220-2	8	175	650	12	1.45
BSDH10G65E2		TO-220-2	10	175	650	14.5	1.45
BSDH10G120E2		TO-220-2	10	175	1200	22	1.42
BSDH10S65E6		TO-220-2	10	175	650	24	1.29

TO-247-2 SIP

Model Number	Photo	Package	$I_{F(AV)}$ Max. (A)	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDV10G120E2		TO-247-2	10	175	1200	22	1.42

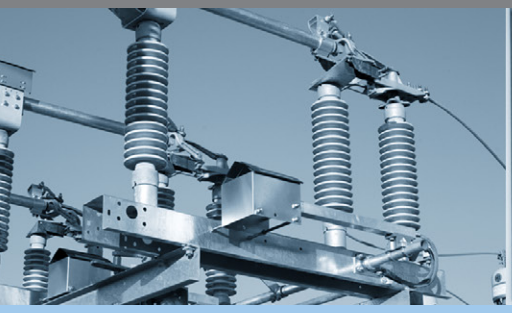
TO-247-3 SIP

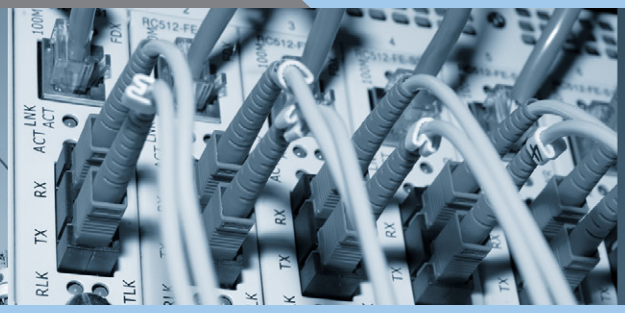
Model Number	Photo	Package	$I_{F(AV)}$ Max. (A) Dual Diodes Conducting	T_J Max. (°C)	V_{RRM} Max. (V)	Q_r Typ. (nC)	V_F Typ. @ T_J = 25 °C, $I_{F(av)}$ (V)
BSDW20G65C2		TO-247-3	20	175	650	14.5	1.45
BSDW20S65C6		TO-247-3	20	175	650	24	1.29
BSDW20G120C2		TO-247-3	20	175	1200	22	1.42

SiC Schottky Barrier Diode Product Portfolio

V_{RRM} $I_{(AV)}$ Type	TO-220-2	TO-247-2	TO-247-3	TO-252 (DPAK)	TO-263 (D^2PAK)	DFN8x8
650 V, 6 A, General V_F	BSDH06G65E2	—	—	BSDD06G65E2	—	—
650 V, 8 A, General V_F	BSDH08G65E2	—	—	BSDD08G65E2	—	—
650 V, 10 A, General V_F	BSDH10G65E2	—	—	BSDD10G65E2	—	—
650 V, 10 A, Low V_F	BSDH10S65E6	—	—	BSDD10S65E6	BSDB10S65E6	BSDL10S65E6
1200 V, 5 A, General V_F	—	—	—	BSDD05G120E2	—	—
1200 V, 10 A, General V_F	BSDH10G120E2	BSDV10G120E2	—	—	—	—
650 V, 20 A, General V_F (Dual)	—	—	BSDW20G65C2	—	—	—
650 V, 20 A, Low V_F (Dual)	—	—	BSDW20S65C6	—	—	—
1200 V, 20 A, General V_F (Dual)	—	—	BSDW20G120C2	—	—	—

Worldwide Sales Offices





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Specifications subject to change without notice. Actual performance in specific customer applications may differ due to the influence of other variables. Customers should verify actual device performance in their specific applications.