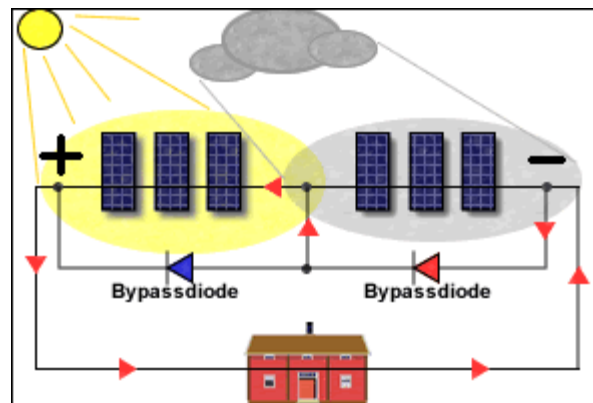


NEWSLETTER 001-2010

Power Rectifiers for Solar Photovoltaic Applications

Taiwan Semiconductor is currently expanding its Solar Photovoltaic Applications portfolio. We have launched this Newsletter to provide the best possible support, explain the major differences between Blocking and Bypass diodes and add our recommendation for each application.

Blocking diodes and Bypass diodes are NOT the same application. Often the actual diode type is the same, but serves different purposes. See the illustration below for examples of both. The explanation follows on the next page.



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Power Rectifiers for Solar Photovoltaic Applications

Bypass Diodes

When a part of the PV module is overcast, the overcast block is not able to produce as much current as the sunlit block. Since all cells are connected in series, the same amount of current has to flow through each cell. The sunlit cells will force the overcast cells to pass more current than their new short circuit current. The only way the overcast cells can operate at a current higher than their short circuit current is to operate in a region of negative voltage that causes a net voltage loss to the system. The current multiplied by this negative voltage gives the negative power produced by the overcast cells. In other words, the overcast cells dissipate power as heat and cause "hot spots". The overcast cells will reduce the overall IV curve of the group of cells. The effect of the overcast is also dependent on how the module is overcast. One cell overcast by 75% is worse than three cells overcast by 25% each. If overcasting cannot be avoided, it should be spread over more cells. One way to minimize the effect the overcast has on a single module in a series string, is to use bypass diodes in the junction box. Bypass diodes allow current to pass around overcast cells thereby reducing the voltage losses in the module. When a module becomes overcast its bypass diode becomes "forward biased" and begins to conduct current through itself. All current greater than the overcast cell's new short circuit current is "bypassed" through the diode, thus reducing drastically the amount of local heating at the overcast area. The diode also holds the entire overcast module or group of cells to a small negative voltage of approximately -0.7 volts, thus limiting the reduction in the array output.

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Blocking Diodes

Diodes placed in series with cells or modules can perform another function that of blocking reverse leakage current backwards through the modules. There are two situations in which blocking diodes can help prevent this phenomenon.

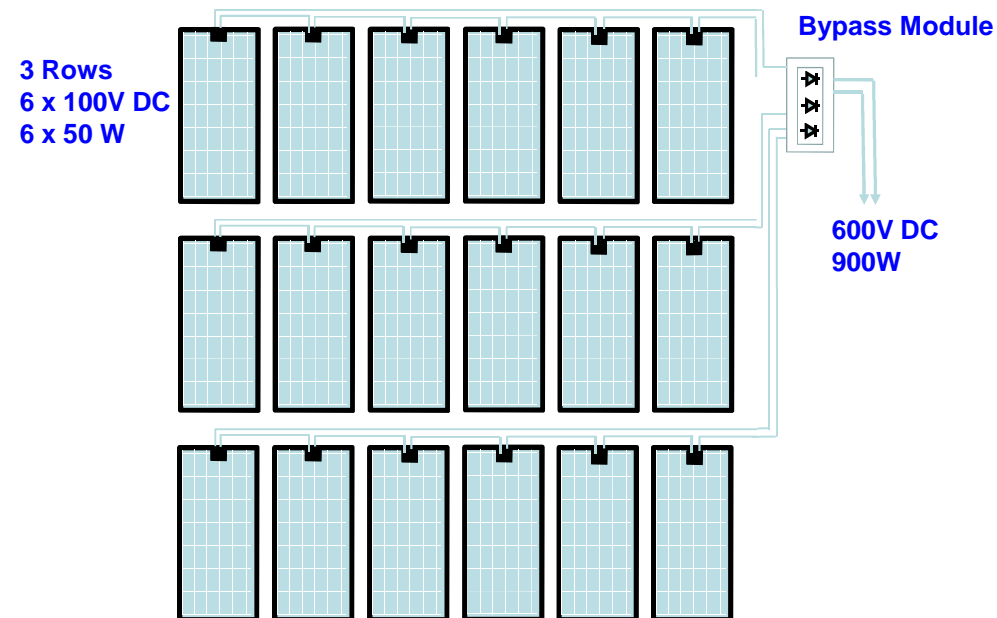
1. Blocking reverse flow of current from the battery through the module at night. In battery charging systems, the module potential drops to zero at night, the battery could therefore discharge all night backwards through the module. This would not be harmful to the module but result in the loss of precious energy from the battery bank. Diodes placed in the circuit between the module and the battery can block any night-time leakage flow.

2. Blocking reverse flow down damaged modules from parallel modules during the day. Blocking diodes placed ahead of separate series wired strings in high voltage systems can perform yet another function during daylight conditions. If one string becomes severely shaded, or if there is a short circuit in one of the modules, the blocking diode prevents the other strings from losing current backwards down the shaded or damaged string. The shaded or damaged string is “isolated” from the others, and more current is sent on to the load. In this configuration, the blocking diodes are sometimes called “isolation diodes”.

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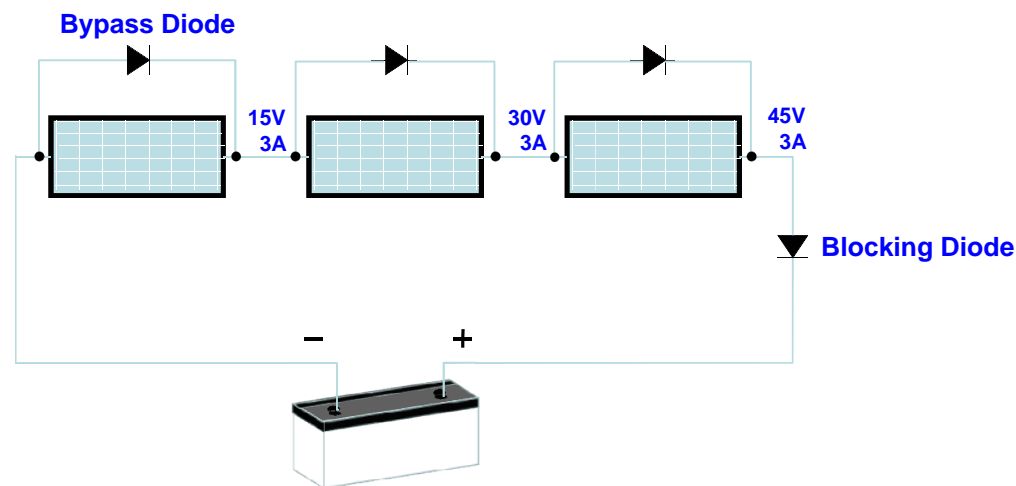
Example



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Power Rectifiers for Solar Photovoltaic Applications

Example (continued)



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Power Rectifiers for Solar Photovoltaic Applications

Rectifier Overview for Solar Applications

Schottky Rectifiers

$V_{BR} = 20 - 150V$

$I_{FAV} = 3 - 40A$

$V_F = 0.55 - 0.95V$

$T_J \text{ max.} = 150^\circ C$

Axial / Power Pack / D²-Pak

High Temperature Schottky Rectifiers

$V_{BR} = 45 - 200V$

$I_{FAV} = 3 - 40A$

$V_F = 0.55 - 0.95V$

$T_J \text{ max.} = 175^\circ C - 200^\circ C$

Axial / Power Pack / D²-Pak

High Voltage Rectifiers

$V_{BR} = 50 - 1000V$

$I_{FAV} = 3 - 16A$

$V_F = 0.90 - 1.10V$

$T_J \text{ max.} = 150^\circ C$

Axial / Power Pack

High Voltage Glass Passivated Rectifiers

$V_{BR} = 50 - 1000V$

$I_{FAV} = 3 - 16A$

$V_F = 0.90 - 1.10V$

$T_J \text{ max.} = 150^\circ C$

Axial / Power Pack

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Power Rectifiers for Solar Photovoltaic Applications

Rectifier Overview for Solar Applications

Schottky Rectifiers

Axial

single die

SR30x Series
SR50x Series
SR80x Series

D²Pak

single die

SRAS8xx Series
SRAS16xx Series (*)
SRAS20xx Series

dual dice

MBRS10xxCT Series
SRAS10xx Series (*)
MBRS15xxCT Series
SRAS16xx Series (*)
MBRS20xxCT Series
SRAS20xx Series (*)
MBRS25xxCT Series

Power Pack

single die

SRA10xx Series
SRA16xx Series
SRA20xx Series

dual dice

MBR10xxCT Series
SR10xx Series
MBR15xxCT Series
SR16xx Series
MBR20xxCT Series
MBR25xxCT Series
MBR30xxCT Series
SR20xx Series
MBR40xxPT Series

(*) Please check with local sales about availability

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Power Rectifiers for Solar Photovoltaic Applications

Rectifier Overview for Solar Applications

High Temperature Schottky Rectifiers

Axial

single die SR120x Series
SR150x Series

Power Pack

dual dice MBR10HxxxCT
MBR20HxxxCT

D2Pak

dual dice MBRS10HxxxCT
MBRS20HxxxCT

New Release

High Voltage Glass Passivated Rectifiers

Axial

single die 1N5400G Series
6AxxG Series

Power Pack

single die GPA80x Series
GPA160x Series
GP160x Series

High Voltage Rectifiers

Axial

single die 1N540x Series
6Axx Series
GP160x Series

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Rectifier Selection for Solar Applications

Bypass & Blocking Diodes

Small Current Panels

Low Voltage Modules - Axial Schottky Rectifiers

High Voltage Modules - Axial Glass Passivated Rectifier

High Current Panels

Low Voltage Modules - Power Pack Schottky Rectifiers

High Voltage Modules - Power Pack Glass Passivated Rectifier