System Solution Guide - Preview

Solar Inverter

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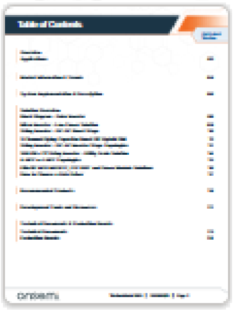
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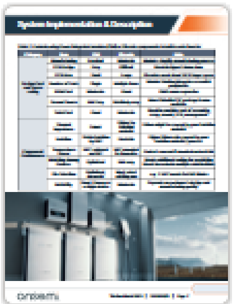
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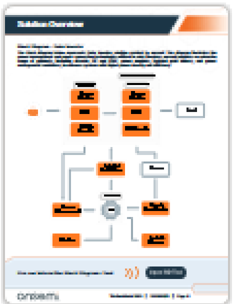
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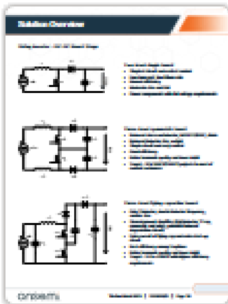
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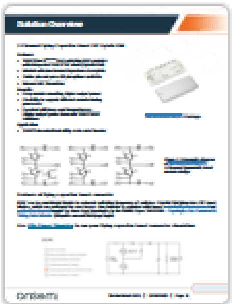
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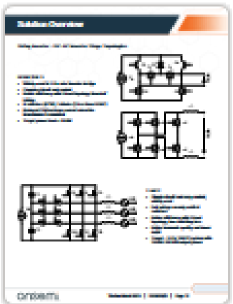
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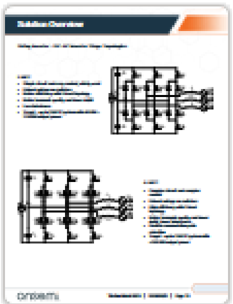
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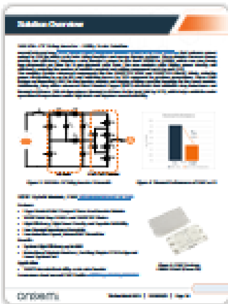
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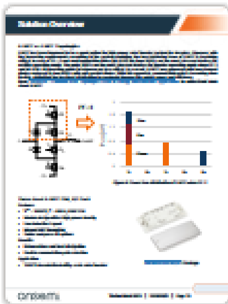
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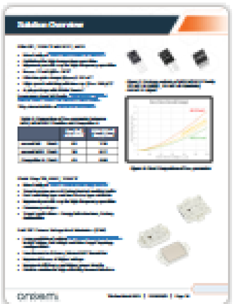
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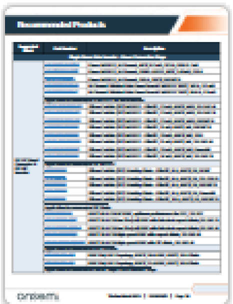
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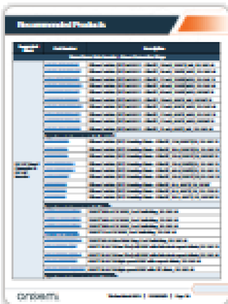
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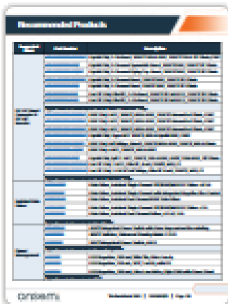
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Block Diagram - Solar Inverter

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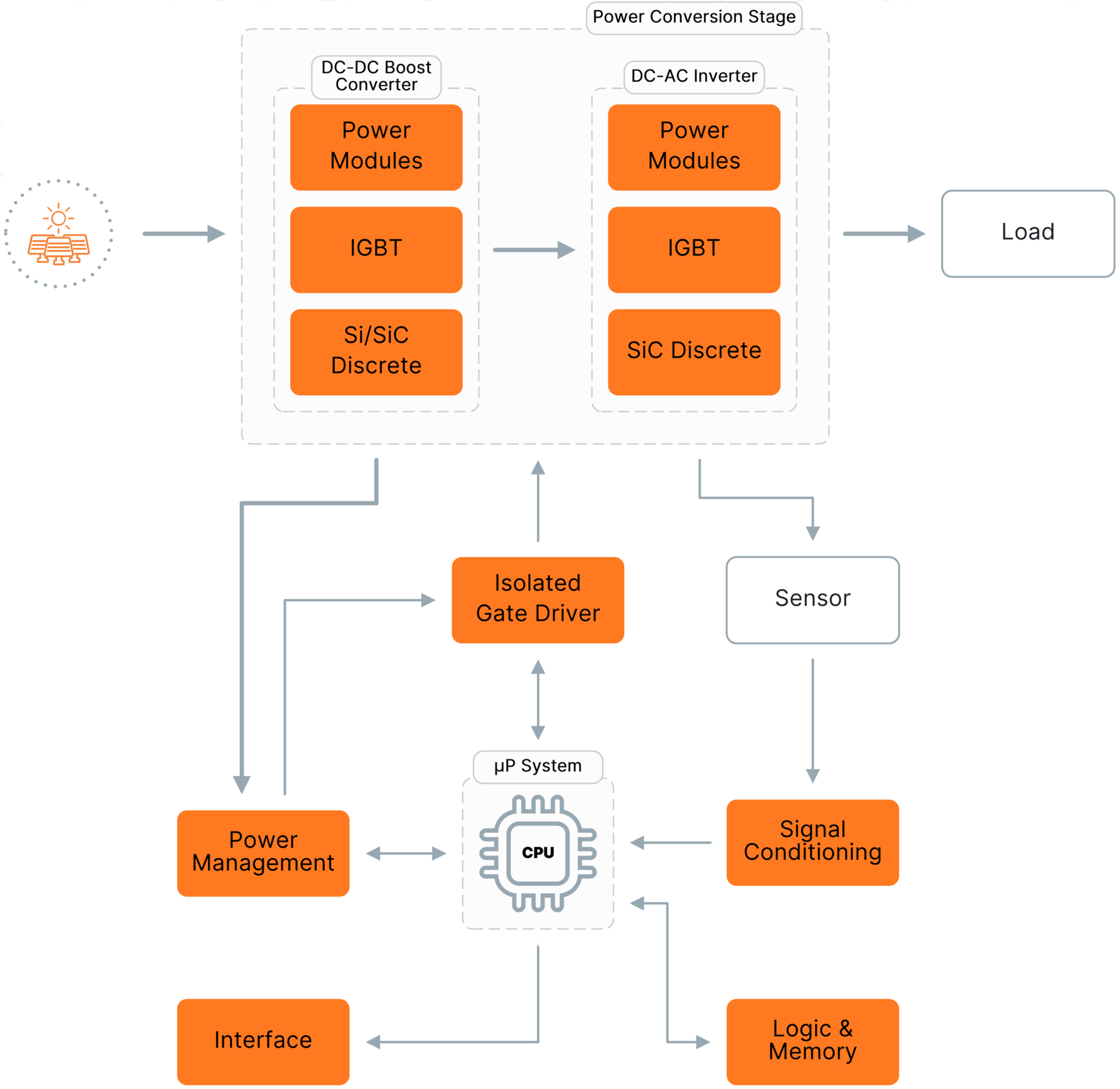
Block Diagram - Solar Inverter

The block diagram below represents Solar Inverter solution created by **onsemi**. The diagram illustrates the power management and power conversion technologies utilized in solar inverters. **onsemi** provides an extensive range of products, including discrete SiC and IGBT, power modules, isolated gate drivers, and power management controllers, to enhance systems with higher power density and efficiency.



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Market Information & Trends

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Silicon Carbide Replacement

Silicon Carbide aids in providing higher efficiency for actual trends. SiC devices are most useful for higher voltages compared with traditional silicon MOSFET/IGBTs. Higher voltage devices can simplify the topology, eliminating the need for multilevel converters. SiC inverter solutions have lower losses than IGBT solutions. SiC MOSFETs are also faster switching, which can shrink the size of the passive devices, particularly the inductors. These two factors increase power density, allowing higher power in the same size and weight equipment.
However, trade-offs between cost and performance must be made, understand the actual requirements and decide the most appropriate solution.

IGBT & SiC Diode

SiC diode replacement is becoming common especially in DC-DC stage because the cost is getting affordable, no need for big changes regarding circuit design, and the most important, system performance is well improved. Besides, the improved frequency can reduce the passive sizes.
In high-power products (> about 200 kW), IGBT is the 1st choice because IGBT has a good performance when dealing with high current. And the system doesn't require a very high operating switching rate, which means the slow turn-off of IGBT won't bring too much trouble. Another point is that a full SiC system requires a completely new system design which costs a lot. For example, the driving circuit of IGBT-based converter is not compatible with a SiC-based system. New protection approach also needs to be considered because SiC components have smaller short circuit withstand time (SCWT) than IGBT.

Higher Bus Voltage

High power demands are growing, using 1500 V instead of 1100 V strings reduces the cost of the interconnection for a given power as current is lower. To meet such trend, higher voltage switches were developed. With either high-voltage switches or multi-level topology, the operating power of a solar inverter can be improved significantly. See comparison between 1500 V inverter and 1100 V inverter.

Table 1: Comparison between 1500V (Model-2) and 1100V solar inverter

Part Number	MODEL-2	MODEL-1
Dimension	1091×678×341 mm	1008×678×343 mm
Rated Output Power	**250 kW**	**136 kW**
Max. Bus Voltage	**1500 V**	**1100 V**
Max. Input Current per MPPT	30 A	30 A
Number of Strings per MPPT	2	2
Weight	**111 kg**	**98.5 kg**

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300 kW+ PV String Inverter - Utility Scale Solution

onsemi released new Si/SiC hybrid Power Integrated Modules (PIMs) in an **F5BP package** that enhance power output by **15%** for utility-scale solar string inverters and energy storage systems. These modules increase power density and efficiency, allowing a solar inverter's power to rise from 300kW to 350kW, which can save nearly two megawatts per hour for a one-gigawatt solar farm. The new modules offer higher power density and efficiency, reducing the number of modules needed and cutting component costs by over **25%**.
The modules feature advanced components like the 1050V FS7 IGBT and 1200V D3 **EliteSiC** diode, reducing power dissipation by up to 8% and switching losses by 15% compared to previous generations. These PIMs feature an innovative I-NPC for the inverter module and employ a flying capacitor topology for the boost module. Additionally, they utilize advanced Direct Bonded Copper (DBC) substrates that minimize stray inductance and thermal resistance. This design reduces thermal resistance to the heat sink by 9.3%, which helps maintain cooler operational temperatures under high loads and improves overall reliability.

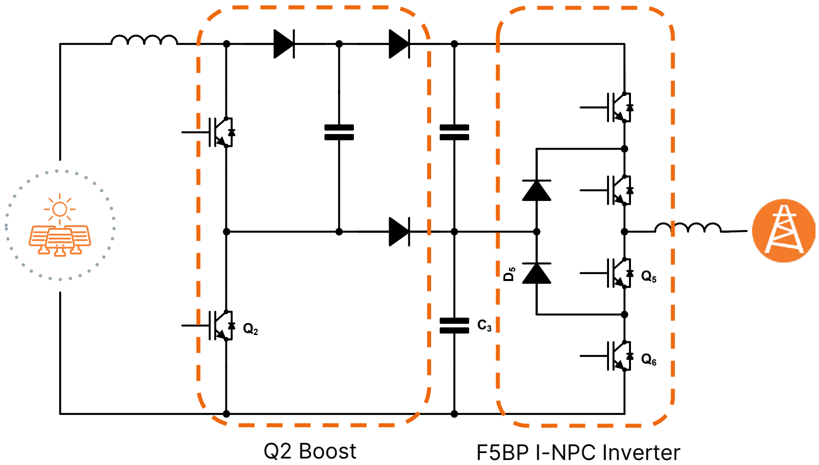

Figure 3: 300 kW+ PV String Inverter Schematic

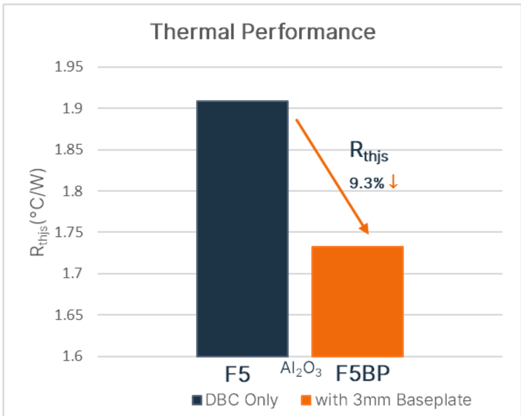

Figure 4: Thermal Performance of F5BP vs F5

Si/SiC Hybrid Module, F5BP NXH600N105H7F5P2HG

Features

- I-type Neutral Point Clamped Three-level Inverter Module
- 1050V Field Stop 7 IGBTs and 1200V SiC Diodes
- High Efficiency, High Power Density and Superior Reliability
- Low Thermal Impedance Baseplate
- Low Inductive Layout, Internal NTC thermistor

Benefits

- System High Efficiency up to 99%
- Reduction of Module Numbers, Enabling Simpler PCB Design and Lower System Cost

Application

- 1500 V decentralized utility-scale solar inverter

Learn more about **onsemi** F5BP families: Si/SiC hybrid PIM, IGBT PIM

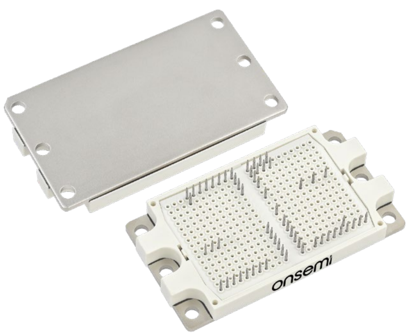

Figure 5: F5BP Package PIM60 112x62 (Press Fit)

Solar Inverter

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