



System Solution Guide - Preview

Uninterruptible Power Supply (UPS)



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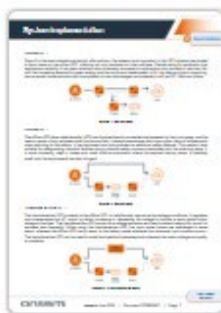
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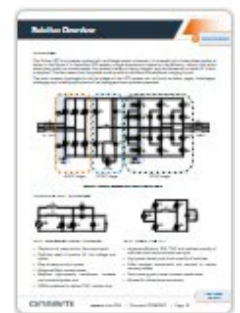
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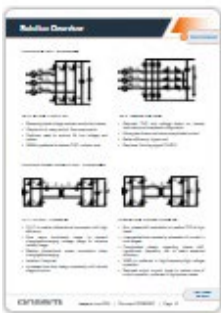
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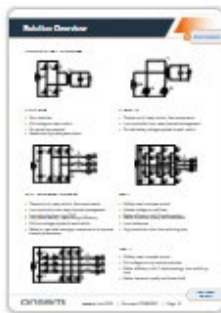
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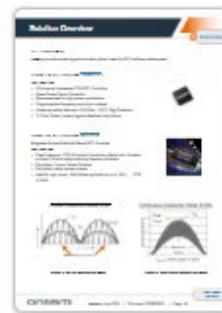
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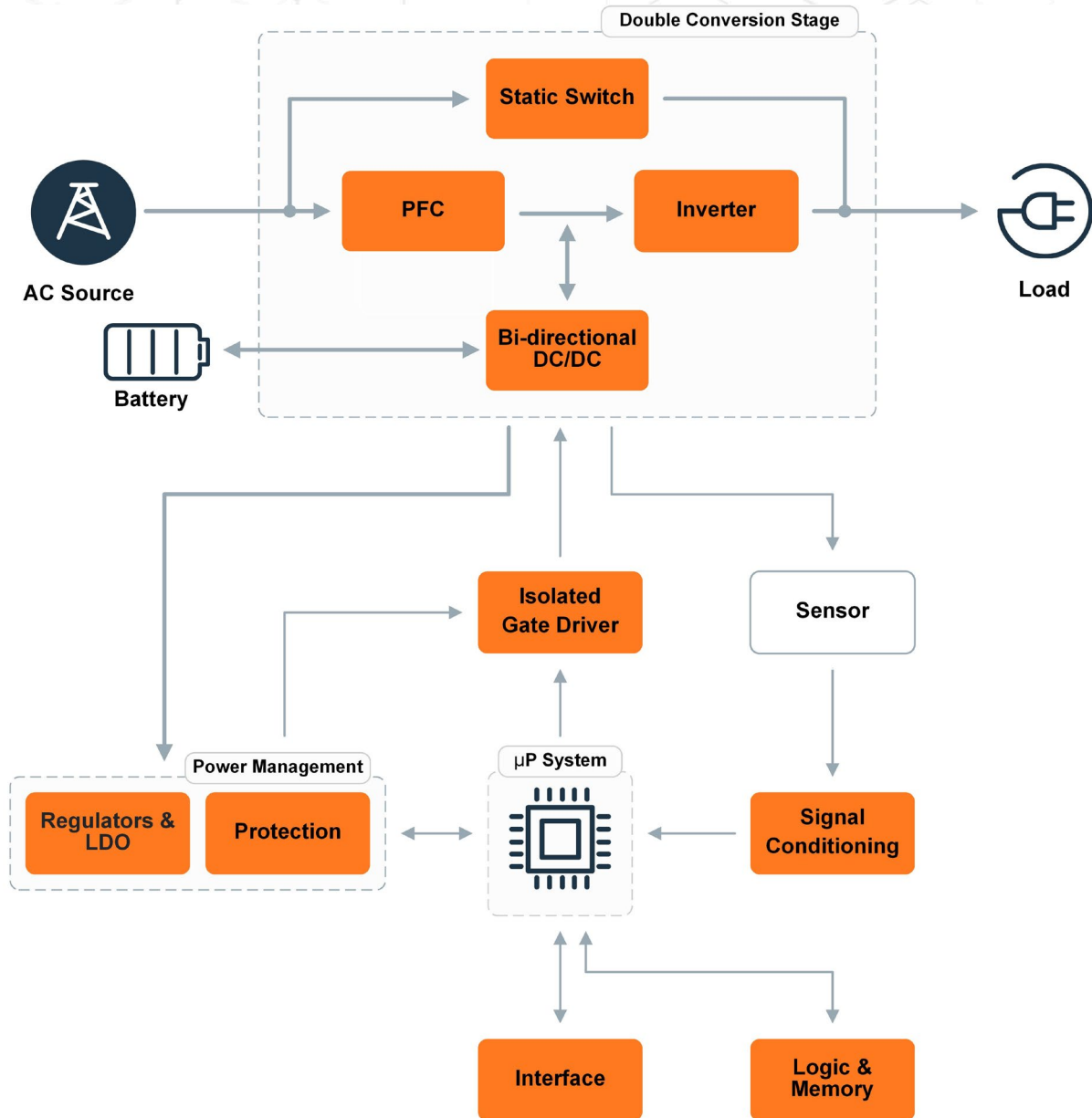
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Block Diagram - Online UPS

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Block Diagram - Online UPS

The block diagram below represents Online UPS solution created by **onsemi**. The online UPS provides continuous power by converting incoming AC to DC and then back to AC, ensuring a stable and uninterrupted power supply. **onsemi** offers a wide 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.



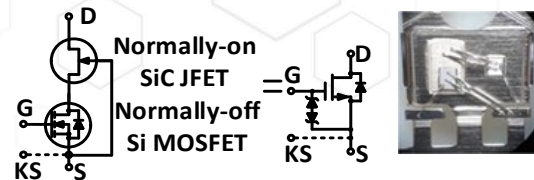
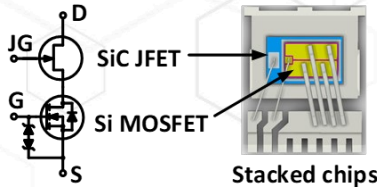
Use our Interactive Block Diagrams Tool



Open IBD Tool

Silicon Carbide (SiC) JFET Portfolios

onsemi's new EliteSiC JFET product portfolios deliver best-in-class switching speed and ultra-low on-resistance per unit area ($R_{DS(on)} \times \text{Area}$), translating into significantly higher system efficiency and reduced thermal losses in UPS systems. Furthermore, SiC JFETs are also an ideal choice for **static switches** by improving the performance and reliability.



SiC Combo JFETs

Key Features:

- 2 chips in 1 package → Combo JFET
- Separate access to MOSFET and JFET gates → better switching dV/dt control
- Ultra low $R_{DS(on)}$, high pulse current
- 1200V, $R_{DS(on)} \leq 10m\Omega$
- 750V, $R_{DS(on)} \dots 5m\Omega - 10m\Omega$
- Target application: Solid state circuit breaker, disconnect switches

Learn more about [SiC Combo JFET Portfolio](#)

SiC Cascode JFETs

Key Features:

- 2 chips in co-packed Cascode
- Pick and place replacement for standard normally-off MOSFET
- Ultra low $R_{DS(on)}$, high pulse current
- 1700V, $R_{DS(on)} \dots 410m\Omega$
- 1200V, $R_{DS(on)} \dots 9m\Omega - 410m\Omega$
- 750V, $R_{DS(on)} \dots 5.4m\Omega - 58m\Omega$
- Target application: Power Supply, Inverters, On-board Chargers, DC-DC Converters

Learn more about [SiC Cascode JFET Portfolio](#)

IGBT Discrete

IGBTs are ideal for high voltage applications, since compared to the Si MOSFETs, they provides higher blocking voltage for the equivalent material thickness. IGBT switches are ideal to be used in DC/AC inverters and in the slow leg of the totem pole PFC.

Field Stop VII, IGBT, 1200V

- New Family of 1200 V Trench Field Stop VII IGBT
- Fast switching type suitable for high switching applications
- Improved parasitic cap for high-frequency operation
- Optimized diode for low V_F and softness

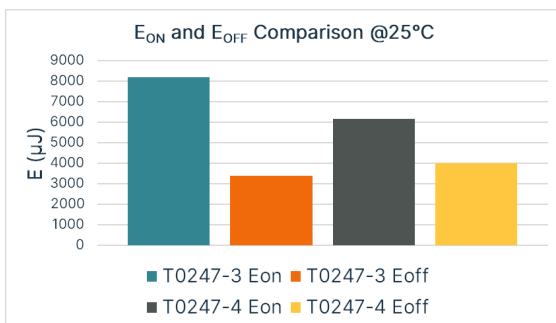


Figure 10: Comparison of switching losses of Field Stop VII in TO247-3 and TO247-4 packages

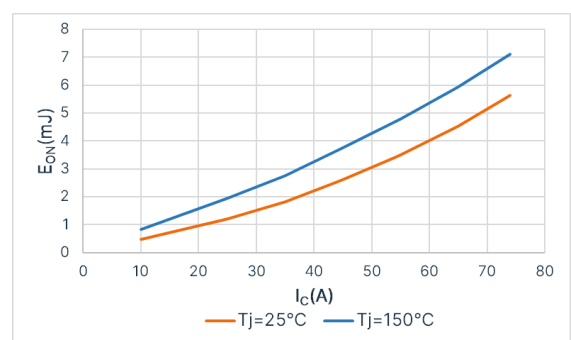


Figure 9: Switching-on losses of Field Stop VII @ $V_{CE}=600V$

IGBT [FGY4L140T120SWD](#)

- 1200V, 140A IGBT from FS7 family
- TO247-4 package has lower E_{on} , which enables higher switching frequency and power

Power Integrated Modules (PIM) in UPS Systems

onsemi has shown outstanding performance in the industrial power integrated module (PIM) design area, using SiC MOSFET and IGBT technologies to enable UPS design improvements, including a PFC, DC/DC and Inverter modules using 1200 V SiC devices. SiC power devices are getting adopted fast in the Energy-infrastructure segment to improve efficiency or increase power density. Lower switching losses enable higher efficiency with less cooling efforts or higher switching frequency with reduced size and value of passive components. These benefits can justify the higher costs of SiC power devices.

Employing a SiC MOSFET module has proven to provide benefits in terms of electrical and thermal performance as well as power density. **onsemi** released its 2nd generation of 1200V SiC modules, with M3S MOSFET technology which is focused on improving switching performance and reduction of $R_{DS(on)} * Area$.

Table 3: SiC PIM Modules for UPS

Half-Bridge (2-Pack) Modules	Full-Bridge (4-Pack) Modules	T-Type & Vienna Modules	Boost Stage Modules
Half-Bridge SiC PIM List	Full-Bridge SiC PIM List	Recommended SiC PIM List	Recommended SiC PIM List

Full SiC PIM [NXH011F120M3F2PTHG](#)

SiC 1200V Full-Bridge module contains also a thermistor with HPS DBC in an F2 package.

- M3S MOSFET technology provides typical $R_{DS(ON)} = 11.3 \text{ m}\Omega$ at $V_{GS} = 18\text{V}$, $I_D = 100\text{A}$
- Use [Elite Power Simulator](#) and [PLECS Model Generator](#) to simulate wide range of power topologies with SiC modules

Full SiC PIM [NXH008T120M3F2PTHG](#)

T-type neutral point clamped converter (TNPC) SiC module based on 1200V M3S technology

- M3S MOSFET technology provides typical $R_{DS(ON)} = 8.5 \text{ m}\Omega$ at $V_{GS} = 18\text{V}$, $I_D = 100\text{A}$

IGBT PIM [NXH800H120L7QDSG](#)

1200V, 800A rated IGBT Half-Bridge power module with PIM11 (QD3) Package

- New Field Stop Trench 7 IGBT technology and Gen. 7 diodes provide lower conduction losses and switching losses, enabling designers to achieve high efficiency and superior reliability
- NTC Thermistor, Low Inductive Layout



Figure 8: Various **onsemi** Module Packages

Table 4: IGBT and Hybrid PIM Modules for UPS

IGBT Based PIM Modules	Hybrid PIM Modules (IGBT + SiC)
Available PIM Modules (Various Topologies)	Available PIM Modules (Various Topologies)

Frequently Asked Questions (FAQ)

What is Uninterruptible Power Supply (UPS), and why is it essential for mission-critical systems?

1 A modern UPS provides emergency backup power during utility outages and also improves power quality by filtering line noise, suppressing surges/transients, stabilizing voltage/frequency, and extending runtime where reliable power is required. As efficiency and sustainability become priorities, UPS platforms are evolving into compact, intelligent power conditioning systems for data centers, industrial systems, commercial infrastructure, and other mission-critical electronics.

What's the difference between online, offline, and line-interactive UPS topologies?

2 Offline (standby) UPS powers the load directly from mains and switches to battery during failures, with a short interruption and limited protection. Line-interactive adds an active voltage conditioner to regulate output voltage and reduce battery usage, but does not provide PFC or frequency regulation. Online UPS uses double conversion (AC-DC-AC) for continuous, stable power with no switching delay and highest protection, at higher cost and demanding efficiency needs.

Which UPS type protects best against power grid anomalies like brownouts, over/undervoltage, and harmonics?

3 All three UPS types cover outages, surges, and spikes/transients, but protection diverges for deeper anomalies. Offline UPS does not protect against under/overvoltage, brownouts, or frequency variation/harmonic distortion. Line-interactive protects against under/overvoltage and brownouts, but not frequency variation/harmonics. Online UPS provides the broadest protection set, including frequency variation/harmonic distortion, making it best for sensitive and critical loads.

How does onsemi enable higher-efficiency, higher-power-density UPS designs?

4 onsemi supports UPS power stages with discrete SiC and IGBT devices, power integrated modules (PIM), isolated gate drivers, and power management/controllers to increase efficiency and power density. The guide highlights SiC's role in high-frequency fast legs (e.g., totem-pole PFC) to reduce losses and passive size, plus the EliteSiC MOSFET/diode portfolios and PIM options to improve electrical/thermal performance and compactness.

What are key design considerations for UPS power stages (PFC, bidirectional DC-DC, inverter) and device choices?

5 UPS designs typically use a PFC front end, a bidirectional battery charger (DC-DC) between PFC and inverter, and a DC-AC inverter aimed at sine-wave output. Totem-pole PFC uses a high-frequency fast leg (often SiC recommended) and a mains-frequency slow leg (IGBTs/SUPERFETs). Bidirectional chargers commonly use isolated CLLC or DAB topologies depending on isolation and power level. Inverters often use three-level/multi-level topologies; IGBTs are widely used due to maturity and cost.




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