

1000V Q3-Class HiPerFET™ Power MOSFET In SMPD Technology

MORE POWER, LESS PACKAGE (ultra-low profile, energy efficient, and rugged)

August 2012

OVERVIEW

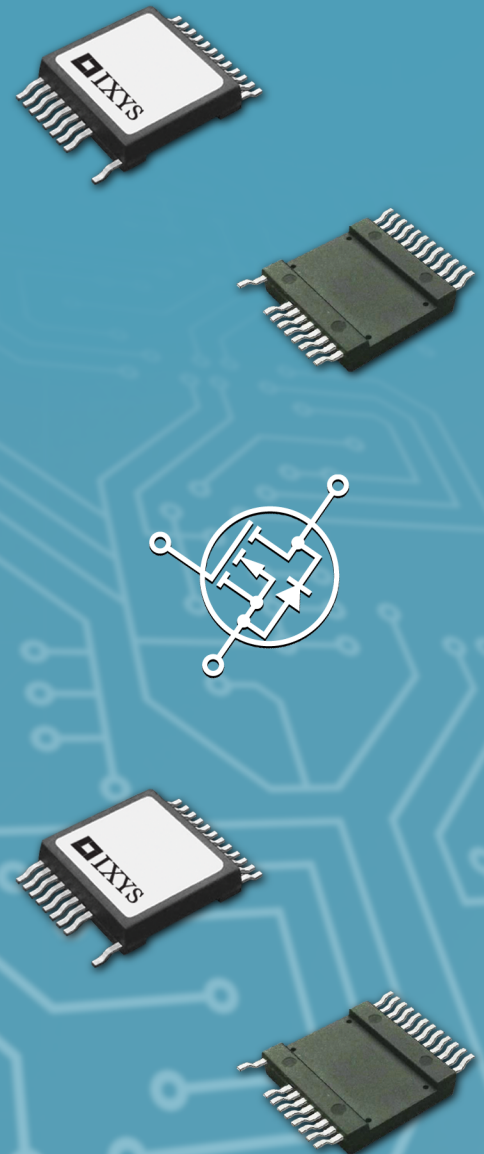
The 1000V/30A Q3-Class HiPerFET™ Power MOSFET is now available in the IXYS Surface Mount Power Device (SMPD) package. The device can be easily surface-mounted on a Printed Circuit Board (PCB), using a standard pick-and-place and reflow soldering process. No costly screws, cables, bus-bars or hand soldered contacts are needed. Weighing only 8g, it is much lighter (typically by 50%) than comparable conventional power modules, enabling a lower carbon footprint for end users. This is one of the key “green” initiatives of IXYS Corporation as it develops new products lighter in weight for the Cleantech industry.

Due to its new compact and high performance SMPD package, the MMIX1F44N100Q3 MOSFET exhibits a low package inductance and high current handling capability. A ceramic isolation of 2500V is achieved with the Direct Copper Bond (DCB) substrate technology—an electrically isolated tab is provided for heat sinking.

The Q3-Class is a direct result of combining the latest PolarHV™ technology platform with advanced double metal construction, resulting in an optimal combination of low on-state resistance ($R_{DS(on)}$) and gate charge (Q_g). Additionally the device has a low gate-to-drain (Miller) charge (Q_{gd}) and low intrinsic gate resistance (R_{gi}). These enhancements lower gate drive requirements and switching losses.

What’s more, the power switching capability and ruggedness of the device are further enhanced by the proven HiPerFET™ process, yielding a power MOSFET with a fast intrinsic rectifier; the result is a low reverse recovery charge (Q_{rr}), an ability to sustain hard-switching operations, and an excellent commutating dv/dt rating (up to 50V/ns). These featured diode properties translate into a faster transient response, an increase in power efficiency, and higher operating frequencies. Other beneficial product features include a low junction-to-case thermal resistance ($R_{thJC(max)}$) of 0.18 °C/W and high avalanche energy (E_{AS}) rating of 4 Joules.

The new Power MOSFET is well suited for such applications as, among others, DC-DC converters, battery chargers, switch-mode and resonant power supplies, DC choppers, temperature and lighting controls, and high frequency plasma generators. In particular, the enhanced dv/dt rating and high avalanche energy capability mean additional safety margins for stresses encountered in high voltage industrial switching applications, improving the long-term reliability of these systems.



FEATURES

- Low $R_{DS(on)}$ and gate charge (Q_g)
- Low intrinsic gate resistance
- Fast intrinsic rectifier
- Excellent dv/dt performance
- High power density
- High avalanche energy rating

SMPD ADVANTAGES

- Ultra-low and compact package profile (5.3mm height x 24.8mm length x 32.3mm width)
- Surface mountable via standard reflow process
- Low package weight (8g)
- 2500V ceramic isolation (DCB)
- Low package inductance
- Excellent thermal performance
- High power cycling capability

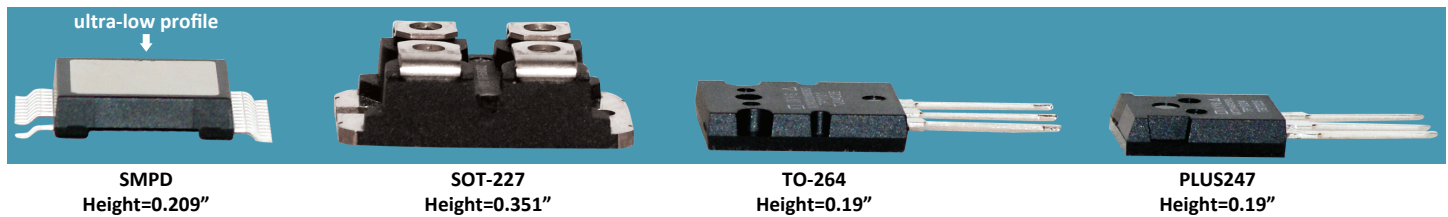
APPLICATIONS

- DC-DC converters
- Battery chargers
- Switching and resonant power Supplies
- DC choppers
- Temperature and lighting controls

SMPD Q3-Class HiPerFET Power MOSFET Summary Table

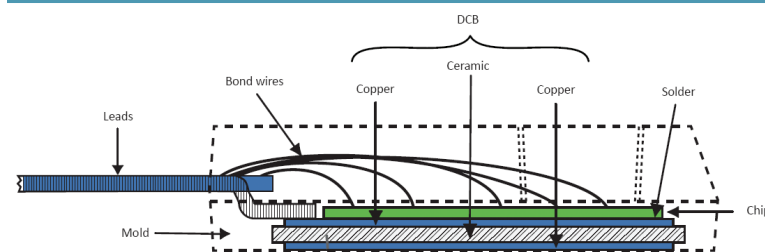
Part Number	$V_{DSS\ max}$ (V)	$I_{D(cont)} T_c=25^\circ C$ (A)	$R_{DS(on)\ max} T_j=25^\circ C$ (Ω)	C_{iss} typ (pF)	Q_g typ (nC)	t_{rr} max (ns)	P_D (W)	$R_{th(jc)\ max}$ ($^\circ C/W$)	Package Style
MMIX1F44N100Q3	1000	30	0.245	13600	264	300	694	0.18	SMPD

Ultra-low profile SMPD package



The above figure accentuates the compact and low-profile nature of the device. Compared to a conventional high power package such as the SOT-227, the IXYS SMPD features ¼ the weight and 1/3 the volume and provides similar electrical and thermal characteristics.

Direct Copper Bond (DCB) isolation



- Provides 2500V ceramic isolation
- Improves temperature and power cycling capabilities
- Reduces EMI/RFI due to low coupling capacitance between die and heat sink
- Lowers thermal resistance ($R_{th(jc)}$)
- Allows new circuit configurations

Application Circuits

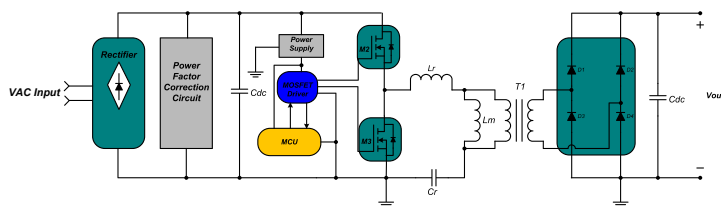


Figure 1: SMPS - Half-Bridge Resonant-Mode Converter

Figure 1 illustrates a simplified SMPS circuit diagram that uses an LLC resonant converter as the primary power conversion element of the circuit. The indicated SMPS circuit consists of a primary rectifier, power factor correction circuit, control unit (power supply, MCU, and MOSFET Driver), LLC half-bridge resonant converter, isolation transformer, and secondary rectifier stage. Two Q3-Class SMPD power MOSFETs (**MMIX1F44N100Q3**) are paired to form the LLC half-bridge resonant converter stage to ensure a fast, space-saving, and energy-efficient power switching operation.

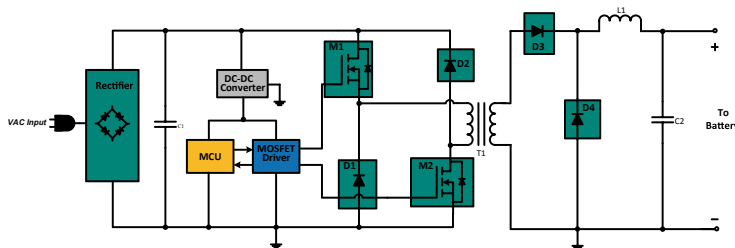


Figure 3: Battery Charger Circuit

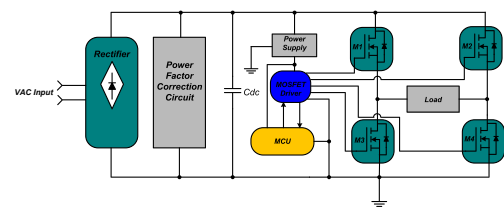


Figure 2: SMPS - HF Full-Bridge Switch-Mode Converter

Figure 2 depicts a basic HF switch-mode power supply for industrial applications. This circuit topology consists of a primary rectifier, power factor correction circuit, control unit (power supply, MCU, and MOSFET Driver), full-bridge DC-DC converter and load. An AC power source is converted into a DC value via the bridge rectifier stage. This DC value is then processed via the PFC boost stage to keep the main current and voltage in phase and provide a DC bus voltage which is normally higher than the rectified output. This DC voltage is then fed into a full-bridge converter to drive a load. Four Q3-Class power MOSFETs (**MMIX1F44N100Q3**) are used to implement the full-bridge converter stage (M1-M4), providing an energy-efficient power switching operation capable of hard switching speeds of up to 1 MHz.

Figure 3 illustrates a battery charger circuit that utilizes a half-bridge asymmetrical forward converter topology. Commonly implemented on the primary side of 220VAC offline switch-mode power supplies, it consists of a primary rectifier, a control unit (DC-DC converter, MCU, MOSFET Driver), and a half-bridge asymmetrical forward converter. Two Q3-Class SMPD devices, **MMIX1F44N100Q3** (M1 & M2), form the forward converter stage of the circuit, providing a reliable and energy-efficient power conversion.

