

# Q3-Class HiPerFET™ Power MOSFETs

Latest Generation Of Energy-efficient, Extremely Fast Switching, And Rugged Q-class Power MOSFETs

April 2012

## OVERVIEW

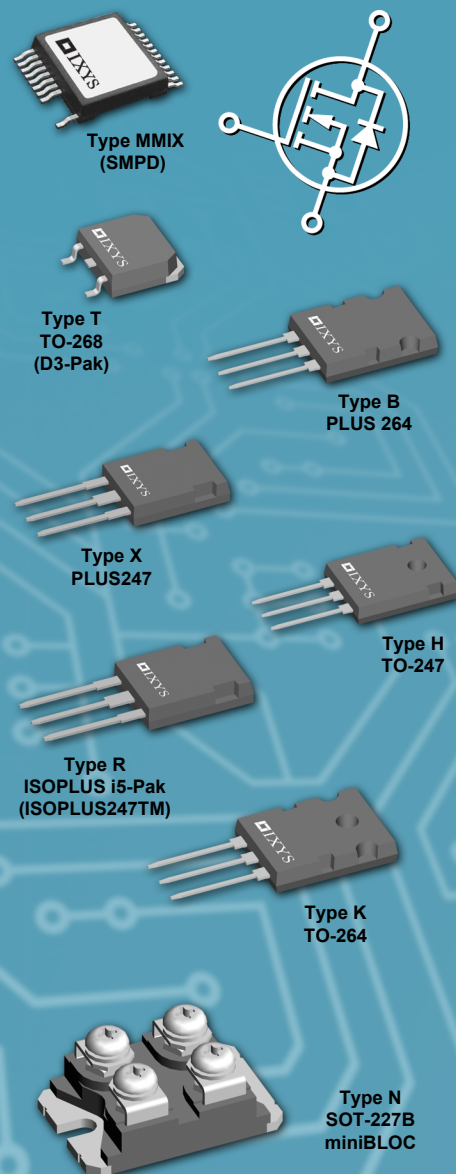
IXYS extends its portfolio of energy-efficient, extremely fast-switching and rugged Q-Class Power MOSFET solutions with the release of its latest Q3-Class HiPerFET™ family. Available with drain-to-source voltage ratings of 200V - 1000V and drain current ratings of 10A – 100A, the new Q3-Class product family compliments IXYS' extensive Power MOSFET portfolio, providing the end-customer with a broad selection range of devices that demonstrate exceptional power switching performance, excellent thermal characteristics, enhanced device ruggedness, and high energy efficiency. The superior performance and energy savings of these new devices allow for the development of more energy efficient and reliable power subsystems in high-power, high-performance applications such as industrial switch-mode power supplies, power factor correction circuits, server and telecom power systems, arc welding, plasma cutting, battery chargers, induction heating, solar inverters and MPPT (maximum power point trackers) in solar generation systems.

The new Q3-Class is a direct result of combining IXYS' latest PolarHV technology platform and advanced double metal construction to deliver a power switching solution to market that achieves benchmark electrical and thermal characteristics. These device characteristics include an optimized combination of low on-state resistance ( $R_{ds(on)}$ ) and gate charge ( $Q_g$ ), resulting in a substantial reduction in both the conduction and switching loss of the device. In addition, these new devices feature significant reductions in gate-to-drain (Miller) charge ( $Q_{gd}$ ) and internal gate resistance ( $R_{gi}$ ) device specifications - enhancements that further reduces the power switching loss of the device, enabling faster switching, and lowers gate drive power consumption.

Power switching capabilities and device ruggedness is further enhanced through the utilization of IXYS' proven HiPerFET™ process, yielding a device with a fast intrinsic rectifier which provides for low reverse recovery charge ( $Q_{rr}$ ) while enhancing the commutating  $dV/dt$  ratings (up to 50V/ns) of the device. These featured diode properties play a pivotal role in the overall device performance by providing faster transient response, increased power efficiency, improved ruggedness and enabling higher operating frequencies. Additional product features include low junction-to-case thermal resistances ( $R_{thjc}$  as low as 0.08°C/W), high avalanche energy ( $E_{as}$ ) capabilities, and high threshold voltages ( $V_{th}$ ) for improved noise immunity. These devices are capable of sustaining hard switching operation of up to 1 MHz in high frequency (HF) applications and 4-27 MHz for radio frequency (RF) applications.

High frequency switching applications such as (HF) plasma generators, radio frequency (RF) switch-mode power supplies and HF DC-DC converters will greatly benefit using the Q3-Class MOSFETs. Industrial power supplies for plasma heating, steel sheet heating, hardening, and seam welding are prime examples of industrial applications that can take full advantage of the superior switching performance, energy savings, and high noise immunity these new products have to offer. Furthermore, the enhanced  $dV/dt$  ratings and high avalanche energy capabilities provide for additional safety margins for stresses encountered in industrial high voltage switching applications, thus improving upon the long-term reliability of these systems.

The new Q3-Class Power MOSFETs are designed to replace previously released "F" and "Q2" discrete families. In comparison to previous Q2-Class generations, these new Q3-Class demonstrate up to a 20 percent reduction in on-state resistance ( $R_{ds(on)}$ ), 27 percent reduction in input capacitance ( $C_{iss}$ ), 28 percent reduction in gate charge ( $Q_g$ ), 41 percent increase in maximum power dissipation ( $P_d$ ), and as much as 50 percent reduction in thermal resistances ( $R_{thjc}$ ).



## FEATURES

- Low  $R_{ds(on)}$  per silicon area
- Low  $Q_g$  and  $Q_{gd}$
- Excellent  $dV/dt$  Performance
- High Speed Switching
- Fast Intrinsic Rectifier
- Low Intrinsic Gate Resistance
- High Avalanche Energy Capabilities
- Excellent Thermal Performance

## ADVANTAGES/BENEFITS

- High Power Density
- Easy to Mount
- Space Savings

## APPLICATIONS

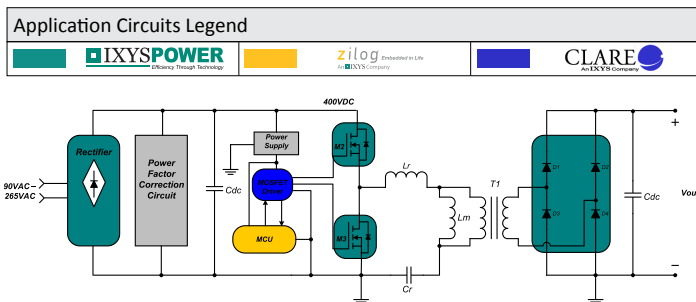
- Switch-Mode and Resonant-Mode Power Supplies
- Power Factor Correction
- Server and Telecom Power Systems
- Arc Welding
- Plasma Cutting
- Battery Chargers
- Induction Heating
- Solar Generation Systems
- Motor Controls

# Q3-Class HiPerFET Power MOSFET Summary Table

Part Number	VDSS Max (V)	ID(cont) TC=25°C (A)	RDS(on) max TJ=25°C (Ω)	Ciss Typ (pF)	Qg Typ (nC)	trr Max (ns)	PD (W)	RthJC Max (°C/W)	Package Style
IXF(1)70N20Q3	200	70	0.04	3150	67	250	690	0.18	H, T
IXF(1)50N30Q3	300	50	0.08	3160	65	250	690	0.18	H, T
IXF(1)70N30Q3	300	70	0.054	4735	98	250	830	0.15	H, T
IXFR44N50Q3	500	25	0.154	4800	93	250	300	0.41	R
IXF(1)30N50Q3	500	30	0.2	3200	62	250	690	0.18	H, T
IXF(1)44N50Q3	500	44	0.14	4800	93	250	830	0.15	H, T
IXFR64N50Q3	500	45	0.094	6950	145	250	500	0.25	R
IXFR80N50Q3	500	50	0.072	10000	200	250	570	0.22	R
IXFN80N50Q3	500	63	0.065	10000	200	250	780	0.16	N
IXF(1)64N50Q3	500	64	0.085	6950	145	250	1000	0.125	K, X
IXF(1)80N50Q3	500	80	0.065	10000	200	250	1250	0.1	K, X
IXFN100N50Q3	500	82	0.049	13800	255	250	960	0.13	N
IXFB100N50Q3	500	100	0.049	13800	255	250	1560	0.08	B
IXFR48N60Q3	600	32	0.154	7020	140	300	500	0.25	R
IXFR64N60Q3	600	42	0.104	9930	190	300	568	0.22	R
IXF(1)48N60Q3	600	48	0.14	7020	140	300	1000	0.125	K, X
IXF(1)64N60Q3	600	64	0.095	9930	190	300	1250	0.1	K, X
IXFN82N60Q3	600	66	0.075	13500	275	300	960	0.13	N
IXFB82N60Q3	600	82	0.075	13500	275	300	1560	0.08	B
IXFR32N80Q3	800	24	0.3	6940	140	300	500	0.25	R
IXF(1)32N80Q3	800	32	0.27	6940	140	300	1000	0.125	K, X
IXFN44N80Q3	800	37	0.19	9840	185	300	780	0.1	N
IXF(1)44N80Q3	800	44	0.19	9840	185	300	1250	0.1	K, X
IXFN62N80Q3	800	49	0.14	13600	270	300	960	0.13	N
IXFB62N80Q3	800	62	0.14	13600	270	300	1560	0.08	B
IXFR15N100Q3	1000	10	1.2	3250	64	250	400	0.31	R
IXF(1)15N100Q3	1000	15	1.05	3250	64	250	690	0.18	H, T
IXF(1)18N100Q3	1000	18	0.66	4890	90	3	830	0.15	H, T
IXFR24N100Q3	1000	18	0.49	7200	140	300	500	0.25	R
IXFR32N100Q3	1000	23	0.35	9940	195	300	570	0.22	R
IXF(1)24N100Q3	1000	24	0.44	7200	140	300	1000	0.125	K, X
IXFN32N100Q3	1000	28	0.32	9940	195	300	780	0.16	N
MMIX1F44N100Q3	1000	30	0.245	13600	264	300	694	0.18	MMIX
IXF(1)32N100Q3	1000	32	0.32	9940	195	250	1250	0.1	K, X
IXFN44N100Q3	1000	38	0.22	13600	264	300	960	0.13	N
IXFB44N100Q3	1000	44	0.22	13600	264	300	1560	0.08	B

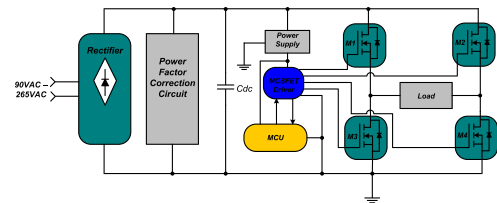
(1) Place holder in part number for package designator (B=PLUS264, H=TO-247, K=TO-264, R=ISOPLUS247, T=TO-268, X=PLUS247, MMIX=SMPD)

## Application Circuits



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

The figure above 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 Gate driver), LLC half-bridge resonant converter, isolation transformer, and a secondary rectifier stage. Two Q3-Class Power MOSFETs (**IXFK48N60Q3**) are paired to form the LLC half-bridge resonant converter stage of circuit to ensure fast, reliable and energy-efficient power switching operation.



**Figure 2: SMPS - (HF) Full-Bridge Switch-Mode Converter for Industrial Applications**

The illustration above 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 Gate driver), full-bridge DC to DC converter and a load. An AC power source is converted into a DC value via the bridge rectifier stage. This DC value is then processed via PFC boost stage to keep the main current and voltage in phase and to provide 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 (**IXFK64N60Q3**) are implemented in the full-bridge converter stage (M1-M4), providing energy-efficient power switching operation capable of hard switching speeds of up to 1 MHz.





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