

Polar3™ Power MOSFETs

Next Generation Of Energy-efficient And Reliable Power-switching Solutions

April 2012

OVERVIEW

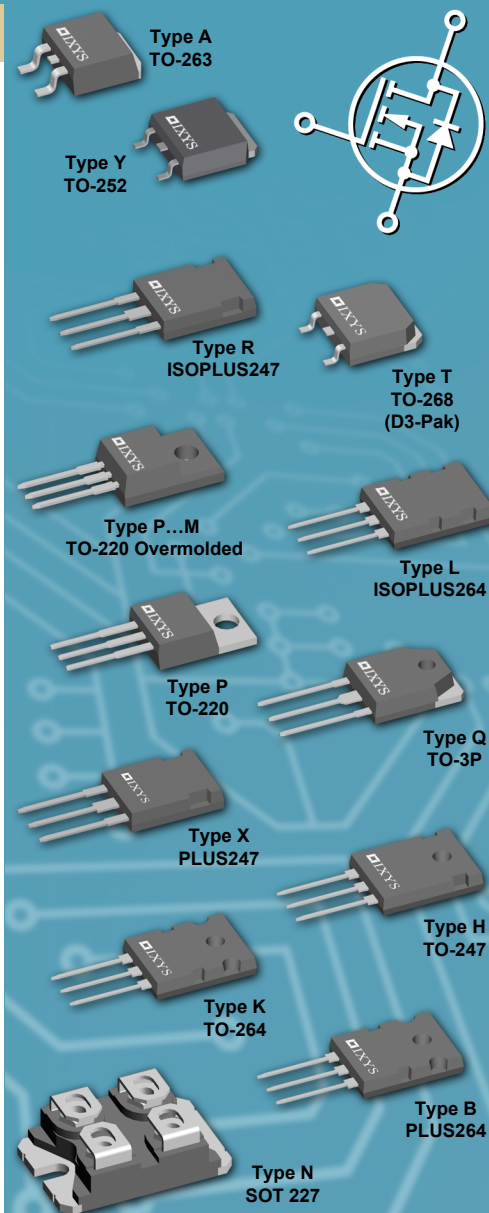
The Polar3™ Power MOSFET family is the latest addition to IXYS' benchmark high-performance Polar-Series Power MOSFET product line. These new devices are manufactured using IXYS' proprietary Polar3™ Technology Platform, yielding new and improved devices that feature an optimized combination of low on-state resistance ($R_{ds(on)}$) and gate charge (Q_g). The end result is a device that achieves a Figure of Merit (FOM) performance index (device on-resistance multiplied by gate charge) as low as 9.6 Ω nC. Additional device features include low thermal resistances ($R_{th(jc)}$), dynamic dV/dt ratings, high power dissipation (P_d), and high avalanche energy capabilities. These outstanding electrical and thermal device characteristics are essential for implementing improved power efficiency and reliability in today's demanding high-voltage conversion systems.

The featured Polar3™ family is initially available in two voltage grades; 500V and 600V grade respectively. 500V Polar3™ offerings will include drain current ($I_d @ T_c=25^\circ\text{C}$) ratings of 8Amperes to 132Amperes. Conversely, 600V Polar3™ offerings will have drain current ($I_d @ T_c=25^\circ\text{C}$) ratings of 4Amperes to 110 Amperes. These devices feature low on-resistances (as low as 39m Ω) while delivering low gate charge values (as low as 6.9nC). The combined low conduction and switching losses resulted in a significant reduction in the overall power consumption of the device. In comparison to previous Polar-Series generations (Polar2 HiPerFET™), these new Polar3 HiPerFETs demonstrate up to a 12 percent reduction in on-state resistance ($R_{ds(on)}$), 14 percent reduction in gate charge (Q_g) and as high as 20 percent increase in maximum power dissipation (P_d). Lower thermal resistances are also achieved due to reduced chip thicknesses, increasing total power density of the device.

High speed switching applications such as switch mode power supplies (SMPS) and uninterruptible power supplies (UPS) will greatly benefit from the low total gate charge and gate drain charge ($Q_{gd}=6.9\text{nC}$, $Q_{gd}=2.8\text{nC}$, $V_{gs}@10\text{V}$) characteristics of these devices. The low total gate charge and gate drain charge characteristic allows designers the ability to boost power conversion efficiency through the use of high-speed switching and to promote the use of smaller passive components, thus freeing up additional PCB real-estate and reducing the cost of bulky passive components. In addition, the low total gate charge reduces the amount of gate drive power requirement (Gate Drive Power = $Q_g \times V_{gs} \times F_{sw}$) needed for the Power MOSFET to fully conduct. Since these devices require less gate drive power, simple economical gate drive solutions can be implemented, further reducing cost and complexity.

Power switching capabilities and device ruggedness of these devices are further enhanced through the utilization of IXYS' HiPerFET™ process, yielding a device with a fast intrinsic diode for low reverse recovery charge (Q_{rr}) and improved turn-off dV/dt immunity. The enhanced dV/dt ratings of these devices offer significant safety margins for the stresses encountered in high-voltage switching applications. Furthermore, these new devices eliminate the need for discrete anti-parallel high voltage diodes used in conventional designs, thereby reducing part count, simplifying PCB layouts, reducing overall losses and improving power density.

Other applications that will greatly benefit from the superior performance, energy savings, rugged design, and cost-effectiveness of these new 3rd generation Polar-Series Power MOSFETs include applications such as power factor correction circuits, motor drives, lamp ballasts, laser drivers, DC-DC converters, battery chargers, solar inverters, robotic and servo control.



FEATURES

- Low $R_{ds(on)}$
- Low Q_g
- Dynamic dV/dt ratings
- Avalanche Rated
- High power dissipation (P_d)
- Low Thermal Resistance ($R_{th(jc)}$)
- Fast intrinsic rectifier
- Low gate drive power requirements
- Low package inductance

BENEFITS

- High power density
- Reduces conduction and switching losses
- Enables high-speed switching
- Promotes use of smaller passive components
- Promotes use of simple economical gate drive solutions
- Cooler device operation
- Enables system miniaturization
- Increased device ruggedness
- Easy to mount

APPLICATIONS

- Switch Mode Power Supplies
- Uninterruptible Power Supplies
- Power Factor Correction Circuits
- DC-DC converters
- Laser Drivers
- Battery Chargers
- AC and DC Motor Drives
- Robotics and Servo Controls
- Solar Inverters
- Lamp Ballasts

N-Channel Polar3™ Power MOSFET Family

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
IXFP20N50P3M	500	8	0.3	1800	36	250	58	2.15	P
IXF(1)20N50P3	500	20	0.3	1800	36	250	380	0.36	Q, A, H, P
IXF(1)60N50P3	500	60	0.1	6250	96	250	1040	0.12	H, Q, T
IXFL132N50P3	500	63	0.043	18600	250	250	520	0.24	L
IXF(1)78N50P3	500	78	0.068	9900	147	250	1130	0.11	X,K
IXF(1)98N50P3	500	98	0.05	13100	197	250	1300	0.096	K, X
IXFN132N50P3	500	112	0.039	18600	250	250	1500	0.083	N
IXFB132N50P3	500	132	0.039	18600	250	250	1890	0.066	B
IXF(1)4N60P3	600	4	2.2	365	6.9	250	114	1.1	P, Y, A
IXF(1)7N60P3	600	7	1.15	705	13.3	250	180	0.69	P,A
IXF(1)14N60P3	600	14	0.54	1480	25	250	327	0.38	H,A,P
IXF(1)16N60P3	600	16	0.44	1830	36	250	347	0.36	A,P,H
IXF(1)22N60P3	600	22	0.36	2600	38	250	500	0.25	Q,P,H,A
IXF(1)28N60P3	600	28	0.26	3560	50	250	695	0.18	Q,H
IXFH42N60P3	600	42	0.185	5150	78	250	830	0.15	H
IXFR80N60P3	600	48	0.076	13100	190	250	540	0.23	R
IXF(1)50N60P3	600	50	0.145	6300	94	250	1040	0.12	H,T,Q
IXF(1)64N60P3	600	64	0.095	9900	145	250	1130	0.11	K,X
IXFN80N60P3	600	66	0.07	13100	190	250	960	0.13	N
IXF(1)80N60P3	600	80	0.07	13100	190	250	1300	0.096	X,K
IXFN110N60P3	600	90	0.056	18000	245	250	1500	0.083	N
IXFB110N60P3	600	110	0.056	18000	245	250	1890	0.066	B

(1) Place holder in part number for package designator

Application Circuits

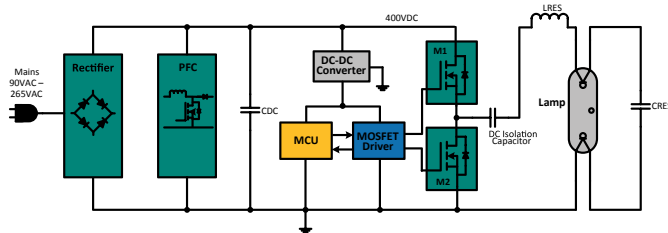


Figure 1: Lamp Ballast Circuit

Figure 1 illustrates a basic fluorescent lamp ballast circuit. This electronic lamp ballast circuit topology consists of a primary rectifier, power factor correction circuit, control unit (DC-DC Converter, MCU, and Gate Driver), half-bridge inverter and a resonant output stage. 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 voltages of up to 400VDC. This DC value is then fed into a half-bridge inverter to drive the resonant output stage, which is implemented to control the fluorescent lamp. Two Polar3™ HiPerFET™ Power MOSFETs, IXFH60N60P3 (M1 & M2), are employed in the half-bridge inverter stage for efficient and robust power switching duties.

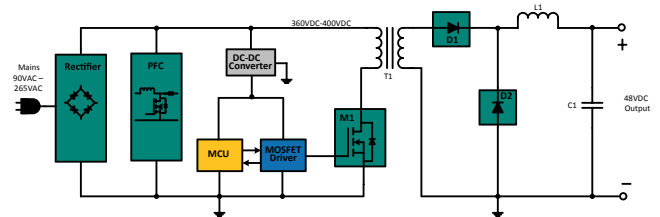


Figure 2: 48V Telecom SMPS Circuit

Figure 2 depicts a basic 48V Telecom Switch-Mode Power Supply circuit. This power supply topology consists of a primary rectifier, power factor correction circuit, control unit (DC-DC Converter, MCU, and Gate Driver), and a forward converter stage. High speed switching applications such as SMPS will greatly benefit from the ultra-low total gate charge and gate drain charge characteristics of new Polar3™ devices. A Polar3HiPerFET™ IXFH22N60P3 (M1) is utilized in the forward converter stage of circuit (primary side), providing fast and efficient power switching operation.

Figure 3: Battery Charger Circuit

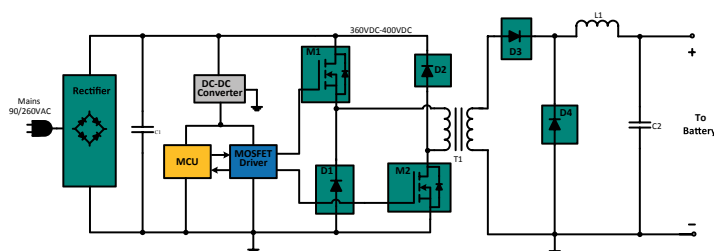


Figure 3 illustrates a battery charger circuit that utilizes a half-bridge asymmetrical forward converter topology. This topology is commonly implemented on the primary side of 220VAC off-line Switch-Mode Power Supplies. The battery charger circuit topology consists of a primary rectifier, control unit (DC-DC Converter, MCU, and Gate Driver), and a half-bridge asymmetrical forward converter stage. Two Polar3 HiPerFET™ devices, IXFH60N50P3 (M1 & M2), are implemented in the forward converter stage of the circuit to provide reliable and energy-efficient power conversion.