IXYSPOWER
Efficiency Through Technology

NEW PRODUCT BRIEF

# 600V XPT IGBTs

## NEW DISCRETE 600V EXTREME LIGHT PUNCH THROUGH (XPT) IGBTS

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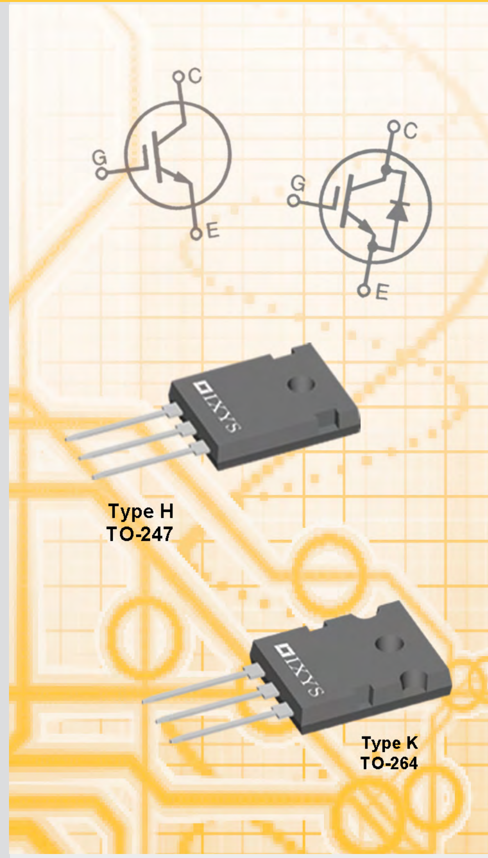


### OVERVIEW

IXYS expands its benchmark XPT IGBT portfolio with new 600V discrete XPT IGBTs. These new discrete IGBTs are especially tailored to address market demands for highly rugged, low loss semiconductor devices that offer the ability to be easily configured in parallel. The featured devices demonstrate superior performance and exceptional ruggedness in applications such as power inverters, uninterruptible power supplies, motor drives, switch mode power supplies, power factor correction circuits, battery chargers, welding machines, and lamp ballasts.

The introduced 600V XPT IGBTs are available with collector current (Ic) ratings from 100 Amperes to 210 Amperes (Tc=25°C). Developed using thin wafer technology and IXYS' extreme light punch through (XPT) design platform, these new devices feature excellent electrical characteristics which include low typical collector to emitter saturation voltages (Vcesat as low as 1.8V), low typical current fall times (tfi as low as 42ns), and low typical turn-off energy per pulse values (Eoff as low as 0.33mJ @ Tj=25°C). In addition, they exhibit exceptional ruggedness during switching and under short circuit conditions, establishing a new benchmark regarding device ruggedness. This is achieved through a 10us short circuit safe operating area (SCSOA), dynamic avalanche ratings, and a square reverse bias safe operating area (RBSOA) rated up to the device's blocking voltage. Furthermore, these devices feature an extended forward bias safe operating area (FBSOA), allowing for a "wider operating window" as dictated by the power limitations of the device, resulting in improved ruggedness and reliability.

These new IGBTs are available in two distinctive speed classifications; the B3 and C3 Classes respectively. The B3 and C3 speed classifications present designers with a more flexible approach to device selection regarding critical requirements such as switching frequency, saturation voltage, and cost. B3-Class devices feature an excellent balance between conduction and switching losses and are optimized for hard switching frequencies from 10 kHz to 30 kHz. C3-Class devices are optimized for minimal switching losses and are recommended for hard switching frequencies from 20 kHz to 60 kHz. Additional features include a maximum operating temperature of 175 degree Centigrade and a positive forward voltage coefficient, which enables parallel operation, allowing designers the ability to utilize multiple discrete devices in parallel to achieve the desired high current requirements of their application.

These IGBTs are available with IXYS' Sonic-FRD™ and HiPerFRED™ anti-parallel ultra-fast diodes (Sonic-FRD™ – Suffix H1, ie. IXXK100N60C3H1) (HiPerFRED™ – Suffix D1, ie. IXXH50N60C3D1). The combination of XPT IGBT and Sonic-FRD™ or HiPerFRED™ ultra-fast diodes result in an optimal match for reduced turn-off losses. Furthermore the high dynamic ruggedness, combined with the smooth switching behavior of IXYS' Sonic-FRD™ or HiPerFRED™ anti-parallel ultra-fast diodes provides users the greatest freedom in designing their systems without the need for any dV/dt or peak-voltage limiters such as snubbers or clamps. Moreover, it allows the XPT IGBT to be switched on at very high di/dt's regardless of low current and temperature condition and provides excellent EMI performance despite the level of the switched current. The extended SOA of these devices also allows for higher switching speeds, which in turn translate into lower switching losses.

### FEATURES

- B3 class optimized for 10-30khz switching
- C3 class optimized for 20-60khz switching
- Square RBSOA
- Avalanche Rated
- Short Circuit Capability
- High Current Capability
- Optional Antiparallel Ultrafast Diode
- International Standard Packages

### ADVANTAGES

- High Power density
- Low Gate Drive Requirement

### APPLICATIONS

- Power Inverters, UPS, SMPS, PFC, Battery chargers, Welding Machines, Lamp ballasts and Motor Drives

# 600V XPT IGBT Summary Table

| Part Number | VCES (V) | IC25 Tc=25°C (A) | IC110 Tc=110°C (A) | Vce(sat) max (V) | tfi typ (ns) | Eoff typ TJ=125°C (mJ) | RthJC max (°C/W) | Configuration | Package Style |
|---|---|---|---|---|---|---|---|---|---|
| IXXH100N60B3 | 600 | 210 | 100 | 1.8 | 150 | 2.80 | 0.18 | Single | TO-247 |
| IXXK100N60B3H1 | 600 | 190 | N/A | 1.8 | 150 | 2.80 | 0.18 | Co-pack (Sonic-FRD) | TO-264 |
| IXXH50N60C3 | 600 | 100 | 50 | 2.3 | 42 | 0.48 | 0.25 | Single | TO-247 |
| IXXH50N60C3D1 | 600 | 100 | 50 | 2.3 | 42 | 0.48 | 0.25 | Co-pack (HiPerFRED) | TO-247 |
| IXXH100N60C3 | 600 | 190 | 100 | 2.2 | 75 | 1.40 | 0.18 | Single | TO-247 |
| IXXK100N60C3H1 | 600 | 170 | N/A | 2.2 | 75 | 1.40 | 0.18 | Co-pack (Sonic-FRD) | TO-264 |

# Application Circuits

Application Circuits Legend

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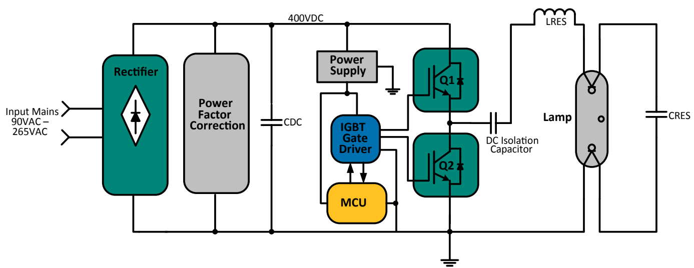



**Figure 1: Electronic Lamp Ballast**

Figure 1 illustrates a simplified (medium-power) electronic lamp ballast circuit. This electronic lamp ballast circuit topology consists of a primary rectifier, power factor correction circuit, control unit (Power supply, MCU, and Gate Drivers), half-bridge inverter and a resonant output stage. Two IXXH50N60C3D1 XPT IGBTs (Q1 & Q2) are paired to form the half-bridge power inverter stage used to facilitate the ignition and to sustain the nominal running AC voltage across the resonant output stage of the lamp from a 400VDC intermediate rail.

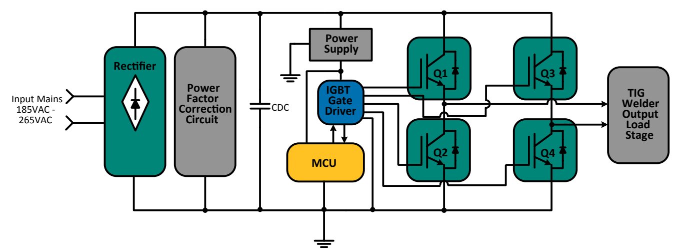



**Figure 2: TIG Welding Inverter**

Figure 2 shows a simplified circuit diagram of a high-current TIG welding inverter. This circuit is comprised of a rectification stage, power factor correction stage, control stage (Power supply, MCU, and Gate Drivers), and a power inverter stage. AC input mains (185VAC-265VAC) from the power grid is applied to the rectification stage to be converted into a DC Value. This DC value is then processed via a power factor correction circuit to reshape the distorted input current into a waveform that is in phase with the input voltage. The DC output of the PFC circuit enters the power stage which employs a full bridge inverter topology comprised of four IXXK100N60C3H1 XPT IGBTs (Q1, Q2, Q3, Q4) to convert the voltage back to AC at higher frequencies (typically from 30kHz to 70kHz). This AC voltage signal is then fed into the output stage of the TIG welder.

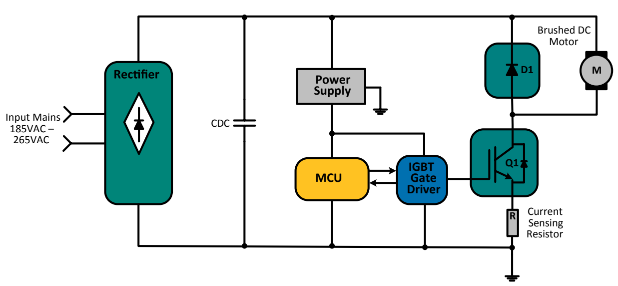
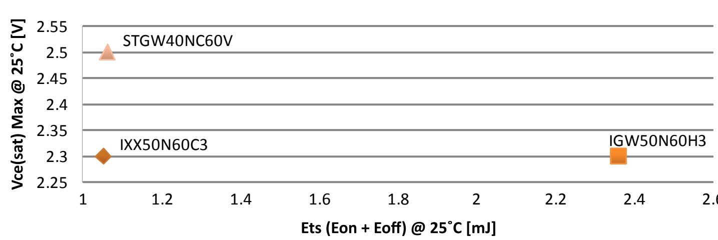



**Figure 3: Brushed DC Motor Drive**

Figure 3 portrays a simplified low-side brushed DC Motor Drive Circuit. A rectified voltage is applied across the brush DC motor which varies via pulse wide modulation mode at an inaudible switching frequency (typically >20 kHz). A DC supply provides smooth current operation, reducing (acoustic) motor noise and improving motor efficiency. An IXXK100N60B3H1 XPT IGBT (Q1) is used as the main switching element of this circuit to provide efficient and reliable power switching operation.

# Tradeoff Diagram




The IXXH50N60C3 features an excellent balance between switching and conduction losses as indicated in the trade-off diagram (Vcesat vs. Ets). The IXXH50N60C3 demonstrates as high as a 25% reduction in total switching energy loss and a 8% reduction in saturation voltage in comparision to other comparable IGBT devices on the market.