IXYSPOWER
Efficiency Through Technology

PRODUCT BRIEF

650V XPT™ Trench IGBTs

Highly Efficient Low On-State Voltage IGBTs for Hard or Soft Switching Applications

March 2013

OVERVIEW

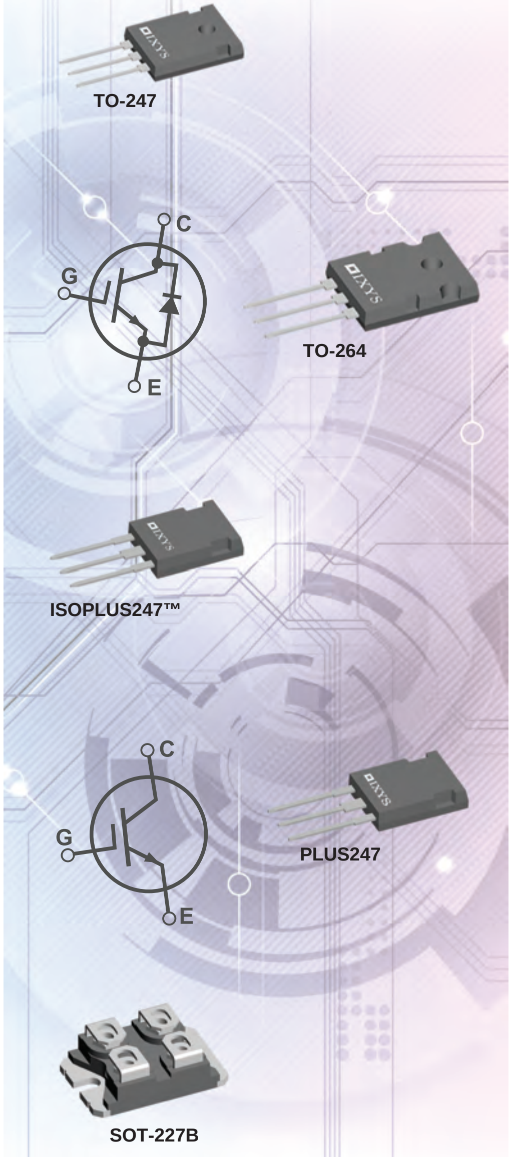
IXYS Corporation (NASDAQ: IXYS) announces the release of a new IGBT product line – 650V XPT™ Trench IGBTs. The current ratings of devices in the new product family range from 30A to 200A at a high temperature of 110°C. With on-stage voltages as low as 1.7V, these new eXtreme-light Punch-Through (XPT™) devices are designed to minimize conduction and switching losses, especially in hard-switching applications. Optimized for different switching speed ranges (up to 60kHz), these IGBTs provide designers with flexibility in device selection in terms of cost, saturation voltage, and switching frequency. Devices co-packed with IXYS ultra-fast Sonic-FRD™ diodes are also available.

Developed using the IXYS XPT™ thin-wafer technology and state-of-the-art 4th generation (GenX4™) Trench IGBT process, these devices feature reduced thermal resistance, low energy losses, fast switching, low tail current, and high current densities. In addition, they display exceptional ruggedness under short-circuit conditions – a 10µs Short Circuit Safe Operating Area (SCSOA). Moreover these IGBTs have square Reverse Bias Safe Operating Areas (RBSOA) up to the breakdown voltage of 650V, making them ideal for snubber-less hard-switching applications. Other qualities include a positive collector-to-emitter voltage temperature coefficient which enables designers to use multiple devices in parallel to meet high current requirements and low gate charges which help reduce gate drive requirements and switching losses.

Thanks to its speed and ‘soft recovery’ characteristics, the co-packed Sonic-FRD™ diode is an ideal match for these XPT™ IGBTs in reducing turn-on and turn-off losses. It is optimized to suppress ringing oscillations and voltage spikes in recovery, thereby producing smooth switching waveforms and significantly lowering electromagnetic interference (EMI) in the process. The temperature stability of its forward voltage also helps lower switching losses when devices are operated in parallel.

The new IGBTs are well-suited for a wide variety of power conversion applications, including lighting control, battery chargers, motor drives, power inverters, power factor correction circuits, switch-mode power supplies, uninterruptible power supplies, E-Bikes, and welding machines.

These 650V XPT™ IGBTs are available in the following international standard packages: TO-247, TO-264, SOT-227B, PLUS247, and ISOPLUS247™. Some example part numbers are IXXH30N65B4, IXXN110N65C4H1, IXXK160N65C4, and IXXX200N65B4, with collector current ratings of 65A, 234A, 290A, and 370A, respectively.



FEATURES

- Low on-state voltages $V_{CE(sat)}$
- Optimized for high-speed switching (up to 60kHz)
- Short circuit capability (10µs)
- Square RBSOA
- Positive thermal coefficient of $V_{CE(sat)}$
- Ultra-fast anti-parallel diodes (Sonic-FRD™)
- International standard packages

ADVANTAGES

- Hard-switching capabilities
- High power densities
- Temperature stability of diode forward voltage V_F
- Low gate drive requirements

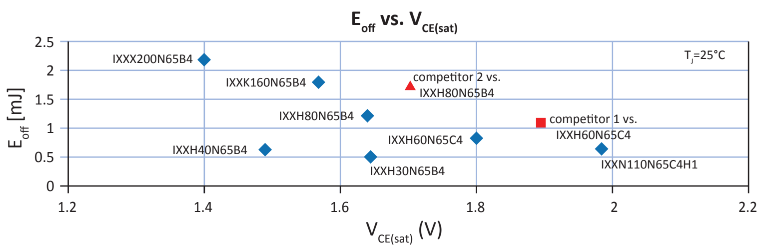
APPLICATIONS

- Battery chargers
- Lamp ballasts
- Motor drives
- Power inverters
- Power Factor Correction (PFC) circuits
- Switch-mode power supplies
- Uninterruptible power supplies (UPS)
- Welding machines

650V XPT™ Trench IGBTs Summary Table

Part Number	V_{CES} (V)	I_{C25} T_C=25°C (A)	I_{C110} T_C=110°C (A)	$V_{CE(sat)}$ max T_J=25°C (V)	t_{fi} typ T_J=150°C (ns)	E_{off} typ T_J=150°C (mJ)	R_{thJC} max IGBT (°C/W)	Configuration	Package Style
IXXH30N65B4	650	65	30	2	100	0.6	0.65	Single	TO-247
IXXH60N65B4H1	650	116	60	2	94	1.34	0.33	Copacked (Sonic-FRD™)	TO-247
IXXH60N65B4	650	116	60	2	94	1.34	0.33	Single	TO-247
IXXH60N65C4	650	118	60	2.2	47	0.93	0.33	Single	TO-247
IXXH40N65B4	650	120	40	1.8	73	0.78	0.33	Single	TO-247
IXXR110N65B4H1	650	150	70	2.15	105	1.4	0.33	Copacked (Sonic-FRD™)	ISOPLUS247™
IXXH80N65B4	650	160	80	2	65	1.65	0.24	Single	TO-247
IXXH80N65B4H1	650	160	80	2	65	1.65	0.24	Copacked (Sonic-FRD™)	TO-247
IXXN110N65C4H1	650	210	110	2.35	43	0.77	0.2	Copacked (Sonic-FRD™)	SOT-227B
IXXN110N65B4H1	650	215	110	2.1	105	1.4	0.2	Copacked (Sonic-FRD™)	SOT-227B
IXXH110N65C4	650	234	110	2.35	43	0.77	0.17	Single	TO-247
IXXK110N65B4H1	650	240	110	2.1	105	1.4	0.17	Copacked (Sonic-FRD™)	TO-264
IXXX110N65B4H1	650	240	110	2.1	105	1.4	0.17	Copacked (Sonic-FRD™)	PLUS247
IXXK160N65C4	650	290	160	2.1	57	1.3	0.16	Single	TO-264
IXXX160N65C4	650	290	160	2.1	57	1.3	0.16	Single	PLUS247
IXXK160N65B4	650	310	160	1.8	160	2.36	0.16	Single	TO-264
IXXX160N65B4	650	310	160	1.8	160	2.36	0.16	Single	PLUS247
IXXK200N65B4	650	370	200	1.7	110	2.54	0.13	Single	TO-264
IXXX200N65B4	650	370	200	1.7	110	2.54	0.13	Single	PLUS247

Tradeoff Diagram [turn-off loss vs. on-state voltage]



These 650V XPT™ Trench IGBTs are optimized to achieve low switching and conduction losses while maintaining low on-state voltages. The graph demonstrates a superior trade-off (turn-off energy loss vs. on-state voltage) of the new IGBTs (in particular, the IXXH60N65C4 against competitor 1 and IXXH80N65B4 against competitor 2).

Application Circuits

Application Circuits Legend

IXYSPOWER	zilog	IXYS

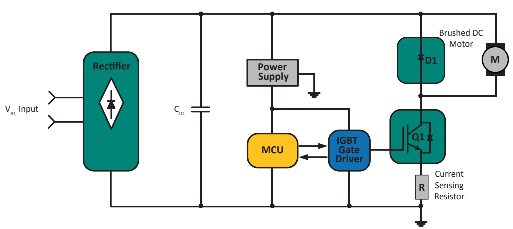


Figure 1: Brushed DC Motor Drive

Figure 1 portrays a simplified low-side brushed DC motor drive circuit. A rectified voltage is applied across the brushed DC motor which varies according to a Pulse Width Modulation (PWM) signal at an inaudible switching frequency (typically higher than 20 kHz). A DC supply provides a smooth current operation, reducing (acoustic) motor noise and improving motor efficiency. An XPT™ Trench IGBT, the **IXXK110N65B4H1** (Q1), is used as the main switching element to ensure an efficient and reliable power switching operation.

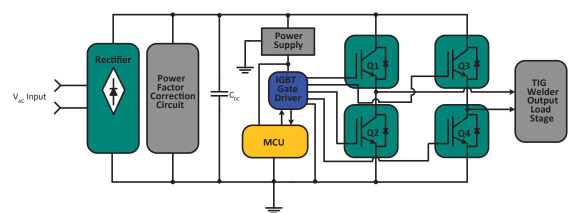


Figure 2: TIG Welding Inverter

Figure 2 shows a general circuit diagram of a high-current TIG welding inverter. This topology is comprised of a rectification stage, power factor correction (PFC) stage, control stage (Power supply, MCU, and IGBT Gate Driver), and power-inverter stage. An AC input (185VAC-265VAC) from the power grid is applied to the rectification stage to be converted into a DC value. This DC value then goes through the PFC circuit where its distorted current is reshaped into a waveform in phase with the input voltage. The DC output of the PFC circuit next enters the power-inverter stage, which is a full-bridge inverter and made up of four **IXXN110N65C4H1** XPT™ Trench IGBTs (Q1, Q2, Q3, Q4), to be converted back to an AC voltage that has a higher frequency (typically ranging from 30kHz to 50kHz). This AC voltage signal is applied to the output stage of the TIG welder.

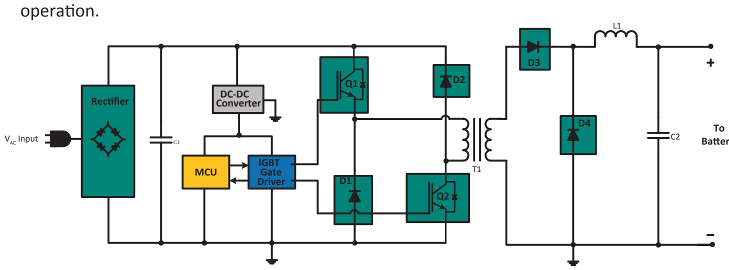


Figure 3: Battery Charger Circuit

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, IGBT Gate Driver), and a half-bridge asymmetrical forward converter. Two XPT™ Trench IGBTs devices, **IXXH60N65B4H1** (Q1 & Q2), form the forward converter stage of the circuit, providing a reliable and energy-efficient power conversion.