IXYSPOWER
Efficiency Through Technology

Product Brief

650V XPT™ IGBTs

For demanding high-speed hard-switching power conversion systems

December 2013

OVERVIEW

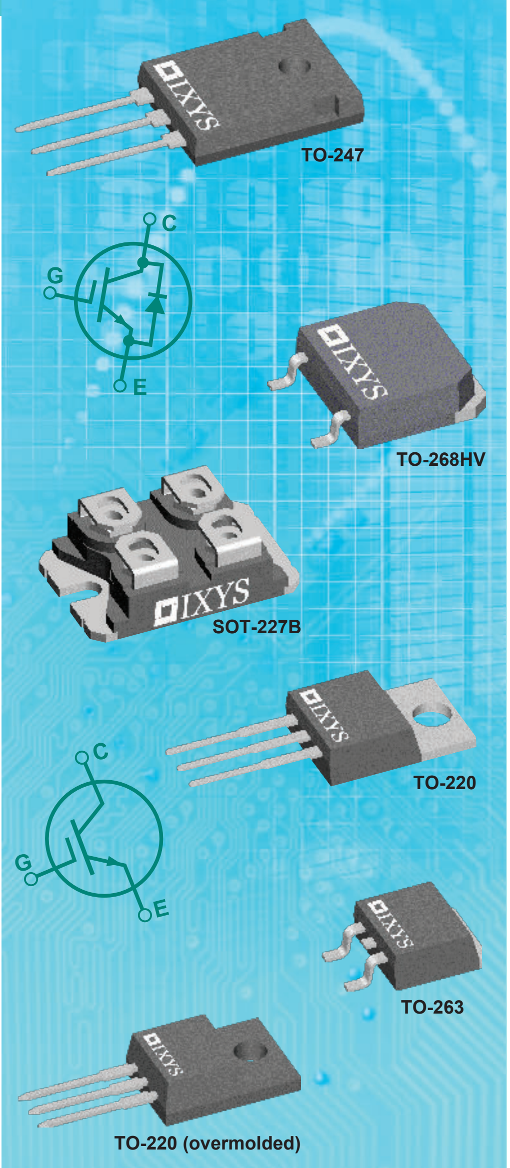
IXYS Corporation (NASDAQ: IXYS), a manufacturer of power semiconductors and integrated circuits for energy efficiency, power management, and motor control applications, today announced an expansion of its 650V XPT™ IGBT product portfolio. With current ratings ranging from 16A to 200A, these new devices are designed to achieve an optimal balance between the turn-off energy loss and on-state voltage, especially in hard-switching applications. Able to support switching frequencies up to 60 kHz, they allow designers to use smaller and lighter components in their systems. Devices co-packed with anti-parallel fast diodes are also available.

Built with the proprietary thin-wafer technology called Extreme-light Punch-Through (XPT™) and the state-of-the-art 3rd generation (GenX3™) IGBT process, these devices exhibit such qualities as reduced thermal resistance, low tail current, low energy loss, and high-speed switching capability. They are avalanche rated and able to withstand short-circuit conditions. They also have square Reverse Bias Safe Operating Areas (RBSOAs) up to the breakdown voltage of 650V. All of these attributes make them exceptionally rugged and particularly useful for snubberless hard-switching designs.

Other advantages include low gate charge and a positive temperature coefficient of the on-state voltage, translating into lower gate drive requirements and multiple-device paralleling capability, respectively. Moreover the optional co-packed diode 'Sonic-FRD™' is optimized to help reduce turn-off losses and suppress ringing oscillations that can cause electromagnetic interference (EMI) in the system. These diodes can also be operated in parallel thanks to the temperature stability of the forward voltage.

A wide array of power conversion applications can benefit from deploying these new IGBTs. Among these are power inverters, uninterruptible power supplies, switch-mode power supplies, power factor correction circuits, battery chargers, welding machines, lamp ballasts, and E-Bikes.

The new 650V XPT™ IGBTs are available in the following international standard size packages: TO-220 (regular and over-molded), TO-247, TO-263, TO-268HV, and SOT-227B. The TO-268HV is a proprietary high-voltage package with an increased creepage distance between leads, compared to the standard one. Some example part numbers include IXYP15N65C3D1M, IXYP10N65C3, IXYH40N65C3H1, and IXYH100N65C3, with collector current ratings of 16A, 30A, 80A, and 200A, respectively.



FEATURES

- Optimized for 20kHz-60kHz switching
- Square RBSOA
- Short circuit capability (8µs-10µs)
- Avalanche rated
- Positive thermal coefficient of $V_{CE(sat)}$
- Ultra-fast anti-parallel diode (Sonic-FRD™)
- International standard and proprietary high voltage packages

ADVANTAGES

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

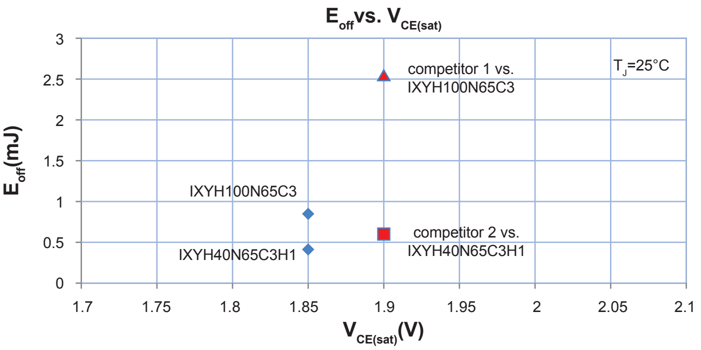
APPLICATIONS

- Battery chargers
- E-Bikes
- Lamp ballasts
- Power inverters
- Power Factor Correction (PFC) circuits
- Switched-mode power supplies
- Uninterruptible Power Supplies (UPS)
- Welding machines

Available Parts

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
IXYP15N65C3D1M	650	16	8	2.5	42	0.24	3.1	Copacked (FRED)	TO-220 (overmolded)
IXYP20N65C3D1M	650	18	9	2.5	36	0.4	3	Copacked (FRED)	TO-220 (overmolded)
IXYP10N65C3	650	30	10	2.5	38	0.15	0.94	Single	TO-220
IXYP15N65C3	650	38	15	2.5	42	0.24	0.75	Single	TO-220
IXYH20N65C3	650	50	20	2.5	36	0.4	0.65	Single	TO-247
IXYH30N65C3	650	60	30	2.7	30	0.41	0.55	Single	TO-247
IXYH30N65C3H1	650	60	30	2.7	30	0.41	0.55	Copacked (Sonic-FRD™)	TO-247
IXYT30N65C3H1HV	650	60	30	2.7	30	0.41	0.55	Copacked (Sonic-FRD™)	TO-268HV
IXYH40N65C3	650	80	40	2.2	80	0.46	0.5	Single	TO-247
IXYH40N65C3H1	650	80	40	2.2	80	0.46	0.5	Copacked (Sonic-FRD™)	TO-247
IXYA50N65C3	650	130	50	2.1	42	0.56	0.25	Single	TO-263
IXYH50N65C3	650	130	50	2.1	42	0.56	0.25	Single	TO-247
IXYH50N65C3H1	650	130	50	2.1	42	0.56	0.25	Copacked (Sonic-FRD™)	TO-247
IXYP50N65C3	650	130	50	2.1	42	0.56	0.25	Single	TO-220
IXYN100N65C3H1	650	166	90	2.3	77	1.2	0.25	Copacked (Sonic-FRD™)	SOT-227B
IXYH75N65C3	650	170	75	2.3	58	1.3	0.2	Single	TO-247
IXYH75N65C3H1	650	170	75	2.3	58	1.3	0.2	Copacked (Sonic-FRD™)	TO-247
IXYH100N65C3	650	200	100	2.3	77	1.2	0.18	Single	TO-247

Superior Trade-off: turn-off energy vs. on-stage voltage



These 650V XPT™ IGBTs are designed to achieve an optimal balance between the turn-off energy loss and on-stage voltage, especially in hard-switching applications. The graph demonstrates a superior trade-off of the new IGBTs (in particular, the IXYH100N65C3 against competitor 1 and IXYH40N65C3H1 against competitor 2).

Application Circuits

Application Circuits Legend

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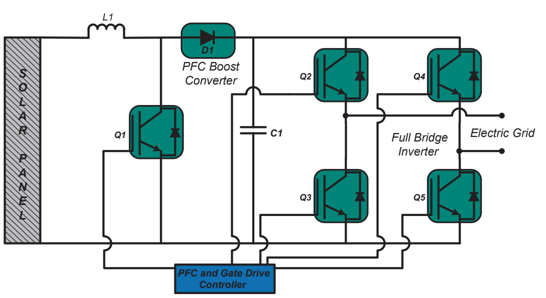

Figure 1: Solar Inverter

Figure 1 depicts a general solar inverter circuit comprised of a Power Factor Correction (PFC) boost converter and full-bridge power inverter stage. The input power from the solar panel enters the PFC converter and then the full-bridge inverter, before interfacing with the electrical grid. Five **IXYT30N65C3H1HV** XPT™ IGBTs (Q1, Q2, Q3, Q4, Q5 can be utilized to construct the inverter and PFC).

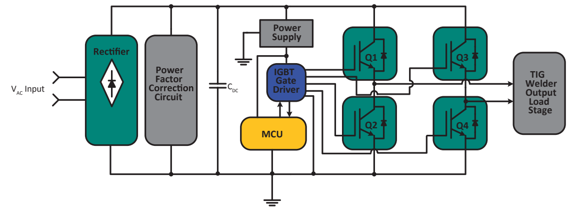

Figure 2: TIG Welding Inverter

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 **IXYH40N65C3H1** XPT™ 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.

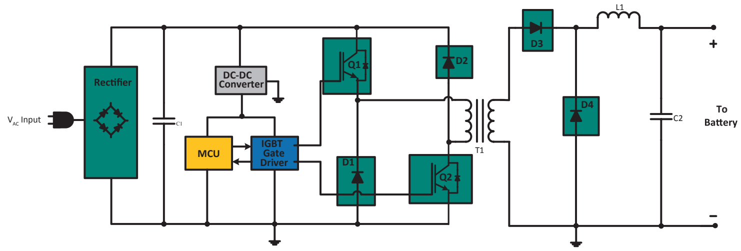

Figure 3: Battery Charger Circuit

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™ IGBTs devices, **IXYH30N65C3H1** (Q1 & Q2), form the forward converter stage of the circuit, providing a reliable and energy-efficient power conversion.