# Bidirectional Switch with NPT³ IGBT and fast Diode Bridge
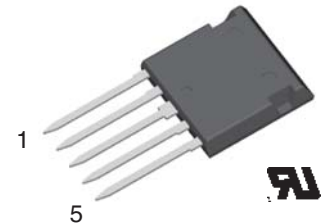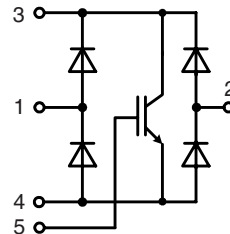
in ISOPLUS i4-PAC™

$I_{C25}$ = 50 A
$V_{CES}$ = 1200 V
$V_{CE(sat)\,typ.}$ = 2.0 V



## IGBT

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_{VJ}$ = 25°C to 150°C | 1200 | V |
| $V_{GES}$ | | ± 20 | V |
| $I_{C25}$ | $T_C$ = 25°C | 50 | A |
| $I_{C90}$ | $T_C$ = 90°C | 32 | A |
| $I_{CM}$ | $V_{GE}$ = ±15 V; $R_G$ = 39 Ω; $T_{VJ}$ = 125°C | 50 | A |
| $V_{CEK}$ | RBSOA, Clamped inductive load; L = 100 µH | $V_{CES}$ | |
| $t_{SC}$ (SCSOA) | $V_{CE}$ = 900V; $V_{GE}$ = ±15 V; $R_G$ = 39 Ω; $T_{VJ}$ = 125°C non-repetitive | 10 | µs |
| $P_{tot}$ | $T_C$ = 25°C | 200 | W |

| Symbol | Conditions | Characteristic Values ($T_{VJ}$ = 25°C, unless otherwise specified) | | | |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| $V_{CE(sat)}$ | $I_C$ = 30 A; $V_{GE}$ = 15 V; $T_{VJ}$ = 25°C | | 2.0 | 2.6 | V |
| | $T_{VJ}$ = 125°C | | 2.3 | | V |
| $V_{GE(th)}$ | $I_C$ = 1 mA; $V_{GE}$ = $V_{CE}$ | 4.5 | | 6.5 | V |
| $I_{CES}$ | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V; $T_{VJ}$ = 25°C | | | 0.4 | mA |
| | $T_{VJ}$ = 125°C | | 0.4 | | mA |
| $I_{GES}$ | $V_{CE}$ = 0 V; $V_{GE}$ = ± 20 V | | | 200 | nA |
| $t_{d(on)}$ | | | 85 | | ns |
| $t_r$ | Inductive load, $T_{VJ}$ = 125°C | | 50 | | ns |
| $t_{d(off)}$ | $V_{CE}$ = 600 V; $I_C$ = 30 A | | 440 | | ns |
| $t_f$ | $V_{GE}$ = ±15 V; $R_G$ = 39 Ω | | 50 | | ns |
| $E_{on}$ | | | 4.6 | | mJ |
| $E_{off}$ | | | 2.2 | | mJ |
| $C_{ies}$ | $V_{CE}$ = 25 V; $V_{GE}$ = 0 V; f = 1 MHz | | 2 | | nF |
| $Q_{Gon}$ | $V_{CE}$ = 600 V; $V_{GE}$ = 15 V; $I_C$ = 35 A | | 150 | | nC |
| $R_{thJC}$ | | | | 0.6 | K/W |
| $R_{thJS}$ | | | 1.2 | | K/W |

## Features

- NPT³ IGBT
  - low saturation voltage
  - positive temperature coefficient for easy paralleling
  - fast switching
  - short tail current for optimized performance in resonant circuits
- HiPerFRED™ diodes
  - fast reverse recovery
  - low operating forward voltage
  - low leakage current
- ISOPLUS i4-PAC™ package
  - isolated back surface
  - low coupling capacity between pins and heatsink
  - enlarged creepage towards heatsink
  - application friendly pinout
  - low inductive current path
  - high reliability
  - industry standard outline
  - UL registered, E 72873

## Applications

switches to control bidirectional current flow by a single control signal:
- matrix converters
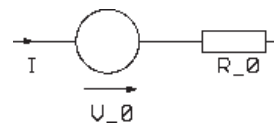- spare matrix converters
- AC controllers

## Diodes

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $I_{F25}$ | $T_C = 25°C$ | 48 | A |
| $I_{F90}$ | $T_C = 90°C$ | 25 | A |

| Symbol | Conditions | Characteristic Values | | |
|---|---|---|---|---|
| | | min. | typ. | max. |
| $V_F$ | $I_F = 30$ A; $T_{VJ} = 25°C$ | | 2.4 | 2.8 V |
| | $T_{VJ} = 125°C$ | | 1.8 | V |
| $I_{RM}$ | | | 27 | A |
| $t_{rr}$ | | | 150 | ns |
| $R_{thJC}$ | (per diode) | | | 1.3 K/W |
| $R_{thJS}$ | | | 1.6 | K/W |

## Component

| Symbol | Conditions | Maximum Ratings | |
|---|---|---|---|
| $T_{VJ}$ | | -55...+150 | °C |
| $T_{stg}$ | | -55...+125 | °C |
| $V_{ISOL}$ | $I_{ISOL} \leq 1$ mA; 50/60 Hz | 2500 | V~ |
| $F_C$ | mounting force with clip | 20...120 | N |

| Symbol | Conditions | Characteristic Values | | |
|---|---|---|---|---|
| | | min. | typ. | max. |
| $C_p$ | coupling capacity between shorted pins and mounting tab in the case | | 40 | pF |
| $d_S, d_A$ | pin - pin | 1.7 | | mm |
| $d_S, d_A$ | pin - backside metal | 5.5 | | mm |
| **Weight** | | | 9 | g |

### Equivalent Circuits for Simulation

**Conduction**



IGBT (typ. at $V_{GE}$ = 15 V; $T_J$ = 125°C)
$V_0 = 0.95$ V; $R_0 = 45$ m$\Omega$

Diode (typ. at $T_J$ = 125°C)
$V_0 = 1.26$V; $R_0 = 15$ m$\Omega$

**Thermal Response**



IGBT
$C_{th1} = 0.067$ J/K; $R_{th1} = 0.108$ K/W
$C_{th2} = 0.175$ J/K; $R_{th2} = 0.491$ K/W

Diode
$C_{th1} = 0.039$ J/K; $R_{th1} = 0.337$ K/W
$C_{th2} = 0.090$ J/K; $R_{th2} = 0.963$ K/W
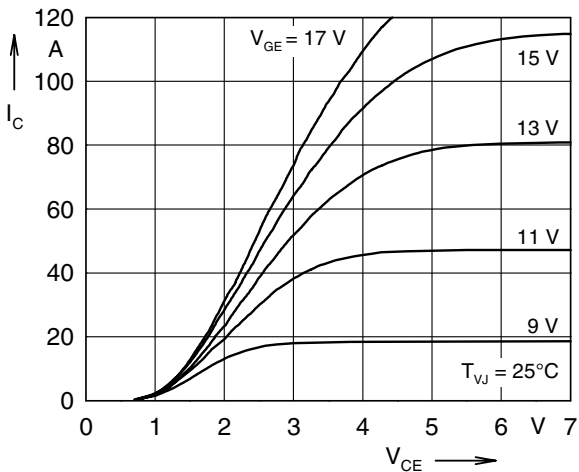
**Dimensions in mm (1 mm = 0.0394")**

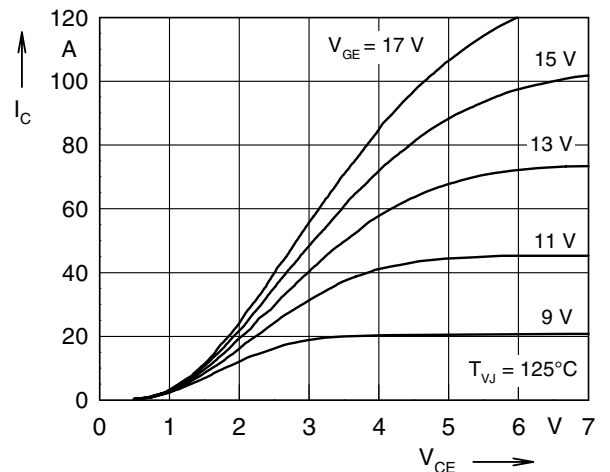Fig. 1   Typ. output characteristics



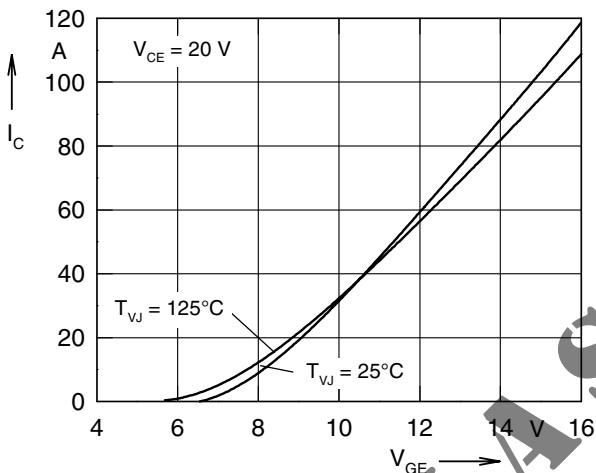Fig. 2   Typ. output characteristics



Fig. 3   Typ. transfer characteristics
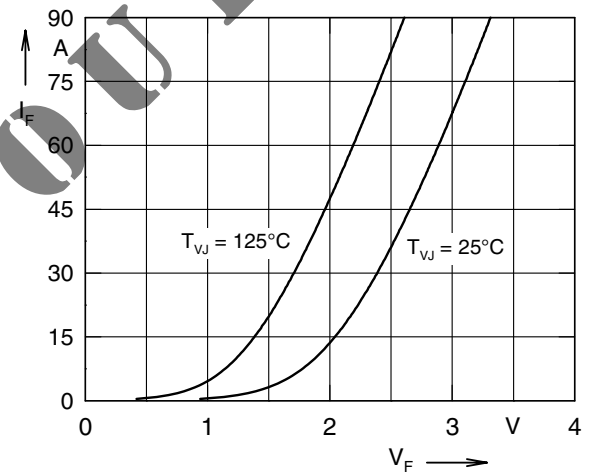


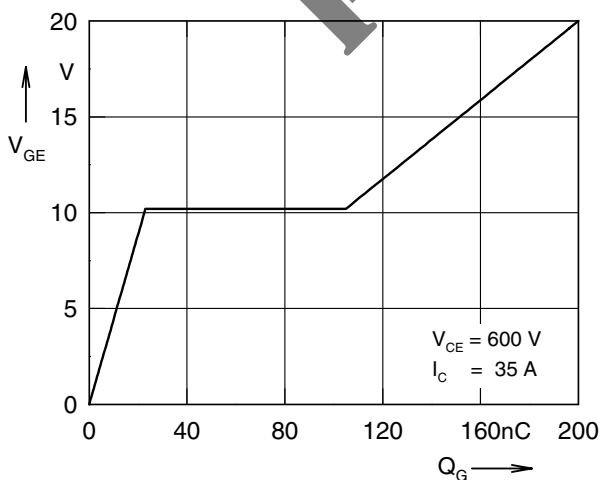Fig. 4    Typ. forward characteristics of free wheeling diode
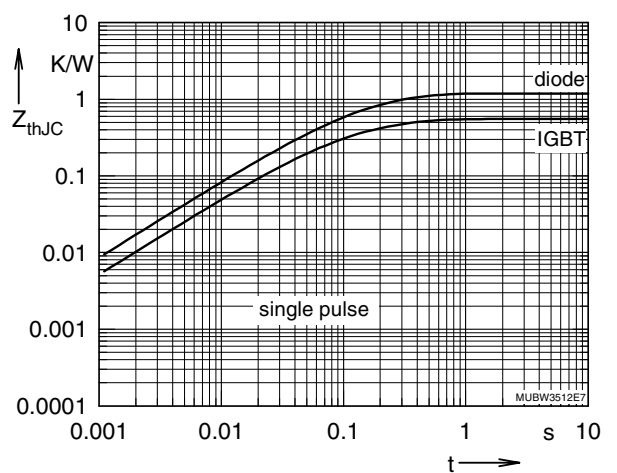


Fig. 5    Typ. turn on gate charge



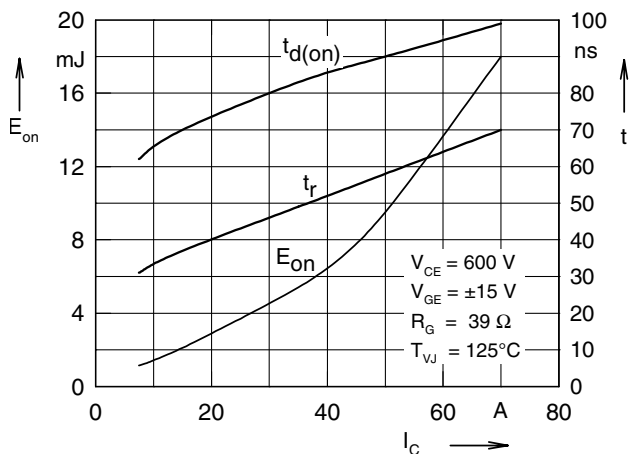Fig. 6    Typ. transient thermal impedance

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# IXYS



Fig. 7    Typ. turn on energy and switching
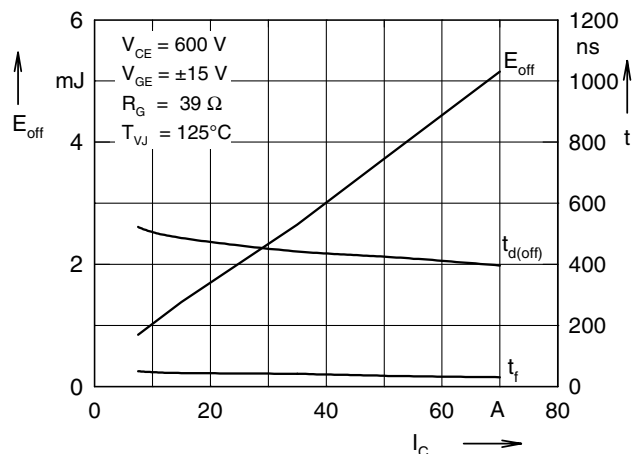times versus collector current



Fig. 8    Typ. turn off energy and switching
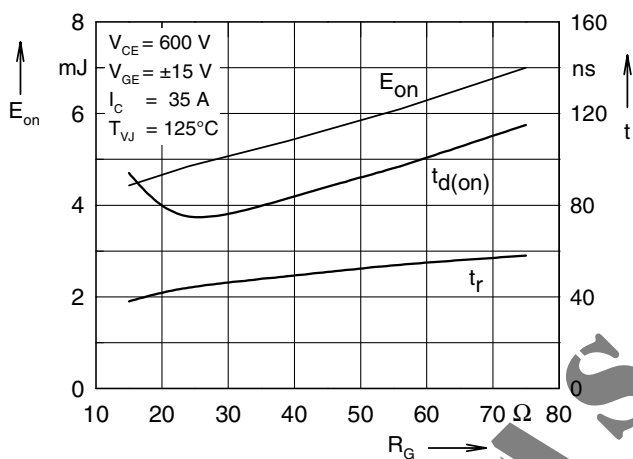times versus collector current



Fig. 9    Typ. turn on energy and switching
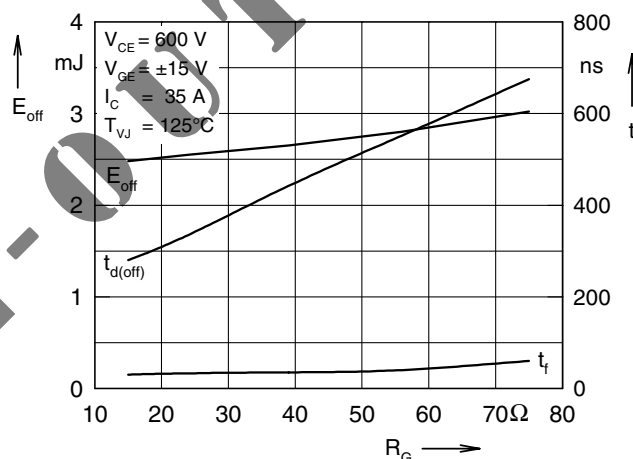times versus gate resistor



Fig.10   Typ. turn off energy and switching
times versus gate resistor

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