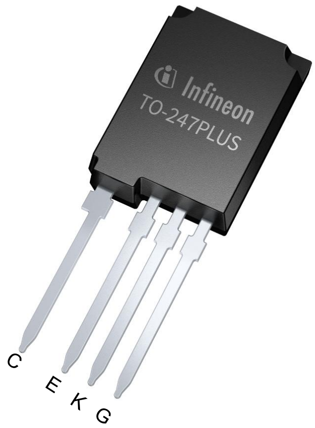
# High speed and low saturation voltage 650 V TRENCHSTOP™ IGBT7 technology copacked with soft, fast recovery Emitter Controlled 7 diode

## Features

- $V_{CE}$ = 650 V
- $I_C$ = 150 A
- Low switching losses
- Very low collector-emitter saturation voltage $V_{CEsat}$
- Very soft, fast recovery antiparallel diode
- Smooth switching behavior
- Humidity robustness
- Optimized for hard switching, two- and three-level topologies
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/




## Potential applications

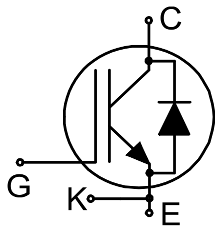
- Industrial UPS
- EV-Charging
- String inverter
- Welding

## Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Lead-free
Green
Halogen-free
RoHS

## Description




| Type | Package | Marking |
|---|---|---|
| IKY150N65EH7 | PG-TO247-4-PLUS-NN5.1 | K150EEH7 |

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# 1 Package

**Table 1 Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Internal emitter inductance measured 5 mm (0.197 in.) from case | $L_E$ | | | 13 | | nH |
| Storage temperature | $T_{stg}$ | | -55 | | 150 | °C |
| Soldering temperature | $T_{sold}$ | wave soldering 1.6 mm (0.063 in.) from case for 10 s | | | 260 | °C |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | | | | 40 | K/W |
| IGBT thermal resistance, junction-case | $R_{th(j-c)}$ | | | 0.19 | 0.24 | K/W |
| Diode thermal resistance, junction-case | $R_{th(j-c)}$ | | | 0.26 | 0.33 | K/W |

# 2 IGBT

**Table 2 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | $T_{vj} \geq 25$ °C | | 650 | V |
| DC collector current, limited by $T_{vjmax}$ | $I_C$ | limited by bondwire | $T_c = 25$ °C | 160 | A |
| | | | $T_c = 100$ °C | 160 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ | | | 600 | A |
| Turn-off safe operating area | | $V_{CE} \leq 650$ V, $t_p \leq 1$ µs, $T_{vj} \leq 175$ °C | | 600 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p \leq 10$ µs, $D < 0.01$ | | ±30 | V |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 621 | W |
| | | | $T_c = 100$ °C | 307 | |

**Table 3 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C = 150$ A, $V_{GE} = 15$ V | $T_{vj} = 25$ °C | | 1.4 | 1.65 | V |
| | | | $T_{vj} = 175$ °C | | 1.6 | | |

**(table continues...)**

**Table 3 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C$ = 1.32 mA, $V_{CE}$ = $V_{GE}$ | | 2.9 | 3.85 | 4.8 | V |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 650 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 50 | µA |
| | | | $T_{vj}$ = 175 °C | | 8600 | | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V | | | | 100 | nA |
| Transconductance | $g_{fs}$ | $I_C$ = 150 A, $V_{CE}$ = 20 V | | | 179 | | S |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 7908 | | pF |
| Output capacitance | $C_{oes}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 240.1 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 33.3 | | pF |
| Gate charge | $Q_G$ | $V_{CC}$ = 520 V, $I_C$ = 150 A, $V_{GE}$ = 15 V | | | 300 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 44 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 41 | | |
| Rise time (inductive load) | $t_r$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 22 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 31 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 343 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 383 | | |
| Fall time (inductive load) | $t_f$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 24 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 28 | | |
| Turn-on energy | $E_{on}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 2.3 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 3.6 | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 2.9 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 3.9 | | |

**(table continues...)**

**Table 3 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Total switching energy | $E_{ts}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 10 Ω, $R_{G(off)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_C$ = 150 A | | 5.2 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 150 A | | 7.5 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

## 3 Diode

**Table 4 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | limited by bondwire | $T_c$ = 25 °C | 160 | A |
| | | | $T_c$ = 100 °C | 153 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpulse}$ | | | 600 | A |
| Power dissipation | $P_{tot}$ | | $T_c$ = 25 °C | 454 | W |
| | | | $T_c$ = 100 °C | 226 | |

**Table 5 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F$ = 150 A | $T_{vj}$ = 25 °C | | 1.65 | 2 | V |
| | | | $T_{vj}$ = 175 °C | | 1.55 | | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 400 V, $R_{G(on)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_F$ = 150 A | | 65 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 150 A | | 127 | | |
| Diode reverse recovery charge | $Q_{rr}$ | $V_R$ = 400 V, $R_{G(on)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_F$ = 150 A | | 3.7 | | µC |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 150 A | | 10.4 | | |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R$ = 400 V, $R_{G(on)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_F$ = 150 A | | 100 | | A |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 150 A | | 146 | | |

**(table continues...)**

**Table 5 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $V_R$ = 400 V, $R_{G(on)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_F$ = 150 A | | -2790 | | A/µs |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 150 A | | -2080 | | |
| Reverse recovery energy | $E_{rec}$ | $V_R$ = 400 V, $R_{G(on)}$ = 10 Ω | $T_{vj}$ = 25 °C, $I_F$ = 150 A | | 0.89 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 150 A | | 2.84 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

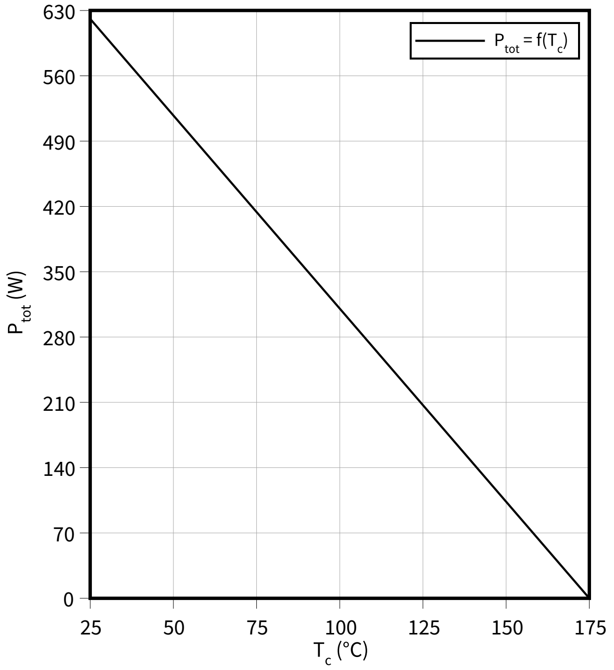
*Note:* *For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

*Electrical Characteristic at $T_{vj}$ = 25°C, unless otherwise specified.*

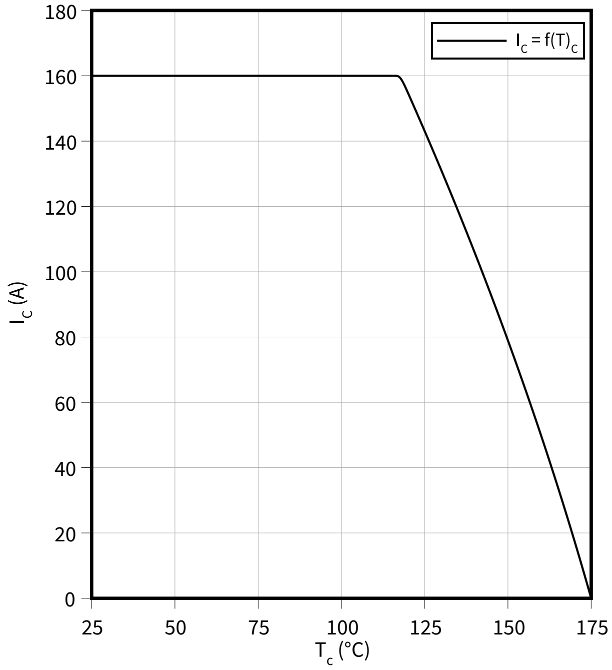
*Dynamic test circuit, parasitic inductance $L_\sigma$ = 8 nH, parasitic capacitor $C_\sigma$ = 30 pF from Fig. E. Energy losses include “tail” and diode reverse recovery.*

# 4 Characteristics diagrams

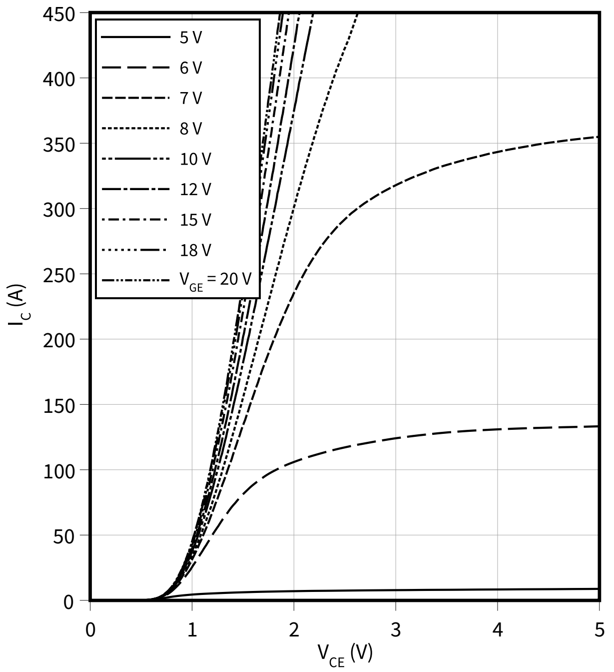
**Power dissipation as a function of case temperature**
$P_{tot} = f(T_c)$
$T_{vj} \leq 175\ °C$



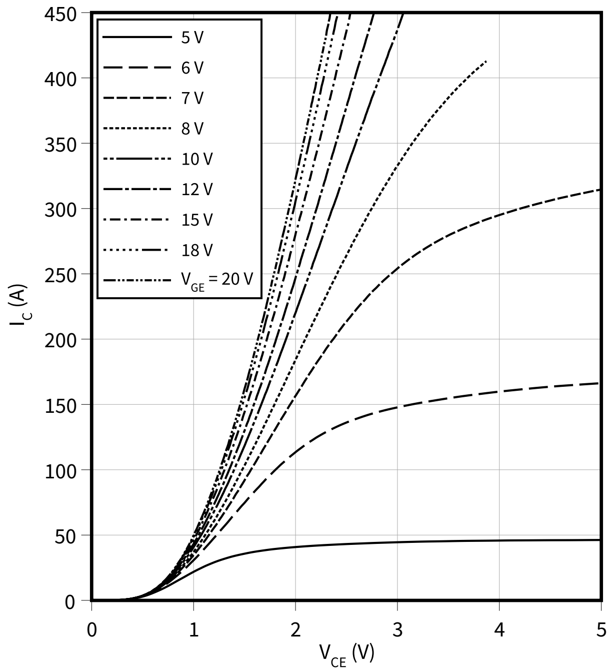

**Collector current as a function of case temperature**
$I_C = f(T_c)$
$V_{GE} \geq 15\ V$, $T_{vj} \leq 175\ °C$




**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$



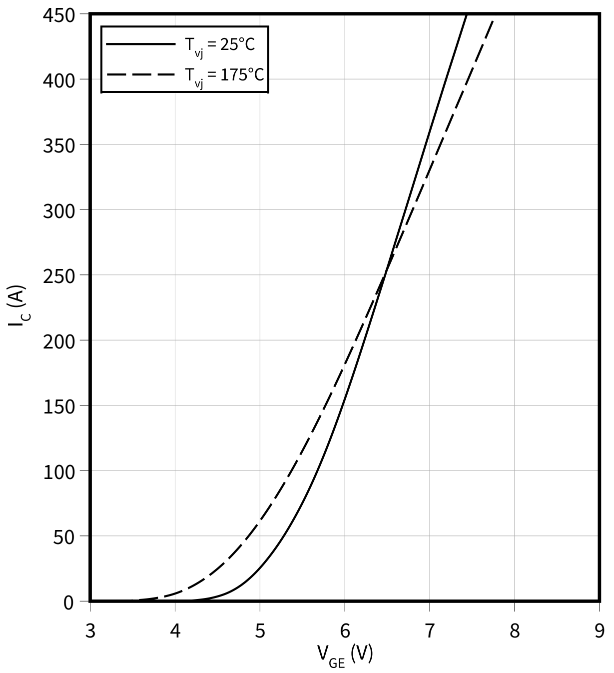

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



**Typical transfer characteristic**

$I_C = f(V_{GE})$

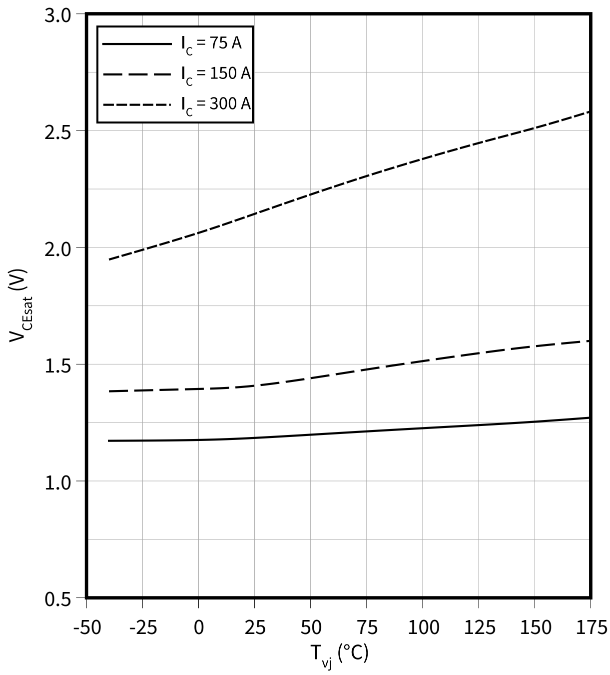
$V_{CE} = 20$ V




**Typical collector-emitter saturation voltage as a function of junction temperature**

$V_{CEsat} = f(T_{vj})$

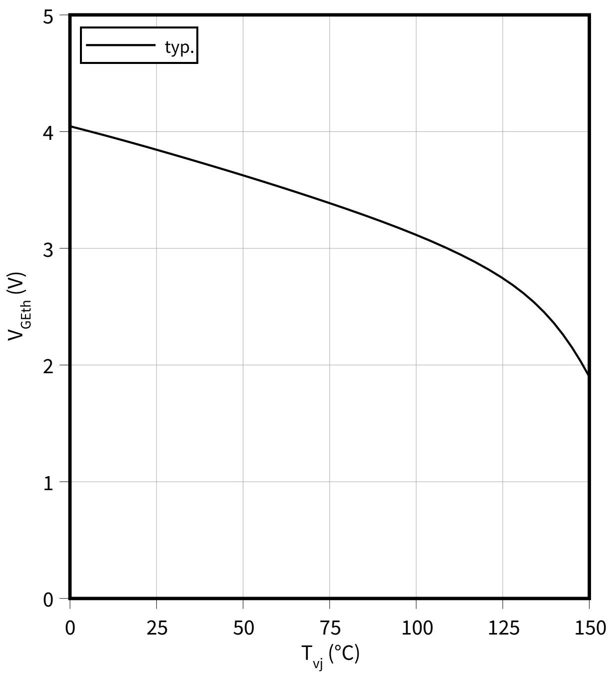
$V_{GE} = 15$ V




**Gate-emitter threshold voltage as a function of junction temperature**

$V_{GEth} = f(T_{vj})$

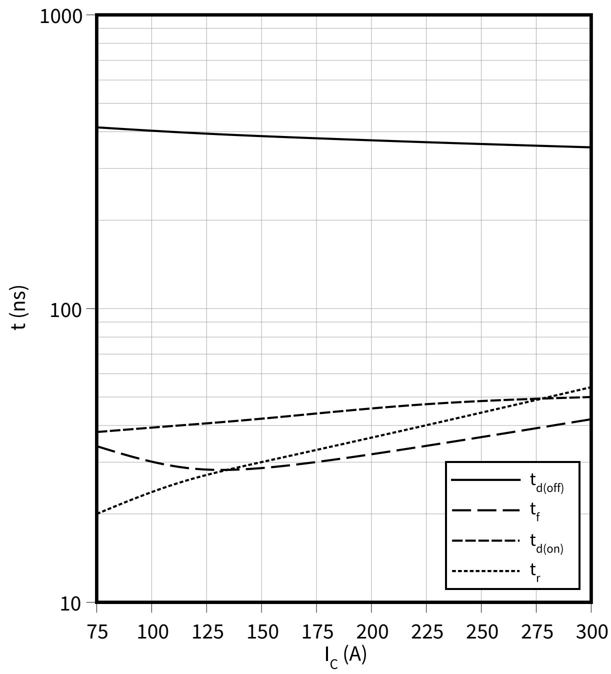
$I_C = 1.32$ mA




**Typical switching times as a function of collector current**

$t = f(I_C)$

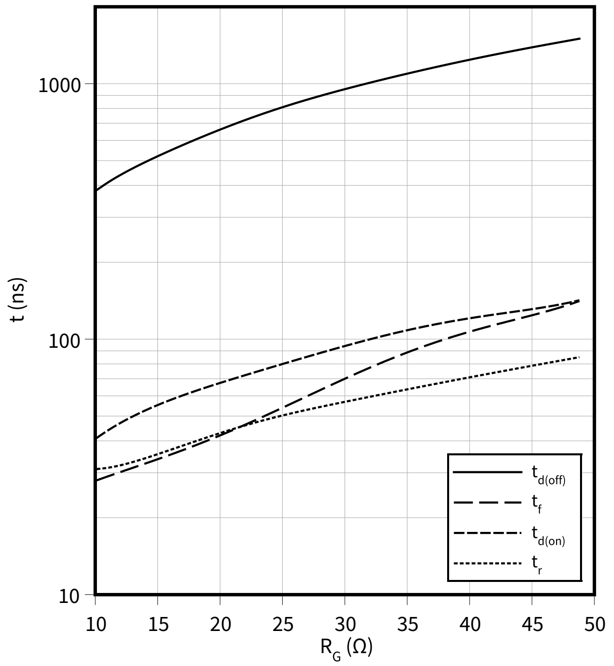
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 10\ \Omega$



**Typical switching times as a function of gate resistor**

$t = f(R_G)$

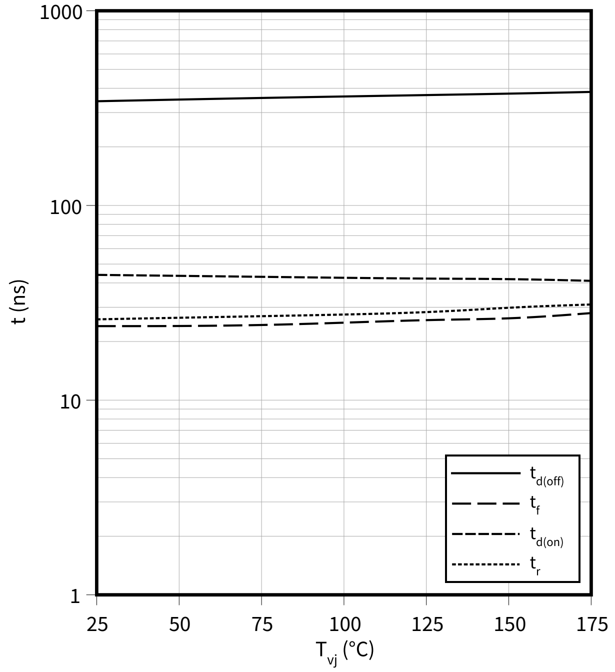
$I_C$ = 150 A, $V_{CC}$ = 400 V, $T_{vj}$ = 175 °C, $V_{GE}$ = 0/15 V




**Typical switching times as a function of junction temperature**

$t = f(T_{vj})$

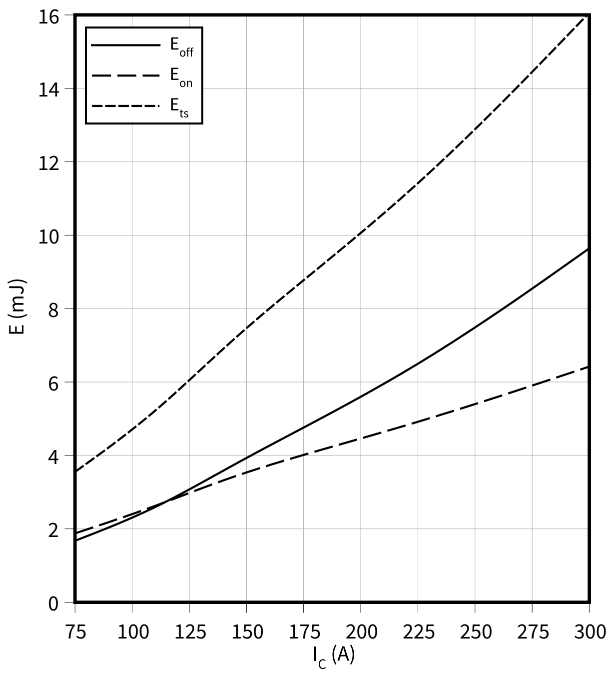
$I_C$ = 150 A, $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_G$ = 10 Ω




**Typical switching energy losses as a function of collector current**

$E = f(I_C)$

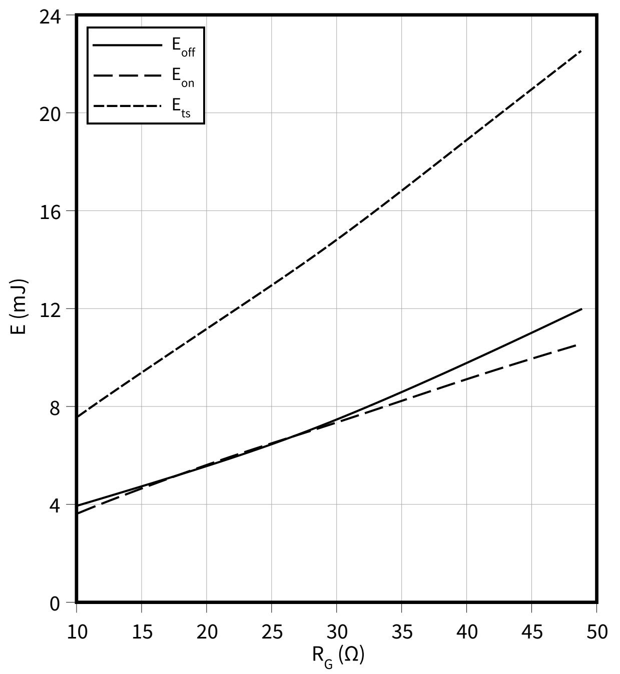
$V_{CC}$ = 400 V, $T_{vj}$ = 175 °C, $V_{GE}$ = 0/15 V, $R_G$ = 10 Ω




**Typical switching energy losses as a function of gate resistor**

$E = f(R_G)$

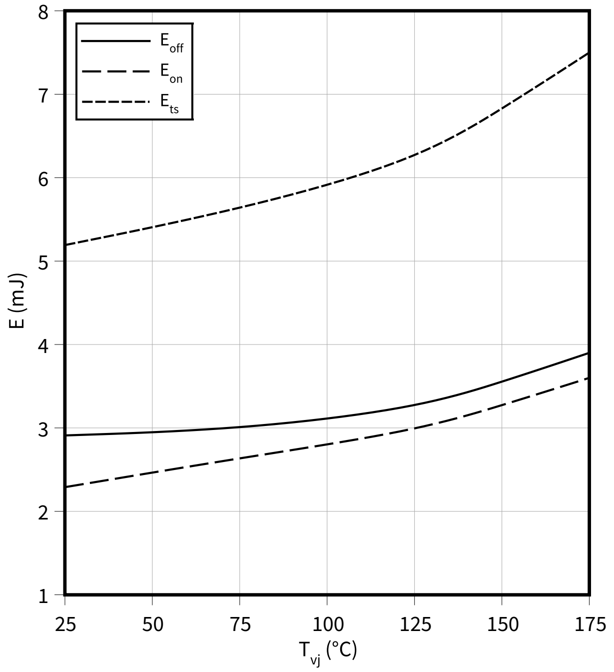
$I_C$ = 150 A, $V_{CC}$ = 400 V, $T_{vj}$ = 175 °C, $V_{GE}$ = 0/15 V



**Typical switching energy losses as a function of junction temperature**

$E = f(T_{vj})$

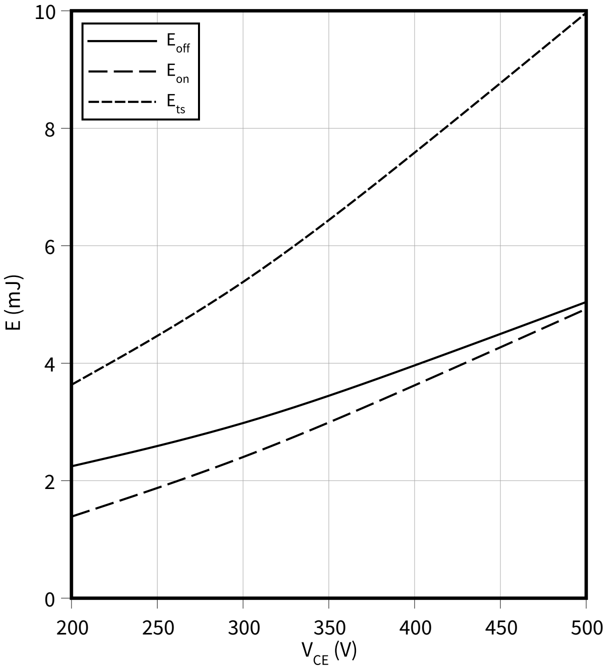
$I_C$ = 150 A, $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_G$ = 10 Ω




**Typical switching energy losses as a function of collector emitter voltage**

$E = f(V_{CE})$

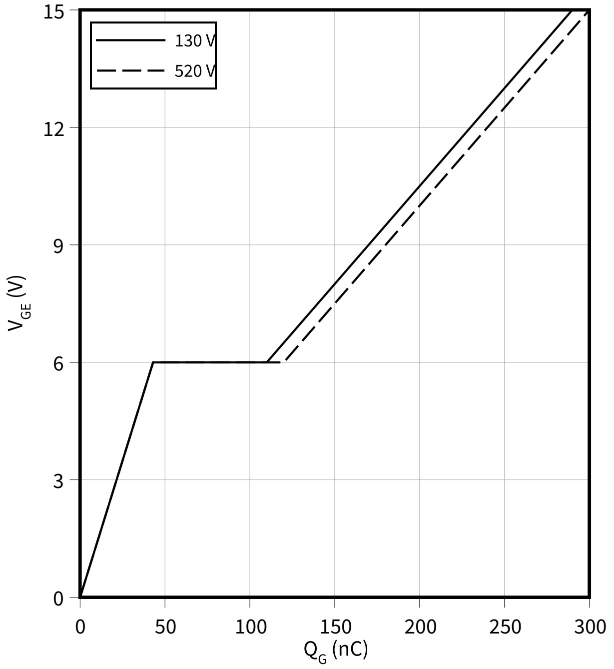
$I_C$ = 150 A, $T_{vj}$ = 175 °C, $V_{GE}$ = 0/15 V, $R_G$ = 10 Ω




**Typical gate charge**

$V_{GE} = f(Q_G)$

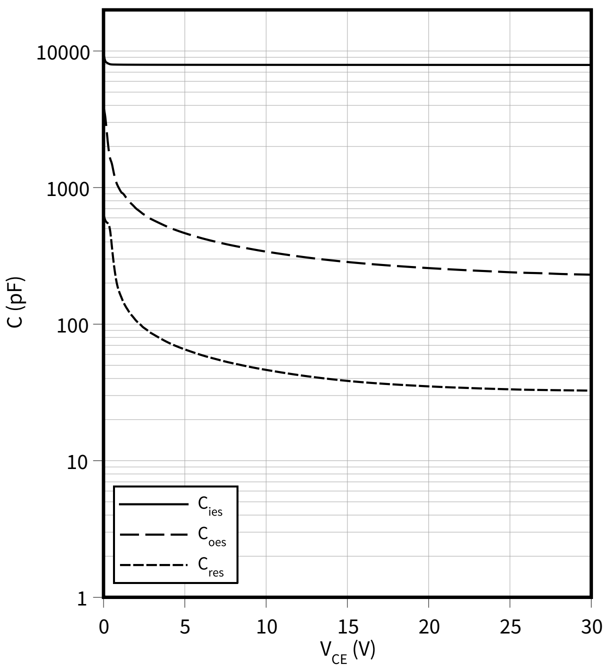
$I_C$ = 150 A




**Typical capacitance as a function of collector-emitter voltage**

$C = f(V_{CE})$

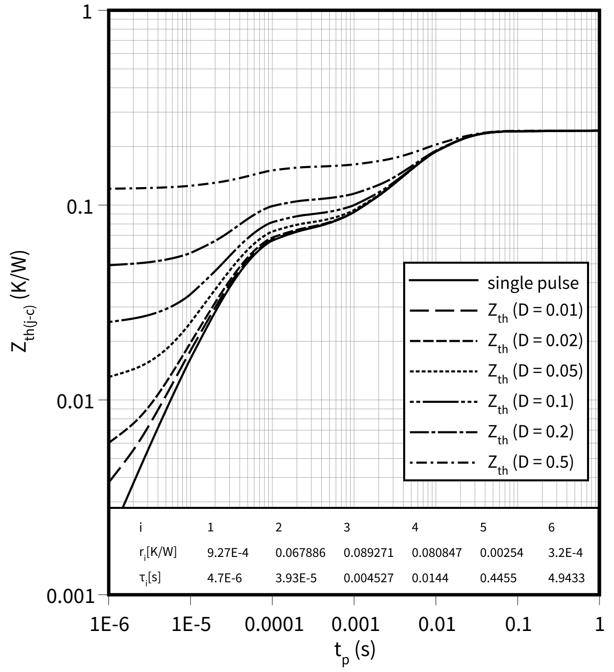
f = 100 kHz, $V_{GE}$ = 0 V



## IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$

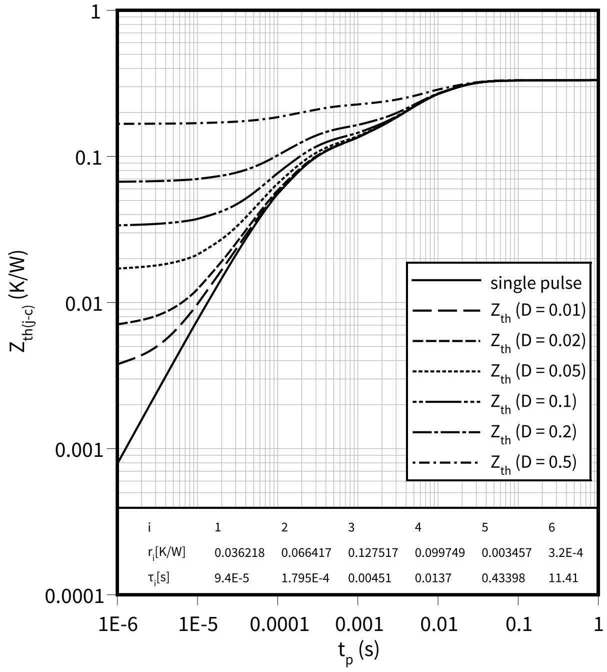
$D = t_p/T$




## Diode transient thermal impedance as a function of pulse width

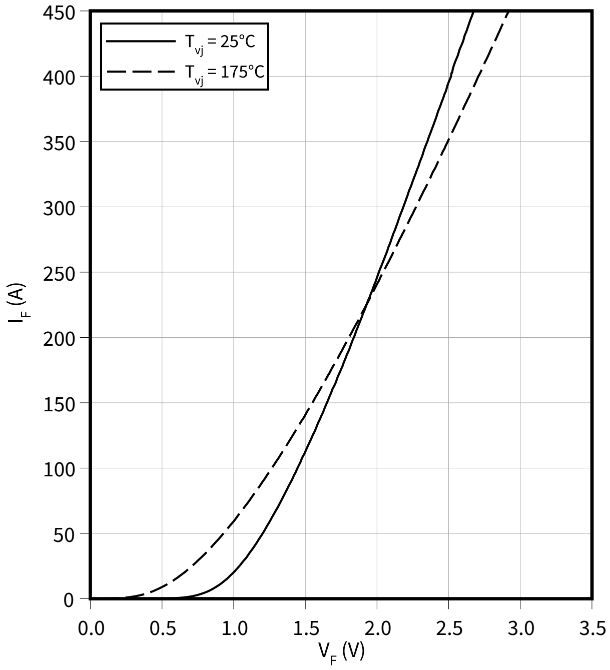
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



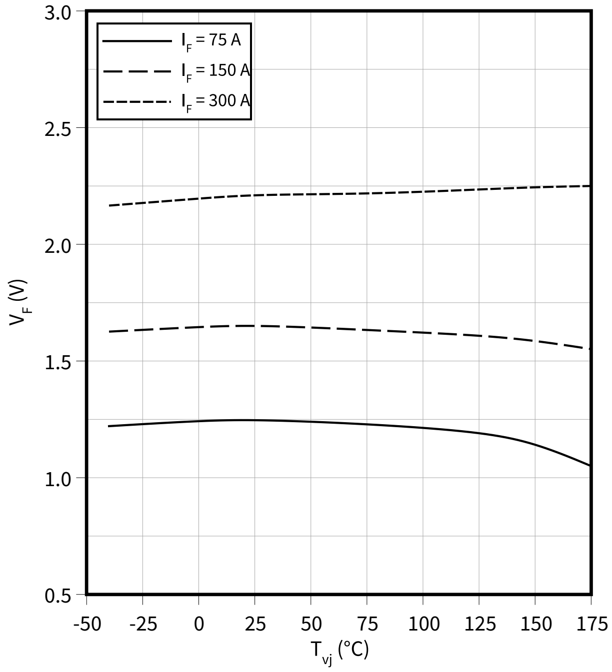

## Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$




## Typical diode forward voltage as a function of junction temperature

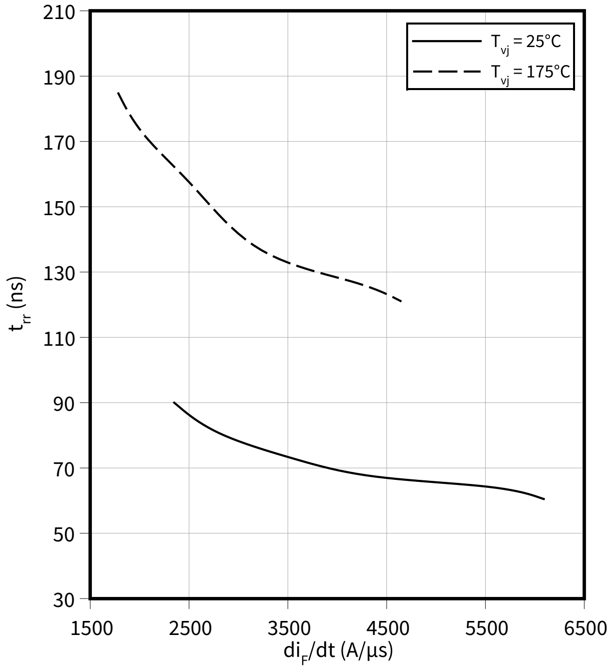
$V_F = f(T_{vj})$



### Typical reverse recovery time as a function of diode current slope

$t_{rr} = f(di_F/dt)$

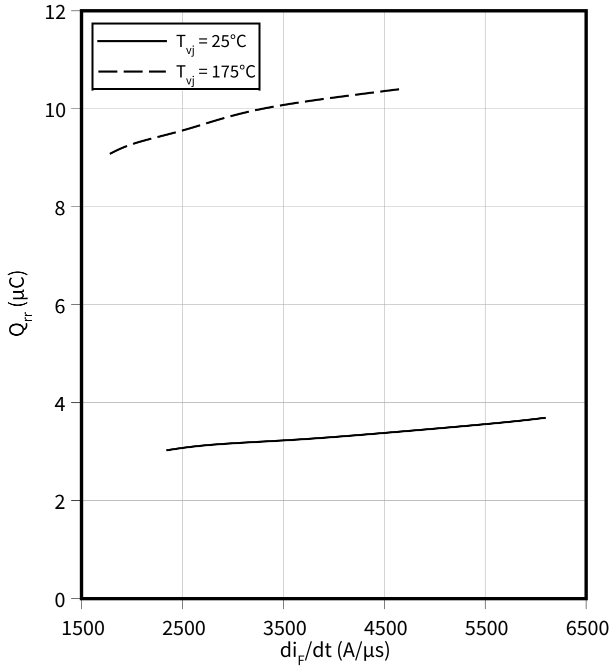
$V_R = 400$ V, $I_F = 150$ A




### Typical reverse recovery charge as a function of diode current slope

$Q_{rr} = f(di_F/dt)$

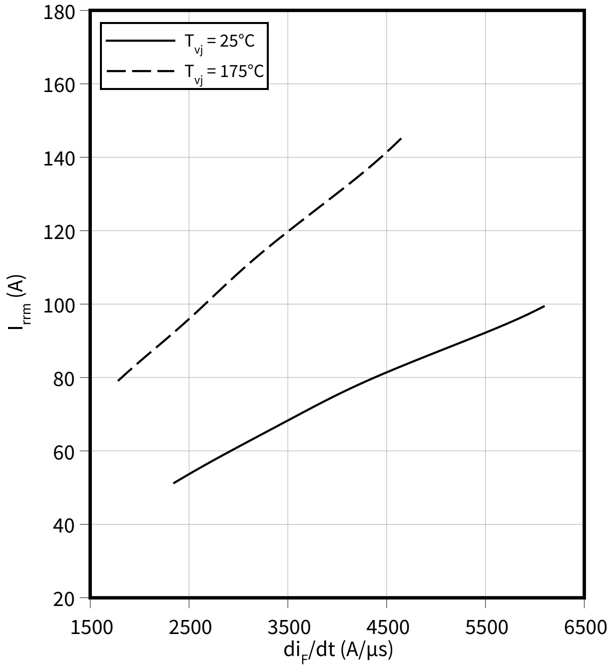
$V_R = 400$ V, $I_F = 150$ A




### Typical reverse recovery current as a function of diode current slope

$I_{rrm} = f(di_F/dt)$

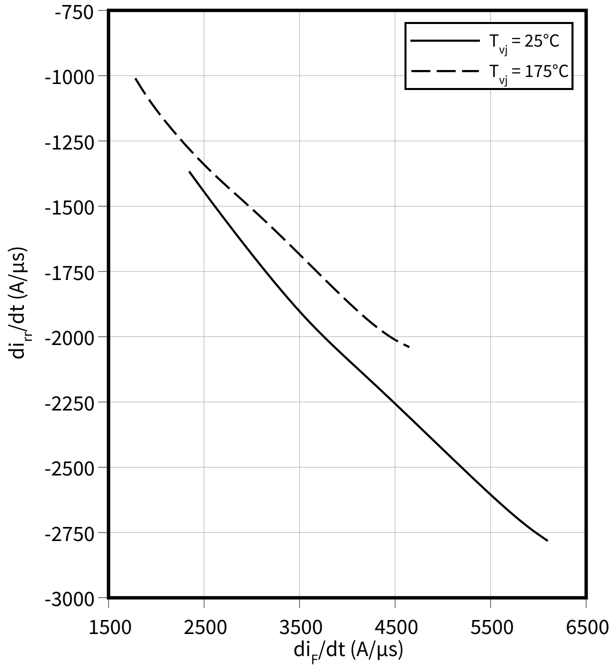
$V_R = 400$ V, $I_F = 150$ A




### Typical diode peak rate of fall of reverse recovery current as a function of diode current slope

$di_{rr}/dt = f(di_F/dt)$

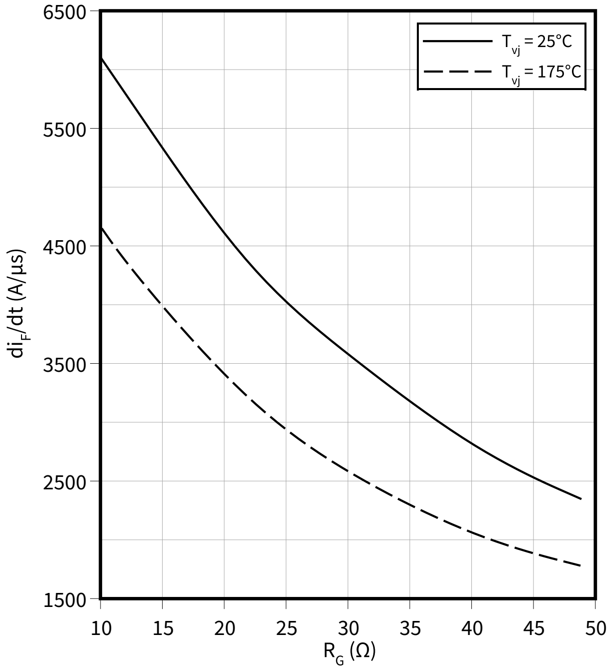
$V_R = 400$ V, $I_F = 150$ A



**Typical diode current slope as a function of gate resistor**

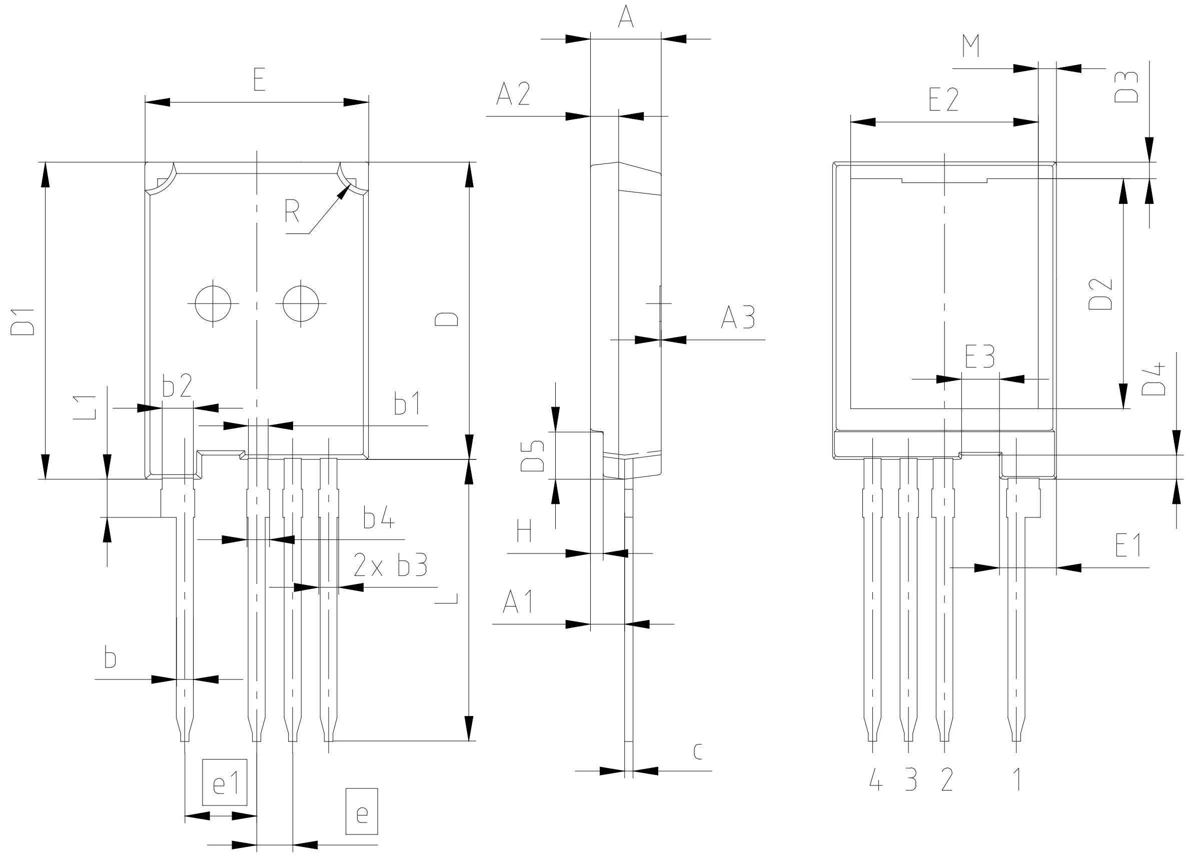
$di_F/dt = f(R_G)$

$V_R$ = 400 V, $I_F$ = 150 A



# 5 Package outlines

**PG-TO247-4-PLUS-NN5.1**




NOTES:
PACKAGE SURFACE ROUTE BETWEEN PIN 1 & PIN 2 WILL BE 5.1 mm MIN.
ALL b... AND c DIMENSIONS INCLUDING PLATING EXPECT AREA OF CUTTING

PACKAGE - GROUP NUMBER: **PG-TO247-4-U10**

| DIMENSIONS | MILLIMETERS | | DIMENSIONS | MILLIMETERS | |
|---|---|---|---|---|---|
| | MIN. | MAX. | | MIN. | MAX. |
| **A** | 4.90 | 5.10 | **E** | 15.70 | 15.90 |
| **A1** | 2.31 | 2.51 | **E1** | 3.90 | 4.10 |
| **A2** | 1.90 | 2.10 | **E2** | 13.10 | 13.50 |
| **b** | 1.16 | 1.29 | **E3** | 2.58 | 2.78 |
| **b1** | 1.36 | 1.49 | **e** | 2.54 | |
| **b2** | 2.16 | 2.29 | **e1** | 5.08 | |
| **b3** | 1.16 | 1.45 | **H** | 0.80 | 1.00 |
| **b4** | 1.16 | 1.65 | **N** | 4 | |
| **c** | 0.59 | 0.66 | **L** | 19.80 | 20.10 |
| **D** | 20.90 | 21.10 | **L1** | 2.55 | 2.85 |
| **D1** | 22.30 | 22.50 | **M** | 0.97 | 1.57 |
| **D2** | 15.95 | 16.55 | **R** | 1.90 | 2.10 |
| **D3** | 1.00 | 1.35 | | | |
| **D4** | 1.60 | 1.80 | | | |
| **D5** | 3.24 | 3.44 | | | |

**Figure 1**

# 6 Testing conditions

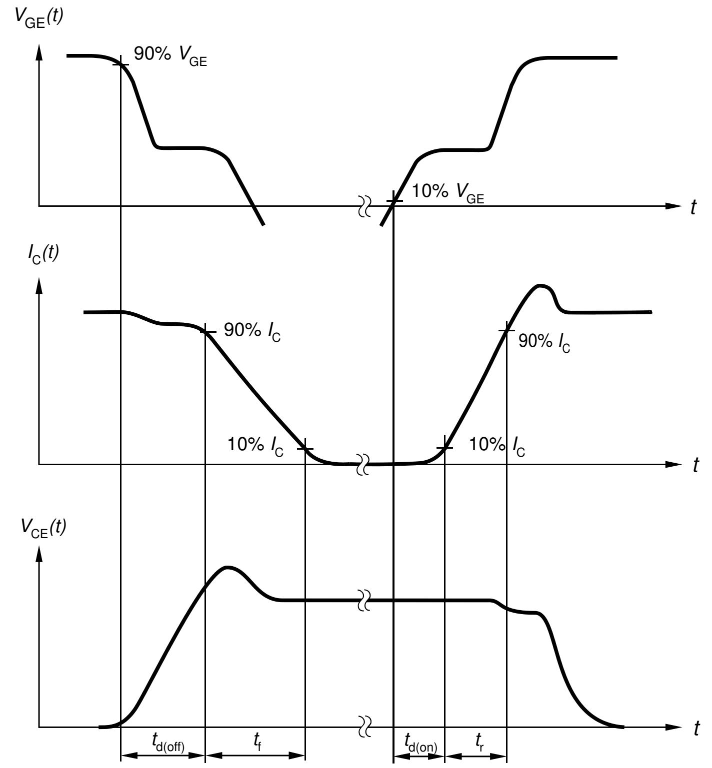



Figure A. **Definition of switching times**

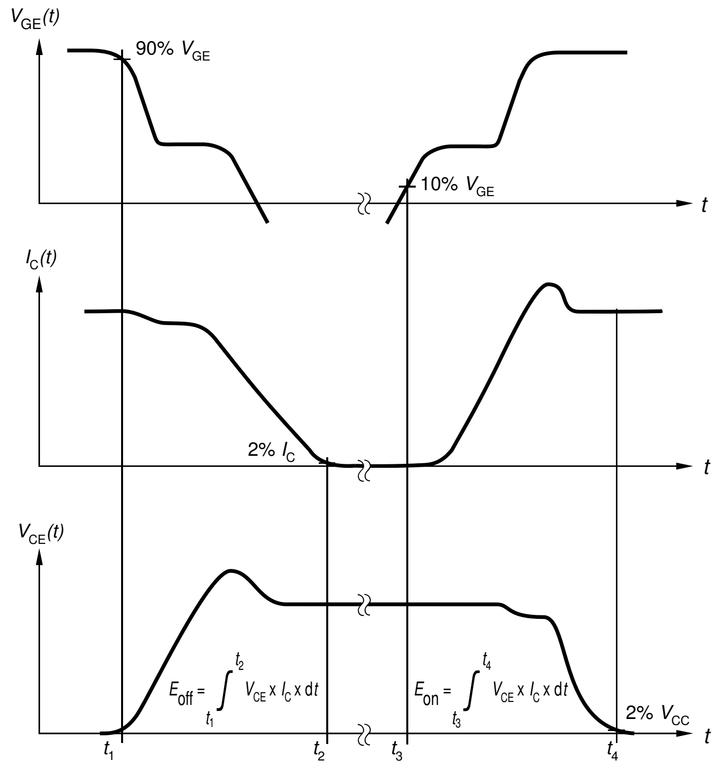



Figure B. **Definition of switching losses**

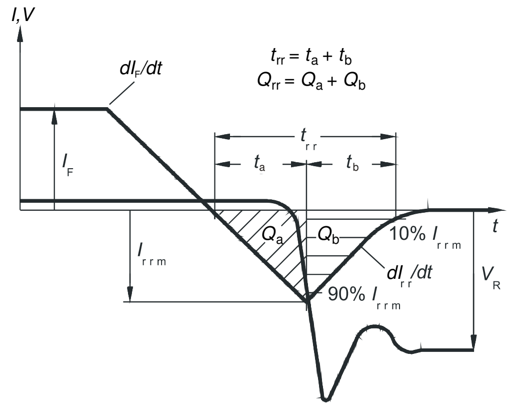



Figure C. **Definition of diode switching characteristics**

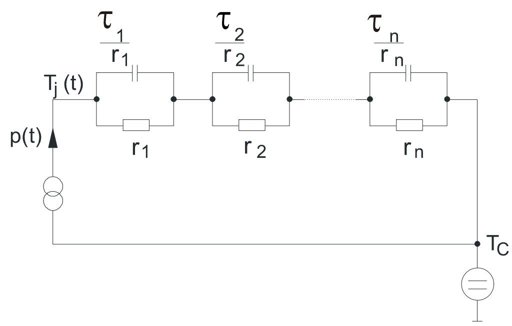



Figure D. **Thermal equivalent circuit**

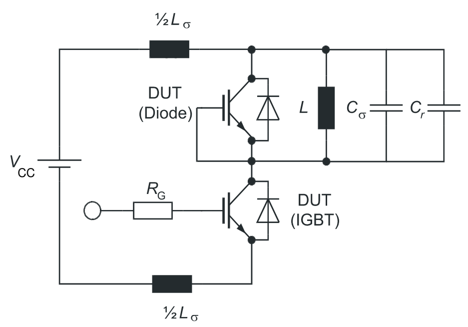



Figure E. **Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

**Figure 2**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| 1.00 | 2023-04-27 | Final datasheet |

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