## Low loss Duopack: IGBT 7 with Trench and Fieldstop technology

Lead-free
Green
Halogen-free
RoHS

### Features

- $V_{CE}$ = 650 V
- $I_C$ = 75 A
- Very low $V_{CE,sat}$
- Low turn-off losses
- Short tail current
- Reduced EMI
- Very soft, fast recovery antiparallel diode
- Maximum junction temperature $T_{vjmax}$ = 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt7/

### Potential applications

- Servo drives
- General purpose drives (GPD)
- Industrial UPS
- Industrial SMPS
- Solar optimizer
- Solar string inverter

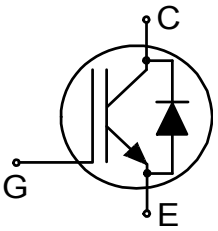
### Product validation

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

### Description

Package pin definition:

- Pin C & backside - Collector
- Pin E - Emitter
- Pin G - Gate




| Type | Package | Marking |
|---|---|---|
| IKW75N65ET7 | PG-TO247-3 | K75EET7 |

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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 |
| Mounting torque | $M$ | M3 screw, Maximum of mounting processes: 3 | | | 0.6 | Nm |
| Thermal resistance, junction-ambient | $R_{th(j-a)}$ | | | | 40 | K/W |
| IGBT thermal resistance, junction-case | $R_{th(j-c)}$ | | | | 0.45 | K/W |
| Diode thermal resistance, junction-case | $R_{th(j-c)}$ | | | | 0.6 | 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 | 80 | A |
| | | | $T_c = 100$ °C | 78.5 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ [1)] | $I_{Cpulse}$ | | | 225 | A |
| Turn-off safe operating area[2)] | | $V_{CE} \leq 650$ V, $t_p = 1$ µs, $T_{vj} \leq 175$ °C | | 225 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p \leq 10$ µs, $D < 0.01$ | | ±30 | V |
| Short-circuit withstand time | $t_{SC}$ | $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s | $V_{CC} \leq 330$ V, $T_{vj} = 100$ °C | 5 | µs |
| | | | $V_{CC} \leq 400$ V, $T_{vj} = 150$ °C | 3 | |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 333 | W |
| | | | $T_c = 100$ °C | 167 | |

1) Defined by design. Not subject to production test.
2) Clamped inductive load current test for each device, $I_C = 225$ A, $V_{CC} = 400$ V, $T_c = 25$°C, $V_{GE} = 20$ V, L = 80 µH, $R_G = 10\ \Omega$

**Table 3** **Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C$ = 75 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25 °C | | 1.35 | 1.65 | V |
| | | | $T_{vj}$ = 125 °C | | 1.5 | | |
| | | | $T_{vj}$ = 175 °C | | 1.6 | | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C$ = 0.75 mA, $V_{CE}$ = $V_{GE}$ | | 4.3 | 5 | 5.7 | V |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 650 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 40 | µA |
| | | | $T_{vj}$ = 175 °C | | 1200 | | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V | | | | 100 | nA |
| Transconductance | $g_{fs}$ | $I_C$ = 75 A, $V_{CE}$ = 20 V | | | 40 | | S |
| Short-circuit collector current | $I_{SC}$ | $V_{CC}$ ≤ 400 V, $V_{GE}$ = 15 V, $t_{SC}$ ≤ 3 µs, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj}$ = 150 °C | | | 350 | | A |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1000 kHz | | | 4460 | | pF |
| Output capacitance | $C_{oes}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1000 kHz | | | 135 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1000 kHz | | | 46 | | pF |
| Gate charge | $Q_G$ | $I_C$ = 75 A, $V_{GE}$ = 15 V, $V_{CC}$ = 520 V | | | 435 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_\sigma$ = 32 nH, $C_\sigma$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 28 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 26 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 31 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 28 | | |
| Rise time (inductive load) | $t_r$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_\sigma$ = 32 nH, $C_\sigma$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 25 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 13 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 30 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 18 | | |

**(table continues...)**

**Table 3** **(continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_{\sigma}$ = 32 nH, $C_{\sigma}$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 310 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 330 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 365 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 415 | | |
| Fall time (inductive load) | $t_f$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_{\sigma}$ = 32 nH, $C_{\sigma}$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 15 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 11 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 25 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 20 | | |
| Turn-on energy | $E_{on}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_{\sigma}$ = 32 nH, $C_{\sigma}$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 2.17 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 0.79 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 3.45 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 1.52 | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_{\sigma}$ = 32 nH, $C_{\sigma}$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 1.23 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 0.56 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 2.05 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 1.11 | | |

**(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, $R_{G(on)}$ = 4.7 Ω, $R_{G(off)}$ = 4.7 Ω, $L_{\sigma}$ = 32 nH, $C_{\sigma}$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 75 A | | 3.4 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 1.35 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 75 A | | 5.5 | | |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 37.5 A | | 2.63 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

# 3 Diode

**Table 4** **Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Repetitive peak reverse voltage | $V_{RRM}$ | $T_{vj}$ ≥ 25 °C | | 650 | V |
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | limited by bondwire | $T_c$ = 25 °C | 80 | A |
| | | | $T_c$ = 100 °C | 74 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ [1)] | $I_{Fpulse}$ | | | 225 | A |

*1)* Defined by design. Not subject to production test.

**Table 5** **Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F$ = 75 A | $T_{vj}$ = 25 °C | | 1.65 | 2 | V |
| | | | $T_{vj}$ = 125 °C | | 1.6 | | |
| | | | $T_{vj}$ = 175 °C | | 1.55 | | |

**(table continues...)**

**Table 5 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 400 V | $T_{vj}$ = 25 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 100 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2725 A/µs | | 70 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 155 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2260 A/µs | | 125 | | |
| Diode reverse recovery charge | $Q_{rr}$ | $V_R$ = 400 V | $T_{vj}$ = 25 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 1.5 | | µC |
| | | | $T_{vj}$ = 25 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2725 A/µs | | 1.15 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 4.4 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2260 A/µs | | 3.36 | | |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R$ = 400 V | $T_{vj}$ = 25 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 22 | | A |
| | | | $T_{vj}$ = 25 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2725 A/µs | | 34 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 41 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2260 A/µs | | 43 | | |

**(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 | $T_{vj}$ = 25 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 480 | | A/µs |
| | | | $T_{vj}$ = 25 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2725 A/µs | | 600 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 75 A, $-di_F/dt$ = 1650 A/µs | | 590 | | |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 37.5 A, $-di_F/dt$ = 2260 A/µs | | 500 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

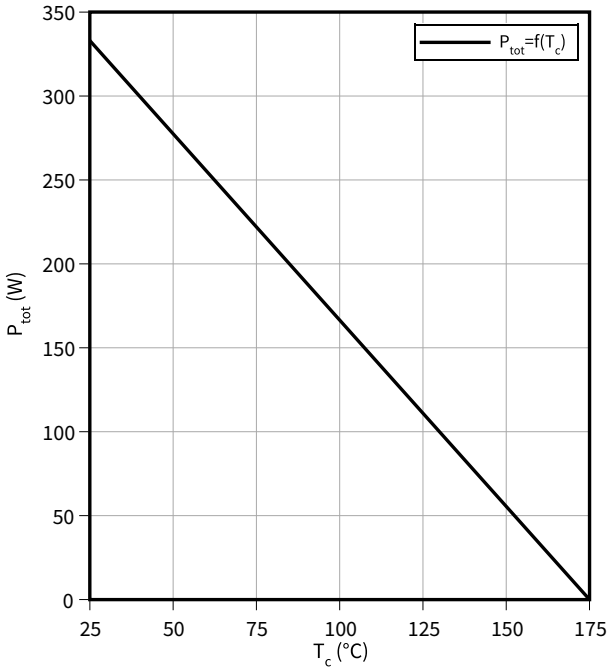
*Note:* *Maximum rated values: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

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

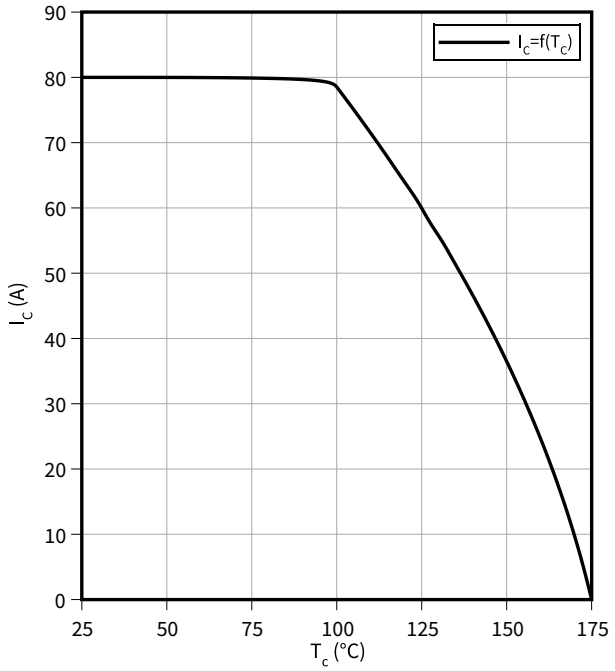
*Dynamic test circuit, $L_\sigma$, $C_\sigma$ from Fig. E. Energy losses include "tail" and diode reverse recovery.*

# 4 Characteristics diagrams

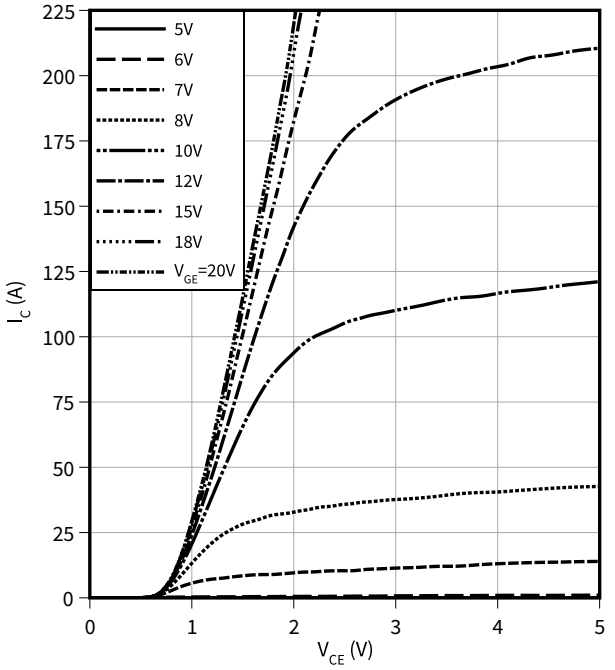
**Power dissipation as a function of case temperature**
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



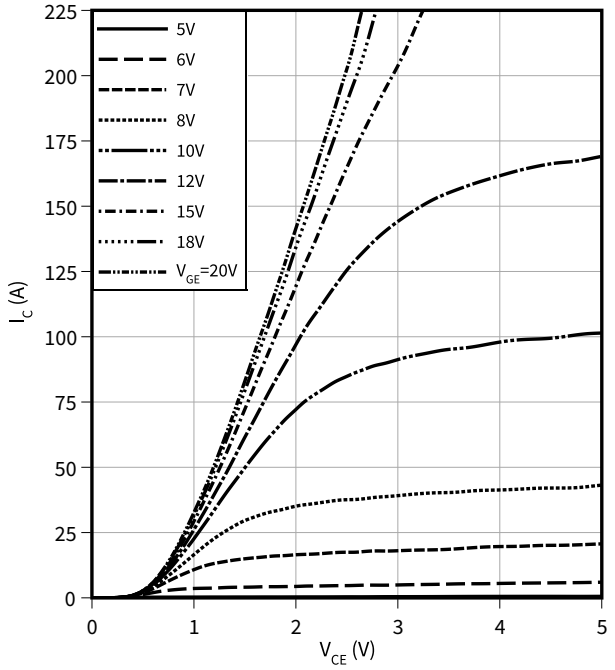

**Collector current as a function of case temperature**
$I_C = f(T_c)$
$T_{vj} \leq 175$ °C, $V_{GE} \geq 15$ V




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

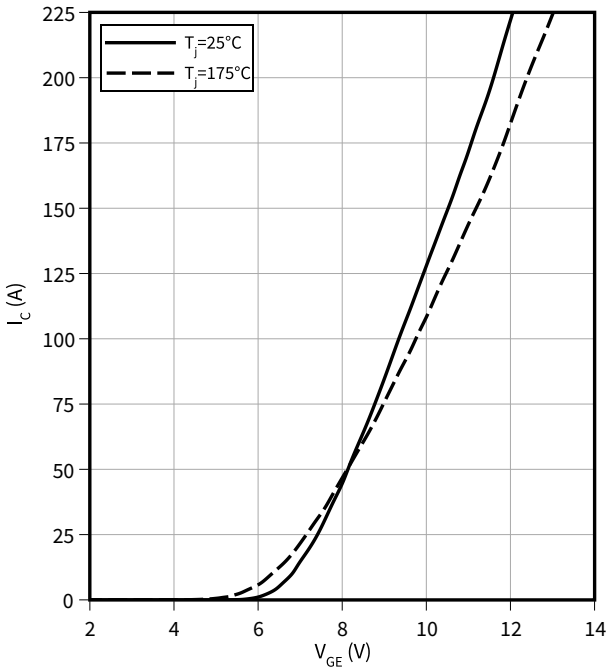



**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



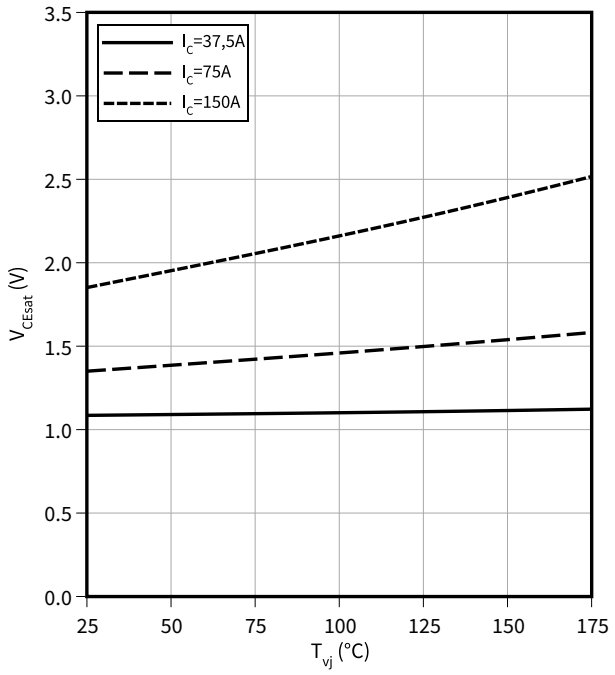
### Typical transfer characteristic

$I_C = f(V_{GE})$
$V_{CE} = 20$ V



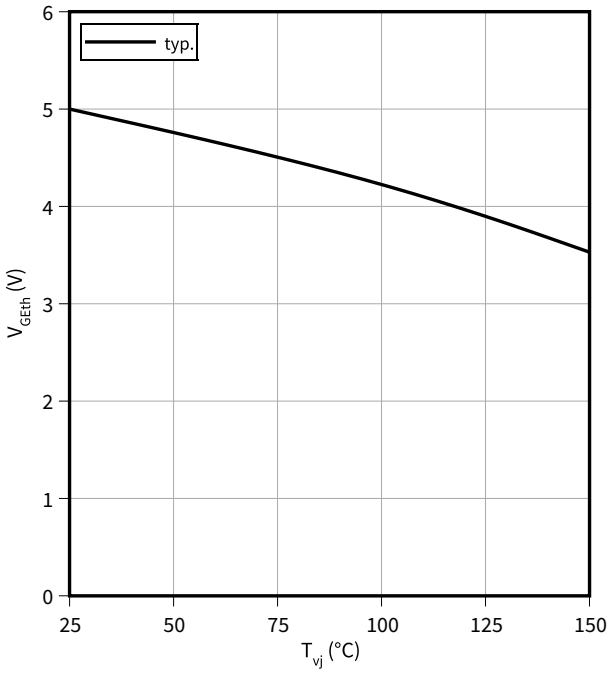

### Typical collector-emitter saturation voltage as a function of junction temperature

$V_{CEsat} = f(T_{vj})$
$V_{GE} = 15$ V



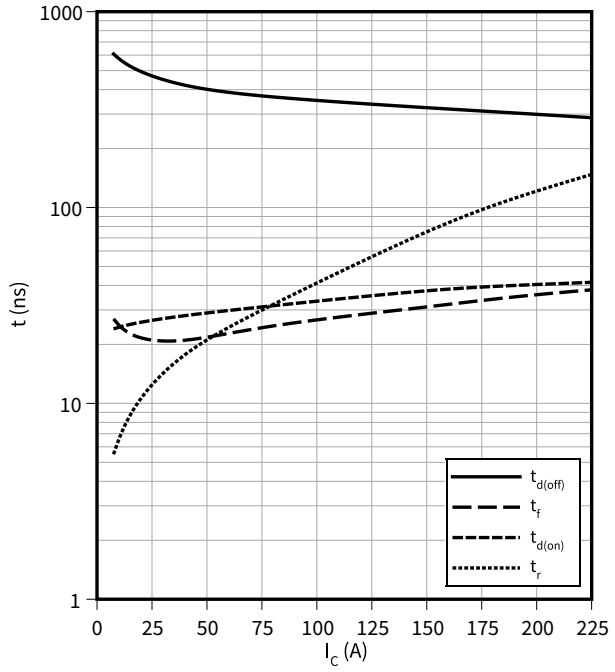

### Gate-emitter threshold voltage as a function of junction temperature

$V_{GEth} = f(T_{vj})$
$I_C = 0.75$ mA

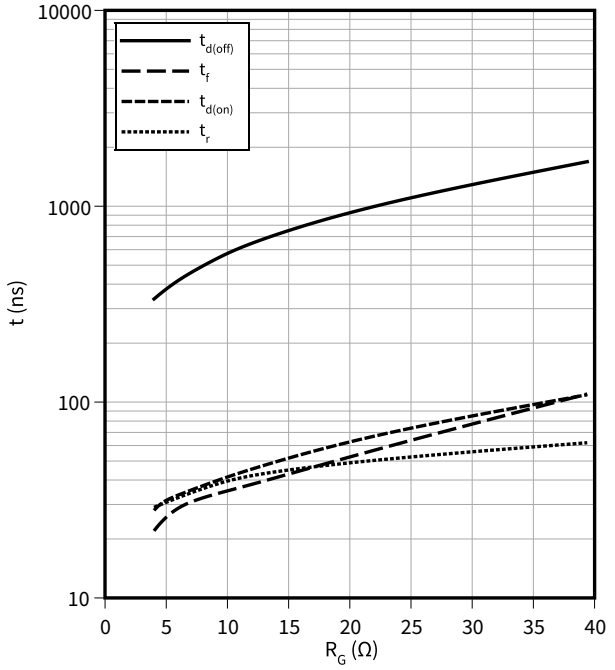



### Typical switching times as a function of collector current

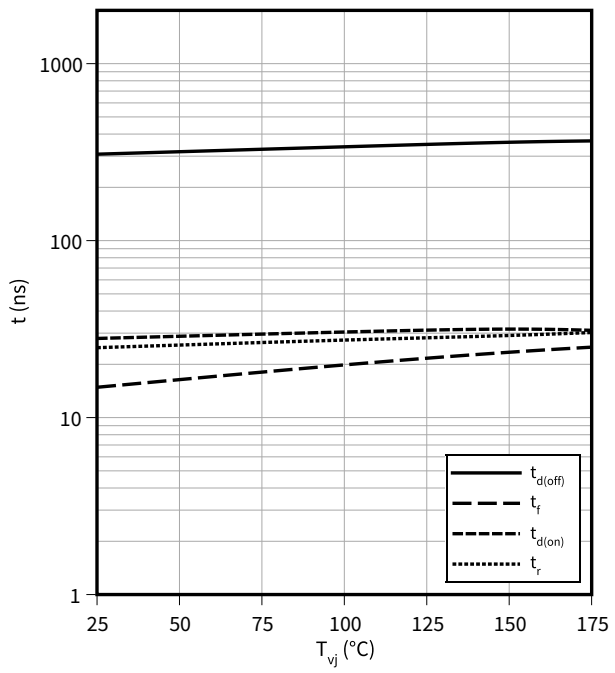
$t = f(I_C)$
$V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.7\ \Omega$



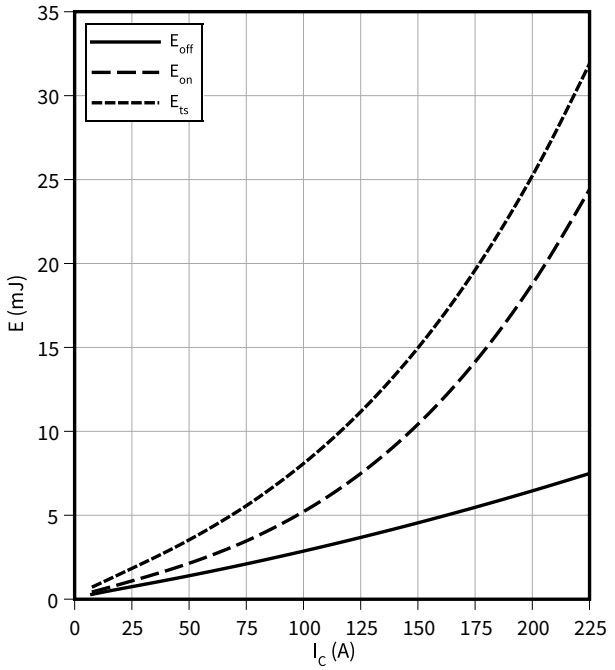
**Typical switching times as a function of gate resistor**
$t = f(R_G)$
$I_C = 75$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



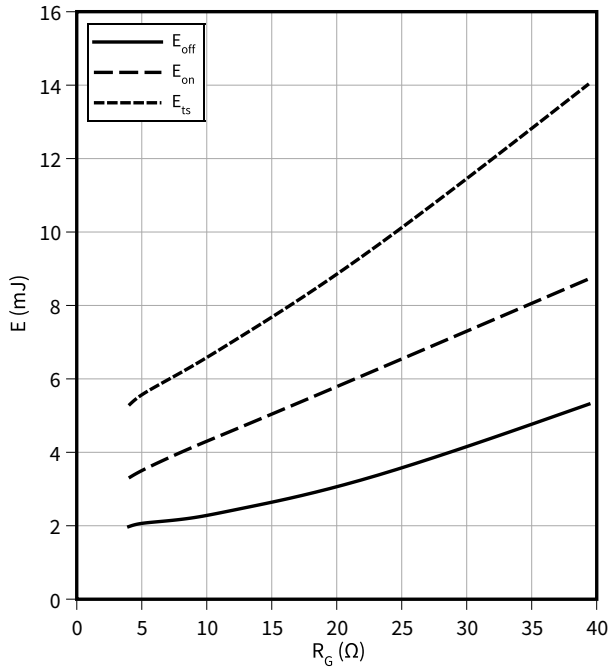

**Typical switching times as a function of junction temperature**
$t = f(T_{vj})$
$I_C = 75$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 4.7\ \Omega$




**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, $R_G = 4.7\ \Omega$



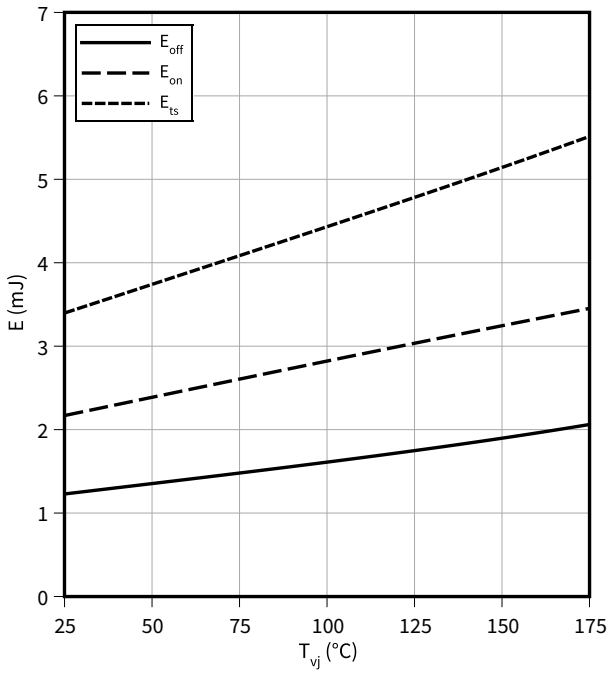

**Typical switching energy losses as a function of gate resistor**
$E = f(R_G)$
$I_C = 75$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$E = f(T_{vj})$

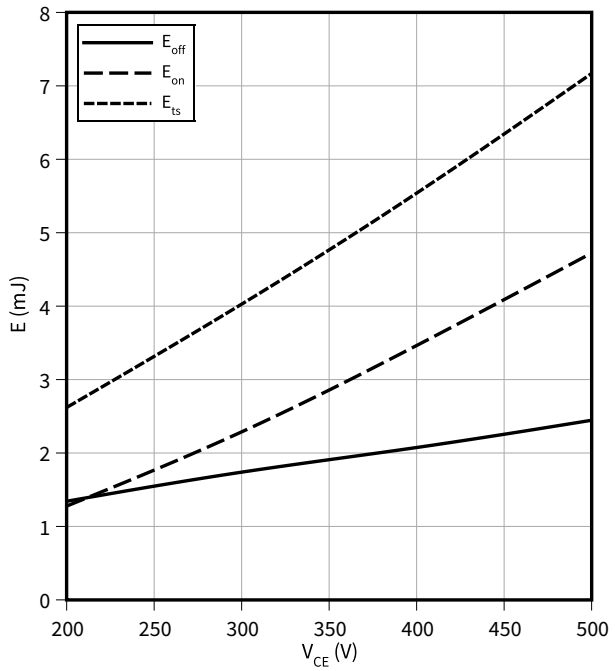
$I_C = 75$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 4.7\ \Omega$




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

$E = f(V_{CE})$

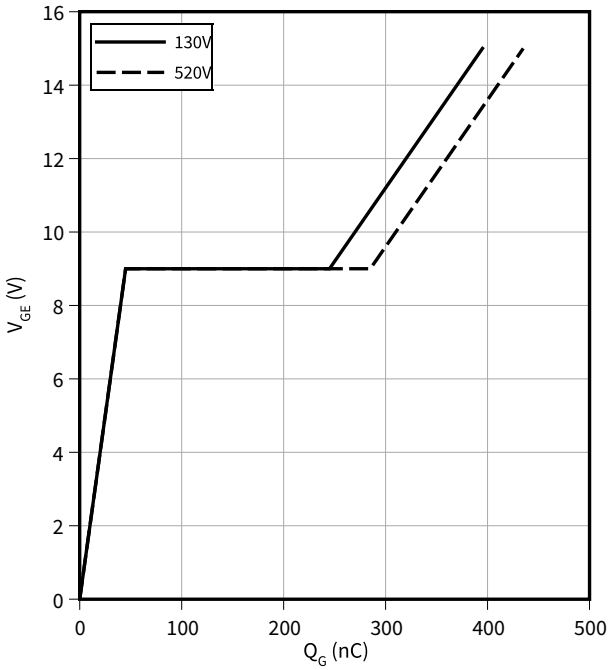
$I_C = 75$ A, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.7\ \Omega$




**Typical gate charge**

$V_{GE} = f(Q_G)$

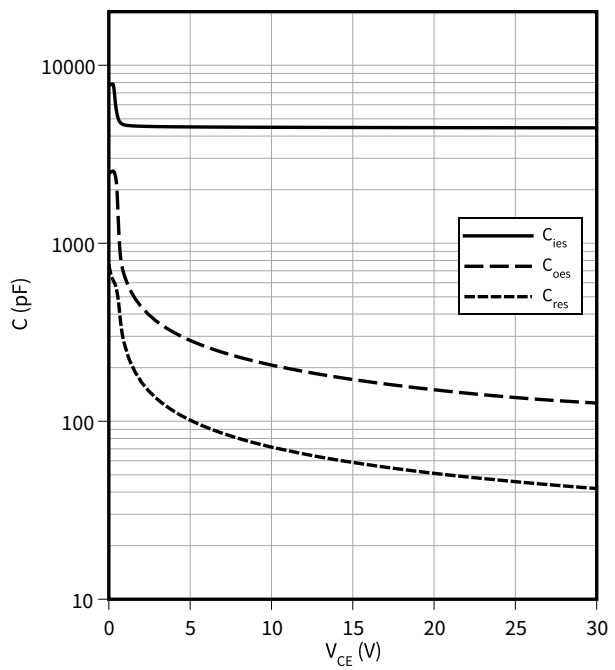
$I_C = 75$ A




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

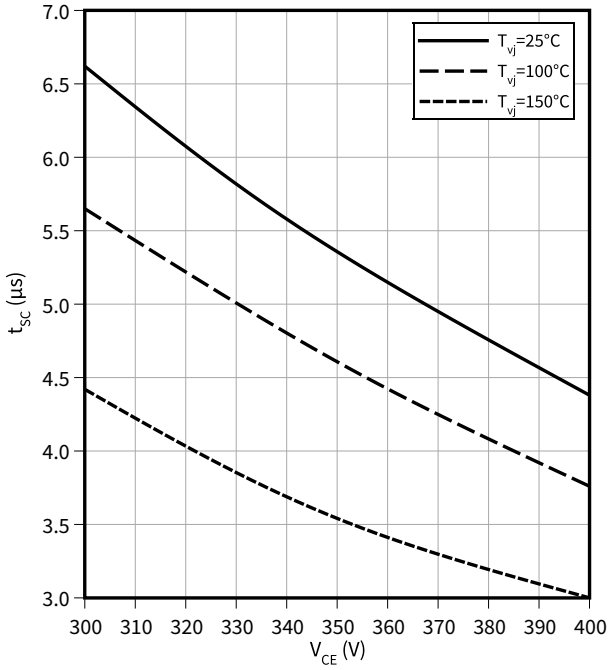
$C = f(V_{CE})$

$f = 1000$ kHz, $V_{GE} = 0$ V



### Typical short circuit safe operating range as a function of collector-emitter voltage

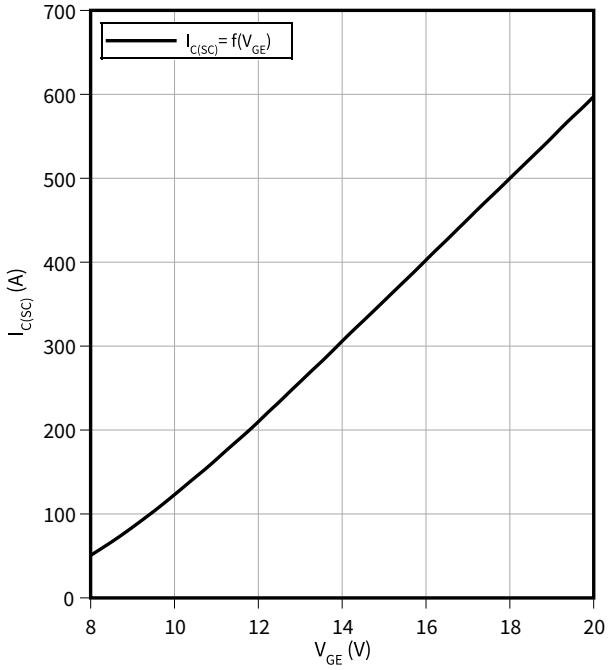
$t_{SC} = f(V_{CE})$




### Typical short circuit collector current as a function of gate-emitter voltage

$I_{C(SC)} = f(V_{GE})$

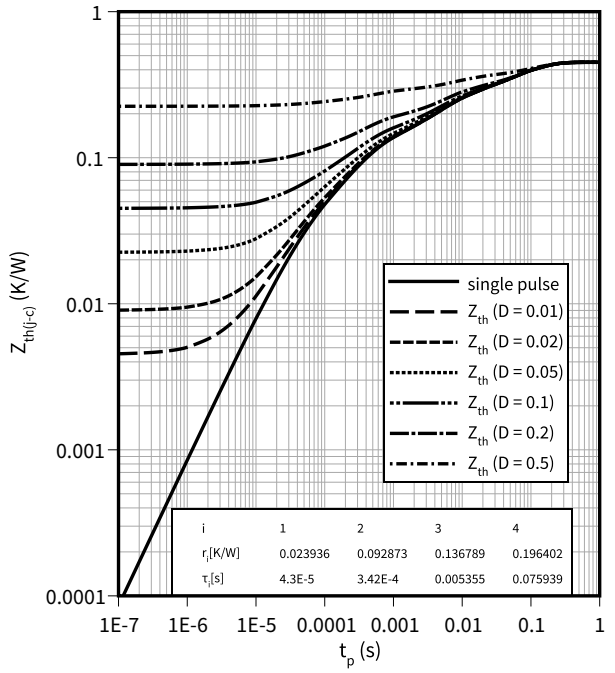
$T_{vj}$ = 150 °C, $V_{CE} \leq 400$ V




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

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

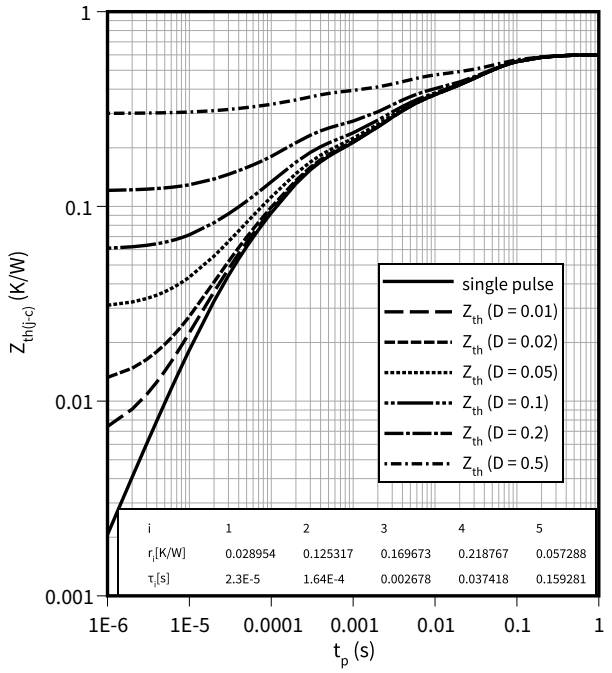
$D = t_p/T$




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

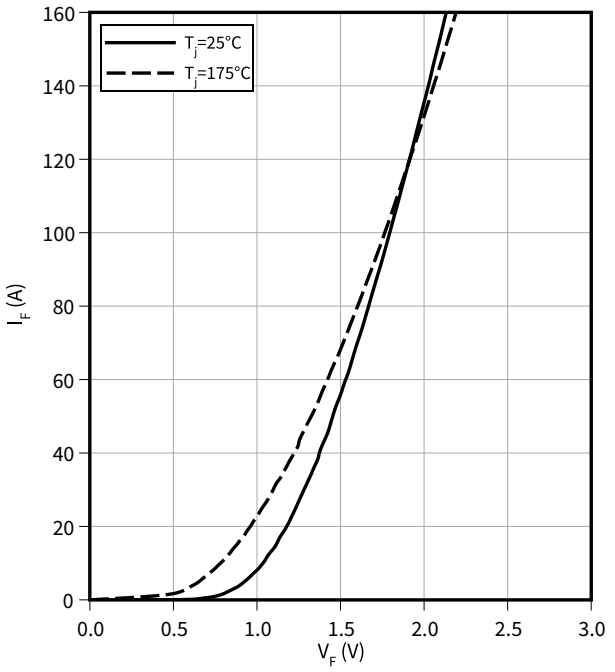
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$



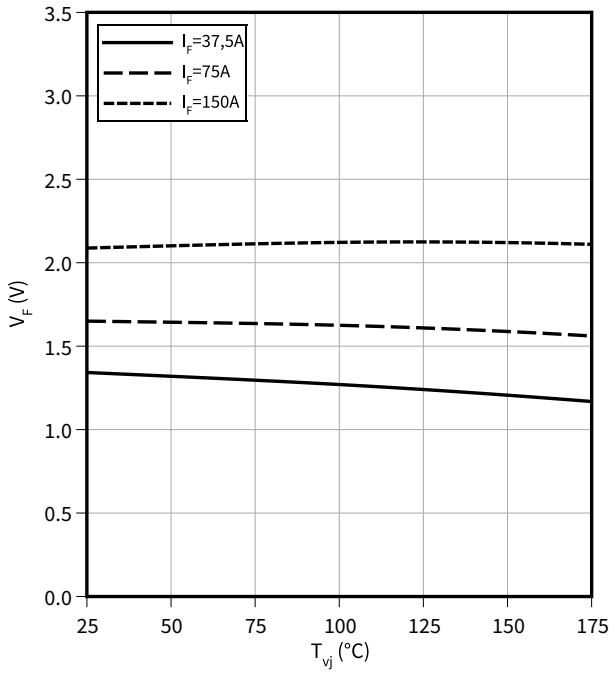
**Typical diode forward current as a function of forward voltage**

$I_F = f(V_F)$




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

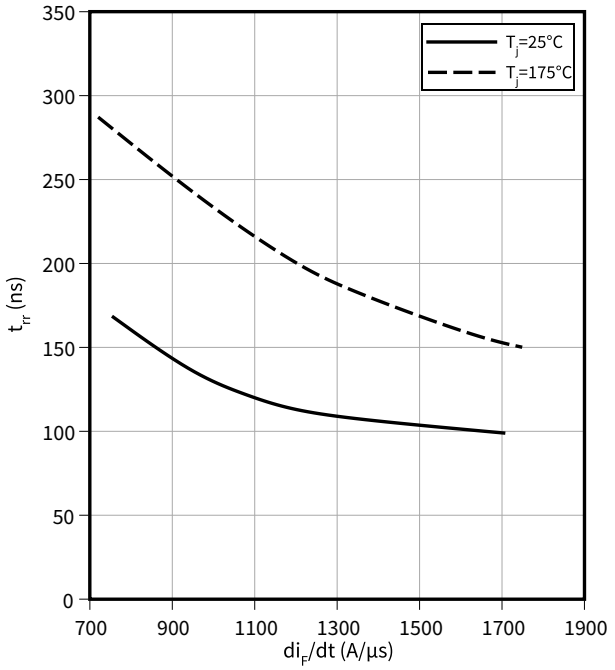
$V_F = f(T_{vj})$




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

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

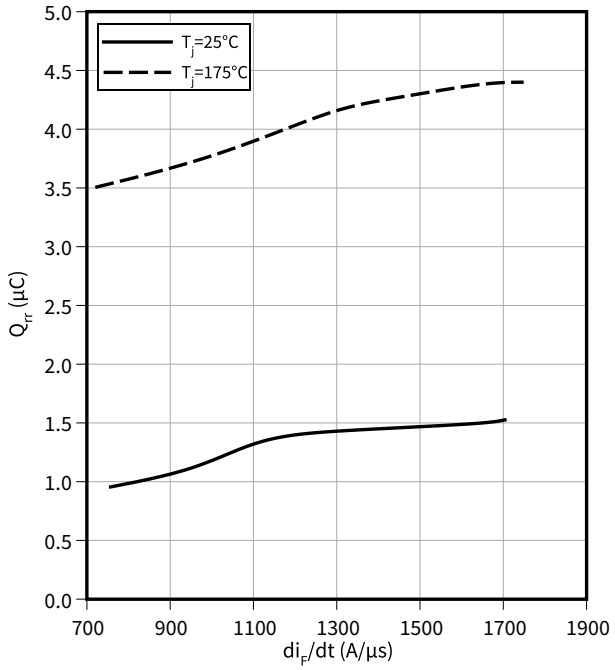
$V_R = 400$ V, $I_F = 75$ A




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

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

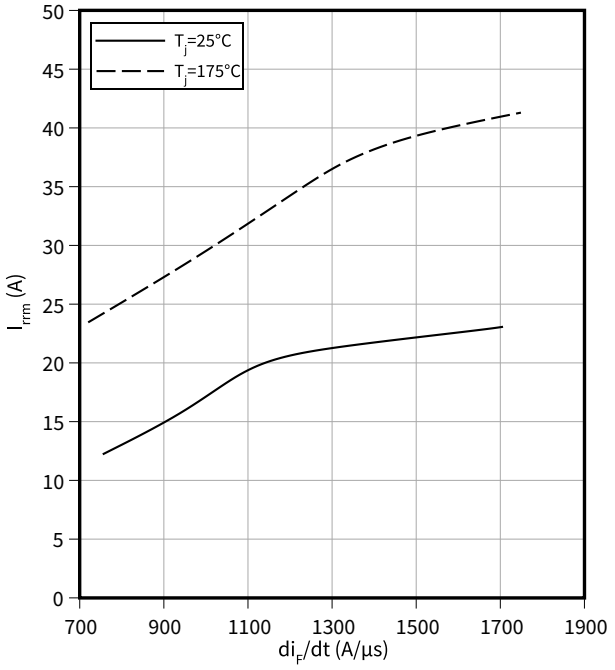
$V_R = 400$ V, $I_F = 75$ A



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

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

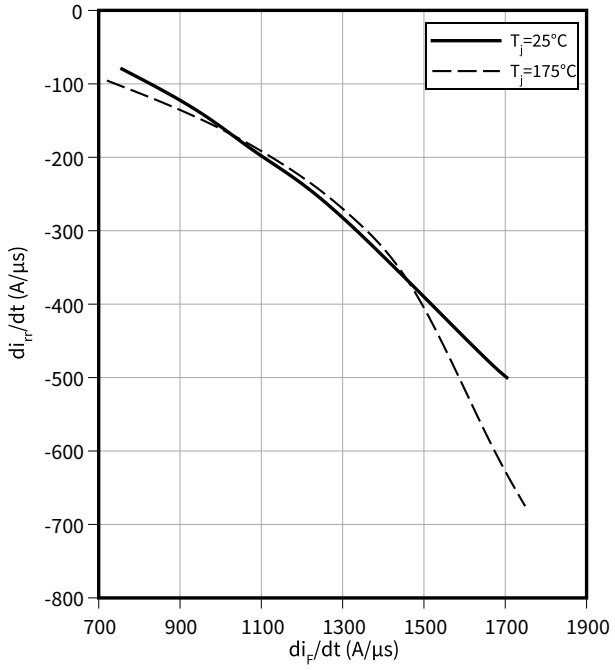
$V_R = 400$ V, $I_F = 75$ A




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

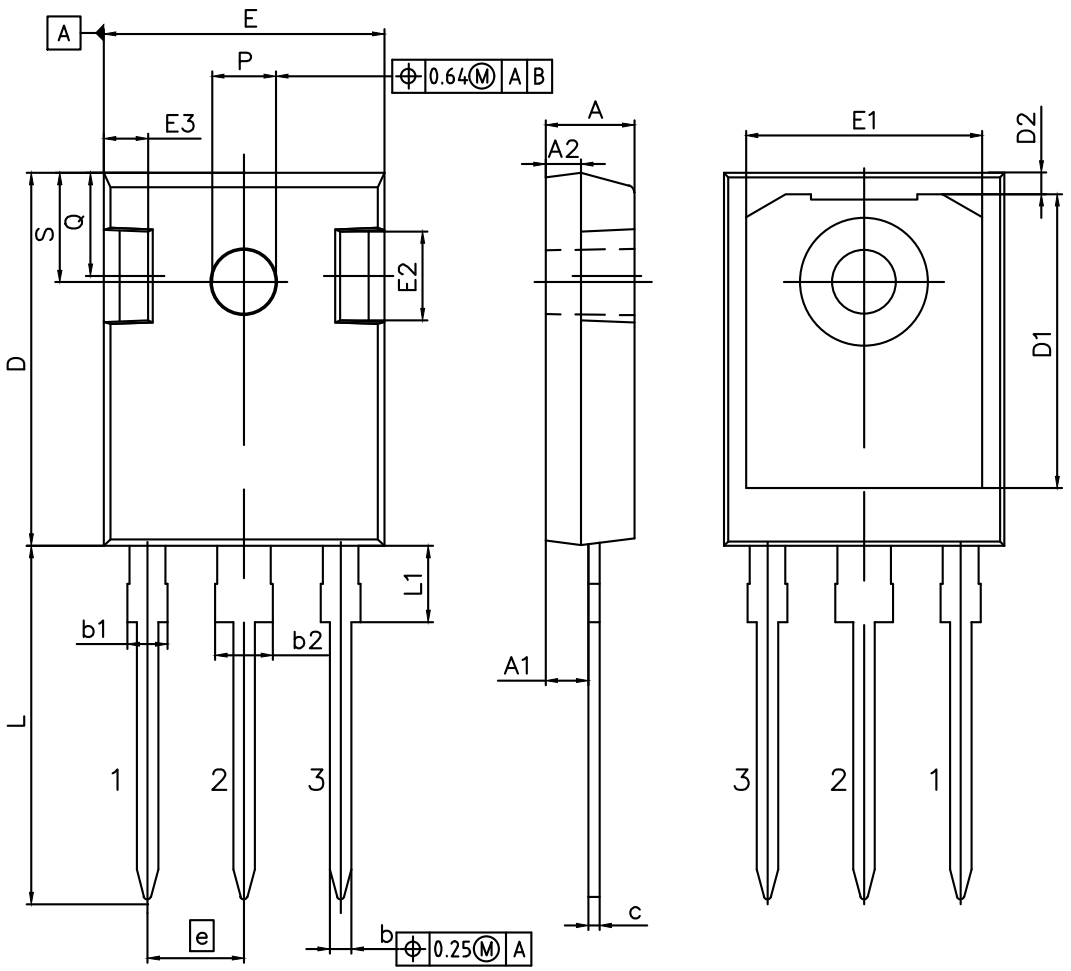
$di_{rr}/dt = f(di_F/dt)$

$V_R = 400$ V, $I_F = 75$ A



# 5 Package outlines

## Package Drawing PG-TO247-3




| DIMENSIONS | MILLIMETERS | |
|---|---|---|
| | MIN. | MAX. |
| **A** | 4.70 | 5.30 |
| **A1** | 2.20 | 2.60 |
| **A2** | 1.50 | 2.50 |
| **b** | 1.00 | 1.40 |
| **b1** | 1.60 | 2.41 |
| **b2** | 2.57 | 3.43 |
| **c** | 0.38 | 0.89 |
| **D** | 20.70 | 21.50 |
| **D1** | 13.08 | 17.65 |
| **D2** | 0.51 | 1.35 |
| **E** | 15.50 | 16.30 |
| **E1** | 12.38 | 14.15 |
| **E2** | 3.40 | 5.10 |
| **E3** | 1.00 | 2.60 |
| **e** | 5.44 | |
| **L** | 19.80 | 20.40 |
| **L1** | 3.85 | 4.50 |
| **P** | 3.50 | 3.70 |
| **Q** | 5.35 | 6.25 |
| **S** | 6.04 | 6.30 |

**DOCUMENT NO.**
Z8B00003327

**REVISION**
06

**SCALE 3:1**
0 1 2 3 4 5mm

**EUROPEAN PROJECTION**

**ISSUE DATE**
25.07.2018

**Figure 1**

# 6 Testing conditions

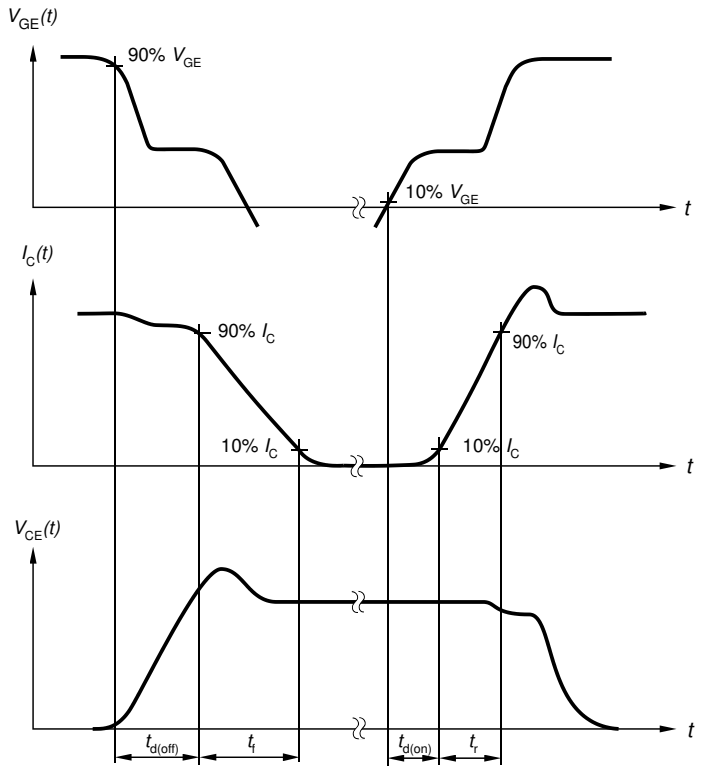



Figure A. **Definition of switching times**

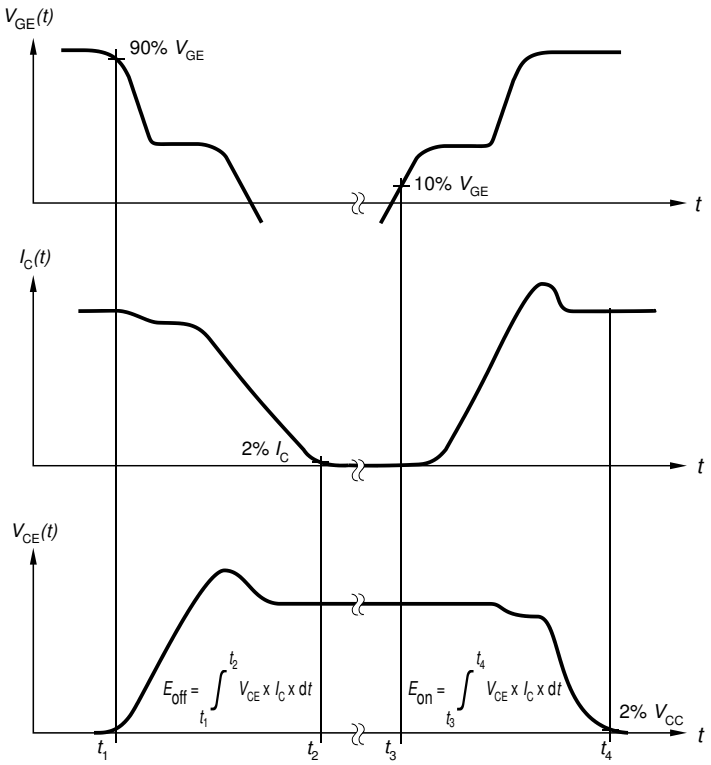



Figure B. **Definition of switching losses**

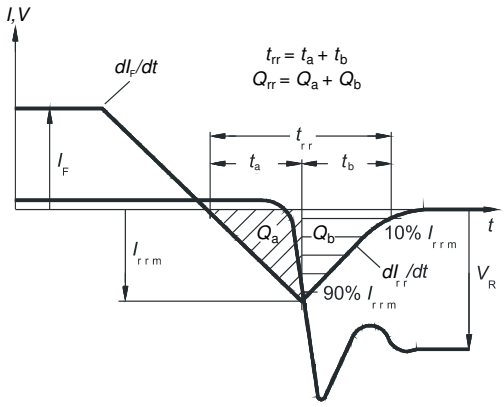



Figure C. **Definition of diode switching characteristics**

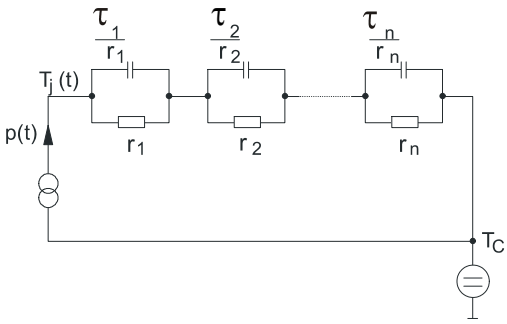



Figure D. **Thermal equivalent circuit**

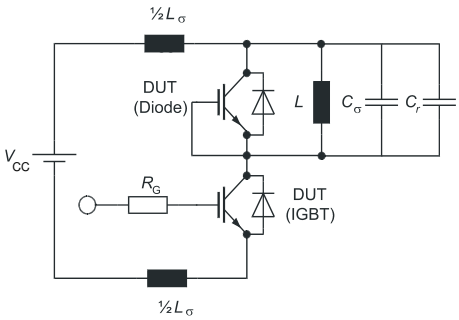



Figure E. **Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

**Figure 2**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| V0.1 | 2019-10-25 | Target Data Sheet |
| V1.1 | 2020-04-20 | Preliminary data sheet |
| V2.1 | 2020-05-12 | Final data sheet |
| n/a | 2020-11-30 | Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy |
| 1.00 | 2021-06-29 | Change of potential applications and new diagram added ($t_{SC}$ as function of $V_{CE}$) |
| 1.10 | 2023-01-26 | Feature list corrections<br>Editorial changes |

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