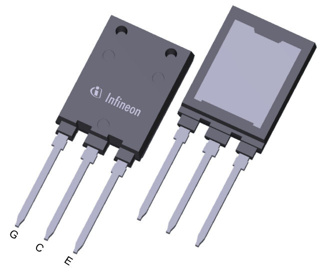
## Short circuit rugged 750 V EDT2 IGBT in reflow-solderable package co-packed with soft and fast recovery diode




Green

Halogen-free

RoHS

### Features

- $V_{CE}$ = 750 V
- $I_C$ = 120 A
- Low saturation voltage $V_{CEsat}$ = 1.4 V
- Low switching losses
- Short circuit ruggedness 3 µs
- IGBT co-packed with full current, soft and fast recovery diode
- Optimized for hard switching topologies up to 10 kHz
- Package backside suitable for reflow soldering at 245°C, 3 times
- Plating of pins further enable electrical resistance welding
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

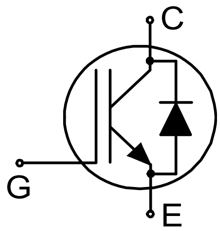
### Potential applications

- CAV Powertrain Control Modules
- General purpose drives (GPD)

### Product validation

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

### Description




| Type | Package | Marking |
|---|---|---|
| IKQB120N75CP2 | PG-TO247-3-PLUS-NN8.5 | K120GCP2 |

# Table of contents

# 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 | $T_{sold}$ | reflow soldering (MSL1 according to JEDEC J-STA-020) | | | 245 | °C |
| Thermal resistance, junction-ambient | $R_{th(j\text{-}a)}$ | | | | 40 | K/W |
| IGBT thermal resistance, junction-case | $R_{th(j\text{-}c)}$ | | | | 0.26 | K/W |
| Diode thermal resistance, junction-case | $R_{th(j\text{-}c)}$ | | | | 0.45 | 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 | | 750 | V |
| DC collector current, limited by $T_{vjmax}$ | $I_C$ | limited by bondwire | $T_c = 25$ °C | 150 | A |
| | | | $T_c = 120$ °C | 120 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ | | | 360 | A |
| Turn-off safe operating area | | $V_{CE} \leq 750$ V, $T_{vj} \leq 175$ °C | | 360 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p = 10$ µs, $D < 0.01$ | | ±30 | V |
| Short-circuit withstand time | $t_{SC}$ | $V_{CC} \leq 450$ V, $V_{GE} = 15$ V, Allowed number of short circuits < 1000, Time between short circuits ≥ 1.0 s, $T_{vj} = 125$ °C | | 3 | µs |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 577 | W |
| | | | $T_c = 120$ °C | 211 | |

**Table 3 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C = 120$ A, $V_{GE} = 15$ V | $T_{vj} = 25$ °C | | 1.4 | 1.65 | V |
| | | | $T_{vj} = 175$ °C | | 1.7 | | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C = 1.6$ mA, $V_{CE} = V_{GE}$ | | 5 | 5.8 | 6.5 | V |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE} = 750$ V, $V_{GE} = 0$ V | $T_{vj} = 25$ °C | | | 200 | µA |
| | | | $T_{vj} = 175$ °C | | 6000 | | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE} = 0$ V, $V_{GE} = 20$ V | | | | 100 | nA |
| Transconductance | $g_{fs}$ | $I_C = 120$ A, $V_{CE} = 20$ V | | | 87 | | S |
| Input capacitance | $C_{ies}$ | $V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz | | | 12980 | | pF |
| Output capacitance | $C_{oes}$ | $V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz | | | 339 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE} = 25$ V, $V_{GE} = 0$ V, $f = 100$ kHz | | | 59 | | pF |
| Gate charge | $Q_G$ | $V_{CC} = 600$ V, $I_C = 120$ A, $V_{GE} = 15$ V | | | 481 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8\ \Omega$, $R_{G(off)} = 4.8\ \Omega$, $L_\sigma = 144$ nH, $C_\sigma = 30$ pF | $T_{vj} = 25$ °C, $I_C = 120$ A | | 57 | | ns |
| | | | $T_{vj} = 175$ °C, $I_C = 120$ A | | 54 | | |
| Rise time (inductive load) | $t_r$ | $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8\ \Omega$, $R_{G(off)} = 4.8\ \Omega$, $L_\sigma = 144$ nH, $C_\sigma = 30$ pF | $T_{vj} = 25$ °C, $I_C = 120$ A | | 50 | | ns |
| | | | $T_{vj} = 175$ °C, $I_C = 120$ A | | 50 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8\ \Omega$, $R_{G(off)} = 4.8\ \Omega$, $L_\sigma = 144$ nH, $C_\sigma = 30$ pF | $T_{vj} = 25$ °C, $I_C = 120$ A | | 285 | | ns |
| | | | $T_{vj} = 175$ °C, $I_C = 120$ A | | 346 | | |
| Fall time (inductive load) | $t_f$ | $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8\ \Omega$, $R_{G(off)} = 4.8\ \Omega$, $L_\sigma = 144$ nH, $C_\sigma = 30$ pF | $T_{vj} = 25$ °C, $I_C = 120$ A | | 33 | | ns |
| | | | $T_{vj} = 175$ °C, $I_C = 120$ A | | 55 | | |
| Turn-on energy | $E_{on}$ | $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_{G(on)} = 4.8\ \Omega$, $R_{G(off)} = 4.8\ \Omega$, $L_\sigma = 144$ nH, $C_\sigma = 30$ pF | $T_{vj} = 25$ °C, $I_C = 120$ A | | 6.4 | | mJ |
| | | | $T_{vj} = 175$ °C, $I_C = 120$ A | | 8.7 | | |

**(table continues...)**

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

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 450 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, $L_σ$ = 144 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 120 A | | 3.4 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 120 A | | 5.5 | | |
| Total switching energy | $E_{ts}$ | $V_{CC}$ = 450 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 4.8 Ω, $R_{G(off)}$ = 4.8 Ω, $L_σ$ = 144 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 120 A | | 9.8 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 120 A | | 14.2 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

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

# 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 | | 750 | V |
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | | $T_c$ = 25 °C | 150 | A |
| | | | $T_c$ = 75 °C | 120 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpulse}$ | | | 360 | A |
| Power dissipation | $P_{tot}$ | | $T_c$ = 25 °C | 333 | W |
| | | | $T_c$ = 120 °C | 122 | |

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

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F$ = 120 A | $T_{vj}$ = 25 °C | | 1.8 | 2 | V |
| | | | $T_{vj}$ = 175 °C | | 1.9 | | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 450 V | $T_{vj}$ = 25 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 259 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 325 | | |

**(table continues...)**

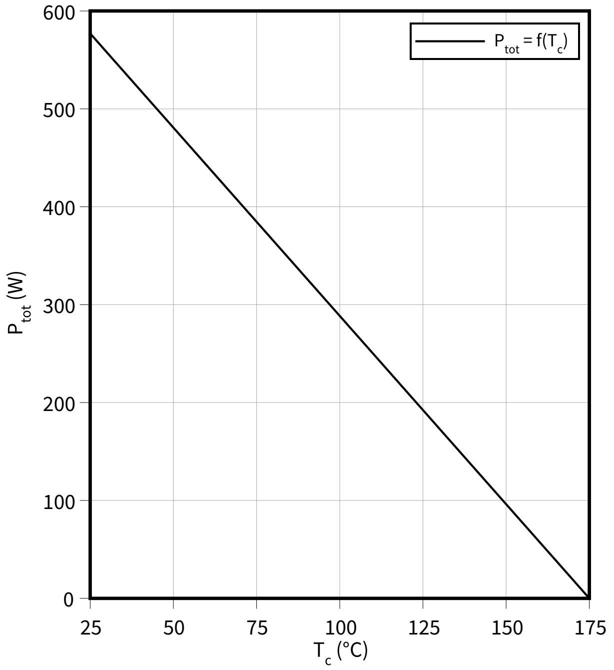
**Table 5** **(continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode reverse recovery charge | $Q_{rr}$ | $V_R$ = 450 V | $T_{vj}$ = 25 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 3.2 | | µC |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 7.8 | | |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R$ = 450 V | $T_{vj}$ = 25 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 24.2 | | A |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 42 | | |
| Diode peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $V_R$ = 450 V | $T_{vj}$ = 25 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 290 | | A/µs |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 120 A, $-di_F/dt$ = 1000 A/µs | | 250 | | |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

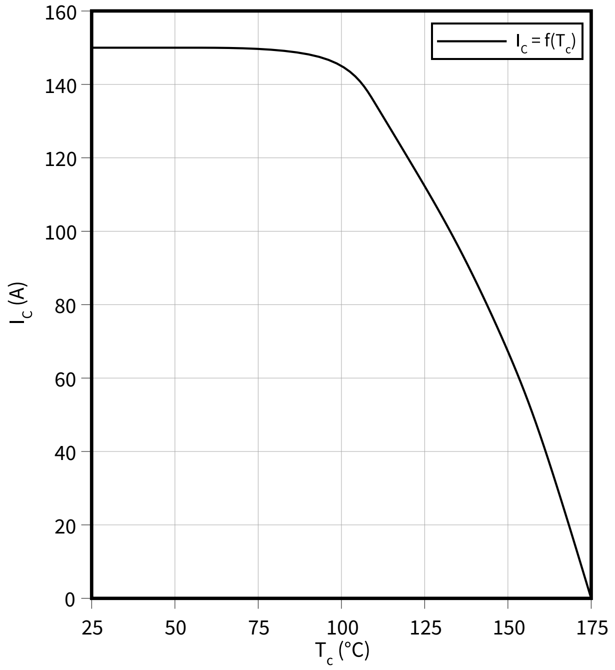
*Note:* *For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.*

# 4 Characteristics diagrams

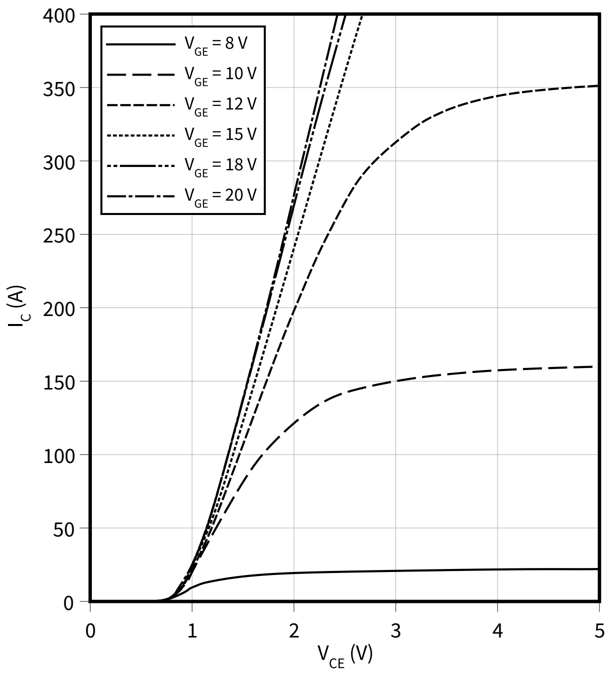
**Power dissipation as a function of case temperature**
$P_{tot} = f(T_c)$
$T_{vj} \leq 175$ °C



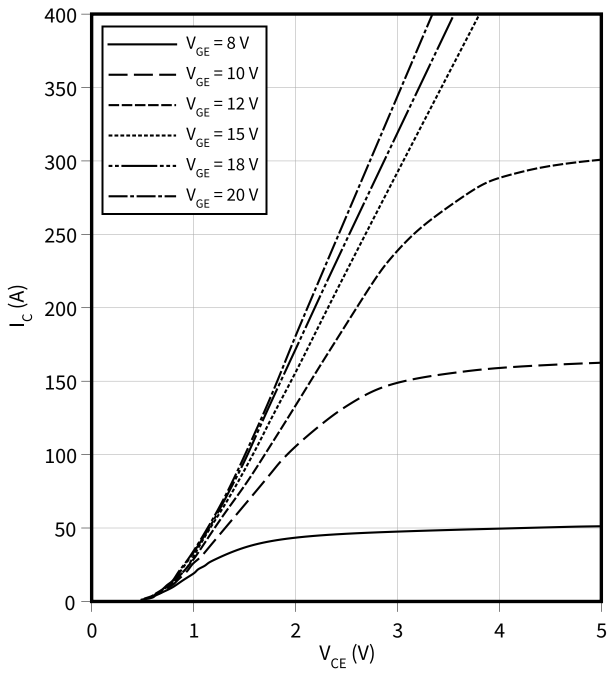

**Collector current as a function of case temperature**
$I_C = f(T_c)$
$V_{GE} \geq 15$ V, $T_{vj} \leq 175$ °C




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



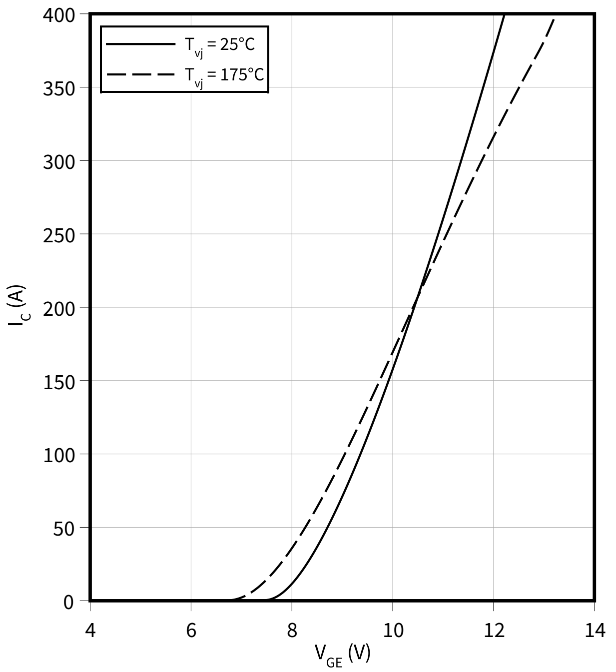

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



### Typical transfer characteristic

$I_C = f(V_{GE})$

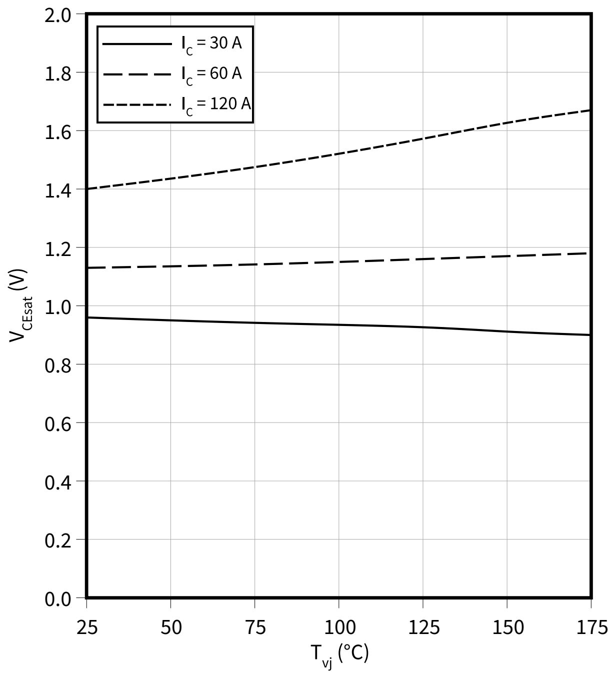
$V_{CE} = 20\ V$




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

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

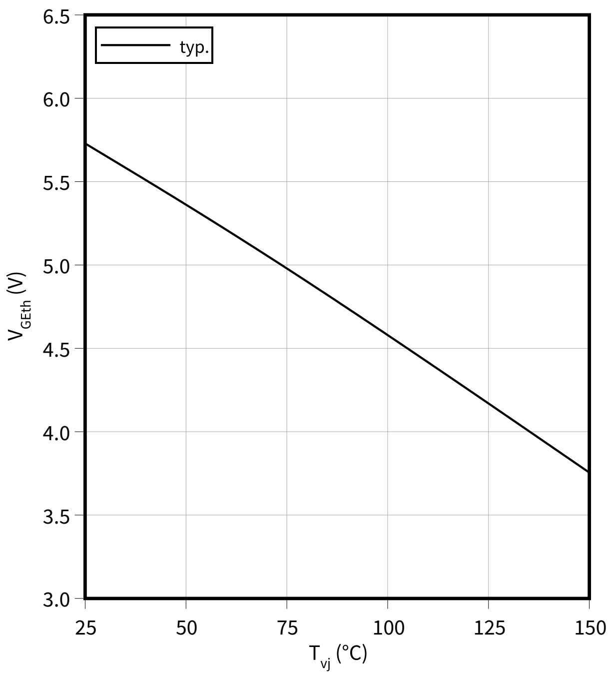
$V_{GE} = 15\ V$




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

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

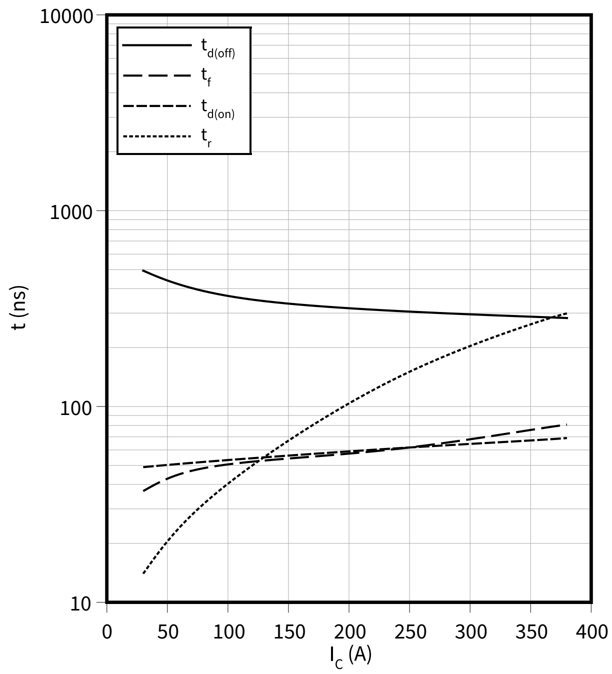
$I_C = 1.6\ mA$



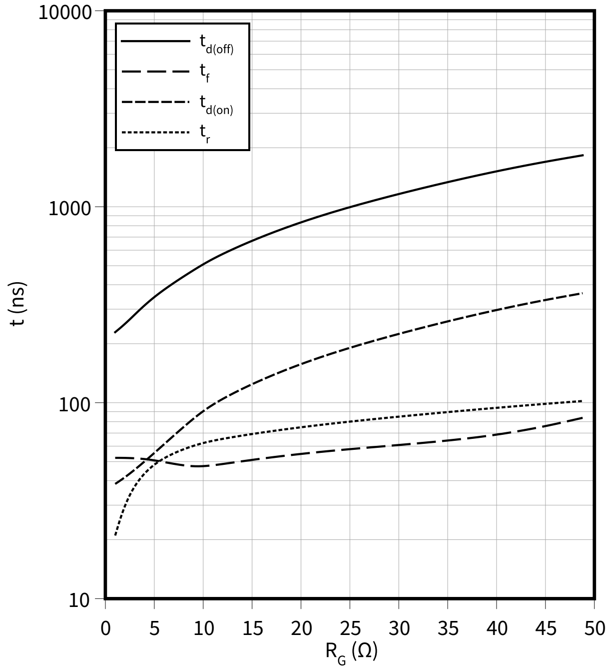

### Typical switching times as a function of collector current

$t = f(I_C)$

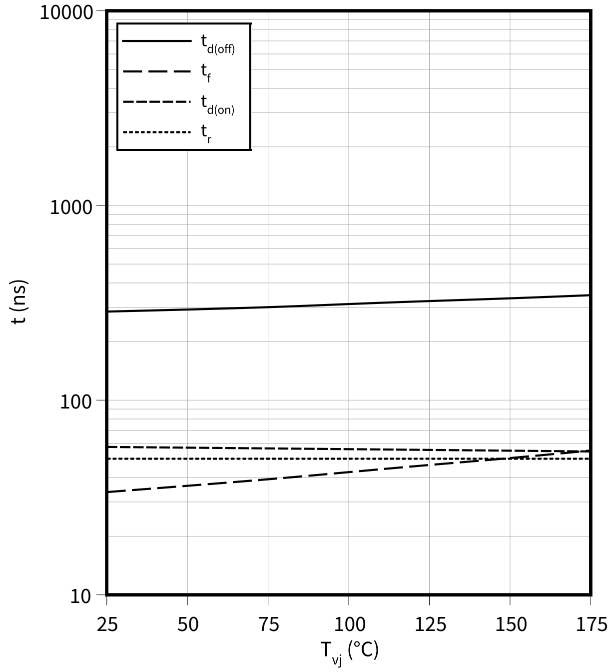
$V_{CC} = 450\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 4.8\ \Omega$



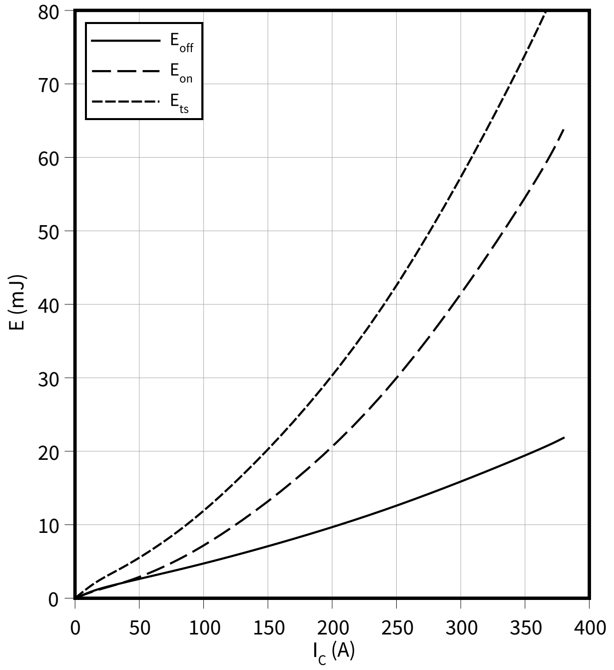
**Typical switching times as a function of gate resistor**
$t = f(R_G)$
$I_C = 120$ A, $V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



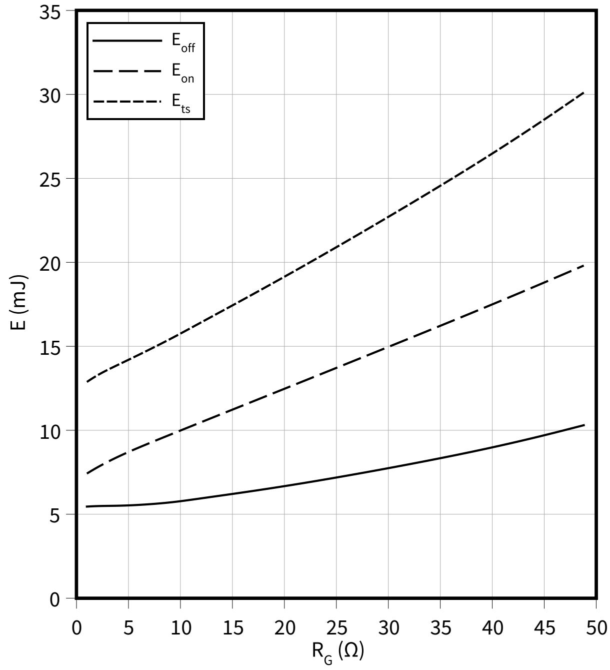

**Typical switching times as a function of junction temperature**
$t = f(T_{vj})$
$I_C = 120$ A, $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_G = 4.8$ Ω




**Typical switching energy losses as a function of collector current**
$E = f(I_C)$
$V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 4.8$ Ω



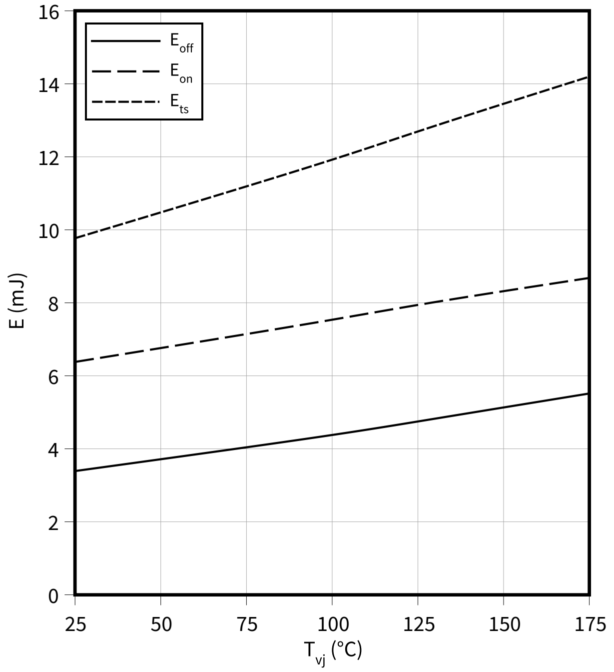

**Typical switching energy losses as a function of gate resistor**
$E = f(R_G)$
$I_C = 120$ A, $V_{CC} = 450$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$E = f(T_{vj})$

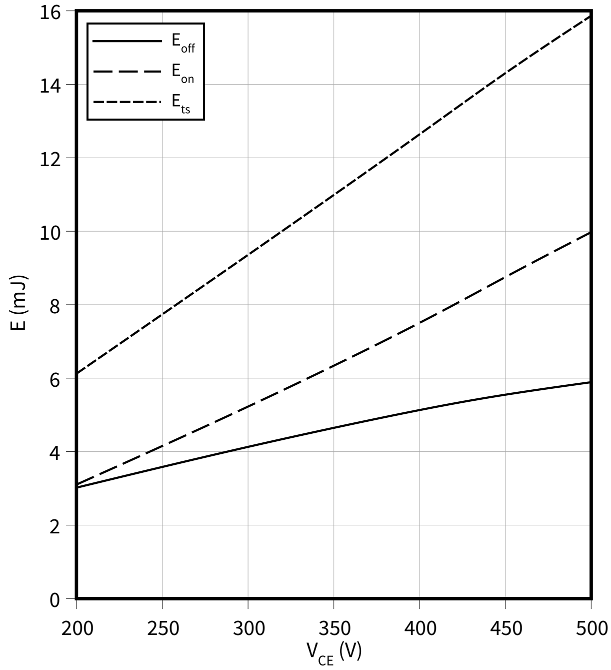
$I_C = 120$ A, $V_{CC} = 450$ V, $V_{GE} = 0/15$ V, $R_G = 4.8\ \Omega$




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

$E = f(V_{CE})$

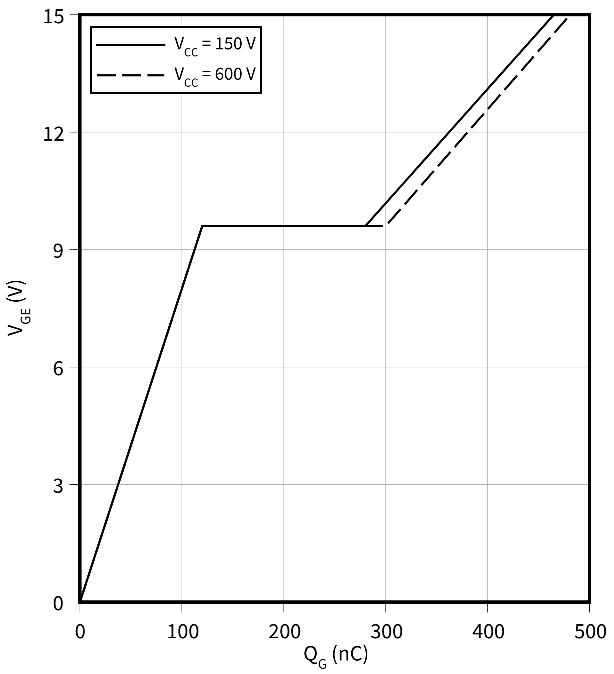
$I_C = 120$ A, $V_{GE} = 0/15$ V, $T_{vj} = 175$ °C, $R_G = 4.8\ \Omega$




**Typical gate charge**

$V_{GE} = f(Q_G)$

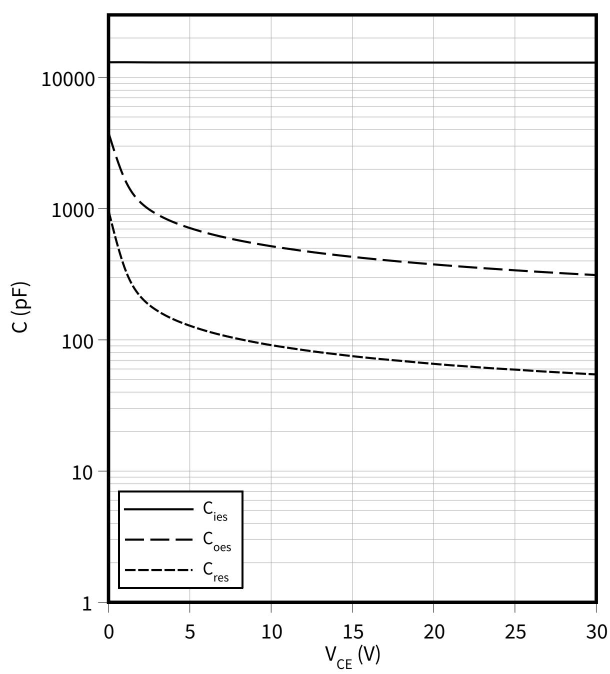
$I_C = 120$ A




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

$C = f(V_{CE})$

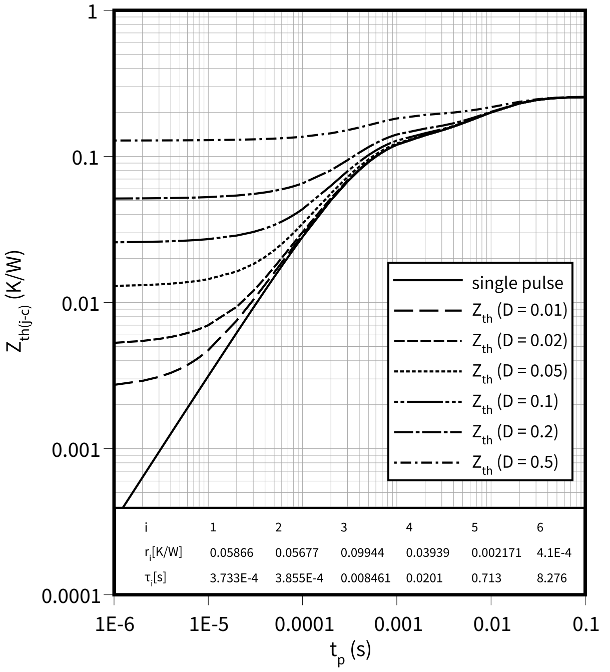
$f = 100$ kHz, $V_{GE} = 0$ V



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

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

$D = t_p/T$

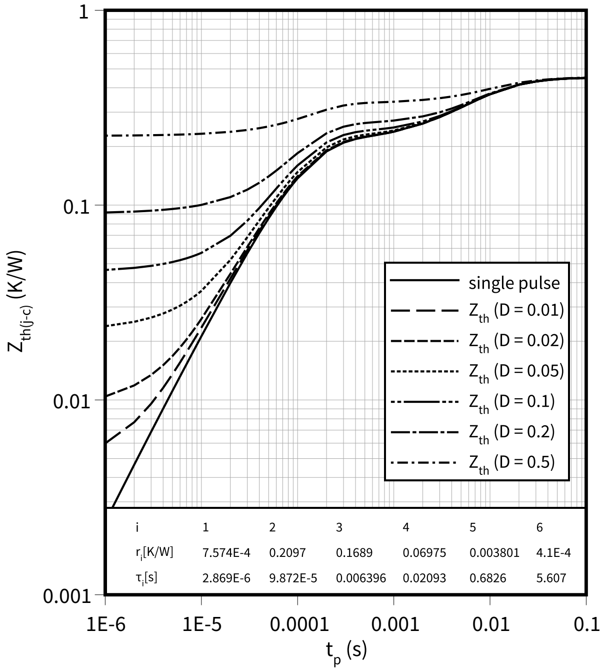



| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $r_i$[K/W] | 0.05866 | 0.05677 | 0.09944 | 0.03939 | 0.002171 | 4.1E-4 |
| $\tau_i$[s] | 3.733E-4 | 3.855E-4 | 0.008461 | 0.0201 | 0.713 | 8.276 |

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

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

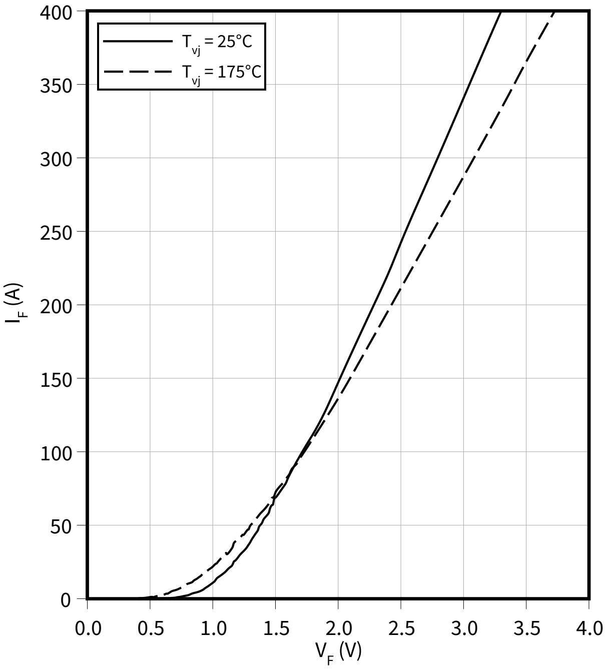
$D = t_p/T$




| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $r_i$[K/W] | 7.574E-4 | 0.2097 | 0.1689 | 0.06975 | 0.003801 | 4.1E-4 |
| $\tau_i$[s] | 2.869E-6 | 9.872E-5 | 0.006396 | 0.02093 | 0.6826 | 5.607 |

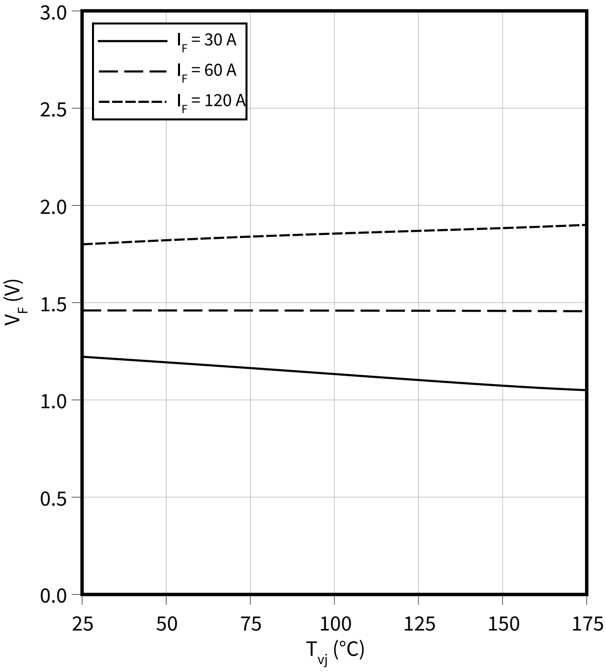
## Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$




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

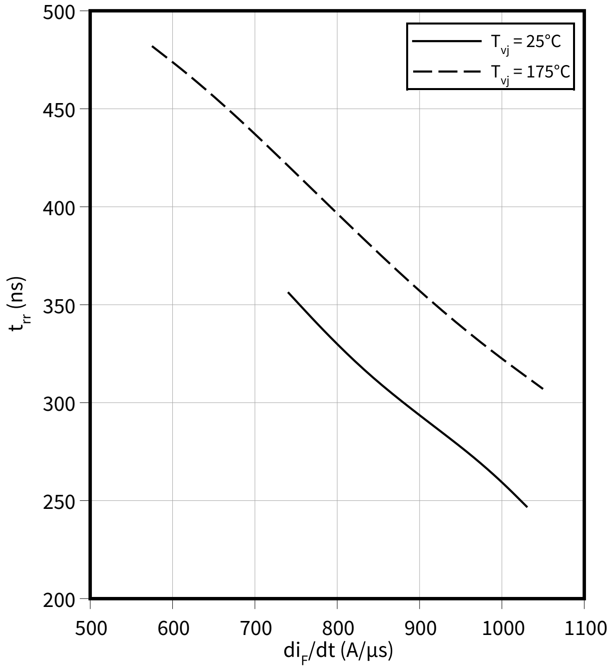
$V_F = f(T_{vj})$



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

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

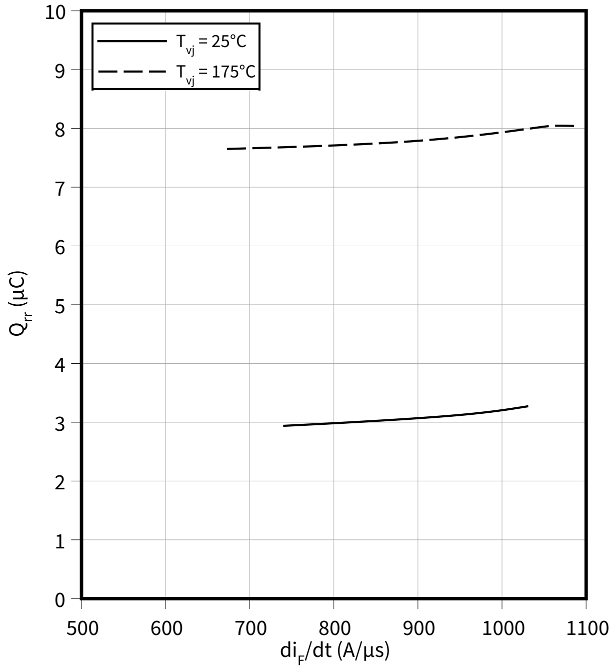
$V_R = 450$ V, $I_F = 120$ A




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

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

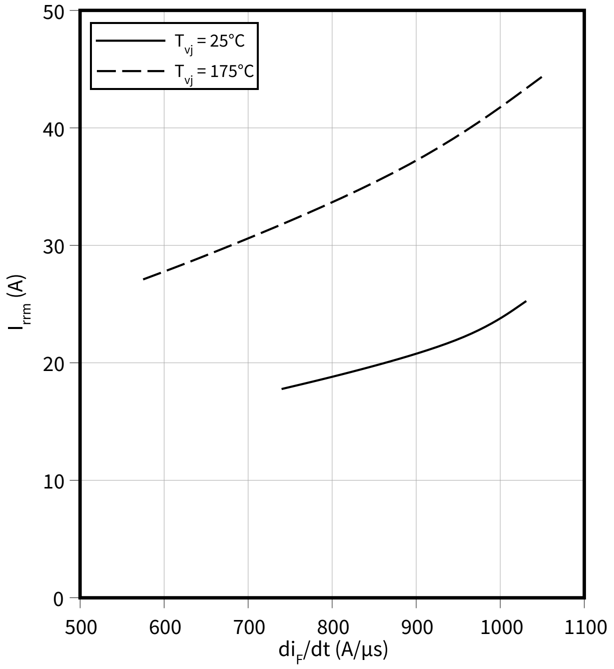
$V_R = 450$ V, $I_F = 120$ A




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

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

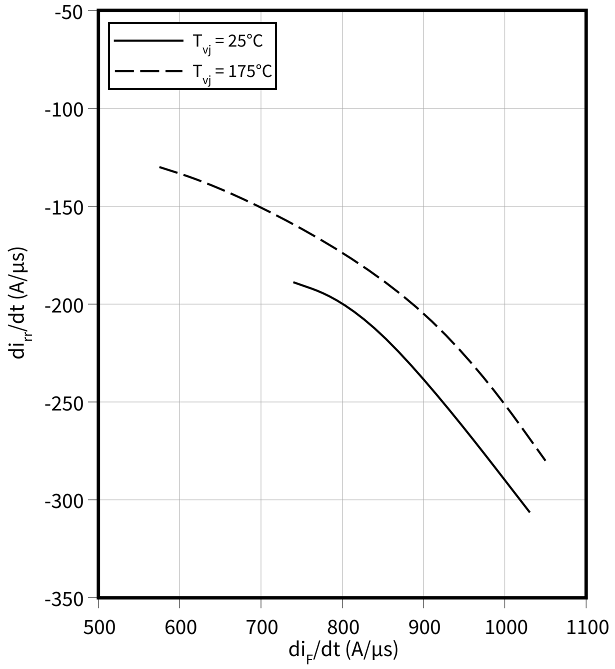
$V_R = 450$ V, $I_F = 120$ A




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

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

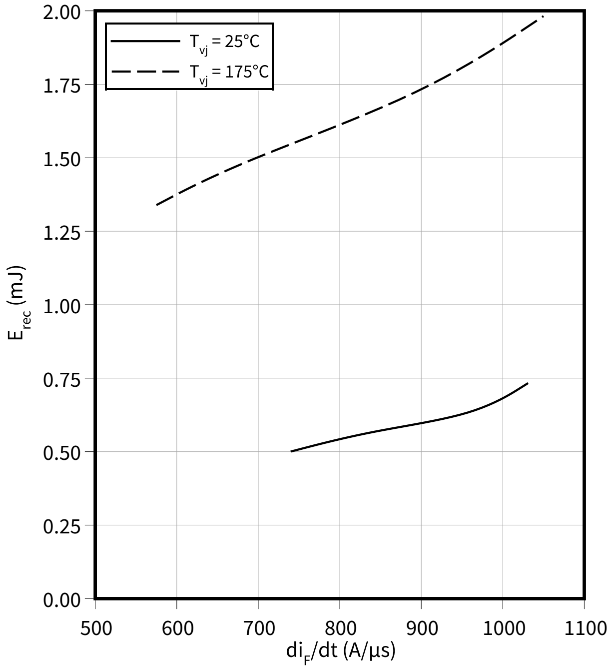
$V_R = 450$ V, $I_F = 120$ A



**Typical reverse energy losses as a function of diode current slope**

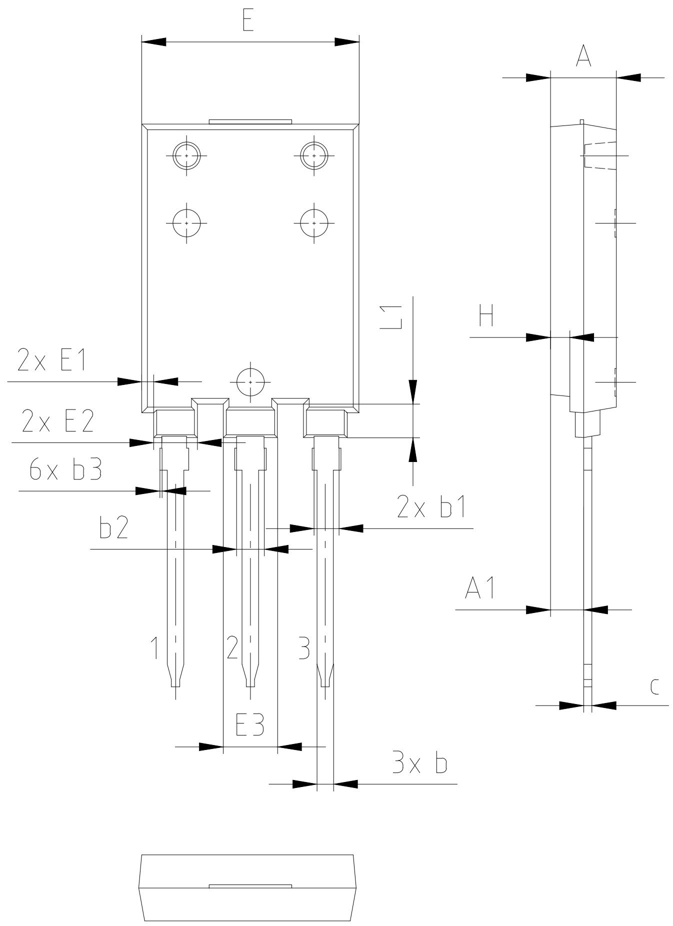
$E_{rec} = f(di_F/dt)$

$V_R = 450$ V, $I_F = 120$ A



# 5 Package outlines

PG-TO247-3-PLUS-NN8.5




| PACKAGE - GROUP NUMBER: | PG-TO247-3-U02 | |
|---|---|---|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 4.70 | 4.90 |
| A1 | 2.16 | 2.66 |
| b | 1.10 | 1.30 |
| b1 | 1.80 | |
| b2 | 2.00 | |
| b3 | 0.00 | 0.15 |
| c | 0.50 | 0.70 |
| D | 22.70 | 22.90 |
| D1 | 14.69 | 14.89 |
| E | 15.70 | 15.90 |
| E1 | 0.76 | 0.96 |
| E2 | 3.08 | 3.28 |
| E3 | 3.84 | 4.04 |
| E4 | 12.28 | 12.48 |
| e | 5.44 | |
| N | 3 | |
| H | 1.30 | 1.50 |
| L | 18.01 | 18.21 |
| L1 | 2.34 | 2.54 |
| aaa | 0.25 | |

NOTES:
(1) ALL METAL SURFACES TIN PLATED EXCEPT AREA OF CUT
(2) MOLD GATE PROTRUSION AFTER DEGATING.

**Figure 1**

# 6 Testing conditions

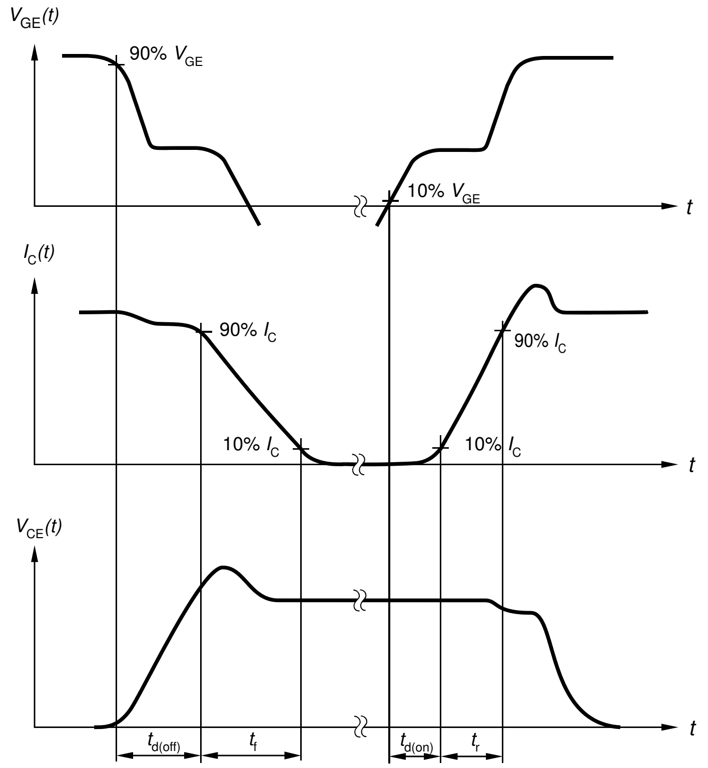



Figure A. **Definition of switching times**

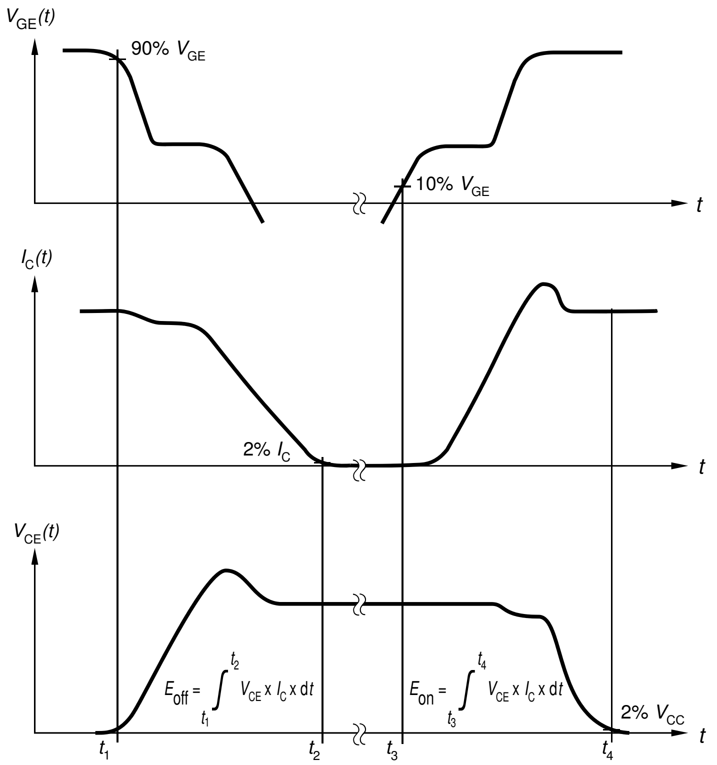



Figure B. **Definition of switching losses**

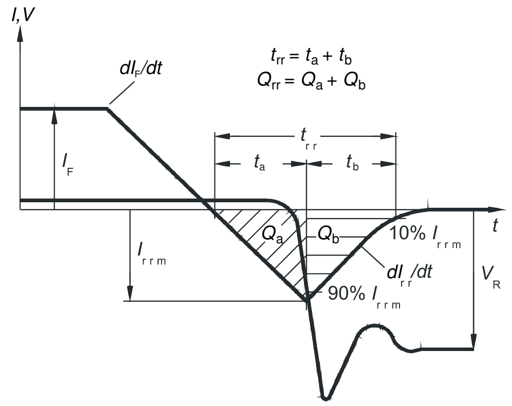



Figure C. **Definition of diode switching characteristics**

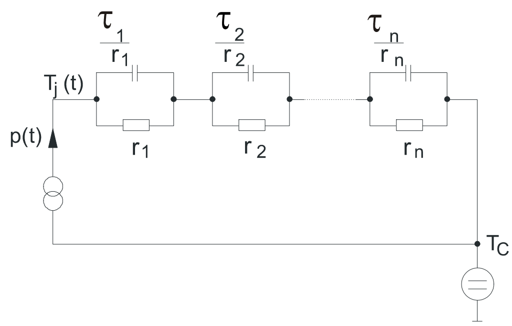



Figure D. **Thermal equivalent circuit**

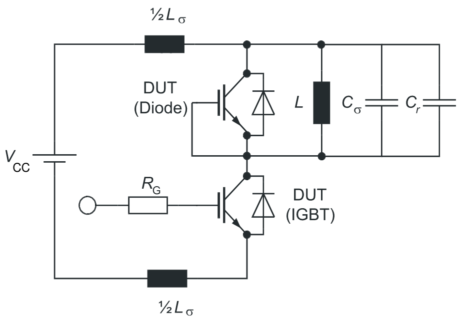



Figure E. **Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

**Figure 2**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| V0.1 | | Target 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 | 2022-11-23 | Final datasheet |
| 1.10 | 2023-06-30 | Editorial changes on cover page |

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