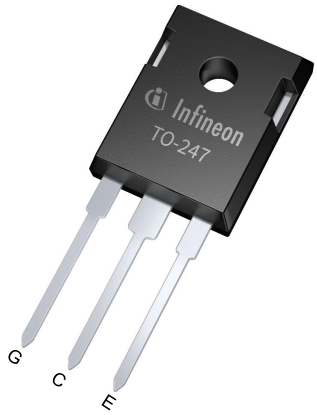
# IKW50N120CH7

**High speed 1200 V TRENCHSTOP™ IGBT 7 Technology**

## High speed 1200 V TRENCHSTOP™ IGBT 7 Technology co-packed with full rated current, soft-commutating, ultra-fast recovery and low Qrr emitter controlled 7 Rapid diode




### Features

- $V_{CE}$ = 1200 V
- $I_C$ = 50 A
- Maximum junction temperature $T_{vjmax}$ = 175°C
- Best-in-class high speed IGBT co-packed with full rated current, low $Q_{rr}$ and soft-commutating high speed diode
- Low saturation voltage $V_{CEsat}$ = 1.7 V at $T_{vj}$ = 25°C
- Optimized for high efficiency in high speed hard switching topologies (2-L inverter, 3-L NPC T-type, ...)
- Easy paralleling capability due to positive temperature coefficient in $V_{CEsat}$
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

Halogen-free

Lead-free

Green

RoHS

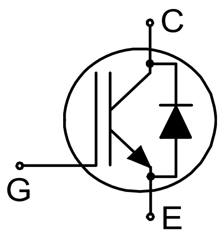
### Potential applications

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

### Product validation

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

### Description




| Type | Package | Marking |
|---|---|---|
| IKW50N120CH7 | PG-TO247-3-STD-NN2.5 | K50MCH7 |

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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 process: 3 | | | 0.6 | Nm |
| Thermal resistance, junction-ambient | $R_{th(j\text{-}a)}$ | | | | 40 | K/W |
| IGBT thermal resistance, junction-case | $R_{th(j\text{-}c)}$ | | | 0.29 | 0.38 | K/W |
| Diode thermal resistance, junction-case | $R_{th(j\text{-}c)}$ | | | 0.5 | 0.65 | 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 | | 1200 | V |
| DC collector current, limited by $T_{vjmax}$ | $I_C$ | limited by bondwire | $T_c = 25$ °C | 86 | A |
| | | | $T_c = 100$ °C | 73 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ | | | 200 | A |
| Turn-off safe operating area | | $V_{CC} \leq 800$ V, $V_{CE,peak} < 1200$ V, $V_{GE} = 0/15$ V, $R_{Goff} \geq 8\ \Omega$, $T_{vj} \leq 175$ °C | | 200 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p \leq 0.5$ µs, $D < 0.001$ | | ±25 | V |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 398 | W |
| | | | $T_c = 100$ °C | 199 | |

**Table 3 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $I_C = 50$ A, $V_{GE} = 15$ V | $T_{vj} = 25$ °C | | 1.7 | 2.15 | V |
| | | | $T_{vj} = 175$ °C | | 2 | | |

**(table continues...)**

**Table 3 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C$ = 0.8 mA, $V_{CE} = V_{GE}$ | | 4.7 | 5.5 | 6.2 | V |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 1200 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 40 | µA |
| | | | $T_{vj}$ = 175 °C | | 3500 | | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V | | | | 100 | nA |
| Transconductance | $g_{fs}$ | $I_C$ = 50 A, $V_{CE}$ = 20 V | | | 91 | | S |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 6.6 | | nF |
| Output capacitance | $C_{oes}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 133 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 100 kHz | | | 37 | | pF |
| Gate charge | $Q_G$ | $I_C$ = 50 A, $V_{GE}$ = 15 V, $V_{CC}$ = 960 V | | | 375 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 39 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 37 | | |
| Rise time (inductive load) | $t_r$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 27 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 30 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 319 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 387 | | |
| Fall time (inductive load) | $t_f$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 41 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 127 | | |
| Turn-on energy | $E_{on}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 2.33 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 3.49 | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 1.12 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 2.74 | | |

**(table continues...)**

**Table 3 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Total switching energy | $E_{ts}$ | $V_{CC}$ = 600 V, $V_{GE}$ = 0/15 V, $R_{G(on)}$ = 8 Ω, $R_{G(off)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_C$ = 50 A | | 3.45 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_C$ = 50 A | | 6.23 | | |
| 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 |
|---|---|---|---|---|---|
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | limited by bondwire | $T_c$ = 25 °C | 77 | A |
| | | | $T_c$ = 100 °C | 51 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpulse}$ | | | 200 | A |
| Power dissipation | $P_{tot}$ | | $T_c$ = 25 °C | 231 | W |
| | | | $T_c$ = 100 °C | 115 | |

**Table 5 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F$ = 50 A | $T_{vj}$ = 25 °C | | 2.5 | 3 | V |
| | | | $T_{vj}$ = 175 °C | | 2.3 | | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 600 V, $R_{G(on)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_F$ = 50 A | | 116 | | ns |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 50 A | | 194 | | |
| Diode reverse recovery charge | $Q_{rr}$ | $V_R$ = 600 V, $R_{G(on)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_F$ = 50 A | | 1.48 | | µC |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 50 A | | 3.71 | | |
| Diode peak reverse recovery current | $I_{rrm}$ | $V_R$ = 600 V, $R_{G(on)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_F$ = 50 A | | 28 | | A |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 50 A | | 41 | | |

**(table continues...)**

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

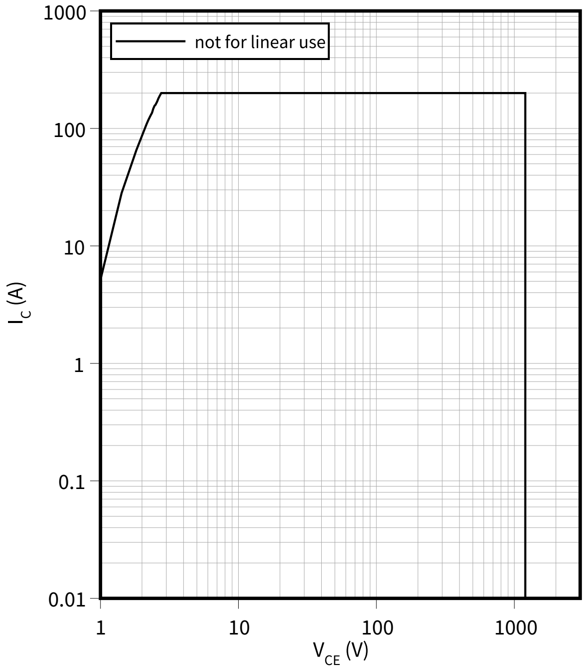
| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $V_R$ = 600 V, $R_{G(on)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_F$ = 50 A | | -383 | | A/µs |
| | | | $T_{vj}$ = 150 °C, $I_F$ = 50 A | | -323 | | |
| Reverse recovery energy | $E_{rec}$ | $V_R$ = 600 V, $R_{G(on)}$ = 8 Ω | $T_{vj}$ = 25 °C, $I_F$ = 50 A | | 0.43 | | mJ |
| | | | $T_{vj}$ = 175 °C, $I_F$ = 50 A | | 1.22 | | |
| 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.*

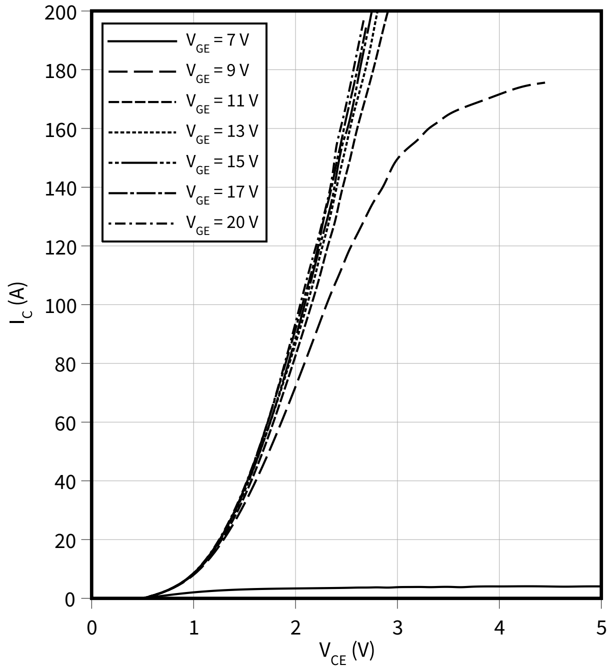
*Dynamic test circuit, parasitic inductance $L_\sigma$ = 30 nH, $C_\sigma$ = 18 pF*

# 4 Characteristics diagrams

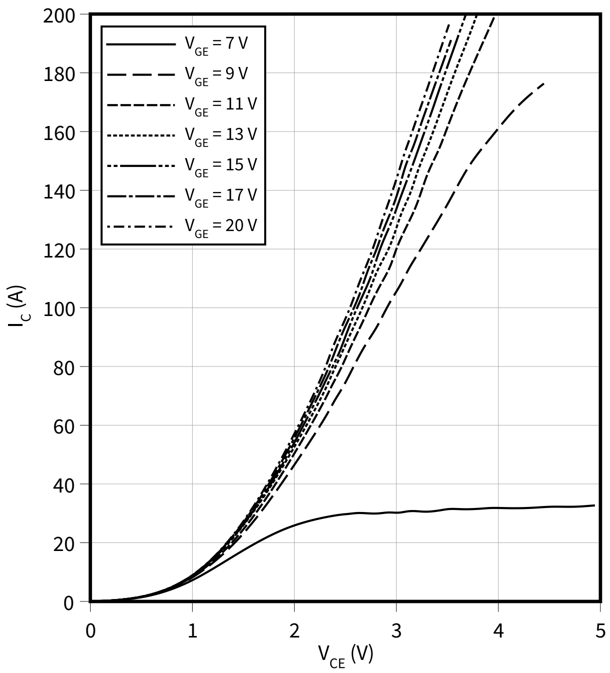
**Reverse bias safe operating area**
$I_C = f(V_{CE})$
$T_{vj} \leq 175\ °C$, $V_{GE} = 0/15\ V$



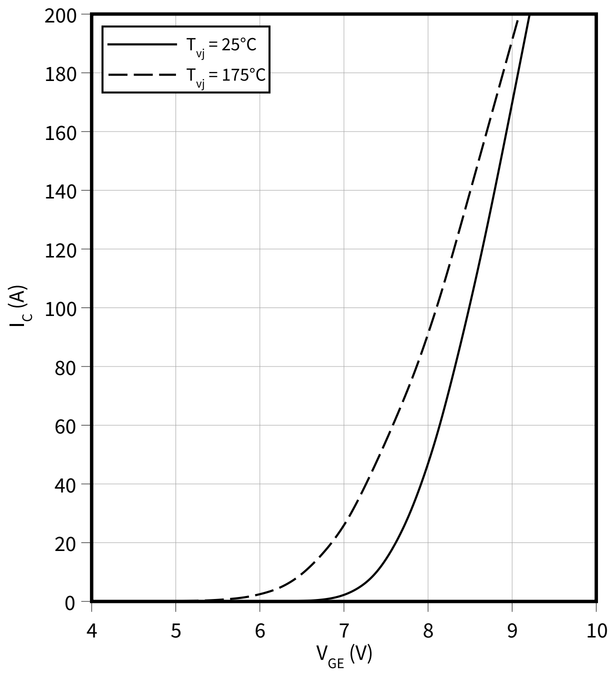

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 25\ °C$




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



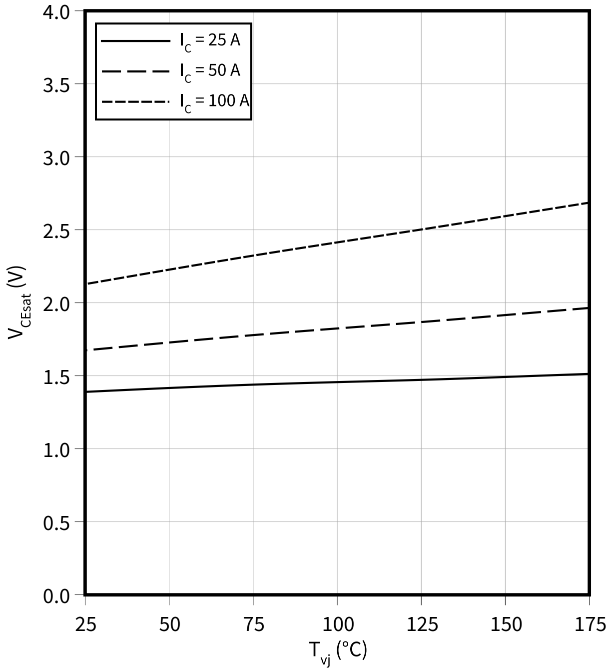

**Typical transfer characteristic**
$I_C = f(V_{GE})$
$V_{CE} = 20\ V$



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

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

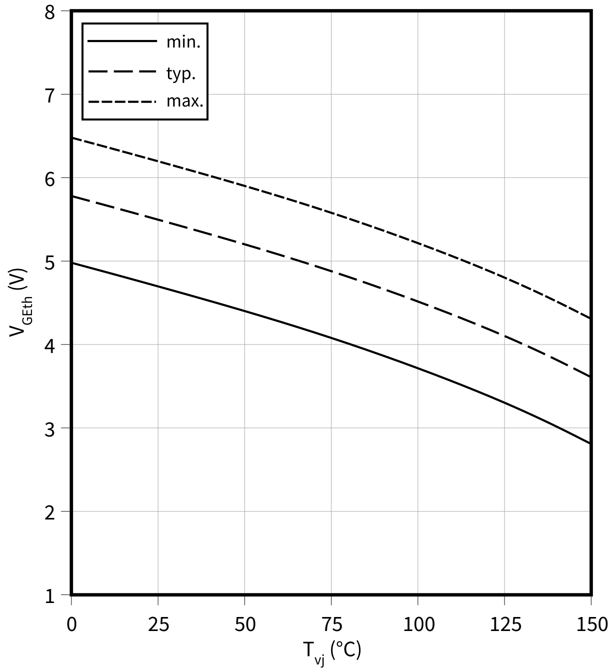
$V_{GE} = 15$ V




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

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

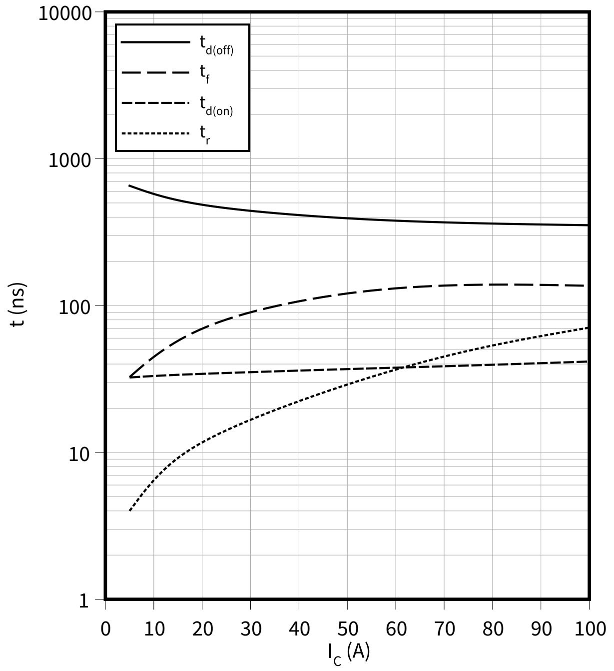
$I_C = 0.85$ mA




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

$t = f(I_C)$

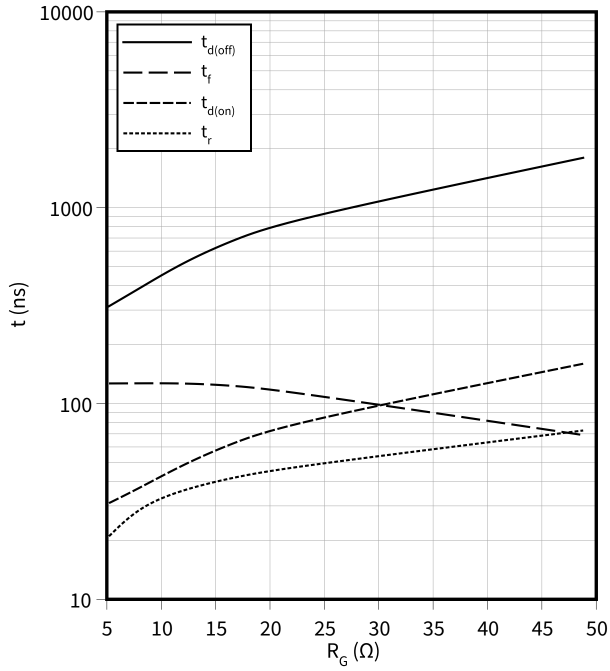
$V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V, $R_G = 8\ \Omega$




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

$t = f(R_G)$

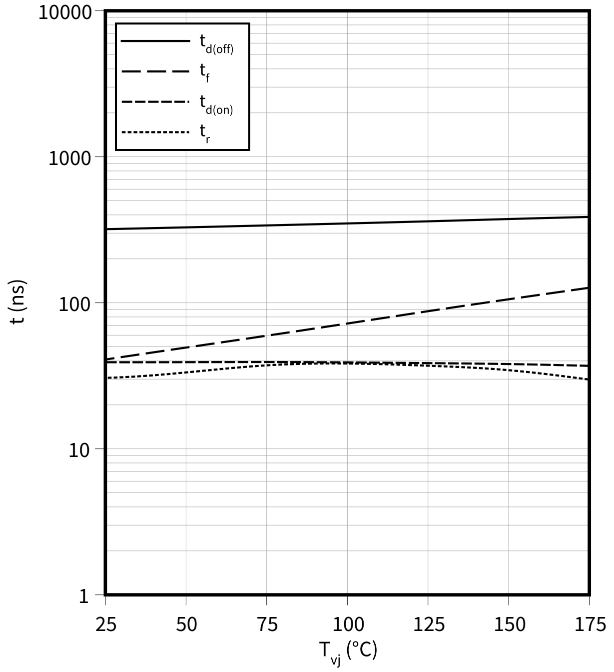
$I_C = 50$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$t = f(T_{vj})$

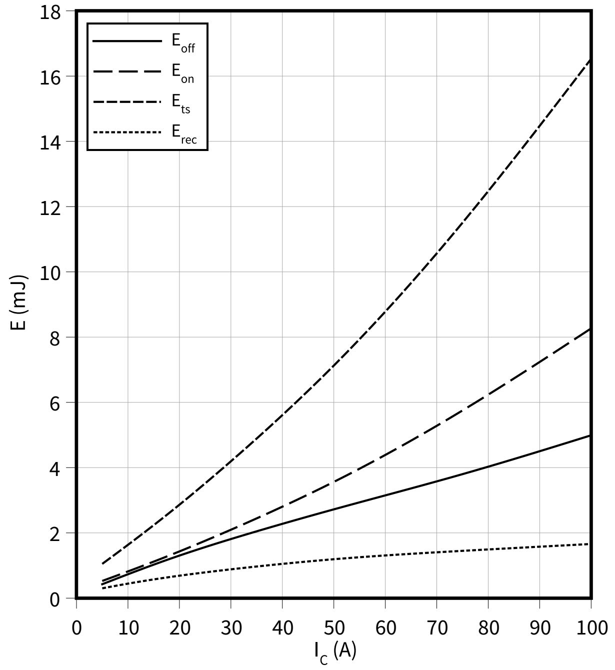
$I_C = 50\ A$, $V_{CC} = 600\ V$, $V_{GE} = 0/15\ V$, $R_G = 8\ \Omega$




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

$E = f(I_C)$

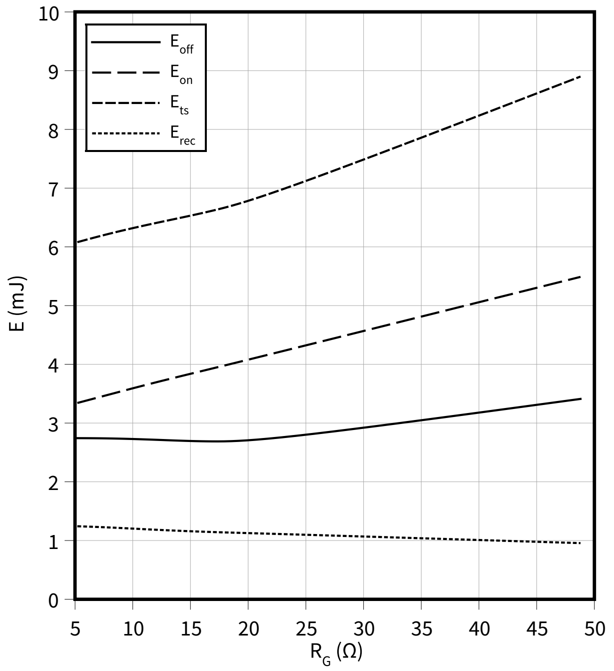
$V_{CC} = 600\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 8\ \Omega$




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

$E = f(R_G)$

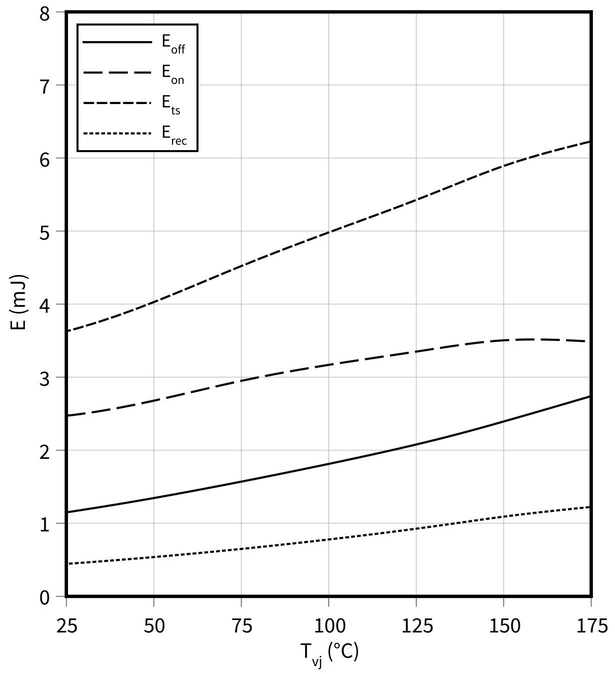
$I_C = 50\ A$, $V_{CC} = 600\ V$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$




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

$E = f(T_{vj})$

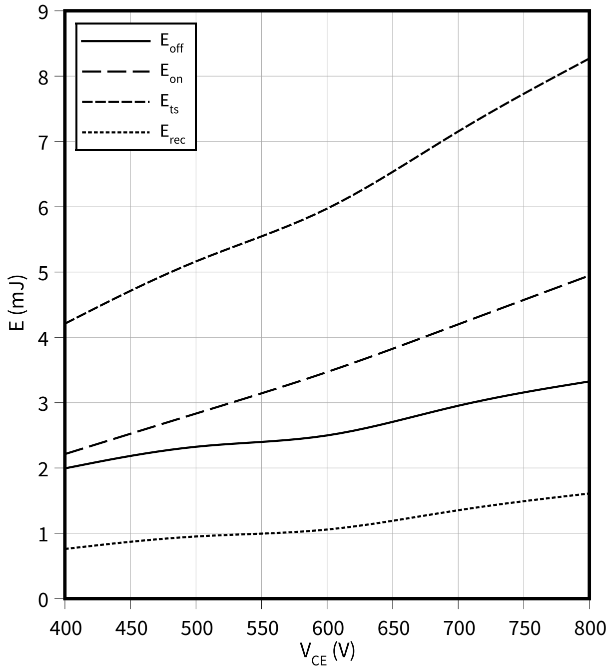
$I_C = 50\ A$, $V_{CC} = 600\ V$, $V_{GE} = 0/15\ V$, $R_G = 8\ \Omega$



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

$E = f(V_{CE})$

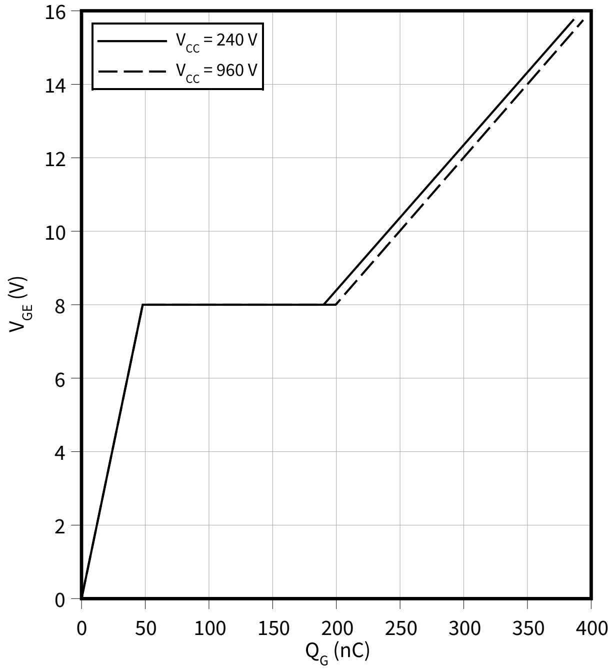
$I_C = 50\ A$, $T_{vj} = 175\ °C$, $V_{GE} = 0/15\ V$, $R_G = 8\ \Omega$




### Typical gate charge

$V_{GE} = f(Q_G)$

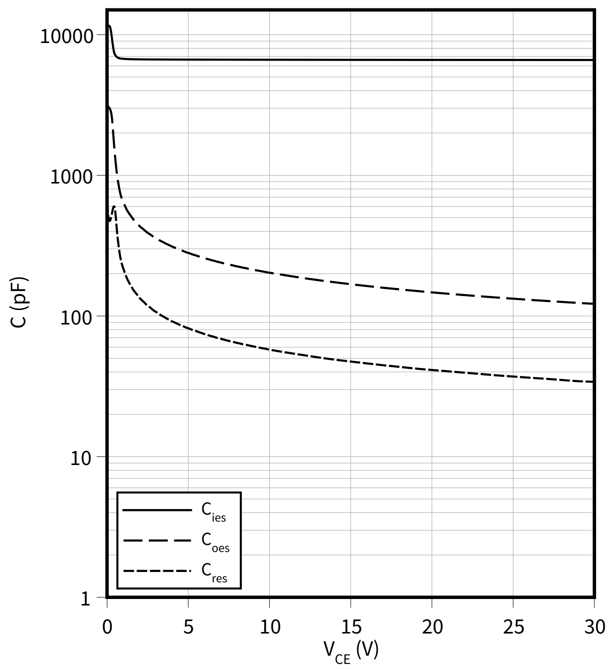
$I_C = 50\ A$




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

$C = f(V_{CE})$

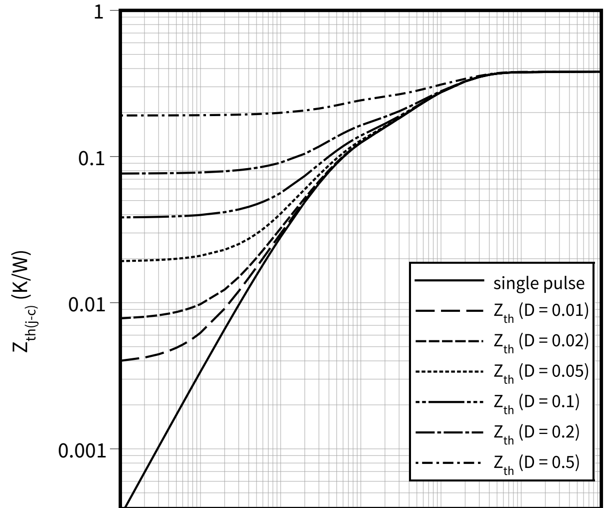
$f = 100\ kHz$, $V_{GE} = 0\ V$




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

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

$D = t_p/T$

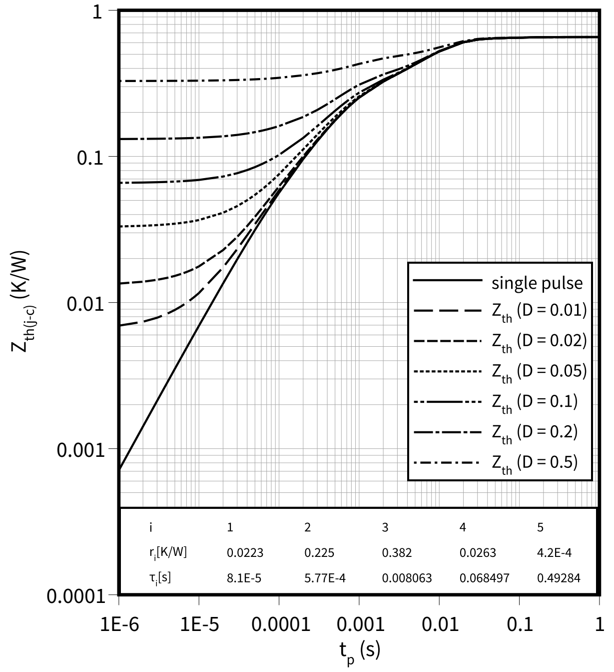



| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $r_i$[K/W] | 0.00357 | 0.09454 | 0.108182 | 0.1699014 | 0.004854 | 8.584E-4 |
| $\tau_i$[s] | 5.5E-5 | 3.86E-4 | 0.00416 | 0.016089 | 0.2589 | 6.6029 |

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

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

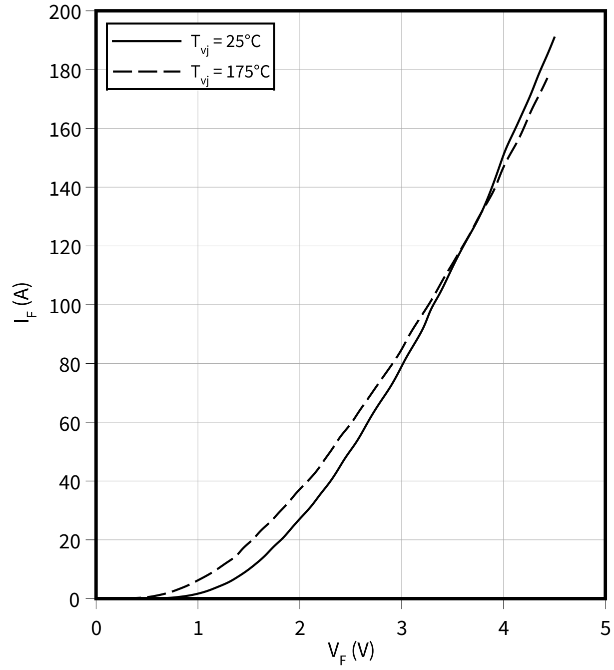
$D = t_p/T$




| i | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $r_i$[K/W] | 0.0223 | 0.225 | 0.382 | 0.0263 | 4.2E-4 |
| $\tau_i$[s] | 8.1E-5 | 5.77E-4 | 0.008063 | 0.068497 | 0.49284 |

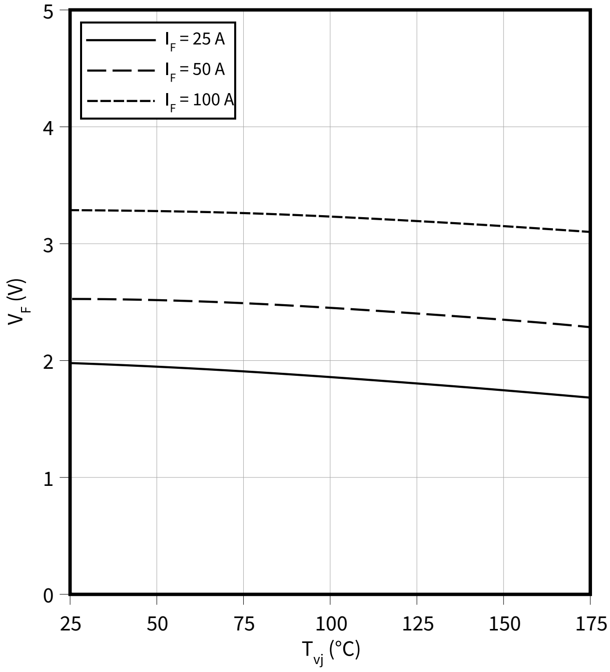
### Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$




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

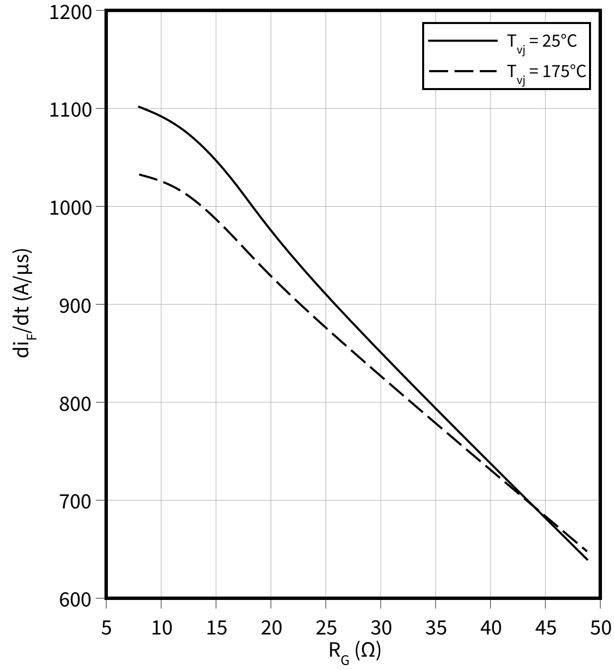
$V_F = f(T_{vj})$




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

$di_F/dt = f(R_G)$

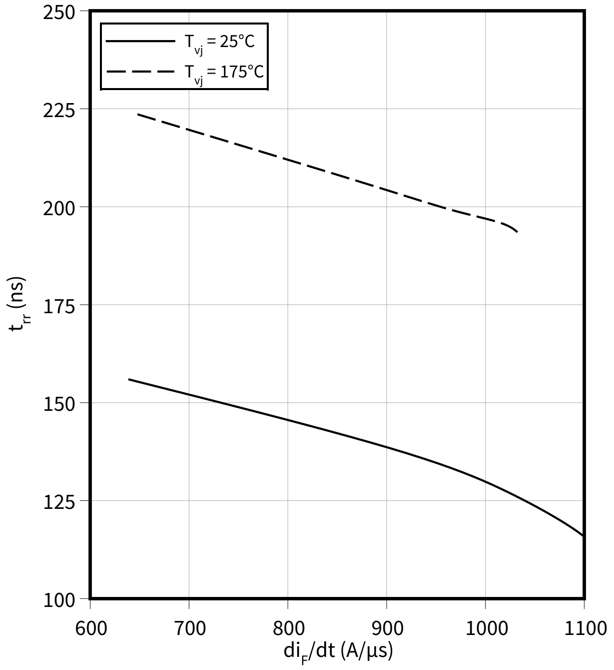
$V_R = 600\ V$, $I_F = 50\ A$



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

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

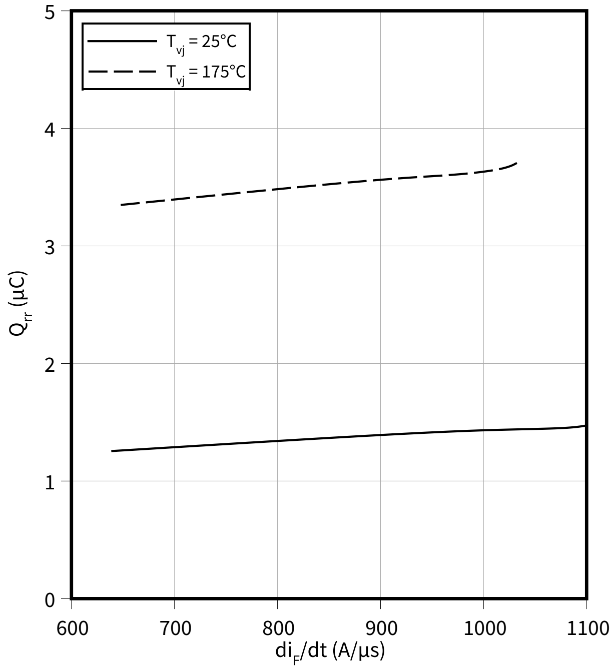
$V_R = 600$ V, $I_F = 50$ A




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

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

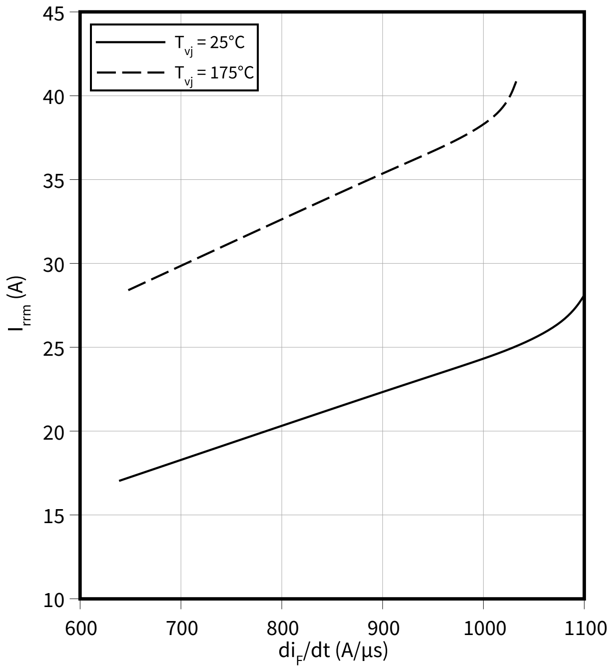
$V_R = 600$ V, $I_F = 50$ A




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

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

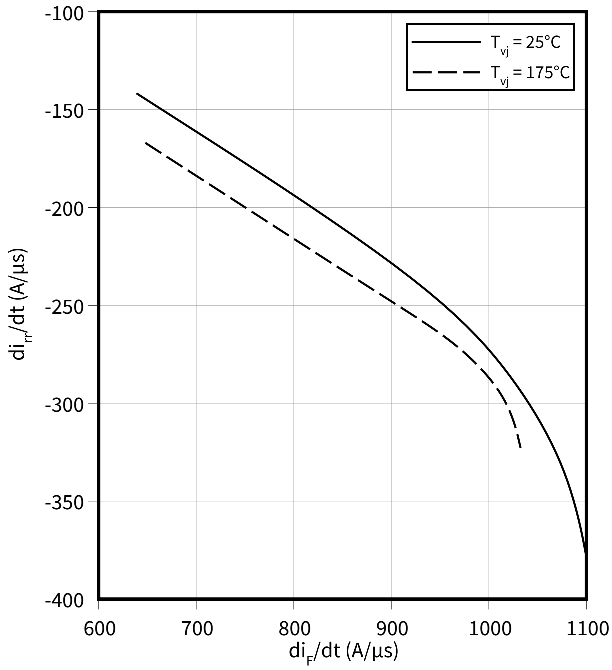
$V_R = 600$ V, $I_F = 50$ A

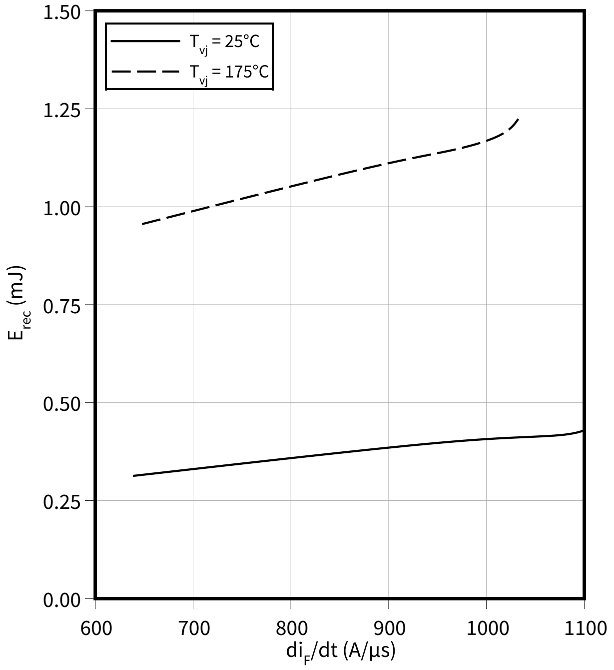



**Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

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

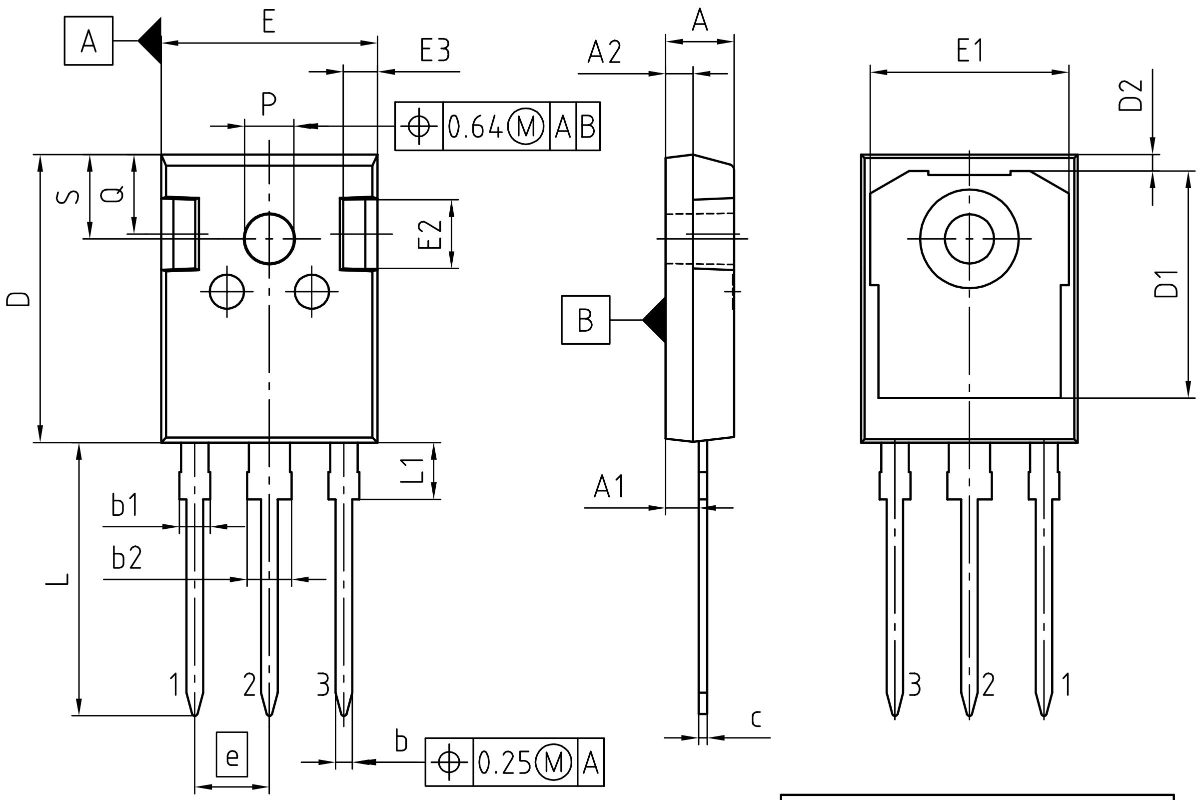
$V_R = 600$ V, $I_F = 50$ A



| **Typical reverse energy losses as a function of diode current slope**<br>$E_{rec} = f(di_F/dt)$<br>$V_R = 600$ V, $I_F = 50$ A | |
|---|---|
|  | |

# 5 Package outlines

PG-TO247-3-STD-NN2.5




| PACKAGE - GROUP NUMBER: | PG-TO247-3-U06 | |
|---|---|---|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 4.83 | 5.21 |
| A1 | 2.27 | 2.54 |
| A2 | 1.85 | 2.16 |
| b | 1.07 | 1.33 |
| b1 | 1.90 | 2.41 |
| b2 | 2.87 | 3.38 |
| c | 0.55 | 0.68 |
| D | 20.80 | 21.10 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.35 |
| E | 15.70 | 16.13 |
| E1 | 13.10 | 14.15 |
| E2 | 3.68 | 5.10 |
| E3 | 1.00 | 2.60 |
| e | 5.44 | |
| N | 3 | |
| L | 19.80 | 20.32 |
| L1 | 4.10 | 4.47 |
| øP | 3.50 | 3.70 |
| Q | 5.49 | 6.00 |
| S | 6.04 | 6.30 |

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

**Figure 1**

# 6 Testing conditions

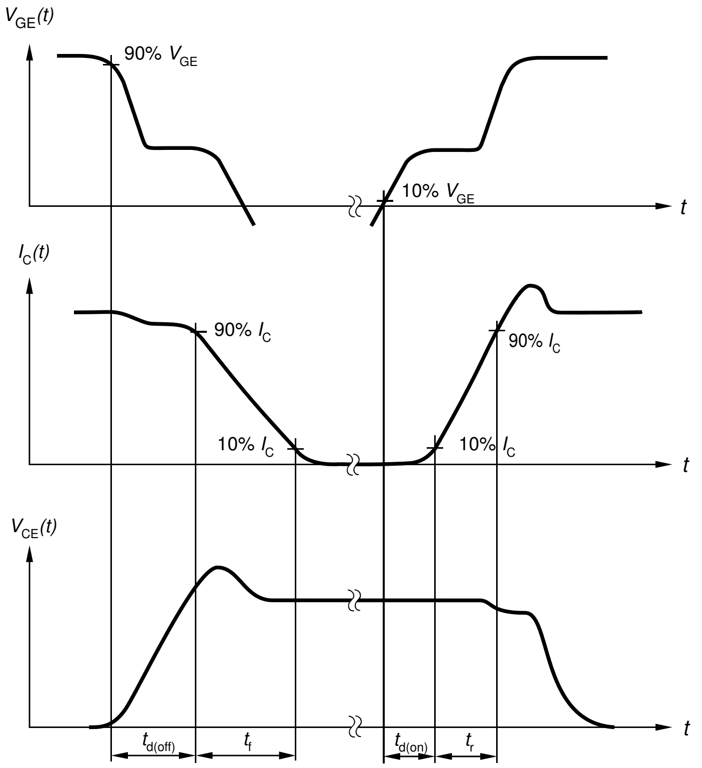



Figure A. **Definition of switching times**

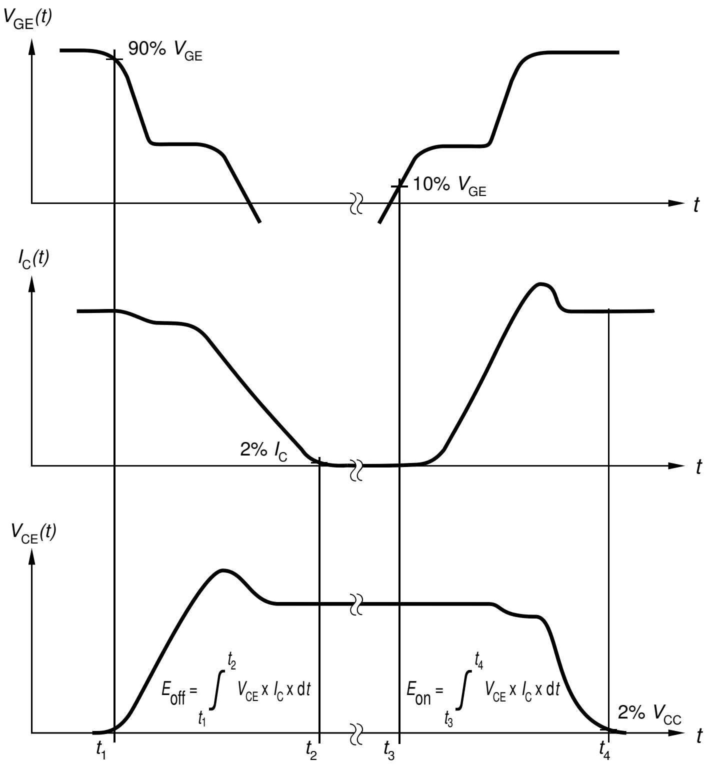



Figure B. **Definition of switching losses**

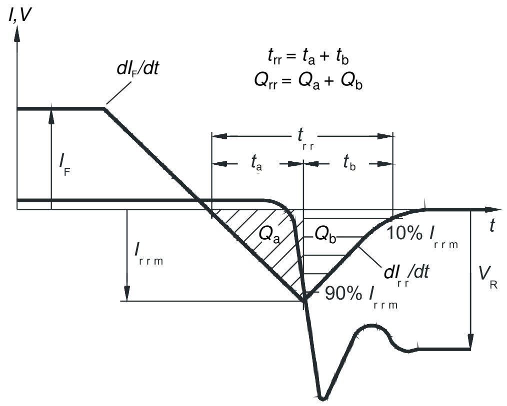



Figure C. **Definition of diode switching characteristics**

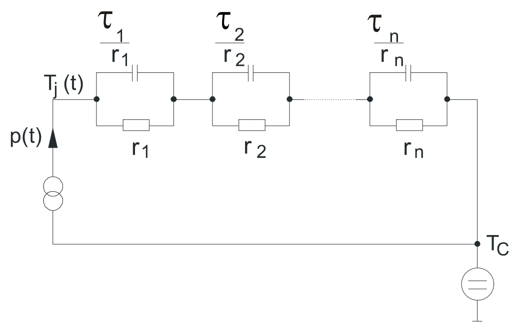



Figure D. **Thermal equivalent circuit**

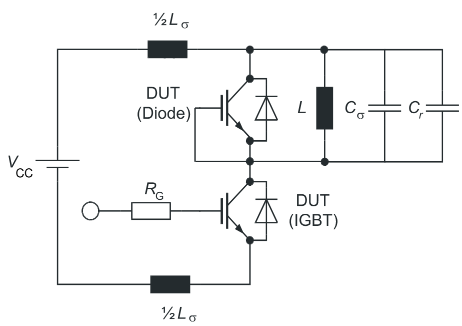



Figure E. **Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

**Figure 2**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| 0.10 | 2022-05-02 | Target datasheet |
| 0.20 | 2022-05-19 | Editorial changes |
| 0.30 | 2022-06-01 | Editorial changes |
| 1.00 | 2022-11-02 | Final datasheet |
| 1.10 | 2022-11-25 | Update of potential applications |

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**Edition 2022-11-25**

**Published by**

**Infineon Technologies AG**

**81726 Munich, Germany**



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**Document reference**
**IFX-ABB244-005**