# IGBT

High speed 5 IGBT in TRENCHSTOP$^{TM}$ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

# IKZ75N65EH5

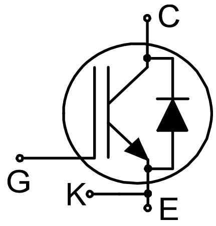
650V DuoPack IGBT and diode
High speed series fifth generation

## Data sheet

Industrial Power Control

# High speed 5 IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

**Features and Benefits:**




High speed H5 technology offering
- Ultra low loss switching thanks to Kelvin emitter pin in combination with TRENCHSTOP™ 5
- Best-in-class efficiency in hard switching and resonant topologies
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low gate charge $Q_G$
- IGBT copacked with RAPID 1 fast and soft antiparallel diode
- Maximum junction temperature 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/igbt/


**Applications**

- Uninterruptible power supplies
- Welding converters
- Mid to high range switching frequency converters
- Solar string inverters

**Package pin definition:**

- Pin C & backside - collector
- Pin E - emitter
- Pin K - Kelvin emitter
- Pin G - gate

Please note: The emitter and Kelvin emitter pins are not exchangeable. Their exchange might lead to malfunction.

Green

Halogen-Free

RoHS

**Key Performance and Package Parameters**

| Type | $V_{CE}$ | $I_C$ | $V_{CEsat}$, $T_{vj}$=25°C | $T_{vjmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IKZ75N65EH5 | 650V | 75A | 1.65V | 175°C | K75EEH5 | PG-TO247-4 |

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## Maximum Ratings

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

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage, $T_{vj} \geq 25°C$ | $V_{CE}$ | 650 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25°C$ value limited by bondwire<br>$T_C = 100°C$ | $I_C$ | 90.0<br>75.0 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$[1) | $I_{Cpuls}$ | 300.0 | A |
| Turn off safe operating area<br>$V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1µs$[1) | - | 300.0 | A |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C = 25°C$ value limited by bondwire<br>$T_C = 100°C$ | $I_F$ | 95.0<br>85.0 | A |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$[1) | $I_{Fpuls}$ | 300.0 | A |
| Gate-emitter voltage<br>Transient Gate-emitter voltage ($t_p \leq 10µs$, D < 0.010) | $V_{GE}$ | ±20<br>±30 | V |
| Power dissipation $T_C = 25°C$<br>Power dissipation $T_C = 100°C$ | $P_{tot}$ | 395.0<br>197.0 | W |
| Operating junction temperature | $T_{vj}$ | -40...+175 | °C |
| Storage temperature | $T_{stg}$ | -55...+150 | °C |
| Soldering temperature,<br>wave soldering 1.6mm (0.063in.) from case for 10s | | 260 | °C |
| Mounting torque, M3 screw<br>Maximum of mounting processes: 3 | $M$ | 0.6 | Nm |

## Thermal Resistance

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---|---|---|---|
| **Characteristic** | | | | |
| IGBT thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | 0.38 | K/W |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | 0.46 | K/W |
| Thermal resistance<br>junction - ambient | $R_{th(j-a)}$ | | 40 | K/W |

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

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

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Static Characteristic** | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0V, $I_C$ = 0.20mA | 650 | - | - | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = 15.0V, $I_C$ = 75.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 100°C<br>$T_{vj}$ = 150°C | -<br>-<br>- | 1.65<br>1.82<br>1.90 | 2.10<br>-<br>- | V |
| Diode forward voltage | $V_F$ | $V_{GE}$ = 0V, $I_F$ = 75.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 100°C<br>$T_{vj}$ = 150°C | -<br>-<br>- | 1.35<br>1.33<br>1.30 | 1.70<br>-<br>- | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.75mA, $V_{CE}$ = $V_{GE}$ | 3.2 | 4.0 | 4.8 | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$ = 650V, $V_{GE}$ = 0V<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | -<br>- | -<br>3300.0 | 75.0<br>- | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = 20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$ = 20V, $I_C$ = 75.0A | - | 104.0 | - | S |

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

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | - | 4300 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 130 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 16 | - | |
| Gate charge | $Q_G$ | $V_{CC}$ = 520V, $I_C$ = 75.0A,<br>$V_{GE}$ = 15V | - | 166.0 | - | nC |
| Internal emitter inductance[1)] measured 5mm (0.197 in.) from case | $L_E$ | | - | 13.0 | - | nH |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 25°C** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$ = 25°C,<br>$V_{CC}$ = 400V, $I_C$ = 37.5A,<br>$V_{GE}$ = 0.0/15.0V,<br>$R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 18.0Ω,<br>$L\sigma$ = 30nH, $C\sigma$ = 25pF<br>$L\sigma$, $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | - | 26 | - | ns |
| Rise time | $t_r$ | | - | 11 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 347 | - | ns |
| Fall time | $t_f$ | | - | 15 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 0.68 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.43 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 1.11 | - | mJ |

1) The internal emitter inductance does not affect the gate control circuitry if bypassed by using the emitter sense pin.

**Diode Characteristic, at $T_{vj}$ = 25°C**

| | | | | | | |
|---|---|---|---|---|---|---|
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$ = 25°C,<br>$V_R$ = 400V,<br>$I_F$ = 37.5A,<br>$di_F/dt$ = 1500A/µs | - | 58 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.02 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 29.0 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -2800 | - | A/µs |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 150°C** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$ = 150°C,<br>$V_{CC}$ = 400V, $I_C$ = 37.5A,<br>$V_{GE}$ = 0.0/15.0V,<br>$R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 18.0Ω,<br>$L\sigma$ = 30nH, $C\sigma$ = 25pF<br>$L\sigma$, $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | - | 24 | - | ns |
| Rise time | $t_r$ | | - | 13 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 400 | - | ns |
| Fall time | $t_f$ | | - | 15 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 1.10 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.48 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 1.58 | - | mJ |

**Diode Characteristic, at $T_{vj}$ = 150°C**

| | | | | | | |
|---|---|---|---|---|---|---|
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$ = 150°C,<br>$V_R$ = 400V,<br>$I_F$ = 37.5A,<br>$di_F/dt$ = 1500A/µs | - | 91 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 2.58 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 42.0 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -1845 | - | A/µs |

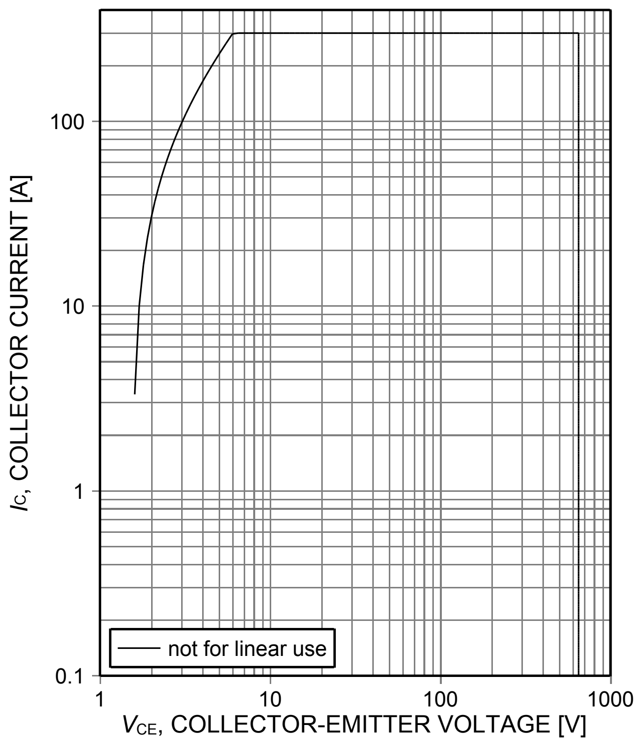



Figure 1. **Forward bias safe operating area**
($D$=0, $T_C$=25°C, $T_{vj}$≤175°C, $V_{GE}$=15V, $t_p$=1µs, $I_{Cmax}$ defined by design - not subject to production test)

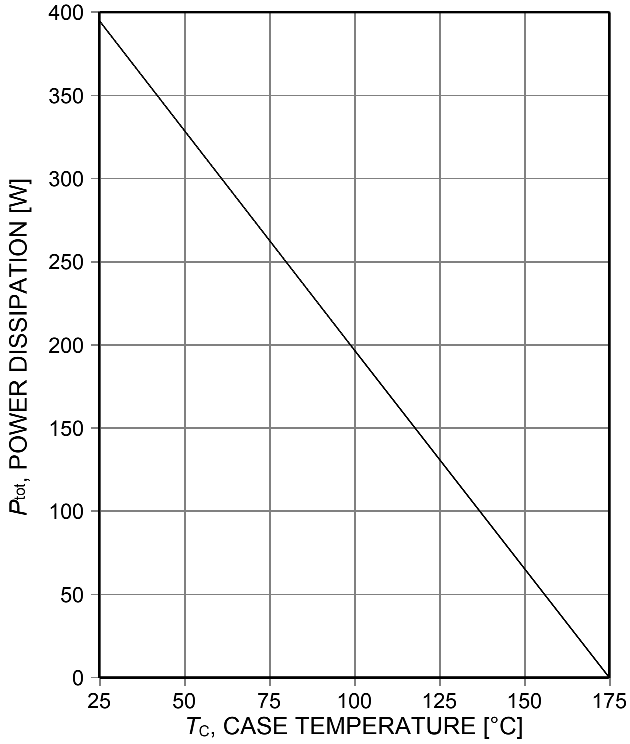



Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}$≤175°C)

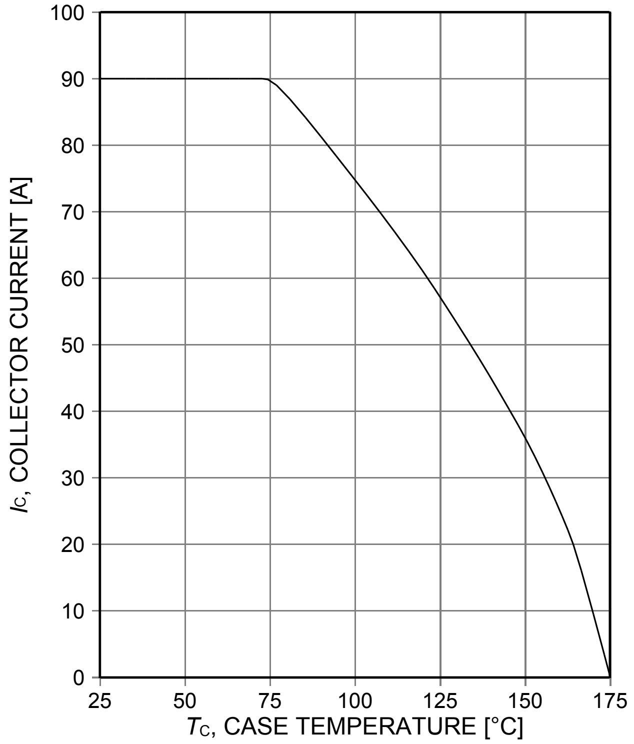



Figure 3. **Collector current as a function of case temperature**
($V_{GE}$≥15V, $T_{vj}$≤175°C)

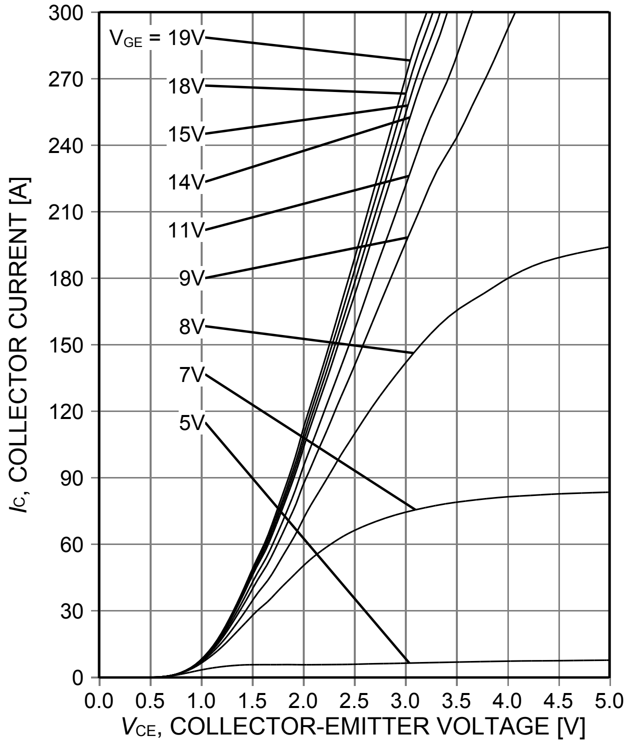



Figure 4. **Typical output characteristic**
($T_{vj}$=25°C)

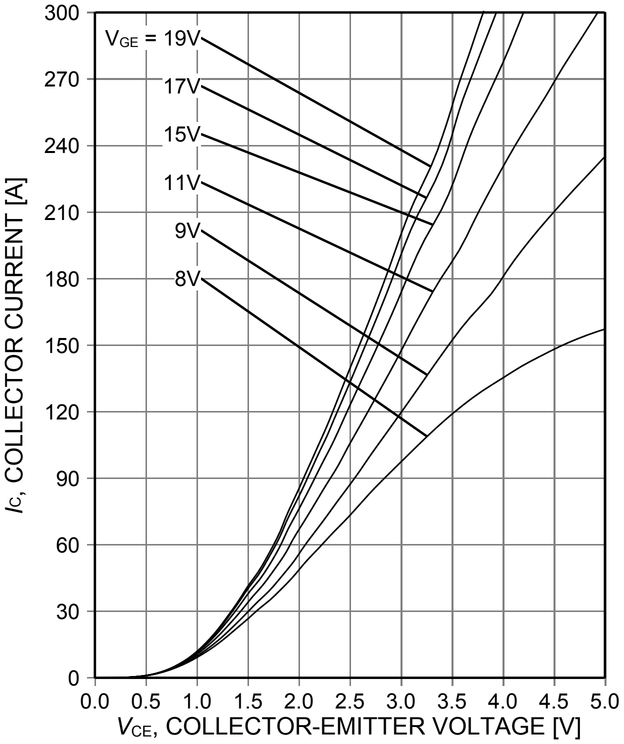



Figure 5. **Typical output characteristic**
($T_{vj}$=175°C)

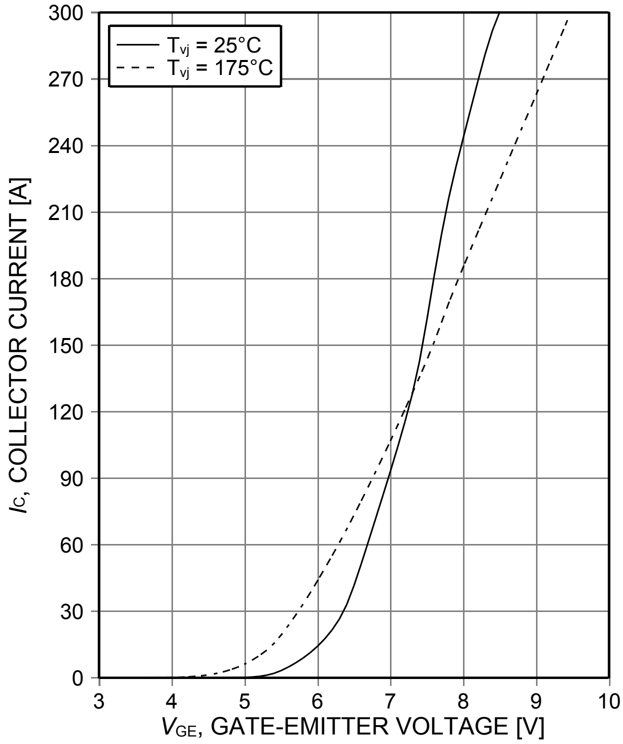



Figure 6. **Typical transfer characteristic**
($V_{CE}$=20V)

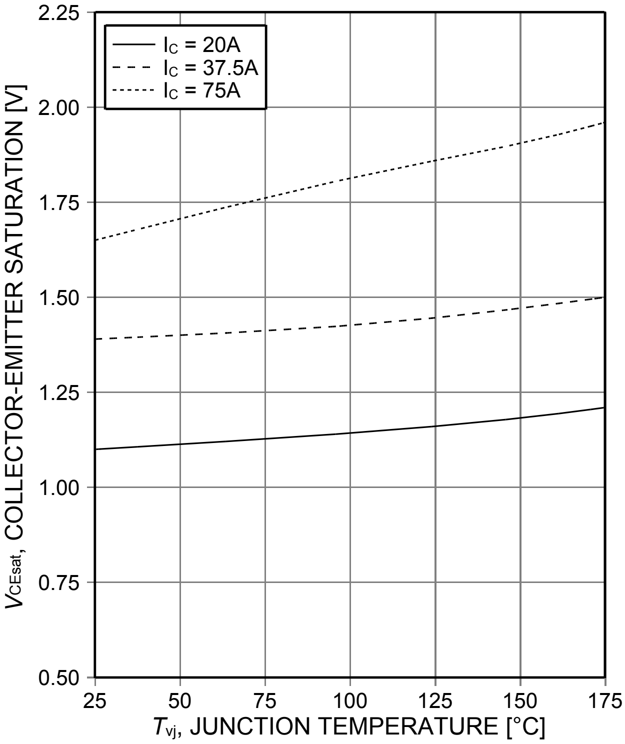



Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$=15V)

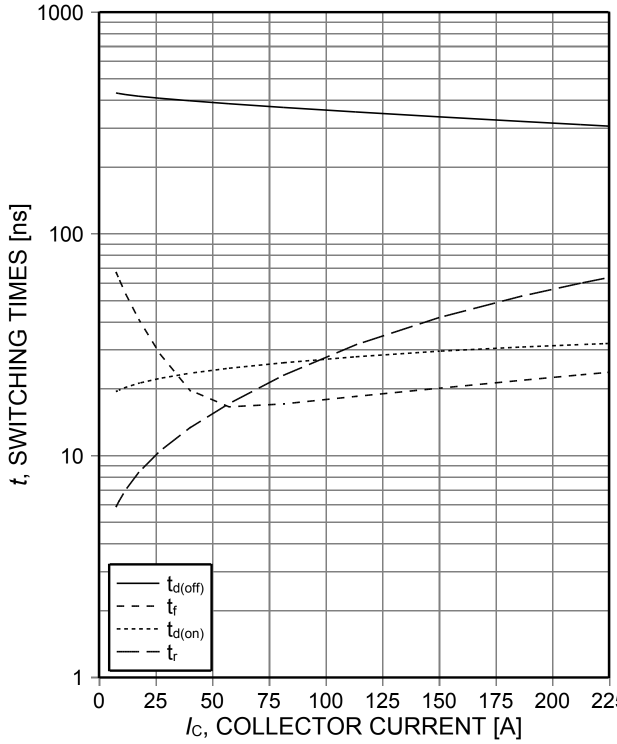



Figure 8. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=150°C, $V_{CE}$=400V, $V_{GE}$=0/15V, $R_{G(on)}$=10Ω, $R_{G(off)}$=18Ω, dynamic test circuit in Figure E)

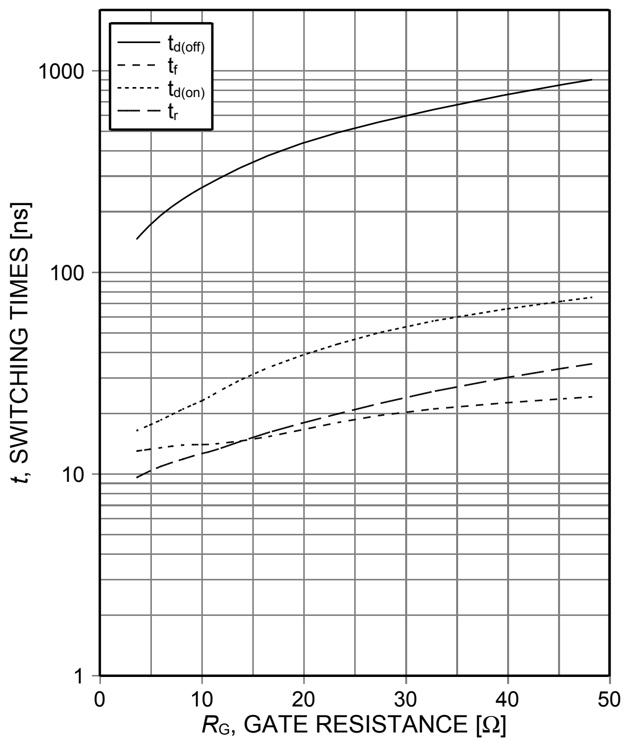



Figure 9. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}$=150°C, $V_{CE}$=400V, $V_{GE}$=0/15V, $I_C$=37.5A, dynamic test circuit in Figure E)

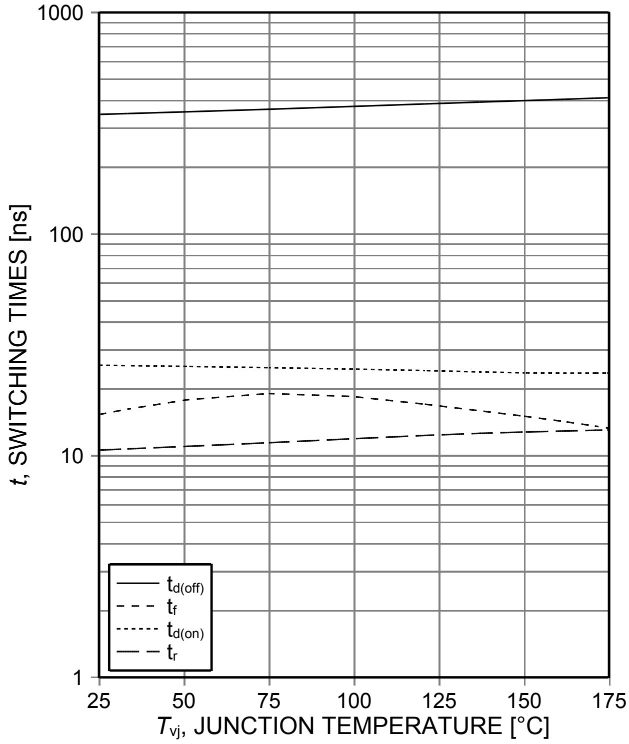



Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$=400V, $V_{GE}$=0/15V, $I_C$=37.5A, $R_{G(on)}$=10Ω, $R_{G(off)}$=18Ω, dynamic test circuit in Figure E)

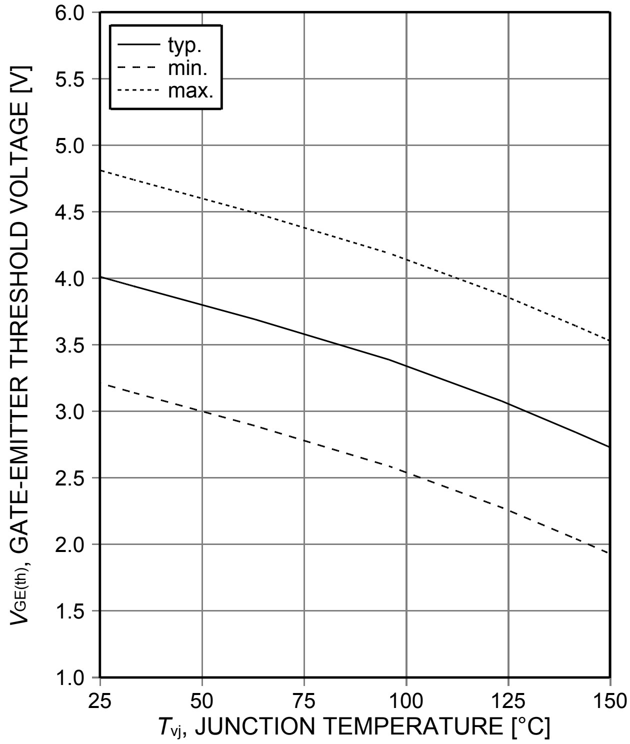



Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C$=0.75mA)

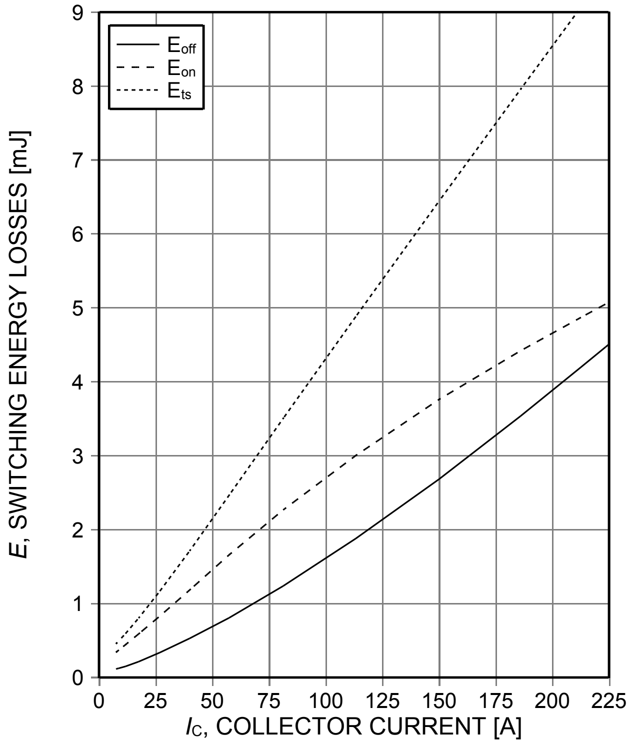



Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}$=150°C, $V_{CE}$=400V, $V_{GE}$=0/15V, $R_{G(on)}$=10Ω, $R_{G(off)}$=18Ω, dynamic test circuit in Figure E)

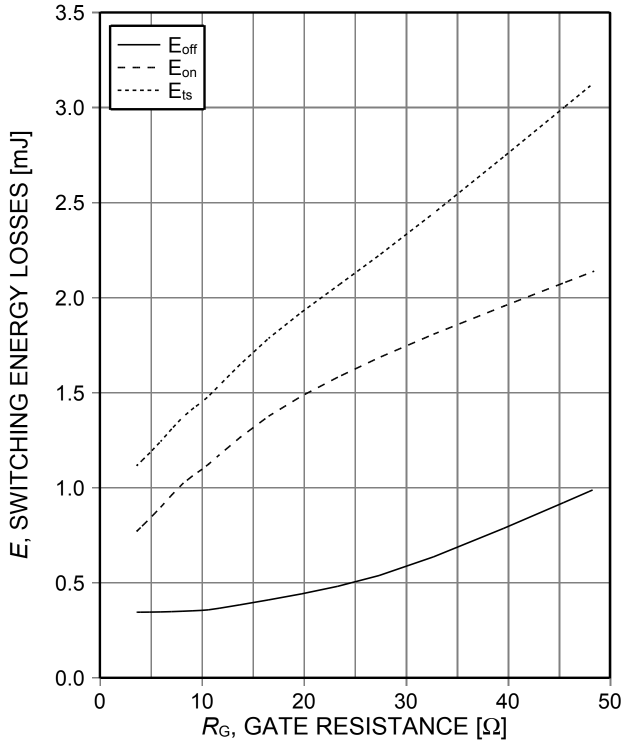



Figure 13. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}$=150°C, $V_{CE}$=400V, $V_{GE}$=0/15V, $I_C$=37.5A, dynamic test circuit in Figure E)

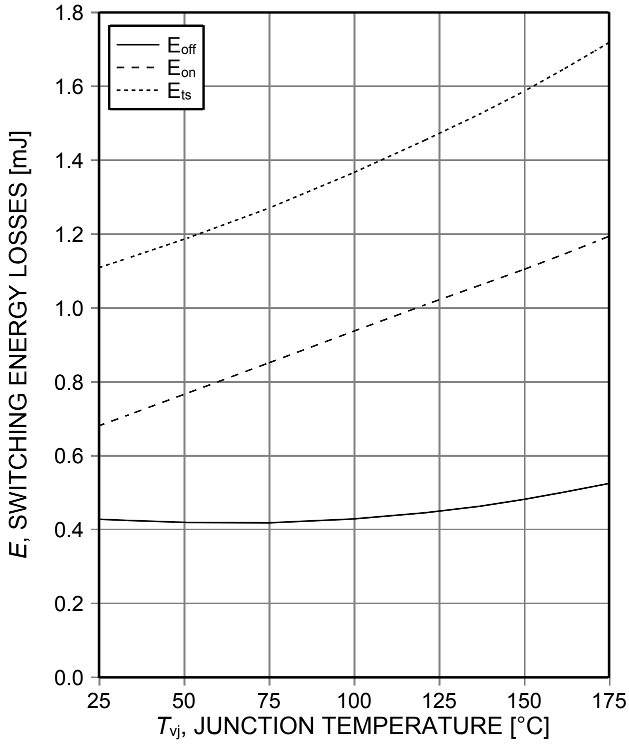



Figure 14. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}$=400V, $V_{GE}$=0/15V, $I_C$=37.5A, $R_{G(on)}$=10Ω, $R_{G(off)}$=18Ω, dynamic test circuit in Figure E)

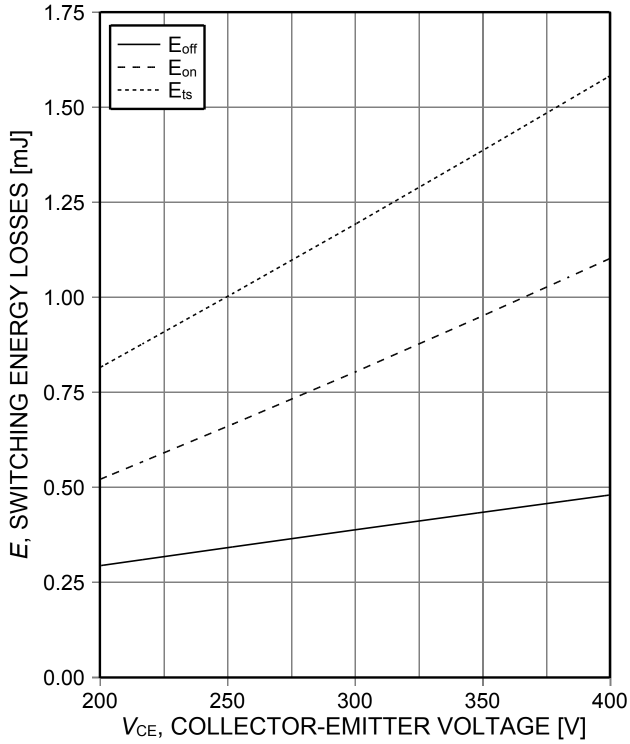



Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_{vj}$=150°C, $V_{GE}$=0/15V, $I_C$=37.5A, $R_{G(on)}$=10Ω, $R_{G(off)}$=18Ω, dynamic test circuit in Figure E)

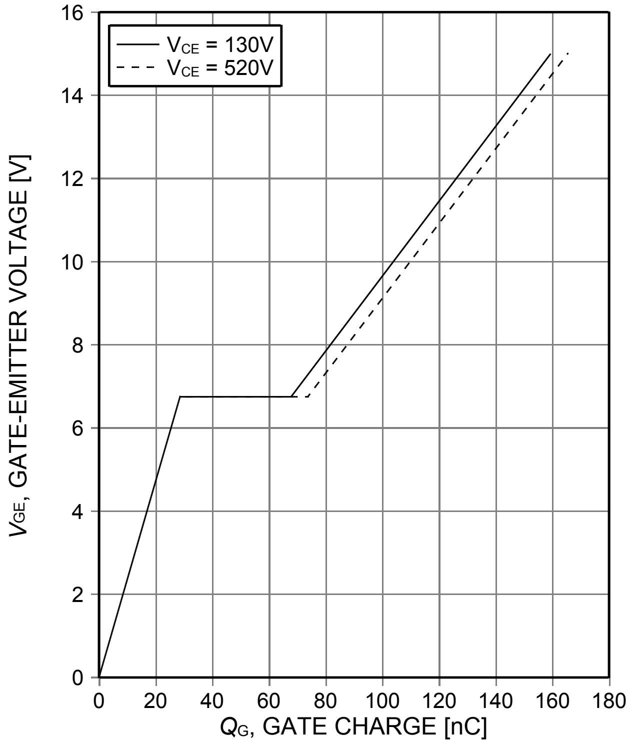



Figure 16. **Typical gate charge**
($I_C$=75A)

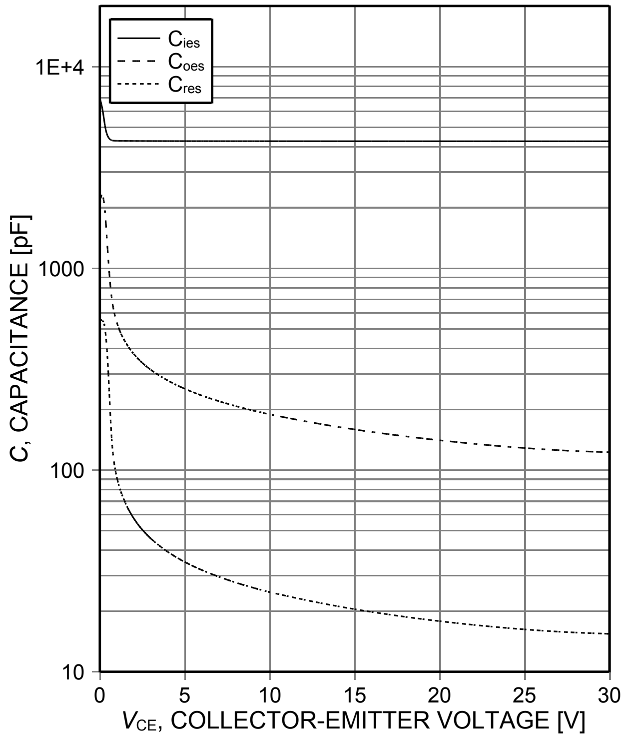



Figure 17. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

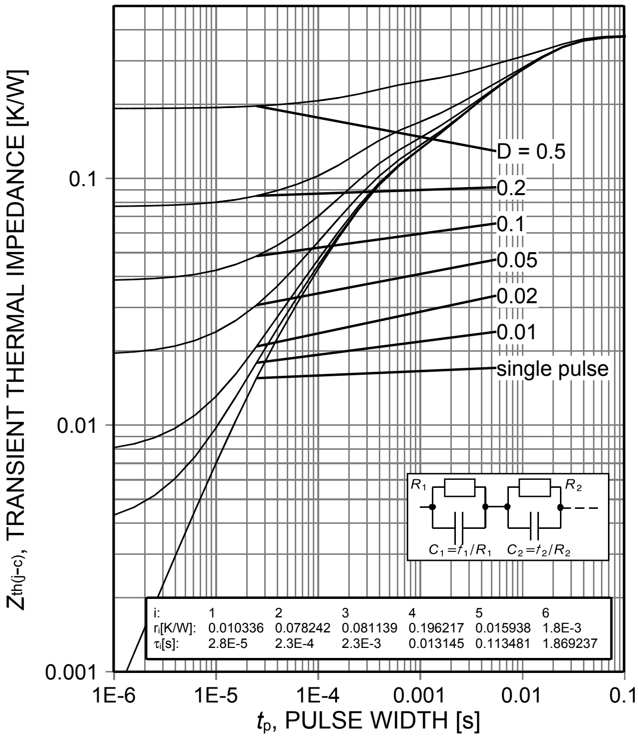



Figure 18. **IGBT transient thermal impedance**
($D$=$t_p$/T)

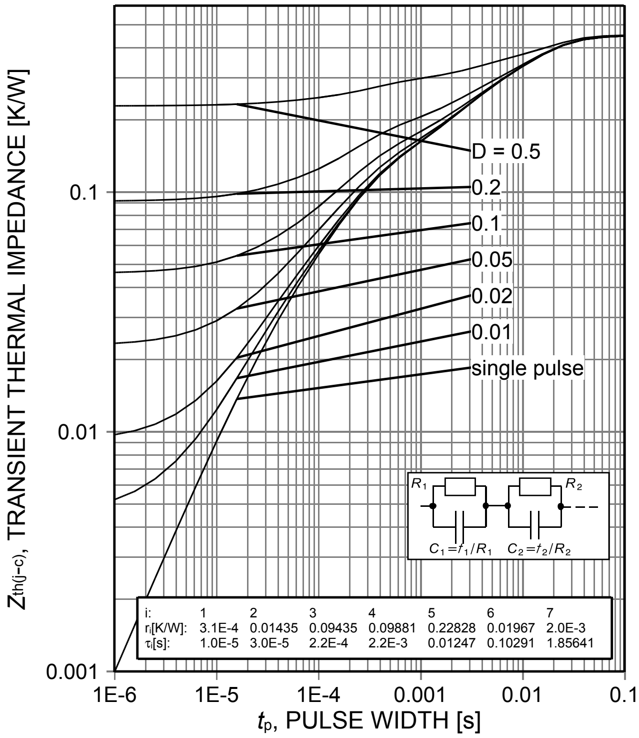



Figure 19. **Diode transient thermal impedance as a function of pulse width**
($D$=$t_p$/T)

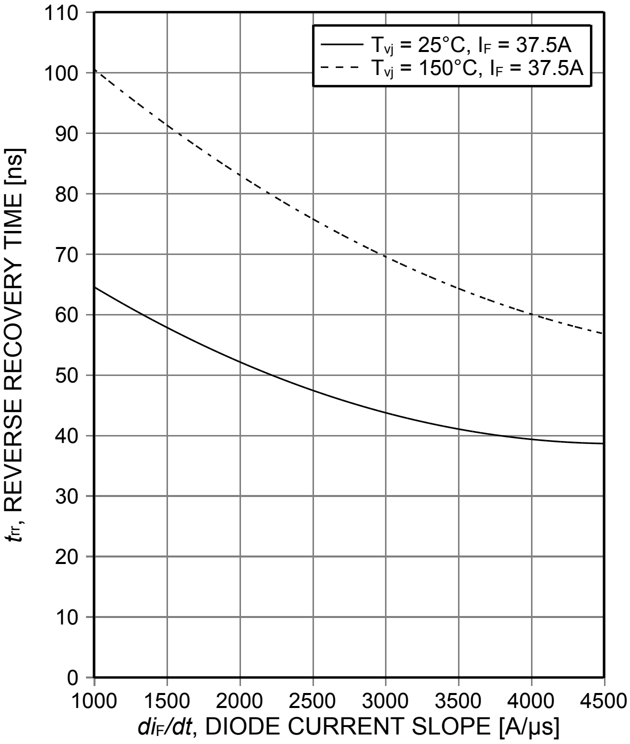



Figure 20. **Typical reverse recovery time as a function of diode current slope**
($V_R$=400V)

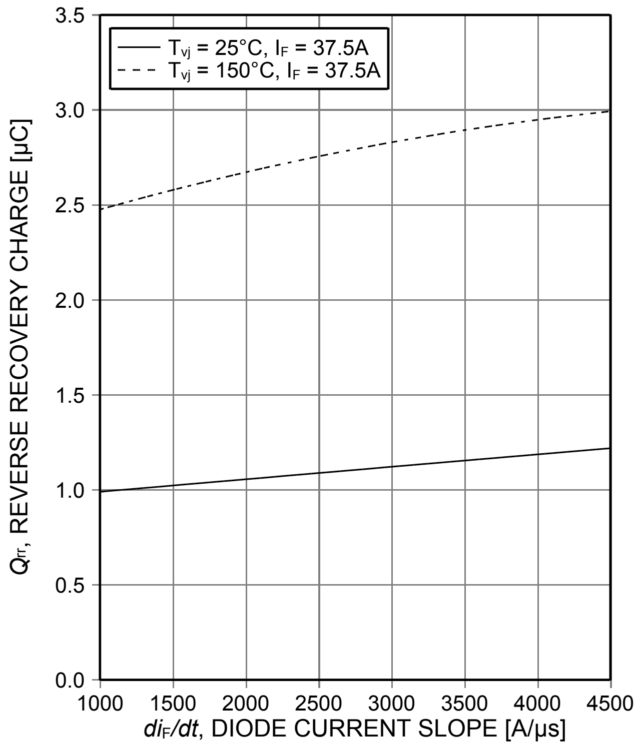



Figure 21. **Typical reverse recovery charge as a function of diode current slope**
($V_R$=400V)

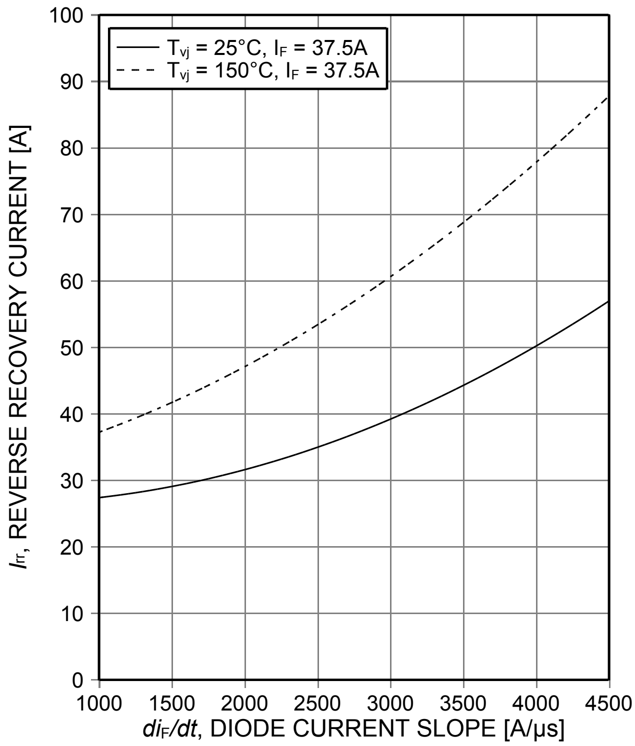



Figure 22. **Typical reverse recovery current as a function of diode current slope**
($V_R$=400V)

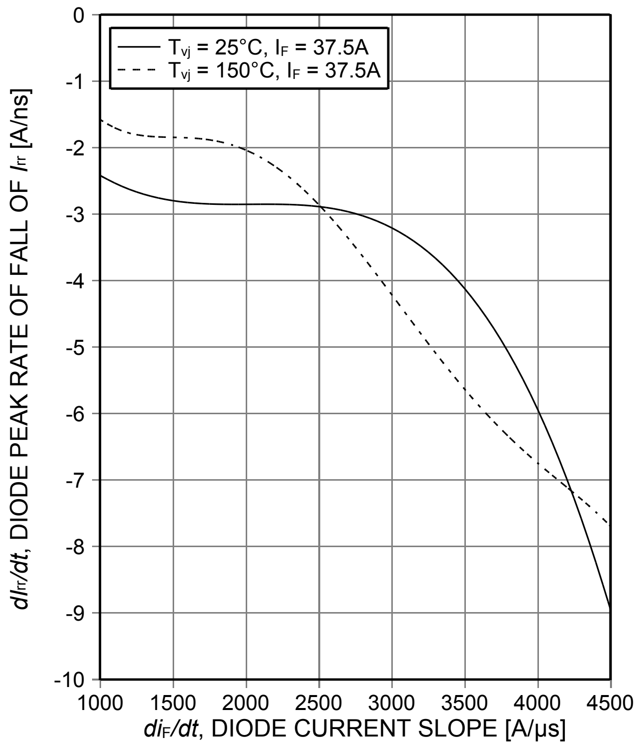



Figure 23. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R$=400V)

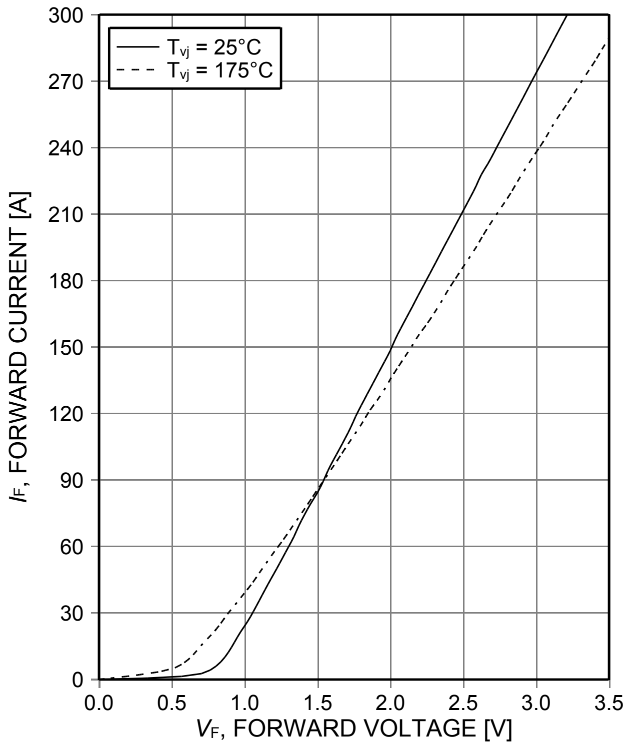



Figure 24. **Typical diode forward current as a function of forward voltage**

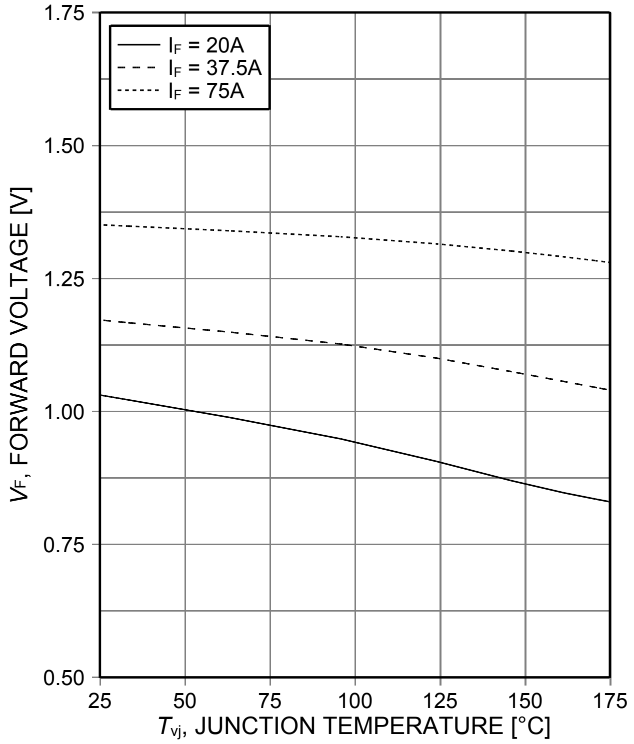
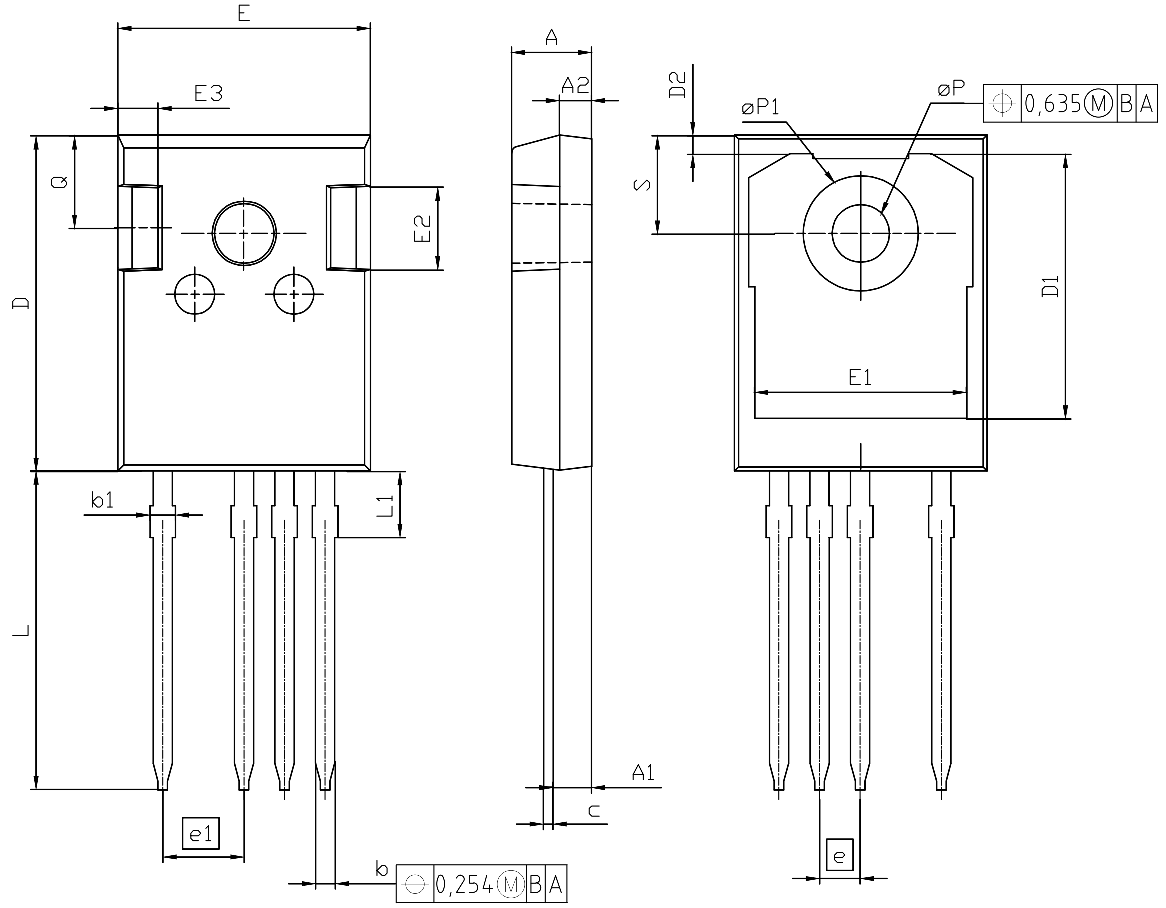



Figure 25. **Typical diode forward voltage as a function of junction temperature**

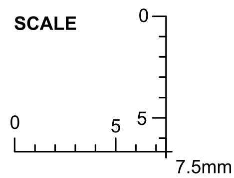
# PG-TO247-4



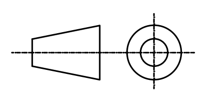

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **A** | 4.83 | 5.21 | 0.190 | 0.205 |
| **A1** | 2.29 | 2.54 | 0.090 | 0.100 |
| **A2** | 1.90 | 2.16 | 0.075 | 0.085 |
| **b** | 1.07 | 1.33 | 0.042 | 0.052 |
| **b1** | 1.10 | 1.70 | 0.043 | 0.067 |
| **c** | 0.50 | 0.70 | 0.020 | 0.028 |
| **D** | 20.80 | 21.10 | 0.819 | 0.831 |
| **D1** | 16.25 | 17.65 | 0.640 | 0.695 |
| **D2** | 0.95 | 1.35 | 0.037 | 0.053 |
| **E** | 15.70 | 16.13 | 0.618 | 0.635 |
| **E1** | 13.10 | 14.15 | 0.516 | 0.557 |
| **E2** | 3.68 | 5.10 | 0.145 | 0.201 |
| **E3** | 1.00 | 2.60 | 0.039 | 0.102 |
| **e** | 2.54 (BSC) | | 0.100 (BSC) | |
| **e1** | 5.08 | | 0.200 | |
| **N** | 4 | | 4 | |
| **L** | 19.72 | 20.32 | 0.776 | 0.800 |
| **L1** | 4.02 | 4.40 | 0.158 | 0.173 |
| **øP** | 3.50 | 3.70 | 0.138 | 0.146 |
| **øP1** | 7.00 | 7.40 | 0.276 | 0.291 |
| **Q** | 5.49 | 6.00 | 0.216 | 0.236 |
| **S** | 6.04 | 6.30 | 0.238 | 0.248 |

**DOCUMENT NO.**
Z8B00168124

**SCALE**




**EUROPEAN PROJECTION**



**ISSUE DATE**
29-01-2013

**REVISION**
1

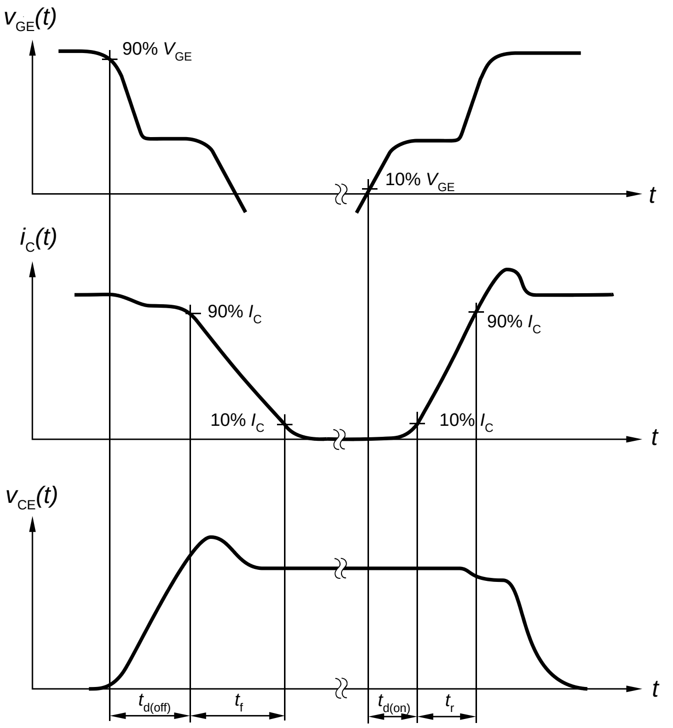



**Figure A. Definition of switching times**

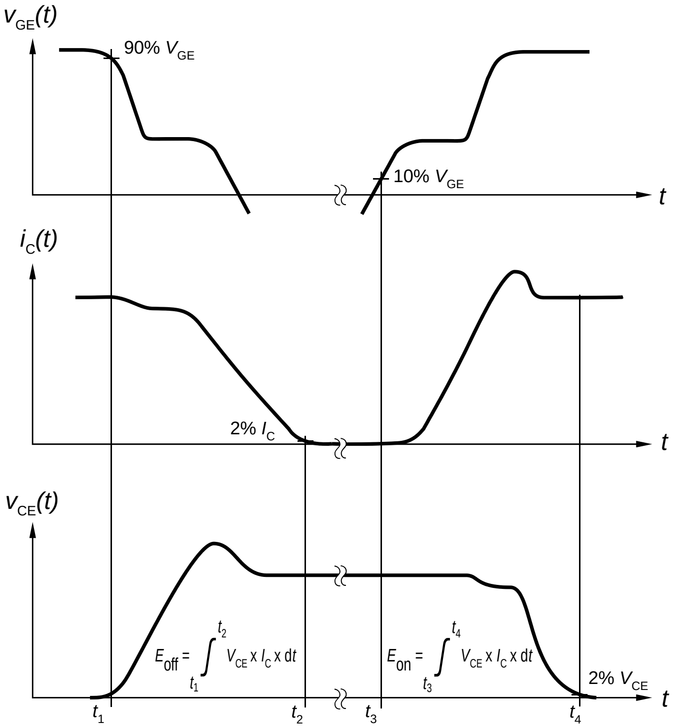



**Figure B. Definition of switching losses**

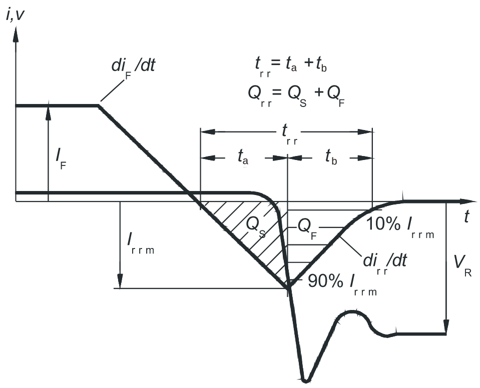



**Figure C. Definition of diodes switching characteristics**

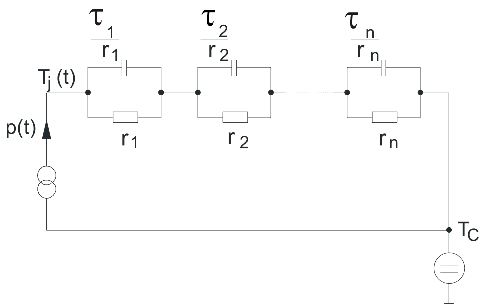



**Figure D. Thermal equivalent circuit**

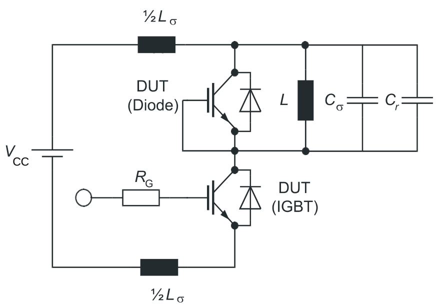



**Figure E. Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

Revision History

IKZ75N65EH5

Revision: 2014-10-31, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.1 | 2014-10-17 | Preliminary data sheet |
| 2.1 | 2014-10-31 | Final data sheet |

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