

IGBT

IGBT with integrated diode in packages offering space saving advantage

IKD10N60RA

600V TRENCHSTOP™ RC-Series for hard switching applications

Data sheet

IGBT with integrated diode in packages offering space saving advantage

Features:

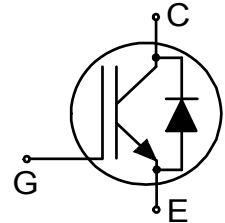
TRENCHSTOP™ Reverse Conducting (RC) technology for 600V applications offering

- Optimised V_{CEsat} and V_F for low conduction losses
- Smooth switching performance leading to low EMI levels
- Very tight parameter distribution
- Operating range of 1 to 20kHz
- Maximum junction temperature 175°C
- Short circuit capability of 5µs
- Best in class current versus package size performance
- Qualified according to AECQ101
- Pb-free lead plating; RoHS compliant (for PG-TO252: solder temperature 260°C, MSL1)

Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>

Applications:

- HID lighting
- Piezo injection



Key Performance and Package Parameters

| Type | V_{CE} | I_C | $V_{CEsat}, T_{vj}=25^\circ\text{C}$ | T_{vjmax} | Marking | Package |
|------------|----------|-------|--------------------------------------|-------------|---------|------------|
| IKD10N60RA | 600V | 10A | 1.65V | 175°C | K10R60A | PG-TO252-3 |



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Maximum ratings

| Parameter | Symbol | Value | Unit |
|---|-------------|--------------|------------------|
| Collector-emitter voltage | V_{CE} | 600 | V |
| DC collector current, limited by T_{vjmax} $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$ | I_C | 20.0 10.0 | A |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpuls} | 30.0 | A |
| Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^\circ\text{C}$ | - | 30.0 | A |
| Diode forward current, limited by T_{vjmax} $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$ | I_F | 20.0 10.0 | A |
| Diode pulsed current, t_p limited by T_{vjmax} | I_{Fpuls} | 30.0 | A |
| Gate-emitter voltage | V_{GE} | ± 20 | V |
| Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 400\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^\circ\text{C}$ | t_{SC} | 5 | μs |
| Power dissipation $T_C = 25^\circ\text{C}$ | P_{tot} | 150.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | -55...+175 | $^\circ\text{C}$ |
| Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020) | | 260 | $^\circ\text{C}$ |

Thermal Resistance

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---------------|------------|------------|------|
| Characteristic | | | | |
| IGBT thermal resistance, ¹⁾ junction - case | $R_{th(j-c)}$ | | 1.00 | K/W |
| Diode thermal resistance, ²⁾ junction - case | $R_{th(j-c)}$ | | 2.60 | K/W |
| Thermal resistance, min. footprint junction - ambient | $R_{th(j-a)}$ | | 75 | K/W |
| Thermal resistance, 6cm ² Cu on PCB junction - ambient | $R_{th(j-a)}$ | | 50 | K/W |

¹⁾ Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the IGBT, is not possible using a thermocouple.

²⁾ Rth/Zth based on single cooling pulse. Please be aware that a correct Rth measurement of the Diode, is not possible using a thermocouple.

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---------------|--|--------|--------------|----------------|---------------|
| | | | min. | typ. | max. | |
| Static Characteristic | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}, I_C = 0.20\text{mA}$ | 600 | - | - | V |
| Collector-emitter saturation voltage | V_{CESat} | $V_{GE} = 15.0\text{V}, I_C = 10.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | 1.65 1.85 | 2.10 - | V |
| Diode forward voltage | V_F | $V_{GE} = 0\text{V}, I_F = 10.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | 1.70 1.70 | 2.10 - | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.17\text{mA}, V_{CE} = V_{GE}$ | 4.3 | 5.0 | 5.7 | V |
| Zero gate voltage collector current ¹⁾ | I_{CES} | $V_{CE} = 600\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | - - | 40.0 1000.0 | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}, I_C = 10.0\text{A}$ | - | 6.1 | - | S |
| Integrated gate resistor | r_G | | | none | | Ω |

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|-------------|--|-------|------|------|------|
| | | | min. | typ. | max. | |
| Dynamic Characteristic | | | | | | |
| Input capacitance | C_{ies} | | - | 655 | - | pF |
| Output capacitance | C_{oes} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 37 | - | |
| Reverse transfer capacitance | C_{res} | | - | 22 | - | |
| Gate charge | Q_G | $V_{CC} = 480\text{V}, I_C = 10.0\text{A},$ $V_{GE} = 15\text{V}$ | - | 64.0 | - | nC |
| Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0\text{s}$ | $I_{C(SC)}$ | $V_{GE} = 15.0\text{V}, V_{CC} \leq 400\text{V},$ $t_{SC} \leq 5\mu\text{s}$ $T_{vj} = 25^{\circ}\text{C}$ | - | 74 | - | A |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|--------------|--|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 10.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $r_G = 23.0\Omega, L\sigma = 60\text{nH},$ $C\sigma = 40\text{pF}$ $L\sigma, C\sigma$ from Fig. E | - | 14 | - | ns |
| Rise time | t_r | | - | 10 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 192 | - | ns |
| Fall time | t_f | | - | 139 | - | ns |
| Turn-on energy | E_{on} | | - | 0.21 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.38 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.59 | - | mJ |

¹⁾ Not subject to production test - verified by design/characterization

Diode Characteristic, at $T_{vj} = 25^{\circ}\text{C}$

| | | | | | | |
|--|--------------|--|---|------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 10.0\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$ | - | 62 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 0.56 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 20.3 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -260 | - | $\text{A}/\mu\text{s}$ |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|-----------|--------|------------|-------|------|------|------|
| | | | min. | typ. | max. | |

IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

| | | | | | | |
|------------------------|---------------------|--|---|------|---|----|
| Turn-on delay time | $t_{d(\text{on})}$ | $T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 10.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $r_G = 23.0\Omega$, $L\sigma = 60\text{nH}$, $C\sigma = 40\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E | - | 13 | - | ns |
| Rise time | t_r | | - | 11 | - | ns |
| Turn-off delay time | $t_{d(\text{off})}$ | | - | 217 | - | ns |
| Fall time | t_f | | - | 211 | - | ns |
| Turn-on energy | E_{on} | | - | 0.35 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.58 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.93 | - | mJ |

Diode Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

| | | | | | | |
|--|--------------|---|---|------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 175^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 10.0\text{A}$, $di_F/dt = 1000\text{A}/\mu\text{s}$ | - | 98 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 1.22 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 20.5 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -259 | - | $\text{A}/\mu\text{s}$ |

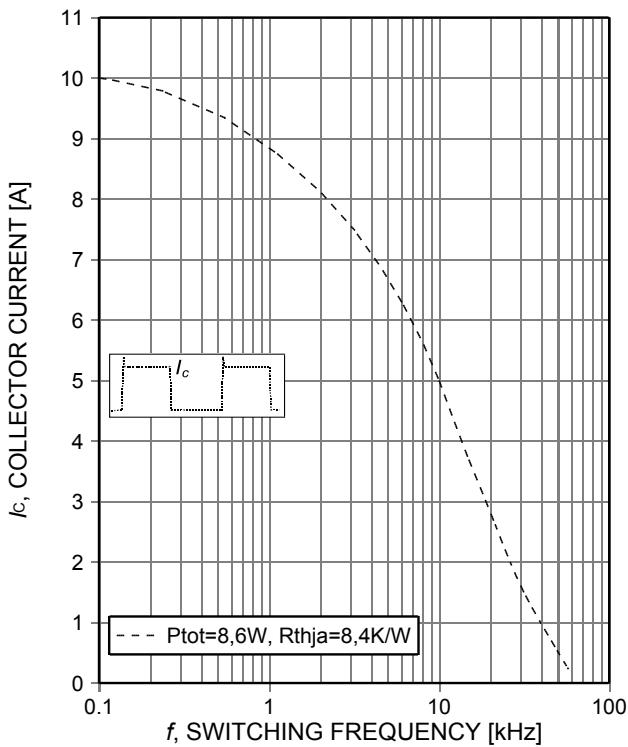


Figure 1. **Collector current as a function of switching frequency**
 ($T_{vj} \leq 175^\circ\text{C}$, $T_a = 55^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $r_G = 23\Omega$, PCB mounting with thermal vias and heatsink, see Appnote: www.infineon.com/igbt)

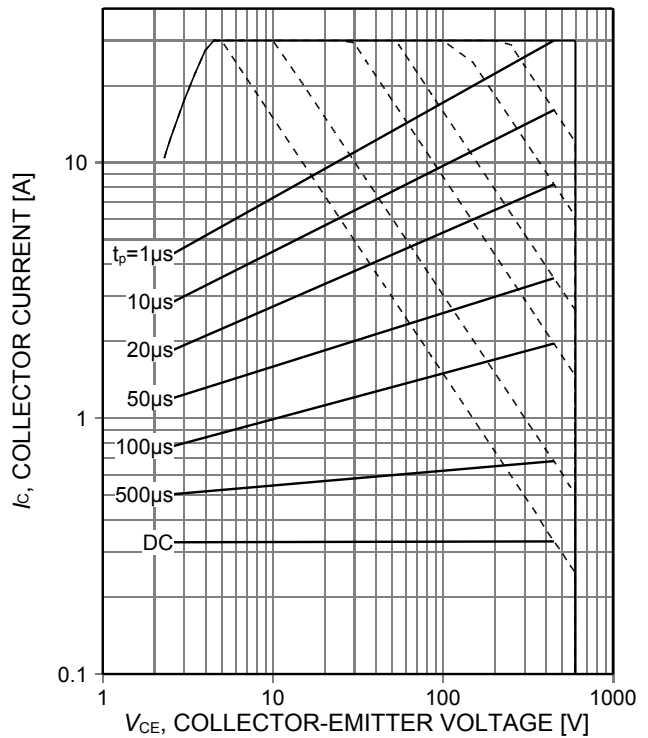


Figure 2. **Forward bias safe operating area**
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_{vj} \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$)

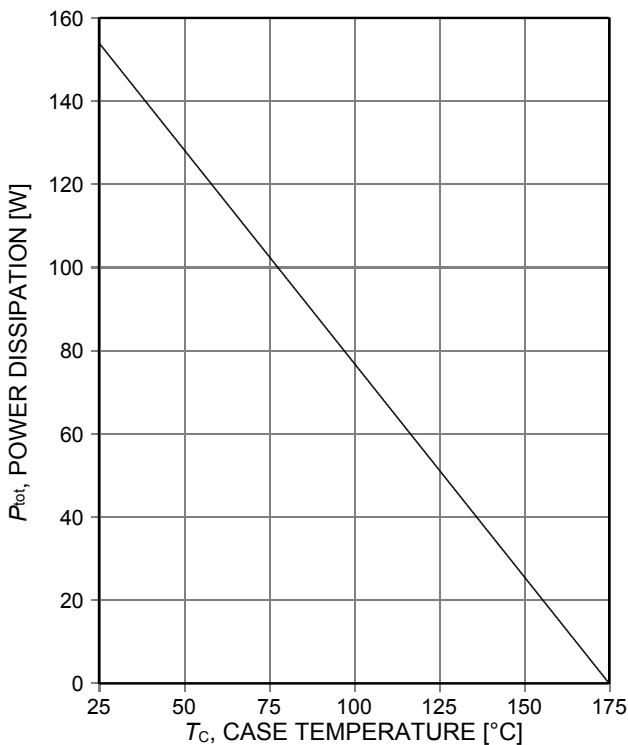


Figure 3. **Power dissipation as a function of case temperature**
 ($T_{vj} \leq 175^\circ\text{C}$)

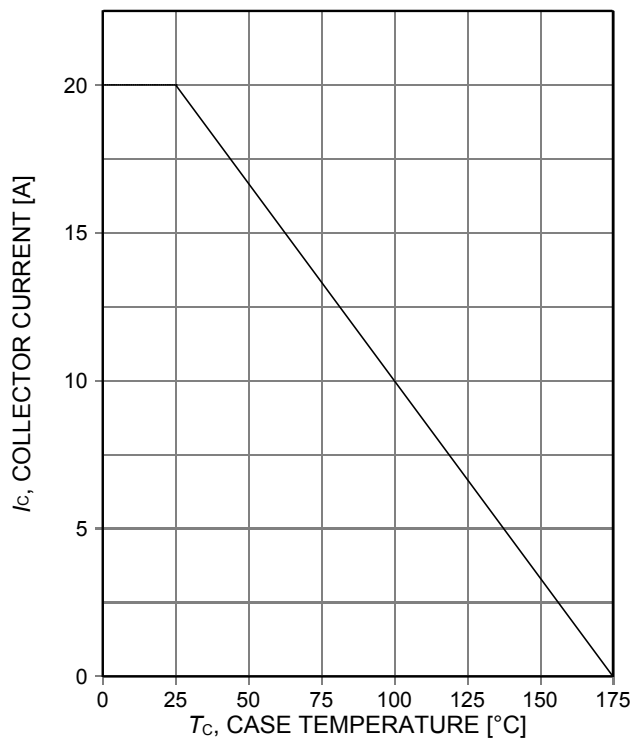


Figure 4. **Collector current as a function of case temperature**
 ($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

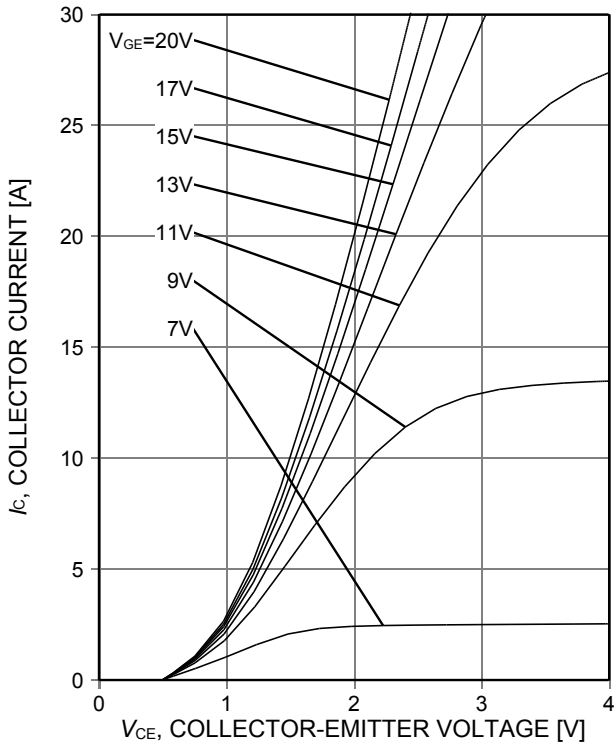


Figure 5. Typical output characteristic ($T_{vj}=25^{\circ}\text{C}$)

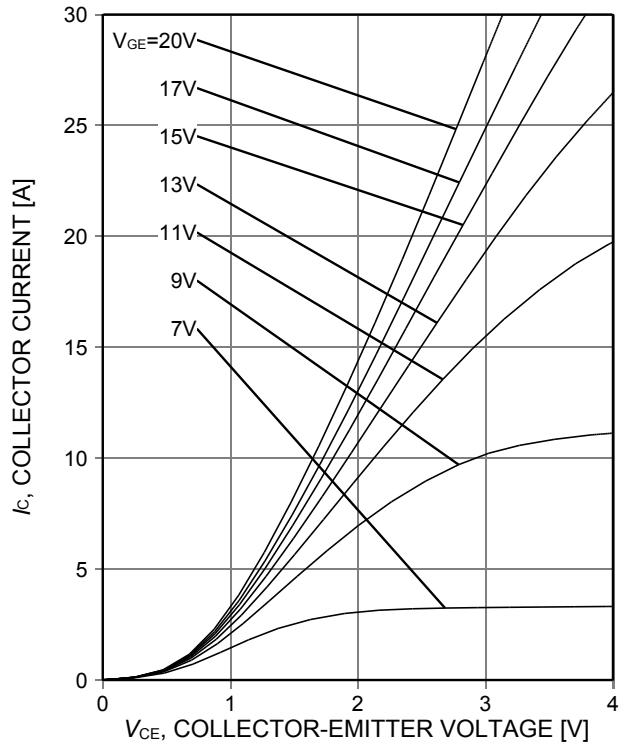


Figure 6. Typical output characteristic ($T_{vj}=175^{\circ}\text{C}$)

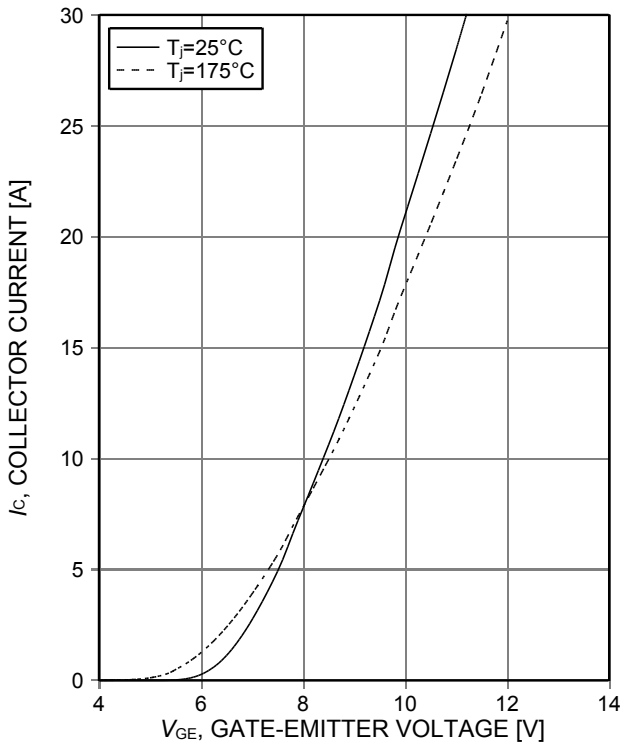


Figure 7. Typical transfer characteristic ($V_{ce}=10\text{V}$)

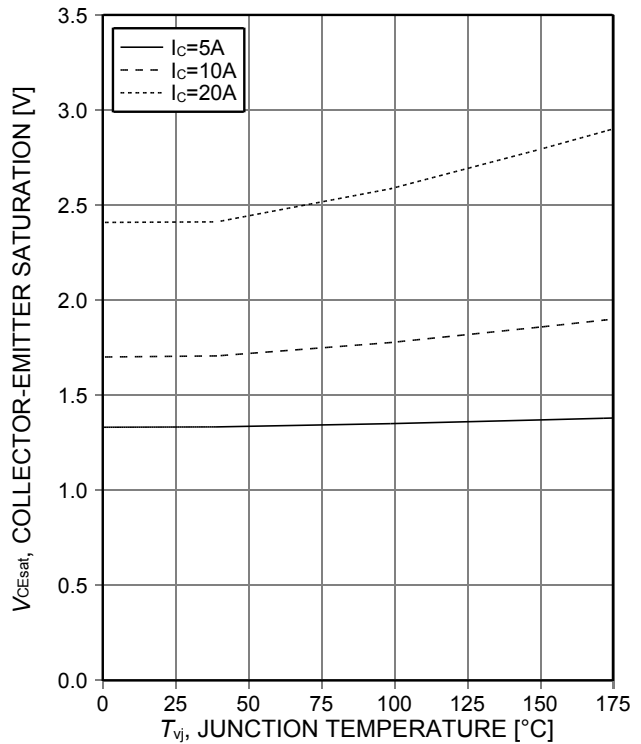


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{ge}=15\text{V}$)

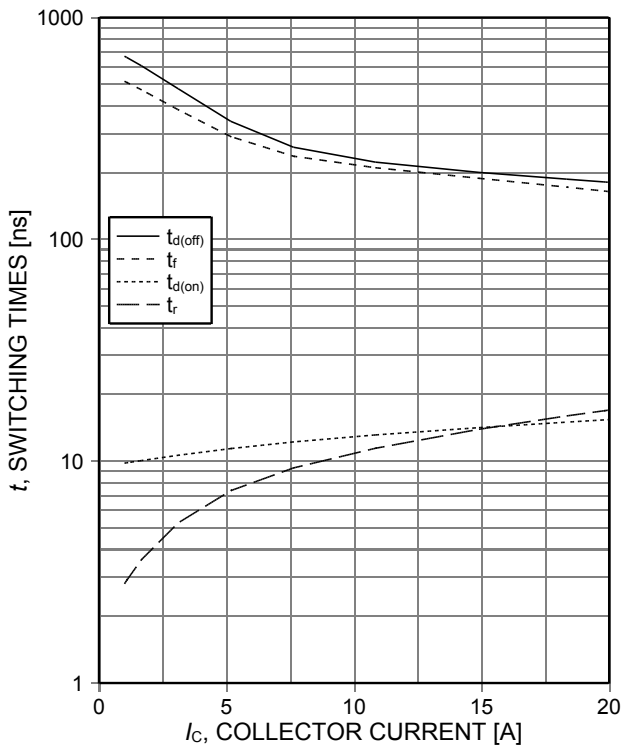


Figure 9. **Typical switching times as a function of collector current**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

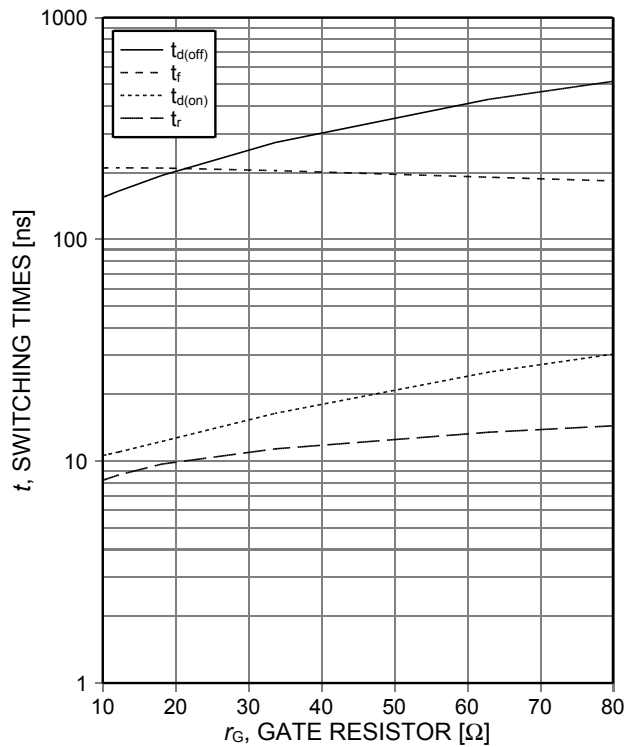


Figure 10. **Typical switching times as a function of gate resistor**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, Dynamic test circuit in Figure E)

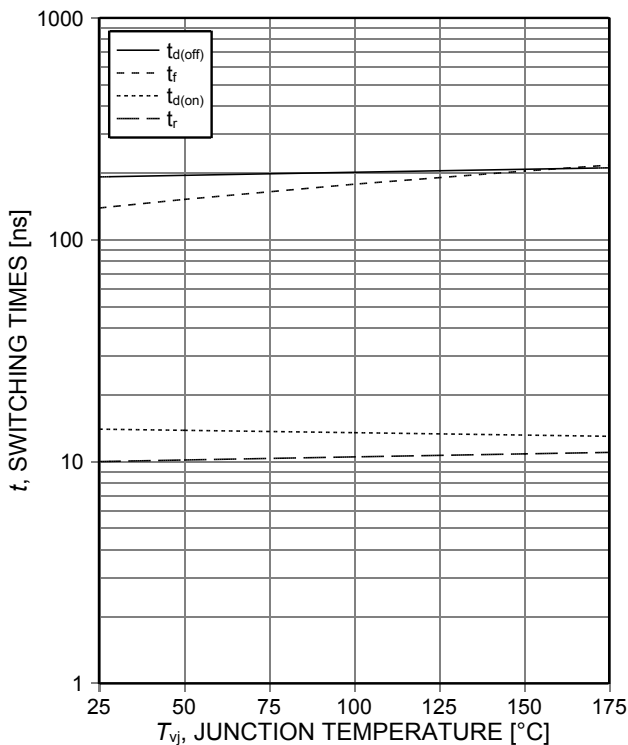


Figure 11. **Typical switching times as a function of junction temperature**
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

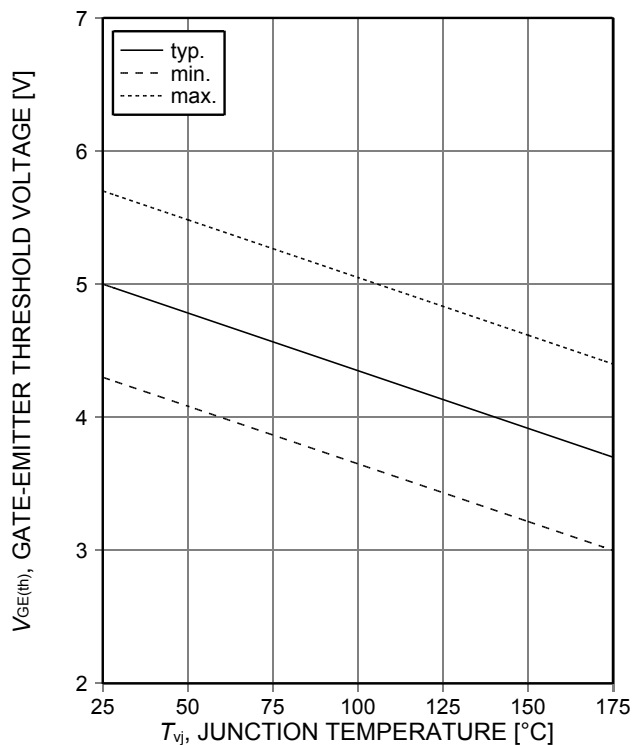


Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
 ($I_C=0.17\text{mA}$)

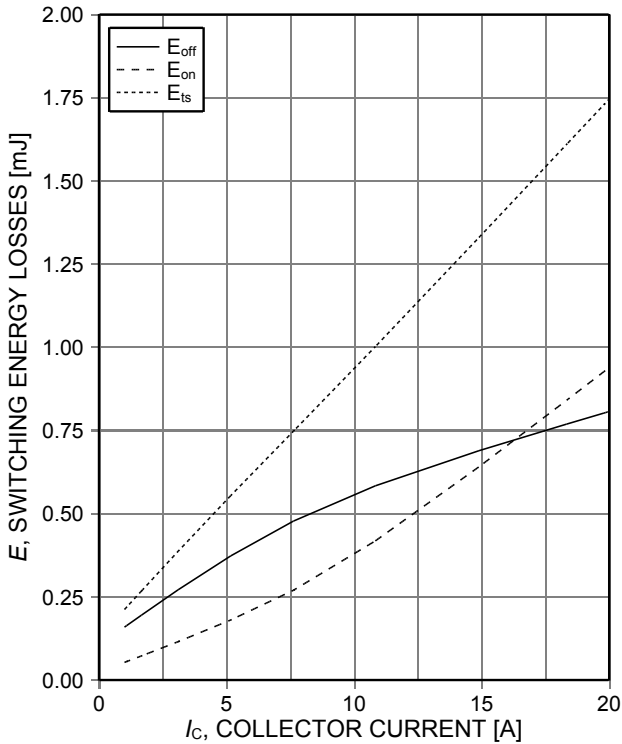


Figure 13. **Typical switching energy losses as a function of collector current**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

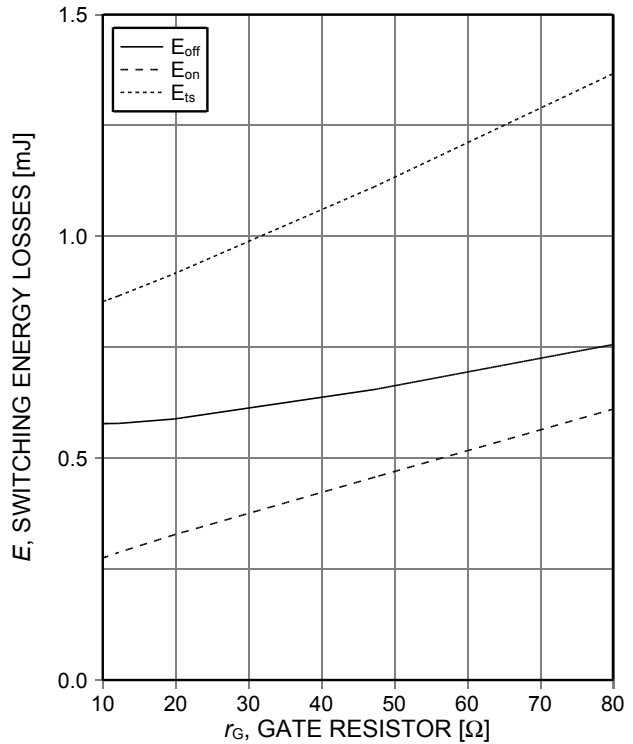


Figure 14. **Typical switching energy losses as a function of gate resistor**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, Dynamic test circuit in Figure E)

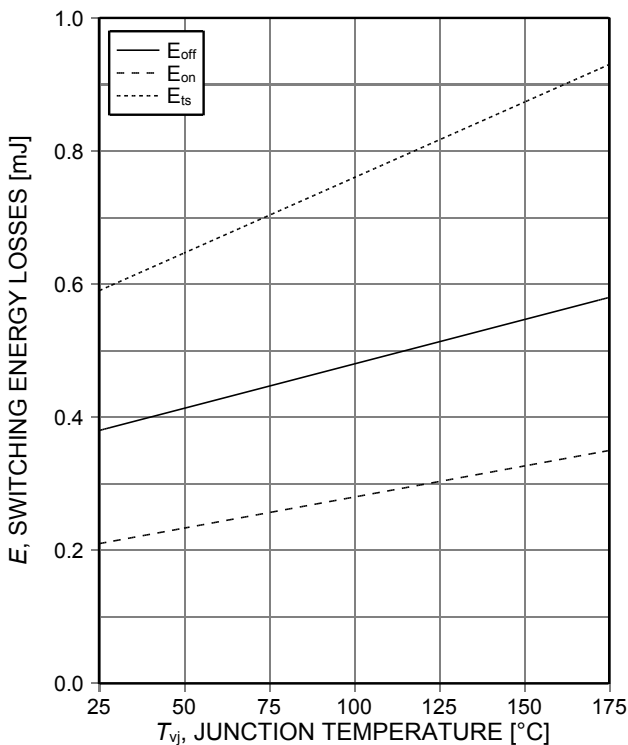


Figure 15. **Typical switching energy losses as a function of junction temperature**
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

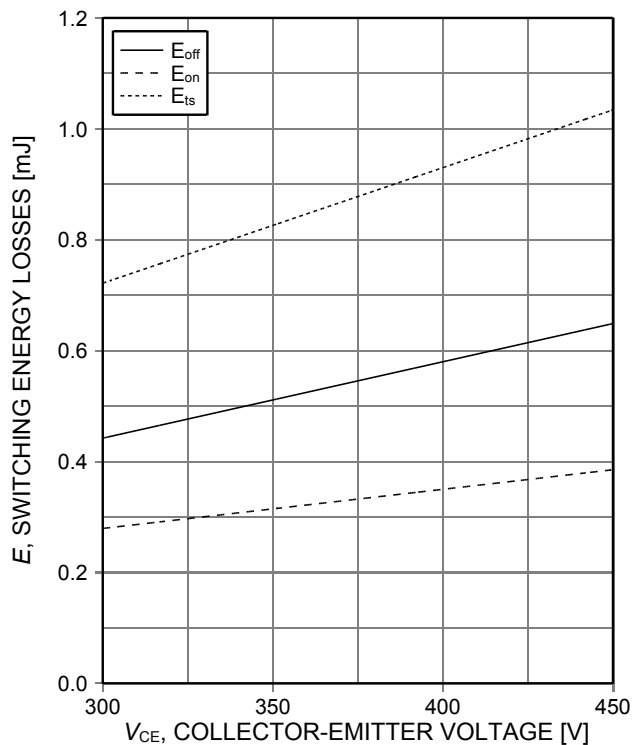


Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
 (inductive load, $T_{vj}=175^{\circ}\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=23\Omega$, Dynamic test circuit in Figure E)

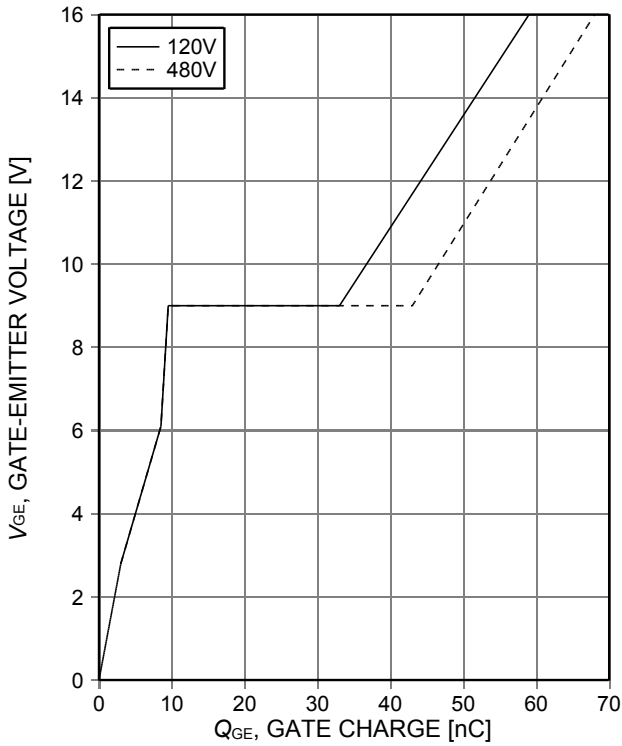


Figure 17. **Typical gate charge**
($I_C=10A$)

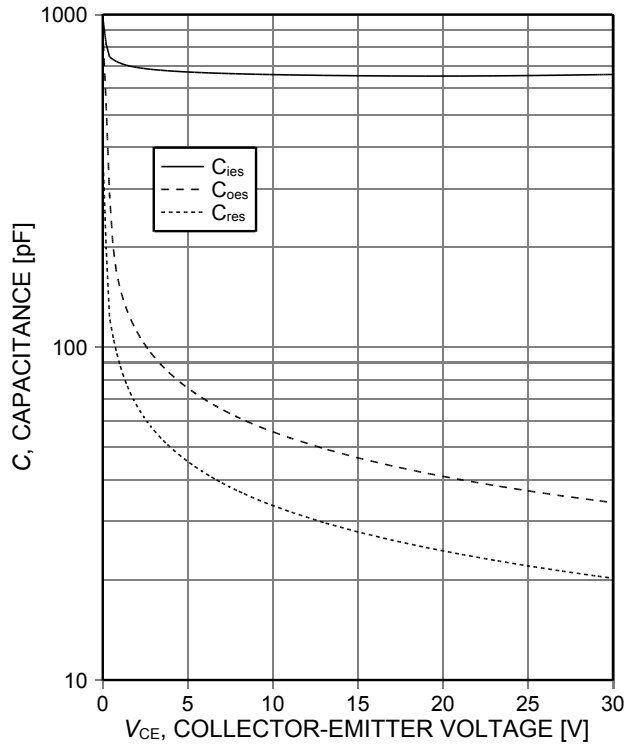


Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}=0V$, $f=1MHz$)

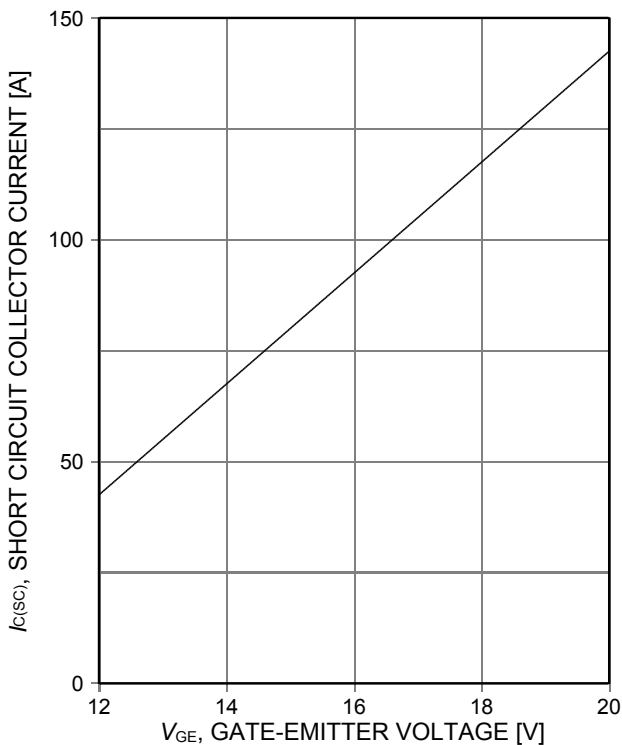


Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_{vj}=25^\circ C$)

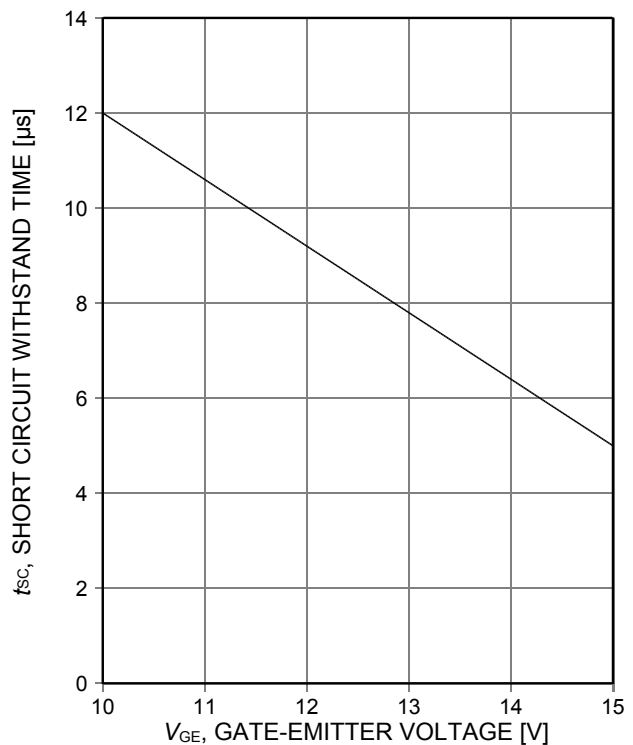


Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}\leq 400V$, start at $T_{vj}\leq 150^\circ C$)

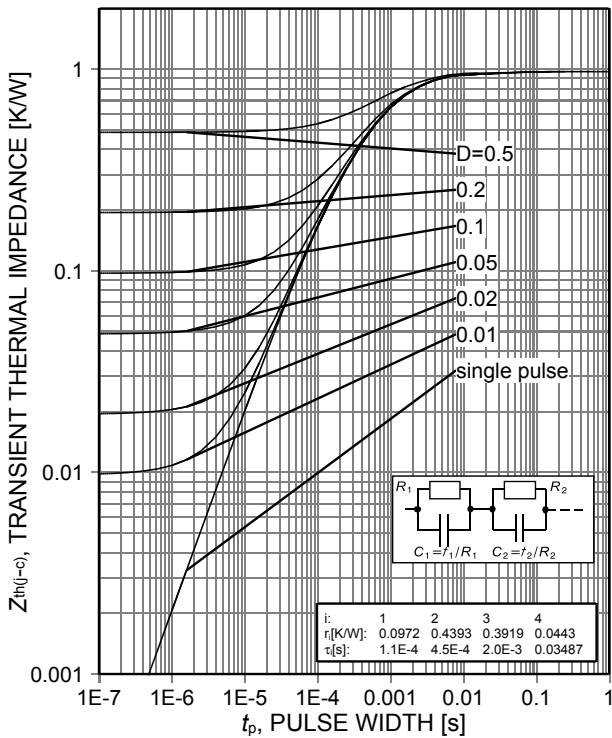


Figure 21. IGBT transient thermal impedance as a function of pulse width ¹⁾ (see page 4) ($D=t_p/T$)

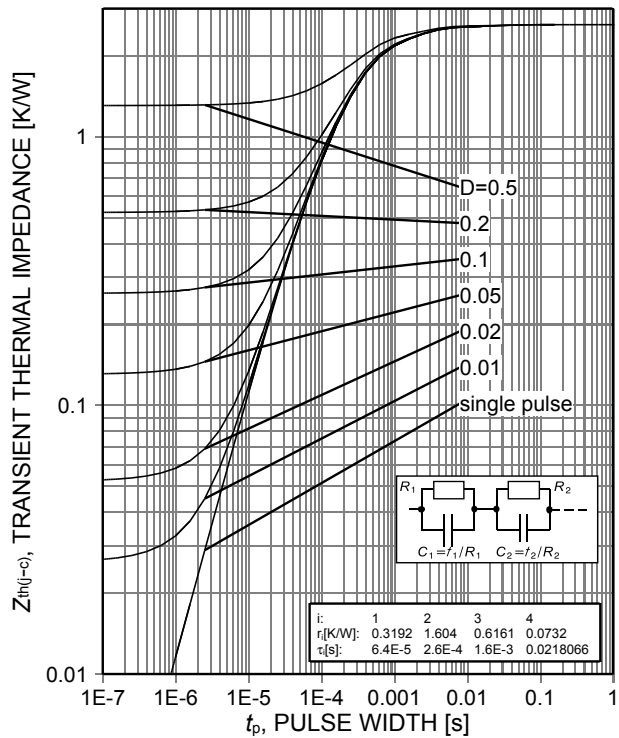


Figure 22. Diode transient thermal impedance as a function of pulse width ²⁾ (see page 4) ($D=t_p/T$)

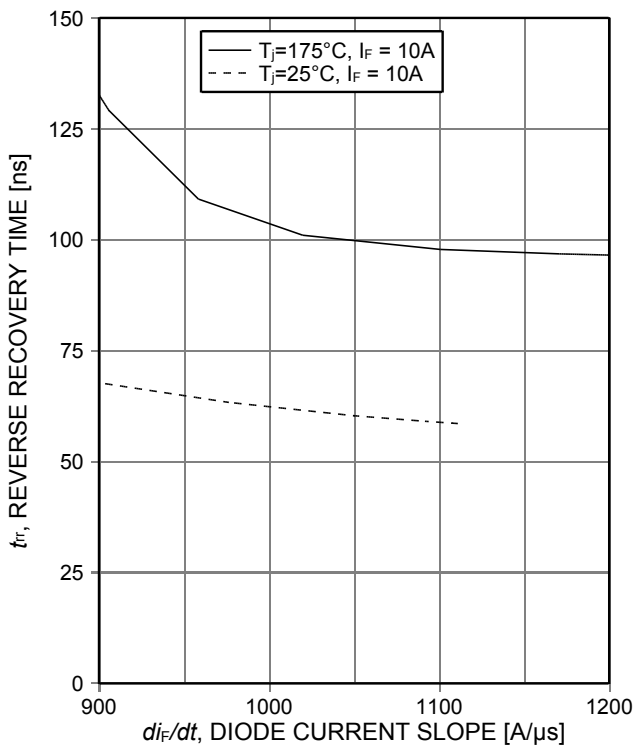


Figure 23. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

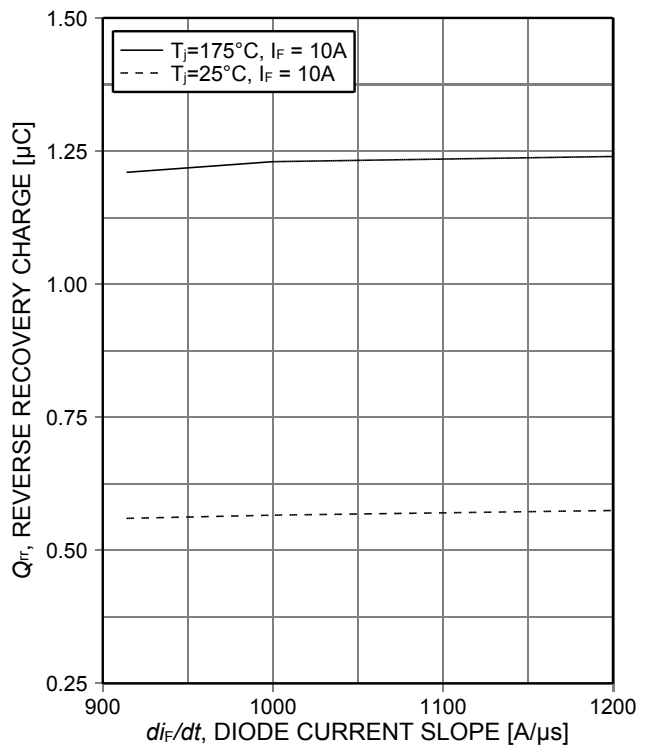


Figure 24. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

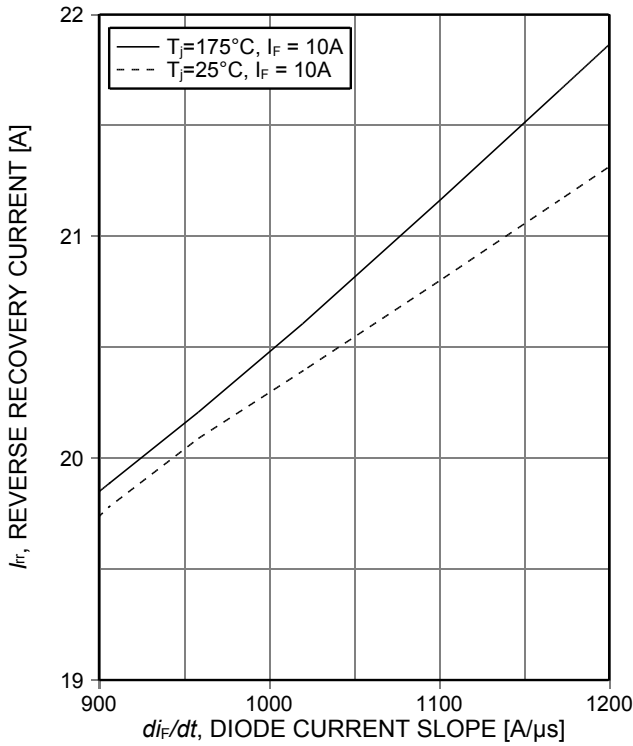


Figure 25. Typical reverse recovery current as a function of diode current slope ($V_R=400V$)

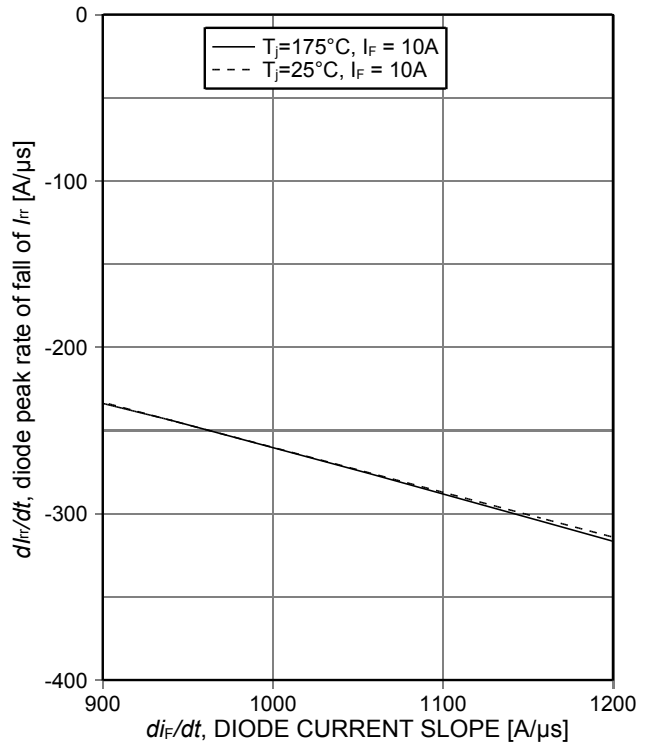


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope ($V_R=400V$)

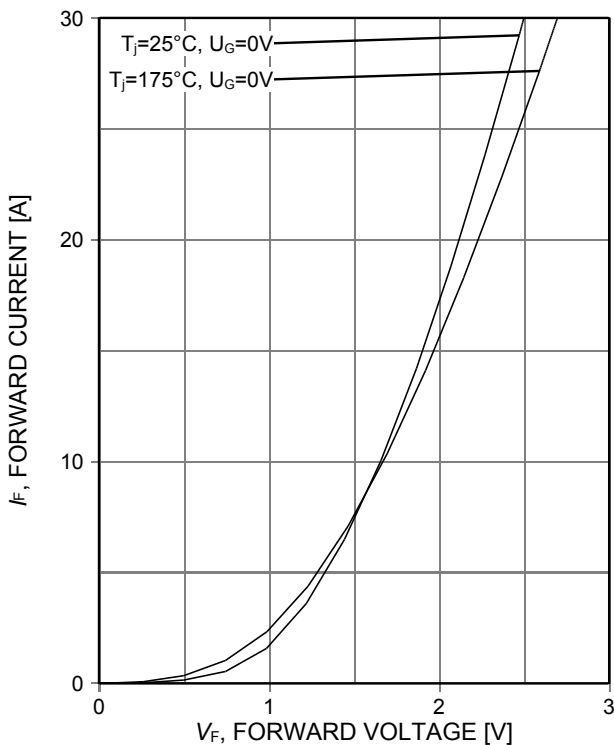


Figure 27. Typical diode forward current as a function of forward voltage

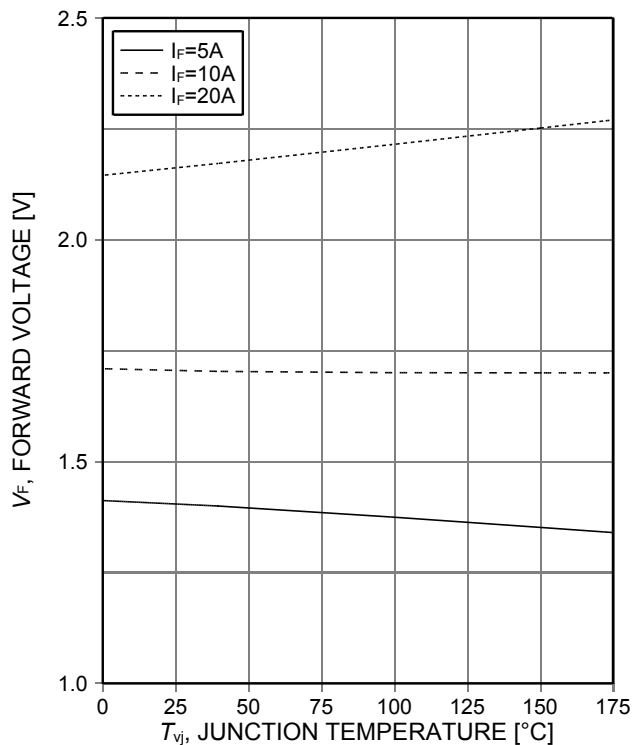
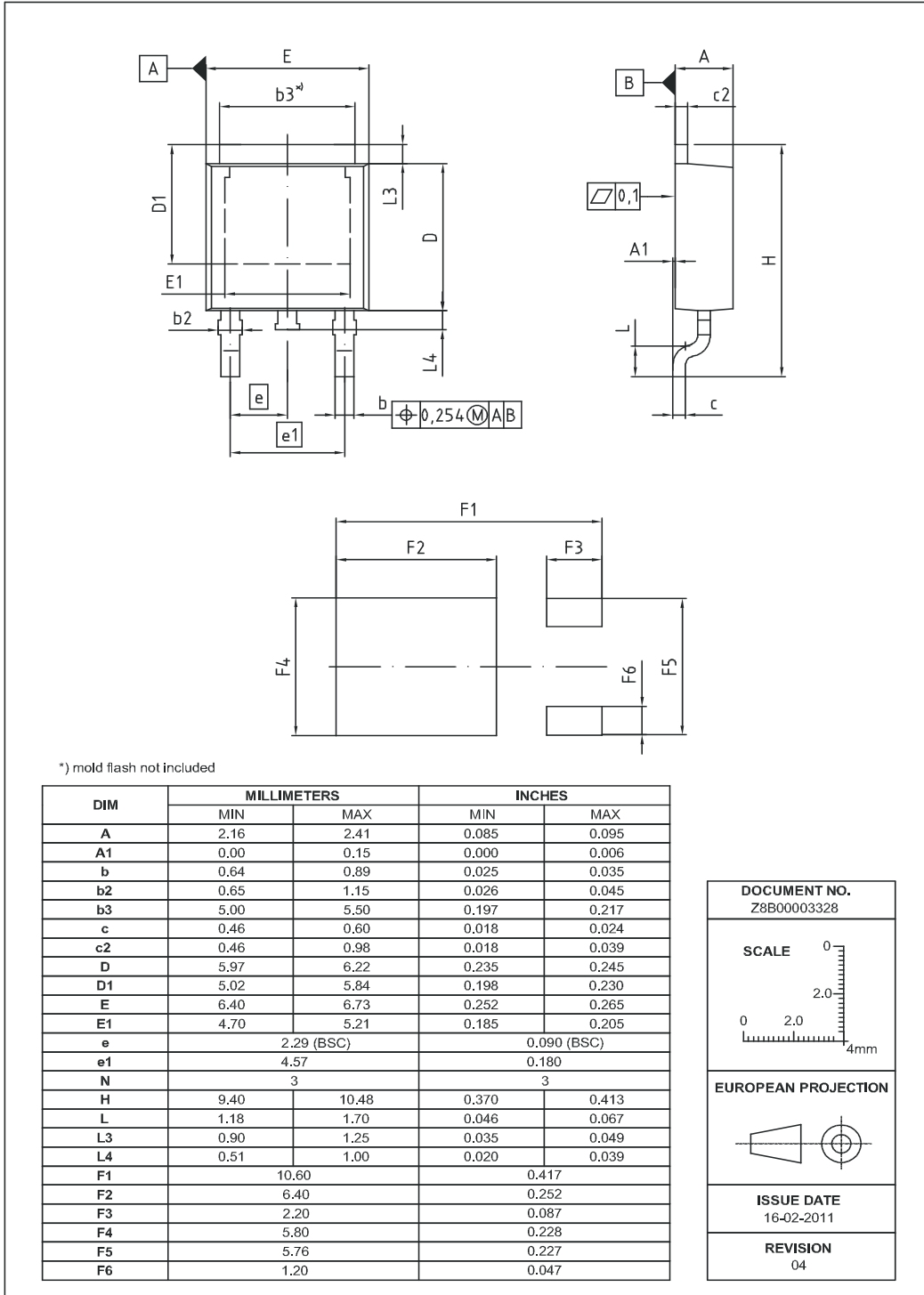


Figure 28. Typical diode forward voltage as a function of junction temperature

PG-TO252 -3



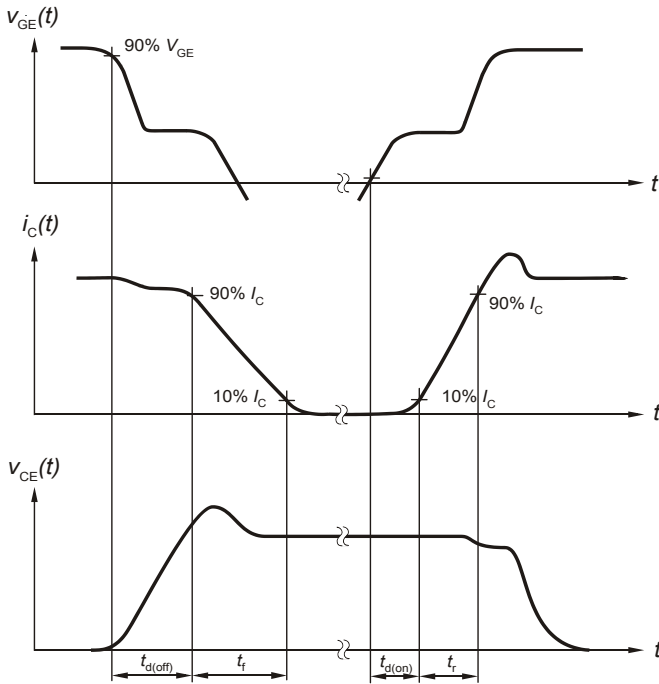


Figure A. Definition of switching times

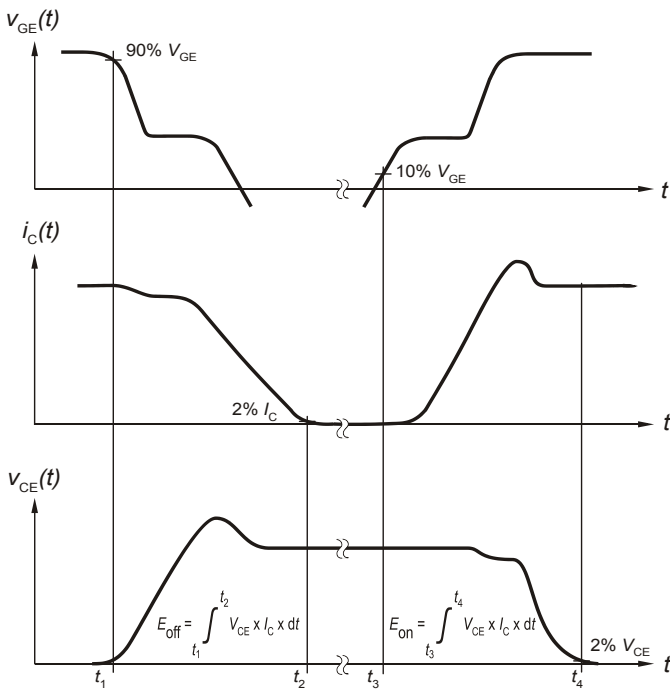


Figure B. Definition of switching losses

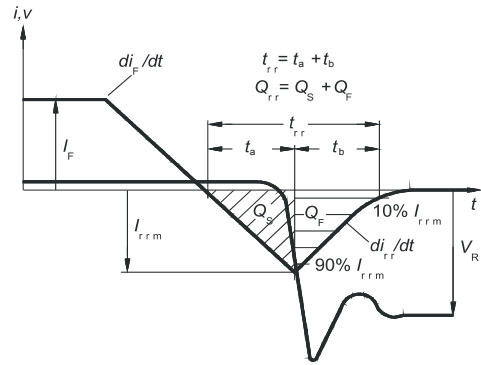


Figure C. Definition of diodes switching characteristics

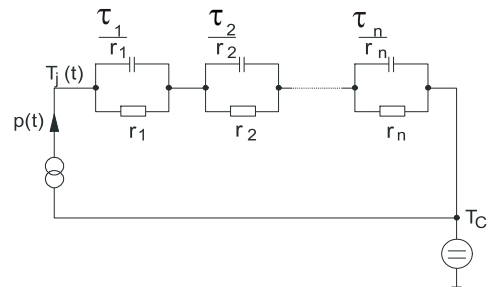


Figure D. Thermal equivalent circuit

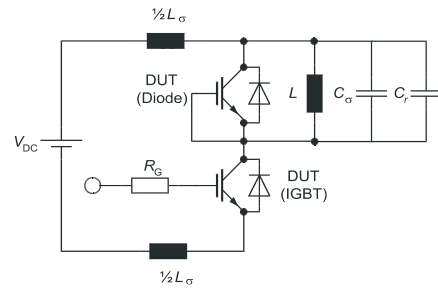


Figure E. Dynamic test circuit
Parasitic inductance L_σ ,
Parasitic capacitor C_σ ,
Relief capacitor C_r
(only for ZVT switching)

Revision History

IKD10N60RA

Revision: 2014-02-28, Rev. 2.2

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 1.1 | 2010-06-10 | Preliminary datasheet |
| 2.1 | 2010-10-28 | Release of final datasheet |
| 2.2 | 2014-02-28 | Data sheet with AECQ logo |

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The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.



Стандарт Электрон Связь

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

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