## 英飞凌CoolSiC™ 混合单管 - TRENCHSTOP™ 5 H5 IGBT

## 与半额定值第六代 CoolSiC™ 二极管共同封装


### 特性

- $V_{CE}$ = 650 V
- $I_C$ = 75 A
- TRENCHSTOP™ 5 与 CoolSiC™ 技术相结合，实现超低开关损耗
- 硬开关拓扑中的基准效率
- 即插即用，替代纯硅器件
- 最高结温 $T_{vjmax}$ = 175°C
- 符合 JEDEC 目标应用要求
- 无铅镀层；符合RoHS标准
- 完整的产品品类和 PSpice 模型： http://www.infineon.com/igbt/

Lead-free
Green
Halogen-free
RoHS

### 潜在应用

- 工业开关电源
- 工业级不间断电源（UPS）
- 光伏组串逆变器
- 储能
- 充电器

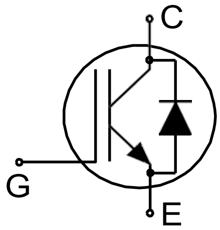
### 产品验证

- 根据 JEDEC20/22 相关测试的测试条件，符合上述应用要求

### 描述

封装引脚定义：

- 引脚G - 栅极
- 引脚 C & 背面 - 集电极
- 引脚 E - 发射极




| Type | Package | Marking |
|---|---|---|
| IKW75N65RH5 | PG-TO247-3 | K75ERH5 |

***本数据手册的原文使用英文撰写。为方便起见，英飞凌提供了译文；由于翻译过程中可能使用了自动化工具，英飞凌不保证译文的准确性。 为确认准确性请务必访问 infineon.com 参考最新的英文版本（控制文档）。***

# 目录

描述 ........ 1
特性 ........ 1
潜在应用 ........ 1
产品验证 ........ 1
目录 ........ 2
1 封装 ........ 3
2 IGBT ........ 3
3 二极管 ........ 6
4 特性图 ........ 7
5 封装外形 ........ 13
6 测试条件 ........ 14
修订记录 ........ 15
免责声明 ........ 16

# 1 封装

**表 1 特征值**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Internal emitter inductance measured 5 mm (0.197 in.) from case | $L_E$ | | | 13.0 | | nH |
| Storage temperature | $T_{stg}$ | | -55 | | 150 | °C |
| Soldering temperature | | 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 | $R_{th(j-a)}$ | | | | 40 | K/W |

# 2 IGBT

**表2 最大额定值**

| 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 | 75 | |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpulse}$ | | | 300 | A |
| Turn-off safe operating area | | $V_{CE} \leq 650$ V, $t_p = 1$ µs, $T_{vj} \leq 175$ °C | | 300 | A |
| Gate-emitter voltage | $V_{GE}$ | | | ±20 | V |
| Transient gate-emitter voltage | $V_{GE}$ | $t_p \leq 10$ µs, $D < 0.01$ | | ±30 | V |
| Power dissipation | $P_{tot}$ | | $T_c = 25$ °C | 395 | W |
| | | | $T_c = 100$ °C | 198 | |

**表3 特征值**

| 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 | | 1.65 | 2.1 | V |
| | | | $T_{vj} = 125$ °C | | 1.85 | | |
| | | | $T_{vj} = 175$ °C | | 1.95 | | |
| Gate-emitter threshold voltage | $V_{GEth}$ | $I_C = 0.75$ mA, $V_{CE} = V_{GE}$ | | 3.2 | 4 | 4.8 | V |

（表格续下页……）

**表 3　　（续）特征值**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 650 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 1000 | µA |
| | | | $T_{vj}$ = 175 °C | | 2500 | | |
| Zero gate-voltage collector current | $I_{CES}$ | $V_{CE}$ = 480 V, $V_{GE}$ = 0 V | $T_{vj}$ = 25 °C | | | 30 | µA |
| 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 | | | 105 | | S |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 250 kHz | | | 4000 | | pF |
| Output capacitance | $C_{oes}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 250 kHz | | | 460 | | pF |
| Reverse transfer capacitance | $C_{res}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 250 kHz | | | 15 | | pF |
| Gate charge | $Q_G$ | $I_C$ = 75 A, $V_{GE}$ = 15 V, $V_{CC}$ = 520 V | | | 168 | | nC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_\sigma$ = 30 nH, $C_\sigma$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 26 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 26 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 24 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 20 | | |
| Rise time (inductive load) | $t_r$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_\sigma$ = 30 nH, $C_\sigma$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 9 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 3 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 12 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 5 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_\sigma$ = 30 nH, $C_\sigma$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 180 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 220 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 205 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 240 | | |

**（表格续下页……）**

**表 3 （续） 特征值**

| Parameter | Symbol | Note or test condition | | Values Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Fall time (inductive load) | $t_f$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_σ$ = 30 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 15 | | ns |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 35 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 18 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 40 | | |
| Turn-on energy | $E_{on}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_σ$ = 30 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 0.36 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 0.07 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 0.45 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 0.09 | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_σ$ = 30 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 0.3 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 0.08 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 0.4 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 0.11 | | |
| Total switching energy | $E_{ts}$ | $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $R_{Gon}$ = 9 Ω, $R_{Goff}$ = 9 Ω, $L_σ$ = 30 nH, $C_σ$ = 30 pF | $T_{vj}$ = 25 °C, $I_C$ = 37.5 A | | 0.66 | | mJ |
| | | | $T_{vj}$ = 25 °C, $I_C$ = 7.5 A | | 0.15 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 37.5 A | | 0.85 | | |
| | | | $T_{vj}$ = 150 °C, $I_C$ = 7.5 A | | 0.2 | | |
| IGBT thermal resistance, junction-case | $R_{th(j-c)}$ | | | | | 0.38 | K/W |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

# 3 Diode

## 表4 最大额定值

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Repetitive peak reverse voltage | $V_{RRM}$ | $T_{vj} \geq 25$ °C | | 650 | V |
| Diode forward current, limited by $T_{vjmax}$ | $I_F$ | | $T_c = 25$ °C | 45.7 | A |
| | | | $T_c = 100$ °C | 30.7 | |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ [1)] | $I_{Fpulse}$ | | | 112.5 | A |

*1)* 脉冲电流水平取决于二极管芯片的 $T_{vj}$，另见图“最大脉冲电流与结温的关系”

## 表5 特征值

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Diode forward voltage | $V_F$ | $I_F = 30$ A | $T_{vj} = 25$ °C | | 1.35 | 1.5 | V |
| | | | $T_{vj} = 125$ °C | | 1.55 | | |
| | | | $T_{vj} = 175$ °C | | 1.65 | | |
| Diode thermal resistance, junction-case | $R_{th(j-c)}$ | | | | | 1.2 | K/W |
| Operating junction temperature | $T_{vj}$ | | | -40 | | 175 | °C |

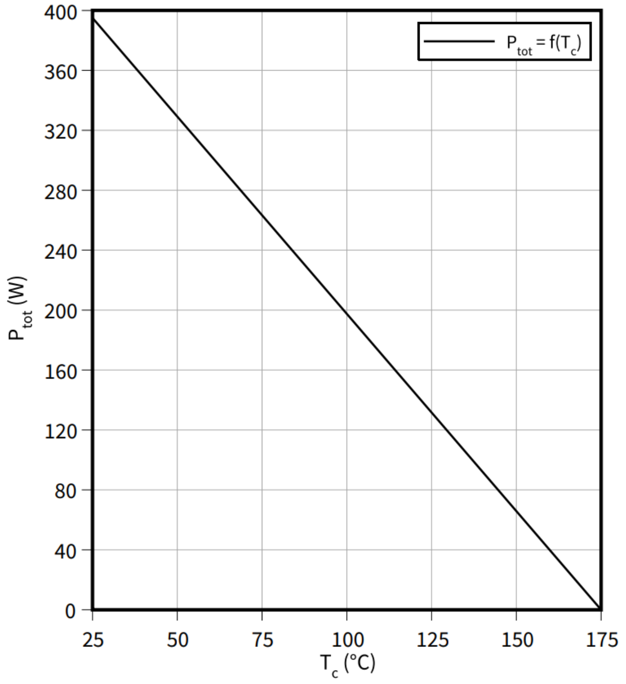
*注意：为了获得最佳的使用寿命和可靠性，英飞凌建议运行条件不超过本数据手册中所述最大额定值的80%。*

除非另有规定，*电气特性均为 $T_{vj} = 25$°C。*

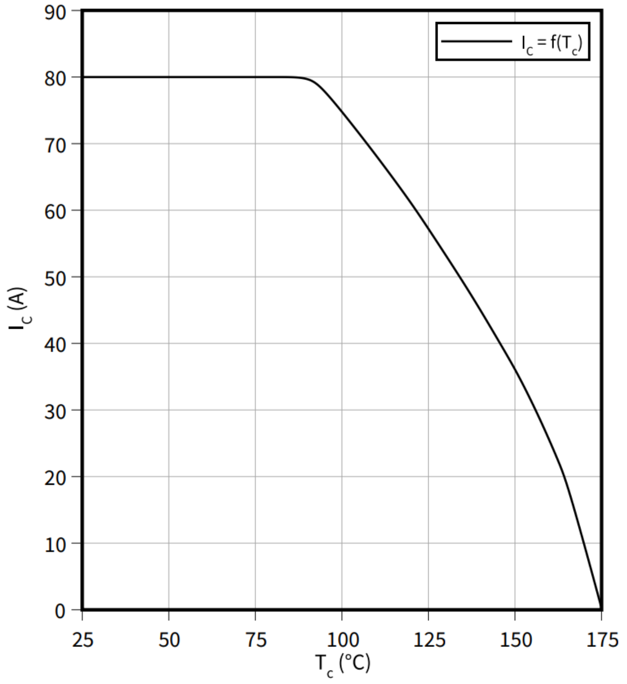
*动态测试电路，寄生电感 $L_\sigma$，寄生电容 $C_\sigma$，来自图E。能量损失包括“拖尾”和二极管反向恢复。*

# 4 特性图

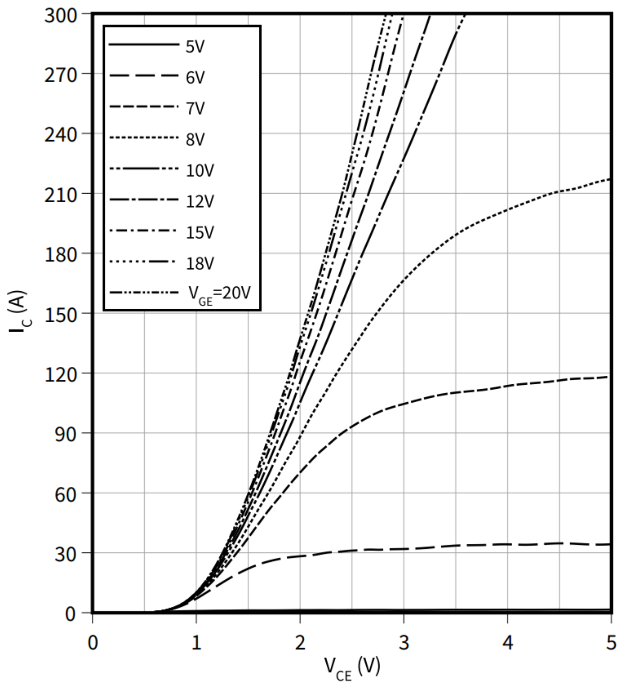
**Power dissipation as a function of case temperature**
$P_{tot} = f(T_c)$
$T_{vj} \leq 175\ °C$



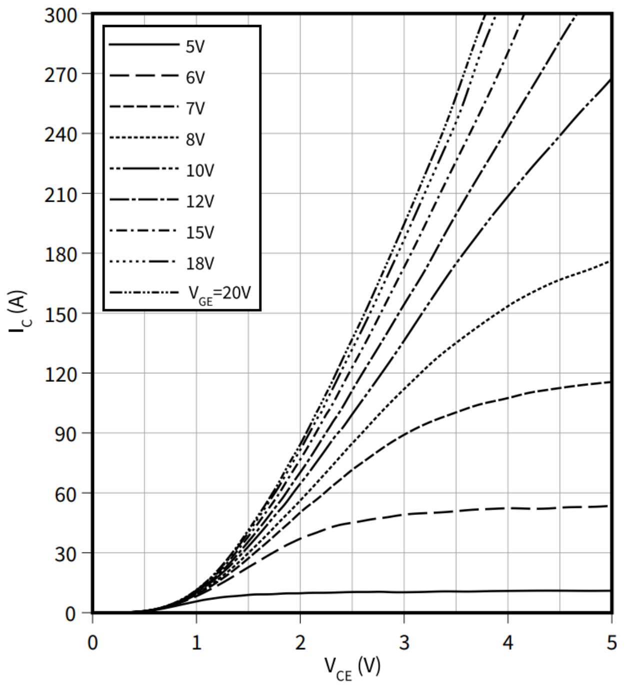

**Collector current as a function of case temperature**
$I_C = f(T_c)$
$T_{vj} \leq 175\ °C, V_{GE} \geq 15\ V$




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



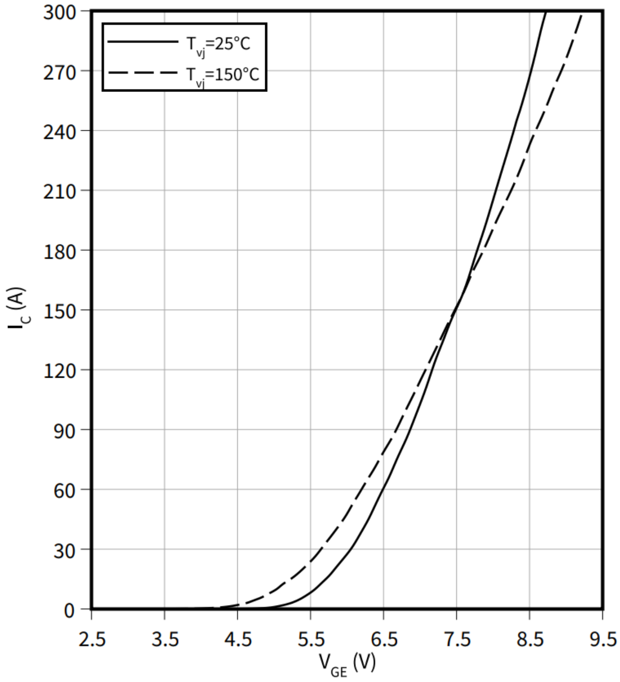

**Typical output characteristic**
$I_C = f(V_{CE})$
$T_{vj} = 150\ °C$



**Typical transfer characteristic**

$I_C = f(V_{GE})$

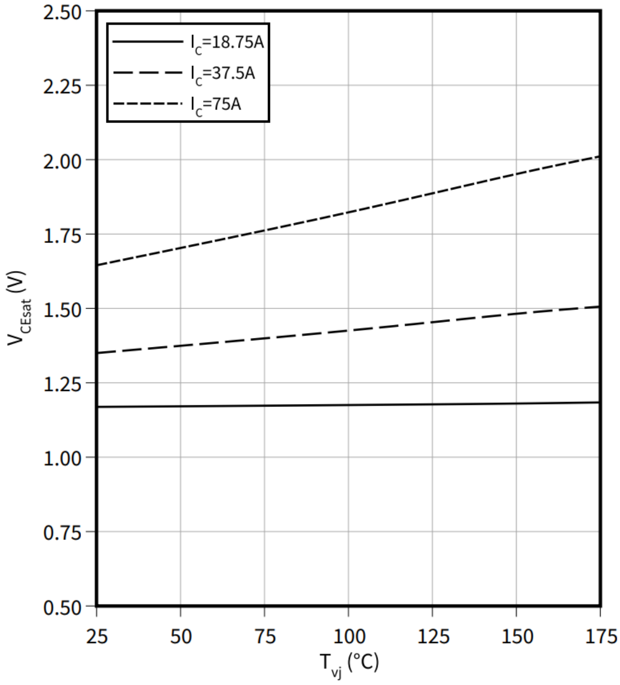
$V_{CE} = 20$ V




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

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

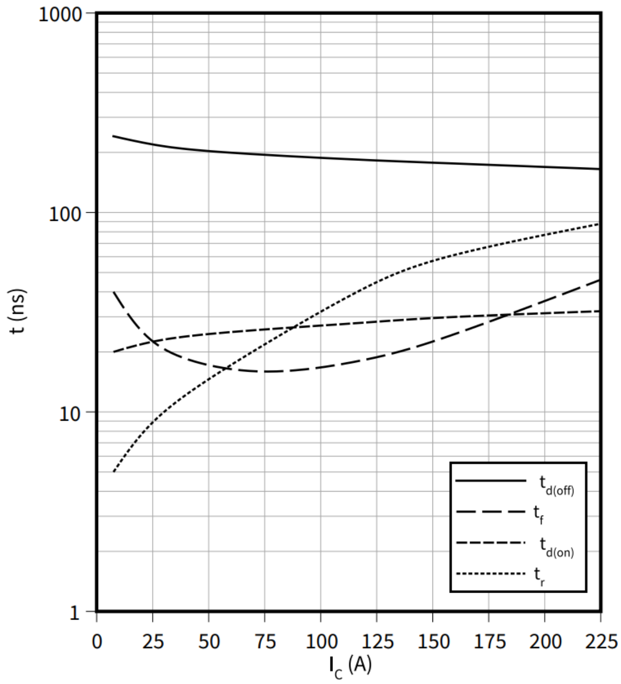
$V_{GE} = 15$ V




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

$t = f(I_C)$

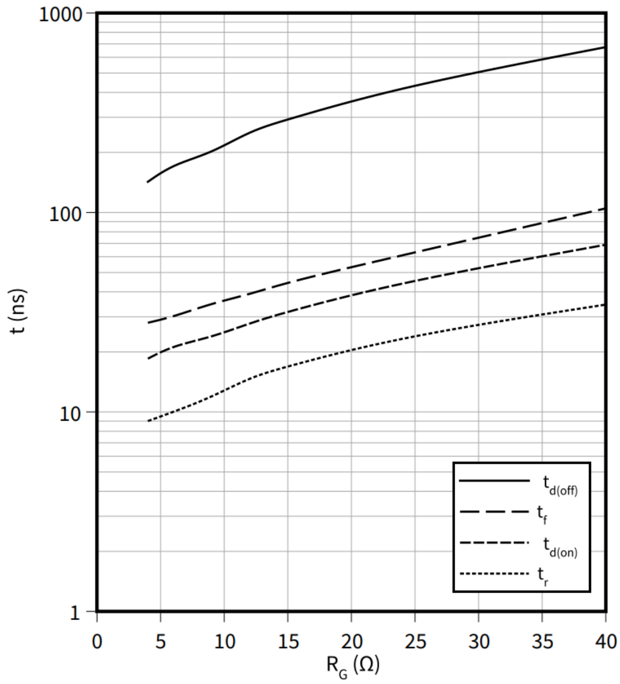
$V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$




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

$t = f(R_G)$

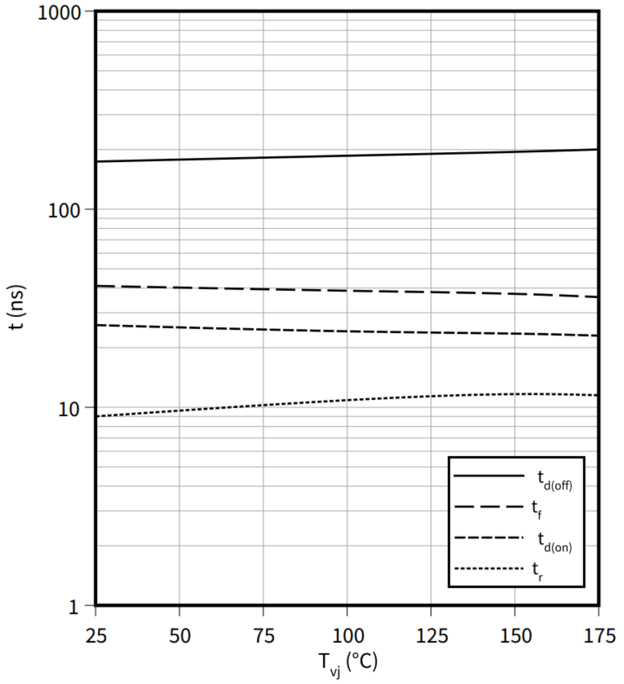
$I_C = 37.5$ A, $V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V



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

$t = f(T_{vj})$

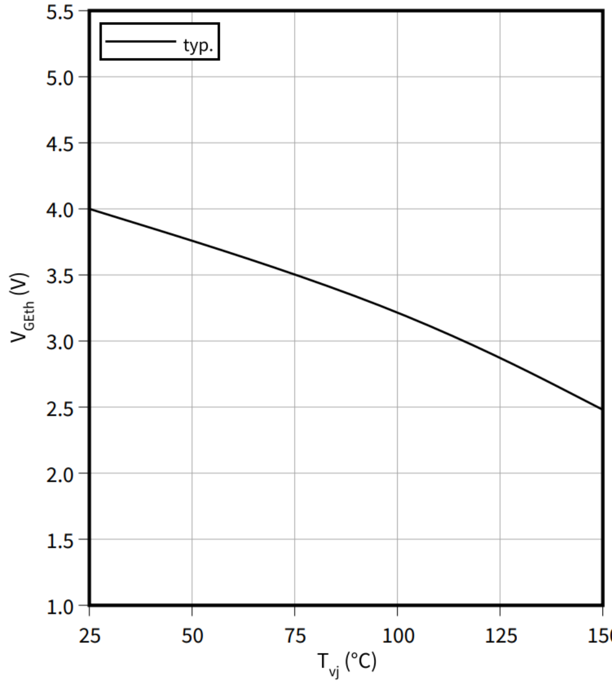
$I_C = 37.5$ A, $V_{CC} = 400$ V, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$




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

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

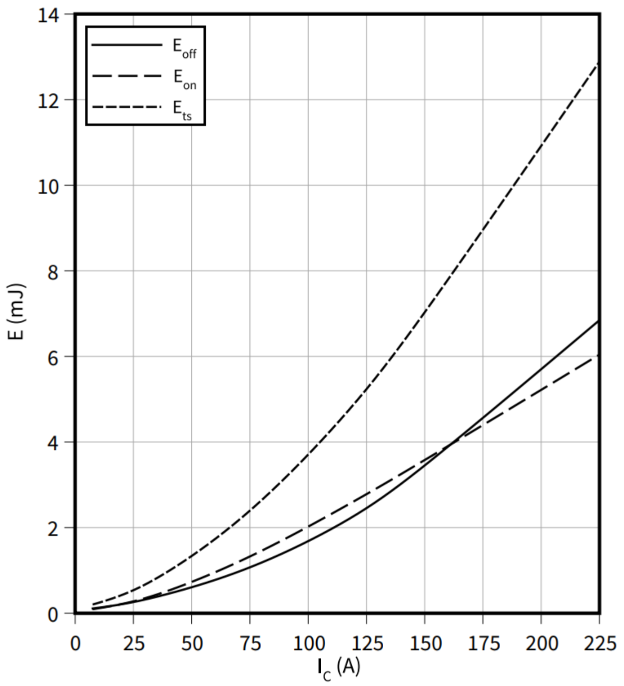
$I_C = 0.75$ mA




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

$E = f(I_C)$

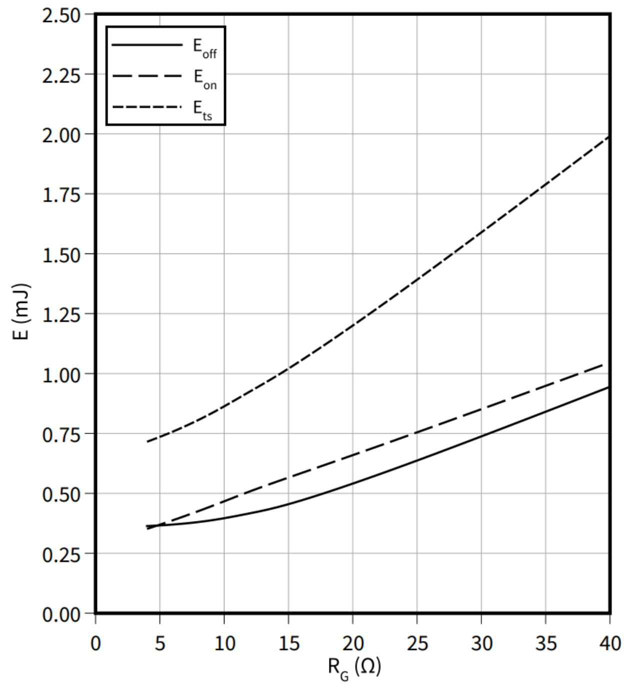
$V_{CC} = 400$ V, $T_{vj} = 150$ °C, $V_{GE} = 0/15$ V, $R_G = 9\ \Omega$




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

$E = f(R_G)$

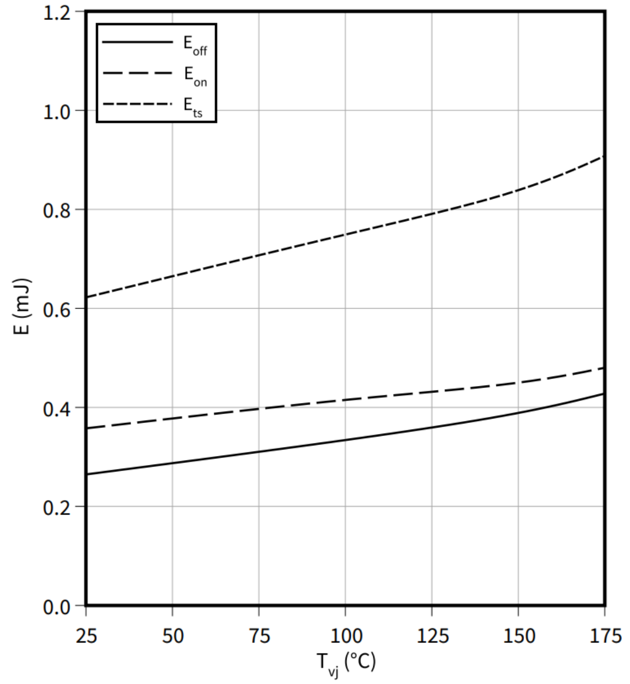
$I_C = 37.5$ A, $V_{CC} = 400$ V, $T_{vj} = 175$ °C, $V_{GE} = 0/15$ V



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

$E = f(T_{vj})$

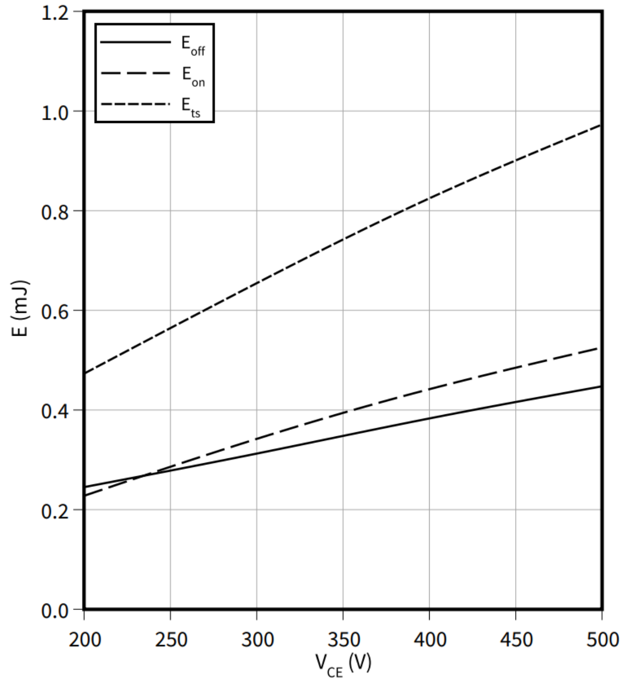
$I_C = 37.5\ A$, $V_{CC} = 400\ V$, $V_{GE} = 0/15\ V$, $R_G = 9\ \Omega$




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

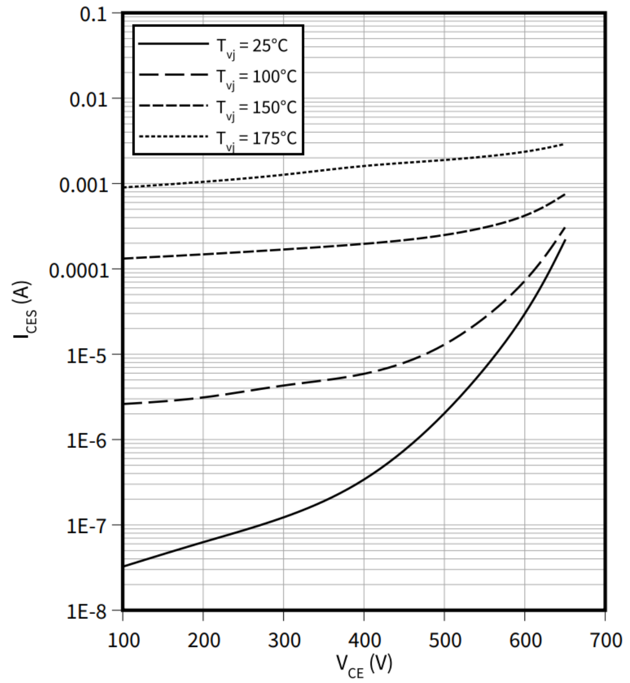
$E = f(V_{CE})$

$I_C = 37.5\ A$, $T_{vj} = 150\ °C$, $V_{GE} = 0/15\ V$, $R_G = 9\ \Omega$




**Typ. reverse current vs. reverse voltage as a function of Tvj**

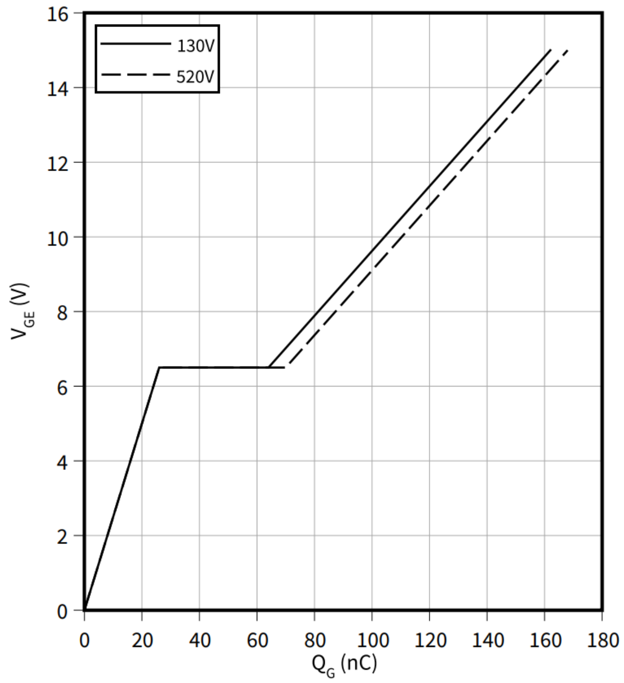
$I_{CES} = f(V_{CE})$




**Typical gate charge**

$V_{GE} = f(Q_G)$

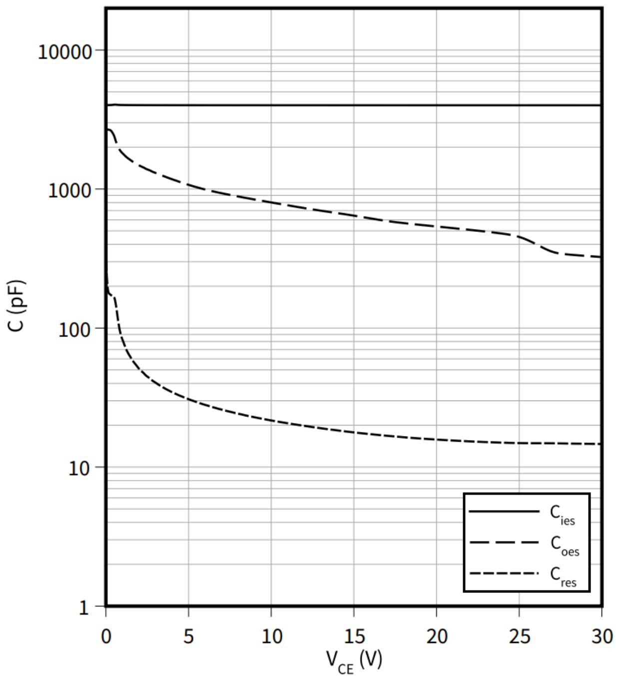
$I_C = 75\ A$



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

$C = f(V_{CE})$

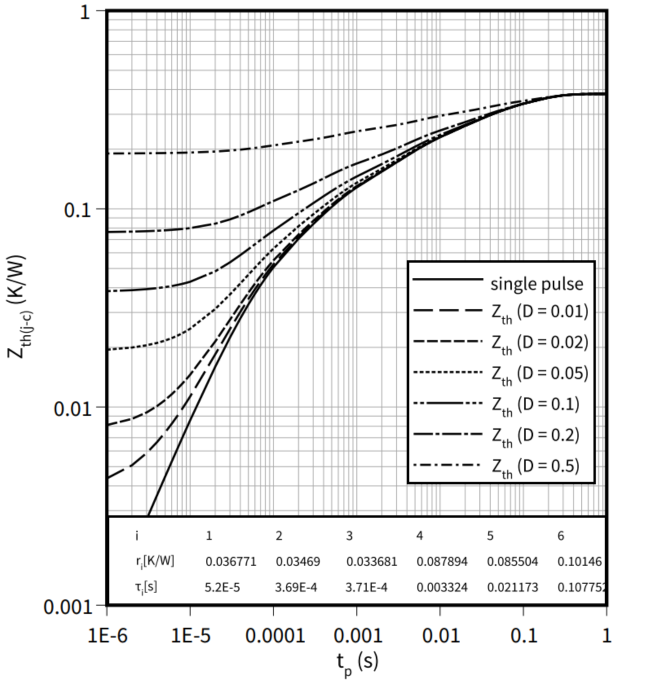
$f = 250$ kHz, $V_{GE} = 0$ V




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

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

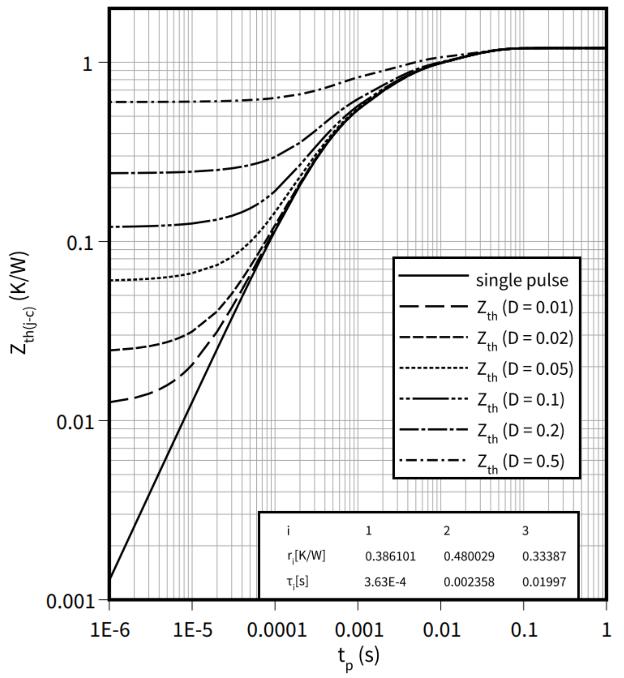
$D = t_p/T$




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

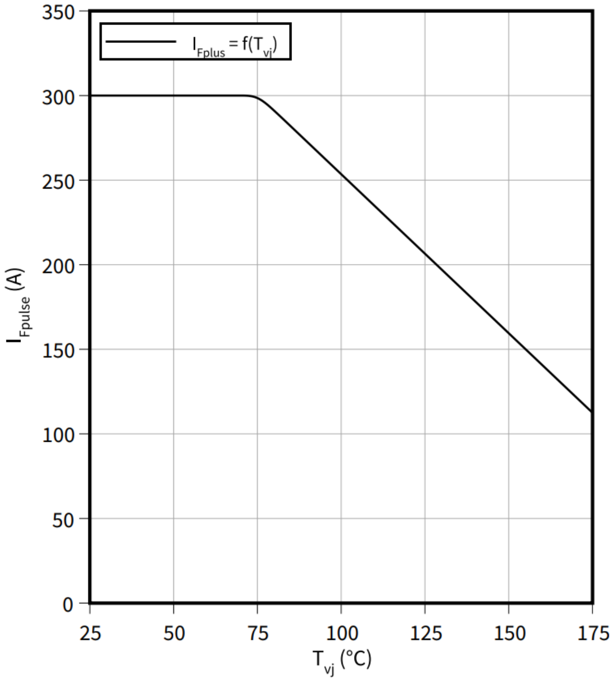
$Z_{th(j-c)} = f(t_p)$

$D = t_p/T$

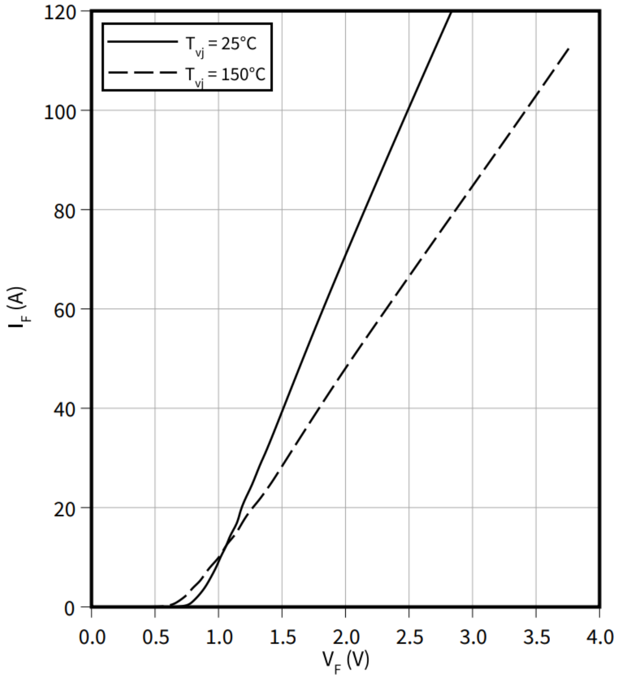
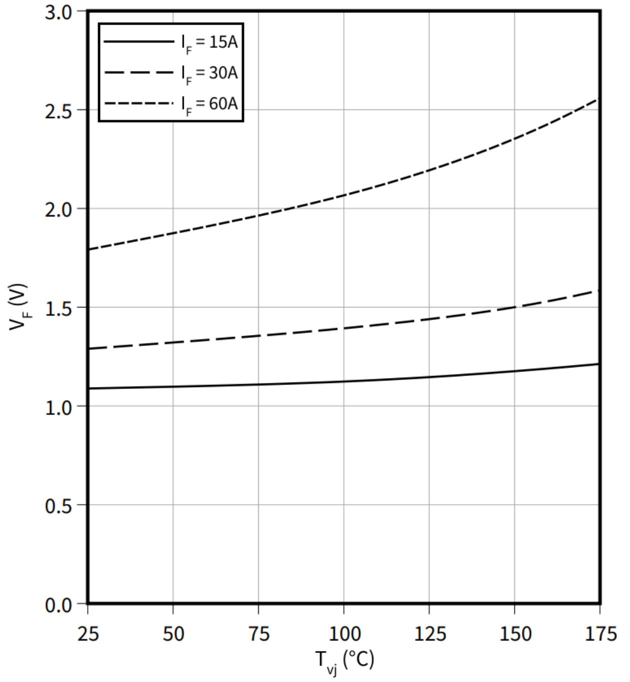



### Maximum pulse current as a function of junction temperature

$I_{Fpulse} = f(T_{vj})$

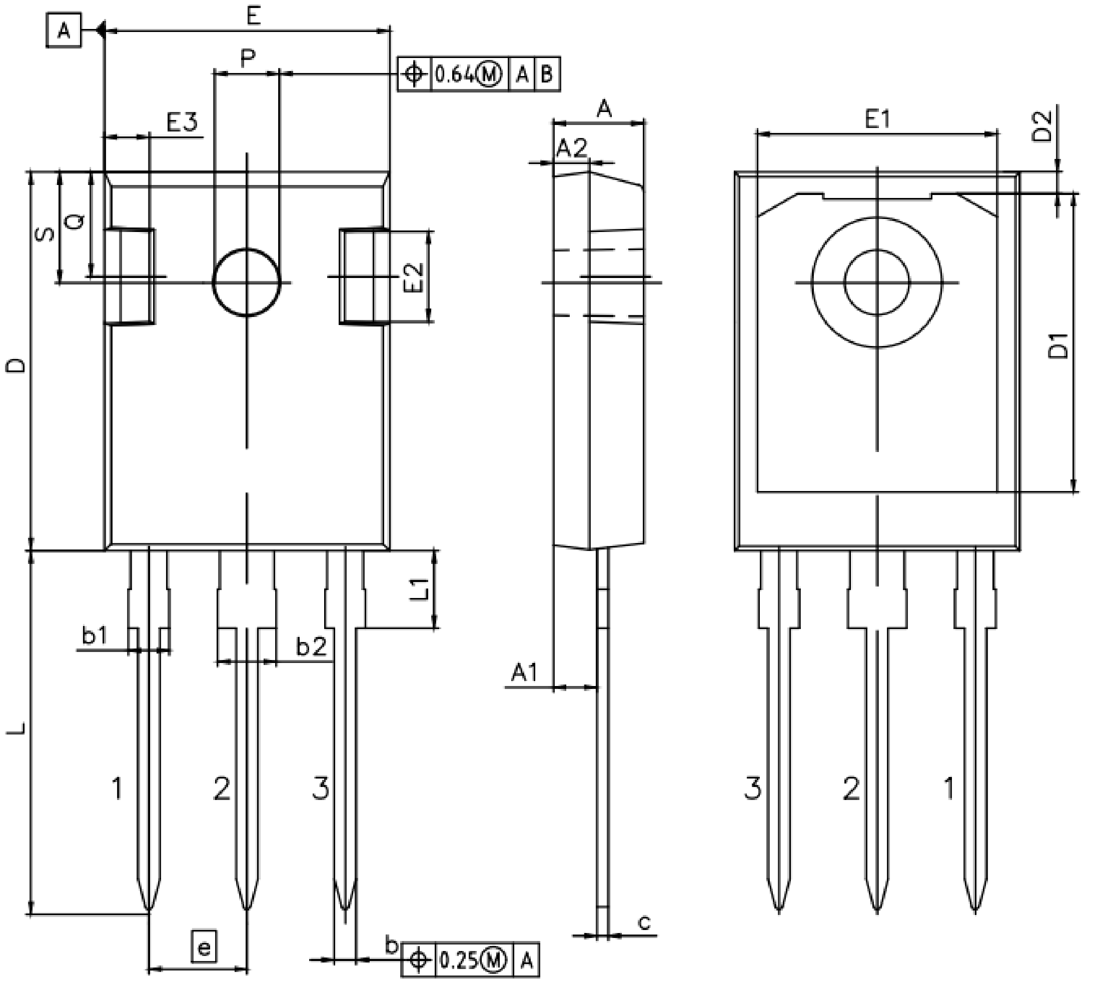


**4 特性图**

| **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** $V_F = f(T_{vj})$ |
|---|---|
|  |  |

# 5 封装外形

**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.<br>Z8B00003327 |
| REVISION<br>06 |
| SCALE 3:1<br>0 1 2 3 4 5mm |
| EUROPEAN PROJECTION |
| ISSUE DATE<br>25.07.2018 |

**图 1**

# 6 测试条件

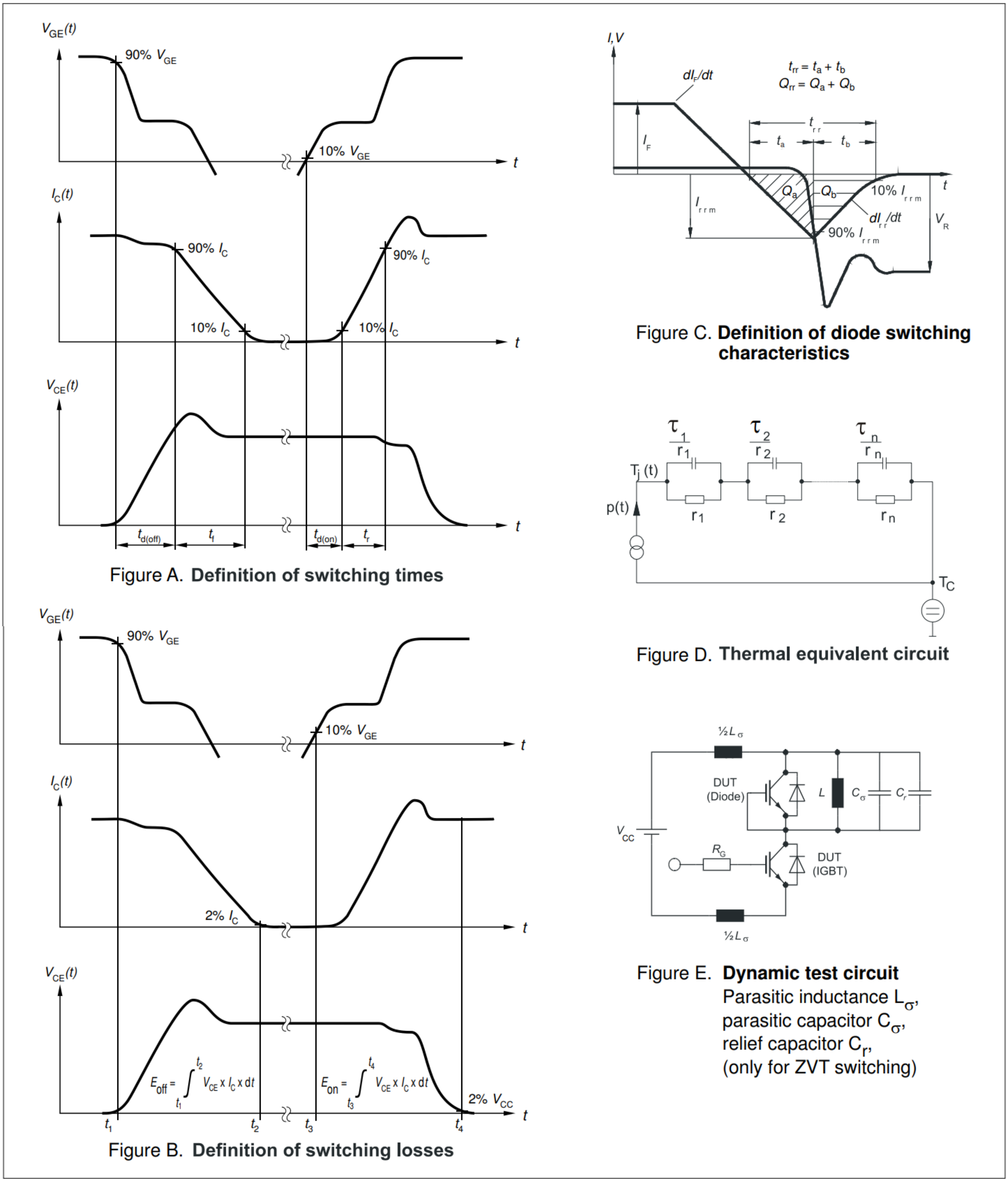



Figure A. **Definition of switching times**

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)

**图 2**

# 修订记录

| Document revision | Date of release | Description of changes |
|---|---|---|
| V1.1 | 2020-03-20 | Preliminary Data Sheet |
| V2.1 | 2020-07-27 | 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 |
| 1.10 | 2022-09-22 | Rename of product family name from “Hybrid CoolSiC™ IGBT” to “CoolSiC™ hybrid discrete” |

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