

# 英飞凌谐振开关系列

反向导通 IGBT，具有单片体二极管

IHW30N65R5

数据手册

工业功率控制

## 反向导通 IGBT，具有单片体二极管

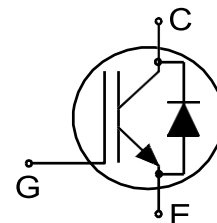
### 特性：

- 功能强大的单片反向导电二极管，正向电压低
- TRENCHSTOP™ 技术提供：
  - 参数分布紧密
  - 高健稳性、温度稳定性
  - 极低的  $V_{CEsat}$  和低  $E_{off}$
  - 由于  $V_{CEsat}$  具有正温度系数，因此易于并联
- 低电磁干扰
- 符合 JESD-022 目标应用要求
- 无铅引脚镀层；符合 RoHS 标准
- 完整的产品品类和 PSpice 模型：

<http://www.infineon.cn/igbt/>

### 应用：

- 电磁炉烹饪
- 变频微波炉
- 谐振变换器



### 关键性能和封装参数

| Type       | $V_{CE}$ | $I_C$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|------------|----------|-------|---------------------------------|-------------|---------|------------|
| IHW30N65R5 | 650V     | 30A   | 1.35V                           | 175°C       | H30ER5  | PG-TO247-3 |

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](http://infineon.com) 参考最新的英文版本（控制文档）。

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## 最大额定值

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%。

| Parameter                                                                                                            | Symbol      | Value            | Unit               |
|----------------------------------------------------------------------------------------------------------------------|-------------|------------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$                                                          | $V_{CE}$    | 650              | V                  |
| DC collector current, limited by $T_{vjmax}$<br>$T_c = 25^{\circ}\text{C}$<br>$T_c = 100^{\circ}\text{C}$            | $I_C$       | 60.0<br>30.0     | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$                                                               | $I_{Cpuls}$ | 90.0             | A                  |
| Turn off safe operating area<br>$V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}$ | -           | 90.0             | A                  |
| Diode forward current, limited by $T_{vjmax}$<br>$T_c = 25^{\circ}\text{C}$<br>$T_c = 100^{\circ}\text{C}$           | $I_F$       | 23.0<br>14.0     | A                  |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$                                                                   | $I_{Fpuls}$ | 42.0             | A                  |
| Gate-emitter voltage                                                                                                 | $V_{GE}$    | $\pm 20$         | V                  |
| Power dissipation $T_c = 25^{\circ}\text{C}$ Power<br>dissipation $T_c = 100^{\circ}\text{C}$                        | $P_{tot}$   | 176.0<br>88.0    | W                  |
| Operating junction temperature                                                                                       | $T_{vj}$    | $-40 \dots +175$ | $^{\circ}\text{C}$ |
| Storage temperature                                                                                                  | $T_{stg}$   | $-55 \dots +150$ | $^{\circ}\text{C}$ |
| Soldering temperature,<br>wave soldering 1.6mm (0.063in.) from case for 10s                                          |             | 260              | $^{\circ}\text{C}$ |
| Mounting torque, M3 screw Maximum<br>of mounting processes: 3                                                        | $M$         | 0.6              | Nm                 |

## 热阻抗特性

| Parameter                                    | Symbol        | Conditions | Max. Value | Unit |
|----------------------------------------------|---------------|------------|------------|------|
| 特性                                           |               |            |            |      |
| IGBT thermal resistance, junction<br>- case  | $R_{th(j-c)}$ |            | 0.81       | K/W  |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ |            | 3.81       | K/W  |
| Thermal resistance<br>junction - ambient     | $R_{th(j-a)}$ |            | 40         | K/W  |

电气特性，测于  $T_{vj} = 25^{\circ}\text{C}$  的条件下，除非另有规定

| Parameter                            | Symbol        | Conditions                                                                         | Value  |              |           | Unit     |
|--------------------------------------|---------------|------------------------------------------------------------------------------------|--------|--------------|-----------|----------|
|                                      |               |                                                                                    | min.   | typ.         | max.      |          |
| 静态特性                                 |               |                                                                                    |        |              |           |          |
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.20mA$                                                        | 650    | -            | -         | V        |
| Collector-emitter saturation voltage | $V_{CESat}$   | $V_{GE} = 15.0V, I_C = 30.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$ | -<br>- | 1.35<br>1.60 | 1.70<br>- | V        |
| Diode forward voltage                | $V_F$         | $V_{GE} = 0V, I_F = 30.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$    | -<br>- | 1.70<br>2.00 | 2.10<br>- | V        |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C = 0.30mA, V_{CE} = V_{GE}$                                                    | 3.2    | 4.0          | 4.8       | V        |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE} = 650V, V_{GE} = 0V$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$  | -<br>- | -<br>-       | 40<br>-   | $\mu A$  |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                        | -      | -            | 100       | nA       |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 30.0A$                                                        | -      | 35.0         | -         | S        |
| Integrated gate resistor             | $r_G$         |                                                                                    |        | none         |           | $\Omega$ |

电气特性，测于  $T_{vj} = 25^{\circ}\text{C}$  的条件下，除非另有规定

| Parameter                                                            | Symbol           | Conditions                                                            | Value |       |      | Unit |
|----------------------------------------------------------------------|------------------|-----------------------------------------------------------------------|-------|-------|------|------|
|                                                                      |                  |                                                                       | min.  | typ.  | max. |      |
| 动态特性                                                                 |                  |                                                                       |       |       |      |      |
| Input capacitance                                                    | C <sub>ies</sub> | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                 | -     | 3690  | -    | pF   |
| Output capacitance                                                   | C <sub>oes</sub> |                                                                       | -     | 34    | -    |      |
| Reverse transfer capacitance                                         | C <sub>res</sub> |                                                                       | -     | 15    | -    |      |
| Gate charge                                                          | Q <sub>G</sub>   | V <sub>CC</sub> = 520V, I <sub>C</sub> = 30.0A, V <sub>GE</sub> = 15V | -     | 153.0 | -    | nC   |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from<br>case | L <sub>E</sub>   |                                                                       | -     | 13.0  | -    | nH   |

开关特性、感性负载

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

IGBT特性，测于  $T_{vj} = 25^{\circ}\text{C}$  的条件下

|                        |              |                                                                                                                                                                                                                                                                                                                                    |   |      |   |    |
|------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-on delay time     | $t_{d(on)}$  | $T_{vj} = 25^{\circ}\text{C},$<br>$V_{CC} = 400\text{V}, I_C = 30.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(on)} = 13.0\Omega, R_{G(off)} = 13.0\Omega,$<br>$L_{\sigma} = 35\text{nH}, C_{\sigma} = 32\text{pF}$<br>$L_{\sigma}, C_{\sigma}$ from Fig. E<br>Energy losses include "tail" and<br>diode reverse recovery. | - | 29   | - | ns |
| Rise time              | $t_r$        |                                                                                                                                                                                                                                                                                                                                    | - | 17   | - | ns |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                    | - | 220  | - | ns |
| Fall time              | $t_f$        |                                                                                                                                                                                                                                                                                                                                    | - | 8    | - | ns |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                                                                                                                                                                                                    | - | 0.85 | - | mJ |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                    | - | 0.24 | - | mJ |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                                                                                                                                                                    | - | 1.09 | - | mJ |

二极管特性，测于  $T_{vj} = 25^{\circ}\text{C}$  的条件下

|                                                                  |              |                                                                                                                         |   |       |   |                        |
|------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------|---|-------|---|------------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 25^{\circ}\text{C},$<br>$V_R = 400\text{V},$<br>$I_F = 30.0\text{A},$<br>$di_F/dt = 1100\text{A}/\mu\text{s}$ | - | 95    | - | ns                     |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                         | - | 1.90  | - | $\mu\text{C}$          |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                         | - | 28.0  | - | A                      |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                         | - | -2000 | - | $\text{A}/\mu\text{s}$ |

## 开关特性、感性负载

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

IGBT特性，测于  $T_{vj} = 175^{\circ}\text{C}$  的条件下

|                        |              |                                                                                                                                                                                                                                                                                                                                  |   |      |   |    |
|------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-on delay time     | $t_{d(on)}$  | $T_{vj} = 175^{\circ}\text{C},$<br>$V_{CC} = 400\text{V}, I_C = 30.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(on)} = 13.0\Omega, R_{G(off)} = 13.0\Omega,$<br>$L_{\sigma} = 35\text{nH}, C_{\sigma} = 32\text{pF}$<br>$L_{\sigma}, C_{\sigma}$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | - | 28   | - | ns |
| Rise time              | $t_r$        |                                                                                                                                                                                                                                                                                                                                  | - | 16   | - | ns |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                  | - | 240  | - | ns |
| Fall time              | $t_f$        |                                                                                                                                                                                                                                                                                                                                  | - | 18   | - | ns |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                                                                                                                                                                                                  | - | 0.95 | - | mJ |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                  | - | 0.41 | - | mJ |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                                                                                                                                                                  | - | 1.36 | - | mJ |

二极管特性，测于  $T_{vj} = 175^{\circ}\text{C}$  的条件下

|                                                                  |              |                                                                                                                          |   |       |   |                        |
|------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------|---|-------|---|------------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 175^{\circ}\text{C}, V_R$<br>$= 400\text{V}, I_F =$<br>$30.0\text{A},$<br>$di_F/dt = 1100\text{A}/\mu\text{s}$ | - | 114   | - | ns                     |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                          | - | 3.30  | - | $\mu\text{C}$          |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                          | - | 45.0  | - | A                      |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                          | - | -1650 | - | $\text{A}/\mu\text{s}$ |

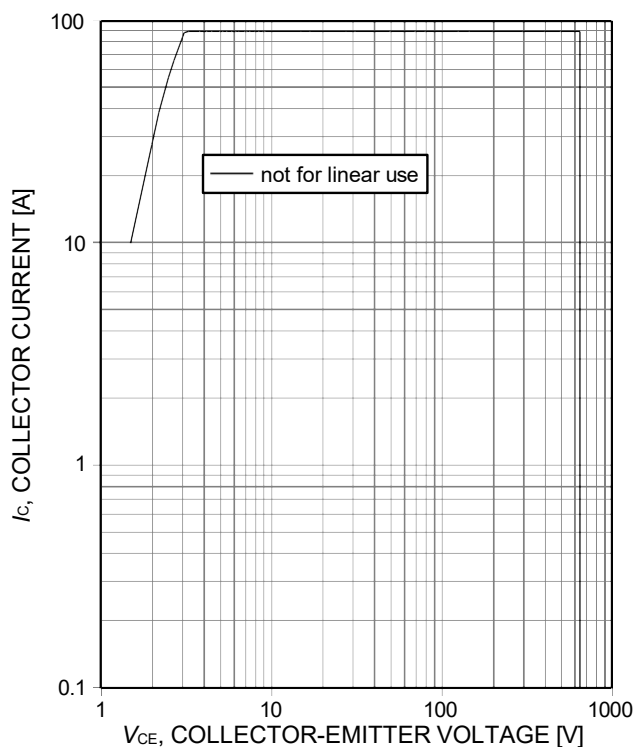


Figure 1. **Safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ )

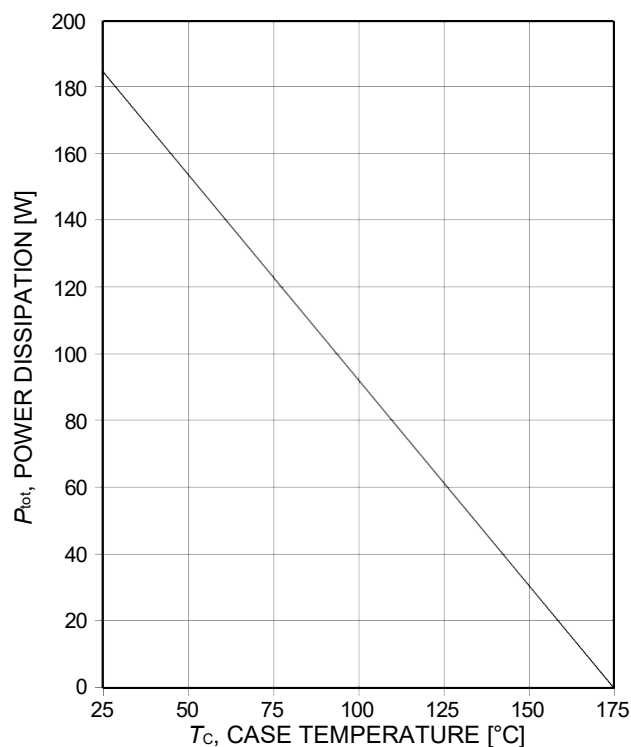


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

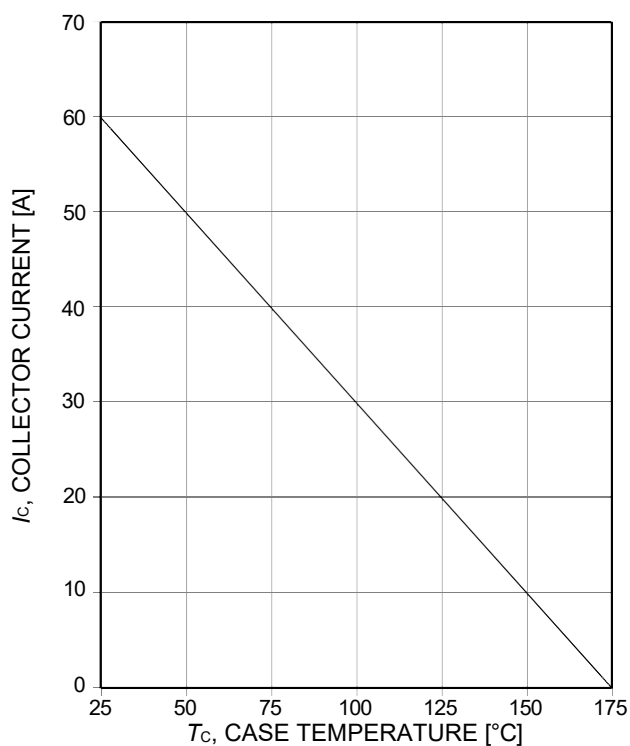


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

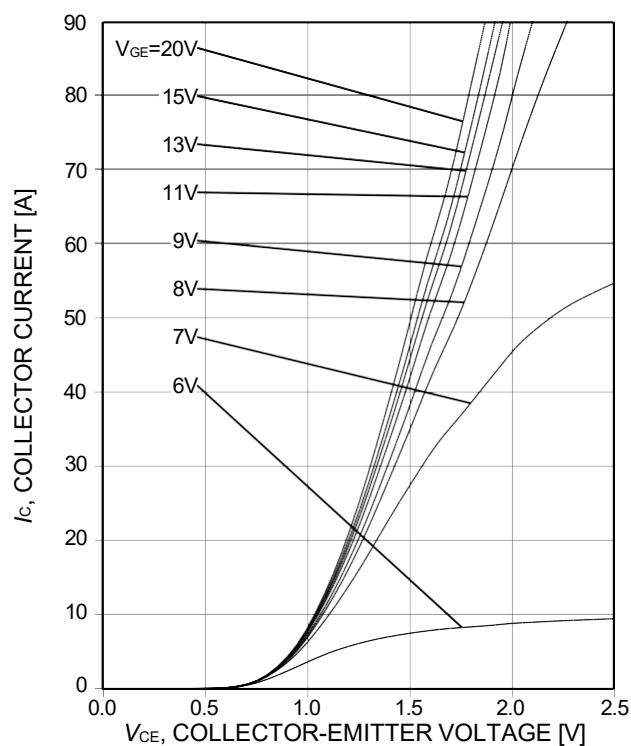


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

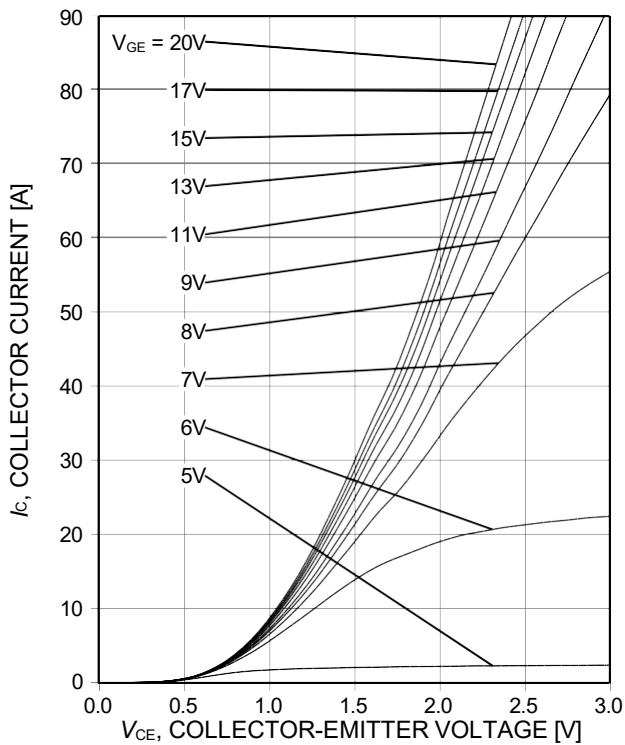


Figure 5. **Typical output characteristic**  
( $T_{vj}=175^{\circ}\text{C}$ )

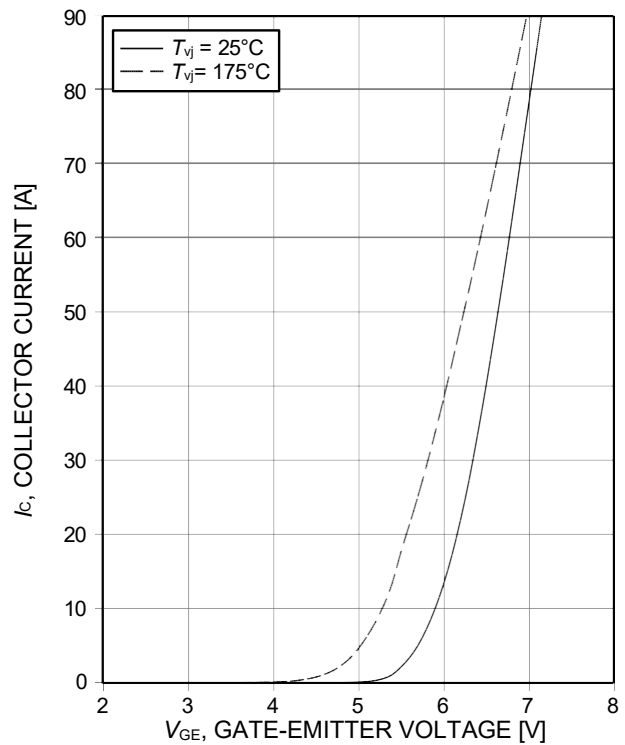


Figure 6. **Typical transfer characteristic**  
( $V_{ce}=20\text{V}$ )

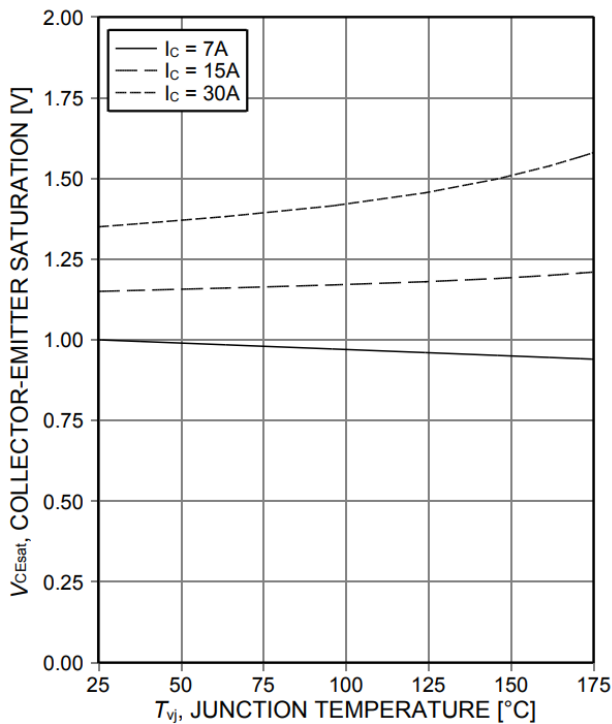


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{ge}=15\text{V}$ )

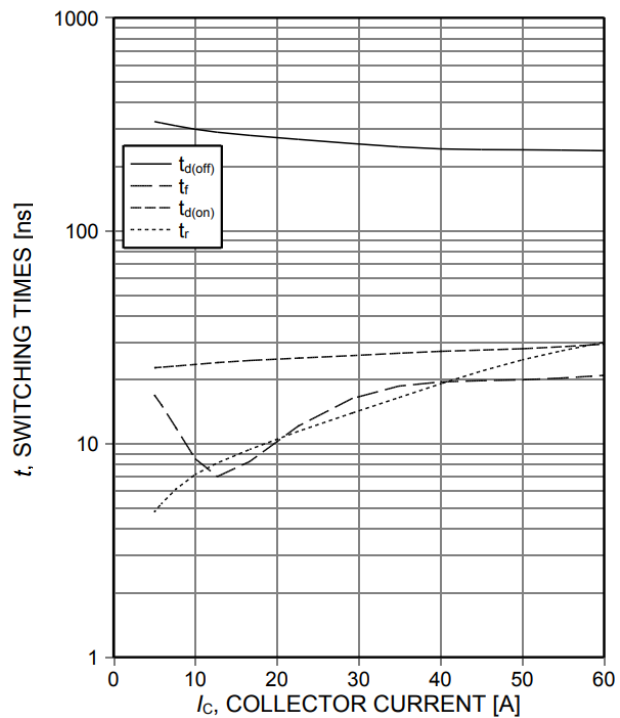


Figure 8. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{ce}=400\text{V}$ ,  
 $V_{ge}=0/15\text{V}$ ,  $R_{gon}=13\Omega$ ,  $R_{goff}=13\Omega$ , dynamic test circuit in Figure E)

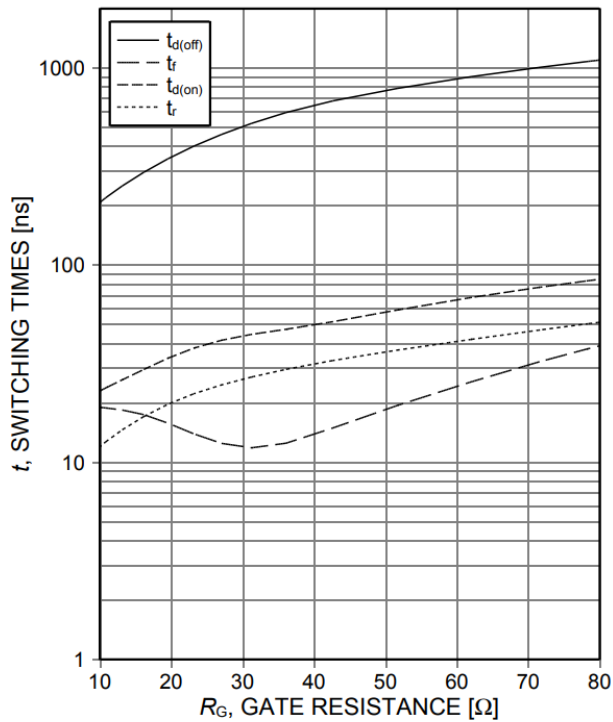


Figure 9. **Typical switching times as a function of gate resistance**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=30\text{A}$ , dynamic test circuit in Figure E)

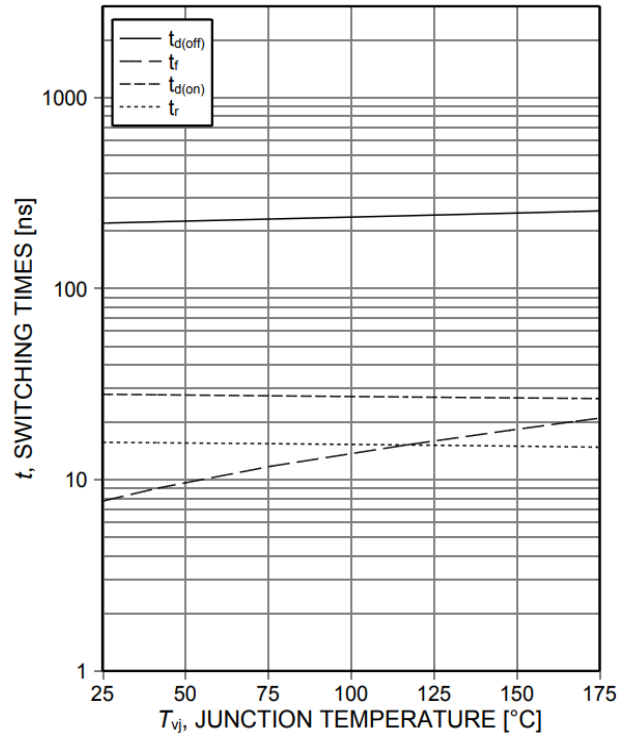


Figure 10. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=30\text{A}$ ,  $R_{Gon}=13\Omega$ ,  $R_{Goff}=13\Omega$ , dynamic test circuit in Figure E)

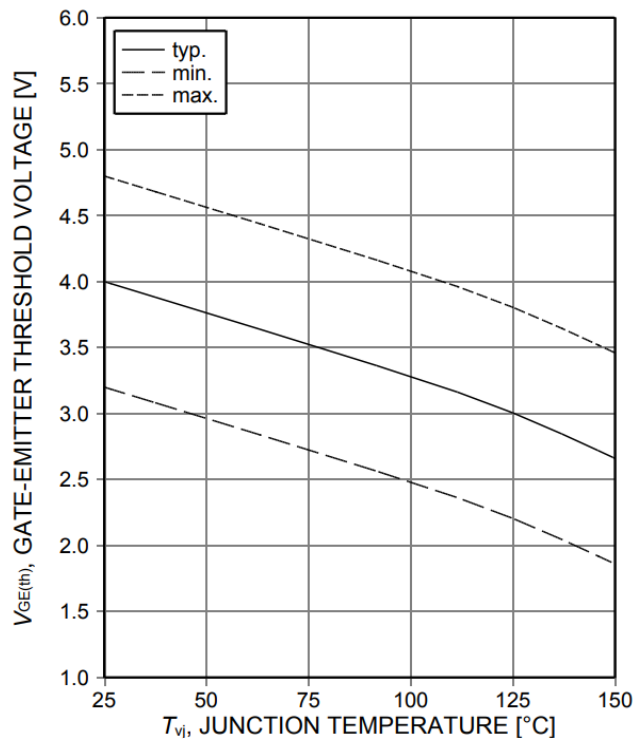


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.3\text{mA}$ )

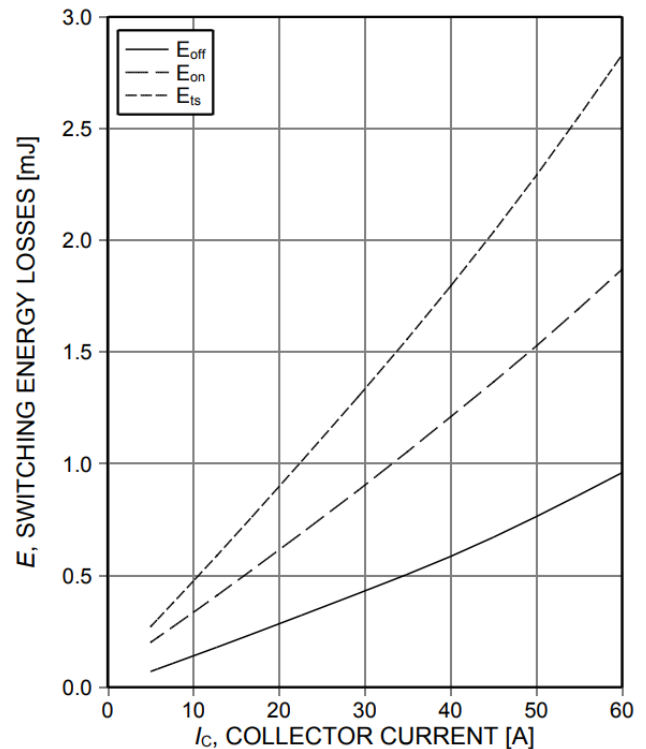


Figure 12. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{Gon}=13\Omega$ ,  $R_{Goff}=13\Omega$ , dynamic test circuit in Figure E)

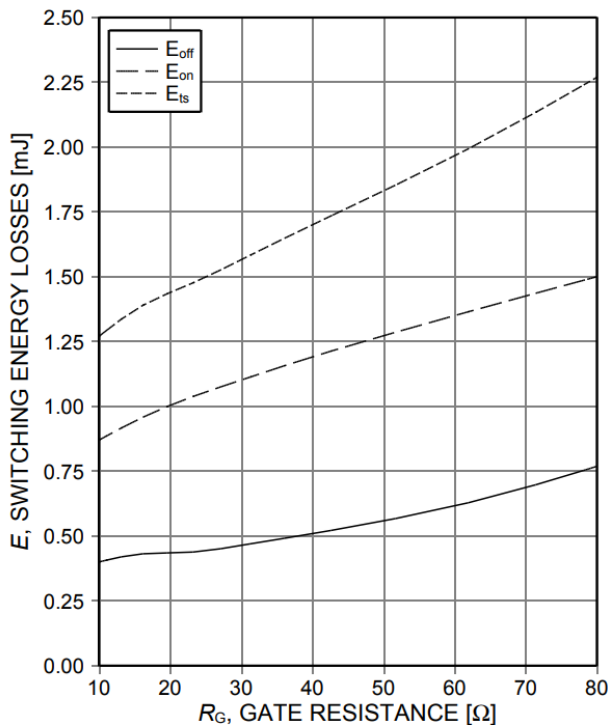


Figure 13. **Typical switching energy losses as a function of gate resistance**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=30\text{A}$ , dynamic test circuit in Figure E)

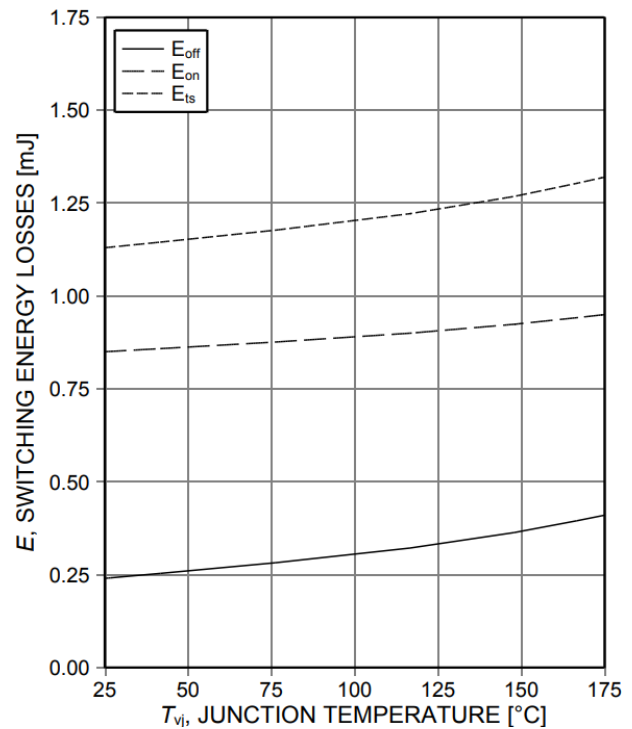


Figure 14. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=30\text{A}$ ,  $R_{Gon}=13\Omega$ ,  $R_{Goff}=13\Omega$ , dynamic test circuit in Figure E)

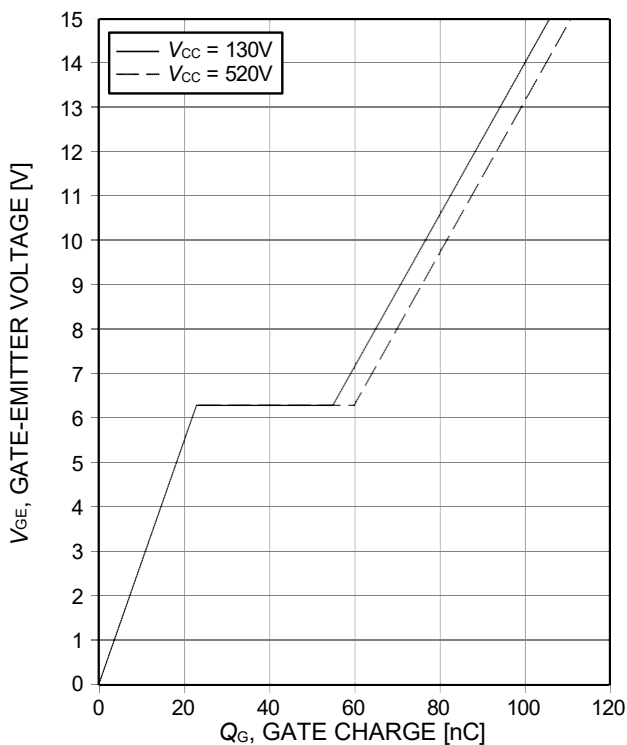


Figure 15. **Typical gate charge**  
( $I_C=30\text{A}$ )

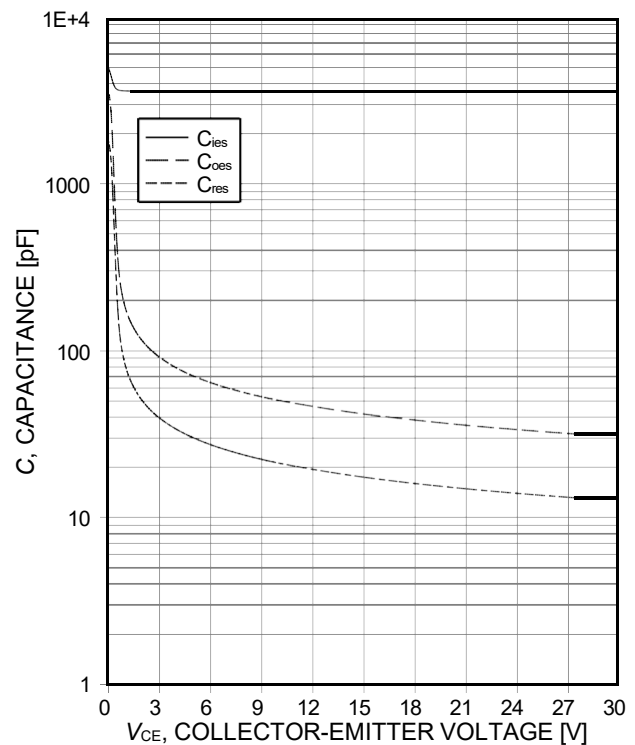


Figure 16. **Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f=1\text{MHz}$ )

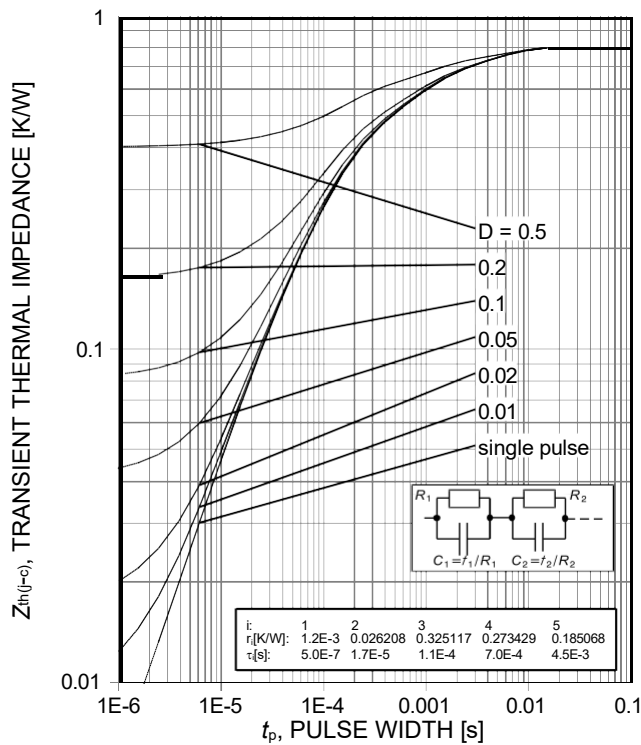


Figure 17. IGBT transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

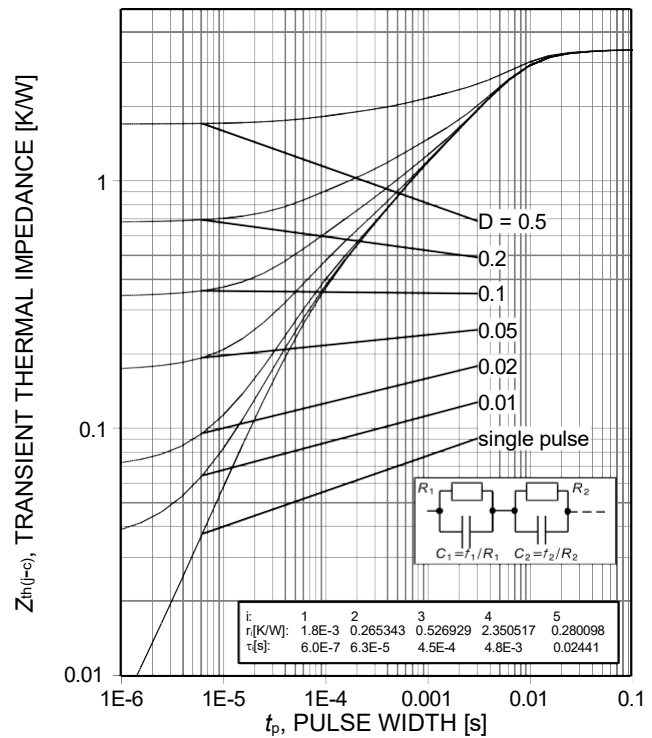


Figure 18. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

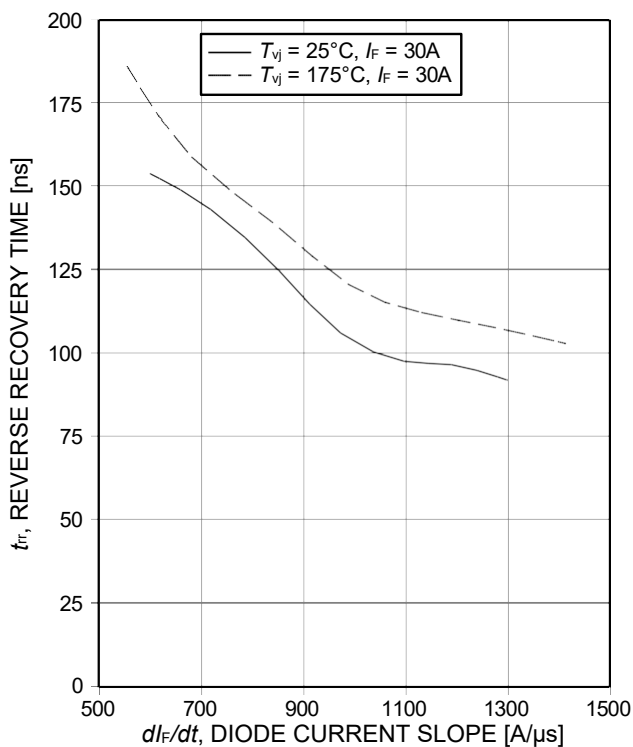


Figure 19. Typical reverse recovery time as a function of diode current slope ( $V_R=400V$ )

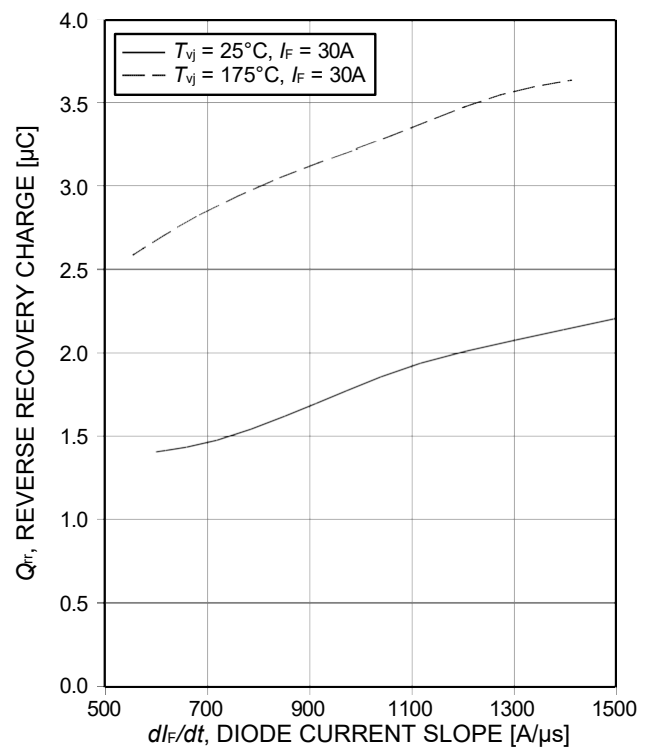


Figure 20. Typical reverse recovery charge as a function of diode current slope ( $V_R=400V$ )

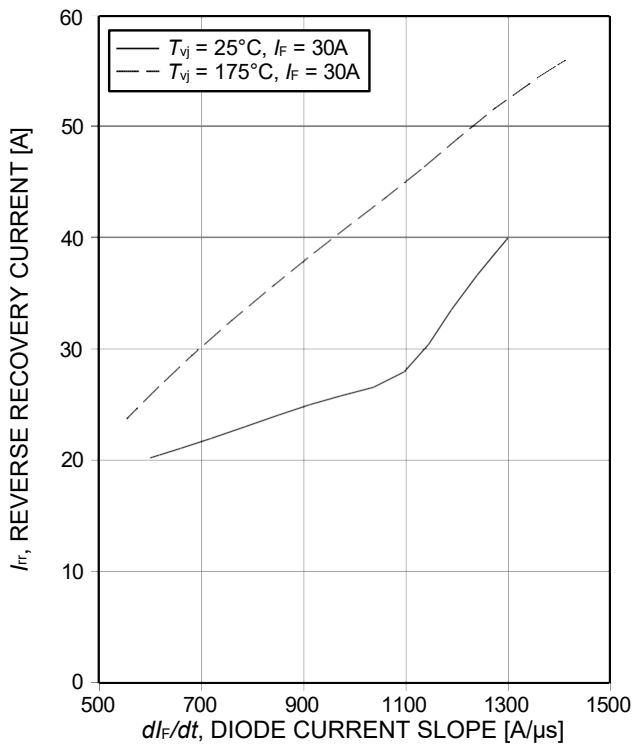


Figure 21. **Typical reverse recovery current as a function of diode current slope**  
( $V_R=400V$ )

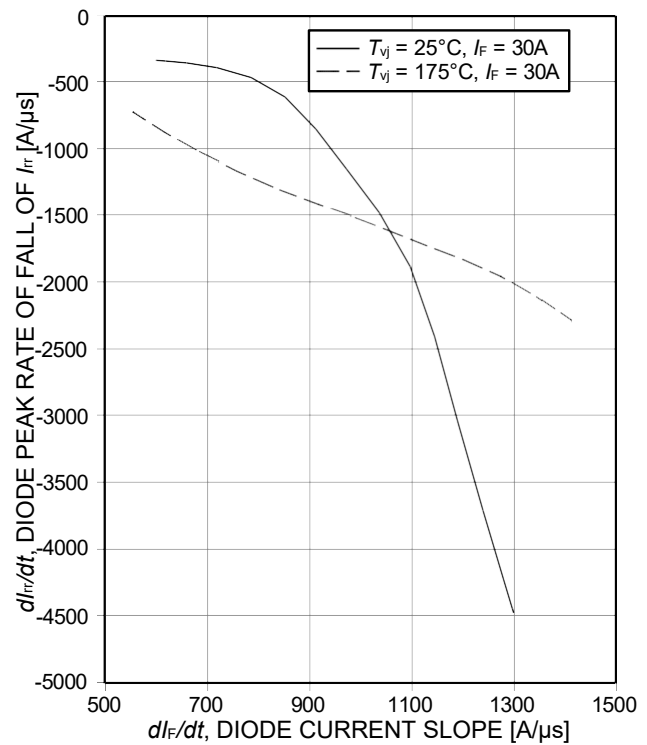


Figure 22. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**  
( $V_R=400V$ )

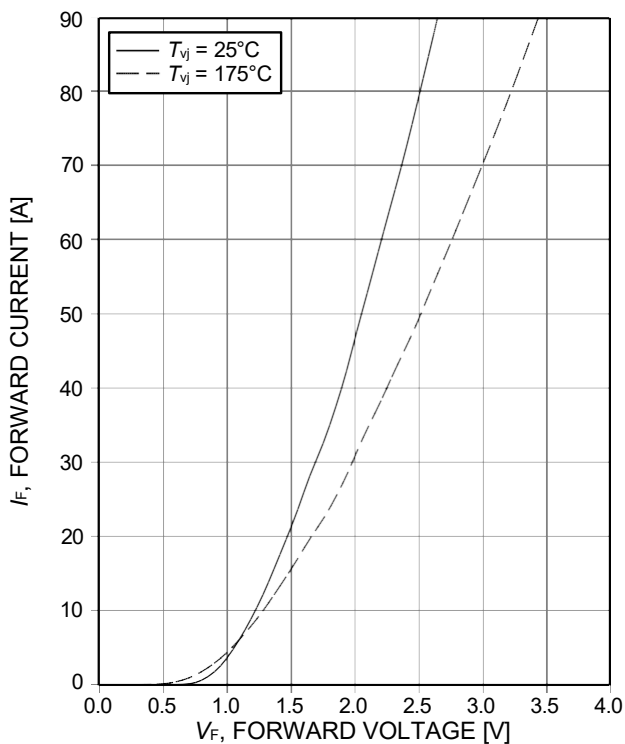


Figure 23. **Typical diode forward current as a function of forward voltage**

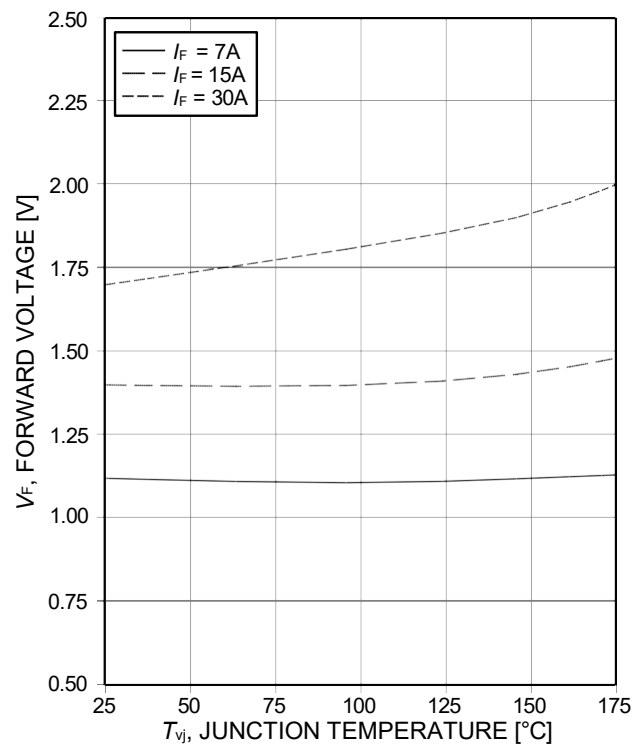
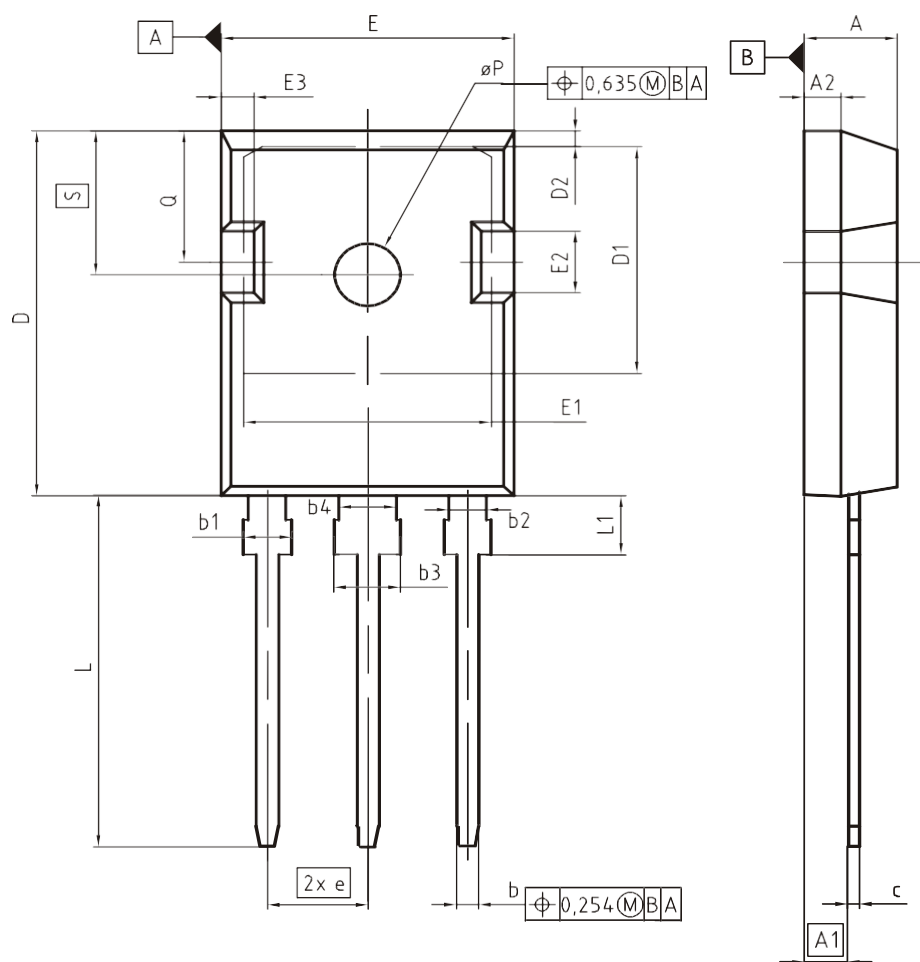
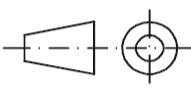


Figure 24. **Typical diode forward voltage as a function of junction temperature**

封装图 PG-T0247-3



| DIM | MILLIMETERS |       | INCHES      |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | 4.83        | 5.21  | 0.190       | 0.205 |
| A1  | 2.27        | 2.54  | 0.089       | 0.100 |
| A2  | 1.85        | 2.16  | 0.073       | 0.085 |
| b   | 1.07        | 1.33  | 0.042       | 0.052 |
| b1  | 1.90        | 2.41  | 0.075       | 0.095 |
| b2  | 1.90        | 2.16  | 0.075       | 0.085 |
| b3  | 2.87        | 3.38  | 0.113       | 0.133 |
| b4  | 2.87        | 3.13  | 0.113       | 0.123 |
| c   | 0.55        | 0.68  | 0.022       | 0.027 |
| 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   | 5.44 (BSC)  |       | 0.214 (BSC) |       |
| N   | 3           |       | 3           |       |
| L   | 19.80       | 20.32 | 0.780       | 0.800 |
| L1  | 4.10        | 4.47  | 0.161       | 0.176 |
| øP  | 3.50        | 3.70  | 0.138       | 0.146 |
| Q   | 5.49        | 6.00  | 0.216       | 0.236 |
| S   | 6.04        | 6.30  | 0.238       | 0.248 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00003327                                                                                  |
| <b>SCALE</b><br>0 5 5 7.5mm                                                                                         |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>09-07-2010                                                                                     |
| <b>REVISION</b><br>05                                                                                               |

# 测试条件

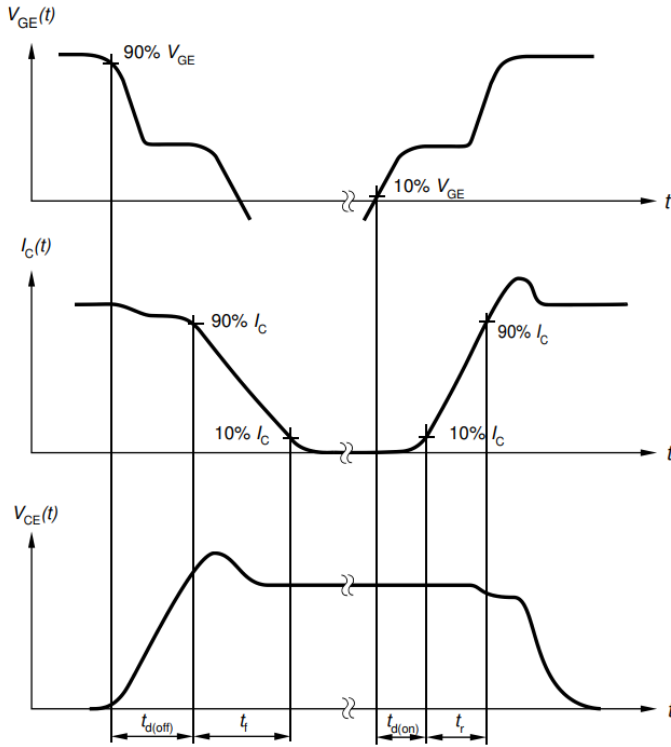


Figure A. Definition of switching times

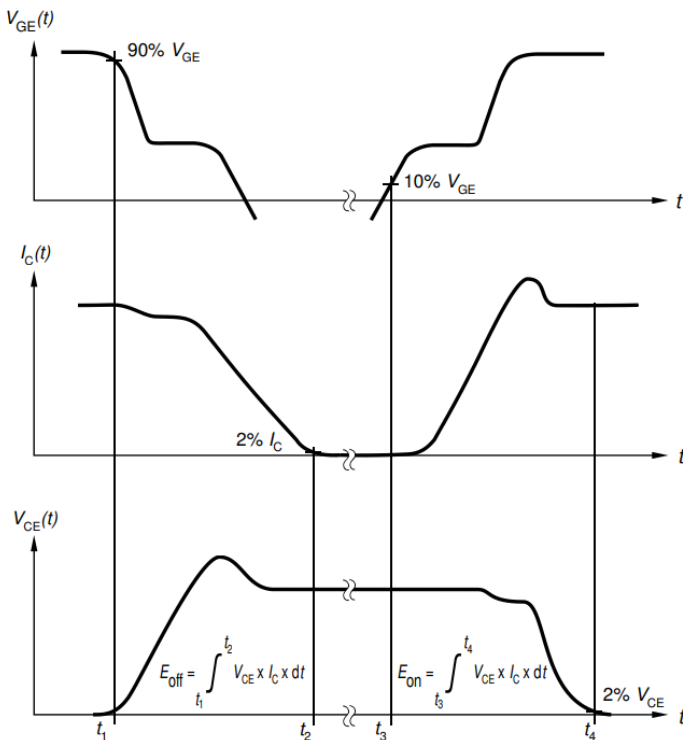


Figure B. Definition of switching losses

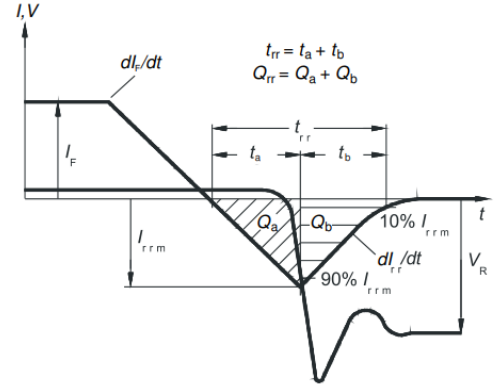


Figure C. Definition of diode switching characteristics

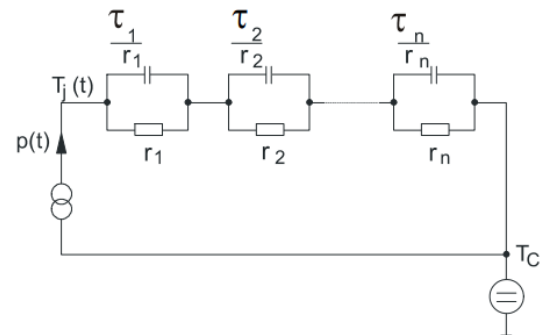


Figure D. Thermal equivalent circuit

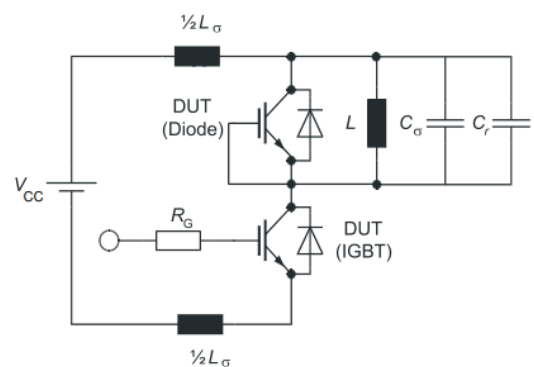


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $C_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

**修订记录**

IHW30N65R5

**Revision: 2015-12-22, Rev. 2.1****历史修订**

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 1.1      | 2015-06-01 | Preliminary                                  |
| 2.1      | 2015-12-22 | Final data sheet                             |

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