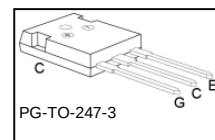
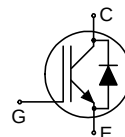


## Fast IGBT in NPT-technology with soft, fast recovery anti-parallel Emitter Controlled Diode

- 40% lower  $E_{off}$  compared to previous generation
- Short circuit withstand time – 10  $\mu$ s
- Designed for:
  - Motor controls
  - Inverter
  - SMPS
- NPT-Technology offers:
  - very tight parameter distribution
  - high ruggedness, temperature stable behaviour
  - parallel switching capability
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1</sup> for target applications
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



| Type      | $V_{CE}$ | $I_C$ | $E_{off}$ | $T_j$ | Marking | Package     |
|-----------|----------|-------|-----------|-------|---------|-------------|
| SKW25N120 | 1200V    | 25A   | 2.9mJ     | 150°C | K25N120 | PG-TO-247-3 |

### Maximum Ratings

| Parameter                                                                                    | Symbol         | Value      | Unit    |
|----------------------------------------------------------------------------------------------|----------------|------------|---------|
| Collector-emitter voltage                                                                    | $V_{CE}$       | 1200       | V       |
| DC collector current                                                                         | $I_C$          | 46         | A       |
| $T_C = 25^\circ\text{C}$                                                                     |                | 25         |         |
| $T_C = 100^\circ\text{C}$                                                                    |                |            |         |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$                                        | $I_{Cpuls}$    | 84         |         |
| Turn off safe operating area                                                                 | -              | 84         |         |
| $V_{CE} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$                                       |                |            |         |
| Diode forward current                                                                        | $I_F$          | 42         |         |
| $T_C = 25^\circ\text{C}$                                                                     |                | 25         |         |
| $T_C = 100^\circ\text{C}$                                                                    |                |            |         |
| Diode pulsed current, $t_p$ limited by $T_{jmax}$                                            | $I_{Fpuls}$    | 80         |         |
| Gate-emitter voltage                                                                         | $V_{GE}$       | $\pm 20$   | V       |
| Short circuit withstand time <sup>2</sup>                                                    | $t_{SC}$       | 10         | $\mu$ s |
| $V_{GE} = 15\text{V}, 100\text{V} \leq V_{CC} \leq 1200\text{V}, T_j \leq 150^\circ\text{C}$ |                |            |         |
| Power dissipation                                                                            | $P_{tot}$      | 313        | W       |
| $T_C = 25^\circ\text{C}$                                                                     |                |            |         |
| Operating junction and storage temperature                                                   | $T_j, T_{stg}$ | -55...+150 |         |
| Soldering temperature,<br>wavesoldering, 1.6mm (0.063 in.) from case for 10s                 | $T_s$          | 260        |         |

<sup>1</sup> J-STD-020 and JEDEC-022

<sup>2</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

**Thermal Resistance**

| Parameter                                    | Symbol      | Conditions | Max. Value | Unit |
|----------------------------------------------|-------------|------------|------------|------|
| <b>Characteristic</b>                        |             |            |            |      |
| IGBT thermal resistance,<br>junction – case  | $R_{thJC}$  |            | 0.4        | K/W  |
| Diode thermal resistance,<br>junction – case | $R_{thJCD}$ |            | 1.15       |      |
| Thermal resistance,<br>junction – ambient    | $R_{thJA}$  |            | 40         |      |

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

| Parameter                                     | Symbol        | Conditions                                                                                     | Value    |             |             | Unit    |
|-----------------------------------------------|---------------|------------------------------------------------------------------------------------------------|----------|-------------|-------------|---------|
|                                               |               |                                                                                                | min.     | typ.        | max.        |         |
| Static Characteristic                         |               |                                                                                                |          |             |             |         |
| Collector-emitter breakdown voltage           | $V_{(BR)CES}$ | $V_{GE}=0V$ ,<br>$I_C=1500\mu A$                                                               | 1200     | -           | -           | V       |
| Collector-emitter saturation voltage          | $V_{CE(sat)}$ | $V_{GE} = 15V$ , $I_C=25A$<br>$T_j=25^{\circ}C$<br>$T_j=150^{\circ}C$                          | 2.5<br>- | 3.1<br>3.7  | 3.6<br>4.3  |         |
| Diode forward voltage                         | $V_F$         | $V_{GE}=0V$ , $I_F=25A$<br>$T_j=25^{\circ}C$<br>$T_j=150^{\circ}C$                             | -        | 2.0<br>1.75 | 2.5         |         |
| Gate-emitter threshold voltage                | $V_{GE(th)}$  | $I_C=1000\mu A$ ,<br>$V_{CE}=V_{GE}$                                                           | 3        | 4           | 5           |         |
| Zero gate voltage collector current           | $I_{CES}$     | $V_{CE}=1200V$ , $V_{GE}=0V$<br>$T_j=25^{\circ}C$<br>$T_j=150^{\circ}C$                        | -<br>-   | -<br>-      | 350<br>1400 | $\mu A$ |
| Gate-emitter leakage current                  | $I_{GES}$     | $V_{CE}=0V$ , $V_{GE}=20V$                                                                     | -        | -           | 100         |         |
| Transconductance                              | $g_{fs}$      | $V_{CE}=20V$ , $I_C=25A$                                                                       |          | 20          | -           | S       |
| Dynamic Characteristic                        |               |                                                                                                |          |             |             |         |
| Input capacitance                             | $C_{iss}$     | $V_{CE}=25V$ ,<br>$V_{GE}=0V$ ,<br>$f=1MHz$                                                    | -        | 2150        | 2600        | pF      |
| Output capacitance                            | $C_{oss}$     |                                                                                                | -        | 260         | 310         |         |
| Reverse transfer capacitance                  | $C_{rss}$     |                                                                                                | -        | 110         | 130         |         |
| Gate charge                                   | $Q_{Gate}$    | $V_{CC}=960V$ , $I_C=25A$<br>$V_{GE}=15V$                                                      | -        | 225         | 300         | nC      |
| Internal emitter inductance                   | $L_E$         |                                                                                                | -        | 13          | -           | nH      |
| Measured 5mm (0.197 in.) from case            |               |                                                                                                |          |             |             |         |
| Short circuit collector current <sup>1)</sup> | $I_{C(SC)}$   | $V_{GE}=15V$ , $t_{SC}\leq 10\mu s$<br>$100V\leq V_{CC}\leq 1200V$ ,<br>$T_i\leq 150^{\circ}C$ | -        | 240         | -           | A       |

<sup>1)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s

**Switching Characteristic, Inductive Load, at  $T_j=25^\circ\text{C}$** 

| Parameter              | Symbol       | Conditions                                                                                                                                                                                    | Value |      |      | Unit |
|------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                        |              |                                                                                                                                                                                               | Min.  | typ. | max. |      |
| IGBT Characteristic    |              |                                                                                                                                                                                               |       |      |      |      |
| Turn-on delay time     | $t_{d(on)}$  | $T_j=25^{\circ}\text{C}$ ,<br>$V_{CC}=800\text{V}$ , $I_C=25\text{A}$ ,<br>$V_{GE}=15/0\text{V}$ ,<br>$R_G=22\Omega$ ,<br>$L_{\sigma}^{(1)}=180\text{nH}$ ,<br>$C_{\sigma}^{(1)}=40\text{pF}$ | -     | 45   | 60   | ns   |
| Rise time              | $t_r$        |                                                                                                                                                                                               | -     | 40   | 52   |      |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                               | -     | 730  | 950  |      |
| Fall time              | $t_f$        |                                                                                                                                                                                               | -     | 30   | 39   |      |
| Turn-on energy         | $E_{on}$     | Energy losses include<br>“tail” and diode<br>reverse recovery.                                                                                                                                | -     | 2.2  | 2.9  | mJ   |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                               | -     | 1.5  | 2.0  |      |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                               | -     | 3.7  | 4.9  |      |

**Anti-Parallel Diode Characteristic**

|                                                                  |              |                                                                                                         |   |     |  |                  |
|------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------|---|-----|--|------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_j=25^\circ\text{C}$ ,<br>$V_R=800\text{V}$ , $I_F=25\text{A}$ ,<br>$di_F/dt=650\text{A}/\mu\text{s}$ | - | 90  |  | ns               |
|                                                                  | $t_S$        |                                                                                                         | - |     |  |                  |
|                                                                  | $t_F$        |                                                                                                         | - |     |  |                  |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                         | - | 1.0 |  | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                         | - | 20  |  | A                |
| Diode peak rate of fall of reverse recovery current during $t_F$ | $di_{rr}/dt$ |                                                                                                         | - | 470 |  | A/ $\mu\text{s}$ |

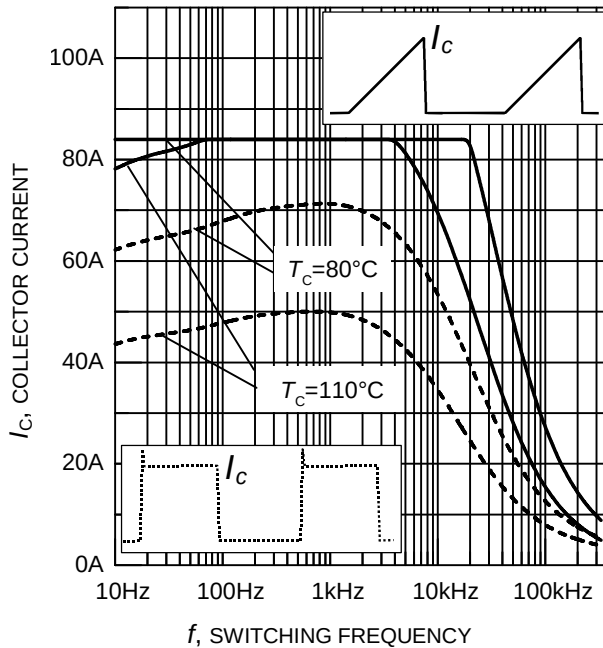
**Switching Characteristic, Inductive Load, at  $T_j=150^\circ\text{C}$** 

| Parameter              | Symbol       | Conditions                                                                                                                                                                            | Value                                 |      |      | Unit |     |
|------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------|------|------|-----|
|                        |              |                                                                                                                                                                                       | Min.                                  | typ. | max. |      |     |
| IGBT Characteristic    |              |                                                                                                                                                                                       |                                       |      |      |      |     |
| Turn-on delay time     | $t_{d(on)}$  | $T_j=150^{\circ}\text{C}$<br>$V_{CC}=800\text{V}, I_C=25\text{A},$<br>$V_{GE}=15/0\text{V},$<br>$R_G=22\Omega,$<br>$L_{\sigma}^{(1)}=180\text{nH},$<br>$C_{\sigma}^{(1)}=40\text{pF}$ | -                                     | 50   | 60   | ns   |     |
| Rise time              | $t_r$        |                                                                                                                                                                                       | $V_{CC}=800\text{V}, I_C=25\text{A},$ | -    | 36   |      | 43  |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                       | $V_{GE}=15/0\text{V},$                | -    | 820  |      | 990 |
| Fall time              | $t_f$        |                                                                                                                                                                                       | $R_G=22\Omega,$                       | -    | 42   |      | 50  |
| Turn-on energy         | $E_{on}$     | Energy losses include<br>“tail” and diode<br>reverse recovery.                                                                                                                        | -                                     | 3.8  | 4.6  | mJ   |     |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                       | -                                     | 2.9  | 3.8  |      |     |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                       | -                                     | 6.7  | 8.4  |      |     |

**Anti-Parallel Diode Characteristic**

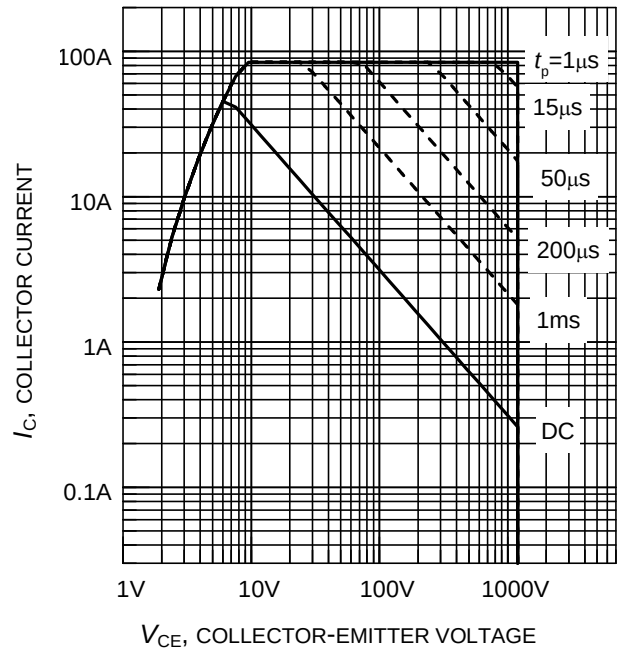
|                                                                  |              |                                                                                                        |   |     |  |                  |
|------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------|---|-----|--|------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_j=150^\circ\text{C}$<br>$V_R=800\text{V}$ , $I_F=25\text{A}$ ,<br>$di_F/dt=750\text{A}/\mu\text{s}$ | - | 280 |  | ns               |
|                                                                  | $t_S$        |                                                                                                        | - |     |  |                  |
|                                                                  | $t_F$        |                                                                                                        | - |     |  |                  |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                        | - | 4.3 |  | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                        | - | 32  |  | A                |
| Diode peak rate of fall of reverse recovery current during $t_F$ | $di_{rr}/dt$ |                                                                                                        | - | 130 |  | A/ $\mu\text{s}$ |

<sup>1)</sup> Leakage inductance  $L_{\sigma}$  and stray capacity  $C_{\sigma}$  due to dynamic test circuit in figure E.



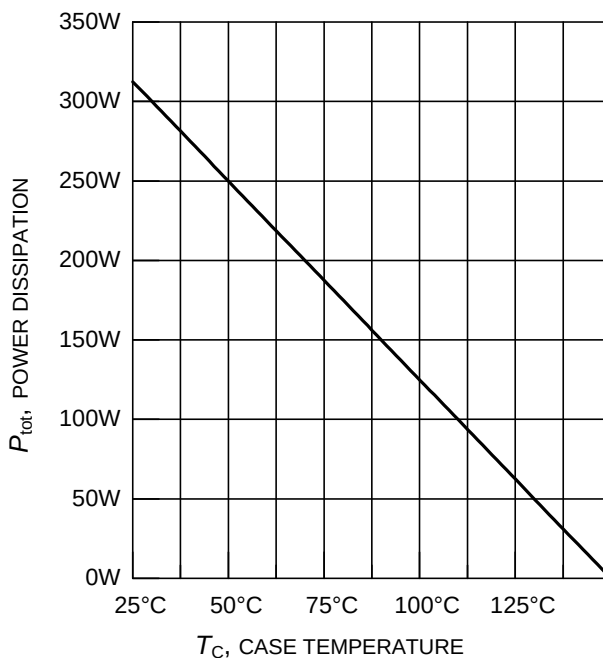
**Figure 1. Collector current as a function of switching frequency**

( $T_j \leq 150^\circ\text{C}$ ,  $D = 0.5$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 22\Omega$ )



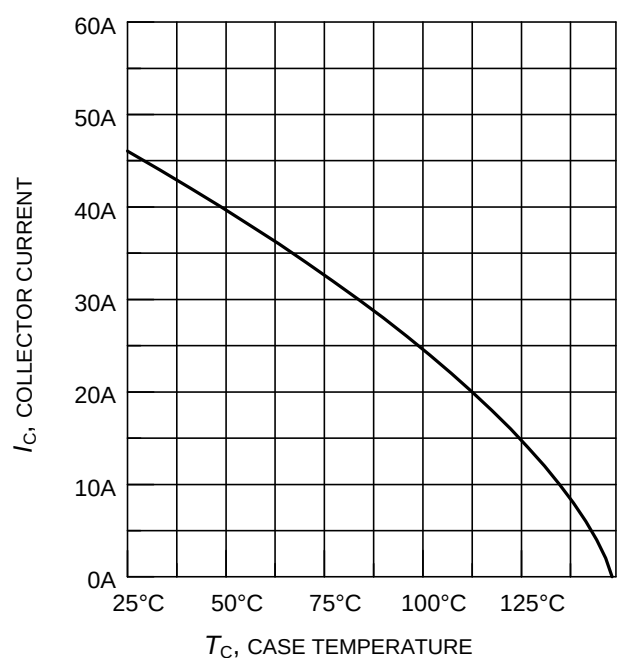
**Figure 2. Safe operating area**

( $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  $T_j \leq 150^\circ\text{C}$ )



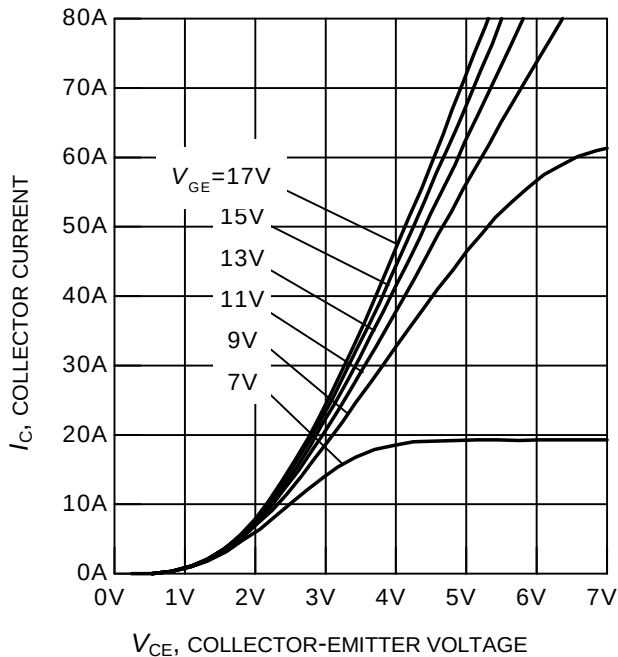
**Figure 3. Power dissipation as a function of case temperature**

( $T_j \leq 150^\circ\text{C}$ )

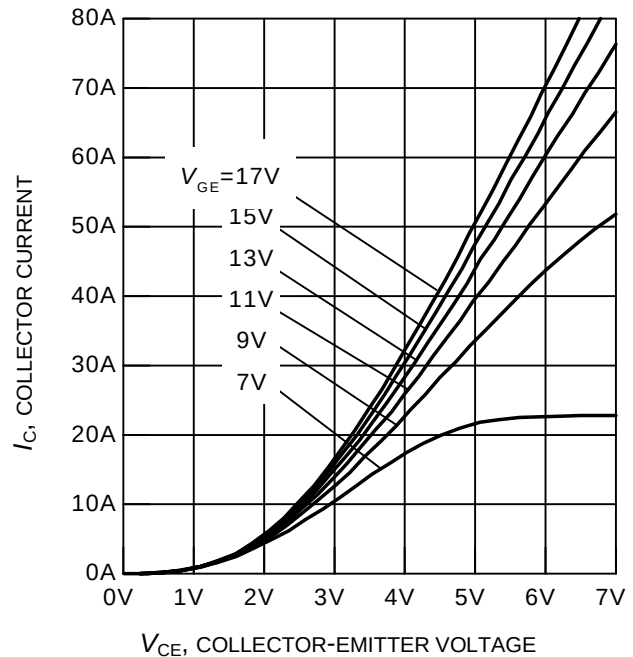


**Figure 4. Collector current as a function of case temperature**

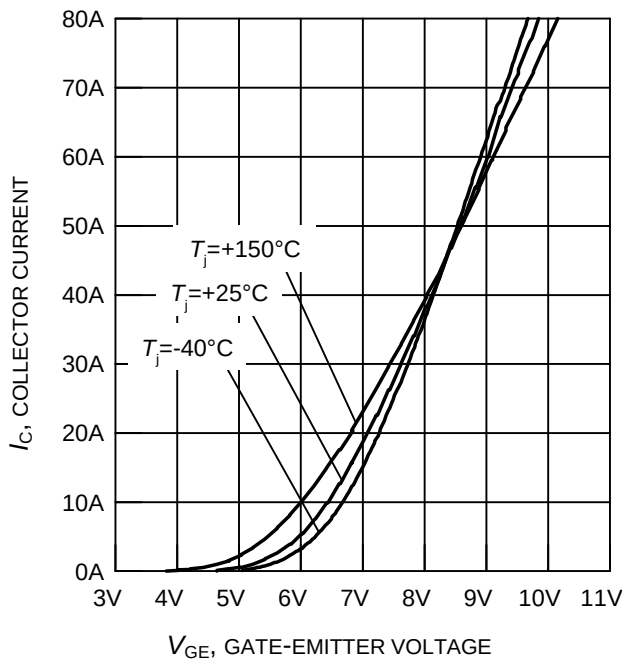
( $V_{GE} \leq 15\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )



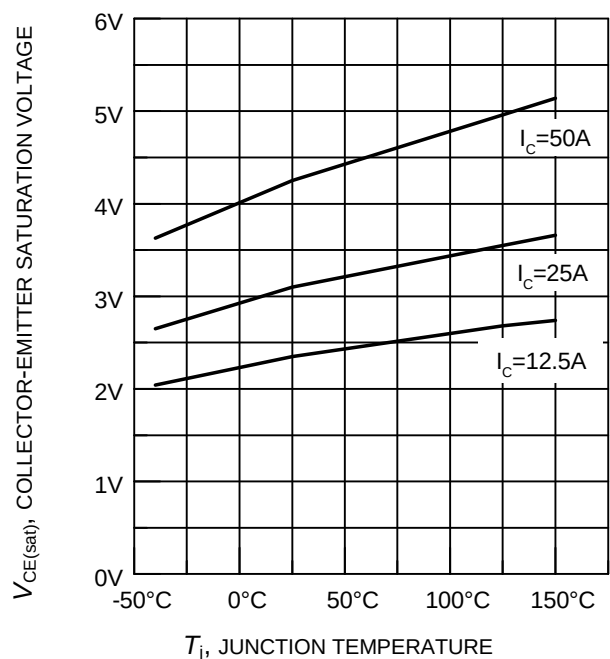
**Figure 5. Typical output characteristics**  
( $T_j = 25^\circ\text{C}$ )



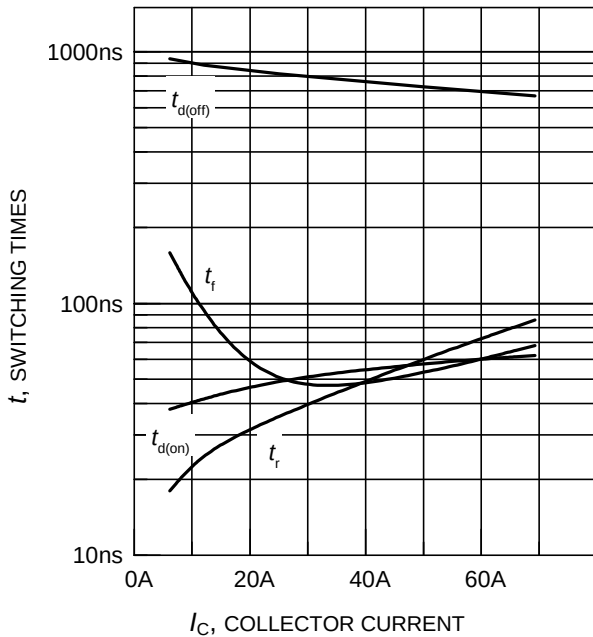
**Figure 6. Typical output characteristics**  
( $T_j = 150^\circ\text{C}$ )



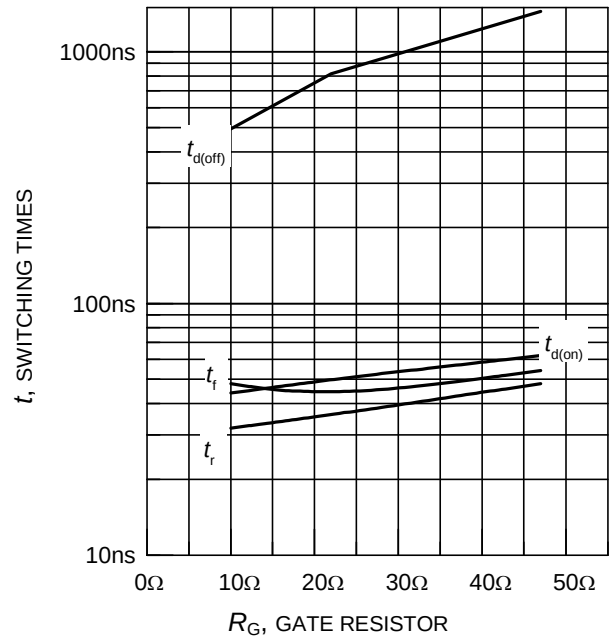
**Figure 7. Typical transfer characteristics**  
( $V_{CE} = 20V$ )



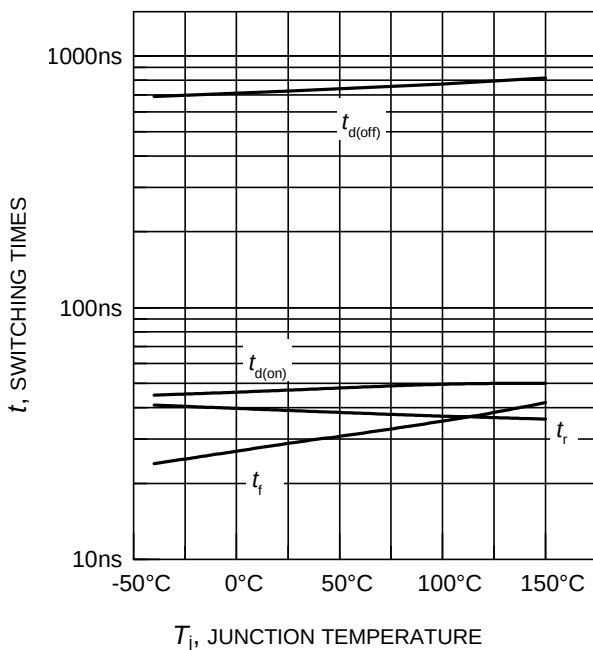
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15V$ )



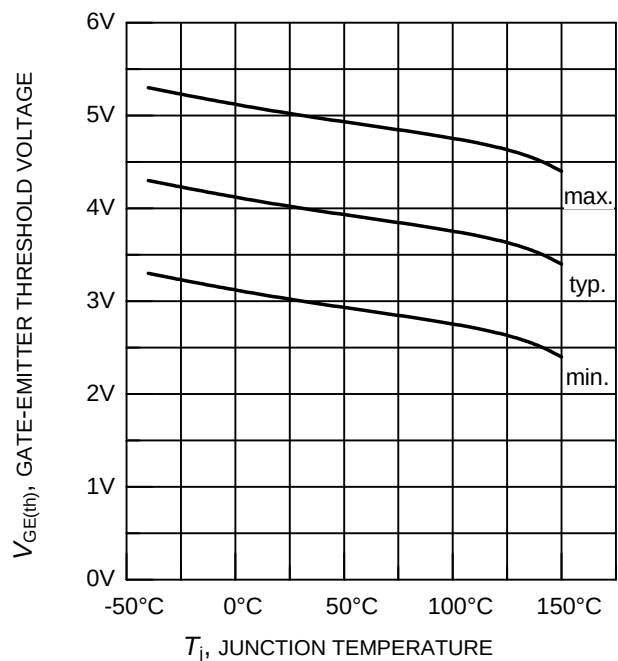
**Figure 9. Typical switching times as a function of collector current**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  
 $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 22\Omega$ ,  
dynamic test circuit in Fig.E )



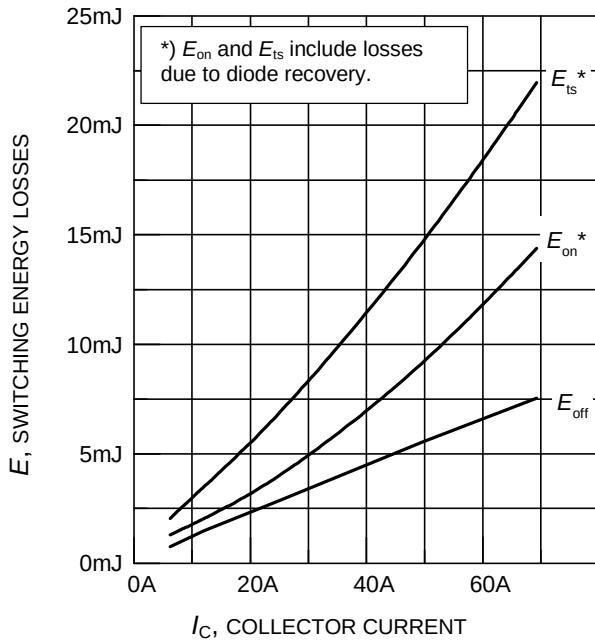
**Figure 10. Typical switching times as a function of gate resistor**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  
 $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 25\text{A}$ ,  
dynamic test circuit in Fig.E )



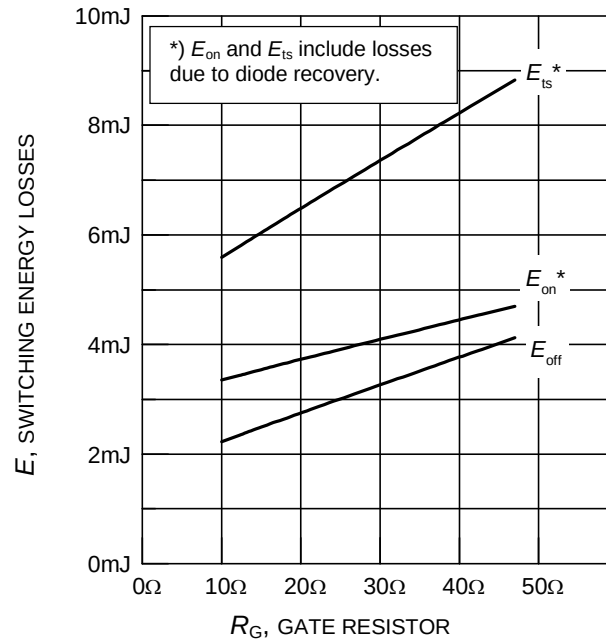
**Figure 11. Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE} = 800\text{V}$ ,  
 $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 25\text{A}$ ,  $R_G = 22\Omega$ ,  
dynamic test circuit in Fig.E )



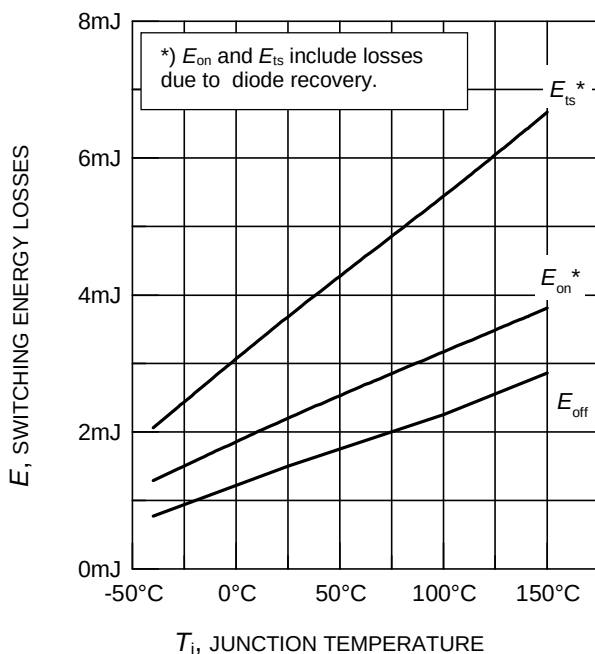
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C = 0.3\text{mA}$ )



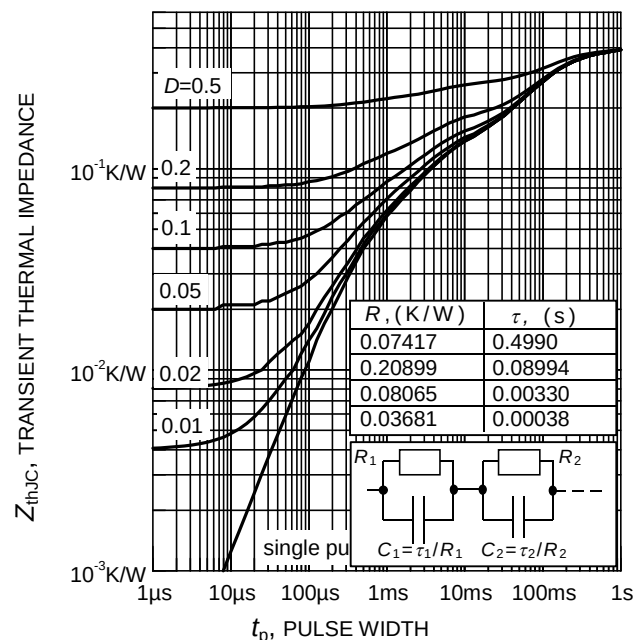
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $R_G = 22\Omega$ , dynamic test circuit in Fig.E )



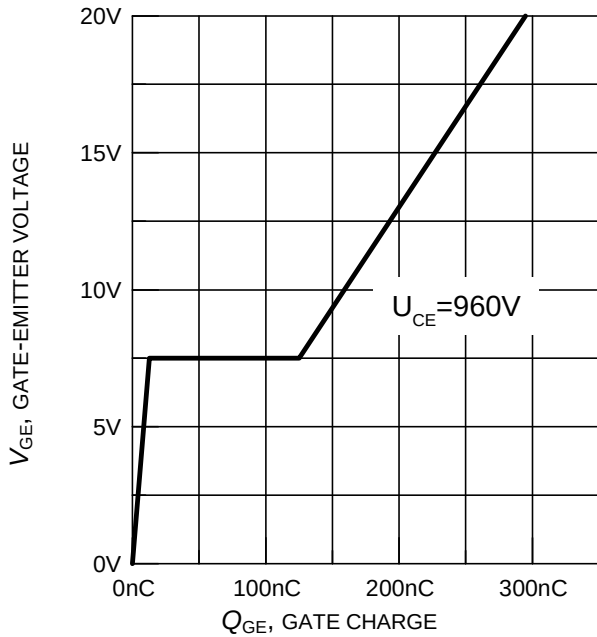
**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_j = 150^\circ\text{C}$ ,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 25\text{A}$ , dynamic test circuit in Fig.E )



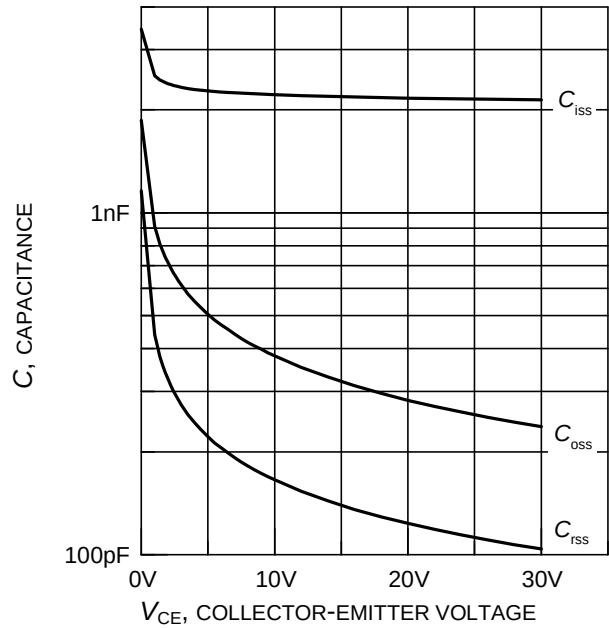
**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE} = 800\text{V}$ ,  $V_{GE} = +15\text{V}/0\text{V}$ ,  $I_C = 25\text{A}$ ,  $R_G = 22\Omega$ , dynamic test circuit in Fig.E )



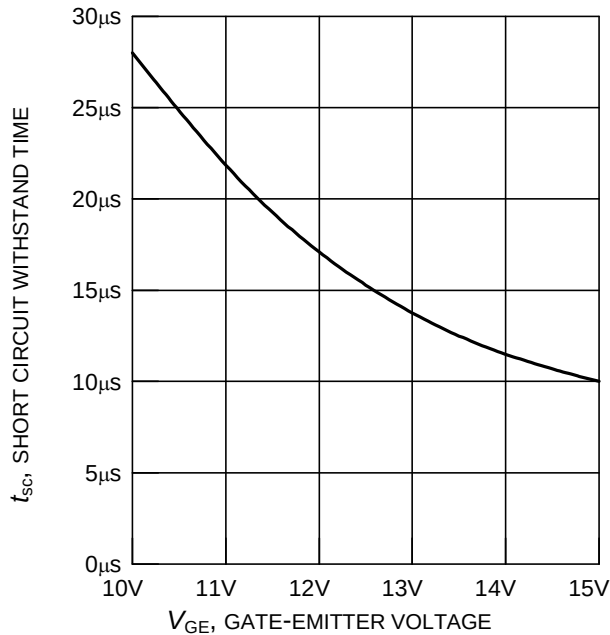
**Figure 16. IGBT transient thermal impedance as a function of pulse width**  
( $D = t_p / T$ )



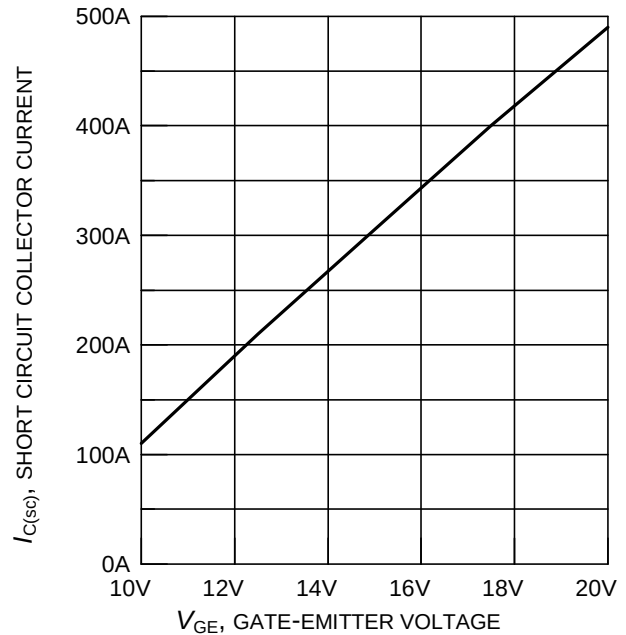
**Figure 17. Typical gate charge**  
( $I_C = 25A$ )



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

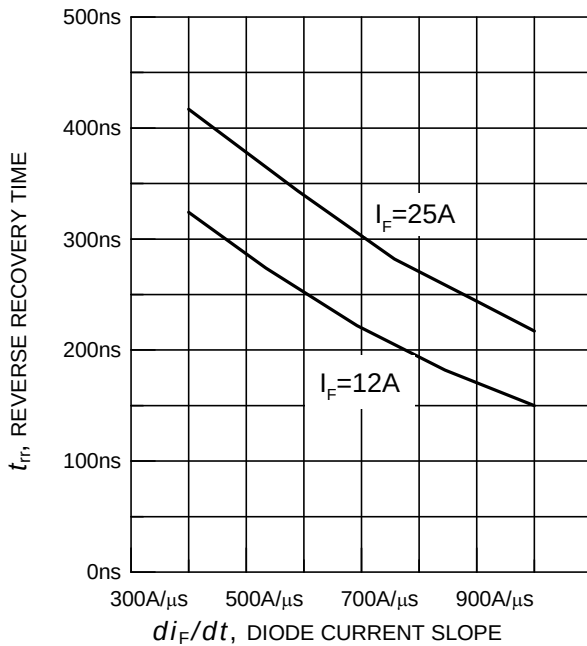


**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE} = 1200V$ , start at  $T_j = 25^\circ C$ )



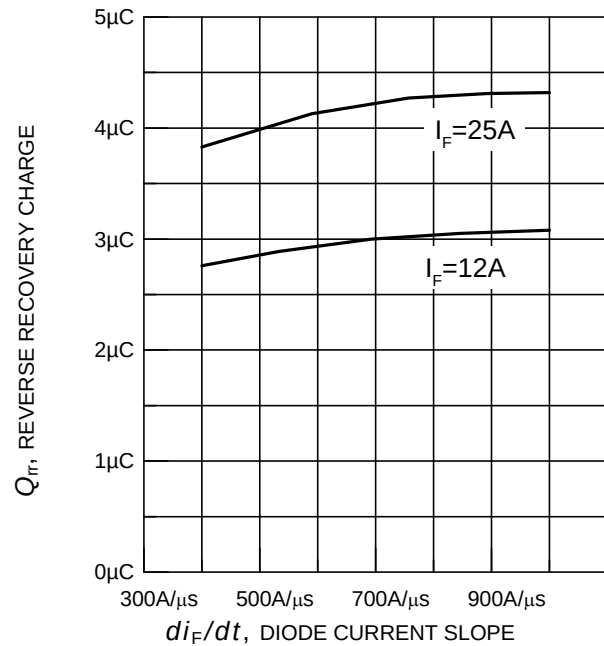
**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**  
( $100V \leq V_{CE} \leq 1200V$ ,  $T_C = 25^\circ C$ ,  $T_j \leq 150^\circ C$ )





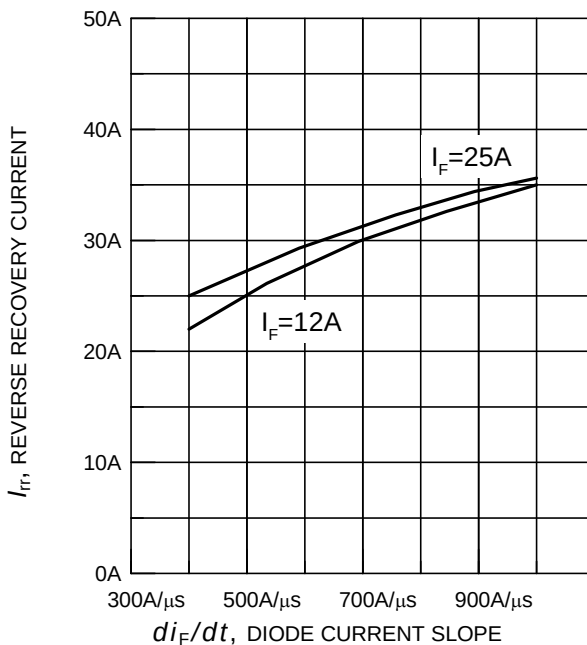
**Figure 21. Typical reverse recovery time as a function of diode current slope**

( $V_R = 800V$ ,  $T_j = 150^\circ C$ , dynamic test circuit in Fig.E )



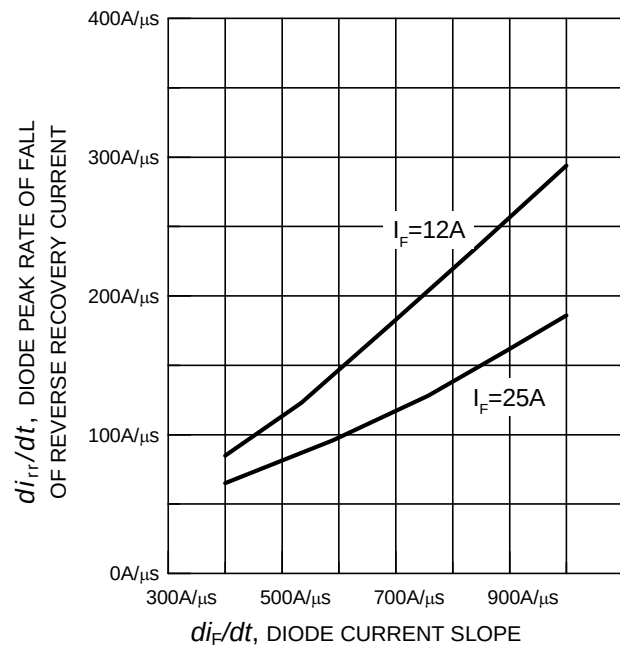
**Figure 22. Typical reverse recovery charge as a function of diode current slope**

( $V_R = 800V$ ,  $T_j = 150^\circ C$ , dynamic test circuit in Fig.E )



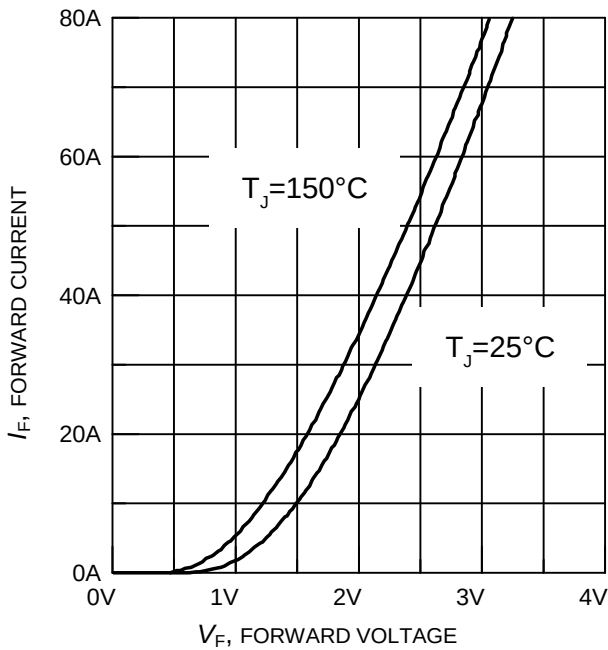
**Figure 23. Typical reverse recovery current as a function of diode current slope**

( $V_R = 800V$ ,  $T_j = 150^\circ C$ , dynamic test circuit in Fig.E )

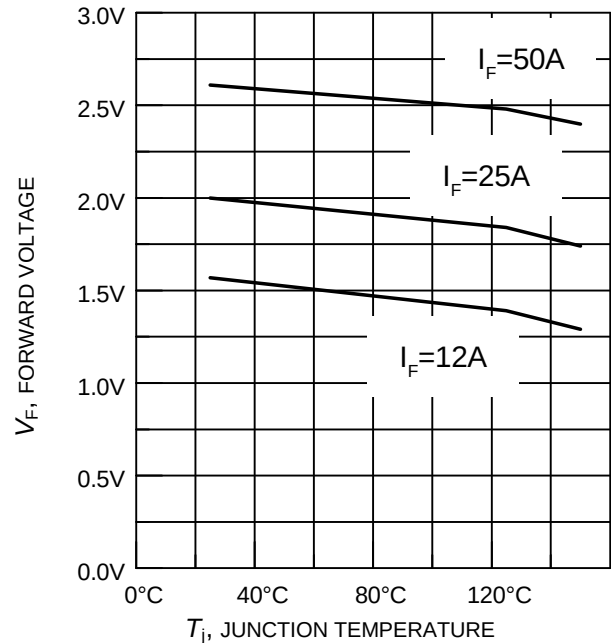


**Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**

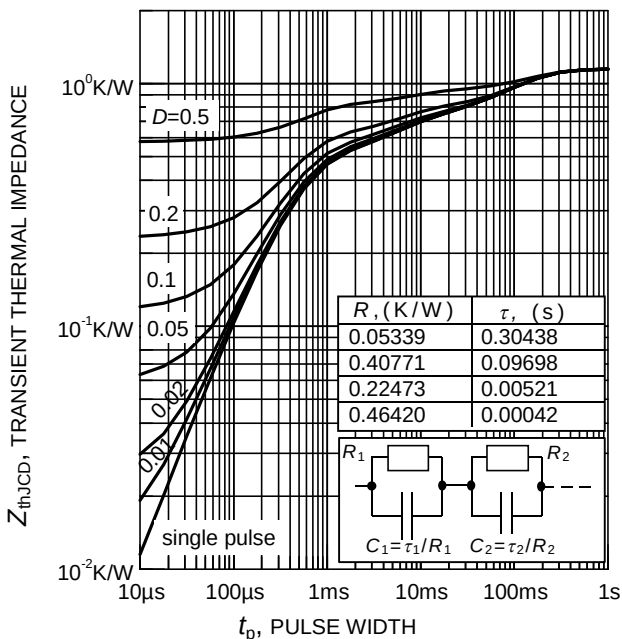
( $V_R = 800V$ ,  $T_j = 150^\circ C$ , dynamic test circuit in Fig.E )



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

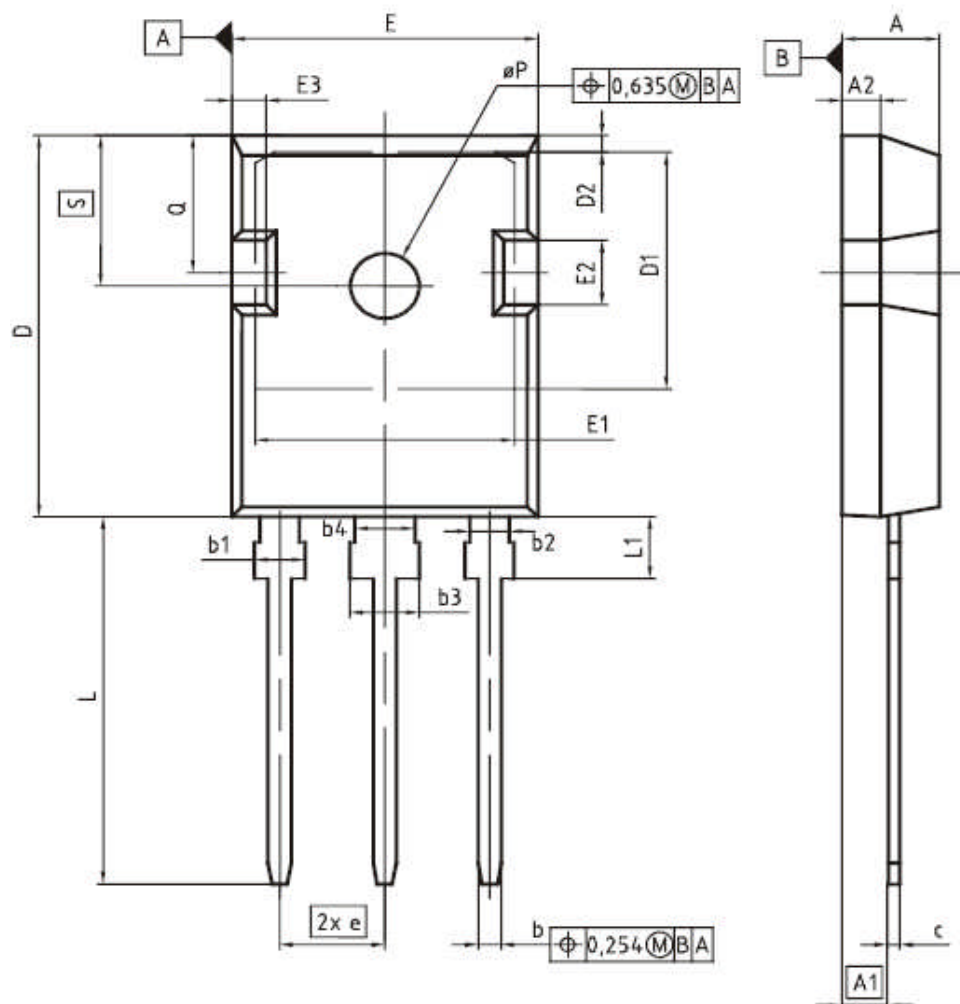


**Figure 26. Typical diode forward voltage as a function of junction temperature**

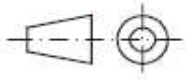


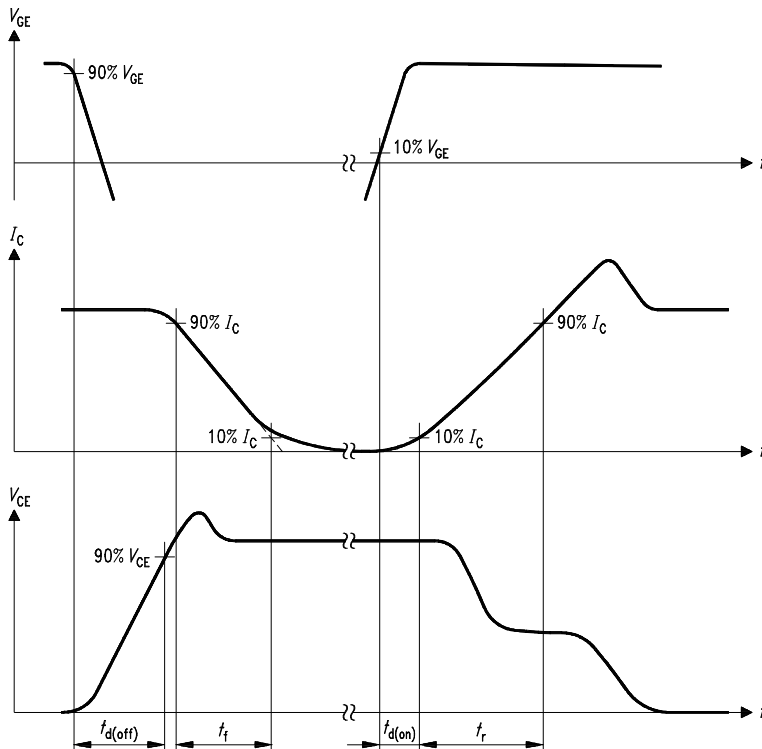
**Figure 27. Diode transient thermal impedance as a function of pulse width ( $D = t_p / T$ )**

## PG-TO247-3

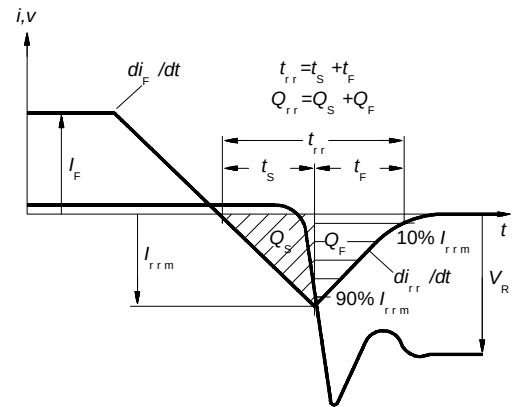


| DIM | MILLIMETERS |       | INCHES      |       |
|-----|-------------|-------|-------------|-------|
|     | MIN         | MAX   | MIN         | MAX   |
| A   | 4,83        | 5,21  | 0,190       | 0,205 |
| A1  | 2,27        | 2,54  | 0,089       | 0,100 |
| A2  | 1,85        | 2,16  | 0,073       | 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        | 0,88  | 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 |

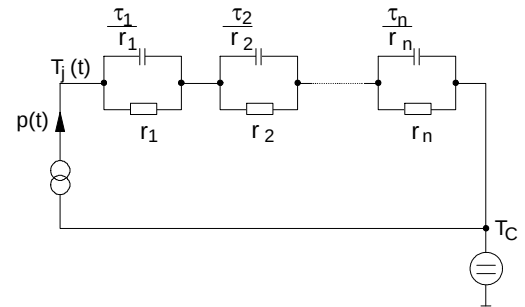
|                                                                                                              |
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| DOCUMENT NO.<br>Z8B00003327                                                                                  |
| SCALE<br>0 5 5 7,5mm                                                                                         |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>09-07-2010                                                                                     |
| REVISION<br>05                                                                                               |



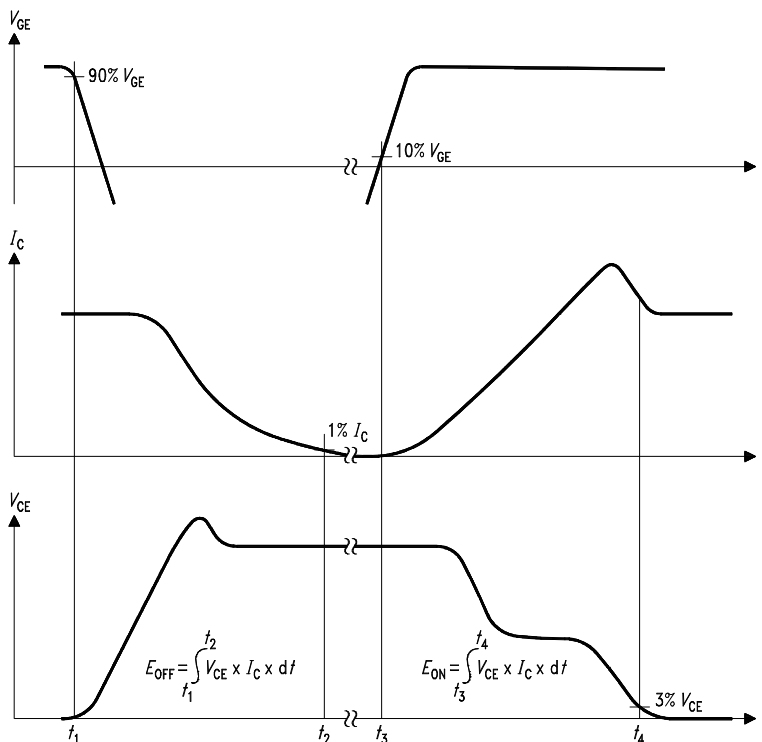
**Figure A. Definition of switching times**



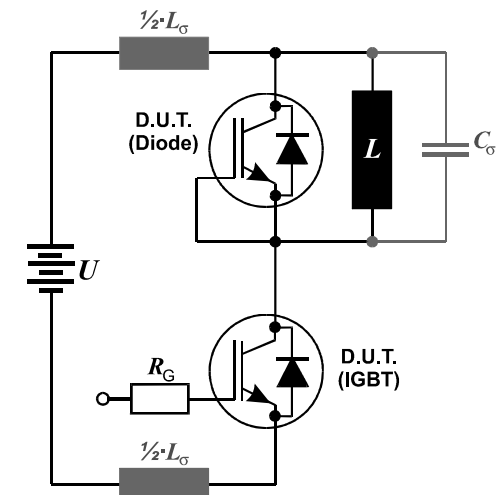
**Figure C. Definition of diodes switching characteristics**



**Figure D. Thermal equivalent circuit**



**Figure B. Definition of switching losses**



**Figure E. Dynamic test circuit**  
Leakage inductance  $L_\sigma=180\text{nH}$ ,  
and stray capacity  $C_\sigma=40\text{pF}$ .

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