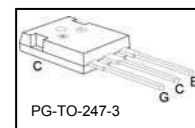
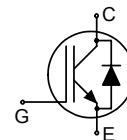


Low Loss DuoPack : IGBT in 2<sup>nd</sup> generation **TrenchStop®**  
with soft, fast recovery anti-parallel EmCon diode

- Short circuit withstand time – 10μs
- Designed for :
  - Frequency Converters
  - Uninterrupted Power Supply
- **TrenchStop®** 2<sup>nd</sup> generation for 1200 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
- Easy paralleling capability due to positive temperature coefficient in  $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Very soft, fast recovery anti-parallel EmCon HE diode
- Qualified according to JEDEC<sup>1</sup> for target applications
- Pb-free lead plating; RoHS compliant



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

| Type        | $V_{CE}$ | $I_C$ | $V_{CE(sat)}, T_J=25^\circ C$ | $T_{j,max}$ | Marking Code | Package     |
|-------------|----------|-------|-------------------------------|-------------|--------------|-------------|
| IKW25N120T2 | 1200V    | 25A   | 1.7V                          | 175°C       | K25T1202     | PG-TO-247-3 |

#### Maximum Ratings

| Parameter                                                       | Symbol      | Value      | Unit |
|-----------------------------------------------------------------|-------------|------------|------|
| Collector-emitter voltage                                       | $V_{CE}$    | 1200       | V    |
| DC collector current ( $T_J=150^\circ C$ )                      | $I_C$       |            | A    |
| $T_C = 25^\circ C$                                              |             | 50         |      |
| $T_C = 110^\circ C$                                             |             | 25         |      |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$           | $I_{Cpuls}$ | 100        |      |
| Turn off safe operating area                                    | -           | 100        |      |
| $V_{CE} \leq 1200V, T_J \leq 175^\circ C$                       |             |            |      |
| Diode forward current ( $T_J=150^\circ C$ )                     | $I_F$       |            |      |
| $T_C = 25^\circ C$                                              |             | 40         |      |
| $T_C = 110^\circ C$                                             |             | 25         |      |
| Diode pulsed current, $t_p$ limited by $T_{jmax}$               | $I_{Fpuls}$ | 100        |      |
| Gate-emitter voltage                                            | $V_{GE}$    | $\pm 20$   | V    |
| Short circuit withstand time <sup>2)</sup>                      | $t_{SC}$    | 10         | μs   |
| $V_{GE} = 15V, V_{CC} \leq 600V, T_{j, start} \leq 175^\circ C$ |             |            |      |
| Power dissipation                                               | $P_{tot}$   | 349        | W    |
| $T_C = 25^\circ C$                                              |             |            |      |
| Operating junction temperature                                  | $T_J$       | -40...+175 | °C   |
| Storage temperature                                             | $T_{stg}$   | -55...+150 |      |
| Soldering temperature, 1.6mm (0.063 in.) from case for 10s      | -           | 260        |      |
| Wavesoldering only, temperature on leads only                   |             |            |      |

<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  | $R_{thJC}$  |            | 0.43       | K/W  |
| Diode thermal resistance,<br>junction – case | $R_{thJCD}$ |            | 0.81       |      |
| 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  | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=500\mu A$      | 1200  | -    | -    | V    |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE} = 15V, I_C=25A$        |       |      |      |      |
|                                      |               | $T_j=25^{\circ}C$              | -     | 1.7  | 2.2  |      |
|                                      |               | $T_j=150^{\circ}C$             | -     | 2.1  | -    |      |
|                                      |               | $T_j=175^{\circ}C$             | -     | 2.2  | -    |      |
| Diode forward voltage                | $V_F$         | $V_{GE}=0V, I_F=25A$           |       |      |      |      |
|                                      |               | $T_j=25^{\circ}C$              | -     | 1.65 | 2.2  |      |
|                                      |               | $T_j=150^{\circ}C$             | -     | 1.7  | -    |      |
|                                      |               | $T_j=175^{\circ}C$             | -     | 1.65 | -    |      |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C=1.0mA, V_{CE}=V_{GE}$     | 5.2   | 5.8  | 6.4  |      |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE}=1200V,$<br>$V_{GE}=0V$ |       |      |      | mA   |
|                                      |               | $T_j=25^{\circ}C$              | -     | -    | 0.4  |      |
|                                      |               | $T_j=150^{\circ}C$             | -     | -    | 4.0  |      |
|                                      |               | $T_j=175^{\circ}C$             |       |      | 20   |      |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V$        | -     | -    | 200  | nA   |
| Transconductance                     | $g_{fs}$      | $V_{CE}=20V, I_C=25A$          | -     | 13.5 | -    | S    |

## Dynamic Characteristic

|                                                                   |             |                                                                                                                    |   |            |   |    |
|-------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------|---|------------|---|----|
| Input capacitance                                                 | $C_{iss}$   | $V_{CE}=25V,$                                                                                                      | - | 1600       | - | pF |
| Output capacitance                                                | $C_{oss}$   | $V_{GE}=0V,$                                                                                                       | - | 155        | - |    |
| Reverse transfer capacitance                                      | $C_{rss}$   | $f=1MHz$                                                                                                           | - | 90         | - |    |
| Gate charge                                                       | $Q_{Gate}$  | $V_{CC}=960V, I_C=40A$<br>$V_{GE}=15V$                                                                             | - | 120        | - | nC |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from case | $L_E$       |                                                                                                                    | - | 13         | - | nH |
| Short circuit collector current <sup>1)</sup>                     | $I_{C(SC)}$ | $V_{GE}=15V, t_{SC} \leq 10\mu s$<br>$V_{CC} = 600V,$<br>$T_{j,start} = 25^\circ C$<br>$T_{j,start} = 175^\circ C$ | - | 150<br>115 | - | A  |

## Switching Characteristic, Inductive Load, at $T_j=25^\circ C$

| Parameter              | Symbol       | Conditions                                                                                                                                       | Value |      |      | Unit |
|------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                        |              |                                                                                                                                                  | min.  | typ. | max. |      |
| IGBT Characteristic    |              |                                                                                                                                                  |       |      |      |      |
| Turn-on delay time     | $t_{d(on)}$  | $T_j=25^{\circ}C$ ,<br>$V_{CC}=600V, I_C=25A$ ,<br>$V_{GE}=0/15V$ ,<br>$R_G=16.4\Omega$ ,<br>$L_{\sigma}^{2)}=105nH$ ,<br>$C_{\sigma}^{2)}=39pF$ | -     | 27   | -    | ns   |
| Rise time              | $t_r$        |                                                                                                                                                  | -     | 20   | -    |      |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                  | -     | 265  | -    |      |
| Fall time              | $t_f$        |                                                                                                                                                  | -     | 95   | -    |      |
| Turn-on energy         | $E_{on}$     | Energy losses include<br>“tail” and diode<br>reverse recovery.                                                                                   | -     | 1.55 | -    | mJ   |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                  | -     | 1.35 | -    |      |
| Total switching energy | $E_{ts}$     |                                                                                                                                                  | -     | 2.9  | -    |      |

## Anti-Parallel Diode Characteristic

|                                                                     |              |                       |   |      |   |            |
|---------------------------------------------------------------------|--------------|-----------------------|---|------|---|------------|
| Diode reverse recovery time                                         | $t_{rr}$     | $T_j=25^\circ C,$     | - | 195  | - | ns         |
| Diode reverse recovery charge                                       | $Q_{rr}$     | $V_R=600V, I_F=25A,$  | - | 2.05 |   | $\mu C$    |
| Diode peak reverse recovery current                                 | $I_{rrm}$    | $di_F/dt=1050A/\mu s$ | - | 20   |   | A          |
| Diode peak rate of fall of reverse<br>recovery current during $t_b$ | $di_{rr}/dt$ |                       | - | 475  | - | A/ $\mu s$ |

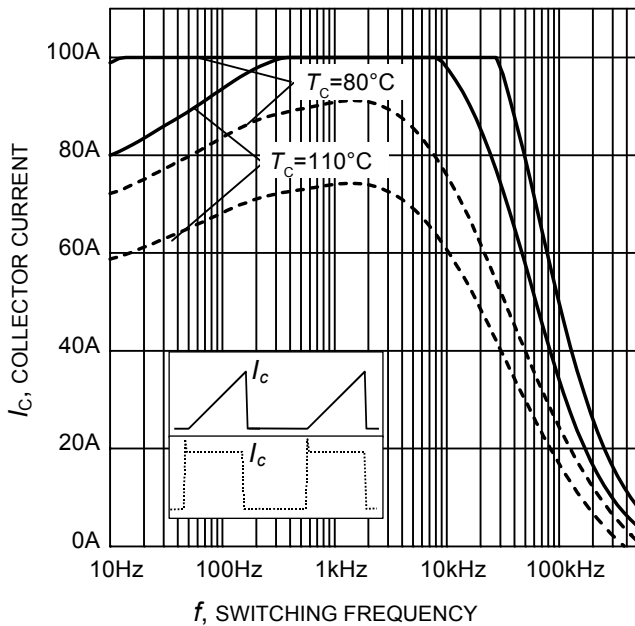
<sup>1)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

<sup>2)</sup> Leakage inductance  $L_{\sigma}$  and Stray capacity  $C_{\sigma}$  due to dynamic test circuit in Figure E.

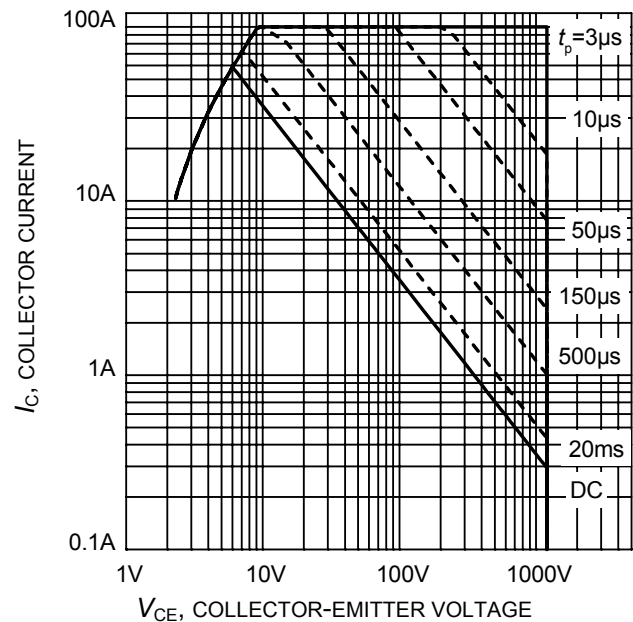
**Switching Characteristic, Inductive Load, at  $T_j=175^\circ\text{C}$**

| Parameter                                                        | Symbol       | Conditions                                                                                                                                                                                                                                              | Value |      |      | Unit             |
|------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------------------|
|                                                                  |              |                                                                                                                                                                                                                                                         | min.  | typ. | max. |                  |
| IGBT Characteristic                                              |              |                                                                                                                                                                                                                                                         |       |      |      |                  |
| Turn-on delay time                                               | $t_{d(on)}$  | $T_j=175^{\circ}\text{C}$<br>$V_{CC}=600\text{V}, I_C=25\text{A},$<br>$V_{GE}=0/15\text{V},$<br>$R_G=16.4\Omega,$<br>$L_{\sigma}^{1)}=175\text{nH},$<br>$C_{\sigma}^{1)}=67\text{pF}$<br>Energy losses include<br>“tail” and diode<br>reverse recovery. | -     | 25   | -    | ns               |
| Rise time                                                        | $t_r$        |                                                                                                                                                                                                                                                         | -     | 24   | -    |                  |
| Turn-off delay time                                              | $t_{d(off)}$ |                                                                                                                                                                                                                                                         | -     | 340  | -    |                  |
| Fall time                                                        | $t_f$        |                                                                                                                                                                                                                                                         | -     | 164  | -    |                  |
| Turn-on energy                                                   | $E_{on}$     | Energy losses include<br>“tail” and diode<br>reverse recovery.                                                                                                                                                                                          | -     | 2.25 | -    | mJ               |
| Turn-off energy                                                  | $E_{off}$    |                                                                                                                                                                                                                                                         | -     | 2.05 | -    |                  |
| Total switching energy                                           | $E_{ts}$     |                                                                                                                                                                                                                                                         | -     | 4.3  | -    |                  |
| Anti-Parallel Diode Characteristic                               |              |                                                                                                                                                                                                                                                         |       |      |      |                  |
| Diode reverse recovery time                                      | $t_{rr}$     | $T_j=175^{\circ}\text{C}$<br>$V_R=600\text{V}, I_F=25\text{A},$<br>$di_F/dt=1000\text{A}/\mu\text{s}$                                                                                                                                                   | -     | 290  | -    | ns               |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                                                                                                                                                         | -     | 3.65 | -    | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                                                                                                                                                         | -     | 24   | -    | A                |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                                                                                                                                                         | -     | 330  |      | A/ $\mu\text{s}$ |

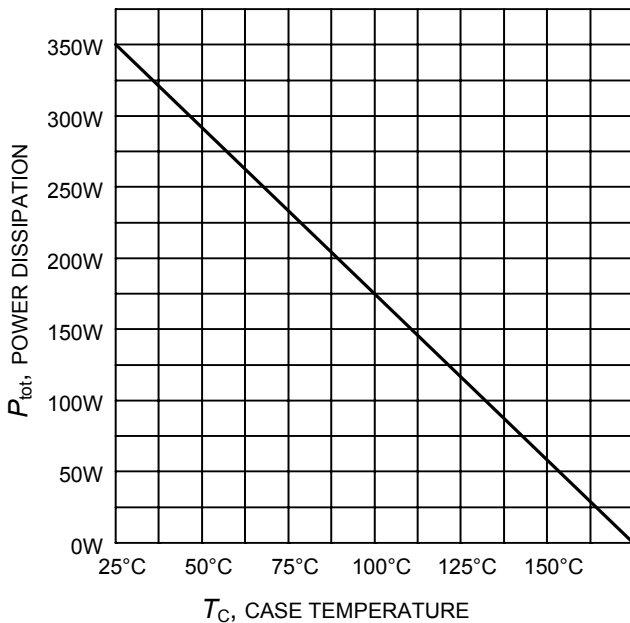
<sup>1)</sup> Leakage inductance  $L_{\sigma}$  and Stray capacity  $C_{\sigma}$  due to dynamic test circuit in Figure E.



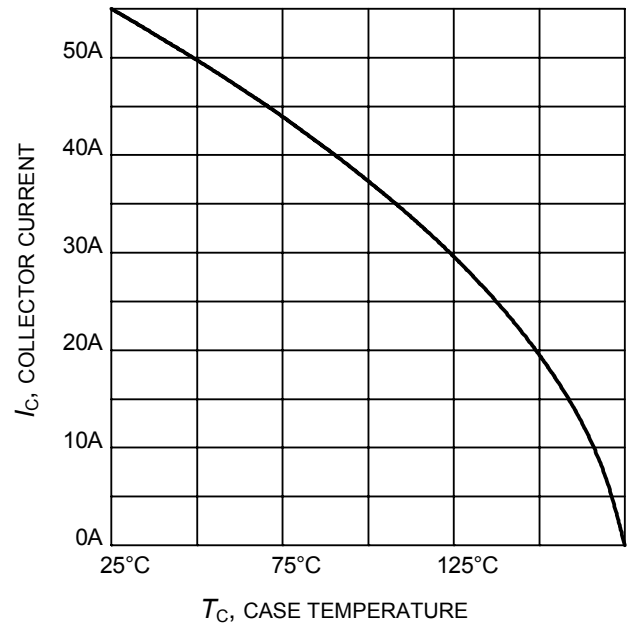
**Figure 1. Collector current as a function of switching frequency**  
 $(T_j \leq 175^\circ\text{C}, D = 0.5, V_{CE} = 600\text{V}, V_{GE} = 0/+15\text{V}, R_G = 12\Omega)$



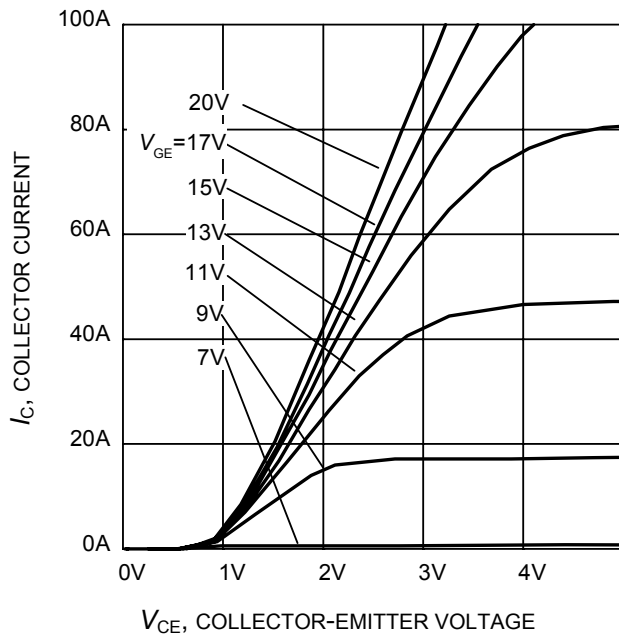
**Figure 2. Safe operating area**  
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 175^\circ\text{C}; V_{GE} = 15\text{V})$



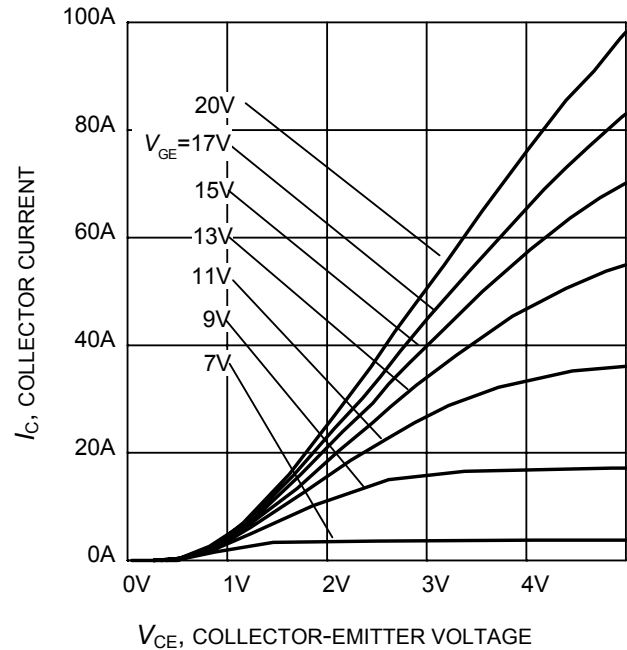
**Figure 3. Maximum power dissipation as a function of case temperature**  
 $(T_j \leq 175^\circ\text{C})$



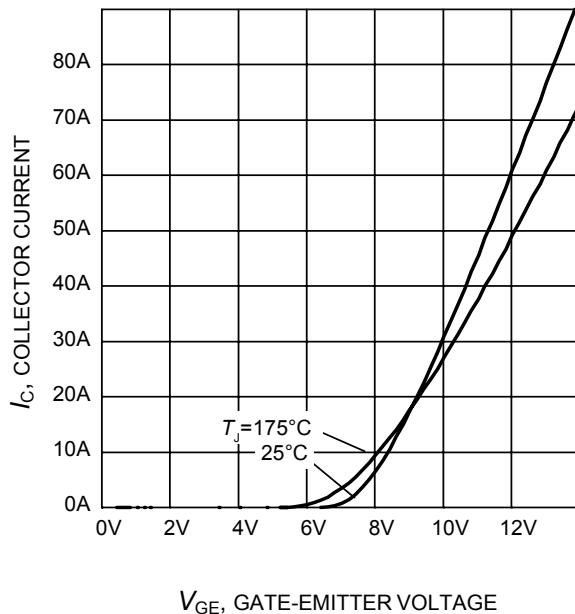
**Figure 4. Maximum collector current as a function of case temperature**  
 $(V_{GE} \geq 15\text{V}, T_j \leq 175^\circ\text{C})$



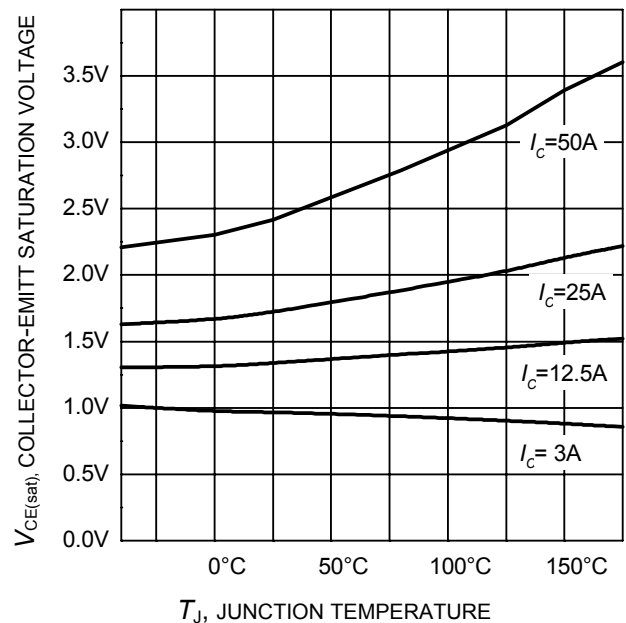
**Figure 5. Typical output characteristic**  
( $T_j = 25^\circ\text{C}$ )



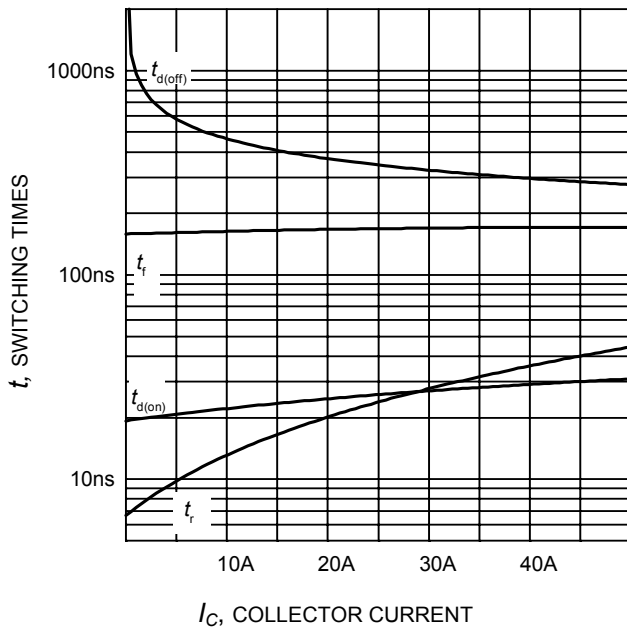
**Figure 6. Typical output characteristic**  
( $T_j = 175^\circ\text{C}$ )



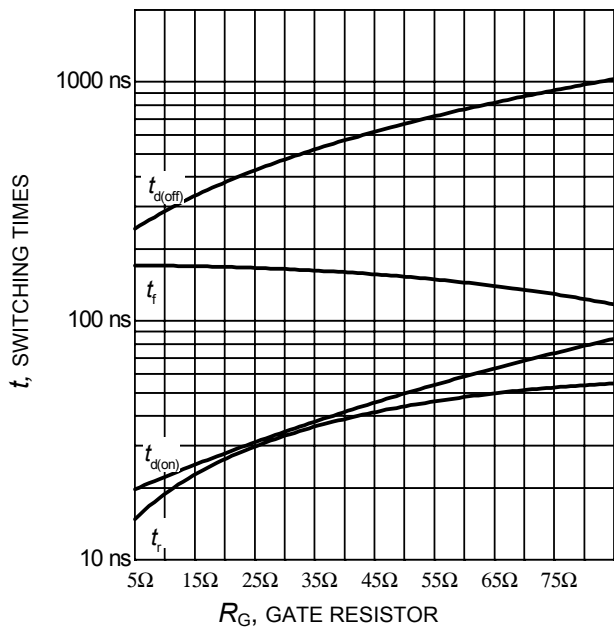
**Figure 7. Typical transfer characteristic**  
( $V_{ce}=20\text{V}$ )



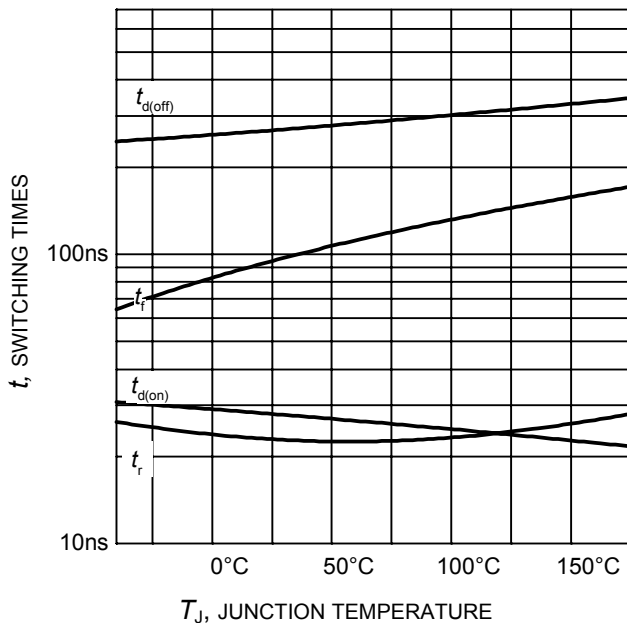
**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{ge} = 15\text{V}$ )



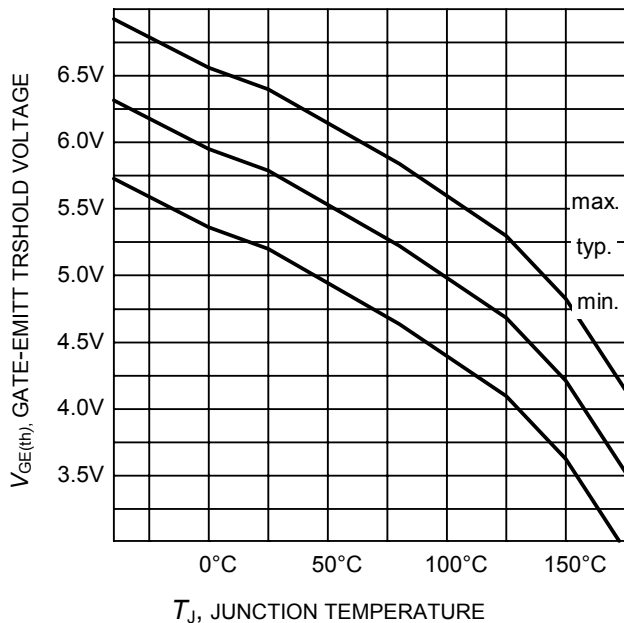
**Figure 9. Typical switching times as a function of collector current**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=16.4\Omega$ , Dynamic test circuit in Figure E)



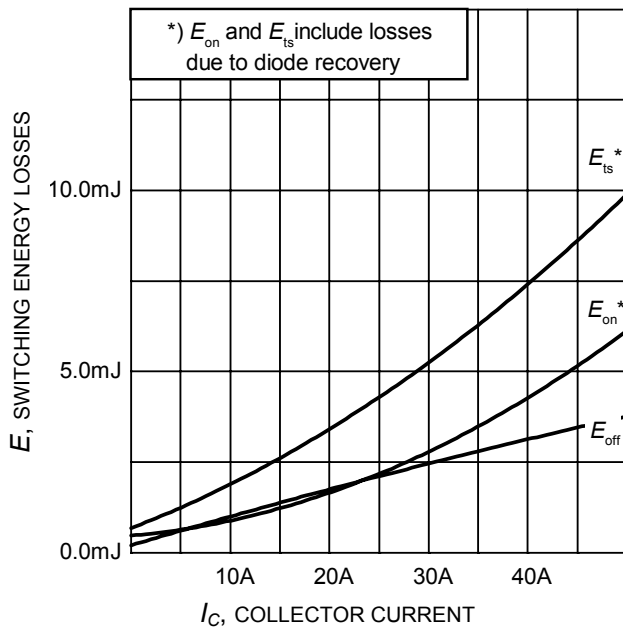
**Figure 10. Typical switching times as a function of gate resistor**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ , Dynamic test circuit in Figure E)



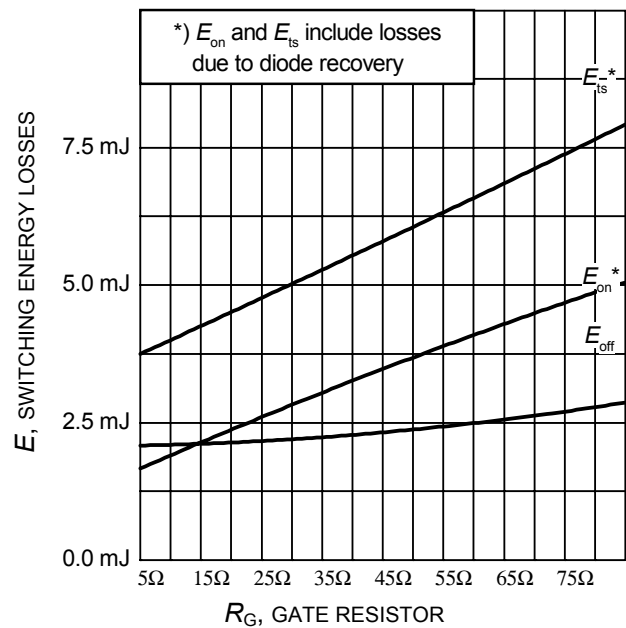
**Figure 11. Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=16.4\Omega$ , Dynamic test circuit in Figure E)



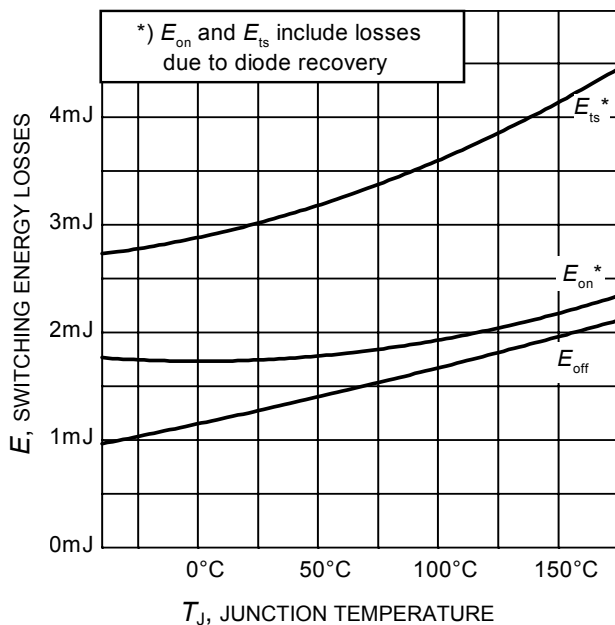
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C = 1.0\text{mA}$ )



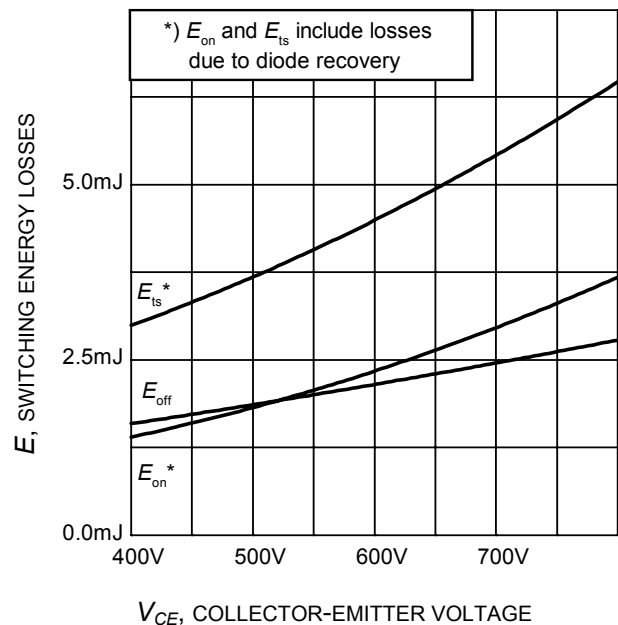
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_G=16.4\Omega$ , Dynamic test circuit in Figure E)



**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ , Dynamic test circuit in Figure E)

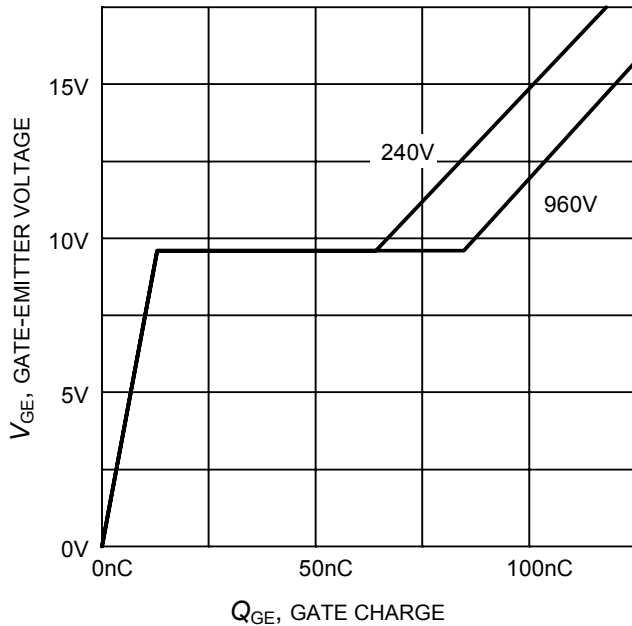


**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=16.4\Omega$ , Dynamic test circuit in Figure E)

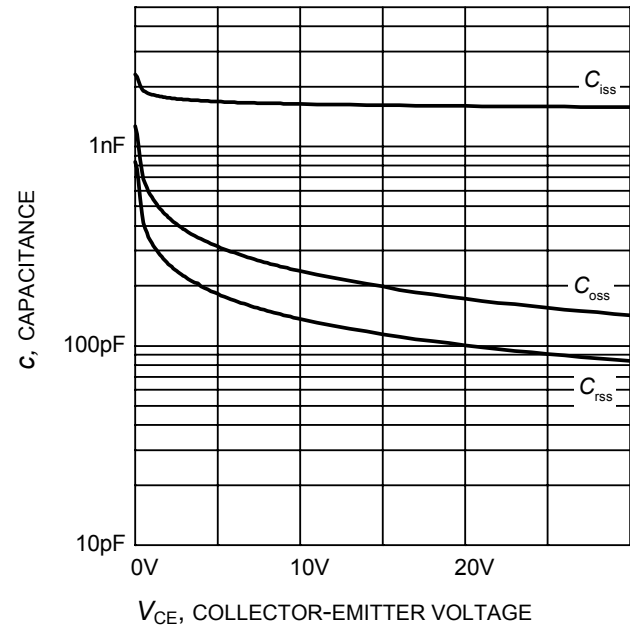


**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=25\text{A}$ ,  $R_G=16.4\Omega$ , Dynamic test circuit in Figure E)

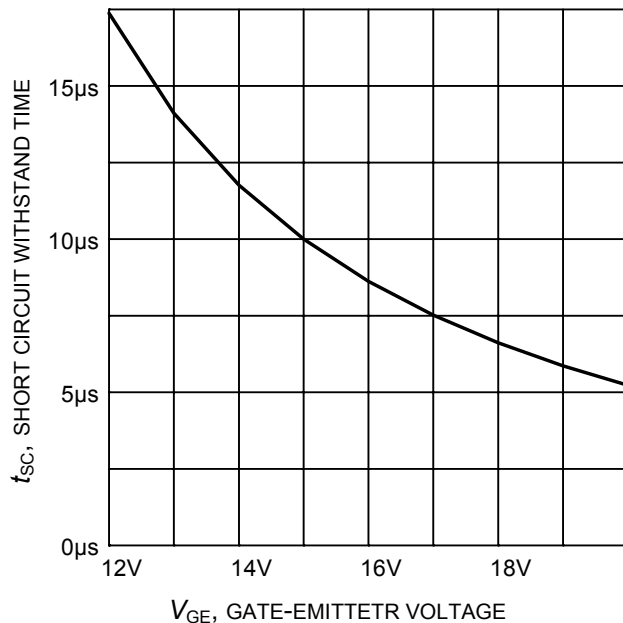




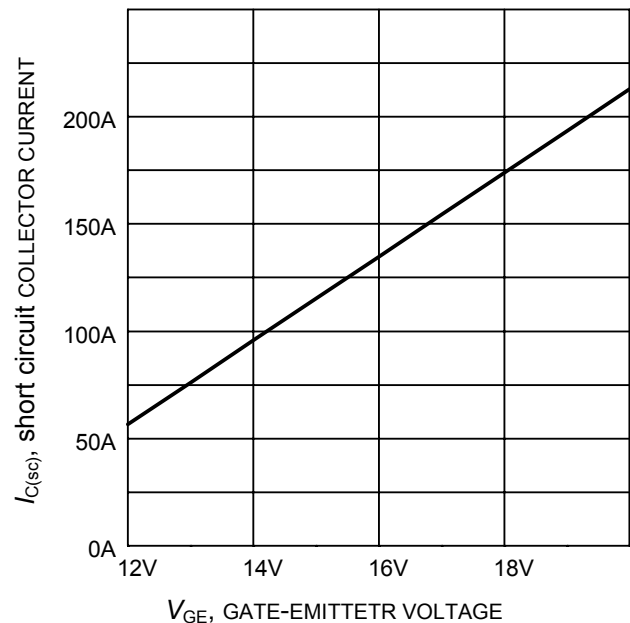
**Figure 17. Typical gate charge**  
( $I_C=25\text{ A}$ )



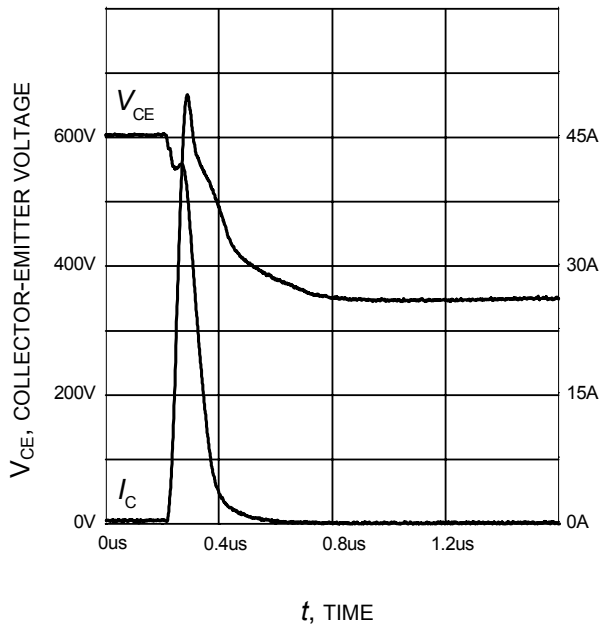
**Figure 18. Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f = 1\text{ MHz}$ )



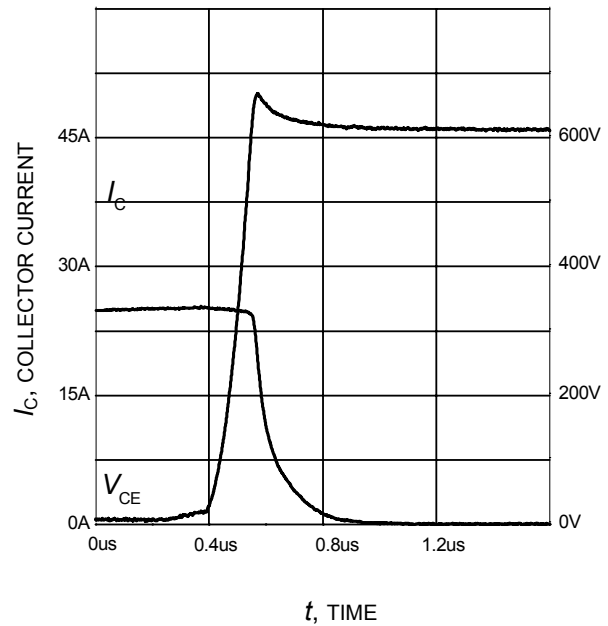
**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}=600\text{V}$ , start at  $T_J \leq 175^\circ\text{C}$ )



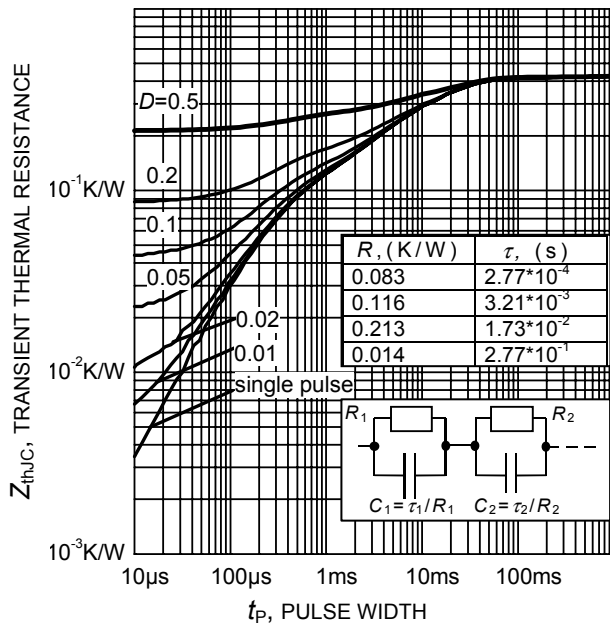
**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE} \leq 600\text{V}$ ,  $T_{j,\text{start}} = 175^\circ\text{C}$ )



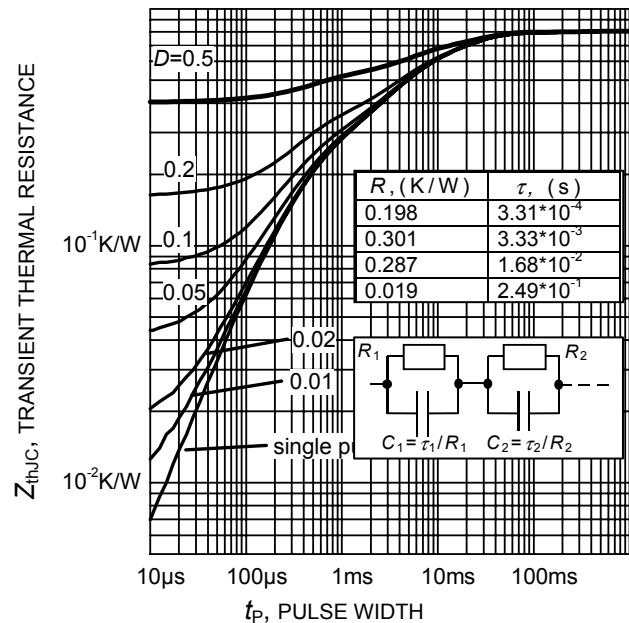
**Figure 21. Typical turn on behavior**  
 $(V_{GE}=0/15V, R_G=16.4\Omega, T_J = 175^\circ C,$   
 Dynamic test circuit in Figure E)



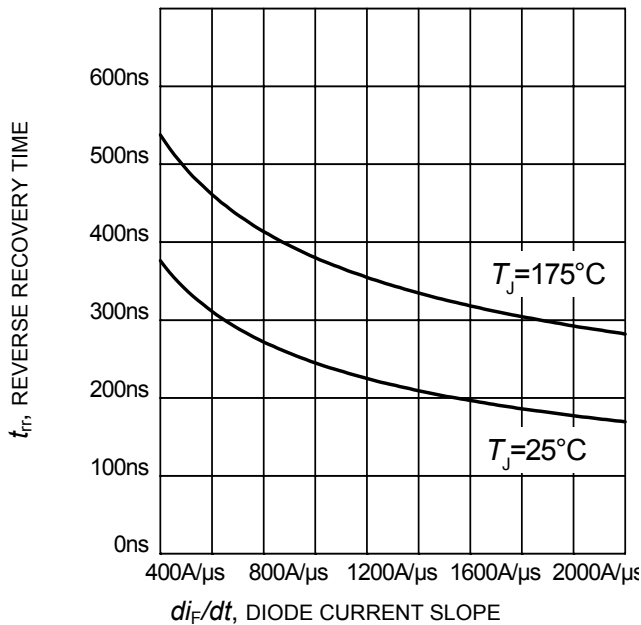
**Figure 22. Typical turn off behavior**  
 $(V_{GE}=15/0V, R_G=16.4\Omega, T_J = 175^\circ C,$   
 Dynamic test circuit in Figure E)



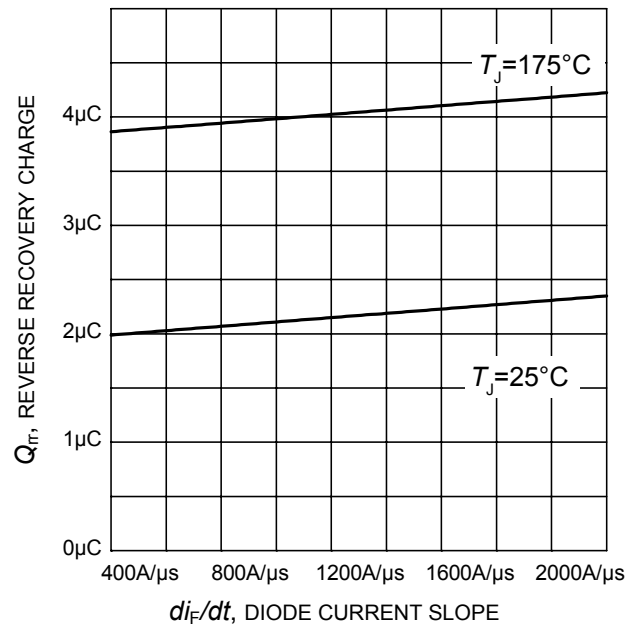
**Figure 23. IGBT transient thermal resistance**  
 $(D = t_p / T)$



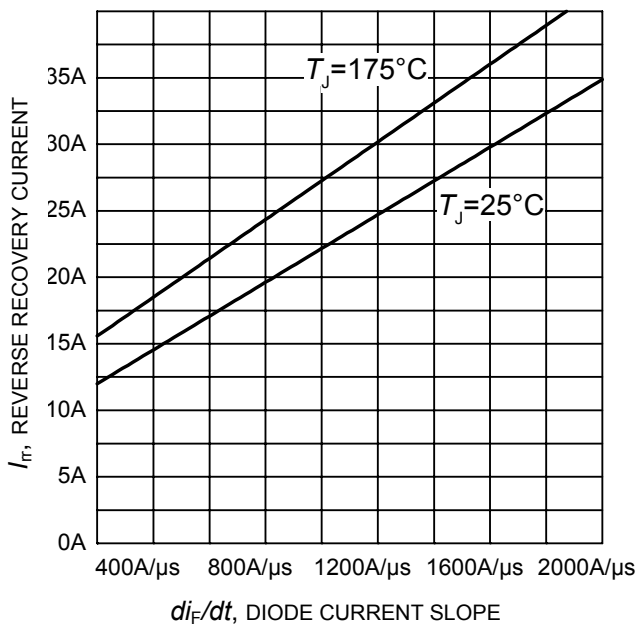
**Figure 24. Diode transient thermal impedance as a function of pulse width**  
 $(D = t_p / T)$



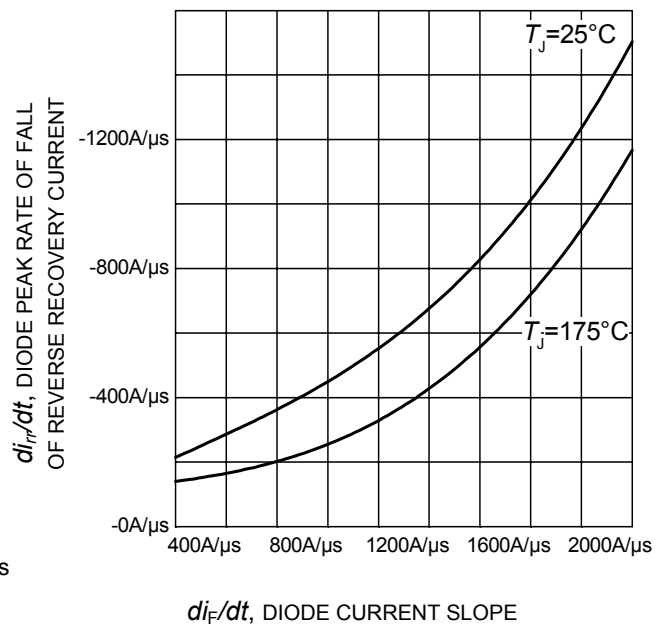
**Figure 23. Typical reverse recovery time as a function of diode current slope**  
( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
Dynamic test circuit in Figure E)



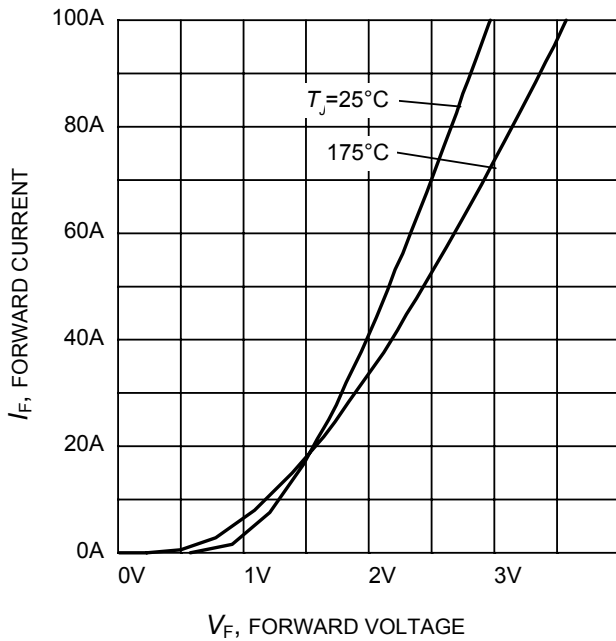
**Figure 24. Typical reverse recovery charge as a function of diode current slope**  
( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
Dynamic test circuit in Figure E)



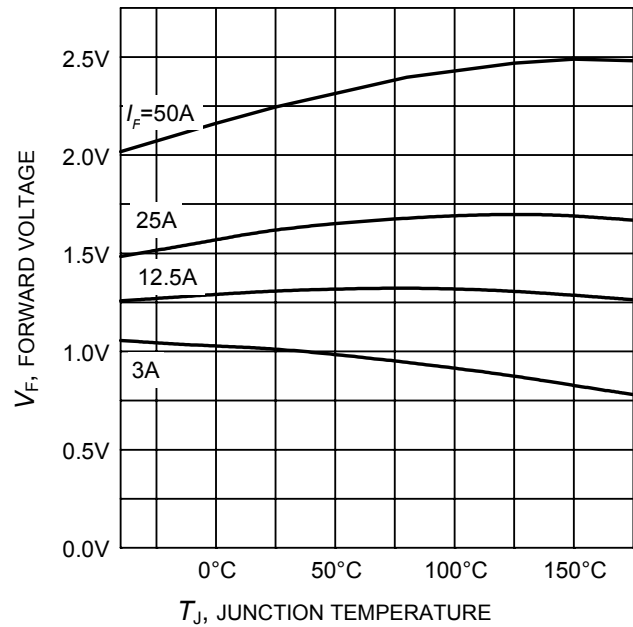
**Figure 25. Typical reverse recovery current as a function of diode current slope**  
( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
Dynamic test circuit in Figure E)



**Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**  
( $V_R=600\text{V}$ ,  $I_F=25\text{A}$ ,  
Dynamic test circuit in Figure E)

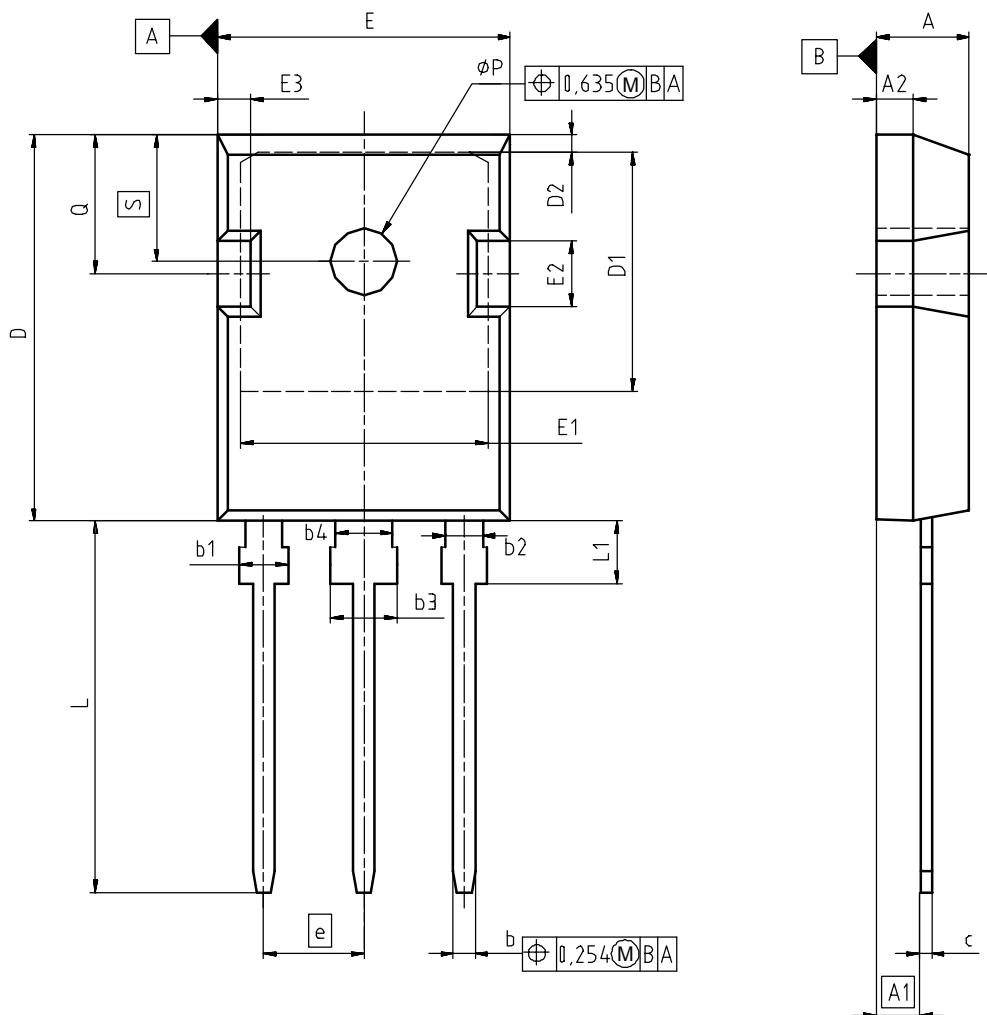


**Figure 27. Typical diode forward current as a function of forward voltage**

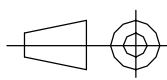


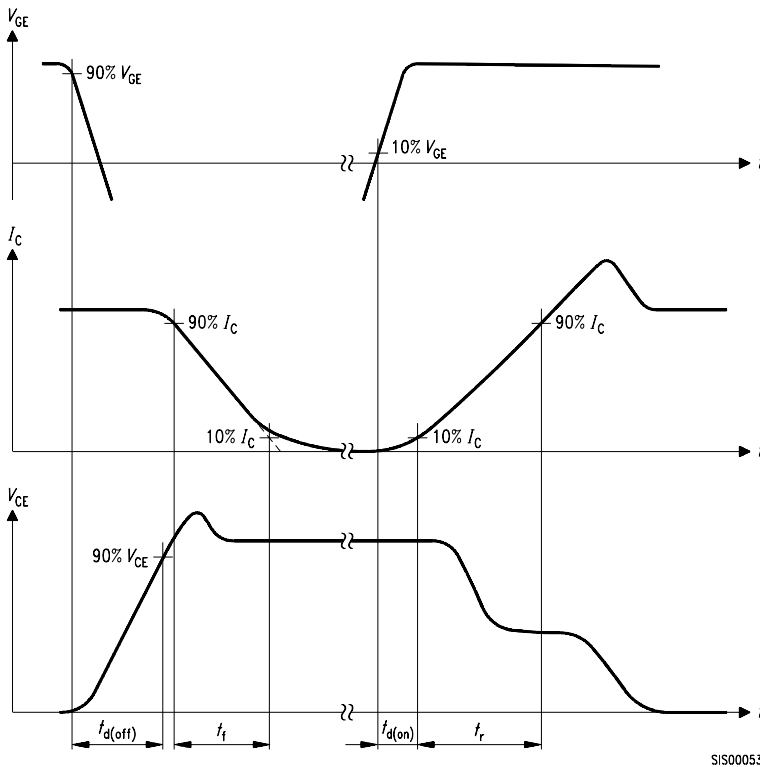
**Figure 28. Typical diode forward voltage as a function of junction temperature**

## PG-TO247-3

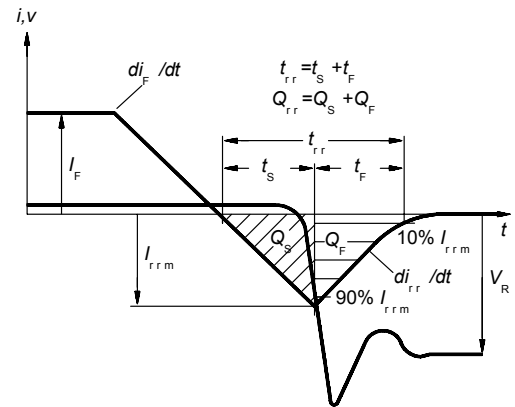


| DIM      | MILLIMETERS |       | INCHES |       |
|----------|-------------|-------|--------|-------|
|          | MIN         | MAX   | MIN    | MAX   |
| A        | 4.90        | 5.16  | 0.193  | 0.203 |
| A1       | 2.27        | 2.53  | 0.089  | 0.099 |
| A2       | 1.85        | 2.11  | 0.073  | 0.083 |
| 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        | 20.82       | 21.10 | 0.820  | 0.831 |
| D1       | 16.25       | 17.65 | 0.640  | 0.695 |
| D2       | 1.05        | 1.35  | 0.041  | 0.053 |
| E        | 15.70       | 16.03 | 0.618  | 0.631 |
| E1       | 13.10       | 14.15 | 0.516  | 0.557 |
| E2       | 3.68        | 5.10  | 0.145  | 0.201 |
| E3       | 1.68        | 2.60  | 0.066  | 0.102 |
| e        | 5.44        |       | 0.214  |       |
| N        | 3           |       | 3      |       |
| L        | 19.80       | 20.31 | 0.780  | 0.799 |
| L1       | 4.17        | 4.47  | 0.164  | 0.176 |
| $\phi P$ | 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 |

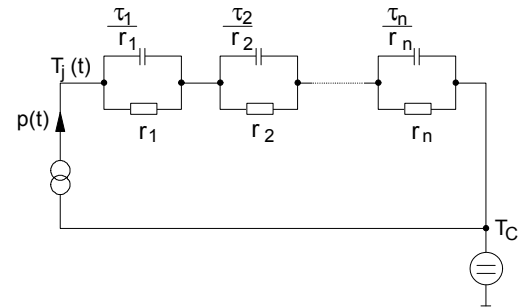
|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003327                                                                                  |
| SCALE<br>0 5 5 7.5mm                                                                                         |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>17-12-2007                                                                                     |
| REVISION<br>03                                                                                               |



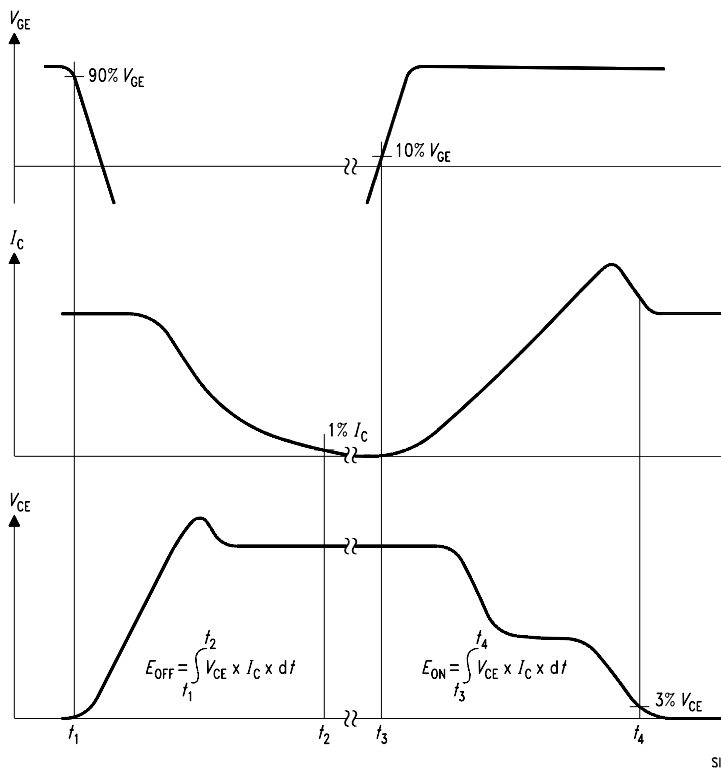
**Figure A. Definition of switching times**



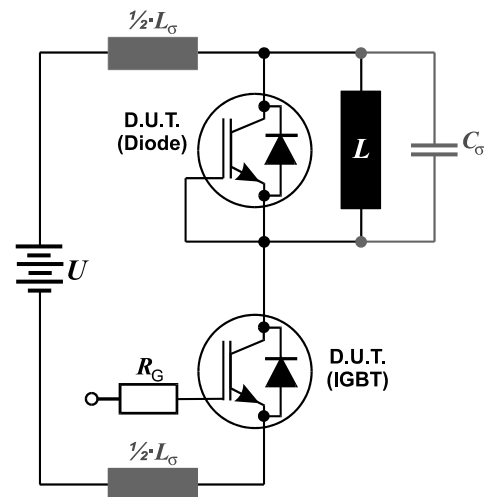
**Figure C. Definition of diodes switching characteristics**



**Figure D. Thermal equivalent circuit**



**Figure B. Definition of switching losses**



**Figure E. Dynamic test circuit**

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