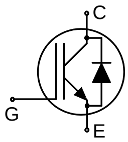
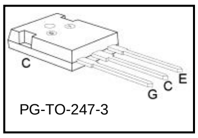
# THE DATASHEET OF

# IKW25N120T2FKSA1

Low Loss DuoPack : IGBT in $2^{nd}$ generation **TrenchStop**®
with soft, fast recovery anti-parallel Emitter Controlled Diode




- Short circuit withstand time – 10µs
- Designed for :
  - Frequency Converters
  - Uninterrupted Power Supply
- **TrenchStop**® $2^{nd}$ 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 Emitter Controlled HE Diode
- Qualified according to JEDEC[1] for target applications
- Pb-free lead plating; RoHS compliant

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

| Type | $V_{CE}$ | $I_C$ | $V_{CE(sat),Tj=25°C}$ | $T_{j,max}$ | 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°C)<br>$T_C$ = 25°C<br>$T_C$ = 110°C | $I_C$ | <br>50<br>25 | A |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$ | $I_{Cpuls}$ | 100 | |
| Turn off safe operating area<br>$V_{CE} \le$ 1200V, $T_j \le$ 175°C | - | 100 | |
| Diode forward current ($T_j$=150°C)<br>$T_C$ = 25°C<br>$T_C$ = 110°C | $I_F$ | <br>40<br>25 | |
| Diode pulsed current, $t_p$ limited by $T_{jmax}$ | $I_{Fpuls}$ | 100 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Short circuit withstand time[2)]<br>$V_{GE}$ = 15V, $V_{CC} \le$ 600V, $T_{j,\,start} \le$ 175°C | $t_{SC}$ | 10 | µs |
| Power dissipation<br>$T_C$ = 25°C | $P_{tot}$ | 349 | W |
| 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<br>Wavesoldering only, temperature on leads only | - | 260 | |

[1] J-STD-020 and JESD-022
[2)] Allowed number of short circuits: <1000; time between short circuits: >1s.

**Thermal Resistance**

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---|---|---|---|
| **Characteristic** | | | | |
| IGBT thermal resistance, junction – case | $R_{thJC}$ | | 0.43 | K/W |
| Diode thermal resistance, junction – case | $R_{thJCD}$ | | 0.81 | |
| Thermal resistance, junction – ambient | $R_{thJA}$ | | 40 | |

**Electrical Characteristic,** at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Static Characteristic** | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$=0V, $I_C$=500µA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15V, $I_C$=25A<br>$T_j$=25°C<br>$T_j$=150°C<br>$T_j$=175°C | <br>-<br>-<br>- | <br>1.7<br>2.1<br>2.2 | <br>2.2<br>-<br>- | |
| Diode forward voltage | $V_F$ | $V_{GE}$=0V, $I_F$=25A<br>$T_j$=25°C<br>$T_j$=150°C<br>$T_j$=175°C | <br>-<br>-<br>- | <br>1.65<br>1.7<br>1.65 | <br>2.2<br>-<br>- | |
| 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, $V_{GE}$=0V<br>$T_j$=25°C<br>$T_j$=150°C<br>$T_j$=175°C | <br>-<br>- | <br>-<br>- | <br>0.4<br>4.0<br>20 | mA |
| 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, $V_{GE}$=0V, $f$=1MHz | - | 1600 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 155 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 90 | - | |
| Gate charge | $Q_{Gate}$ | $V_{CC}$=960V, $I_C$=25A $V_{GE}$=15V | - | 120 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | | - | 13 | - | nH |
| Short circuit collector current[1] | $I_{C(SC)}$ | $V_{GE}$=15V,$t_{SC}\leq$10µs $V_{CC}$ = 600V, $T_{j,start}$ = 25°C | - | 150 | - | A |
| | | $T_{j,start}$ = 175°C | | 115 | | |

**Switching Characteristic, Inductive Load,** at $T_j$=25 °C

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j$=25°C, $V_{CC}$=600V,$I_C$=25A, $V_{GE}$=0/15V, $R_G$=16.4Ω, $L_\sigma$[2]=105nH, $C_\sigma$[2]=39pF Energy losses include "tail" and diode reverse recovery. | - | 27 | - | ns |
| Rise time | $t_r$ | | - | 20 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 265 | - | |
| Fall time | $t_f$ | | - | 95 | - | |
| Turn-on energy | $E_{on}$ | | - | 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°C, $V_R$=600V, $I_F$=25A, $di_F/dt$=1050A/µs | - | 195 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 2.05 | | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 20 | | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | 475 | - | A/µs |

[1] Allowed number of short circuits: <1000; time between short circuits: >1s.
[2] 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 °C

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j$=175°C<br>$V_{CC}$=600V,$I_C$=25A,<br>$V_{GE}$=0/15V,<br>$R_G$= 16.4Ω,<br>$L_\sigma$[1)]=175nH,<br>$C_\sigma$[1)]=67pF<br>Energy losses include "tail" and diode 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 | $E_{on}$ | | - | 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°C<br>$V_R$=600V, $I_F$=25A,<br>$di_F/dt$=1000A/µs | - | 290 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 3.65 | - | µC |
| 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/µs |

[1)] Leakage inductance $L_\sigma$ and Stray capacity $C_\sigma$ due to dynamic test circuit in Figure E.

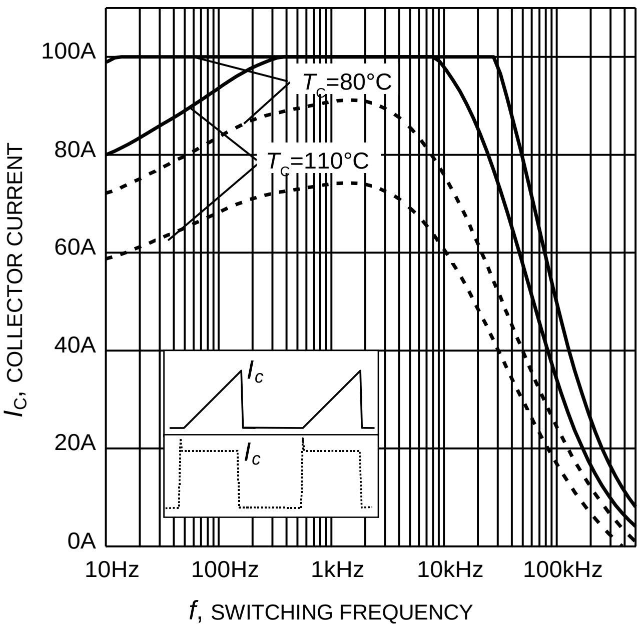



**Figure 1. Collector current as a function of switching frequency**
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 600V$, $V_{GE} = 0/+15V$, $R_G = 12\Omega$)

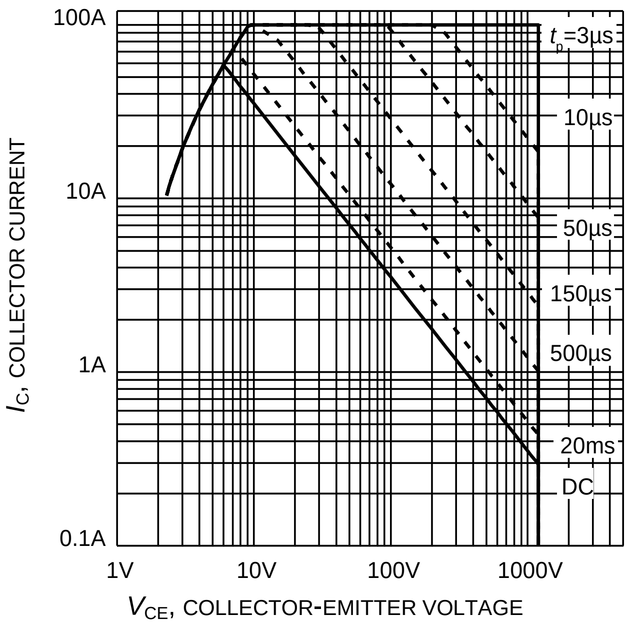



**Figure 2. Safe operating area**
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; $V_{GE}=15V$)

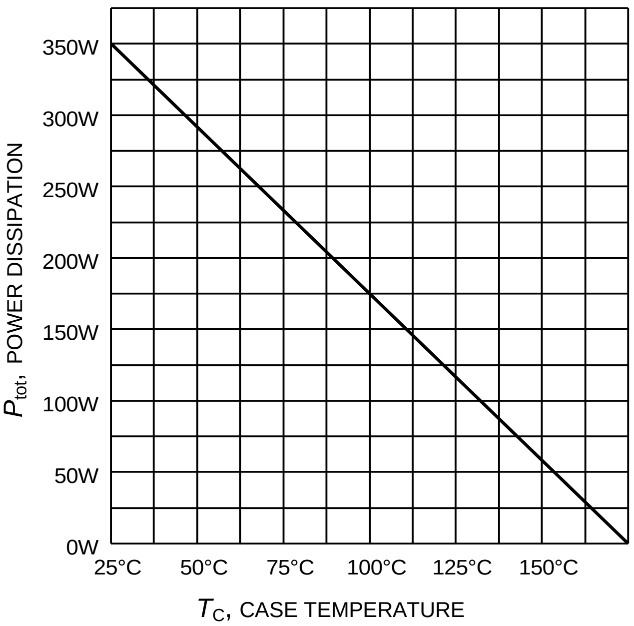



**Figure 3. Maximum power dissipation as a function of case temperature**
($T_j \leq 175°C$)

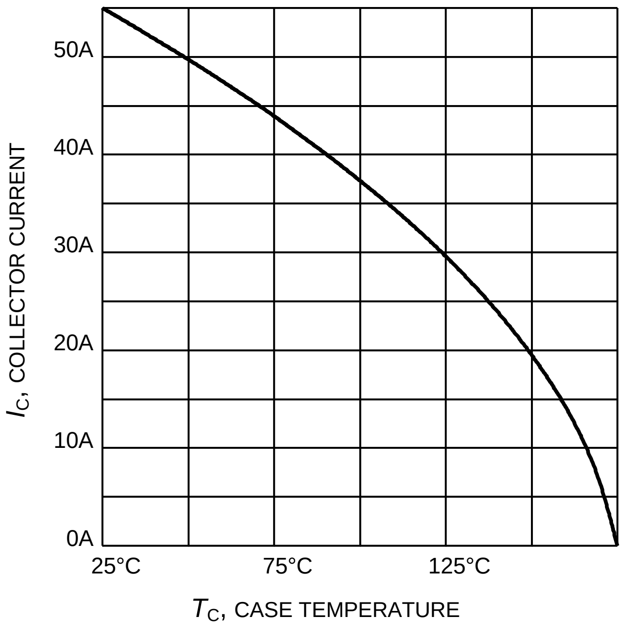



**Figure 4. Maximum collector current as a function of case temperature**
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

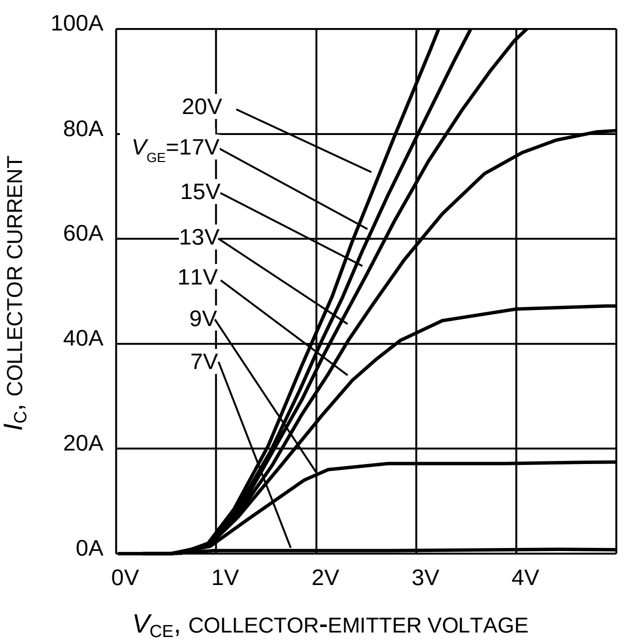



**Figure 5. Typical output characteristic**
($T_j$ = 25°C)

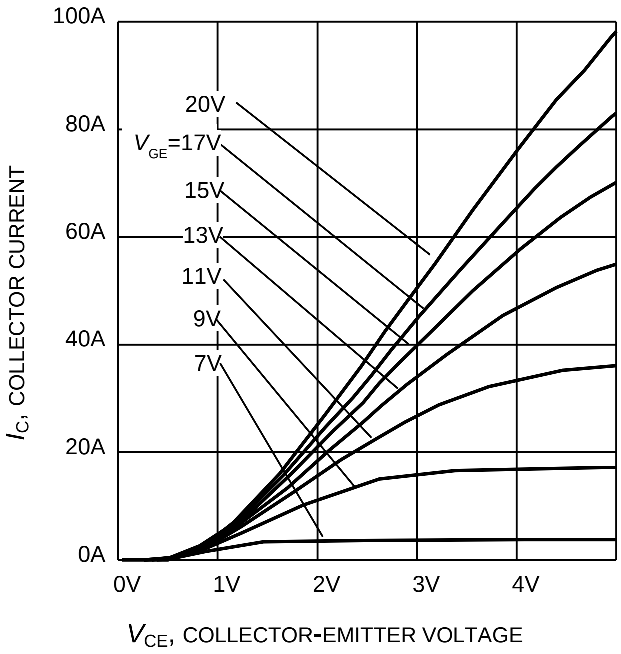



**Figure 6. Typical output characteristic**
($T_j$ = 175°C)

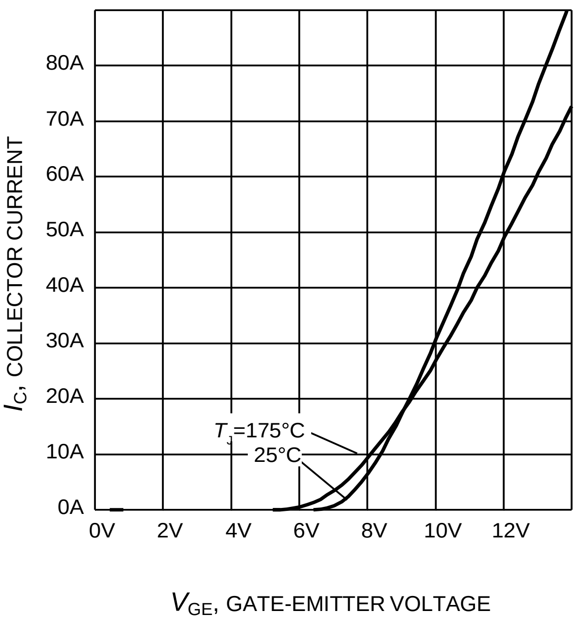



**Figure 7. Typical transfer characteristic**
($V_{CE}$=20V)

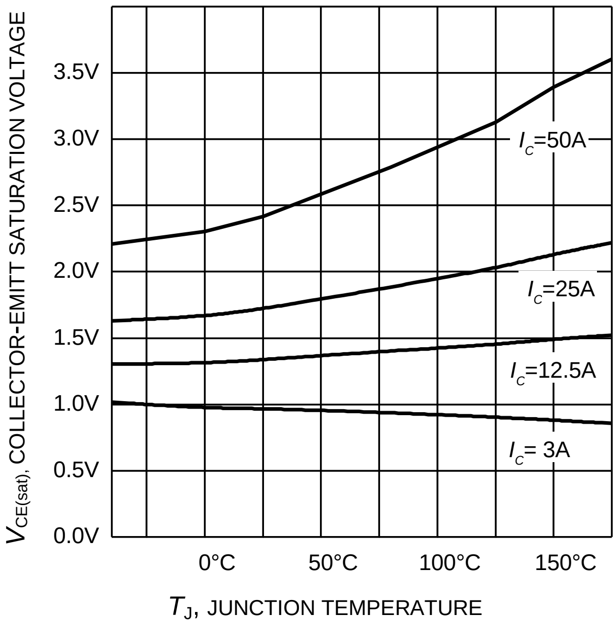



**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$ = 15V)

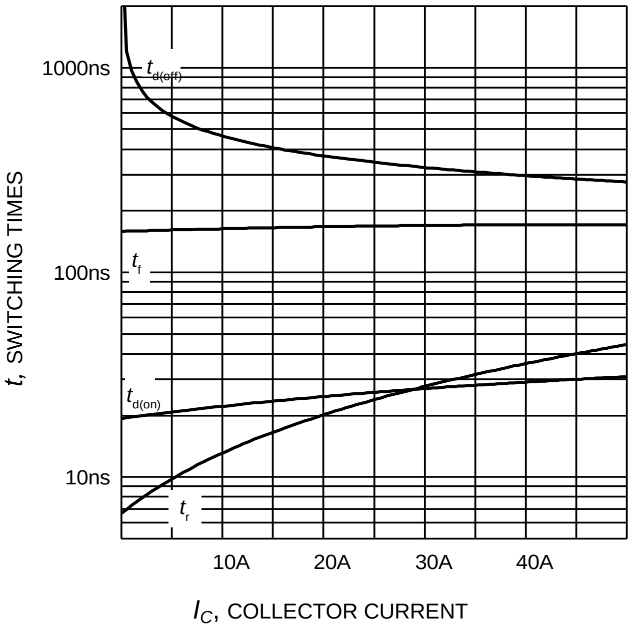



**Figure 9. Typical switching times as a function of collector current**
(inductive load, $T_J$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=16.4Ω, Dynamic test circuit in Figure E)

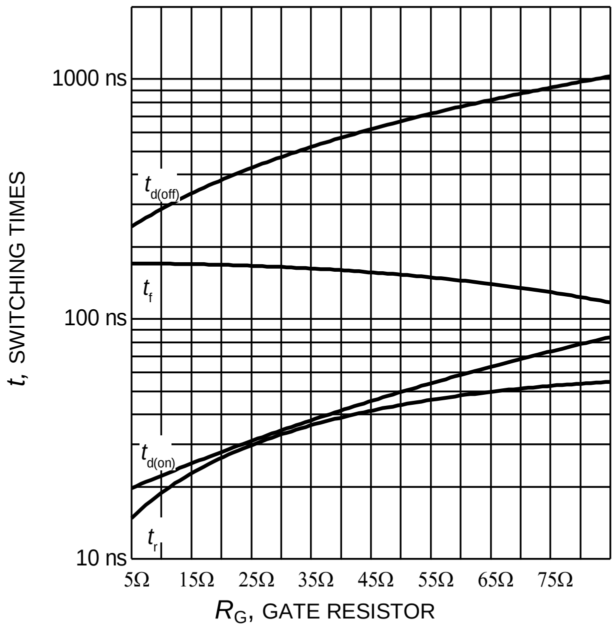



**Figure 10. Typical switching times as a function of gate resistor**
(inductive load, $T_J$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=25A, Dynamic test circuit in Figure E)

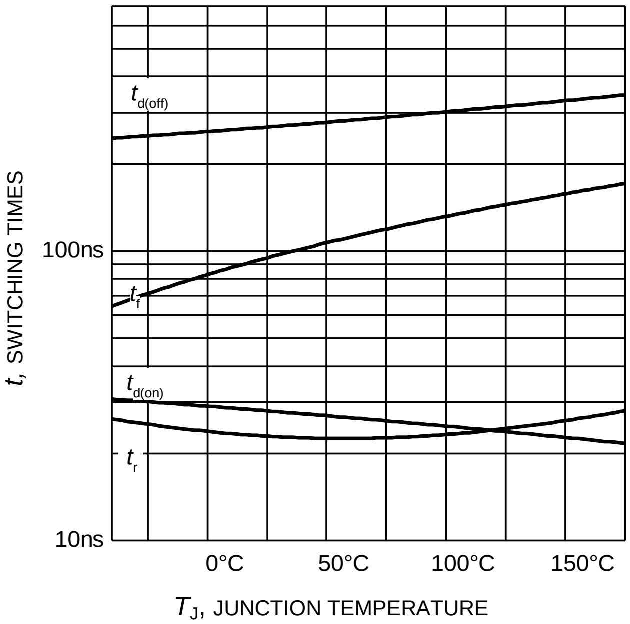



**Figure 11. Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=25A, $R_G$=16.4Ω, Dynamic test circuit in Figure E)

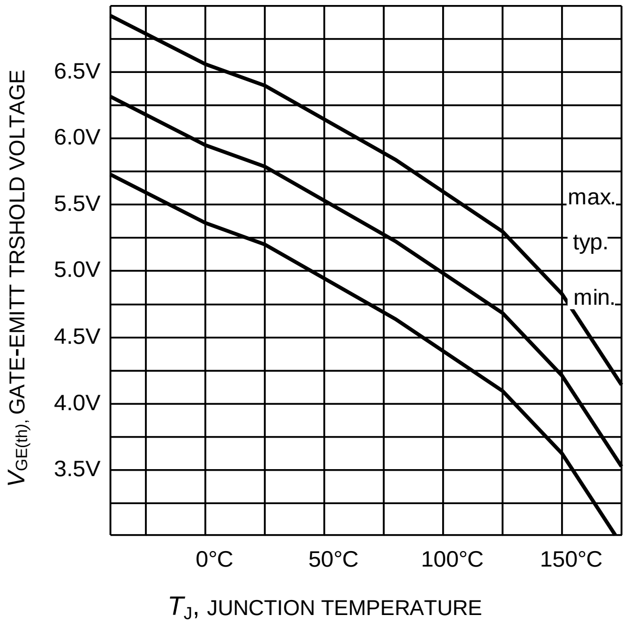



**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
($I_C$ = 1.0mA)

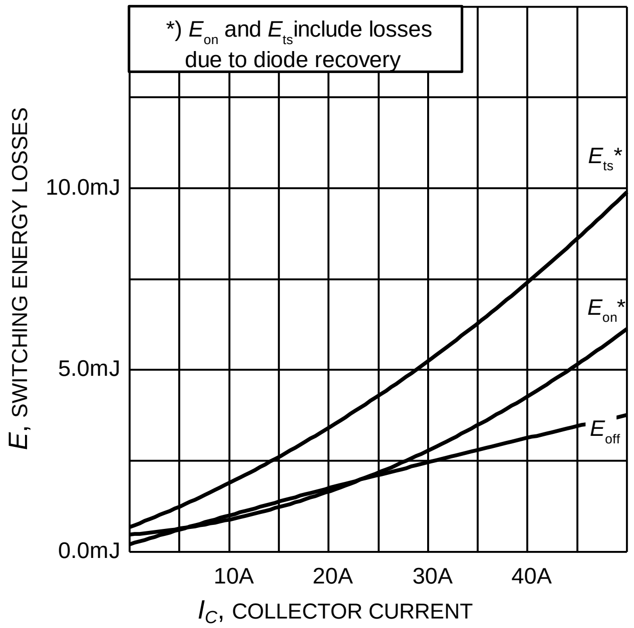



**Figure 13. Typical switching energy losses as a function of collector current**
(inductive load, $T_J$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=16.4Ω, Dynamic test circuit in Figure E)

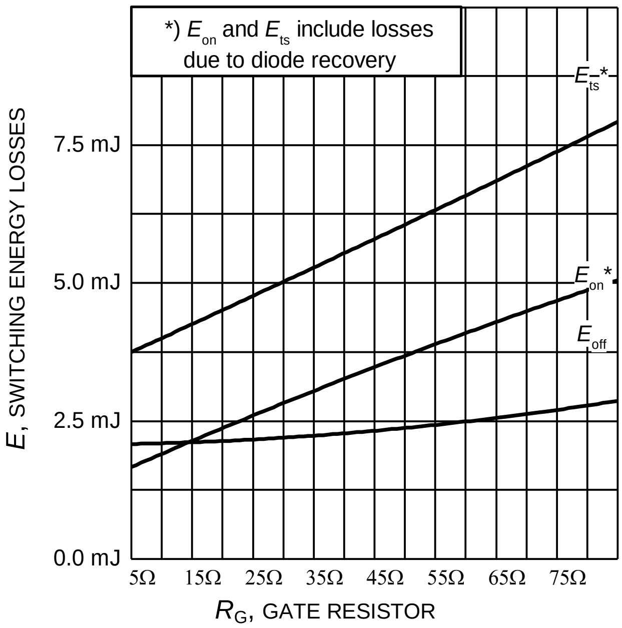



**Figure 14. Typical switching energy losses as a function of gate resistor**
(inductive load, $T_J$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=25A, Dynamic test circuit in Figure E)

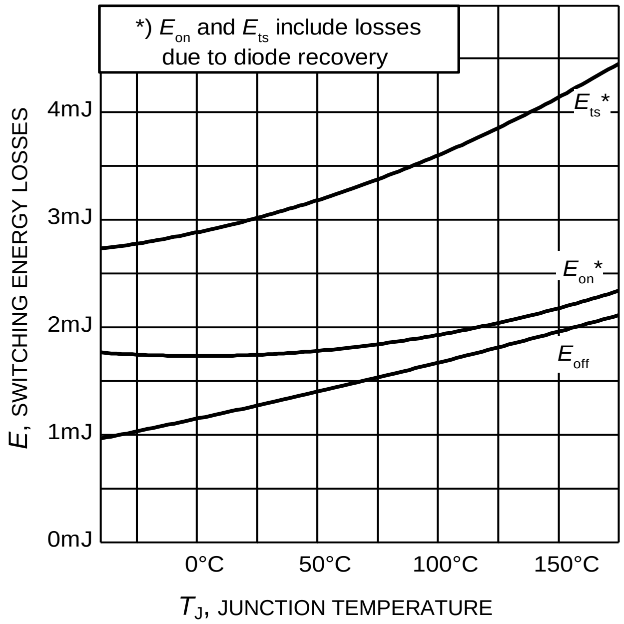



**Figure 15. Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=25A, $R_G$=16.4Ω, Dynamic test circuit in Figure E)

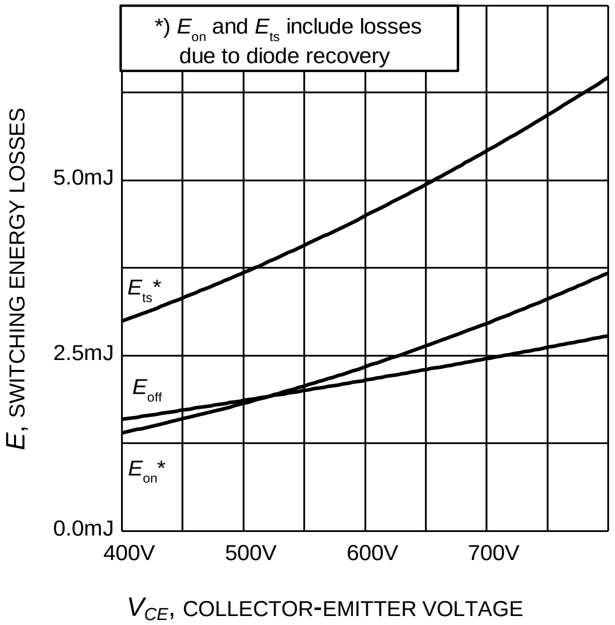



**Figure 16. Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_J$=175°C, $V_{GE}$=0/15V, $I_C$=25A, $R_G$=16.4Ω, Dynamic test circuit in Figure E)

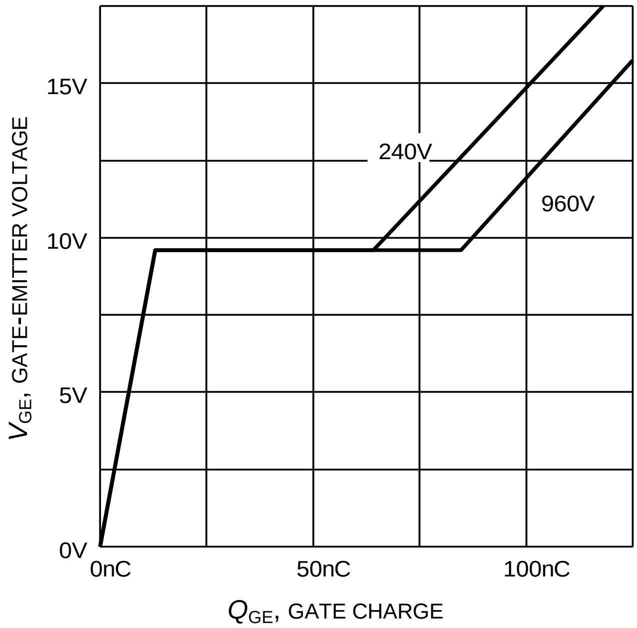



**Figure 17. Typical gate charge**
($I_C$=25 A)

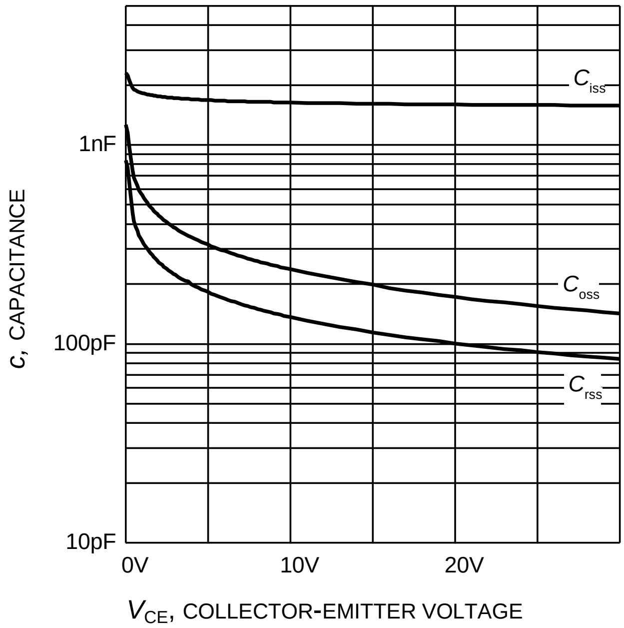



**Figure 18. Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, $f$ = 1 MHz)

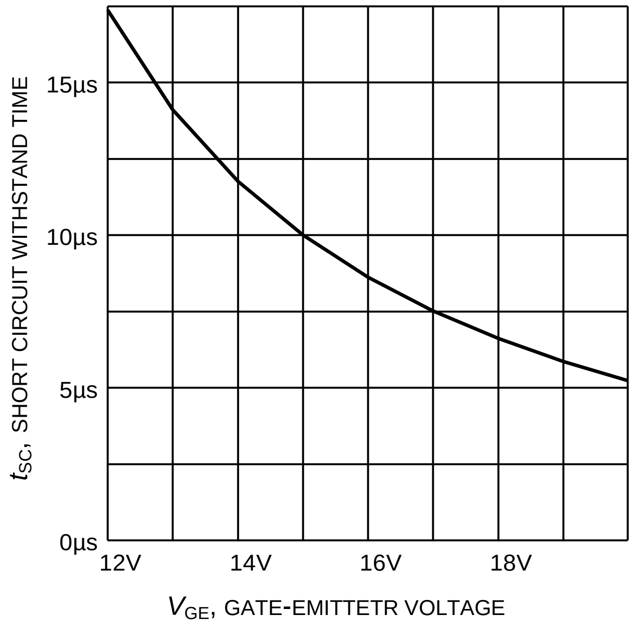



**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$=600V, start at $T_J \leq 175°C$)

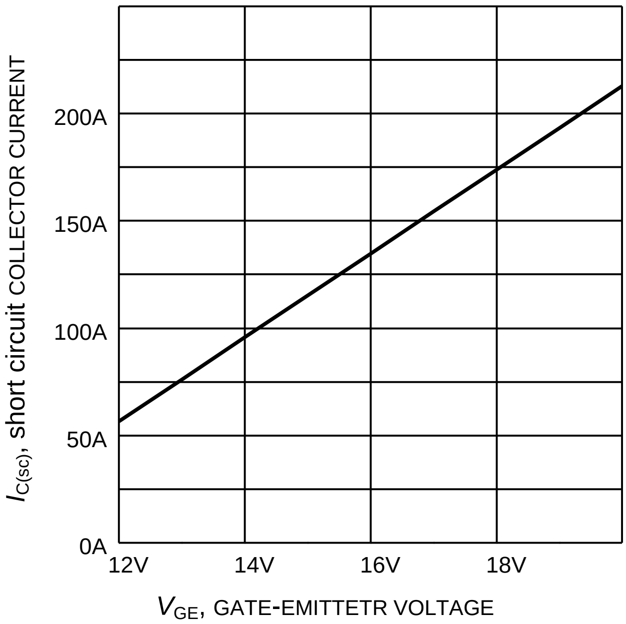



**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE} \leq 600V$, $T_{j,start}$ = 175°C)

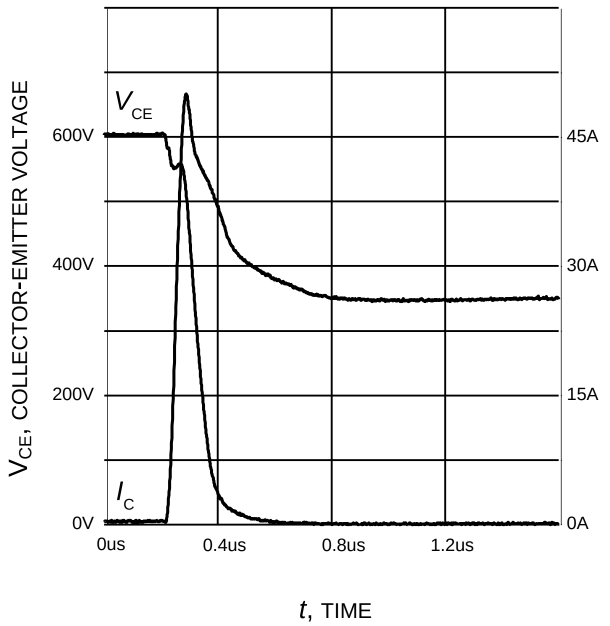



**Figure 21. Typical turn on behavior**
($V_{GE}$=0/15V, $R_G$=16.4Ω, $T_j$ = 175°C, Dynamic test circuit in Figure E)

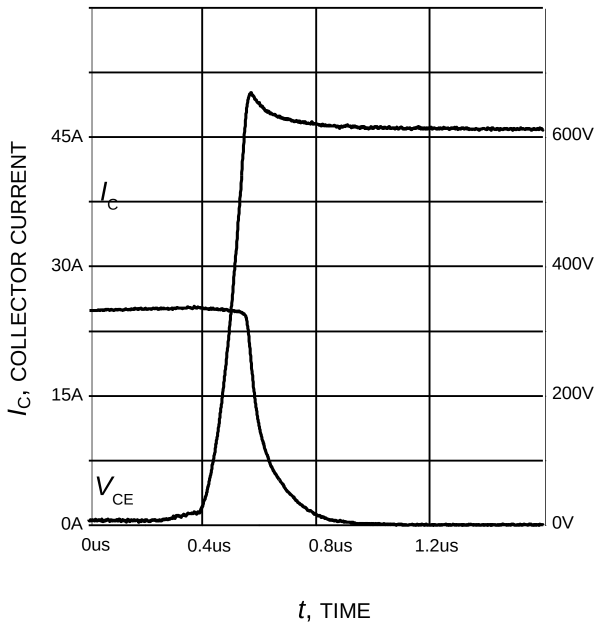



**Figure 22. Typical turn off behavior**
($V_{GE}$=15/0V, $R_G$=16.4Ω, $T_j$ = 175°C, Dynamic test circuit in Figure E)

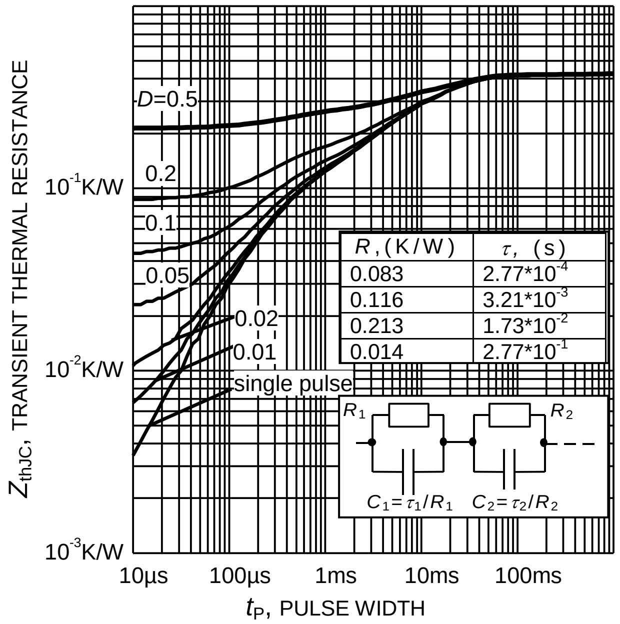



**Figure 23. IGBT transient thermal resistance**
($D$ = $t_p$ / $T$)

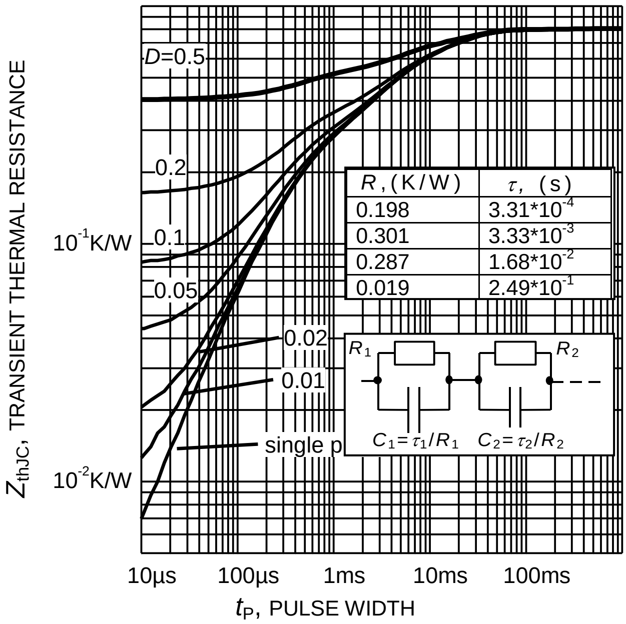



**Figure 24. Diode transient thermal impedance as a function of pulse width**
($D$=$t_P$/$T$)

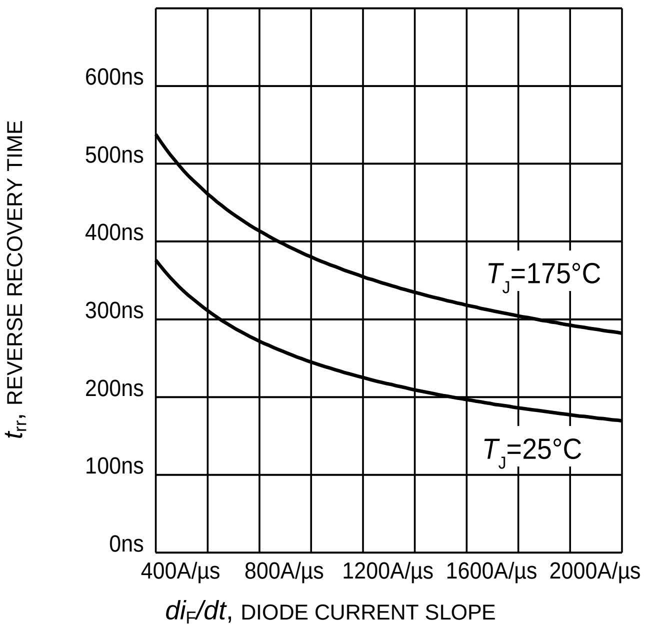



**Figure 23. Typical reverse recovery time as a function of diode current slope**
($V_R$=600V, $I_F$=25A,
Dynamic test circuit in Figure E)

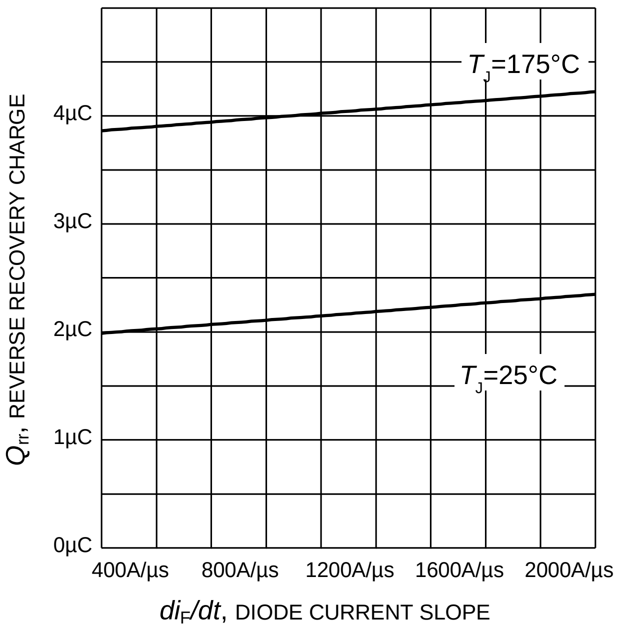



**Figure 24. Typical reverse recovery charge as a function of diode current slope**
($V_R$=600V, $I_F$=25A,
Dynamic test circuit in Figure E)

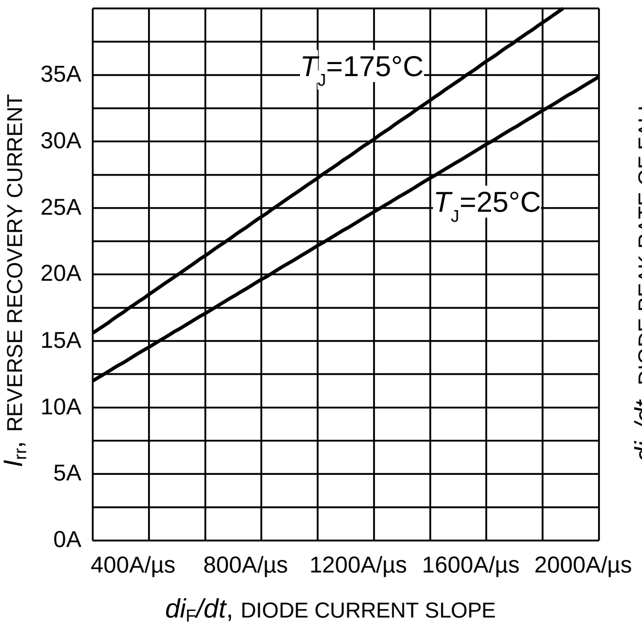



**Figure 25. Typical reverse recovery current as a function of diode current slope**
($V_R$=600V, $I_F$=25A,
Dynamic test circuit in Figure E)

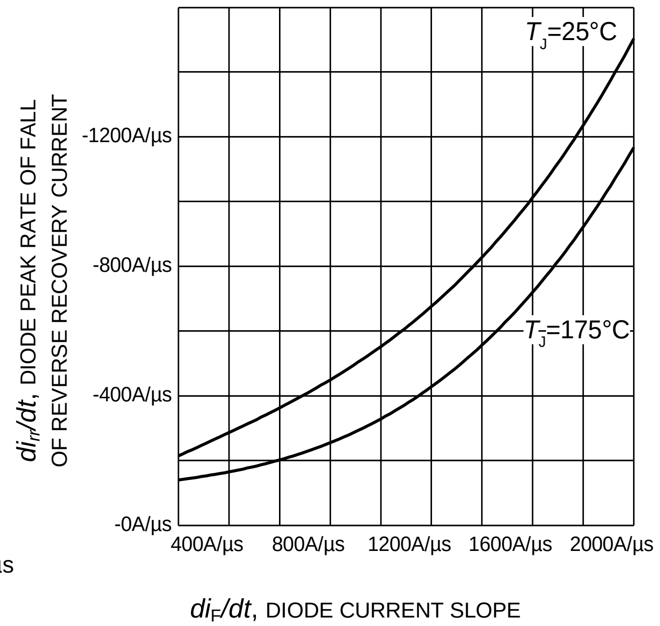



**Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R$=600V, $I_F$=25A,
Dynamic test circuit in Figure E)

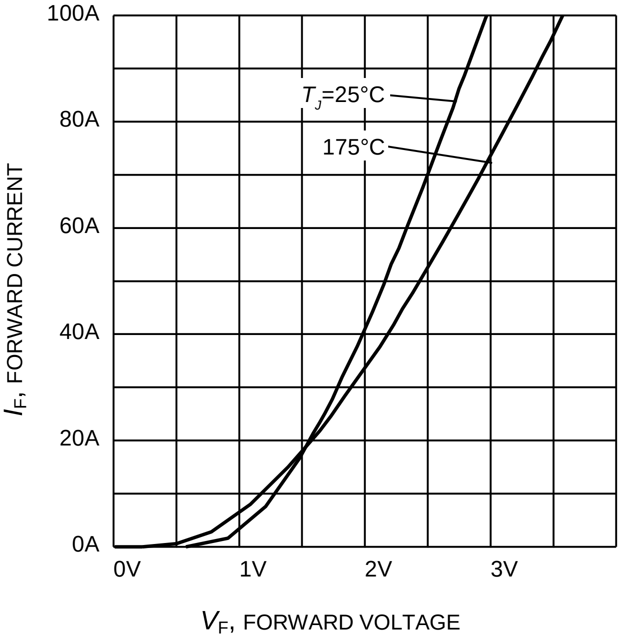



**Figure 27. Typical diode forward current as a function of forward voltage**

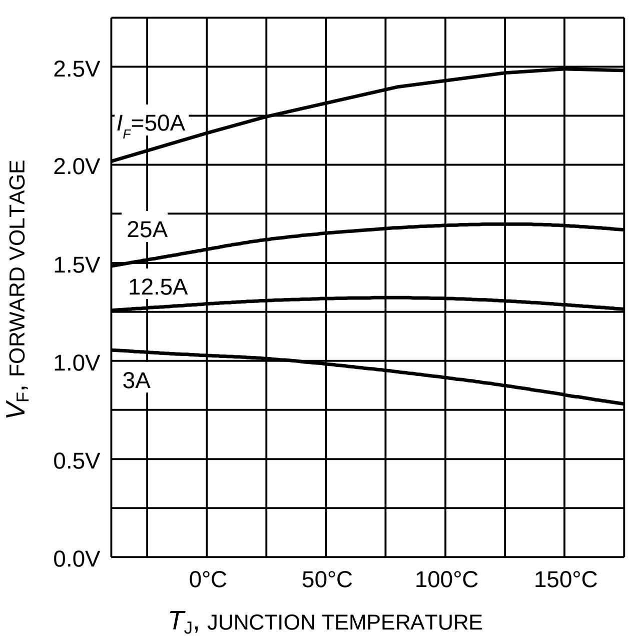
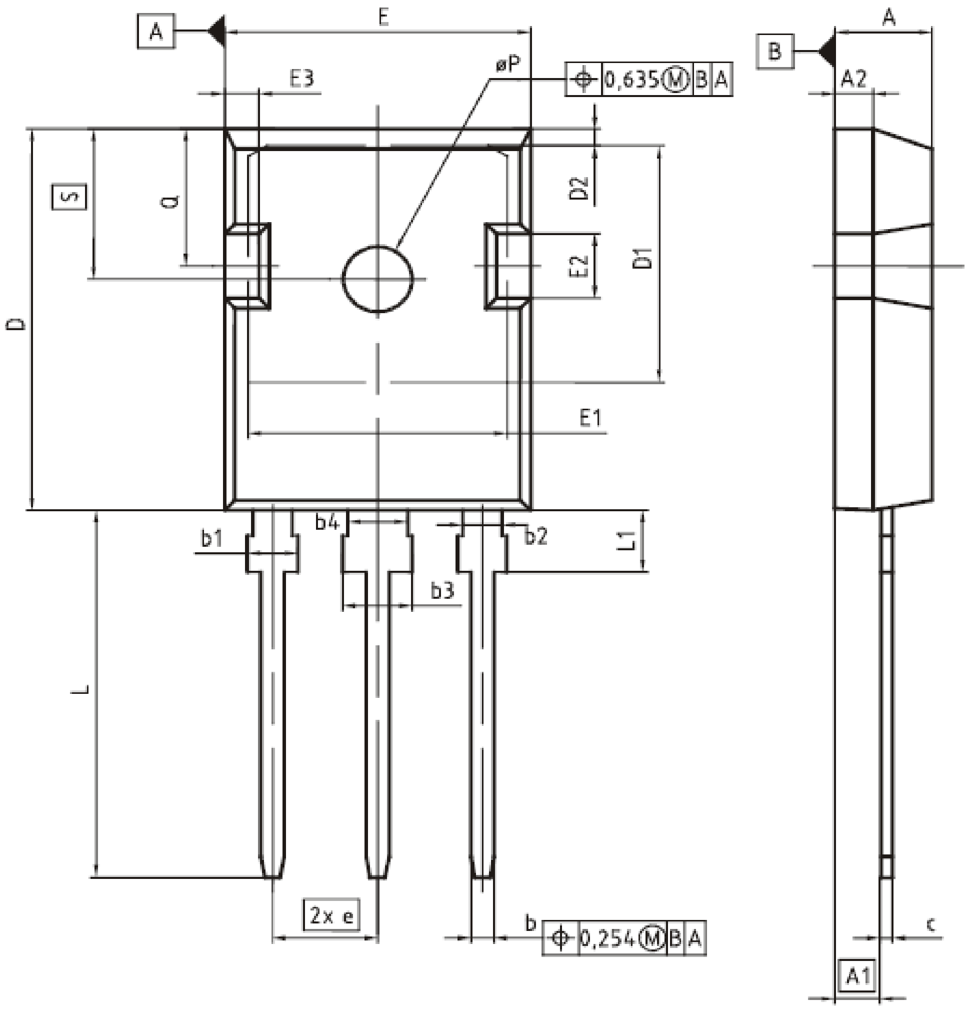



**Figure 28. Typical diode forward voltage as a function of junction temperature**

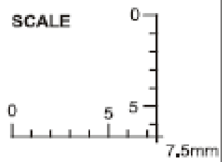
# PG-TO247-3



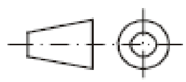

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4,83 | 5,21 | 0,190 | 0,205 |
| A1 | 2,27 | 2,54 | 0,089 | 0,100 |
| A2 | 1,85 | 2,16 | 0,073 | 0,085 |
| b | 1,07 | 1,33 | 0,042 | 0,052 |
| b1 | 1,90 | 2,41 | 0,075 | 0,095 |
| b2 | 1,90 | 2,16 | 0,075 | 0,085 |
| 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 |

DOCUMENT NO.
Z8B00003327

SCALE




EUROPEAN PROJECTION



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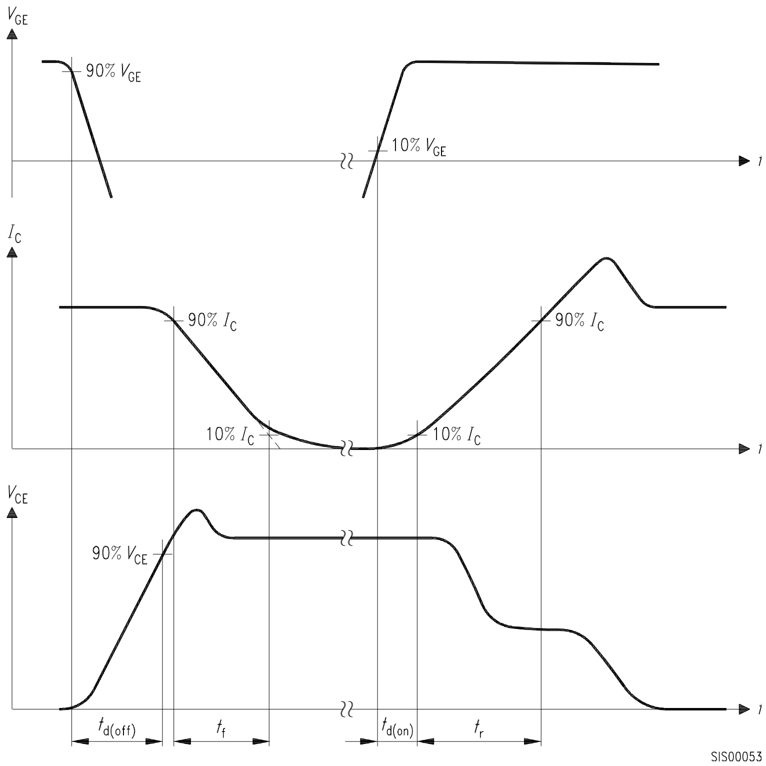


**Figure A. Definition of switching times**

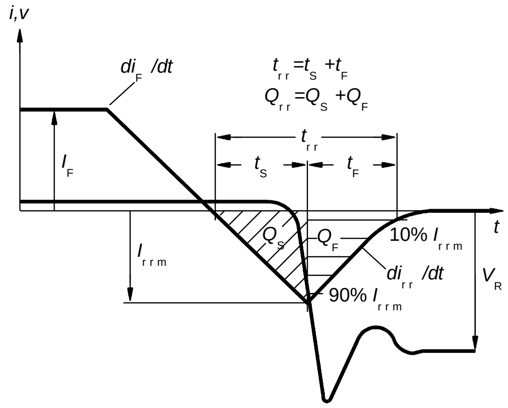


**Figure C. Definition of diodes switching characteristics**

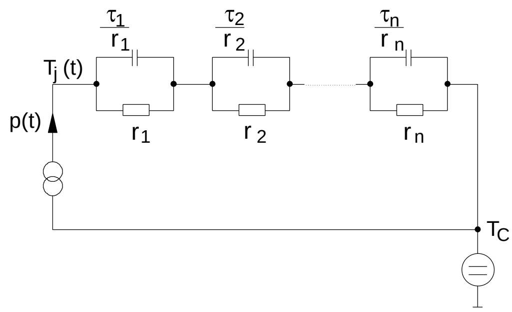


**Figure D. Thermal equivalent circuit**

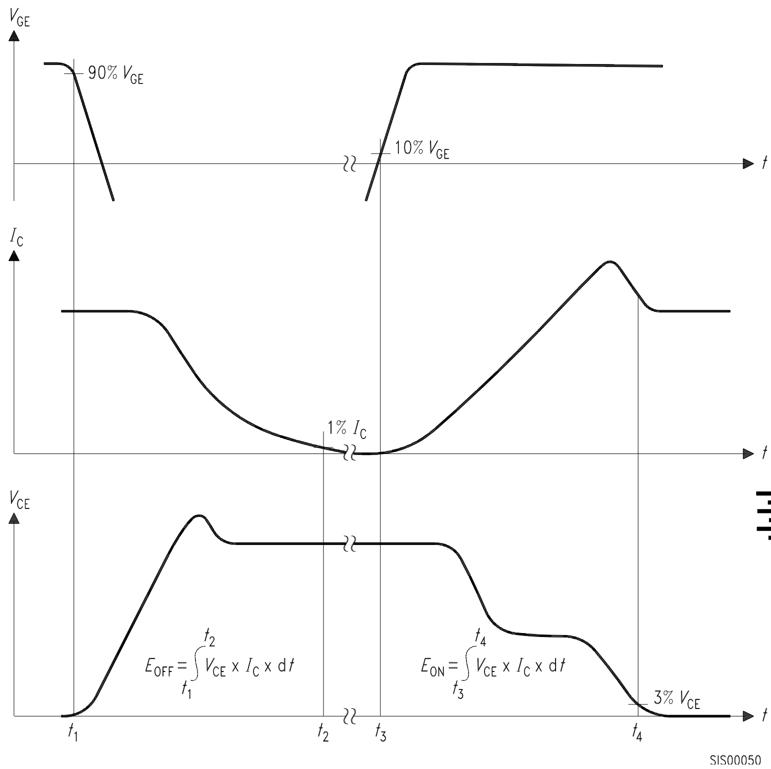


**Figure B. Definition of switching losses**

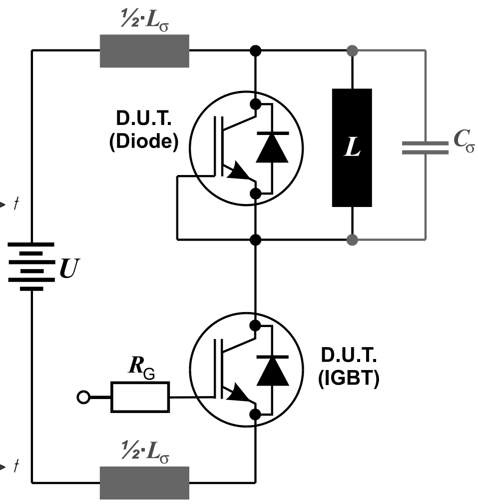


**Figure E. Dynamic test circuit**

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