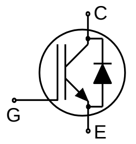
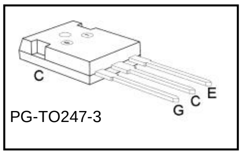
# IKW30N60TA

TrenchStop® Series

Low Loss DuoPack : IGBT in TrenchStop® and Fieldstop technology with soft, fast recovery anti-parallel Emitter Controlled HE diode




**Features:**

- Automotive AEC Q101 qualified
- Designed for DC/AC converters for Automotive Application
- Very low $V_{CE(sat)}$ 1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time 5 µs
- TrenchStop® and Fieldstop technology for 600 V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - very high switching speed
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Green Package
- Very soft, fast recovery anti-parallel Emitter Controlled HE diode

**Applications:**

- Main inverter
- Air – Con compressor
- PTC heater
- Motor drives

| Type | $V_{CE}$ | $I_C$ | $V_{CE(sat),Tj=25°C}$ | $T_{j,max}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IKW30N60TA | 600V | 30A | 1.5V | 175°C | K30T60A | PG-TO247-3 |

**Maximum Ratings**

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector-emitter voltage, $T_j \geq 25°C$ | | $V_{CE}$ | 600 | V |
| DC collector current, limited by $T_{jmax}$ | $T_C = 25°C$ | $I_C$ | 60 | A |
| | $T_C = 105°C$ | | 30 | |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$[1)] | | $I_{Cpuls}$ | 90 | |
| Turn off safe operating area, $V_{CE} \leq 600V$, $T_j \leq 175°C$, $t_p \leq 1\mu s$[1)] | | - | 90 | |
| Diode forward current, limited by $T_{jmax}$ | $T_C = 25°C$ | $I_F$ | 60 | |
| | $T_C = 100°C$ | | 30 | |
| Diode pulsed current, $t_p$ limited by $T_{jmax}$[1)] | | $I_{Fpuls}$ | 90 | |
| Gate-emitter voltage | | $V_{GE}$ | ±20 | V |
| Short circuit withstand time[2)] $V_{GE} = 15V$, $V_{CC} \leq 400V$, $T_j \leq 150°C$ | | $t_{SC}$ | 5 | µs |
| Power dissipation $T_C = 25°C$ | | $P_{tot}$ | 187 | W |
| Operating junction temperature | | $T_j$ | -40...+175 | °C |
| Storage temperature | | $T_{stg}$ | -55...+150 | |
| Soldering temperature (wavesoldering only allowed at leads, 1.6mm (0.063 in.) from case for 10s)[3)] | | $T_{sold}$ | 260 | |

1) Defined by design. Not subject to production test.
2) Allowed number of short circuits: <1000; time between short circuits: >1s.
3) Package not recommended for surface mount application.

**Thermal Resistance**

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---|---|---|---|
| **Characteristic** | | | | |
| IGBT thermal resistance, junction – case | $R_{thJC}$ | | 0.80 | K/W |
| Diode thermal resistance, junction – case | $R_{thJCD}$ | | 1.05 | |
| 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, $I_C$=0.2mA | 600 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15V, $I_C$=30A<br>$T_j$=25°C<br>$T_j$=175°C | <br>-<br>- | <br>1.5<br>1.9 | <br>2.05<br>- | |
| Diode forward voltage | $V_F$ | $V_{GE}$=0V, $I_F$=30A<br>$T_j$=25°C<br>$T_j$=175°C | <br>-<br>- | <br>1.65<br>1.6 | <br>2.05<br>- | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$=0.43mA, $V_{CE}$=$V_{GE}$ | 4.1 | 4.9 | 5.7 | |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$=600V, $V_{GE}$=0V<br>$T_j$=25°C<br>$T_j$=175°C | <br>-<br>- | <br>-<br>- | <br>40<br>2000 | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$=0V,$V_{GE}$=20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$=20V, $I_C$=30A | - | 16.7 | - | S |
| Integrated gate resistor | $R_{Gint}$ | | | - | | Ω |

**Dynamic Characteristic**

| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{ies}$ | $V_{CE}$=25V, | - | 1630 | - | pF |
| Output capacitance | $C_{oes}$ | $V_{GE}$=0V, | - | 108 | - | |
| Reverse transfer capacitance | $C_{res}$ | $f$=1MHz | - | 50 | - | |
| Gate charge | $Q_{Gate}$ | $V_{CC}$=480V, $I_C$=30A<br>$V_{GE}$=15V | - | 167 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | | - | 13 | - | nH |
| Short circuit collector current<br>Allowed number of short circuits: <1000; time between short circuits: >1s. | $I_{C(SC)}$ | $V_{GE}$=15V,$t_{SC}$≤5µs<br>$V_{CC}$ = 400V,<br>$T_j$ = 150°C | - | 275 | - | A |

**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, $V_{CC}$=400V, $I_C$=30A, $V_{GE}$=0/15V, $R_G$=10.6Ω, $L_\sigma$=136nH, $C_\sigma$=39pF $L_\sigma$, $C_\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery. | - | 23 | - | ns |
| Rise time | $t_r$ | | - | 21 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 254 | - | |
| Fall time | $t_f$ | | - | 46 | - | |
| Turn-on energy | $E_{on}$ | | - | 0.69 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.77 | - | |
| Total switching energy | $E_{ts}$ | | - | 1.46 | - | |
| **Anti-Parallel Diode Characteristic** | | | | | | |
| Diode reverse recovery time | $t_{rr}$ | $T_j$=25°C, $V_R$=400V, $I_F$=30A, $di_F/dt$=910A/µs | - | 85 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 0.8 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 16 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -630 | - | A/µs |

**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, $V_{CC}$=400V, $I_C$=30A, $V_{GE}$=0/15V, $R_G$=10.6Ω, $L_\sigma$=139nH, $C_\sigma$=39pF $L_\sigma$, $C_\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery. | - | 24 | - | ns |
| Rise time | $t_r$ | | - | 26 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 292 | - | |
| Fall time | $t_f$ | | - | 90 | - | |
| Turn-on energy | $E_{on}$ | | - | 1.0 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.1 | - | |
| Total switching energy | $E_{ts}$ | | - | 2.1 | - | |
| **Anti-Parallel Diode Characteristic** | | | | | | |
| Diode reverse recovery time | $t_{rr}$ | $T_j$=175°C $V_R$=400V, $I_F$=30A, $di_F/dt$=910A/µs | - | 240 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 2.39 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 22 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -320 | - | A/µs |

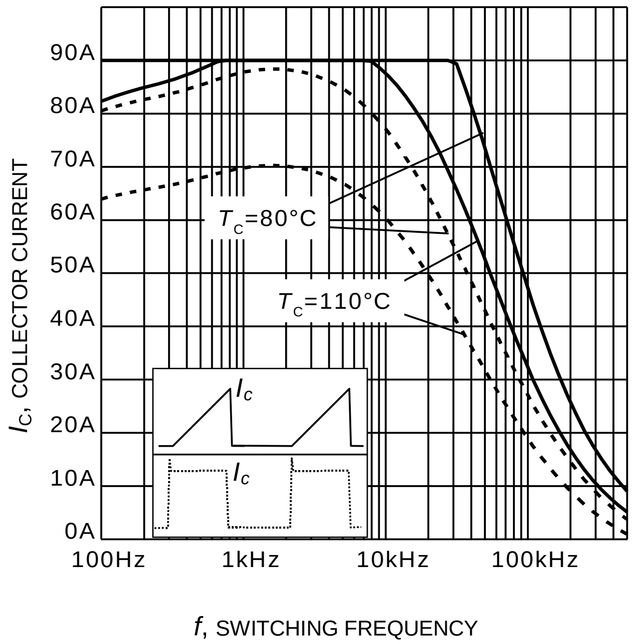



**Figure 1. Collector current as a function of switching frequency**
($T_j \leq 175°C$, $D = 0.5$, $V_{CE} = 400V$, $V_{GE} = 0/15V$, $R_G = 10\Omega$)

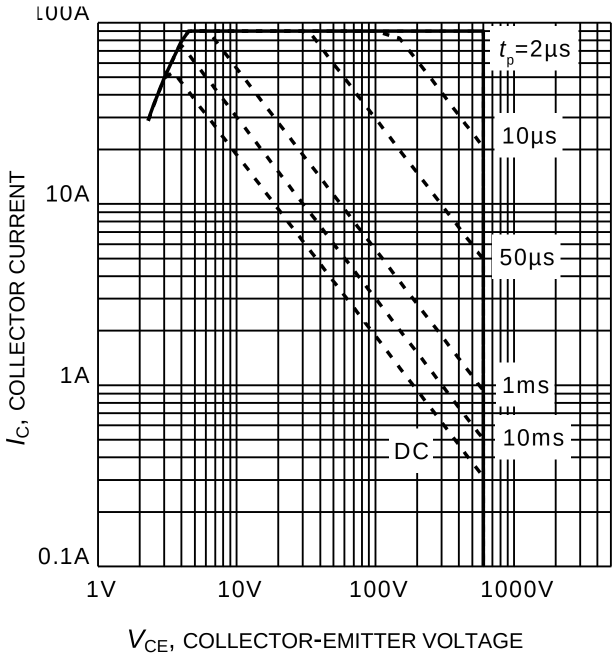



**Figure 2. Safe operating area**
($D = 0$, $T_C = 25°C$, $T_j \leq 175°C$; $V_{GE}$=0/15V)

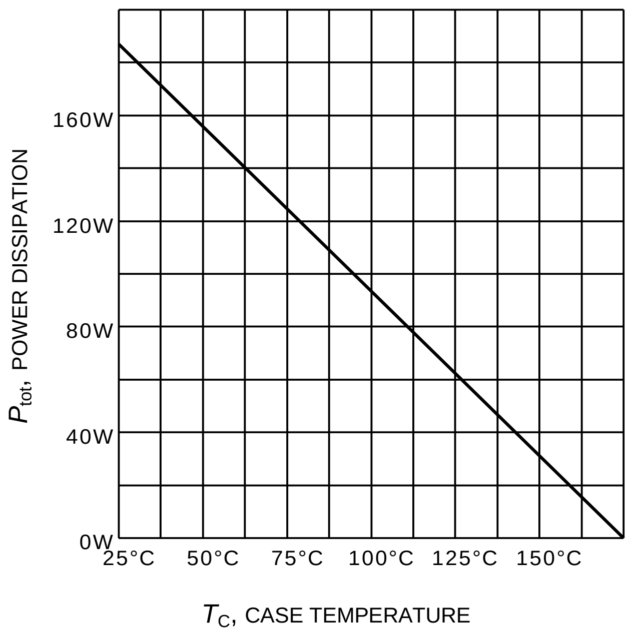



**Figure 3. Power dissipation as a function of case temperature**
($T_j \leq 175°C$)

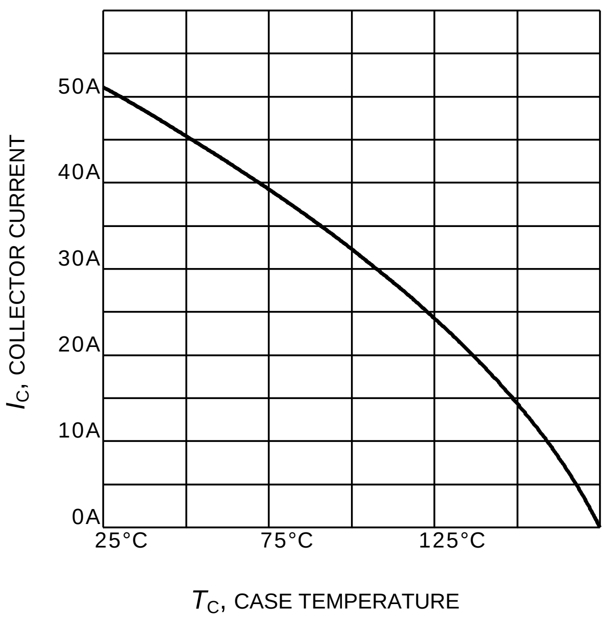



**Figure 4. Collector current as a function of case temperature**
($V_{GE} \geq 15V$, $T_j \leq 175°C$)

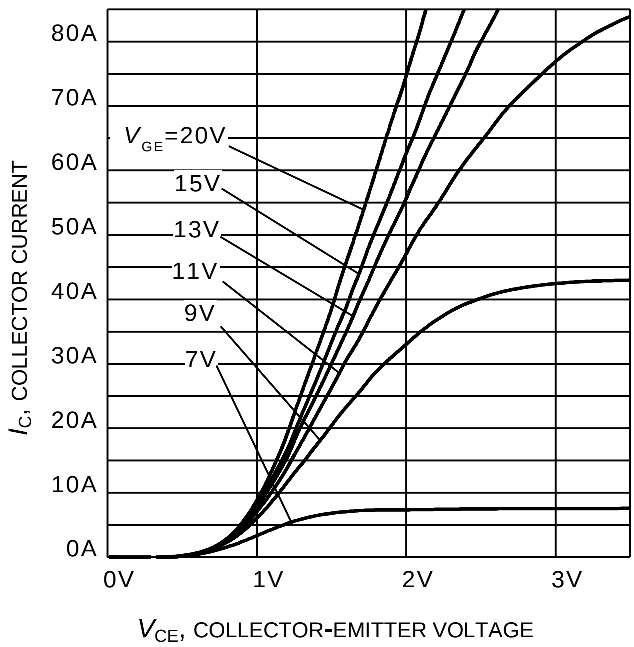



**Figure 5. Typical output characteristic**
($T_j$ = 25°C)

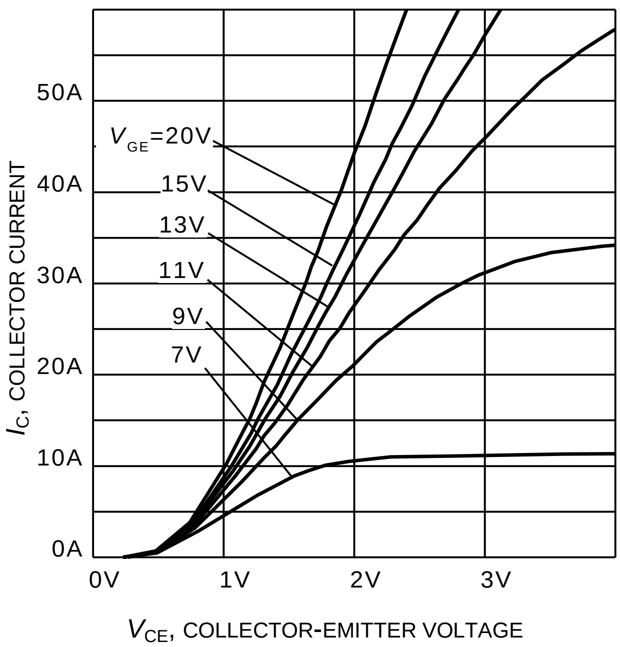



**Figure 6. Typical output characteristic**
($T_j$ = 175°C)

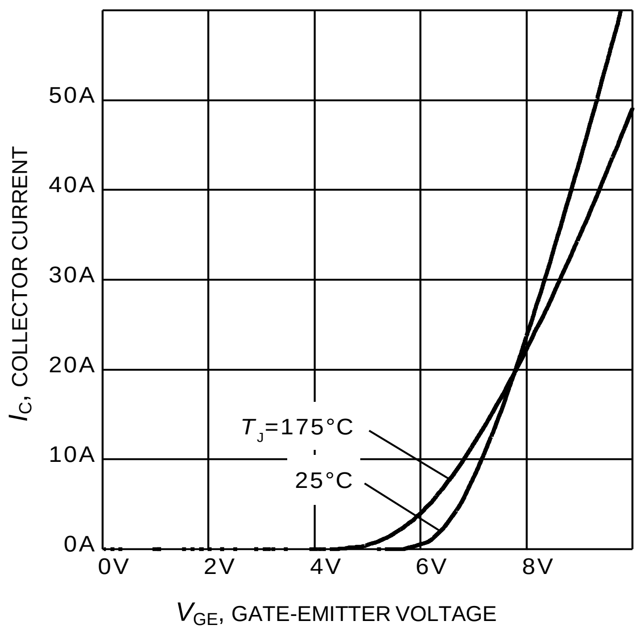



**Figure 7. Typical transfer characteristic**
($V_{CE}$=10V)

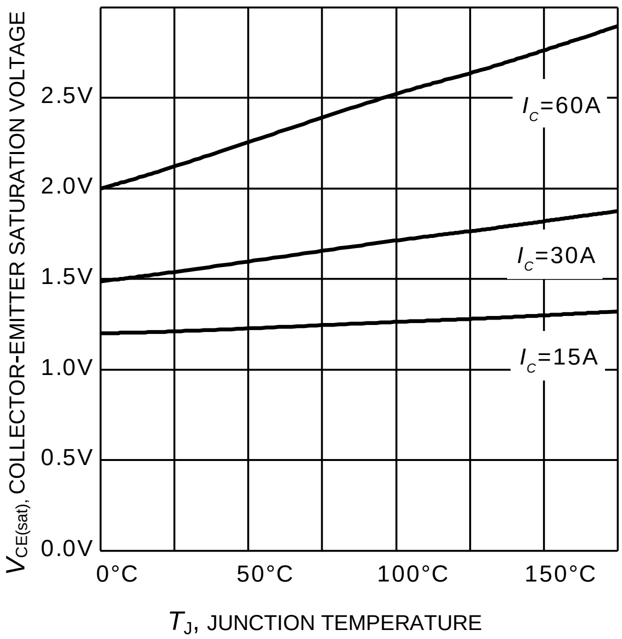



**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$ = 15V)

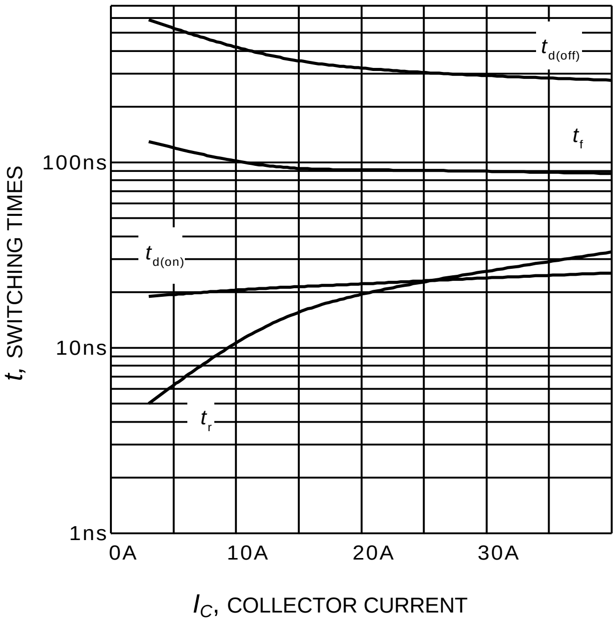



**Figure 9. Typical switching times as a function of collector current**
(inductive load, $T_J$=175°C, $V_{CE}$ = 400V, $V_{GE}$ = 0/15V, $R_G$ = 10Ω, Dynamic test circuit in Figure E)

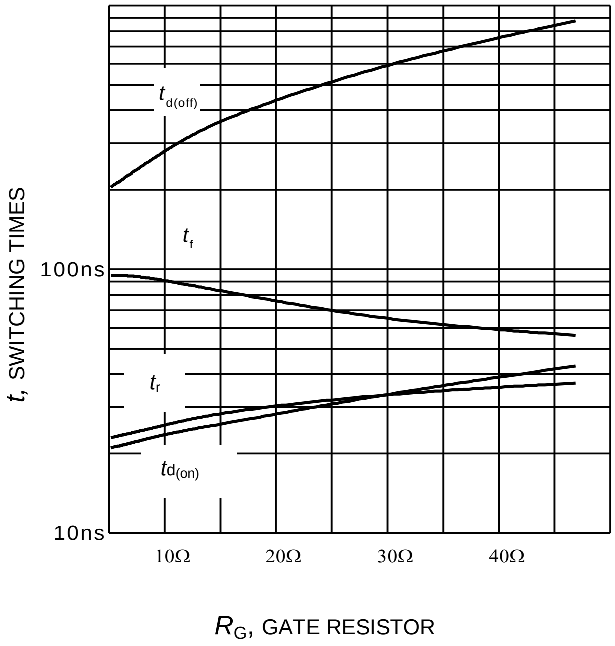



**Figure 10. Typical switching times as a function of gate resistor**
(inductive load, $T_J$ = 175°C, $V_{CE}$= 400V, $V_{GE}$ = 0/15V, $I_C$ = 30A, Dynamic test circuit in Figure E)

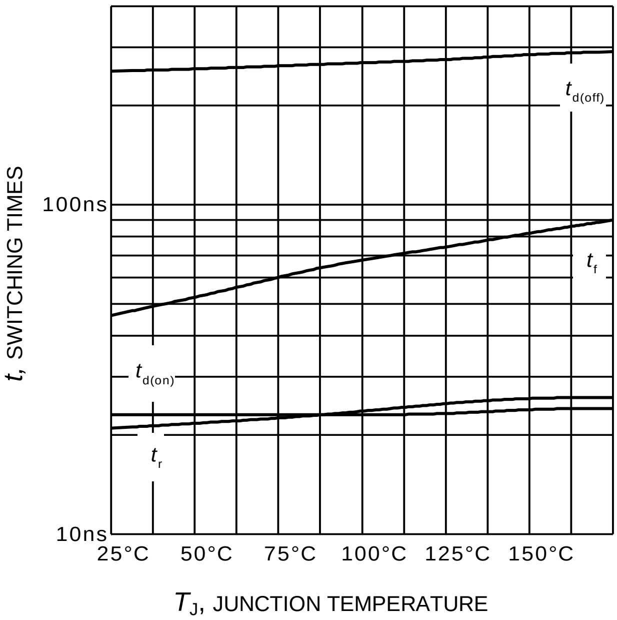



**Figure 11. Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$ = 400V, $V_{GE}$ = 0/15V, $I_C$ = 30A, $R_G$=10Ω, Dynamic test circuit in Figure E)

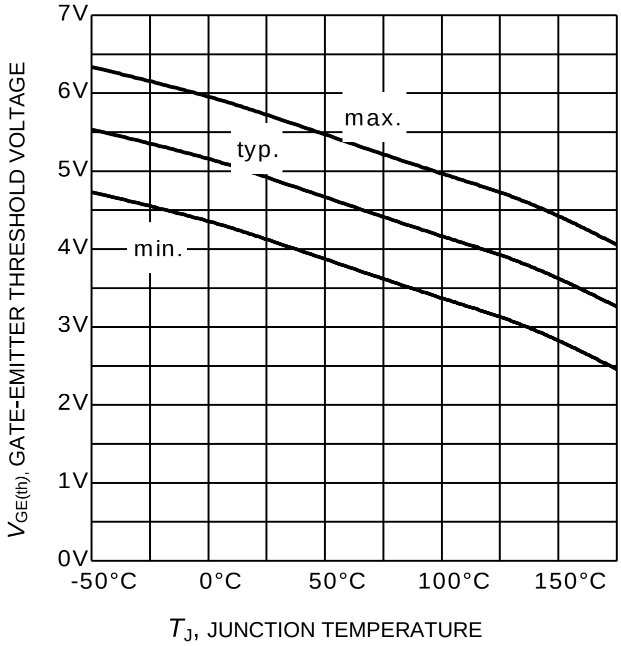



**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
($I_C$ = 0.43mA)

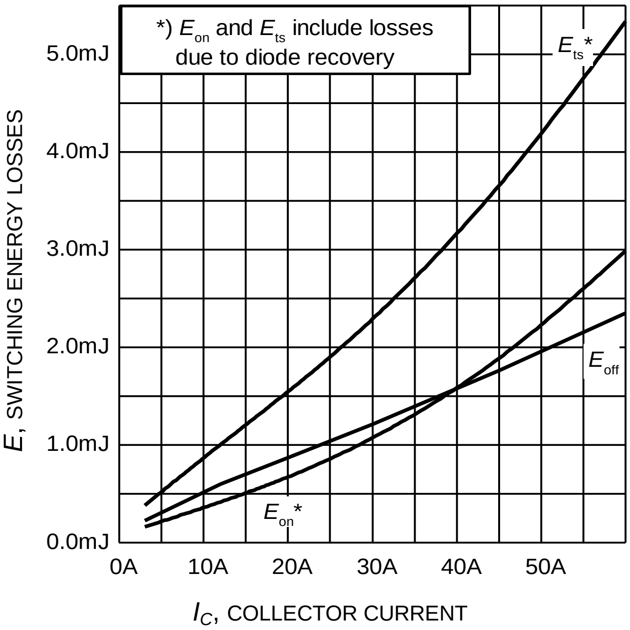



**Figure 13. Typical switching energy losses as a function of collector current**
(inductive load, $T_J$ = 175°C, $V_{CE}$ = 400V, $V_{GE}$ = 0/15V, $R_G$ = 10Ω, Dynamic test circuit in Figure E)

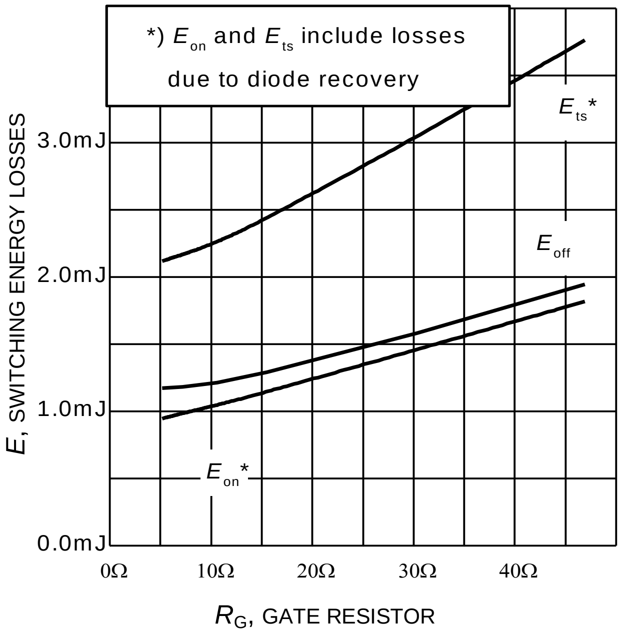



**Figure 14. Typical switching energy losses as a function of gate resistor**
(inductive load, $T_J$ = 175°C, $V_{CE}$ = 400V, $V_{GE}$ = 0/15V, $I_C$ = 30A, Dynamic test circuit in Figure E)

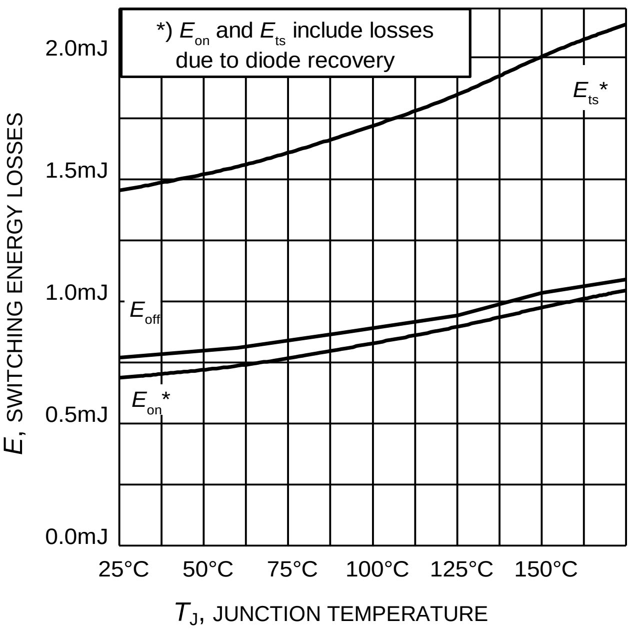



**Figure 15. Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}$ = 400V, $V_{GE}$ = 0/15V, $I_C$ = 30A, $R_G$ = 10Ω, Dynamic test circuit in Figure E)

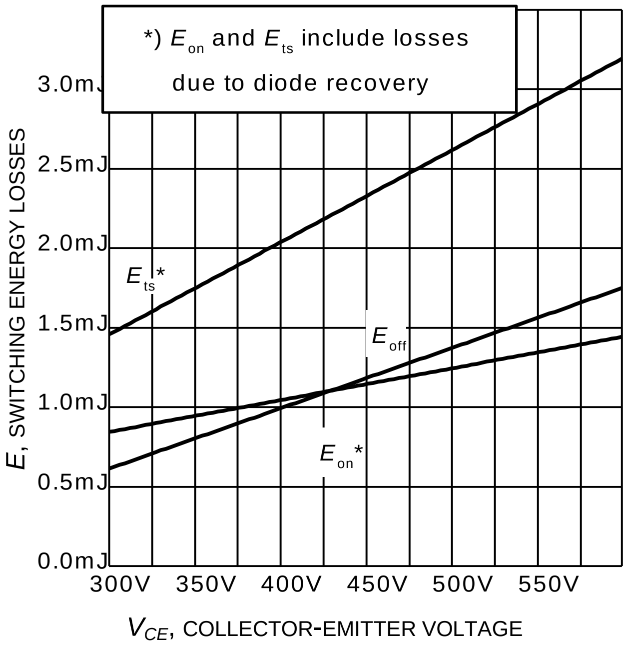



**Figure 16. Typical switching energy losses as a function of collector emitter voltage**
(inductive load, $T_J$ = 175°C, $V_{GE}$ = 0/15V, $I_C$ = 30A, $R_G$ = 10Ω, Dynamic test circuit in Figure E)

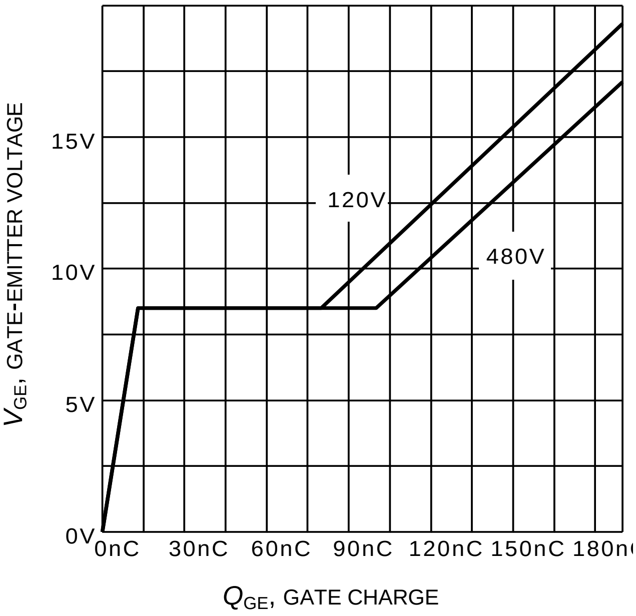



**Figure 17. Typical gate charge**
($I_C$=30 A)

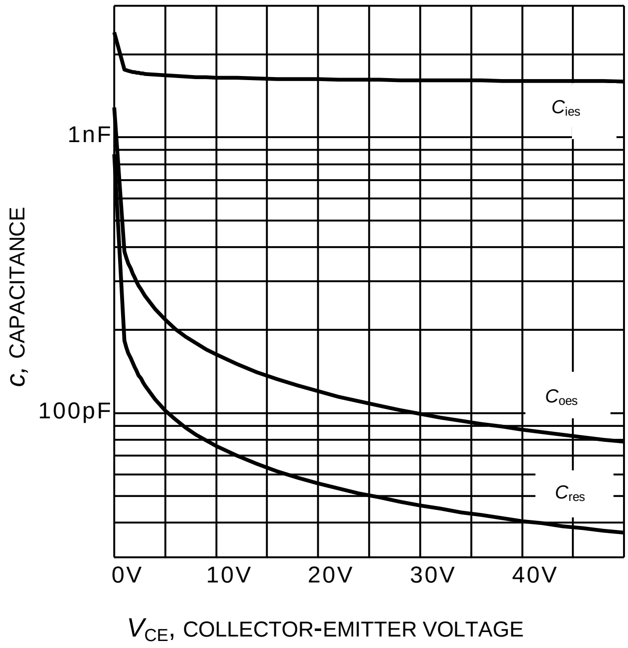



**Figure 18. Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, $f$ = 1 MHz)

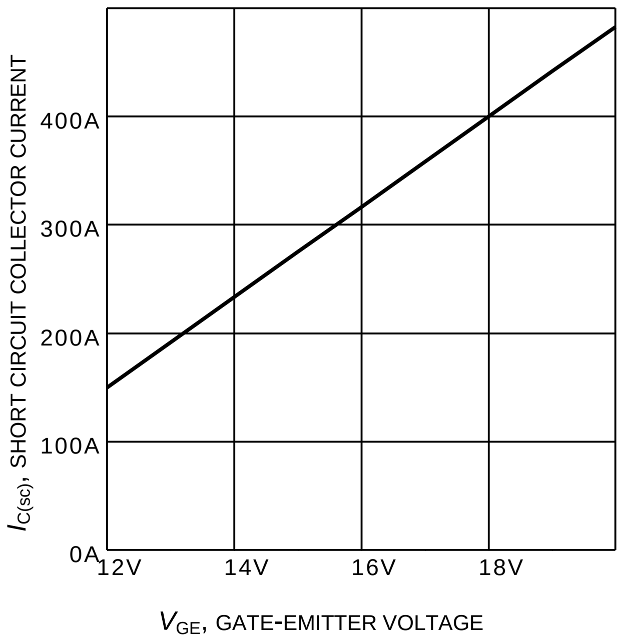



**Figure 19. Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE} \leq 400V$, $T_j \leq 150°C$)

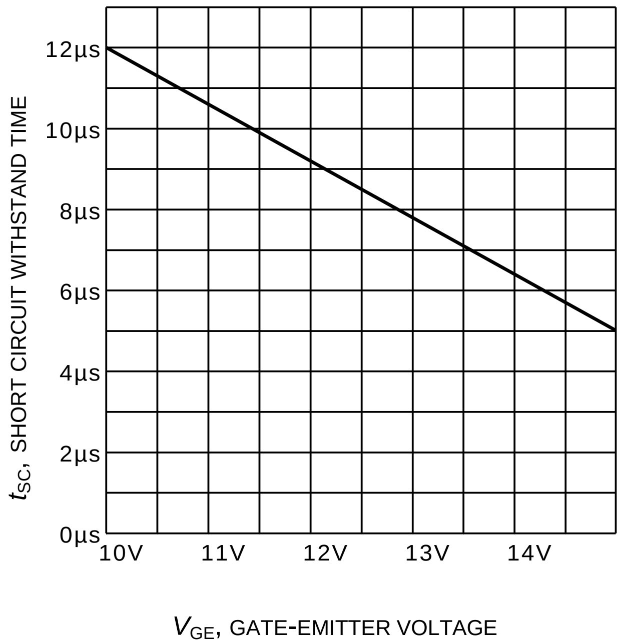



**Figure 20. Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$=400V, start at $T_J$=25°C, $T_{Jmax}$<150°C)

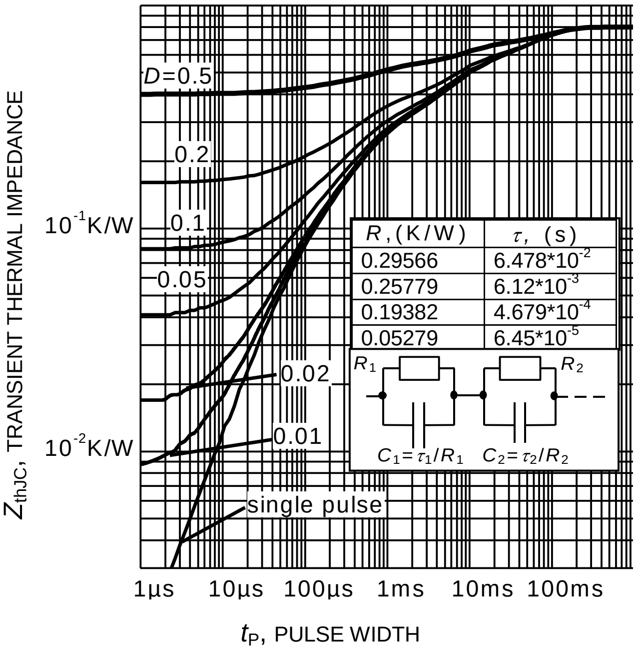



**Figure 21. IGBT transient thermal impedance**
($D = t_p$ / $T$)

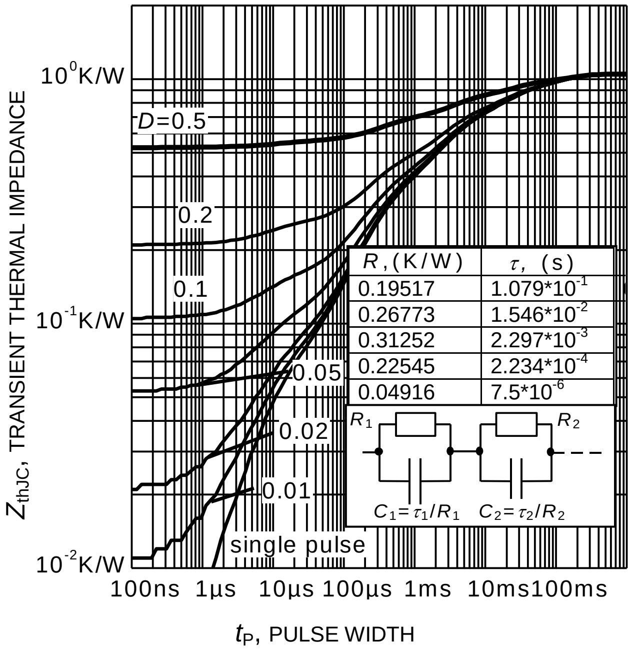



**Figure 22. Diode transient thermal impedance as a function of pulse width**
($D=t_P/T$)

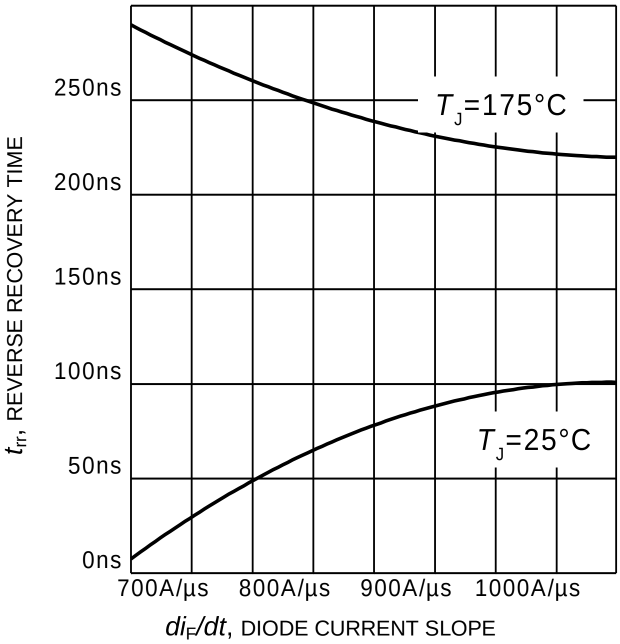



**Figure 23. Typical reverse recovery time as a function of diode current slope**
($V_R$=400V, $I_F$=30A,
Dynamic test circuit in Figure E)

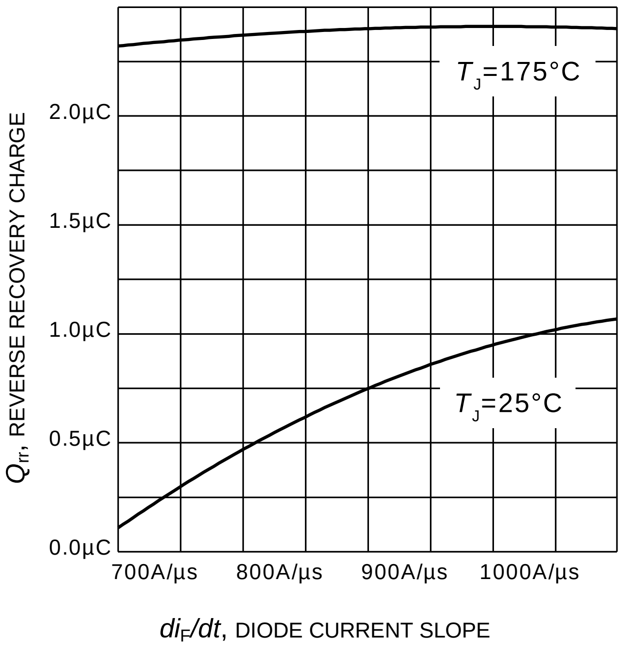



**Figure 24. Typical reverse recovery charge as a function of diode current slope**
($V_R$ = 400V, $I_F$ = 30A,
Dynamic test circuit in Figure E)

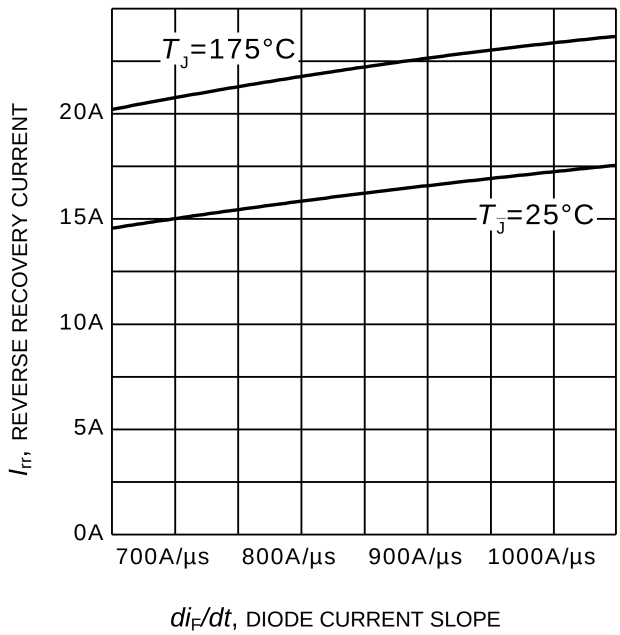



**Figure 25. Typical reverse recovery current as a function of diode current slope**
($V_R$ = 400V, $I_F$ = 30A,
Dynamic test circuit in Figure E)

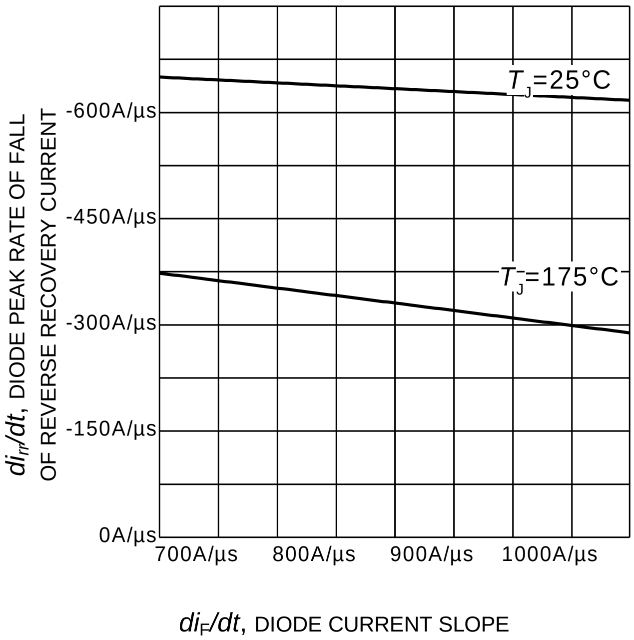



**Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R$=400V, $I_F$=30A,
Dynamic test circuit in Figure E)

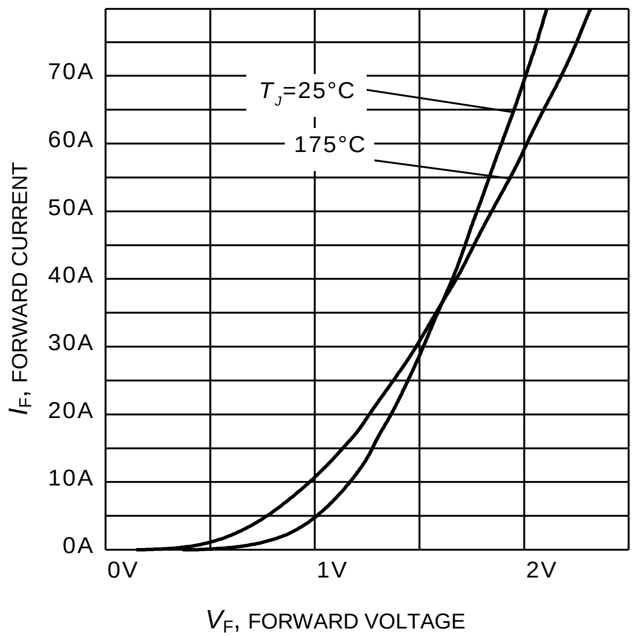



**Figure 27. Typical diode forward current as a function of forward voltage**

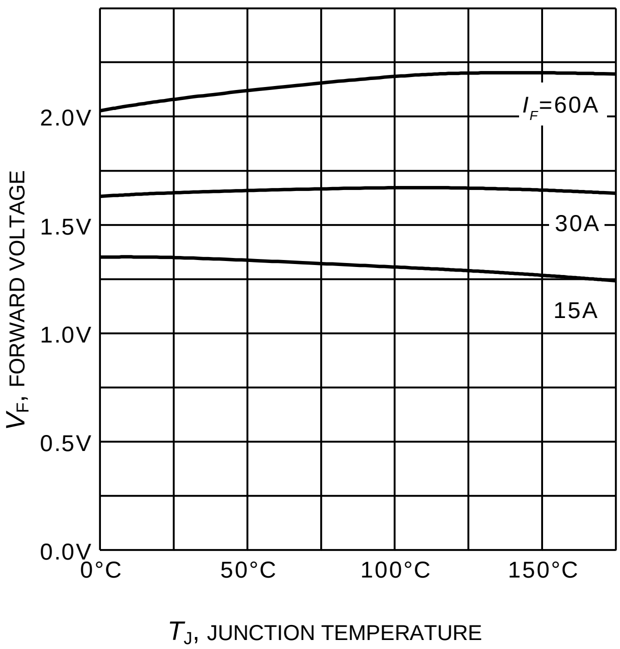
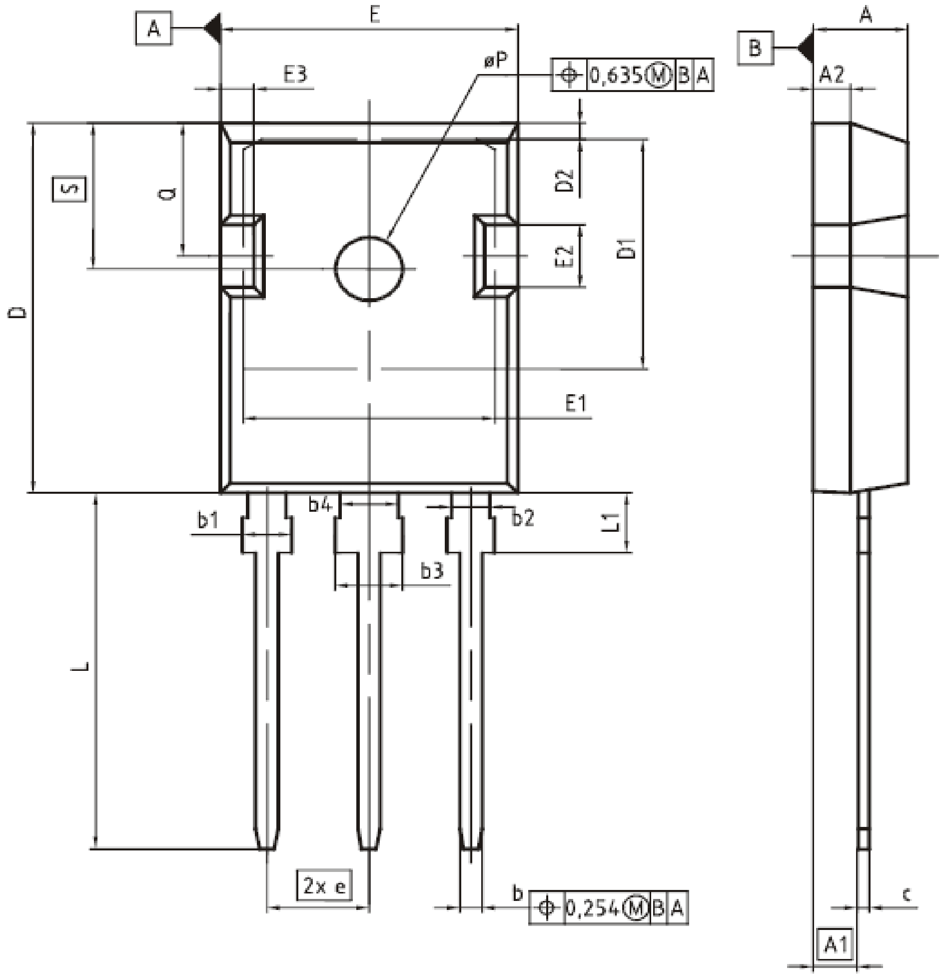



**Figure 28. Typical diode forward voltage as a function of junction temperature**

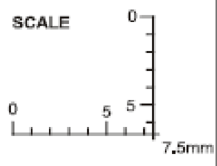
# PG-TO247-3



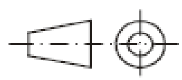

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| 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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**REVISION**
05

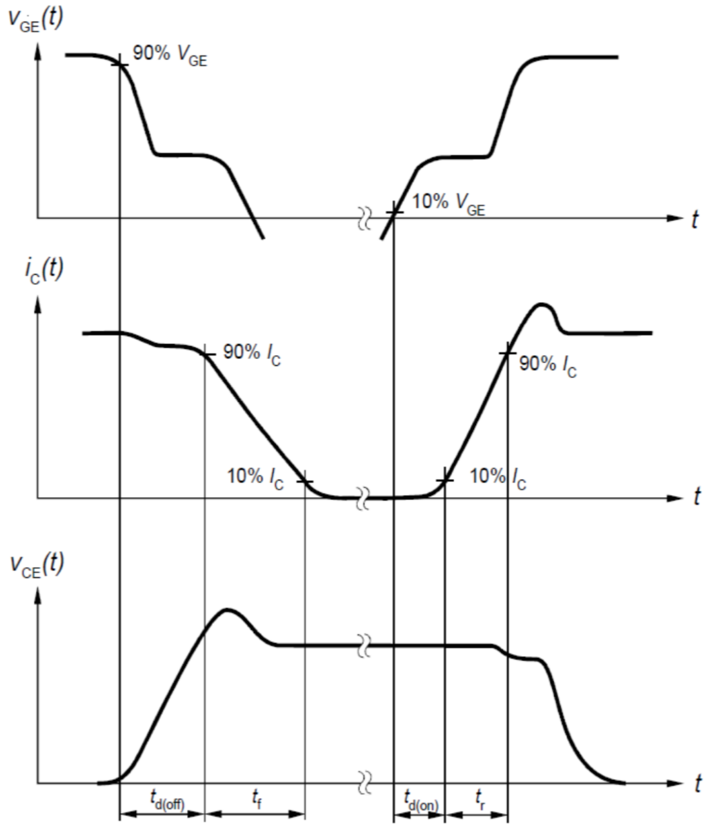


**Figure A. Definition of switching times**

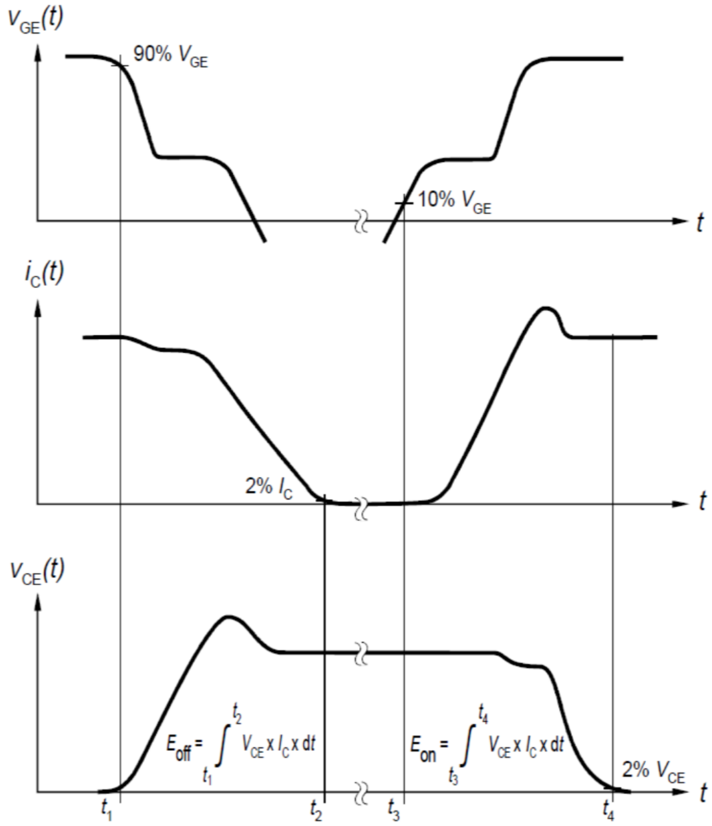


**Figure B. Definition of switching losses**

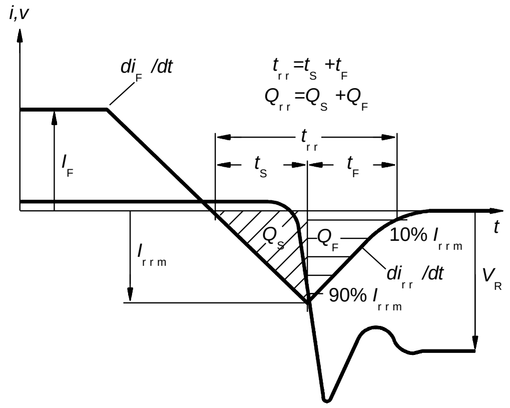


**Figure C. Definition of diodes switching characteristics**

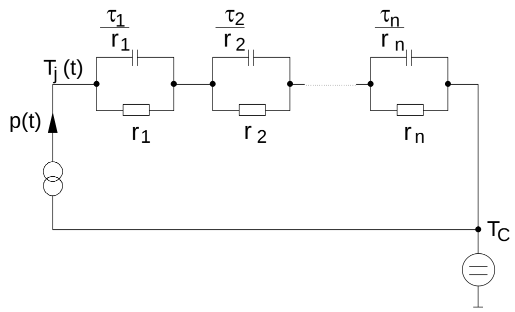


**Figure D. Thermal equivalent circuit**

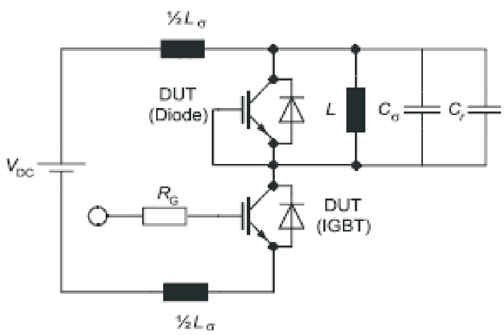


**Figure E. Dynamic test circuit**
Parasitic inductance $L_\sigma$,
Parasitic capacitor $C_\sigma$,
Relief capacitor $C_r$,
(only for ZVT switching)

**Revision History**

IKW30N60TA

**Revision: 2014-09-17, Rev. 2.3**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.1 | 2010-01-10 | Preliminary datasheet |
| 2.1 | 2010-04-09 | Release of final datasheet |
| 2.2 | 2013-08-27 | Update minor changes |
| 2.3 | | Update minor changes figures 24 and 26 |

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