# IGBT

High speed DuoPack: IGBT in Trench and Fieldstop technology
with soft, fast recovery anti-parallel diode

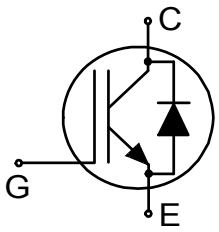
# IKW30N60H3

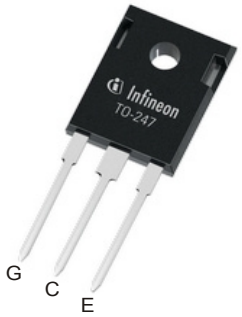
600V high speed switching series third generation

Data sheet

Industrial Power Control

# High speed DuoPack: IGBT in Trench and Fieldstop technology with soft, fast recovery anti-parallel diode




**Features:**

TRENCHSTOP™ technology offering
- very low $V_{CEsat}$
- low EMI
- Very soft, fast recovery anti-parallel diode
- maximum junction temperature 175°C
- qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- complete product spectrum and PSpice Models: http://www.infineon.com/igbt/

**Applications:**

- uninterruptible power supplies
- welding converters
- converters with high switching frequency

Pb-free
Green
Halogen-Free
RoHS

**Key Performance and Package Parameters**

| Type | $V_{CE}$ | $I_C$ | $V_{CEsat}$, $T_{vj}$=25°C | $T_{vjmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IKW30N60H3 | 600V | 30A | 1.95V | 175°C | K30H603 | PG-TO247-3 |

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## Maximum ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage, $T_{vj} \geq 25°C$ | $V_{CE}$ | 600 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25°C$<br>$T_C = 100°C$ | $I_C$ | <br>60.0<br>30.0 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpuls}$ | 120.0 | A |
| Turn off safe operating area<br>$V_{CE} \leq 600V$, $T_{vj} \leq 175°C$, $t_p = 1\mu s$ | - | 120.0 | A |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C = 25°C$<br>$T_C = 100°C$ | $I_F$ | <br>30.0<br>15.0 | A |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpuls}$ | 120.0 | A |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Short circuit withstand time<br>$V_{GE} = 15.0V$, $V_{CC} \leq 400V$<br>Allowed number of short circuits < 1000<br>Time between short circuits: ≥ 1.0s<br>$T_{vj} = 150°C$ | $t_{SC}$ | <br><br><br>5 | µs |
| Power dissipation $T_C = 25°C$<br>Power dissipation $T_C = 100°C$ | $P_{tot}$ | 187.0<br>94.0 | W |
| Operating junction temperature | $T_{vj}$ | -40...+175 | °C |
| Storage temperature | $T_{stg}$ | -55...+150 | °C |
| Soldering temperature,<br>wave soldering 1.6 mm (0.063 in.) from case for 10s | | 260 | °C |
| Mounting torque, M3 screw<br>Maximum of mounting processes: 3 | $M$ | 0.6 | Nm |

## Thermal Resistance

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---|---|---|---|
| **Characteristic** | | | | |
| IGBT thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | 0.80 | K/W |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | 1.90 | K/W |
| Thermal resistance<br>junction - ambient | $R_{th(j-a)}$ | | 40 | K/W |

**Electrical Characteristic, at $T_{vj}$ = 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, $I_C$ = 2.00mA | 600 | - | - | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = 15.0V, $I_C$ = 30.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C<br>$T_{vj}$ = 175°C | <br>-<br>-<br>- | <br>1.95<br>2.30<br>2.50 | <br>2.40<br>-<br>- | V |
| Diode forward voltage | $V_F$ | $V_{GE}$ = 0V, $I_F$ = 15.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C<br>$T_{vj}$ = 175°C | <br>-<br>-<br>- | <br>1.65<br>1.67<br>1.65 | <br>2.05<br>-<br>- | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.43mA, $V_{CE}$ = $V_{GE}$ | 4.1 | 5.1 | 5.7 | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$ = 600V, $V_{GE}$ = 0V<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | <br>-<br>- | <br>-<br>- | <br>40.0<br>2000.0 | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = 20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$ = 20V, $I_C$ = 30.0A | - | 16.0 | - | S |

**Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | - | 1630 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 107 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 50 | - | |
| Gate charge | $Q_G$ | $V_{CC}$ = 480V, $I_C$ = 30.0A,<br>$V_{GE}$ = 15V | - | 165.0 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | | - | 13.0 | - | nH |
| Short circuit collector current<br>Max. 1000 short circuits<br>Time between short circuits: ≥ 1.0s | $I_{C(SC)}$ | $V_{GE}$ = 15.0V, $V_{CC}$ ≤ 400V,<br>$t_{SC}$ ≤ 5µs<br>$T_{vj}$ = 150°C | - | <br><br>160 | - | A |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 25°C** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$ = 25°C, $V_{CC}$ = 400V, $I_C$ = 30.0A, $V_{GE}$ = 0.0/15.0V, $r_G$ = 10.5Ω, $L\sigma$ = 95nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery. | - | 21 | - | ns |
| Rise time | $t_r$ | | - | 33 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 207 | - | ns |
| Fall time | $t_f$ | | - | 22 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 0.94 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.44 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 1.38 | - | mJ |
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$ = 25°C, $V_R$ = 400V, $I_F$ = 15.0A, $di_F/dt$ = 1000A/µs | - | 38 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 0.32 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 12.0 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -765 | - | A/µs |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 175°C** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj}$ = 175°C, $V_{CC}$ = 400V, $I_C$ = 30.0A, $V_{GE}$ = 0.0/15.0V, $r_G$ = 10.5Ω, $L\sigma$ = 95nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery. | - | 20 | - | ns |
| Rise time | $t_r$ | | - | 30 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 239 | - | ns |
| Fall time | $t_f$ | | - | 23 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 1.12 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.60 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 1.72 | - | mJ |
| Diode reverse recovery time | $t_{rr}$ | $T_{vj}$ = 175°C, $V_R$ = 400V, $I_F$ = 15.0A, $di_F/dt$ = 1000A/µs | - | 117 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.08 | - | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 16.6 | - | A |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ | | - | -530 | - | A/µs |

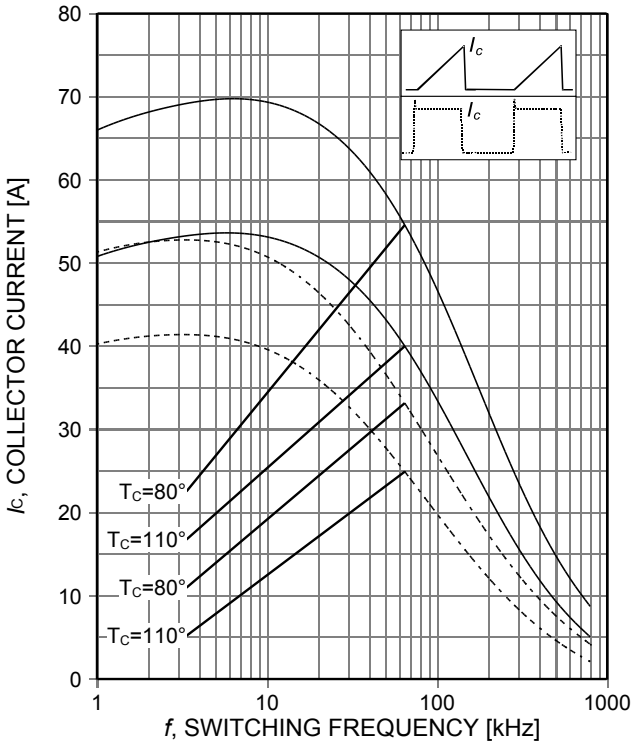



Figure 1. **Collector current as a function of switching frequency**
($T_j$≤175°C, $D$=0.5, $V_{CE}$=400V, $V_{GE}$=15/0V, $r_G$=10,5Ω)

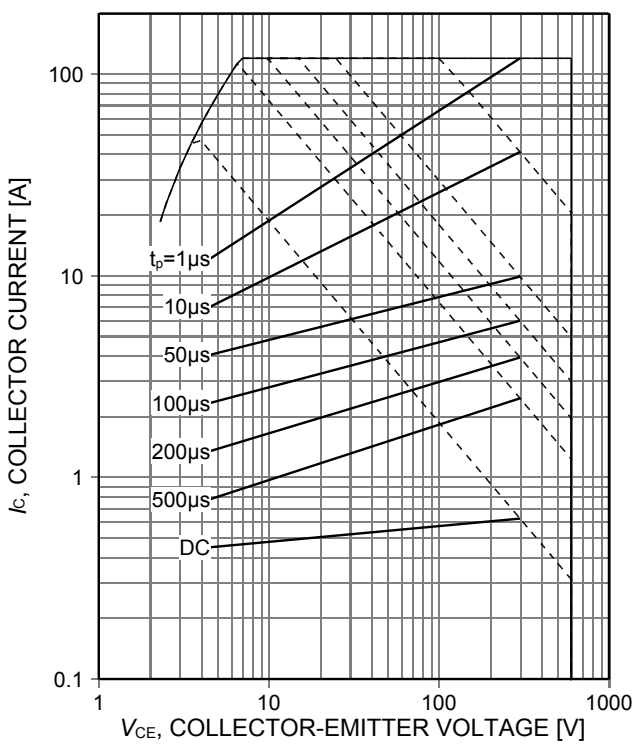



Figure 2. **Forward bias safe operating area**
($D$=0, $T_C$=25°C, $T_j$≤175°C; $V_{GE}$=15V)

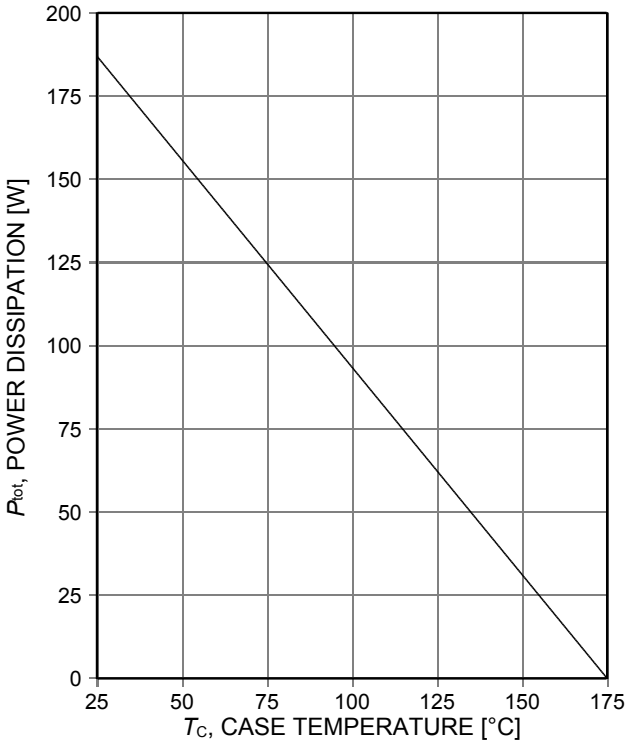



Figure 3. **Power dissipation as a function of case temperature**
($T_j$≤175°C)

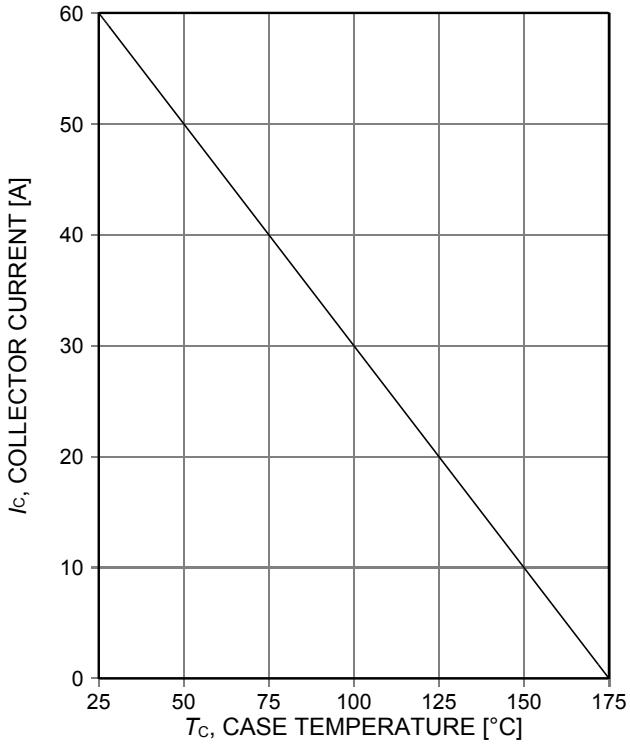



Figure 4. **Collector current as a function of case temperature**
($V_{GE}$≥15V, $T_j$≤175°C)

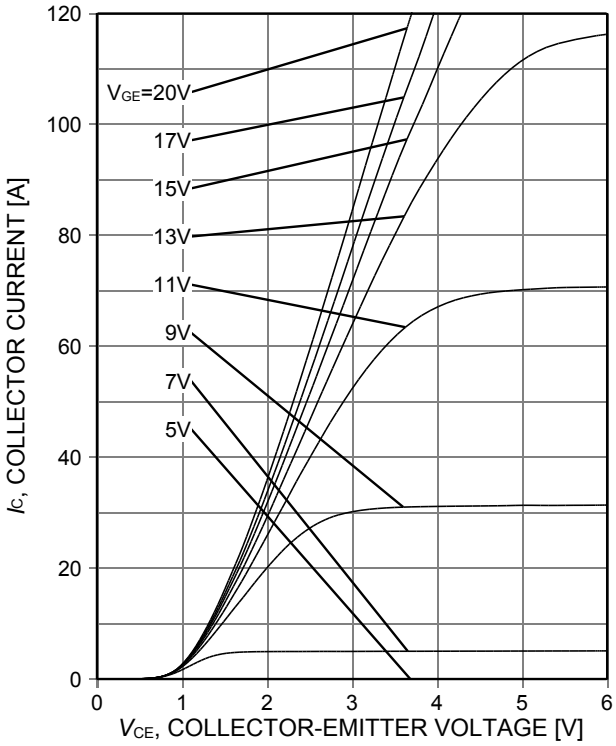



Figure 5. **Typical output characteristic**
($T_j$=25°C)

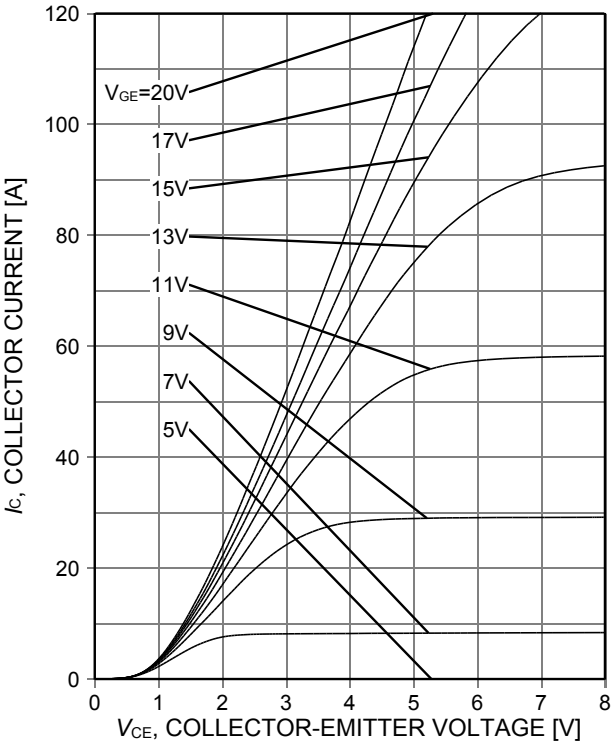



Figure 6. **Typical output characteristic**
($T_j$=175°C)

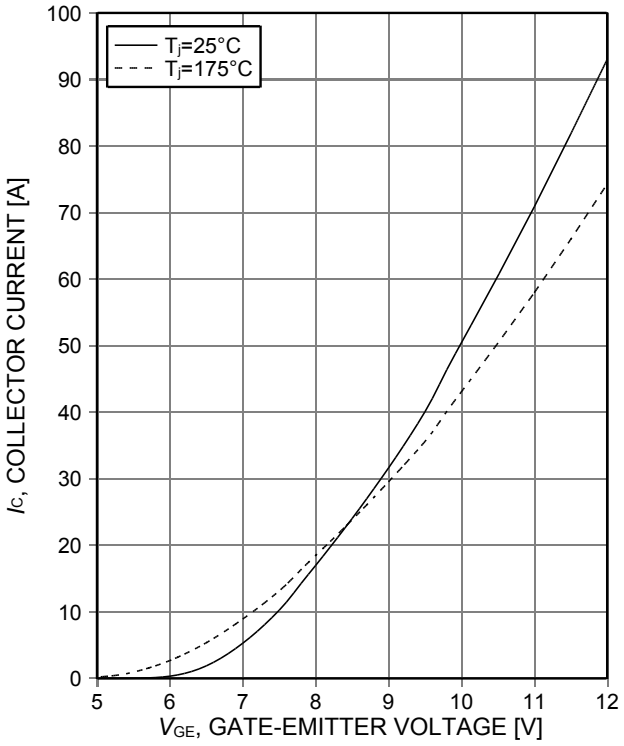



Figure 7. **Typical transfer characteristic**
($V_{CE}$=20V)

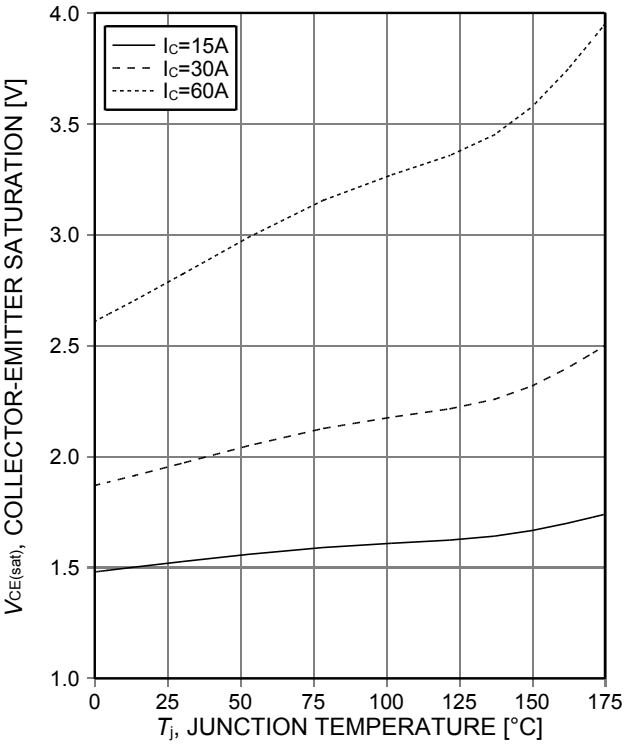



Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$=15V)

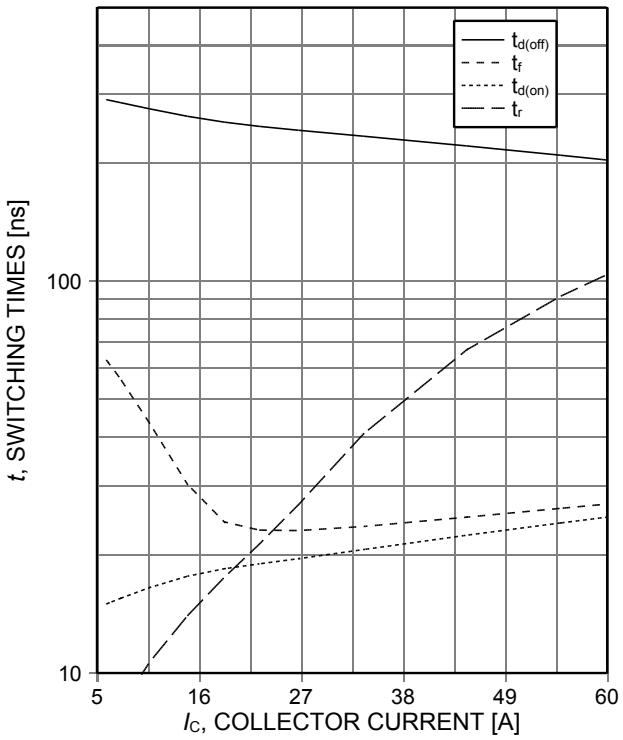



Figure 9. **Typical switching times as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=400V, $V_{GE}$=15/0V, $r_G$=10,5Ω, test circuit in Fig. E)

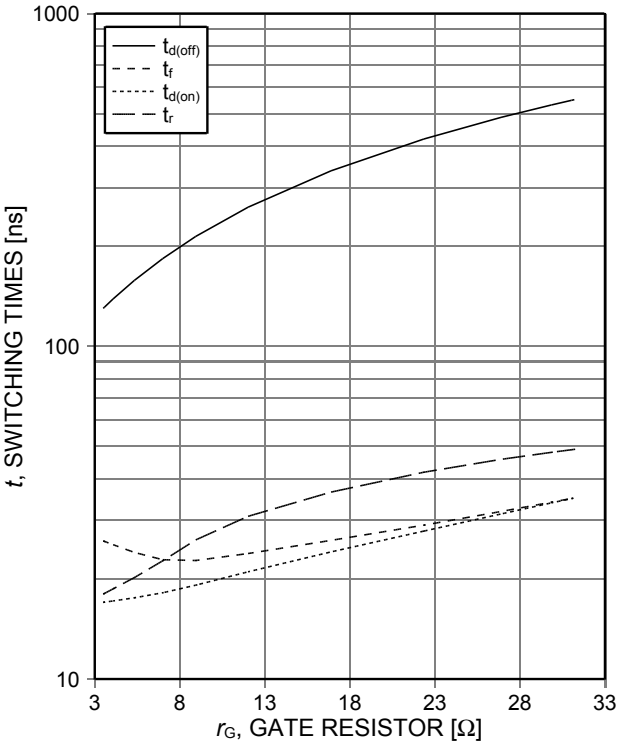



Figure 10. **Typical switching times as a function of gate resistor**
(ind. load, $T_j$=175°C, $V_{CE}$=400V, $V_{GE}$=15/0V, $I_C$=30A, test circuit in Fig. E)

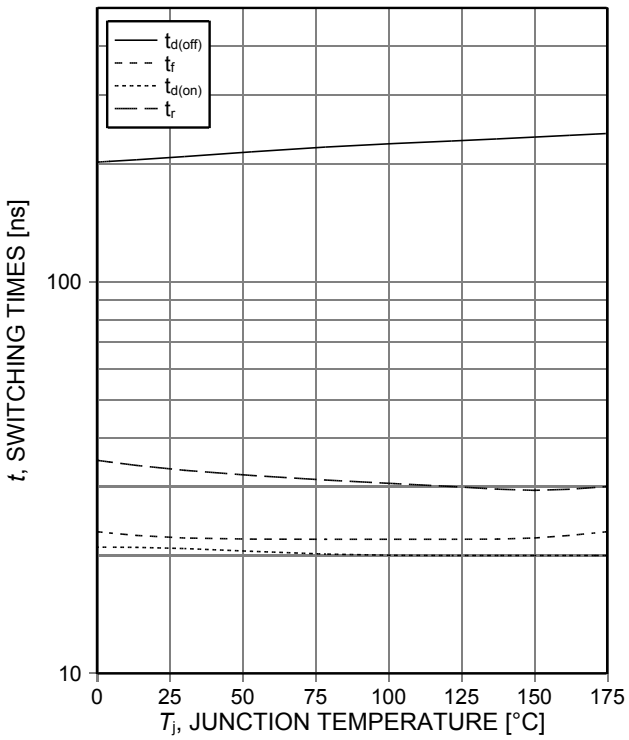



Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}$=400V, $V_{GE}$=15/0V, $I_C$=30A, $r_G$=10,5Ω, test circuit in Fig. E)

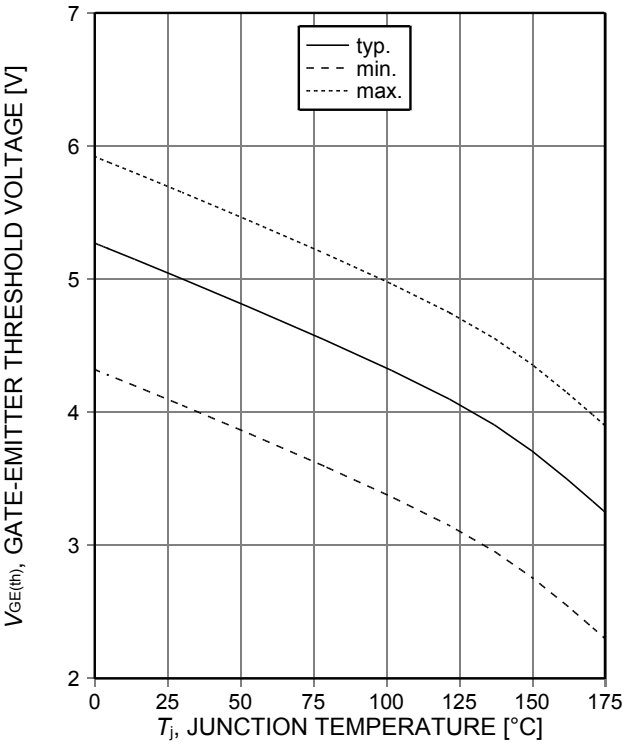



Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C$=0.43mA)

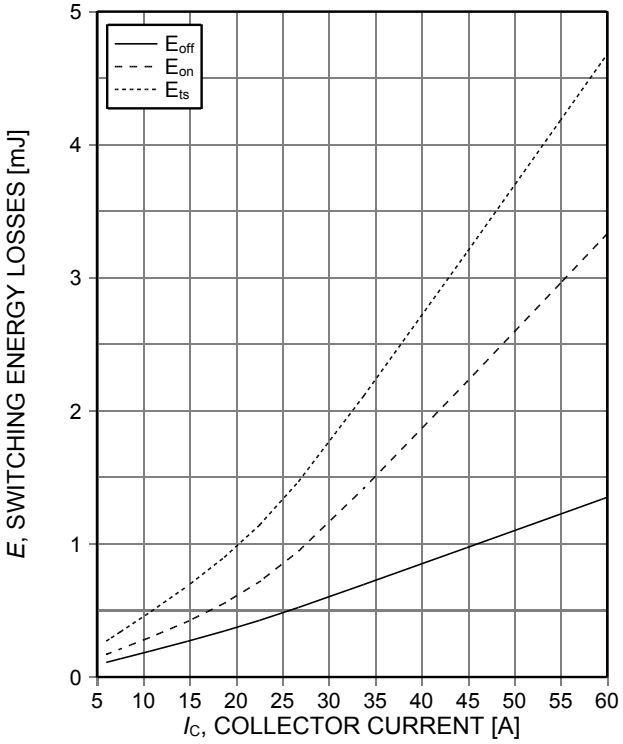



Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=400V, $V_{GE}$=15/0V, $r_G$=10,5Ω, test circuit in Fig. E)

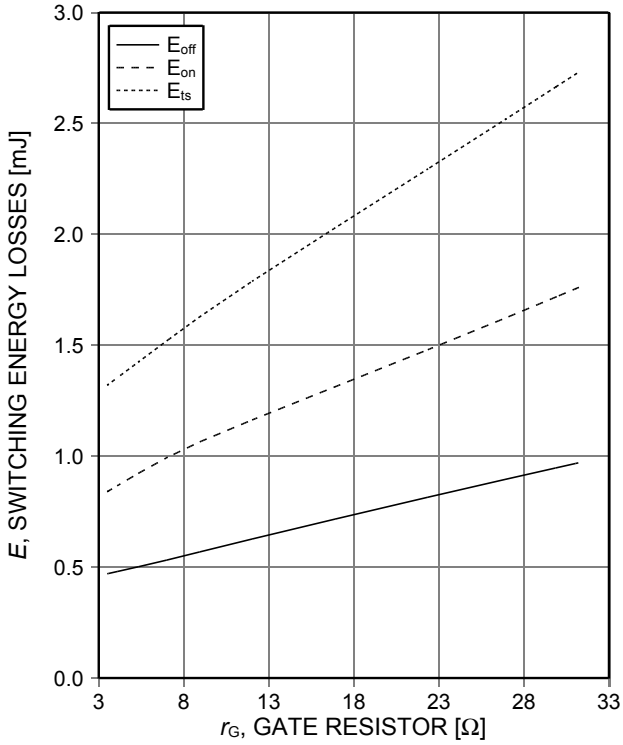



Figure 14. **Typical switching energy losses as a function of gate resistor**
(ind. load, $T_j$=175°C, $V_{CE}$=400V, $V_{GE}$=15/0V, $I_C$=30A, test circuit in Fig. E)

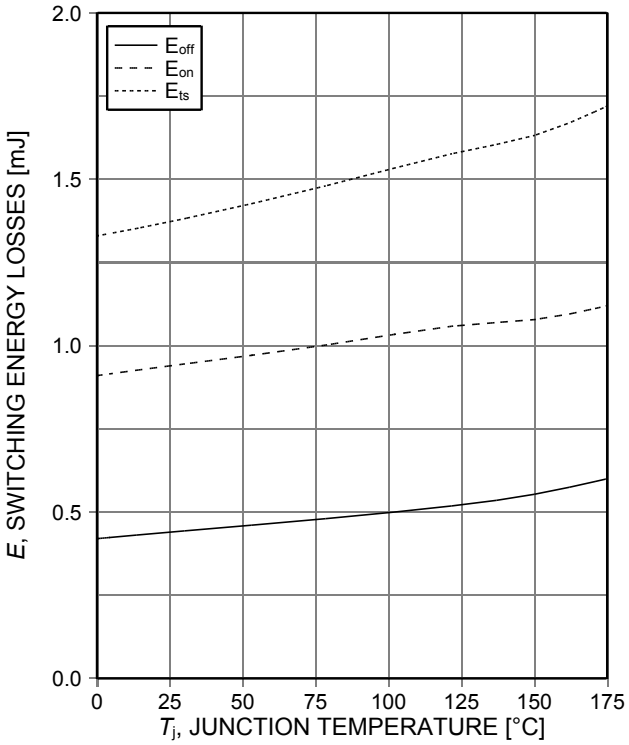



Figure 15. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}$=400V, $V_{GE}$=15/0V, $I_C$=30A, $r_G$=10,5Ω, test circuit in Fig. E)

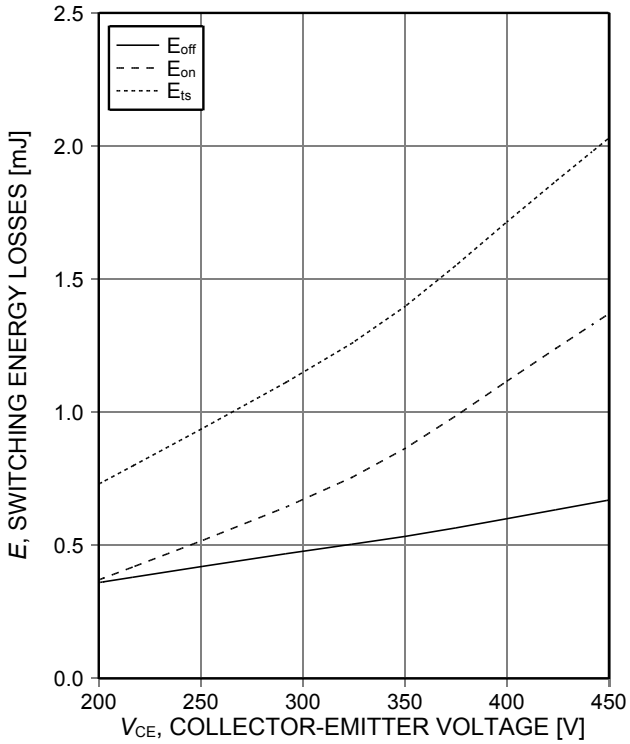



Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j$=175°C, $V_{GE}$=15/0V, $I_C$=30A, $r_G$=10,5Ω, test circuit in Fig. E)

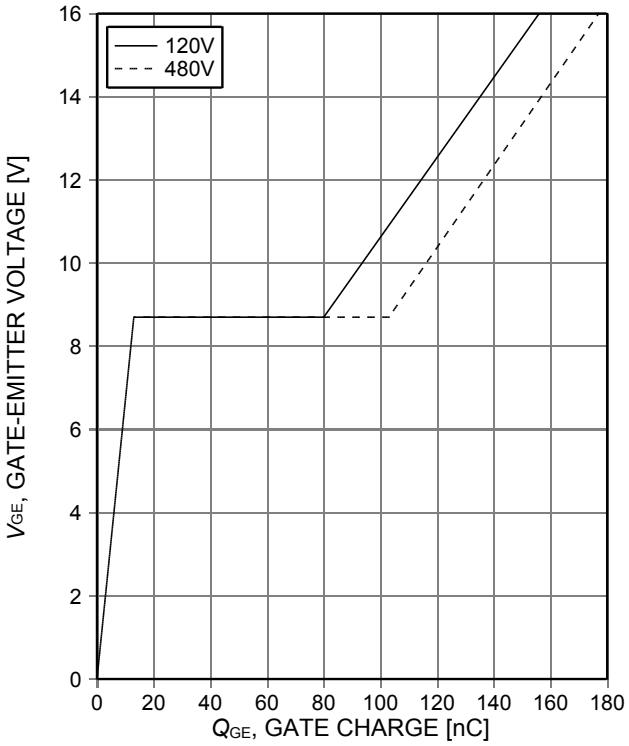



Figure 17. **Typical gate charge**
($I_C$=30A)

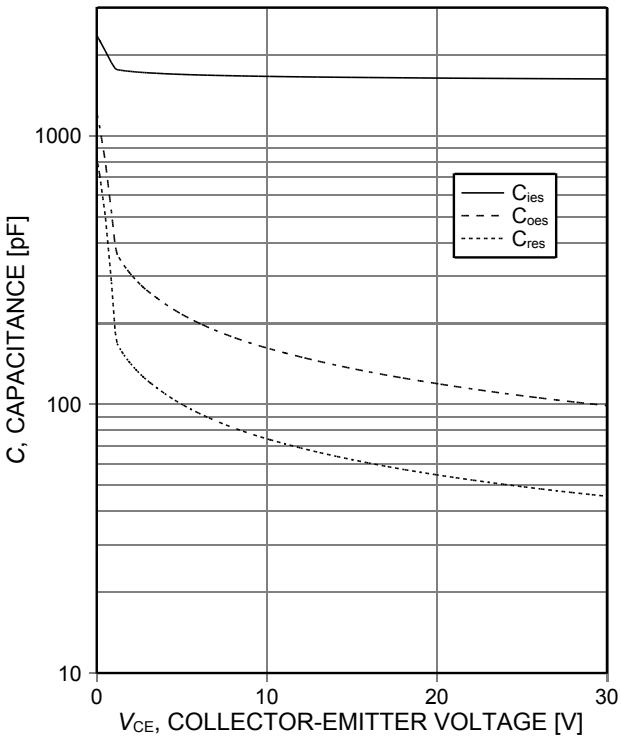



Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

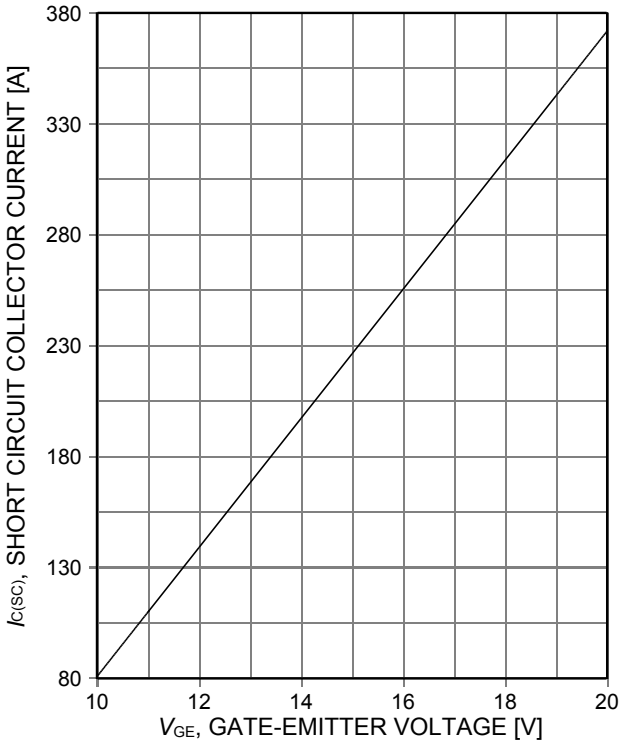



Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}$≤400V, start at$T_j$=25°C)

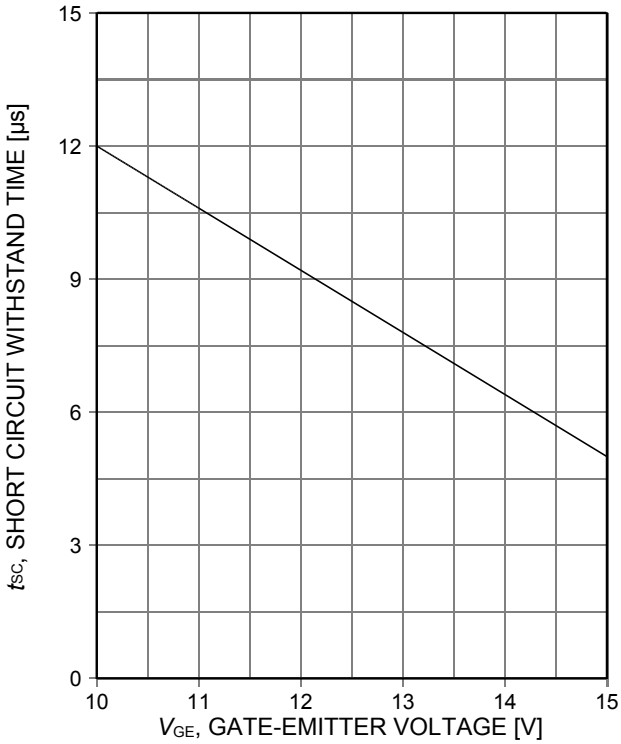



Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$≤400V, start at $T_j$≤150°C)

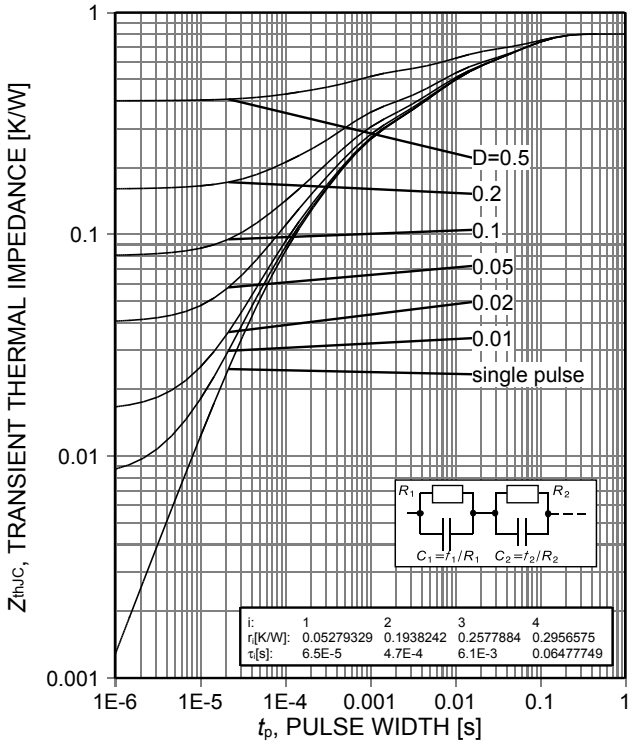



Figure 21. **IGBT transient thermal impedance** ($D=t_p/T$)

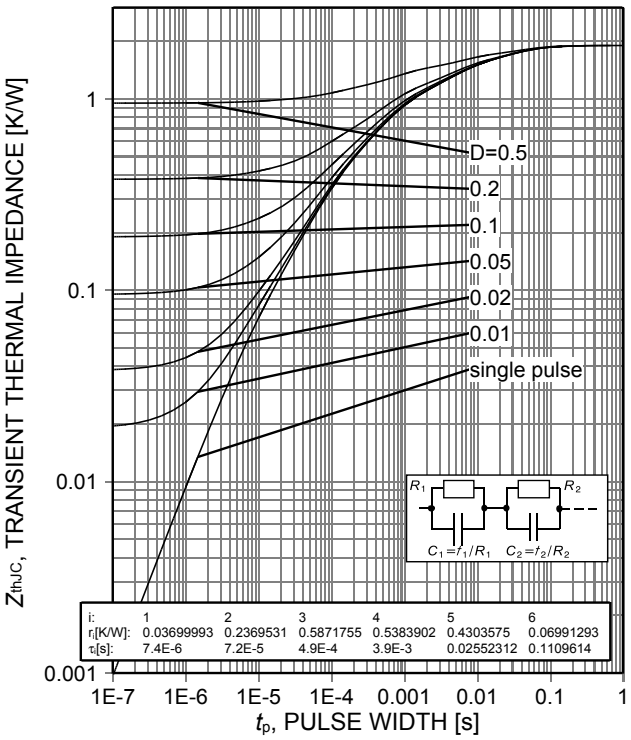



Figure 22. **Diode transient thermal impedance as a function of pulse width** ($D=t_p/T$)

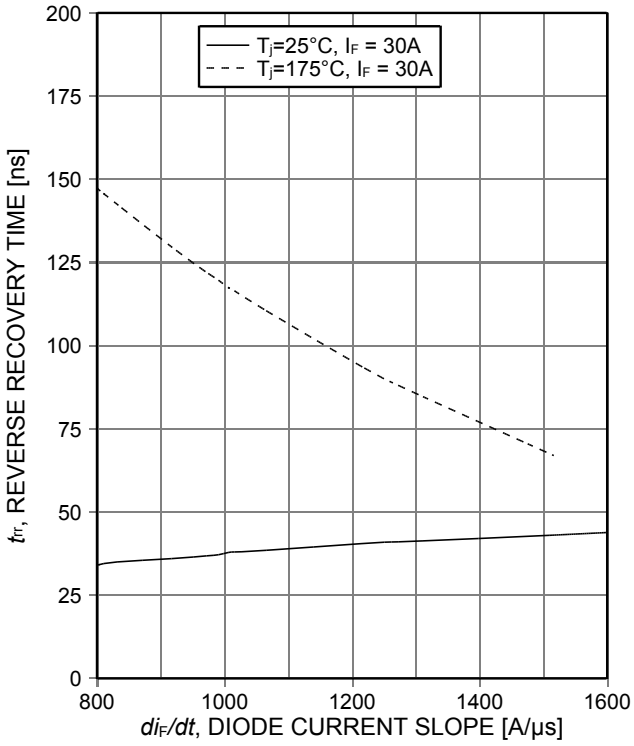



Figure 23. **Typical reverse recovery time as a function of diode current slope** ($V_R$=400V)

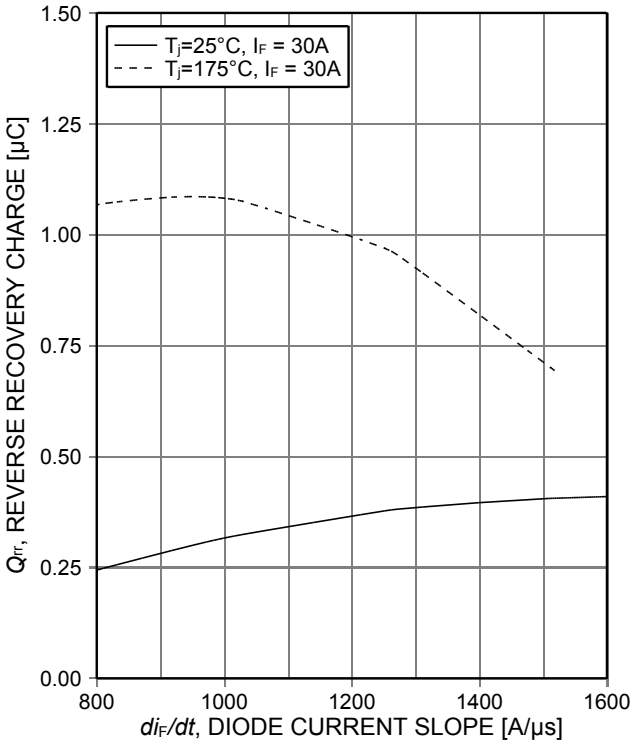



Figure 24. **Typical reverse recovery charge as a function of diode current slope** ($V_R$=400V)

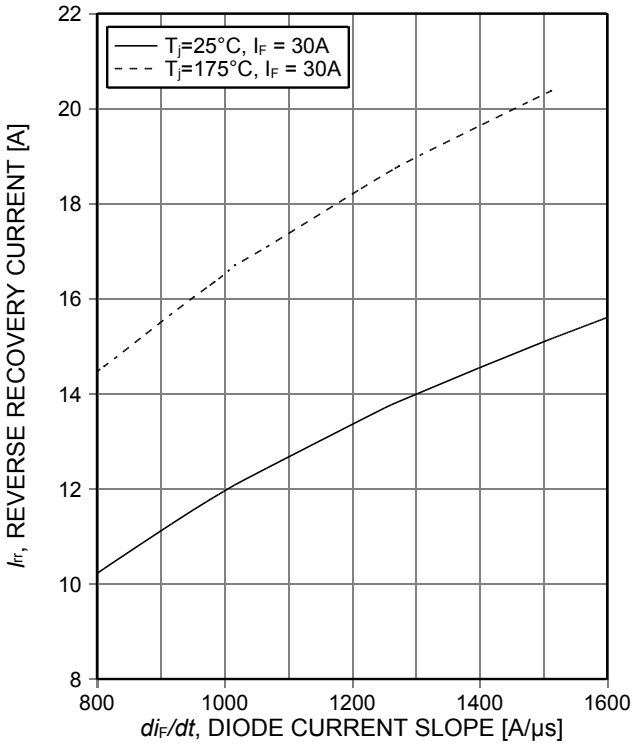



Figure 25. **Typical reverse recovery current as a function of diode current slope**
($V_R$=400V)

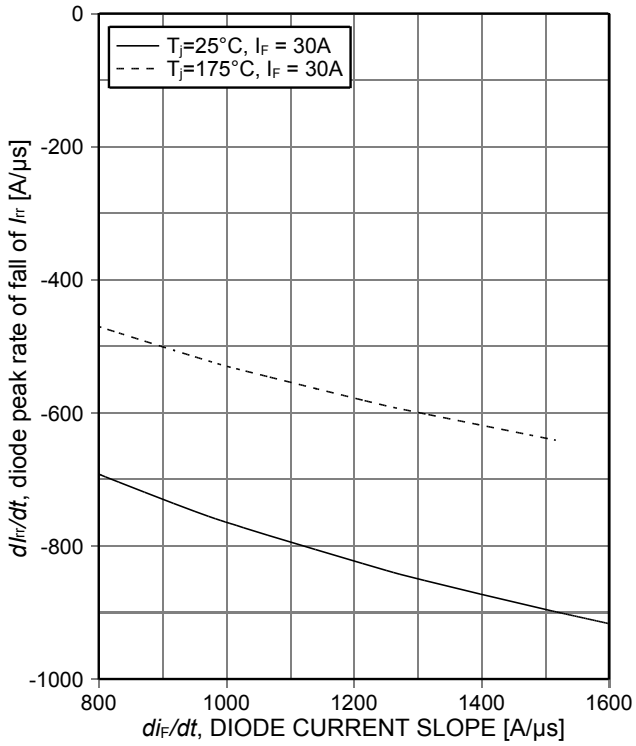



Figure 26. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R$=400V)

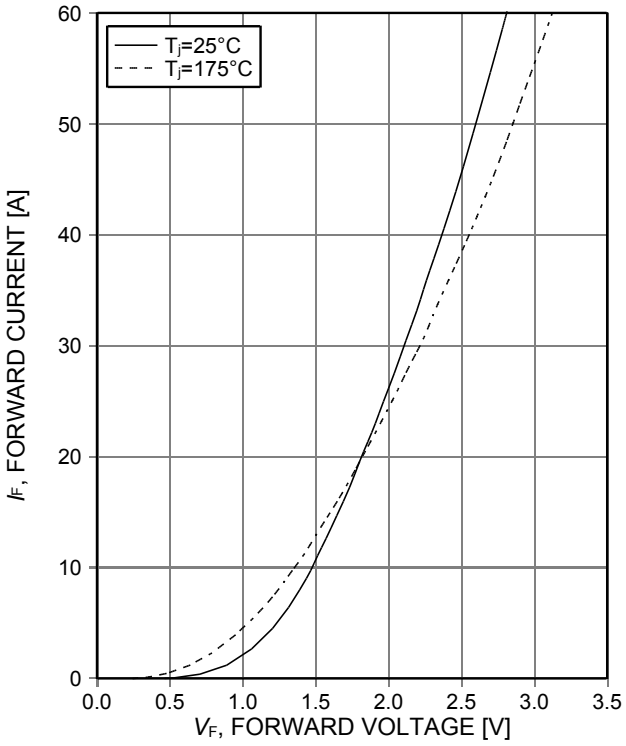



Figure 27. **Typical diode forward current as a function of forward voltage**

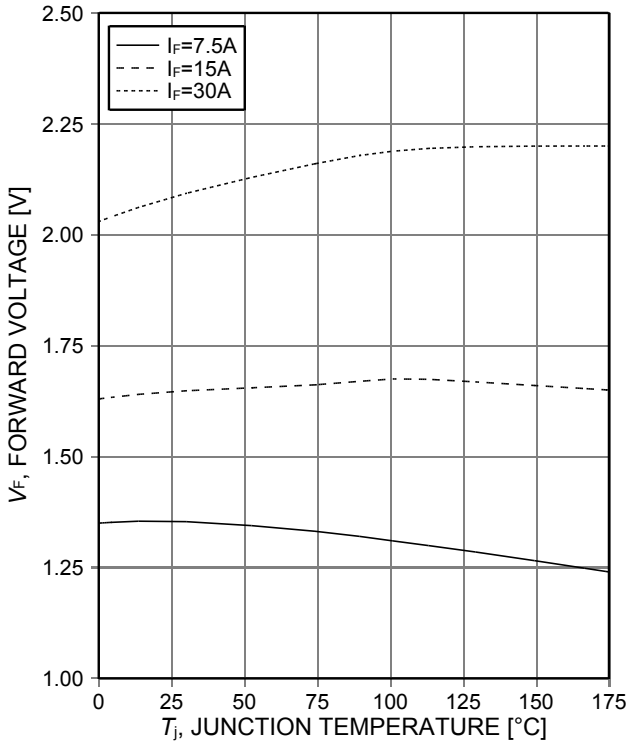
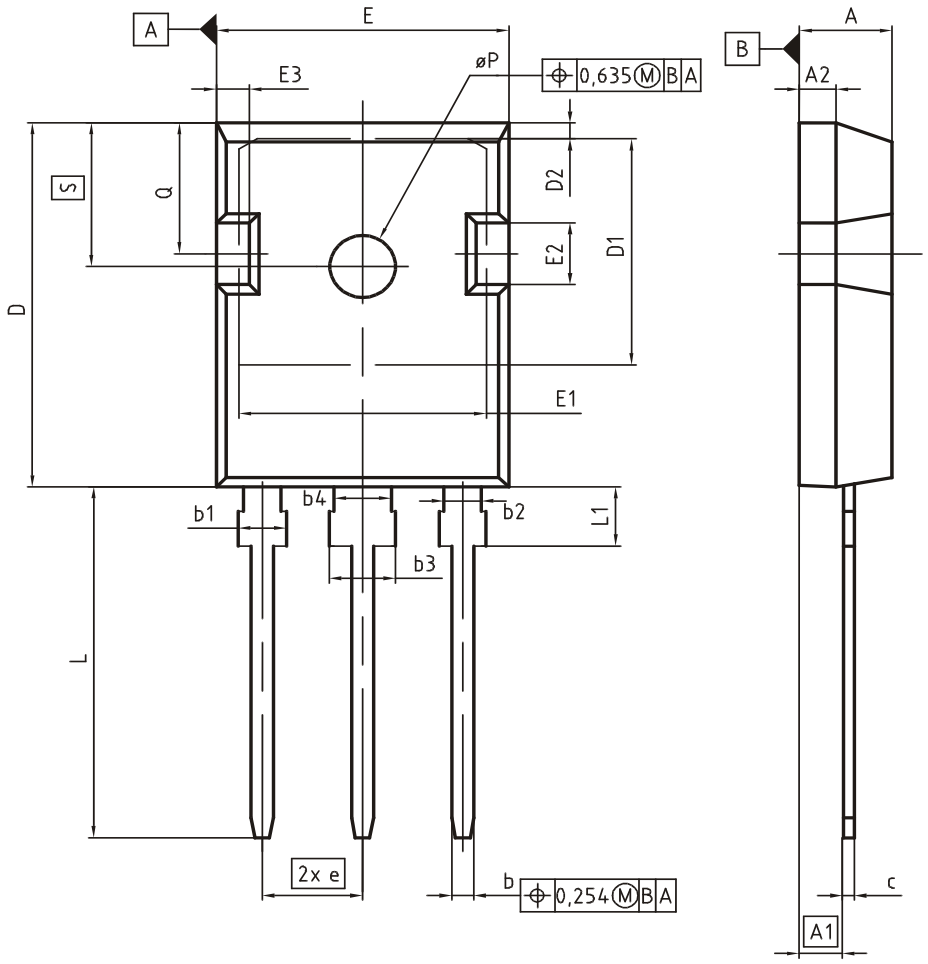



Figure 28. **Typical diode forward voltage as a function of junction temperature**

# PG-TO247-3

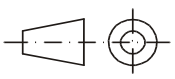



| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| 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**
0 5 5 7.5mm

**EUROPEAN PROJECTION**



**ISSUE DATE**
09-07-2010

**REVISION**
05

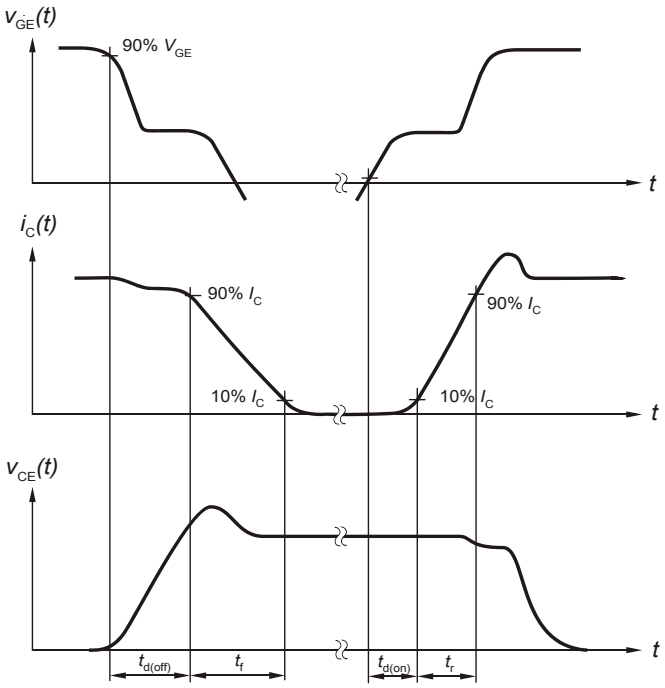



**Figure A. Definition of switching times**

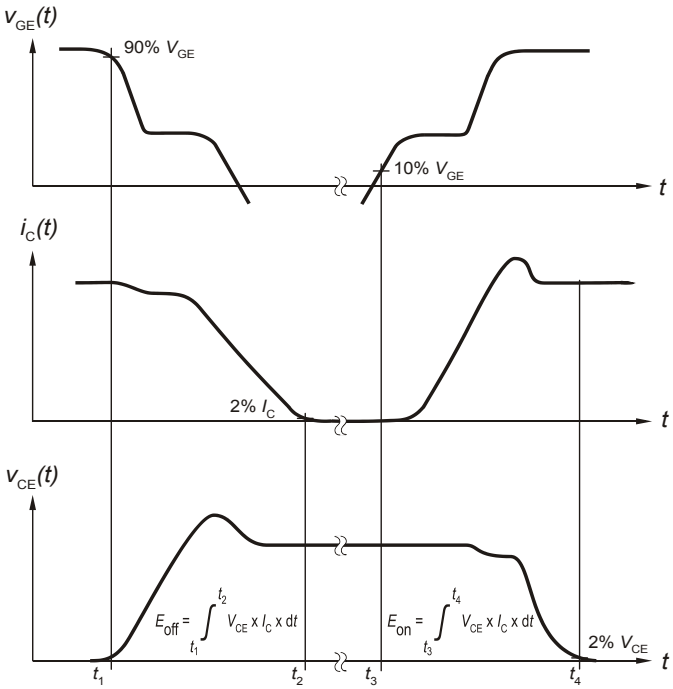



**Figure B. Definition of switching losses**

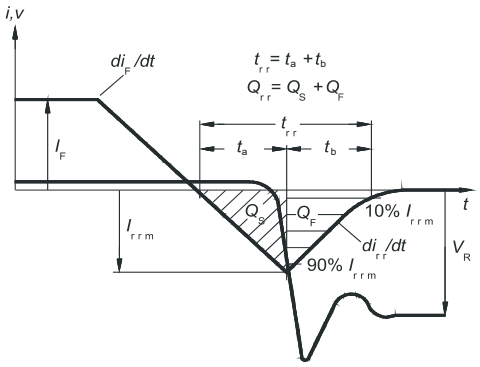



**Figure C. Definition of diodes switching characteristics**

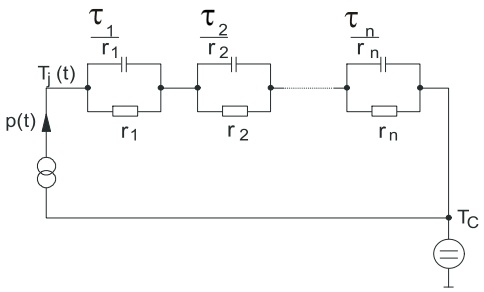



**Figure D. Thermal equivalent circuit**

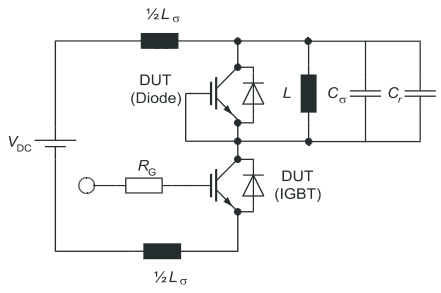



**Figure E. Dynamic test circuit**
Parasitic inductance $L_\sigma$,
Parasitic capacitor $C_\sigma$,
Relief capacitor $C_r$
(only for ZVT switching)

## Revision History

IKW30N60H3

**Revision: 2014-03-12, Rev. 2.2**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.1 | 2010-02-01 | - |
| 1.2 | 2010-07-26 | Preliminary datasheet |
| 2.1 | 2013-12-09 | New value IRmax limit at 175°C |
| 2.2 | 2014-03-12 | Max ratings Vce, Tvj ≥ 25°C |

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