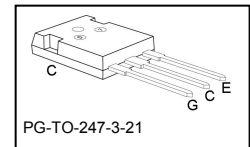
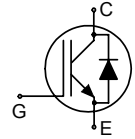


Low Loss DuoPack : IGBT in TrenchStop® -technology with anti-parallel diode

Features:

- Very low $V_{CE(sat)}$ 1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time – 5µs
- TrenchStop® and Fieldstop technology for 600 V applications offers :
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
 - low $V_{CE(sat)}$
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Qualified according to JEDEC¹ for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Applications:

- Inductive Cooking
- Soft Switching Applications

| Type | V_{CE} | I_C | $V_{CE(sat), T_j=25^\circ C}$ | $T_{j,max}$ | Marking | Package |
|-----------|----------|-------|-------------------------------|-------------|---------|----------------|
| IHW40N60T | 600V | 40A | 1.55V | 175°C | H40T60 | PG-TO-247-3-21 |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|--------------|------------|------|
| Collector-emitter voltage | V_{CE} | 600 | V |
| DC collector current, limited by $T_{j,max}$ | I_C | | A |
| $T_C = 25^\circ C$ | | 80 | |
| $T_C = 100^\circ C$ | | 40 | |
| Pulsed collector current, t_p limited by $T_{j,max}$ | $I_{C,puls}$ | 120 | |
| Turn off safe operating area ($V_{CE} \leq 600V, T_j \leq 175^\circ C$) | - | 120 | |
| Diode forward current, limited by $T_{j,max}$ | I_F | | |
| $T_C = 25^\circ C$ | | 40 | |
| $T_C = 100^\circ C$ | | 20 | |
| Diode pulsed current, t_p limited by $T_{j,max}$ | $I_{F,puls}$ | 60 | |
| Gate-emitter voltage | V_{GE} | ± 20 | V |
| Transient Gate-emitter voltage ($t_p < 5$ ms) | | ± 25 | |
| Short circuit withstand time ²⁾ | t_{SC} | 5 | µs |
| $V_{GE} = 15V, V_{CC} \leq 400V, T_j \leq 150^\circ C$ | | | |
| Power dissipation $T_C = 25^\circ C$ | P_{tot} | 303 | W |
| Operating junction temperature | T_j | -40...+175 | °C |
| Storage temperature | T_{stg} | -55...+175 | |
| Soldering temperature, 1.6mm (0.063 in.) from case for 10s | - | 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} | | 0.49 | K/W |
| Diode thermal resistance, junction – case | R_{thJCD} | | 0.76 | |
| Thermal resistance, 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 | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=0.5mA$ | 600 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE} = 15V, I_C=40A$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$ | - | 1.55 | 2.05 | |
| Diode forward voltage | V_F | $V_{GE}=0V, I_F=20A$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$ | - | 1.1 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C=0.8mA,$ $V_{CE}=V_{GE}$ | 4.1 | 4.9 | 5.7 | |
| Zero gate voltage collector current | I_{CES} | $V_{CE}=600V,$ $V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$ | - | - | 40 | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE}=0V, V_{GE}=20V$ | - | - | 100 | |
| Transconductance | g_{fs} | $V_{CE}=20V, I_C=40A$ | - | 22 | - | S |
| Integrated gate resistor | R_{Gint} | | | - | | Ω |

Dynamic Characteristic

| | | | | | | |
|--|------------|--|---|------|---|-------------|
| Input capacitance | C_{iss} | $V_{CE}=25V,$ $V_{GE}=0V,$ $f=1\text{MHz}$ | - | 2423 | - | pF |
| Output capacitance | C_{oss} | | - | 113 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 72 | - | |
| Gate charge | Q_{Gate} | $V_{CC}=480V, I_C=40A$ $V_{GE}=15V$ | - | 215 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | L_E | | - | 13 | - | nH |

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

| Parameter | Symbol | Conditions | Value | | | Unit |
|----------------------------|--------------|---|-------|------|------|------|
| | | | min. | Typ. | max. | |
| IGBT Characteristic | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=40\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=5.6\ \Omega$, $L_{\sigma}^{(1)}=40\text{nH}$, $C_{\sigma}^{(1)}=30\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | - | - | ns |
| Rise time | t_r | | - | - | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 186 | - | |
| Fall time | t_f | | - | 66.3 | - | |
| Turn-on energy | E_{on} | | - | - | - | mJ |
| Turn-off energy | E_{off} | | - | 0.92 | - | |
| Total switching energy | E_{ts} | | - | 0.92 | - | |

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 | $t_{d(on)}$ | $T_j=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=40\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=5.6\ \Omega$, $L_{\sigma}^{(1)}=40\text{nH}$, $C_{\sigma}^{(1)}=30\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | - | - | ns |
| Rise time | t_r | | - | - | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 196 | - | |
| Fall time | t_f | | - | 76.5 | - | |
| Turn-on energy | E_{on} | | - | - | - | mJ |
| Turn-off energy | E_{off} | | - | 1.4 | - | |
| Total switching energy | E_{ts} | | - | 1.4 | - | |

¹⁾ Leakage inductance L_{σ} and Stray capacity C_{σ} due to dynamic test circuit in Figure E.

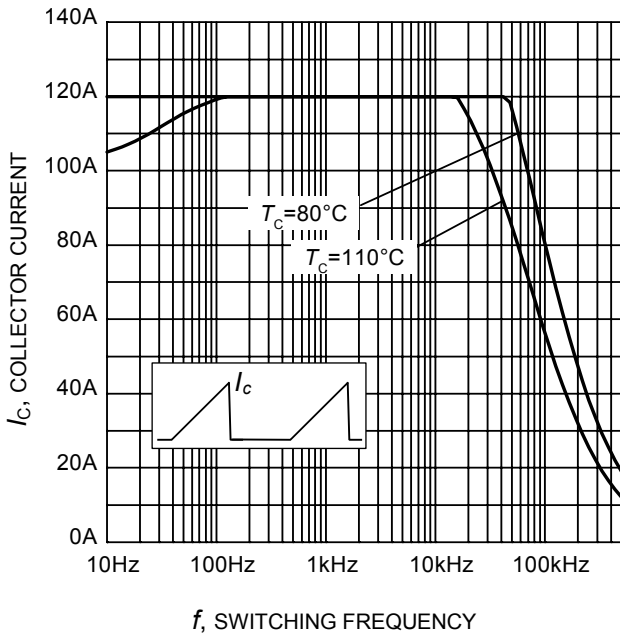


Figure 1. Collector current as a function of switching frequency for triangular current ($E_{on} = 0$, hard turn-off)
 ($T_j \leq 175^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 5.6\Omega$)

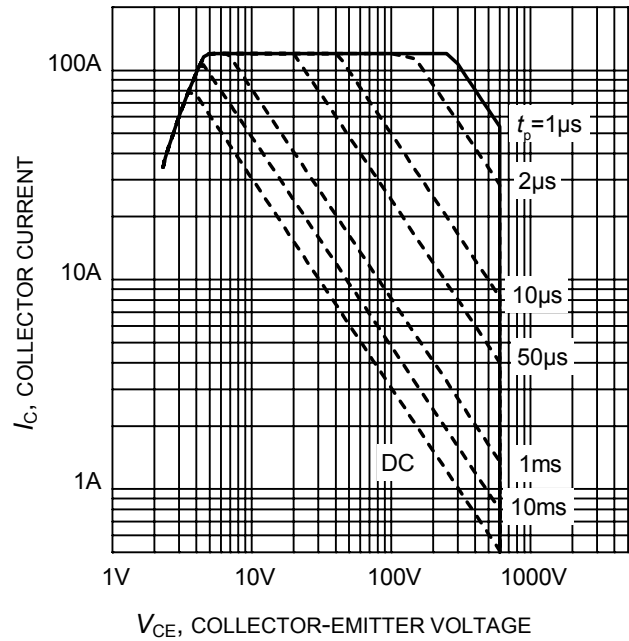


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 175^\circ\text{C}$;
 $V_{GE} = 15\text{V}$)

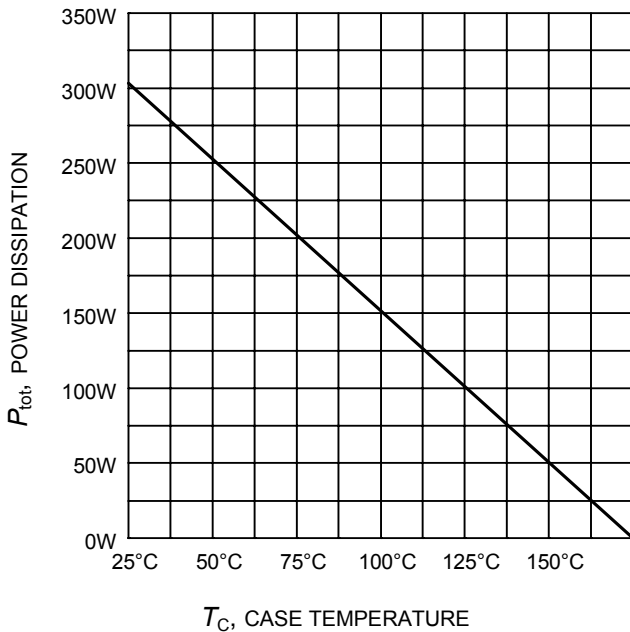


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 175^\circ\text{C}$)

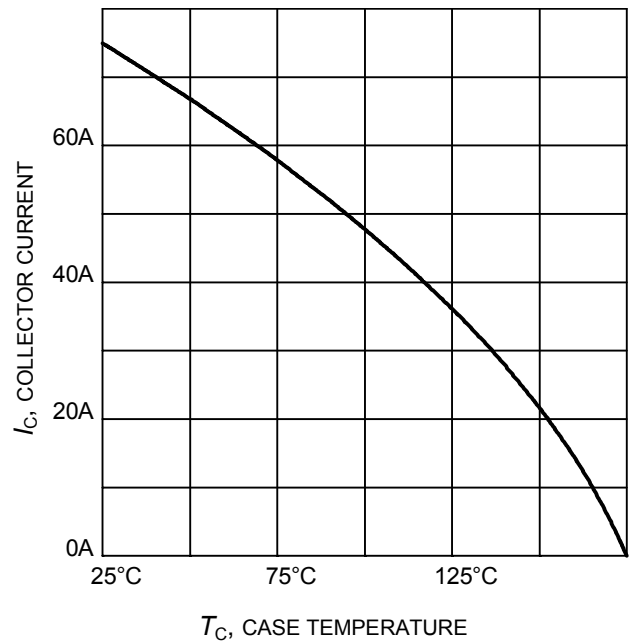


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

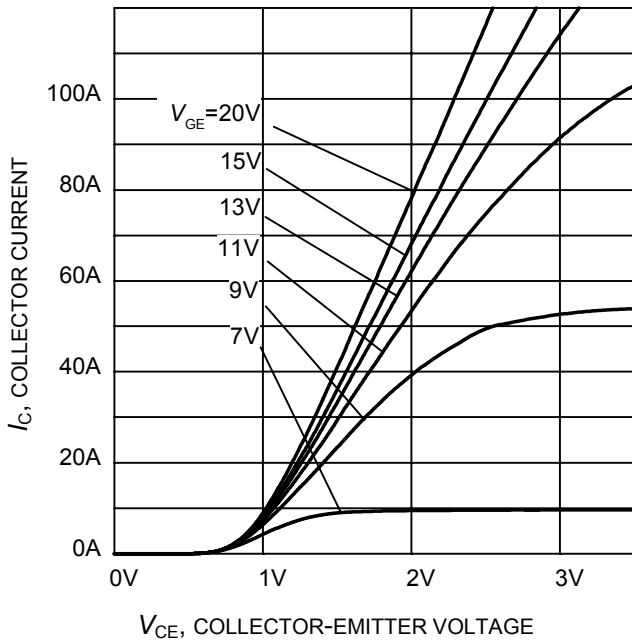


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

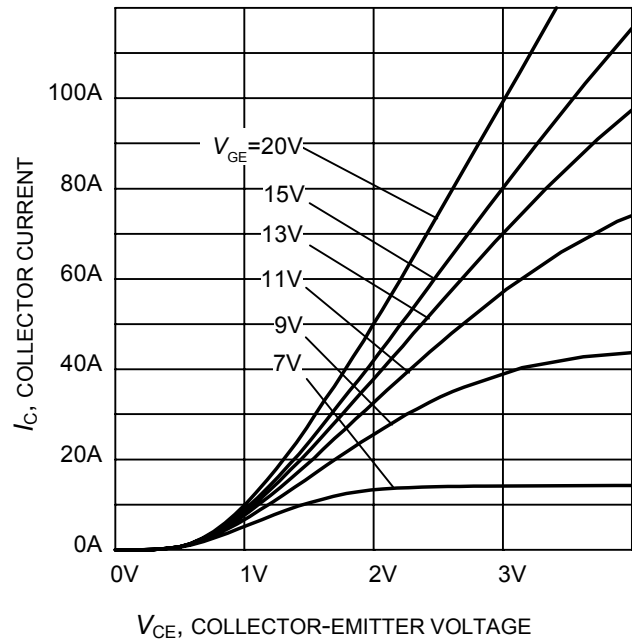


Figure 6. Typical output characteristic
($T_j = 175^\circ\text{C}$)

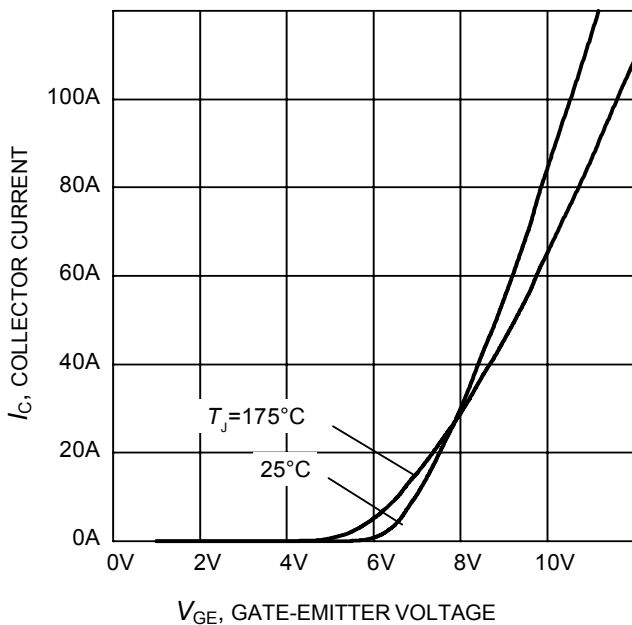


Figure 7. Typical transfer characteristic
($V_{CE} = 20\text{V}$)

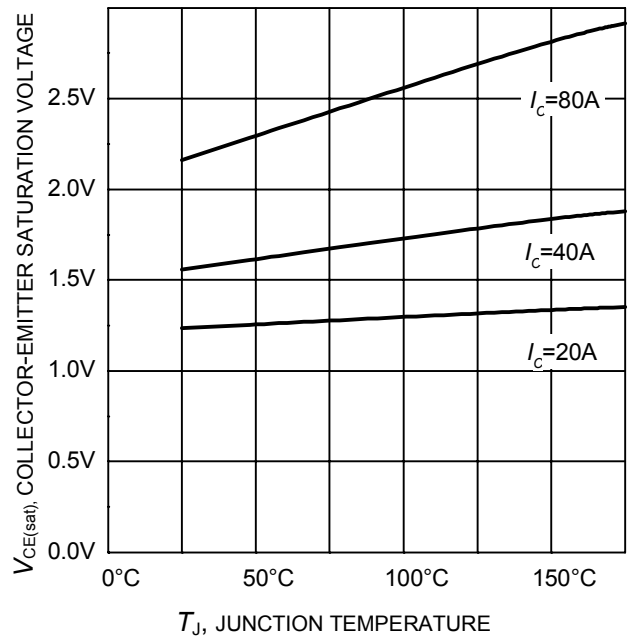


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

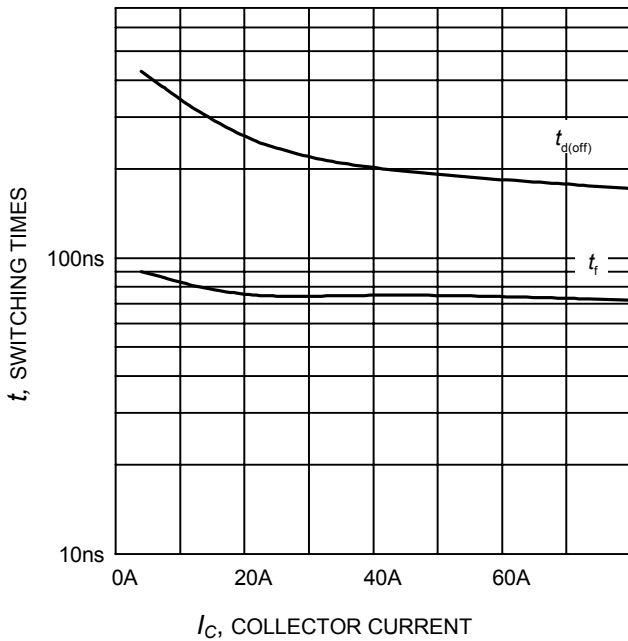


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_J=175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $R_G = 5.6\Omega$, Dynamic test circuit in Figure E)

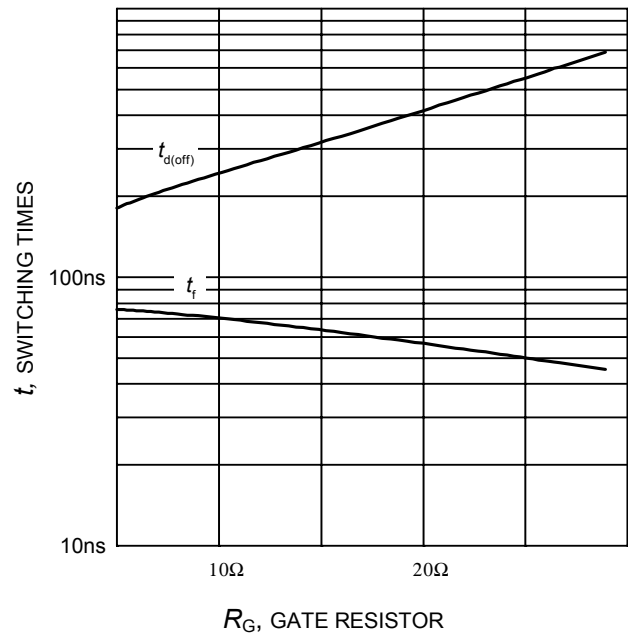


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_J = 175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 40\text{A}$, Dynamic test circuit in Figure E)

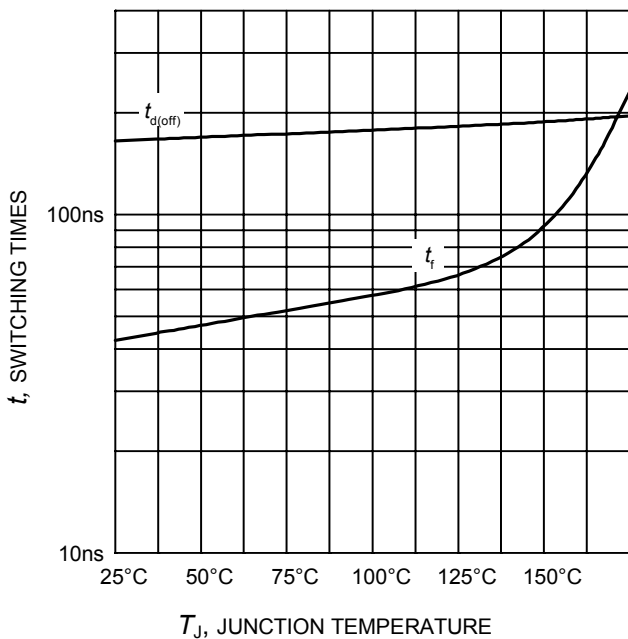


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 40\text{A}$, $R_G=5.6\Omega$, Dynamic test circuit in Figure E)

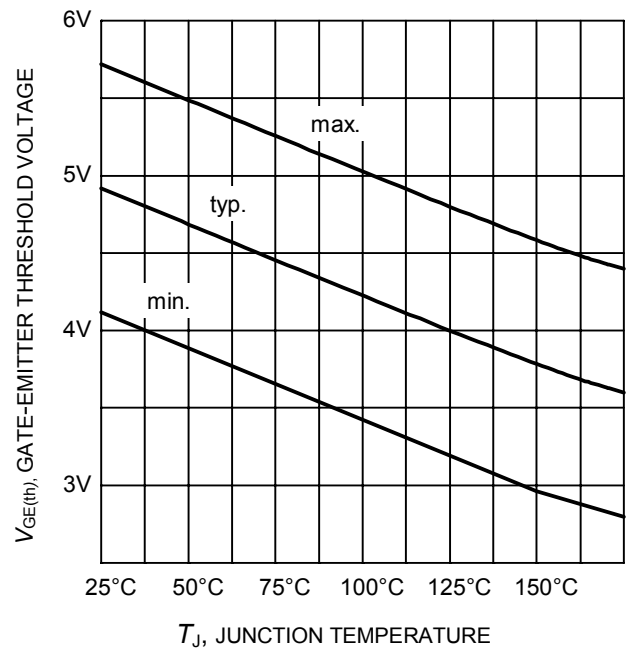


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 0.8\text{mA}$)

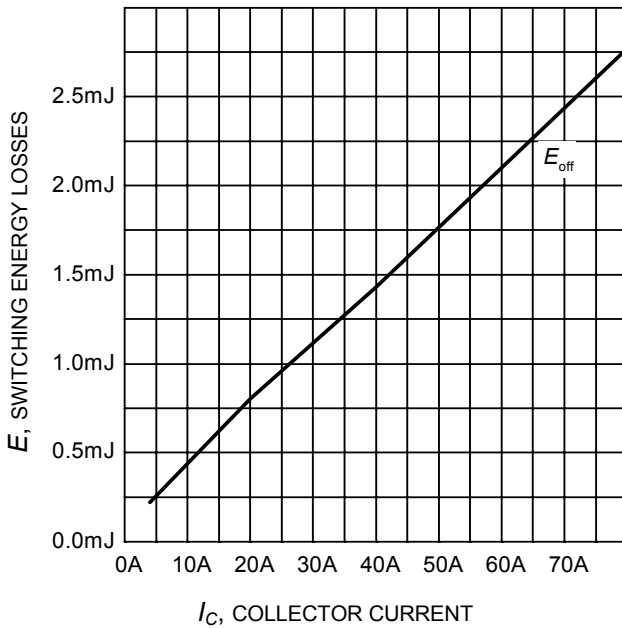


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_J = 175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $R_G = 5.6\Omega$, Dynamic test circuit in Figure E)

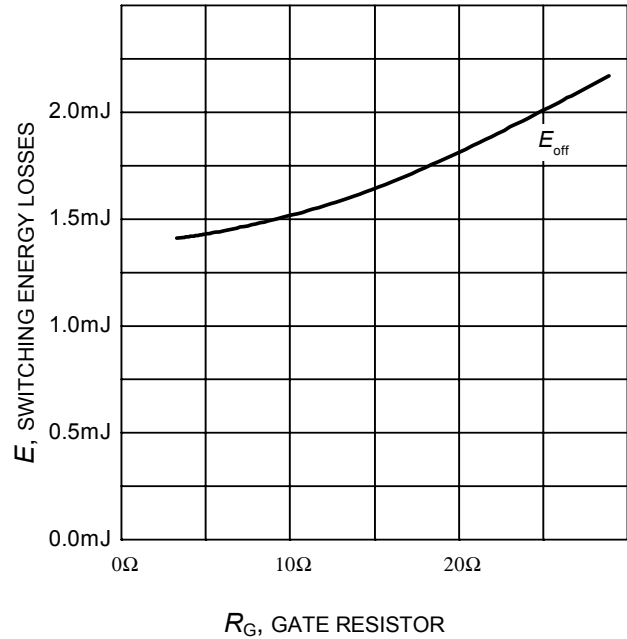


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_J = 175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 40\text{A}$, Dynamic test circuit in Figure E)

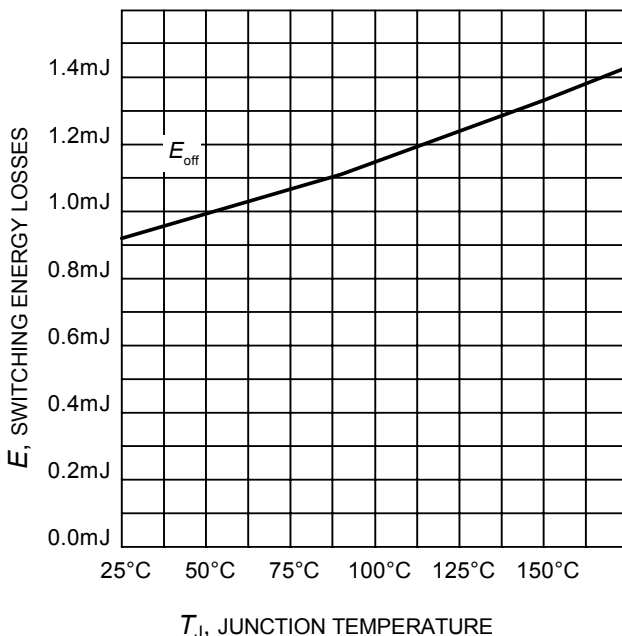


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 40\text{A}$, $R_G = 5.6\Omega$, Dynamic test circuit in Figure E)

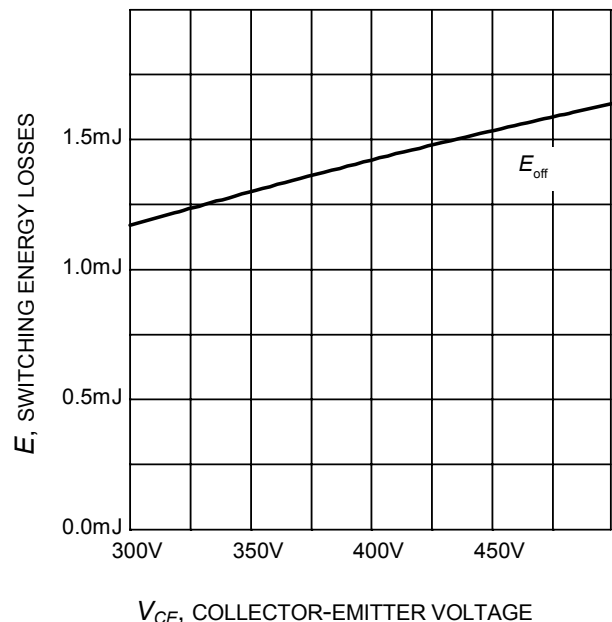


Figure 16. Typical switching energy losses as a function of collector emitter voltage
 (inductive load, $T_J = 175^\circ\text{C}$, $V_{GE} = 0/15\text{V}$, $I_C = 40\text{A}$, $R_G = 5.6\Omega$, Dynamic test circuit in Figure E)

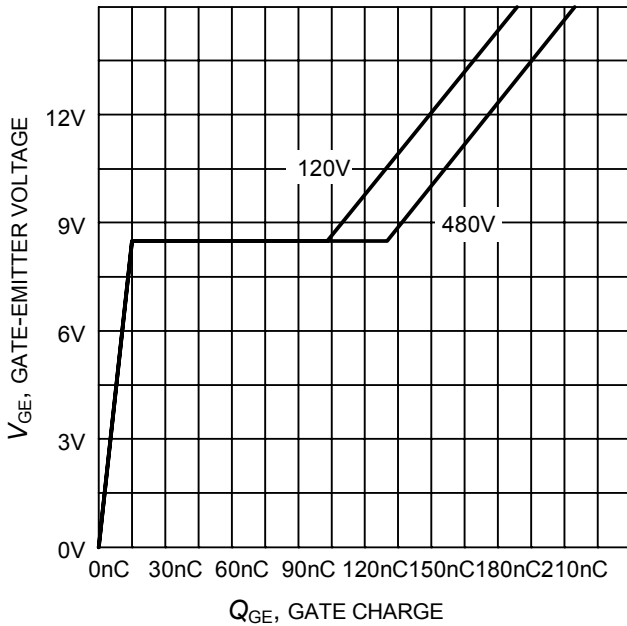


Figure 17. Typical gate charge
($I_C=40\text{ A}$)

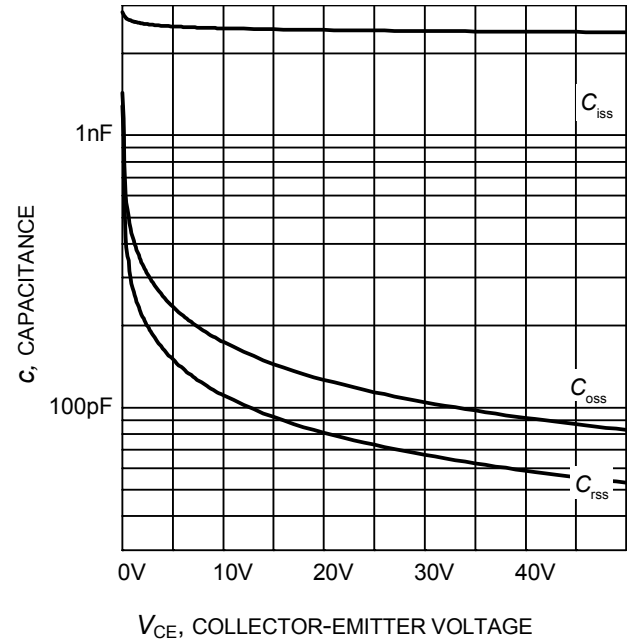


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

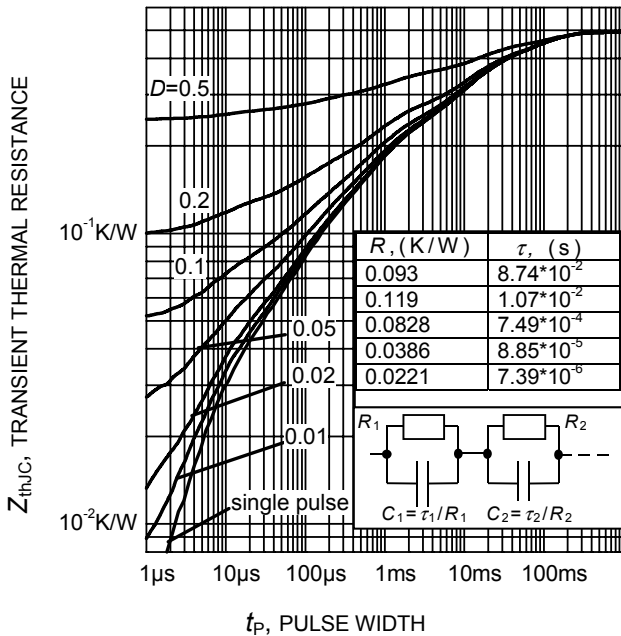


Figure 19. IGBT transient thermal resistance
($D = t_p / T$)

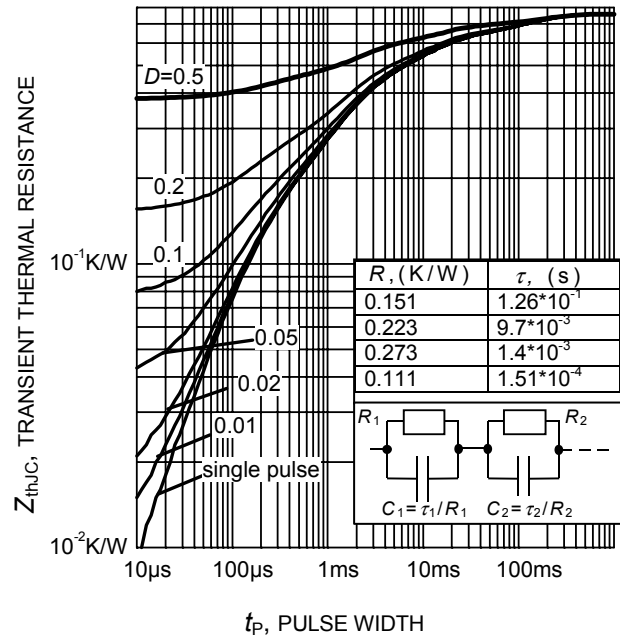


Figure 20. Diode transient thermal impedance as a function of pulse width
($D=t_p/T$)

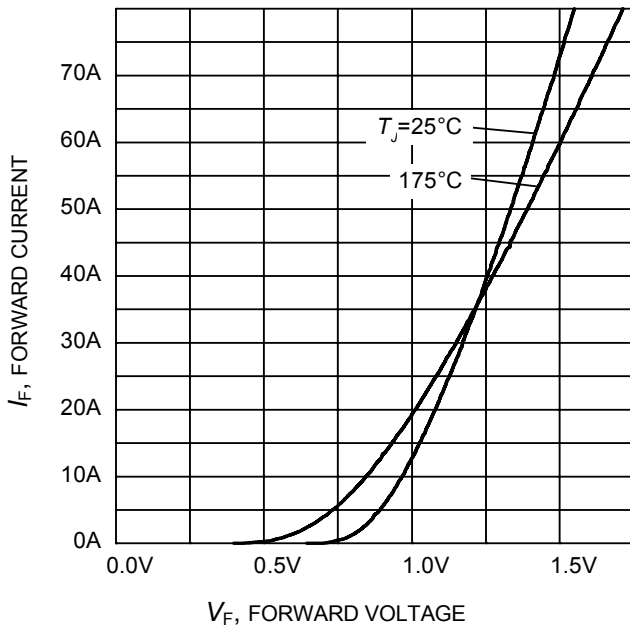


Figure 21. Typical diode forward current as a function of forward voltage

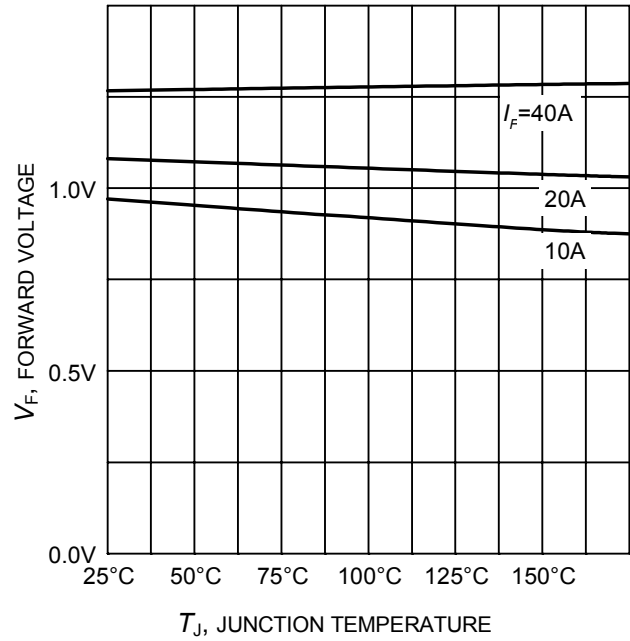
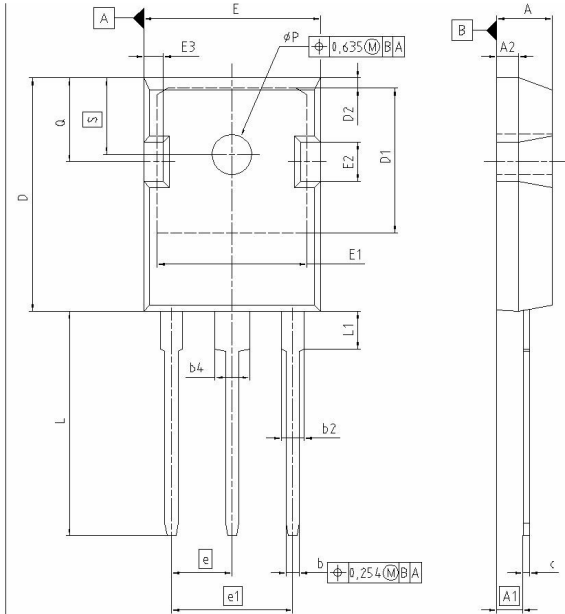


Figure 22. Typical diode forward voltage as a function of junction temperature

PG-TO247-3-21



| DIM | MILLIMETERS | | INCHES | |
|-----------|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.903 | 5.157 | 0.193 | 0.203 |
| A1 | 2.273 | 2.527 | 0.092 | 0.096 |
| A2 | 1.853 | 2.107 | 0.075 | 0.081 |
| b | 1.073 | 1.327 | 0.047 | 0.052 |
| b2 | 1.903 | 2.386 | 0.075 | 0.094 |
| b4 | 2.870 | 3.454 | 0.113 | 0.136 |
| c | 0.549 | 0.752 | 0.024 | 0.030 |
| D | 20.823 | 21.077 | 0.820 | 0.830 |
| D1 | 17.323 | 17.831 | 0.682 | 0.702 |
| D2 | 1.063 | 1.317 | 0.042 | 0.052 |
| E | 15.773 | 16.027 | 0.621 | 0.631 |
| E1 | 13.893 | 14.147 | 0.547 | 0.557 |
| E2 | 3.683 | 3.937 | 0.145 | 0.155 |
| E3 | 1.683 | 1.937 | 0.066 | 0.076 |
| e | 5.450 | | 0.215 | |
| e1 | 10.900 | | 0.430 | |
| N | 3 | | 3 | |
| L | 20.053 | 20.307 | 0.789 | 0.799 |
| L1 | 4.168 | 4.472 | 0.164 | 0.176 |
| øP | 3.559 | 3.661 | 0.140 | 0.144 |
| Q | 5.493 | 5.747 | 0.216 | 0.226 |
| S | 6.043 | 6.297 | 0.238 | 0.248 |

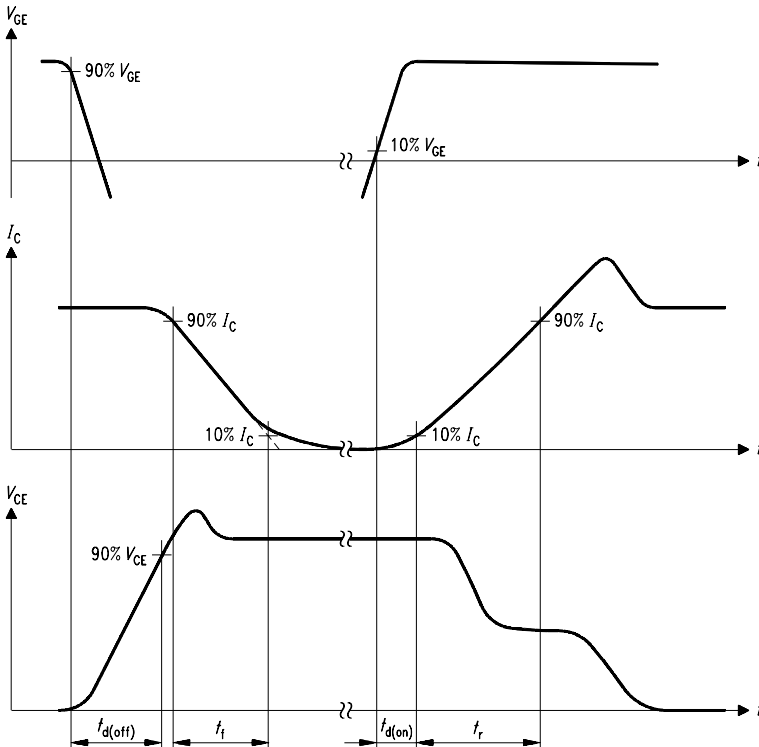


Figure A. Definition of switching times

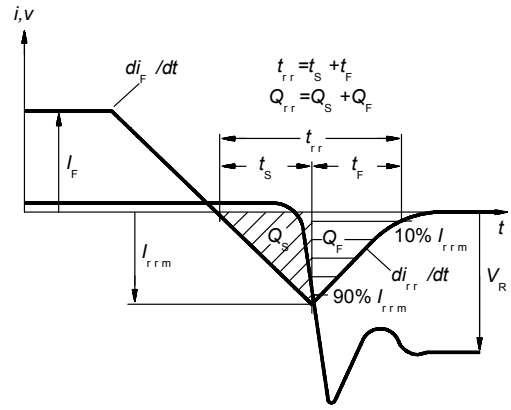


Figure C. Definition of diodes switching characteristics

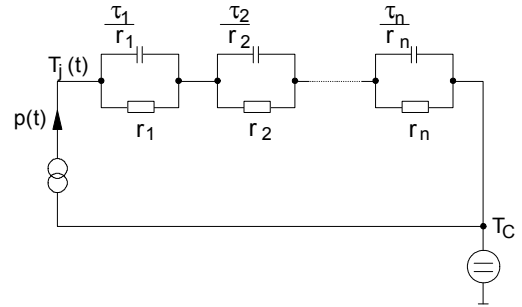


Figure D. Thermal equivalent circuit

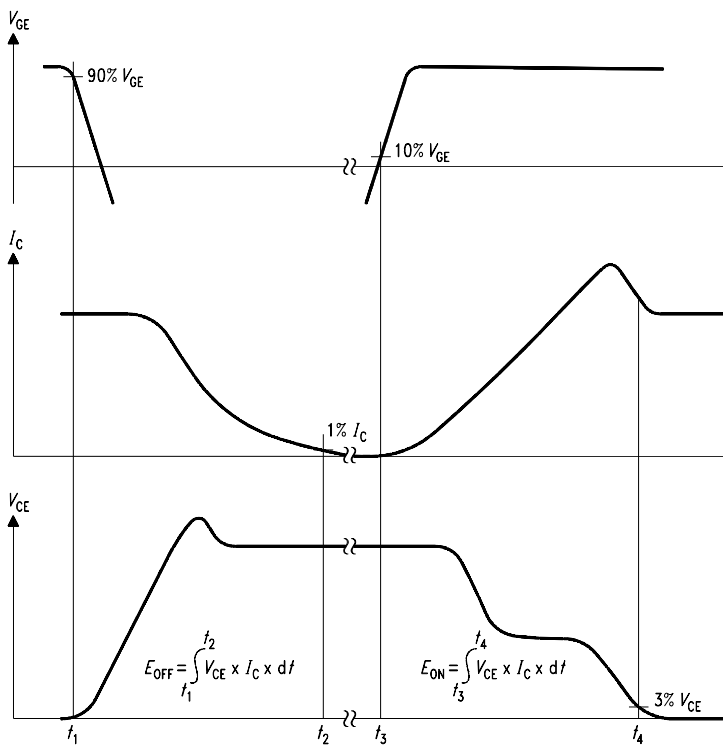


Figure B. Definition of switching losses

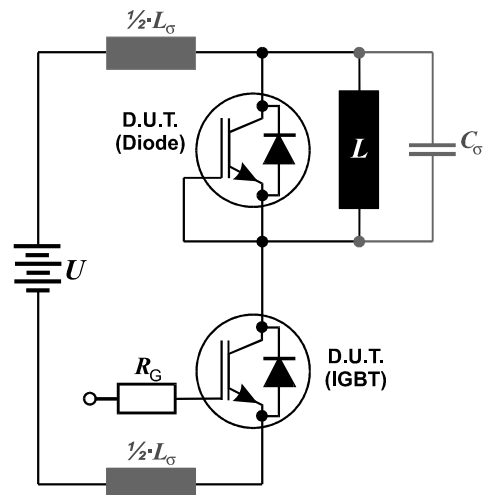


Figure E. Dynamic test circuit

Edition 2006-01

**Published by
Infineon Technologies AG
81726 München, Germany**

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