

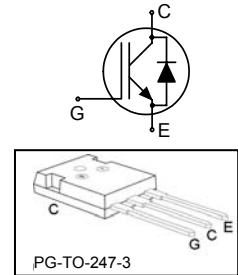


THE DATASHEET OF SKW30N60HSFKSA1



High Speed IGBT in NPT-technology

- 30% lower E_{off} compared to previous generation
- Short circuit withstand time – 10 μ s
- Designed for operation above 30 kHz
- NPT-Technology for 600V applications offers:
 - parallel switching capability
 - moderate E_{off} increase with temperature
 - very tight parameter distribution
- High ruggedness, temperature stable behaviour
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹ for target applications
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



| Type | V_{CE} | I_C | E_{off} | T_j | Marking | Package |
|------------|----------|-------|-------------|-------|----------|-------------|
| SKW30N60HS | 600V | 30 | 480 μ J | 150°C | K30N60HS | PG-TO-247-3 |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|--|----------------------|----------------------|------------------|
| Collector-emitter voltage | V_{CE} | 600 | V |
| DC collector current | I_C | 41 | A |
| $T_C = 25^\circ\text{C}$ | | 30 | |
| $T_C = 100^\circ\text{C}$ | | | |
| Pulsed collector current, t_p limited by T_{jmax} | I_{Cpuls} | 112 | |
| Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$ | - | 112 | |
| Diode forward current | I_F | 41 | |
| $T_C = 25^\circ\text{C}$ | | 28 | |
| $T_C = 100^\circ\text{C}$ | | | |
| Diode pulsed current, t_p limited by T_{jmax} | I_{Fpuls} | 112 | |
| Gate-emitter voltage static transient ($t_p < 1\mu\text{s}$, $D < 0.05$) | V_{GE} | ± 20 ± 30 | V |
| Short circuit withstand time ²⁾ $V_{GE} = 15\text{V}$, $V_{CC} \leq 600\text{V}$, $T_j \leq 150^\circ\text{C}$ | t_{SC} | 10 | μs |
| Power dissipation $T_C = 25^\circ\text{C}$ | P_{tot} | 250 | W |
| Operating junction and storage temperature | T_j , T_{stg} | -55...+150 | $^\circ\text{C}$ |
| Time limited operating junction temperature for $t < 150\text{h}$ | $T_{j(tl)}$ | 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} | | 0.5 | K/W |
| Diode thermal resistance, junction – case | R_{thJCD} | | 1.29 | |
| 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 | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=500\mu A$ | 600 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE} = 15V, I_C=30A$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$ | | 2.8 3.5 | 3.15 4.00 | |
| Diode forward voltage | V_F | $V_{GE}=0V, I_F=30A$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$ | - | 1.55 1.55 | 2.05 2.05 | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C=700\mu A, V_{CE}=V_{GE}$ | 3 | 4 | 5 | |
| Zero gate voltage collector current | I_{CES} | $V_{CE}=600V, V_{GE}=0V$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$ | - - | - - | 40 3000 | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE}=0V, V_{GE}=20V$ | - | - | 100 | |
| Transconductance | g_{fs} | $V_{CE}=20V, I_C=30A$ | - | 20 | | S |

Dynamic Characteristic

| | | | | | | |
|--|-------------|---|---|------|--|----|
| Input capacitance | C_{iss} | $V_{CE}=25V,$ | - | 1500 | | pF |
| Output capacitance | C_{oss} | $V_{GE}=0V,$ | - | 203 | | |
| Reverse transfer capacitance | C_{riss} | $f=1\text{MHz}$ | - | 92 | | |
| Gate charge | Q_{Gate} | $V_{CC}=480V, I_C=30A$ $V_{GE}=15V$ | - | 141 | | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | L_E | | - | 13 | | nH |
| Short circuit collector current ¹⁾ | $I_{C(SC)}$ | $V_{GE}=15V, t_{SC}\leq 10\mu s$ $V_{CC}\leq 600V,$ $T_j\leq 150^\circ\text{C}$ | - | 220 | | A |

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

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 | $t_{d(on)}$ | $T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=30\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=11\Omega$ $L_{\sigma}^{2)}=60\text{nH}$, $C_{\sigma}^{2)}=40\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | 20 | | ns |
| Rise time | t_r | | - | 21 | | |
| Turn-off delay time | $t_{d(off)}$ | | - | 250 | | |
| Fall time | t_f | | - | 25 | | |
| Turn-on energy | E_{on} | | - | 0.60 | | mJ |
| Turn-off energy | E_{off} | | - | 0.55 | | |
| Total switching energy | E_{ts} | | - | 1.15 | | |

Anti-Parallel Diode Characteristic

| | | | | | | |
|--|--------------|--|---|------|--|------------------------|
| Diode reverse recovery time | t_{rr} | $T_j=25^\circ\text{C}$, $V_R=400\text{V}$, $I_F=30\text{A}$, $di_F/dt=1100\text{A}/\mu\text{s}$ | - | 125 | | ns |
| | t_s | | - | 20 | | |
| | t_F | | - | 105 | | |
| Diode reverse recovery charge | Q_{rr} | | - | 0.82 | | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 17 | | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | 580 | | $\text{A}/\mu\text{s}$ |

²⁾ Leakage inductance L_{σ} and Stray capacity C_{σ} due to test circuit in Figure E.

Switching Characteristic, Inductive Load, at $T_j=150^\circ\text{C}$

| Parameter | Symbol | Conditions | Value | | | Unit |
|----------------------------|--------------|---|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}, I_C=30\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=1.8\Omega$ | - | 16 | | ns |
| Rise time | t_r | | - | 13 | | |
| Turn-off delay time | $t_{d(off)}$ | | - | 122 | | |
| Fall time | t_f | | - | 29 | | |
| Turn-on energy | E_{on} | $L_{\sigma}^{(1)}=60\text{nH},$ $C_{\sigma}^{(1)}=40\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | 0.78 | | mJ |
| Turn-off energy | E_{off} | | - | 0.48 | | |
| Total switching energy | E_{ts} | | - | 1.26 | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j=150^\circ\text{C}$ $V_{CC}=400\text{V}, I_C=30\text{A},$ $V_{GE}=0/15\text{V},$ $R_G=11\Omega$ | - | 20 | | ns |
| Rise time | t_r | | - | 19 | | |
| Turn-off delay time | $t_{d(off)}$ | | - | 274 | | |
| Fall time | t_f | | - | 27 | | |
| Turn-on energy | E_{on} | $L_{\sigma}^{(1)}=60\text{nH},$ $C_{\sigma}^{(1)}=40\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | 0.91 | | mJ |
| Turn-off energy | E_{off} | | - | 0.70 | | |
| Total switching energy | E_{ts} | | - | 1.61 | | |

Anti-Parallel Diode Characteristic

| | | | | | | |
|--|--------------|---|---|-----|--|------------------------|
| Diode reverse recovery time | t_{rr} | $T_j=150^\circ\text{C}$ $V_R=400\text{V}, I_F=30\text{A},$ $di_F/dt=1250\text{A}/\mu\text{s}$ | - | 190 | | ns |
| | t_s | | - | 30 | | |
| | t_F | | - | 160 | | |
| Diode reverse recovery charge | Q_{rr} | | - | 2.0 | | 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 | | - | 480 | | $\text{A}/\mu\text{s}$ |

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

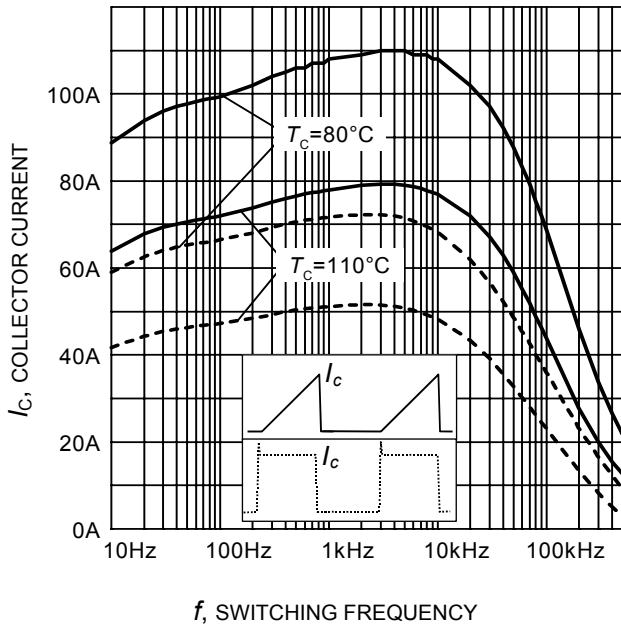


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 400\text{V}$, $V_{GE} = 0/+15\text{V}$, $R_G = 11\Omega$)

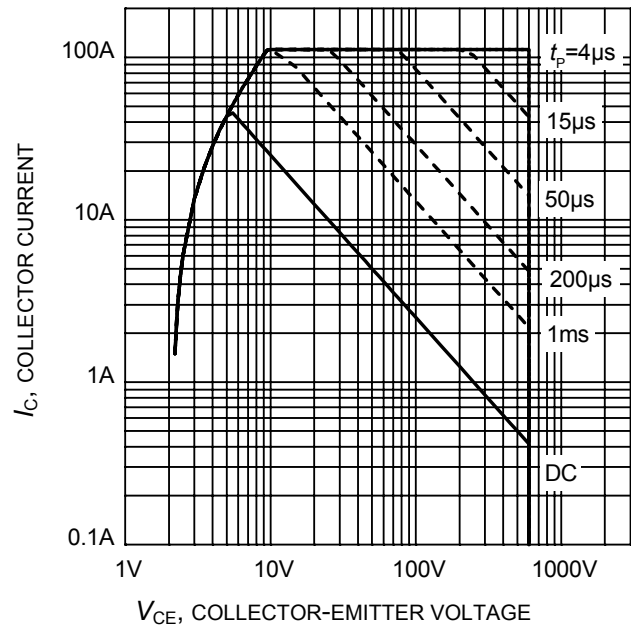


Figure 2. Safe operating area
 ($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$; $V_{GE} = 15\text{V}$)

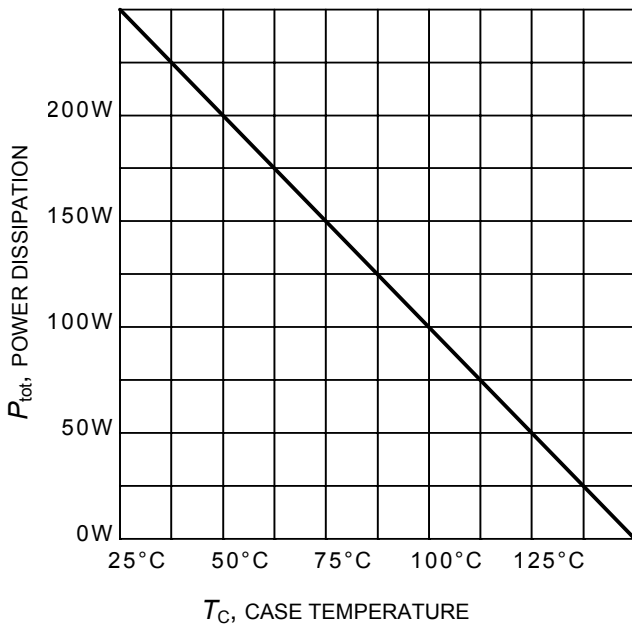


Figure 3. Power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

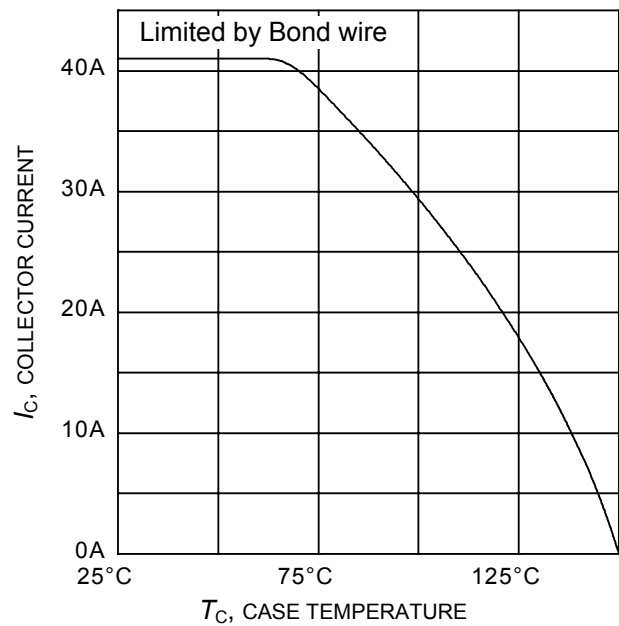


Figure 4. Collector current as a function of case temperature
 ($V_{GE} \leq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

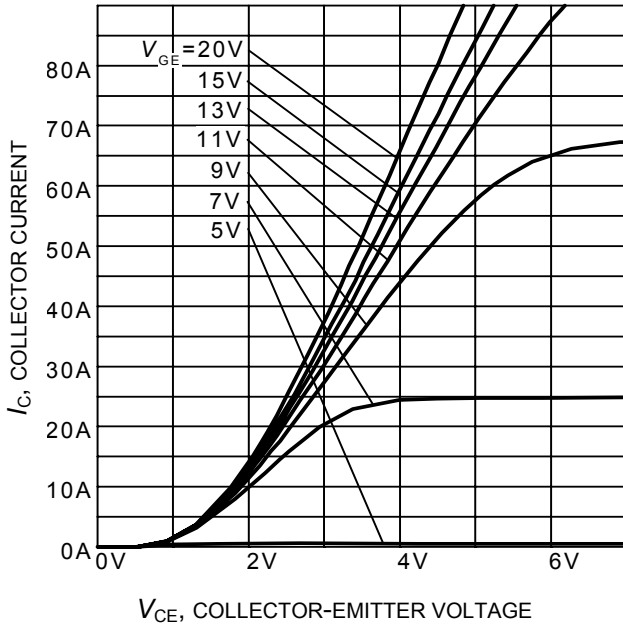


Figure 5. Typical output characteristic
($T_j = 25^\circ\text{C}$)

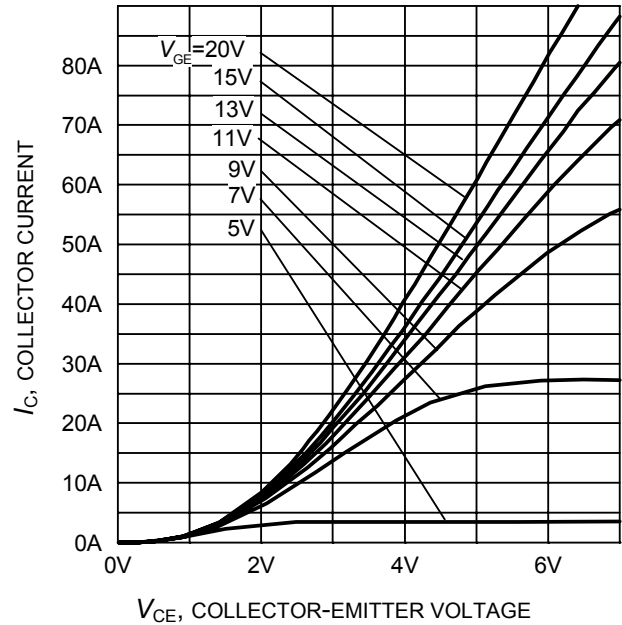


Figure 6. Typical output characteristic
($T_j = 150^\circ\text{C}$)

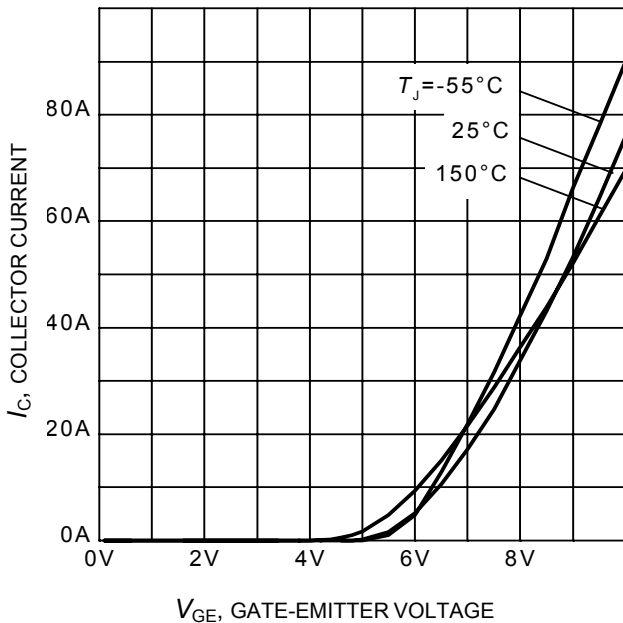


Figure 7. Typical transfer characteristic
($V_{CE} = 10\text{V}$)

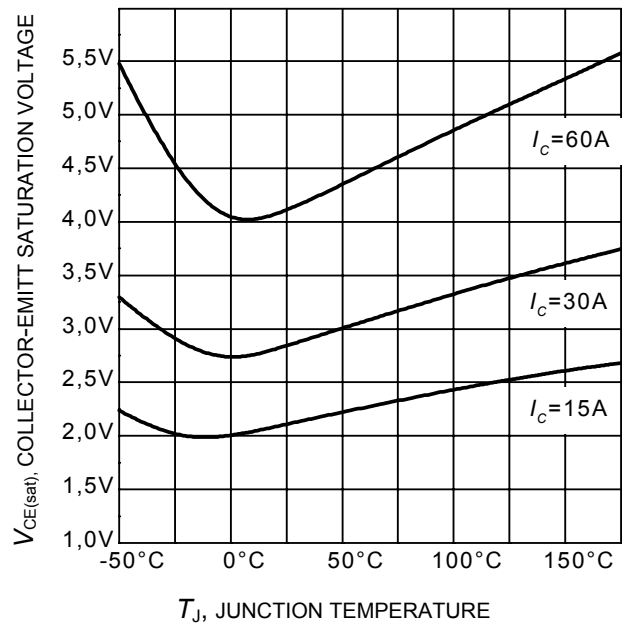


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)

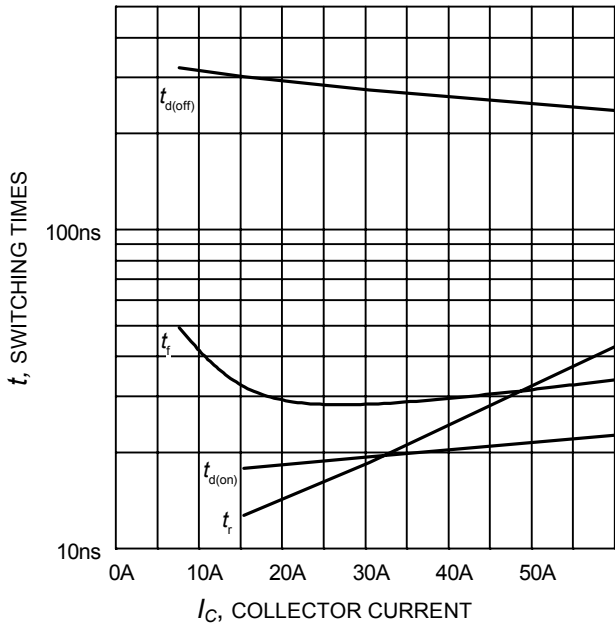


Figure 9. Typical switching times as a function of collector current
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=11\Omega$, Dynamic test circuit in Figure E)

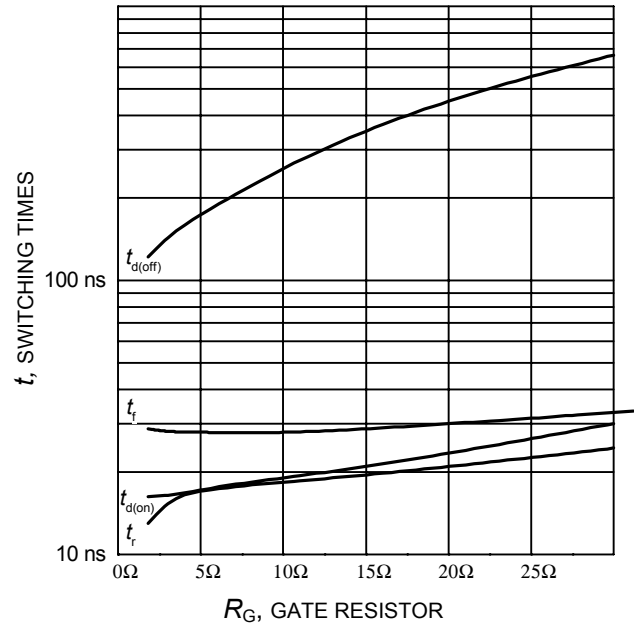


Figure 10. Typical switching times as a function of gate resistor
 (inductive load, $T_J=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, Dynamic test circuit in Figure E)

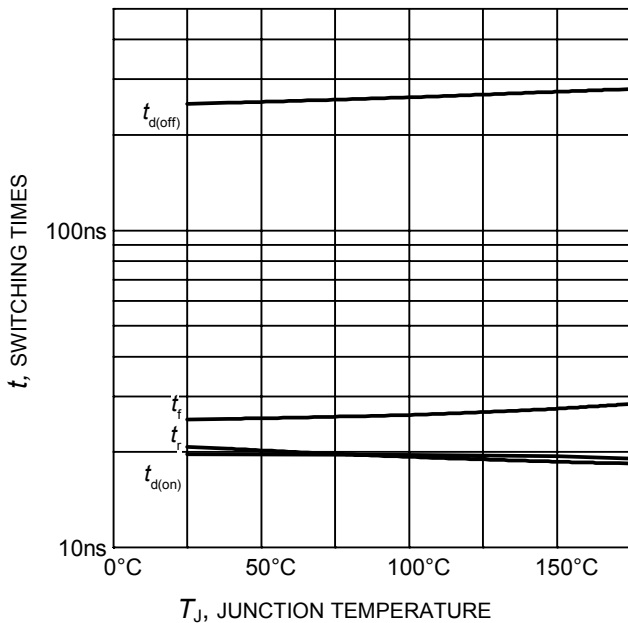


Figure 11. Typical switching times as a function of junction temperature
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_G=11\Omega$, Dynamic test circuit in Figure E)

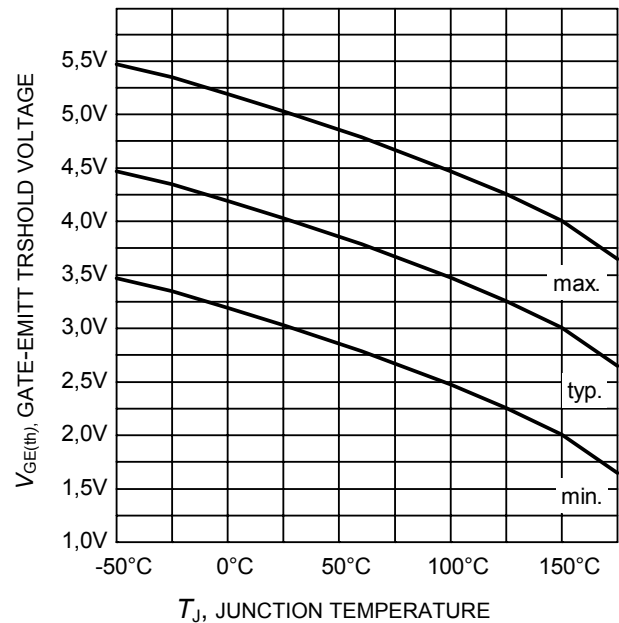


Figure 12. Gate-emitter threshold voltage as a function of junction temperature
 ($I_C = 0.7\text{mA}$)

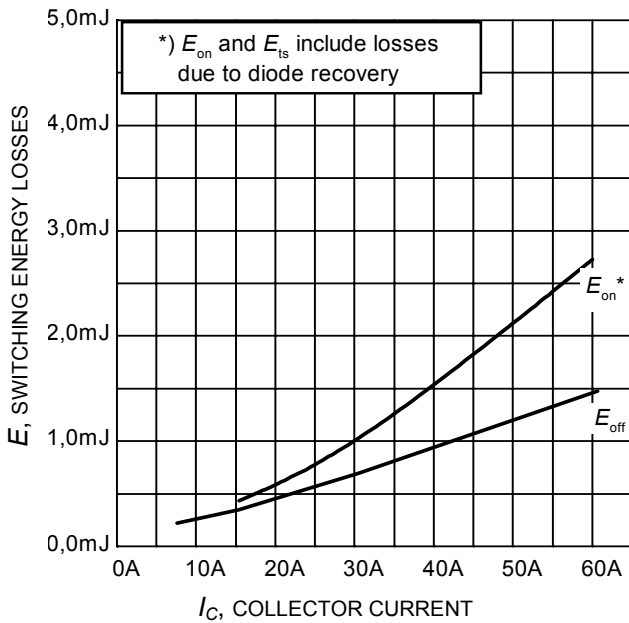


Figure 13. Typical switching energy losses as a function of collector current
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=11\Omega$, Dynamic test circuit in Figure E)

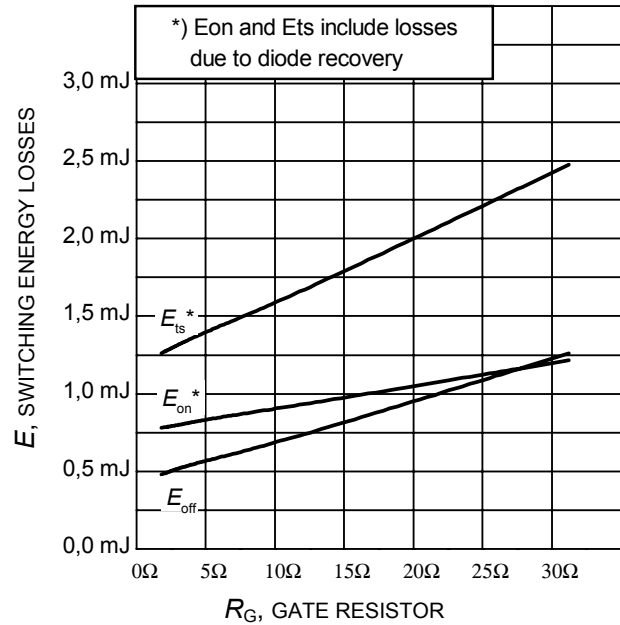


Figure 14. Typical switching energy losses as a function of gate resistor
 (inductive load, $T_J=150^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, Dynamic test circuit in Figure E)

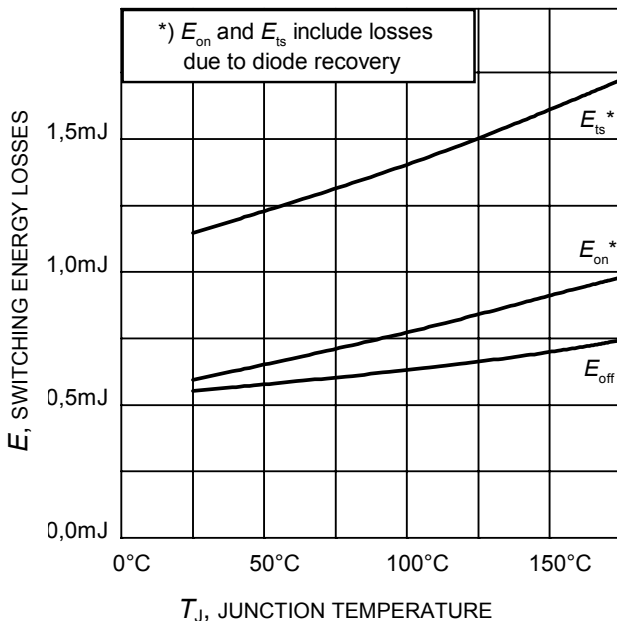


Figure 15. Typical switching energy losses as a function of junction temperature
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=30\text{A}$, $R_G=11\Omega$, Dynamic test circuit in Figure E)

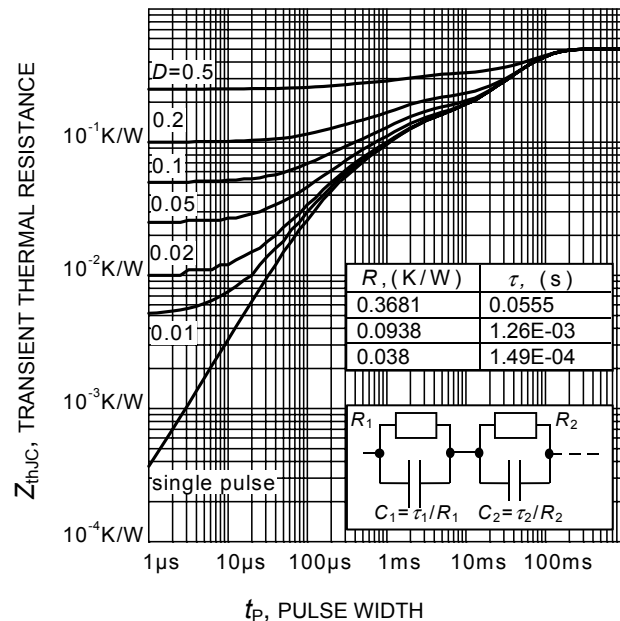


Figure 16. IGBT transient thermal resistance
 ($D = t_p / T$)

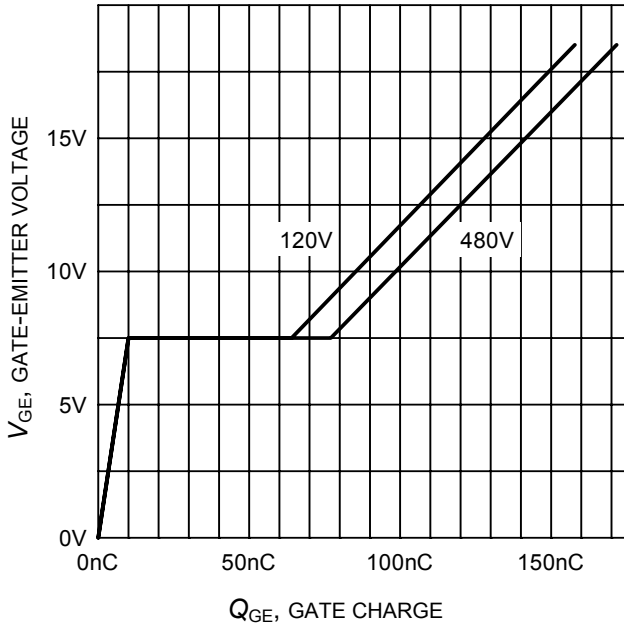


Figure 17. Typical gate charge
($I_C=30\text{ A}$)

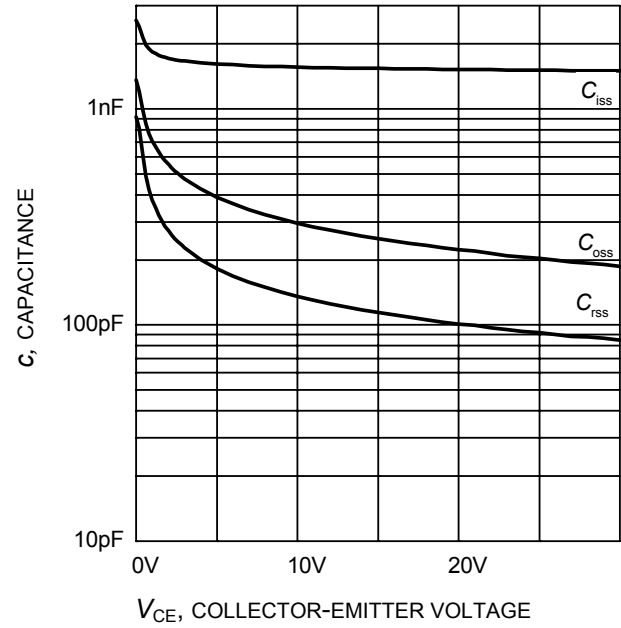


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

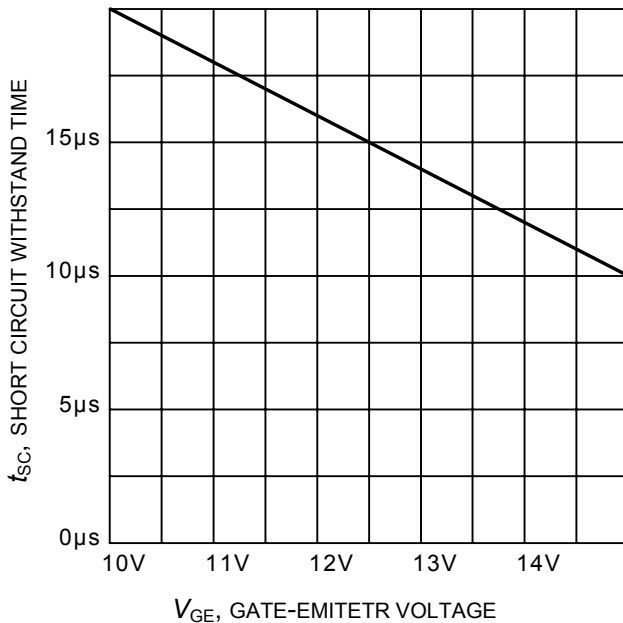


Figure 19. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600\text{V}$, start at $T_J=25^\circ\text{C}$)

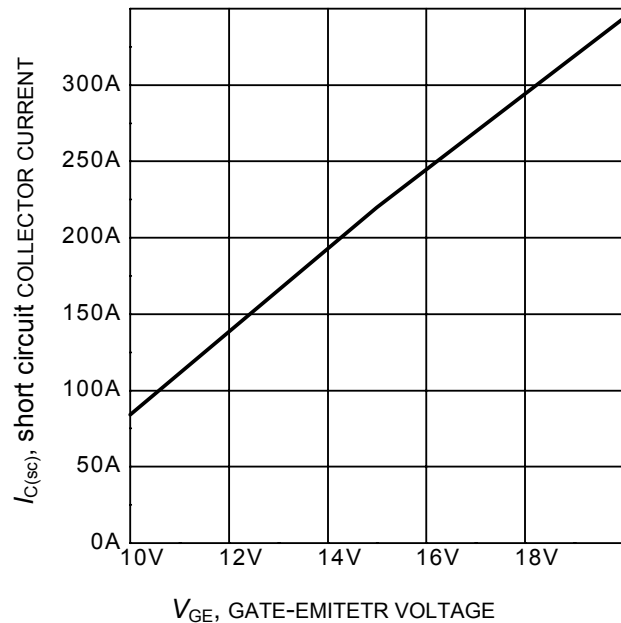
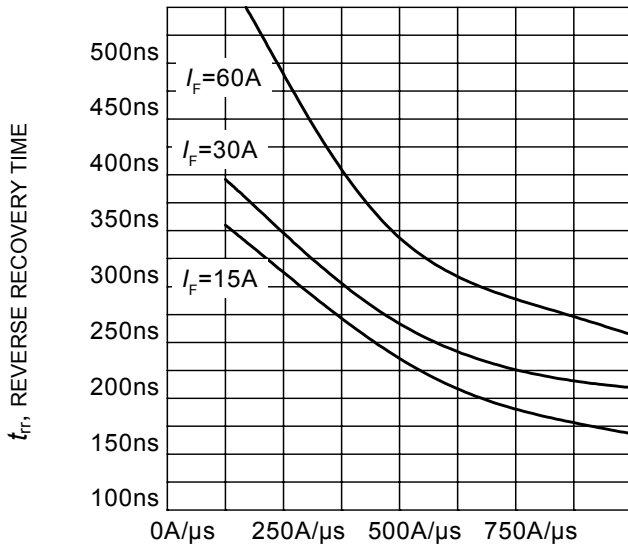
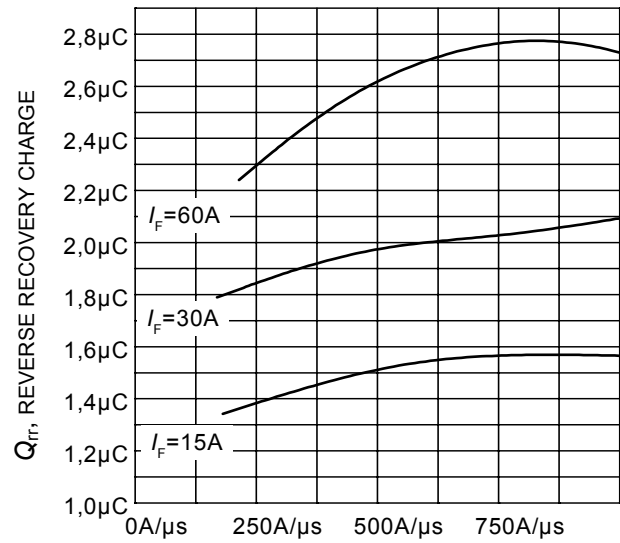


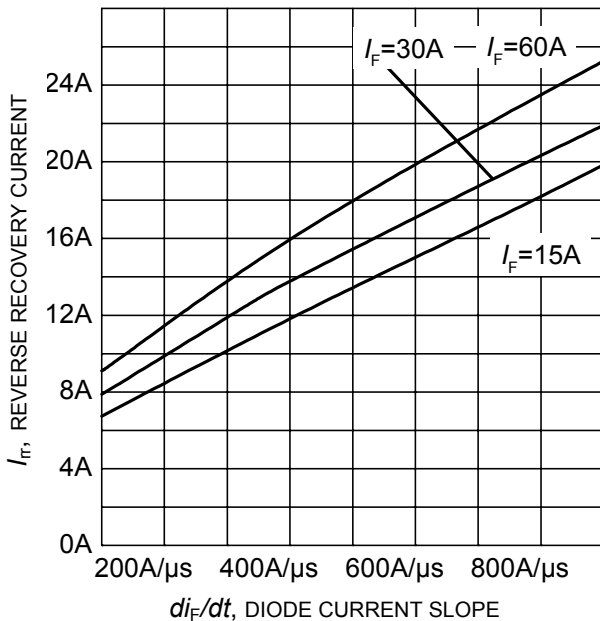
Figure 20. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 600\text{V}$, $T_J \leq 150^\circ\text{C}$)



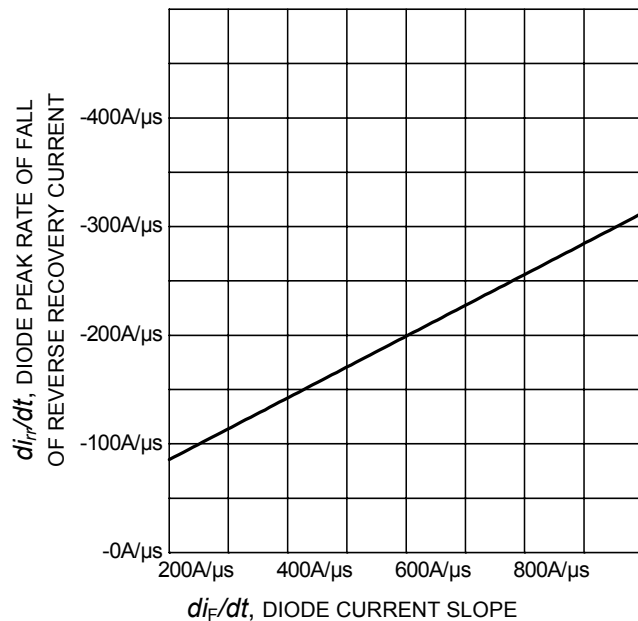
di_F/dt , DIODE CURRENT SLOPE
Figure 21. Typical reverse recovery time as a function of diode current slope
 ($V_R=400V$, $T_J=150^\circ C$,
 Dynamic test circuit in Figure E)



di_F/dt , DIODE CURRENT SLOPE
Figure 22. Typical reverse recovery charge as a function of diode current slope
 ($V_R=400V$, $T_J=150^\circ C$,
 Dynamic test circuit in Figure E)



di_F/dt , DIODE CURRENT SLOPE
Figure 23. Typical reverse recovery current as a function of diode current slope
 ($V_R=400V$, $T_J=150^\circ C$,
 Dynamic test circuit in Figure E)



di_F/dt , DIODE CURRENT SLOPE
Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 ($V_R=400V$, $T_J=150^\circ C$,
 Dynamic test circuit in Figure E)

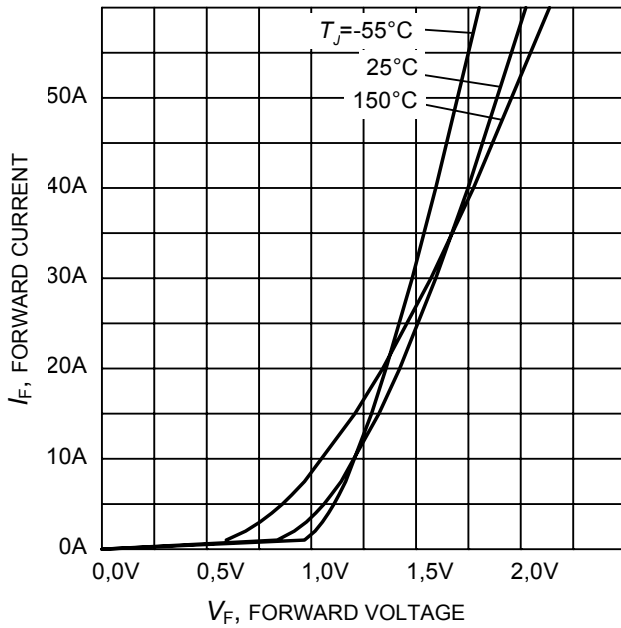


Figure 25. Typical diode forward current as a function of forward voltage

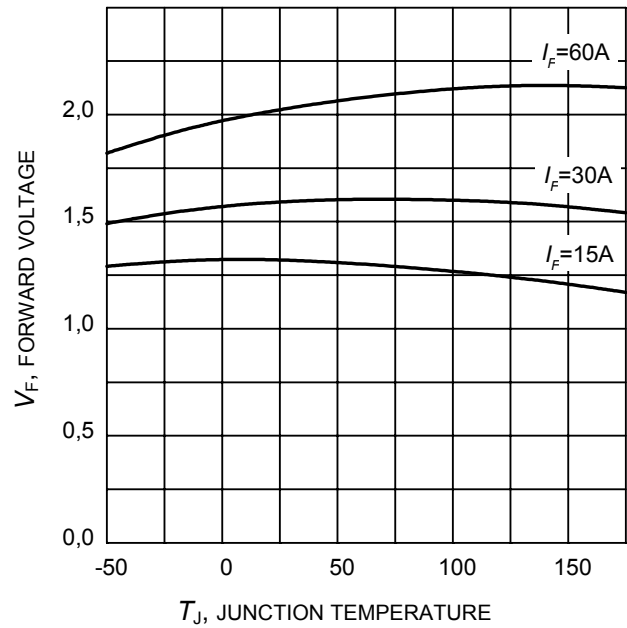


Figure 26. Typical diode forward voltage as a function of junction temperature

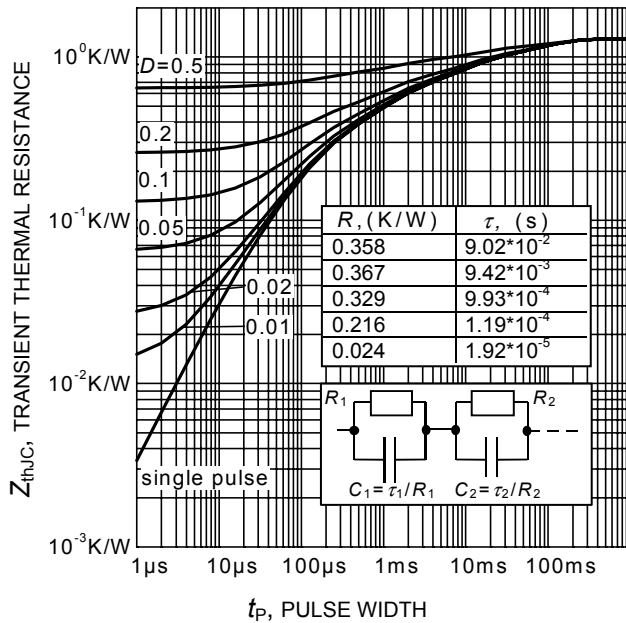
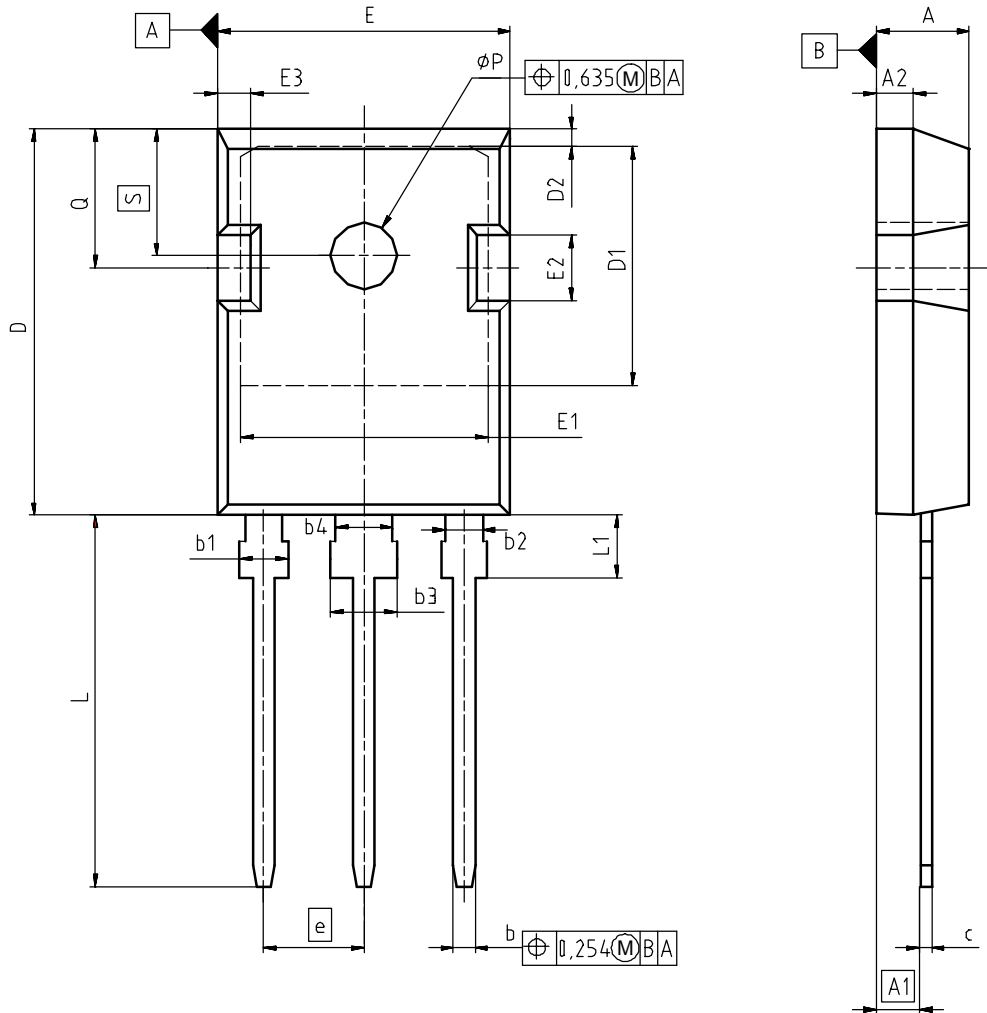


Figure 27. Diode transient thermal impedance as a function of pulse width ($D = t_p / T$)

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 |
| 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 |

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| EUROPEAN PROJECTION |
| ISSUE DATE 17-12-2007 |
| REVISION 03 |

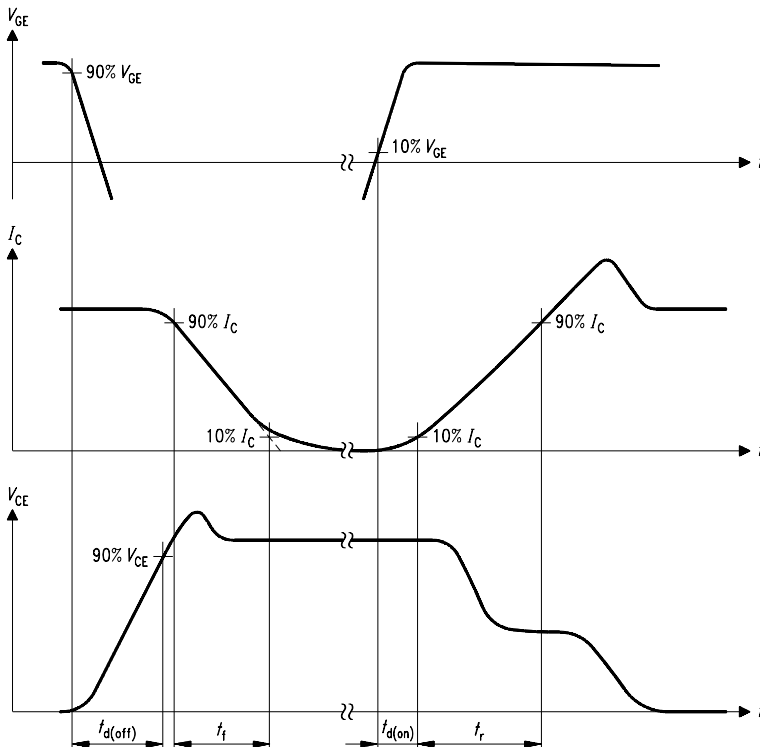


Figure A. Definition of switching times

SIS00053

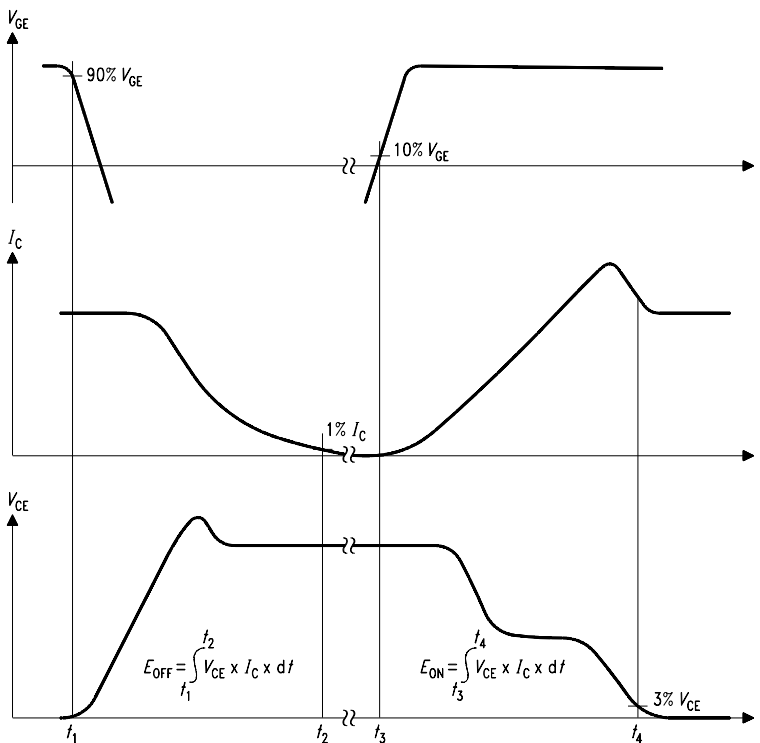


Figure B. Definition of switching losses

SIS00050

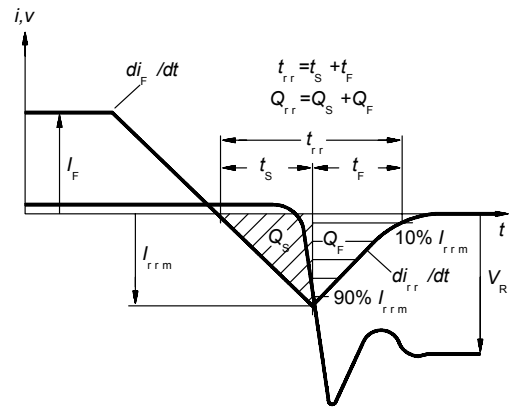


Figure C. Definition of diodes switching characteristics

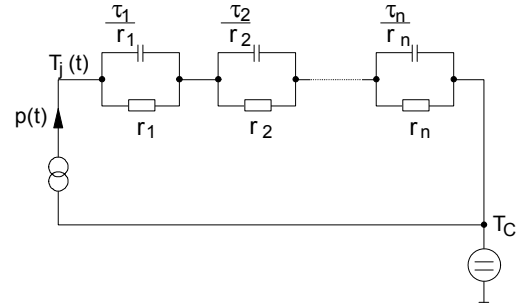


Figure D. Thermal equivalent circuit

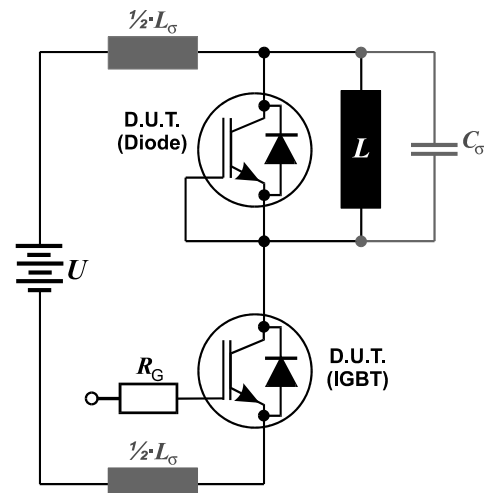


Figure E. Dynamic test circuit
Leakage inductance $L_{\sigma} = 60\text{nH}$
and Stray capacity $C_{\sigma} = 40\text{pF}$.

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Warnings

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