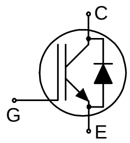
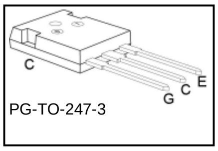
# SKW25N120

Fast IGBT in NPT-technology with soft, fast recovery anti-parallel Emitter Controlled Diode

- 40lower $E_{off}$ compared to previous generation
- Short circuit withstand time – 10 µs
- Designed for:
  - Motor controls
  - Inverter
  - SMPS
- NPT-Technology offers:
  - very tight parameter distribution
  - high ruggedness, temperature stable behaviour
  - parallel switching capability
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[1] 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 |
|---|---|---|---|---|---|---|
| SKW25N120 | 1200V | 25A | 2.9mJ | 150°C | K25N120 | PG-TO-247-3 |

**Maximum Ratings**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | 1200 | V |
| DC collector current<br>$T_C$ = 25°C<br>$T_C$ = 100°C | $I_C$ | <br>46<br>25 | A |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$ | $I_{Cpuls}$ | 84 | |
| Turn off safe operating area<br>$V_{CE} \leq$ 1200V, $T_j \leq$ 150°C | - | 84 | |
| Diode forward current<br>$T_C$ = 25°C<br>$T_C$ = 100°C | $I_F$ | <br>42<br>25 | |
| Diode pulsed current, $t_p$ limited by $T_{jmax}$ | $I_{Fpuls}$ | 80 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Short circuit withstand time[2]<br>$V_{GE}$ = 15V, 100V$\leq V_{CC} \leq$1200V, $T_j \leq$ 150°C | $t_{SC}$ | 10 | µs |
| Power dissipation<br>$T_C$ = 25°C | $P_{tot}$ | 313 | W |
| Operating junction and storage temperature | $T_j$ , $T_{stg}$ | -55...+150 | °C |
| Soldering temperature,<br>wavesoldering, 1.6mm (0.063 in.) from case for 10s | $T_s$ | 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 | $R_{thJC}$ | | 0.4 | K/W |
| Diode thermal resistance, junction – case | $R_{thJCD}$ | | 1.15 | |
| 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, $I_C$=1500µA | 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>2.5<br>- | <br>3.1<br>3.7 | <br>3.6<br>4.3 | |
| Diode forward voltage | $V_F$ | $V_{GE}$=0V, $I_F$=25A<br>$T_j$=25°C<br>$T_j$=150°C | <br><br>- | <br>2.0<br>1.75 | <br>2.5<br> | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$=1000µA, $V_{CE}$=$V_{GE}$ | 3 | 4 | 5 | |
| Zero gate voltage collector current . | $I_{CES}$ | $V_{CE}$=1200V,$V_{GE}$=0V<br>$T_j$=25°C<br>$T_j$=150°C | <br>-<br>- | <br>-<br>- | <br>350<br>1400 | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$=0V,$V_{GE}$=20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$=20V, $I_C$=25A | | 20 | - | S |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{CE}$=25V, | - | 2150 | 2600 | pF |
| Output capacitance | $C_{oss}$ | $V_{GE}$=0V, | - | 260 | 310 | |
| Reverse transfer capacitance | $C_{rss}$ | $f$=1MHz | - | 110 | 130 | |
| Gate charge | $Q_{Gate}$ | $V_{CC}$=960V, $I_C$=25A<br>$V_{GE}$=15V | - | 225 | 300 | nC |
| Internal emitter inductance<br>Measured 5mm (0.197 in.) from case | $L_E$ | | - | 13 | - | nH |
| Short circuit collector current[1)] | $I_{C(SC)}$ | $V_{GE}$=15V,$t_{SC}$≤10µs<br>100V≤$V_{CC}$≤1200V,<br>$T_j$ ≤ 150°C | - | 240 | - | A |

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

**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, $V_{CC}$=800V, $I_C$=25A, $V_{GE}$=15/0V, $R_G$=22Ω, $L_σ$[1)]=180nH, $C_σ$[1)]=40pF Energy losses include "tail" and diode reverse recovery. | - | 45 | 60 | ns |
| Rise time | $t_r$ | | - | 40 | 52 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 730 | 950 | |
| Fall time | $t_f$ | | - | 30 | 39 | |
| Turn-on energy | $E_{on}$ | | - | 2.2 | 2.9 | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.5 | 2.0 | |
| Total switching energy | $E_{ts}$ | | - | 3.7 | 4.9 | |
| **Anti-Parallel Diode Characteristic** | | | | | | |
| Diode reverse recovery time | $t_{rr}$<br>$t_S$<br>$t_F$ | $T_j$=25°C, $V_R$=800V, $I_F$=25A, $di_F/dt$=650A/µs | -<br>-<br>- | 90 | | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.0 | | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 20 | | A |
| Diode peak rate of fall of reverse recovery current during $t_F$ | $di_{rr}/dt$ | | - | 470 | | A/µs |

**Switching Characteristic, Inductive Load,** at $T_j$=150 °C

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | typ. | max. | |
| **IGBT Characteristic** | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_j$=150°C $V_{CC}$=800V, $I_C$=25A, $V_{GE}$=15/0V, $R_G$=22Ω, $L_σ$[1)]=180nH, $C_σ$[1)]=40pF Energy losses include "tail" and diode reverse recovery. | - | 50 | 60 | ns |
| Rise time | $t_r$ | | - | 36 | 43 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 820 | 990 | |
| Fall time | $t_f$ | | - | 42 | 50 | |
| Turn-on energy | $E_{on}$ | | - | 3.8 | 4.6 | mJ |
| Turn-off energy | $E_{off}$ | | - | 2.9 | 3.8 | |
| Total switching energy | $E_{ts}$ | | - | 6.7 | 8.4 | |
| **Anti-Parallel Diode Characteristic** | | | | | | |
| Diode reverse recovery time | $t_{rr}$<br>$t_S$<br>$t_F$ | $T_j$=150°C $V_R$=800V, $I_F$=25A, $di_F/dt$=750A/µs | -<br>-<br>- | 280 | | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 4.3 | | µC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 32 | | A |
| Diode peak rate of fall of reverse recovery current during $t_F$ | $di_{rr}/dt$ | | - | 130 | | A/µs |

[1)] Leakage inductance $L_σ$ and stray capacity $C_σ$ due to dynamic test circuit in figure E.

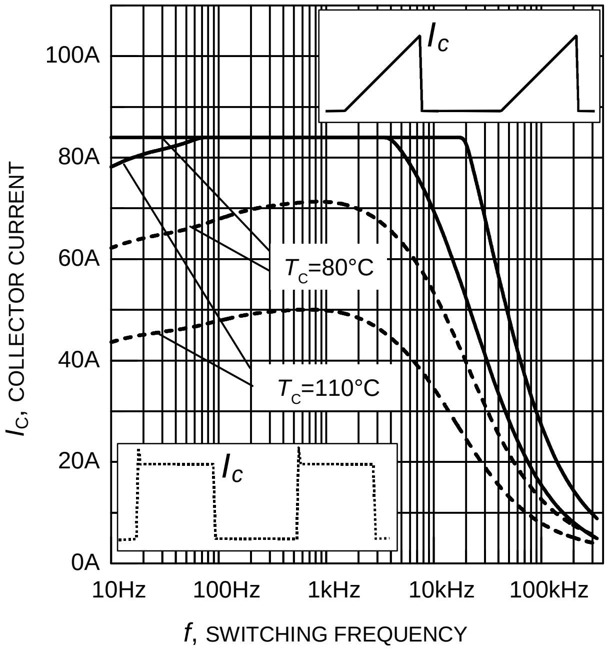



**Figure 1. Collector current as a function of switching frequency**
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 22\Omega$)

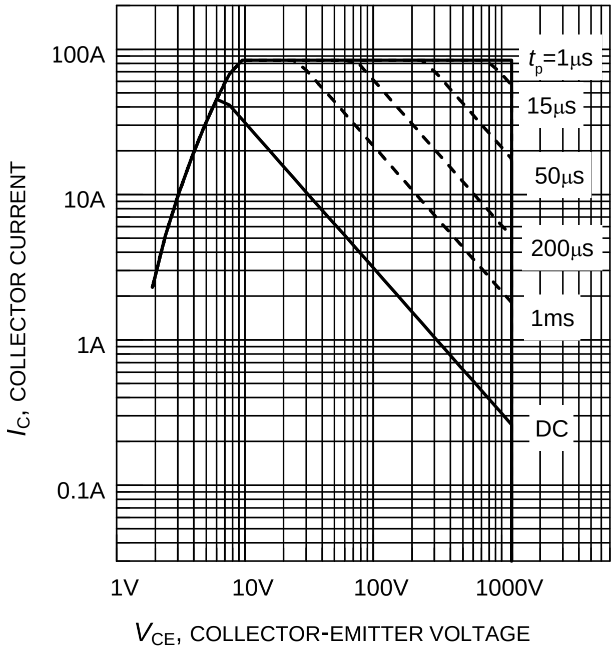



**Figure 2. Safe operating area**
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$)

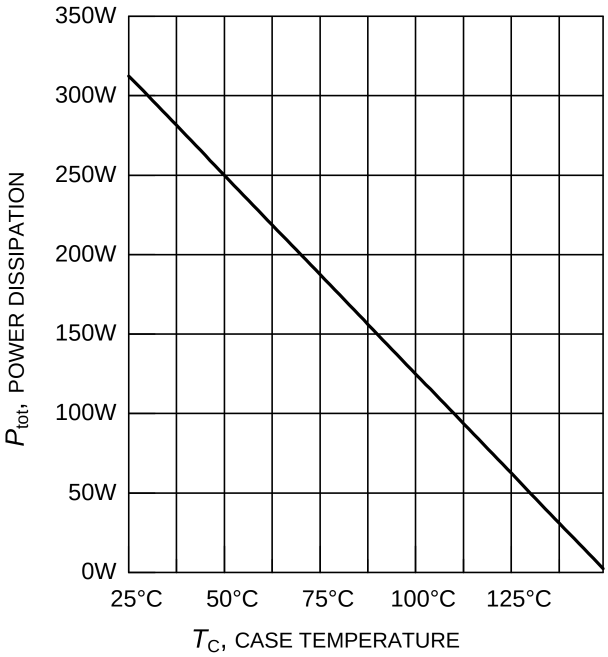



**Figure 3. Power dissipation as a function of case temperature**
($T_j \leq 150°C$)

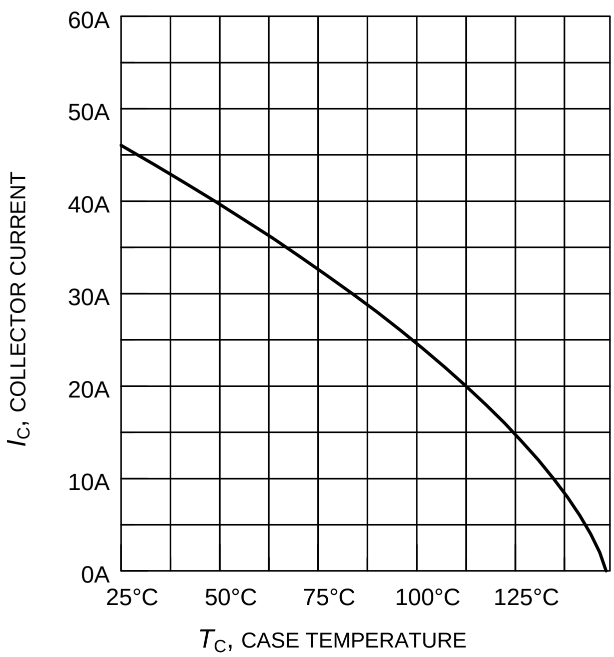



**Figure 4. Collector current as a function of case temperature**
($V_{GE} \leq 15V$, $T_j \leq 150°C$)

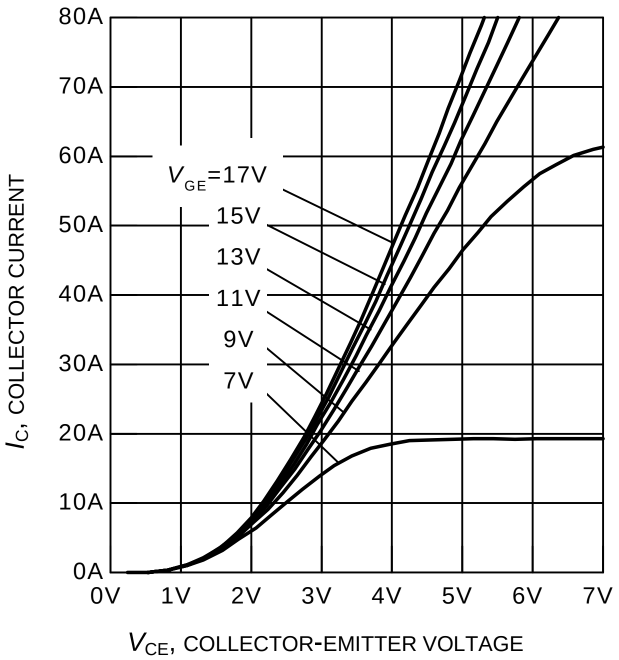



**Figure 5. Typical output characteristics**
($T_j$ = 25°C)

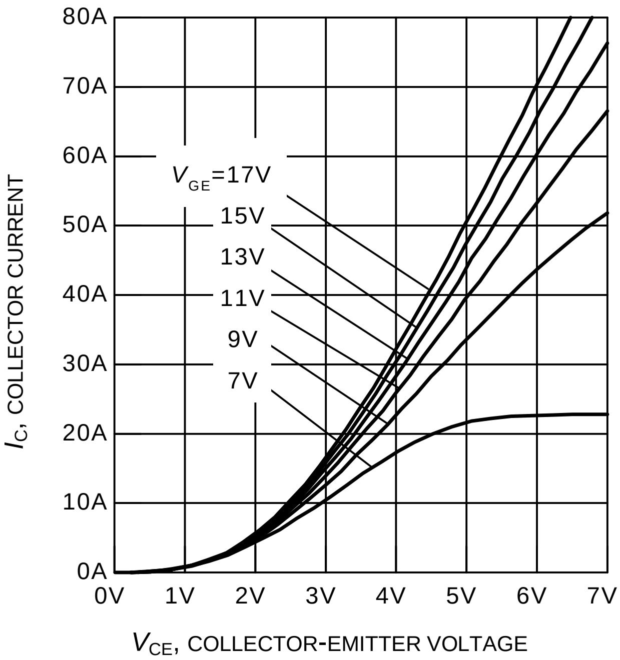



**Figure 6. Typical output characteristics**
($T_j$ = 150°C)

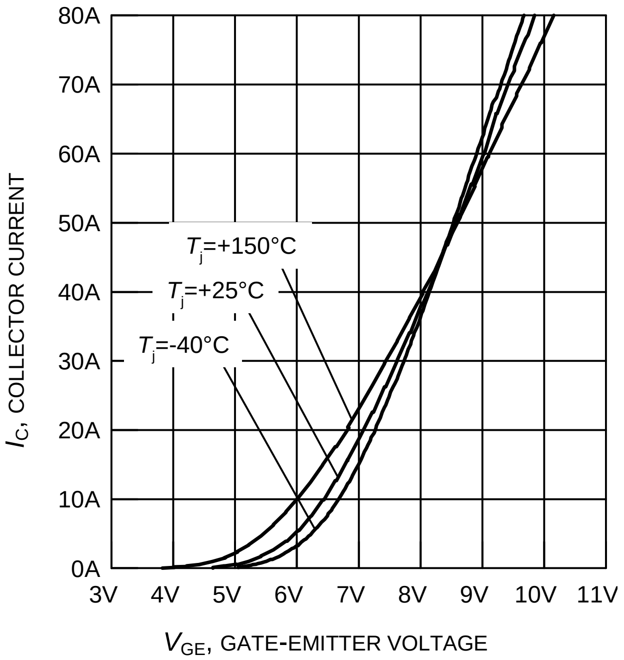



**Figure 7. Typical transfer characteristics**
($V_{CE}$ = 20V)

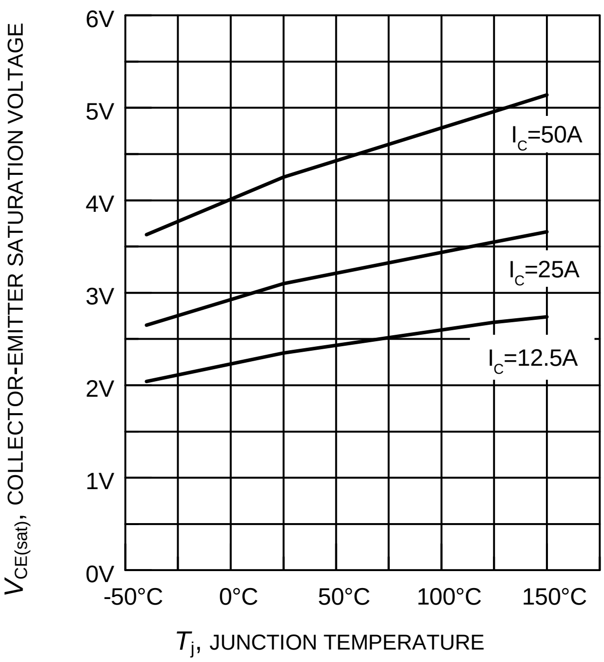



**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$ = 15V)

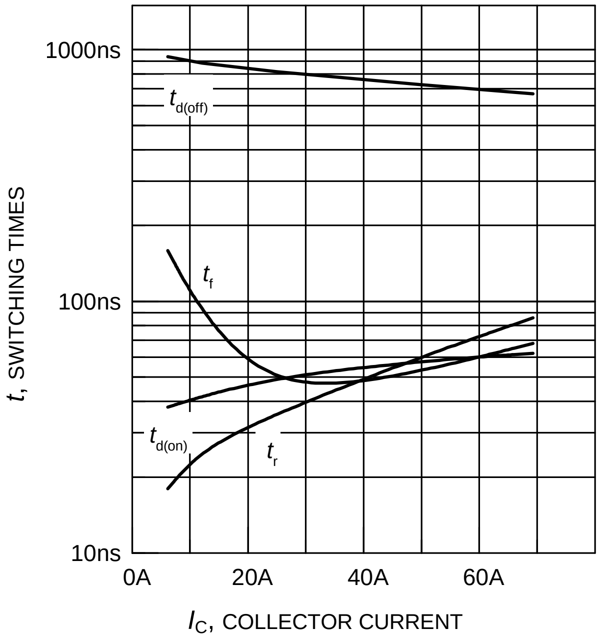



**Figure 9. Typical switching times as a function of collector current**
(inductive load, $T_j$ = 150°C, $V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 22Ω, dynamic test circuit in Fig.E )

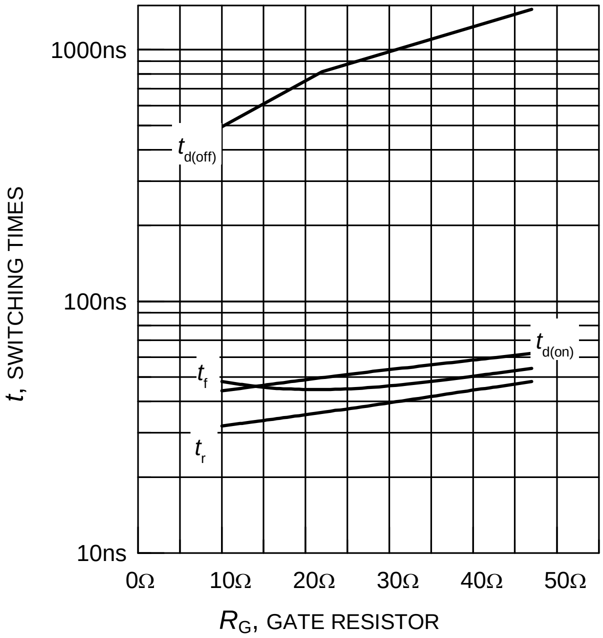



**Figure 10. Typical switching times as a function of gate resistor**
(inductive load, $T_j$ = 150°C, $V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 25A, dynamic test circuit in Fig.E )

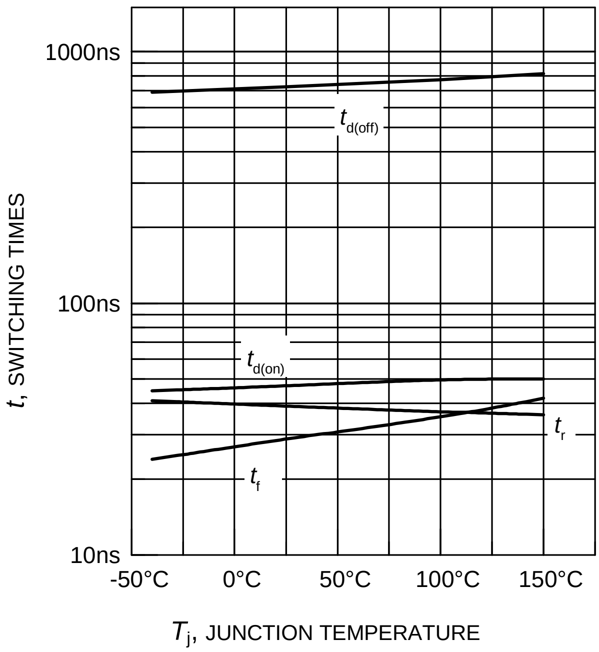



**Figure 11. Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 25A, $R_G$ = 22Ω, dynamic test circuit in Fig.E )

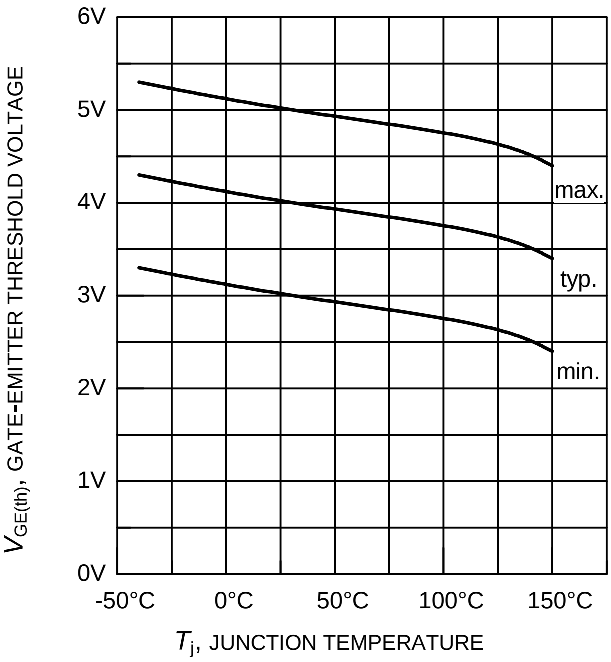



**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
($I_C$ = 0.3mA)

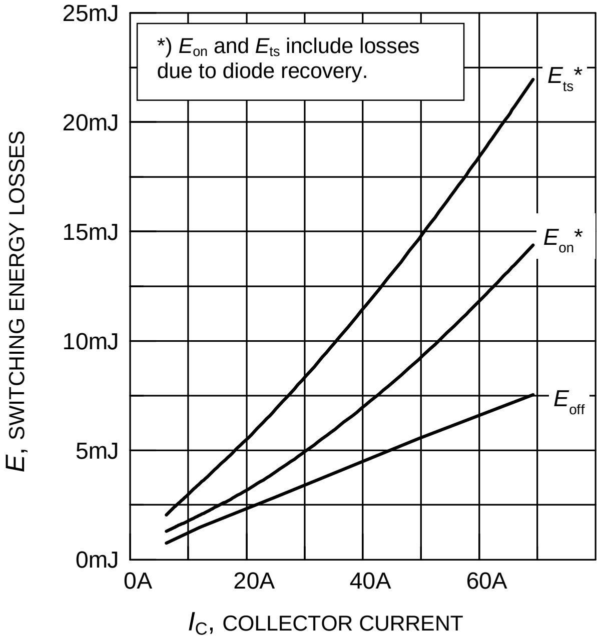



**Figure 13. Typical switching energy losses as a function of collector current**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 22Ω,
dynamic test circuit in Fig.E )

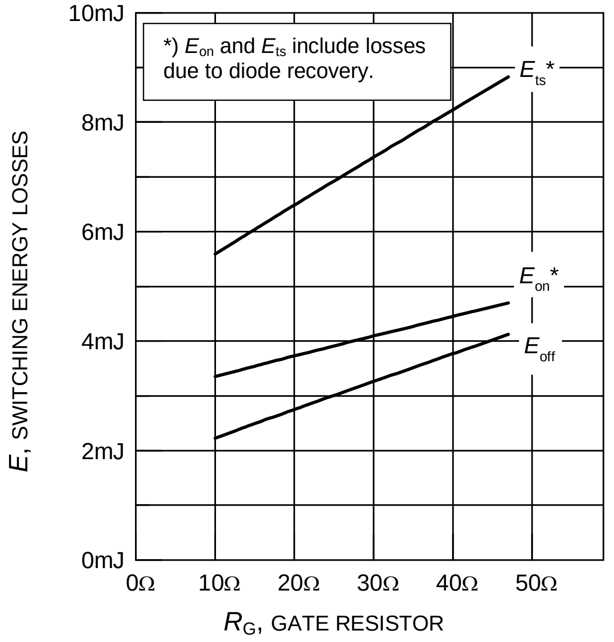



**Figure 14. Typical switching energy losses as a function of gate resistor**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 25A,
dynamic test circuit in Fig.E )

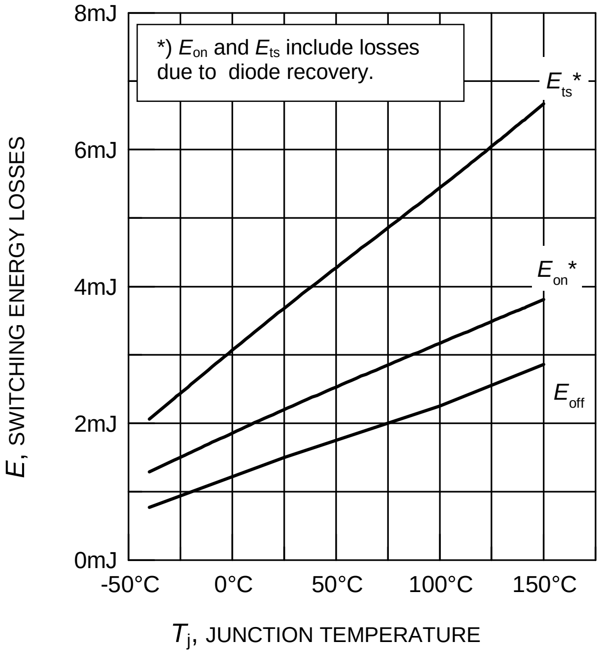



**Figure 15. Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}$ = 800V,
$V_{GE}$ = +15V/0V, $I_C$ = 25A, $R_G$ = 22Ω,
dynamic test circuit in Fig.E )

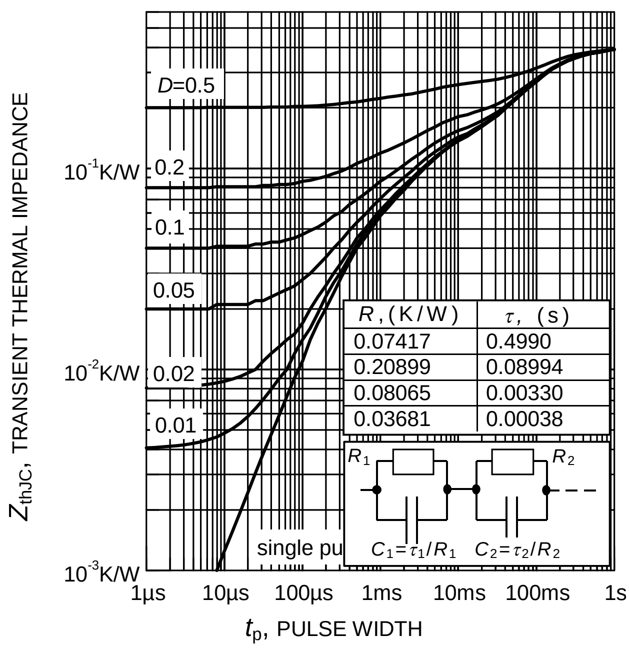



**Figure 16. IGBT transient thermal impedance as a function of pulse width**
($D = t_p / T$)

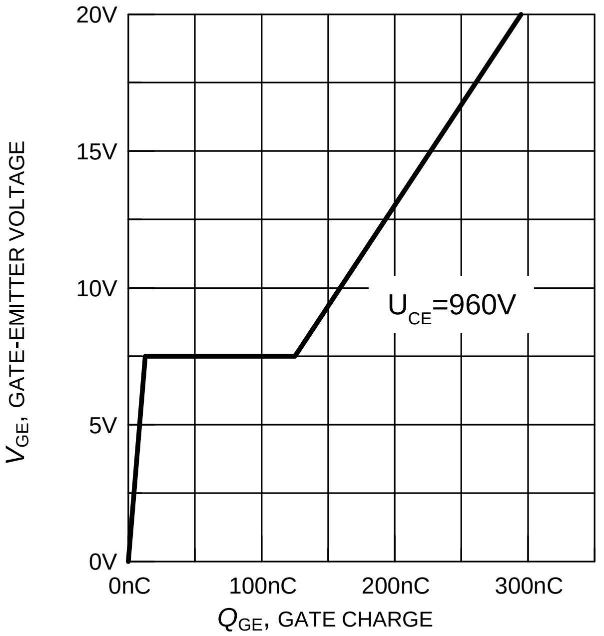



**Figure 17. Typical gate charge**
($I_C$ = 25A)

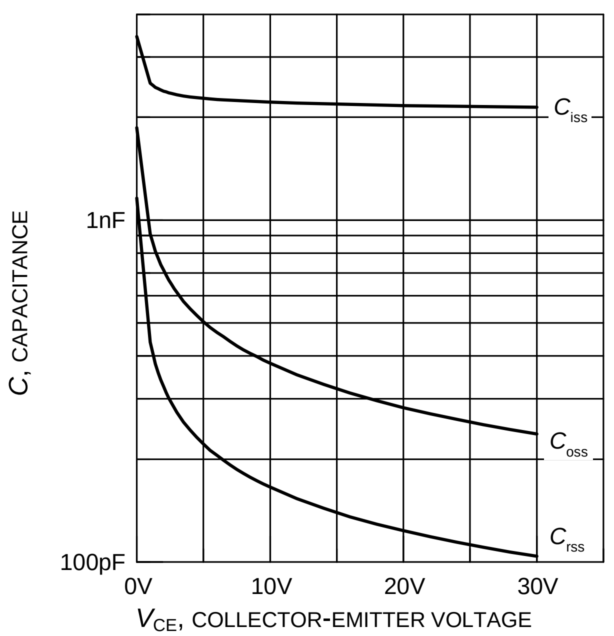



**Figure 18. Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$ = 0V, $f$ = 1MHz)

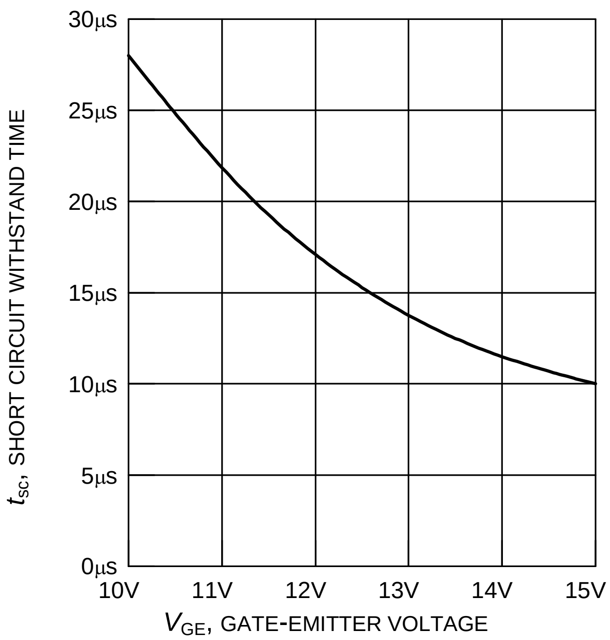



**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$ = 1200V, start at $T_j$ = 25°C)

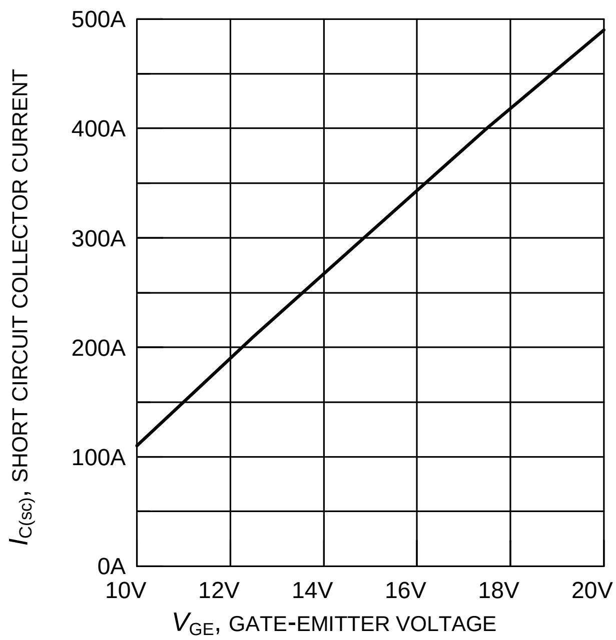



**Figure 20. Typical short circuit collector current as a function of gate-emitter voltage**
(100V≤$V_{CE}$ ≤1200V, $T_C$ = 25°C, $T_j$ ≤ 150°C)

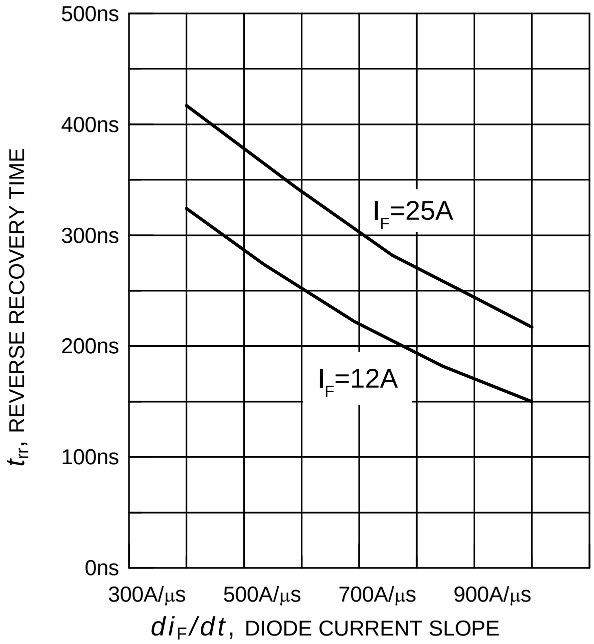



**Figure 21. Typical reverse recovery time as a function of diode current slope**
($V_R$ = 800V, $T_j$ = 150°C, dynamic test circuit in Fig.E )

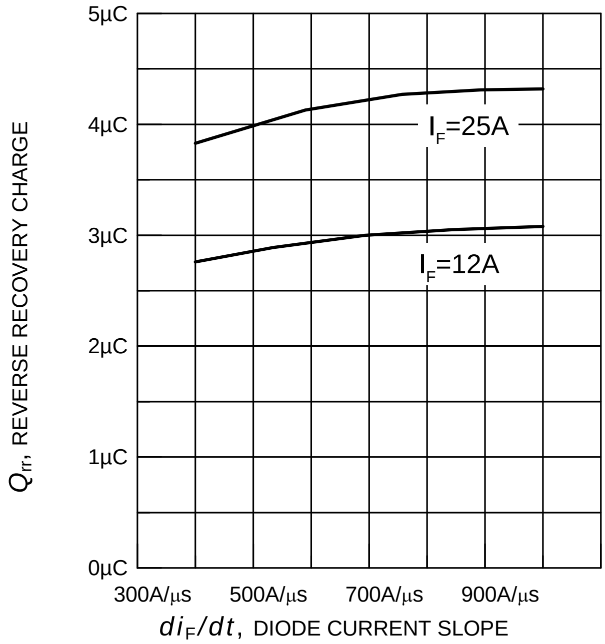



**Figure 22. Typical reverse recovery charge as a function of diode current slope**
($V_R$ = 800V, $T_j$ = 150°C, dynamic test circuit in Fig.E )

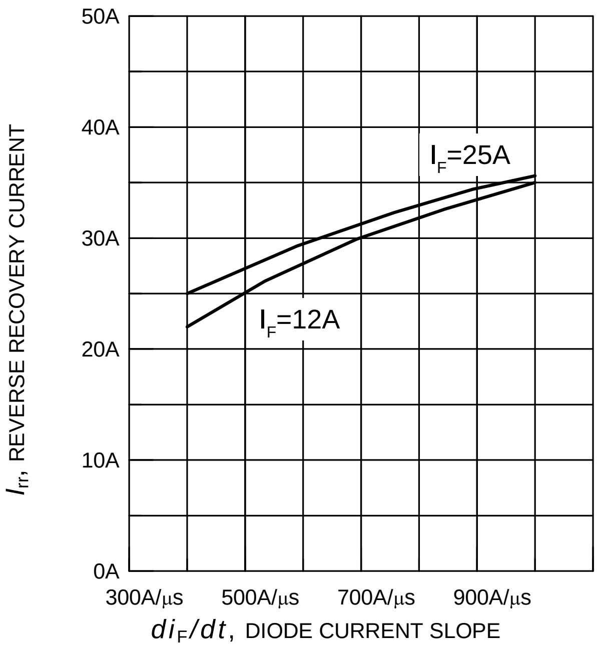



**Figure 23. Typical reverse recovery current as a function of diode current slope**
($V_R$ = 800V, $T_j$ = 150°C, dynamic test circuit in Fig.E )

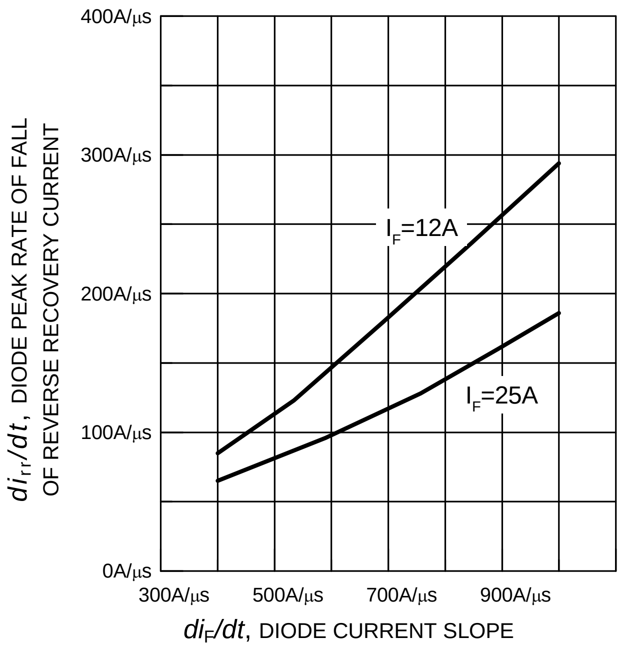



**Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
($V_R$ = 800V, $T_j$ = 150°C, dynamic test circuit in Fig.E )

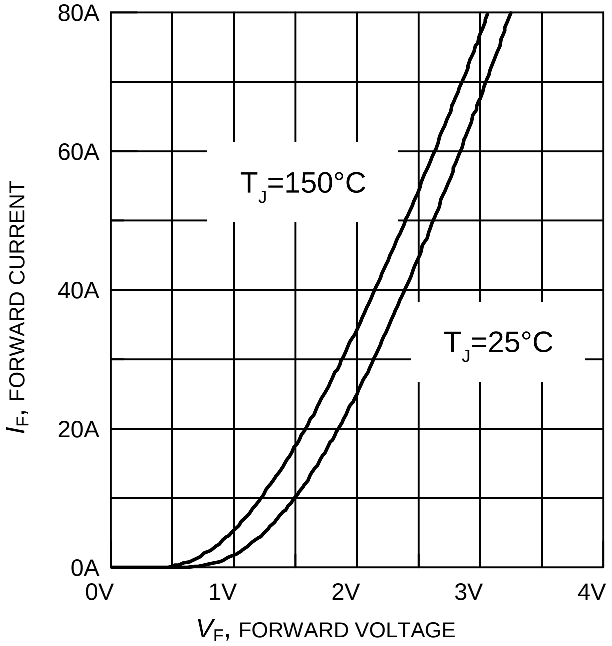



**Figure 25. Typical diode forward current as a function of forward voltage**

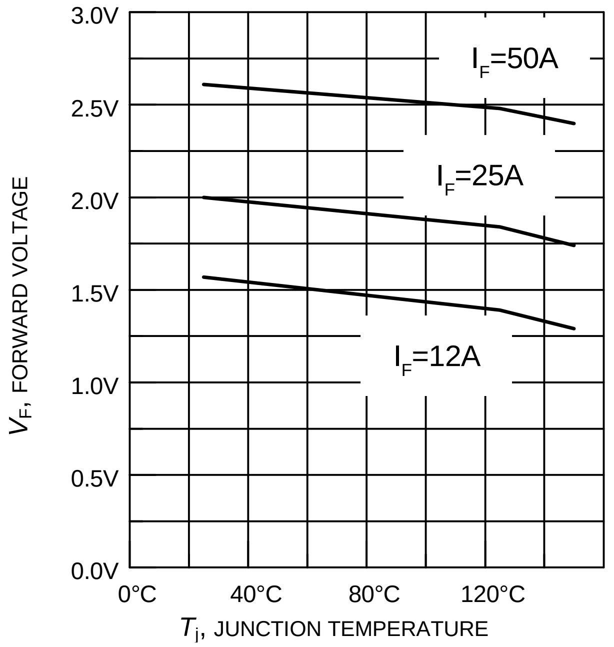



**Figure 26. Typical diode forward voltage as a function of junction temperature**

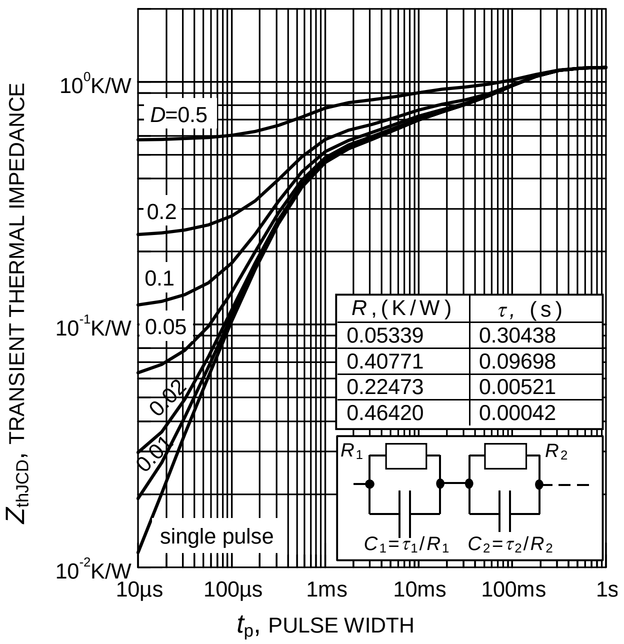



**Figure 27. Diode transient thermal impedance as a function of pulse width**
($D = t_p / T$)

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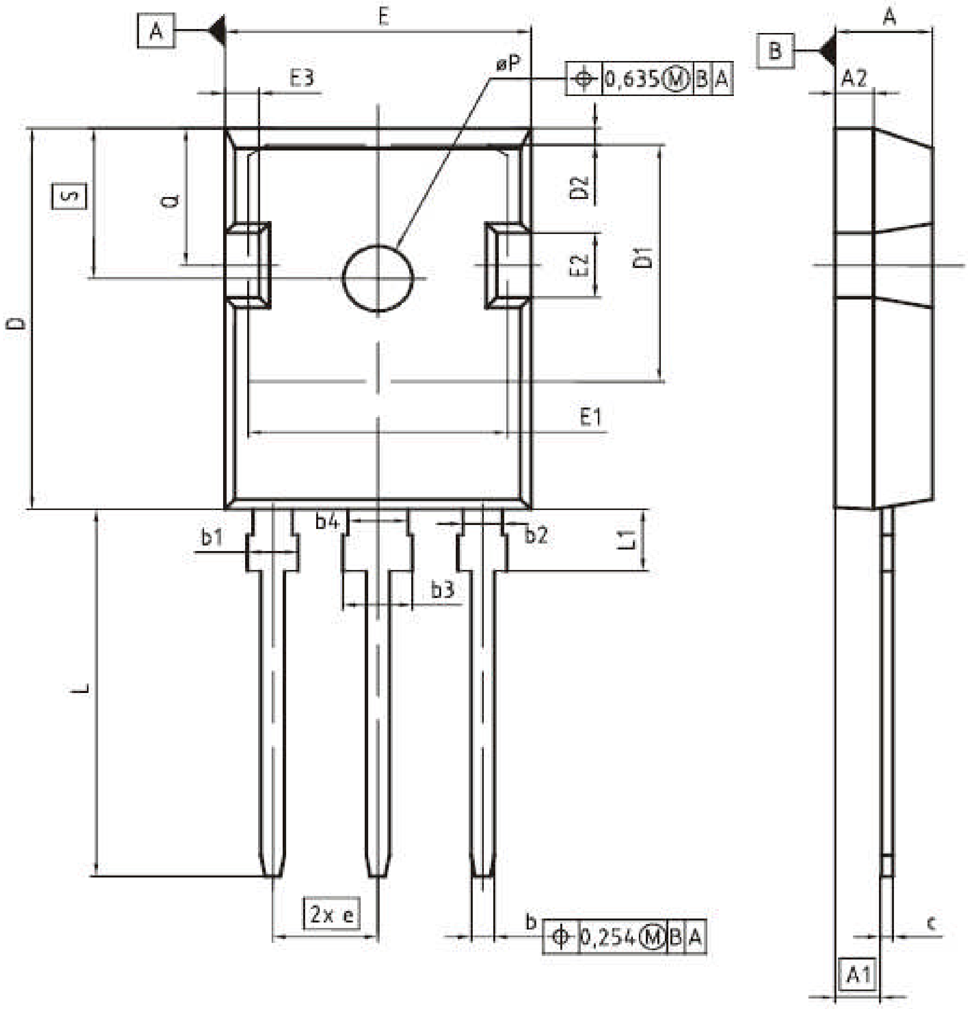


| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4,83 | 5,21 | 0,190 | 0,205 |
| A1 | 2,27 | 2,54 | 0,089 | 0,100 |
| A2 | 1,85 | 2,16 | 0,073 | 0,085 |
| b | 1,07 | 1,33 | 0,042 | 0,052 |
| b1 | 1,90 | 2,41 | 0,075 | 0,095 |
| b2 | 1,90 | 2,16 | 0,075 | 0,085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

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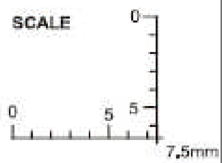
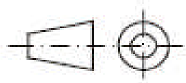
SCALE




EUROPEAN PROJECTION



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05

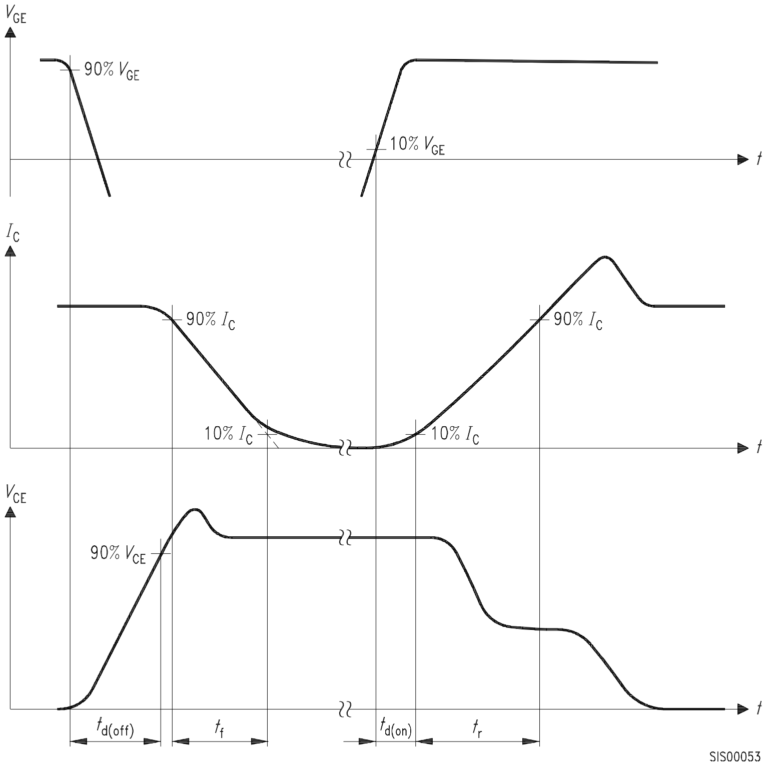


Figure A. Definition of switching times

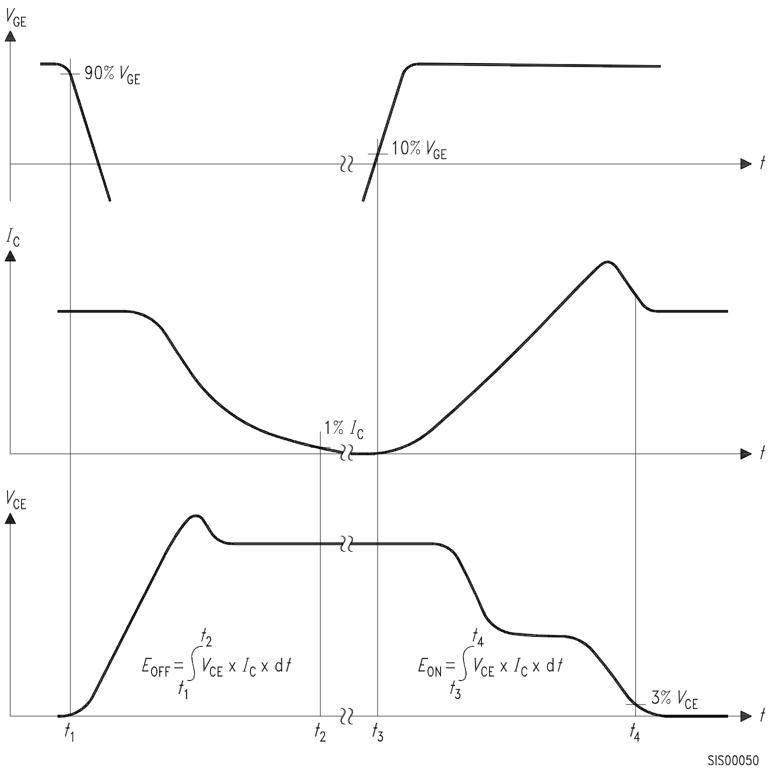


Figure B. Definition of switching losses

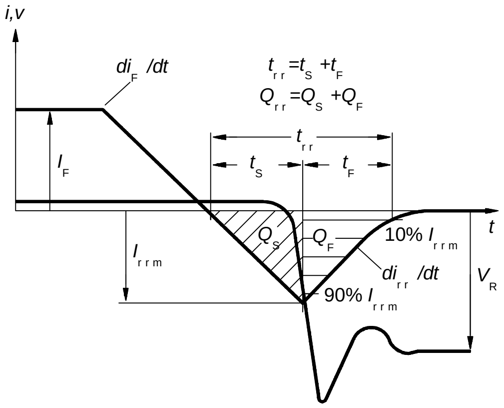


Figure C. Definition of diodes switching characteristics

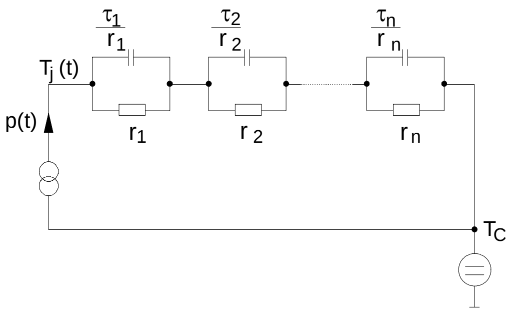


Figure D. Thermal equivalent circuit

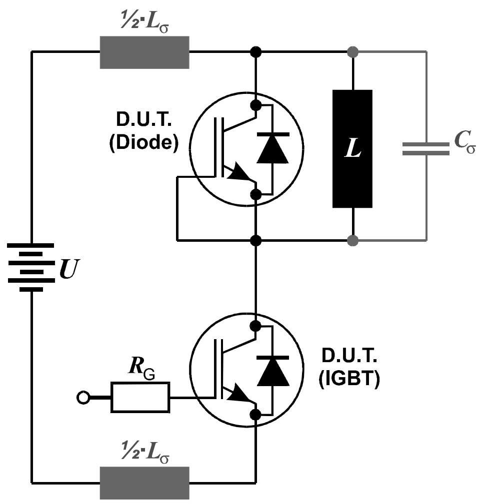


**Figure E. Dynamic test circuit**
Leakage inductance $L_{\sigma}$=180nH,
and stray capacity $C_{\sigma}$ =40pF.

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