# SGB02N120
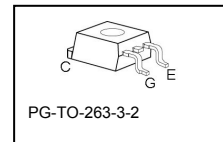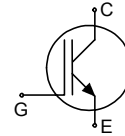
## Fast IGBT in NPT-technology

- Lower $E_{off}$ 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

- Qualified according to JEDEC[1] for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

PG-TO-263-3-2

| Type | $V_{CE}$ | $I_C$ | $E_{off}$ | $T_j$ | Marking | Package |
|------|------|------|------|------|---------|---------|
| SGB02N120 | 1200V | 2A | 0.11mJ | 150°C | GB02N120 | PG-TO-263-3-2 |

## Maximum Ratings

| Parameter | Symbol | Value | Unit |
|-----------|--------|-------|------|
| Collector-emitter voltage | $V_{CE}$ | 1200 | V |
| DC collector current | $I_C$ | | A |
| $T_C$ = 25°C | | 6.2 | |
| $T_C$ = 100°C | | 2.8 | |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$ | $I_{Cpuls}$ | 9.6 | |
| Turn off safe operating area $V_{CE} \le$ 1200V, $T_j \le$ 150°C | - | 9.6 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Avalanche energy, single pulse $I_C$ = 2A, $V_{CC}$ = 50V, $R_{GE}$ = 25Ω, start at $T_j$ = 25°C | $E_{AS}$ | 10 | mJ |
| Short circuit withstand time[2] $V_{GE}$ = 15V, 100V $\le V_{CC} \le$ 1200V, $T_j \le$ 150°C | $t_{SC}$ | 10 | µs |
| Power dissipation $T_C$ = 25°C | $P_{tot}$ | 62 | W |
| Operating junction and storage temperature | $T_j$ , $T_{stg}$ | -55...+150 | °C |
| Soldering temperature (reflow soldering, MSL1) | $T_s$ | 245 | |

[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 | $R_{thJC}$ | | 2.0 | K/W |
| 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, $I_C$=100µA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15V, $I_C$=2A | | | | |
| | | $T_j$=25°C | 2.5 | 3.1 | 3.6 | |
| | | $T_j$=150°C | - | 3.7 | 4.3 | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$=100µA, $V_{CE}$=$V_{GE}$ | 3 | 4 | 5 | |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$=1200V, $V_{GE}$=0V | | | | µA |
| | | $T_j$=25°C | - | - | 25 | |
| | | $T_j$=150°C | - | - | 100 | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$=20V, $I_C$=2A | | 1.5 | - | S |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{CE}$=25V, | - | 205 | 250 | pF |
| Output capacitance | $C_{oss}$ | $V_{GE}$=0V, | - | 20 | 25 | |
| Reverse transfer capacitance | $C_{rss}$ | $f$=1MHz | - | 12 | 14 | |
| Gate charge | $Q_{Gate}$ | $V_{CC}$=960V, $I_C$=2A $V_{GE}$=15V | - | 11 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | | - | 7 | - | nH |
| Short circuit collector current[2] | $I_{C(SC)}$ | $V_{GE}$=15V, $t_{SC}$≤10µs 100V≤$V_{CC}$≤1200V, $T_j$ ≤ 150°C | - | 24 | - | A |

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

# SGB02N120

**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, | - | 23 | 30 | ns |
| Rise time | $t_r$ | $V_{CC}$=800V, $I_C$=2A, | - | 16 | 21 | |
| Turn-off delay time | $t_{d(off)}$ | $V_{GE}$=15V/0V, | - | 260 | 340 | |
| Fall time | $t_f$ | $R_G$=91$\Omega$, | - | 61 | 80 | |
| Turn-on energy | $E_{on}$ | $L_\sigma^{1)}$=180nH, $C_\sigma^{1)}$=40pF | - | 0.16 | 0.21 | mJ |
| Turn-off energy | $E_{off}$ | Energy losses include "tail" and diode reverse recovery. | - | 0.06 | 0.08 | |
| Total switching energy | $E_{ts}$ | | - | 0.22 | 0.29 | |

**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 | - | 26 | 31 | ns |
| Rise time | $t_r$ | $V_{CC}$=800V, | - | 14 | 17 | |
| Turn-off delay time | $t_{d(off)}$ | $I_C$=2A, | - | 290 | 350 | |
| Fall time | $t_f$ | $V_{GE}$=15V/0V, | - | 85 | 102 | |
| Turn-on energy | $E_{on}$ | $R_G$=91$\Omega$, $L_\sigma^{1)}$=180nH, $C_\sigma^{1)}$=40pF | - | 0.27 | 0.33 | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.11 | 0.15 | |
| Total switching energy | $E_{ts}$ | Energy losses include "tail" and diode reverse recovery. | - | 0.38 | 0.48 | |

[1] Leakage inductance $L_\sigma$ and stray capacity $C_\sigma$ due to dynamic test circuit in figure E.
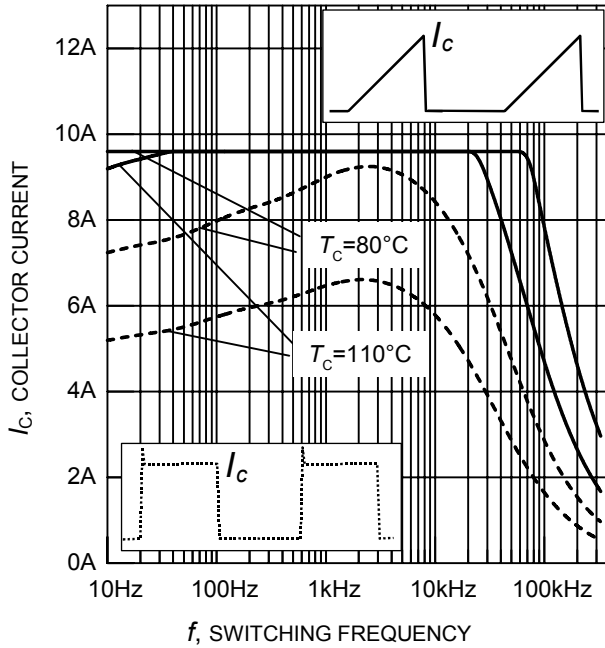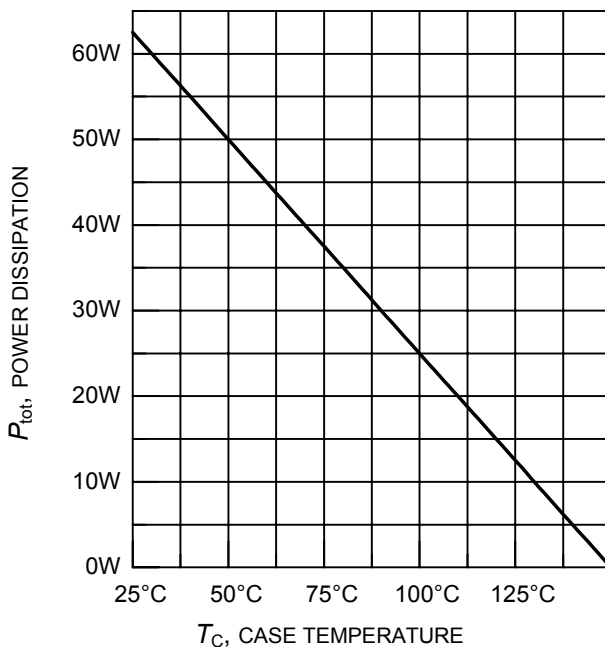
**Figure 1. Collector current as a function of switching frequency**
($T_j \leq 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 91\Omega$)
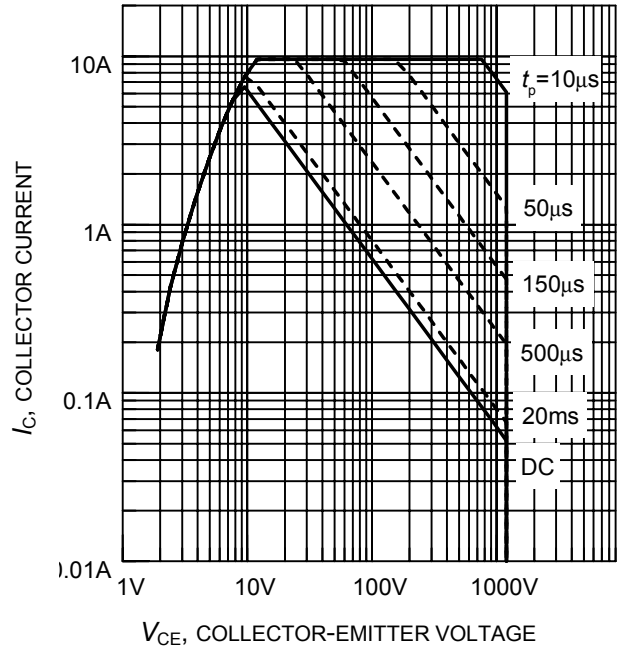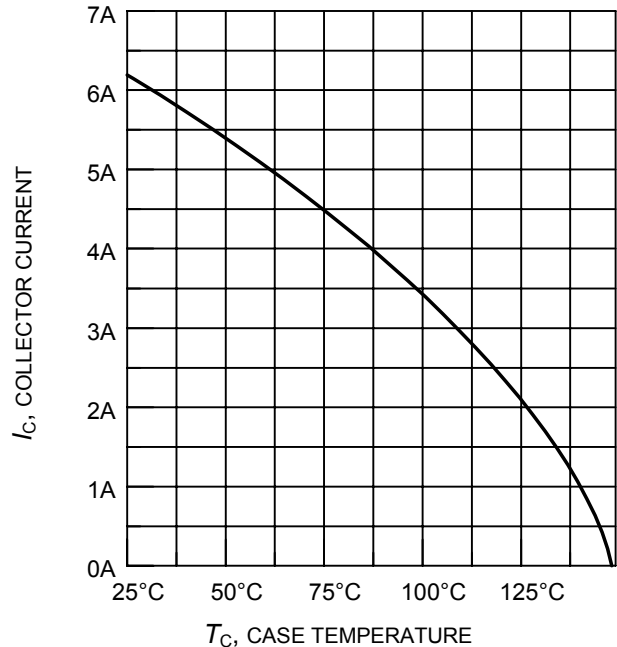


**Figure 2. Safe operating area**
($D = 0$, $T_C = 25°C$, $T_j \leq 150°C$)
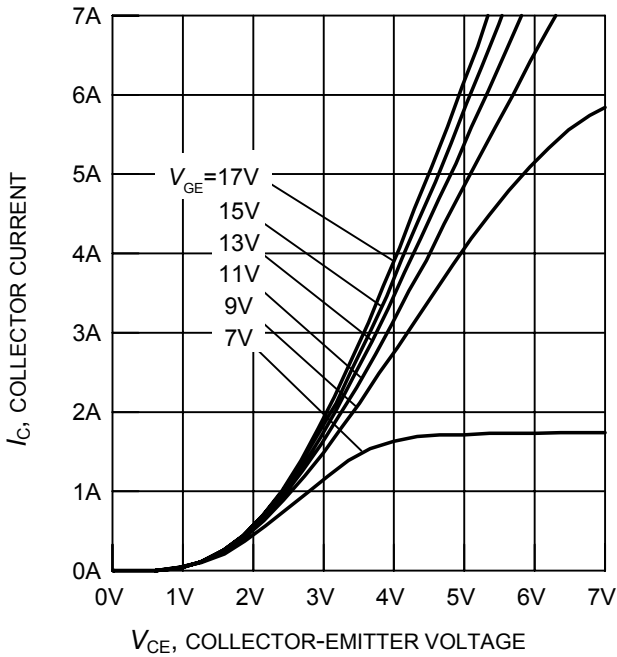


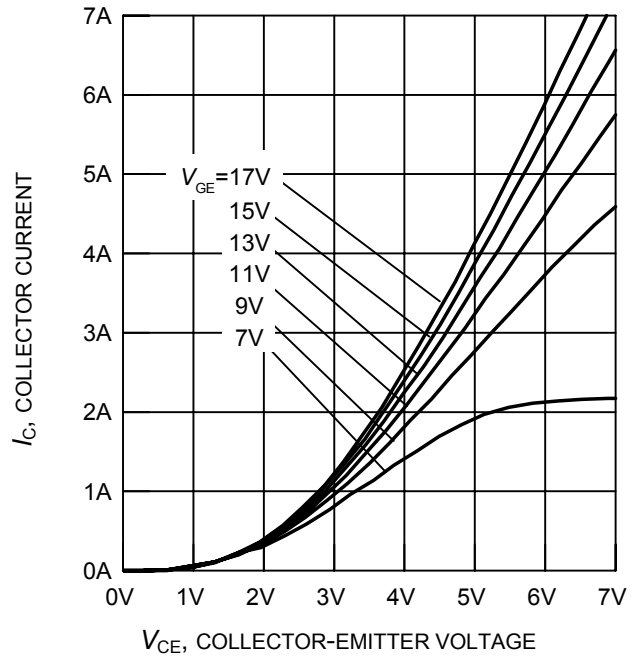**Figure 3. Power dissipation as a function of case temperature**
($T_j \leq 150°C$)



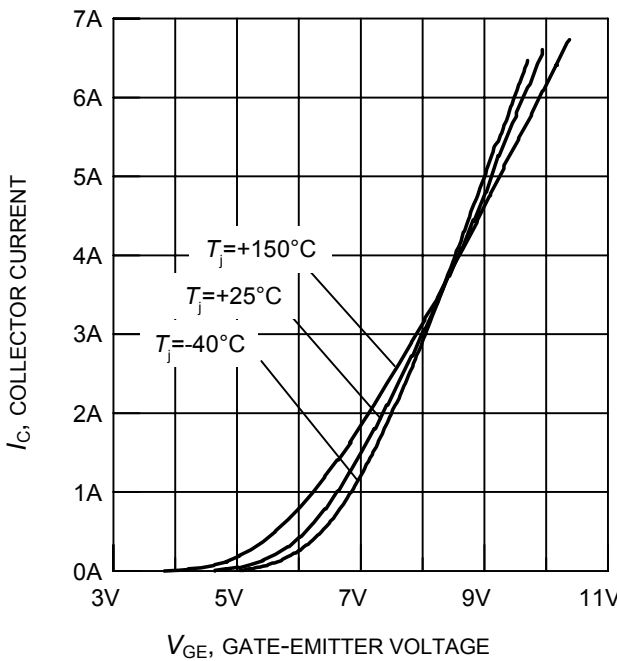**Figure 4. Collector current as a function of case temperature**
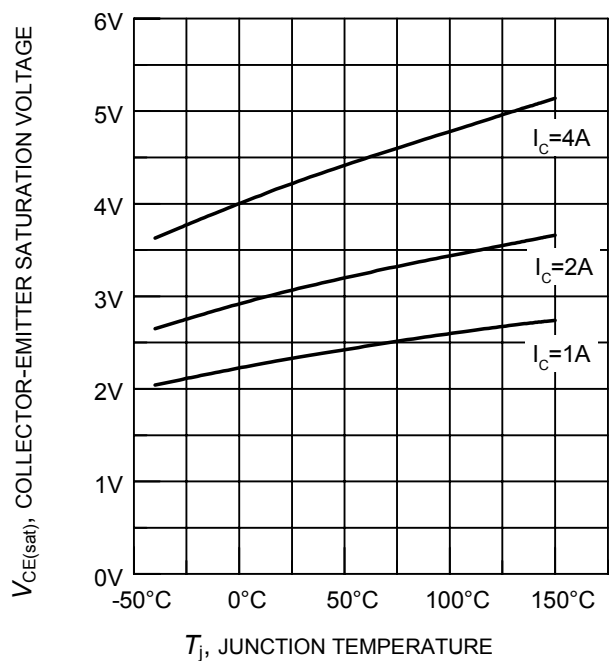($V_{GE} \leq 15V$, $T_j \leq 150°C$)

**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**
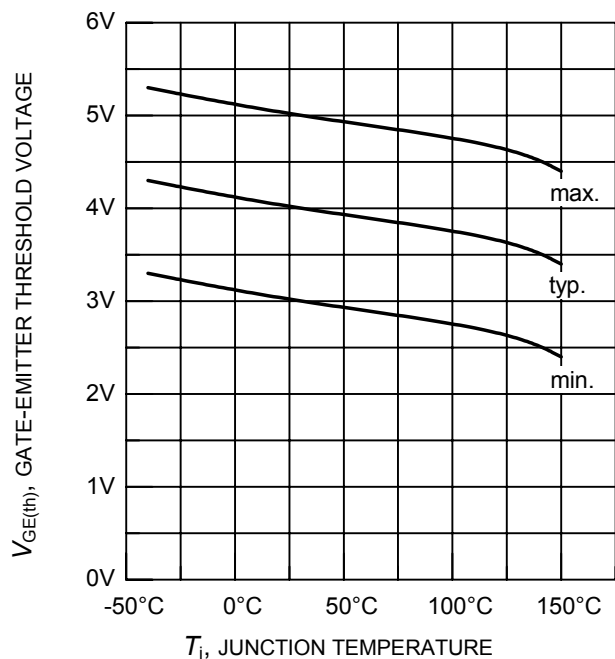($V_{GE}$ = 15V)
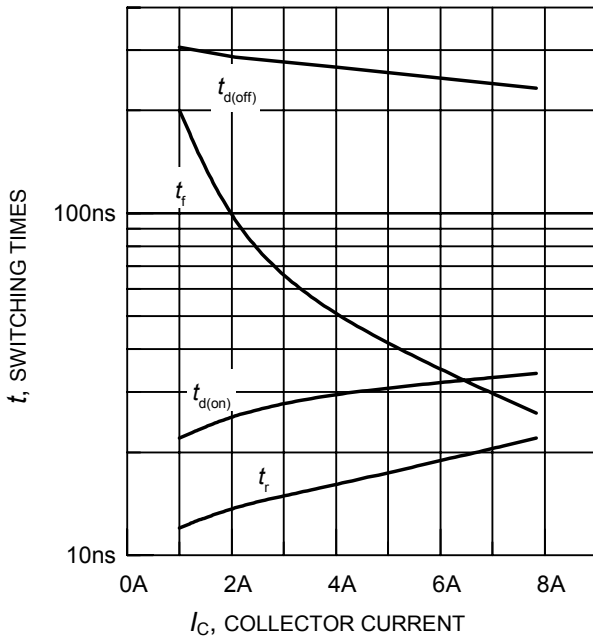
**Figure 9. Typical switching times as a function of collector current**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 91Ω,
dynamic test circuit in Fig.E)
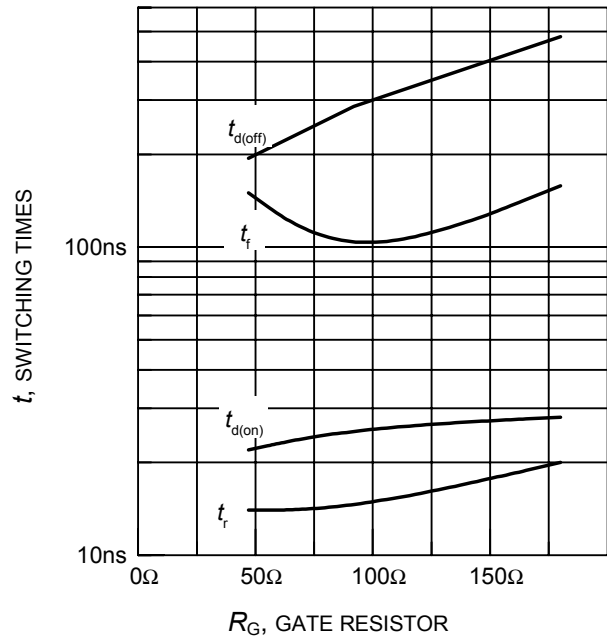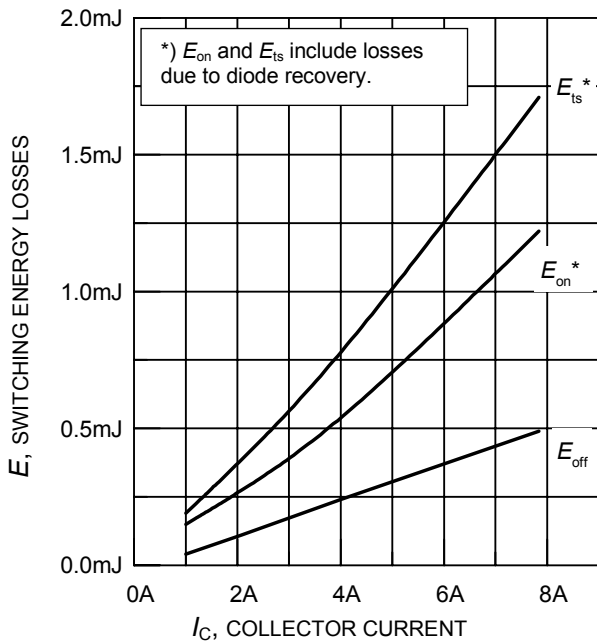


**Figure 10. Typical switching times as a function of gate resistor**
(inductive load, $T_j$ = 150°C,
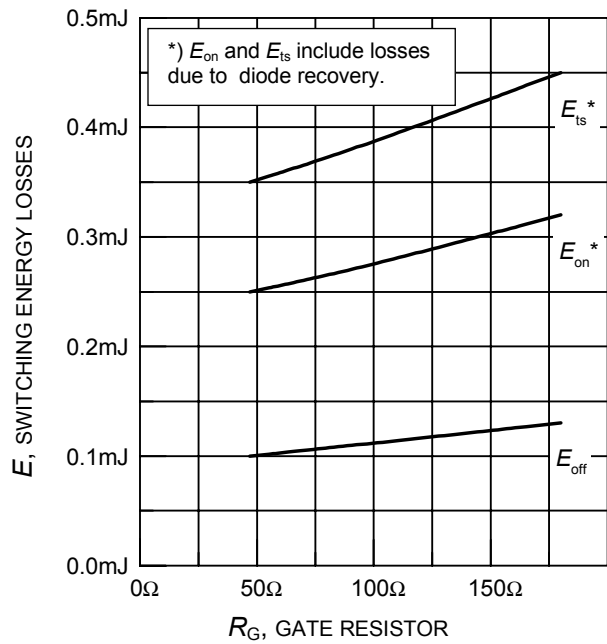$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 2A,
dynamic test circuit in Fig.E)
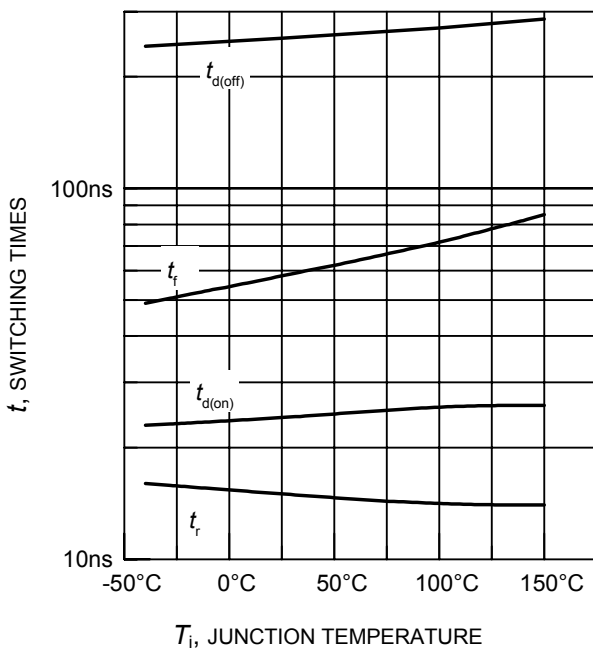


**Figure 11. Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$ = 800V,
$V_{GE}$ = +15V/0V, $I_C$ = 2A, $R_G$ = 91Ω,
dynamic test circuit in Fig.E)
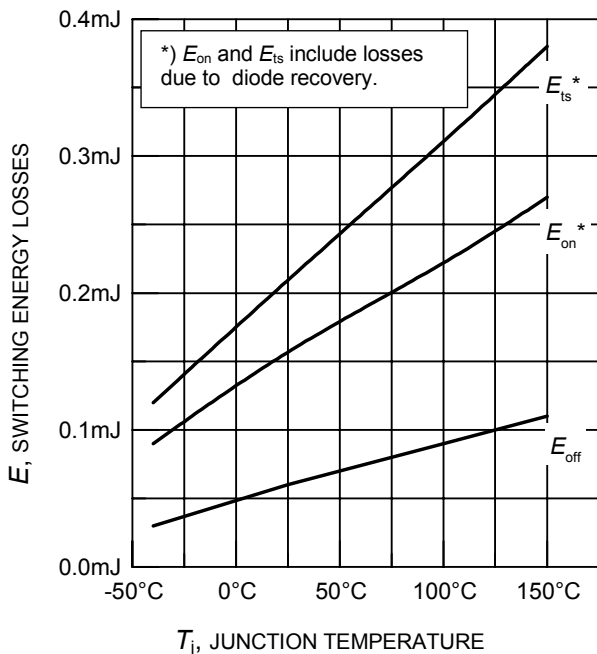


**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
($I_C$ = 0.3mA)

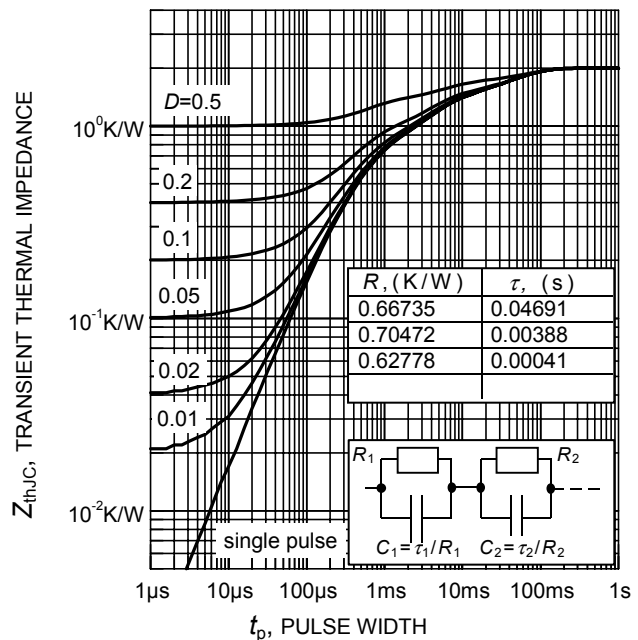**Figure 13. Typical switching energy losses as a function of collector current**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 91Ω,
dynamic test circuit in Fig.E )



**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, $I_C$ = 2A,
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, $I_C$ = 2A, $R_G$ = 91Ω,
dynamic test circuit in Fig.E )



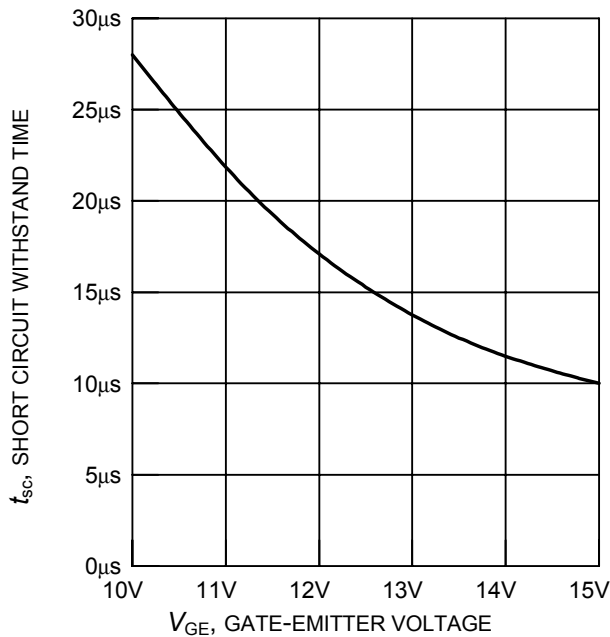| $R$, ( K / W ) | $\tau$, ( s ) |
|---|---|
| 0.66735 | 0.04691 |
| 0.70472 | 0.00388 |
| 0.62778 | 0.00041 |

**Figure 16. IGBT transient thermal impedance as a function of pulse width**
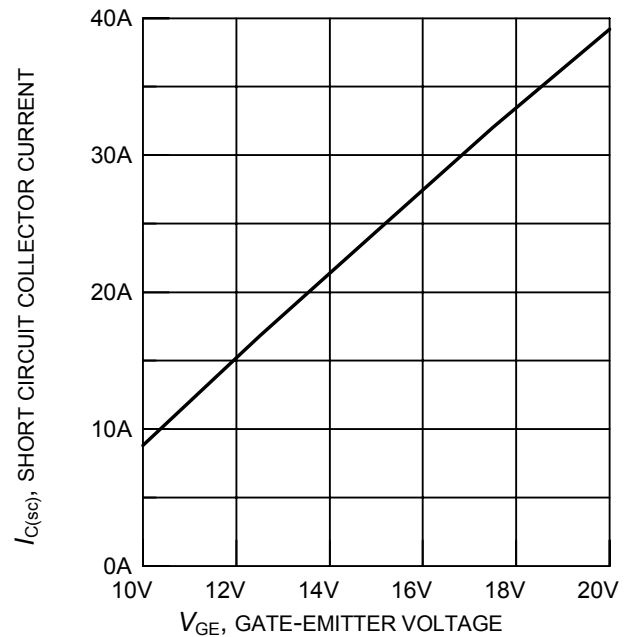($D = t_p / T$)
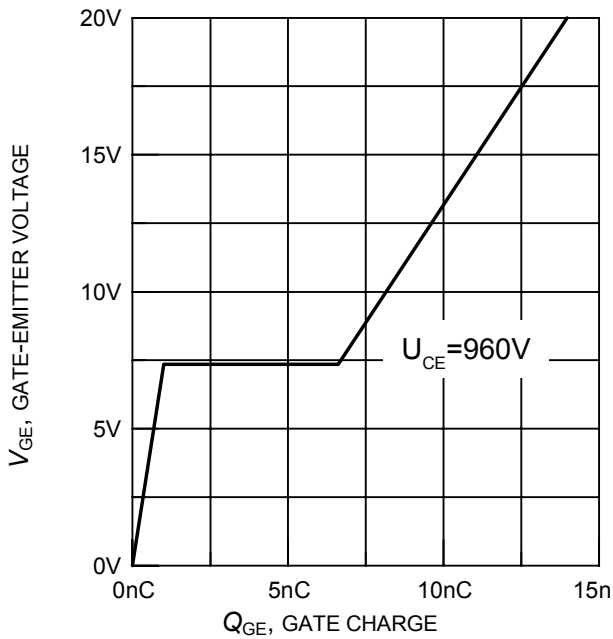
**Figure 17. Typical gate charge**
($I_C$ = 2A)

$U_{CE}$=960V
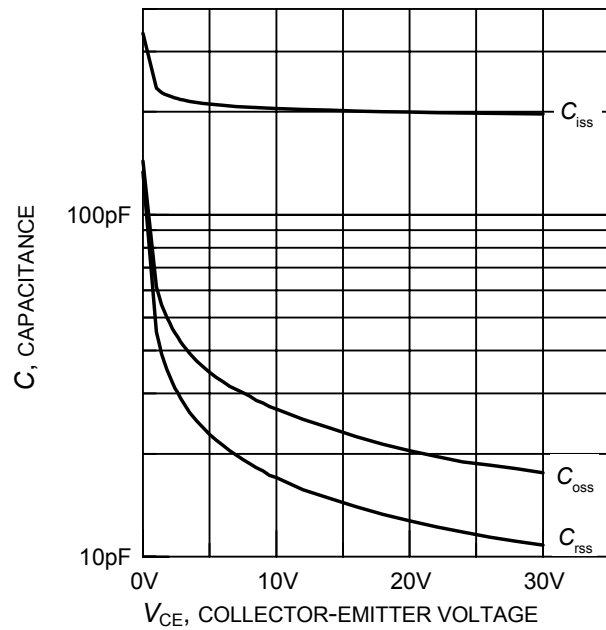
**Figure 18. Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$ = 0V, $f$ = 1MHz)

$C_{iss}$

$C_{oss}$

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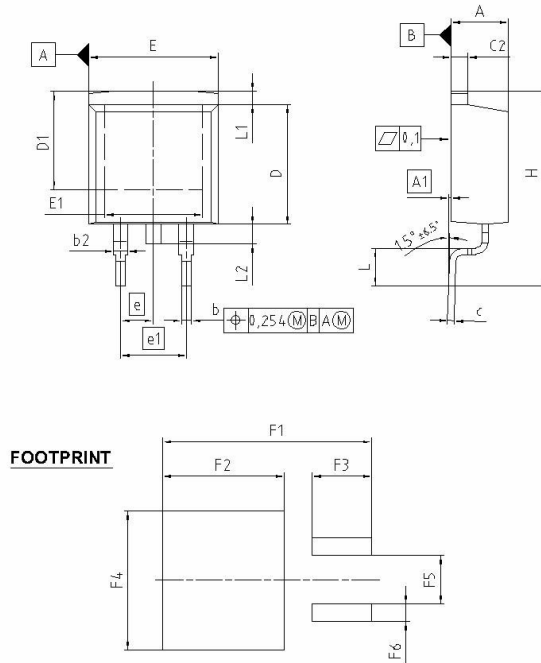
**Figure 19. Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$ = 1200V, start at $T_j$ = 25°C)

**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)

PG-TO263-3-2



**FOOTPRINT**



| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 0.000 | 0.254 | 0.000 | 0.010 |
| b | 0.650 | 0.850 | 0.026 | 0.033 |
| b2 | 0.950 | 1.321 | 0.037 | 0.052 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c2 | 0.170 | 1.400 | 0.046 | 0.055 |
| D | 8.509 | 9.450 | 0.335 | 0.372 |
| D1 | 7.100 | - | 0.280 | - |
| E | 9.800 | 10.312 | 0.386 | 0.406 |
| E1 | 6.500 | | 0.256 | |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 2 | | 2 | |
| H | 14.605 | 15.875 | 0.575 | 0.625 |
| L | 2.200 | 3.000 | 0.087 | 0.118 |
| L1 | - | 1.600 | - | 0.063 |
| L2 | 1.000 | 1.778 | 0.039 | 0.070 |
| F1 | 16.050 | 16.250 | 0.632 | 0.640 |
| F2 | 9.300 | 9.500 | 0.366 | 0.374 |
| F3 | 4.500 | 4.700 | 0.177 | 0.185 |
| F4 | 10.700 | 10.900 | 0.421 | 0.429 |
| F5 | 3.630 | 3.830 | 0.143 | 0.151 |
| F6 | 1.100 | 1.300 | 0.043 | 0.051 |

REFERENCE
JEDEC TO263

SCALE

7.5mm

EUROPEAN PROJECTION

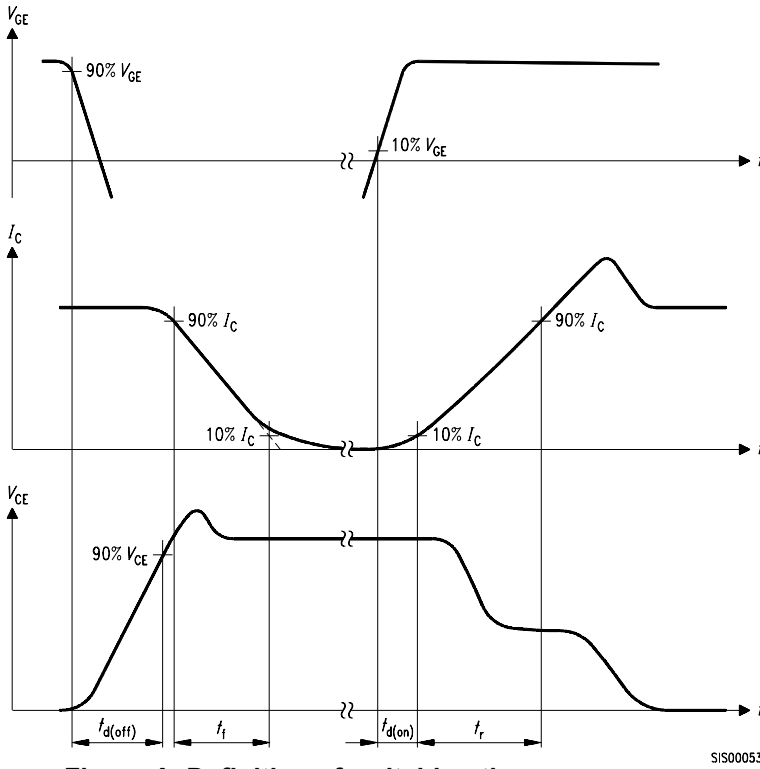ISSUE DATE
12-02-2006

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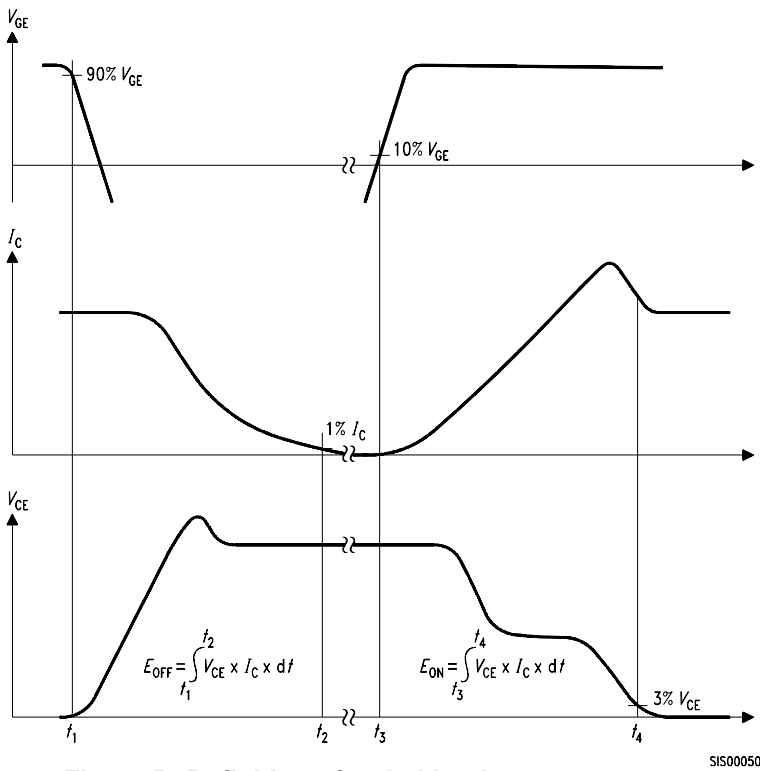TO263_2

Figure A. Definition of switching times

$$E_{OFF} = \int_{t_1}^{t_2} V_{CE} \times I_C \times dt$$

$$E_{ON} = \int_{t_3}^{t_4} V_{CE} \times I_C \times dt$$

Figure B. Definition of switching losses
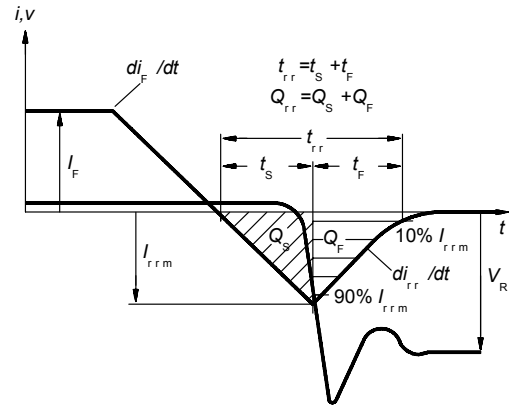
$t_{rr} = t_S + t_F$
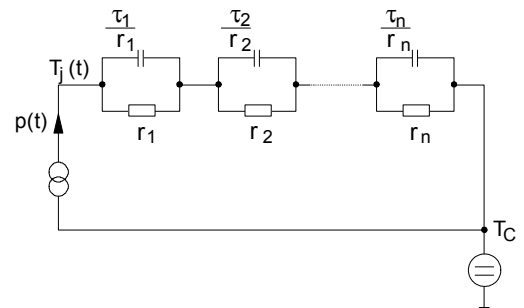$Q_{rr} = Q_S + Q_F$

Figure C. Definition of diodes switching characteristics
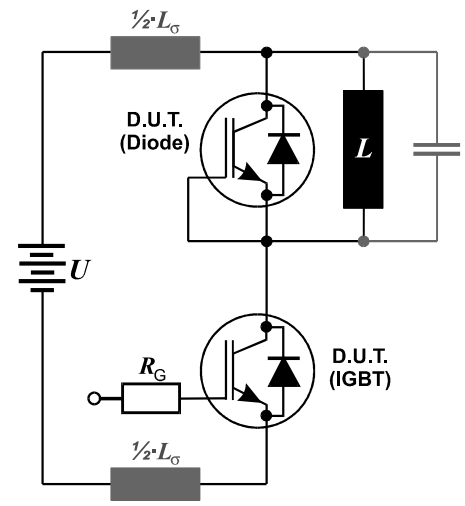
Figure D. Thermal equivalent circuit

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