# IGBT

High speed IGBT in Trench and Fieldstop technology
recommended in combination with SiC Diode IDH15S120

# IGW25N120H3

1200V high speed switching series third generation

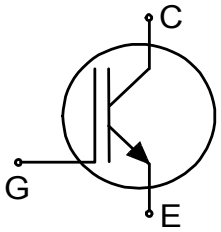
Data sheet

Industrial Power Control

# High speed IGBT in Trench and Fieldstop technology recommended in combination with SiC Diode IDH15S120

**Features:**

TRENCHSTOP™ technology offering
• best in class switching performance: less than 500µJ total switching losses achievable
• very low $V_{CEsat}$
• low EMI
• 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:**

• solar inverters
• uninterruptible power supplies
• welding converters
• converters with high switching frequency

**Package pin definition:**

• Pin 1 - gate
• Pin 2 & backside - collector
• Pin 3 - emitter

Green

Halogen-Free

RoHS

**Key Performance and Package Parameters**

| Type | $V_{CE}$ | $I_C$ | $V_{CEsat}$, $T_{vj}$=25°C | $T_{vjmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IGW25N120H3 | 1200V | 25A | 2.05V | 175°C | G25H1203 | PG-TO247-3 |

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## Maximum ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | 1200 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C$ = 25°C<br>$T_C$ = 100°C | $I_C$ | <br>50.0<br>25.0 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpuls}$ | 100.0 | A |
| Turn off safe operating area $V_{CE} \le 1200V$, $T_{vj} \le 175°C$ | - | 100.0 | A |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Short circuit withstand time<br>$V_{GE}$ = 15.0V, $V_{CC} \le 600V$<br>Allowed number of short circuits < 1000<br>Time between short circuits: ≥ 1.0s<br>$T_{vj}$ = 175°C | $t_{SC}$ | <br><br><br><br>10 | µs |
| Power dissipation $T_C$ = 25°C<br>Power dissipation $T_C$ = 100°C | $P_{tot}$ | 326.0<br>156.0 | 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 | $R_{th(j-c)}$ | | 0.46 | 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, $I_C$ = 0.50mA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = 15.0V, $I_C$ = 25.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C<br>$T_{vj}$ = 175°C | <br>-<br>-<br>- | <br>2.05<br>2.50<br>2.70 | <br>2.40<br>-<br>- | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.85mA, $V_{CE}$ = $V_{GE}$ | 5.0 | 5.8 | 6.5 | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$ = 1200V, $V_{GE}$ = 0V<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | <br>-<br>- | <br>-<br>- | <br>250.0<br>2500.0 | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = 20V | - | - | 600 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$ = 20V, $I_C$ = 25.0A | - | 13.0 | - | 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 | - | 1430 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 95 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 75 | - | |
| Gate charge | $Q_G$ | $V_{CC}$ = 960V, $I_C$ = 25.0A, $V_{GE}$ = 15V | - | 115.0 | - | nC |
| Short circuit collector current<br>Max. 1000 short circuits<br>Time between short circuits: ≥ 1.0s | $I_{C(SC)}$ | $V_{GE}$ = 15.0V, $V_{CC}$ ≤ 600V,<br>$t_{SC}$ ≤ 10µs<br>$T_{vj}$ = 175°C | - | 87 | - | 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,<br>$V_{CC}$ = 600V, $I_C$ = 25.0A,<br>$V_{GE}$ = 0.0/15.0V,<br>$r_G$ = 23.0Ω, $L\sigma$ = 80nH,<br>$C\sigma$ = 67pF<br>$L\sigma$, $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode (IKW25N120H3) reverse recovery. | - | 27 | - | ns |
| Rise time | $t_r$ | | - | 41 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 277 | - | ns |
| Fall time | $t_f$ | | - | 17 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 1.80 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.85 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 2.65 | - | mJ |
| Turn-on energy | $E_{on}$ | $T_{vj}$ = 25°C,<br>$V_{CC}$ = 800V, $I_C$ = 10.0A,<br>$V_{GE}$ = 0.0/15.0V,<br>$r_G$ = 3.0Ω, $L\sigma$ = 80nH,<br>$C\sigma$ = 67pF<br>$L\sigma$, $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode (IDH15S120) reverse recovery. | - | 0.08 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.27 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 0.35 | - | mJ |

**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, $V_{CC}$ = 600V, $I_C$ = 25.0A, $V_{GE}$ = 0.0/15.0V, $r_G$ = 23.0Ω, $L\sigma$ = 80nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode (IKW25N120H3) reverse recovery. | - | 26 | - | ns |
| Rise time | $t_r$ | | - | 35 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 347 | - | ns |
| Fall time | $t_f$ | | - | 50 | - | ns |
| Turn-on energy | $E_{on}$ | | - | 2.60 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.70 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 4.30 | - | mJ |
| Turn-on energy | $E_{on}$ | $T_{vj}$ = 175°C, $V_{CC}$ = 800V, $I_C$ = 10.0A, $V_{GE}$ = 0.0/15.0V, $r_G$ = 3.0Ω, $L\sigma$ = 80nH, $C\sigma$ = 67pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode (IDH15S120) reverse recovery. | - | 0.10 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.62 | - | mJ |
| Total switching energy | $E_{ts}$ | | - | 0.72 | - | mJ |

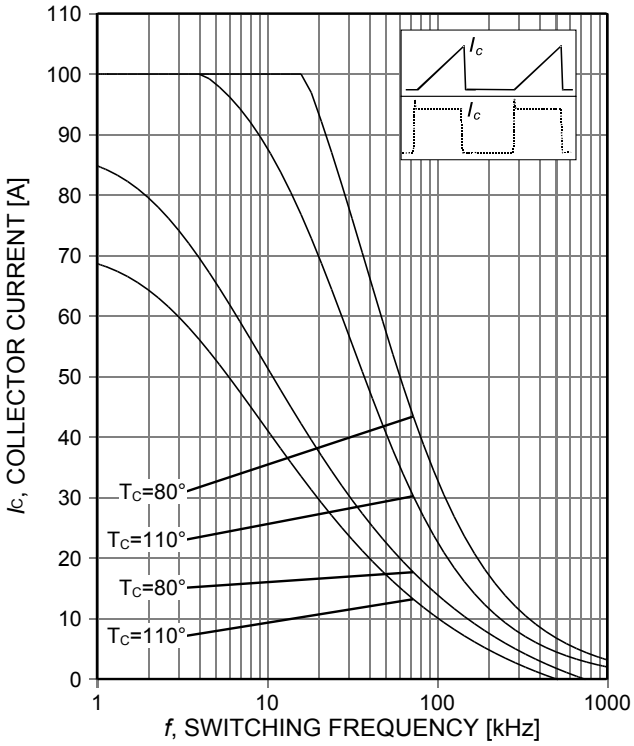



Figure 1. **Collector current as a function of switching frequency**
($T_j$≤175°C, $D$=0.5, $V_{CE}$=600V, $V_{GE}$=15/0V, $r_G$=23Ω)

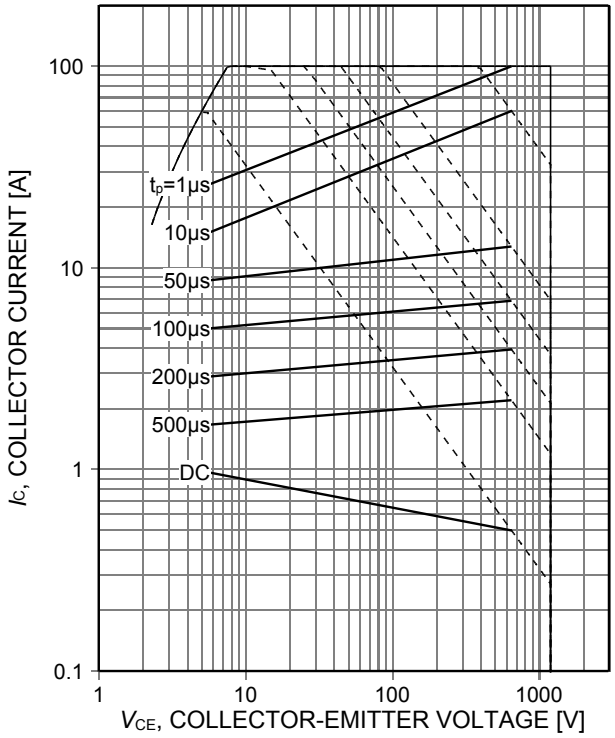



Figure 2. **Forward bias safe operating area**
($D$=0, $T_C$=25°C, $T_j$≤175°C; $V_{GE}$=15V)

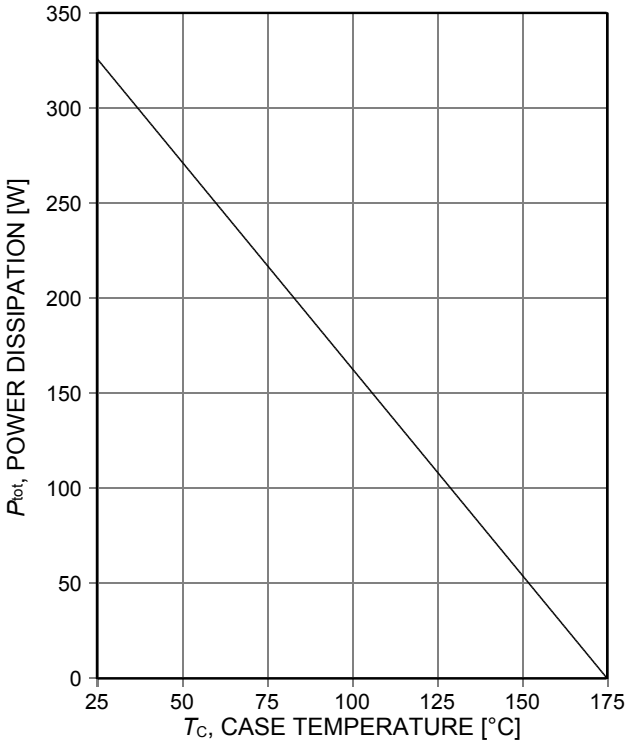



Figure 3. **Power dissipation as a function of case temperature**
($T_j$≤175°C)

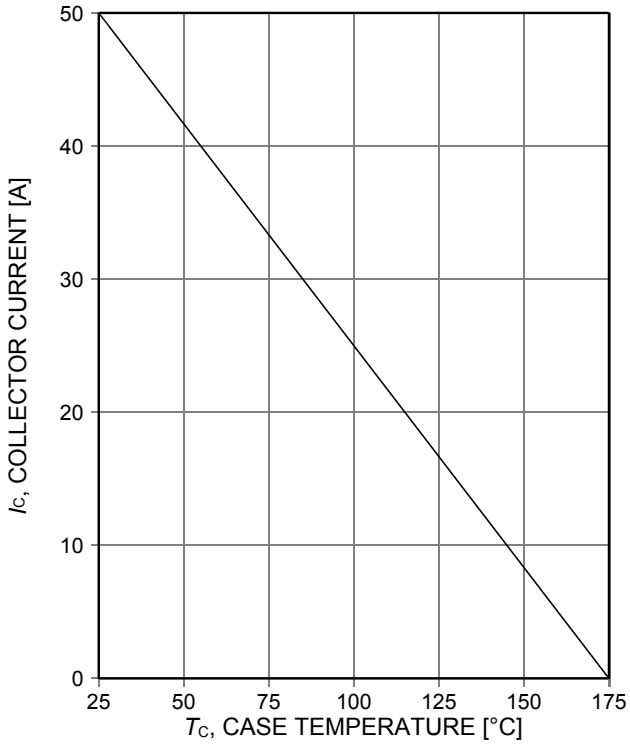



Figure 4. **Collector current as a function of case temperature**
($V_{GE}$≥15V, $T_j$≤175°C)

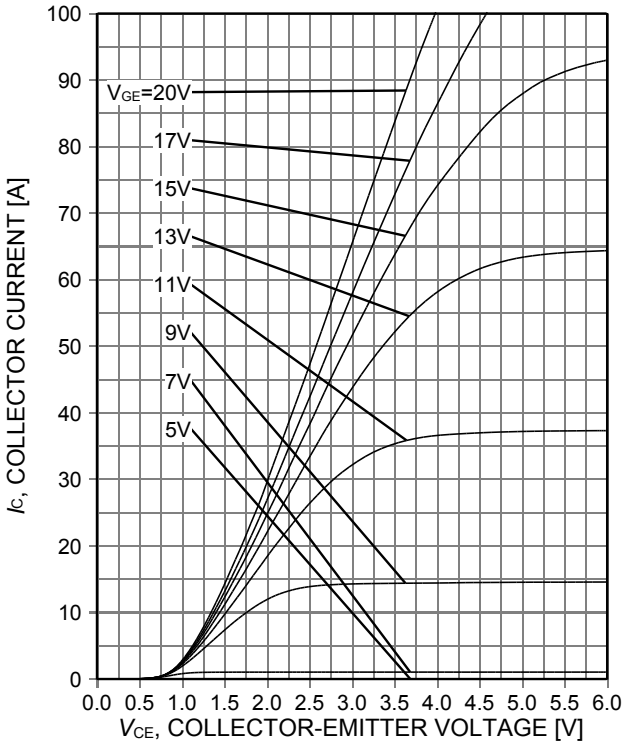



Figure 5. **Typical output characteristic**
($T_j$=25°C)

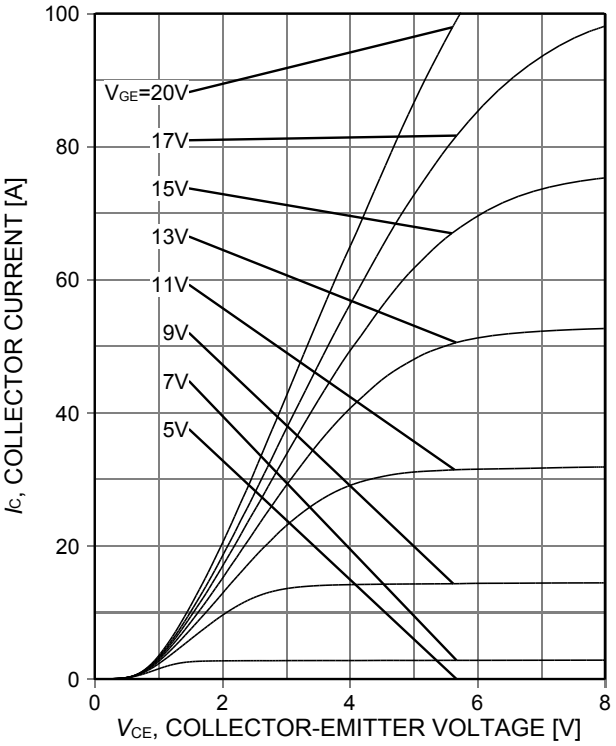



Figure 6. **Typical output characteristic**
($T_j$=175°C)

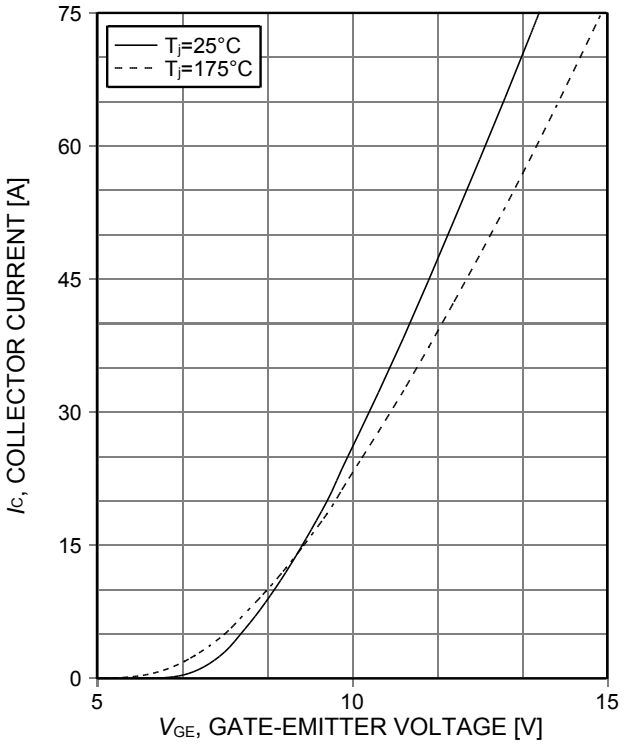



Figure 7. **Typical transfer characteristic**
($V_{CE}$=20V)

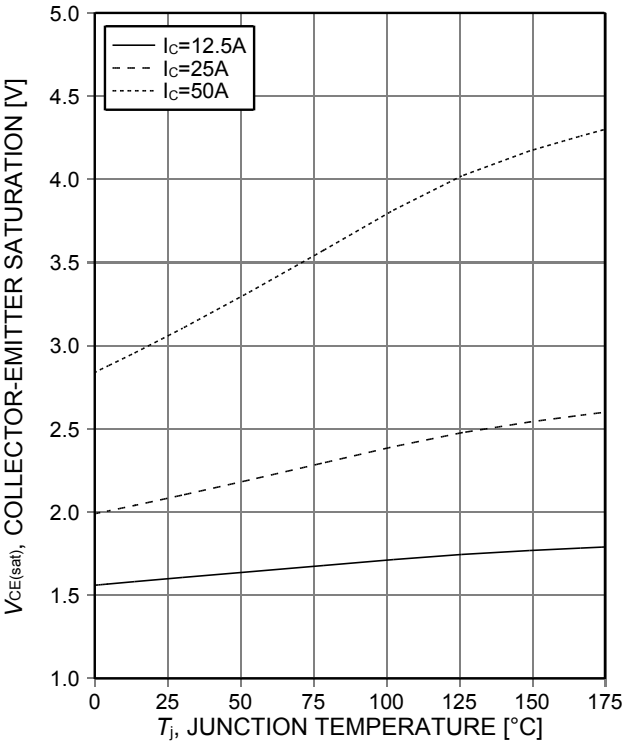



Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$=15V)

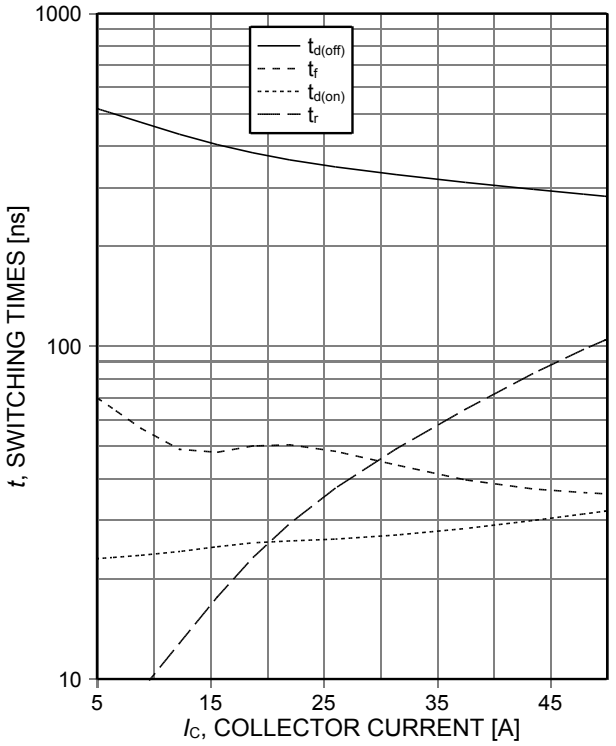



Figure 9. **Typical switching times as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=15/0V, $r_G$=23Ω, test circuit in Fig. E)

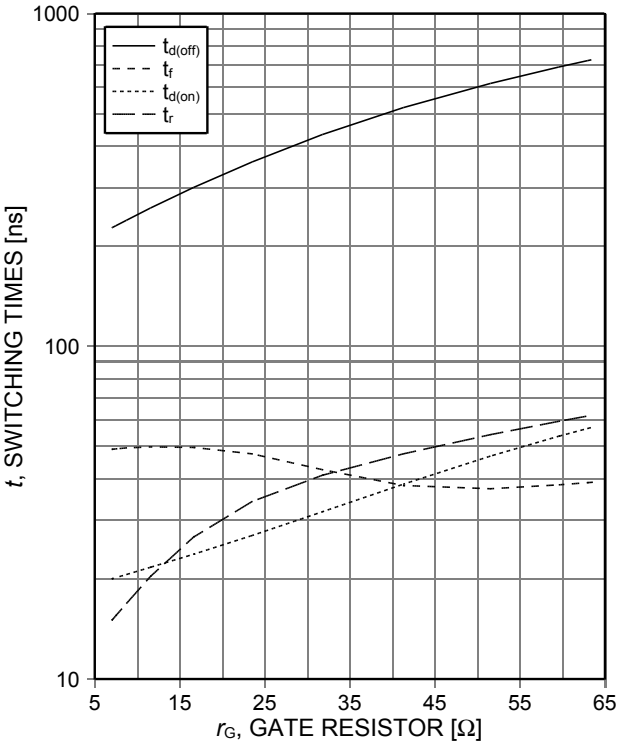



Figure 10. **Typical switching times as a function of gate resistor**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=25A, test circuit in Fig. E)

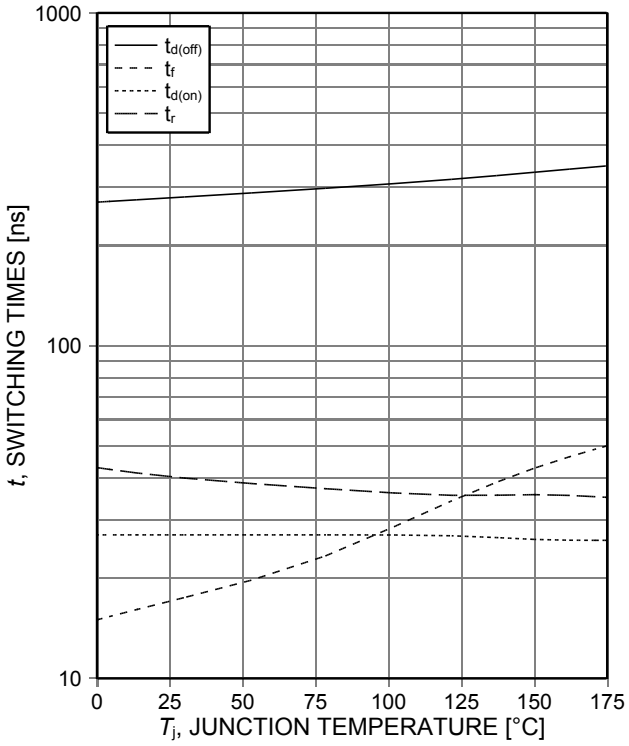



Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=25A, $r_G$=23Ω, test circuit in Fig. E)

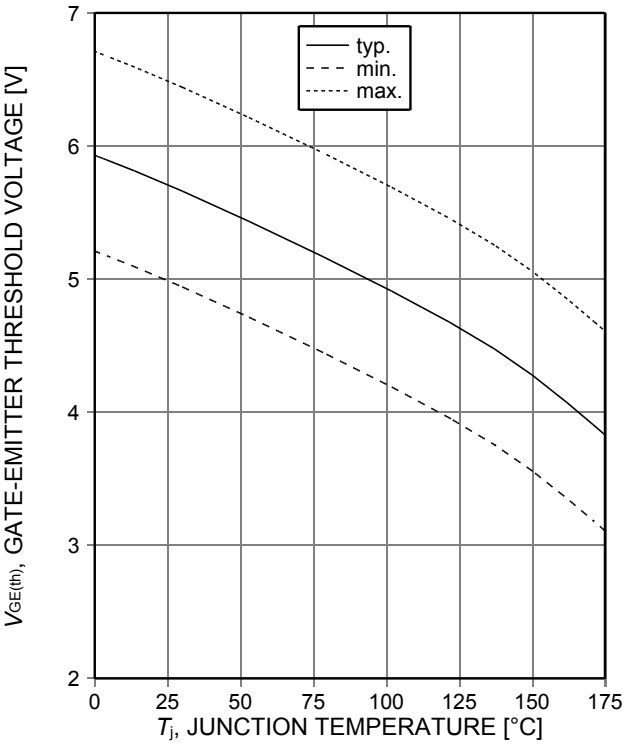



Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C$=0.85mA)

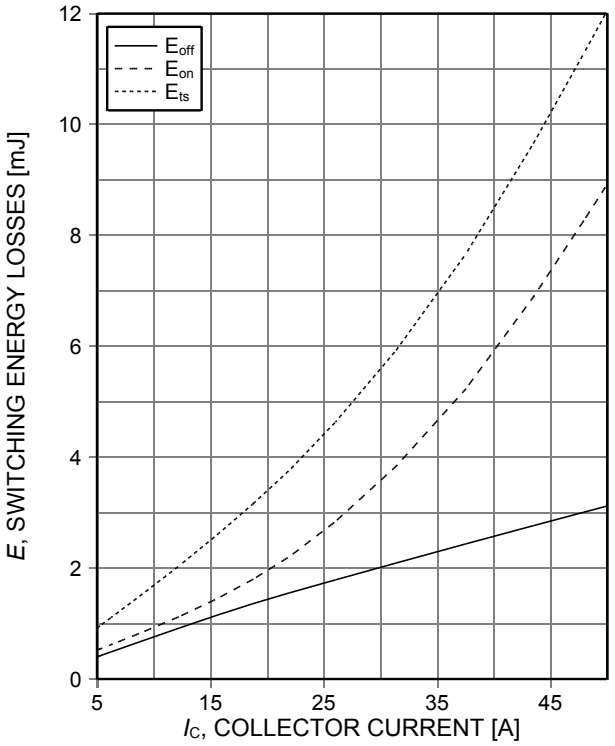



Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=15/0V, $r_G$=23Ω, test circuit in Fig. E)

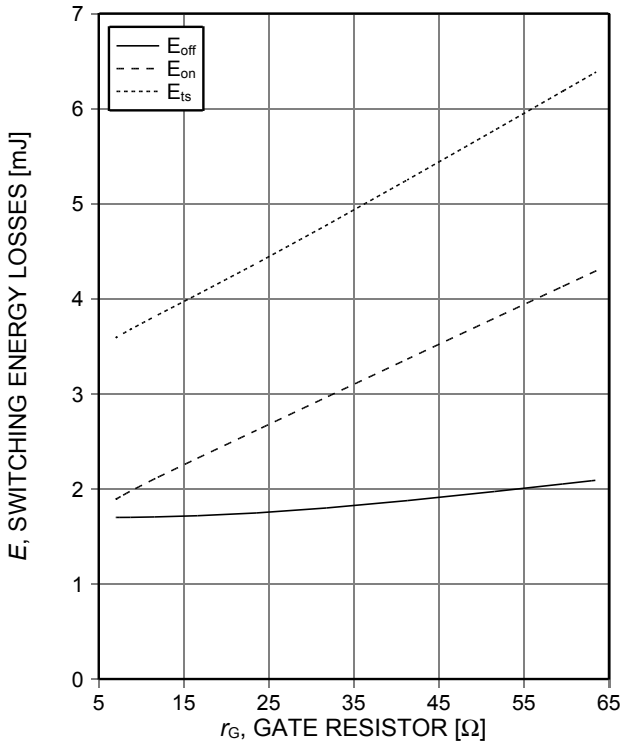



Figure 14. **Typical switching energy losses as a function of gate resistor**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=25A, test circuit in Fig. E)

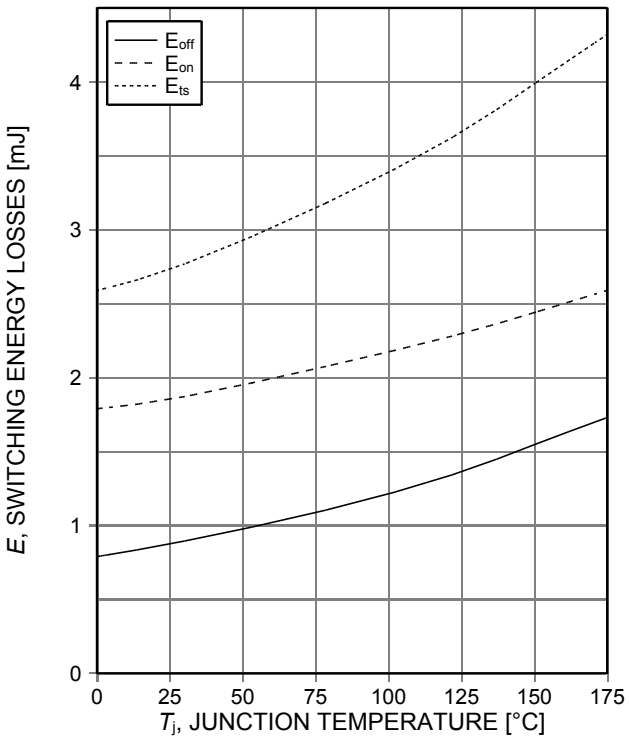



Figure 15. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=25A, $r_G$=23Ω, test circuit in Fig. E)

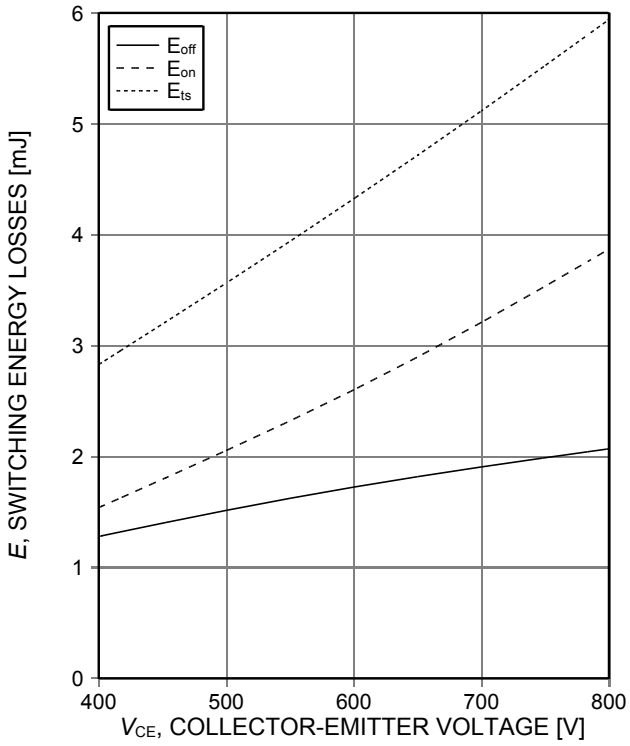



Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j$=175°C, $V_{GE}$=15/0V, $I_C$=25A, $r_G$=23Ω, test circuit in Fig. E)

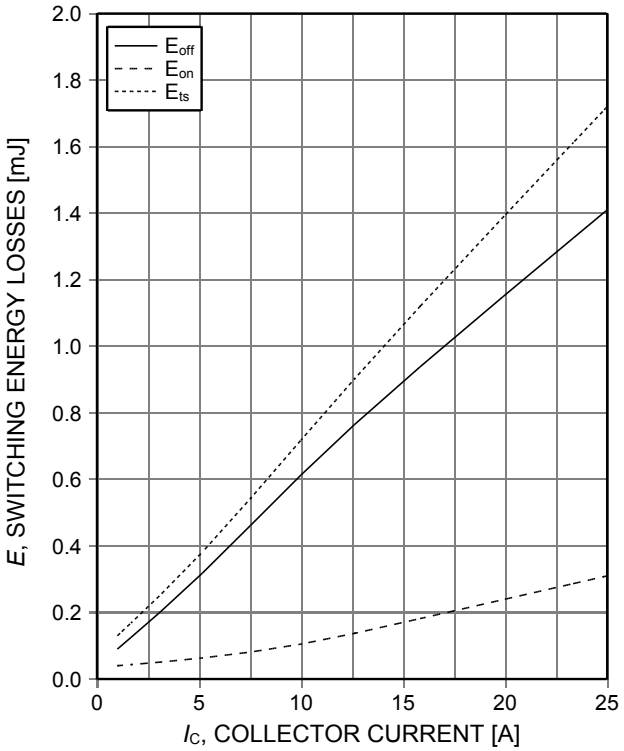



Figure 1. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j$=125°C, $V_{CE}$=800V, $V_{GE}$=15/0V, $r_G$=3Ω, Diode IDH15S120)

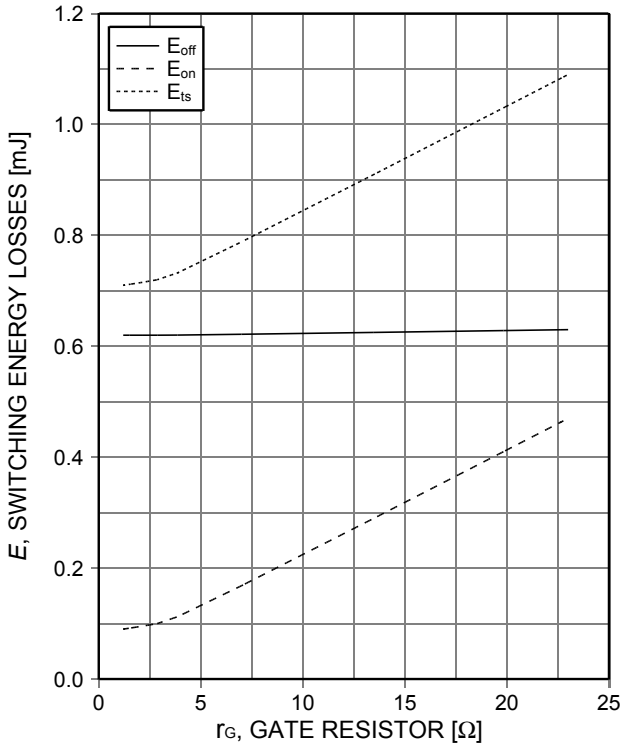



Figure 2. **Typical switching energy losses as a function of gate resistor**
(ind. load, $T_j$=125°C, $V_{CE}$=800V, $V_{GE}$=15/0V, $I_C$=10A, Diode IDH15S120)

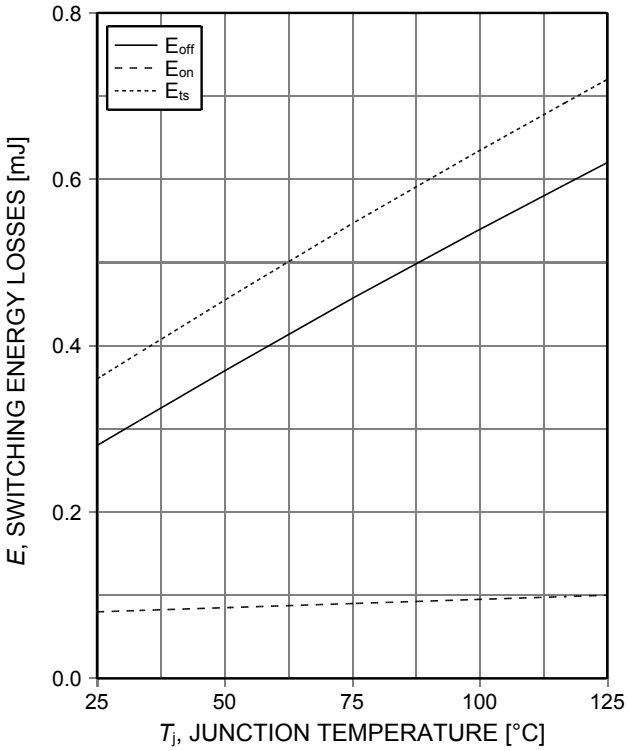



Figure 3. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}$=800V, $V_{GE}$=15/0V, $I_C$=10A, $r_G$=3Ω, Diode IDH15S120)

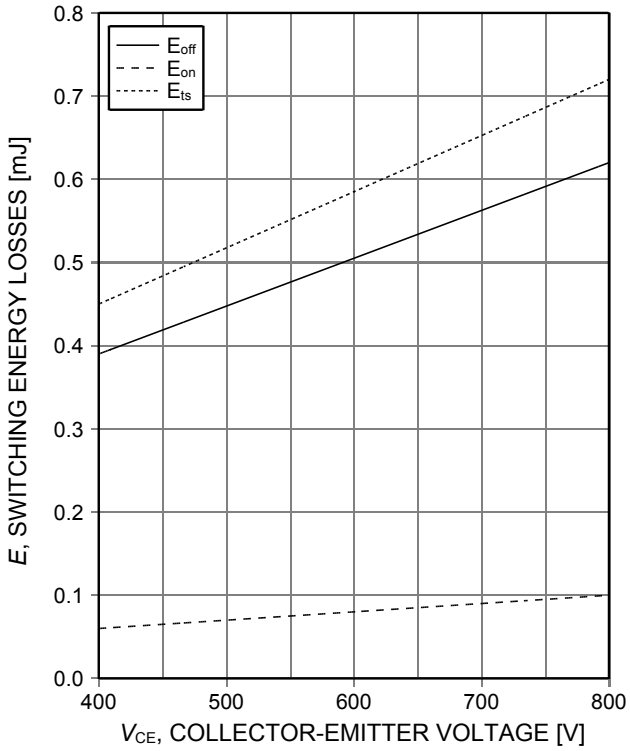



Figure 4. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j$=125°C, $V_{GE}$=15/0V, $I_C$=10A, $r_G$=3Ω, Diode IDH15S120)

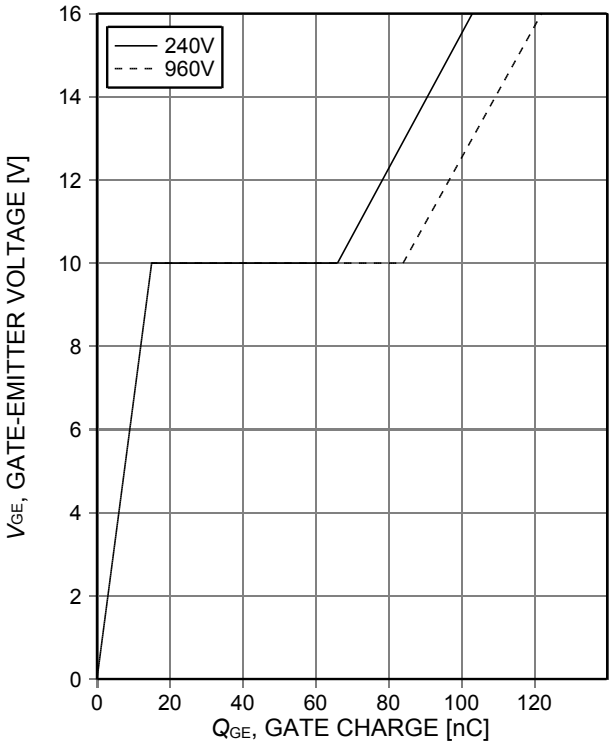



Figure 17. **Typical gate charge**
($I_C$=25A)

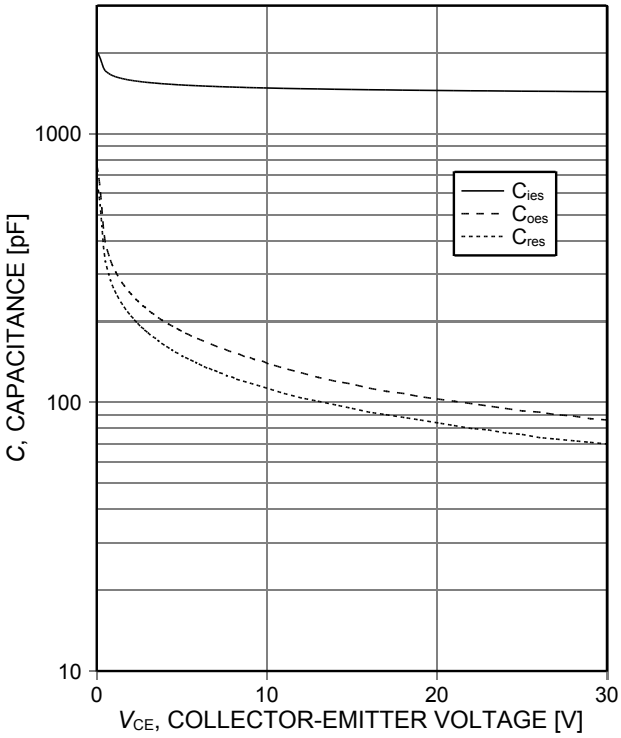



Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

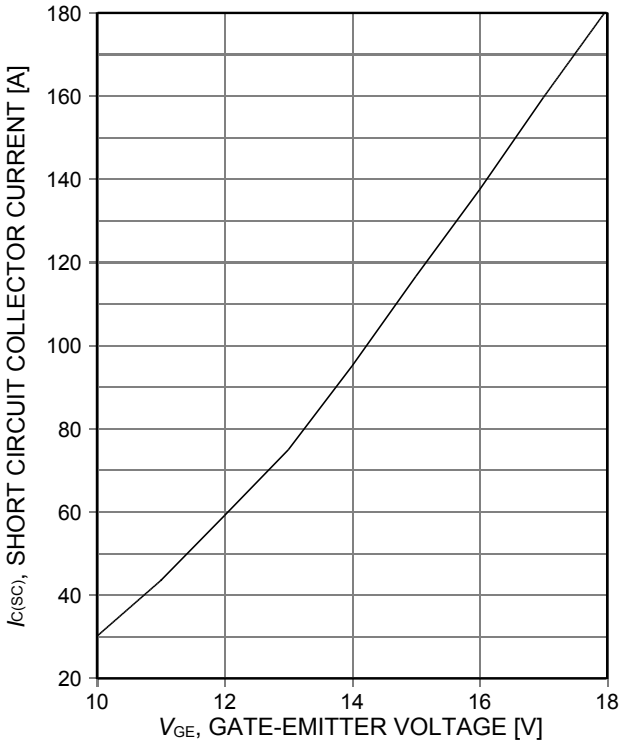



Figure 19. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE}$≤600V, start at$T_j$=25°C)

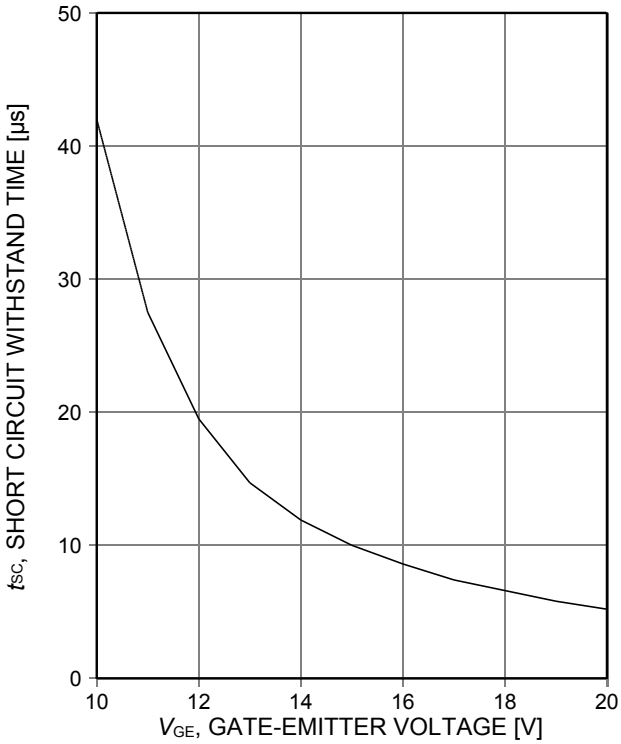



Figure 20. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}$≤600V, start at $T_j$≤150°C)

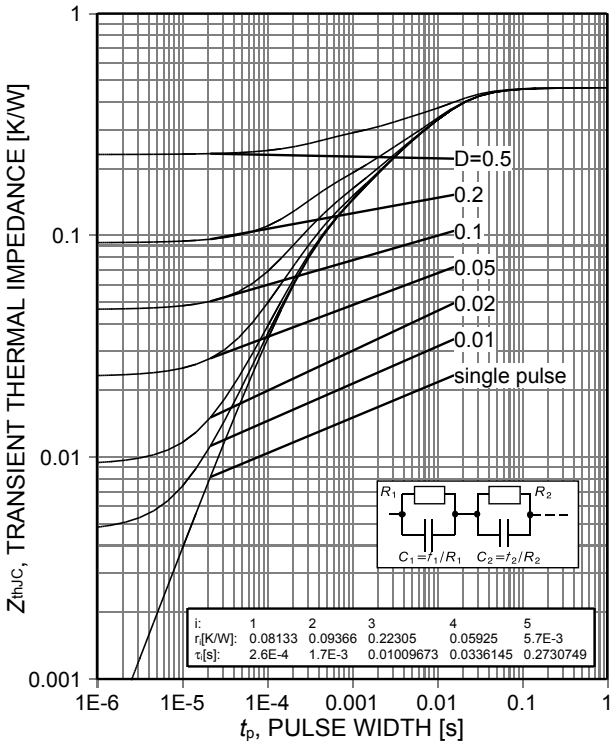
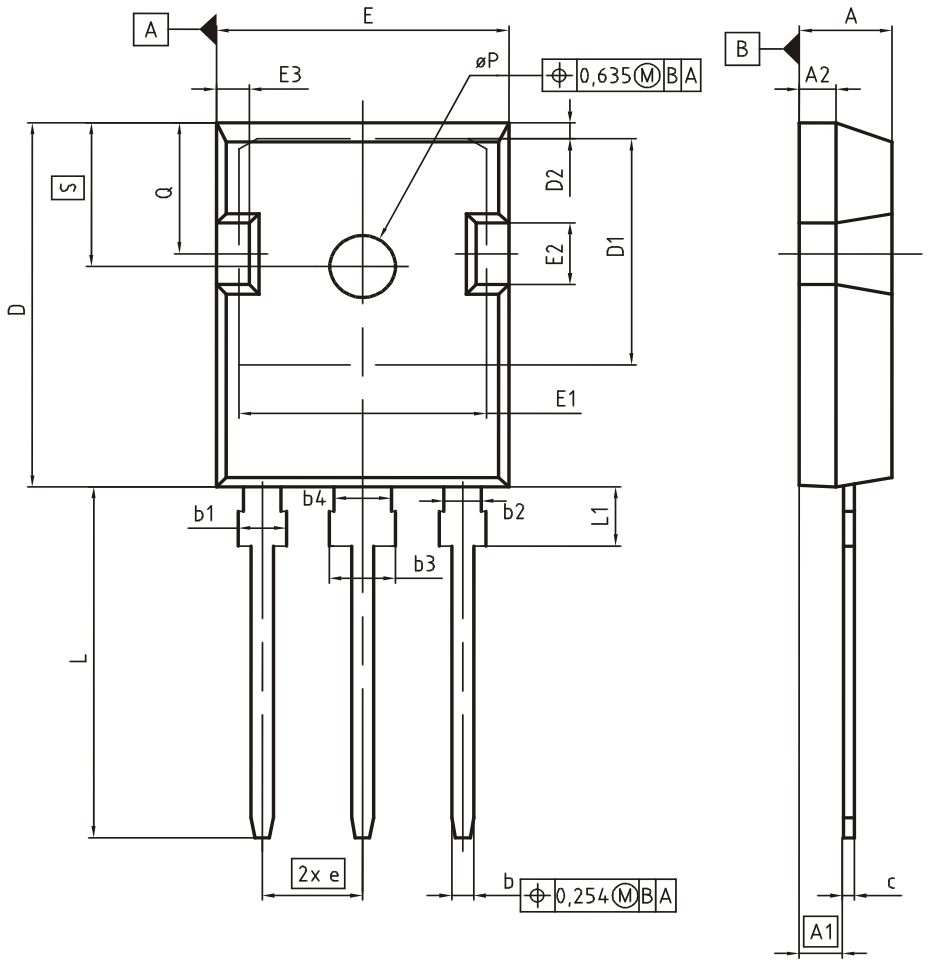



Figure 21. **IGBT transient thermal impedance** ($D=t_p/T$)

# 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 |

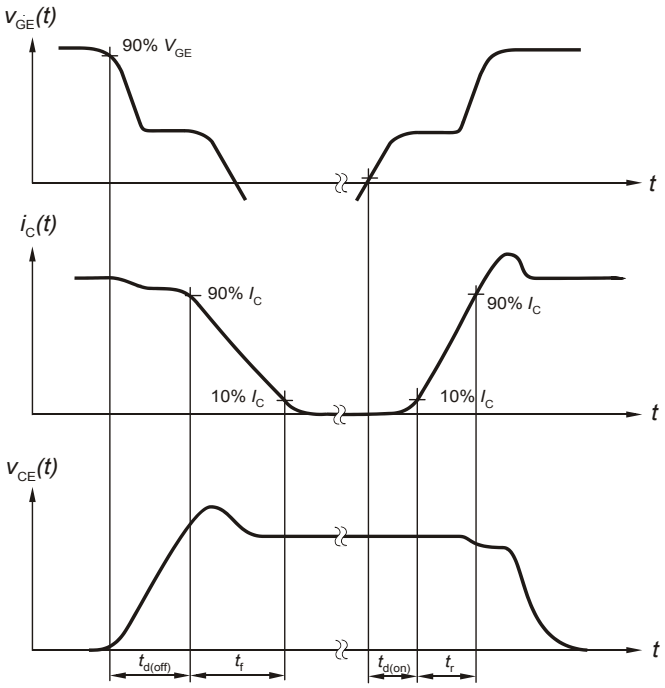



**Figure A. Definition of switching times**

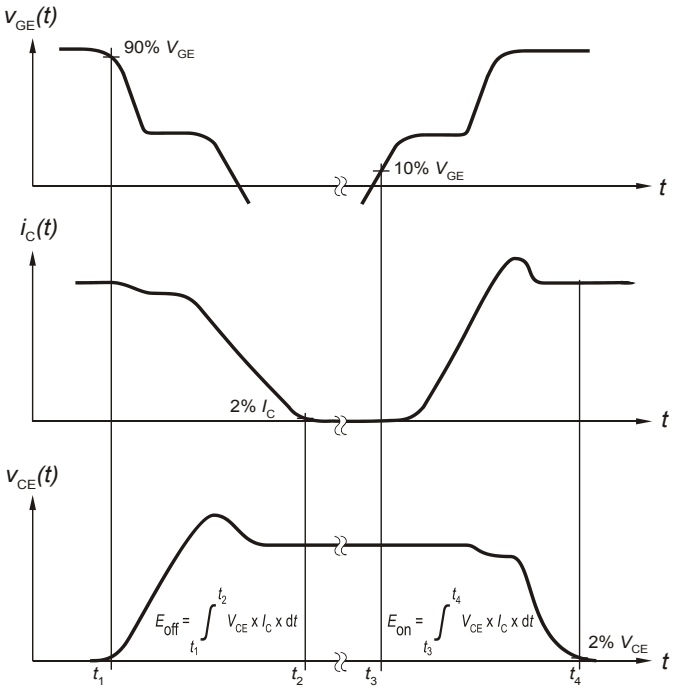



**Figure B. Definition of switching losses**

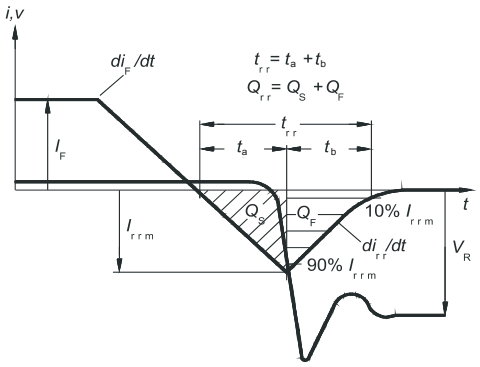



**Figure C. Definition of diodes switching characteristics**

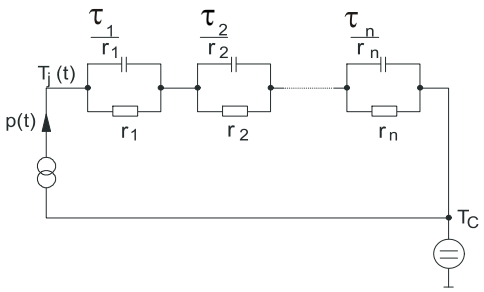



**Figure D. Thermal equivalent circuit**

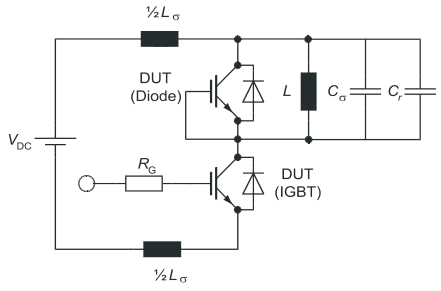



**Figure E. Dynamic test circuit**
Parasitic inductance $L_\sigma$,
Parasitic capacitor $C_\sigma$,
Relief capacitor $C_r$
(only for ZVT switching)

## Revision History

IGW25N120H3

**Revision: 2014-02-27, Rev. 2.1**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.1 | 2011-12-12 | Preliminary data sheet |
| 2.1 | 2014-02-27 | Final data sheet |

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