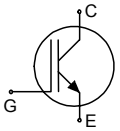
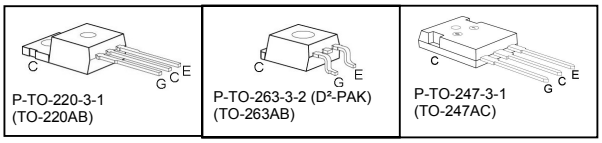
## HighSpeed 2-Technology

- **Designed for:**
  - SMPS
  - Lamp Ballast
  - ZVS-Converter
  - optimised for soft-switching / resonant topologies




- **2nd generation HighSpeed-Technology for 1200V applications offers:**
  - loss reduction in resonant circuits
  - temperature stable behavior
  - parallel switching capability
  - tight parameter distribution
  - $E_{off}$ optimized for $I_C$ =3A




• Complete product spectrum and PSpice Models : http://www.infineon.com/igbt/

| Type | $V_{CE}$ | $I_C$ | $E_{off}$ | $T_j$ | Package | Ordering Code |
|---|---|---|---|---|---|---|
| IGW03N120H2 | 1200V | 3A | 0.15mJ | 150°C | P-TO-247 | Q67040-S4596 |
| IGP03N120H2 | 1200V | 3A | 0.15mJ | 150°C | P-TO-220-3-1 | Q67040-S4599 |
| IGB03N120H2 | 1200V | 3A | 0.15mJ | 150°C | P-TO-263 ($D^2$PAK) | Q67040-S4598 |

**Maximum Ratings**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | 1200 | V |
| Triangular collector current<br>$T_C$ = 25°C, $f$ = 140kHz<br>$T_C$ = 100°C, $f$ = 140kHz | $I_C$ | <br>9.6<br>3.9 | A |
| Pulsed collector current, $t_p$ limited by $T_{jmax}$ | $I_{Cpuls}$ | 9.9 | |
| Turn off safe operating area<br>$V_{CE} \le$ 1200V, $T_j \le$ 150°C | - | 9.9 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Power dissipation<br>$T_C$ = 25°C | $P_{tot}$ | 62.5 | W |
| Operating junction and storage temperature | $T_j$ , $T_{stg}$ | -40...+150 | °C |
| Soldering temperature, 1.6mm (0.063 in.) from case for 10s | - | 260<br>225 (for SMD) | |

**Thermal Resistance**

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---|---|---|---|
| **Characteristic** | | | | |
| IGBT thermal resistance, junction – case | $R_{thJC}$ | | 2.0 | K/W |
| Thermal resistance, junction – ambient | $R_{thJA}$ | P-TO-220-3-1<br>P-TO-247-3-1 | 62 | |
| SMD version, device on PCB[1)] | $R_{thJA}$ | P-TO-263 ($D^2$PAK) | 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, $I_C$=300µA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$ = 15V, $I_C$=3A | | | | |
| | | $T_j$=25°C | - | 2.2 | 2.8 | |
| | | $T_j$=150°C | - | 2.5 | - | |
| | | $V_{GE}$ = 10V, $I_C$=3A, $T_j$=25°C | - | 2.4 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$=90µA, $V_{CE}$=$V_{GE}$ | 2.1 | 3 | 3.9 | |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$=1200V, $V_{GE}$=0V | | | | µA |
| | | $T_j$=25°C | - | - | 20 | |
| | | $T_j$=150°C | - | - | 80 | |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$=20V, $I_C$=3A | - | 2 | - | S |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{CE}$=25V, | - | 205 | - | pF |
| Output capacitance | $C_{oss}$ | $V_{GE}$=0V, | - | 24 | - | |
| Reverse transfer capacitance | $C_{rss}$ | $f$=1MHz | - | 7 | - | |
| Gate charge | $Q_{Gate}$ | $V_{CC}$=960V, $I_C$=3A | - | 22 | - | nC |
| | | $V_{GE}$=15V | | | | |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | P-TO-220-3-1 | - | 7 | - | nH |
| | | P-TO-247-3-1 | | 13 | | |

[1)] Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm$^2$ (one layer, 70µm thick) copper area for collector connection. PCB is vertical without blown air.

**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, $I_C$=3A, $V_{GE}$=15V/0V, $R_G$=82Ω, $L_\sigma$ [2)]=180nH, $C_\sigma$ [2)]=40pF Energy losses include "tail" and diode [3)] reverse recovery. | - | 9.2 | - | ns |
| Rise time | $t_r$ | | - | 5.2 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 281 | - | |
| Fall time | $t_f$ | | - | 29 | - | |
| Turn-on energy | $E_{on}$ | | - | 0.14 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.15 | - | |
| Total switching energy | $E_{ts}$ | | - | 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 $V_{CC}$=800V, $I_C$=3A, $V_{GE}$=15V/0V, $R_G$=82Ω, $L_\sigma$ [2)]=180nH, $C_\sigma$ [2)]=40pF Energy losses include "tail" and diode [3)] reverse recovery. | - | 9.4 | - | ns |
| Rise time | $t_r$ | | - | 6.7 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 340 | - | |
| Fall time | $t_f$ | | - | 63 | - | |
| Turn-on energy | $E_{on}$ | | - | 0.22 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 0.26 | - | |
| Total switching energy | $E_{ts}$ | | - | 0.48 | - | |

**Switching Energy ZVT, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic** | | | | | | |
| Turn-off energy | $E_{off}$ | $V_{CC}$=800V, $I_C$=3A, $V_{GE}$=15V/0V, $R_G$=82Ω, $C_r$ [2)]=4nF | | | | mJ |
| | | $T_j$=25°C | - | 0.05 | - | |
| | | $T_j$=150°C | - | 0.09 | - | |

[2)] Leakage inductance $L_\sigma$ and stray capacity $C_\sigma$ due to dynamic test circuit in figure E
[3)] Commutation diode from device IKP03N120H2

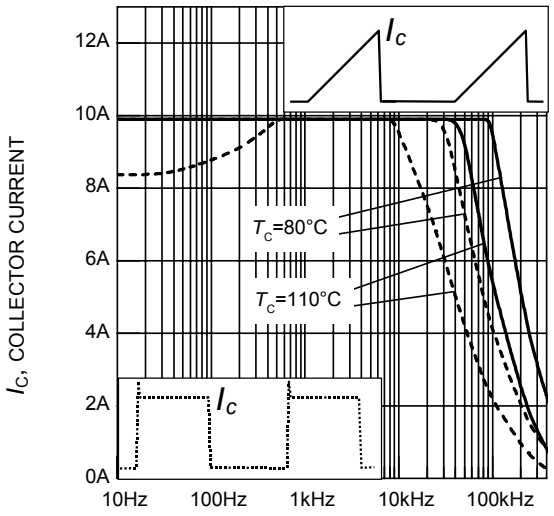



**Figure 1. Collector current as a function of switching frequency**
($T_j \le 150°C$, $D = 0.5$, $V_{CE} = 800V$, $V_{GE} = +15V/0V$, $R_G = 82\Omega$)

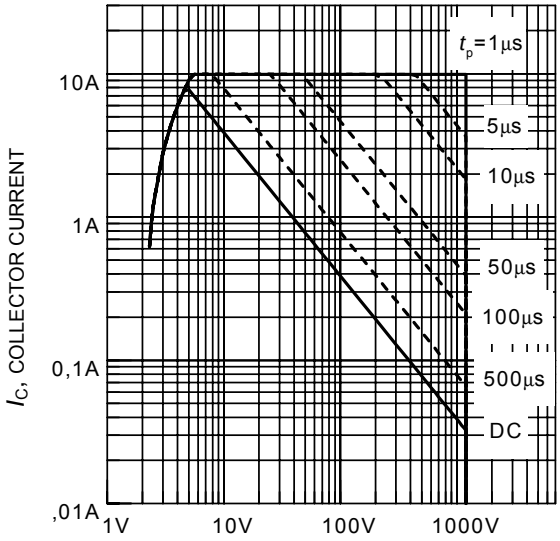



**Figure 2. Safe operating area**
($D = 0$, $T_C = 25°C$, $T_j \le 150°C$)

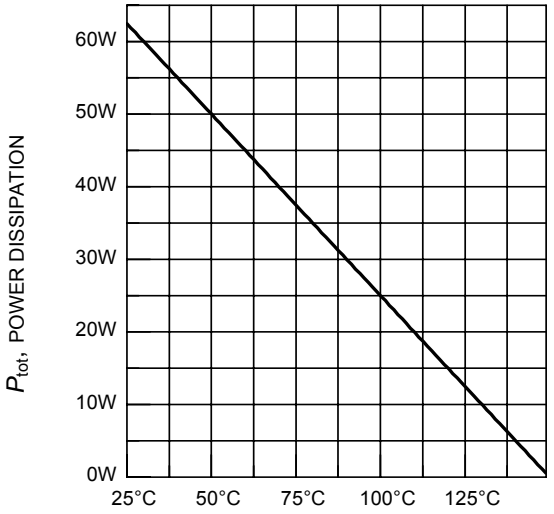



**Figure 3. Power dissipation as a function of case temperature**
($T_j \le 150°C$)

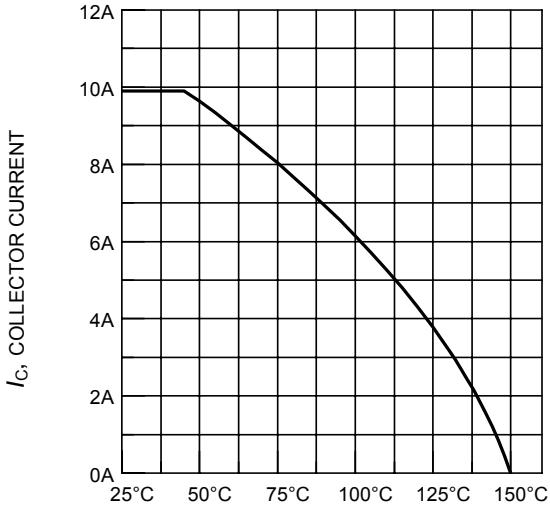



**Figure 4. Collector current as a function of case temperature**
($V_{GE} \le 15V$, $T_j \le 150°C$)

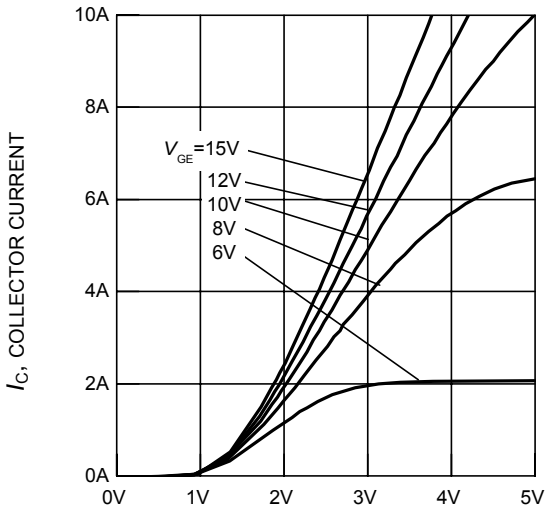



**Figure 5. Typical output characteristics**
($T_j$ = 25°C)

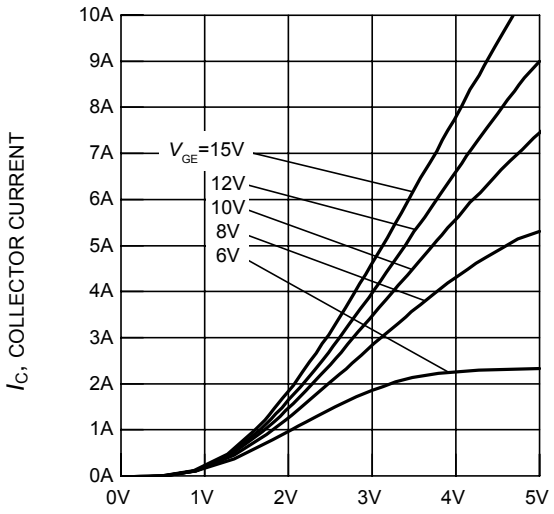



**Figure 6. Typical output characteristics**
($T_j$ = 150°C)

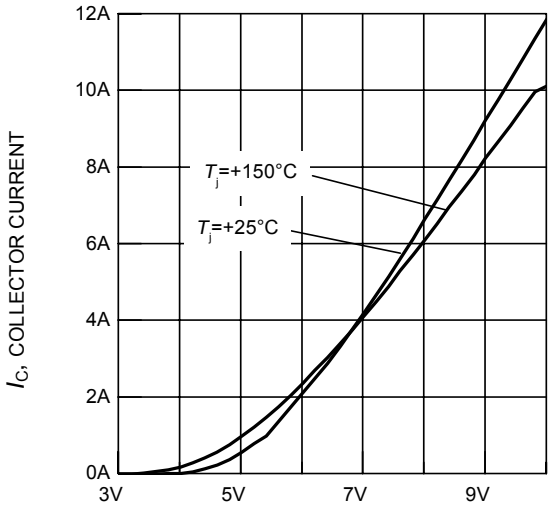



**Figure 7. Typical transfer characteristics**
($V_{CE}$ = 20V)

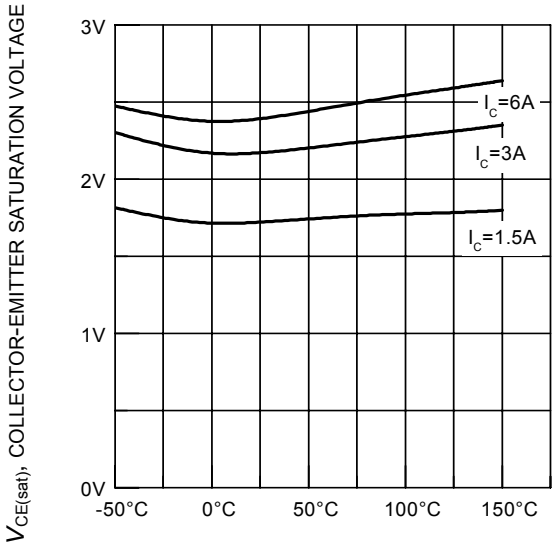



**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$ = 15V)

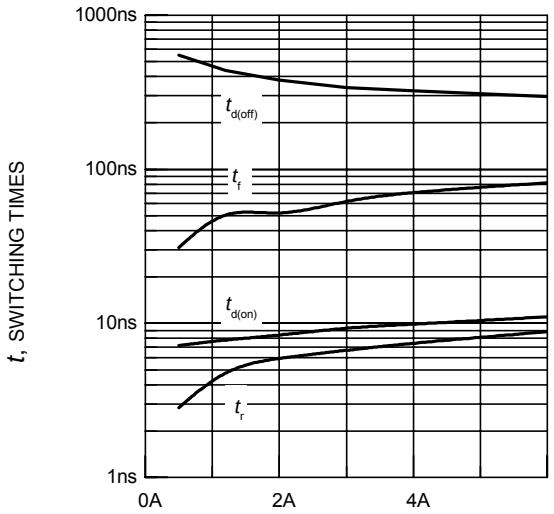



**Figure 9. Typical switching times as a function of collector current**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 82Ω,
dynamic test circuit in Fig.E)

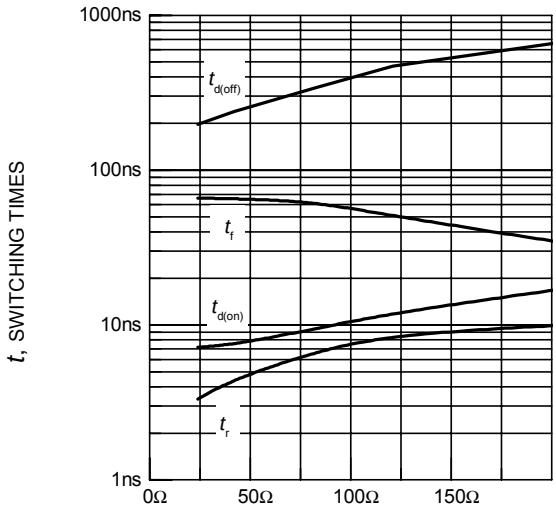



**Figure 10. Typical switching times as a function of gate resistor**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 3A,
dynamic test circuit in Fig.E)

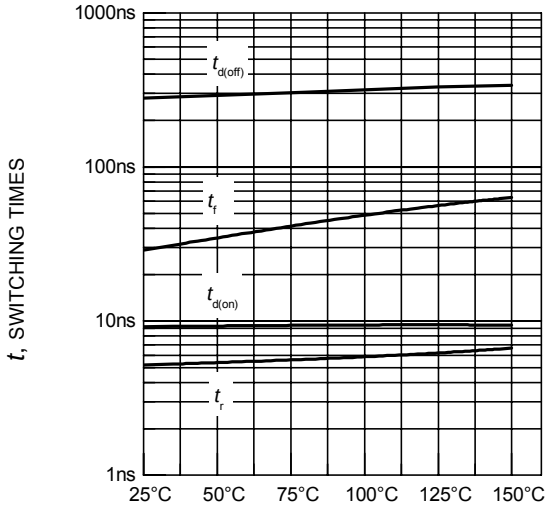



**Figure 11. Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}$ = 800V,
$V_{GE}$ = +15V/0V, $I_C$ = 3A, $R_G$ = 82Ω,
dynamic test circuit in Fig.E)

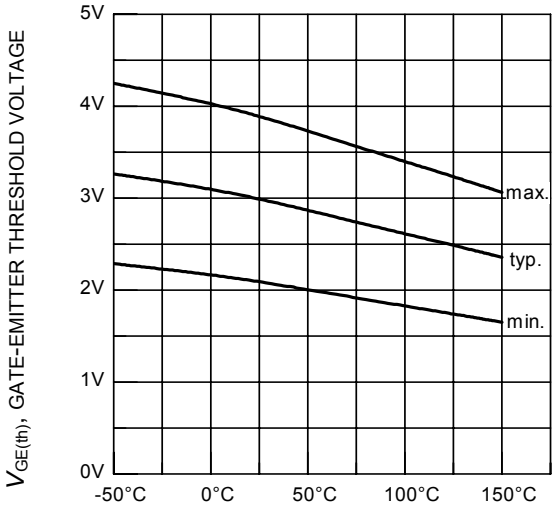



**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**
($I_C$ = 0.09mA)

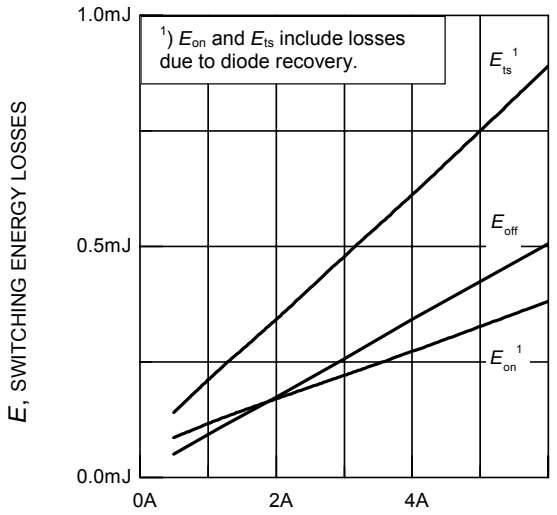



**Figure 13. Typical switching energy losses as a function of collector current**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $R_G$ = 82Ω,
dynamic test circuit in Fig.E )

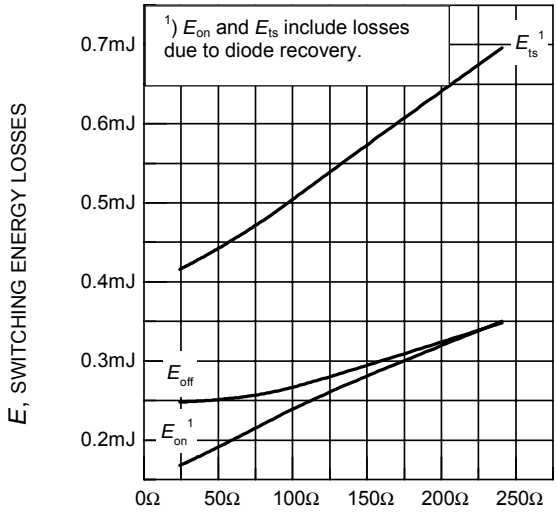



**Figure 14. Typical switching energy losses as a function of gate resistor**
(inductive load, $T_j$ = 150°C,
$V_{CE}$ = 800V, $V_{GE}$ = +15V/0V, $I_C$ = 3A,
dynamic test circuit in Fig.E )

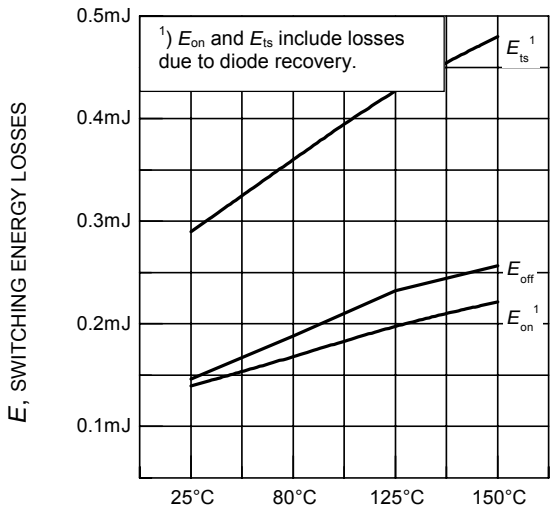



**Figure 15. Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{CE}$ = 800V,
$V_{GE}$ = +15V/0V, $I_C$ = 3A, $R_G$ = 82Ω,
dynamic test circuit in Fig.E )

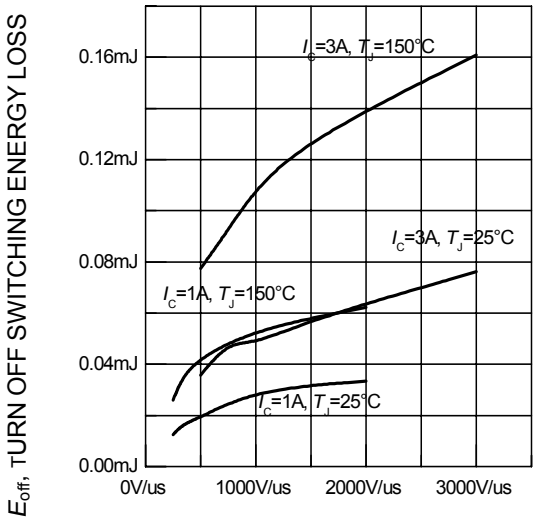
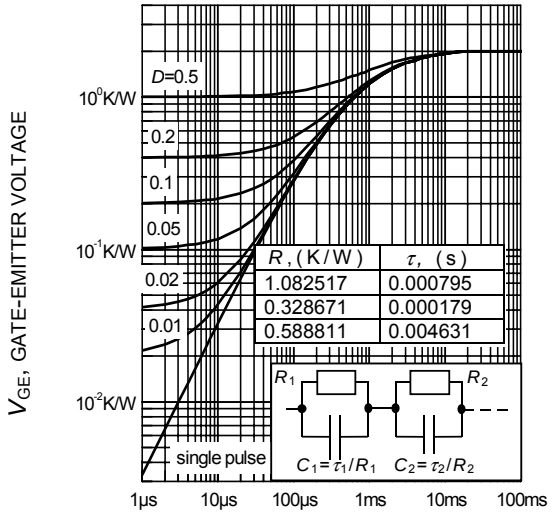
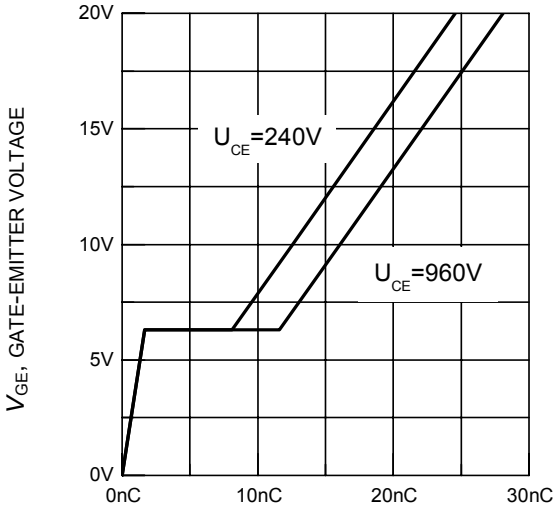



**Figure 16. Typical turn off switching energy loss for soft switching**
(*dynamic test circuit in Fig. E*)



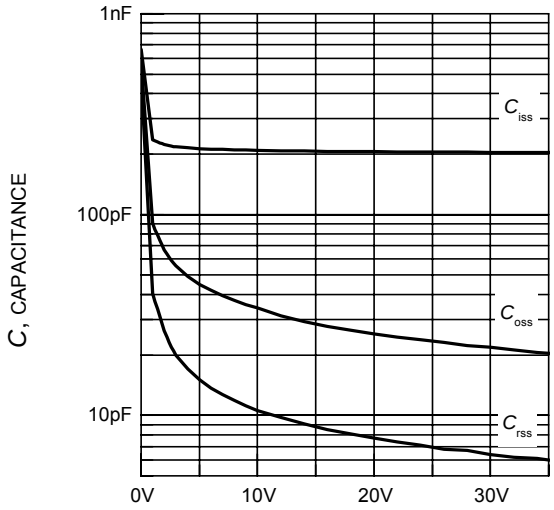

$Q_{GE}$, GATE CHARGE

**Figure 17. Typical gate charge**
($I_C$ = 3A)



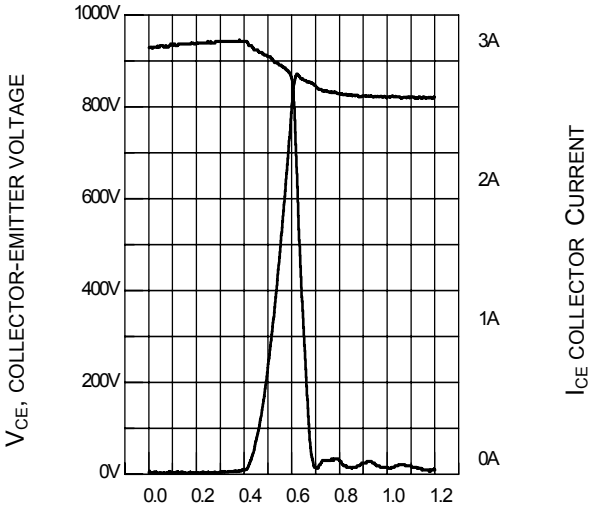

$Q_{GE}$, GATE CHARGE

**Figure 17. Typical gate charge**
($I_C$ = 3A)




$V_{CE}$, COLLECTOR-EMITTER VOLTAGE

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




$t_p$, PULSE WIDTH

**Figure 20. Typical turn off behavior, hard switching**
($V_{GE}$=15/0V, $R_G$=82Ω, $T_j$ = 150°C, Dynamic test circuit in Figure E)

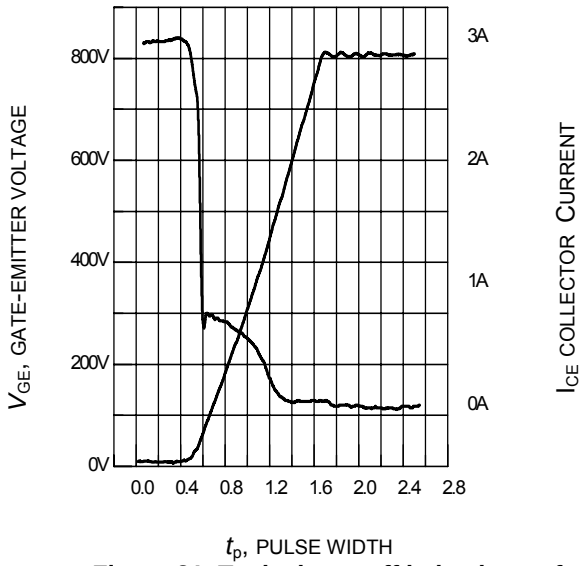
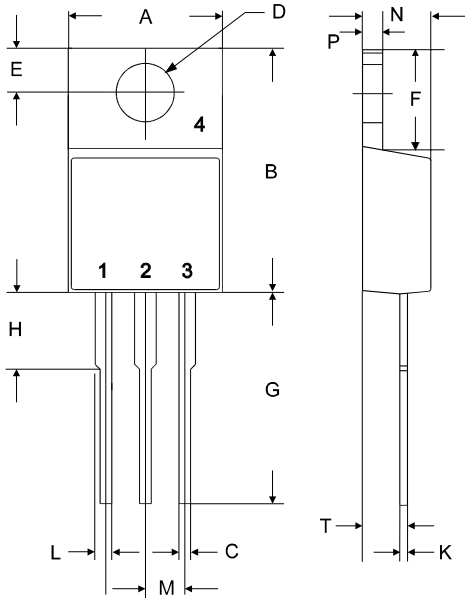


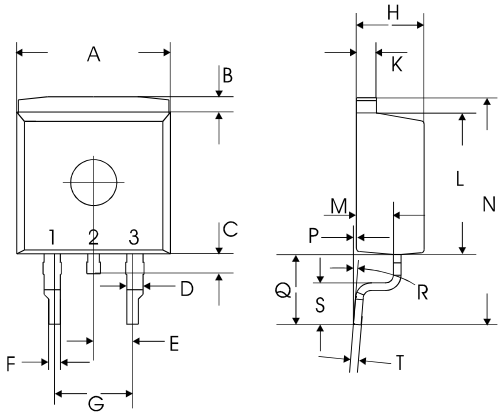

**Figure 21. Typical turn off behavior, soft switching**
($V_{GE}$=15/0V, $R_G$=82Ω, $T_j$ = 150°C,
Dynamic test circuit in Figure E)

TO-220AB

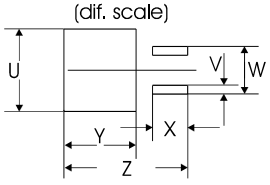



| symbol | dimensions | | | |
|---|---|---|---|---|
| | [mm] | | [inch] | |
| | min | max | min | max |
| A | 9.70 | 10.30 | 0.3819 | 0.4055 |
| B | 14.88 | 15.95 | 0.5858 | 0.6280 |
| C | 0.65 | 0.86 | 0.0256 | 0.0339 |
| D | 3.55 | 3.89 | 0.1398 | 0.1531 |
| E | 2.60 | 3.00 | 0.1024 | 0.1181 |
| F | 6.00 | 6.80 | 0.2362 | 0.2677 |
| G | 13.00 | 14.00 | 0.5118 | 0.5512 |
| H | 4.35 | 4.75 | 0.1713 | 0.1870 |
| K | 0.38 | 0.65 | 0.0150 | 0.0256 |
| L | 0.95 | 1.32 | 0.0374 | 0.0520 |
| M | 2.54 typ. | | 0.1 typ. | |
| N | 4.30 | 4.50 | 0.1693 | 0.1772 |
| P | 1.17 | 1.40 | 0.0461 | 0.0551 |
| T | 2.30 | 2.72 | 0.0906 | 0.1071 |

TO-263AB (D²Pak)

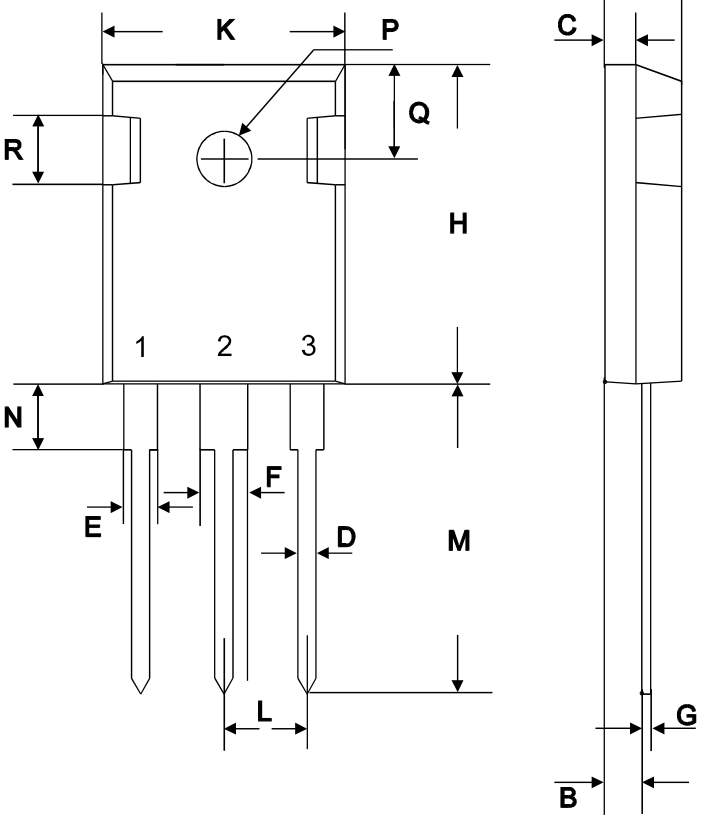



Footprint
(dif. scale)




| symbol | dimensions | | | |
|---|---|---|---|---|
| | [mm] | | [inch] | |
| | min | max | min | max |
| A | 9.80 | 10.20 | 0.3858 | 0.4016 |
| B | 0.70 | 1.30 | 0.0276 | 0.0512 |
| C | 1.00 | 1.60 | 0.0394 | 0.0630 |
| D | 1.03 | 1.07 | 0.0406 | 0.0421 |
| E | 2.54 typ. | | 0.1 typ. | |
| F | 0.65 | 0.85 | 0.0256 | 0.0335 |
| G | 5.08 typ. | | 0.2 typ. | |
| H | 4.30 | 4.50 | 0.1693 | 0.1772 |
| K | 1.17 | 1.37 | 0.0461 | 0.0539 |
| L | 9.05 | 9.45 | 0.3563 | 0.3720 |
| M | 2.30 | 2.50 | 0.0906 | 0.0984 |
| N | 15 typ. | | 0.5906 typ. | |
| P | 0.00 | 0.20 | 0.0000 | 0.0079 |
| Q | 4.20 | 5.20 | 0.1654 | 0.2047 |
| R | 8° max | | 8° max | |
| S | 2.40 | 3.00 | 0.0945 | 0.1181 |
| T | 0.40 | 0.60 | 0.0157 | 0.0236 |
| U | 10.80 | | 0.4252 | |
| V | 1.15 | | 0.0453 | |
| W | 6.23 | | 0.2453 | |
| X | 4.60 | | 0.1811 | |
| Y | 9.40 | | 0.3701 | |
| Z | 16.15 | | 0.6358 | |

TO-247AC




| symbol | dimensions | | | |
|---|---|---|---|---|
| | [mm] | | symbol | |
| | min | | min | |
| A | 4.78 | A | 4.78 | A |
| B | 2.29 | B | 2.29 | B |
| C | 1.78 | C | 1.78 | C |
| D | 1.09 | D | 1.09 | D |
| E | 1.73 | | E | |
| F | 2.67 | F | 2.67 | F |
| G | 0.76 max | G | 0.76 max | G |
| H | 20.80 | H | 20.80 | H |
| K | 15.65 | K | 15.65 | K |
| L | 5.21 | L | 5.21 | L |
| M | 19.81 | M | 19.81 | M |
| N | 3.560 | N | 3.560 | N |
| ∅P | 3.61 | ∅P | 3.61 | ∅P |
| Q | 6.12 | Q | 6.12 | Q |
| | **dimensions** | | **dimensions** | |
| **symbol** | [mm] | **symbol** | [mm] | **symbol** |
| | min | | min | |

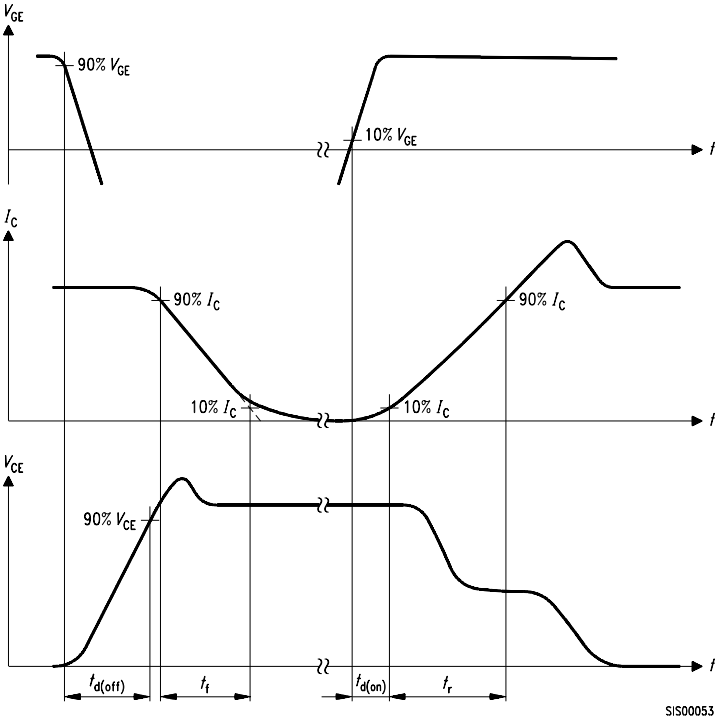



**Figure A. Definition of switching times**

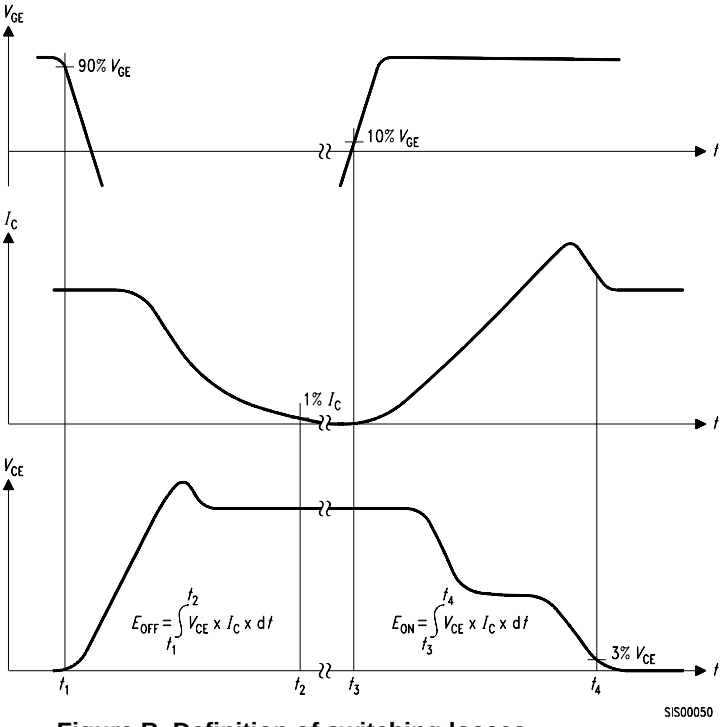



**Figure B. Definition of switching losses**

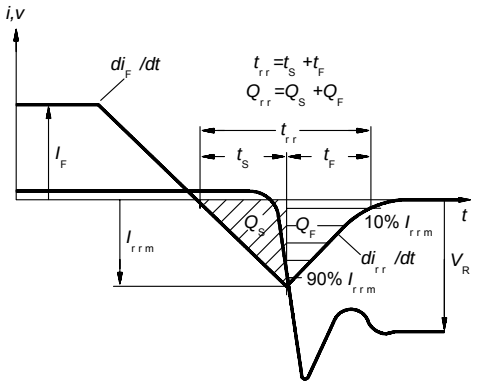



**Figure C. Definition of diodes switching characteristics**

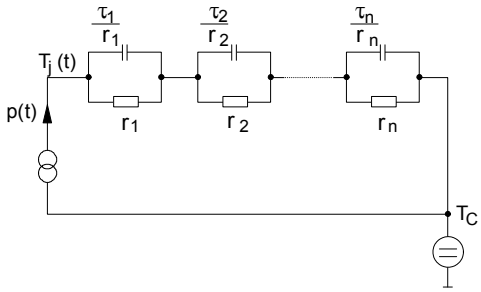



**Figure D. Thermal equivalent circuit**

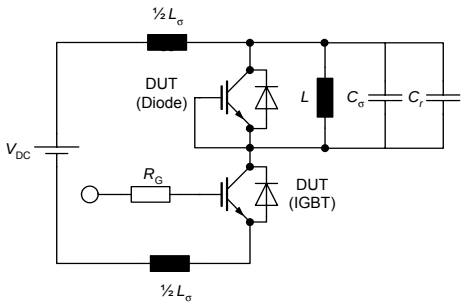



**Figure E. Dynamic test circuit**
Leakage inductance $L_\sigma$= 180nH,
Stray capacitor $C_\sigma$ = 40pF,
Relief capacitor $C_r$ = 4nF (only for ZVT switching)

**Published by**
**Infineon Technologies AG i Gr.,**
**Bereich Kommunikation**
**St.-Martin-Strasse 53,**
**D-81541 München**


**Attention please!**

The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

**Information**

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

**Warnings**

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.