

## IGBT

High speed 5 IGBT in TRENCHSTOP™ 5 technology

## IGP30N65H5

650V IGBT high speed switching series fifth generation

Data sheet

Industrial Power Control

### High speed 5 IGBT in TRENCHSTOP™ 5 technology

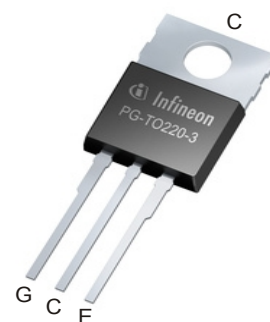
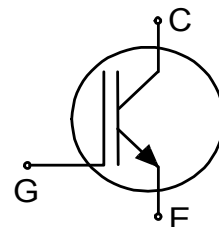
#### Features and Benefits:

High speed H5 technology offering

- Best-in-Class efficiency in hard switching and resonant topologies
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low gate charge  $Q_G$
- 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 converters
- Uninterruptible power supplies
- Welding converters
- Mid to high range switching frequency converters



#### Key Performance and Package Parameters

| Type       | $V_{CE}$ | $I_C$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|------------|----------|-------|---------------------------------|-------------|---------|------------|
| IGP30N65H5 | 650V     | 30A   | 1.65V                           | 175°C       | G30EH5  | PG-TO220-3 |

**Table of Contents**

|                                           |    |
|-------------------------------------------|----|
| Description .....                         | 2  |
| Table of Contents .....                   | 3  |
| Maximum Ratings .....                     | 4  |
| Thermal Resistance .....                  | 4  |
| Electrical Characteristics .....          | 4  |
| Electrical Characteristics Diagrams ..... | 7  |
| Package Drawing .....                     | 12 |
| Testing Conditions .....                  | 13 |
| Revision History .....                    | 14 |
| Disclaimer .....                          | 14 |

## Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

| Parameter                                                                                                            | Symbol      | Value                | Unit               |
|----------------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$                                                          | $V_{CE}$    | 650                  | V                  |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25^{\circ}\text{C}$<br>$T_C = 100^{\circ}\text{C}$            | $I_C$       | 55.0<br>35.0         | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$                                                               | $I_{Cpuls}$ | 90.0                 | A                  |
| Turn off safe operating area<br>$V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}$ | -           | 90.0                 | A                  |
| Gate-emitter voltage<br>Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )                    | $V_{GE}$    | $\pm 20$<br>$\pm 30$ | V                  |
| Power dissipation $T_C = 25^{\circ}\text{C}$<br>Power dissipation $T_C = 100^{\circ}\text{C}$                        | $P_{tot}$   | 188.0<br>93.0        | W                  |
| Operating junction temperature                                                                                       | $T_{vj}$    | $-40 \dots +175$     | $^{\circ}\text{C}$ |
| Storage temperature                                                                                                  | $T_{stg}$   | $-55 \dots +150$     | $^{\circ}\text{C}$ |
| Soldering temperature,<br>wave soldering 1.6mm (0.063in.) from case for 10s                                          |             | 260                  | $^{\circ}\text{C}$ |
| Mounting torque, M3 screw<br>Maximum of mounting processes: 3                                                        | $M$         | 0.6                  | Nm                 |

## Thermal Resistance

| Parameter                                   | Symbol        | Conditions | Max. Value | Unit |
|---------------------------------------------|---------------|------------|------------|------|
| <b>Characteristic</b>                       |               |            |            |      |
| IGBT thermal resistance,<br>junction - case | $R_{th(j-c)}$ |            | 0.80       | K/W  |
| Thermal resistance<br>junction - ambient    | $R_{th(j-a)}$ |            | 62         | K/W  |

## Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified

| Parameter                            | Symbol        | Conditions                                                                                                    | Value       |                      |                | Unit    |
|--------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------|-------------|----------------------|----------------|---------|
|                                      |               |                                                                                                               | min.        | typ.                 | max.           |         |
| Static Characteristic                |               |                                                                                                               |             |                      |                |         |
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.20mA$                                                                                   | 650         | -                    | -              | V       |
| Collector-emitter saturation voltage | $V_{CEsat}$   | $V_{GE} = 15.0V, I_C = 30.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 125^{\circ}C$<br>$T_{vj} = 175^{\circ}C$ | -<br>-<br>- | 1.65<br>1.85<br>1.95 | 2.10<br>-<br>- | V       |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C = 0.30mA, V_{CE} = V_{GE}$                                                                               | 3.2         | 4.0                  | 4.8            | V       |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE} = 650V, V_{GE} = 0V$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$                             | -<br>-      | -<br>-               | 40.0<br>4000.0 | $\mu A$ |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                                                   | -           | -                    | 100            | nA      |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 30.0A$                                                                                   | -           | 39.5                 | -              | S       |

**Electrical Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified**

| Parameter                                                      | Symbol    | Conditions                                 | Value |      |      | Unit |
|----------------------------------------------------------------|-----------|--------------------------------------------|-------|------|------|------|
|                                                                |           |                                            | min.  | typ. | max. |      |
| Dynamic Characteristic                                         |           |                                            |       |      |      |      |
| Input capacitance                                              | $C_{ies}$ | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$      | -     | 1800 | -    | pF   |
| Output capacitance                                             | $C_{oes}$ |                                            | -     | 45   | -    |      |
| Reverse transfer capacitance                                   | $C_{res}$ |                                            | -     | 7    | -    |      |
| Gate charge                                                    | $Q_G$     | $V_{CC} = 520V, I_C = 30.0A, V_{GE} = 15V$ | -     | 70.0 | -    | nC   |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$     |                                            | -     | 7.0  | -    | nH   |

**Switching Characteristic, Inductive Load**

| Parameter                                             | Symbol              | Conditions                                                                                                                                                                                                                                                                                                                                        | Value |      |      | Unit |
|-------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                                       |                     |                                                                                                                                                                                                                                                                                                                                                   | min.  | typ. | max. |      |
| IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ |                     |                                                                                                                                                                                                                                                                                                                                                   |       |      |      |      |
| Turn-on delay time                                    | $t_{d(\text{on})}$  | $T_{vj} = 25^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 15.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 23.0\Omega$ , $R_{G(\text{off})} = 23.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | -     | 19   | -    | ns   |
| Rise time                                             | $t_r$               |                                                                                                                                                                                                                                                                                                                                                   | -     | 9    | -    | ns   |
| Turn-off delay time                                   | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                   | -     | 177  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                                   | -     | 14   | -    | ns   |
| Turn-on energy                                        | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.28 | -    | mJ   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.10 | -    | mJ   |
| Total switching energy                                | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.38 | -    | mJ   |
|                                                       |                     |                                                                                                                                                                                                                                                                                                                                                   |       |      |      |      |
| Turn-on delay time                                    | $t_{d(\text{on})}$  | $T_{vj} = 25^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 5.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 23.0\Omega$ , $R_{G(\text{off})} = 23.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery.  | -     | 18   | -    | ns   |
| Rise time                                             | $t_r$               |                                                                                                                                                                                                                                                                                                                                                   | -     | 4    | -    | ns   |
| Turn-off delay time                                   | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                   | -     | 180  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                                   | -     | 22   | -    | ns   |
| Turn-on energy                                        | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.09 | -    | mJ   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.03 | -    | mJ   |
| Total switching energy                                | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                   | -     | 0.12 | -    | mJ   |

**Switching Characteristic, Inductive Load**

| Parameter                                              | Symbol              | Conditions                                                                                                                                                                                                                                                                                                                                         | Value |      |      | Unit |
|--------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                                        |                     |                                                                                                                                                                                                                                                                                                                                                    | min.  | typ. | max. |      |
| IGBT Characteristic, at $T_{vj} = 150^{\circ}\text{C}$ |                     |                                                                                                                                                                                                                                                                                                                                                    |       |      |      |      |
| Turn-on delay time                                     | $t_{d(\text{on})}$  | $T_{vj} = 150^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 15.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 23.0\Omega$ , $R_{G(\text{off})} = 23.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | -     | 18   | -    | ns   |
| Rise time                                              | $t_r$               |                                                                                                                                                                                                                                                                                                                                                    | -     | 10   | -    | ns   |
| Turn-off delay time                                    | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                    | -     | 208  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                    | -     | 16   | -    | ns   |
| Turn-on energy                                         | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.41 | -    | mJ   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.14 | -    | mJ   |
| Total switching energy                                 | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.55 | -    | mJ   |
|                                                        |                     |                                                                                                                                                                                                                                                                                                                                                    |       |      |      |      |
| Turn-on delay time                                     | $t_{d(\text{on})}$  | $T_{vj} = 150^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 5.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 23.0\Omega$ , $R_{G(\text{off})} = 23.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery.  | -     | 16   | -    | ns   |
| Rise time                                              | $t_r$               |                                                                                                                                                                                                                                                                                                                                                    | -     | 5    | -    | ns   |
| Turn-off delay time                                    | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                    | -     | 228  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                    | -     | 27   | -    | ns   |
| Turn-on energy                                         | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.15 | -    | mJ   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.05 | -    | mJ   |
| Total switching energy                                 | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                    | -     | 0.20 | -    | mJ   |

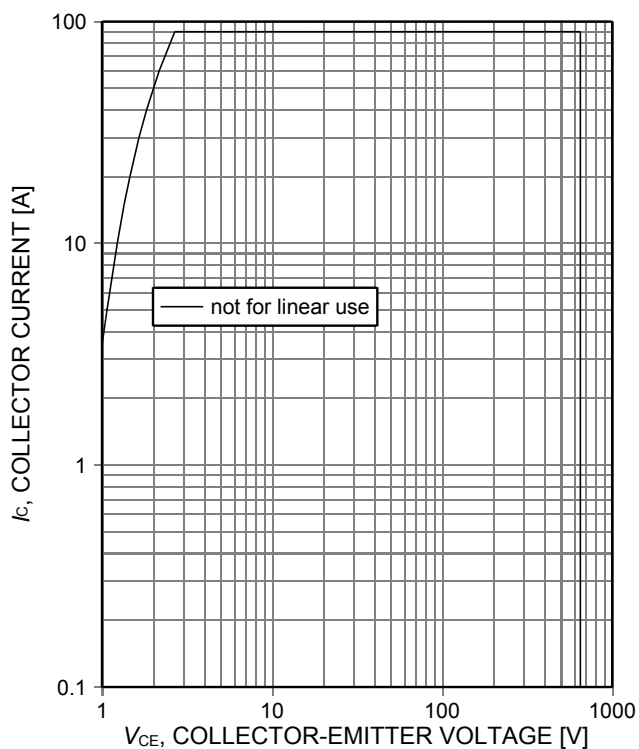


Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ .  
Recommended use at  $V_{GE}\geq 7.5\text{V}$ )

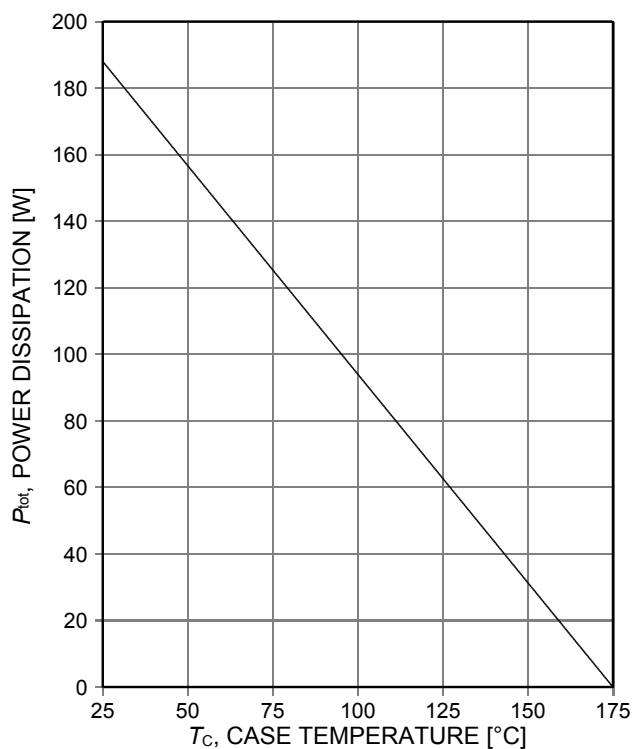


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

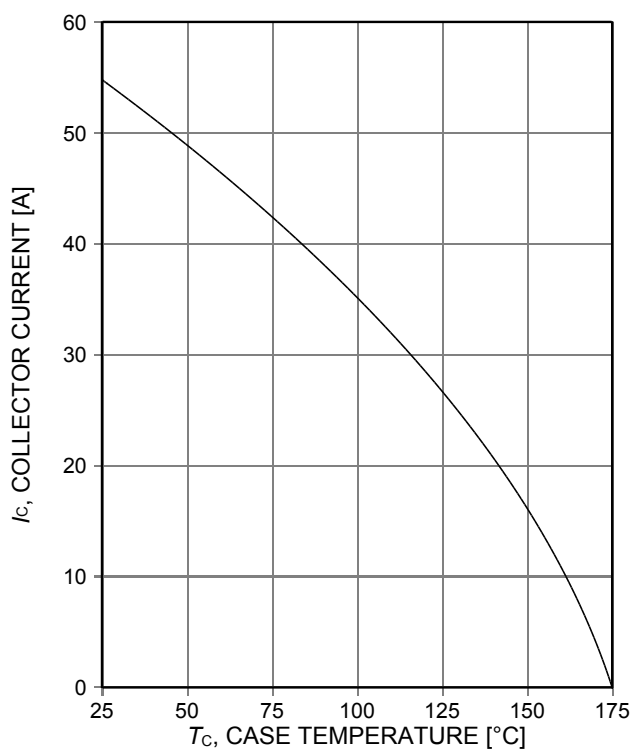


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

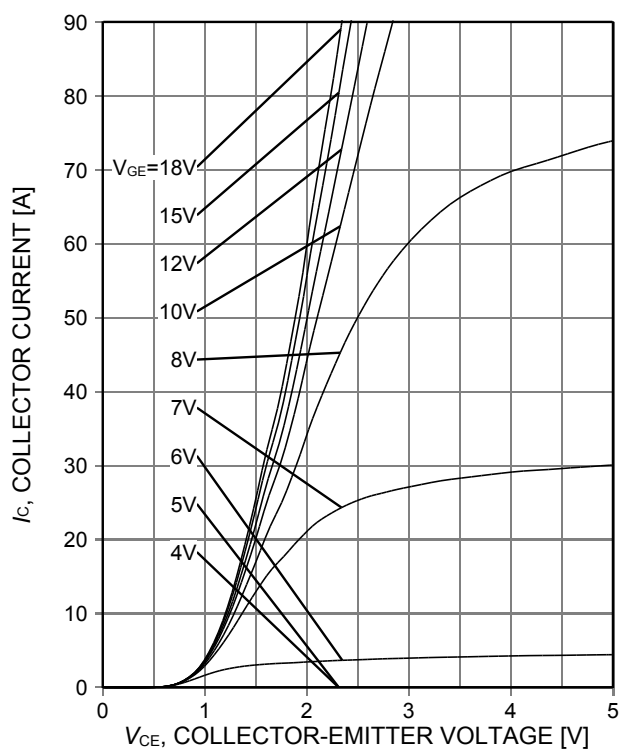


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

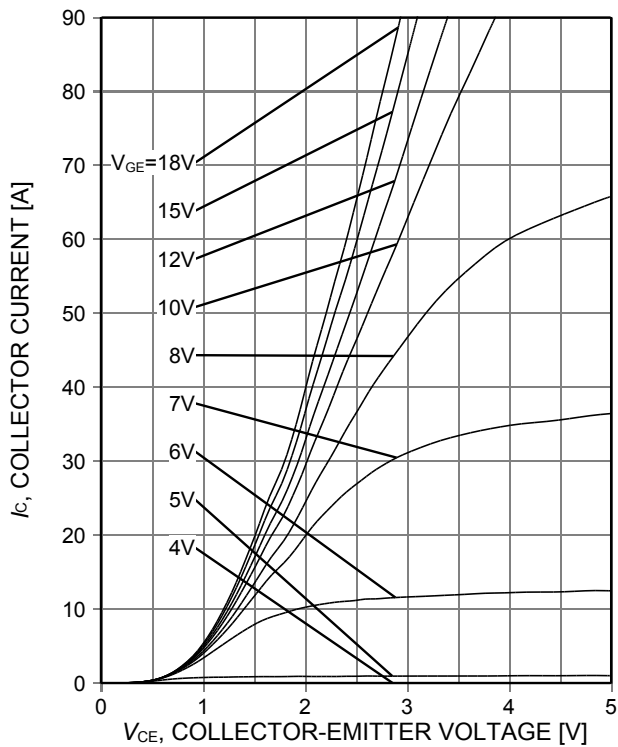


Figure 5. **Typical output characteristic**  
( $T_j=150^\circ\text{C}$ )

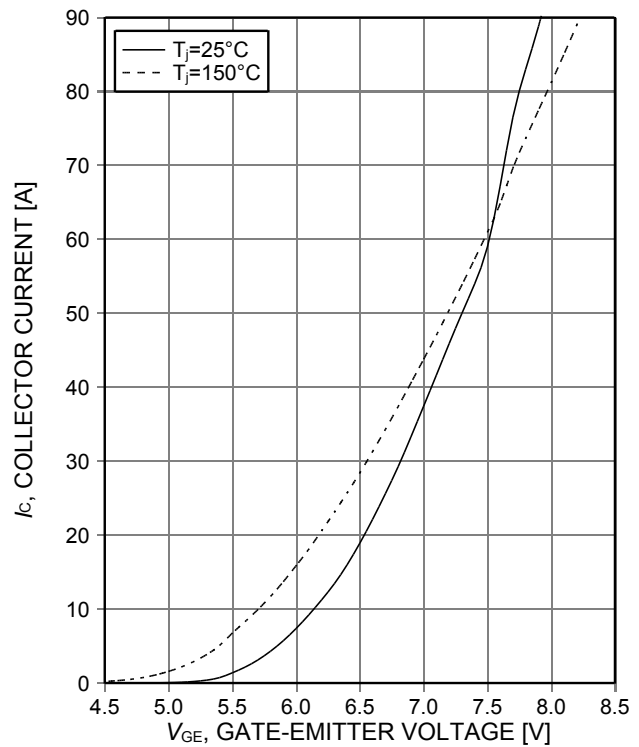


Figure 6. **Typical transfer characteristic**  
( $V_{CE}=20\text{V}$ )

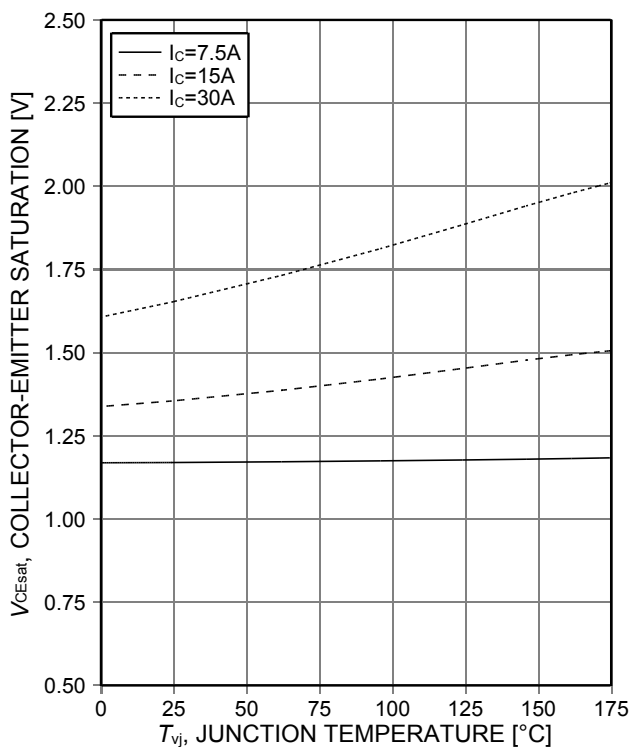


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE}=15\text{V}$ )

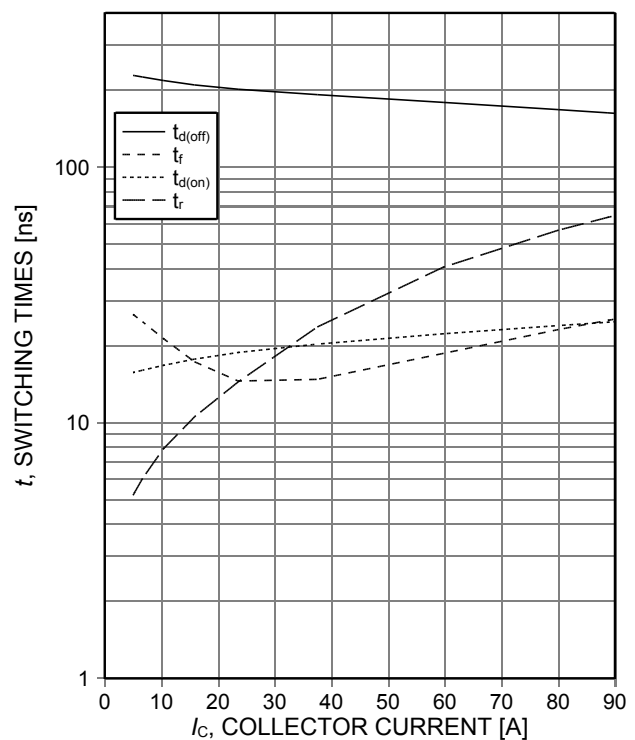


Figure 8. **Typical switching times as a function of collector current**  
(inductive load,  $T_j=150^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $r_G=23\Omega$ , Dynamic test circuit in Figure E)

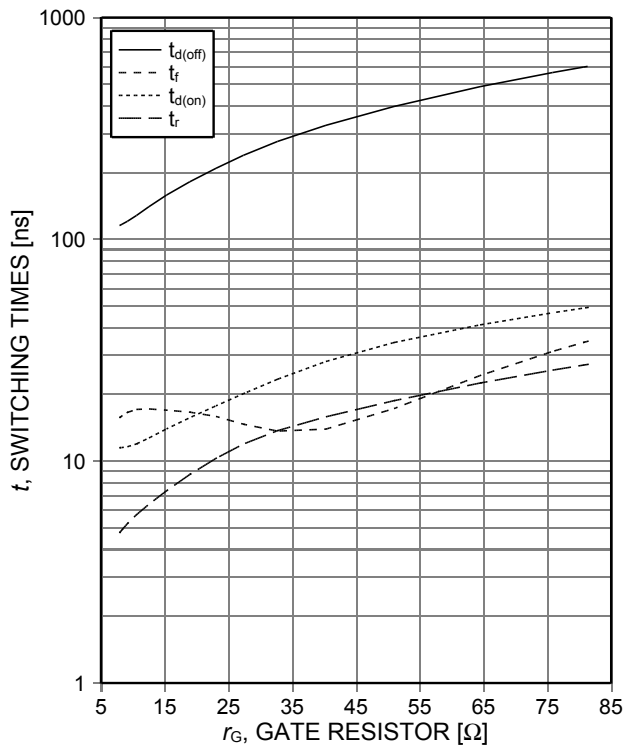


Figure 9. **Typical switching times as a function of gate resistor**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=15\text{A}$ , Dynamic test circuit in Figure E)

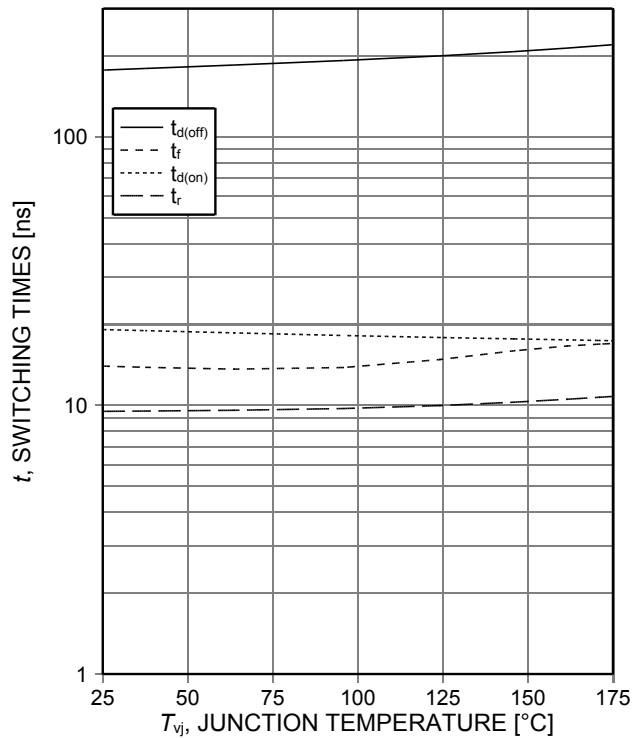


Figure 10. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=15\text{A}$ ,  $r_G=23\Omega$ , Dynamic test circuit in Figure E)

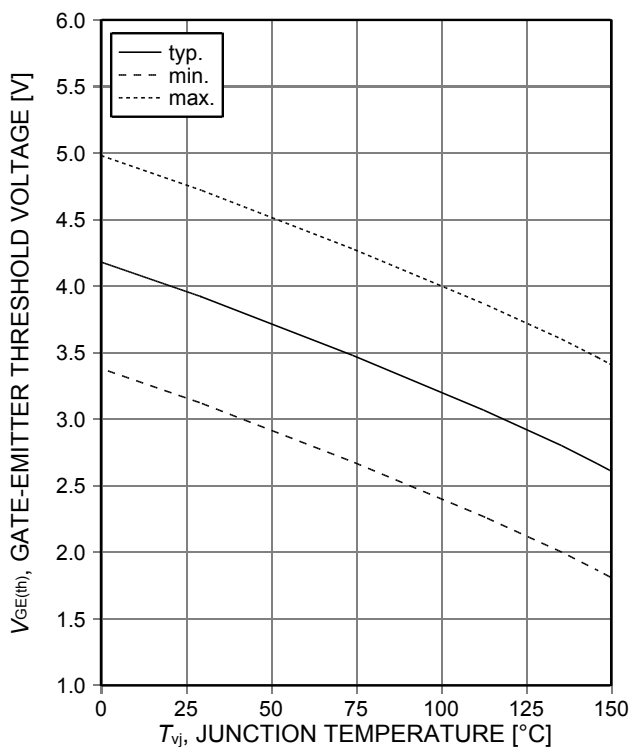


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.3\text{mA}$ )

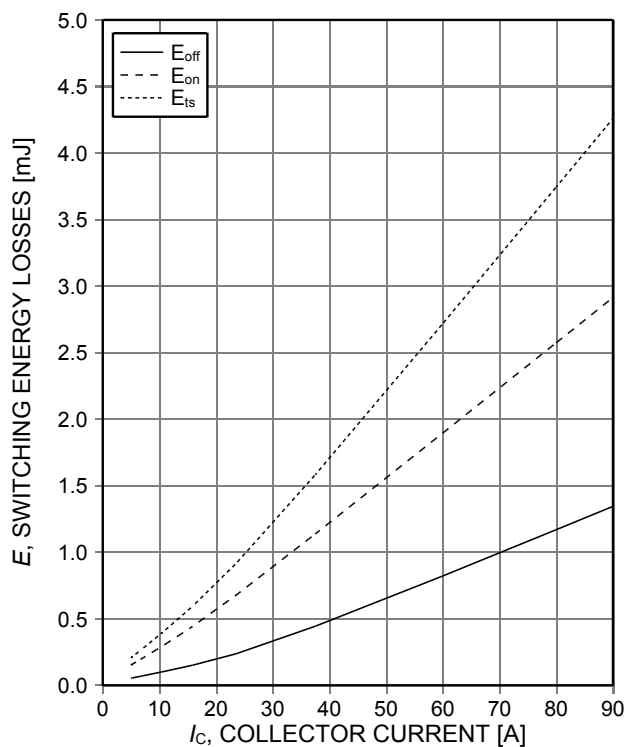


Figure 12. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $r_G=23\Omega$ , Dynamic test circuit in Figure E)

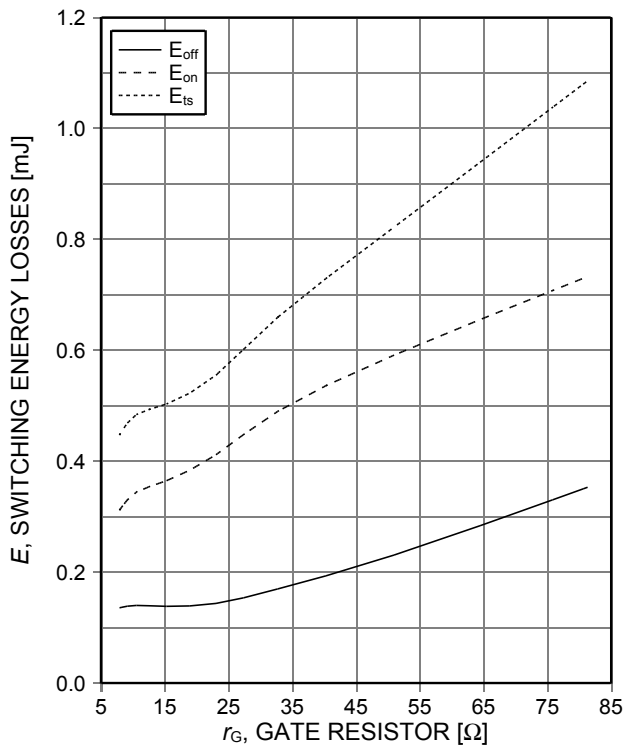


Figure 13. **Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=15\text{A}$ , Dynamic test circuit in Figure E)

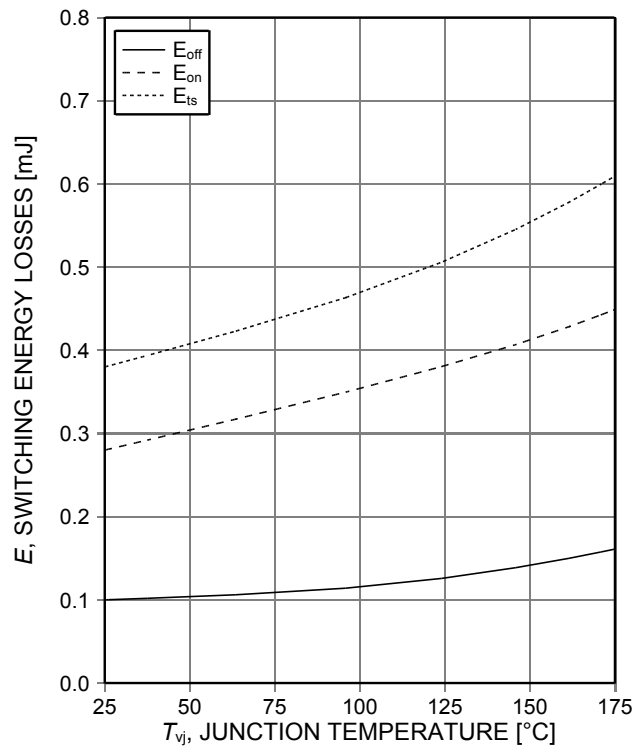


Figure 14. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=15\text{A}$ ,  $r_G=23\Omega$ , Dynamic test circuit in Figure E)

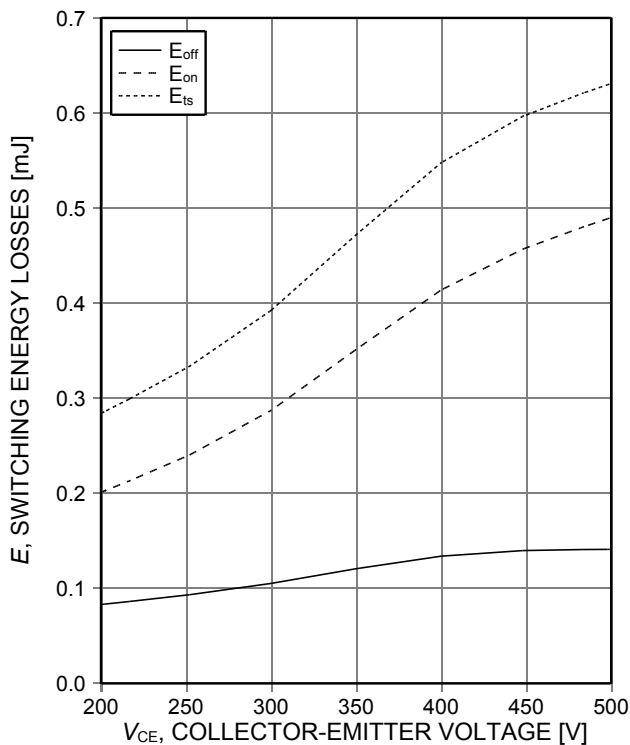


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{GE}=15/0\text{V}$ ,  $I_C=15\text{A}$ ,  $r_G=23\Omega$ , Dynamic test circuit in Figure E)

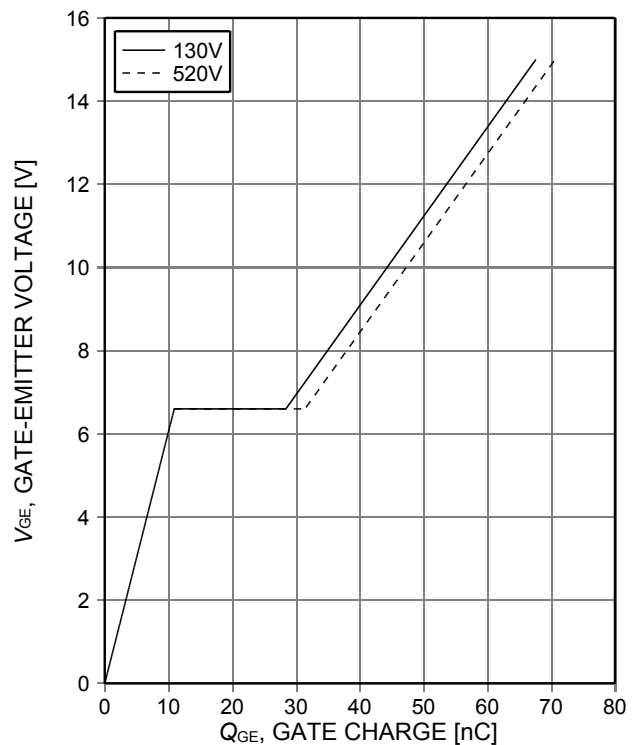


Figure 16. **Typical gate charge**  
( $I_C=30\text{A}$ )

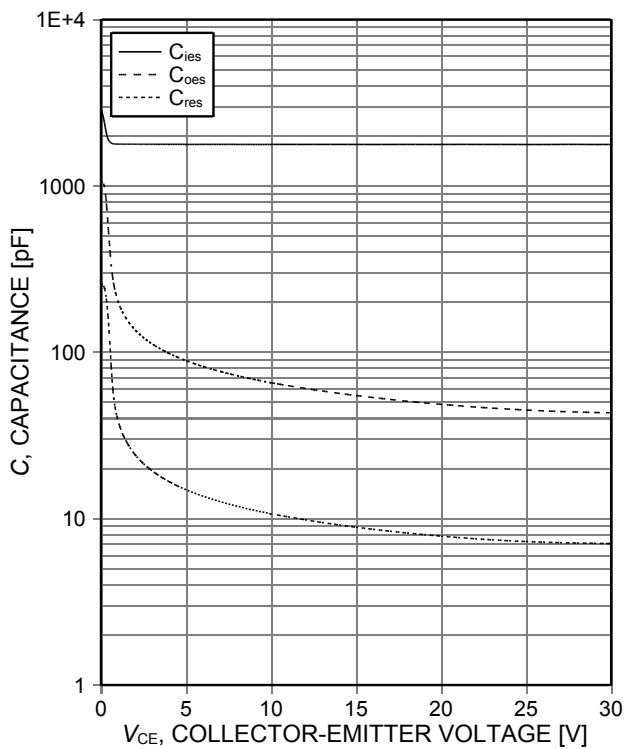


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

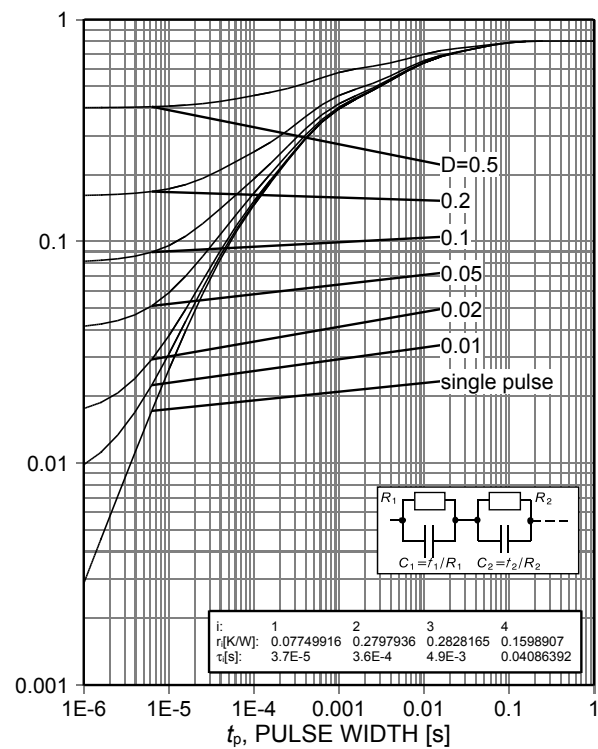
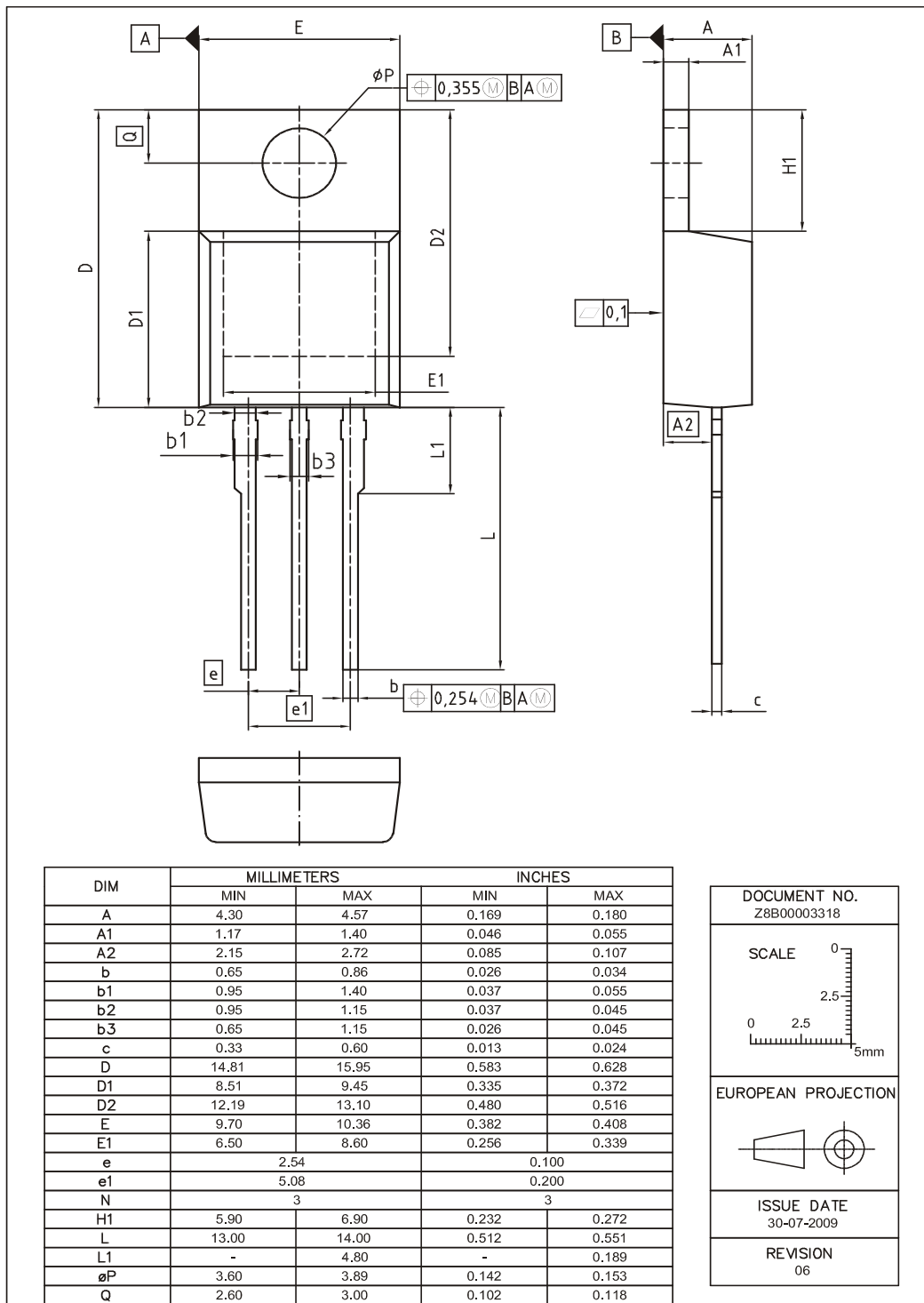


Figure 18. IGBT transient thermal impedance ( $D=t_p/T$ )

## PG-TO220-3



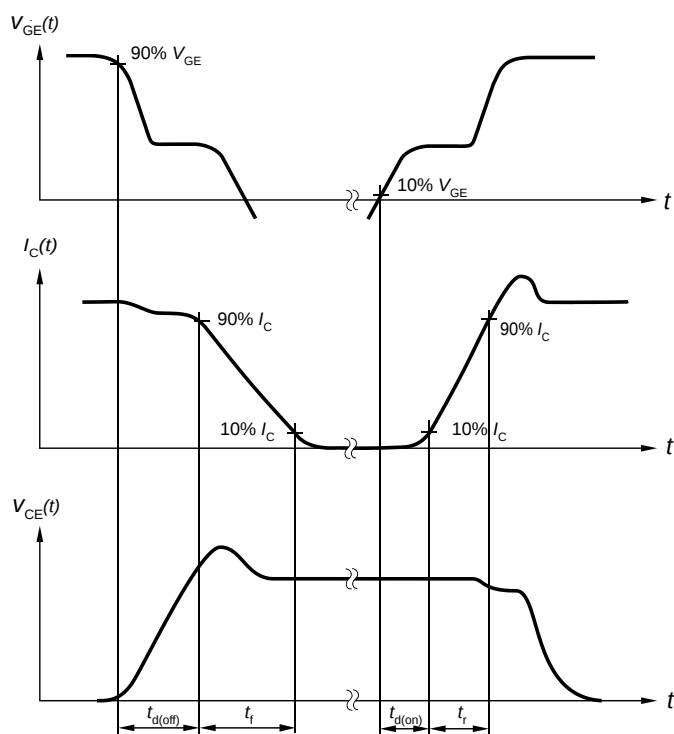


Figure A. Definition of switching times

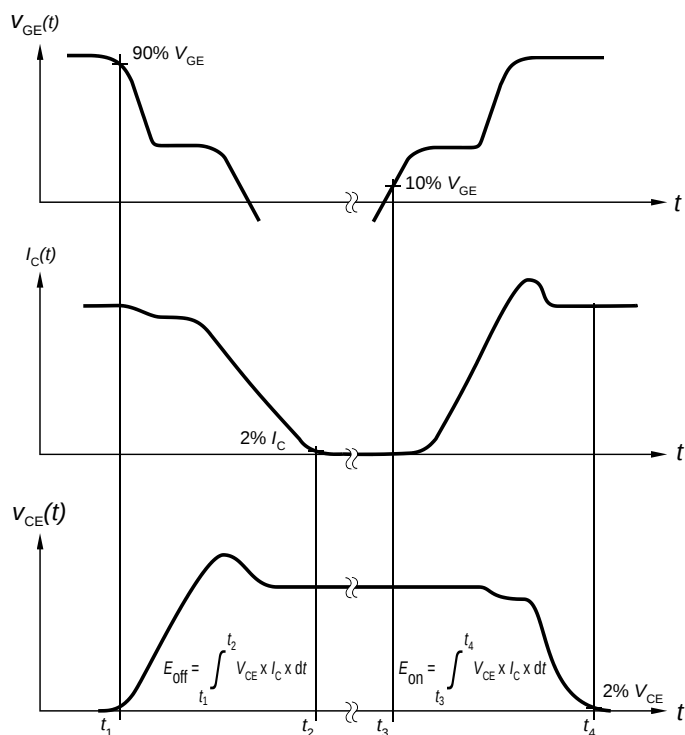
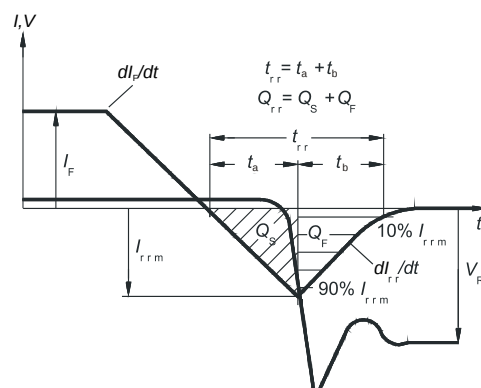


Figure B. Definition of switching losses



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

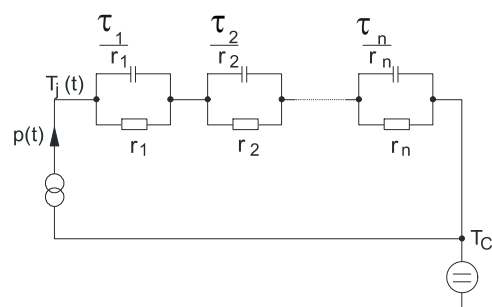


Figure D. Thermal equivalent circuit

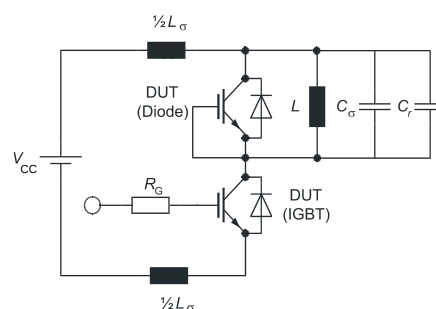


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_{\sigma}$ ,  
parasitic capacitor  $L_{\sigma}$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

## Revision History

IGP30N65H5

Revision: 2014-12-04, Rev. 2.2

## Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.1      | 2014-06-11 | Final data sheet                             |
| 2.2      | 2014-12-04 | Minor changes Fig.1 and Fig.14               |

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## Warnings

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

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only 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, automotive, aviation and aerospace 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.

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