

High speed series fifth generation

## High speed 5 IGBT in TRENCHSTOP™ 5 technology

### Features and Benefits:

High speed H5 technology offering

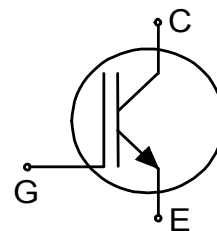
- Best-in-Class efficiency in hard switching and resonant topologies
- Plug and play replacement of previous generation IGBTs
- 650V breakdown voltage
- Low  $Q_G$
- Maximum junction temperature 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:  
<http://www.infineon.com/igbt/>

### Applications:

- Uninterruptible power supplies
- Solar converters
- Welding converters
- Mid to high range switching frequency converters

### Package pin definition:

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



### Key Performance and Package Parameters

| Type       | $V_{CE}$ | $I_C$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|------------|----------|-------|---------------------------------|-------------|---------|------------|
| IGW75N65H5 | 650V     | 75A   | 1.65V                           | 175°C       | G75EH5  | PG-TO247-3 |

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## 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>$T_C = 25^{\circ}\text{C}$ value limited by bondwire<br>$T_C = 100^{\circ}\text{C}$ | $I_C$       | 120.0<br>75.0        | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}^{1)}$                                                                         | $I_{Cpuls}$ | 300.0                | A                  |
| Turn off safe operating area<br>$V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}^{1)}$           | -           | 300.0                | 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 $T_C = 100^{\circ}\text{C}$                                       | $P_{tot}$   | 395.0<br>198.0       | 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, PG-TO247-pin123<br>Maximum of mounting processes: 3                                                      | $M$         | 0.6                  | Nm                 |

## Thermal Resistance

| Parameter                                   | Symbol        | Conditions | Value |      |      | Unit |
|---------------------------------------------|---------------|------------|-------|------|------|------|
|                                             |               |            | min.  | typ. | max. |      |
| IGBT thermal resistance,<br>junction - case | $R_{th(j-c)}$ |            | -     | -    | 0.38 | K/W  |
| Thermal resistance<br>junction - ambient    | $R_{th(j-a)}$ |            | -     | -    | 40   | K/W  |

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

| Parameter                            | Symbol        | Conditions                                                                                                                                          | Value       |                      |                | Unit          |
|--------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|----------------|---------------|
|                                      |               |                                                                                                                                                     | min.        | typ.                 | max.           |               |
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}$ , $I_C = 0.20\text{mA}$                                                                                                        | 650         | -                    | -              | V             |
| Collector-emitter saturation voltage | $V_{CEsat}$   | $V_{GE} = 15.0\text{V}$ , $I_C = 75.0\text{A}$<br>$T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 125^{\circ}\text{C}$<br>$T_{vj} = 175^{\circ}\text{C}$ | -<br>-<br>- | 1.65<br>1.85<br>1.95 | 2.10<br>-<br>- | V             |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C = 0.75\text{mA}$ , $V_{CE} = V_{GE}$                                                                                                           | 3.2         | 4.0                  | 4.8            | V             |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE} = 650\text{V}$ , $V_{GE} = 0\text{V}$<br>$T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = 175^{\circ}\text{C}$                                    | -<br>-      | 0<br>800             | 75<br>-        | $\mu\text{A}$ |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$                                                                                                        | -           | -                    | 100            | nA            |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20\text{V}$ , $I_C = 75.0\text{A}$                                                                                                        | -           | 104.0                | -              | S             |

<sup>1)</sup> Defined by design. Not subject to production test.

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**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 <sub>ies</sub> | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                 | -     | 3800  | -    | pF   |
| Output capacitance                                             | C <sub>oes</sub> |                                                                       | -     | 80    | -    |      |
| Reverse transfer capacitance                                   | C <sub>res</sub> |                                                                       | -     | 17    | -    |      |
| Gate charge                                                    | Q <sub>G</sub>   | V <sub>CC</sub> = 520V, I <sub>C</sub> = 75.0A, V <sub>GE</sub> = 15V | -     | 160.0 | -    | nC   |
| Internal emitter inductance measured 5mm (0.197 in.) from case | L <sub>E</sub>   |                                                                       | -     | 13.0  | -    | 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>$V_{CC} = 400\text{V}, I_C = 75.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(\text{on})} = 8.0\Omega, R_{G(\text{off})} = 8.0\Omega,$<br>$L\sigma = 30\text{nH}, C\sigma = 25\text{pF}$<br>$L\sigma, C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. Diode from IKW75N65EH5. | -     | 28   | -    | ns   |
| Rise time                                             | $t_r$               |                                                                                                                                                                                                                                                                                                                                                         | -     | 33   | -    | ns   |
| Turn-off delay time                                   | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                         | -     | 174  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                                         | -     | 41   | -    | ns   |
| Turn-on energy                                        | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                         | -     | 2.25 | -    | mJ   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                         | -     | 0.95 | -    | mJ   |
| Total switching energy                                | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                         | -     | 3.20 | -    | mJ   |
|                                                       |                     |                                                                                                                                                                                                                                                                                                                                                         |       |      |      |      |
| Turn-on delay time                                    | $t_{d(\text{on})}$  | $T_{vj} = 25^{\circ}\text{C},$<br>$V_{CC} = 400\text{V}, I_C = 37.5\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(\text{on})} = 8.0\Omega, R_{G(\text{off})} = 8.0\Omega,$<br>$L\sigma = 30\text{nH}, C\sigma = 25\text{pF}$<br>$L\sigma, C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. Diode from IKW75N65EH5. | -     | 25   | -    | ns   |
| Rise time                                             | $t_r$               |                                                                                                                                                                                                                                                                                                                                                         | -     | 14   | -    | ns   |
| Turn-off delay time                                   | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                         | -     | 178  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                                         | -     | 18   | -    | ns   |
| Turn-on energy                                        | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                         | -     | 0.90 | -    | mJ   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                         | -     | 0.30 | -    | mJ   |
| Total switching energy                                | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                         | -     | 1.20 | -    | mJ   |

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**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>$V_{CC} = 400\text{V}$ , $I_C = 75.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 8.0\Omega$ , $R_{G(\text{off})} = 8.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 25\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and<br>diode reverse recovery. Diode<br>from IKW75N65EH5. | -     | 27   | -    | ns   |
| Rise time                                              | $t_r$               |                                                                                                                                                                                                                                                                                                                                                                                | -     | 34   | -    | ns   |
| Turn-off delay time                                    | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                                                | -     | 194  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                                                | -     | 38   | -    | ns   |
| Turn-on energy                                         | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                                                | -     | 3.00 | -    | mJ   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                                                | -     | 1.00 | -    | mJ   |
| Total switching energy                                 | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                                                | -     | 4.00 | -    | mJ   |
|                                                        |                     |                                                                                                                                                                                                                                                                                                                                                                                |       |      |      |      |
| Turn-on delay time                                     | $t_{d(\text{on})}$  | $T_{vj} = 150^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 37.5\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 8.0\Omega$ , $R_{G(\text{off})} = 8.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 25\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and<br>diode reverse recovery. Diode<br>from IKW75N65EH5. | -     | 25   | -    | ns   |
| Rise time                                              | $t_r$               |                                                                                                                                                                                                                                                                                                                                                                                | -     | 16   | -    | ns   |
| Turn-off delay time                                    | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                                                                | -     | 207  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                                                | -     | 14   | -    | ns   |
| Turn-on energy                                         | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                                                                | -     | 1.80 | -    | mJ   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                                                | -     | 0.40 | -    | mJ   |
| Total switching energy                                 | $E_{\text{ts}}$     |                                                                                                                                                                                                                                                                                                                                                                                | -     | 2.20 | -    | mJ   |

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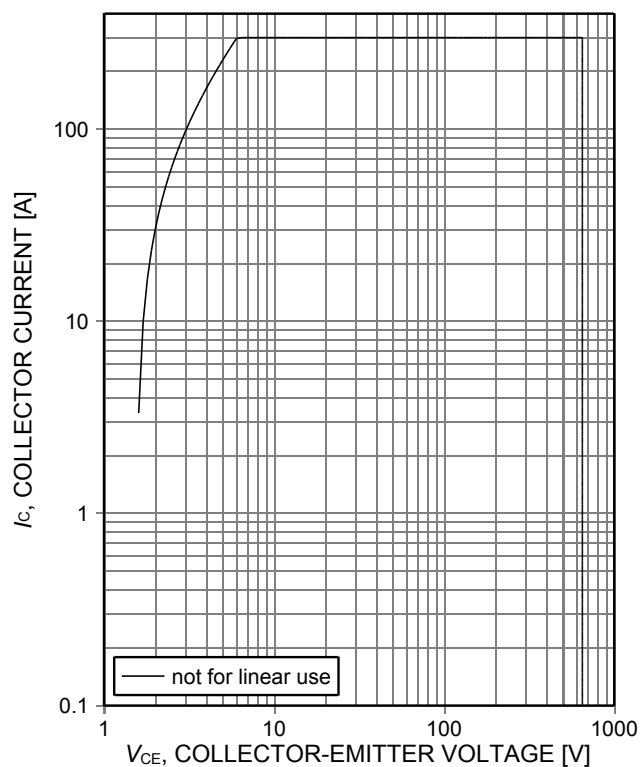


Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ,  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ ,  
 $I_{Cmax}$  defined by design - not subject to  
production test)

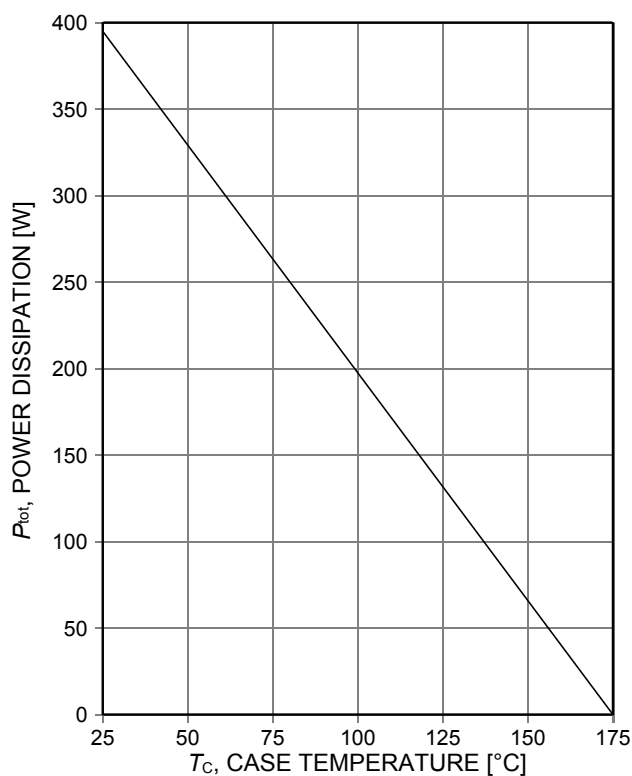


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

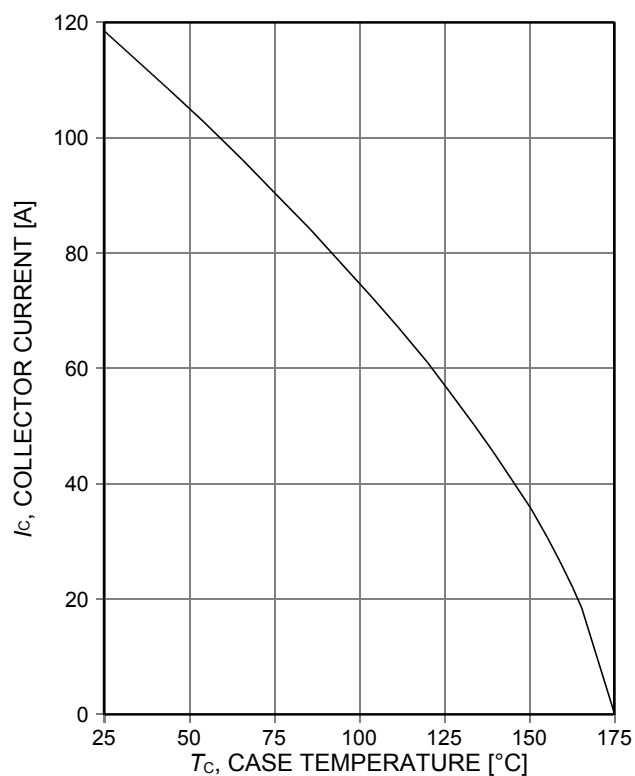


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

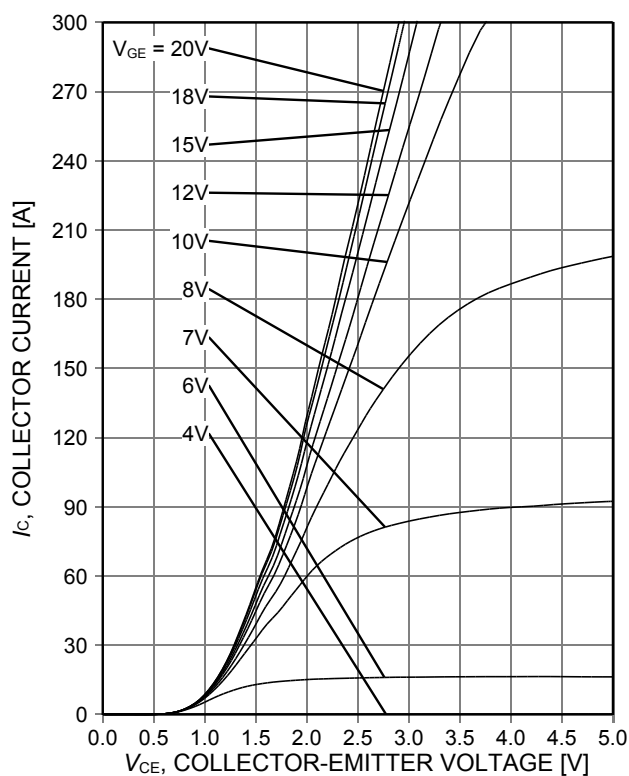


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

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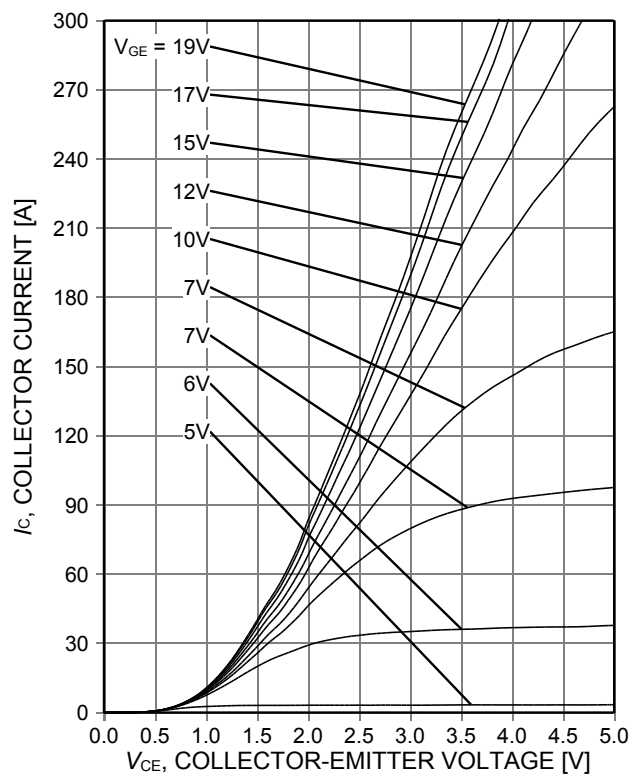


Figure 5. **Typical output characteristic**  
( $T_{vj}=150^{\circ}\text{C}$ )

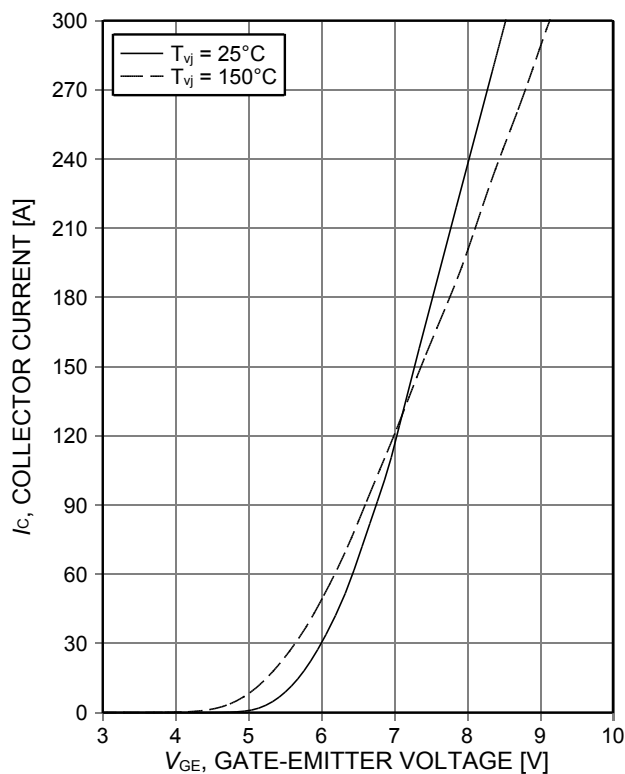


Figure 6. **Typical transfer characteristic**  
( $V_{ce}=20\text{V}$ )

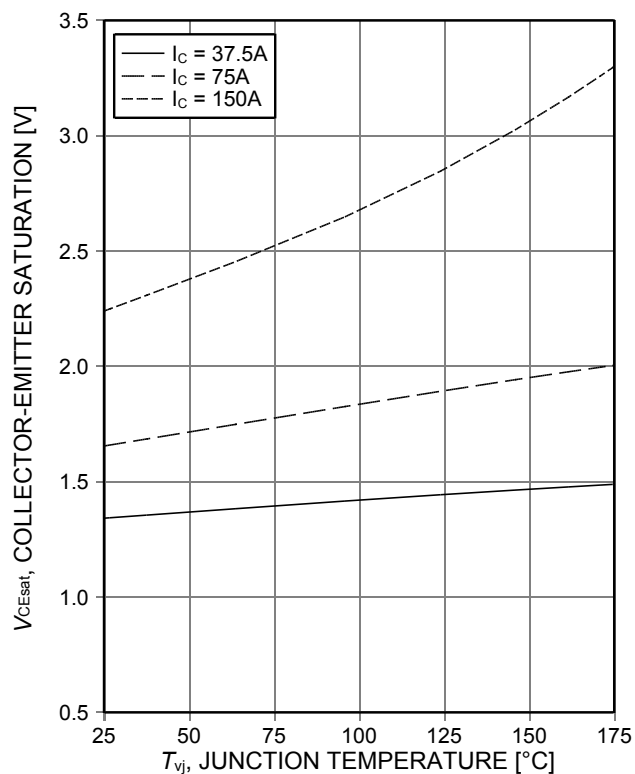


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{ge}=15\text{V}$ )

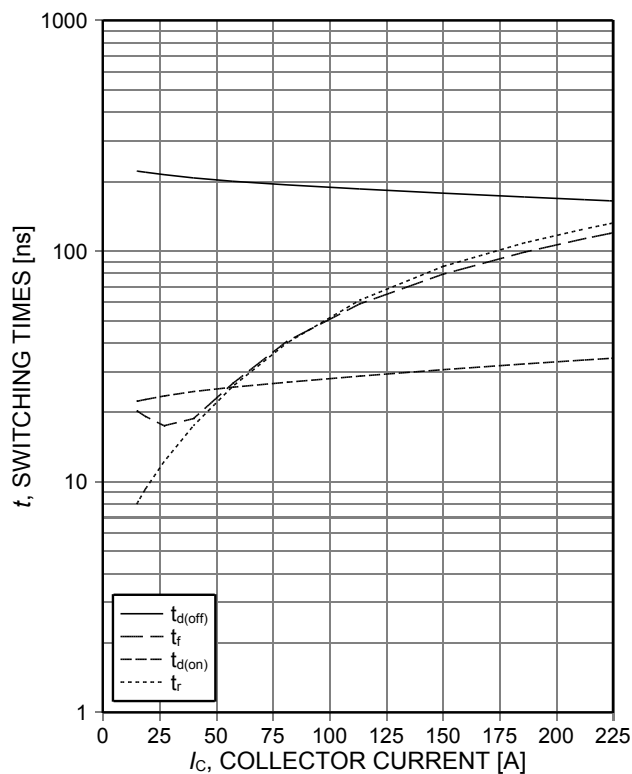


Figure 8. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{ce}=400\text{V}$ ,  $V_{ge}=0/15\text{V}$ ,  $R_{G(on)}=8\Omega$ ,  $R_{G(off)}=8\Omega$ , dynamic test circuit in Figure E)

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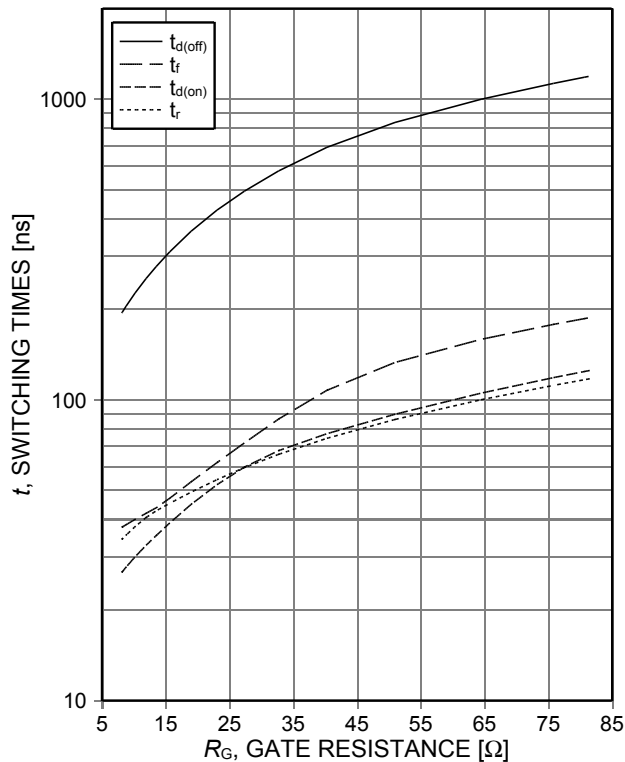


Figure 9. **Typical switching times as a function of gate resistance**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ , dynamic test circuit in Figure E)

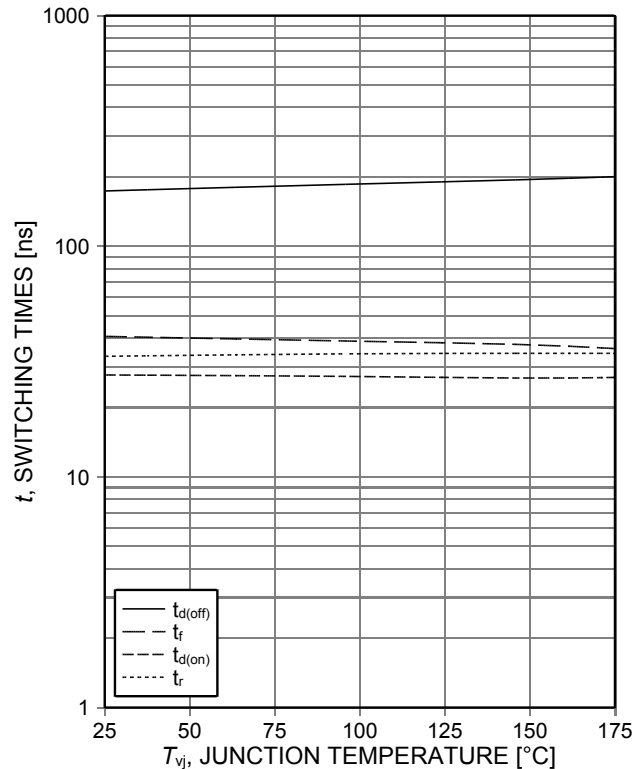


Figure 10. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ ,  $R_{G(on)}=8\Omega$ ,  $R_{G(off)}=8\Omega$ , dynamic test circuit in Figure E)

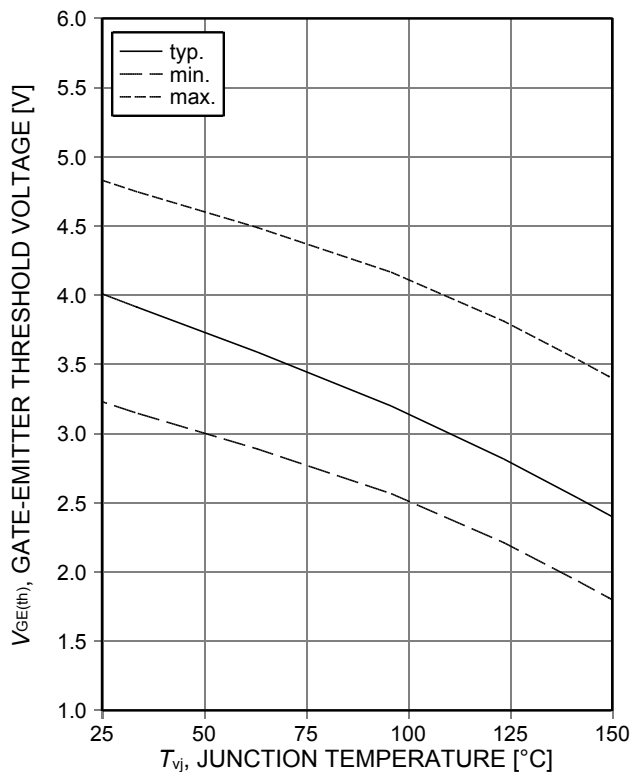


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.75\text{mA}$ )

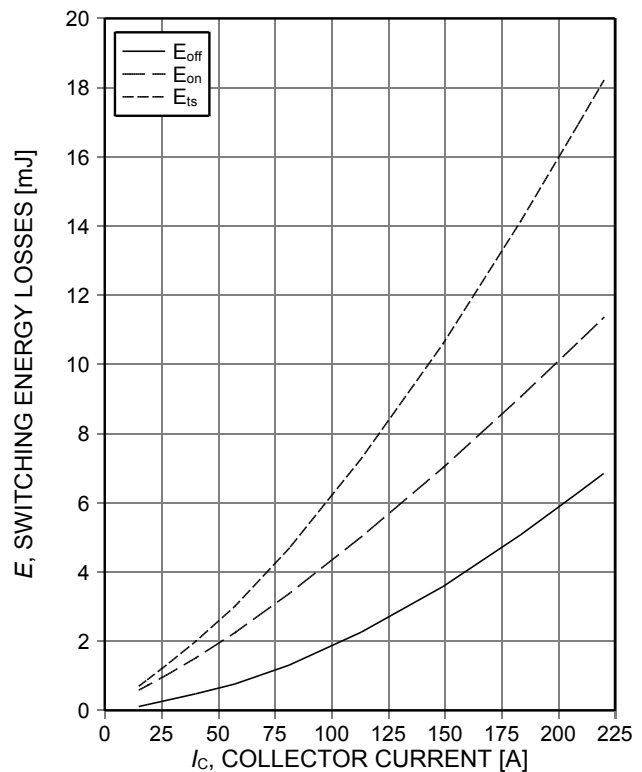


Figure 12. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{G(on)}=8\Omega$ ,  $R_{G(off)}=8\Omega$ , dynamic test circuit in Figure E)

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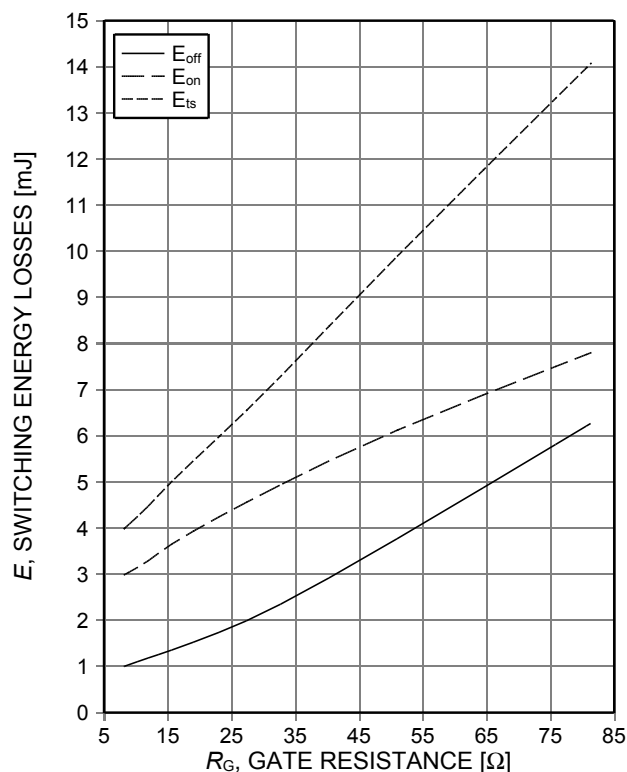


Figure 13. **Typical switching energy losses as a function of gate resistance**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ , dynamic test circuit in Figure E)

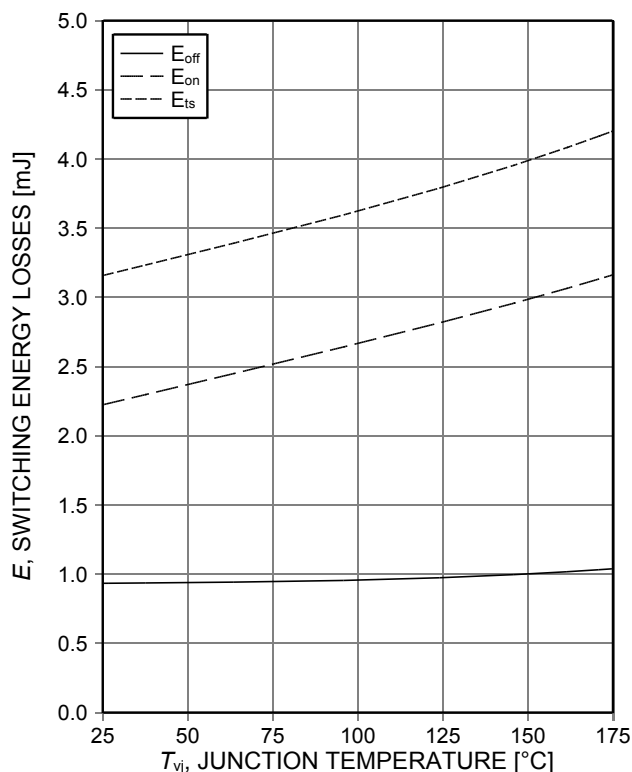


Figure 14. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=400\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ ,  $R_{G(on)}=8\Omega$ ,  $R_{G(off)}=8\Omega$ , dynamic test circuit in Figure E)

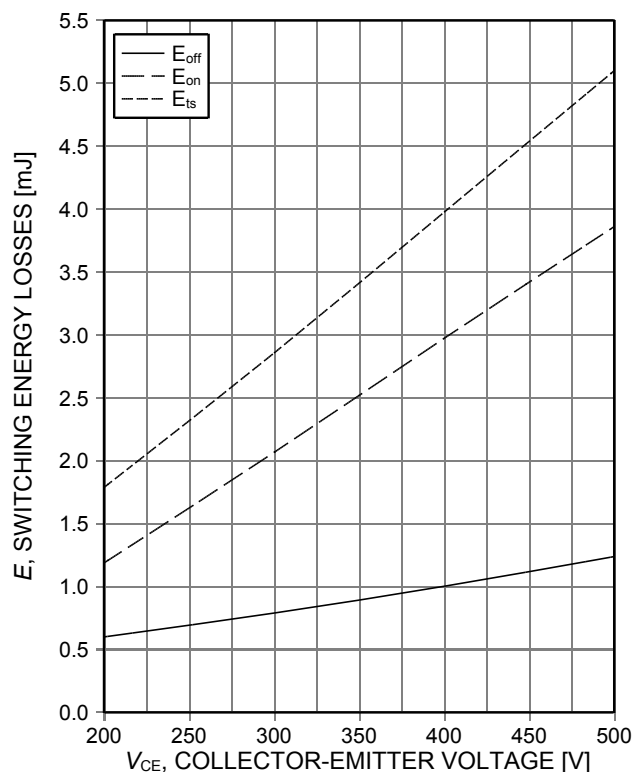


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_{vj}=150^{\circ}\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=75\text{A}$ ,  $R_{G(on)}=8\Omega$ ,  $R_{G(off)}=8\Omega$ , dynamic test circuit in Figure E)

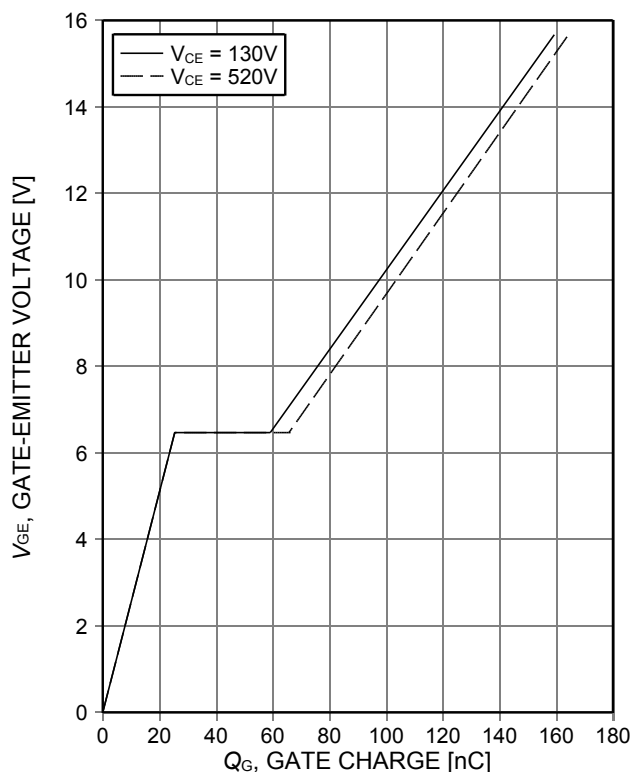


Figure 16. **Typical gate charge**  
( $I_C=75\text{A}$ )

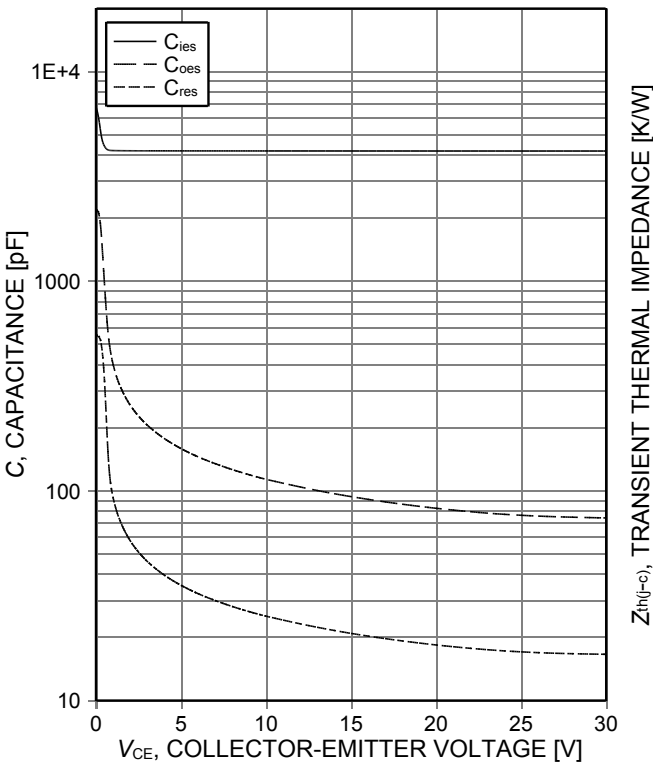


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0$  V,  $f=1$  MHz)

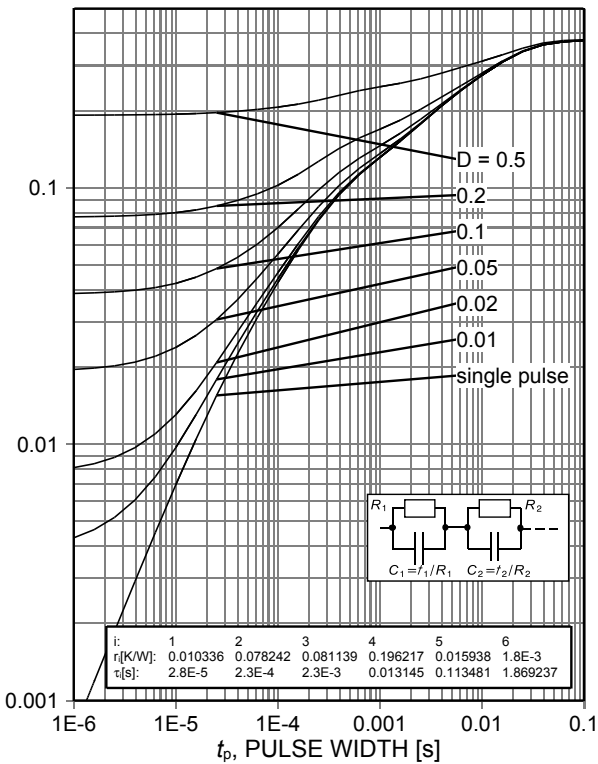
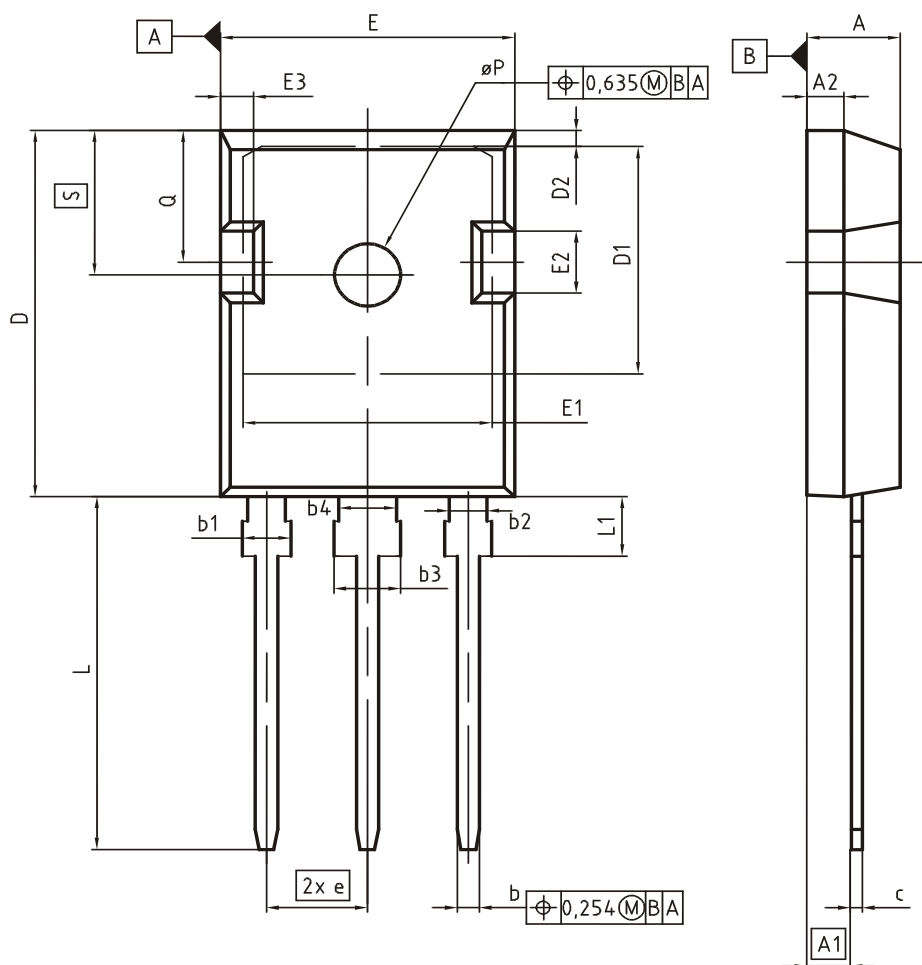
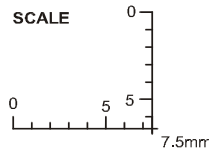
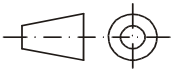


Figure 18. IGBT transient thermal impedance ( $D=t_p/T$ )

## Package Drawing 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 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00003327                                                                                  |
| <b>SCALE</b><br>               |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>09-07-2010                                                                                     |
| <b>REVISION</b><br>05                                                                                               |

## Testing Conditions

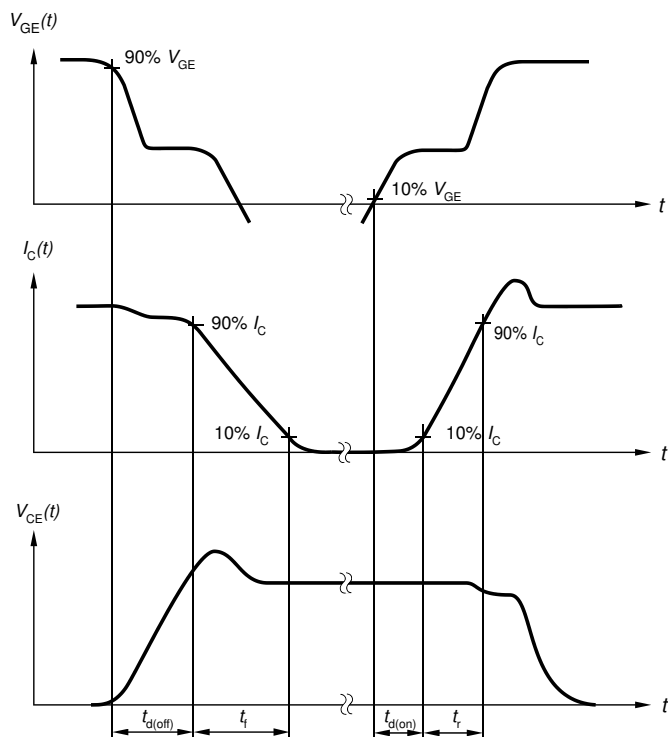


Figure A. Definition of switching times

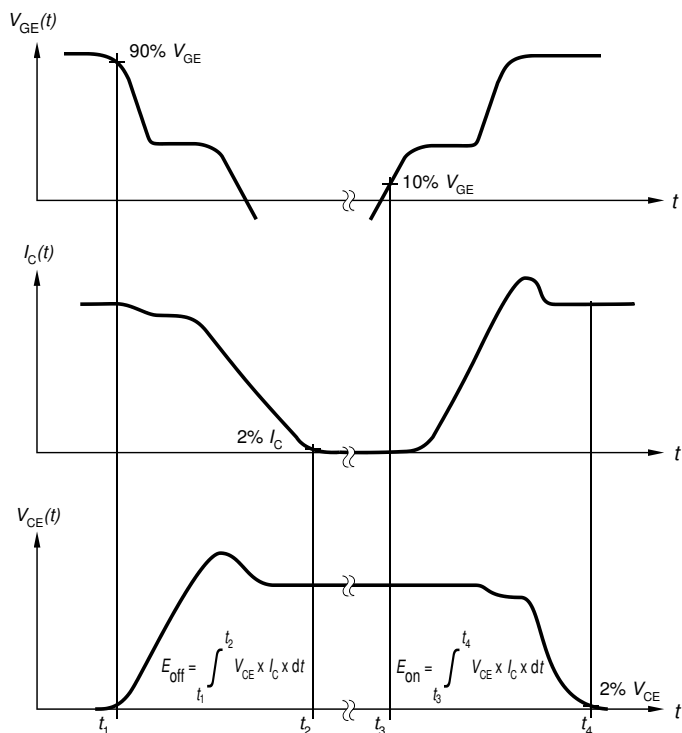


Figure B. Definition of switching losses

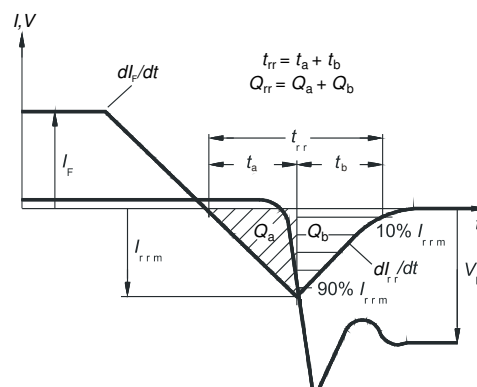


Figure C. Definition of diode switching characteristics

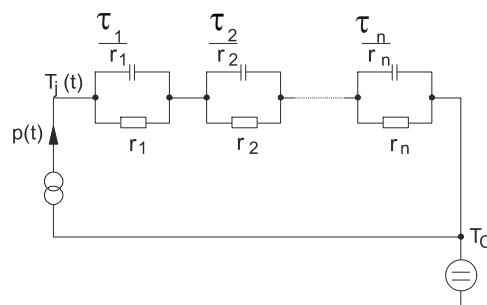


Figure D. Thermal equivalent circuit

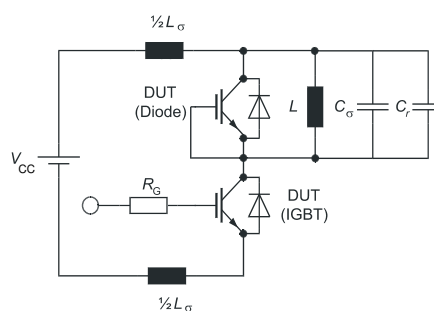


Figure E. **Dynamic test circuit**  
 Parasitic inductance  $L_{\sigma}$ ,  
 parasitic capacitor  $C_{\sigma}$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

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High speed series fifth generation

#### Revision History

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IGW75N65H5

**Revision: 2017-07-27, Rev. 2.2**

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Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.1      | 2015-05-20 | Final data sheet                             |
| 2.2      | 2017-07-27 | Correction Fig. 1                            |

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