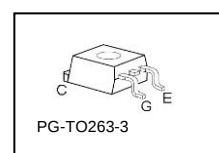
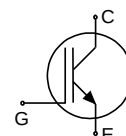


Low Loss IGBT : IGBT in TRENCHSTOP™ and Fieldstop technology



### Features:

- Very low  $V_{CE(sat)}$  1.5V (typ.)
- Maximum Junction Temperature 175°C
- Short circuit withstand time 5μs
- Designed for frequency inverters for washing machines, fans, pumps and vacuum cleaners
- TRENCHSTOP™ technology for 600V applications offers :
  - very tight parameter distribution
  - high ruggedness, temperature stable behavior
  - very high switching speed
- Positive temperature coefficient in  $V_{CE(sat)}$
- Low EMI
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1</sup> for target applications
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



| Type      | $V_{CE}$ | $I_C$ | $V_{CE(sat)}, T_j=25^\circ\text{C}$ | $T_{j,max}$ | Marking Code | Package    |
|-----------|----------|-------|-------------------------------------|-------------|--------------|------------|
| IGB30N60T | 600V     | 30A   | 1.5V                                | 175°C       | G30T60       | PG-TO263-3 |

### Maximum Ratings

| Parameter                                                                                                                         | Symbol       | Value      | Unit |
|-----------------------------------------------------------------------------------------------------------------------------------|--------------|------------|------|
| Collector-emitter voltage, $T_j \geq 25^\circ\text{C}$                                                                            | $V_{CE}$     | 600        | V    |
| DC collector current, limited by $T_{j,max}$<br>$T_C = 25^\circ\text{C}$ , value limited by bondwire<br>$T_C = 100^\circ\text{C}$ | $I_C$        | 45<br>39   | A    |
| Pulsed collector current, $t_p$ limited by $T_{j,max}$                                                                            | $I_{C,puls}$ | 90         |      |
| Turn off safe operating area, $V_{CE} = 600\text{V}$ , $T_j = 175^\circ\text{C}$ , $t_p = 1\mu\text{s}$                           | -            | 90         |      |
| Gate-emitter voltage                                                                                                              | $V_{GE}$     | $\pm 20$   | V    |
| Short circuit withstand time <sup>2)</sup><br>$V_{GE} = 15\text{V}$ , $V_{CC} \leq 400\text{V}$ , $T_j \leq 150^\circ\text{C}$    | $t_{SC}$     | 5          | μs   |
| Power dissipation $T_C = 25^\circ\text{C}$                                                                                        | $P_{tot}$    | 187        | W    |
| Operating junction temperature                                                                                                    | $T_j$        | -40...+175 | °C   |
| Storage temperature                                                                                                               | $T_{stg}$    | -55...+150 |      |
| Soldering temperature (reflow soldering, MSL1)                                                                                    | -            | 260        |      |

<sup>1</sup> J-STD-020 and JESD-022

<sup>2)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

### Thermal Resistance

| Parameter                                   | Symbol     | Conditions           | Max. Value | Unit |
|---------------------------------------------|------------|----------------------|------------|------|
| <b>Characteristic</b>                       |            |                      |            |      |
| IGBT thermal resistance,<br>junction – case | $R_{thJC}$ |                      | 0.80       | K/W  |
| Thermal resistance,<br>junction – ambient   | $R_{thJA}$ | 6 cm <sup>2</sup> Cu | 40         |      |

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

| Parameter                            | Symbol        | Conditions                                                               | Value  |            |            | Unit     |
|--------------------------------------|---------------|--------------------------------------------------------------------------|--------|------------|------------|----------|
|                                      |               |                                                                          | min.   | typ.       | max.       |          |
| Static Characteristic                |               |                                                                          |        |            |            |          |
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=0.2mA$                                                   | 600    | -          | -          | V        |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE} = 15V, I_C=30A$<br>$T_j=25^{\circ}C$<br>$T_j=175^{\circ}C$       | -<br>- | 1.5<br>1.9 | 2.05<br>-  |          |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C=0.43mA,$<br>$V_{CE}=V_{GE}$                                         | 4.1    | 4.9        | 5.7        |          |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE}=600V,$<br>$V_{GE}=0V$<br>$T_j=25^{\circ}C$<br>$T_j=175^{\circ}C$ | -<br>- | -<br>-     | 40<br>2000 | $\mu A$  |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE}=0V, V_{GE}=20V$                                                  | -      | -          | 100        | nA       |
| Transconductance                     | $g_{fs}$      | $V_{CE}=20V, I_C=30A$                                                    | -      | 16.7       | -          | S        |
| Integrated gate resistor             | $R_{Gint}$    |                                                                          | -      |            |            | $\Omega$ |

### Dynamic Characteristic

|                                                                   |             |                                                                                  |   |      |   |    |
|-------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------|---|------|---|----|
| Input capacitance                                                 | $C_{iss}$   | $V_{CE}=25V,$<br>$V_{GE}=0V,$<br>$f=1MHz$                                        | - | 1630 | - | pF |
| Output capacitance                                                | $C_{oss}$   |                                                                                  | - | 108  | - |    |
| Reverse transfer capacitance                                      | $C_{rss}$   |                                                                                  | - | 50   | - |    |
| Gate charge                                                       | $Q_{Gate}$  | $V_{CC}=480V, I_C=30A$<br>$V_{GE}=15V$                                           | - | 167  | - | nC |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from case | $L_E$       |                                                                                  | - | 7    | - | nH |
| Short circuit collector current <sup>1)</sup>                     | $I_{C(SC)}$ | $V_{GE}=15V, t_{SC}\leq 5\mu s$<br>$V_{CC} = 400V,$<br>$T_j = 150^\circ\text{C}$ | - | 275  | - | A  |

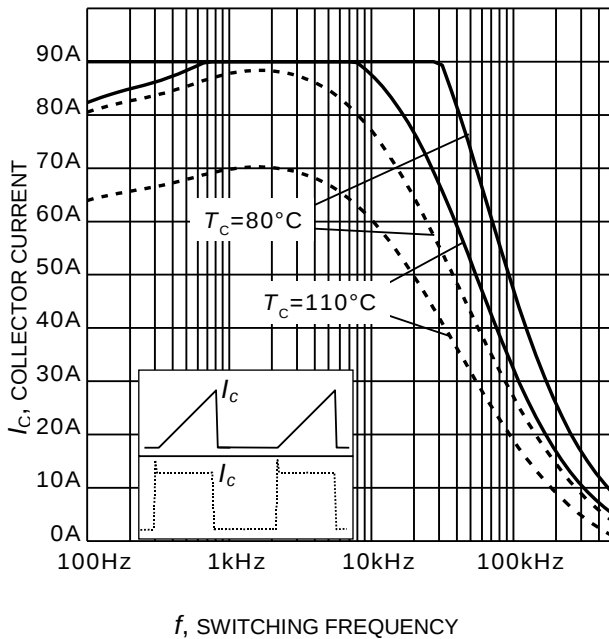
<sup>1)</sup> Allowed number of short circuits: <1000; time between short circuits: >1s.

### Switching Characteristic, Inductive Load, at $T_j=25^\circ\text{C}$

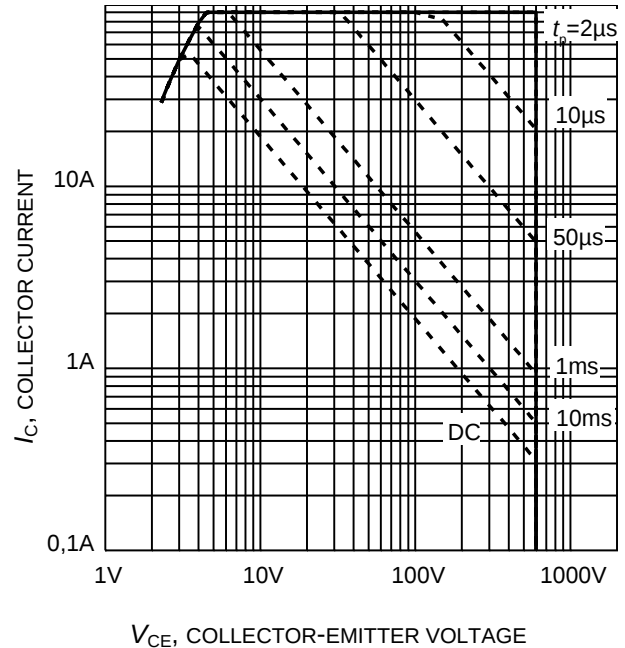
| Parameter              | Symbol       | Conditions                                                                                                                                                                                                                                                                                    | Value |      |      | Unit |
|------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                        |              |                                                                                                                                                                                                                                                                                               | min.  | Typ. | max. |      |
| IGBT Characteristic    |              |                                                                                                                                                                                                                                                                                               |       |      |      |      |
| Turn-on delay time     | $t_{d(on)}$  | $T_j=25^{\circ}\text{C}$ ,<br>$V_{CC}=400\text{V}$ , $I_C=30\text{A}$ ,<br>$V_{GE}=0/15\text{V}$ ,<br>$r_G=10.6\Omega$ ,<br>$L_{\sigma}=136\text{nH}$ , $C_{\sigma}=39\text{pF}$<br>$L_{\sigma}$ , $C_{\sigma}$ from Fig. E<br>Energy losses include<br>“tail” and diode reverse<br>recovery. | -     | 23   | -    | ns   |
| Rise time              | $t_r$        |                                                                                                                                                                                                                                                                                               | -     | 21   | -    |      |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                               | -     | 254  | -    |      |
| Fall time              | $t_f$        |                                                                                                                                                                                                                                                                                               | -     | 46   | -    |      |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                                                                                                                                                               | -     | 0.69 | -    | mJ   |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                                                                                                                               | -     | 0.77 | -    |      |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                                                                                                                               | -     | 1.46 | -    |      |

### Switching Characteristic, Inductive Load, at $T_j=175^\circ\text{C}$

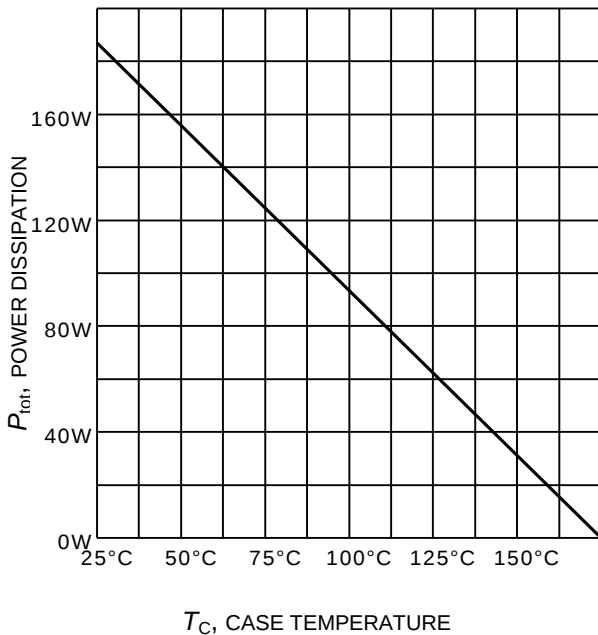
| Parameter              | Symbol       | Conditions                                                                                                                                                                                                                                                                                     | Value |      |      | Unit |
|------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                        |              |                                                                                                                                                                                                                                                                                                | min.  | Typ. | max. |      |
| IGBT Characteristic    |              |                                                                                                                                                                                                                                                                                                |       |      |      |      |
| Turn-on delay time     | $t_{d(on)}$  | $T_j=175^{\circ}\text{C}$ ,<br>$V_{CC}=400\text{V}$ , $I_C=30\text{A}$ ,<br>$V_{GE}=0/15\text{V}$ ,<br>$r_G=10.6\Omega$ ,<br>$L_{\sigma}=136\text{nH}$ , $C_{\sigma}=39\text{pF}$<br>$L_{\sigma}$ , $C_{\sigma}$ from Fig. E<br>Energy losses include<br>“tail” and diode reverse<br>recovery. | -     | 24   | -    | ns   |
| Rise time              | $t_r$        |                                                                                                                                                                                                                                                                                                | -     | 26   | -    |      |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                | -     | 292  | -    |      |
| Fall time              | $t_f$        |                                                                                                                                                                                                                                                                                                | -     | 90   | -    |      |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                                                                                                                                                                | -     | 1.0  | -    | mJ   |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                                                                                                                                | -     | 1.1  | -    |      |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                                                                                                                                | -     | 2.1  | -    |      |



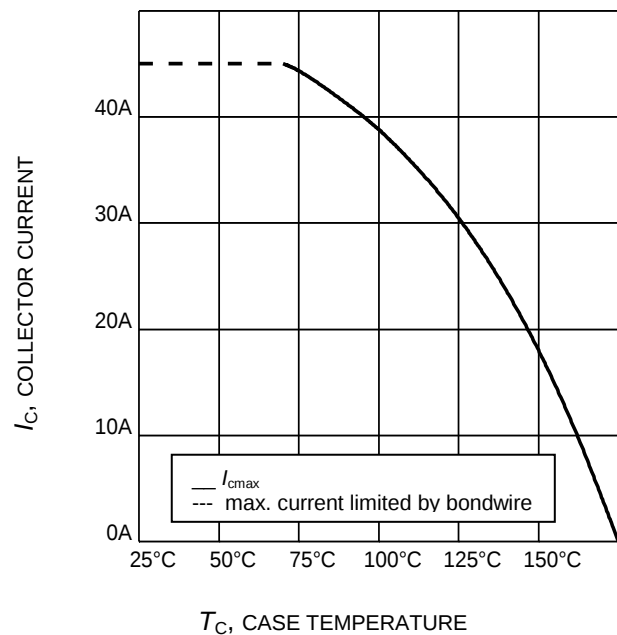
**Figure 1. Collector current as a function of switching frequency**  
 $(T_j \leq 175^\circ\text{C}, D = 0.5, V_{CE} = 400\text{V}, V_{GE} = 0/15\text{V}, r_G = 10\Omega)$



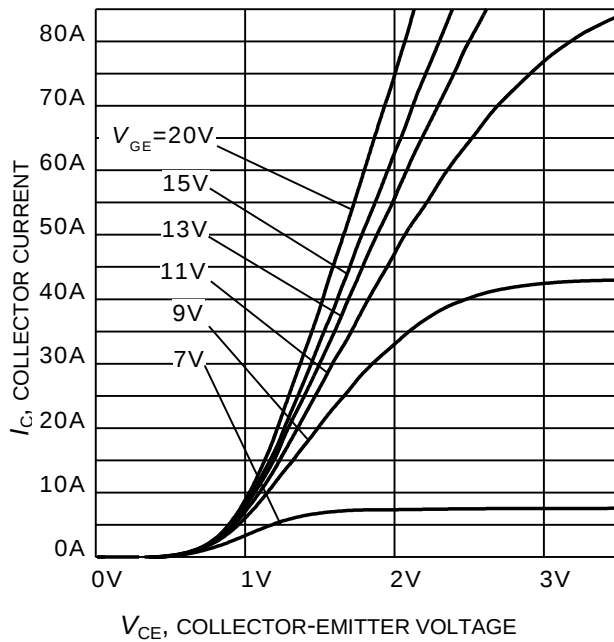
**Figure 2. Safe operating area**  
 $(D = 0, T_C = 25^\circ\text{C}, T_j \leq 175^\circ\text{C}; V_{GE} = 0/15\text{V})$



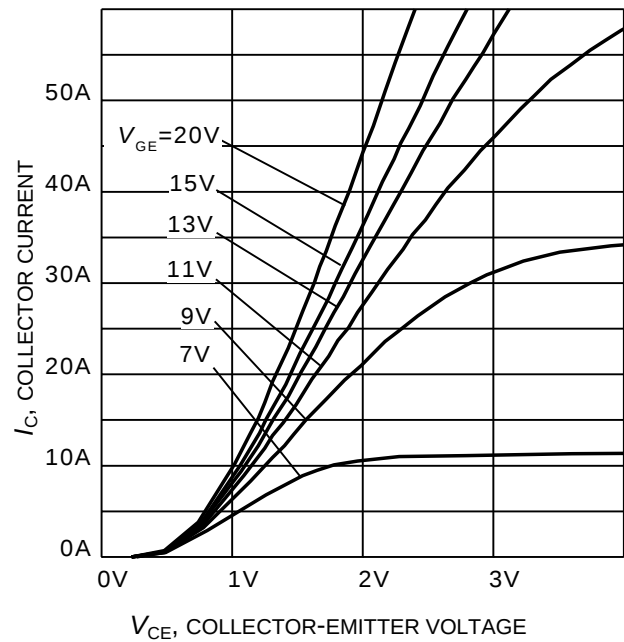
**Figure 3. Power dissipation as a function of case temperature**  
 $(T_j \leq 175^\circ\text{C})$



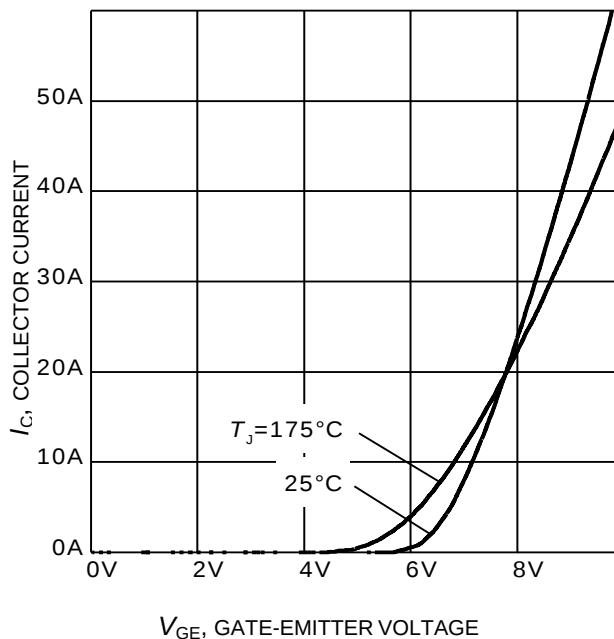
**Figure 4. Collector current as a function of case temperature**  
 $(V_{GE} \geq 15\text{V}, T_j \leq 175^\circ\text{C})$



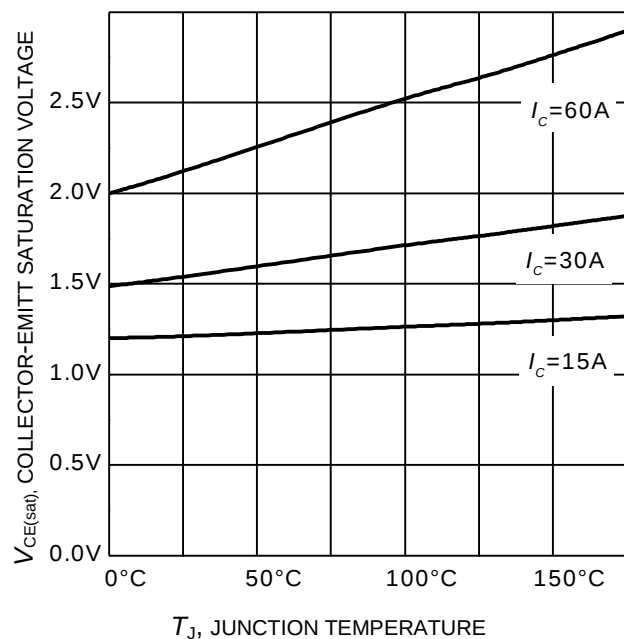
**Figure 5. Typical output characteristic**  
( $T_j = 25^\circ\text{C}$ )



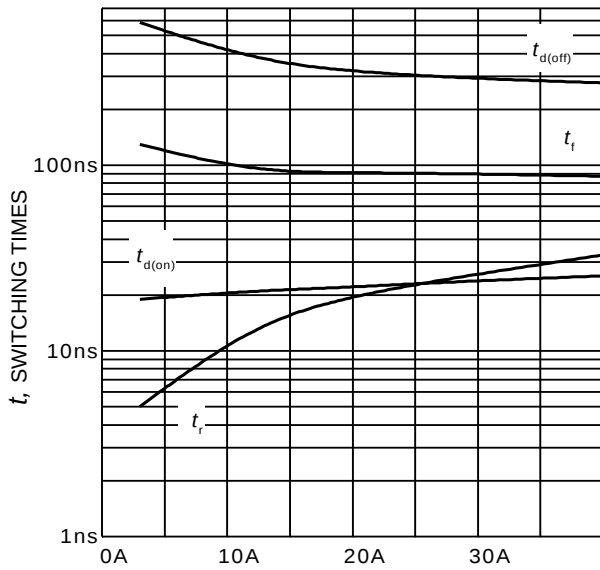
**Figure 6. Typical output characteristic**  
( $T_j = 175^\circ\text{C}$ )



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

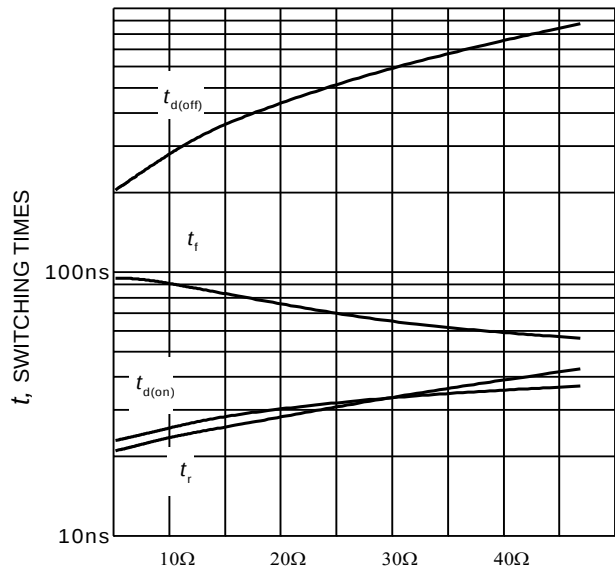


**Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{V}$ )



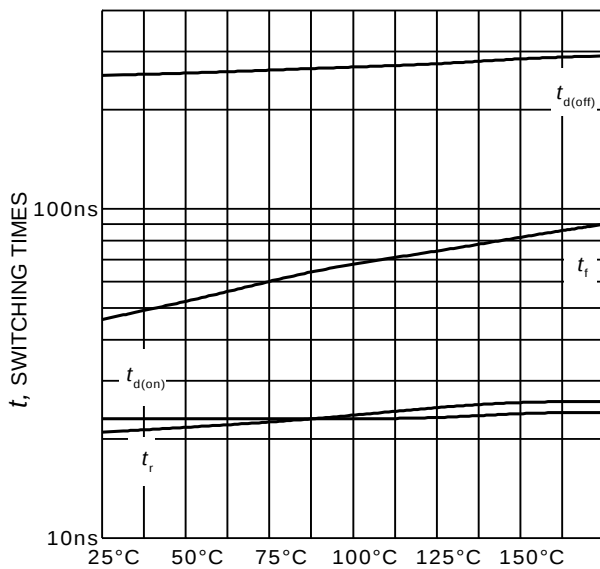
$I_C$ , COLLECTOR CURRENT

**Figure 9. Typical switching times as a function of collector current**  
(inductive load,  $T_J=175^\circ\text{C}$ ,  
 $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $r_G = 10\Omega$ ,  
Dynamic test circuit in Figure E)



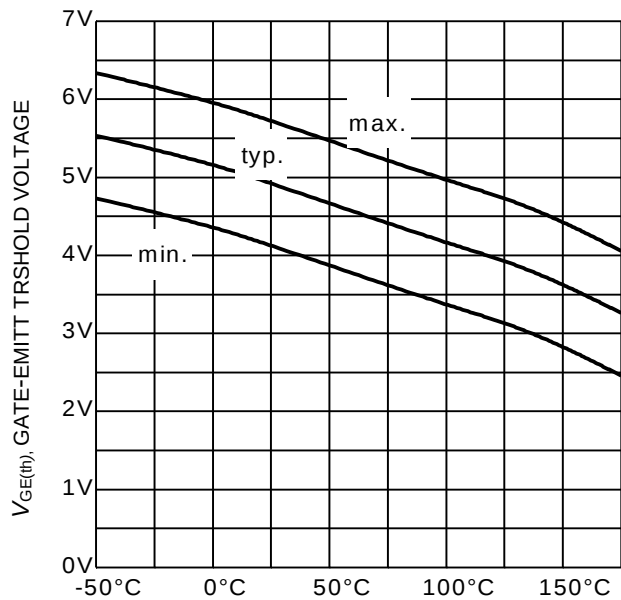
$R_G$ , GATE RESISTOR

**Figure 10. Typical switching times as a function of gate resistor**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  
 $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 30\text{A}$ ,  
Dynamic test circuit in Figure E)



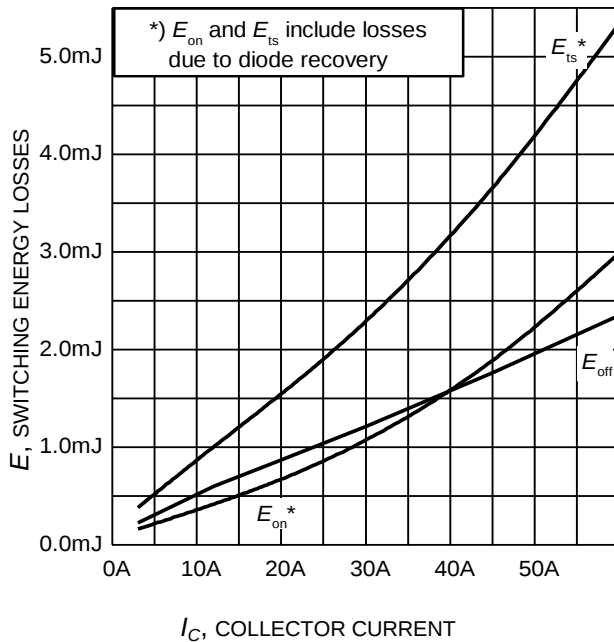
$T_J$ , JUNCTION TEMPERATURE

**Figure 11. Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE} = 400\text{V}$ ,  
 $V_{GE} = 0/15\text{V}$ ,  $I_C = 30\text{A}$ ,  $r_G=10\Omega$ ,  
Dynamic test circuit in Figure E)

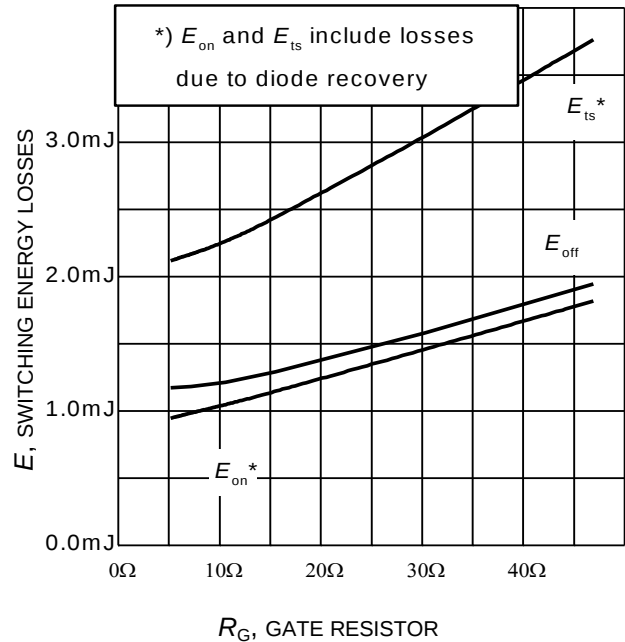


$T_J$ , JUNCTION TEMPERATURE

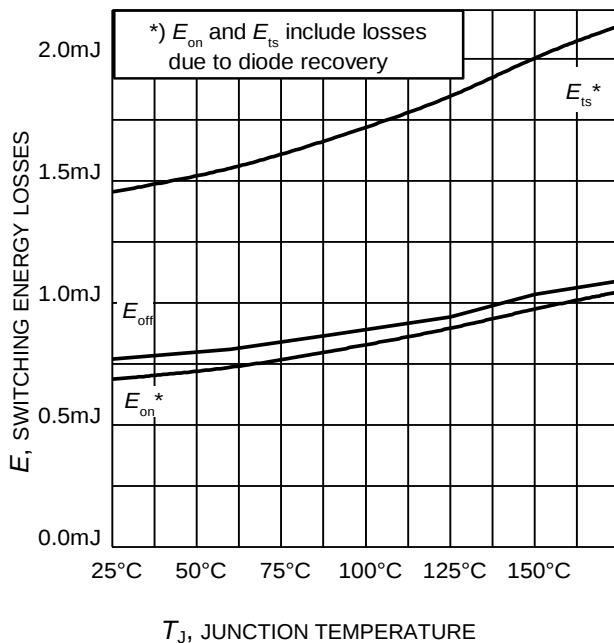
**Figure 12. Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C = 0.43\text{mA}$ )



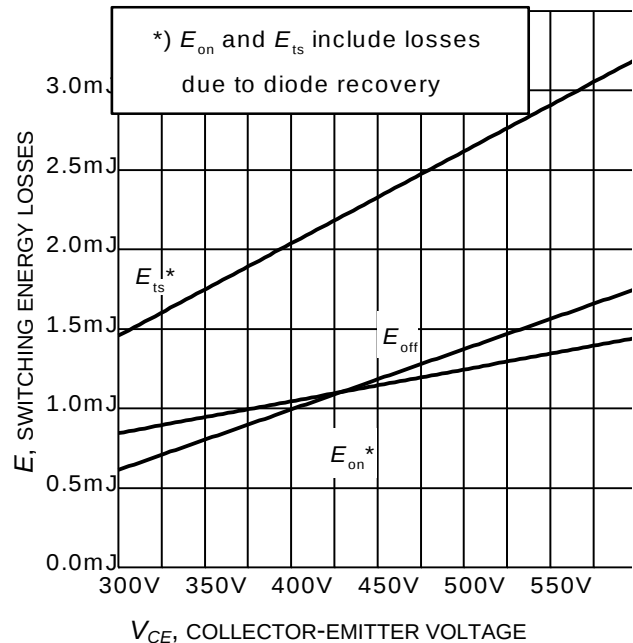
**Figure 13. Typical switching energy losses as a function of collector current**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $r_G = 10\Omega$ , Dynamic test circuit in Figure E)



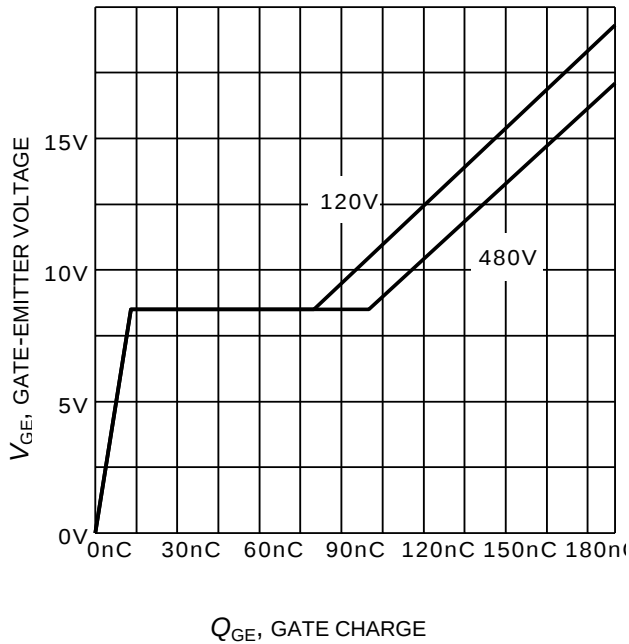
**Figure 14. Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 30\text{A}$ , Dynamic test circuit in Figure E)



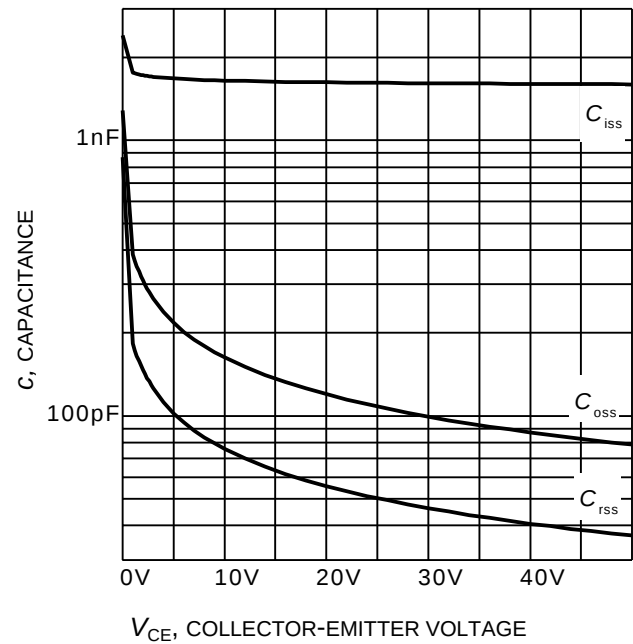
**Figure 15. Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE} = 400\text{V}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 30\text{A}$ ,  $r_G = 10\Omega$ , Dynamic test circuit in Figure E)



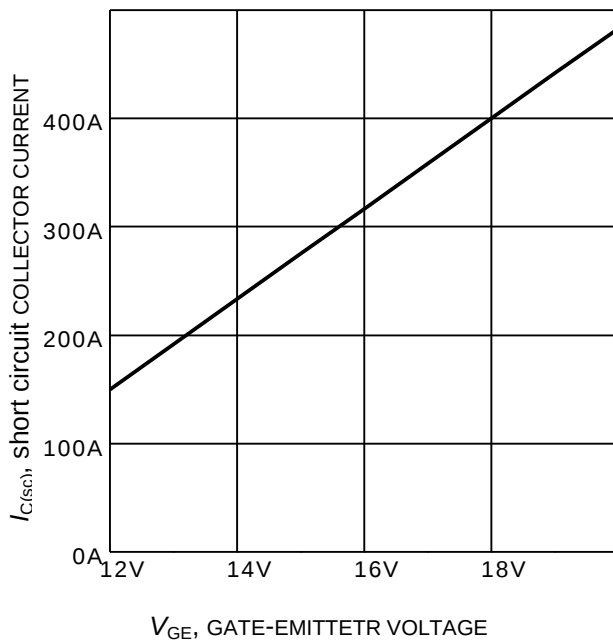
**Figure 16. Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_J = 175^\circ\text{C}$ ,  $V_{GE} = 0/15\text{V}$ ,  $I_C = 30\text{A}$ ,  $r_G = 10\Omega$ , Dynamic test circuit in Figure E)



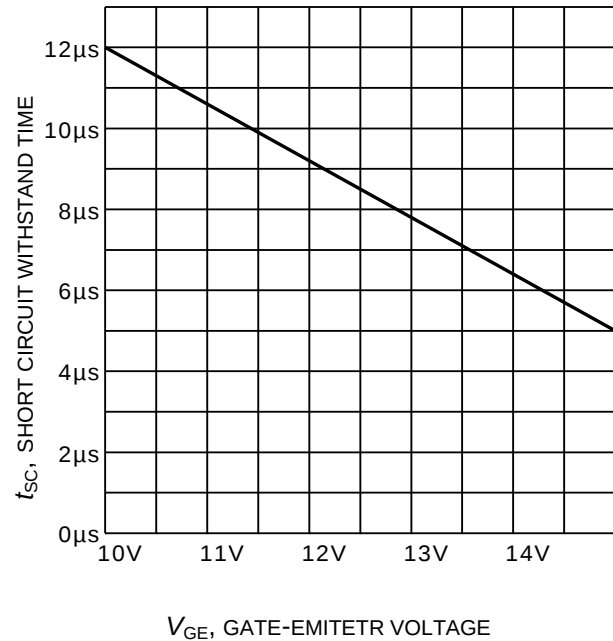
**Figure 17. Typical gate charge**  
( $I_C=30\text{ A}$ )



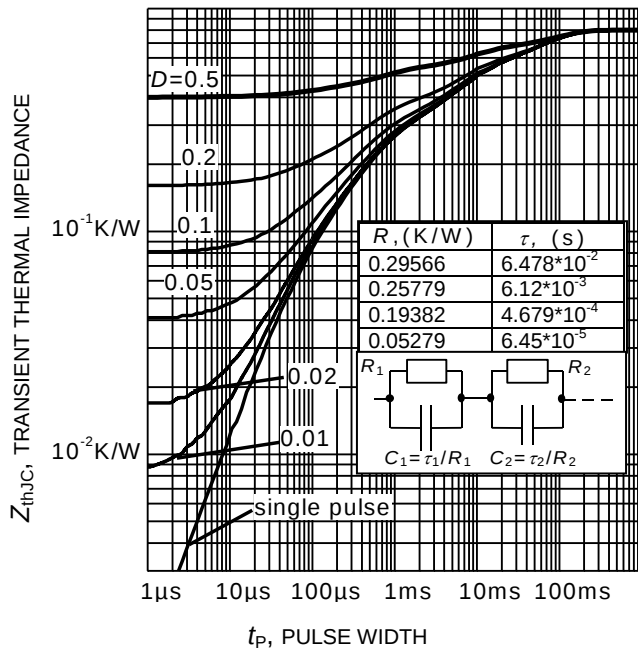
**Figure 18. Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0\text{V}$ ,  $f = 1\text{ MHz}$ )



**Figure 19. Typical short circuit collector current as a function of gate-emitter voltage**  
( $V_{CE} \leq 400\text{V}$ ,  $T_j \leq 150^\circ\text{C}$ )

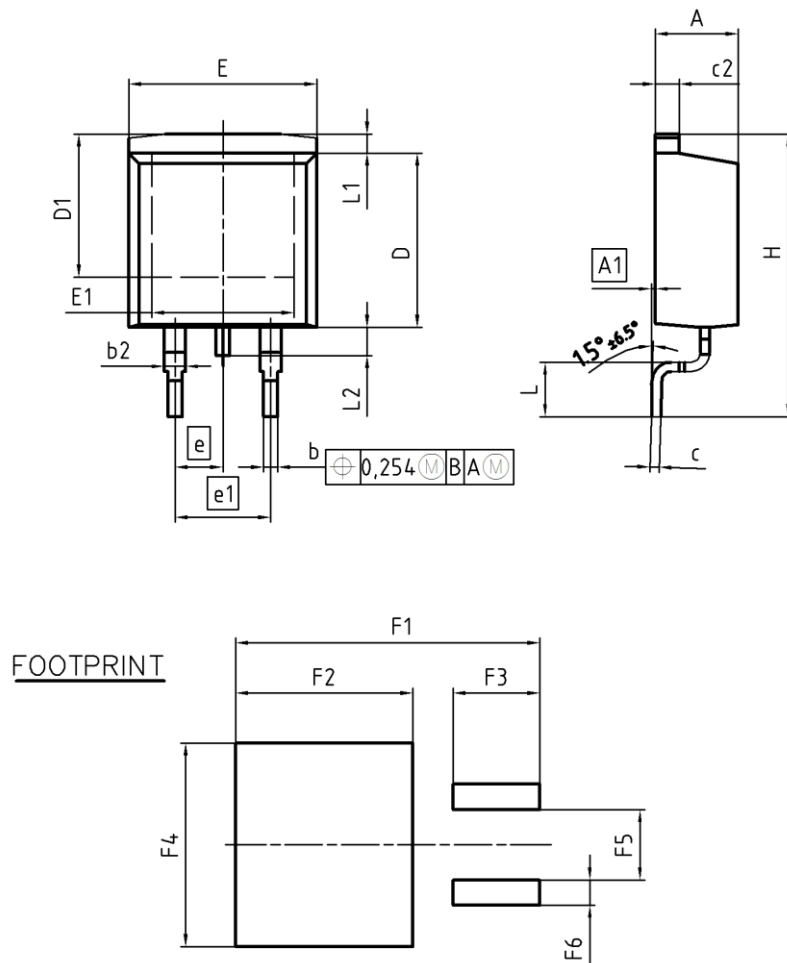


**Figure 20. Short circuit withstand time as a function of gate-emitter voltage**  
( $V_{CE}=400\text{V}$ , start at  $T_j=25^\circ\text{C}$ ,  $T_{Jmax}<150^\circ\text{C}$ )

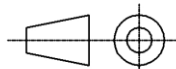


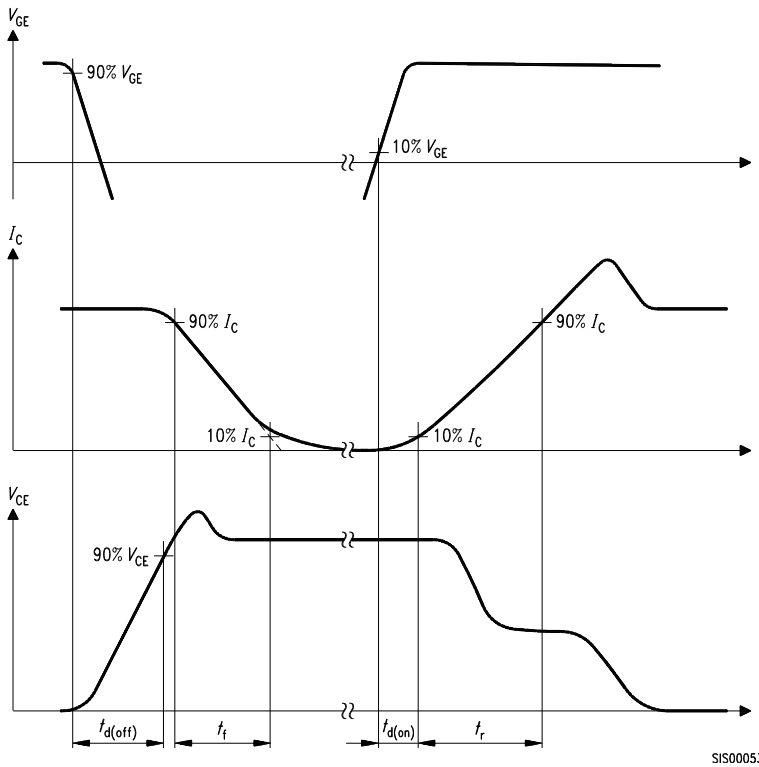
**Figure 21. IGBT transient thermal impedance**  
( $D = t_p / T$ )

### PG-TO263-3

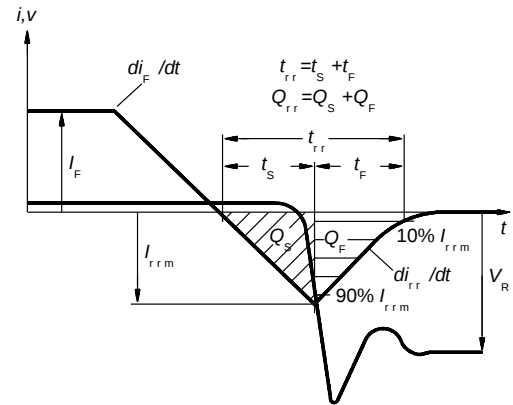


| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 0.00        | 0.25  | 0.000  | 0.010 |
| b   | 0.65        | 0.85  | 0.026  | 0.033 |
| b2  | 0.95        | 1.15  | 0.037  | 0.045 |
| c   | 0.33        | 0.65  | 0.013  | 0.026 |
| c2  | 1.17        | 1.40  | 0.046  | 0.055 |
| D   | 8.51        | 9.45  | 0.335  | 0.372 |
| D1  | 7.10        | 7.90  | 0.280  | 0.311 |
| E   | 9.80        | 10.31 | 0.386  | 0.406 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| N   | 2           |       | 2      |       |
| H   | 14.61       | 15.88 | 0.575  | 0.625 |
| L   | 2.29        | 3.00  | 0.090  | 0.118 |
| L1  | 0.70        | 1.60  | 0.028  | 0.063 |
| L2  | 1.00        | 1.78  | 0.039  | 0.070 |
| F1  | 16.05       | 16.25 | 0.632  | 0.640 |
| F2  | 9.30        | 9.50  | 0.366  | 0.374 |
| F3  | 4.50        | 4.70  | 0.177  | 0.185 |
| F4  | 10.70       | 10.90 | 0.421  | 0.429 |
| F5  | 3.65        | 3.85  | 0.144  | 0.152 |
| F6  | 1.25        | 1.45  | 0.049  | 0.057 |

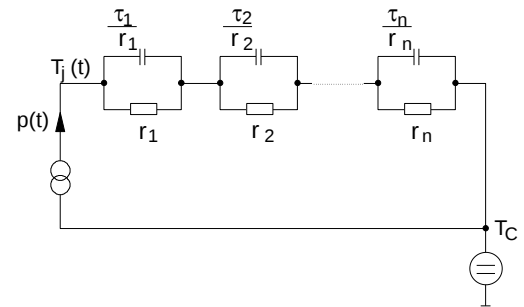
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| DOCUMENT NO.<br>Z8B00003324                                                                                  |
| SCALE<br>0 5 5 7.5mm                                                                                         |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>30-08-2007                                                                                     |
| REVISION<br>01                                                                                               |



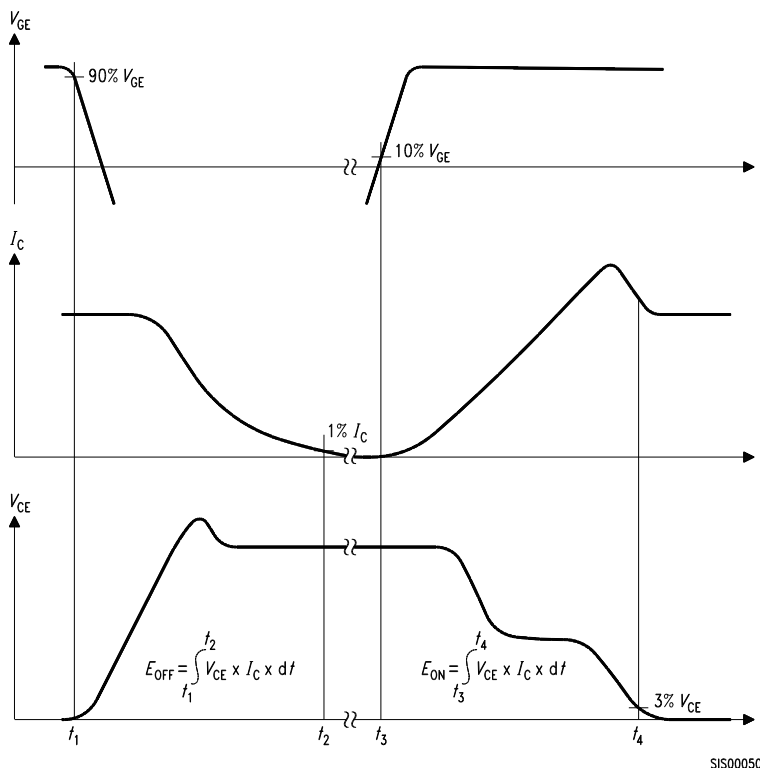
**Figure A. Definition of switching times**



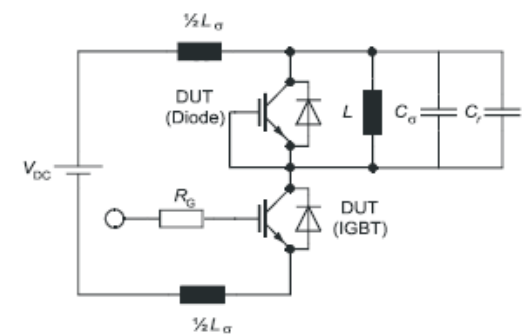
**Figure C. Definition of diodes switching characteristics**



**Figure D. Thermal equivalent circuit**



**Figure B. Definition of switching losses**



**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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