

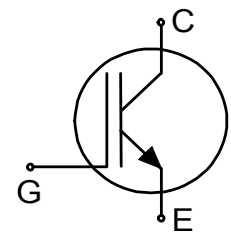
High speed switching series fifth generation

High speed IGBT in TRENCHSTOP™ 5 technology

Features and Benefits:

High speed H5 technology offering

- Best-in-Class efficiency in hard switching and resonant topologies
- 650V breakdown voltage
- Low Q_G
- Maximum junction temperature 175°C
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>



Potential Applications:

- Energy Generation
 - Solar String Inverter
 - Solar Micro Inverter
- Industrial Power Supplies
 - Industrial SMPS
 - Industrial UPS
- Metal Treatment
 - Welding
- Energy Distribution
 - Energy Storage
- Infrastructure – Charge
 - Charger



Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22



Key Performance and Package Parameters

| Type | V_{CE} | I_C | $V_{CEsat}, T_{vj}=25^{\circ}C$ | T_{vjmax} | Marking | Package |
|------------|----------|-------|---------------------------------|-------------|---------|------------|
| IGB50N65H5 | 650V | 50A | 1.65V | 175°C | G50EH5 | PG-TO263-3 |

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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} $T_c = 25^{\circ}\text{C}$ value limited by bondwire $T_c = 100^{\circ}\text{C}$ | I_C | 80.0 53.7 | A |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpuls} | 150.0 | A |
| Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ | - | 150.0 | A |
| Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$) | V_{GE} | ± 20 ± 30 | V |
| Power dissipation $T_c = 25^{\circ}\text{C}$ Power dissipation $T_c = 100^{\circ}\text{C}$ | P_{tot} | 270.0 135.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -55...+150 | $^{\circ}\text{C}$ |
| Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020) | | 260 | $^{\circ}\text{C}$ |

Thermal Resistance

| Parameter | Symbol | Conditions | Value | | | Unit |
|-------------------------------------------------------------------------|---------------|------------|-------|------|------|------|
| | | | min. | typ. | max. | |
| R_{th} Characteristics | | | | | | |
| IGBT thermal resistance, junction - case | $R_{th(j-c)}$ | | - | - | 0.55 | K/W |
| Thermal resistance, min. footprint junction - ambient | $R_{th(j-a)}$ | | - | - | 65 | K/W |
| Thermal resistance, 6cm ² Cu on PCB 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. | |
| Static Characteristic | | | | | | |
| 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} | $V_{GE} = 15.0\text{V}$, $I_C = 50.0\text{A}$ | - | 1.65 | 2.10 | V |
| | | $T_{vj} = 25^{\circ}\text{C}$ | - | 1.85 | - | |
| | | $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 1.95 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.50\text{mA}$, $V_{CE} = V_{GE}$ | 3.2 | 4.0 | 4.8 | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE} = 650\text{V}$, $V_{GE} = 0\text{V}$ | - | - | 50 | μA |
| | | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 2000 | - | |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}$, $V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}$, $I_C = 50.0\text{A}$ | - | 62.0 | - | S |

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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_{ies} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 3000 | - | pF |
| Output capacitance | C_{oes} | | - | 50 | - | |
| Reverse transfer capacitance | C_{res} | | - | 11 | - | |
| Gate charge | Q_G | $V_{CC} = 520\text{V}, I_C = 50.0\text{A}, V_{GE} = 15\text{V}$ | - | 120.0 | - | 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 | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 50.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | 23 | - | ns |
| Rise time | t_r | | - | 31 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 173 | - | ns |
| Fall time | t_f | | - | 40 | - | ns |
| Turn-on energy | E_{on} | | - | 1.59 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.75 | - | mJ |
| Total switching energy | E_{ts} | | - | 2.34 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 25.0\text{A}, V_{GE} = 0.0/15.0\text{V}, R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega, L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ Energy losses include "tail" and diode reverse recovery. | - | 21 | - | ns |
| Rise time | t_r | | - | 15 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 180 | - | ns |
| Fall time | t_f | | - | 18 | - | ns |
| Turn-on energy | E_{on} | | - | 0.52 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.18 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.70 | - | 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 | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 50.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 23 | - | ns |
| Rise time | t_r | | - | 29 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 190 | - | ns |
| Fall time | t_f | | - | 33 | - | ns |
| Turn-on energy | E_{on} | | - | 1.95 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.73 | - | mJ |
| Total switching energy | E_{ts} | | - | 2.68 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 25.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 20 | - | ns |
| Rise time | t_r | | - | 15 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 205 | - | ns |
| Fall time | t_f | | - | 26 | - | ns |
| Turn-on energy | E_{on} | | - | 0.75 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.27 | - | mJ |
| Total switching energy | E_{ts} | | - | 1.02 | - | mJ |

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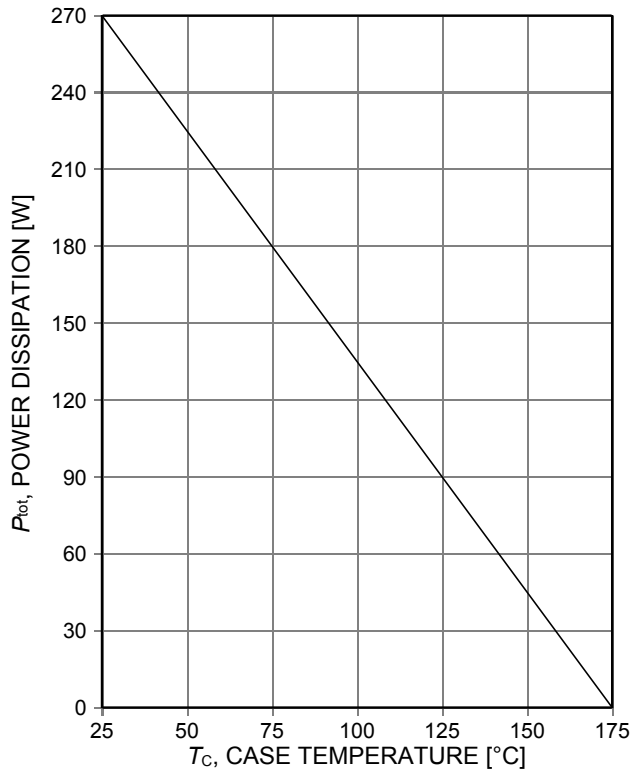


Figure 1. Power dissipation as a function of case temperature ($T_{vj} \leq 175^\circ\text{C}$)

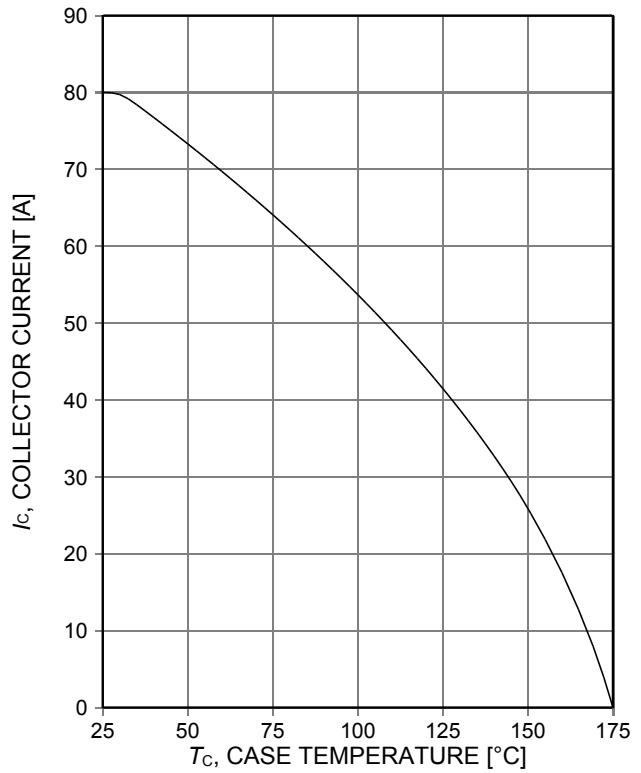


Figure 2. Collector current as a function of case temperature ($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

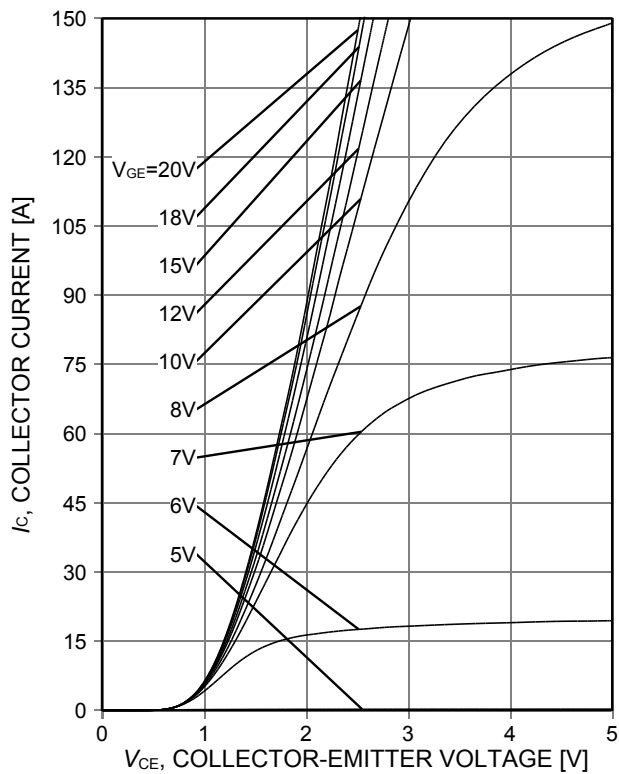


Figure 3. Typical output characteristic ($T_{vj} = 25^\circ\text{C}$)

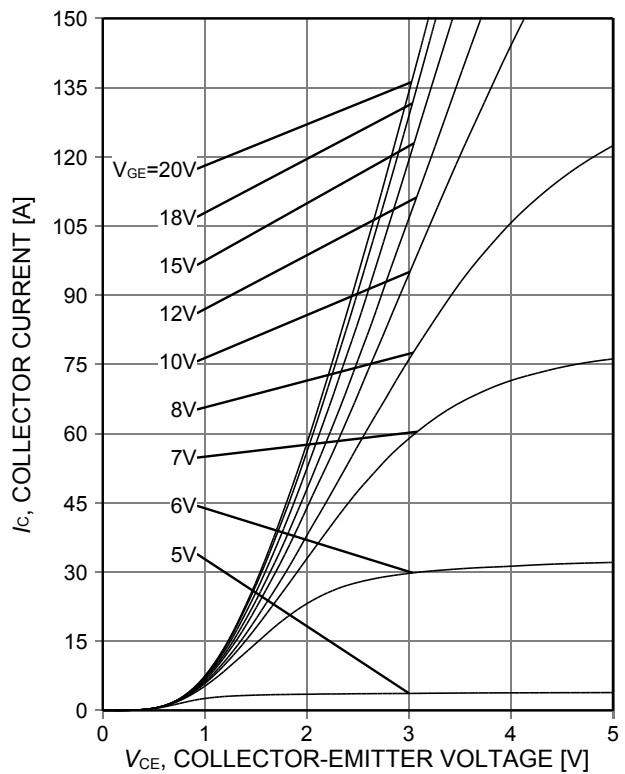


Figure 4. Typical output characteristic ($T_{vj} = 150^\circ\text{C}$)

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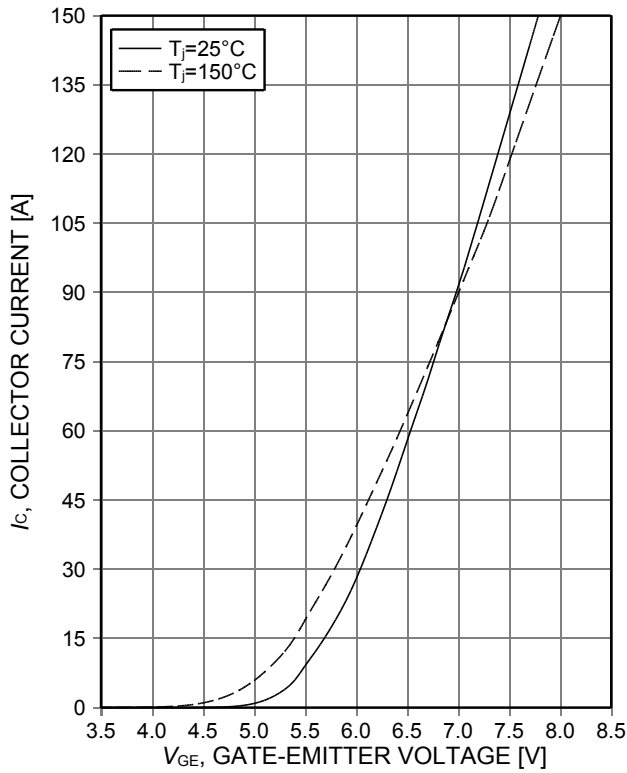


Figure 5. **Typical transfer characteristic**
($V_{CE}=20V$)

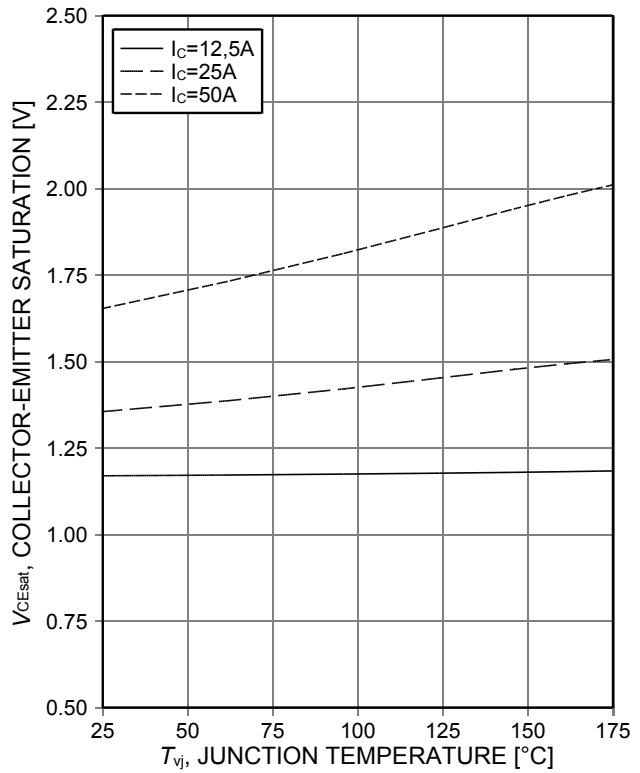


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

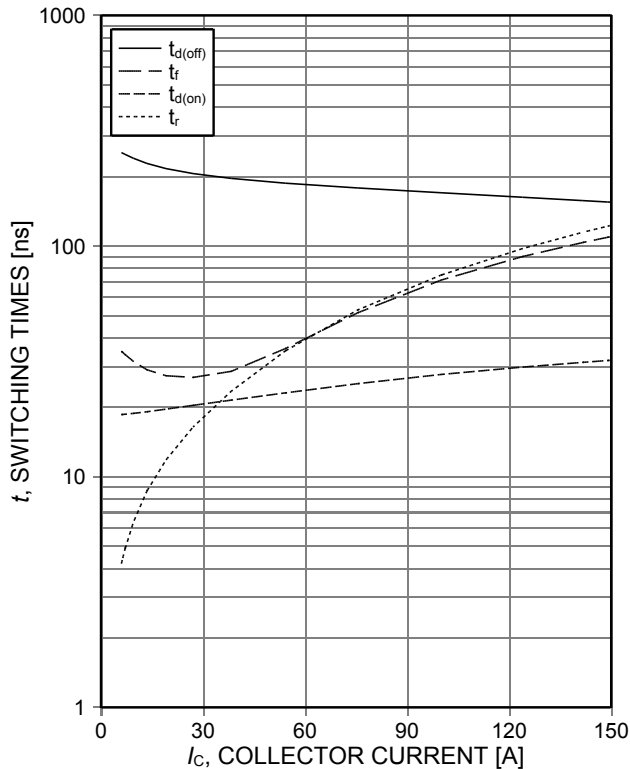


Figure 7. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

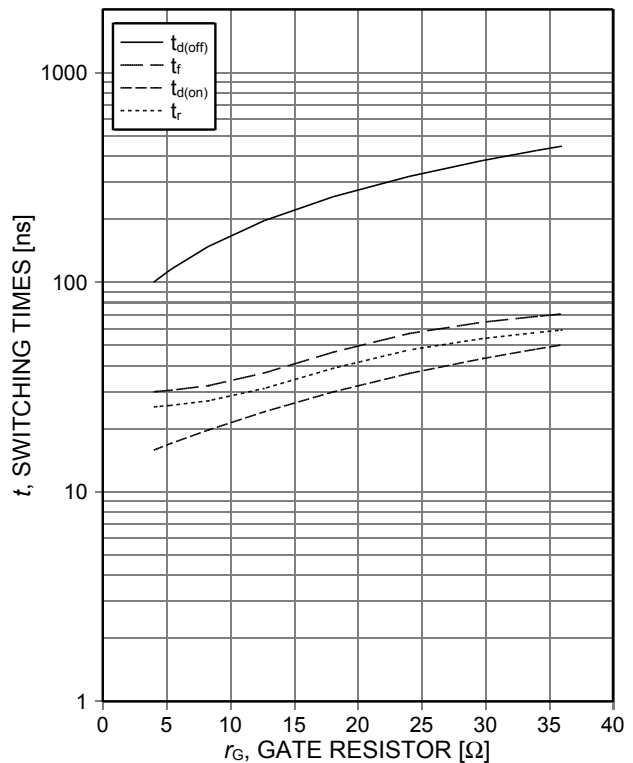


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=50A$, Dynamic test circuit in Figure E)

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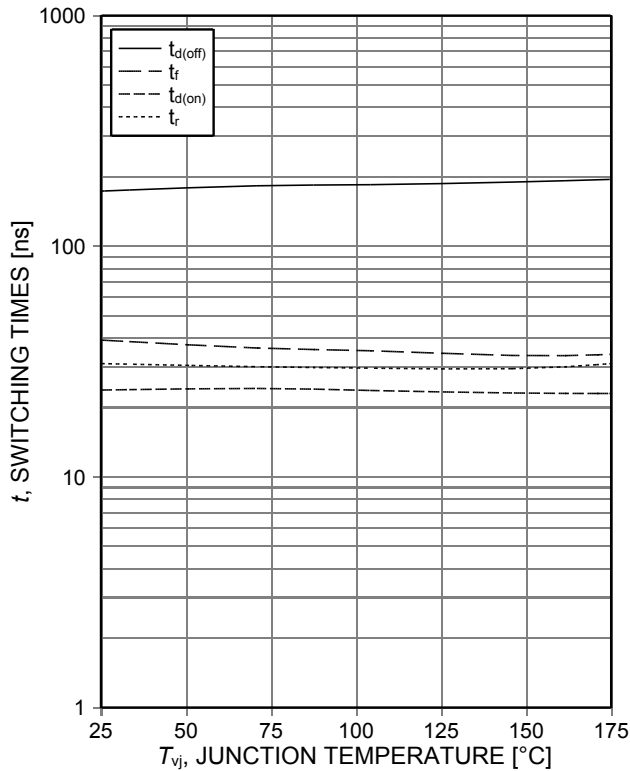


Figure 9. Typical switching times as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=50A$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

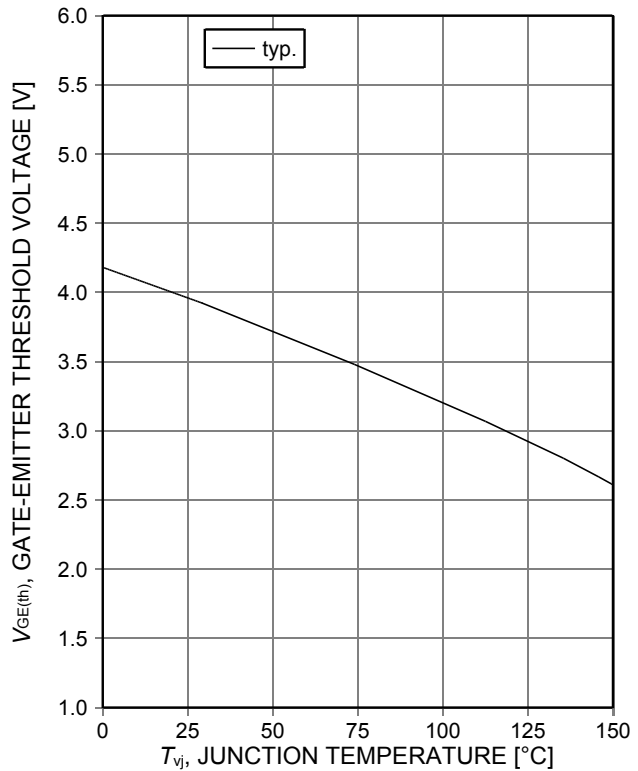


Figure 10. Gate-emitter threshold voltage as a function of junction temperature ($I_C=0.5mA$)

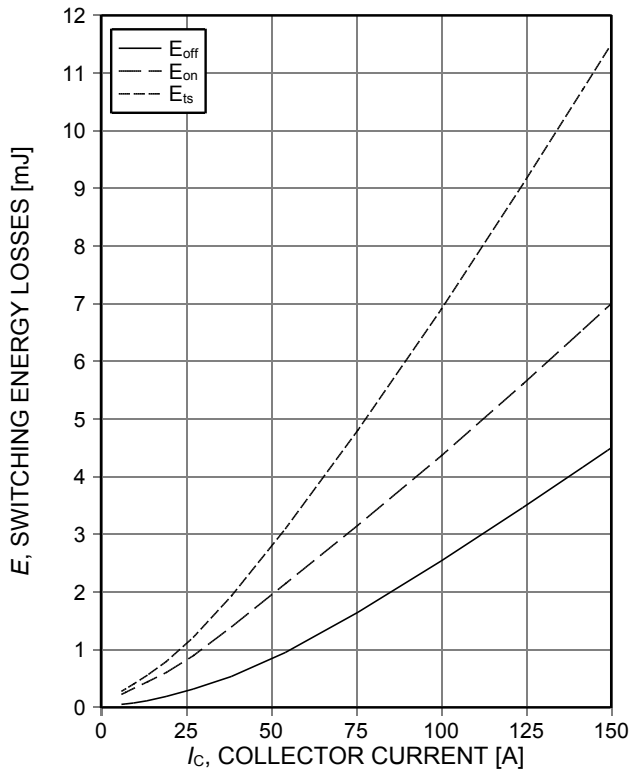


Figure 11. Typical switching energy losses as a function of collector current (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

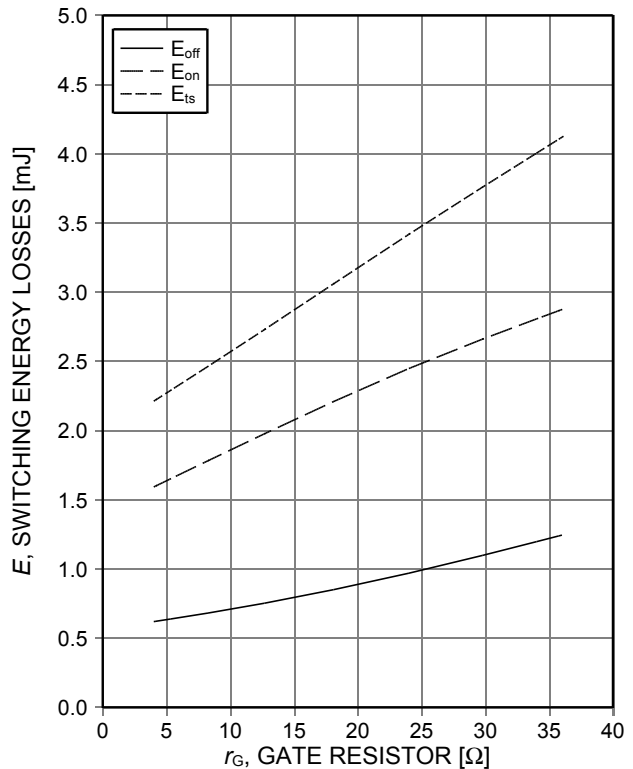


Figure 12. Typical switching energy losses as a function of gate resistor (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=50A$, Dynamic test circuit in Figure E)

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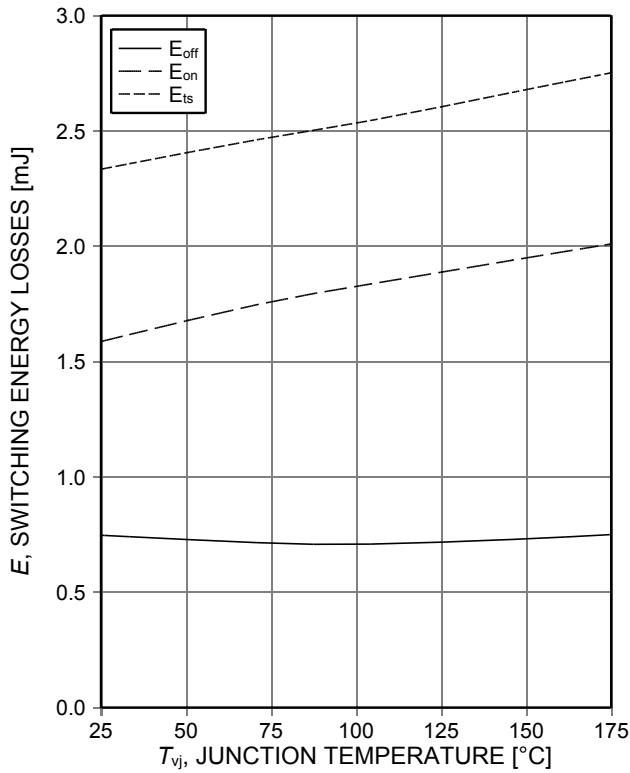


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=50A$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

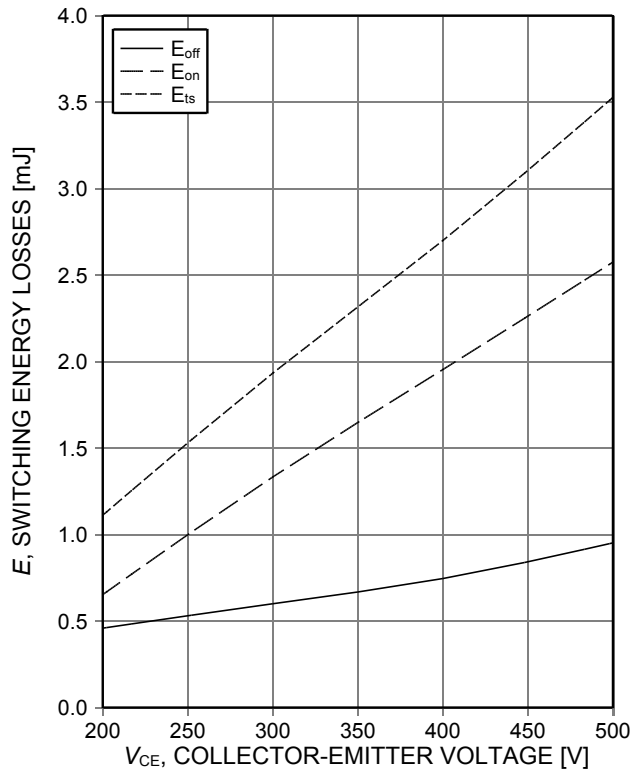


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, $T_{vj}=150^\circ C$, $V_{GE}=0/15V$, $I_C=50A$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

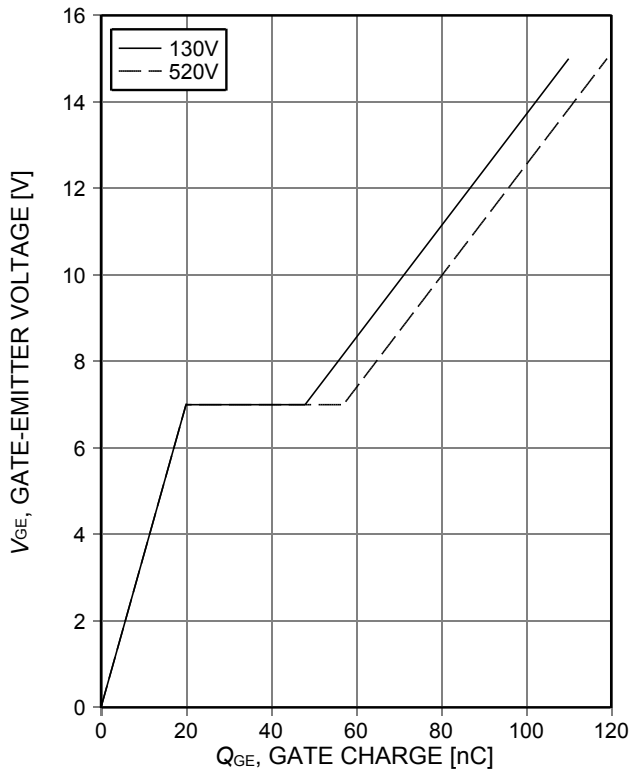


Figure 15. **Typical gate charge** ($I_C=50A$)

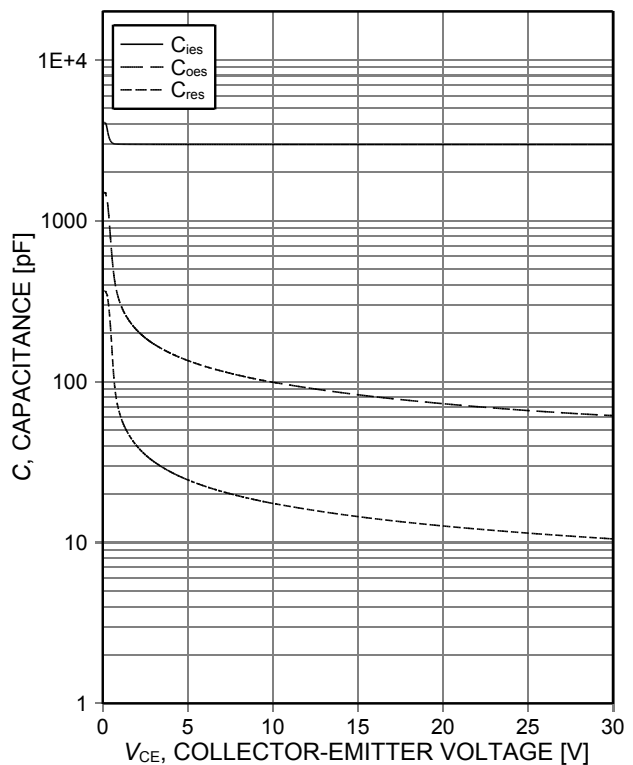


Figure 16. **Typical capacitance as a function of collector-emitter voltage** ($V_{GE}=0V$, $f=1MHz$)

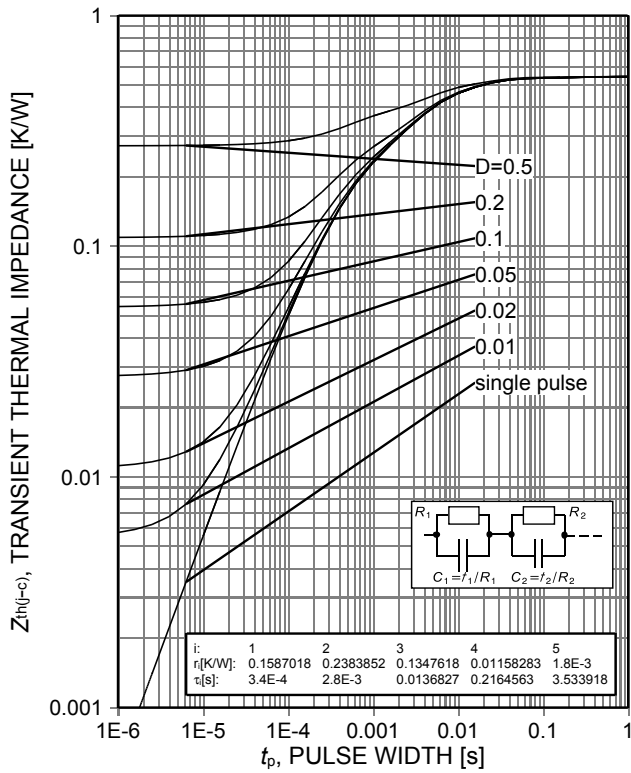
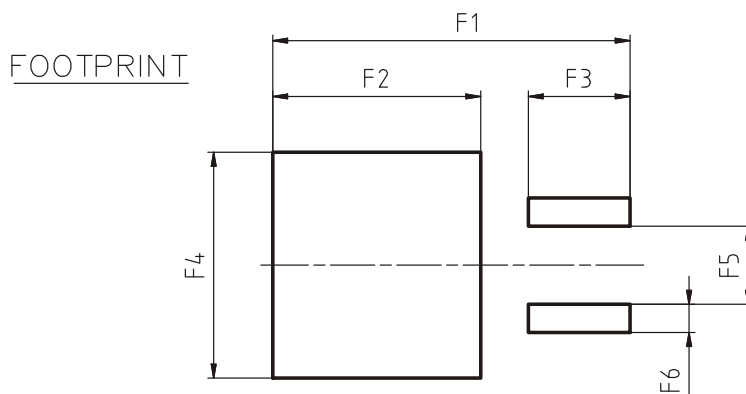
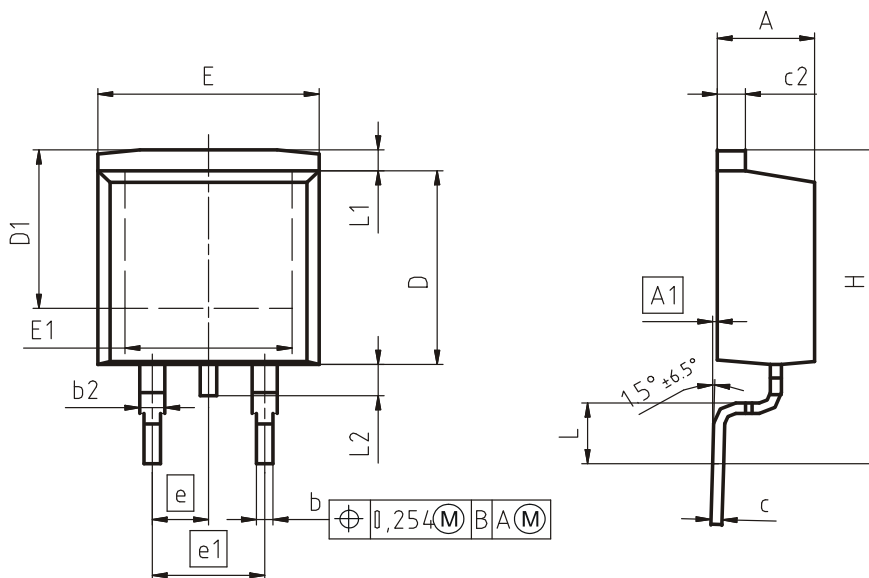


Figure 17. IGBT transient thermal impedance ($D=t_p/T$)

Package Drawing 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 |

DOCUMENT NO.
Z8B00003324

SCALE

7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

Testing Conditions

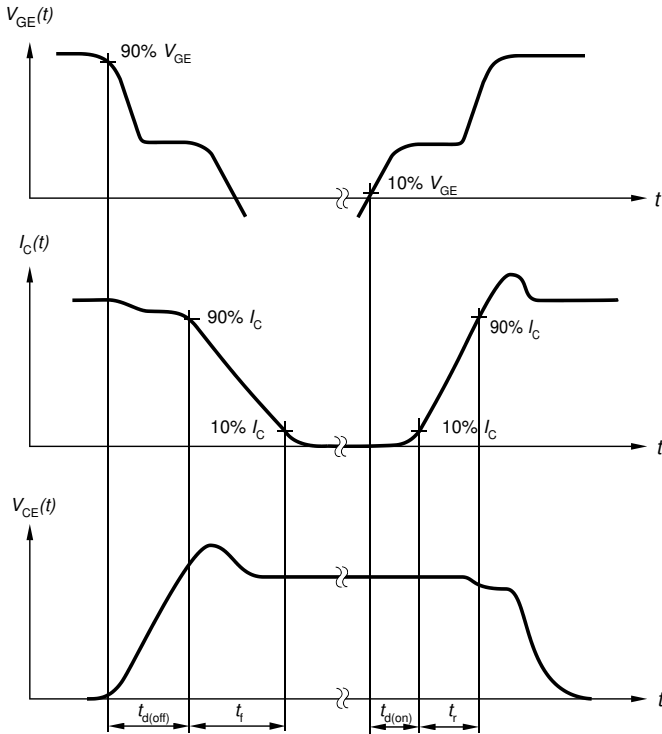


Figure A. Definition of switching times

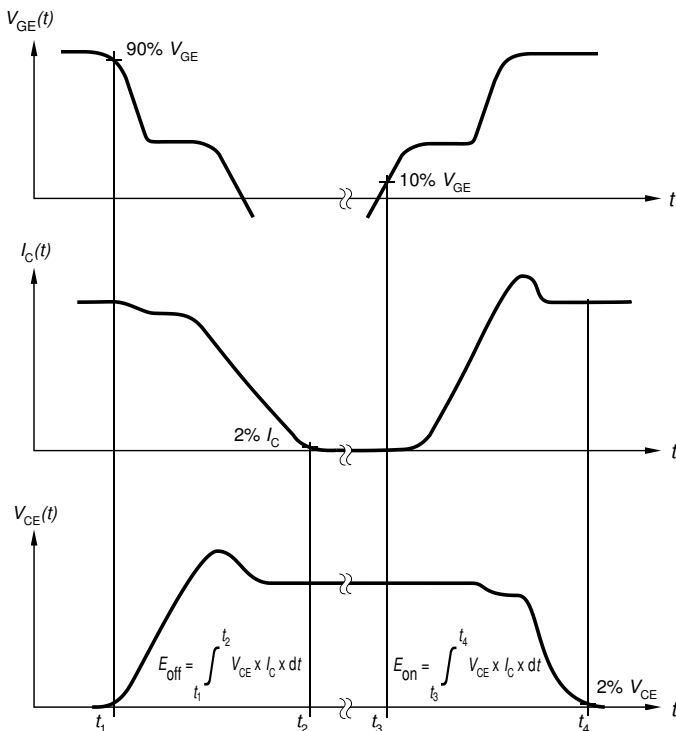


Figure B. Definition of switching losses



Figure C. Definition of diode switching characteristics



Figure D. Thermal equivalent circuit



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

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Revision History

IGB50N65H5

Revision: 2018-01-11, Rev. 2.2

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|-------------------------------------------------|
| 2.1 | 2017-05-19 | Final data sheet |
| 2.2 | 2018-01-11 | Remove of Pb-free symbol and editorial changes. |

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