

IGBT

High speed 5 IGBT in TRENCHSTOP™ 5 technology

IGP20N65H5

650V IGBT high speed switching series fifth generation

Data sheet

Industrial Power Control

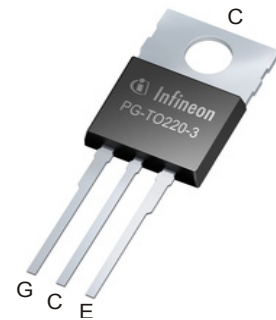
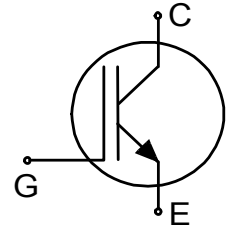
High speed 5 IGBT in TRENCHSTOP™ 5 technology

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 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 |
|------------|----------|-------|---------------------------------|-------------|---------|------------|
| IGP20N65H5 | 650V | 20A | 1.65V | 175°C | G20EH5 | 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 Drawing12

Testing Conditions13

Revision History14

Disclaimer14

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} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$ | I_C | 42.0 21.0 | A |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpuls} | 60.0 | A |
| Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ | - | 60.0 | 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} | 125.0 63.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -55...+150 | $^{\circ}\text{C}$ |
| Soldering temperature, wave soldering 1.6 mm (0.063 in.) from case for 10s | | 260 | $^{\circ}\text{C}$ |
| Mounting torque, M3 screw Maximum of mounting processes: 3 | M | 0.6 | Nm |

Thermal Resistance

| Parameter | Symbol | Conditions | Max. Value | Unit |
|---|---------------|------------|------------|------|
| Characteristic | | | | |
| IGBT thermal resistance, junction - case | $R_{th(j-c)}$ | | 1.20 | K/W |
| Thermal resistance 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 | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}$, $I_C = 0.20\text{mA}$ | 650 | - | - | V |
| Collector-emitter saturation voltage | V_{CEsat} | $V_{GE} = 15.0\text{V}$, $I_C = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - - | 1.65 1.85 1.95 | 2.10 - - | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.20\text{mA}$, $V_{CE} = V_{GE}$ | 3.2 | 4.0 | 4.8 | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE} = 650\text{V}$, $V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | - - | 40.0 4000.0 | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}$, $V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}$, $I_C = 20.0\text{A}$ | - | 24.0 | - | 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} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 1200 | - | pF |
| Output capacitance | C_{oes} | | - | 30 | - | |
| Reverse transfer capacitance | C_{res} | | - | 5 | - | |
| Gate charge | Q_G | $V_{CC} = 520\text{V}, I_C = 20.0\text{A}, V_{GE} = 15\text{V}$ | - | 48.0 | - | 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 | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 10.0\text{A}, V_{GE} = 0.0/15.0\text{V}, r_G = 32.0\Omega, L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 18 | - | ns |
| Rise time | t_r | | - | 8 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 156 | - | ns |
| Fall time | t_f | | - | 13 | - | ns |
| Turn-on energy | E_{on} | | - | 0.17 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.06 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.23 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C}, V_{CC} = 400\text{V}, I_C = 2.0\text{A}, V_{GE} = 0.0/15.0\text{V}, r_G = 32.0\Omega, L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$ $L\sigma, C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 16 | - | ns |
| Rise time | t_r | | - | 3 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 168 | - | ns |
| Fall time | t_f | | - | 36 | - | ns |
| Turn-on energy | E_{on} | | - | 0.04 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.02 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.06 | - | 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 | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 10.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $r_G = 32.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 17 | - | ns |
| Rise time | t_r | | - | 11 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 190 | - | ns |
| Fall time | t_f | | - | 28 | - | ns |
| Turn-on energy | E_{on} | | - | 0.27 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.11 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.38 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 2.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $r_G = 32.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 15 | - | ns |
| Rise time | t_r | | - | 4 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 224 | - | ns |
| Fall time | t_f | | - | 55 | - | ns |
| Turn-on energy | E_{on} | | - | 0.08 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.04 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.12 | - | mJ |

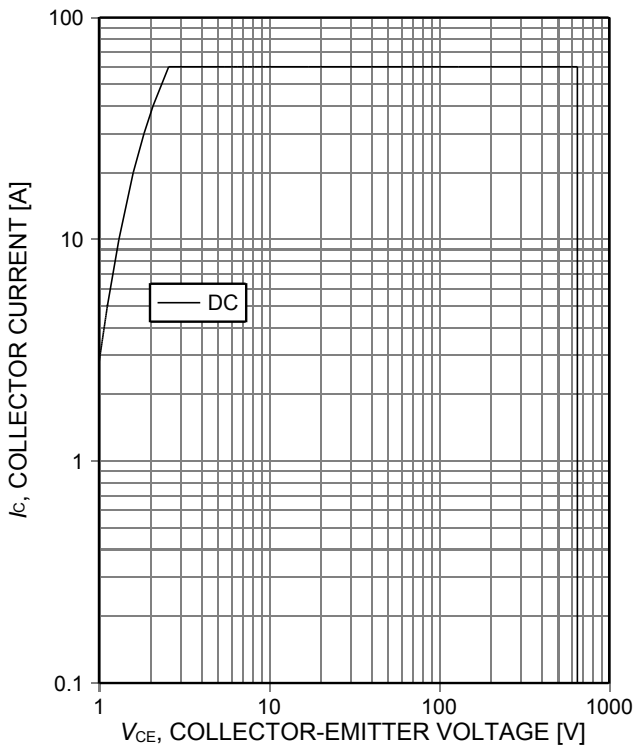


Figure 1. **Forward bias safe operating area**
 ($D=0$, $T_C=25^\circ\text{C}$, $T_{vj}\leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$.
 Recommended use at $V_{GE}\geq 7.5\text{V}$)

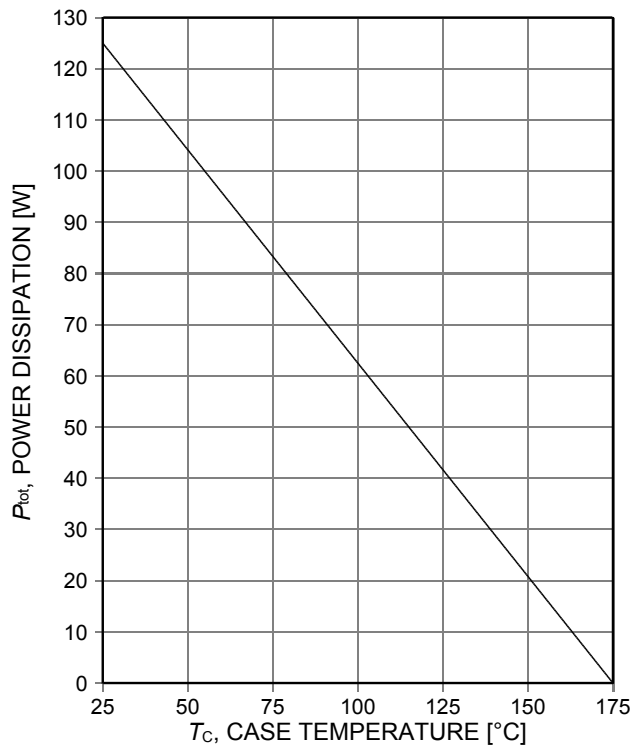


Figure 2. **Power dissipation as a function of case temperature**
 ($T_{vj}\leq 175^\circ\text{C}$)

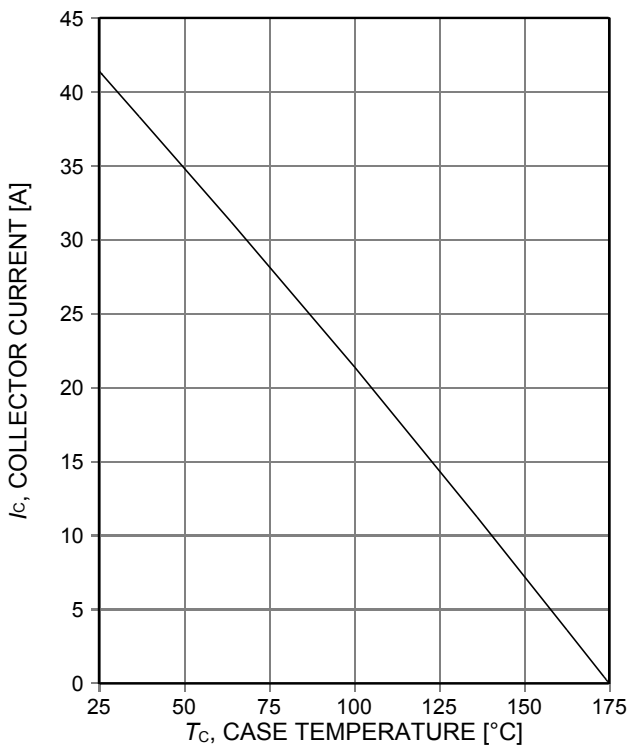


Figure 3. **Collector current as a function of case temperature**
 ($V_{GE}\geq 15\text{V}$, $T_{vj}\leq 175^\circ\text{C}$)

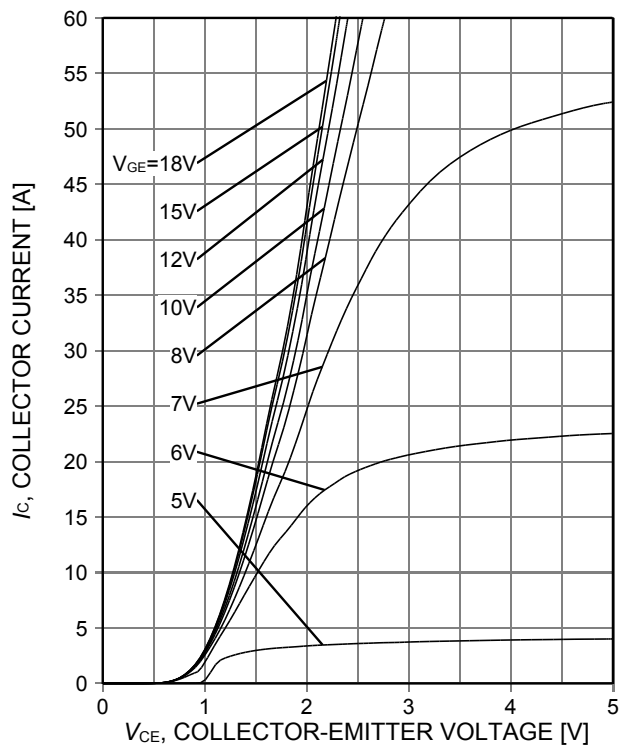


Figure 4. **Typical output characteristic**
 ($T_{vj}=25^\circ\text{C}$)

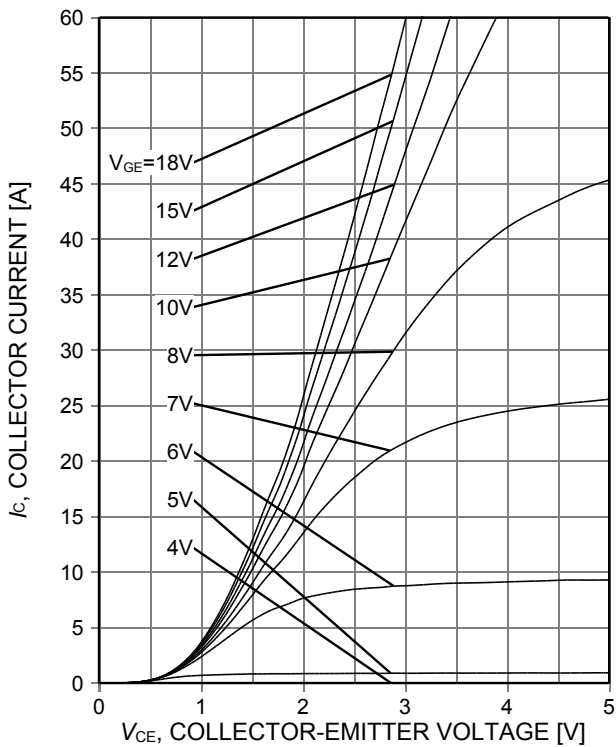


Figure 5. Typical output characteristic ($T_{vj}=150^{\circ}\text{C}$)

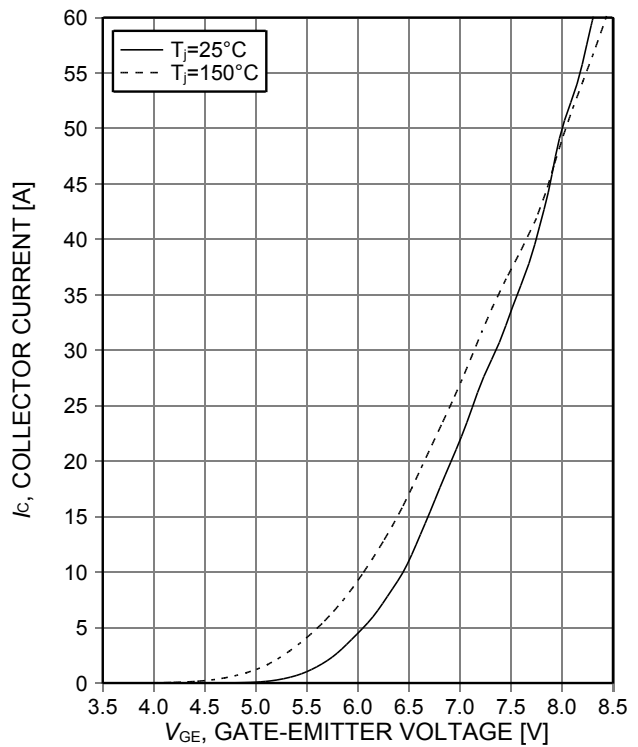


Figure 6. Typical transfer characteristic ($V_{CE}=20\text{V}$)

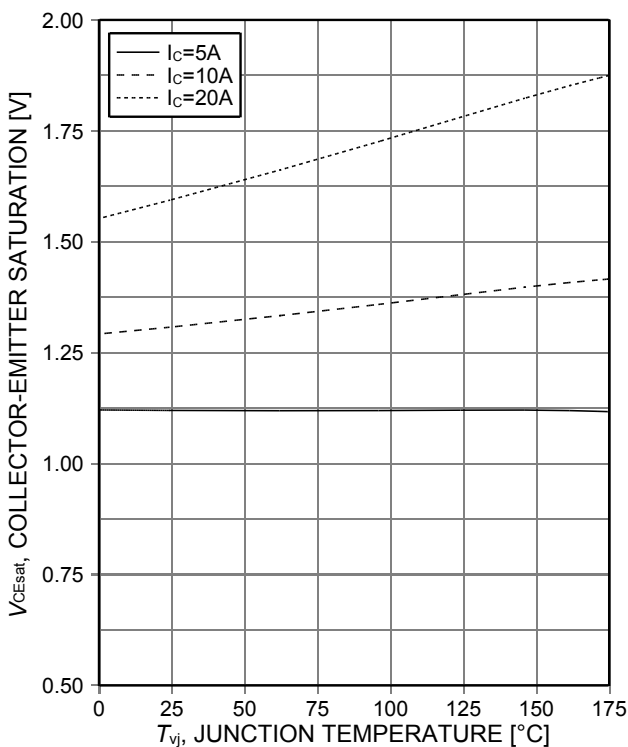


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{GE}=15\text{V}$)

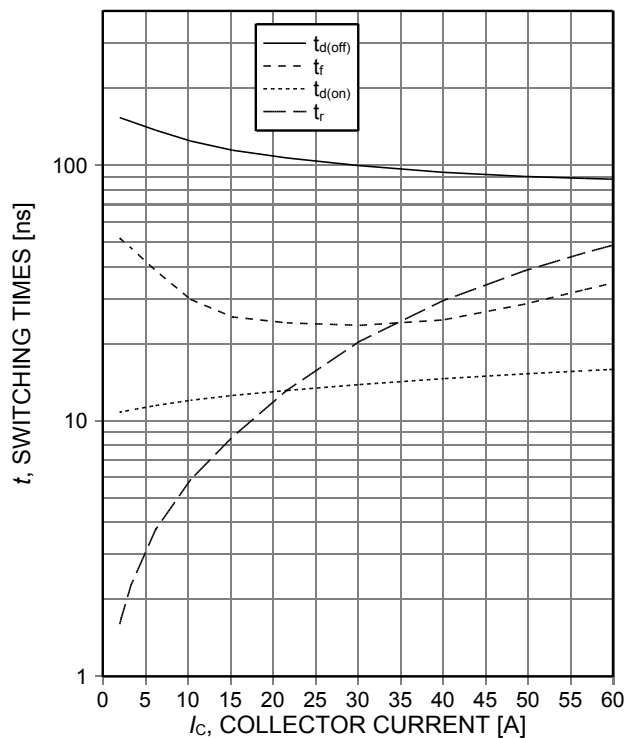


Figure 8. Typical switching times as a function of collector current (inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=32\Omega$, Dynamic test circuit in Figure E)

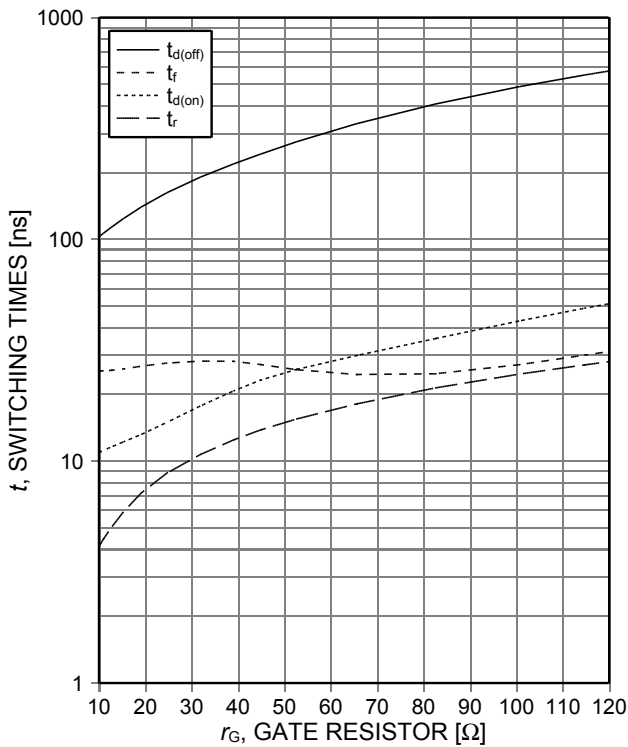


Figure 9. **Typical switching times as a function of gate resistor**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, Dynamic test circuit in Figure E)

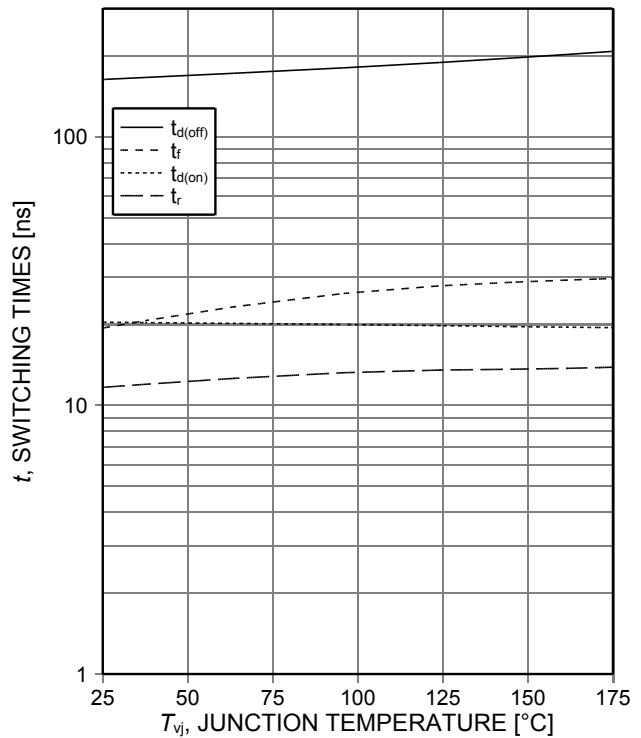


Figure 10. **Typical switching times as a function of junction temperature**
(inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=32\Omega$, Dynamic test circuit in Figure E)

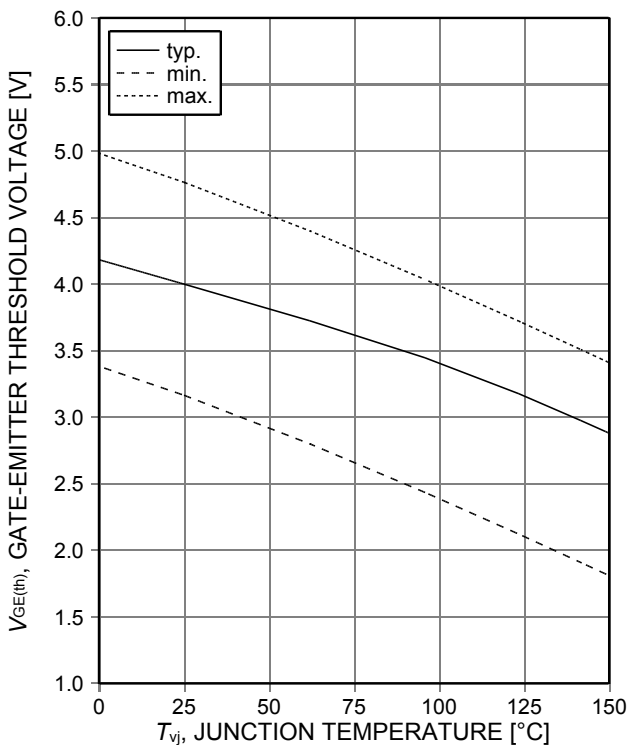


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C=0.2\text{mA}$)

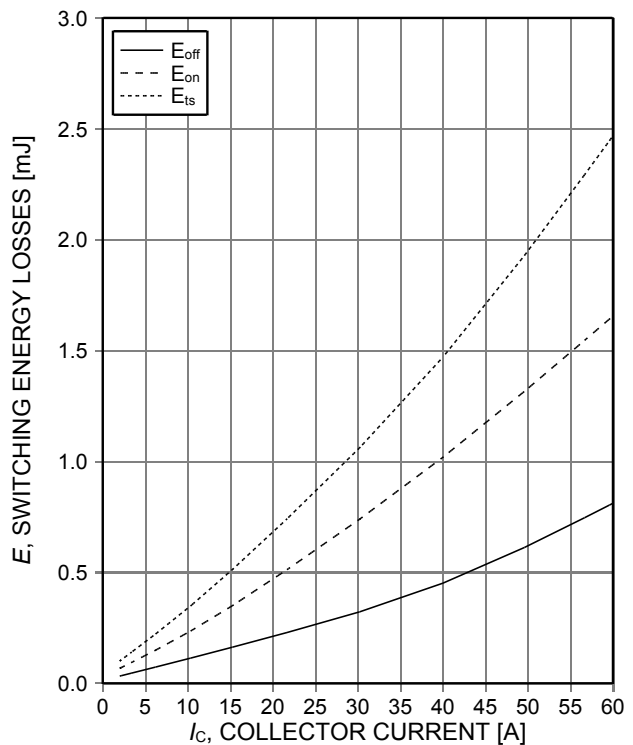


Figure 12. **Typical switching energy losses as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $r_G=32\Omega$, Dynamic test circuit in Figure E)

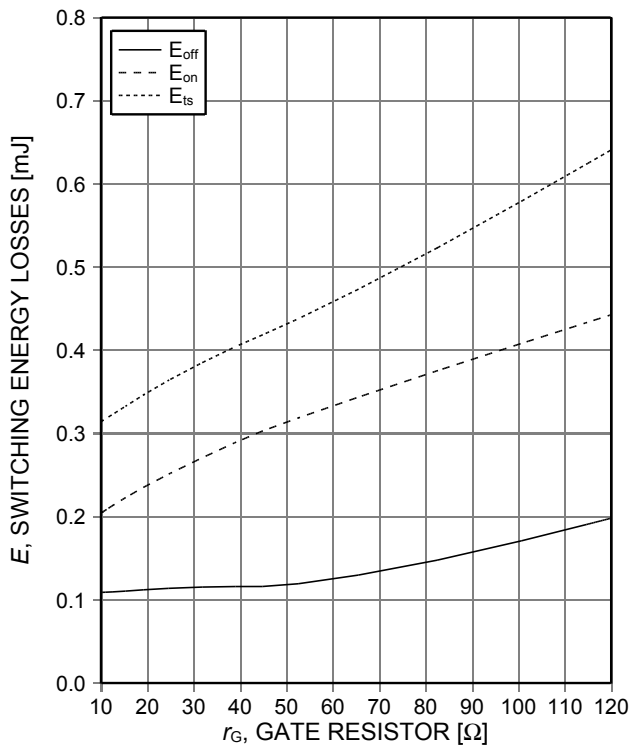


Figure 13. **Typical switching energy losses as a function of gate resistor**
 (inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, Dynamic test circuit in Figure E)

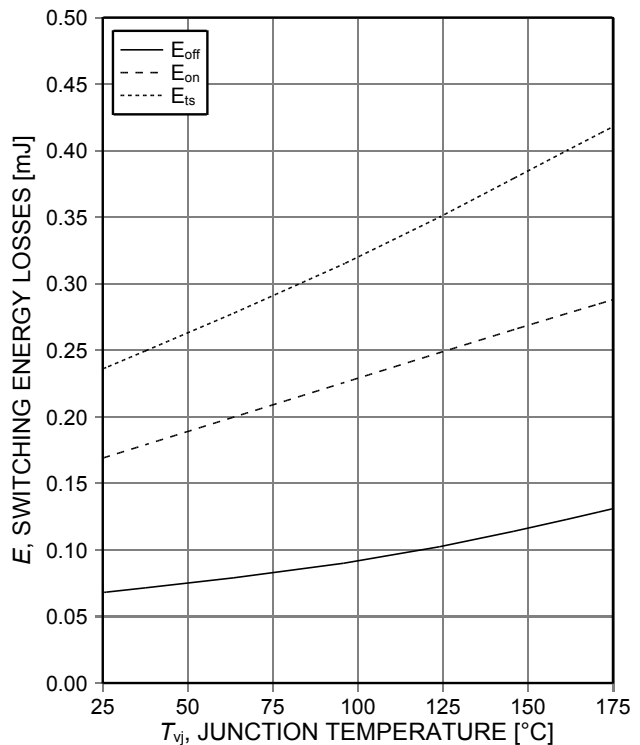


Figure 14. **Typical switching energy losses as a function of junction temperature**
 (inductive load, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=32\Omega$, Dynamic test circuit in Figure E)

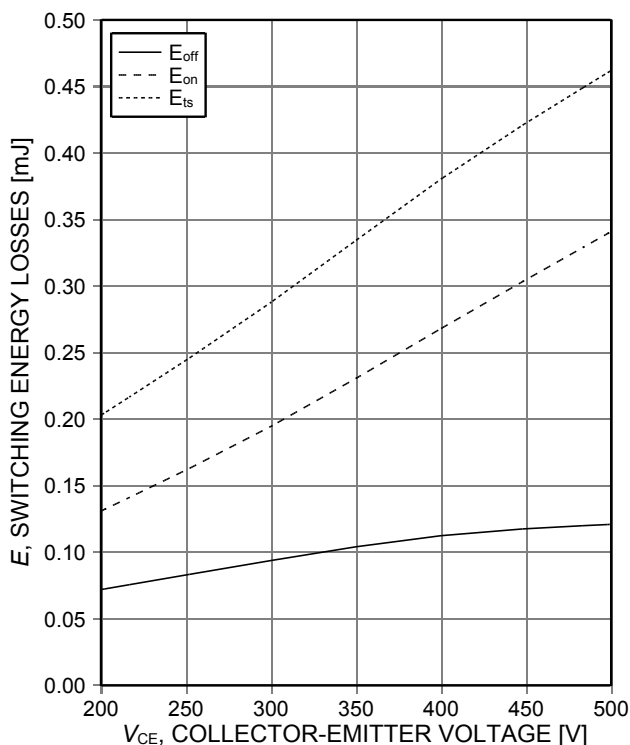


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**
 (inductive load, $T_{vj}=150^{\circ}\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=10\text{A}$, $r_G=32\Omega$, Dynamic test circuit in Figure E)

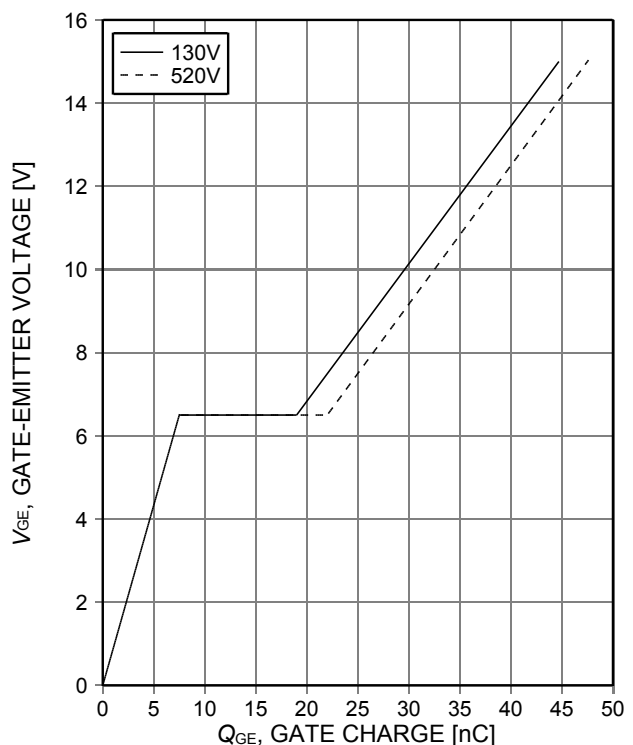


Figure 16. **Typical gate charge**
 ($I_C=20\text{A}$)

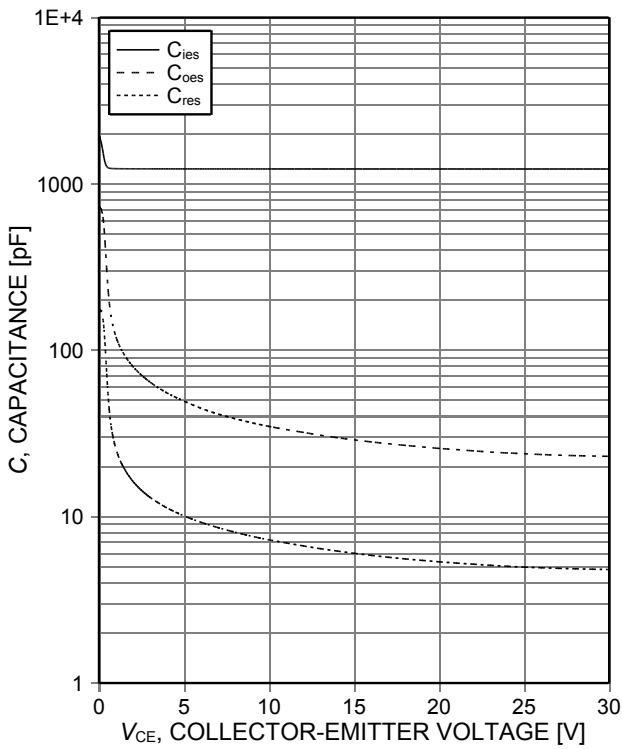


Figure 17. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0V$, $f=1MHz$)

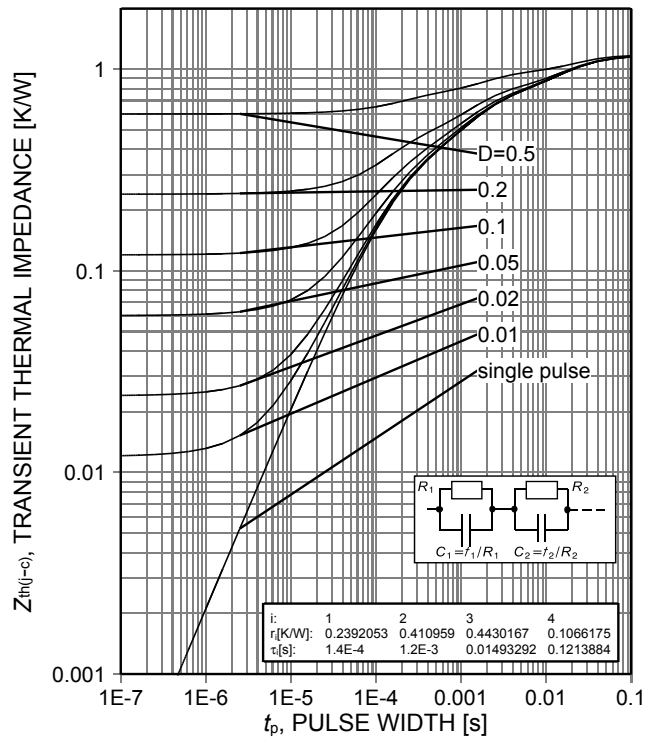
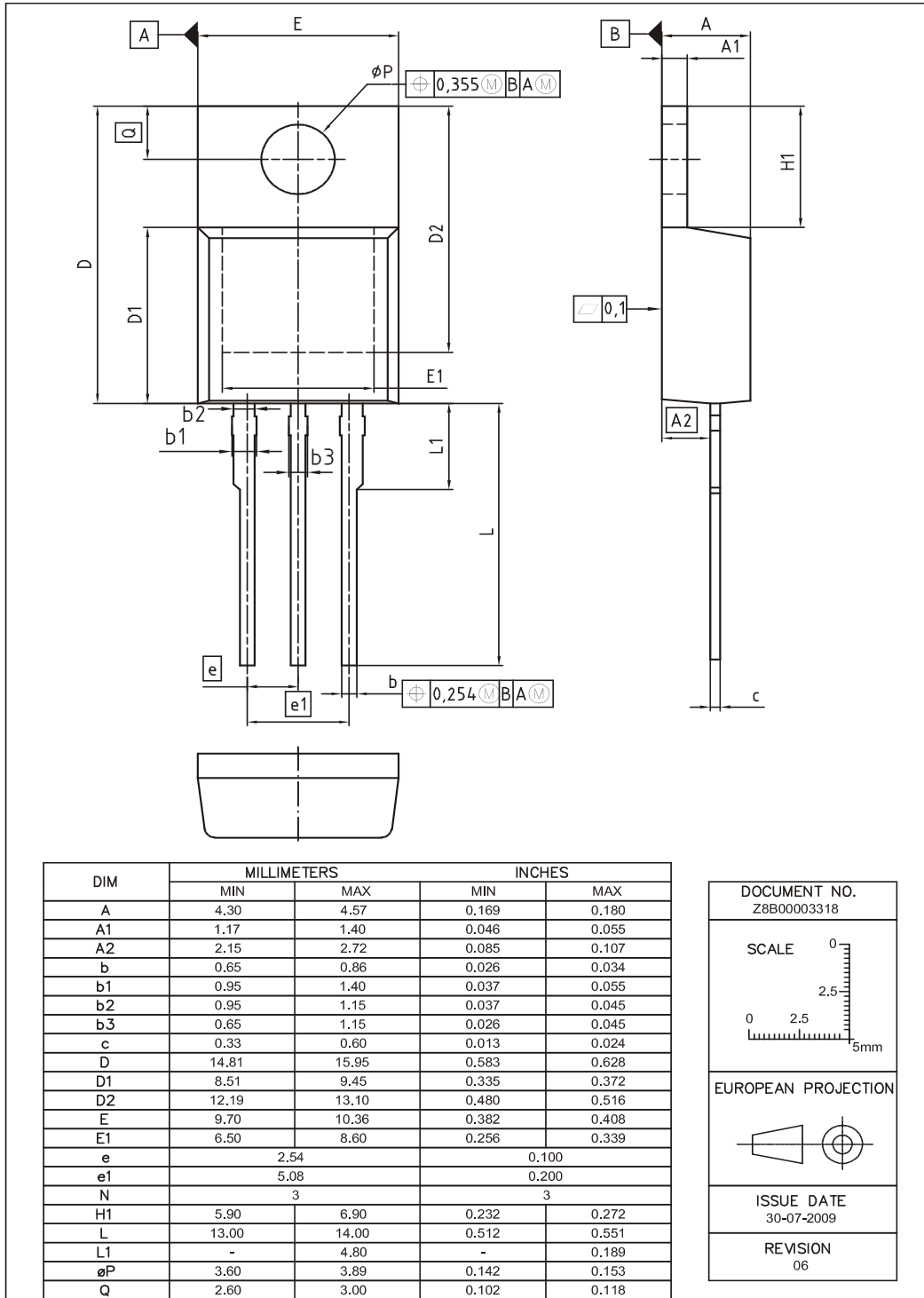


Figure 18. IGBT transient thermal impedance ($D=t_p/T$)

PG-TO220-3



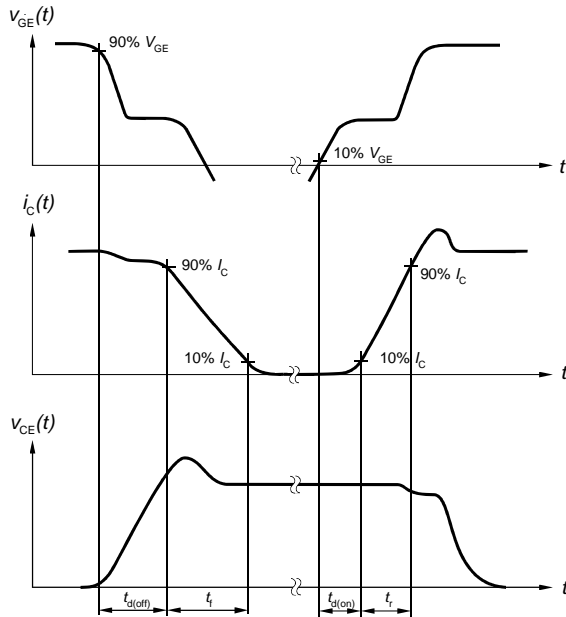


Figure A. Definition of switching times

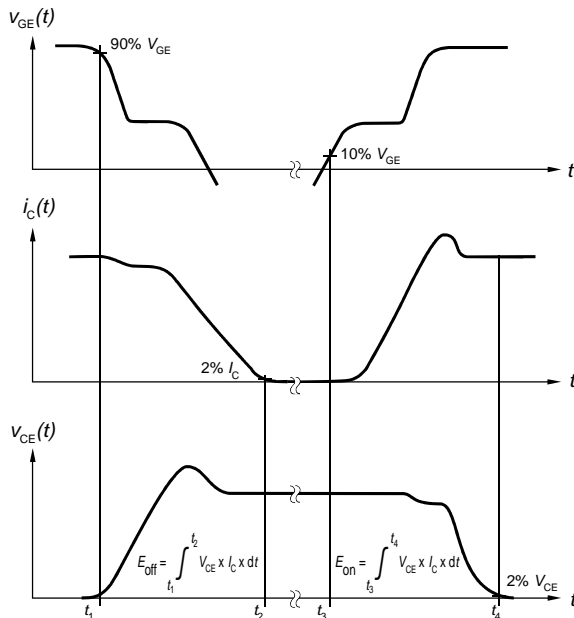


Figure B. Definition of switching losses

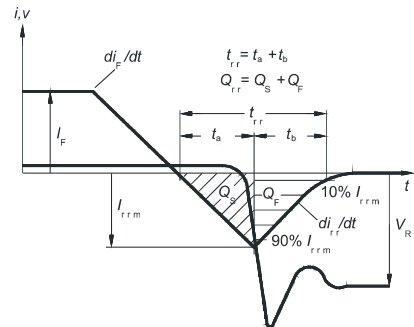


Figure C. Definition of diodes switching characteristics

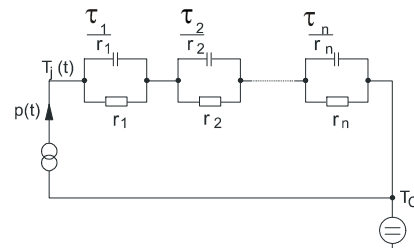


Figure D. Thermal equivalent circuit

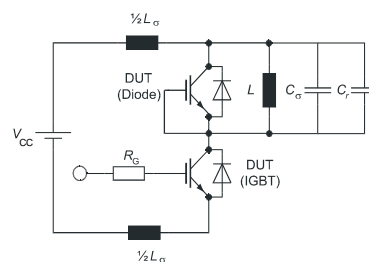


Figure E. Dynamic test circuit
Parasitic inductance L_σ ,
Parasitic capacitor C_σ ,
Relief capacitor C_r
(only for ZVT switching)

Revision History

IGP20N65H5

Revision: 2014-06-11, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.1 | 2014-06-11 | Final data sheet |

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