# Resonant Switching Series

Reverse conducting IGBT with monolithic body diode

## IHW20N120R3

Data sheet

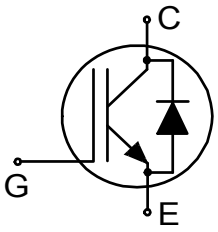
Industrial Power Control

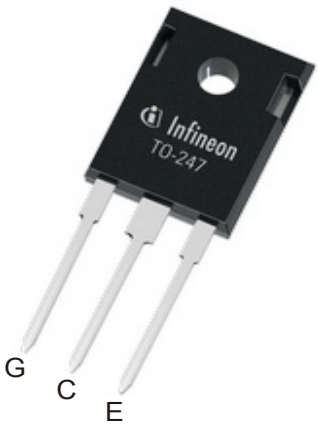
Resonant Switching Series

# Reverse conducting IGBT with monolithic body diode

**Features:**

• Powerful monolithic body diode with low forward voltage designed for soft commutation only
• TRENCHSTOP™ technology applications offers:
- very tight parameter distribution
- high ruggedness, temperature stable behavior
- low $V_{CEsat}$
- easy parallel switching capability due to positive temperature coefficient in $V_{CEsat}$
• Low EMI
• 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:**

• Inductive cooking
• Inverterized microwave ovens
• Resonant converters
• Soft switching applications

Green

Halogen-Free

RoHS

**Key Performance and Package Parameters**

| Type | $V_{CE}$ | $I_C$ | $V_{CEsat}$, $T_{vj}$=25°C | $T_{vjmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IHW20N120R3 | 1200V | 20A | 1.48V | 175°C | H20R1203 | PG-TO247-3 |

**Table of Contents**

Description . . . . . 2
Table of Contents . . . . . 3
Maximum Ratings . . . . . 4
Thermal Resistance . . . . . 4
Electrical Characteristics . . . . . 5
Electrical Characteristics Diagrams . . . . . 7
Package Drawing . . . . . 13
Testing Conditions . . . . . 14
Revision History . . . . . 15
Disclaimer . . . . . 16

Resonant Switching Series

## 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 | $V_{CE}$ | 1200 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_c$ = 25°C<br>$T_c$ = 100°C | $I_C$ | <br>40.0<br>20.0 | A |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$ | $I_{Cpuls}$ | 60.0 | A |
| Non repetitive peak collector current[1)] | $I_{CSM}$ | 200 | A |
| Turn off safe operating area $V_{CE} \le 1200V$, $T_{vj} \le 175°C$ | - | 60.0 | A |
| Diode forward current, limited by $T_{vjmax}$<br>$T_c$ = 25°C<br>$T_c$ = 100°C | $I_F$ | <br>40.0<br>20.0 | A |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$ | $I_{Fpuls}$ | 60.0 | A |
| Gate-emitter voltage<br>Transient Gate-emitter voltage ($t_p \le 10\mu s$, $D < 0.010$) | $V_{GE}$ | ±20<br>±25 | V |
| Power dissipation $T_c$ = 25°C<br>Power dissipation $T_c$ = 100°C | $P_{tot}$ | 310.0<br>155.0 | W |
| Operating junction temperature | $T_{vj}$ | -40...+175 | °C |
| Storage temperature | $T_{stg}$ | -55...+175 | °C |
| Soldering temperature,<br>wave soldering 1.6mm (0.063in.) from case for 10s | | 260 | °C |
| Mounting torque, M3 screw<br>Maximum of mounting processes: 3 | $M$ | 0.6 | Nm |

## Thermal Resistance

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **$R_{th}$ Characteristics** | | | | | | |
| IGBT thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | - | - | 0.48 | K/W |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | - | - | 0.48 | K/W |
| Thermal resistance<br>junction - ambient | $R_{th(j-a)}$ | | - | - | 40 | K/W |

[1)] capacitor charging saturation current limited by $T_{vjmax}$ < 175°C and $t_p$ < 3µs

**Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Static Characteristic** | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0V, $I_C$ = 0.50mA | 1200 | - | - | V |
| Collector-emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = 15.0V, $I_C$ = 20.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C<br>$T_{vj}$ = 175°C | <br>-<br>-<br>- | <br>1.48<br>1.70<br>1.80 | <br>1.70<br>-<br>- | V |
| Diode forward voltage | $V_F$ | $V_{GE}$ = 0V, $I_F$ = 20.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C<br>$T_{vj}$ = 175°C | <br>-<br>-<br>- | <br>1.55<br>1.70<br>1.80 | <br>1.75<br>-<br>- | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.50mA, $V_{CE}$ = $V_{GE}$ | 5.1 | 5.8 | 6.4 | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{CE}$ = 1200V, $V_{GE}$ = 0V<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 175°C | <br>-<br>- | <br>-<br>- | <br>100<br>2500 | µA |
| Gate-emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = 20V | - | - | 100 | nA |
| Transconductance | $g_{fs}$ | $V_{CE}$ = 20V, $I_C$ = 20.0A | - | 18.3 | - | S |
| Integrated gate resistor | $r_G$ | | | none | | Ω |

**Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic Characteristic** | | | | | | |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | - | 1503 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 50 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 42 | - | |
| Gate charge | $Q_G$ | $V_{CC}$ = 960V, $I_C$ = 20.0A,<br>$V_{GE}$ = 15V | - | 211.0 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | $L_E$ | | - | 13.0 | - | nH |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 25°C** | | | | | | |
| Turn-off delay time | $t_{d(off)}$ | $T_{vj}$ = 25°C,<br>$V_{CC}$ = 600V, $I_C$ = 20.0A,<br>$V_{GE}$ = 0.0/15.0V,<br>$R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω,<br>Lσ = 180nH, Cσ = 39pF<br>Lσ, Cσ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | - | 387 | - | ns |
| Fall time | $t_f$ | | - | 25 | - | ns |
| Turn-off energy | $E_{off}$ | | - | 0.95 | - | mJ |

**Switching Characteristic, Inductive Load**

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **IGBT Characteristic, at $T_{vj}$ = 175°C** | | | | | | |
| Turn-off delay time | $t_{d(off)}$ | $T_{vj}$ = 175°C, $V_{CC}$ = 600V, $I_C$ = 20.0A, $V_{GE}$ = 0.0/15.0V, $R_{G(on)}$ = 15.0Ω, $R_{G(off)}$ = 15.0Ω, $L\sigma$ = 180nH, $C\sigma$ = 39pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery. | - | 454 | - | ns |
| Fall time | $t_f$ | | - | 84 | - | ns |
| Turn-off energy | $E_{off}$ | | - | 1.65 | - | mJ |

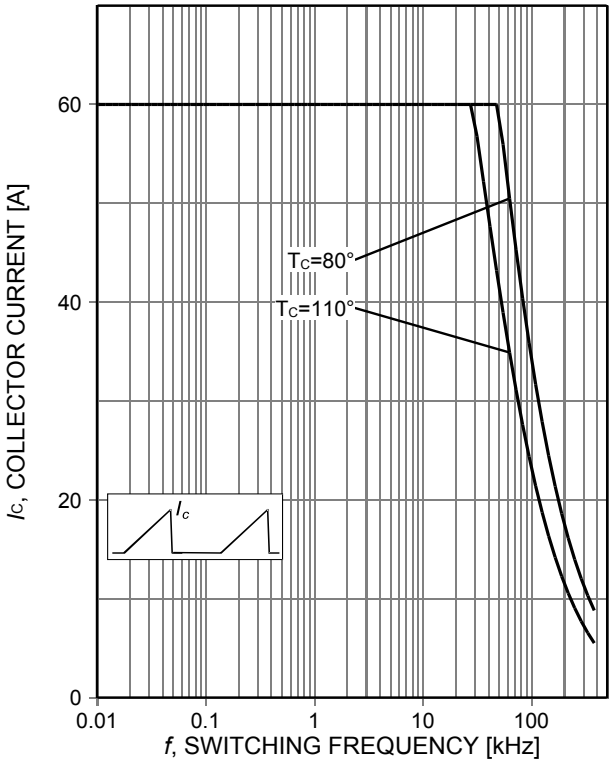



Figure 1. **Collector current as a function of switching frequency**
($T_j$≤175°C, $D$=0.5, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_G$=15Ω)

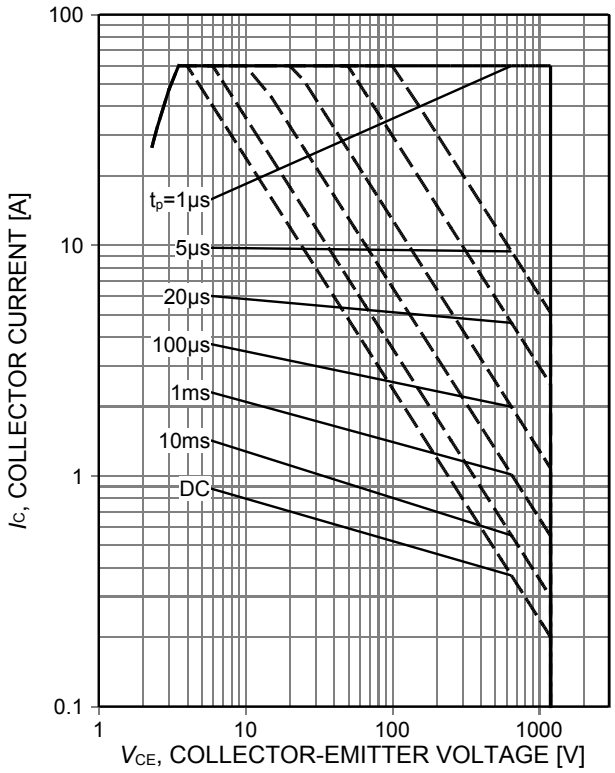



Figure 2. **Forward bias safe operating area**
($D$=0, $T_C$=25°C, $T_j$≤175°C; $V_{GE}$=15V)

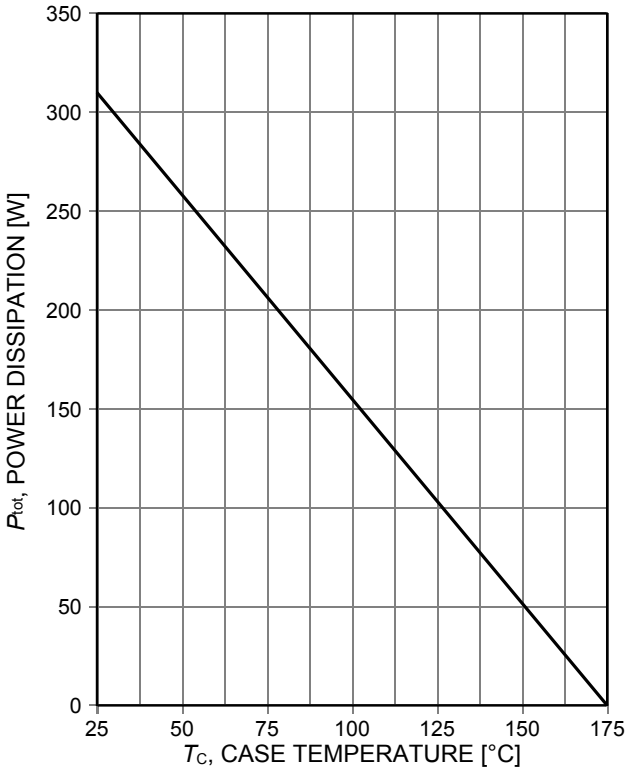



Figure 3. **Power dissipation as a function of case temperature**
($T_j$≤175°C)

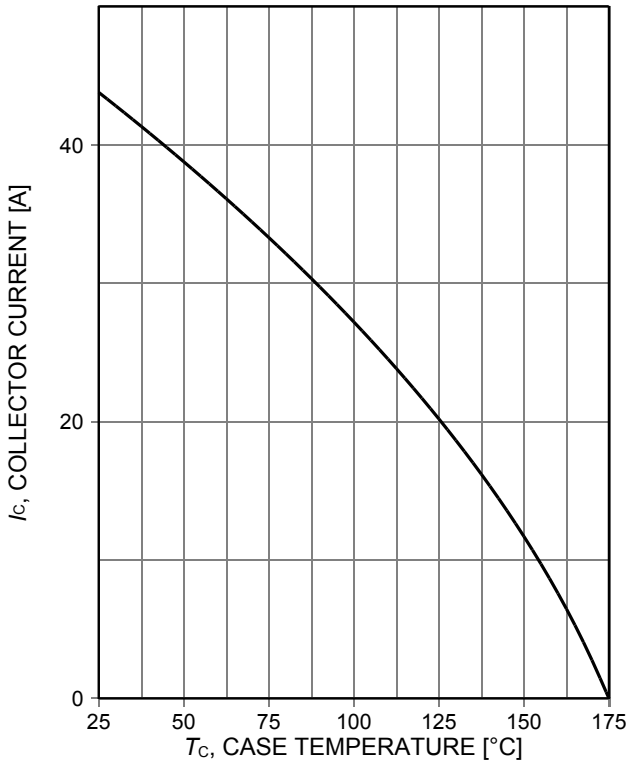



Figure 4. **Collector current as a function of case temperature**
($V_{GE}$≥15V, $T_j$≤175°C)

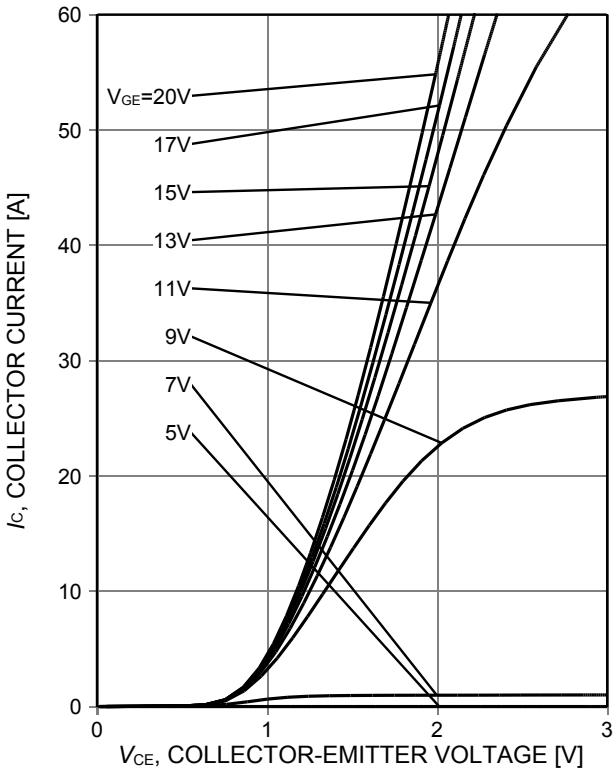



Figure 5. **Typical output characteristic** ($T_j$=25°C)

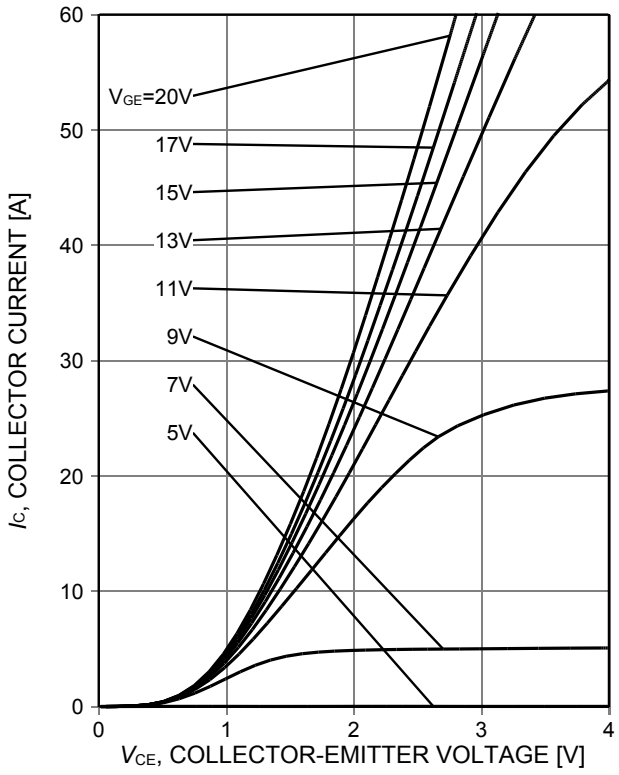



Figure 6. **Typical output characteristic** ($T_j$=175°C)

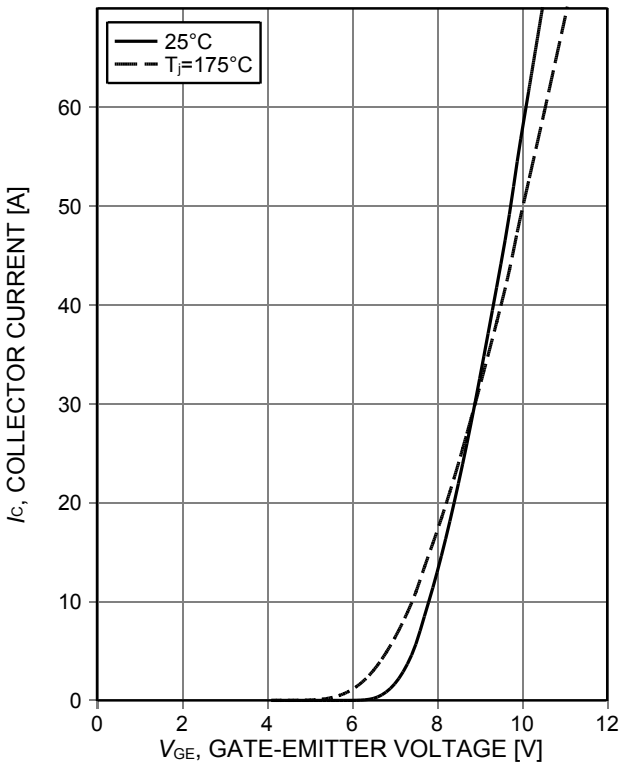



Figure 7. **Typical transfer characteristic** ($V_{CE}$=20V)

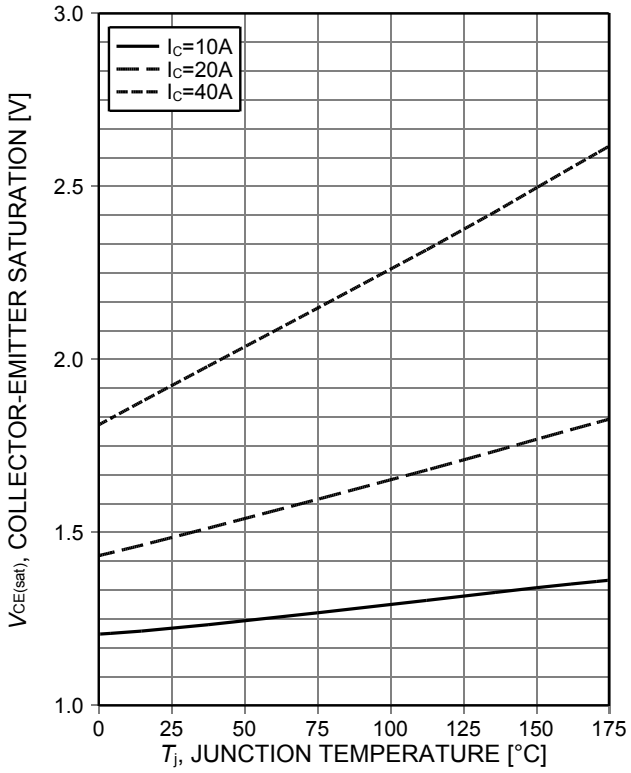



Figure 8. **Typical collector-emitter saturation voltage as a function of junction temperature** ($V_{GE}$=15V)

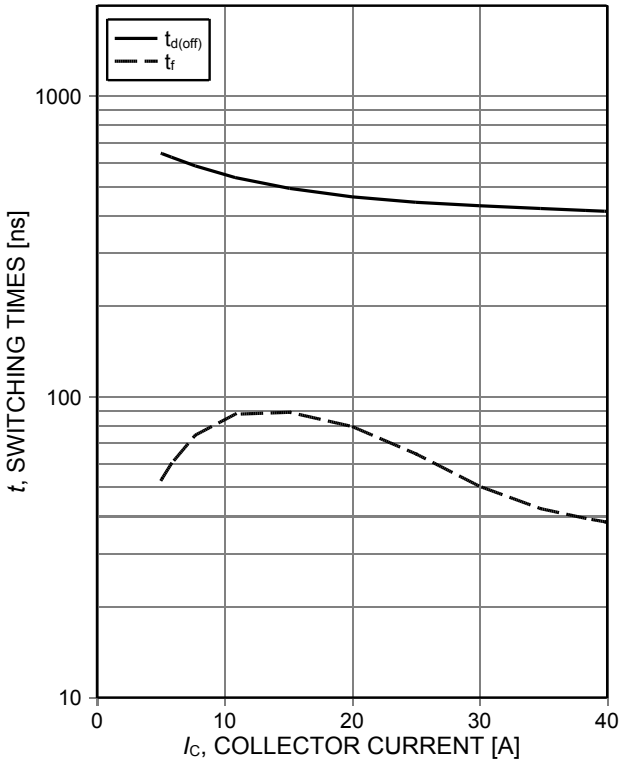



Figure 9. **Typical switching times as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_{G(on)}$=15Ω, $R_{G(off)}$=15Ω, test circuit in Fig. E)

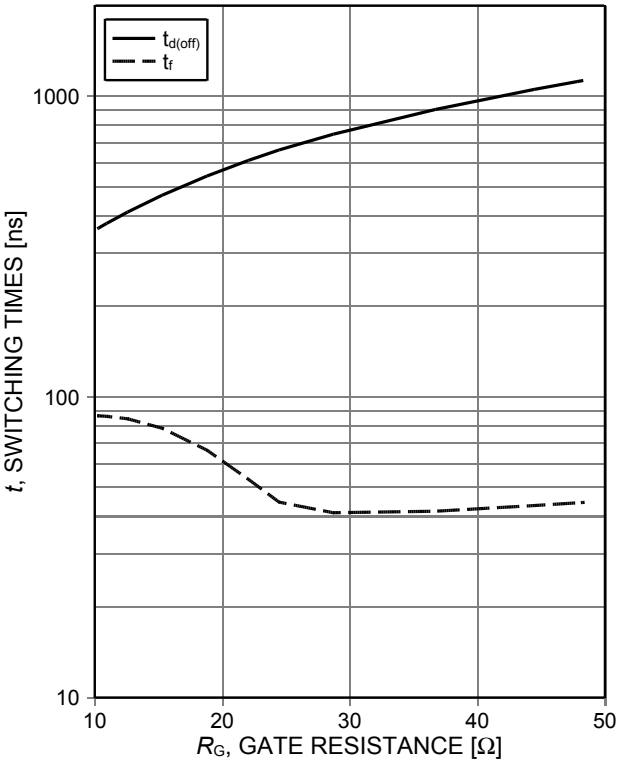



Figure 10. **Typical switching times as a function of gate resistance**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=20A, test circuit in Fig. E)

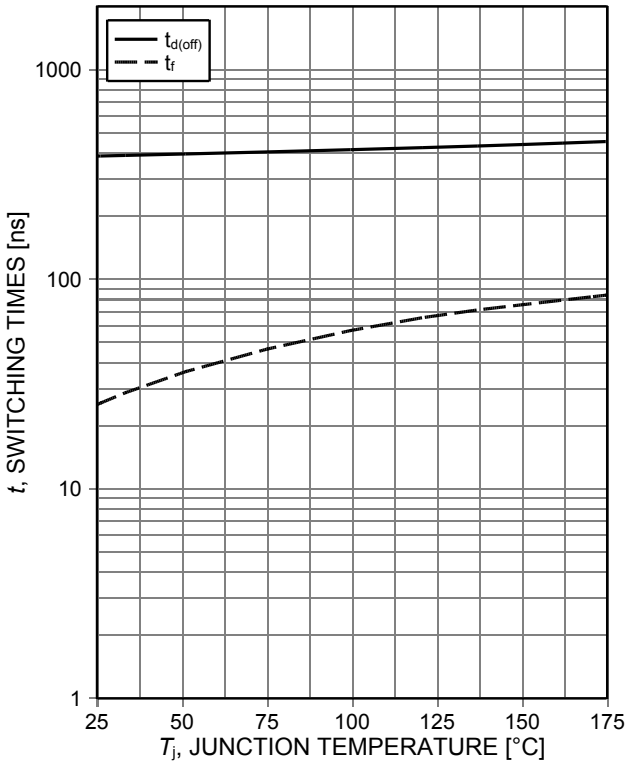



Figure 11. **Typical switching times as a function of junction temperature**
(ind. load, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=20A, $R_{G(on)}$=15Ω, $R_{G(off)}$=15Ω, test circuit in Fig. E)

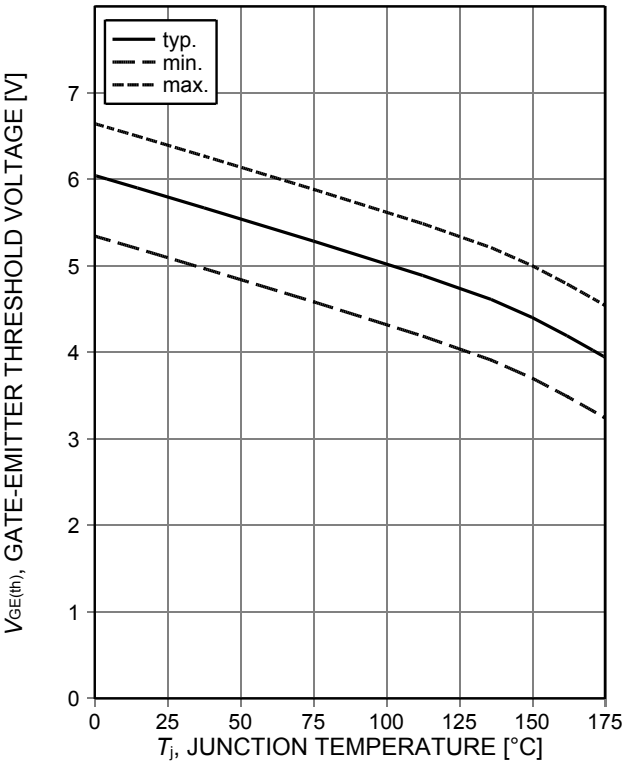



Figure 12. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C$=0.5mA)

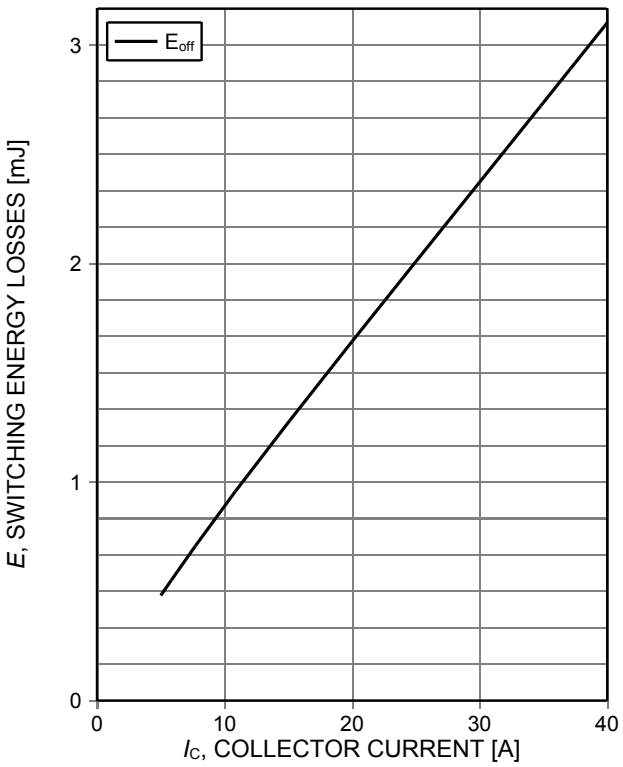



Figure 13. **Typical switching energy losses as a function of collector current**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=0/15V, $R_{G(on)}$=15, $R_{G(off)}$=15Ω, test circuit in Fig. E)

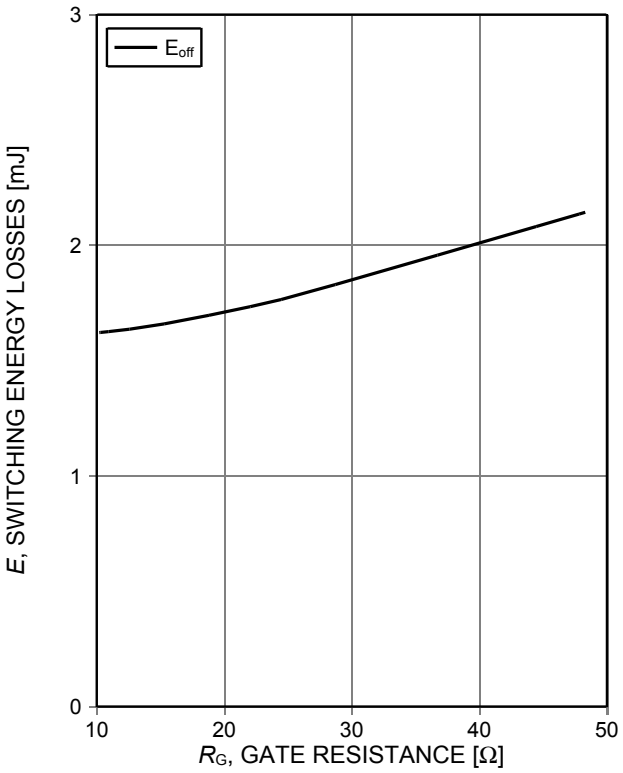



Figure 14. **Typical switching energy losses as a function of gate resistance**
(ind. load, $T_j$=175°C, $V_{CE}$=600V, $V_{GE}$=15/0V, test circuit in Fig. E)

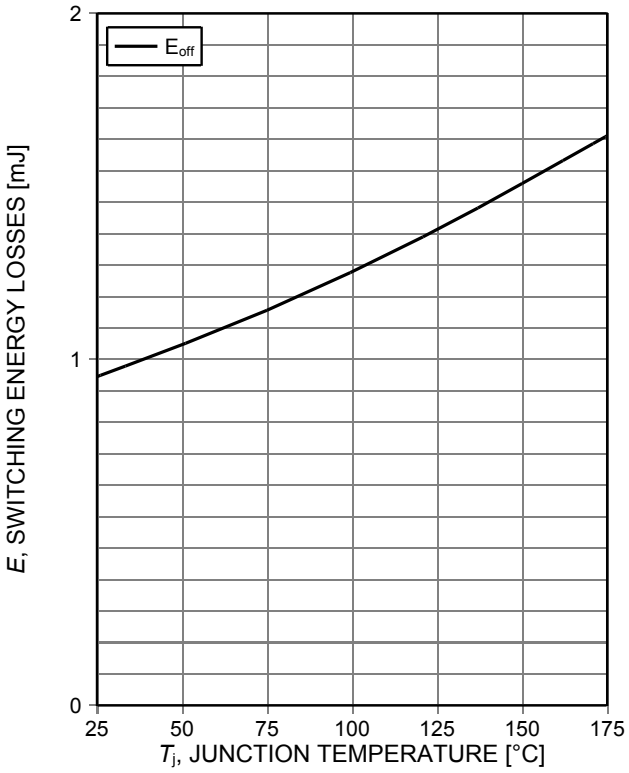



Figure 15. **Typical switching energy losses as a function of junction temperature**
(ind load, $V_{CE}$=600V, $V_{GE}$=0/15V, $I_C$=20A, $R_{G(on)}$=15Ω, $R_{G(off)}$=15Ω, test circuit in Fig. E)

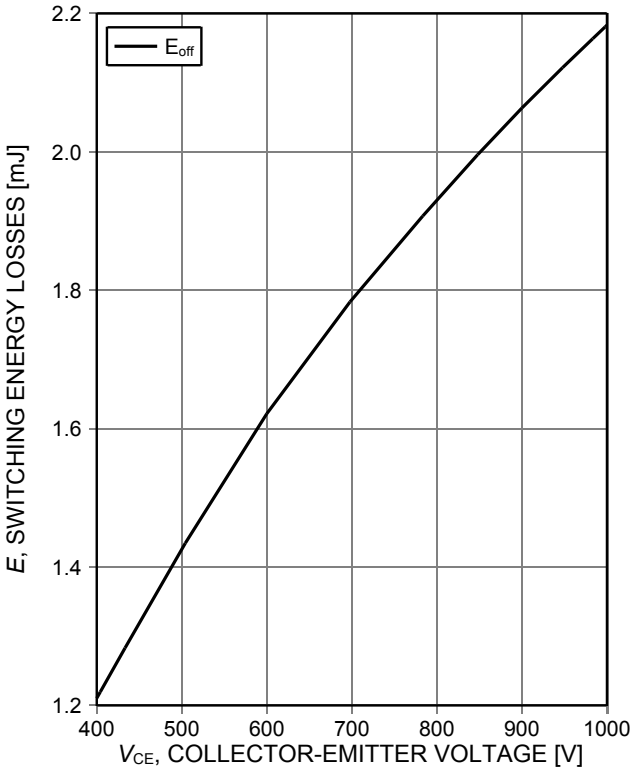



Figure 16. **Typical switching energy losses as a function of collector emitter voltage**
(ind. load, $T_j$=175°C, $V_{GE}$=150/V, $I_C$=20A, $R_{G(on)}$=15Ω, $R_{G(off)}$=15Ω, test circuit in Fig. E)

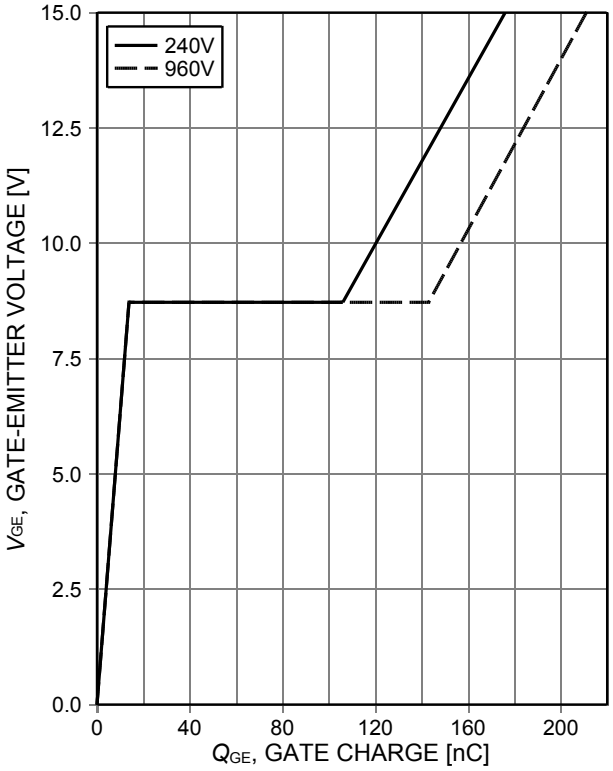



Figure 17. **Typical gate charge**
($I_C$=20A)

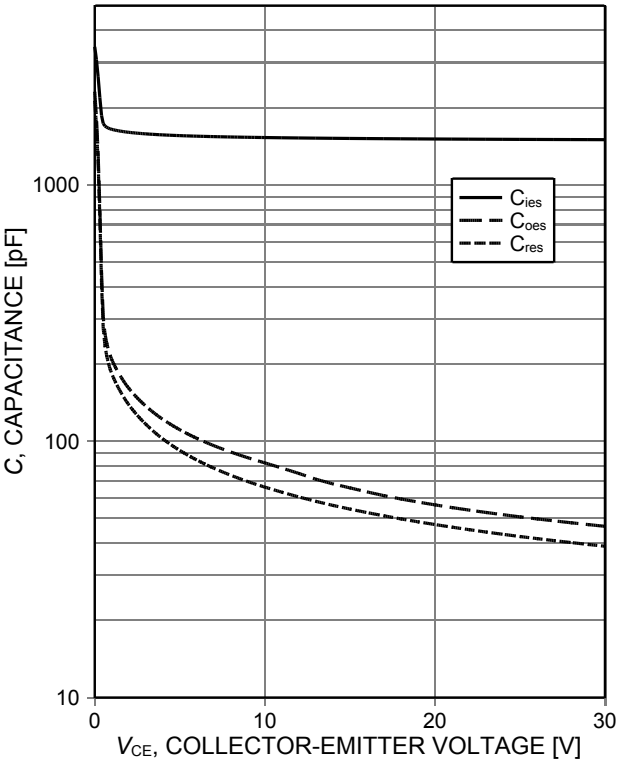



Figure 18. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

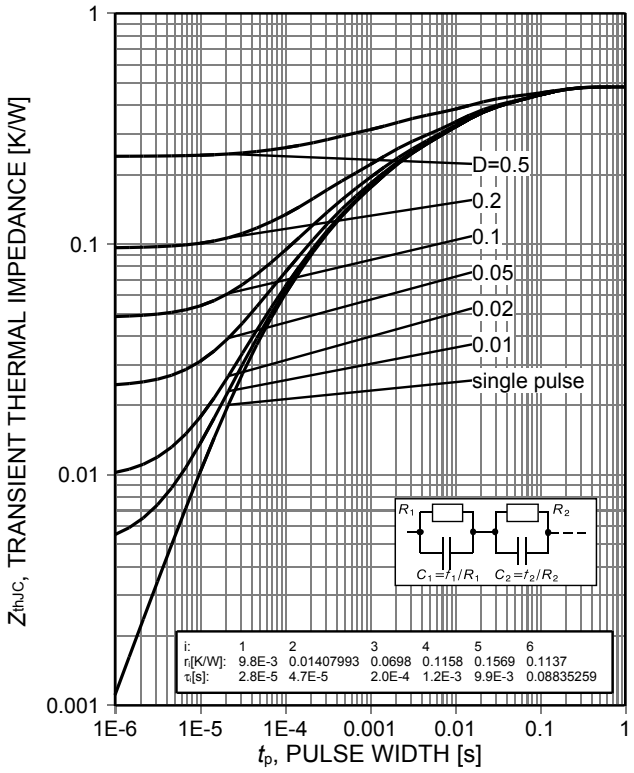



Figure 19. **IGBT transient thermal impedance**
($D=t_p/T$)

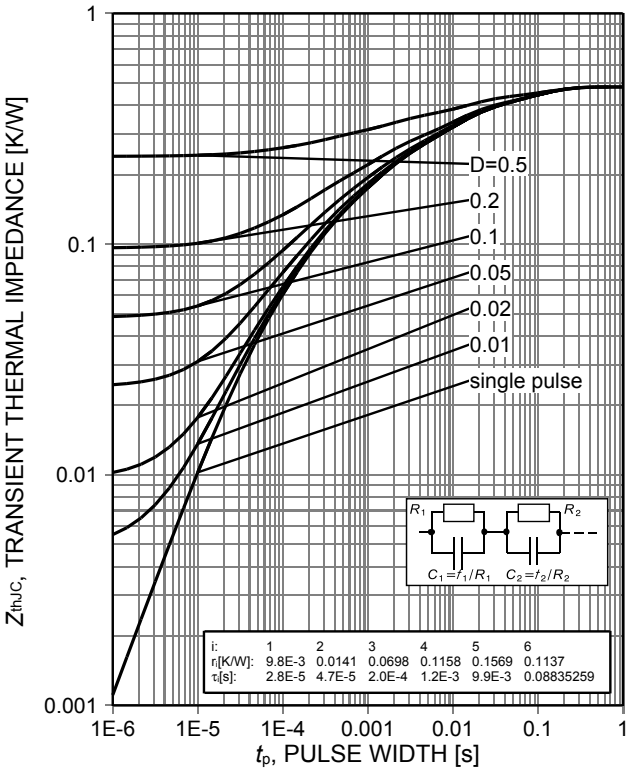



Figure 20. **Diode transient thermal impedance as a function of pulse width**
($D=t_p/T$)

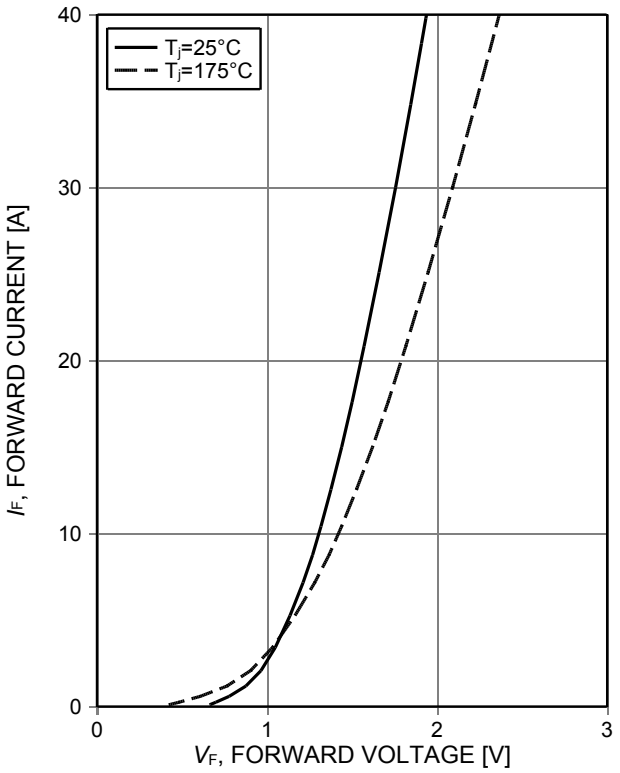



Figure 21. **Typical diode forward current as a function of forward voltage**

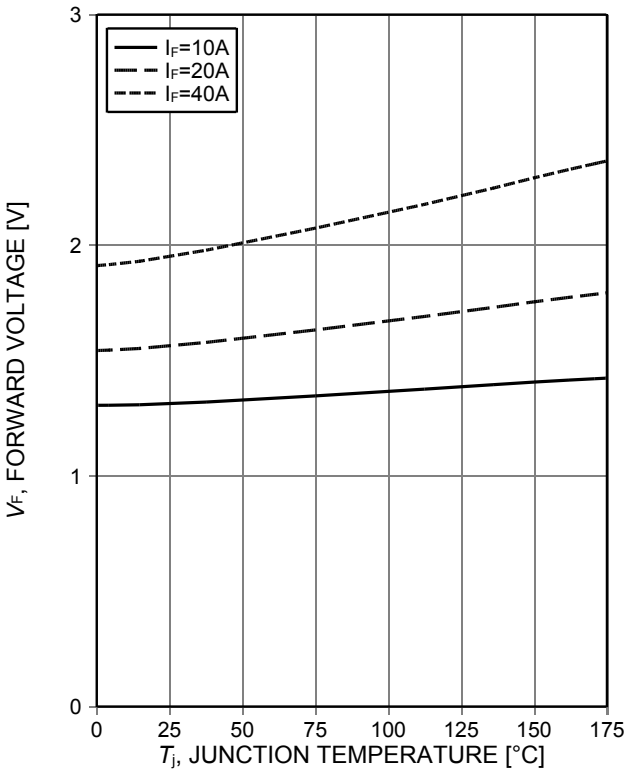
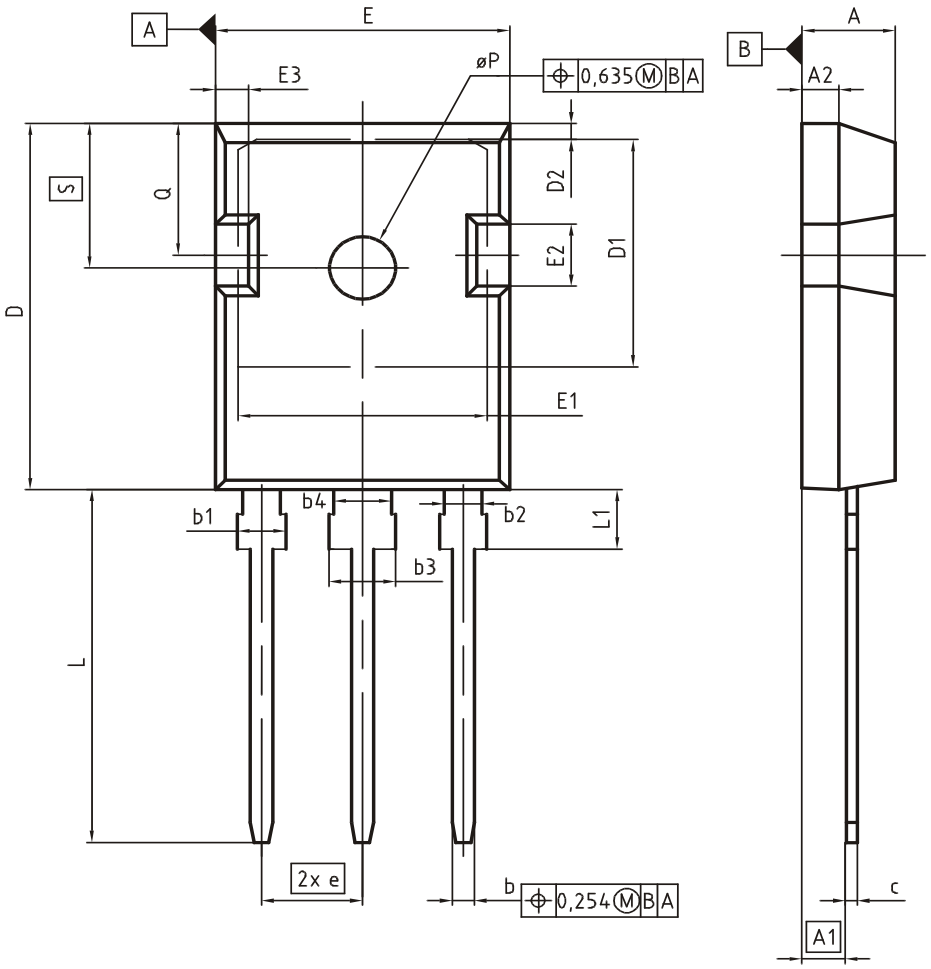



Figure 22. **Typical diode forward voltage as a function of junction temperature**

## 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 |

| | |
|---|---|
| DOCUMENT NO. | Z8B00003327 |
| SCALE | 0 5 5 7.5mm |
| EUROPEAN PROJECTION | |
| ISSUE DATE | 09-07-2010 |
| REVISION | 05 |

### Testing Conditions

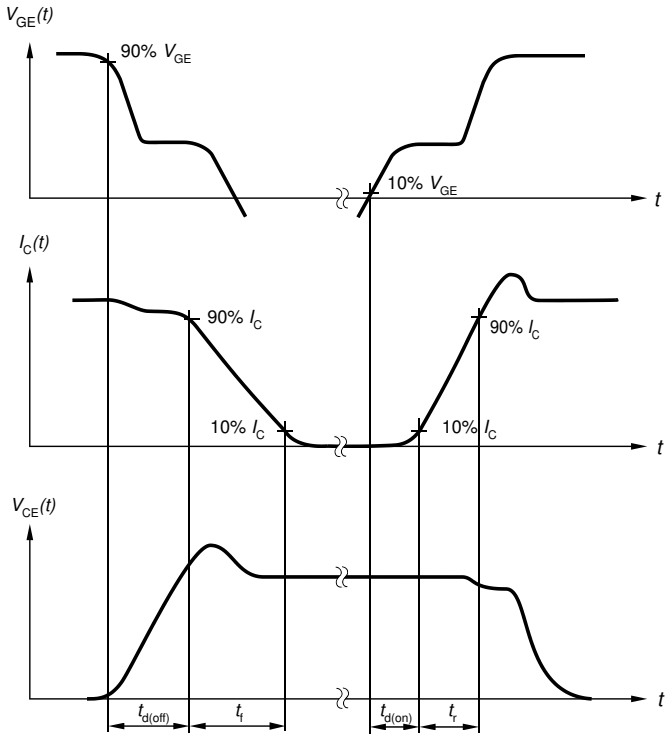



Figure A. **Definition of switching times**

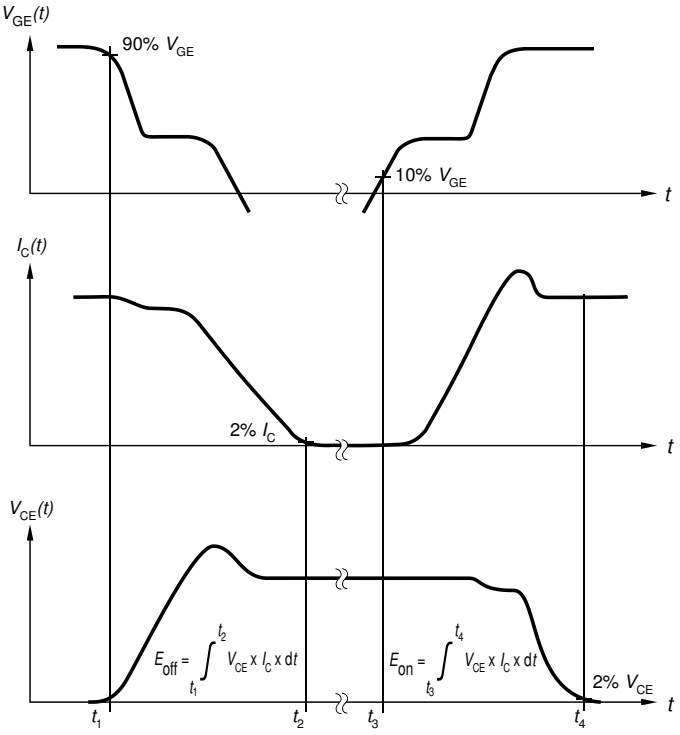



Figure B. **Definition of switching losses**

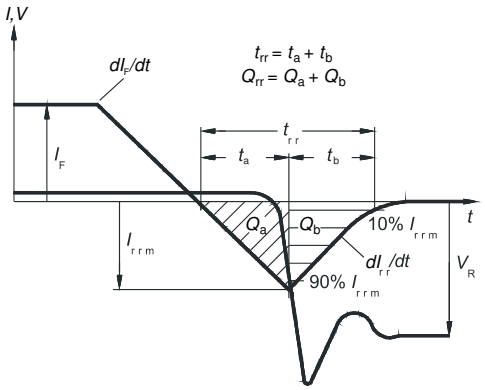



Figure C. **Definition of diode switching characteristics**

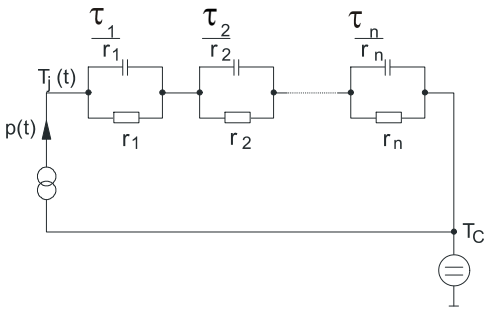



Figure D. **Thermal equivalent circuit**

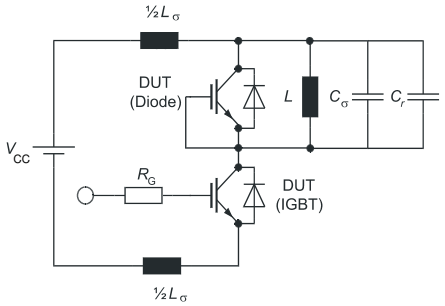



Figure E. **Dynamic test circuit**
Parasitic inductance $L_\sigma$,
parasitic capacitor $C_\sigma$,
relief capacitor $C_r$,
(only for ZVT switching)

## Revision History

IHW20N120R3

**Revision: 2019-09-19, Rev. 2.7**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.1 | 2008-05-06 | - |
| 1.2 | 2008-07-11 | - |
| 2.3 | 2008-07-29 | - |
| 2.4 | 2009-04-01 | - |
| 2.5 | 2013-02-12 | Layout change |
| 2.6 | 2015-01-26 | Minor changes |
| 2.7 | 2019-09-19 | additional parameter in maximum ratings table: non repetitive peak collector current |

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