

## Resonant Switching Series

Reverse Conducting IGBT with monolithic body diode

IHW20N135R5

Data sheet

Industrial Power Control

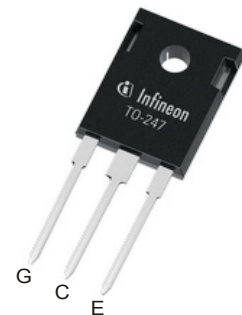
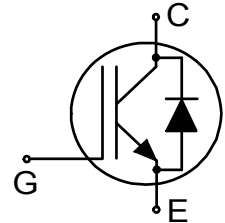
## Reverse Conducting IGBT with monolithic body diode

### Features:

- Offers high breakdown voltage of 1350V for improved reliability
- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- TRENCHSTOP™ technology offering:
  - 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 JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Halogen free (according to IEC 61249-2-21)
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

### Applications:

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



### Key Performance and Package Parameters

| Type        | $V_{CE}$ | $I_C$ | $V_{CEsat}$ , $T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|-------------|----------|-------|------------------------------------|-------------|---------|------------|
| IHW20N135R5 | 1350V    | 20A   | 1.65V                              | 175°C       | H20PR5  | 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                                                                              | $V_{CE}$    | 1350                 | V                |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$  | $I_C$       | 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 <sup>1)</sup>                                                    | $I_{CSM}$   | 200                  | A                |
| Turn off safe operating area $V_{CE} \leq 1350\text{V}$ , $T_{vj} \leq 175^\circ\text{C}$              | -           | 60.0                 | A                |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$ | $I_F$       | 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 ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )      | $V_{GE}$    | $\pm 20$<br>$\pm 25$ | V                |
| Power dissipation $T_C = 25^\circ\text{C}$<br>Power dissipation $T_C = 100^\circ\text{C}$              | $P_{tot}$   | 288.0<br>144.0       | W                |
| Operating junction temperature                                                                         | $T_{vj}$    | -40...+175           | $^\circ\text{C}$ |
| Storage temperature                                                                                    | $T_{stg}$   | -55...+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<br>Maximum of mounting processes: 3                                          | $M$         | 0.6                  | Nm               |

### Thermal Resistance

| Parameter                                    | Symbol        | Conditions | Max. Value | Unit |
|----------------------------------------------|---------------|------------|------------|------|
| <b>Characteristic</b>                        |               |            |            |      |
| IGBT thermal resistance,<br>junction - case  | $R_{th(j-c)}$ |            | 0.52       | K/W  |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ |            | 0.52       | K/W  |
| Thermal resistance<br>junction - ambient     | $R_{th(j-a)}$ |            | 40         | K/W  |

<sup>1)</sup> capacitor charging saturation current limited by  $T_{vjmax} < 175^\circ\text{C}$  and  $t_p < 3\mu\text{s}$

**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  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.50mA$                                                                                   | 1350        | -                    | -              | V        |
| Collector-emitter saturation voltage | $V_{CEsat}$   | $V_{GE} = 15.0V, I_C = 20.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 125^{\circ}C$<br>$T_{vj} = 175^{\circ}C$ | -<br>-<br>- | 1.65<br>1.85<br>1.95 | 1.85<br>-<br>- | V        |
| Diode forward voltage                | $V_F$         | $V_{GE} = 0V, I_F = 20.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 125^{\circ}C$<br>$T_{vj} = 175^{\circ}C$    | -<br>-<br>- | 1.65<br>1.85<br>1.95 | 1.90<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  | $I_{CES}$     | $V_{CE} = 1350V, V_{GE} = 0V$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$                            | -<br>-      | -<br>350.0           | 100.0<br>-     | $\mu A$  |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                                                   | -           | -                    | 100            | nA       |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 20.0A$                                                                                   | -           | 15.8                 | -              | S        |
| Integrated gate resistor             | $r_G$         |                                                                                                               |             | none                 |                | $\Omega$ |

**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                  | -     | 1360  | -    | pF   |
| Output capacitance           | C <sub>oes</sub> |                                                                        | -     | 43    | -    |      |
| Reverse transfer capacitance | C <sub>res</sub> |                                                                        | -     | 34    | -    |      |
| Gate charge                  | Q <sub>G</sub>   | V <sub>CC</sub> = 1080V, I <sub>C</sub> = 20.0A, V <sub>GE</sub> = 15V | -     | 170.0 | -    | nC   |

**Switching Characteristic, Inductive Load**

| Parameter                                             | Symbol              | Conditions                                                                                                                                                                                                                                                                                                                         | Value |      |      | Unit |
|-------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                                       |                     |                                                                                                                                                                                                                                                                                                                                    | min.  | typ. | max. |      |
| IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ |                     |                                                                                                                                                                                                                                                                                                                                    |       |      |      |      |
| Turn-off delay time                                   | $t_{d(\text{off})}$ | $T_{vj} = 25^{\circ}\text{C},$<br>$V_{CC} = 600\text{V}, I_C = 20.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(\text{on})} = 10.0\Omega, R_{G(\text{off})} = 10.0\Omega,$<br>$L\sigma = 175\text{nH}, C\sigma = 40\text{pF}$<br>$L\sigma, C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | -     | 235  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                    | -     | 50   | -    | ns   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                    | -     | 0.95 | -    | mJ   |

**Switching Characteristic, Inductive Load**

| Parameter                                              | Symbol              | Conditions                                                                                                                                                                                                                                                                                                                                          | Value |      |      | Unit |
|--------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                                        |                     |                                                                                                                                                                                                                                                                                                                                                     | min.  | typ. | max. |      |
| IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$ |                     |                                                                                                                                                                                                                                                                                                                                                     |       |      |      |      |
| Turn-off delay time                                    | $t_{d(\text{off})}$ | $T_{vj} = 175^{\circ}\text{C}$ ,<br>$V_{CC} = 600\text{V}$ , $I_C = 20.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(\text{on})} = 10.0\Omega$ , $R_{G(\text{off})} = 10.0\Omega$ ,<br>$L\sigma = 175\text{nH}$ , $C\sigma = 40\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and diode reverse recovery. | -     | 350  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                     | -     | 100  | -    | ns   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                     | -     | 2.00 | -    | mJ   |

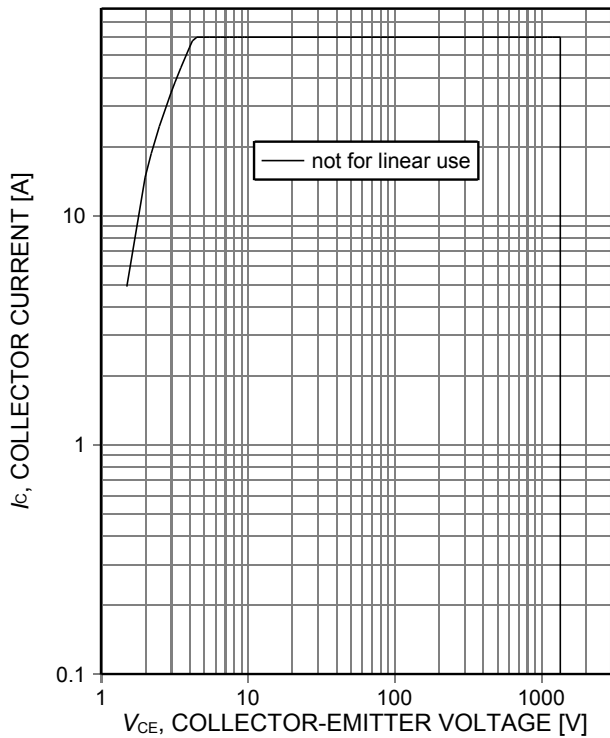


Figure 1. **Safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}=175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ )

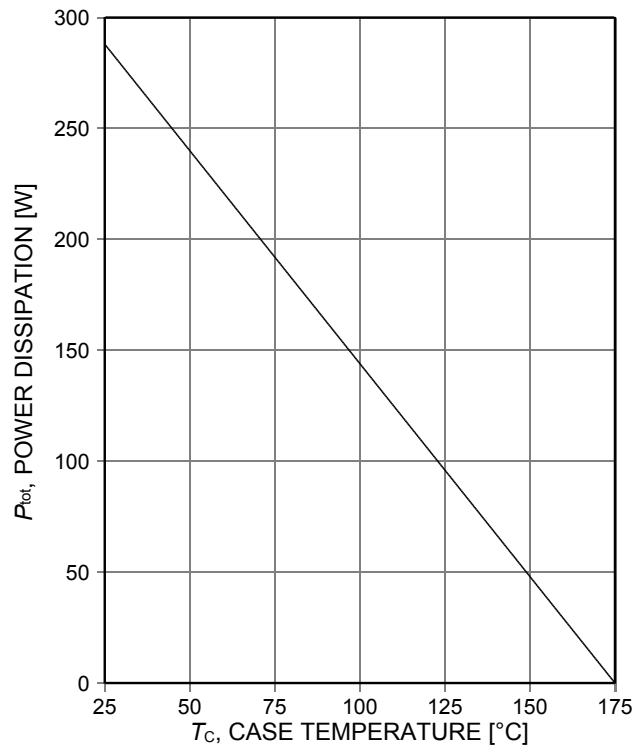


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

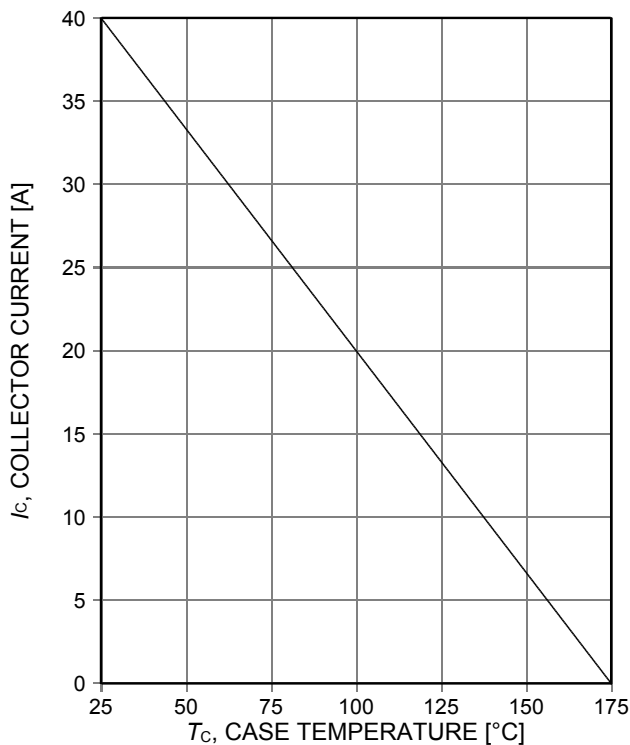


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

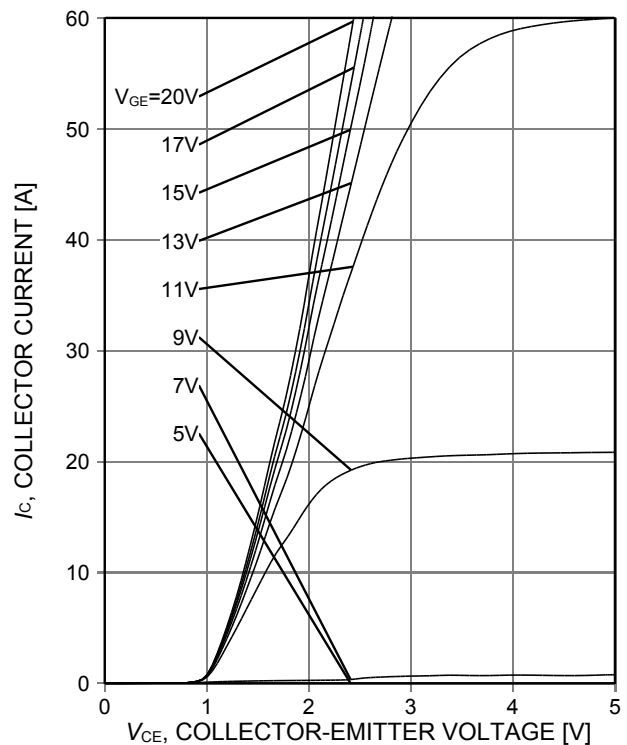


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

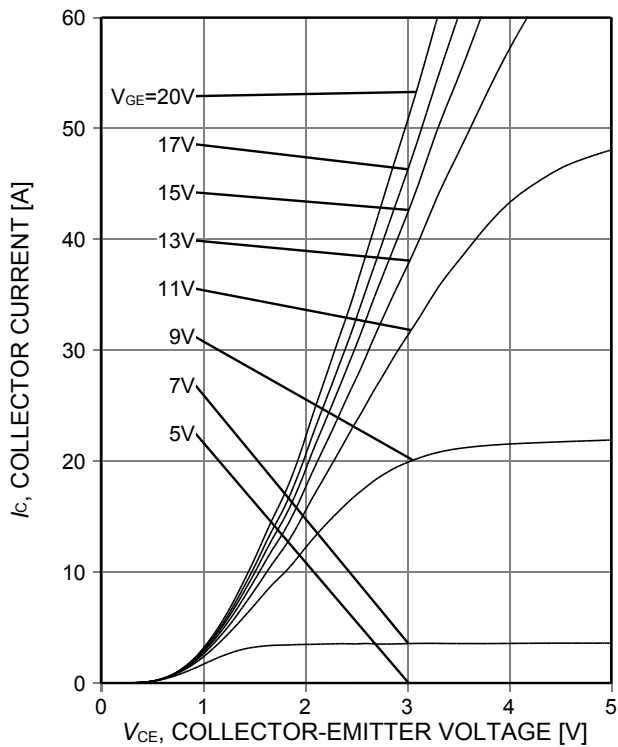


Figure 5. **Typical output characteristic**  
( $T_{vj}=175^{\circ}\text{C}$ )

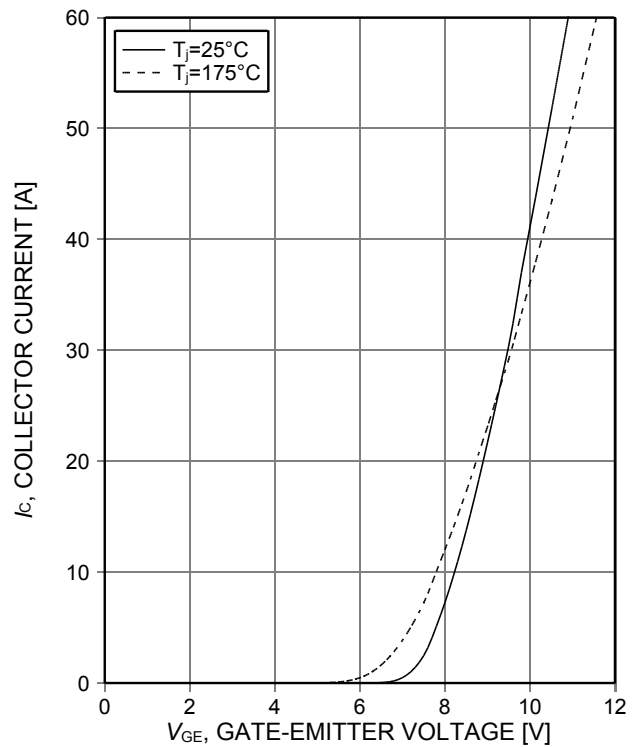


Figure 6. **Typical transfer characteristic**  
( $V_{ce}=20\text{V}$ )

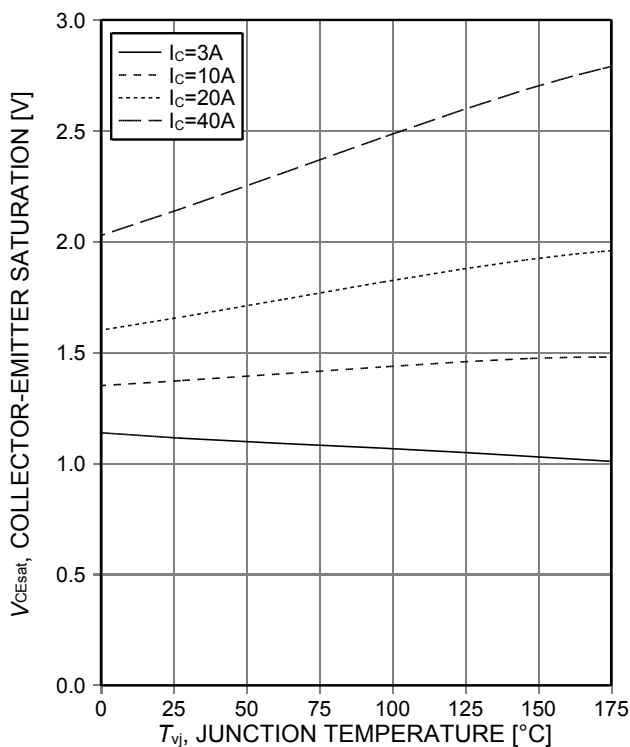


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{ge}=15\text{V}$ )

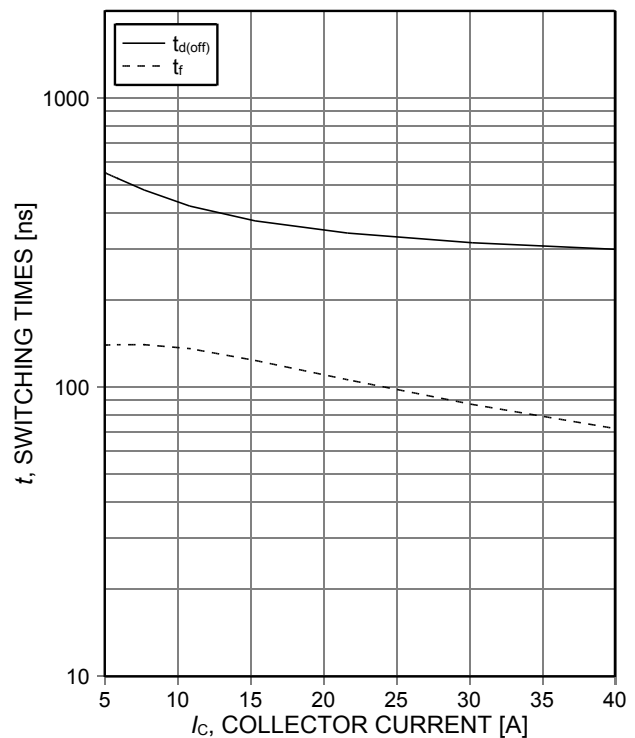


Figure 8. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{ce}=600\text{V}$ ,  $V_{ge}=0/15\text{V}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)



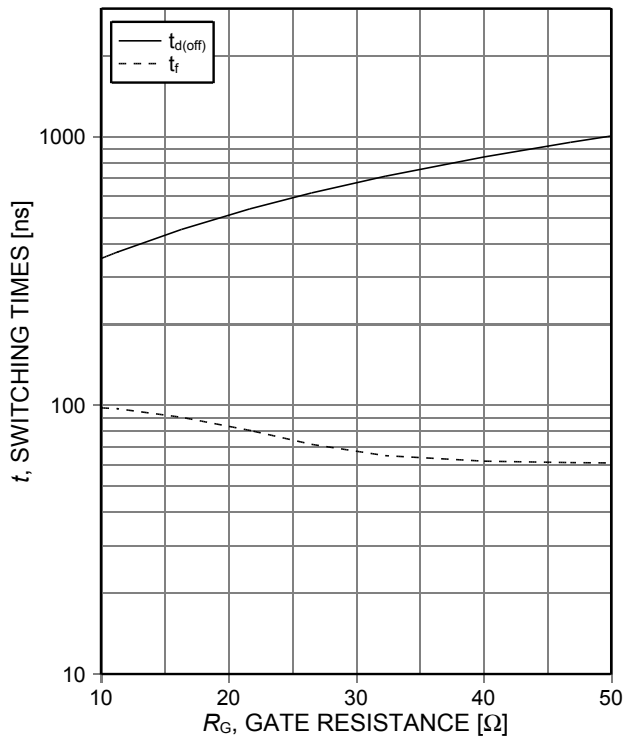


Figure 9. **Typical switching times as a function of gate resistance**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ , dynamic test circuit in Figure E)

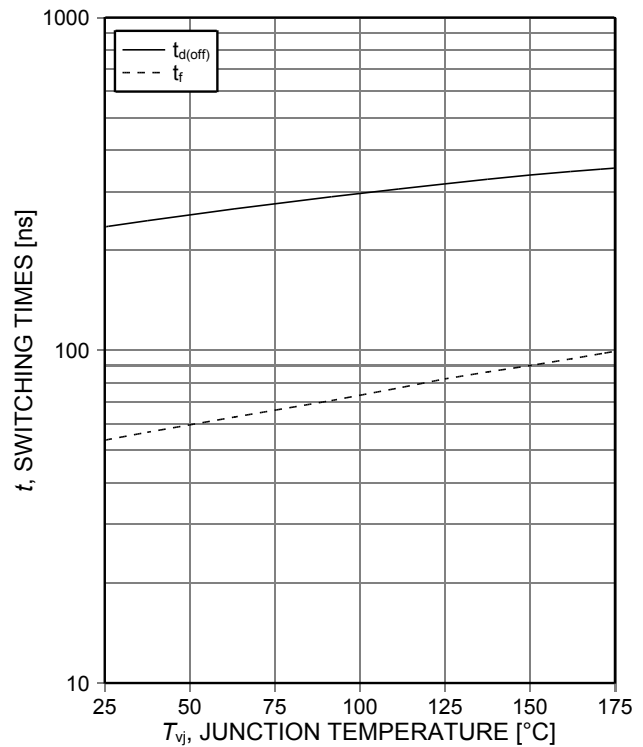


Figure 10. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

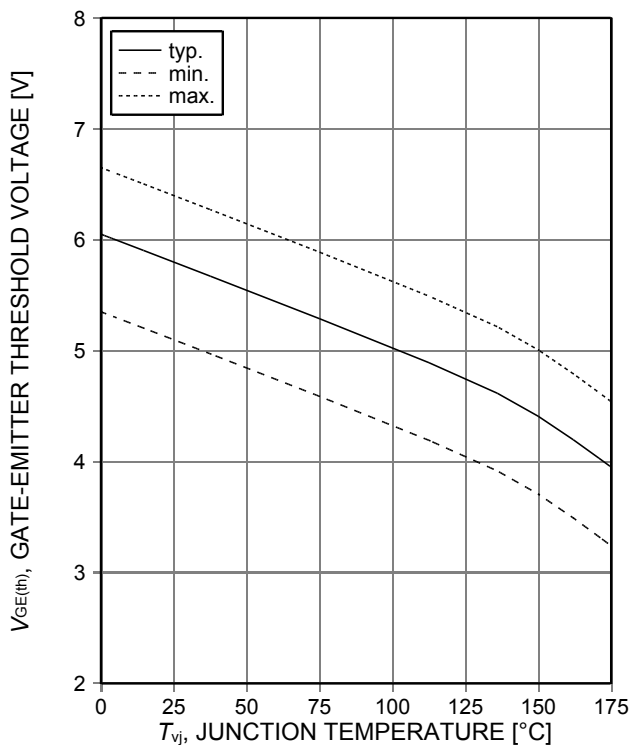


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.5\text{mA}$ , min / max values verified by design)

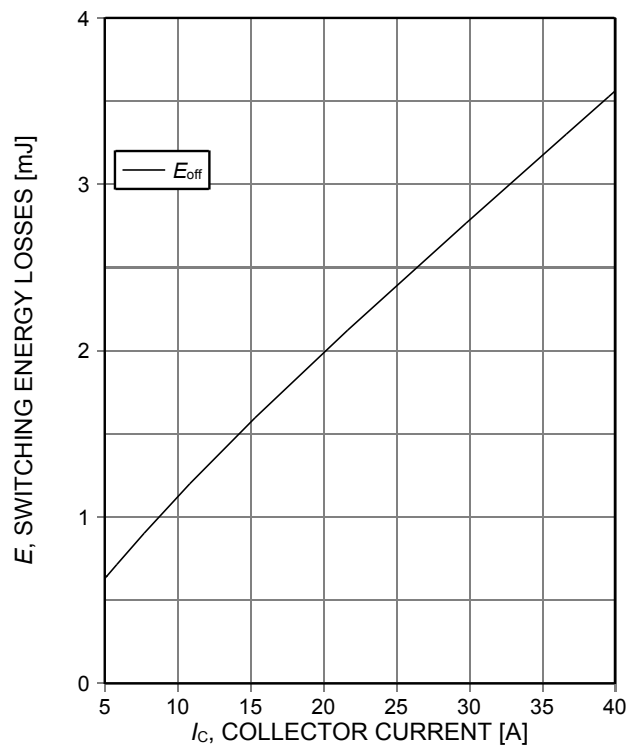


Figure 12. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

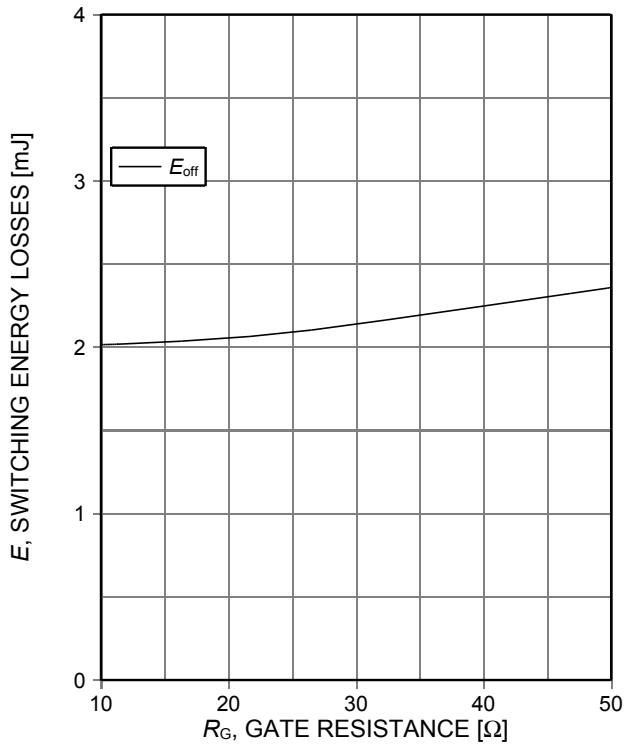


Figure 13. **Typical switching energy losses as a function of gate resistance**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ , dynamic test circuit in Figure E)

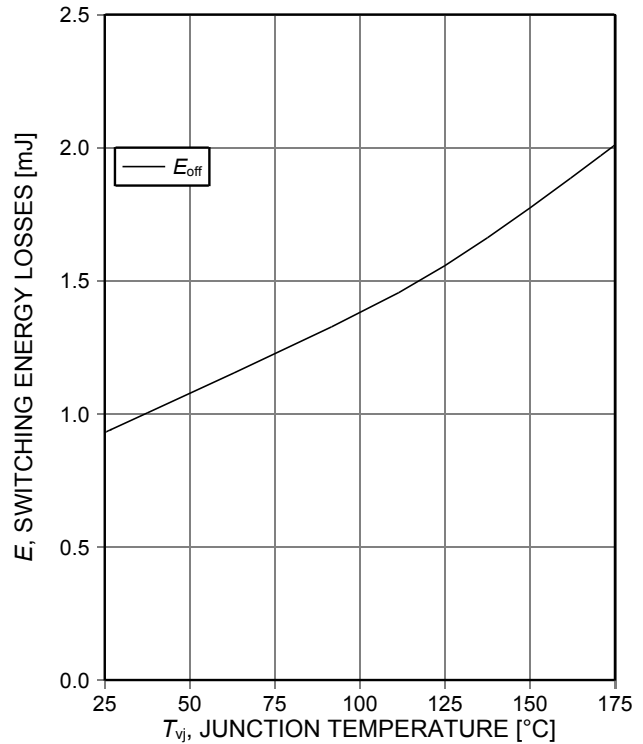


Figure 14. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

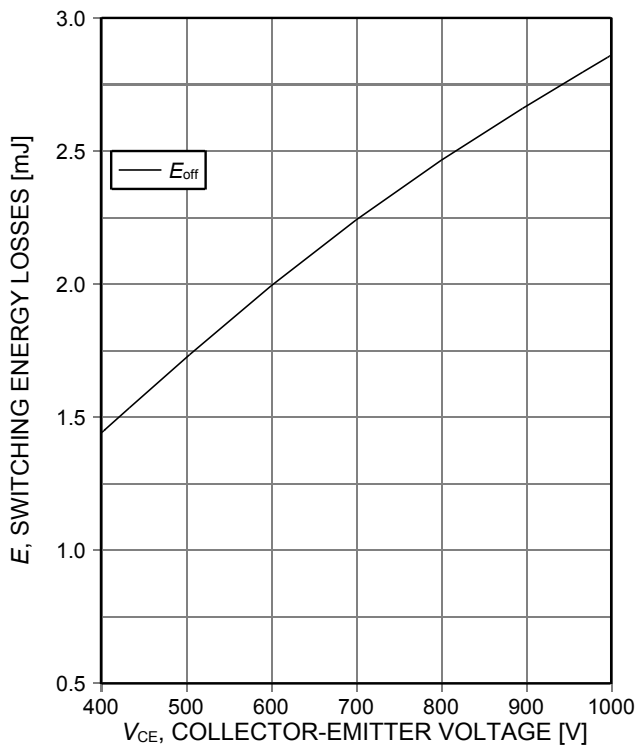


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

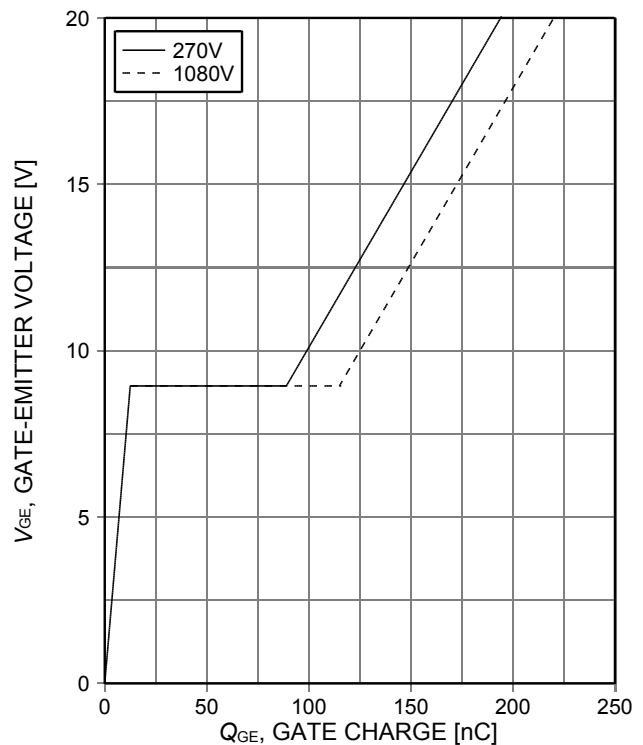


Figure 16. **Typical gate charge**  
( $I_C=20\text{A}$ )

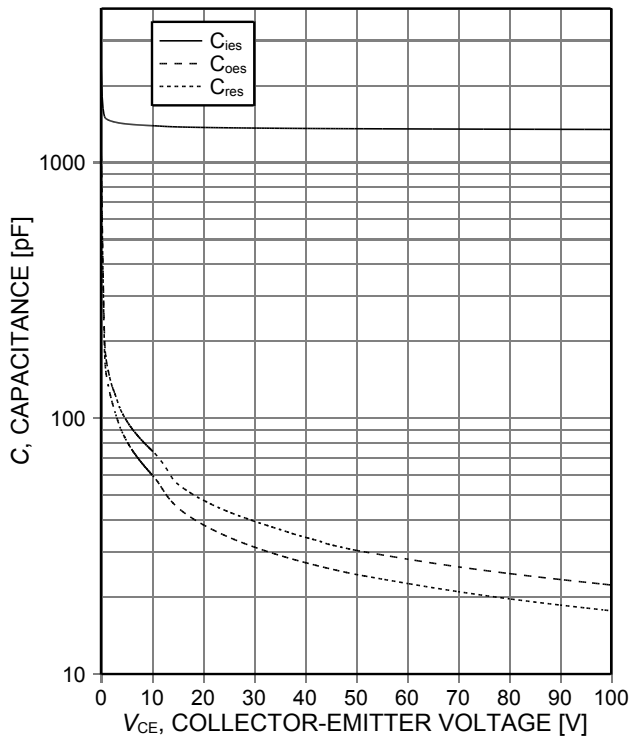


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

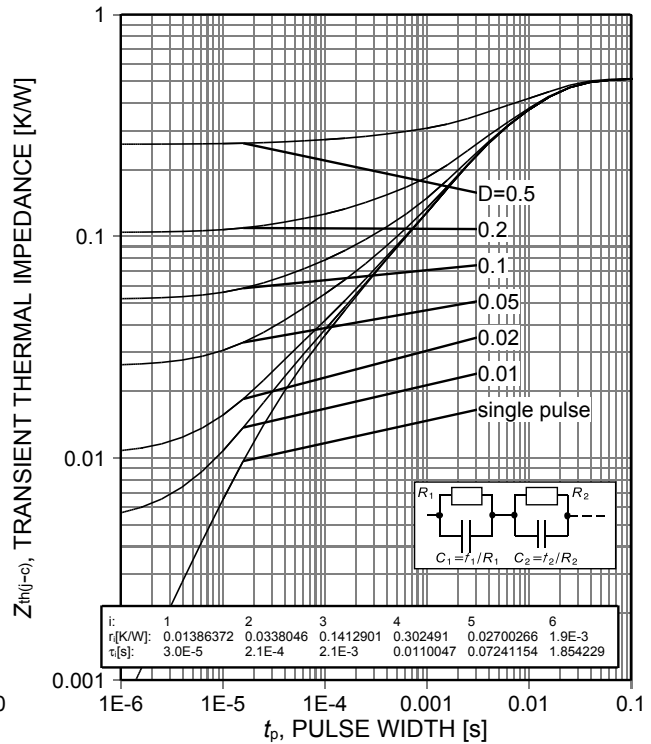


Figure 18. IGBT transient thermal impedance ( $D=t_p/T$ )

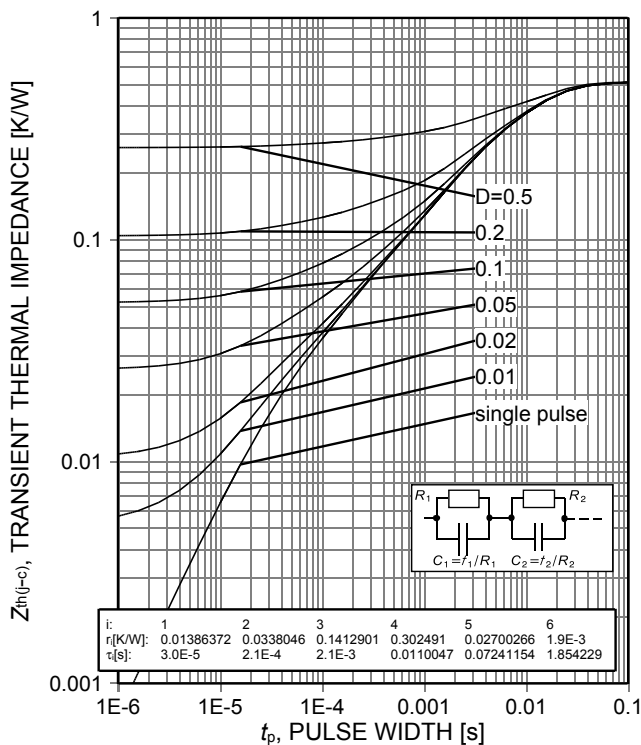


Figure 19. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

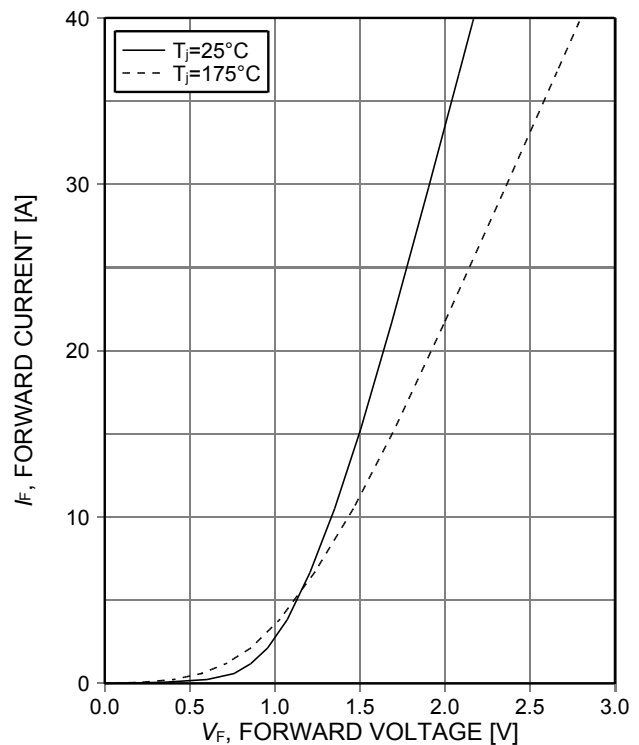


Figure 20. Typical diode forward current as a function of forward voltage

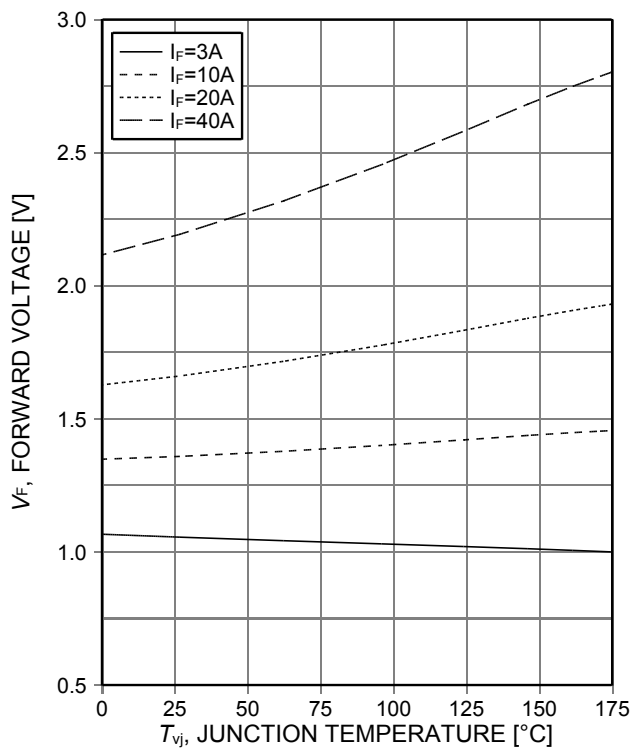
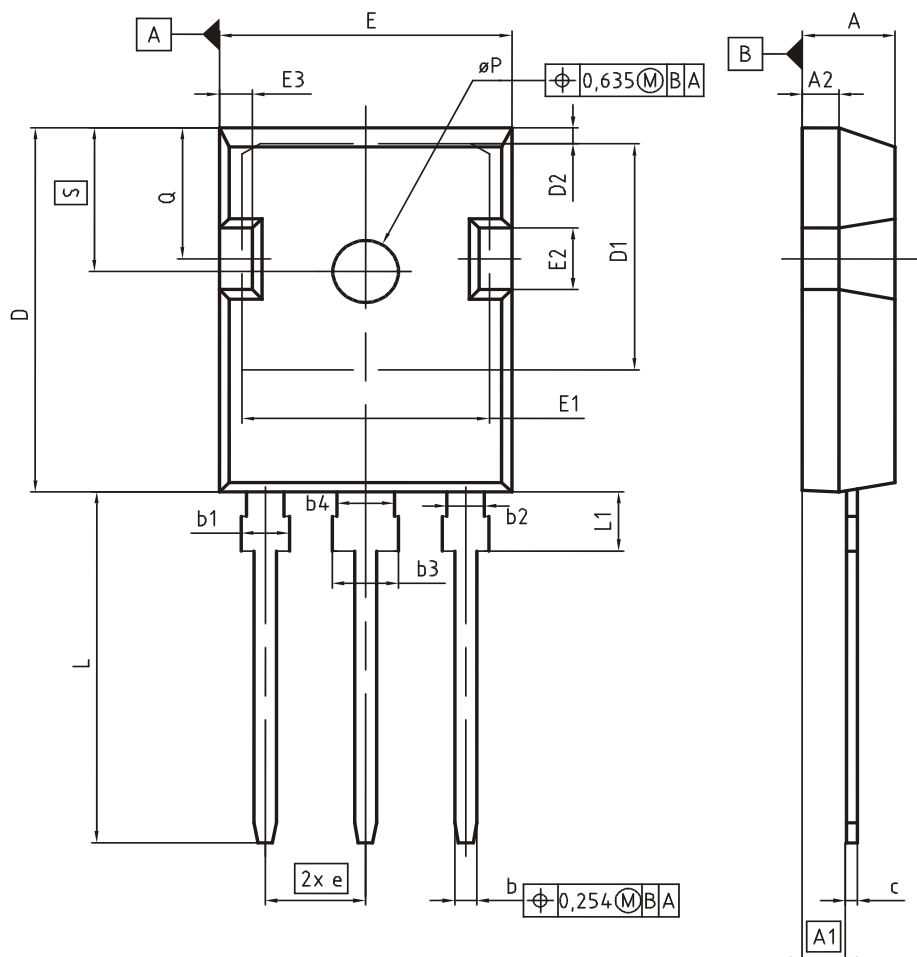
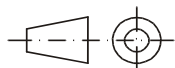


Figure 21. Typical diode forward voltage as a function of junction temperature

## 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>0 5 7.5mm                                                                                           |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>09-07-2010                                                                                     |
| <b>REVISION</b><br>05                                                                                               |

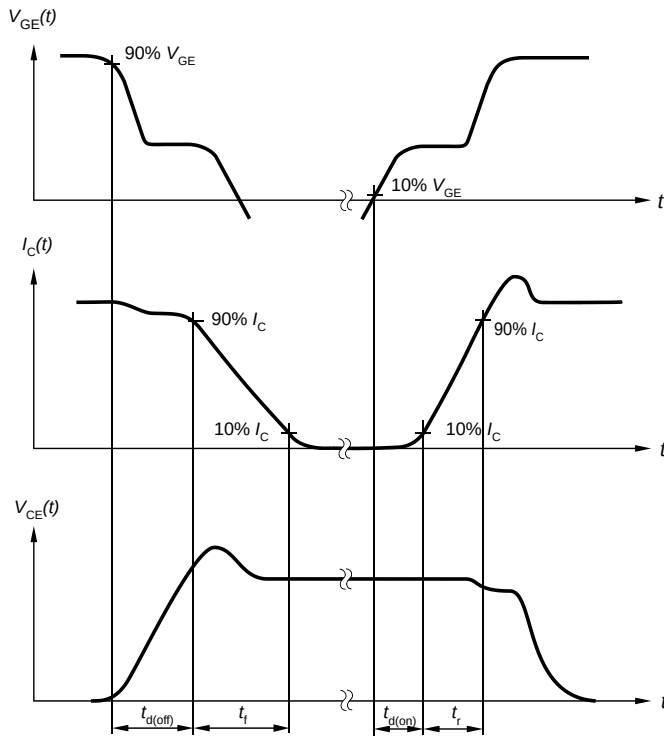


Figure A. Definition of switching times

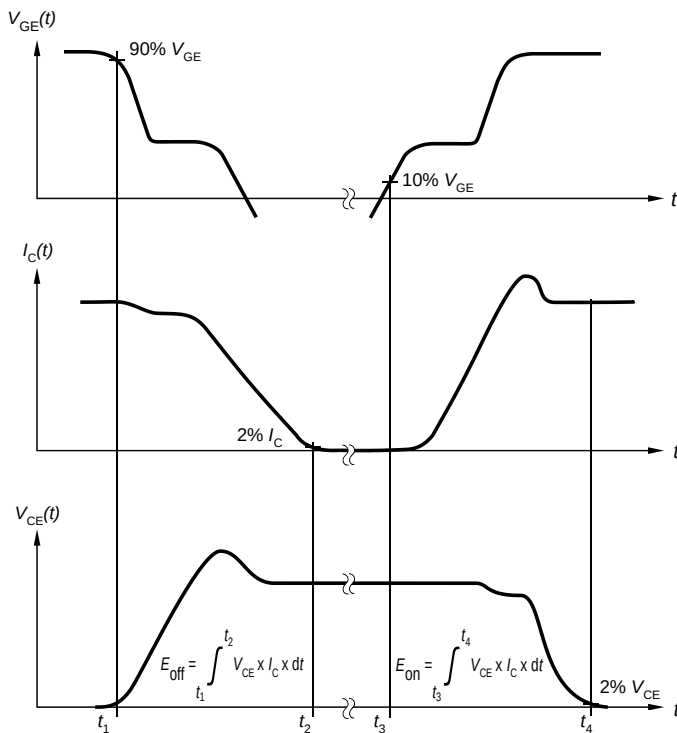


Figure B. Definition of switching losses

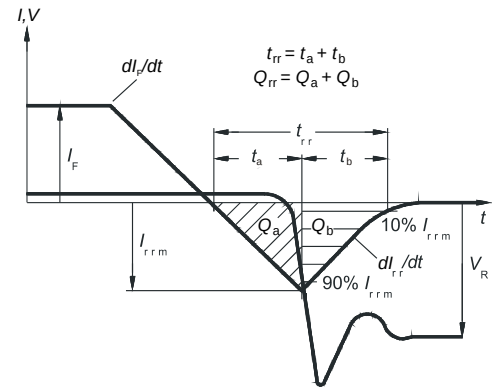


Figure C. Definition of diode switching characteristics

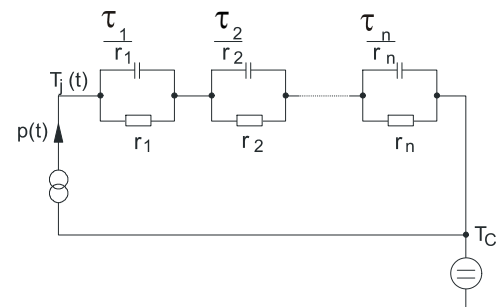
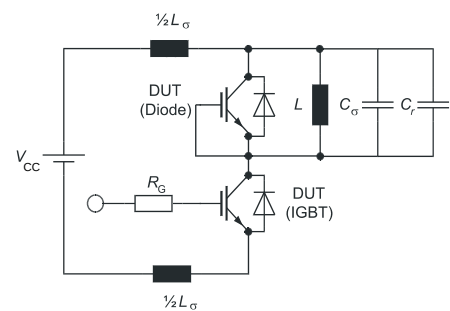


Figure D. Thermal equivalent circuit


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

## Revision History

IHW20N135R5

Revision: 2015-01-26, Rev. 2.1

## Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 1.1      | 2014-01-23 | Preliminary data sheet                       |
| 2.1      | 2015-01-26 | Final data sheet                             |

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## Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

## Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.