

## Resonant Switching Series

Reverse Conducting IGBT with monolithic body diode

IHW20N120R5

Data sheet

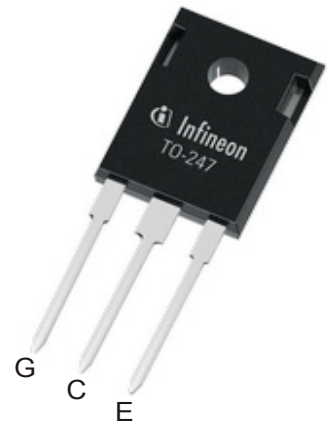
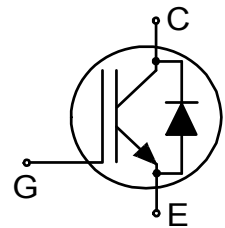
Industrial Power Control

## Resonant Switching Series

## Reverse Conducting IGBT with monolithic body diode

## Features:

- Powerful monolithic body diode with low forward voltage designed for soft commutation
- 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
- 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

## Product Validation:

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

## Package pin definition:

- Pin 1 - gate
- Pin 2 & backside - collector
- Pin 3 - emitter



## Key Performance and Package Parameters

| Type        | $V_{CE}$ | $I_C$ | $V_{CEsat}$ , $T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|-------------|----------|-------|------------------------------------|-------------|---------|------------|
| IHW20N120R5 | 1200V    | 20A   | 1.55V                              | 175°C       | H20MR5  | 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, $T_{vj} \geq 25^{\circ}\text{C}$                                                           | $V_{CE}$    | 1200                 | 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<br>$V_{CE} \leq 1200\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}$ | -           | 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 | Value |      |      | Unit |
|----------------------------------------------|----------------------|------------|-------|------|------|------|
|                                              |                      |            | min.  | typ. | max. |      |
| R <sub>th</sub> Characteristics              |                      |            |       |      |      |      |
| IGBT thermal resistance,<br>junction - case  | R <sub>th(j-c)</sub> |            | -     | -    | 0.52 | K/W  |
| Diode thermal resistance,<br>junction - case | R <sub>th(j-c)</sub> |            | -     | -    | 0.52 | K/W  |
| Thermal resistance<br>junction - ambient     | R <sub>th(j-a)</sub> |            | -     | -    | 40   | K/W  |

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

## Resonant Switching Series

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  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.50mA$                                                                                   | 1200        | -                    | -              | 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>- | 1.55<br>1.75<br>1.80 | 1.75<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>- | 1.60<br>1.75<br>1.85 | 1.85<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>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$                            | -<br>-      | -<br>300             | 100<br>-       | $\mu A$  |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                                                   | -           | -                    | 100            | nA       |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 20.0A$                                                                                   | -           | 15.2                 | -              | 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                  | -     | 1340  | -    | 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   |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from<br>case | L <sub>E</sub>   |                                                                        | -     | 13.0  | -    | nH   |

## Switching Characteristic, Inductive Load

| Parameter           | Symbol       | Conditions                                                                                                                                                                                                                                                                                                                          | Value |      |      | Unit |
|---------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                     |              |                                                                                                                                                                                                                                                                                                                                     | min.  | typ. | max. |      |
| Turn-off delay time | $t_{d(off)}$ | $T_{vj} = 25^{\circ}\text{C},$<br>$V_{CC} = 600\text{V}, I_C = 20.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(on)} = 10.0\Omega, R_{G(off)} = 10.0\Omega,$<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<br>diode reverse recovery. | -     | 260  | -    | ns   |
| Fall time           | $t_f$        |                                                                                                                                                                                                                                                                                                                                     | -     | 50   | -    | ns   |
| Turn-off energy     | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                     | -     | 0.75 | -    | mJ   |

## Resonant Switching Series

## 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<br>diode reverse recovery. | -     | 350  | -    | ns   |
| Fall time                                              | $t_f$               |                                                                                                                                                                                                                                                                                                                                                        | -     | 90   | -    | ns   |
| Turn-off energy                                        | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                                        | -     | 1.55 | -    | mJ   |

## Resonant Switching Series

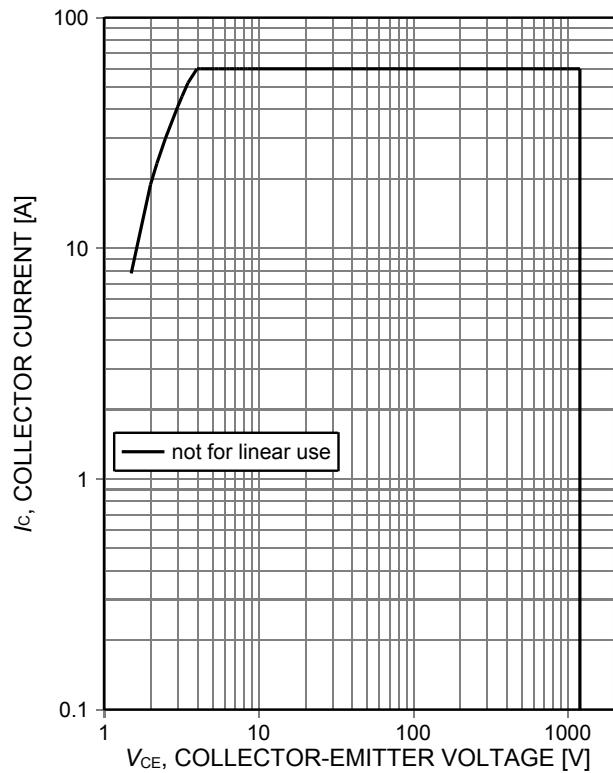


Figure 1. **Forward bias safe operating area**  
( $D=0$ ,  $T_C=25^\circ\text{C}$ ,  $T_{vj}\leq 175^\circ\text{C}$ ;  $V_{GE}=15\text{V}$ ,  $t_p=1\mu\text{s}$ )

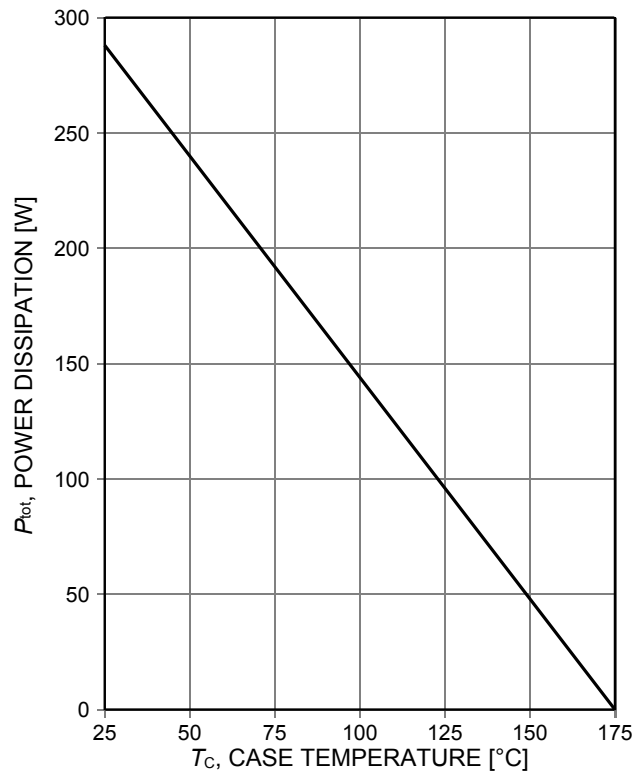


Figure 2. **Power dissipation as a function of case temperature**  
( $T_{vj}\leq 175^\circ\text{C}$ )

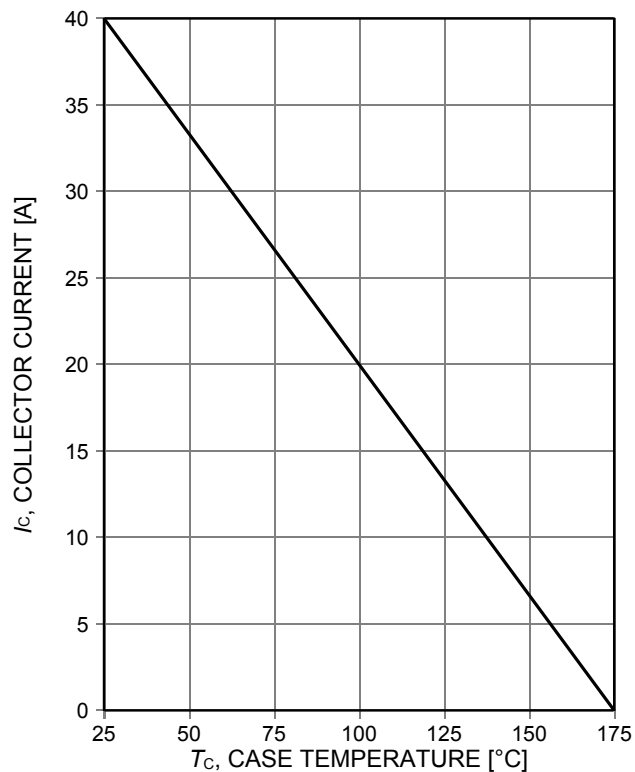


Figure 3. **Collector current as a function of case temperature**  
( $V_{GE}\geq 15\text{V}$ ,  $T_{vj}\leq 175^\circ\text{C}$ )

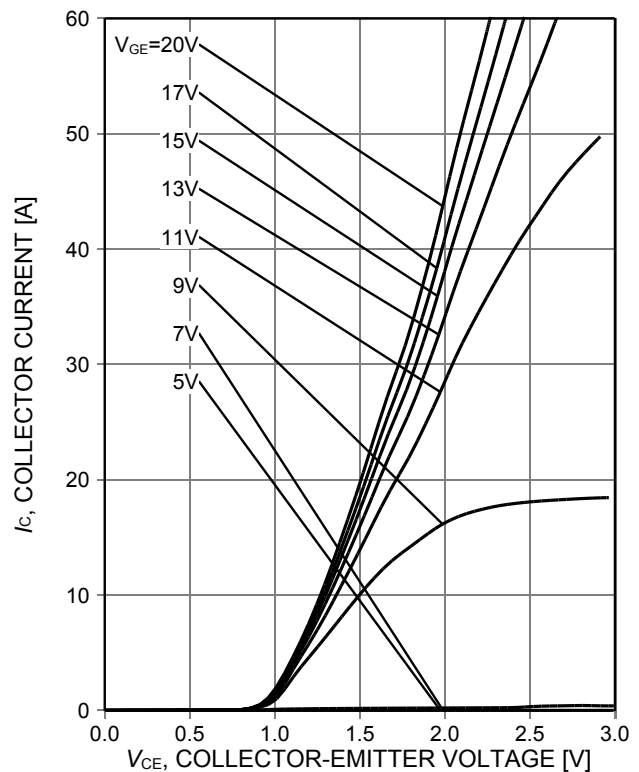


Figure 4. **Typical output characteristic**  
( $T_{vj}=25^\circ\text{C}$ )

## Resonant Switching Series

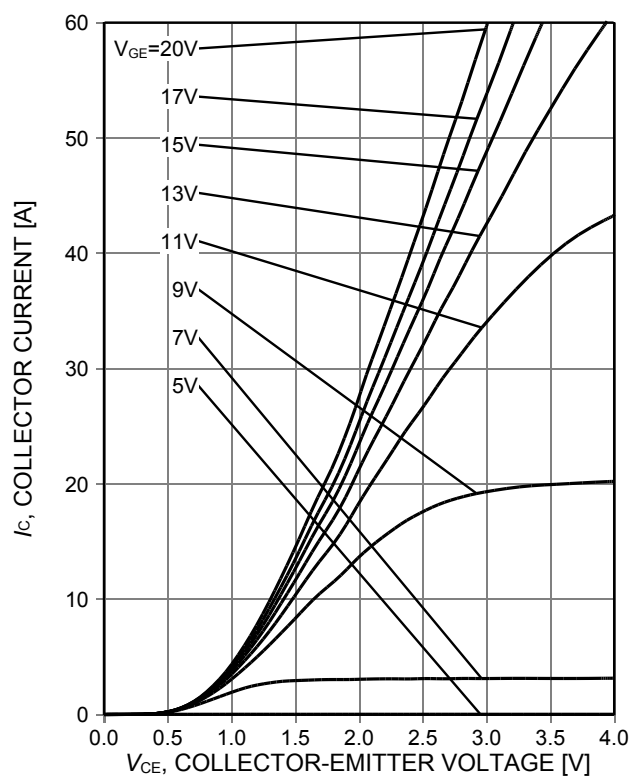


Figure 5. **Typical output characteristic**  
( $T_{vj}=175^{\circ}\text{C}$ )

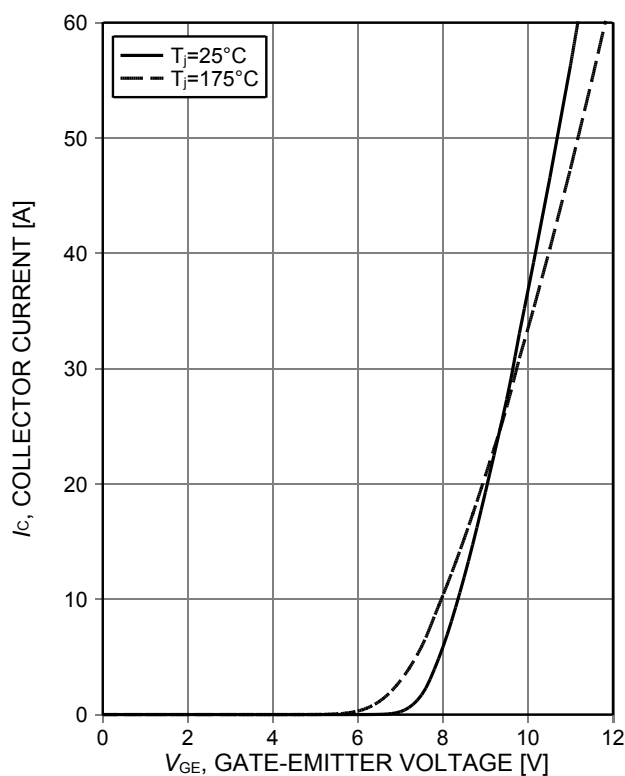


Figure 6. **Typical transfer characteristic**  
( $V_{ce}=20\text{V}$ )

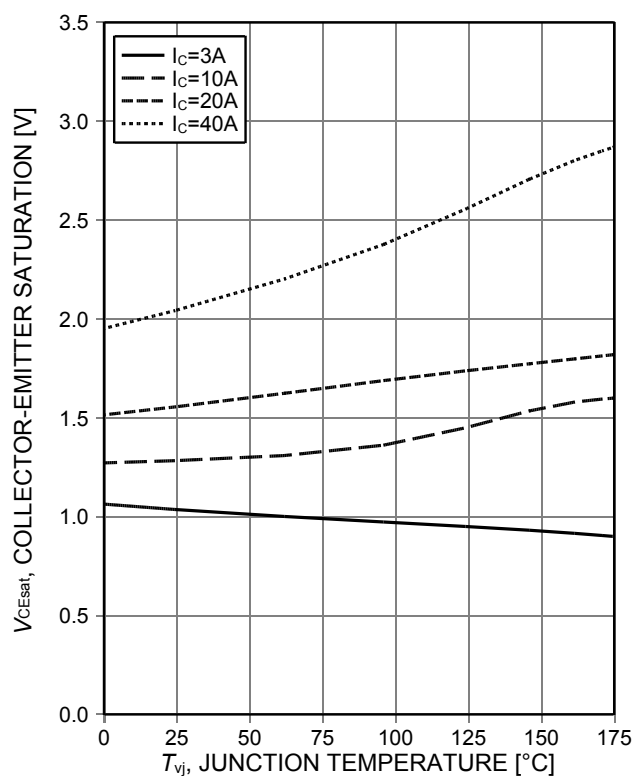


Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{ge}=15\text{V}$ )

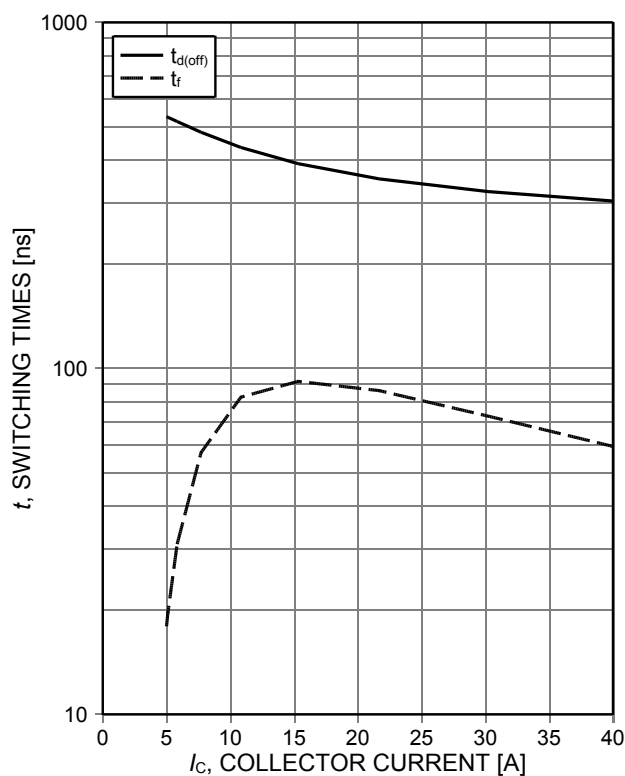


Figure 8. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{ce}=600\text{V}$ ,  $V_{ge}=0/15\text{V}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)



## Resonant Switching Series

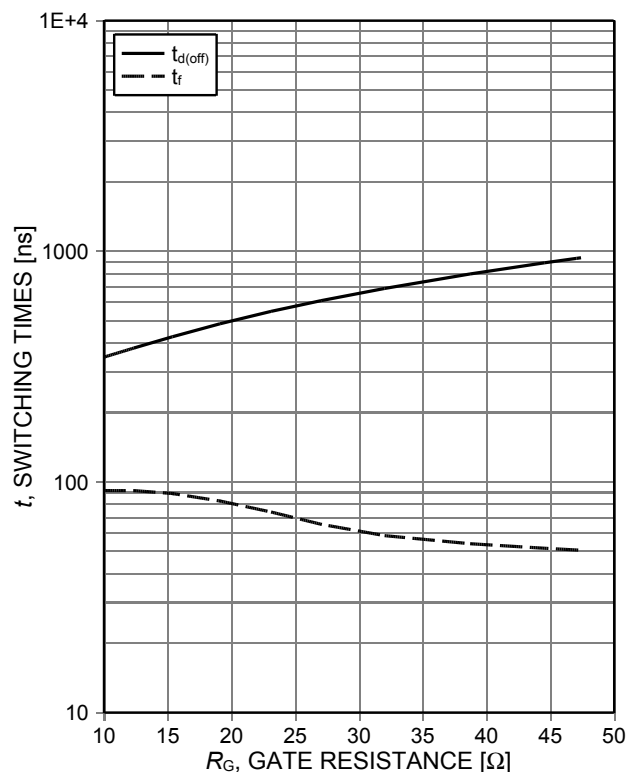


Figure 9. **Typical switching times as a function of gate resistance**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ , dynamic test circuit in Figure E)

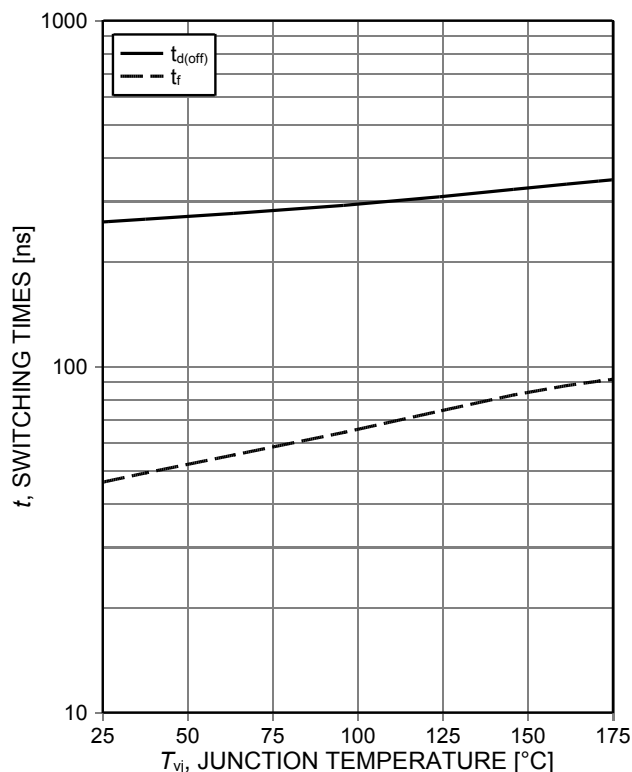


Figure 10. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

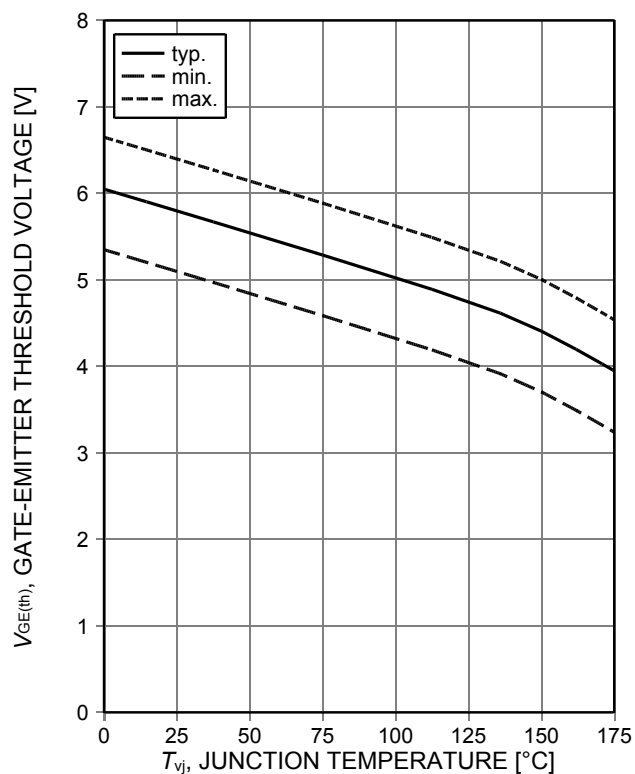


Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.5\text{mA}$ , min / max values verified by chip design)

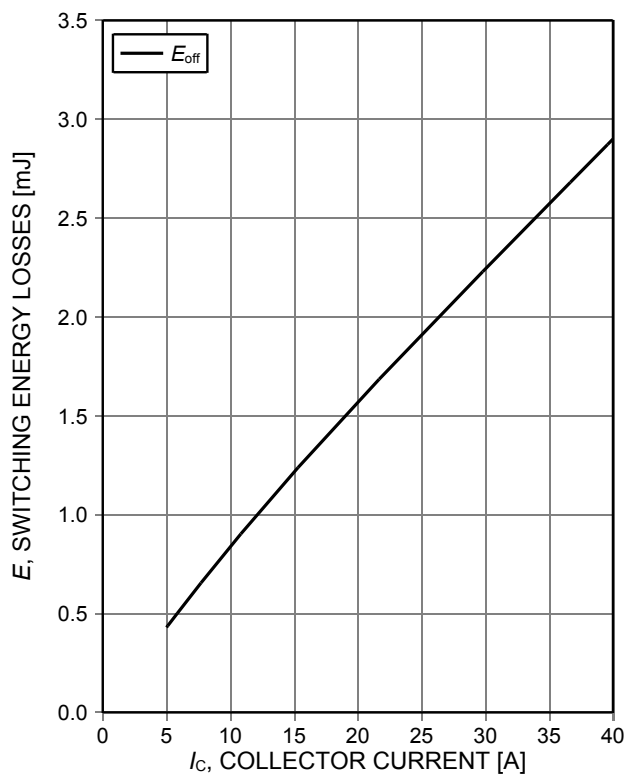


Figure 12. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=175^{\circ}\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

## Resonant Switching Series

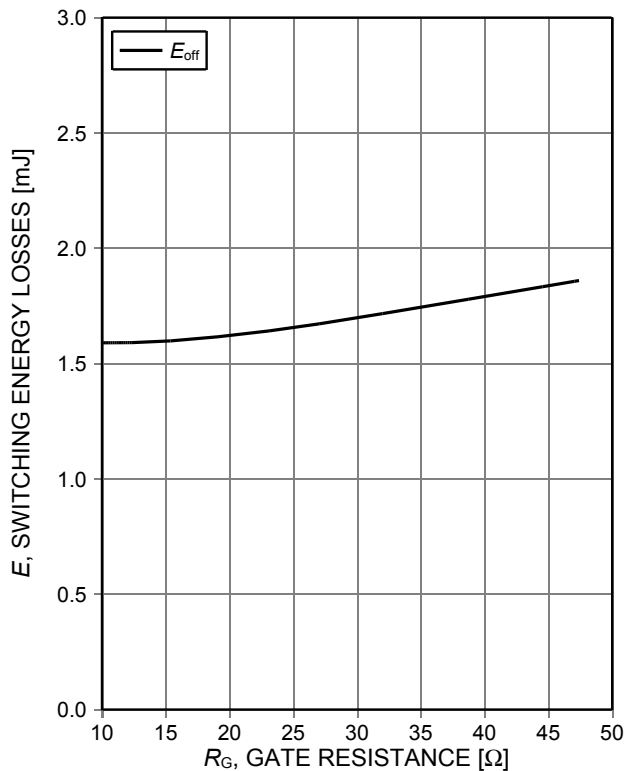


Figure 13. **Typical switching energy losses as a function of gate resistance**  
(inductive load,  $T_{vj}=175^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ , dynamic test circuit in Figure E)

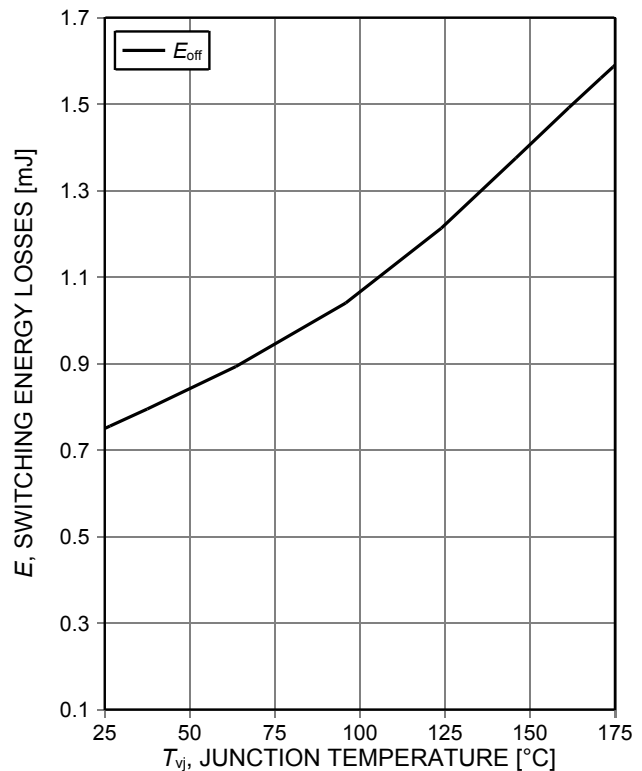


Figure 14. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=600\text{V}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

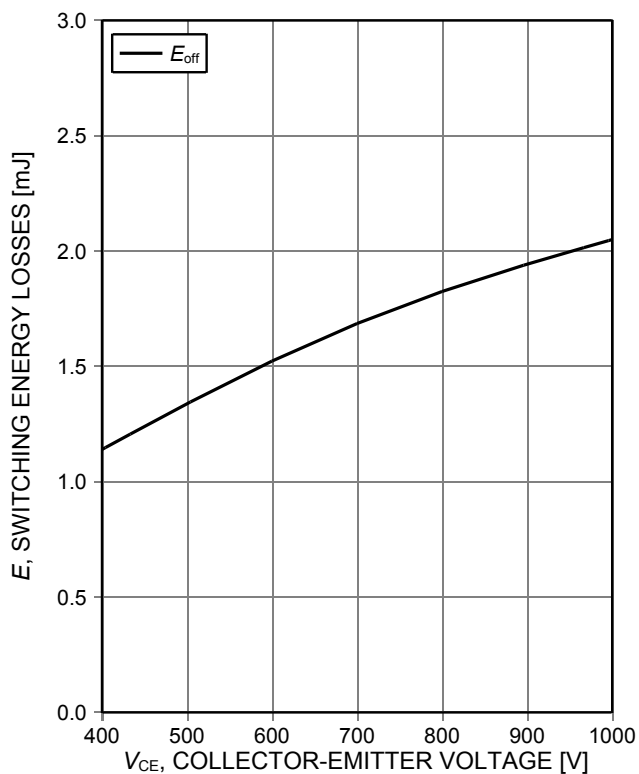


Figure 15. **Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_{vj}=175^\circ\text{C}$ ,  $V_{GE}=0/15\text{V}$ ,  $I_C=20\text{A}$ ,  $R_{G(on)}=10\Omega$ ,  $R_{G(off)}=10\Omega$ , dynamic test circuit in Figure E)

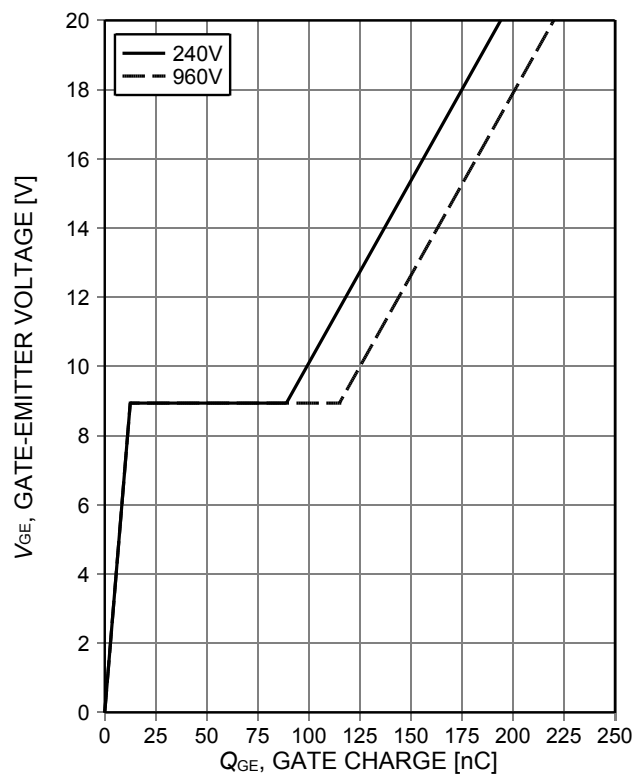


Figure 16. **Typical gate charge**  
( $I_C=20\text{A}$ )

Resonant Switching Series

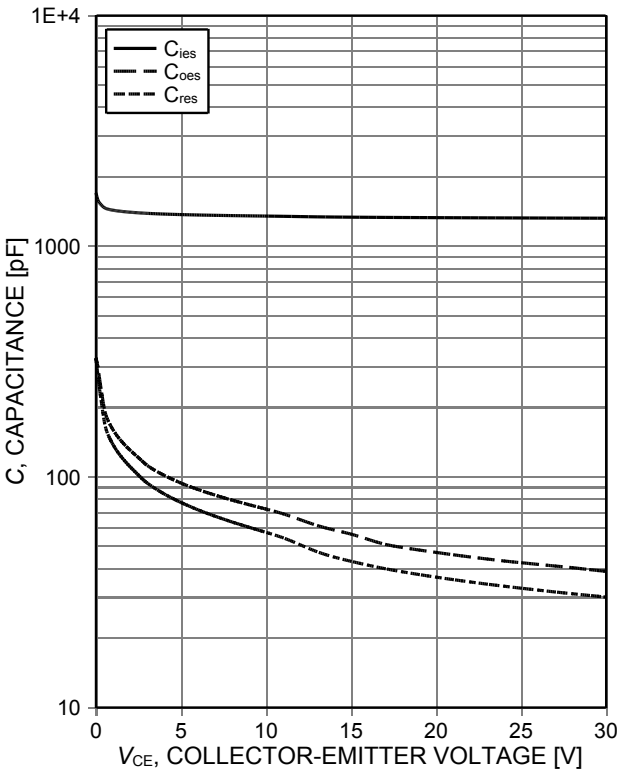


Figure 17. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0V$ ,  $f=1MHz$ )

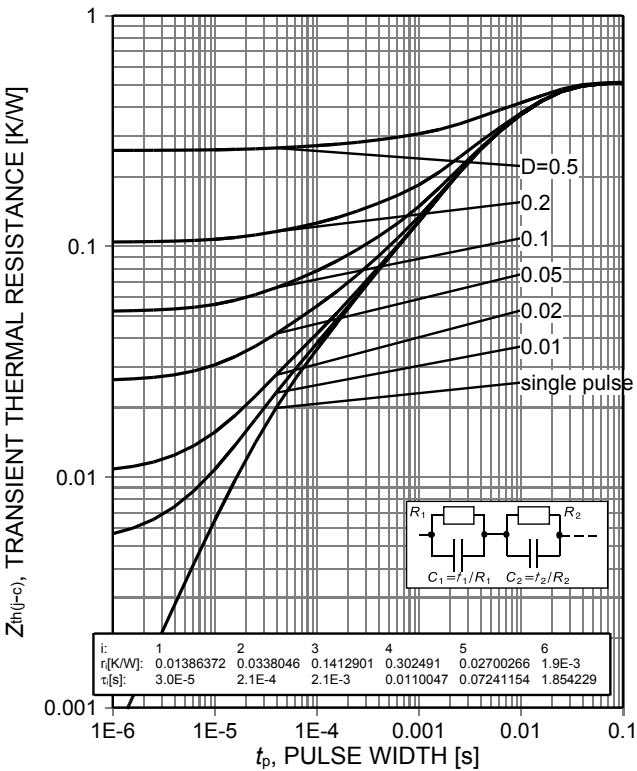


Figure 18. IGBT transient thermal resistance ( $D=t_p/T$ )

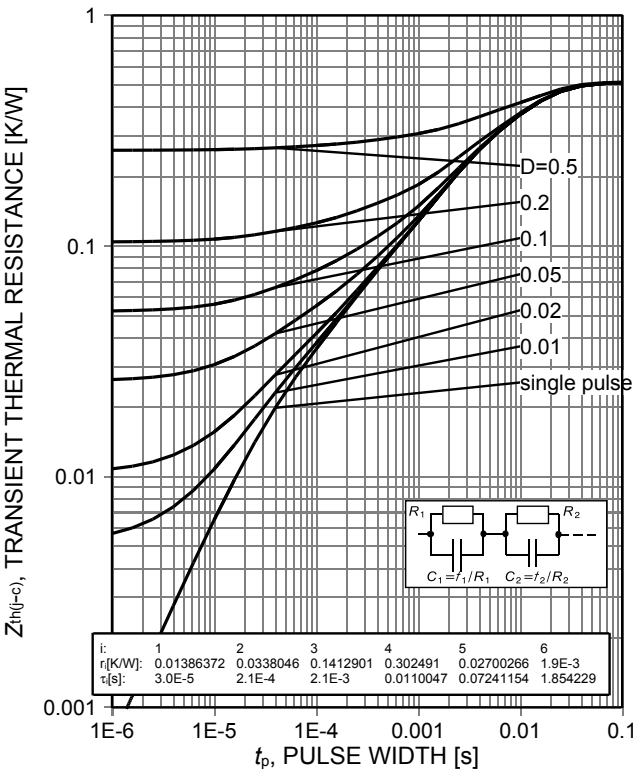


Figure 19. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

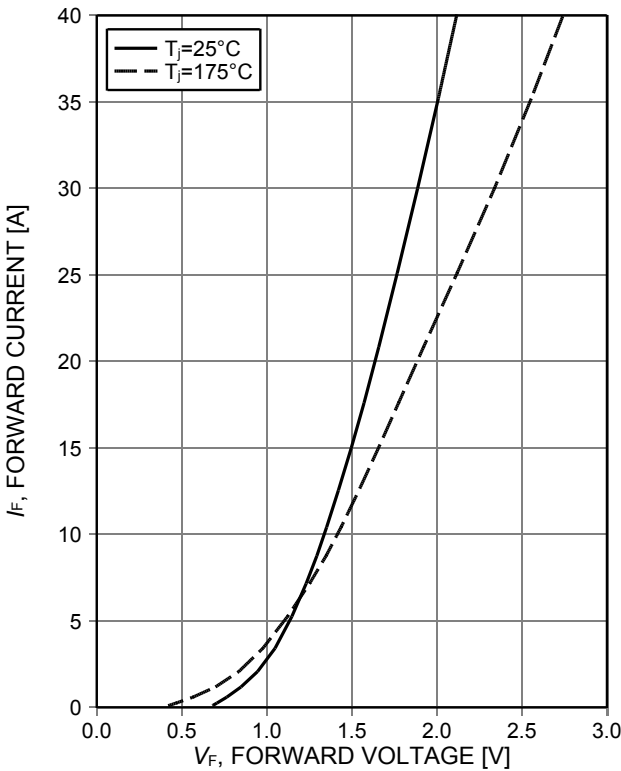


Figure 20. Typical diode forward current as a function of forward voltage

Resonant Switching Series

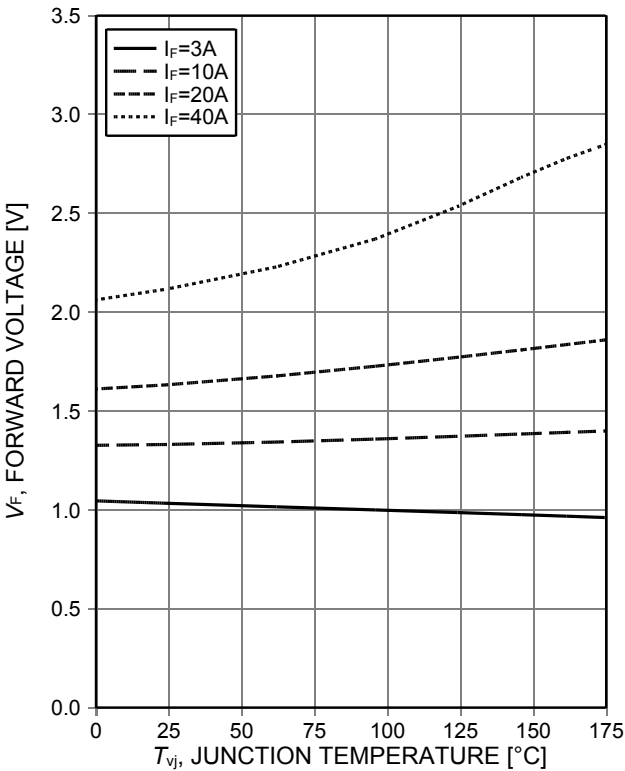
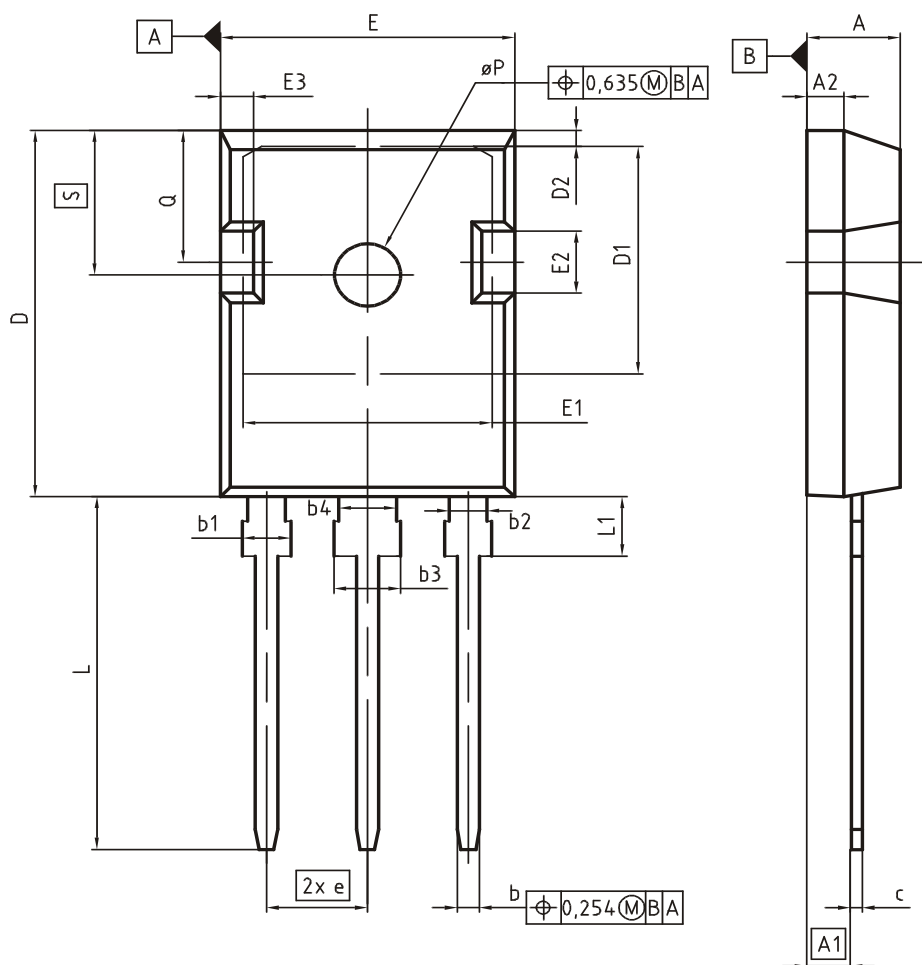


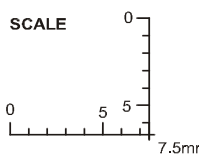
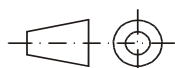
Figure 21. Typical diode forward voltage as a function of junction temperature

## Resonant Switching Series

## 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.<br>Z8B00003327                                                           |                                                                                       |
| SCALE                                                                                 |  |
| EUROPEAN PROJECTION                                                                   |                                                                                       |
|  |                                                                                       |
| ISSUE DATE<br>09-07-2010                                                              |                                                                                       |
| REVISION<br>05                                                                        |                                                                                       |

## Resonant Switching Series

## Testing Conditions

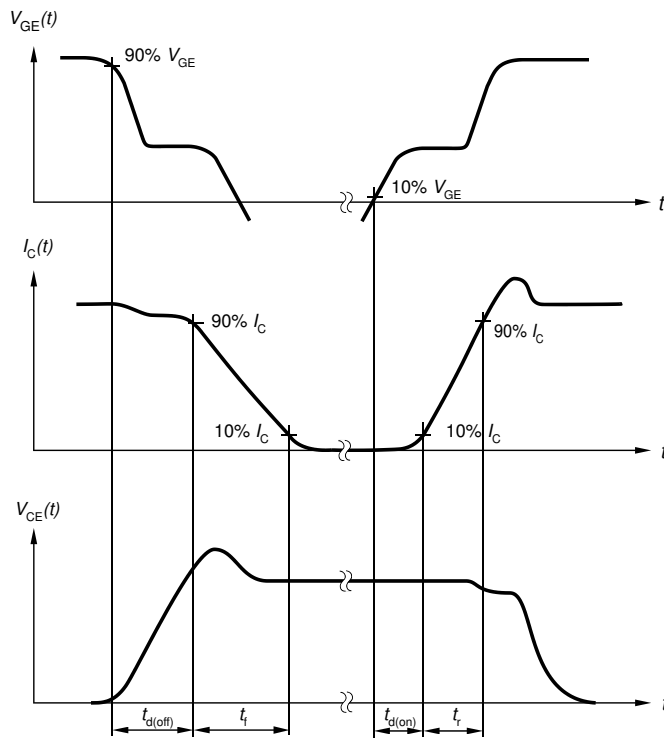


Figure A. Definition of switching times

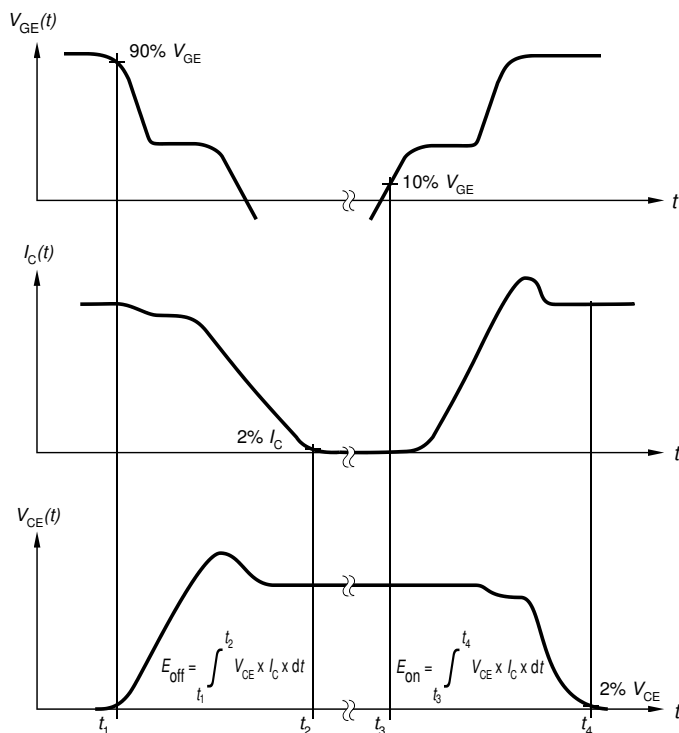


Figure B. Definition of switching losses

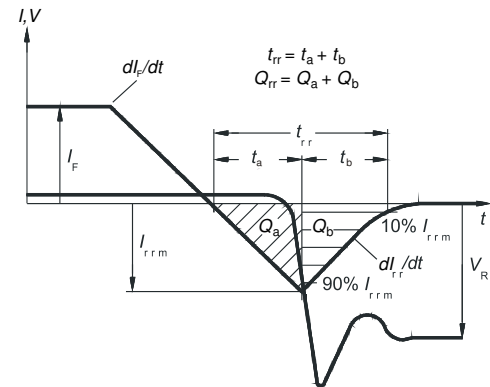


Figure C. Definition of diode switching characteristics

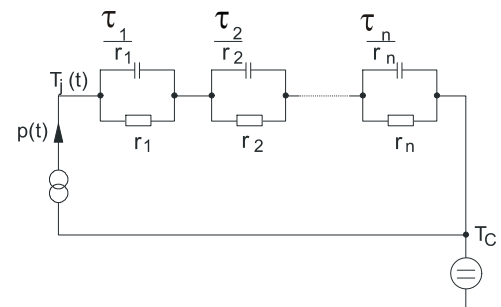


Figure D. Thermal equivalent circuit

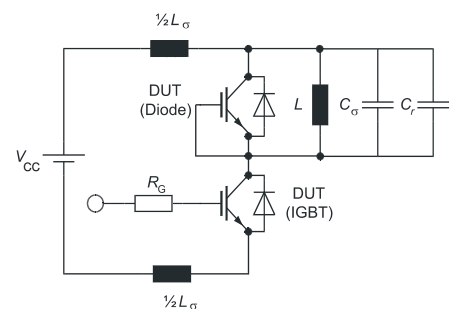


Figure E. **Dynamic test circuit**  
 Parasitic inductance  $L_\sigma$ ,  
 parasitic capacitor  $C_\sigma$ ,  
 relief capacitor  $C_r$ ,  
 (only for ZVT switching)

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Resonant Switching Series**Revision History**

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IHW20N120R5**Revision: 2019-09-19, Rev. 2.2**

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Previous Revision

| Revision | Date       | Subjects (major changes since last revision)                                         |
|----------|------------|--------------------------------------------------------------------------------------|
| 1.1      | 2014-04-17 | Preliminary data sheet                                                               |
| 2.1      | 2015-01-26 | Final data sheet                                                                     |
| 2.2      | 2019-09-19 | additional parameter in maximum ratings table: non repetitive peak collector current |

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