

## Resonant Soft-Switching Series

Reverse conducting IGBT with monolithic body Diode for soft-switching

IHW25N120E1

Data sheet

Industrial Power Control

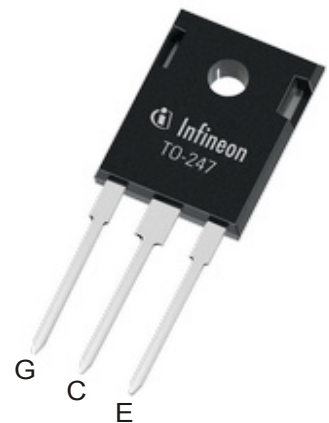
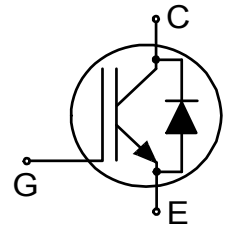
## Reverse conducting IGBT with monolithic body diode

### 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



### Key Performance and Package Parameters

| Type        | $V_{CE}$ | $I_C$ | $V_{CEsat}$ , $T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|-------------|----------|-------|------------------------------------|-------------|---------|------------|
| IHW25N120E1 | 1200V    | 25A   | 1.5V                               | 150°C       | H25ME1  | 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, $T_{vj} \geq 25^{\circ}\text{C}$                                                | $V_{CE}$    | 1200                 | V                  |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25^{\circ}\text{C}$<br>$T_C = 100^{\circ}\text{C}$  | $I_C$       | 50.0<br>25.0         | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$                                                     | $I_{Cpuls}$ | 75.0                 | A                  |
| Turn off safe operating area $V_{CE} \leq 1200\text{V}$ , $T_{vj} \leq 150^{\circ}\text{C}^{1)}$           | -           | 75.0                 | A                  |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C = 25^{\circ}\text{C}$<br>$T_C = 100^{\circ}\text{C}$ | $I_F$       | 50.0<br>25.0         | A                  |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$                                                         | $I_{Fpuls}$ | 75.0                 | 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 $T_C = 100^{\circ}\text{C}$              | $P_{tot}$   | 231.0<br>92.4        | W                  |
| Operating junction temperature                                                                             | $T_{vj}$    | $-40 \dots +150$     | $^{\circ}\text{C}$ |
| Storage temperature                                                                                        | $T_{stg}$   | $-55 \dots +150$     | $^{\circ}\text{C}$ |
| 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> |            | -     | -    | 0.54 | K/W  |
| Diode thermal resistance,<br>junction - case | R <sub>th(j-c)</sub> |            | -     | -    | 0.54 | K/W  |
| Thermal resistance<br>junction - ambient     | R <sub>th(j-a)</sub> |            | -     | -    | 40   | K/W  |

<sup>1)</sup>  $dV/dt < 1\text{KV}/\mu\text{s}$

**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  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.50mA$                                                                                   | 1200        | -                    | -              | V        |
| Collector-emitter saturation voltage | $V_{CESat}$   | $V_{GE} = 15.0V, I_C = 25.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 100^{\circ}C$<br>$T_{vj} = 150^{\circ}C$ | -<br>-<br>- | 1.50<br>1.65<br>1.75 | 2.00<br>-<br>- | V        |
| Diode forward voltage                | $V_F$         | $V_{GE} = 0V, I_F = 25.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 100^{\circ}C$<br>$T_{vj} = 150^{\circ}C$    | -<br>-<br>- | 1.90<br>2.15<br>2.35 | 2.50<br>-<br>- | V        |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C = 0.80mA, V_{CE} = V_{GE}$                                                                               | 4.0         | 5.8                  | 8.0            | V        |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE} = 1200V, V_{GE} = 0V$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 150^{\circ}C$                            | -<br>-      | -<br>500             | 100<br>-       | $\mu A$  |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                                                   | -           | -                    | 100            | nA       |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 25.0A$                                                                                   | -           | 23.0                 | -              | S        |
| Integrated gate resistor             | $r_G$         |                                                                                                               |             | 8.5                  |                | $\Omega$ |

**Electrical Characteristic, at  $T_{vj} = 25^{\circ}\text{C}$ , unless otherwise specified**

| Parameter                                                            | Symbol    | Conditions                                      | Value |       |      | Unit |
|----------------------------------------------------------------------|-----------|-------------------------------------------------|-------|-------|------|------|
|                                                                      |           |                                                 | min.  | typ.  | max. |      |
| Dynamic Characteristic                                               |           |                                                 |       |       |      |      |
| Input capacitance                                                    | $C_{ies}$ | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$           | -     | 1300  | -    | pF   |
| Output capacitance                                                   | $C_{oes}$ |                                                 | -     | 37    | -    |      |
| Reverse transfer capacitance                                         | $C_{res}$ |                                                 | -     | 31    | -    |      |
| Gate charge                                                          | $Q_G$     | $V_{CC} = 960V, I_C = 25.0A,$<br>$V_{GE} = 15V$ | -     | 147.0 | -    | nC   |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from<br>case | $L_E$     |                                                 | -     | 13.0  | -    | nH   |

**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             | $t_{d(off)}$ | $T_{vj} = 25^{\circ}\text{C}, V_{CC} = 105\text{V}, I_C = 25.0\text{A}, V_{GE} = 0.0/18.0\text{V}, R_{G(off)} = 10.2\Omega$ | - | 229  | - | ns |
| Fall time                       | $t_f$        | Energy losses include "tail" according Figure B. (Test circuit Figure E, $C_r = 300\text{nF}$ ).                            | - | 1020 | - | ns |
| Turn-off energy, soft switching | $E_{off}$    | $dv/dt = 83.0\text{V}/\mu\text{s}$                                                                                          | - | 0.08 | - | mJ |

## Resonant Soft-Switching Series

|                                 |              |                                                                                                                                                                                                                       |   |      |   |    |
|---------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-off delay time             | $t_{d(off)}$ | $T_{vj} = 25^{\circ}\text{C}$ ,                                                                                                                                                                                       | - | 249  | - | ns |
| Fall time                       | $t_f$        | $V_{CC} = 210\text{V}$ , $I_C = 50.0\text{A}$ ,<br>$V_{GE} = 0.0/18.0\text{V}$ ,<br>$R_{G(off)} = 10.2\Omega$<br><br>Energy losses include "tail" according Figure B. (Test circuit Figure E, $C_r = 300\text{nF}$ ). | - | 850  | - | ns |
| Turn-off energy, soft switching | $E_{off}$    | $dv/dt = 166.0\text{V}/\mu\text{s}$                                                                                                                                                                                   | - | 0.24 | - | mJ |

## Switching Characteristic, Inductive Load

| Parameter                                              | Symbol              | Conditions                                                                                                                                                                                                                   | Value |      |      | Unit |
|--------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|------|------|
|                                                        |                     |                                                                                                                                                                                                                              | min.  | typ. | max. |      |
| IGBT Characteristic, at $T_{vj} = 150^{\circ}\text{C}$ |                     |                                                                                                                                                                                                                              |       |      |      |      |
| Turn-off delay time                                    | $t_{d(\text{off})}$ | $T_{vj} = 150^{\circ}\text{C}$ ,                                                                                                                                                                                             | -     | 240  | -    | ns   |
| Fall time                                              | $t_f$               | $V_{CC} = 105\text{V}$ , $I_C = 25.0\text{A}$ ,<br>$V_{GE} = 0.0/18.0\text{V}$ ,<br>$R_{G(\text{off})} = 10.2\Omega$<br><br>Energy losses include “tail” according Figure B. (Test circuit Figure E, $C_r = 300\text{nF}$ ). | -     | 1764 | -    | ns   |
| Turn-off energy, soft switching                        | $E_{\text{off}}$    | $dv/dt = 83.0\text{V}/\mu\text{s}$                                                                                                                                                                                           | -     | 0.19 | -    | mJ   |
|                                                        |                     |                                                                                                                                                                                                                              |       |      |      |      |
| Turn-off delay time                                    | $t_{d(\text{off})}$ | $T_{vj} = 150^{\circ}\text{C}$ ,                                                                                                                                                                                             | -     | 253  | -    | ns   |
| Fall time                                              | $t_f$               | $V_{CC} = 210\text{V}$ , $I_C = 50.0\text{A}$ ,<br>$V_{GE} = 0.0/18.0\text{V}$ ,<br>$R_{G(\text{off})} = 10.2\Omega$<br><br>Energy losses include “tail” according Figure B. (Test circuit Figure E, $C_r = 300\text{nF}$ ). | -     | 1424 | -    | ns   |
| Turn-off energy, soft switching                        | $E_{\text{off}}$    | $dv/dt = 166.0\text{V}/\mu\text{s}$                                                                                                                                                                                          | -     | 0.52 | -    | mJ   |

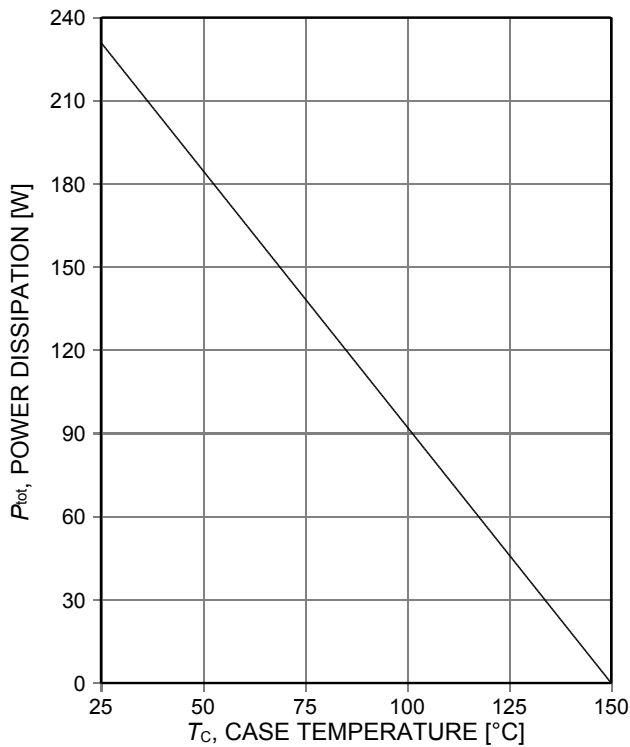


Figure 1. **Power dissipation as a function of case temperature**  
( $T_{vj} \leq 150^\circ\text{C}$ )

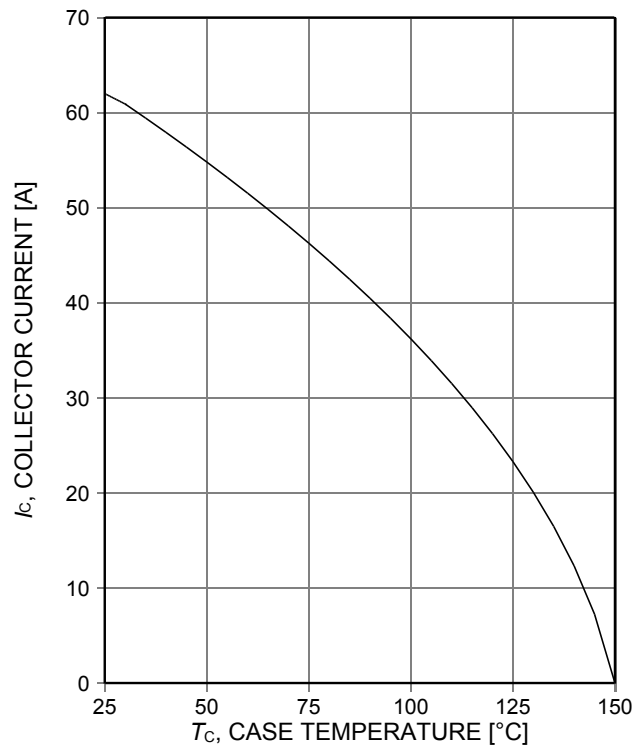


Figure 2. **Collector current as a function of case temperature**  
( $V_{GE} \geq 15\text{V}$ ,  $T_{vj} \leq 150^\circ\text{C}$ )

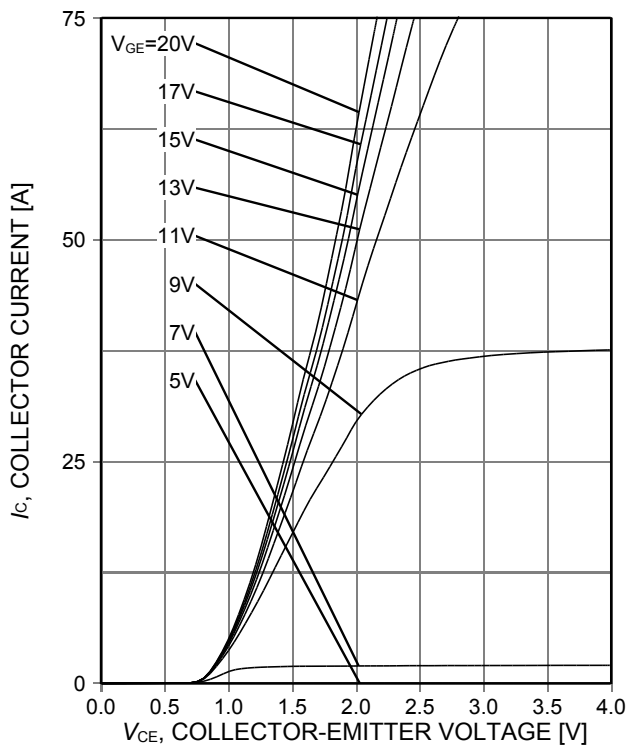


Figure 3. **Typical output characteristic**  
( $T_{vj} = 25^\circ\text{C}$ )

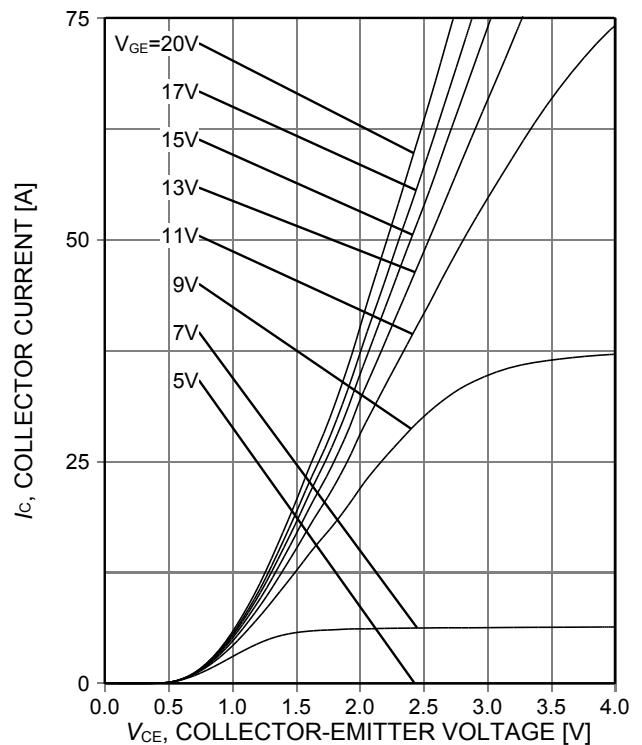


Figure 4. **Typical output characteristic**  
( $T_{vj} = 150^\circ\text{C}$ )

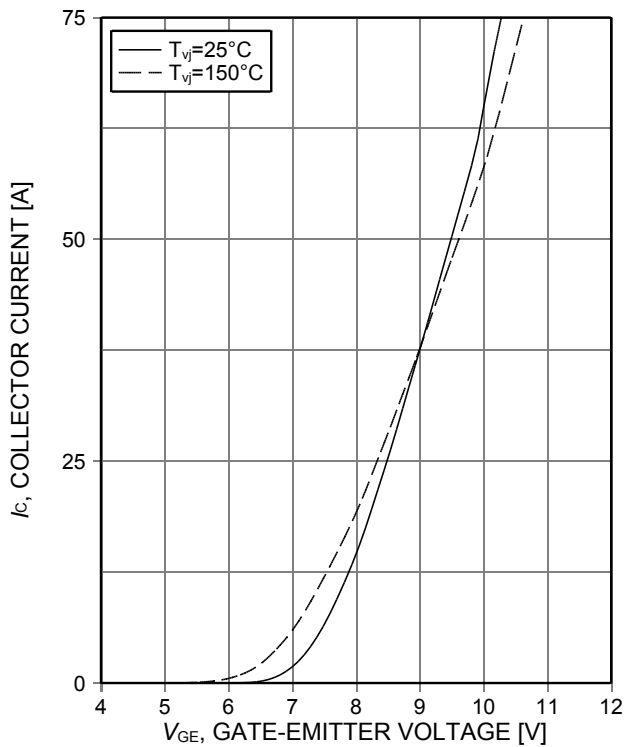


Figure 5. **Typical transfer characteristic**  
( $V_{CE}=20V$ )

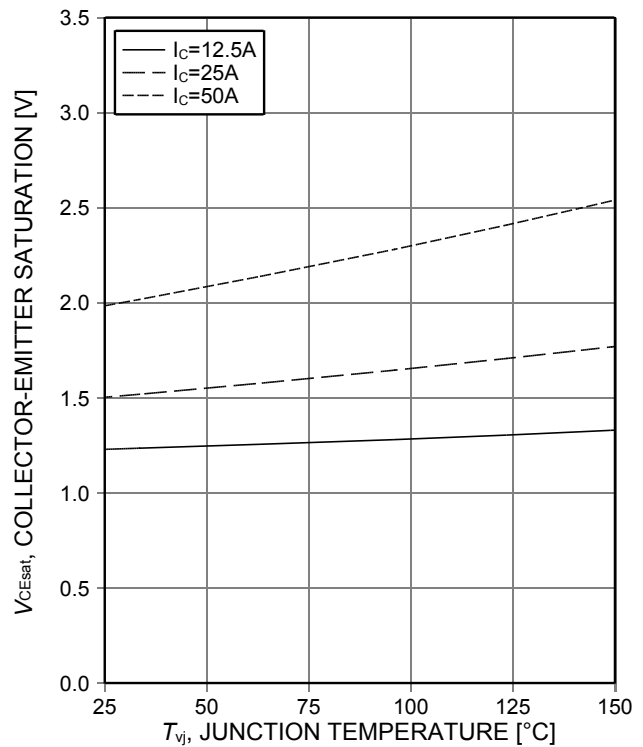


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE}=15V$ )

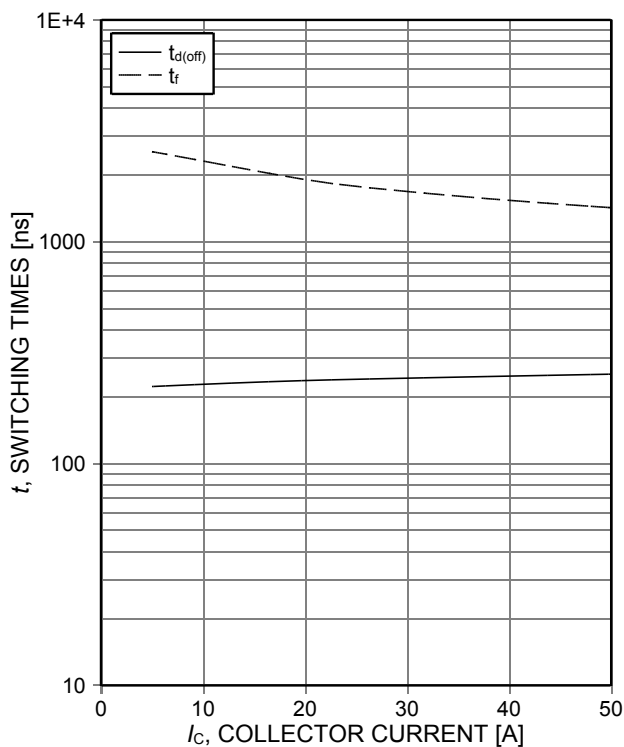


Figure 7. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{GE}=0/18V$ ,  $R_G=10.2\Omega$ , Dynamic test circuit in Figure E)

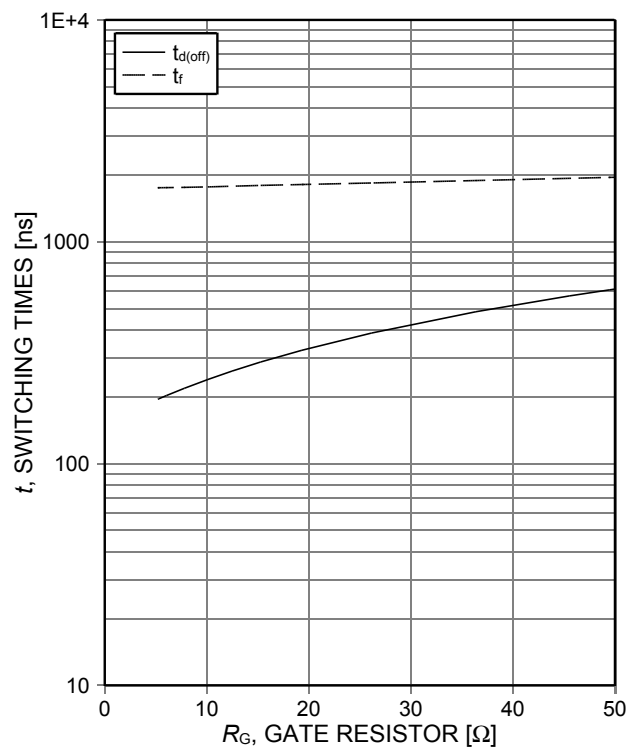


Figure 8. **Typical switching times as a function of gate resistance**  
(inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{GE}=0/18V$ ,  $I_C=25A$ , Dynamic test circuit in Figure E)

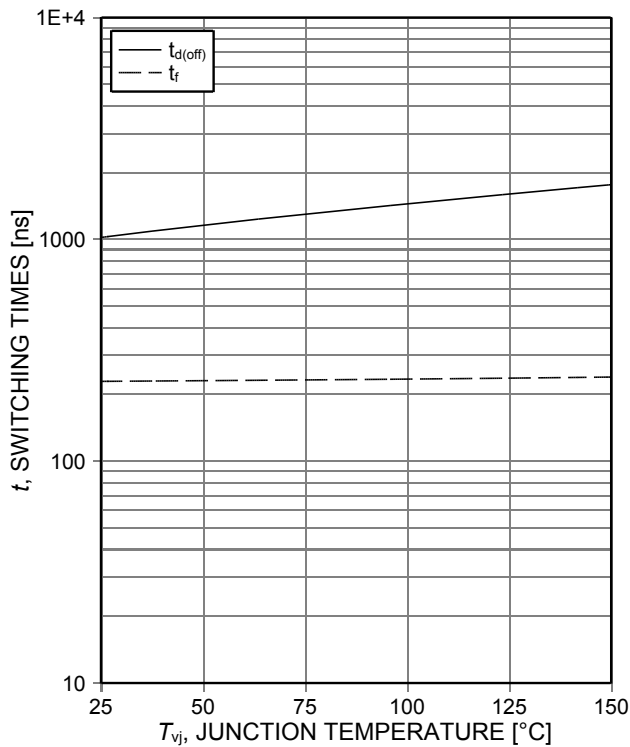


Figure 9. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{GE}=0/18V$ ,  $I_C=25A$ ,  $R_G=10.2\Omega$ , Dynamic test circuit in Figure E)

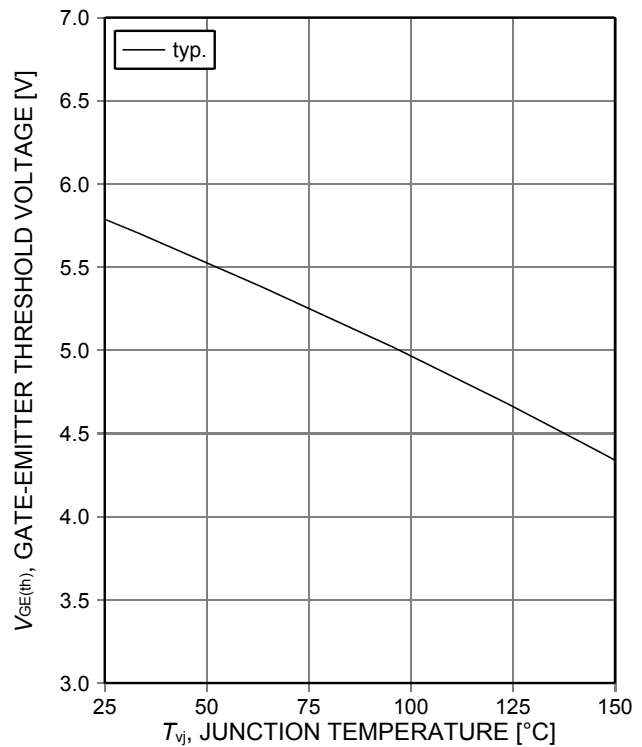


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.8mA$ )

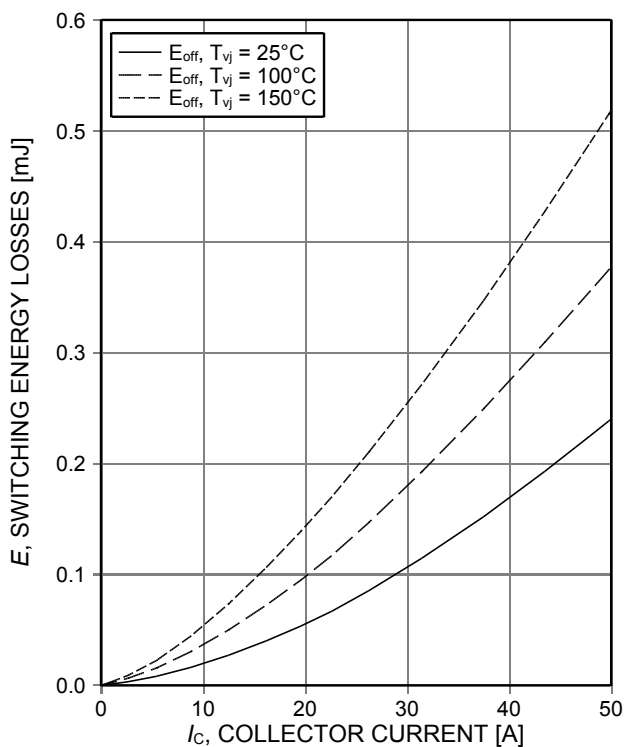


Figure 11. **Typical switching energy losses as a function of collector current**  
(inductive load,  $V_{GE}=0/18V$ ,  $R_G=10.2\Omega$ , Dynamic test circuit in Figure E)

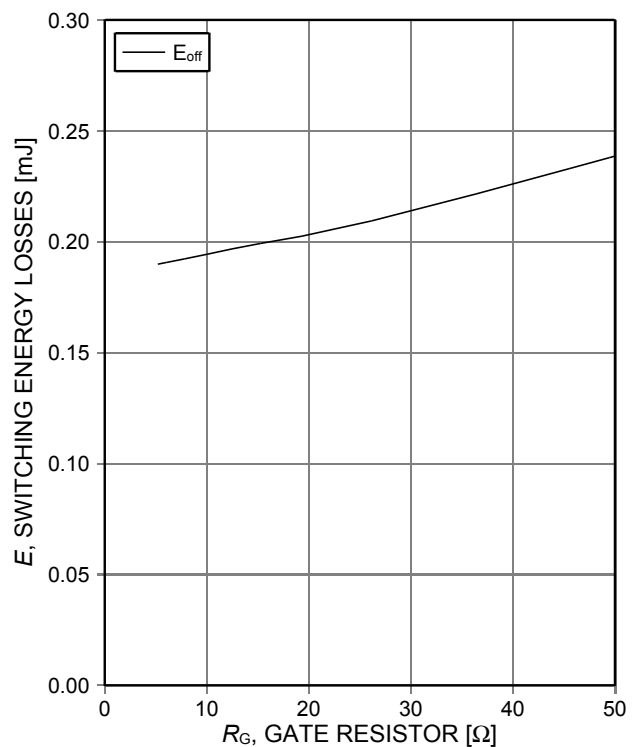


Figure 12. **Typical switching energy losses as a function of gate resistance**  
(inductive load,  $T_{vj}=150^\circ C$ ,  $V_{GE}=0/18V$ ,  $I_C=25A$ , Dynamic test circuit in Figure E)

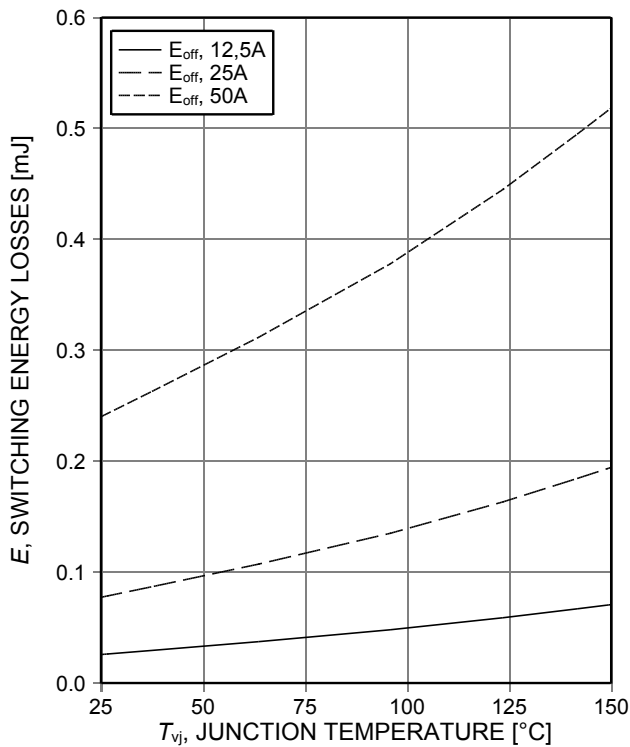


Figure 13. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{GE}=0/18V$ ,  $I_C=25A$ ,  $R_G=10.2\Omega$ , Dynamic test circuit in Figure E)

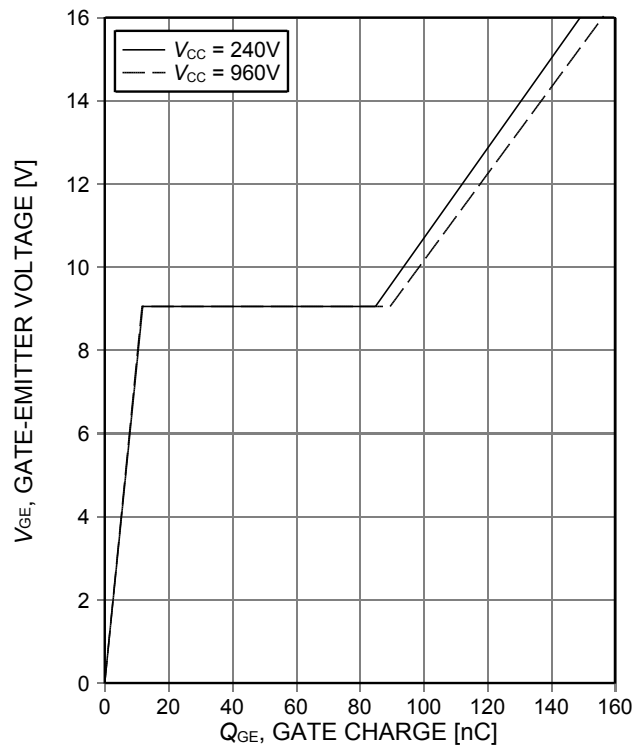


Figure 14. **Typical gate charge**  
( $I_C=25A$ )

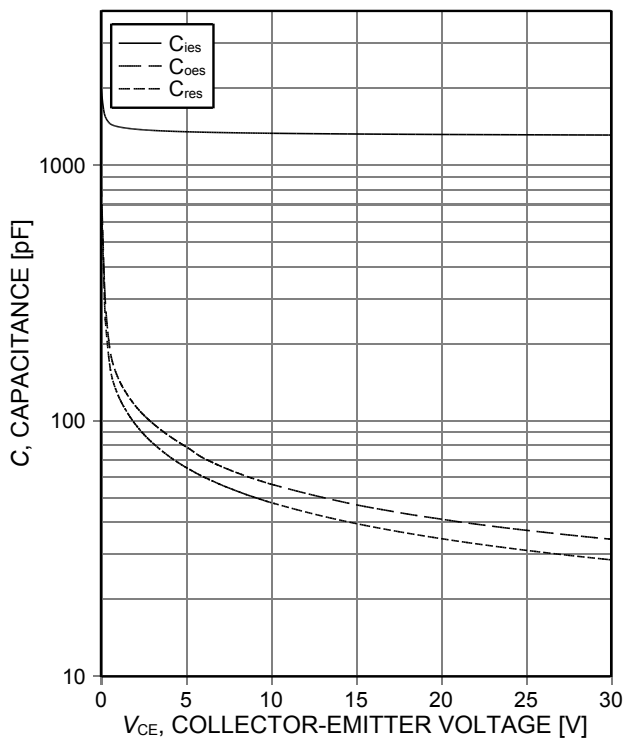


Figure 15. **Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0V$ ,  $f=1MHz$ )

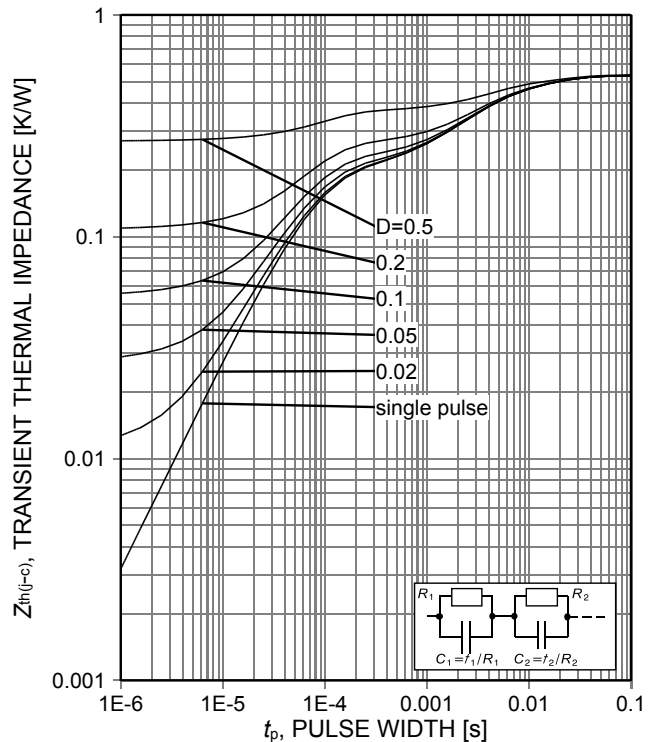


Figure 16. **IGBT / Diode transient thermal impedance**  
( $D=t_p/T$ )

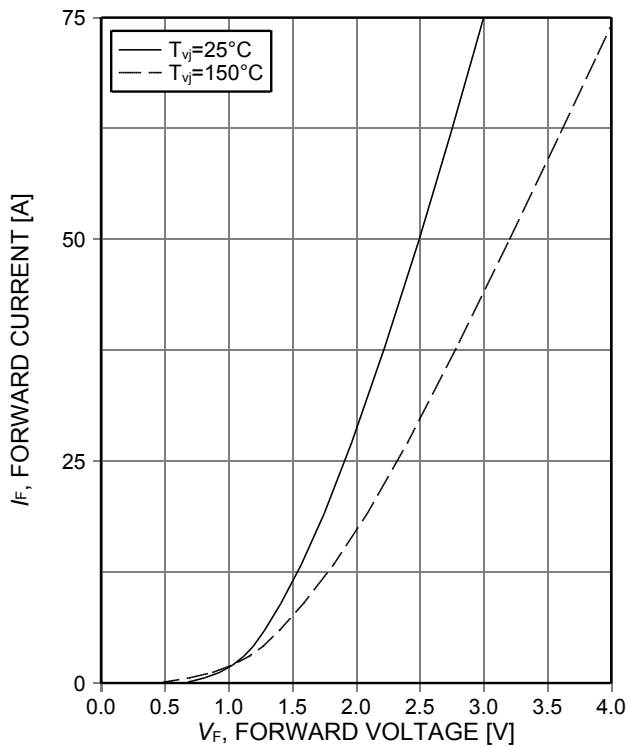


Figure 17. Typical diode forward current as a function of forward voltage

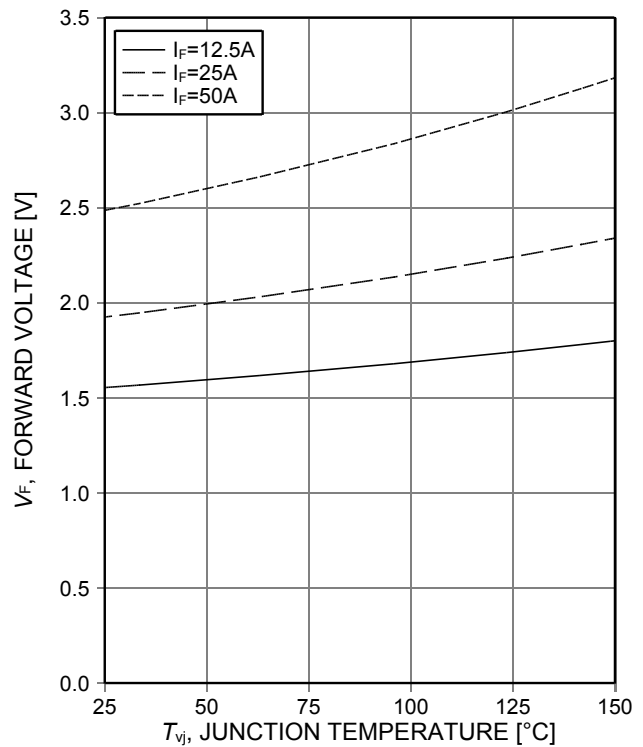
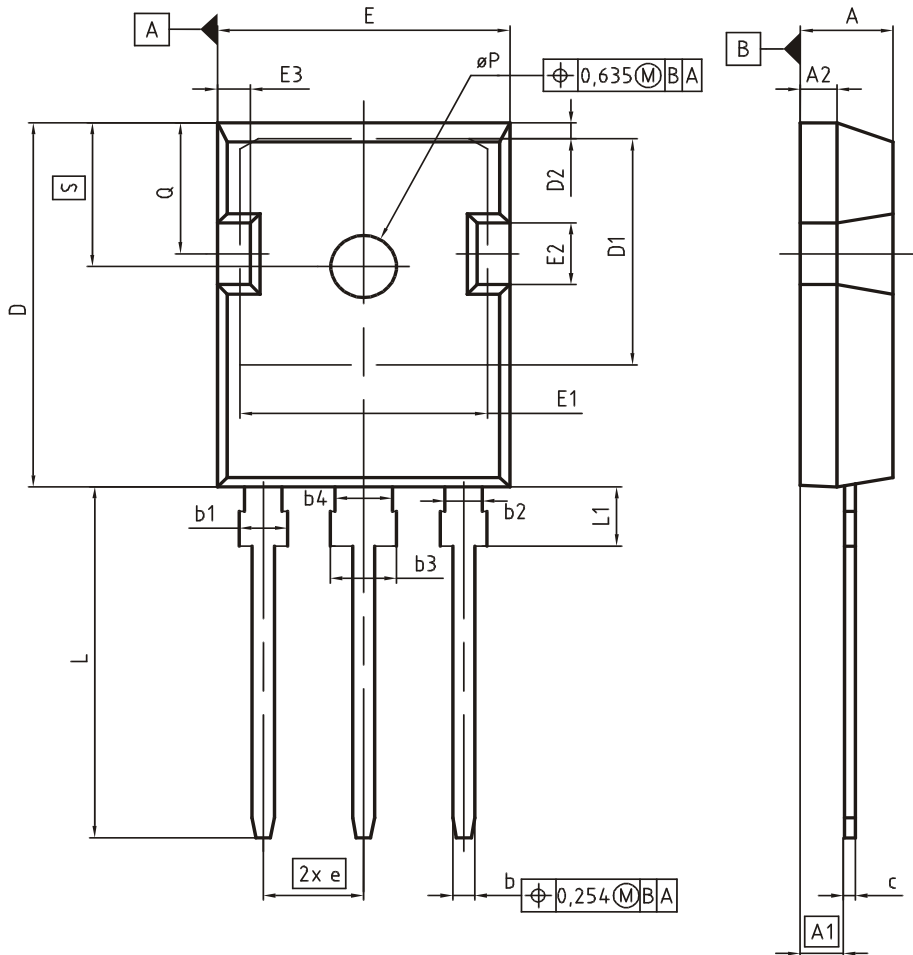
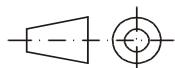


Figure 18. Typical diode forward voltage as a function of junction temperature

## 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 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <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                                                                                               |

### Testing Conditions

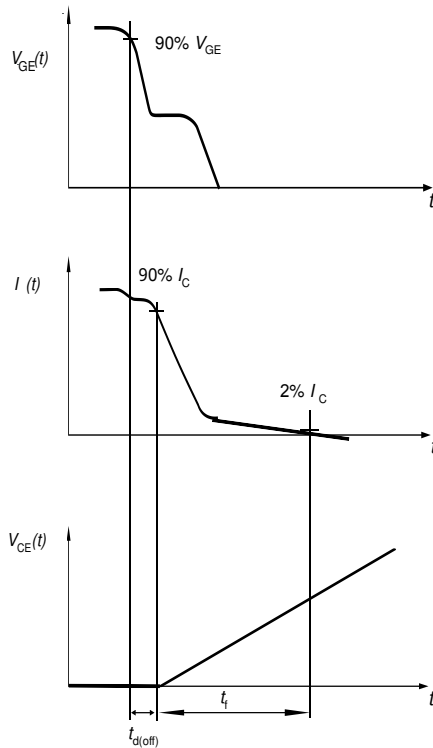


Figure A. Definition of switching times

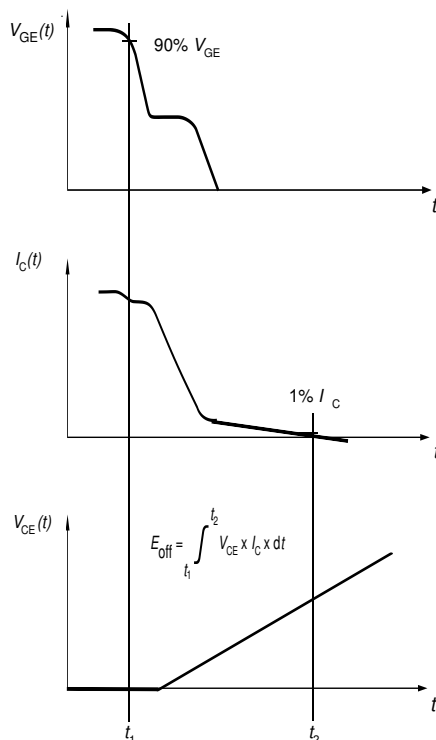


Figure B. Definition of switching losses

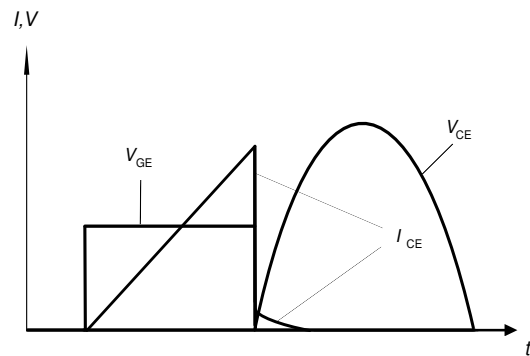


Figure C. Typical switching behavior in resonant applications

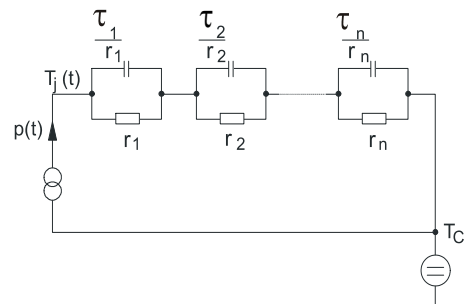


Figure D. Thermal equivalent circuit

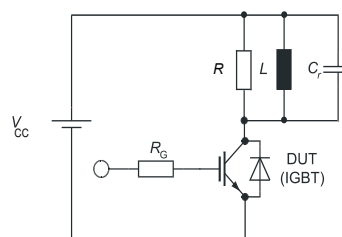


Figure E. Dynamic test circuit  
Resonant capacitor,  $C_r$   
Damping resistor,  $R$

**Revision History**

IHW25N120E1

**Revision: 2016-07-29, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.1      | 2016-07-29 | Final data sheet                             |

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