# Resonant Soft-Switching Series

Reverse conducting IGBT with monolithic body Diode for soft-switching

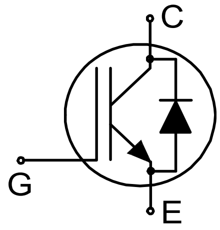
# IHW25N120E1

## Data sheet

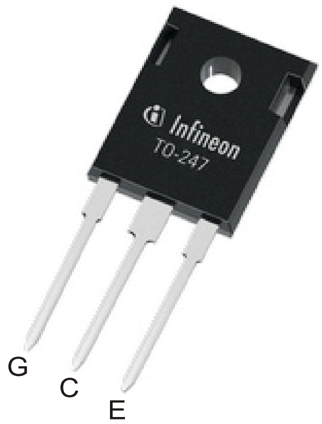
Industrial Power Control

# 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°C | $T_{vjmax}$ | Marking | Package |
|---|---|---|---|---|---|---|
| IHW25N120E1 | 1200V | 25A | 1.5V | 150°C | H25ME1 | PG-TO247-3 |

**Table of Contents**

## 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, $T_{vj} \geq 25°C$ | $V_{CE}$ | 1200 | V |
| DC collector current, limited by $T_{vjmax}$<br>$T_C = 25°C$<br>$T_C = 100°C$ | $I_C$ | 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 $V_{CE} \leq 1200V$, $T_{vj} \leq 150°C$[1)] | - | 75.0 | A |
| Diode forward current, limited by $T_{vjmax}$<br>$T_C = 25°C$<br>$T_C = 100°C$ | $I_F$ | 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 ($t_p \leq 10\mu s$, D < 0.010) | $V_{GE}$ | ±20<br>±25 | V |
| Power dissipation $T_C = 25°C$<br>Power dissipation $T_C = 100°C$ | $P_{tot}$ | 231.0<br>92.4 | W |
| Operating junction temperature | $T_{vj}$ | -40...+150 | °C |
| Storage temperature | $T_{stg}$ | -55...+150 | °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 | $R_{th(j-c)}$ | | - | - | 0.54 | K/W |
| Diode thermal resistance,<br>junction - case | $R_{th(j-c)}$ | | - | - | 0.54 | K/W |
| Thermal resistance<br>junction - ambient | $R_{th(j-a)}$ | | - | - | 40 | K/W |

1) dV/dt < 1kV/µs

## 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, $I_C$ = 25.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 100°C<br>$T_{vj}$ = 150°C | <br>-<br>-<br>- | <br>1.50<br>1.65<br>1.75 | <br>2.00<br>-<br>- | V |
| Diode forward voltage | $V_F$ | $V_{GE}$ = 0V, $I_F$ = 25.0A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 100°C<br>$T_{vj}$ = 150°C | <br>-<br>-<br>- | <br>1.90<br>2.15<br>2.35 | <br>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°C<br>$T_{vj}$ = 150°C | <br>-<br>- | <br>-<br>500 | <br>100<br>- | µA |
| 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 | | 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 | - | 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 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>$V_{CC}$ = 105V, $I_C$ = 25.0A,<br>$V_{GE}$ = 0.0/18.0V,<br>$R_{G(off)}$ = 10.2Ω<br><br>Energy losses include "tail" according Figure B. (Test circuit Figure E, $C_r$ = 300nF). | - | 229 | - | ns |
| Fall time | $t_f$ | | - | 1020 | - | ns |
| Turn-off energy, soft switching | $E_{off}$ | *dv/dt* = 83.0V/µs | - | 0.08 | - | mJ |

| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Turn-off delay time | $t_{d(off)}$ | $T_{vj}$ = 25°C,<br>$V_{CC}$ = 210V, $I_C$ = 50.0A,<br>$V_{GE}$ = 0.0/18.0V,<br>$R_{G(off)}$ = 10.2Ω<br><br>Energy losses include "tail" according Figure B. (Test circuit Figure E, $C_r$ = 300nF ). | - | 249 | - | ns |
| Fall time | $t_f$ | | - | 850 | - | ns |
| Turn-off energy, soft switching | $E_{off}$ | $dv/dt$ = 166.0V/µs | - | 0.24 | - | mJ |

**Switching Characteristic, Inductive Load**

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

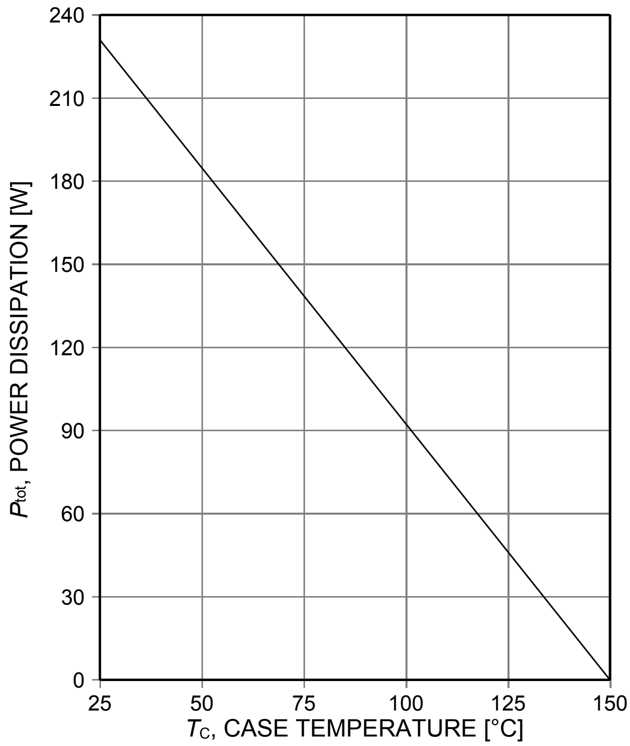



Figure 1. **Power dissipation as a function of case temperature**
($T_{vj}$≤150°C)

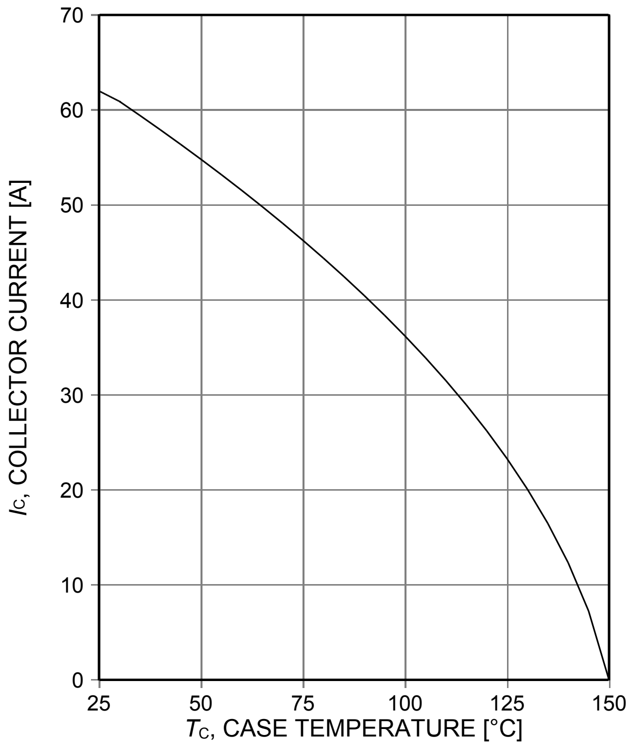



Figure 2. **Collector current as a function of case temperature**
($V_{GE}$≥15V, $T_{vj}$≤150°C)

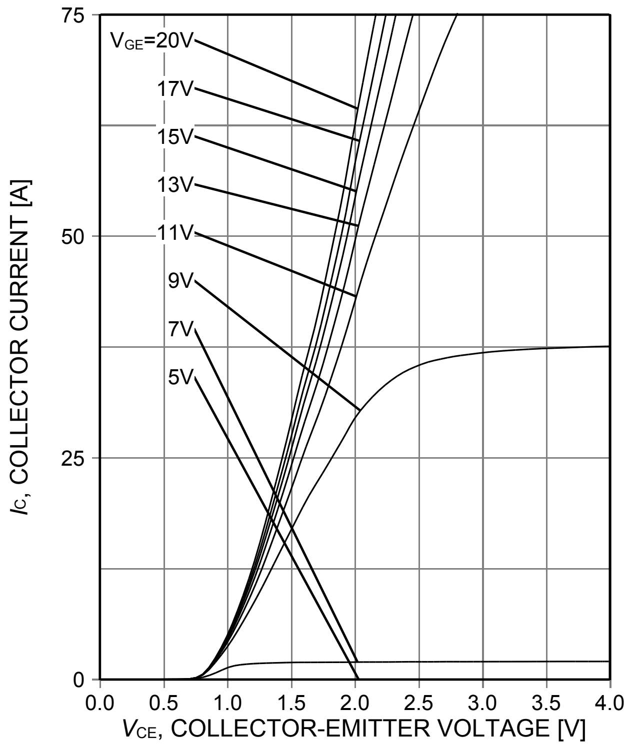



Figure 3. **Typical output characteristic**
($T_{vj}$=25°C)

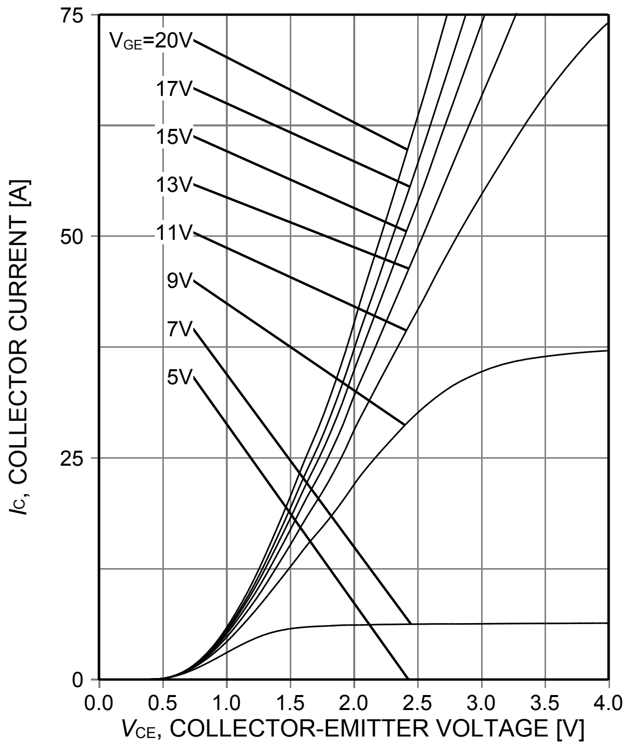



Figure 4. **Typical output characteristic**
($T_{vj}$=150°C)

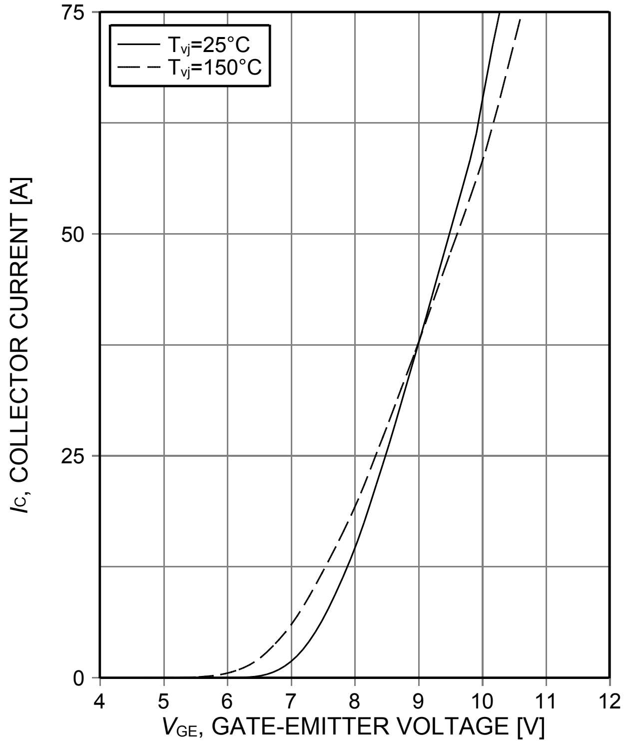



Figure 5. **Typical transfer characteristic**
($V_{CE}$=20V)

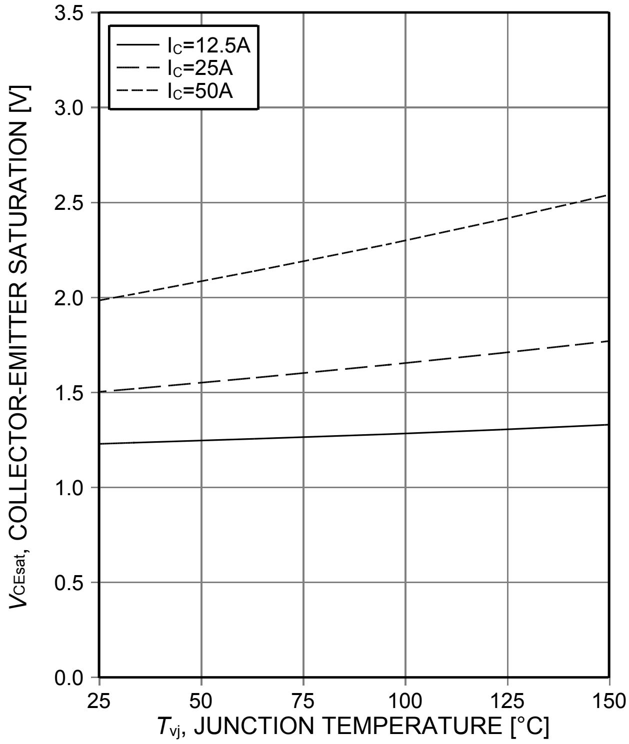



Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}$=15V)

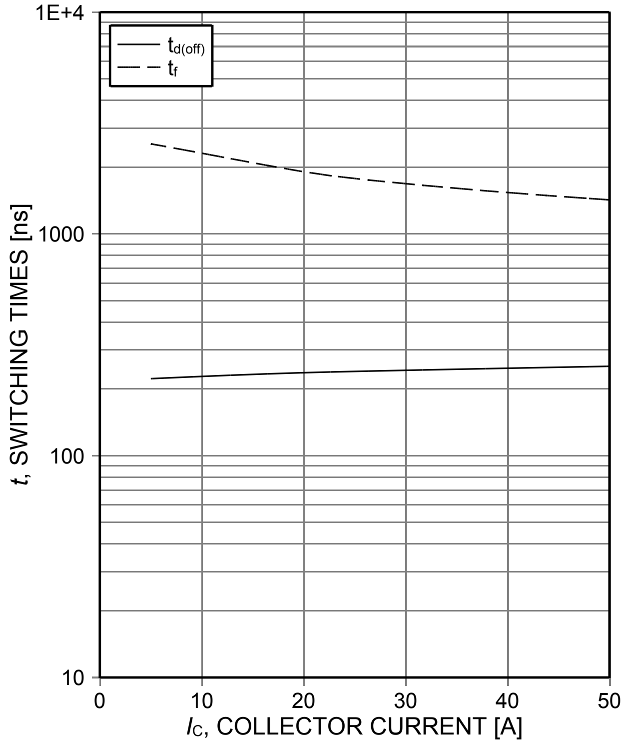



Figure 7. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}$=150°C, $V_{GE}$=0/18V, $R_G$=10.2Ω, Dynamic test circuit in Figure E)

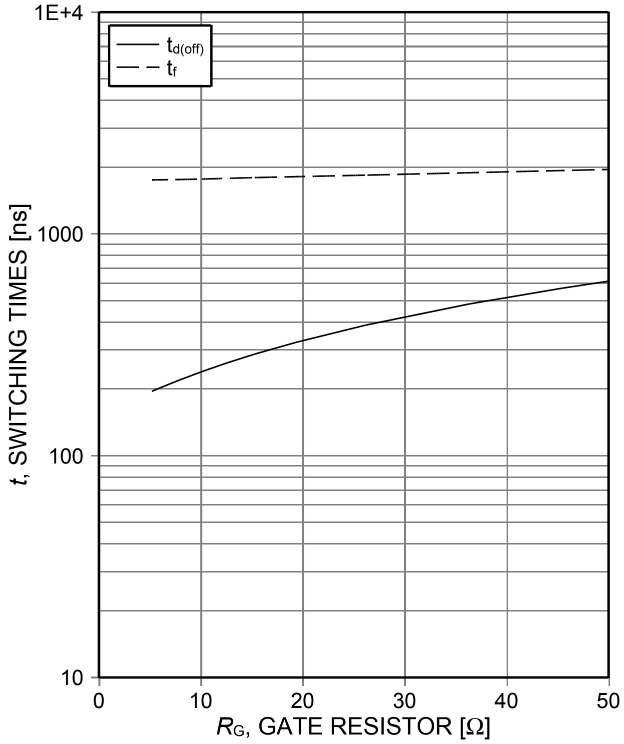



Figure 8. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}$=150°C, $V_{GE}$=0/18V, $I_C$=25A, Dynamic test circuit in Figure E)

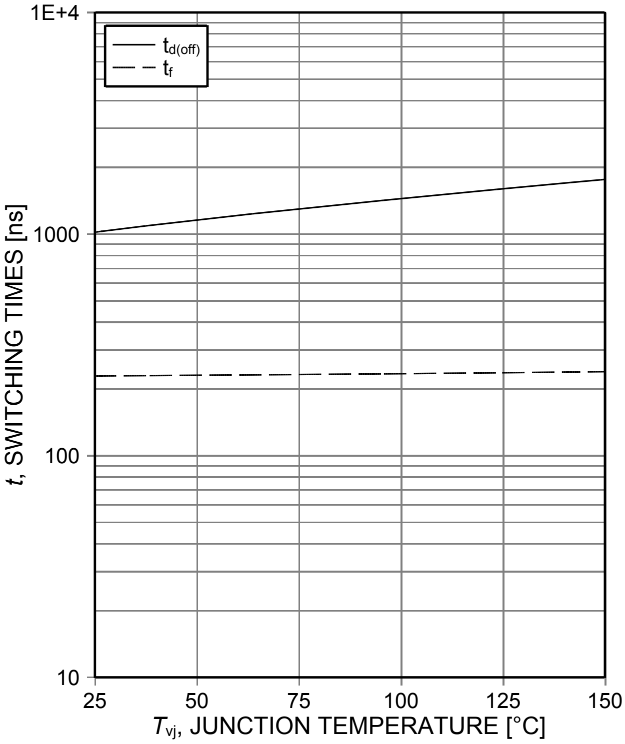



Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, $V_{GE}$=0/18V, $I_C$=25A, $R_G$=10.2Ω, Dynamic test circuit in Figure E)

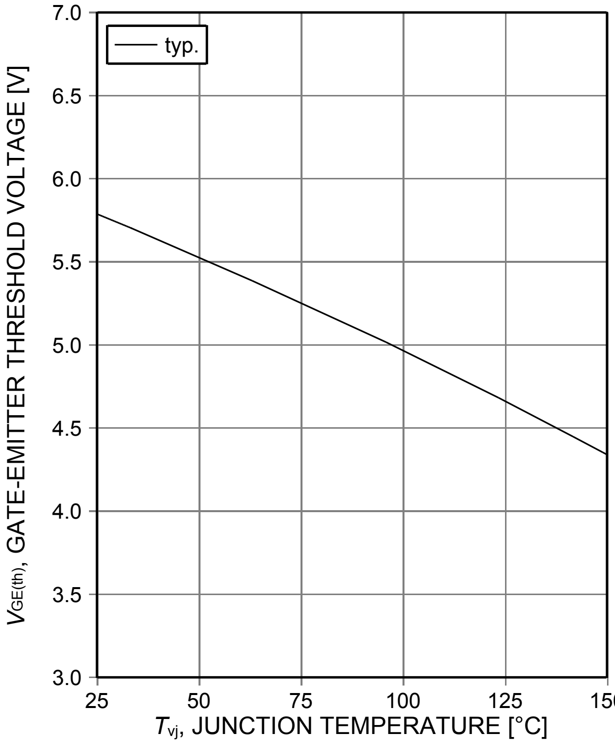



Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
($I_C$=0.8mA)

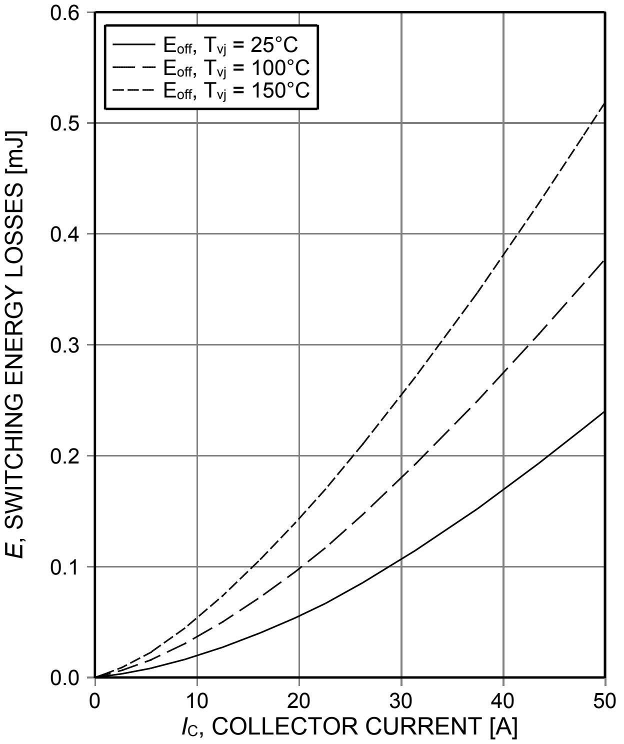



Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, $V_{GE}$=0/18V, $R_G$=10.2Ω, Dynamic test circuit in Figure E)

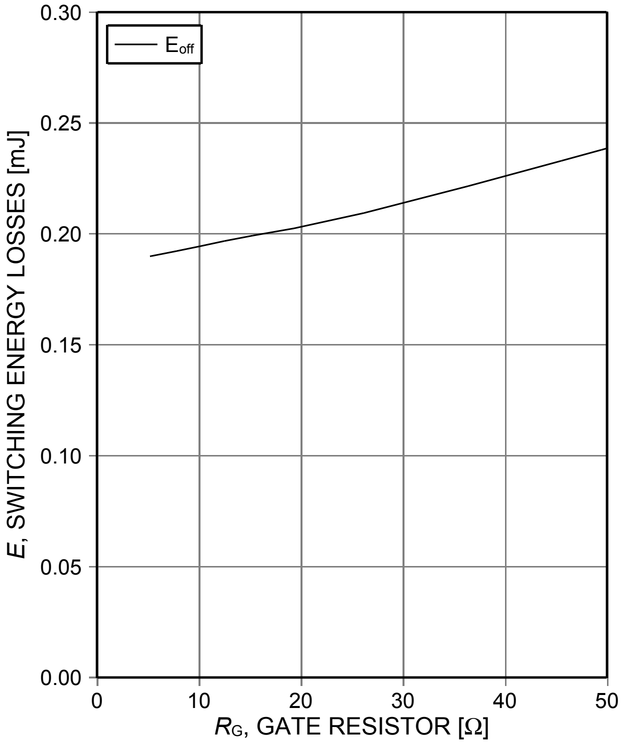



Figure 12. **Typical switching energy losses as a function of gate resistance**
(inductive load, $T_{vj}$=150°C, $V_{GE}$=0/18V, $I_C$=25A, Dynamic test circuit in Figure E)

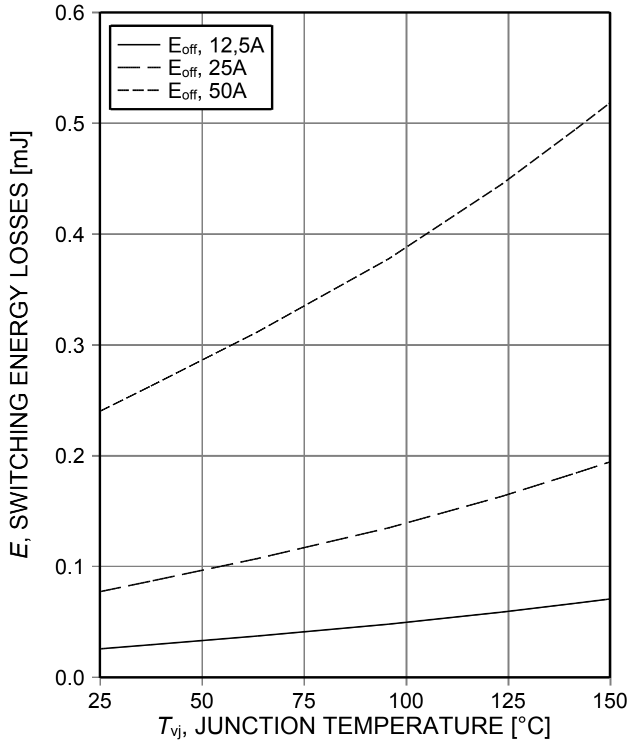



Figure 13. **Typical switching energy losses as a function of junction temperature**
(inductive load, $V_{GE}$=0/18V, $I_C$=25A, $R_G$=10.2Ω, Dynamic test circuit in Figure E)

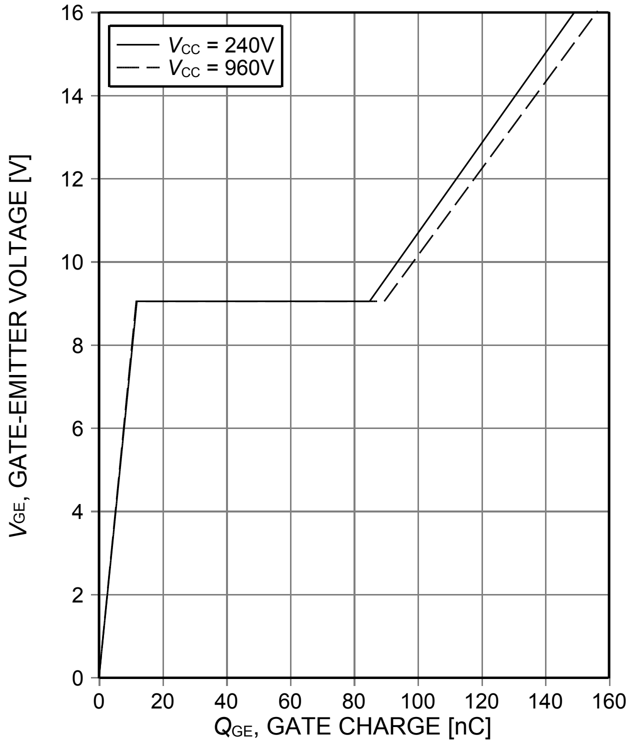



Figure 14. **Typical gate charge**
($I_C$=25A)

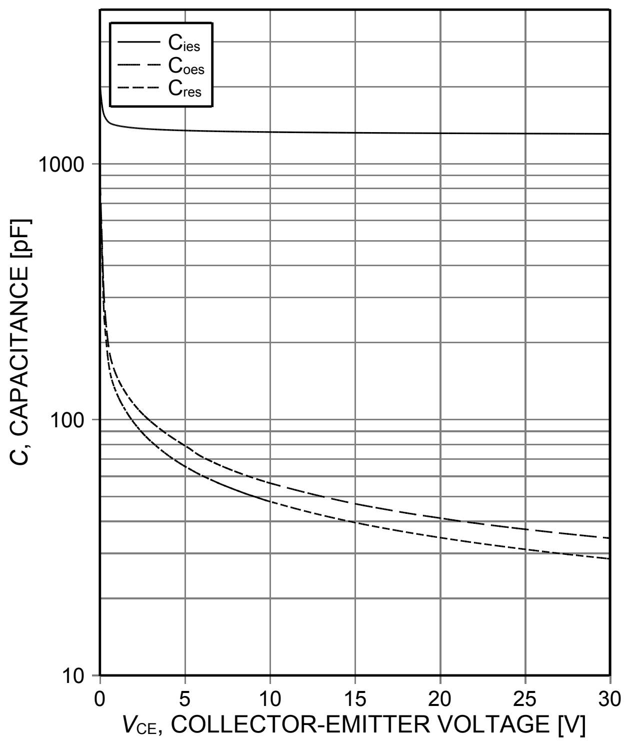



Figure 15. **Typical capacitance as a function of collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

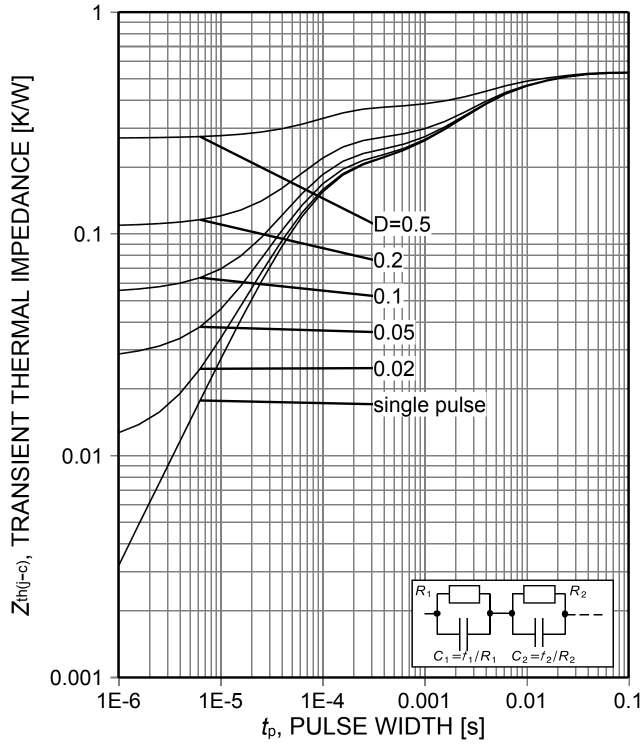



Figure 16. **IGBT / Diode transient thermal impedance**
($D$=$t_p$/T)

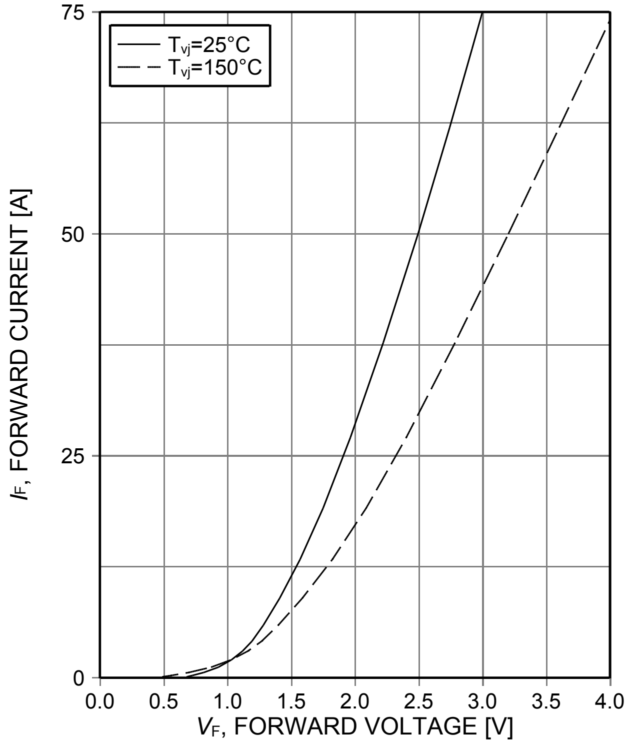



Figure 17. **Typical diode forward current as a function of forward voltage**

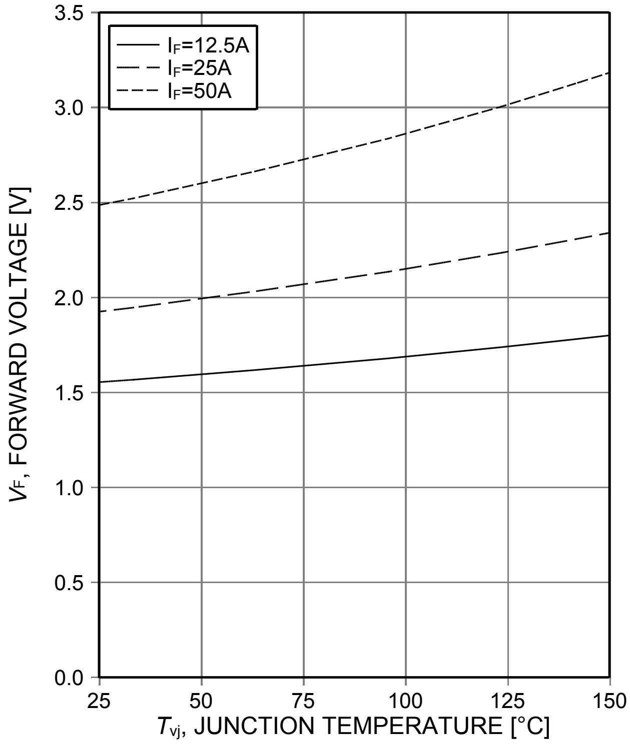
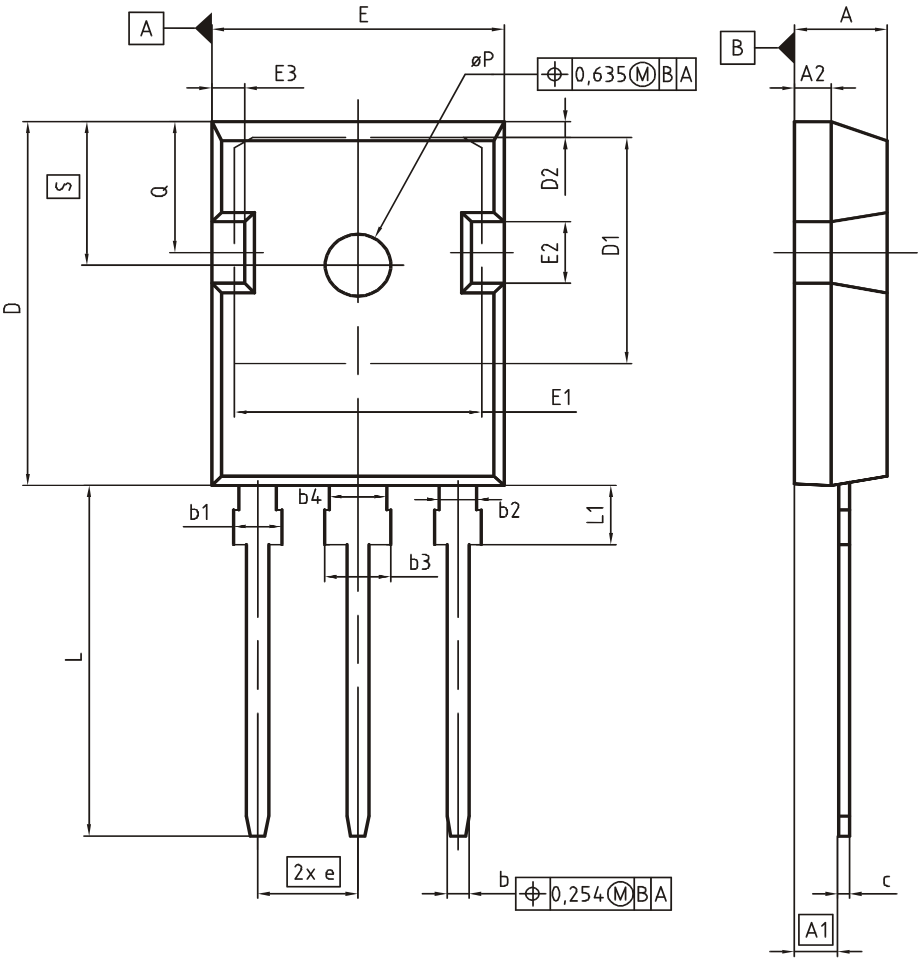



Figure 18. **Typical diode forward voltage as a function of junction temperature**

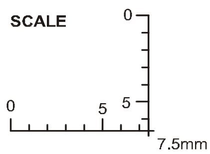
## Package Drawing PG-TO247-3



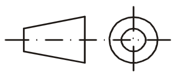

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| 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 |

**DOCUMENT NO.**
Z8B00003327

**SCALE**




**EUROPEAN PROJECTION**



**ISSUE DATE**
09-07-2010

**REVISION**
05

**Testing Conditions**

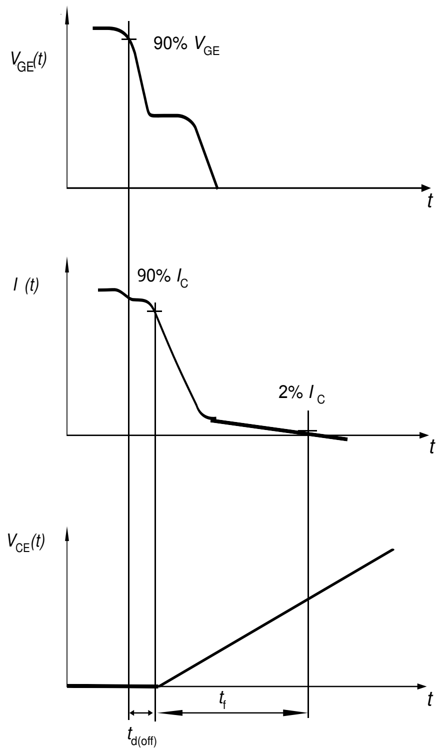



Figure A. **Definition of switching times**

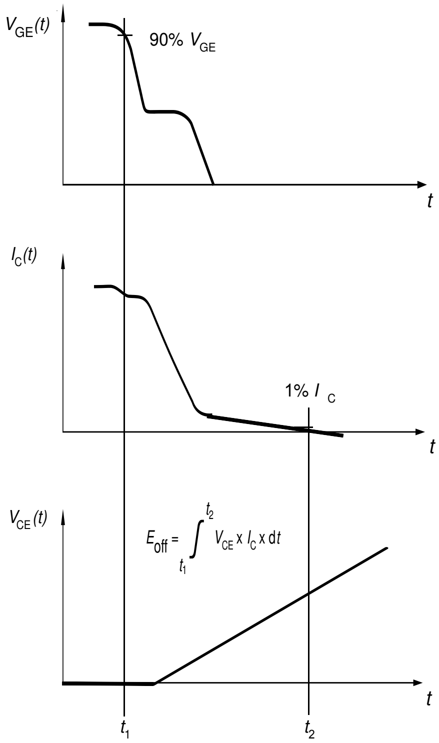



Figure B. **Definition of switching losses**

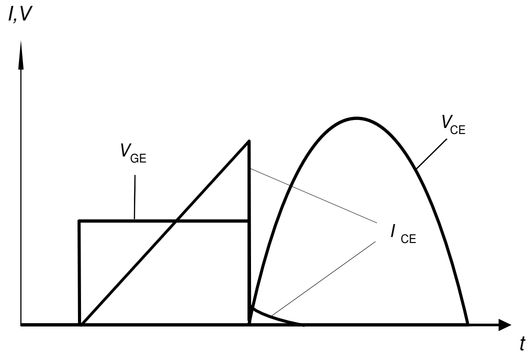



Figure C. **Typical switching behavior in resonant applications**

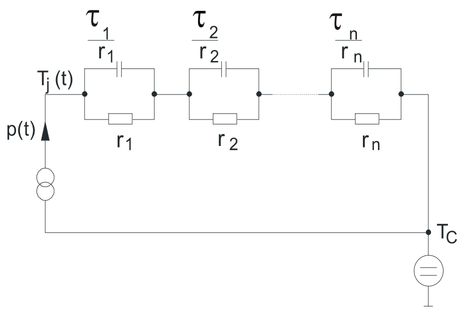



Figure D. **Thermal equivalent circuit**

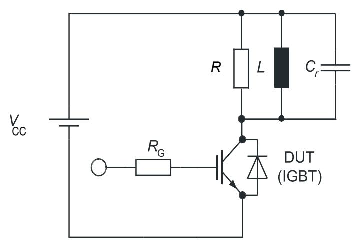



Figure E. **Dynamic test circuit**
Resonant capacitor, $C_r$
Damping resistor, R

**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 |

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**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