# WG30N65HAW1

## IGBT

Rev.01 - 29 November 2023 Product data sheet

## 1. General description

WG30N65HAW1 uses advanced Fine Trench Field-stop IGBT technology with anti-parallel diode in TO247 package to provide extremely low $V_{CE(sat)}$, and excellent switching performance. This device offers Best-in-Class efficiency in hard switching and resonant topology.

## 2. Features and benefits

- Maximum junction temperature 175 °C
- Positive Temperature efficient for easy paralleling
- Very soft, fast recovery anti-parallel diode
- High switching speed
- EMI Improved Design

## 3. Applications

- PFC
- Solar converters
- UPS
- Welding Converters
- Mid to high range switching frequency converters

## 4. Quick reference data

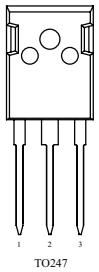
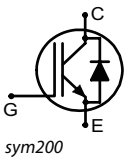
**Table 1. Quick reference data**

| Symbol | Parameter | Notes | Value | Unit |
|---|---|---|---|---|
| $V_{CE}$ | Collector-emitter voltage, $T_j \geq 25$ °C | | 650 | V |
| $I_C$ | DC collector current, limited by $T_{j(max)}$<br>$T_C$ = 100 °C | | 30 | A |

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V; $I_C$ = 30 A; $T_j$ = 25 °C | | - | 1.55 | 2.1 | V |

# 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |  TO247 |  sym200 |
| 2 | C | collector | | |
| 3 | E | emitter | | |
| mb | C | mounting base; connected to collector | | |

# 6. Ordering information

**Table 3. Ordering information**

| Type number | Package Name | Orderable part number | Packing method | Small packing quantity | Package version | Package issue date |
|---|---|---|---|---|---|---|
| WG30N65HAW1 | TO247 | WG30N65HAW1Q | Tube | 30 | SOT429 | 25-Mar-2013 |

# 7. Marking

**Table 4. Marking codes**

| Type number | Marking codes |
|---|---|
| WG30N65HAW1 | G30N65<br>HAW1 |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# 8. Limiting values

**Table 5. Limiting values**

| Symbol | Parameter | Notes | Value | Unit |
|---|---|---|---|---|
| $V_{CE}$ | Collector-emitter voltage, $T_j \geq 25$ °C | | 650 | V |
| $I_C$ | DC collector current, limited by $T_{j(max)}$<br>$T_C = 25$ °C<br>$T_C = 100$ °C | | <br>60<br>30 | A |
| $I_{C(puls)}$ | Pulsed collector current, $t_p$ limited by $T_{j(max)}$ | | 90 | A |
| - | Turn off safe operating area<br>$V_{CE} \leq 650$ V, $T_j \leq 175$ °C, $t_p = 1$ µs | | 90 | A |
| $I_F$ | Diode forward current, limited by $T_{j(max)}$<br>$T_C = 25$ °C<br>$T_C = 100$ °C | | <br>20<br>10 | A |
| $I_{Fpuls}$ | Diode pulsed current, $t_p$ limited by $T_{j(max)}$ | | 30 | A |
| $V_{GE}$ | Gate-emitter voltage | | ±20 | V |
| $P_{tot}$ | Power dissipation $T_C = 25$ °C<br>Power dissipation $T_C = 100$ °C | | 312<br>156 | W |
| $T_{stg}$ | Storage temperature | | -55 to +150 | °C |
| $T_{jmax}$ | Maximum operating junction temperature | | 175 | °C |
| - | Peak soldering temperture | | 260 | °C |
| M | Mounting Torque with washer | | 0.55 | Nm |


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# 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-c)}$ | IGBT thermal resistance from junction to case | | | - | 0.48 | - | K/W |
| $R_{th(j-c)}$ | Diode thermal resistance from junction to case | | | - | 2 | - | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | | | - | 40 | - | K/W |

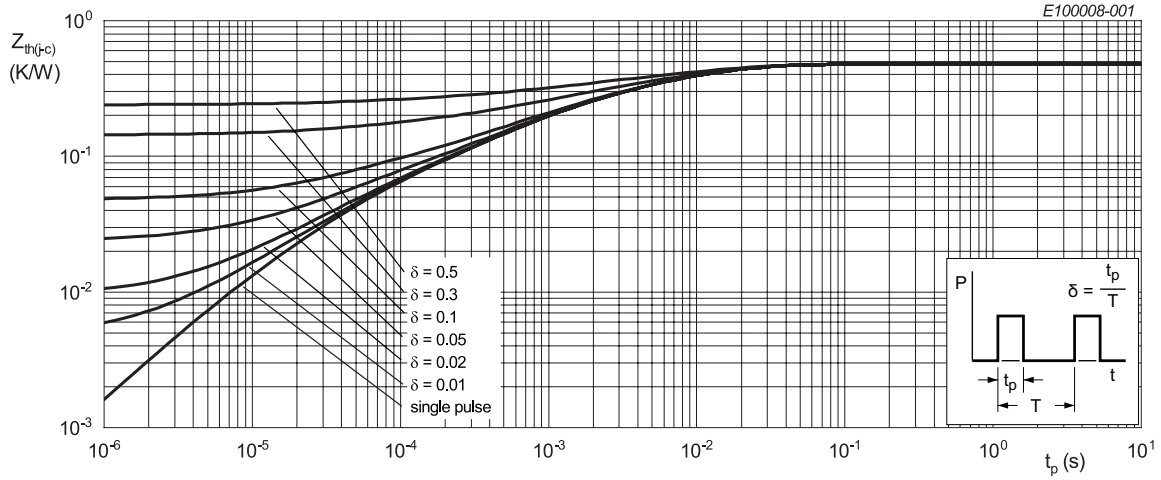


**Fig. 1. Transient thermal impedance from junction to case as a function of pulse duration; IGBT**

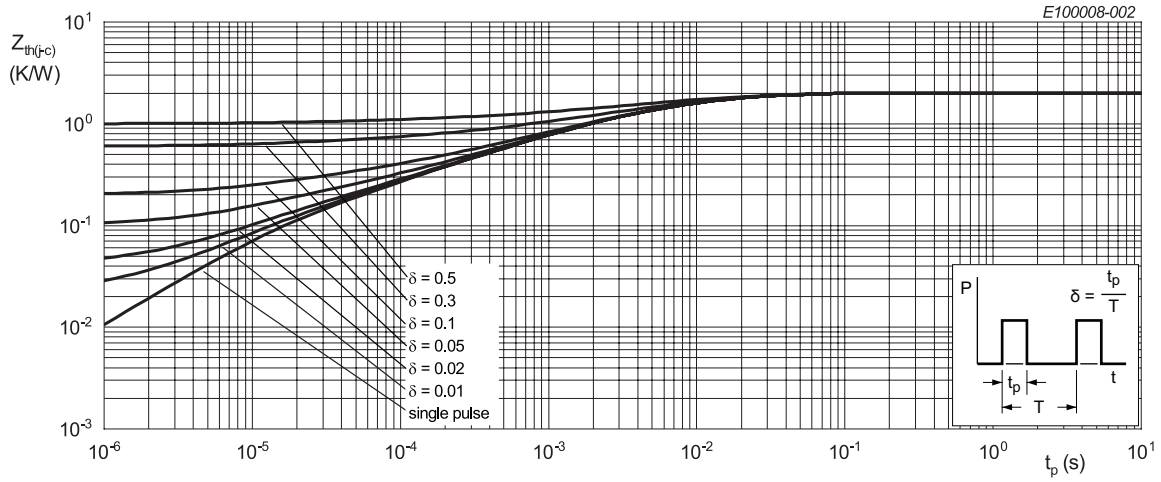


**Fig. 2. Transient thermal impedance from junction to case as a function of pulse duration; Diode**


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# 10. Characteristics

**Table 7. Characteristics**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $BV_{CES}$ | Collector-emitter breakdown voltage | $V_{GE}$ = 0 V; $I_C$ = 1.0 mA | | 650 | - | - | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V; $I_C$ = 30 A; $T_j$ = 25 °C | | - | 1.55 | 2.1 | V |
| | | $V_{GE}$ = 15 V; $I_C$ = 30 A; $T_j$ = 175 °C | | - | 2.05 | - | V |
| $V_F$ | Diode forward voltage | $V_{GE}$ = 0 V; $I_F$ = 10 A; $T_j$ = 25 °C | | - | 1.9 | - | V |
| | | $V_{GE}$ = 0 V; $I_F$ = 10 A; $T_j$ = 175 °C | | - | 1.45 | - | V |
| $V_{GE(th)}$ | Gate-emitter threhold voltage | $I_C$ = 0.6 mA; $V_{CE}$ = $V_{GE}$ | | 4.3 | 5.4 | 6.5 | V |
| $I_{CES}$ | Zero gate voltage collector current | $V_{CE}$ = 650 V; $V_{GE}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | μA |
| | | $V_{CE}$ = 650 V; $V_{GE}$ = 0 V; $T_j$ = 175 °C | | - | - | 1 | mA |
| $g_{fs}$ | Transconductance | $V_{CE}$ = 20 V; $I_C$ = 30 A | | - | 21 | - | S |
| **Dynamic characteristics** | | | | | | | |
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 30 V; $V_{GE}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C | | - | 1593 | - | pF |
| $C_{oes}$ | Output capacitance | | | - | 45 | - | pF |
| $C_{res}$ | Reverse transfer capacitance | | | - | 18 | - | pF |
| $Q_G$ | Gate charge | $V_{CC}$ = 520 V; $I_C$ = 30 A; $V_{GE}$ = 15 V; $T_j$ = 25 °C | | - | 74 | - | nC |


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# 11. Switching Characteristics

**Table 8. Switching Characteristics, Inductive Load**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **IGBT characteristics** | | | | | | | |
| $t_{d(on)}$ | Turn-on delay time | $T_j$ = 25 °C; $V_{CC}$ = 400 V; $I_C$ = 30 A; $V_{GE}$ = 15V / 0V; $R_G$ = 10 Ω | | - | 30 | - | nS |
| $t_r$ | Rise time | | | - | 33 | - | nS |
| $t_{d(off)}$ | Turn-off delay time | | | - | 120 | - | nS |
| $t_f$ | Fall time | | | - | 23 | - | nS |
| $E_{on}$ | Turn-on energy | | | - | 0.6 | - | mJ |
| $E_{off}$ | Turn-off energy | | | - | 0.3 | - | mJ |
| $E_{ts}$ | Total switching energy | | | - | 0.9 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $T_j$ = 175 °C; $V_{CC}$ = 400 V; $I_C$ = 30 A; $V_{GE}$ = 15V / 0V; $R_G$ = 10 Ω | | - | 29 | - | nS |
| $t_r$ | Rise time | | | - | 33 | - | nS |
| $t_{d(off)}$ | Turn-off delay time | | | - | 143 | - | nS |
| $t_f$ | Fall time | | | - | 38 | - | nS |
| $E_{on}$ | Turn-on energy | | | - | 0.9 | - | mJ |
| $E_{off}$ | Turn-off energy | | | - | 0.45 | - | mJ |
| $E_{ts}$ | Total switching energy | | | - | 1.35 | - | mJ |
| **Diode characteristics** | | | | | | | |
| $t_{rr}$ | Reverse recovery time | $T_j$ = 25 °C; $V_R$ = 400 V; $I_F$ = 10 A; $dI_F/dt$ = 500A/us | | - | 32 | - | nS |
| $Q_r$ | Reverse recovery charge | | | - | 148 | - | nC |
| $I_{RM}$ | Reverse recovery peak current | | | - | 8 | - | A |
| $t_{rr}$ | Reverse recovery time | $T_j$ = 175 °C; $V_R$ = 400 V; $I_F$ = 10 A; $dI_F/dt$ = 500A/us | | - | 71 | - | nS |
| $Q_r$ | Reverse recovery charge | | | - | 508 | - | nC |
| $I_{RM}$ | Reverse recovery peak current | | | - | 12 | - | A |


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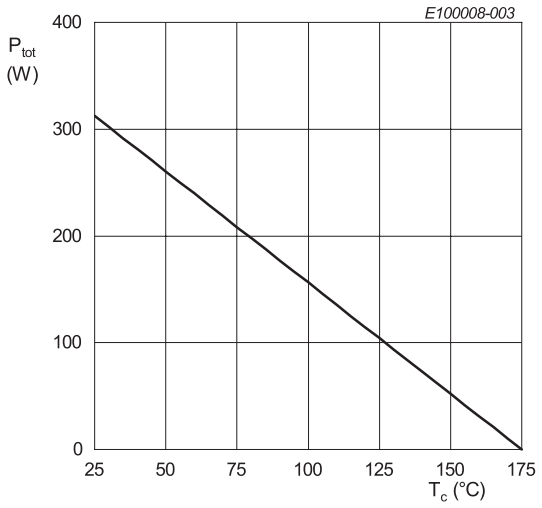
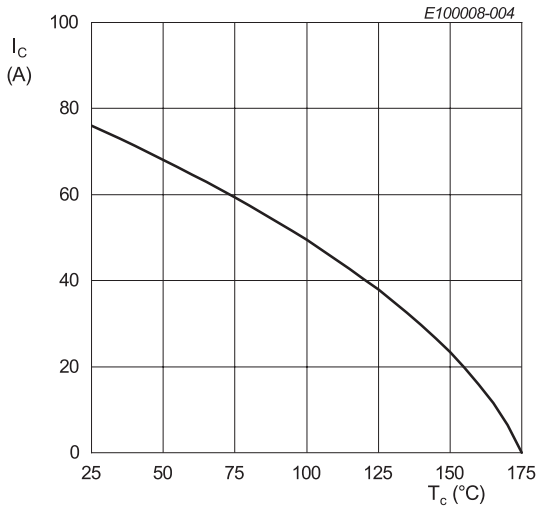


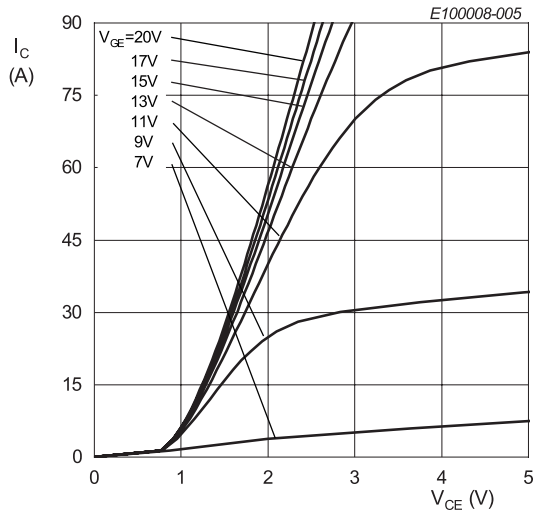

$T_j \leq 175$ °C

**Fig. 3. Power dissipation as a function of case temperature**



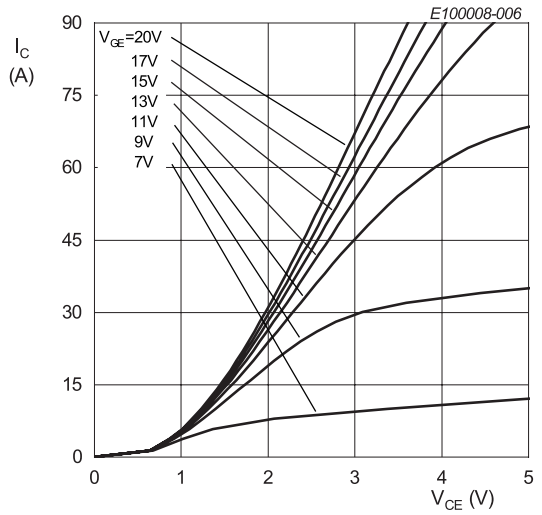

$V_{GE} \geq 15$ V; $T_j \leq 175$ °C

**Fig. 4. Collector current as a function of case temperature**




$T_j = 25$ °C

**Fig. 5. Typical output characteristic**




$T_j = 175$ °C

**Fig. 6. Typical output characteristic**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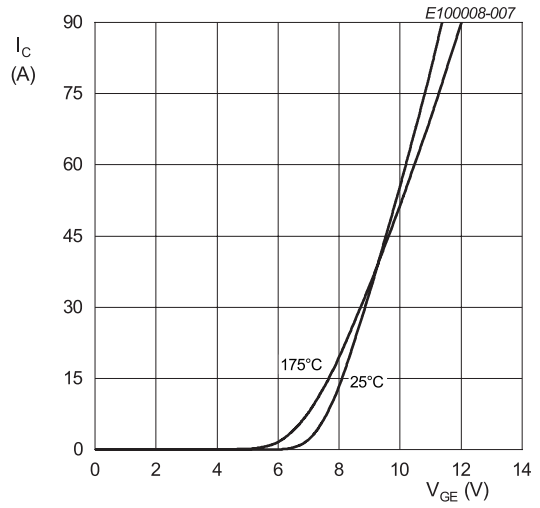
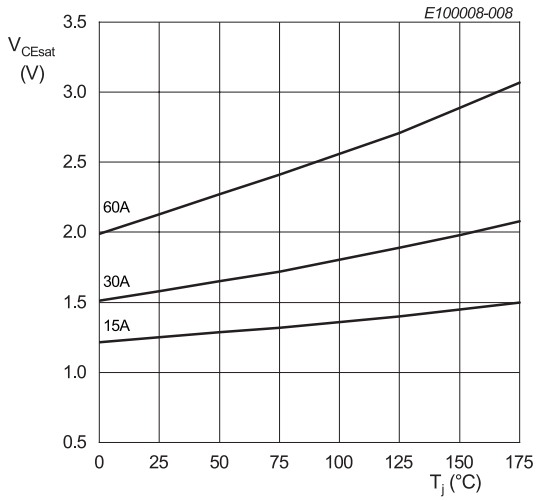


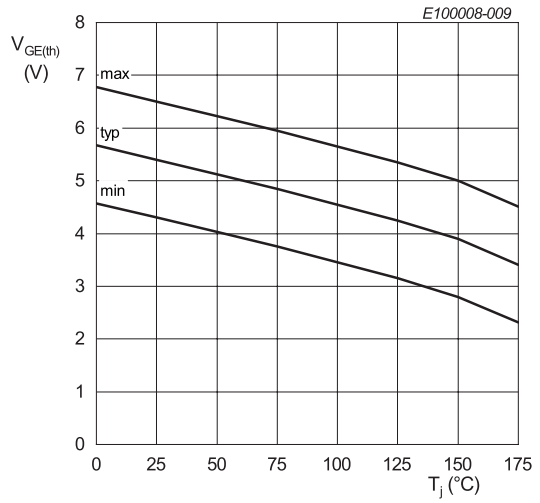

$V_{CE}$ = 20 V

**Fig. 7. Typical transfer characteristic**



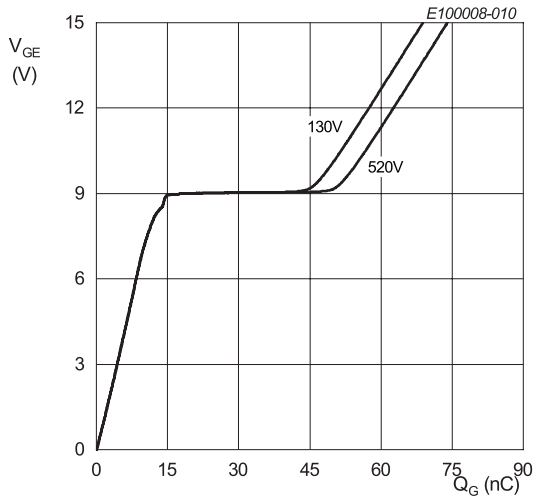

$V_{GE}$ = 15 V

**Fig. 8. Typical collector-emitter saturation voltage as a function of junction temperature**




$I_C$ = 600 µA

**Fig. 9. Gate-emitter threshold voltage as a function of junction temperature**




$I_C$ = 30 A

**Fig. 10. Typical gate charge**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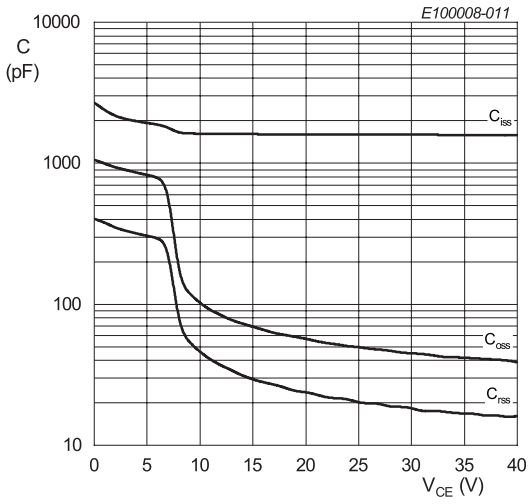



$V_{GE}$ = 0 V; f = 1 MHz

**Fig. 11. Typical capacitance as a function of collector-emitter voltage**

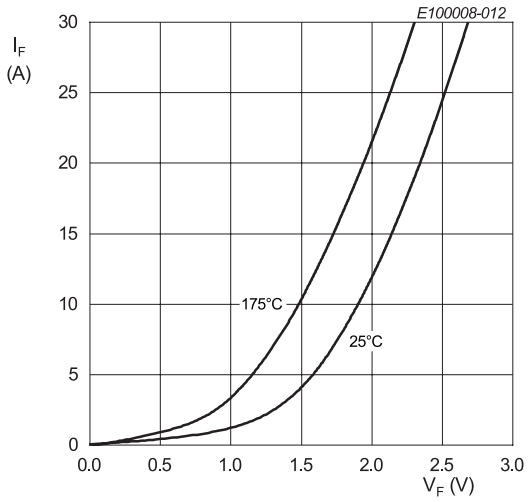
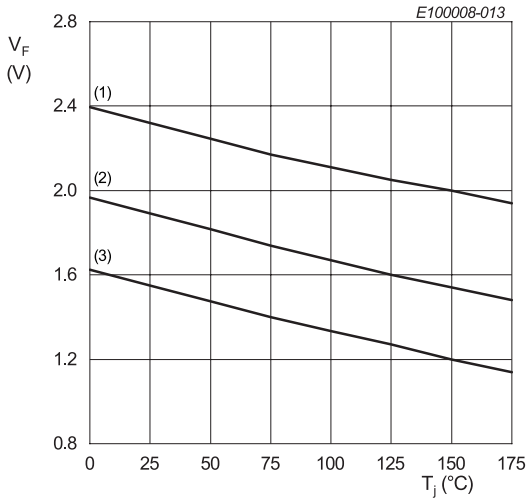
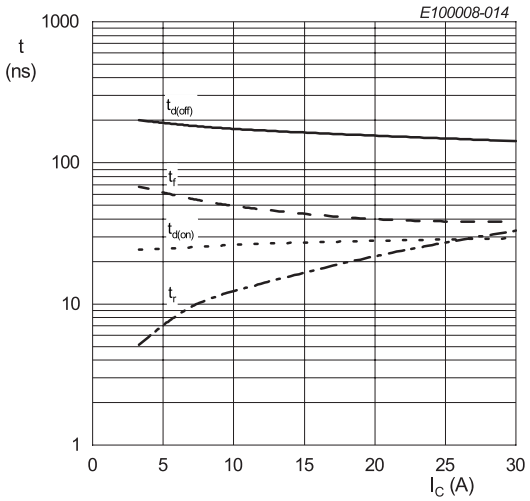



**Fig. 12. Typical diode forward current as a function of forward voltage**




(1) $I_F$ = 20 A
(2) $I_F$ = 10 A
(3) $I_F$ = 5 A

**Fig. 13. Typical diode forward voltage as a function of junction temperature**




$R_g$ = 10 Ω; $V_{GE}$ = 15V/0V; $T_j$ = 175 °C; $V_{CE}$ = 400 V; inductive load

**Fig. 14. Typical switching times as a function of collector current**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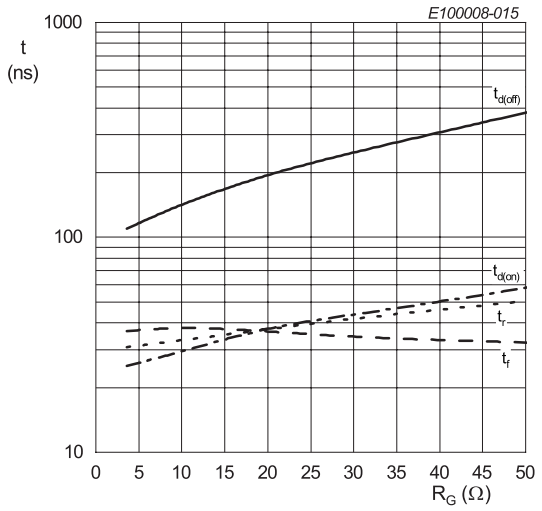
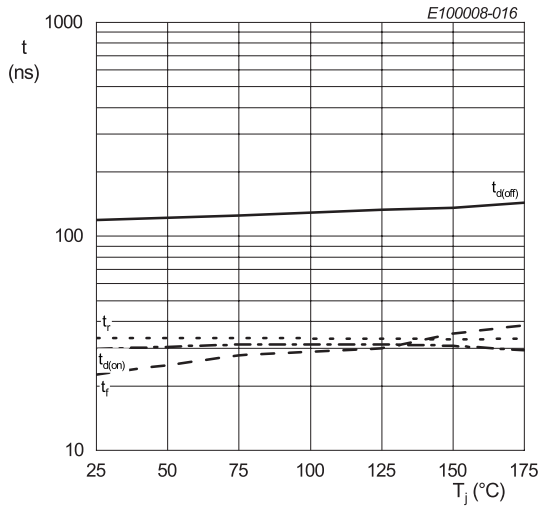


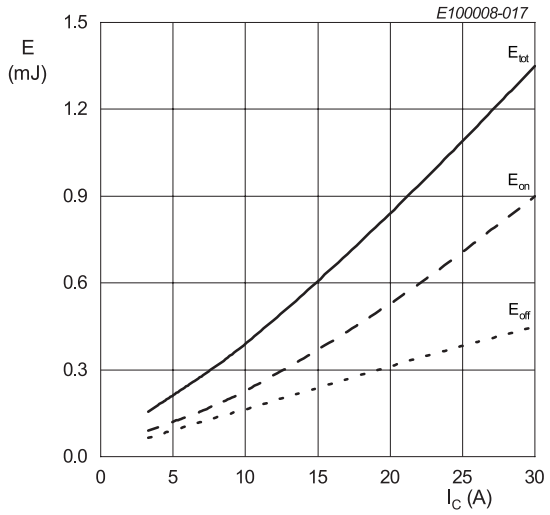

$I_C$ = 30 A; $V_{GE}$ = 15V/0V; $T_j$ = 175 °C;
$V_{CE}$ = 400 V; inductive load

**Fig. 15. Typical switching times as a function of gate resistance**



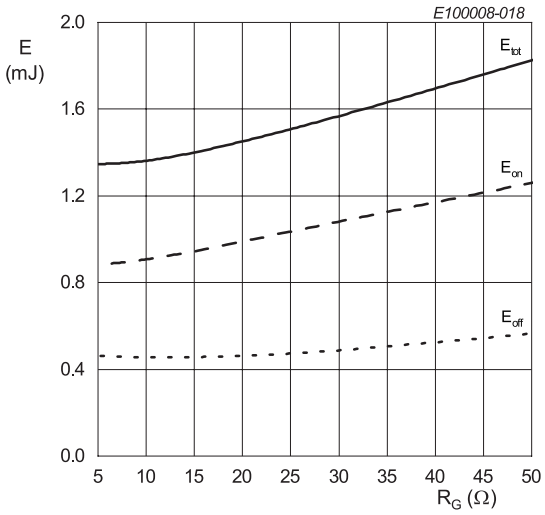

$I_C$ = 30 A; $V_{GE}$ = 15V/0V; $R_g$ = 10 Ω;
$V_{CE}$ = 400 V; inductive load

**Fig. 16. Typical switching times as a function of junction temperature**




$R_g$ = 10 Ω; $V_{GE}$ = 15V/0V; $T_j$ = 175 °C;
$V_{CE}$ = 400 V; inductive load

**Fig. 17. Typical switching energy losses as a function of collector current**




$I_C$ = 30 A; $V_{GE}$ = 15V/0V; $T_j$ = 175 °C;
$V_{CE}$ = 400 V; inductive load

**Fig. 18. Typical switching energy losses as a function of gate resistance**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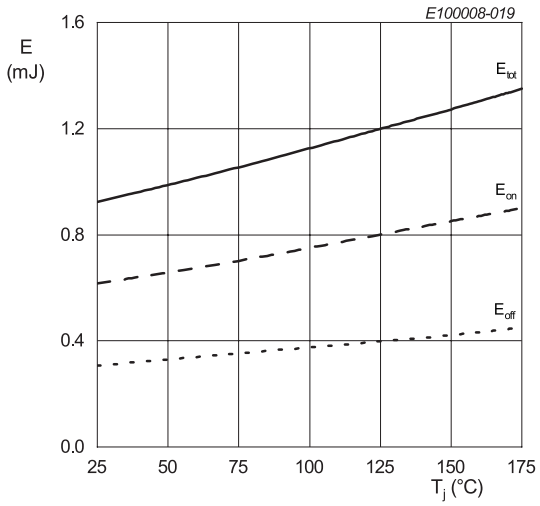


$I_C$ = 30 A; $V_{GE}$ = 15V/0V; $R_g$ = 10 Ω;
$V_{CE}$ = 400 V; inductive load

**Fig. 19. Typical switching energy losses as a function of junction temperature**

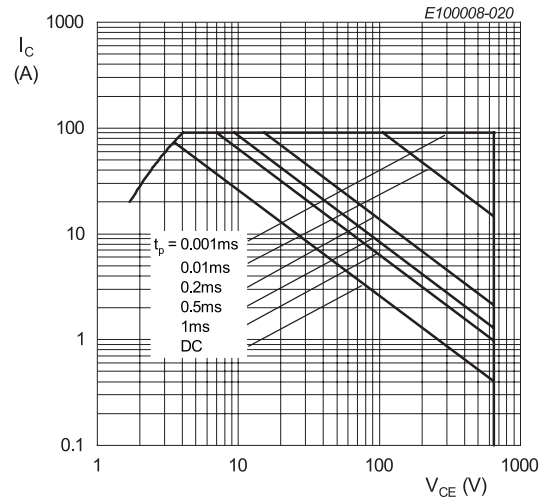


**Fig. 20. Forward bias safe operating area**

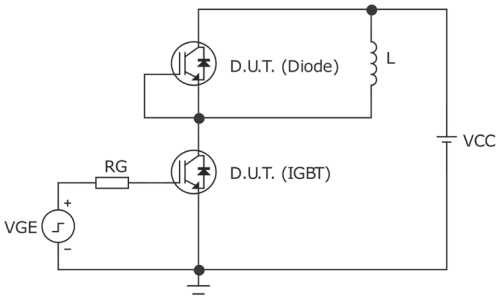


**Fig. 21. Test circuit for inductive load switching**

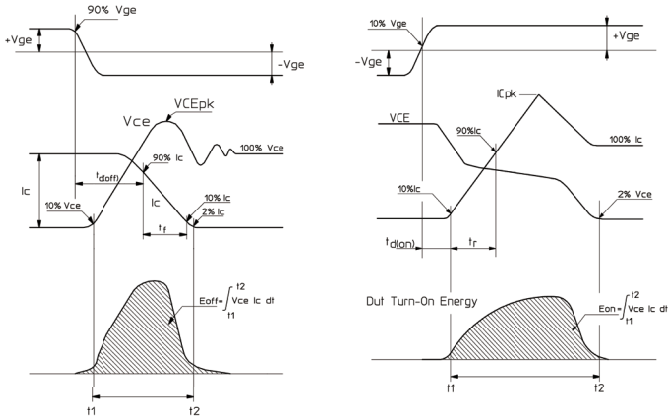


**Fig. 22. Definition of switching times and losses**


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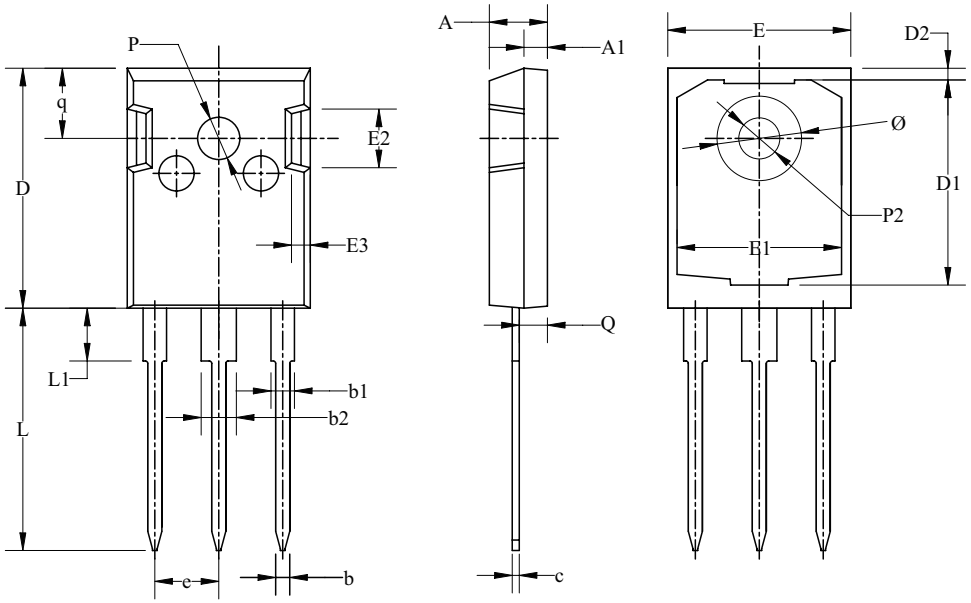
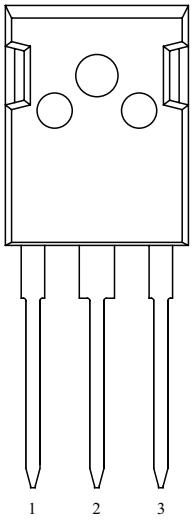
## 12. Package outline

Plastic single-ended through-hole pack age; headsink mounted; 1 mounting hole; 3 leads TO-247 TO247




| Dim | All Dimensions in Millimeters | | |
|---|---|---|---|
| | Min | Typ | Max |
| A | 4.70 | 4.95 | 5.20 |
| A1 | 1.90 | 2.00 | 2.10 |
| b | 1.00 | 1.20 | 1.40 |
| b1 | 1.80 | 2.00 | 2.20 |
| b2 | 2.80 | 3.00 | 3.20 |
| c | 0.50 | 0.60 | 0.70 |
| D | 20.30 | 20.45 | 20.60 |
| D1 | 17.28 | 17.48 | 17.68 |
| D2 | 0.80 | 1.00 | 1.20 |
| E | 15.45 | 15.60 | 15.75 |
| E1 | 13.82 | 14.02 | 14.22 |
| E2 | 4.80 | 5.00 | 5.20 |
| E3 | 1.40 | 1.60 | 1.80 |
| e | 5.45 BSC | | |
| L | 20.40 | 20.65 | 20.90 |
| L1 | 4.25 | 4.50 | 4.75 |
| P2 | 3.40 | 3.50 | 3.60 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 2.20 | 2.40 | 2.60 |
| q | 5.78 | 5.98 | 6.18 |
| Ø | 7.10 | 7.19 | 7.30 |




TO247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# 13. Legal information

## Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.ween-semi.com.

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