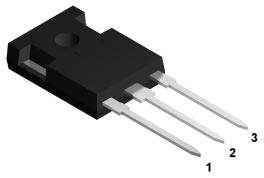
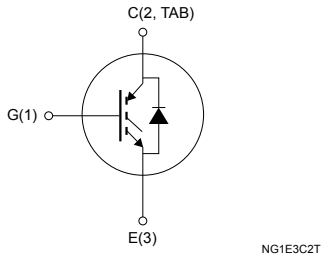
# STGWA50IH65DF

Datasheet

## Trench gate field-stop 650 V, 50 A, soft switching IH series IGBT in a TO-247 long leads package




TO-247 long leads




## Features

- Designed for soft-commutation only
- Maximum junction temperature: $T_J$ = 175 °C
- $V_{CE(sat)}$ = 1.5 V (typ.) @ $I_C$ = 50 A
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low voltage drop freewheeling co-packaged diode
- Positive $V_{CE(sat)}$ temperature coefficient

## Applications

- Induction heating
- Resonant converters
- Microwave ovens

## Description

The newest IGBT 650 V soft-switching IH series has been developed using an advanced proprietary trench gate field-stop structure, whose performance is optimized both in conduction and switching losses for soft commutation. A freewheeling diode with a low drop forward voltage is included. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching applications.

| Product status link |
|---|
| STGWA50IH65DF |

| Product summary | |
|---|---|
| **Order code** | STGWA50IH65DF |
| **Marking** | G50IH65DF |
| **Package** | TO-247 long leads |
| **Packing** | Tube |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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage ($V_{GE}$ = 0 V) | 650 | V |
| $I_C$ | Continuous collector current at $T_C$ = 25 °C | 100 | A |
| | Continuous collector current at $T_C$ = 100 °C | 50 | |
| $I_{CP}$(1) | Pulsed collector current | 150 | |
| $V_{GE}$ | Gate-emitter voltage | ±20 | V |
| $I_F$ | Continuous forward current at $T_C$ = 25 °C | 50 | A |
| | Continuous forward current at $T_C$ = 100 °C | 25 | |
| $I_{FP}$(1) | Pulsed forward current | 150 | |
| $P_{TOT}$ | Total power dissipation at $T_C$ = 25 °C | 300 | W |
| $T_{STG}$ | Storage temperature range | - 55 to 150 | °C |
| $T_J$ | Operating junction temperature range | - 55 to 175 | |

1. *Pulse width limited by maximum junction temperature.*

**Table 2. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance junction-case IGBT | 0.5 | °C/W |
| | Thermal resistance junction-case diode | 1.47 | |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50 | |


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# 2 Electrical characteristics

$T_C$ = 25 °C unless otherwise specified

**Table 3. Static characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage | $V_{GE}$ = 0 V, $I_C$ = 250 µA | 650 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 50 A | | 1.50 | 2.00 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A, $T_J$ = 125 °C | | 1.75 | | |
| | | $V_{GE}$ = 15 V, $I_C$ = 50 A, $T_J$ = 175 °C | | 1.90 | | |
| $V_F$ | Forward on-voltage | $I_F$ = 25 A | | 1.75 | 2.50 | |
| | | $I_F$ = 25 A, $T_J$ = 125 °C | | 1.50 | | |
| | | $I_F$ = 25 A, $T_J$ = 175 °C | | 1.40 | | |
| | | $I_F$ = 50 A | | 2.15 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA | 5 | 6 | 7 | |
| $I_{CES}$ | Collector cut-off current | $V_{GE}$ = 0 V, $V_{CE}$ = 650 V | | | 25 | µA |
| $I_{GES}$ | Gate-emitter leakage current | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | | ±250 | nA |

**Table 4. Dynamic characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input capacitance | $V_{CE}$= 25 V, f = 1 MHz, $V_{GE}$ = 0 V | - | 2980 | - | pF |
| $C_{oes}$ | Output capacitance | | - | 150 | - | |
| $C_{res}$ | Reverse transfer capacitance | | - | 81 | - | |
| $Q_g$ | Total gate charge | $V_{CC}$ = 520 V, $I_C$ = 50 A, $V_{GE}$ = 0 to 15 V (see Figure 23. Gate charge test circuit) | - | 158 | - | nC |
| $Q_{ge}$ | Gate-emitter charge | | - | 25 | - | |
| $Q_{gc}$ | Gate-collector charge | | - | 72 | - | |

**Table 5. IGBT switching characteristics (inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(off)}$ | Turn-off-delay time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V, $R_G$ = 22 Ω (see Figure 21. Test circuit for inductive load switching) | - | 260 | - | ns |
| $t_f$ | Current fall time | | - | 17 | - | |
| $t_{d(off)}$ | Turn-off-delay time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V, $R_G$ = 22 Ω, $T_J$ = 175 °C (see Figure 21. Test circuit for inductive load switching) | - | 270 | - | ns |
| $t_f$ | Current fall time | | - | 24 | - | |


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**Table 6. IGBT switching characteristics (snubbed inductive load)**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $E_{off}$ (1) | Turn-off switching energy | L = 100 µH, $C_{snub}$ = 22 nF<br>$V_{CC}$ = 320 V, $R_G$ = 10 Ω,<br>$I_C$ = 50 A<br>(see Figure 22. Test circuit for snubbed inductive load switching) | - | 284 | - | µJ |
| | | L = 100 µH, $C_{snub}$ = 22 nF,<br>$V_{CC}$ = 320 V, $R_G$ = 10 Ω,<br>$I_C$ = 50 A, $T_J$ = 175 °C<br>(see Figure 22. Test circuit for snubbed inductive load switching) | - | 469 | - | |

1. *Including the tail of the collector current.*


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## 2.1 Electrical characteristics (curves)

**Figure 1. Power dissipation vs case temperature**

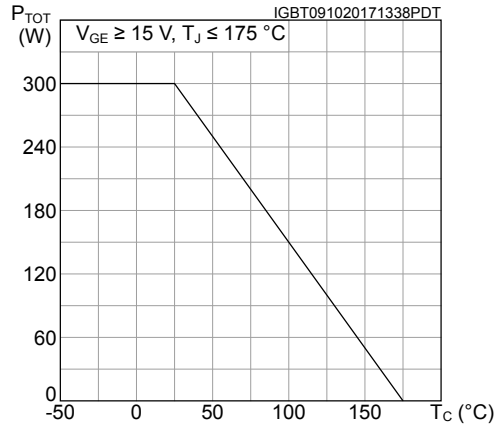


**Figure 2. Collector current vs case temperature**

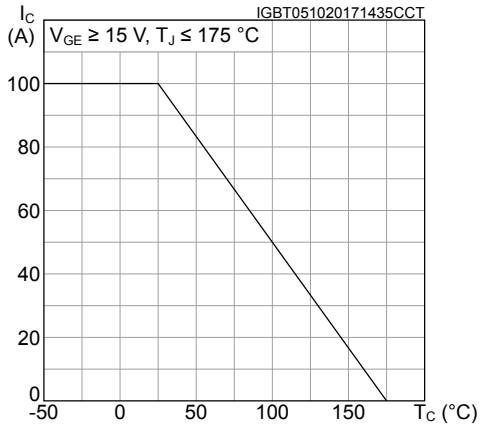


**Figure 3. Output characteristics ($T_J$ = 25 °C)**

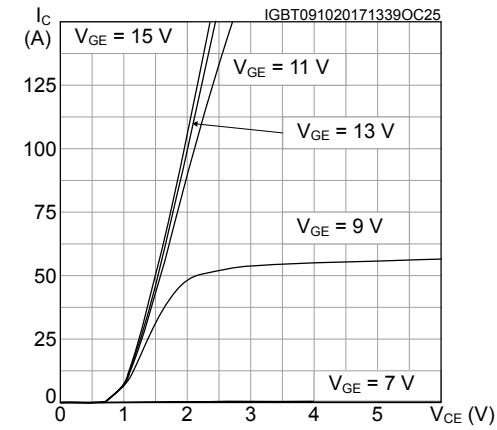


**Figure 4. Output characteristics ($T_J$ = 175 °C)**

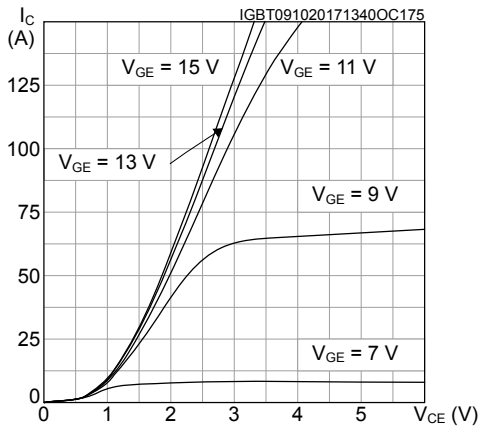


**Figure 5. $V_{CE(sat)}$ vs junction temperature**

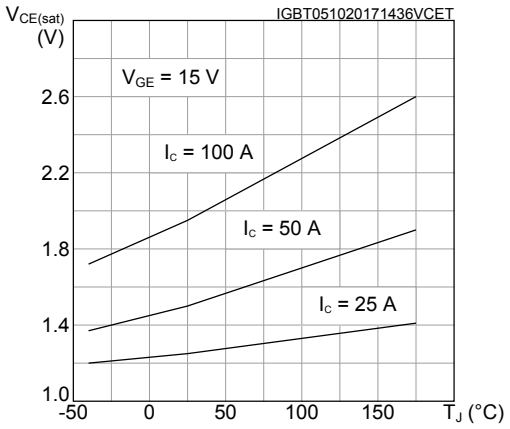


**Figure 6. $V_{CE(sat)}$ vs collector current**

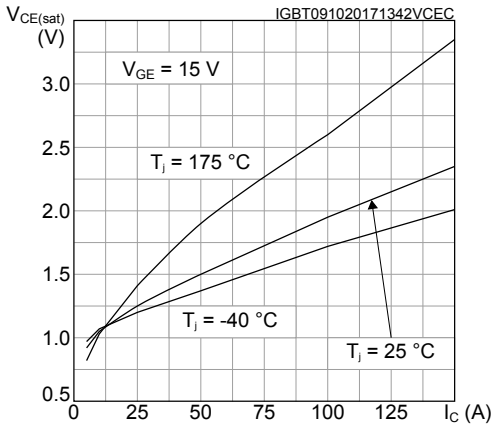



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**Figure 7. Forward bias safe operating area**

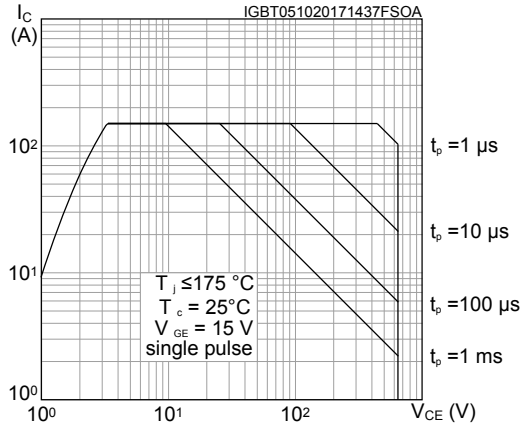


**Figure 8. Transfer characteristics**

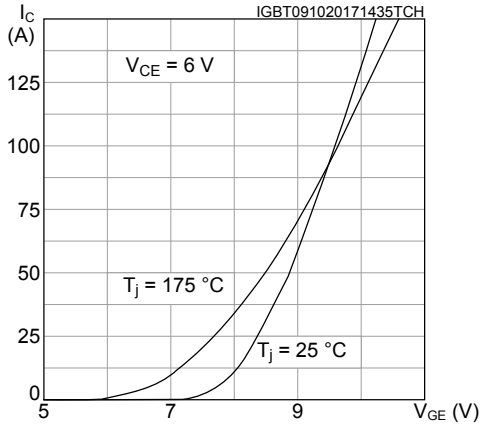


**Figure 9. Diode $V_F$ vs forward current**

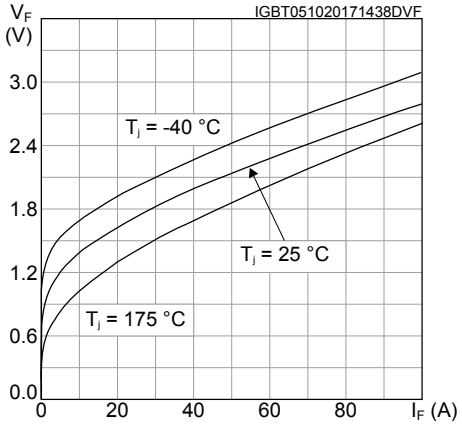


**Figure 10. Normalized $V_{GE(th)}$ vs junction temperature**

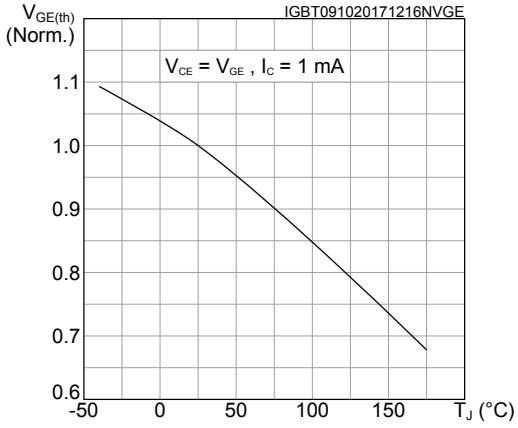


**Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature**

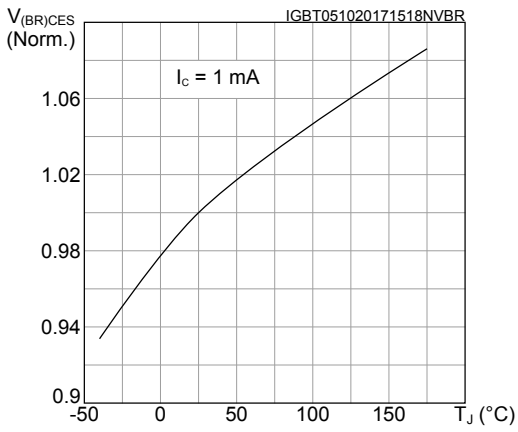


**Figure 12. Capacitance variations**

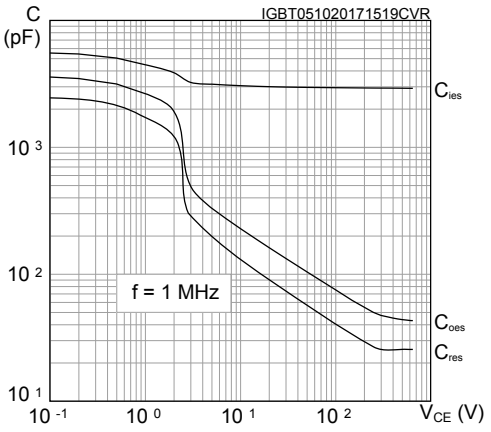



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**Figure 13. Gate charge vs gate-emitter voltage**

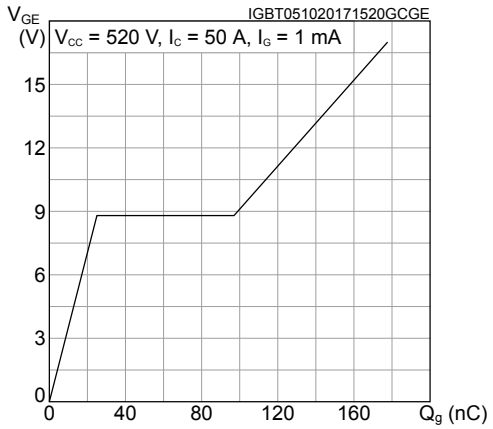


**Figure 14. Switching energy vs collector current**

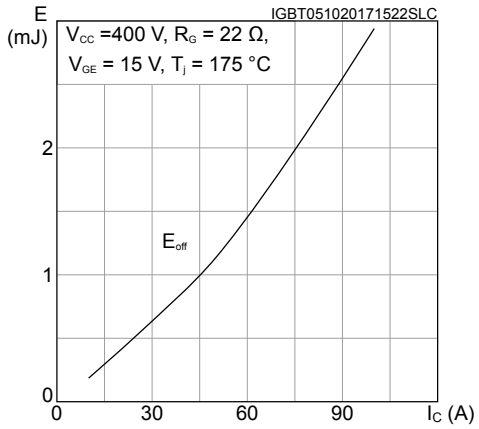


**Figure 15. Switching energy vs temperature**

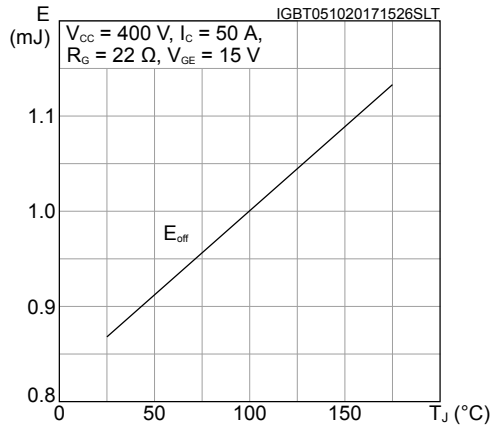


**Figure 16. Switching energy vs collector-emitter voltage**

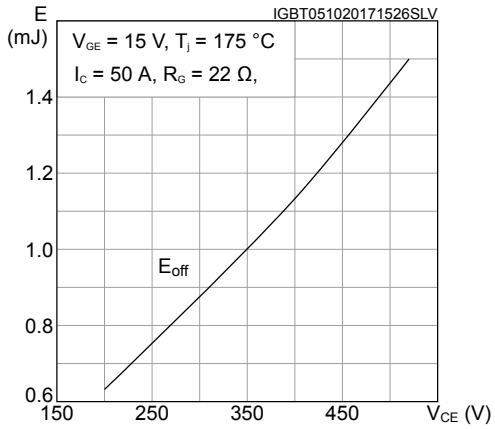


**Figure 17. Switching times vs collector current**

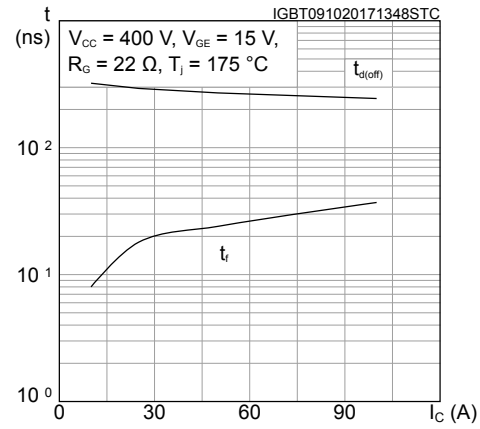


**Figure 18. Switching energy vs snubber capacitance**

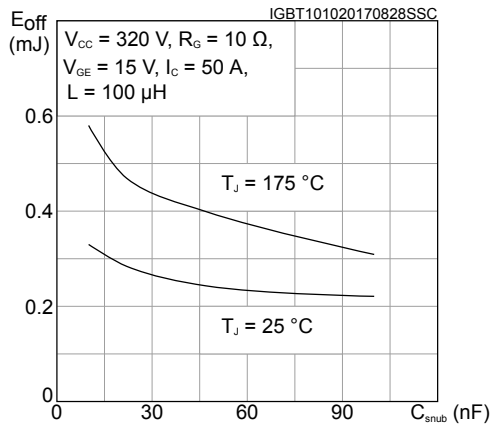



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Figure 19. **Thermal impedance for IGBT**

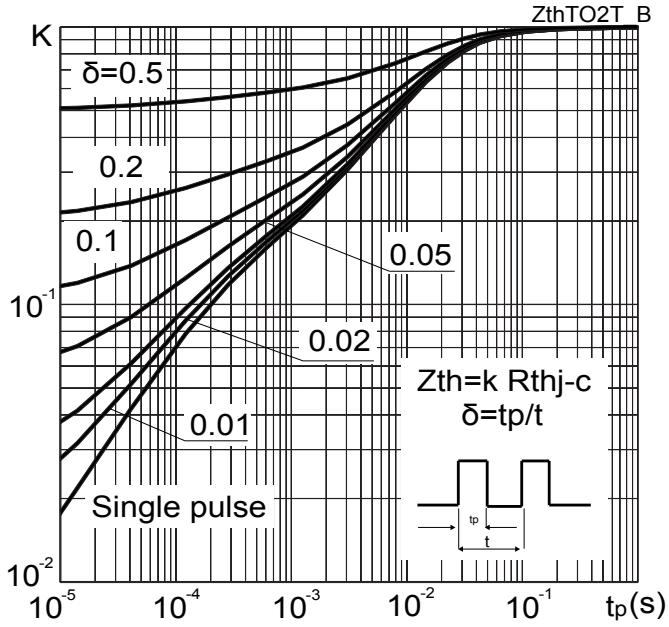
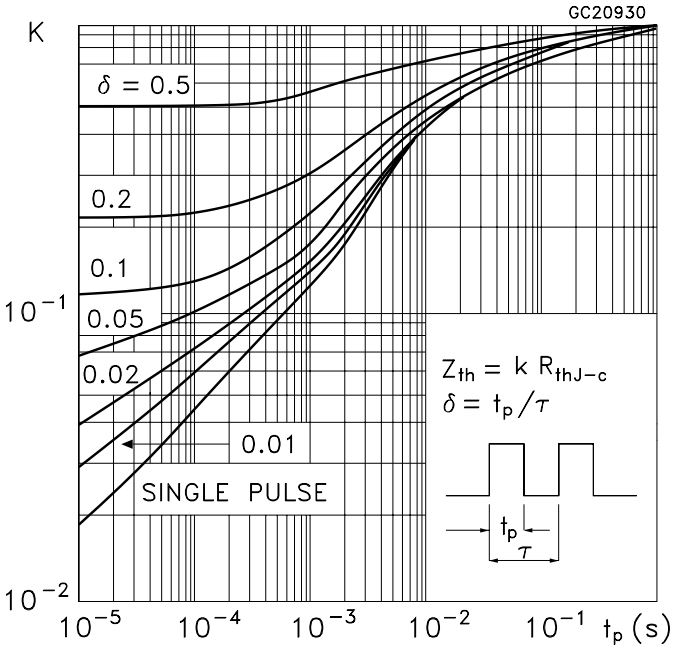



Figure 20. **Thermal impedance for diode**





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# 3 Test circuits

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

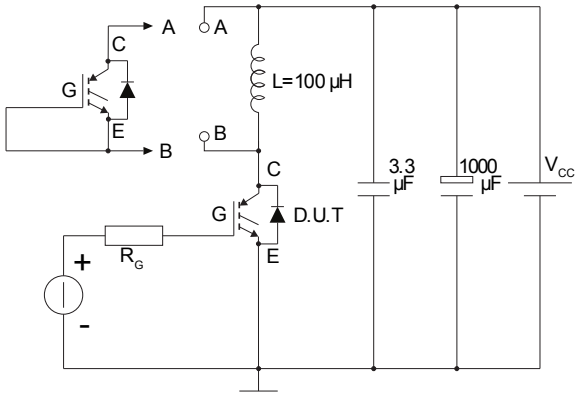



**Figure 22. Test circuit for snubbed inductive load switching**

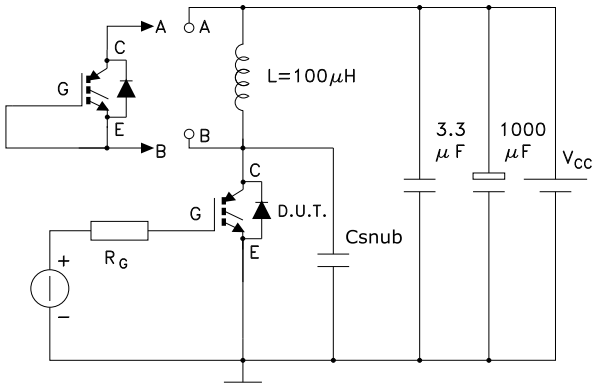



**Figure 23. Gate charge test circuit**

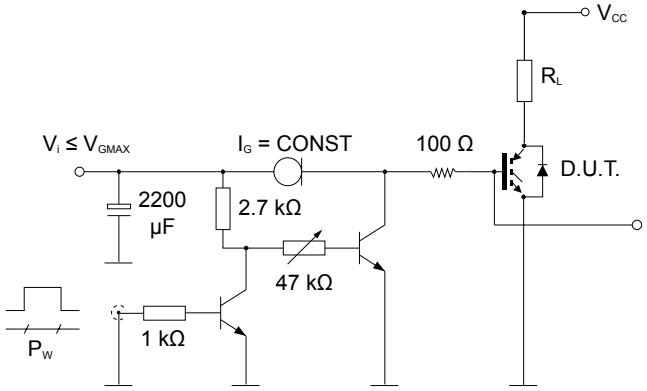
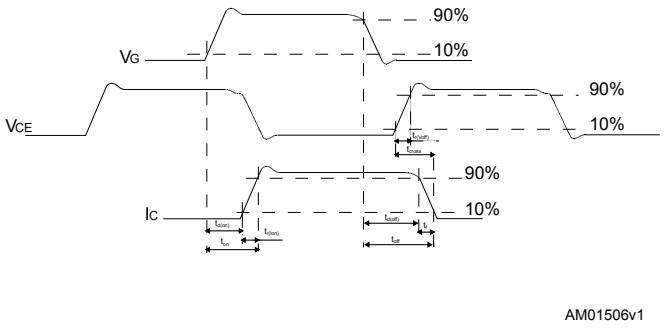



**Figure 24. Switching waveform**





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# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

## 4.1 TO-247 long leads package information

**Figure 25. TO-247 long leads package outline**

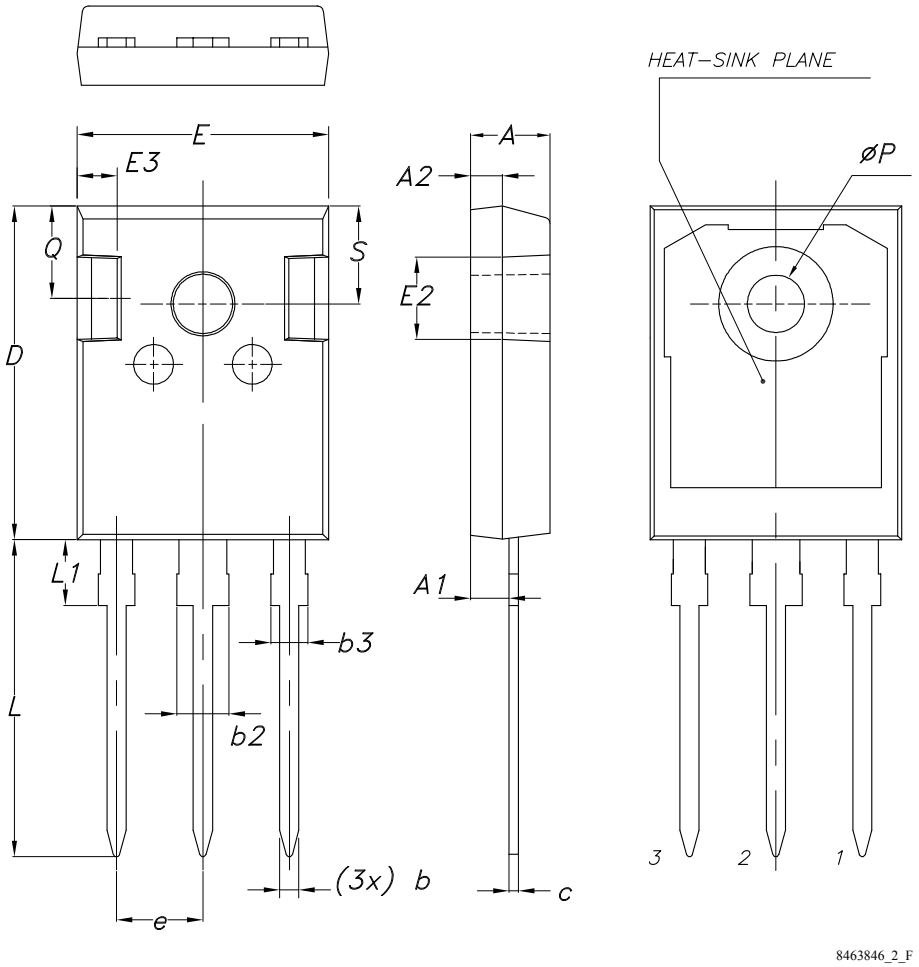



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Table 7. **TO-247 long leads package mechanical data**

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.90 | 5.00 | 5.10 |
| A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.16 | | 1.26 |
| b2 | | | 3.25 |
| b3 | | | 2.25 |
| c | 0.59 | | 0.66 |
| D | 20.90 | 21.00 | 21.10 |
| E | 15.70 | 15.80 | 15.90 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 5.34 | 5.44 | 5.54 |
| L | 19.80 | 19.92 | 20.10 |
| L1 | | | 4.30 |
| P | 3.50 | 3.60 | 3.70 |
| Q | 5.60 | | 6.00 |
| S | 6.05 | 6.15 | 6.25 |


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## Revision history

Table 8. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 02-Sep-2016 | 1 | First release. |
| 05-Oct-2017 | 2 | Modified title, silhouette, features and description.<br>Modified *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"*, *Table 4: "Static characteristics"*, *Table 5: "Dynamic characteristics"*, *Table 6: "IGBT switching characteristics (inductive load)"*and *Table 7: "IGBT switching characteristics (snubbed inductive load)"*.<br>Added *Section 2.1: "Electrical characteristics (curves)"*.<br>Minor text changes. |
| 15-Apr-2020 | 3 | Updated Internal schematic in cover page.<br>Updated Figure 13. Gate charge vs gate-emitter voltage.<br>Minor text changes. |


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# Contents




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