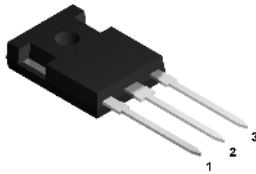
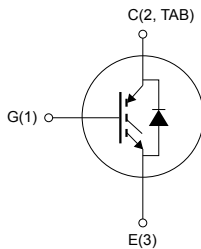


Trench gate field-stop 650 V, 50 A, soft switching IH series IGBT in a TO-247 long leads package



TO-247 long leads



NG1E3C2T

Features

- Designed for soft-commutation only
- Maximum junction temperature: $T_J = 175\text{ °C}$
- $V_{CE(sat)} = 1.5\text{ V (typ.) @ } I_C = 50\text{ A}$
- 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 |

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 | |

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified

Table 3. Static characteristics

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

Table 4. Dynamic characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------|------|------|
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$ | - | 2980 | - | pF |
| C_{oes} | Output capacitance | | - | 150 | - | |
| C_{res} | Reverse transfer capacitance | | - | 81 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}, I_C = 50\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$ (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 | $V_{CC} = 400\text{ V}, I_C = 50\text{ A},$ $V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega$ | - | 260 | - | ns |
| t_f | Current fall time | (see Figure 21. Test circuit for inductive load switching) | - | 17 | - | |
| $t_{d(off)}$ | Turn-off-delay time | $V_{CC} = 400\text{ V}, I_C = 50\text{ A},$ $V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega, T_J = 175\text{ °C}$ | - | 270 | - | ns |
| t_f | Current fall time | (see Figure 21. Test circuit for inductive load switching) | - | 24 | - | |

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 _s = 22 nF V _{CC} = 320 V, R _G = 10 Ω, I _C = 50 A (see Figure 22. Test circuit for snubbed inductive load switching) | - | 284 | - | μJ |
| | | L = 100 μH, C _s = 22 nF, V _{CC} = 320 V, R _G = 10 Ω, I _C = 50 A, T _J = 175 °C (see Figure 22. Test circuit for snubbed inductive load switching) | - | 469 | - | |

1. Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

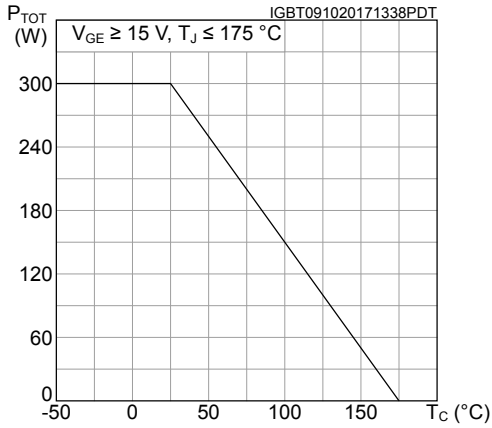


Figure 2. Collector current vs case temperature

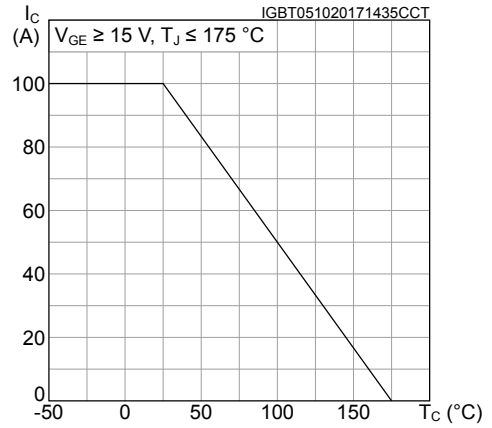


Figure 3. Output characteristics (T_J = 25 °C)

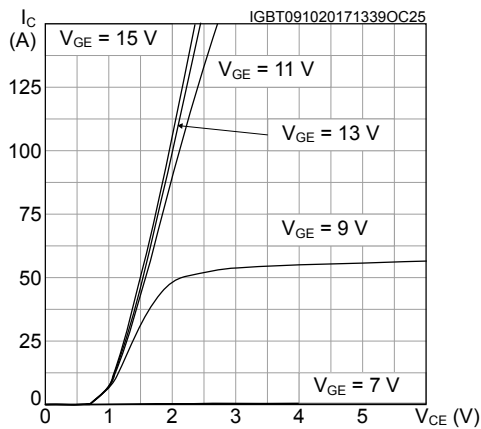


Figure 4. Output characteristics (T_J = 175 °C)

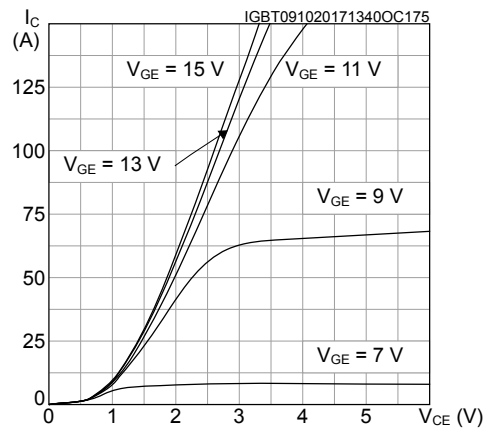


Figure 5. V_{CE(sat)} vs junction temperature

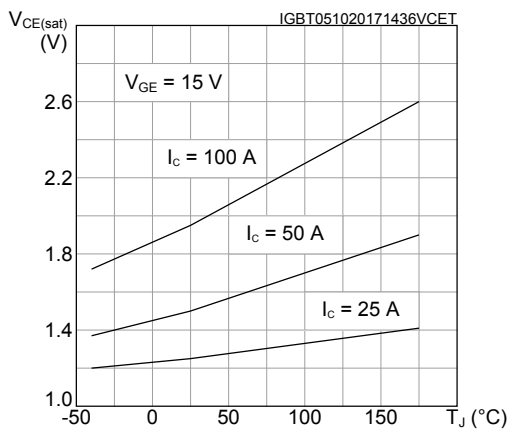


Figure 6. V_{CE(sat)} vs collector current

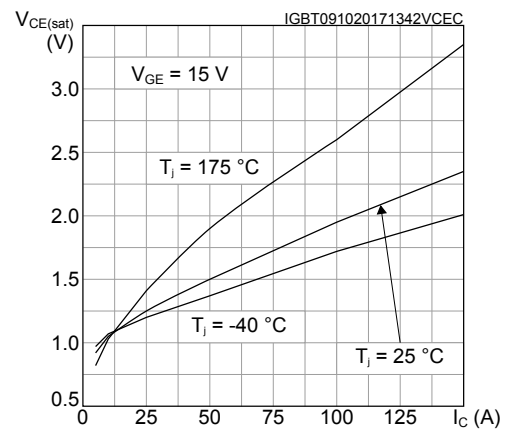


Figure 7. Forward bias safe operating area

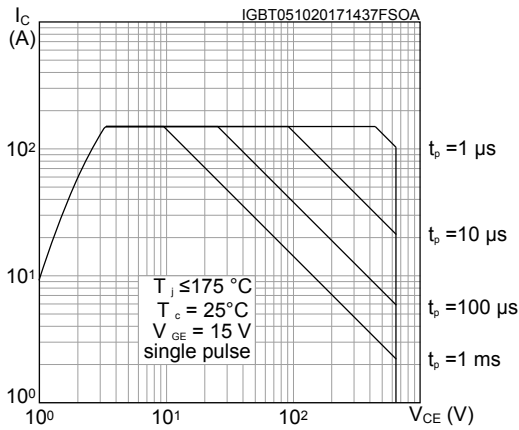


Figure 8. Transfer characteristics

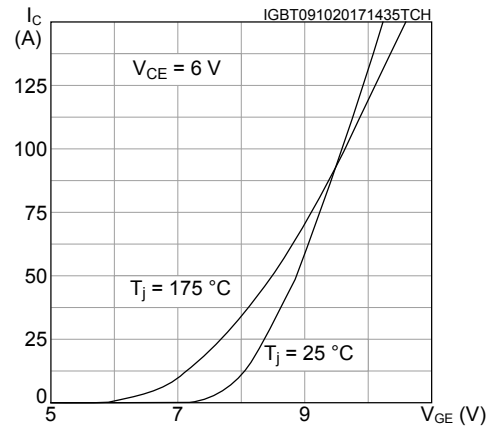


Figure 9. Diode V_F vs forward current

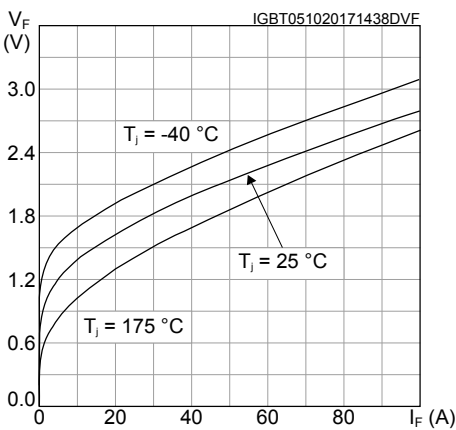


Figure 10. Normalized V_GE(th) vs junction temperature

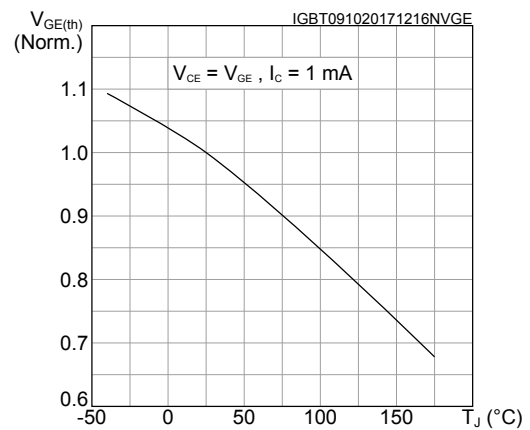


Figure 11. Normalized V_(BR)CES vs junction temperature

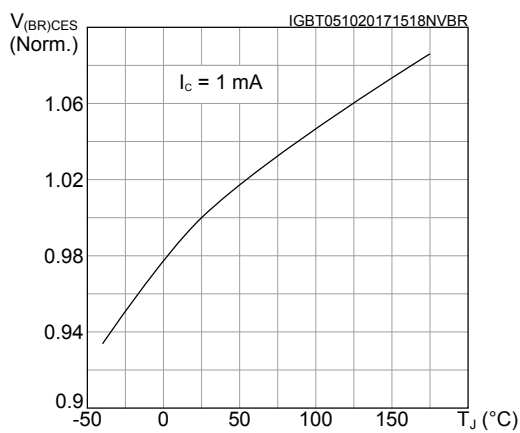


Figure 12. Capacitance variations

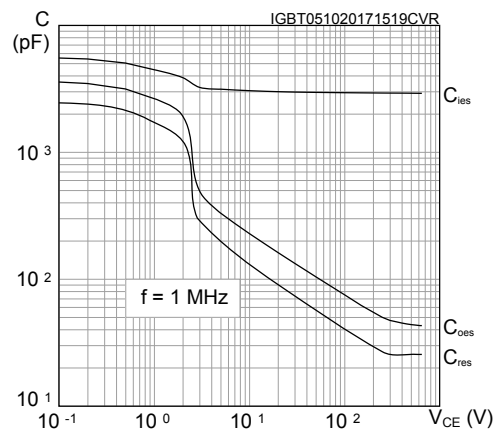


Figure 13. Gate charge vs gate-emitter voltage

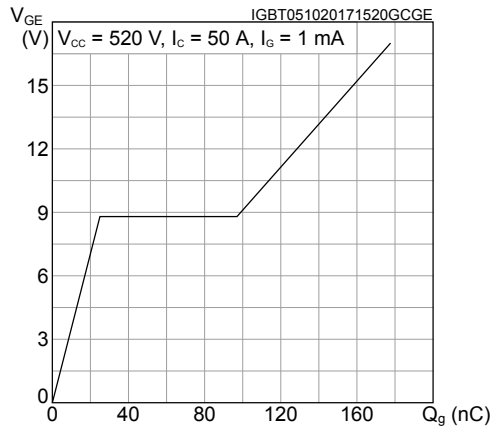


Figure 14. Switching energy vs collector current

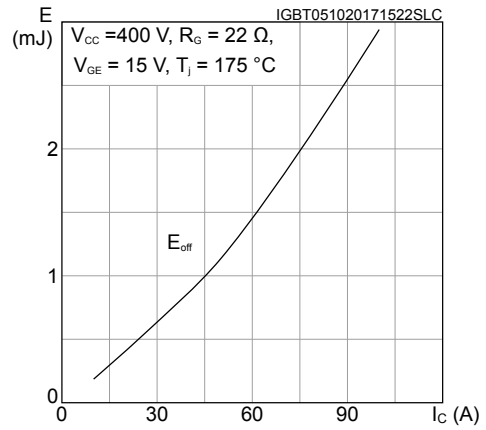


Figure 15. Switching energy vs temperature

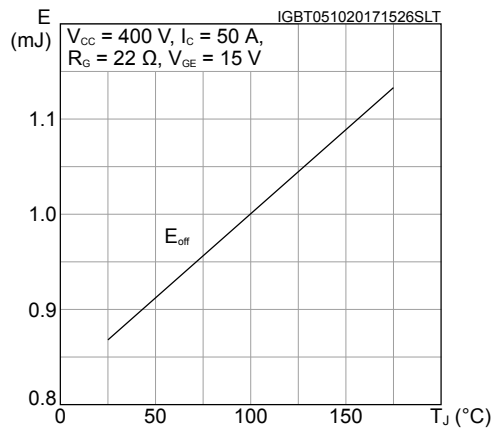


Figure 16. Switching energy vs collector-emitter voltage

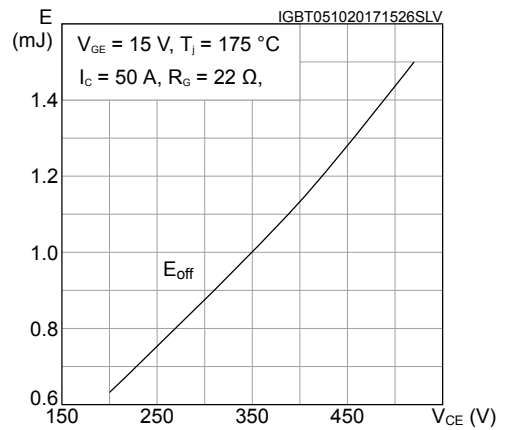


Figure 17. Switching times vs collector current

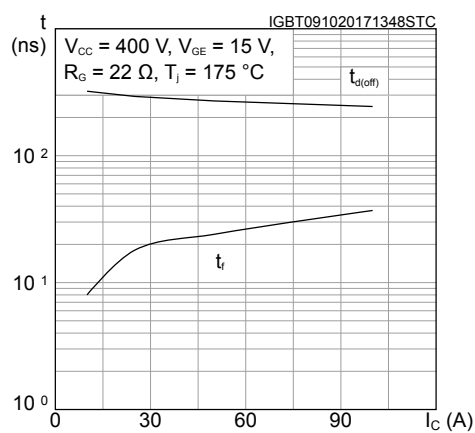


Figure 18. Switching energy vs snubber capacitance

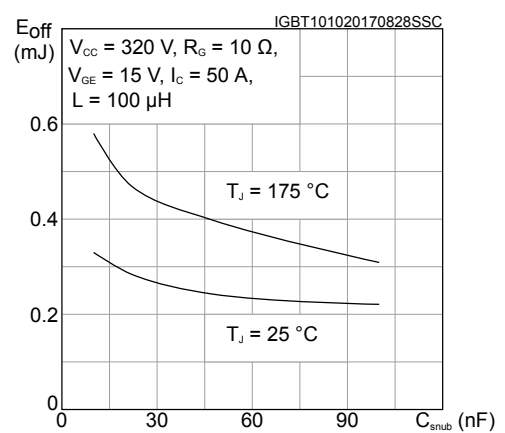


Figure 19. Thermal impedance for IGBT

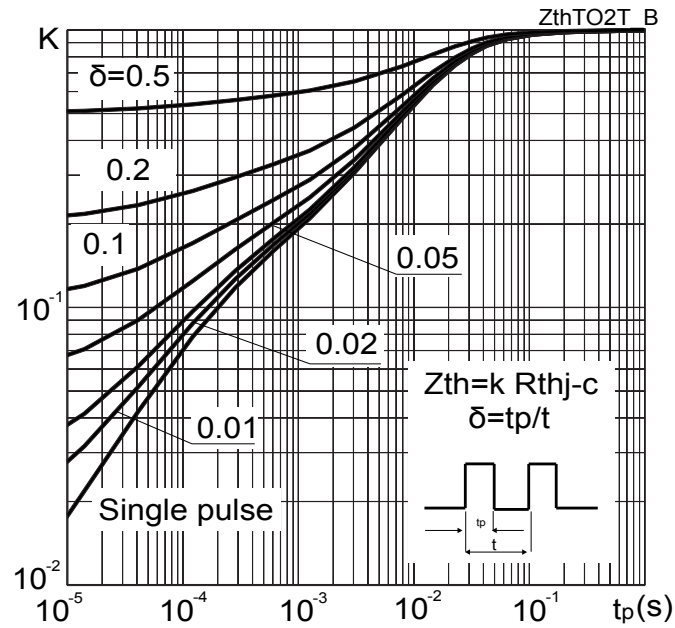
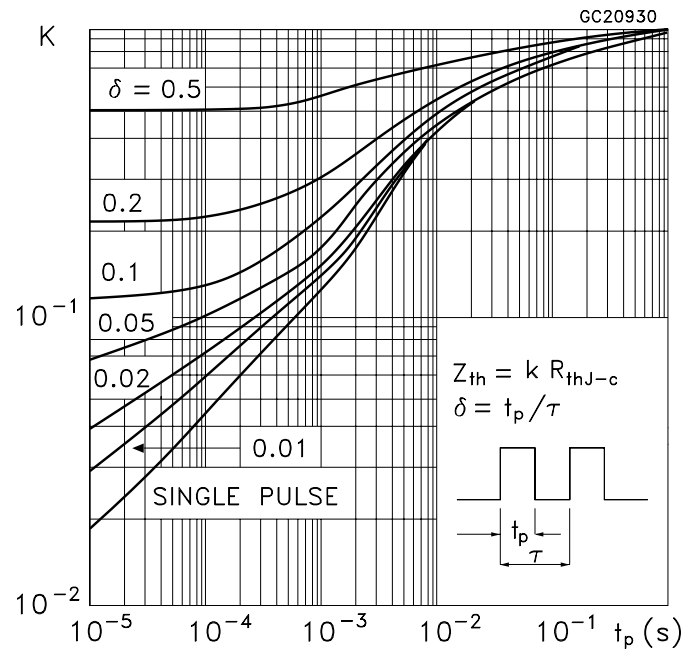


Figure 20. Thermal impedance for diode



3 Test circuits

Figure 21. Test circuit for inductive load switching

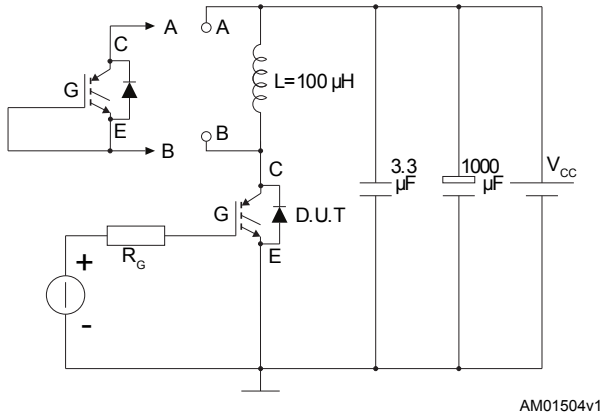


Figure 22. Test circuit for snubbed inductive load switching

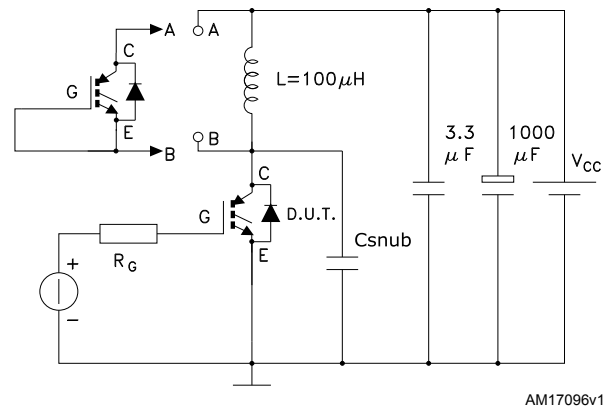


Figure 23. Gate charge test circuit

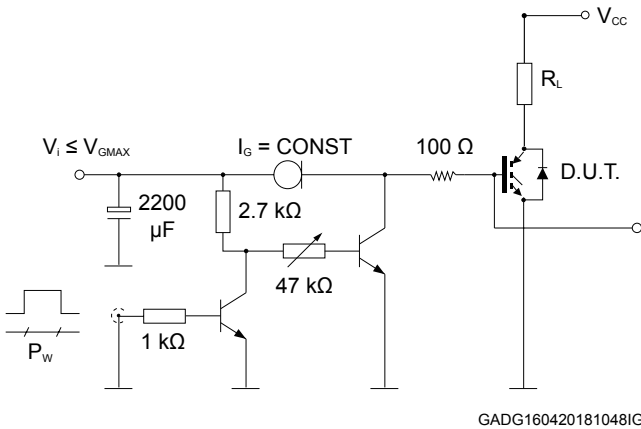
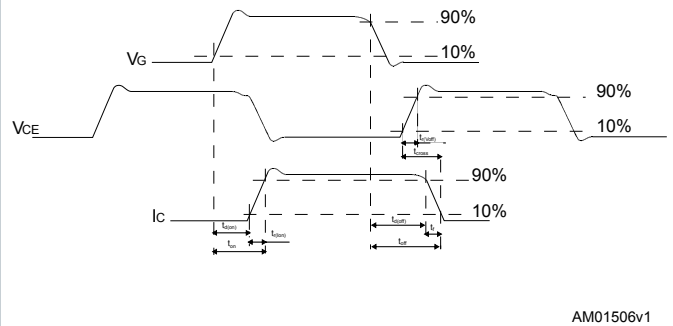


Figure 24. Switching waveform

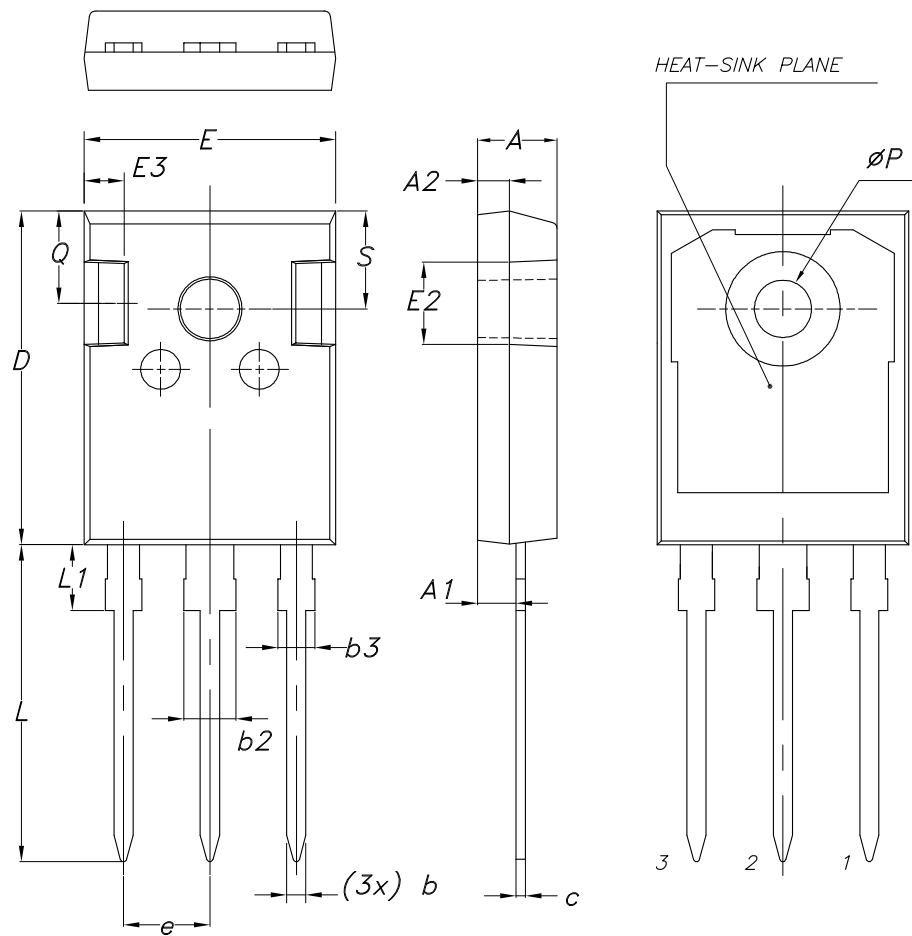


4 Package information

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



8463846_2_F

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 |

Revision history

Table 8. Document revision history

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

Contents

| | | |
|------------|--|-----------|
| 1 | Electrical ratings | 2 |
| 2 | Electrical characteristics | 3 |
| 2.1 | Electrical characteristics (curves) | 5 |
| 3 | Test circuits | 9 |
| 4 | Package information | 10 |
| 4.1 | TO-247 long leads package information | 10 |
| | Revision history | 12 |

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