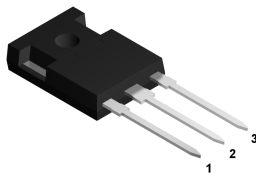
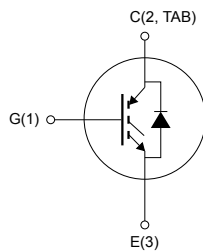


Trench gate field-stop 650 V, 40 A, soft-switching IH series IGBT in a TO-247 long leads package



TO-247 long leads



NG1E3C2T

Features

- Designed for soft commutation only
- Maximum junction temperature: $T_J = 175\text{ °C}$
- $V_{CE(sat)} = 1.5\text{ V (typ.) @ } I_C = 40\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low drop voltage 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

[STGWA40IH65DF](#)

Product summary

| | |
|-------------------|-------------------|
| Order code | STGWA40IH65DF |
| Marking | G40IH65DF |
| 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 | 80 | A |
| | Continuous collector current at $T_C = 100$ °C | 40 | |
| $I_{CP}^{(1)}$ | Pulsed collector current | 120 | A |
| V_{GE} | Gate-emitter voltage | ±20 | V |
| I_F | Continuous forward current at $T_C = 25$ °C | 40 | A |
| | Continuous forward current at $T_C = 100$ °C | 20 | |
| $I_{FP}^{(1)}$ | Pulsed forward current | 120 | |
| P_{TOT} | Total power dissipation at $T_C = 25$ °C | 238 | 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 | 0.63 | °C/W |
| | Thermal resistance junction-case diode | 2.08 | |
| 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 | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ | | 1.50 | 2.00 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 125\text{ °C}$ | | 1.75 | | |
| | | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175\text{ °C}$ | | 1.90 | | |
| V_F | Forward on-voltage | $I_F = 20\text{ A}$ | | 1.85 | 2.65 | V |
| | | $I_F = 20\text{ A}, T_J = 125\text{ °C}$ | | 1.60 | | |
| | | $I_F = 20\text{ A}, T_J = 175\text{ °C}$ | | 1.55 | | |
| | | $I_F = 40\text{ A}$ | | 2.30 | | |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$ | 5 | 6 | 7 | V |
| I_{CES} | Collector cut-off current | $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$ | | | 25 | μA |
| 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 | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$ | - | 2210 | - | pF |
| C_{oes} | Output capacitance | | - | 105 | - | |
| C_{res} | Reverse transfer capacitance | | - | 63 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}, I_C = 40\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 23. Gate charge test circuit) | - | 114 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 21 | - | |
| Q_{gc} | Gate-collector charge | | - | 49 | - | |

Table 5. IGBT switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------|--|------|------|------|------|
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, | - | 210 | - | ns |
| t_f | Current fall time | $V_{GE} = 15\text{ V}$, $R_G = 22\ \Omega$ (see Figure 21. Test circuit for inductive load switching) | - | 12.5 | - | |
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, | - | 216 | - | ns |
| t_f | Current fall time | $V_{GE} = 15\text{ V}$, $R_G = 22\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 21. Test circuit for inductive load switching) | - | 47 | - | ns |

Table 6. IGBT switching characteristics (capacitive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---|------|------|------|---------------|
| $E_{off}^{(1)}$ | Turn-off switching energy | $V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 40\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$ (see Figure 22. Test circuit for snubbed inductive load switching) | - | 190 | - | μJ |
| | | $V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 40\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 22. Test circuit for snubbed inductive load switching) | - | 385 | - | |

1. Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

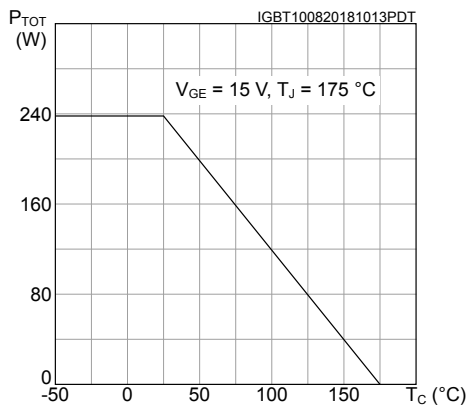


Figure 2. Collector current vs case temperature

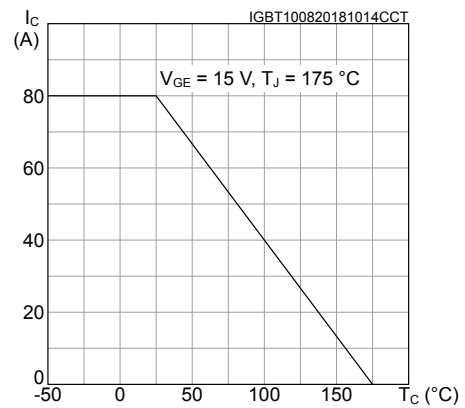


Figure 3. Output characteristics ($T_J = 25\text{ }^\circ\text{C}$)

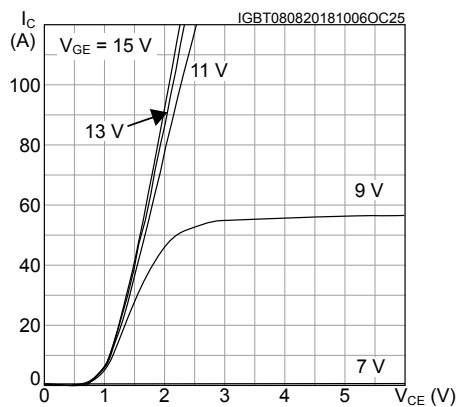


Figure 4. Output characteristics ($T_J = 175\text{ }^\circ\text{C}$)

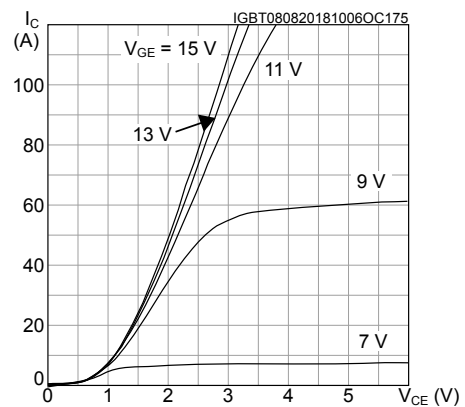


Figure 5. $V_{CE(sat)}$ vs junction temperature

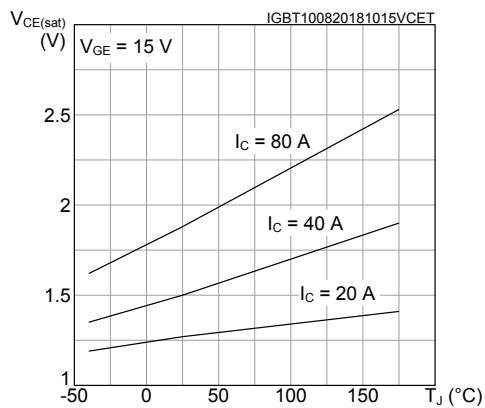


Figure 6. $V_{CE(sat)}$ vs collector current

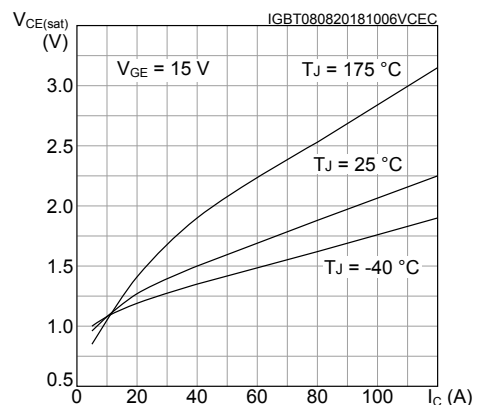


Figure 7. Forward bias safe operating area

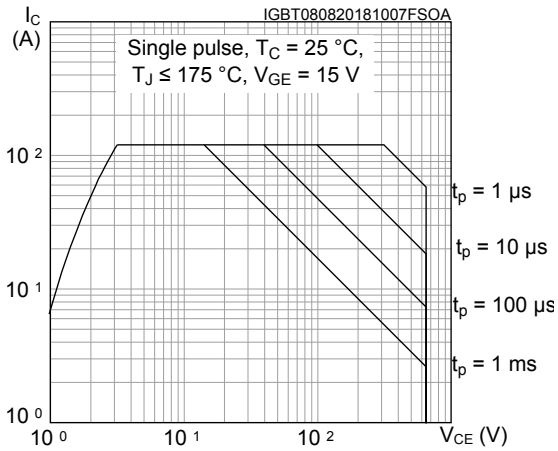


Figure 8. Transfer characteristics

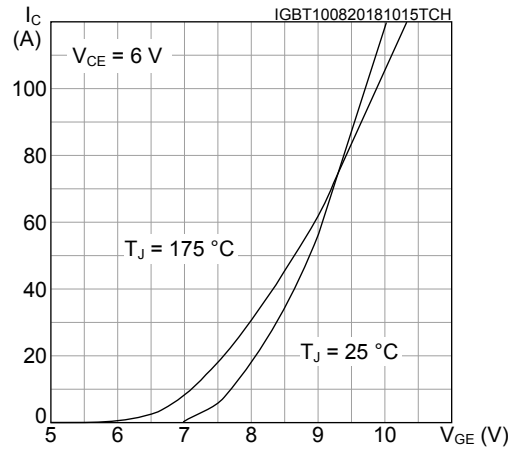


Figure 9. Diode V_F vs forward current

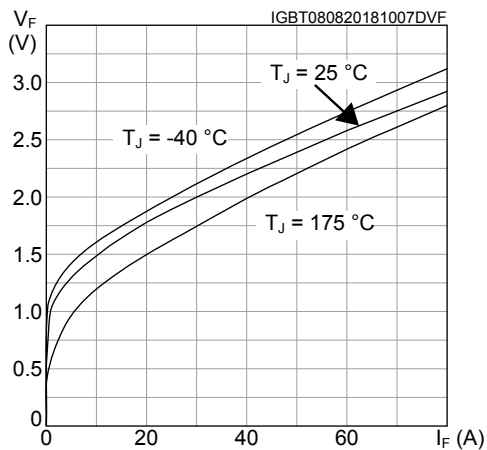


Figure 10. Normalized V_GE(th) vs junction temperature

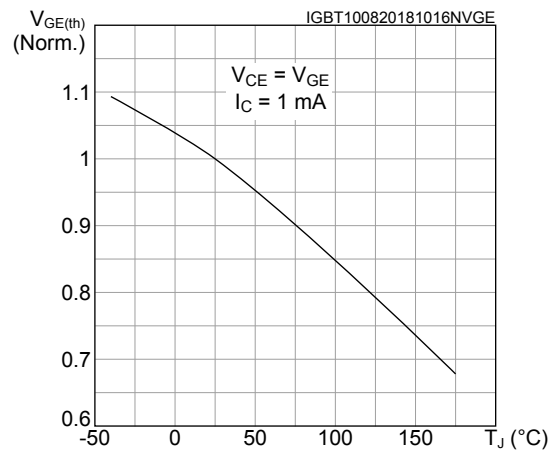


Figure 11. Normalized V_(BR)CES vs junction temperature

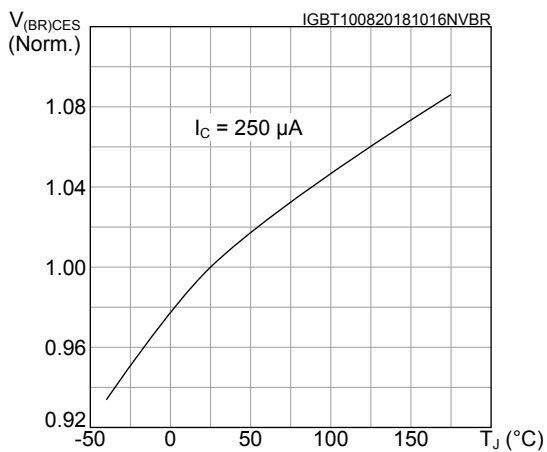


Figure 12. Capacitance variations

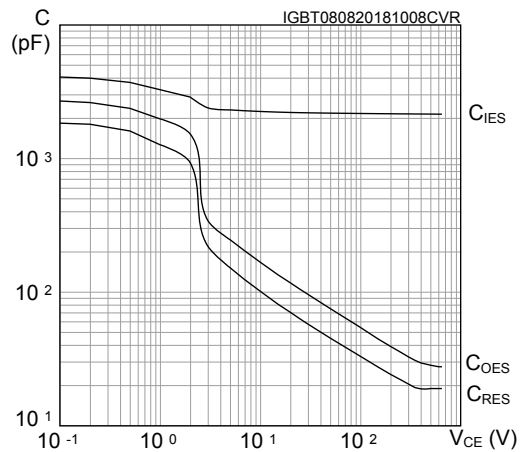


Figure 13. Gate charge vs gate-emitter voltage

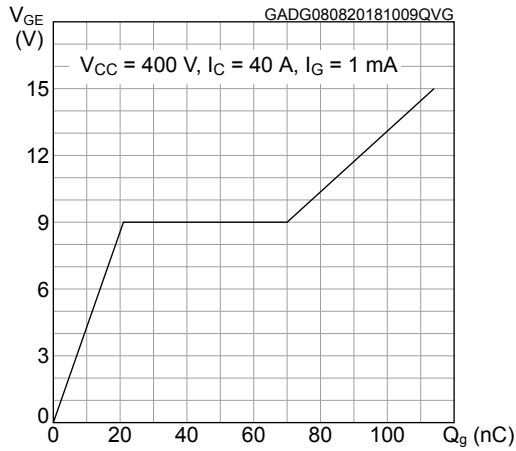


Figure 14. Switching energy vs collector current

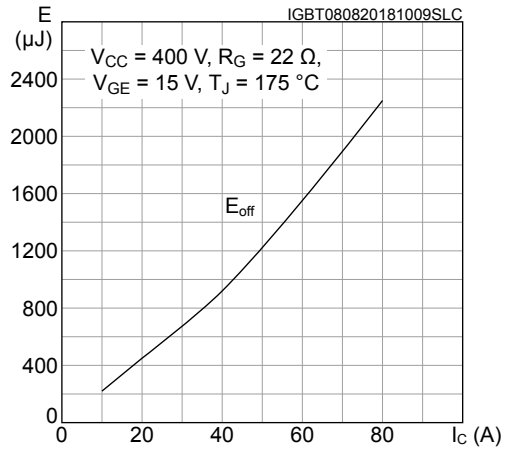


Figure 15. Switching energy vs temperature

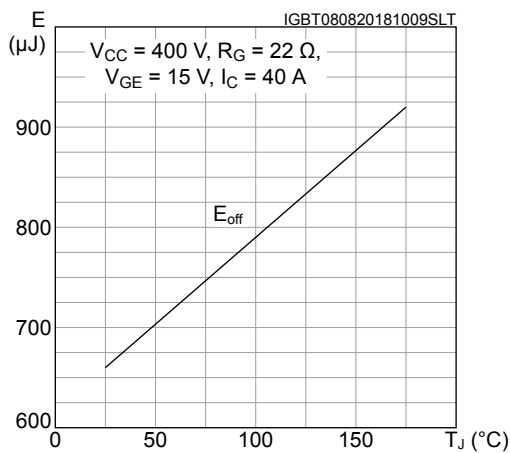


Figure 16. Switching energy vs collector emitter voltage

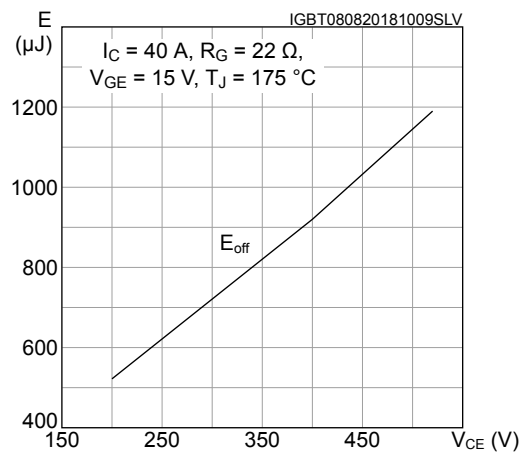


Figure 17. Switching times vs collector current

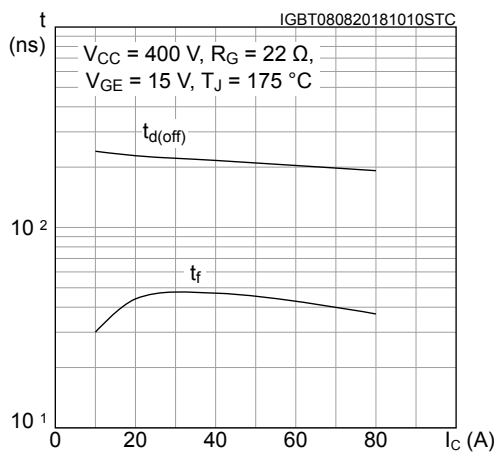


Figure 18. Switching energy vs snubber capacitance

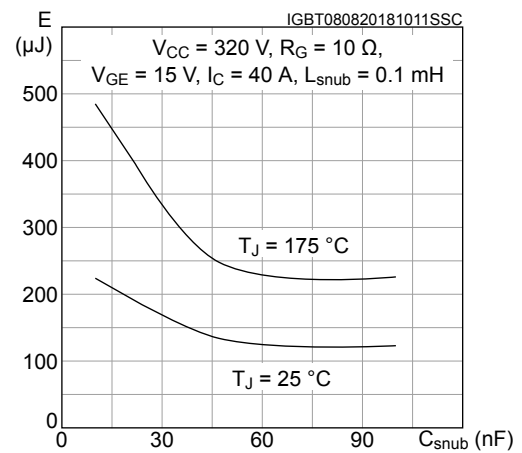


Figure 19. Thermal impedance for IGBT

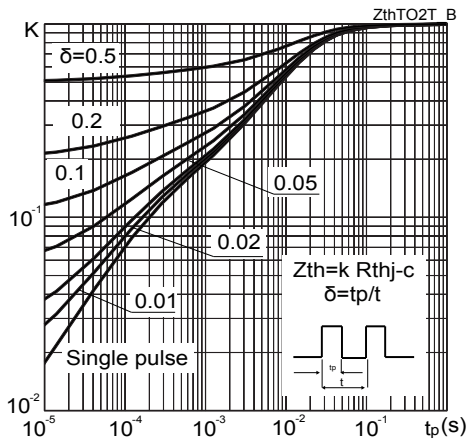
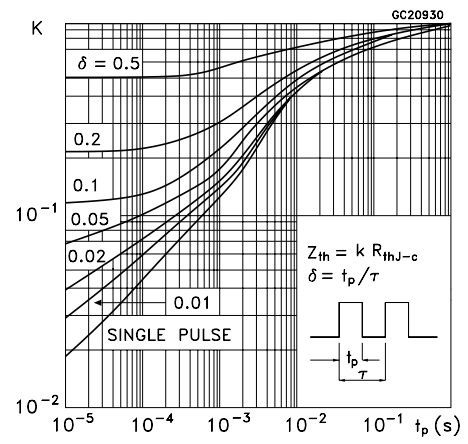
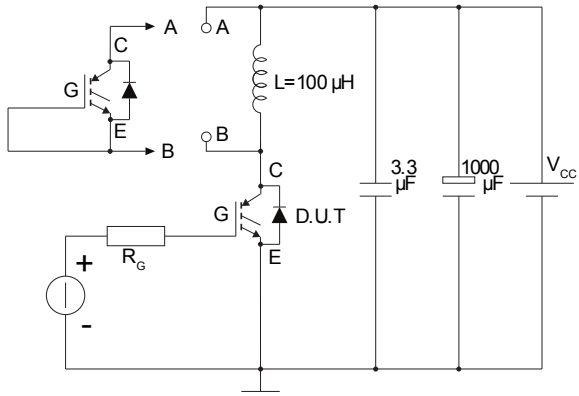
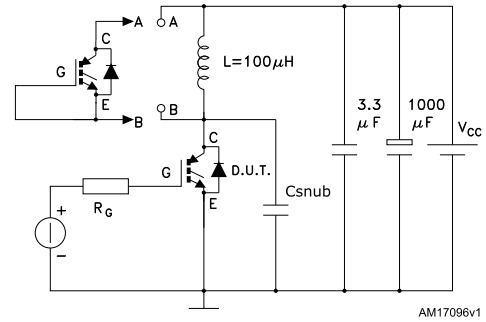
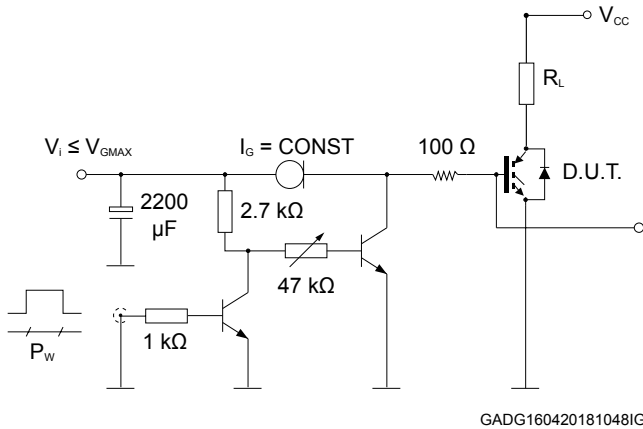
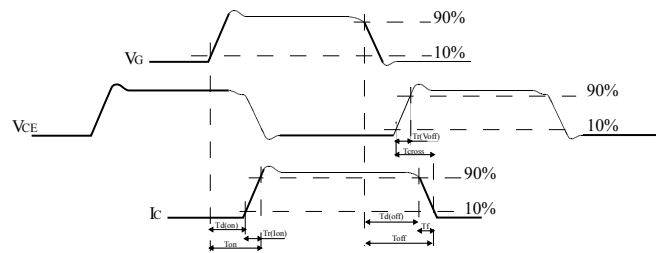


Figure 20. Thermal impedance for diode



3 Test circuits

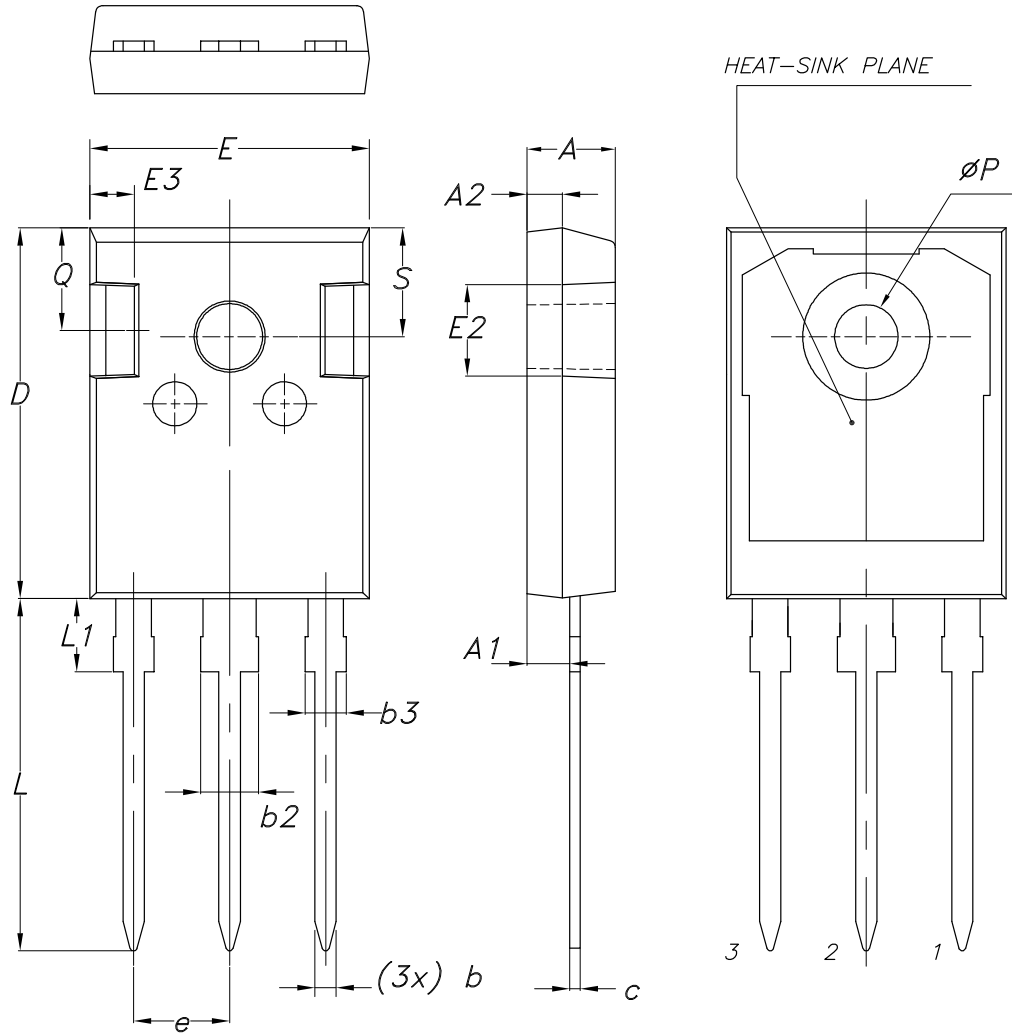
Figure 21. Test circuit for inductive load switching

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. |
| 10-Aug-2018 | 2 | Updated features on cover page. Updated <i>Section 1 Electrical ratings</i> and <i>Section 2 Electrical characteristics</i> . Added <i>Section 2.1 Electrical characteristics (curves)</i> . Minor text changes. |
| 24-Sep-2018 | 3 | Updated schematic on cover page. Updated Section 2.1 Electrical characteristics (curves) . Minor text changes |

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 | 13 |

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