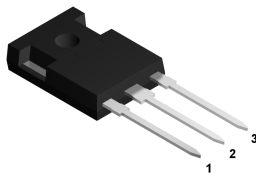
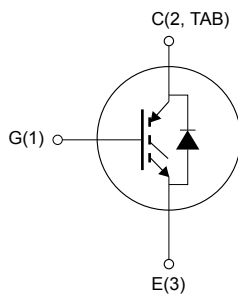


Trench gate field-stop, 650 V, 40 A, high-speed HB2 series IGBT in a TO-247 long leads package



TO-247 long leads



NG1E3C2T



Features

- Maximum junction temperature : $T_J = 175\text{ }^\circ\text{C}$
- Low $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 40\text{ A}$
- Co-packaged protection diode
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Welding
- Power factor correction

Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performance of the HB2 series is optimized in terms of conduction, thanks to a better $V_{CE(sat)}$ behavior at low current values, as well as in terms of reduced switching energy. A diode used for protection purposes only is co-packaged in antiparallel with the IGBT. The result is a product specifically designed to maximize efficiency for a wide range of fast applications.

Product status link

[STGWA40HP65FB2](#)

Product summary

| | |
|------------|-------------------|
| Order code | STGWA40HP65FB2 |
| Marking | G40HP65FB2 |
| 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 | 72 | A |
| | Continuous collector current at $T_C = 100$ °C | 45 | A |
| $I_{CP}^{(1)(2)}$ | Pulsed collector current | 120 | A |
| V_{GE} | Gate-emitter voltage | ±20 | V |
| | Transient gate-emitter voltage ($t_p \leq 10$ µs) | ±30 | |
| I_F | Continuous forward current at $T_C = 25$ °C | 5 | A |
| | Continuous forward current at $T_C = 100$ °C | 5 | |
| $I_{FP}^{(1)(2)}$ | Pulsed forward current | 10 | A |
| P_{TOT} | Total power dissipation at $T_C = 25$ °C | 230 | W |
| T_{STG} | Storage temperature range | -55 to 150 | °C |
| T_J | Operating junction temperature range | -55 to 175 | °C |

1. Pulse width is limited by maximum junction temperature.
2. Defined by design, not subject to production test.

Table 2. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|--|-------|------|
| R_{thJC} | Thermal resistance junction-case IGBT | 0.65 | °C/W |
| | Thermal resistance junction-case diode | 5 | |
| 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 | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$ | 650 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ | | 1.55 | 2 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 125\text{ °C}$ | | 1.75 | | |
| | | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175\text{ °C}$ | | 1.85 | | |
| V_F | Forward on-voltage | $I_F = 5\text{ A}$ | | 2 | 2.8 | V |
| | | $I_F = 5\text{ A}, T_J = 125\text{ °C}$ | | 1.85 | | |
| | | $I_F = 5\text{ A}, T_J = 175\text{ °C}$ | | 1.75 | | |
| $V_{GE(th)}$ | 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 | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$ | - | 2300 | - | pF |
| C_{oes} | Output capacitance | | - | 122 | - | |
| C_{res} | Reverse transfer capacitance | | - | 64 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}, I_C = 40\text{ A},$ | - | 153 | - | nC |
| Q_{ge} | Gate-emitter charge | $V_{GE} = 0\text{ to }15\text{ V}$ | - | 29 | - | |
| Q_{gc} | Gate-collector charge | (see Figure 27. Gate charge test circuit) | - | 67 | - | |

Table 5. Switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---|------|------|------|---------------|
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, | - | 125 | - | ns |
| t_f | Current fall time | $V_{GE} = 15\text{ V}$, $R_G = 4.7\ \Omega$ | - | 24 | - | ns |
| $E_{off}^{(1)}$ | Turn-off switching energy | (see Figure 26. Test circuit for inductive load switching) | - | 410 | - | μJ |
| $t_{d(off)}$ | Turn-off delay time | $V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, | - | 131 | - | ns |
| t_f | Current fall time | $V_{GE} = 15\text{ V}$, $R_G = 4.7\ \Omega$, | - | 58 | - | ns |
| $E_{off}^{(1)}$ | Turn-off switching energy | $T_J = 175\text{ }^\circ\text{C}$ (see Figure 26. Test circuit for inductive load switching) | - | 780 | - | μJ |

1. Including the tail of the collector current.

Table 6. Diode switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|--------------|--|--|------|------|------|------------------------|
| t_{rr} | Reverse recovery time | $I_F = 5\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 29. Diode reverse recovery waveform) | - | 140 | - | ns |
| Q_{rr} | Reverse recovery charge | | - | 21 | - | nC |
| I_{rrm} | Reverse recovery current | | - | 6.6 | - | A |
| di_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 430 | - | $\text{A}/\mu\text{s}$ |
| E_{rr} | Reverse recovery energy | | - | 1.6 | - | μJ |
| t_{rr} | Reverse recovery time | $I_F = 5\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 29. Diode reverse recovery waveform) | - | 200 | - | ns |
| Q_{rr} | Reverse recovery charge | | - | 47.3 | - | nC |
| I_{rrm} | Reverse recovery current | | - | 9.6 | - | A |
| di_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 428 | - | $\text{A}/\mu\text{s}$ |
| E_{rr} | Reverse recovery energy | | - | 3.2 | - | μJ |

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

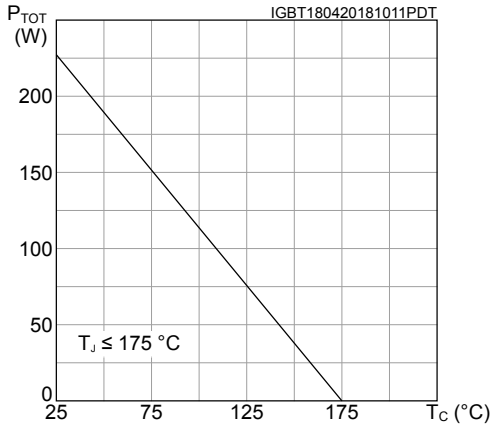


Figure 2. Collector current vs case temperature

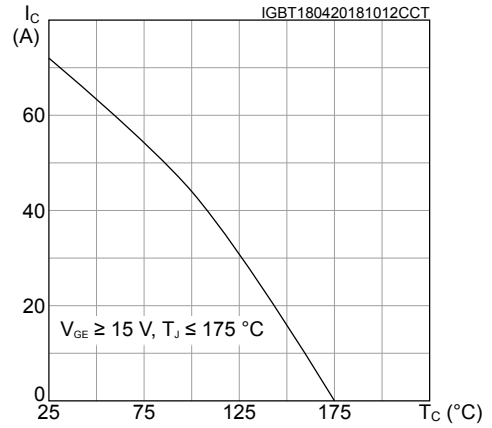


Figure 3. Output characteristics ($T_J = 25^{\circ}C$)

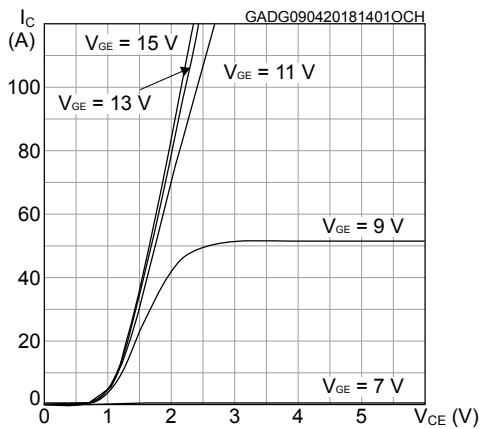


Figure 4. Output characteristics ($T_J = 175^{\circ}C$)

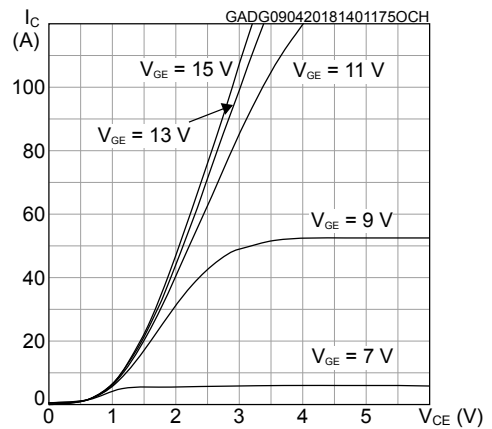


Figure 5. $V_{CE(sat)}$ vs junction temperature

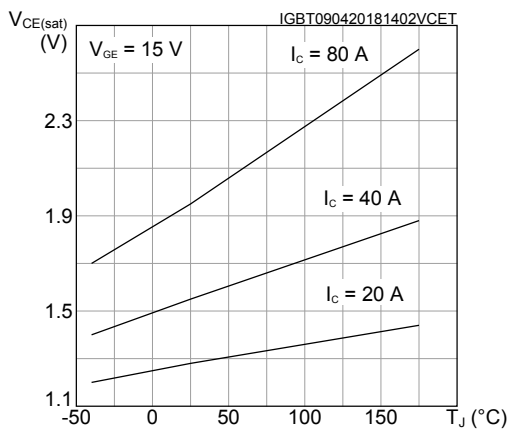


Figure 6. $V_{CE(sat)}$ vs collector current

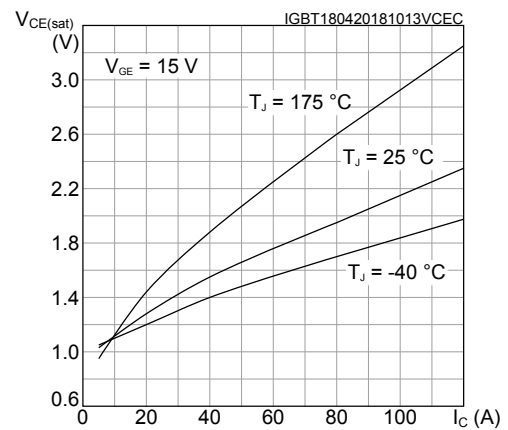


Figure 7. Forward bias safe operating area

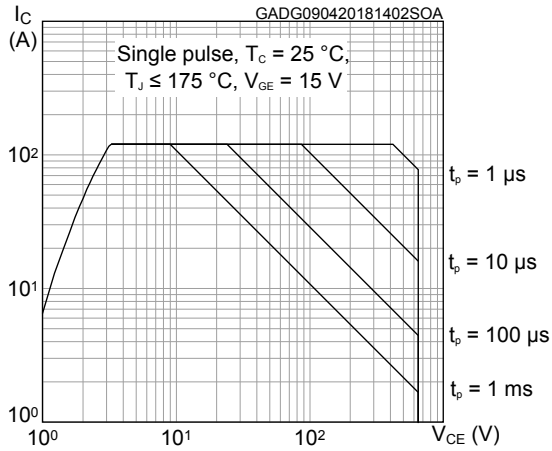


Figure 8. Transfer characteristics

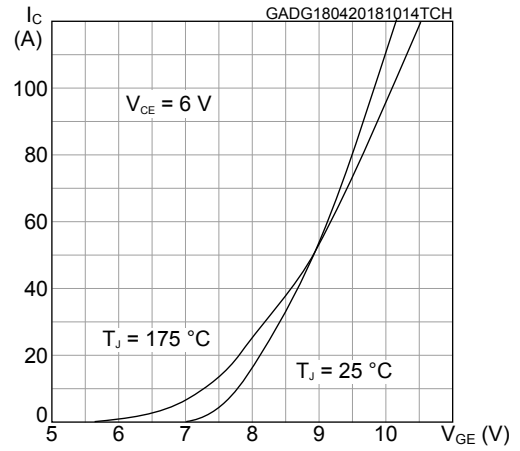


Figure 9. Diode V_F vs forward current

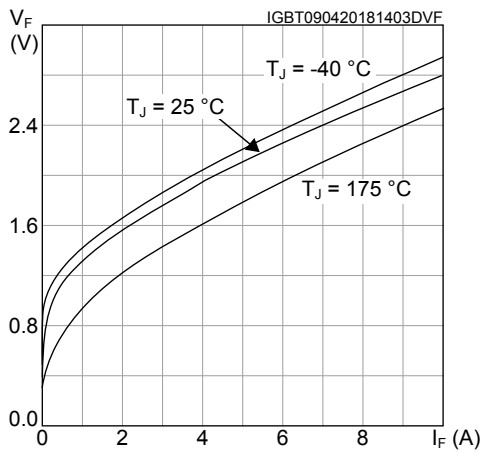


Figure 10. Normalized V_GE(th) vs junction temperature

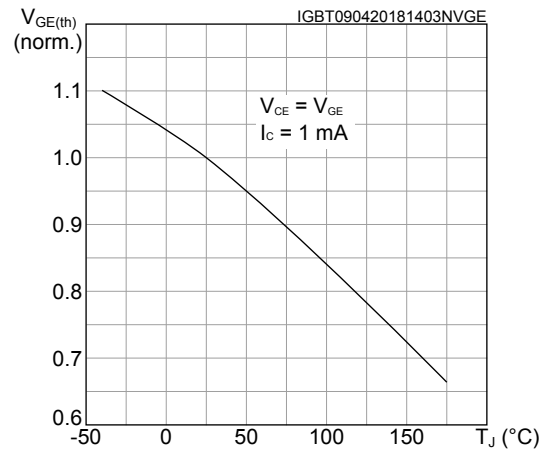


Figure 11. Normalized V_(BR)CES vs junction temperature

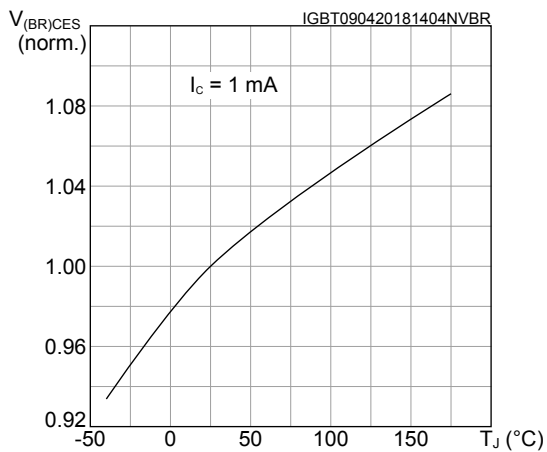


Figure 12. Capacitance variations

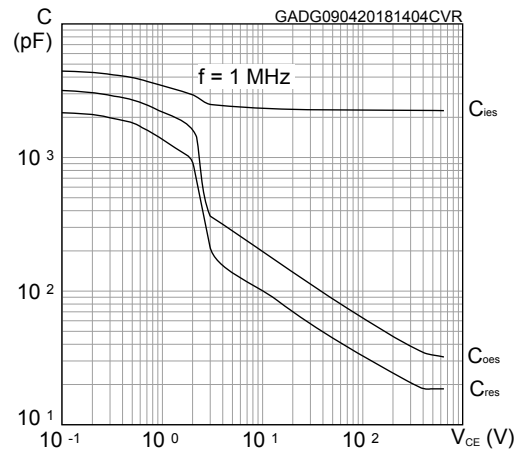


Figure 13. Gate charge vs gate-emitter voltage

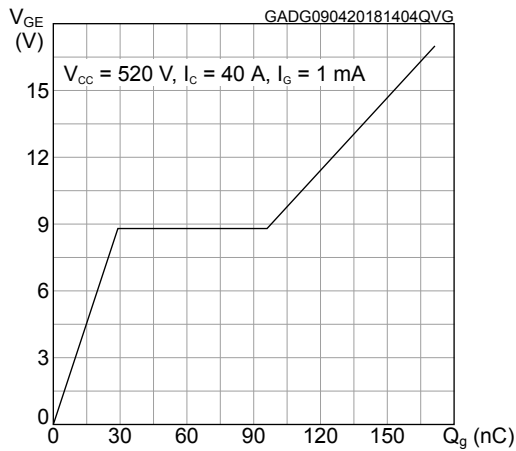


Figure 14. Switching energy vs collector current

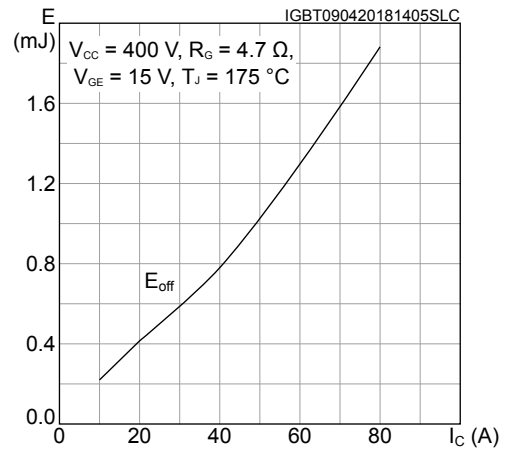


Figure 15. Switching energy vs temperature

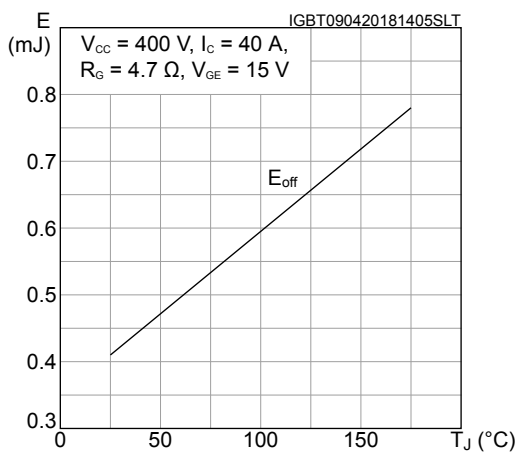


Figure 16. Switching energy vs collector emitter voltage

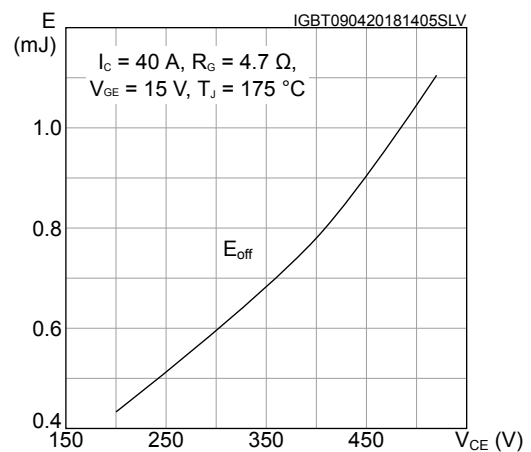


Figure 17. Switching energy vs gate resistance

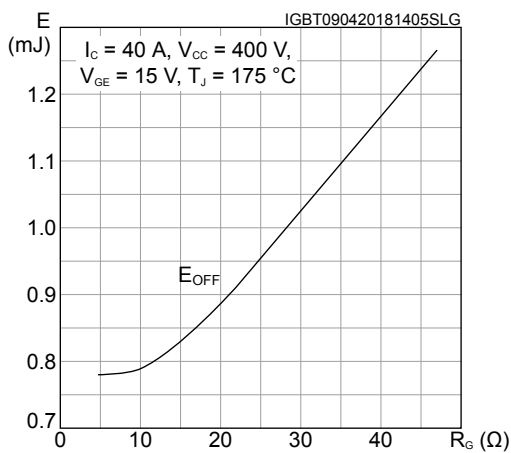


Figure 18. Switching times vs collector current

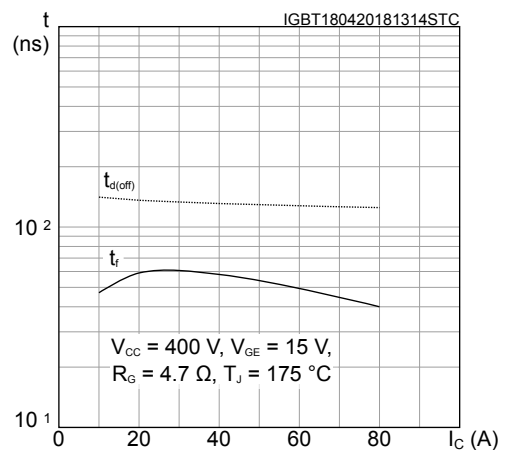


Figure 19. Switching times vs gate resistance

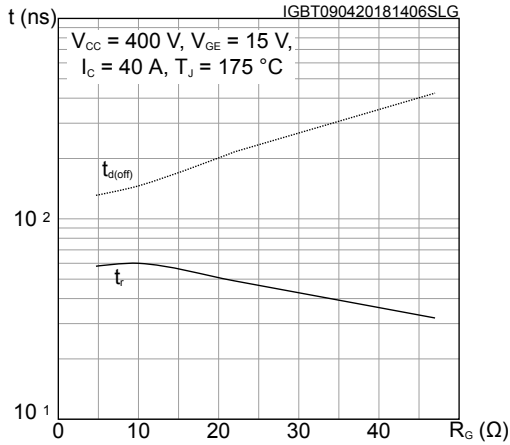


Figure 20. Reverse recovery current vs diode current slope

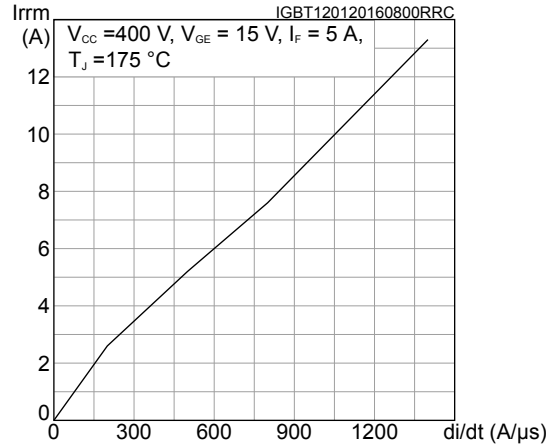


Figure 21. Reverse recovery time vs diode current slope

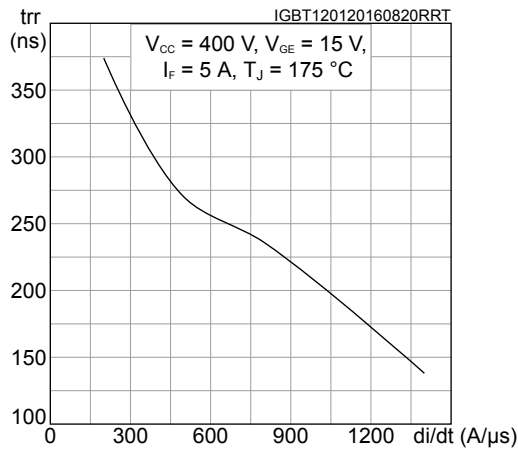


Figure 22. Reverse recovery charge vs diode current slope

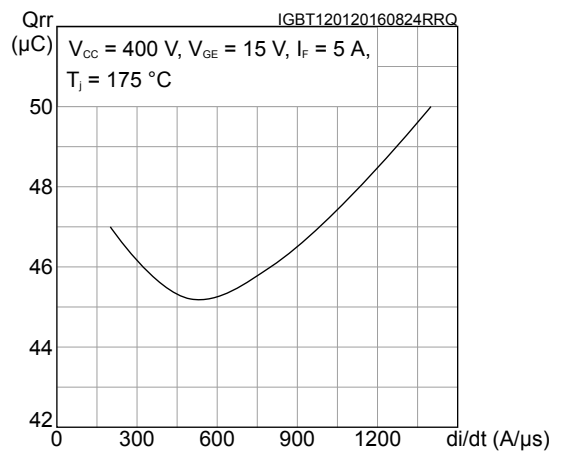


Figure 23. Reverse recovery energy vs diode current slope

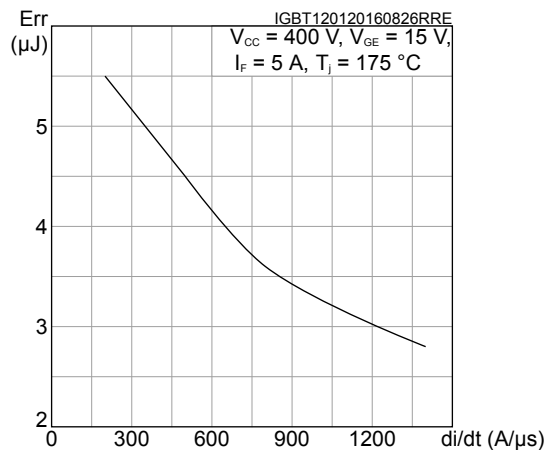


Figure 24. Thermal impedance for IGBT

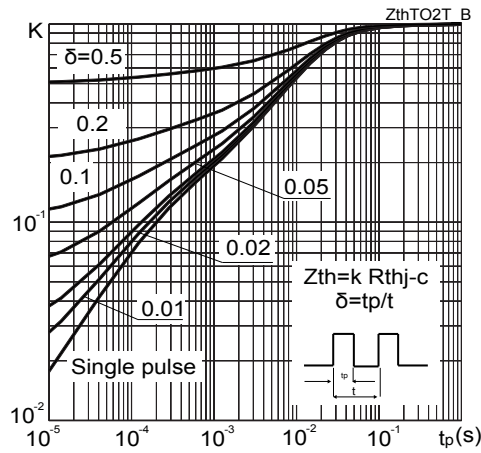
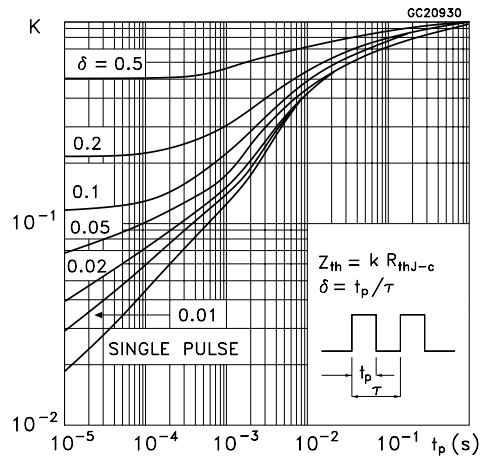
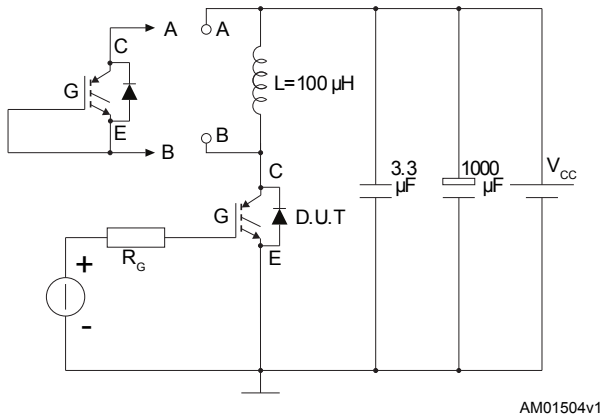
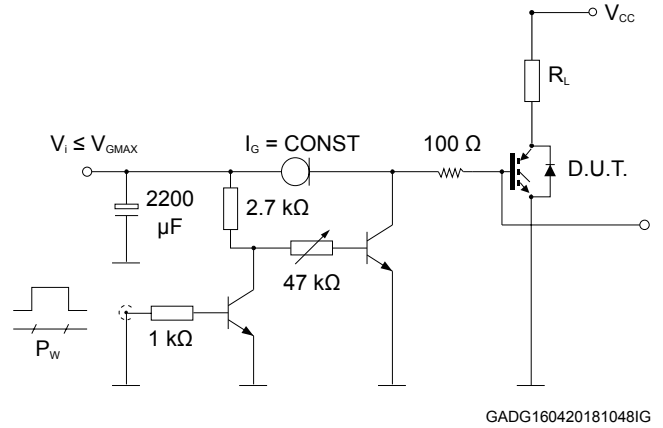
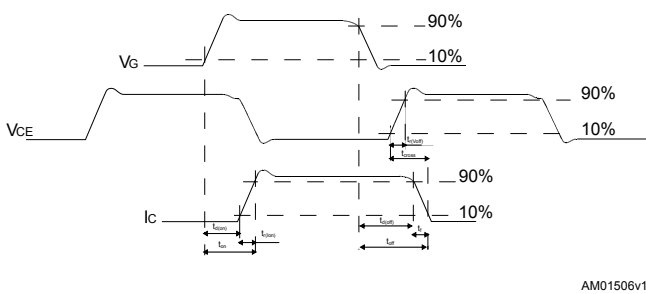
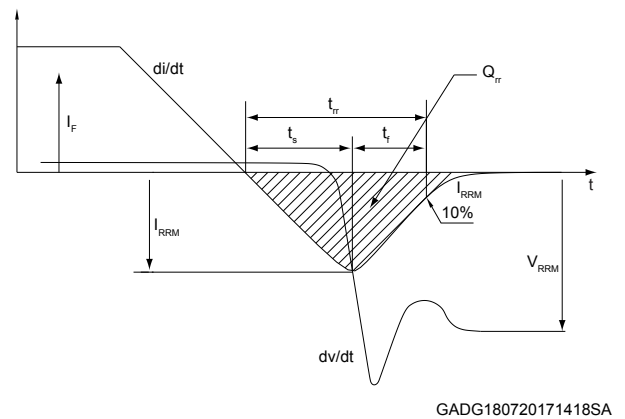


Figure 25. Thermal impedance for diode



3 Test circuits

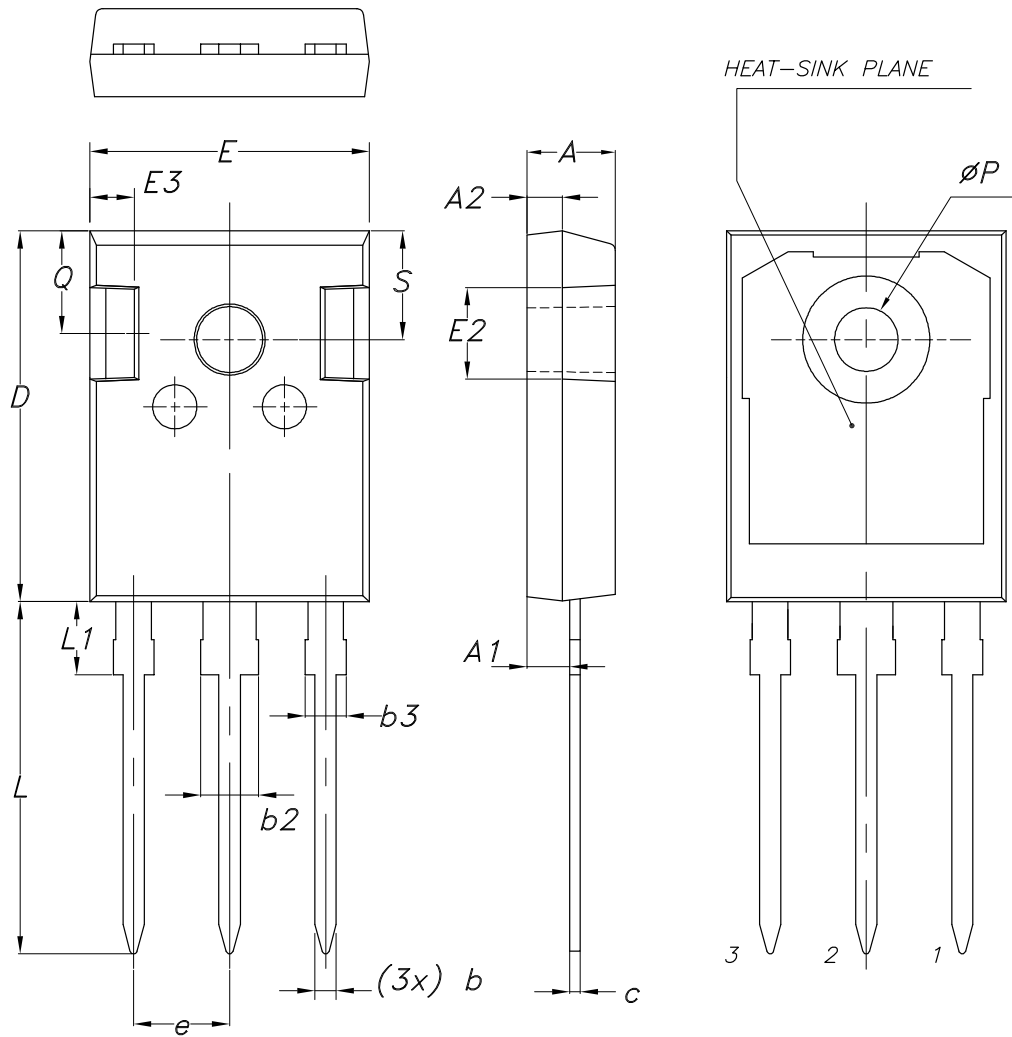
Figure 26. Test circuit for inductive load switching

Figure 27. Gate charge test circuit

Figure 28. Switching waveform

Figure 29. Diode reverse recovery 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 30. 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 | Version | Changes |
|-------------|---------|---|
| 18-Apr-2018 | 1 | Initial release. The document status is production data. |
| 05-Jul-2018 | 2 | Modified <i>Table Switching characteristics (inductive load)</i> . Modified <i>Figure Switching energy vs temperature</i> . Minor text changes. |
| 24-Jul-2019 | 3 | Updated Table 1. Absolute maximum ratings and Table 2. Thermal data . Minor text changes. |

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| 4.1 | TO-247 long leads package information | 11 |
| | Revision history | 14 |

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