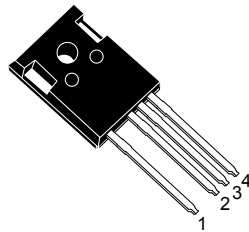
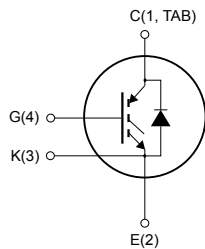


Trench gate field-stop 650 V, 60 A high speed HB series IGBT



TO247-4



NG4K3E2C1_TAB



Product status link

[STGW60H65DFB-4](#)

Product summary

| | |
|-------------------|----------------|
| Order code | STGW60H65DFB-4 |
| Marking | G60H65DFB |
| Package | TO247-4 |
| Packing | Tube |

Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- Excellent switching performance thanks to the extra driving kelvin pin
- Low $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 60\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Very fast soft recovery antiparallel diode

Applications

- Photovoltaic inverters
- High-frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. A faster switching event can be achieved by the Kelvin pin, which separates power path from driving signal. Furthermore, the slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

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 ⁽¹⁾ | A |
| | Continuous collector current at $T_C = 100$ °C | 60 | |
| I_{CP} ⁽²⁾ | Pulsed collector current | 240 | A |
| V_{GE} | Gate-emitter voltage | ±20 | V |
| | Transient gate-emitter voltage | ±30 | |
| I_F | Continuous forward current at $T_C = 25$ °C | 80 ⁽¹⁾ | A |
| | Continuous forward current at $T_C = 100$ °C | 60 | |
| I_{FP} ⁽²⁾ | Pulsed forward current | 240 | A |
| P_{TOT} | Total power dissipation at $T_C = 25$ °C | 375 | W |
| T_{STG} | Storage temperature range | -55 to 150 | °C |
| T_J | Operating junction temperature range | -55 to 175 | |

1. Current level is limited by bond wires.
2. Pulse width is limited by maximum junction temperature.

Table 2. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|--|-------|------|
| R_{thJC} | Thermal resistance junction-case IGBT | 0.4 | °C/W |
| R_{thJC} | Thermal resistance junction-case diode | 1.14 | |
| 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 | $V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$ | 650 | | | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 60\text{ A}$ | | 1.6 | 2.0 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 60\text{ A}, T_J = 125\text{ °C}$ | | 1.75 | | |
| | | $V_{GE} = 15\text{ V}, I_C = 60\text{ A}, T_J = 175\text{ °C}$ | | 1.85 | | |
| V_F | Forward on-voltage | $I_F = 60\text{ A}$ | | 2 | 2.6 | V |
| | | $I_F = 60\text{ A}, T_J = 125\text{ °C}$ | | 1.7 | | |
| | | $I_F = 60\text{ A}, T_J = 175\text{ °C}$ | | 1.6 | | |
| $V_{GE(th)}$ | 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 | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$ | - | 7792 | - | nF |
| C_{oes} | Output capacitance | | - | 262 | - | |
| C_{res} | Reverse transfer capacitance | | - | 158 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}, I_C = 60\text{ A}, V_{GE} = 0$ to 15 V (see Figure 29. Gate charge test circuit) | - | 306 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 126 | - | |
| Q_{gc} | Gate-collector charge | | - | 58 | - | |

Table 5. IGBT switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---|------|------|---------------|------------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 60\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (see Figure 28. Test circuit for inductive load switching) | - | 65 | - | ns |
| t_r | Current rise time | | - | 26 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 1846 | - | A/ μs |
| $t_{d(off)}$ | Turn-off-delay time | | - | 261 | - | ns |
| t_f | Current fall time | | - | 21 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 346 | - | μJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 1161 | - | μJ |
| E_{ts} | Total switching energy | - | 1507 | - | μJ | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 60\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching) | - | 61 | - | ns |
| t_r | Current rise time | | - | 30 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 1640 | - | A/ μs |
| $t_{d(off)}$ | Turn-off-delay time | | - | 284 | - | ns |
| t_f | Current fall time | | - | 45 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 644 | - | μJ |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 1633 | - | μJ |
| E_{ts} | Total switching energy | - | 2277 | - | μJ | |

1. Including the reverse recovery of the diode.
2. 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 | $I_F = 60\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 28. Test circuit for inductive load switching) | - | 60 | - | ns |
| Q_{rr} | Reverse recovery charge | | - | 99 | - | nC |
| I_{rrm} | Reverse recovery current | | - | 3.3 | - | A |
| dI_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 187 | - | A/ μs |
| E_{rr} | Reverse recovery energy | | - | 68 | - | μJ |
| t_{rr} | Reverse recovery time | $I_F = 60\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching) | - | 310 | - | ns |
| Q_{rr} | Reverse recovery charge | | - | 1550 | - | nC |
| I_{rrm} | Reverse recovery current | | - | 10 | - | A |
| dI_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 59 | - | A/ μs |
| E_{rr} | Reverse recovery energy | | - | 674 | - | μJ |

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

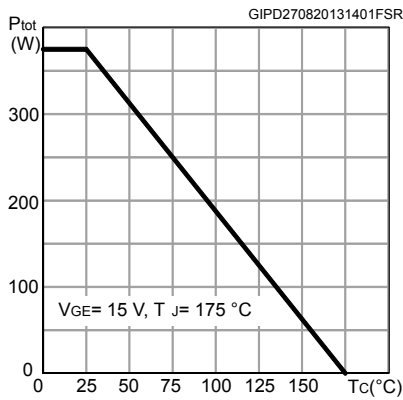


Figure 2. Collector current vs. case temperature

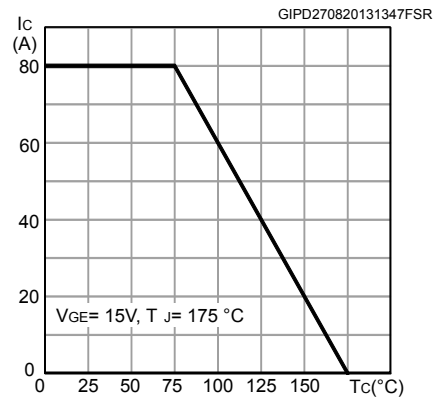


Figure 3. Output characteristics ($T_J = 25\text{ }^\circ\text{C}$)

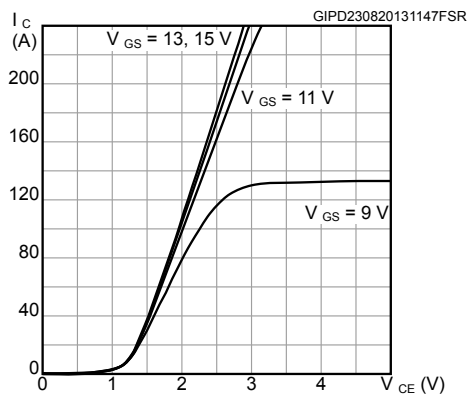


Figure 4. Output characteristics ($T_J = 175\text{ }^\circ\text{C}$)

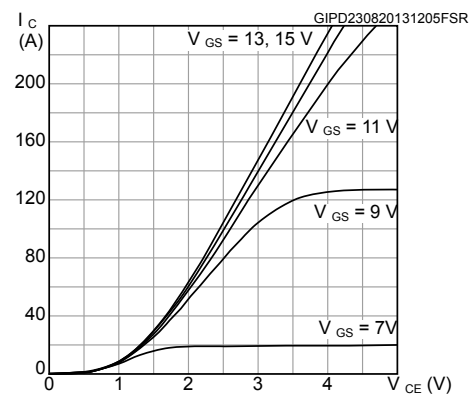


Figure 5. $V_{CE(sat)}$ vs. junction temperature

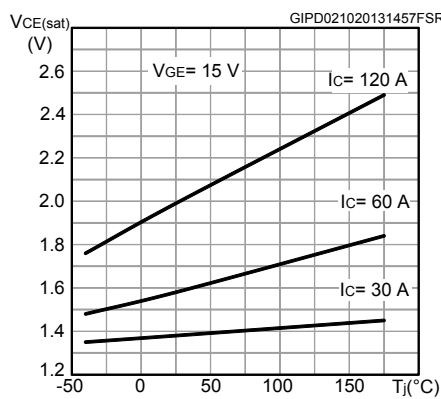


Figure 6. $V_{CE(sat)}$ vs. collector current

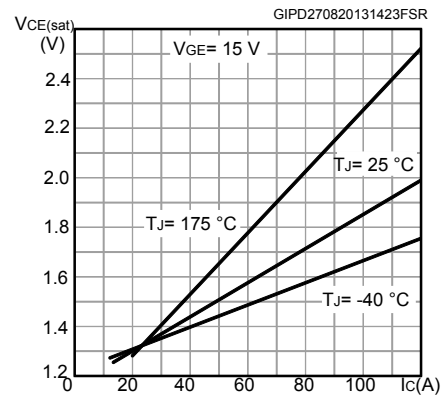


Figure 7. Collector current vs. switching frequency

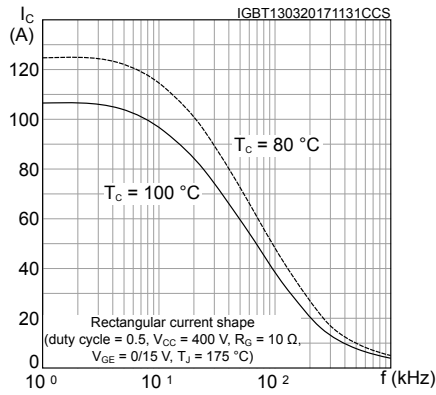


Figure 8. Forward bias safe operating area

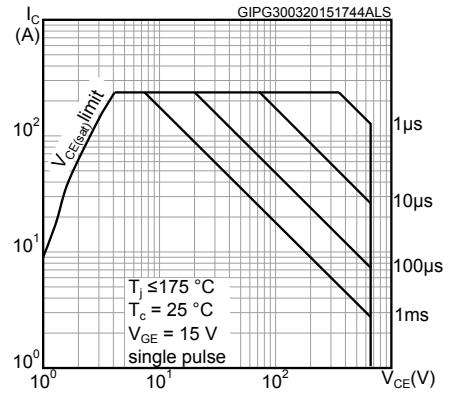


Figure 9. Transfer characteristics

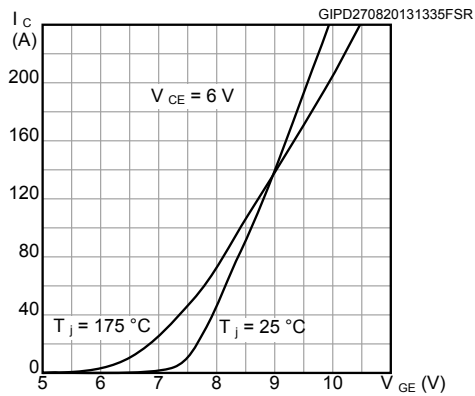


Figure 10. Diode VF vs. forward current

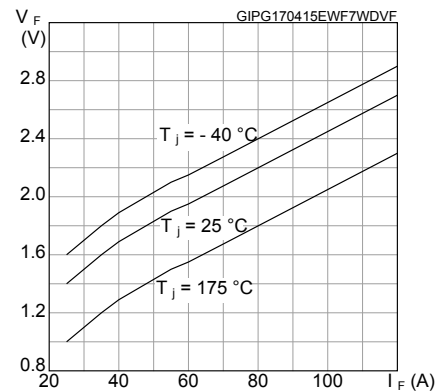


Figure 11. Normalized VGE(th) vs. junction temperature

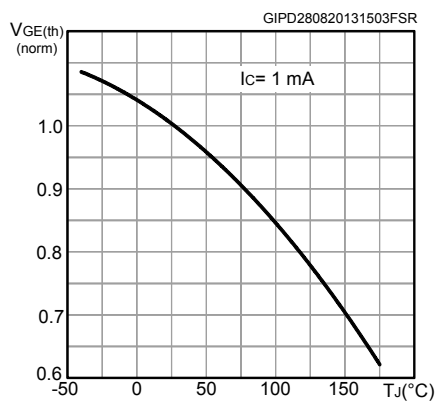


Figure 12. Normalized V(BR)CES vs. junction temperature

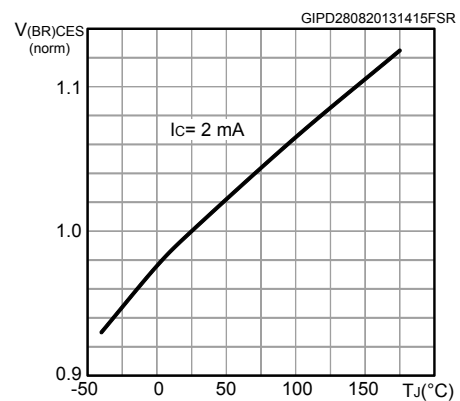


Figure 13. Capacitance variations

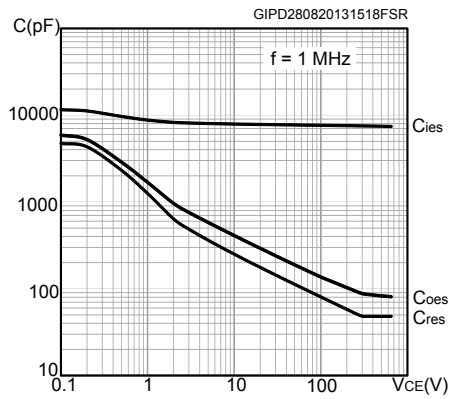


Figure 14. Gate charge vs. gate-emitter voltage

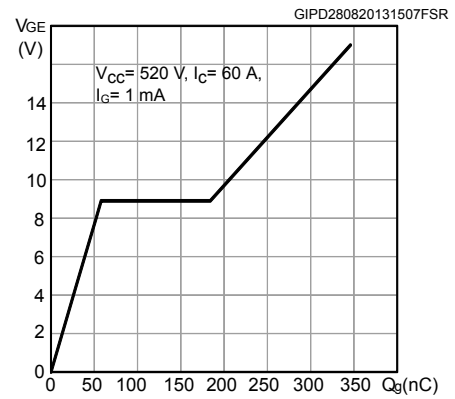


Figure 15. Switching energy vs. collector current

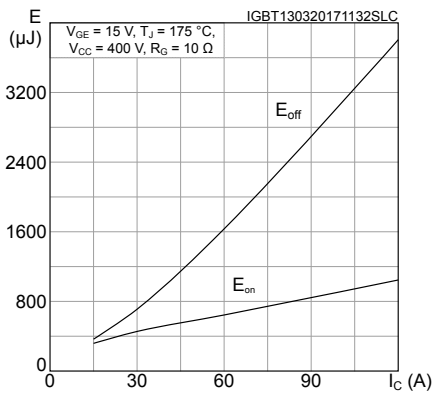


Figure 16. Switching energy vs. gate resistance

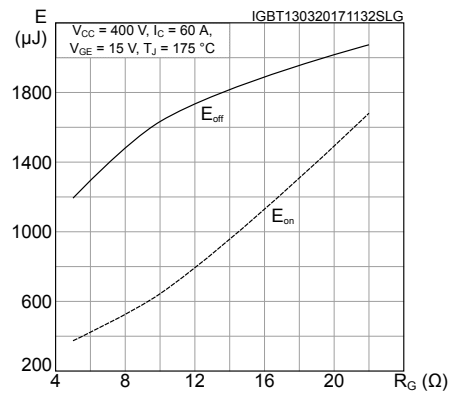


Figure 17. Switching energy vs. temperature

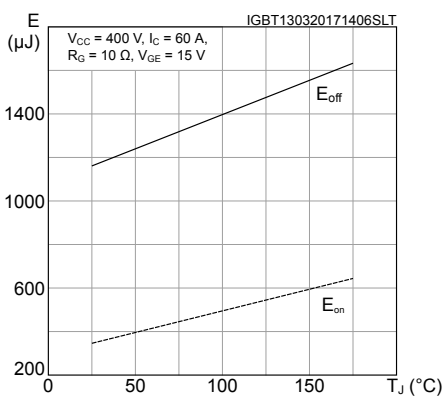


Figure 18. Switching energy vs. collector emitter voltage

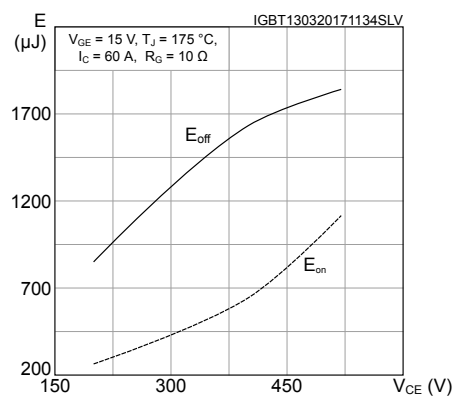


Figure 19. Switching times vs. collector current

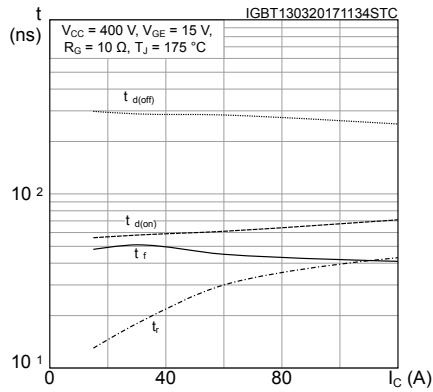


Figure 20. Switching times vs. gate resistance

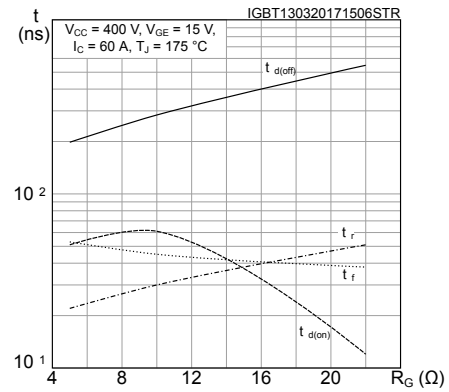


Figure 21. Reverse recovery current vs. diode current slope

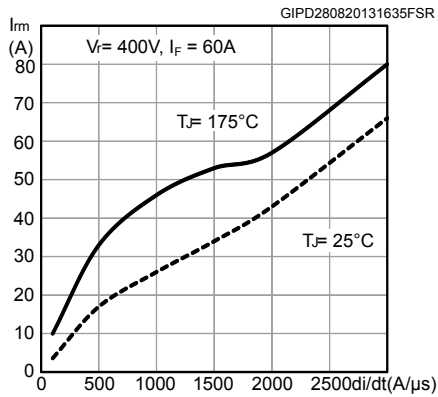


Figure 22. Reverse recovery time vs. diode current slope

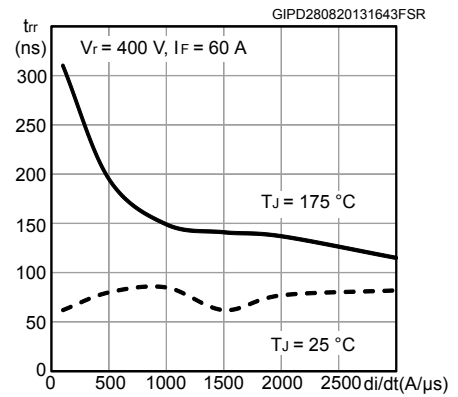


Figure 23. Reverse recovery charge vs. diode current slope

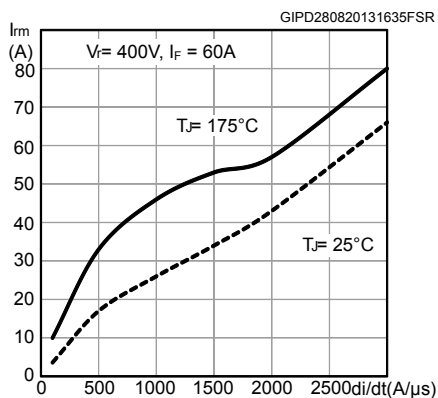


Figure 24. Reverse recovery energy vs. diode current slope

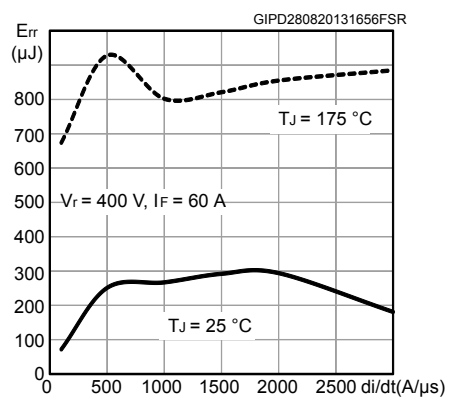


Figure 25. Thermal impedance for IGBT

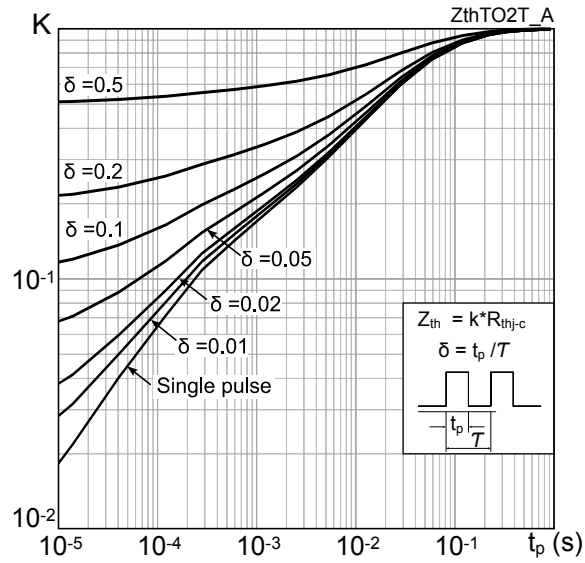
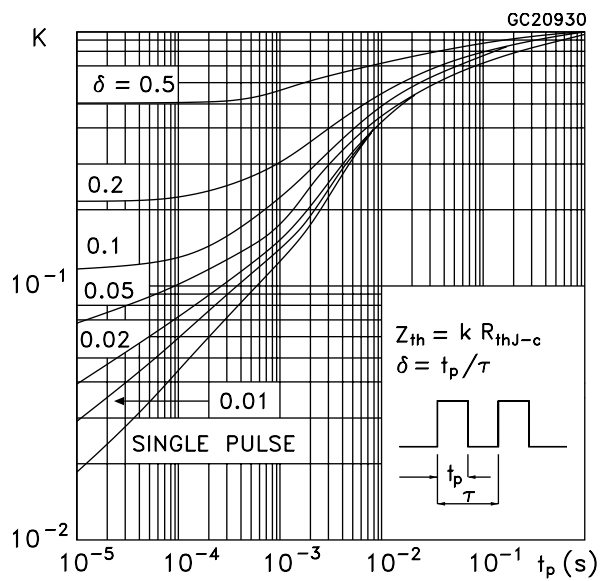


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

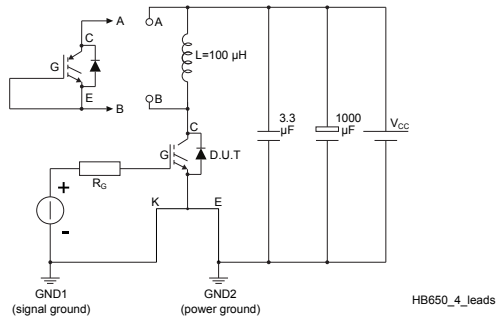


Figure 28. Gate charge test circuit

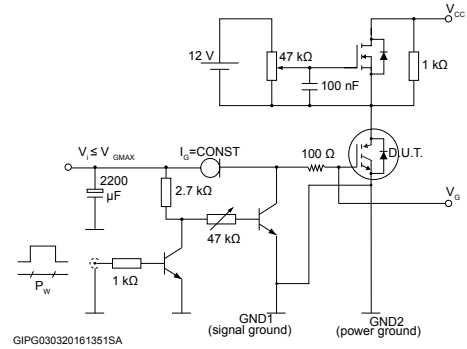


Figure 29. Switching waveform

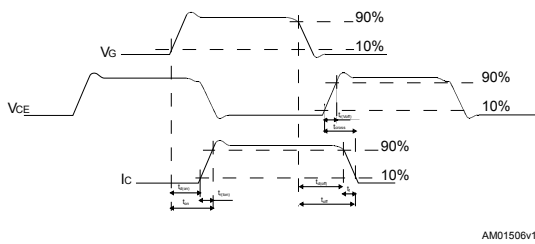
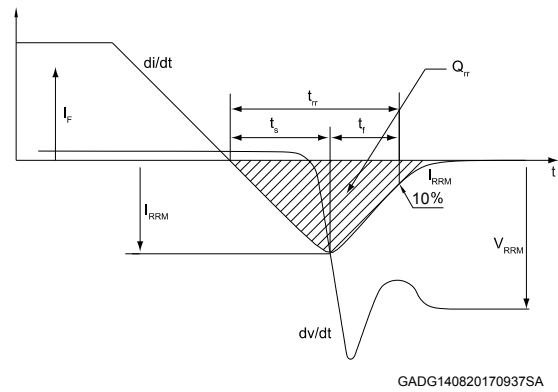


Figure 30. Diode reverse recovery waveform

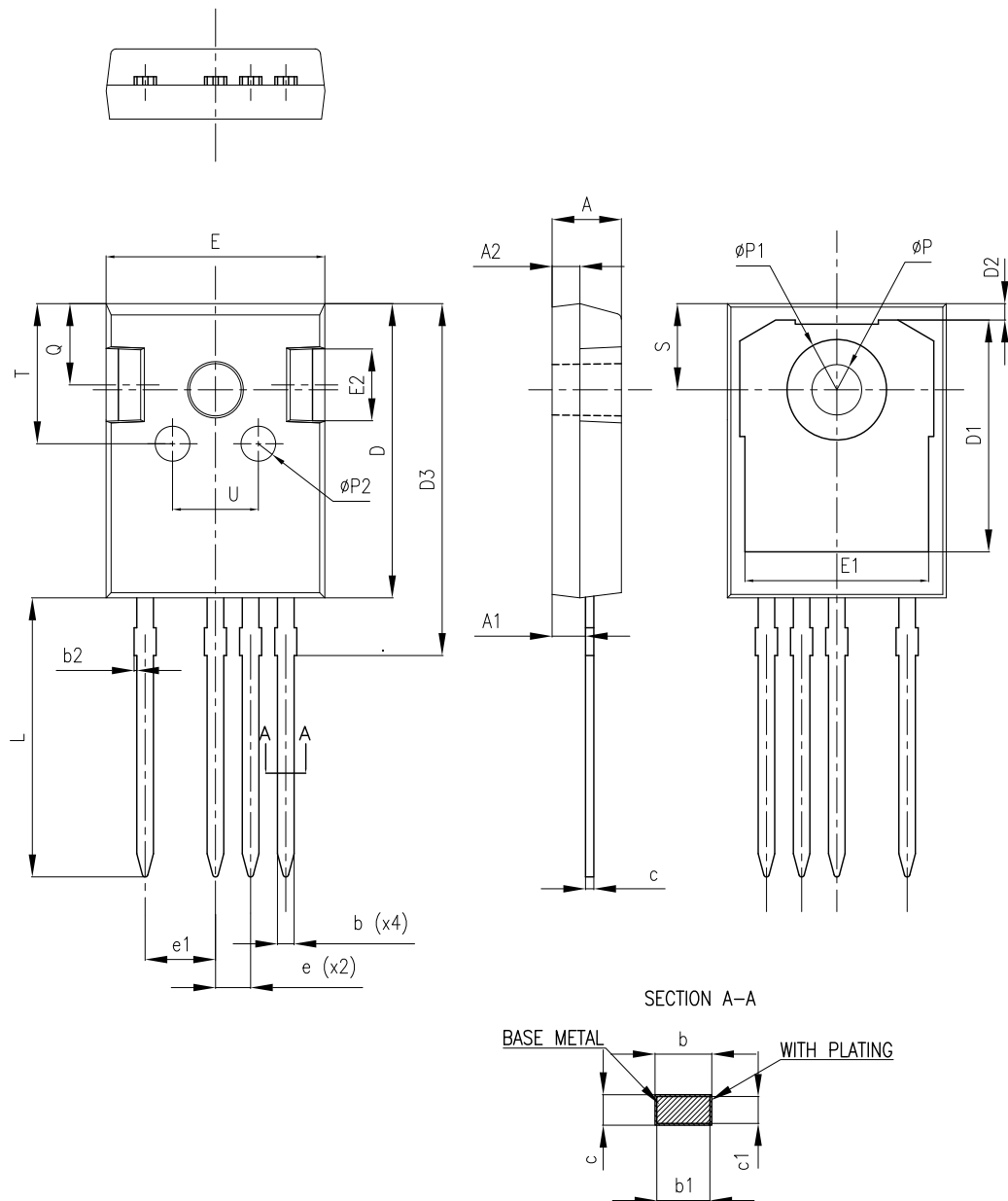


4 Package information

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 TO247-4 package information

Figure 31. TO247-4 package outline



8405626_2

Table 7. TO247-4 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 | | 1.29 |
| b1 | 1.15 | 1.20 | 1.25 |
| b2 | 0 | | 0.20 |
| c | 0.59 | | 0.66 |
| c1 | 0.58 | 0.60 | 0.62 |
| D | 20.90 | 21.00 | 21.10 |
| D1 | 16.25 | 16.55 | 16.85 |
| D2 | 1.05 | 1.20 | 1.35 |
| D3 | 24.97 | 25.12 | 25.27 |
| E | 15.70 | 15.80 | 15.90 |
| E1 | 13.10 | 13.30 | 13.50 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 2.44 | 2.54 | 2.64 |
| e1 | 4.98 | 5.08 | 5.18 |
| L | 19.80 | 19.92 | 20.10 |
| P | 3.50 | 3.60 | 3.70 |
| P1 | | | 7.40 |
| P2 | 2.40 | 2.50 | 2.60 |
| Q | 5.60 | | 6.00 |
| S | | 6.15 | |
| T | 9.80 | | 10.20 |
| U | 6.00 | | 6.40 |

Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 30-May-2016 | 1 | First release. |
| 21-Mar-2017 | 2 | Updated <i>Table Absolute maximum ratings</i> and <i>Table IGBT switching characteristics (inductive load)</i> . Updated <i>Section STGW60H65DFB-4 electrical characteristics curves</i> . Minor text changes |
| 20-Jun-2019 | 3 | Updated title. Updated Section Features and schematic diagram in cover page. Updated Table 1. Absolute maximum ratings . Minor text changes. |

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| | Revision history | 13 |

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