

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

Datasheet - production data

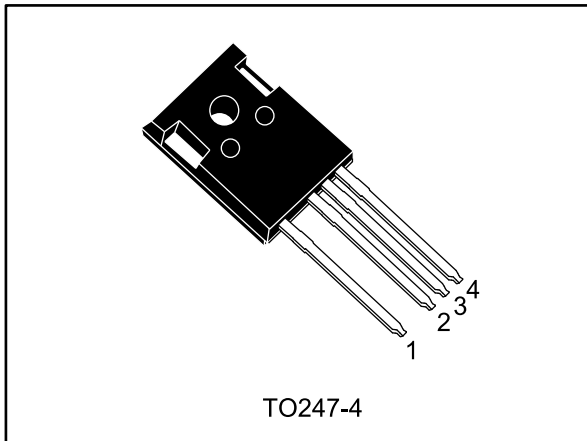
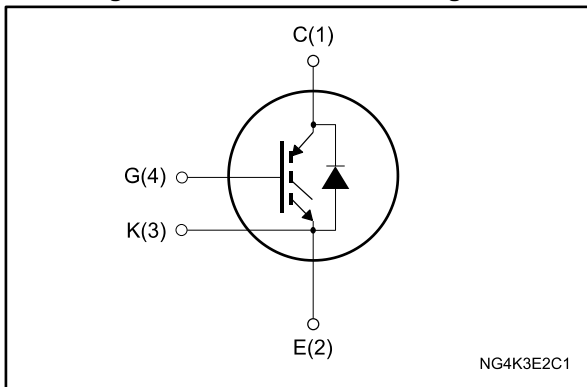


Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- 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 inverter
- High frequency converter

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.

Table 1: Device summary

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

Contents

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1 Electrical ratings

Table 2: 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 |
| 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 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 | |

Notes:

⁽¹⁾Current level is limited by bond wires.

⁽²⁾Pulse width is limited by maximum junction temperature.

Table 3: 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 4: 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 5: 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 | $V_{CC} = 520\text{ V}$, $I_C = 60\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 29: "Gate charge test circuit") | - | 306 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 126 | - | |
| Q_{gc} | Gate-collector charge | | - | 58 | - | |

Table 6: 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/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | | - | 261 | - | ns |
| t_f | Current fall time | | - | 21 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 346 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 1161 | - | μ J |
| E_{ts} | Total switching energy | - | 1507 | - | μ J | |
| $t_{d(on)}$ | 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/ μ s |
| $t_{d(off)}$ | Turn-off-delay time | | - | 284 | - | ns |
| t_f | Current fall time | | - | 45 | - | ns |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 644 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 1633 | - | μ J |
| E_{ts} | Total switching energy | - | 2277 | - | μ J | |

Notes:

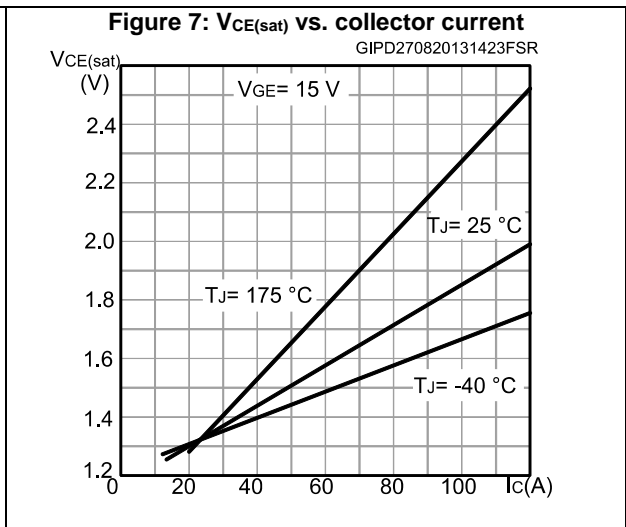
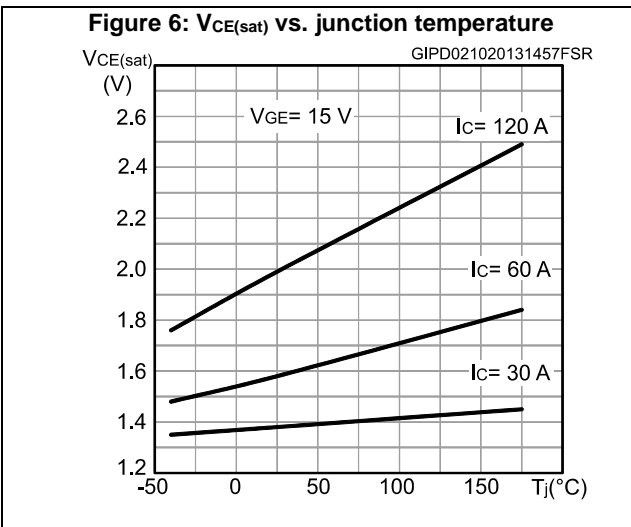
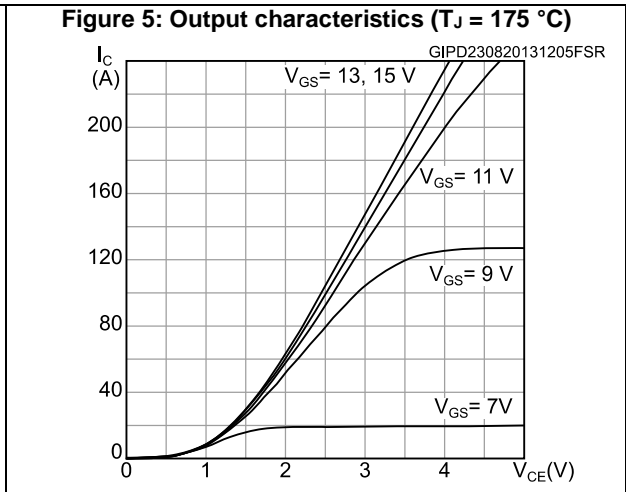
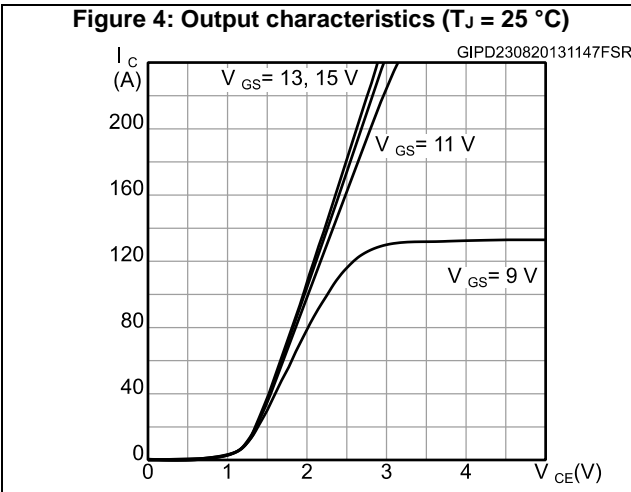
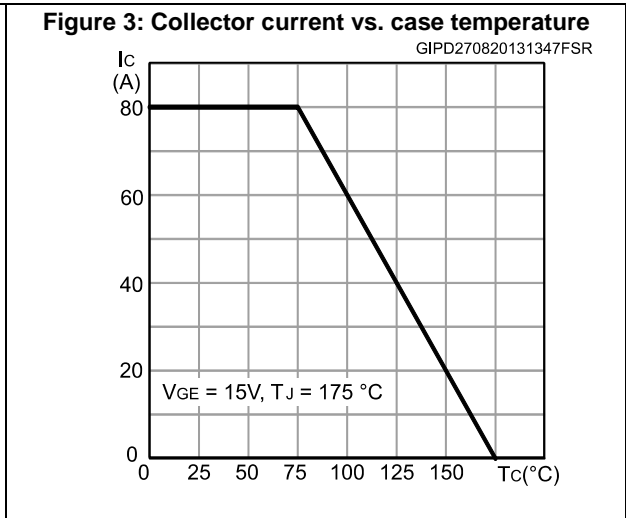
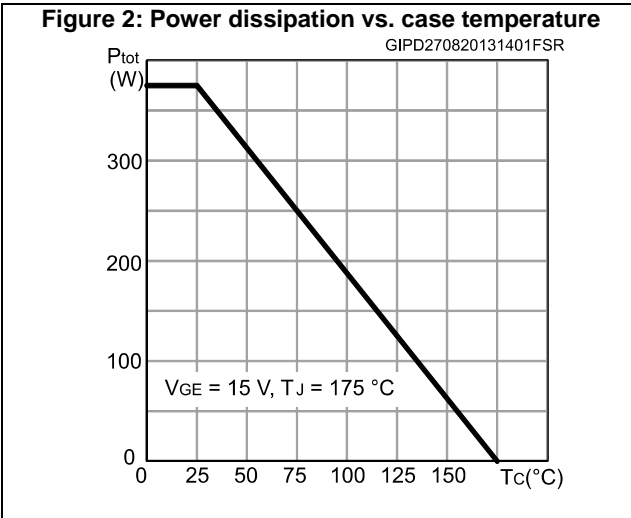
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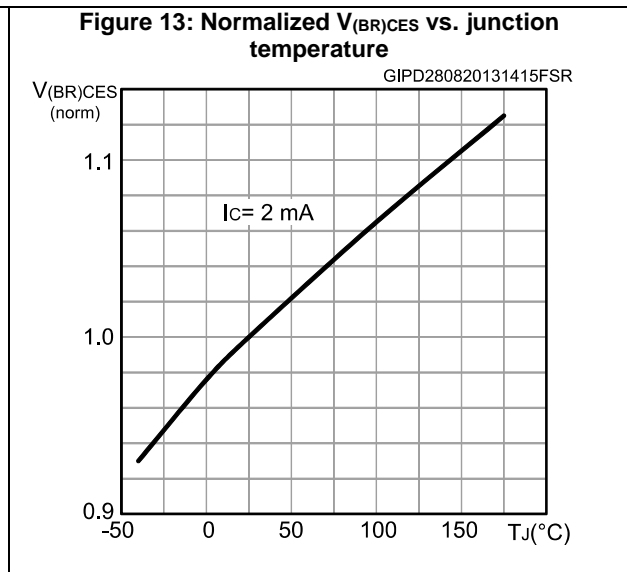
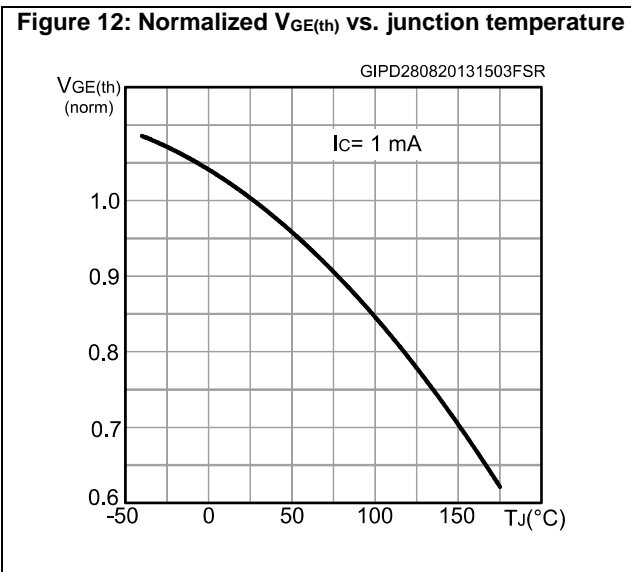
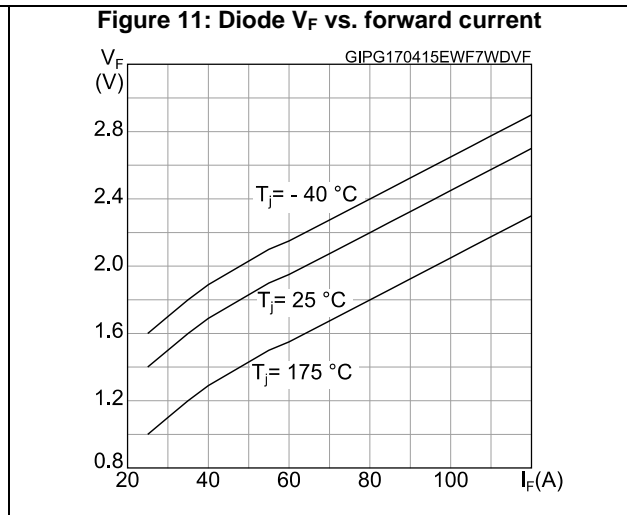
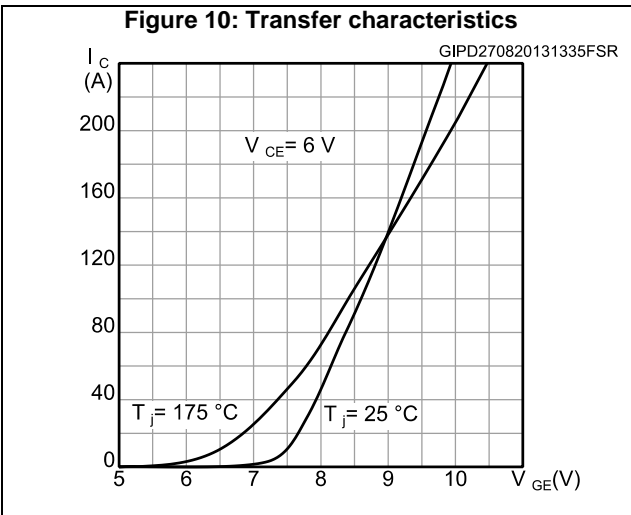
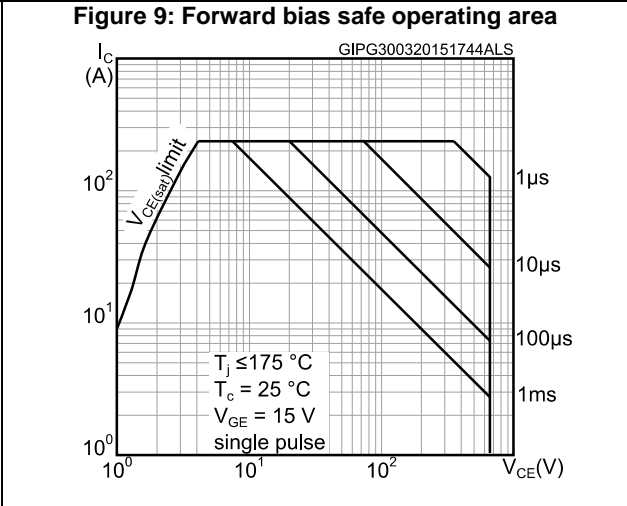
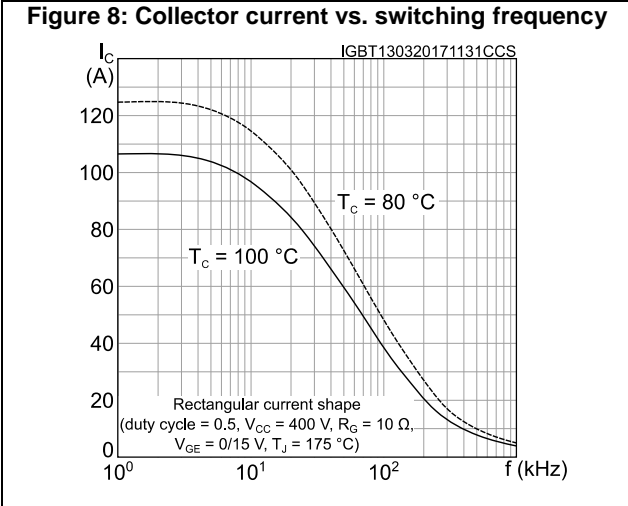
(2)Including the tail of the collector current.

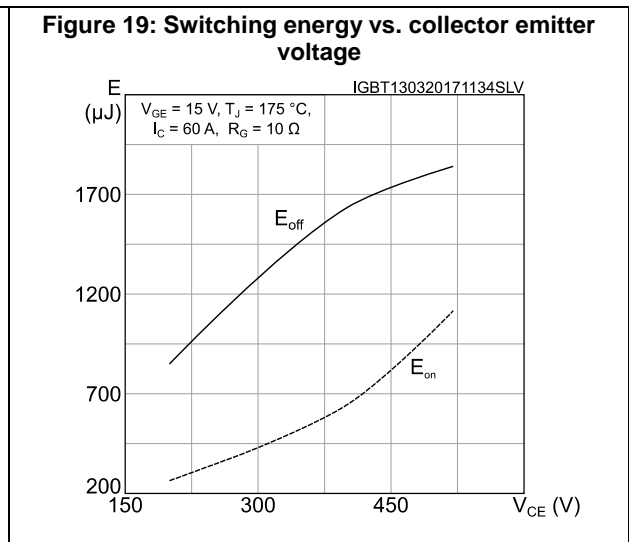
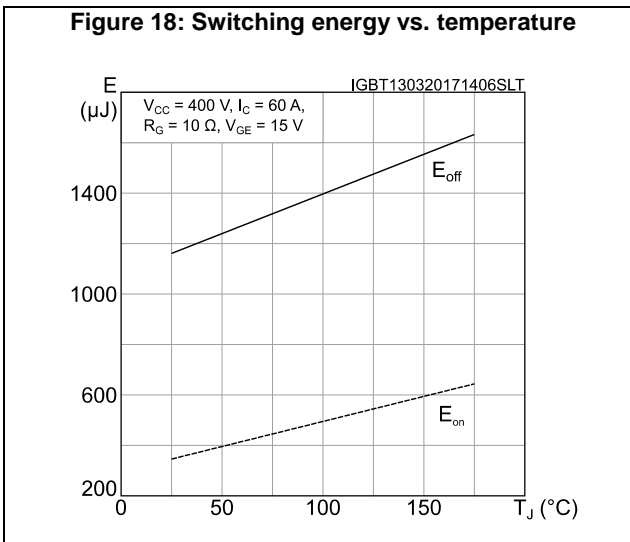
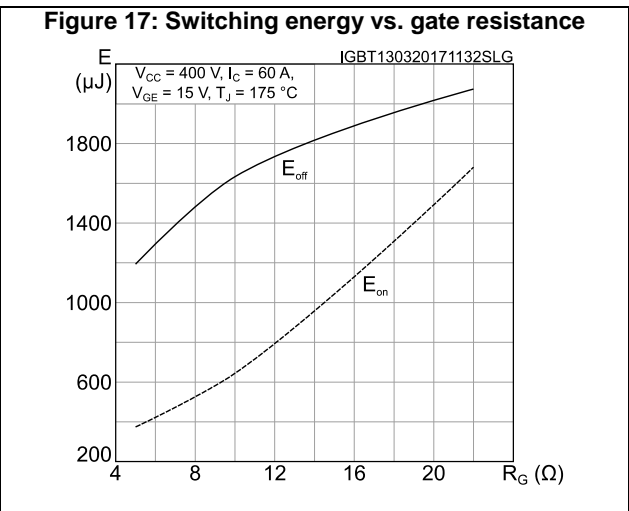
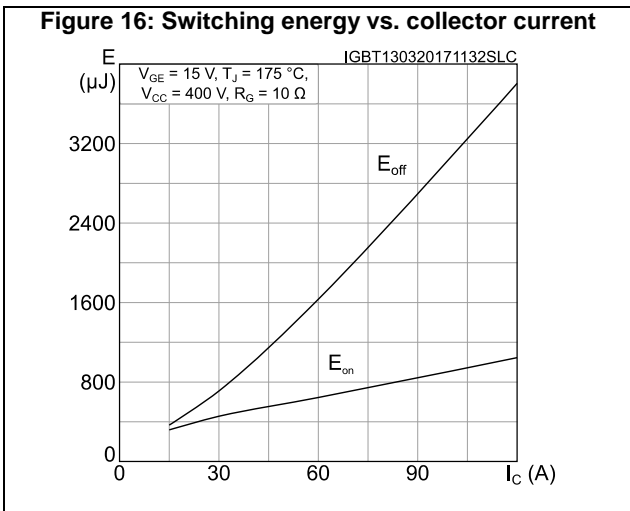
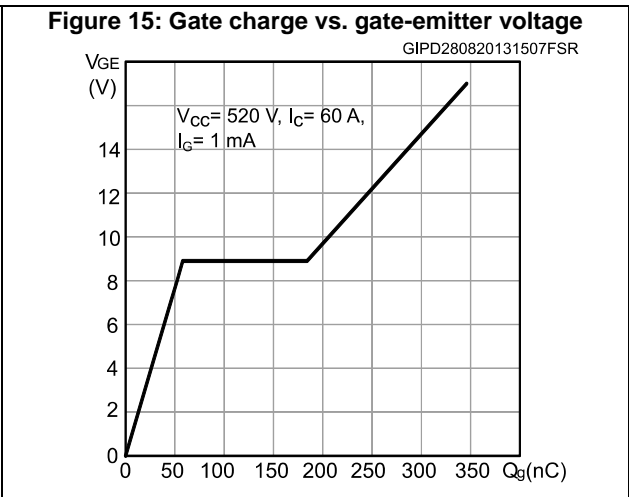
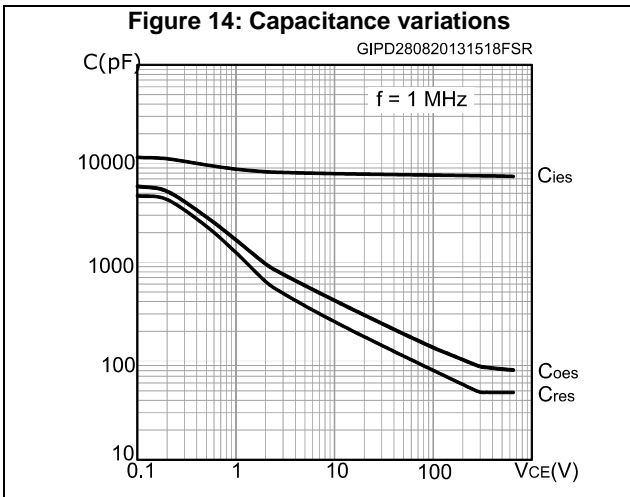
Table 7: Diode switching characteristics (inductive load)

| 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 |
| dl_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 187 | - | A/ μ s |
| E_{rr} | Reverse recovery energy | | - | 68 | - | μ J |
| 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 |
| dl_{rr}/dt | Peak rate of fall of reverse recovery current during t_b | | - | 59 | - | A/ μ s |
| E_{rr} | Reverse recovery energy | | - | 674 | - | μ J |

2.1 Electrical characteristics (curves)







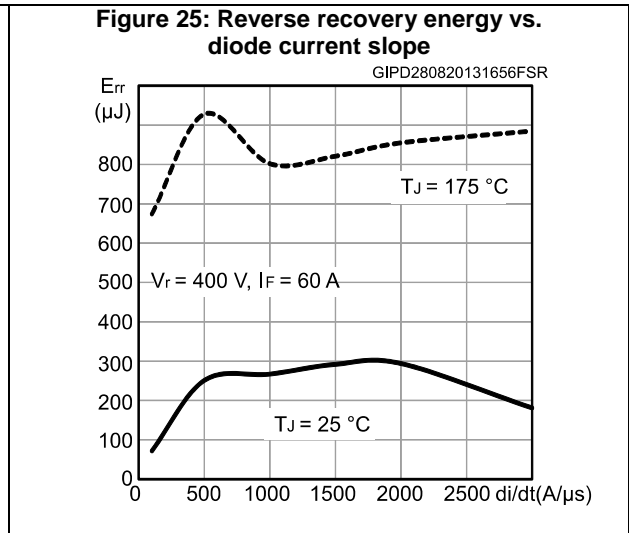
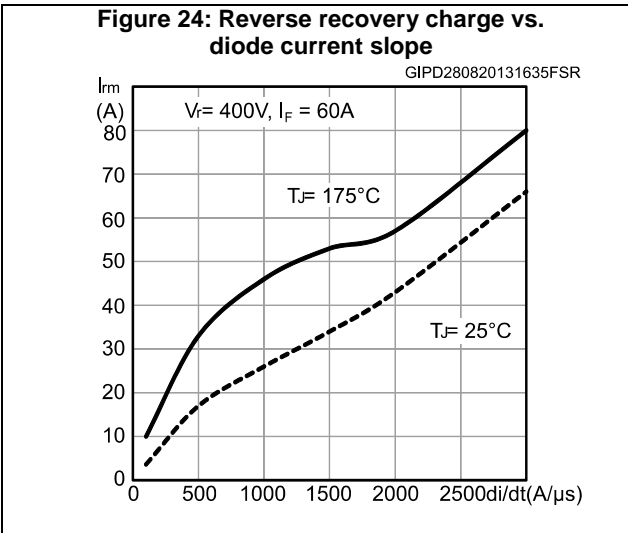
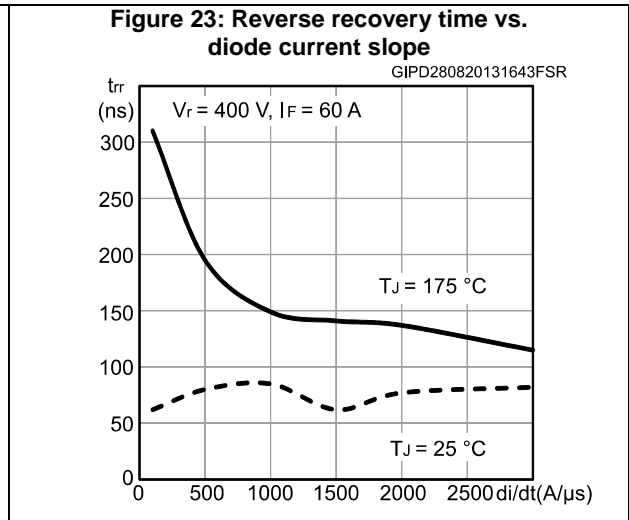
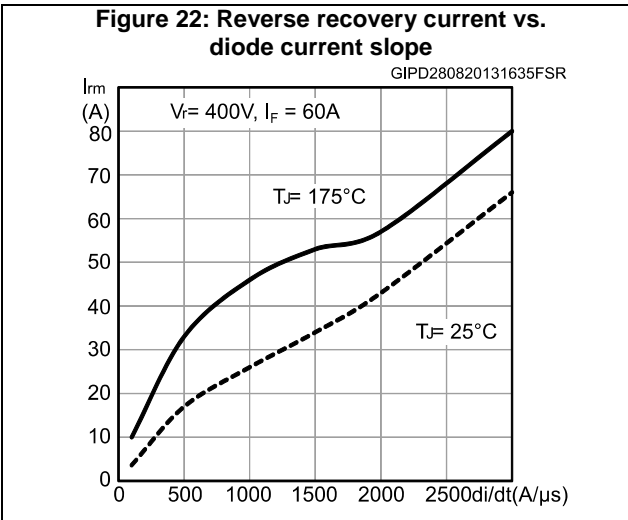
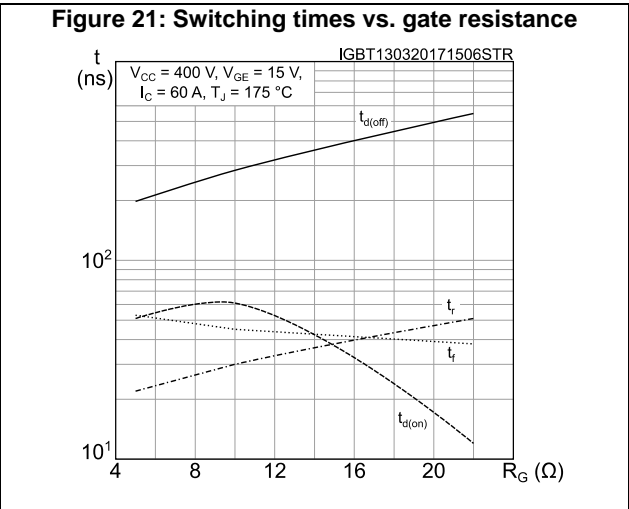
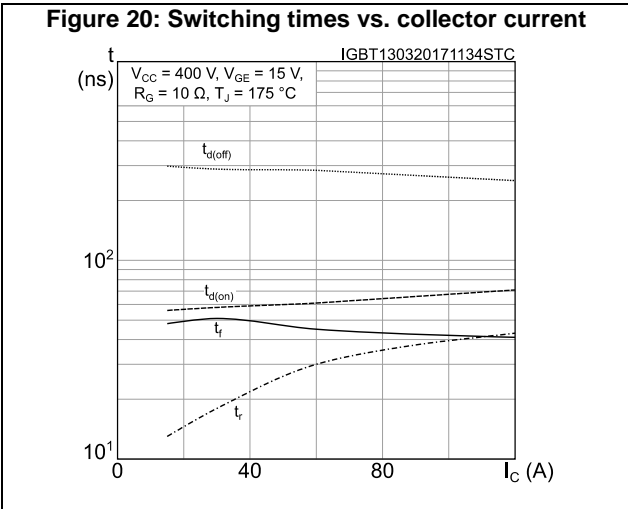


Figure 26: Thermal impedance for IGBT

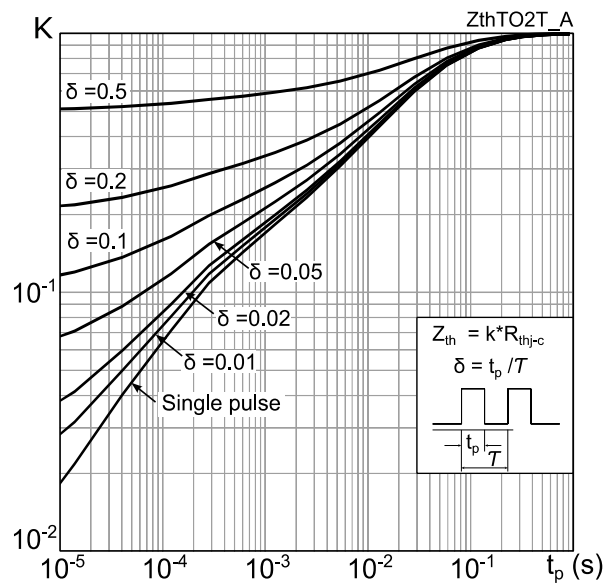
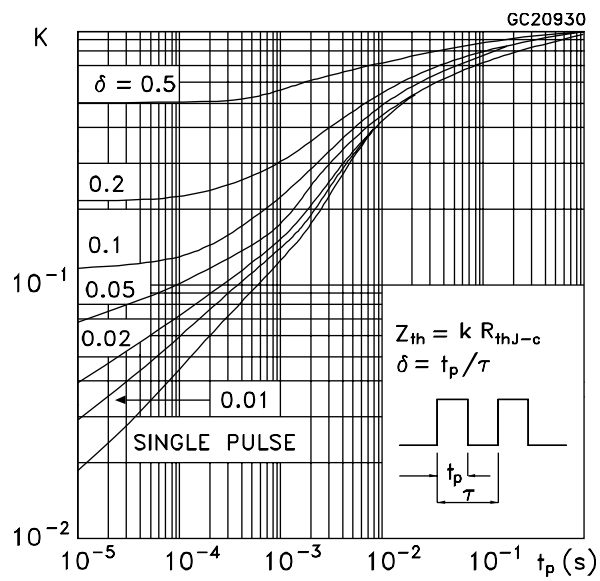


Figure 27: Thermal impedance for diode



3 Test circuits

Figure 28: Test circuit for inductive load switching

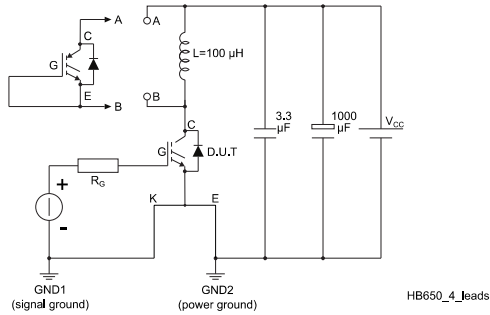


Figure 29: Gate charge test circuit

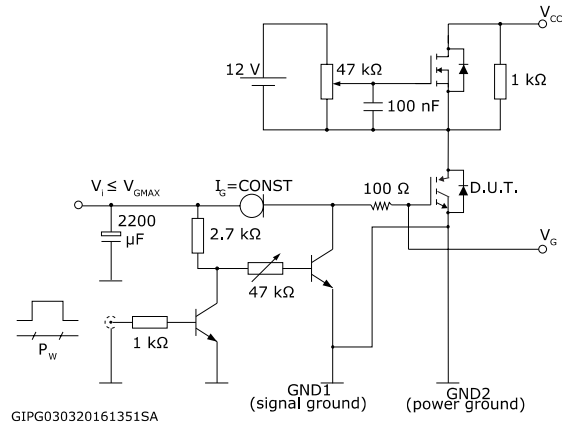
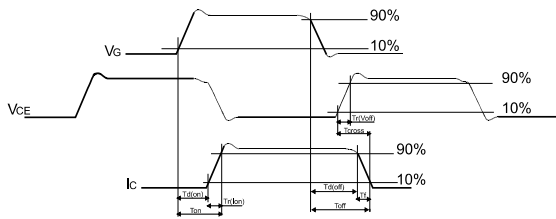
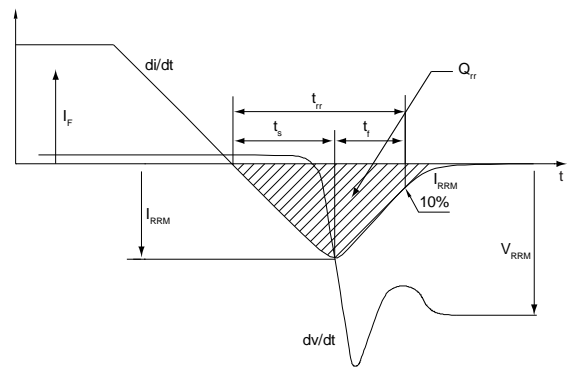


Figure 30: Switching waveform



AM01506v1

Figure 31: Diode reverse recovery waveform



AM01507v1

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 32: TO247-4 package outline

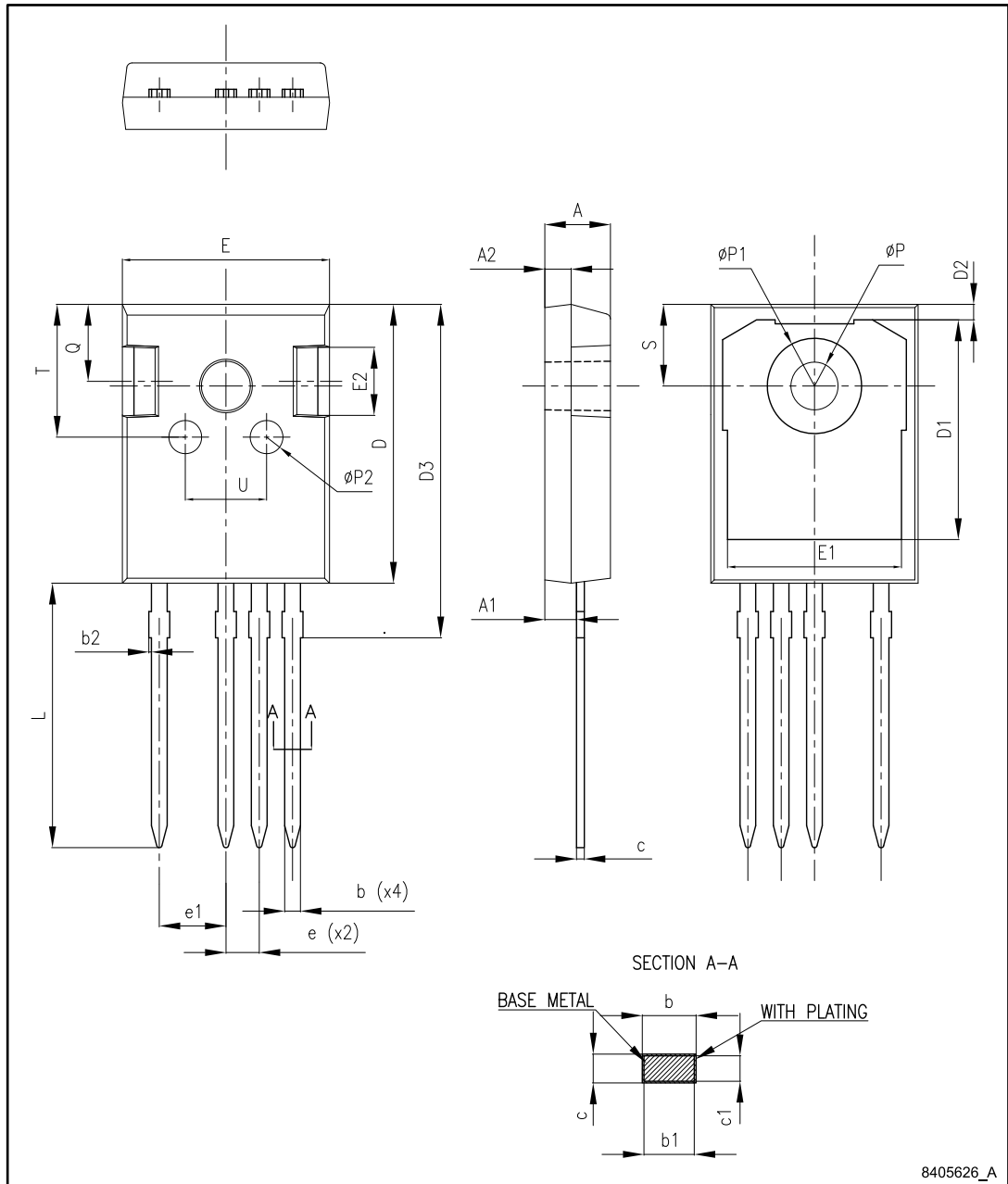


Table 8: TO247-4 mechanical data

| 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 |

5 Revision history

Table 9: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 30-May-2016 | 1 | First release |
| 21-Mar-2017 | 2 | Updated Table 2: "Absolute maximum ratings" and Table 6: "IGBT switching characteristics (inductive load)" . Updated Section 2.1: "Electrical characteristics (curves)" . Minor text changes |

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