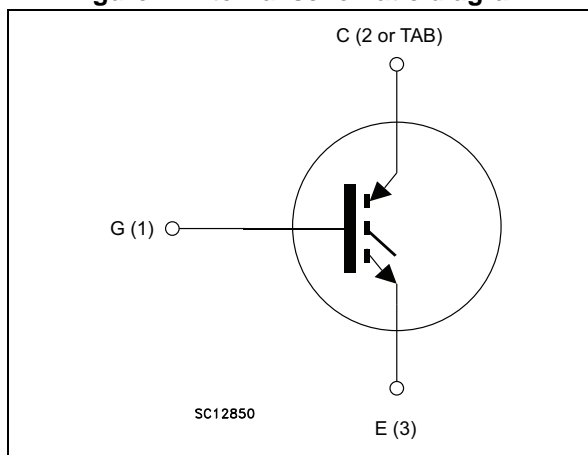


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 80\text{ A}$
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance

### Applications

- Photovoltaic inverters
- High frequency converters

### Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. The device is part of the new “HB” series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of any frequency converter. Furthermore, a 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           | Packaging |
|--------------|------------|-------------------|-----------|
| STGW80H65FB  | GW80H65FB  | TO-247            | Tube      |
| STGWA80H65FB | GWA80H65FB | TO-247 long leads | Tube      |
| STGWT80H65FB | GWT80H65FB | TO-3P             | Tube      |

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                  | Parameter   | Value              | Unit |
|-------------------------|---|--------------------|------|
| $V_{CES}$               | Collector-emitter voltage ( $V_{GE} = 0$ )            | 650                | V    |
| $I_C$                   | Continuous collector current at $T_C = 25\text{ °C}$  | 120 <sup>(1)</sup> | A    |
| $I_C$                   | Continuous collector current at $T_C = 100\text{ °C}$ | 80                 | A    |
| $I_{CP}$ <sup>(2)</sup> | Pulsed collector current                              | 240                | A    |
| $V_{GE}$                | Gate-emitter voltage                                  | $\pm 20$           | V    |
| $P_{TOT}$               | Total dissipation at $T_C = 25\text{ °C}$             | 469                | W    |
| $T_{STG}$               | Storage temperature range                             | - 55 to 150        | °C   |
| $T_J$                   | Operating junction temperature                        | - 55 to 175        | °C   |

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

**Table 3. Thermal data**

| Symbol     | Parameter                           | Value | Unit |
|------------|-------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 0.32  | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50    | °C/W |

## 2 Electrical characteristics

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

**Table 4. Static characteristics**

| Symbol        | Parameter  | Test conditions  | Min. | Typ. | Max. | Unit          |
|---------------|--|--|------|------|------|---------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage ( $V_{GE} = 0$ ) | $I_C = 2\text{ mA}$  | 650  |      |      | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage                 | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$                          |      | 1.6  | 2    | V             |
|               |  | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$<br>$T_J = 125\text{ °C}$ |      | 1.8  |      |               |
|               |  | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$<br>$T_J = 175\text{ °C}$ |      | 1.9  |      |               |
| $V_{GE(th)}$  | Gate threshold voltage                               | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$                               | 5    | 6    | 7    | V             |
| $I_{CES}$     | Collector cut-off current ( $V_{GE} = 0$ )           | $V_{CE} = 650\text{ V}$  |      |      | 100  | $\mu\text{A}$ |
| $I_{GES}$     | Gate-emitter leakage current ( $V_{CE} = 0$ )        | $V_{GE} = \pm 20\text{ V}$   |      |      | 250  | nA            |

**Table 5. Dynamic characteristics**

| Symbol    | Parameter                    | Test conditions  | Min. | Typ.  | Max. | Unit |
|-----------|------------------------------|--|------|-------|------|------|
| $C_{ies}$ | Input capacitance            | $V_{CE} = 25\text{ V}, f = 1\text{ MHz},$<br>$V_{GE} = 0$  | -    | 10524 | -    | pF   |
| $C_{oes}$ | Output capacitance           |  | -    | 385   | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |  | -    | 215   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC} = 520\text{ V}, I_C = 80\text{ A},$<br>$V_{GE} = 15\text{ V},$ see <a href="#">Figure 23</a> | -    | 414   | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |  | -    | 78    | -    | nC   |
| $Q_{gc}$  | Gate-collector charge        |  | -    | 170   | -    | nC   |

Table 6. IGBT switching characteristics (inductive load)

| Symbol          | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit       |
|-----------------|---------------------------|---|------|------|------|------------|
| $t_{d(on)}$     | Turn-on delay time        | $V_{CE} = 400\text{ V}$ , $I_C = 80\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>see <a href="#">Figure 22</a>                                     | -    | 84   | -    | ns         |
| $t_r$           | Current rise time         |   | -    | 52   | -    | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1270 | -    | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 280  | -    | ns         |
| $t_f$           | Current fall time         |   | -    | 31   | -    | ns         |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 2.1  | -    | mJ         |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 1.5  | -    | mJ         |
| $E_{ts}$        | Total switching losses    | -   | 3.6  | -    | mJ   |            |
| $t_{d(on)}$     | Turn-on delay time        | $V_{CE} = 400\text{ V}$ , $I_C = 80\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 22</a> | -    | 77   | -    | ns         |
| $t_r$           | Current rise time         |   | -    | 51   | -    | ns         |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1270 | -    | A/ $\mu$ s |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 328  | -    | ns         |
| $t_f$           | Current fall time         |   | -    | 30   | -    | ns         |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 4.4  | -    | mJ         |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 2.1  | -    | mJ         |
| $E_{ts}$        | Total switching losses    | -   | 6.5  | -    | mJ   |            |

1. Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW80H65DFB
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics ( $T_J = 25^\circ\text{C}$ )

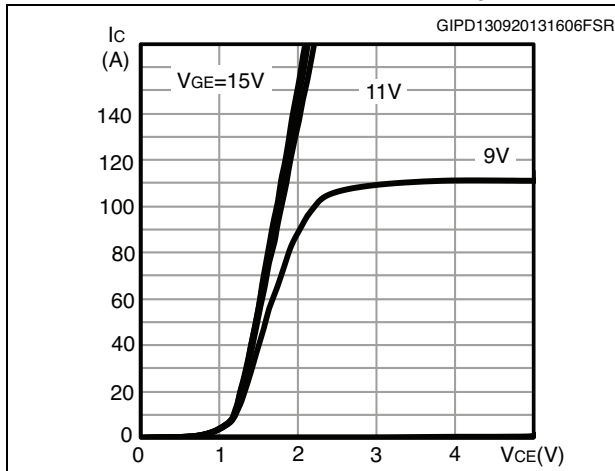


Figure 3. Output characteristics ( $T_J = 175^\circ\text{C}$ )

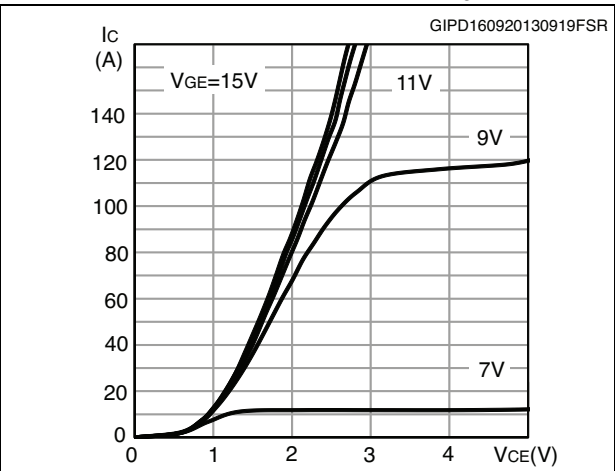


Figure 4. Transfer characteristics

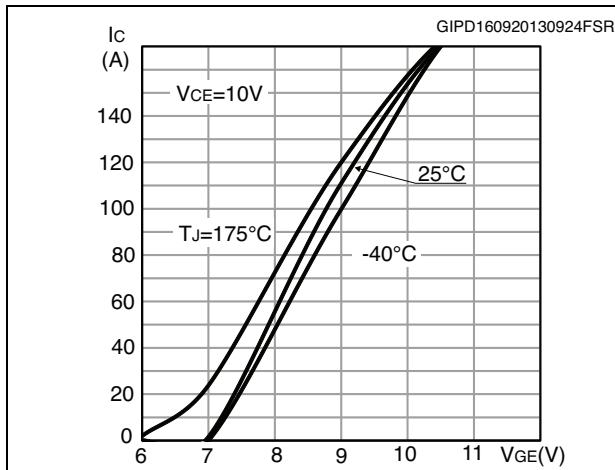


Figure 5. Collector current vs. case temperature

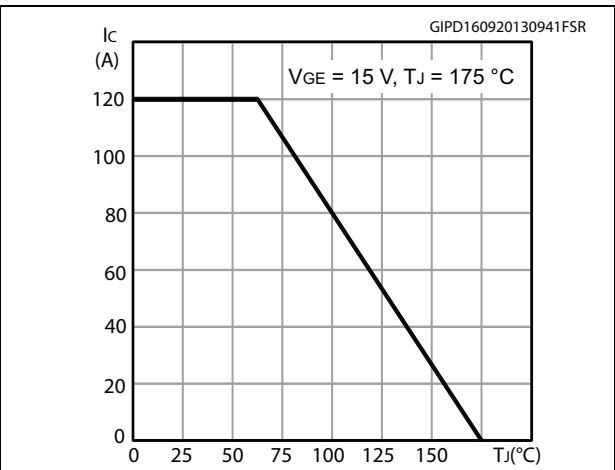


Figure 6. Power dissipation vs. case temperature

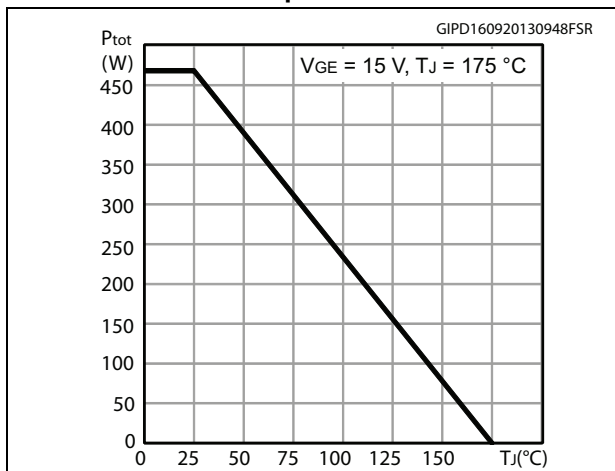


Figure 7.  $V_{CE(sat)}$  vs. junction temperature

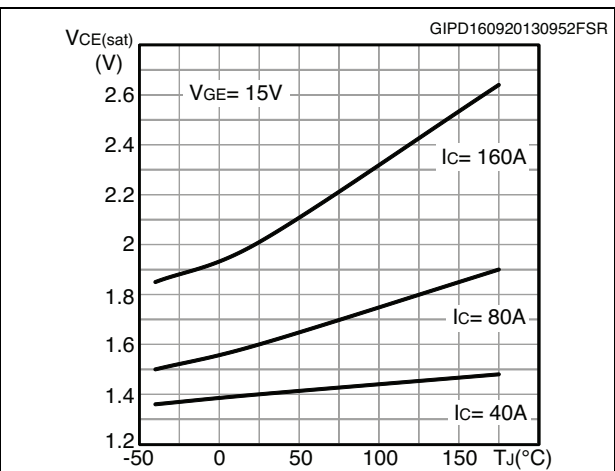


Figure 8.  $V_{CE(sat)}$  vs. collector current

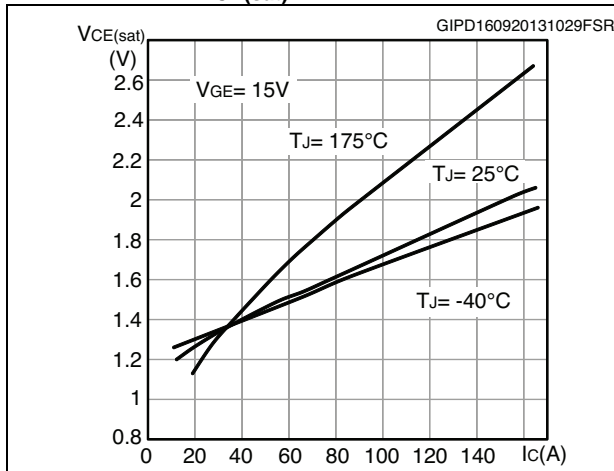


Figure 9. Forward bias safe operating area

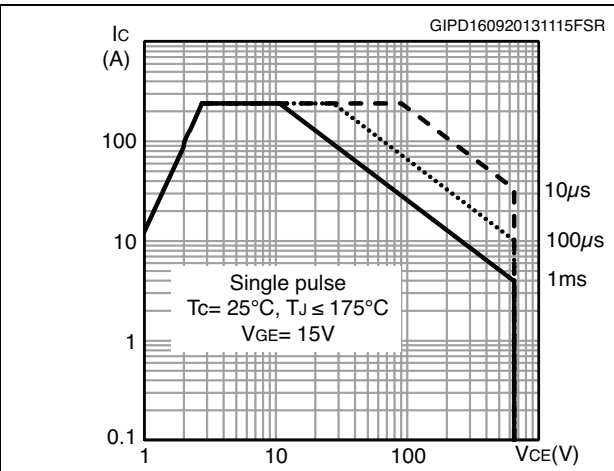


Figure 10. Capacitance variations

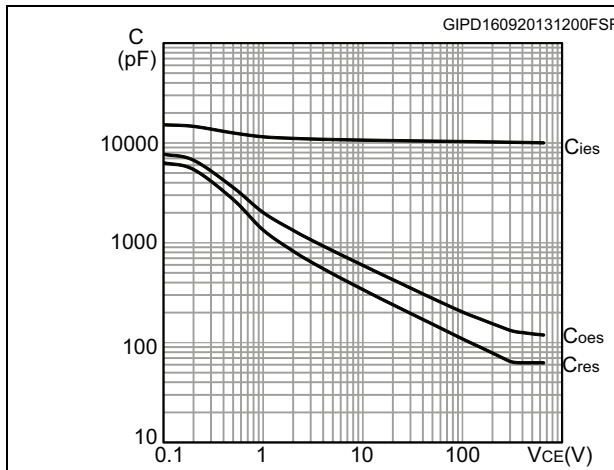


Figure 11. Normalized  $V_{(BR)CES}$  vs. junction temperature

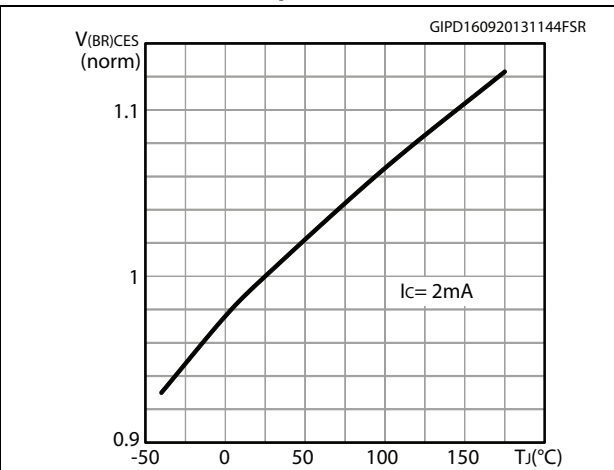


Figure 12. Normalized  $V_{GE(th)}$  vs. junction temperature

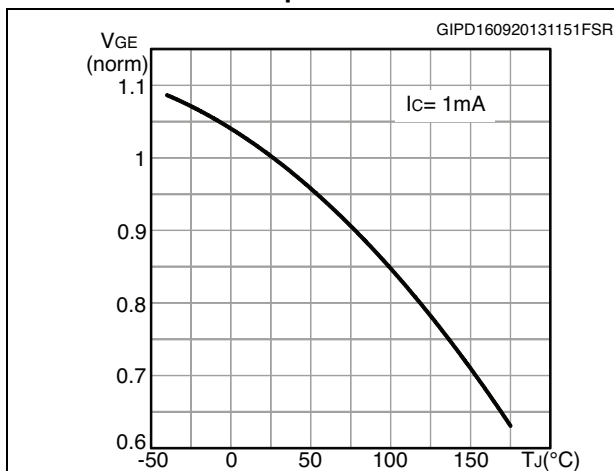


Figure 13. Gate charge vs. gate-emitter voltage

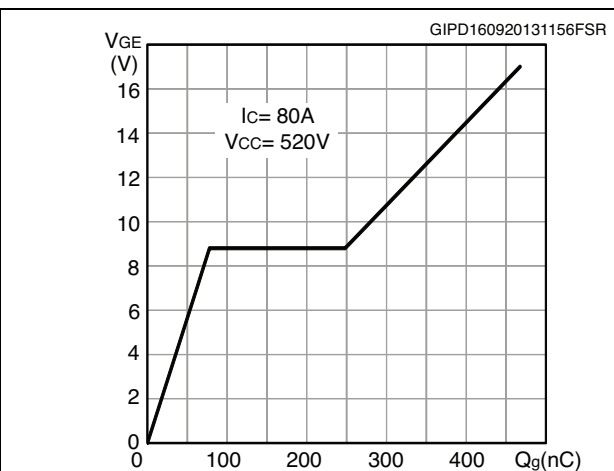


Figure 14. Switching loss vs temperature

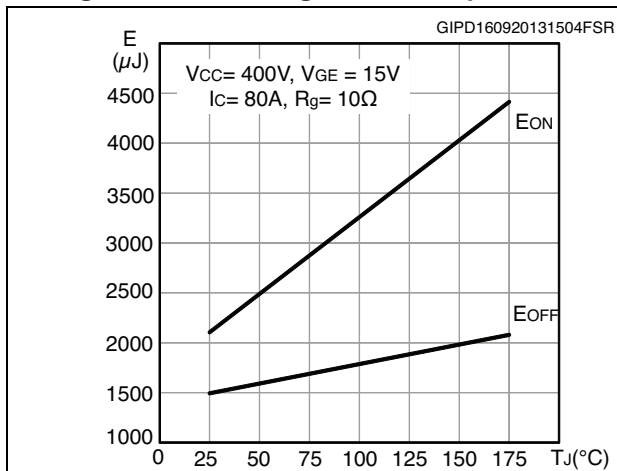


Figure 15. Switching loss vs gate resistance

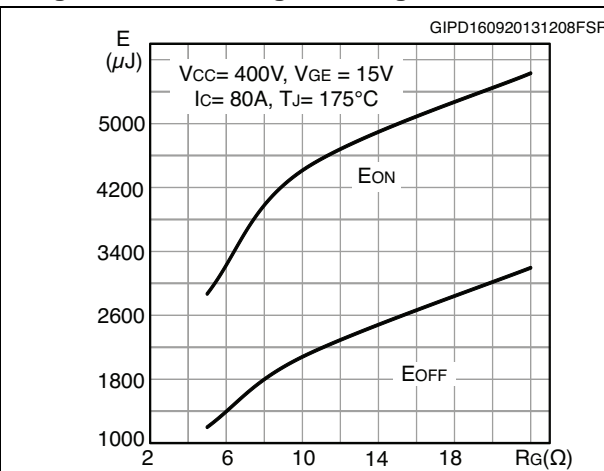


Figure 16. Switching loss vs collector current

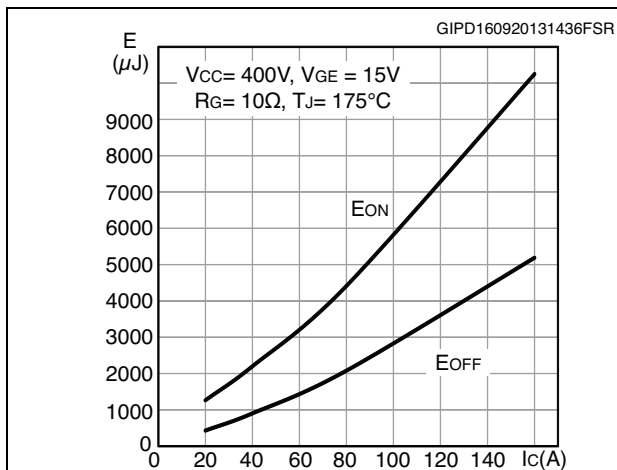


Figure 17. Switching loss vs collector emitter voltage

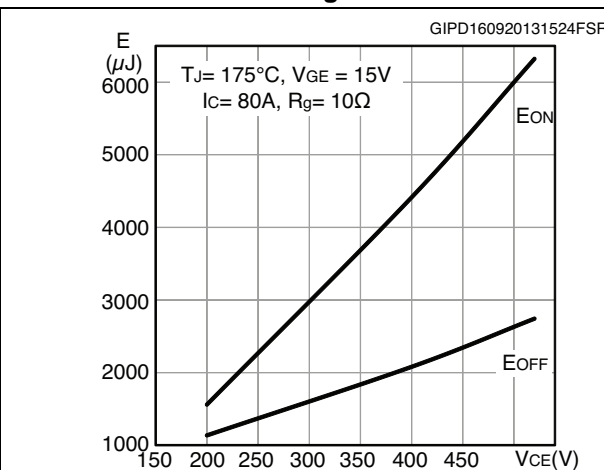


Figure 18. Switching times vs. collector current

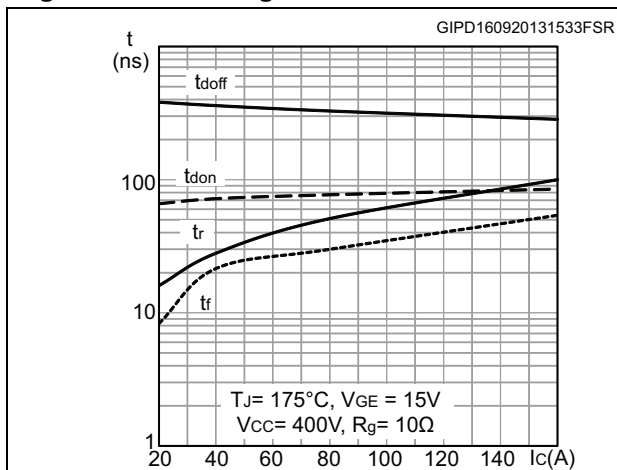


Figure 19. Switching times vs. gate resistance

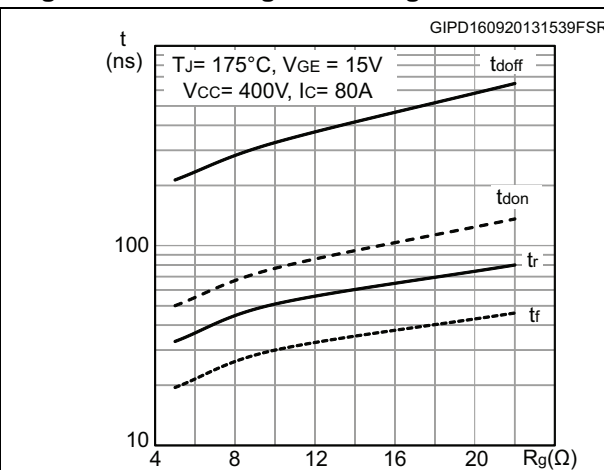
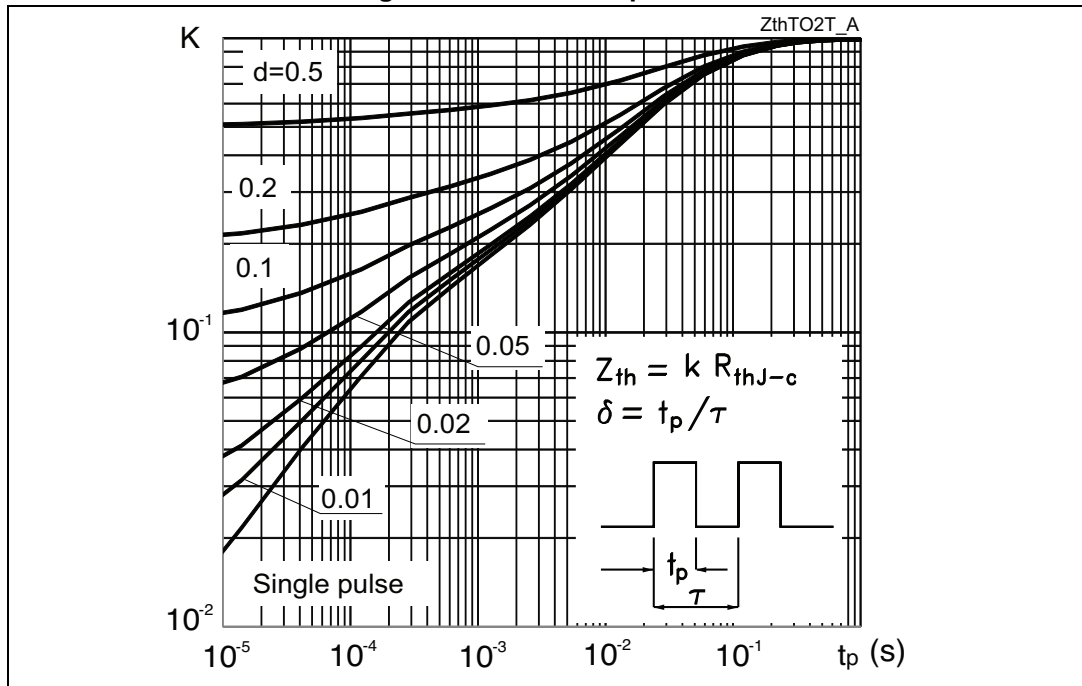




Figure 20. Collector current vs. switching frequency



Figure 21. Thermal impedance



### 3 Test circuits

Figure 22. Test circuit for inductive load switching

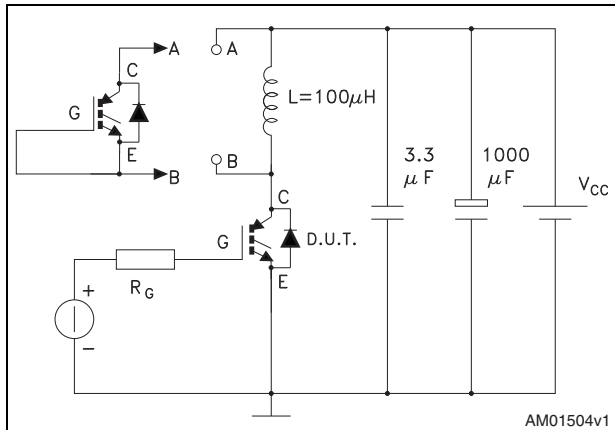


Figure 23. Gate charge test circuit

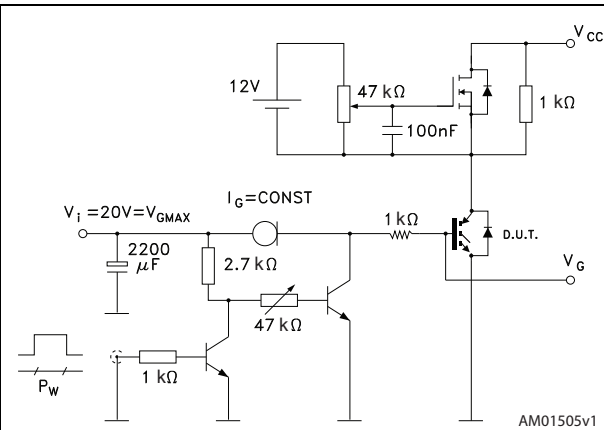
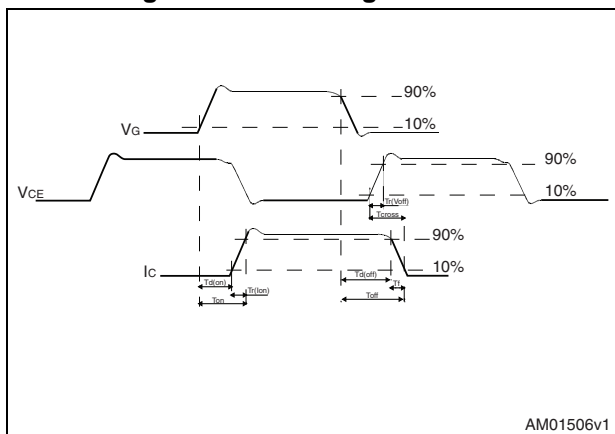


Figure 24. Switching waveform



## 4 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-247, STGW80H65FB

Figure 25. TO-247 drawing

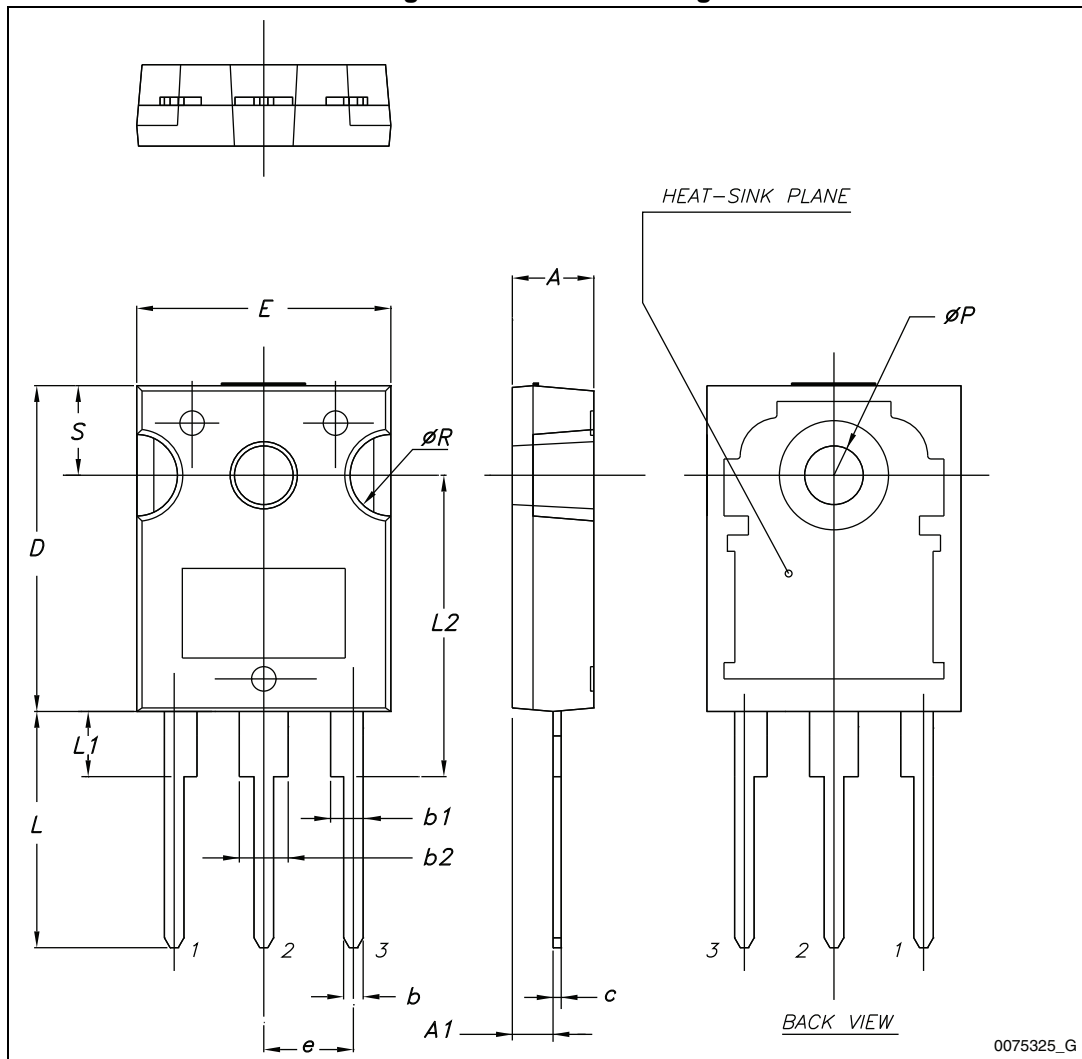


Table 7. TO-247 mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.85  |       | 5.15  |
| A1   | 2.20  |       | 2.60  |
| b    | 1.0   |       | 1.40  |
| b1   | 2.0   |       | 2.40  |
| b2   | 3.0   |       | 3.40  |
| c    | 0.40  |       | 0.80  |
| D    | 19.85 |       | 20.15 |
| E    | 15.45 |       | 15.75 |
| e    | 5.30  | 5.45  | 5.60  |
| L    | 14.20 |       | 14.80 |
| L1   | 3.70  |       | 4.30  |
| L2   |       | 18.50 |       |
| ØP   | 3.55  |       | 3.65  |
| ØR   | 4.50  |       | 5.50  |
| S    | 5.30  | 5.50  | 5.70  |

4.2 TO-247 long leads, STGWA80H65FB

Figure 26. TO-247 long leads drawing



Table 8. TO-247 long leads 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  |

4.3 TO-3P, STGWT80H65FB

Figure 27. TO-3P drawing



Table 9. TO-3P mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.60  | 4.80  | 5     |
| A1   | 1.45  | 1.50  | 1.65  |
| A2   | 1.20  | 1.40  | 1.60  |
| b    | 0.80  | 1.00  | 1.20  |
| b1   | 1.80  | 2.00  | 2.20  |
| b2   | 2.80  | 3.00  | 3.20  |
| c    | 0.55  | 0.60  | 0.75  |
| D    | 19.70 | 19.90 | 20.10 |
| D1   | 13.70 | 13.90 | 14.10 |
| E    | 15.40 | 15.60 | 15.80 |
| E1   | 13.40 | 13.60 | 13.80 |
| E2   | 9.40  | 9.60  | 9.90  |
| e    | 5.15  | 5.45  | 5.75  |
| L    | 19.80 | 20    | 20.20 |
| L1   | 3.30  | 3.50  | 3.70  |
| L2   | 18.20 | 18.40 | 18.60 |
| øP   | 3.30  | 3.40  | 3.50  |
| øP1  | 3.10  | 3.20  | 3.30  |
| Q    | 4.80  | 5     | 5.20  |
| Q1   | 3.60  | 3.80  | 4     |



## 5 Revision history

Table 10. Document revision history

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 13-Jun-2014 | 1        | Initial release. |

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- Техническая поддержка проекта;
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