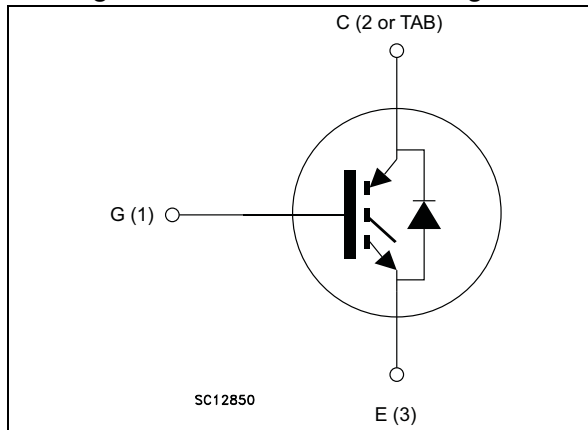


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- 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
- 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 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           | Packing |
|---------------|-------------|-------------------|---------|
| STGY80H65DFB  | GY80H65DFB  | Max247            | Tube    |
| STGW80H65DFB  | GW80H65DFB  | TO-247            | Tube    |
| STGWA80H65DFB | GW80H65DFB  | TO-247 long leads | Tube    |
| STGWT80H65DFB | GWT80H65DFB | TO-3P             | Tube    |

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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    |
|                         | Continuous collector current at $T_C = 100\text{ °C}$ | 80                 |      |
| $I_{CP}$ <sup>(2)</sup> | Pulsed collector current                              | 240                | A    |
| $V_{GE}$                | Gate-emitter voltage                                  | $\pm 20$           | V    |
| $I_F$                   | Continuous forward current at $T_C = 25\text{ °C}$    | 120 <sup>(1)</sup> | A    |
|                         | Continuous forward current at $T_C = 100\text{ °C}$   | 80                 |      |
| $I_{FP}$ <sup>(2)</sup> | Pulsed forward current                                | 240                | A    |
| $P_{TOT}$               | 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        |      |

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 IGBT  | 0.32  | °C/W |
| $R_{thJC}$ | Thermal resistance junction-case diode | 0.66  |      |
| $R_{thJA}$ | Thermal resistance junction-ambient    | 50    |      |

## 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  |      |               |
| $V_F$         | Forward on-voltage                                   | $I_F = 80\text{ A}$  |      | 1.9  | 2.3  | V             |
|               |  | $I_F = 80\text{ A}, T_J = 125\text{ °C}$                           |      | 1.6  |      |               |
|               |  | $I_F = 80\text{ A}, T_J = 175\text{ °C}$                           |      | 1.5  |      |               |
| $V_{GE(th)}$  | 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   | -    |      |
| $C_{res}$ | Reverse transfer capacitance |  | -    | 215   | -    |      |
| $Q_g$     | Total gate charge            | $V_{CC} = 520\text{ V}, I_C = 80\text{ A},$<br>$V_{GE} = 15\text{ V},$ see <a href="#">Figure 29</a> | -    | 414   | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |  | -    | 78    | -    |      |
| $Q_{gc}$  | Gate-collector charge        |  | -    | 170   | -    |      |

**Table 6. IGBT switching characteristics (inductive load)**

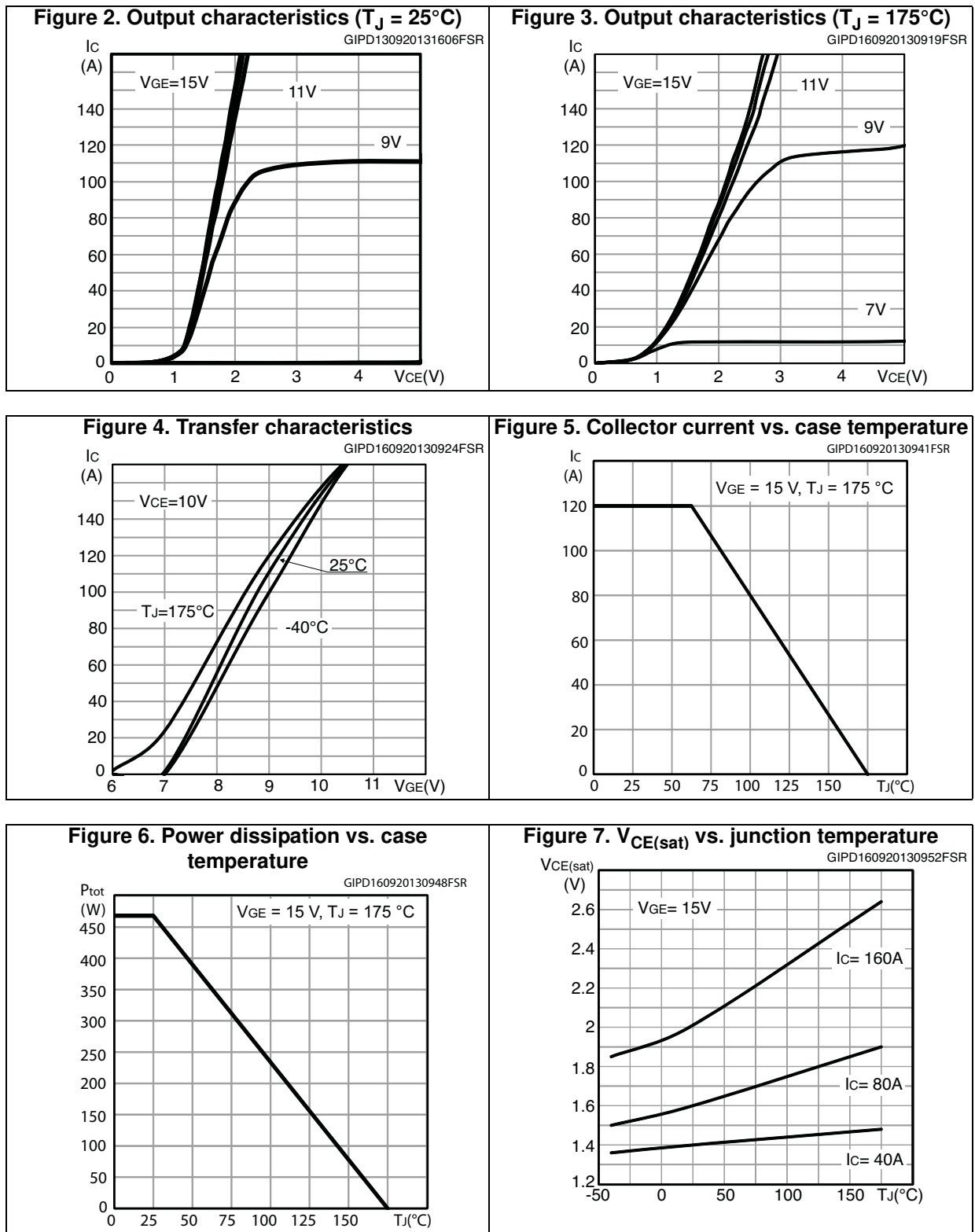
| Symbol          | Parameter                 | Test conditions   | Min. | Typ. | Max. | Unit             |
|-----------------|---------------------------|---|------|------|------|------------------|
| $t_{d(on)}$     | Turn-on delay time        | $V_{CE} = 400\text{ V}$ , $I_C = 80\text{ A}$ ,<br>$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,<br>see <a href="#">Figure 28</a>                                     | -    | 84   | -    | ns               |
| $t_r$           | Current rise time         |   | -    | 52   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1270 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | 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 28</a> | -    | 77   | -    | ns               |
| $t_r$           | Current rise time         |   | -    | 51   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 1270 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | 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   |                  |

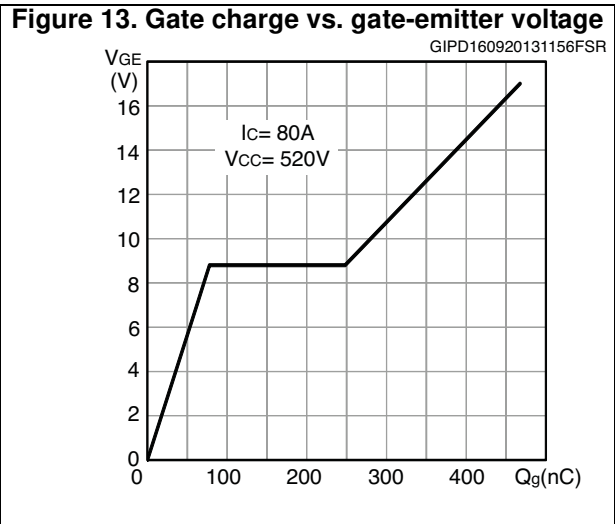
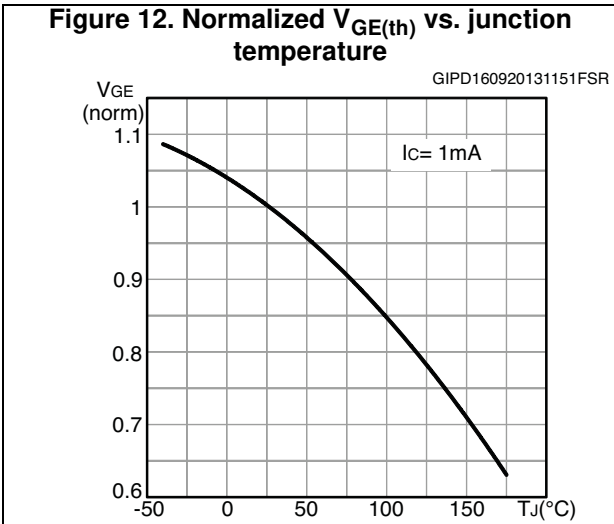
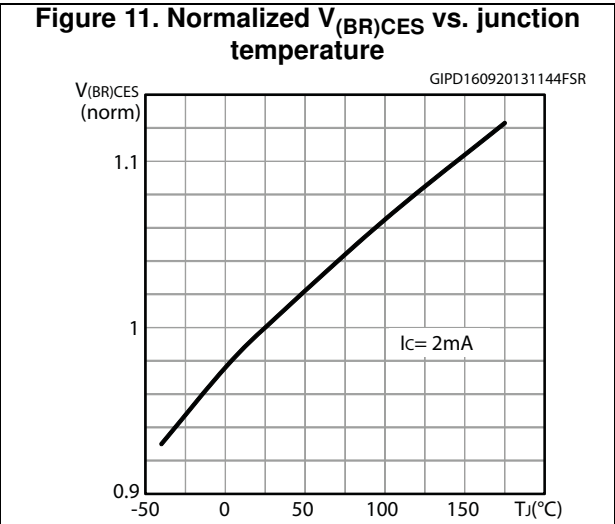
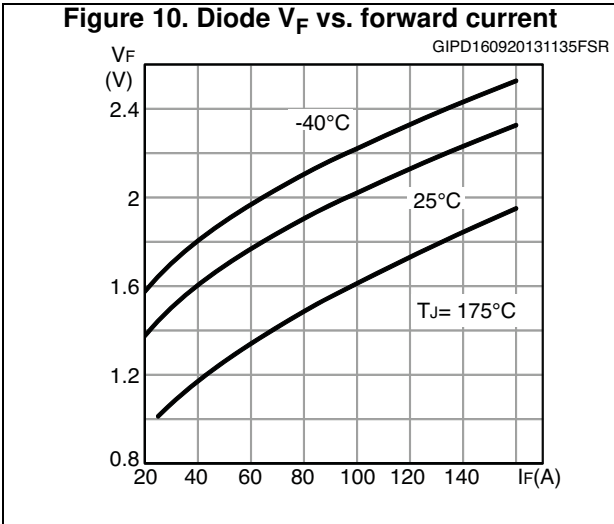
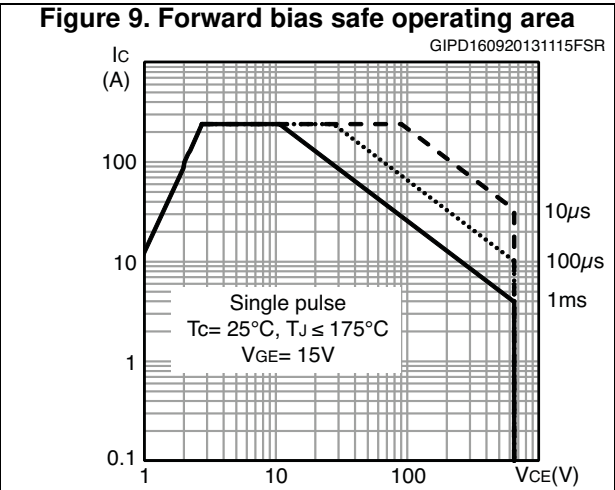
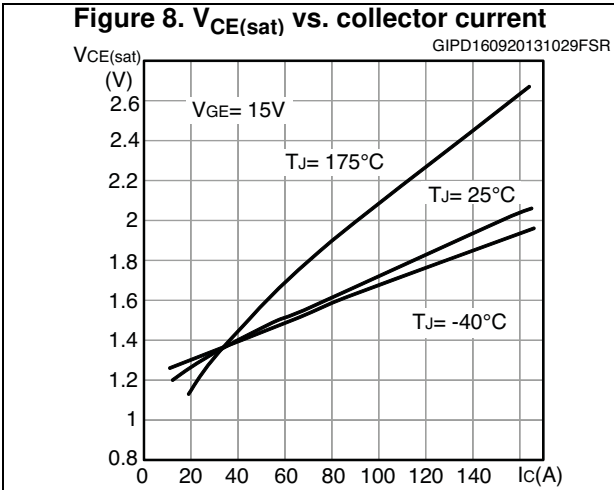
1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

**Table 7. Diode switching characteristics (inductive load)**

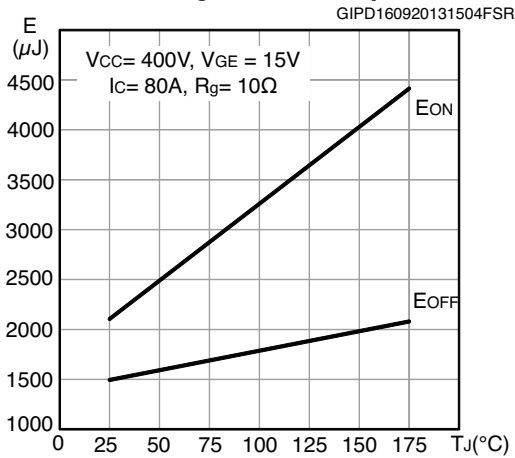
| Symbol       | Parameter  | Test conditions  | Min. | Typ. | Max. | Unit             |
|--------------|--|--|------|------|------|------------------|
| $t_{rr}$     | Reverse recovery time                                      | $I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ ,<br>$di/dt = 1000\text{ A}/\mu\text{s}$ ,<br>$V_{GE} = 15\text{ V}$ ,<br>see <a href="#">Figure 28</a>                                     | -    | 85   | -    | ns               |
| $Q_{rr}$     | Reverse recovery charge                                    |  | -    | 1105 | -    | nC               |
| $I_{rrm}$    | Reverse recovery current                                   |  | -    | 26   | -    | A                |
| $dl_{rr}/dt$ | Peak rate of fall of reverse recovery current during $t_b$ |  | -    | 722  | -    | A/ $\mu\text{s}$ |
| $E_{rr}$     | Reverse recovery energy                                    |  | -    | 267  | -    | $\mu\text{J}$    |
| $t_{rr}$     | Reverse recovery time                                      | $I_F = 80\text{ A}$ , $V_R = 400\text{ V}$ ,<br>$di/dt = 1000\text{ A}/\mu\text{s}$ ,<br>$V_{GE} = 15\text{ V}$ ,<br>$T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 28</a> | -    | 149  | -    | ns               |
| $Q_{rr}$     | Reverse recovery charge                                    |  | -    | 4920 | -    | nC               |
| $I_{rrm}$    | Reverse recovery current                                   |  | -    | 66   | -    | A                |
| $dl_{rr}/dt$ | Peak rate of fall of reverse recovery current during $t_b$ |  | -    | 546  | -    | A/ $\mu\text{s}$ |
| $E_{rr}$     | Reverse recovery energy                                    |  | -    | 1172 | -    | $\mu\text{J}$    |

## 2.1 Electrical characteristics (curves)

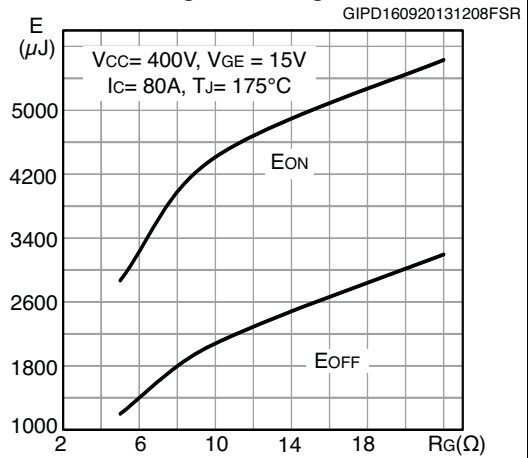




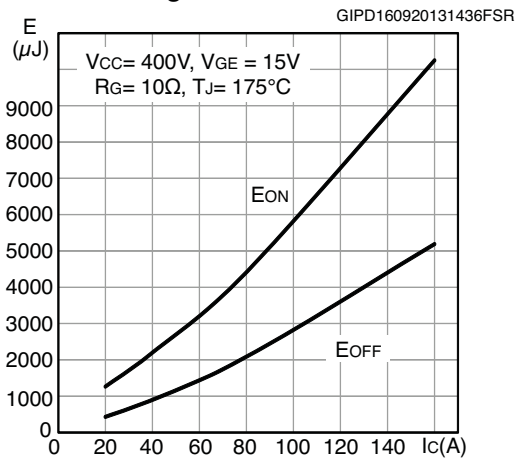
**Figure 14. Switching loss vs. temperature**



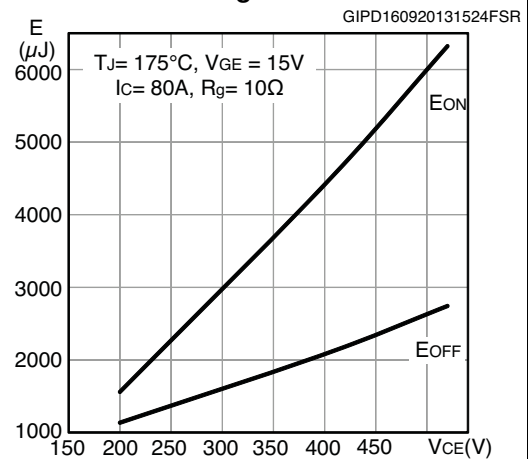
**Figure 15. Switching loss vs. gate resistance**



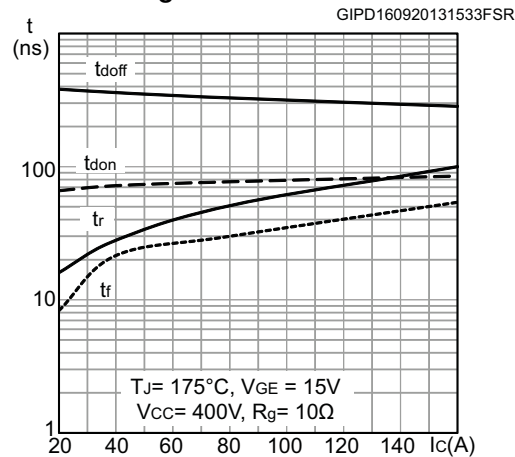
**Figure 16. Switching loss vs. collector current**



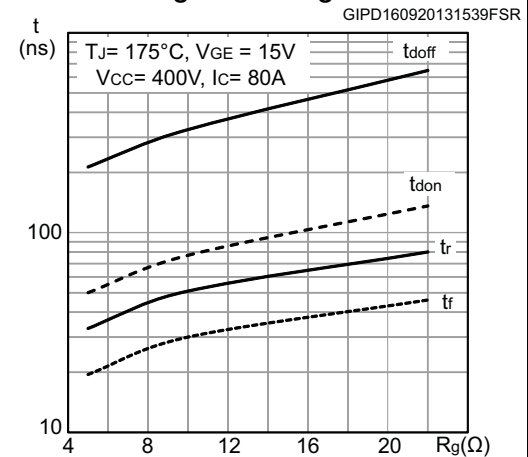
**Figure 17. Switching loss vs. collector emitter voltage**



**Figure 18. Switching times vs. collector current**



**Figure 19. Switching times vs. gate resistance**





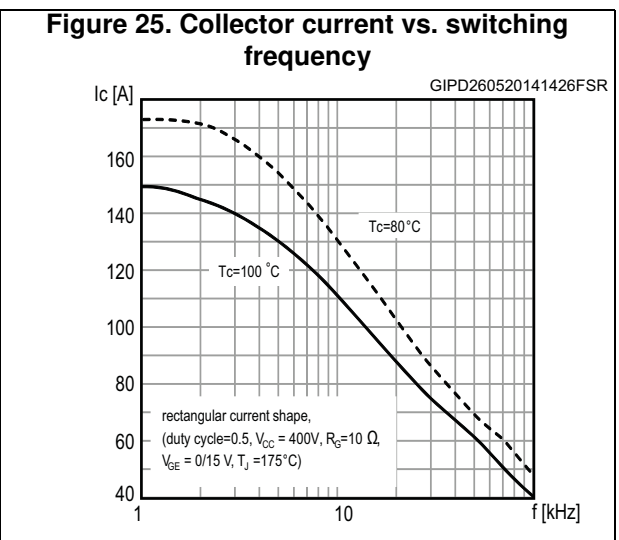
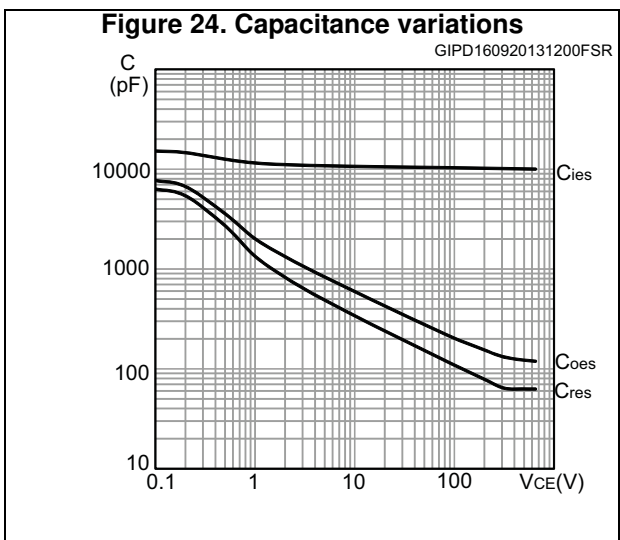
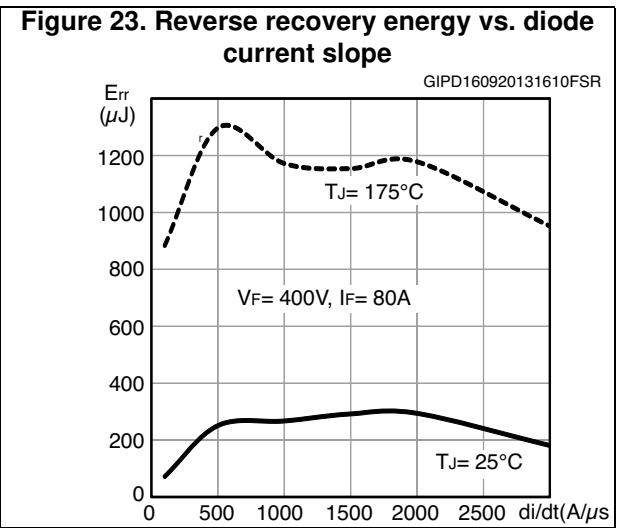
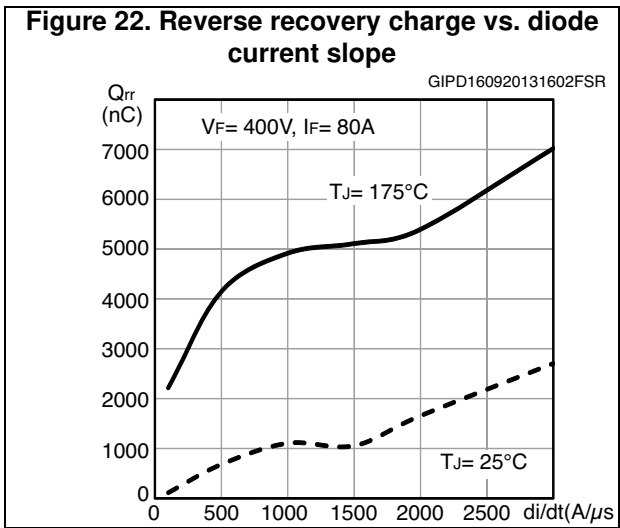
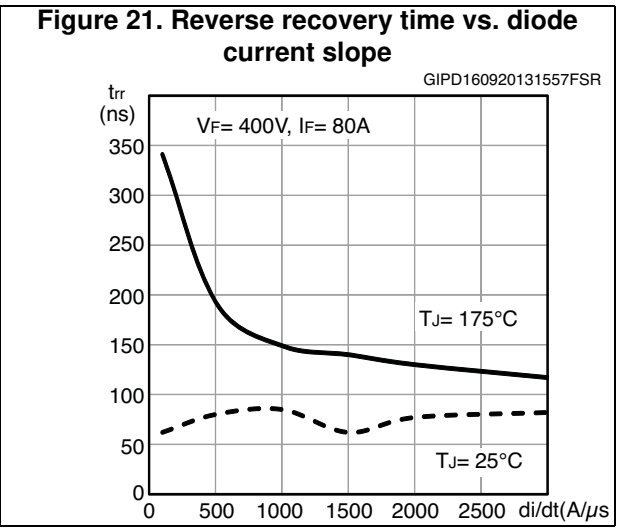
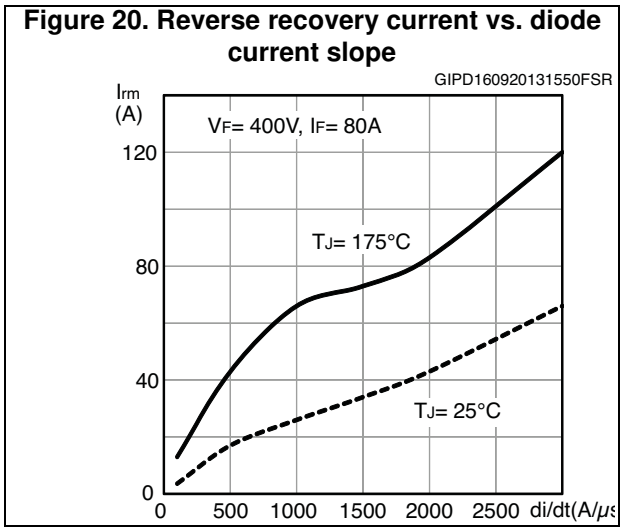


Figure 26. Thermal impedance for IGBT

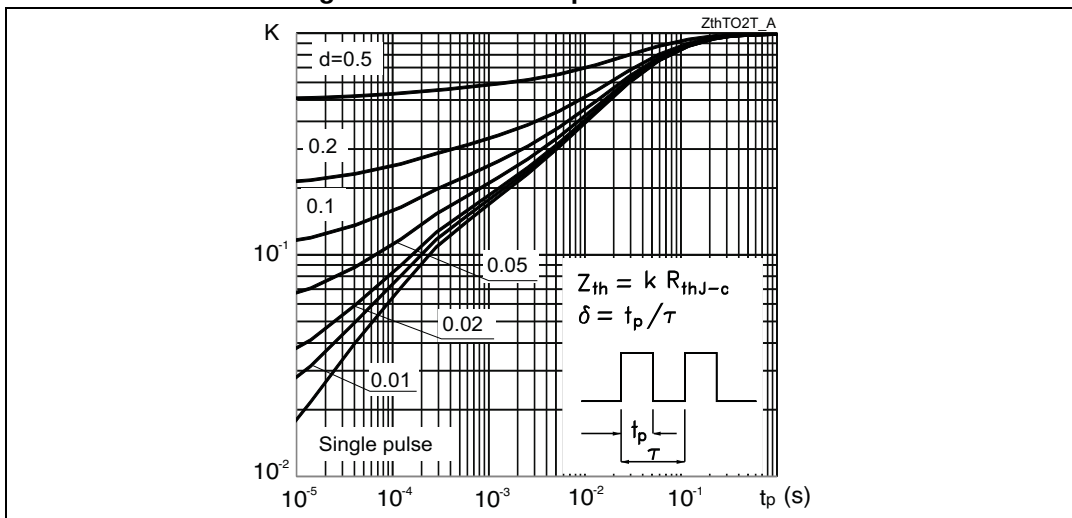
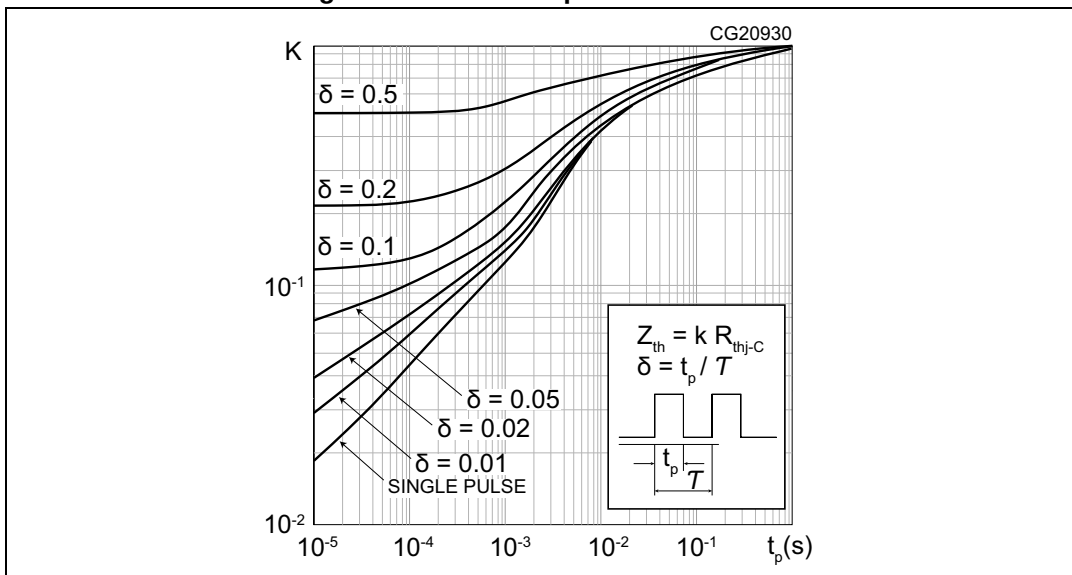
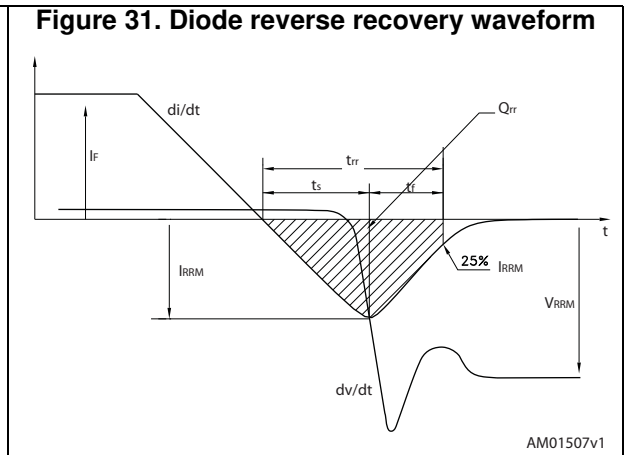
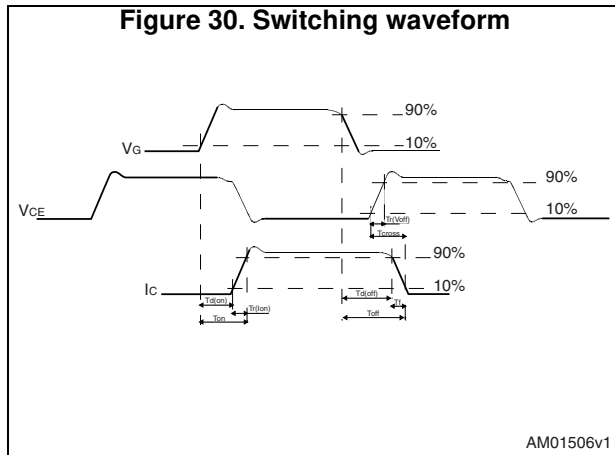
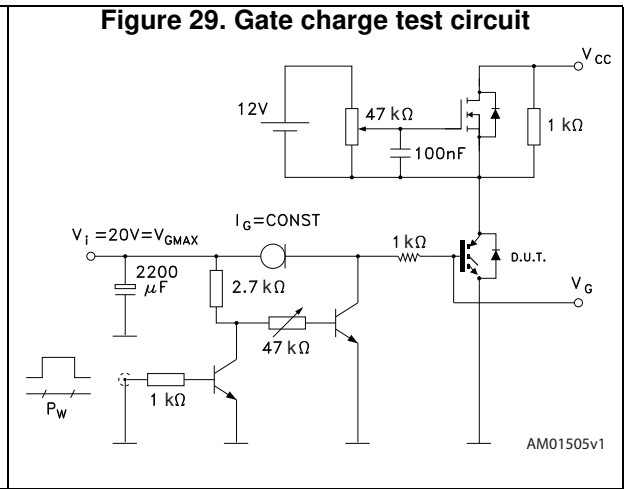
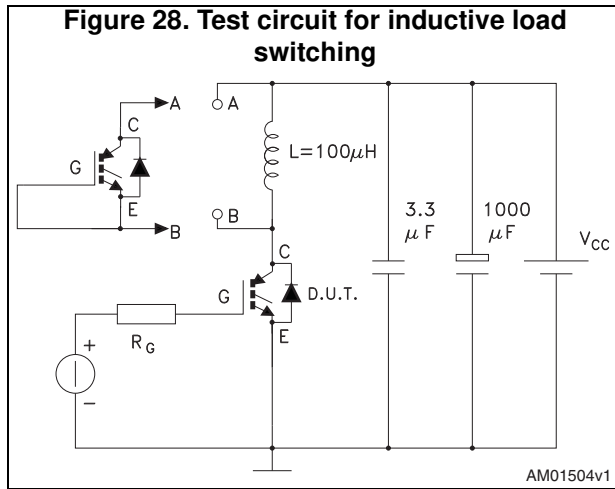


Figure 27. thermal impedance for diode



### 3 Test circuits

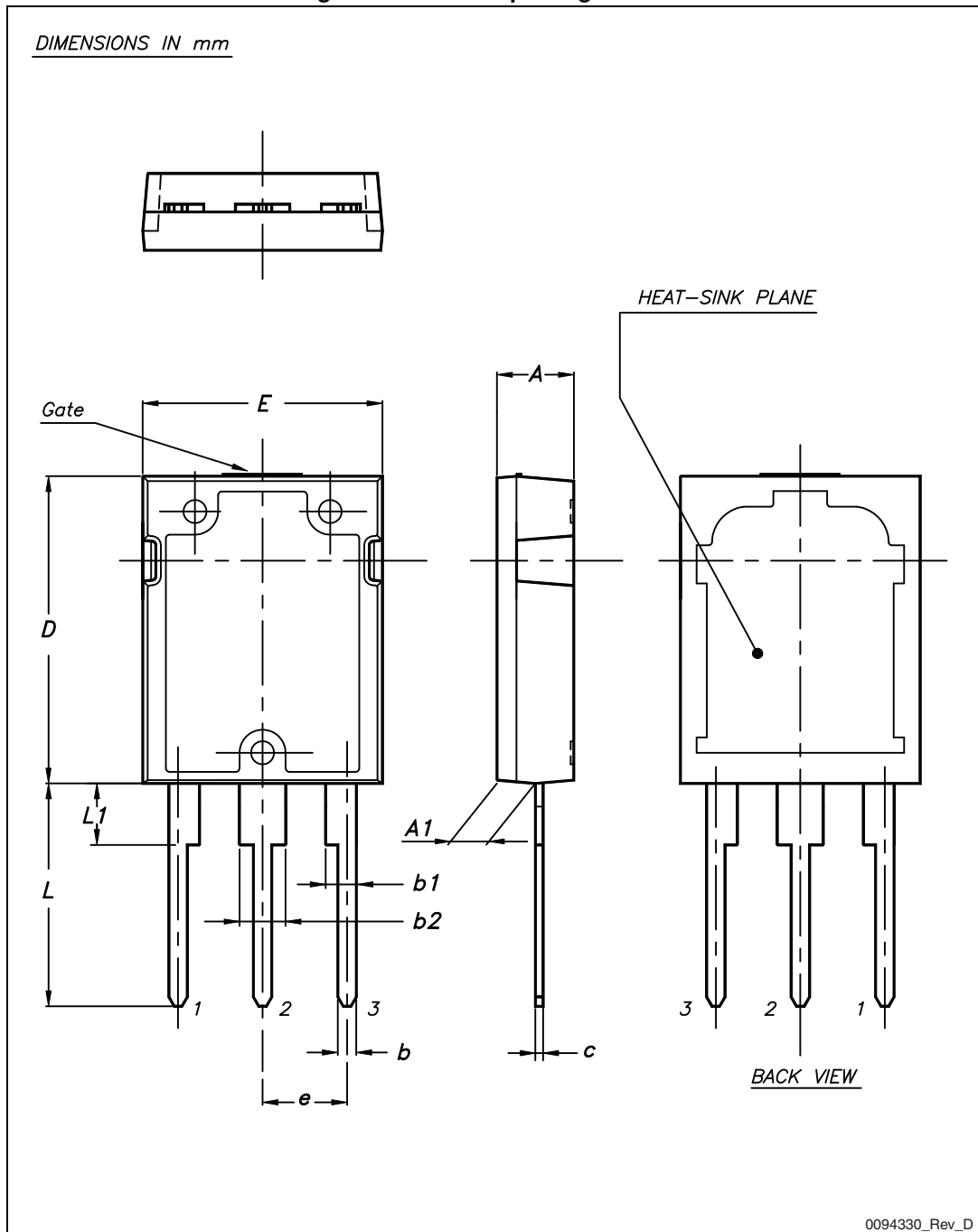


## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 Max247 package information

Figure 32. Max247 package outline



**Table 8. Max247 package mechanical data**

| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 4.70  |      | 5.30  |
| A1   | 2.20  |      | 2.60  |
| b    | 1.00  |      | 1.40  |
| b1   | 2.00  |      | 2.40  |
| b2   | 3.00  |      | 3.40  |
| c    | 0.40  |      | 0.80  |
| D    | 19.70 |      | 20.30 |
| e    | 5.35  |      | 5.55  |
| E    | 15.30 |      | 15.90 |
| L    | 14.20 |      | 15.20 |
| L1   | 3.70  |      | 4.30  |

## 4.2 TO-247 package information

Figure 33. TO-247 package outline

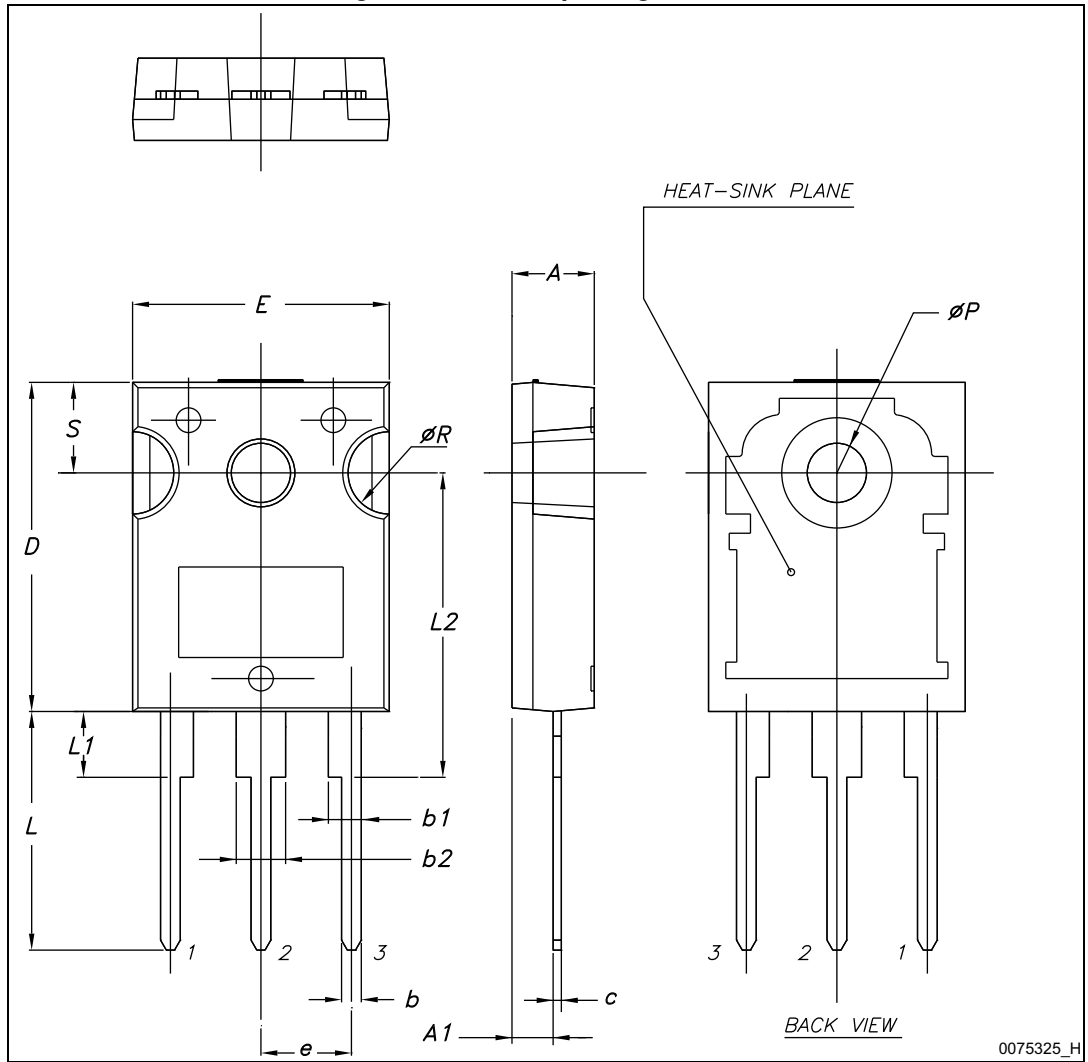


Table 9. TO-247 package mechanical data

| 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  |



### 4.3 TO-247 long leads package information

Figure 34. TO-247 long leads package outline

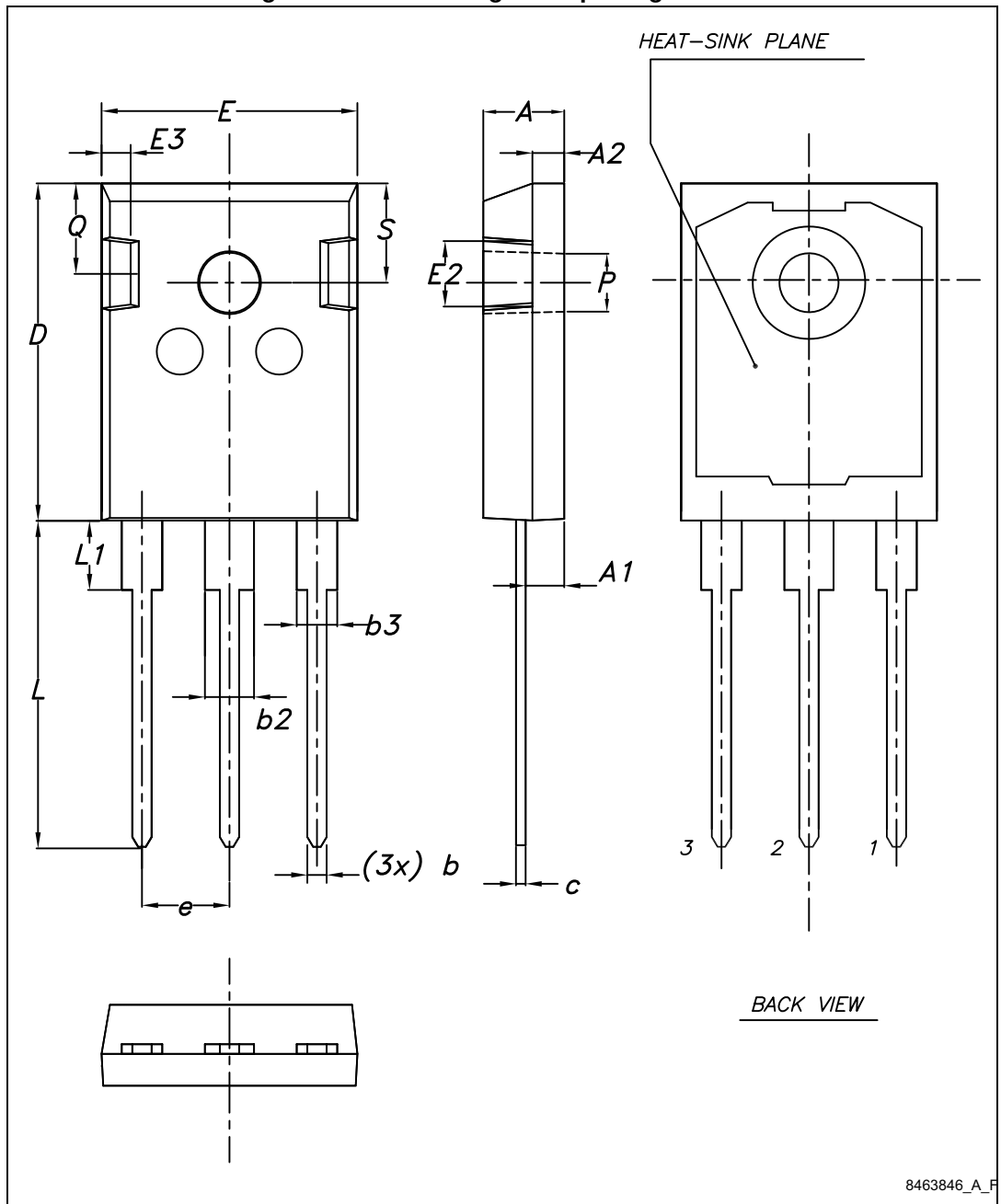


Table 10. TO-247 long leads package mechanical data

| 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  |

### 4.4 TO-3P package information

Figure 35. TO-3P package outline

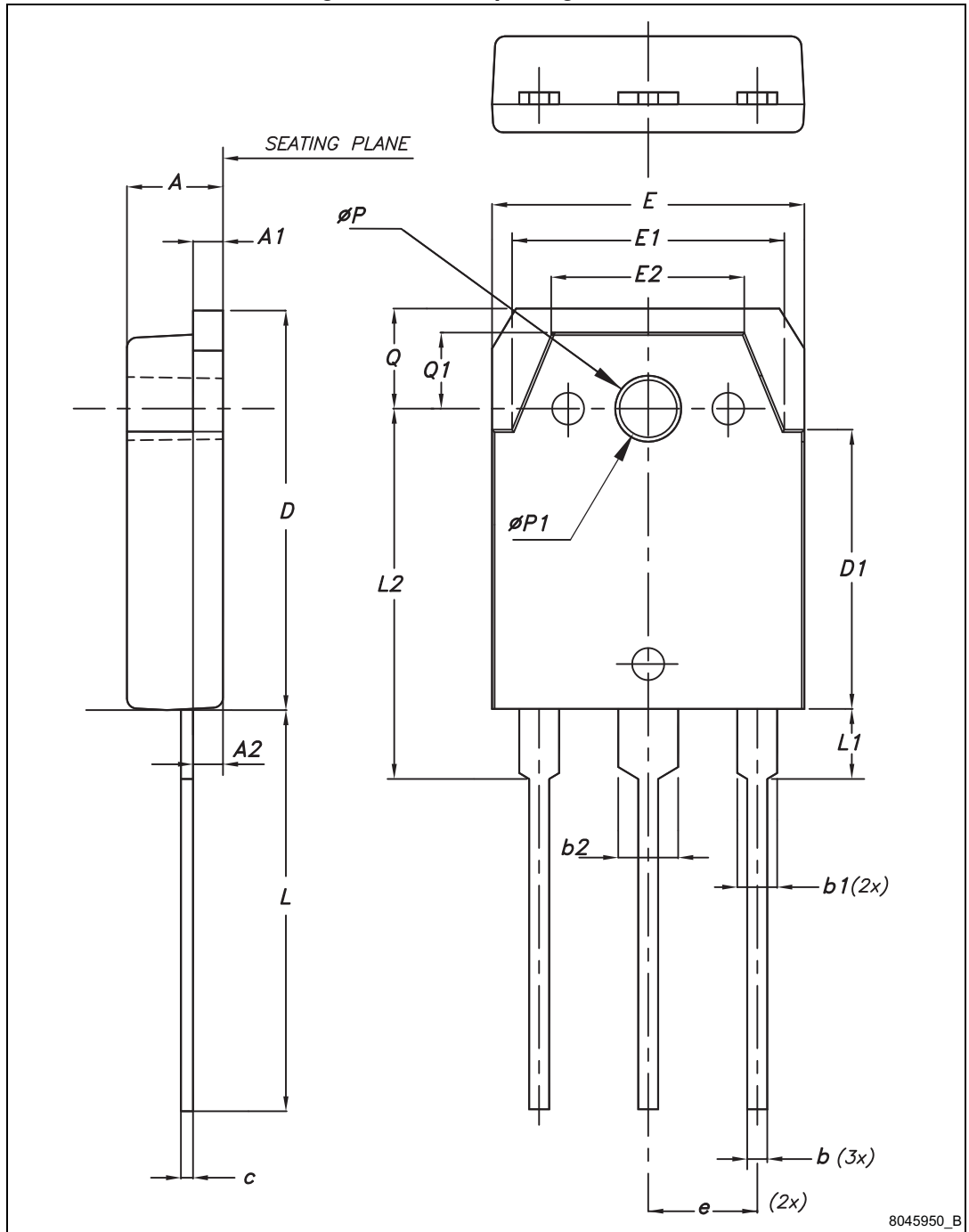


Table 11. TO-3P package mechanical data

| 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 12. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 12-Mar-2013 | 1        | Initial release.  |
| 18-Sep-2013 | 2        | Document status promoted from preliminary to production data.<br>Added <a href="#">Section 2.1: Electrical characteristics (curves)</a>   |
| 20-Nov-2013 | 3        | Added device in Max247.<br>Modified <a href="#">Table 1</a> accordingly.<br>Updated <a href="#">Section 4: Package information</a> .<br>Minor text changes in cover page.   |
| 24-Jan-2014 | 4        | Updated title and description in cover page.<br>Updated <a href="#">Table 6: IGBT switching characteristics (inductive load)</a> , <a href="#">Table 7: Diode switching characteristics (inductive load)</a> , <a href="#">Figure 9: Forward bias safe operating area</a> and <a href="#">Figure 14: Switching loss vs. temperature</a> .   |
| 13-Jun-2014 | 5        | Updated <a href="#">Figure 5: Collector current vs. case temperature</a> , <a href="#">Figure 6: Power dissipation vs. case temperature</a> , <a href="#">Figure 18: Switching times vs. collector current</a> , <a href="#">Figure 19: Switching times vs. gate resistance</a> and <a href="#">Figure 24: Capacitance variations</a> .<br>Added <a href="#">Figure 25: Collector current vs. switching frequency</a> .<br>Updated <a href="#">Section 4: Package information</a> . |
| 07-May-2015 | 6        | Added TO-247 long leads package information   |

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