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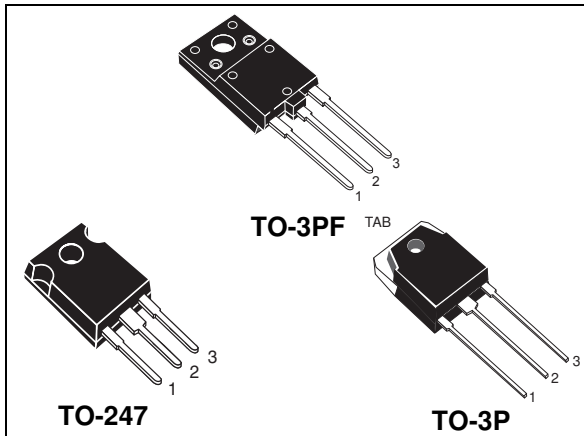
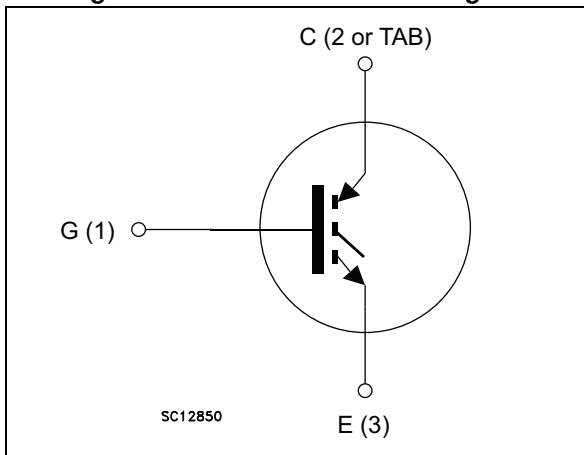


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 80\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

### Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very 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 V series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, a 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 |
|-------------|-----------|---------|-----------|
| STGFW80V60F | GFW80V60F | TO-3PF  | Tube      |
| STGW80V60F  | GW80V60F  | TO-247  | Tube      |
| STGWT80V60F | GWT80V60F | TO-3P   | Tube      |

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol                  | Parameter   | Value              |        | Unit |
|-------------------------|---|--------------------|--------|------|
|                         |   | TO-247<br>TO-3P    | TO-3PF |      |
| $V_{CES}$               | Collector-emitter voltage ( $V_{GE} = 0$ )  | 600                |        | 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  | ±20                |        | V    |
| $P_{TOT}$               | Total dissipation at $T_C = 25\text{ °C}$   | 469                | 79     | W    |
| $V_{ISO}$               | Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ °C}$ ) | 3.5                |        | kV   |
| $T_{STG}$               | 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 |
|------------|-------------------------------------|-----------------|--------|------|
|            |                                     | TO-247<br>TO-3P | TO-3PF |      |
| $R_{thJC}$ | Thermal resistance junction-case    | 0.32            | 1.9    | °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 ( $V_{GE} = 0$ ) | $I_C = 2\text{ mA}$  | 600  |      |      | V             |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage                 | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$                          |      | 1.85 | 2.3  | V             |
|               |  | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$<br>$T_J = 125\text{ °C}$ |      | 2.15 |      |               |
|               |  | $V_{GE} = 15\text{ V}, I_C = 80\text{ A}$<br>$T_J = 175\text{ °C}$ |      | 2.4  |      |               |
| $V_{GE(th)}$  | Gate threshold voltage                               | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$                               | 5    | 6    | 7    | V             |
| $I_{CES}$     | Collector cut-off current ( $V_{GE} = 0$ )           | $V_{CE} = 600\text{ V}$  |      |      | 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>$V_{GE} = 0$  | -    | 10800 | -    | nF   |
| $C_{oes}$ | Output capacitance           |  | -    | 390   | -    | pF   |
| $C_{res}$ | Reverse transfer capacitance |  | -    | 220   | -    | pF   |
| $Q_g$     | Total gate charge            | $V_{CC} = 480\text{ V}, I_C = 80\text{ A},$<br>$V_{GE} = 15\text{ V},$ see <a href="#">Figure 28</a> | -    | 448   | -    | nC   |
| $Q_{ge}$  | Gate-emitter charge          |  | -    | 76    | -    | nC   |
| $Q_{gc}$  | Gate-collector charge        |  | -    | 184   | -    | nC   |



Table 6. 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 27</a>                                     | -    | 60   | -    | ns               |
| $t_r$           | Current rise time         |   | -    | 30   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 2200 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 220  | -    | ns               |
| $t_f$           | Current fall time         |   | -    | 17   | -    | ns               |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 1.8  | -    | mJ               |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 1    | -    | mJ               |
| $E_{ts}$        | Total switching losses    | -   | 2.8  | -    | 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 27</a> | -    | 60   | -    | ns               |
| $t_r$           | Current rise time         |   | -    | 30   | -    | ns               |
| $(di/dt)_{on}$  | Turn-on current slope     |   | -    | 2100 | -    | A/ $\mu\text{s}$ |
| $t_{d(off)}$    | Turn-off delay time       |   | -    | 240  | -    | ns               |
| $t_f$           | Current fall time         |   | -    | 22   | -    | ns               |
| $E_{on}^{(1)}$  | Turn-on switching losses  |   | -    | 3.8  | -    | mJ               |
| $E_{off}^{(2)}$ | Turn-off switching losses |   | -    | 1.25 | -    | mJ               |
| $E_{ts}$        | Total switching losses    | -   | 5.05 | -    | mJ   |                  |

1. Energy loss include reverse recovery of the external diode. The diode is the same of the co-packed STGW80V60DF
2. Turn-off losses include also the tail of the collector current.

## 2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature for TO-247 and TO-3P

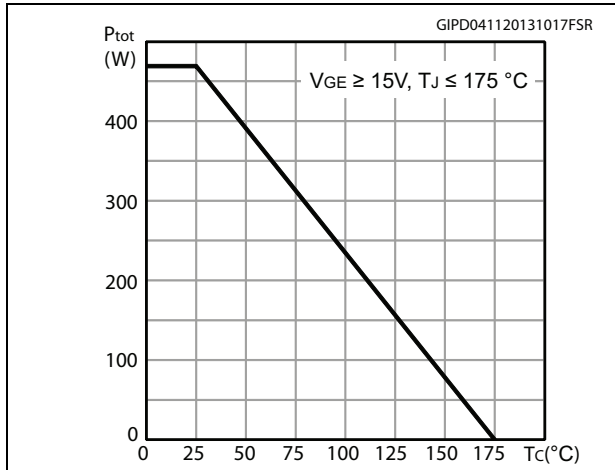


Figure 3. Collector current vs. case temperature for TO-247 and TO-3P

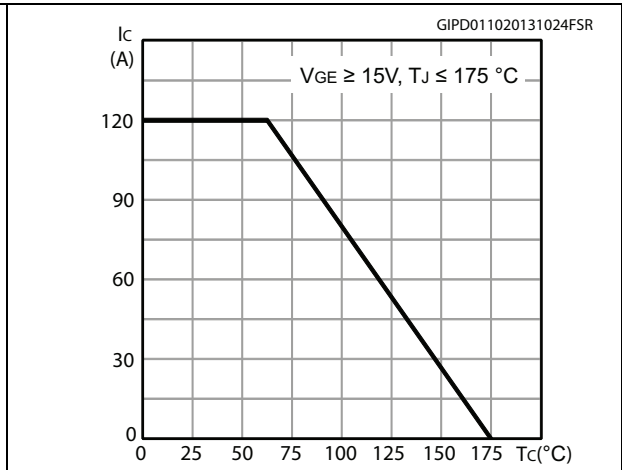


Figure 4. Power dissipation vs. case temperature for TO-3PF

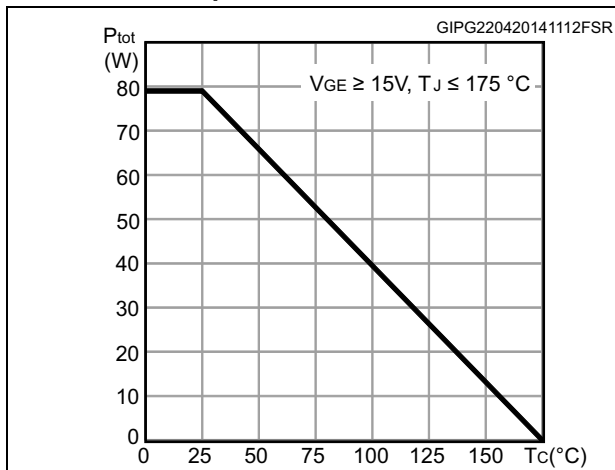


Figure 5. Collector current vs. case temperature for TO-3PF

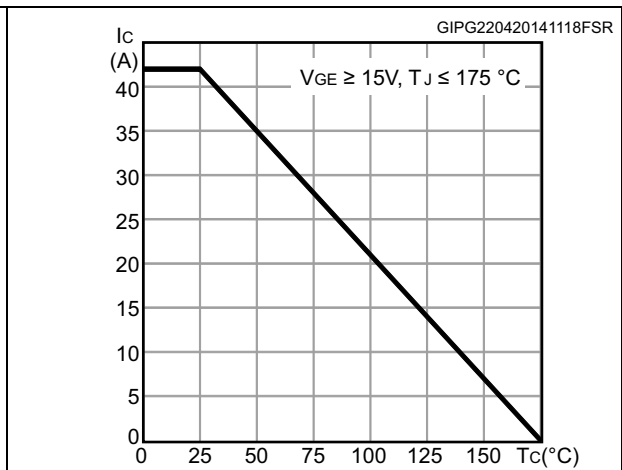


Figure 6. Output characteristics ( $T_J = 25^{\circ}C$ )

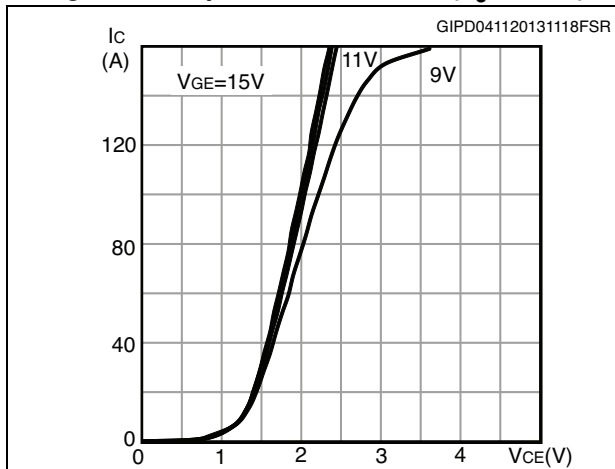


Figure 7. Output characteristics ( $T_J = 175^{\circ}C$ )

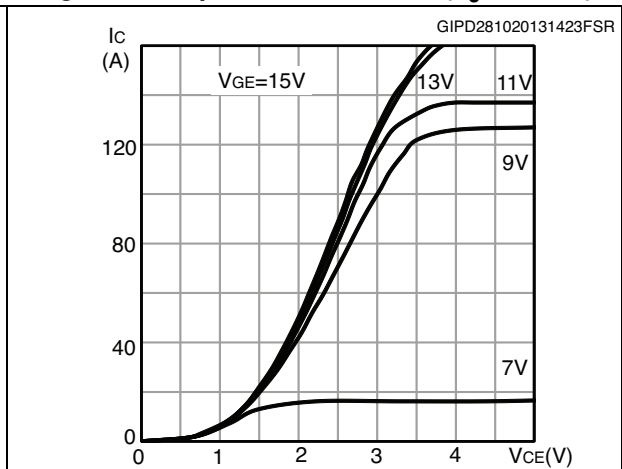


Figure 8.  $V_{CE(sat)}$  vs. junction temperature

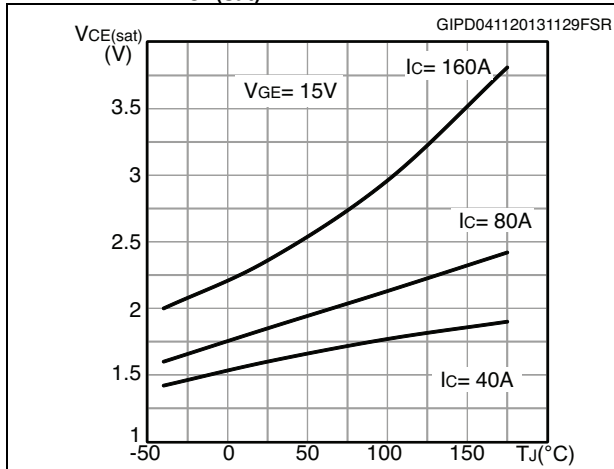


Figure 9.  $V_{CE(sat)}$  vs. collector current

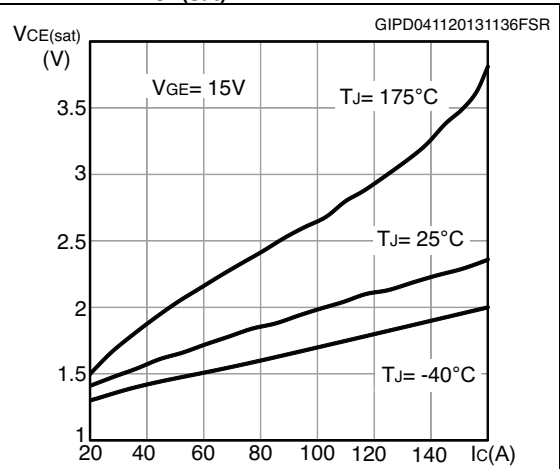


Figure 10. Collector current vs. switching frequency for TO-247 and TO-3P

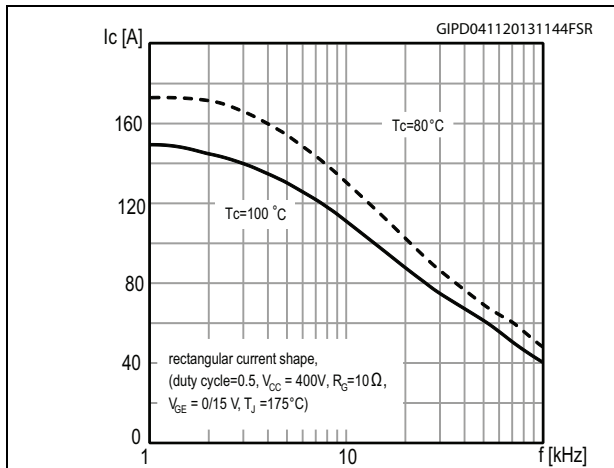


Figure 11. Collector current vs. switching frequency for TO-3PF

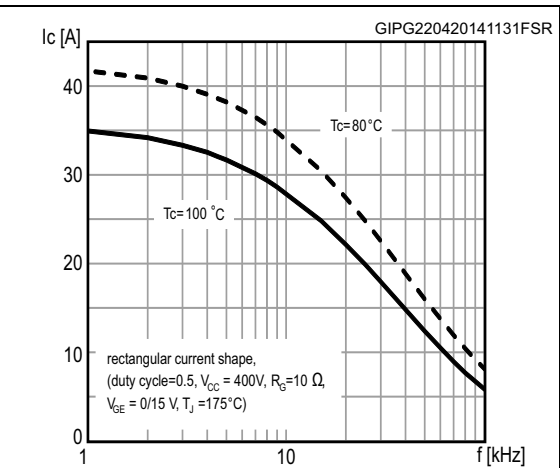


Figure 12. Forward bias safe operating area for TO-247 and TO-3P

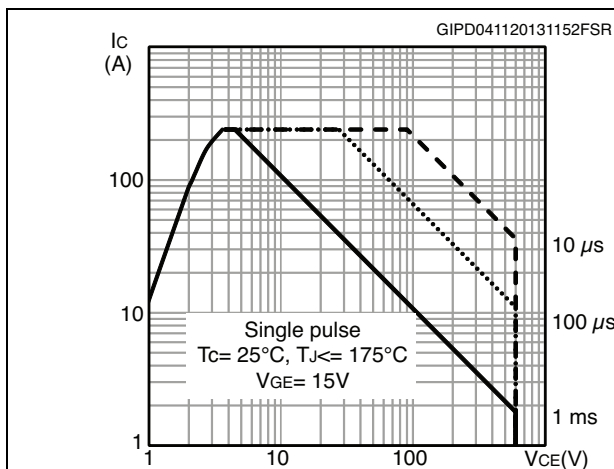


Figure 13. Forward bias safe operating area for TO-3PF

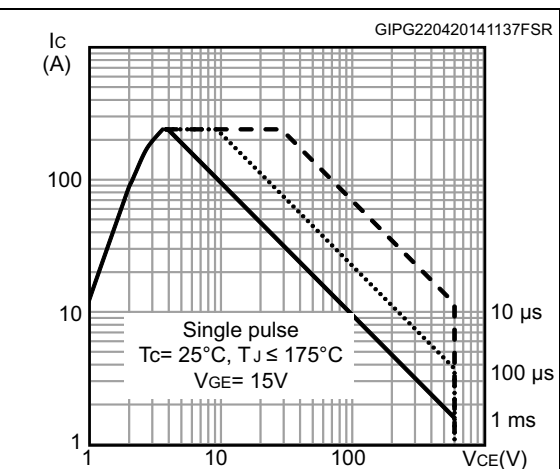




Figure 14. Normalized  $V_{GE(th)}$  vs junction temperature

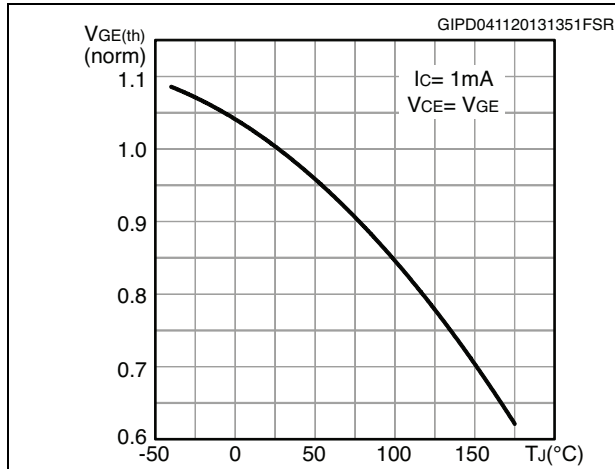


Figure 15. Normalized  $V_{(BR)CES}$  vs. junction temperature

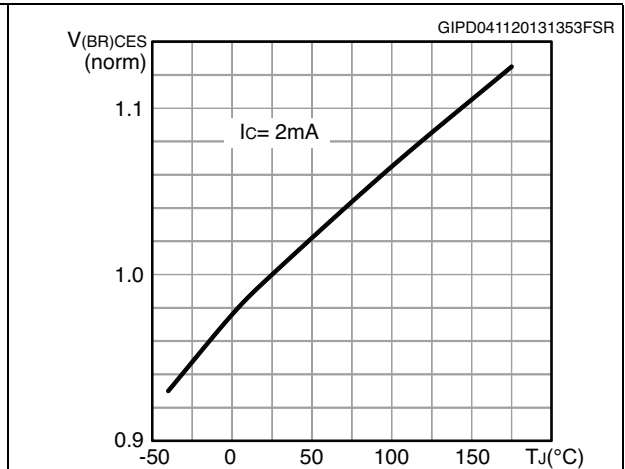


Figure 16. Capacitance variation

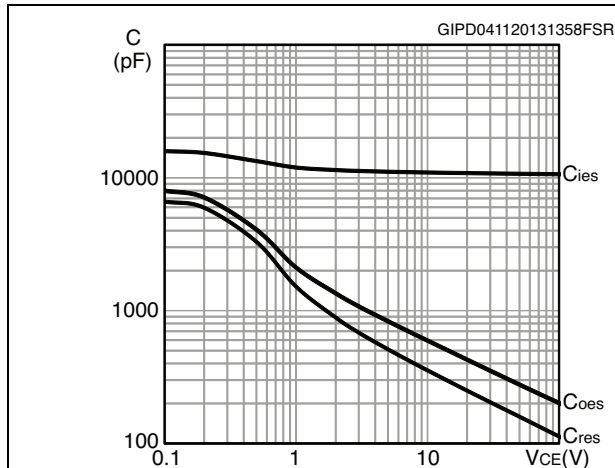


Figure 17. Gate charge vs. gate-emitter voltage

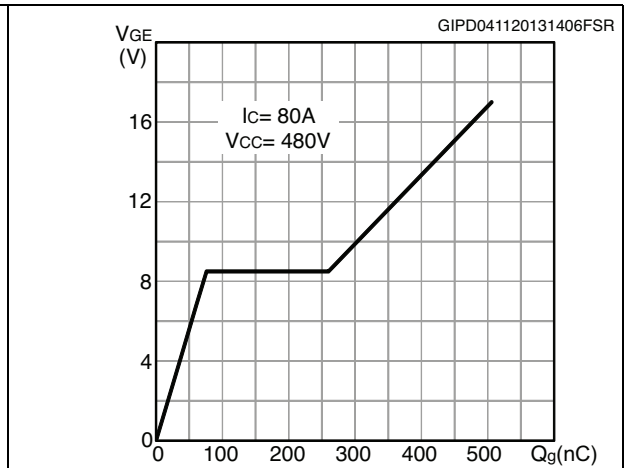


Figure 18. Switching loss vs collector current

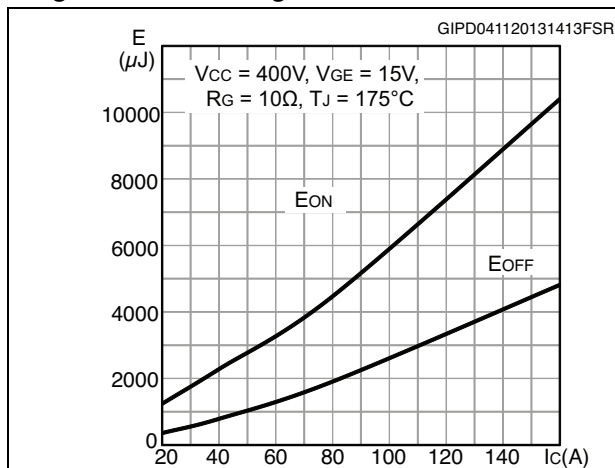


Figure 19. Switching loss vs gate resistance

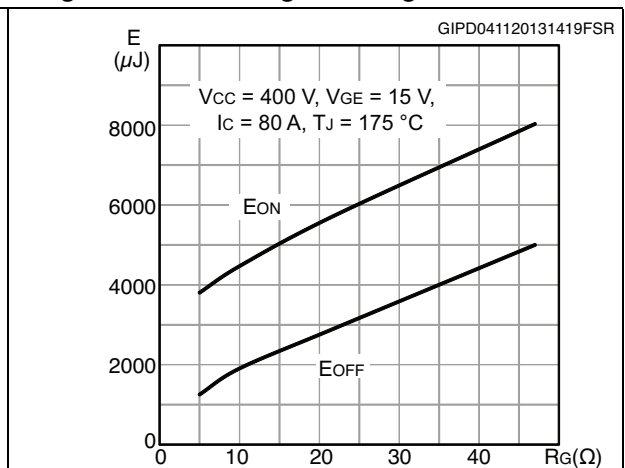


Figure 20. Switching loss vs temperature

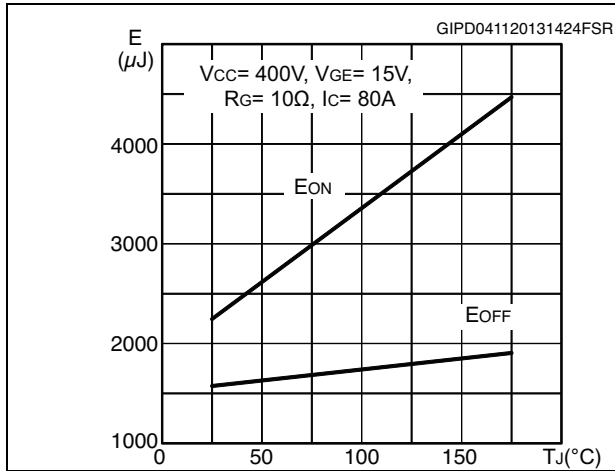


Figure 21. Switching loss vs collector-emitter voltage

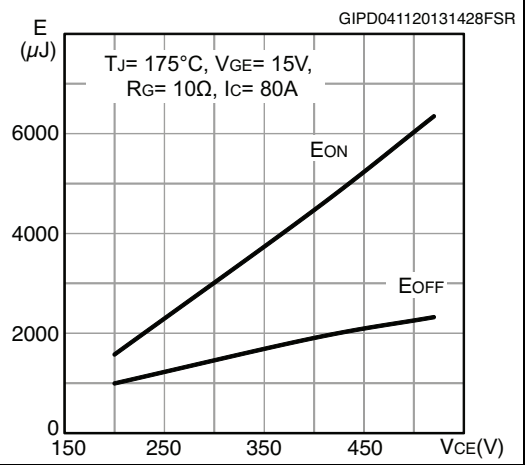


Figure 22. Switching times vs. collector current

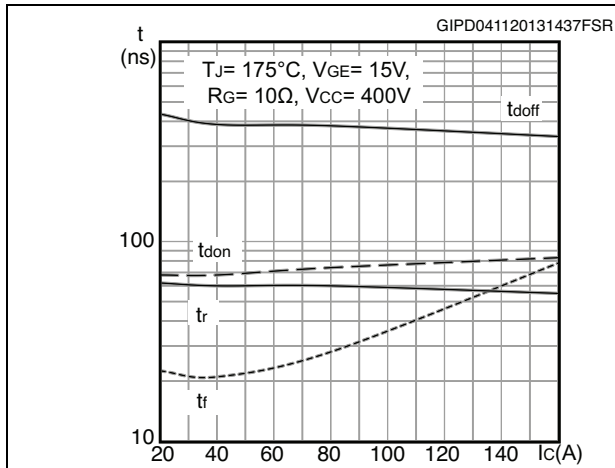


Figure 23. Switching times vs. gate resistance

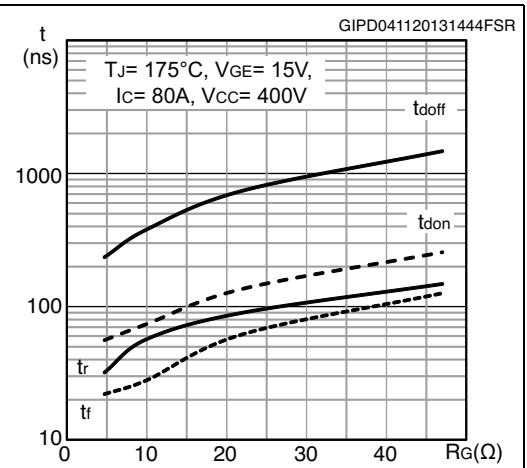


Figure 24. Transfer characteristics

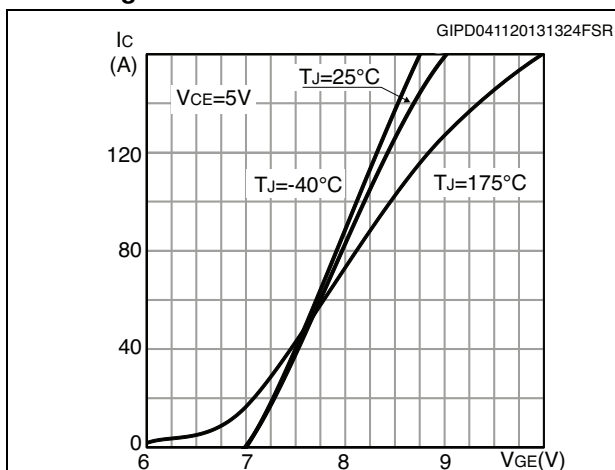


Figure 25. Thermal impedance for TO-247 and TO-3P

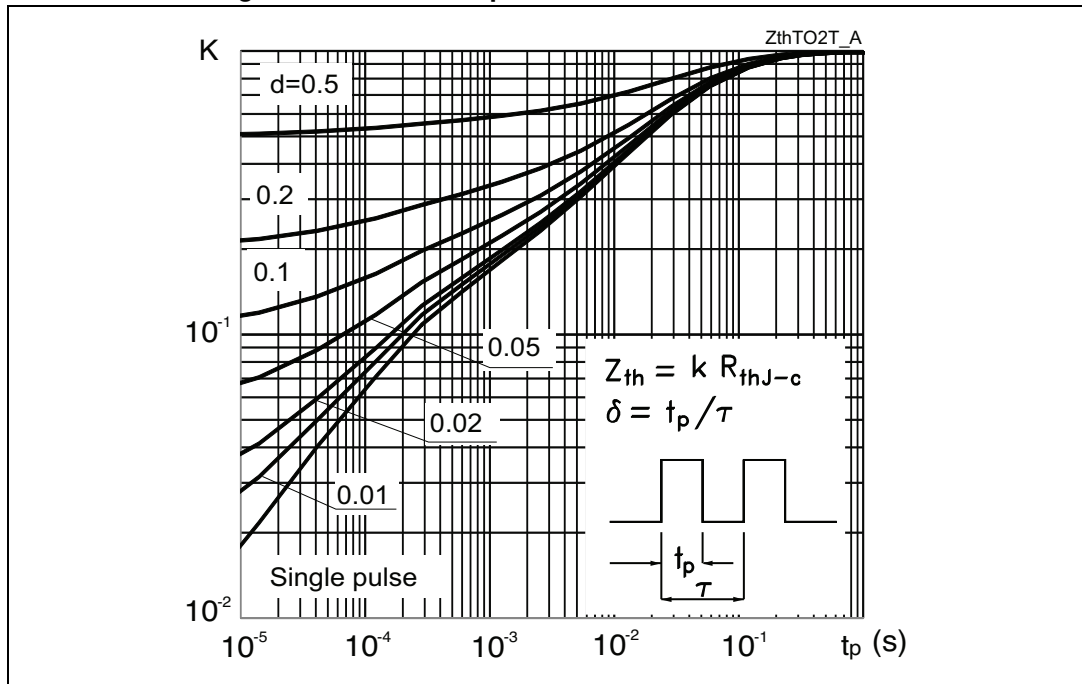
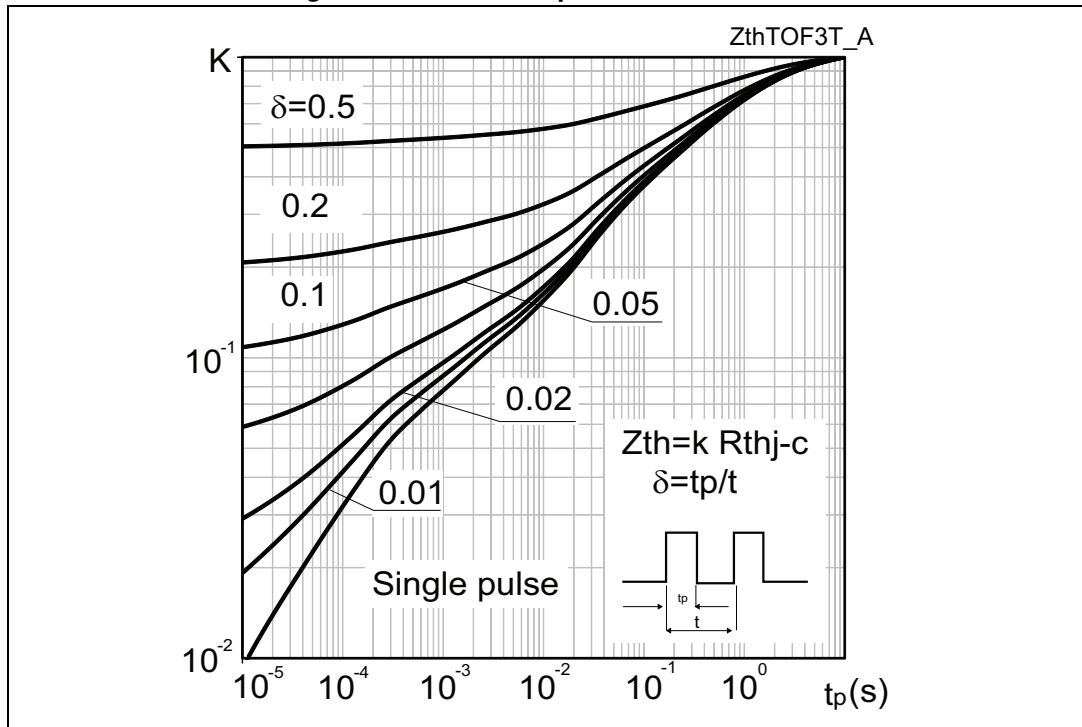


Figure 26. Thermal impedance for TO-3PF



### 3 Test circuits

Figure 27. Test circuit for inductive load switching

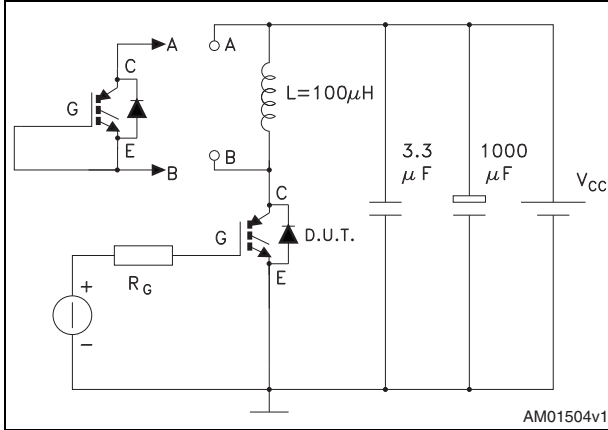


Figure 28. Gate charge test circuit

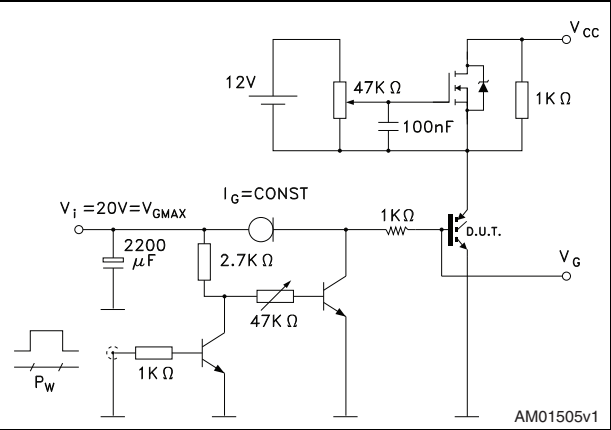
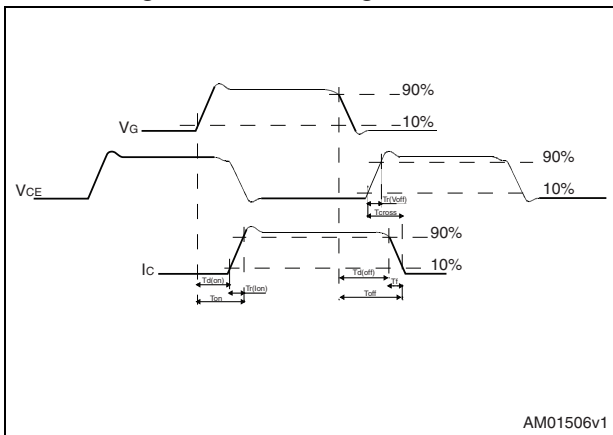


Figure 29. Switching waveform

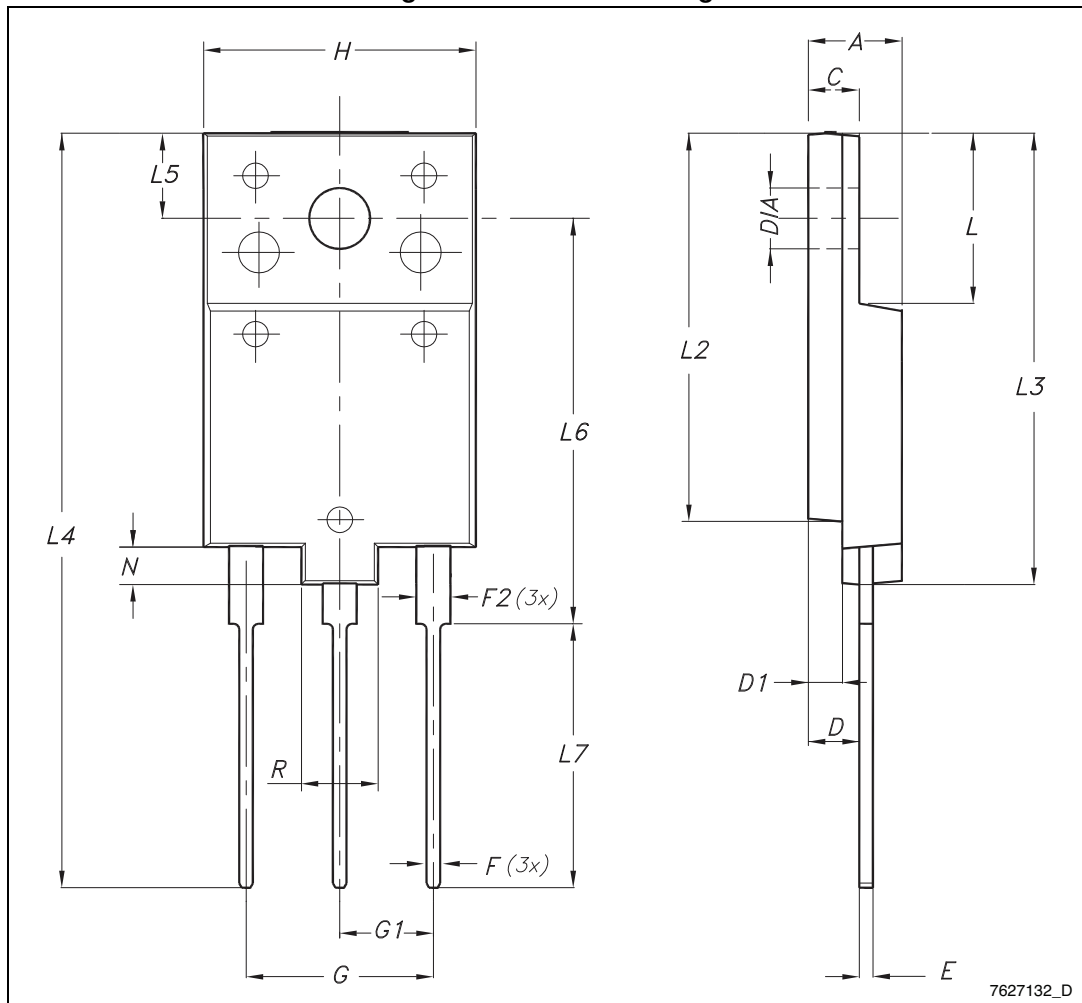


## 4 Package mechanical data

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-3PF, STGFW80V60F

Figure 30. TO-3PF drawing



7627132\_D

Table 7. TO-3PF mechanical data

| Dim. | mm    |      |       |
|------|-------|------|-------|
|      | Min.  | Typ. | Max.  |
| A    | 5.30  |      | 5.70  |
| C    | 2.80  |      | 3.20  |
| D    | 3.10  |      | 3.50  |
| D1   | 1.80  |      | 2.20  |
| E    | 0.80  |      | 1.10  |
| F    | 0.65  |      | 0.95  |
| F2   | 1.80  |      | 2.20  |
| G    | 10.30 |      | 11.50 |
| G1   |       | 5.45 |       |
| H    | 15.30 |      | 15.70 |
| L    | 9.80  | 10   | 10.20 |
| L2   | 22.80 |      | 23.20 |
| L3   | 26.30 |      | 26.70 |
| L4   | 43.20 |      | 44.40 |
| L5   | 4.30  |      | 4.70  |
| L6   | 24.30 |      | 24.70 |
| L7   | 14.60 |      | 15    |
| N    | 1.80  |      | 2.20  |
| R    | 3.80  |      | 4.20  |
| Dia  | 3.40  |      | 3.80  |



### 4.2 TO-247, STGW80V60F

Figure 31. TO-247 drawing

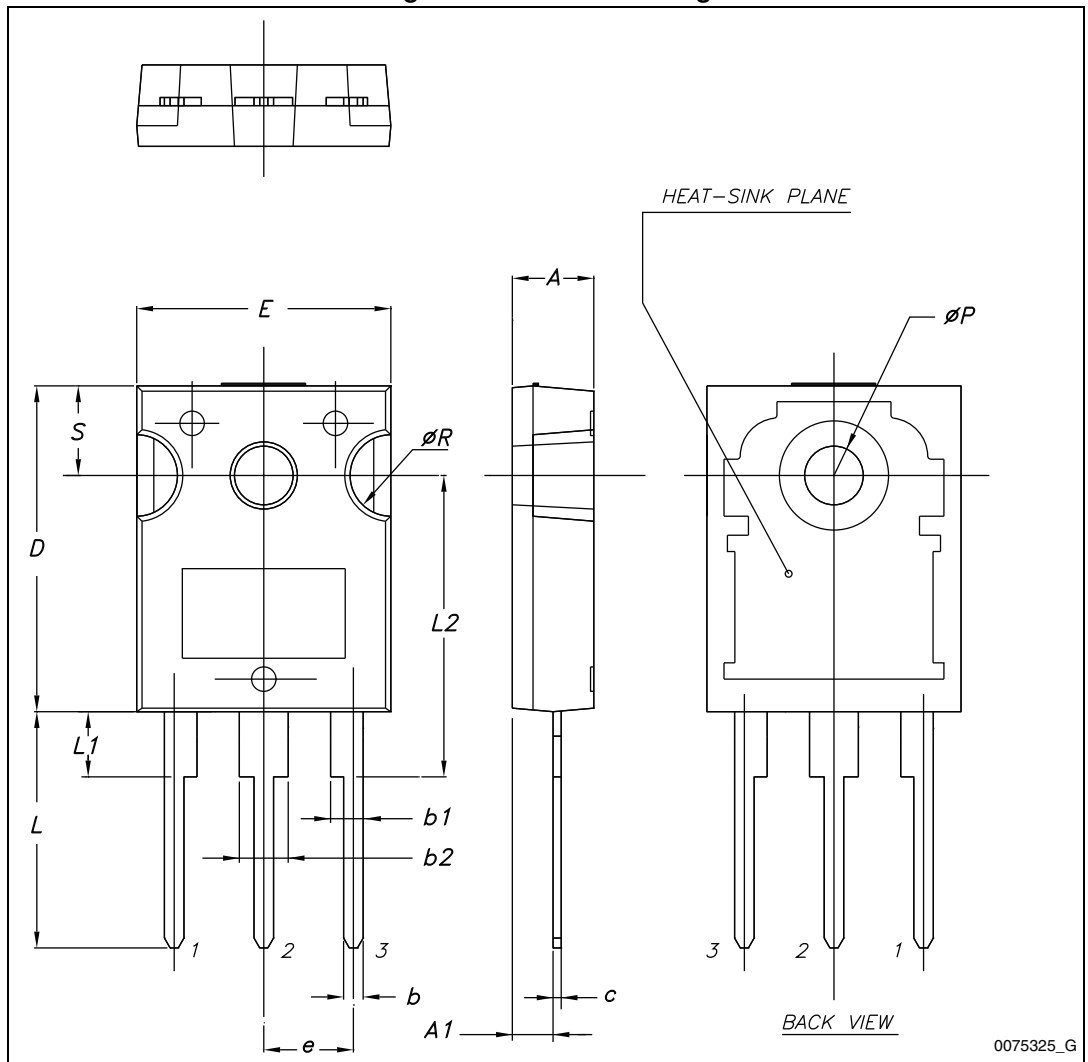
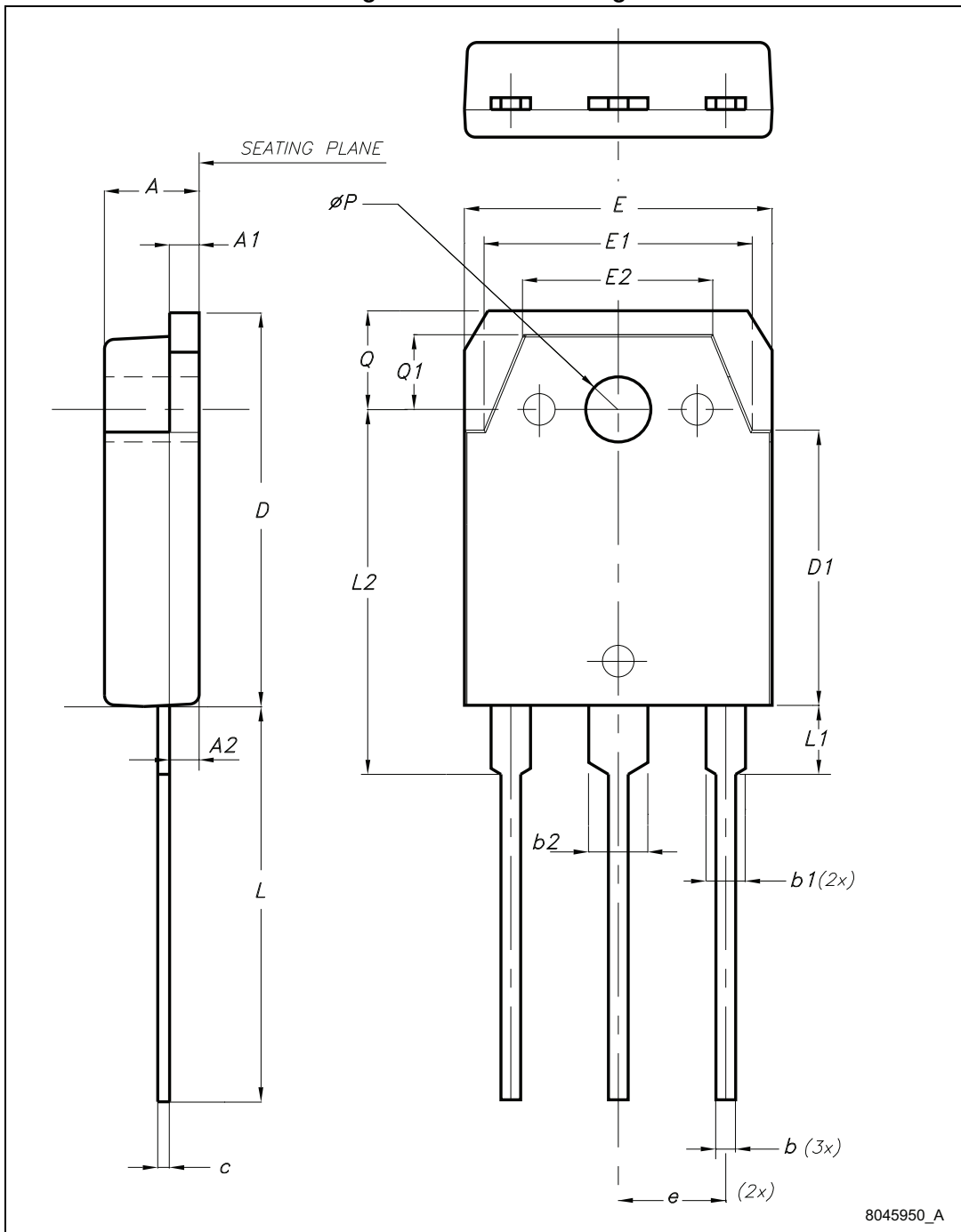


Table 8. TO-247 mechanical data

| 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  |

### 4.3 TO-3P, STGWT80V60F

Figure 32. TO-3P drawing



8045950\_A

Table 9. TO-3P mechanical data

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 4.60  |       | 5     |
| A1   | 1.45  | 1.50  | 1.65  |
| A2   | 1.20  | 1.40  | 1.60  |
| b    | 0.80  | 1     | 1.20  |
| b1   | 1.80  |       | 2.20  |
| b2   | 2.80  |       | 3.20  |
| c    | 0.55  | 0.60  | 0.75  |
| D    | 19.70 | 19.90 | 20.10 |
| D1   |       | 13.90 |       |
| E    | 15.40 |       | 15.80 |
| E1   |       | 13.60 |       |
| E2   |       | 9.60  |       |
| e    | 5.15  | 5.45  | 5.75  |
| L    | 19.50 | 20    | 20.50 |
| L1   |       | 3.50  |       |
| L2   | 18.20 | 18.40 | 18.60 |
| øP   | 3.10  |       | 3.30  |
| Q    |       | 5     |       |
| Q1   |       | 3.80  |       |

## 5 Revision history

Table 10. Document revision history

| Date        | Revision | Changes          |
|-------------|----------|------------------|
| 22-May-2014 | 1        | Initial release. |

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