

Trench gate field-stop IGBT, HB series 650 V, 40 A high speed

Datasheet - production data

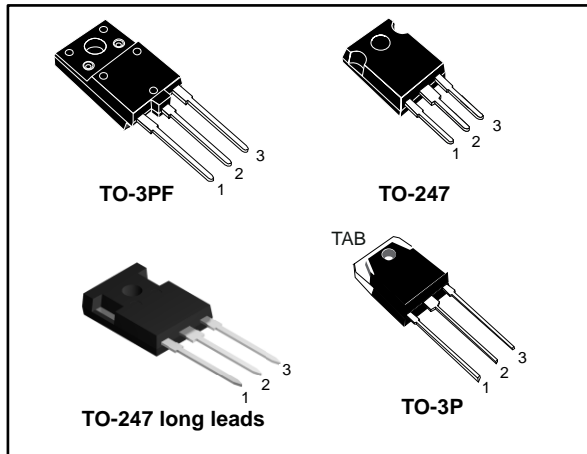
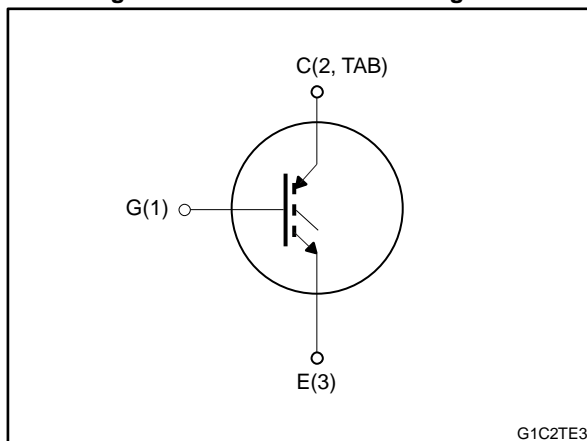


Figure 1: Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ °C}$
- High speed switching series
- Minimized tail current
- Very low saturation voltage: $V_{CE(sat)} = 1.6\text{ V}$ (typ) @ $I_C = 40\text{ A}$
- Safe paralleling
- Tight parameter distribution
- Low thermal resistance

Applications

- Photovoltaic inverters
- High frequency converters

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the new HB series of IGBTs, which represent an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. 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 |
|--------------|------------|-------------------|---------|
| STGFW40H65FB | GFW40H65FB | TO-3PF | Tube |
| STGW40H65FB | GW40H65FB | TO-247 | Tube |
| STGWA40H65FB | GWA40H65FB | TO-247 long leads | Tube |
| STGWT40H65FB | GWT40H65FB | TO-3P | Tube |

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1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|--------------------------------|---|--|--------|------|
| | | TO-247, TO-247 long leads, TO-3P | TO-3PF | |
| V _{CEs} | Collector-emitter voltage (V _{GE} = 0 V) | 650 | | V |
| I _C | Continuous collector current at T _C = 25 °C | 80 | | A |
| | Continuous collector current at T _C = 100 °C | 40 | | |
| I _{CP} ⁽¹⁾ | Pulsed collector current | 160 | | A |
| V _{GE} | Gate-emitter voltage | ±20 | | V |
| P _{TOT} | Total dissipation at T _C = 25 °C | 283 | 62.5 | W |
| V _{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C) | | 3.5 | kV |
| T _{STG} | Storage temperature range | -55 to 150 | | °C |
| T _J | Operating junction temperature range | -55 to 175 | | °C |

Notes:

⁽¹⁾Pulse width is limited by maximum junction temperature.

Table 3: Thermal data

| Symbol | Parameter | Value | | Unit |
|-------------------|-------------------------------------|--|--------|------|
| | | TO-247, TO-247 long leads, TO-3P | TO-3PF | |
| R _{thJC} | Thermal resistance junction-case | 0.53 | 2.4 | °C/W |
| R _{thJA} | Thermal resistance junction-ambient | 50 | | °C/W |

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 | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$ | | 1.6 | 2 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 125\text{ °C}$ | | 1.7 | | |
| | | $V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_J = 175\text{ °C}$ | | 1.8 | | |
| $V_{GE(th)}$ | 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 | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 5412 | - | pF |
| C_{oes} | Output capacitance | | - | 198 | - | |
| C_{res} | Reverse transfer capacitance | | - | 107 | - | |
| Q_g | Total gate charge | $V_{CC} = 520\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 28: "Gate charge test circuit") | - | 210 | - | nC |
| Q_{ge} | Gate-emitter charge | | - | 39 | - | |
| Q_{gc} | Gate-collector charge | | - | 82 | - | |

Table 6: Switching characteristics (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|---|------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\ \Omega$ (see Figure 27: "Test circuit for inductive load switching") | - | 40 | - | ns |
| t_r | Current rise time | | - | 13 | - | |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 2413 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off delay time | | - | 142 | - | ns |
| t_f | Current fall time | | - | 27 | - | |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 498 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 363 | - | |
| E_{ts} | Total switching energy | - | 861 | - | | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 5\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27: "Test circuit for inductive load switching") | - | 38 | - | ns |
| t_r | Current rise time | | - | 14 | - | |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 2186 | - | A/ μ s |
| $t_{d(off)}$ | Turn-off delay time | | - | 141 | - | ns |
| t_f | Current fall time | | - | 61 | - | |
| $E_{on}^{(1)}$ | Turn-on switching energy | | - | 1417 | - | μ J |
| $E_{off}^{(2)}$ | Turn-off switching energy | | - | 764 | - | |
| E_{ts} | Total switching energy | - | 2181 | - | | |

Notes:

(1)Including the reverse recovery of the external diode. The diode is the same of the co-packed STGW40H65DFB.

(2)Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Power dissipation vs. case temperature for TO-247, TO-247 long leads and TO-3P

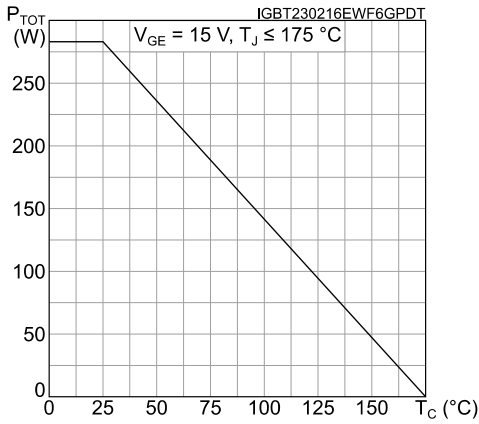


Figure 3: Collector current vs. case temperature for TO-247, TO-247 long leads and TO-3P

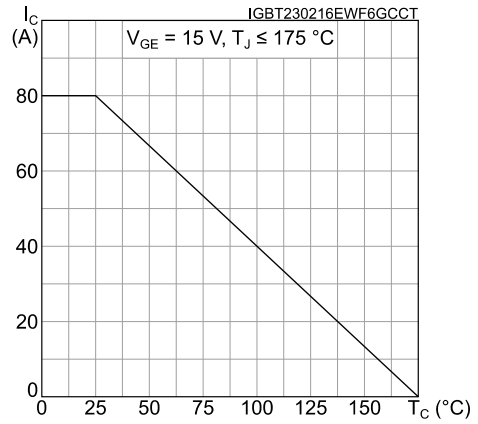


Figure 4: Power dissipation vs. case temperature for TO-3PF

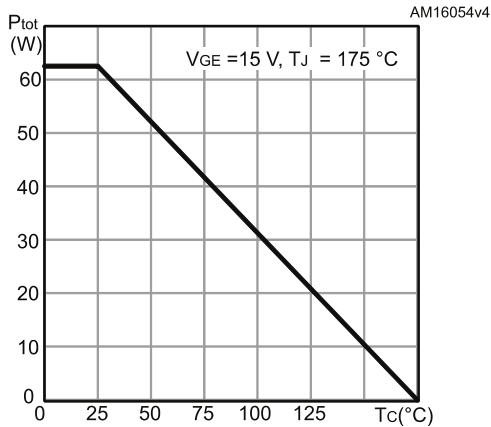


Figure 5: Collector current vs. case temperature for TO-3PF

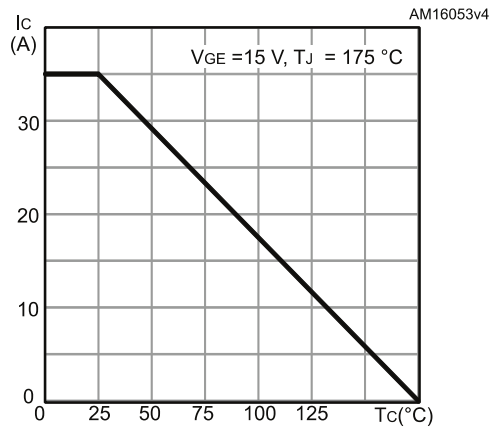


Figure 6: Output characteristics ($T_J = 25 \text{ }^\circ\text{C}$)

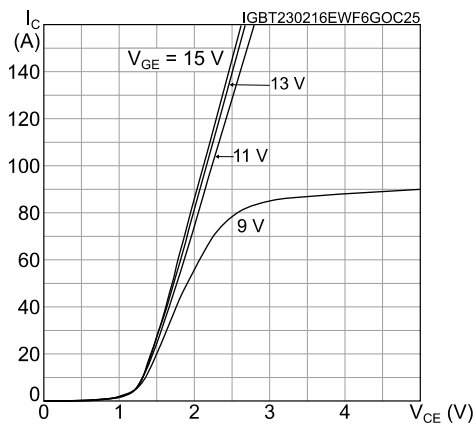
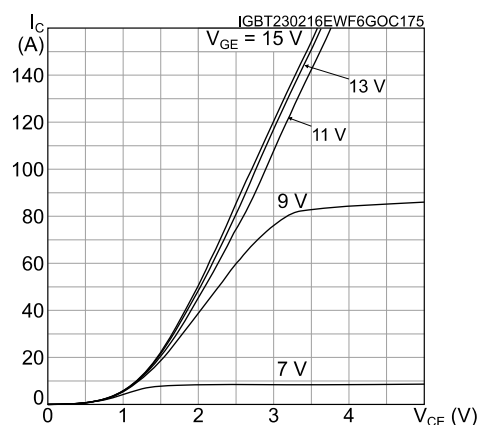
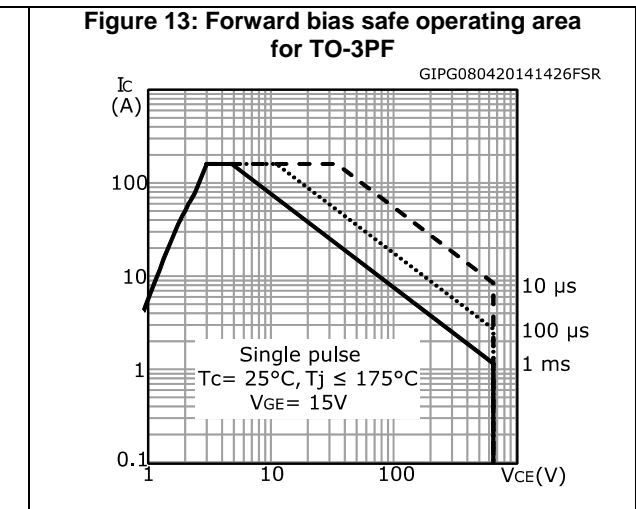
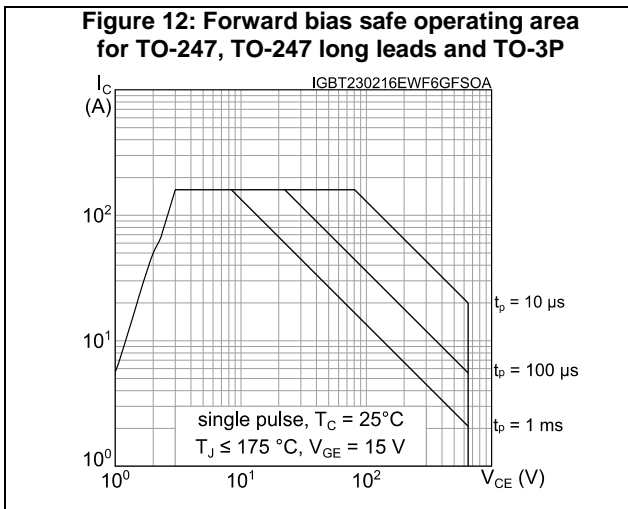
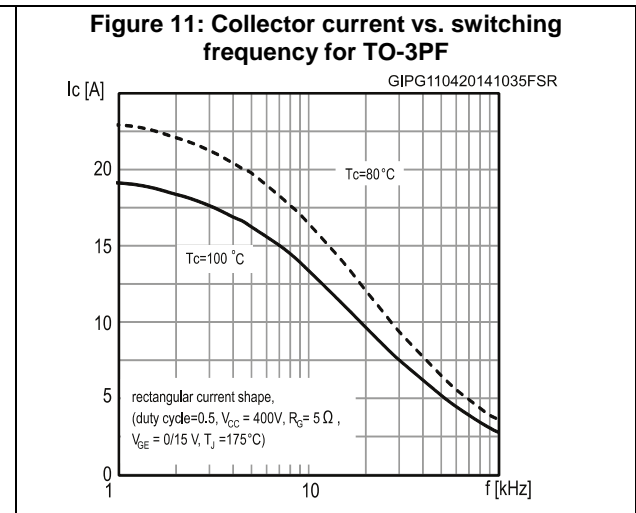
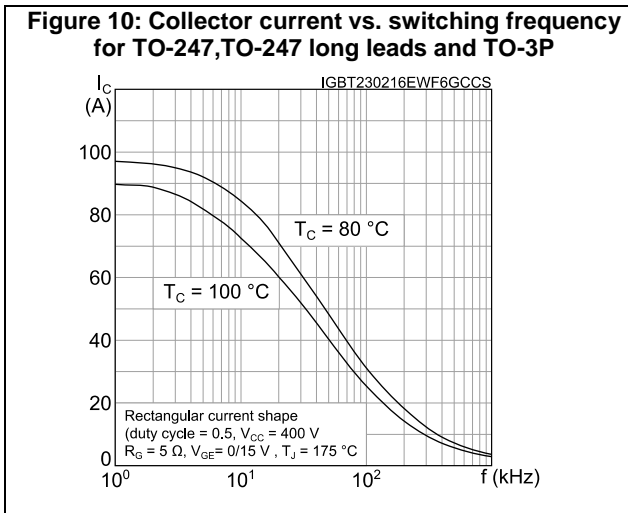
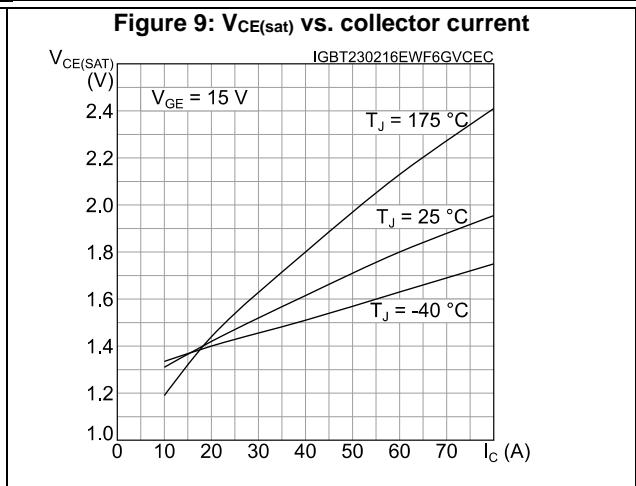
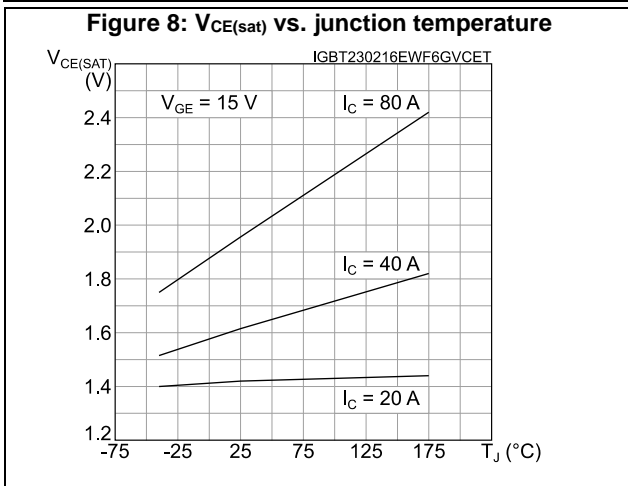
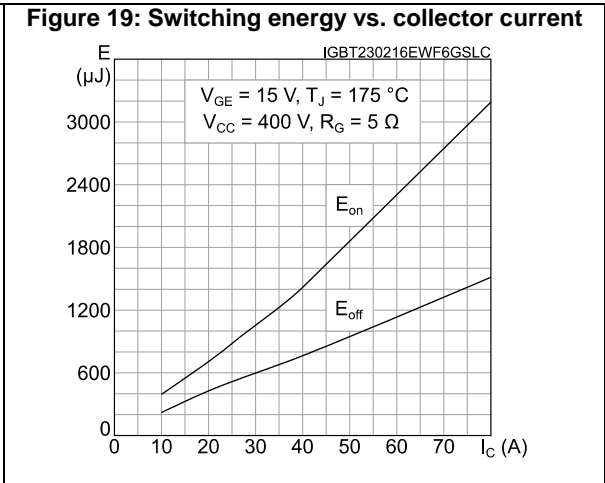
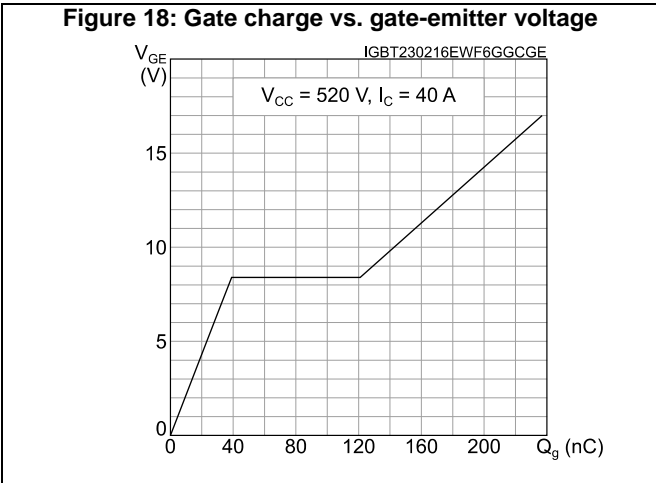
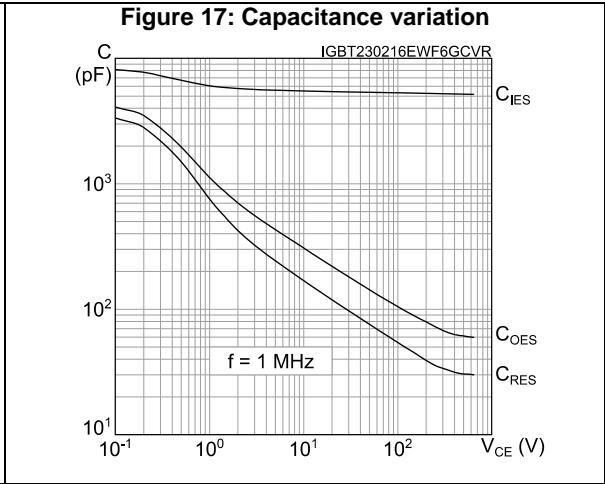
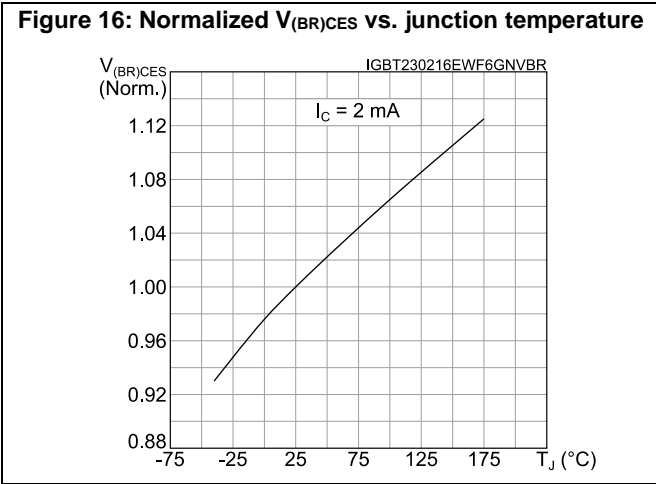
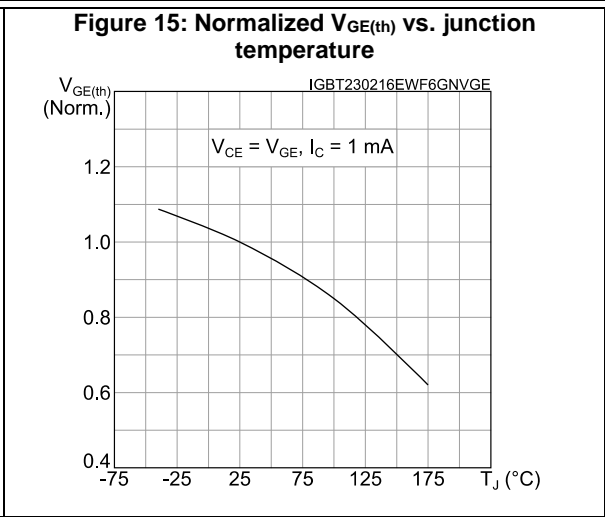
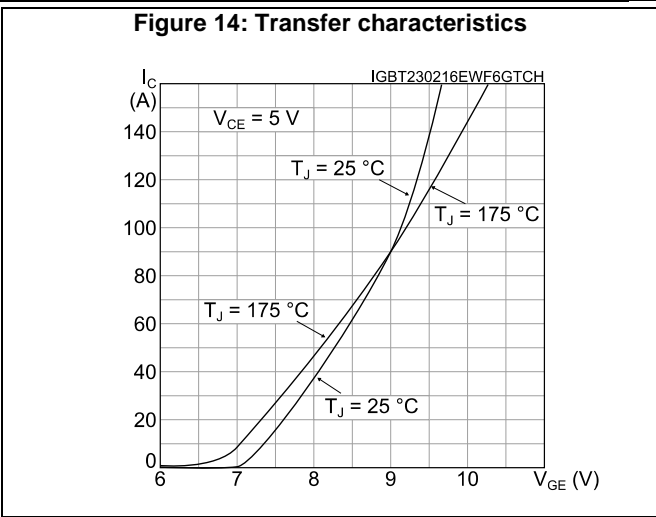


Figure 7: Output characteristics ($T_J = 175 \text{ }^\circ\text{C}$)







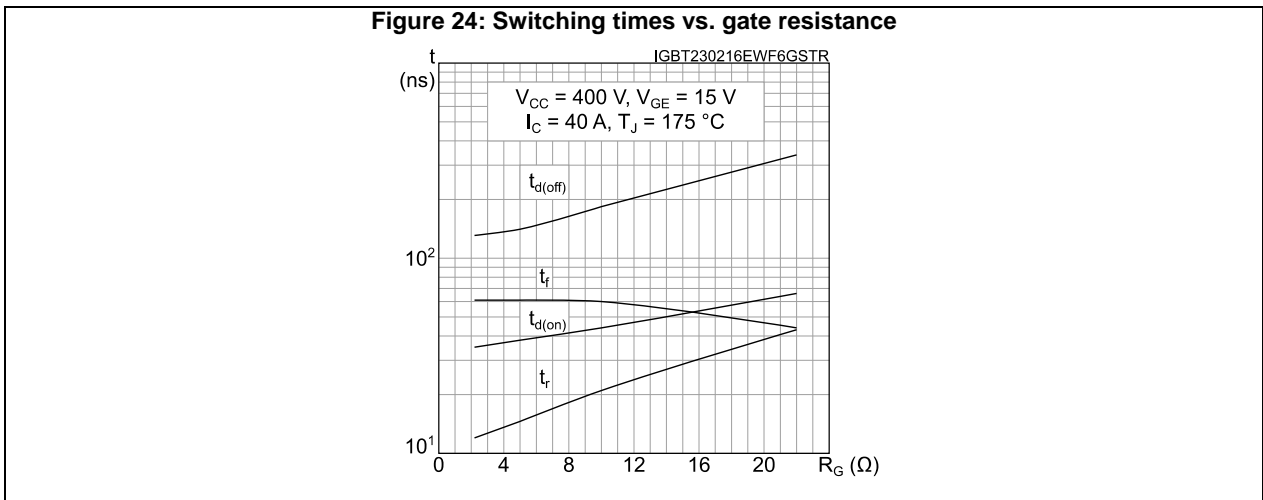
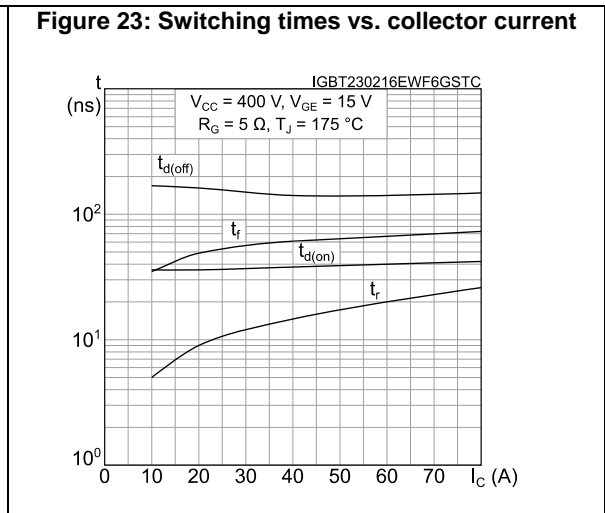
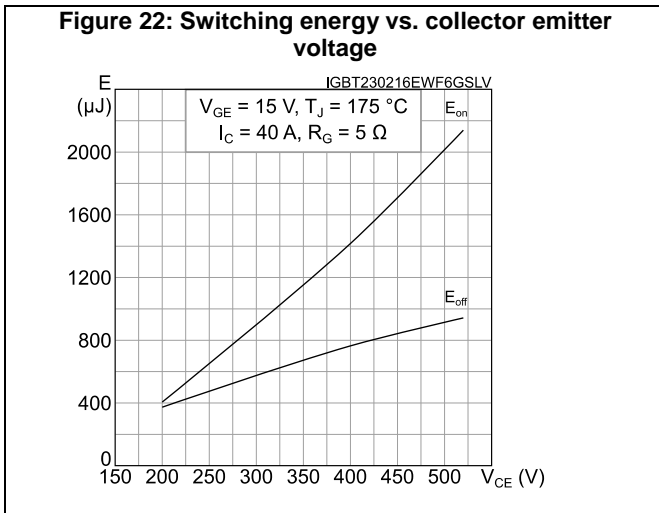
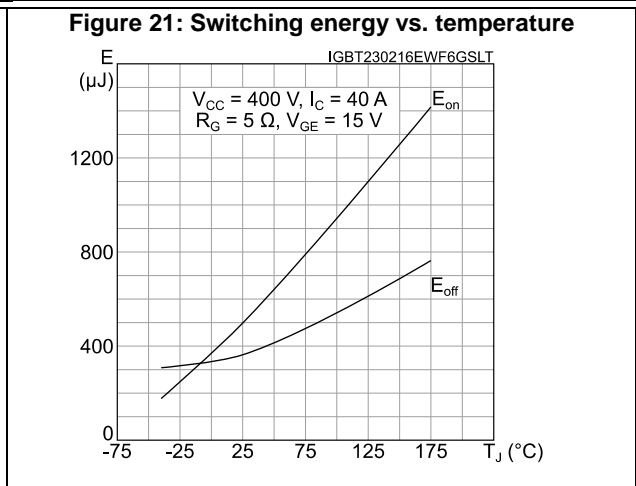
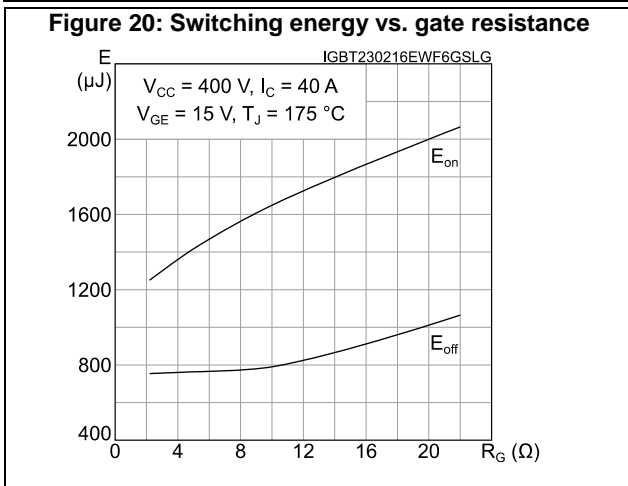


Figure 25: Thermal impedance for TO-247, TO-247 long leads and TO-3P

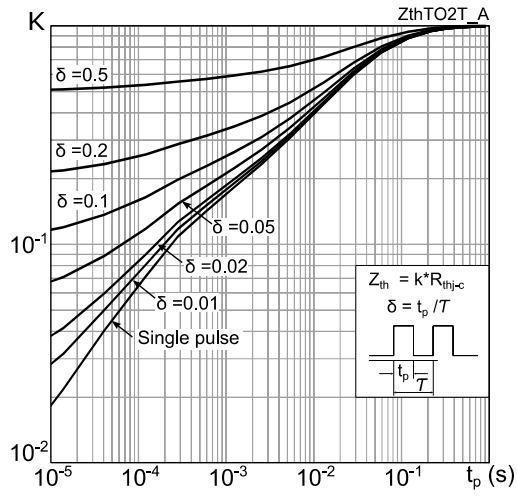
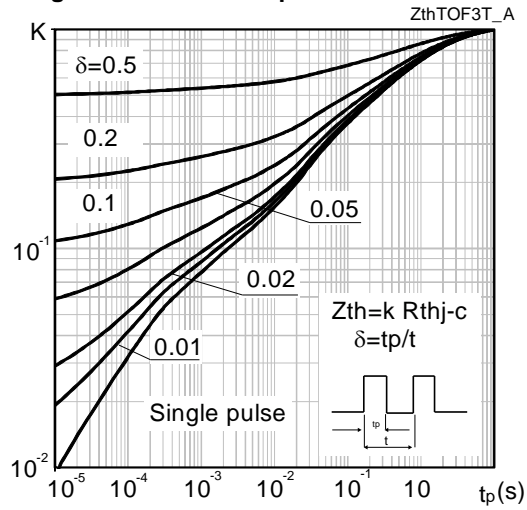
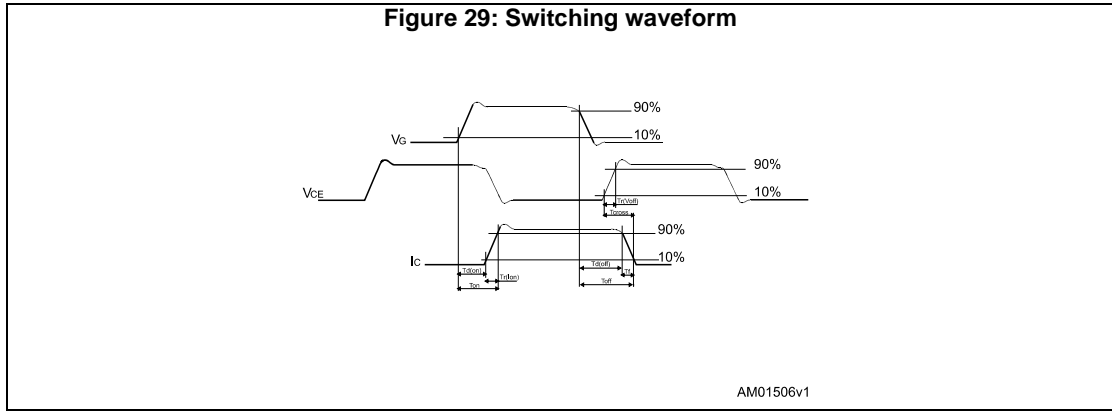
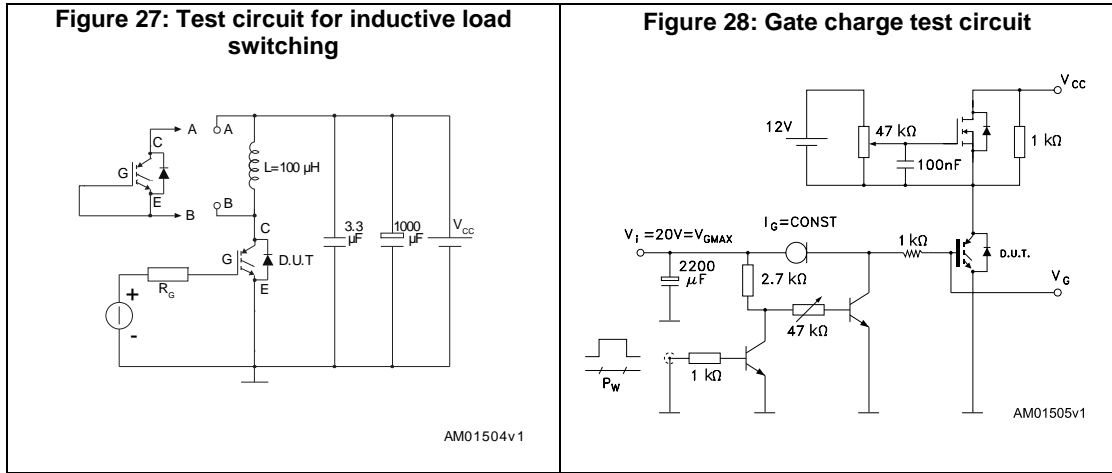


Figure 26: Thermal impedance for TO-3PF



3 Test circuits



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 TO-3PF package information

Figure 30: TO-3PF package outline

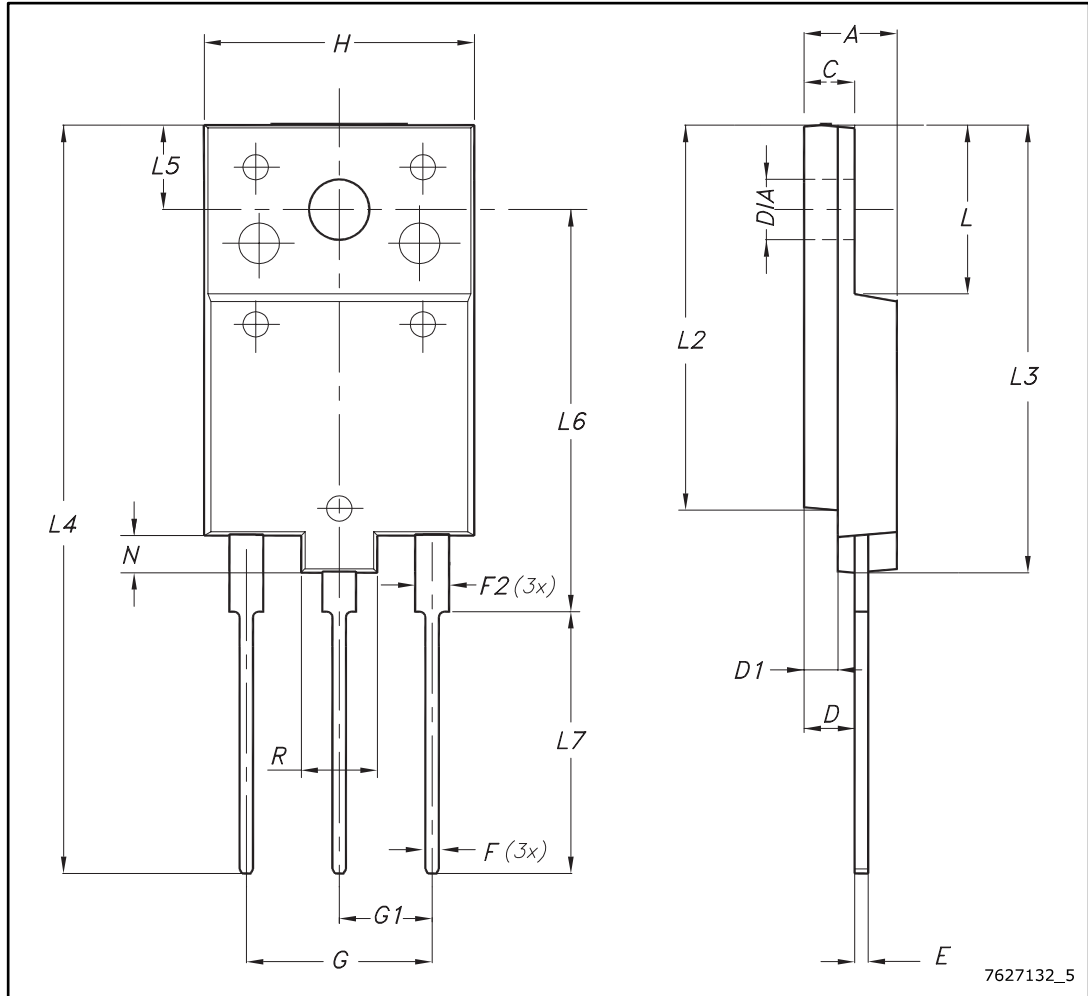


Table 7: TO-3PF mechanical data

| 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 package information

Figure 31: TO-247 package outline

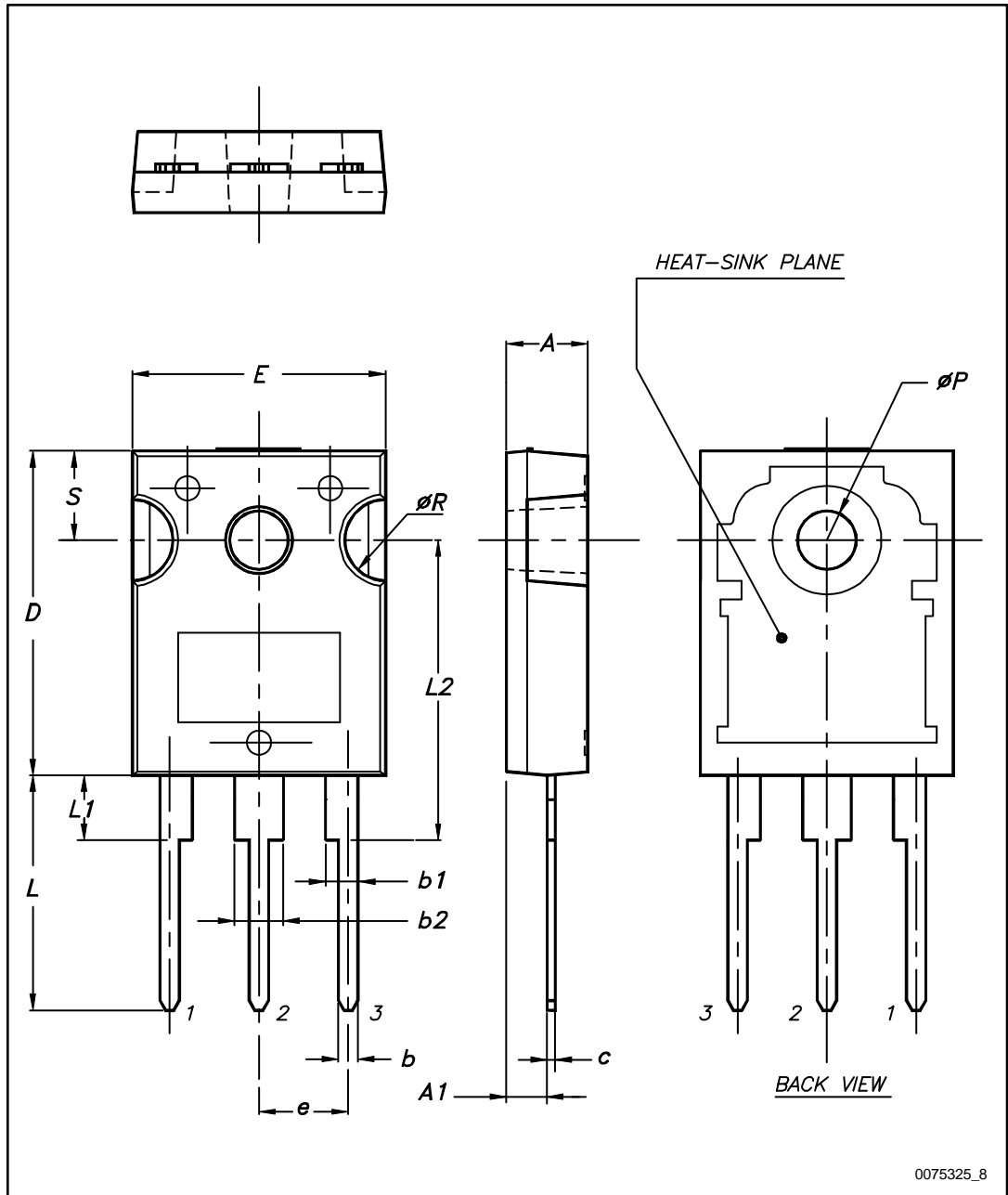
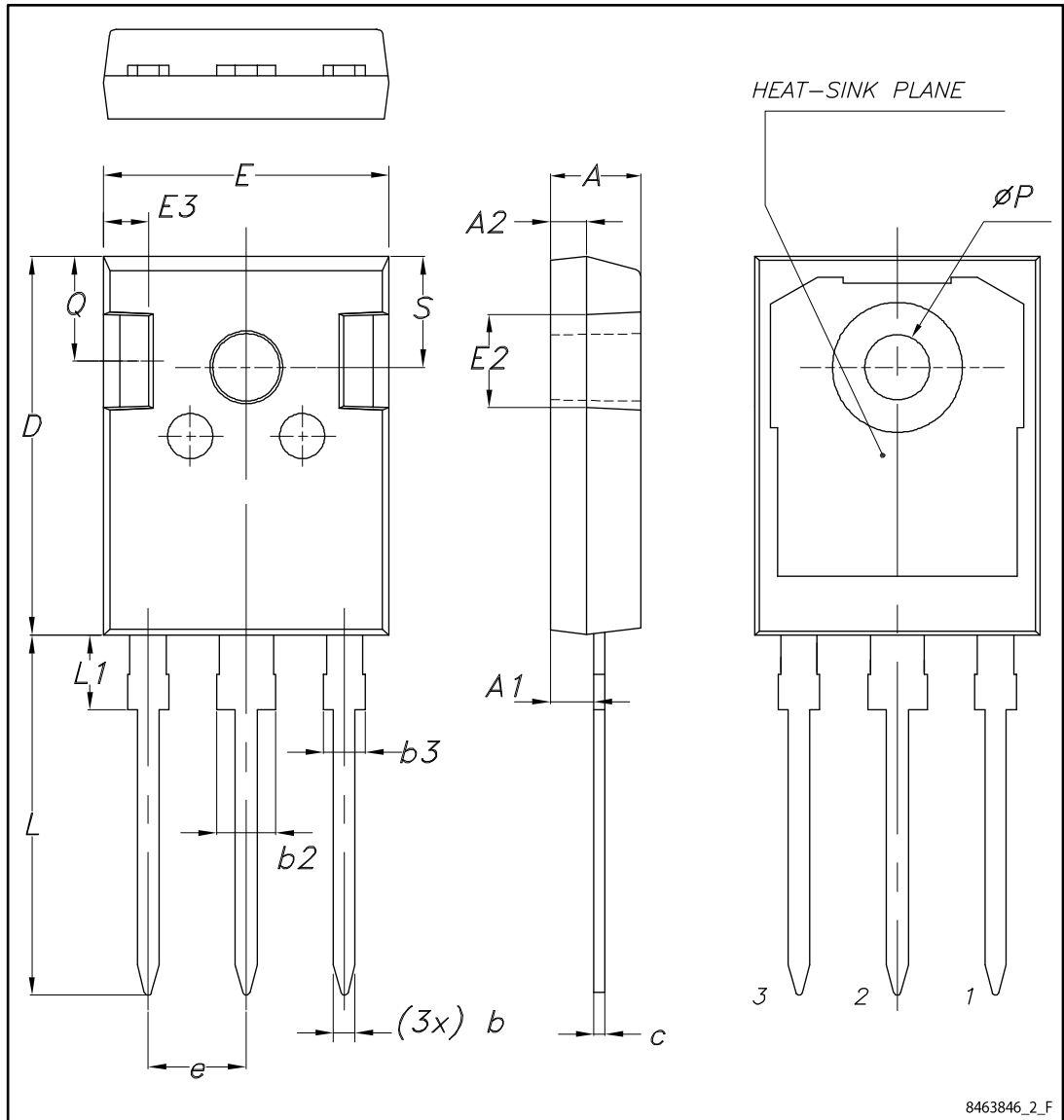


Table 8: TO-247 package mechanical data

| 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 32: TO-247 long leads package outline



8463846_2_F

Table 9: 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 33: TO-3P package outline

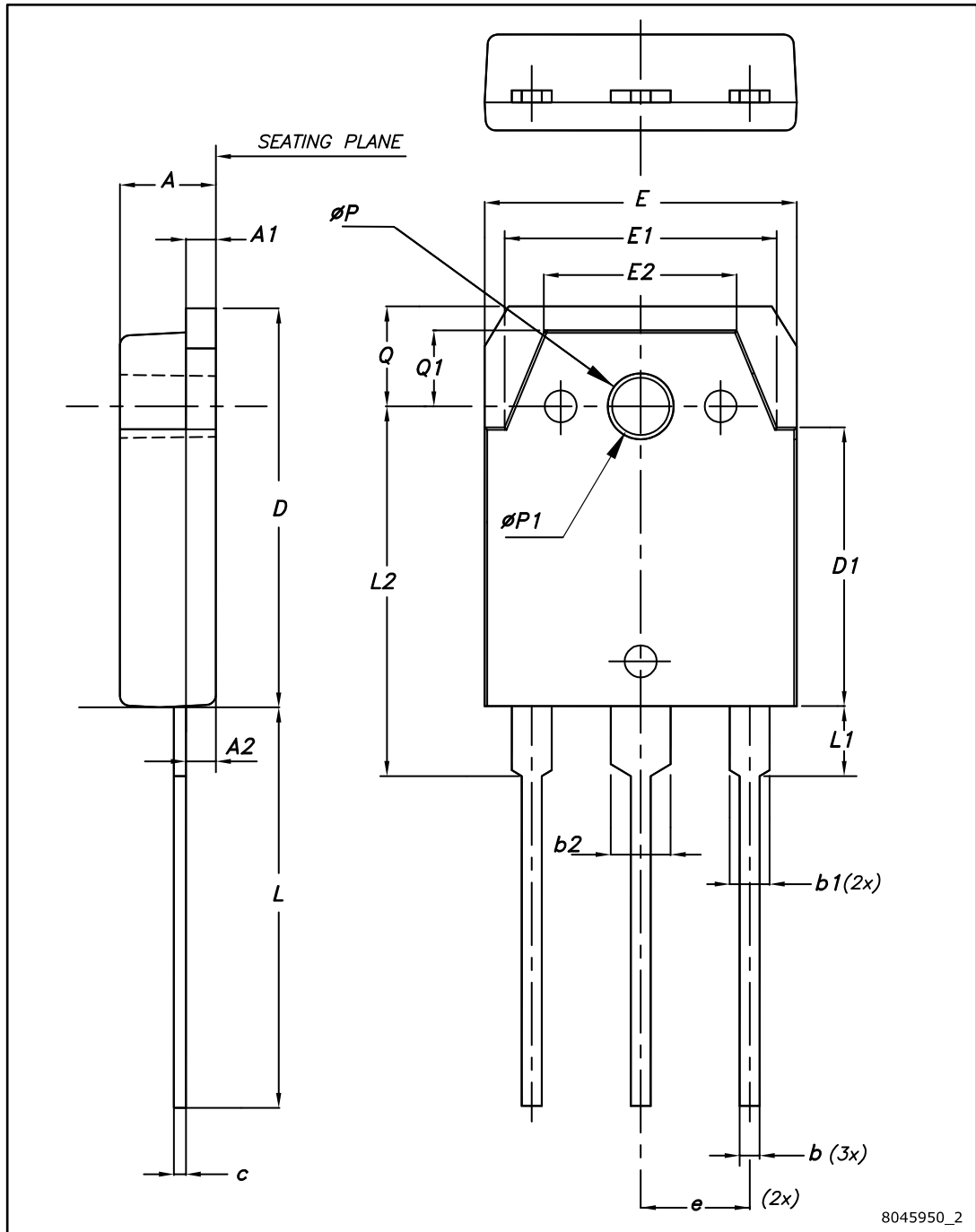


Table 10: TO-3P package mechanical data

| Dim. | mm | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A | 4.60 | 4.80 | 5.00 |
| 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 | 20.00 | 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 | 5.00 | 5.20 |
| Q1 | 3.60 | 3.80 | 4 |

5 Revision history

Table 11: Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 30-Aug-2013 | 1 | Initial release |
| 11-Sep-2013 | 2 | Document status changed from preliminary to production data. Inserted <i>Section 2.1: Electrical characteristics (curves)</i> . |
| 28-Feb-2014 | 3 | Updated title and description in cover page. |
| 05-Mar-2014 | 4 | Updated units in <i>Table 6: Switching characteristics (inductive load)</i> . |
| 11-Apr-2014 | 5 | Added part number and references for the device in a TO-3PF package. |
| 03-Nov-2016 | 6 | Added device in TO-247 long leads and updated the document accordingly. Updated <i>Section 2.1: Electrical characteristics (curves)</i> and <i>Section 4.3: TO-247 long leads, package information</i> . Minor text changes. |
| 21-Mar-2017 | 7 | Updated <i>Table 1: "Device summary"</i> . Added <i>Figure 26: "Thermal impedance for TO-3PF"</i> . Minor text changes |

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Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331