

PowerMESH™ IGBT, S series 600 V, 13 A low drop

Datasheet - production data

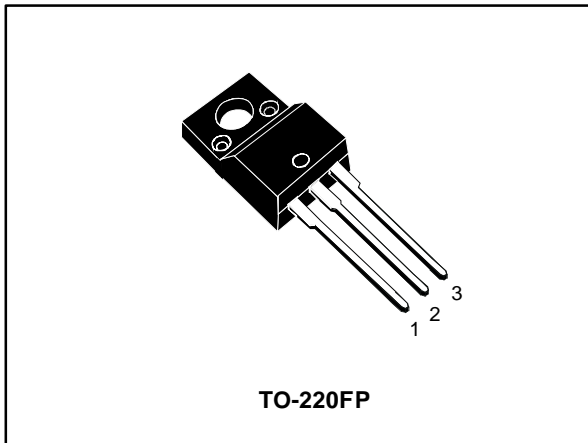
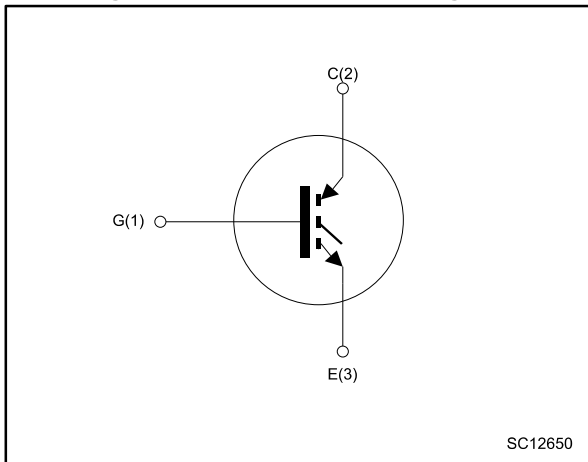


Figure 1: Internal schematic diagram



Features

- Low on-voltage drop ($V_{CE(sat)}$)
- High current capability

Applications

- Light dimmer
- Static relays
- Motor control

Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performance. The suffix “S” represents a series optimized to achieve minimum on-voltage drop for low frequency applications.

Table 1: Device summary

| Order code | Marking | Package | Packing |
|-------------|-----------|----------|---------|
| STGF20NB60S | GF20NB60S | TO-220FP | Tube |

Contents

| | | |
|----------|---|-----------|
| 1 | Electrical ratings | 3 |
| 2 | Electrical characteristics | 4 |
| | 2.1 Electrical characteristics (curves) | 6 |
| 3 | Test circuits | 9 |
| 4 | Package information | 10 |
| | 4.1 TO-220FP package information | 11 |
| 5 | Revision history | 13 |

1 Electrical ratings

Table 2: Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|---|------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$ V) | 600 | V |
| V_{ECS} | Emitter-collector voltage ($V_{GE} = 0$ V) | -20 | V |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| I_C | Continuous collector current at $T_C = 25$ °C | 24 | A |
| | Continuous collector current at $T_C = 100$ °C | 13 | |
| I^{CL} | Turn-off latching current | 70 | A |
| $I_{CM}^{(1)}$ | Pulsed collector current | 70 | A |
| P_{TOT} | Total dissipation at $T_C = 25$ °C | 40 | W |
| V_{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1$ s, $T_C = 25$ °C) | 2.5 | kV |
| T_{STG} | Storage temperature range | -55 to 150 | °C |
| T_J | Operating junction temperature | | |

Notes:

⁽¹⁾Pulse width limited by safe operating area.

Table 3: Thermal data

| Symbol | Parameter | Value | Unit |
|----------------|-------------------------------------|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case | 3.1 | °C/W |
| $R_{thj-amb}$ | Thermal resistance junction-ambient | 62.5 | |

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 | $V_{GE} = 0\text{ V}$, $I_C = 250\text{ }\mu\text{A}$ | 600 | | | V |
| $V_{(BR)ECS}$ | Emitter-collector breakdown voltage | $V_{GE} = 0\text{ V}$, $I_C = 10\text{ mA}$ | -20 | | | |
| I_{CES} | Collector cut-off current | $V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$ | | | 10 | μA |
| | | $V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_C = 125\text{ °C}$ | | | 100 | |
| I_{GES} | Gate-emitter leakage current | $V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$ | 2.5 | | 5 | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$ | | 1.25 | 1.7 | V |
| | | $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 150\text{ °C}$ | | 1.2 | | |

Table 5: Dynamic characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|--|------|------|------|---------------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{CE} = 10\text{ V}$, $I_C = 8\text{ A}$ | - | 20 | - | S |
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$ | - | 1820 | - | μF |
| C_{oes} | Output capacitance | | - | 167 | - | |
| C_{res} | Reverse transfer capacitance | | - | 27 | - | |
| Q_g | Total gate charge | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 17: "Gate charge test circuit") | - | 83 | 115 | nC |
| Q_{ge} | Gate-emitter charge | | - | 10 | - | |
| Q_{gc} | Gate-collector charge | | - | 27 | - | |

Notes:

⁽¹⁾Pulse duration= 300 μs , duty cycle 1.5 %

Table 6: Inductive load switching on characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\text{ }\Omega$ (see Figure 16: "Test circuit for inductive load switching") | - | 92 | - | ns |
| t_r | Current rise time | | - | 70 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 340 | - | A/ μs |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\text{ }\Omega$, $T_J = 125\text{ °C}$ (see Figure 16: "Test circuit for inductive load switching") | - | 80 | - | ns |
| t_r | Current rise time | | - | 73 | - | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | - | 320 | - | A/ μs |

Table 7: Inductive load switching off characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------|
| t_c | Cross-over time | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\ \Omega$ (see Figure 16: "Test circuit for inductive load switching") | - | 1.6 | - | ns |
| $t_r(V_{off})$ | Off voltage rise time | | - | 0.8 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 1.1 | - | |
| t_f | Current fall time | | - | 0.8 | - | |
| t_c | Cross-over time | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\ \Omega$, $T_j = 125\text{ }^\circ\text{C}$ (see Figure 16: "Test circuit for inductive load switching") | - | 2.4 | - | ns |
| $t_r(V_{off})$ | Off voltage rise time | | - | 1.1 | - | |
| $t_{d(off)}$ | Turn-off delay time | | - | 2.4 | - | |
| t_f | Current fall time | | - | 1.2 | - | |

Table 8: Inductive load switching loss characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|-------------------------|---|------|-------|------|------|
| $E_{on}^{(1)}$ | Turn-on switching loss | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\ \Omega$ (see Figure 18: "Switching waveform") | - | 0.84 | - | mJ |
| $E_{off}^{(2)}$ | Turn-off switching loss | | - | 7.4 | - | |
| E_{ts} | Total switching loss | | - | 8.24 | - | |
| $E_{on}^{(1)}$ | Turn-on switching loss | $V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 100\ \Omega$, $T_j = 125\text{ }^\circ\text{C}$ (see Figure 18: "Switching waveform") | - | 0.86 | - | mJ |
| $E_{off}^{(2)}$ | Turn-off switching loss | | - | 11.5 | - | |
| E_{ts} | Total switching loss | | - | 12.36 | - | |

Notes:

⁽¹⁾ E_{on} is the turn-on loss when an external diode is used in the test circuit in [Figure 16: "Test circuit for inductive load switching"](#).

⁽²⁾Turn-off loss includes the tail of the collector current.

2.1 Electrical characteristics (curves)

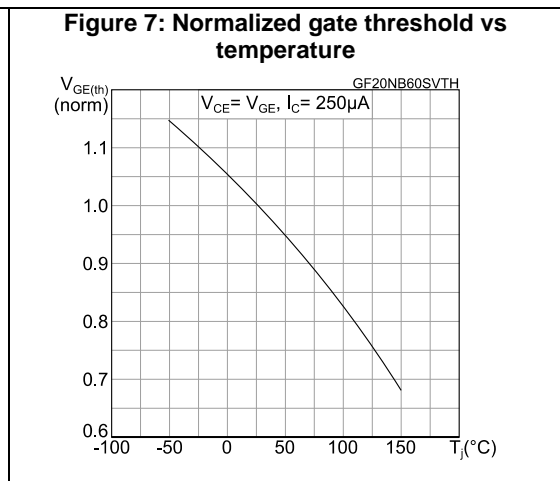
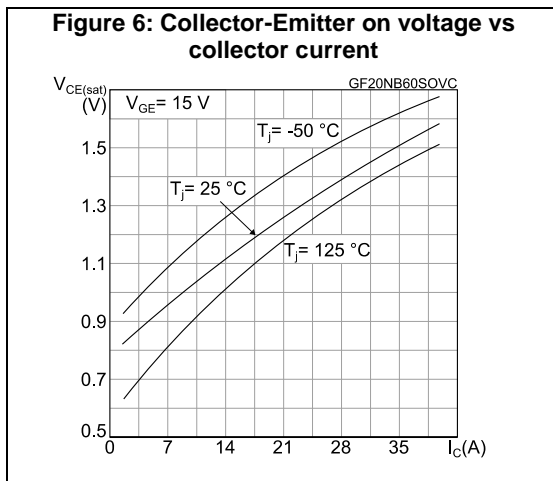
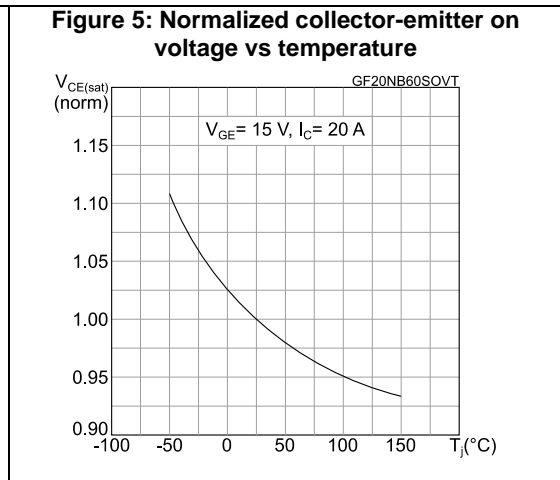
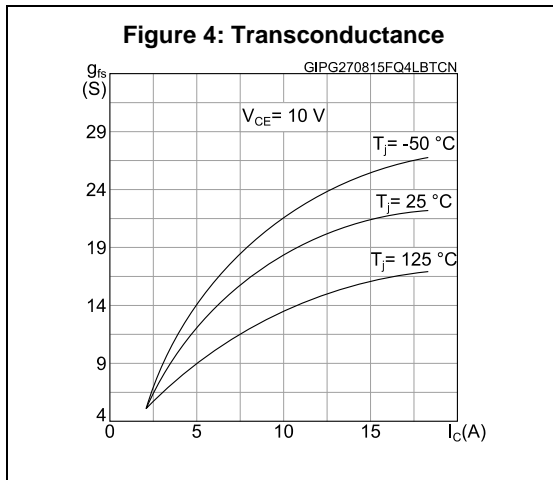
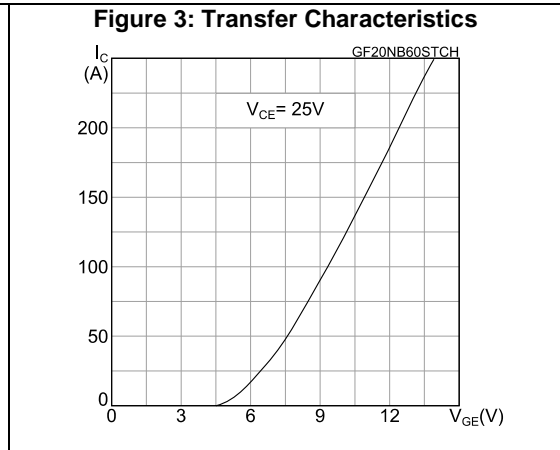
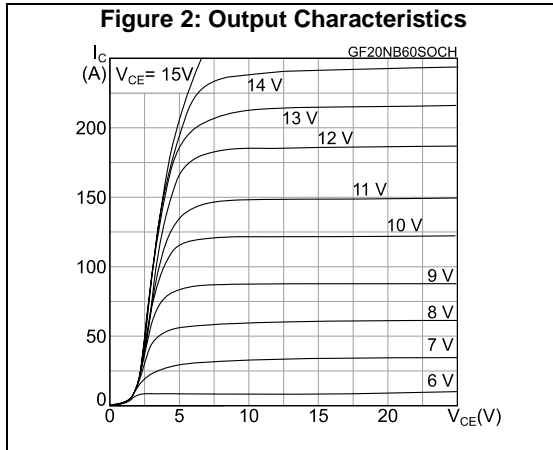


Figure 8: Normalized breakdown voltage vs temperature

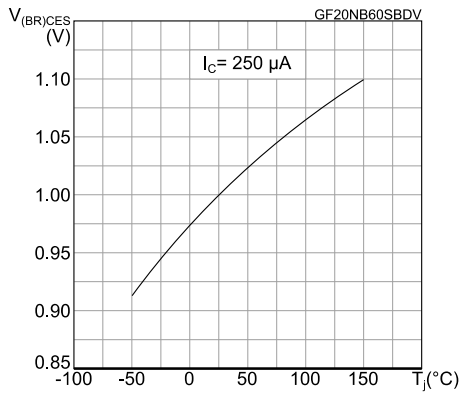


Figure 9: Gate charge vs gate-emitter voltage

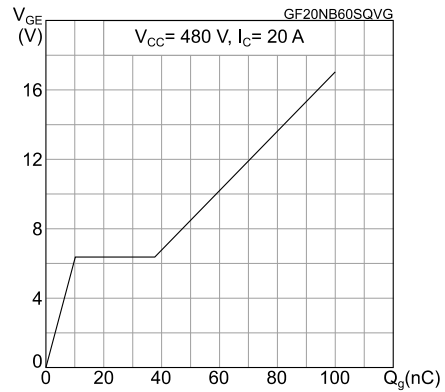


Figure 10: Capacitance variations

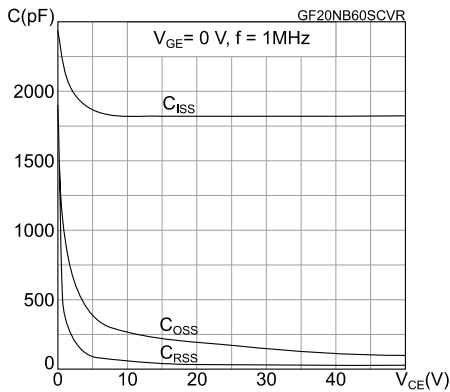


Figure 11: Switching loss vs gate resistance

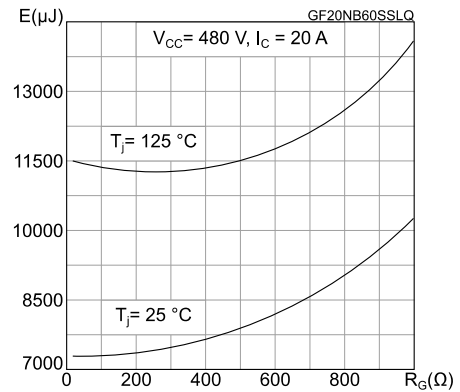


Figure 12: Switching loss vs temperature

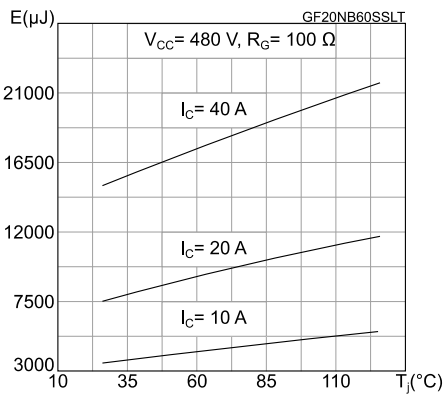
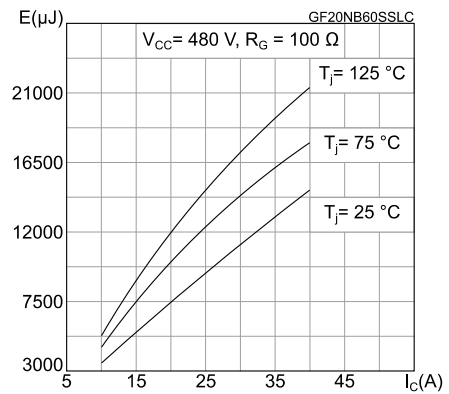
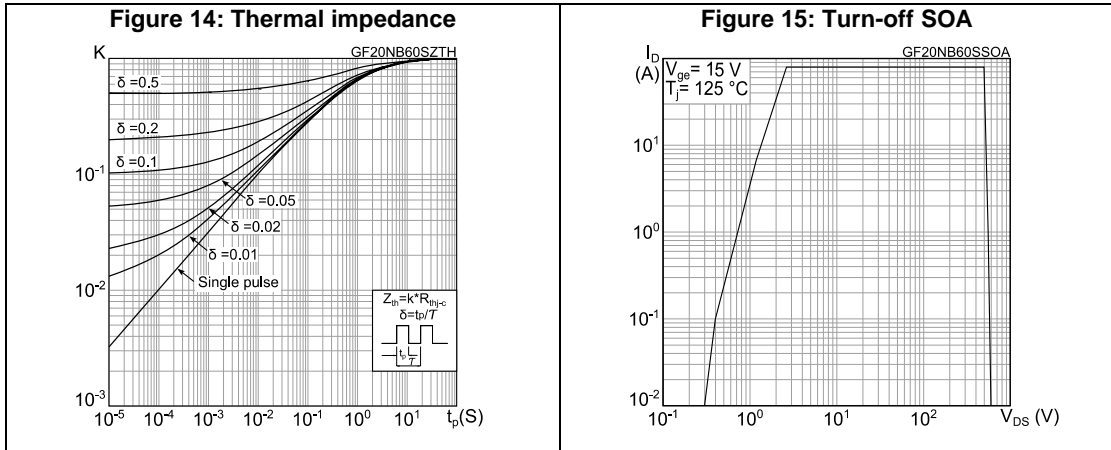


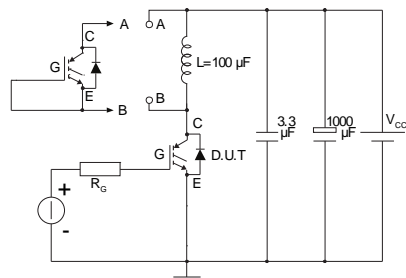
Figure 13: Switching loss vs collector current





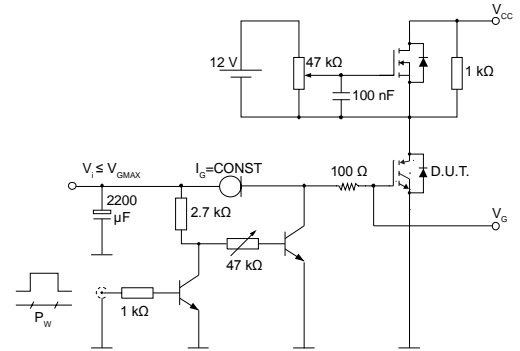
3 Test circuits

Figure 16: Test circuit for inductive load switching



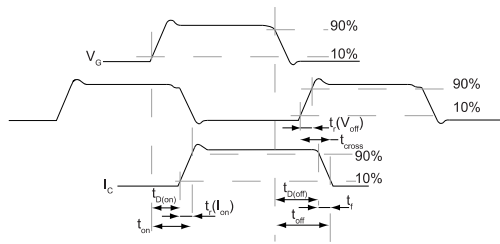
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Figure 17: Gate charge test circuit



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Figure 18: Switching waveform



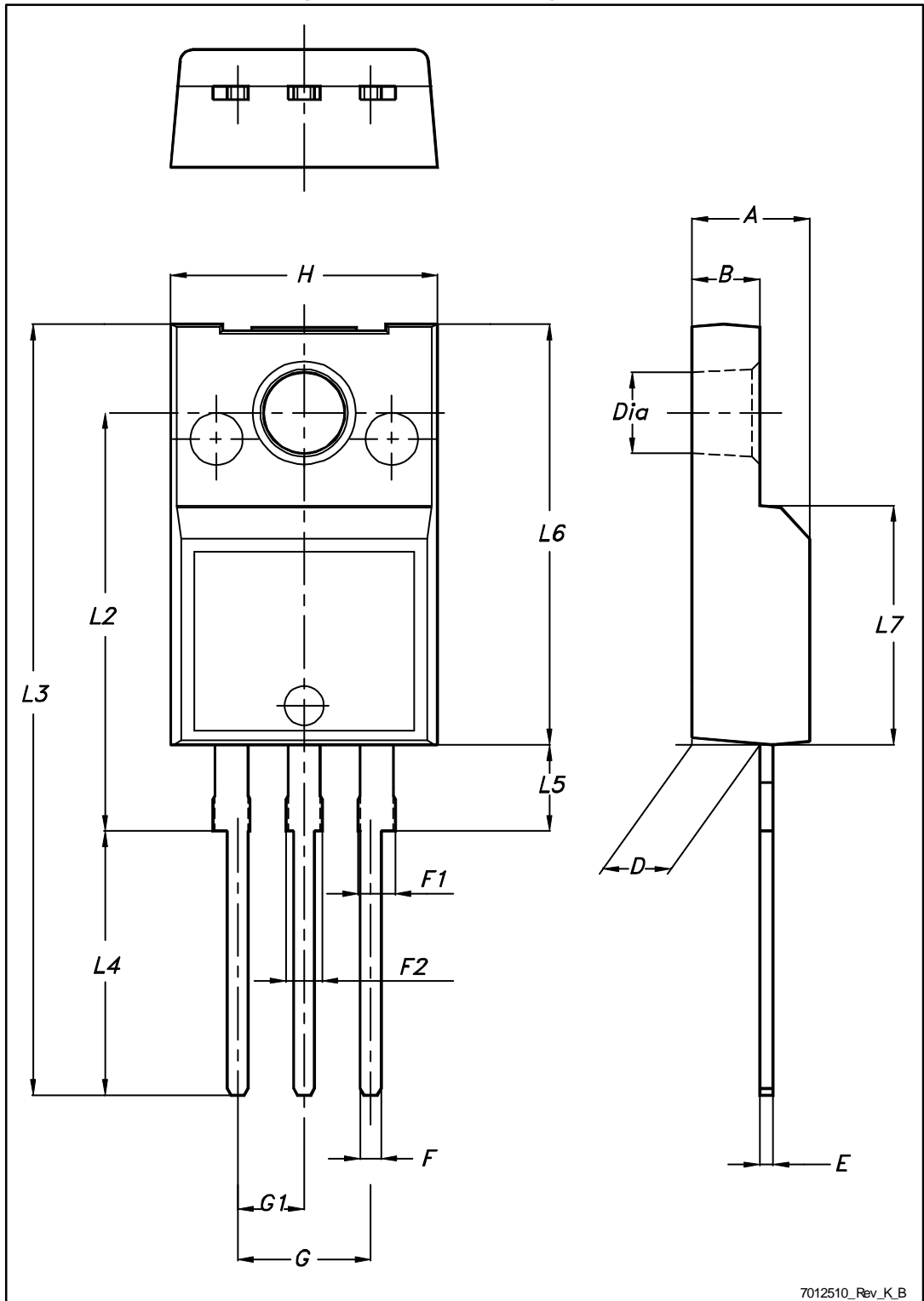
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4 Package information

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-220FP package information

Figure 19: TO-220FP package outline



7012510_Rev_K.B

Table 9: TO-220FP package mechanical data

| Dim. | mm | | |
|------|------|------|------|
| | Min. | Typ. | Max. |
| A | 4.4 | | 4.6 |
| B | 2.5 | | 2.7 |
| D | 2.5 | | 2.75 |
| E | 0.45 | | 0.7 |
| F | 0.75 | | 1 |
| F1 | 1.15 | | 1.70 |
| F2 | 1.15 | | 1.70 |
| G | 4.95 | | 5.2 |
| G1 | 2.4 | | 2.7 |
| H | 10 | | 10.4 |
| L2 | | 16 | |
| L3 | 28.6 | | 30.6 |
| L4 | 9.8 | | 10.6 |
| L5 | 2.9 | | 3.6 |
| L6 | 15.9 | | 16.4 |
| L7 | 9 | | 9.3 |
| Dia | 3 | | 3.2 |

5 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 17-Dec-2004 | 2 | New template, no content change |
| 05-Aug-2005 | 3 | Some values changed in table 6 |
| 02-Dec-2015 | 4 | Text and formatting changes throughout document On cover page: - updated Title, Features and Description Added Electrical ratings section heading In section Electrical ratings: - updated tables Absolute Maximum ratings and Thermal Data In section Electrical characteristics: - updated table Static characteristics Added section Package information Updated TO-220FP package information |

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