

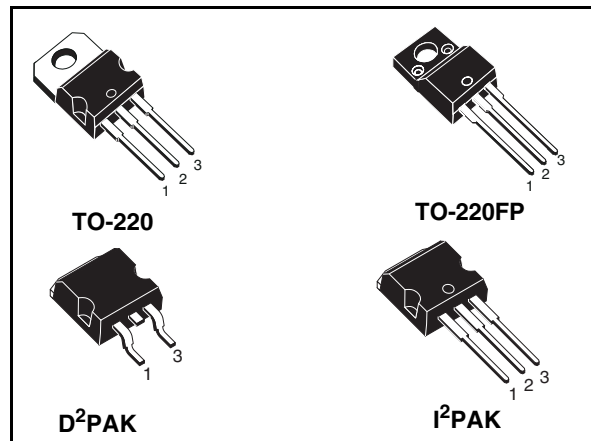
High voltage fast-switching NPN power transistors

Features

- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed
- High ruggedness

Applications

- Electronic transformers for halogen lamps
- Flyback and forward single transistor low power converters



Description

The devices are manufactured using high voltage multi-epitaxial planar technology for high switching speeds and high voltage capability. The devices are designed for use in electronic transformer for halogen lamps.

Figure 1. Internal schematic diagram

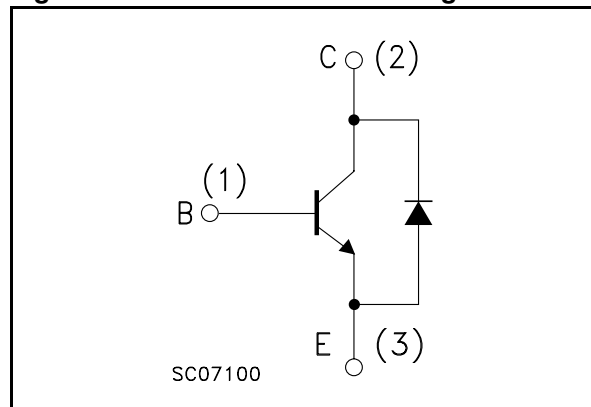


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|------------|----------|--------------------|---------------|
| BUL49D | BUL49D | TO-220 | Tube |
| BUL49DFP | BUL49DFP | TO-220FP | Tube |
| BULB49D-1 | BULB49D | I ² PAK | Tube |
| BULB49DT4 | BULB49D | D ² PAK | Tape and reel |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|------------------|---|--|----------|------|
| | | D ² PAK I ² PAK TO-220 | TO-220FP | |
| V _{CES} | Collector-emitter voltage (V _{BE} =0) | 850 | | V |
| V _{CEO} | Collector-emitter voltage (I _B =0) | 450 | | V |
| V _{EBO} | Emitter-base voltage (I _C =0, I _B <2 A, t _p < 10 ms) | V _{(BR)EBO} | | V |
| I _C | Collector current | 5 | | A |
| I _{CM} | Collector peak current (t _p < 5ms) | 10 | | A |
| I _B | Base current | 2 | | A |
| I _{BM} | Base peak current (t _p < 5 ms) | 4 | | A |
| P _{tot} | Total dissipation at T _c ≤25°C | 80 | 34 | W |
| T _{stg} | Storage temperature | -65 to 150 | | °C |
| T _J | Max. operating junction temperature | 150 | | °C |

Table 3. Thermal data

| Symbol | Parameter | D ² PAK I ² PAK TO-220 | TO-220FP | Unit |
|-----------------------|---|--|----------|------|
| R _{thj-case} | Thermal resistance junction-case max | 1.56 | 3.67 | °C/W |
| R _{thj-amb} | Thermal resistance junction-ambient max | 62.5 | 62.5 | °C/W |

2 Electrical characteristics

($T_{\text{case}} = 25^{\circ}\text{C}$ unless otherwise specified)

Table 4. Electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|--|--|---------|-----------|-------------------|--------------------------------|
| I_{CES} | Collector cut-off current ($V_{\text{BE}} = 0$) | $V_{\text{CE}} = 850 \text{ V}$ $V_{\text{CE}} = 850 \text{ V}$ $T_{\text{c}} = 125^{\circ}\text{C}$ | | | 100 500 | μA μA |
| I_{EBO} | Emitter cut-off current ($I_{\text{C}} = 0$) | $V_{\text{EB}} = 9 \text{ V}$ | | | 100 | μA |
| $V_{(\text{BR})\text{EBO}}$ | Emitter-base breakdown voltage ($I_{\text{C}} = 0$) | $I_{\text{E}} = 10 \text{ mA}$ | 10 | | 18 | V |
| $V_{\text{CEO(sus)}}^{(1)}$ | Collector-emitter sustaining voltage ($I_{\text{B}} = 0$) | $I_{\text{C}} = 10 \text{ mA}$ | 450 | | | V |
| $V_{\text{CE(sat)}}^{(1)}$ | Collector-emitter saturation voltage | $I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$ $I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 0.4 \text{ A}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B}} = 0.8 \text{ A}$ | | 0.1 | 0.3 0.6 1.2 | V V V |
| $V_{\text{BE(sat)}}^{(1)}$ | Base-emitter saturation voltage | $I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B}} = 0.8 \text{ A}$ | | | 1 1.3 | V V |
| $h_{\text{FE}}^{(1)}$ | DC current gain | $I_{\text{C}} = 10 \text{ mA}$ $V_{\text{CE}} = 5 \text{ V}$ $I_{\text{C}} = 500 \text{ mA}$ $V_{\text{CE}} = 5 \text{ V}$ $I_{\text{C}} = 7 \text{ A}$ $V_{\text{CE}} = 10 \text{ V}$ | 10 4 | | 60 10 | |
| $V_{\text{CEW}}^{(1)}$ | Maximum collector- emitter voltage without snubber | $I_{\text{C}} = 8 \text{ A}$ $V_{\text{BB}} = -2.5 \text{ V}$ $L = 50 \mu\text{H}$ $R_{\text{BB}} = 0$ $t_{\text{p}} = 10 \mu\text{s}$ | 450 | | | V |
| t_{s} t_{f} | Resistive load Storage time Fall time | $V_{\text{CC}} = 250 \text{ V}$ $I_{\text{C}} = 2 \text{ A}$ $I_{\text{B1}} = -I_{\text{B2}} = 400 \text{ mA}$ (see Figure 12) | 2 | | 3 0.8 | μs μs |
| t_{s} t_{f} | Inductive load Storage time Fall time | $V_{\text{CL}} = 300 \text{ V}$ $I_{\text{C}} = 4 \text{ A}$ $I_{\text{B(on)}} = 800 \text{ mA}$ $R_{\text{BB(off)}} = 0$ $V_{\text{BE(off)}} = -5 \text{ V}$ $L = 1 \text{ mH}$ (see Figure 13) | | 0.6 50 | 1.3 100 | μs ns |
| V_{F} | Diode forward voltage | $I_{\text{C}} = 3 \text{ A}$ | | | 1.5 | V |

1. Pulsed duration = 300 ms, duty cycle $\leq 1.5\%$

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area (for TO-220 - D²PAK - I²PAK)

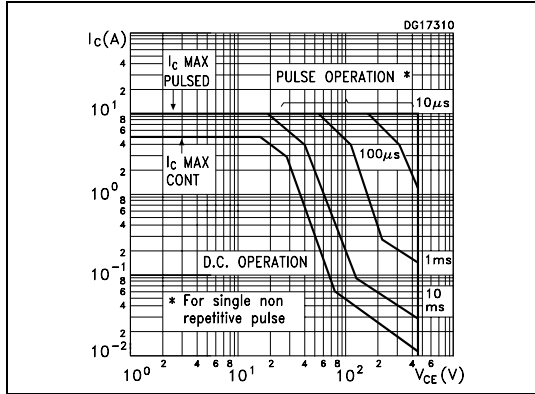


Figure 3. Safe operating area (for TO-220FP)

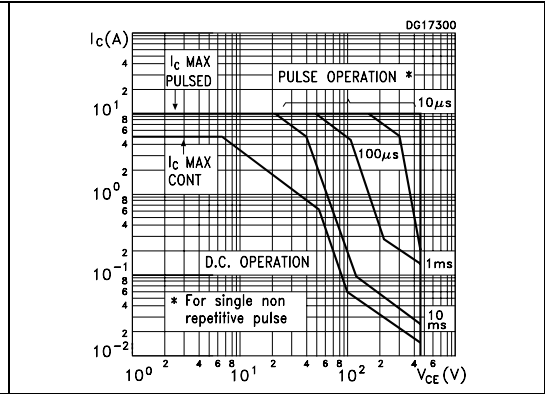


Figure 4. Derating curves

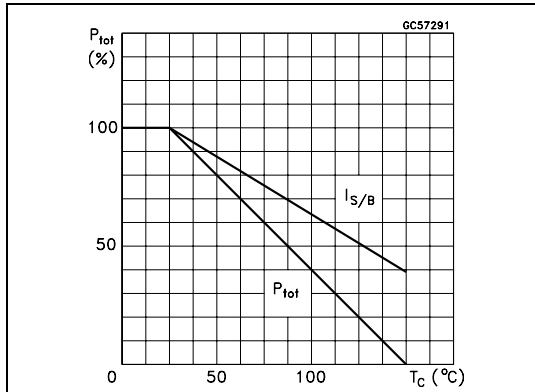


Figure 5. Output characteristics

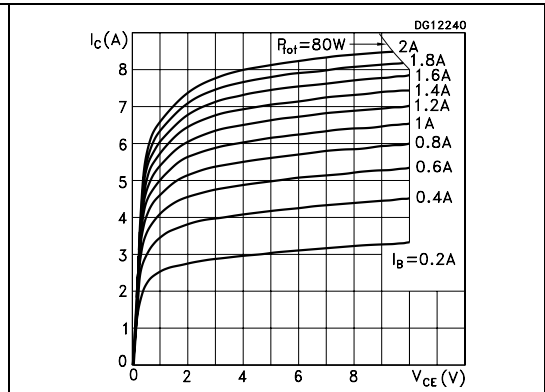


Figure 6. Collector-emitter saturation voltage

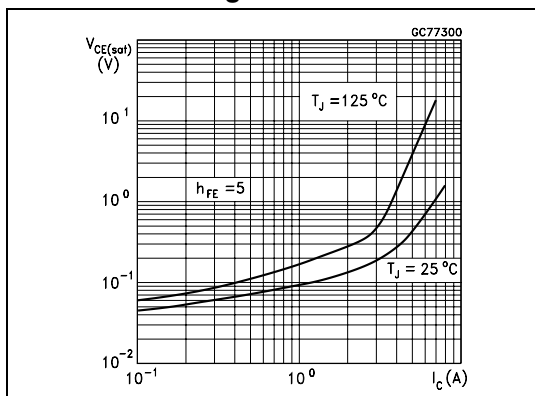


Figure 7. Base-emitter saturation voltage

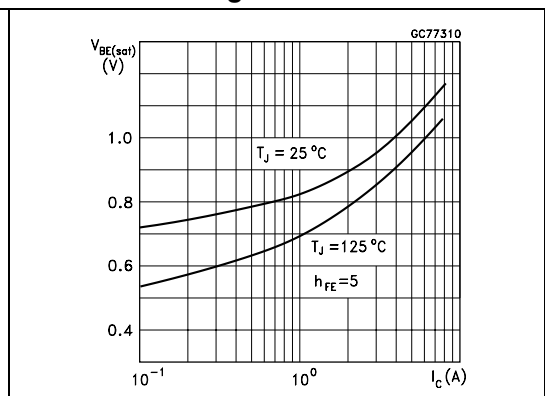


Figure 8. DC current gain

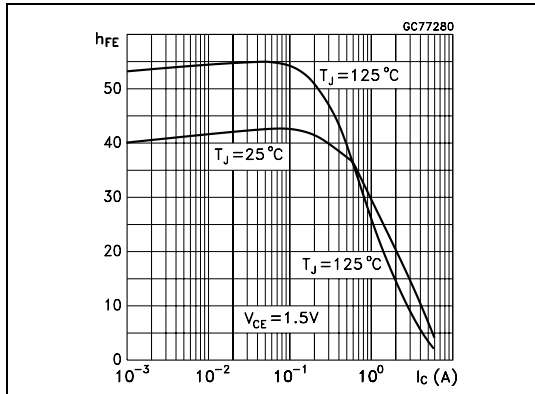


Figure 9. DC current gain

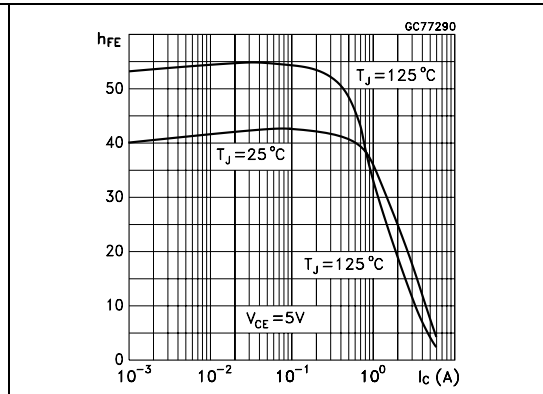


Figure 10. Inductive load storage time

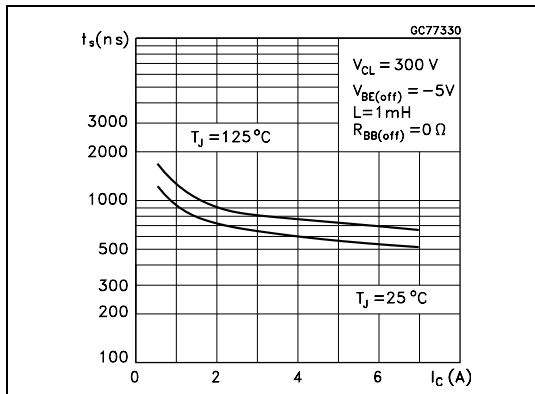


Figure 11. Inductive load fall time

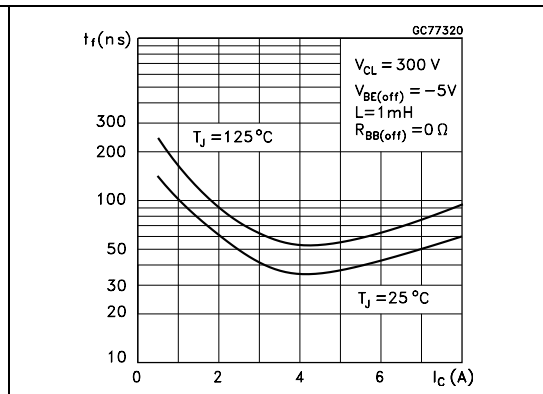
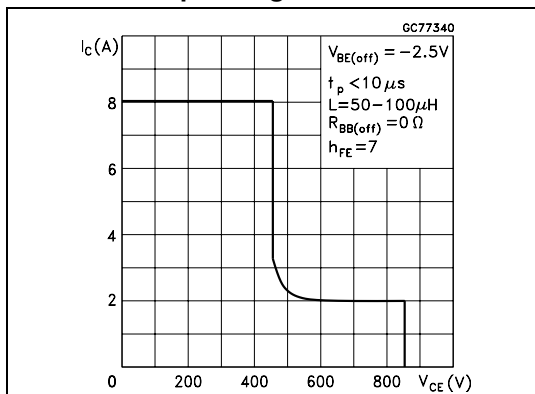


Figure 12. Reverse biased safe operating area



2.2 Test circuits

Figure 13. Resistive load switching test circuit

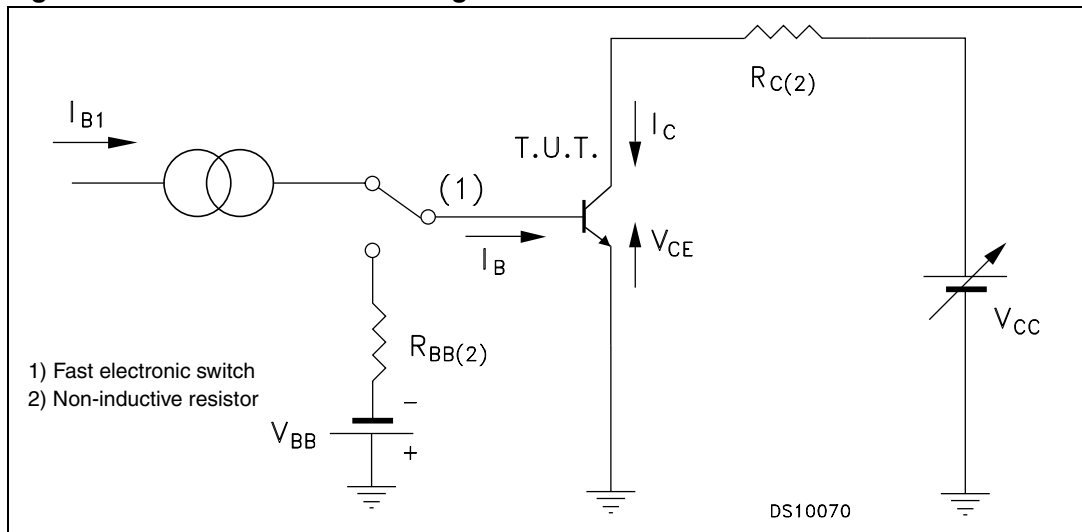
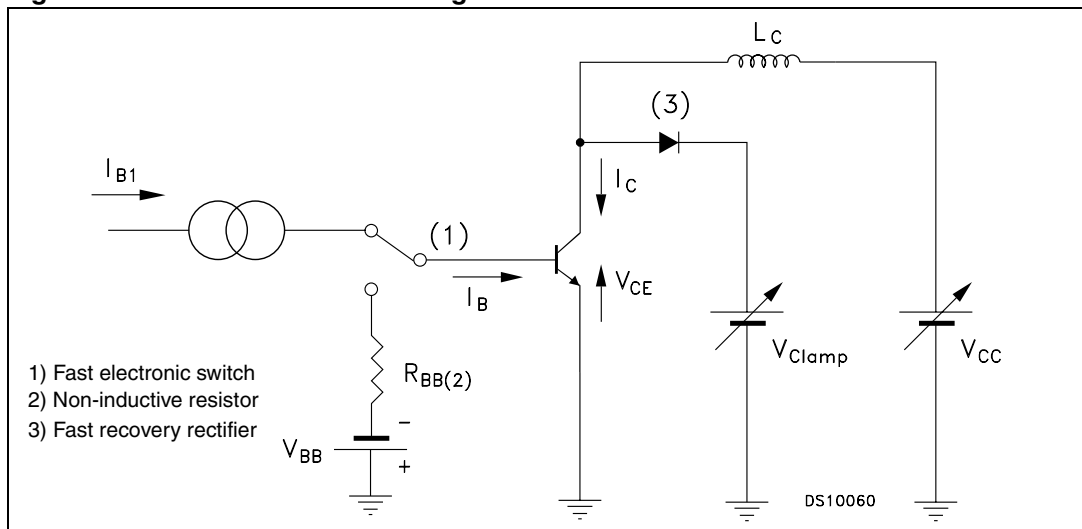


Figure 14. Inductive load switching test circuit

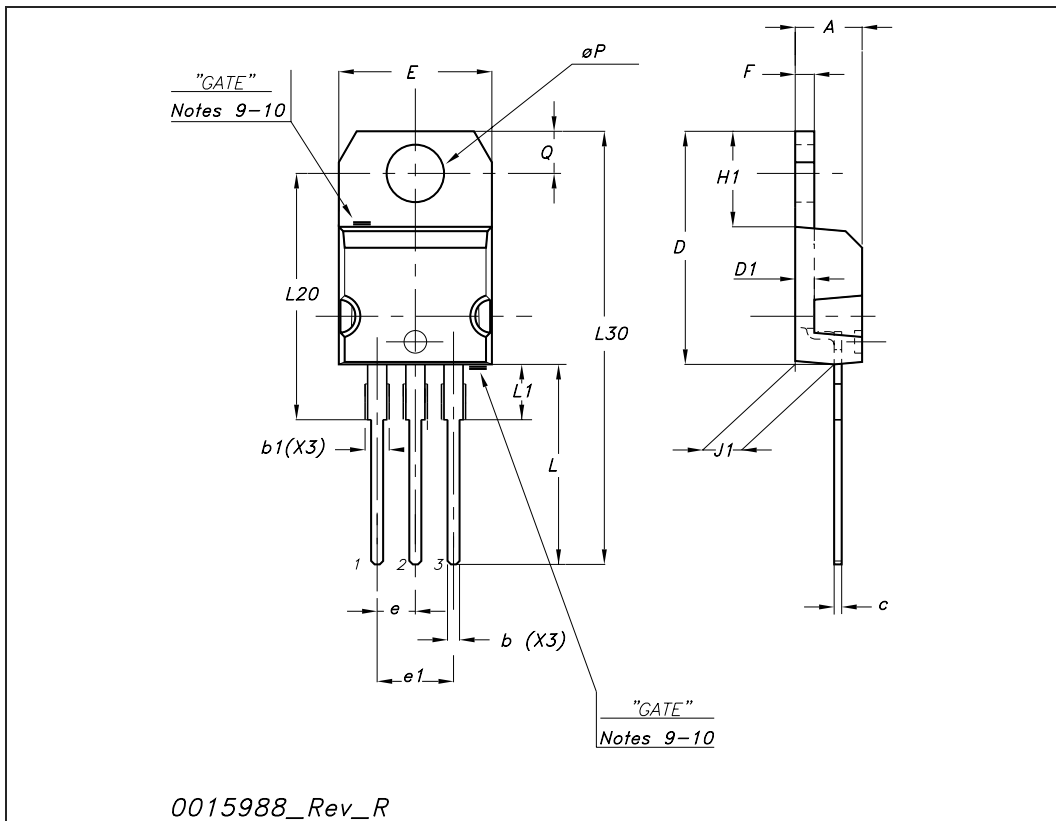


3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

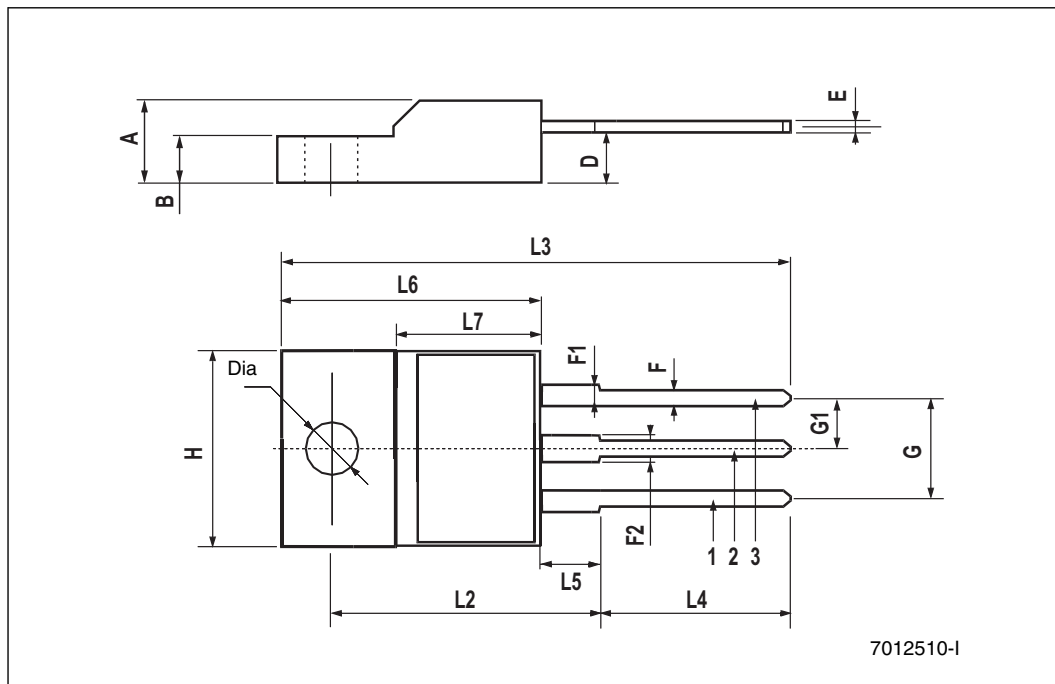
TO-220 mechanical data

| Dim | mm | | | inch | | |
|-----|-------|-------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| F | 1.23 | | 1.32 | 0.048 | | 0.051 |
| H1 | 6.20 | | 6.60 | 0.244 | | 0.256 |
| J1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L20 | | 16.40 | | | 0.645 | |
| L30 | | 28.90 | | | 1.137 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



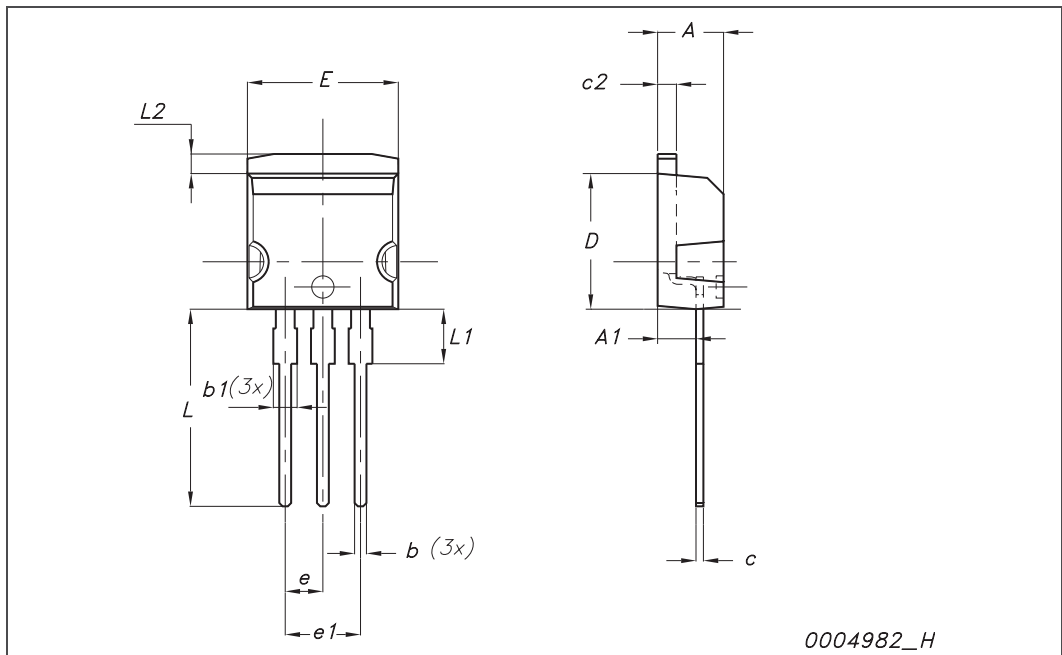
TO-220FP mechanical data

| Dim. | mm. | | | inch | | |
|------|-------|-----|-------|-------|-------|-------|
| | Min. | Typ | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| B | 2.5 | | 2.7 | 0.098 | | 0.106 |
| D | 2.5 | | 2.75 | 0.098 | | 0.108 |
| E | 0.45 | | 0.70 | 0.017 | | 0.027 |
| F | 0.75 | | 1.00 | 0.030 | | 0.039 |
| F1 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| F2 | 1.15 | | 1.50 | 0.045 | | 0.067 |
| G | 4.95 | | 5.20 | 0.195 | | 0.204 |
| G1 | 2.40 | | 2.70 | 0.094 | | 0.106 |
| H | 10 | | 10.40 | 0.393 | | 0.409 |
| L2 | | 16 | | | 0.630 | |
| L3 | 28.6 | | 30.6 | 1.126 | | 1.204 |
| L4 | 9.80 | | 10.60 | 0.385 | | 0.417 |
| L5 | 2.9 | | 3.6 | 0.114 | | 0.141 |
| L6 | 15.90 | | 16.40 | 0.626 | | 0.645 |
| L7 | 9 | | 9.30 | 0.354 | | 0.366 |
| Dia | 3 | | 3.2 | 0.118 | | 0.126 |



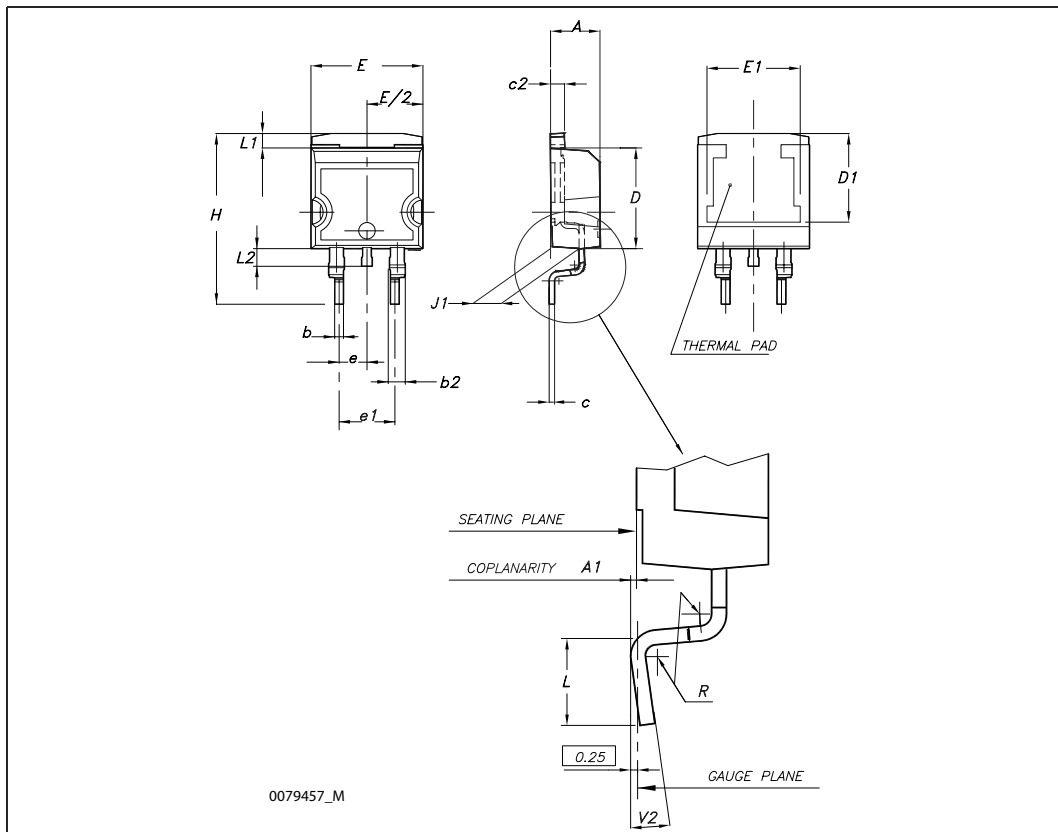
I²PAK (TO-262) mechanical data

| Dim | mm | | | inch | | |
|-----|------|-----|-------|-------|-----|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 2.40 | | 2.72 | 0.094 | | 0.107 |
| b | 0.61 | | 0.88 | 0.024 | | 0.034 |
| b1 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| c2 | 1.23 | | 1.32 | 0.048 | | 0.052 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| e | 2.40 | | 2.70 | 0.094 | | 0.106 |
| e1 | 4.95 | | 5.15 | 0.194 | | 0.202 |
| E | 10 | | 10.40 | 0.393 | | 0.410 |
| L | 13 | | 14 | 0.511 | | 0.551 |
| L1 | 3.50 | | 3.93 | 0.137 | | 0.154 |
| L2 | 1.27 | | 1.40 | 0.050 | | 0.055 |



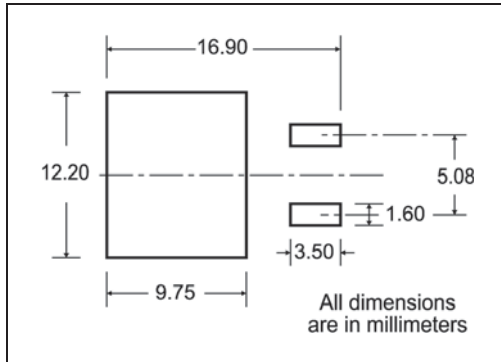
D²PAK (TO-263) mechanical data

| Dim | mm | | | inch | | |
|-----|------|------|-------|-------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 4.40 | | 4.60 | 0.173 | | 0.181 |
| A1 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| b | 0.70 | | 0.93 | 0.027 | | 0.037 |
| b2 | 1.14 | | 1.70 | 0.045 | | 0.067 |
| c | 0.45 | | 0.60 | 0.017 | | 0.024 |
| c2 | 1.23 | | 1.36 | 0.048 | | 0.053 |
| D | 8.95 | | 9.35 | 0.352 | | 0.368 |
| D1 | 7.50 | | | 0.295 | | |
| E | 10 | | 10.40 | 0.394 | | 0.409 |
| E1 | 8.50 | | | 0.334 | | |
| e | | 2.54 | | | 0.1 | |
| e1 | 4.88 | | 5.28 | 0.192 | | 0.208 |
| H | 15 | | 15.85 | 0.590 | | 0.624 |
| J1 | 2.49 | | 2.69 | 0.099 | | 0.106 |
| L | 2.29 | | 2.79 | 0.090 | | 0.110 |
| L1 | 1.27 | | 1.40 | 0.05 | | 0.055 |
| L2 | 1.30 | | 1.75 | 0.051 | | 0.069 |
| R | | 0.4 | | | 0.016 | |
| V2 | 0° | | 8° | 0° | | 8° |



4 Packaging information

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| BASE QTY | BULK QTY |
|----------|----------|
| 1000 | 1000 |

TRAILER (TRL) FEED DIRECTION

5 Revision history

Table 5. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 10-Sep-2003 | 1 | First release. |
| 04-May-2007 | 2 | The document has been reformatted. |
| 09-Jun-2008 | 3 | Inserted devices in: D ² PAK and I ² PAK. |

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