

High voltage fast-switching NPN power transistor

Features

- High voltage capability
- Low spread of dynamic parameters
- Very high switching speed
- Large RBSOA
- Integrated antiparallel collector-emitter diode

Applications

- Electronic ballast for fluorescent lighting
- Flyback and forward single transistor low power converters

Description

The device is manufactured using high voltage multi epitaxial planar technology for high switching speeds and medium voltage capability. It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA. The device is designed for use in lighting applications and low cost switch-mode power supplies.

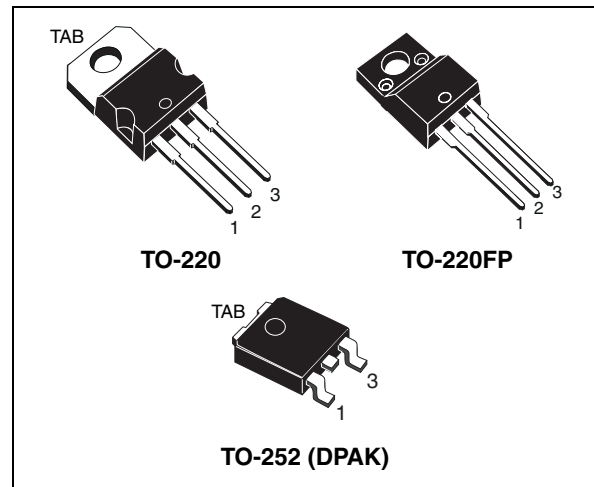


Figure 1. Internal schematic diagram

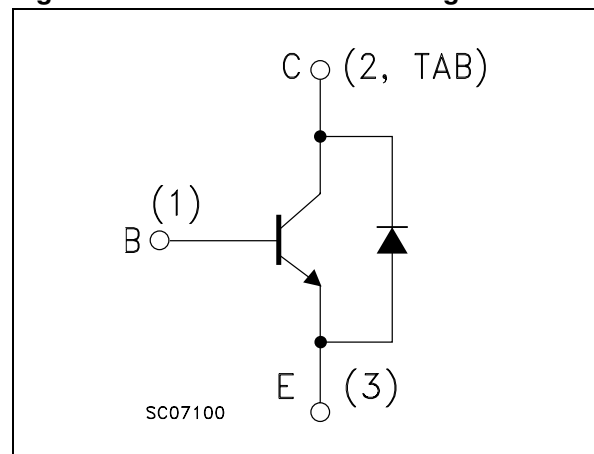


Table 1. Device summary

| Order codes | Marking | Packages | Packaging |
|-------------|----------|----------|---------------|
| STL128DN | L128DN | TO-220 | Tube |
| STL128DNFP | L128DNFP | TO-220FP | Tube |
| STLD128DNT4 | LD128DN | DPAK | Tape and reel |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|-----------|---------------------------------------------------------------------|---------------|------|
| V_{CES} | Collector-emitter voltage ($V_{BE} = 0$) | 700 | V |
| V_{CEO} | Collector-emitter voltage ($I_B = 0$) | 400 | V |
| V_{EBO} | Base-emitter voltage ($I_C = 0$, $I_B = 2$ A, $t_P < 10$ μ s) | $V_{(BR)EBO}$ | V |
| I_C | Collector current | 4 | A |
| I_{CM} | Collector peak current ($t_P < 5$ ms) | 8 | 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 for TO-220 | 60 | W |
| | Total dissipation at $T_c = 25$ °C for TO-220FP | 28 | W |
| | Total dissipation at $T_c = 25$ °C for DPAK | 20 | W |
| T_{stg} | Storage temperature | -65 to 150 | °C |
| T_J | Max. operating junction temperature | 150 | °C |

Table 3. Thermal data

| Symbol | Parameter | TO-220 | TO-220FP | DPAK | Unit |
|------------|--------------------------------------|--------|----------|------|------|
| R_{thJC} | Thermal resistance junction-case max | 2.08 | 4.46 | 6.25 | °C/W |

2 Electrical characteristics

$T_{\text{case}} = 25\text{ °C}$ unless otherwise specified

Table 4. Electrical characteristics

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------|------|------|------|---------------|
| I_{CES} | Collector cut-off current ($V_{\text{BE}} = 0$) | $V_{\text{CE}} = 700\text{ V}$ | | | 100 | μA |
| | | $V_{\text{CE}} = 700\text{ V}$ $T_{\text{c}} = 125\text{ °C}$ | | | 500 | μA |
| I_{CEO} | Collector cut-off current ($I_{\text{B}} = 0$) | $V_{\text{CE}} = 400\text{ V}$ | | | 250 | μA |
| $V_{(\text{BR})\text{EBO}}$ | Emitter-base breakdown voltage ($I_{\text{C}} = 0$) | $I_{\text{E}} = 10\text{ mA}$ | 9 | | 18 | V |
| $V_{\text{CEO(sus)}}^{(1)}$ | Collector-emitter sustaining voltage ($I_{\text{B}} = 0$) | $I_{\text{C}} = 10\text{ mA}$ | 400 | | | V |
| $V_{\text{CE(sat)}}^{(1)}$ | Collector-emitter saturation voltage | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$ | | | 0.5 | V |
| | | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$ | | | 1 | V |
| $V_{\text{BE(sat)}}^{(1)}$ | Base-emitter saturation voltage | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B}} = 0.2\text{ A}$ | | | 1.2 | V |
| | | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$ | | | 1.3 | V |
| $h_{\text{FE}}^{(1)}$ | DC current gain | $I_{\text{C}} = 10\text{ mA}$ $V_{\text{CE}} = 5\text{ V}$ | 10 | | | |
| | | $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$ | 8 | | 24 | |
| V_{F} | Diode forward voltage | $I_{\text{F}} = 1\text{ A}$ | | | 2.5 | V |
| t_{s} t_{f} | Resistive load Storage time | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B1}} = - I_{\text{B2}} = 0.2\text{ A}$ | | | 4.5 | μs |
| | Fall time | $V_{\text{CC}} = 125\text{ V}$ $t_{\text{p}} = 20\text{ }\mu\text{s}$ | | | 0.4 | μs |

1. Pulse test: pulse duration $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

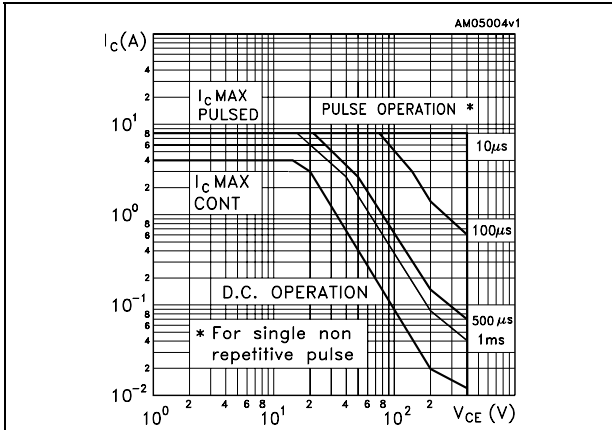


Figure 3. Safe operating area for TO-220FP

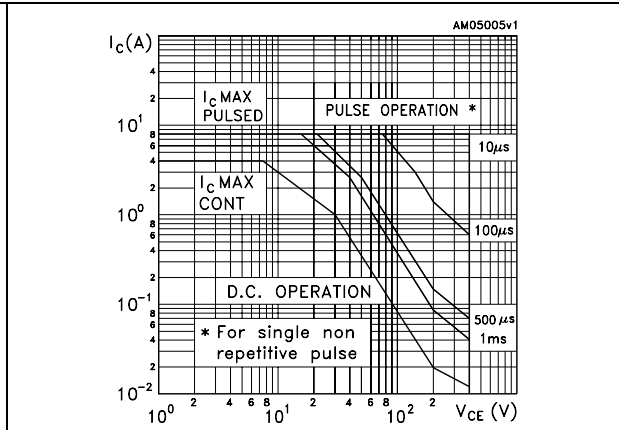


Figure 4. Safe operating area for DPAK

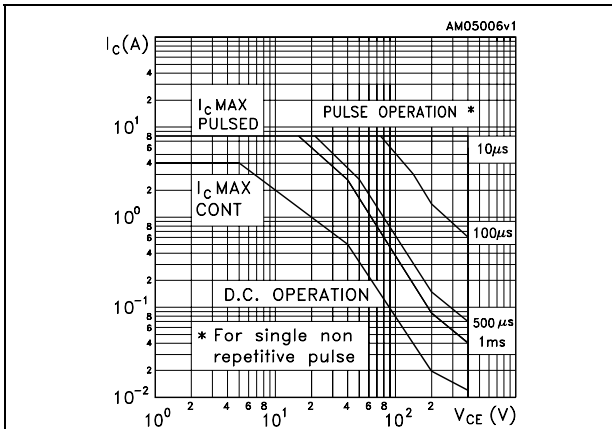


Figure 5. Derating curve

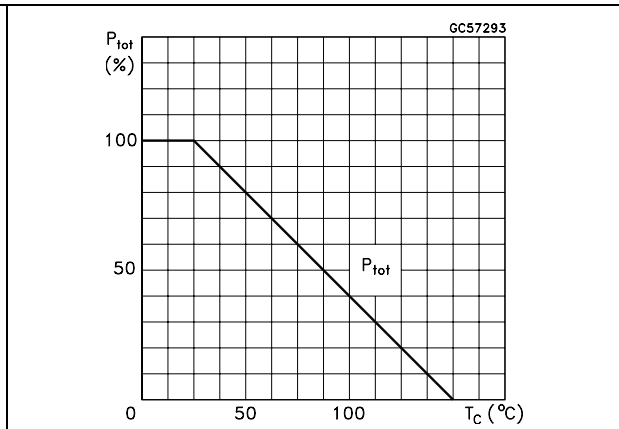


Figure 6. DC current gain ($V_{CE} = 1V$)

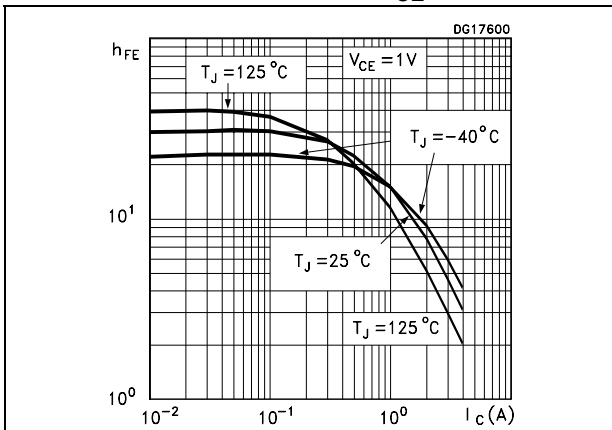


Figure 7. DC current gain ($V_{CE} = 5V$)

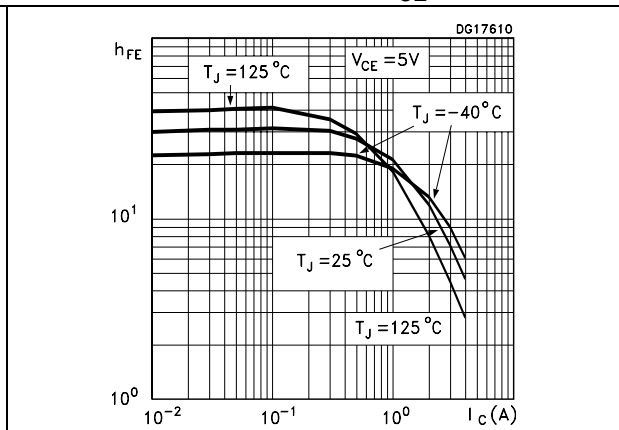


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage

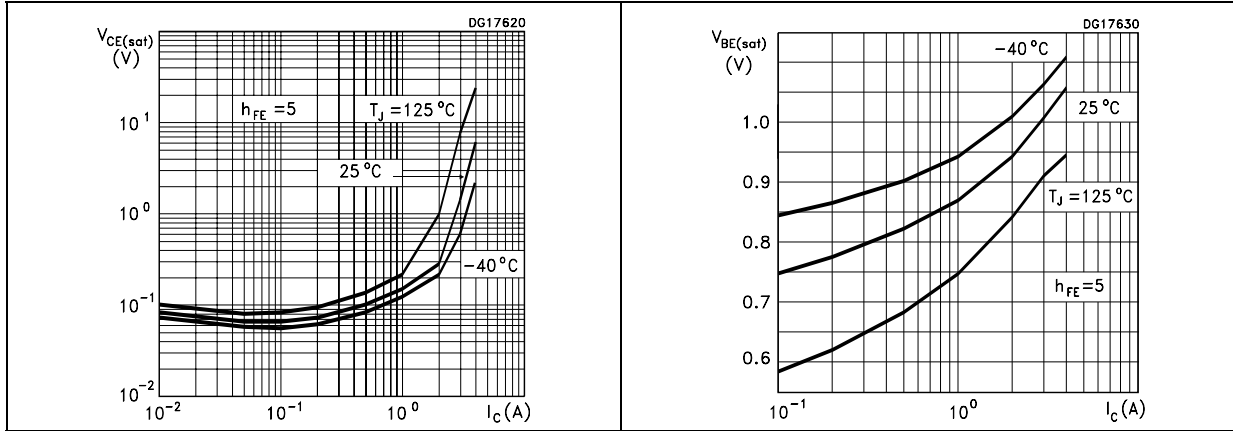


Figure 10. Freewheel diode forward voltage Figure 11. Resistive load switching time

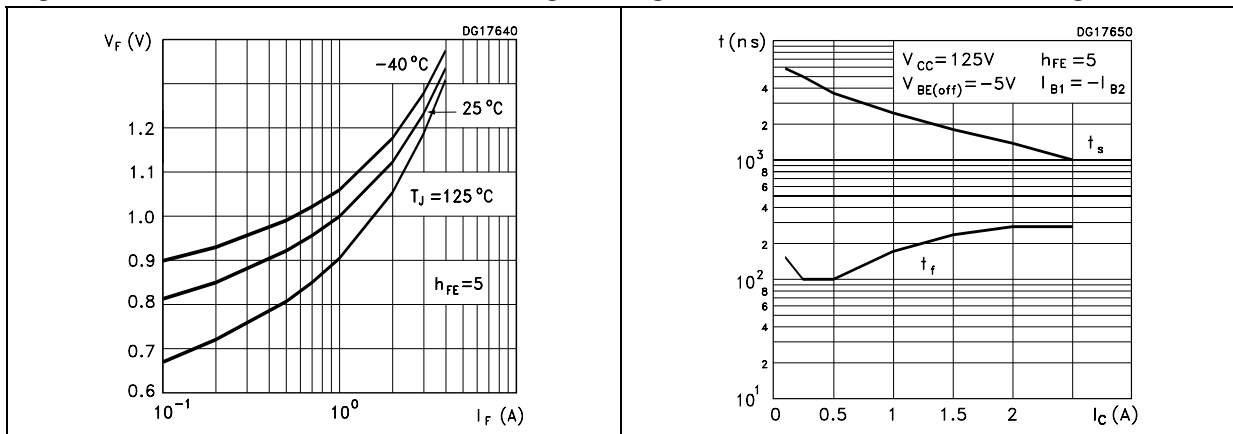
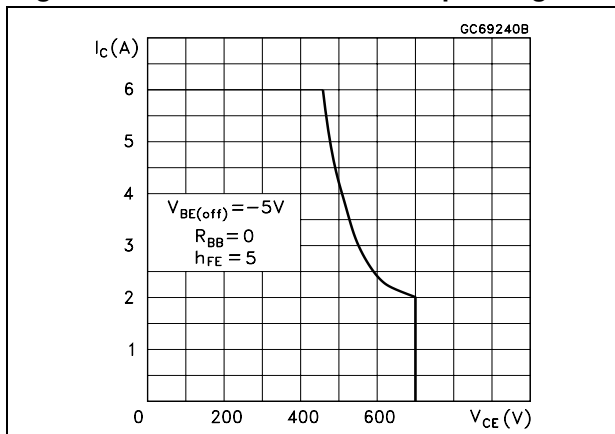
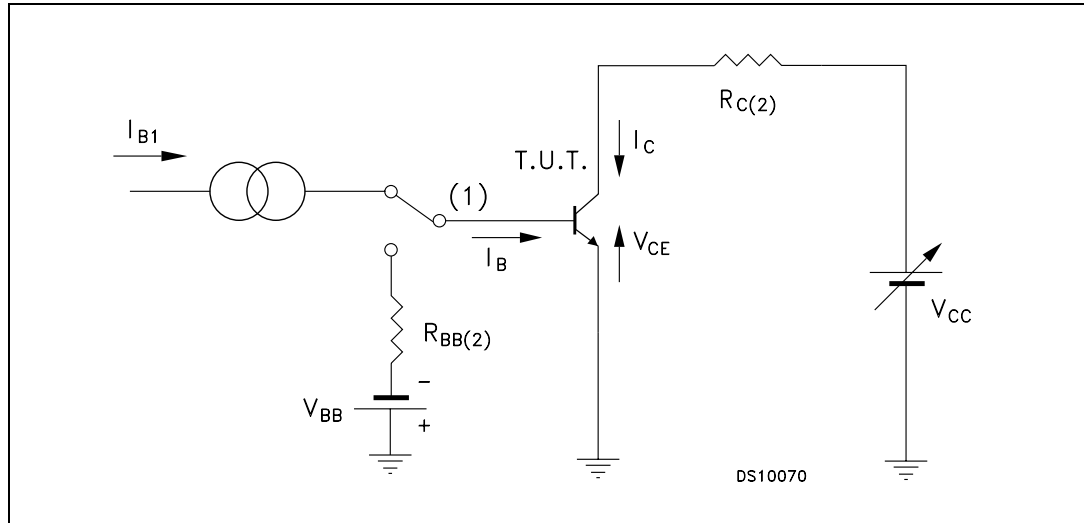


Figure 12. Reverse biased safe operating area



3 Test circuit

Figure 13. Resistive load switching test circuit



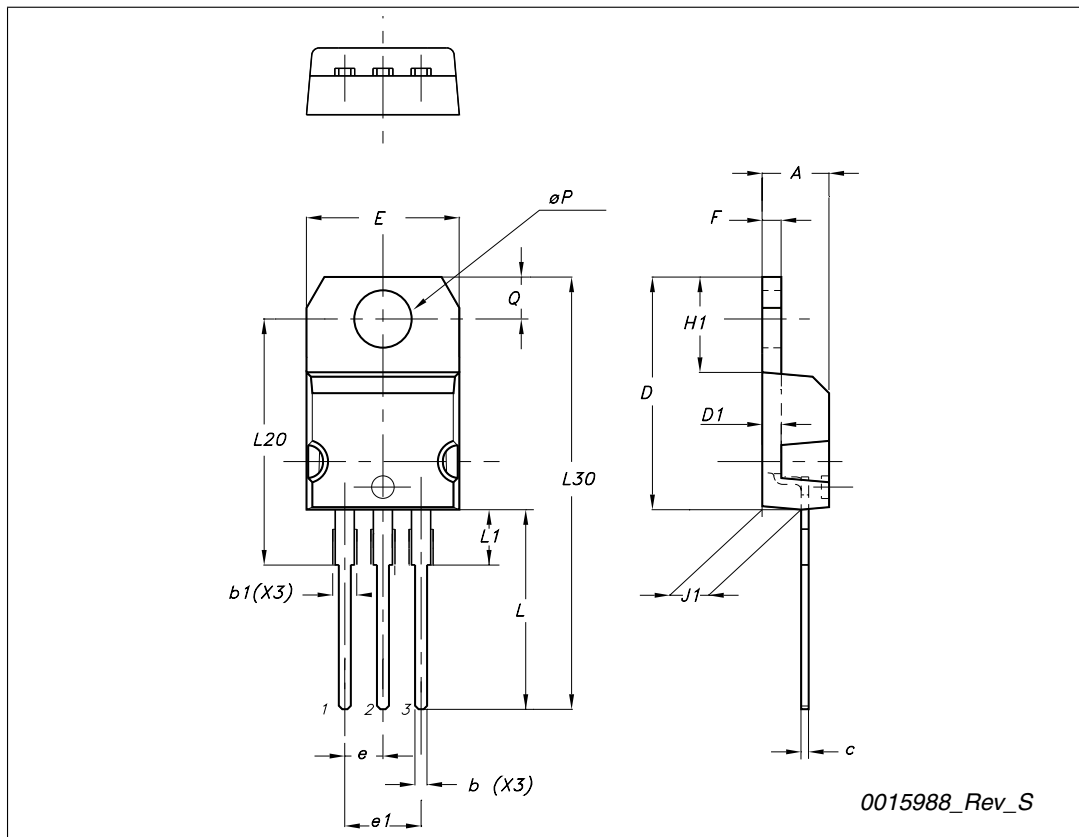
1. Fast electronic switch
2. Non-inductive resistor

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. ECOPACK[®] is an ST trademark.

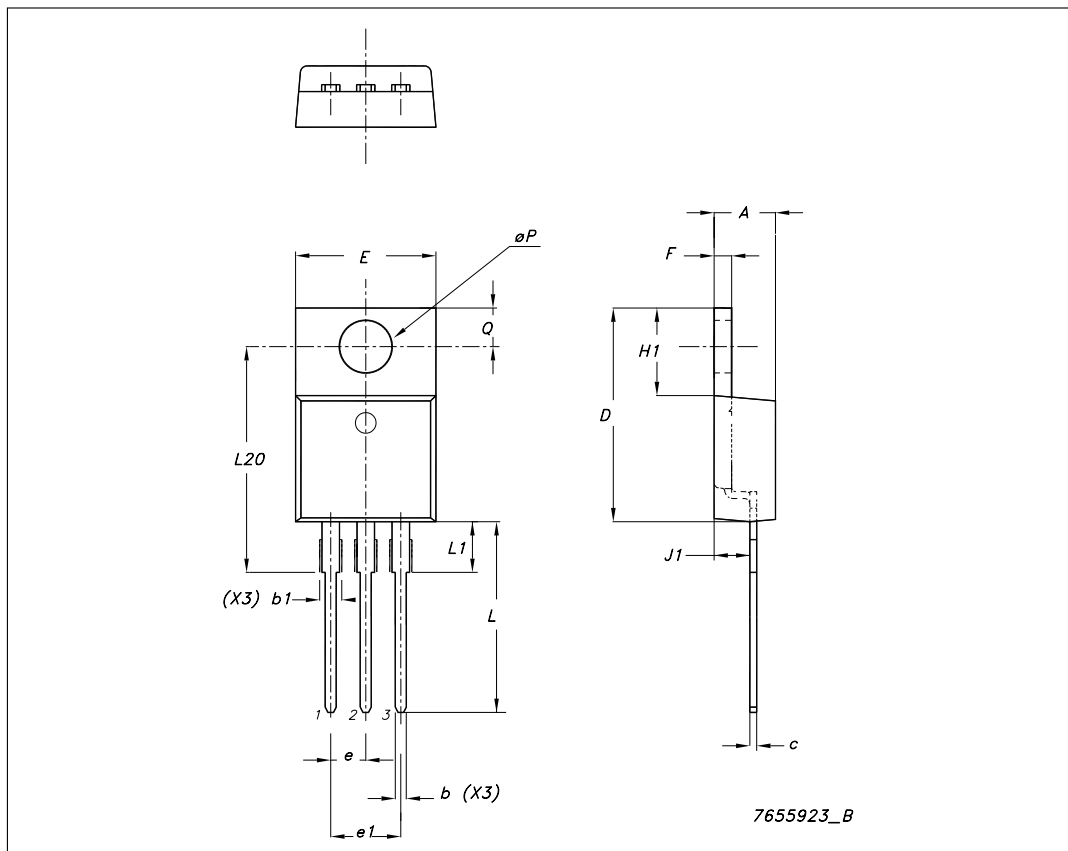
TO-220 type A mechanical data

| Dim | mm | | |
|-----|-------|-------|-------|
| | Min | Typ | Max |
| A | 4.40 | | 4.60 |
| b | 0.61 | | 0.88 |
| b1 | 1.14 | | 1.70 |
| c | 0.48 | | 0.70 |
| D | 15.25 | | 15.75 |
| D1 | | 1.27 | |
| E | 10 | | 10.40 |
| e | 2.40 | | 2.70 |
| e1 | 4.95 | | 5.15 |
| F | 1.23 | | 1.32 |
| H1 | 6.20 | | 6.60 |
| J1 | 2.40 | | 2.72 |
| L | 13 | | 14 |
| L1 | 3.50 | | 3.93 |
| L20 | | 16.40 | |
| L30 | | 28.90 | |
| ∅P | 3.75 | | 3.85 |
| Q | 2.65 | | 2.95 |



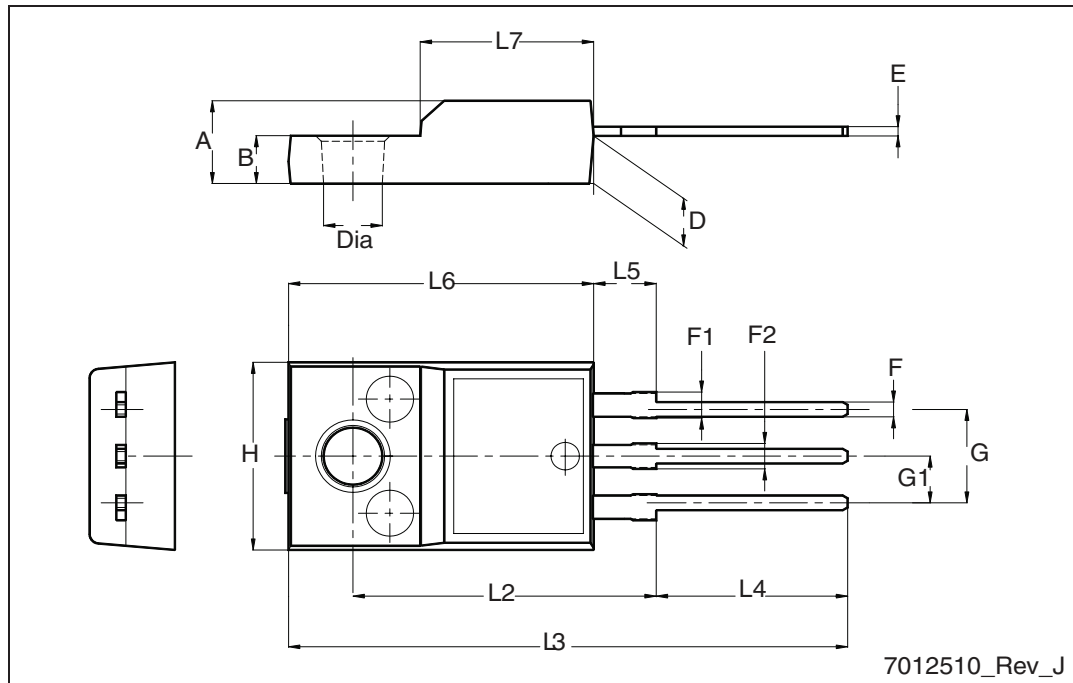
TO-220 type E mechanical data

| Dim | mm | | |
|-----|-------|------|-------|
| | Min | Typ | Max |
| A | 4.47 | | 4.67 |
| b | 0.70 | | 0.91 |
| b1 | 1.17 | | 1.37 |
| c | 0.31 | | 0.53 |
| D | 14.60 | | 15.70 |
| E | 9.96 | | 10.36 |
| e | | 2.54 | |
| e1 | 4.98 | 5.08 | 5.18 |
| F | 1.17 | | 1.37 |
| H1 | 6.10 | | 6.80 |
| J1 | 2.52 | | 2.82 |
| L | 12.70 | | 13.80 |
| L1 | 3.20 | | 3.96 |
| L20 | 15.21 | | 16.77 |
| øP | 3.73 | | 3.94 |
| Q | 2.59 | | 2.89 |



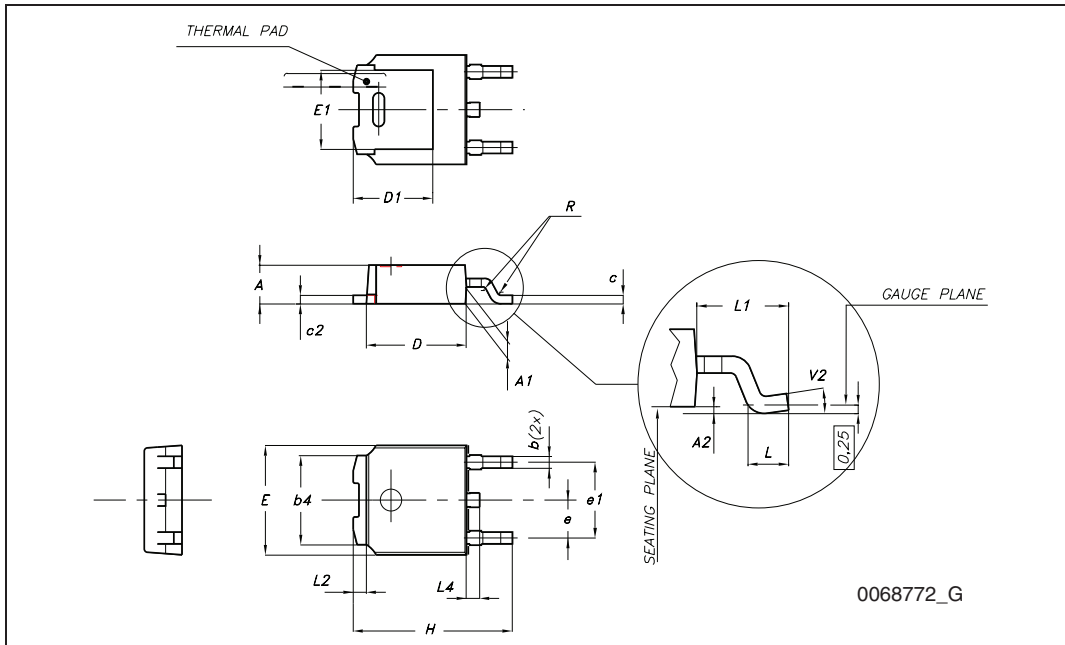
TO-220FP mechanical data

| 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 | | 1.5 |
| 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 |



TO-252 (DPAK) mechanical data

| DIM. | mm. | | |
|------|------|------|-------|
| | min. | typ | max. |
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| b | 0.64 | | 0.90 |
| b4 | 5.20 | | 5.40 |
| c | 0.45 | | 0.60 |
| c2 | 0.48 | | 0.60 |
| D | 6.00 | | 6.20 |
| D1 | | 5.10 | |
| E | 6.40 | | 6.60 |
| E1 | | 4.70 | |
| e | | 2.28 | |
| e1 | 4.40 | | 4.60 |
| H | 9.35 | | 10.10 |
| L | 1 | | |
| L1 | | 2.80 | |
| L2 | | 0.80 | |
| L4 | 0.60 | | 1 |
| R | | 0.20 | |
| V2 | 0° | | 8° |



5 Revision history

Table 5. Document revision history

| Date | Revision | Changes |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 04-Oct-2007 | 1 | First release |
| 14-Feb-2008 | 2 | Updated TO-220, type E, mechanical data |
| 01-Oct-2009 | 3 | Updated: collector and base current values Table 2 on page 3 , $V_{CE(sat)}$ maximum values Table 4 on page 4 . |

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