

## High voltage fast-switching NPN power transistor

### Features

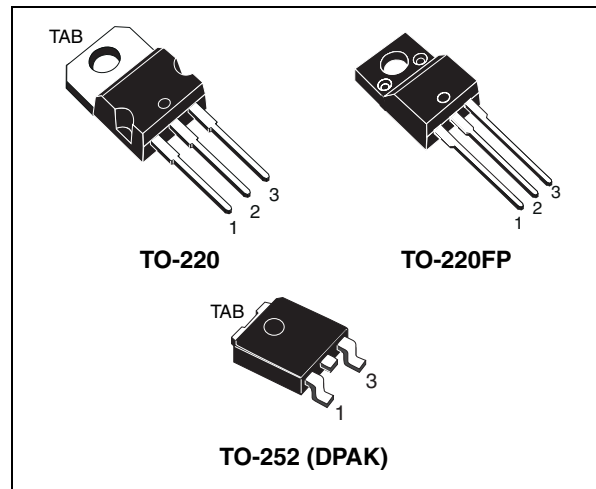
- High voltage capability
- Low spread of dynamic parameters
- Very high switching speed
- Large RBSOA
- Integrated antiparallel collector-emitter diode

### Applications

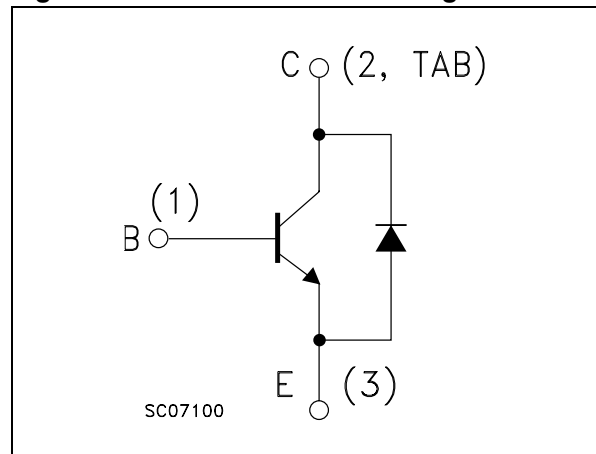
- Electronic ballast for fluorescent lighting
- Flyback and forward single transistor low power converters

### 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 |

# Content

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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, $t_P < 10$ $\mu$ 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          |
|----------------------------------|---|---|------|------|------|---------------|
| $I_{\text{CES}}$                 | Collector cut-off current ( $V_{\text{BE}} = 0$ )           | $V_{\text{CE}} = 700\text{ V}$  |      |      | 100  | $\mu\text{A}$ |
|                                  |   | $V_{\text{CE}} = 700\text{ V}$ $T_{\text{c}} = 125\text{ °C}$               |      |      | 500  | $\mu\text{A}$ |
| $I_{\text{CEO}}$                 | Collector cut-off current ( $I_{\text{B}} = 0$ )            | $V_{\text{CE}} = 400\text{ V}$  |      |      | 250  | $\mu\text{A}$ |
| $V_{(\text{BR})\text{EBO}}$      | 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   |               |
| $V_{\text{F}}$                   | Diode forward voltage                                       | $I_{\text{F}} = 1\text{ A}$   |      |      | 2.5  | V             |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Resistive load  |   |      |      |      |               |
|                                  | Storage time  | $I_{\text{C}} = 1\text{ A}$ $I_{\text{B1}} = -I_{\text{B2}} = 0.2\text{ A}$ |      |      | 4.5  | $\mu\text{s}$ |
|                                  | Fall time   | $V_{\text{CC}} = 125\text{ V}$ $t_{\text{p}} = 20\text{ }\mu\text{s}$       |      |      | 0.4  | $\mu\text{s}$ |

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

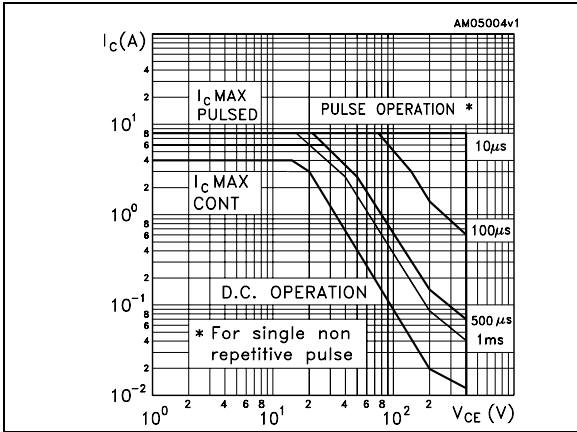


Figure 3. Safe operating area for TO-220FP

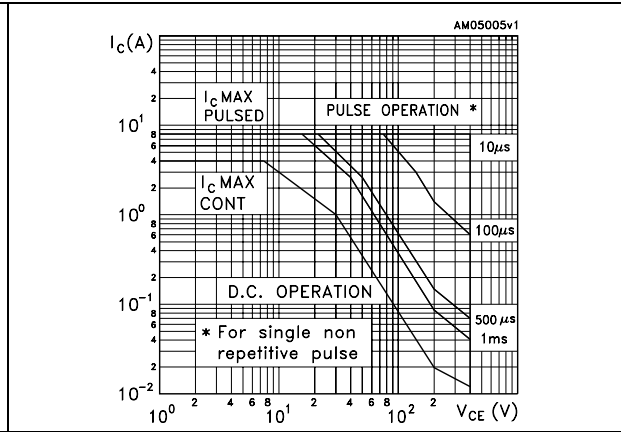


Figure 4. Safe operating area for DPAK

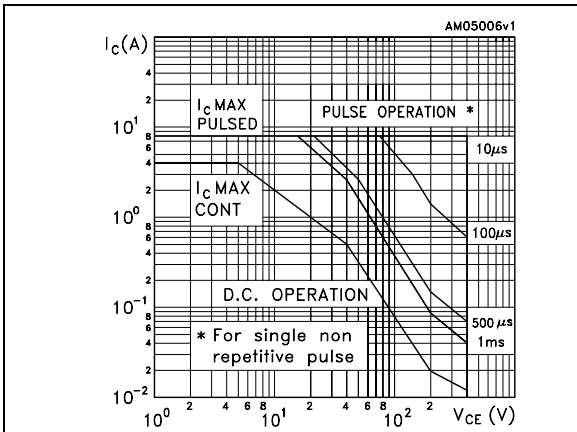


Figure 5. Derating curve

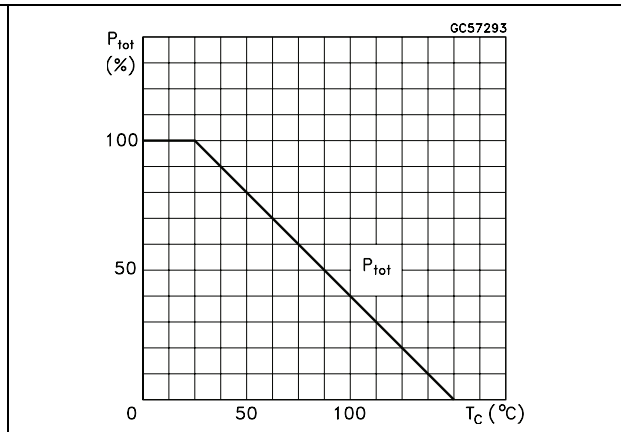


Figure 6. DC current gain ( $V_{CE} = 1$  V)

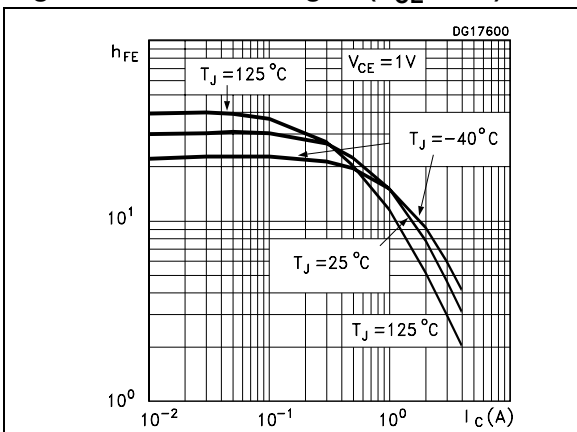


Figure 7. DC current gain ( $V_{CE} = 5$  V)

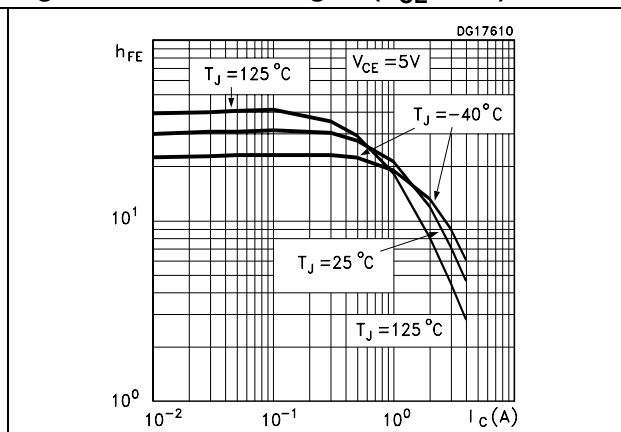


Figure 8. Collector-emitter saturation voltage Figure 9. Base-emitter saturation voltage

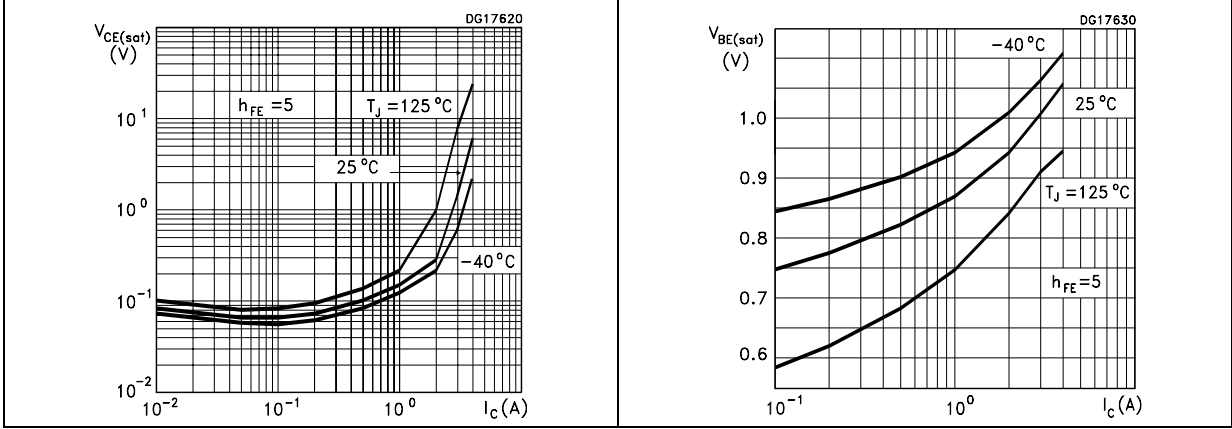


Figure 10. Freewheel diode forward voltage Figure 11. Resistive load switching time

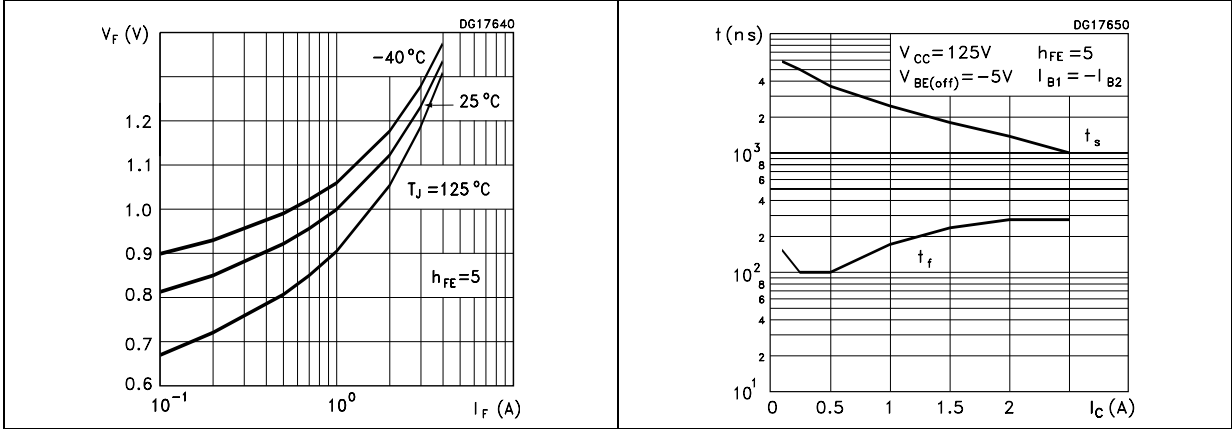
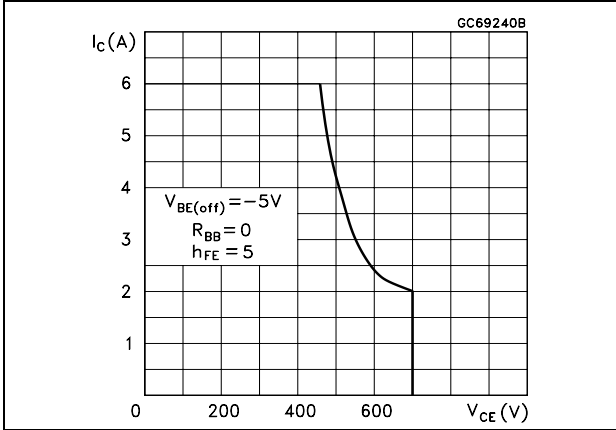
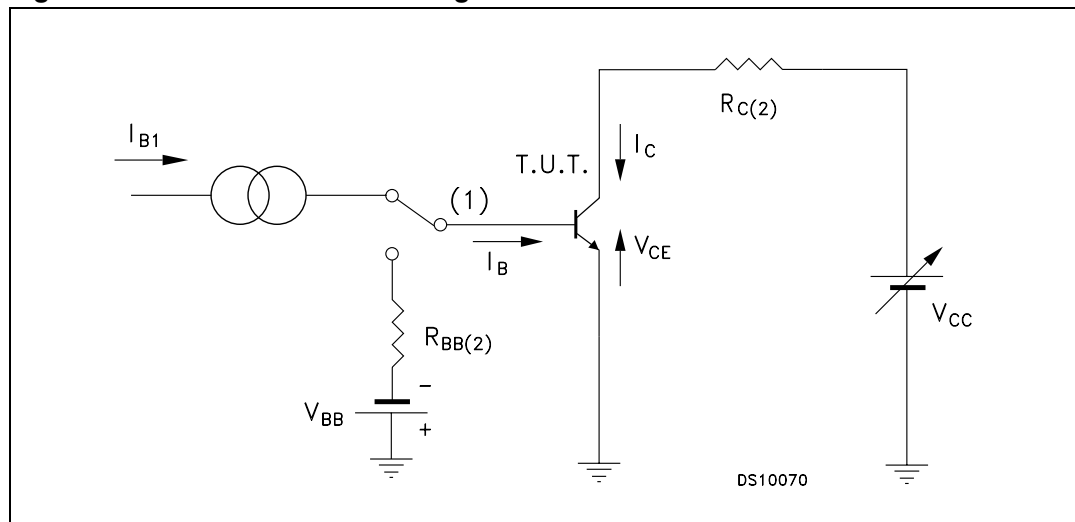


Figure 12. Reverse biased safe operating area



### 3 Test circuit

Figure 13. Resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

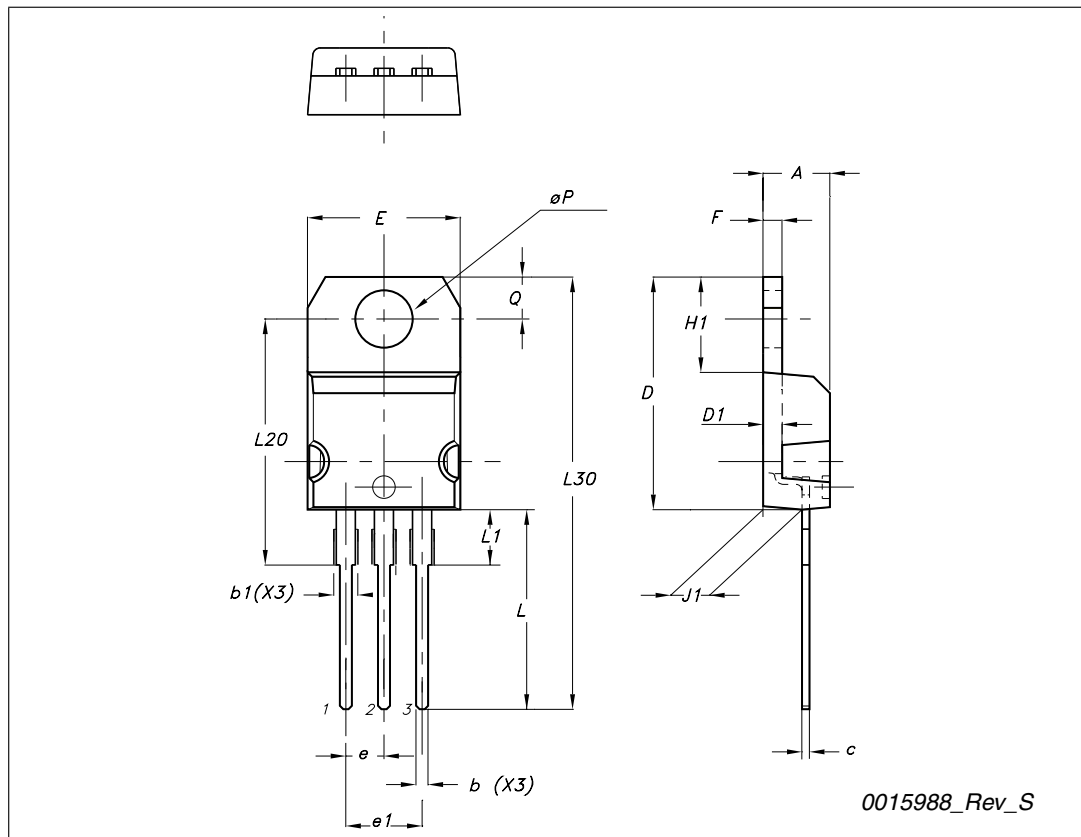
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.



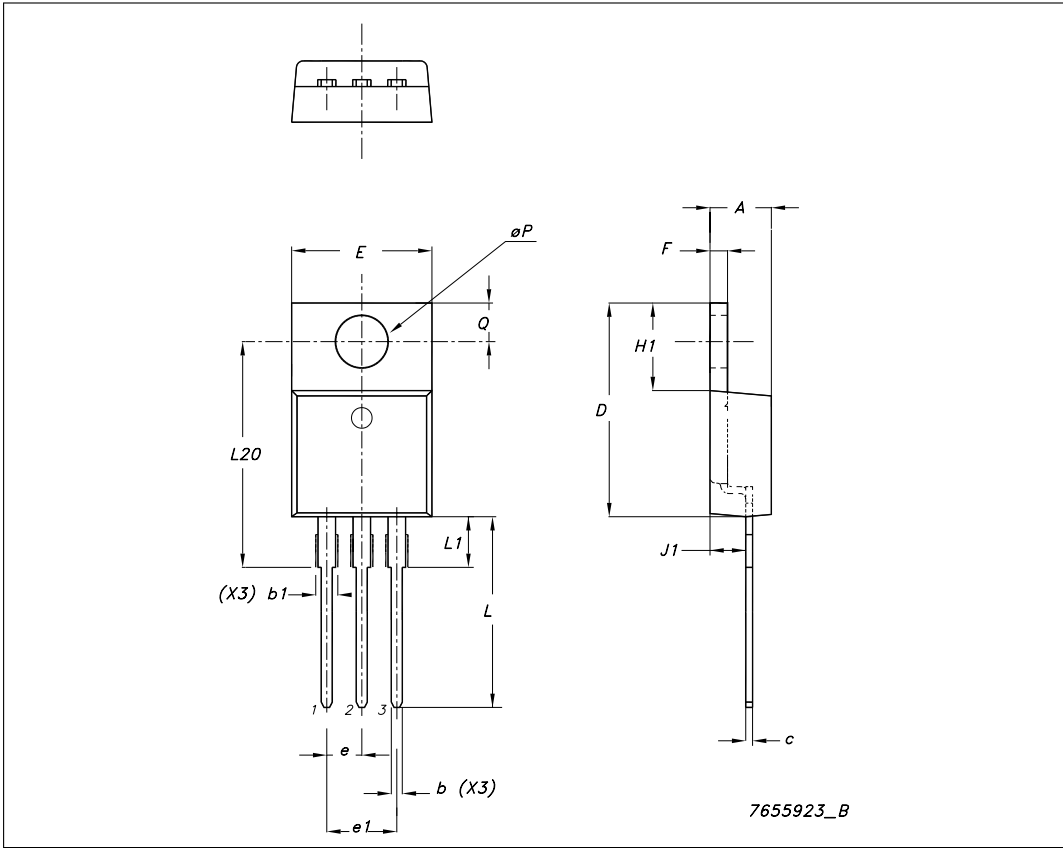
TO-220 type A mechanical data

| 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  |



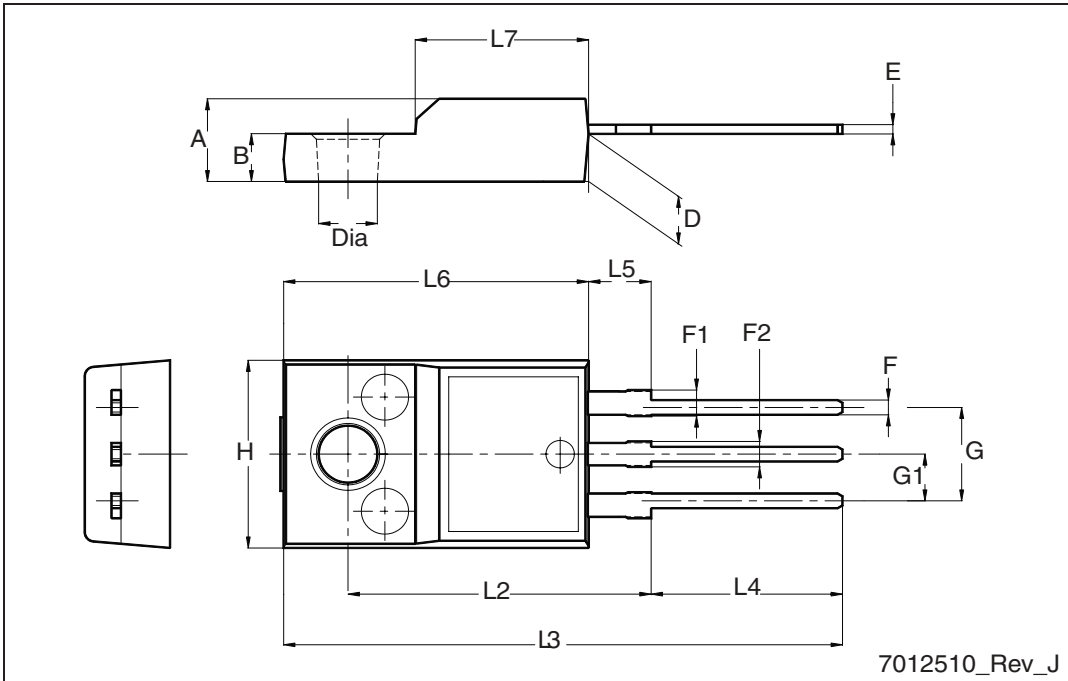
**TO-220 type E mechanical data**

| 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  |



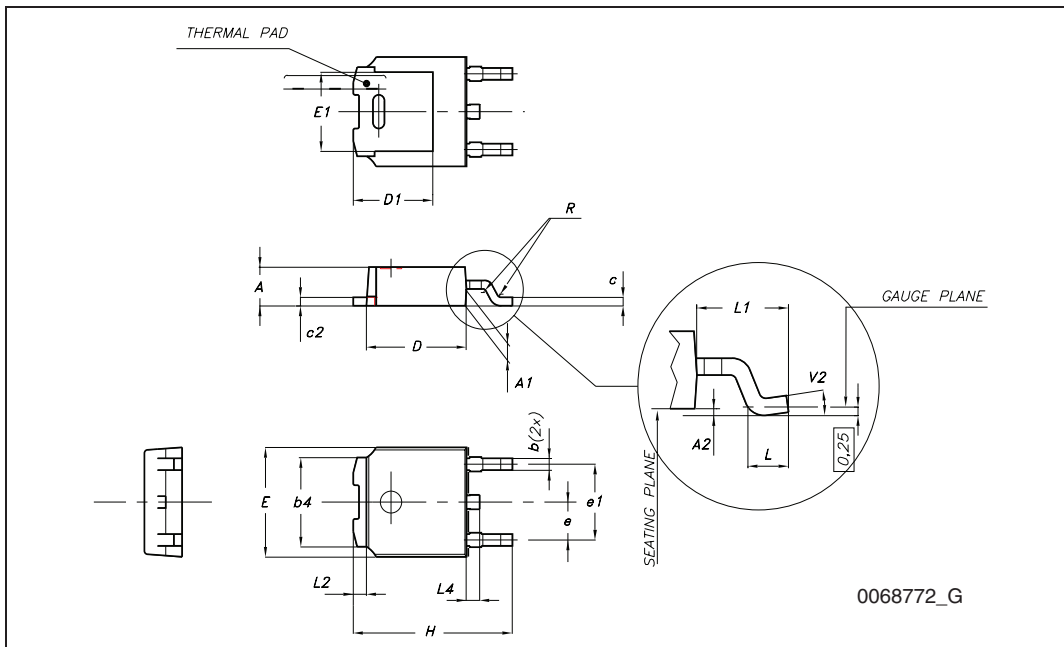
TO-220FP mechanical data

| 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 <a href="#">Table 2 on page 3</a> , $V_{CE(sat)}$ maximum values <a href="#">Table 4 on page 4</a> . |

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