

## High voltage fast-switching NPN power transistor

### Features

- DC current gain classification
- High voltage capability
- Low spread of dynamic parameters
- Very high switching speed

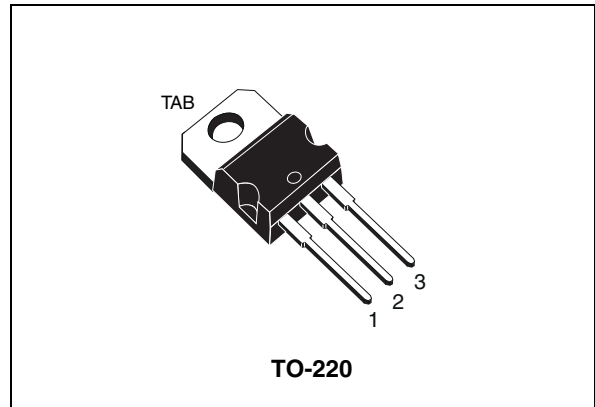
### Applications

- Electronic ballast for fluorescent lighting
- Switch mode power supplies

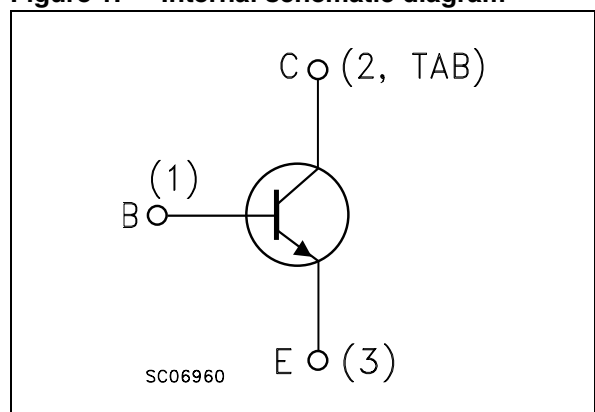
### Description

The device is manufactured using high voltage multi-epitaxial planar technology for high switching speeds and high voltage capability.

It uses a cellular emitter structure with planar edge termination to enhance switching speeds while maintaining the wide RBSOA.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

| Order code | Marking <sup>(1)</sup> | Package | Packaging |
|------------|------------------------|---------|-----------|
| ST13007    | ST13007A               | TO-220  | Tube      |
|            | ST13007B               |         |           |

1. The product is classified in DC current gain group A and group B, see [Table 5: hFE classification](#). STMicroelectronics reserves the right to ship from any group according to production availability.

# 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    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )         | 9           | V    |
| $I_C$     | Collector current                          | 8           | A    |
| $I_{CM}$  | Collector peak current ( $t_P < 5$ ms)     | 16          | A    |
| $I_B$     | Base current                               | 4           | A    |
| $I_{BM}$  | Base peak current ( $t_P < 5$ ms)          | 8           | A    |
| $P_{TOT}$ | Total dissipation at $T_C = 25$ °C         | 80          | W    |
| $T_{STG}$ | Storage temperature                        | - 65 to 150 | °C   |
| $T_J$     | Max. operating junction temperature        | 150         | °C   |

**Table 3. Thermal data**

| Symbol     | Parameter                            | Value | Unit |
|------------|--------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case max | 1.56  | °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<br>( $V_{\text{BE}} = 0$ )              | $V_{\text{CE}} = 700\text{ V}$<br>$V_{\text{CE}} = 700\text{ V}$ $T_{\text{C}} = 125\text{ °C}$                                                                                                                                                                         |         |           | 10<br>0.5         | $\mu\text{A}$<br>$\text{mA}$ |
| $I_{\text{EBO}}$                 | Emitter cut-off current<br>( $I_{\text{C}} = 0$ )                 | $V_{\text{EB}} = 9\text{ V}$                                                                                                                                                                                                                                            |         |           | 100               | $\mu\text{A}$                |
| $V_{\text{CEO(sus)}}^{(1)}$      | Collector-emitter<br>sustaining voltage<br>( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 10\text{ mA}$                                                                                                                                                                                                                                           | 400     |           |                   | V                            |
| $V_{\text{CE(sat)}}^{(1)}$       | Collector-emitter<br>saturation voltage                           | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$<br>$I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 1\text{ A}$<br>$I_{\text{C}} = 8\text{ A}$ $I_{\text{B}} = 2\text{ A}$<br>$I_{\text{C}} = 5\text{ A}, I_{\text{B}} = 1\text{ A}, T_{\text{C}} = 100\text{ °C}$ |         |           | 1<br>2<br>3<br>3  | V<br>V<br>V<br>V             |
| $V_{\text{BE(sat)}}^{(1)}$       | Base-emitter saturation<br>voltage                                | $I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$<br>$I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 1\text{ A}$<br>$I_{\text{C}} = 5\text{ A}, I_{\text{B}} = 1\text{ A}, T_{\text{C}} = 100\text{ °C}$                                                            |         |           | 1.2<br>1.6<br>1.5 | V<br>V<br>V                  |
| $h_{\text{FE}}$                  | DC current gain                                                   | $I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$<br>$I_{\text{C}} = 5\text{ A}$ $V_{\text{CE}} = 5\text{ V}$                                                                                                                                                    | 16<br>5 |           | 40<br>30          |                              |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Resistive load<br>Storage time<br>Fall time                       | $V_{\text{CC}} = 300\text{ V}$ $I_{\text{C}} = 2\text{ A}$<br>$I_{\text{B(on)}} = - I_{\text{B(off)}} = 400\text{ mA}$<br>$T_{\text{P}} = 30\text{ }\mu\text{s}$                                                                                                        | 3       |           | 4.5<br>350        | $\mu\text{s}$<br>$\text{ns}$ |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Inductive load<br>Storage time<br>Fall time                       | $I_{\text{C}} = 5\text{ A}$ $V_{\text{Clamp}} = 250\text{ V}$<br>$I_{\text{B(on)}} = 1\text{ A}$ $I_{\text{B(off)}} = - 2\text{ A}$<br>$L = 200\text{ }\mu\text{H}$                                                                                                     |         | 1.5<br>40 | 2.5<br>110        | $\mu\text{s}$<br>$\text{ns}$ |
| $t_{\text{s}}$<br>$t_{\text{f}}$ | Inductive load<br>Storage time<br>Fall time                       | $I_{\text{C}} = 5\text{ A}$ $V_{\text{Clamp}} = 250\text{ V}$<br>$I_{\text{B(on)}} = 1\text{ A}$ $I_{\text{B(off)}} = - 2\text{ A}$<br>$L = 200\text{ }\mu\text{H}$ $T_{\text{C}} = 125\text{ °C}$                                                                      |         | 2<br>70   |                   | $\mu\text{s}$<br>$\text{ns}$ |

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

**Table 5.  $h_{\text{FE}}$  classification**

| Symbol          | Parameter                                                                  | Group | Min. | Max. | Unit |
|-----------------|----------------------------------------------------------------------------|-------|------|------|------|
| $h_{\text{FE}}$ | DC current gain<br>$I_{\text{C}} = 2\text{ A}, V_{\text{CE}} = 5\text{ V}$ | A     | 16   | 30   |      |
|                 |                                                                            | B     | 26   | 40   |      |

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

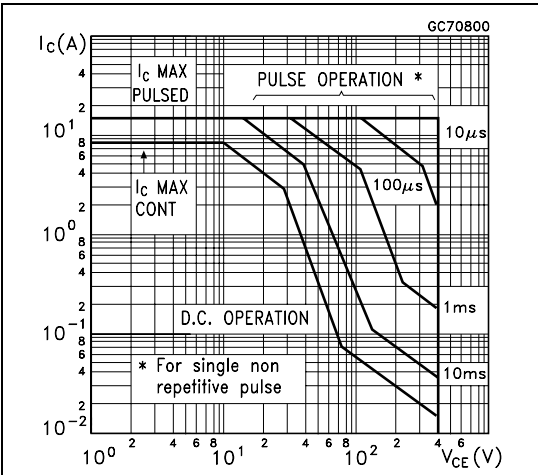


Figure 3. Derating curve

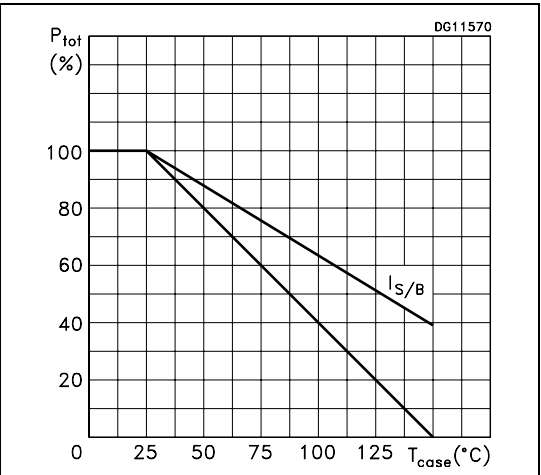


Figure 4. DC current gain ( $V_{CE} = 2 V$ )

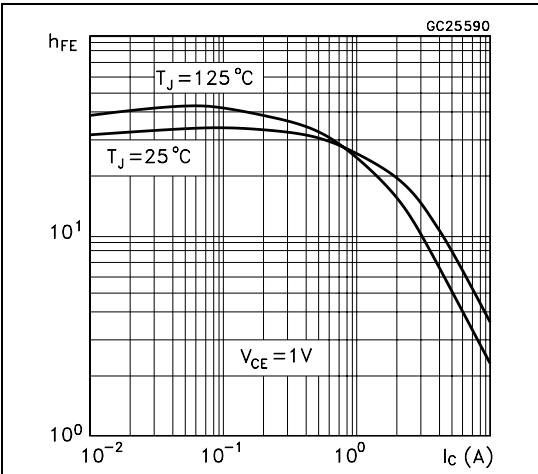


Figure 5. DC current gain ( $V_{CE} = 5 V$ )

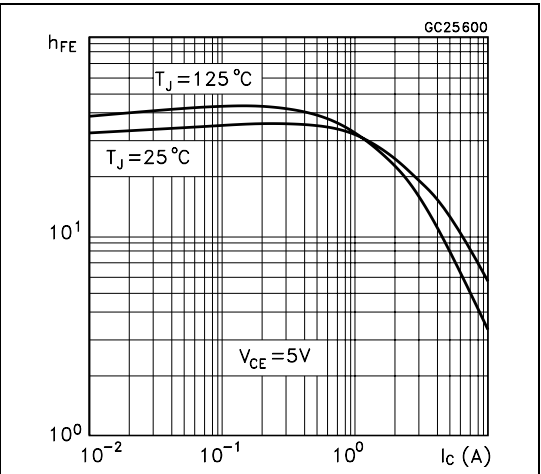


Figure 6. Collector-emitter saturation voltage

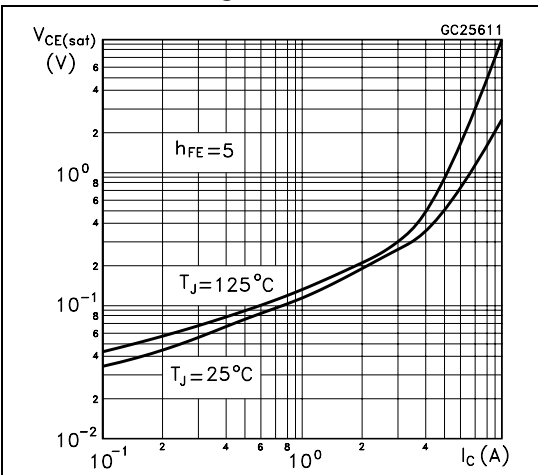


Figure 7. Base-emitter saturation voltage

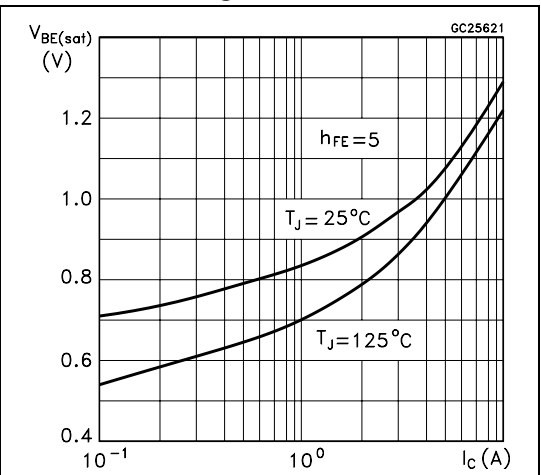


Figure 8. Inductive fall time

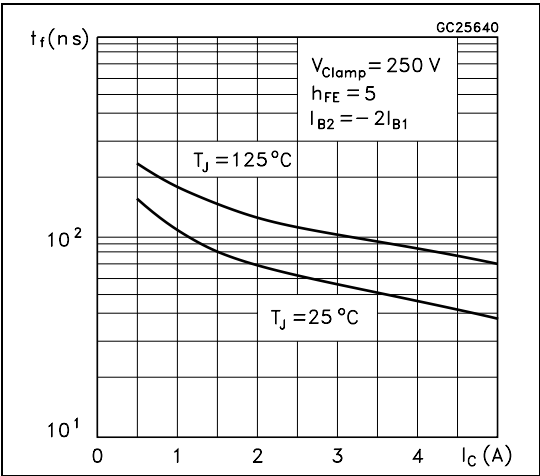


Figure 9. Inductive storage time

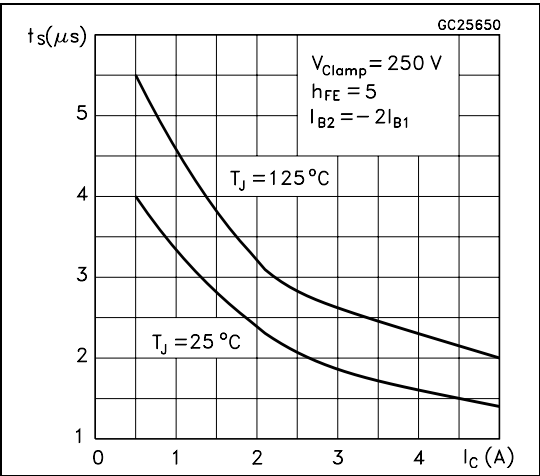
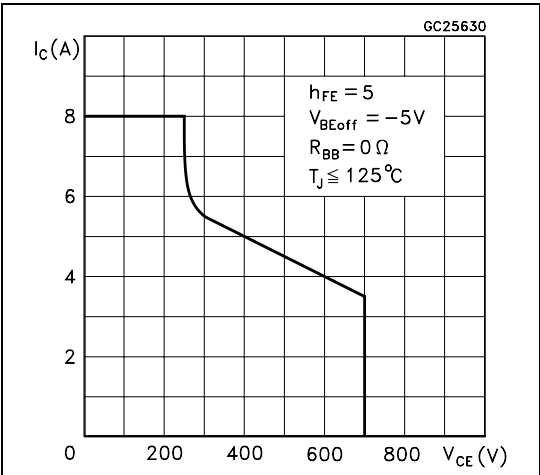
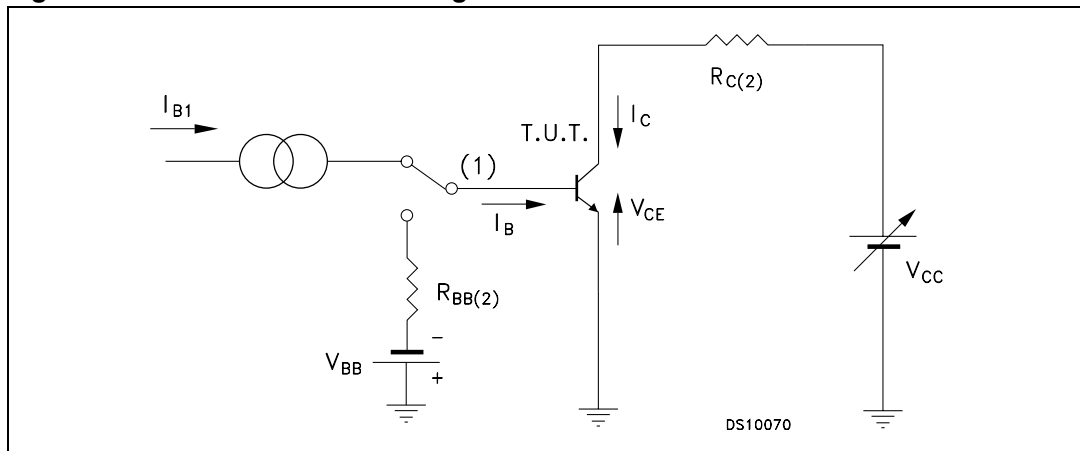


Figure 10. Reverse biased SOA



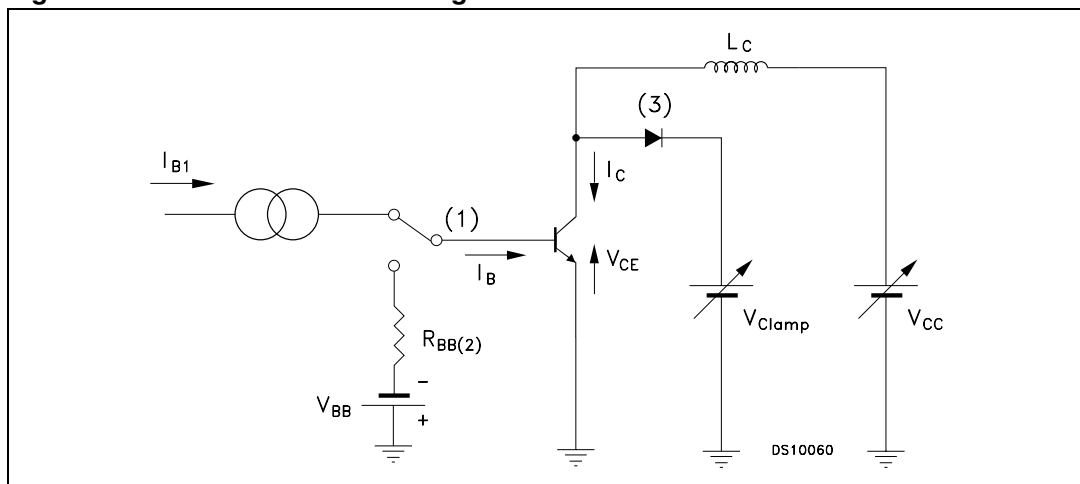
## 2.2 Test circuits

**Figure 11. Resistive load switching test circuit**



1. Fast electronic switch
2. Non-inductive resistor

**Figure 12. Inductive load switching test circuit**



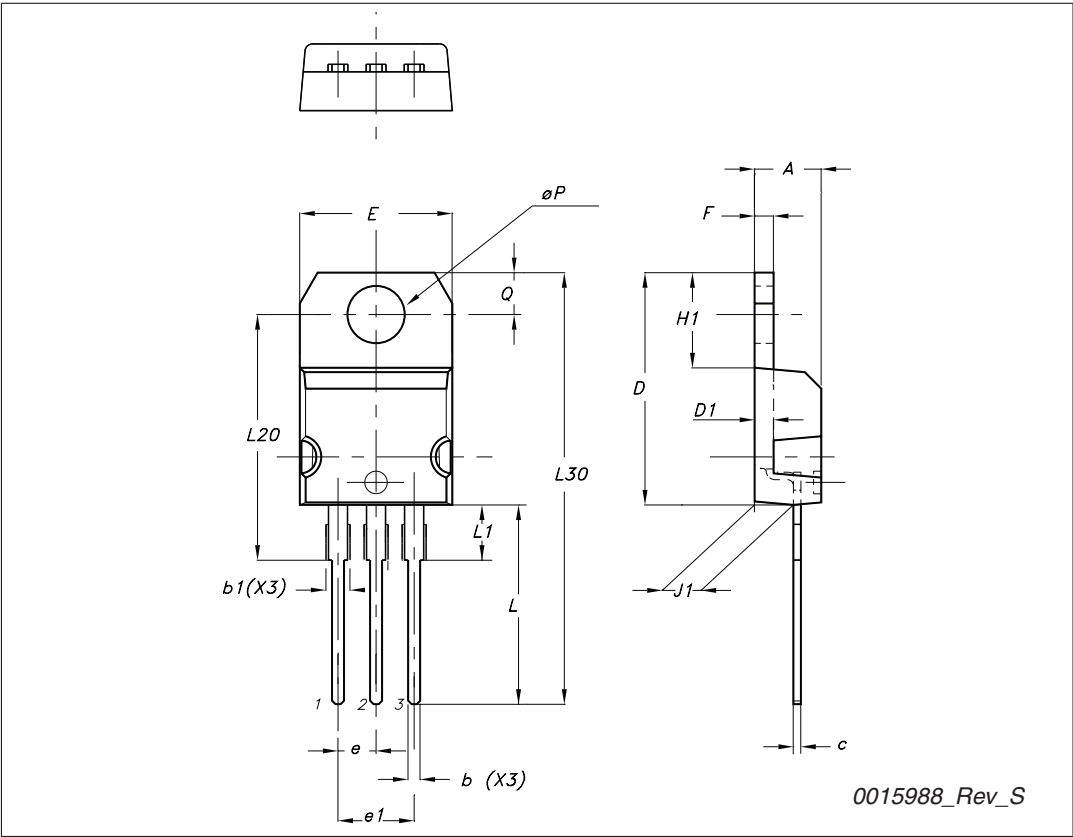
1. Fast electronic switch
2. Non-inductive resistor
3. Fast recovery rectifier

### 3      **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

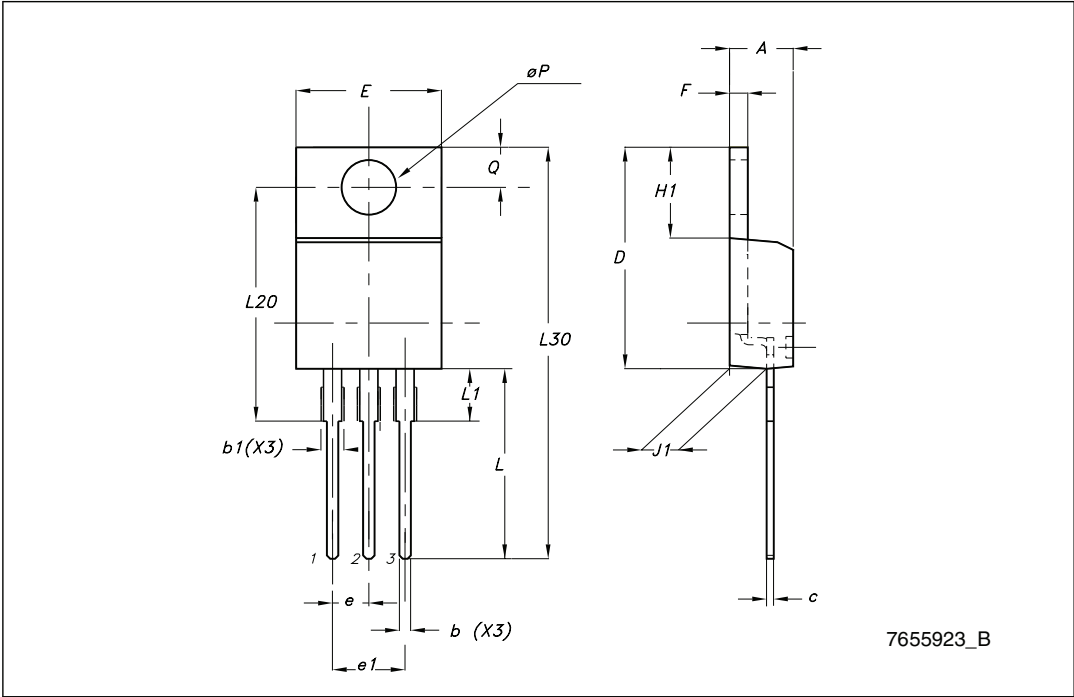
| Dim | mm    |       |       |
|-----|-------|-------|-------|
|     | Min   | Typ   | Max   |
| A   | 4.40  |       | 4.60  |
| b   | 0.61  |       | 0.88  |
| b1  | 1.14  |       | 1.70  |
| c   | 0.48  |       | 0.70  |
| D   | 15.25 |       | 15.75 |
| D1  |       | 1.27  |       |
| E   | 10    |       | 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 |       |
| ØP  | 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  |



## 4 Revision history

**Table 6. Document revision history**

| Date        | Revision | Changes                                 |
|-------------|----------|-----------------------------------------|
| 21-Jun-2004 | 3        | Document migration, no content change.  |
| 16-Dec-2009 | 4        | Updated TO-220 package mechanical data. |

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