



# TIP120, TIP121, TIP122 TIP125, TIP126, TIP127

## Complementary power Darlington transistors

### Features

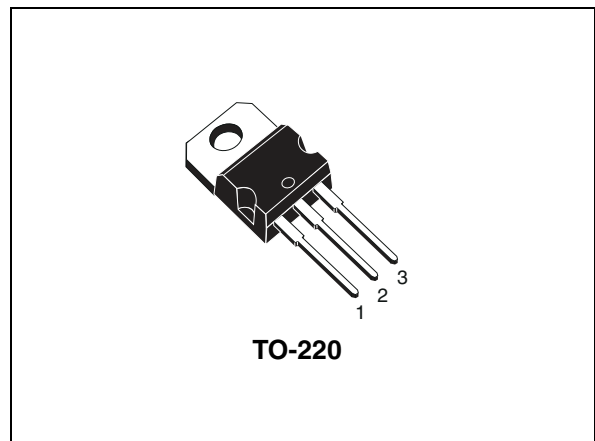
- Low collector-emitter saturation voltage
- Complementary NPN - PNP transistors

### Applications

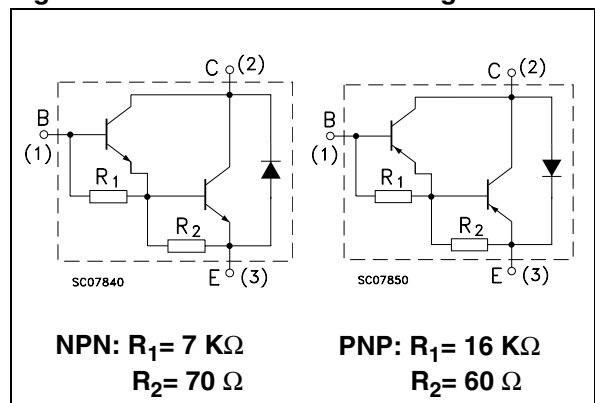
- General purpose linear and switching

### Description

The devices are manufactured in planar technology with “base island” layout and monolithic Darlington configuration. The resulting transistors show exceptional high gain performance coupled with very low saturation voltage.



**Figure 1. Internal schematic diagrams**



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|-------------|---------|---------|-----------|
| TIP120      | TIP120  | TO-220  | Tube      |
| TIP121      | TIP121  |         |           |
| TIP122      | TIP122  |         |           |
| TIP125      | TIP125  |         |           |
| TIP126      | TIP126  |         |           |
| TIP127      | TIP127  |         |           |

## Content

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# 1 Electrical ratings

**Table 2. Absolute maximum rating<sup>(1)</sup>**

| Symbol    | Parameter   | Value      |        |        |        | Unit |
|-----------|---|------------|--------|--------|--------|------|
|           |   | NPN        | TIP120 | TIP121 | TIP122 |      |
|           |   | PNP        | TIP125 | TIP126 | TIP127 |      |
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )  | 60         | 80     | 100    | V      |      |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )                                     | 60         | 80     | 100    | V      |      |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )  | 5          |        |        | V      |      |
| $I_C$     | Collector current   | 5          |        |        | A      |      |
| $I_{CM}$  | Collector peak current  | 8          |        |        | A      |      |
| $I_B$     | Base current  | 0.12       |        |        | A      |      |
| $P_{TOT}$ | Total dissipation at $T_C \leq 25\text{ °C}$<br>$T_{amb} \leq 25\text{ °C}$ | 65         |        |        | W      |      |
|           |   | 2          |        |        |        |      |
| $T_{stg}$ | Storage temperature   | -65 to 150 |        |        | °C     |      |
| $T_J$     | Max. operating junction temperature   | 150        |        |        |        |      |

1. For PNP types voltage and current values are negative.

**Table 3. Thermal data**

| Symbol         | Parameter                                | Value | Unit |
|----------------|--|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case max.    | 1.92  | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient max. | 62.5  |      |

## 2 Electrical characteristics

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

**Table 4. Electrical characteristics<sup>(1)</sup>**

| Symbol                      | Parameter   | Test conditions   | Min.            | Typ. | Max.              | Unit           |
|-----------------------------|---|---|-----------------|------|-------------------|----------------|
| $I_{\text{CEO}}$            | Collector cut-off current<br>( $I_{\text{B}} = 0$ )               | for TIP120/125 $V_{\text{CE}} = 30\text{ V}$<br>for TIP121/126 $V_{\text{CE}} = 40\text{ V}$<br>for TIP122/127 $V_{\text{CE}} = 50\text{ V}$  |                 |      | 0.5<br>0.5<br>0.5 | mA<br>mA<br>mA |
| $I_{\text{CBO}}$            | Collector cut-off current<br>( $I_{\text{B}} = 0$ )               | for TIP120/125 $V_{\text{CE}} = 60\text{ V}$<br>for TIP121/126 $V_{\text{CE}} = 80\text{ V}$<br>for TIP122/127 $V_{\text{CE}} = 100\text{ V}$ |                 |      | 0.2<br>0.2<br>0.2 | mA<br>mA<br>mA |
| $I_{\text{EBO}}$            | Emitter cut-off current<br>( $I_{\text{C}} = 0$ )                 | $V_{\text{EB}} = 5\text{ V}$  |                 |      | 2                 | mA             |
| $V_{\text{CEO(sus)}}^{(2)}$ | Collector-emitter<br>sustaining voltage<br>( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 30\text{ mA}$<br>for TIP120/125<br>for TIP121/126<br>for TIP122/127   | 60<br>80<br>100 |      |                   | V<br>V<br>V    |
| $V_{\text{CE(sat)}}^{(2)}$  | Collector-emitter<br>saturation voltage                           | $I_{\text{C}} = 3\text{ A}$ $I_{\text{B}} = 12\text{ mA}$<br>$I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 20\text{ mA}$                        |                 |      | 2<br>4            | V<br>V         |
| $V_{\text{BE(on)}}^{(2)}$   | Base-emitter on voltage   | $I_{\text{C}} = 3\text{ A}$ $V_{\text{CE}} = 3\text{ V}$  |                 |      | 2.5               | V              |
| $h_{\text{FE}}^{(2)}$       | DC current gain   | $I_{\text{C}} = 0.5\text{ A}$ $V_{\text{CE}} = 3\text{ V}$<br>$I_{\text{C}} = 3\text{ A}$ $V_{\text{CE}} = 3\text{ V}$                        | 1000<br>1000    |      |                   |                |

1. For PNP types voltage and current values are negative.

2. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

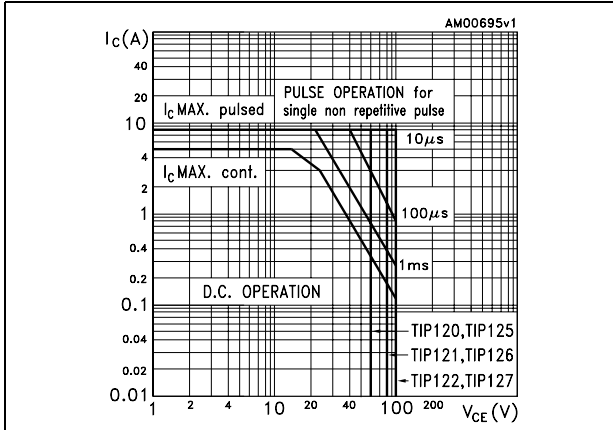


Figure 3. Derating curve

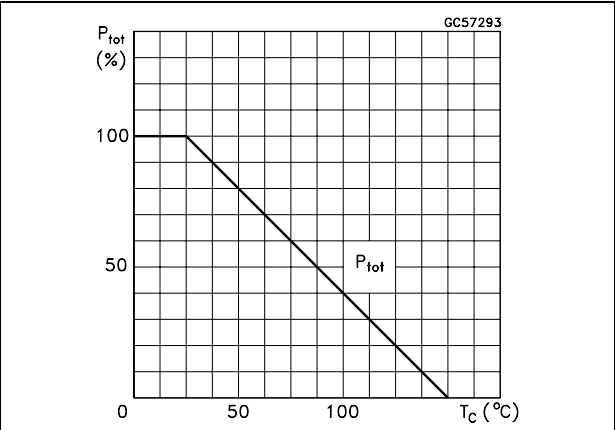


Figure 4. DC current gain for NPN type

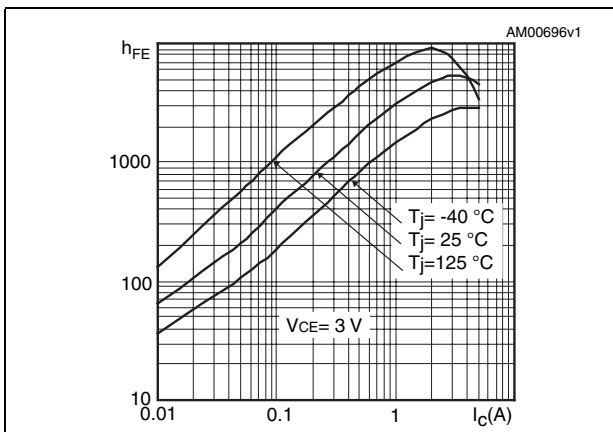


Figure 5. DC current gain for PNP type

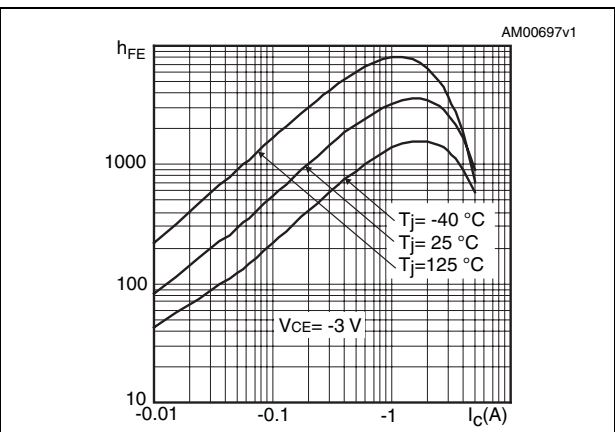


Figure 6. Collector-emitter saturation voltage for NPN type

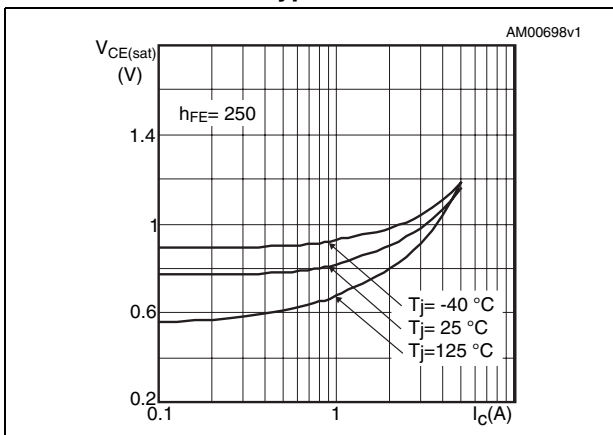


Figure 7. Collector-emitter saturation voltage for PNP type

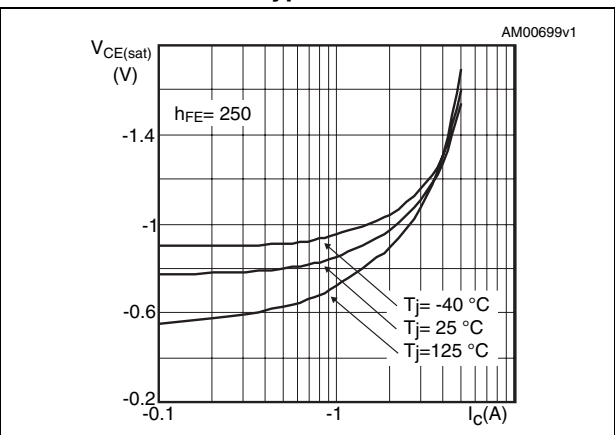


Figure 8. Base-emitter saturation voltage for NPN type

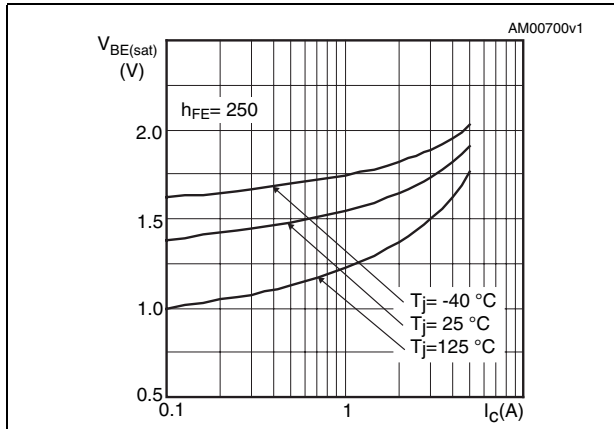


Figure 9. Base-emitter saturation voltage for PNP type

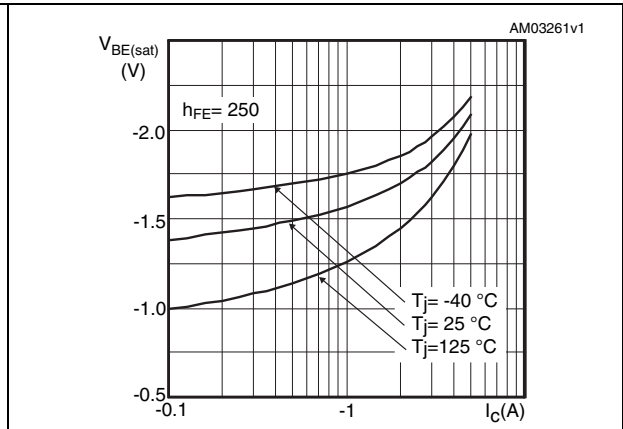


Figure 10. Base-emitter on voltage for NPN type

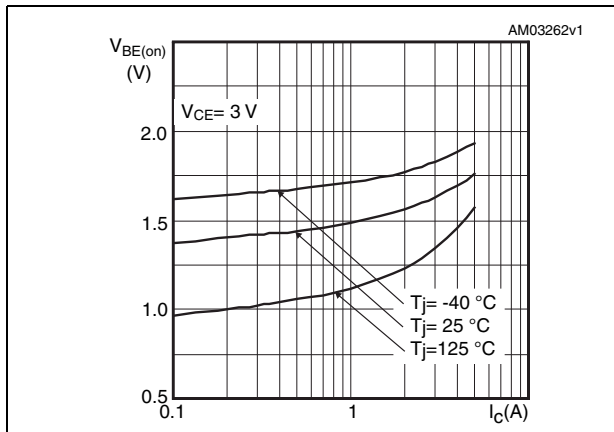


Figure 11. Base-emitter on voltage for PNP type

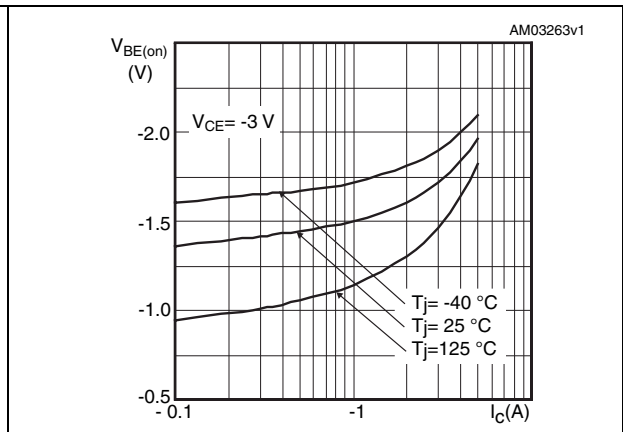


Figure 12. Switching time on resistive load for NPN type (on)

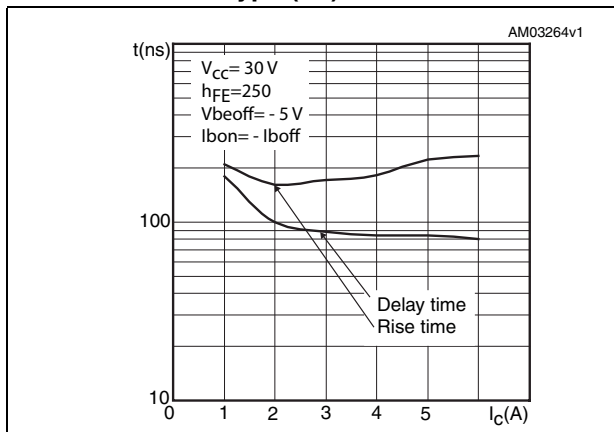


Figure 13. Switching time on resistive load for PNP type (on)

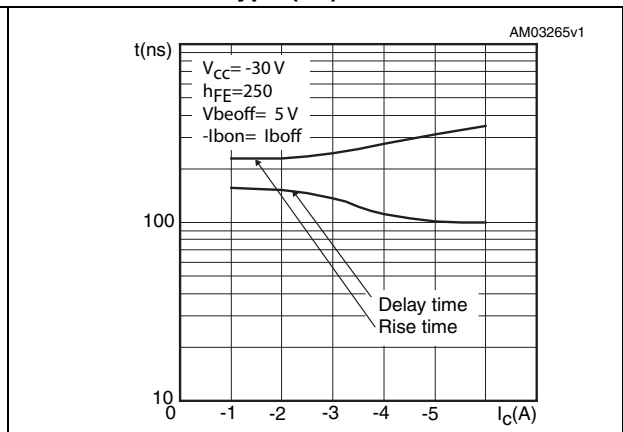


Figure 14. Switching time on resistive load for NPN type (off)

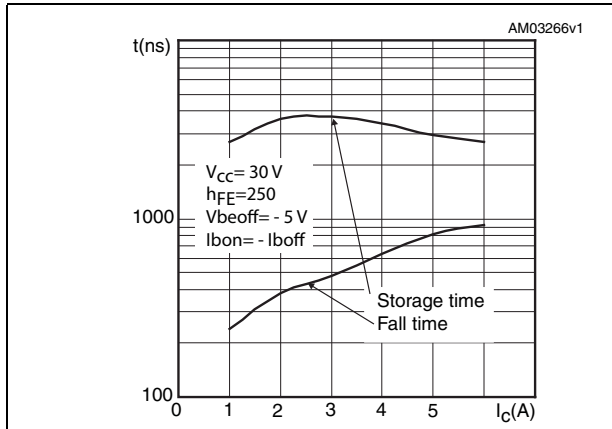


Figure 15. Switching time on resistive load for PNP type (off)

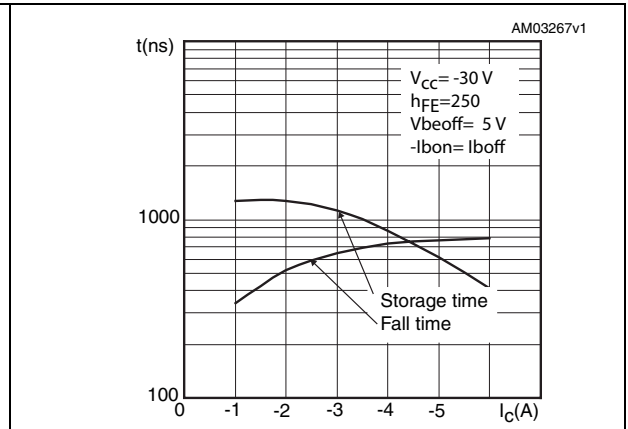


Figure 16. Capacitances for NPN type

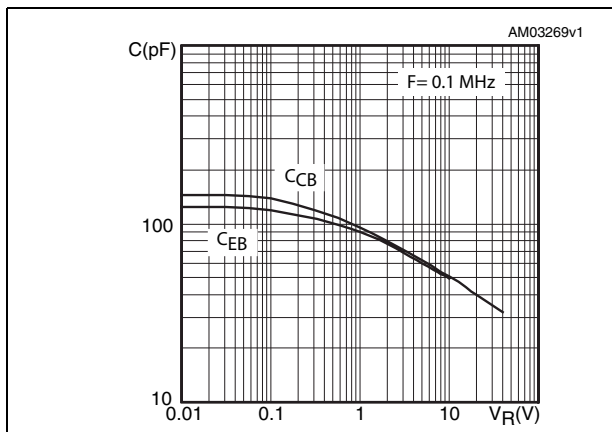
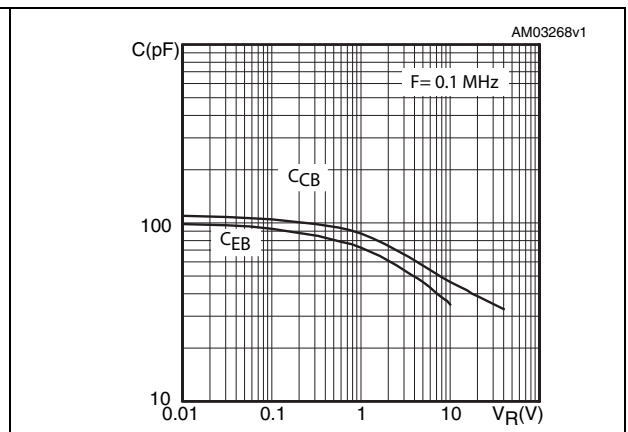


Figure 17. Capacitances for PNP type



### 3 Test circuits

Figure 18. Resistive load switching for NPN type

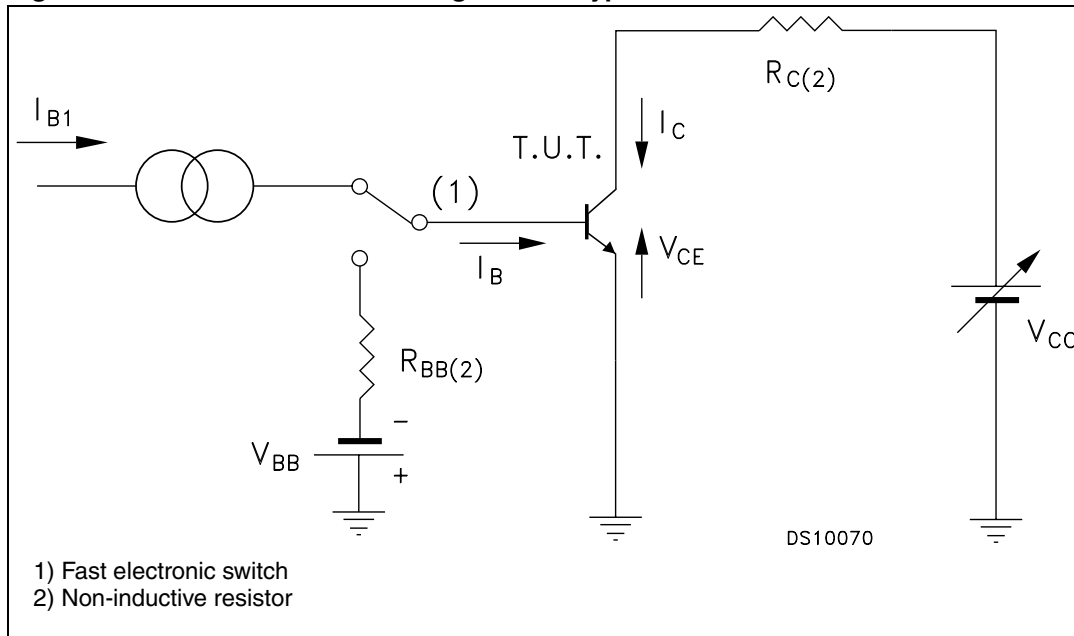
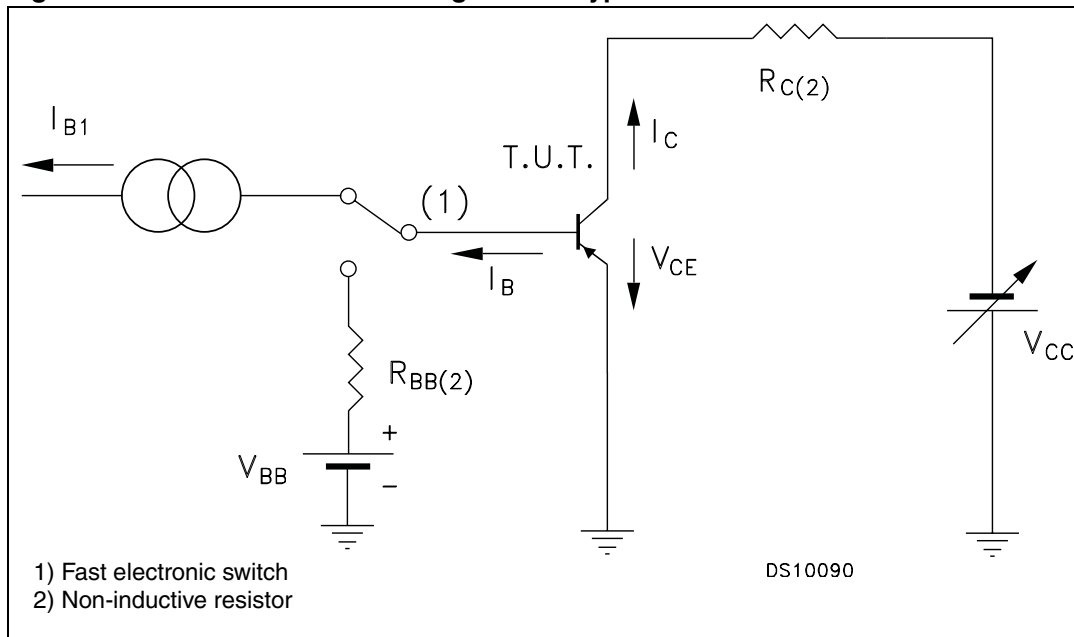


Figure 19. Resistive load switching for PNP type



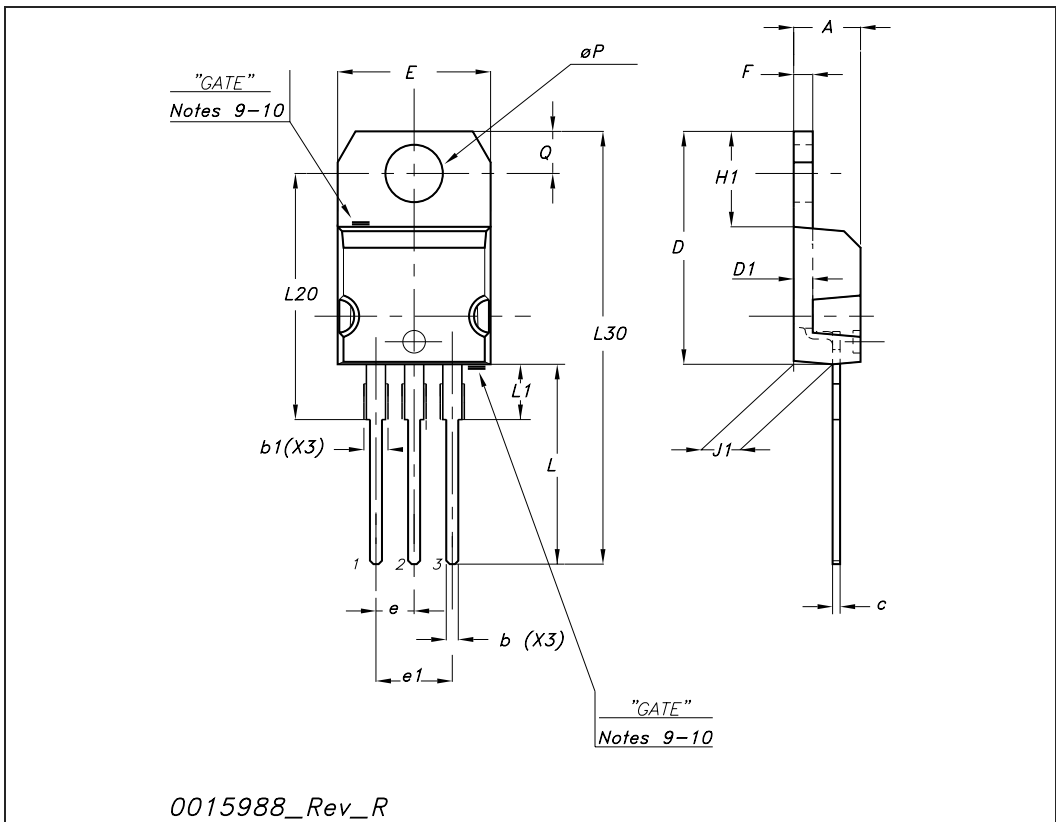


## 4 Package mechanical data

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](http://www.st.com)

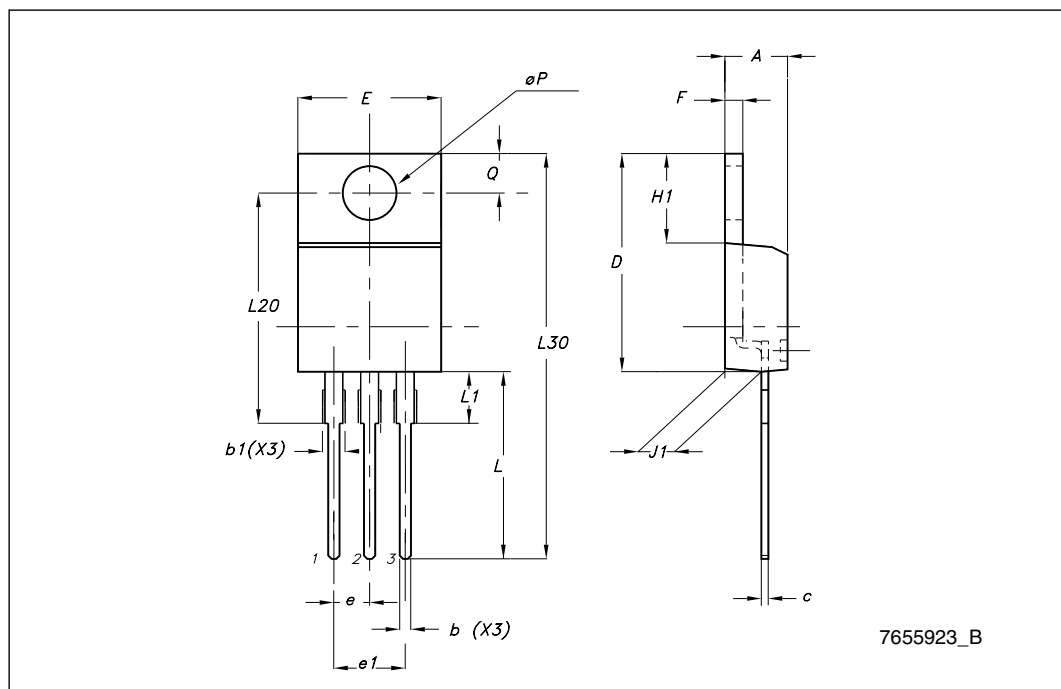
TO-220 mechanical data

| 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-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  |



## 5 Revision history

**Table 5. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 21-Jun-2004 | 3        |   |
| 25-Nov-2008 | 4        | Inserted new <a href="#">Section 2.1: Electrical characteristics (curves)</a> |

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