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# TIP120, TIP121, TIP122 TIP125, TIP126, TIP127

## Complementary power Darlington transistors

### Features

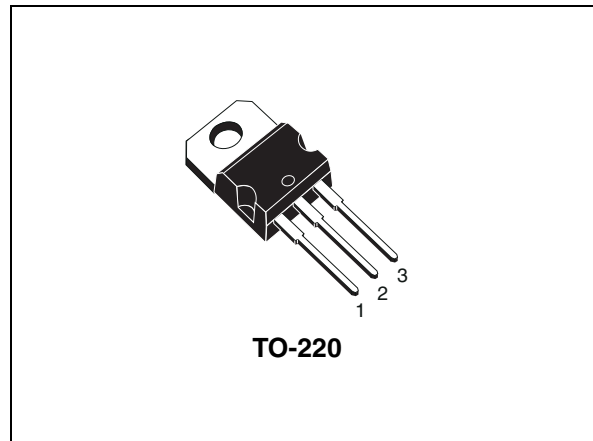
- Low collector-emitter saturation voltage
- Complementary NPN - PNP transistors

### Applications

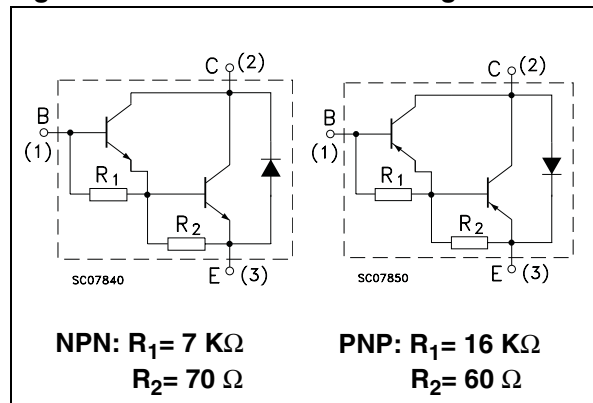
- General purpose linear and switching

### 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

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	5
<b>3</b>	<b>Test circuits</b> .....	<b>7</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>8</b>
<b>5</b>	<b>Revision history</b> .....	<b>11</b>

# 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 $T_C \leq 25\text{ °C}$ $T_{amb} \leq 25\text{ °C}$	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 ( $I_{\text{B}} = 0$ )	for TIP120/125 $V_{\text{CE}} = 30\text{ V}$ for TIP121/126 $V_{\text{CE}} = 40\text{ V}$ for TIP122/127 $V_{\text{CE}} = 50\text{ V}$			0.5 0.5 0.5	mA mA mA
$I_{\text{CBO}}$	Collector cut-off current ( $I_{\text{B}} = 0$ )	for TIP120/125 $V_{\text{CE}} = 60\text{ V}$ for TIP121/126 $V_{\text{CE}} = 80\text{ V}$ for TIP122/127 $V_{\text{CE}} = 100\text{ V}$			0.2 0.2 0.2	mA mA mA
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 5\text{ V}$			2	mA
$V_{\text{CEO(sus)}}^{(2)}$	Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 30\text{ mA}$ for TIP120/125 for TIP121/126 for TIP122/127	60 80 100			V V V
$V_{\text{CE(sat)}}^{(2)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 3\text{ A}$ $I_{\text{B}} = 12\text{ mA}$ $I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 20\text{ mA}$			2 4	V 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	$I_{\text{C}} = 0.5\text{ A}$ $V_{\text{CE}} = 3\text{ V}$ $I_{\text{C}} = 3\text{ A}$ $V_{\text{CE}} = 3\text{ V}$	1000 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

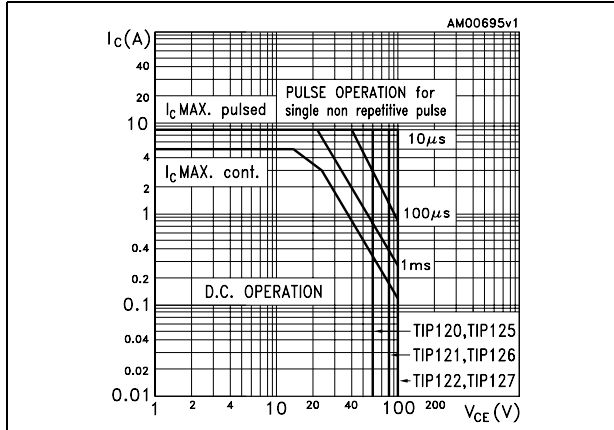


Figure 3. Derating curve

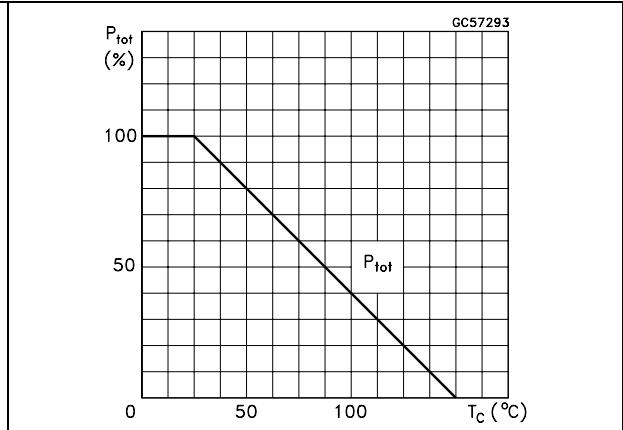


Figure 4. DC current gain for NPN type

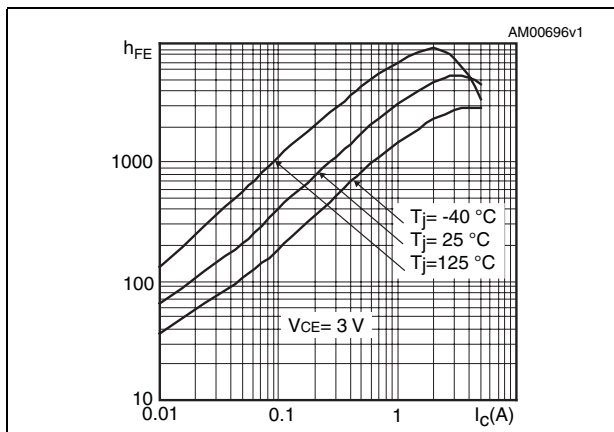


Figure 5. DC current gain for PNP type

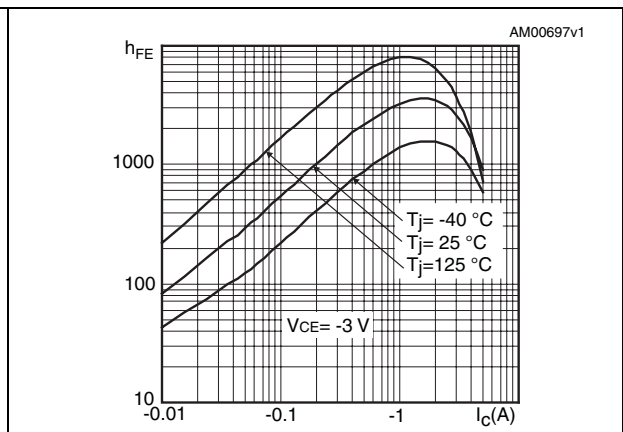


Figure 6. Collector-emitter saturation voltage for NPN type

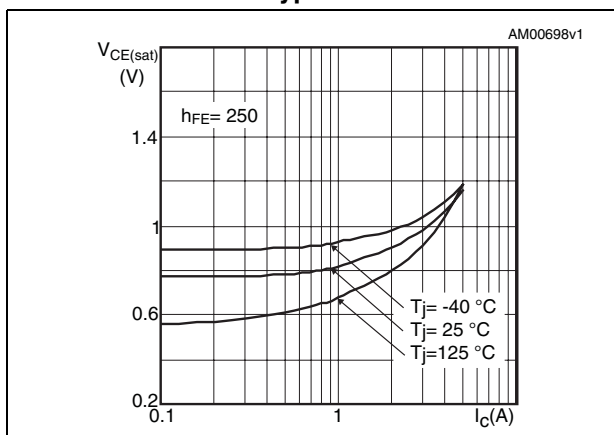


Figure 7. Collector-emitter saturation voltage for PNP type

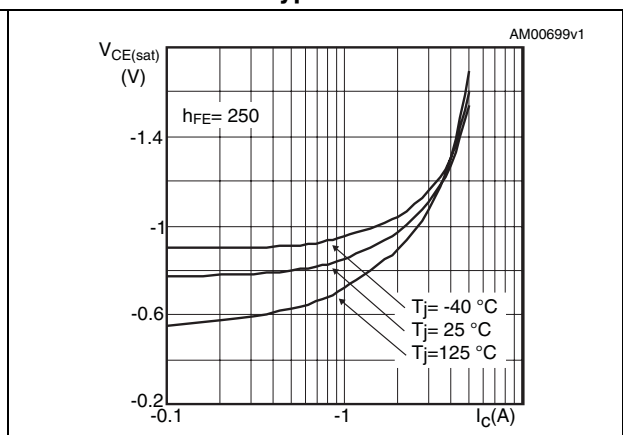


Figure 8. Base-emitter saturation voltage for NPN type

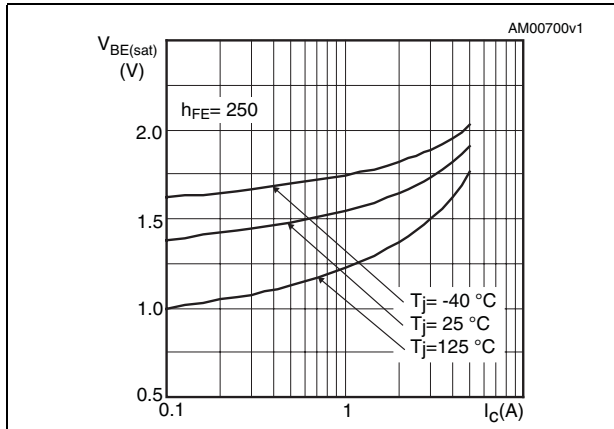


Figure 9. Base-emitter saturation voltage for PNP type

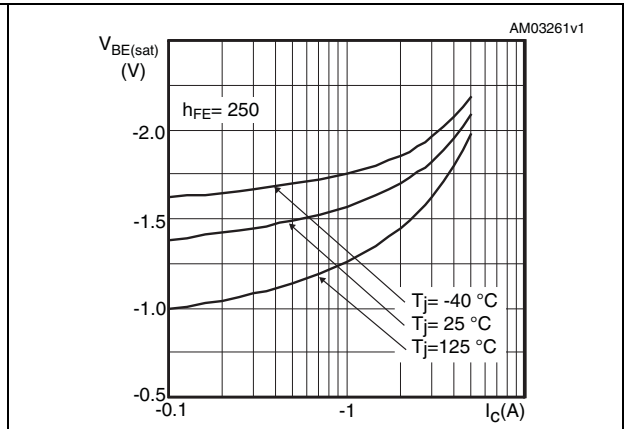


Figure 10. Base-emitter on voltage for NPN type

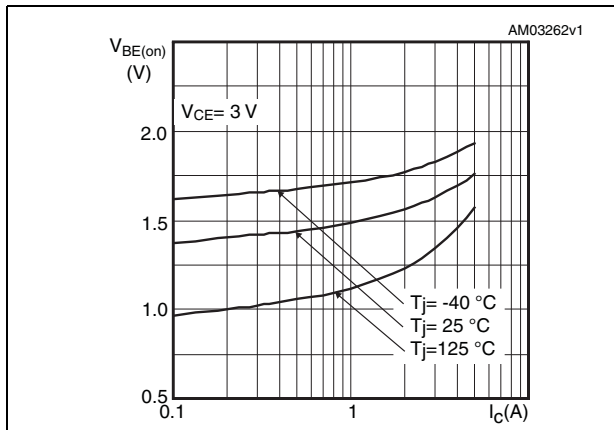


Figure 11. Base-emitter on voltage for PNP type

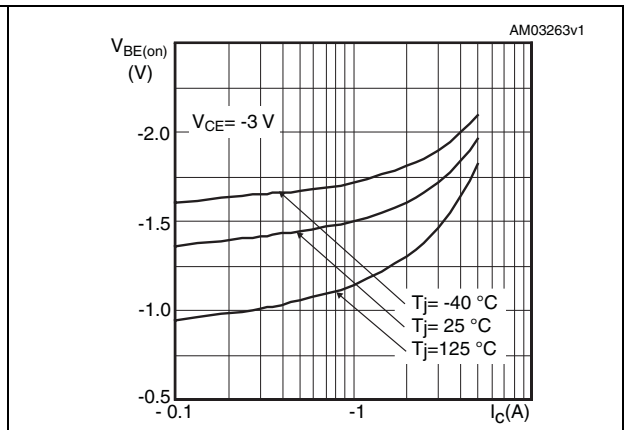


Figure 12. Switching time on resistive load for NPN type (on)

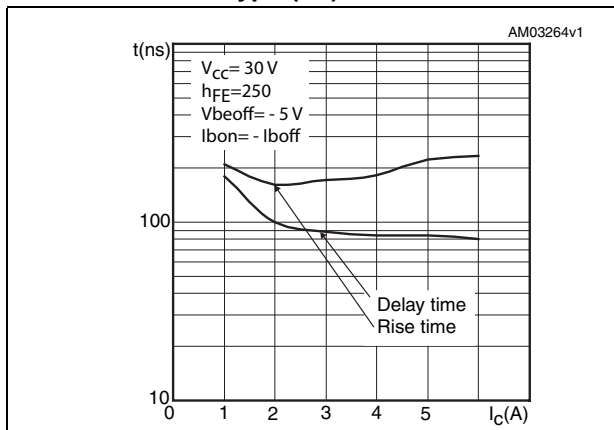


Figure 13. Switching time on resistive load for PNP type (on)

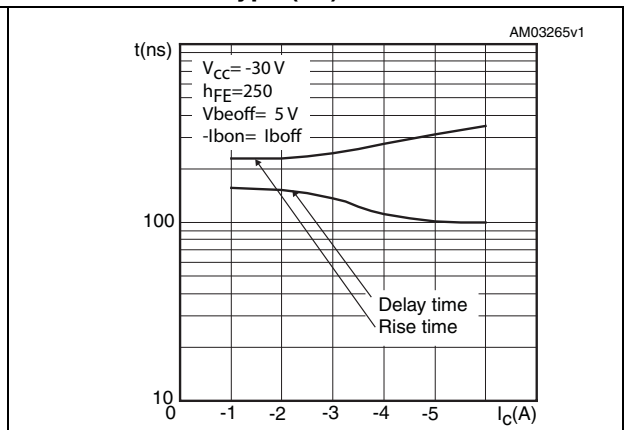


Figure 14. Switching time on resistive load for NPN type (off)

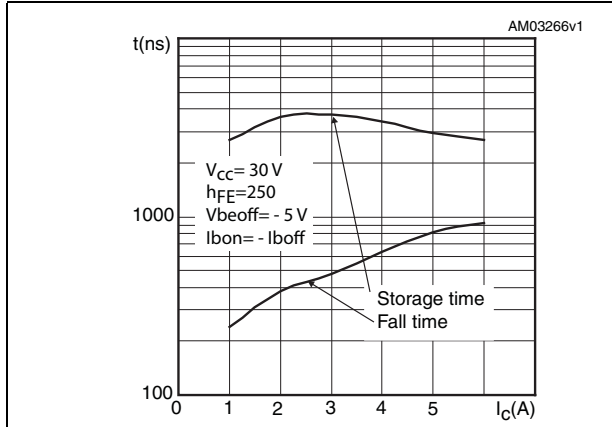


Figure 15. Switching time on resistive load for PNP type (off)

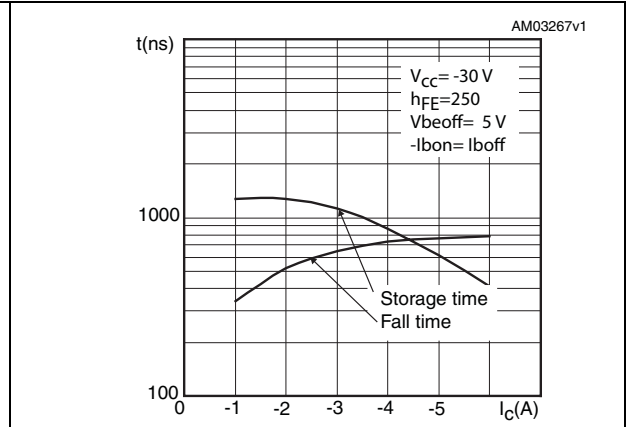


Figure 16. Capacitances for NPN type

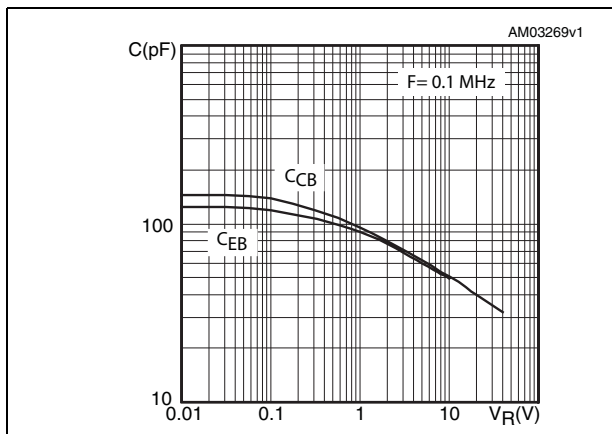
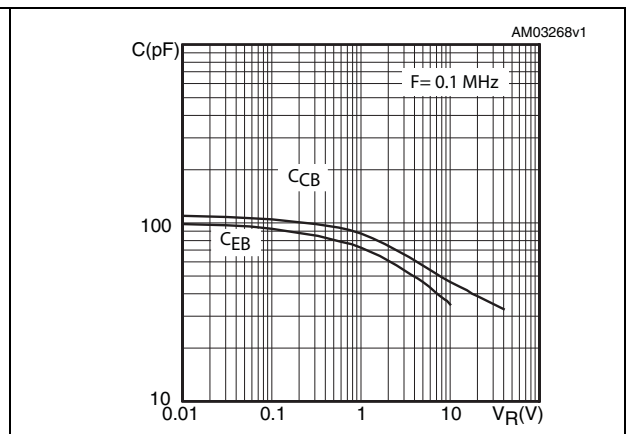


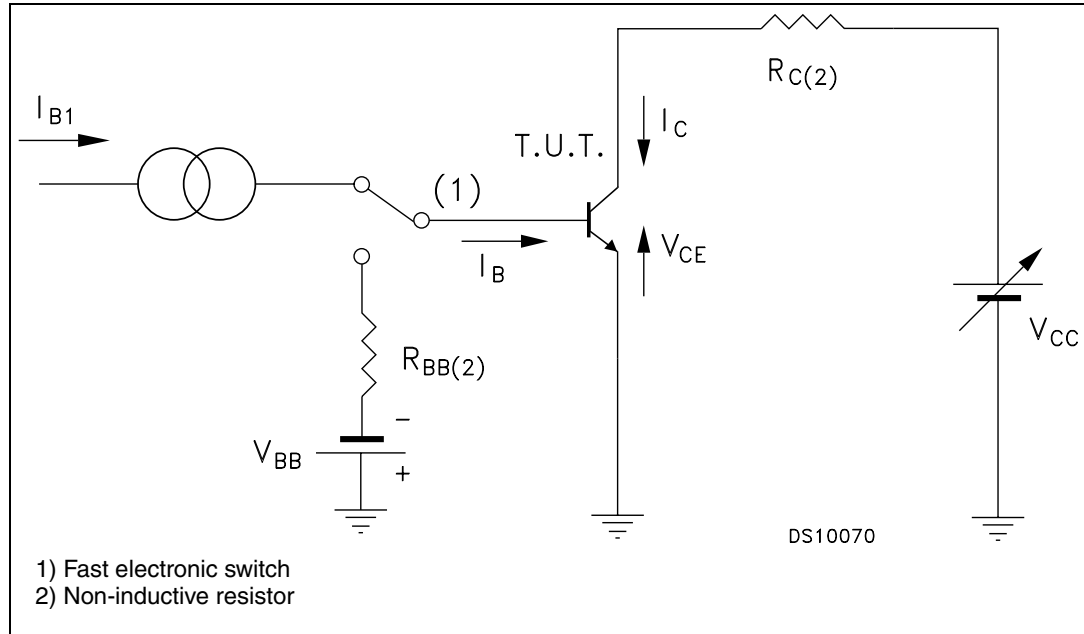
Figure 17. Capacitances for PNP type



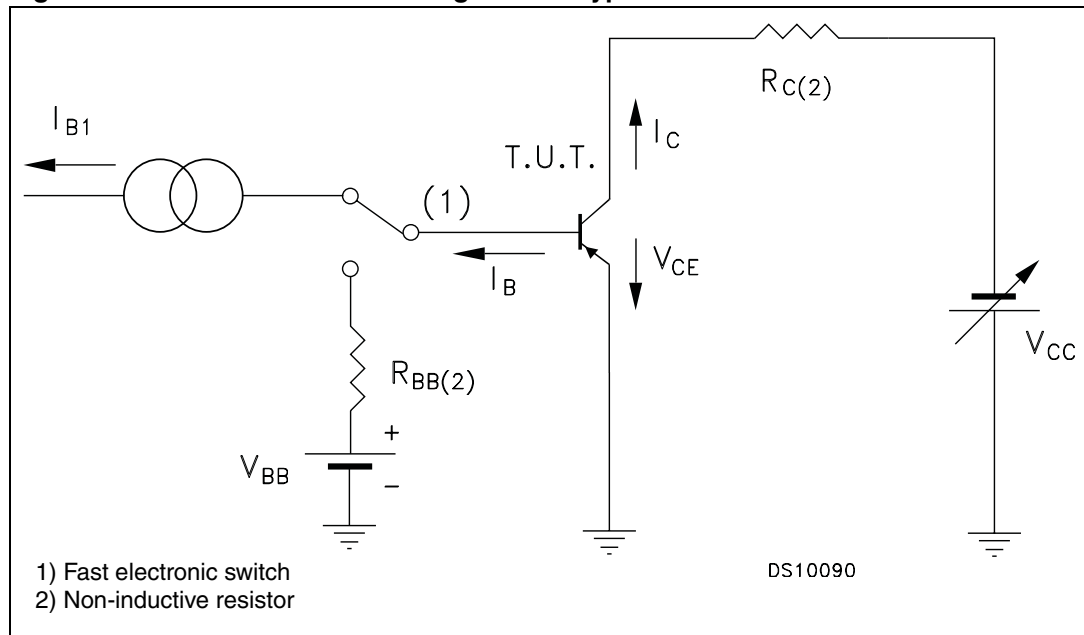


### 3 Test circuits

**Figure 18. Resistive load switching for NPN type**



**Figure 19. Resistive load switching for PNP type**

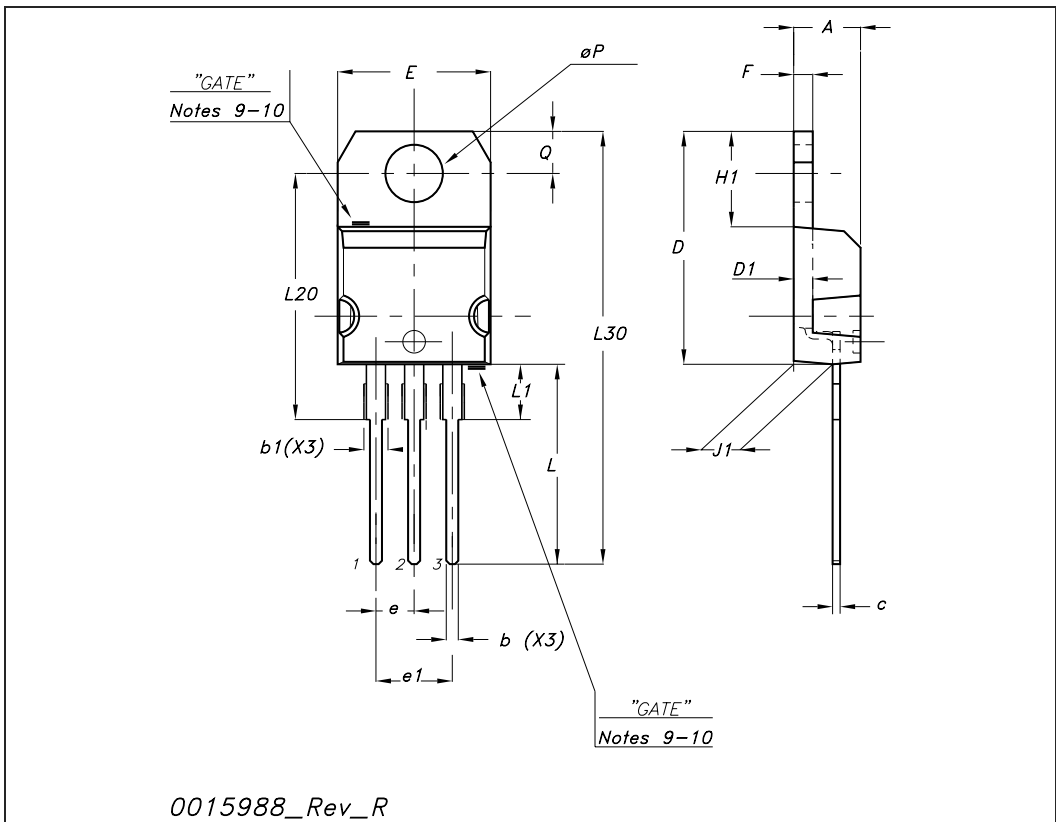


## 4 Package mechanical data

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)

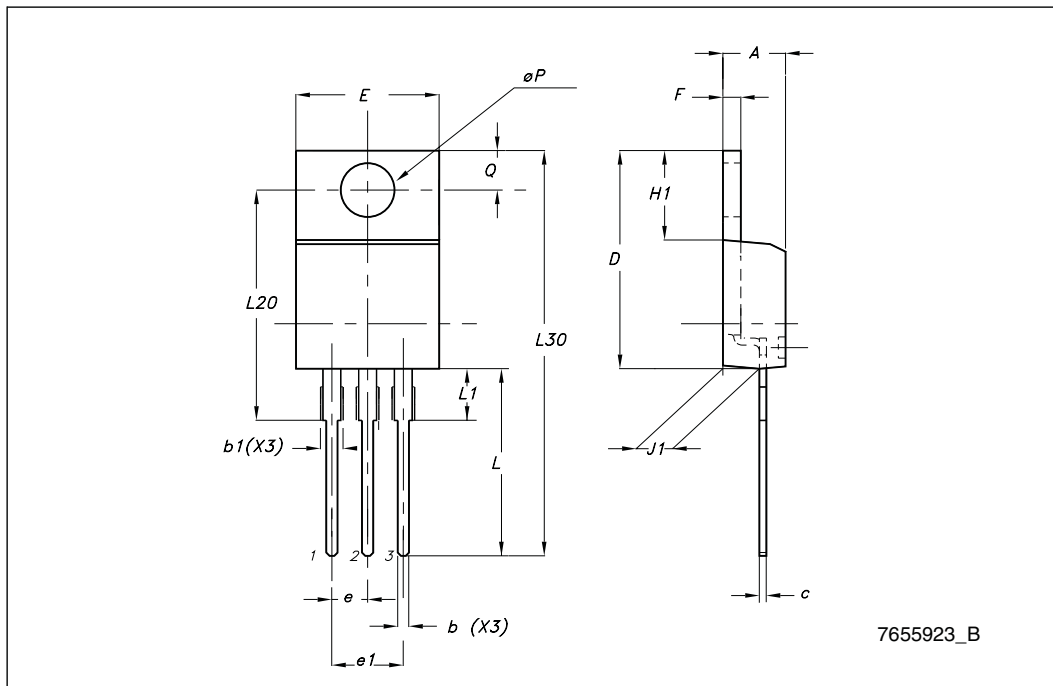
TO-220 mechanical data

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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