

## 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.

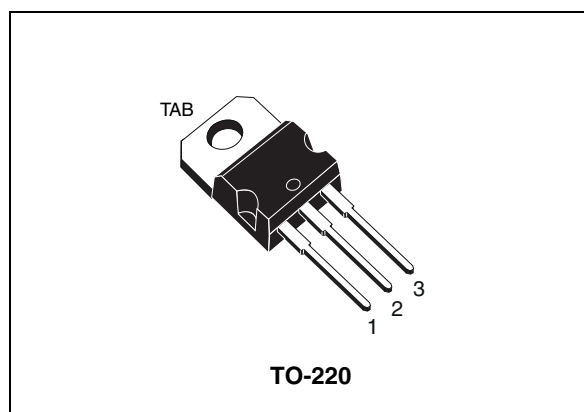


Figure 1. Internal schematic diagram

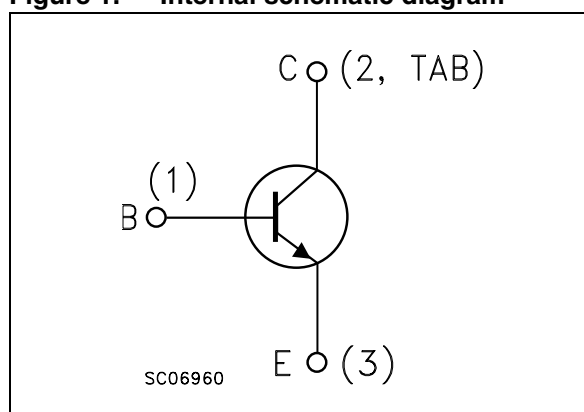


Table 1. Device summary

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 ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 700\text{ V}$			10	$\mu\text{A}$
		$V_{\text{CE}} = 700\text{ V}$ $T_{\text{C}} = 125\text{ °C}$			0.5	mA
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 9\text{ V}$			100	$\mu\text{A}$
$V_{\text{CEO(sus)}}^{(1)}$	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	$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$			1	V
		$I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 1\text{ A}$			2	V
		$I_{\text{C}} = 8\text{ A}$ $I_{\text{B}} = 2\text{ A}$			3	V
		$I_{\text{C}} = 5\text{ A}, I_{\text{B}} = 1\text{ A}, T_{\text{C}} = 100\text{ °C}$			3	V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 2\text{ A}$ $I_{\text{B}} = 0.4\text{ A}$			1.2	V
		$I_{\text{C}} = 5\text{ A}$ $I_{\text{B}} = 1\text{ A}$			1.6	V
		$I_{\text{C}} = 5\text{ A}, I_{\text{B}} = 1\text{ A}, T_{\text{C}} = 100\text{ °C}$			1.5	V
$h_{\text{FE}}$	DC current gain	$I_{\text{C}} = 2\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	16		40	
		$I_{\text{C}} = 5\text{ A}$ $V_{\text{CE}} = 5\text{ V}$	5		30	
$t_{\text{s}}$ $t_{\text{f}}$	Resistive load Storage time	$V_{\text{CC}} = 300\text{ V}$ $I_{\text{C}} = 2\text{ A}$ $I_{\text{B(on)}} = - I_{\text{B(off)}} = 400\text{ mA}$	3		4.5	$\mu\text{s}$
	Fall time	$T_{\text{P}} = 30\text{ }\mu\text{s}$			350	ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time	$I_{\text{C}} = 5\text{ A}$ $V_{\text{Clamp}} = 250\text{ V}$ $I_{\text{B(on)}} = 1\text{ A}$ $I_{\text{B(off)}} = - 2\text{ A}$		1.5	2.5	$\mu\text{s}$
	Fall time	$L = 200\text{ }\mu\text{H}$		40	110	ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time	$I_{\text{C}} = 5\text{ A}$ $V_{\text{Clamp}} = 250\text{ V}$ $I_{\text{B(on)}} = 1\text{ A}$ $I_{\text{B(off)}} = - 2\text{ A}$		2		$\mu\text{s}$
	Fall time	$L = 200\text{ }\mu\text{H}$ $T_{\text{C}} = 125\text{ °C}$		70		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 $I_{\text{C}} = 2\text{ A}, V_{\text{CE}} = 5\text{ V}$	A	16	30	
		B	26	40	

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

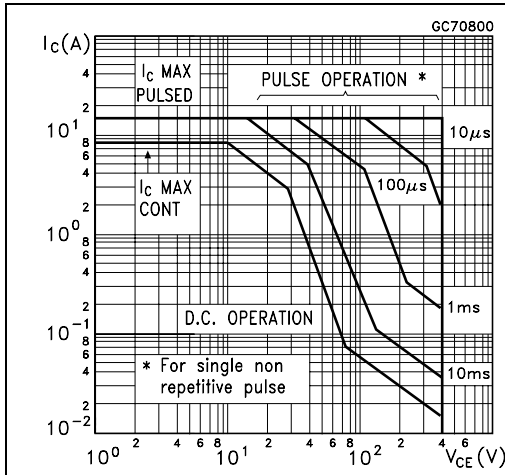


Figure 3. Derating curve

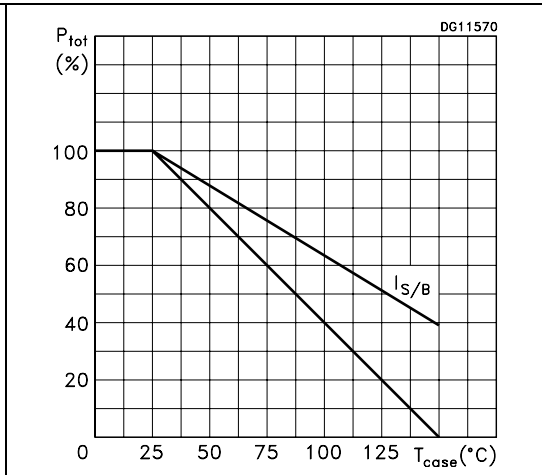


Figure 4. DC current gain ( $V_{CE} = 2V$ )

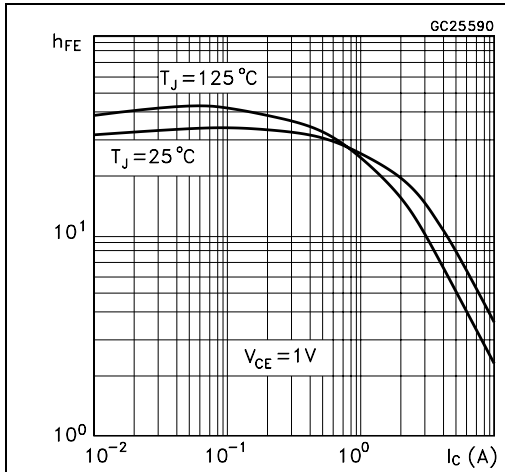


Figure 5. DC current gain ( $V_{CE} = 5V$ )

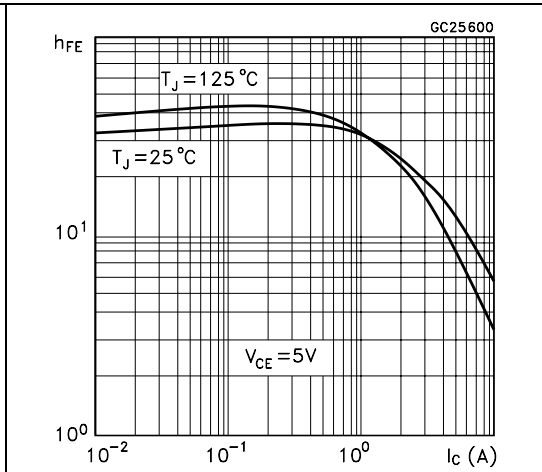


Figure 6. Collector-emitter saturation voltage

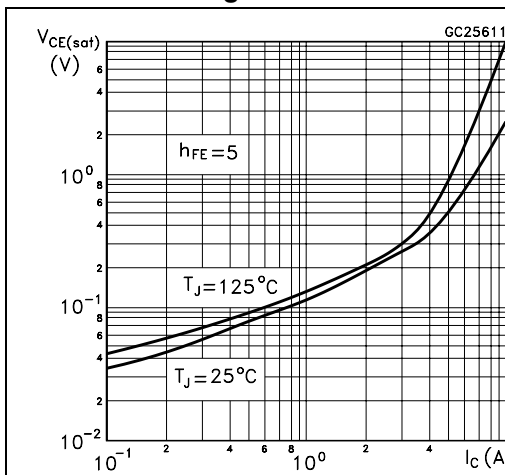
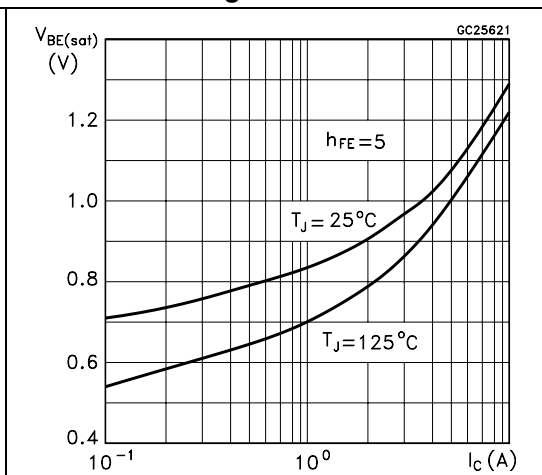
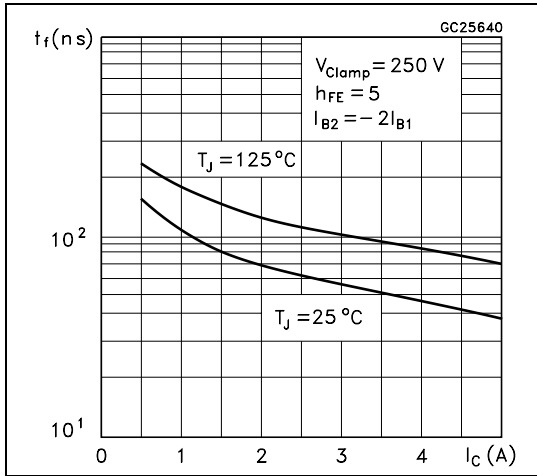


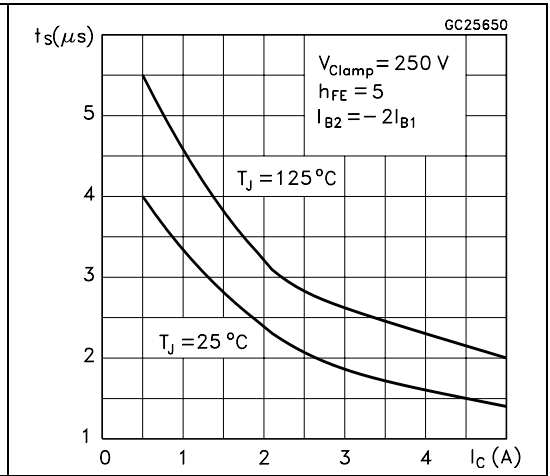
Figure 7. Base-emitter saturation voltage



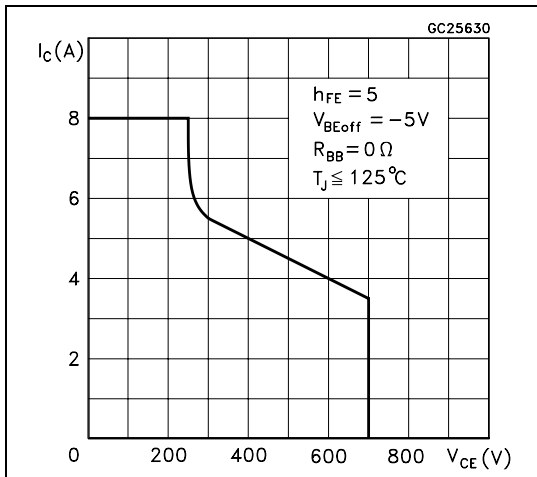
**Figure 8. Inductive fall time**



**Figure 9. Inductive storage time**

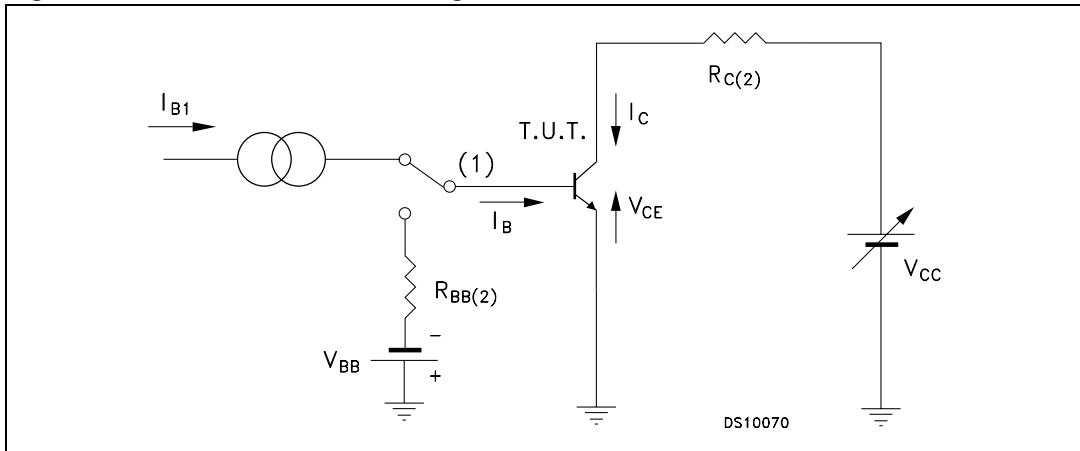


**Figure 10. Reverse biased SOA**



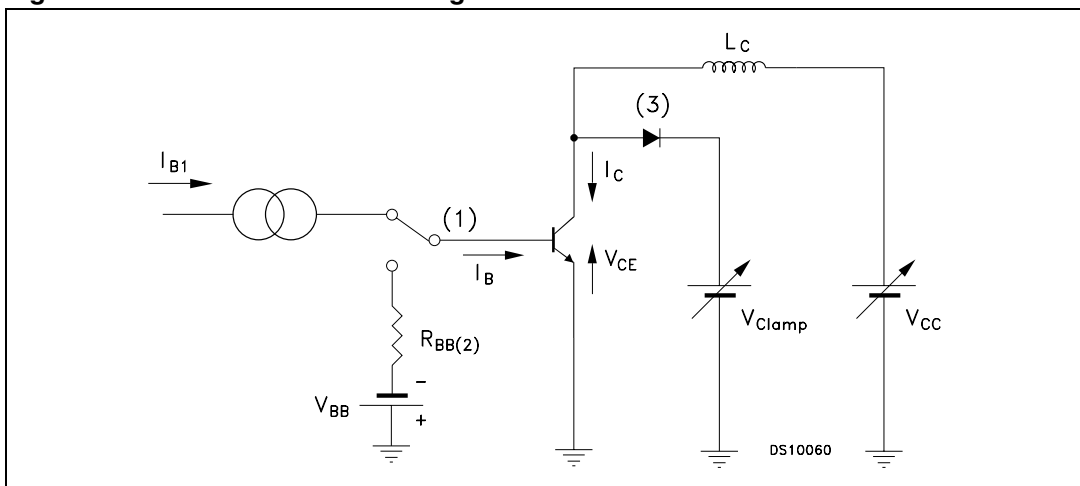
## 2.2 Test circuits

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



1. Fast electronic switch
2. Non-inductive resistor

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



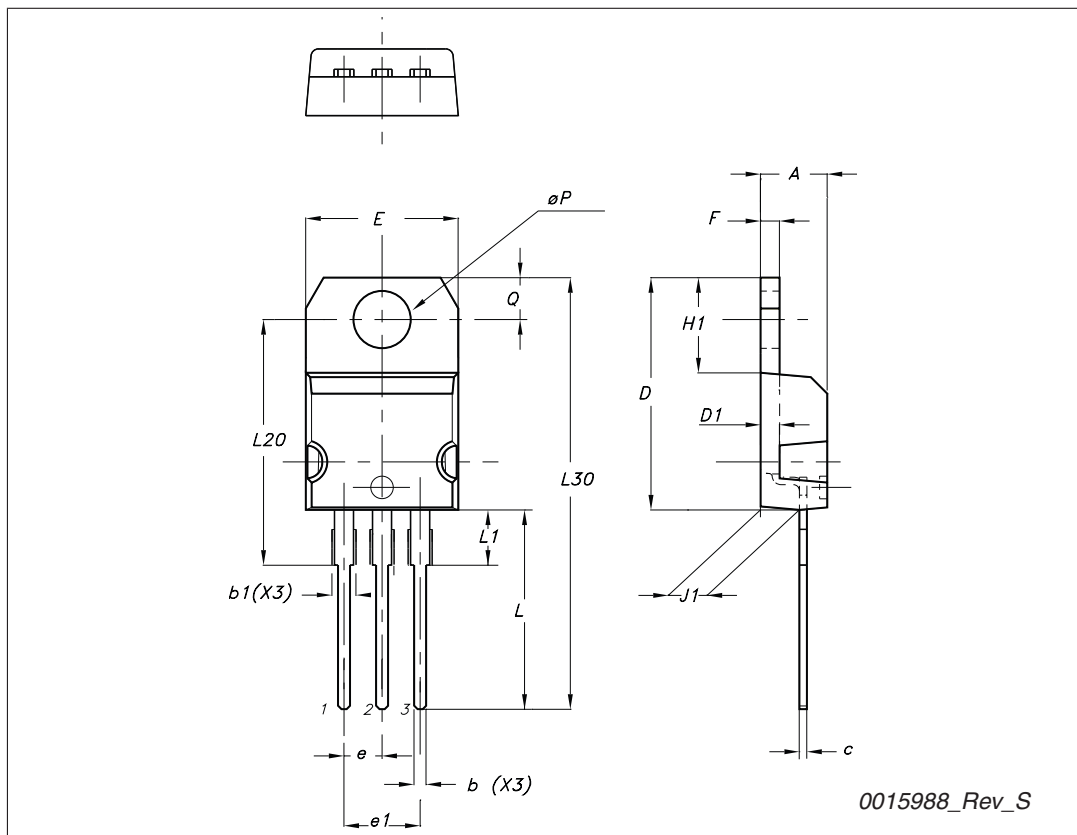
1. Fast electronic switch
2. Non-inductive resistor
3. Fast recovery rectifier

### 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**

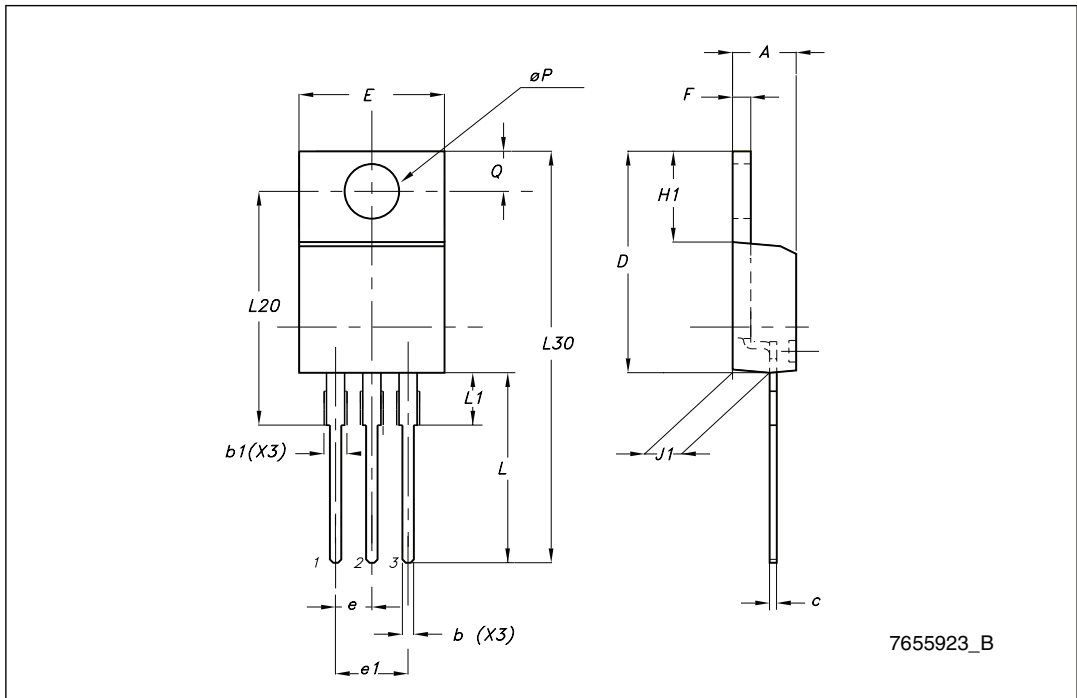
Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95





**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



## 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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