



# ST13009

## High voltage fast-switching NPN power transistor

### Features

- Low spread of dynamic parameters
- High voltage capability
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed

### Applications

- 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 hollow emitter structure to enhance switching speeds.

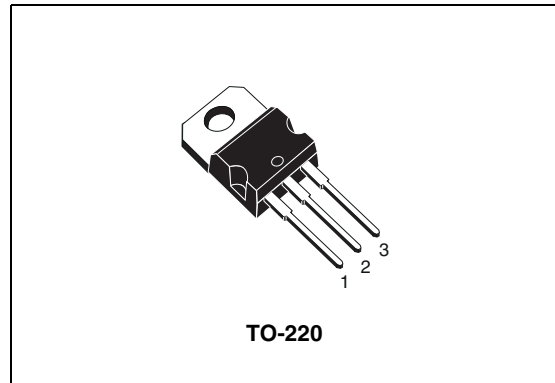


Figure 1. Internal schematic diagram

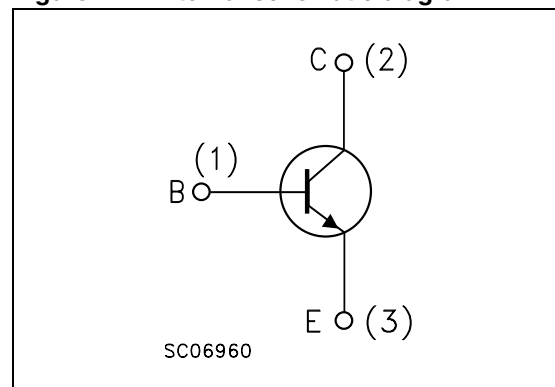


Table 1. Device summary

Order code	Marking <sup>(1)</sup>	Package	Packaging
ST13009	13009 L 13009 H	TO-220	Tube

1. Product is pre-selected in DC current gain (group L and group H). STMicroelectronics reserves the right to ship either groups according to production availability. Please contact your nearest STMicroelectronics sales office for delivery details.

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CEV}$	Collector-emitter voltage ( $V_{BE} = -1.5$ V)	700	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	400	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )	12	V
$I_C$	Collector current	12	A
$I_{CM}$	Collector peak current ( $t_p < 5$ ms)	24	A
$I_B$	Base current	6	A
$I_{BM}$	Base peak current ( $t_p < 5$ ms)	12	A
$P_{tot}$	Total dissipation at $T_c = 25^\circ\text{C}$	100	W
$T_{stg}$	Storage temperature	-65 to 150	$^\circ\text{C}$
$T_J$	Max. operating junction temperature	150	$^\circ\text{C}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	Max 1.25	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

( $T_{\text{case}} = 25^{\circ}\text{C}$  unless otherwise specified)

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{\text{CEV}}$	Collector cut-off current ( $V_{\text{BE}} = -1.5 \text{ V}$ )	$V_{\text{CE}} = 700 \text{ V}$ $V_{\text{CE}} = 700 \text{ V}$ $T_{\text{C}} = 100^{\circ}\text{C}$			10 500	$\mu\text{A}$ $\mu\text{A}$
$I_{\text{EBO}}$	Emitter cut-off current ( $I_{\text{C}} = 0$ )	$V_{\text{EB}} = 10 \text{ V}$			10	$\mu\text{A}$
$V_{\text{CEO(sus)}}^{(1)}$	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	$I_{\text{C}} = 4 \text{ A}$ $I_{\text{B}} = 0.8 \text{ A}$ $I_{\text{C}} = 5 \text{ A}$ $I_{\text{B}} = 1 \text{ A}$ $I_{\text{C}} = 8 \text{ A}$ $I_{\text{B}} = 1.6 \text{ A}$ $I_{\text{C}} = 12 \text{ A}$ $I_{\text{B}} = 3 \text{ A}$			0.85 0.9 1.25 2.5	V V V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 5 \text{ A}$ $I_{\text{B}} = 1 \text{ A}$ $I_{\text{C}} = 8 \text{ A}$ $I_{\text{B}} = 1.6 \text{ A}$			1.2 1.6	V V
$h_{\text{FE}}^{(1)(2)}$	DC current gain	$I_{\text{C}} = 5 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$ Group L Group H $I_{\text{C}} = 8 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$	15 26 10		31 39 30	
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$I_{\text{C}} = 5 \text{ A}$ $V_{\text{CC}} = 250 \text{ V}$ $I_{\text{B1}} = 1 \text{ A}$ $I_{\text{B2}} = -2 \text{ A}$ $L = 200 \mu\text{H}$ see <a href="#">Figure 9</a>		1.6 60	2.5 110	$\mu\text{s}$ ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$I_{\text{C}} = 5 \text{ A}$ $V_{\text{CC}} = 125 \text{ V}$ $I_{\text{B1}} = - I_{\text{B2}} = 1.6 \text{ A}$ $L = 200 \mu\text{H}$ $t_{\text{c}} = 125^{\circ}\text{C}$ see <a href="#">Figure 9</a>		2.3 110		$\mu\text{s}$ ns

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$
2. Product is pre-selected in DC current gain (group L and group H). STMicroelectronics reserves the right to ship either groups according to production availability. Please contact your nearest STMicroelectronics sales office for delivery details.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

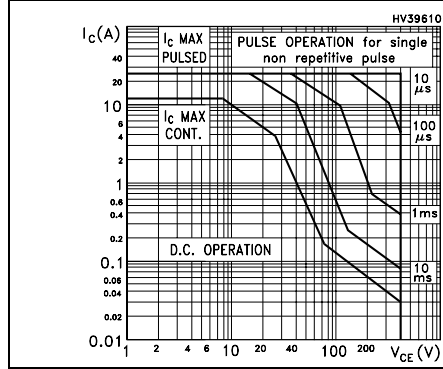


Figure 3. Derating curve

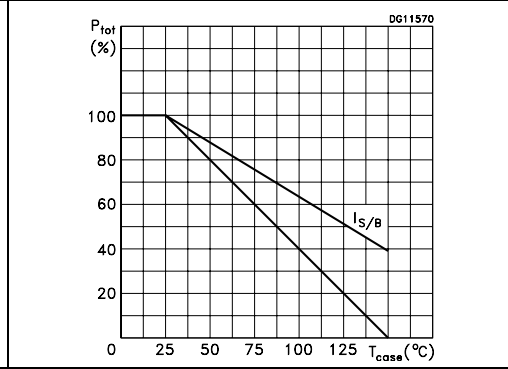


Figure 4. DC current gain

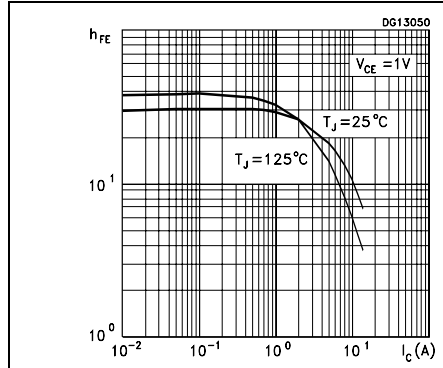


Figure 5. DC current gain

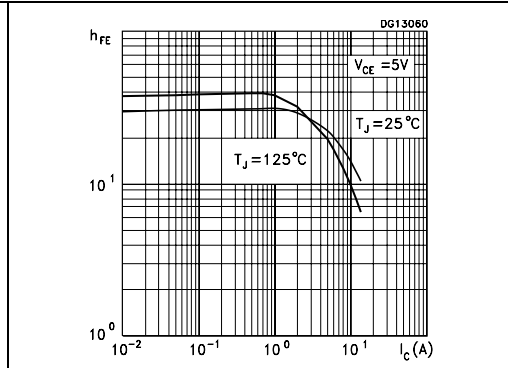


Figure 6. Collector-emitter saturation voltage

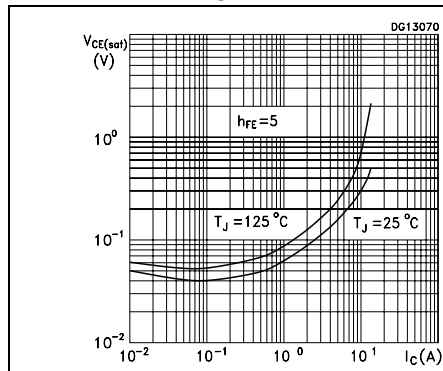


Figure 7. Base-emitter saturation voltage

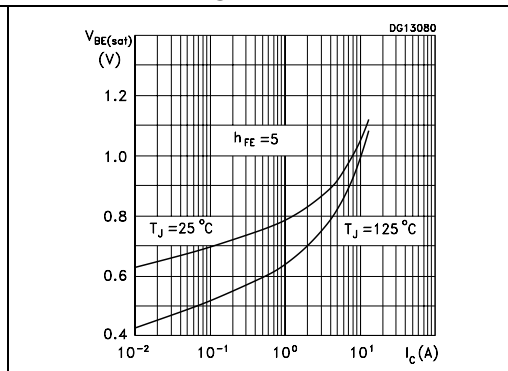
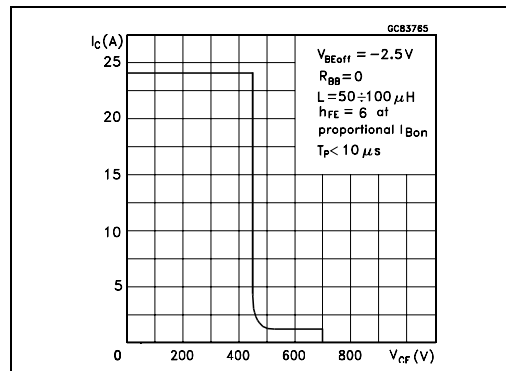
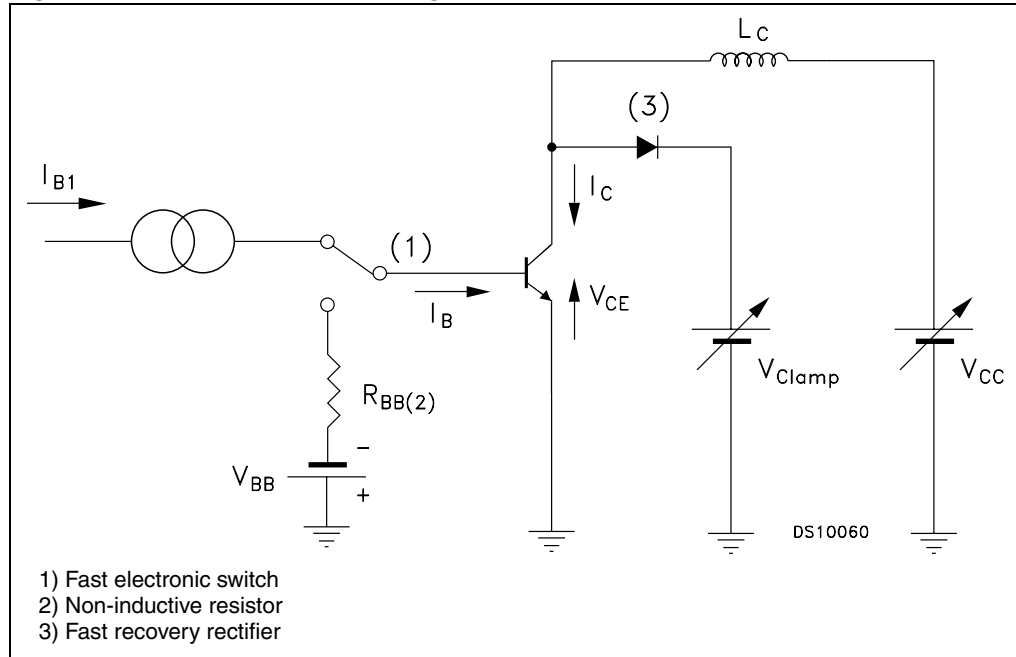


Figure 8. Reverse biased operating area



### 3 Test circuit

Figure 9. Inductive load switching



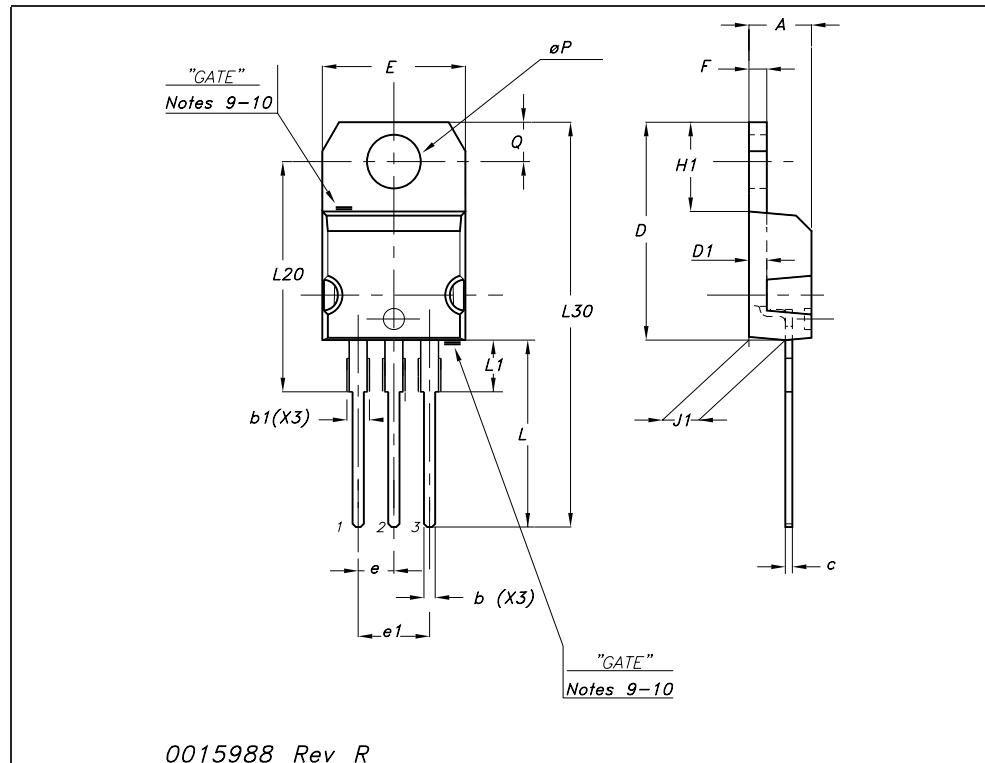
## 4 Package mechanical data

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 is an ST trademark.



## 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



## 5 Revision history

Table 5. Document revision history

Date	Revision	Changes
12-Jun-2005	1	First version
23-Aug-2007	2	Added figures: <a href="#">2</a> , and <a href="#">3</a>
30-Jun-2009	3	Updated value for $h_{FE}$ see <a href="#">Table 4: Electrical characteristics</a>

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