

## High voltage fast-switching NPN power transistor

### General features

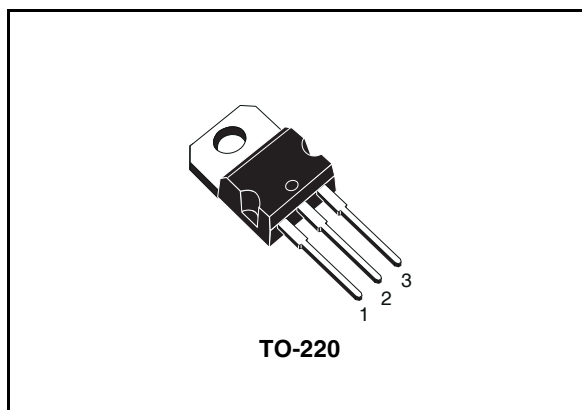
- High voltage capability
- Minimum lot-to-lot spread for reliable operation
- Low base drive requirements
- Very high switching speed
- Fully characterized at 125 °C
- In compliance with the 2002/93/EC European Directive

### Applications

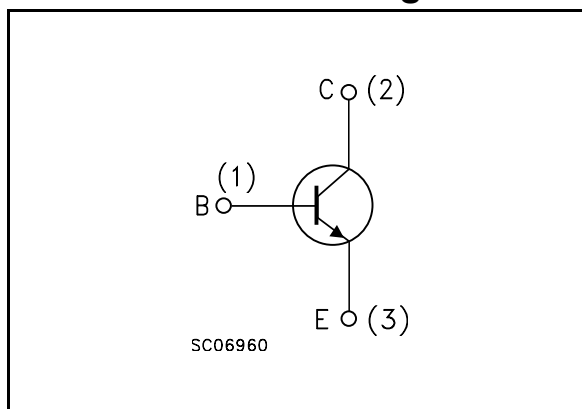
- Electronic transformers for halogen lamps
- Switch mode power supply

### Description

The device is manufactured using high voltage Multi-Epitaxial Planar technology for cost-effective high performance. It uses a Hollow Emitter structure to enhance switching speeds. The device is designed for use in lighting applications and low cost switch-mode power supplies.



### Internal schematic diagram



### Order code

Part Number	Marking	Package	Packing
BUL98	BUL98	TO-220	Tube

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{BE} = 0$ )	800	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )	450	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )	9	V
$I_C$	Collector current	12	A
$I_{CM}$	Collector peak current ( $t_P < 5\text{ms}$ )	25	A
$I_B$	Base current	6	A
$I_{BM}$	Base peak current ( $t_P < 5\text{ms}$ )	12	A
$P_{tot}$	Total dissipation at $T_c \leq 25^\circ\text{C}$	110	W
$T_{stg}$	Storage temperature	-65 to 150	$^\circ\text{C}$
$T_J$	Max. operating junction temperature	150	$^\circ\text{C}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.14	$^\circ\text{C/W}$

## 2 Electrical characteristics

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

**Table 3. Electrical characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{\text{CES}}$	Collector cut-off current ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 800\text{V}$ $V_{\text{CE}} = 800\text{V}$ $T_j = 125^{\circ}\text{C}$			100 500	$\mu\text{A}$ $\mu\text{A}$
$I_{\text{CEO}}$	Collector-emitter current ( $I_{\text{B}} = 0$ )	$V_{\text{CE}} = 450\text{V}$			100	$\mu\text{A}$
$V_{\text{CEO(sus)}}^{(1)}$	Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 10\text{mA}$ $L = 25\text{mH}$	450			V
$V_{\text{EBO}}$	Emitter-base voltage ( $I_{\text{C}} = 0$ )	$I_{\text{E}} = 10\text{mA}$	9			V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = 5\text{A}$ $I_{\text{B}} = 1\text{A}$ $I_{\text{C}} = 9\text{A}$ $I_{\text{B}} = 1.8\text{A}$ $I_{\text{C}} = 12\text{A}$ $I_{\text{B}} = 2.4\text{A}$		0.15 0.3 0.5	0.5 0.8 1.5	V V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 5\text{A}$ $I_{\text{B}} = 1\text{A}$ $I_{\text{C}} = 9\text{A}$ $I_{\text{B}} = 1.8\text{A}$ $I_{\text{C}} = 12\text{A}$ $I_{\text{B}} = 2.4\text{A}$		0.95 1 1.1	1.2 1.3 1.4	V V V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = 10\text{mA}$ $V_{\text{CE}} = 5\text{V}$ $I_{\text{C}} = 5\text{A}$ $V_{\text{CE}} = 5\text{V}$	10 15		35	
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$V_{\text{CL}} = 350\text{V}$ $I_{\text{C}} = 9\text{A}$ $V_{\text{BE(off)}} = -5\text{V}$ $I_{\text{B1}} = 1.8\text{A}$ $L = 200\mu\text{H}$ $R_{\text{BB(off)}} = 0\Omega$ (see figure 8)		1.1 55	1.8 100	$\mu\text{s}$ ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time Fall time	$V_{\text{CL}} = 350\text{V}$ $I_{\text{C}} = 9\text{A}$ $V_{\text{BE(off)}} = -5\text{V}$ $I_{\text{B1}} = 1.8\text{A}$ $L = 200\mu\text{H}$ $R_{\text{BB(off)}} = 0\Omega$ $T_j = 100^{\circ}\text{C}$ (see figure 8)		1.5 80		$\mu\text{s}$ ns

Note (1) Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

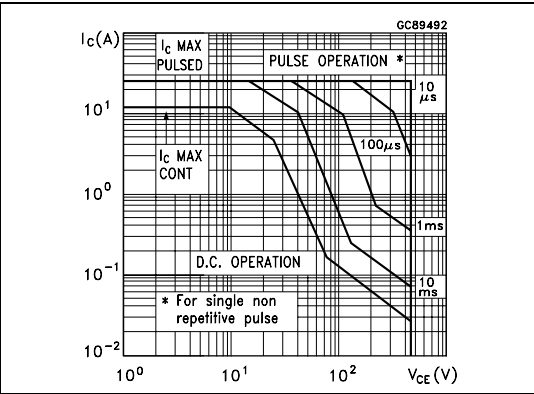


Figure 2. Derating curve

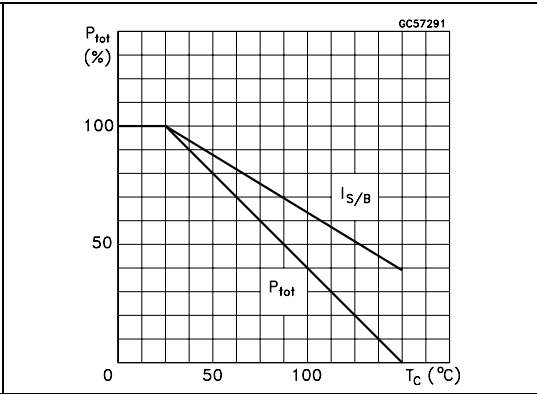


Figure 3. Collector-emitter saturation voltage

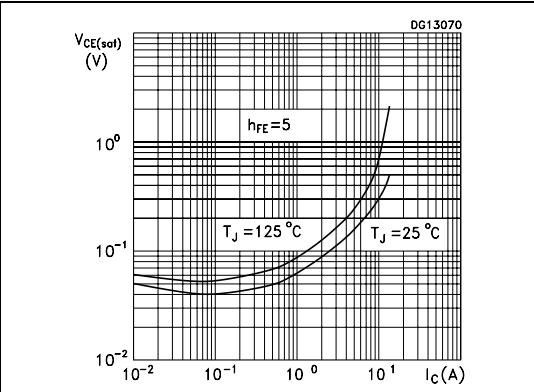


Figure 4. Base-emitter saturation voltage

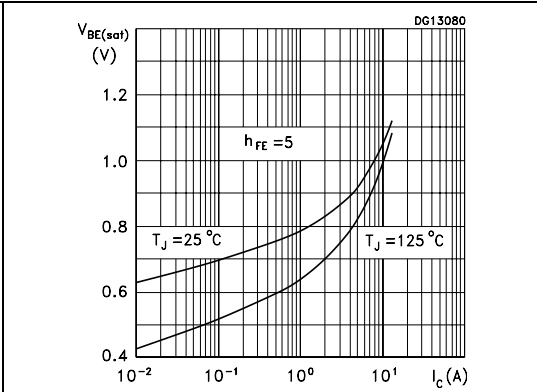


Figure 5. DC current gain

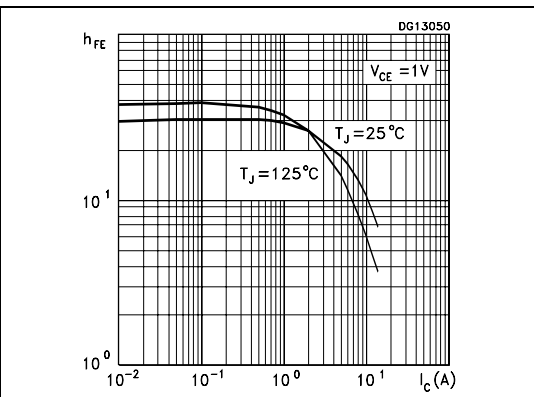


Figure 6. DC current gain

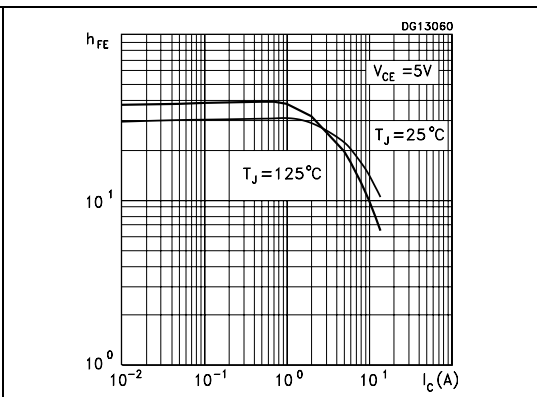
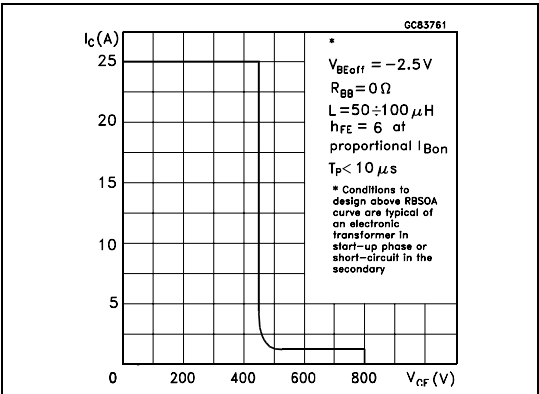
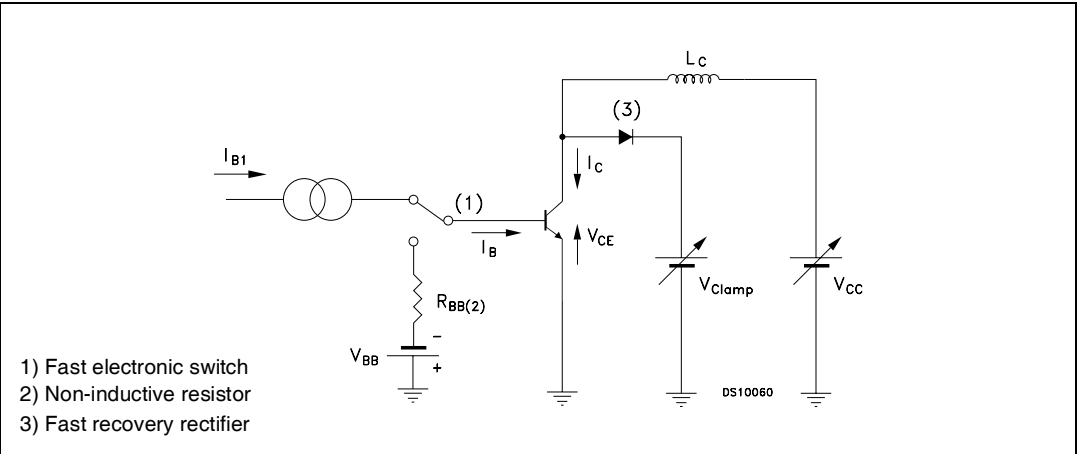


Figure 7. Reverse biased safe operating area



## 2.2 Test circuits

Figure 8. Inductive load switching test circuit

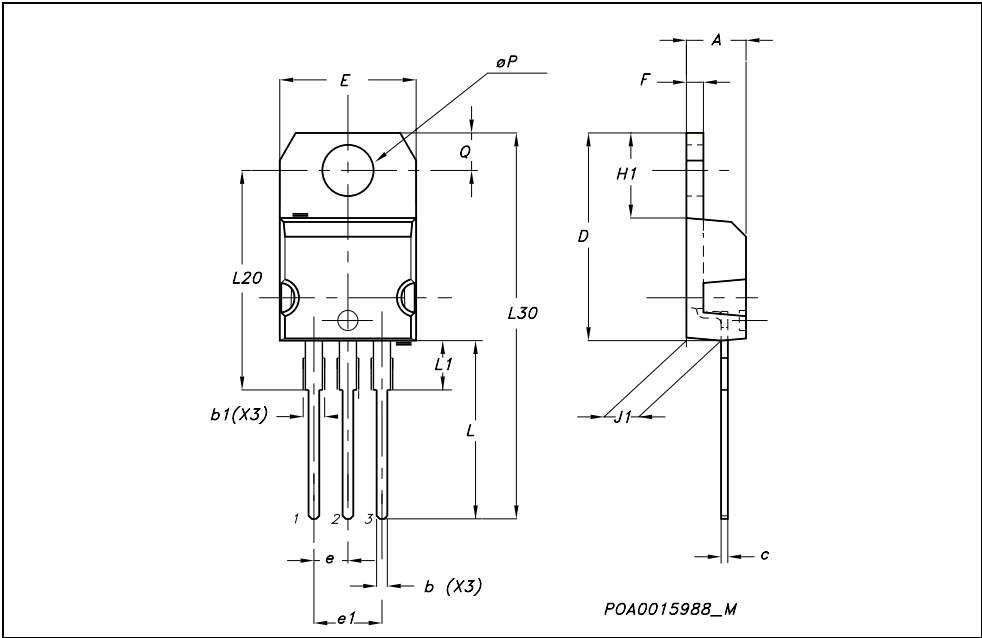


### 3 Package mechanical data

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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116





## 4 Revision history

**Table 4. Revision history**

Date	Revision	Changes
30-Jun-2005	1	First release.
07-Nov-2006	2	The document has been reformatted

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