

## High voltage fast-switching NPN power transistor

### Features

- High voltage capability
- Low spread of dynamic parameters
- Minimum lot-to-lot spread for reliable operation
- Very high switching speed
- High ruggedness
- Fully characterized at 125 °C
- Integrated antiparallel collector-emitter diode

### Applications

- Electronic transformers for halogen lamps
- Switch mode power supplies

### Description

The BUL38D is manufactured using high voltage multi epitaxial planar technology for high switching speeds and high voltage capability.

The device is designed for use in electronic transformer for halogen lamps.

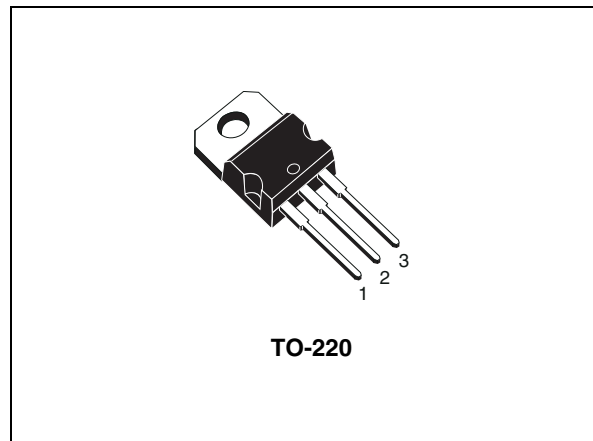


Figure 1. Internal schematic diagram

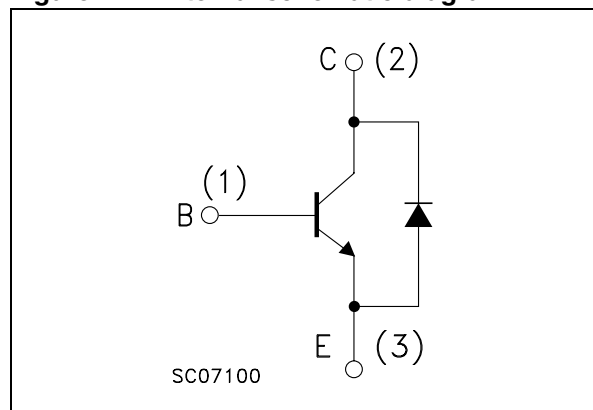


Table 1. Device summary

Order code	Marking <sup>(1)</sup>	Package	Packaging
BUL38D	BUL38D A or BUL38D B	TO-220	Tube

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

# 1 Electrical ratings

**Table 2. 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	5	A
$I_{CM}$	Collector peak current ( $t_P < 5$ ms)	10	A
$I_B$	Base current	2	A
$I_{BM}$	Base peak current ( $t_P < 5$ ms)	4	A
$P_{tot}$	Total dissipation at $T_C \leq 25$ °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
$R_{thJA}$	Thermal resistance junction-ambient max	62.5	°C/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
$I_{\text{CES}}$	Collector cut-off current ( $V_{\text{BE}} = 0$ )	$V_{\text{CE}} = 800 \text{ V}$			100	$\mu\text{A}$
		$V_{\text{CE}} = 800 \text{ V}$ $T_{\text{c}} = 125^{\circ}\text{C}$			500	$\mu\text{A}$
$I_{\text{CEO}}$	Collector cut-off current ( $I_{\text{B}} = 0$ )	$V_{\text{CE}} = 450 \text{ V}$			250	$\mu\text{A}$
$V_{\text{CEO(sus)}}^{(1)}$	Collector-emitter sustaining voltage ( $I_{\text{B}} = 0$ )	$I_{\text{C}} = 100 \text{ mA}$	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	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$			0.5	V
		$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 0.4 \text{ A}$			0.7	V
		$I_{\text{C}} = 3 \text{ A}$ $I_{\text{B}} = 0.75 \text{ A}$			1.1	V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = 1 \text{ A}$ $I_{\text{B}} = 0.2 \text{ A}$			1.1	V
		$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B}} = 0.4 \text{ A}$			1.2	V
$h_{\text{FE}}^{(1)(2)}$	DC current gain	$I_{\text{C}} = 10 \text{ mA}$ $V_{\text{CE}} = 5 \text{ V}$	10			
		$I_{\text{C}} = 0.5 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$			60	
		$I_{\text{C}} = 2 \text{ A}$ $V_{\text{CE}} = 5 \text{ V}$				
		Group A	13		23	
	Group B	22		32		
$t_{\text{s}}$ $t_{\text{f}}$	Resistive load Storage time	$V_{\text{CC}} = 150 \text{ V}$ $I_{\text{C}} = 2.5 \text{ A}$ $I_{\text{B(on)}} = -I_{\text{B(off)}} = 0.5 \text{ A}$	1		2.2	$\mu\text{s}$
	Fall time	$t_{\text{p}} = 30 \mu\text{s}$			0.8	$\mu\text{s}$
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time	$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B(on)}} = 0.4 \text{ A}$ $V_{\text{BE(off)}} = -5 \text{ V}$ $R_{\text{BB(off)}} = 0$		1	1.8	$\mu\text{s}$
	Fall time	$V_{\text{CL}} = 250 \text{ V}$ $L = 200 \mu\text{H}$		55	100	ns
$t_{\text{s}}$ $t_{\text{f}}$	Inductive load Storage time	$I_{\text{C}} = 2 \text{ A}$ $I_{\text{B(on)}} = 0.4 \text{ A}$ $V_{\text{BE(off)}} = -5 \text{ V}$ $R_{\text{BB(off)}} = 0$		1.3		$\mu\text{s}$
	Fall time	$V_{\text{CL}} = 250 \text{ V}$ $L = 200 \mu\text{H}$ $T_{\text{C}} = 125^{\circ}\text{C}$		100		ns
$V_{\text{F}}$	Diode forward voltage	$I_{\text{F}} = 2 \text{ A}$			1.5	V

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

2. The product is pre-selected in DC current gain (Group A and Group B). 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

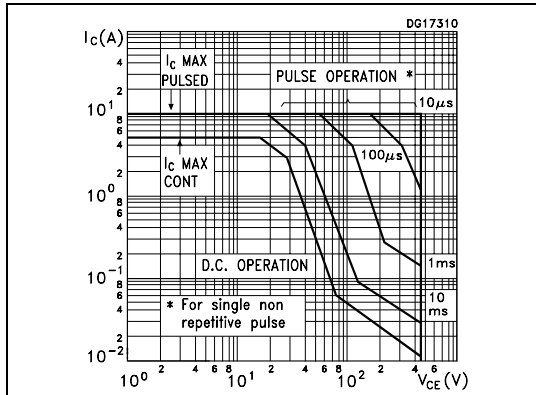


Figure 3. Derating curves

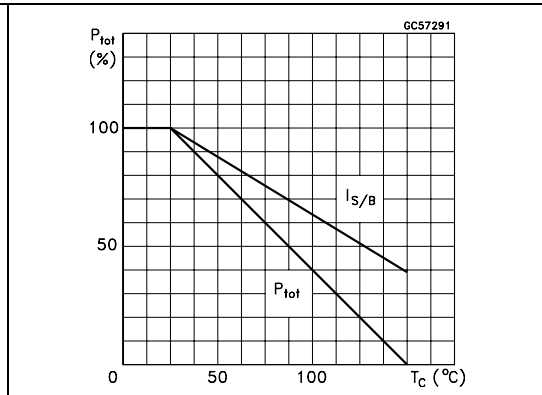


Figure 4. Output characteristics

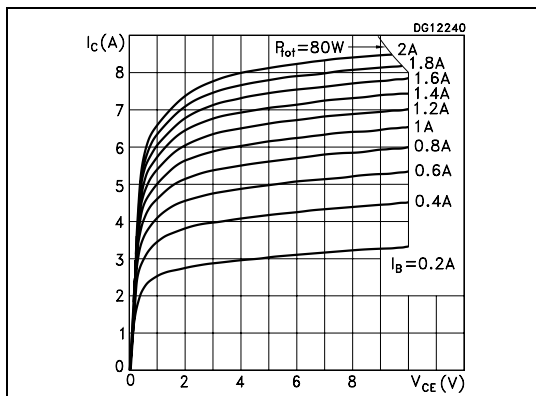


Figure 5. Reverse biased safe operating area

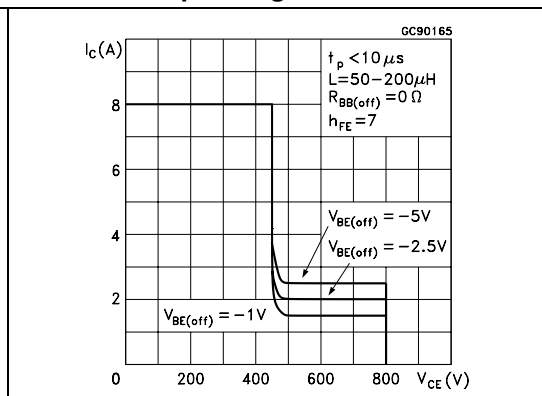


Figure 6. DC current gain ( $V_{CE} = 1.5V$ )

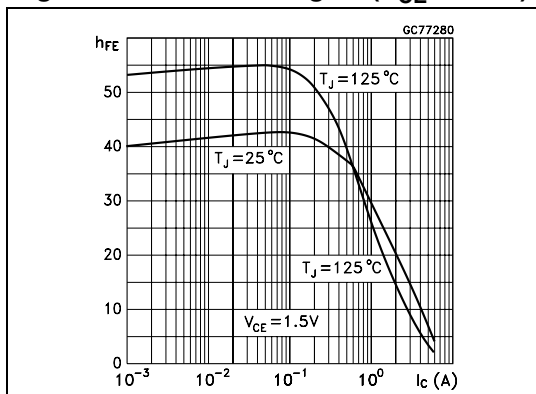
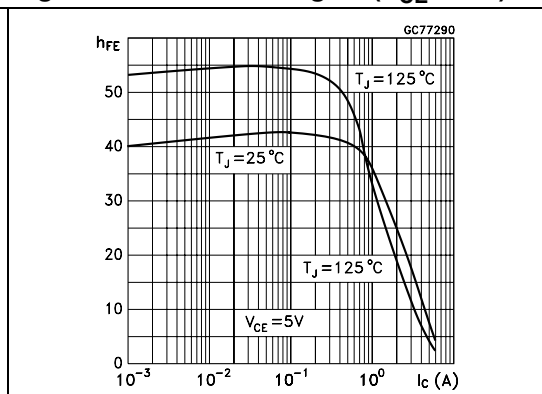
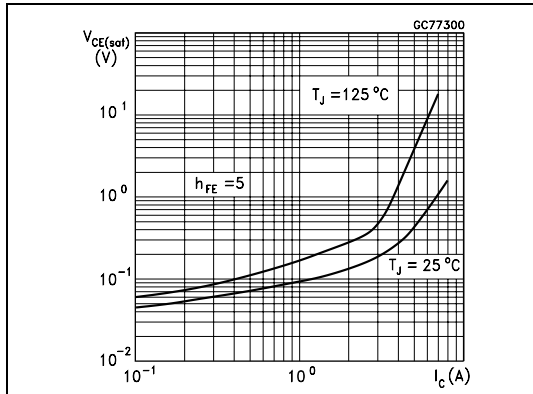


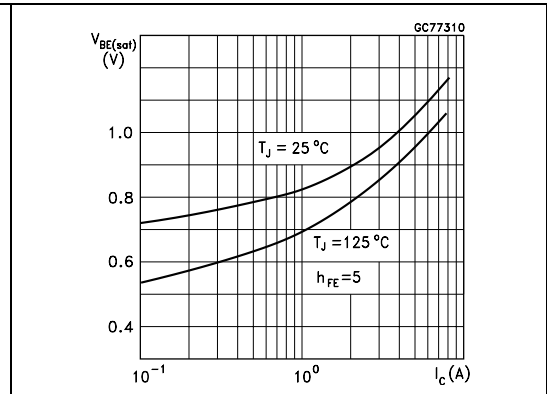
Figure 7. DC current gain ( $V_{CE} = 5V$ )



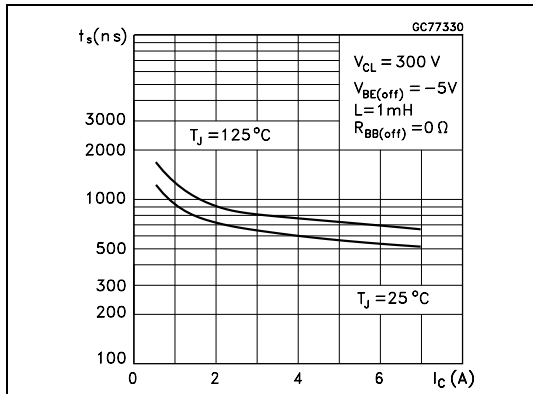
**Figure 8. Collector-emitter saturation Voltage**



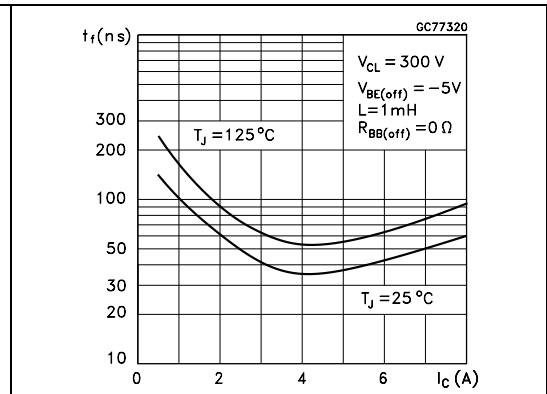
**Figure 9. Base-emitter saturation voltage**



**Figure 10. Inductive load storage time**

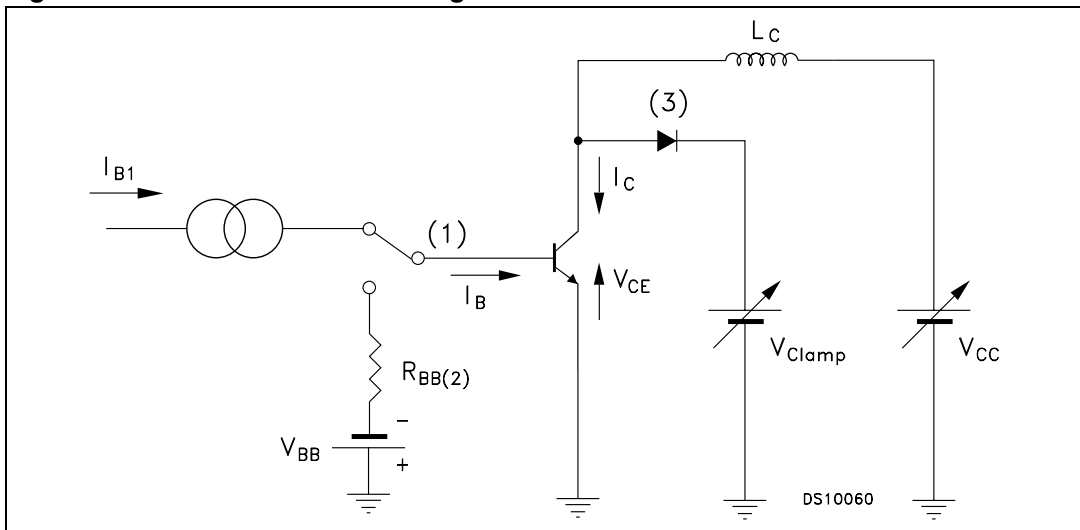


**Figure 11. Inductive load fall time**



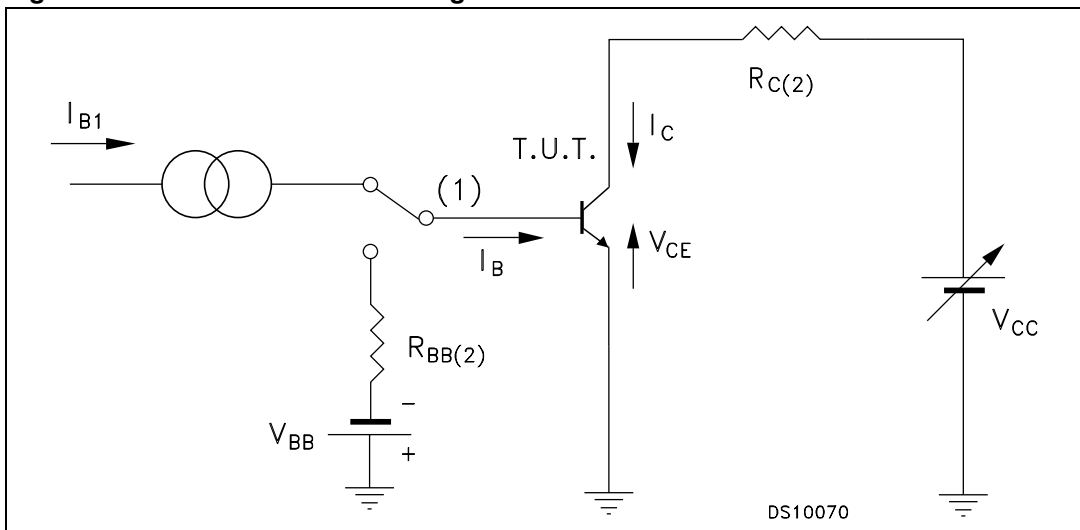
## 2.2 Test circuits

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



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

**Figure 13. Resistive load switching test circuit**



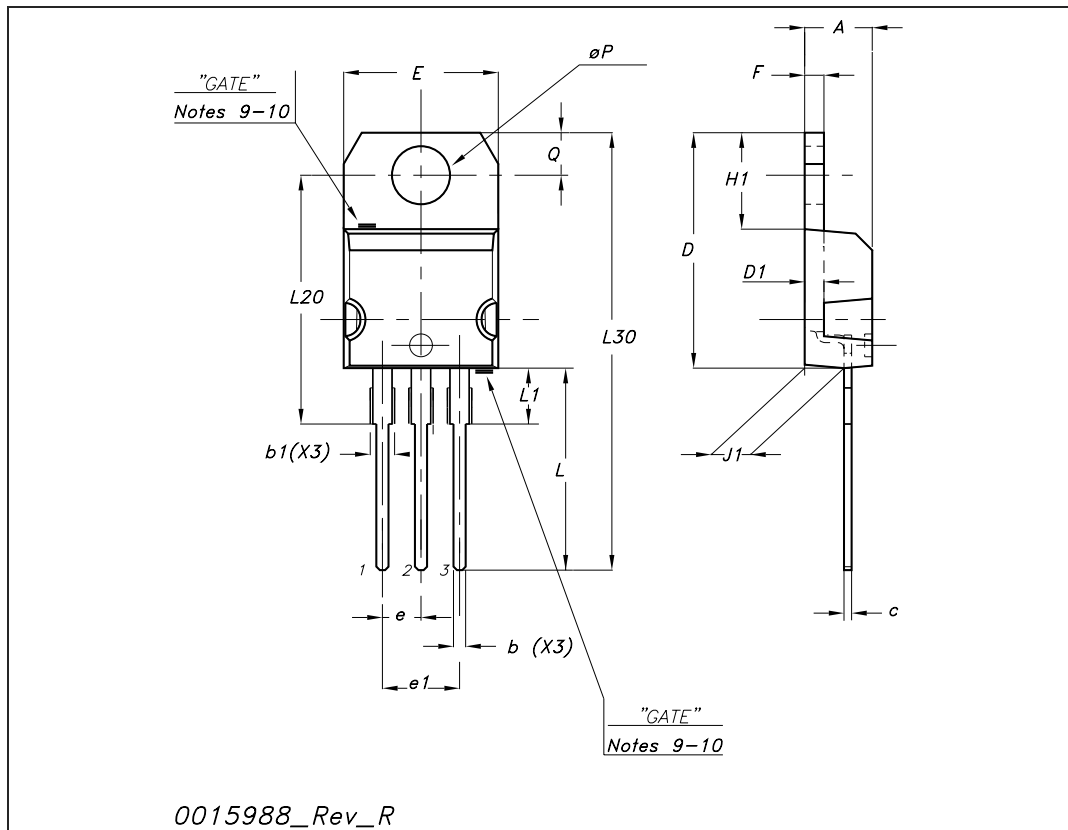
1. Fast electronic switch
2. Non-inductive resistor

### 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 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





## 4 Revision history

**Table 5. Document revision history**

Date	Revision	Changes
16-Jun-2004	2	Document migration, no content change.
23-Jun-2009	3	Updated TO-220 mechanical data.

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