

## 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.

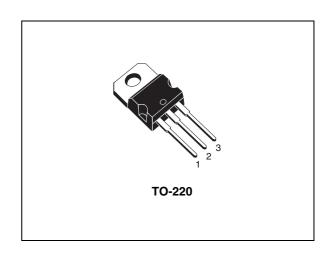


Figure 1. Internal schematic diagram

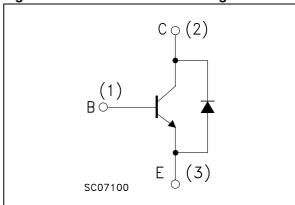


Table 1. Device summary

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

<sup>1.</sup> 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.

Electrical ratings BUL38D

# 1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-emitter voltage (V <sub>BE</sub> = 0)	800	V
V <sub>CEO</sub>	Collector-emitter voltage (I <sub>B</sub> = 0)	450	V
V <sub>EBO</sub>	Emitter-base voltage (I <sub>C</sub> = 0)	9	V
Ic	Collector current	5	Α
I <sub>CM</sub>	Collector peak current (t <sub>P</sub> < 5 ms)	10	Α
I <sub>B</sub>	Base current	2	Α
I <sub>BM</sub>	Base peak current (t <sub>P</sub> < 5 ms)	4	Α
P <sub>tot</sub>	Total dissipation at T <sub>c</sub> ≤25 °C	80	W
T <sub>stg</sub>	Storage temperature	-65 to 150	°C
T <sub>J</sub>	Max. operating junction temperature	150	°C

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R <sub>thJC</sub>	Thermal resistance junction-case max	1.56	°C/W
R <sub>thJA</sub>	Thermal resistance junction-ambient max	62.5	°C/W

## 2 Electrical characteristics

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

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I <sub>CES</sub>	Collector cut-off current (V <sub>BE</sub> = 0)	V <sub>CE</sub> = 800 V V <sub>CE</sub> = 800 V T <sub>c</sub> = 125 °C			100 500	μ <b>Α</b> μ <b>Α</b>
I <sub>CEO</sub>	Collector cut-off current (I <sub>B</sub> =0)	V <sub>CE</sub> = 450 V			250	μΑ
V <sub>CEO(sus)</sub> <sup>(1)</sup>	Collector-emitter sustaining voltage (I <sub>B</sub> = 0)	I <sub>C</sub> =100 mA	450			٧
V <sub>EBO</sub>	Emitter-base voltage (I <sub>C</sub> = 0)	I <sub>E</sub> = 10 mA	9			>
	Collector-emitter	$I_C = 1 A$ $I_B = 0.2 A$			0.5	V
V <sub>CE(sat)</sub> (1)	saturation voltage	$I_C = 2 A$ $I_B = 0.4 A$			0.7	V
		$I_C = 3 A$ $I_B = 0.75 A$			1.1	V
V <sub>BE(sat)</sub> (1)	Base-emitter saturation	$I_C = 1 A$ $I_B = 0.2 A$			1.1	V
VBE(sat) ` '	voltage	$I_C = 2 A$ $I_B = 0.4 A$			1.2	V
h <sub>FE</sub> <sup>(1)(2)</sup>	DC current gain	$\begin{split} I_{C} &= 10 \text{ mA} & V_{CE} &= 5 \text{ V} \\ I_{C} &= 0.5 \text{ A} & V_{CE} &= 5 \text{ V} \\ I_{C} &= 2 \text{ A} & V_{CE} &= 5 \text{ V} \\ Group A & Group B & \end{split}$	10 13 22		60 23 32	
t <sub>s</sub>	Resistive load Storage time Fall time	$V_{CC} = 150 \text{ V}$ $I_{C} = 2.5 \text{ A}$ $I_{B(on)} = -I_{B(off)} = 0.5 \text{ A}$ $I_{P} = 30  \mu\text{s}$	1		2.2 0.8	μs μs
t <sub>s</sub>	Inductive load Storage time Fall time	$\begin{split} I_{C} &= 2 \text{ A} & I_{B(on)} = 0.4 \text{ A} \\ V_{BE(off)} &= -5 \text{ V} & R_{BB(off)} = 0 \\ V_{CL} &= 250 \text{ V} & L = 200  \mu\text{H} \end{split}$		1 55	1.8 100	μs ns
t <sub>s</sub>	Inductive load Storage time Fall time	$\begin{split} I_{C} &= 2 \text{ A} & I_{B(on)} = 0.4 \text{ A} \\ V_{BE(off)} &= -5 \text{ V} & R_{BB(off)} = 0 \\ V_{CL} &= 250 \text{ V} & L = 200 \mu\text{H} \\ T_{C} &= 125 ^{\circ}\text{C} \end{split}$		1.3 100		μs ns
V <sub>F</sub>	Diode forward voltage	I <sub>F</sub> = 2 A			1.5	V

<sup>1.</sup> Pulsed duration = 300  $\mu$ s, duty cycle  $\leq$ 1.5%.

<sup>2.</sup> 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.

Electrical characteristics BUL38D

### 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

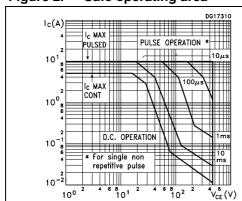


Figure 3. Derating curves

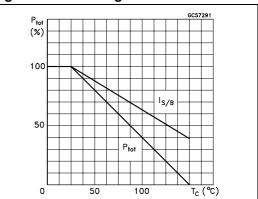
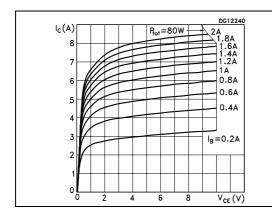


Figure 4. Output characteristics

Figure 5. Reverse biased safe operating area



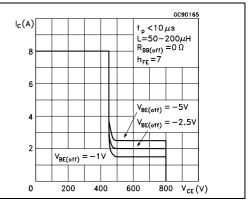
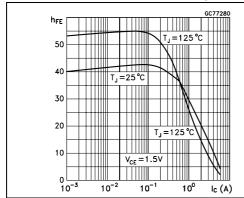


Figure 6. DC current gain ( $V_{CE} = 1.5 \text{ V}$ ) Figure 7. DC current gain ( $V_{CE} = 5 \text{ V}$ )



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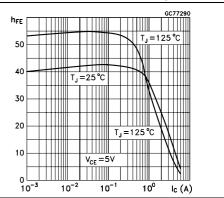


Figure 8. Collector-emitter saturation Figure 9. Base-emitter saturation Voltage voltage

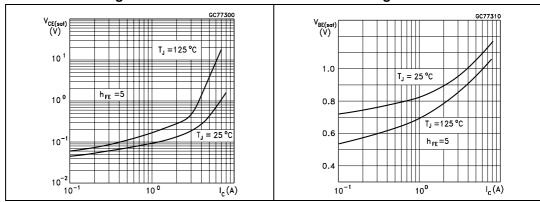
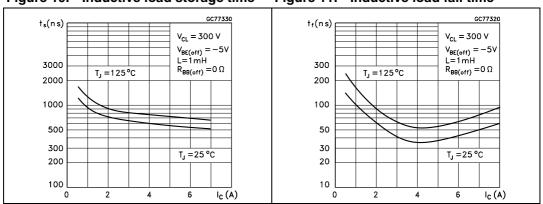


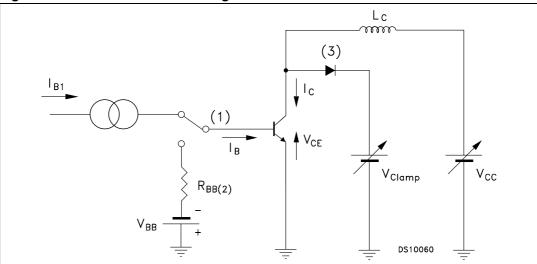
Figure 10. Inductive load storage time Figure 11. Inductive load fall time



Electrical characteristics BUL38D

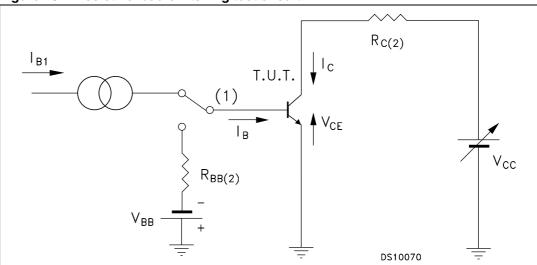
### 2.2 Test circuits

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



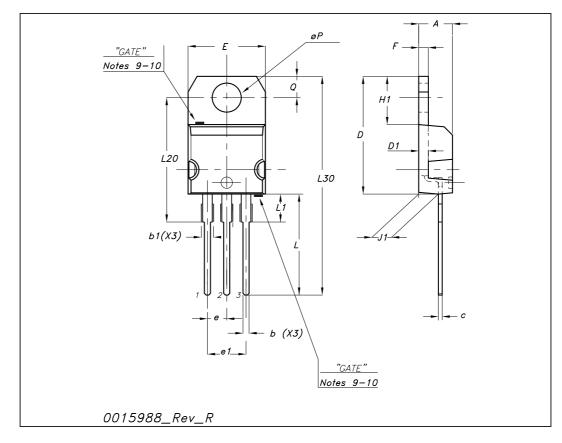
- 1. Fast electronic switch
- 2. Non-inductive resistor

# 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: <a href="https://www.st.com">www.st.com</a>. ECOPACK<sup>®</sup> is an ST trademark.

#### TO-220 mechanical data

Dim		mm		inch		
	Min	Тур	Max	Min	Тур	Max
А	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
С	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
е	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	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



BUL38D Revision history

# 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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