

## 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.

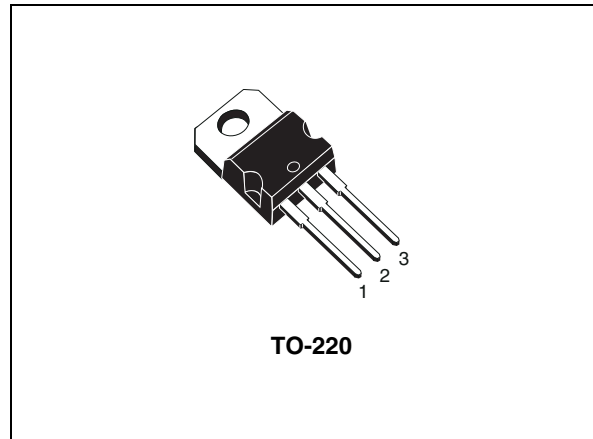


Figure 1. Internal schematic diagram

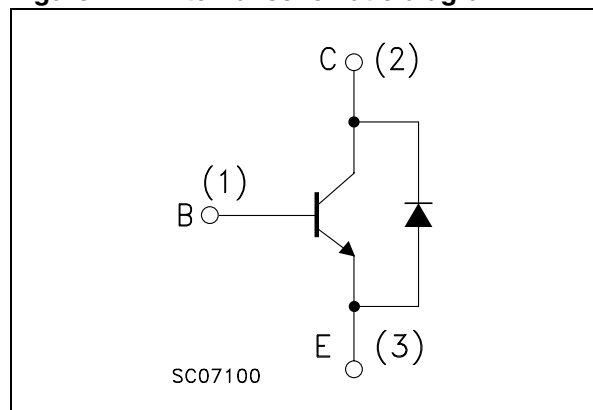


Table 1. Device summary

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

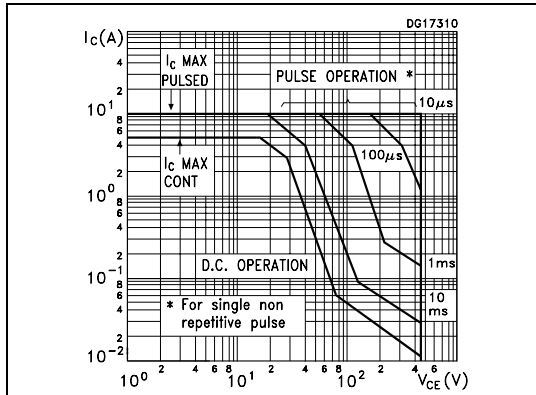


Figure 3. Derating curves

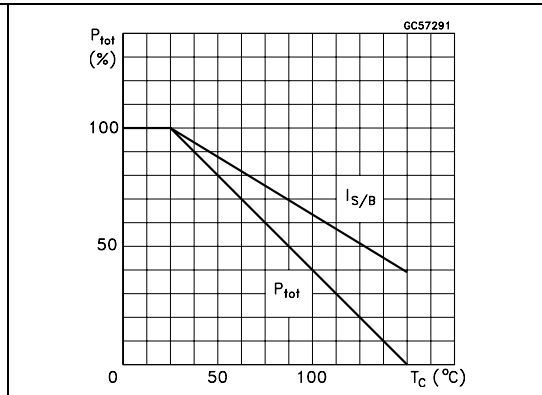


Figure 4. Output characteristics

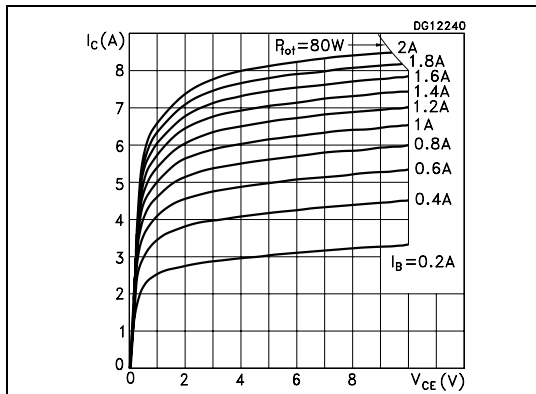


Figure 5. Reverse biased safe operating area

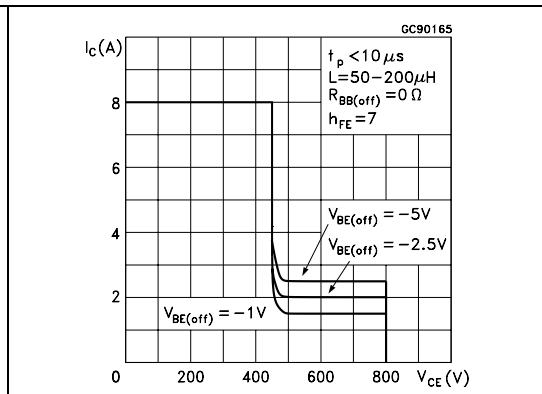


Figure 6. DC current gain ( $V_{CE} = 1.5 V$ )

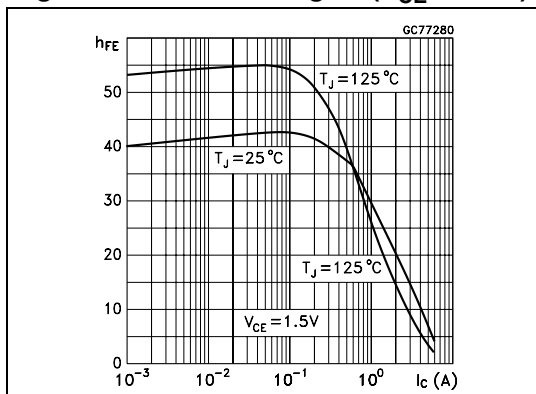
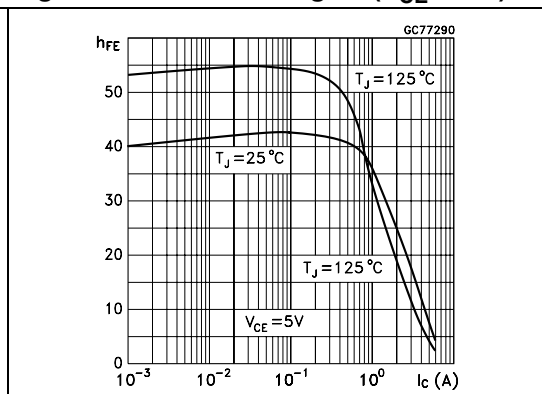
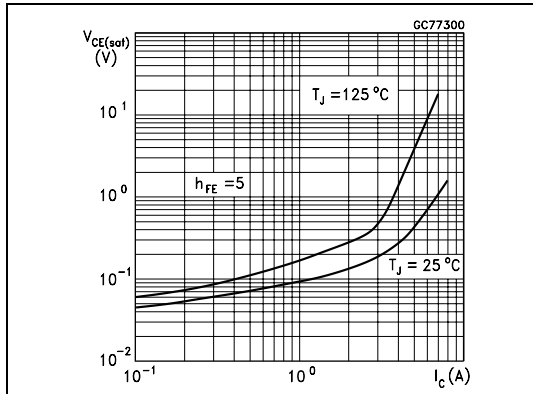


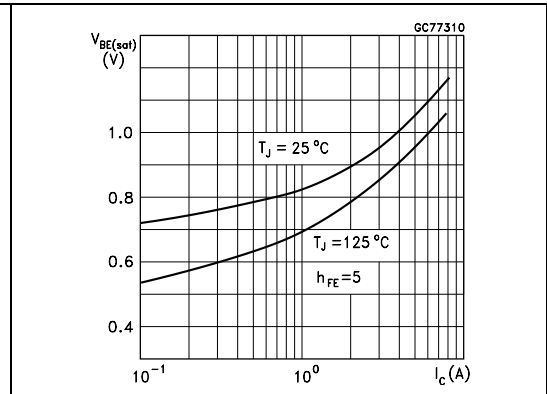
Figure 7. DC current gain ( $V_{CE} = 5 V$ )



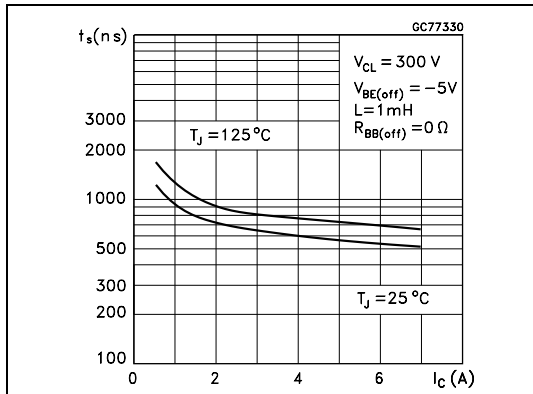
**Figure 8. Collector-emitter saturation Voltage**



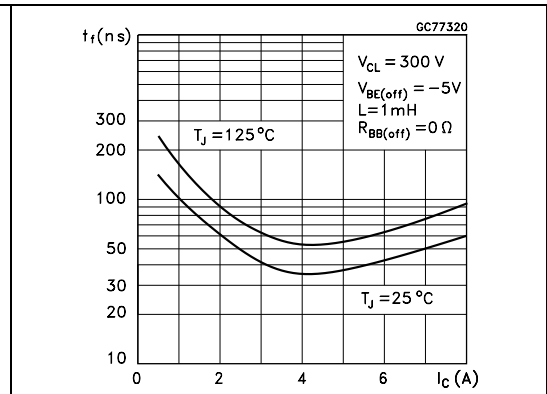
**Figure 9. Base-emitter saturation voltage**



**Figure 10. Inductive load storage time**

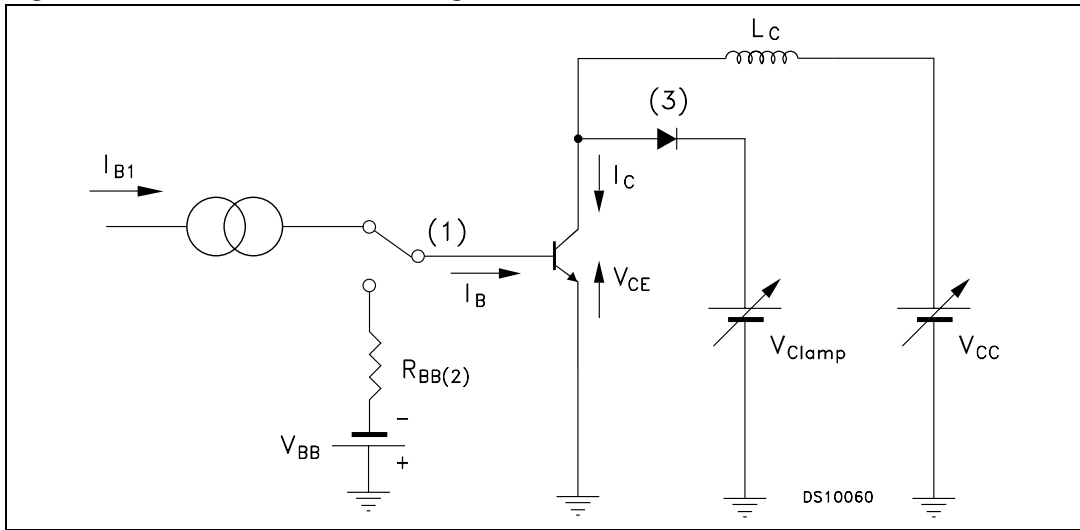


**Figure 11. Inductive load fall time**



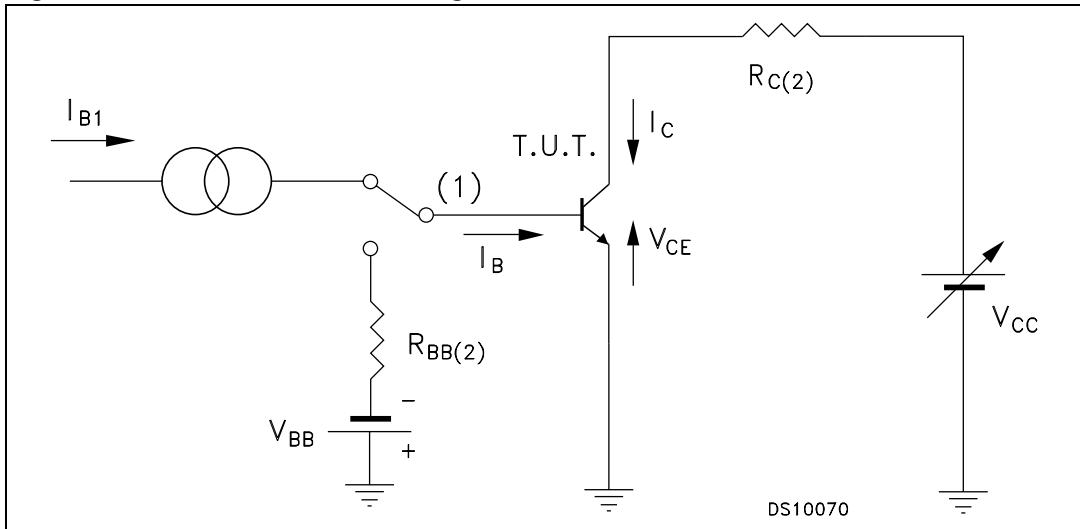
## 2.2 Test circuits

**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**



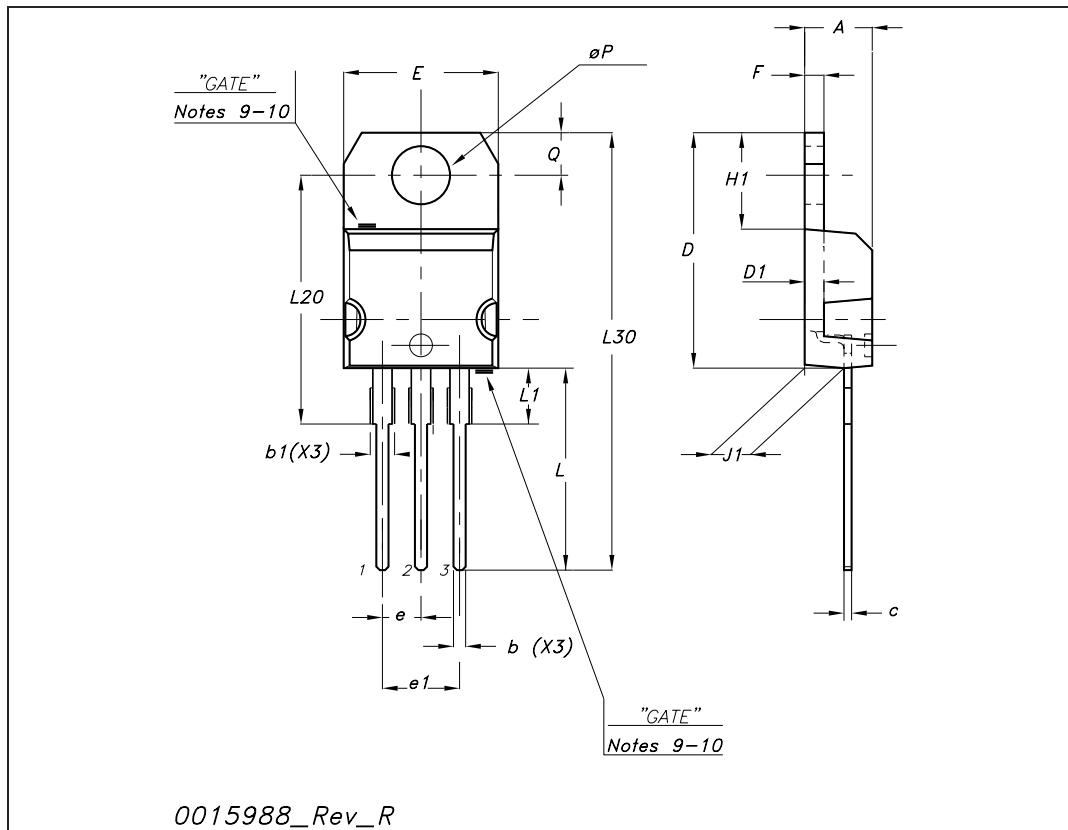
1. Fast electronic switch
2. Non-inductive resistor

### 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.

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2009 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)