

## Data line protection

### Applications

Where transient overvoltage protection in sensitive equipment is required, such as:

- Universal Serial Bus ports
- RS-423 interfaces
- RS-485 interfaces
- ISDN equipment
- T1/E1 line cards
- HDSL / ASDL interfaces

### Features

- Full diode bridge with integrated clamping protection
- Breakdown voltage:  $V_{BR} = 6\text{ V min.}$
- Peak pulse power dissipation:  $P_{PP} = 500\text{ W}$  (8/20  $\mu\text{s}$ )
- Very low capacitance, compatible with high debit data or signal rates.

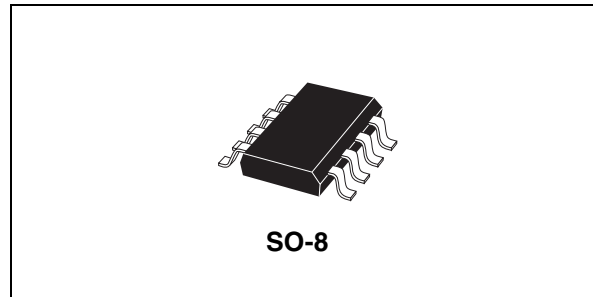
### Description

In order to prevent fast transients from leading to severe damages in a high speed data system, a specific protection has been developed by STMicroelectronics.

The **USB6B1** protects the two input lines against overvoltage. Besides, this device also keeps the power rails in a safe limit thanks to the integrated Transil diode.

### Benefits

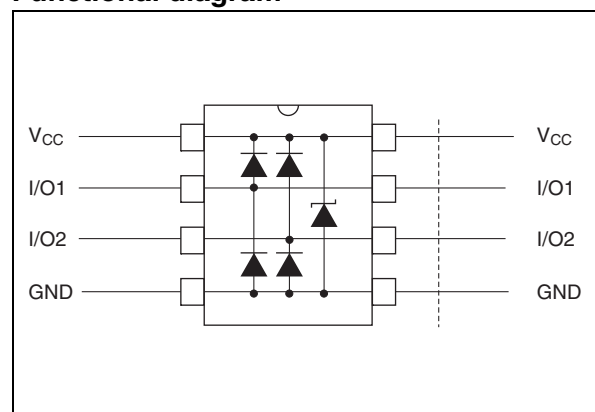
- Provides protection for each line and between the supply voltage and GND: 25 A, 8/20  $\mu\text{s}$ .
- High ESD protection level: up to level 3 per MIL STD 883C-Method 3015-6
- Separated inputs and outputs (so-called 4-point structure) to improve ESD susceptibility.
- Comprehensive package pin-out for immediate implementation.



### Order Codes

Part Numbers	Marking
USB6B1	USB62
USB6B1RL	USB62

### Functional diagram



### Complies with the following standards:

#### MIL STD 883C - Method 3015-6

class 3       $C = 100\text{ pF}$        $R = 1500\ \Omega$   
 3 positive strikes and 3 negative strikes ( $F = 1\text{ Hz}$ )

#### IEC 61000-4-2 level 4

15 kV (air discharge)  
 8 kV (contact discharge)

# 1 Characteristics

**Table 1. Absolute maximum ratings**

Symbol	Parameter		Value	Unit
$V_{PP}$	Peak pulse voltage	IEC61000-4-2 contact discharge	8	kV
		IEC61000-4-2 air discharge	15	
		MIL STD883C-Method 30 15-6	4	
$P_{PP}$	Peak pulse power	8/20 $\mu$ s	500	W
$I_{PP}$	Peak pulse current	8/20 $\mu$ s	25	A
		2/10 $\mu$ s	40	
$T_{stg}$	Storage temperature range		- 55 to + 150	$^{\circ}$ C
$T_{op}$	Operating temperature range		- 40 to + 85	$^{\circ}$ C
$T_L$	Lead solder temperature (10 s duration)		260	$^{\circ}$ C

**Table 2. Electrical characteristics** ( $T_{amb} = 25^{\circ}$  C)

Symbol	Parameter		Value			Unit
			Min	Typ	Max	
$V_{BR}$	Breakdown voltage between $V_{BUS}$ and GND	$I_R = 1$ mA	6			V
$I_{RM}$	Leakage current	$V_{RM} = 5.25$ V			10	$\mu$ A
C	Capacitance between pins D+ and D- $V_{OSC} = 30$ mV, $F = 1$ MHz, $V_R = 0$ V	$V_{CC}$ not connected		15		pF
	Capacitance between pins D+(or D-) and GND $V_{OSC} = 30$ mV, $F = 1$ MHz, $V_R = 5$ V	$V_{CC} = 5$ V		25		pF

Figure 1. Peak power dissipation versus initial junction temperature

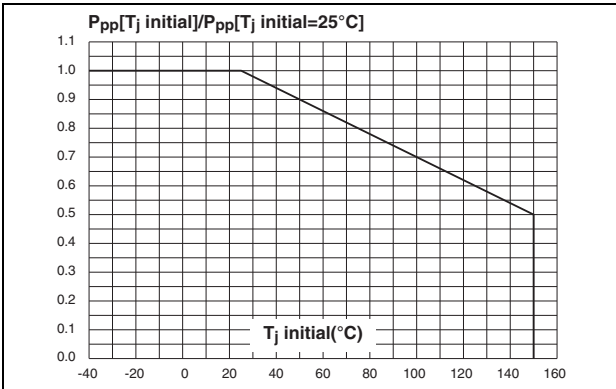


Figure 2. Relative variation of leakage current versus junction temperature (typical values)

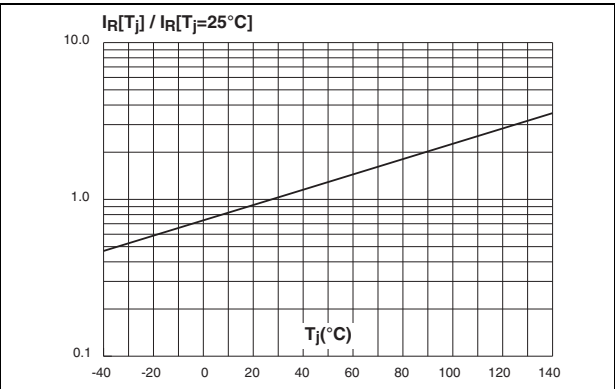
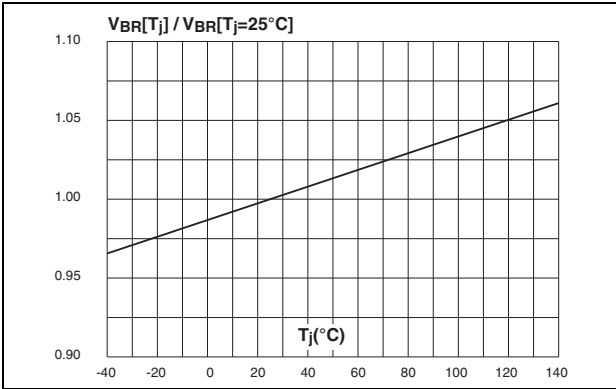


Figure 3. Relative variation of breakdown voltage versus junction temperature (typical values)



## 2 Technical information

### 2.1 Surge protection

The USB6B1 is optimized to perform surge protection based on the rail to rail topology.

The clamping voltage  $V_{CL}$  can be estimated as follow:

$$V_{CL+} = V_{CC} + V_F \text{ for positive surges}$$

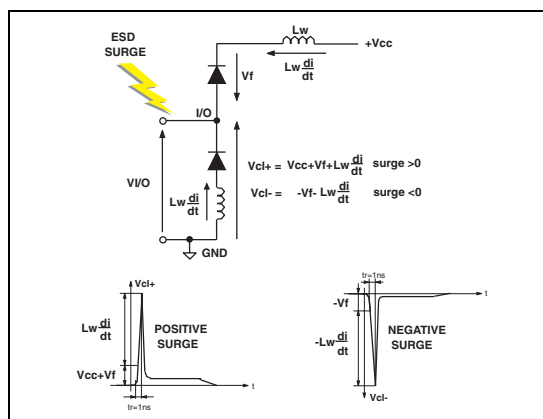
$$V_{CL-} = -V_F \text{ for negative surges}$$

with:  $V_F = V_t + r_d \cdot I_p$

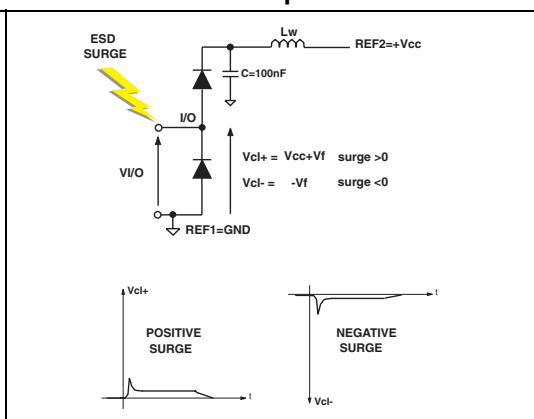
$V_F$  = forward drop voltage,  $V_t$  = forward drop threshold voltage

*Note:* The estimations do not take into account phenomena due to parasitic inductances.

**Figure 4. Surge behavior**



**Figure 5. ESD behavior: optimized layout and addition of a 100 nF capacitor**



### 2.2 How to ensure good ESD protection

While the USB6B1 provides a high immunity to ESD surge, an efficient protection depends on the layout of the board. In the same way, with the rail to rail topology, the track from the  $V_{CC}$  pin to the power supply and from the GND pin to GND voltage must be as short as possible to avoid overvoltages due to parasitic phenomena (see [Figure 4.](#))

It's often harder to connect the power supply near to the USB6B1 unlike the ground thanks to the ground plane that allows a short connection. To ensure the same efficiency for positive surges when the connections can't be short enough, we recommend to putting a 100 nF capacitor close to the USB6B1 between  $V_{CC}$  and ground to prevent these kinds of overvoltage disturbances (see [Figure 5.](#)) The addition of this capacitor offers better protection by providing a constant voltage during the surge.

[Figure 6.](#) shows the improvement of the ESD protection according to the recommendations described above.

**Important:** An important precaution to take is to put the protection device closer to the disturbance source (generally the connection).

## 2.3 Universal Serial Bus

The data transmission standard, Universal Serial Bus (USB) is being driven by market leaders in the world of Computer and Telecommunications, including Compaq, DEC, IBM, Intel, Microsoft, NEC and Nortel, and has become a leading transmission protocol.

This standard mainly provides simplified interconnectivity. Specialized ports on the back of the present PC will largely be replaced by USB ports. Many peripherals such as printers, key-boards, monitors and joysticks use USB ports.

The USB offers high speed communication rates up to 480 Mbit/s. Only two wires (D+, D-) are required for data transfer. Additionally, limited amount of power for USB devices located on the downstream can also be transmitted on two separate conductors within the same cable.

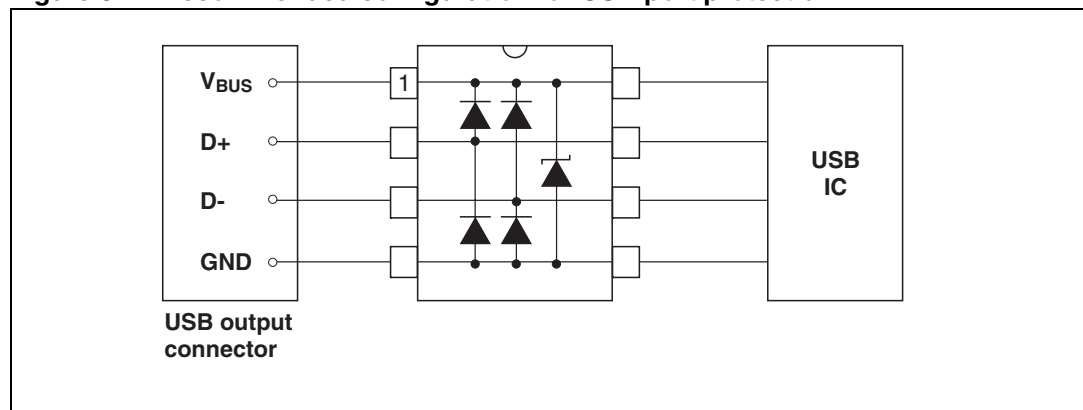
## 2.4 Protection to support USB

Designers dealing with the USB chips are concerned about electrostatic discharge sensitivity (ESD) of their USB controller ICs.

The USB controller is more than just a driver / receiver; it acts as a microcontroller which manages power and direct signal traffic. This complexity increases its cost over conventional devices. Therefore, a failure of a USB port could result in costly computer failure.

In order to prevent these fast transients from leading to severe damages in a system, a specific protection has been developed by STMicroelectronics. The USB6Bx protects not only the two wires of data transmission, but also keep the power rails in a safe limit.

**Figure 6. Recommended configuration for USB port protection**



The capacitance between the I/O transmission wires provides no significant signal distortion at the 12 Mbit/s data rate, thus allowing compatibility with USB standard.

Available in a compact SO-8 this protective element requires minimal board space and eases the PCB layout thanks to its direct compatibility with the USB connector pin-out.

### 3 Telecom and datacom applications

Figure 7. ISDN U interface protection

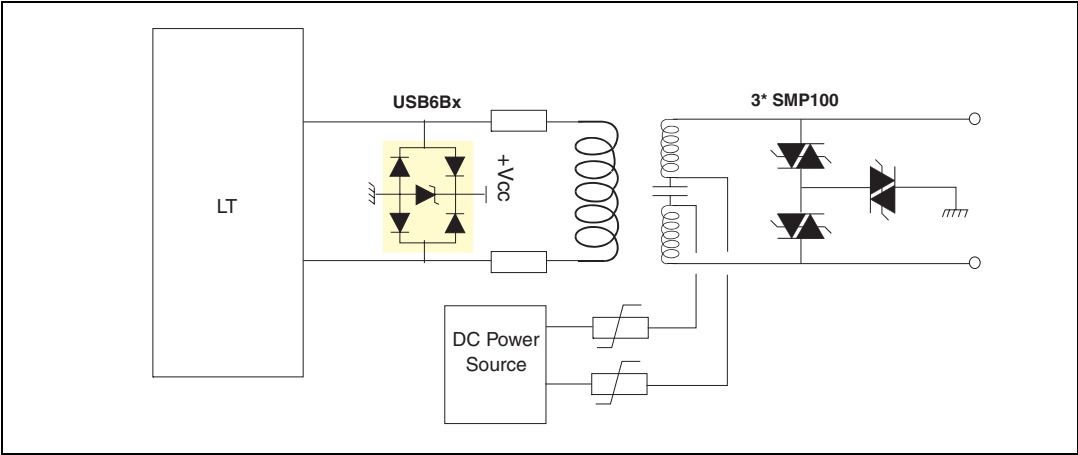


Figure 8. T1 / E1 Line Card Protection.

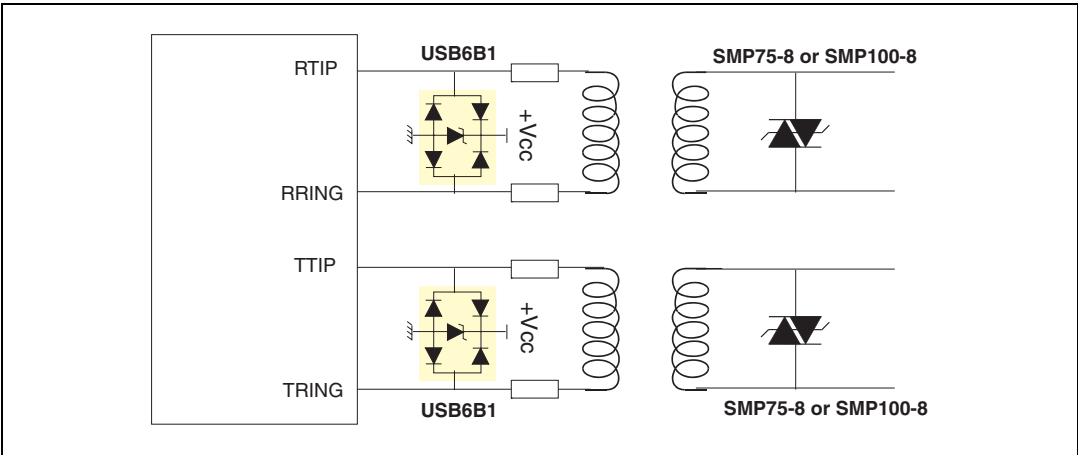
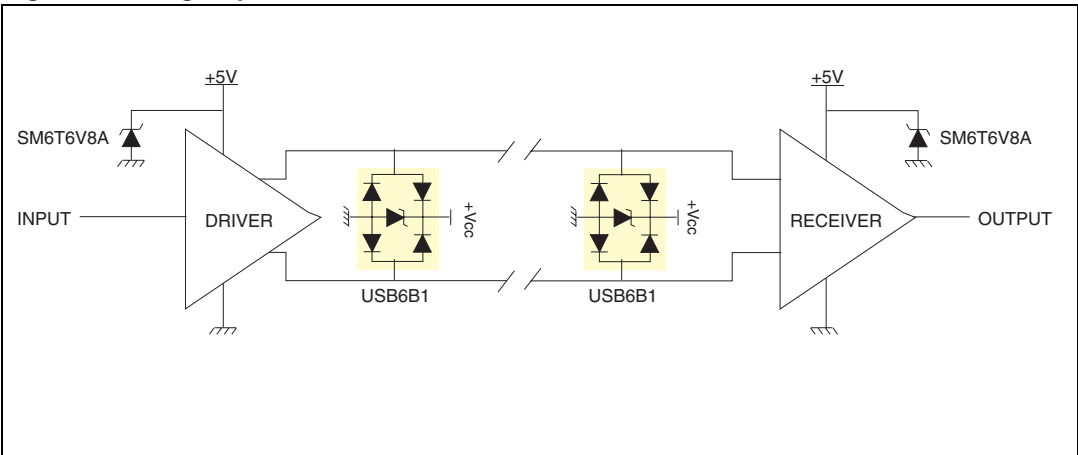
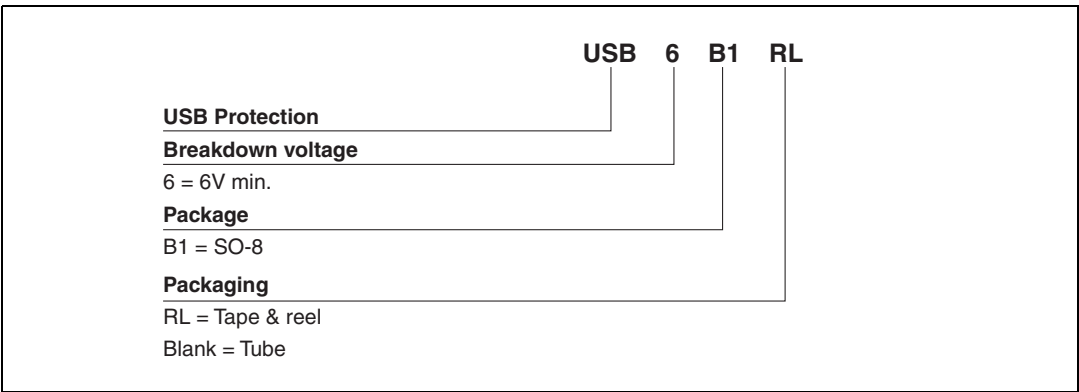


Figure 9. High Speed Line Driver / Receiver Protection



# 4      Ordering information scheme



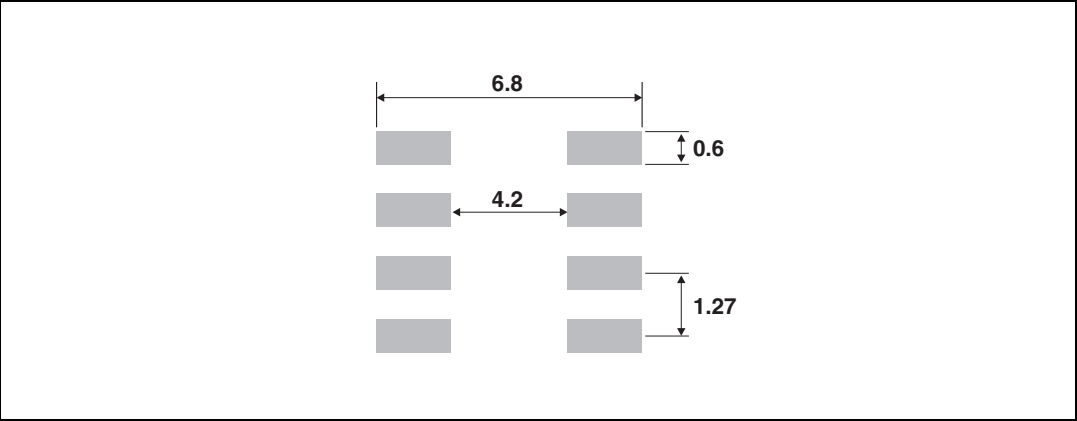
# 5      Package information

Epoxy meets UL94, V0

**Table 3.      SO-8 dimensions**

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.1		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
C	0.17		0.23	0.007		0.009
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.041	
k°	0		8	0		8
ccc			0.10			0.004

Figure 10. SO-8 footprint (dimensions in mm)



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).

## 6 Ordering information

Ordering code	Marking	Package	Weight	Base qty	Delivery mode
USB6B1	USB62	SO-8	0.077 g	100	Tube
USB6B1RL	USB62			2500	Tape and reel

## 7 Revision history

Date	Revision	Description of Changes
Oct-2003	6A	Previous issue.
03-May-2005	7	Figure 1 on page 1: dots connection corrected.
22-Feb-2006	8	Marking typing error corrected on page 1 and 7.
16-Aug-2006	9	Reformatted to current standard. ECOPACK statement added. SO-8 package dimensions corrected.



**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.

© 2006 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 - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

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