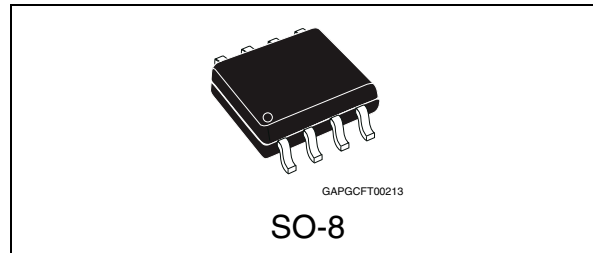


**Hex precision limiter****Features**

- High performance clamping at ground and positive reference voltage
- Fast active clamping
- Operating range 4.75 V - 5.25 V
- Single voltage for supply and positive reference
- Low quiescent current
- Low input leakage current

**Description**

The L9700D-E is a monolithic circuit which is suited for input protection and voltage clamping purpose.

The limiting function is referred to ground and the positive supply voltage.

One single element contains six independent channels.

Very fast speed is achieved by internal feedback and the application of a new vertical PNP-transistor with isolated collector.

**Table 1. Device summary**

Package	Order code	
	Tube	Tape and real
SO-8	L9700D-E	L9700DTR-E

# Contents

- 1      Block diagram and pin connection ..... 5**
- 2      Electrical specification ..... 6**
  - 2.1    Absolute maximum ratings ..... 6
  - 2.2    Thermal data ..... 6
  - 2.3    Electrical characteristics ..... 7
- 3      Application information ..... 9**
- 4      Package and packing information ..... 11**
  - 4.1    ECOPACK® ..... 11
  - 4.2    Package mechanical data ..... 11
- 5      Revision history ..... 13**

## List of tables

Table 1.	Device summary . . . . .	1
Table 2.	Absolute maximum ratings . . . . .	6
Table 3.	Thermal data . . . . .	6
Table 4.	Power section . . . . .	7
Table 5.	SO-8 mechanical data . . . . .	12
Table 6.	Document revision history . . . . .	13

## List of figures

Figure 1.	Block diagram . . . . .	5
Figure 2.	Pin connection . . . . .	5
Figure 3.	DC input characteristic limit points of the characteristic approximation . . . . .	7
Figure 4.	Dynamical input characteristics (part 1/2) . . . . .	8
Figure 5.	Dynamical input characteristics (part 2/2) . . . . .	8
Figure 6.	Typical application . . . . .	9
Figure 7.	SO-8 package dimensions . . . . .	11

# 1 Block diagram and pin connection

Figure 1. Block diagram

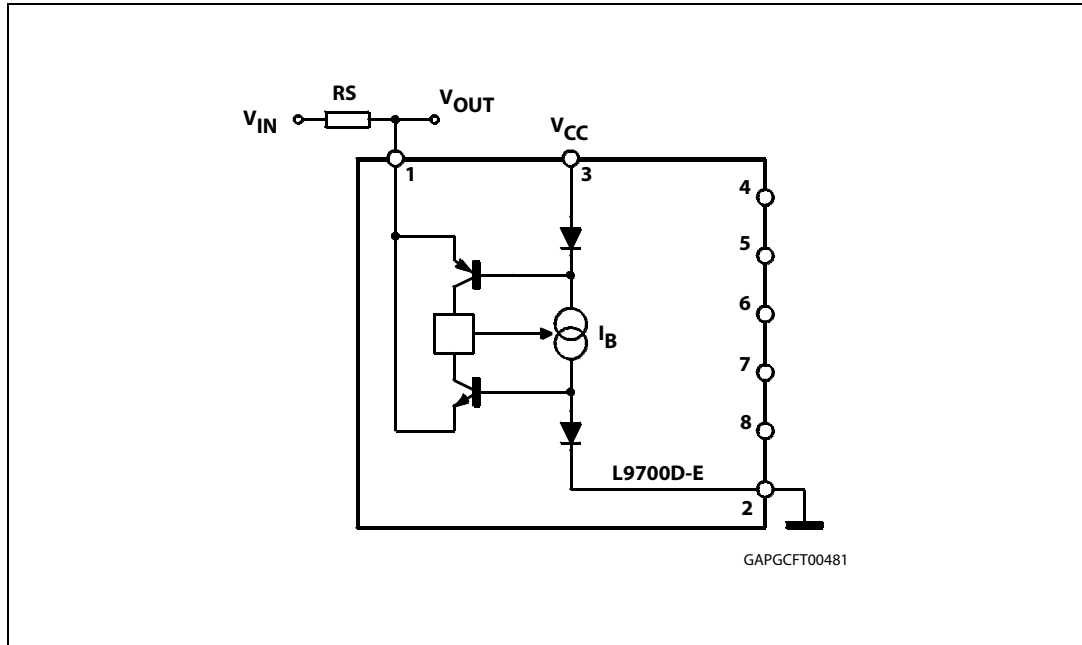
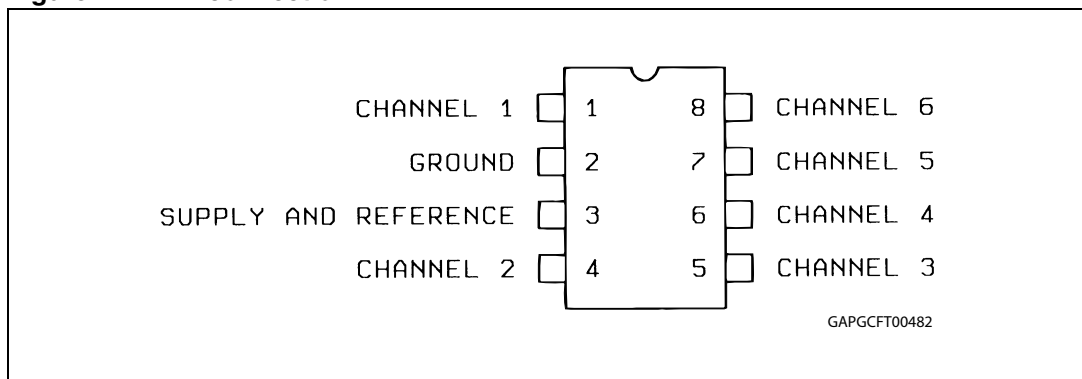


Figure 2. Pin connection



## 2 Electrical specification

### 2.1 Absolute maximum ratings

Stressing the device above the rating listed in [Table 2](#) may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to the conditions in table below for extended periods may affect device reliability.

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage	20	V
$I_{IN}$	Input current per channel	30	mA
$T_j, T_{stg}$	Junction and storage temperature	-55 to 150	°C
$P_{tot}$	Total power dissipation ( $T_{amb} = 85^\circ\text{C}$ )	650	mW

*Note:* The circuit is ESD protected according to MIL-STD-883C

### 2.2 Thermal data

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-amb}$	Thermal resistance junction-ambient (max)	200	°C/W

## 2.3 Electrical characteristics

$V_{CC} = 5\text{ V}$ ;  $T_j = -40\text{ to }125^\circ\text{C}$ , unless otherwise specified.

**Table 4. Power section**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply voltage		4.75		5.25	V
$I_{CC}$	Supply current			1.5	3	mA
$V_{cis}$	Static input clamping voltage	Negative $I_{IN} = -10\text{ mA}$	-250		0	mV
		Positive $I_{IN} = 10\text{ mA}$	$V_{CC}$		$V_{CC} + 250$	mV
$I_{IN}$	Input current (static)	$V_{IN} = 0$			15	$\mu\text{A}$
		$V_{IN} = V_{CC}$			15	$\mu\text{A}$
		$V_{IN} = 50\text{ mV}$			5	$\mu\text{A}$
		$V_{IN} = V_{CC} - 50\text{ mV}$			5	$\mu\text{A}$
$V_{cld}^{(1)}$	Dynamic input clamping voltage	$I_{IN} = \pm 10\text{ mA}$ ; $t_R = 5\text{ ns}$ Positive overshoot			400	mV
		$I_{IN} = \pm 10\text{ mA}$ ; $t_R = 5\text{ ns}$ Negative overshoot			400	mV
$t_S^{(1)}$	Setting time	See <a href="#">Figure 4</a>			20	ns
$R_{IN}^{(1)}$	Dynamic input resistance				5	$\Omega$

1. Design limits are guaranteed by statistical control on production samples over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.

**Figure 3. DC input characteristic limit points of the characteristic approximation**

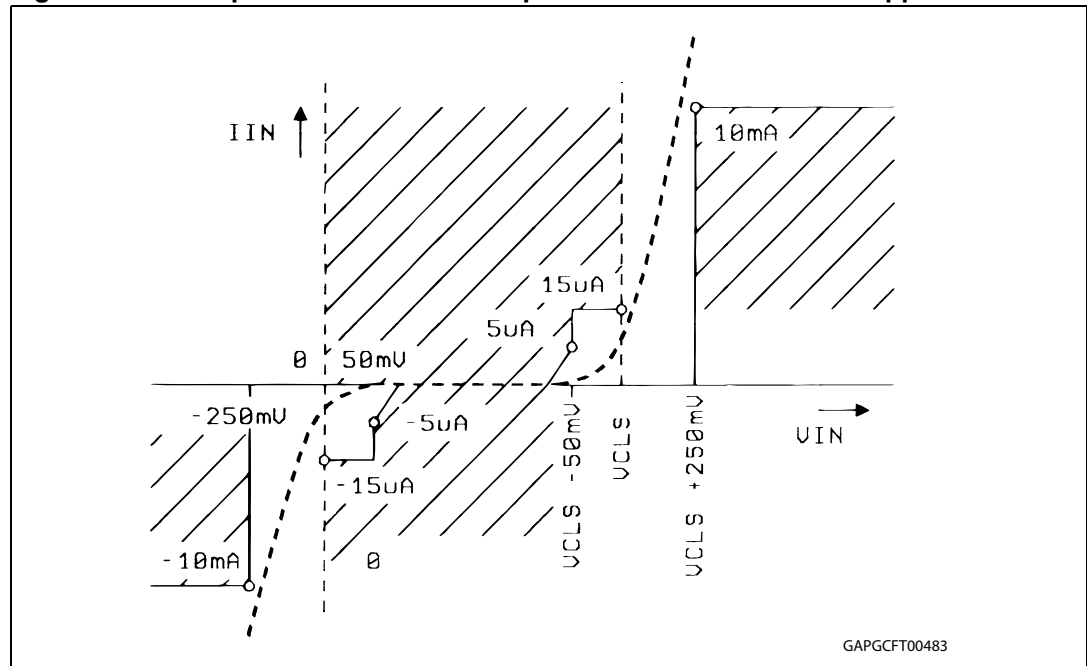


Figure 4. Dynamical input characteristics (part 1/2)

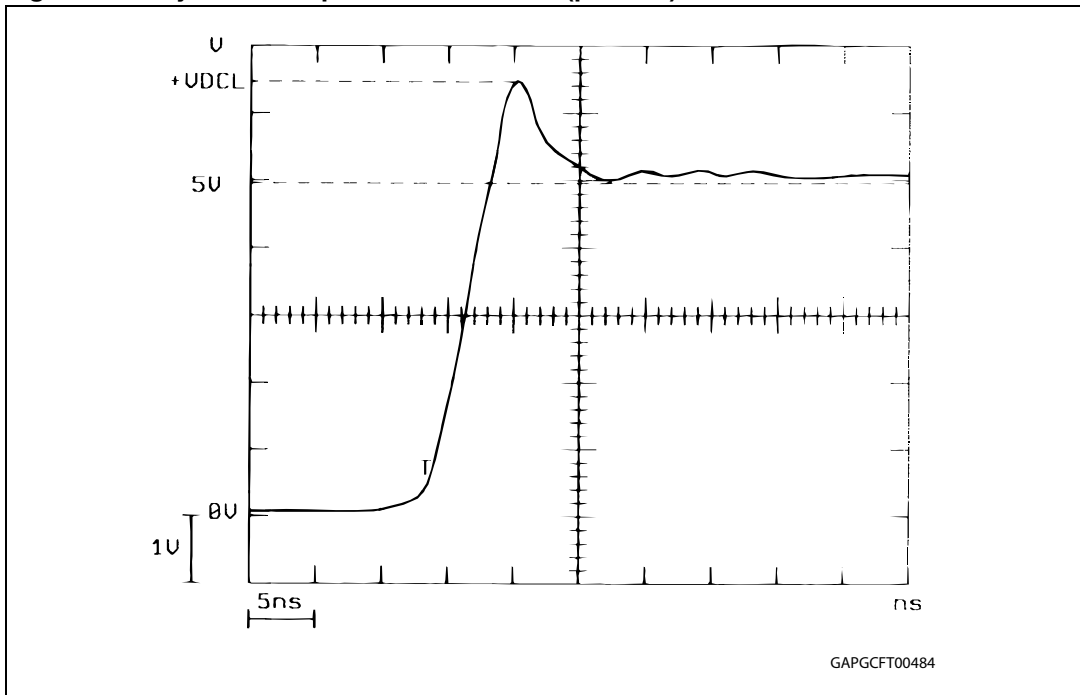
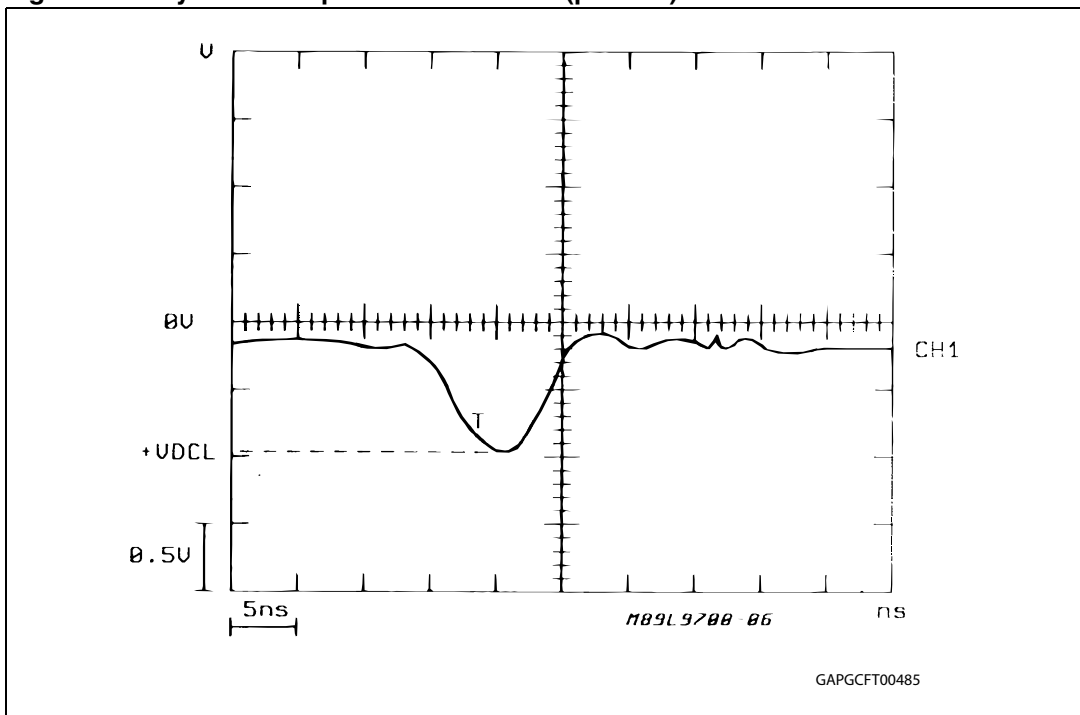


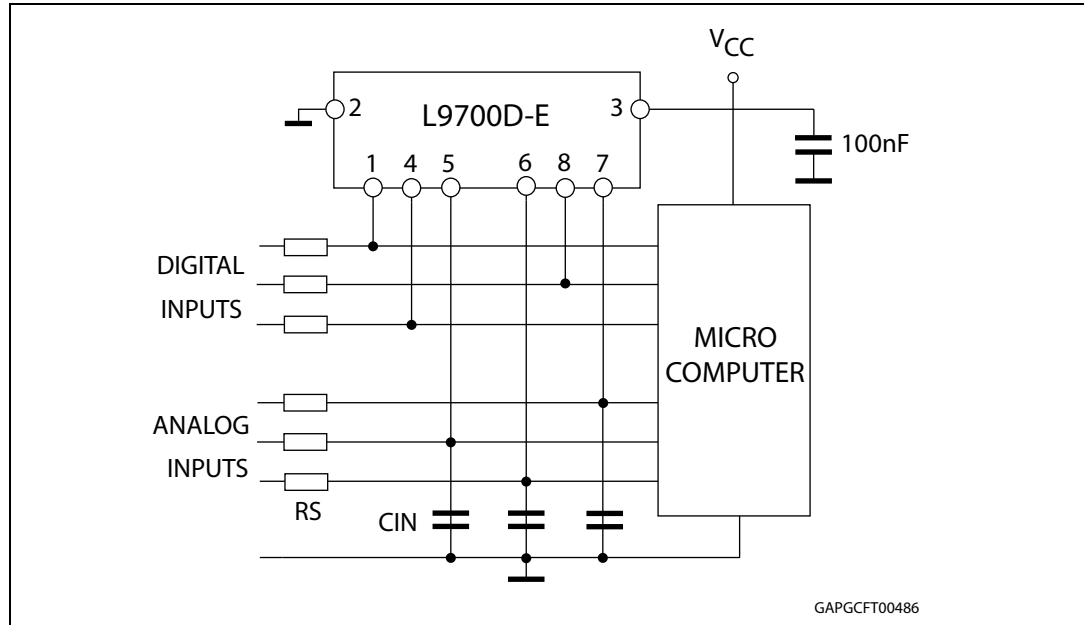
Figure 5. Dynamical input characteristics (part 2/2)





### 3 Application information

Figure 6. Typical application



Most integrated circuits, both HNMOS and bipolar, are very sensitive to positive and negative overvoltages on the supply and at the inputs.

These transients occur in large numbers and with different magnitudes in the automotive environment, making adequate protection for devices aimed at it indispensable.

Overvoltages on the supply line are faced through high voltage integration technologies or through external protection (transil, varistor).

Signal inputs are generally protected using clamp diodes to the supply and ground, and a current limiter resistor. However, such solutions do not always completely satisfy the protection specifications in terms of intervention speed, negative clamping and current leakage high enough to change analog signals.

The L9700D-E device combines a high intervention speed with a high precision positive and negative clamp and a low current leakage providing the optimal solution to the problems of the automotive environment.

The high intervention speed, due to the pre-bias of the limiter stage and internal feedback, limits the voltage overshoot and avoid the use of external capacitors for the limitation of the transient rise times.

*Figure 6* illustrates a typical automotive application scheme. The resistor  $R_S$  limits the input current of the device and is therefore dimensioned considering the characteristics of the transients to be eliminated.

Consequently:

$$R_S = \frac{V_{\text{transient Peak}}}{I_{\text{IN MAX}}}$$

The  $C_{IN}$  capacitors must be used only on analog inputs because they present a low impedance during the sampling period.

The minimum value for  $C_{IN}$  is determined by the accuracy required, the time taken to sample the input and the input impedance during that time, while the maximum value is determined by the required frequency response and the value of  $R_S$ .

Thus for a resistive input A/D connector where:

$T_S$  = sample time (seconds)

$R_D$  = device input resistance (Ohms)

$V_{IN}$  = input voltage (Volts)

$k$  = required accuracy (%)

$Q_1$  = charge on capacitor before sampling

$Q_2$  = charge on capacitor after sampling

$I_D$  = device input current (Amps)

$$\text{Thus: } Q_1 - Q_2 = \frac{k \cdot Q_1}{100}$$

but  $Q_1 = C_{IN} V_{IN}$

and  $Q_1 - Q_2 = I_D T_S$

$$\text{so that } I_D T_S = \frac{k \cdot C_{IN} V_{IN}}{100}$$

$$\text{and } C_{IN}(\text{min}) = \frac{I_D \cdot T_S}{V_{IN} \cdot k} \text{Farad}$$

$$\text{so } C_{IN}(\text{min}) = \frac{100 \cdot T_S}{k \cdot R_D} \text{Farad}$$

The calculation for a sample and hold type convertor is even simpler:

$k$  = required accuracy (%)

$C_H$  = hold capacitor (farad)

$$C_{IN}(\text{min}) = \frac{100 \cdot C_H}{k} \text{Farad}$$

## 4 Package and packing information

### 4.1 ECOPACK®

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

### 4.2 Package mechanical data

Figure 7. SO-8 package dimensions

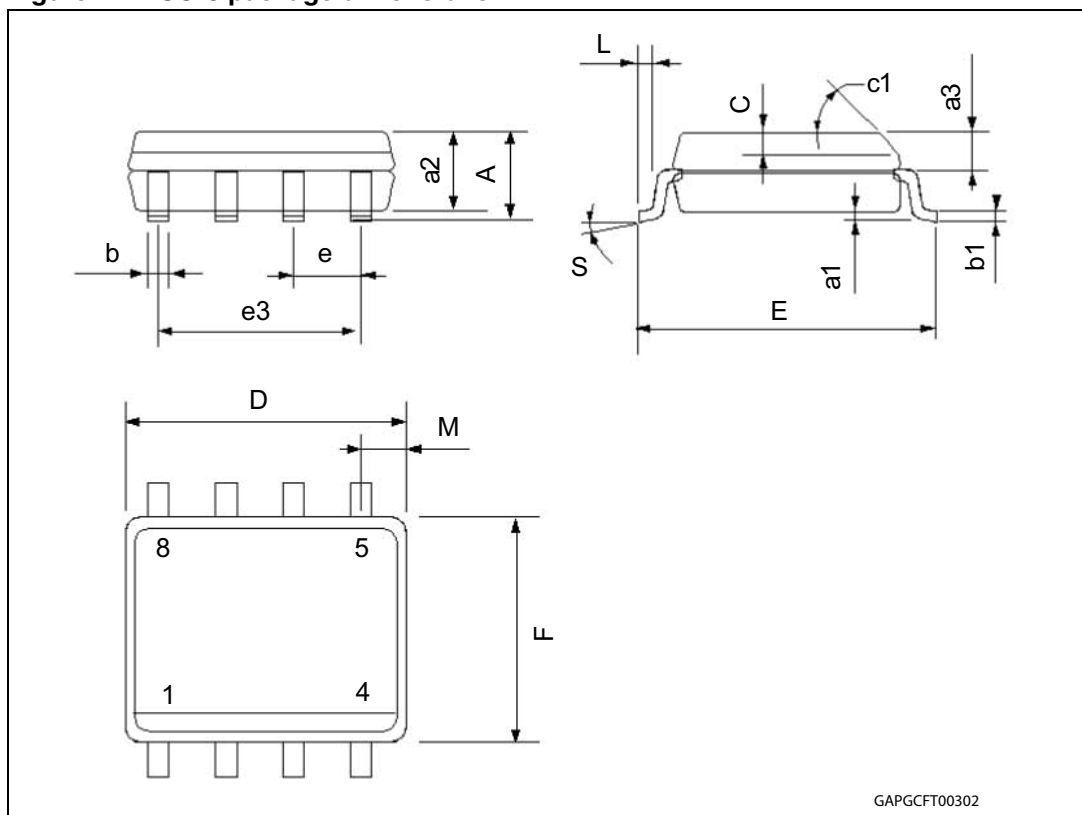


Table 5. SO-8 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A			1.75
a1	0.1		0.25
a2			1.65
a3	0.65		0.85
b	0.35		0.48
b1	0.19		0.25
C	0.25		0.5
c1	45° (typ.)		
D	4.8		5.0
E	5.8		6.2
e		1.27	
e3		3.81	
F	3.8		4.0
L	0.4		1.27
M			0.6
S	8° (max.)		

## 5 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
05-Oct-2011	1	Initial release.

**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 TWO AUTHORIZED ST REPRESENTATIVES, 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.

© 2011 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)