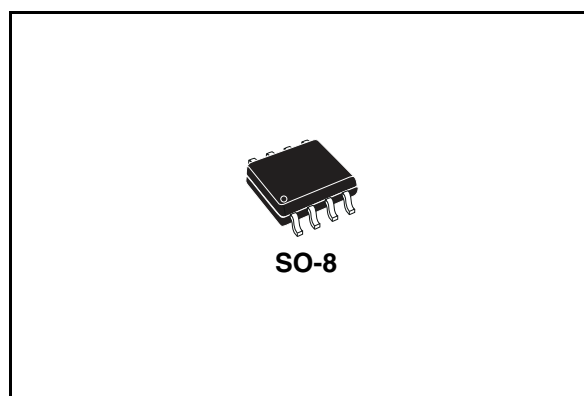


High voltage high-side driver

Features

- High voltage rail up to 160 V
- dV/dt immunity ± 50 V/nsec in full temperature range
- Driver current capability:
500 mA source,
500 mA sink
- Switching times 100 ns rise/fall with 2.5 nF load
- CMOS/TTL Schmitt trigger inputs with hysteresis
- Under voltage lock out
- Clamping on V_{CC}
- Loading circuit for external Bootstrap capacitor
- Inverting input
- Reset circuitry
- SO-8 package



Description

The L9856 is an high voltage device, manufactured with the BCD "OFF-LINE" technology.

It has the capability of driving N-Channel Power MOS transistors. The upper (floating) section is enabled to work with voltage rail up to 160 V. The logic Inputs are CMOS/TTL compatible for ease of interfacing with controlling devices.

Table 1. Device summary

Order code	Operating temp range, °C	Package	Packing
L9856	-40 to +125	SO-8	Tube
L9856TR	-40 to +125	SO-8	Tape and Reel

Contents

- 1 Block diagram and pin description 5**
 - 1.1 Block diagram 5
 - 1.2 Pin description 5

- 2 Electrical specifications 6**
 - 2.1 Thermal data 6
 - 2.2 Absolute maximum ratings 6
 - 2.3 Recommended operating conditions 7
 - 2.4 Electrical characteristics 7
 - 2.5 Logic table 10

- 3 Timing diagrams 11**

- 4 Package information 12**

- 5 Revision history 13**

List of tables

Table 1.	Device summary	1
Table 2.	Pin function	5
Table 3.	Thermal data	6
Table 4.	Absolute maximum ratings	6
Table 5.	Recommended operating conditions	7
Table 6.	Electrical characteristics	7
Table 7.	Logic table	10
Table 8.	Document revision history	13

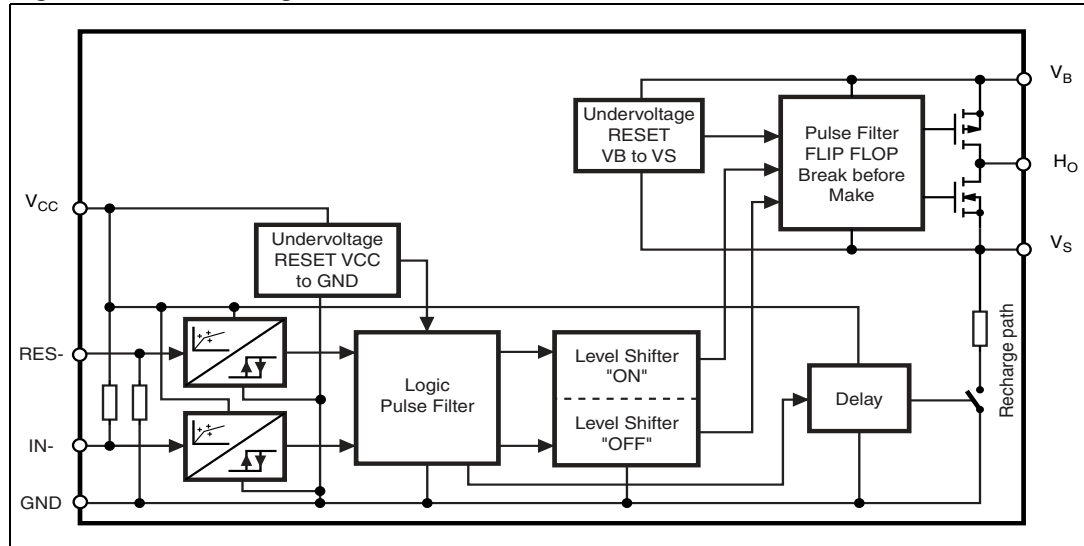
List of figures

Figure 1.	Block diagram	5
Figure 2.	Pin connection (top view)	5
Figure 3.	Input/output timing diagram	11
Figure 4.	Reset timing diagram	11
Figure 5.	SO-8 mechanical data and package dimensions	12

1 Block diagram and pin description

1.1 Block diagram

Figure 1. Block diagram



1.2 Pin description

Figure 2. Pin connection (top view)

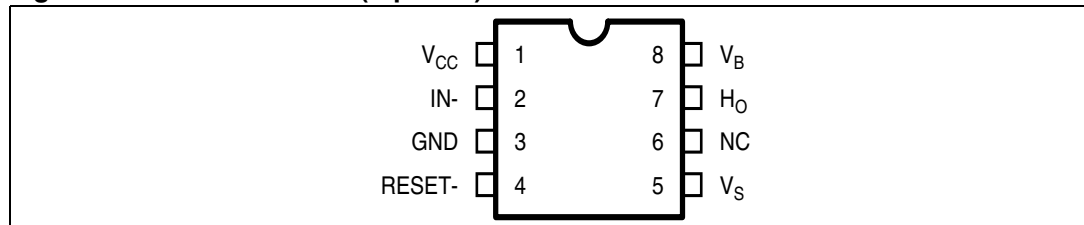


Table 2. Pin function

Pin #	Pin name	Description
1	V_{CC}	Driver supply, typical 5V
2	$IN-$	Driver control signal input (negative logic)
3	GND	Ground
4	$RESET-$	Driver enable signal input (negative logic)
5	V_S	MOSFET source connection
6	NC	No connection (no bondwire)
7	H_O	MOSFET gate connection
8	V_B	Driver output stage supply

2 Electrical specifications

2.1 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{th(j-amb)}$	Thermal resistance junction to ambient	Max. 150	°C/W

2.2 Absolute maximum ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to GND, all currents are defined positive into any lead. An operation above the absolute maximum limit is not implied and can damage the part.

Table 4. Absolute maximum ratings

Symbol	Parameter	Value		Units
		Min.	Max.	
V_{BS}	High side floating supply voltage.	-0.3	20	V
V_B	High side driver output stage voltage neg. transient: 0.5 ms, external MOSFET off.	-5	166	V
V_S	High side floating supply offset voltage neg. transient 0.1 μ s, repetitive pulse over lifetime at every switching event.	-8	150	V
V_{HO}	Output voltage gate connection.	$V_S - 0.3$	$V_B + 0.3$	V
V_{CC}	Supply voltage.	-0.3	20	V
V_{IN}	Input voltage.	-0.3	$V_{CC} + 0.3$	V
I_{IN}	Input injection current. Full function, no latch-up; (guaranteed by design). Test at 5 V and 7 V on Eng. Samples.	---	+1	mA
V_{RES}	Reset input voltage.	-0.3	$V_{CC} + 0.3$	V
V_{esd}	Electrostatic discharge voltage (human body model).	2k		V
V_{CDM}	Charge device model CDM, EOS/ESD Ass. Std 5.3. Number of discharges per pin: 6.	500		V
dV/dt	Allowable offset voltage slew rate.	-50	50	V/nsec
T_J	Junction temperature.	-55	150	°C
T_{stg}	Storage temperature.	-55	150	
T_L	Lead temperature (Soldering, 10 seconds) 3 times Bosch soldering profile acc. to Bosch soldering conditions, Gen. Spec.	-	300	

2.3 Recommended operating conditions

For proper operations the device should be used within the recommended conditions.

Table 5. Recommended operating conditions

Symbol	Parameter	Value		Units
		Min.	Max.	
$V_B^{(1)}$	High side driver output stage voltage	VS+4.4	VS+18	V
V_S	High side floating supply offset voltage (25°C) (125°C)	-3.2 -2.9	150 150	V
V_{HO}	Output voltage gate connection	V_S	V_B	V
V_{CC}	Supply voltage	4.4	6.5	V
V_{IN}	Input voltage	0	V_{CC}	V
V_{RES}	Reset input voltage	0	V_{CC}	V
$dV/dt^{(2)}$	Allowable offset voltage slew rate	-50	50	V/nsec
F_S	Switching frequency		200	kHz

1. Reset-Logic functional for $V_{BS} > 2V$, independent from V_{CC} -level.

2. Guaranteed by design.

2.4 Electrical characteristics

Table 6. Electrical characteristics

Unless otherwise specified, $V_{CC} = 5 V$, $V_{BS} = 7 V$, $V_S = 0 V$, $IN = 0 V$, $RES = 5 V$, load $R = 50 \Omega$, $C = 2.5 nF$. Unless otherwise noted, these specifications apply for an operating ambient temperature range of $-40 \text{ }^\circ\text{C} < T_{amb} < 125 \text{ }^\circ\text{C}$.

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{CC} supply						
V_{CCUV+}	V_{CC} supply undervoltage positive going threshold	V_{CC} rising from 0 V			4.3	V
V_{CCUV-}	V_{CC} supply undervoltage negative going threshold	V_{CC} dropping from 5 V	2.8			
$V_{CCUVHYS}$	V_{CC} supply undervoltage lockout hysteresis		0.02	0.3	0.6	
td_{UVCC}	Undervoltage lockout response time	V_{CC} steps either from 6.5 V to 2.7 V or from 2.7 V to 6.5 V	0.5		20	μs
I_{OCC}	V_{CC} supply current				400	μA

Table 6. Electrical characteristics (continued)

Unless otherwise specified, $V_{CC} = 5\text{ V}$, $V_{BS} = 7\text{ V}$, $V_S = 0\text{ V}$, $I_N = 0\text{ V}$, $R_{ES} = 5\text{ V}$, load $R = 50\ \Omega$, $C = 2.5\text{ nF}$. Unless otherwise noted, these specifications apply for an operating ambient temperature range of $-40\text{ }^\circ\text{C} < T_{amb} < 125\text{ }^\circ\text{C}$.

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{BS} supply						
V_{BSUV+}	V_{BS} supply undervoltage positive going threshold	V_{CC} rising from 0 V			4.3	V
V_{BSUV-}	V_{BS} supply undervoltage negative going threshold	V_{CC} dropping from 5 V	2.8			V
$V_{BSUVHYS}$	V_{BS} supply undervoltage lockout hysteresis		0.02	0.3	0.4	
t_{dUVBS}	Undervoltage lockout response time	V_{BS} steps either from 6.5 V to 2.7 V or from 2.7 V to 6.5V	0.5		20	μs
I_{QBS1}	V_{BS} supply current	static mode, $I_N = 0\text{ V}$ or 5 V			100	μA
I_{QBS2}		static mode, $V_{BS} = 16\text{ V}$, $I_N = 0\text{ V}$ or 5 V			200	μA
ΔV_{BS}	V_{BS} drop due to output turn-on	$C_{BS} = 1\ \mu\text{F}$, $t_{dIG-IN} = 3\ \mu\text{s}$, $t_{TEST} = 100\ \mu\text{s}$			210	mV
Gate driver characteristics						
I_{PKS01}	Peak output source current	$T_j = 25\text{ }^\circ\text{C}$	120	250		mA
I_{PKS02}			70	150		
I_{PKS03}		$V_{BS} = 16\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$	250	500		
I_{PKS04}		$V_{BS} = 16\text{ V}$	150	300		
$I_{HO,off}$	HO off state leakage current	guaranteed by design			1	μA
t_{r1}	Output rise time	$T_j = 25\text{ }^\circ\text{C}$		0.2	0.4	μs
t_{r2}				0.3	0.5	
t_{r3}		$V_{BS} = 16\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$		0.1	0.2	
t_{r4}		$V_{BS} = 16\text{ V}$		0.15	0.3	
I_{PKSi1}	Peak output sink current	$I_N = 5\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$	120	250		mA
I_{PKSi2}		$I_N = 5\text{ V}$	70	150		
I_{PKSi3}		$I_N = 5\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$, $V_{BS} = 16\text{ V}$	250	500		
I_{PKSi4}		$I_N = 5\text{ V}$, $V_{BS} = 16\text{ V}$	150	300		
t_{f1}	Output fall time	$I_N = 5\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$		0.2	0.4	μs
t_{f2}		$I_N = 5\text{ V}$,		0.3	0.5	
t_{f3}		$V_{BS} = 16\text{ V}$, $I_N = 5\text{ V}$, $T_j = 25\text{ }^\circ\text{C}$		0.1	0.2	
t_{f4}		$V_{BS} = 16\text{ V}$, $I_N = 5\text{ V}$,		0.15	0.3	

Table 6. Electrical characteristics (continued)

Unless otherwise specified, $V_{CC} = 5\text{ V}$, $V_{BS} = 7\text{ V}$, $V_S = 0\text{ V}$, $I_N = 0\text{ V}$, $R_{ES} = 5\text{ V}$, load $R = 50\ \Omega$, $C = 2.5\text{ nF}$. Unless otherwise noted, these specifications apply for an operating ambient temperature range of $-40\text{ }^\circ\text{C} < T_{amb} < 125\text{ }^\circ\text{C}$.

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
t_{plhi}	Input-to-output turn-on propagation delay (50 % input level to 10 % output level)			0.1	0.35	μs
t_{phli}	Input-to-output turn-off propagation delay (50 % input level to 90 % output level)			0.1	0.4	
t_{plhr}	RES-to-output turn-on propagation delay (50 % input level to 10% output level)			0.1	0.4	
t_{phlr}	RES-to-output turn-off propagation delay (50 % input level to 90 % output level)			0.1	0.4	
Input characteristics						
V_{INH}	High logic level input threshold	$V_{CC} = 5\text{ V}$	0.6 V_{CC}			V
V_{INL}	Low logic level input threshold				0.28 V_{CC}	
R_{IN}	High logic level input resistance		60	100	250	$\text{k}\Omega$
I_{IN}	High logic level input current	$V_{IN} = V_{CC}$			5	μA
V_{RESH}	High logic level RES input threshold	$V_{CC} = 5\text{ V}$	0.6 V_{CC}			
V_{RESL}	Low logic level RES input threshold				0.28 V_{CC}	
R_{RES}	High logic level RES Input resistance		60	100	250	$\text{k}\Omega$
I_{RES}	Low logic level input current	$V_{RES} = 0$			5	μA
Recharge characteristics						
t_{on_rech}	Recharge transistor turn-on propagation delay	$V_S = 5\text{ V}$	3	6	9	μs
t_{off_rech}	Recharge transistor turn-off propagation delay			0.1	0.5	μs
V_{RECH}	Recharge output transistor on-state voltage drop	1 mA forced on recharge path on	0.5		1.2	V
Deadtime characteristics						
DT_{HOFF}	High side turn-off to recharge gate turn-on	$V_{CC} = 5\text{ V}$	3	6	9	μs
DT_{HON}	Recharge gate turn-off to high side turn-on		0.1	0.4	0.7	

2.5 Logic table

Table 7. Logic table

Supply voltages and thresholds		Signals		Output Ho	Recharge path
V _{CC}	V _{BS}	RESET-	IN-		
< V _{CCUV-}	X	X	X	OFF	ON
X	X	LOW	X	OFF	ON
X	X	X	HIGH	OFF	ON
> V _{CCUV+}	> V _{BSUV+}	HIGH	LOW	ON	OFF
> V _{CCUV+}	< V _{BSUV-}	HIGH	LOW	OFF	OFF

Note: X means independent from signal.

3 Timing diagrams

Figure 3. Input/output timing diagram

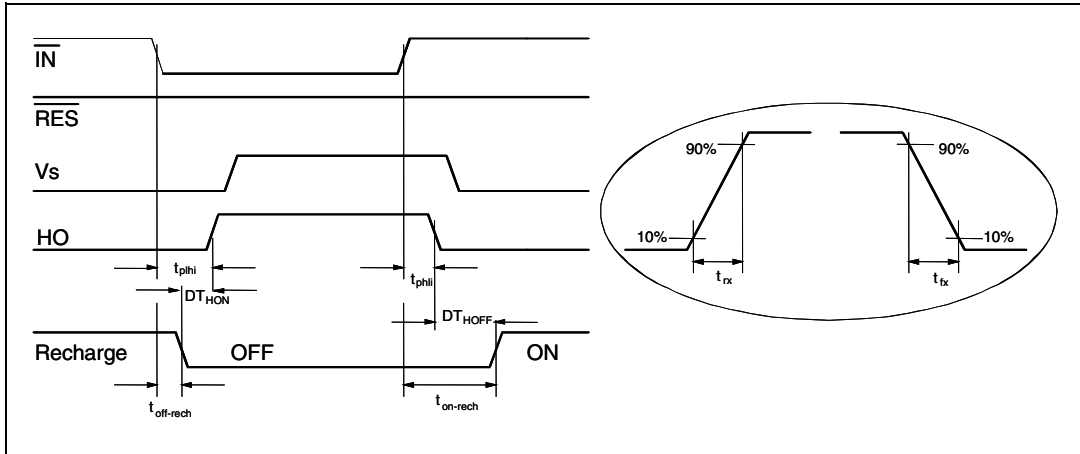
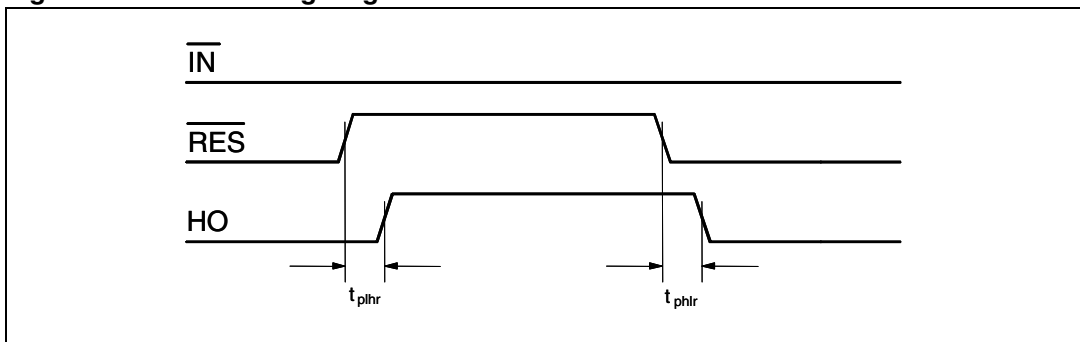


Figure 4. Reset timing diagram

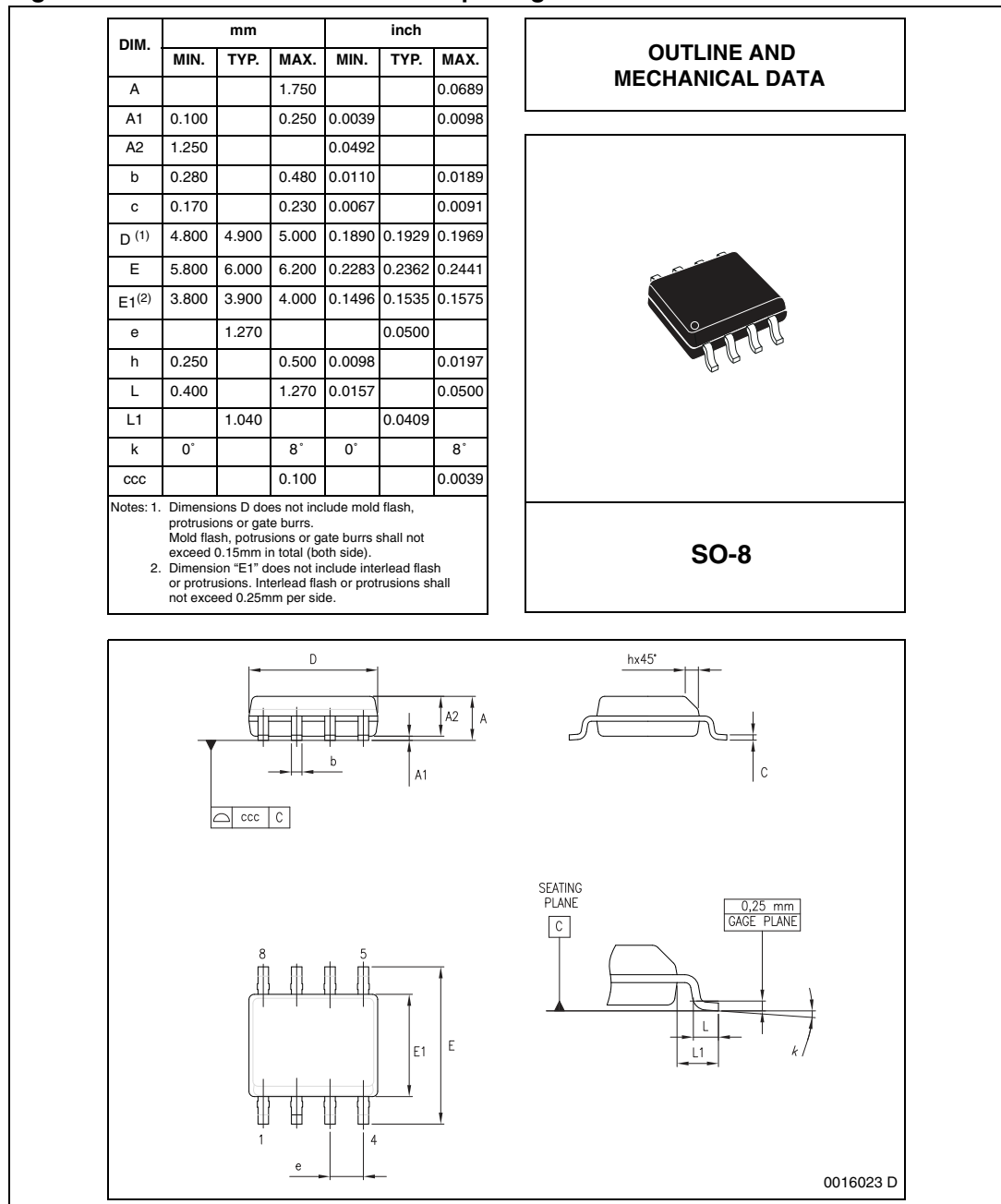


4 Package information

In order to meet environmental requirements, ST (also) offers these devices in ECOPACK® packages. ECOPACK® packages are lead-free. 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.

Figure 5. SO-8 mechanical data and package dimensions



5 Revision history

Table 8. Document revision history

Date	Revision	Changes
29-Jun-2007	1	Initial release.
30-May-2008	2	Update Features section on page 1. Updated Table 4: Absolute maximum ratings on page 6 . Updated Table 5: Recommended operating conditions on page 7 .
20-Sep-2013	3	Updated disclaimer.

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.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

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.

© 2013 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