



ST1S03A

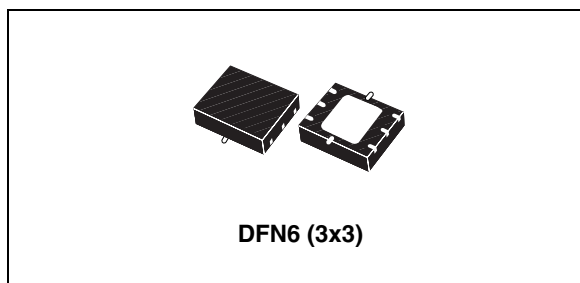
1.5A, 1.5 MHz Adjustable, with inhibit function Step-down switching regulator in DFN6 3x3

Features

- Step-down current mode PWM (1.5MHz) DC-DC converter
- 2% DC output voltage tolerance
- Internal soft start for start-up current limitation and power on delay of 50-100µs
- Typical efficiency: > 85%
- Inhibit function
- 1.5A Output current capability
- Not switching quiescent current: max 1.5mA over temperature range
- Switch V_{DS} : max 200mV @ $I_{SW}=750mA$
- Uses tiny capacitors and inductors
- Available in DFN6 3x3 exposed pad

Description

The ST1S03A is a step down DC-DC converter optimized for powering low-voltage digital core in HDD applications and, generally, to replace the high current linear solution when the power



dissipation may cause an high heating of the application environment. It provides up to 1.5A over an input voltage range of 3V to 5.5V. An high switching frequency (1.5MHz) allows the use of tiny surface-mount components: as well as the resistor divider to set the output voltage value, only an inductor, a schottky diode and two capacitors are required. Besides, a low output ripple is guaranteed by the current mode PWM topology and by the use of low E.S.R. SMD ceramic capacitors. The device is thermal protected and current limited to prevent damages due to accidental short circuit. The ST1S03A is available in DFN6 (3x3).

Order codes

Part number	Packaging	Package
ST1S03APMR	Tape & reel	DFN6 (3x3 mm)
ST1S03AIPMR	Tape & reel	DFN6 (3x3 mm)
ST1S03APUR	Tape & reel	DFN6D (3x3 mm)
ST1S03AIPUR	Tape & reel	DFN6D (3x3 mm)

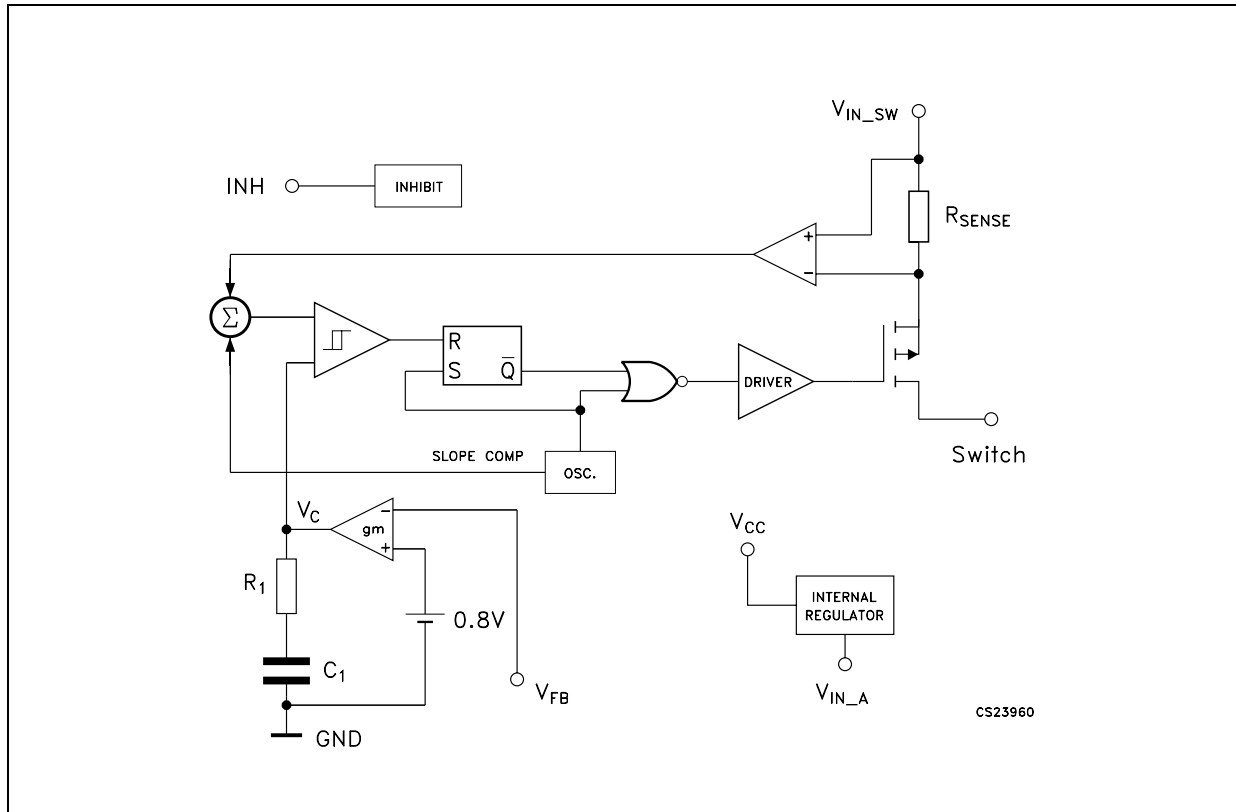
Contents

1	Diagram	3
2	Pin configuration	4
3	Maximum ratings	5
4	Electrical characteristics	6
5	Typical application	7
6	Package mechanical data	9
7	Revision history	12



1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin configuration (top view)

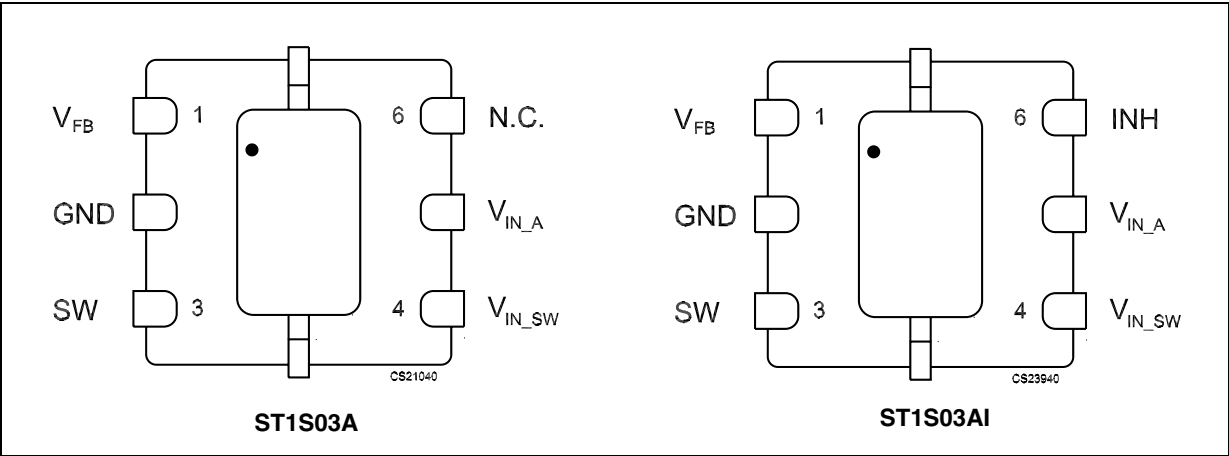


Table 1. Pin description

Pin N°	Symbol	Note
1	V_{FB}	Voltage of feedback
2	GND	System ground
3	SW	Output of the internal power switch
4	V_{IN_SW}	Power supply for the mosfet switch
5	V_{IN_A}	Power supply for the analog circuit
6	N.C./INH	Not connected / or inhibit

3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN_SW}	Positive power supply voltage	-0.3 to 7	V
V_{IN_A}	Positive power supply voltage	-0.3 to 7	V
V_{INH}	Max voltage of inhibit pin	-0.3 to 6	V
SWITCH Voltage	Max. voltage of output pin	-0.3 to 7	V
V_{FB}	Feedback voltage	2.5	V
I_{VFB}	Common mode input voltage	1	mA
T_J	Max junction temperature	150	°C
T_{STG}	Storage temperature range	-25 to 150	°C
T_{LEAD}	Lead temperature (soldering) 10 sec	300	°C

Note: Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional Operation under these conditions is not implied.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJA}	Thermal resistance junction-ambient	10	°C/W
R_{thJC}	Thermal resistance junction-case	55	°C/W

4 Electrical characteristics

Table 4. Electrical characteristics

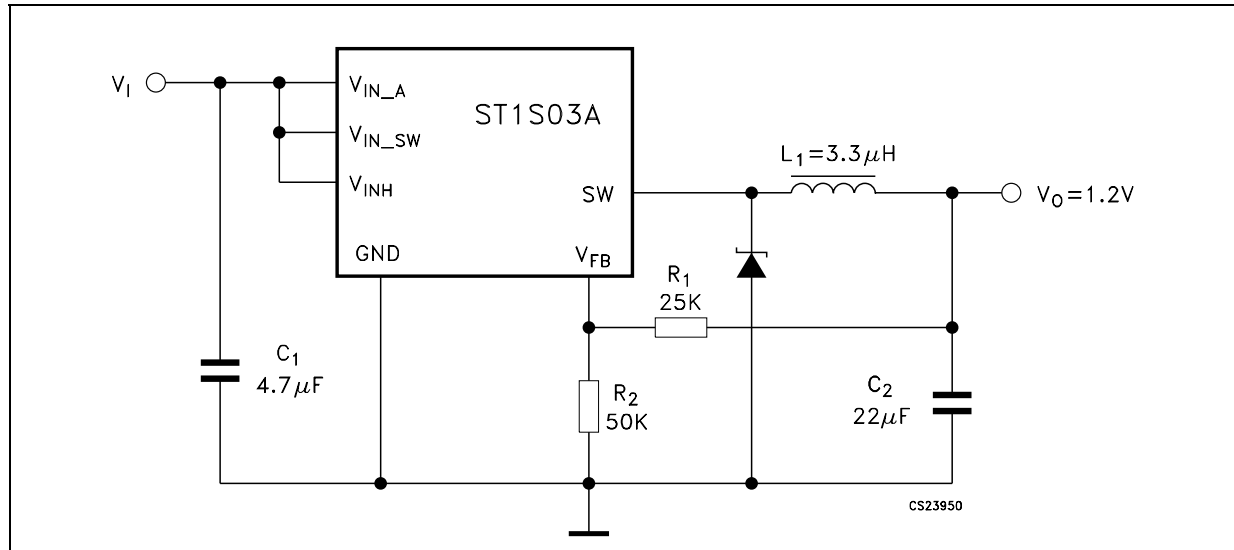
($V_{IN_SW} = V_{IN_A} = V_{INH} = 5V$, $C_1 = 4.7\mu F$, $C_O = 22\mu F$, $L1 = 3.3\mu H$, $T_J = 0$ to $125^\circ C$ (unless otherwise specified. Typical values are referred to $25^\circ C$)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
FB	Feedback voltage		784	800	816	mV
I_{FB}	V_{FB} Pin bias current				600	nA
I_Q	Quiescent current	$V_{INH} > 1.2V$			1.5	mA
		$V_{INH} < 0.4V$			1	μA
V_{INH}	Inhibit threshold	Device ON	1.2			V
		Device OFF			0.4	
I_O	Output current	$V_I = 2.7$ to $5.5V$	1.5			A
I_O	Output current	$V_I = 2.7$ to $5.5V$	0.8			A
I_{MIN}	Minimum output current		1			mA
$\%V_O/\Delta V_I$	Reference line regulation	$V_I = 2.7V$ to $5.5V$		0.2		$\%V_O/\Delta V_I$
$\%V_O/\Delta I_O$	Reference load regulation	$I_O = 10mA$ to $1.5A$		0.2		$\%V_O/\Delta I_O$
PWMf _S	PWM Switching frequency	$V_{FB} = 0.8V$, $T_A = 25^\circ C$ <i>Note: 1</i>	1.2	1.5	1.8	MHz
D _{MAX}	Maximum duty cycle			87		%
I_{SW}	Switching current limitation		2.5			A
V_{DS}	Switch V_{DS}	$I_{SW} = 800mA$			200	mV
η	Efficiency	$I_O = 10mA$ to $100mA$, $V_O = 3.3V$	70			%
		$I_O = 100mA$ to $1.5A$, $V_O = 3.3V$	85			
T_{SHDN}	Thermal shutdown	<i>Note: 1</i>	130	150		$^\circ C$
T_{HYS}	Thermal shutdown hysteresis	<i>Note: 1</i>		15		$^\circ C$
$\%V_O/\Delta I_O$	Load transient response	$I_O = 100mA$ to $1.5A$, $T_A = 25^\circ C$ $t_R = t_F \geq 100ns$, <i>Note: 1</i>	-3		+3	$\%V_O$
$\%V_O/\Delta I_O$ @ $I_O=Short$	Short circuit removal response	$I_O = 10mA$ to short, $T_A = 25^\circ C$ <i>Note: 1</i>	-10		+10	$\%V_O$

Note: 1 Guaranteed by design, but not tested in production

5 Typical application

Figure 3. Application circuit



Application notes

The ST1S03A is an adjustable current mode PWM step-down DC/DC converter with internal 1.5A power switch, packaged in a 6-lead DFN 3x3.

It's a complete 1.5A switching regulator with its internal compensation eliminating additional component.

The constant frequency, current mode, PWM architecture and stable operation with ceramic capacitors results in low, predictable output ripple. However, in order to maximize the power conversion efficiency with light load, the regulator reduces automatically the switching frequency when the output load becomes less than 250mA typically.

To clamp the error amplifier reference voltage a Soft Start control block generating a voltage ramp, has been implemented. Besides an On-Chip Power on Reset of 50=100μs ensure the proper operation when switching on the power supply. Other circuits fitted to the device protection are the Thermal Shut down block which turn off the regulator when the junction temperature exceeds 150°C typically and the Cycle-by-cycle Current Limiting that provides protection against shorted outputs.

Being the ST1S03A an adjustable regulator, the output voltage is determined by an external resistor divider. The desired value is given by the following equation:

$$V_O = V_{FB}[1+R1/R2]$$

To make the device working, only other four external components are required: an inductor a schottky and two capacitors. The chosen inductor must be able to not saturate at the peak current level. Besides, its value can be selected keeping in account that a large inductor value increases the efficiency at low output current and reduces output voltage ripple, while a smaller inductor can be chosen when it is important to reduce the package size and the total cost of the application. Finally, the ST1S03A has been designed to work properly with X5R or X7R SMD ceramic capacitors both at the input and at the output this kind of capacitors, thanks to their very low series resistance (ESR), minimize the output voltage ripple. Other low ESR capacitors can be used according to the need of the application without invalidate the right functioning of the device.

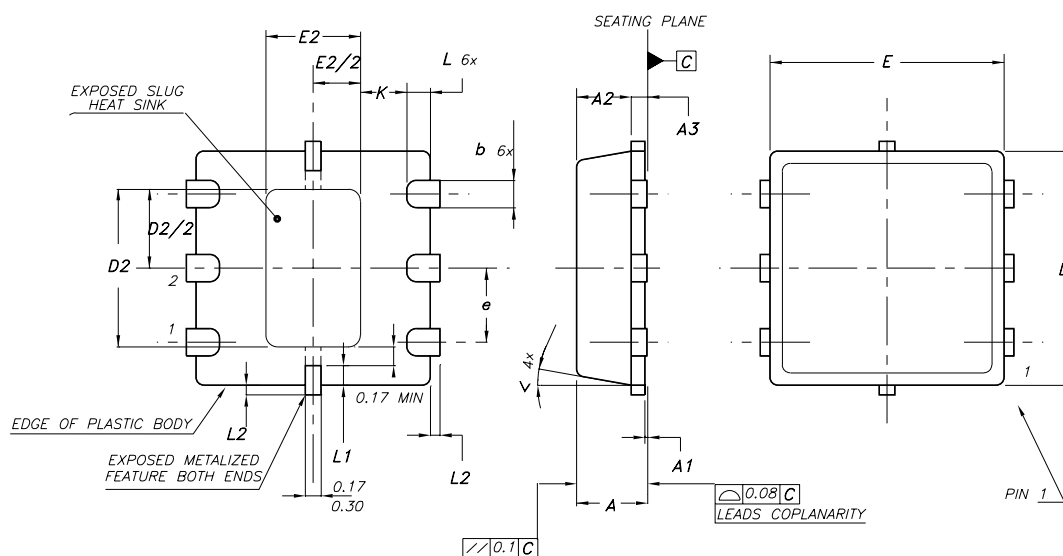
Due to the high switching frequency and peak current, it is important to optimize the application environment reducing the length of the PCB traces and placing all the external component near the device.

6 Package mechanical data

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.

DFN6 (3x3) MECHANICAL DATA

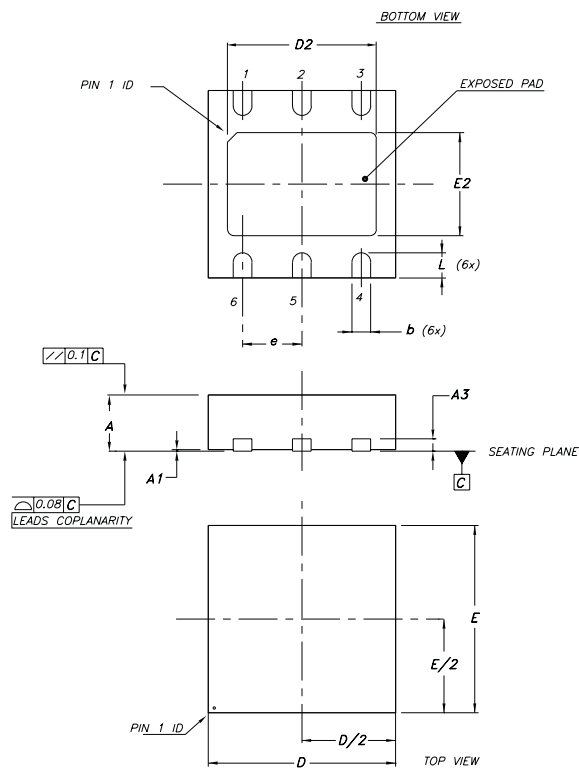
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.80		1.00	31.5		39.4
A1	0		0.05	0.0		2.0
A2	0.65		0.75	25.6		29.5
A3		0.20			7.9	
b	0.33		0.43	13.0		16.9
D	2.90	3.00	3.10	114.2	118.1	122.0
D2	1.92		2.12	75.6		83.5
E	2.90	3.00	3.10	114.2	118.1	122.0
E2	1.11		1.31	43.7		51.6
e		0.95			37.4	
L	0.20		0.45	7.9		17.7
L1		0.24			9.4	
L2			0.13			5.1
K	0.20			7.9		



7387339A

DFN6D (3x3) Mechanical Data

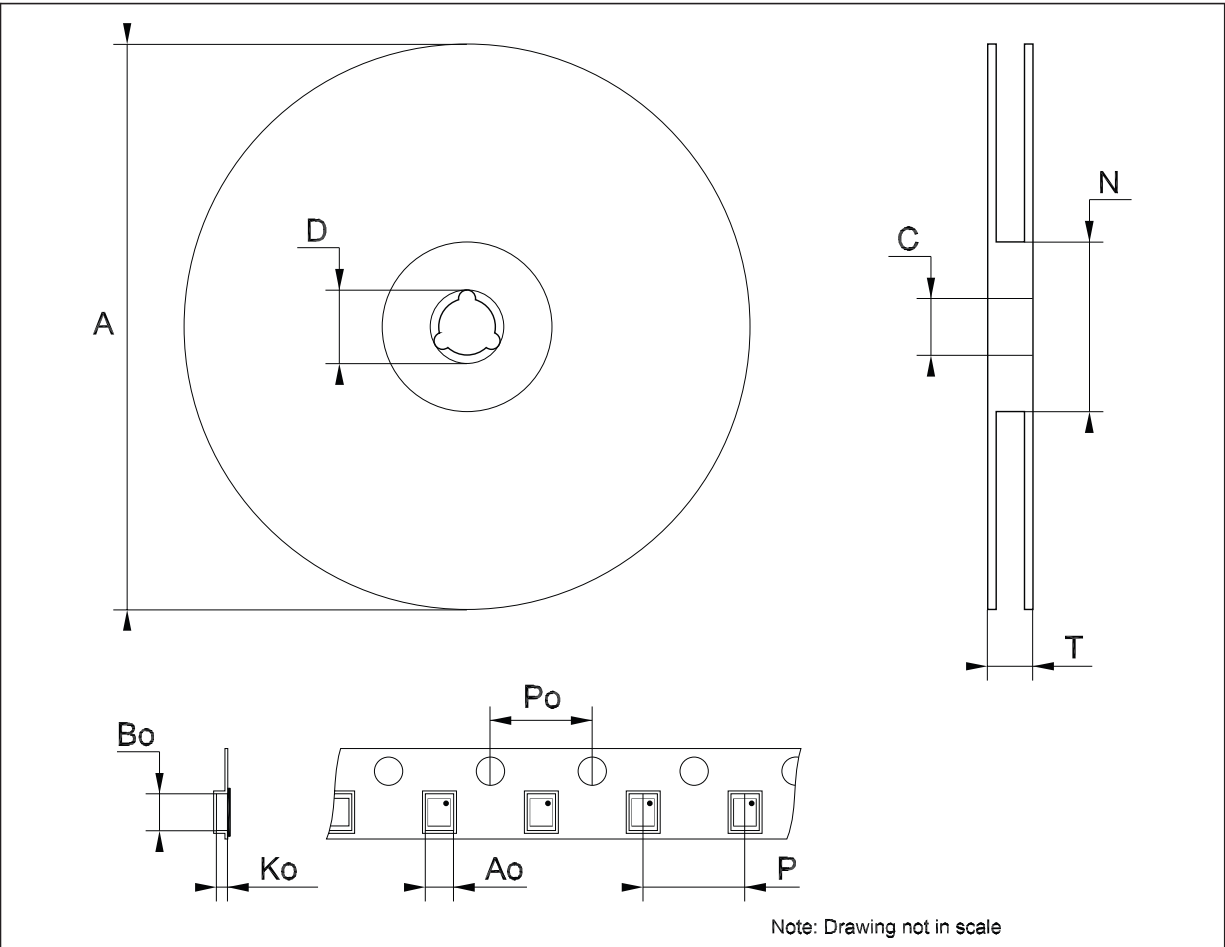
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80		1.00	0.031		0.039
A1	0	0.02	0.05	0	0.001	0.002
A3		0.20			0.008	
b	0.23		0.45	0.009		0.018
D	2.90	3.00	3.10	0.114	0.118	0.122
D2	2.23		2.50	0.088		0.098
E	2.90	3.00	3.10	0.114	0.118	0.122
E2	1.50		1.75	0.059		0.069
e		0.95			0.037	
L	0.30	0.40	0.50	0.012	0.016	0.020



7946637B

Tape & Reel QFNxx/DFNxx (3x3) Mechanical Data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			18.4			0.724
Ao		3.3			0.130	
Bo		3.3			0.130	
Ko		1.1			0.043	
Po		4			0.157	
P		8			0.315	



7 Revision history

Table 5. Revision history

Date	Revision	Changes
04-May-2006	1	First release.
06-Jun-2006	2	Table 2. has been updated.
29-May-2007	3	Add new mechanical data DFN6D and order codes has been updated.

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.

© 2007 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