

## High efficiency rectifier

### Features

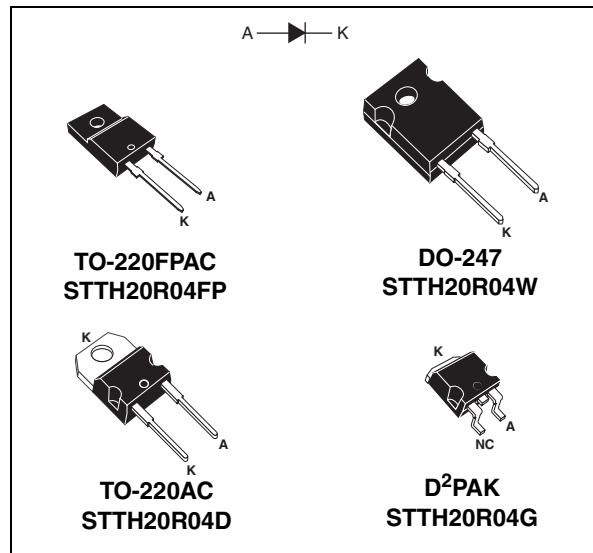
- Ultrafast recovery
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature

### Description

The **STTH20R04** is an ultrafast recovery power rectifier dedicated to **energy recovery in PDP application**.

It is especially designed for clamping function in energy recovery block.

The compromise between forward voltage drop and recovery time offers optimized performances.



**Table 1. Device summary**

$I_{F(\text{peak})}$	20 A
$V_{RRM}$	400 V
$t_{rr} (\text{typ})$	18 ns
$T_j$	175 °C
$V_F (\text{typ})$	1.15 V

# 1 Characteristics

**Table 2. Absolute ratings (limiting values)**

Symbol	Parameter		Value	Unit	
$V_{RRM}$	Repetitive peak reverse voltage		400	V	
$I_{F(RMS)}$	RMS forward current		50	A	
$I_{F(peak)}$	Peak working forward current	DO-247, TO-220AC, D <sup>2</sup> PAK	$T_c = 135\text{ °C}$ $\delta = 0.5$ Square signal	20	A
		TO-220FPAC	$T_c = 105\text{ °C}$ $\delta = 0.5$ Square signal		
$I_{FSM}$	Surge non repetitive forward current		$t_p = 10\text{ ms}$ sinusoidal	150	A
$T_{stg}$	Storage temperature range		-65 to + 175	°C	
$T_j$	Maximum operating junction temperature		175	°C	

**Table 3. Thermal parameters**

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case	DO-247, TO-220AC, D <sup>2</sup> PAK	2.8	°C/W
		TO-220FPAC	5	

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
$I_R^{(1)}$	Reverse leakage current	$T_j = 25\text{ °C}$	$V_R = V_{RRM}$			20	$\mu\text{A}$
		$T_j = 125\text{ °C}$			20	200	
$V_F^{(2)}$	Forward voltage drop	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$		1.5	1.7	V
		$T_j = 125\text{ °C}$			1.15	1.35	

1. Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

2. Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:

$$P = 1.05 \times I_{F(AV)} + 0.015 I_{F(RMS)}^2$$

**Table 5. Recovery characteristics**

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
$t_{rr}$	Reverse recovery time	$T_j = 25\text{ °C}$	$I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ , $I_R = 1\text{ A}$		18	25	ns
			$I_F = 1\text{ A}$ , $V_R = 30\text{ V}$ , $di_F/dt = -50\text{ A}/\mu\text{s}$		35	45	
$t_{fr}$	Forward recovery time	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ $V_{FR} = 1.1 \times V_{Fmax}$			150	ns
$V_{FP}$	Peak forward voltage	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$		1.7	2.5	V
$I_{RM}$	Reverse recovery current	$T_j = 125\text{ °C}$	$I_F = 20\text{ A}$ , $V_{CC} = 200\text{ V}$ $di_F/dt = 200\text{ A}/\mu\text{s}$		8	11	A
$S_{factor}$	Softness factor				0.3		

Figure 1. Conduction losses versus average forward current

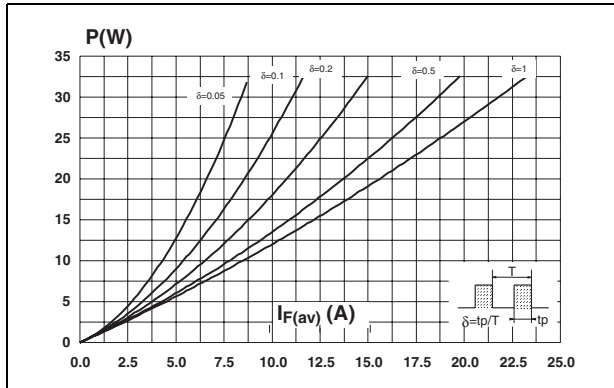


Figure 2. Forward voltage drop versus forward current

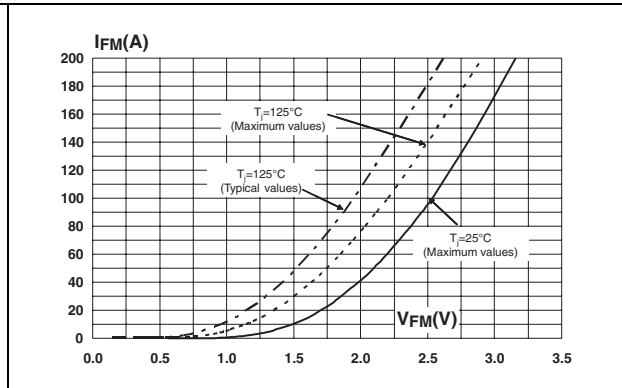


Figure 3. Relative variation of thermal impedance junction to case versus pulse duration

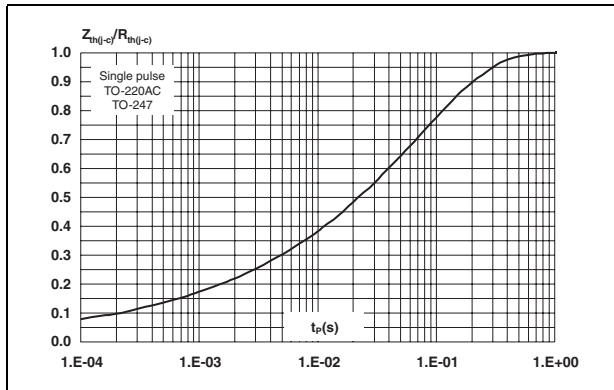


Figure 4. Relative variation of thermal impedance junction to case versus pulse duration

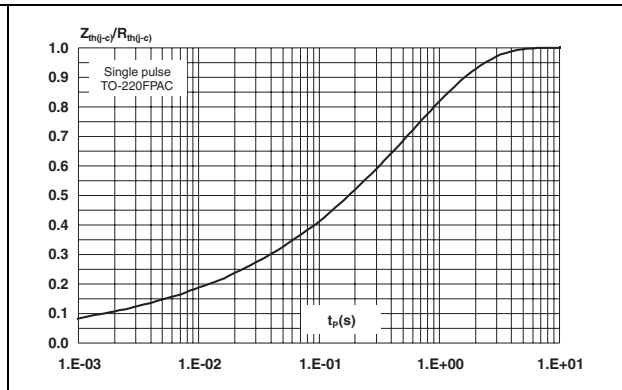


Figure 5. Peak reverse recovery current versus di\_F/dt (typical values)

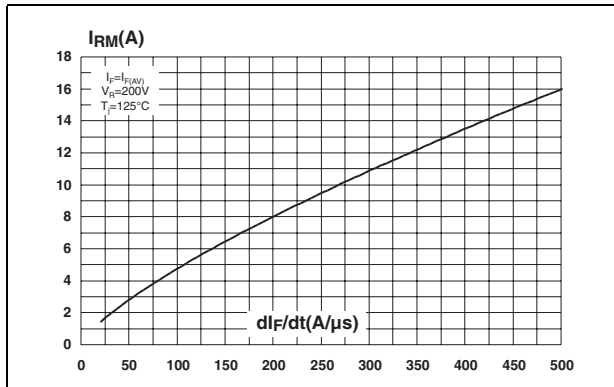


Figure 6. Reverse recovery time versus di\_F/dt (typical values)

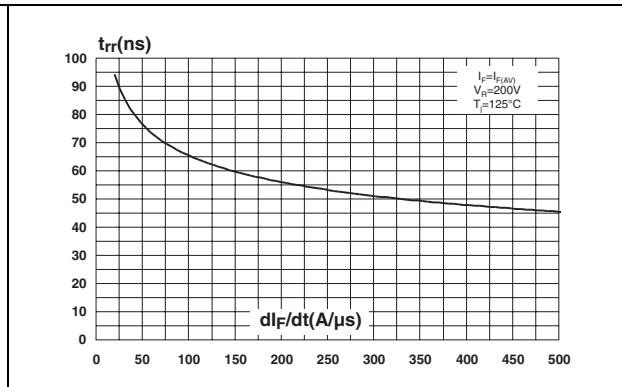


Figure 7. Reverse recovery charges versus  $di_F/dt$  (typical values)

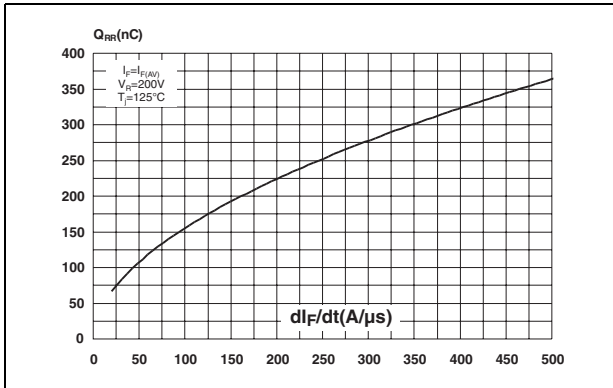


Figure 8. Reverse recovery softness factor versus  $di_F/dt$  (typical values)

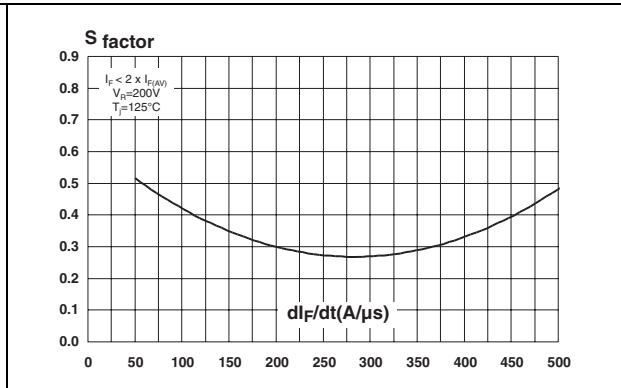


Figure 9. Relative variations of dynamic parameters versus junction temperature

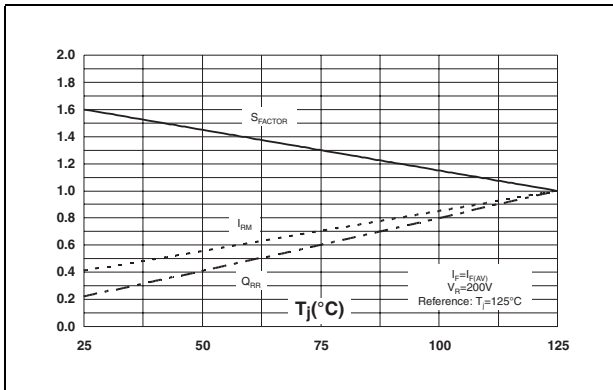


Figure 10. Transient peak forward voltage versus  $di_F/dt$  (typical values)

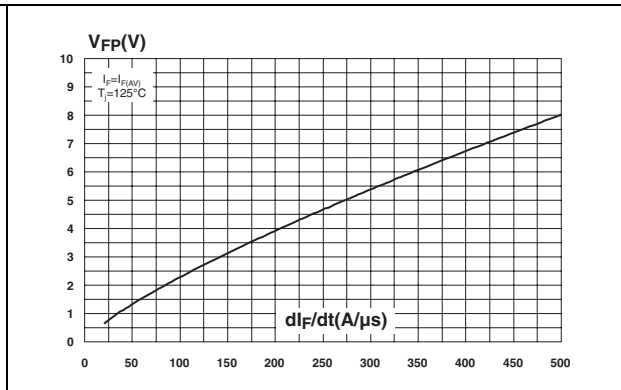


Figure 11. Forward recovery time versus  $di_F/dt$  (typical values)

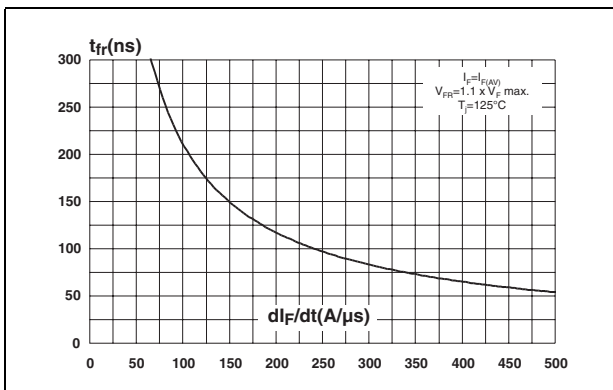
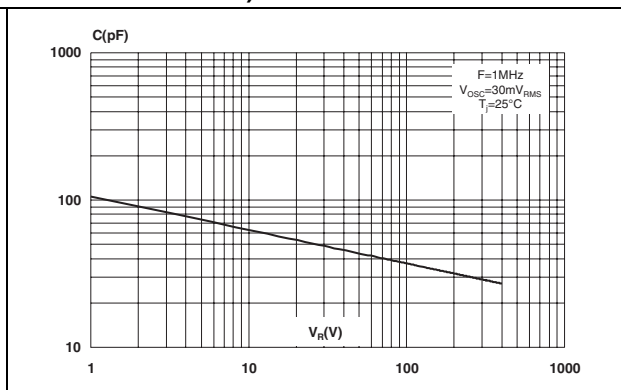


Figure 12. Junction capacitance versus reverse voltage applied (typical values)

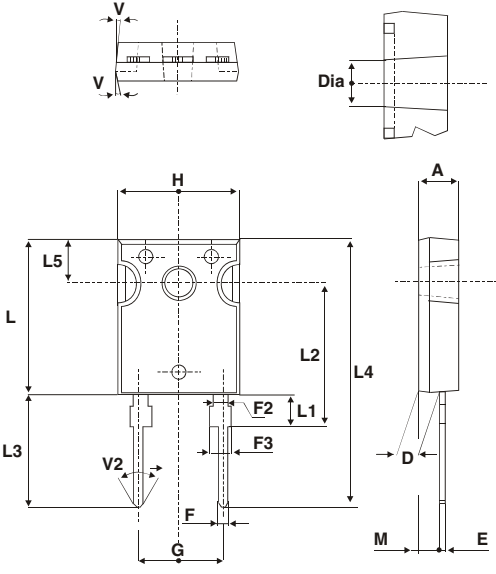


## 2 Package information

- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.8 N·m
- Maximum torque value: 1.0 N·m

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).

**Table 6. DO-247 dimensions**



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.85		5.15	0.191		0.203
D	2.20		2.60	0.086		0.102
E	0.40		0.80	0.015		0.031
F	1.00		1.40	0.039		0.055
F2		2.00			0.078	
F3	2.00		2.40	0.078		0.094
G		10.90			0.429	
H	15.45		15.75	0.608		0.620
L	19.85		20.15	0.781		0.793
L1	3.70		4.30	0.145		0.169
L2		18.50			0.728	
L3	14.20		14.80	0.559		0.582
L4		34.60			1.362	
L5		5.50			0.216	
M	2.00		3.00	0.078		0.118
V		5°			5°	
V2		60°			60°	
Dia.	3.55		3.65	0.139		0.143

Table 7. TO-220AC dimensions

The technical drawing shows two views of a TO-220AC package. The top view (left) shows a rectangular body with a central circular feature of diameter  $\phi I$ . Dimensions include H2 (width), L2 (total height), L5 (height to top of body), L6 (height to top of leads), L9 (lead length), L4 (total lead length), F1 (lead thickness), F (lead width), and G (lead spacing). The side view (right) shows the profile of the package with dimensions A (total height), C (height to top of body), L7 (height to top of leads), D (lead length), M (lead thickness), and E (lead width).

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
H2	10.00	10.40	0.393	0.409
L2	16.40 typ.		0.645 typ.	
L4	13.00	14.00	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam. I	3.75	3.85	0.147	0.151

Table 8. D<sup>2</sup>PAK dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
A2	0.03	0.23	0.001	0.009
B	0.70	0.93	0.027	0.037
B2	1.14	1.70	0.045	0.067
C	0.45	0.60	0.017	0.024
C2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
E	10.00	10.40	0.393	0.409
G	4.88	5.28	0.192	0.208
L	15.00	15.85	0.590	0.624
L2	1.27	1.40	0.050	0.055
L3	1.40	1.75	0.055	0.069
M	2.40	3.20	0.094	0.126
R	0.40 typ.		0.016 typ.	
V2	0°	8°	0°	8°

Figure 13. D<sup>2</sup>PAK footprint (dimensions in mm)

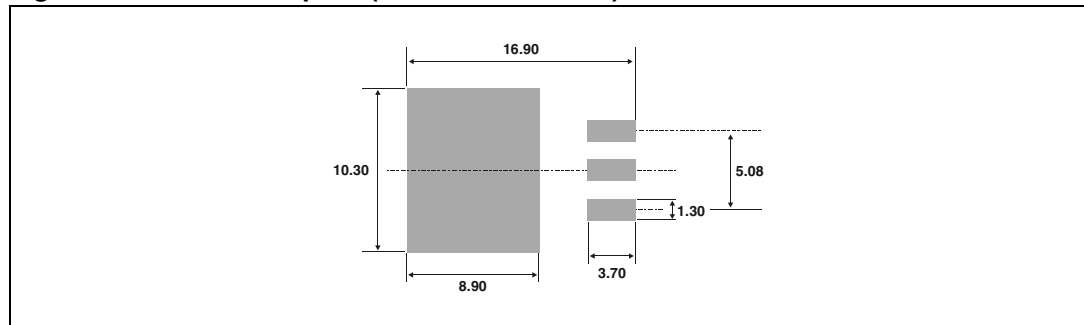


Table 9. TO-220FPAC dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		0.63 Typ.	
L3	28.6	30.6	1.126	1.205
L4	9.8	10.6	0.386	0.417
L5	2.9	3.6	0.114	0.142
L6	15.9	16.4	0.626	0.646
L7	9.00	9.30	0.354	0.366
Dia.	3.00	3.20	0.118	0.126



### 3 Ordering information

Table 10. Ordering information

Order code	Marking	Package	Weight	Base qty	Delivery mode
STTH20R04FP	STTH20R04FP	TO-220FPAC	1.64 g	50	Tube
STTH20R04D	STTH20R04D	TO-220AC	1.86 g	50	Tube
STTH20R04W	STTH20R04W	DO-247	4.4 g	50	Tube
STTH20R04G	STTH20R04G	D <sup>2</sup> PAK	1.48 g	50	Tube
STTH20R04G-TR	STTH20R04G			1000	Tape and reel

### 4 Revision history

Table 11. Document revision history

Date	Revision	Description of changes
08-Nov-2007	1	First issue

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