



STP180NS04ZC

N-channel clamped 3.5 mΩ - 120 A TO-220
fully protected SAFeFET™ Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D
STP180NS04ZC	Clamped	< 4.2 mΩ	120 A

- Low capacitance and gate charge
- 100% avalanche tested
- 175°C maximum junction temperature

Applications

- Switching application

Description

This fully clamped Power MOSFET is produced by using the latest advanced company's mesh OVERLAY process which is based on a novel strip layout. The inherent benefits of the new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encountered in the automotive environment. Any other application requiring extra ruggedness is also recommended.

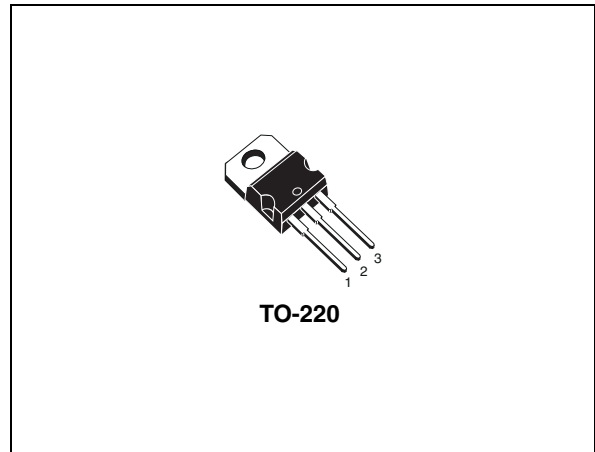


Figure 1. Internal schematic diagram

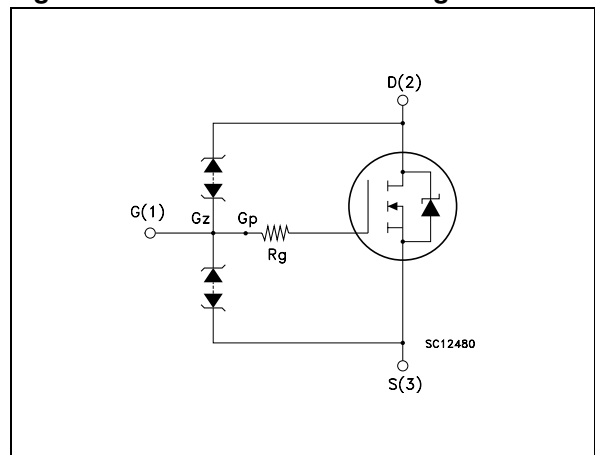


Table 1. Device summary

Order code	Marking	Package	Packaging
STP180NS04ZC	P180NS04ZC	TO-220	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuit	9
4	Package mechanical data	10
5	Revision history	11

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	33 ⁽¹⁾	V
V_{DG}	Drain-gate voltage	33 ⁽¹⁾	V
V_{GS}	Gate-source voltage	± 20 ⁽¹⁾	V
I_D ⁽²⁾	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	120	A
I_D ⁽²⁾	Drain current (continuous) at $T_C=100\text{ }^\circ\text{C}$	120	A
I_{DG}	Drain gate current (continuous)	± 50	mA
I_{GS}	Gate-source current (continuous)	± 50	mA
I_{DM} ⁽³⁾	Drain current (pulsed)	480	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	300	W
	Derating factor	2	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate-source ESD (HBM-C=100 pF, R=1.5 k Ω)	± 8	kV
$V_{ESD(G-D)}$	Gate-drain ESD (HBM-C=100 pF, R=1.5 k Ω)	± 8	kV
$V_{ESD(D-S)}$	Drain-source ESD (HBM-C=100 pF, R=1.5 k Ω)	± 8	kV
T_J	Operating junction temperature	-55 to 175	$^\circ\text{C}$
T_{stg}	Storage temperature		

1. Voltage is limited by zener diodes
2. Current limited by wire bonding
3. Pulse width limited by safe operating area

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.50	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C}/\text{W}$
T_I	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax} $\delta < 1\%$)	80	A
E_{AS}	Single pulse avalanche energy (starting $T_j=25\text{ }^\circ\text{C}$, $I_D=I_{AS}$, $V_{DD}=21\text{ V}$) (see Figure 17, Figure 14.)	1000	mJ

2 Electrical characteristics

($T_{CASE}=25^{\circ}\text{C}$ unless otherwise specified)

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DG}$	Clamped voltage	$I_D = 1 \text{ mA}$, $V_{GS} = 0$ $-40 < T_j < 175^{\circ}\text{C}$	33		41	V
$V_{DSR(CL)}$	Drain-source clamping voltage (DC)	$I_{GS(CL)} = -2 \text{ mA}$, $I_D = 1 \text{ A}$		41		V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 16 \text{ V}$ $V_{DS} = 16 \text{ V}$, $T_j = 150^{\circ}\text{C}$ $V_{DS} = 16 \text{ V}$, $T_j = 175^{\circ}\text{C}$			1 50 100	μA μA μA
$I_{GSS}^{(1)}$	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 10 \text{ V}$ $V_{GS} = \pm 10 \text{ V}$, $T_j = 175^{\circ}\text{C}$ $V_{GS} = \pm 16 \text{ V}$, $T_j = 175^{\circ}\text{C}$			2 50 150	μA μA μA
V_{GSS}	Gate-source breakdown voltage	$I_{GS} = \pm 100 \mu\text{A}$	18		25	V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 1 \text{ mA}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}$, $I_D = 40 \text{ A}$		3.5	4.2	$\text{m}\Omega$
R_G	Internal gate resistor			14		Ω

1. Gate Oxide, without zener diodes, tested at wafer sorting ($I_{GSS} < \pm 100 \text{ nA}$ @ $\pm 20 \text{ V}$ $T_j=25^{\circ}$). [Figure 17.: Unclamped Inductive load test circuit](#) for electrical schematics

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15 \text{ V}$, $I_D = 40 \text{ A}$		95		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GS} = 0$		4560 1700 550		pF pF pF
$t_{r(Voff)}$ t_f t_c	Off voltage rise time Fall time Cross-over time	$V_{CLAMP} = 30 \text{ V}$, $I_D = 80 \text{ A}$, $V_{GS} = 10 \text{ V}$, $R_G = 4.7 \Omega$ (see Figure 16)		250 115 290		ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 20 \text{ V}$, $I_D = 120 \text{ A}$ $V_{GS} = 10 \text{ V}$ (see Figure 15)		110 29 40		nC nC nC

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				120	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				480	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=120\text{ A}$, $V_{GS}=0$			1.5	V
t_{rr}	Reverse recovery time	$I_{SD}=120\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,		56		ns
Q_{rr}	Reverse recovery charge	$V_{DD}=32\text{ V}$, $T_j=150\text{ }^\circ\text{C}$		70		nC
I_{RRM}	Reverse recovery current	(see Figure 16)		12		A

1. Pulse width limited by safe operating area
2. Pulsed: pulse duration=300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

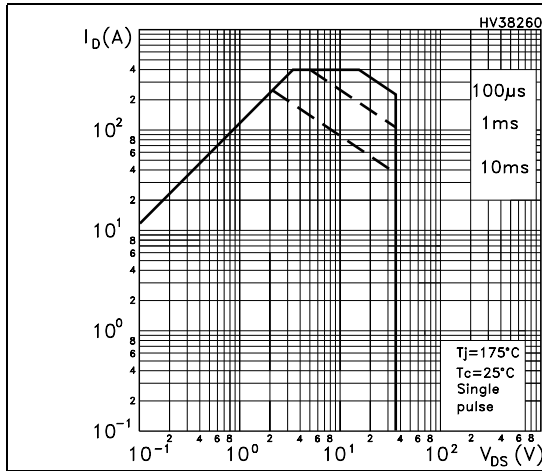


Figure 3. Thermal impedance

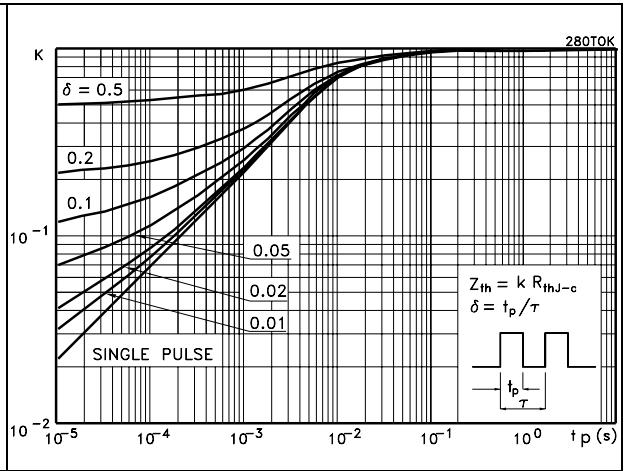


Figure 4. Output characteristics

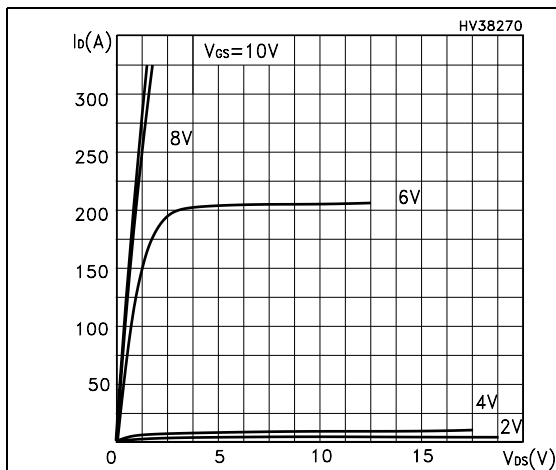


Figure 5. Transfer characteristics

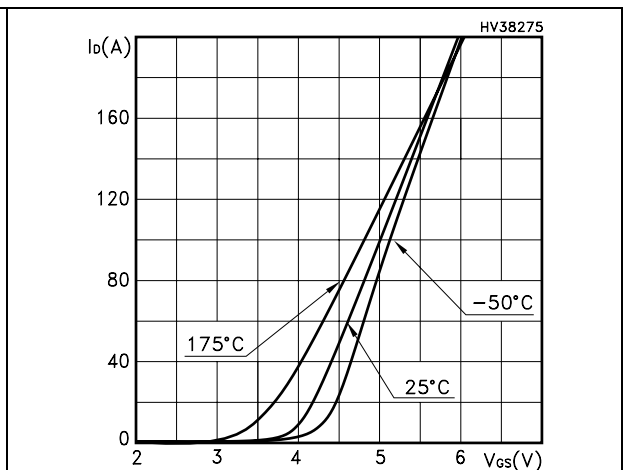


Figure 6. Transconductance

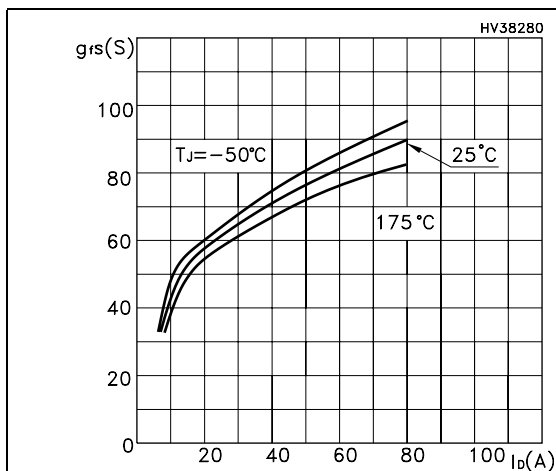


Figure 7. Static drain-source on resistance

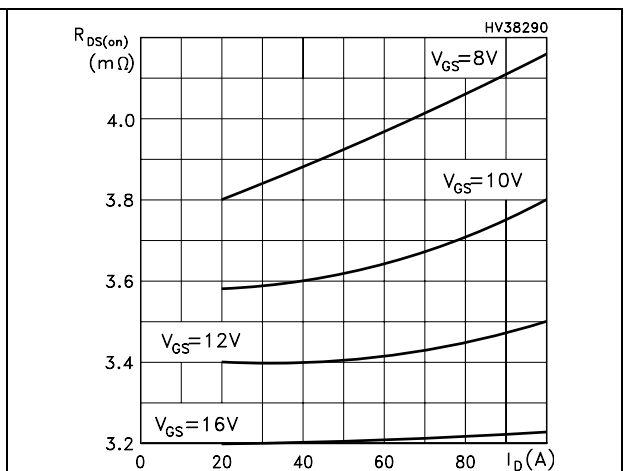


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

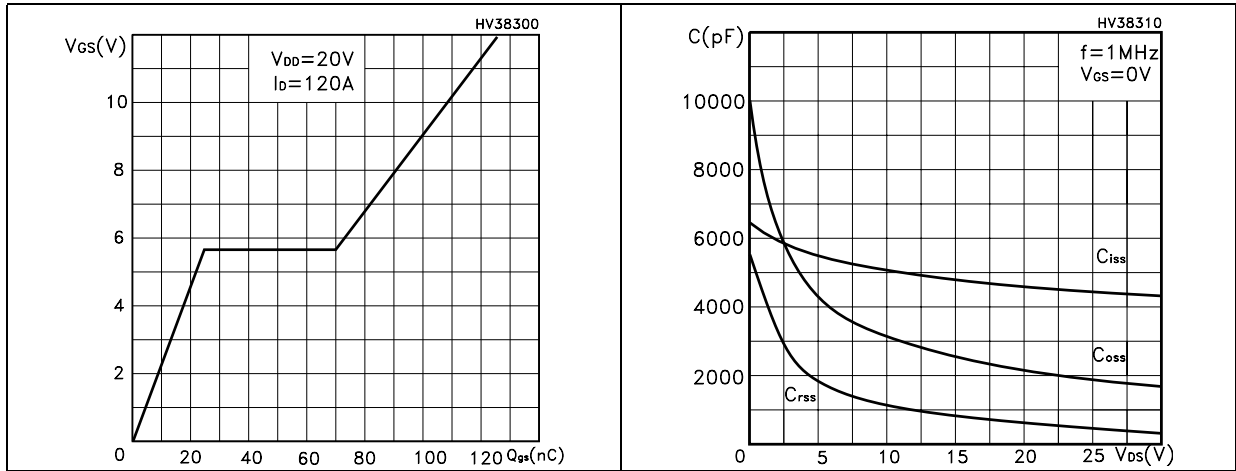


Figure 10. Normalized gate threshold voltage vs temperature

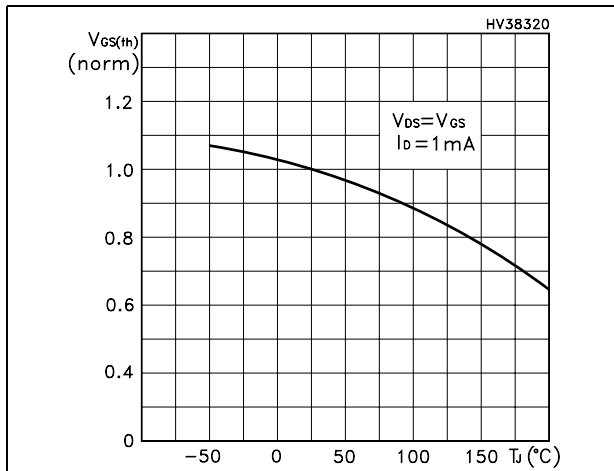


Figure 11. Normalized on resistance vs temperature

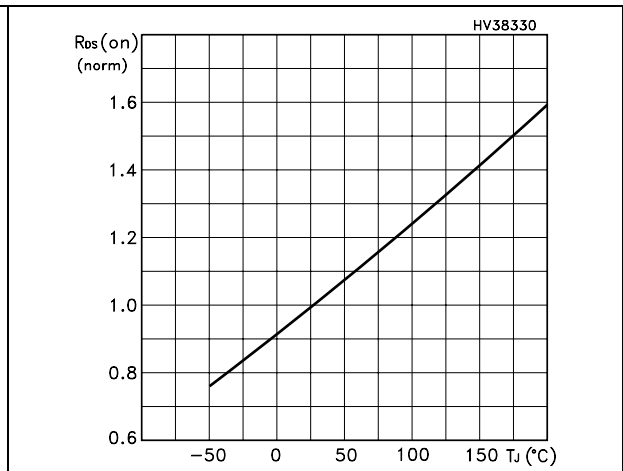


Figure 12. Source-drain diode forward characteristics

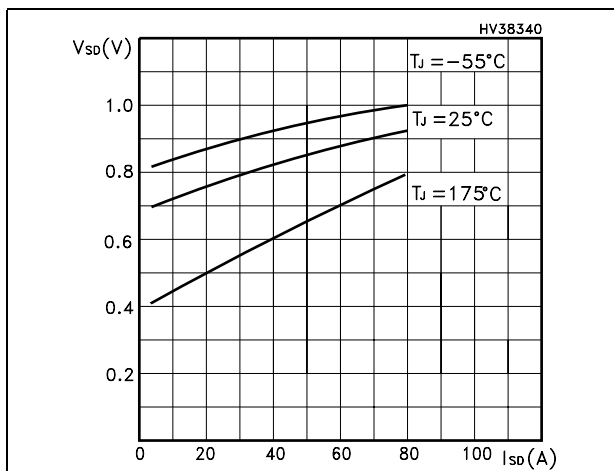
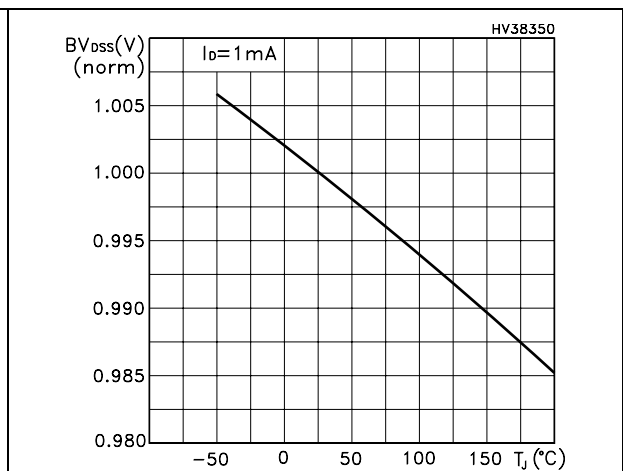


Figure 13. Normalized BV_{DSS} vs temperature

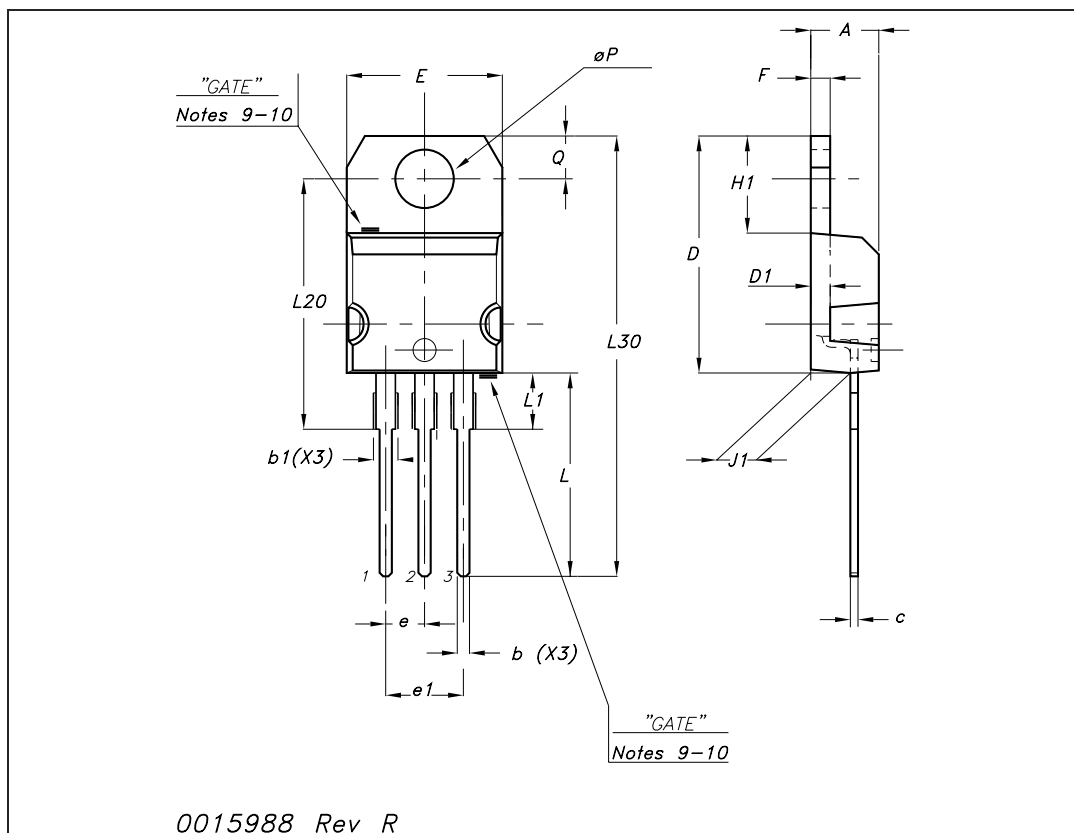


4 Package mechanical data

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

TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



5 Revision history

Table 8. Document revision history

Date	Revision	Changes
03-Apr-2008	1	First 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 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.

© 2008 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