

## N-channel 650 V, 0.075 Ω typ., 22.5 A MDmesh™ V Power MOSFET in PowerFLAT™ 8x8 HV package

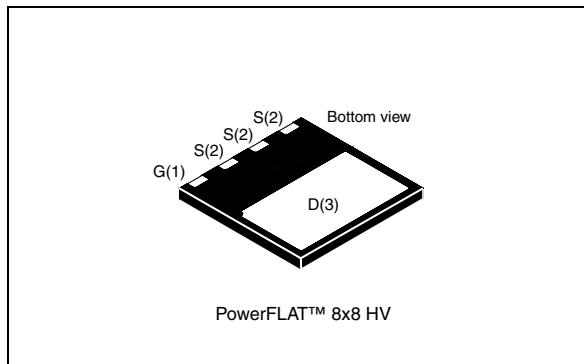
Datasheet — preliminary data

### Features

Order code	V <sub>DSS</sub> @ T <sub>Jmax</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STL45N65M5	710 V	< 0.086 Ω	22.5 A <sup>(1)</sup>

1. The value is rated according to R<sub>thj-case</sub> and limited by package.

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance



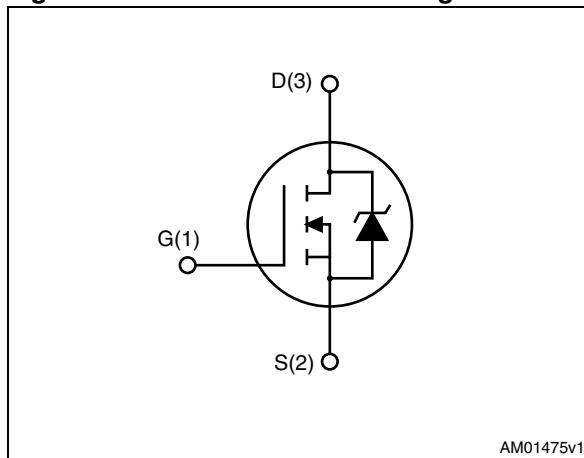
### Applications

- Switching applications

### Description

This device is an N-channel MDmesh™ V Power MOSFET based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESHTM horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Figure 1. Internal schematic diagram



AM01475v1

Table 1. Device summary

Order code	Marking	Package	Packaging
STL45N65M5	45N65M5	PowerFLAT™ 8x8 HV	Tape and reel

## Contents

<b>1</b>	<b>Electrical ratings</b>	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b>	<b>4</b>
2.1	Electrical characteristics (curves)	6
<b>3</b>	<b>Test circuits</b>	<b>9</b>
<b>4</b>	<b>Package mechanical data</b>	<b>10</b>
<b>5</b>	<b>Packaging mechanical data</b>	<b>14</b>
<b>6</b>	<b>Revision history</b>	<b>16</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	650	V
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	22.5	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	18	A
$I_{DM}^{(1),(2)}$	Drain current (pulsed)	90	A
$I_D^{(3)}$	Drain current (continuous) at $T_{amb} = 25^\circ\text{C}$	3.8	A
$I_D^{(3)}$	Drain current (continuous) at $T_{amb} = 100^\circ\text{C}$	2.4	A
$P_{TOT}^{(3)}$	Total dissipation at $T_{amb} = 25^\circ\text{C}$	2.8	W
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25^\circ\text{C}$	160	W
$I_{AR}$	Avalanche current, repetitive or non-repetitive (pulse width limited by $T_j$ max)	9	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50$ V)	810	mJ
$dv/dt^{(4)}$	Peak diode recovery voltage slope	15	V/ns
$T_{stg}$	Storage temperature	- 55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

1. The value is rated according to  $R_{thj-case}$  and limited by package.
2. Pulse width limited by safe operating area.
3. When mounted on FR-4 board of inch<sup>2</sup>, 2oz Cu.
4.  $I_{SD} \leq 22.5$  A,  $di/dt \leq 400$  A/ $\mu\text{s}$ ,  $V_{DD} = 400$  V,  $V_{DS(\text{peak})} < V_{(BR)DSS}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.78	$^\circ\text{C}/\text{W}$
$R_{thj-amb}^{(1)}$	Thermal resistance junction-ambient max	45	$^\circ\text{C}/\text{W}$

1. When mounted on FR-4 board of inch<sup>2</sup>, 2oz Cu.

## 2 Electrical characteristics

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

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	650			V
$I_{\text{DSS}}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 650 \text{ V}$ $V_{DS} = 650 \text{ V}, T_C = 125^\circ\text{C}$			1 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25 \text{ V}$			$\pm 100$	nA
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	3	4	5	V
$R_{DS(\text{on})}$	Static drain-source on-resistance	$V_{GS} = 10 \text{ V}, I_D = 14.5 \text{ A}$		0.075	0.086	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance					pF
$C_{oss}$	Output capacitance					pF
$C_{rss}$	Reverse transfer capacitance	$V_{DS} = 100 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0$	-	3470 82 7	-	pF
$C_{o(er)}^{(1)}$	Equivalent output capacitance energy related			79	-	pF
$C_{o(tr)}^{(2)}$	Equivalent output capacitance time related	$V_{GS} = 0,$ $V_{DS} = 0 \text{ to } 80\% V_{(\text{BR})\text{DSS}}$	-	280	-	pF
$R_G$	Intrinsic gate resistance	$f = 1 \text{ MHz open drain}$	-	2	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520 \text{ V}, I_D = 17.5 \text{ A}, V_{GS} = 10 \text{ V}$		82		nC
$Q_{gs}$	Gate-source charge			18.5	-	nC
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 16</a> )		35		nC

1. Energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$
2. Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_d(v)$	Voltage delay time			79.5		ns
$t_r(v)$	Voltage rise time	$V_{DD} = 400 \text{ V}$ , $I_D = 22.5 \text{ A}$ ,	-	11	-	ns
$t_f(i)$	Current fall time	$R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$		9.3	-	ns
$t_c(\text{off})$	Crossing time	(see <i>Figure 20</i> )		16	-	ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Source-drain current		-		22.5	A
$I_{SDM}^{(1),(2)}$	Source-drain current (pulsed)		-		90	A
$V_{SD}^{(3)}$	Forward on voltage	$I_{SD} = 22.5 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 22.5 \text{ A}$ , $dI/dt = 100 \text{ A}/\mu\text{s}$	-	346		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}$ (see <i>Figure 17</i> )	-	6		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	$V_{DD} = 100 \text{ V}$	-	35		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 22.5 \text{ A}$ , $dI/dt = 100 \text{ A}/\mu\text{s}$	-	432		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$	-	8.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see <i>Figure 17</i> )	-	39		A

1. The value is rated according to  $R_{thj-case}$  and limited by package.

2. Pulse width limited by safe operating area

3. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

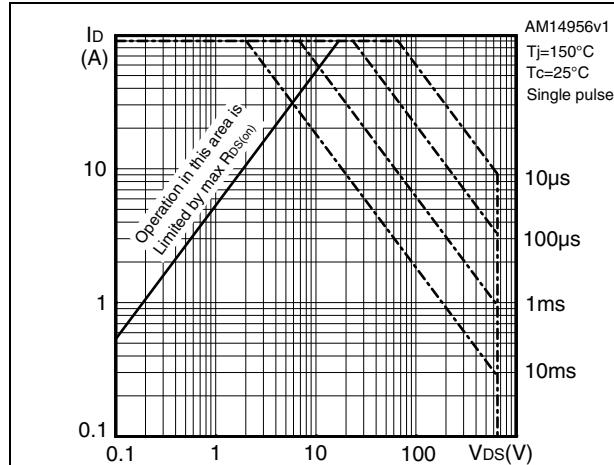


Figure 3. Thermal impedance

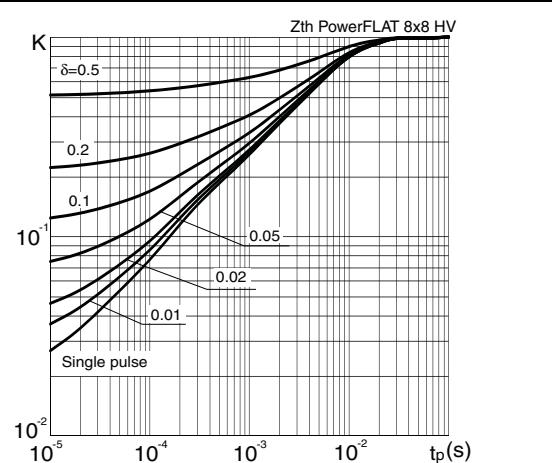


Figure 4. Output characteristics

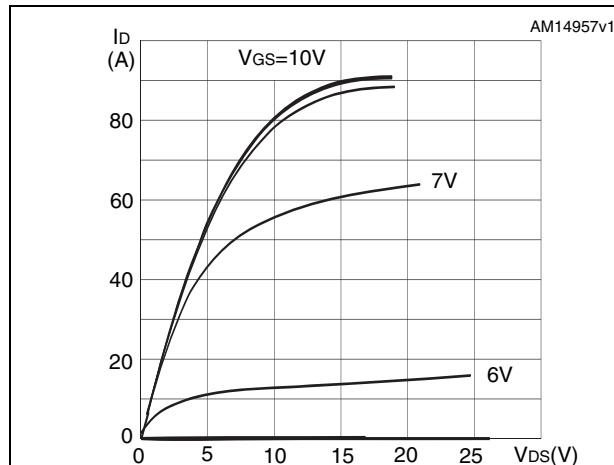


Figure 5. Transfer characteristics

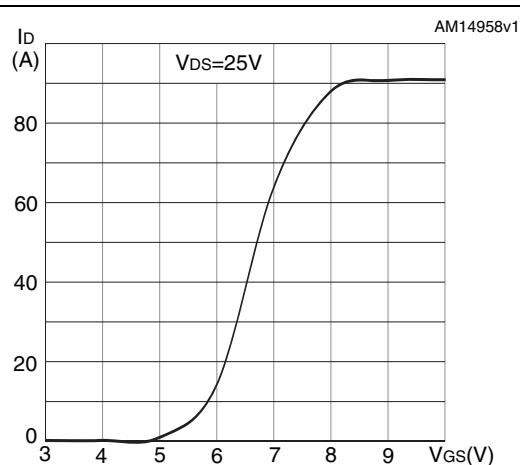


Figure 6. Gate charge vs gate-source voltage

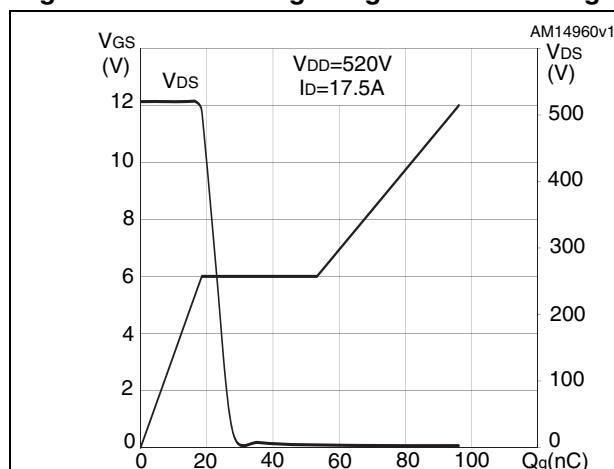
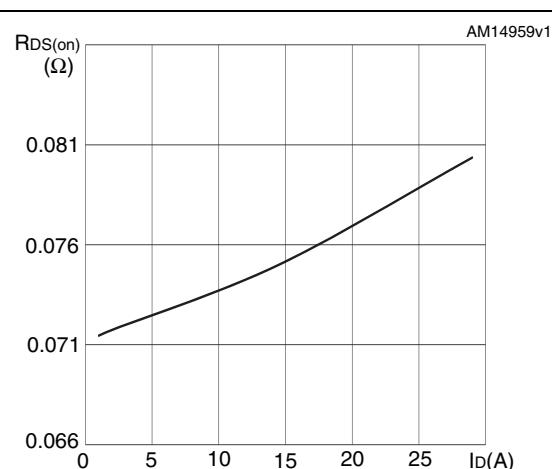
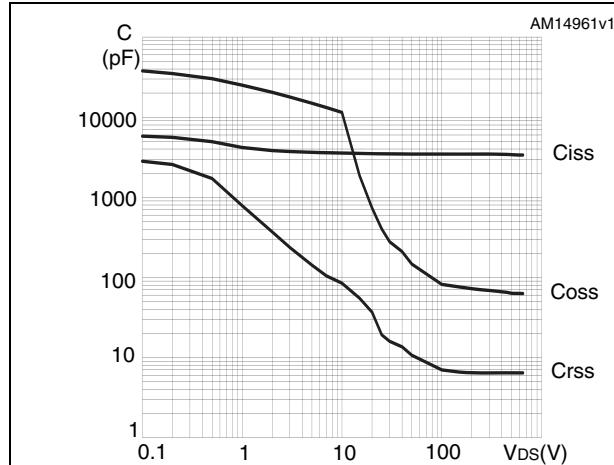
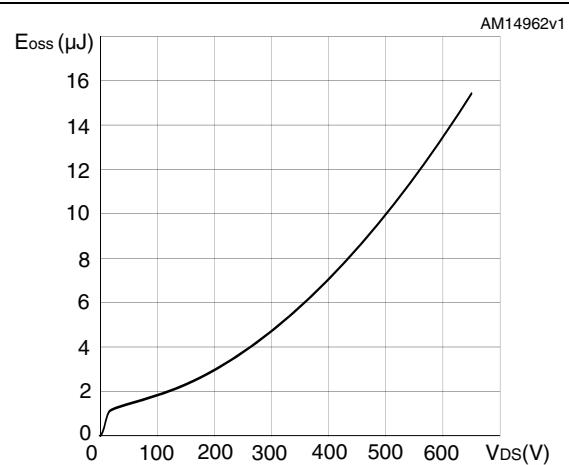
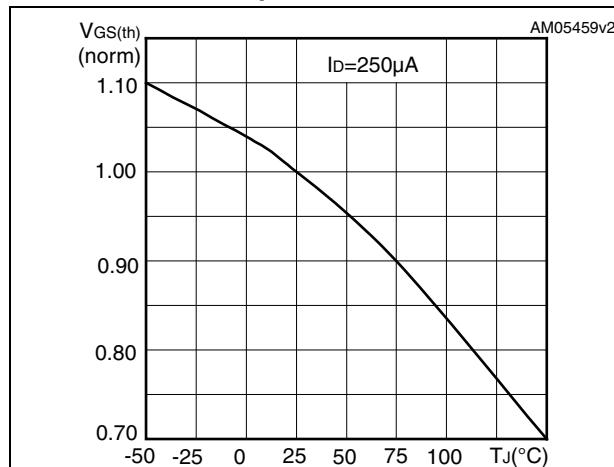
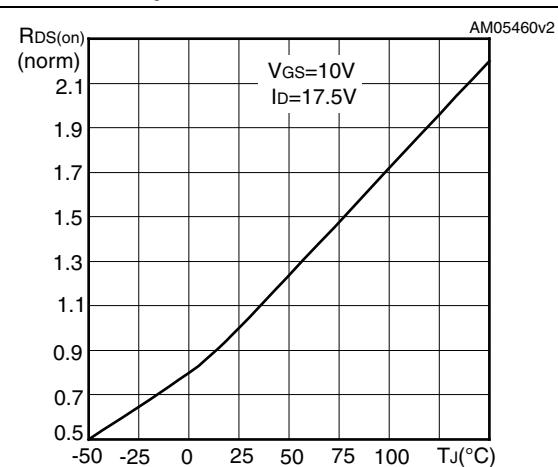
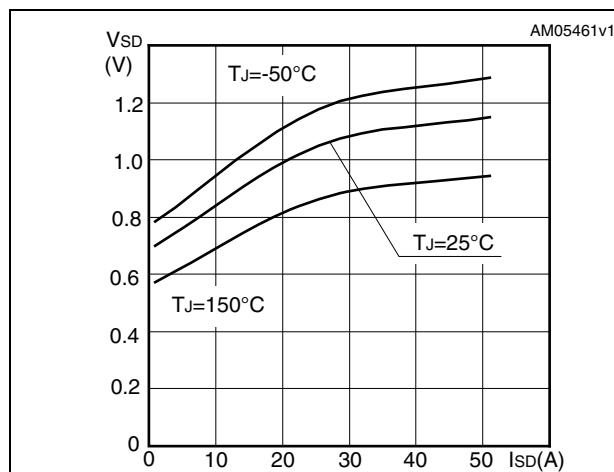
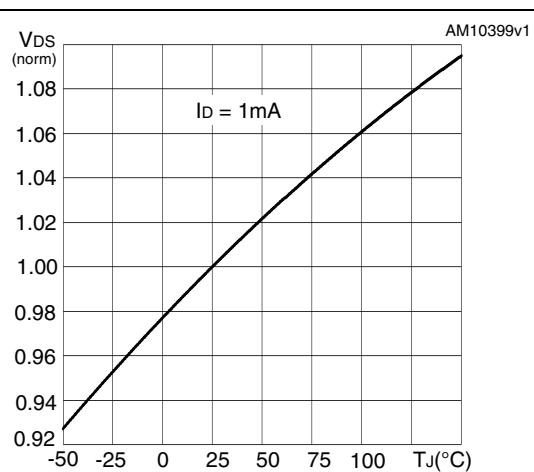
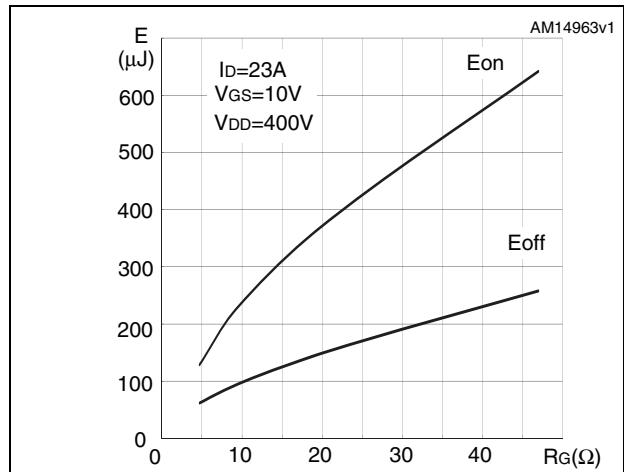


Figure 7. Static drain-source on-resistance



**Figure 8. Capacitance variations****Figure 9. Output capacitance stored energy****Figure 10. Normalized gate threshold voltage vs. temperature****Figure 11. Normalized on-resistance vs. temperature****Figure 12. Drain-source diode forward characteristics****Figure 13. Normalized V<sub>DS</sub> vs. temperature**

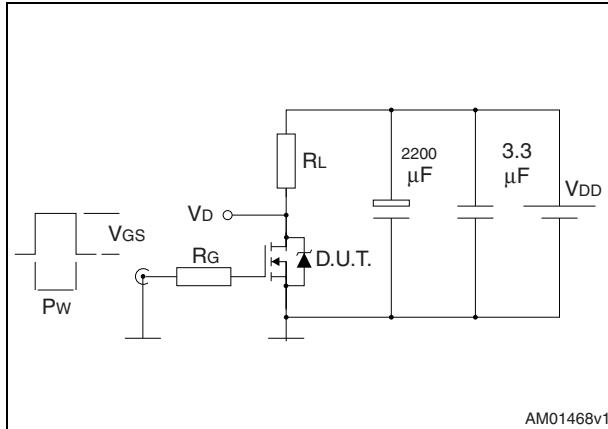
**Figure 14. Switching losses vs. gate resistance<sup>(1)</sup>**



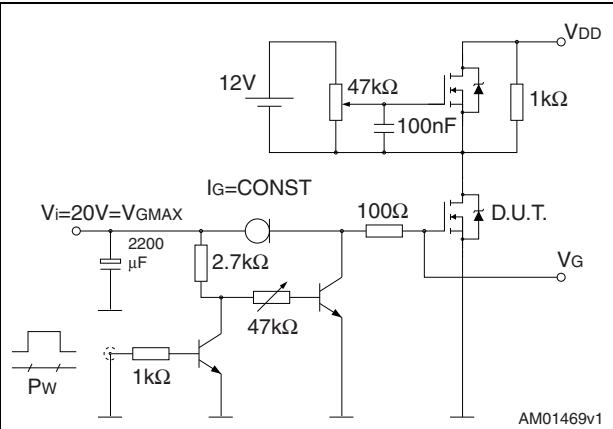
1. Eon including reverse recovery of a SiC diode

### 3 Test circuits

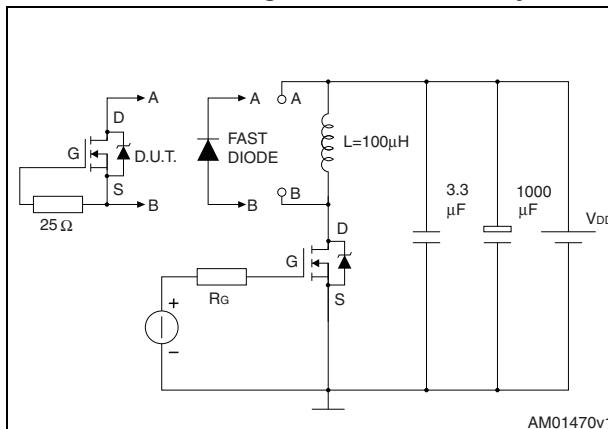
**Figure 15. Switching times test circuit for resistive load**



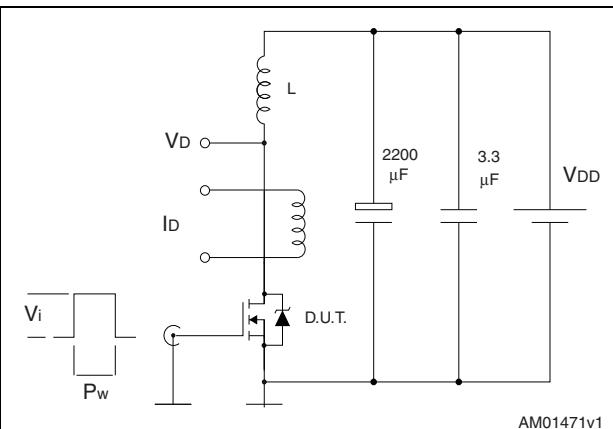
**Figure 16. Gate charge test circuit**



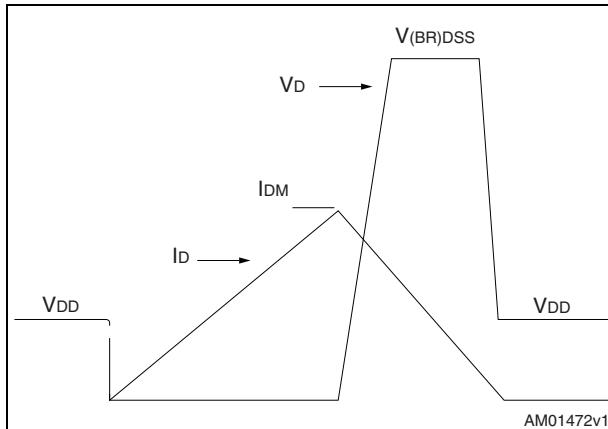
**Figure 17. Test circuit for inductive load switching and diode recovery times**



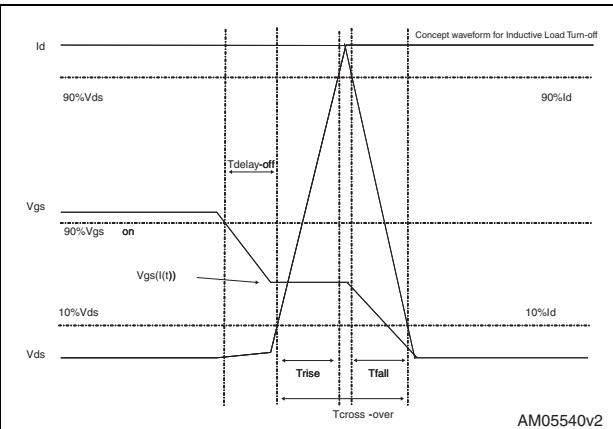
**Figure 18. Unclamped inductive load test circuit**



**Figure 19. Unclamped inductive waveform**



**Figure 20. Switching time waveform**

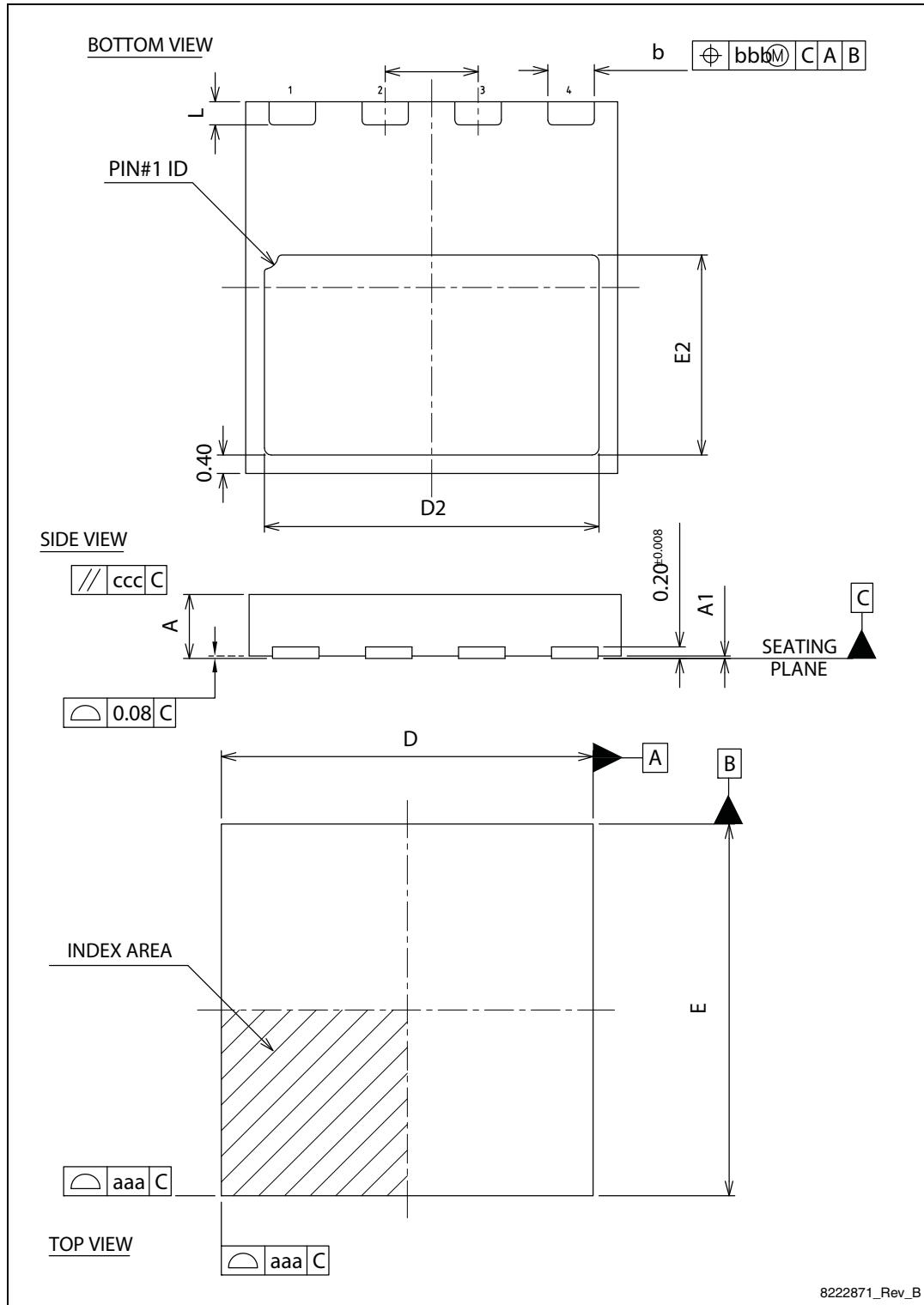


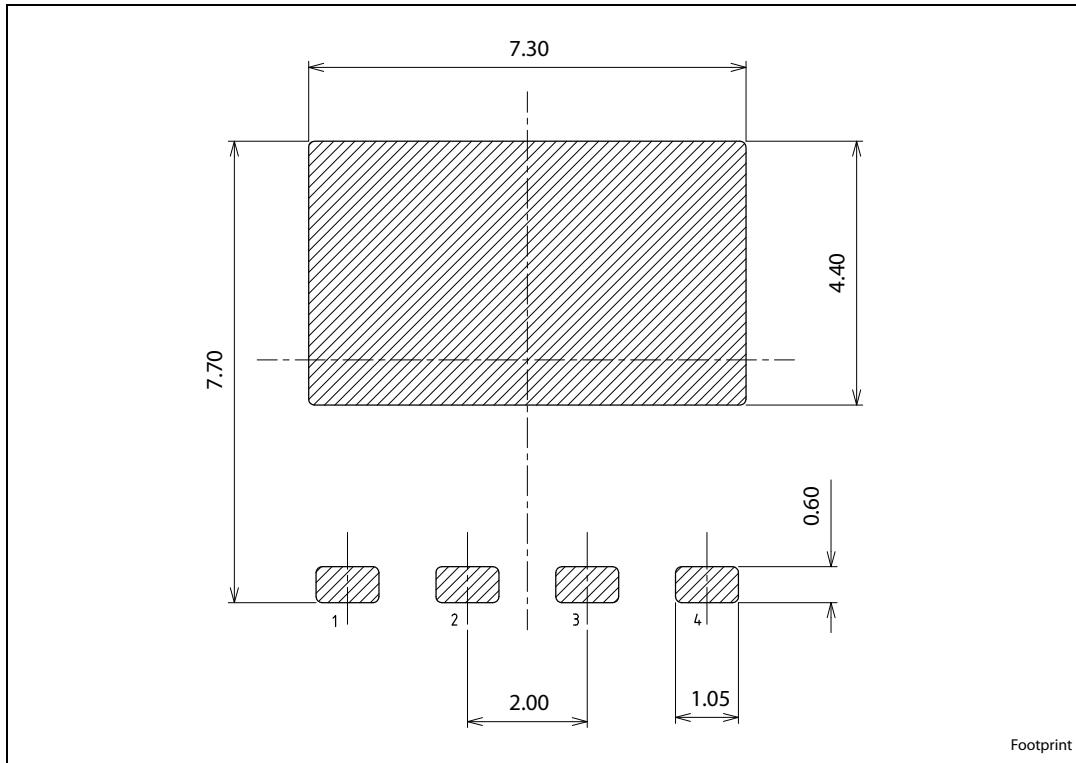
## 4 Package mechanical data

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.

**Table 8. PowerFLAT™ 8x8 HV mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
b	0.95	1.00	1.05
D		8.00	
E		8.00	
D2	7.05	7.20	7.30
E2	4.15	4.30	4.40
e		2.00	
L	0.40	0.50	0.60
aaa		0.10	
bbb		0.10	
ccc		0.10	

**Figure 21. PowerFLAT™ 8x8 HV drawing mechanical data**

**Figure 22. PowerFLAT™ 8x8 HV recommended footprint**

## 5 Packaging mechanical data

Figure 23. PowerFLAT™ 8x8 HV tape

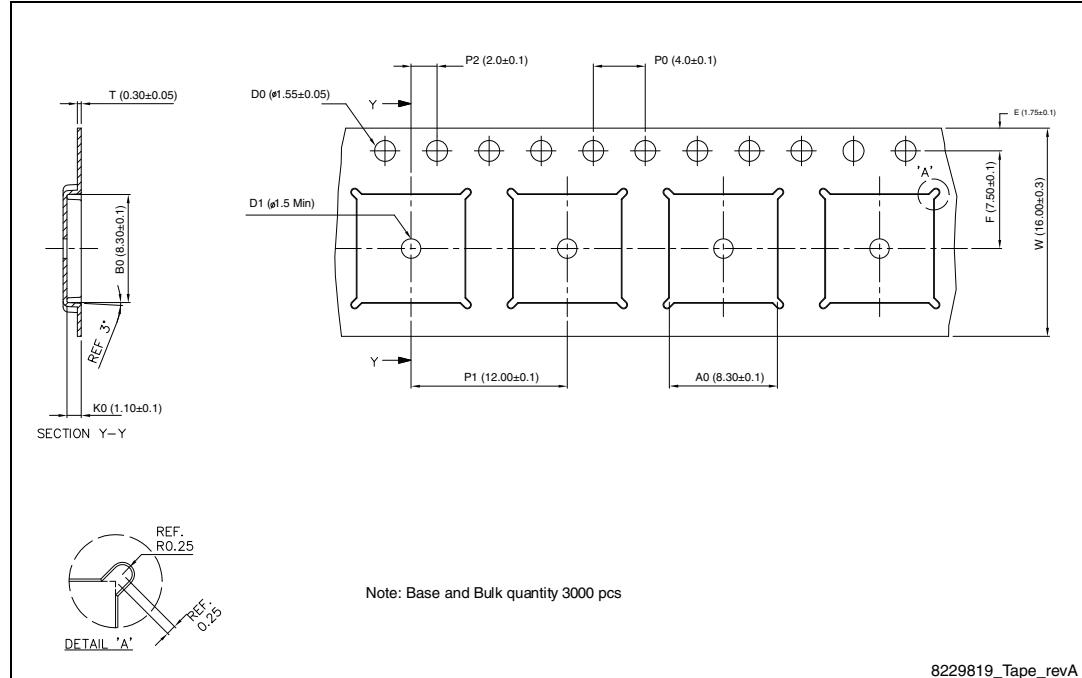
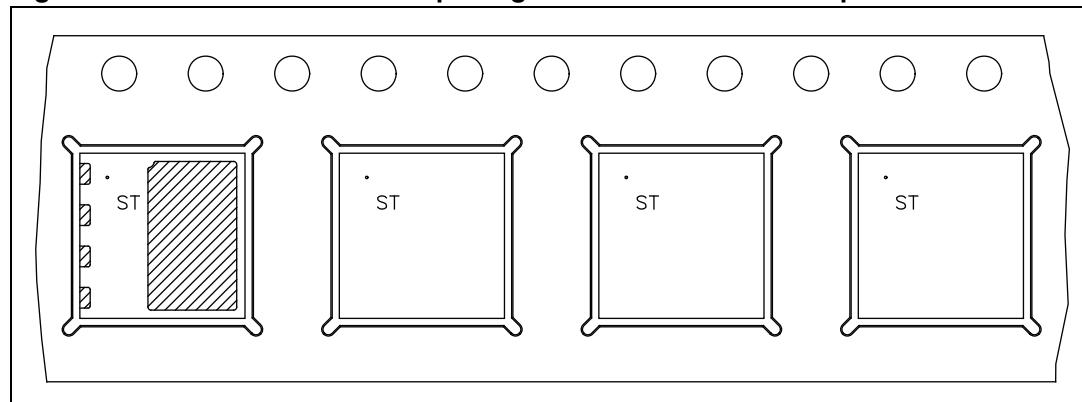
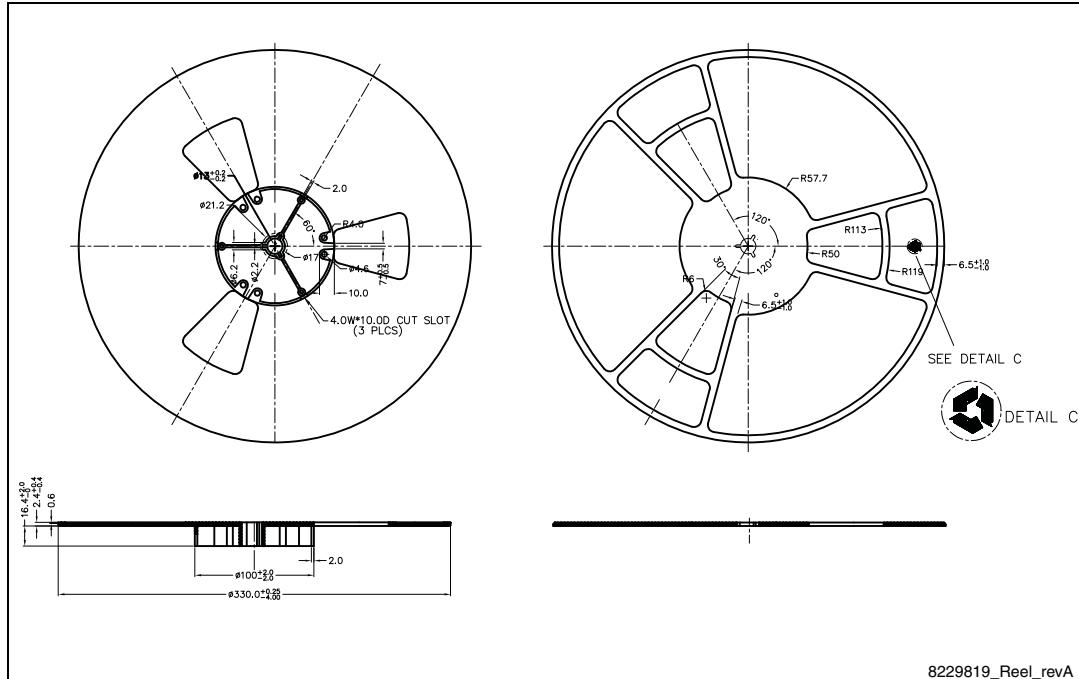


Figure 24. PowerFLAT™ 8x8 HV package orientation in carrier tape.



**Figure 25. PowerFLAT™ 8x8 HV reel**

## 6 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
20-Sep-2012	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 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.

© 2012 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)





Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

#### Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помошь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помошь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: [org@eplast1.ru](mailto:org@eplast1.ru)

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.