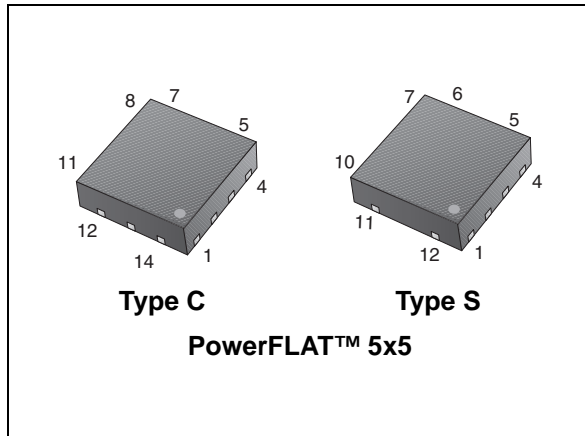


## N-channel 400 V, 4.5 $\Omega$ typ., 0.43 A, SuperMESH™ Power MOSFET in a PowerFLAT™ 5x5 package

Datasheet - production data



### Features

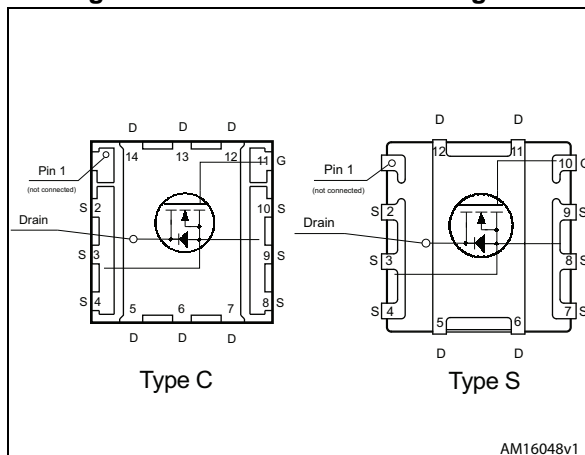
Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STL3NK40	400 V	5.5 $\Omega$	0.43 A	2.5 W

- Extremely high dv/dt capability
- 100% avalanche rated
- Gate charge minimized
- Very low intrinsic capacitances

### Applications

- Switching applications

Figure 1. Internal schematic diagram



### Description

This device is an N-channel Power MOSFET developed using STMicroelectronics' SuperMESH™ technology, achieved through optimization of ST's well established strip-based PowerMESH™ layout. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STL3NK40	3NK40	PowerFLAT™ 5x5	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>8</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>9</b>
<b>5</b>	<b>Revision history</b> .....	<b>15</b>

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	400	V
$V_{DGR}$	Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	400	V
$V_{GS}$	Gate- source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_{pcb} = 25 \text{ }^\circ\text{C}$	0.43	A
	Drain current (continuous) at $T_{pcb} = 100 \text{ }^\circ\text{C}$	0.27	A
$I_{DM}^{(1)}$	Drain current (pulsed)	1.72	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25 \text{ }^\circ\text{C}$	2.5	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$T_{stg}$ $T_j$	Storage temperature Max. operating junction temperature	-55 to 150	$^\circ\text{C}$

1. When mounted on FR-4 Board of 1 inch<sup>2</sup>, 2 oz Cu ( $t < 100 \text{ s}$ )
2.  $I_{SD} < 0.43 \text{ A}$ ,  $di/dt < 200 \text{ A}/\mu\text{s}$ ,  $V_{DD} < 320 \text{ V}$

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	$^\circ\text{C}/\text{W}$

1. When mounted on FR-4 Board of 1 inch<sup>2</sup>, 2 oz Cu ( $t < 100 \text{ s}$ )

**Table 4. Avalanche data**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j \text{ max}$ )	0.43	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25 \text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50 \text{ V}$ )	60	mJ

## 2 Electrical characteristics

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

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	400			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 400\text{ V}$ $V_{DS} = 400\text{ V}$ , $T_C = 125\text{ °C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	0.8	1.6	2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 0.22\text{ A}$		4.5	5.5	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 0.43\text{ A}$	-	1.2		S
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	128	200	pF
$C_{oss}$	Output capacitance		-	16	30	pF
$C_{riss}$	Reverse transfer capacitance		-	4	6	pF
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain	-	12		$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 320\text{ V}$ , $I_D = 1.4\text{ A}$ , $V_{GS} = 10\text{ V}$ (see Figure 10)	-	8.7	13	nC
$Q_{gs}$	Gate-source charge		-	0.9		nC
$Q_{gd}$	Gate-drain charge		-	3.8		nC

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

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 200\text{ V}$ , $I_D = 0.7\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 14)	-	3	-	ns
$t_r$	Rise time		-	4	-	ns
$t_{d(off)}$	Turn-off-delay time		-	18	-	ns
$t_f$	Fall time		-	16	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		0.43	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		1.72	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 0.43\text{ A}$ , $V_{GS} = 0$	-		1.2	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 20\text{ V}$ (see Figure 19)	-	166		ns
$Q_{rr}$	Reverse recovery charge		-	300		nC
$I_{RRM}$	Reverse recovery current		-	3.6		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 20\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see Figure 19)	-	176		ns
$Q_{rr}$	Reverse recovery charge		-	340		nC
$I_{RRM}$	Reverse recovery current		-	3.8		A

1. Pulse width limited by safe operating area.
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

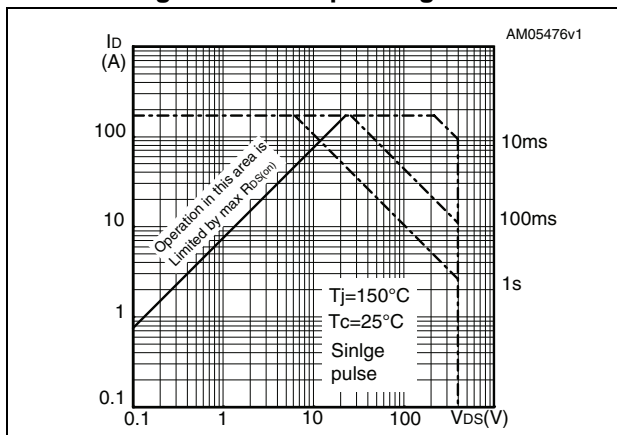


Figure 3. Thermal impedance

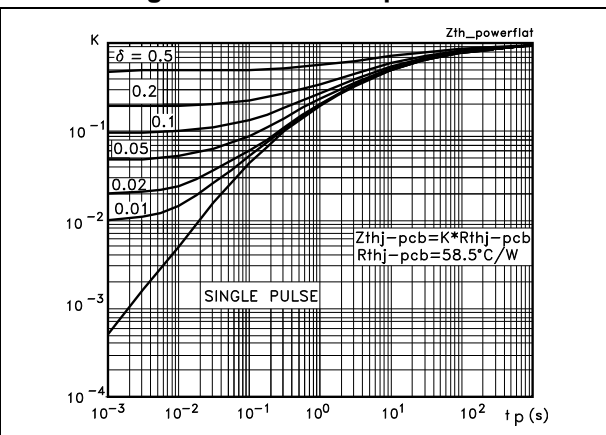


Figure 4. Saturation characteristics

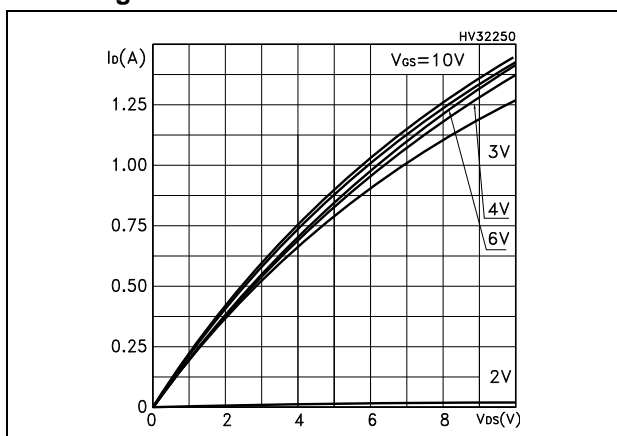


Figure 5. Transfer characteristics

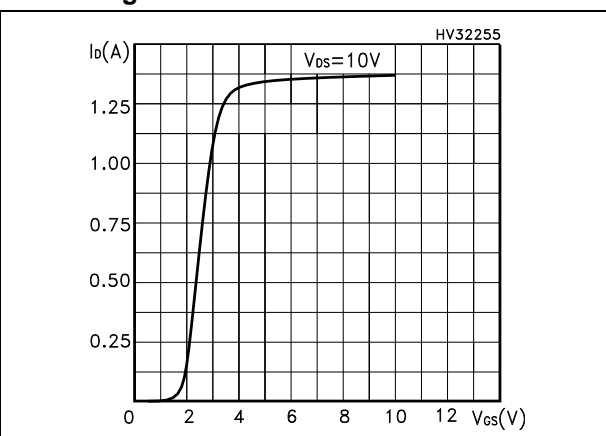


Figure 6. Output characteristics

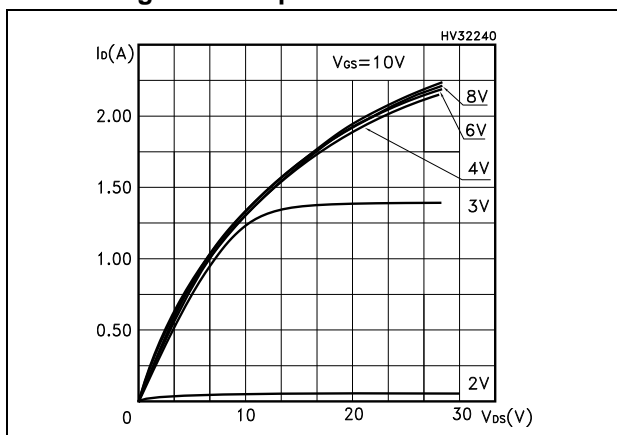


Figure 7. Static drain-source on-resistance

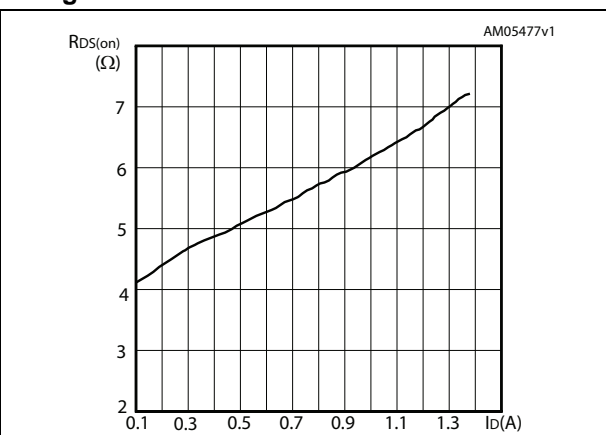


Figure 8. Gate charge vs gate-source voltage

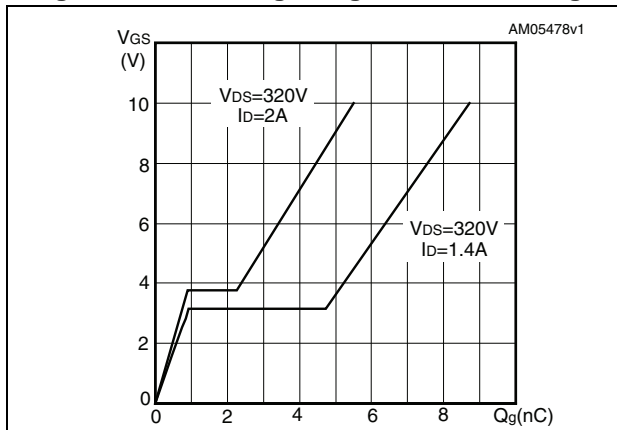


Figure 9. Capacitance variations

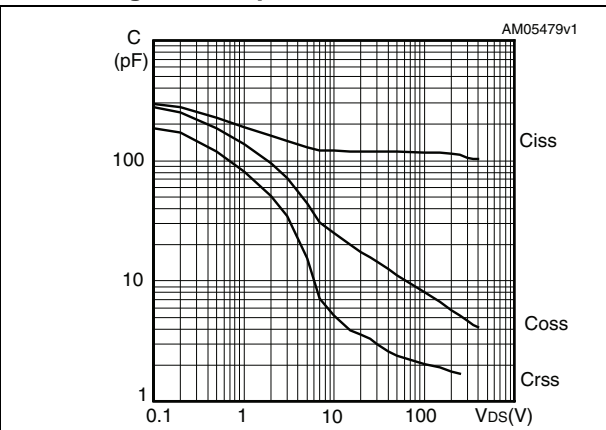


Figure 10. Transconductance

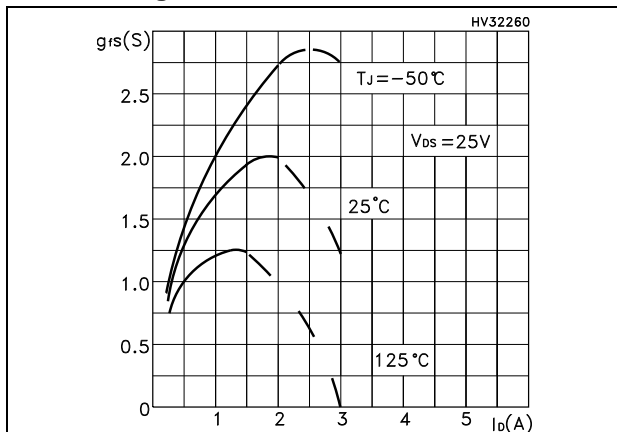


Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature

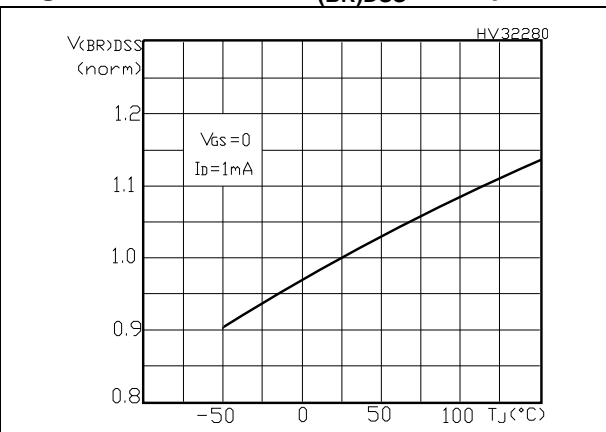


Figure 12. Normalized gate threshold voltage vs temperature

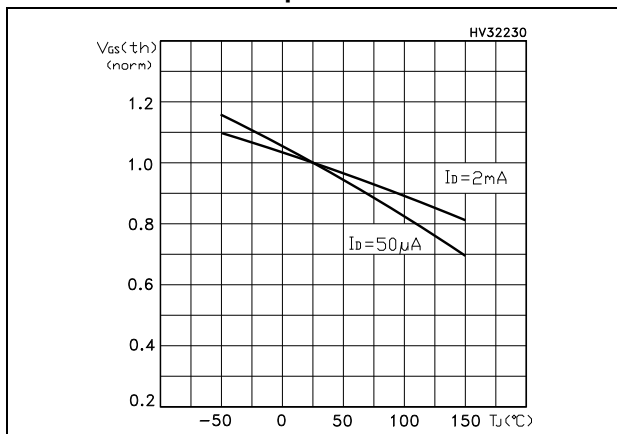
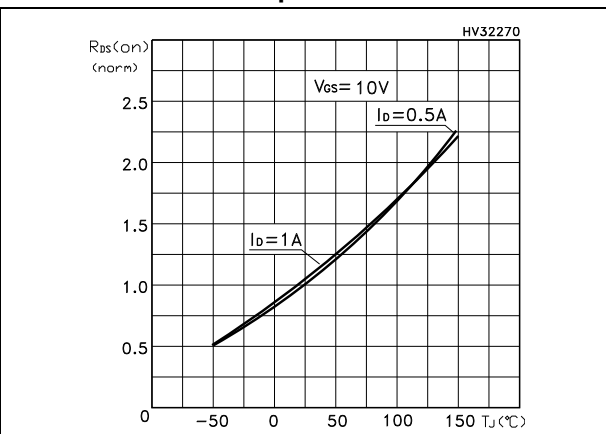


Figure 13. Normalized on-resistance vs temperature



### 3 Test circuits

Figure 14. Switching times test circuit for resistive load



Figure 15. Gate charge test circuit

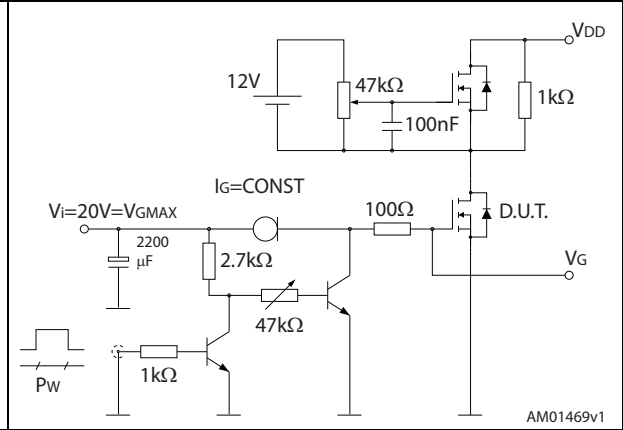


Figure 16. Test circuit for inductive load switching and diode recovery times



Figure 17. Unclamped inductive load test circuit

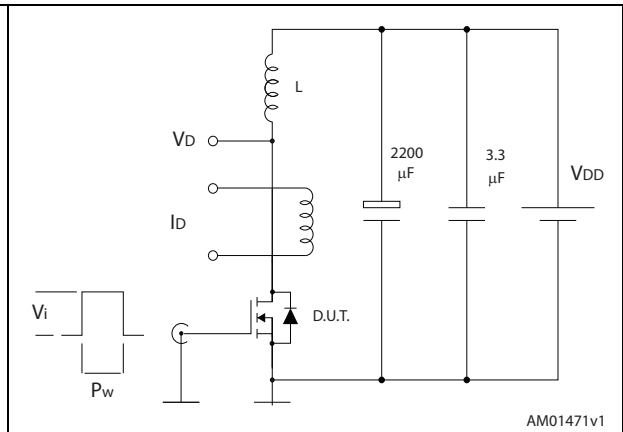
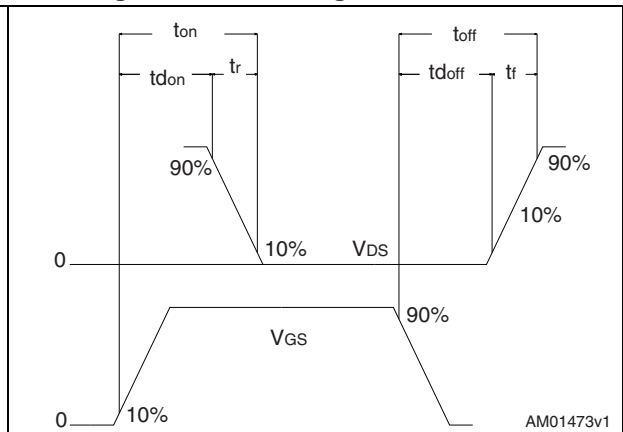


Figure 18. Unclamped inductive waveform



Figure 19. Switching time waveform





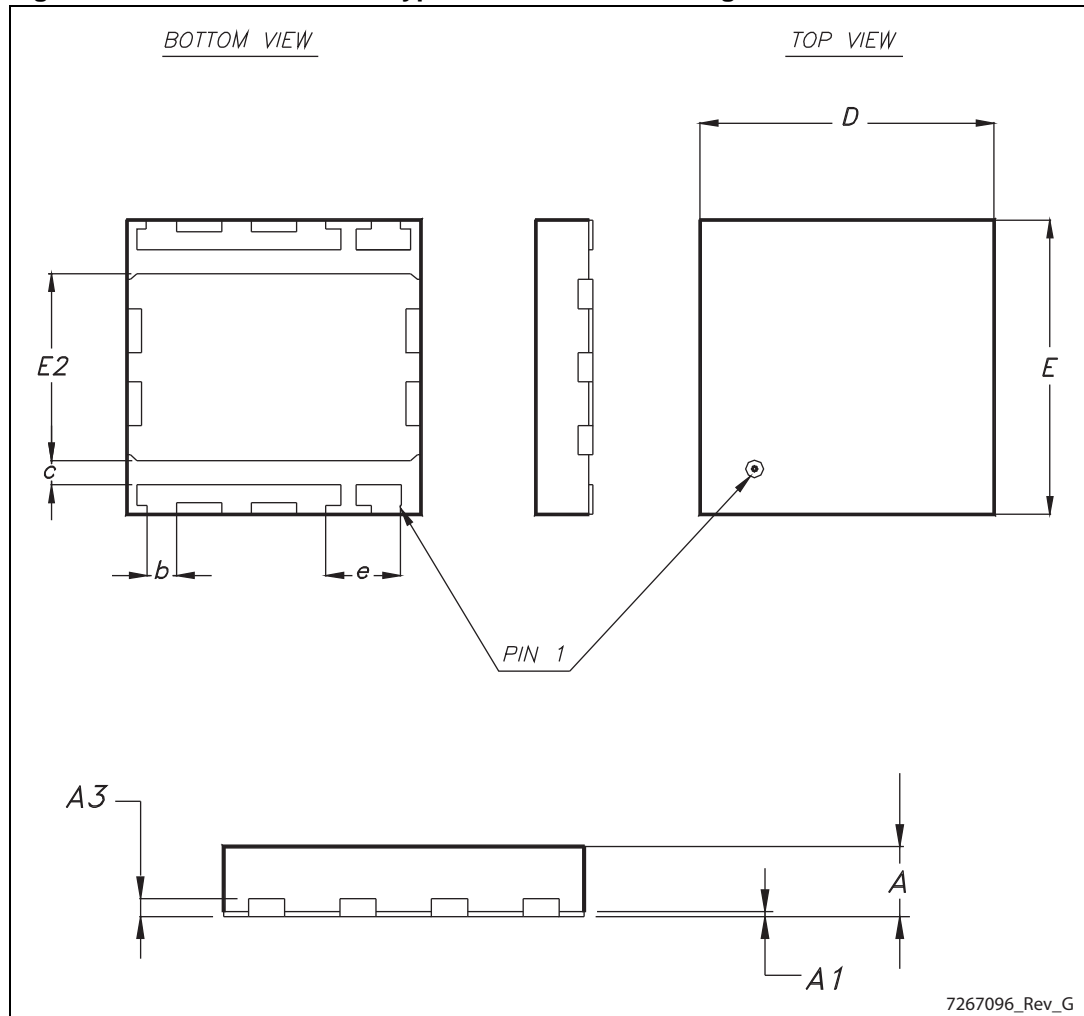
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Table 9. PowerFLAT™ 5x5 type C mechanical dimensions

Dim.	mm		
	Min.	Typ.	Max.
A	0.80	0.90	1.00
A1	0.00	0.002	0.05
A3		0.24	
D	4.90	5.00	5.10
E	4.90	5.00	5.10
e	1.22	1.27	1.32
b	0.43	0.51	0.58
E2	2.49	2.57	2.64
c	0.64	0.71	0.79

Figure 20. PowerFLAT™ 5x5 type C mechanical drawing



7267096\_Rev\_G

Figure 21. PowerFLAT™ 5x5 type C recommended footprint (mm)

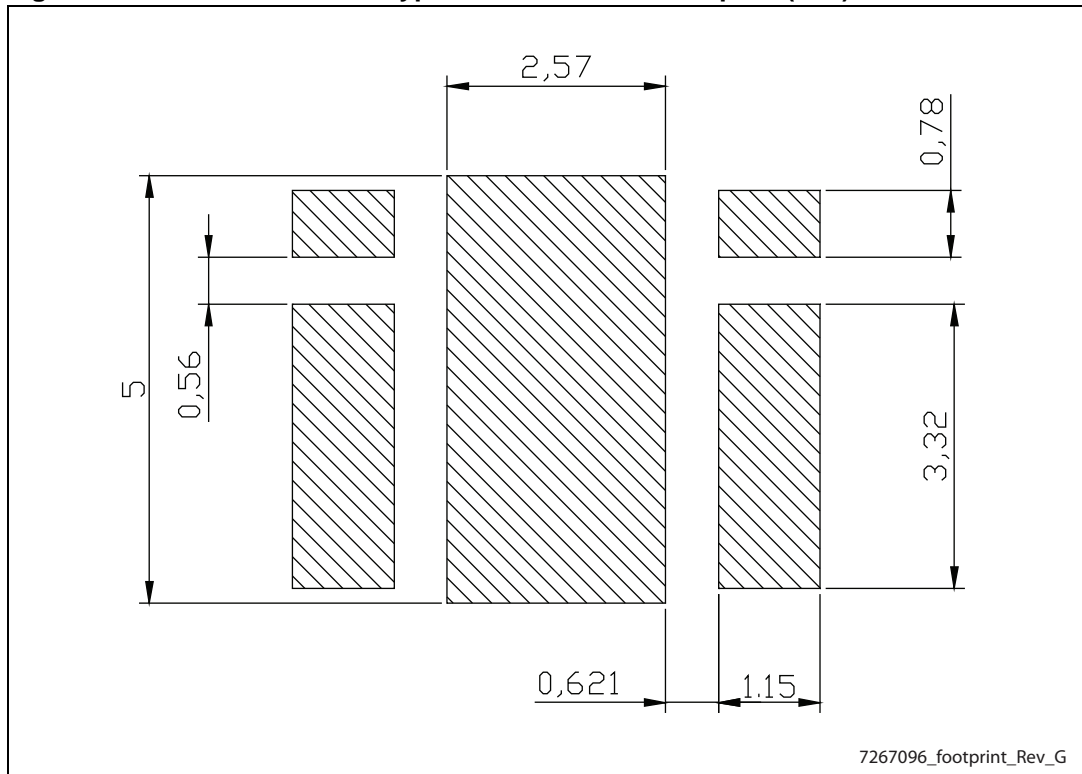


Table 10. PowerFLAT™ 5x5 type S mechanical dimensions

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.0
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
D		5.00	
D1	4.05		4.25
E		5.00	
E1	0.64		0.79
E2	2.25		2.45
e		1.27	
L	0.45		0.75

Figure 22. PowerFLAT™ 5x5 type S mechanical drawing

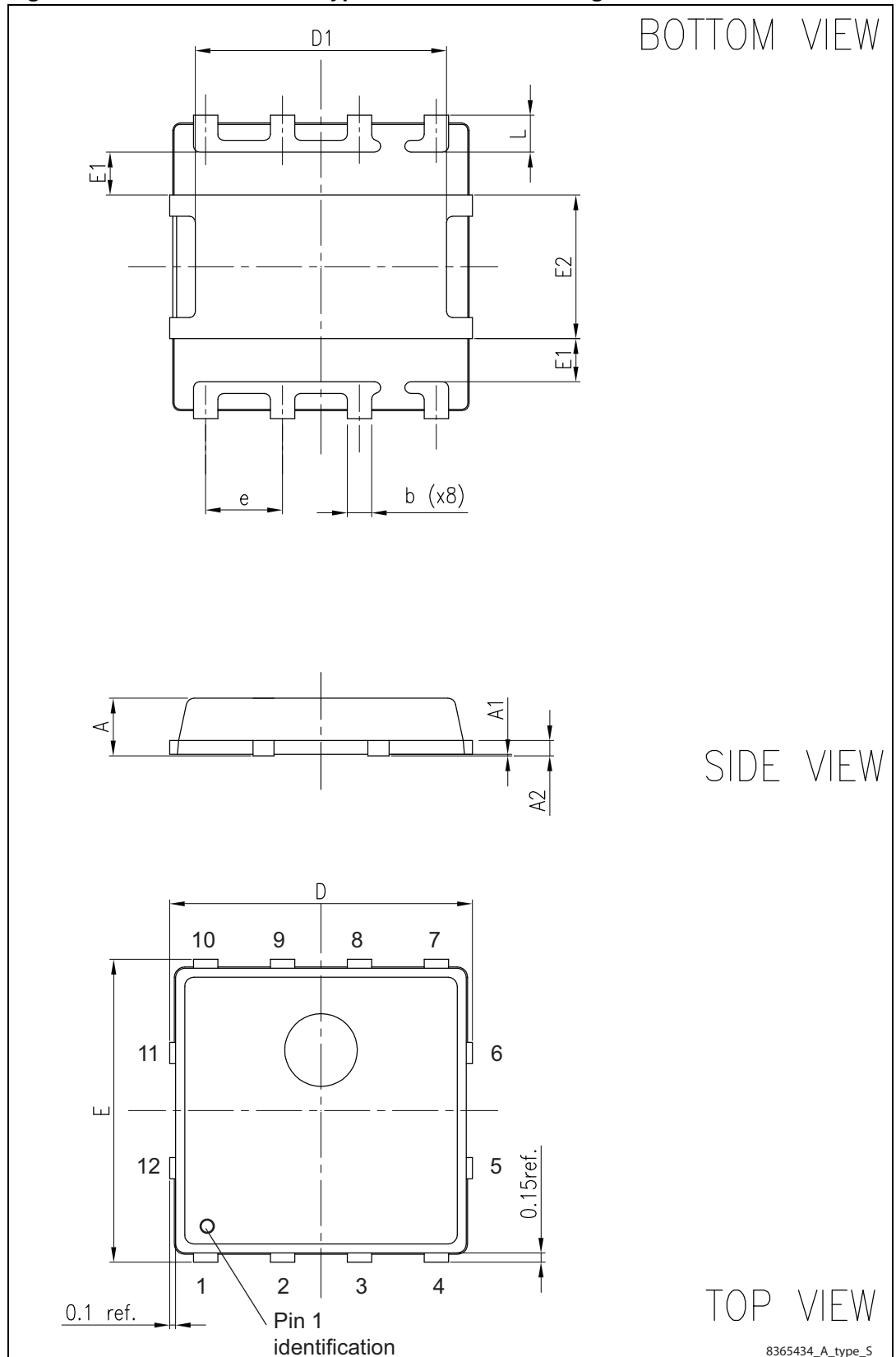
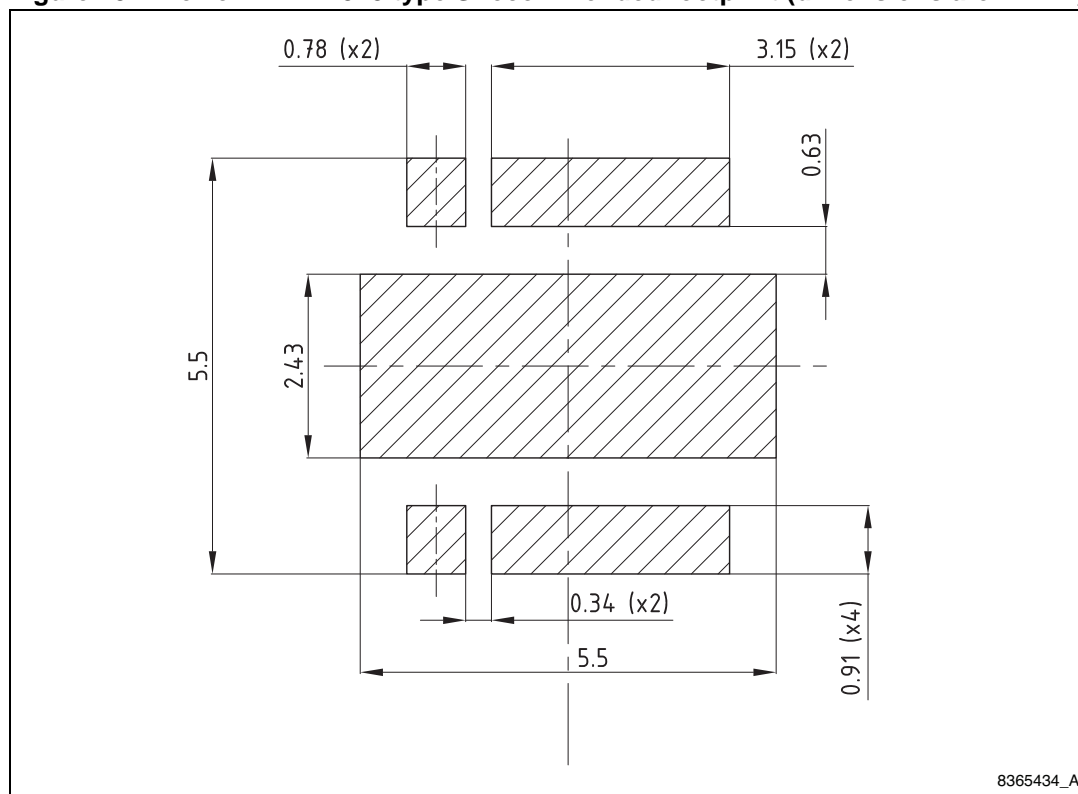


Figure 23. PowerFLAT™ 5x5 type S recommended footprint (dimensions are in mm)



## 5 Revision history

Table 11. Document revision history

Date	Revision	Changes
18-Sep-2009	1	First release
29-Aug-2013	2	– Updated: <a href="#">Section 4: Package mechanical data</a> – Minor text changes

**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 AUTHORIZED FOR USE IN WEAPONS. NOR ARE ST PRODUCTS 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](http://www.st.com)



# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[STMicroelectronics:](#)

[STL3NK40](#)