

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

Datasheet - production data

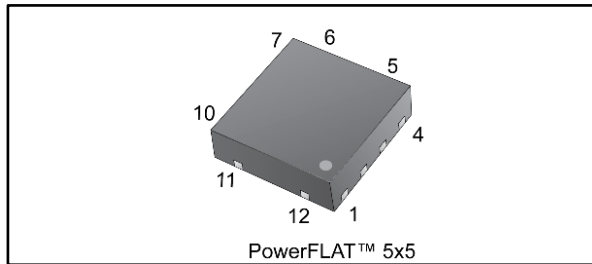
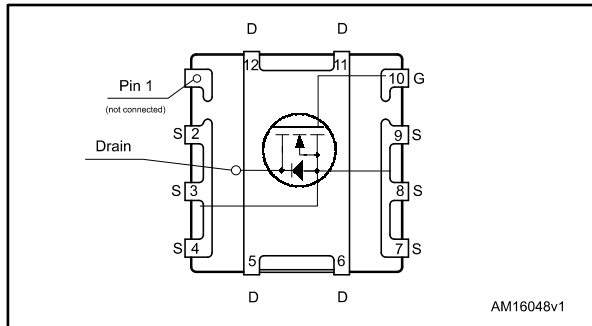


Figure 1: Internal schematic diagram



### 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 tested
- Gate charge minimized

### Applications

- Switching applications

### Description

This high voltage device is an N-channel Power MOSFET developed using the SuperMESH™ technology by STMicroelectronics, an optimization of the well-established PowerMESH™. 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	Package	Packing
STL3NK40	3NK40	PowerFLAT™ 5x5	Tape and reel

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# 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
$I_{DM}^{(2)}$	Drain current (pulsed)	1.72	A
$P_{TOT}^{(1)}$	Total dissipation at $T_{pcb} = 25 \text{ }^\circ\text{C}$	2.5	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5	V/ns
$T_j$	Operating junction temperature range	- 55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		

**Notes:**

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

<sup>(2)</sup>Pulse width limited by safe operating area.

<sup>(3)</sup> $I_{SD} \leq 0.43 \text{ A}$ ,  $di/dt \leq 200 \text{ A}/\mu\text{s}$ ;  $V_{DD} < 320 \text{ V}$ .

**Table 3: Thermal data**

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

**Notes:**

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

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or non-repetitive (pulse width limited by $T_{jmax.}$ )	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

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

**Table 5: On/off-state**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	400			V
$I_{DSS}$	Zero-gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 400\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 400\text{ V}$ $T_C = 125\text{ }^\circ\text{C}^{(1)}$			50	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	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	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	128	200	pF
$C_{oss}$	Output capacitance		-	16	30	pF
$C_{rss}$	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		pF
$Q_g$	Total gate charge	$V_{DD} = 320\text{ V}$ , $I_D = 1.4\text{ A}$	-	8.7	13	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	0.9	-	nC
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 13: "Test circuit for gate charge behavior"</a> )	-	3.8	-	nC

**Table 7: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 200\text{ V}$ , $I_D = 0.7\text{ A}$ , $R_G = 4.7\text{ }\Omega$ $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 12: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 17: "Switching time waveform"</a> )	-	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

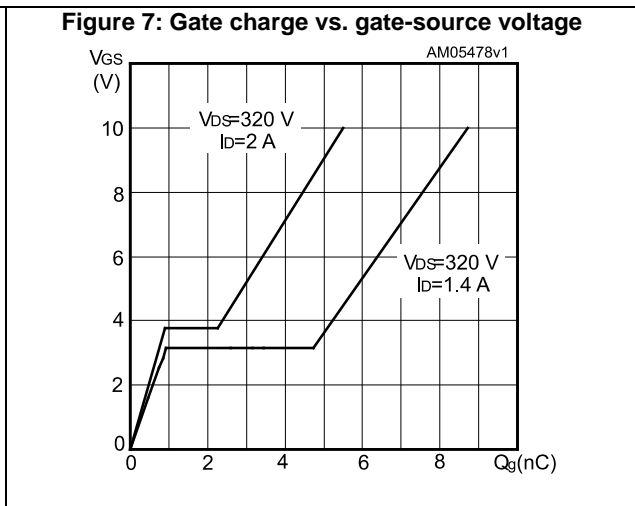
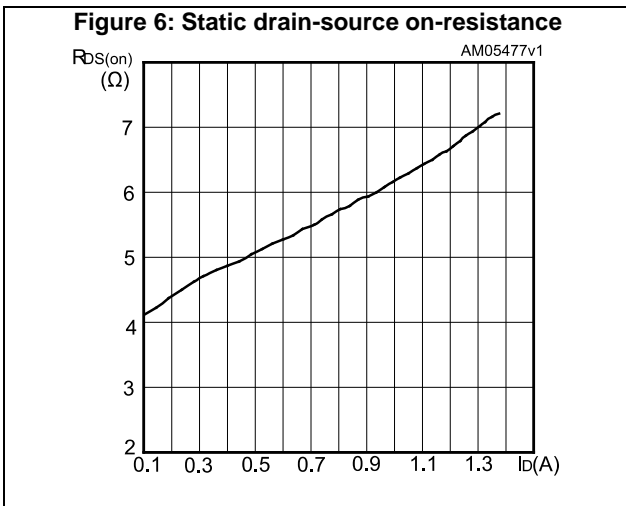
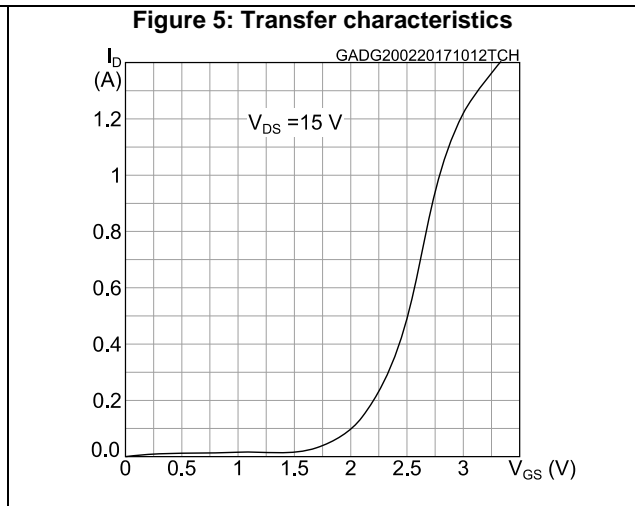
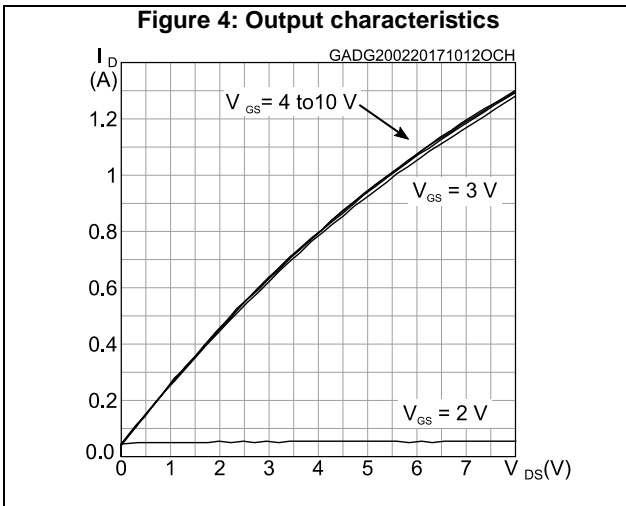
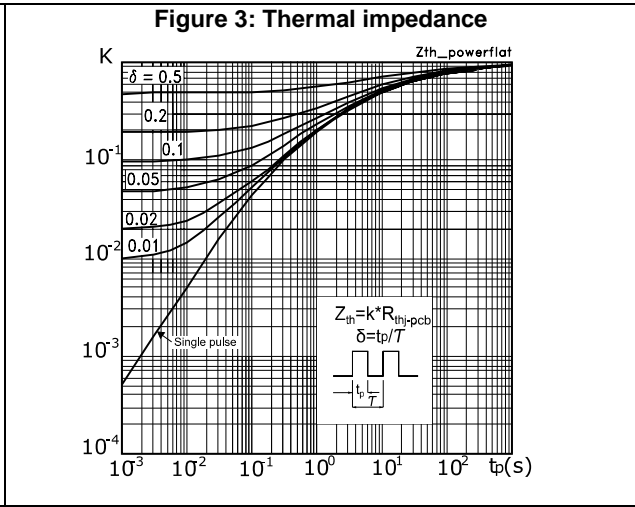
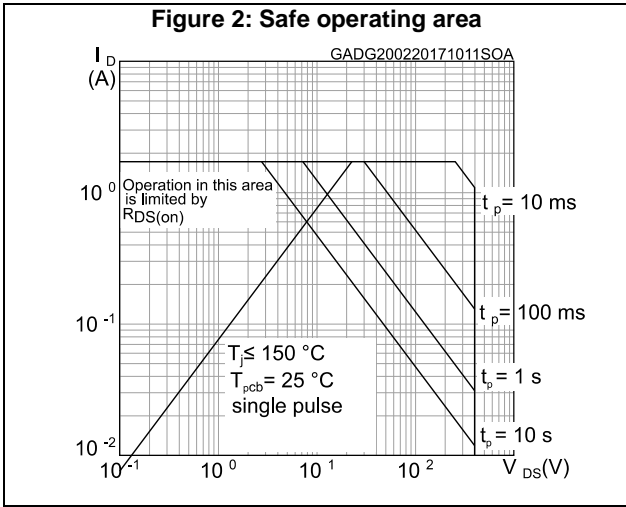
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		0.43	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		1.72	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 0.43 \text{ A}, V_{GS} = 0 \text{ V}$	-		1.2	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.4 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 20 \text{ V}$ (see <a href="#">Figure 14: "Test circuit for inductive load switching and diode recovery times"</a> )	-	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 <a href="#">Figure 14: "Test circuit for inductive load switching and diode recovery times"</a> )	-	176		ns
$Q_{rr}$	Reverse recovery charge		-	340		nC
$I_{RRM}$	Reverse recovery current		-	3.8		A

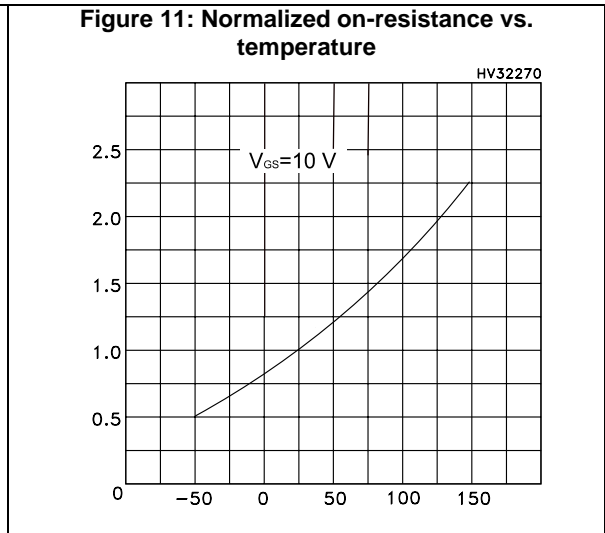
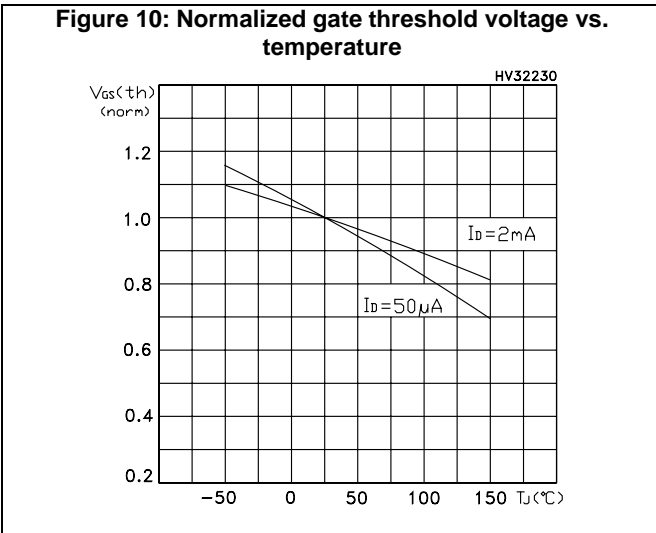
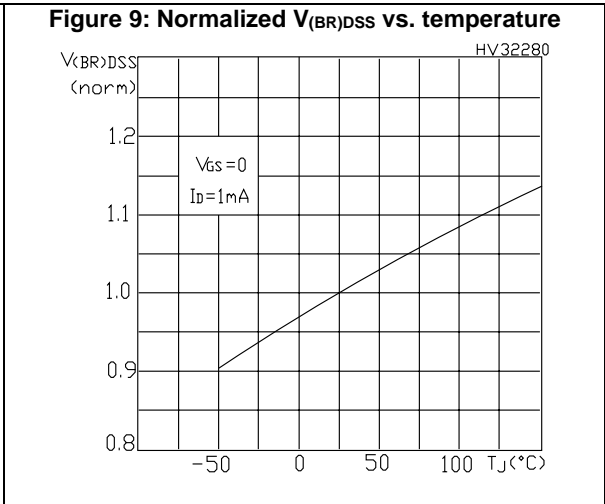
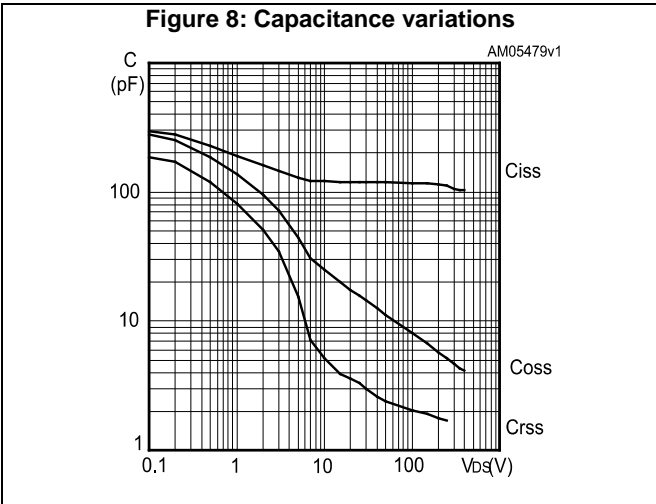
**Notes:**

(1)Pulse width limited by safe operating area.

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

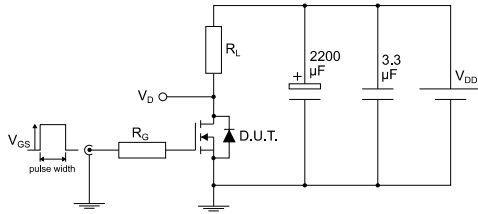
## 2.1 Electrical characteristics (curves)





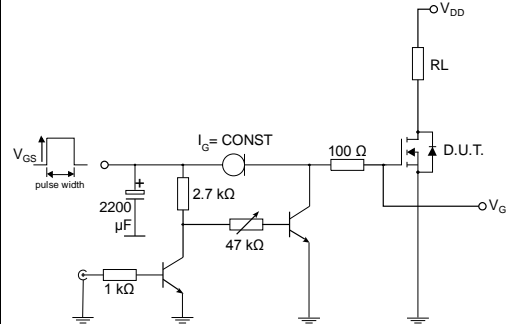
### 3 Test circuits

**Figure 12: Test circuit for resistive load switching times**



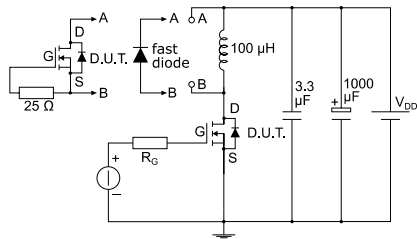
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**Figure 13: Test circuit for gate charge behavior**



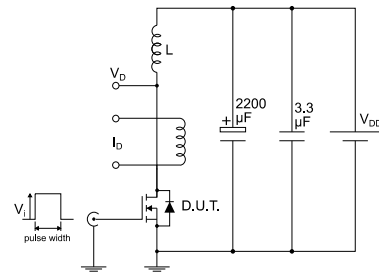
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**Figure 14: Test circuit for inductive load switching and diode recovery times**



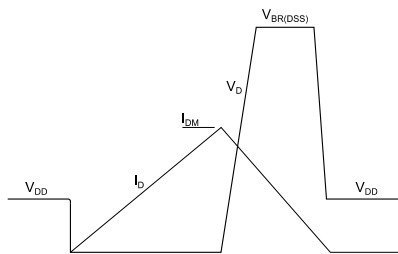
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**Figure 15: Unclamped inductive load test circuit**



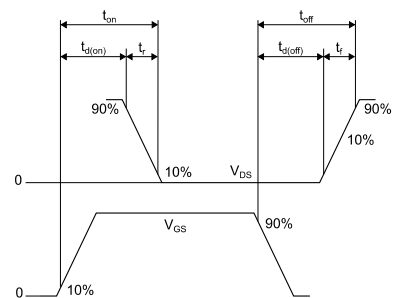
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**Figure 16: Unclamped inductive waveform**



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**Figure 17: Switching time waveform**



AM01473v1



## 4 Package information

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.

### 4.1 PowerFLAT™ 5x5 package information

Figure 18: PowerFLAT™ 5x5 package outline

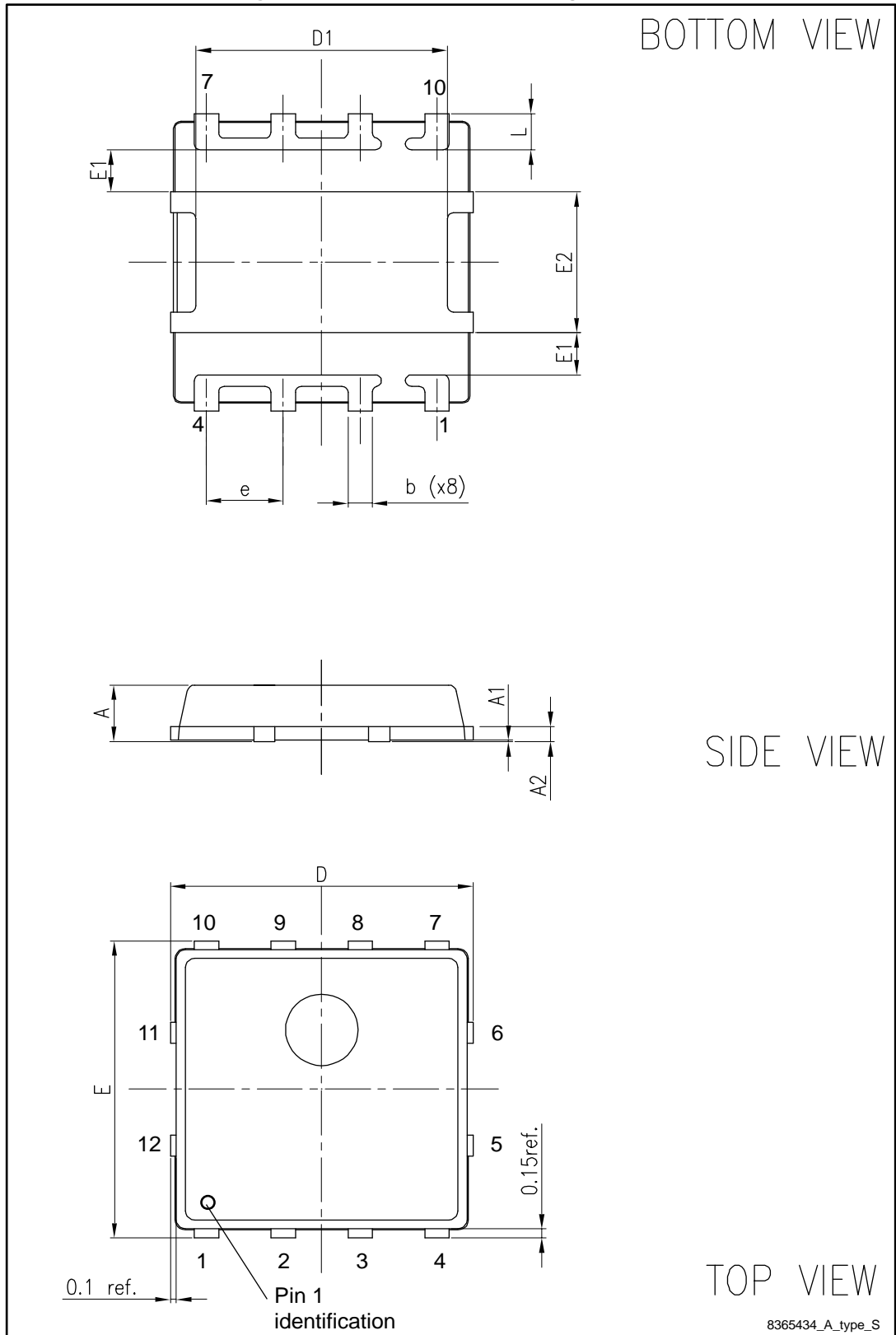
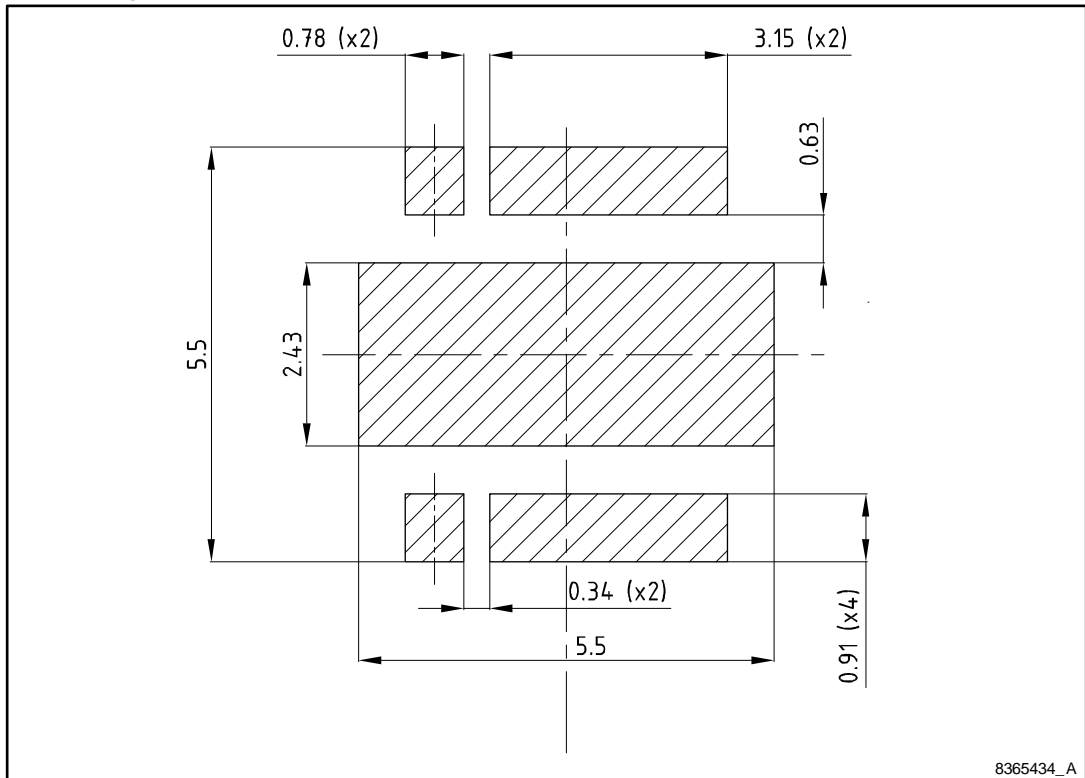


Table 9: PowerFLAT 5x5 package mechanical data

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 19: PowerFLAT™ 5x5 recommended footprint (dimensions are in mm)



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## 5 Revision history

**Table 10: Document revision history**

Date	Revision	Changes
18-Sep-2009	1	First release.
29-Aug-2013	2	Updated: <i>Section 4: Package mechanical data</i> Minor text changes
20-Feb-2017	3	Removed PowerFLAT™ 5x5 type C package information and cover image. Updated <a href="#">Table 6: "Dynamic"</a> and <a href="#">Table 8: "Source-drain diode"</a> . Updated <a href="#">Section 2.1: "Electrical characteristics (curves)"</a> . Minor text changes.

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