

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

Datasheet - production data

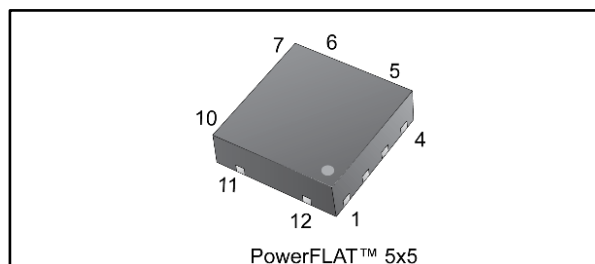
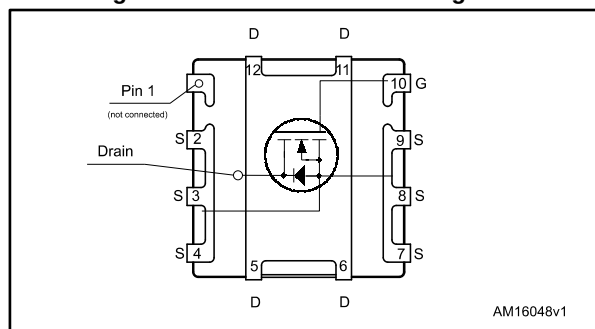


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STL3NK40	400 V	5.5 Ω	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

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves).....	6
3	Test circuits	8
4	Package information	9
	4.1 PowerFLAT™ 5x5 package information.....	10
5	Revision history	12

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	± 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:

⁽¹⁾When mounted on FR-4 board of 1 inch², 2 oz Cu ($t < 100\text{ s}$).

⁽²⁾Pulse width limited by safe operating area.

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

Table 3: Thermal data

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

Notes:

⁽¹⁾When mounted on 1 inch² 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	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 400\text{ V}$ $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$			50	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	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	Ω

Notes:

⁽¹⁾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 Figure 13: "Test circuit for gate charge behavior")	-	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 Figure 12: "Test circuit for resistive load switching times" and Figure 17: "Switching time waveform")	-	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 Figure 14: "Test circuit for inductive load switching and diode recovery times")	-	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 14: "Test circuit for inductive load switching and diode recovery times")	-	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 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

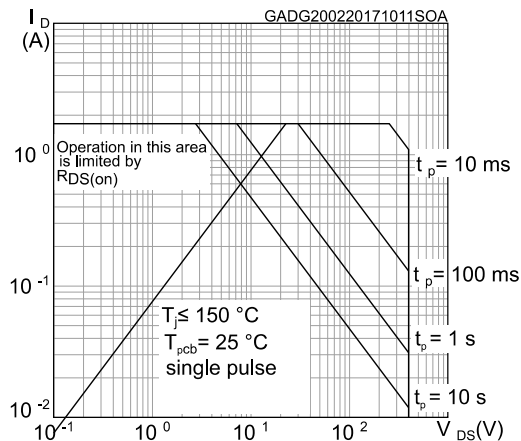


Figure 3: Thermal impedance

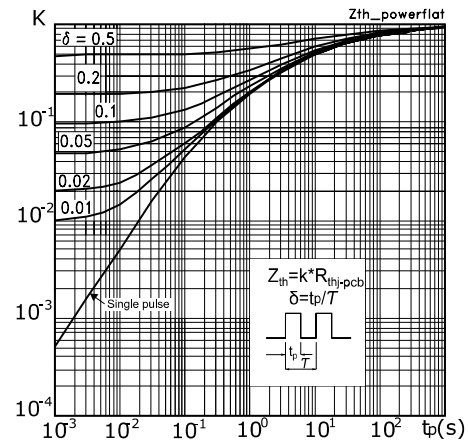


Figure 4: Output characteristics

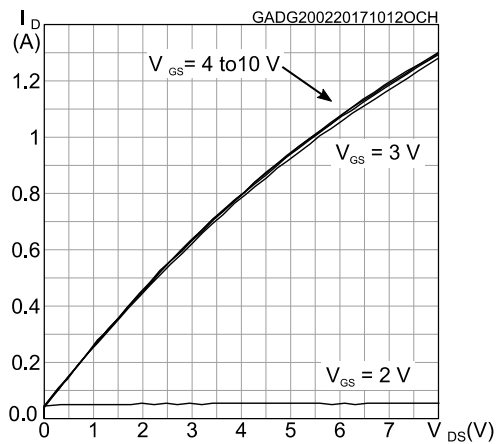


Figure 5: Transfer characteristics

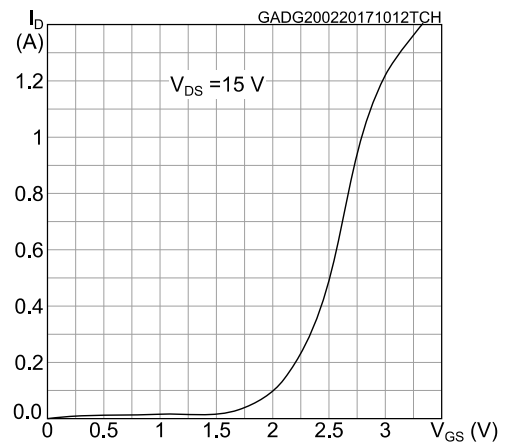


Figure 6: Static drain-source on-resistance

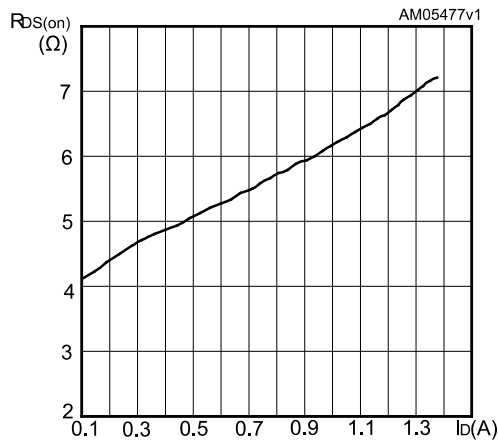


Figure 7: Gate charge vs. gate-source voltage

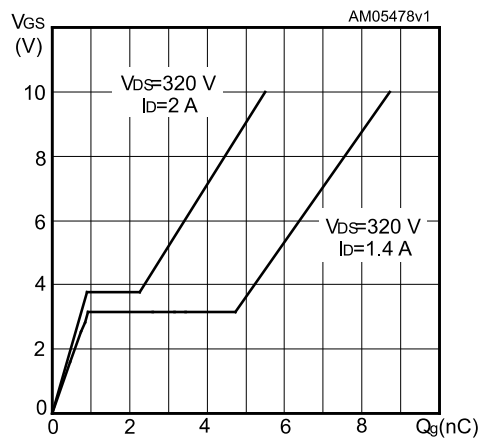


Figure 8: Capacitance variations

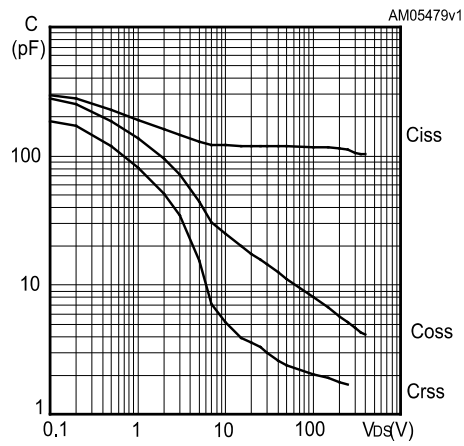
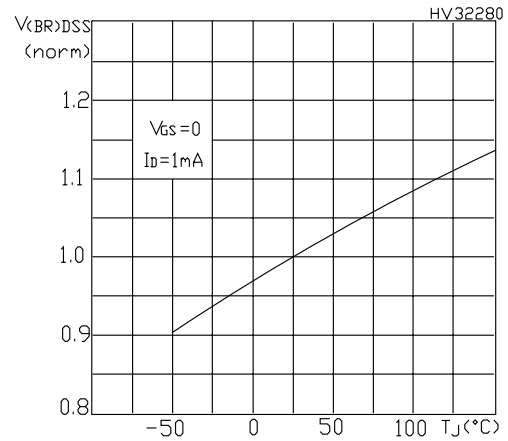
Figure 9: Normalized $V_{(BR)DSS}$ vs. temperature

Figure 10: Normalized gate threshold voltage vs. temperature

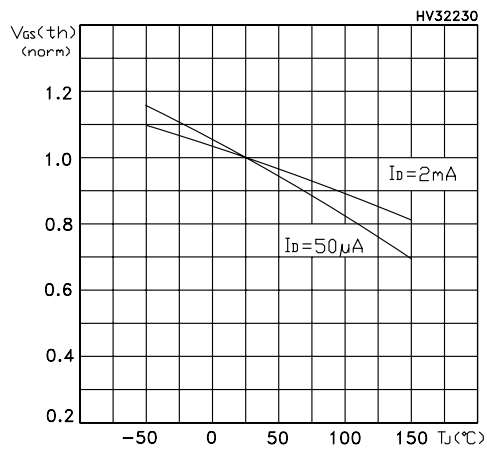
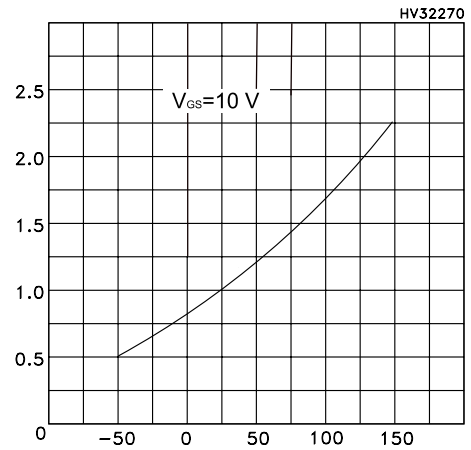
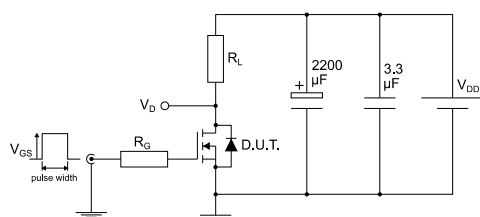


Figure 11: Normalized on-resistance vs. temperature



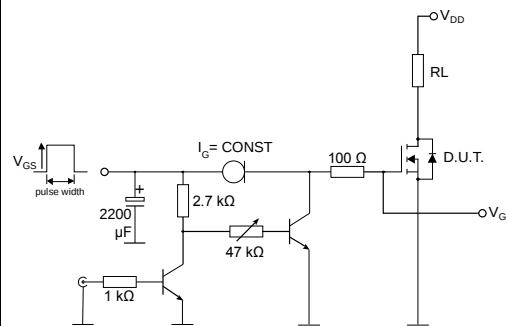
3 Test circuits

Figure 12: Test circuit for resistive load switching times



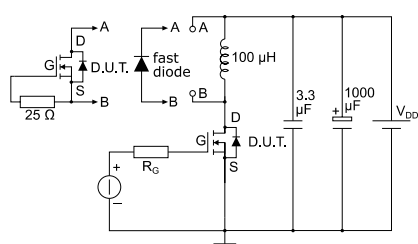
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Figure 13: Test circuit for gate charge behavior



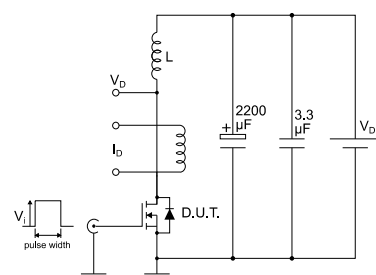
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Figure 14: Test circuit for inductive load switching and diode recovery times



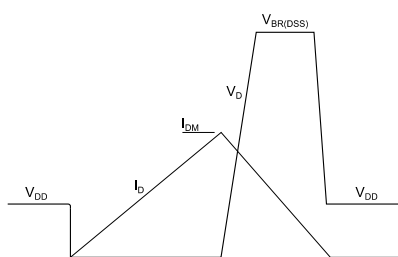
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Figure 15: Unclamped inductive load test circuit



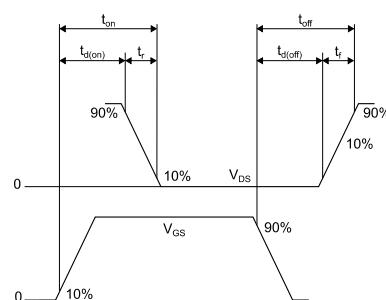
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Figure 16: Unclamped inductive waveform



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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**. ECOPACK® is an ST trademark.

4.1 PowerFLAT™ 5x5 package information

Figure 18: PowerFLAT™ 5x5 package outline

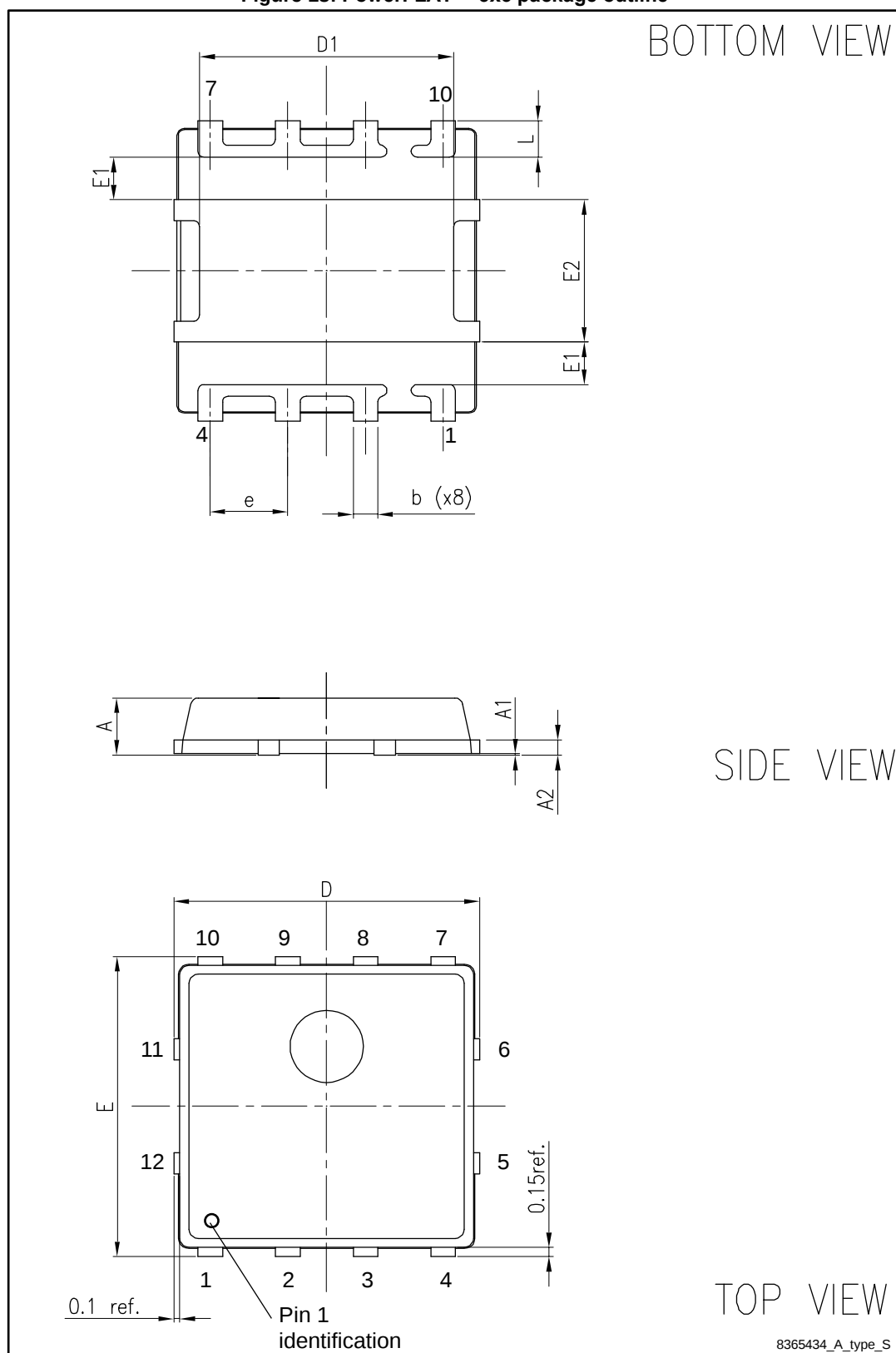
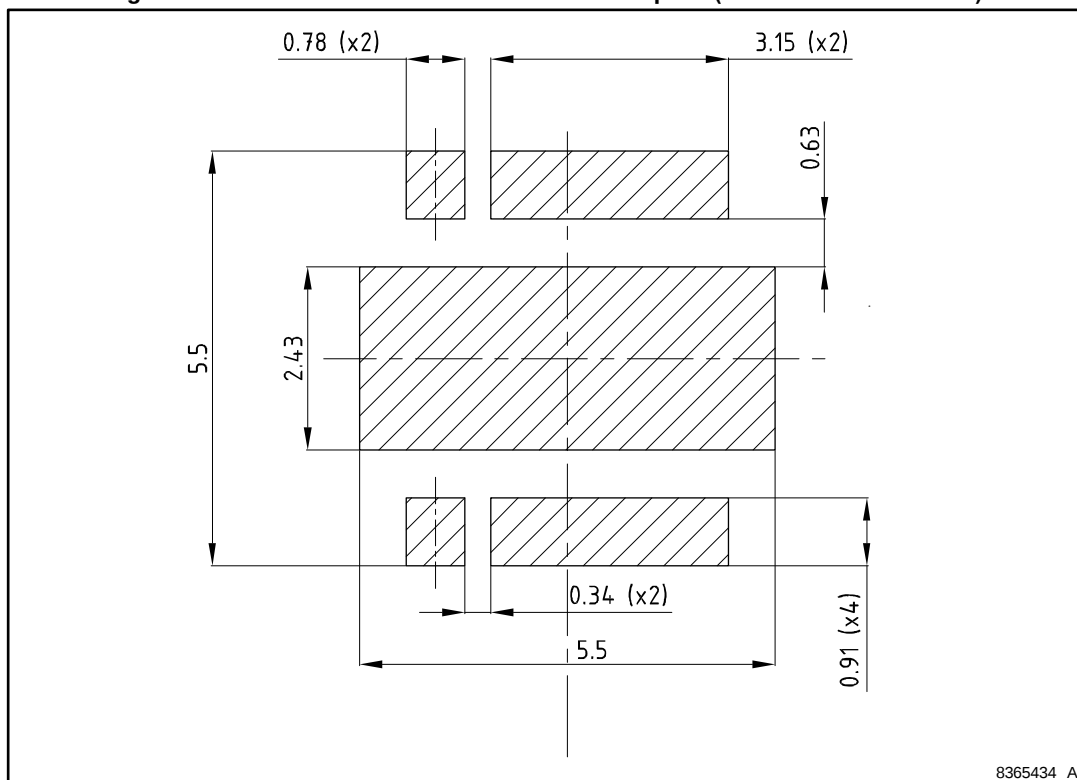


Table 9: PowerFLAT 5x5 package mechanical data

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)



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 Table 6: "Dynamic" and Table 8: "Source-drain diode" . Updated Section 2.1: "Electrical characteristics (curves)" . Minor text changes.

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