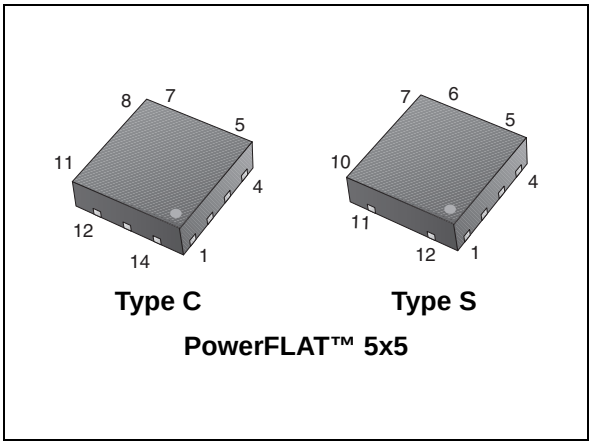
STL3NK40

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

Datasheet - production data



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 rated
- Gate charge minimized
- Very low intrinsic capacitances

Applications

- Switching applications

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.

Figure 1. Internal schematic diagram

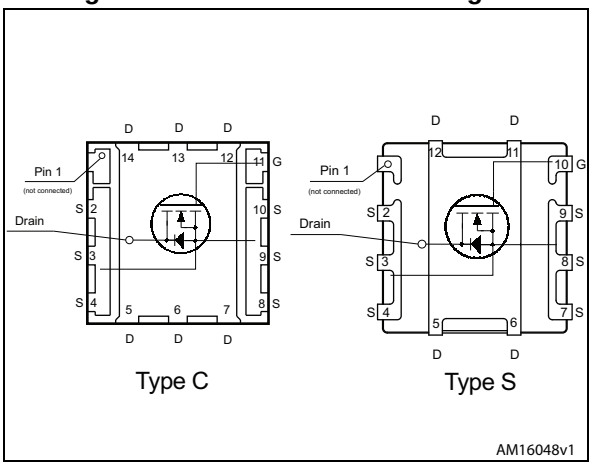


Table 1. Device summary

Order code	Marking	Packages	Packaging
STL3NK40	3NK40	PowerFLAT™ 5x5	Tape and reel

Contents

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 kΩ)	400	V
V_{GS}	Gate- source voltage	± 20	V
I_D (1)	Drain current (continuous) at T_{pcb} = 25 °C	0.43	A
	Drain current (continuous) at T_{pcb} = 100 °C	0.27	A
I_{DM} (1)	Drain current (pulsed)	1.72	A
P_{TOT} (1)	Total dissipation at T_C = 25 °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	°C

1. When mounted on FR-4 Board of 1 inch², 2 oz Cu (t < 100 s)
2. I_{SD} < 0.43 A, di/dt< 200 A/µs, V_{DD} < 320 V

Table 3. Thermal resistance

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

1. When mounted on FR-4 Board of 1 inch², 2 oz Cu (t < 100 s)

Table 4. Avalanche data

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

2 Electrical characteristics

(T_{CASE} = 25 °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 mA, V_{GS} = 0	400			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 400 V V_{DS} = 400 V, T_C = 125 °C			1 50	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			± 10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	0.8	1.6	2	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 0.22 A		4.5	5.5	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward transconductance	V_{DS} = 10 V, I_D = 0.43 A	-	1.2		S
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0	-	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 MHz Gate DC Bias = 0 Test signal level = 20 mV open drain	-	12		Ω
Q_g	Total gate charge	V_{DD} = 320 V, I_D = 1.4 A, V_{GS} = 10 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 µs, 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 V, I_D = 0.7 A, R_G = 4.7 Ω, V_{GS} = 10 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 A, V_{GS} = 0	-		1.2	V
t_{rr}	Reverse recovery time	I_{SD} = 1.4 A, di/dt = 100 A/µs V_{DD} = 20 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 A, di/dt = 100 A/µs V_{DD} = 20 V, T_j = 150 °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 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

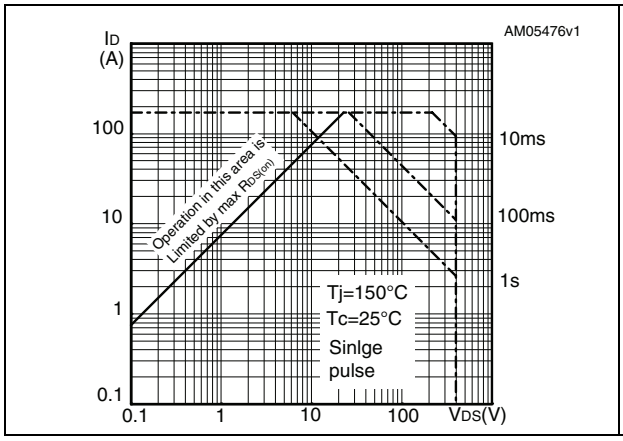


Figure 3. Thermal impedance

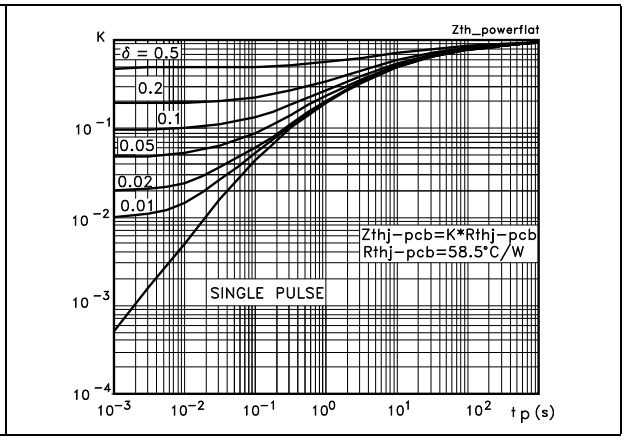


Figure 4. Saturation characteristics

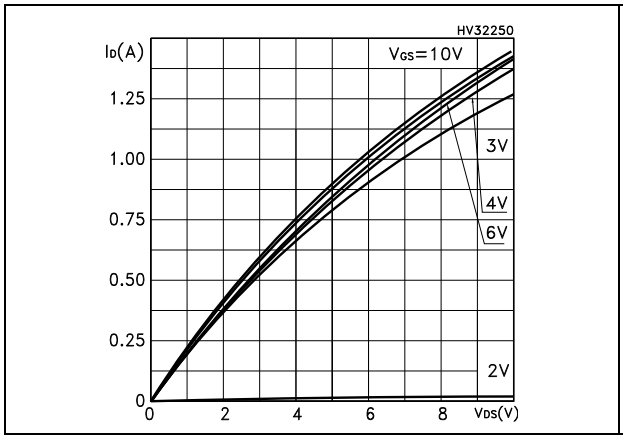


Figure 5. Transfer characteristics

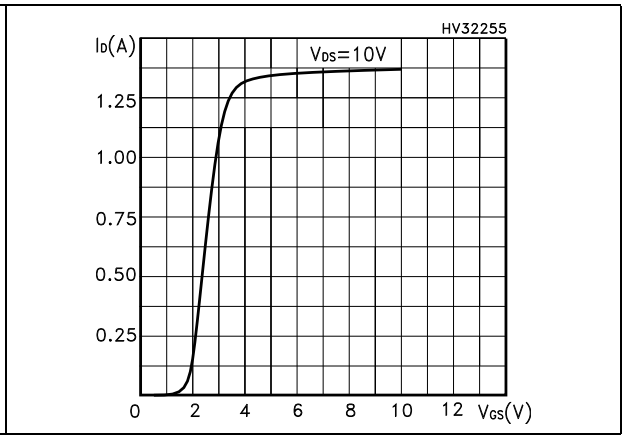


Figure 6. Output characteristics

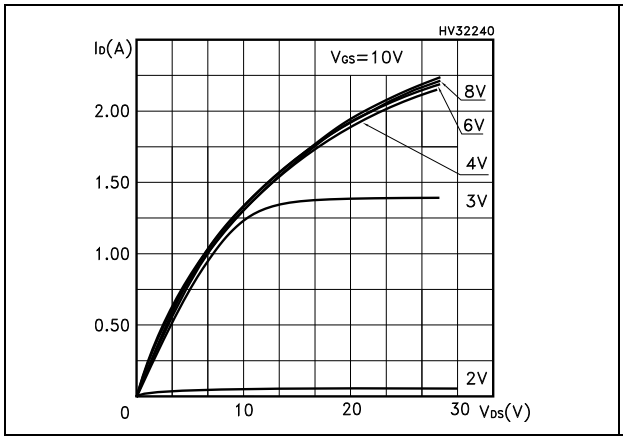


Figure 7. Static drain-source on-resistance

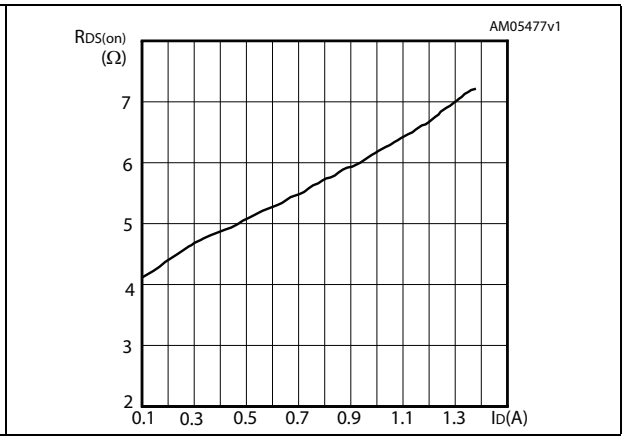


Figure 8. Gate charge vs gate-source voltage

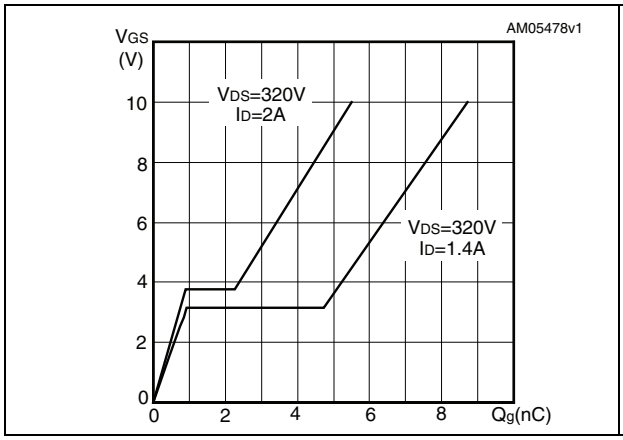


Figure 9. Capacitance variations

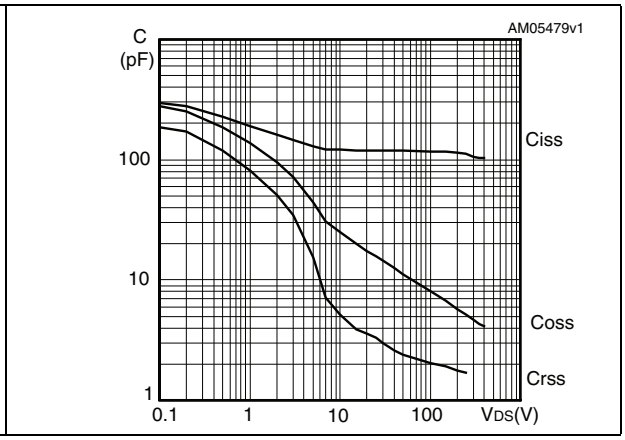


Figure 10. Transconductance

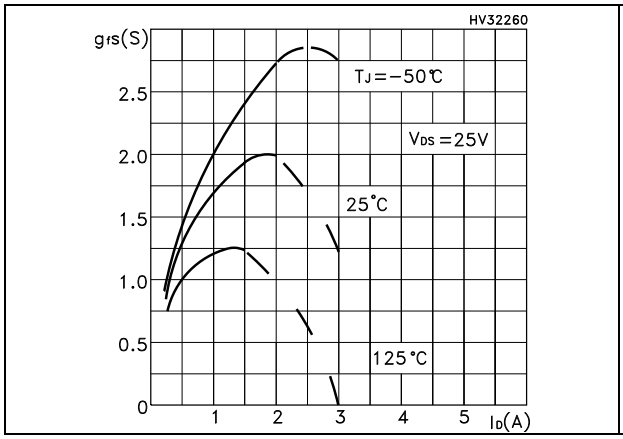


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

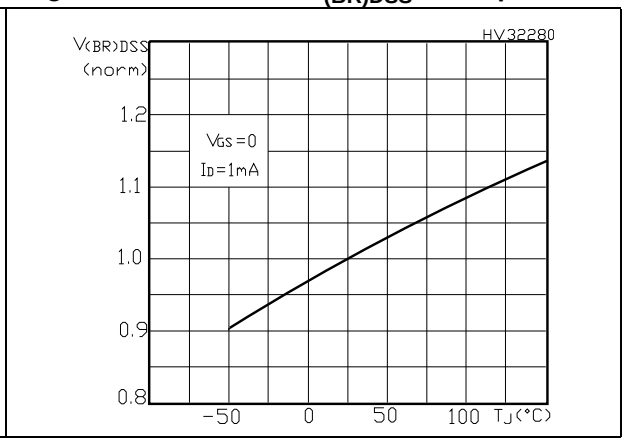


Figure 12. Normalized gate threshold voltage vs temperature

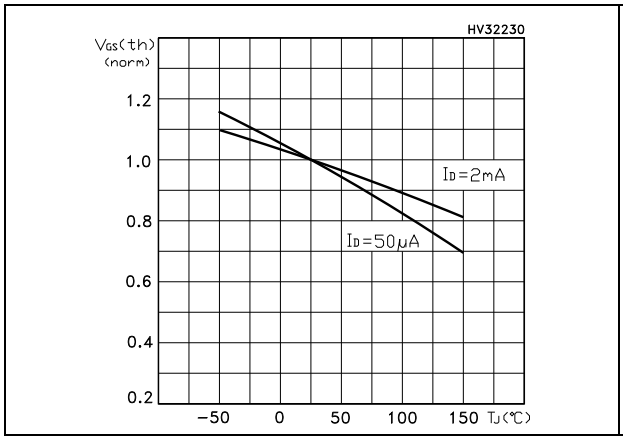
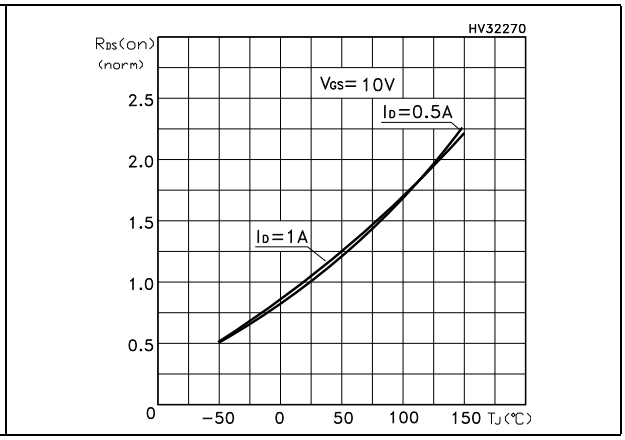


Figure 13. Normalized on-resistance vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

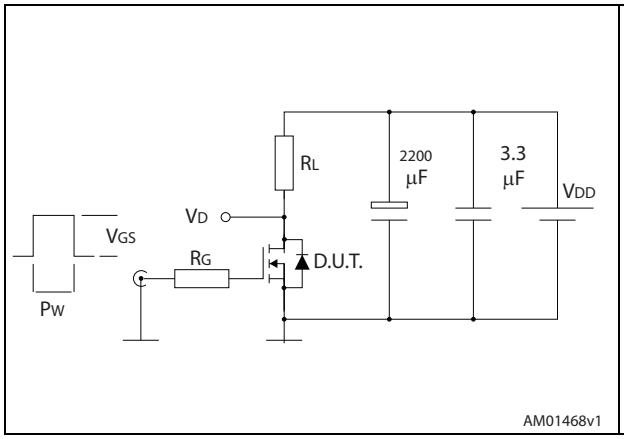


Figure 15. Gate charge test circuit

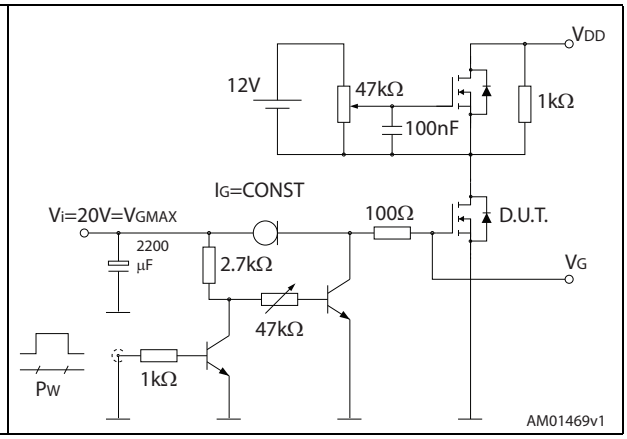


Figure 16. Test circuit for inductive load switching and diode recovery times

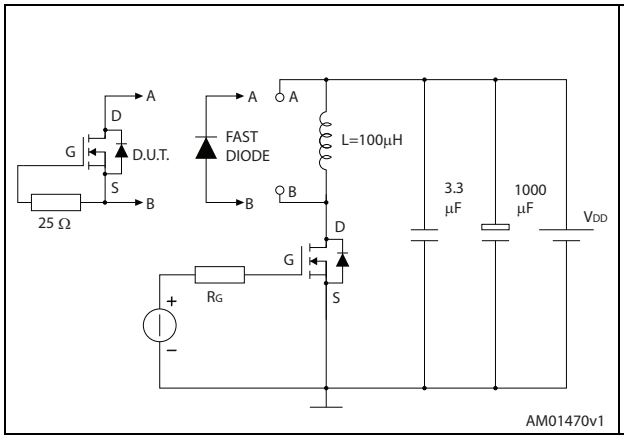


Figure 17. Unclamped inductive load test circuit

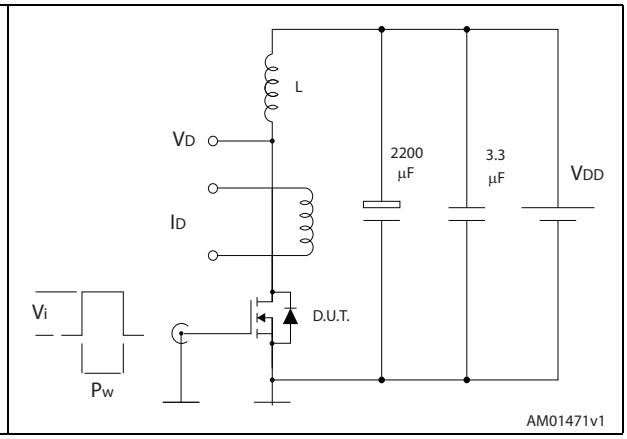


Figure 18. Unclamped inductive waveform

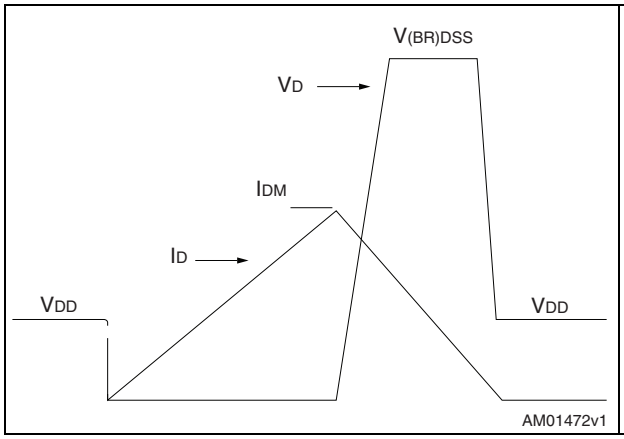
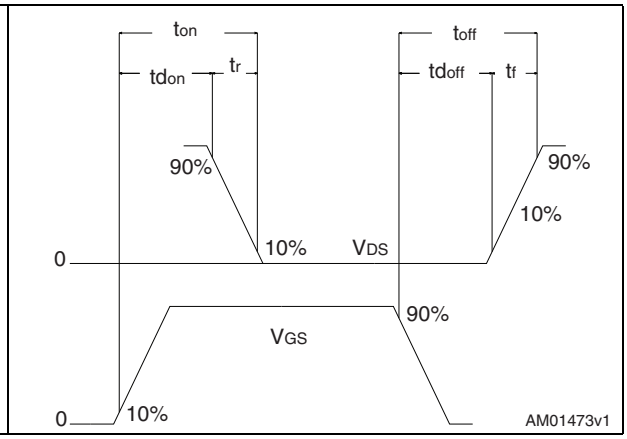


Figure 19. Switching time waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® 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.

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

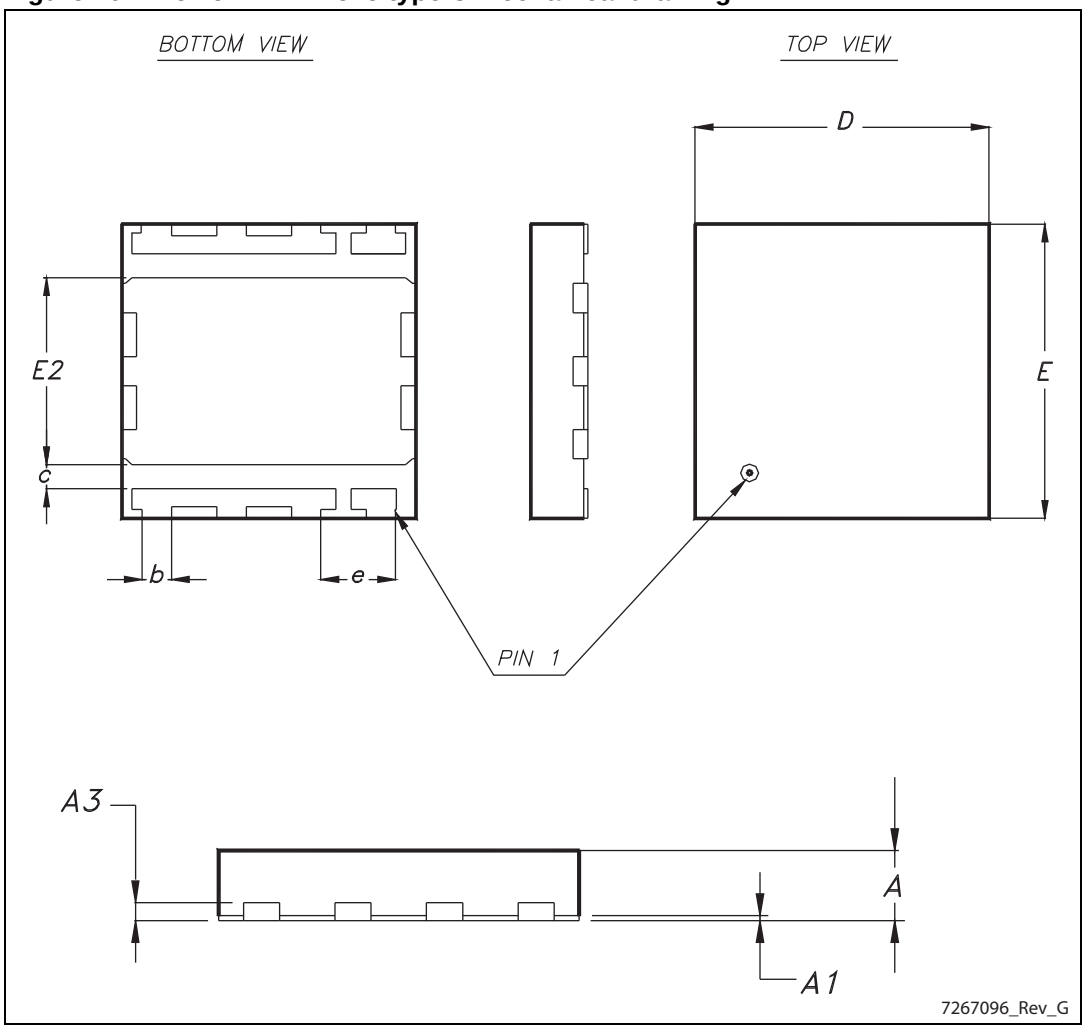


Figure 21. PowerFLAT™ 5x5 type C recommended footprint (mm)

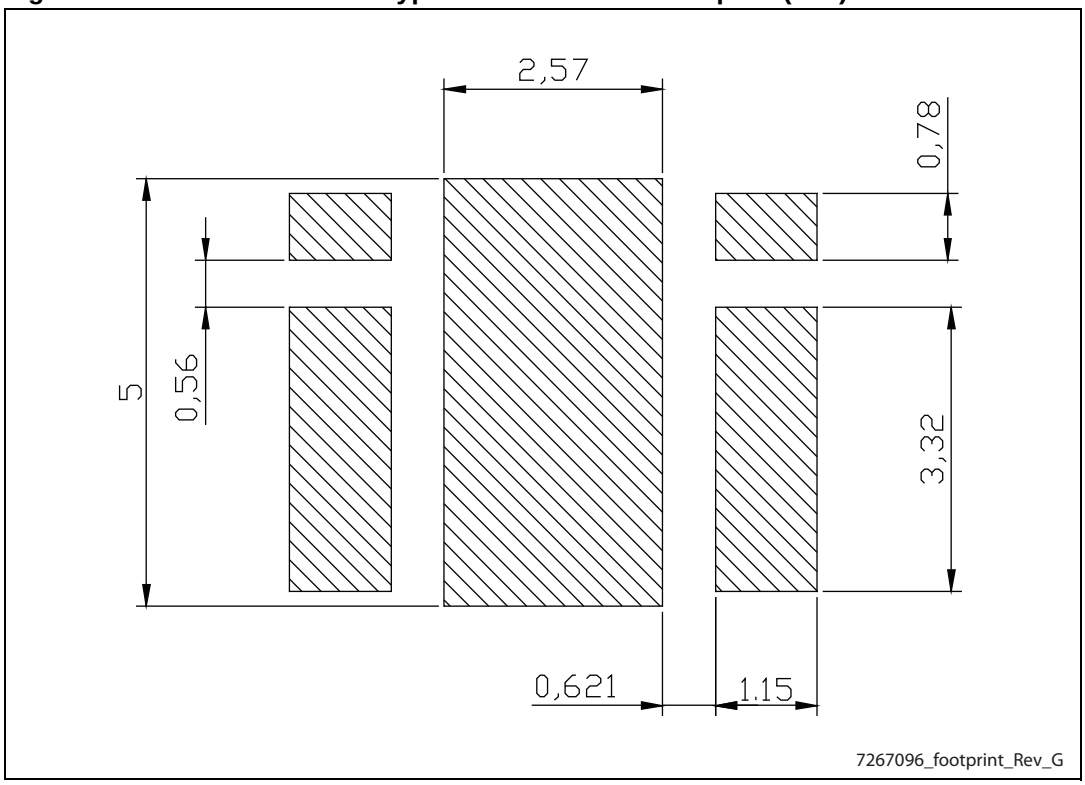


Table 10. PowerFLAT™ 5x5 type S mechanical dimensions

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

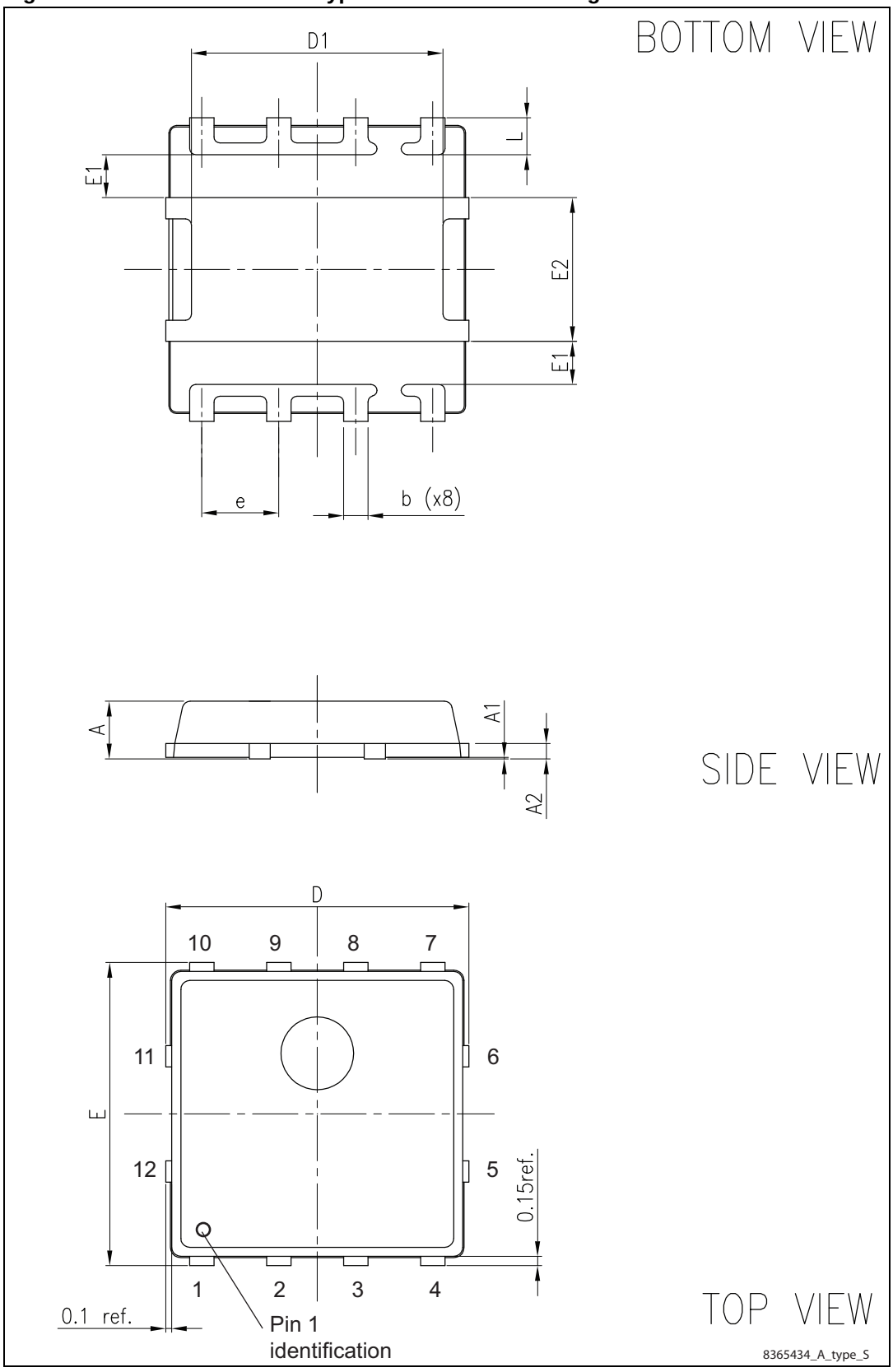
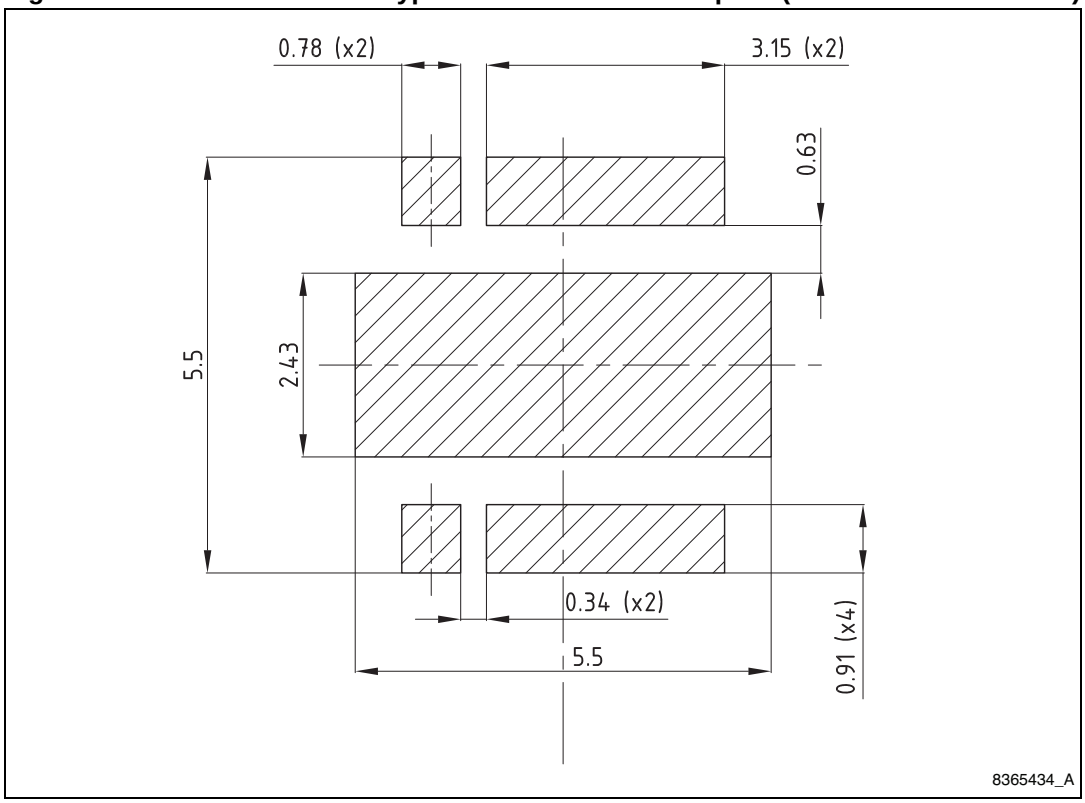


Figure 23. PowerFLAT™ 5x5 type S recommended footprint (dimensions are in mm)



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
18-Sep-2009	1	First release
29-Aug-2013	2	– Updated: *Section 4: Package mechanical data* – Minor text changes

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