



# STL60N3LLH5

N-channel 30 V, 0.0063  $\Omega$ , 17 A PowerFLAT™ (5x6)  
STripFET™ V Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	I <sub>D</sub>
STL60N3LLH5	30 V	<0.0071 $\Omega$	17 A <sup>(1)</sup>

1. The value is rated according R<sub>thj-pcb</sub>

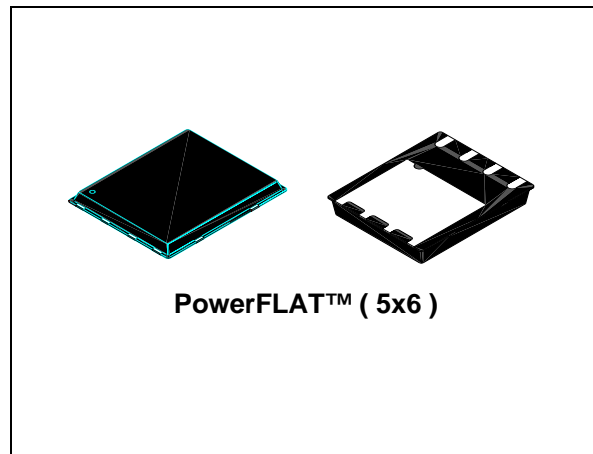
- R<sub>DS(on)</sub> \* Q<sub>g</sub> industry benchmark
- Extremely low on-resistance R<sub>DS(on)</sub>
- Very low switching gate charge
- High avalanche ruggedness
- Low gate drive power losses

## Application

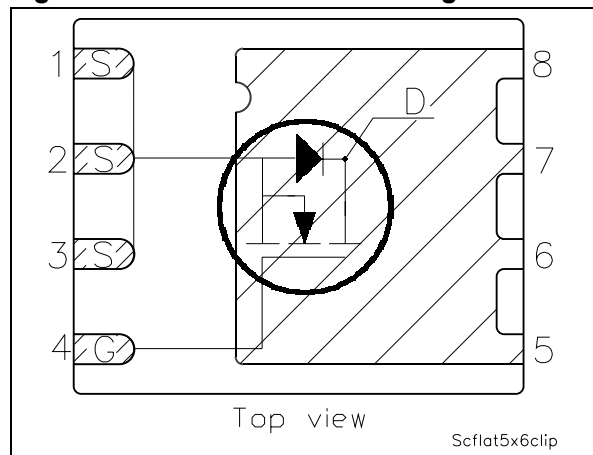
- Switching applications

## Description

This STripFET™V Power MOSFET technology is among the latest improvements, which have been especially tailored to achieve very low on-state resistance providing also one of the best-in-class figure of merit (FOM).



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STL60N3LLH5	60N3LLH5	PowerFLAT™ (5x6)	Tape and reel

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	30	V
$V_{GS}$	Gate-source voltage	$\pm 22$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	60	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	37.5	A
$I_D^{(2)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	17	A
$I_D^{(2)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	10.6	A
$I_{DM}^{(3)}$	Drain current (pulsed)	68	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25^\circ\text{C}$	60	W
$P_{TOT}^{(2)}$	Total dissipation at $T_C = 25^\circ\text{C}$	4	W
	Derating factor	0.03	W/ $^\circ\text{C}$
$T_J$	Operating junction temperature	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature		

1. The value is rated according  $R_{thj-c}$
2. The value is rated according  $R_{thj-pcb}$
3. Pulse width limited by safe operating area

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case (Drain) (steady state)	2.08	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-ambient	31.3	$^\circ\text{C}/\text{W}$

1. When mounted on FR-4 board of 1inch<sup>2</sup>, 2oz Cu,  $t < 10$  sec

**Table 4. Avalanche data**

Symbol	Parameter	Value	Unit
$I_{AV}$	Not-repetitive avalanche current (pulse width limited by $T_J$ Max)	12.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25^\circ\text{C}$ , $I_D = I_{AV}$ , $V_{DD} = 21$ V)	120	mJ

## 2 Electrical characteristics

( $T_{CASE} = 25^{\circ}C$  unless otherwise specified)

**Table 5. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	30			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{max rating},$ $V_{DS} = \text{max rating} @ 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 22 V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	1			V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 V, I_D = 8.5 A$ $V_{GS} = 4.5 V, I_D = 8.5 A$		0.0063 0.0086	0.0071 0.0095	$\Omega$ $\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25 V, f = 1 \text{ MHz},$ $V_{GS} = 0$	-	1290	-	pF
$C_{oss}$	Output capacitance			240		
$C_{rss}$	Reverse transfer capacitance			32		
$Q_g$	Total gate charge	$V_{DD} = 15 V, I_D = 17 A$	-	8	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 4.5 V$	-	3.6	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14)		3.4		nC

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 15 V, I_D = 8.5 A,$ $R_G = 4.7 \Omega, V_{GS} = 10 V$ (see Figure 13)	-	8.6	-	ns
$t_r$	Rise time			11.2		
$t_{d(off)}$	Turn-off delay time			32.4		
$t_f$	Fall time			6		

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		17	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		68	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 17 \text{ A}, V_{GS} = 0$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 17 \text{ A},$		22		ns
$Q_{rr}$	Reverse recovery charge	$di/dt = 100 \text{ A}/\mu\text{s},$	-	15		nC
$I_{RRM}$	Reverse recovery current	$V_{DD} = 25 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$		1.4		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

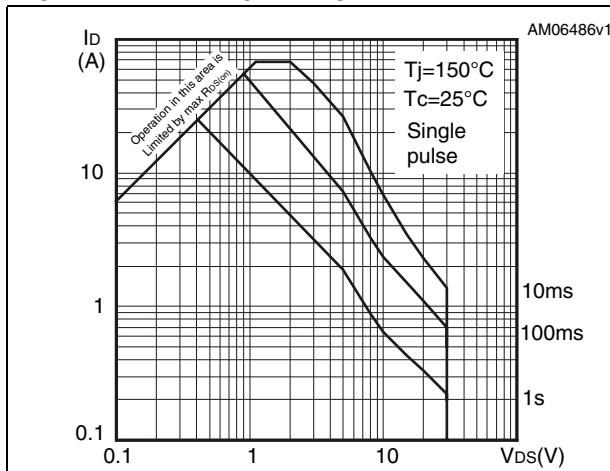


Figure 3. Thermal impedance

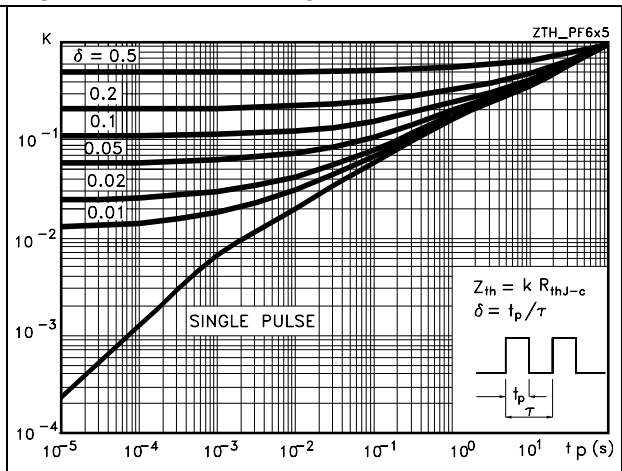


Figure 4. Output characteristics

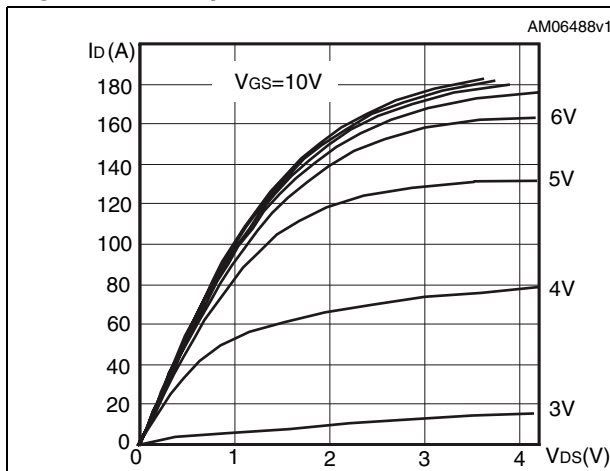


Figure 5. Transfer characteristics

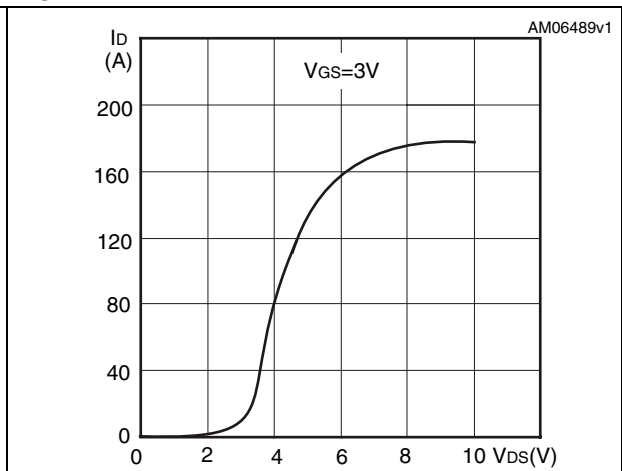


Figure 6. Normalized BV<sub>DSS</sub> vs temperature

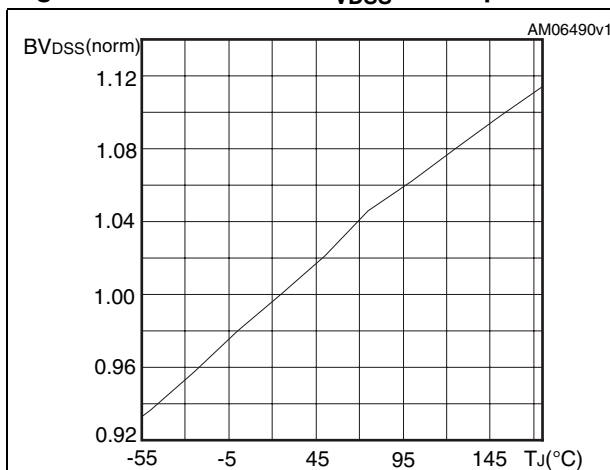


Figure 7. Static drain-source on resistance

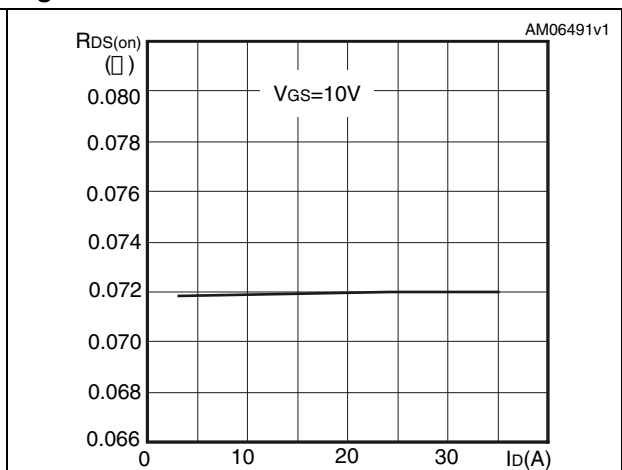


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

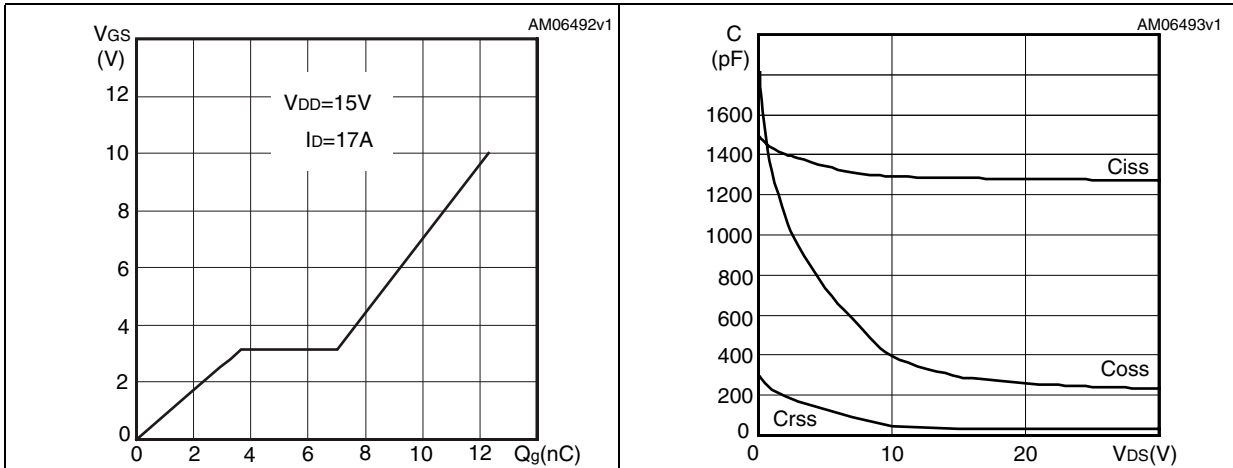


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

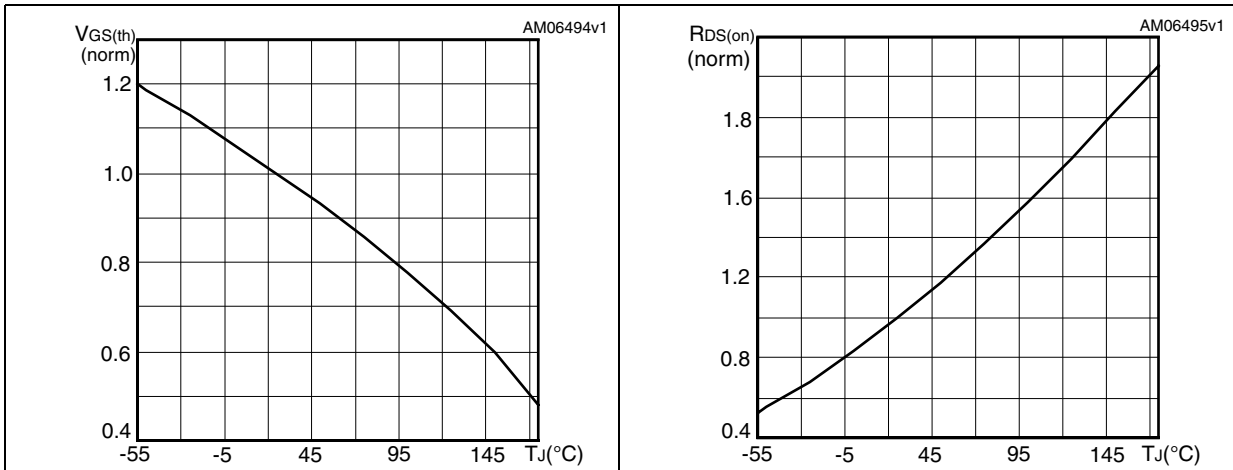
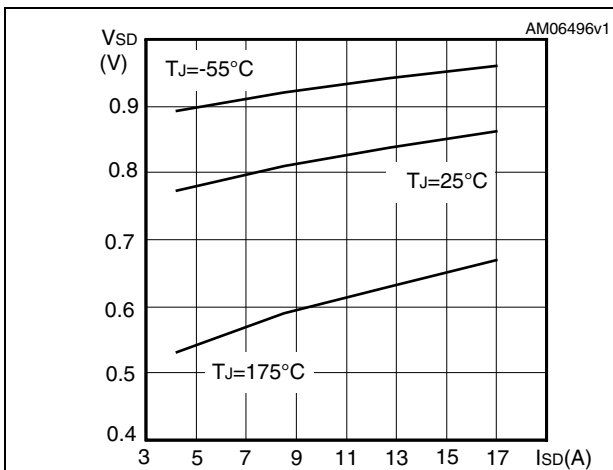


Figure 12. Source-drain diode forward characteristics



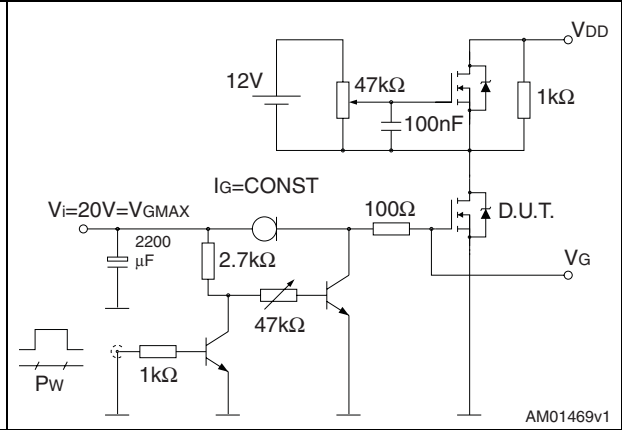
### 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**



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**Figure 14. Gate charge test circuit**



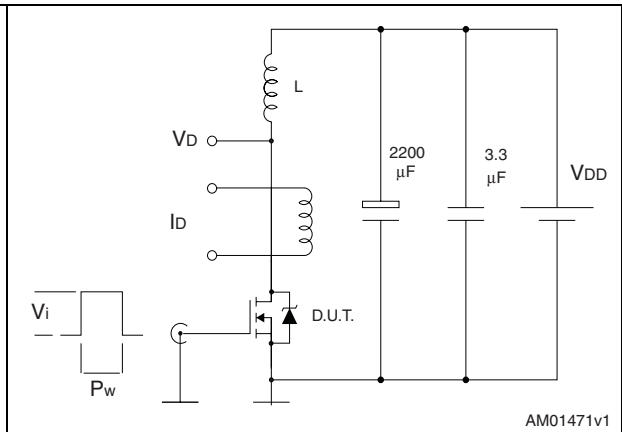
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**Figure 15. Test circuit for inductive load switching and diode recovery times**



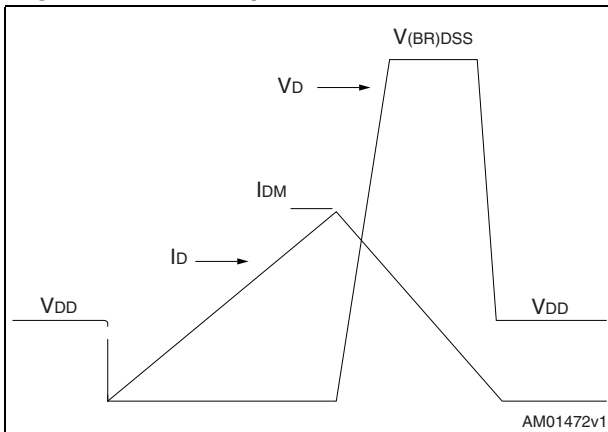
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**Figure 16. Unclamped inductive load test circuit**



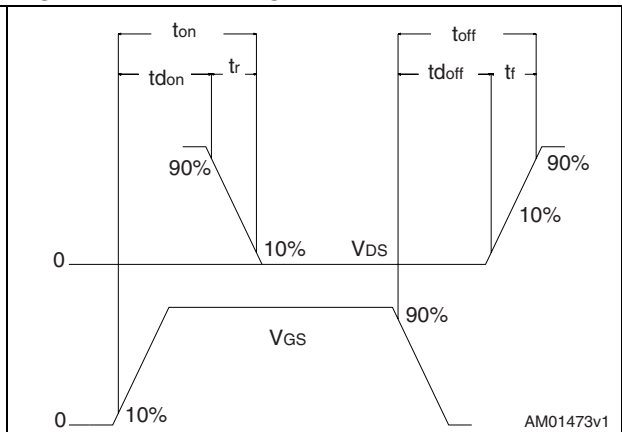
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**Figure 17. Unclamped inductive waveform**



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**Figure 18. Switching time waveform**



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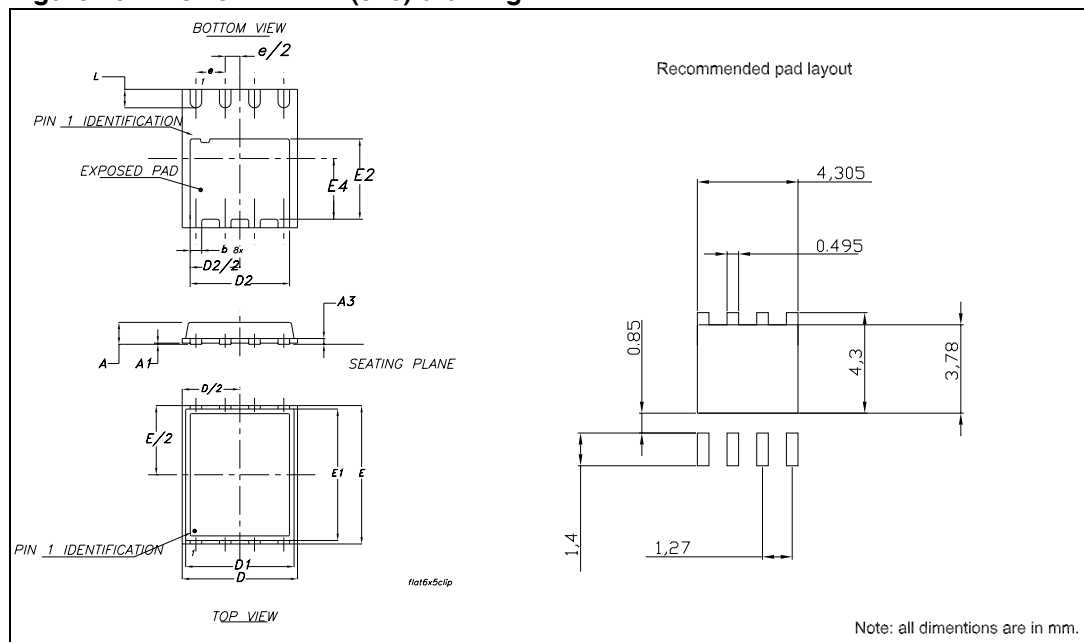
## 4 Package mechanical data

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 9. Power FLAT™ (5x6) mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80	0.83	0.93	0.031	0.32	0.036
A1		0.02	0.05		0.0007	0.0019
A3		0.20			0.007	
b	0.35	0.40	0.47	0.013	0.015	0.018
D		5.00			0.196	
D1		4.75			0.187	
D2	4.15	4.20	4.25	0.163	0.165	0.167
E		6.00			0.236	
E1		5.75			0.226	
E2	3.43	3.48	3.53	0.135	0.137	0.139
E4	2.58	2.63	2.68		0.103	0.105
e		1.27			0.050	
L	0.70	0.80	0.90	0.027	0.031	0.035

Figure 19. Power FLAT™ (5x6) drawing



## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
16-Mar-2010	1	First release

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