

## N-channel 30 V, 0.006 $\Omega$ typ., 11 A STripFET™ VI DeepGATE™ Power MOSFET in a PowerFLAT™ 3.3 x 3.3 package

Datasheet - production data

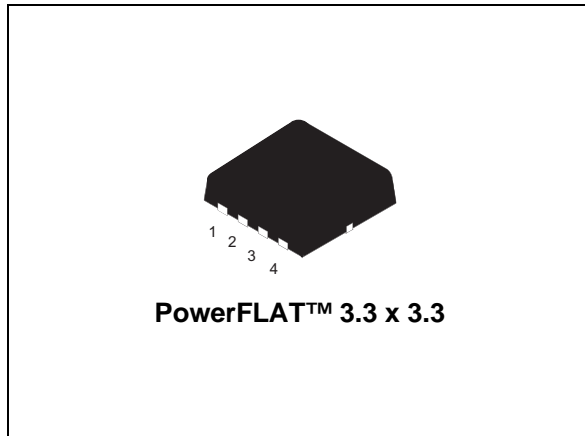
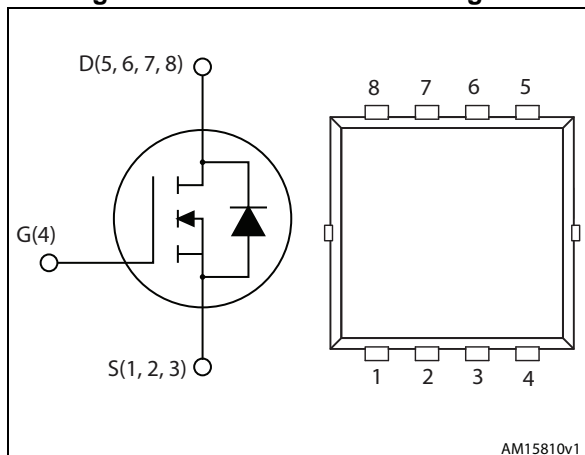


Figure 1. Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STL11N3LLH6	30 V	0.0075 $\Omega$	11 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>
- High avalanche ruggedness
- Low gate drive power losses
- Very low switching gate charge

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the 6<sup>th</sup> generation of STripFET™ DeepGATE™ technology, with a new gate structure. The resulting Power MOSFET exhibits the lowest R<sub>DS(on)</sub> in all packages.

Table 1. Device summary

Order code	Marking	Package	Packaging
STL11N3LLH6	11N3L	PowerFLAT™ 3.3 x 3.3	Tape and reel

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	30	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_{pcb} = 25\text{ }^\circ\text{C}$	11	A
$I_D^{(1)}$	Drain current (continuous) at $T_{pcb} = 100\text{ }^\circ\text{C}$	6.9	A
$I_{DM}^{(2)}$	Drain current (pulsed)	44	A
$P_{TOT}^{(3)}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	50	W
$P_{TOT}^{(1)}$	Total dissipation at $T_{pcb} = 25\text{ }^\circ\text{C}$	2	W
	Derating factor	0.03	W/ $^\circ\text{C}$
$T_J$	Operating junction temperature	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature		$^\circ\text{C}$

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

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}^{(2)}$	Thermal resistance junction-case	2.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	42.8	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(2)}$	Thermal resistance junction-pcb	63.5	$^\circ\text{C}/\text{W}$

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

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	30			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0$ , $V_{DS} = 30\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0$ , $V_{DS} = 30\text{ V}$ , $T_C = 125\text{ °C}$			10	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	1			V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$		0.006	0.0075	$\Omega$
		$V_{GS} = 4.5\text{ V}$ , $I_D = 5.5\text{ A}$		0.0084	0.0095	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 24\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1690	-	pF
$C_{oss}$	Output capacitance		-	290	-	pF
$C_{rss}$	Reverse transfer capacitance		-	176	-	pF
$Q_g$	Total gate charge	$V_{DD} = 24\text{ V}$ , $I_D = 11\text{ A}$	-	17	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 4.5\text{ V}$	-	8	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14)	-	6	-	nC
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ Gate DC Bias = 0 Test signal level = 20 mV open drain	-	1.7	-	$\Omega$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 24\text{ V}$ , $I_D = 5.5\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13)	-	9.5	-	ns
$t_r$	Rise time		-	30	-	ns
$t_{d(off)}$	Turn-off delay time		-	37	-	ns
$t_f$	Fall time		-	12	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		44	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 11 \text{ A}, V_{GS} = 0$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 11 \text{ A},$ $di/dt = 100 \text{ A}/\mu\text{s},$ $V_{DD} = 24 \text{ V}$	-	24		ns
$Q_{rr}$	Reverse recovery charge		-	16.8		nC
$I_{RRM}$	Reverse recovery current		-	1.4		A

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

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

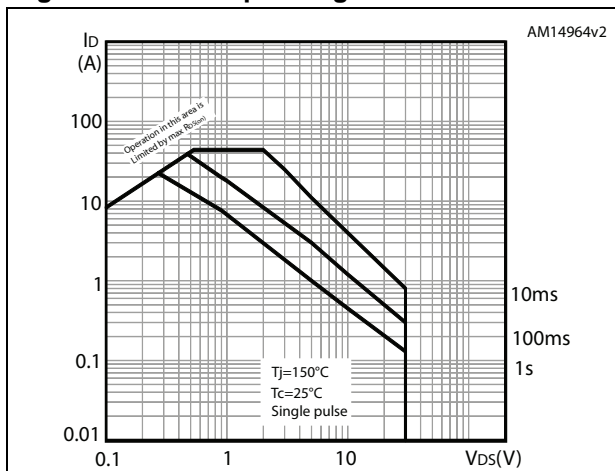


Figure 3. Thermal impedance

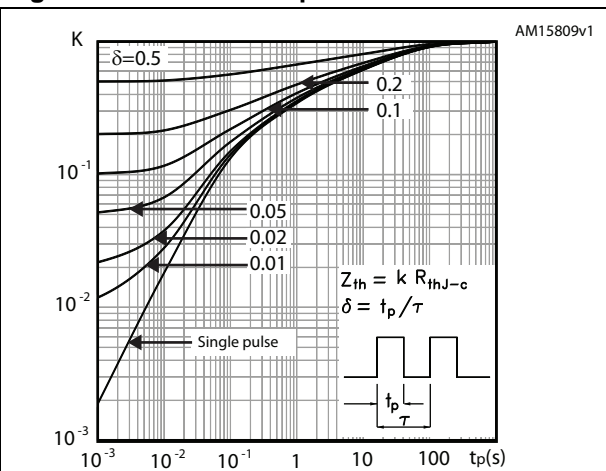


Figure 4. Output characteristics

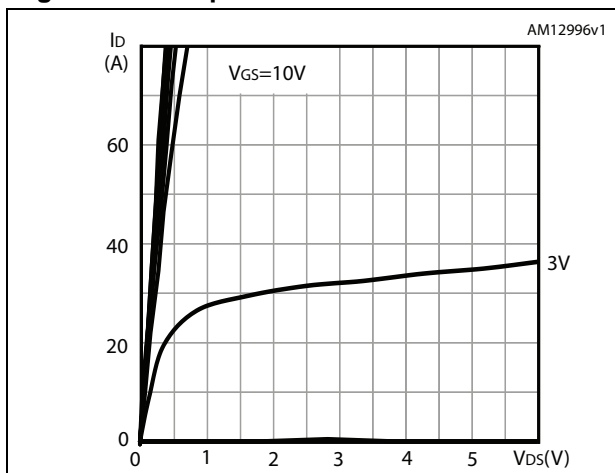


Figure 5. Transfer characteristics

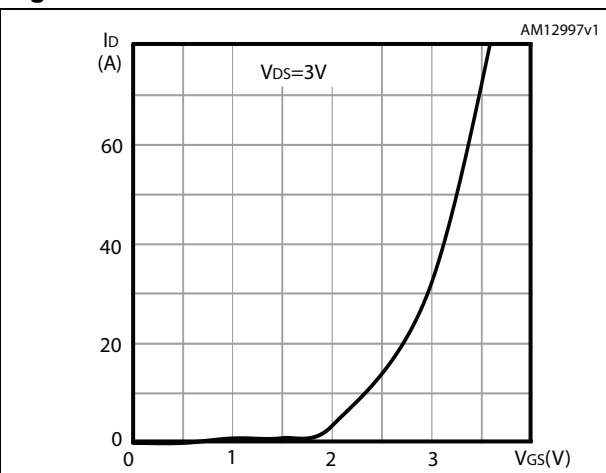


Figure 6. Normalized BV<sub>DSS</sub> vs temperature

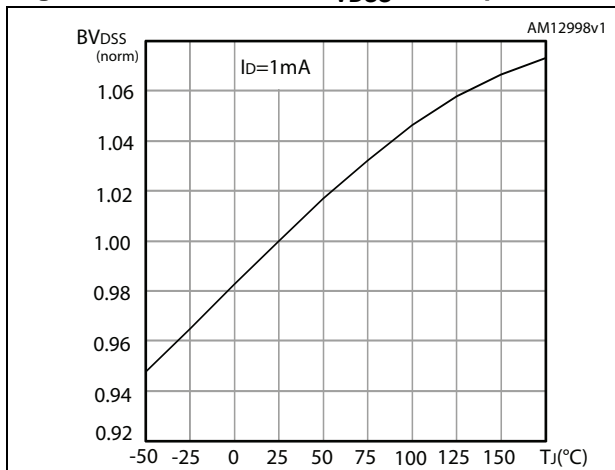


Figure 7. Static drain-source on-resistance

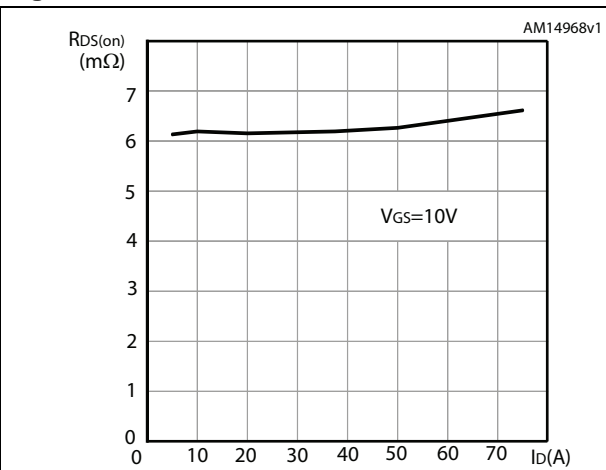


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

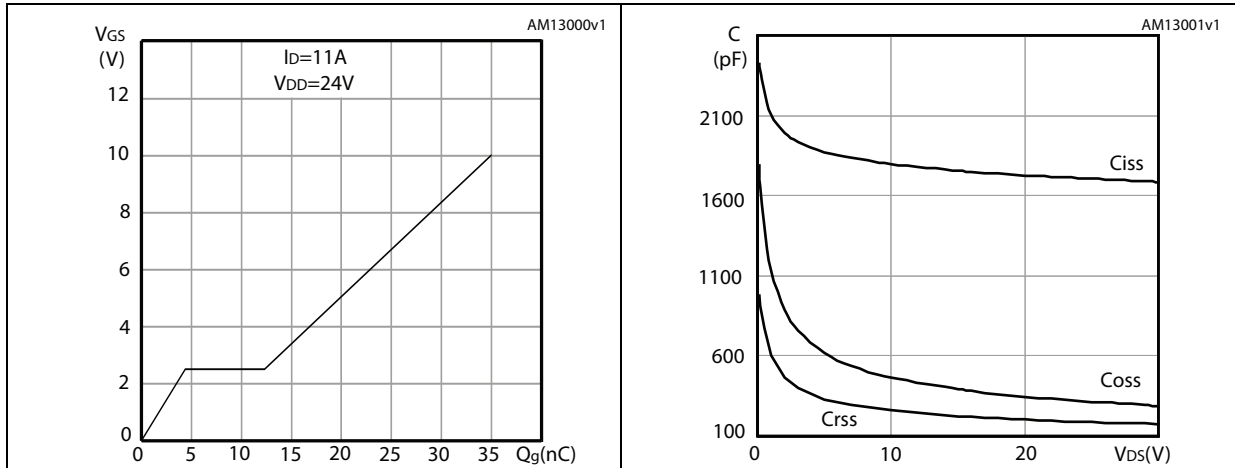


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on-resistance vs temperature

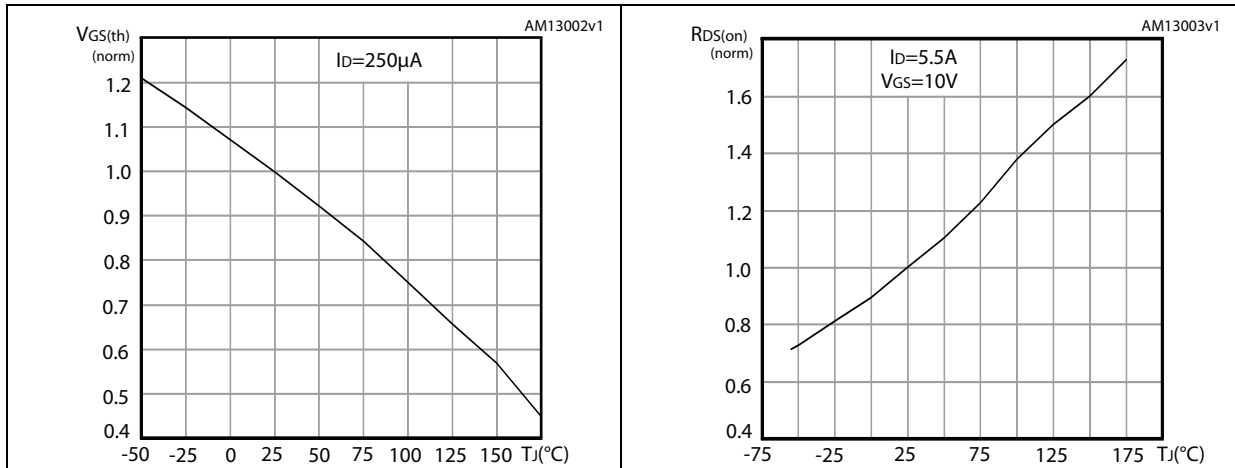
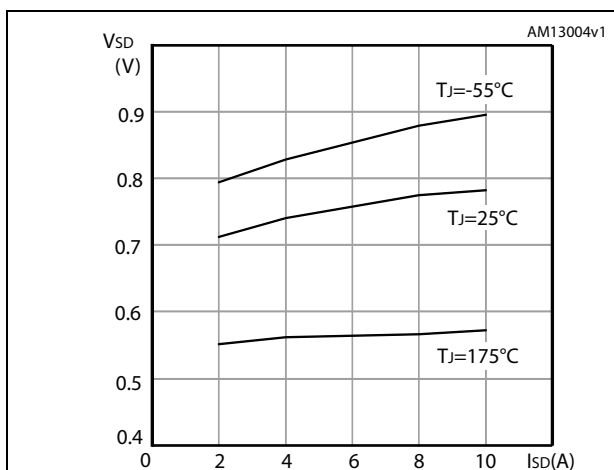
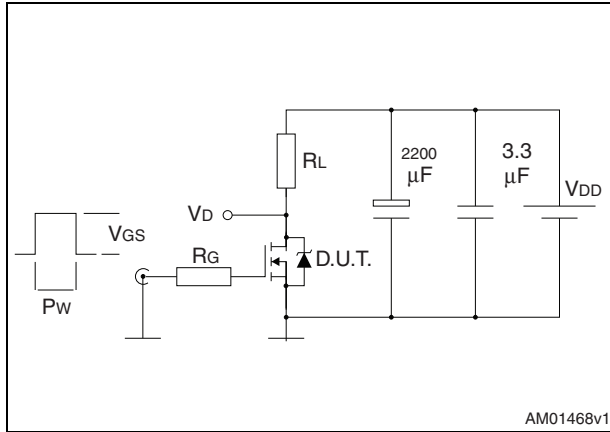


Figure 12. Source-drain diode forward characteristics

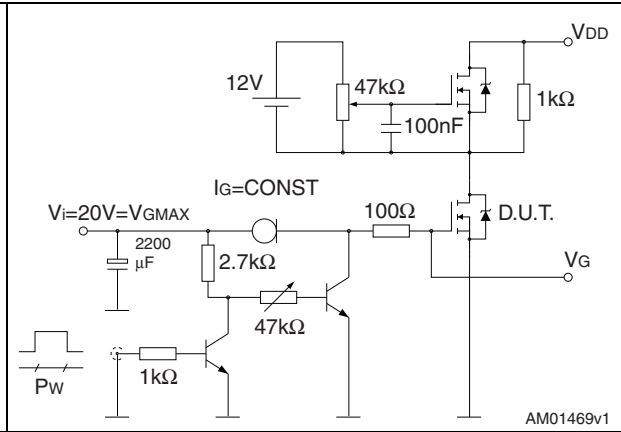


### 3 Test circuits

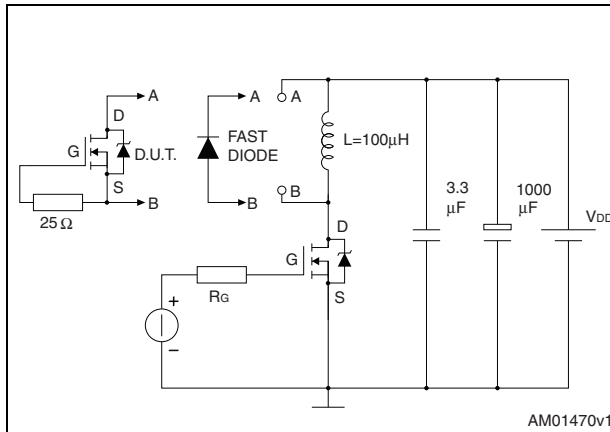
**Figure 13. Switching times test circuit for resistive load**



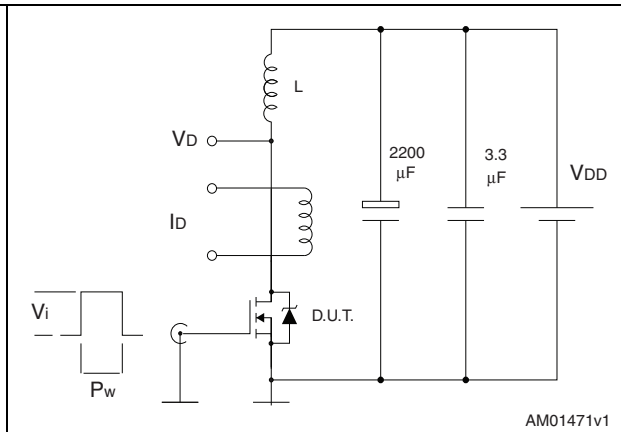
**Figure 14. Gate charge test circuit**



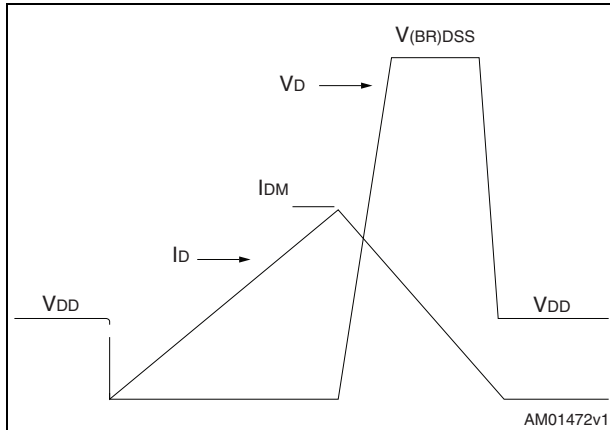
**Figure 15. Test circuit for inductive load switching and diode recovery times**



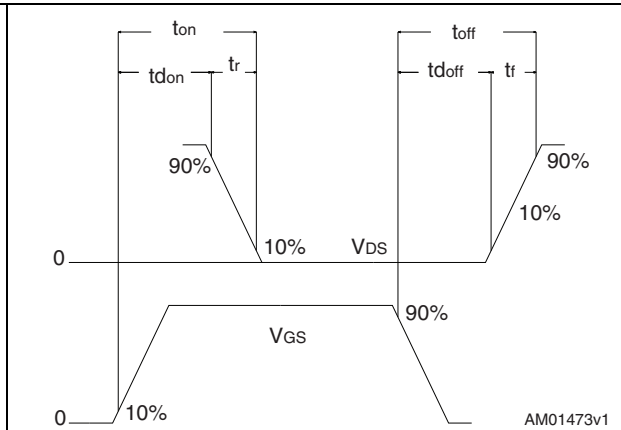
**Figure 16. Unclamped inductive load test circuit**



**Figure 17. Unclamped inductive waveform**



**Figure 18. 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 8. PowerFLAT™ 3.3 x 3.3 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.70	0.80	0.90
b	0.25	0.30	0.39
c	0.14	0.15	0.20
D	3.10	3.30	3.50
D1	3.05	3.15	3.25
D2	2.15	2.25	2.35
e	0.55	0.65	0.75
E	3.10	3.30	3.50
E1	2.90	3.00	3.10
E2	1.60	1.70	1.80
H	0.25	0.40	0.55
K	0.65	0.75	0.85
L	0.30	0.45	0.60
L1	0.05	0.15	0.25
L2			0.15
$\vartheta$	8°	10°	12°

Figure 19. PowerFLAT™ 3.3 x 3.3 drawing

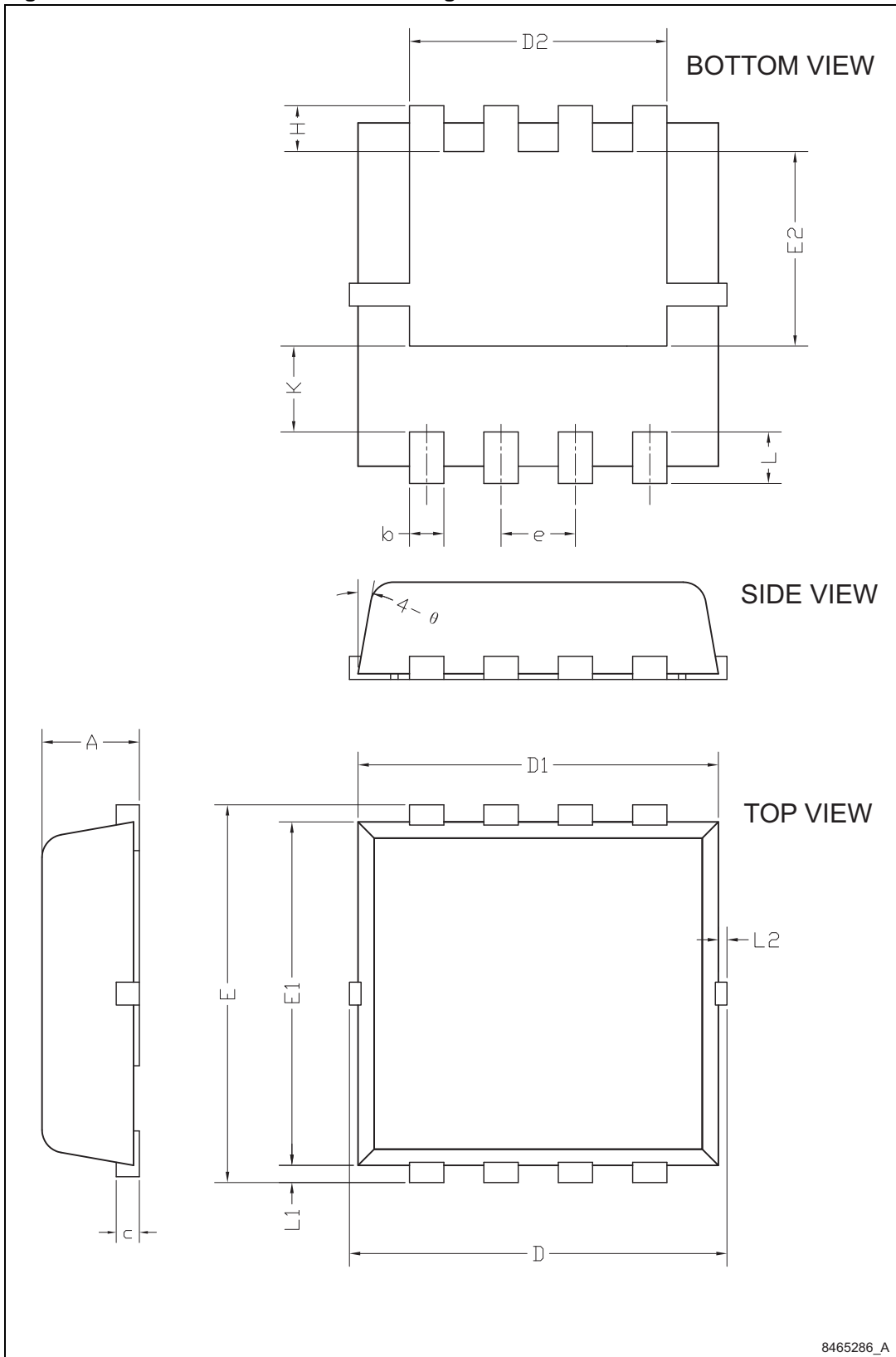
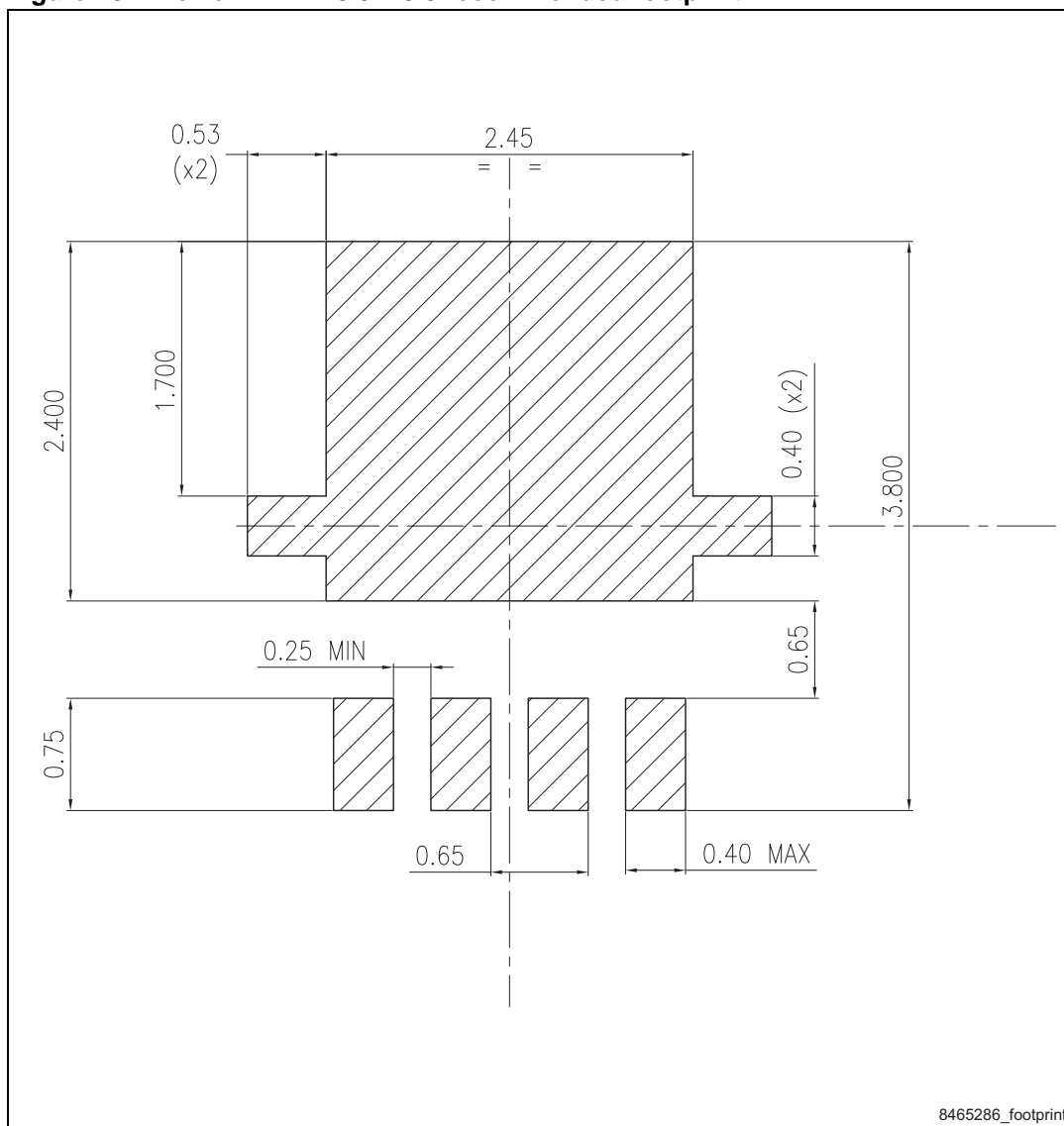


Figure 20. PowerFLAT™ 3.3 x 3.3 recommended footprint<sup>(a)</sup>



a. All dimensions are in millimeters

## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
02-Sep-2010	1	First release.
23-May-2013	2	<ul style="list-style-type: none"><li>– Document status promoted from preliminary data to production data.</li><li>– Updated: <a href="#">Figure 1</a>, silhouette in cover page and <a href="#">Section 4: Package mechanical data</a></li><li>– Modified: the entire typical values in <a href="#">Table 7</a></li><li>– Minor text changes</li></ul>

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