

N-channel 30 V, 0.019  $\Omega$  typ., 10 A, P-channel 30 V, 0.024  $\Omega$  typ., 8 A  
 STripFET™ VI Power MOSFET in a PowerFLAT 5x6 d. i. package

Datasheet - production data

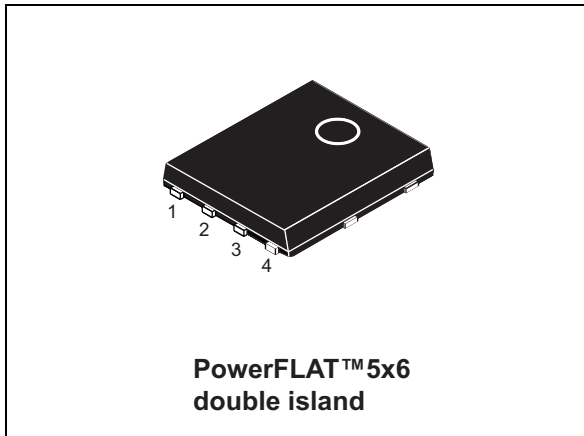
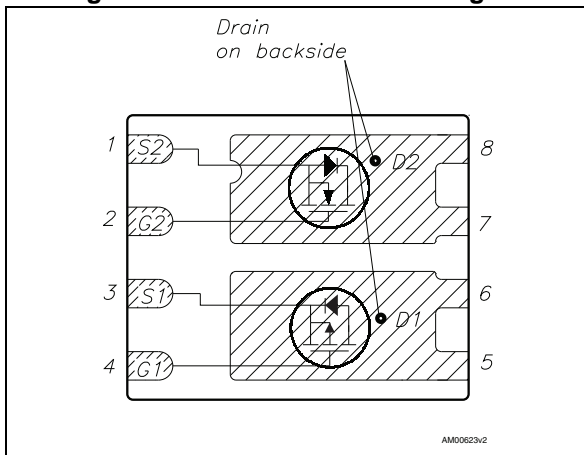


Figure 1. Internal schematic diagram



## Features

Order code	Channel	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STL40C30H3LL	N	30 V	0.021 $\Omega$ @ 10 V	10 A
	P		0.03 $\Omega$ @ 10 V	8 A

- 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

## Applications

- Switching applications

## Description

This device is a complementary N-channel and P-channel Power MOSFET developed using STripFET™ V (P-channel) and STripFET™ VI DeepGATE™ (N-channel) technologies. The resulting device exhibits low on-state resistance and an FOM among the lowest in its voltage class.

Table 1. Device summary

Order code	Marking	Packages	Packaging
STL40C30H3LL	40C30H3L	PowerFLAT 5x6 double island	Tape and reel

Note: For the P-channel MOSFET actual polarity of voltages and current has to be reversed

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		N-channel	P-channel	
$V_{DS}$	Drain-source voltage ( $v_{gs} = 0$ )	30		V
$V_{GS}$	Gate- source voltage	±20		V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25^\circ\text{C}$ single operating	40	30	A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100^\circ\text{C}$ single operating	25	18.75	A
$I_D^{(2)}$	Drain current (continuous) at $T_{pcb} = 25^\circ\text{C}$ single operating	10	8	A
$I_D^{(2)}$	Drain current (continuous) at $T_{pcb} = 100^\circ\text{C}$ single operating	6.5	5	A
$I_{DM}^{(2)(3)}$	Drain current (pulsed)	40	32	A
$P_{TOT}^{(1)}$	Total dissipation at $T_C = 25^\circ\text{C}$	60		W
$P_{TOT}^{(2)}$	Total dissipation at $T_{pcb} = 25^\circ\text{C}$	4		W
$T_{stg}$	Storage temperature	-55 to 150		°C
$T_j$	Operating junction temperature	150		°C

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

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-c}$	Thermal resistance junction-case	2.08	°C/W
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb single operation	32.00	°C/W

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

*Note: For the P-channel MOSFET actual polarity of voltages and current has to be reversed*

## 2 Electrical characteristics

Table 4. On/off states

Symbol	Parameter	Test conditions	Channel	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	N	30			V
			P				
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 30 V$	N			1	$\mu A$
			P				
		$V_{DS}=30 V, T_C=125 \text{ }^\circ C$	N			10	$\mu A$
			P				
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20 V$	N			$\pm 100$	nA
			P				
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	N	1			V
			P				
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10 V, I_D = 4 A$	N		0.019	0.021	$\Omega$
			P		0.024	0.03	$\Omega$
		$V_{GS} = 4.5 V, I_D = 4 A$	N		0.023	0.028	$\Omega$
			P		0.038	0.05	$\Omega$

Table 5. Dynamic

Symbol	Parameter	Test conditions	Channel	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 24 V, f = 1 MHz, V_{GS} = 0$	N	-	475	-	pF
			P	-	1450	-	pF
$C_{oss}$	Output capacitance		N	-	97	-	pF
			P	-	178	-	pF
$C_{rss}$	Reverse transfer capacitance		N	-	19	-	pF
			P	-	120	-	pF
$Q_g$	Total gate charge	$V_{DD}=24 V, I_D=8 A, V_{GS}= 4.5 V$ (see Figure 25)	N	-	4.6	-	nC
			P	-	12	-	nC
$Q_{gs}$	Gate-source charge		N	-	1.7	-	nC
			P	-	4.4	-	nC
$Q_{gd}$	Gate-drain charge		N	-	1.9	-	nC
			P	-	5	-	nC

Note: For the P-channel MOSFET actual polarity of voltages and current has to be reversed

Table 6. Switching times

Symbol	Parameter	Test conditions	Channel	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 24\text{ V}$ , $I_D = 4\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ <i>Figure 24</i>	N	-	4	-	ns
			P	-	15	-	ns
$t_r$	Rise time		N	-	22	-	ns
			P	-	15	-	ns
$t_{d(off)}$	Turn-off delay time		N	-	13	-	ns
			P	-	24	-	ns
$t_f$	Fall time		N	-	2.8	-	ns
			P	-	21	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Channel	Min.	Typ.	Max.	Unit	
$I_{SD}$	Source-drain current	$I_{SD} = 8\text{ A}$ , $V_{GS} = 0$	N	-		10	A	
			P	-		8	A	
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		N	-		40	A	
			P	-		32	A	
$V_{SD}^{(2)}$	Forward on voltage		N	-		1.1	V	
			P	-				
$t_{rr}$	Reverse recovery time		$I_{SD} = 8\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 16\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ <i>Figure 26</i>	N	-	16.2		ns
				P	-	15		ns
$Q_{rr}$	Reverse recovery charge	N		-	8.1		nC	
		P		-	6.5		nC	
$I_{RRM}$	Reverse recovery current	N		-	1		A	
		P		-	0.9		A	

1. Pulse width limited by safe operating area.

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

Note: For the P-channel MOSFET actual polarity of voltages and current has to be reversed

## 2.1 Electrical characteristics (curves) for N-channel

Figure 2. Safe operating area

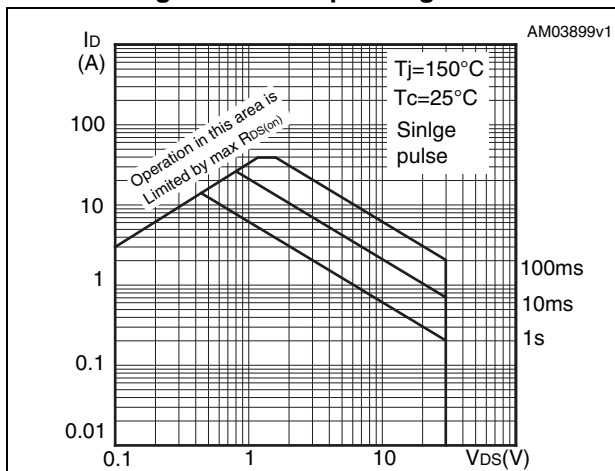


Figure 3. Thermal impedance

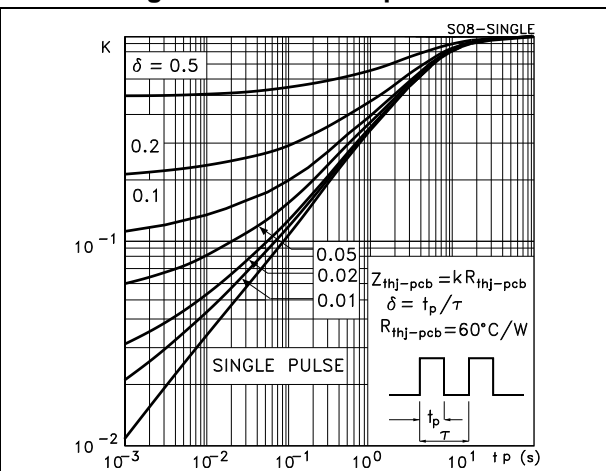


Figure 4. Output characteristics

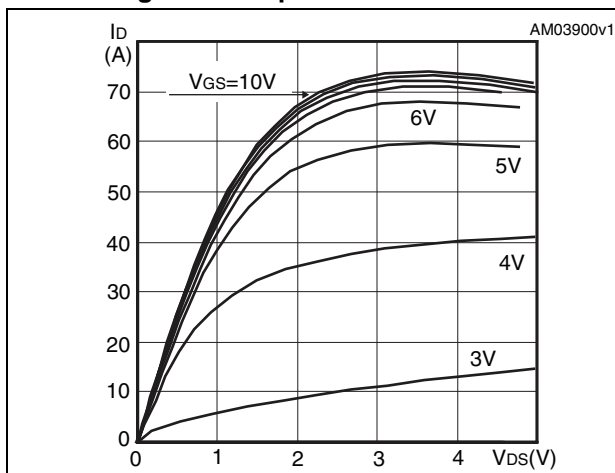


Figure 5. Transfer characteristics

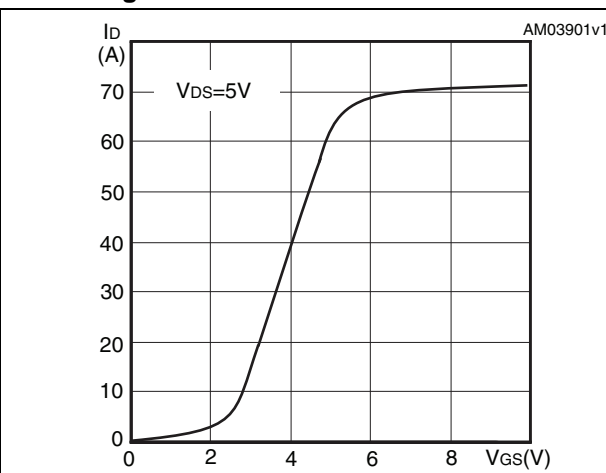


Figure 6. Normalized  $V_{(BR)DSS}$  vs temperature

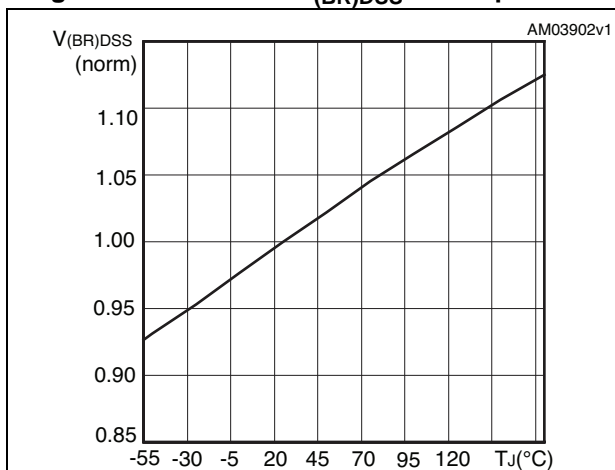


Figure 7. Static drain-source on-resistance

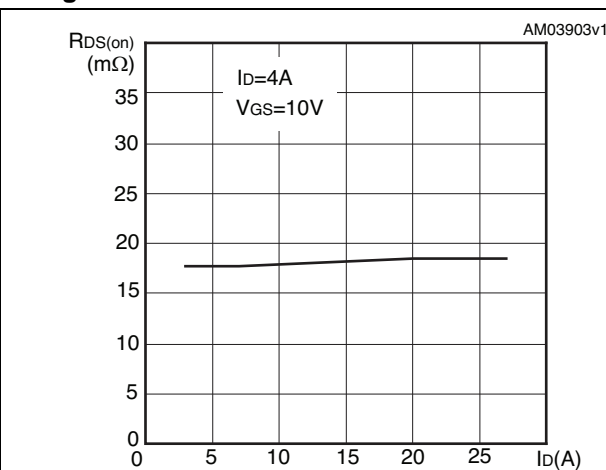


Figure 8. Gate charge vs gate-source voltage

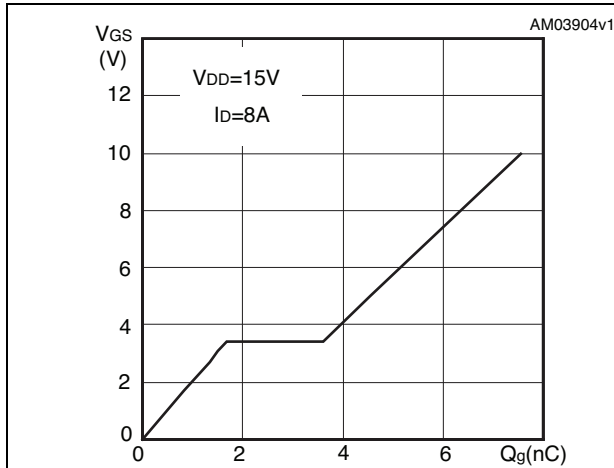


Figure 9. Capacitance variations

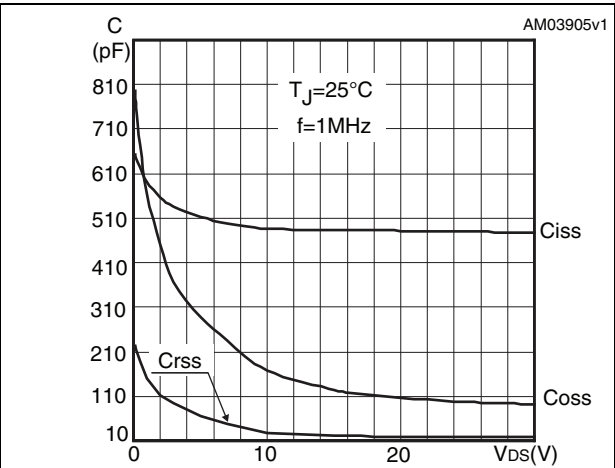


Figure 10. Normalized gate threshold voltage vs temperature

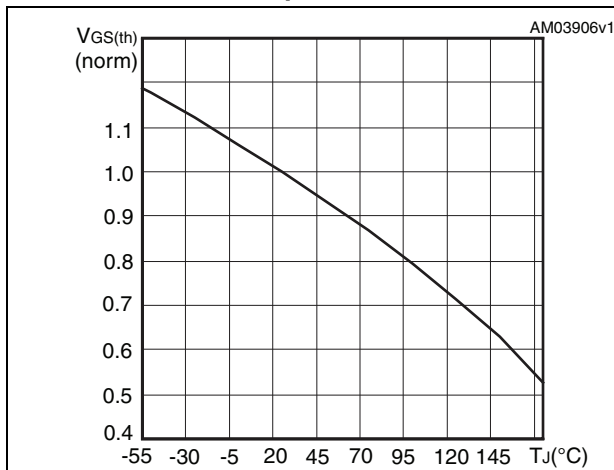


Figure 11. Normalized on-resistance vs temperature

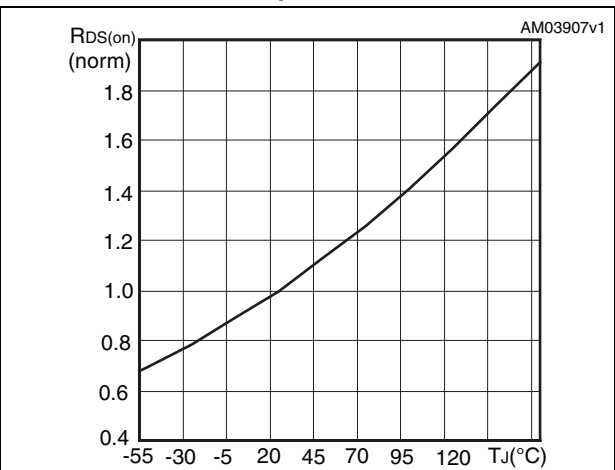
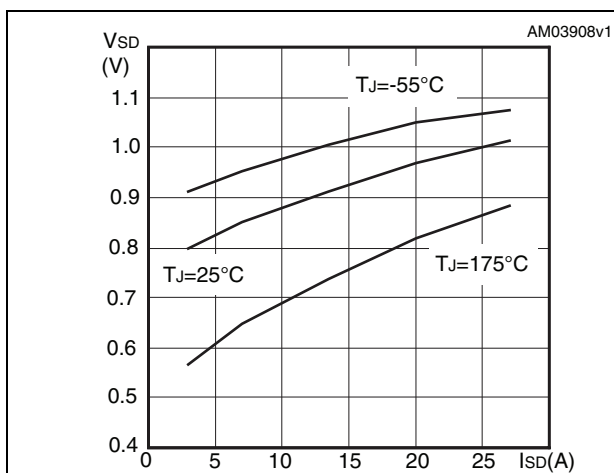


Figure 12. Source-drain diode forward characteristics



## 2.2 Electrical characteristics (curves) for P-channel

Figure 13. Safe operating area

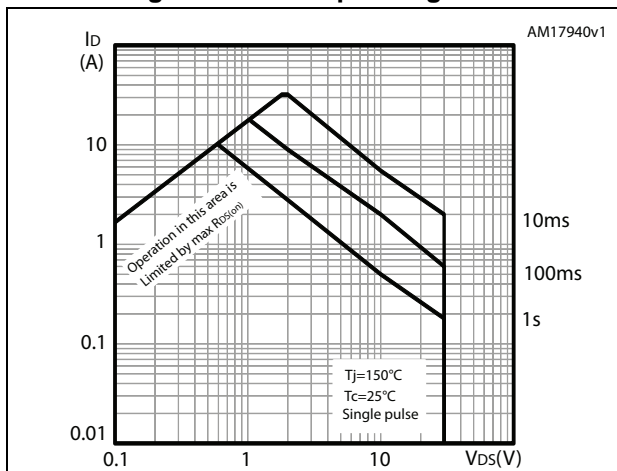


Figure 14. Thermal impedance

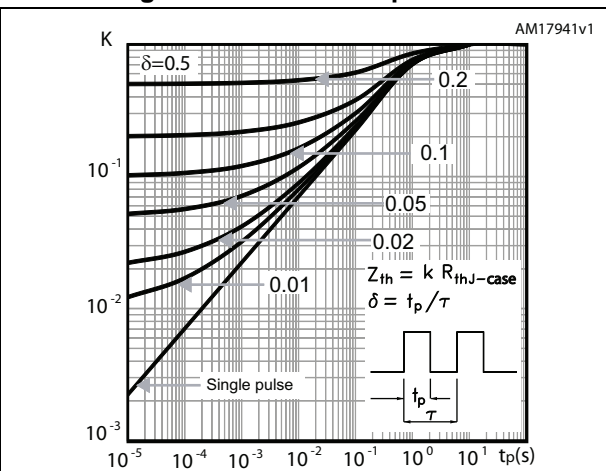


Figure 15. Output characteristics

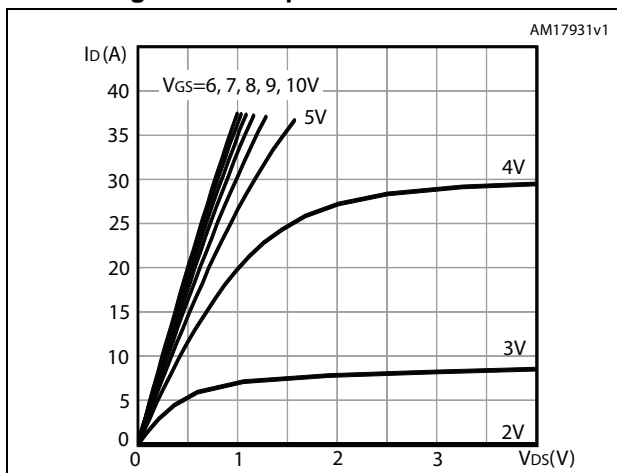


Figure 16. Transfer characteristics

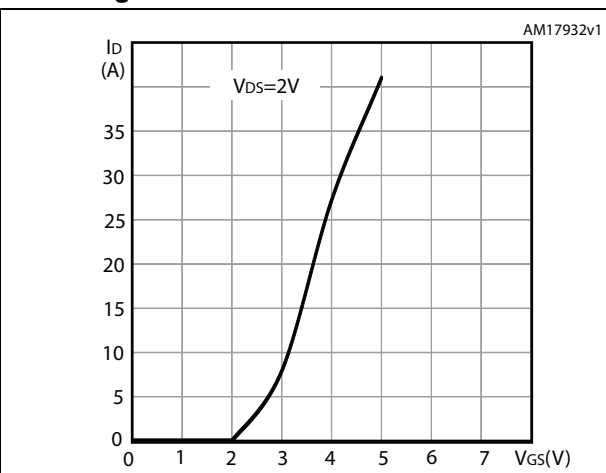


Figure 17. Gate charge vs gate-source voltage

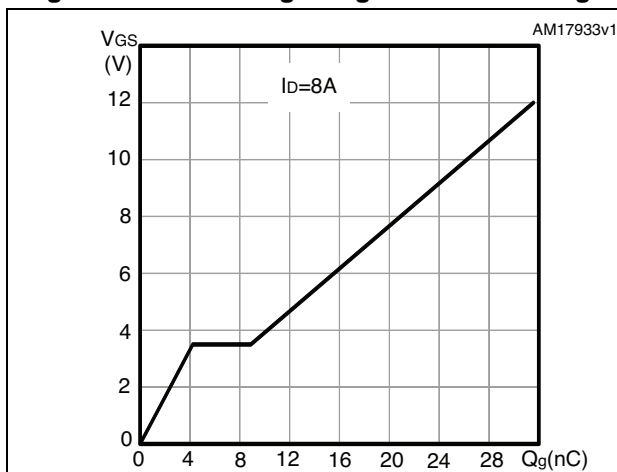


Figure 18. Static drain-source on-resistance

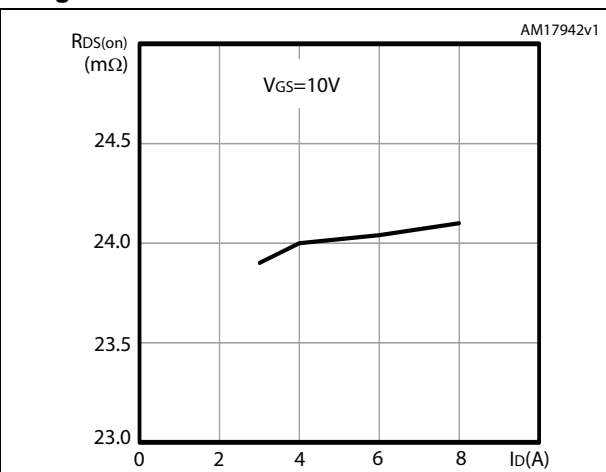




Figure 19. Capacitance variations

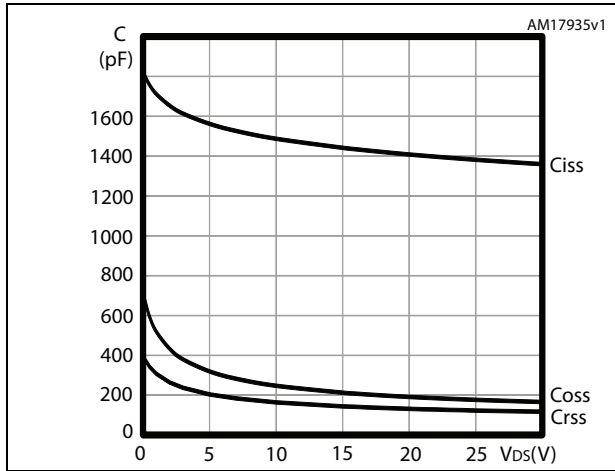


Figure 20. Normalized gate threshold voltage vs temperature

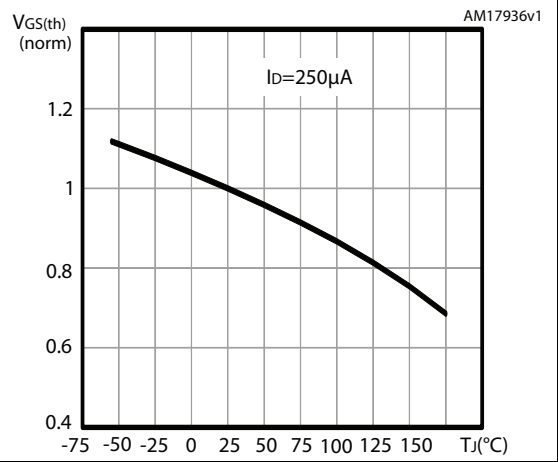


Figure 21. Normalized on-resistance vs temperature

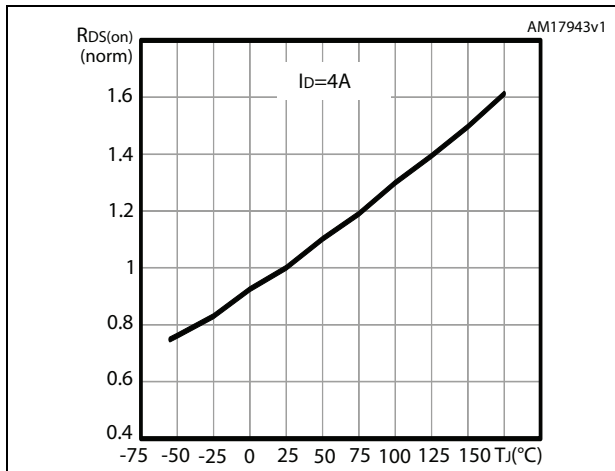


Figure 22. Normalized V(BR)DSS vs temperature

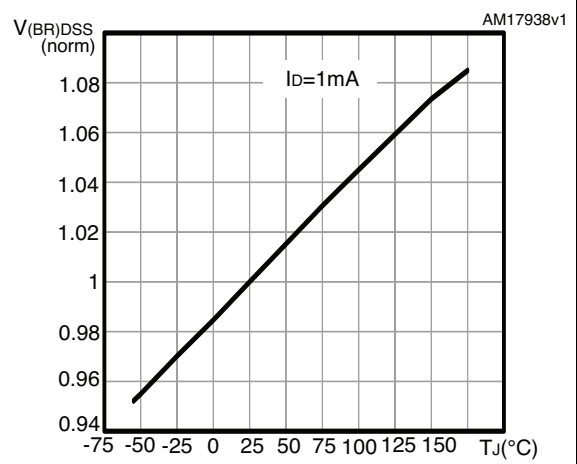
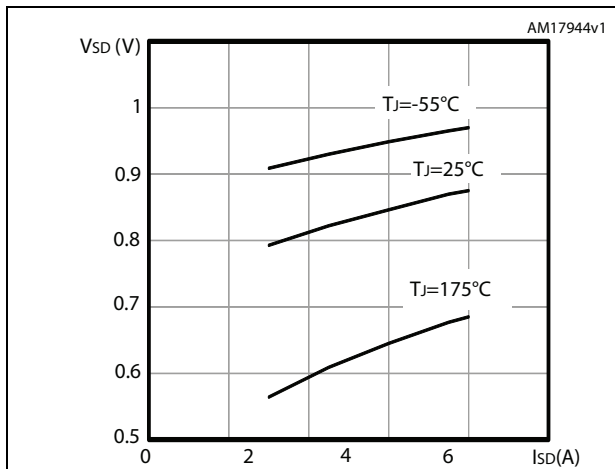


Figure 23. Source-drain diode forward characteristics



### 3 Test circuits for N-channel

Figure 24. Switching times test circuit for resistive load

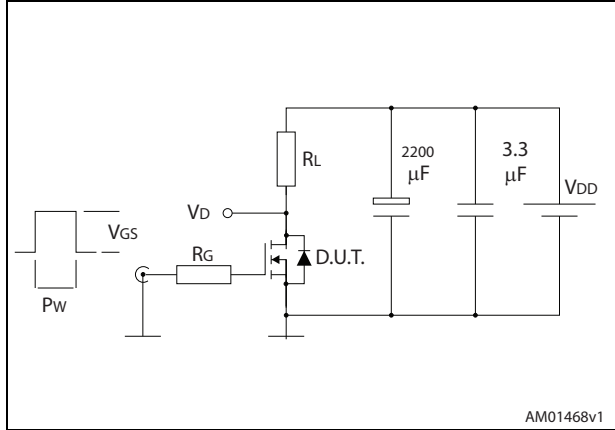


Figure 25. Gate charge test circuit

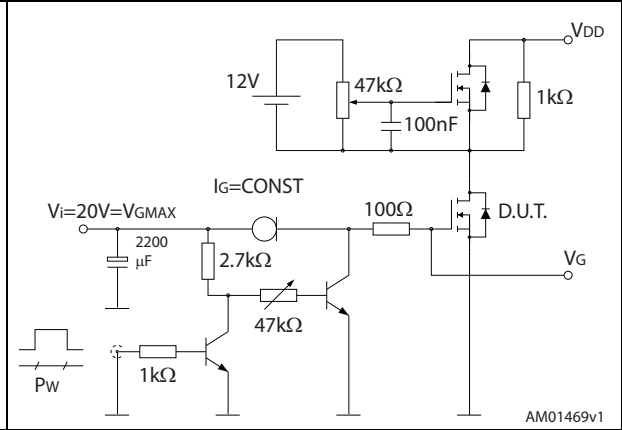


Figure 26. Test circuit for inductive load switching and diode recovery times

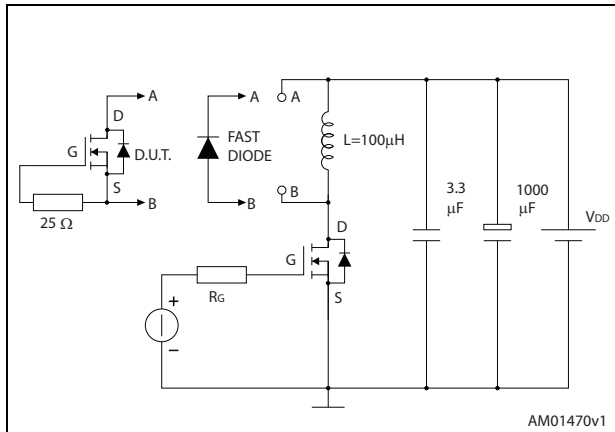


Figure 27. Unclamped inductive load test circuit

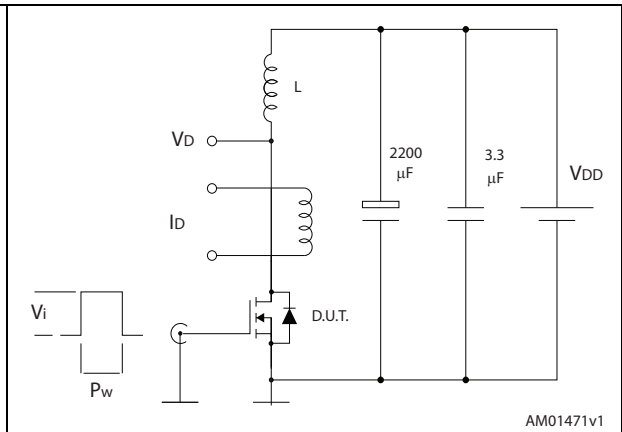


Figure 28. Unclamped inductive waveform

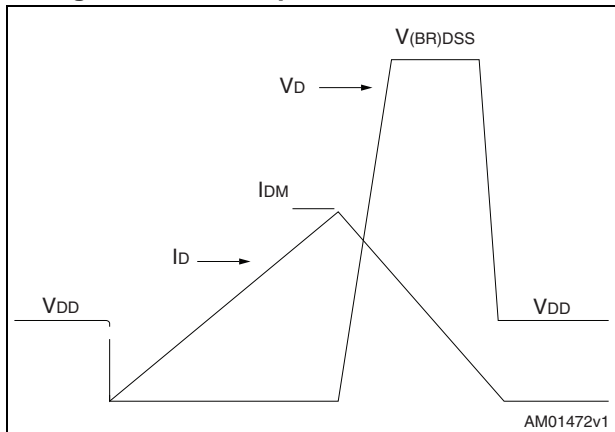
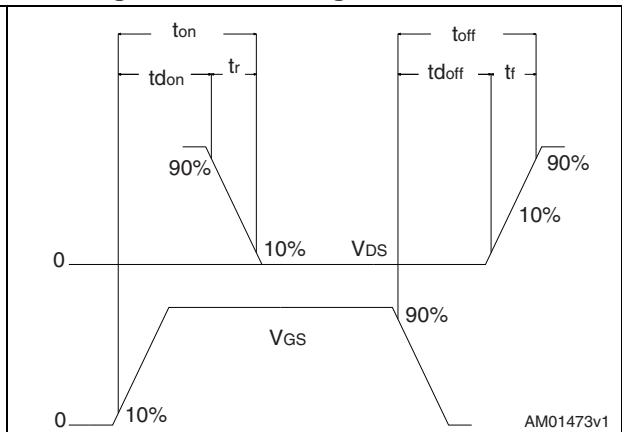
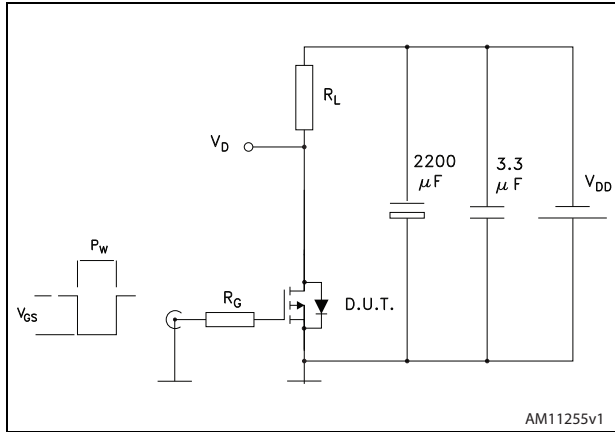


Figure 29. Switching time waveform

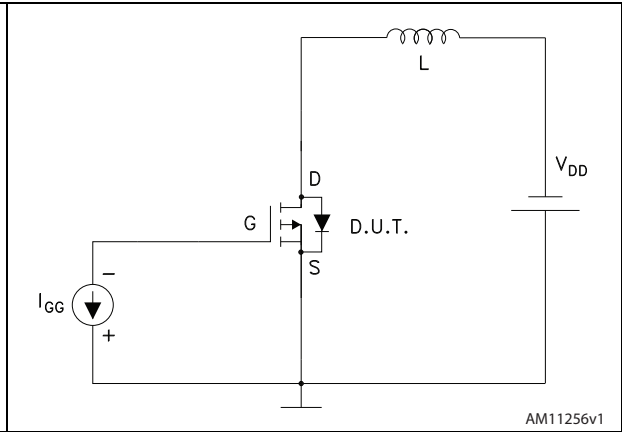


# 4 Test circuits for P-channel

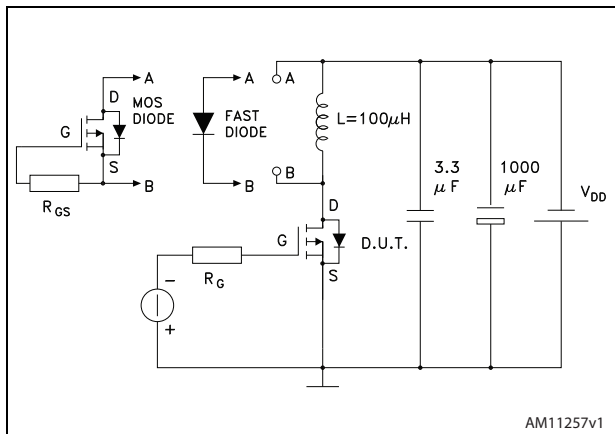
**Figure 30. Switching times test circuit for resistive load**



**Figure 31. Gate charge test circuit**



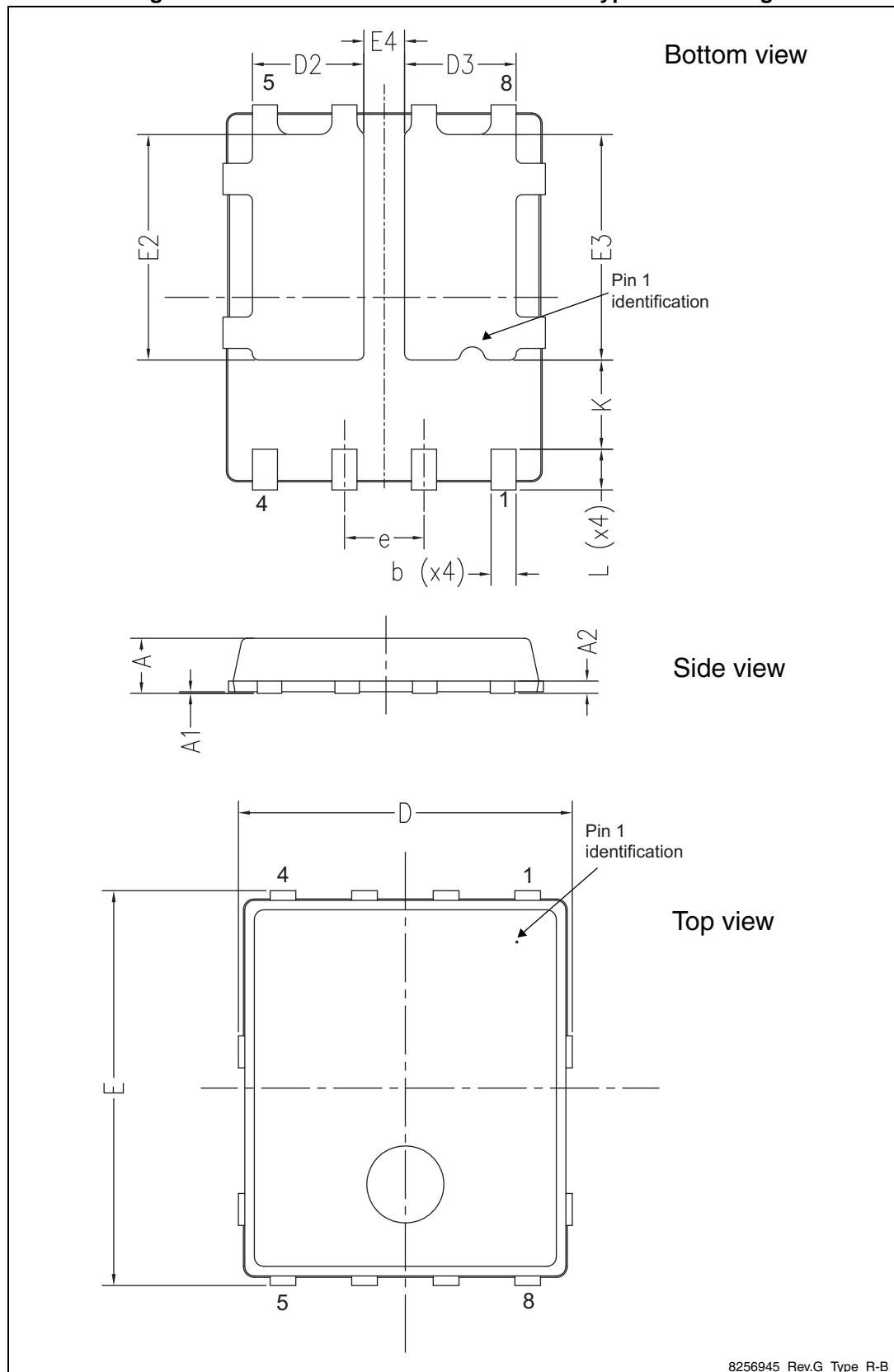
**Figure 32. Test circuit for diode recovery behavior**



## 5 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.

Figure 33. PowerFLAT™ 5x6 - double island type R-B drawing

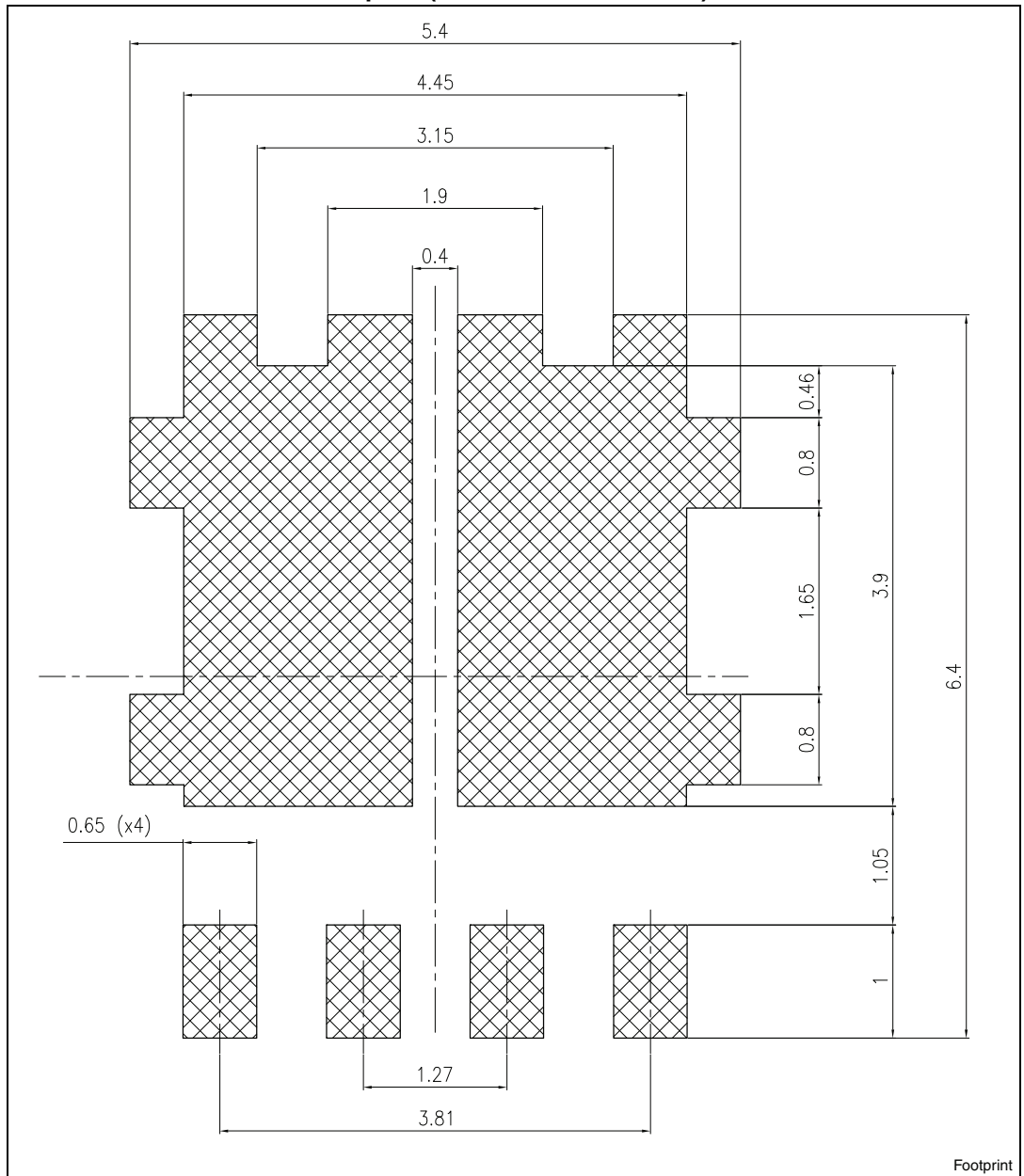


8256945\_Rev.G\_Type\_R-B

Table 8. PowerFLAT™ 5x6 - double island type R-B mechanical data

Ref.	Dimensions (mm)		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
D	5.00	5.20	5.40
E	5.95	6.15	6.35
D2	1.68		1.88
E2	3.50		3.70
D3	1.68		1.88
E3	3.50		3.70
E4	0.55		0.75
e		1.27	
L	0.60		0.80
K	1.275		1.575

Figure 34. PowerFLAT™ 5x6 - double island type R-B drawing recommended footprint (dimensions are in mm)



## 6 Packaging mechanical data

Figure 35. PowerFLAT™ 5x6 tape<sup>(a)</sup>

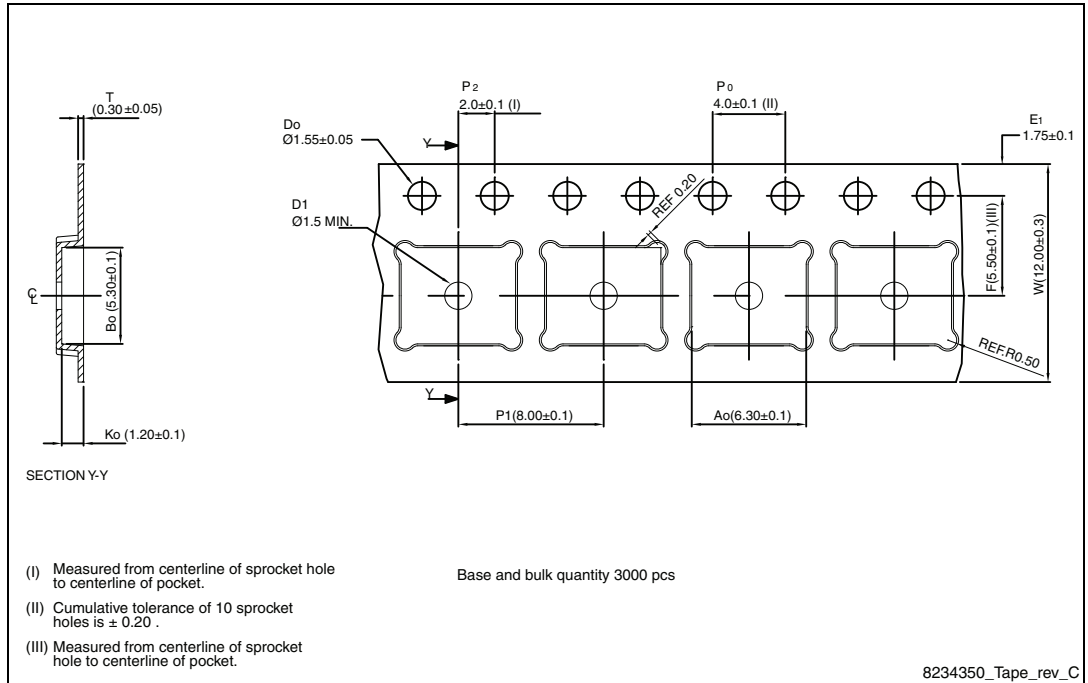
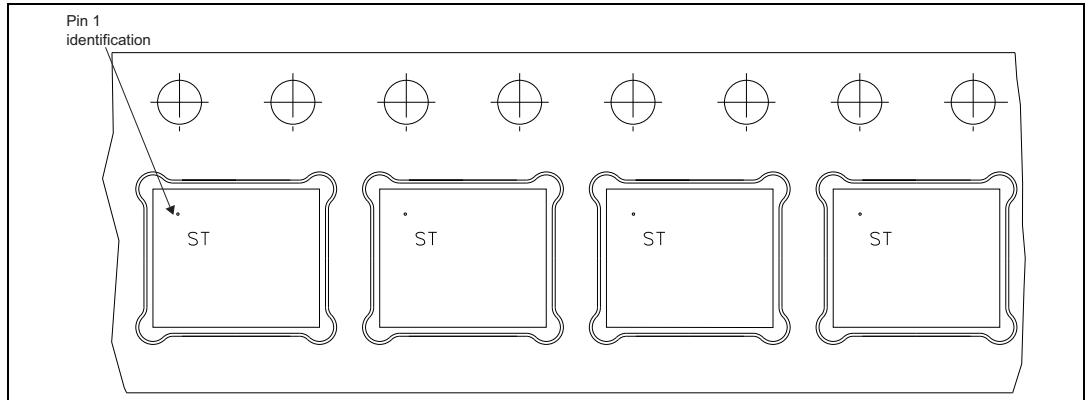


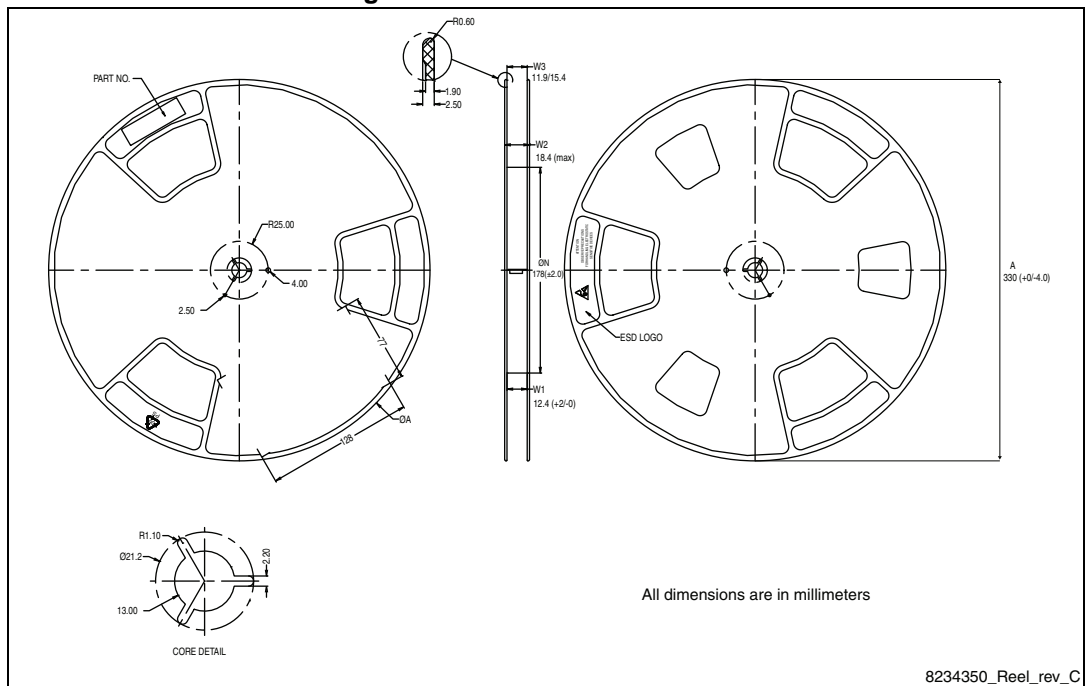
Figure 36. PowerFLAT™ 5x6 package orientation in carrier tape.



a. All dimensions are in millimeters.



Figure 37. PowerFLAT™ 5x6 reel



## 7 Revision history

**Table 9. Revision history**

Date	Revision	Changes
31-Oct-2012	1	First revision.
09-Nov-2012	2	<ul style="list-style-type: none"> <li>– Modified: <math>R_{DS(on)}</math> values for N-channel</li> <li>– Changed: <a href="#">Section 5 on page 12</a></li> </ul>
13-Feb-2013	3	<ul style="list-style-type: none"> <li>– Modified: <math>R_{DS(on)}</math> only for P-channel on the title, <a href="#">Features</a> table and <a href="#">Table 4</a></li> <li>– Modified: typical values on <a href="#">Table 5, 28, 29</a>, <math>V_{SD}</math> max value on <a href="#">Table 29</a> (only for P-channel)</li> <li>– Updated: <a href="#">Section 5: Package mechanical data</a> and <a href="#">Section 6: Packaging mechanical data</a></li> </ul>
28-Nov-2013	4	<ul style="list-style-type: none"> <li>– Modified: <math>V_{GS}</math> (for P-channel) value in <a href="#">Table 2</a></li> <li>– Modified: <math>I_{GSS}</math> (test conditions values)</li> <li>– Modified: <math>Q_g</math> typical values</li> <li>– Modified: <a href="#">Figure 24, 25, 26, 27, 28, 29, 30</a> and <a href="#">31</a></li> <li>– Updated: <a href="#">Section 5: Package mechanical data</a></li> <li>– Minor text changes</li> </ul>
03-Apr-2014	5	<ul style="list-style-type: none"> <li>– Added: <a href="#">Section 2.1: Electrical characteristics (curves) for N-channel</a></li> <li>– Minor text changes</li> </ul>

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