

## N-channel 620 V, 1.7 $\Omega$ , 4.5 A Power MOSFET in a DPAK package

Datasheet – preliminary data

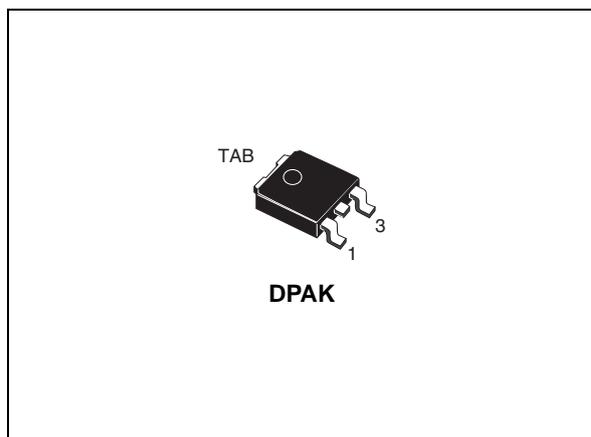
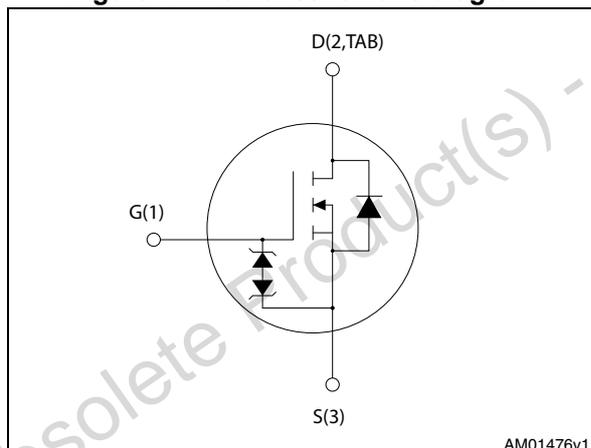


Figure 1. Internal schematic diagram



### Features

Order code	$V_{DS}$	$R_{DS(on)max}$	$I_D$	$P_{TOT}$
STDLED625H	620 V	2 $\Omega$	4.5 A	70 W

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

### Applications

- LED lighting applications

### Description

These Power MOSFETs boast extremely low on-resistance and very good dv/dt capability, rendering them suitable for buck-boost and flyback topologies.

Table 1. Device summary

Order code	Marking	Package	Packaging
STDLED625H	LED625H	DPAK	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	620	V
$V_{GS}$	Gate- source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	4.5	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.3	A
$I_{DM}^{(1)}$	Drain current (pulsed)	18.0	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	3.8	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ )	115	mJ
$V_{ESD(G-S)}$	Gate source ESD(HBM-C = 100 pF, R = 1.5 k $\Omega$ )	2500	V
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	12	V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ }^\circ\text{C}$ )		V
$T_{stg}$	Storage temperature	- 55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area.

2.  $I_{SD} \leq 3.8\text{ A}$ ,  $di/dt = 400\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ .

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.79	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	50	$^\circ\text{C}/\text{W}$

1. When mounted on 1inch<sup>2</sup> FR-4 board, 2 oz Cu.

## 2 Electrical characteristics

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

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0, I_D = 1\text{ mA}$	620			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0, V_{DS} = 620\text{V}$			1	$\mu\text{A}$
		$V_{GS} = 0, V_{DS} = 620\text{V}, T_C = 125\text{ °C}$			50	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 50\text{ }\mu\text{A}$	3	3.6	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 1.9\text{ A}$		1.7	2	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz}, V_{GS} = 0$	-	560 43 7.5	-	$\mu\text{F}$ $\text{pF}$ $\text{pF}$
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }496\text{ V}, V_{GS} = 0$	-	27	-	$\text{pF}$
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz open drain}$	2	5	10	$\Omega$
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 496\text{ V}, I_D = 3.8\text{ A}, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 16</a> )	-	23 4 13	-	nC nC nC

1.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Turn-off-delay time Fall time	$V_{DD} = 300\text{ V}, I_D = 1.9\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15</a> )	-	10 9 29 19	-	ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		3.8	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		15.2	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 3.8 \text{ A}, V_{GS} = 0$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 3.8 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 20</a> )	-	220		ns
$Q_{rr}$	Reverse recovery charge			1.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			13		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 3.8 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}, T_j = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 20</a> )	-	270		ns
$Q_{rr}$	Reverse recovery charge			1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			14		A

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1 \text{ mA}, I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have been specifically designed to enhance not only the device's ESD capability, but also to make them capable of safely absorbing any voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage is appropriate to achieve efficient and cost-effective protection of device integrity. The integrated Zener diodes thus eliminate the need for external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

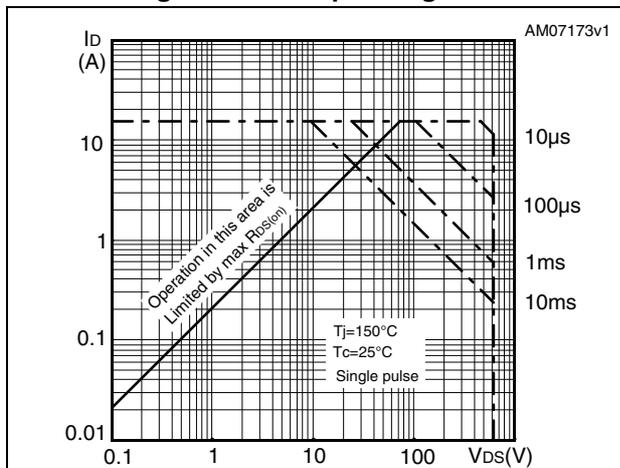


Figure 3. Thermal impedance

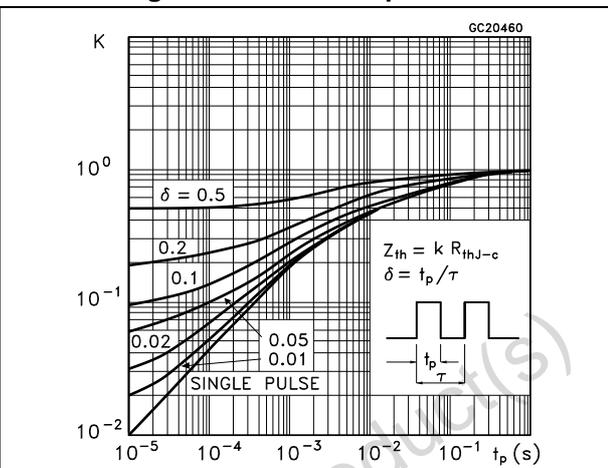


Figure 4. Output characteristics

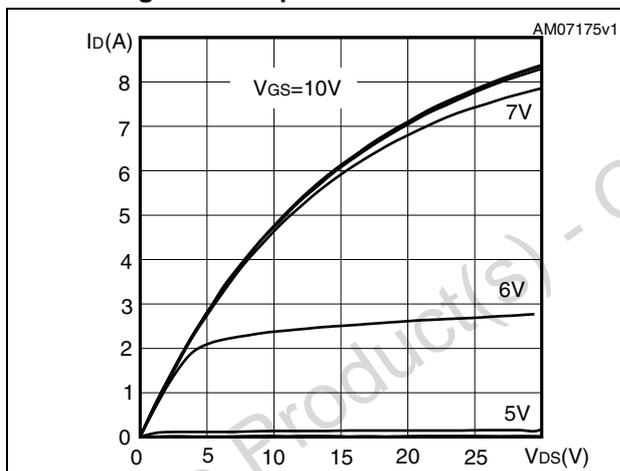


Figure 5. Transfer characteristics

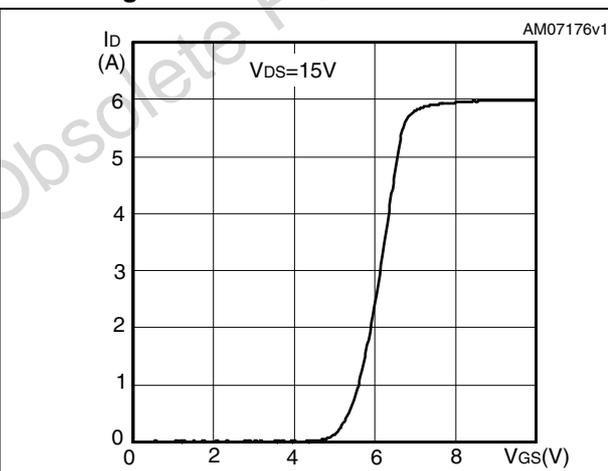


Figure 6. Gate charge vs gate-source voltage

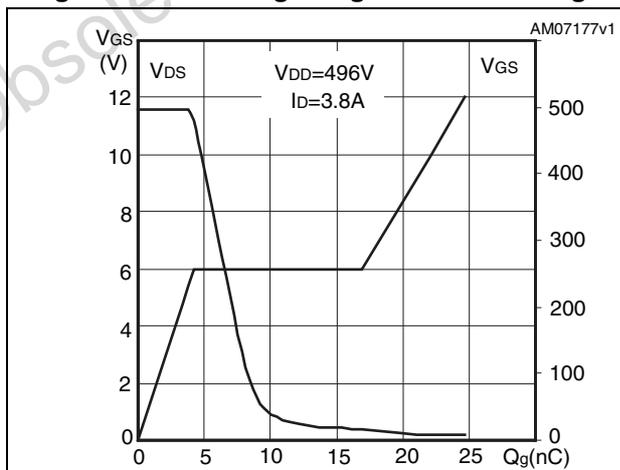


Figure 7. Static drain-source on-resistance

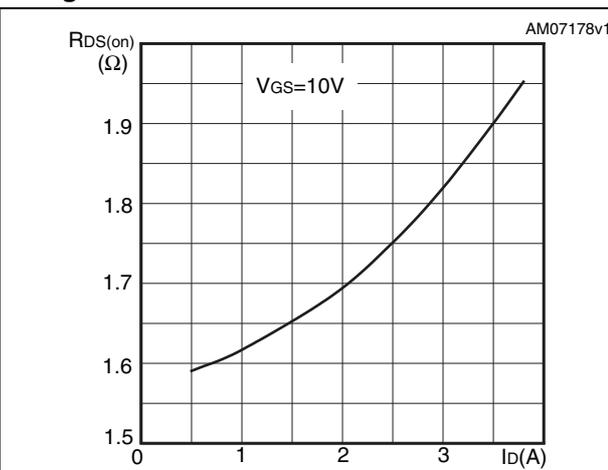


Figure 8. Capacitance variations

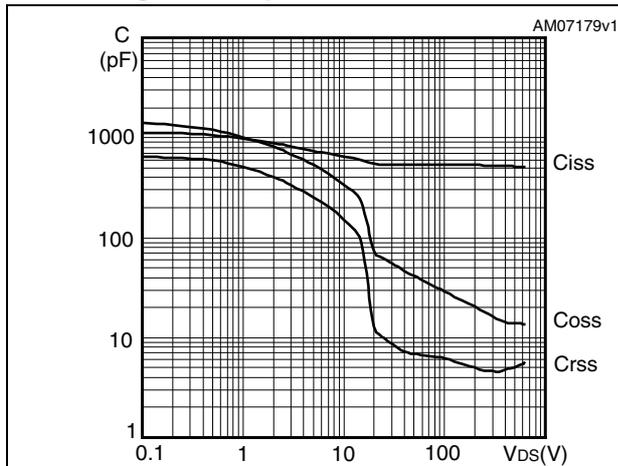


Figure 9. Output capacitance stored energy

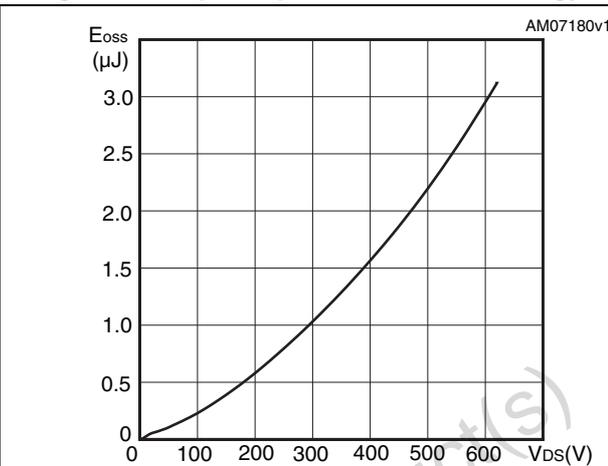


Figure 10. Normalized gate threshold voltage vs temperature

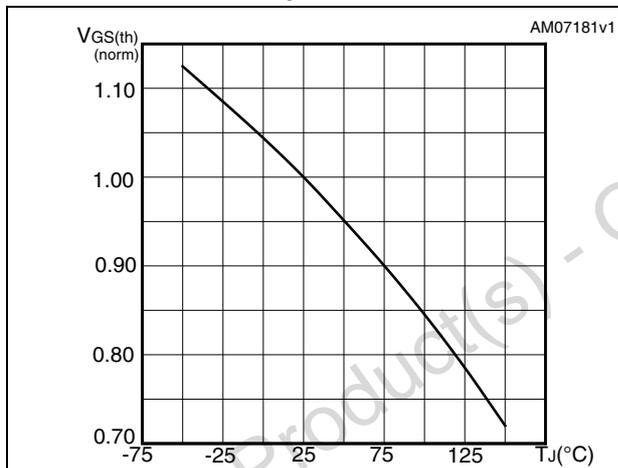


Figure 11. Normalized on-resistance vs temperature

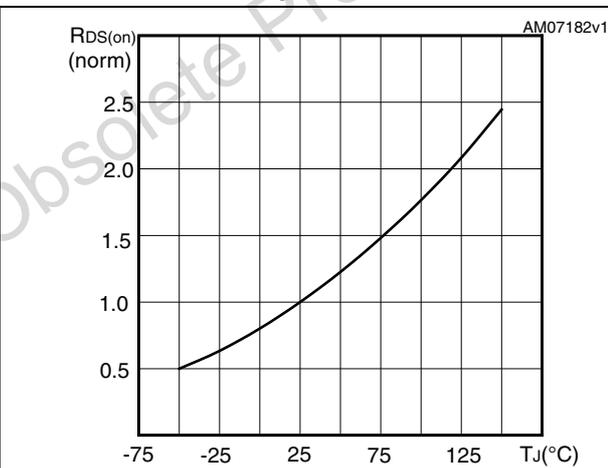


Figure 12. Maximum avalanche energy vs starting T<sub>j</sub>

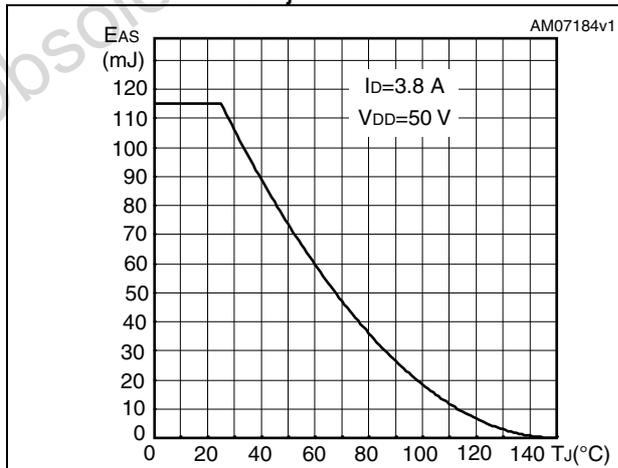


Figure 13. Normalized B<sub>VDS</sub> vs temperature

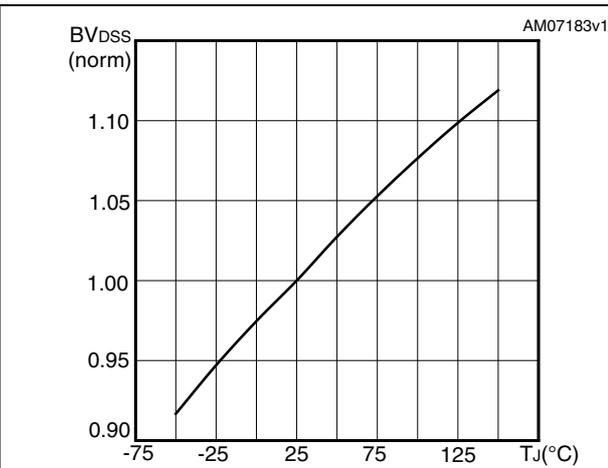
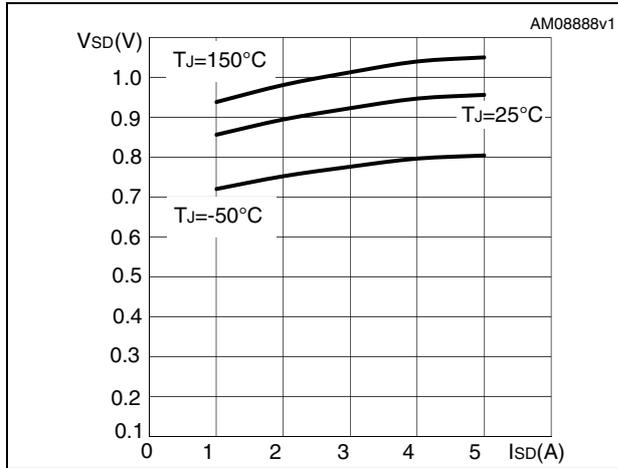


Figure 14. Source-drain diode forward characteristics



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### 3 Test circuits

Figure 15. Switching times test circuit for resistive load

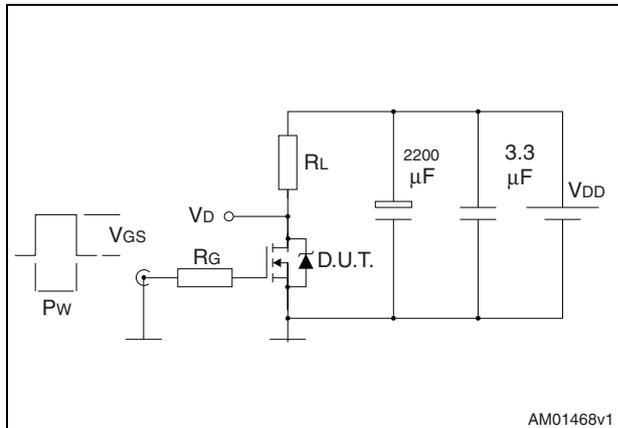


Figure 16. Gate charge test circuit

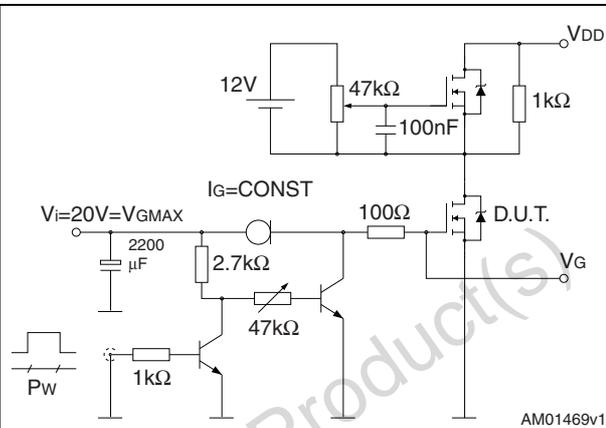


Figure 17. Test circuit for inductive load switching and diode recovery times

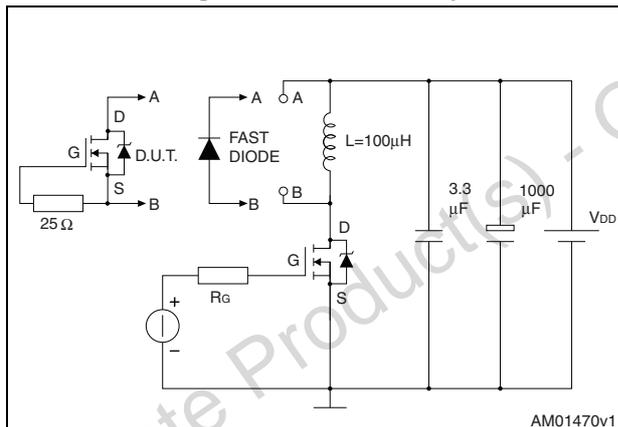


Figure 18. Unclamped Inductive load test circuit

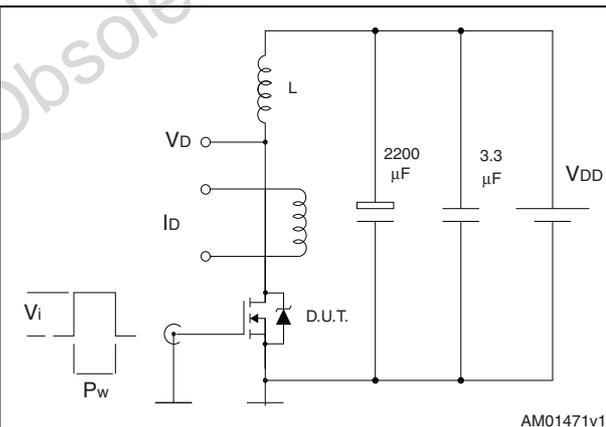


Figure 19. Unclamped inductive waveform

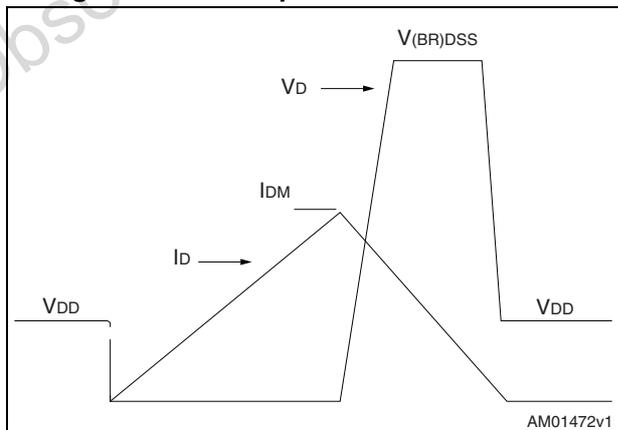
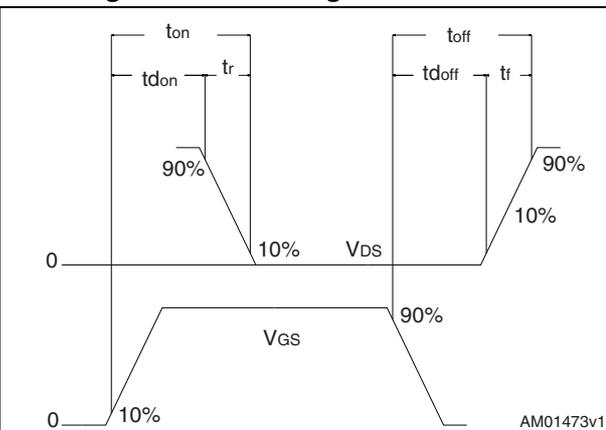


Figure 20. Switching time waveform



## 4 Package mechanical data

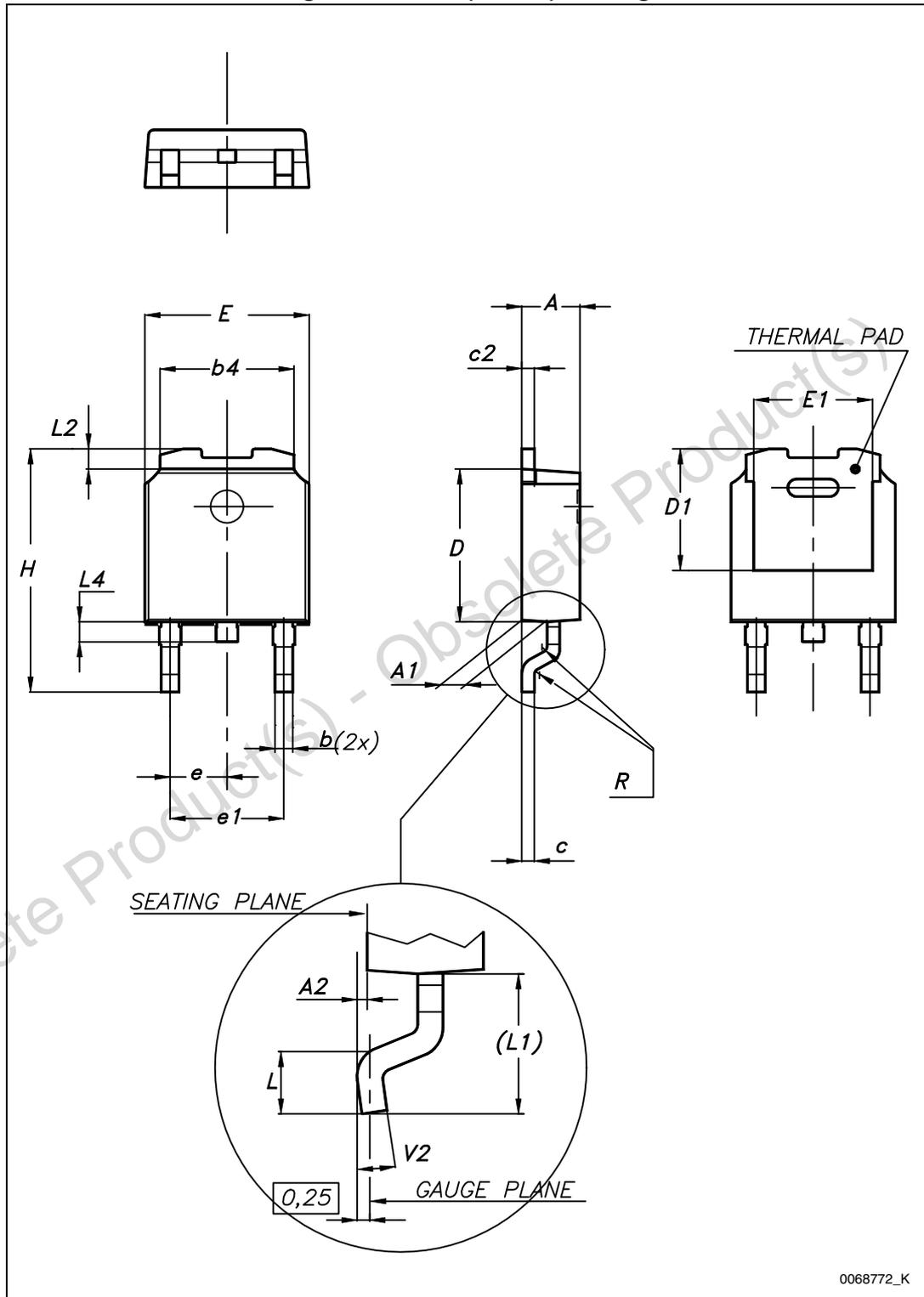
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

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Table 9. DPAK (TO-252) mechanical data

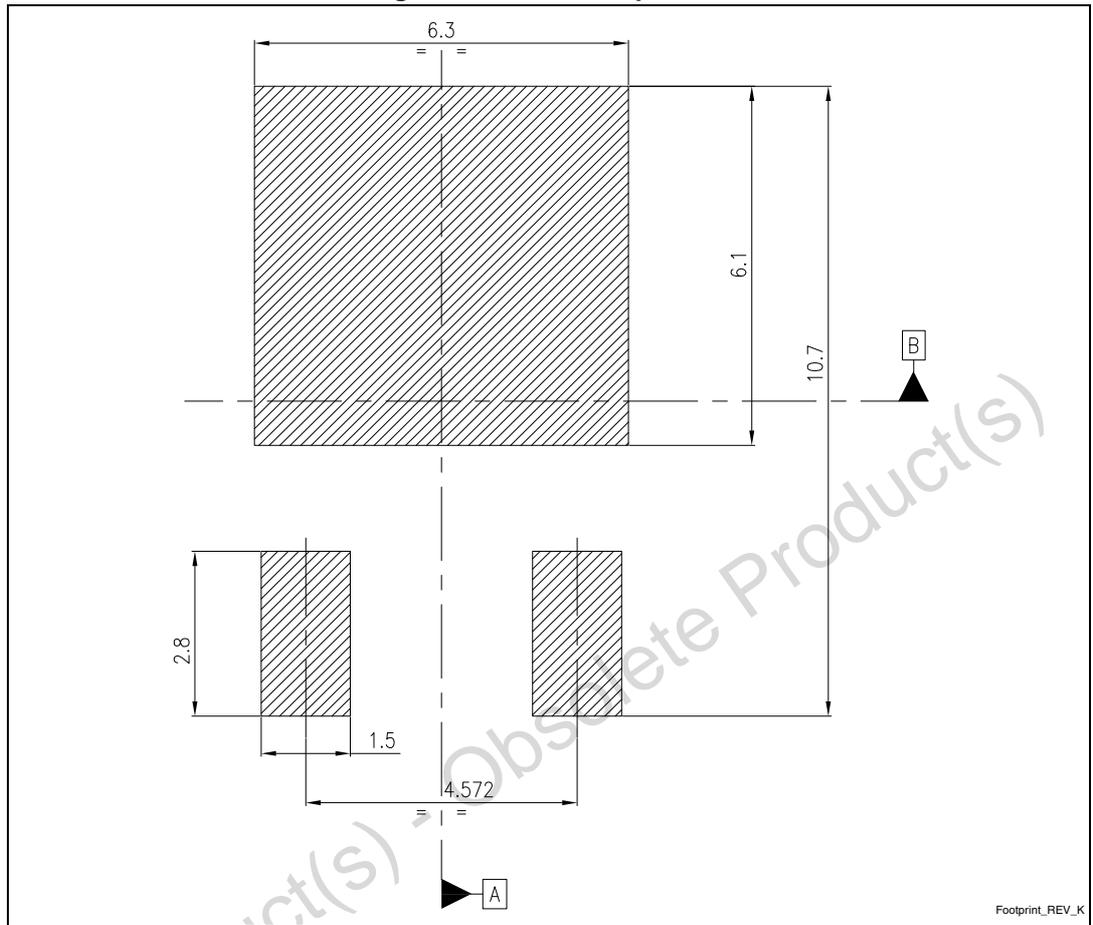
Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21. DPAK (TO-252) drawing



0068772\_K

Figure 22. DPAK footprint (a)



a. All dimensions are in millimeters

## 5 Packaging mechanical data

Table 10. DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1		Base qty.	2500
P1	7.9	8.1		Bulk qty.	2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Figure 23. Tape for DPAK (TO-252)

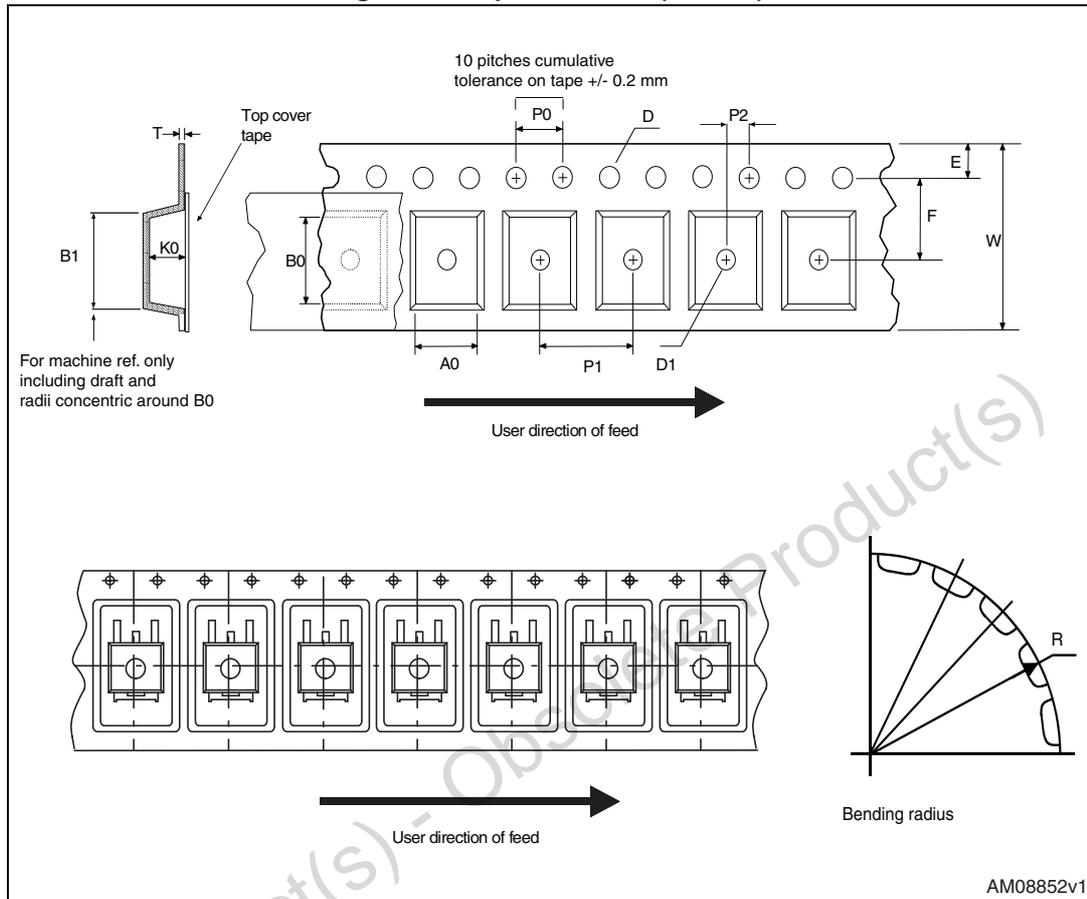
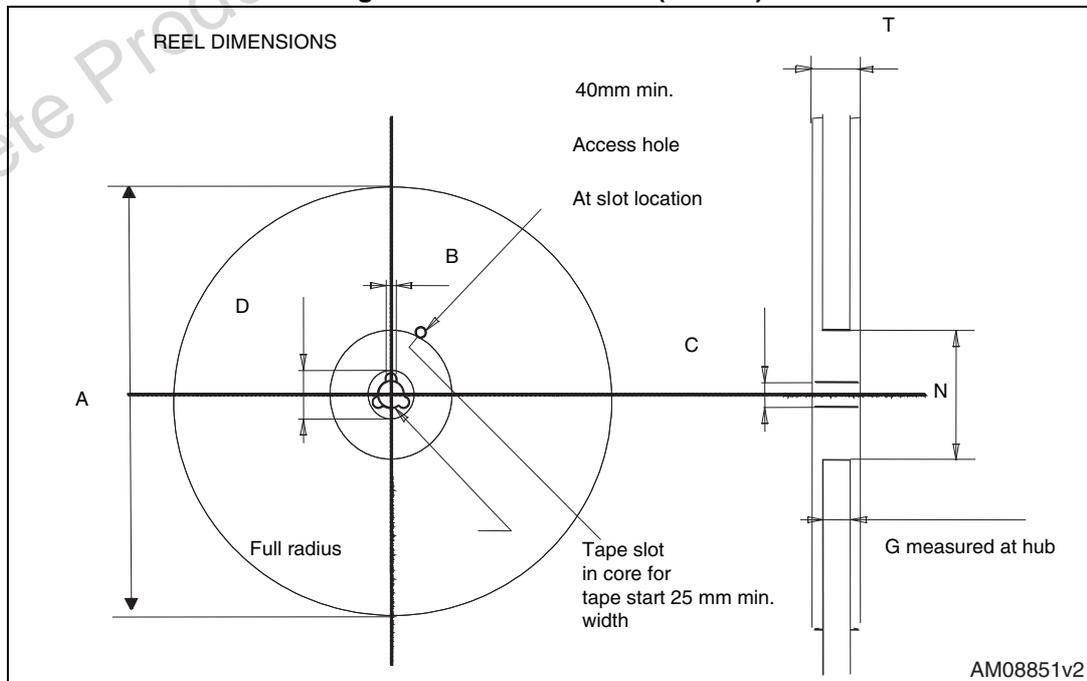


Figure 24. Reel for DPAK (TO-252)



## 6 Revision history

Table 11. Document revision history

Date	Revision	Changes
22-Mar-2013	1	First release.

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