



# STD86N3LH5

N-channel 30 V, 0.0045  $\Omega$ , 80 A, DPAK  
STripFET™ V Power MOSFET

## Features

Order code	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STD86N3LH5	30 V	< 0.005 $\Omega$	80 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

## Application

- Switching applications
  - Automotive

## Description

This product utilizes the 5<sup>th</sup> generation of design rules of ST's proprietary STripFET™ technology. The lowest available R<sub>DS(on)</sub> \* Q<sub>g</sub>, in the standard packages, makes this device suitable for the most demanding DC-DC converter applications, where high power density is to be achieved.

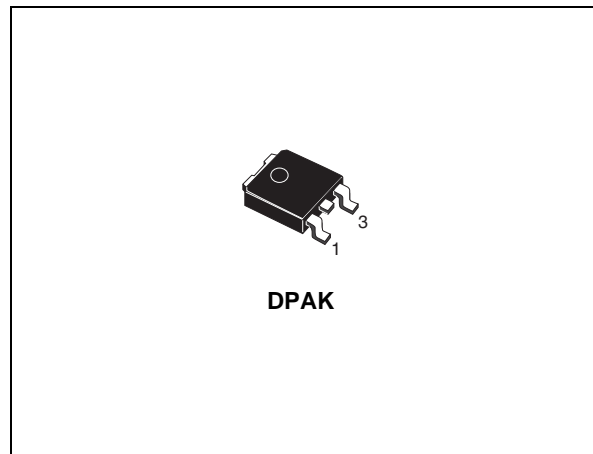


Figure 1. Internal schematic diagram

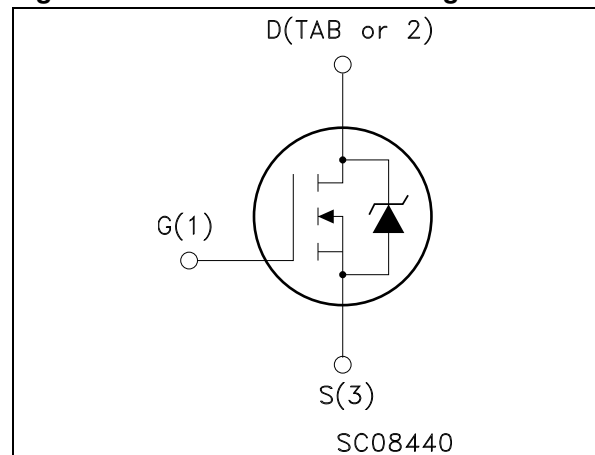


Table 1. Device summary

Order code	Marking	Package	Packaging
STD86N3LH5	86N3LH5	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 ( $V_{GS} = 0$ )	30	V
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ ) @ $T_{JMAX}$	35	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	80	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	55	A
$I_{DM}^{(2)}$	Drain current (pulsed)	320	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
	Derating factor	0.47	W/ $^\circ\text{C}$
$E_{AS}^{(3)}$	Single pulse avalanche energy	165	mJ
$T_{stg}$	Storage temperature	-55 to 175	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	175	$^\circ\text{C}$

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 40\text{ A}$ ,  $V_{DD} = 25\text{ V}$

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.14	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb max	50	$^\circ\text{C}/\text{W}$

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

## 2 Electrical characteristics

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

**Table 4. Static**

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 ( $V_{GS} = 0$ )	$V_{DS} = 20\text{ V}$ $V_{DS} = 20\text{ V}$ , $T_c = 125\text{ °C}$	-	-	1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	1	1.8	2.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 40\text{ A}$	-	0.0045	0.005	$\Omega$
		$V_{GS} = 5\text{ V}$ , $I_D = 40\text{ A}$	-	0.0055	0.0065	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	1850	-	pF
$C_{oss}$	Output capacitance			380		pF
$C_{rss}$	Reverse transfer capacitance			58		pF
$Q_g$	Total gate charge	$V_{DD} = 15\text{ V}$ , $I_D = 80\text{ A}$	-	14	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 5\text{ V}$		6.8		nC
$Q_{gd}$	Gate-drain charge	<a href="#">Figure 16</a>		4.7		nC
$Q_{gs1}$	Pre $V_{th}$ gate-to-source charge	$V_{DD} = 15\text{ V}$ , $I_D = 80\text{ A}$	-	2.3	-	nC
$Q_{gs2}$	Post $V_{th}$ gate-to-source charge	$V_{GS} = 5\text{ V}$ <a href="#">Figure 16</a>		4.5		nC
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ gate bias Bias = 0 test signal level = 20 mV open drain	-	1.2	-	$\Omega$

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on delay time Rise time	$V_{DD} = 15\text{ V}$ , $I_D = 40\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 5\text{ V}$ <i>Figure 15</i>	-	6 14	-	ns ns
$t_{d(off)}$ $t_f$	Turn-off delay time Fall time		-	23.6 10.8	-	ns ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-	-	80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 40\text{ A}$ , $V_{GS} = 0$	-	-	1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 80\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 20\text{ V}$ <i>Figure 17</i>	-	31.8	-	ns
$Q_{rr}$	Reverse recovery charge		-	26.1	-	nC
$I_{RRM}$	Reverse recovery current		-	1.6	-	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

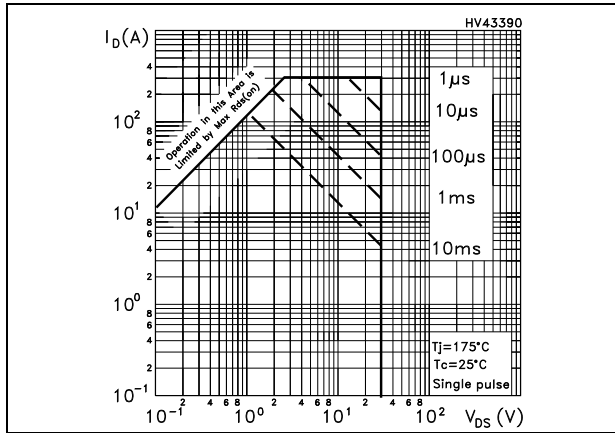


Figure 3. Thermal impedance

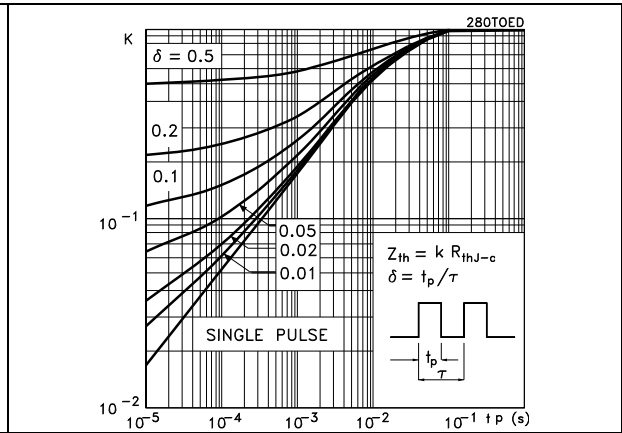


Figure 4. Output characteristics

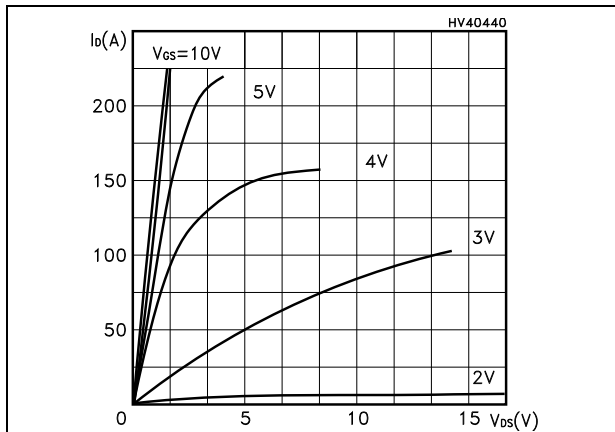


Figure 5. Transfer characteristics

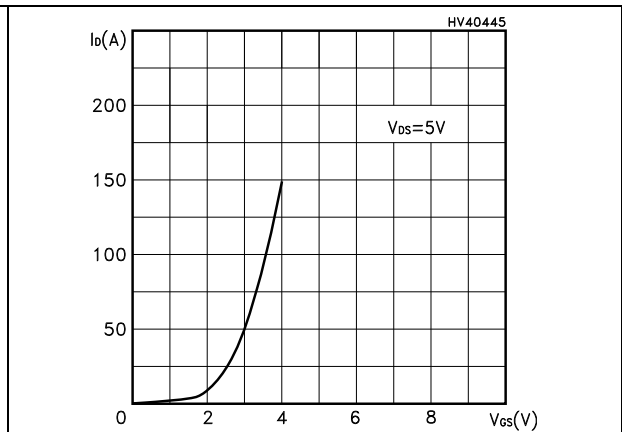


Figure 6. Normalized  $B_{V_{DSS}}$  vs temperature

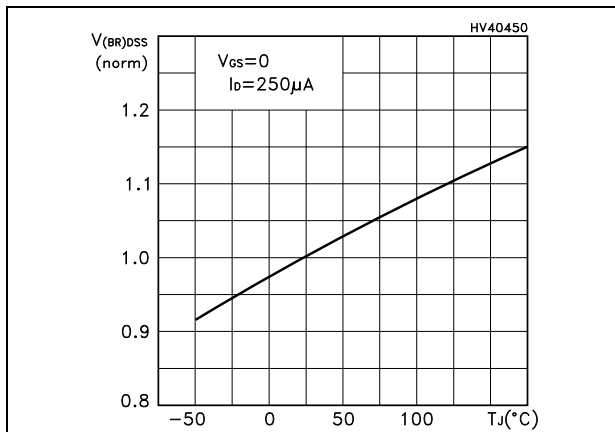


Figure 7. Static drain-source on resistance

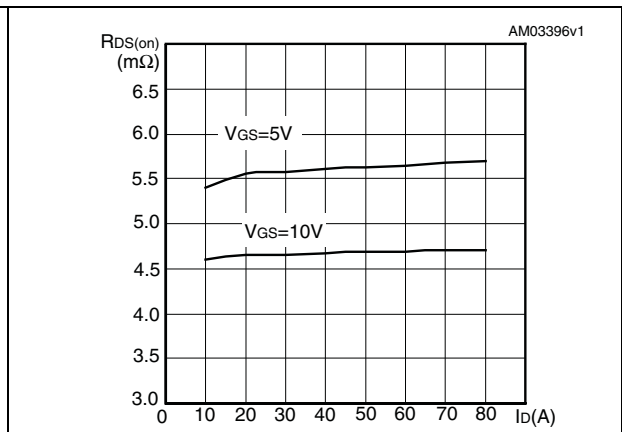


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

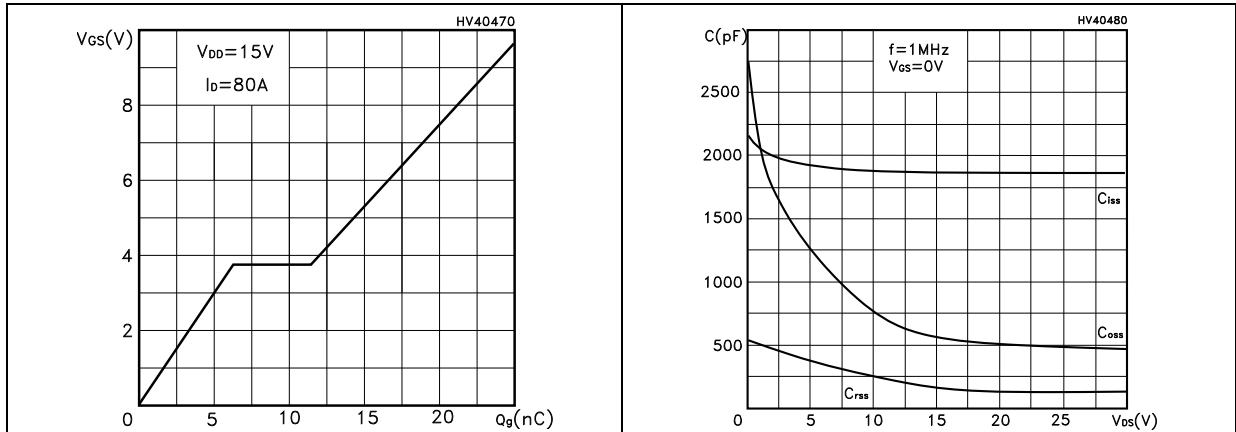


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

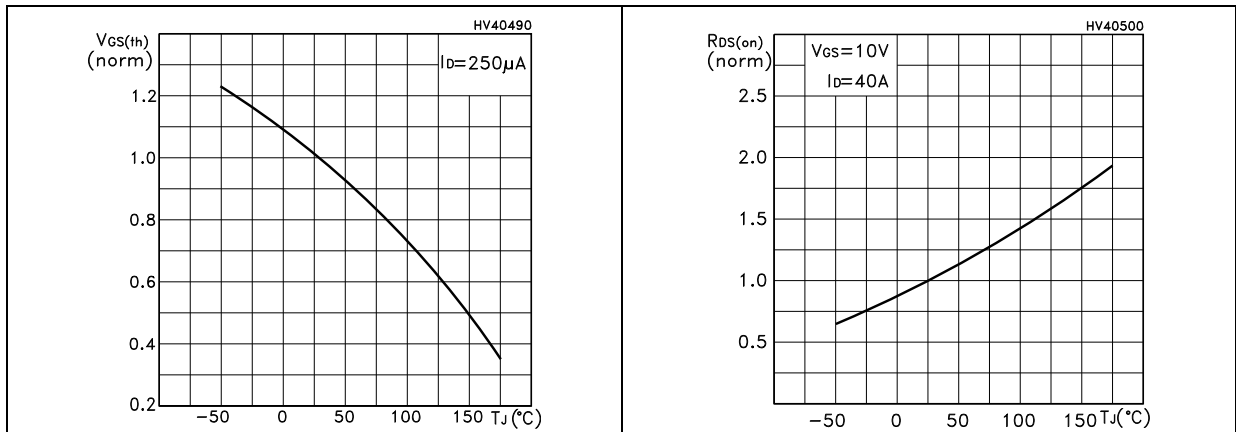
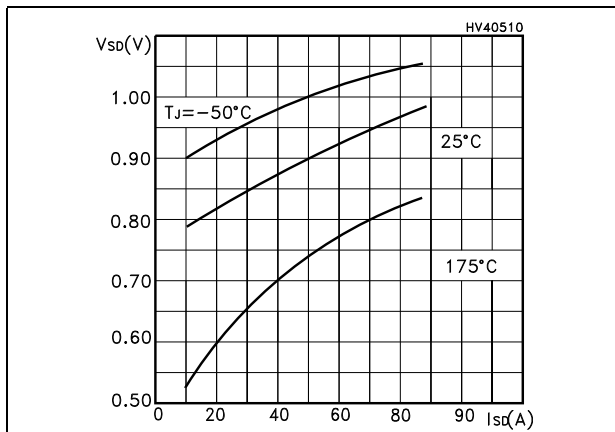


Figure 12. Source-drain diode forward characteristics



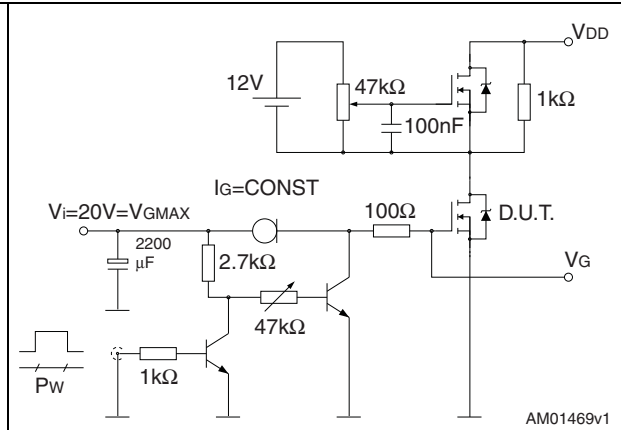
### 3 Test circuit

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



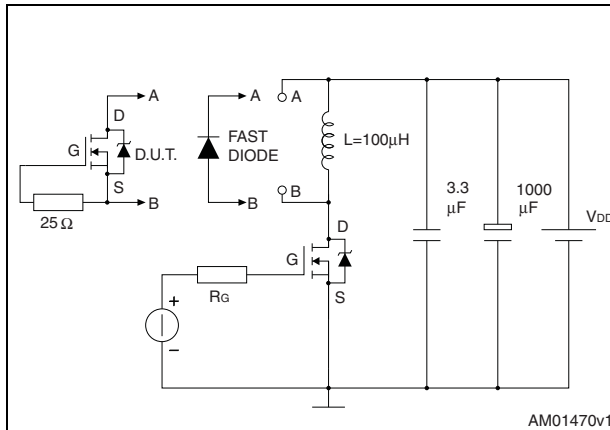
AM01468v1

**Figure 14. Gate charge test circuit**



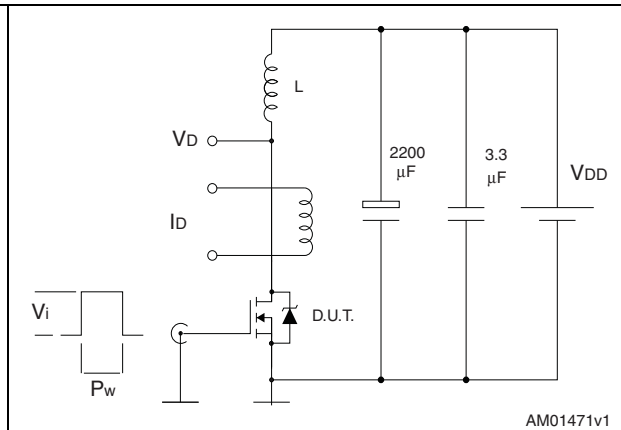
AM01469v1

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



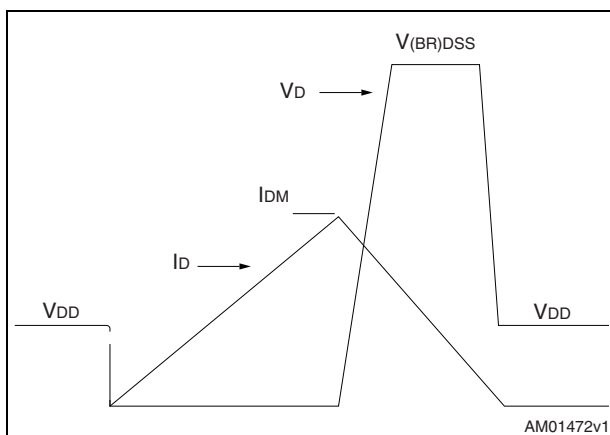
AM01470v1

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



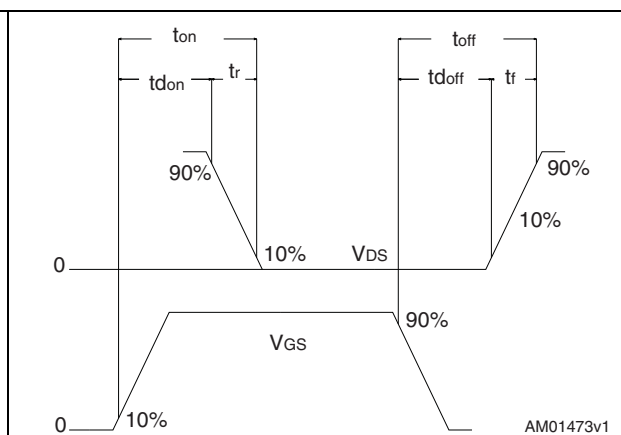
AM01471v1

**Figure 17. Unclamped inductive waveform**



AM01472v1

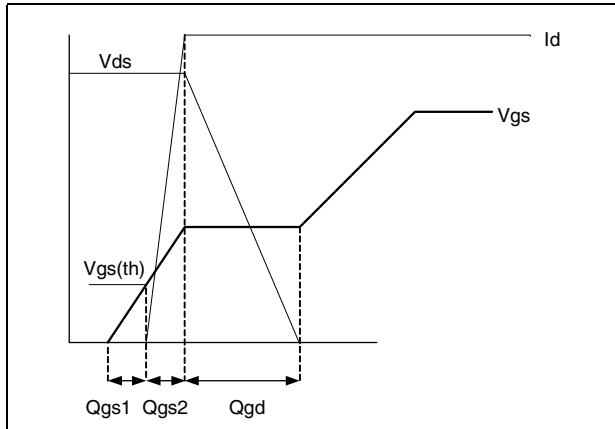
**Figure 18. Switching time waveform**



AM01473v1



Figure 19. Gate charge waveform



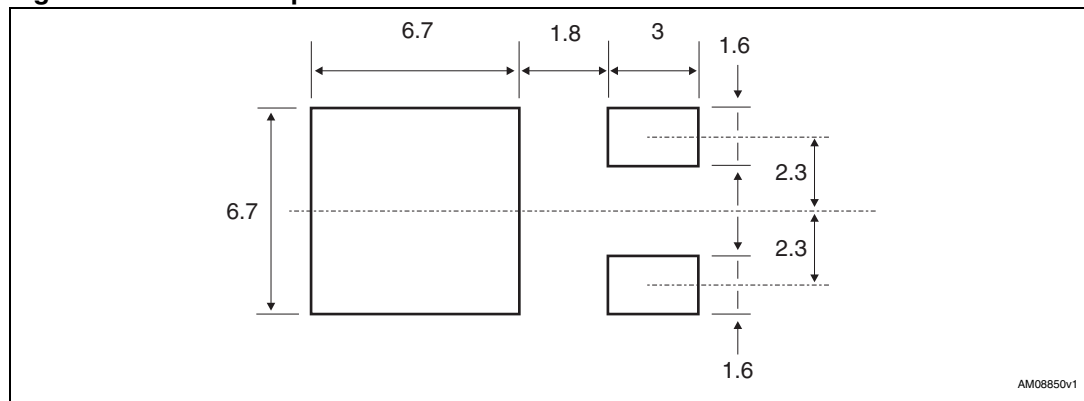
## 4 Package mechanical data

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](http://www.st.com). ECOPACK is an ST trademark.

Table 8. DPAK (TO-252) mechanical data

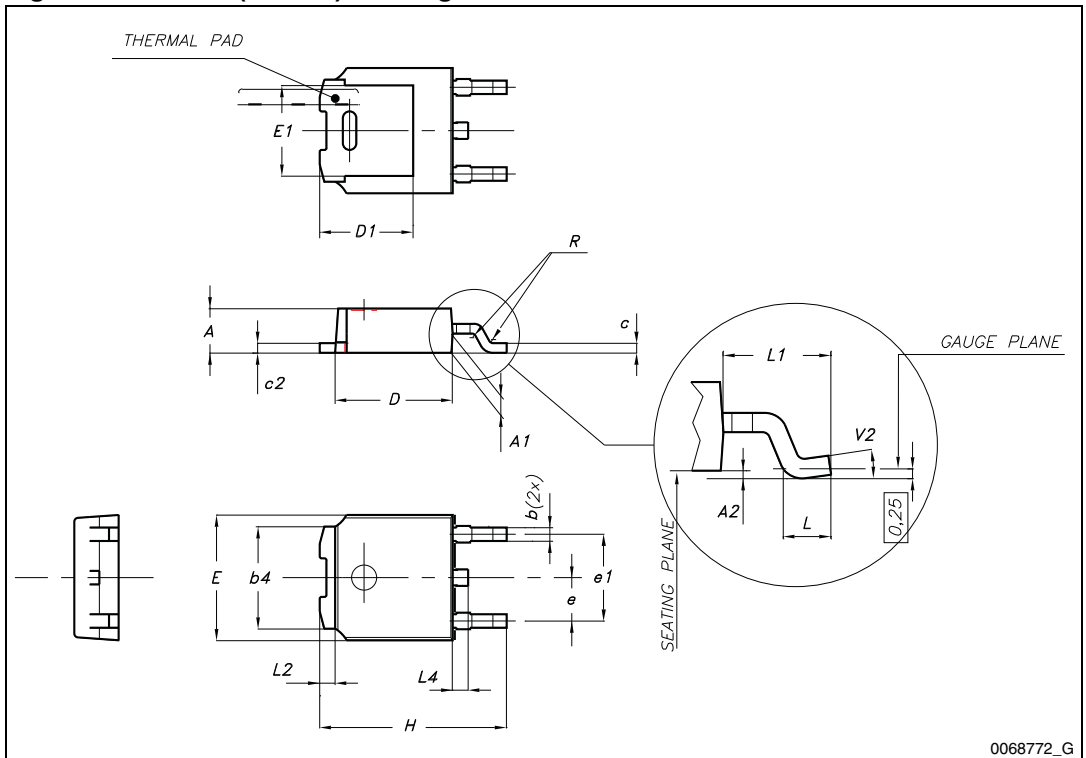
Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°

Figure 20. DPAK footprint<sup>(a)</sup>



a. All dimension are in millimeters

Figure 21. DPAK (TO-252) drawing



## 5 Packaging mechanical data

Table 9. 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 22. Tape for DPAK (TO-252)

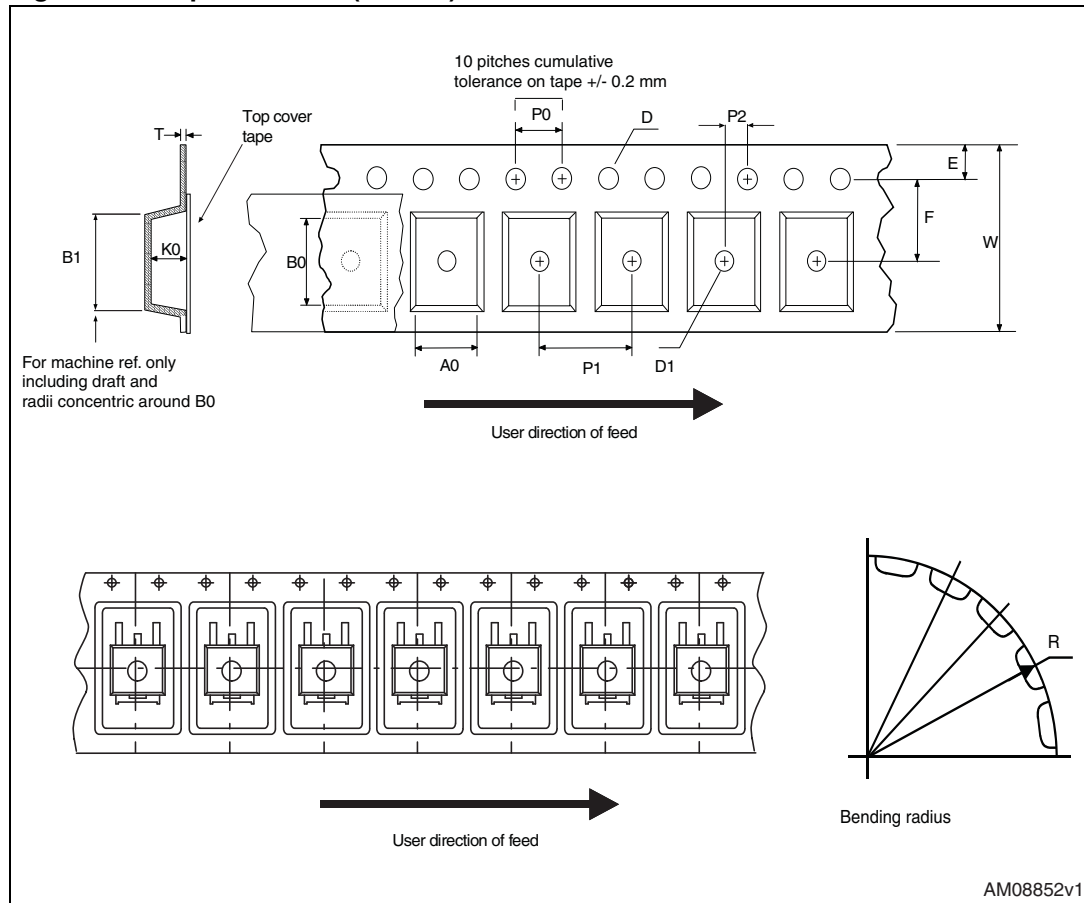
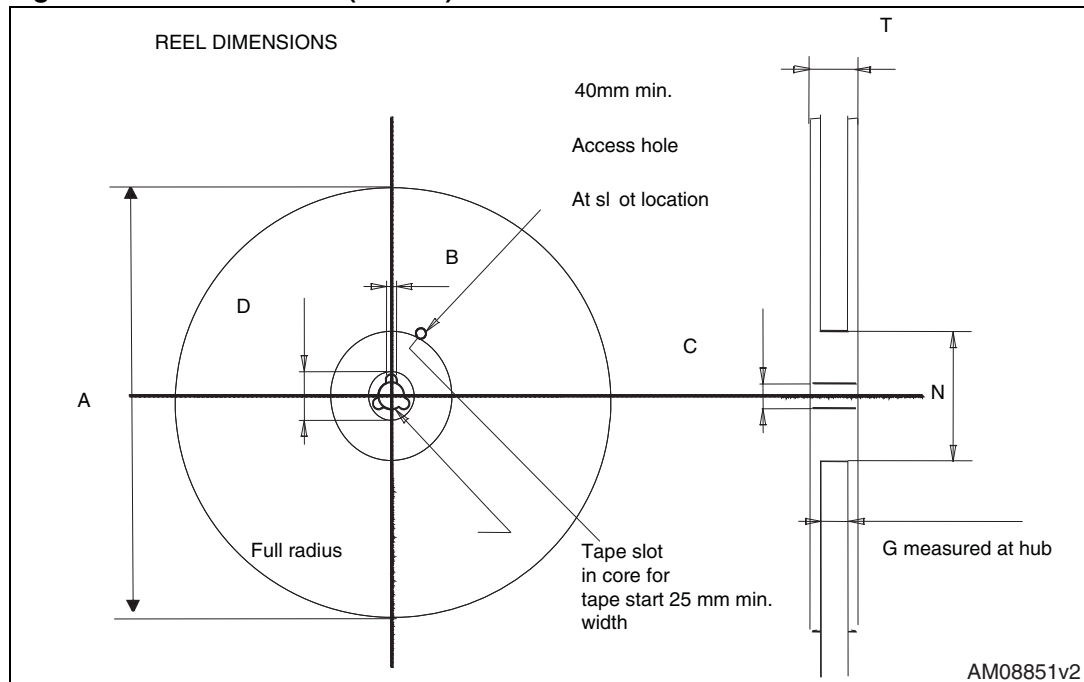


Figure 23. Reel for DPAK (TO-252)



## 6 Revision history

Table 10. Document revision history

Date	Revision	Changes
10-Apr-2009	1	First release.
22-Mar-2011	2	$V_{GS}$ value has been corrected in <a href="#">Table 2</a> and <a href="#">Table 4</a> .

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