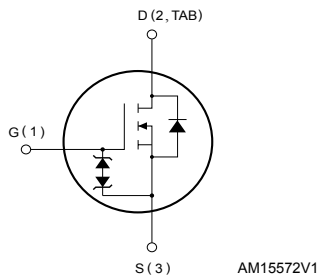


## N-channel 800 V, 0.73 $\Omega$ typ., 7 A MDmesh™ K5 Power MOSFET in a DPAK package


**DPAK**


### Features

Order code	$V_{DS}$	$R_{DS(on)max.}$	$I_D$	$P_{TOT}$
STD9N80K5	800 V	0.90 $\Omega$	7 A	110 W

- Industry's lowest  $R_{DS(on)} \times \text{area}$
- Industry's best figure of merit (FoM)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

#### Product status

STD9N80K5

#### Product summary

<b>Order code</b>	STD9N80K5
<b>Marking</b>	9N80K5
<b>Package</b>	DPAK
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	7	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	4.4	A
$I_D^{(1)}$	Drain current (pulsed)	28	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	110	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	V/ns
$T_{stg}$	Storage temperature range	- 55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature range		

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 7\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ;  $V_{DS(peak)} < V_{(BR)DSS}$ ;  $V_{DD} = 640\text{ V}$
3.  $V_{DS} \leq 640\text{ V}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1.14	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50	$^\circ\text{C}/\text{W}$

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

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	2.4	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	200	mJ

## 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	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	800			V
$I_{DSS}$	Zero gate voltage Drain current	$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}, T_C = 125\text{ °C}^{(1)}$			50	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 3.5\text{ A}$		0.73	0.90	$\Omega$

1. Defined by design, not subject to production test.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	340	-	pF
$C_{oss}$	Output capacitance		-	37	-	pF
$C_{rss}$	Reverse transfer capacitance		-	0.65	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }640\text{ V}, V_{GS} = 0\text{ V}$	-	61	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	22	-	pF
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 7\text{ A}$	-	12	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	3.8	-	nC
$Q_{gd}$	Gate-drain charge	See (Figure 15. Test circuit for gate charge behavior)	-	6.7	-	nC

1.  $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

2.  $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}, I_D = 3.5\text{ A}, R_G = 4.7\text{ }\Omega$	-	11	-	ns
$t_r$	Rise time		$V_{GS} = 10\text{ V}$	-	5.7	-
$t_{d(off)}$	Turn-off delay time	See (Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	65.3	-	ns
$t_f$	Fall time		-	13.6	-	ns

**Table 7. Source-drain diode**

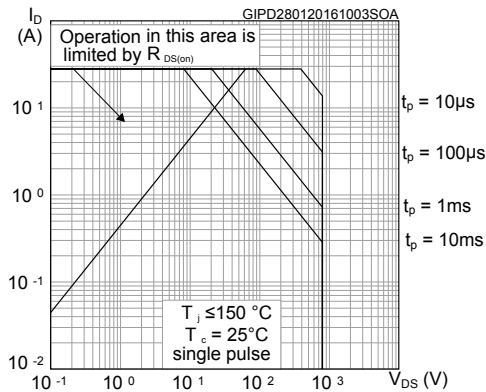
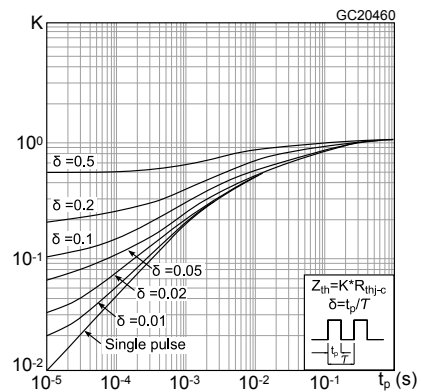
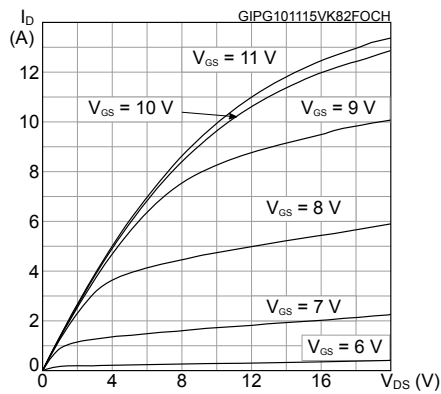
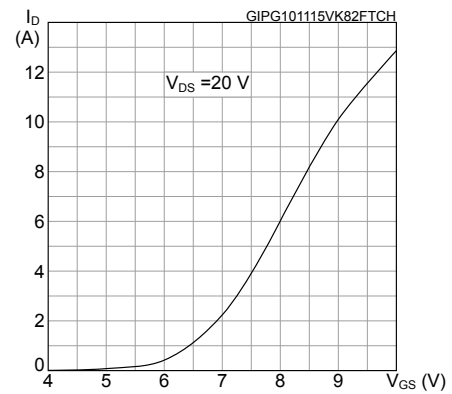
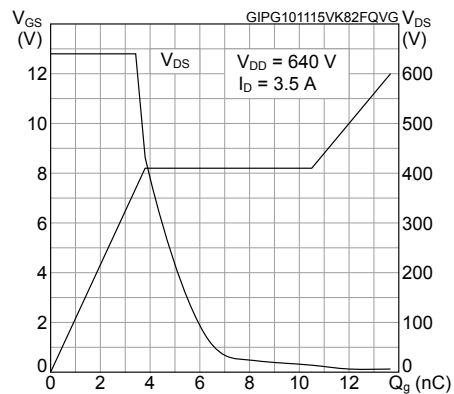
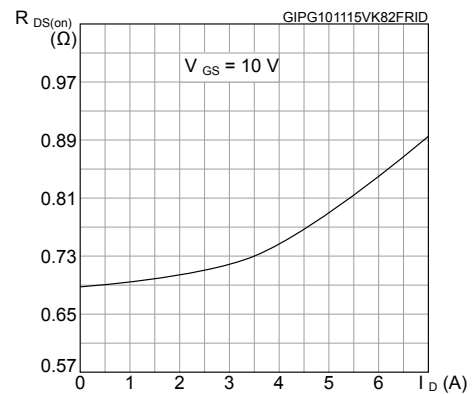
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		28	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ See Figure 16. Test circuit for inductive load switching and diode recovery times	-	292		ns
$Q_{rr}$	Reverse recovery charge		-	2.66		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	18.2		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ See Figure 16. Test circuit for inductive load switching and diode recovery times	-	477		ns
$Q_{rr}$	Reverse recovery charge		-	3.91		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	16.4		A

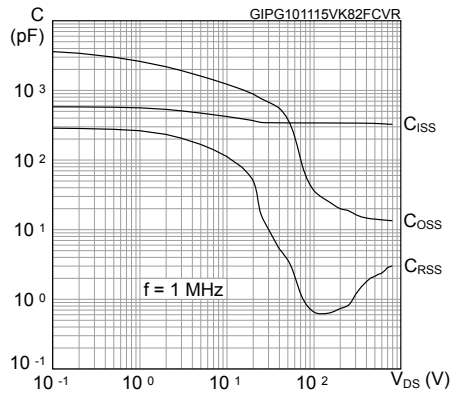
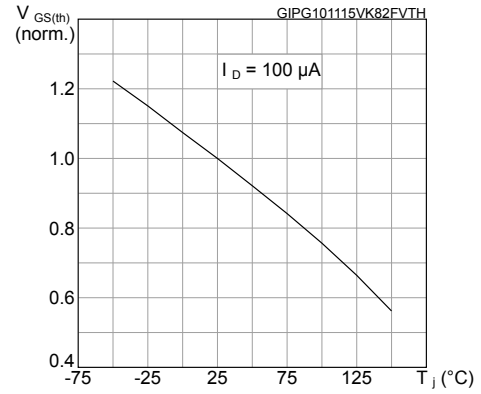
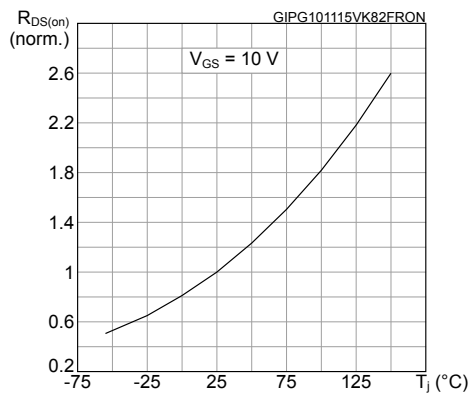
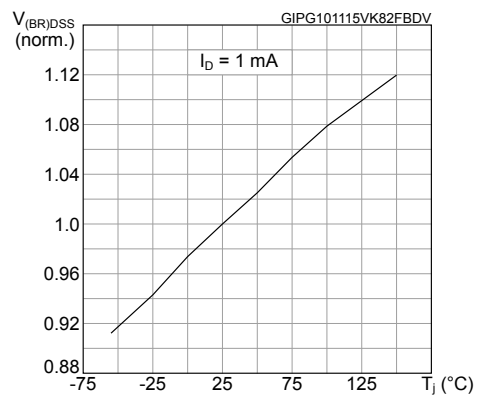
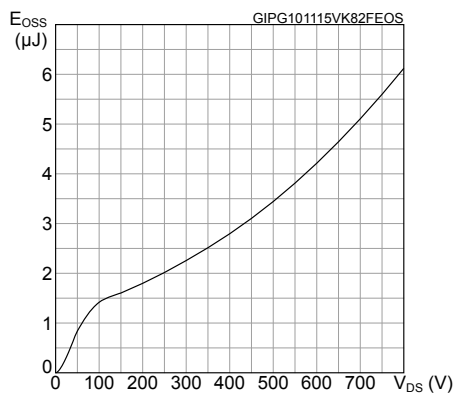
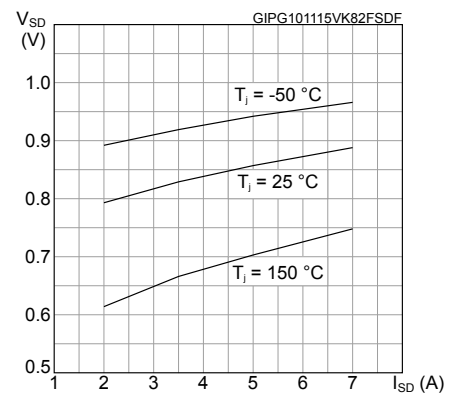
1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

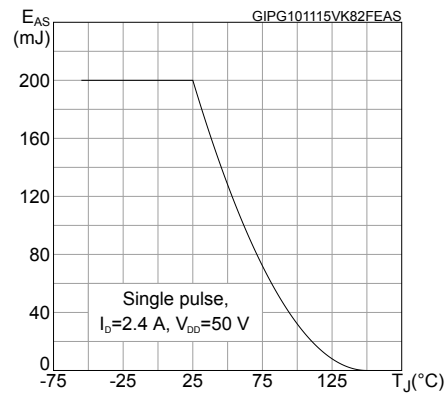
**Table 8. Gate-source Zener diode**

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

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

**2.1 STD9N80K5\_Electrical characteristics curves**
**Figure 1. Safe operating area**

**Figure 2. Thermal impedance**

**Figure 3. Output characteristics**

**Figure 4. Transfer characteristics**

**Figure 5. Gate charge vs gate-source voltage**

**Figure 6. Static drain-source on-resistance**


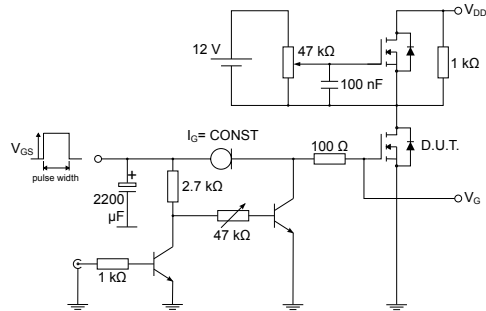
**Figure 7. Capacitance variations**

**Figure 8. Normalized gate threshold voltage vs temperature**

**Figure 9. Normalized on-resistance vs temperature**

**Figure 10. Normalized  $V_{(BR)DSS}$  vs temperature**

**Figure 11. Output capacitance stored energy**

**Figure 12. Source-drain diode forward characteristics**


**Figure 13. Maximum avalanche energy vs starting  $T_J$** 


### 3 Test circuits

**Figure 14. Test circuit for resistive load switching times**


AM01468v1

**Figure 15. Test circuit for gate charge behavior**


AM01469v1

**Figure 16. Test circuit for inductive load switching and diode recovery times**


AM01470v1

**Figure 17. Unclamped inductive load test circuit**


AM01471v1

**Figure 18. Unclamped inductive waveform**


AM01472v1

**Figure 19. Switching time waveform**


AM01473v1



## 4 Package information

---

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.

### 4.1 DPAK (TO-252) type A2 package information

Figure 20. DPAK (TO-252) type A2 package outline



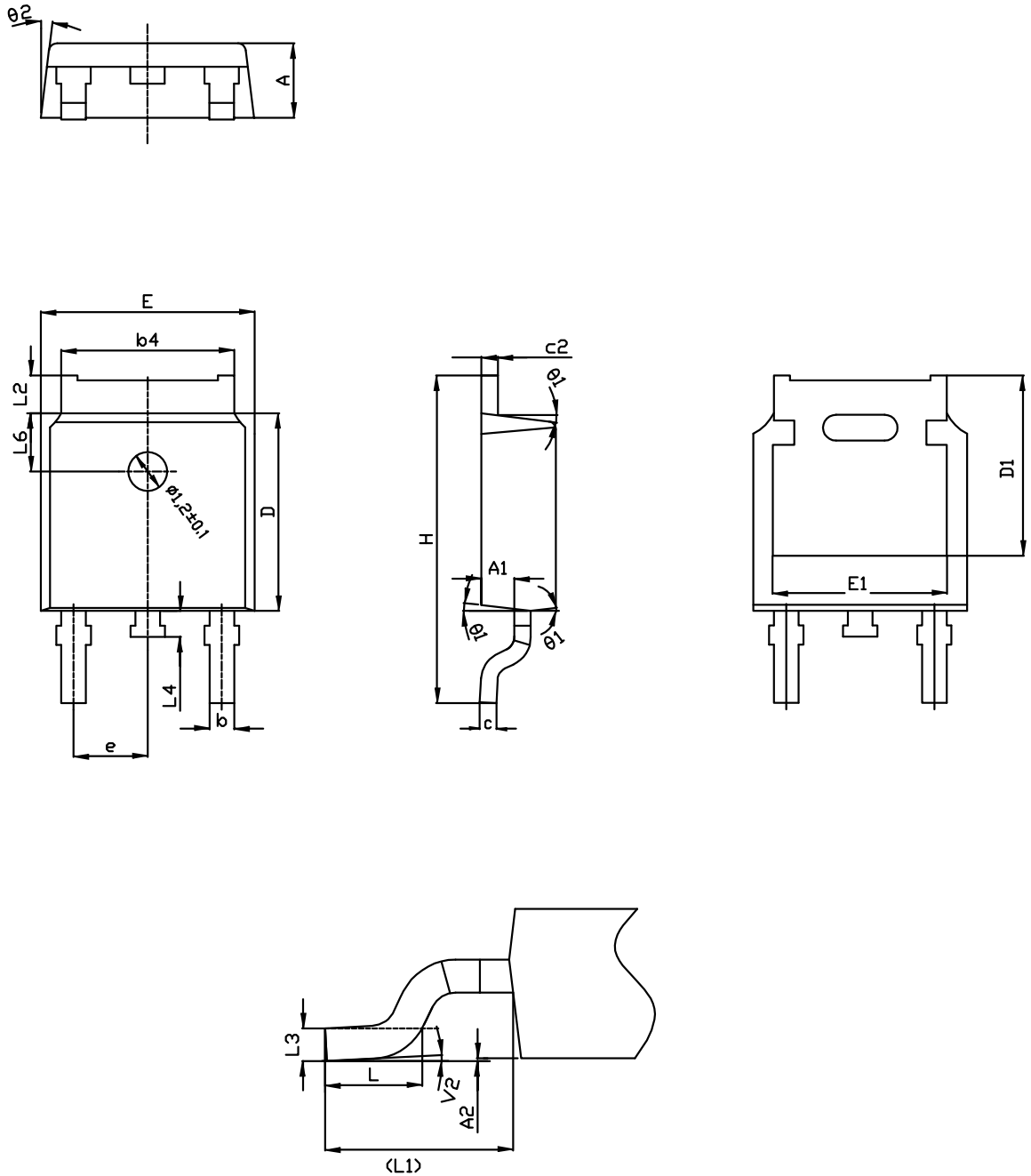
0068772\_type-A2\_rev25

**Table 9. DPAK (TO-252) type A2 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	4.95	5.10	5.25
E	6.40		6.60
E1	5.10	5.20	5.30
e	2.159	2.286	2.413
e1	4.445	4.572	4.699
H	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

## 4.2 DPAK (TO-252) type C2 package information

Figure 21. DPAK (TO-252) type C2 package outline

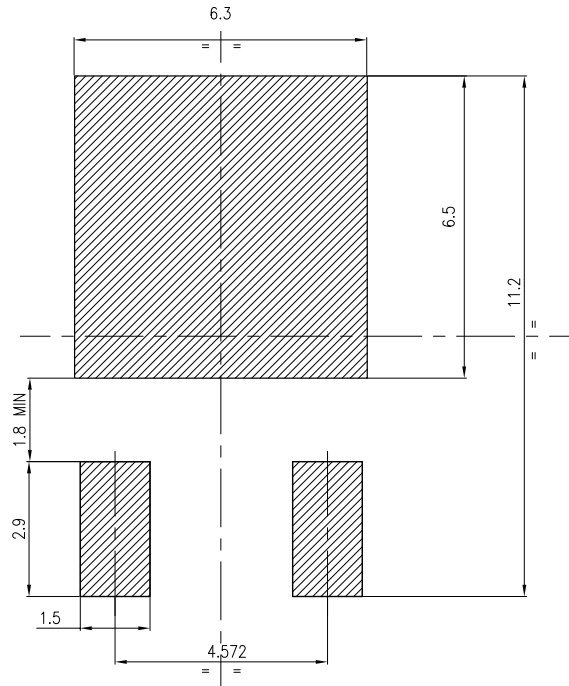


0068772\_C2\_25

**Table 10. DPAK (TO-252) type C2 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

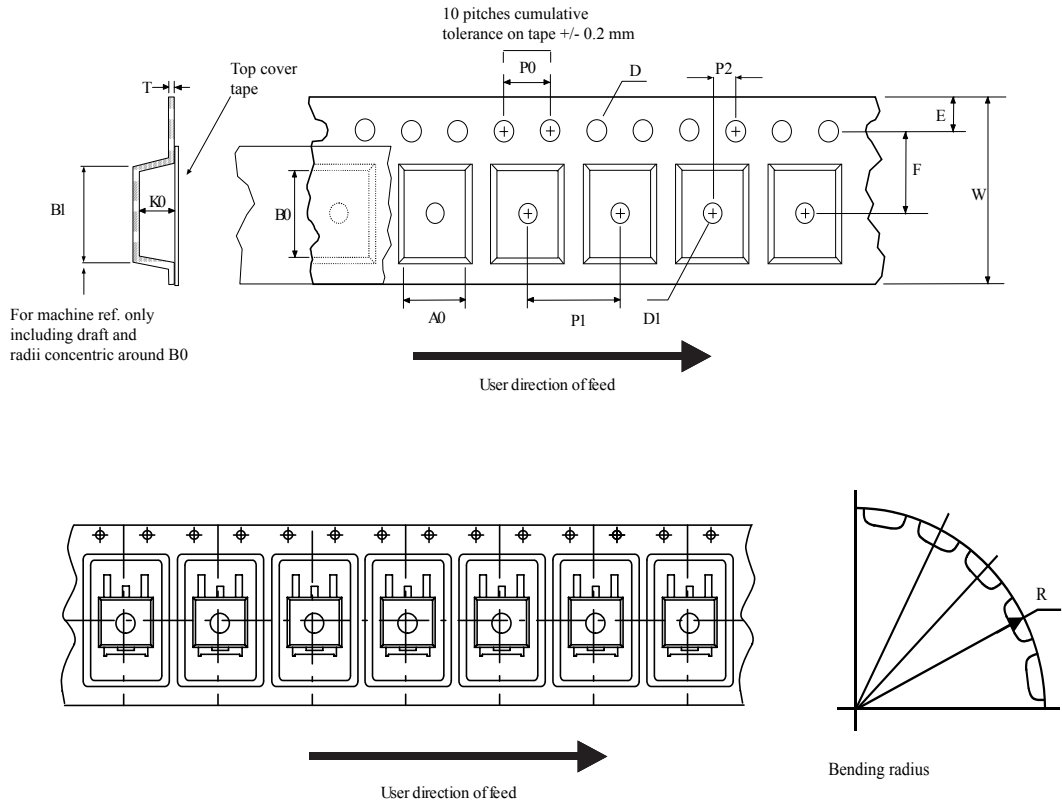
**Figure 22. DPAK (TO-252) recommended footprint (dimensions are in mm)**



FP\_0068772\_25

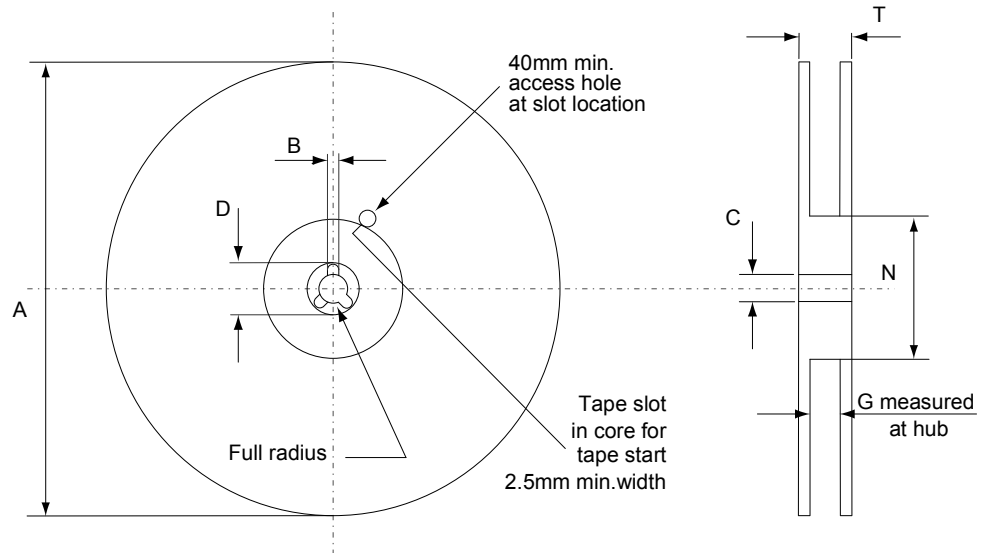
### 4.3 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



AM08852v1

**Figure 24. DPAK (TO-252) reel outline**



AM06038v1

**Table 11. 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			



## Revision history

**Table 12. Document revision history**

Date	Revision	Changes
20-Oct-2015	1	First release.
28-Jan-2016	2	Document status promoted from preliminary to production data. Updated DPAK (TO-252) type A2 package information. Inserted <a href="#">Section 2 Electrical characteristics</a> . Minor text changes.
12-Nov-2018	3	Updated , , <a href="#">Table 5. Dynamic</a> and <a href="#">Table 7. Source-drain diode</a> . Added <a href="#">Section 4.2 DPAK (TO-252) type C2 package information</a> .

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	STD9N80K5_Electrical characteristics curves .....	5
<b>3</b>	<b>Test circuits</b> .....	<b>8</b>
<b>4</b>	<b>Package information</b> .....	<b>9</b>
<b>4.1</b>	DPAK (TO-252) type A2 package information .....	9
<b>4.2</b>	DPAK (TO-252) type C2 package information .....	11
<b>4.3</b>	DPAK (TO-252) packing information .....	14
	<b>Revision history</b> .....	<b>17</b>

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved