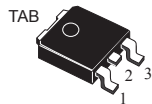
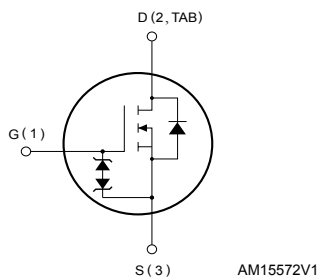


## N-channel 800 V, 0.73 $\Omega$ typ., 7 A MDmesh™ K5 Power MOSFET in a DPAK package


**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.  $I_{SD} \leq 7\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ;  $V_{DS(\text{peak})} < V_{(BR)DSS}$ ;  $V_{DD} = 640\text{ V}$
3.  $V_{DS} \leq 640\text{ V}$

**Table 2. Thermal data**

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

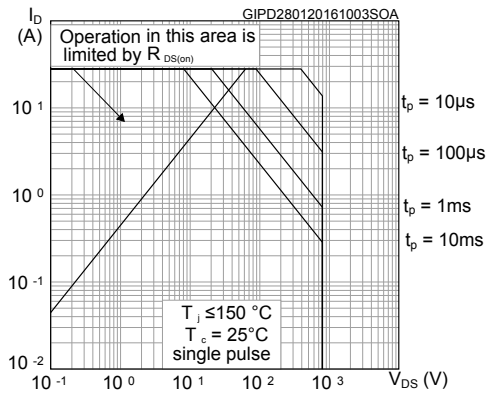
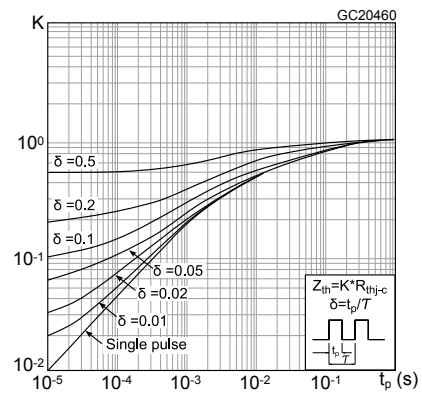
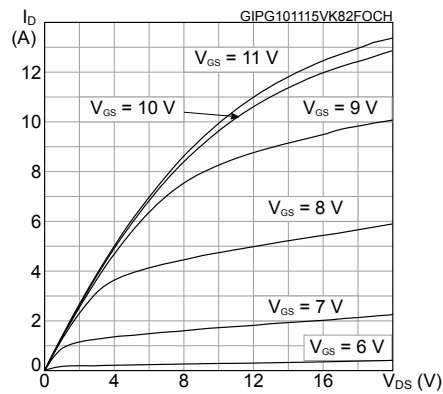
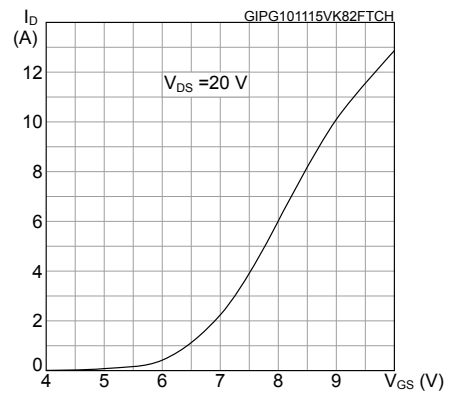
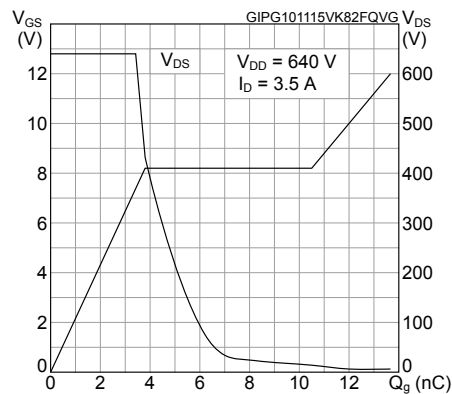
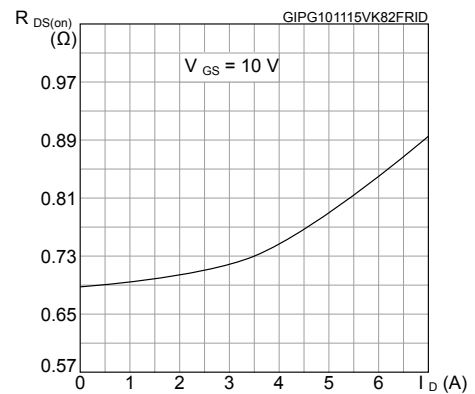
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		7	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		28	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7\text{ A}$ , $di/dt = 100\text{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

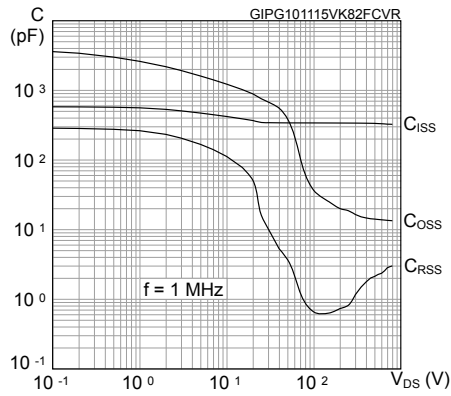
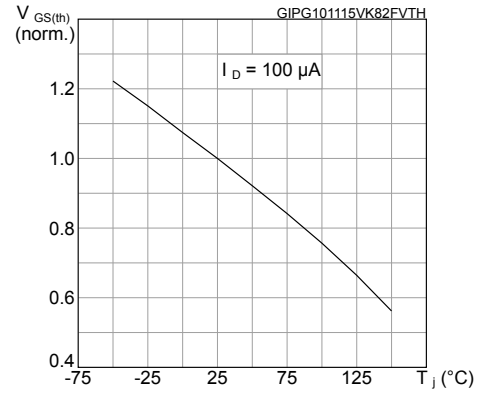
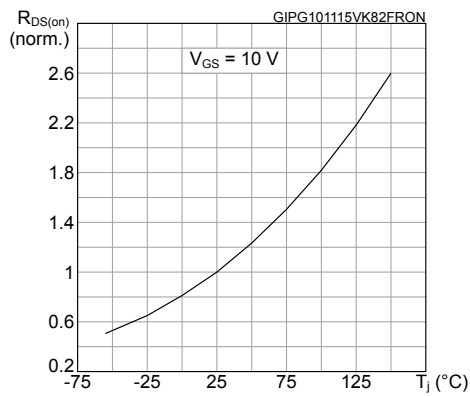
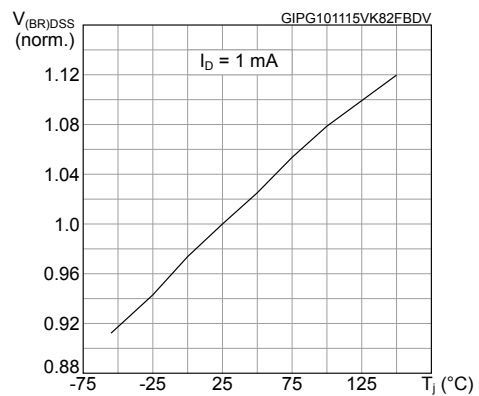
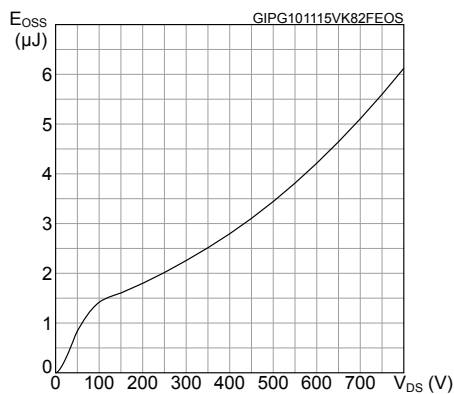
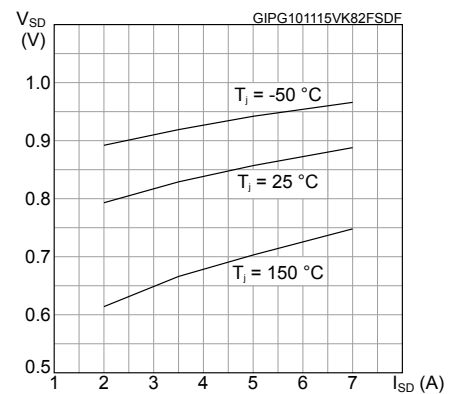
1. Pulse width limited by safe operating area
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

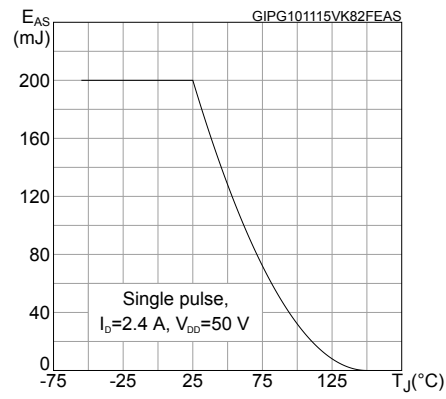
**Table 8. Gate-source Zener diode**

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

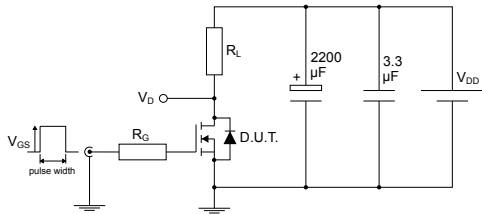
The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

**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**


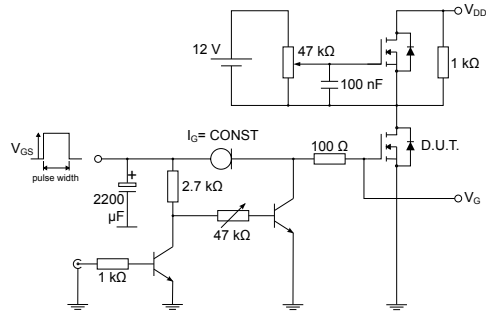
**Figure 7. Capacitance variations**

**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  $T_J$** 


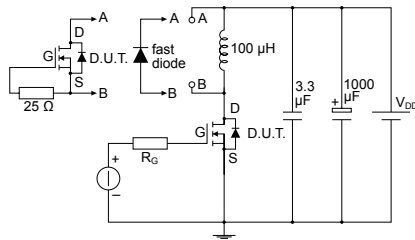
### 3 Test circuits

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


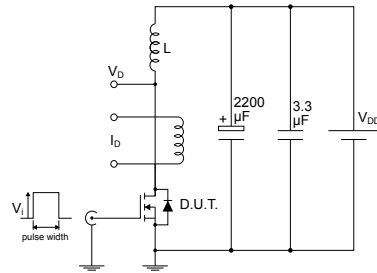
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**Figure 15. Test circuit for gate charge behavior**


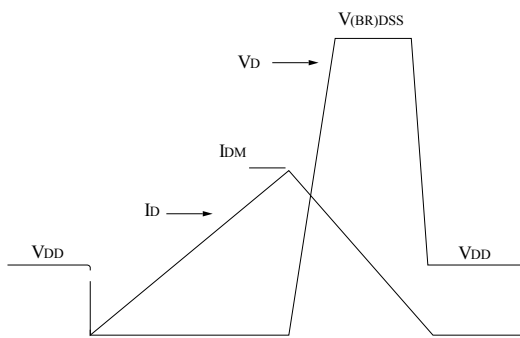
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**Figure 16. Test circuit for inductive load switching and diode recovery times**


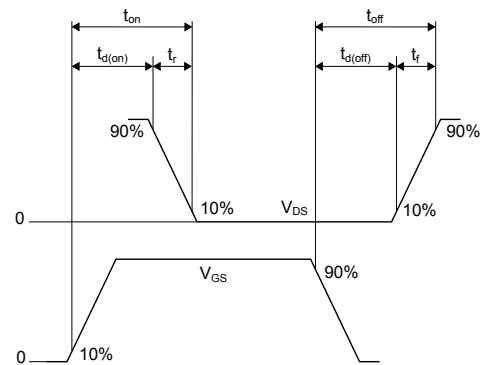
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**Figure 17. Unclamped inductive load test circuit**


AM01471v1

**Figure 18. Unclamped inductive waveform**


AM01472v1

**Figure 19. Switching time waveform**


AM01473v1



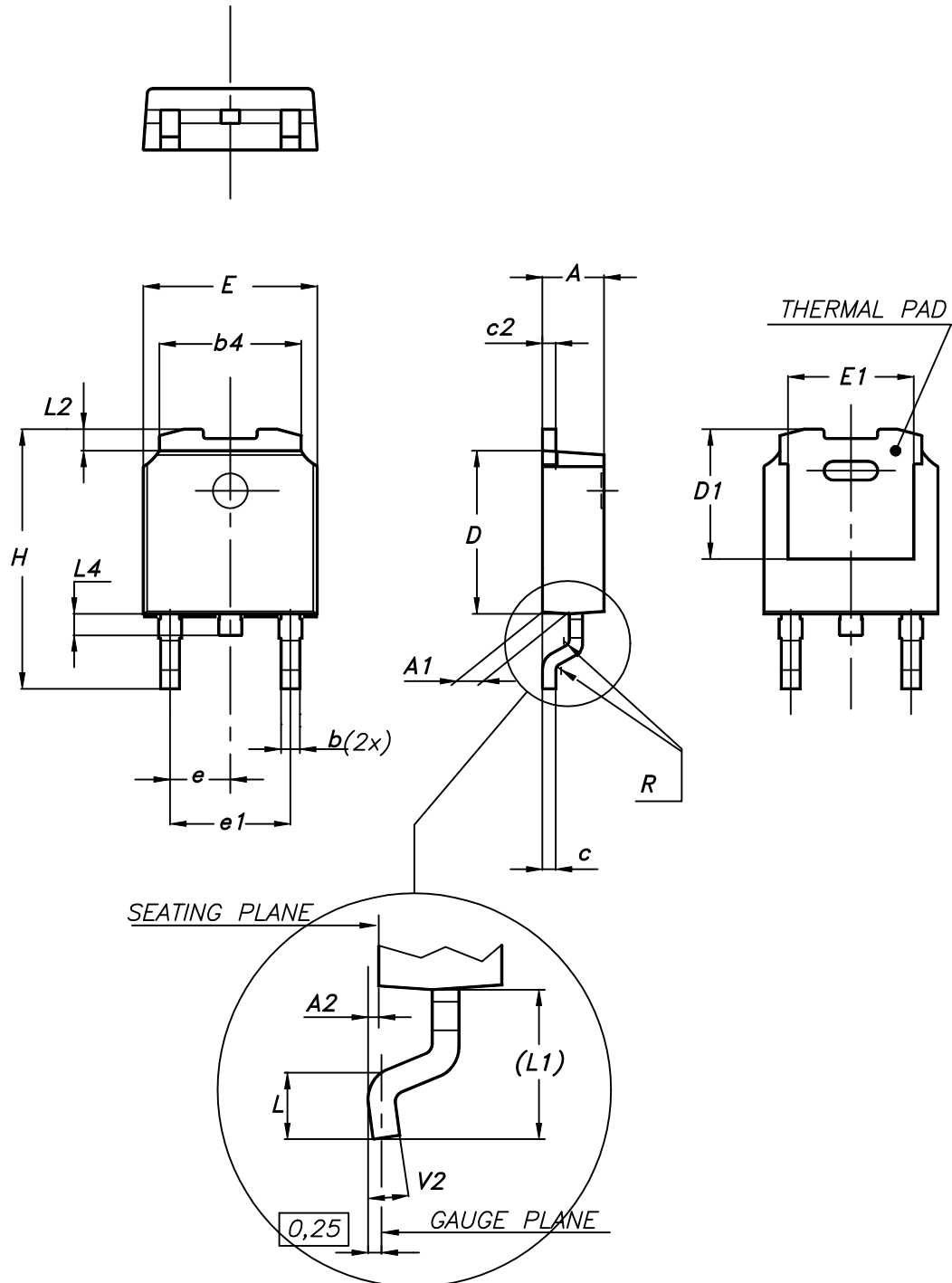
## 4 Package information

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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



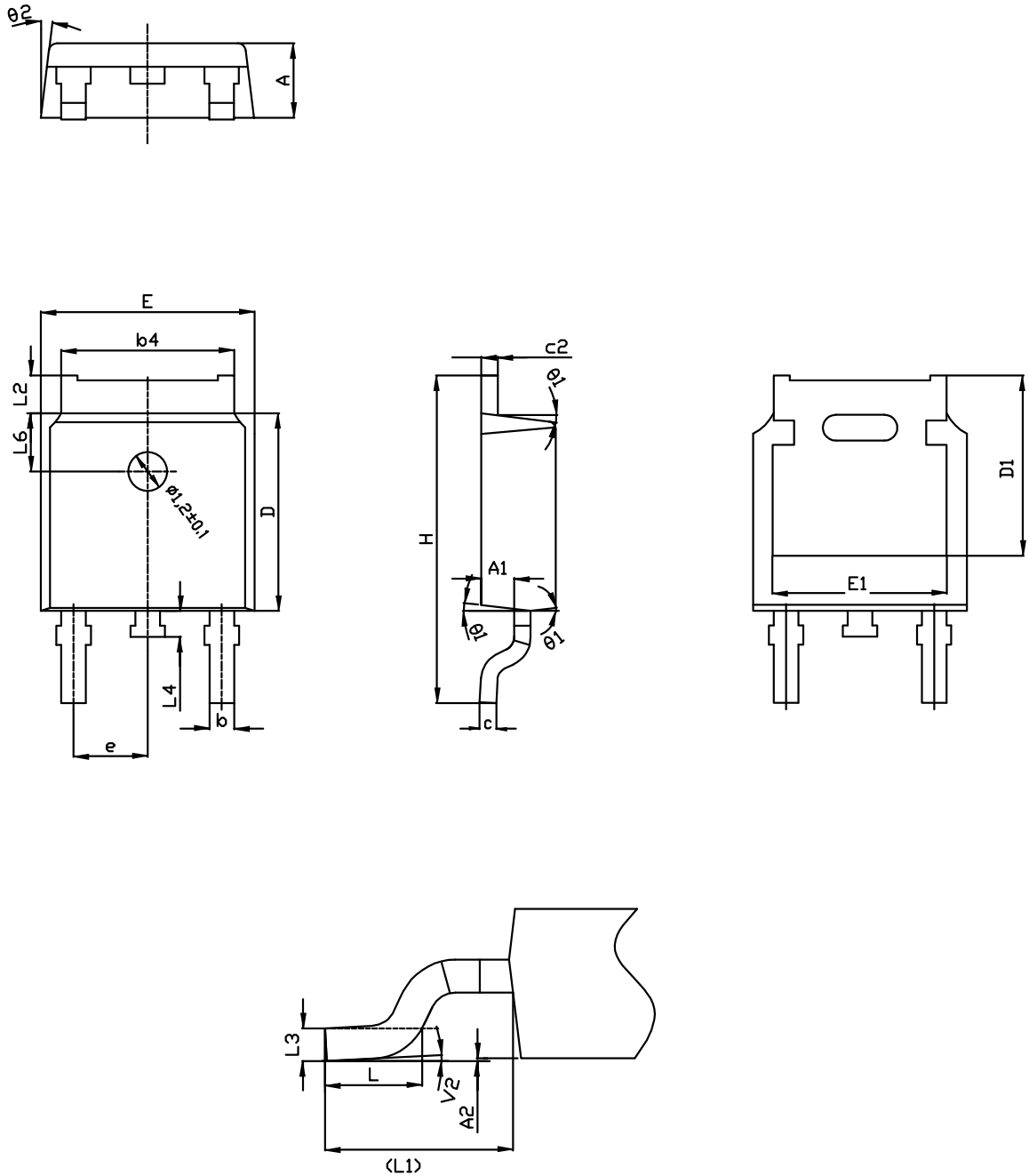
0068772\_type-A2\_rev25

**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

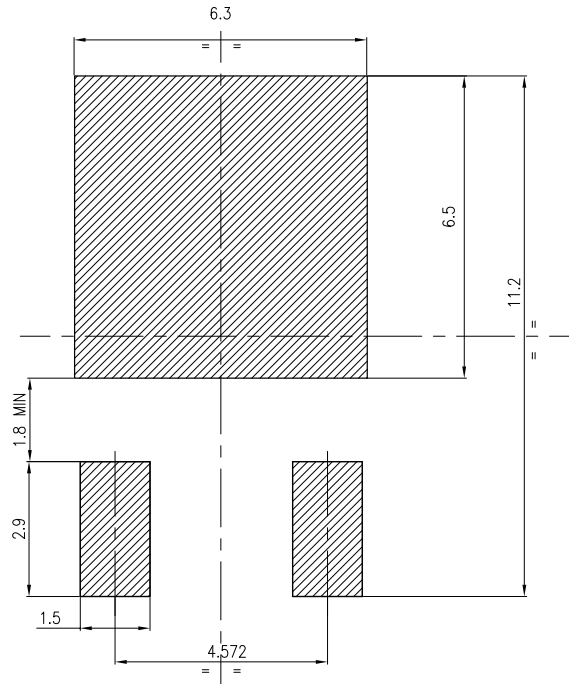


0068772\_C2\_25

**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°

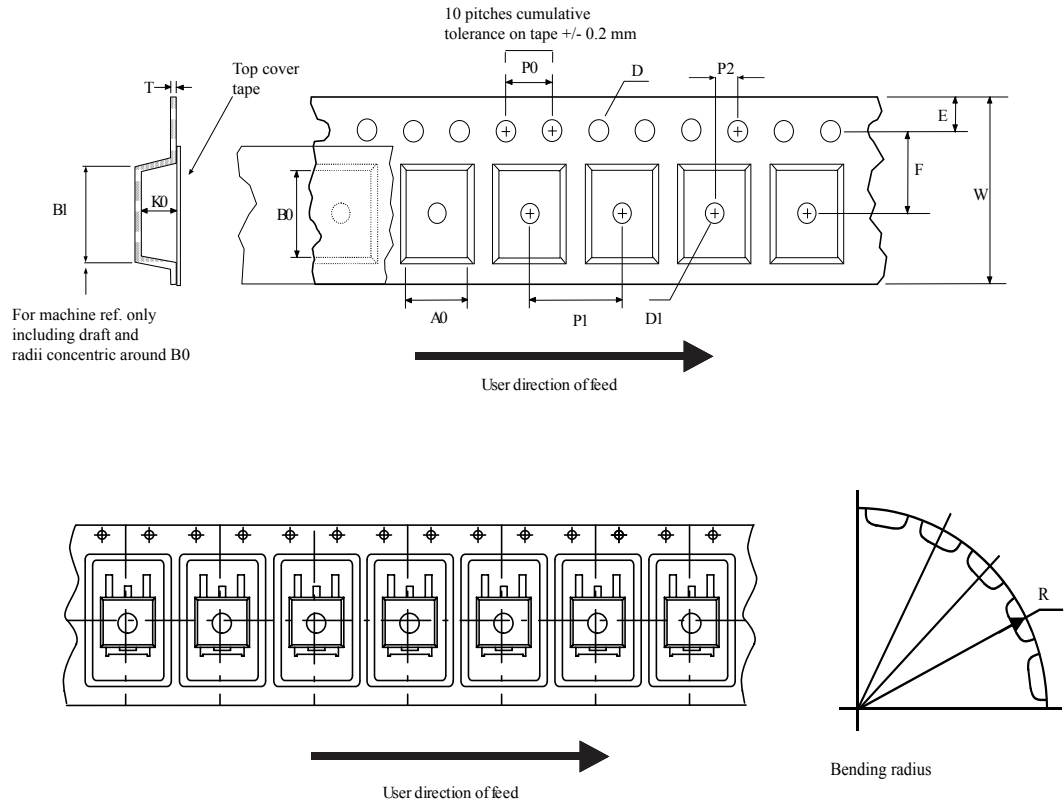
Figure 22. DPAK (TO-252) recommended footprint (dimensions are in mm)



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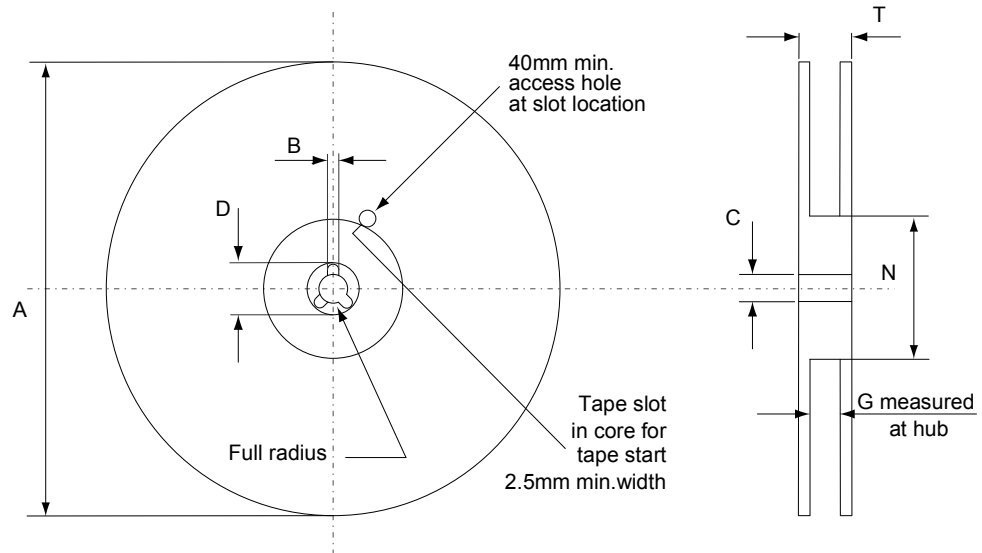
### 4.3 DPAK (TO-252) packing information

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> .

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