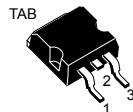
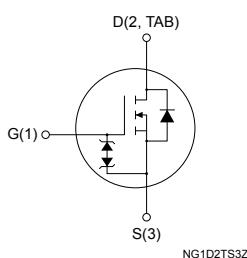


## N-channel 800 V, 0.23 Ω typ., 16 A MDmesh K5 Power MOSFET in a D<sup>2</sup>PAK package

### Features


**D<sup>2</sup>PAK**


Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STB23N80K5	800 V	0.28 Ω	16 A	190 W

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best FoM (figure of merit)
- 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 link

[STB23N80K5](#)

#### Product summary

Order code	STB23N80K5
Marking	23N80K5
Package	D <sup>2</sup> PAK
Packing	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 $T_C = 25^\circ\text{C}$	16	A
	Drain current (continuous) at $T_C = 100^\circ\text{C}$	10	
$I_{DM}^{(1)}$	Drain current (pulsed)	64	A
$P_{TOT}$	Total power dissipation at $T_C = 25^\circ\text{C}$	190	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
$T_{stg}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 16 \text{ A}$ ,  $di/dt=100 \text{ A}/\mu\text{s}$ ;  $V_{DS(\text{peak})} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .
3.  $V_{DS} \leq 640 \text{ V}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-ambient	0.66	$^\circ\text{C}/\text{W}$
$R_{thJA}^{(1)}$	Thermal resistance, junction-to-board	30	

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

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	5	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	400	mJ

1. Pulse width limited by  $T_{Jmax}$ .
2. Starting  $T_J = 25^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50 \text{ V}$ .

## 2 Electrical characteristics

$T_C = 25^\circ\text{C}$  unless otherwise specified.

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}$	800			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0 \text{ V}, V_{DS} = 800 \text{ V}, T_C = 125^\circ\text{C}$ (1)			50	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 20 \text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(\text{th})}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100 \mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{GS} = 10 \text{ V}, I_D = 8 \text{ A}$		0.23	0.28	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100 \text{ V}, f = 1 \text{ MHz}, V_{GS} = 0 \text{ V}$	-	1000	-	$\text{pF}$
$C_{oss}$	Output capacitance		-	65	-	
$C_{rss}$	Reverse transfer capacitance		-	1.5	-	
$C_{O(\text{tr})}$ (1)	Equivalent output capacitance	$V_{DS} = 0 \text{ to } 640 \text{ V}, V_{GS} = 0 \text{ V}$	-	165	-	$\text{pF}$
$C_{O(\text{er})}$ (2)	Equivalent output capacitance	$V_{DS} = 0 \text{ to } 640 \text{ V}, V_{GS} = 0 \text{ V}$	-	59	-	
$R_G$	Intrinsic gate resistance	$f = 1 \text{ MHz}, I_D = 0 \text{ A}$	-	4.7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640 \text{ V}, I_D = 16 \text{ A}, V_{GS} = 0 \text{ to } 10 \text{ V}$ (see Figure 13. Test circuit for gate charge behavior)	-	33	-	$\text{nC}$
$Q_{gs}$	Gate-source charge		-	6	-	
$Q_{gd}$	Gate-drain charge		-	25	-	

- Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .
- Energy related is defined as a constant equivalent capacitance giving the same stored energy 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
$t_{d(\text{on})}$	Turn-on delay time	$V_{DD} = 400 \text{ V}, I_D = 8 \text{ A}, R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$ (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	14	-	$\text{ns}$
$t_r$	Rise time		-	9	-	
$t_{d(\text{off})}$	Turn-off delay time		-	48	-	
$t_f$	Fall time		-	9	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		16	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		64	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 16 \text{ A}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 16 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 60 \text{ V}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	410		ns
$Q_{rr}$	Reverse recovery charge	$I_{SD} = 16 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 60 \text{ V}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	34		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 16 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 60 \text{ V},$ $T_j = 150^\circ\text{C}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	650		ns
$Q_{rr}$	Reverse recovery charge	$I_{SD} = 16 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}, V_{DD} = 60 \text{ V},$ $T_j = 150^\circ\text{C}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	10		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	32		A

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

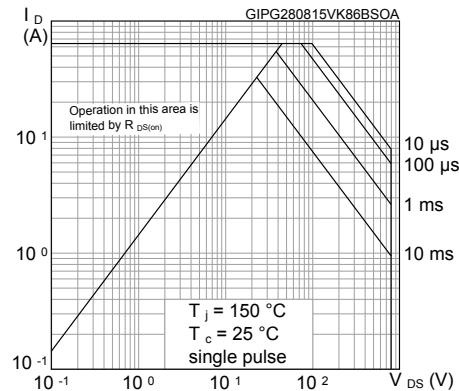
Table 8. Gate-source Zener diode

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

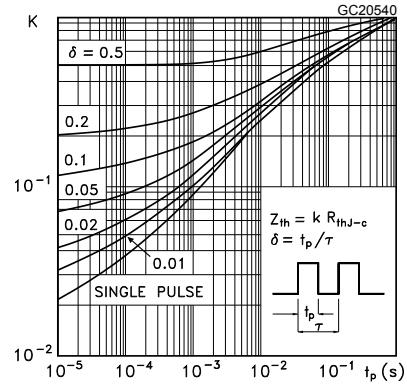
The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

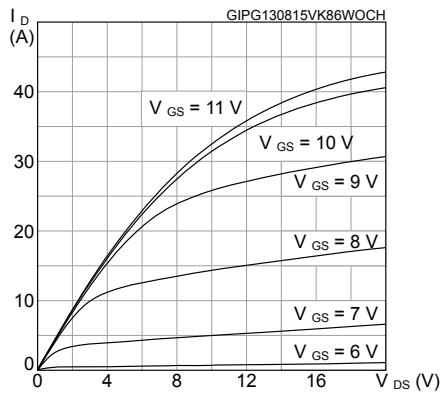
**Figure 1. Safe operating area**



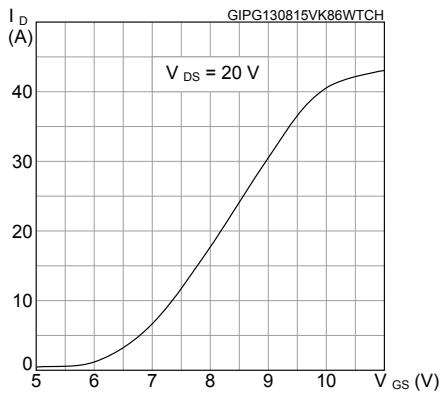
**Figure 2. Normalized transient thermal impedance**



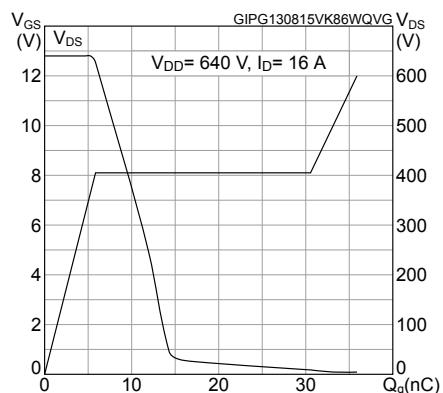
**Figure 3. Typical output characteristics**



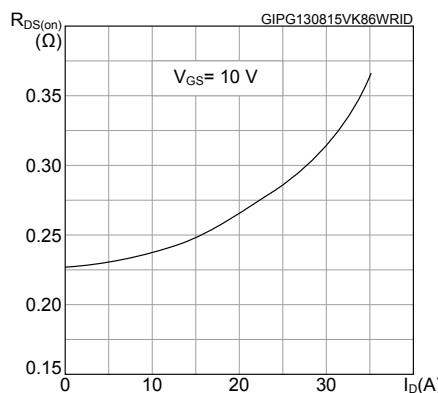
**Figure 4. Typical transfer characteristics**

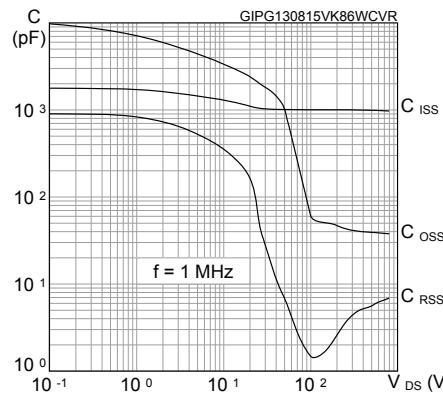
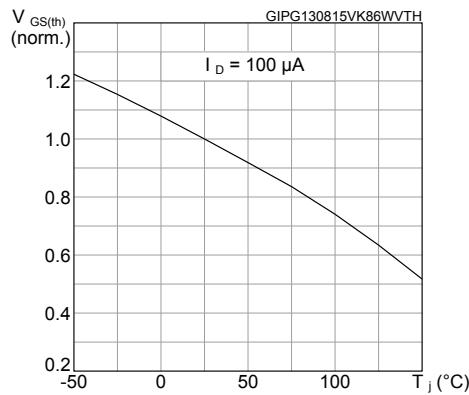
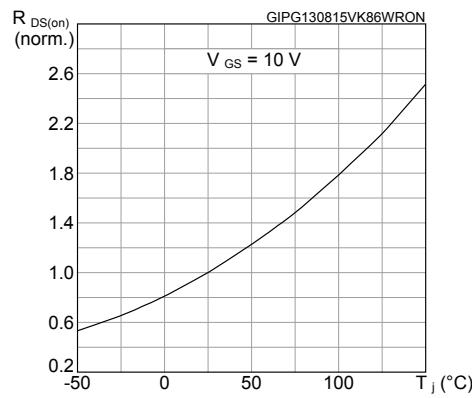
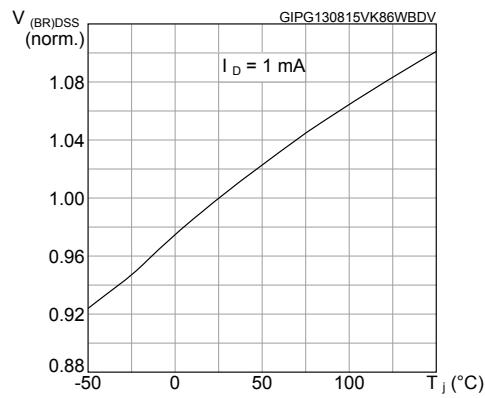
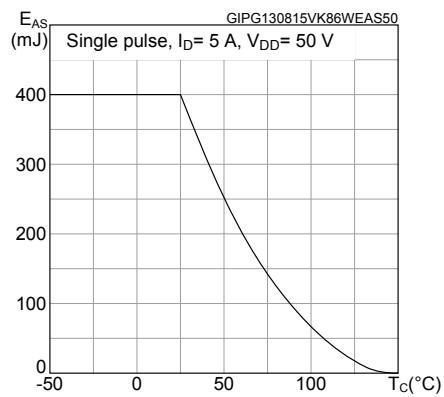


**Figure 5. Typical gate charge characteristics**



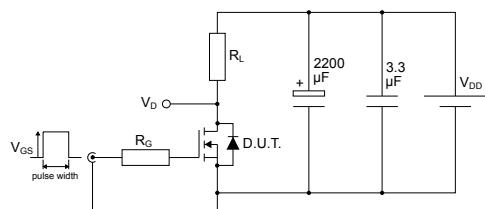
**Figure 6. Typical drain-source on-resistance**



**Figure 7. Typical capacitance characteristics**

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

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

**Figure 10. Normalized breakdown voltage vs temperature**

**Figure 11. Maximum avalanche energy vs temperature**


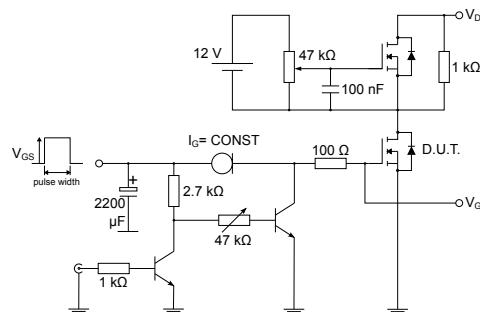
### 3 Test circuits

**Figure 12.** Test circuit for resistive load switching times



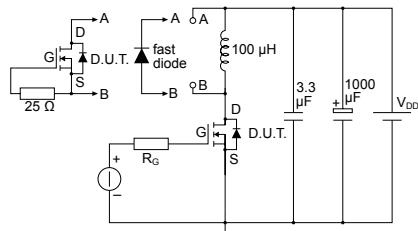
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**Figure 13.** Test circuit for gate charge behavior



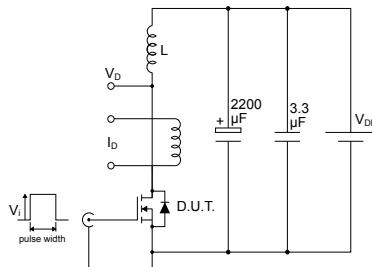
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**Figure 14.** Test circuit for inductive load switching and diode recovery times



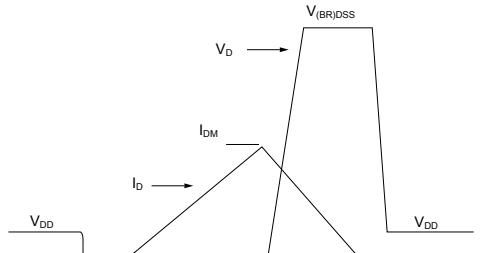
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**Figure 15.** Unclamped inductive load test circuit



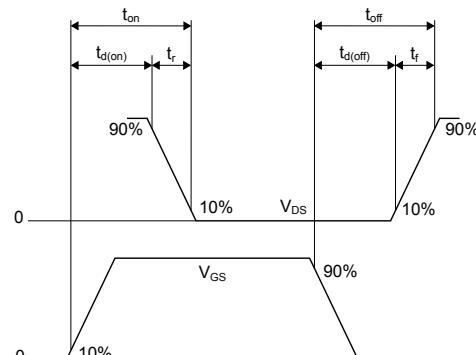
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**Figure 16.** Unclamped inductive waveform



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**Figure 17.** Switching time waveform



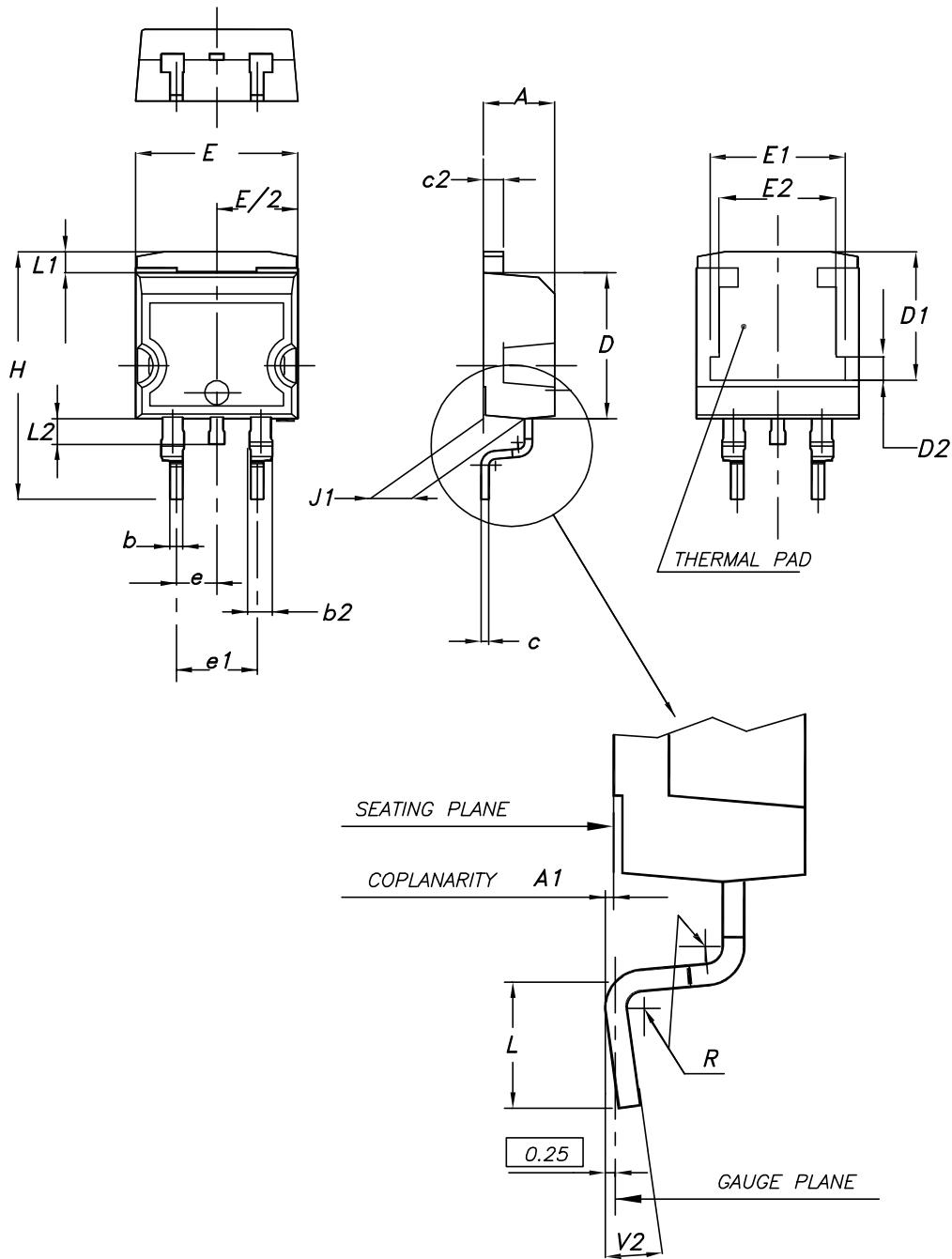
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## 4 Package information

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 D<sup>2</sup>PAK (TO-263) type A package information

Figure 18. D<sup>2</sup>PAK (TO-263) type A package outline

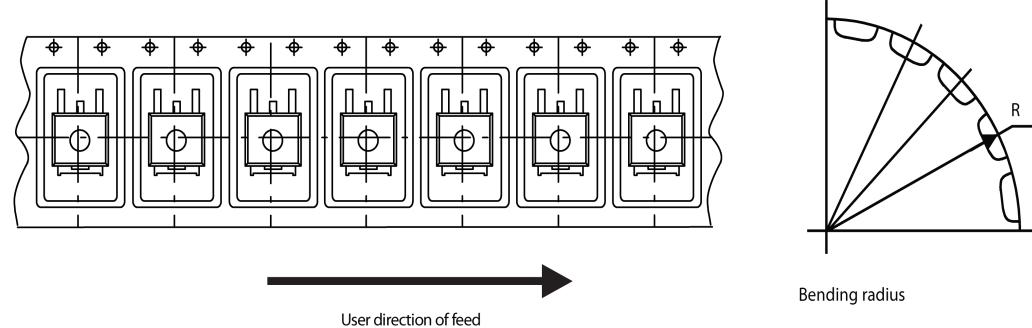
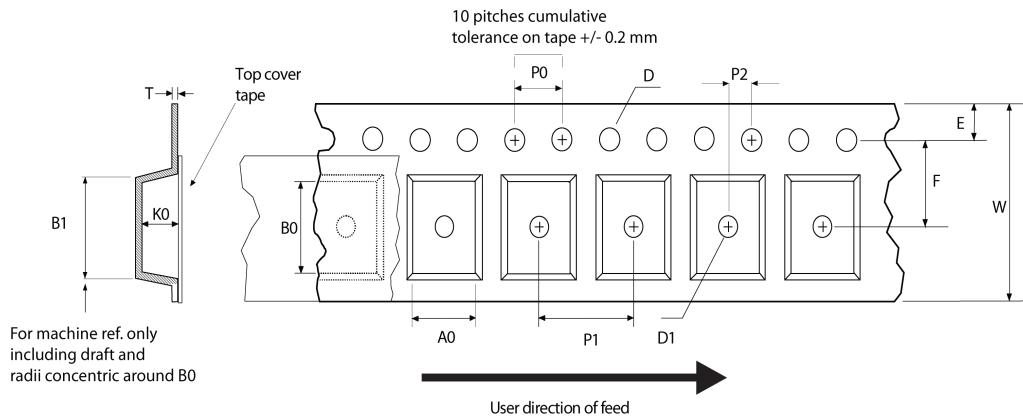


**Table 9.** D<sup>2</sup>PAK (TO-263) type A package mechanical data

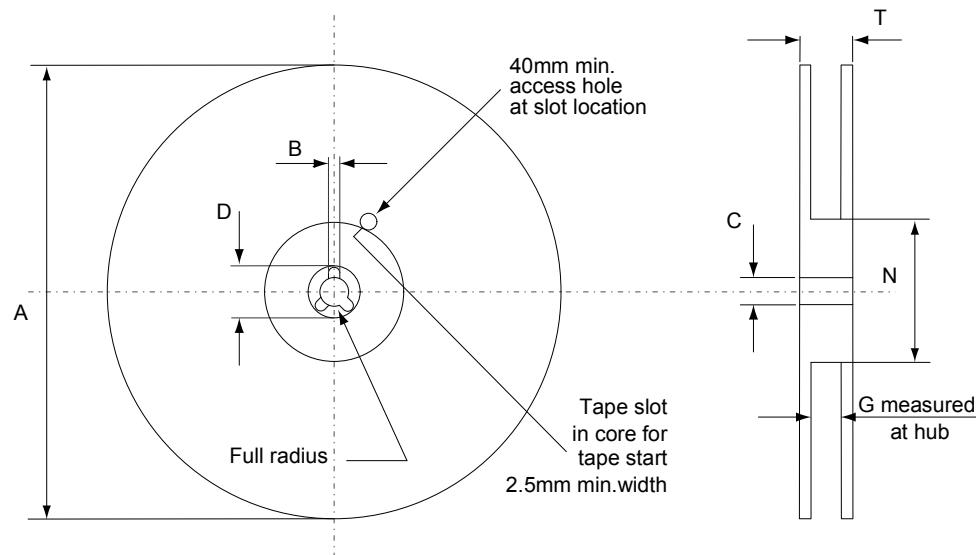
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

## 4.2 D<sup>2</sup>PAK packing information

**Figure 19. D<sup>2</sup>PAK tape outline**



AM08852v1

Figure 20. D<sup>2</sup>PAK reel outline

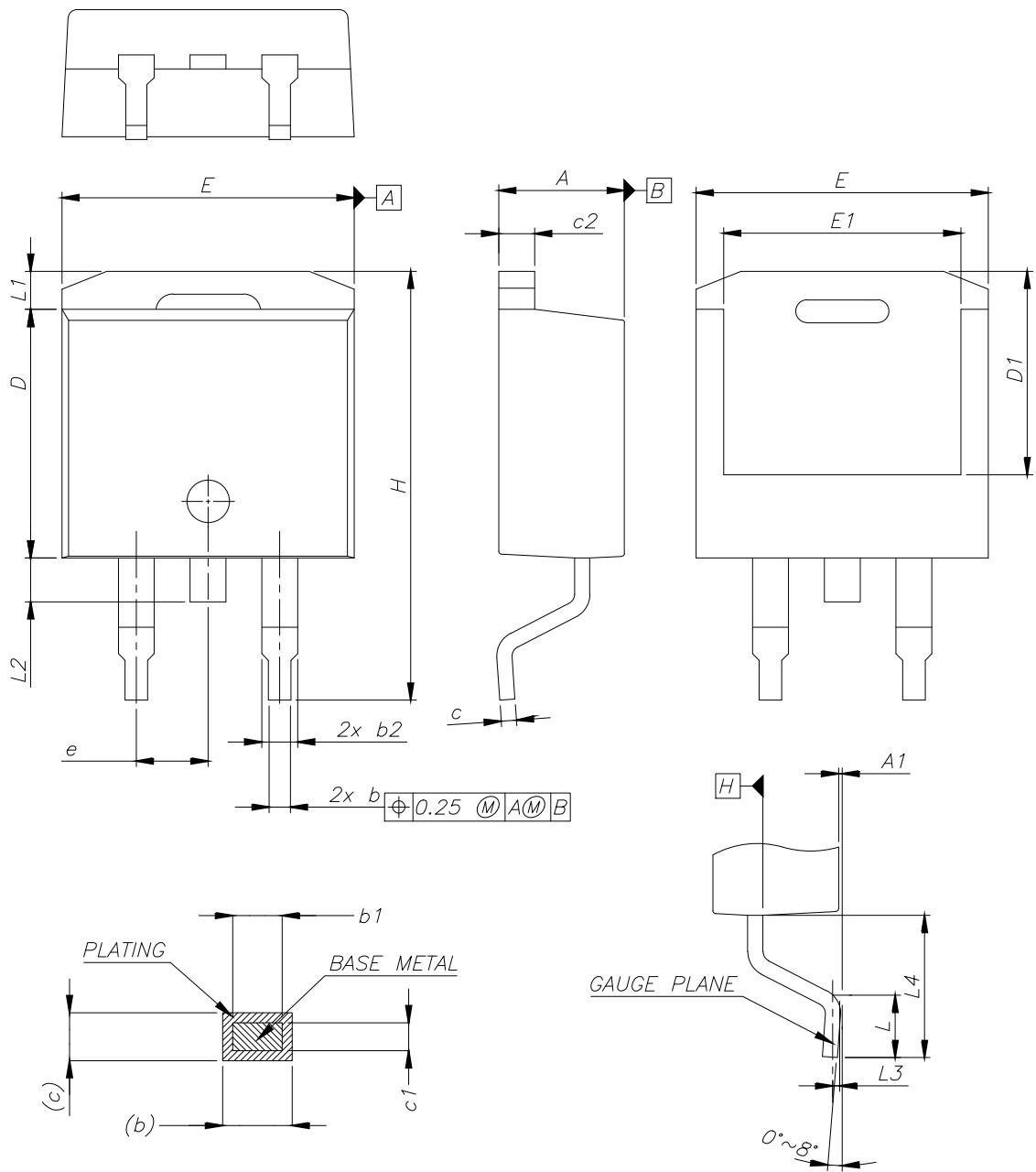
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Table 10. D<sup>2</sup>PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## 4.3 D<sup>2</sup>PAK (TO-263) type B package information

Figure 21. D<sup>2</sup>PAK (TO-263) type B package outline

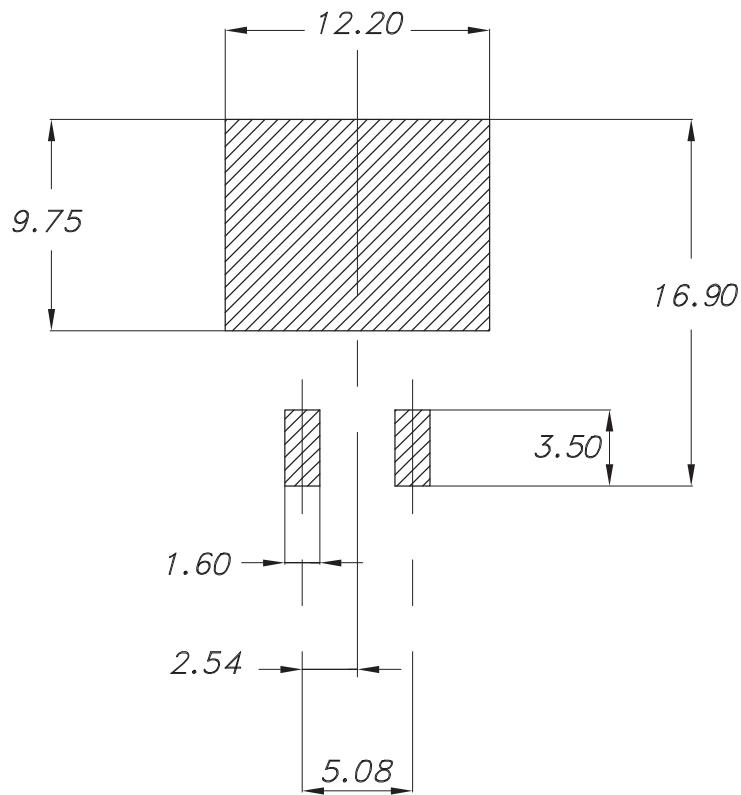


0079457\_26\_B

Table 11. D<sup>2</sup>PAK (TO-263) type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

**Figure 22. D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)**



0079457\_Rev26\_footprint

#### 4.4 D<sup>2</sup>PAK type B packing information

Figure 23. D<sup>2</sup>PAK type B tape outline

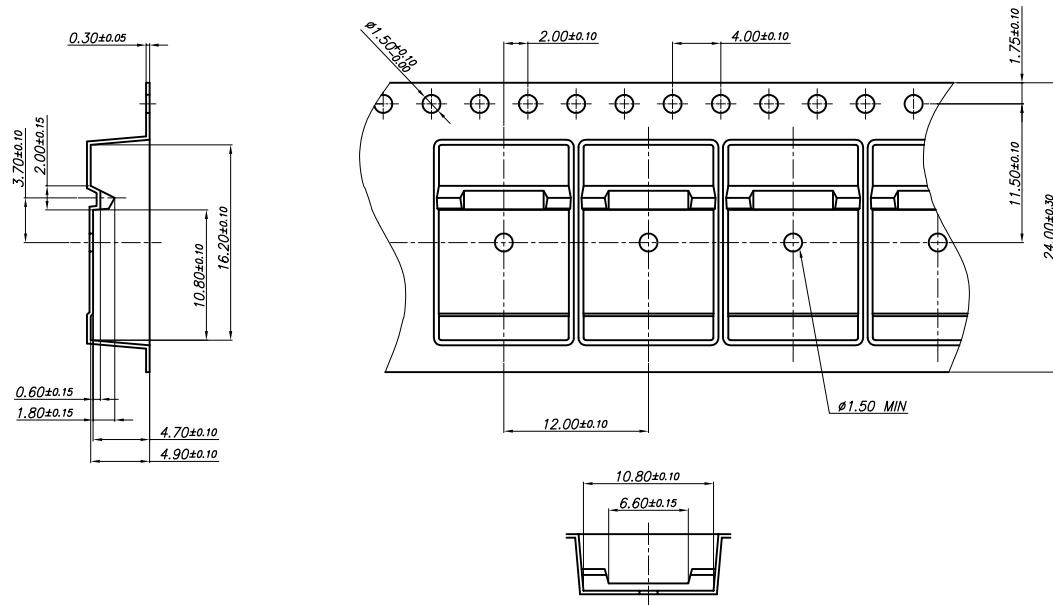
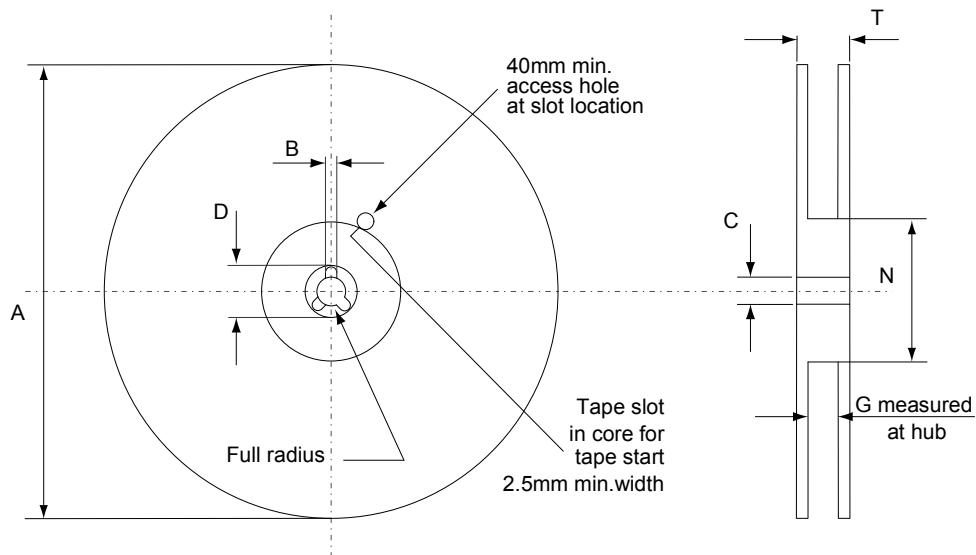


Figure 24. D<sup>2</sup>PAK type B reel outline



AM06038v1

**Table 12. D<sup>2</sup>PAK type B reel mechanical data**

Dim.	mm	
	Min.	Max.
A		330
B	1.5	
C	12.8	13.2
D	20.2	
G	24.4	26.4
N	100	
T		30.4

## Revision history

**Table 13. Document revision history**

Date	Revision	Changes
28-Aug-2015	1	First release.
21-May-2021	2	Updated Section 4.1 D <sup>2</sup> PAK (TO-263) type A package information. Added Section 4.3 D <sup>2</sup> PAK (TO-263) type B package information. Minor text changes.

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