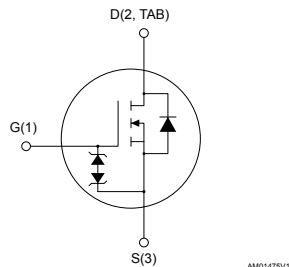
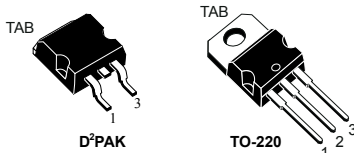


N-channel 525 V, 1.2 Ω typ., 4.4 A MDmesh™ K3 Power MOSFETs in D²PAK and TO-220 packages



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	Package
STB5N52K3	525 V	1.5 Ω	4.4 A	D ² PAK
STP5N52K3				TO-220

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

Applications

- Switching applications

Description

These MDmesh™ K3 Power MOSFETs are the result of improvements applied to STMicroelectronics' MDmesh™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

Product status link

[STB5N52K3](#)
[STP5N52K3](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	525	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	4.4	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.77	A
$I_{DM}^{(1)}$	Drain current (pulsed)	17.6	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	12	V/ns
T_j	Operating junction temperature range	-55 to 150	$^\circ\text{C}$
T_{stg}	Storage temperature range		

1. Pulse width limited by safe operating area.

2. $I_{SD} \leq 4.4\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DSpeak} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case	1.79		$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient		62.5	$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	30		$^\circ\text{C}/\text{W}$

1. When mounted on 1inch² FR-4 board, 2 oz Cu.

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not-repetitive	2.2	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	100	mJ

1. Pulse width limited by T_j max.

2. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	525			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 525\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 525\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			50	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 2.2\text{ A}$		1.2	1.5	Ω

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	545	-	μF
C_{oss}	Output capacitance			45		
C_{rss}	Reverse transfer capacitance			8		
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }420\text{ V}$, $V_{GS} = 0\text{ V}$	-	33	-	μF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	4.7	-	Ω
Q_g	Total gate charge	$V_{DD} = 420\text{ V}$, $I_D = 4.4\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	17	-	nC
Q_{gs}	Gate-source charge			3		
Q_{gd}	Gate-drain charge			10		

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
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 262.5\text{ V}$, $I_D = 2.2\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	9	-	ns
t_r	Rise time			11		
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	29	-	ns
t_f	Fall time			16		

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				4.4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		17.6	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4.4 \text{ A}$, $V_{GS} = 0 \text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 4.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$		210		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	1.3		μC
I_{RRM}	Reverse recovery current			12		A
t_{rr}	Reverse recovery time	$I_{SD} = 4.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$		240		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	1.6		μC
I_{RRM}	Reverse recovery current			13		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , 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	$I_{GS} = \pm 1 \text{ mA}$, $I_D = 0 \text{ A}$	± 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.

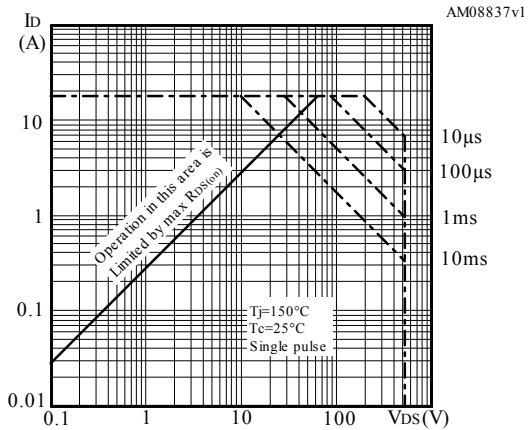
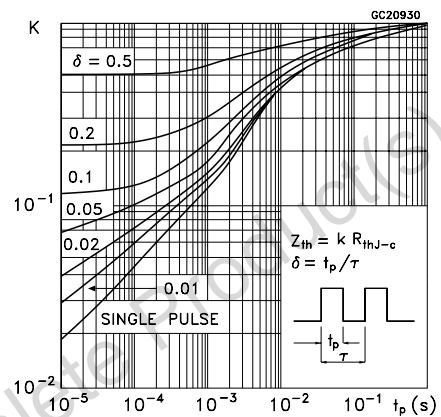
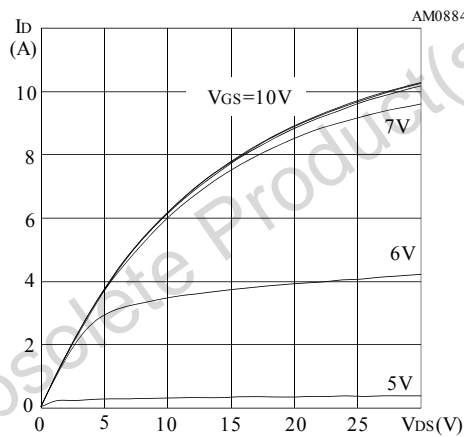
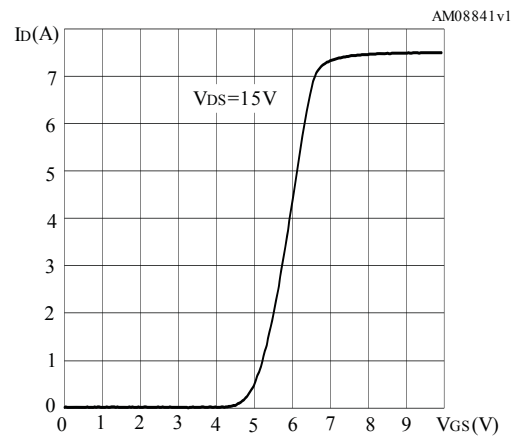
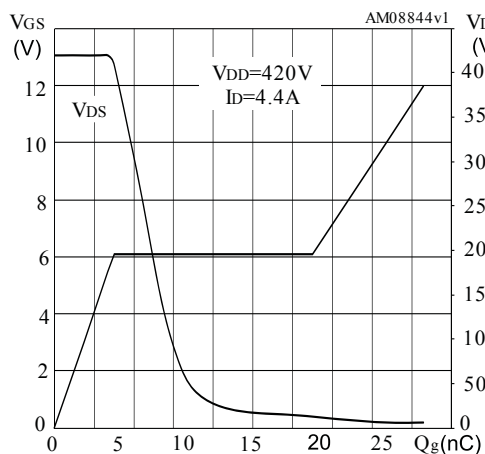
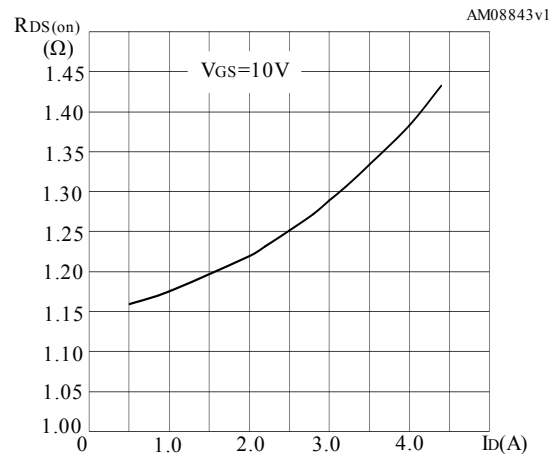
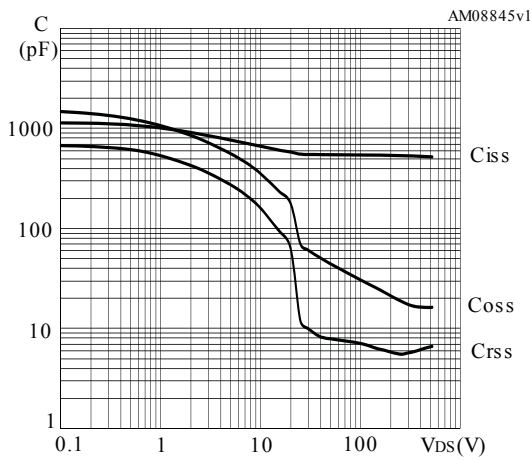
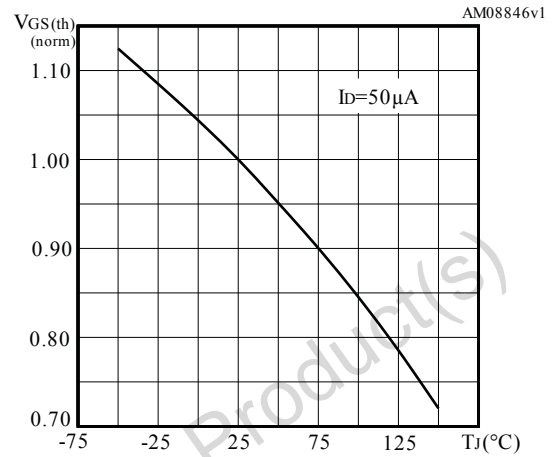
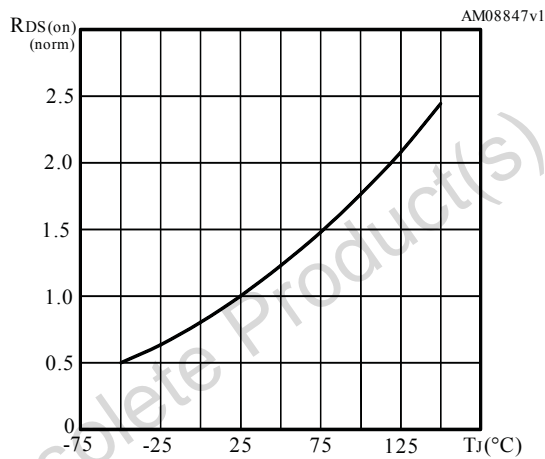
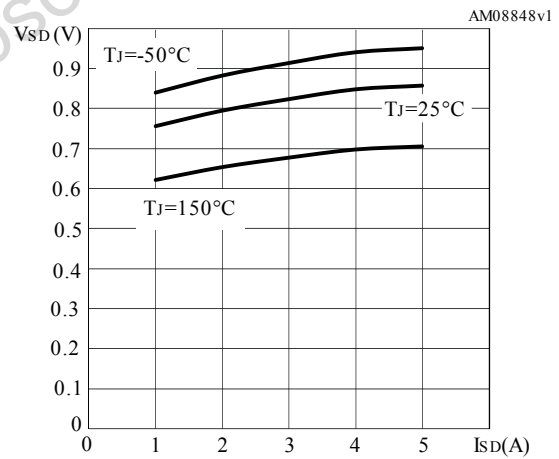
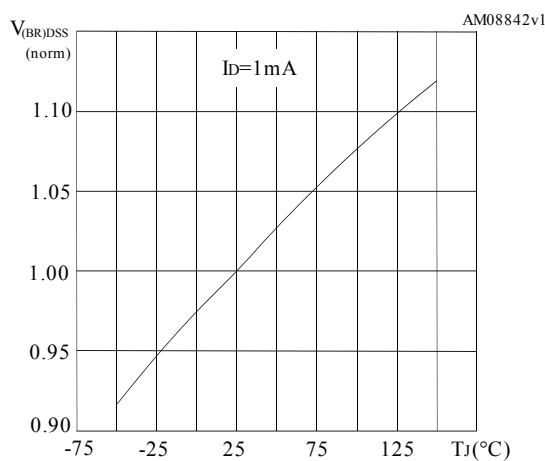
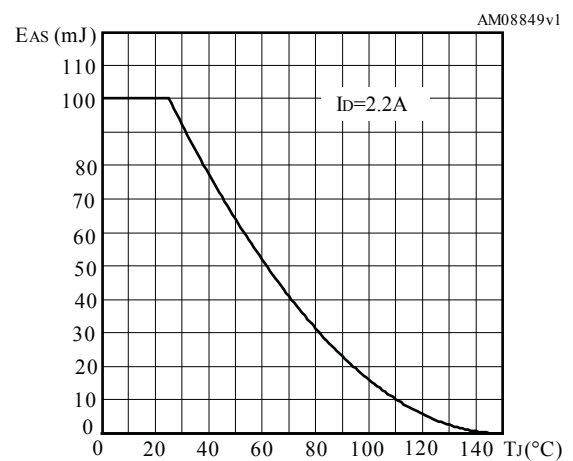
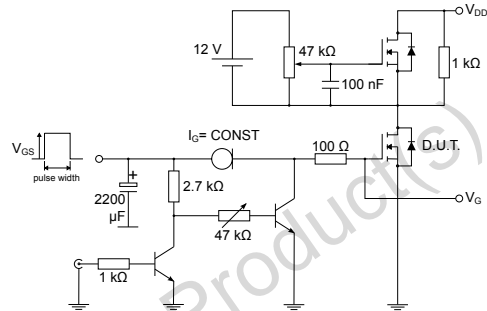
2.1 Electrical characteristics curves
Figure 1. Safe operating area

Figure 2. 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. Source-drain diode forward characteristics

Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

Figure 12. Maximum avalanche energy vs starting T_j


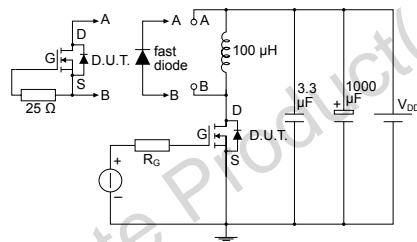
3 Test circuits

Figure 13. Test circuit for resistive load switching times

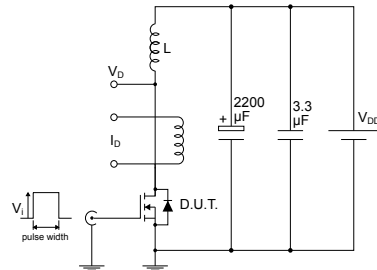

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Figure 14. Test circuit for gate charge behavior


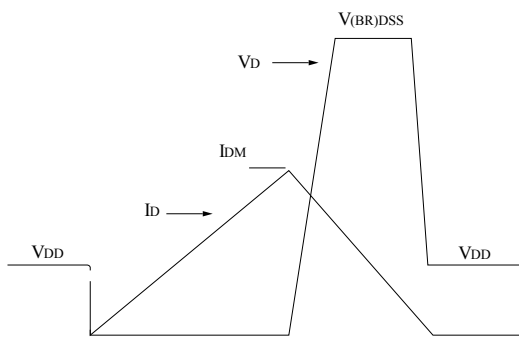
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Figure 15. Test circuit for inductive load switching and diode recovery times


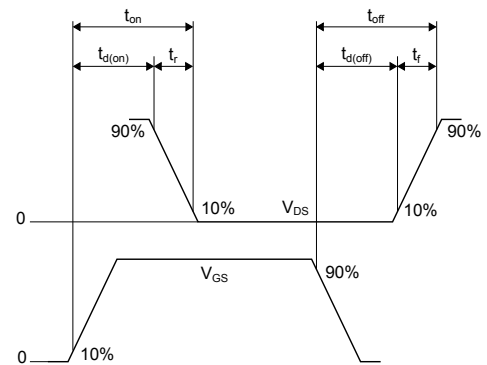
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform


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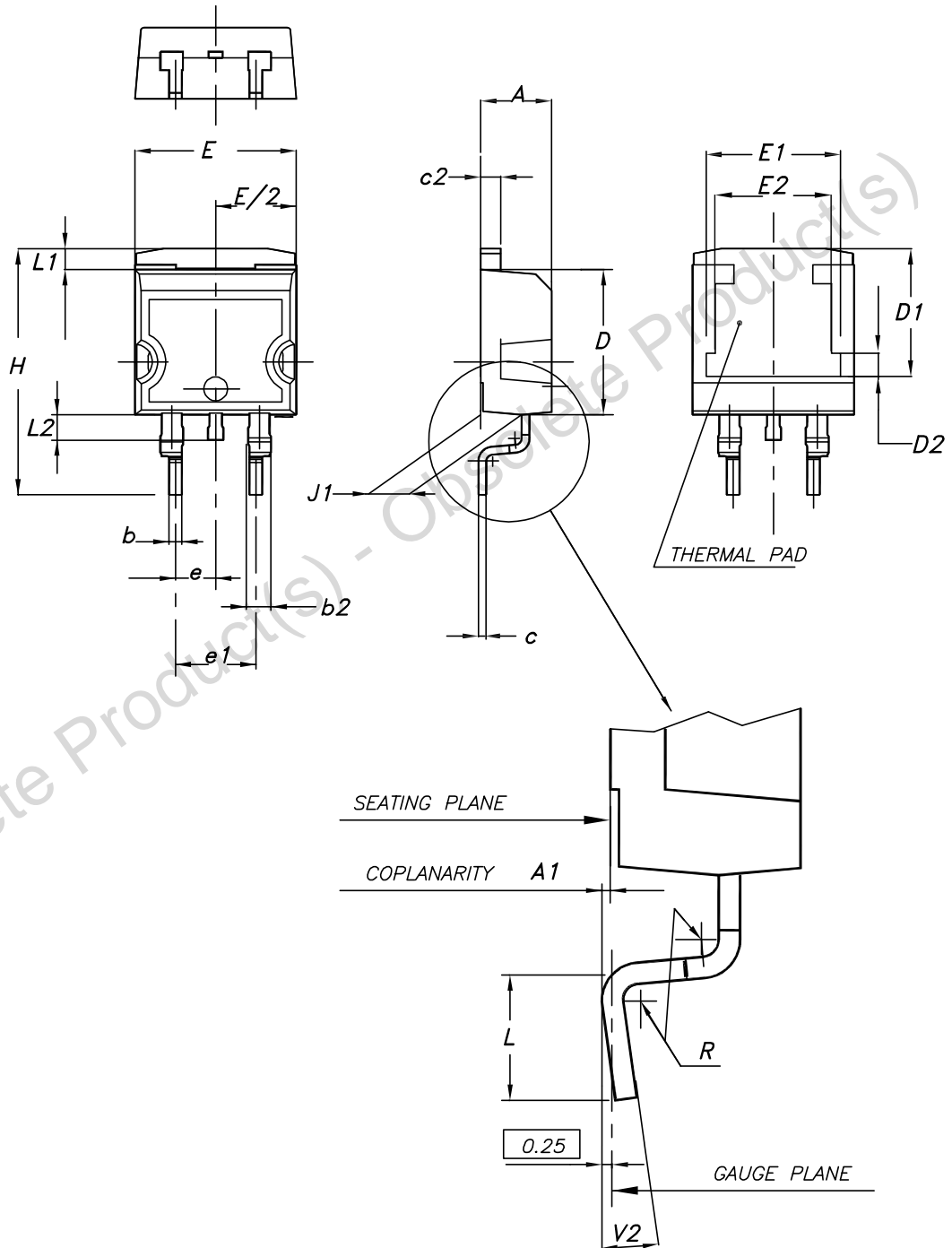
4 Package information

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. ECOPACK® is an ST trademark.

Obsolete Product(s) - Obsolete Product(s)

4.1 D²PAK (TO-263) type A package information

Figure 19. D²PAK (TO-263) type A package outline

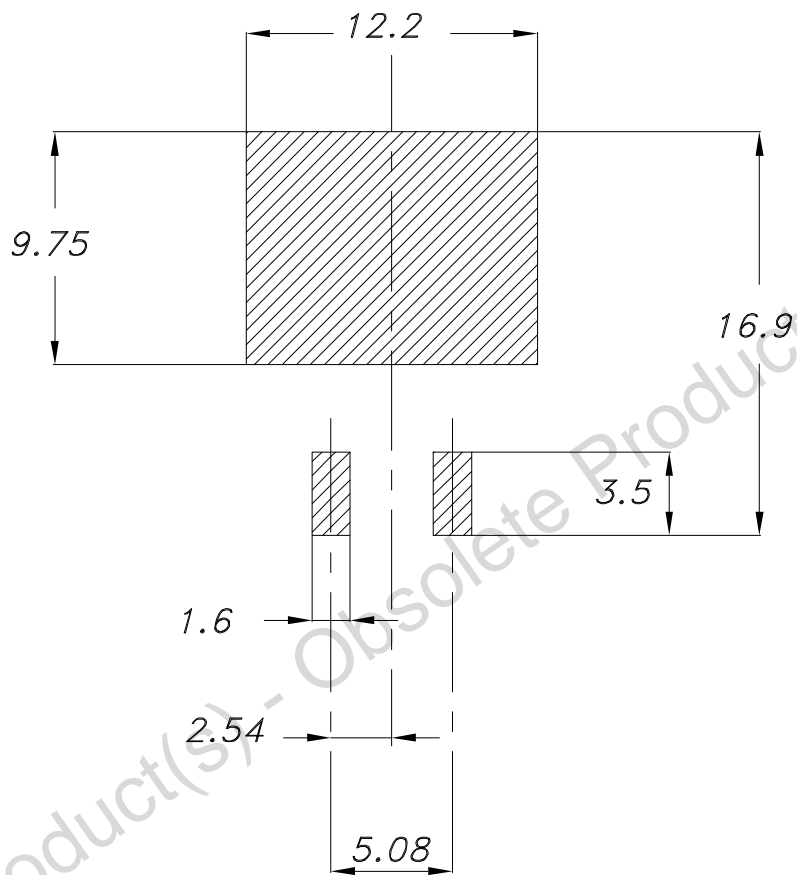


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Table 9. D²PAK (TO-263) type A package mechanical data

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°

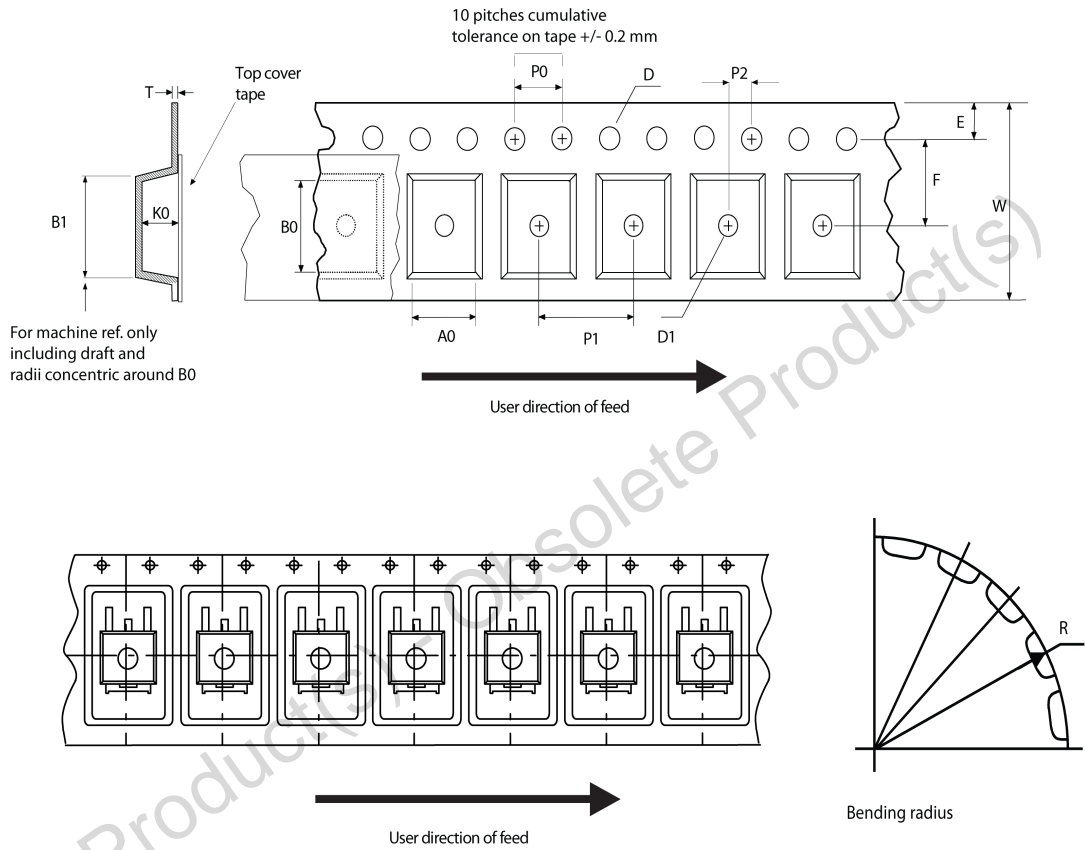
Figure 20. D²PAK (TO-263) recommended footprint (dimensions are in mm)



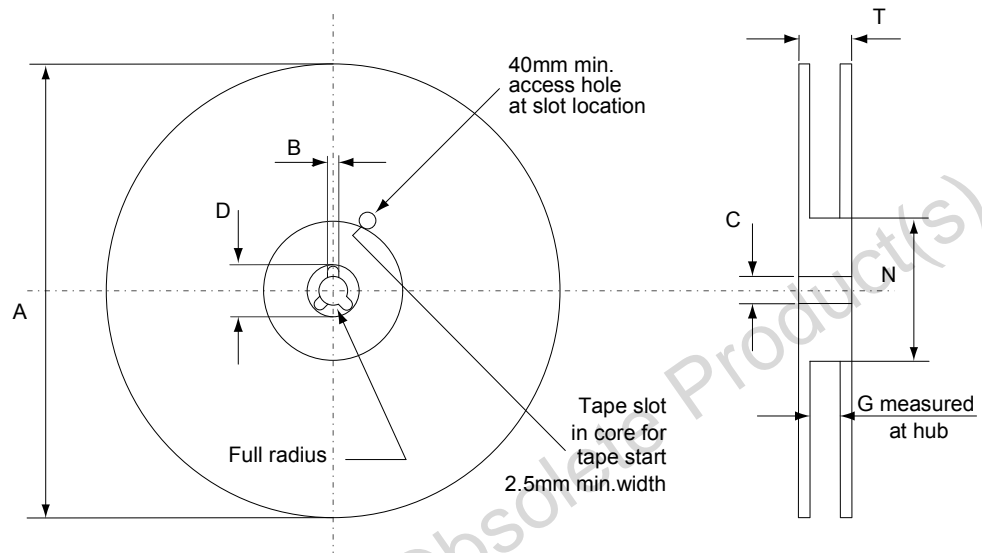
Footprint

4.2 D²PAK packing information

Figure 21. D²PAK tape outline



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Figure 22. D²PAK reel outline


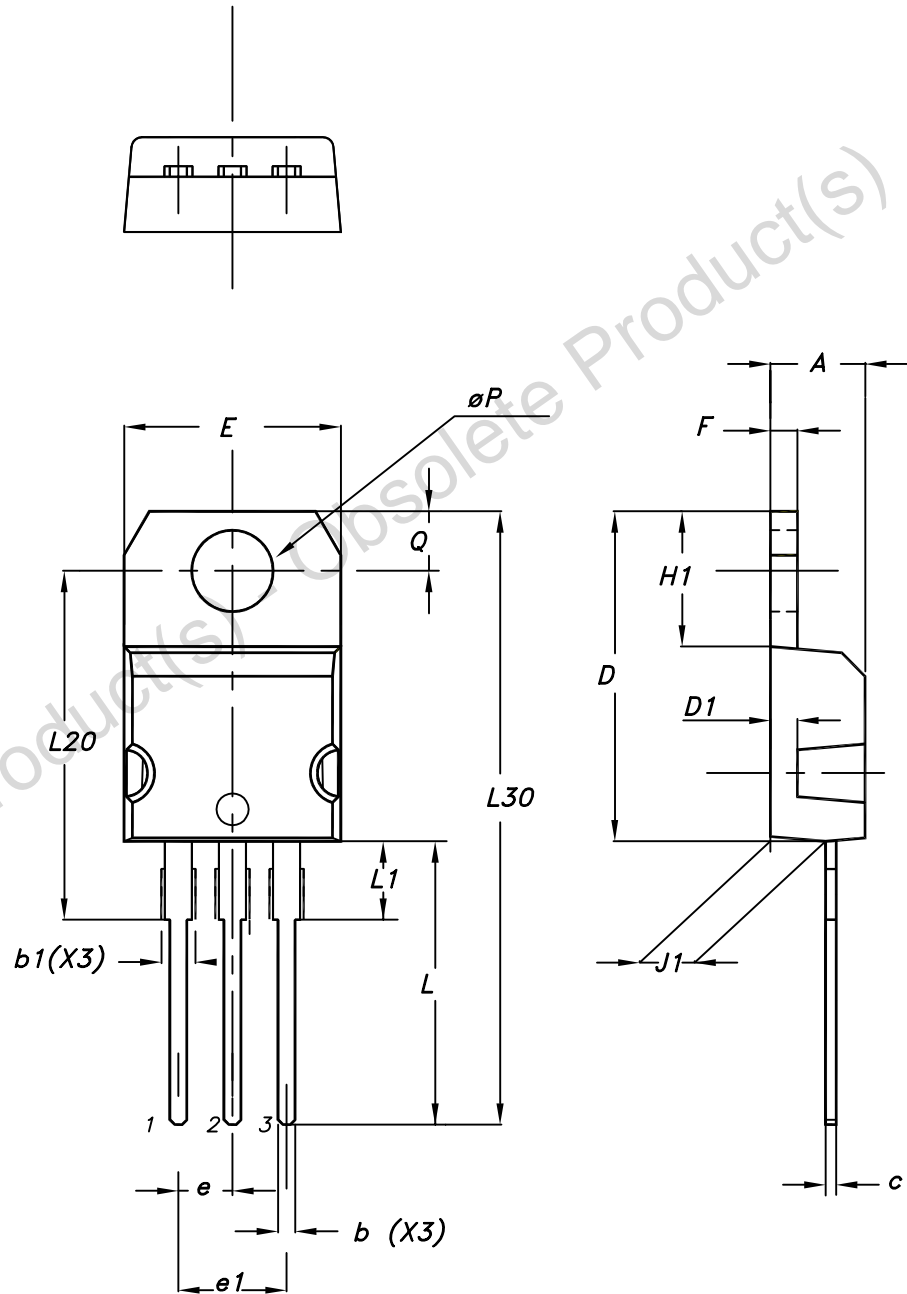
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Table 10. D²PAK tape and reel mechanical data

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 TO-220 type A package information

Figure 23. TO-220 type A package outline



0015988_typeA_Rev_21

Table 11. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

5 Ordering information

Table 12. Order codes

Order code	Marking	Package	Packing
STB5N52K3	5N52K3	D ² PAK	Tape and reel
STP5N52K3		TO-220	Tube

Obsolete Product(s) - Obsolete Product(s)

Revision history

Table 13. Document revision history

Date	Version	Changes
05-Sep-2018	1	First release. Part numbers previously included in datasheet DocID16952.

Obsolete Product(s) - Obsolete Product(s)

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