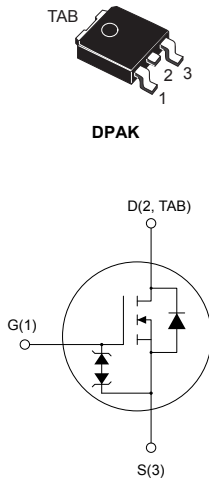


N-channel 800 V, 3.6 Ω typ., 2.5 A SuperMESH Power MOSFET in a DPAK package



AM01476v1_tab


Product status link
[STD3NK80ZT4](#)
Product summary

Order code	STD3NK80ZT4
Marking	D3NK80Z
Package	DPAK
Packing	Tape and reel

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STD3NK80ZT4	800 V	4.5 Ω	2.5 A

- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

Applications

- Switching applications

Description

This high-voltage device is a Zener-protected N-channel Power MOSFET developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, this device is designed to ensure a high level of dv/dt capability for the most demanding applications.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	800	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.57	
$I_{DM}^{(1)}$	Drain current (pulsed)	10	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
ESD	Gate-source, human body model ($R = 1.5\text{ k}\Omega$, $C = 100\text{ pF}$)	2	kV
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 2.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DS} (\text{Peak}) < V_{(BR)DSS}$, $V_{DD} = 640\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.78	$^\circ\text{C}/\text{W}$
$R_{thJA}^{(1)}$	Thermal resistance, junction-to-ambient	50	$^\circ\text{C}/\text{W}$

1. When mounted on an 1-inch² FR-4, 2 Oz copper board.

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width is limited by T_J max.)	2.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	170	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	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V}, T_C = 125\text{ °C}^{(1)}$			50	
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	$V_{GS} = 10\text{ V}, I_D = 1.25\text{ A}$		3.6	4.5	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$	-	485	-	pF
C_{oss}	Output capacitance		-	57	-	pF
C_{rSS}	Reverse transfer capacitance		-	11	-	pF
$C_{oss\ eq}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }640\text{ V}$	-	22	-	pF
Q_g	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 2.5\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	19	-	nC
Q_{gs}	Gate-source charge		-	3.2	-	nC
Q_{gd}	Gate-drain charge		-	10.8	-	nC

1. $C_{oss\ eq}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80%.

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}, I_D = 1.25\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	17	-	ns
t_r	Rise time		-	27	-	ns
$t_{d(off)}$	Turn-off delay time		-	36	-	ns
t_f	Fall time		-	40	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		2.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		10	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2.5 \text{ A}$, $V_{GS} = 0 \text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 2.5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$	-	384		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 50 \text{ V}$	-	1.6		μC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	8.4		A
t_{rr}	Reverse recovery time	$I_{SD} = 2.5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$,	-	474		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 50 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$	-	2.1		μC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	8.8		A

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.
2. Pulse width is limited by safe operating area.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

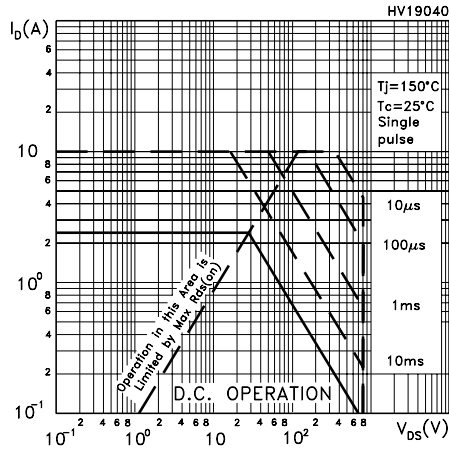


Figure 2. Thermal impedance

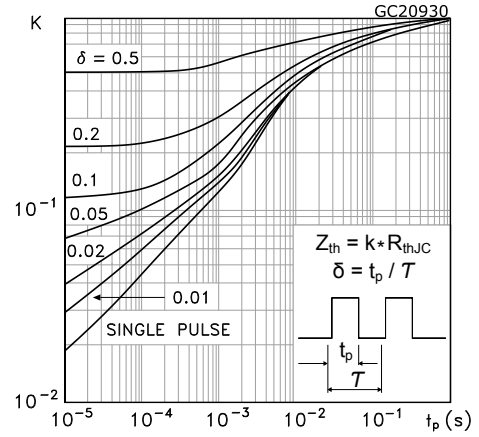


Figure 3. Output characteristics

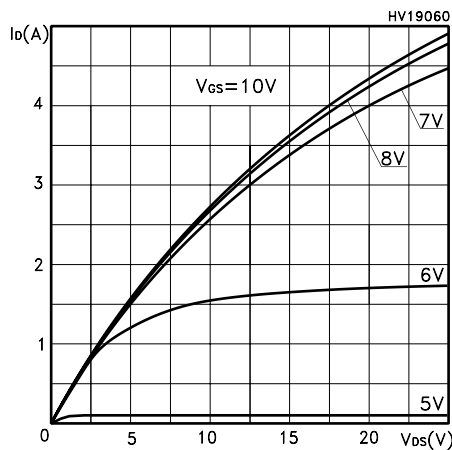


Figure 4. Transfer characteristics

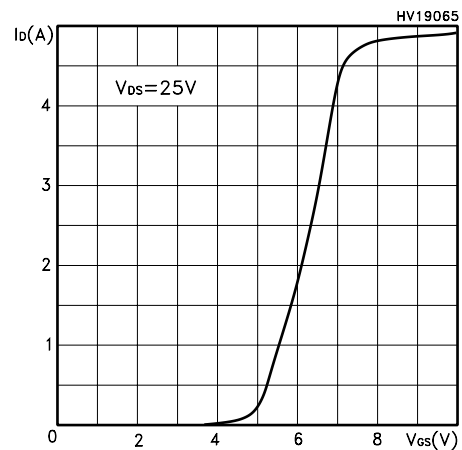


Figure 5. Static drain-source on-resistance

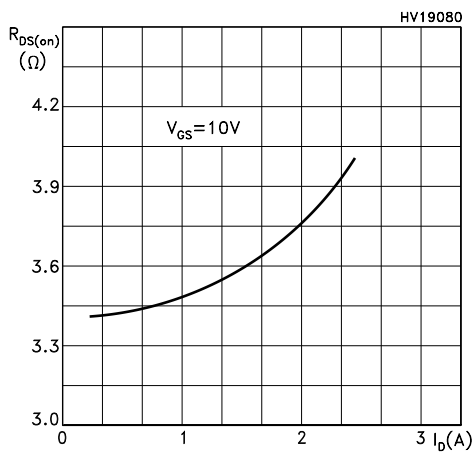


Figure 6. Gate charge vs gate-source voltage

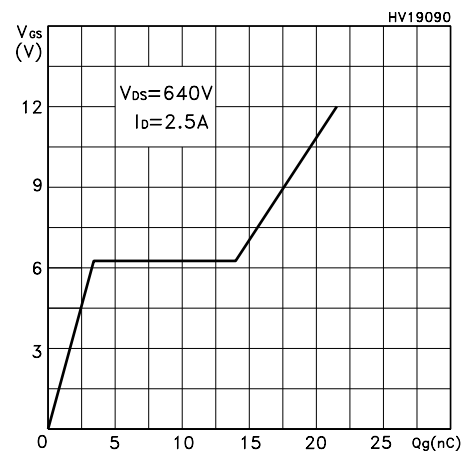


Figure 7. Capacitance variations

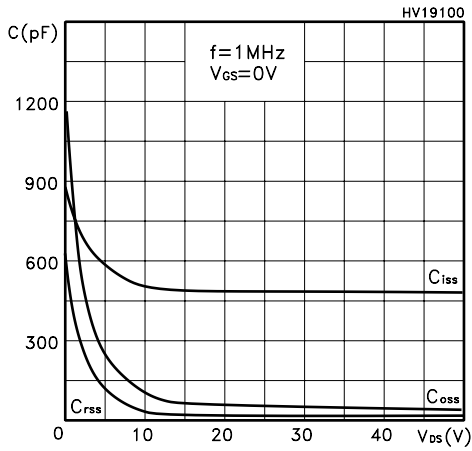


Figure 8. Normalized gate threshold voltage vs temperature

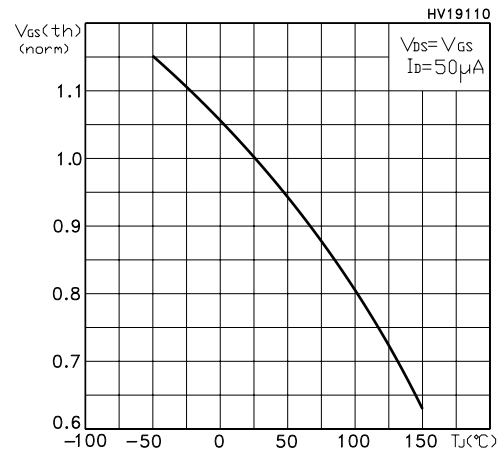


Figure 9. Normalized on-resistance vs temperature

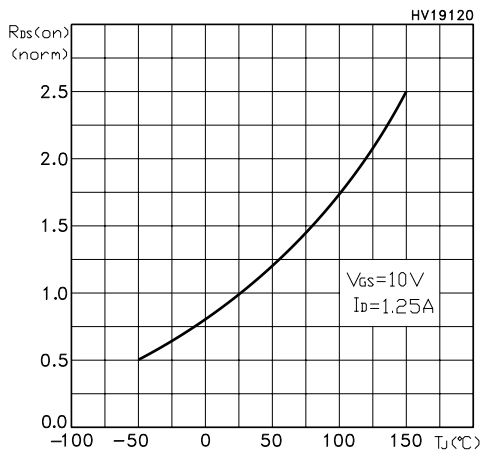


Figure 10. Source-drain diode forward characteristics

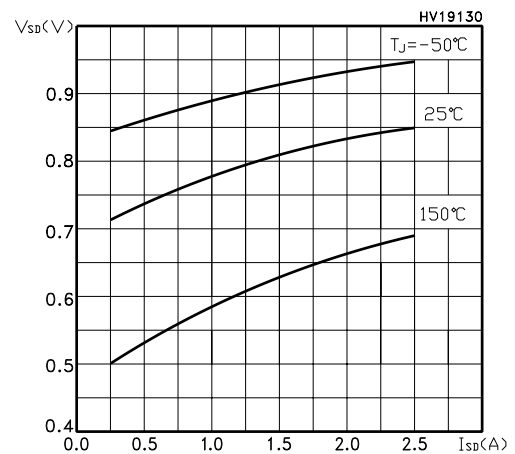


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

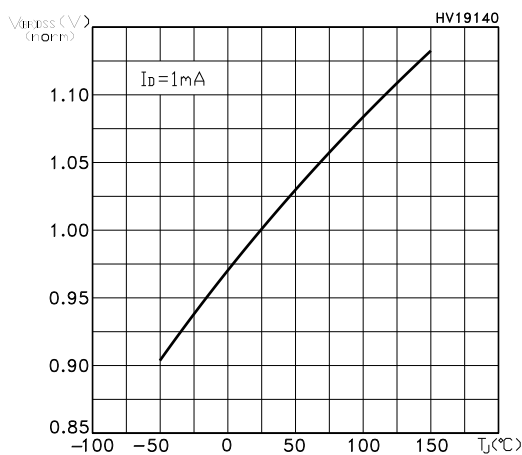
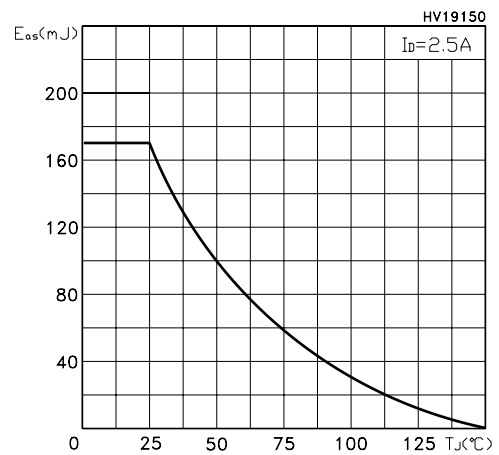


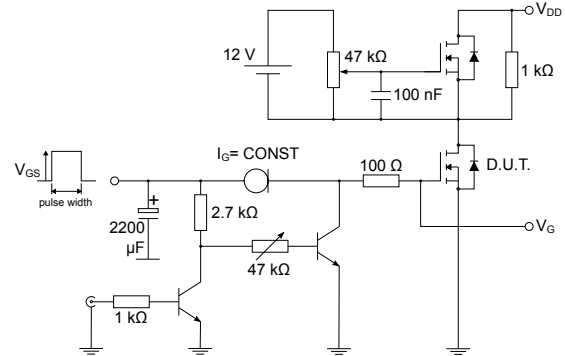
Figure 12. Maximum avalanche energy vs temperature



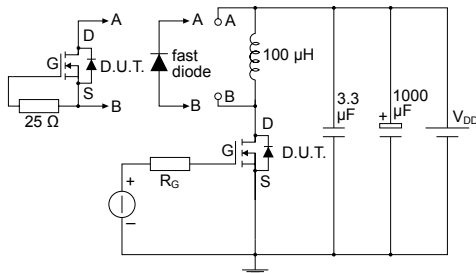
3 Test circuits

Figure 13. Test circuit for resistive load switching times


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Figure 14. Test circuit for gate charge behavior


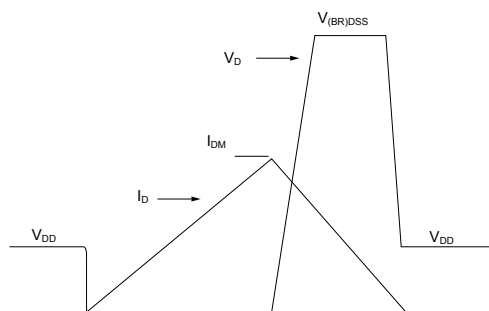
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Figure 15. Test circuit for inductive load switching and diode recovery times


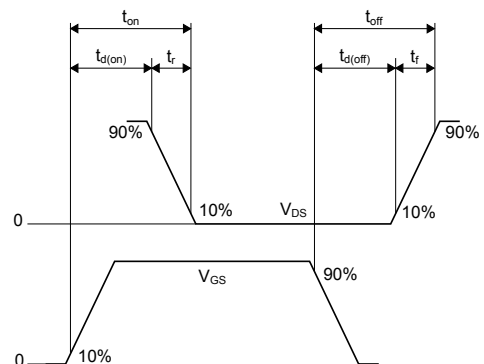
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform


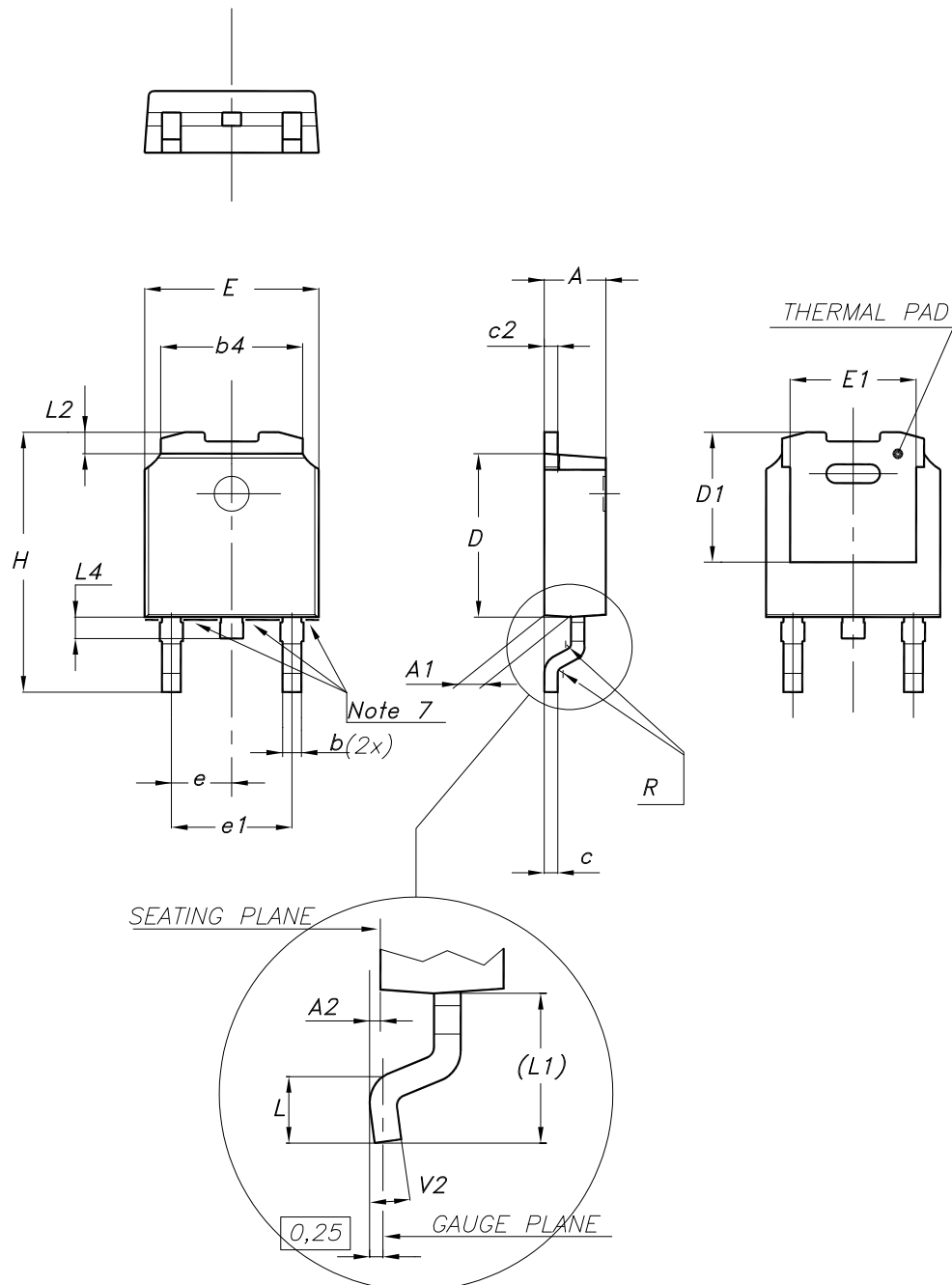
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4 Package information

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.

4.1 DPAK (TO-252) type A package information

Figure 19. DPAK (TO-252) type A package outline



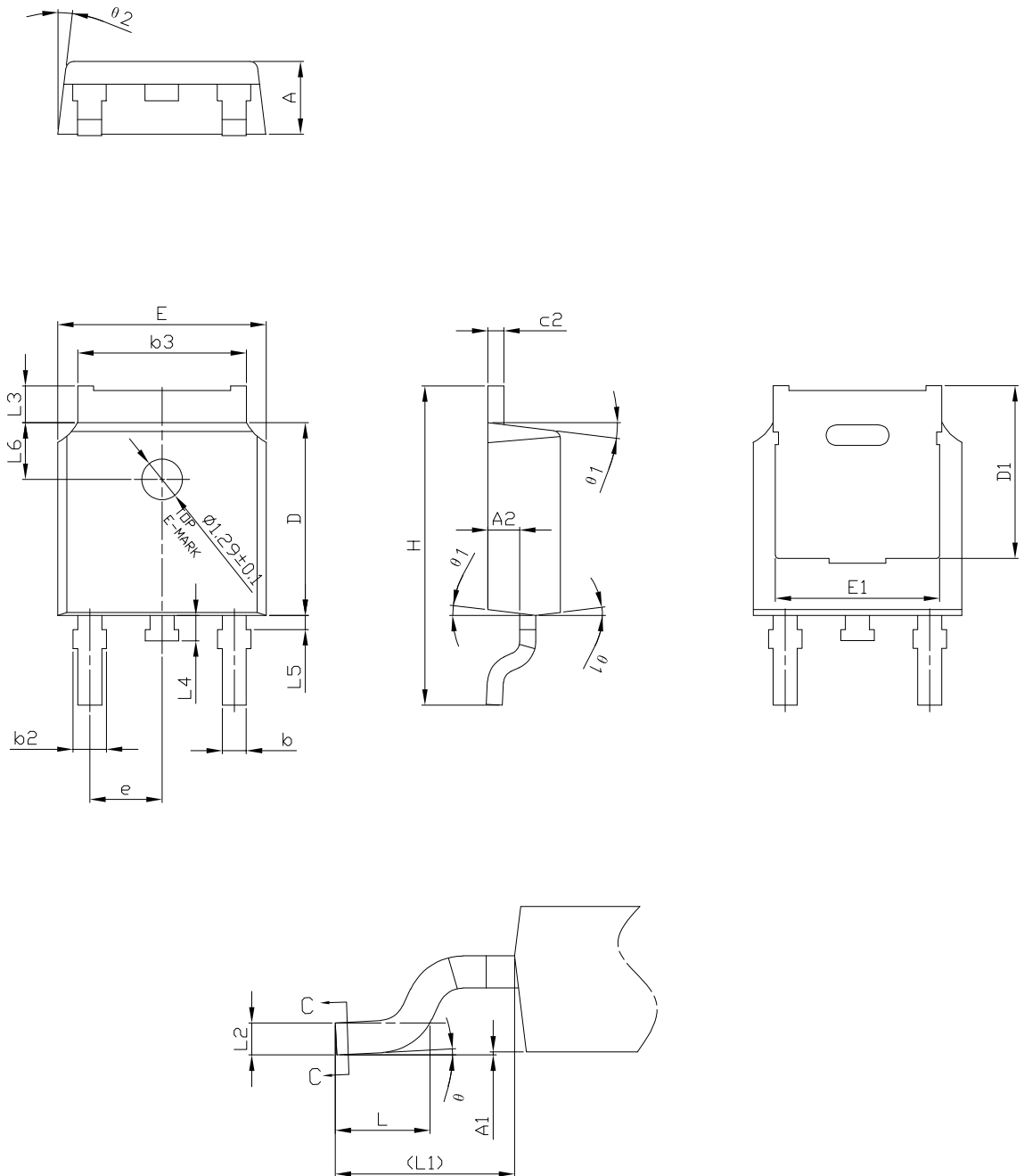
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Table 8. DPAK (TO-252) type A mechanical data

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	4.60	4.70	4.80
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 C3 package information

Figure 20. DPAK (TO-252) type C3 package outline



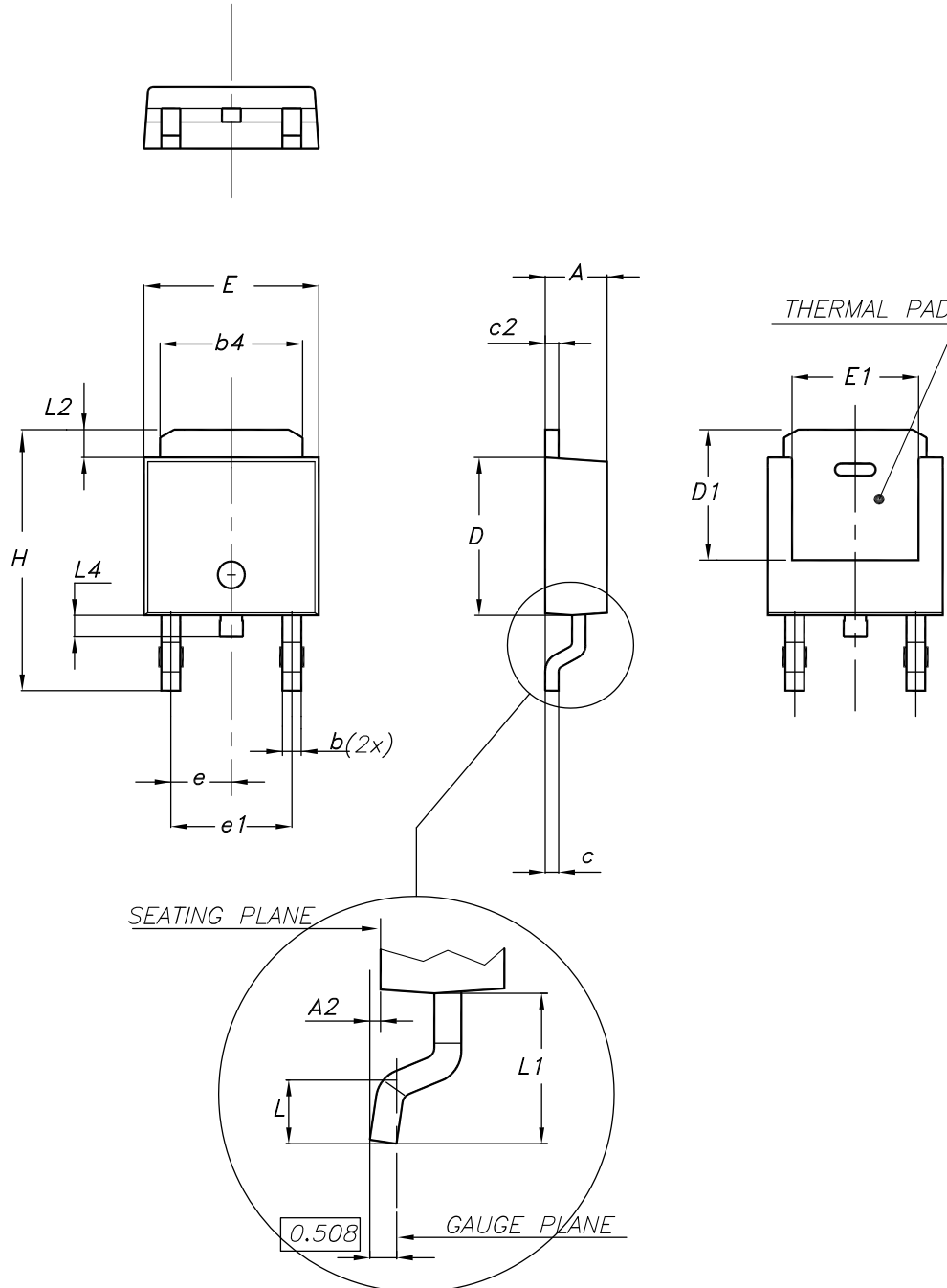
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Table 9. DPAK (TO-252) type C3 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.00		0.10
A2	0.90	1.01	1.10
b	0.72		0.85
b2	0.72		1.10
b3	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.20	5.45	5.70
E	6.50	6.60	6.70
E1	5.00	5.20	5.40
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	0.51 BSC		
L3	0.90		1.25
L4	0.60	0.80	1.00
L5	0.15		0.75
L6	1.80 REF		
θ	0°		8°
θ1	5°	7°	9°
θ2	5°	7°	9°

4.3 DPAK (TO-252) type E package information

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

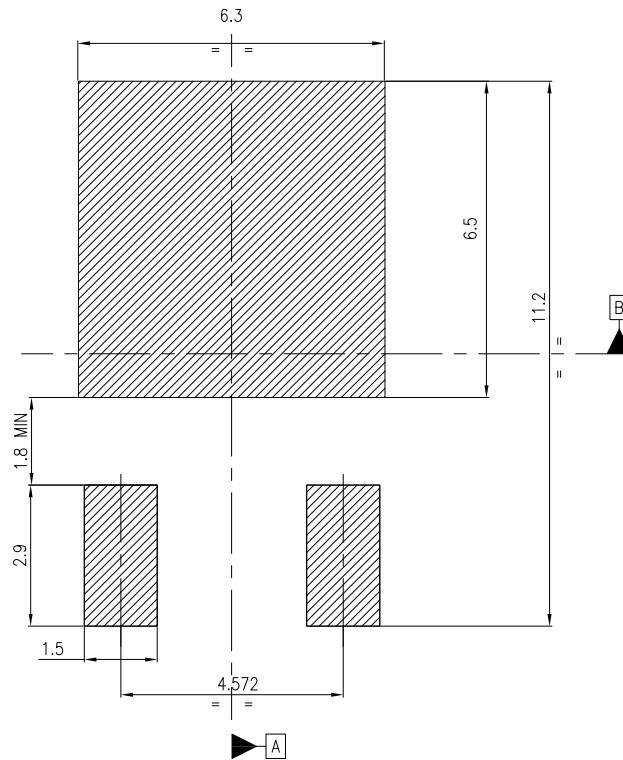


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Table 10. DPAK (TO-252) type E mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

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



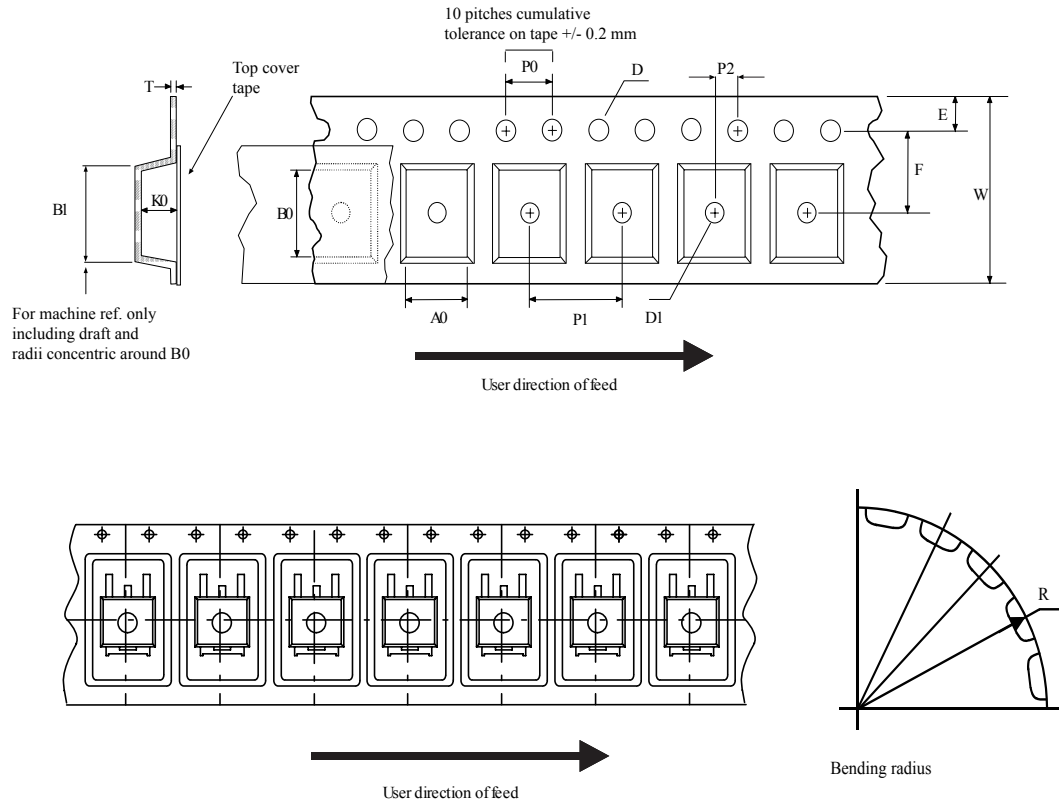
Notes:

- 1) This footprint is able to ensure insulation up to 630 Vrms (according to CEI IEC 664-1)
- 2) The device must be positioned within $\oplus 0.05$ A B

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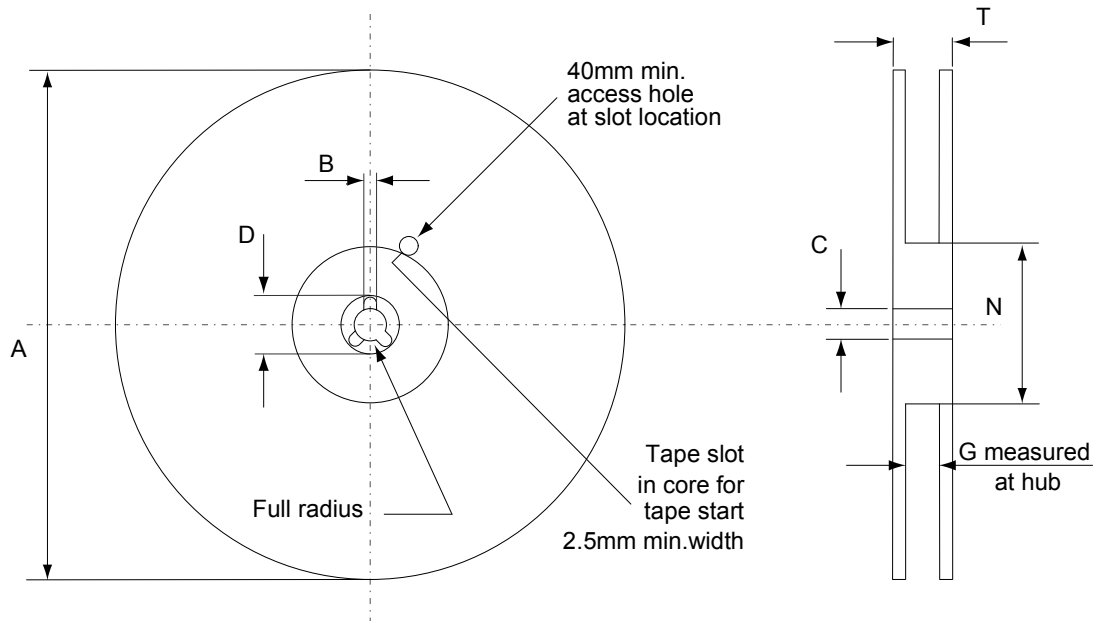
4.4 DPAK (TO-252) packing information

Figure 23. DPAK (TO-252) tape outline



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Figure 24. DPAK (TO-252) reel outline



AM06038v1

Table 11. DPAK (TO-252) tape and reel mechanical data

Dim.	Tape		Dim.	Reel	
	mm			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
09-Sep-2004	3	Complete document
10-Aug-2006	4	New template, no content change
26-Feb-2009	5	Updated mechanical data
07-Sep-2009	6	$V_{ESD(G-S)}$ value has been corrected
06-Apr-2017	7	Updated <i>Section 1: "Electrical ratings"</i> , <i>Section 2: "Electrical characteristics"</i> and <i>Section 4: "Package information"</i> . Minor text changes.
27-Jun-2023	8	The part numbers STD3NK80Z-1, STF3NK80Z and STP3NK80Z have been moved to a separate datasheet and the document has been updated accordingly. Updated <i>Table 4. On /off states</i> and removed " <i>Table 9. Gate-source Zener diode</i> ". Updated <i>Section 4.1 DPAK (TO-252) type A package information</i> , <i>Section 4.3 DPAK (TO-252) type E package information</i> and replaced " <i>Section 4.2.2 DPAK (TO-252) type C2 package information</i> " with <i>Section 4.2 DPAK (TO-252) type C3 package information</i> . Minor text changes.

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