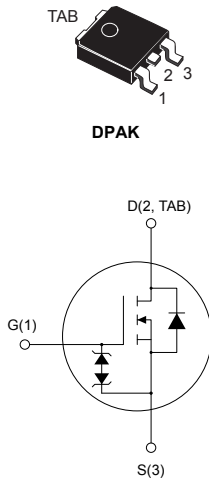


## N-channel 400 V, 0.85 $\Omega$ typ., 5.4 A SuperMESH Power MOSFET in a DPAK package



AM01476v1\_tab



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STD7NK40ZT4	400 V	1 $\Omega$	5.4 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.

#### Product status link

[STD7NK40ZT4](#)

#### Product summary

<b>Order code</b>	STD7NK40ZT4
<b>Marking</b>	D7NK40Z
<b>Package</b>	DPAK
<b>Packing</b>	Tape and reel

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	400	V
$V_{DGR}$	Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )	400	V
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	5.4	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3.4	
$I_{DM}^{(1)}$	Drain current (pulsed)	21.6	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
ESD	Gate-source, human body model ( $R = 1.5\text{ k}\Omega$ , $C = 100\text{ pF}$ )	3	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.  $I_{SD} \leq 5.4\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} < V_{(BR)DSS}$ .

**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-inch<sup>2</sup> 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.)	5.4	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	130	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	$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$	400			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 400\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 400\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			50	
$I_{GSS}$	Gate body leakage current	$V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	3.00	3.75	4.50	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 2.7\text{ A}$		0.85	1	$\Omega$

1. Specified by design, not tested in production.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	535		pF
$C_{oss}$	Output capacitance		-	82		pF
$C_{riss}$	Reverse transfer capacitance		-	18		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }320\text{ V}$	-	53		pF
$Q_g$	Total gate charge	$V_{DD} = 320\text{ V}$ , $I_D = 5.4\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	19	26	nC
$Q_{gs}$	Gate-source charge		-	4		nC
$Q_{gd}$	Gate-drain charge		-	10		nC

1.  $C_{oss\text{ eq.}}$  is defined as the 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	$V_{DD} = 200\text{ V}$ , $I_D = 2.7\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	15	-	ns
$t_r$	Rise time		-	15	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	30	-	ns
$t_f$	Fall time		-	12	-	ns
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 320\text{ V}$ , $I_D = 5.4\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	12	-	ns
$t_f$	Fall time		-	10	-	ns
$t_c$	Crossover time	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	20	-	ns

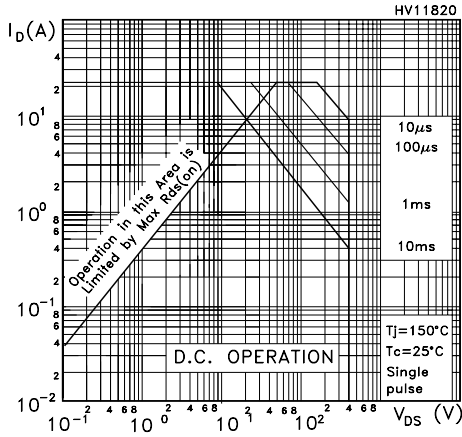
**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		5.4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		21.6	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5.4 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 5.4 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	220		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 50 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$	-	990		nC
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	9		A

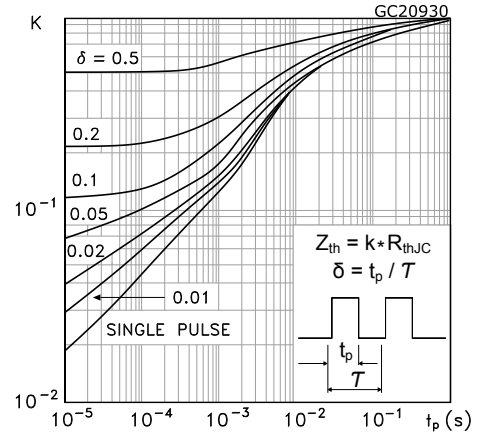
1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.
2. Pulse width is limited by safe operating area.

## 2.1 Electrical characteristics (curves)

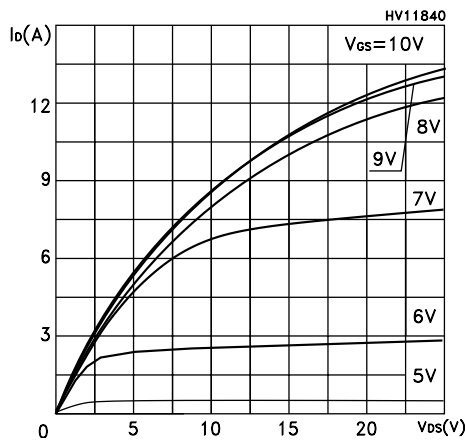
**Figure 1. Safe operating area**



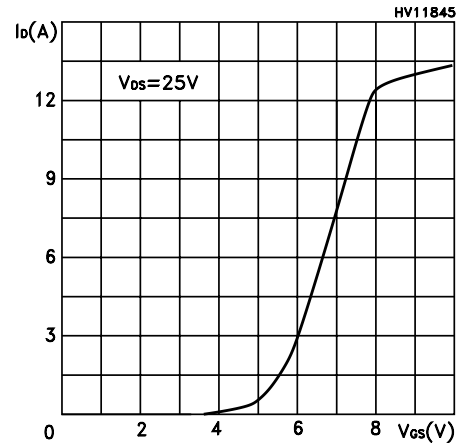
**Figure 2. Thermal impedance**



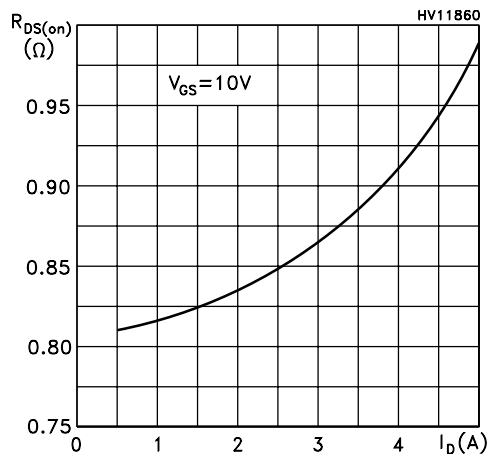
**Figure 3. Output characteristics**



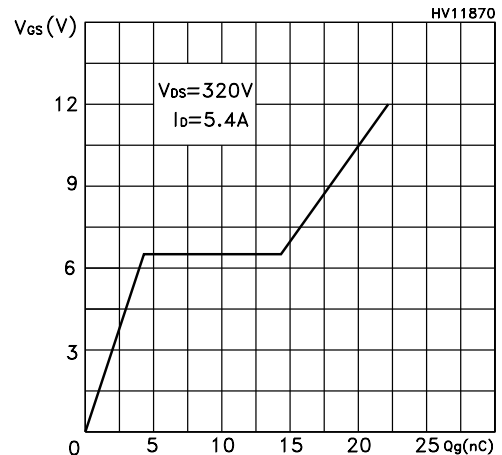
**Figure 4. Transfer characteristics**



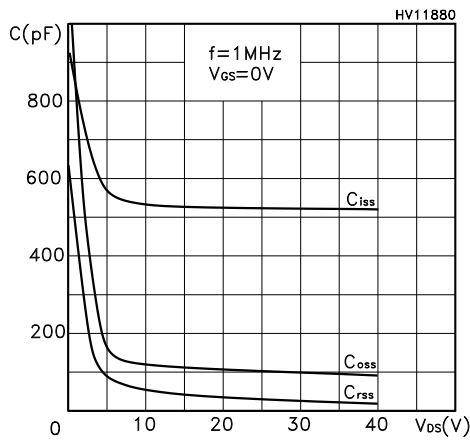
**Figure 5. Static drain-source on-resistance**



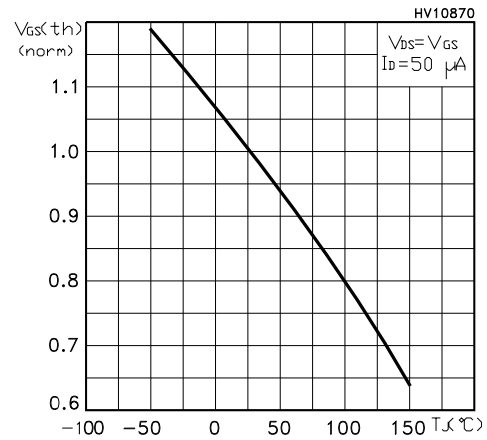
**Figure 6. Gate charge vs gate-source voltage**



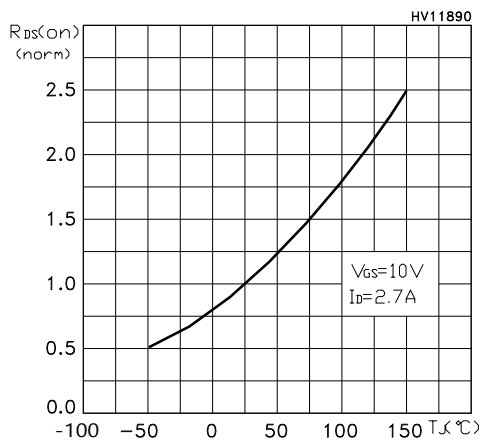
**Figure 7. Capacitance variations**



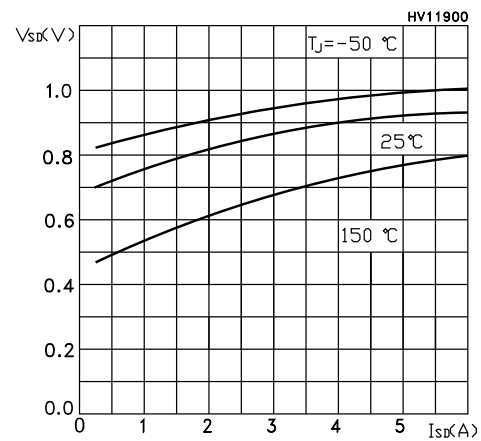
**Figure 8. Normalized gate threshold voltage vs temperature**



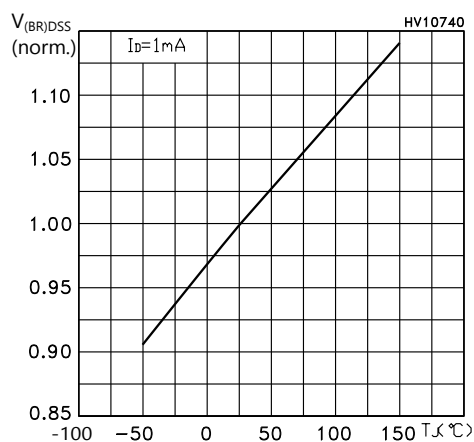
**Figure 9. Normalized on-resistance vs temperature**



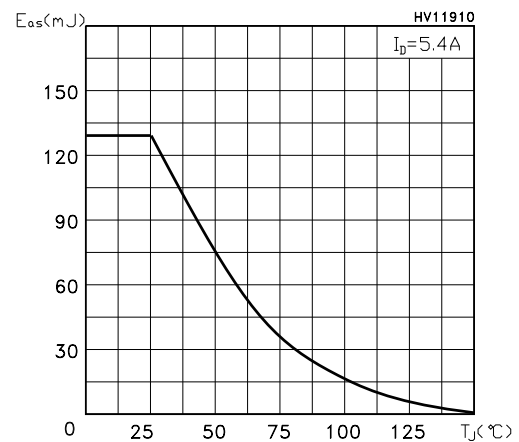
**Figure 10. Source-drain diode forward characteristics**



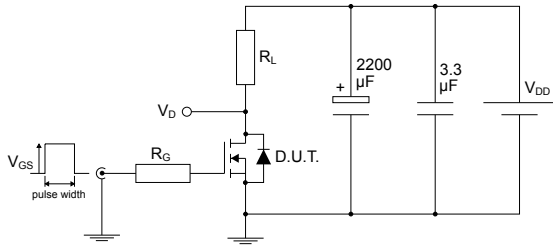
**Figure 11. Normalized V<sub>(BR)DSS</sub> vs temperature**



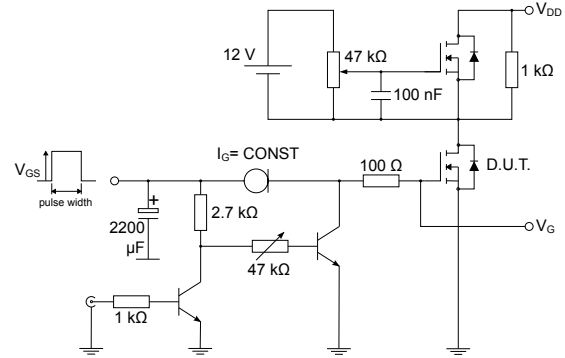
**Figure 12. Maximum avalanche energy vs temperature**



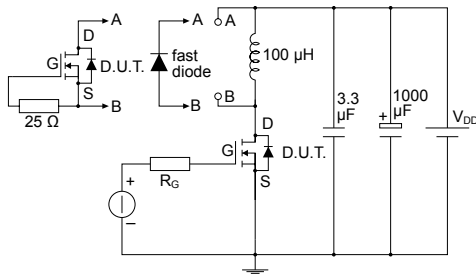
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


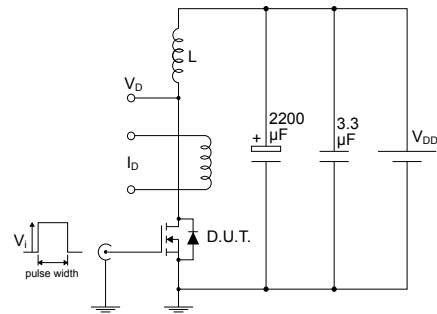
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**Figure 14. Test circuit for gate charge behavior**


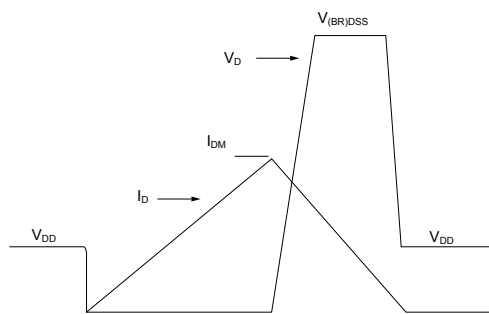
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


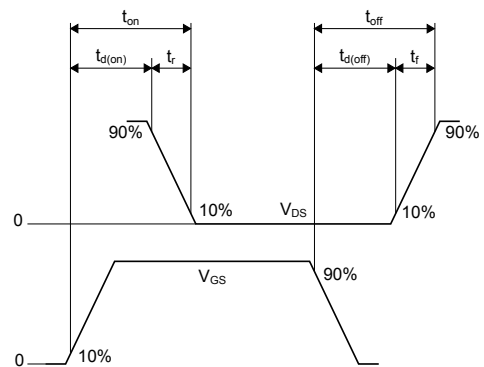
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


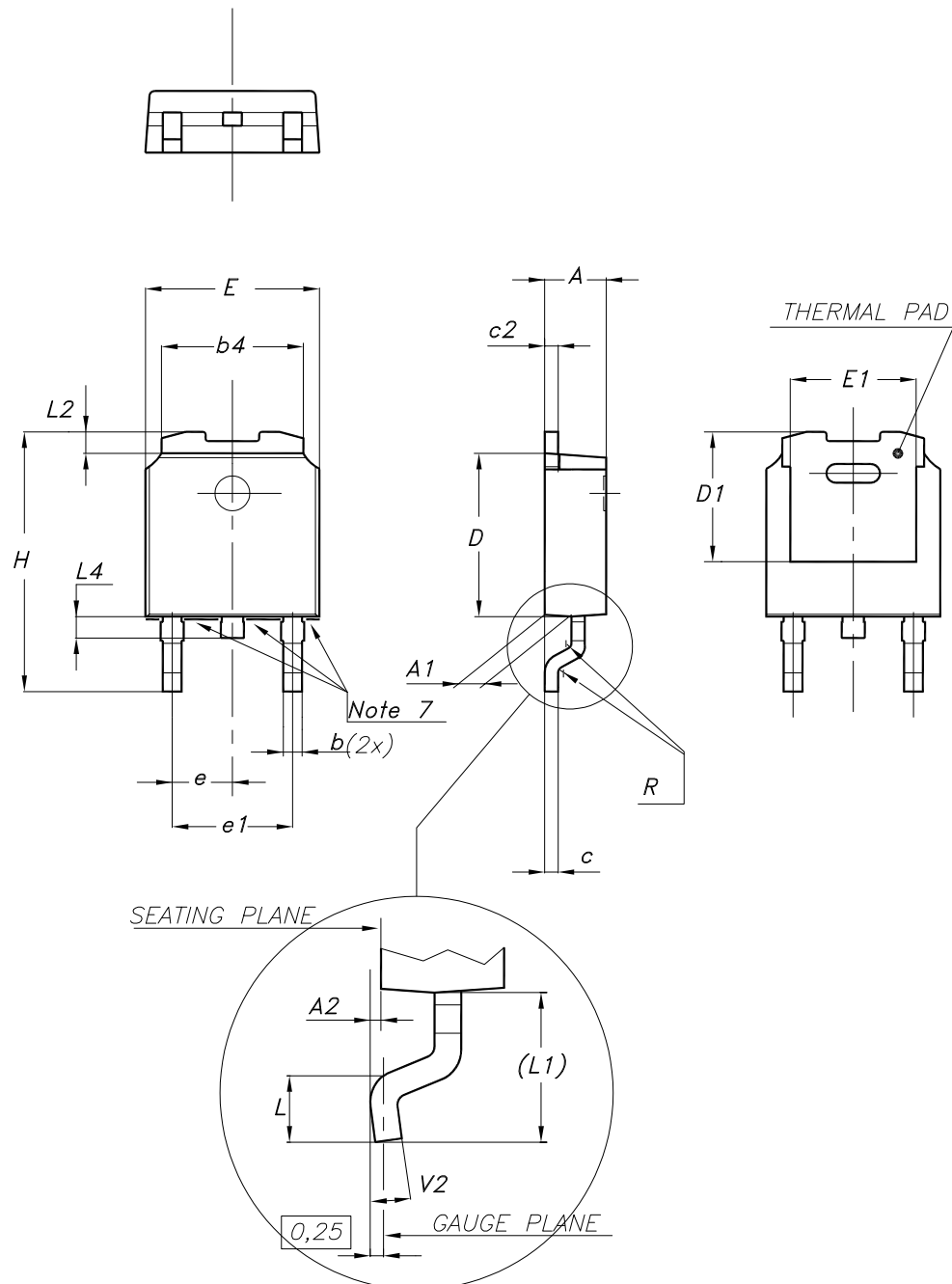
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## 4 Package information

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](http://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



0068772\_A\_34

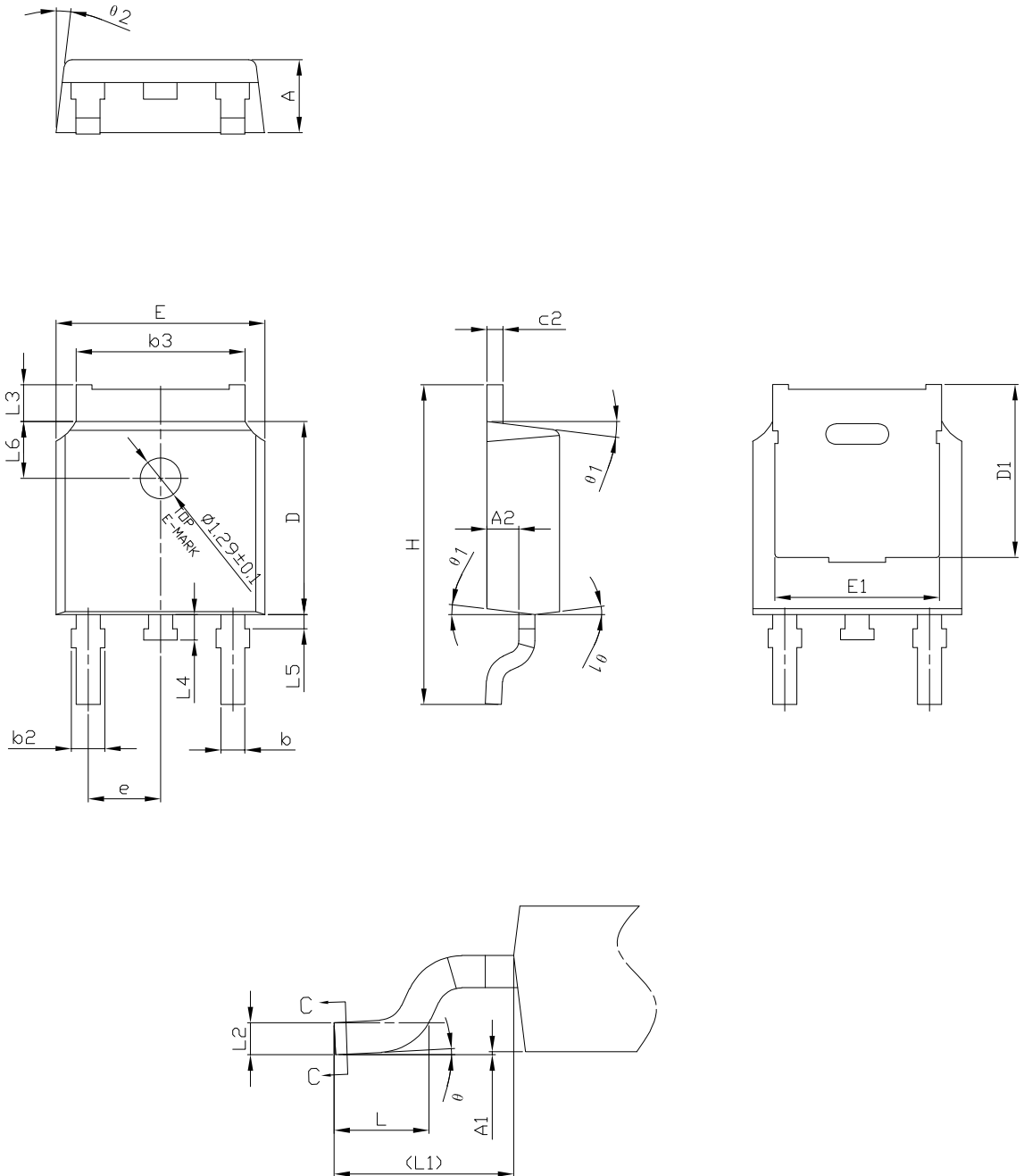


**Table 8. DPAK (TO-252) type A mechanical data**

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



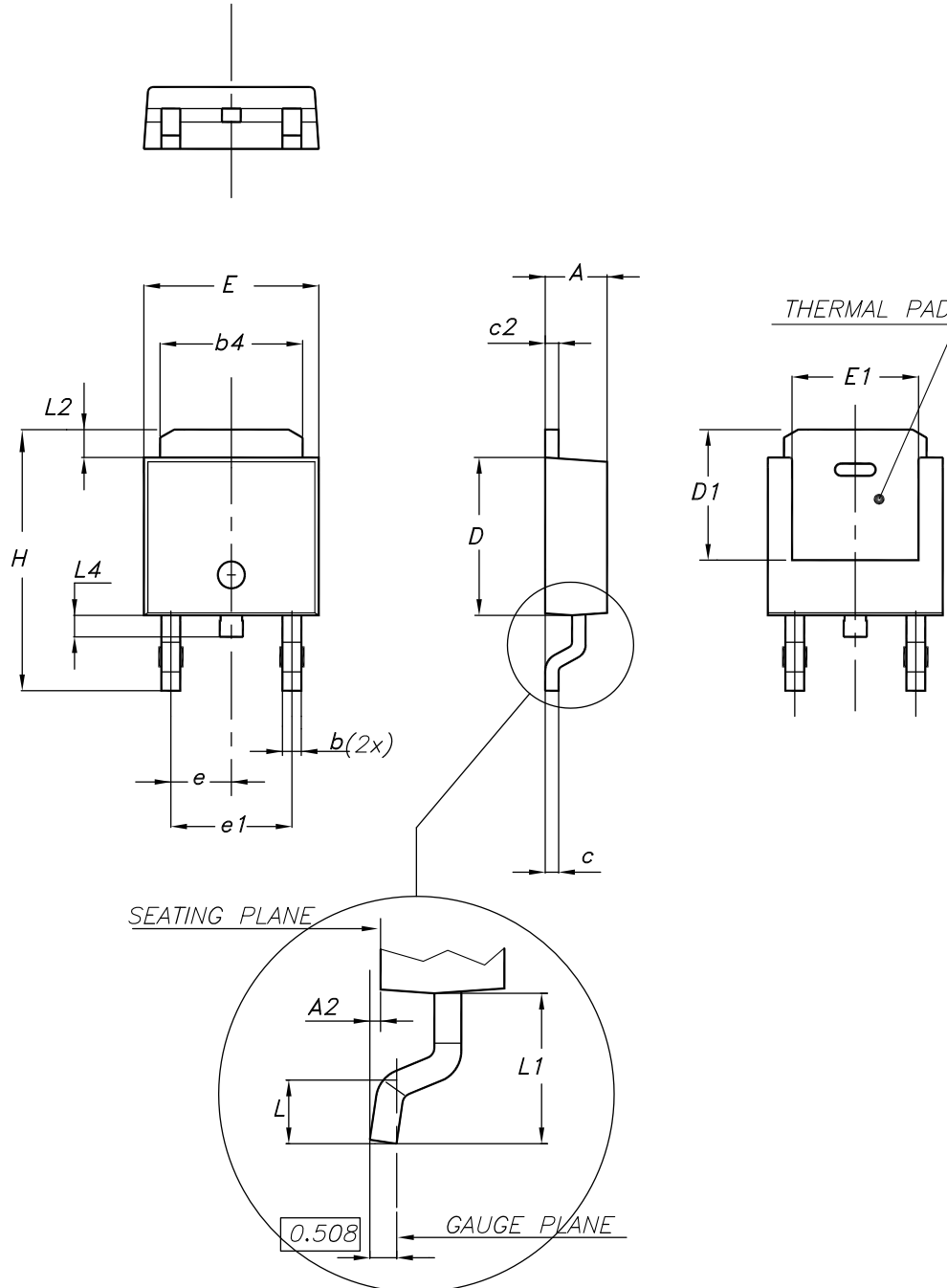
0068772\_type-C3\_rev34

**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

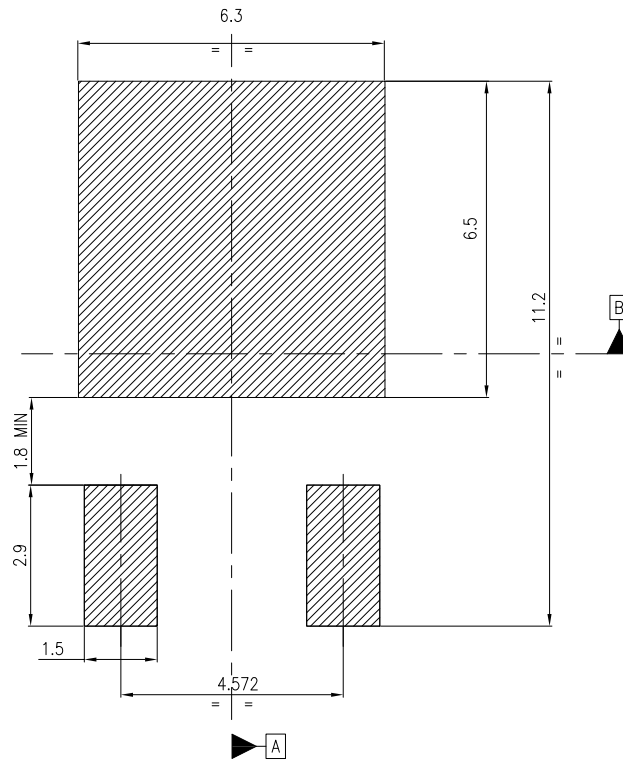


0068772\_typeE\_rev.34

**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)**



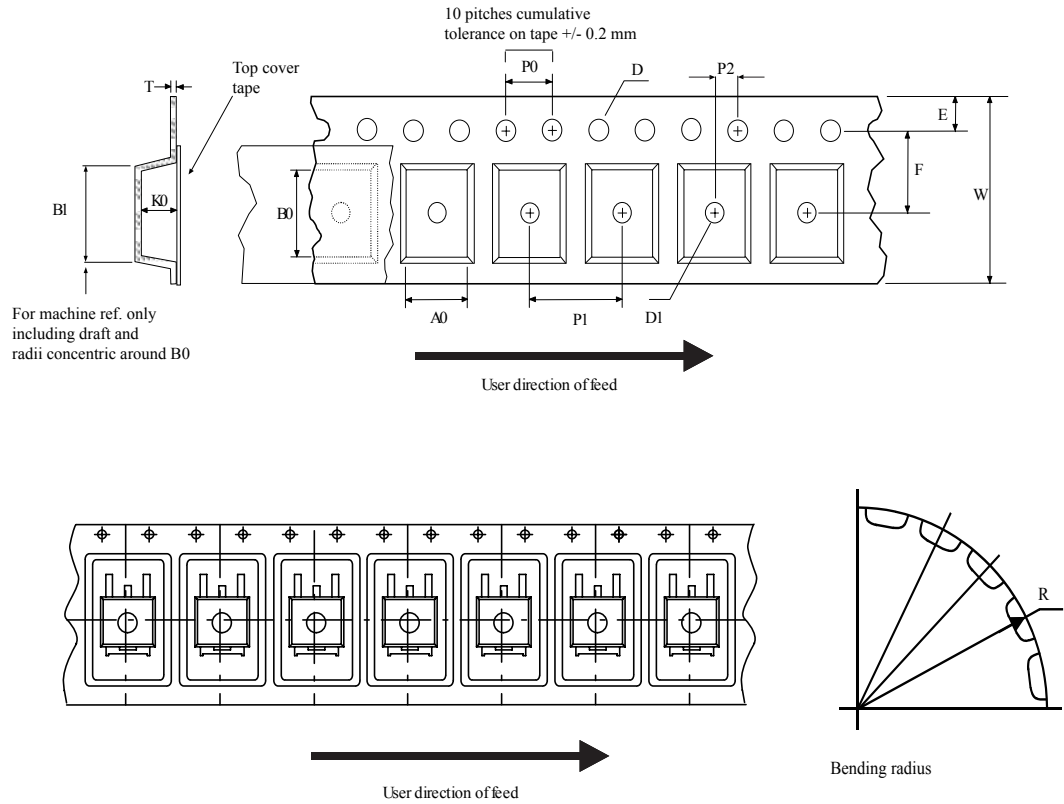
Notes:

- 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

FP\_0068772\_34

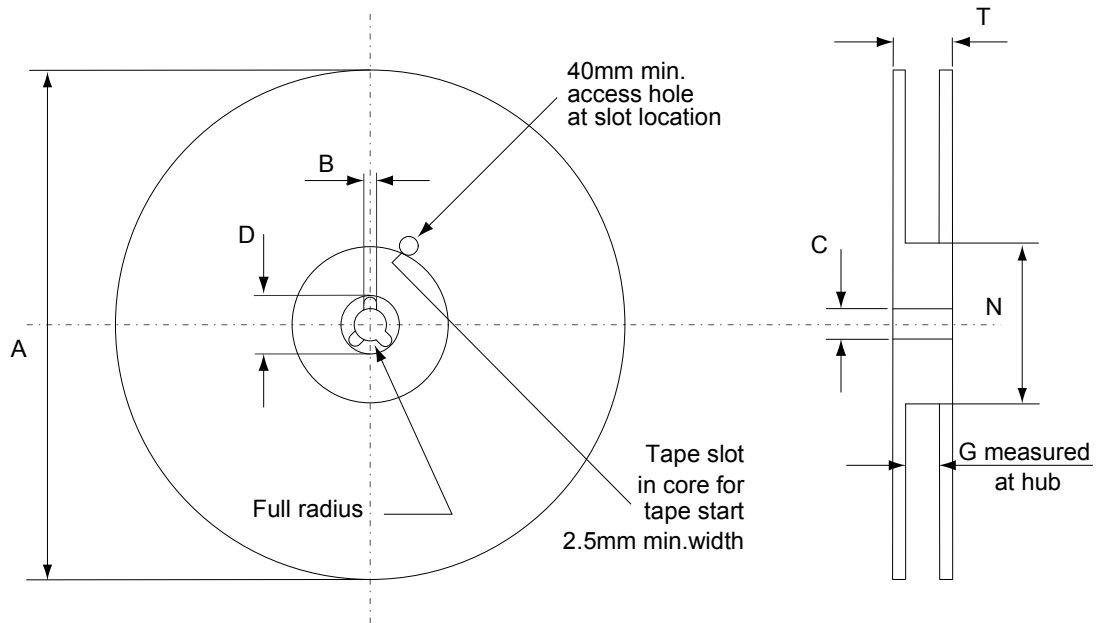
## 4.4 DPAK (TO-252) packing information

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**

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
02-Sep-2002	2	Document updated.
11-Jul-2018	3	Part number STD7NK40Z-1 was moved to a separate datasheet, and the document was updated accordingly. Updated title, features, applications and description on cover page. Updated <i>Section 1 Electrical ratings</i> , <i>Section 2 Electrical characteristics</i> , <i>Section 3 Test circuits</i> and <i>Section 4 Package information</i> . Minor text changes
23-May-2023	4	The part numbers STP7NK40Z and STP7NK40ZFP have been moved to a separate datasheet and the document has been updated accordingly. Removed " <i>Table 8. 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 added <i>Section 4.2 DPAK (TO-252) type C3 package information</i> . Minor text changes.
24-May-2023	5	Updated <b>Features</b> on cover page.

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