STD3NK90ZT4

N-channel 900 V, 3.6 Ω typ., 3 A SuperMESH Power MOSFET in a DPAK package

DPAK

D(2, TAB)

G(1)

S(3)

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Features
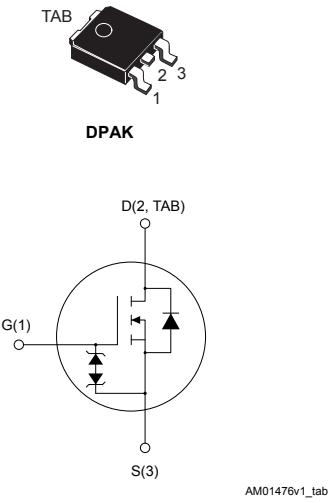
Order code	V$_{DS}$	R$_{DS(on)}$ max.	I$_D$
STD3NK90ZT4	900 V	4.8 Ω	3 A

- 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.

STPOWER

Product status link
STD3NK90ZT4

Product summary	
Order code	STD3NK90ZT4
Marking	D3NK90Z
Package	DPAK
Packing	Tape and reel

DS2980 - Rev 4 - August 2023
For further information contact your local STMicroelectronics sales office.

www.st.com

1 Electrical ratings

Table 1. **Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	900	V
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	3	A
	Drain current (continuous) at T_C = 100 °C	1.89	
I_{DM}[1]	Drain current (pulsed)	12	A
P_{TOT}	Total power dissipation at T_C = 25 °C	90	W
ESD	Gate-source, human body model (R = 1.5 kΩ, C = 100 pF)	4	kV
dv/dt[2]	Peak diode recovery voltage slope	4.5	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*

2. *I_{SD} ≤ 3 A, di/dt ≤ 200 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. **Thermal data**

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.38	°C/W
R_{thJA}[1]	Thermal resistance, junction-to-ambient	50	°C/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.)	3	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	180	mJ

2   Electrical characteristics

T_C = 25 °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 mA, V_{GS} = 0 V	900			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 900 V			1	µA
		V_{GS} = 0 V, V_{DS} = 900 V, T_C = 125 °C[1]			50	
I_{GSS}	Gate body leakage current	V_{GS} = ±20 V, V_{DS} = 0 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	3.00	3.75	4.50	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1.5 A		3.6	4.8	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_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	590	-	pF
C_{oss}	Output capacitance		-	63	-	pF
C_{rss}	Reverse transfer capacitance		-	13	-	pF
$C_{oss\ eq.}$[1]	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 720 V	-	35	-	pF
Q_g	Total gate charge	V_{DD} = 720 V, I_D = 3 A, V_{GS} = 0 to 10 V	-	22.7	-	nC
Q_{gs}	Gate-source charge	(see Figure 14. Test circuit for gate charge behavior)	-	4.2	-	nC
Q_{gd}	Gate-drain charge		-	12	-	nC

1. *$C_{oss\ eq.}$ 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} = 450 V, I_D = 1.5 A,	-	18	-	ns
t_r	Rise time	R_G = 4.7 Ω, V_{GS} = 10 V	-	7	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and	-	45	-	ns
t_f	Fall time	Figure 18. Switching time waveform)	-	18	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3	A
I_{SDM}[1]	Source-drain current (pulsed)		-		12	A
V_{SD}[2]	Forward on voltage	I_{SD} = 3 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 3 A, di/dt = 100 A/µs,	-	510		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 40 V, T_J = 150 °C	-	2.2		nC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	8.7		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
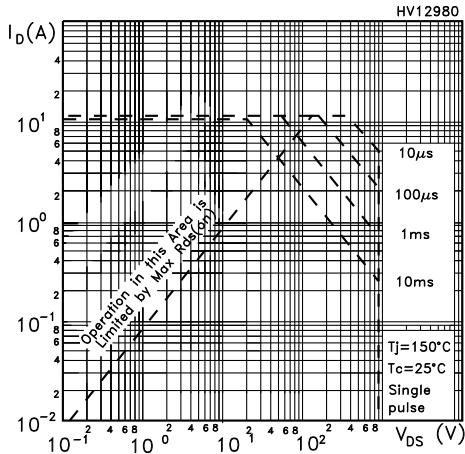
Figure 2. Normalized transient thermal impedance
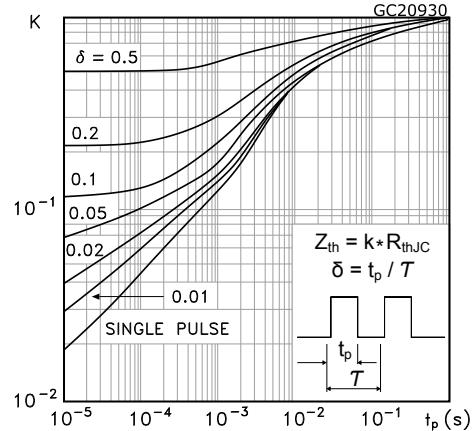
Figure 3. Typical output characteristics
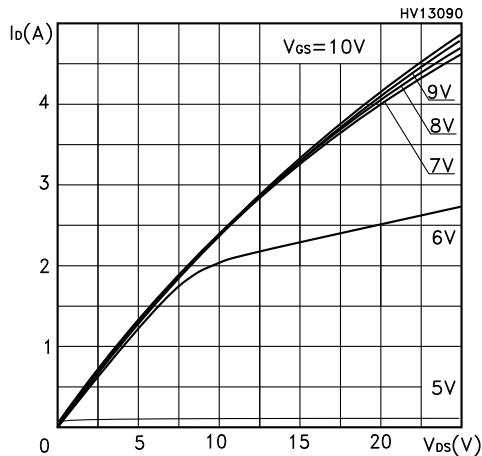
Figure 4. Typical transfer characteristics
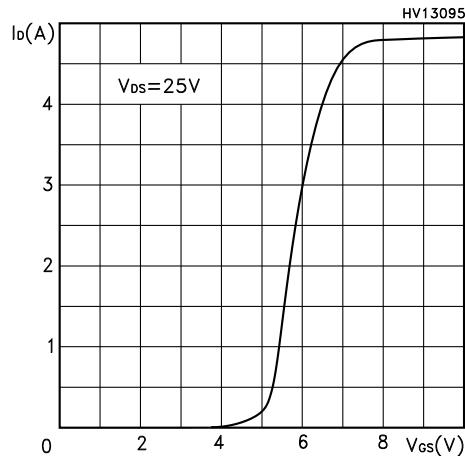
Figure 5. Typical drain-source on-resistance
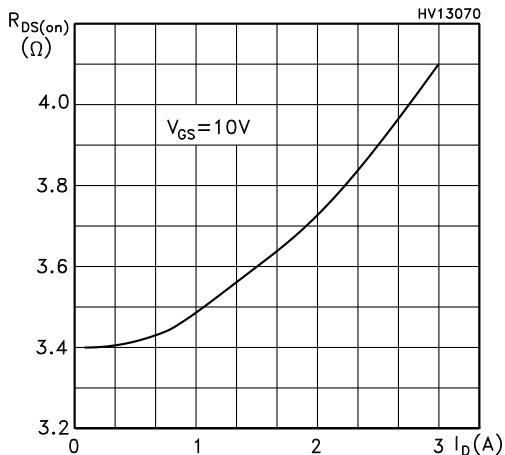

Figure 6. Typical gate charge characteristics
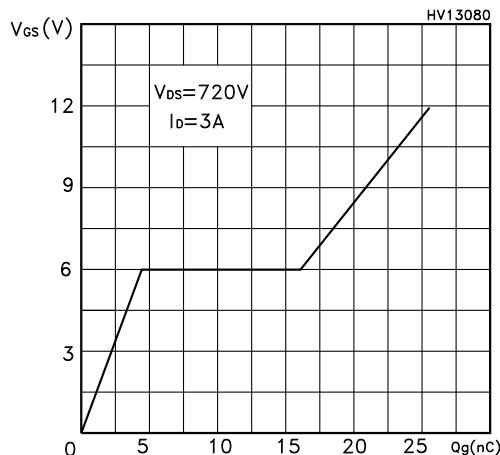
Figure 7. Typical capacitance characteristics
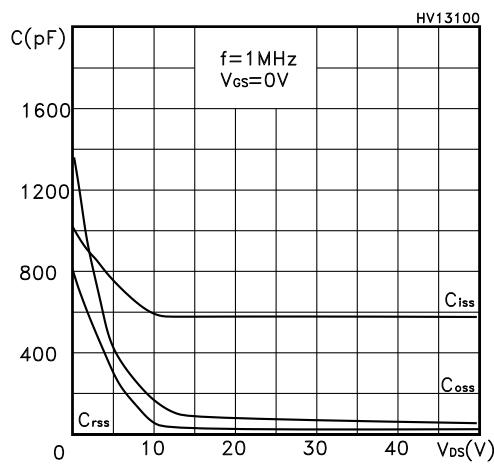

**Figure 8. Normalized gate threshold vs temperature**
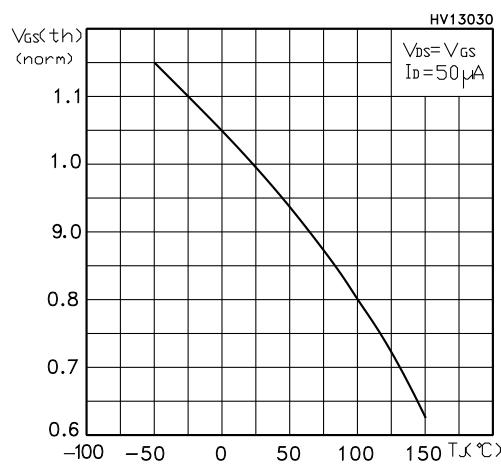
Figure 9. Normalized on-resistance vs temperature
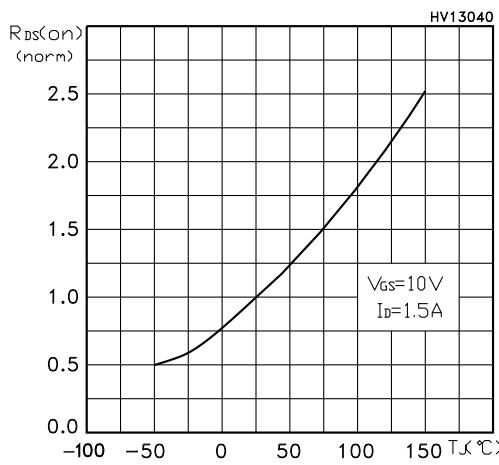
Figure 10. Typical drain-source on-resistance
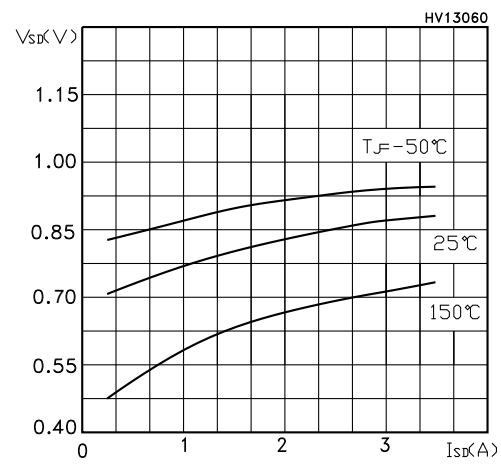
**Figure 11. Normalized breakdown voltage vs temperature**
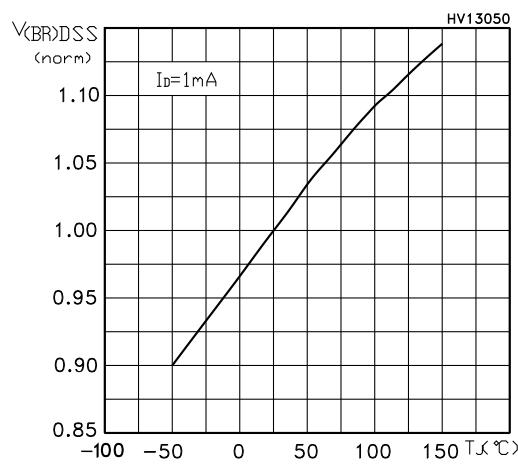
Figure 12. Maximum avalanche energy vs temperature
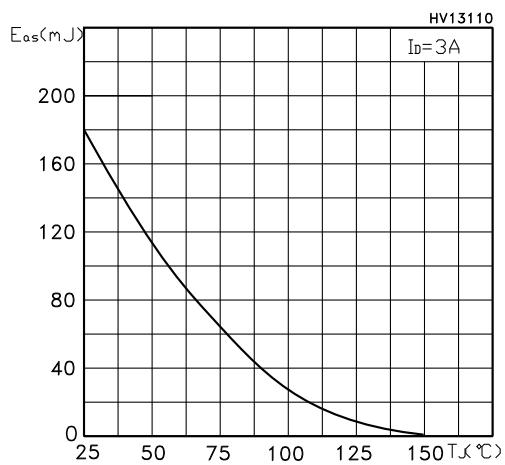
3 Test circuits

Figure 13. Test circuit for resistive load switching times
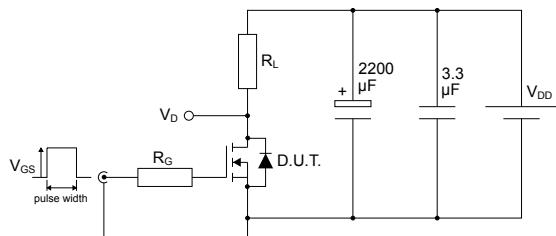

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Figure 14. Test circuit for gate charge behavior

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Figure 15. Test circuit for inductive load switching and diode recovery times
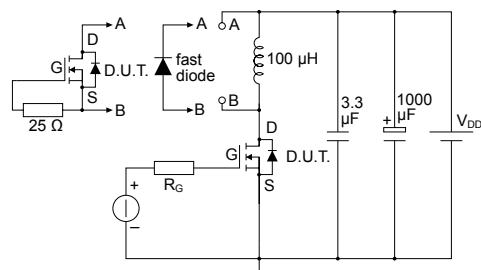
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Figure 16. Unclamped inductive load test circuit

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Figure 17. Unclamped inductive waveform
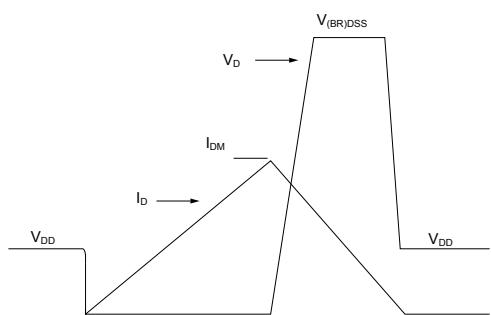
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**Figure 18. Switching time waveform**
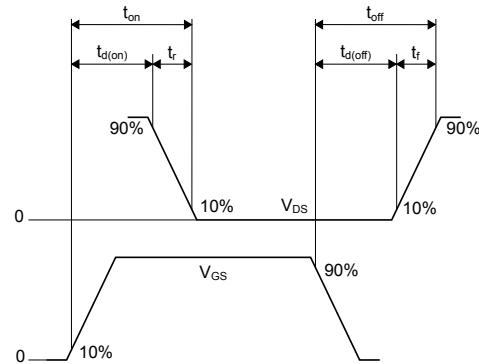
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4 Package information

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 C3 package information

Figure 19. DPAK (TO-252) type C3 package outline
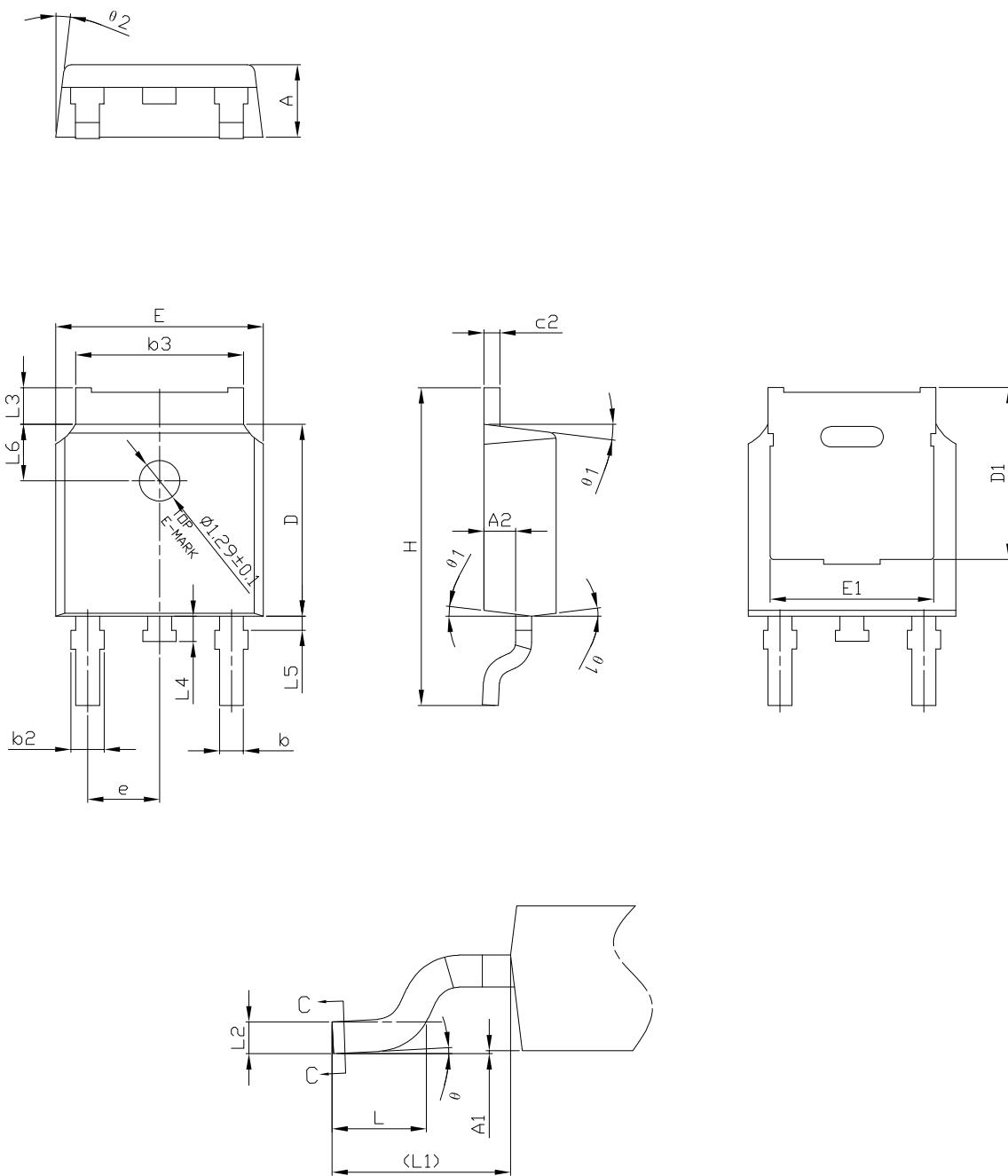
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Table 8. DPAK (TO-252) type C3 mechanical data

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°

**Figure 20. DPAK (TO-252) recommended footprint (dimensions are in mm)**
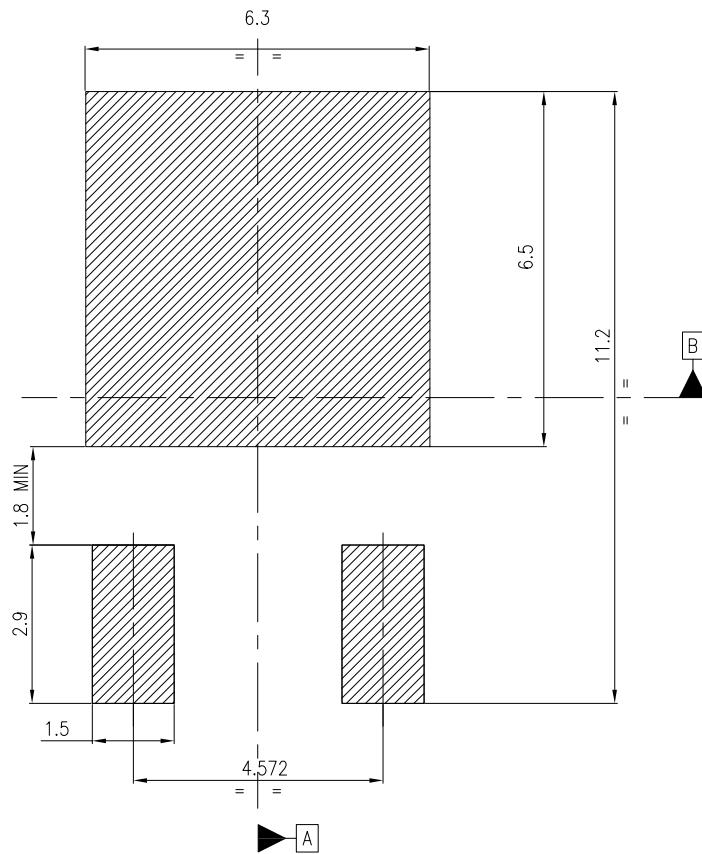
Notes:

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 ⊕ | 0.05 | A | B

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4.2 DPAK (TO-252) packing information

Figure 21. DPAK (TO-252) tape outline
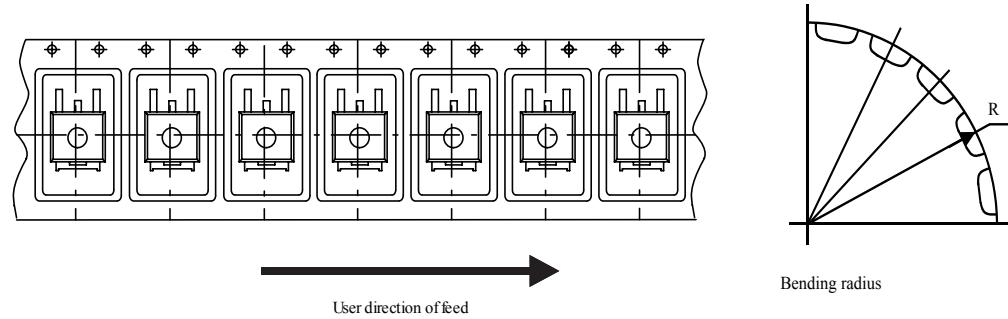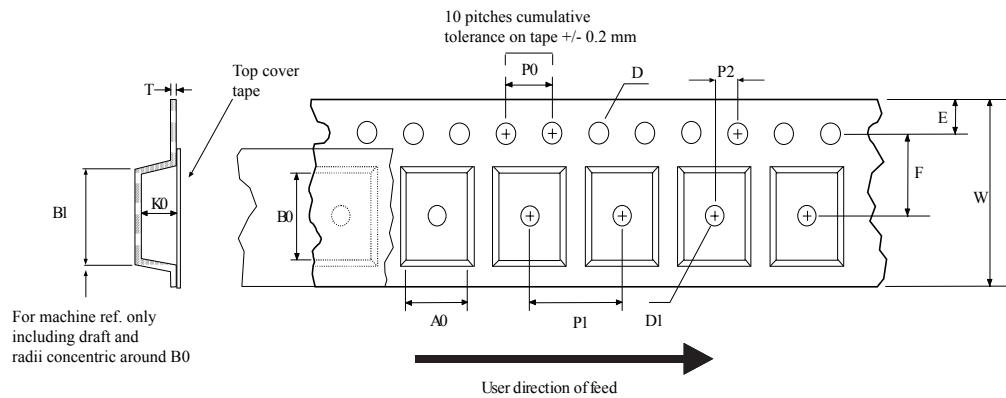
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Figure 22. DPAK (TO-252) reel outline

40mm min.
access hole
at slot location

B

D

A

Full radius

Tape slot
in core for
tape start
2.5mm min.width

T

C

N

G measured
at hub
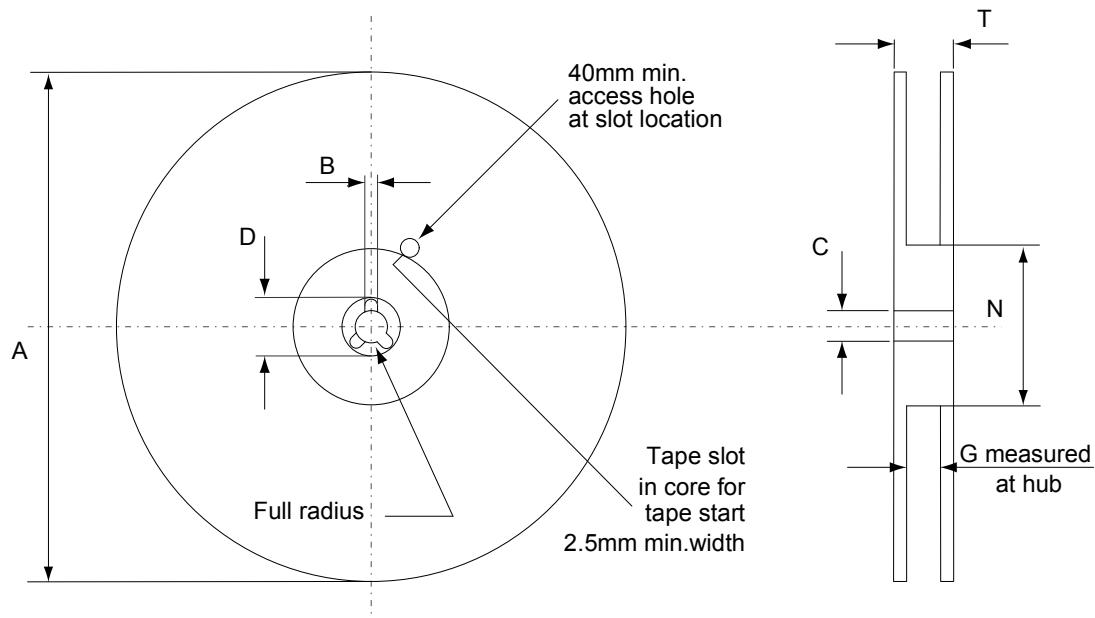
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Table 9. DPAK (TO-252) tape and reel mechanical data

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 10. Document revision history

Date	Version	Changes
24-Oct-2006	1	First release.
29-Jan-2013	2	– The part number STD3NK90Z-1 has been moved to a separate datasheet – Minor text changes – Updated: Section 4: Package mechanical data
20-Aug-2018	3	Removed maturity status indication from cover page. The document status is production data. Updated title in cover page, *Section 1 Electrical ratings*, *Section 2 Electrical characteristics* and *Section 4 Package information*. Minor text changes.
31-Aug-2023	4	The part numbers STP3NK90Z and STP3NK90ZFP have been moved to separate datasheets and the document has been updated accordingly. Updated Section 4 Package information. Minor text changes.

Contents

IMPORTANT NOTICE – READ CAREFULLY