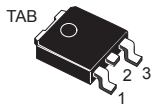
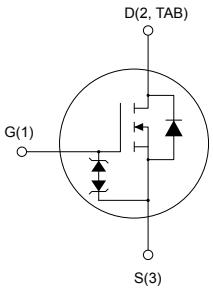
N-channel 600 V, 1.2 Ω typ., 5 A SuperMESH Power MOSFET in a DPAK package



DPAK



AM01476v1_tab

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STD5NK60ZT4	600 V	1.6 Ω	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.

Product status link
STD5NK60ZT4

Product summary	
Order code	STD5NK60ZT4
Marking	D5NK60Z
Package	DPAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	5	A
	Drain current (continuous) at T_C = 100 °C	3.16	
I_{DM}(1)	Drain current (pulsed)	20	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)	3	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} ≤ 5 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	1.39	°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.)	5	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	220	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	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 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 = 2.5 A		1.2	1.6	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	-	690		pF
C_{oss}	Output capacitance		-	90		pF
C_{rss}	Reverse transfer capacitance		-	20		pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 480 V	-	40		pF
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 5 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	26	34 (2)	nC
Q_{gs}	Gate-source charge		-	6		nC
Q_{gd}	Gate-drain charge		-	14		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}.*
2. *Specified by design, not tested in production.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	16	-	ns
t_r	Rise time		-	25	-	ns
$t_{d(off)}$	Turn-off delay time		-	36	-	ns
t_f	Fall time		-	25	-	ns
$t_{r(Voff)}$	Off-voltage rise time	V_{DD} = 480 V, I_D = 5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15. Test circuit for inductive load switching and diode recovery times and Figure 18. Switching time waveform)	-	12	-	ns
t_f	Fall time		-	10	-	ns
t_c	Cross-over time		-	24	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM}(1)	Source-drain current (pulsed)		-		20	A
V_{SD}(2)	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs, V_{DD} = 30 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	485		ns
Q_{rr}	Reverse recovery charge		-	2.7		µC
I_{RRM}	Reverse recovery current		-	11		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

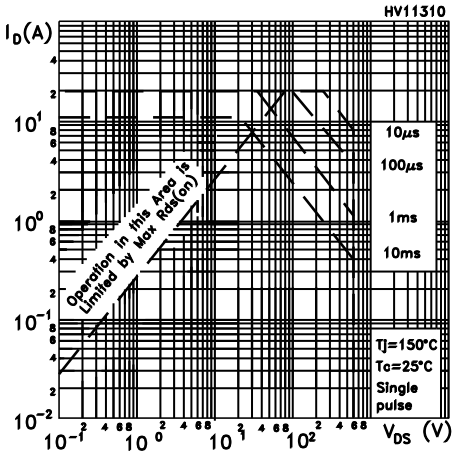


Figure 2. Normalized transient thermal impedance

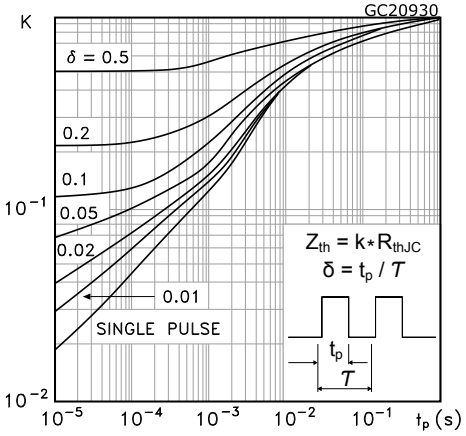


Figure 3. Typical output characteristics

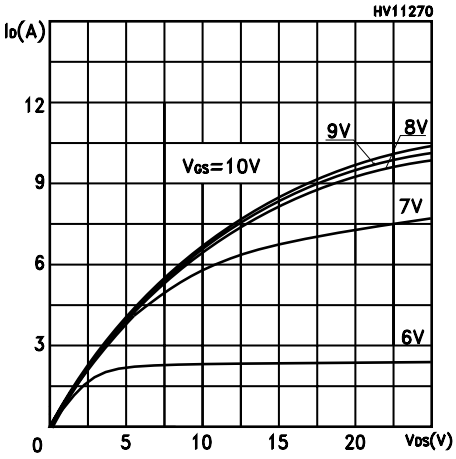


Figure 4. Typical transfer characteristics

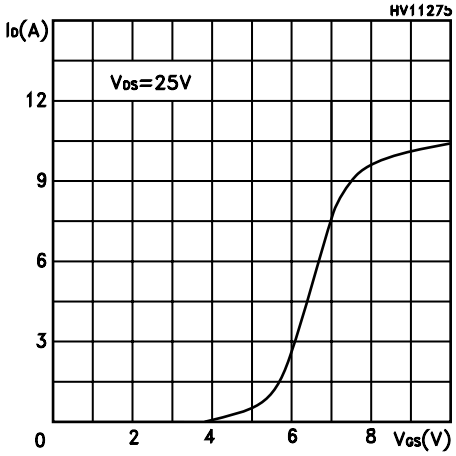


Figure 5. Typical drain-source on-resistance

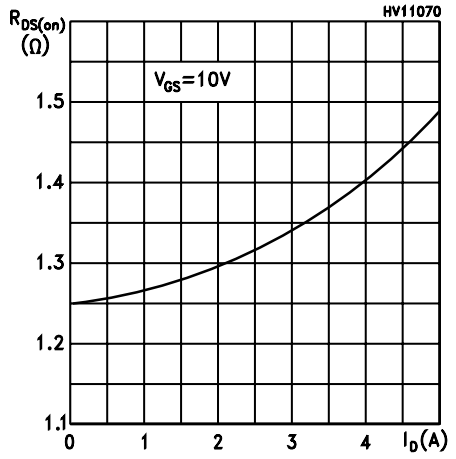


Figure 6. Typical gate charge characteristics

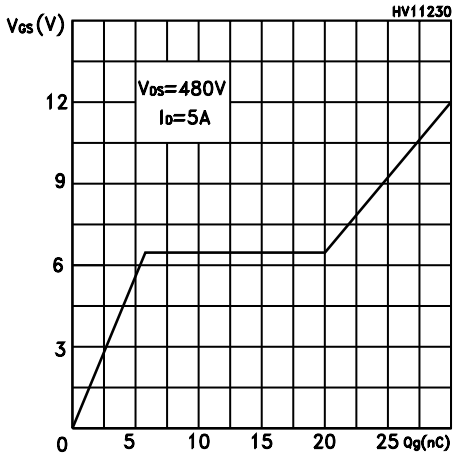


Figure 7. Typical capacitance characteristics

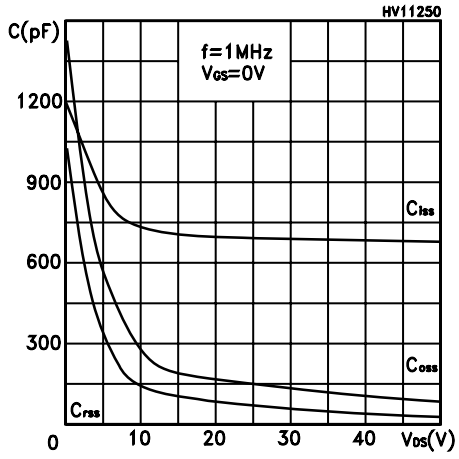


Figure 8. Normalized gate threshold vs temperature

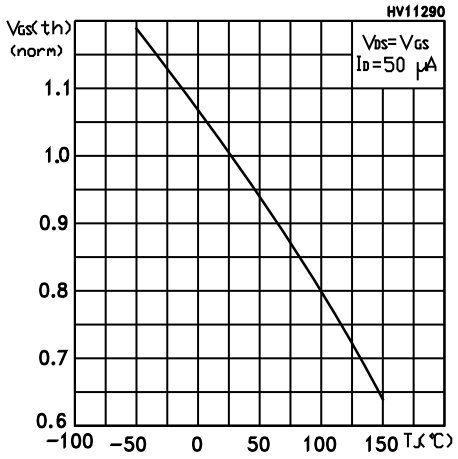


Figure 9. Normalized on-resistance vs temperature

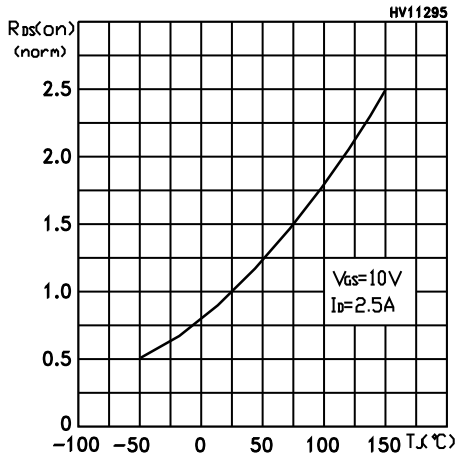


Figure 10. Typical drain-source on-resistance

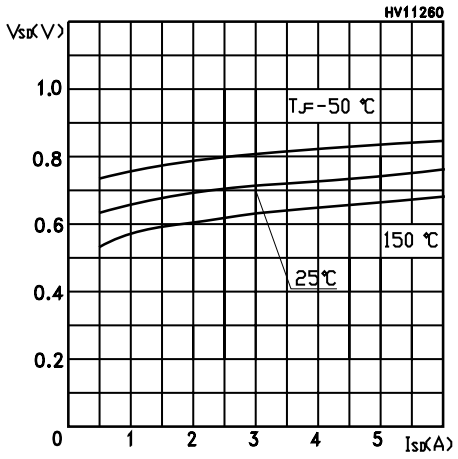


Figure 11. Normalized breakdown voltage vs temperature

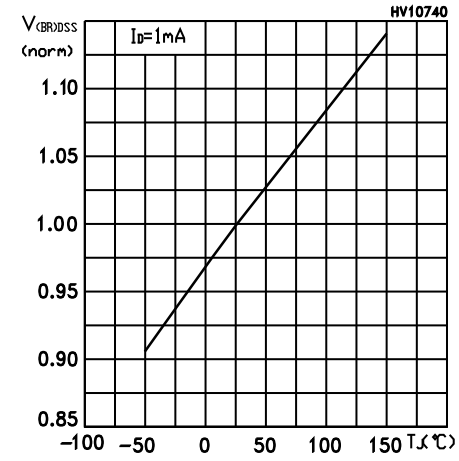
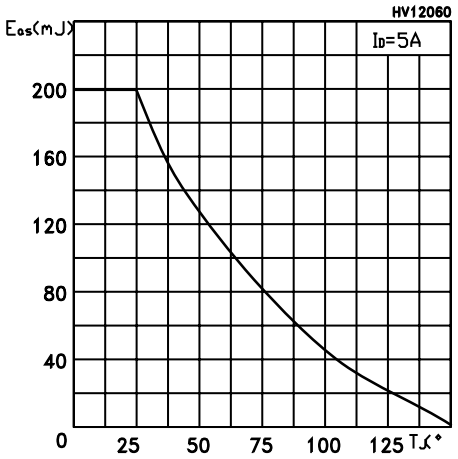
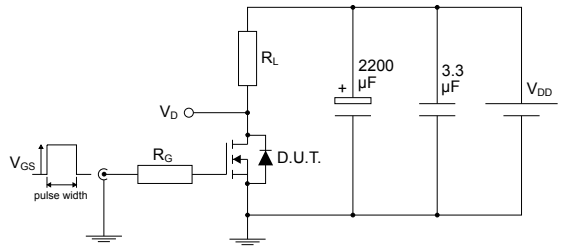


Figure 12. Maximum avalanche energy vs temperature



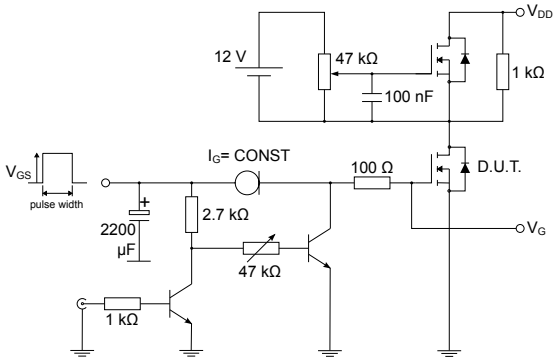
3 Test circuits

Figure 13. Test circuit for resistive load switching times



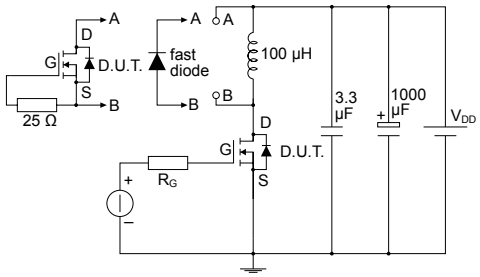
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Figure 14. Test circuit for gate charge behavior



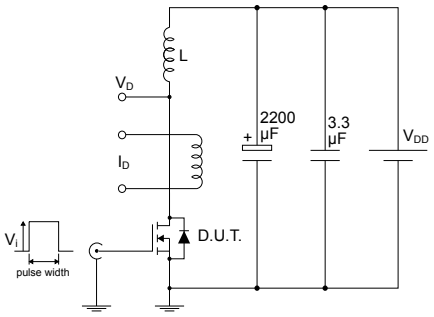
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Figure 15. Test circuit for inductive load switching and diode recovery times



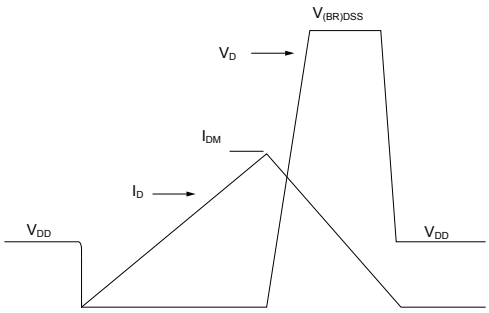
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Figure 16. Unclamped inductive load test circuit



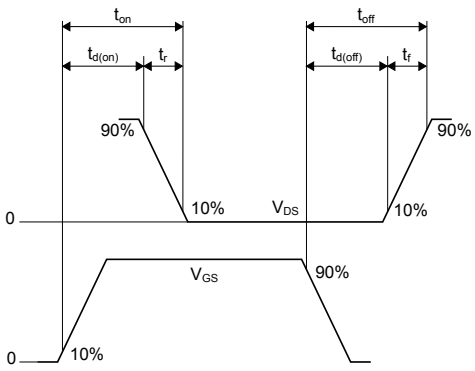
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Figure 17. Unclamped inductive waveform



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Figure 18. Switching time waveform



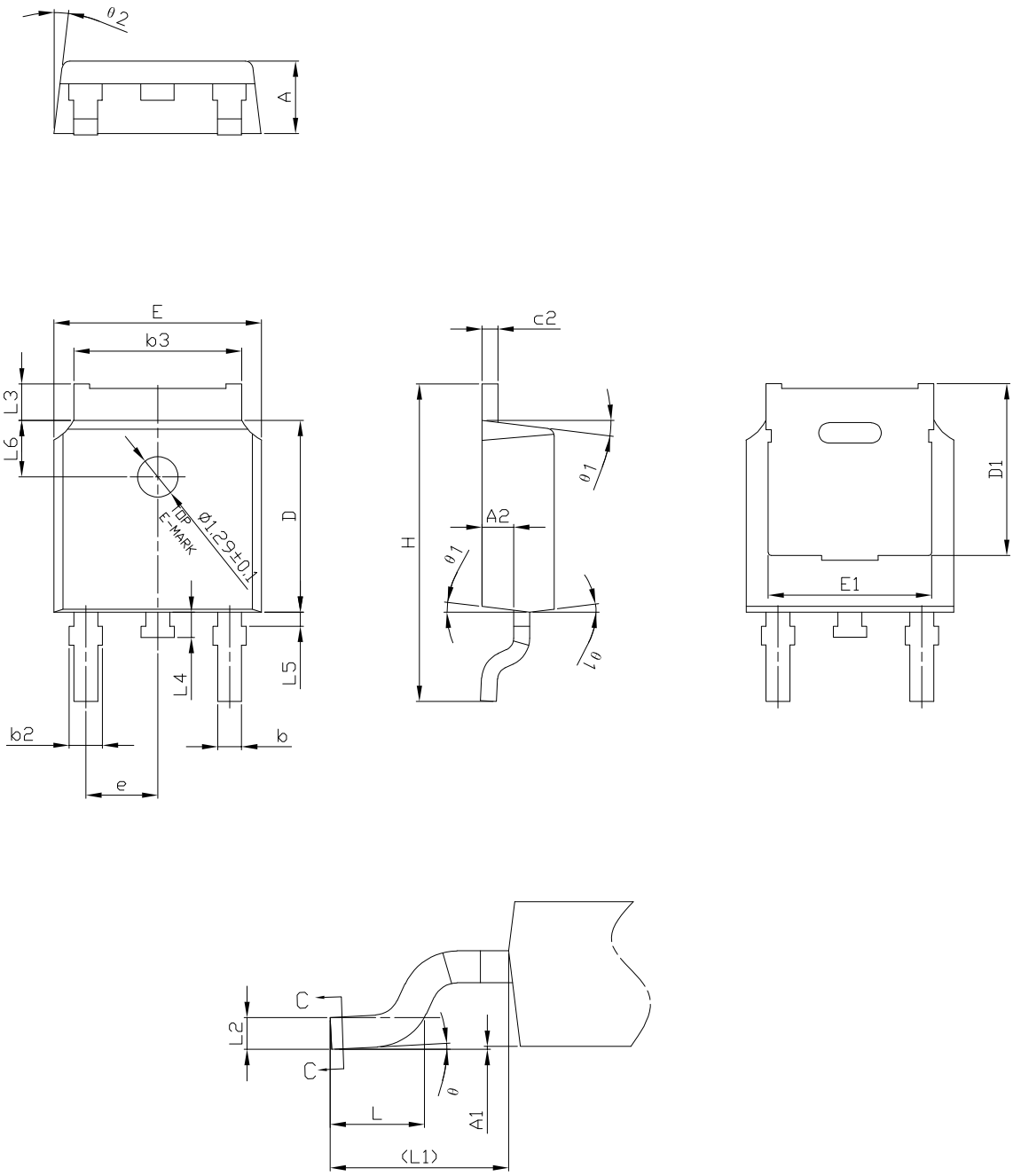
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4 Package information

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**

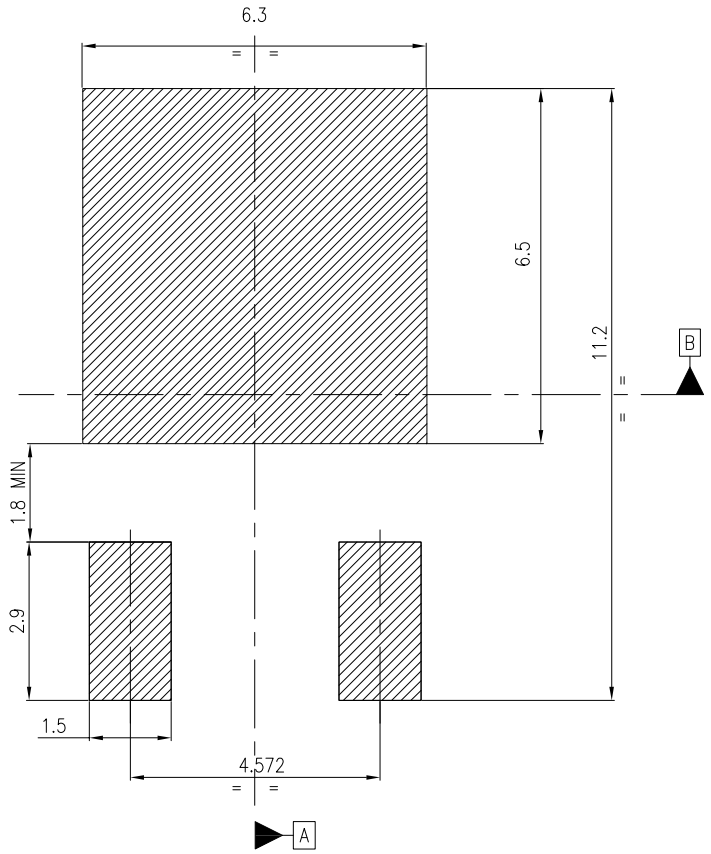


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Table 8. **DPAK (TO-252) type C3 mechanical data**

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**

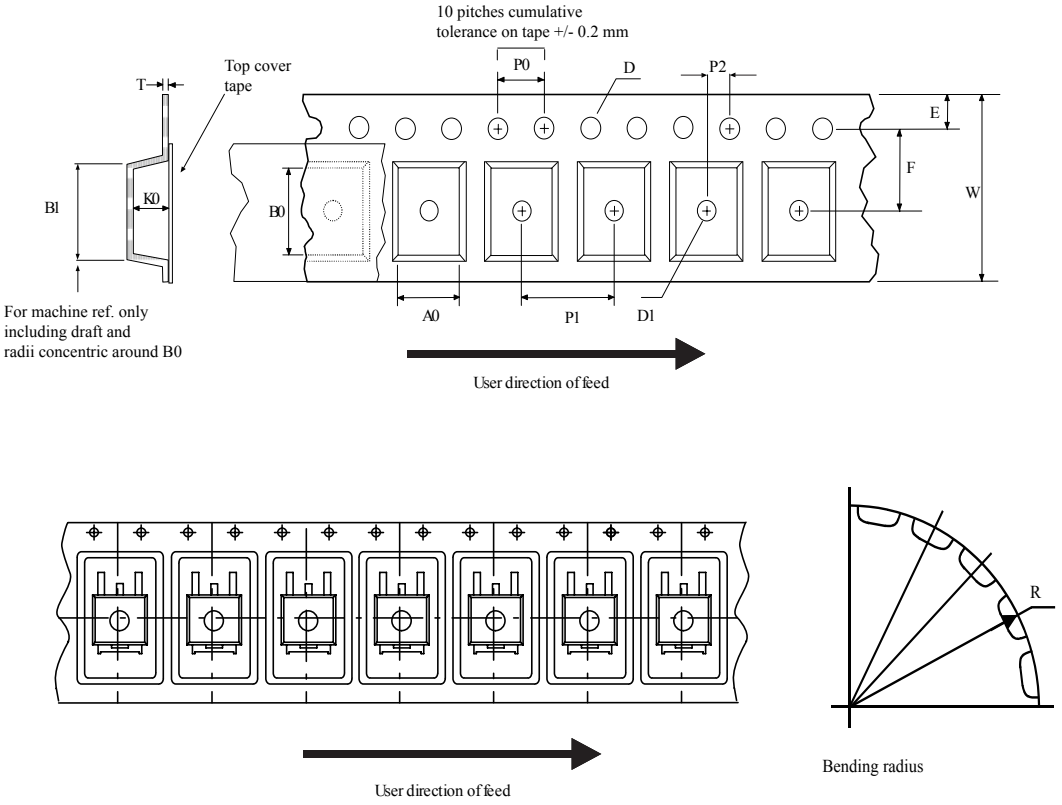
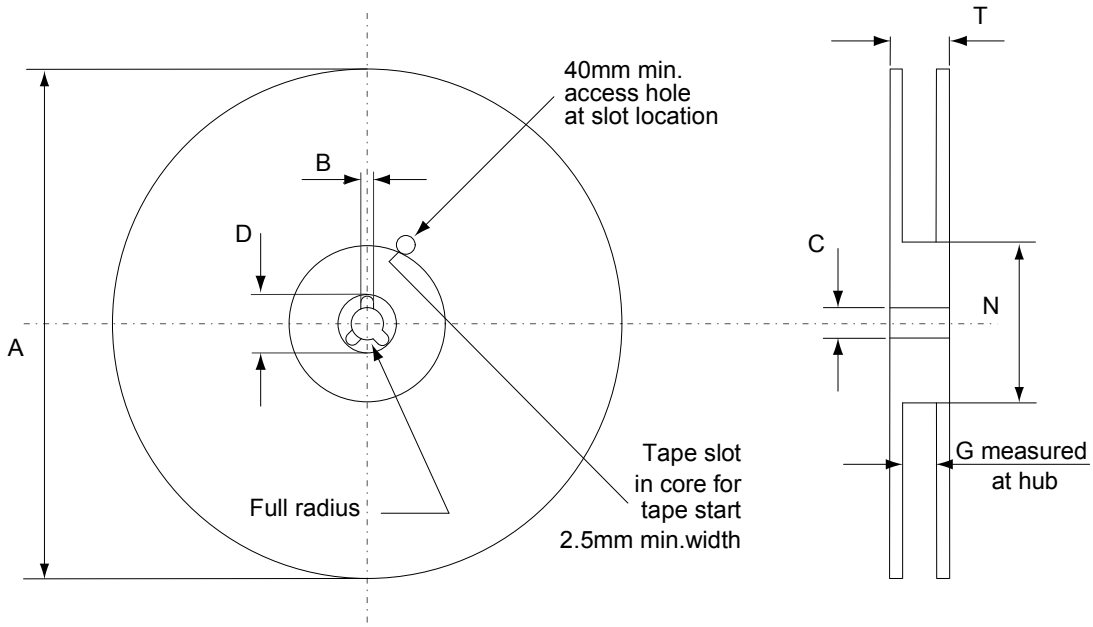


Figure 22. **DPAK (TO-252) reel outline**



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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
05-Apr-2005	1	First issue
29-Apr-2005	2	Modified value in Table 7.
06-Sep-2005	3	Inserted Ecopack indication
14-Oct-2005	4	Modified value on Table 1
28-Oct-2005	5	Tape & Reel info added
14-Nov-2005	6	Modified value on Table 6
15-Dec-2005	7	Various corrections
22-Aug-2018	8	Removed maturity status indication from cover page. The document status is production data. Updated *Section 4 Package information*. Minor text changes.
26-Sep-2023	9	The part numbers STP5NK60Z and STP5NK60ZFP have been moved to separate datasheets and the document has been updated accordingly. Removed gate-source Zener diode table. Updated Section 4 Package information. Minor text changes.

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