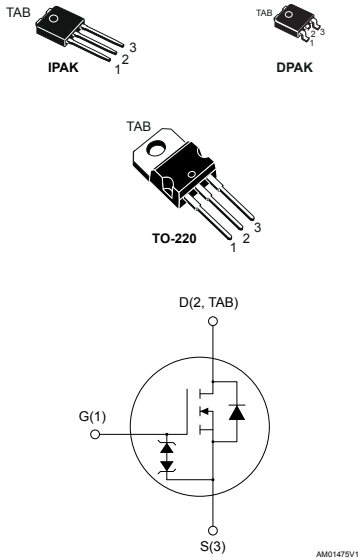


## N-channel 900 V, 5 Ω typ., 2.1 A SuperMESH™ Power MOSFETs in IPAK, DPAK and TO-220 packages



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$	Package
STD2NK90Z-1	900 V	6.5 Ω	2.1 A	IPAK
STD2NK90ZT4				DPAK
STP2NK90Z				TO-220

- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

### Applications

- Switching applications

### Description

These high-voltage devices are Zener-protected N-channel Power MOSFETs developed using the SuperMESH™ technology by STMicroelectronics, an optimization of the well-established PowerMESH™. In addition to a significant reduction in on-resistance, these devices are designed to ensure a high level of dv/dt capability for the most demanding applications.

#### Product status link

[STD2NK90Z-1](#)
[STD2NK90ZT4](#)
[STP2NK90Z](#)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	900	V
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	2.1	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	1.3	A
$I_{DM}^{(1)}$	Drain current (pulsed)	8.4	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
ESD	Gate-source human body model (C = 100 pF, R = 1.5 k $\Omega$ )	2	kV
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	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.  $I_{SD} \leq 2.1\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value			Unit
		DPAK	IPAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case	1.78			$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	50			
$R_{thj-amb}$	Thermal resistance junction-ambient		100	62.5	

1. When mounted on FR-4 board of 1 inch<sup>2</sup>, 2 oz Cu.

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AS}^{(1)}$	Single-pulse avalanche current	2.1	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	150	mJ

1. Pulse width limited by  $T_{jmax}$ .
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	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	900			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 900\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 900\text{ V}$ , $T_C = 125\text{ °C}$ <sup>(1)</sup>			50	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 1.05\text{ A}$		5	6.5	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	485		$\mu\text{F}$
$C_{oss}$	Output capacitance			50		
$C_{rSS}$	Reverse transfer capacitance			10		
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ V to }720\text{ V}$	-	24		$\mu\text{F}$
$Q_g$	Total gate charge	$V_{DD} = 720\text{ V}$ , $I_D = 2\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	19.5	27	nC
$Q_{gs}$	Gate-source charge			3.4		
$Q_{gd}$	Gate-drain charge			10.8		

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	$V_{DD} = 450\text{ V}$ , $I_D = 1\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	21	-	ns
$t_r$	Rise time			11		
$t_{d(off)}$	Turn-off delay time			43		
$t_f$	Fall time			40		

**Table 7. Source-drain diode**

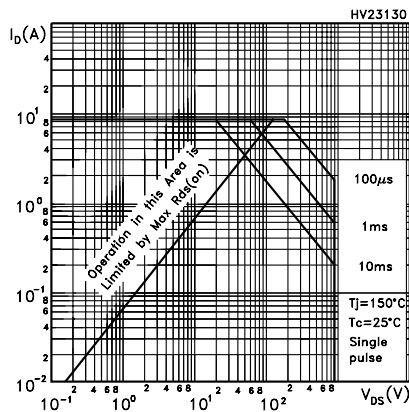
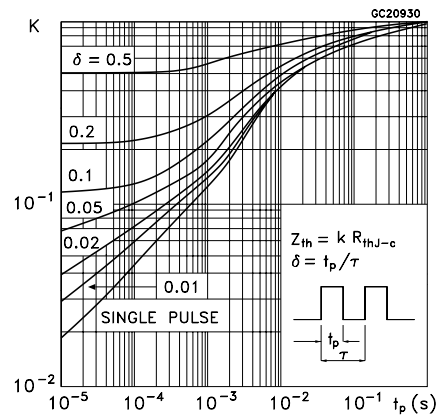
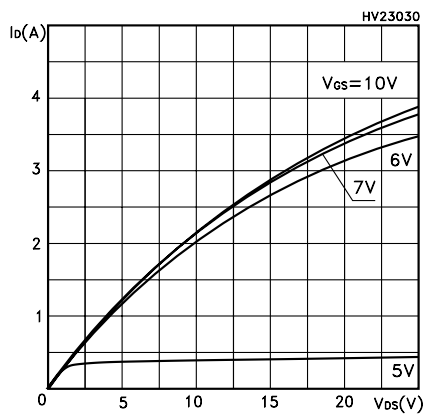
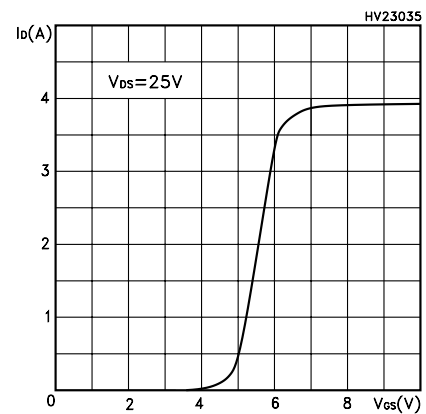
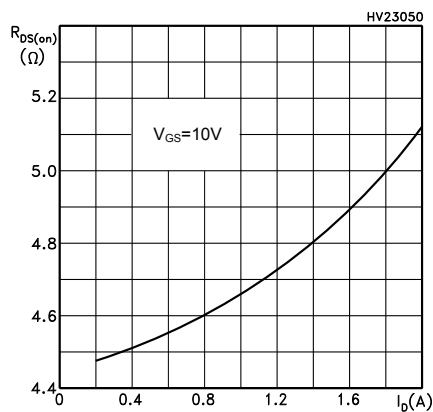
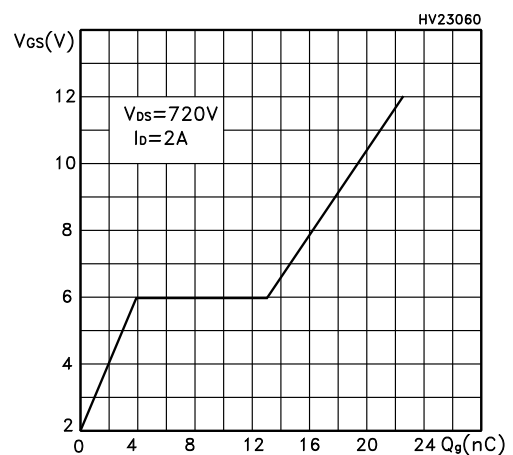
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		2.1	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		8.4	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2.1 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 2 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$	-	415		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 50 \text{ V}$	-	1.5		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	7.2		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 2 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$	-	515		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 50 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$	-	1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	7.5		A

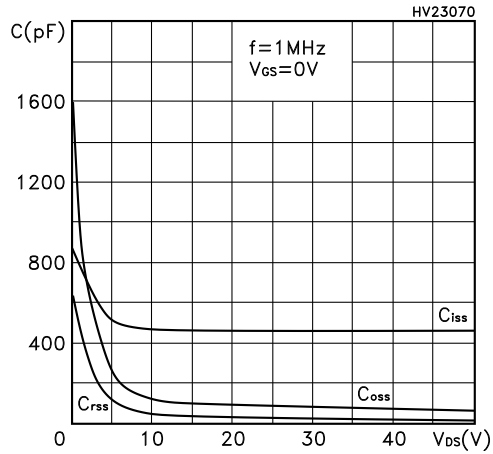
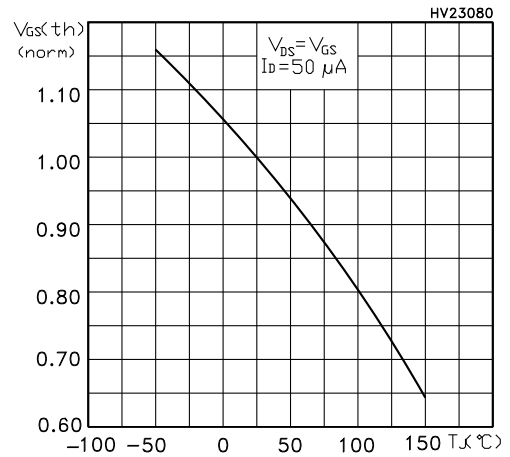
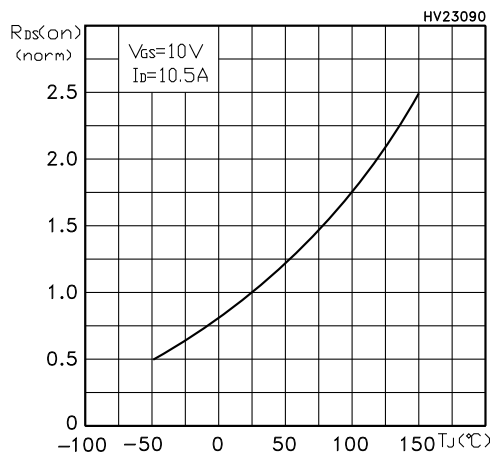
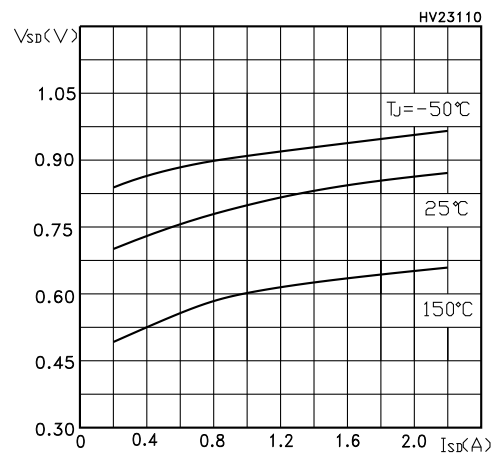
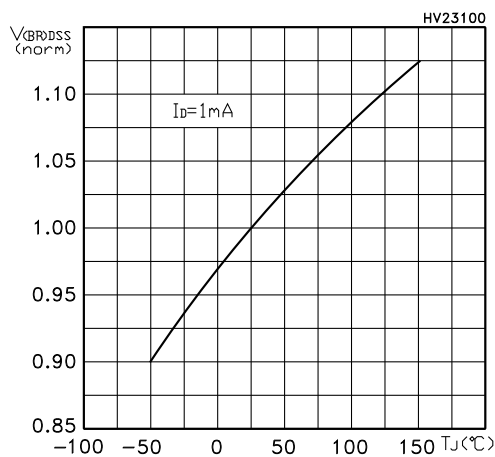
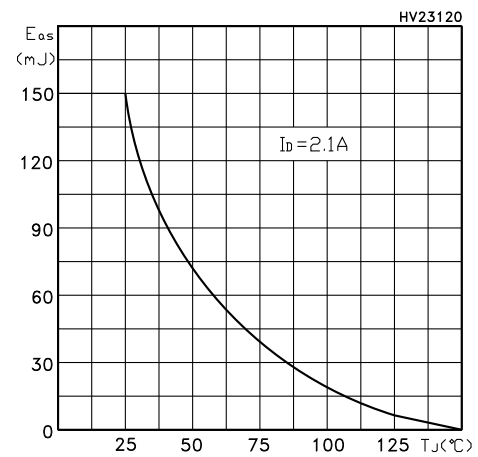
1. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.
2. Pulse width is limited by safe operating area.

**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.

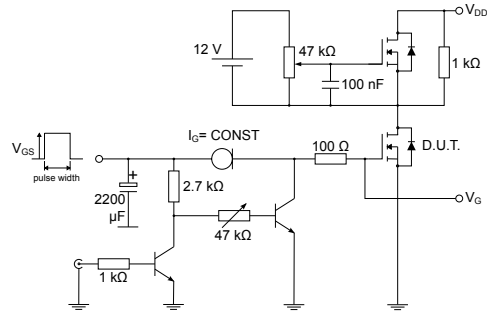
**2.1 Electrical characteristics (curves)**
**Figure 1. Safe operating area**

**Figure 2. Thermal impedance**

**Figure 3. Output characteristics**

**Figure 4. Transfer characteristics**

**Figure 5. 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**


AM01468v1

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


AM01469v1

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

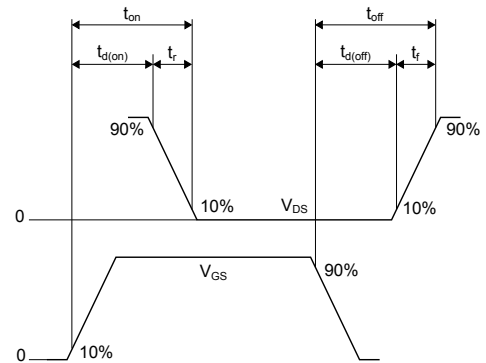

AM01470v1

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


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

## 4 Package information

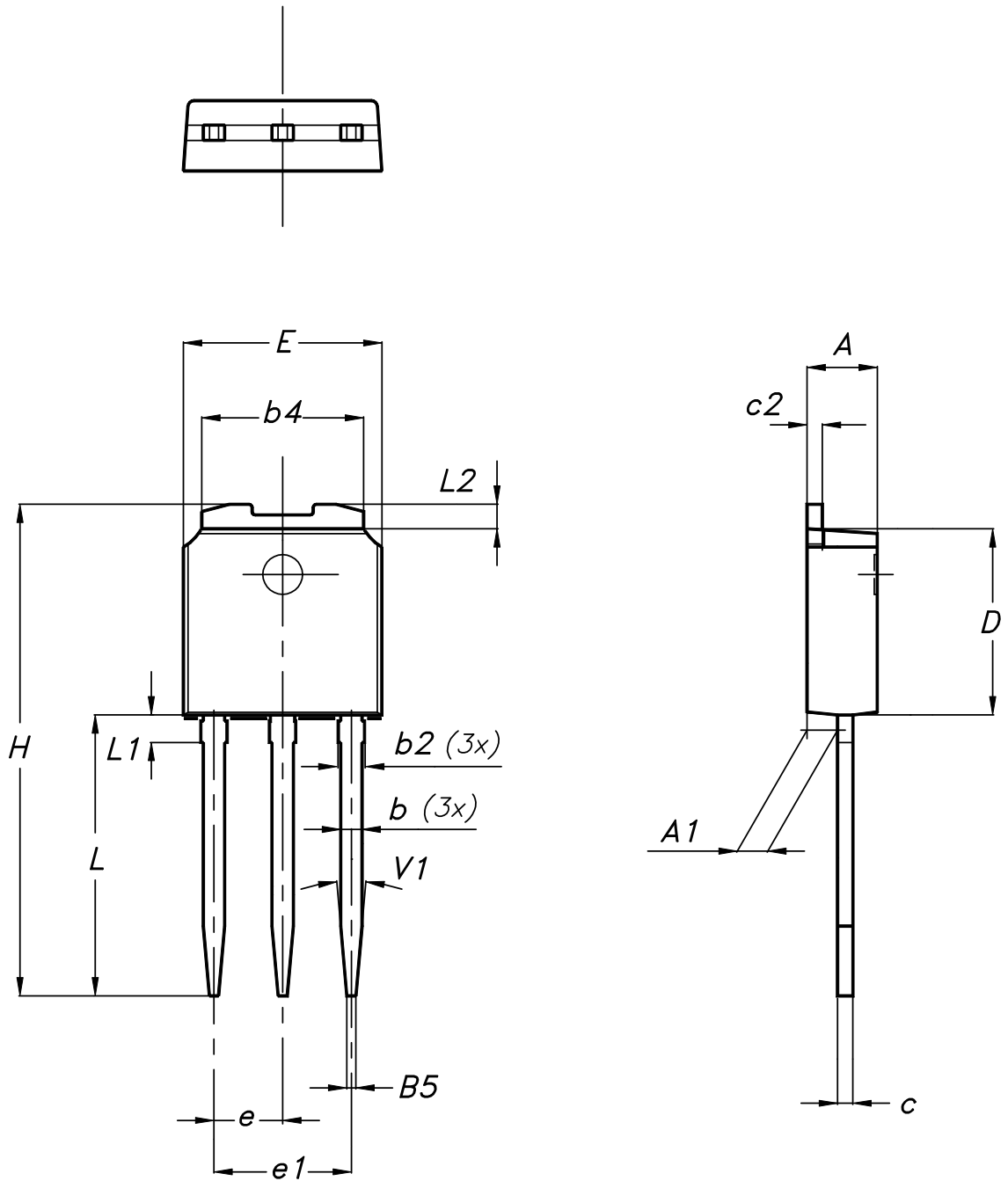
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In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.



### 4.1 IPAk (TO-251) type A package information

Figure 19. IPAk (TO-251) type A package outline



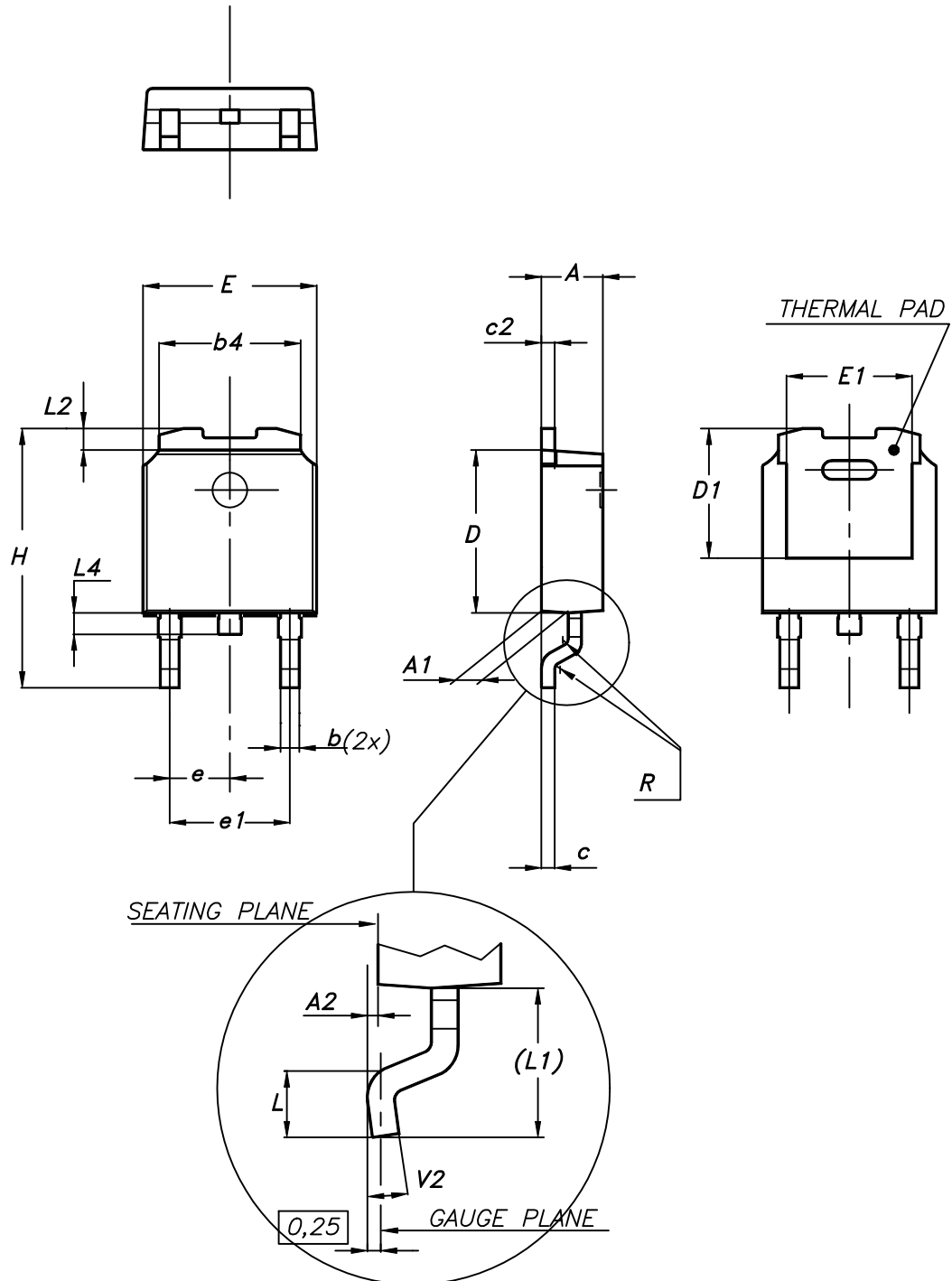
0068771\_IK\_typeA\_rev14

**Table 9. IPAK (TO-251) type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

## 4.2 DPAK (TO-252) type A2 package information

Figure 20. DPAK (TO-252) type A2 package outline



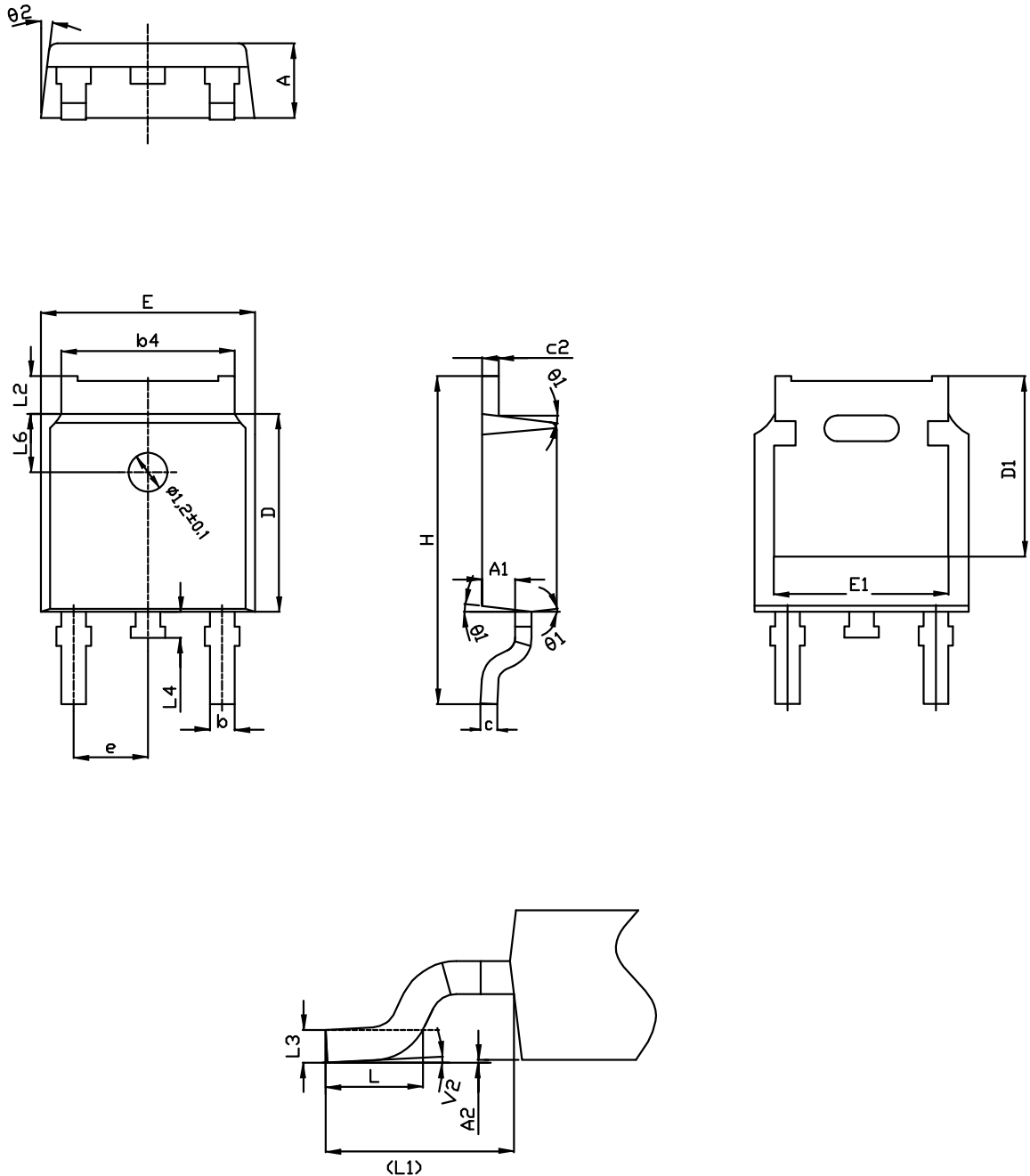
0068772\_type-A2\_rev25

**Table 10. DPAK (TO-252) type A2 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	5.10	5.20	5.30
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°

### 4.3 DPAK (TO-252) type C2 package information

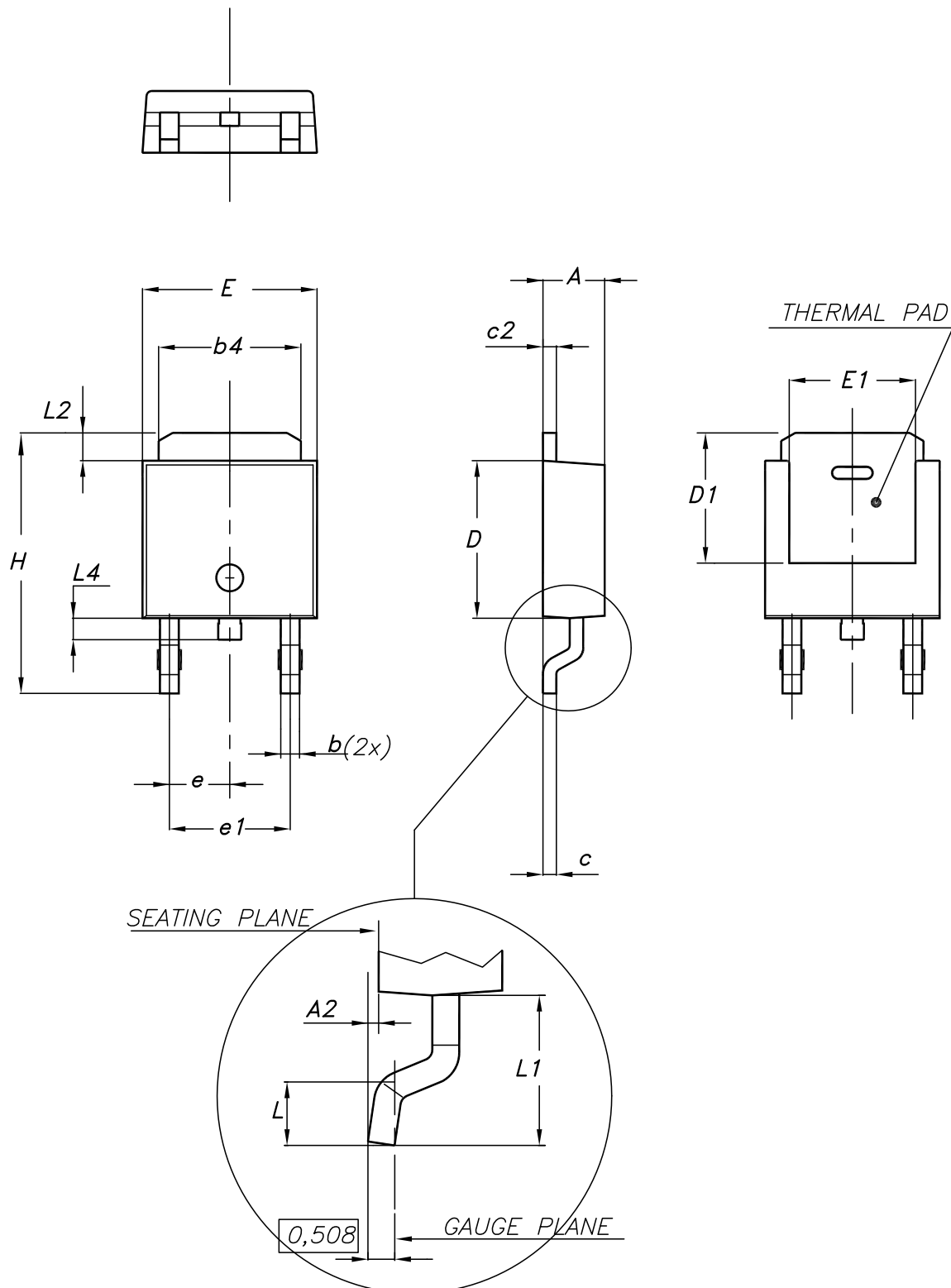
Figure 21. DPAK (TO-252) type C2 package outline



0068772\_C2\_25

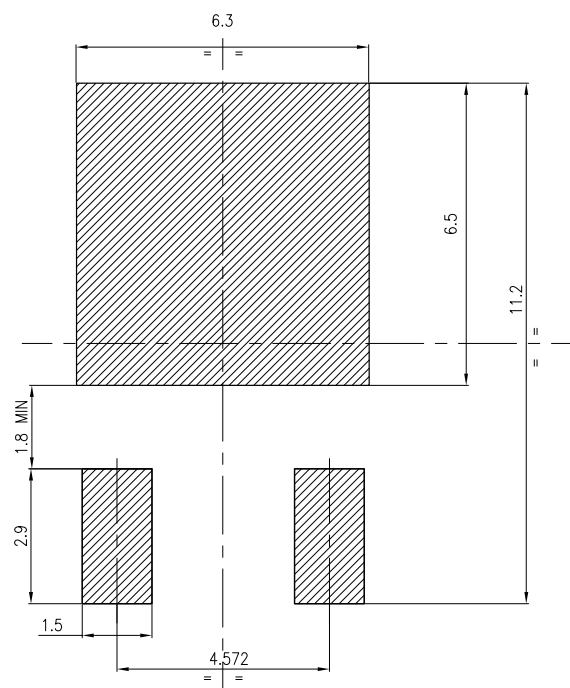
**Table 11. DPAK (TO-252) type C2 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
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	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

**4.4 DPAK (TO-252) type E package information**
**Figure 22. DPAK (TO-252) type E package outline**


**Table 12. 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

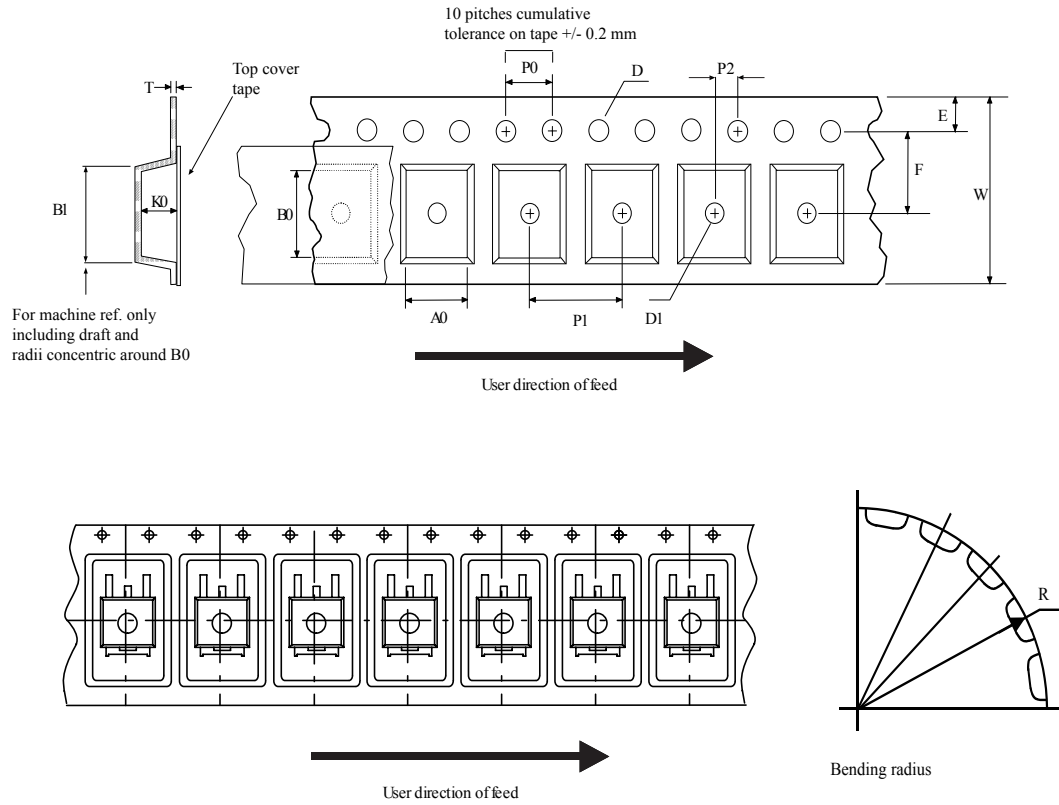
**Figure 23. DPAK (TO-252) recommended footprint (dimensions are in mm)**


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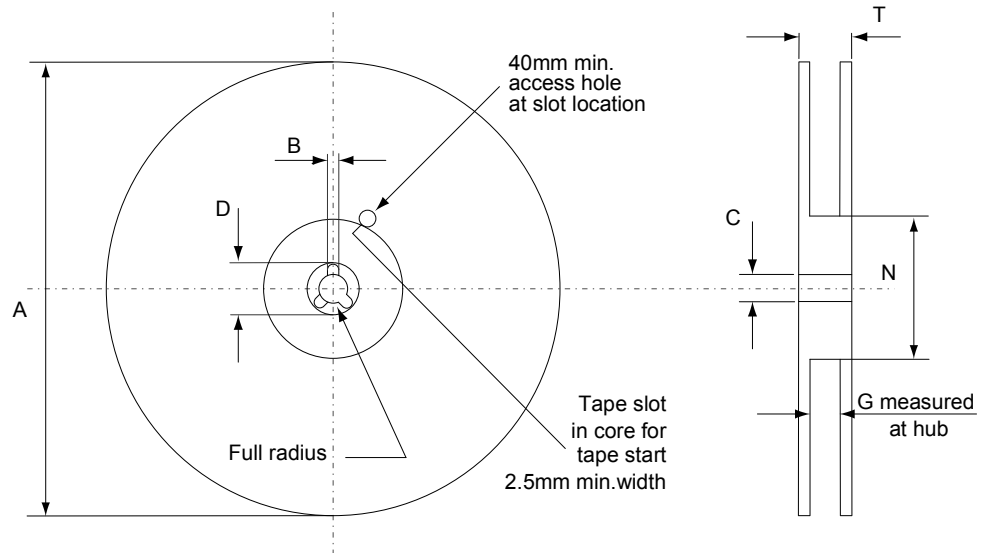


### 4.5 DPAK (TO-252) packing information

Figure 24. DPAK (TO-252) tape outline



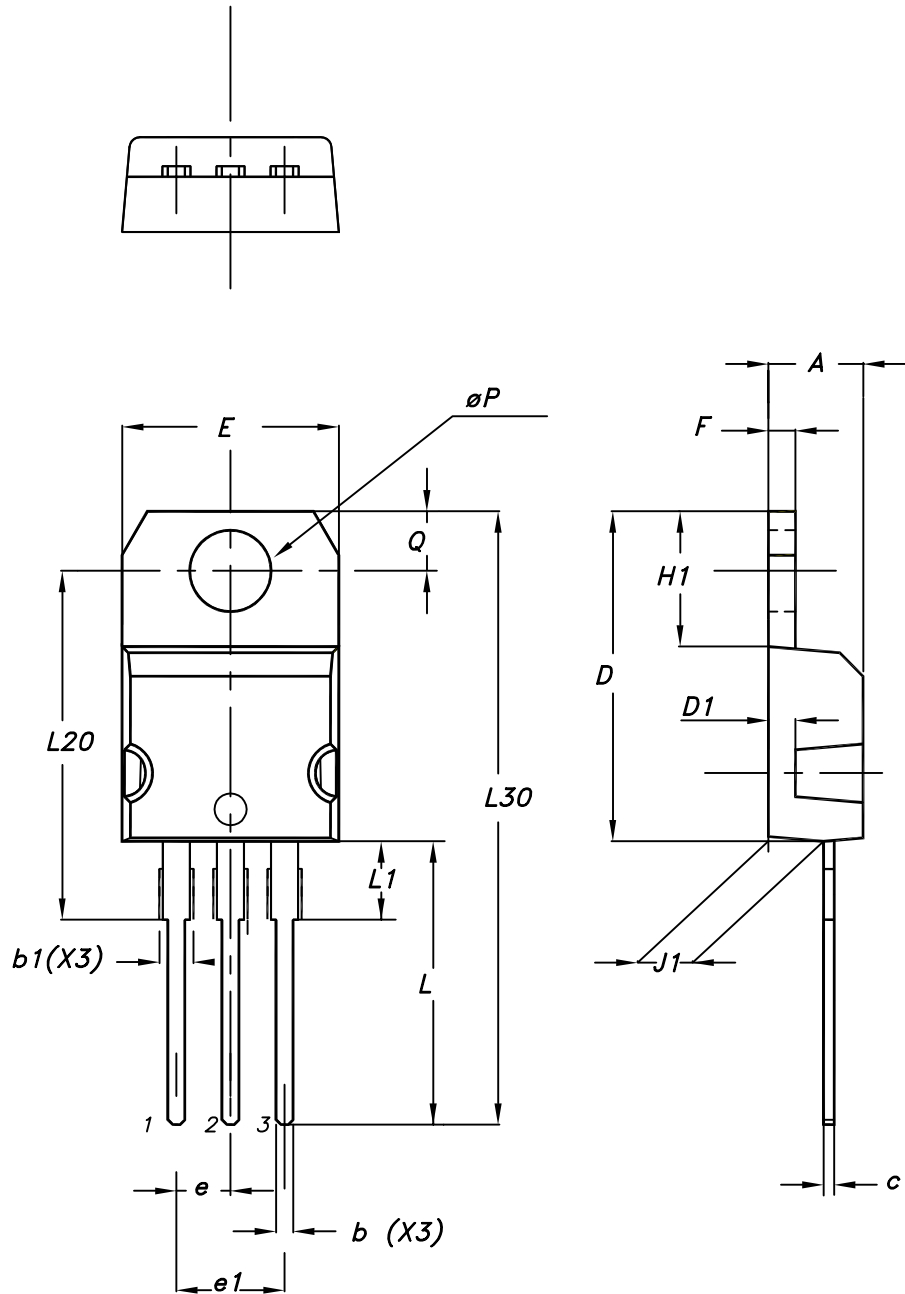
AM08852v1

**Figure 25. DPAK (TO-252) reel outline**


AM06038v1

**Table 13. 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			

**4.6 TO-220 type A package information**
**Figure 26. TO-220 type A package outline**


0015988\_typeA\_Rev\_21

**Table 14. 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 15. Order codes

Order code	Marking	Package	Packing
STD2NK90Z-1	D2NK90Z	IPAK	Tube
STD2NK90ZT4		DPAK	Tape and reel
STP2NK90Z	P2NK90Z	TO-220	Tube

## Revision history

**Table 16. Document revision history**

Date	Version	Changes
06-Oct-2004	1	First version
08-Sep-2005	2	Complete version
05-Mar-2006	3	Inserted Ecopack indication
27-Jul-2006	4	New template, no content change
28-Jun-2018	5	Removed maturity status indication from cover page. The document status is production data. Updated title in cover page, <a href="#">Section 1 Electrical ratings</a> , <a href="#">Section 2 Electrical characteristics</a> and <a href="#">Section 4 Package information</a> . Minor text changes.

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