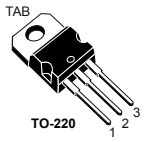
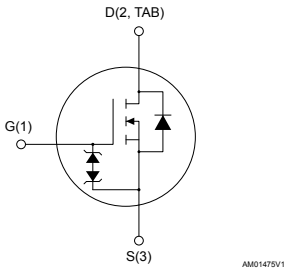
Datasheet

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





Product status link
STD2NK90Z-1
STD2NK90ZT4
STP2NK90Z

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.

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	2.1	A
I_D	Drain current (continuous) at T_C = 100 °C	1.3	A
I_{DM} (1)	Drain current (pulsed)	8.4	A
P_{TOT}	Total dissipation at T_C = 25 °C	70	W
ESD	Gate-source human body model (C = 100 pF, R =1.5 kΩ)	2	kV
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
T_j	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 2.1 A, di/dt ≤ 200 A/µs, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. Thermal data

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

1. *When mounted on FR-4 board of 1 inch², 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°C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

(T_{CASE} = 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	V_{GS} = 0 V, I_D = 1 mA	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	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 1.05 A		5	6.5	Ω

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 V, f = 1 MHz, V_{GS} = 0 V	-	485		pF
C_{oss}	Output capacitance			50		
C_{rss}	Reverse transfer capacitance			10		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 V to 720 V	-	24		pF
Q_g	Total gate charge	V_{DD} = 720 V, I_D = 2 A, V_{GS} = 0 to 10 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. *$C_{oss\ eq.}$ 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 V, I_D = 1 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)	-	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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 2 A, di/dt = 100 A/µs	-	415		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 50 V	-	1.5		µC
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 A, di/dt = 100 A/µs	-	515		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 50 V, T_j = 150 °C	-	1.9		µC
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 µs, 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} = ±1 mA, I_D = 0 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

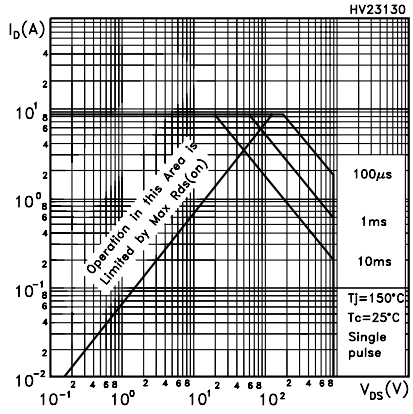


Figure 2. Thermal impedance

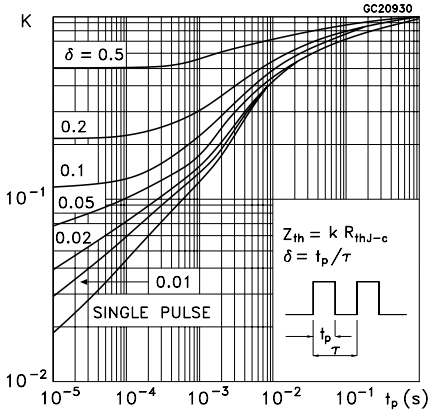


Figure 3. Output characterisics

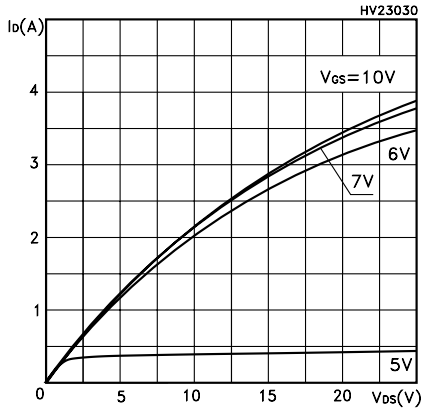


Figure 4. Transfer characteristics

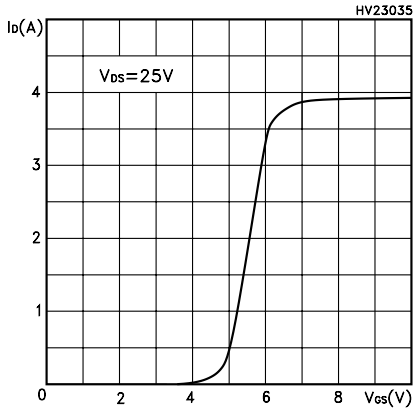


Figure 5. Static drain-source on resistance

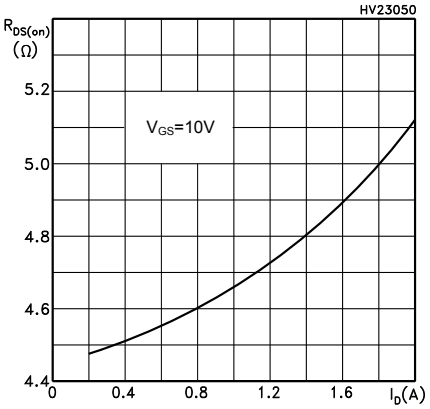


Figure 6. Gate charge vs gate-source voltage

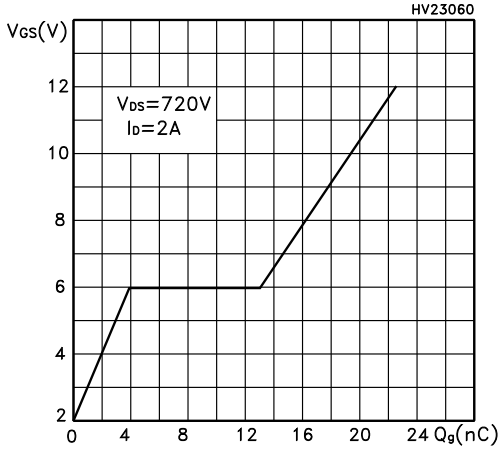


Figure 7. Capacitance variations

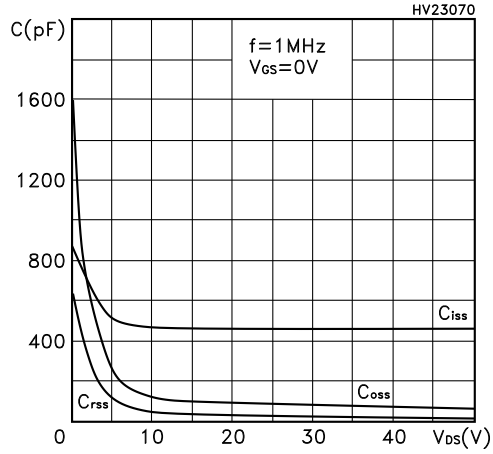


Figure 8. Normalized gate threshold voltage vs temperature

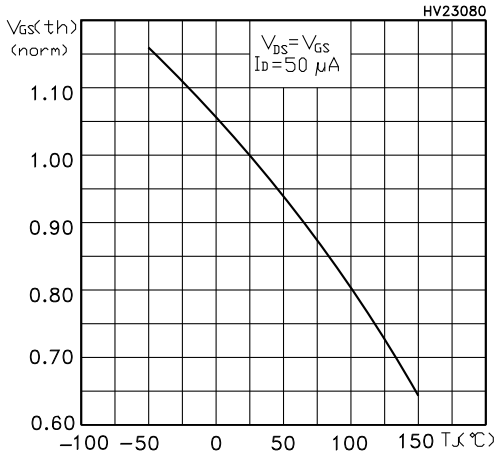


Figure 9. Normalized on resistance vs temperature

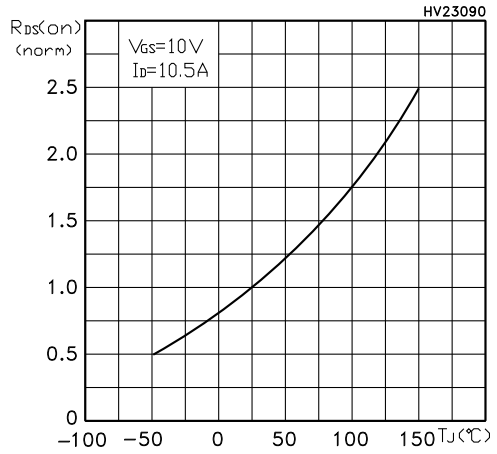


Figure 10. Source-drain diode forward characteristics

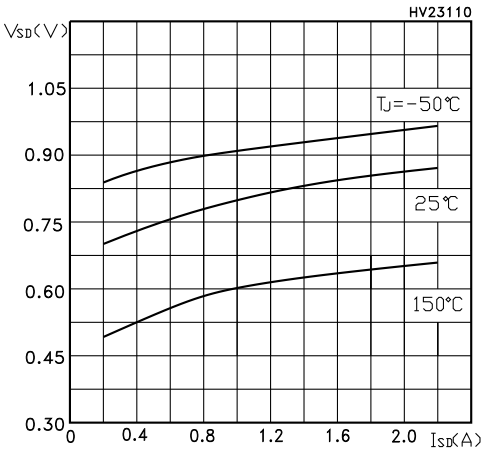


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

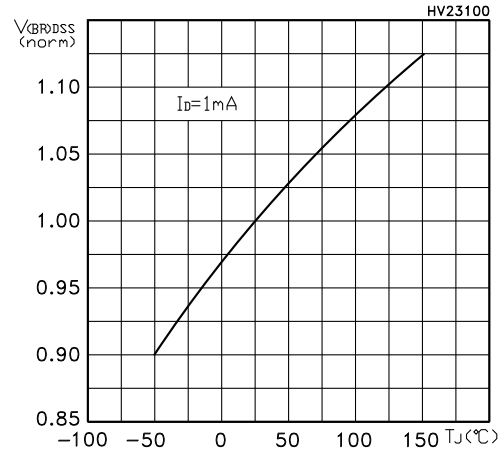
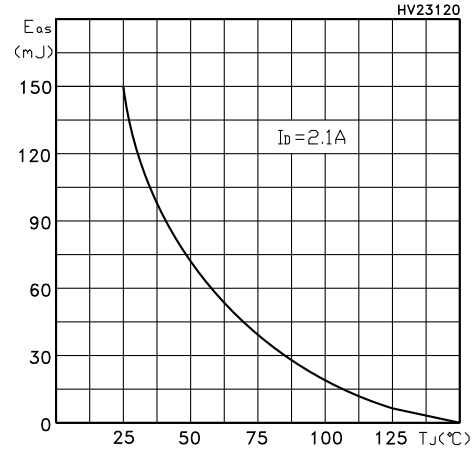


Figure 12. Maximum avalanche energy vs temperature



3 Test circuits

Figure 13. Test circuit for resistive load switching times

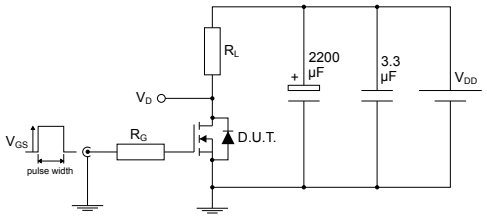


Figure 14. Test circuit for gate charge behavior

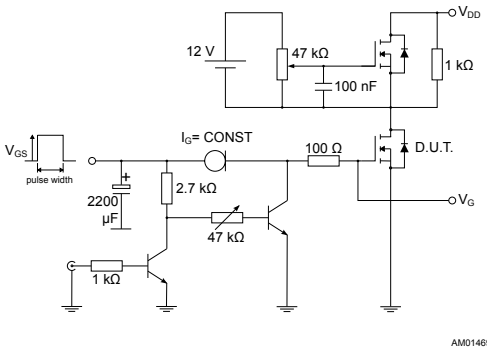


Figure 15. Test circuit for inductive load switching and diode recovery times

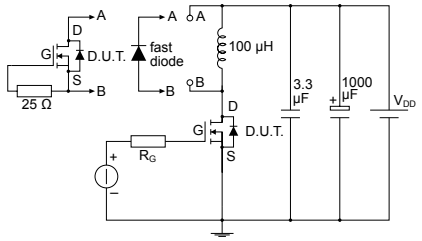


Figure 16. Unclamped inductive load test circuit

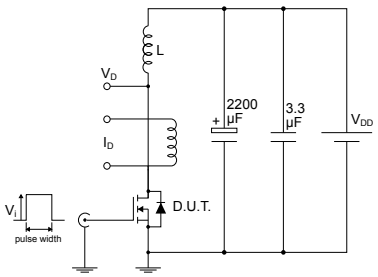


Figure 17. Unclamped inductive waveform

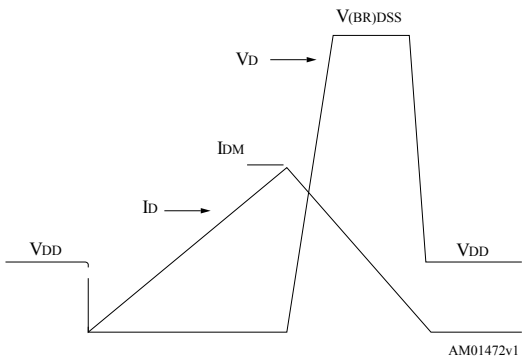
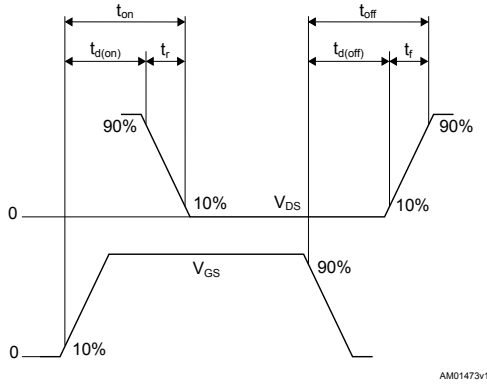


Figure 18. Switching time waveform



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 IPAK (TO-251) type A package information

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

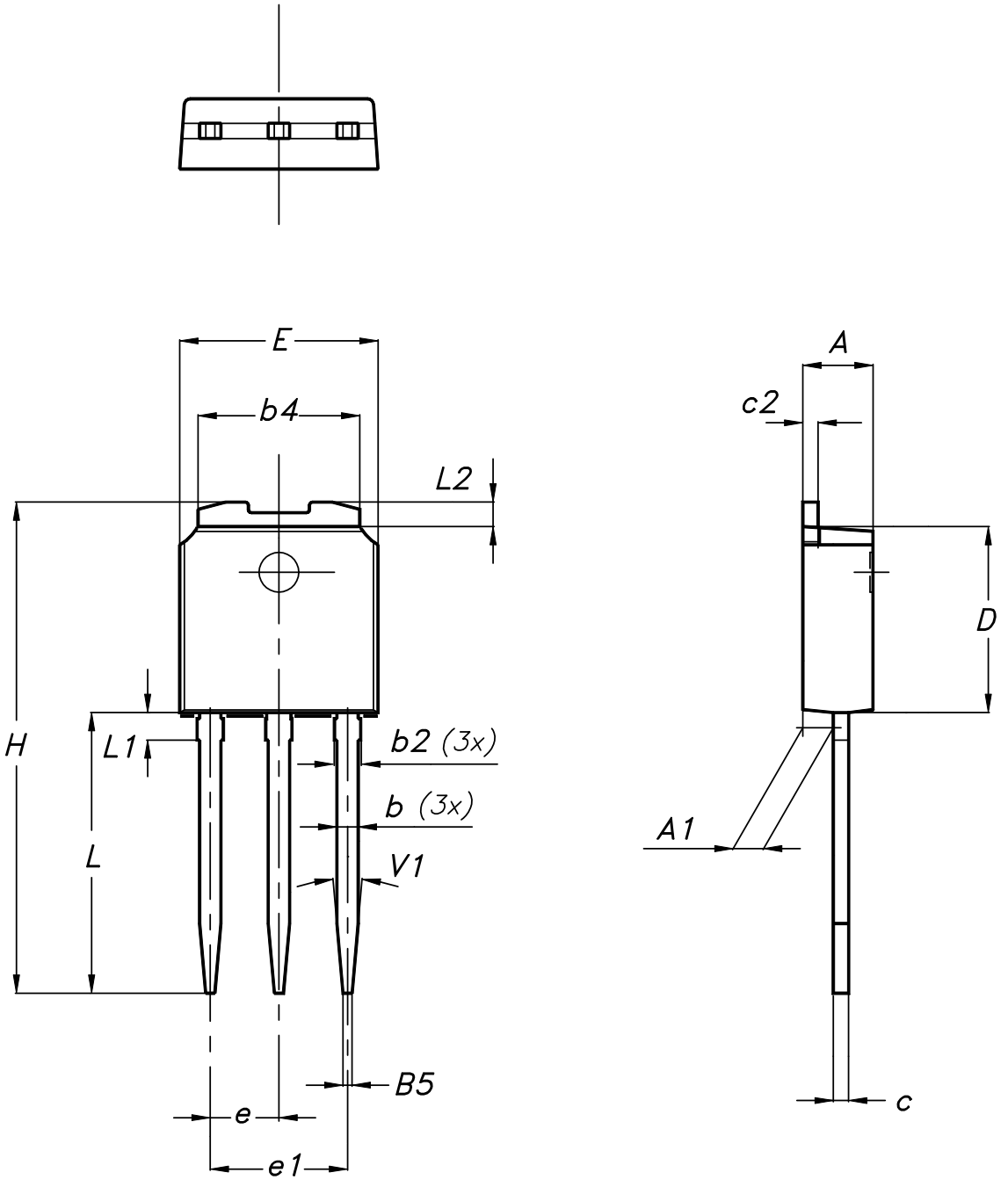


Table 9. **IPAK (TO-251) type A package mechanical data**

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**

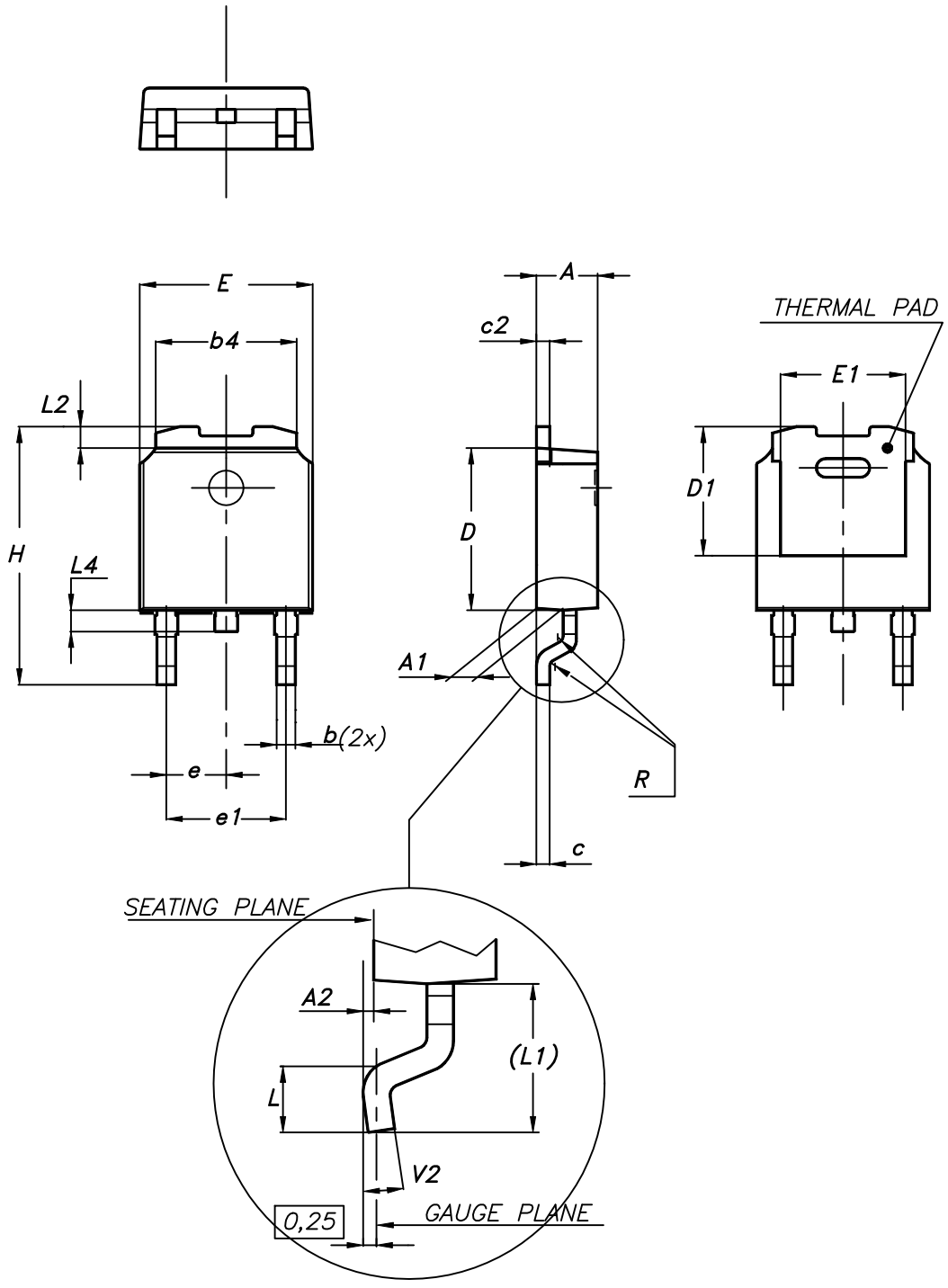


Table 10. DPAK (TO-252) type A2 mechanical data

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**

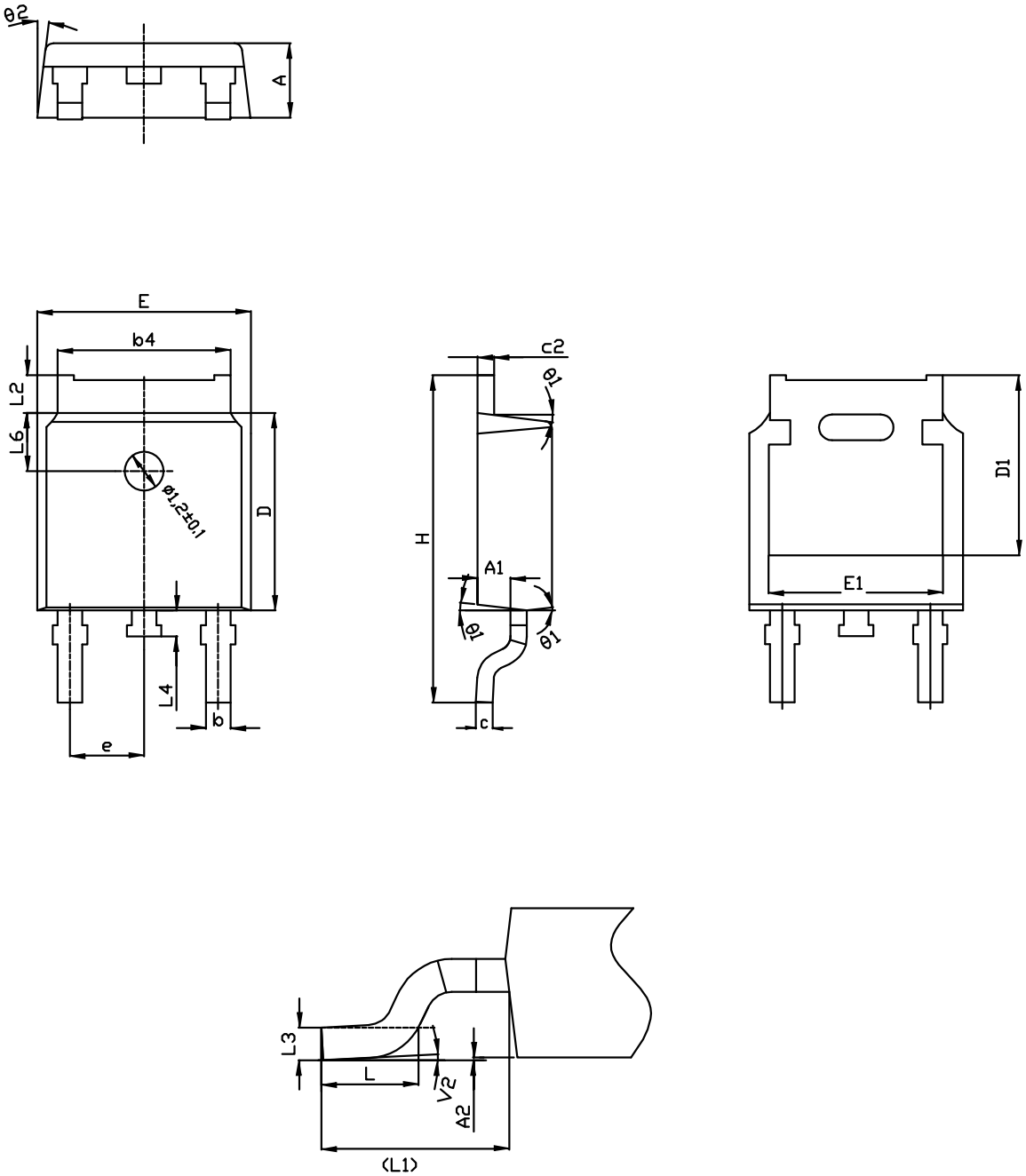


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Table 11. DPAK (TO-252) type C2 mechanical data

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**

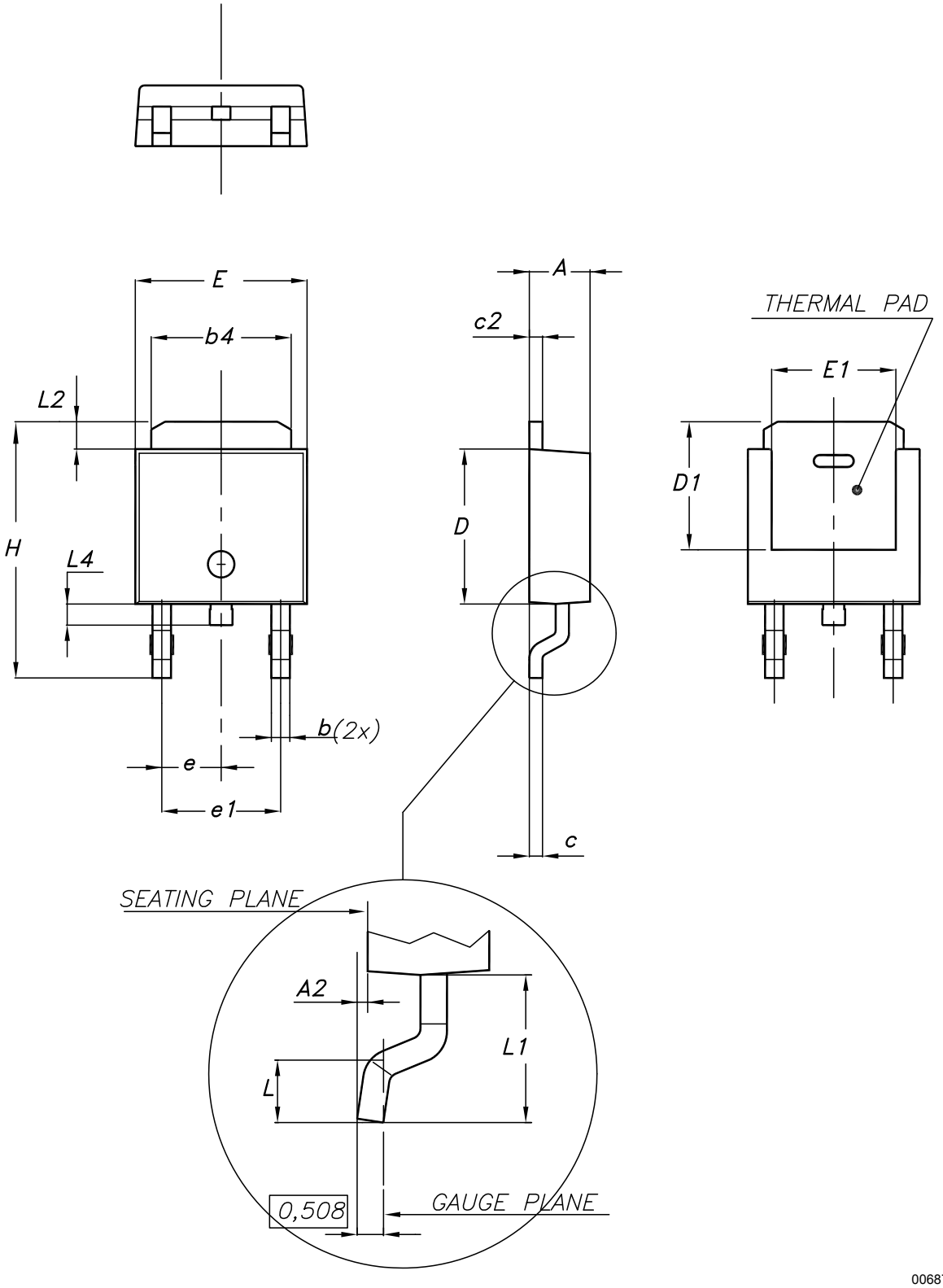

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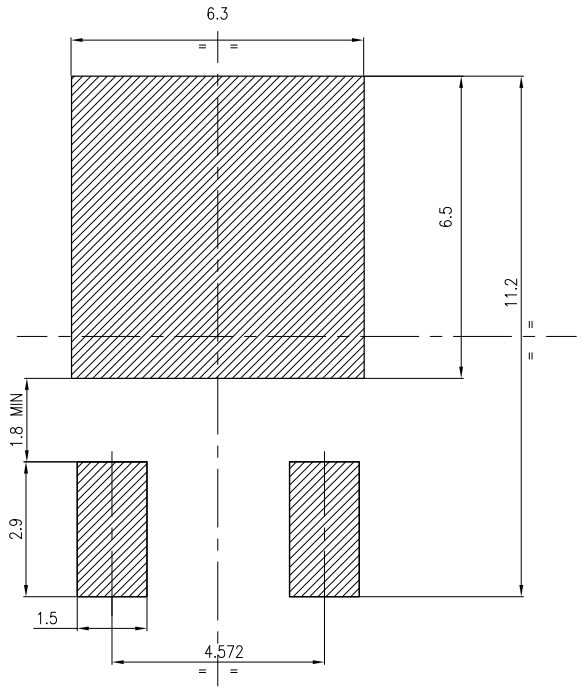
Table 12. **DPAK (TO-252) type E mechanical data**

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**

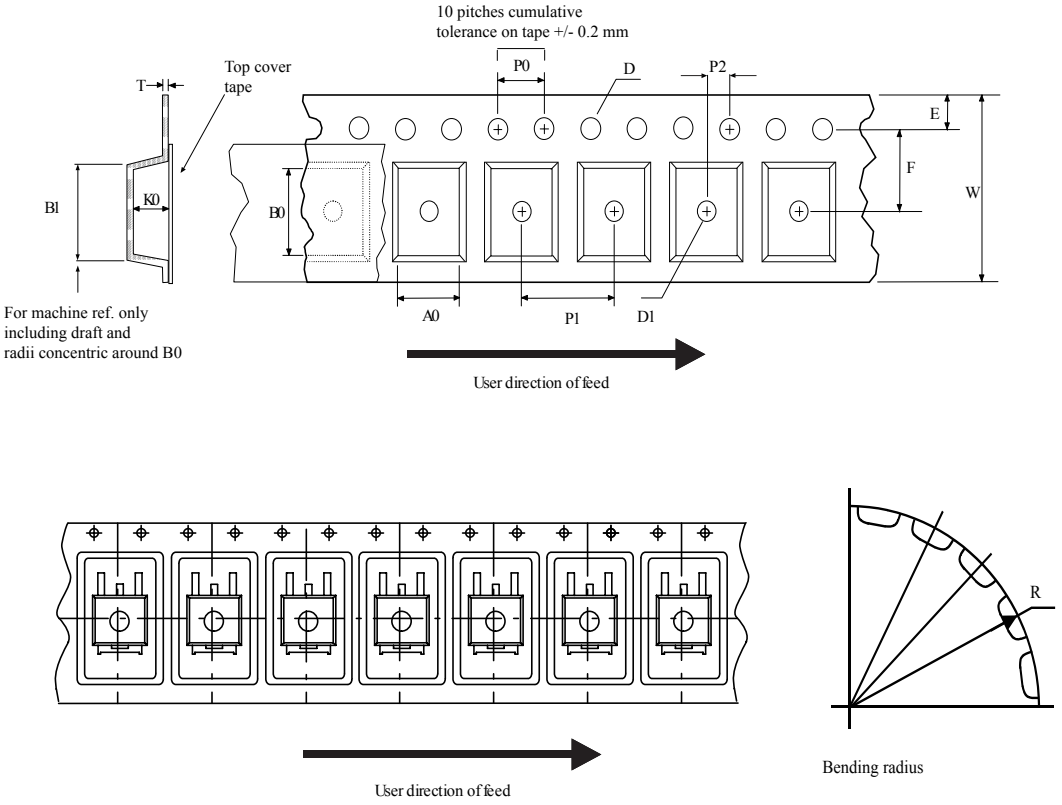

Figure 25. **DPAK (TO-252) reel outline**

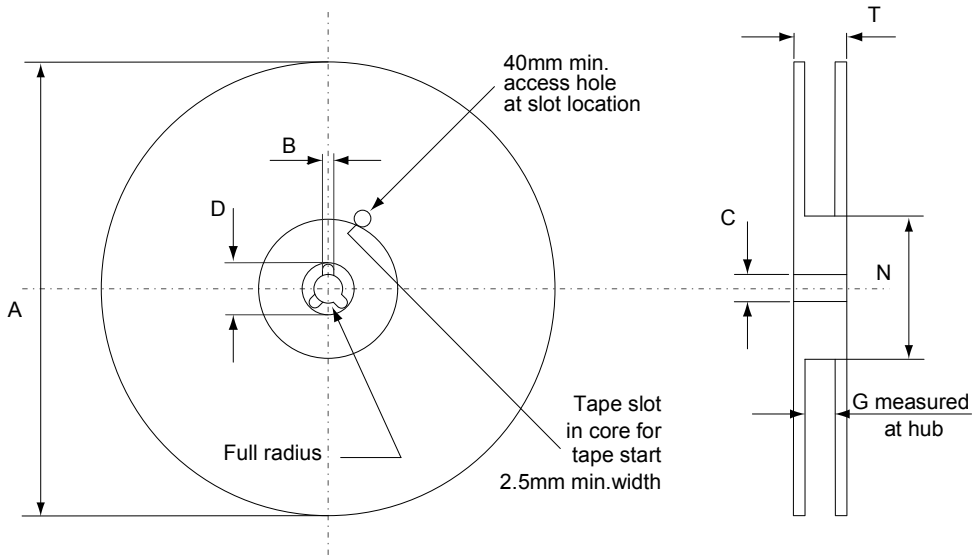

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Table 13. **DPAK (TO-252) tape and reel mechanical data**

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**

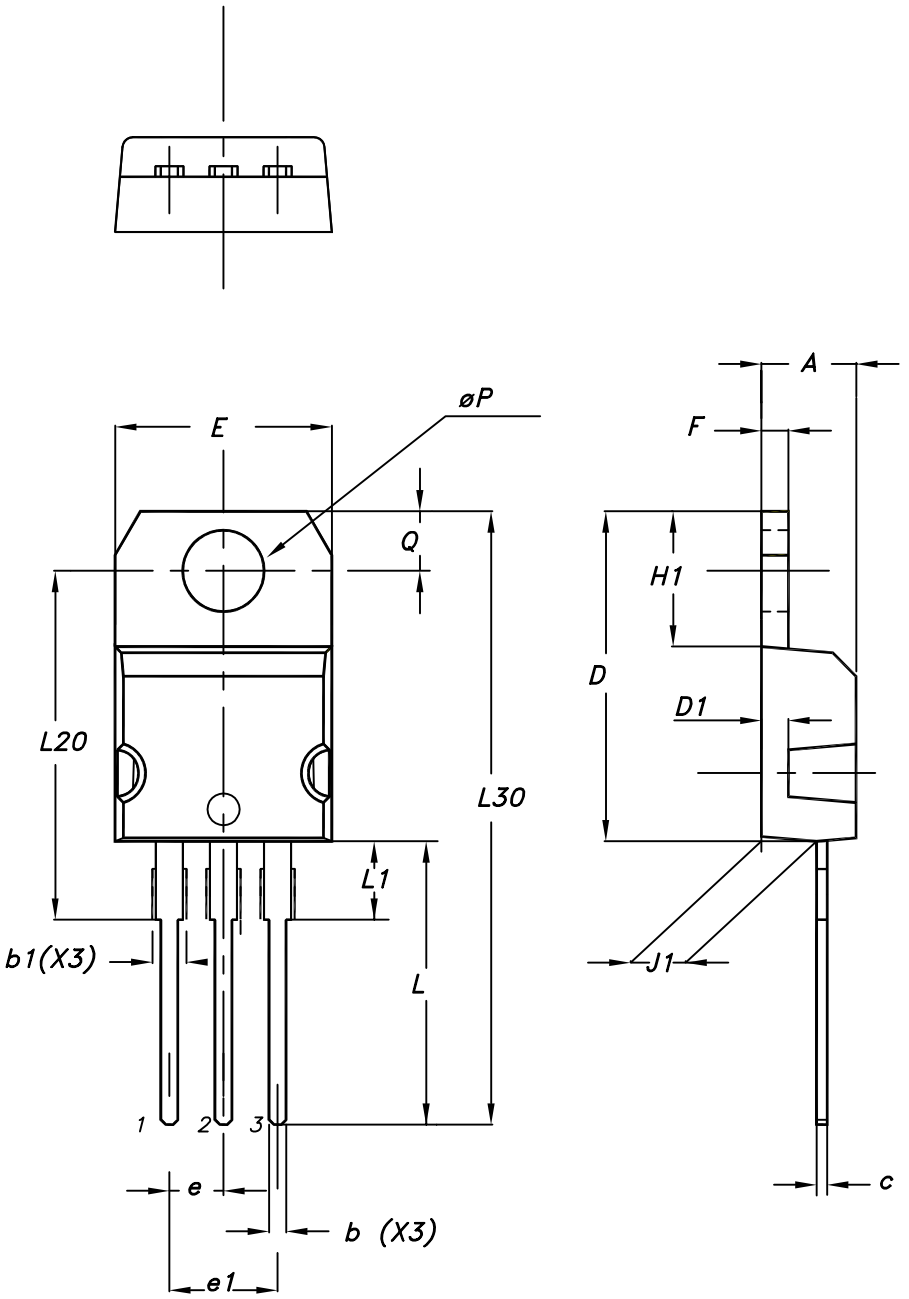

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Table 14. **TO-220 type A package mechanical data**

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, Section 1 Electrical ratings, Section 2 Electrical characteristics and Section 4 Package information. Minor text changes.

Contents