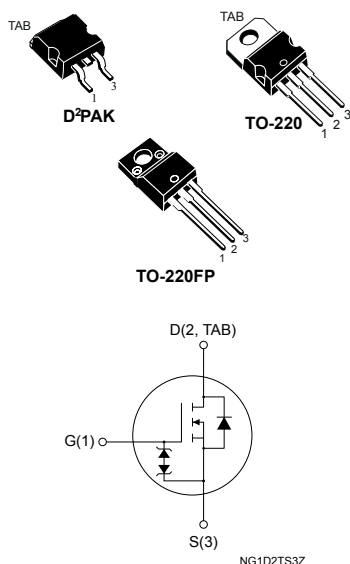




STB9NK50ZT4, STP9NK50Z, STP9NK50ZFP

Datasheet

N-channel 500 V, 700 mΩ typ., 7.2 A SuperMESH Power MOSFET in a D²PAK, TO-220 and TO-220FP packages



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB9NK50ZT4	500 V	850 mΩ	7.2 A
STP9NK50Z			
STP9NK50ZFP			

- 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 links

[STB9NK50ZT4](#)

[STP9NK50Z](#)

[STP9NK50ZFP](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK TO-220	TO-220FP	
V _{DS}	Drain-source voltage	500		V
V _{DGR}	Drain-gate Voltage (R _{GS} = 20 kΩ)	500		V
V _{GS}	Gate-source voltage	±30		V
I _D	Drain current (continuous) at T _C = 25 °C	7.2	7.2 ⁽¹⁾	A
	Drain current (continuous) at T _C = 100 °C	4.5	4.5 ⁽¹⁾	
I _{DM} ⁽²⁾	Drain current (pulsed)	28.8	28.8 ⁽¹⁾	A
P _{TOT}	Total power dissipation at T _C = 25 °C	110	30	W
ESD	Gate-source human body model (C = 100 pF, R = 1.5 kΩ)	3.5		kV
dv/dt ⁽³⁾	Peak diode recovery voltage slope	4.5		V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)	-	2.5	kV
T _J	Operating junction temperature range	-55 to 150		°C
T _{stg}	Storage temperature range			

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. I_{SD} ≤ 7.2 A, di/dt ≤ 200 A/μs.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK TO-220	TO-220FP	
R _{thJC}	Thermal resistance, junction-to-case	1.14	4.2	°C/W
R _{thJA}	Thermal resistance, junction-to-ambient	62.5		°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max.)	7.2	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	190	mJ

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	500	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$	-	-	50	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$	-	-	± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 3.6\text{ A}$	-	700	850	$\text{m}\Omega$

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	910	-	pF
C_{oss}	Output capacitance		-	125	-	pF
C_{rss}	Reverse transfer capacitance		-	30	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0\text{ V}$	-	75	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 7.2\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 16. Test circuit for gate charge behavior)	-	32	-	nC
Q_{gs}	Gate-source charge		-	6	-	nC
Q_{gd}	Gate-drain charge		-	18	-	nC

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 condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 3.6\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see the Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	17	-	ns
t_r	Rise time		-	20	-	ns
$t_{d(off)}$	Turn-off delay time		-	45	-	ns
t_f	Fall time	$V_{DD} = 400\text{ V}$, $I_D = 7.2\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	22	-	ns
$t_{r(voff)}$	Off-voltage rise time		-	15	-	ns
t_f	Fall time		-	13	-	ns
t_c	Cross-over time		-	30	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current	-	-	-	7.2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	28.8	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 7.2 \text{ A}$, $V_{GS} = 0 \text{ V}$	-	-	1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 7.2 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 40 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$ (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	238	-	ns
Q_{rr}	Reverse recovery charge		-	1.5	-	μC
I_{RRM}	Reverse recovery current		-	12.6	-	A

1. Pulse width is limited by safe operating area.

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics curves

Figure 1. Safe operating area for D²PAK and TO-220

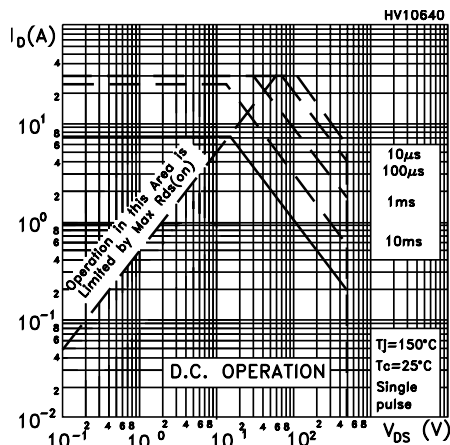


Figure 2. Normalized transient thermal impedance for D²PAK and TO-220

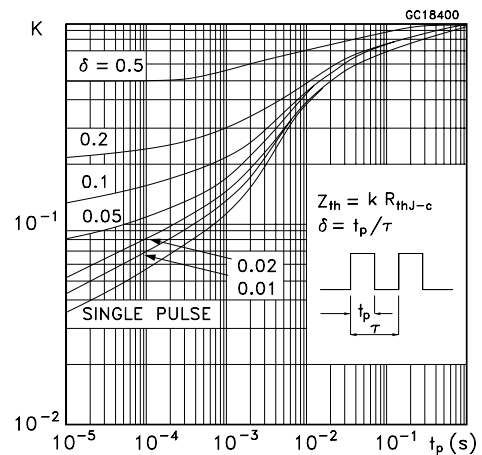


Figure 3. Safe operating area for TO-220FP

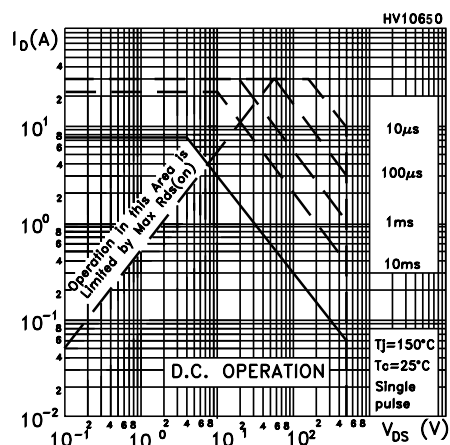


Figure 4. Normalized transient thermal impedance for TO-220FP

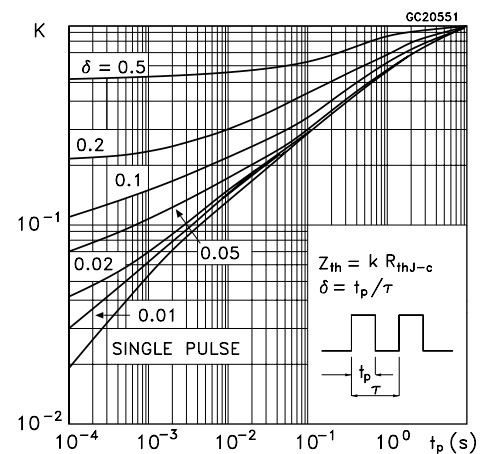


Figure 5. Typical output characteristics

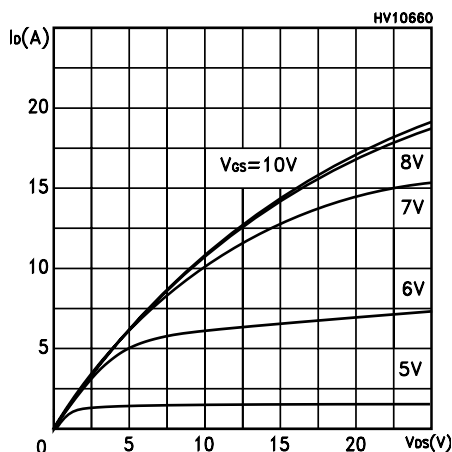


Figure 6. Typical transfer characteristics

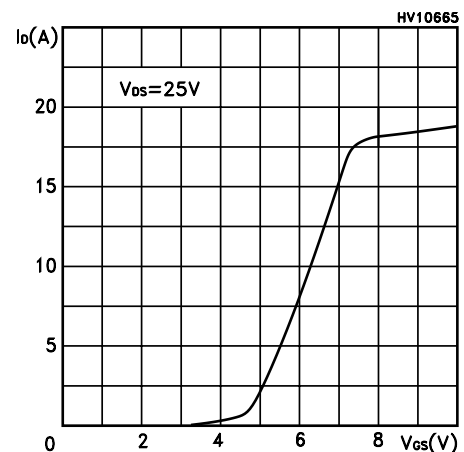


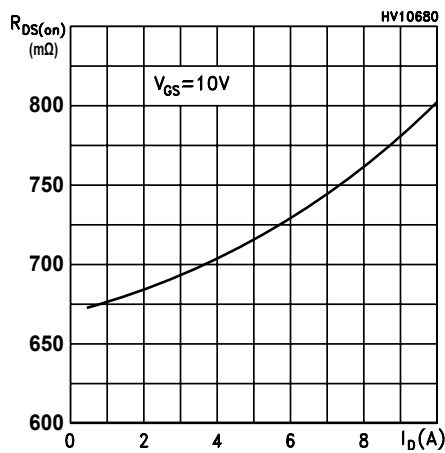
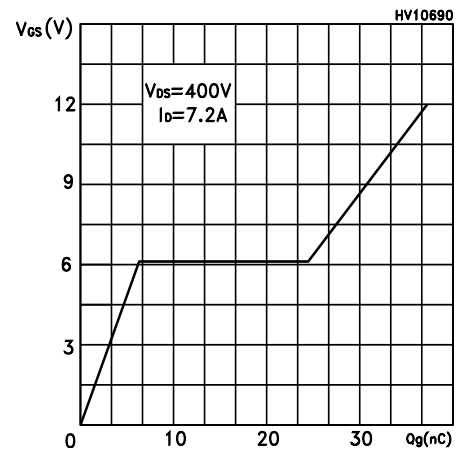
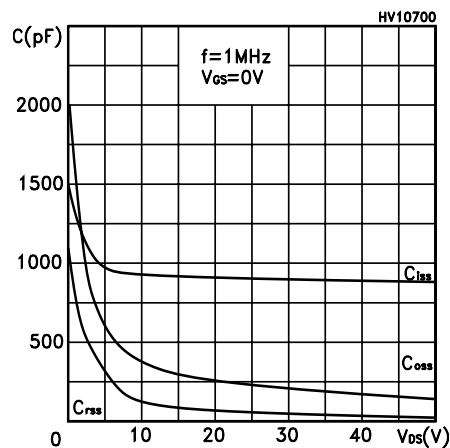
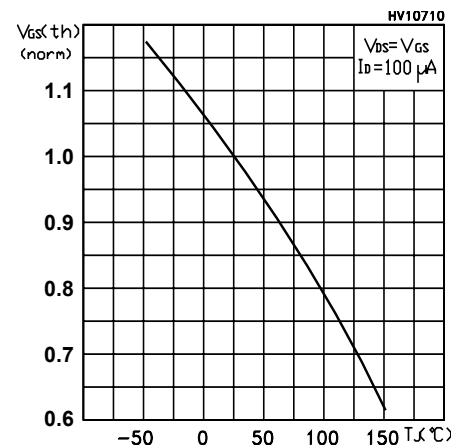
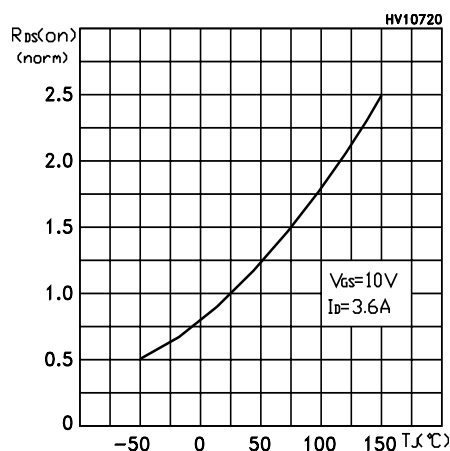
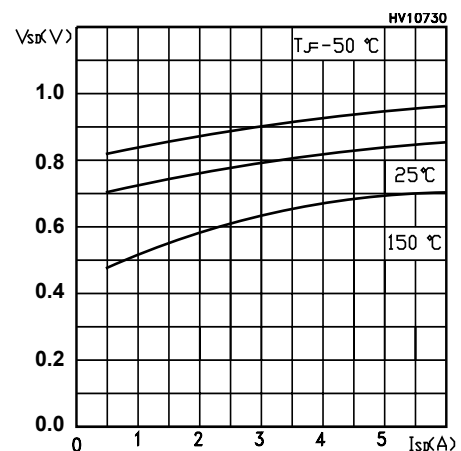
Figure 7. Typical static drain-source on-resistance

Figure 8. Typical gate charge characteristics

Figure 9. Typical capacitance variations

Figure 10. Normalized gate threshold vs temperature

Figure 11. Normalized on-resistance vs temperature

Figure 12. Typical reverse diode forward characteristics


Figure 13. Normalized breakdown voltage vs temperature

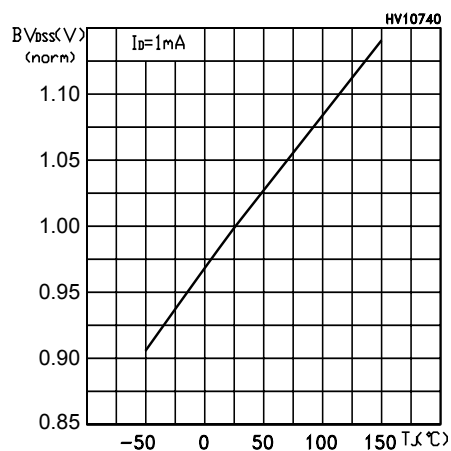
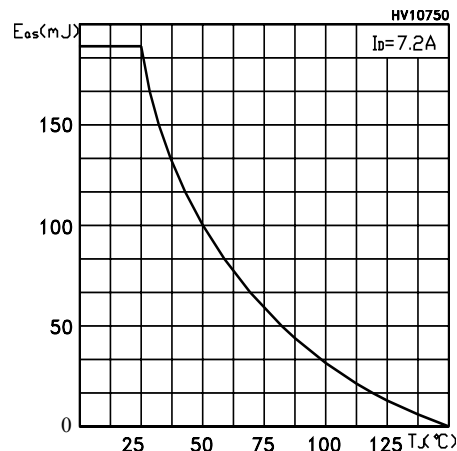
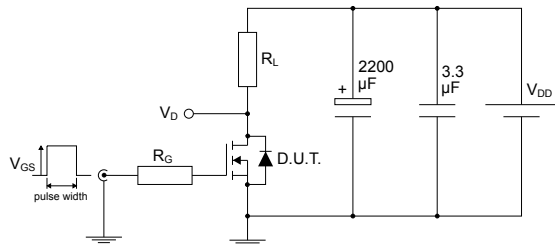


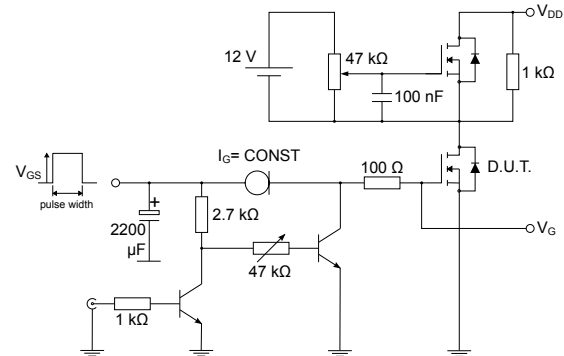
Figure 14. Maximum avalanche energy vs temperature



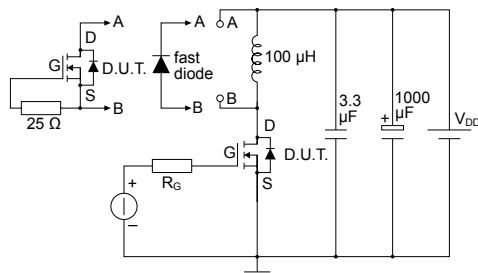
3 Test circuits

Figure 15. Test circuit for resistive load switching times


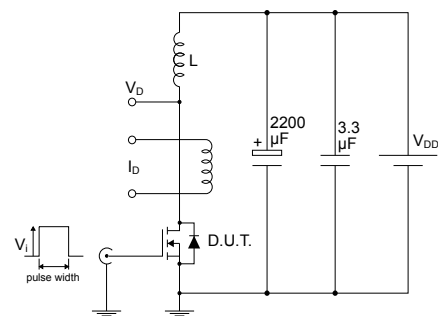
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Figure 16. Test circuit for gate charge behavior


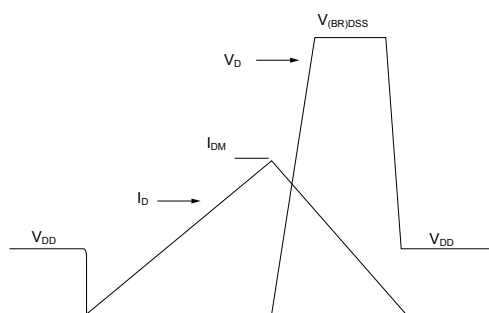
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Figure 17. Test circuit for inductive load switching and diode recovery times


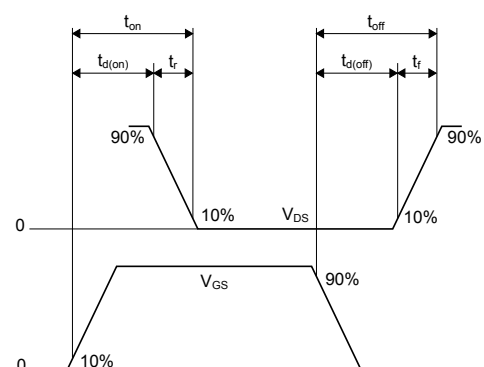
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Figure 18. Unclamped inductive load test circuit


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Figure 19. Unclamped inductive waveform


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Figure 20. Switching time waveform


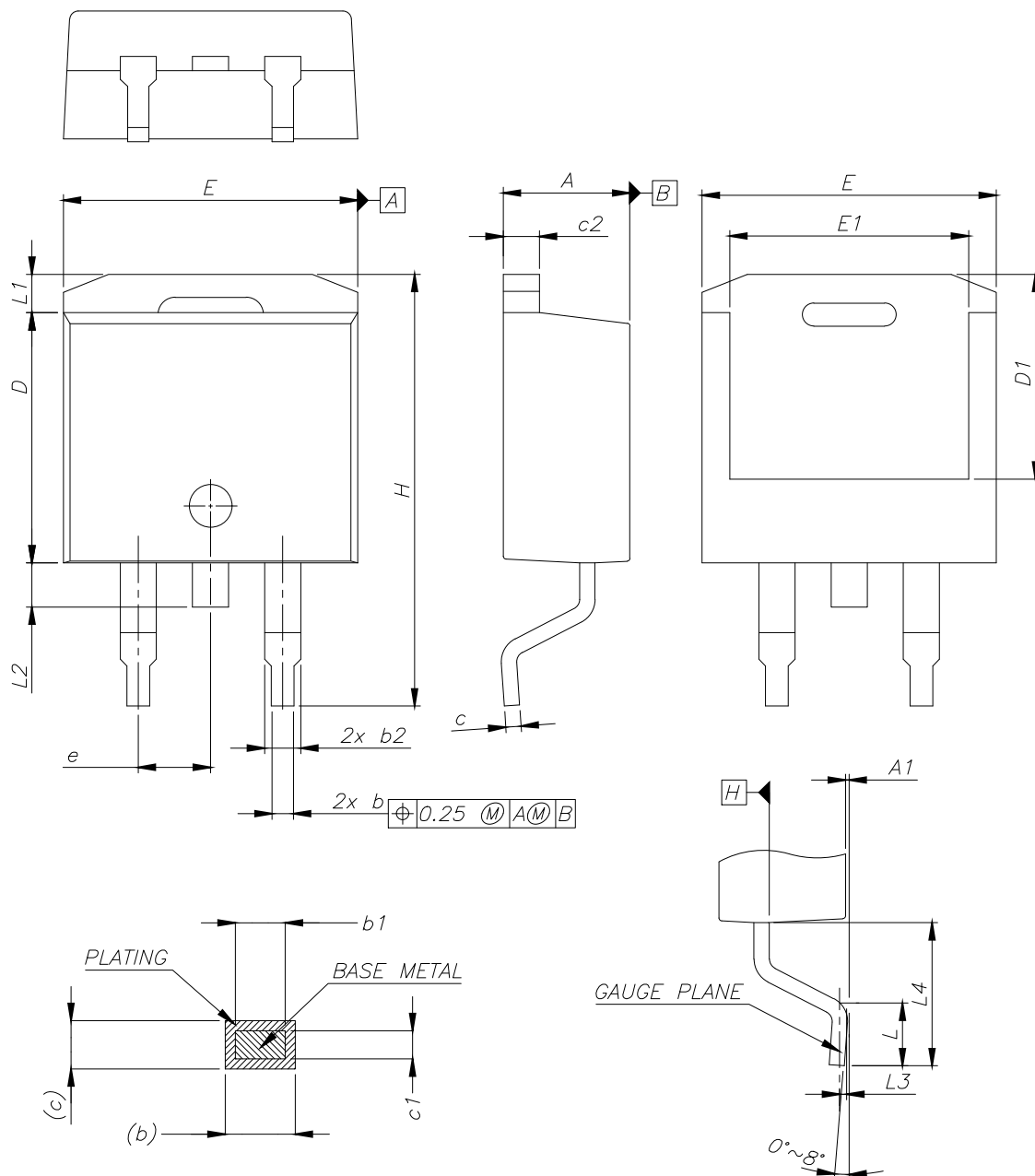
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4

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

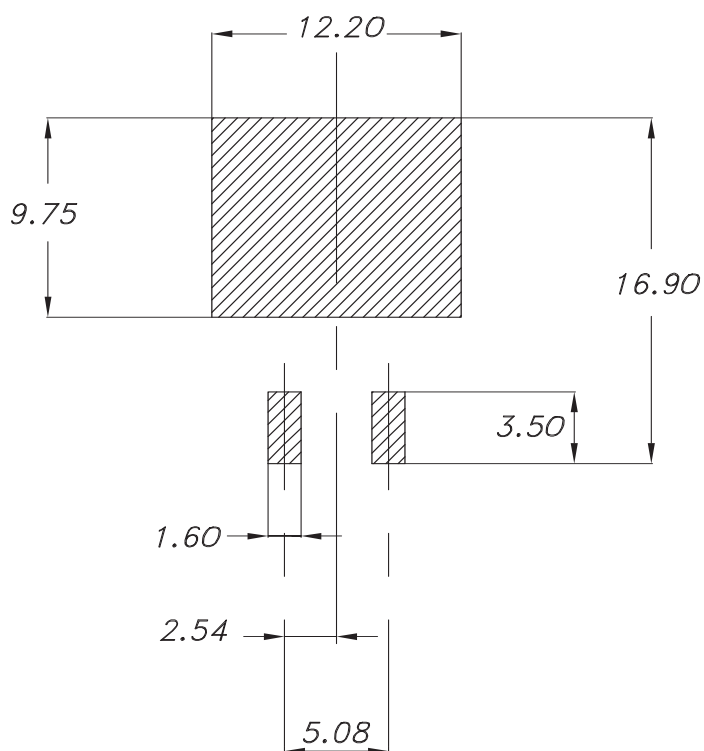
Figure 21. D²PAK (TO-263) type B package outline



0079457_27_B

Table 8. D²PAK (TO-263) type B mechanical data

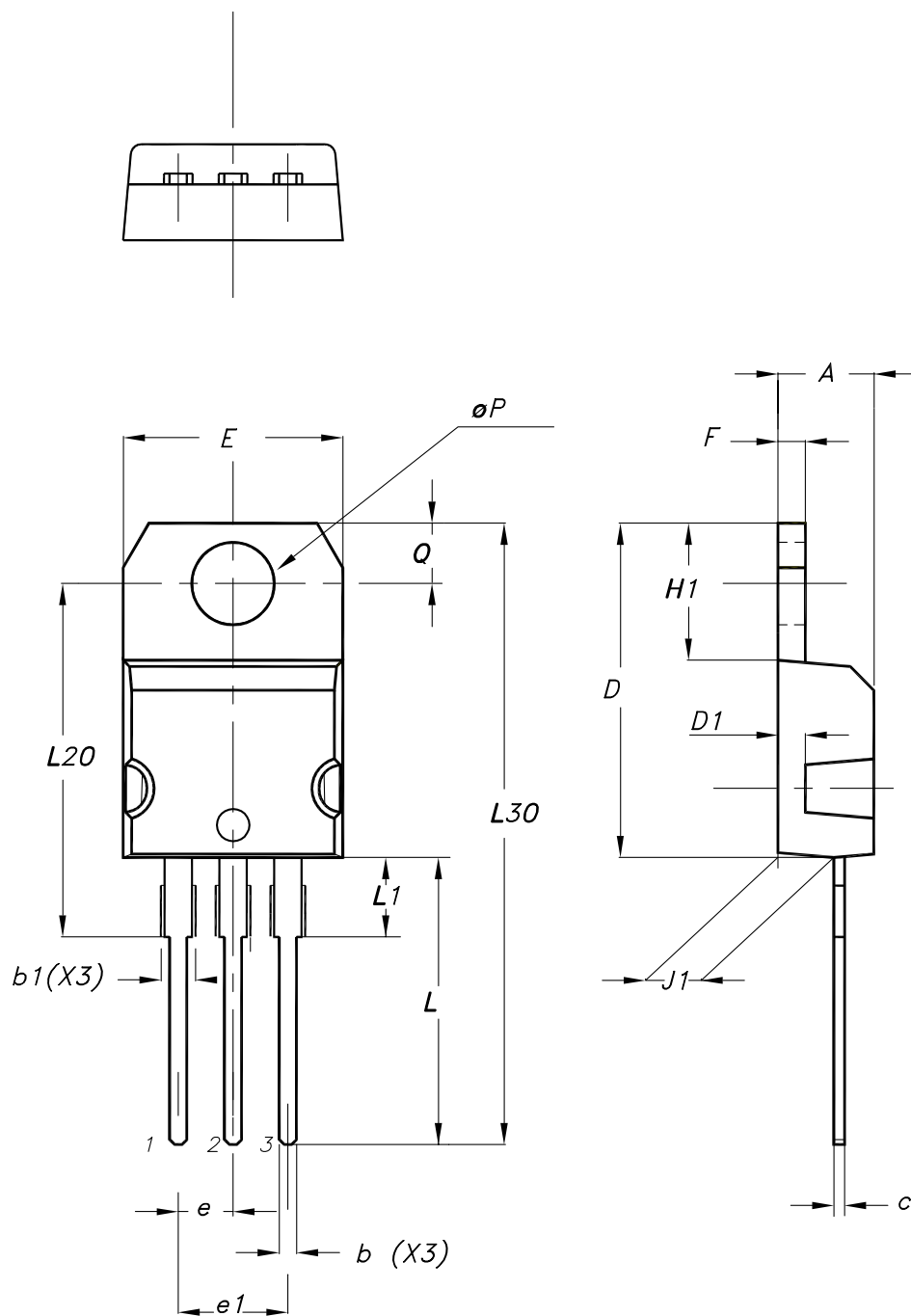
Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 22. D²PAK (TO-263) recommended footprint (dimensions are in mm)


0079457_Rev27_footprint

4.2 TO-220 type A package information

Figure 23. TO-220 type A package outline



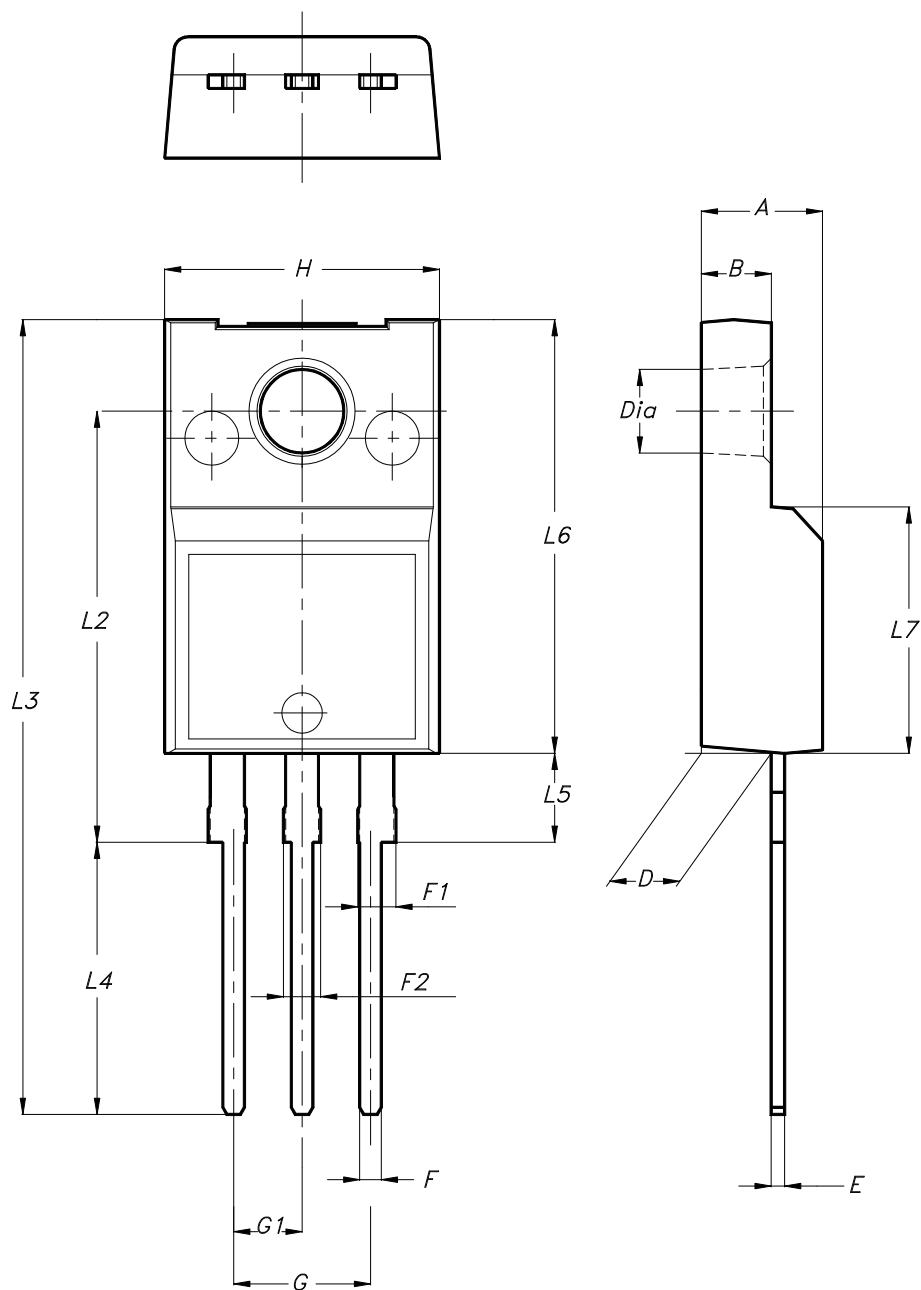
0015988_typeA_Rev_24

Table 9. 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
Slug flatness		0.03	0.10

4.3 TO-220FP type B package information

Figure 24. TO-220FP type B package outline



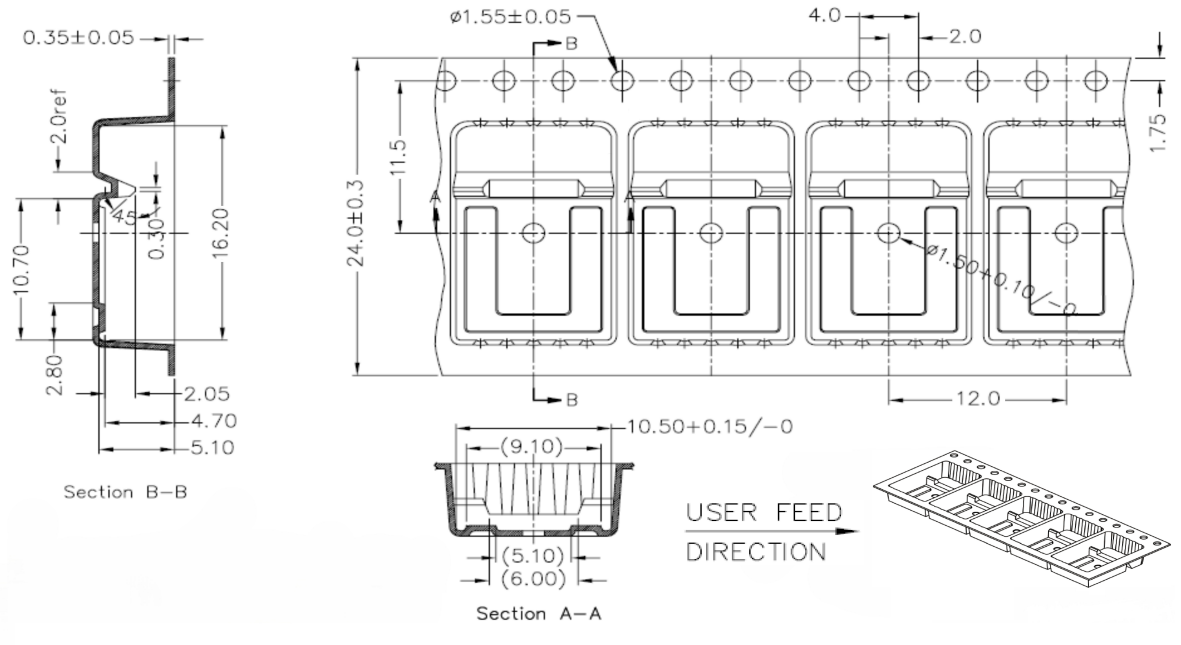
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Table 10. TO-220FP type B package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.4 D²PAK packing information

Figure 25. D²PAK tape drawing (dimensions are in mm)



DM01095771_2



5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STB9NK50ZT4	B9NK50Z	D ² PAK	Tape and reel
STP9NK50Z	P9NK50Z	TO-220	Tube
STP9NK50ZFP	P9NK50ZFP	TO-220FP	

Revision history

Table 12. Document revision history

Date	Version	Changes
27-Oct-2025	3	Updated Section 4: Package information . Removed order code STB9NK50Z-1. Minor text changes.



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