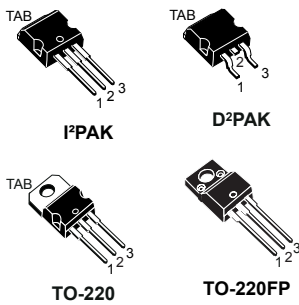




STB6NK60Z-1, STB6NK60ZT4 STP6NK60Z, STP6NK60ZFP

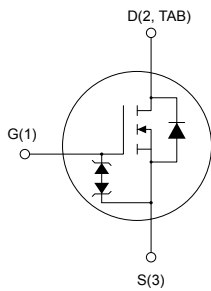
Datasheet

N-channel 600 V, 1 Ω typ., 6 A SuperMESH Power MOSFETs
in I²PAK, D²PAK, TO-220 and TO-220FP packages



TO-220

TO-220FP



AM01476v1_tab



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB6NK60Z-1	600 V	1.2 Ω	6 A
STB6NK60ZT4			
STP6NK60Z			
STP6NK60ZFP			

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- 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

[STB6NK60Z-1](#)

[STB6NK60ZT4](#)

[STP6NK60Z](#)

[STP6NK60ZFP](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		I ² PAK, D ² PAK TO-220	TO-220FP	
V _{DS}	Drain-source voltage	600		V
V _{GS}	Gate-source voltage	±30		V
I _D	Drain current (continuous) at T _C = 25 °C	6	6 ⁽¹⁾	A
	Drain current (continuous) at T _C = 100 °C	3.8	3.8 ⁽¹⁾	
I _{DM} ⁽²⁾	Drain current (pulsed)	24	24 ⁽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 _{stg}	Storage temperature range	-55 to 150		°C
T _J	Operating junction temperature range			

1. Limited by maximum junction temperature.
2. Pulse width is limited by safe operating area.
3. I_{SD} ≤ 6 A, di/dt ≤ 200 A/μs, V_{DD} = 480 V.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		I ² PAK, 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 is limited by T _J max.)	6	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	210	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}^{(1)}$			50	
I_{GSS}	Gate body leakage current	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3.00	3.75	4.50	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 3\text{ A}$		1	1.2	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	905		pF
C_{oss}	Output capacitance		-	115		pF
C_{rss}	Reverse transfer capacitance		-	25		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }480\text{ V}$	-	56		pF
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 6\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 16. Test circuit for gate charge behavior)	-	33	46 ⁽²⁾	nC
Q_{gs}	Gate-source charge		-	6		nC
Q_{gd}	Gate-drain charge		-	17		nC

1. $C_{oss\text{ eq.}}$ 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	$V_{DD} = 300\text{ V}$, $I_D = 3\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	14	-	ns
t_r	Rise time		-	14	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	47	-	ns
t_f	Fall time		-	19	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		6	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		24	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 6\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 6\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	445		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 50\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	2.7		μC
I_{RRM}	Reverse recovery current	(see Figure 17. Test circuit for inductive load switching and diode recovery times)	-	12		A

1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

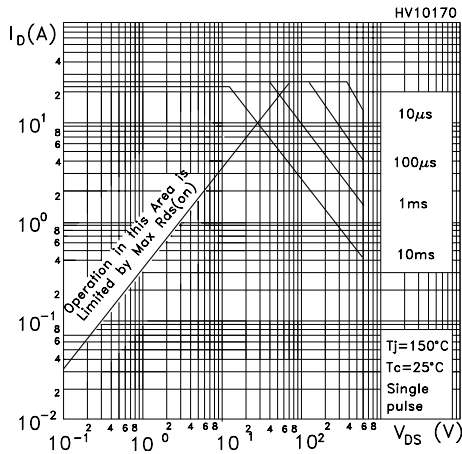
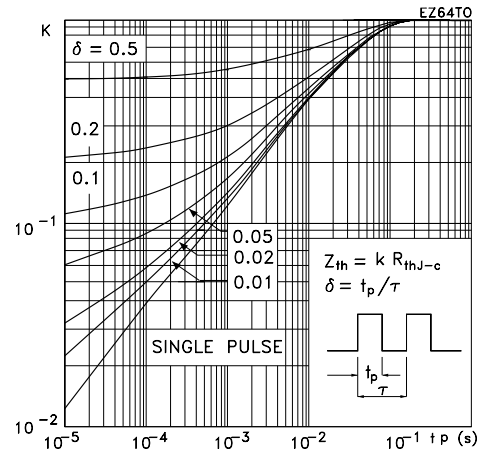
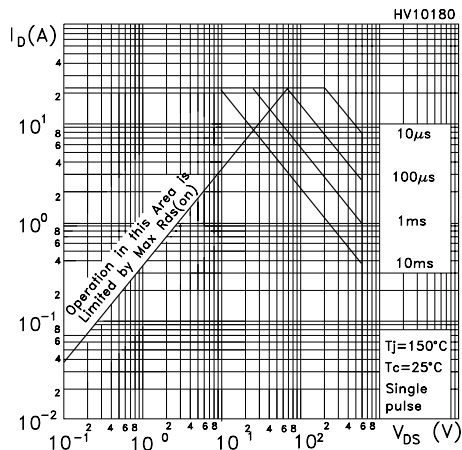
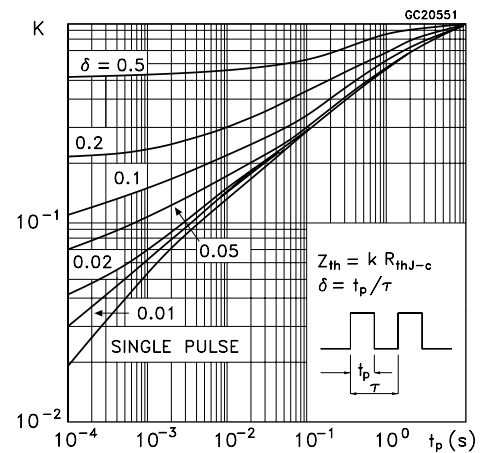
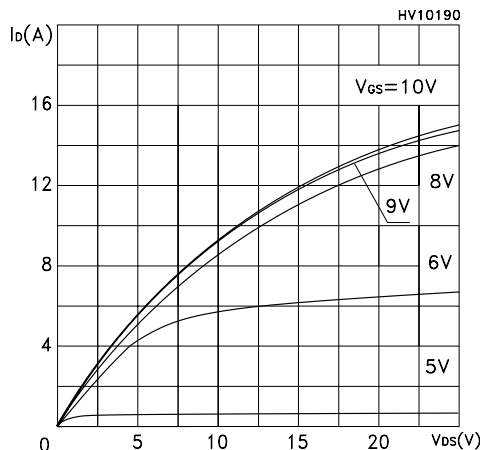
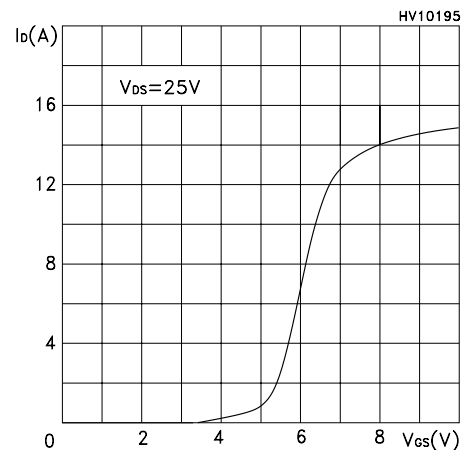
2.1 Electrical characteristics (curves)
Figure 1. Safe operating area for I²PAK, D²PAK and TO-220

Figure 2. Normalized transient thermal impedance for I²PAK, 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


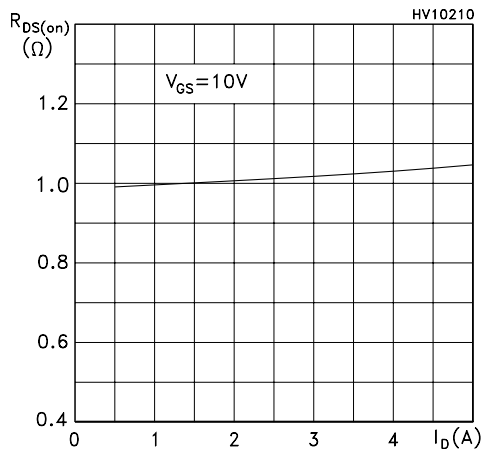
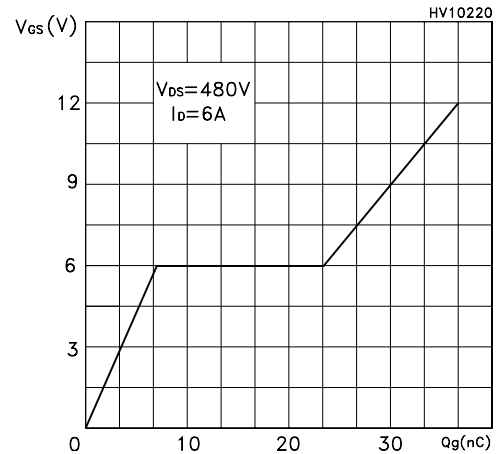
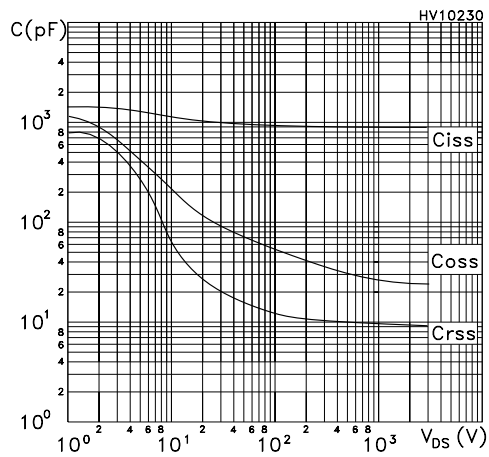
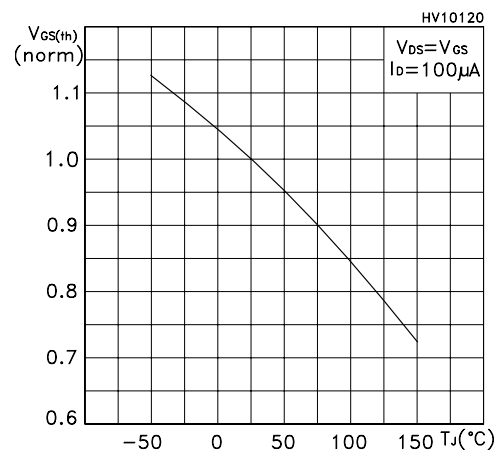
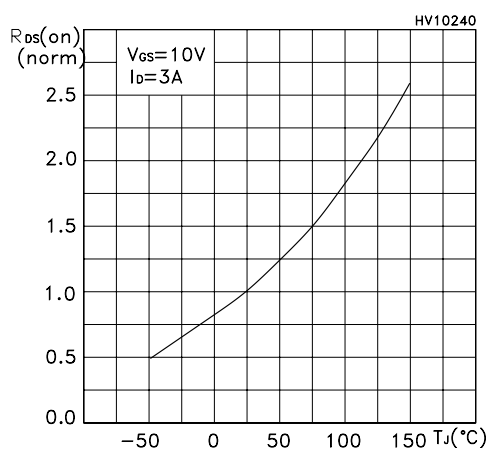
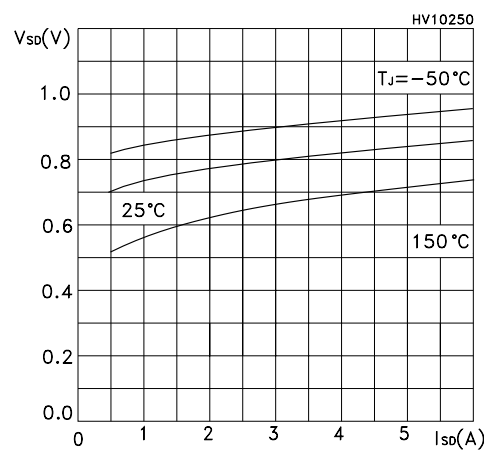
Figure 7. Typical drain-source on-resistance

Figure 8. Typical gate charge characteristics

Figure 9. Typical capacitance characteristics

Figure 10. Normalized gate threshold vs temperature

Figure 11. Normalized on-resistance vs temperature

Figure 12. Typical reverse diode forward characteristics


Figure 13. Maximum avalanche energy vs temperature

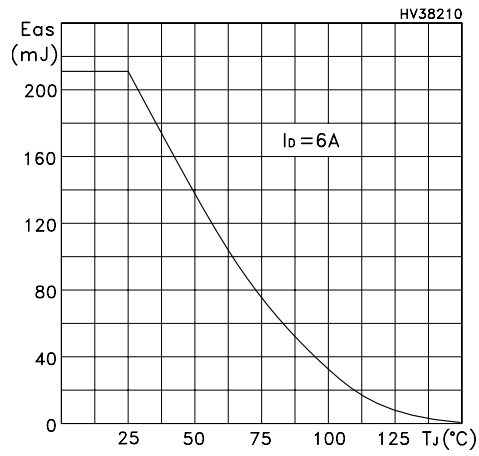
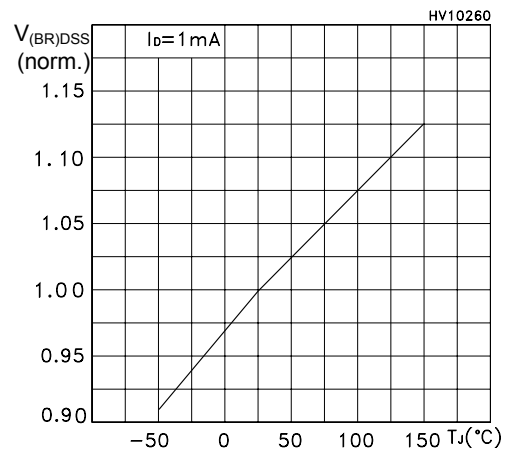
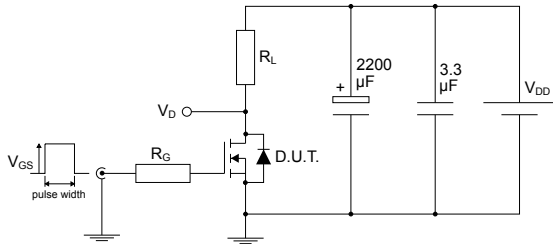


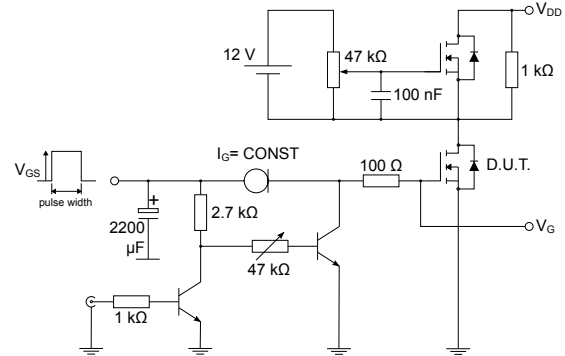
Figure 14. Normalized breakdown voltage vs temperature



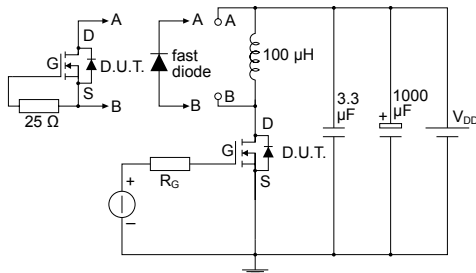
3 Test circuits

Figure 15. Test circuit for resistive load switching times


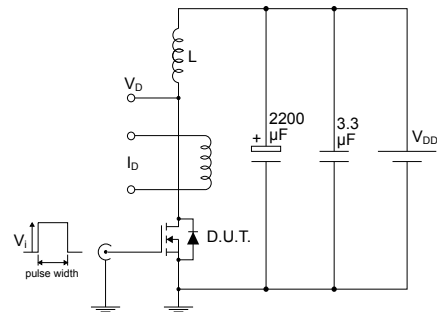
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Figure 16. Test circuit for gate charge behavior


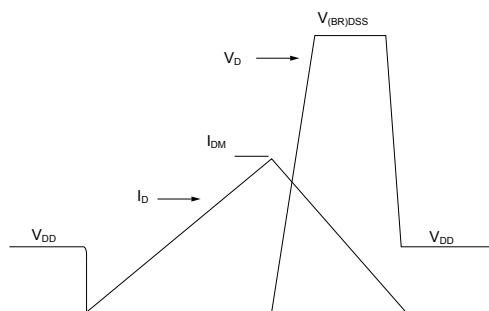
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Figure 17. Test circuit for inductive load switching and diode recovery times


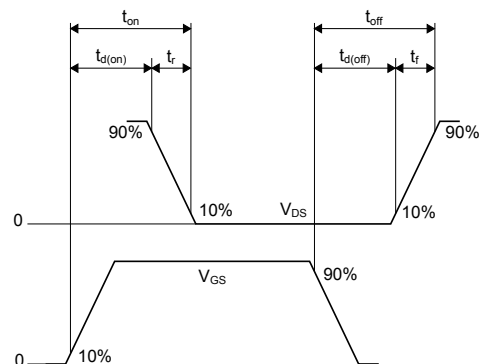
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Figure 18. Unclamped inductive load test circuit


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Figure 19. Unclamped inductive waveform


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Figure 20. Switching time waveform


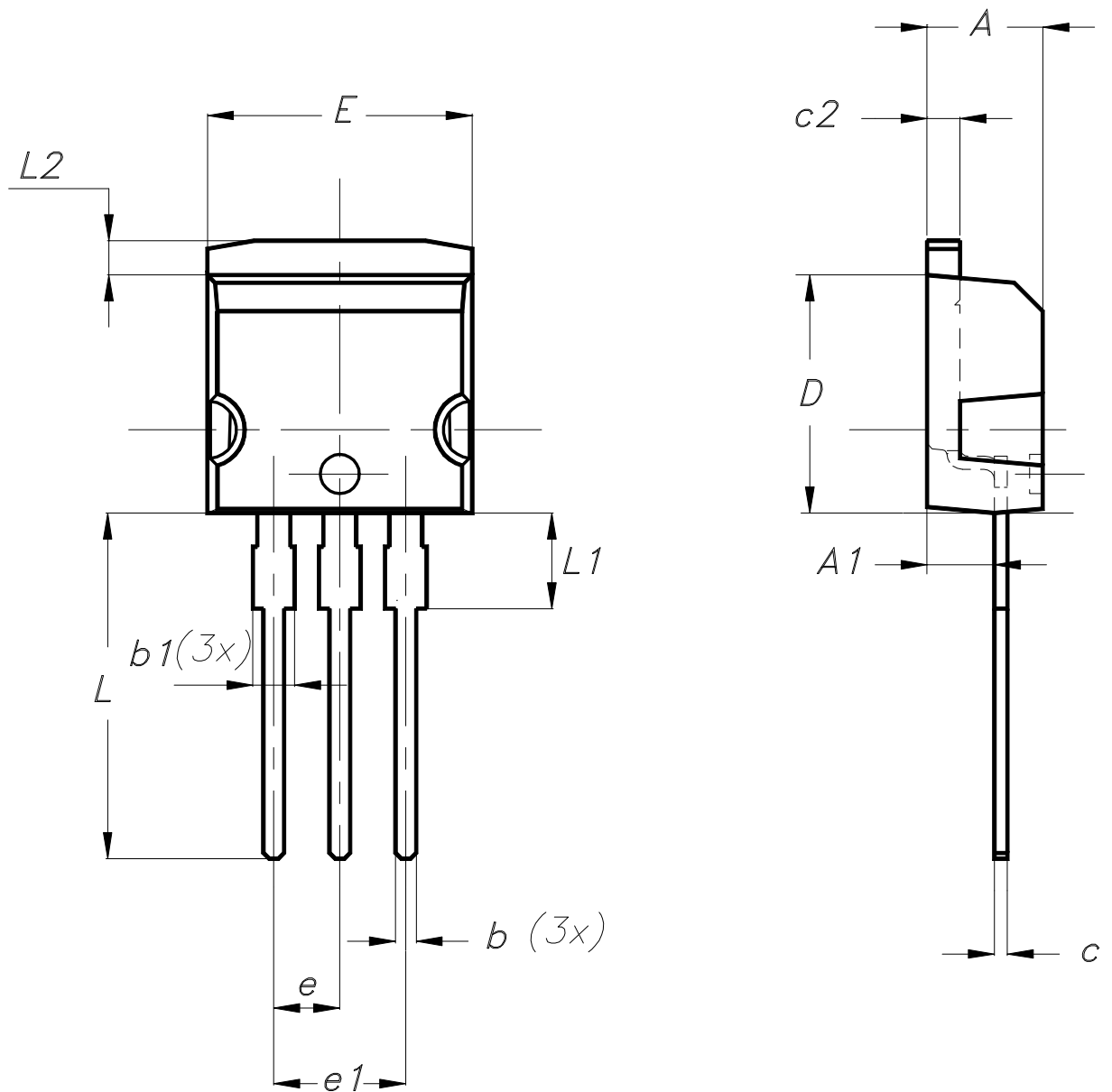
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4 Package information

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 I²PAK package information

Figure 21. I²PAK package outline



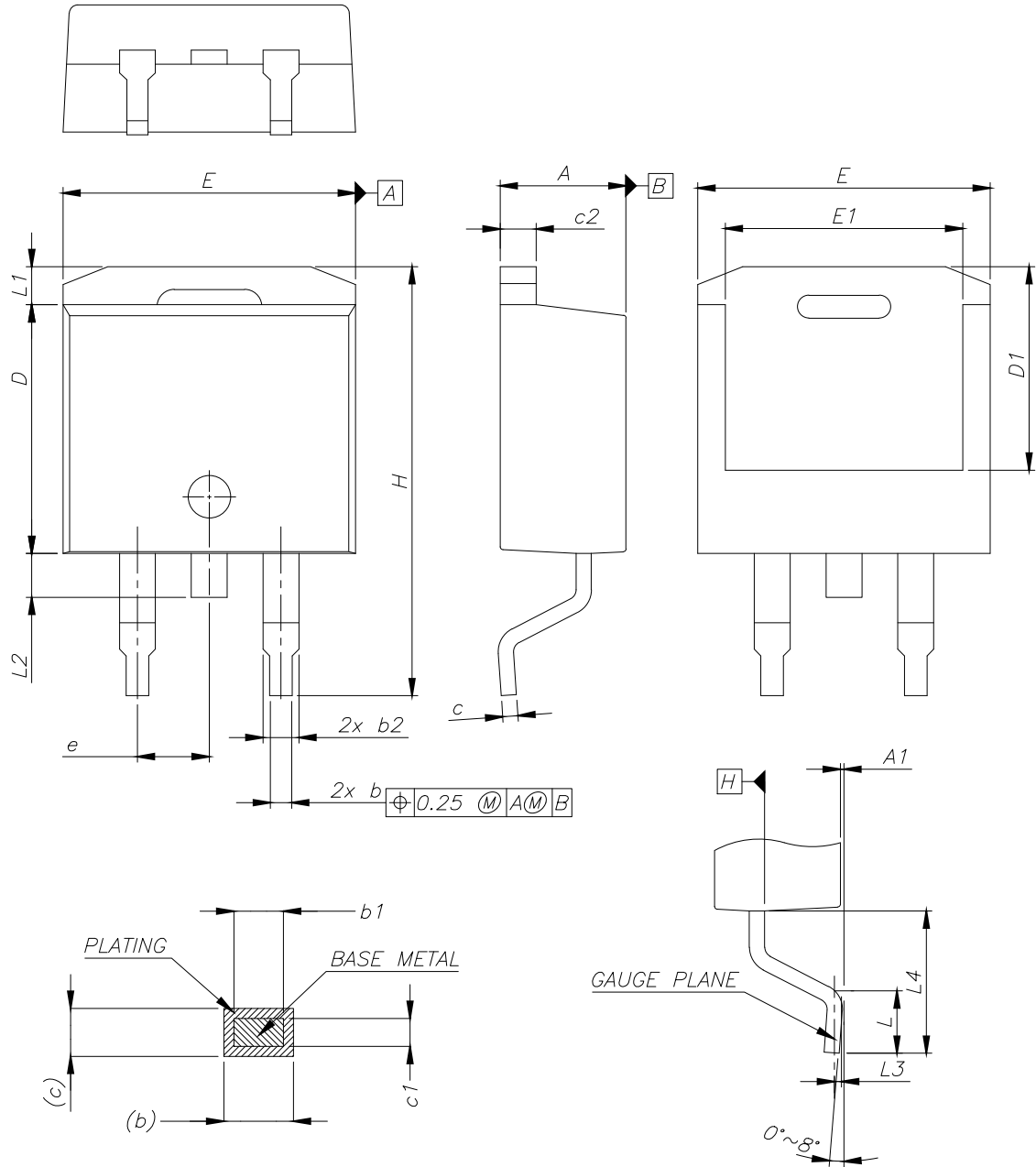
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Table 8. I²PAK package mechanical data

Dim.	mm	
	Min.	Max.
A	4.40	4.60
A1	2.40	2.72
b	0.61	0.88
b1	1.14	1.70
c	0.49	0.70
c2	1.23	1.32
D	8.95	9.35
e	2.40	2.70
e1	4.95	5.15
E	10.00	10.40
L	13.00	14.00
L1	3.50	3.93
L2	1.27	1.40

4.2 D²PAK (TO-263) type B package information

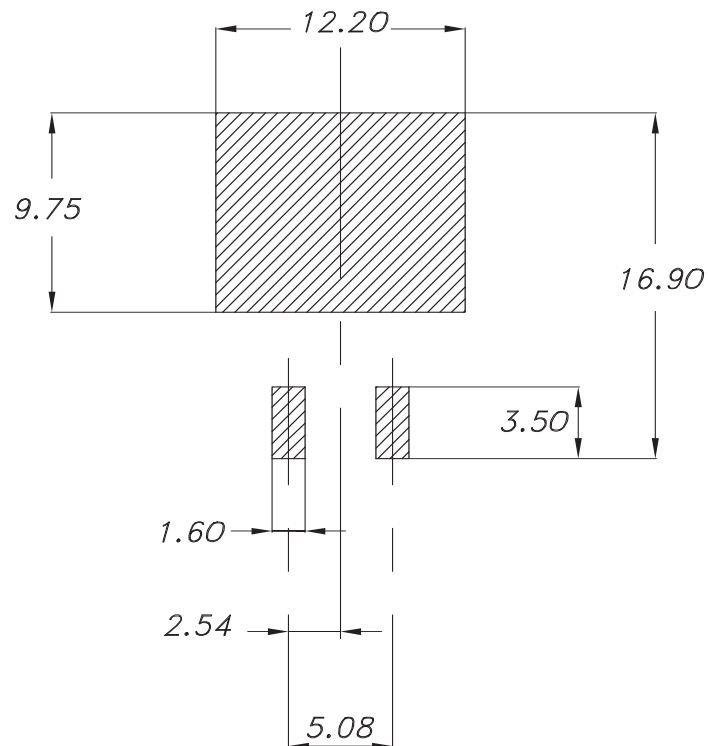
Figure 22. D²PAK (TO-263) type B package outline



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Table 9. D²PAK (TO-263) type B mechanical data

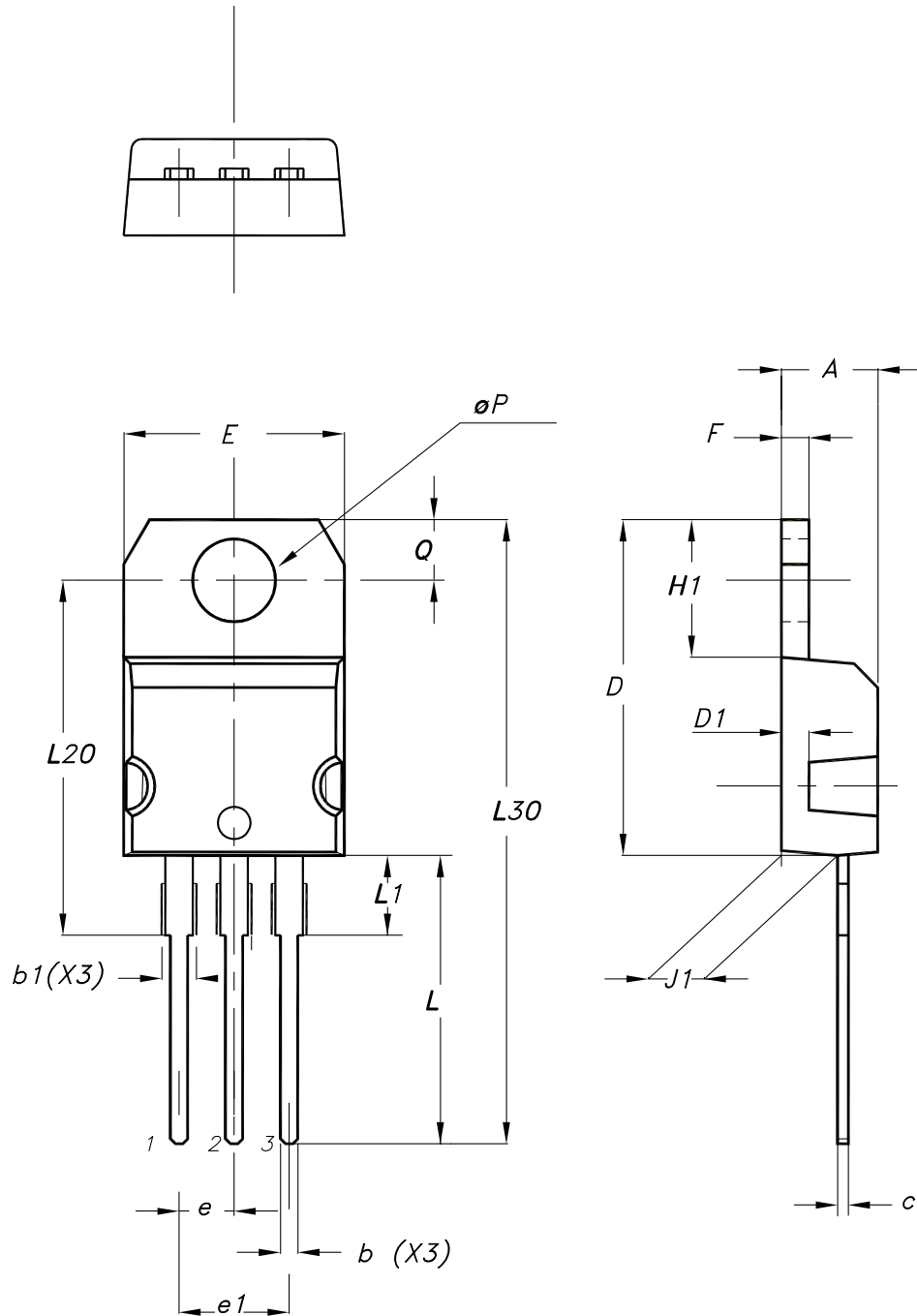
Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 23. D²PAK (TO-263) recommended footprint (dimensions are in mm)


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4.3 TO-220 type A package information

Figure 24. TO-220 type A package outline



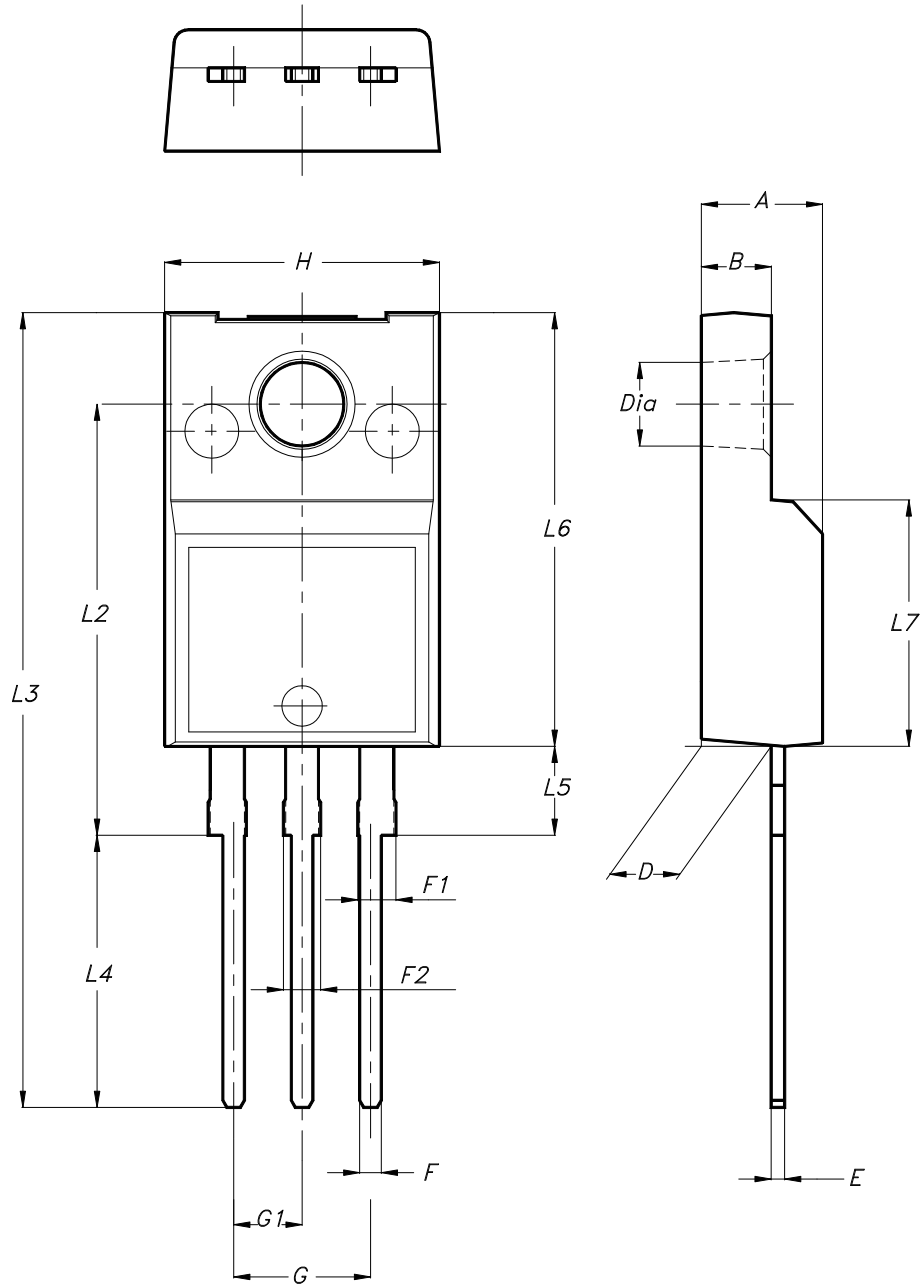
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Table 10. TO-220 type A package mechanical data

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

4.4 TO-220FP type B package information

Figure 25. TO-220FP type B package outline



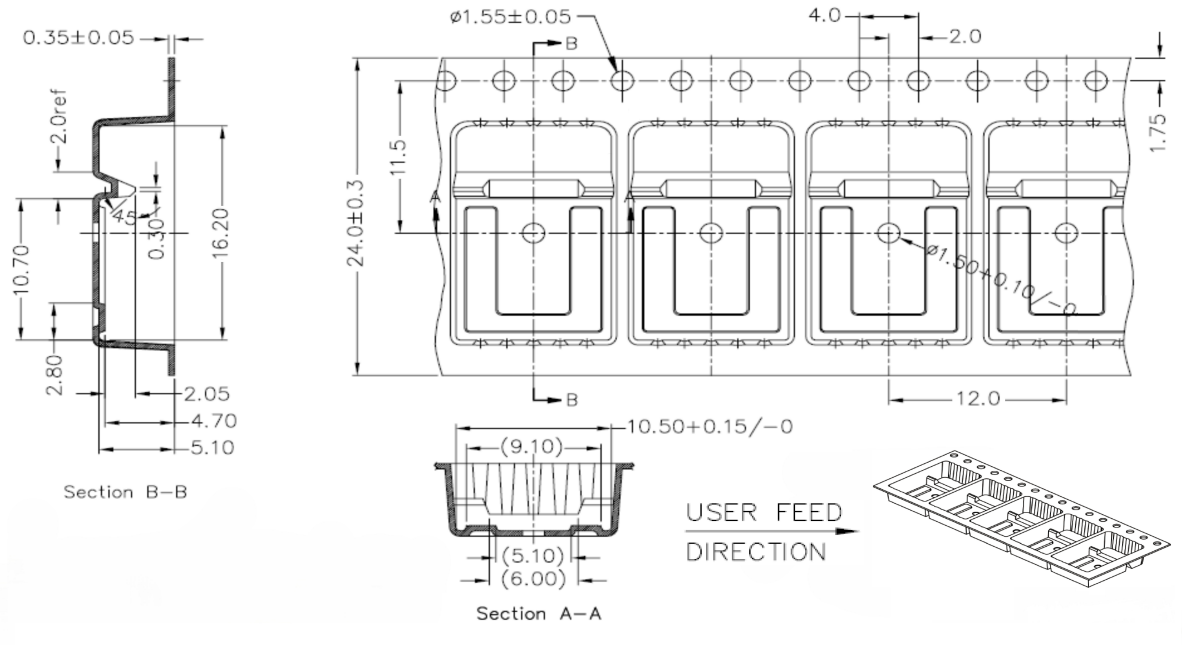
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Table 11. TO-220FP type B package mechanical data

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

4.5 D²PAK packing information

Figure 26. D²PAK tape drawing (dimensions are in mm)



DM01095771_2



5 Ordering information

Table 12. Order codes

Order codes	Marking	Package	Packing
STB6NK60Z-1	B6NK60Z	I ² PAK	Tape and reel
STB6NK60ZT4	B6NK60Z	D ² PAK	Tube
STP6NK60Z	P6NK60Z	TO-220	
STP6NK60ZFP	P6NK60ZFP	TO-220FP	

Revision history

Table 13. Document revision history

Date	Revision	Changes
14-Jan-2004	4	Initial digital version
23-Aug-2005	5	Inserted ecopack label
04-Oct-2005	6	Modified header
23-May-2007	7	Added <i>Figure 16: Maximum avalanche energy vs temperature</i>
22-Nov-2007	8	<i>Figure 11: Capacitance variations has been updated</i> has been updated
23-Oct-2025	9	Updated Section 4: Package information . Minor text changes.



Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	8
4	Package information	9
4.1	I ² PAK package information	9
4.2	D ² PAK (TO-263) type B package information	11
4.3	TO-220 type A package information	13
4.4	TO-220FP type B package information	15
4.5	D ² PAK packing information	17
5	Ordering information	18
	Revision history	19



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