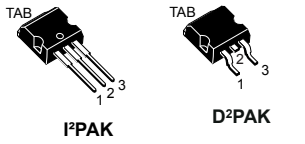
STB6NK60Z-1, STB6NK60ZT4
STP6NK60Z, STP6NK60ZFP

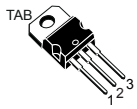
Datasheet

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

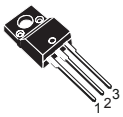


I²PAK

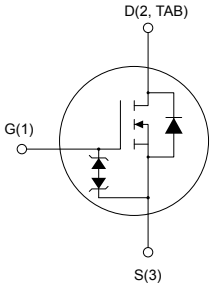
D²PAK



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.

STPOWER

Product status links
STB6NK60Z-1
STB6NK60ZT4
STP6NK60Z
STP6NK60ZFP

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		I^2PAK, D^2PAK 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^2PAK, D^2PAK 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 °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 = 100 µA	3.00	3.75	4.50	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3 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 V, f = 1 MHz, V_{GS} = 0 V	-	905		pF
C_{oss}	Output capacitance		-	115		pF
C_{rss}	Reverse transfer capacitance		-	25		pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 480 V	-	56		pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 6 A, V_{GS} = 0 to 10 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. *$C_{oss\ eq.}$ 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 = 3 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	14	-	ns
t_r	Rise time		-	14	-	ns
$t_{d(off)}$	Turn-off delay time		-	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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 6 A, di/dt = 100 A/µs,	-	445		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 50 V, T_J = 150 °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

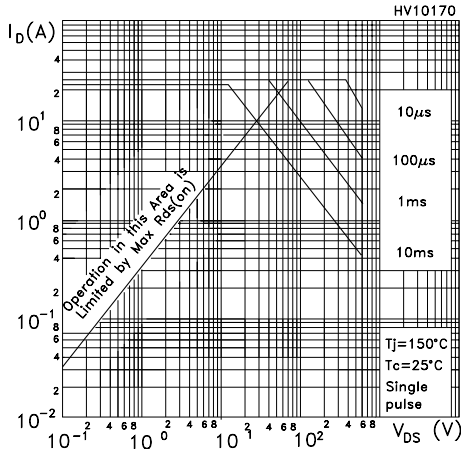


Figure 2. Normalized transient thermal impedance for I²PAK, D²PAK and TO-220

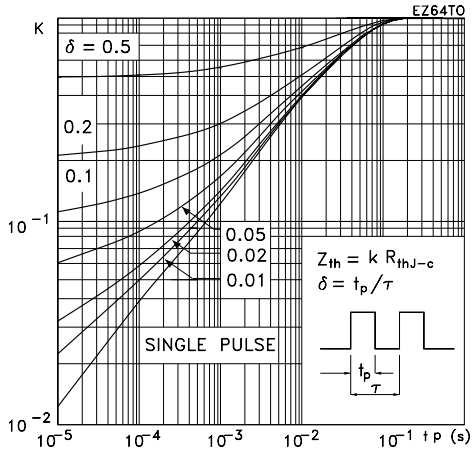


Figure 3. Safe operating area for TO-220FP

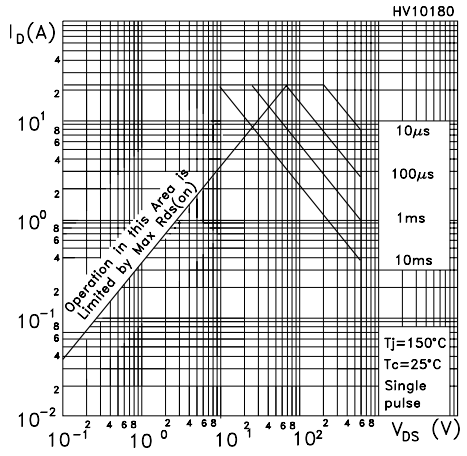


Figure 4. Normalized transient thermal impedance for TO-220FP

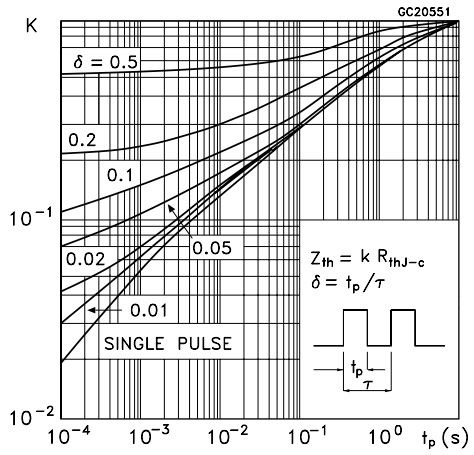


Figure 5. Typical output characteristics

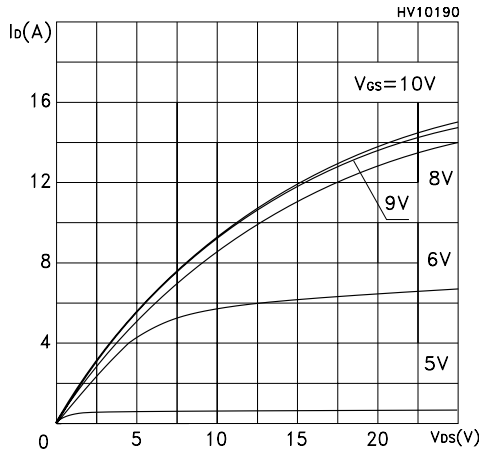


Figure 6. Typical transfer characteristics

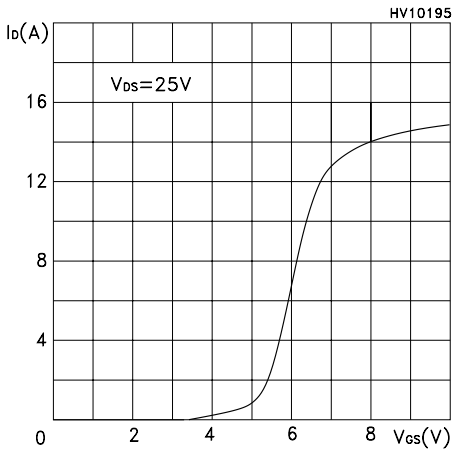


Figure 7. Typical drain-source on-resistance

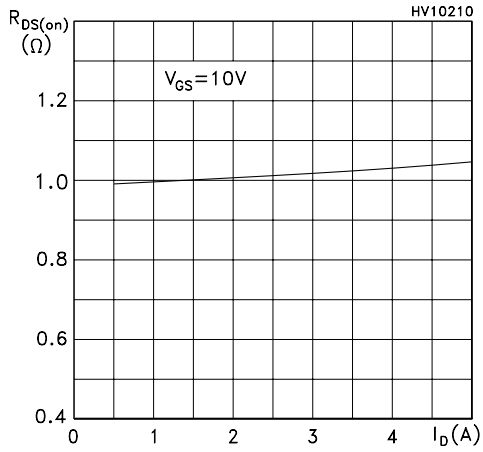


Figure 8. Typical gate charge characteristics

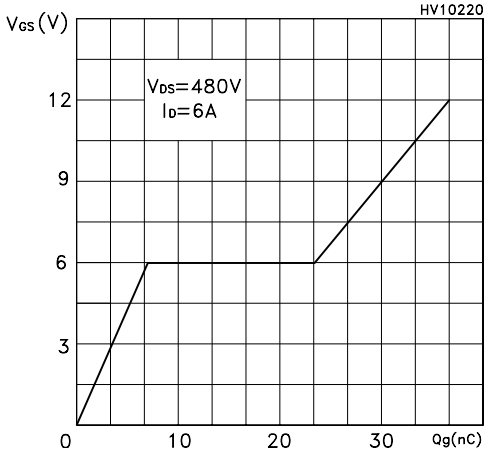


Figure 9. Typical capacitance characteristics

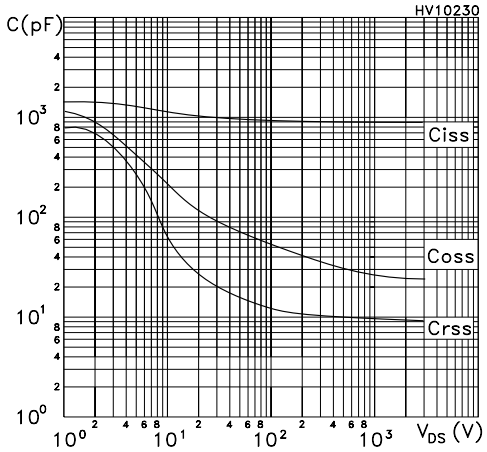


Figure 10. Normalized gate threshold vs temperature

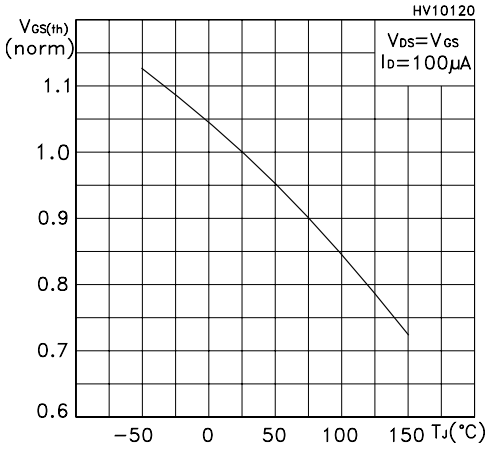


Figure 11. Normalized on-resistance vs temperature

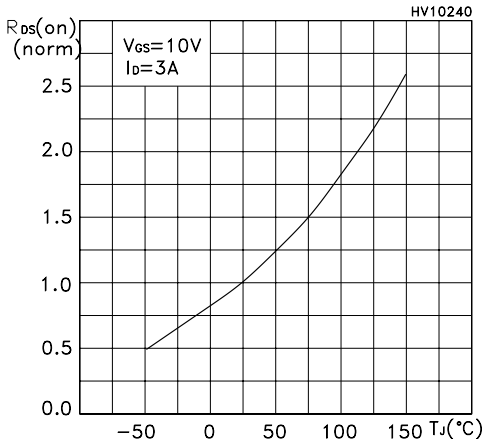


Figure 12. Typical reverse diode forward characteristics

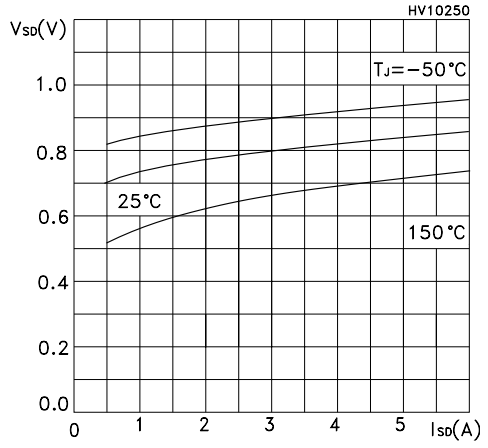


Figure 13. Maximum avalanche energy vs temperature

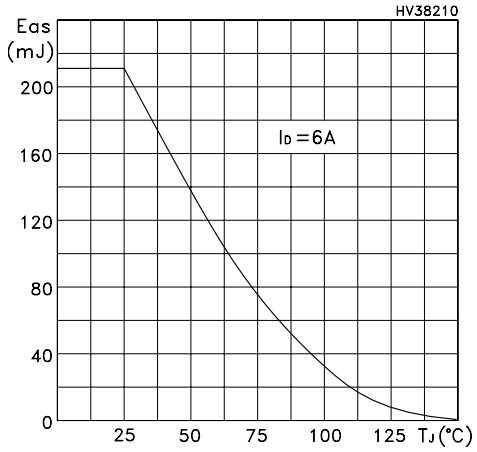
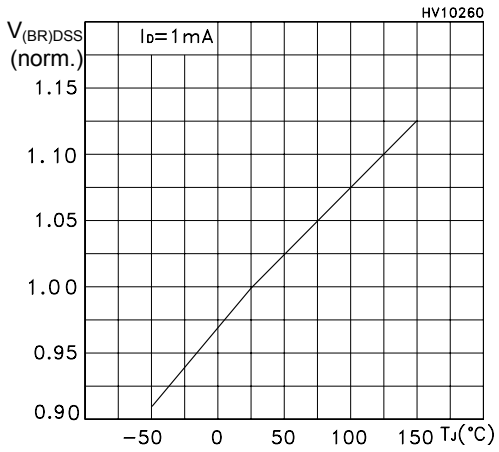


Figure 14. Normalized breakdown voltage vs temperature



3 Test circuits

Figure 15. Test circuit for resistive load switching times

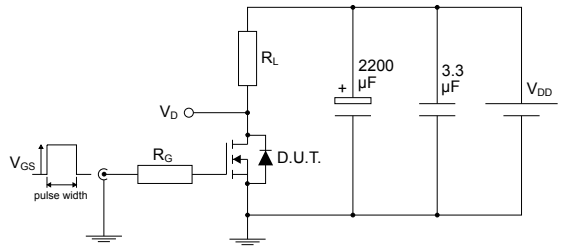


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Figure 16. Test circuit for gate charge behavior

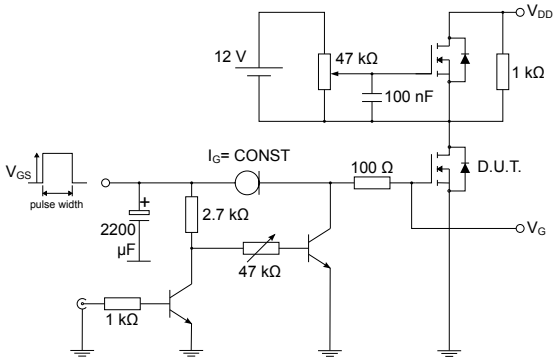

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Figure 17. Test circuit for inductive load switching and diode recovery times

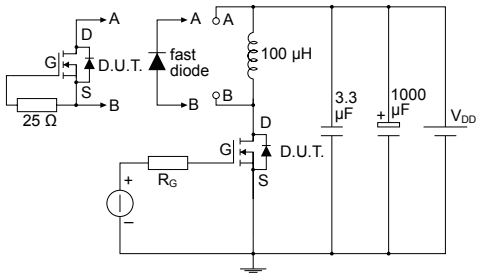

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Figure 18. Unclamped inductive load test circuit

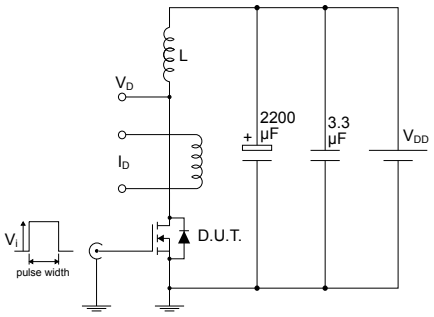

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Figure 19. Unclamped inductive waveform

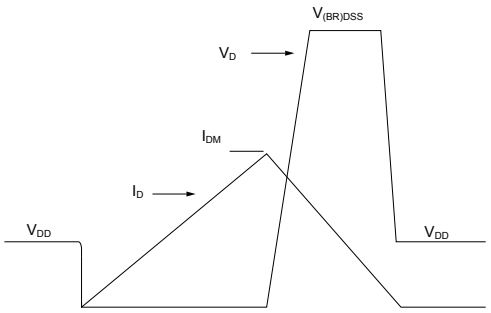

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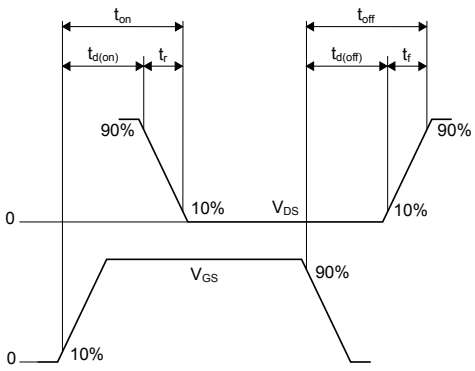
Figure 20. Switching time waveform



AM01473v1

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

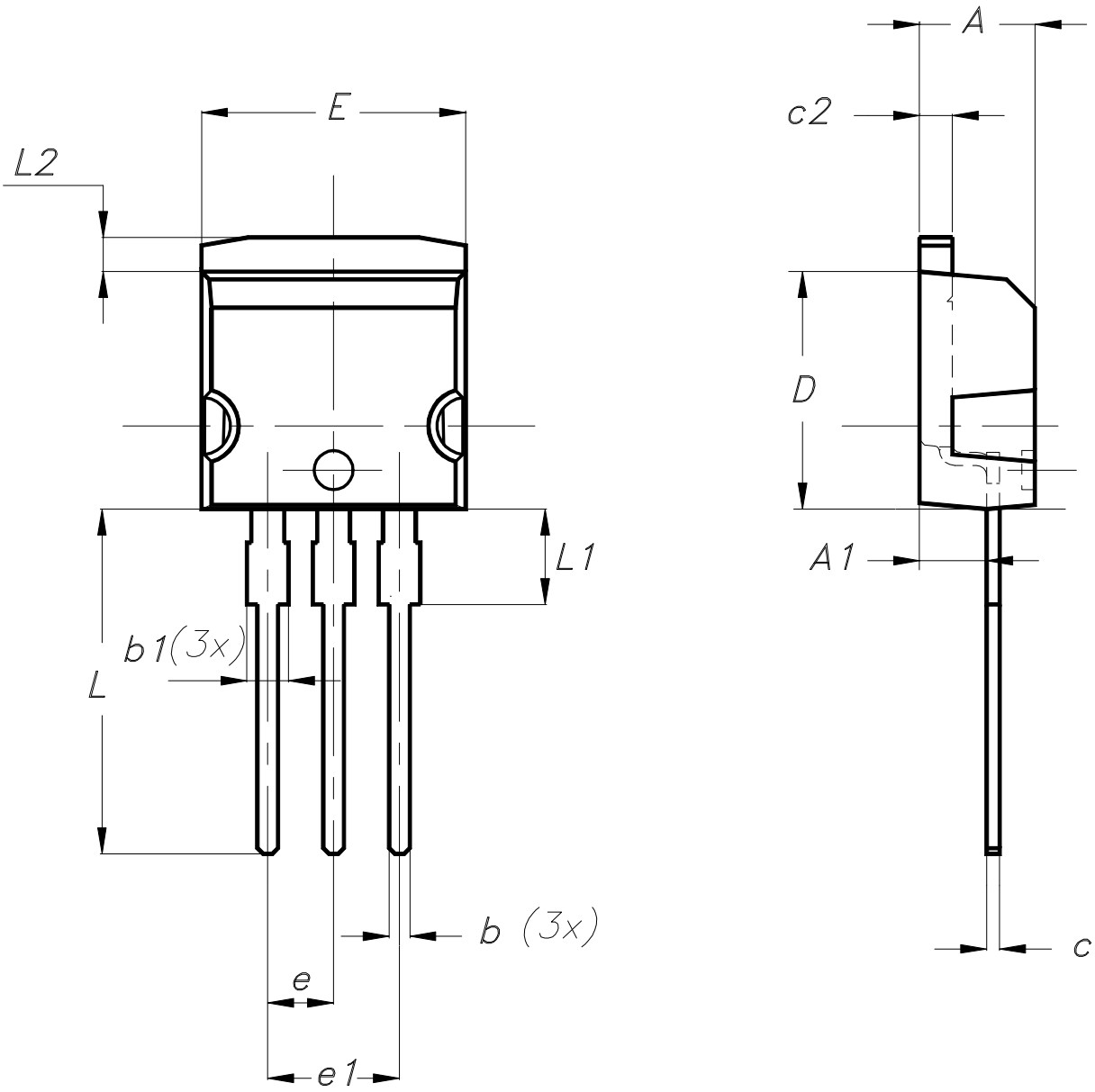


Table 8. I²PAK package mechanical data

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**

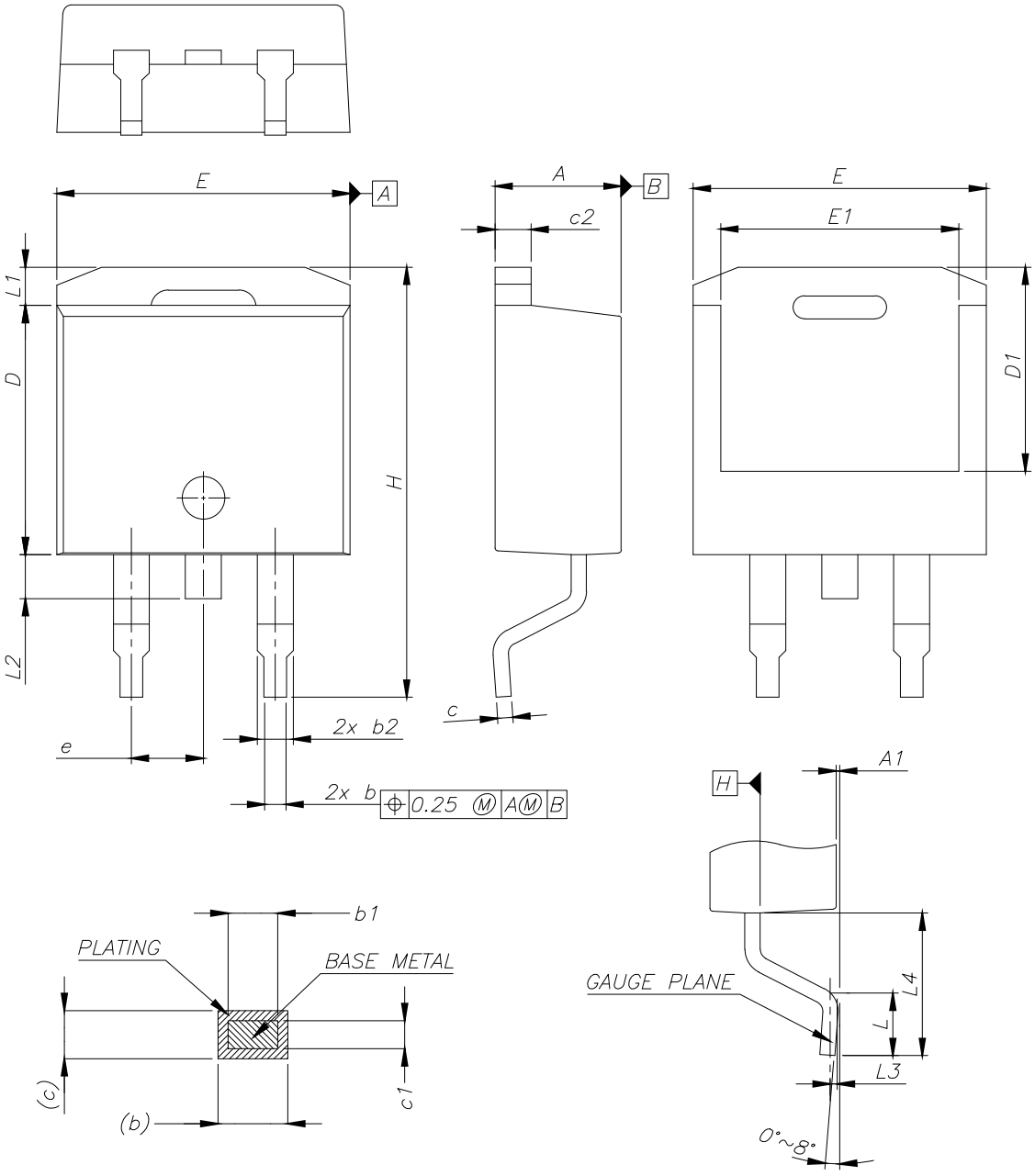


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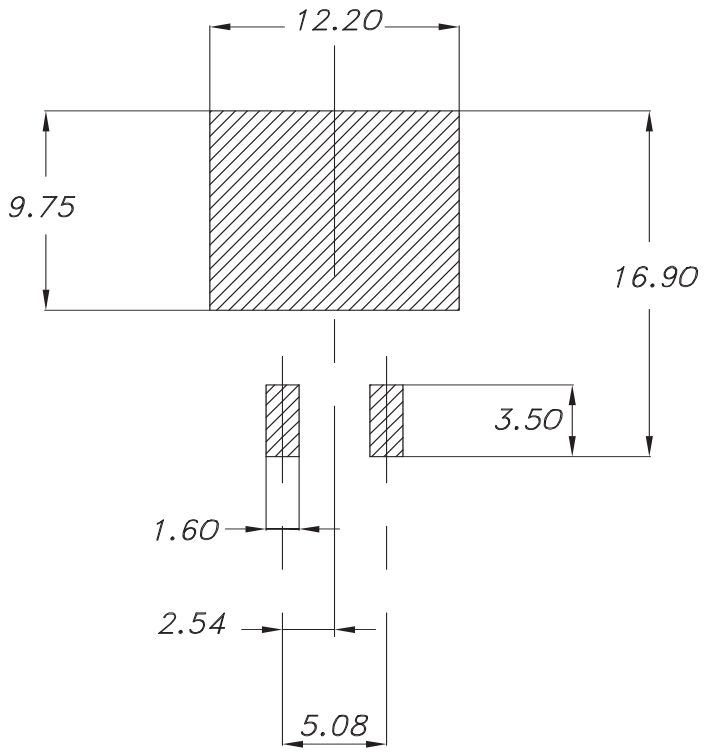
Table 9. **D²PAK (TO-263) type B mechanical data**

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)**



4.3 TO-220 type A package information

Figure 24. **TO-220 type A package outline**

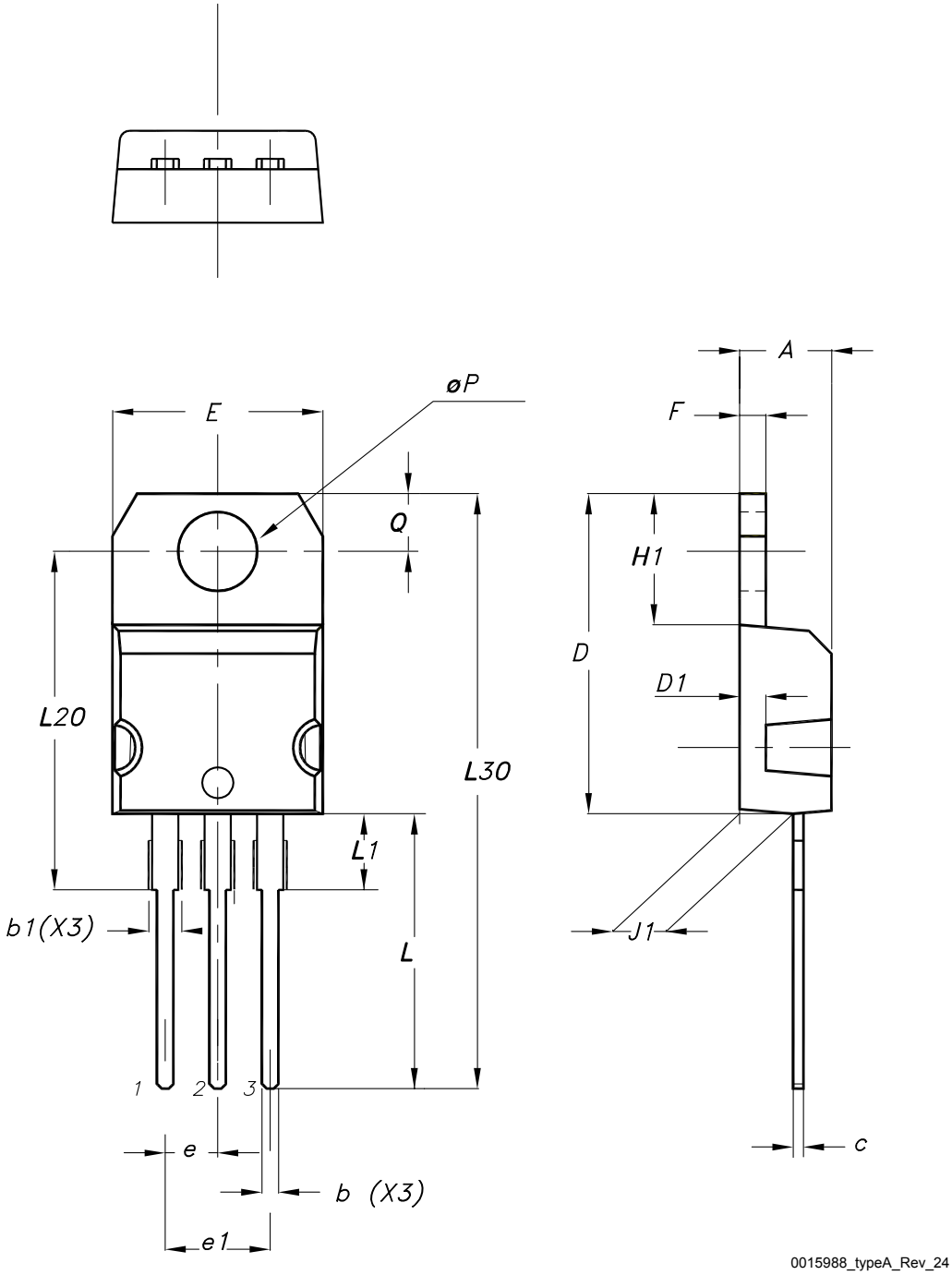


Table 10. **TO-220 type A package mechanical data**

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**

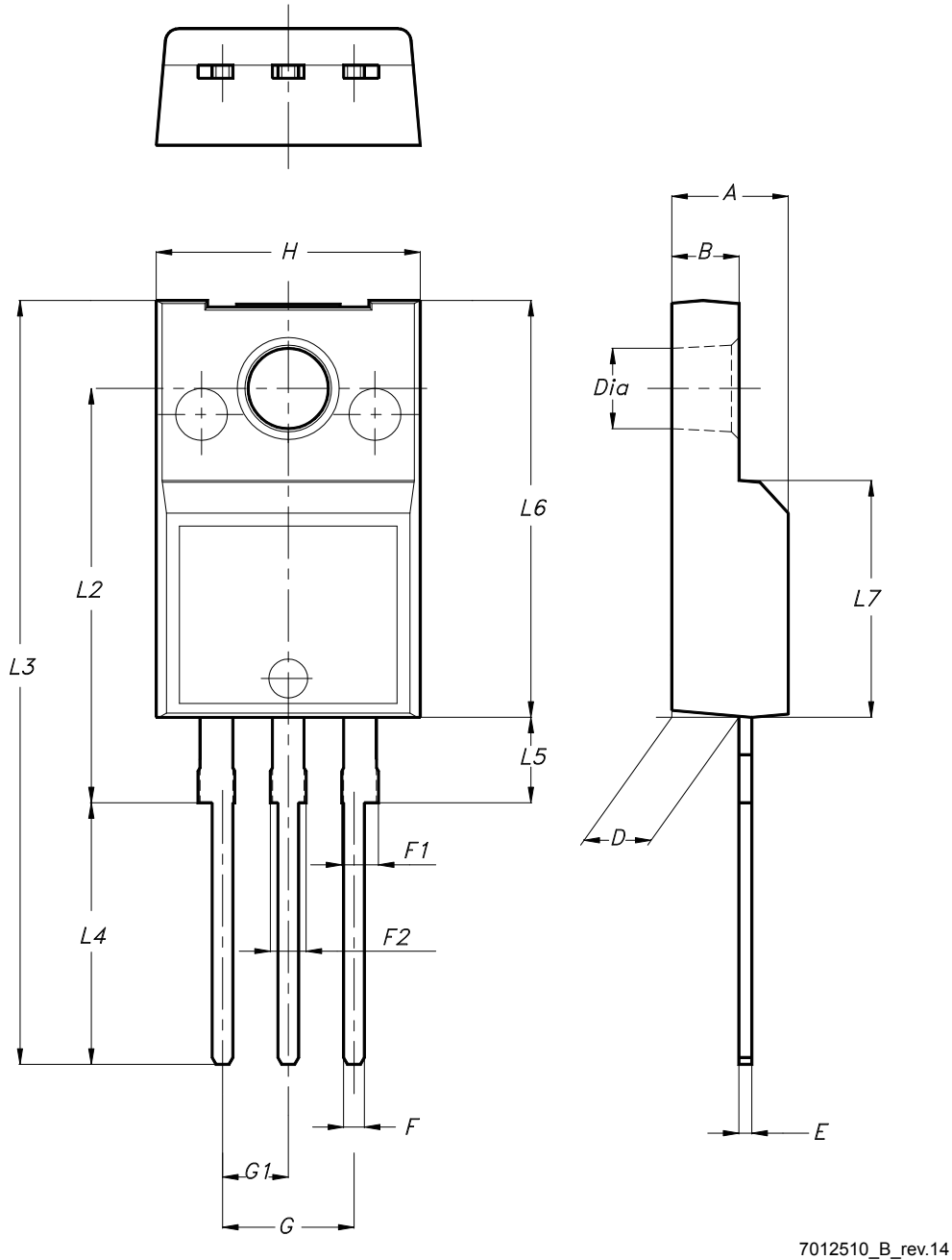


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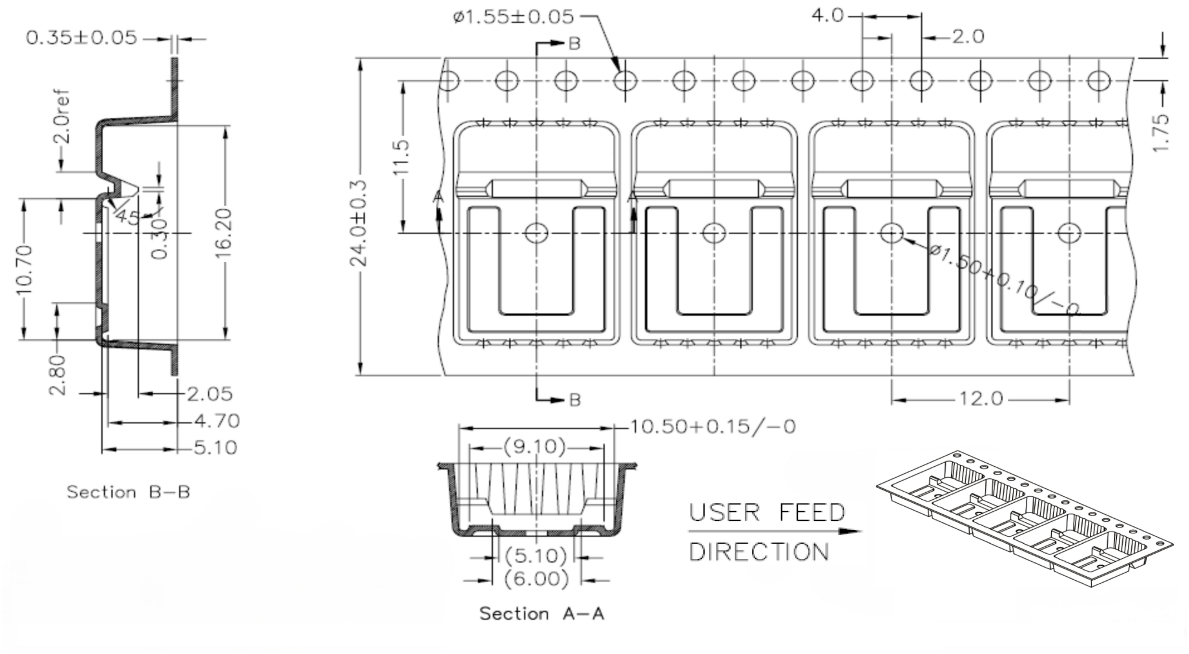
Table 11. **TO-220FP type B package mechanical data**

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	I²PAK	Tape and reel
STB6NK60ZT4	B6NK60Z	D²PAK	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 *Figure 16: Maximum avalanche energy vs temperature*
22-Nov-2007	8	*Figure 11: Capacitance variations has been updated* has been updated
23-Oct-2025	9	Updated Section 4: Package information. Minor text changes.

Contents