

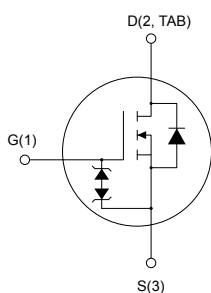
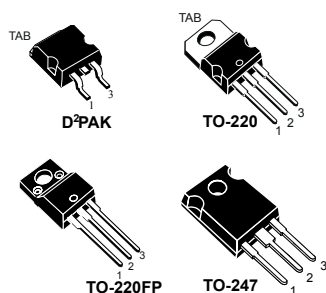


STB13NK60ZT4, STP13NK60Z STP13NK60ZFP, STW13NK60Z

Datasheet

N-channel 600 V, 0.48 Ω typ., 13 A SuperMESH Power MOSFETs in D²PAK, TO-220, TO-220FP and TO-247 packages

Features



AM01476v1_tab

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB13NK60ZT4	600 V	0.55 Ω	13 A
STP13NK60Z			
STP13NK60ZFP			
STW13NK60Z			

- 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

[STB13NK60ZT4](#)

[STP13NK60Z](#)

[STP13NK60ZFP](#)

[STW13NK60Z](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK TO-220, TO-247	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	13	13 ⁽¹⁾	A
	Drain current (continuous) at T _C = 100 °C	8.2	8.2 ⁽¹⁾	
I _{DM} ⁽²⁾	Drain current (pulsed)	52	52 ⁽¹⁾	A
P _{TOT}	Total power dissipation at T _C = 25 °C	150	35	W
ESD	Gate-source human body model (C = 100 pF, R = 1.5 kΩ)	4		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} ≤ 10 A, di/dt ≤ 200 A/μs, V_{DD} = 480 V.

Table 2. Thermal data

Symbol	Parameter	Value				Unit
		D ² PAK	TO-220	TO-220 FP	TO-247	
R _{thJC}	Thermal resistance, junction-to-case	0.83		3.6	0.83	°C/W
R _{thJA}	Thermal resistance, junction-to-ambient	50 ⁽¹⁾	62.5		50	°C/W

1. When mounted on a standard 1 inch² area of FR-4 PCB with 2-oz copper.

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not repetitive (pulse width is limited by T _J max.)	10	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	400	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	$V_{GS} = 10\text{ V}$, $I_D = 4.5\text{ A}$		0.48	0.55	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 8\text{ V}$, $I_D = 5\text{ A}$	-	11		S
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	2030		pF
C_{oss}	Output capacitance		-	210		pF
C_{rss}	Reverse transfer capacitance		-	48		pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }480\text{ V}$	-	125		pF
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 10\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 19. Test circuit for gate charge behavior)	-	66	92 ⁽³⁾	nC
Q_{gs}	Gate-source charge		-	11		nC
Q_{gd}	Gate-drain charge		-	33		nC

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

2. $C_{oss\text{ eq.}}$ 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} .

3. 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	$V_{DD} = 300\text{ V}$, $I_D = 5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	22	-	ns
t_r	Rise time		-	14	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 18. Test circuit for resistive load switching times and Figure 23. Switching time waveform)	-	61	-	ns
t_f	Fall time		-	12	-	ns
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 480\text{ V}$, $I_D = 10\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	10	-	ns
t_f	Fall time		-	9	-	ns
t_c	Cross-over time	(see Figure 20. Test circuit for inductive load switching and diode recovery times)	-	20	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		10	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		40	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 10\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 35\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$ (see Figure 20. Test circuit for inductive load switching and diode recovery times)	-	570		ns
Q_{rr}	Reverse recovery charge		-	4.5		μC
I_{RRM}	Reverse recovery current		-	16		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)

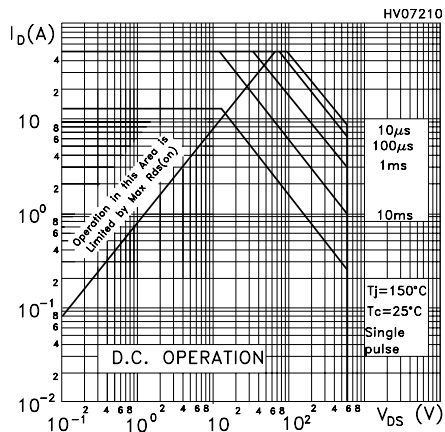
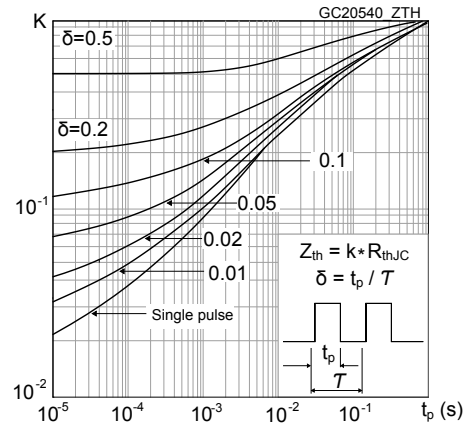
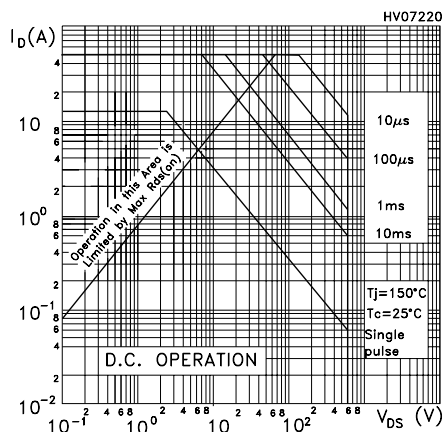
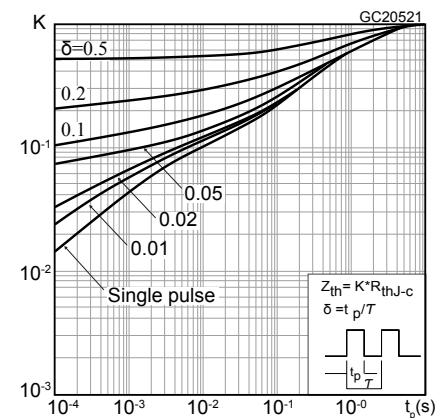
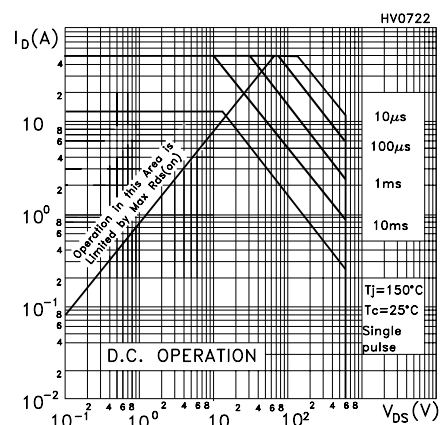
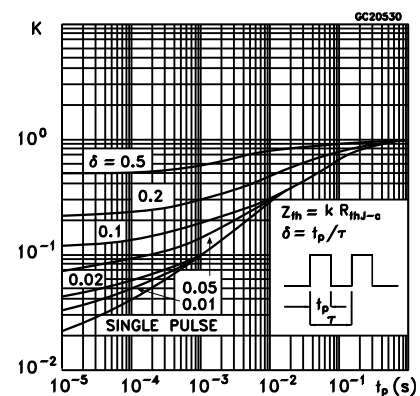
Figure 1. Safe operating area for D²PAK and TO-220

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. Safe operating area for TO-247

Figure 6. Normalized transient thermal impedance for TO-247


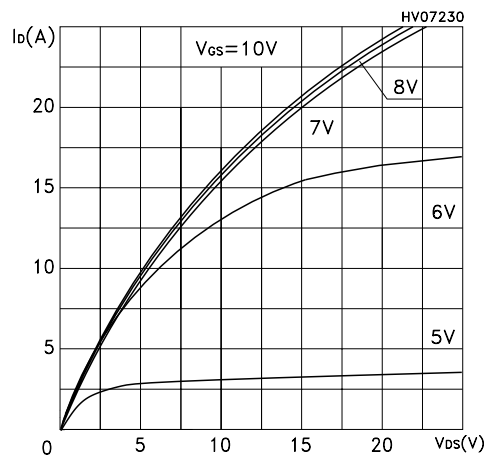
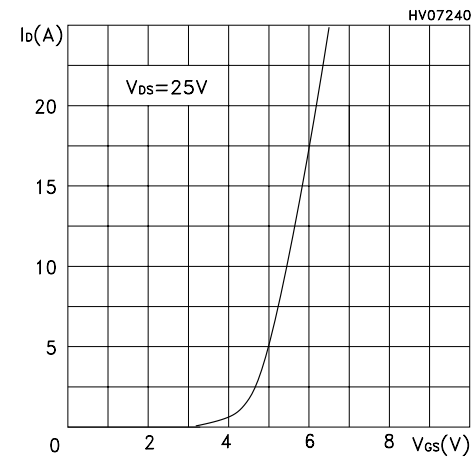
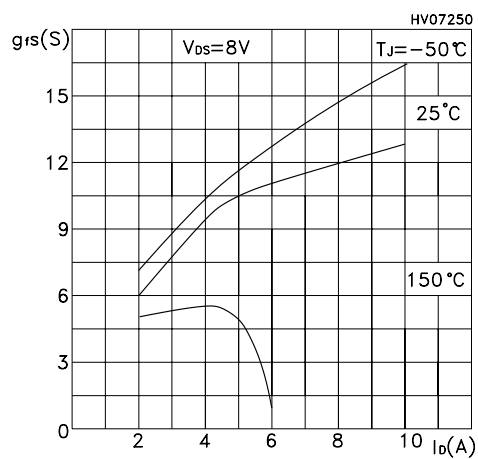
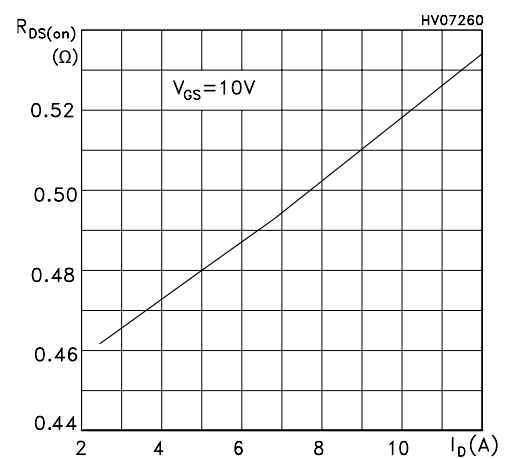
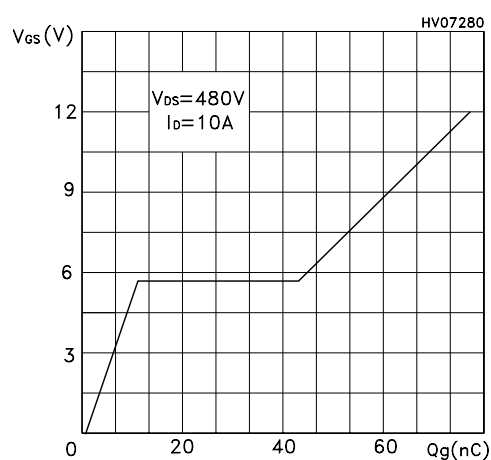
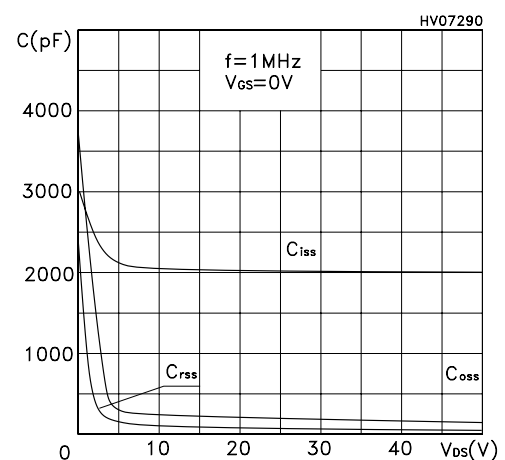
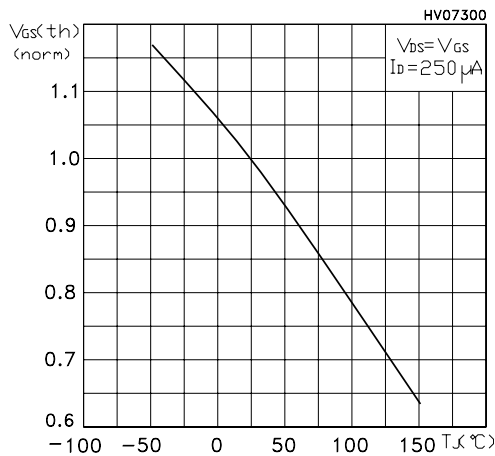
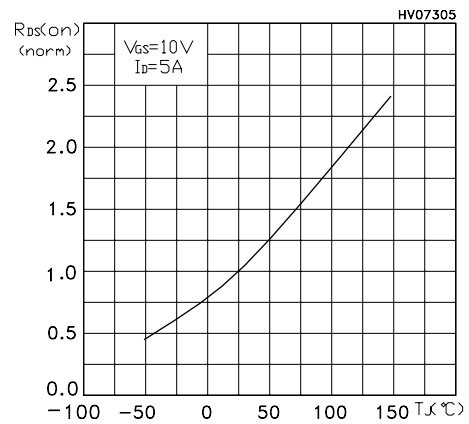
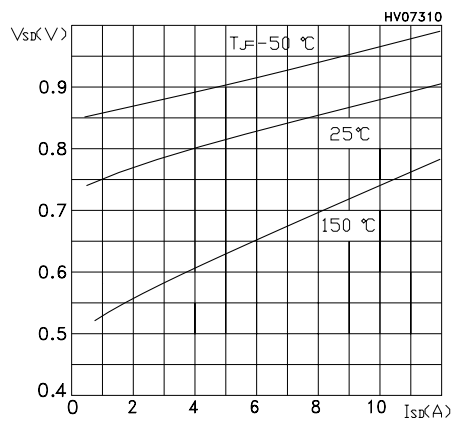
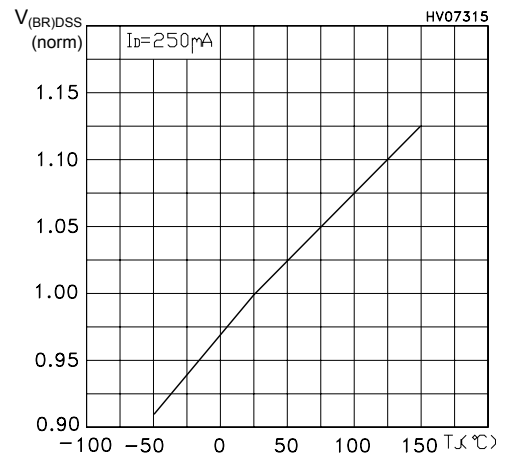
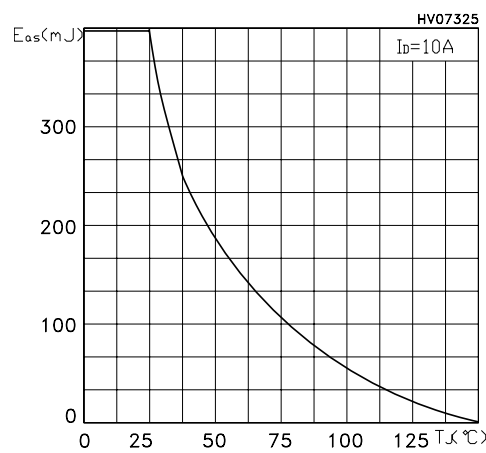
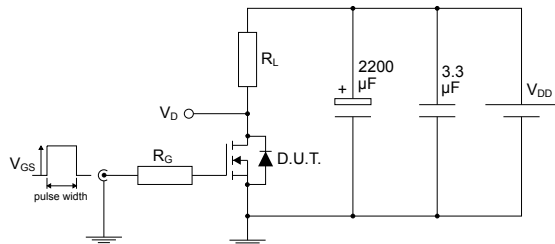
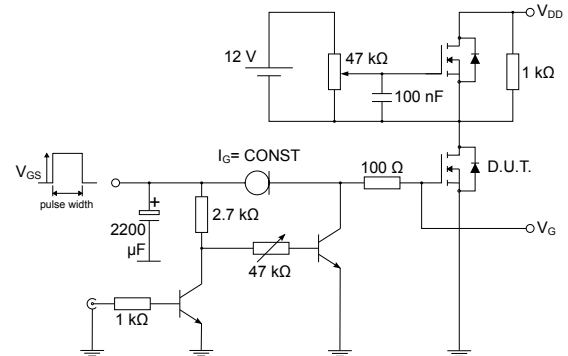
Figure 7. Typical output characteristics

Figure 8. Typical transfer characteristics

Figure 9. Typical transconductance characteristics

Figure 10. Typical drain-source on-resistance

Figure 11. Typical gate charge characteristics

Figure 12. Typical capacitance characteristics


Figure 13. Normalized gate threshold vs temperature

Figure 14. Normalized on-resistance vs temperature

Figure 15. Typical reverse diode forward characteristics

Figure 16. Normalized breakdown voltage vs temperature

Figure 17. Maximum avalanche energy vs temperature


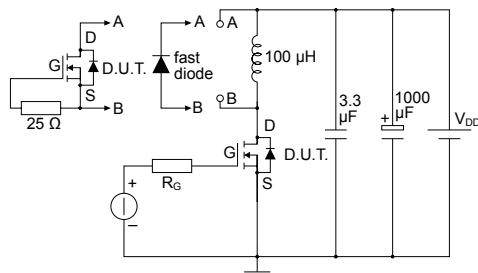
3 Test circuits

Figure 18. Test circuit for resistive load switching times


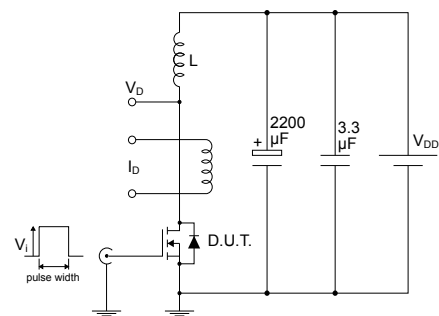
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Figure 19. Test circuit for gate charge behavior


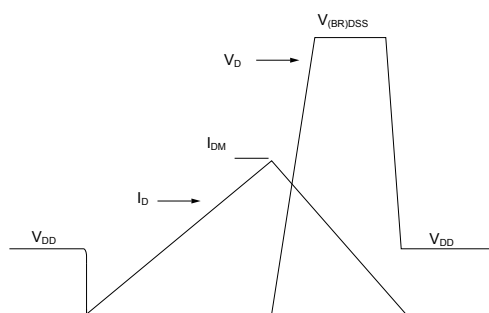
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Figure 20. Test circuit for inductive load switching and diode recovery times


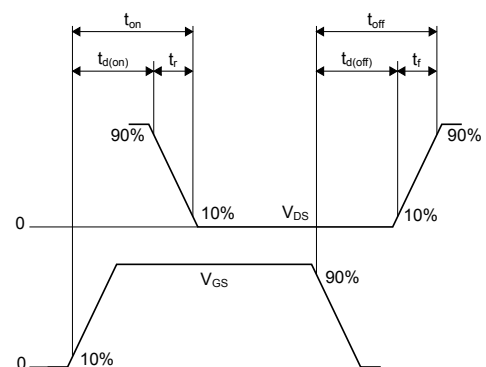
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Figure 21. Unclamped inductive load test circuit


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Figure 22. Unclamped inductive waveform


AM01472v1

Figure 23. Switching time waveform


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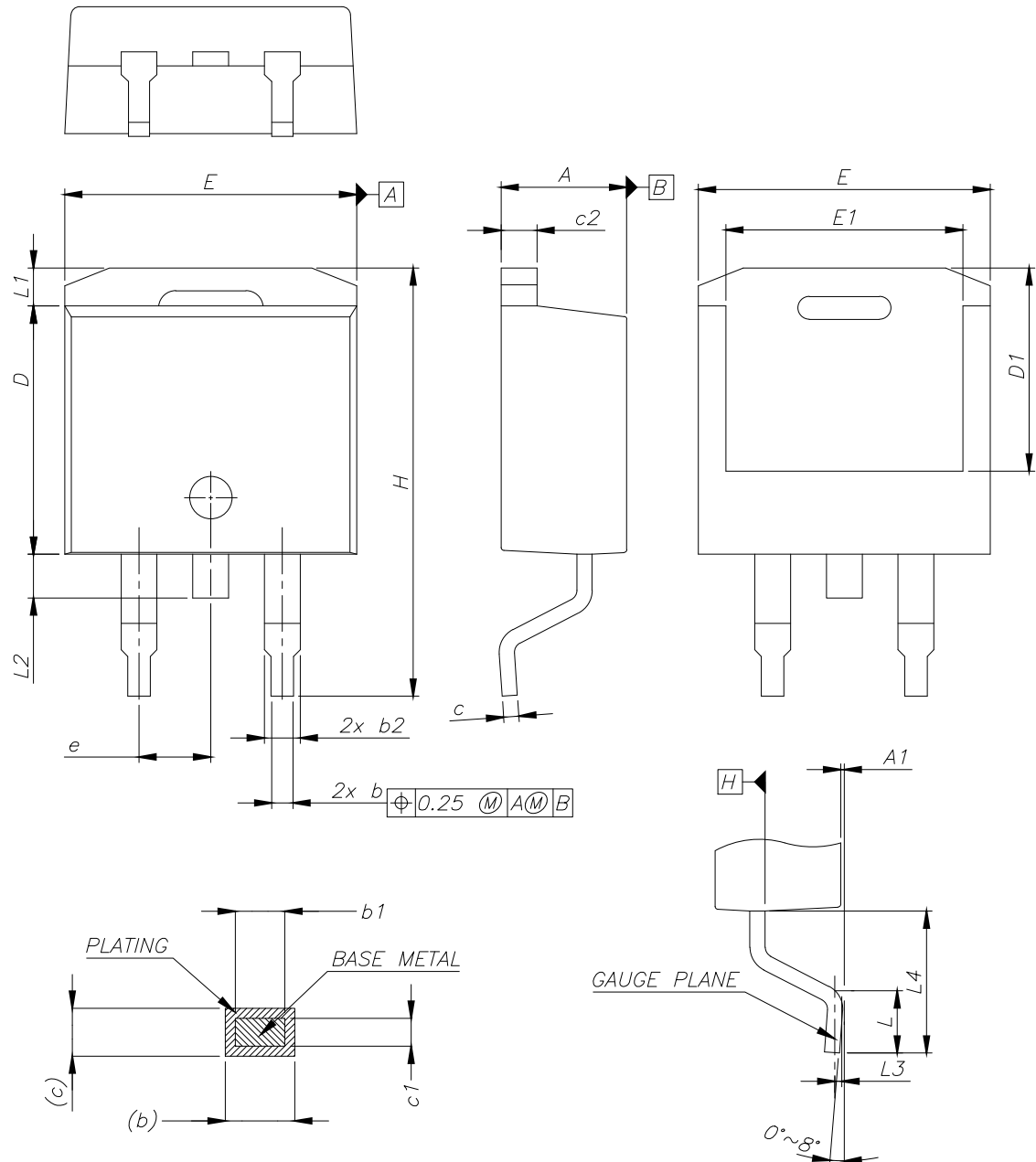


4 Package information

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 D²PAK (TO-263) type B package information

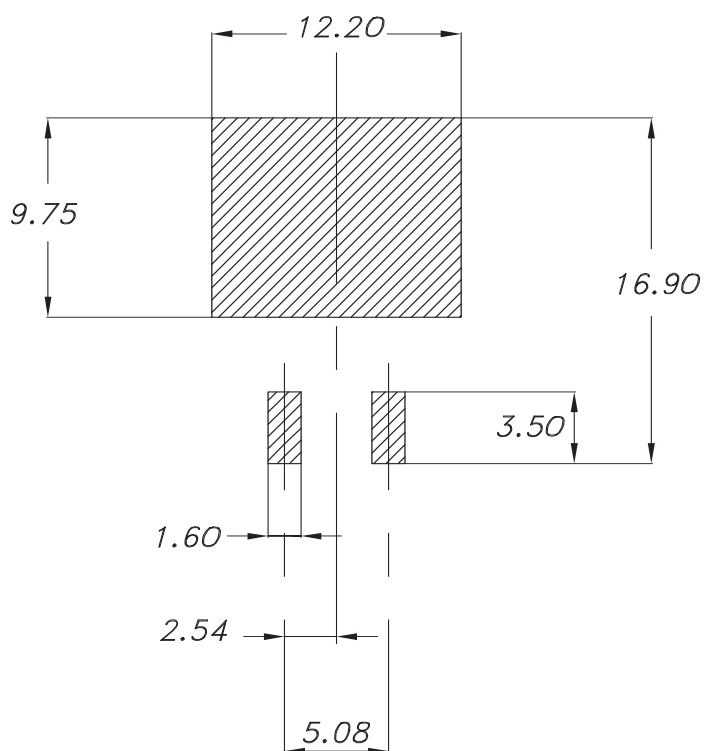
Figure 24. D²PAK (TO-263) type B package outline



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

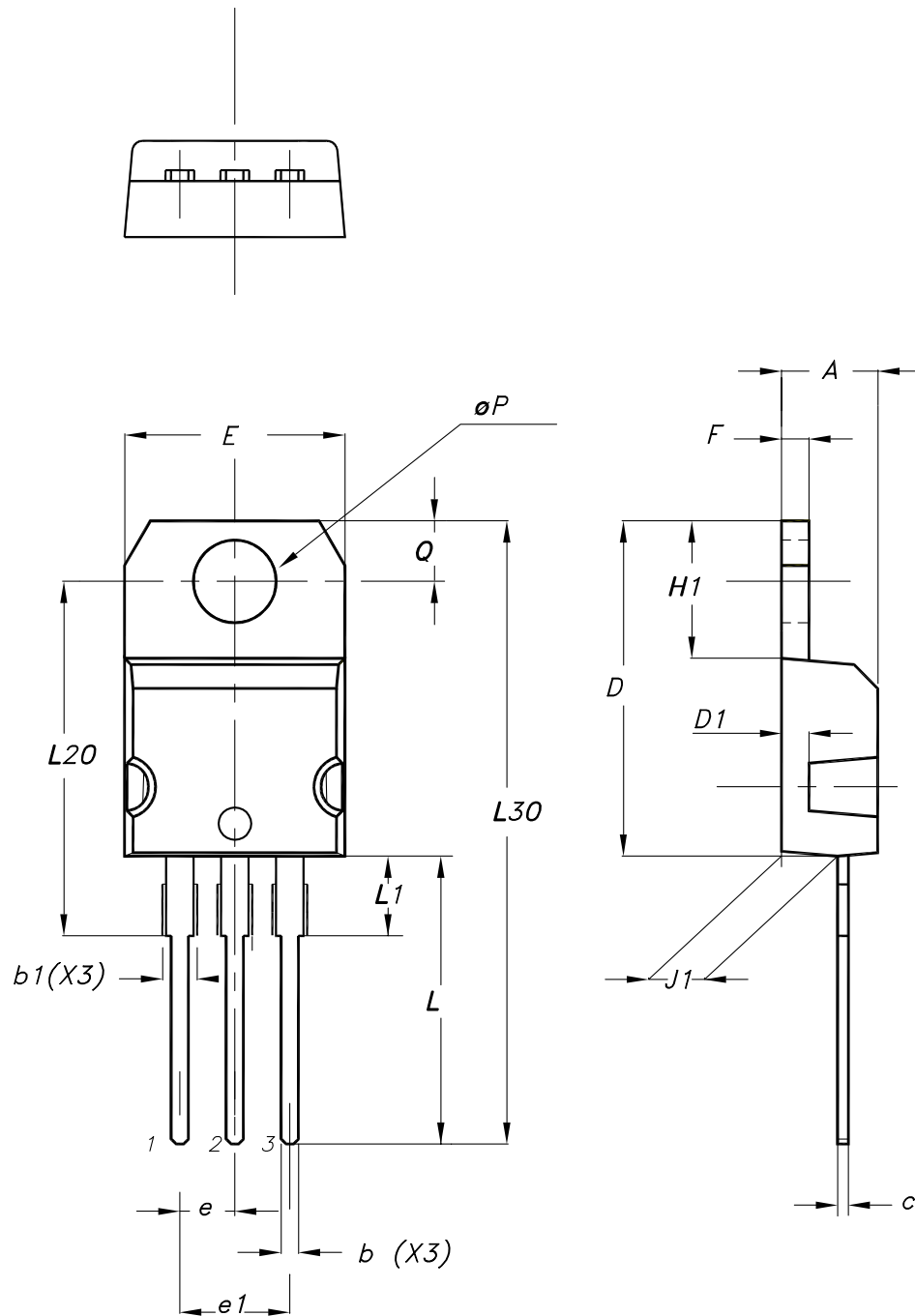
Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 25. D²PAK (TO-263) recommended footprint (dimensions are in mm)


0079457_Rev27_footprint

4.2 TO-220 type A package information

Figure 26. TO-220 type A package outline



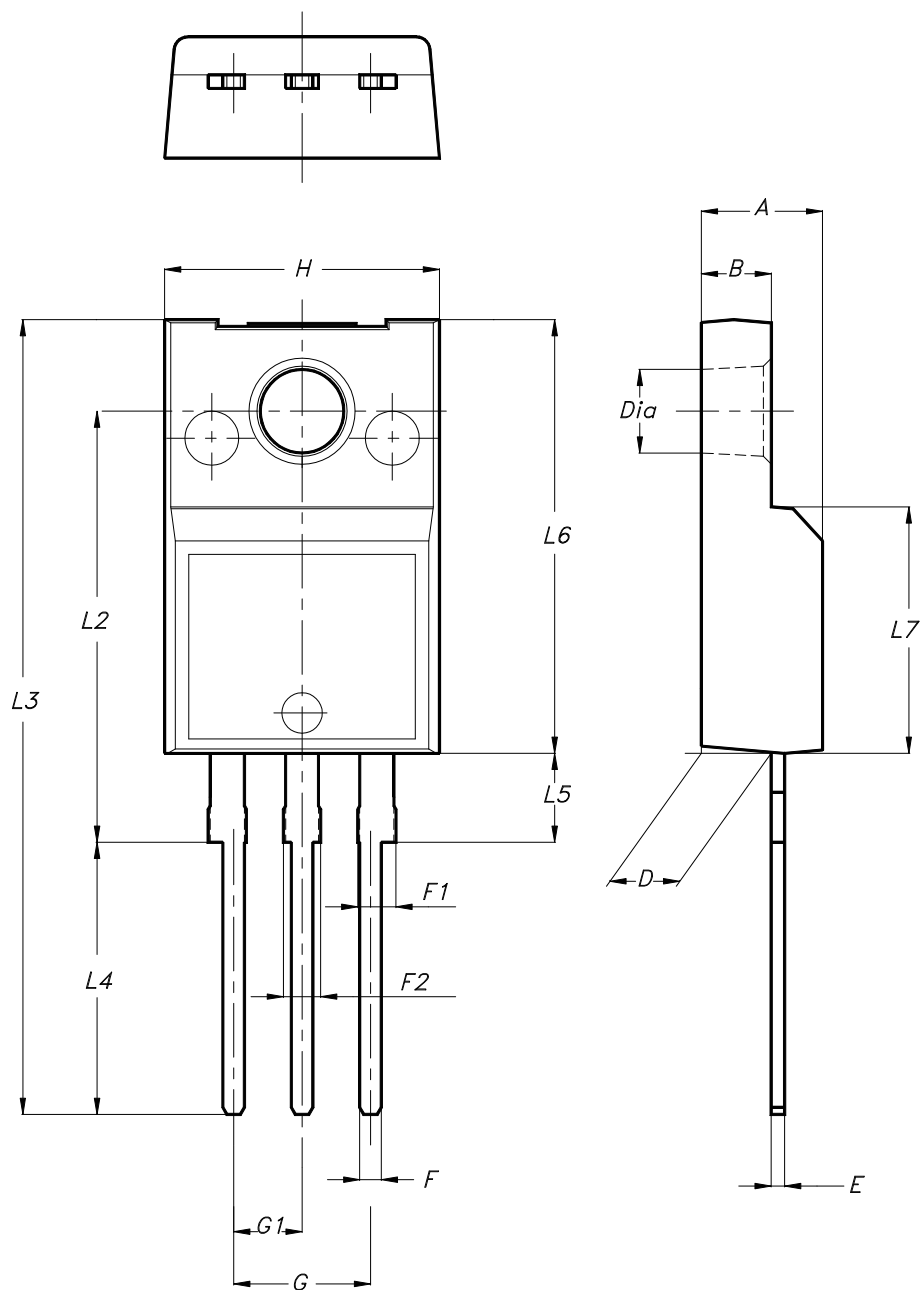
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Table 9. TO-220 type A package mechanical data

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 27. TO-220FP type B package outline



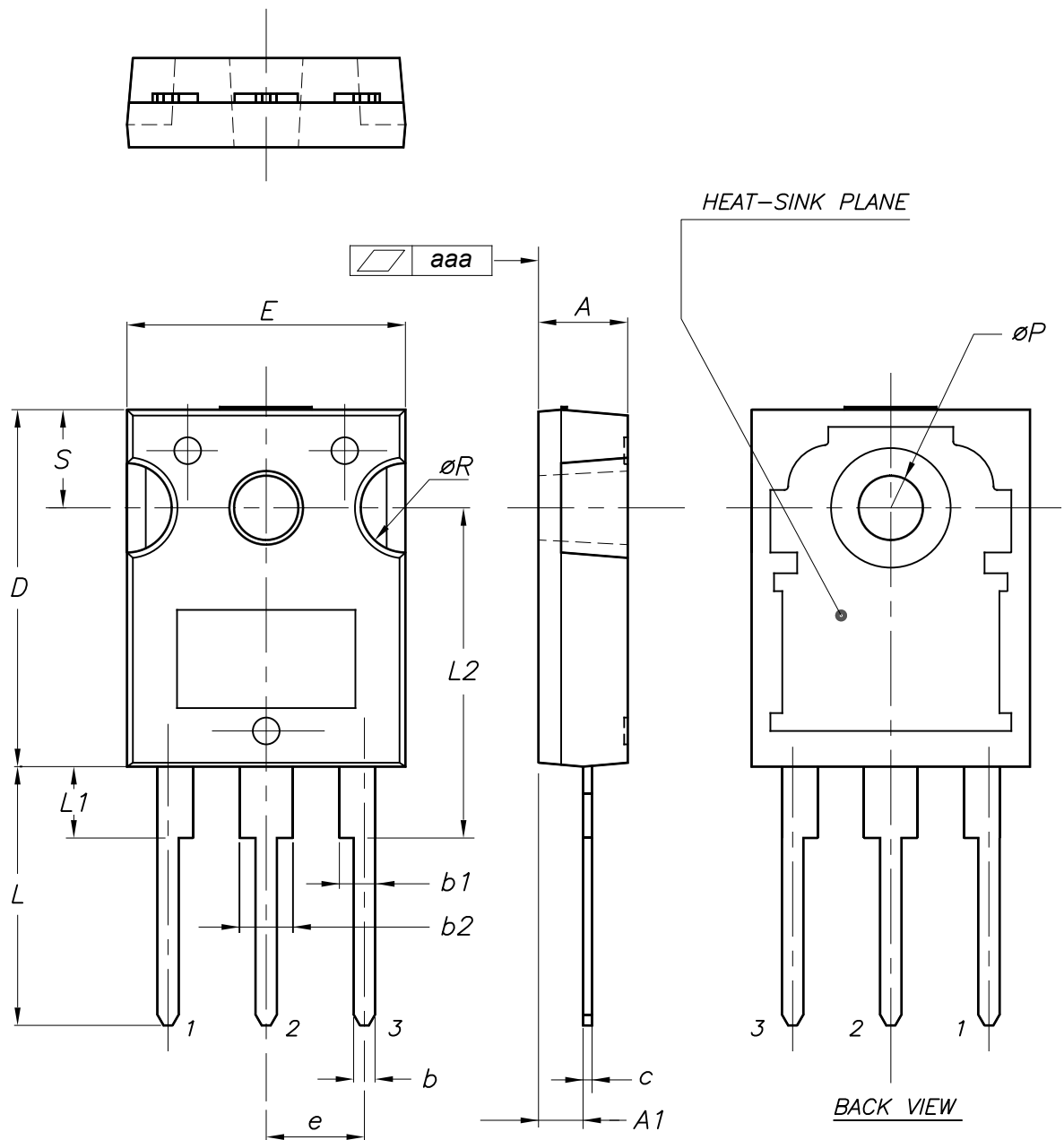
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Table 10. TO-220FP type B package mechanical data

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 TO-247 package information

Figure 28. TO-247 package outline



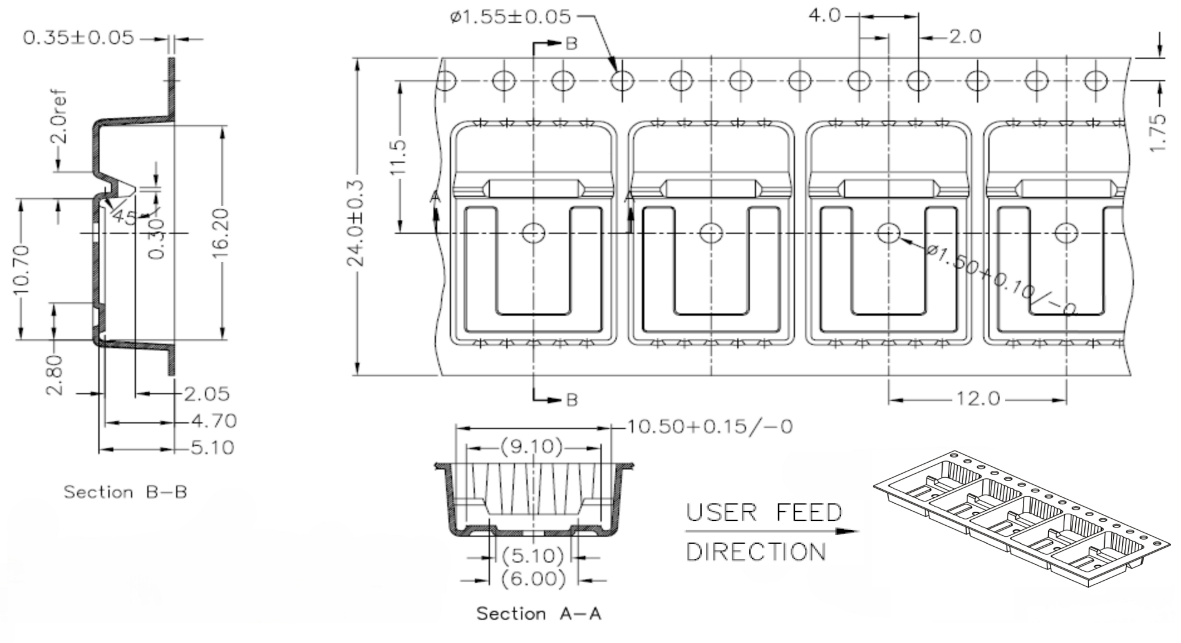
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Table 11. TO-247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

4.5 D²PAK packing information

Figure 29. D²PAK tape drawing (dimensions are in mm)



DM01095771_2



5 Ordering information

Table 12. Order codes

Order codes	Marking	Package	Packing
STB13NK60ZT4	B13NK60Z	D ² PAK	Tape and reel
STP13NK60Z	P13NK60Z	TO-220	Tube
STP13NK60ZFP	P13NK60ZFP	TO-220FP	
STW13NK60Z	W13NK60Z	TO-247	



Revision history

Table 13. Document revision history

Date	Revision	Changes
20-Sep-2005	4	
05-Oct-2005	5	Inserted ECOPACK® indication
29-Feb-2008	6	V _{ISO} parameter on <i>Table</i> has been updated
15-Apr-2009	7	Order codes in <i>Table 1: Device summary</i> has been changed
22-Jul-2025	8	Updated Section 4: Package information . Minor text changes.



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