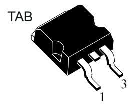
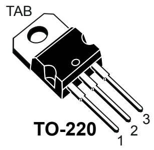
STB6NK90ZT4, STP6NK90Z
STP6NK90ZFP, STW7NK90Z

Datasheet

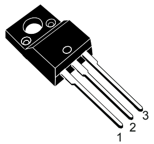
N-channel 900 V, 1.56 Ω typ., 5.8 A SuperMESH™ Power MOSFET in D^2PAK, TO-220, TO-220FP and TO-247 packages



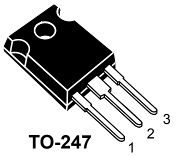
D^2PAK



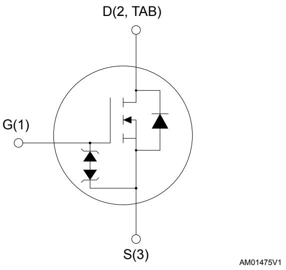
TO-220



TO-220FP



TO-247



Features

Order codes	V_{DS}	$R_{DS(on)}$max.	I_D
STB6NK90ZT4	900 V	2 Ω	5.8 A
STP6NK90Z			
STP6NK90ZFP			
STW7NK90Z			

- Extremely high dv/dt capability
- 100% avalanche tested
- 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
STB6NK90ZT4
STP6NK90Z
STP6NK90ZFP
STW7NK90Z

1 Electrical ratings

Table 1. **Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D^2PAK, TO-220, TO-247	TO-220FP	
V_{DS}	Drain-source voltage	900		V
V_{GS}	Gate-source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25 °C	5.8	5.8 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	3.65	3.65 (1)	A
I_{DM} (2)	Drain current (pulsed)	23.2	23.2	A
P_{TOT}	Total dissipation at T_C = 25 °C	140	30	W
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)	-	2500	V
T_j	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			°C

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *$I_{SD} \leq 5.8$ A, di/dt ≤ 200 A/μs, $V_{DD} \leq V_{(BR)DSS}$.*

Table 2. **Thermal data**

Symbol	Parameter	Value				Unit
		D^2PAK	TO-220	TO-220FP	TO-247	
$R_{thj-case}$	Thermal resistance junction-case	0.89		4.2	0.89	°C/W
$R_{thj-pcb}$	Thermal resistance junction-pcb	60				°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5			50	°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)	5.8	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	300	mJ

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	I_D = 1 mA, V_{GS} = 0 V	900			V
	Breakdown voltage					
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 = 100 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 2.9 A		1.56	2	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		1350		pF
C_{oss}	Output capacitance			130		
C_{rss}	Reverse transfer capacitance			26		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 V to 720 V		70		pF
$t_{d(on)}$	Turn-on delay time	V_{DD} = 450 V, I_D = 3 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 17. Test circuit for resistive load switching times and Figure 22. Switching time waveform)		17		ns
t_r	Rise time			20		
$t_{r(off)}$	Turn-off delay time			45		
t_r	Fall time			20		
Q_g	Total gate charge	V_{DD} = 720 V, I_D = 5.8 A, V_{GS} = 0 to 10 V (see Figure 18. Test circuit for gate charge behavior)		46.5	60.5	nC
Q_{gs}	Gate-source charge			8.5		
Q_{gd}	Gate-drain charge			25		
$t_{r(Voff)}$	Off-voltage rise time	V_{DD} = 720 V, I_D = 5.8 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 19. Test circuit for inductive load switching and diode recovery times)		11		ns
t_r	Fall time			12		
t_c	Cross-over time			20		

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. **Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				5.8	A
I_{SDM}	Source-drain current (pulsed)				23.2	
V_{SD}	Forward on voltage	I_{SD} = 5.8 A, V_{GS} = 0 V			1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 5.8 A, di/dt = 100 A/µs V_{DD} = 36 V, T_j = 150 °C (see Figure 19. Test circuit for inductive load switching and diode recovery times)		840		ns
Q_{rr}	Reverse recovery charge			5880		nC
I_{RRM}	Reverse recovery current			14		A

Table 7. **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 for TO-220/D^{2}PAK

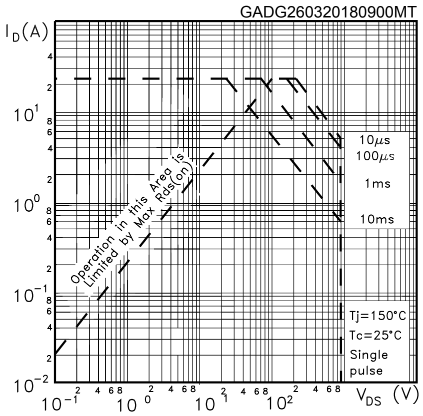


Figure 2. Thermal impedance for TO-220/D^{2}PAK

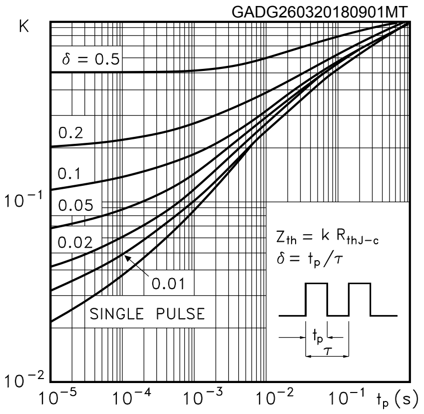


Figure 3. Safe operating area for TO-220FP

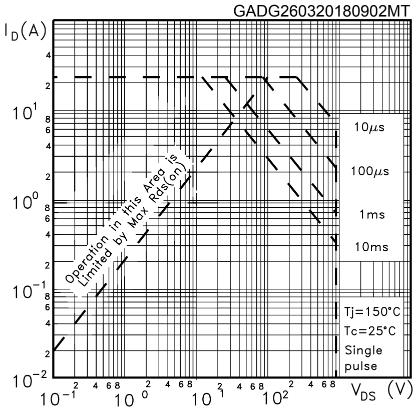


Figure 4. Thermal impedance for TO-220FP

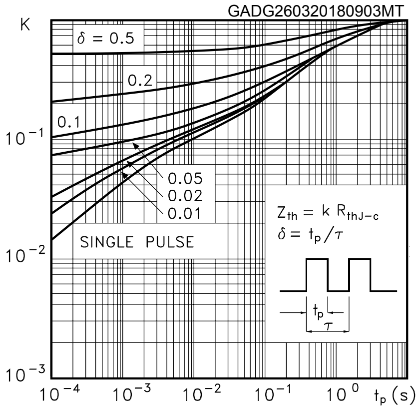


Figure 5. Safe operating area for TO-247

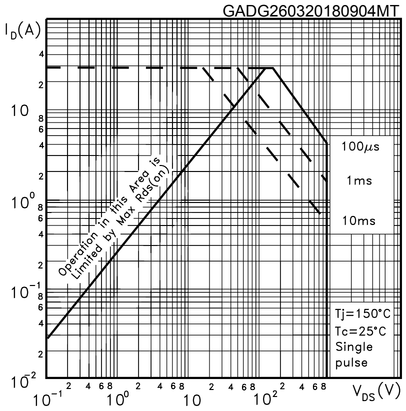


Figure 6. Thermal impedance for TO-247

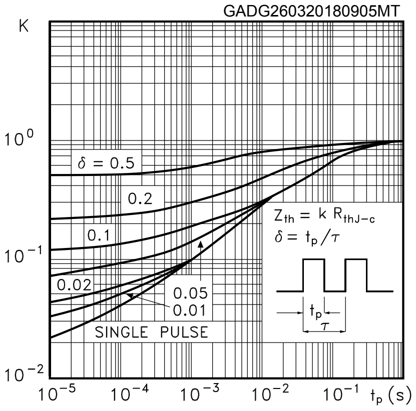


Figure 7. Output characterisics

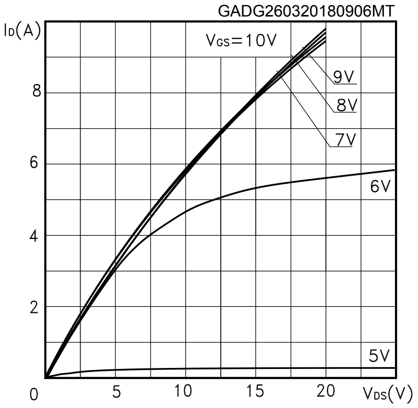


Figure 8. Transfer characteristics

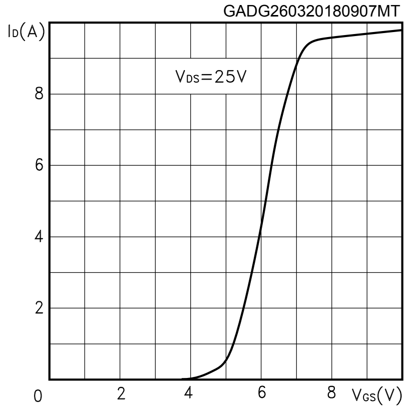


Figure 9. Static drain-source on resistance

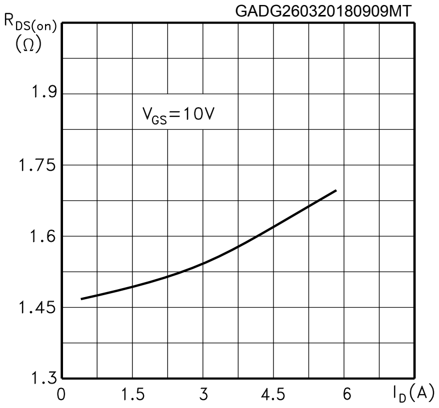


Figure 10. Gate charge vs gate-source voltage

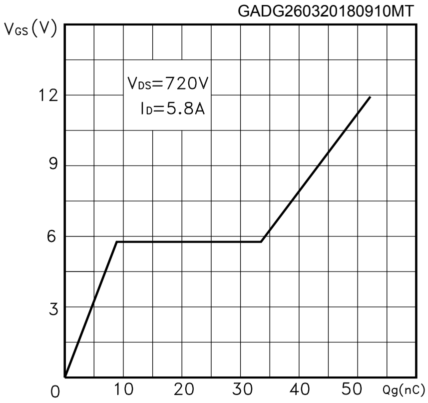


Figure 11. Capacitance variations

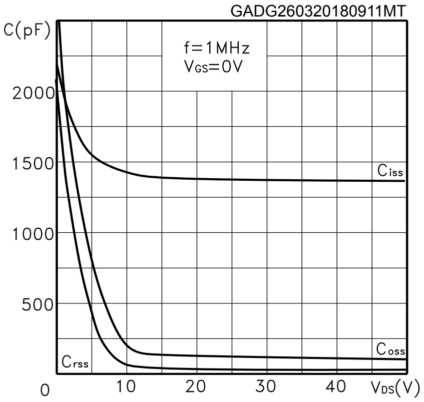


Figure 12. Normalized gate threshold voltage vs temperature

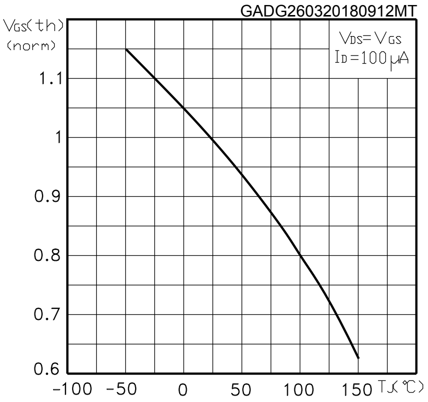


Figure 13. Normalized on resistance vs temperature

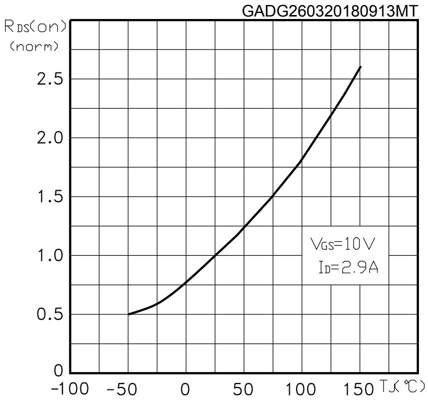


Figure 14. Source-drain diode forward characteristic

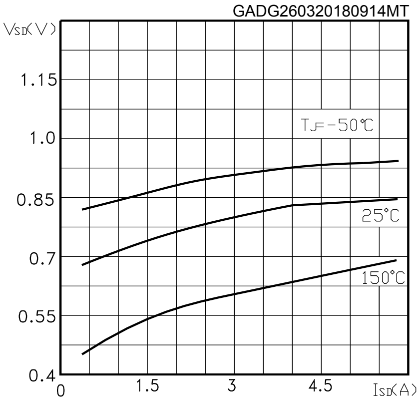


Figure 15. Normalized $V_{(BR)DSS}$ vs temperature

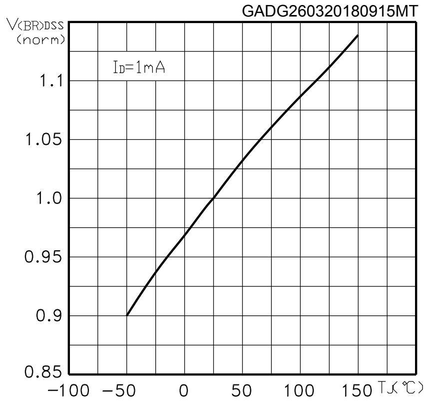
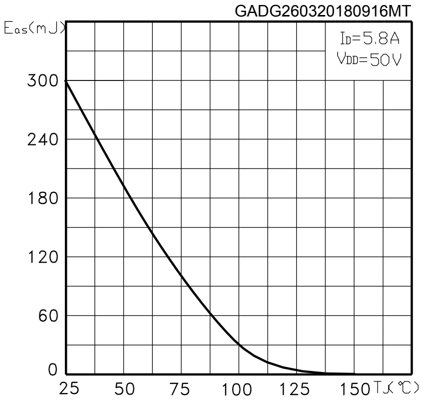


Figure 16. Maximum avalanche energy vs temperature



3 Test circuits

Figure 17. **Test circuit for resistive load switching times**

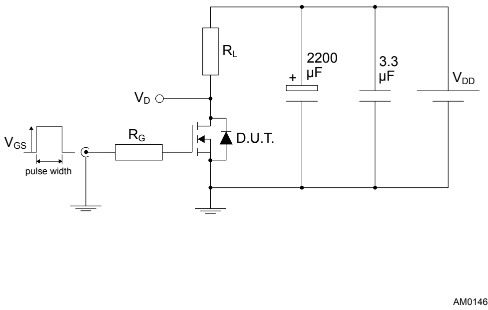


Figure 18. **Test circuit for gate charge behavior**

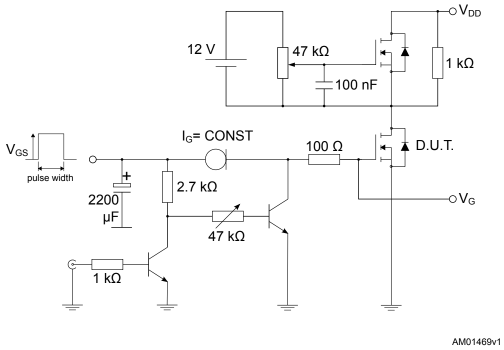


Figure 19. **Test circuit for inductive load switching and diode recovery times**

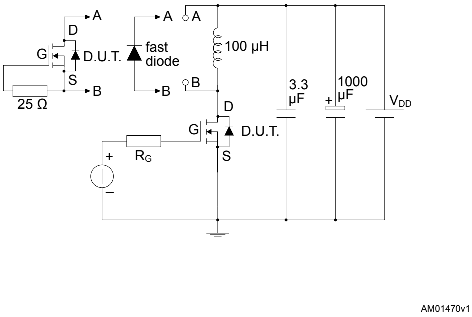


Figure 20. **Unclamped inductive load test circuit**

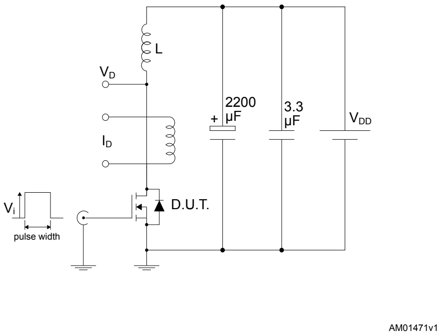


Figure 21. **Unclamped inductive waveform**

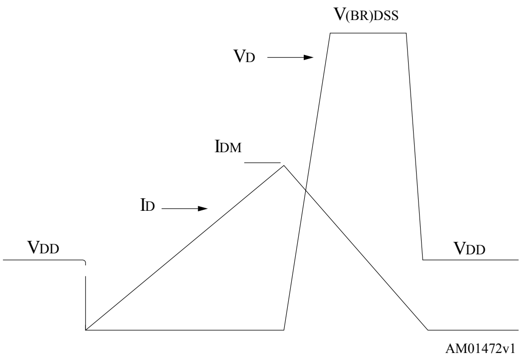
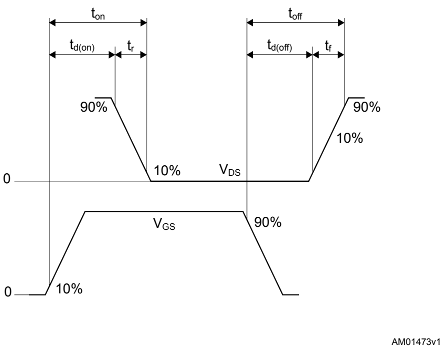


Figure 22. **Switching time waveform**



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 D²PAK (TO-263) package information

Figure 23. D²PAK (TO-263) type A package outline

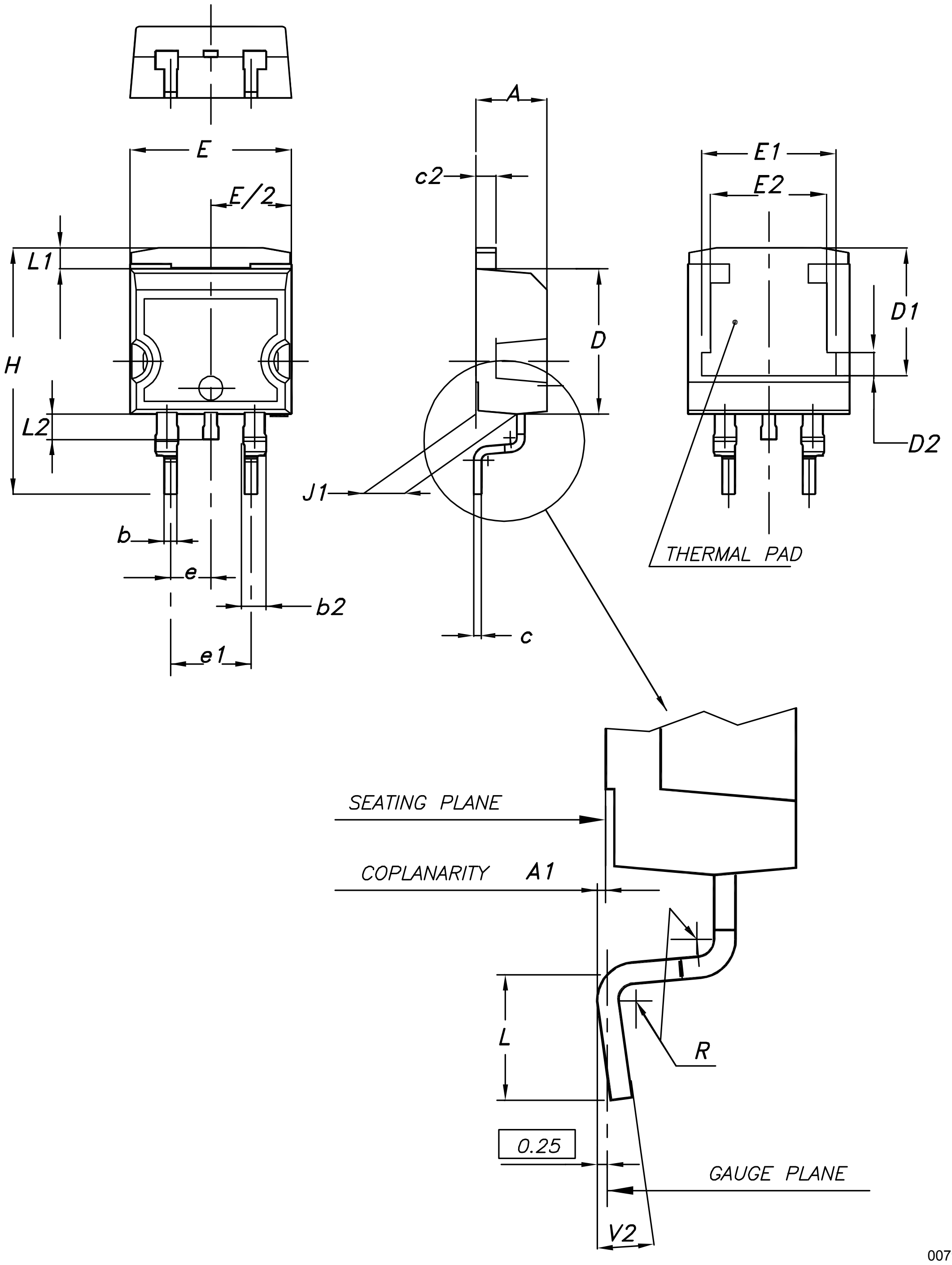


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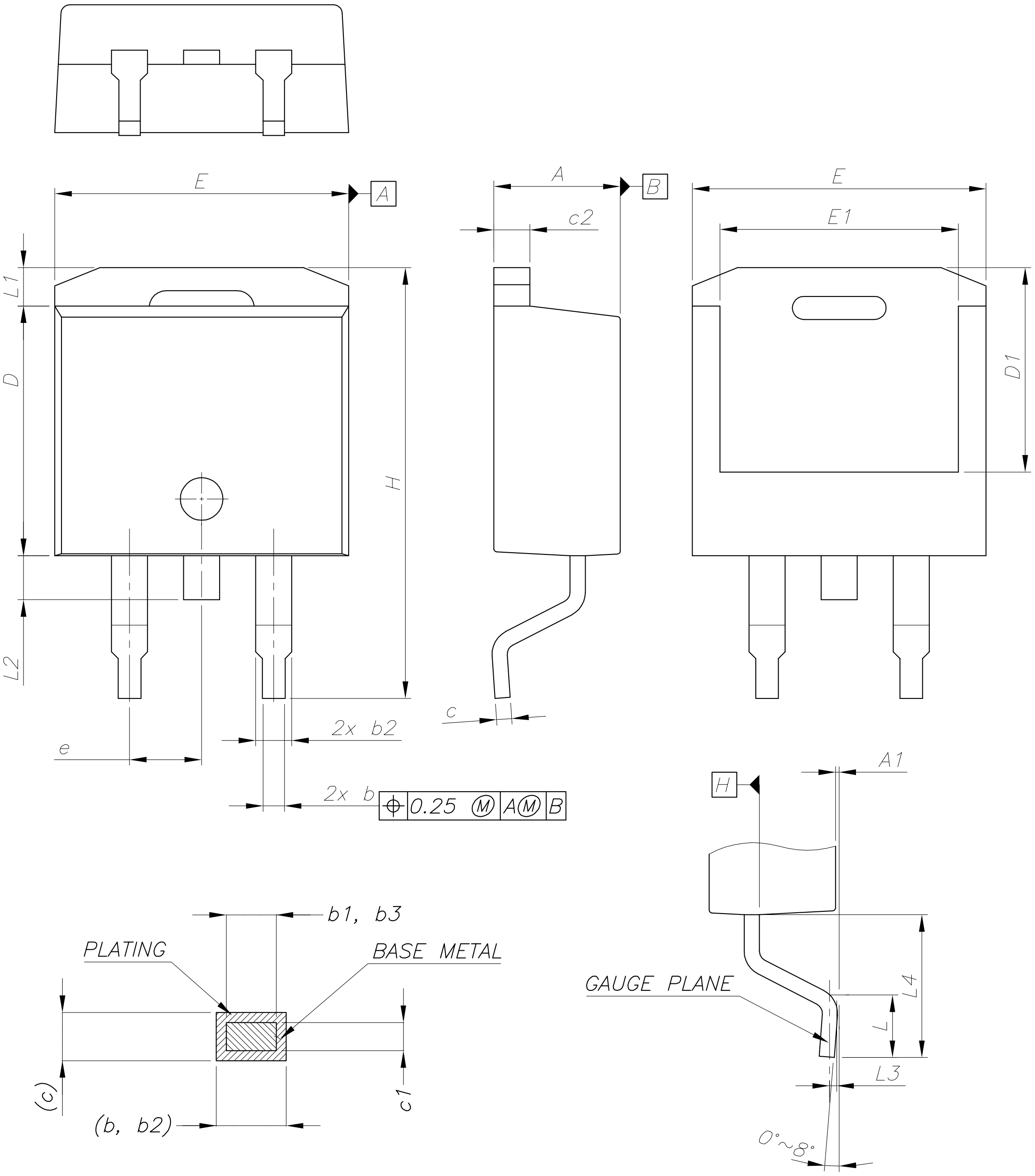
Table 8. D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

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

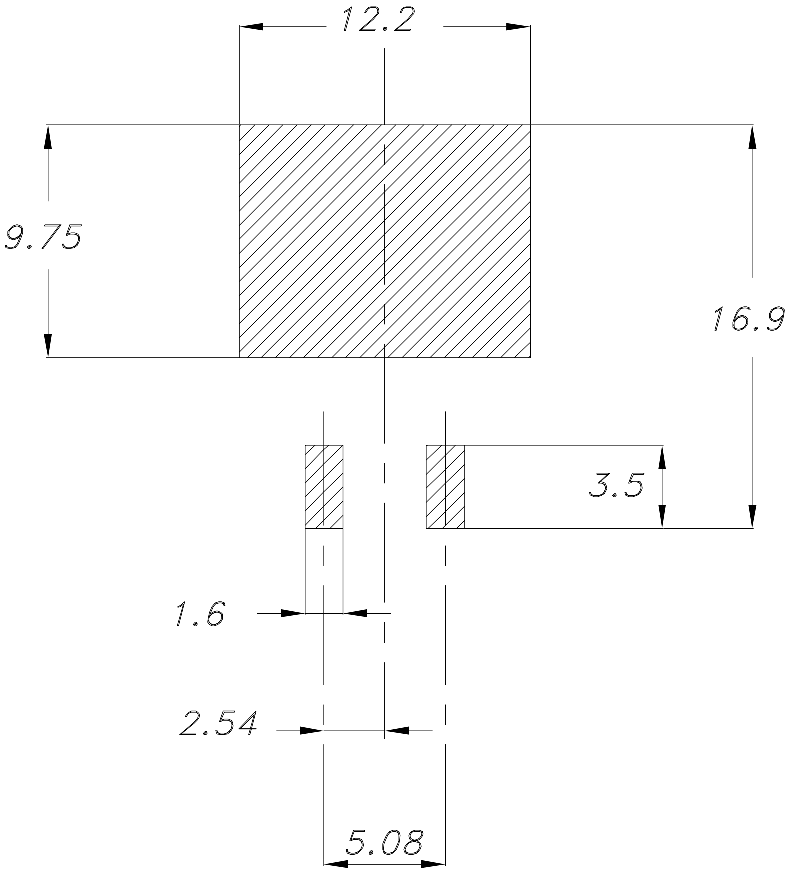


0079457_24_B

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

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
b3	1.36		1.46
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

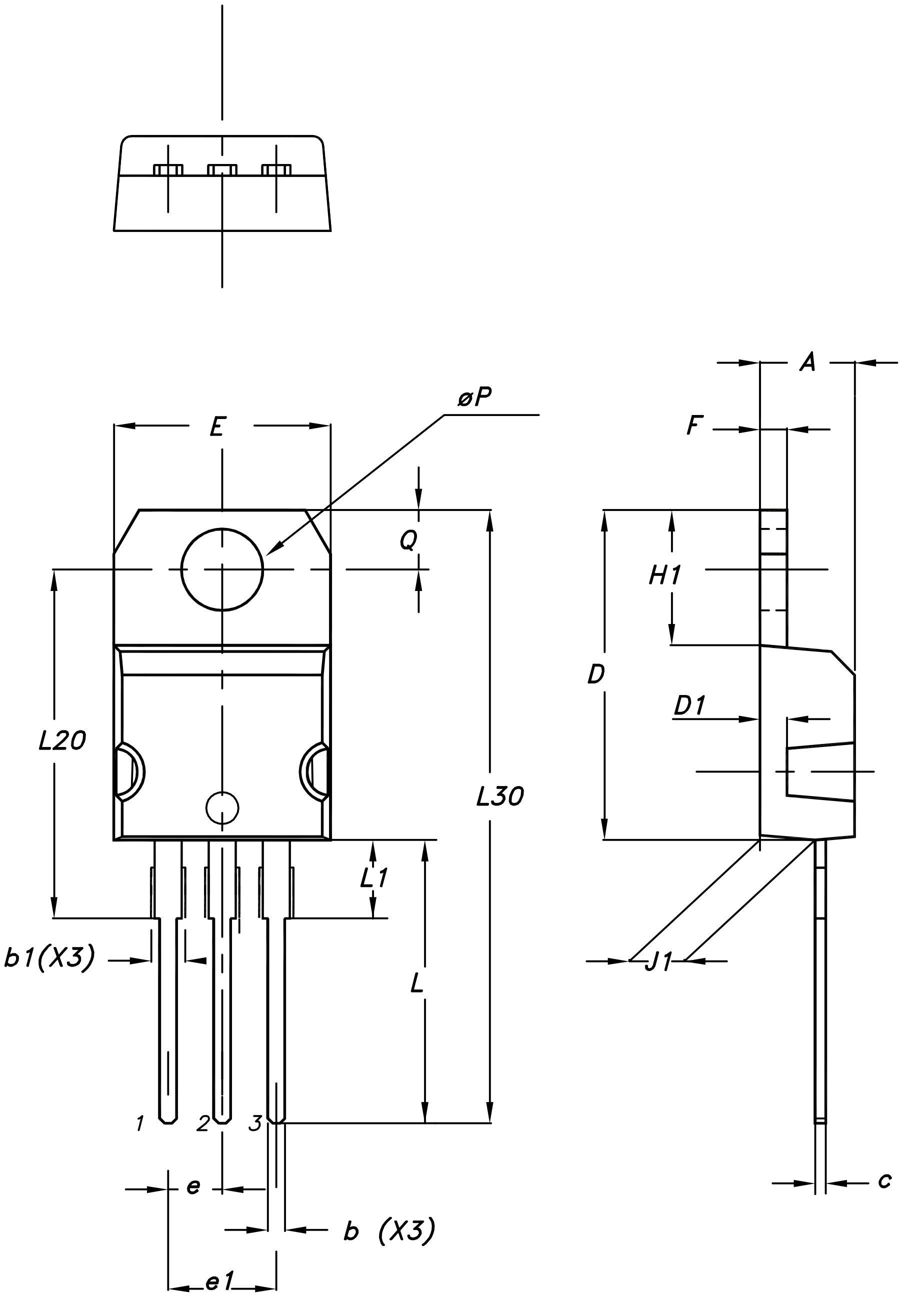
Figure 25. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint

4.2 TO-220 type A package information

Figure 26. TO-220 type A package outline



0015988_typeA_Rev_21

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

4.3 TO-220 type H package information

Figure 27. **TO-220 type H package outline**

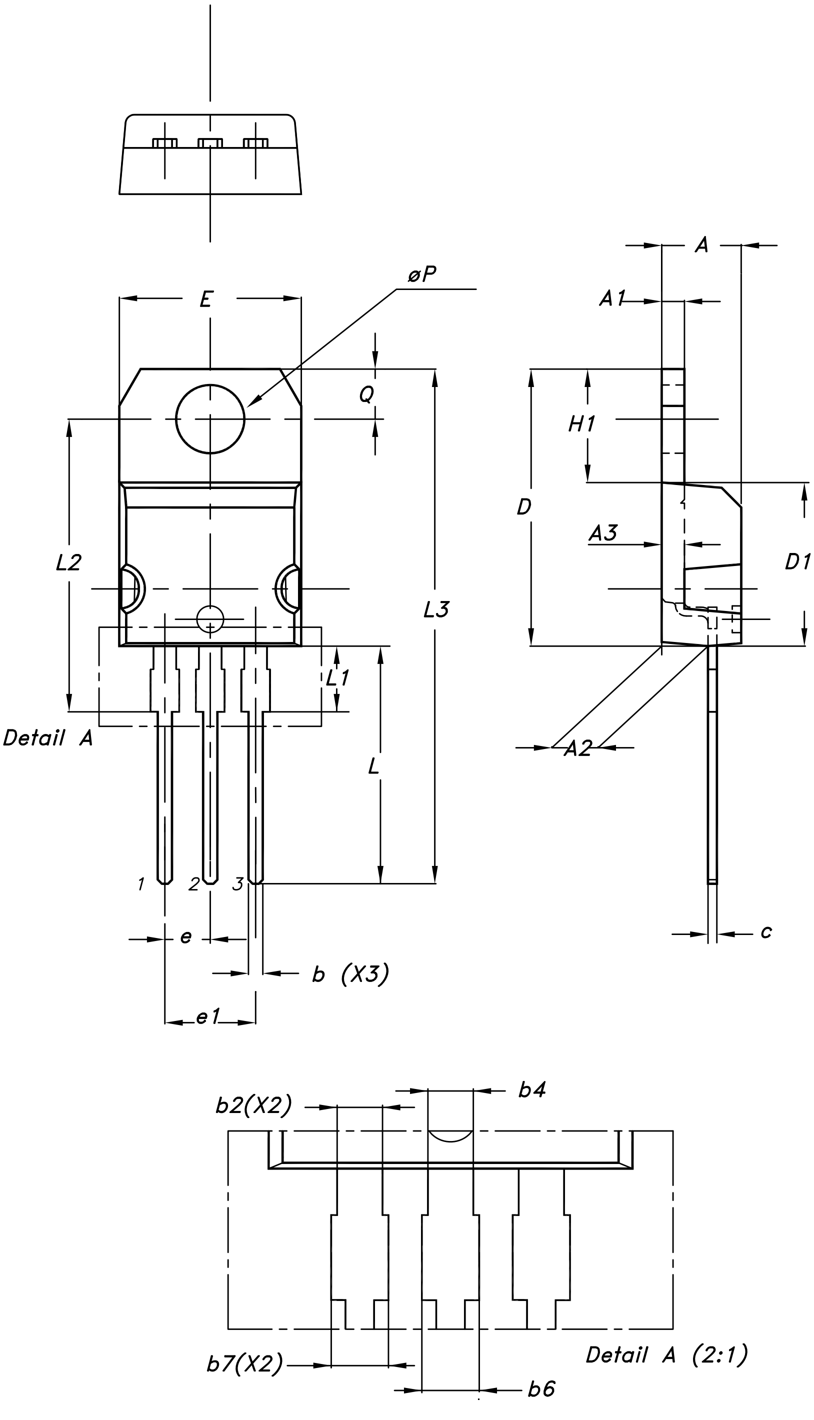
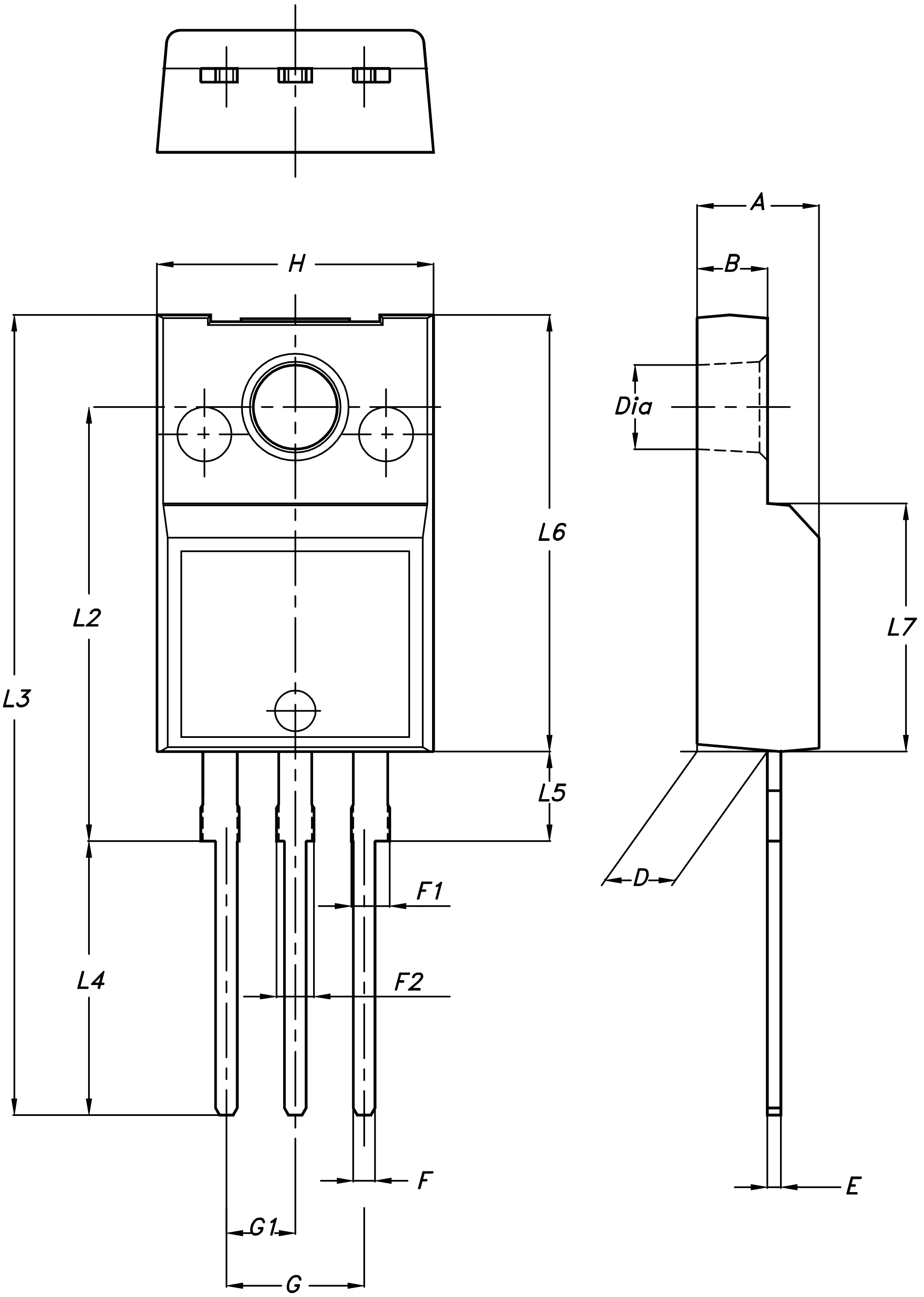


Table 11. **TO-220 type H package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	4.45	4.50
A1	1.22		1.32
A2	2.49	2.59	2.69
A3	1.17	1.27	1.37
b	0.78		0.87
b2	1.25		1.34
b4	1.20		1.29
b6			1.50
b7			1.45
c	0.49		0.56
D	15.40	15.50	15.60
D1	9.05	9.15	9.25
E	10.08	10.18	10.28
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
H1	6.25	6.35	6.45
L	13.20	13.40	13.60
L1	3.50	3.70	3.90
L2	16.30	16.40	16.50
L3	28.70	28.90	29.10
∅P	3.75	3.80	3.85
Q	2.70	2.80	2.90

4.4 TO-220FP package information

Figure 28. TO-220FP package outline



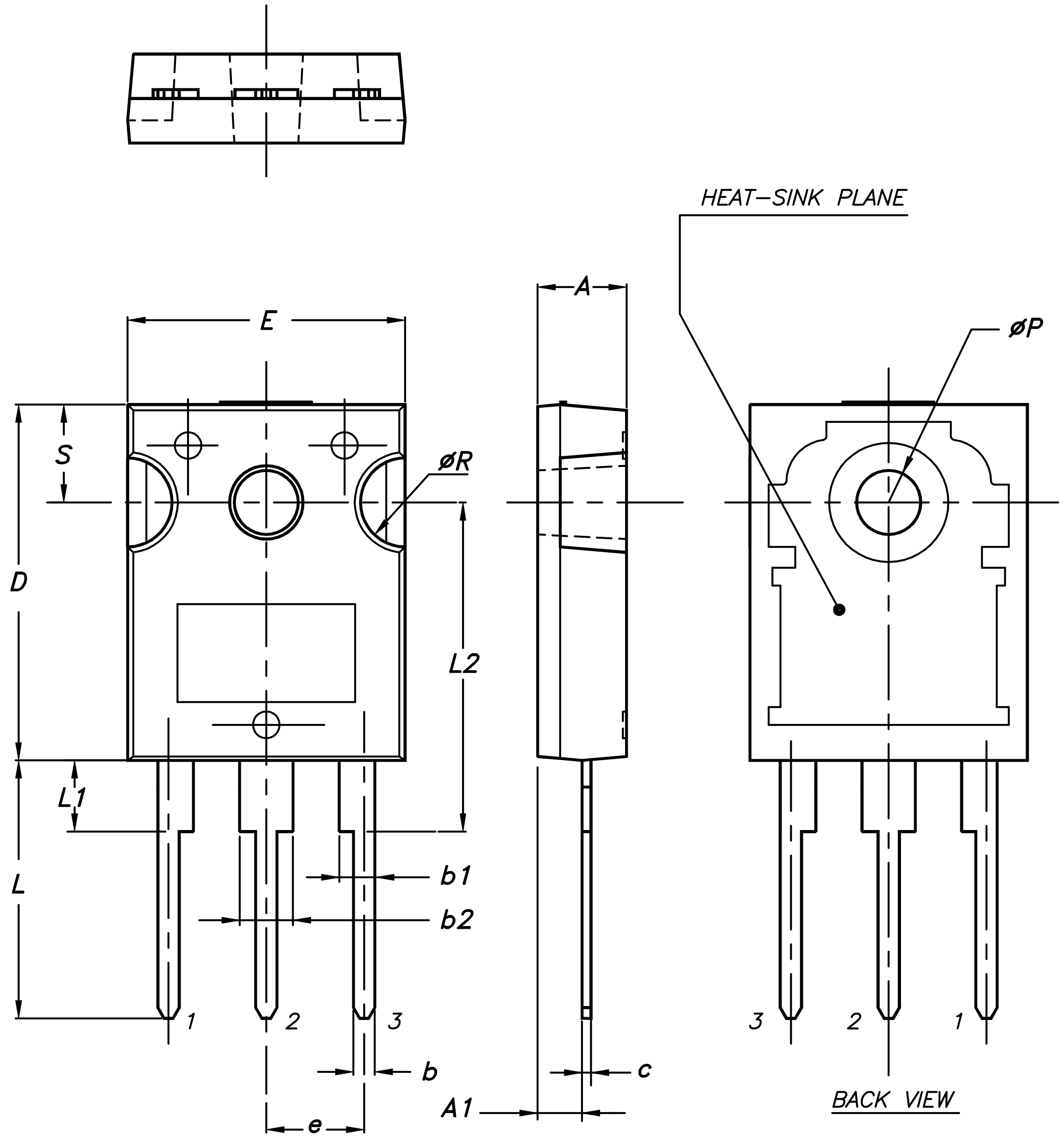
7012510_Rev_12_B

Table 12. TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

4.5 TO-247 package information

Figure 29. TO-247 package outline



0075325_9

Table 13. **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

5 Ordering information

Table 14. **Order codes**

Order code	Marking	Package	Packing
STB6NK90ZT4	B6NK90Z	D^2PAK	Tape e reel
STP6NK90Z	P6NK90Z	TO-220	Tube
STP6NK90ZFP	P6NK90ZFP	TO-220FP	Tube
STW7NK90Z	W7NK90Z	TO-247	Tube

Revision history

Table 15. **Document revision history**

Date	Version	Changes
29-Nov-2005	3	Complete version
16-Aug-2006	4	New template, no content change
10-Apr-2007	5	Typo mistake on Table 2
04-Apr-2018	6	Removed maturity status indication from cover page. The document status is production data. Updated Table 5. **Dynamic** and Table 6. **Source drain diode**. Minor text changes.

Contents