

N-channel 800 V, 1.3 Ω typ., 4.5 A MDmesh™ K5
Power MOSFETs in D²PAK, DPAK, I²PAK and TO-220 packages

Datasheet - production data

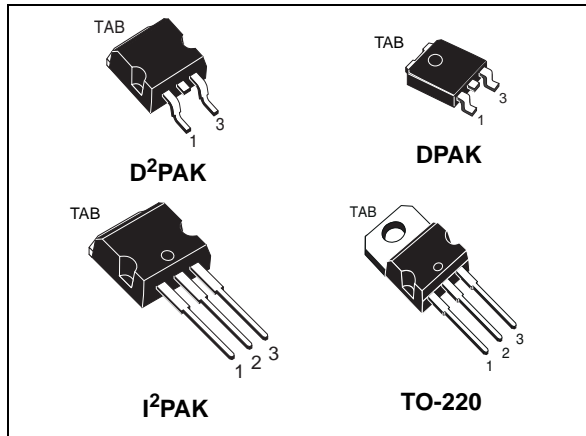
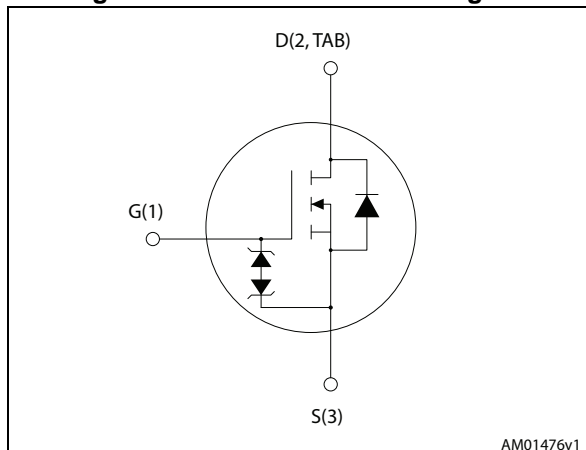


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS}	R _{DS(on)} max	I _D	P _{TOT}
STB6N80K5	800 V	1.6 Ω	4.5 A	85 W
STD6N80K5				
STI6N80K5				
STP6N80K5				

- Industry's lowest R_{DS(on)}
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These very high voltage N-channel Power MOSFETs are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1. Device summary

Order code	Marking	Package	Packaging
STB6N80K5	6N80K5	D ² PAK	Tape and reel
STD6N80K5		DPAK	
STI6N80K5		I ² PAK	Tube
STP6N80K5		TO-220	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	30	V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	4.5	A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	2.8	A
$I_{DM}^{(1)}$	Drain current (pulsed)	18	A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	85	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	1.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	85	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 150	°C

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 4.5\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, peak $V_{DS} \leq V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		D ² PAK	DPAK	I ² PAK	TO-220	
$R_{thj-case}$	Thermal resistance junction-case	1.47				°C/W
$R_{thj-amb}$	Thermal resistance junction-amb			62.50	62.50	
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb	30	50			

1. When mounted on FR-4 board of 1 inch², 2 oz Cu

2 Electrical characteristics

($T_{CASE} = 25\text{ °C}$ unless otherwise specified).

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage ($V_{GS} = 0$)	$I_D = 1\text{ mA}$	800			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 800\text{ V}$ $V_{DS} = 800\text{ V}, T_j = 125\text{ °C}$			1 50	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 2\text{ A}$		1.3	1.6	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0$	-	270	-	pF
C_{oss}	Output capacitance		-	25	-	pF
C_{rss}	Reverse transfer capacitance		-	0.7	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0,$ $V_{DS} = \text{from } 0 \text{ to } 640\text{ V}$	-	38	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	16	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0$	-	7.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 4.5\text{ A}$ $V_{GS} = 10\text{ V}$	-	13	-	nC
Q_{gs}	Gate-source charge		-	2.1	-	nC
Q_{gd}	Gate-drain charge		-	9.6	-	nC

1. Time related 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}
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 2.25\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$	-	16	-	ns
t_r	Rise time		-	7.5	-	ns
$t_{d(off)}$	Turn-off delay time		-	28.5	-	ns
t_f	Fall time		-	16	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		4.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		18	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4.5\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 4.5\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$,	-	280		ns
Q_{rr}	Reverse recovery charge		-	2.2		μC
I_{RRM}	Reverse recovery current		-	15.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 4.5\text{ A}$, $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 150\text{ }^\circ\text{C}$	-	450		ns
Q_{rr}	Reverse recovery charge		-	3.15		μC
I_{RRM}	Reverse recovery current		-	14		A

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

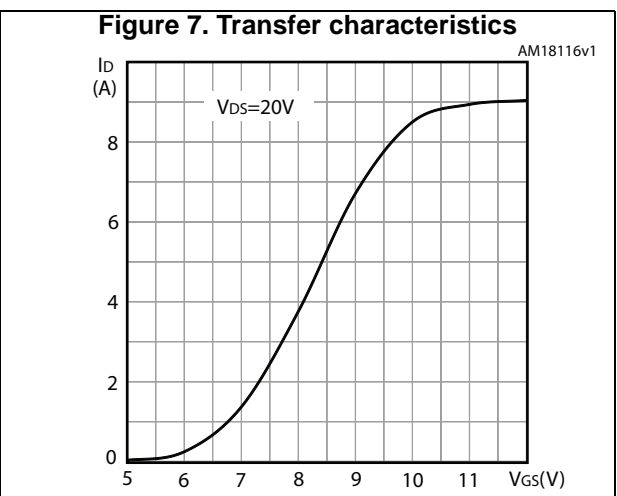
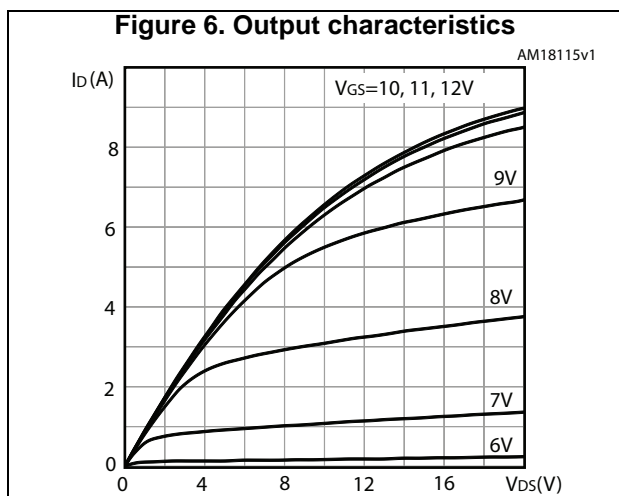
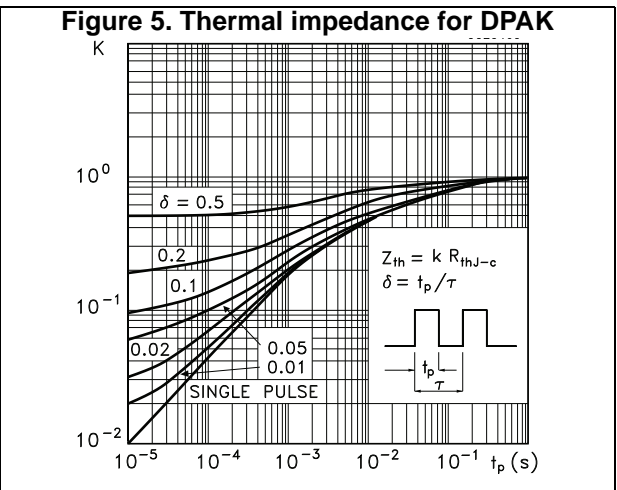
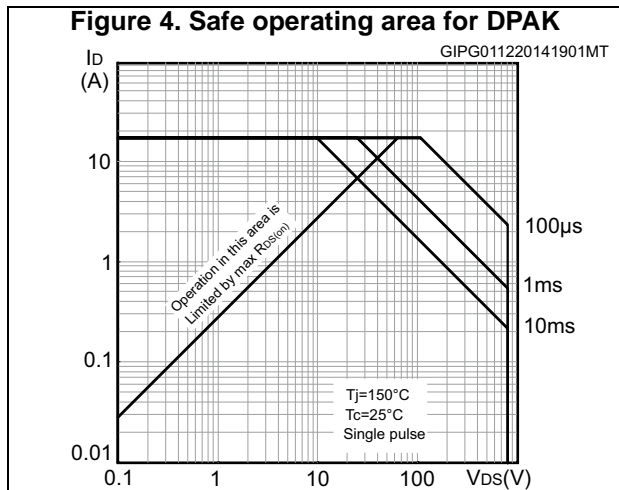
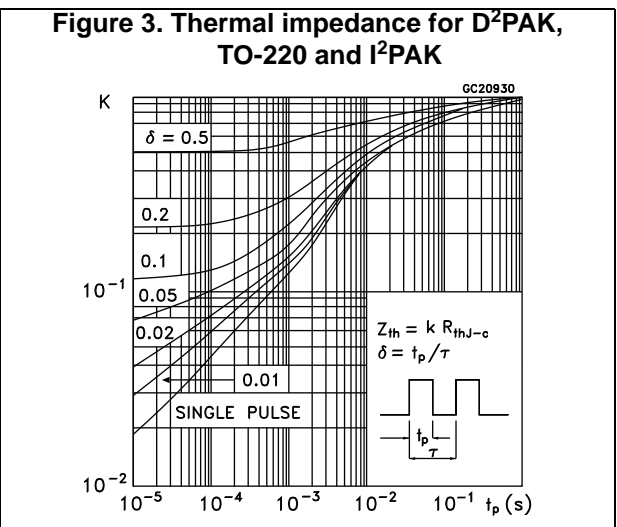
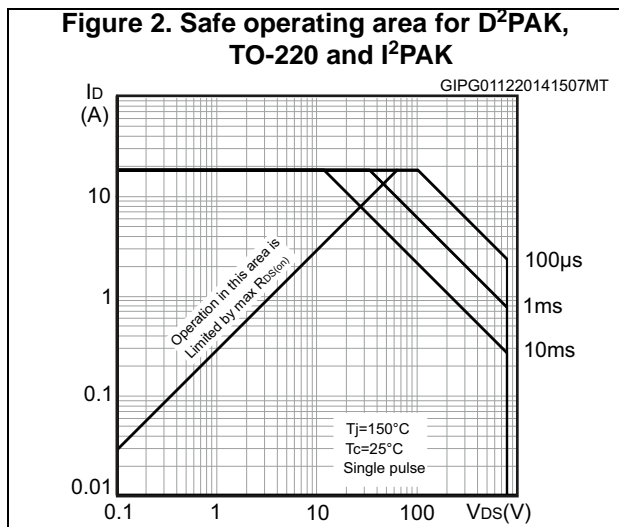


Figure 8. Gate charge vs gate-source voltage

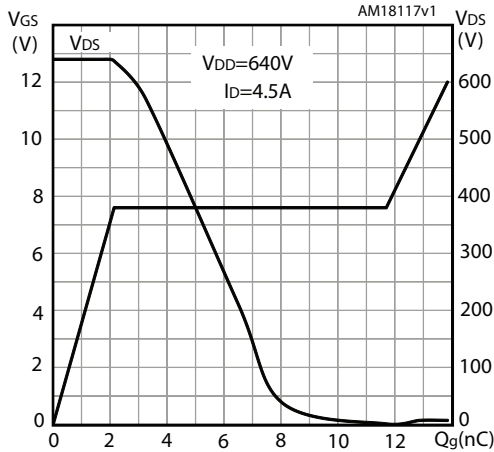


Figure 9. Static drain-source on-resistance

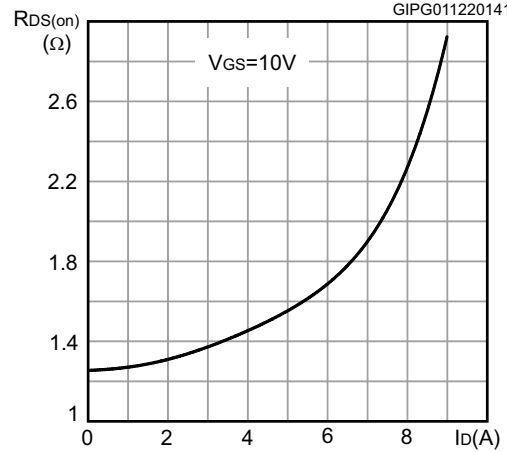


Figure 10. Capacitance variations

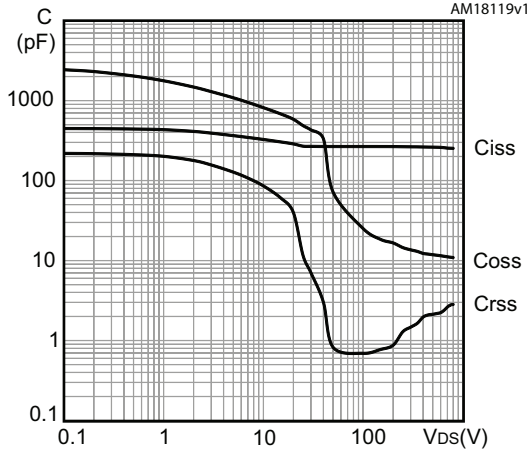


Figure 11. Output capacitance stored energy

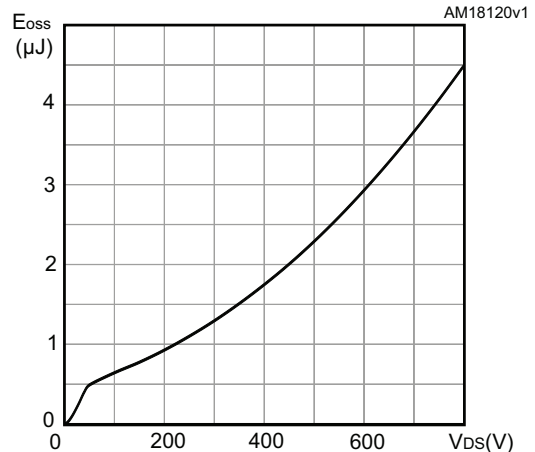


Figure 12. Normalized gate threshold voltage vs temperature

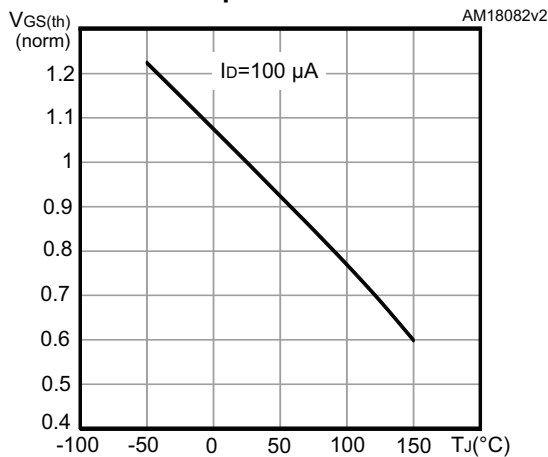


Figure 13. Normalized on-resistance vs temperature

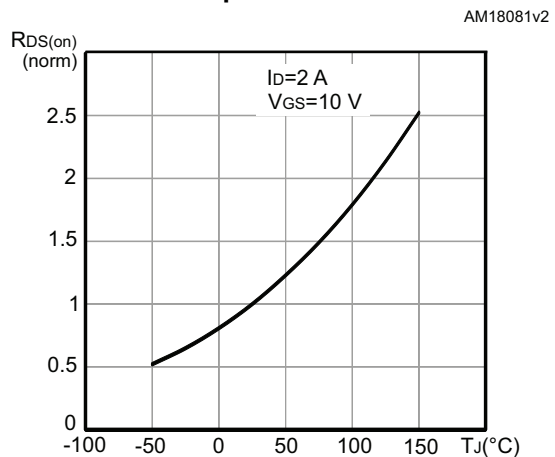


Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

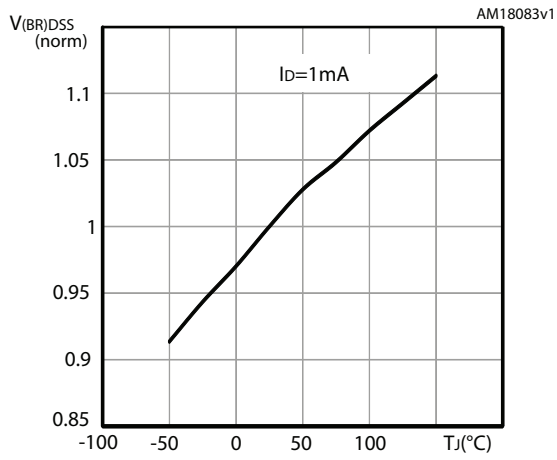
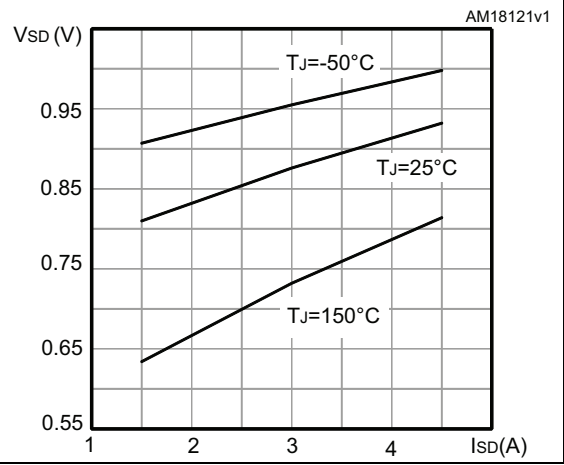
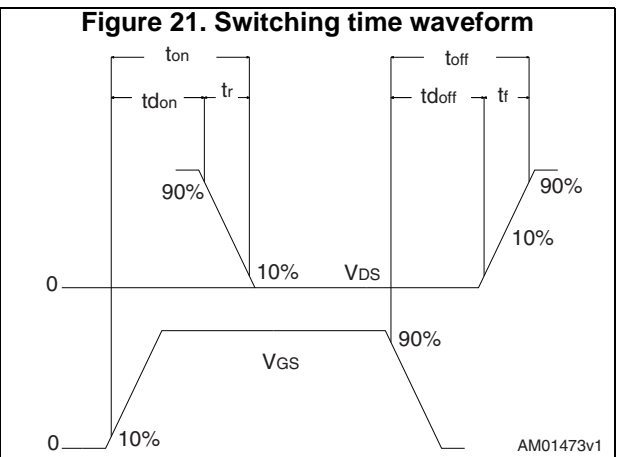
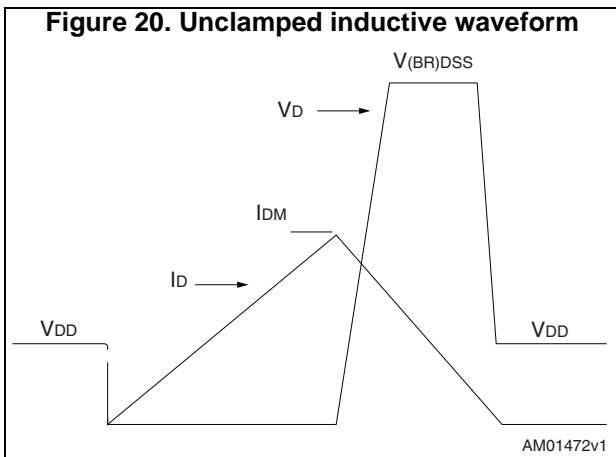
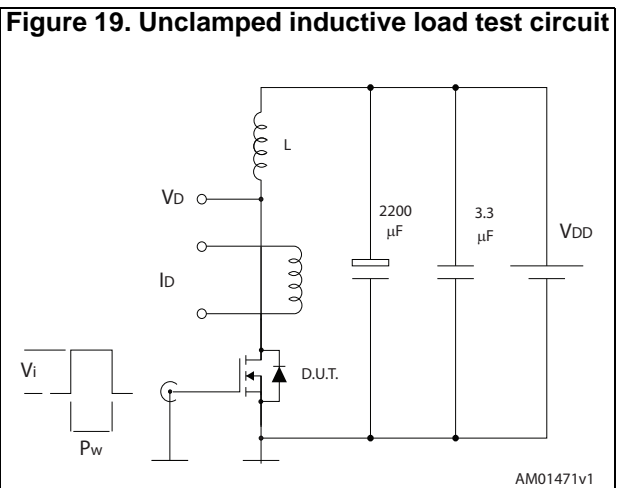
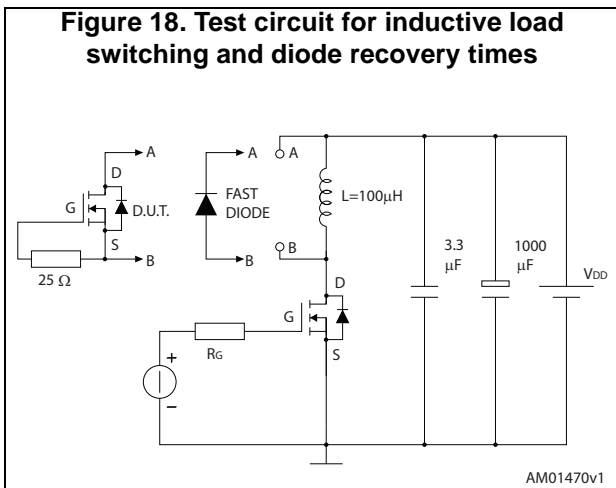
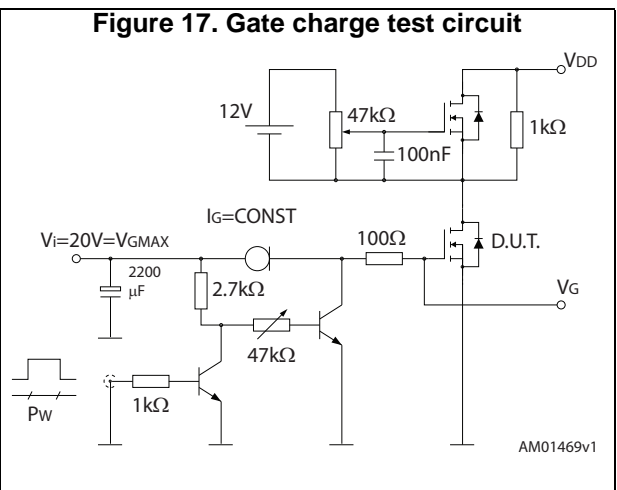
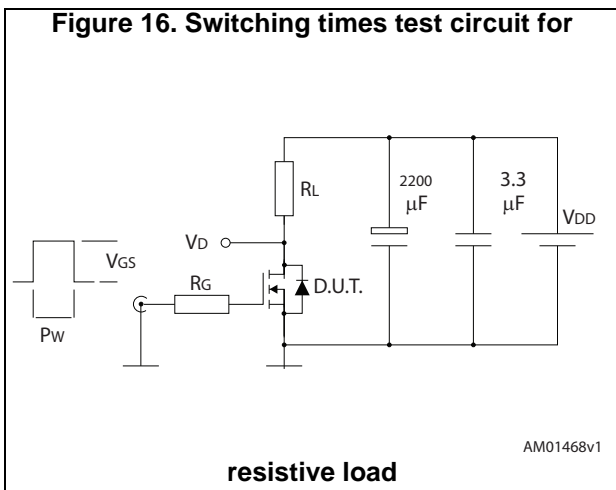


Figure 15. Source-drain diode forward characteristics



3 Test circuits



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 package information

Figure 22. D²PAK outline

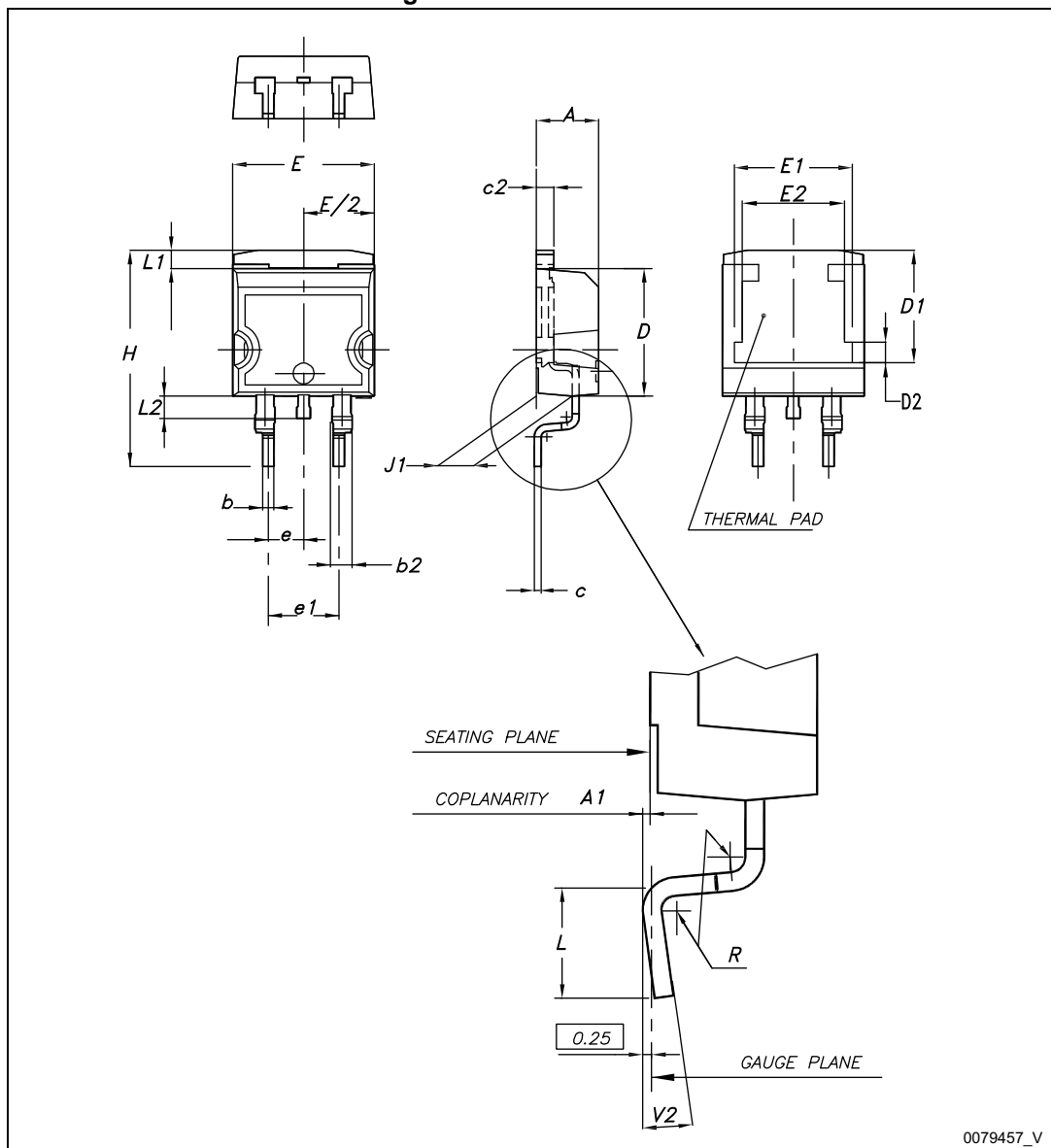
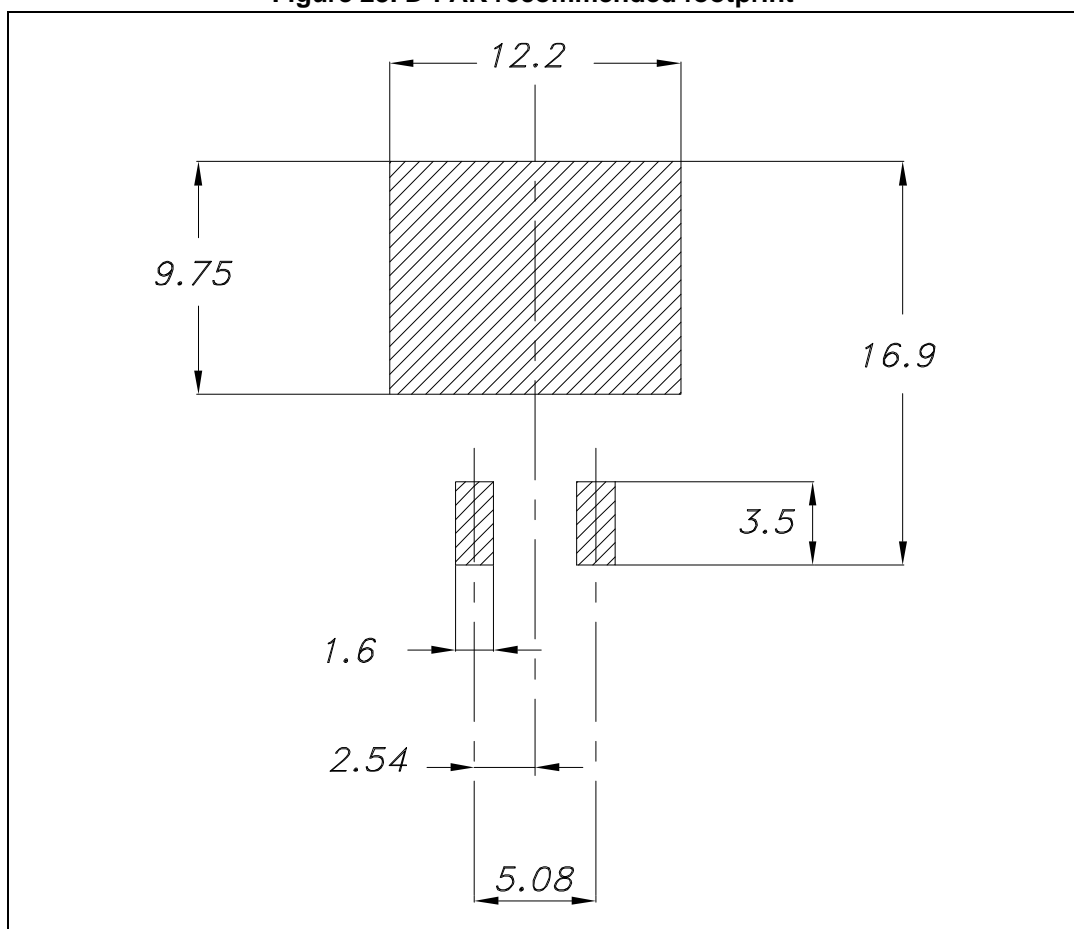


Table 9. D²PAK mechanical data

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		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		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 23. D²PAK recommended footprint^(a)



a. All dimension are in millimeters

4.2 DPAK package information

Figure 24. DPAK (TO-252) type A2 outline

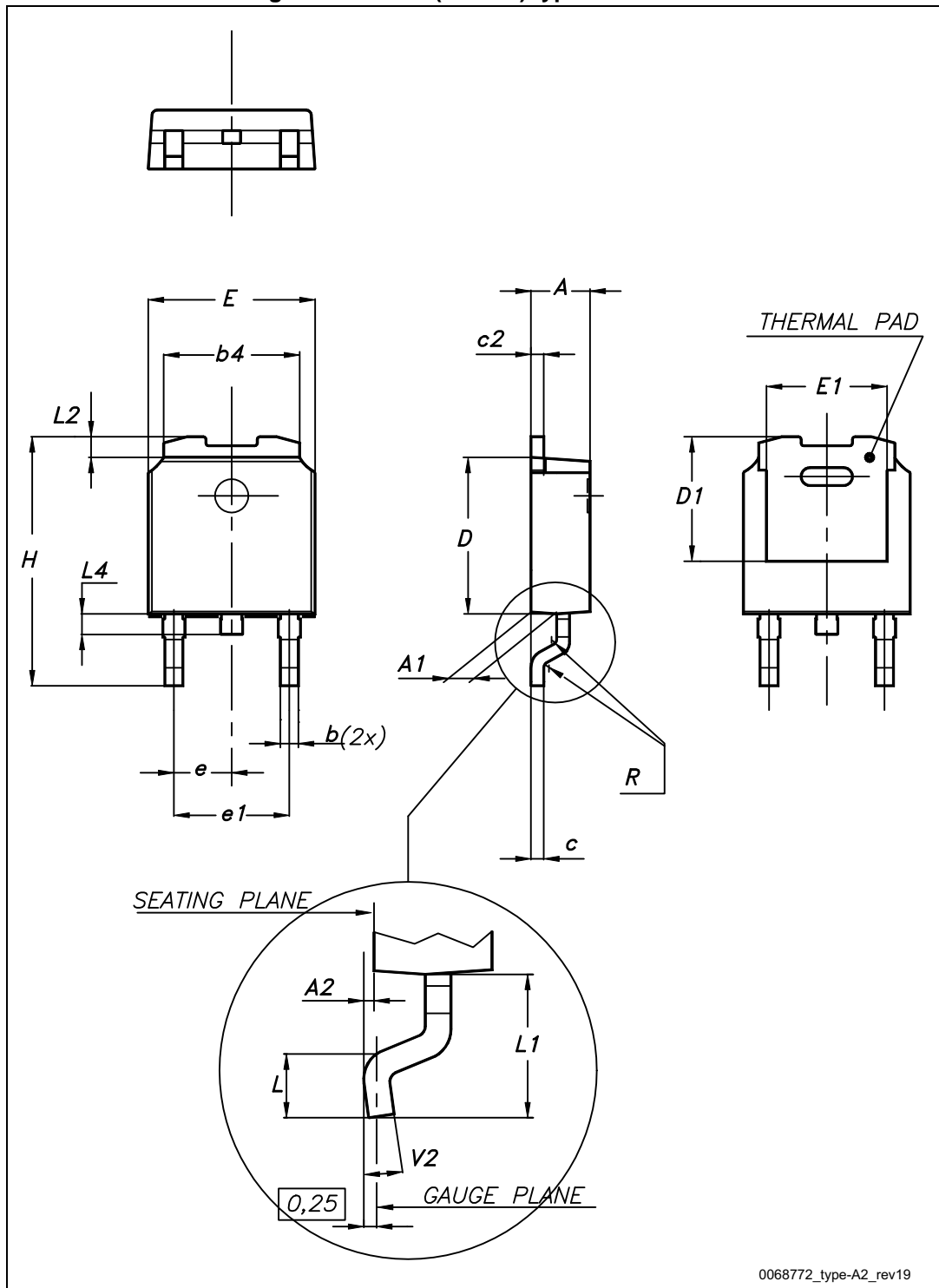


Table 10. DPAK (TO-252) type A2 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	5.10	5.20	5.30
e	2.16	2.28	2.40
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 25. DPAK (TO-252) type E outline

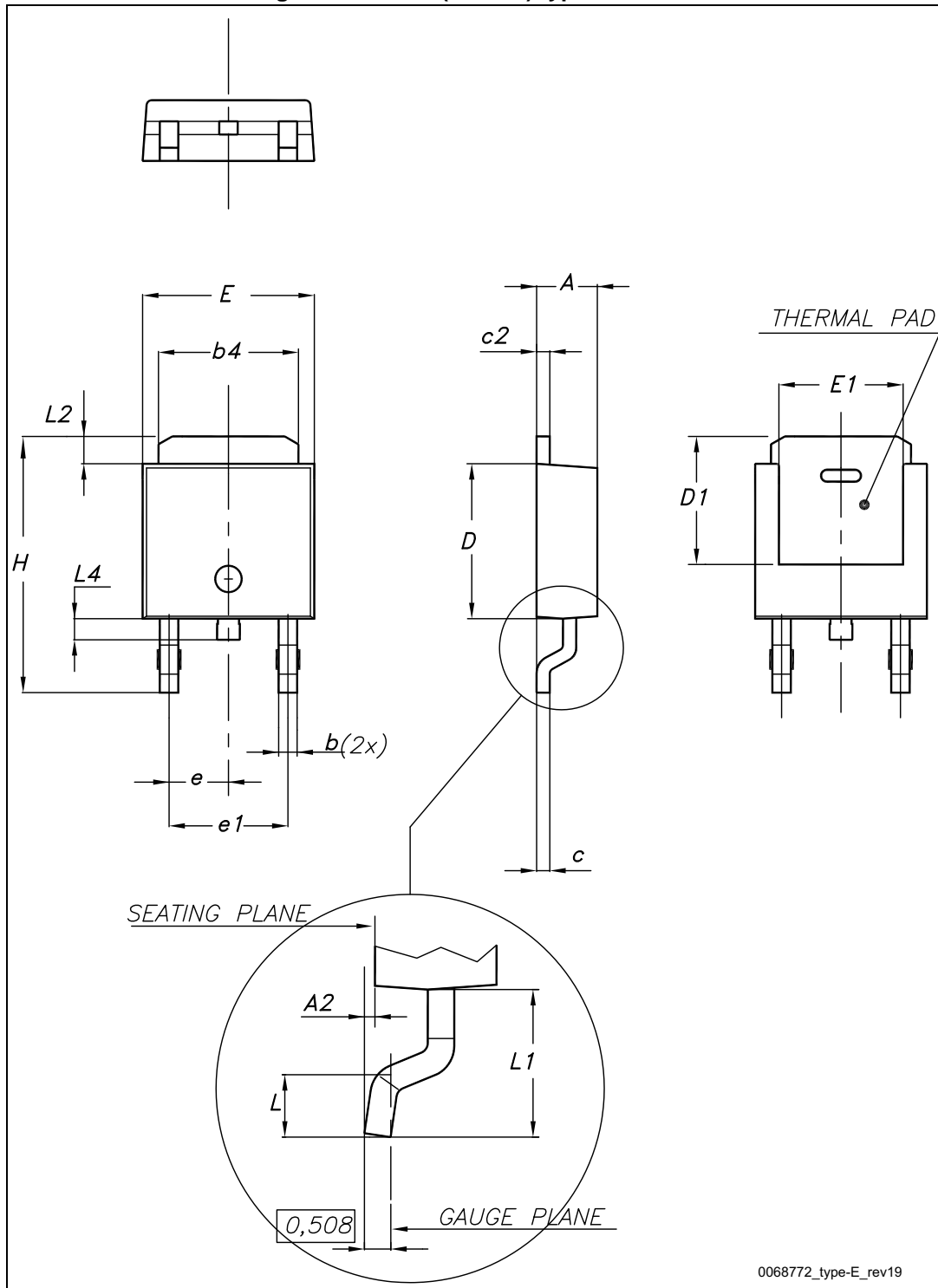
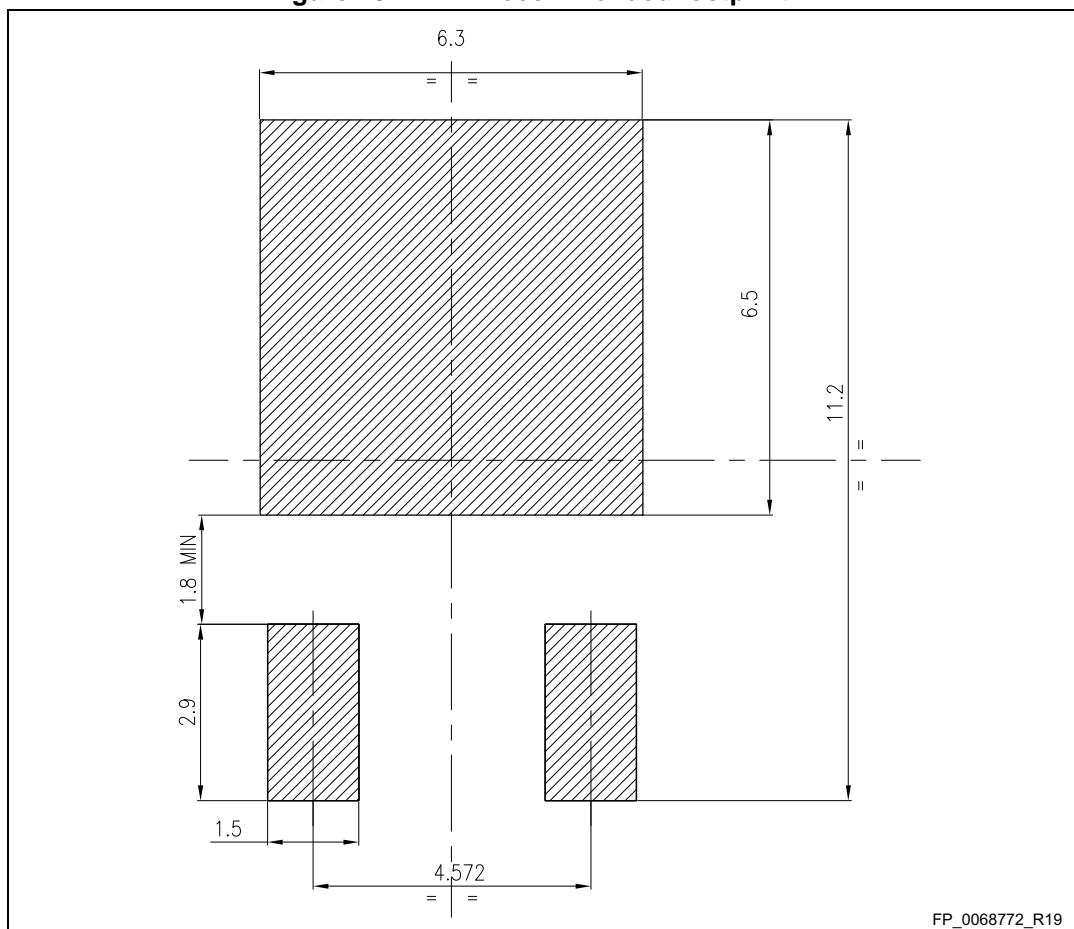


Table 11. DPAK (TO-252) type E mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 26. DPAK recommended footprint (b)



b. All dimensions are in millimeters

4.3 I²PAK package information

Figure 27. I²PAK outline

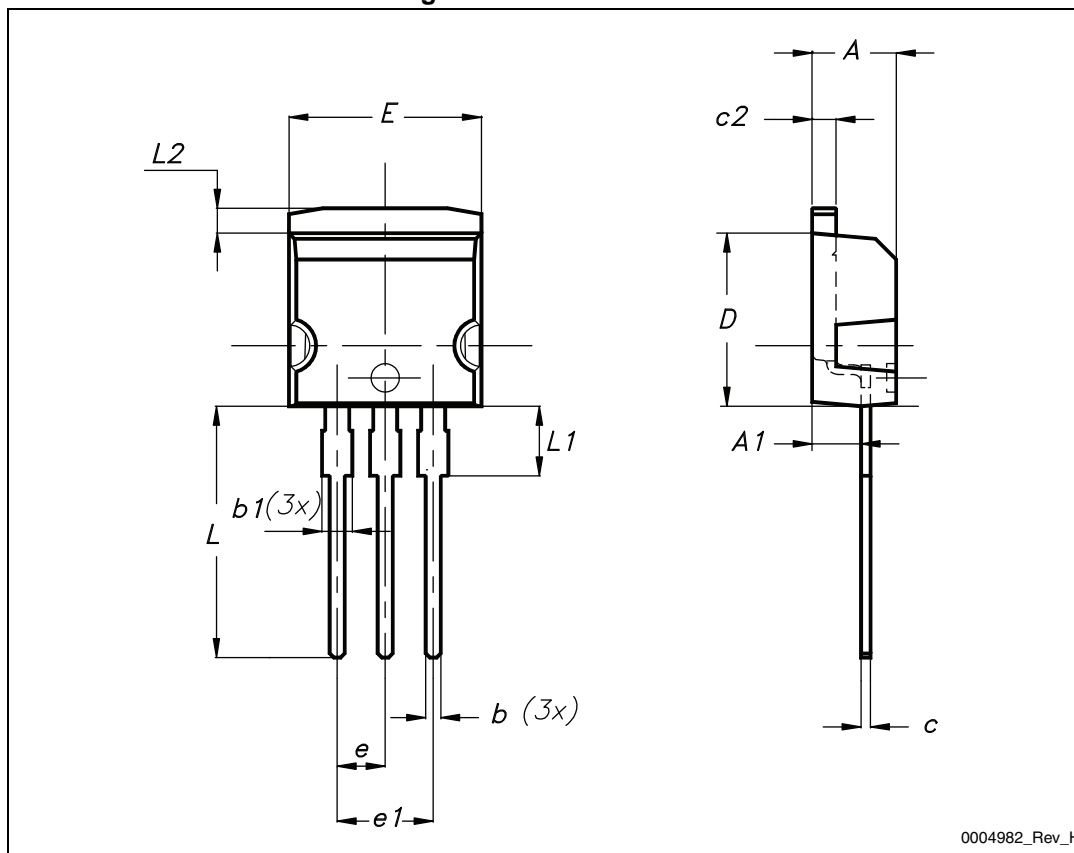


Table 12. I²PAK mechanical data

DIM.	mm.		
	min.	typ.	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		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

4.4 TO-220 package information

Figure 28. TO-220 type A outline

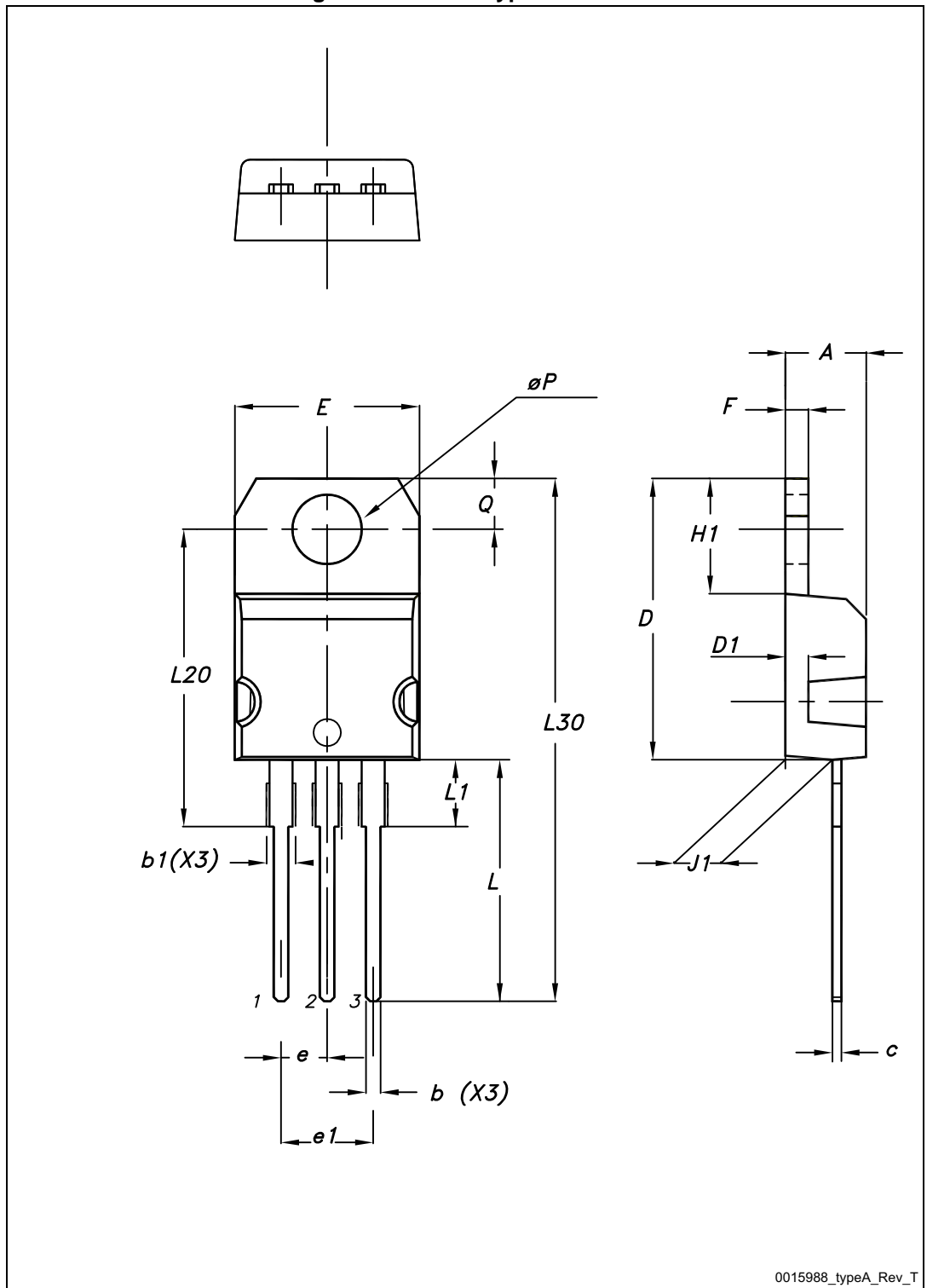


Table 13. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
ØP	3.75		3.85
Q	2.65		2.95

5 Packing information

5.1 D²PAK and DPAK tape and reel packing information

Figure 29. Tape for D²PAK and DPAK

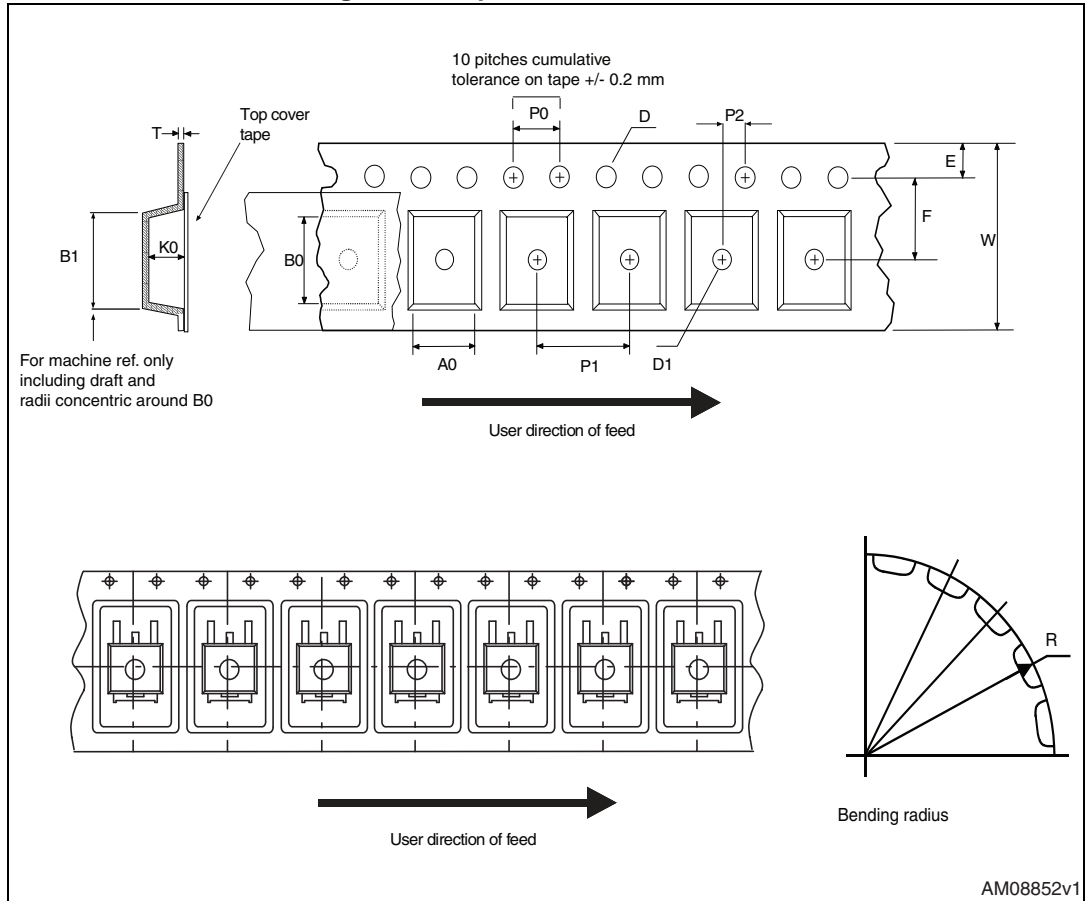


Figure 30. Reel for D²PAK and DPAK

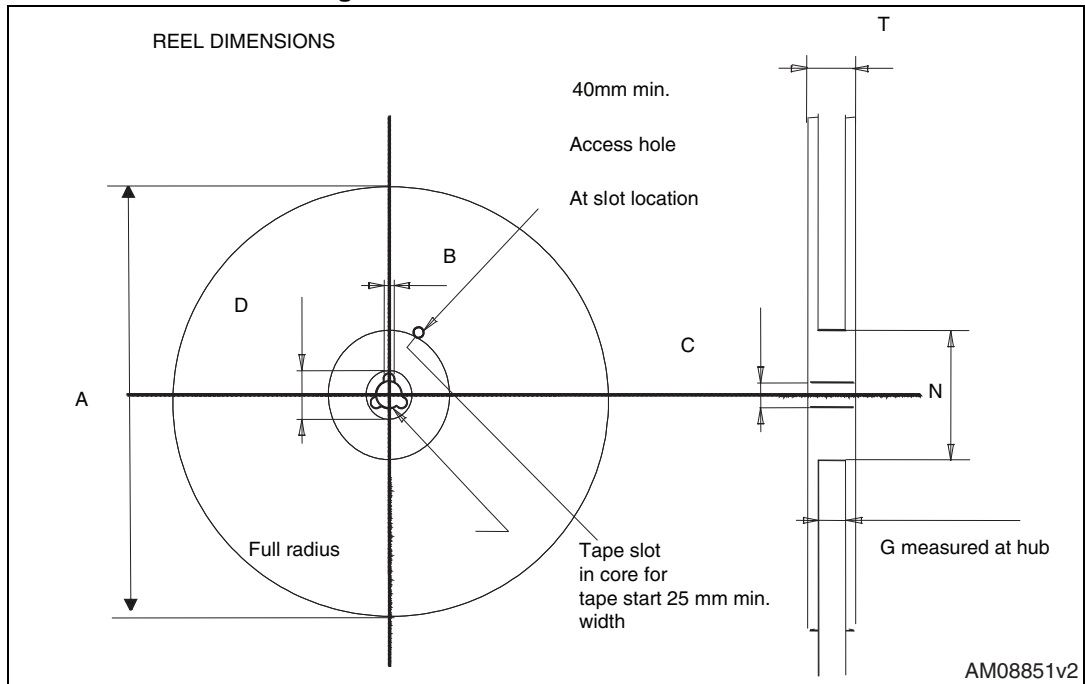


Table 14. D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base qty	1000
P2	1.9	2.1		Bulk qty	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Table 15. DPAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

6 Revision history

Table 16. Document revision history

Date	Revision	Changes
28-May-2013	1	First release.
05-Dec-2014	2	Updated title, features and description in cover page. Added Section 2.1: Electrical characteristics (curves) . Updated Section 4: Package information . Minor text changes.
27-Mar-2015	3	Updated Section 4: Package information . Minor text changes.

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