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STB19NF20, STD19NF20, STF19NF20, STP19NF20

N-channel 200 V, 0.11 Ω typ., 15 A MESH OVERLAY™
Power MOSFET in D²PAK, DPAK, TO-220FP and TO-220 packages

Datasheet — production data

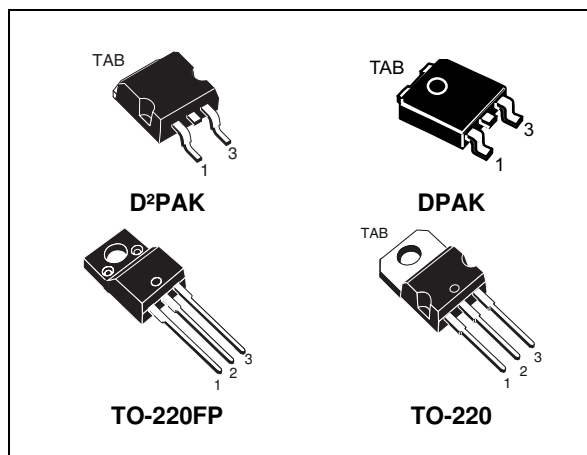
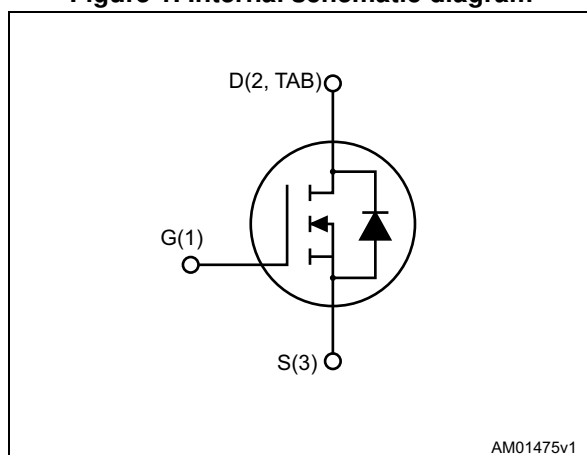


Figure 1. Internal schematic diagram



Features

Type	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STB19NF20	200 V	0.16 Ω	15 A	90 W
STD19NF20	200 V	0.16 Ω	15 A	90 W
STF19NF20	200 V	0.16 Ω	15 A	25 W
STP19NF20	200 V	0.16 Ω	15 A	90 W

- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances

Applications

- Switching application

Description

This Power MOSFET is designed using the company's consolidated strip layout-based MESH OVERLAY™ process. The result is a product that matches or improves on the performance of comparable standard parts from other manufacturers.

Table 1. Device summary

Order code	Marking	Package	Packing
STB19NF20	19NF20	D ² PAK	Tape and reel
STD19NF20	19NF20	DPAK	
STF19NF20	19NF20	TO-220FP	Tube
STP19NF20	19NF20	TO-220	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, DPAK, TO-220	TO-220FP	
V _{DS}	Drain-source voltage	200		V
V _{GS}	Gate-source voltage	± 20		V
I _D	Drain current (continuous) at T _C = 25 °C	15	15 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	9.45	9.45 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	60	60 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	90	25	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)		2500	V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15		V/ns
T _j	Operating junction temperature	-55 to 150		°C
T _{stg}	Storage temperature			

1. Limited by package.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤ 15 A, di/dt ≤ 300 A/μs, V_{DD} = 80% V_{(BR)DSS}.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		D ² PAK	DPAK	TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case	1.39			5	°C/W
R _{thj-pcb}	Thermal resistance junction-pcb	35	50			
R _{thj-a}	Thermal resistance junction-ambient			62.5		

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j max.)	15	A
E _{AS}	Single pulse avalanche energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	110	mJ

2 Electrical characteristics

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

Table 5. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	200			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 200\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 200\text{ V}$, $T_C = 125\text{ °C}$			10	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 7.5\text{ A}$		0.11	0.16	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 8\text{ V}$, $I_D = 7.5\text{ A}$		12		S
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$		800		pF
C_{oss}	Output capacitance			165		
C_{rss}	Reverse transfer capacitance			26		
Q_g	Total gate charge	$V_{DD} = 160\text{ V}$, $I_D = 15\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 17)		24		nC
Q_{gs}	Gate-source charge			4.4		
Q_{gd}	Gate-drain charge			11.6		

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

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 100\text{ V}$, $I_D = 7.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)		11.5		ns
t_r	Rise time			22		
$t_{d(off)}$	Turn-off delay time			19		
t_f	Fall time			11		

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current				15	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				60	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 15\text{ A}$, $V_{GS} = 0\text{ V}$			1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 15\text{ A}$, $V_{DD} = 50\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, (see Figure 21)		125		ns
Q_{rr}	Reverse recovery charge			0.55		μC
I_{RRM}	Reverse recovery current			8.8		A
t_{rr}	Reverse recovery time	$I_{SD} = 15\text{ A}$, $V_{DD} = 50\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 21)		148		ns
Q_{rr}	Reverse recovery charge			0.73		μC
I_{RRM}	Reverse recovery current			9.9		A

1. Pulse width limited by safe operating area.

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D²PAK, DPAK and TO-220

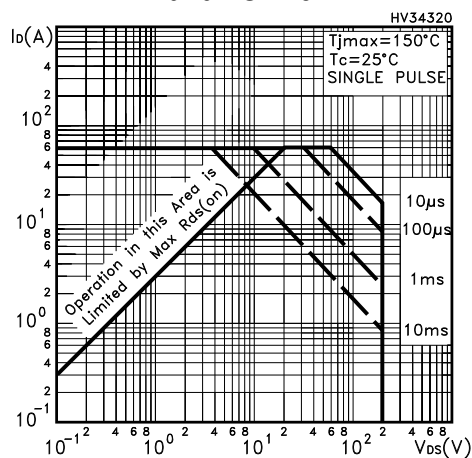


Figure 3. Thermal impedance for D²PAK, DPAK and TO-220

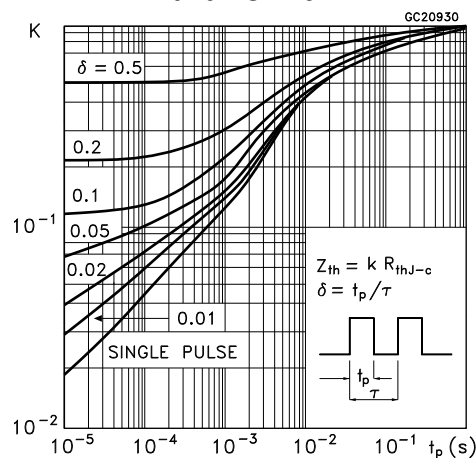


Figure 4. Safe operating area for TO-220FP

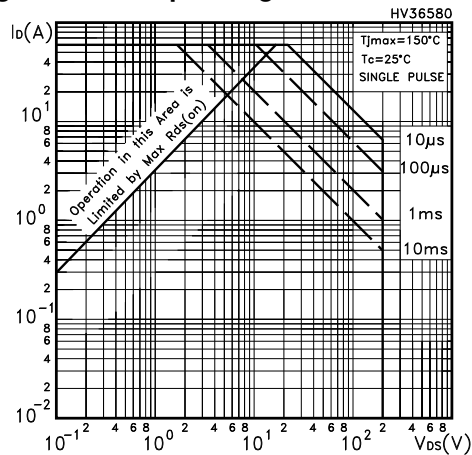


Figure 5. Thermal impedance for TO-220FP

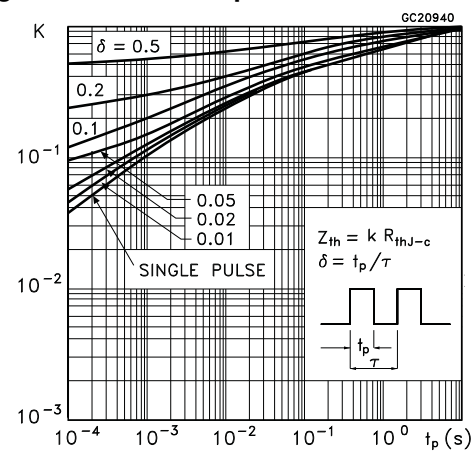


Figure 6. Output characteristics

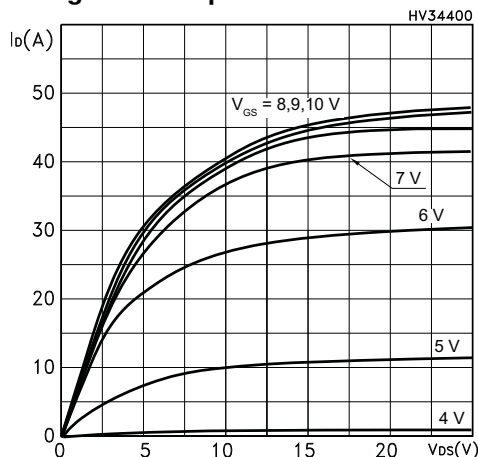


Figure 7. Transfer characteristics

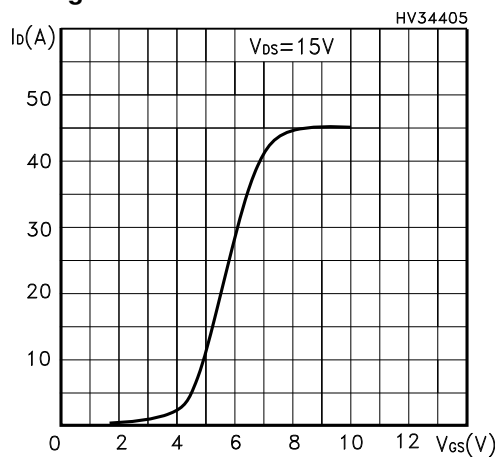


Figure 8. Static drain-source on-resistance

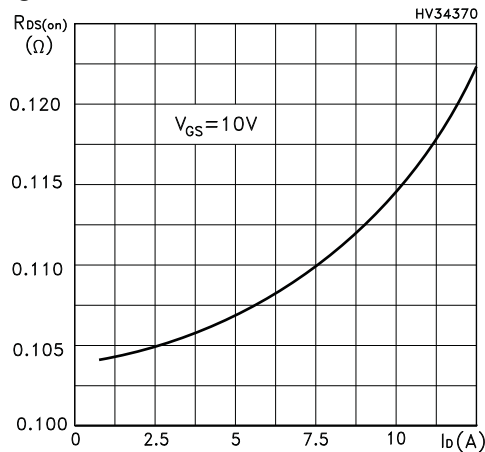
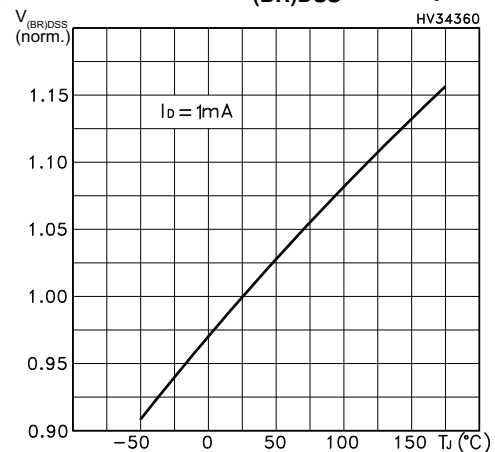
Figure 9. Normalized $V_{(BR)DSS}$ vs temperature

Figure 10. Gate charge vs gate-source voltage

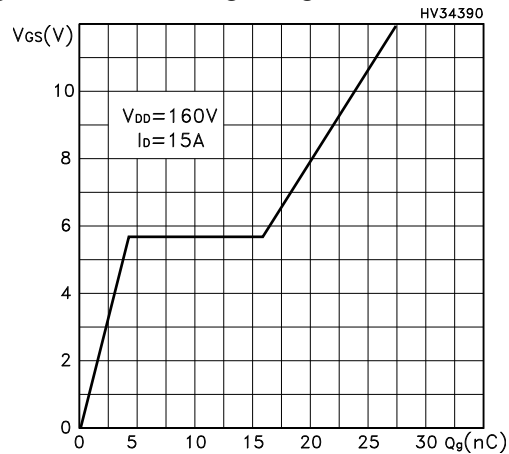


Figure 11. Capacitance variations

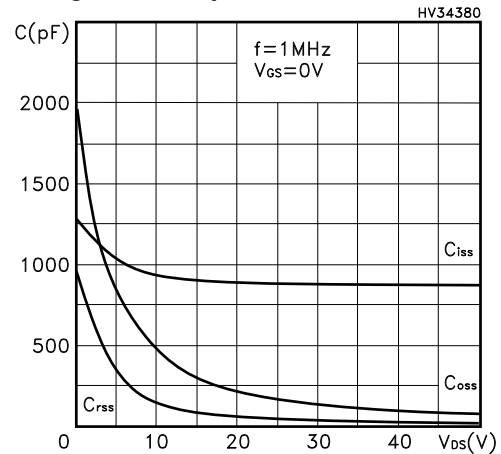


Figure 12. Normalized gate threshold voltage vs temperature

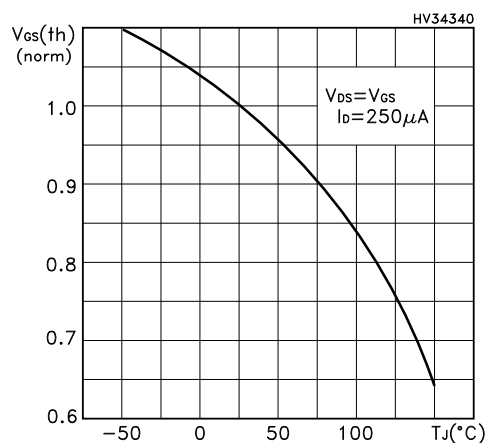


Figure 13. Normalized on-resistance vs temperature

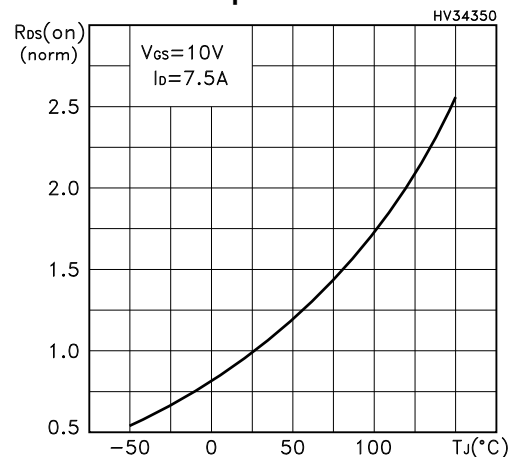


Figure 14. Source-drain forward characteristics

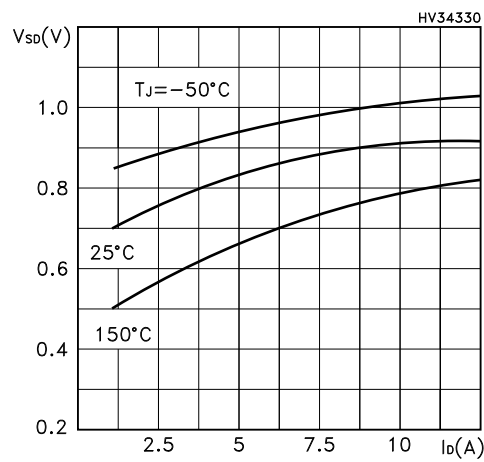
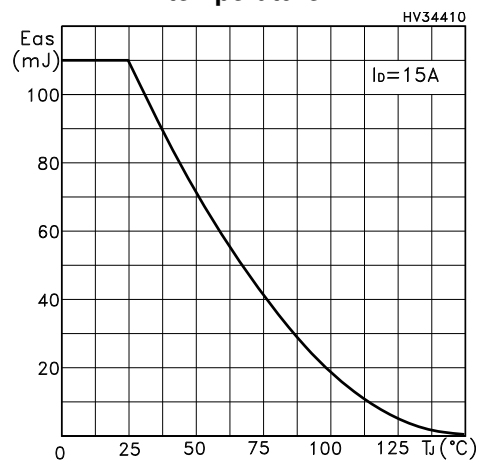
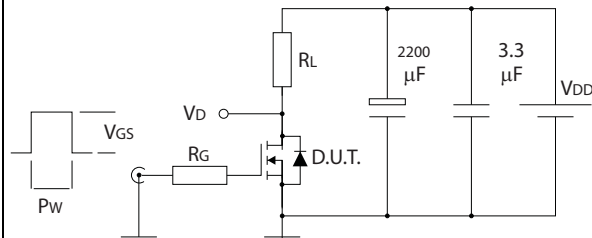


Figure 15. Maximum avalanche energy vs temperature



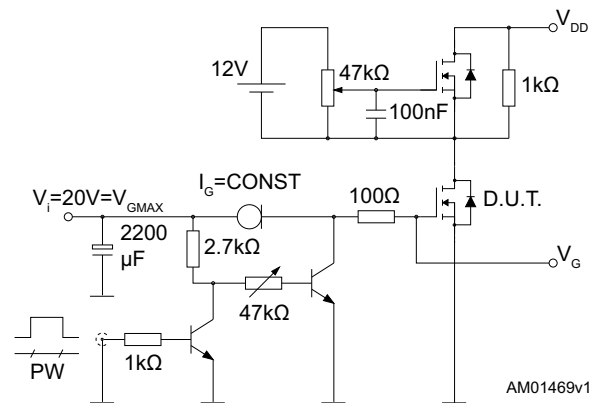
3 Test circuits

Figure 16. Switching times test circuit for resistive load



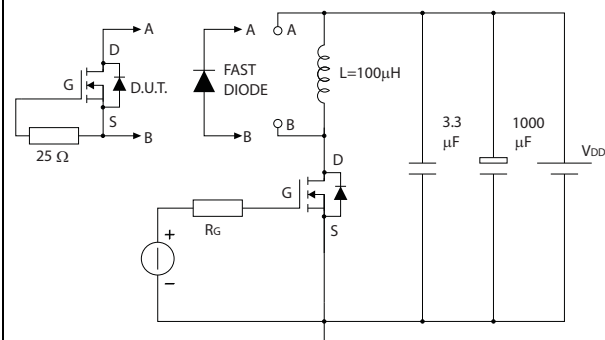
AM01468v1

Figure 17. Gate charge test circuit



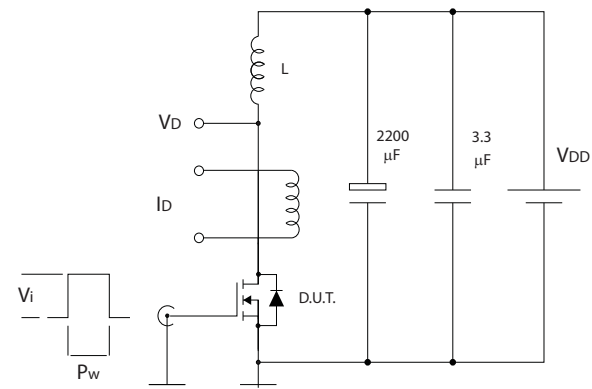
AM01469v1

Figure 18. Test circuit for inductive load switching and diode recovery times



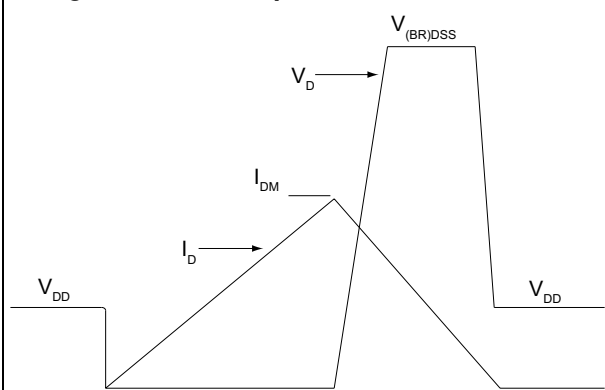
AM01470v1

Figure 19. Unclamped inductive load test circuit



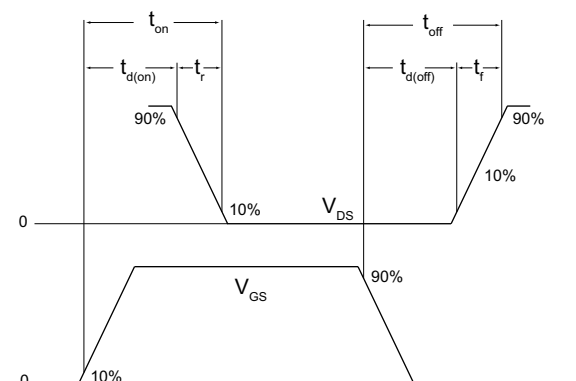
AM01471v1

Figure 20. Unclamped inductive waveform



AM01472v1

Figure 21. Switching time waveform



AM01473v1

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) type A and type B package information

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

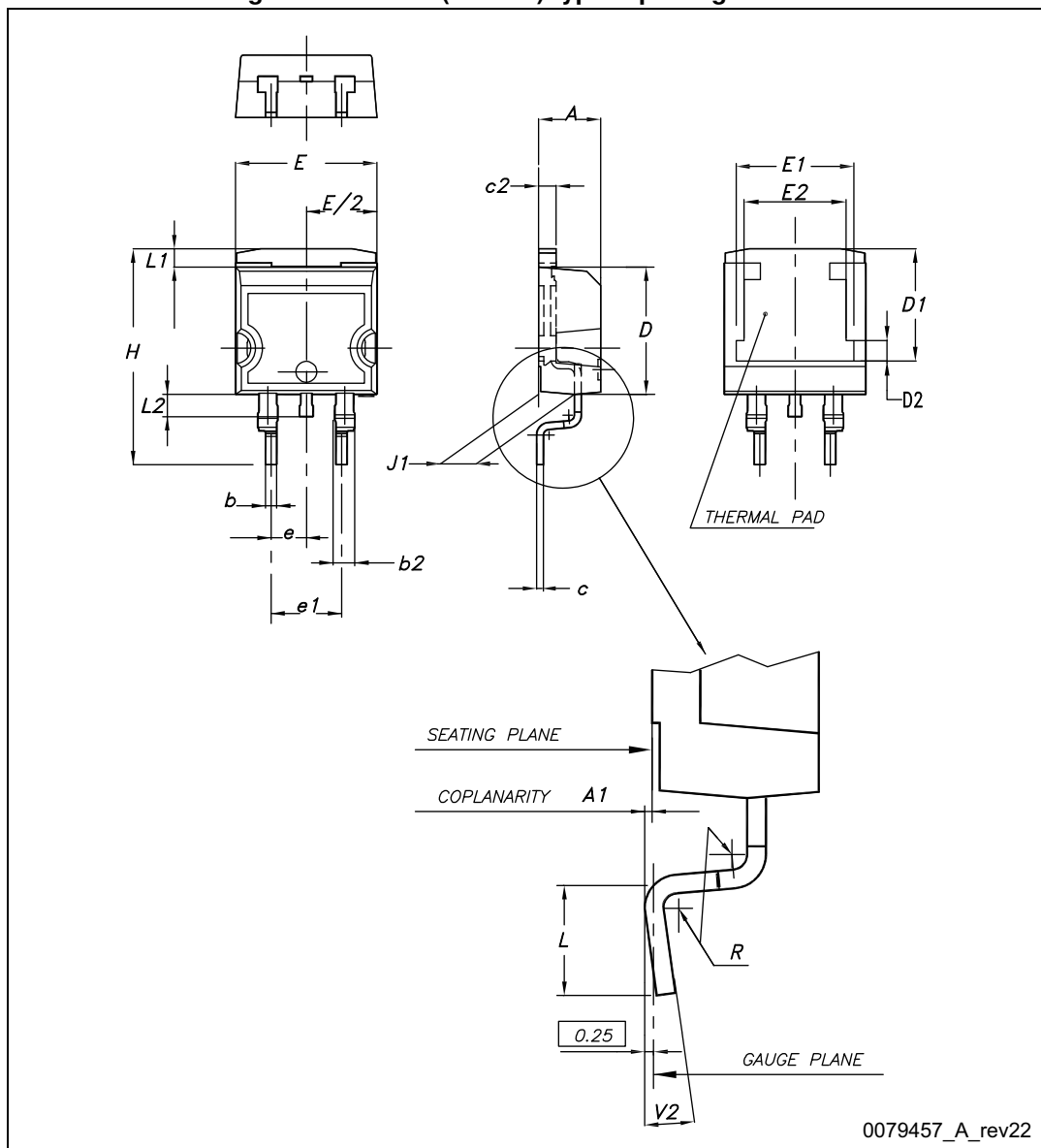


Table 9. D²PAK (TO-263) type A mechanical data

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°

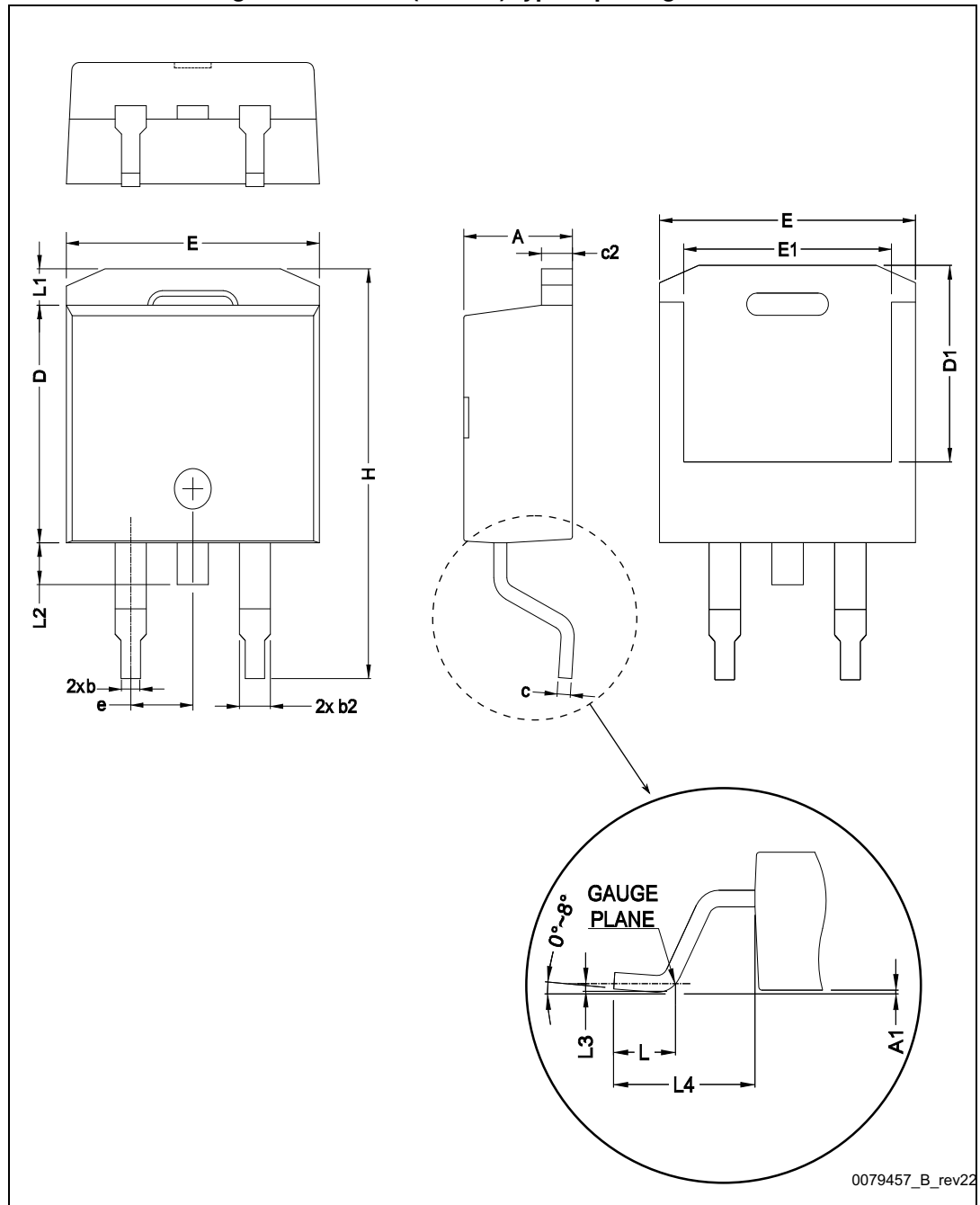
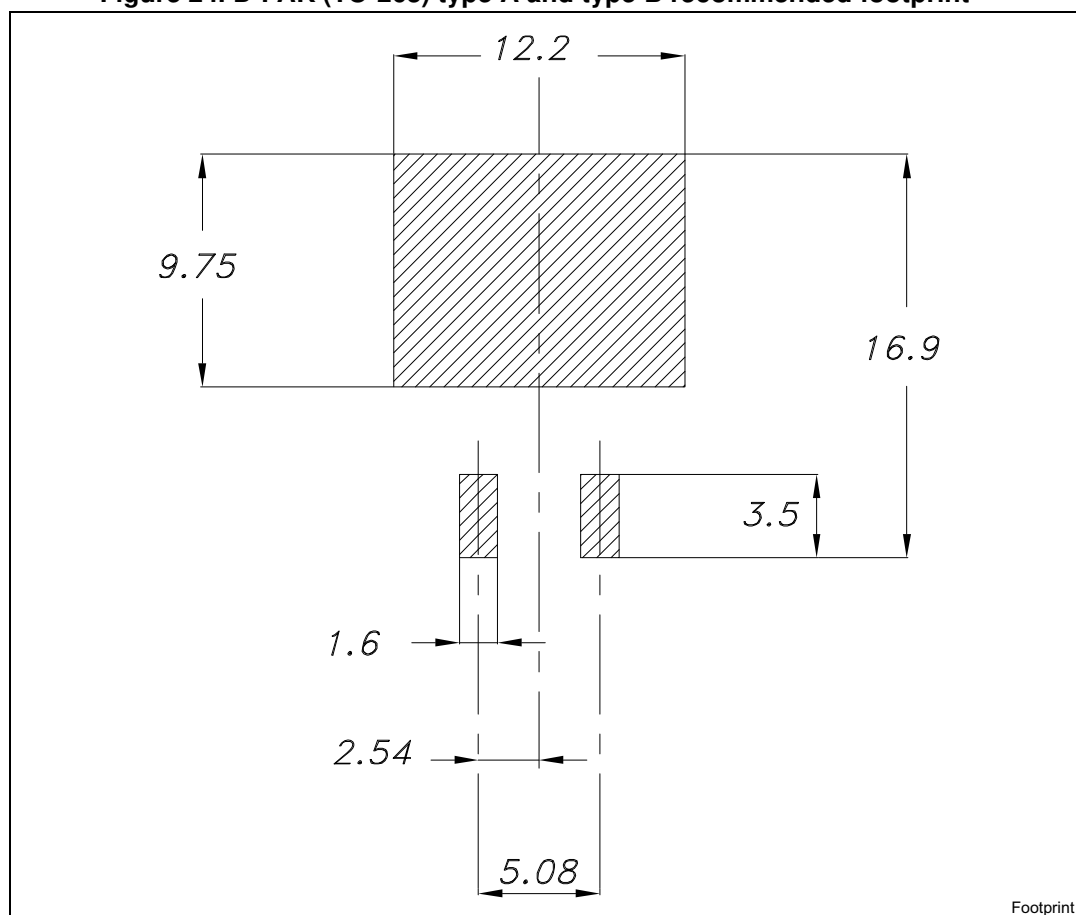
Figure 23. D²PAK (TO-263) type B package outline

Table 10. D²PAK (TO-263) type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.60
A1	0		0.25
b	0.70		0.93
b2	1.14		1.70
c	0.38		0.694
c2	1.19		1.36
D	8.6		9.35
D1	6.9		
E	10		10.55
E1	8.1		
e		2.54	
H	15		15.85
L	1.9		2.79
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 24. D²PAK (TO-263) type A and type B recommended footprint^(a)

a. All dimension are in millimeters

4.2 D²PAK (TO-263) type A and type B packing information

Table 11. D²PAK (TO-263) 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			

Figure 25. D²PAK (TO-263) tape outline

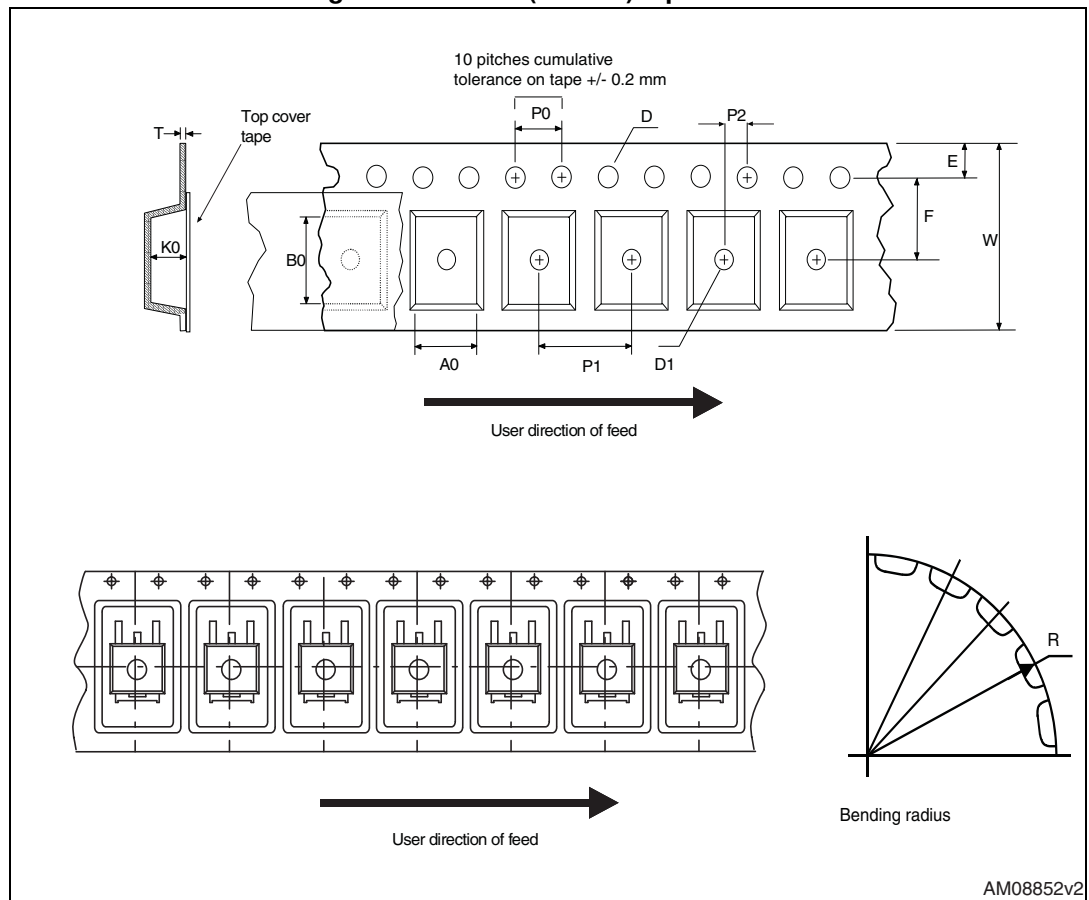
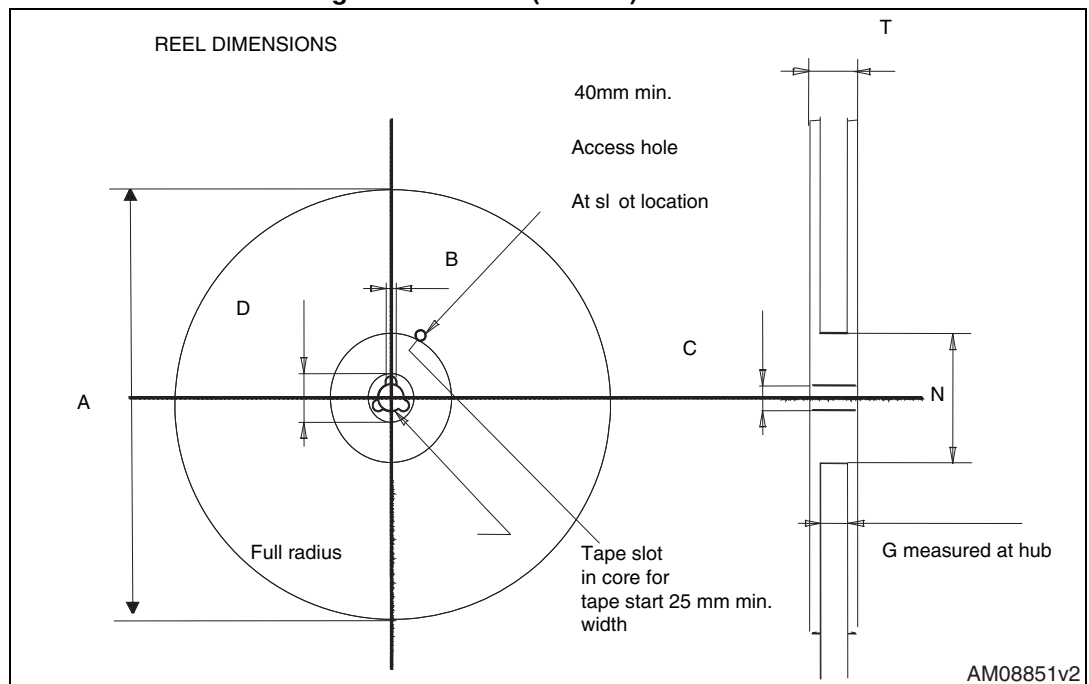


Figure 26. D²PAK (TO-263) reel outline



4.3 DPAK (TO-252) package information

Figure 27. DPAK (TO-252) type A package outline

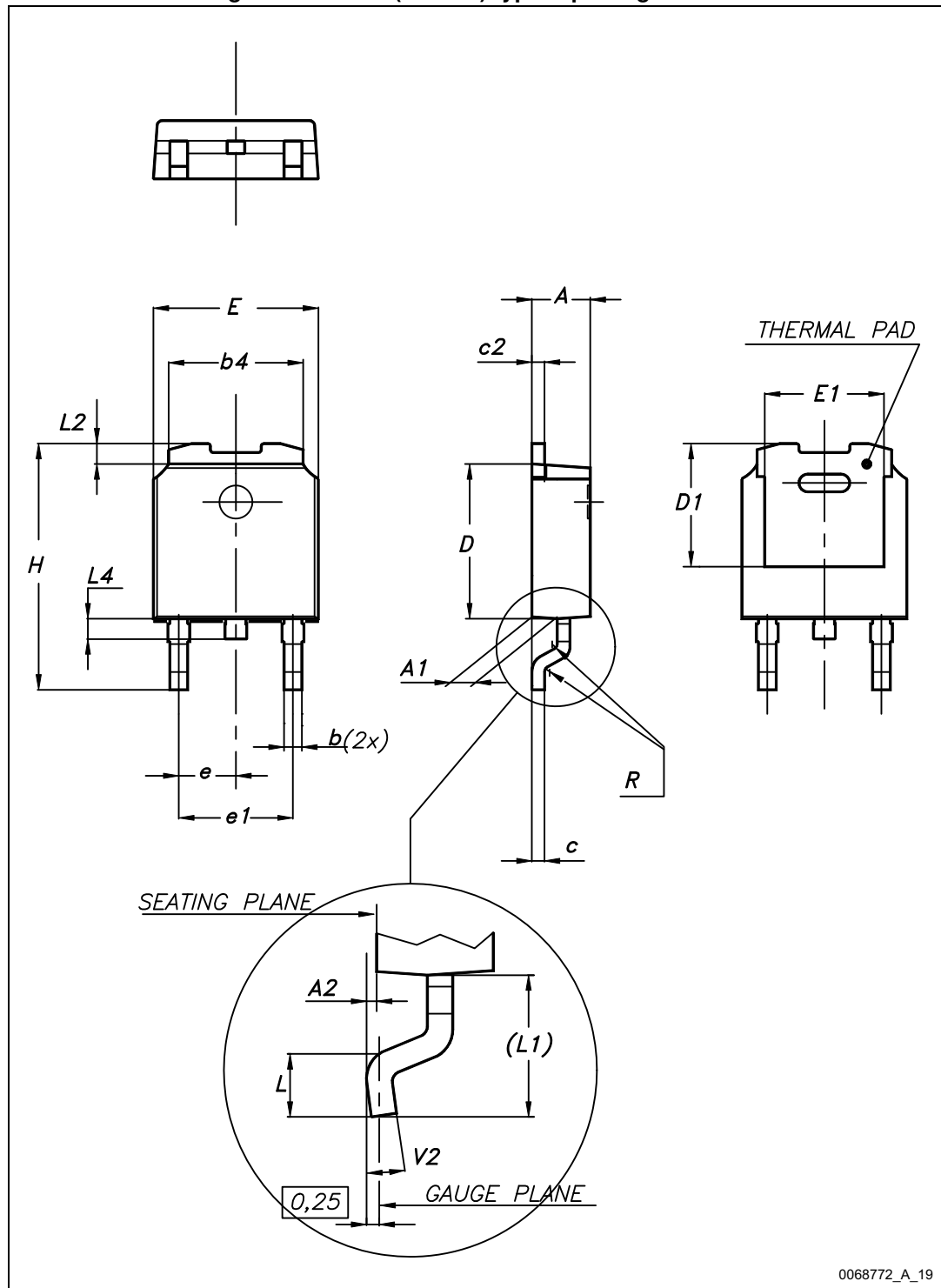
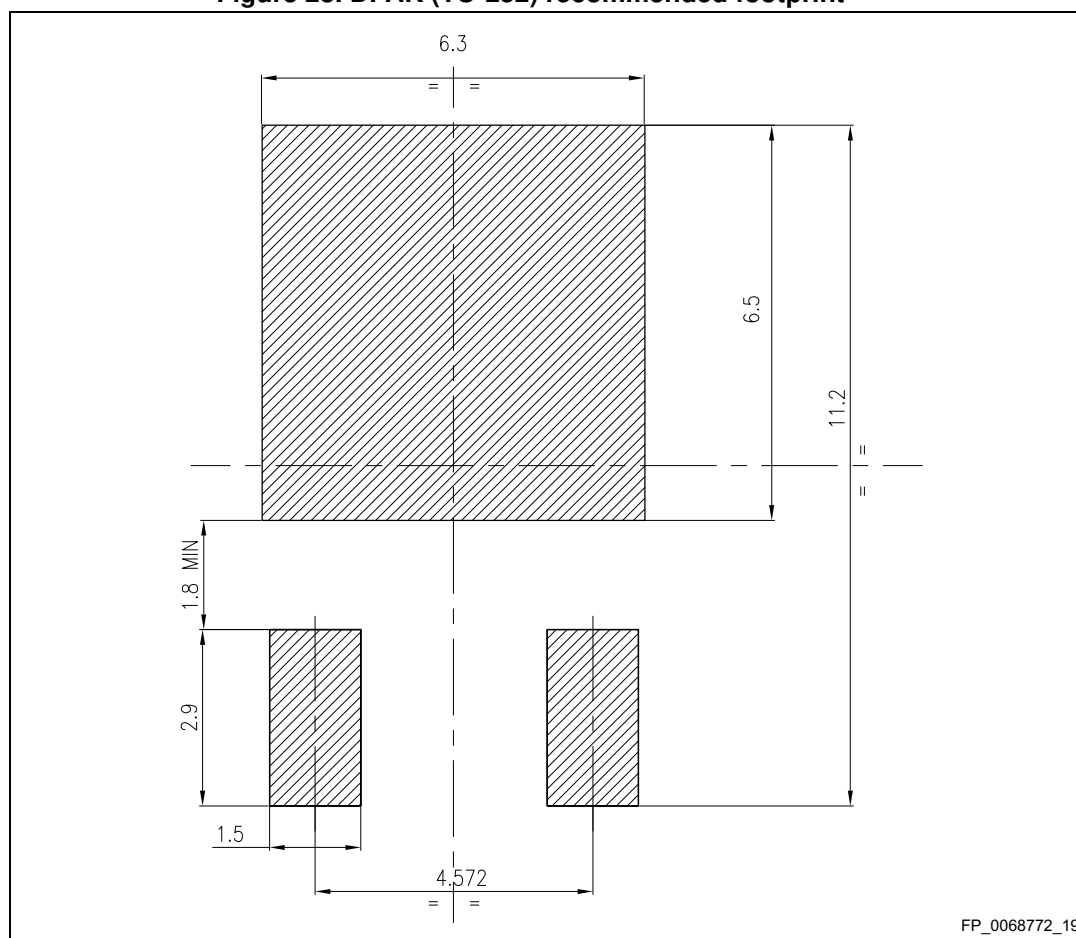


Table 12. DPAK (TO-252) type A mechanical data

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	4.60	4.70	4.80
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 28. DPAK (TO-252) recommended footprint ^(b)

b. All dimensions are in millimeters

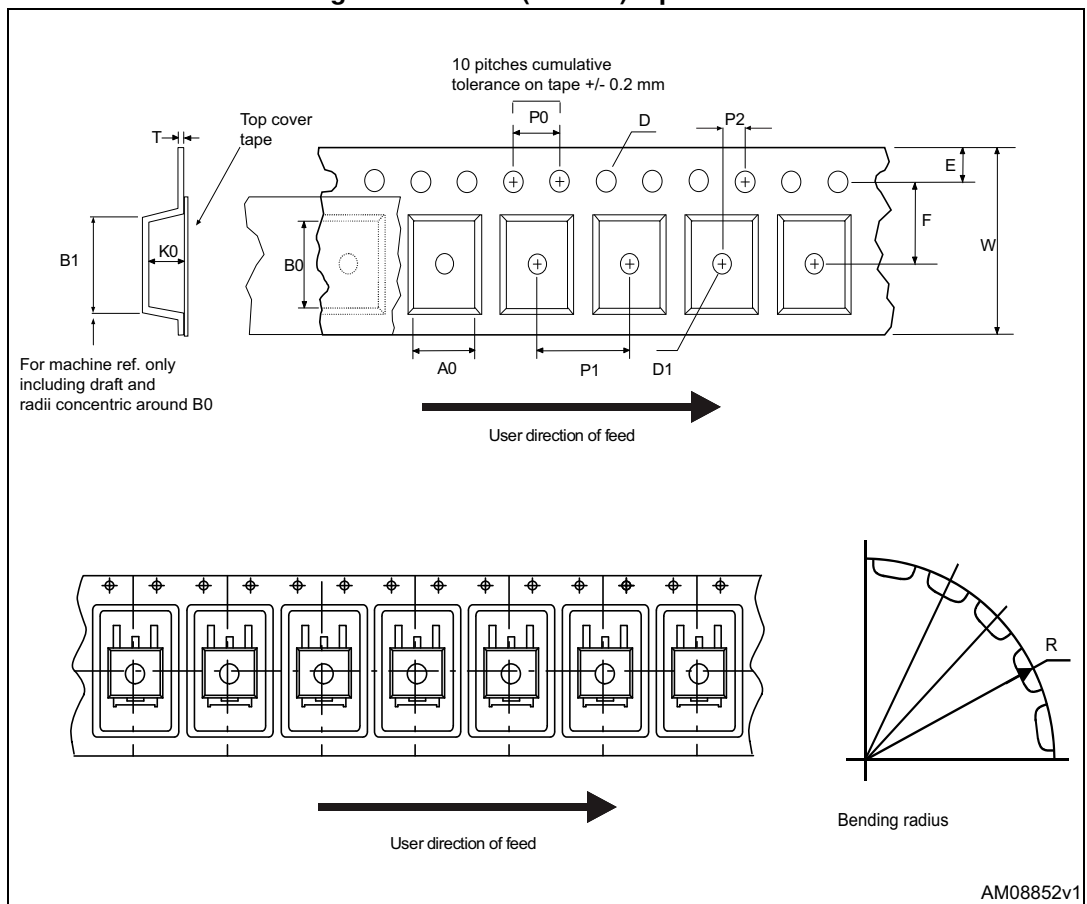


Figure 30. DPAK (TO-252) reel outline

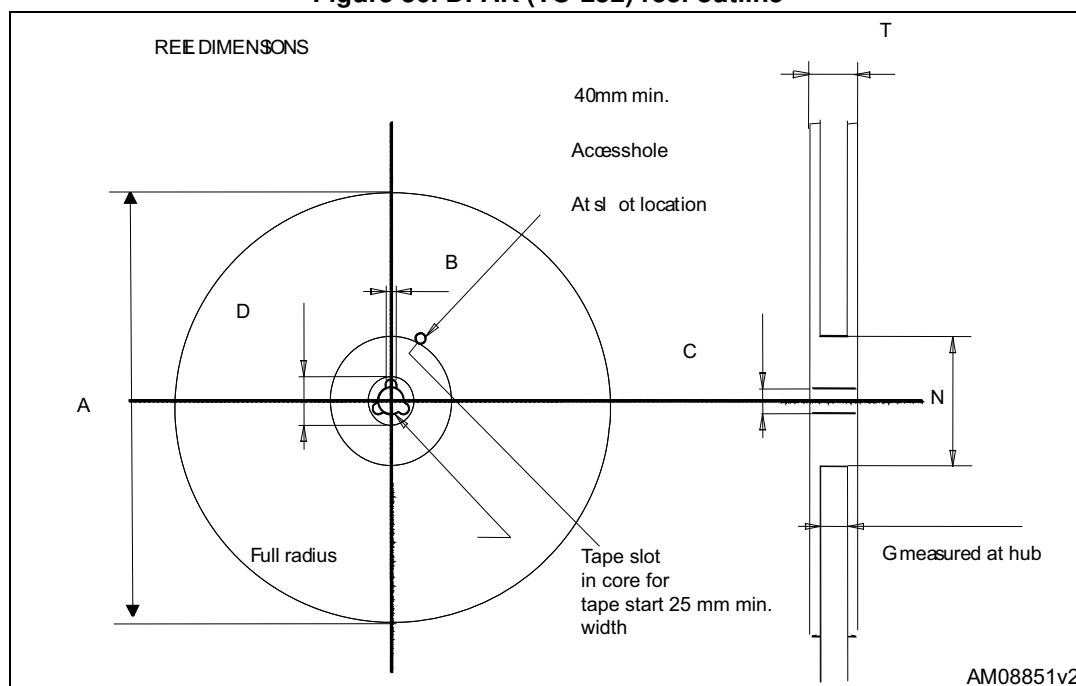


Table 13. DPAK (TO-252) tape and reel mechanical data

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			

4.5 TO-220FP package information

Figure 31. TO-220FP drawing

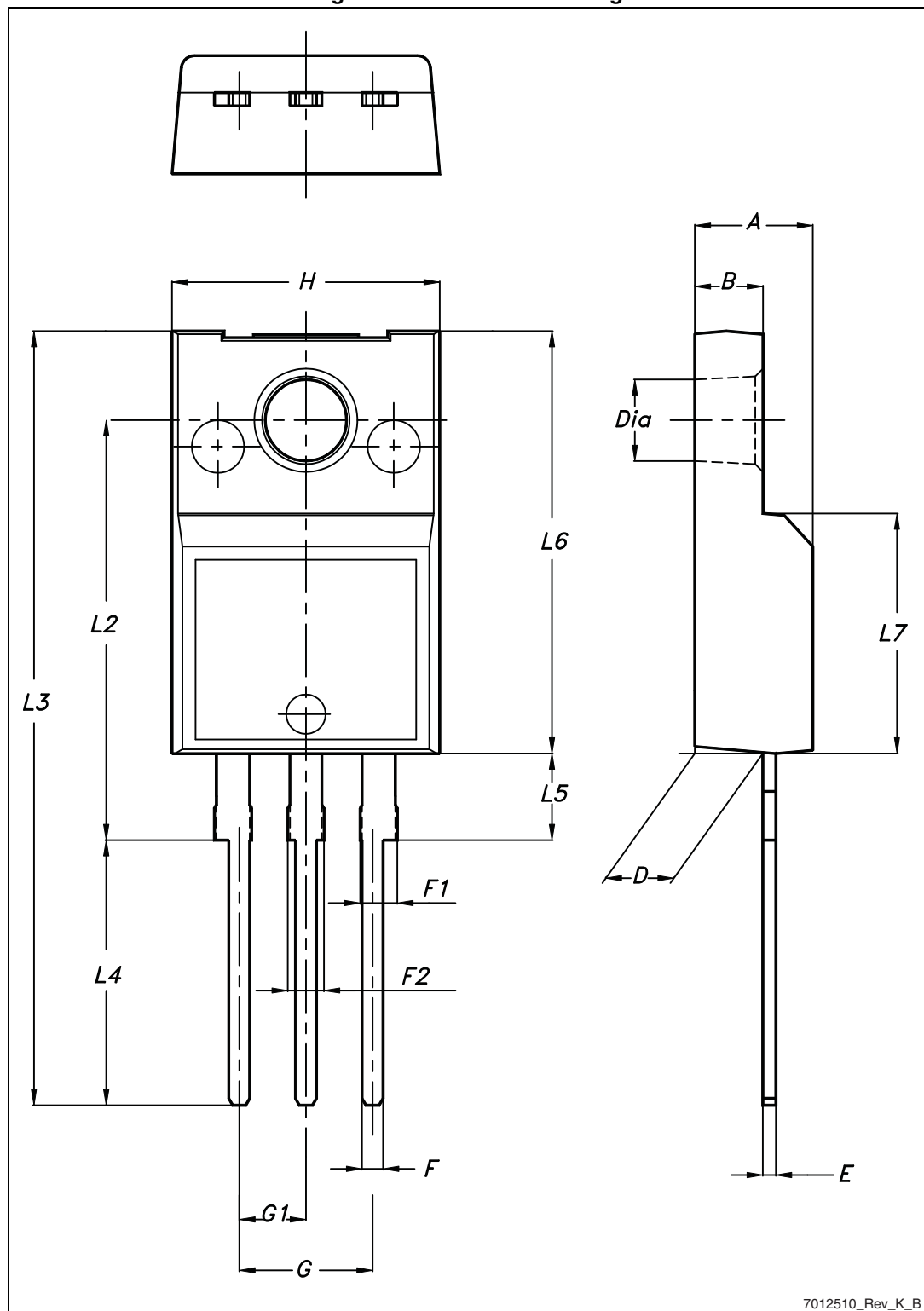


Table 14. TO-220FP mechanical data

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

4.6 TO-220 type A package information

Figure 32. TO-220 type A package outline

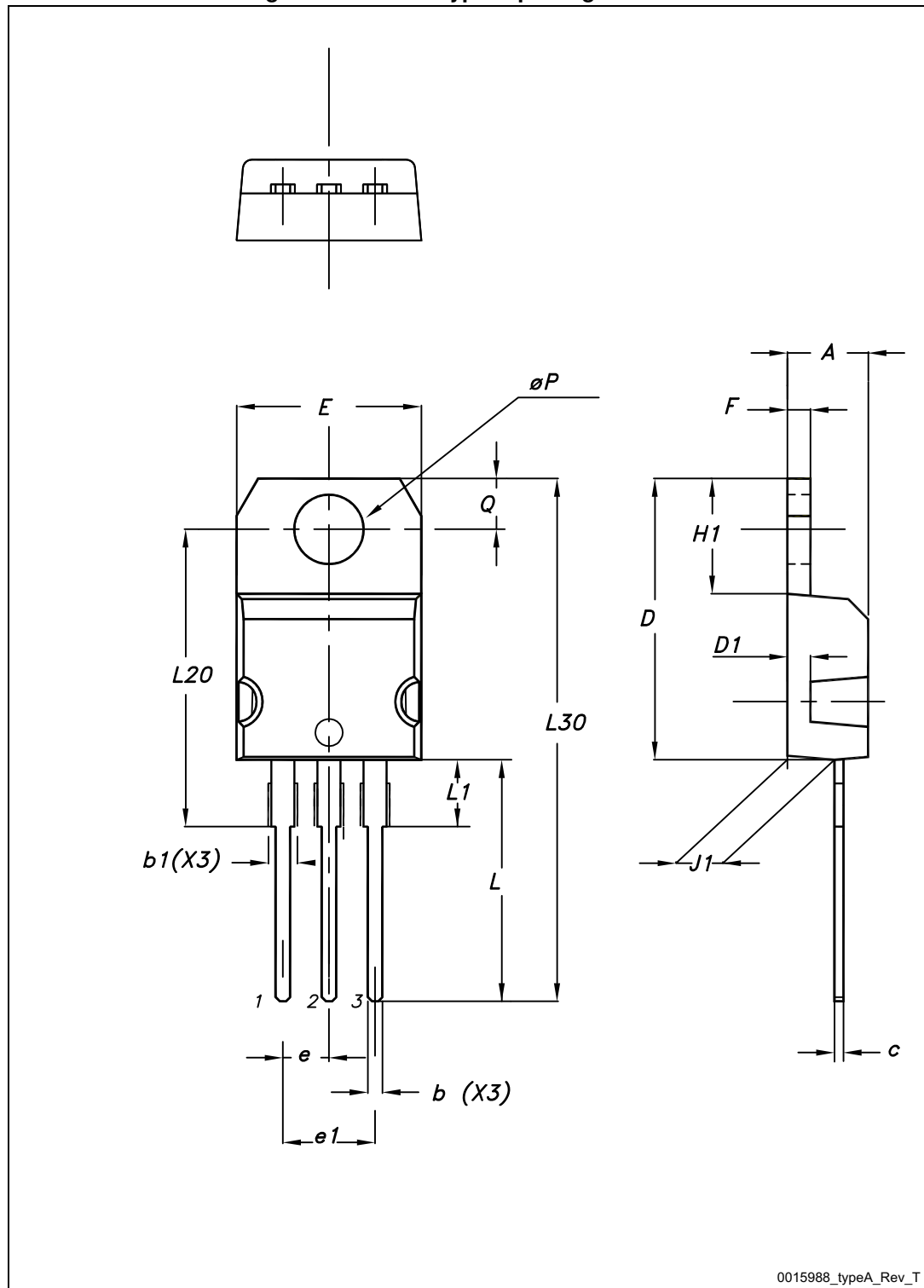


Table 15. TO-220 type A mechanical data

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