

N-channel 200 V, 0.11  $\Omega$  typ., 15 A MESH OVERLAY™  
Power MOSFET in D<sup>2</sup>PAK, DPAK, TO-220FP and TO-220 packages

Datasheet — production data

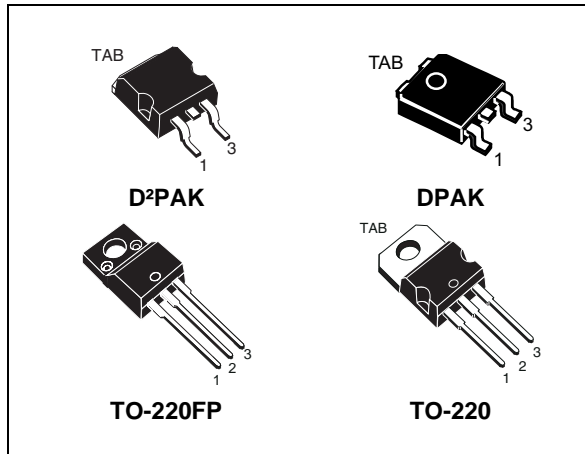
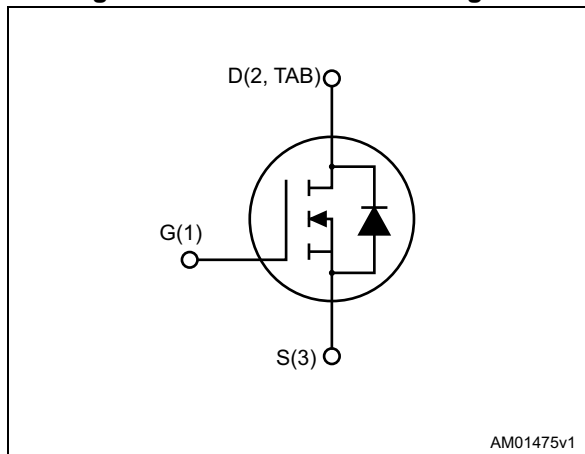


Figure 1. Internal schematic diagram



## Features

Type	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STB19NF20	200 V	0.16 $\Omega$	15 A	90 W
STD19NF20	200 V	0.16 $\Omega$	15 A	90 W
STF19NF20	200 V	0.16 $\Omega$	15 A	25 W
STP19NF20	200 V	0.16 $\Omega$	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 <sup>2</sup> 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 <sup>2</sup> PAK, DPAK, TO-220	TO-220FP	
V <sub>DS</sub>	Drain-source voltage	200		V
V <sub>GS</sub>	Gate-source voltage	± 20		V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	15	15 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	9.45	9.45 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	60	60 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	90	25	W
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)		2500	V
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15		V/ns
T <sub>j</sub>	Operating junction temperature	-55 to 150		°C
T <sub>stg</sub>	Storage temperature			

- Limited by package.
- Pulse width limited by safe operating area.
- I<sub>SD</sub> ≤ 15 A, di/dt ≤ 300 A/μs, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>.

**Table 3. Thermal data**

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

**Table 4. Avalanche data**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not-repetitive (pulse width limited by T <sub>j</sub> max.)	15	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 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	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 200\text{ V}$ , $T_C = 125\text{ °C}$			10	
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 100$	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	$\Omega$

**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		$\text{pF}$
$C_{oss}$	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 <a href="#">Figure 17</a> )		24		nC
$Q_{gs}$	Gate-source charge			4.4		
$Q_{gd}$	Gate-drain charge			11.6		

1. Pulsed: pulse duration=300  $\mu\text{s}$ , 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 <a href="#">Figure 17</a> )		11.5		ns
$t_r$	Rise time			22		
$t_{d(off)}$	Turn-off delay time			19		
$t_f$	Fall time			11		

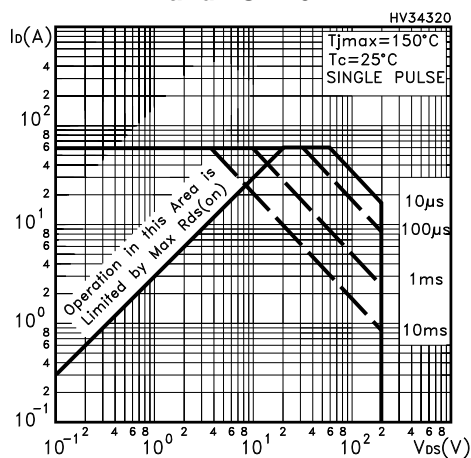
Table 8. Source-drain diode

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 <a href="#">Figure 21</a> )		125		ns
$Q_{rr}$	Reverse recovery charge			0.55		$\mu\text{C}$
$I_{RRM}$	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 <a href="#">Figure 21</a> )		148		ns
$Q_{rr}$	Reverse recovery charge			0.73		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			9.9		A

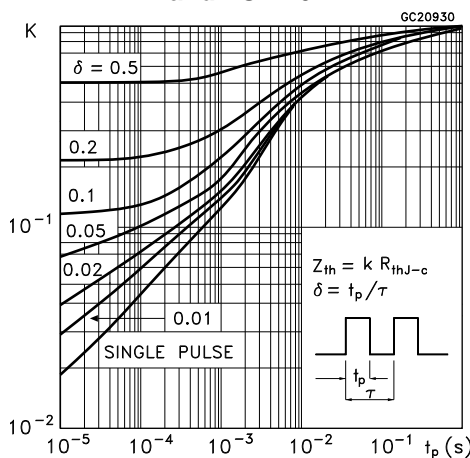
1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

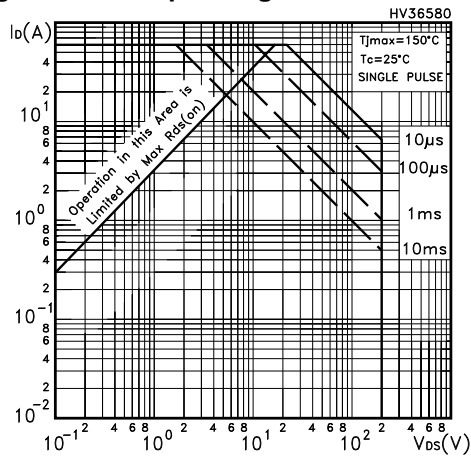
**Figure 2. Safe operating area for D<sup>2</sup>PAK, DPAK and TO-220**



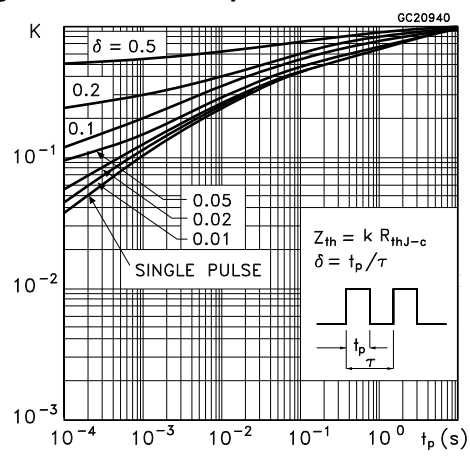
**Figure 3. Thermal impedance for D<sup>2</sup>PAK, DPAK and TO-220**



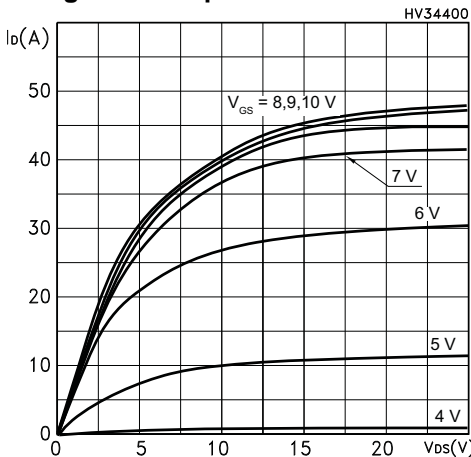
**Figure 4. Safe operating area for TO-220FP**



**Figure 5. Thermal impedance for TO-220FP**



**Figure 6. Output characteristics**



**Figure 7. Transfer characteristics**

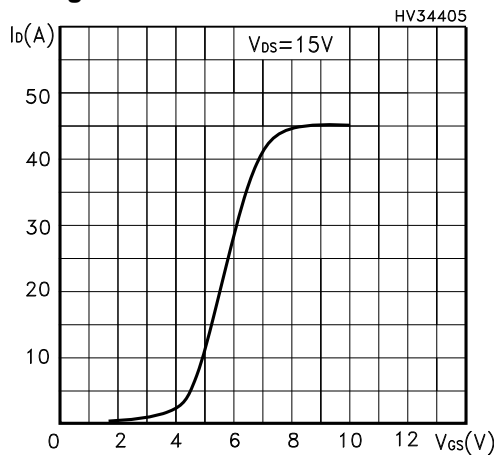


Figure 8. Static drain-source on-resistance

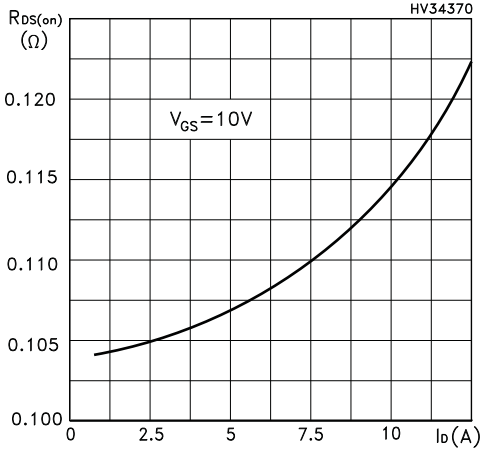


Figure 9. Normalized  $V_{(BR)DSS}$  vs temperature

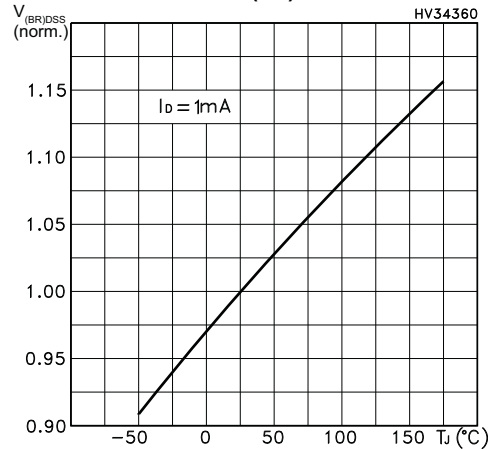


Figure 10. Gate charge vs gate-source voltage

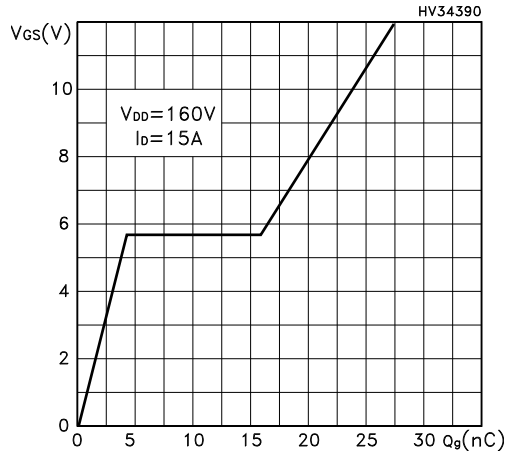


Figure 11. Capacitance variations

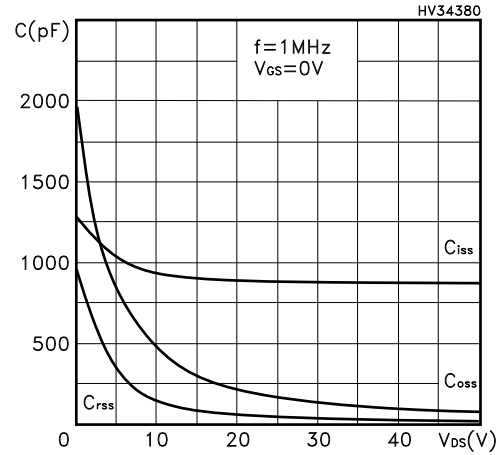


Figure 12. Normalized gate threshold voltage vs temperature

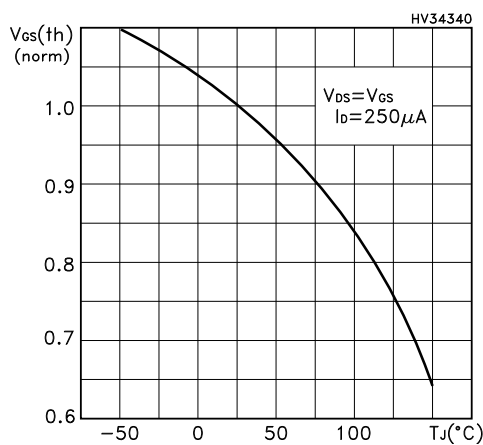


Figure 13. Normalized on-resistance vs temperature

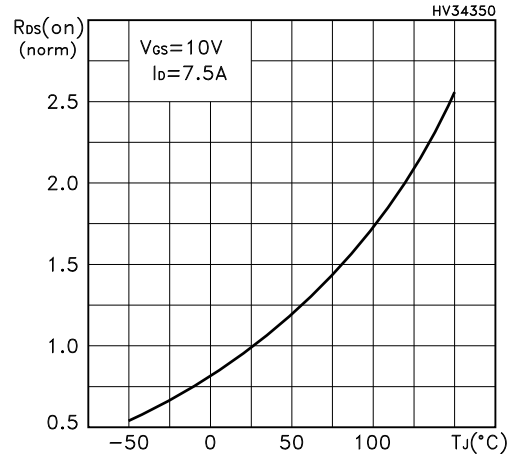


Figure 14. Source-drain forward characteristics

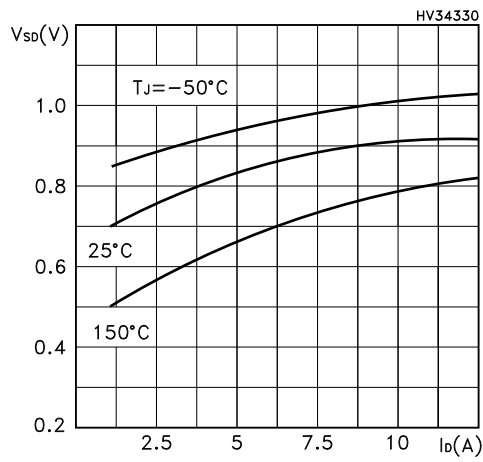
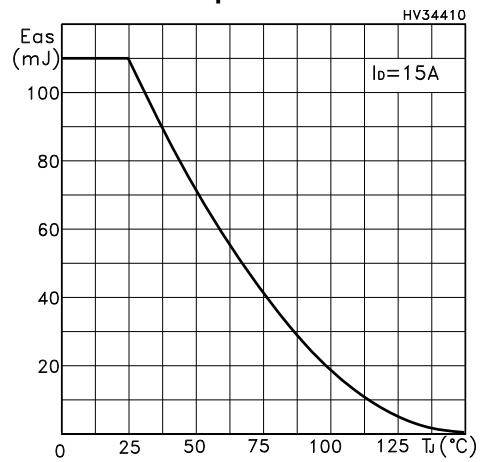
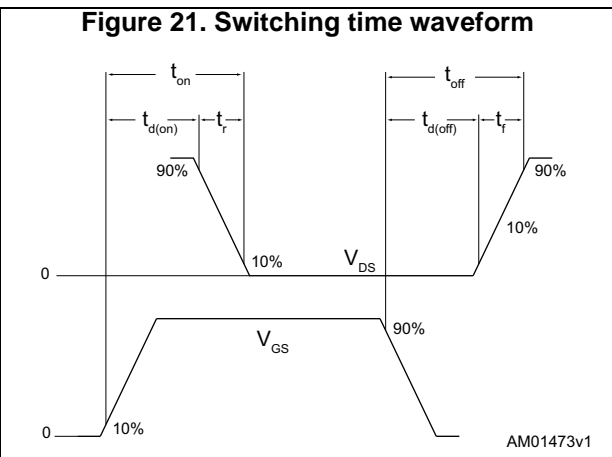
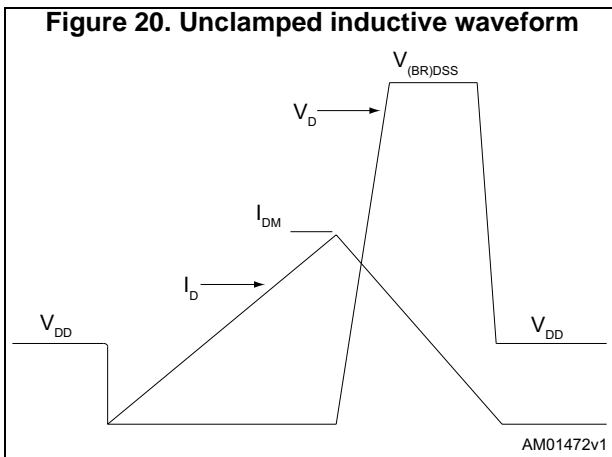
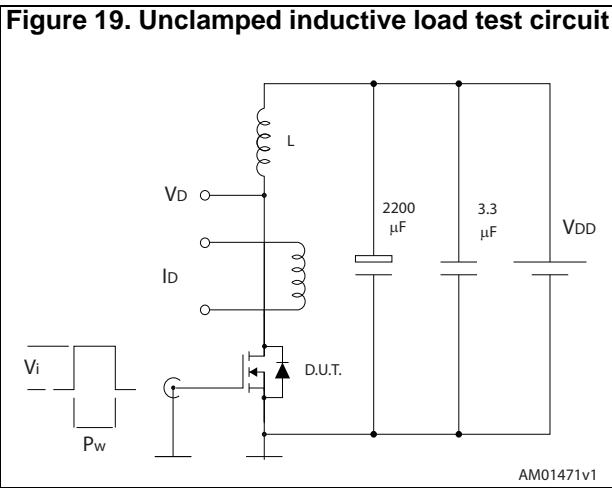
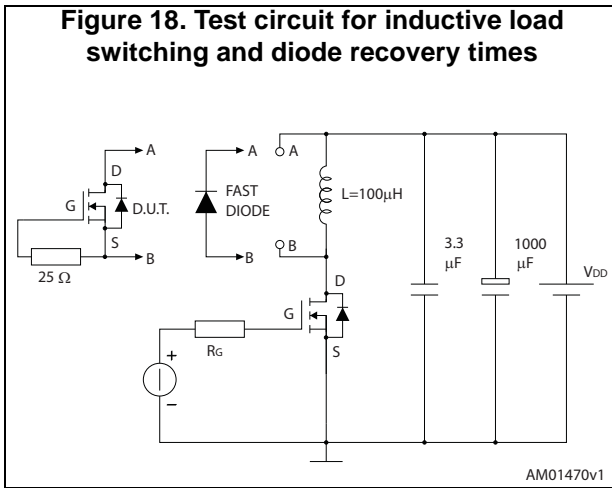
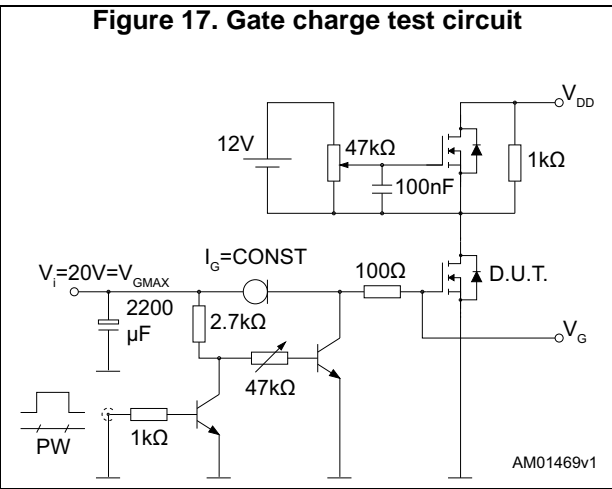
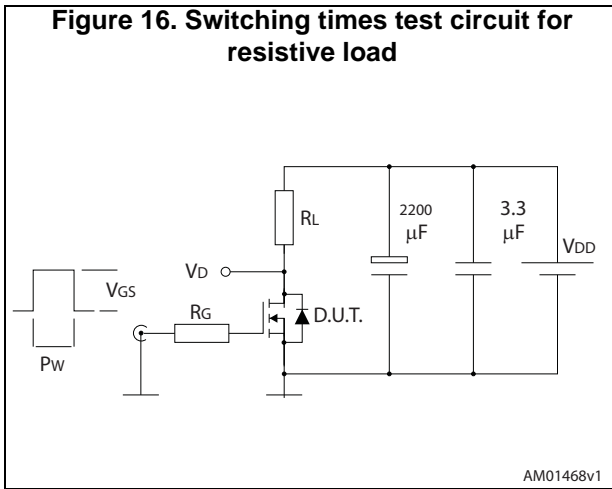


Figure 15. Maximum avalanche energy vs temperature





### 3 Test circuits



## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 D<sup>2</sup>PAK (TO-263) type A and type B package information

Figure 22. D<sup>2</sup>PAK (TO-263) type A package outline

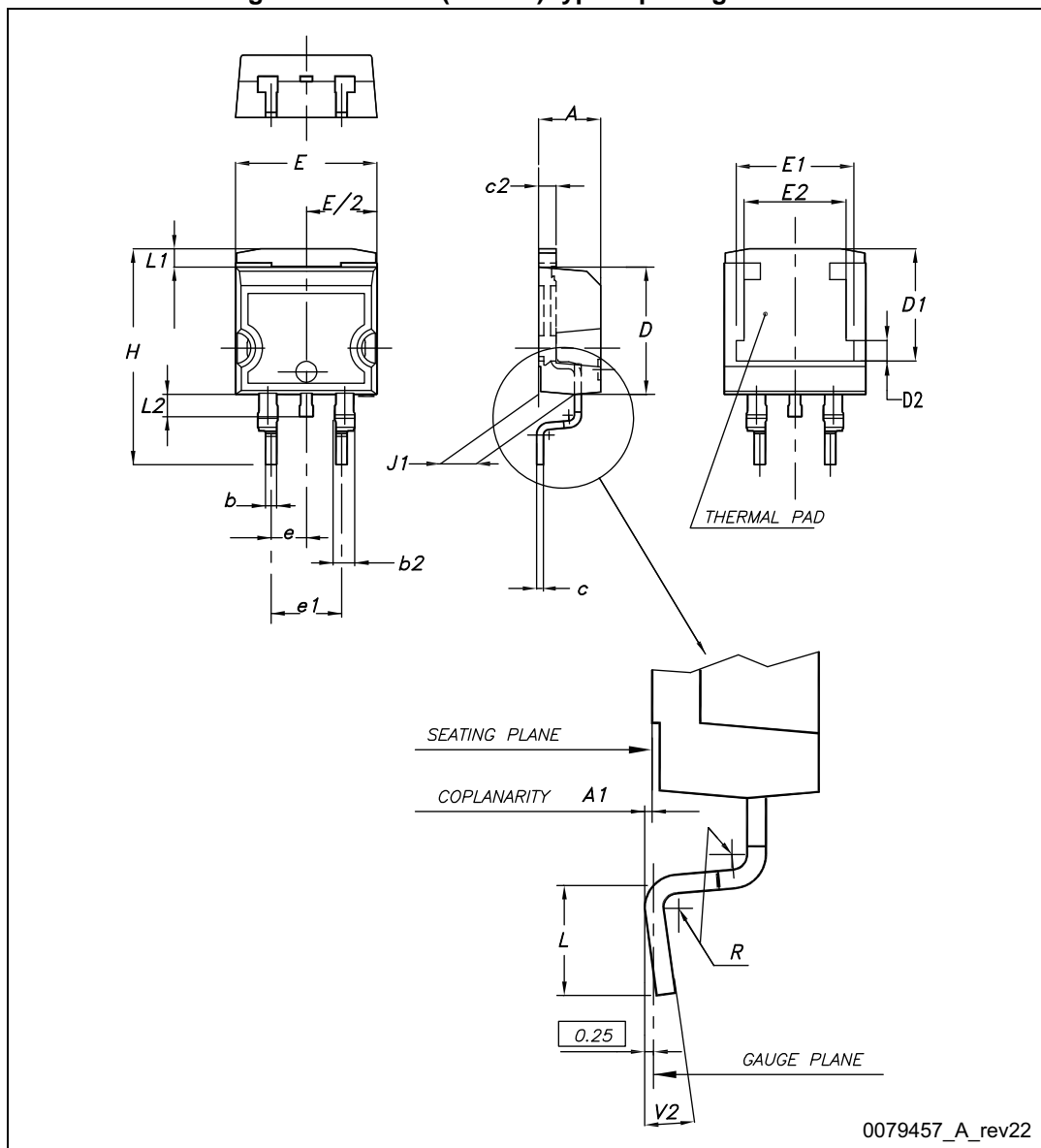


Table 9. D<sup>2</sup>PAK (TO-263) type A mechanical data

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. D<sup>2</sup>PAK (TO-263) type B package outline

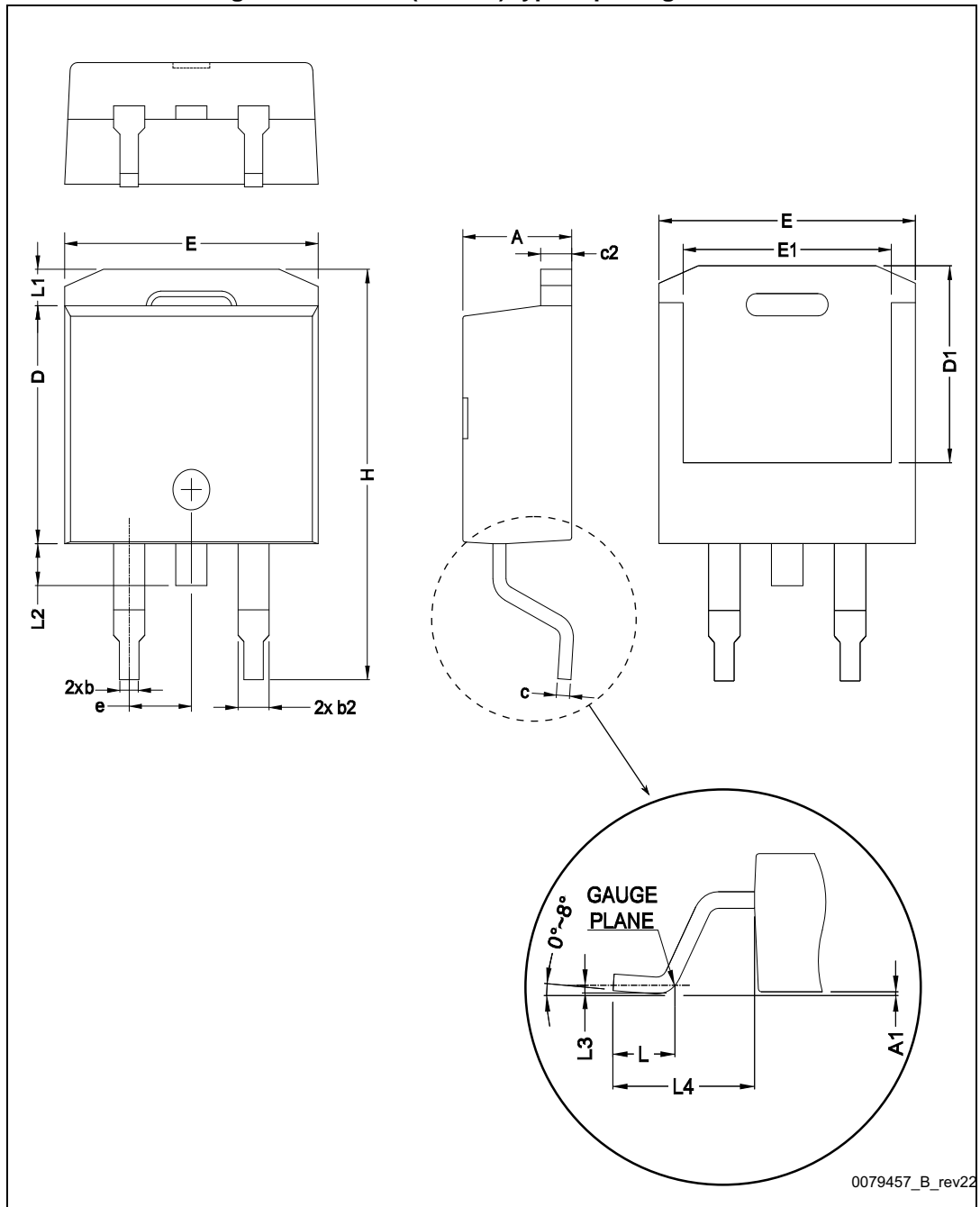
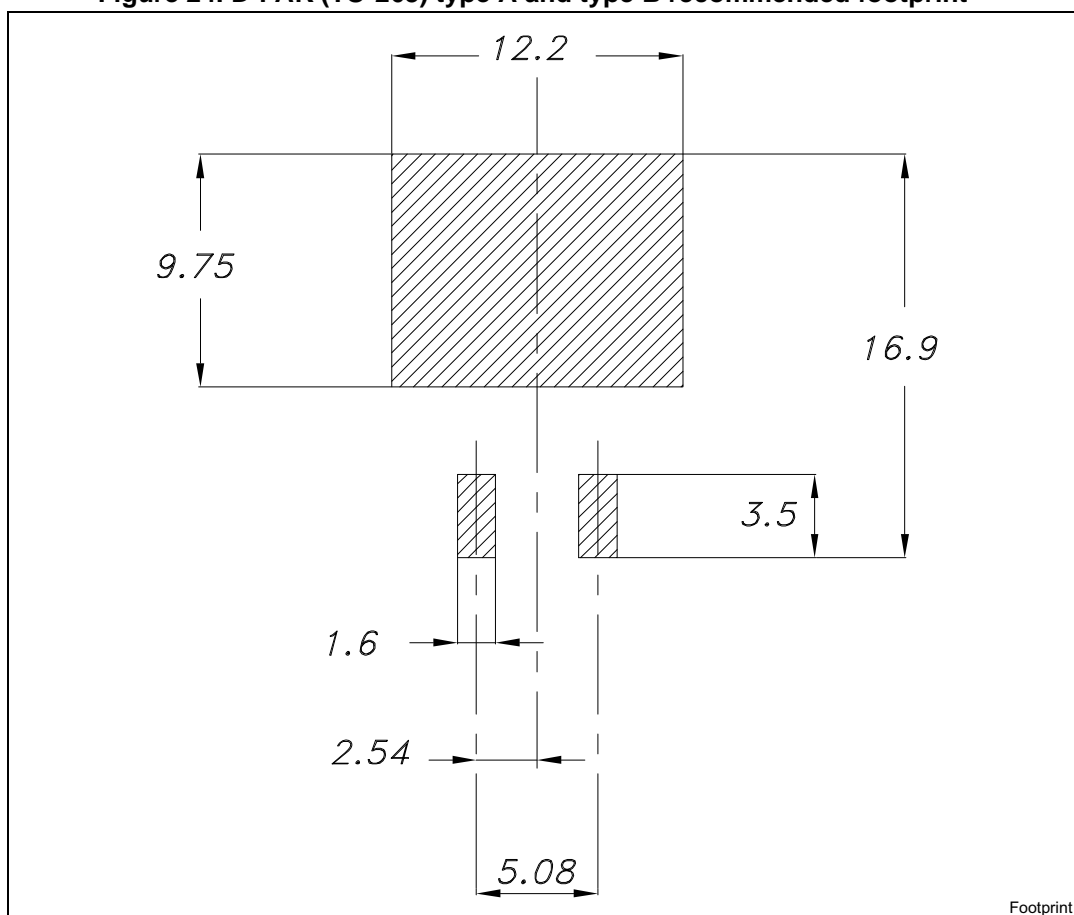


Table 10. D<sup>2</sup>PAK (TO-263) type B mechanical data

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. D<sup>2</sup>PAK (TO-263) type A and type B recommended footprint<sup>(a)</sup>



Footprint

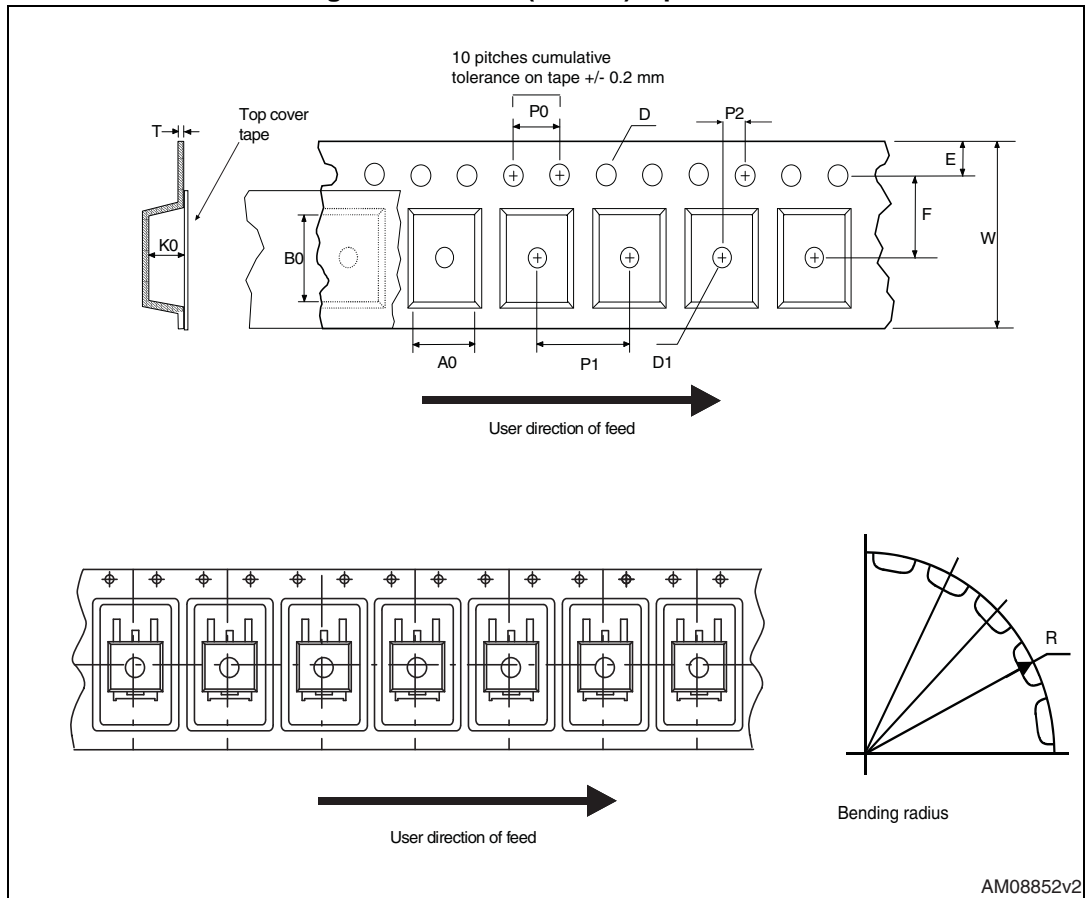
a. All dimension are in millimeters

## 4.2 D<sup>2</sup>PAK (TO-263) type A and type B packing information

Table 11. D<sup>2</sup>PAK (TO-263) tape and reel mechanical data

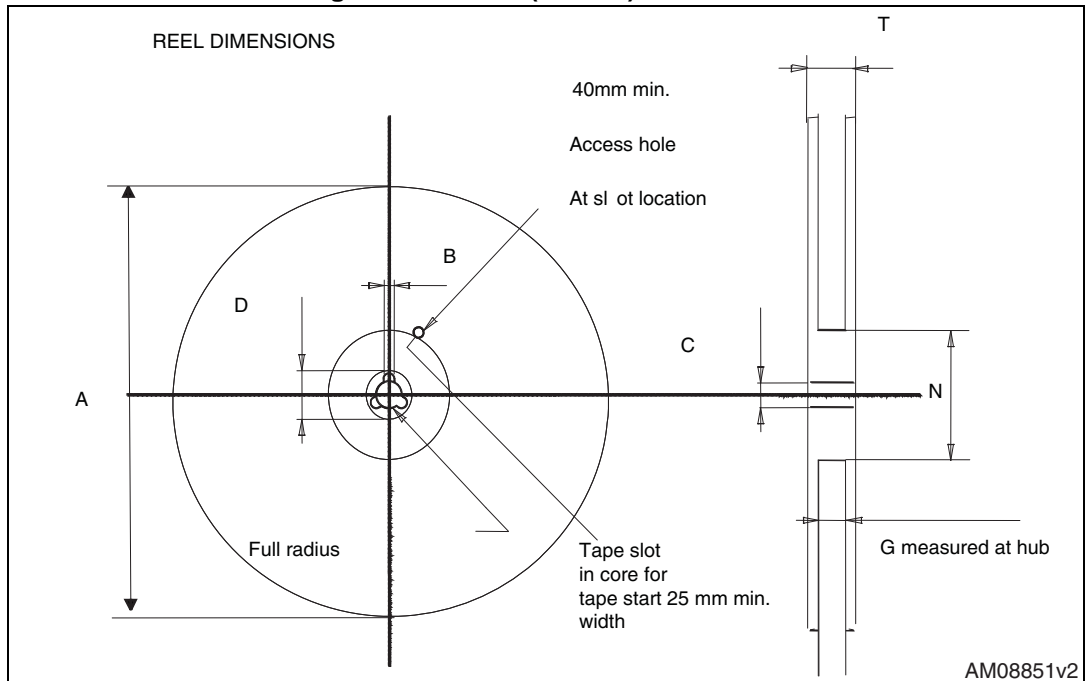
Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base qty.	1000
P2	1.9	2.1		Bulk qty.	1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

Figure 25. D<sup>2</sup>PAK (TO-263) tape outline



AM08852v2

Figure 26. D<sup>2</sup>PAK (TO-263) reel outline



AM08851v2



### 4.3 DPAK (TO-252) package information

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

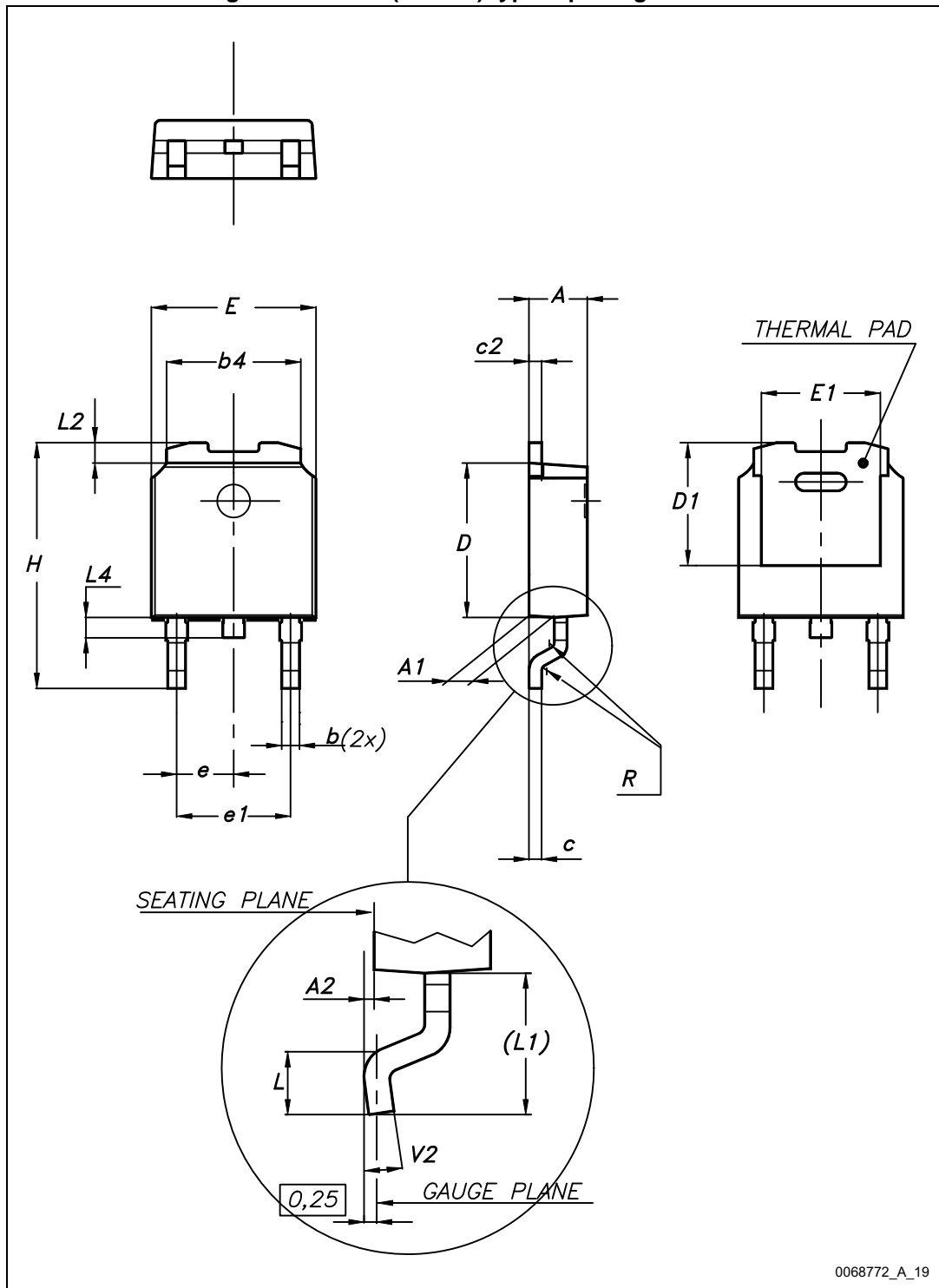
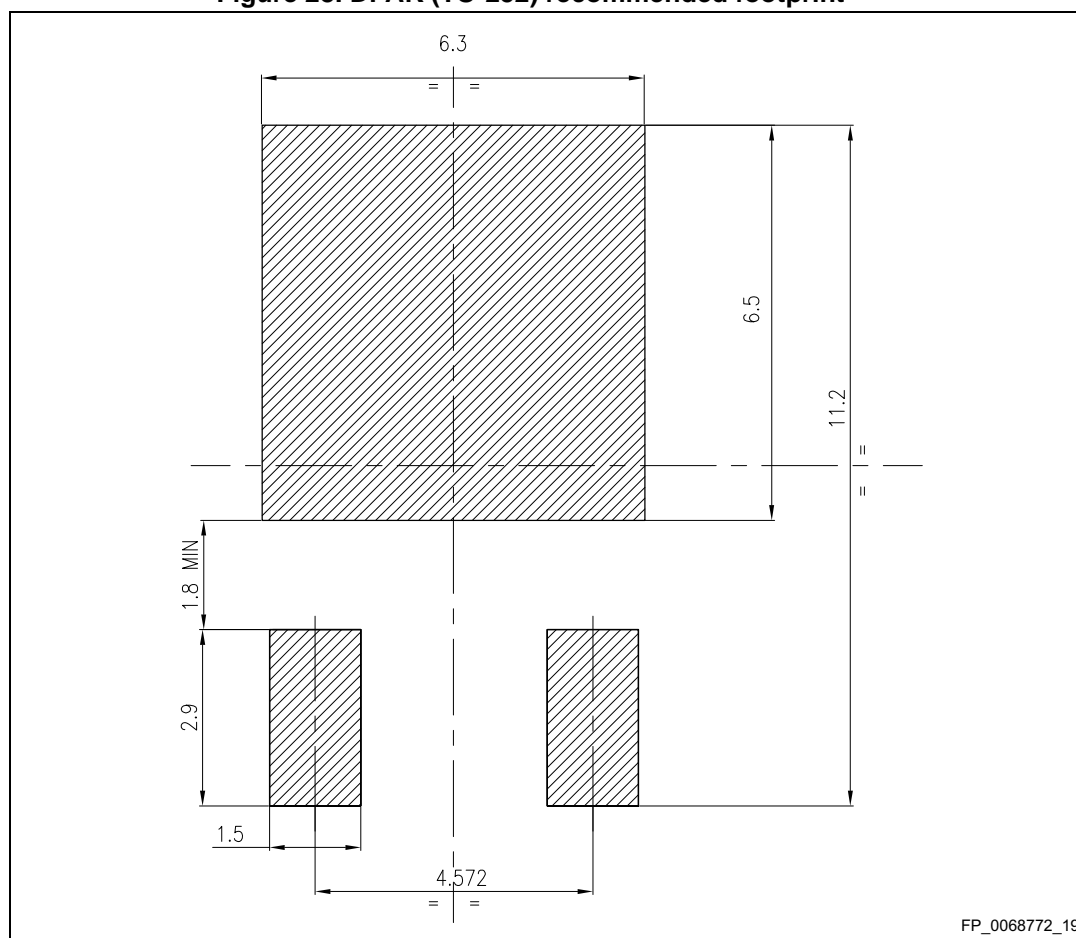


Table 12. DPAK (TO-252) type A mechanical data

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

### 4.4 DPAK (TO-252) packing information

Figure 29. DPAK (TO-252) tape outline

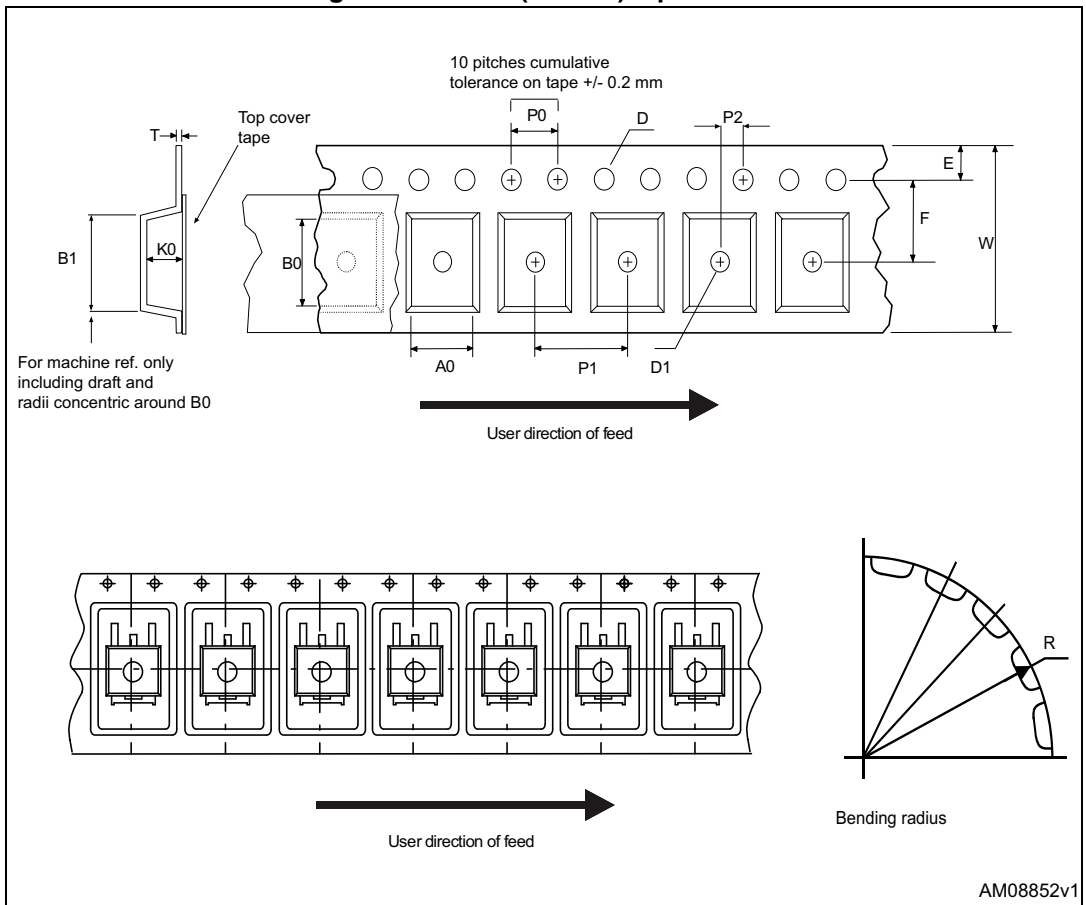


Figure 30. DPAK (TO-252) reel outline

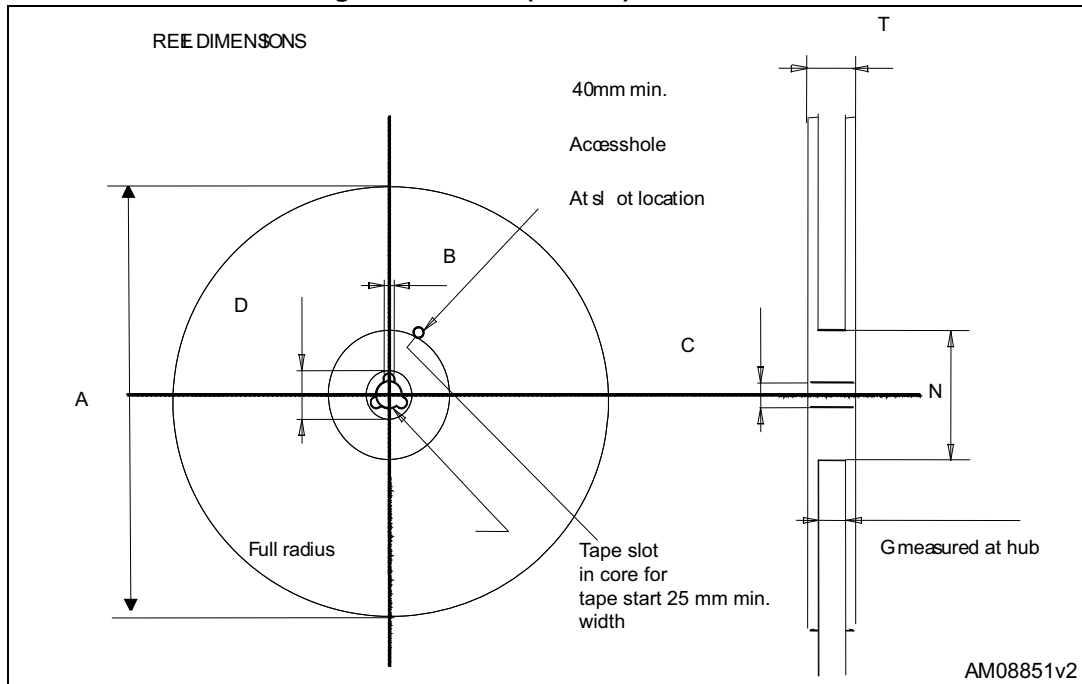
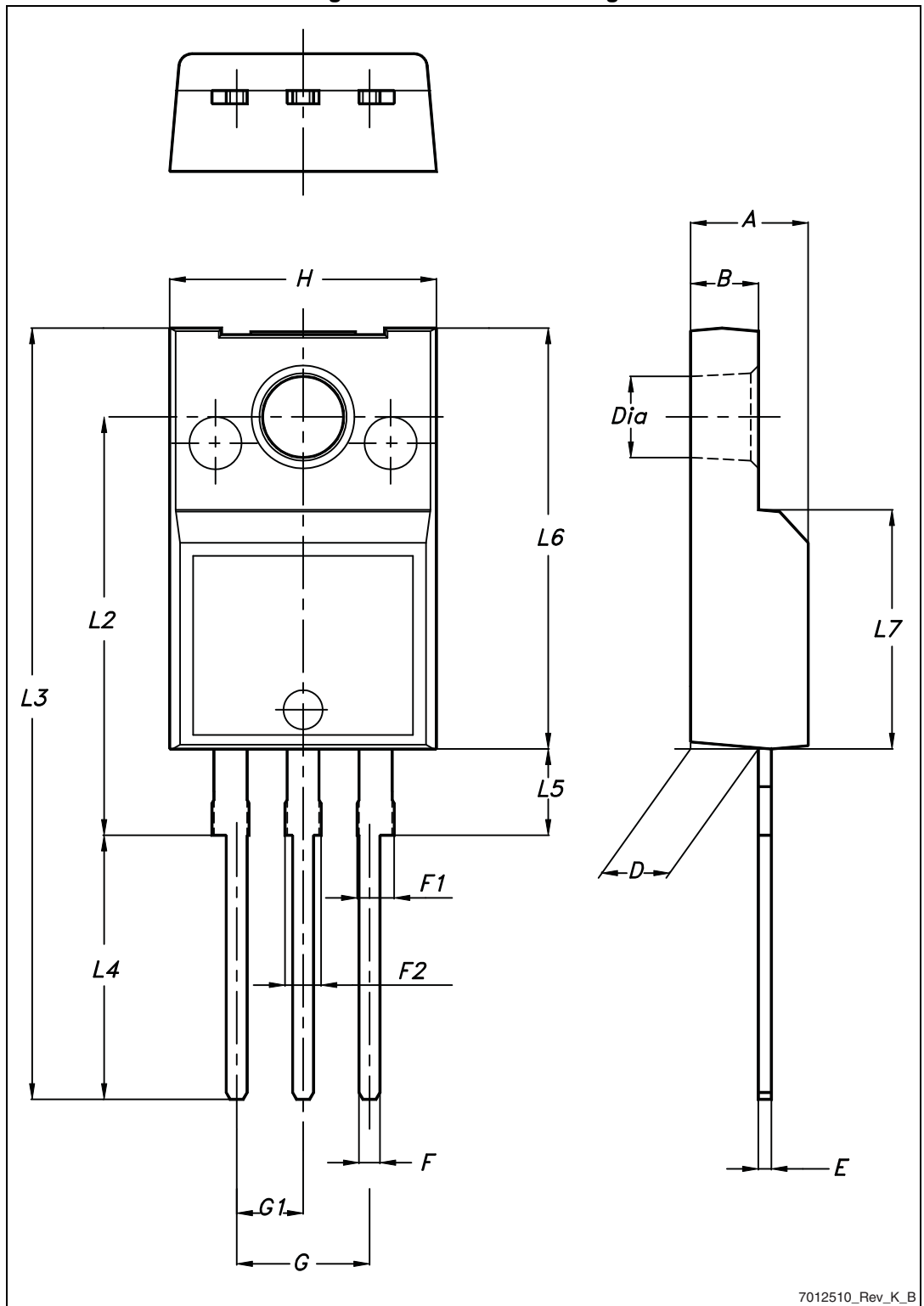


Table 13. DPAK (TO-252) tape and reel mechanical data

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



7012510\_Rev\_K\_B

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

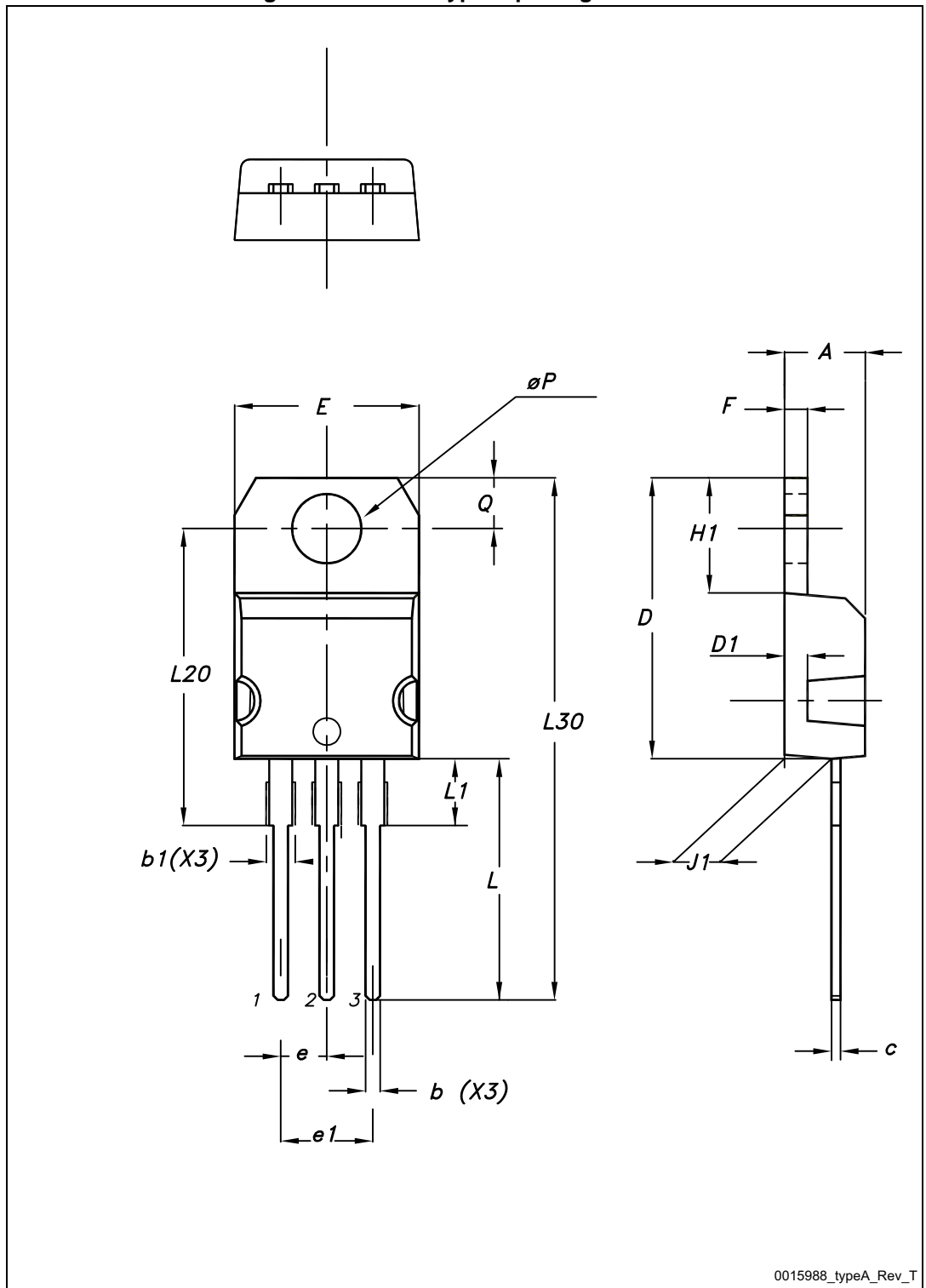




Table 15. TO-220 type A mechanical data

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

## 5 Revision history

Table 16. Document revision history

Date	Revision	Changes
13-Oct-2006	1	First release.
17-Nov-2006	2	Part number has been modified.
02-Feb-2007	3	Preliminary version.
16-Feb-2007	4	TO-220FP package has been added.
15-Oct-2012	5	Updated <a href="#">Section 4: Package information</a> and <a href="#">Section 4: Package information</a> . Minor text changes.
16-Apr-2015	6	Throughout document: – added DPAK package information – text and formatting updates Updated <a href="#">Figure 1: Internal schematic diagram</a> Updated <a href="#">Table 2: Absolute maximum ratings</a> Updated <a href="#">Table 3: Thermal data</a> Updated and renamed <a href="#">Table 5: Static</a> (was On/off states)

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