

N-channel 500 V, 0.24 Ω typ., 13 A, MDmesh™ M2
Power MOSFETs in DPAK, TO-220FP and TO-220 packages

Datasheet – preliminary data

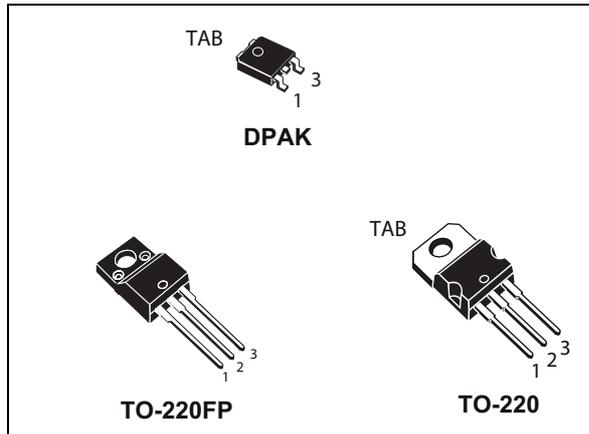
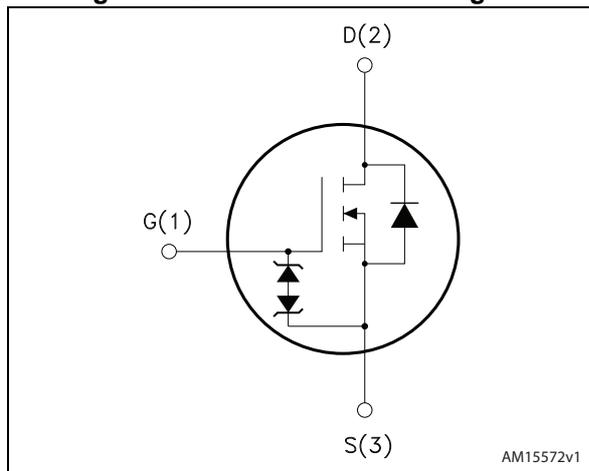


Figure 1. Internal schematic diagram



Features

Order codes	$V_{DS} @ T_{Jmax}$	$R_{DS(on) max.}$	I_D
STD16N50M2	550 V	0.28 Ω	13 A
STF16N50M2			
STP16N50M2			

- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the MDmesh™ M2 technology. Thanks to the strip layout associated to an improved vertical structure, these devices exhibit both low on-resistance and optimized switching characteristics. They are therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD16N50M2	16N50M2	DPAK	Tape and reel
STF16N50M2		TO-220FP	Tube
STP16N50M2		TO-220	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK	TO-220	TO-220FP	
V_{GS}	Gate-source voltage	± 25			V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	13			A
I_D	Drain current (continuous) at $T_C = 100\text{ °C}$	8			A
$I_{DM}^{(1)}$	Drain current (pulsed)	52			A
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	110		25	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15			V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50			V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heatsink ($t = 1\text{ s}$; $T_C = 25\text{ °C}$)			2500	V
T_{stg}	Storage temperature	- 55 to 150			°C
T_j	Max. operating junction temperature				

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 13\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$; $V_{DD} = 400\text{ V}$.
3. $V_{DS} \leq 400\text{ V}$.

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max.	1.14		5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max.		62.5		
$R_{thj-pcb}$	Thermal resistance junction-pcb max. ⁽¹⁾	50			

1. When mounted on 1 inch² FR-4, 2 Oz copper board.

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$; $V_{DD} = 50$)	215	mJ

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 500\text{ V}$ $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$		0.24	0.28	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	710	-	pF
C_{oss}	Output capacitance		-	44	-	pF
C_{rss}	Reverse transfer capacitance		-	1.35	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0$	-	192	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5.2	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 19)	-	19.5	-	nC
Q_{gs}	Gate-source charge		-	4	-	nC
Q_{gd}	Gate-drain charge		-	8	-	nC

1. $C_{oss\text{ eq.}}$ 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 7. Switching times

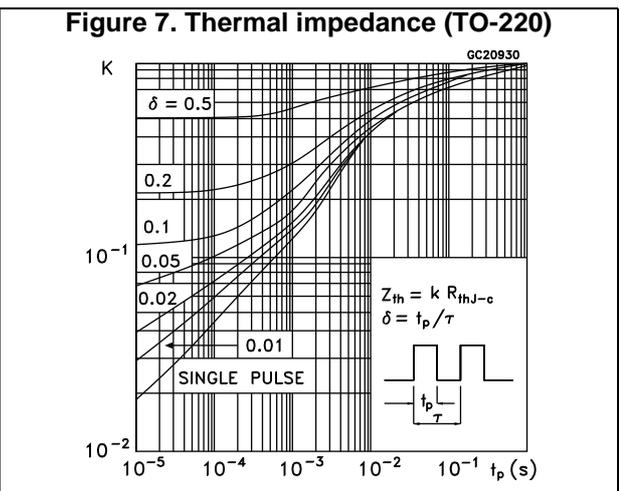
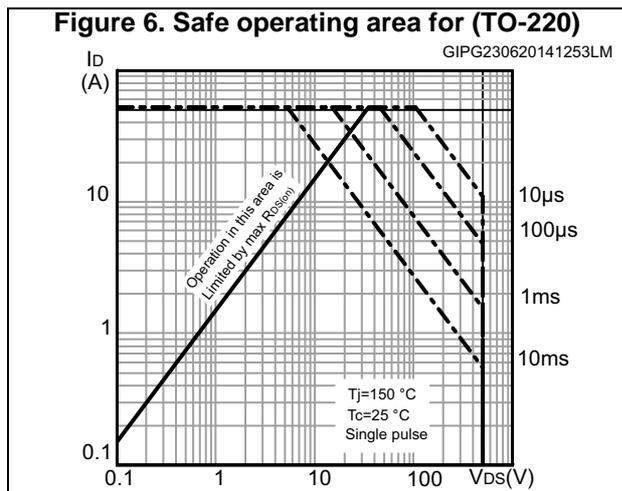
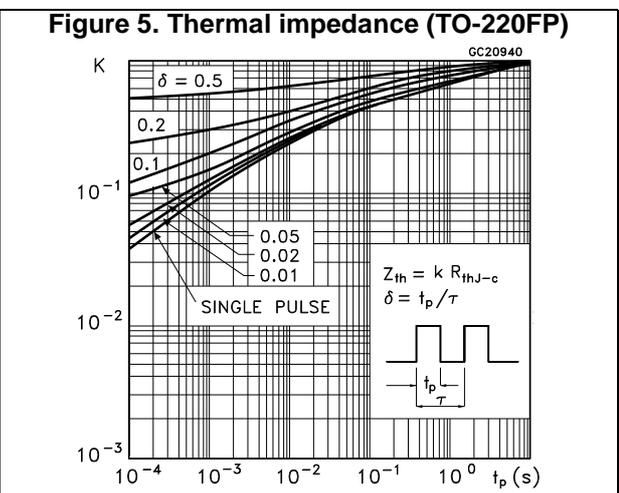
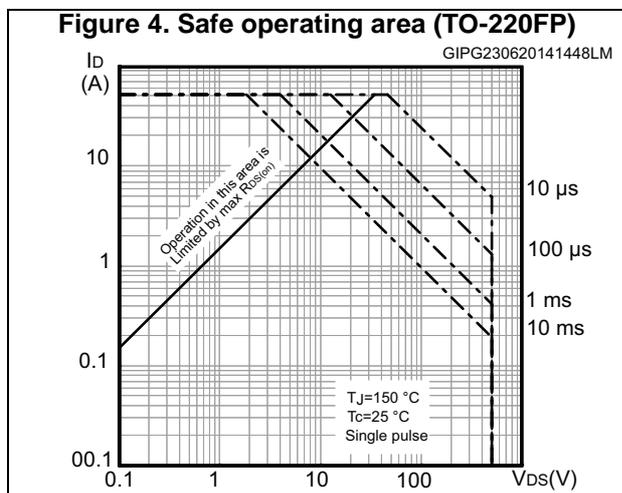
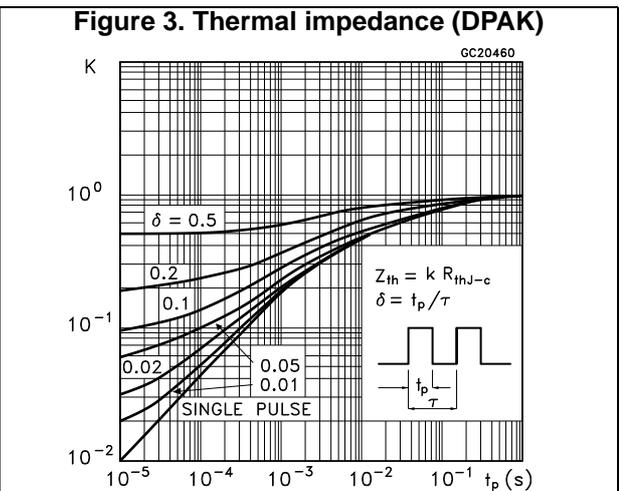
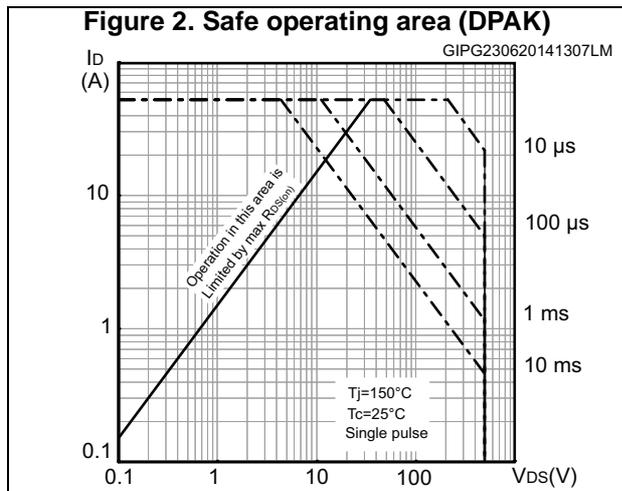
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18 and Figure 23)	-	9.6	-	ns
t_r	Rise time		-	7.6	-	ns
$t_{d(off)}$	Turn-off delay time		-	32	-	ns
t_f	Fall time		-	10	-	ns

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		13	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		52	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 13\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 20)	-	280		ns
Q_{rr}	Reverse recovery charge		-	2.85		μC
I_{RRM}	Reverse recovery current		-	20.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 20)	-	388		ns
Q_{rr}	Reverse recovery charge		-	4.5		μC
I_{RRM}	Reverse recovery current		-	21		A

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

2.1 Electrical characteristics (curves)



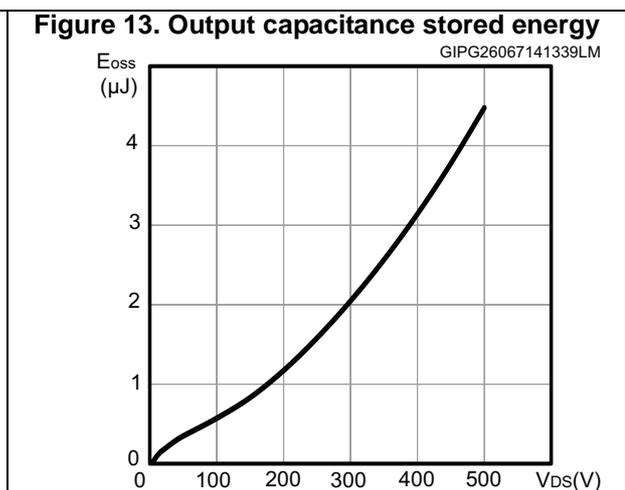
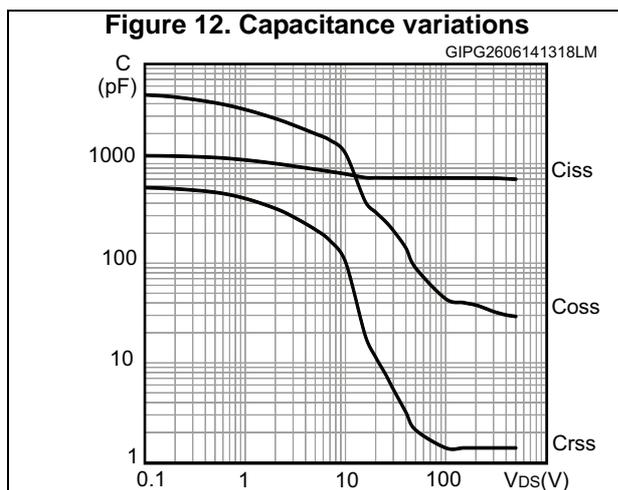
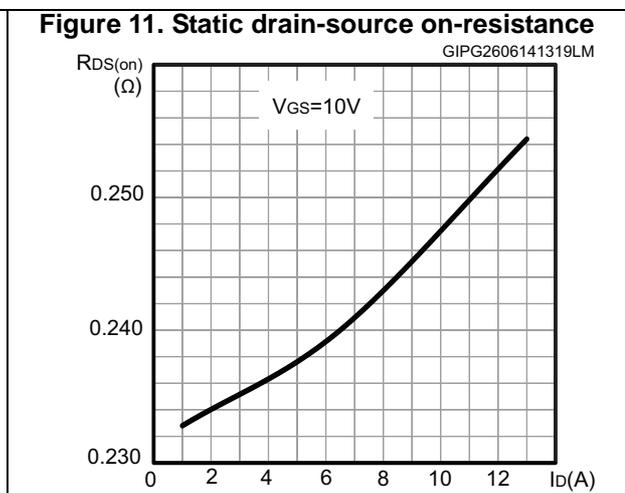
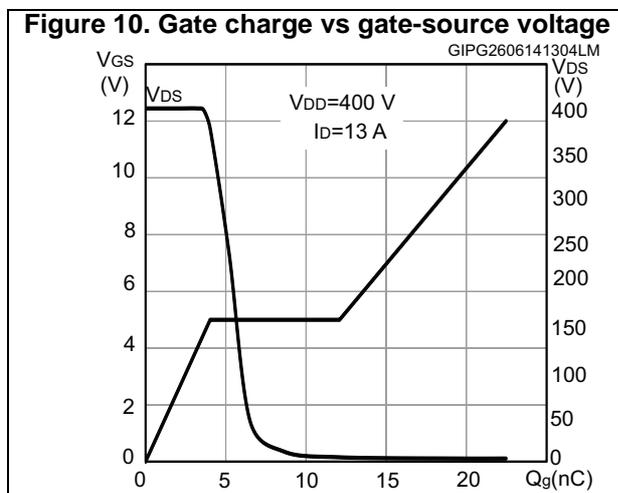
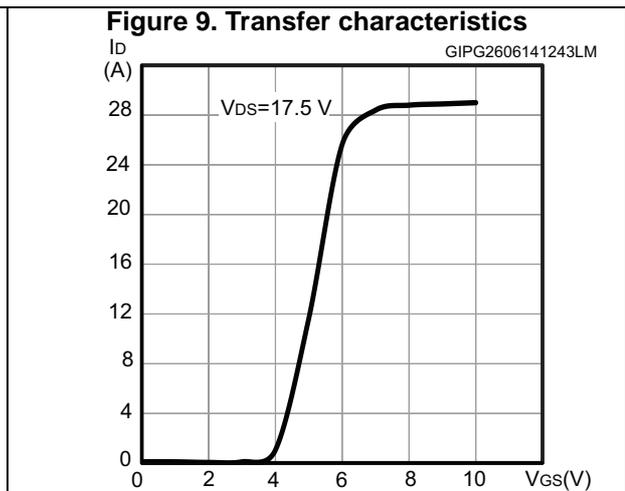
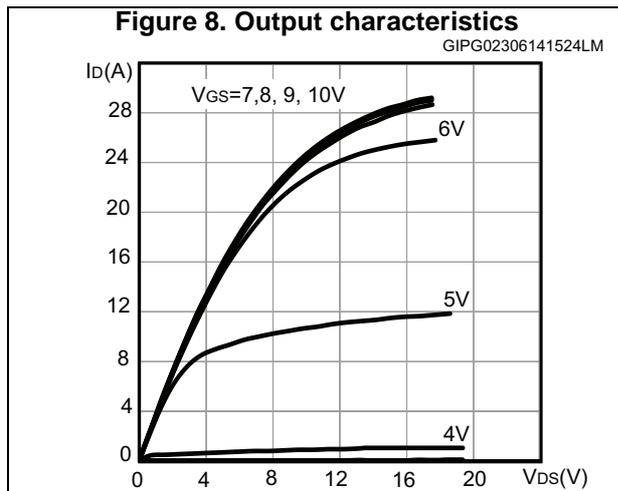


Figure 14. Normalized gate threshold voltage vs temperature

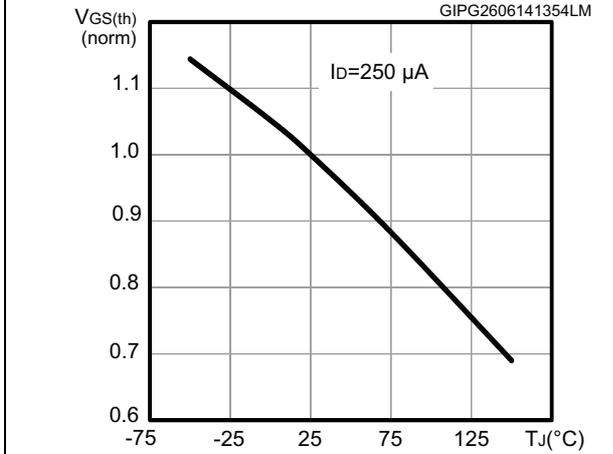


Figure 15. Normalized on-resistance vs temperature

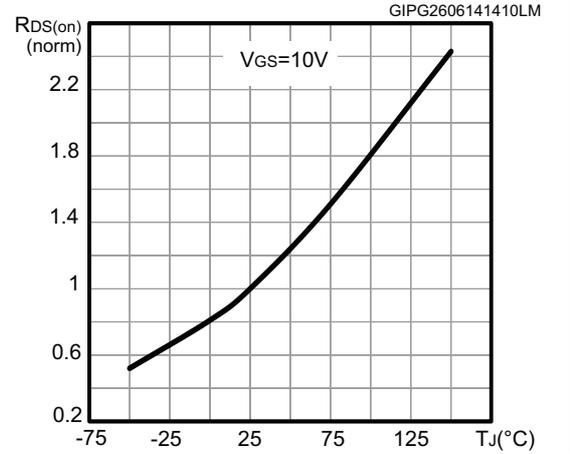


Figure 16. Normalized V_{(BR)DSS} vs temperature

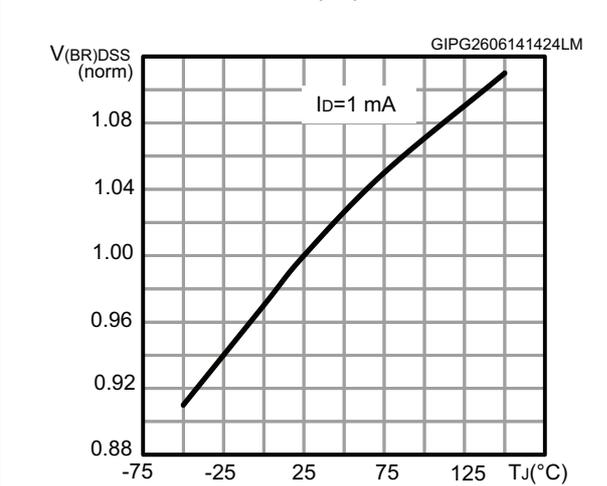
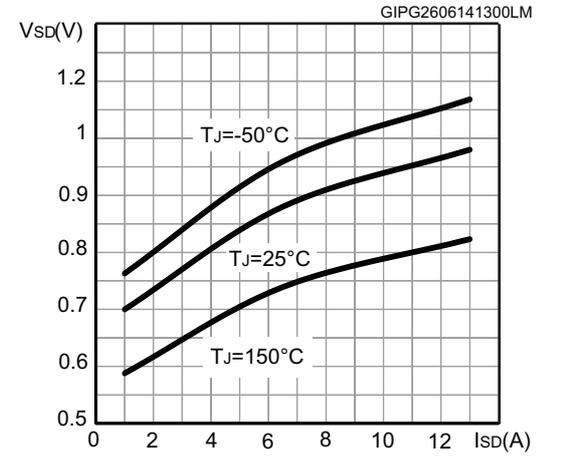
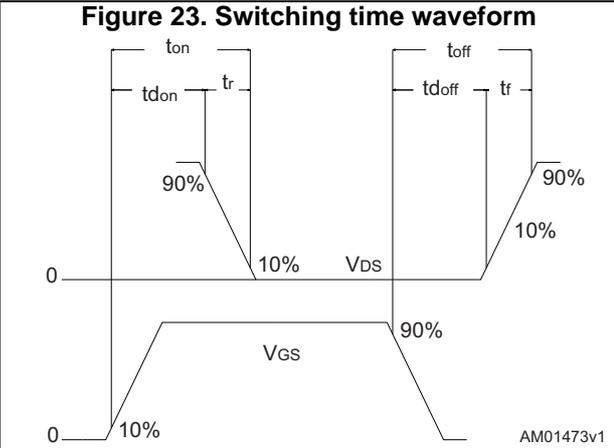
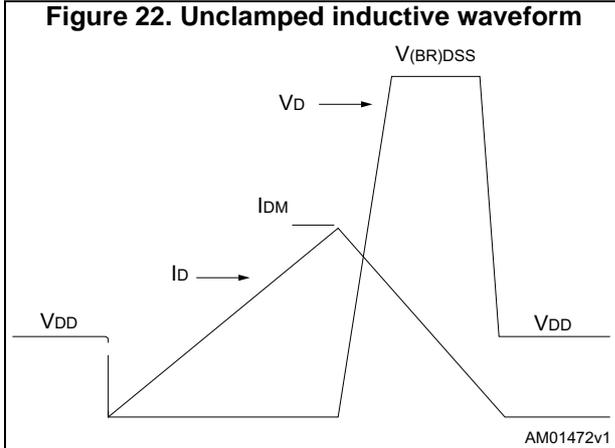
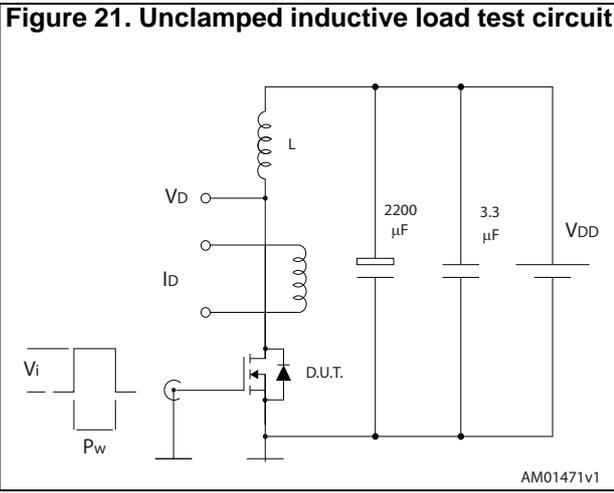
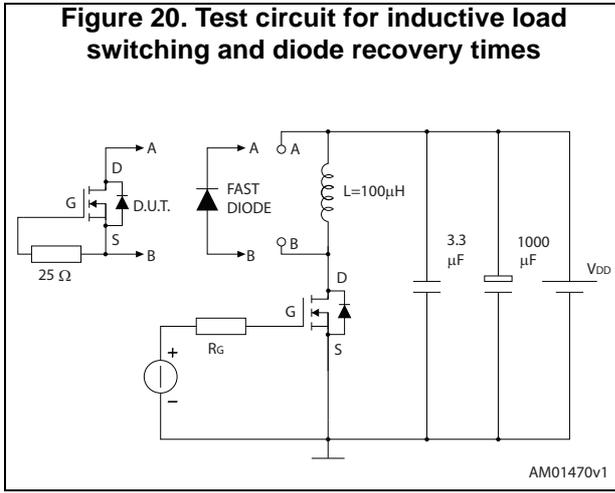
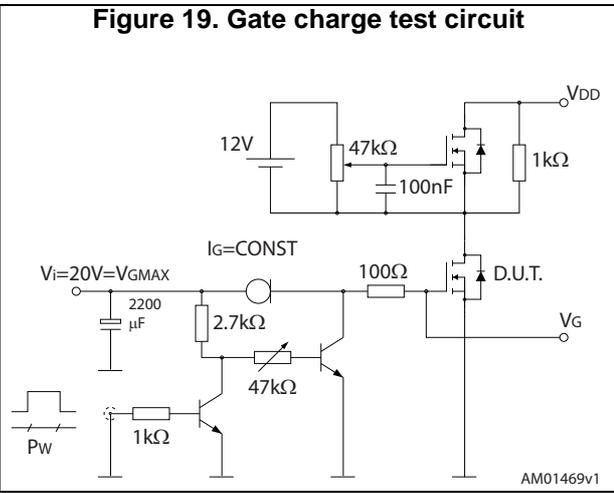
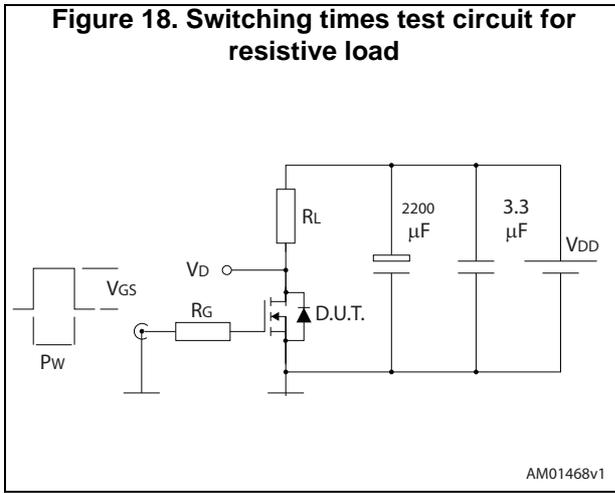


Figure 17. Source-drain diode forward characteristics



3 Test circuits

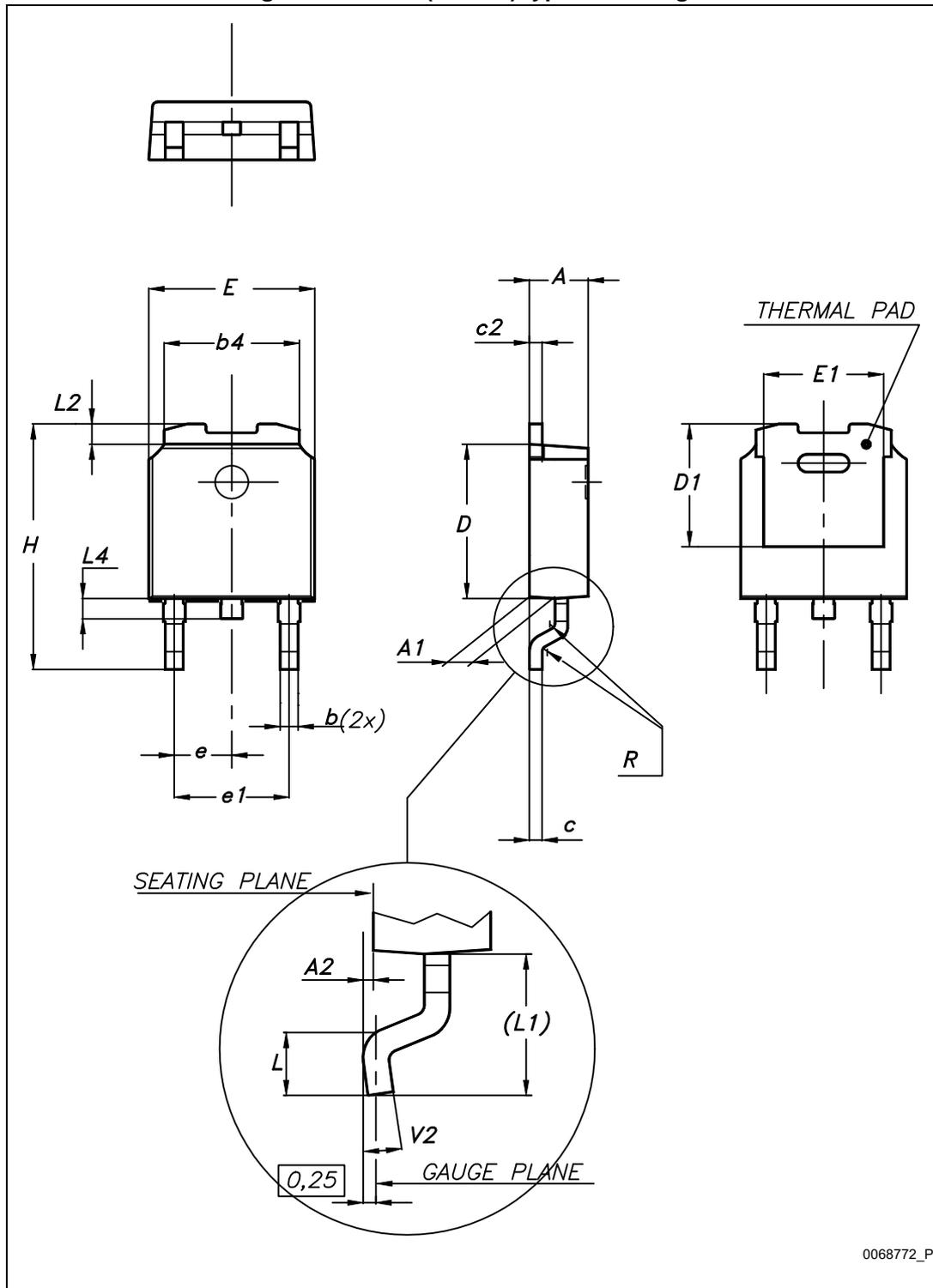


4 Package mechanical data

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 DPAK (TO-252) mechanical data

Figure 24. DPAK (TO-252) type A drawings

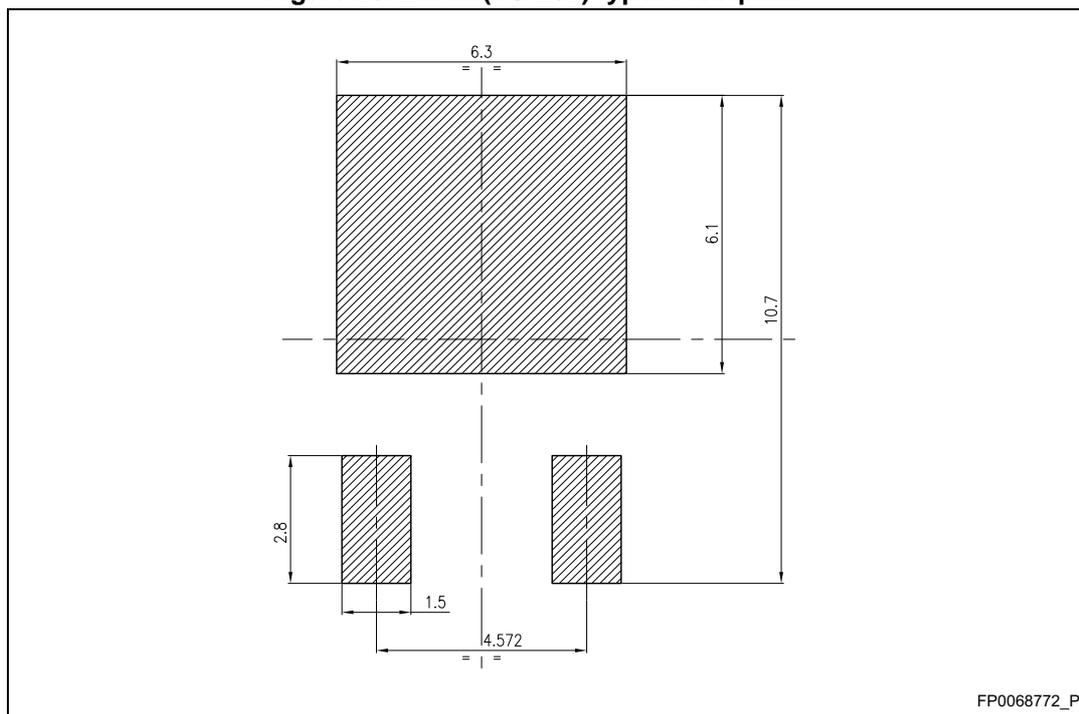


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Table 9. DPAK (TO-252) type A mechanical data

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		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

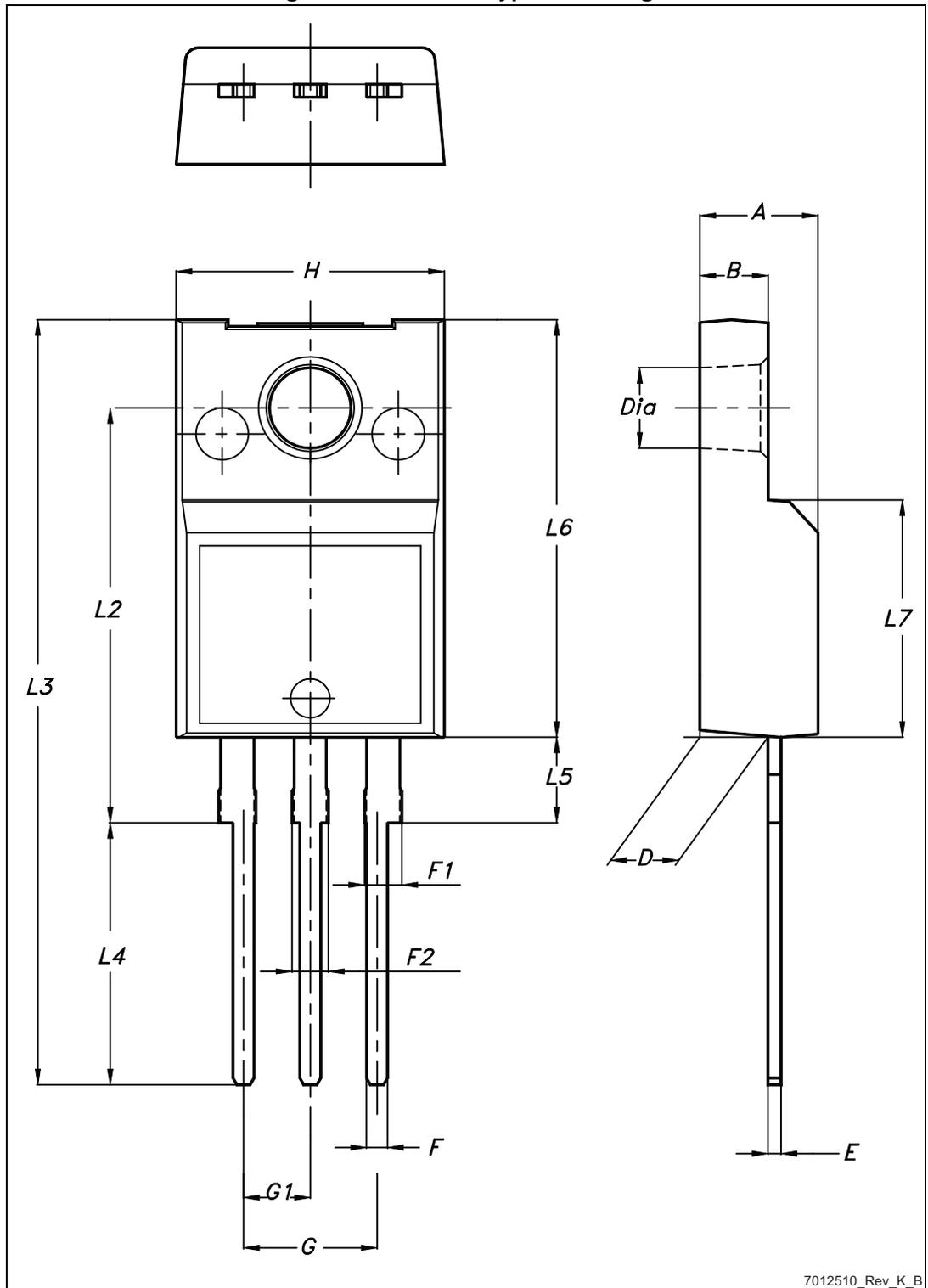
Figure 25. DPAK (TO-252) type A footprint (a)



a. All dimensions are in millimeters

4.2 TO-220FP mechanical data

Figure 26. TO-220FP type B drawings



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Table 10. TO-220FP type B 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
Ø	3		3.2

4.3 TO-220 mechanical data

Figure 27. TO-220 type A drawings

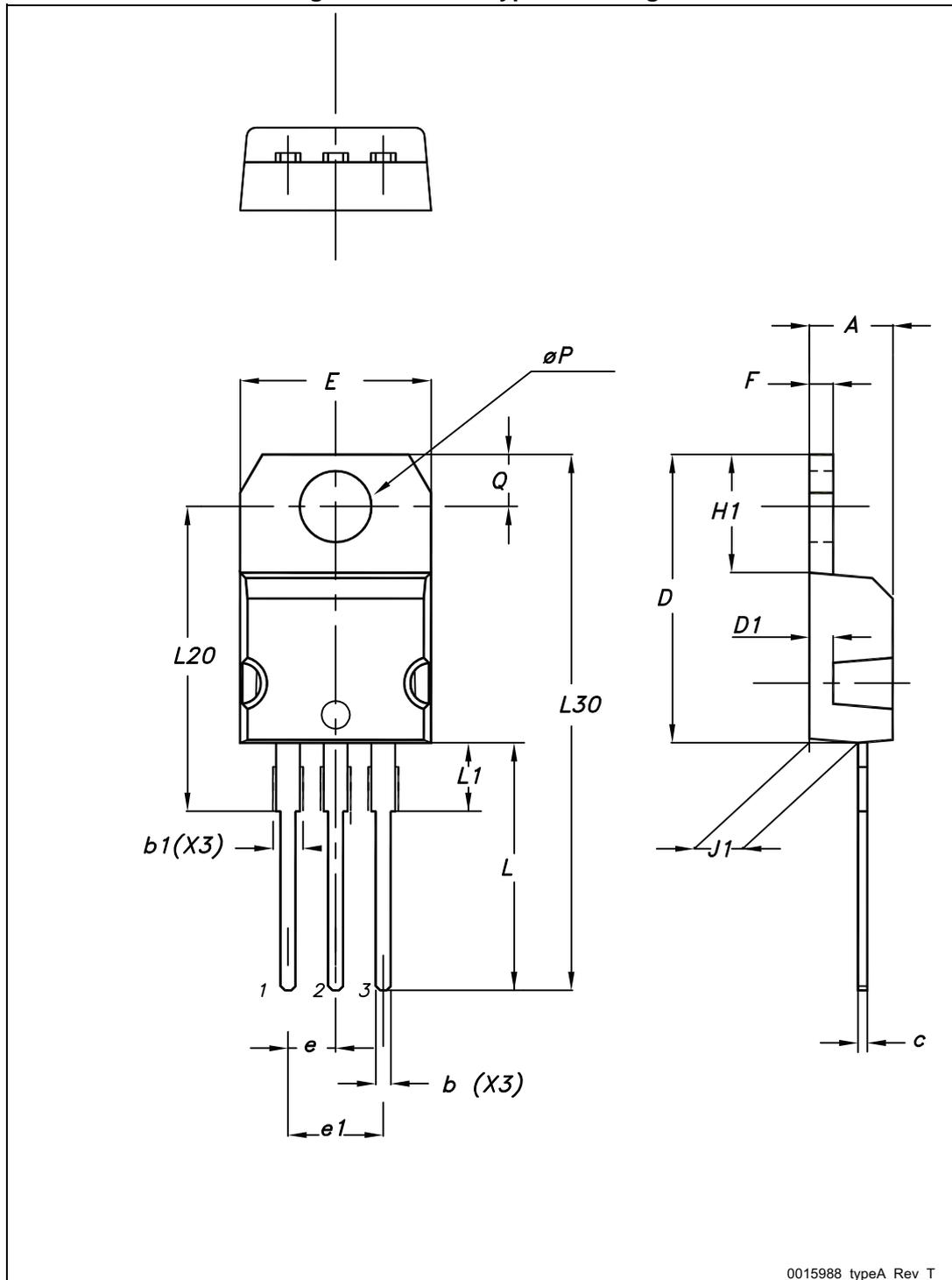


Table 11. TO-220 type A mechanical data

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 Packaging mechanical data

Figure 28. Tape for DPAK (TO-252)

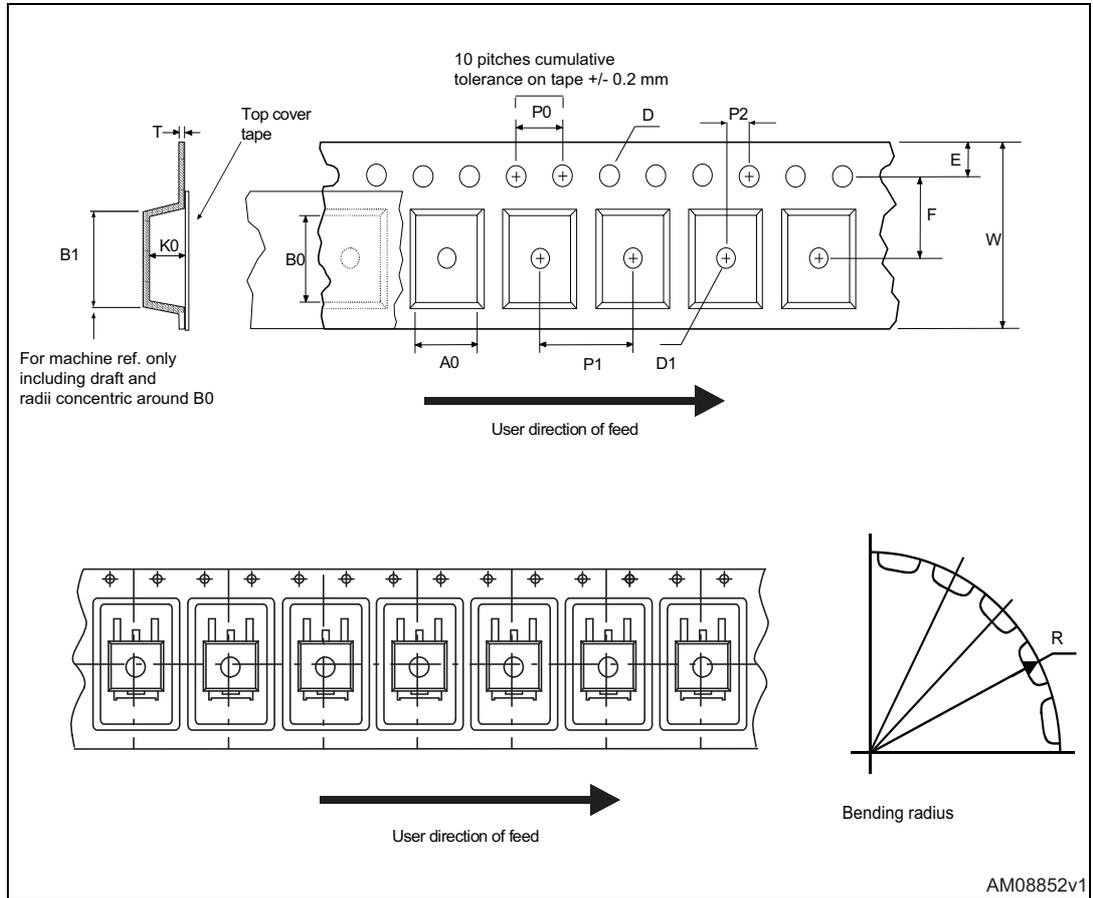


Figure 29. Reel for DPAK (TO-252)

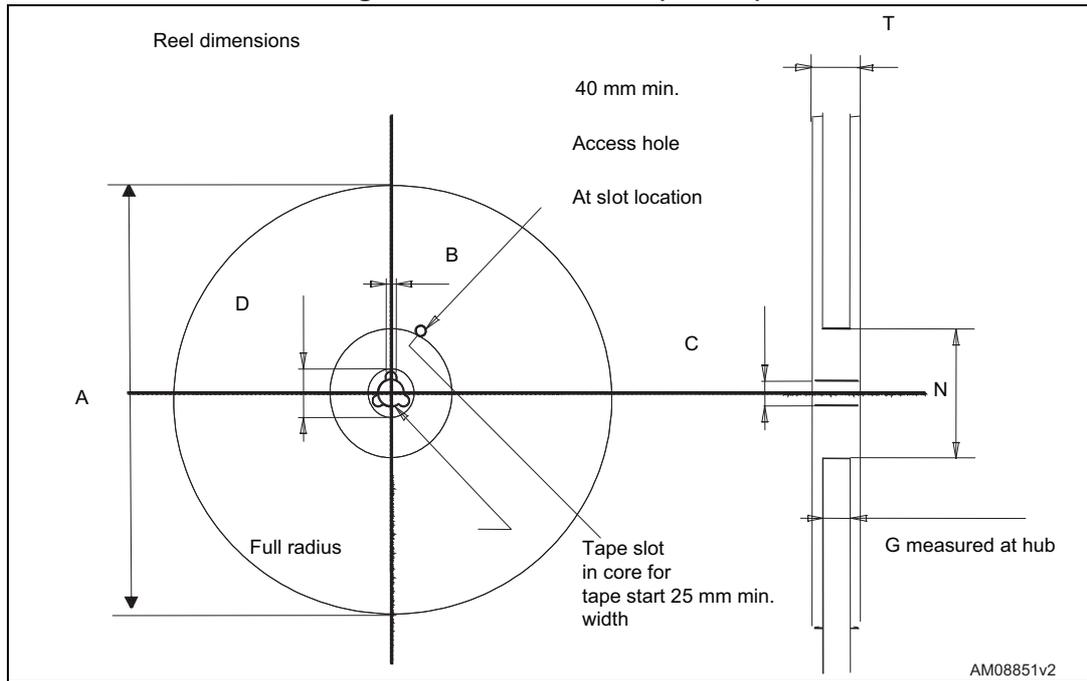


Table 12. DPAK (TO-252) tape and reel mechanical data

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			

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
04-Jul-2014	1	First release.
18-Jul-2014	2	Updated Figure 9 .
31-Jul-2014	3	Updated Figure 2 and Figure 4 .

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