

N-channel 525 V, 1.2 Ω typ., 5.0 A Power MOSFET
in DPAK, I²PAKFP, TO-220 and IPAK packages

Datasheet – preliminary data

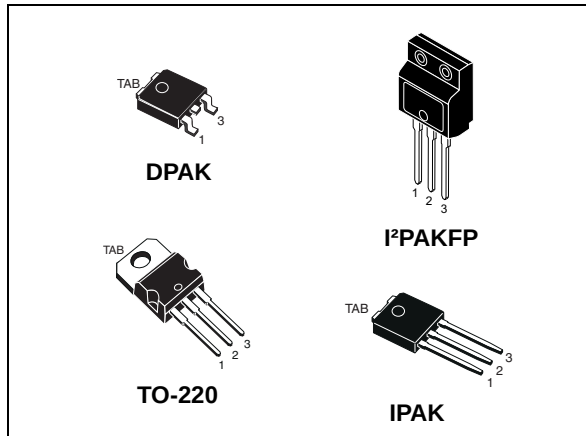
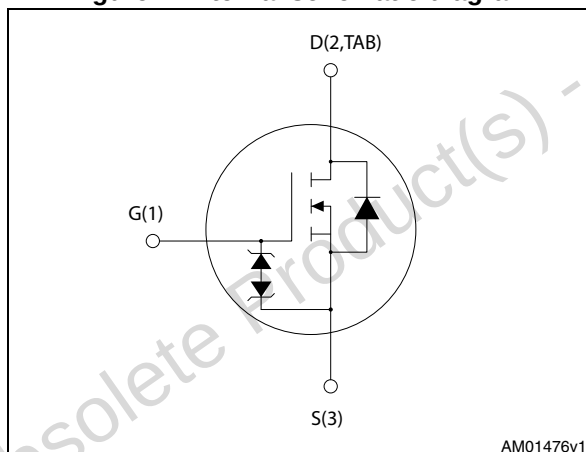


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS}	R _{DS(on)} max	I _D	P _{TOT}
STDLED525	525 V	1.5 Ω	5.0 A	70 W
STFILED525				25 W
STPLED525				70 W
STULED525				

- 100% avalanche tested
- Extremely high dv/dt capability
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

Applications

- LED lighting applications

Description

These Power MOSFETs boast extremely low on-resistance and very good dv/dt capability, rendering them suitable for buck-boost and flyback topologies.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STDLED525	LED525	DPAK	Tape and reel
STFILED525		I ² PAKFP (TO-281)	Tube
STPLED525		TO-220	
STULED525		IPAK	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK, IPAK	I ² PAKFP	TO-220	
V _{DS}	Drain- source voltage	525			V
V _{GS}	Gate- source voltage	± 30			V
I _D	Drain current (continuous) at T _C = 25 °C	5.0	5.0 ⁽¹⁾	5.0	A
I _D	Drain current (continuous) at T _C = 100 °C	3.1	3.1 ⁽¹⁾	3.1	A
I _{DM} ⁽²⁾	Drain current (pulsed)	20.0	20.0 ⁽¹⁾	20.0	A
P _{TOT}	Total dissipation at T _C = 25 °C	70	25	70	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	2.2			A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	100			mJ
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12			V/ns
V _{ISO}	Insulation withstand voltage (AC)		2500		V
T _J T _{stg}	Operating junction temperature Storage temperature	- 55 to 150			°C

1. Limited only by maximum temperature allowed

2. Pulse width limited by safe operating area

3. I_{SD} ≤ 4.4 A, di/dt ≤ 100 A/μs, V_{DS peak} ≤ V_{(BR)DSS}, V_{DD} = 80% V_{(BR)DSS}.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		DPAK	I ² PAKFP	TO-220	IPAK	
R _{thj-case}	Thermal resistance junction-case max.	1.79	5	1.79		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max		62.5		100	°C/W
R _{thj-pcb}	Thermal resistance junction-pcb max.	50				°C/W

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 breakdown voltage	I _D = 1 mA, V _{GS} = 0	525			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = 525 V V _{DS} = 525 V, T _C = 125 °C			1 50	μA μA
I _{GSS}	Gate-body leakage current (V _{DS} = 0)	V _{GS} = ± 20 V; V _{DS} = 0			10	μA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 50 μA	3	3.6	4.5	V
R _{DS(on)}	Static drain-source on resistance	V _{GS} = 10 V, I _D = 2.2 A		1.2	1.5	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss} C _{oss} C _{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V _{DS} = 100 V, f = 1 MHz, V _{GS} = 0	-	555 47 8.2	-	pF pF pF
C _{oss eq.} (1)	Equivalent output capacitance	V _{DS} = 0 to 420 V, V _{GS} = 0	-	33.5	-	pF
R _g	Gate input resistance	f = 1 MHz open drain	-	4.7	-	Ω
Q _g Q _{gs} Q _{gd}	Total gate charge Gate-source charge Gate-drain charge	V _{DD} = 420 V, I _D = 4.4 A, V _{GS} = 10 V (see Figure 19)	-	17.5 3 10	-	nC nC nC

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_{DS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 420 V, I _D = 4.4 A,		9		ns
t _r	Rise time	R _G = 4.7 Ω, V _{GS} = 10 V	-	11	-	ns
t _{d(off)}	Turn-off-delay time	(see Figure 18)		29		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		-		4.4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		17.6	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4.4 \text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 4.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$	-	210		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$	-	1.3		μC
I_{RRM}	Reverse recovery current	(see Figure 20)	-	12		A
t_{rr}	Reverse recovery time	$I_{SD} = 4.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$	-	240		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$ $T_J = 150 \text{ }^\circ\text{C}$	-	1.6		μC
I_{RRM}	Reverse recovery current	(see Figure 20)	-	13		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 not only the device's ESD capability, but also to make them capable of safely absorbing any voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage is appropriate to achieve efficient and cost-effective protection of device integrity. The integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area DPAK, IPAK

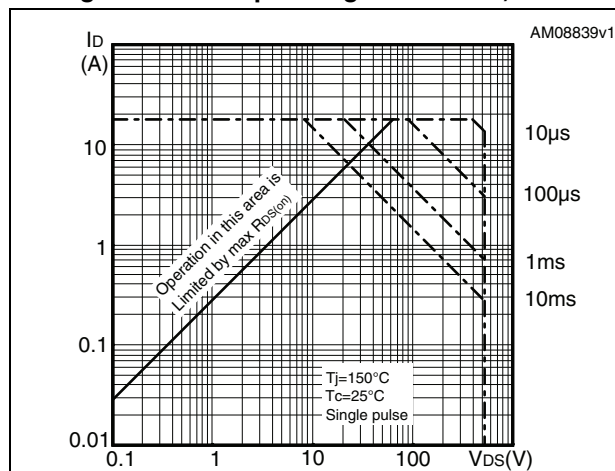


Figure 3. Thermal impedance DPAK, IPAK

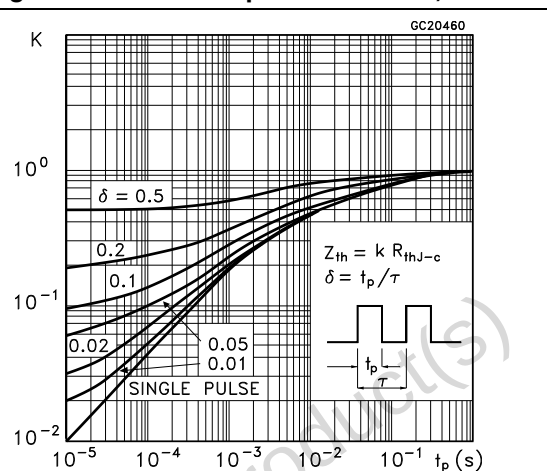
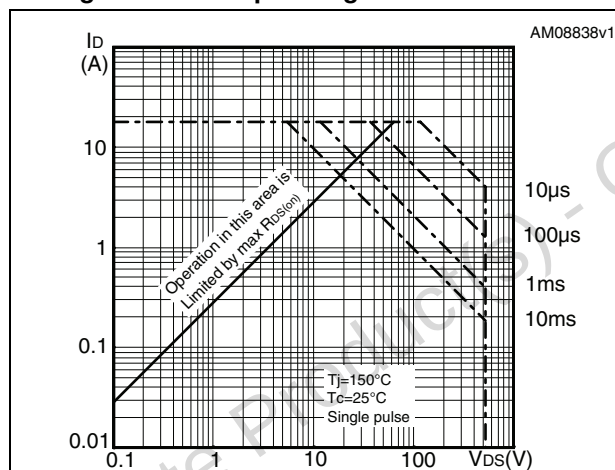
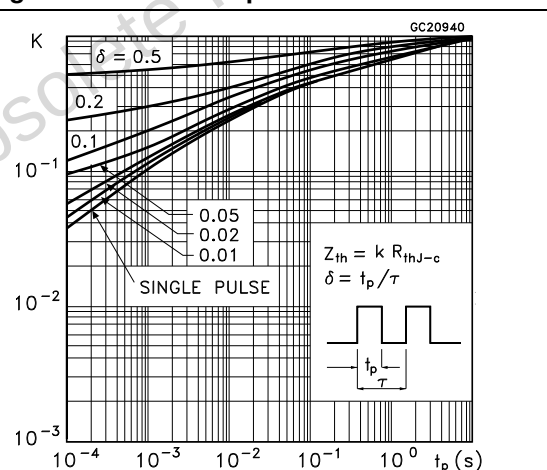
Figure 4. Safe operating area for I²PAKFPFigure 5. Thermal impedance for I²PAKFP

Figure 6. Safe operating area TO-220

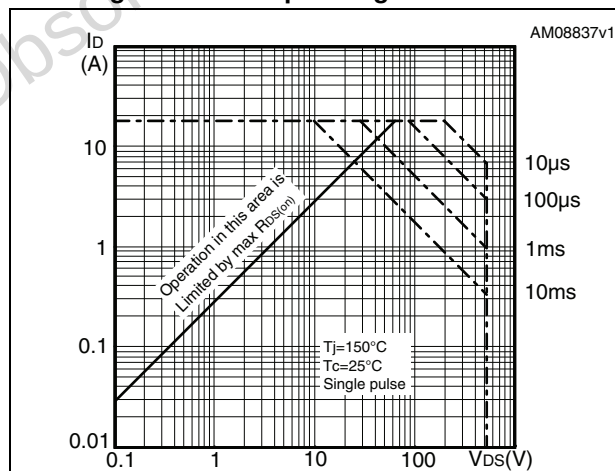


Figure 7. Thermal impedance TO-220

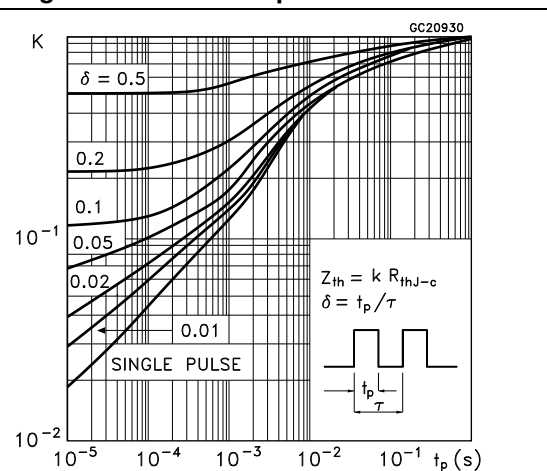


Figure 8. Output characteristics

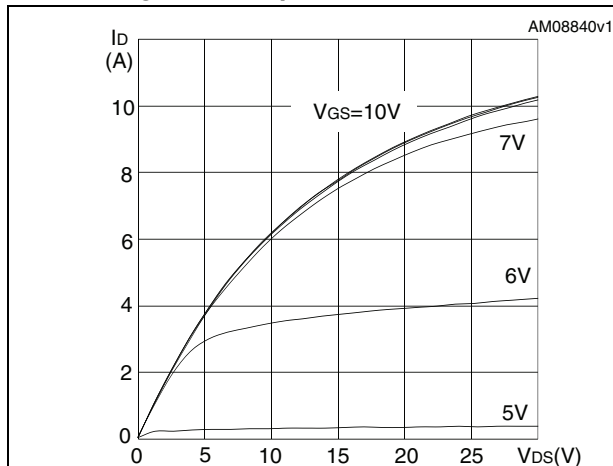


Figure 9. Transfer characteristics

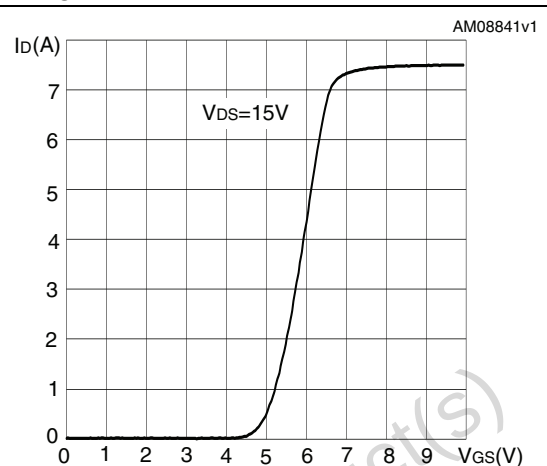
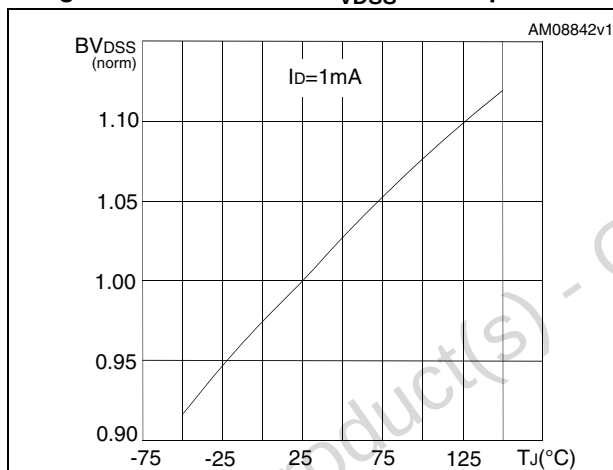
Figure 10. Normalized $B_{V_{DS}}$ vs temperature

Figure 11. Static drain-source on resistance

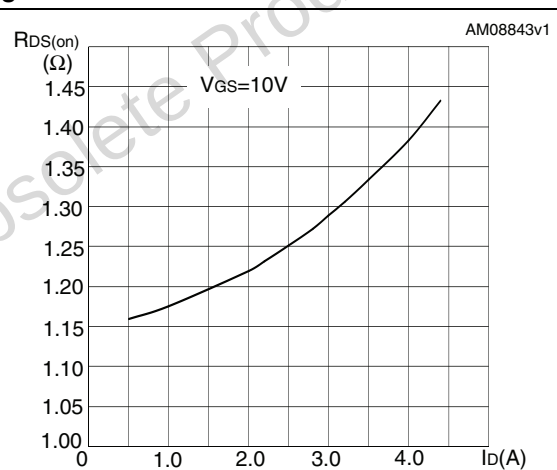


Figure 12. Gate charge vs gate-source voltage

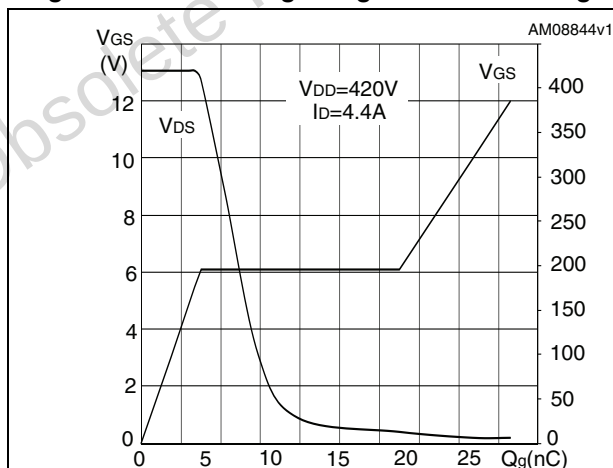


Figure 13. Capacitance variations

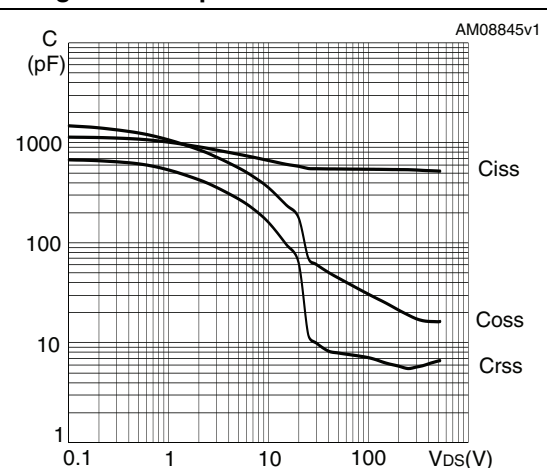


Figure 14. Normalized gate threshold voltage vs temperature

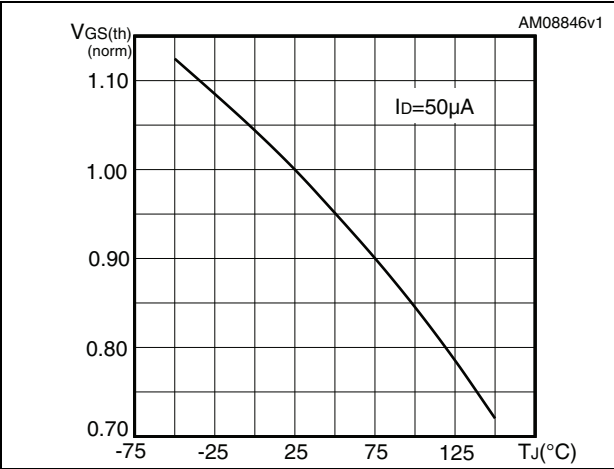


Figure 15. Normalized on-resistance vs temperature

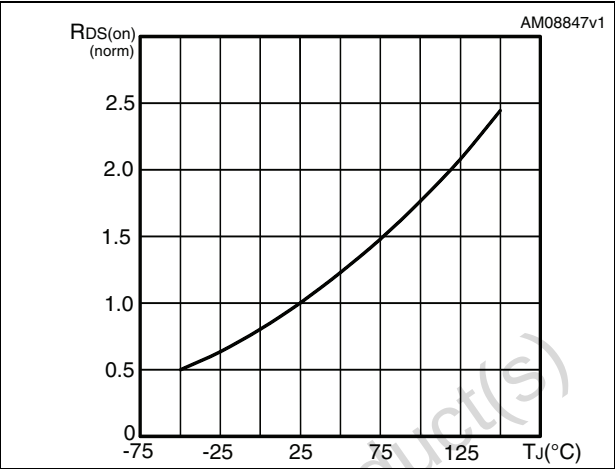


Figure 16. Source-drain diode forward characteristics

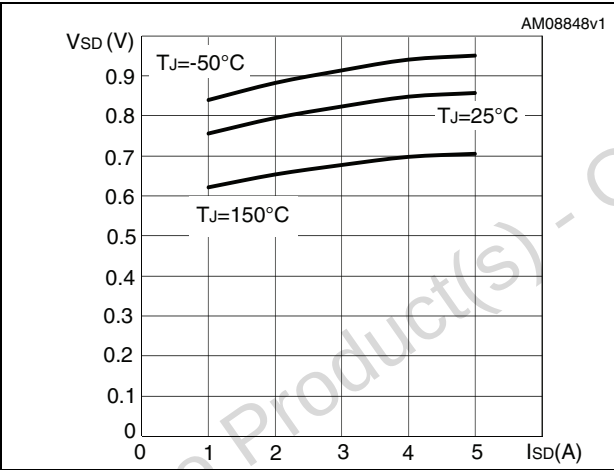
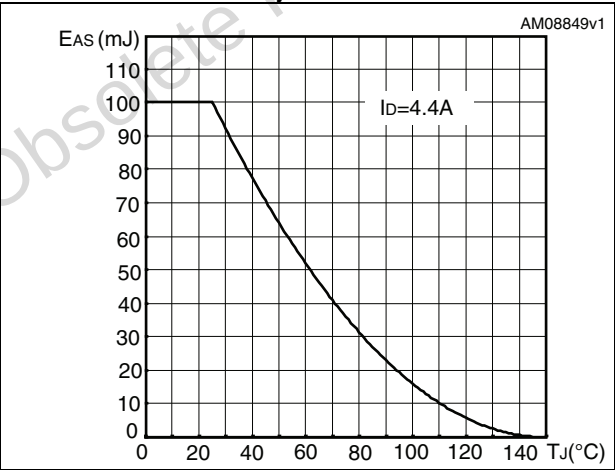


Figure 17. Maximum avalanche energy vs starting TJ



3 Test circuits

Figure 18. Switching times test circuit for resistive load

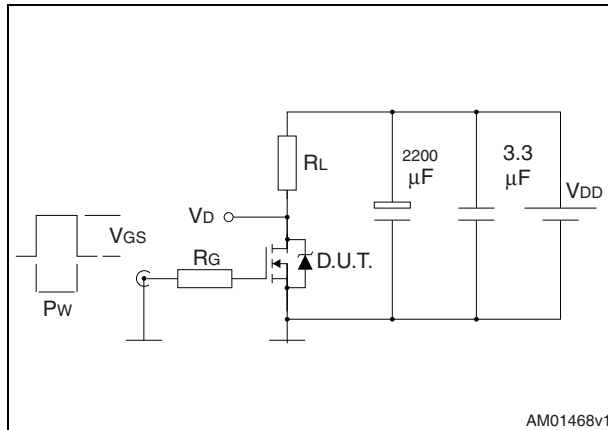


Figure 19. Gate charge test circuit

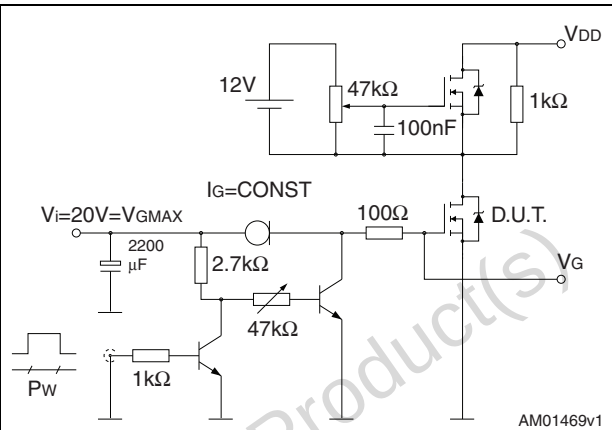


Figure 20. Test circuit for inductive load switching and diode recovery times

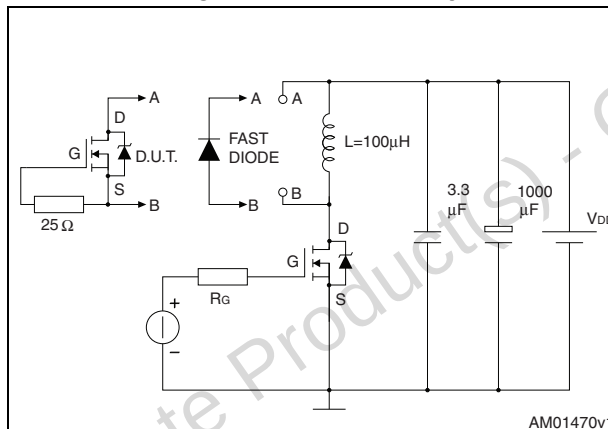


Figure 21. Unclamped inductive load test circuit

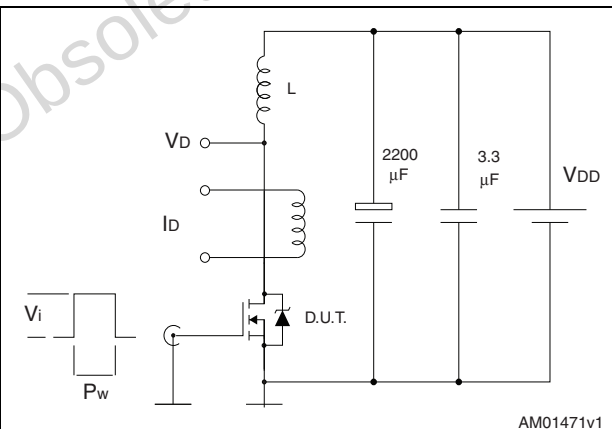


Figure 22. Unclamped inductive waveform

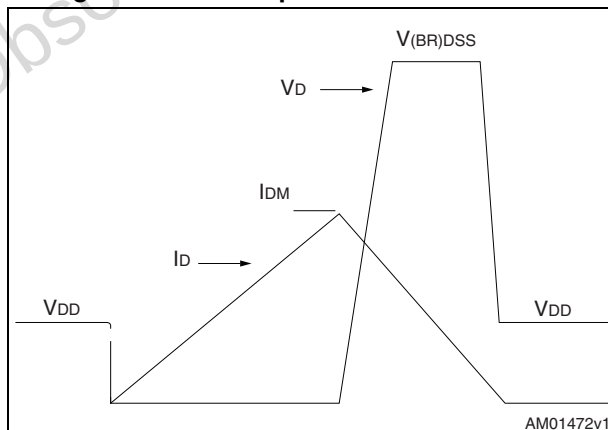
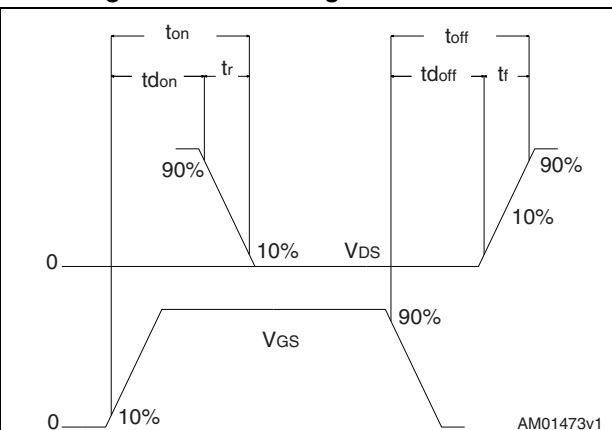


Figure 23. Switching time waveform



4 Package mechanical data

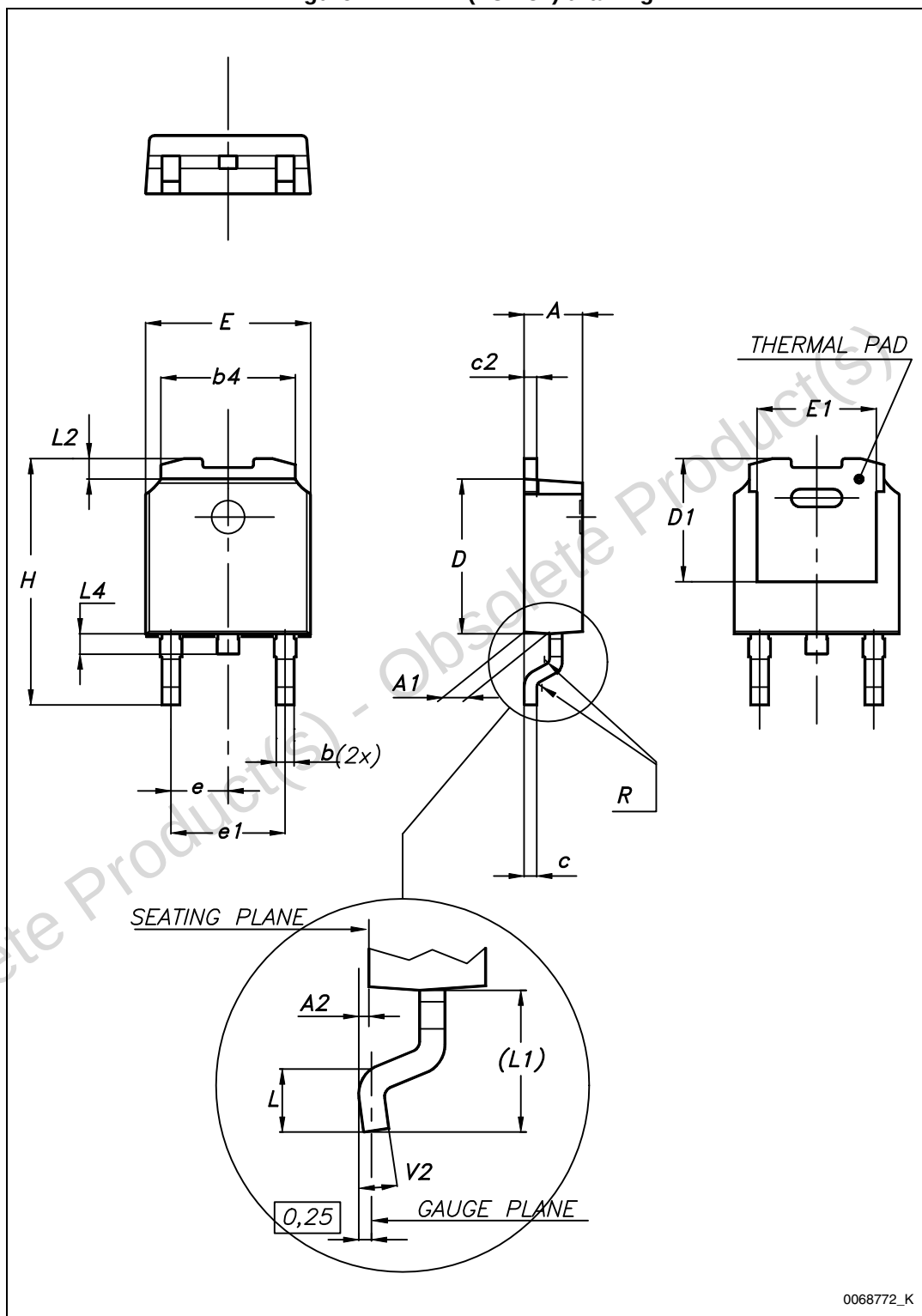
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Table 9. DPAK (TO-252) mechanical data

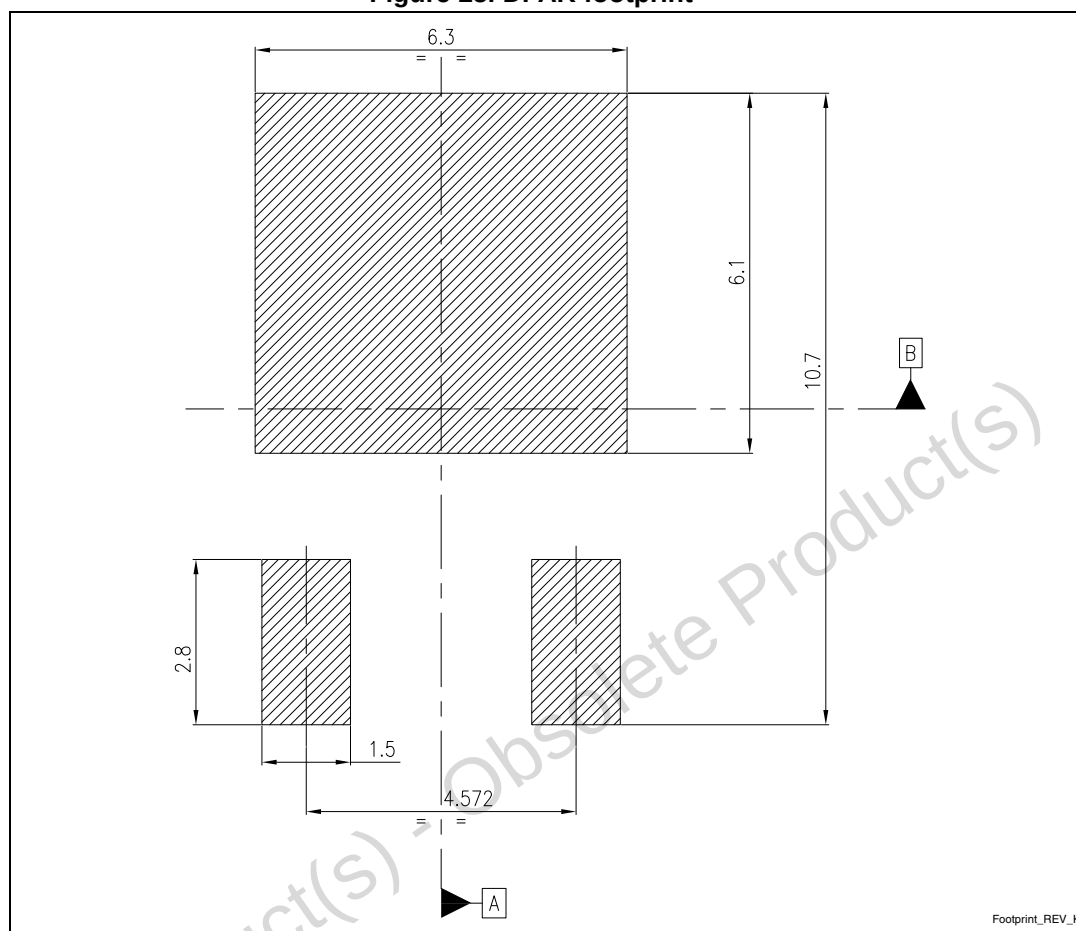
Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 24. DPAK (TO-252) drawing



0068772_K

Figure 25. DPAK footprint (a)



a. All dimensions are in millimeters

Table 10. I²PAKFP (TO-281) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	-	4.60
B	2.50		2.70
D	2.50		2.75
D1	0.65		0.85
E	0.45		0.70
F	0.75		1.00
F1			1.20
G	4.95		5.20
H	10.00		10.40
L1	21.00		23.00
L2	13.20		14.10
L3	10.55		10.85
L4	2.70		3.20
L5	0.85		1.25
L6	7.30		7.50

Figure 26. I²PAKFP (TO-281) drawing

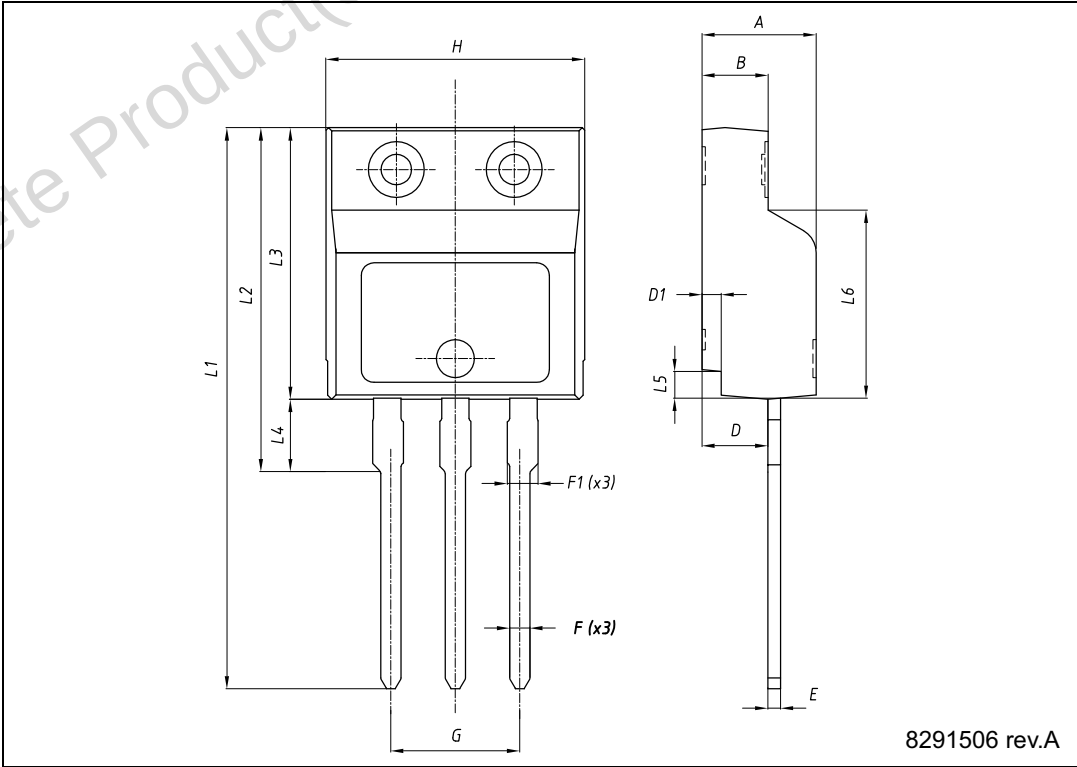


Table 11. TO-220 type A mechanical data

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

Figure 27. TO-220 type A drawing

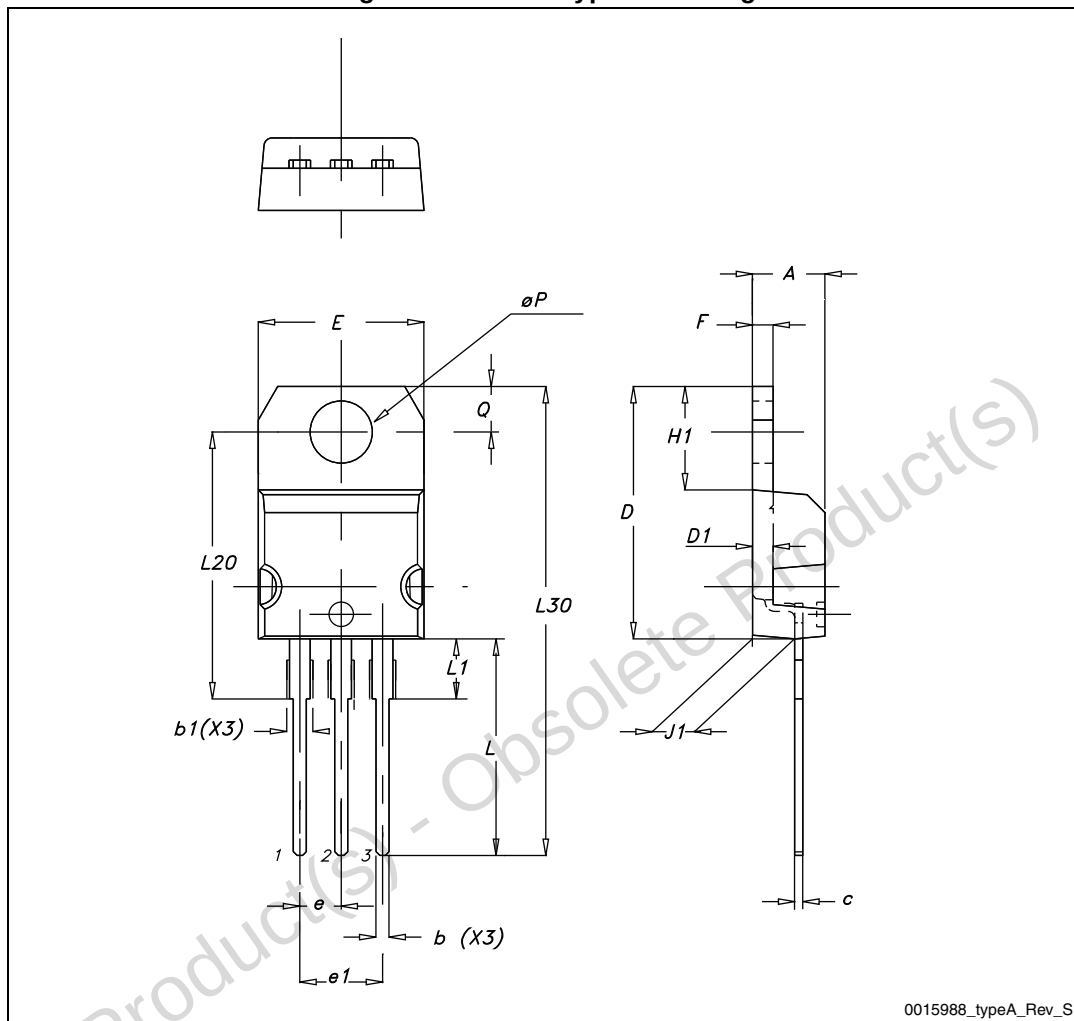
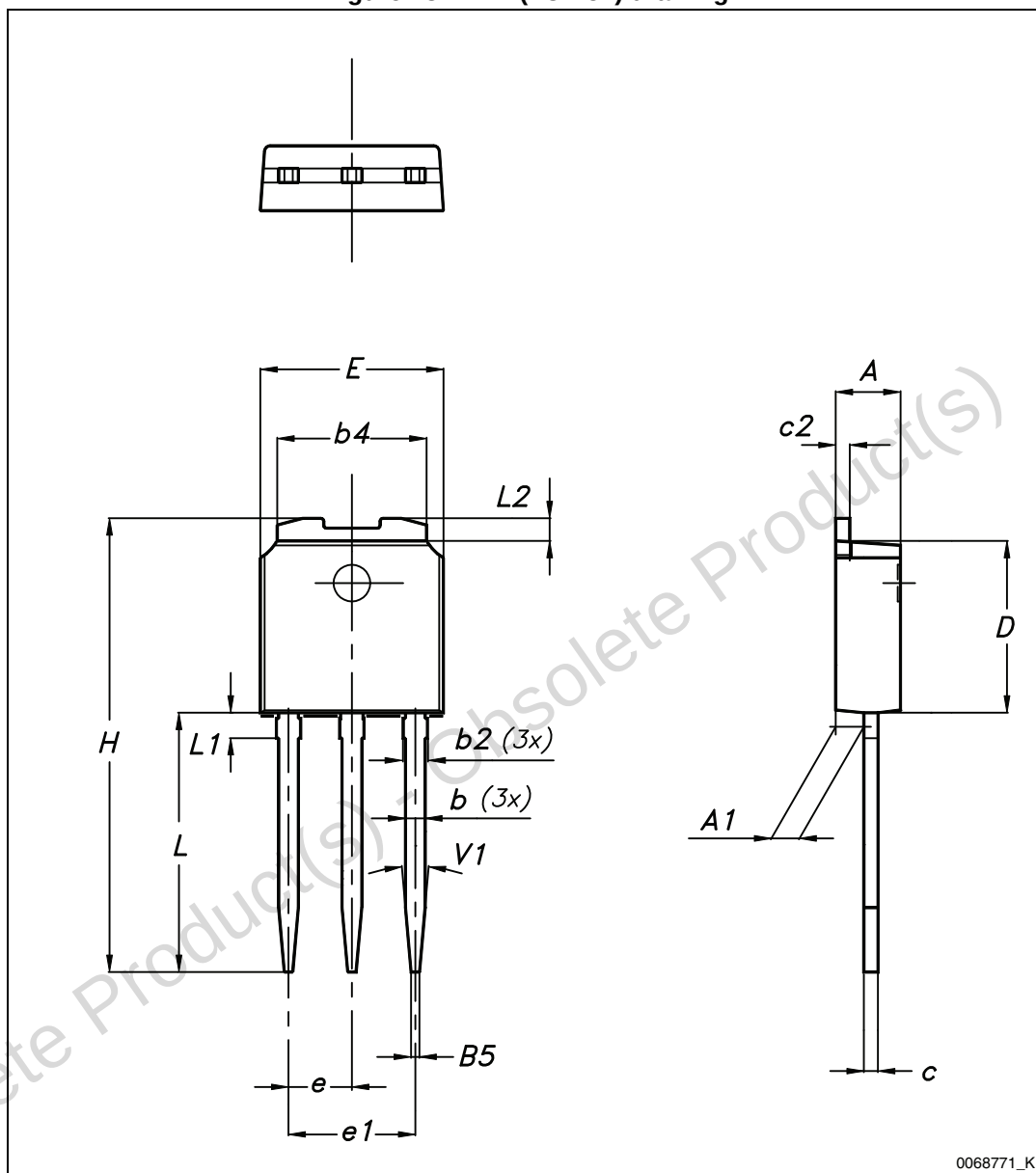


Table 12. IPAK (TO-251) mechanical data

DIM	mm.		
	min.	typ.	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

Figure 28. IPAK (TO-251) drawing



5 Packaging mechanical data

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			

Figure 29. Tape for DPAK (TO-252)

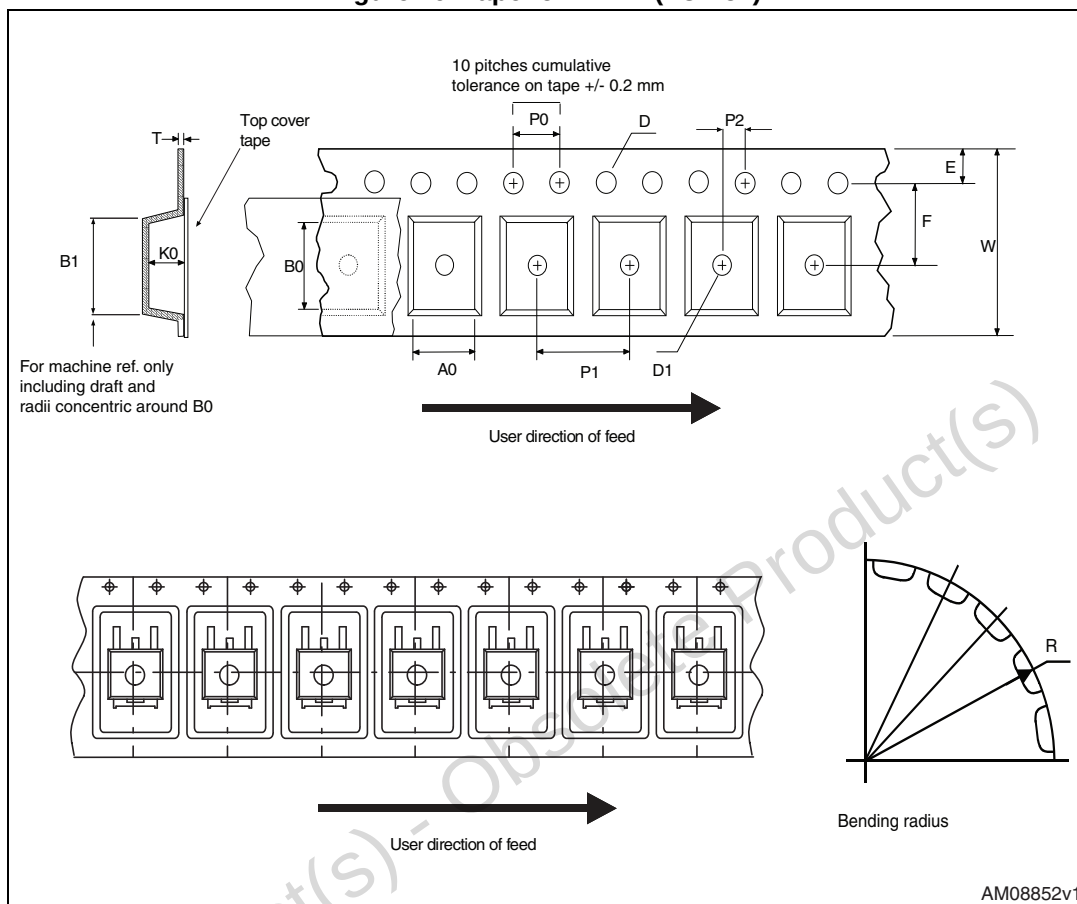
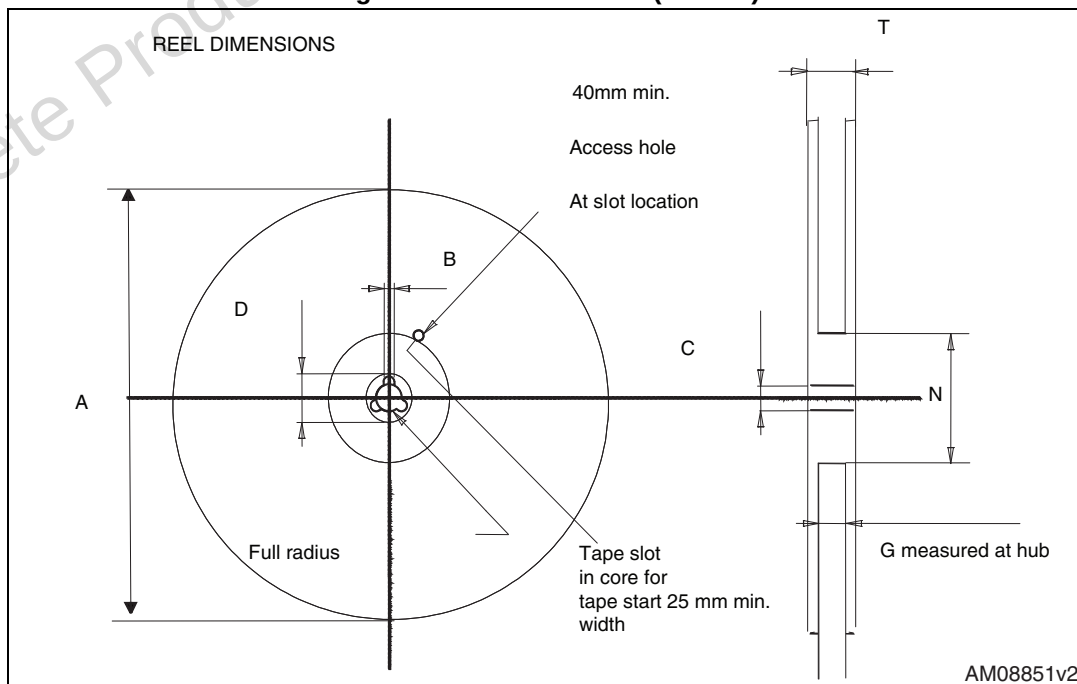


Figure 30. Reel for DPAK (TO-252)



6 Revision history

Table 14. Document revision history

Date	Revision	Changes
25-Mar-2013	1	First release.

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