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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Va		Value		Unit
Symbol	Farameter	TO-220	TO-220FP	IPAK	DPAK	Onit
V_{GS}	Gate- source voltage		± 25			V
I _D	Drain current (continuous) at T _C = 25 °C	10	10 ⁽¹⁾	,	10	Α
I _D	Drain current (continuous) at T _C = 100 °C	5	5 5 (1) 5		5	Α
I _{DM} ⁽²⁾	Drain current (pulsed)	32	32 ⁽¹⁾	32 ⁽¹⁾ 32		Α
P _{TOT}	Total dissipation at T _C = 25 °C	70	0 25 70		70	W
dv/dt ⁽³⁾	Peak diode recovery voltage slope	15				V/ns
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t =1 s; T _C = 25 °C)	2500			V	
T _J	Operating junction temperature	- 55 to 150			°C	
T _{stg}	Storage temperature		- 55 10 13	50		

- 1. Limited by maximum junction temperature.
- 2. Pulse width limited by safe operating area.
- 3. $I_{SD} \leq$ 10 A, di/dt \leq 400 A/ μ s, V_{DS} peak \leq $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.

Table 3. Thermal data

0		Value				
Symbol	Parameter	TO-220	TO-220FP	IPAK	DPAK	Unit
R _{thj-case}	Thermal resistance junction-case max.	1.79 5		1.79		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max.	62.50		100		°C/W
R _{thj-pcb}	Thermal resistance junction-pcb max.				50	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
las	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	4	Α
Eas	Single pulse avalanche energy (starting T _J = 25 °C, ID = IAS, VDD = 50 V)	200	mJ



2 Electrical characteristics

 $(T_{case} = 25 \, ^{\circ}C \, unless \, otherwise \, specified)$

Table 5. On/off-states

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
	Droin agures	$I_D = 1 \text{ mA}, V_{GS} = 0$	600			
V _{(BR)DSS}	Drain-source breakdown voltage	$I_D = 1 \text{ mA}, V_{GS} = 0,$ $T_C = 150 \text{ °C}$		650		V
1	Zero-gate voltage	V _{DS} = 600 V			1	
I _{DSS}	drain current (V _{GS} = 0)	V _{DS} = 600 V, T _C = 125 °C			100	μA
I _{GSS}	Gate-body leakage current (V _{DS} = 0)	V _{GS} = ± 25 V			± 100	nA
V _{GS(th)}	Gate threshold voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	2	3	4	V
R _{DS(on)}	Static drain-source on- resistance	$V_{GS} = 10 \text{ V}, I_D = 4 \text{ A}$		0.53	0.55	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{iss}	Input capacitance		-	540	-	pF
C _{oss}	Output capacitance	$V_{DS} = 50 \text{ V, f} = 1 \text{ MHz,}$	-	44	-	pF
C _{rss}	Reverse transfer capacitance	$V_{GS} = 0$	-	1.2	-	pF
Coss eq ⁽¹⁾	Equivalent capacitance time related	$V_{DS} = 0$ to 480 V, $V_{GS} = 0$	-	110	-	pF
R _g	Gate input resistance	f=1 MHz open drain	-	6	-	Ω
Qg	Total gate charge	V _{DD} = 480 V, I _D = 8 A,	-	19	-	nC
Q_{gs}	Gate-source charge	V _{GS} = 10 V	-	3	-	nC
Q_{gd}	Gate-drain charge	(see Figure 17)	-	10	-	nC

C_{oss eq.} 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}.

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Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time		-	10	-	ns
t _r	Rise time	$V_{DD} = 300 \text{ V}, I_D = 4 \text{ A},$ $R_G = 4.7 \Omega, V_{GS} = 10 \text{ V}$	-	12	-	ns
t _{d(off)}	Turn-off-delay time	$(\text{see } Figure \ 16)$	-	32	-	ns
t _f	Fall time		-	15	-	ns

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{SD}	Source-drain current		-		8	Α
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)				32	^
V _{SD} ⁽²⁾	Forward on voltage	$I_{SD} = 8 \text{ A}, V_{GS} = 0$	-		1.3	V
t _{rr}	Reverse recovery time	I _{SD} = 8 A, di/dt = 100 A/μs	-	250		ns
Q _{rr}	Reverse recovery charge	V _{DD} = 60 V	-	2.12		μC
I _{RRM}	Reverse recovery current	(see Figure 18)		17		Α
t _{rr}	Reverse recovery time	I _{SD} = 8 A, di/dt = 100 A/μs	-	315		ns
Q _{rr}	Reverse recovery charge	V _{DD} = 60 V T _J = 150 °C		2.6		μC
I _{RRM}	Reverse recovery current	(see Figure 18)		16.5		Α

^{1.} Pulse width limited by safe operating area.

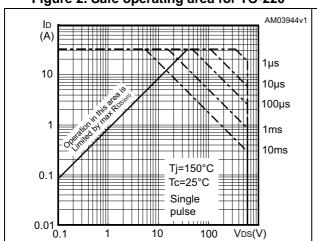


^{2.} Pulsed: pulse duration = 300 μ s, duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

Figure 3. Thermal impedance for TO-220



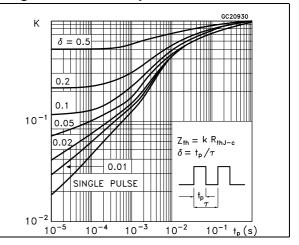
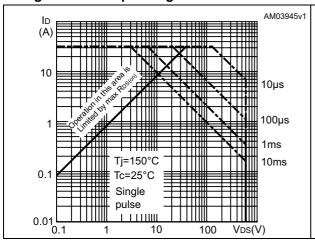


Figure 4. Safe operating area for TO-220FP

Figure 5. Thermal impedance for TO-220FP



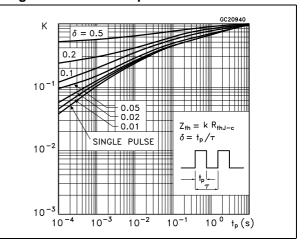
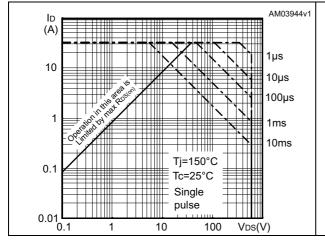


Figure 6. Safe operating area for DPAK, IPAK

Figure 7. Thermal impedance for DPAK, IPAK



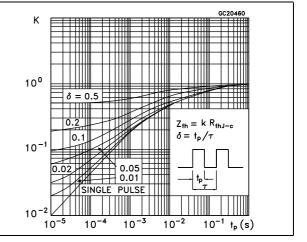


Figure 8. Output characteristics

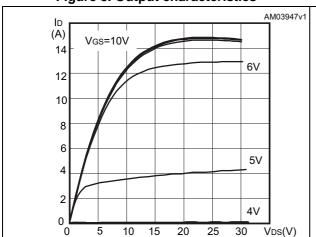


Figure 9. Transfer characteristics

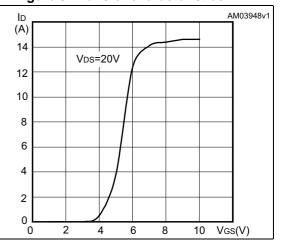
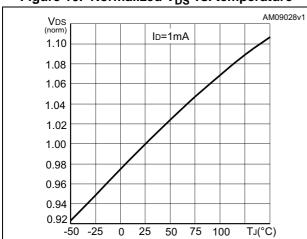


Figure 10. Normalized V_{DS} vs. temperature

Figure 11. Static drain-source on-resistance



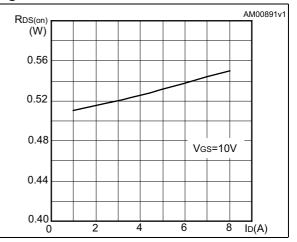
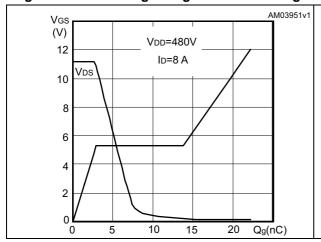
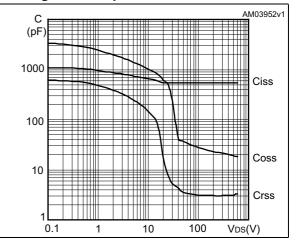


Figure 12. Gate charge vs. gate-source voltage

Figure 13. Capacitance variations

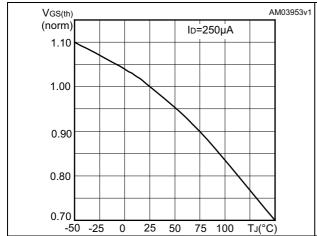


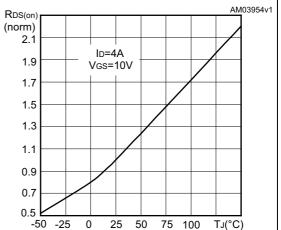


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Figure 14. Normalized gate threshold voltage vs. temperature

Figure 15. Normalized on-resistance vs. temperature





3 Test circuits

Figure 16. Switching times test circuit for resistive load

Figure 17. Gate charge test circuit

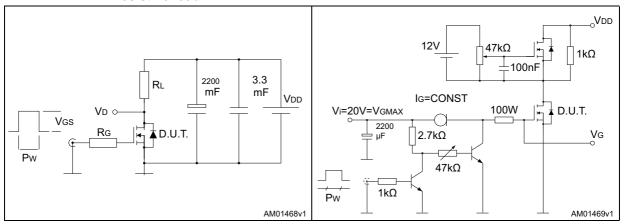


Figure 18. Test circuit for inductive load switching and diode recovery times

Figure 19. Unclamped inductive load test circuit

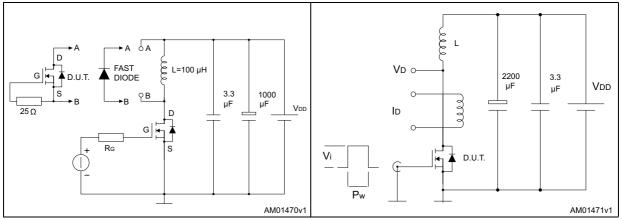
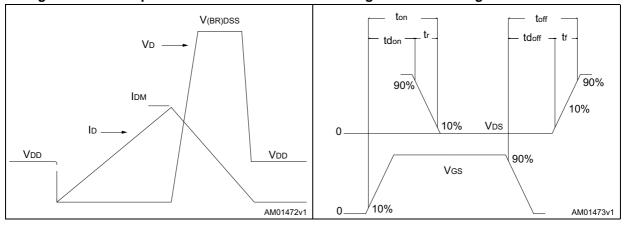


Figure 20. Unclamped inductive waveform

Figure 21. Switching time waveform





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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 STD10NM60N, DPAK (TO-252) package information

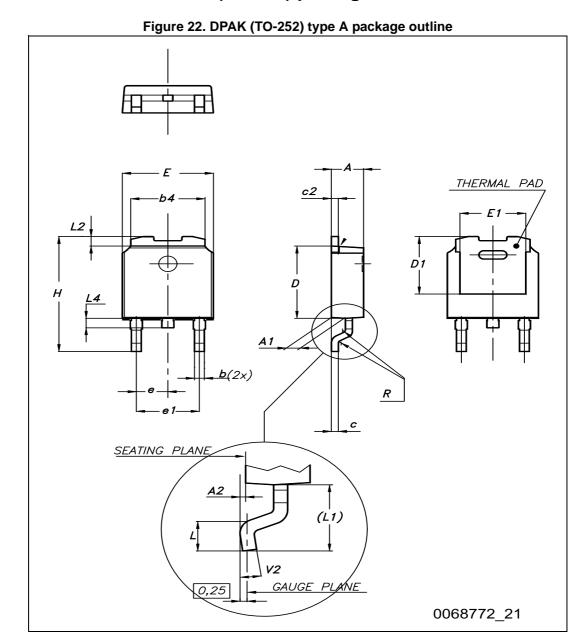


Table 9. DPAK (TO-252) type A mechanical data

Dim		mm	
Dim.	Min.	Тур.	Max.
А	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
С	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
е	2.16	2.28	2.40
e1	4.40		4.60
Н	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°

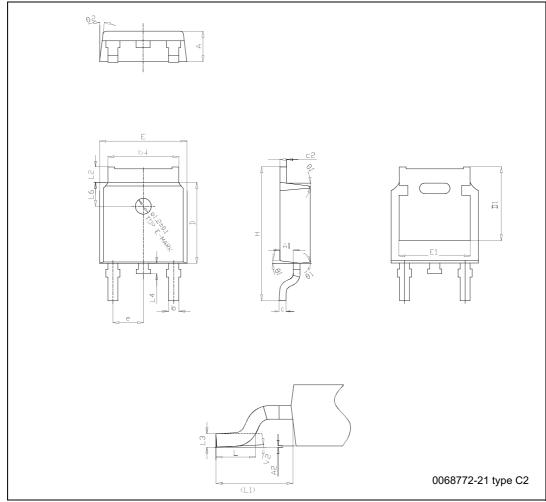


Figure 23. DPAK (TO-252) type C2 outline



Table 10. DPAK (TO-252) type C2 package mechanical data

Dim.		mm		
Dim.	Min.	Тур.	Max.	
А	2.20	2.30	2.38	
A1	0.90	1.01	1.10	
A2	0.00		0.10	
b	0.72		0.85	
b4	5.13	5.33	5.46	
С	0.47		0.60	
c2	0.47		0.60	
D	6.00	6.10	6.20	
D1	5.10		5.60	
E	6.50	6.60	6.70	
E1	5.20		5.50	
е	2.186	2.286	2.386	
Н	9.80	10.10	10.40	
L	1.40	1.50	1.70	
(L1)		2.90 REF		
L2	0.90		1.25	
L3		0.51 BSC		
L4	0.60	0.80	1.00	
L6	1.80 BSC			
θ1	5°	7°	9°	
θ2	5°	7°	9°	
V2	0°		8°	



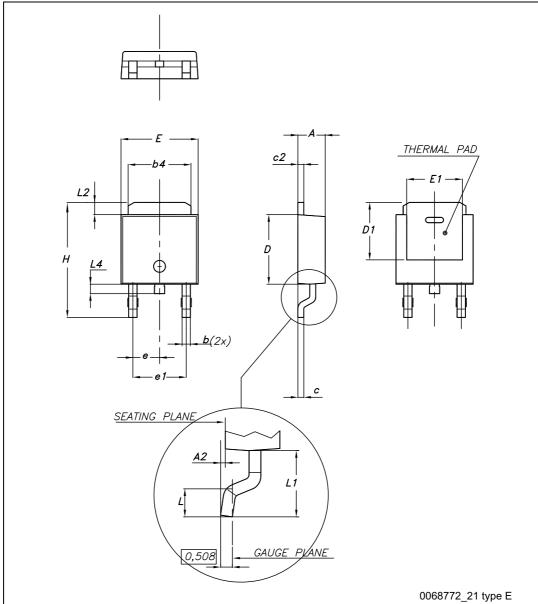


Figure 24. DPAK (TO-252) type E package outline

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

Dim	mm			
Dim.	Min.	Тур.	Max.	
А	2.18		2.39	
A2			0.13	
b	0.65		0.884	
b4	4.95		5.46	
С	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			
е		2.286		
e1		4.572		
Н	9.94		10.34	
L	1.50		1.78	
L1		2.74		
L2	0.89		1.27	
L4			1.02	



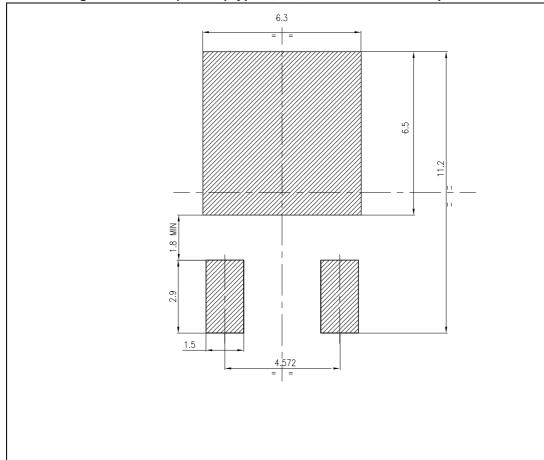


Figure 25. DPAK (TO-252) type A, C2, E recommended footprint ^(a)

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a. All dimensions are in millimeters

4.2 STF10NM60N, TO-220FP package information

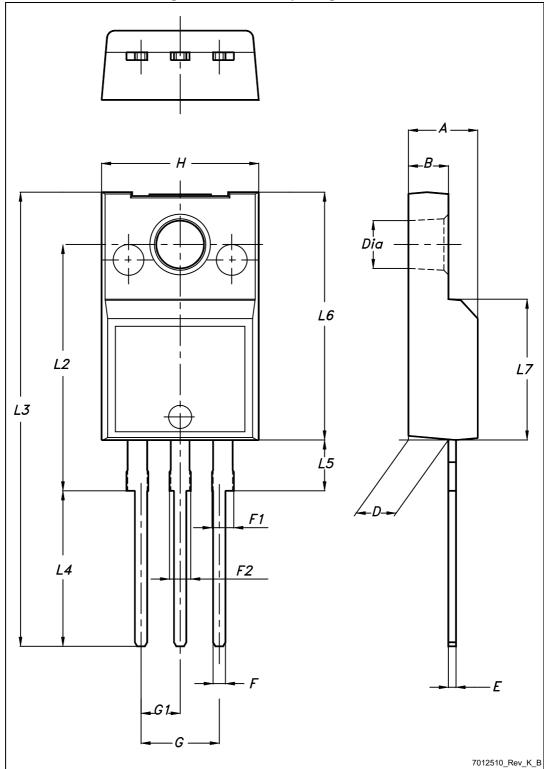


Figure 26. TO-220FP package outline



Table 12. TO-220FP package mechanical data

Dim		mm	
Dim.	Min.	Тур.	Max.
А	4.4		4.6
В	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
Н	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

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4.3 STP10NM60N, TO-220 package information

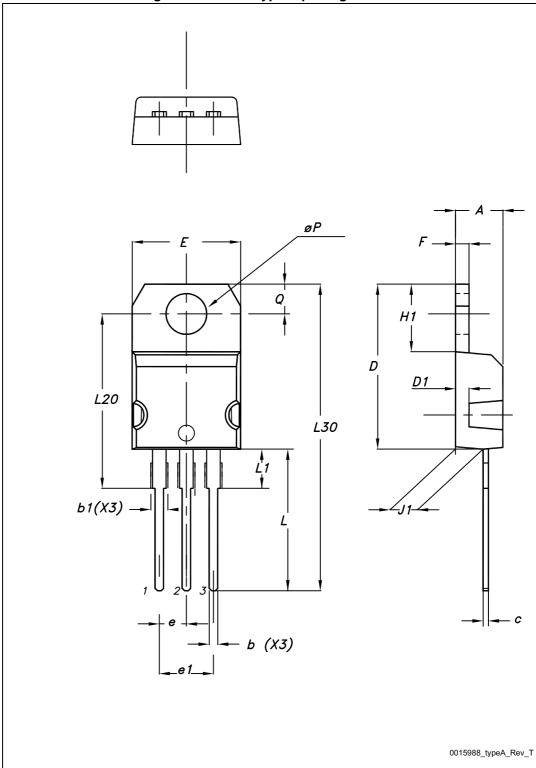


Figure 27. TO-220 type A package outline

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Table 13. TO-220 type A mechanical data

Dim.	mm			
	Min.	Тур.	Max.	
А	4.40		4.60	
b	0.61		0.88	
b1	1.14		1.70	
С	0.48		0.70	
D	15.25		15.75	
D1		1.27		
E	10		10.40	
е	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		
øΡ	3.75		3.85	
Q	2.65		2.95	

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4.4 STU10NM60N, IPAK (TO-251)

L2 D *b2* (3x) **b** (3x) A 1 -*B5* e 1 0068771_IK_typeA_rev13

Figure 28. IPAK (TO-251) type A outline

Table 14. IPAK (TO-251) type A mechanical data

Dim.	mm			
	Min.	Тур.	Max.	
А	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		
С	0.45		0.60	
c2	0.48		0.60	
D	6.00		6.20	
E	6.40		6.60	
е		2.28		
e1	4.40		4.60	
Н		16.10		
L	9.00		9.40	
L1	0.80		1.20	
L2		0.80	1.00	
V1		10°		



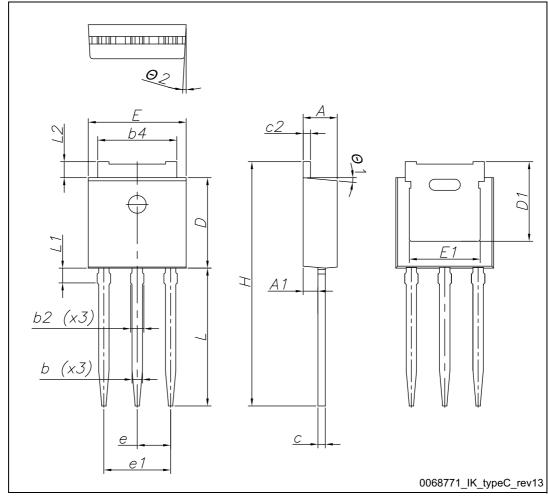


Figure 29. IPAK (TO-251) type C package outline

Table 15. IPAK (TO-251) type C package mechanical data

Dim	mm			
Dim.	Min.	Тур.	Max.	
А	2.20	2.30	2.35	
A1	0.90	1.00	1.10	
b	0.66		0.79	
b2			0.90	
b4	5.23	5.33	5.43	
С	0.46		0.59	
c2	0.46		0.59	
D	6.00	6.10	6.20	
D1	5.20	5.37	5.55	
E	6.50	6.60	6.70	
E1	4.60	4.78	4.95	
е	2.20	2.25	2.30	
e1	4.40	4.50	4.60	
Н	16.18	16.48	16.78	
L	9.00	9.30	9.60	
L1	0.90	1.00	1.20	
L2	0.90	1.08	1.25	
θ1	3°	5°	7°	
θ2	1°	3°	5°	

5 Packing information

Top cover tolerance on tape +/- 0.2 mm

Top cover tolerance on tape +/- 0.2 mm

For machine ref. only including draft and radii concentric around B0

User direction of feed

User direction of feed

AM08852v1

Figure 30. Tape for DPAK (TO-252)

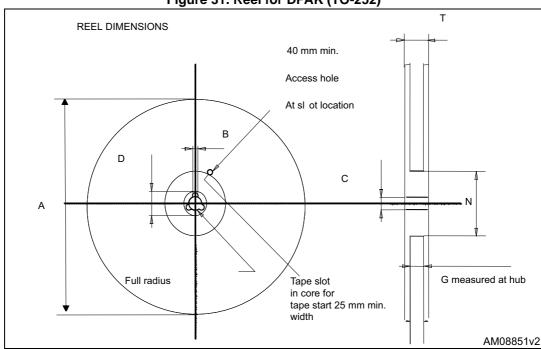


Figure 31. Reel for DPAK (TO-252)

Table 16. DPAK (TO-252) tape and reel mechanical data

Таре				Reel	
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	А		330
В0	10.4	10.6	В	1.5	
B1		12.1	С	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
Е	1.65	1.85	N	50	
F	7.4	7.6	Т		22.4
K0	2.55	2.75			
P0	3.9	4.1	ı	Base quantity	2500
P1	7.9	8.1		Bulk quantity	2500
P2	1.9	2.1			
R	40				
Т	0.25	0.35			
W	15.7	16.3			

6 Revision history

Table 17. Document revision history

Date	Revision	Changes
04-Dec-2015	1	First release. Part numbers previously included in the datasheet with DocID15764.



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