Contents

1	Electrical ratings
2	Electrical characteristics
	2.1 Electrical characteristics (curves)
3	Test circuits
4	Package information
	4.1 DPAK (TO-252) type A package information
	4.2 TO-220FP package information
	4.3 TO-220 package information
	4.4 IPAK (TO-251) type A package information
5	Packaging information
6	Revision history

1 Electrical ratings

Table 2. Absolute maximum ratings

		Val				
Symbol	Parameter	DPAK, TO-220, IPAK	TO-220, TO-220FP			
V_{GS}	Gate- source voltage	3	0	V		
I _D	Drain current (continuous) at T _C = 25 °C	2(1)	Α		
I _D	Drain current (continuous) at T _C = 100 °C	1.3		Α		
I _{DM} ⁽²⁾	Drain current (pulsed)	8		А		
P _{TOT}	Total dissipation at T _C = 25 °C	45 20		W		
I _{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T _{jmax})	0.5		А		
E _{AS}	Single pulse avalanche energy (starting $T_J = 25$ °C, $I_D = I_{AS}$, $V_{DD} = 50$ V)	60.5		mJ		
dv/dt (3)	Peak diode recovery voltage slope	4.5		4.5		V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	IOSFET dv/dt ruggedness 50		V/ns		
T _j	T _j Operating junction temperature -55 to 150		150	°C		
T _{stg}	Storage temperature	-55 (0	7 130	°C		

^{1.} For TO-220FP limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
Symbol		DPAK	TO-220FP	TO-220	IPAK	Oille
R _{thj-case}	Thermal resistance junction-case	2.78	6.25	2.78	2.78	
R _{thj-pcb}	Thermal resistance junction-pcb	50 ⁽¹⁾				°C/W
R _{thj-amb}	Thermal resistance junction-amb	62.5 100		100		

^{1.} When mounted on FR-4 board of 1 inch², 2 oz Cu.

^{2.} Pulse width limited by safe operating area.

^{3.} $I_{SD} \leq$ 2 A, di/dt \leq 100 A/ μ s, peak $V_{DS} \leq V_{(BR)DSS}$

^{4.} $V_{DS} \leq 640 V$

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage (V _{GS} = 0)	I _D = 1 mA	800			V
1	Zero gate voltage drain	V _{DS} = 800 V			1	μΑ
I _{DSS}	current (V _{GS} = 0)	V _{DS} = 800 V T _C =125 °C			50	μA
I _{GSS}	Gate body leakage current (V _{DS} = 0)	V _{GS} = ± 20 V			±10	μΑ
V _{GS(th)}	Gate threshold voltage	$V_{DS} = V_{GS}, I_{D} = 100 \mu A$	3	4	5	V
R _{DS(on)}	Static drain-source on- resistance	V _{GS} = 10 V, I _D = 1 A		3.5	4.5	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{iss}	Input capacitance		-	105	-	pF
C _{oss}	Output capacitance	V _{DS} =100 V, f=1 MHz, V _{GS} =0	-	8	-	pF
C _{rss}	Reverse transfer capacitance	, gg -	-	0.5	-	pF
C _{o(tr)} ⁽¹⁾	Equivalent capacitance time related	$V_{GS} = 0$, $V_{DS} = 0$ to 640 V	-	16	-	pF
C _{o(er)} ⁽²⁾	Equivalent capacitance energy related	V _{GS} = 0, V _{DS} = 0 to 040 V	-	7	-	pF
R_{G}	Intrinsic gate resistance	f = 1 MHz, I _D =0	-	18	-	Ω
Qg	Total gate charge		-	5	-	nC
Q _{gs}	Gate-source charge	$V_{DD} = 640 \text{ V}, I_{D} = 2 \text{ A}$ $V_{GS} = 10 \text{ V}$	-	1	-	nC
Q_{gd}	Gate-drain charge	165 15 1	-	3.7	-	nC

^{1.} 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}

Ay/

^{2.} Energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time		-	8	-	ns
t _r	Rise time	$V_{DD} = 400 \text{ V}, I_{D} = 1 \text{ A},$	-	12	-	ns
t _{d(off)}	Turn-off delay time	R _G =4.7 Ω, V _{GS} =10 V	-	19	-	ns
t _f	Fall time		-	32	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{SD}	Source-drain current		-		2	Α
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)		-		8	Α
V _{SD} ⁽²⁾	Forward on voltage	I _{SD} = 2 A, V _{GS} =0	-		1.5	V
t _{rr}	Reverse recovery time		-	255		ns
Q _{rr}	Reverse recovery charge	I _{SD} = 2 A, V _{DD} = 60 V di/dt = 100 A/µs,	-	1		μC
I _{RRM}	Reverse recovery current	- av at 100 / 1 po,	-	8		Α
t _{rr}	Reverse recovery time	I _{SD} = 2 A,V _{DD} = 60 V	-	285		ns
Q _{rr}	Reverse recovery charge	di/dt=100 A/μs,	-	1.45		μC
I _{RRM}	Reverse recovery current	Tj=150 °C	-	7.5		Α

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

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)GSO}	Gate-source breakdown voltage	I_{GS} = ± 1mA, I_D = 0	30	-	1	V

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK and IPAK

Figure 3. Thermal impedance for DPAK and IPAK

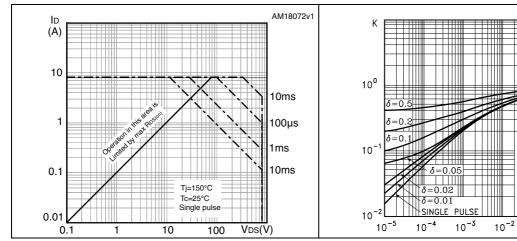


Figure 4. Safe operating area for TO-220FP

Figure 5. Thermal impedance for TO-220FP

10⁻¹

 $t_p(s)$

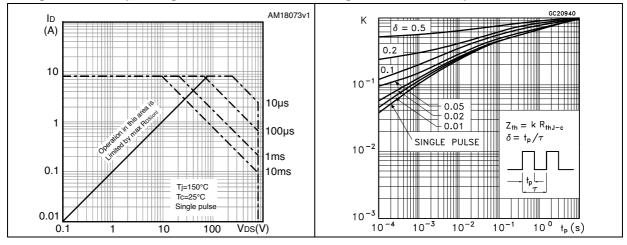


Figure 6. Safe operating area for TO-220

Figure 7. Thermal impedance for TO-220

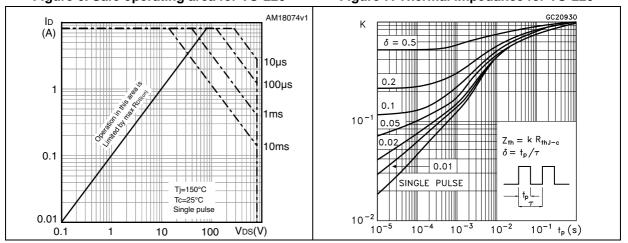


Figure 8. Output characteristics

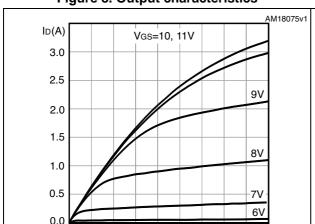


Figure 9. Transfer characteristics

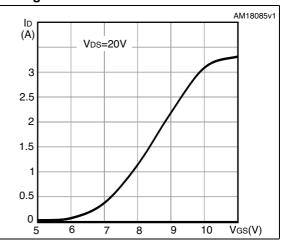


Figure 10. Gate charge vs gate-source voltage

8 10

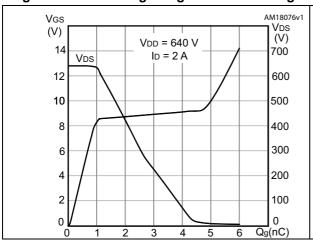
6

12 14

4

0

Figure 11. Static drain-source on-resistance



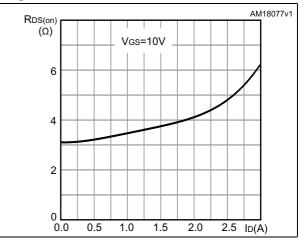
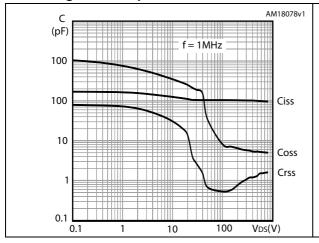
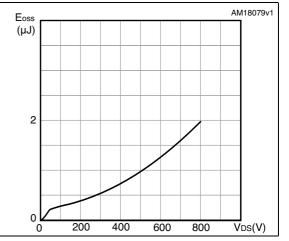


Figure 12. Capacitance variations

Figure 13. Output capacitance stored energy





47/

Figure 14. Normalized gate threshold voltage vs temperature

VGS(th) (norm) AM18082v1 1.2 ID=100 μA 1.1 0.9 0.8 0.7 0.6 0.5 -50 -100 50 100 TJ(°C) 150

Figure 15. Normalized on-resistance vs temperature

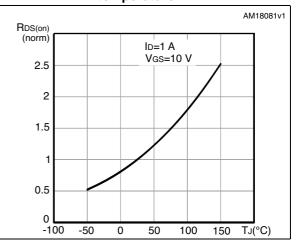
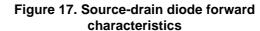
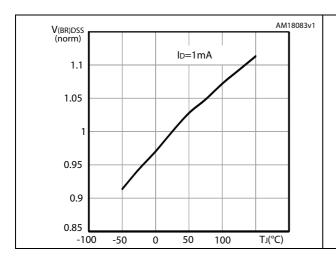


Figure 16. Normalized $V_{(BR)DSS}$ vs temperature





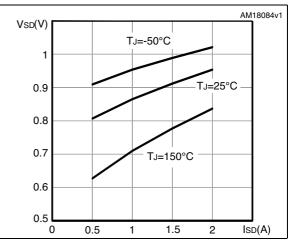
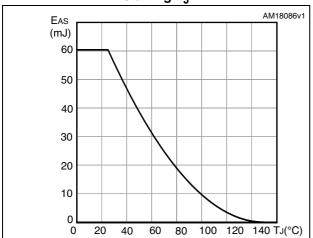


Figure 18. Maximum avalanche energy vs starting T_{.I}



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3 Test circuits

Figure 19. Switching times test circuit for resistive load

Figure 20. Gate charge test circuit

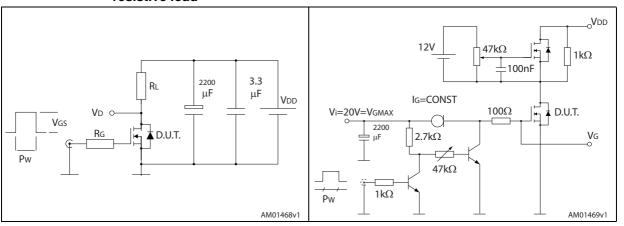


Figure 21. Test circuit for inductive load switching and diode recovery times

Figure 22. Unclamped inductive load test circuit

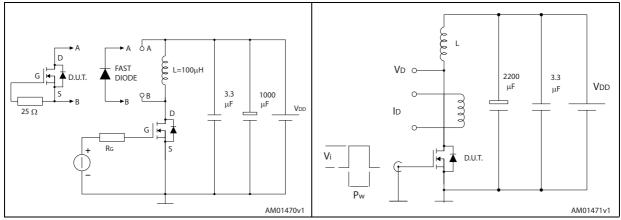
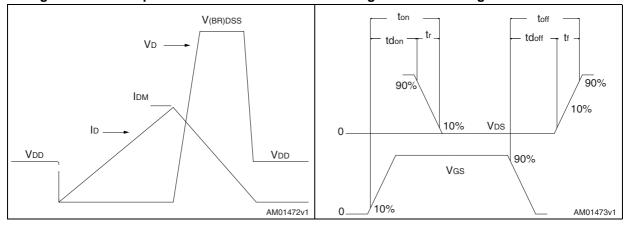


Figure 23. Unclamped inductive waveform

Figure 24. Switching time waveform





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 DPAK (TO-252) type A package information

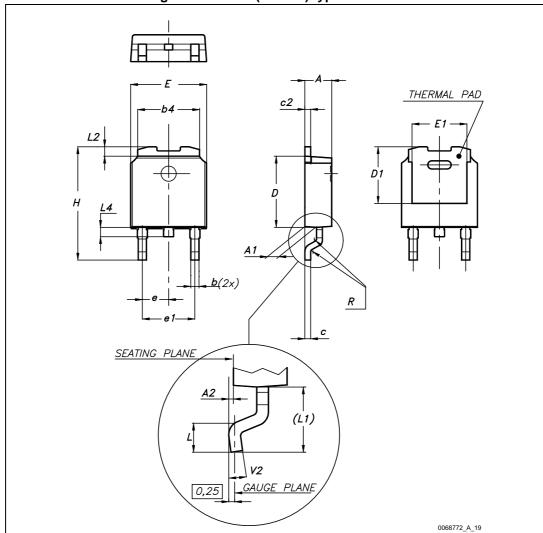


Figure 25. DPAK (TO-252) type A outline

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

Dim		mm	
Dim.	Min.	Тур.	Max.
Α	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
Е	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°

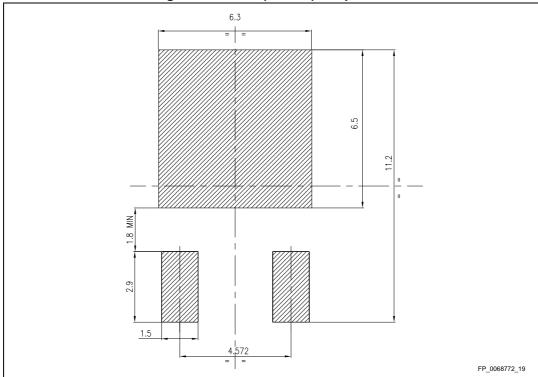


Figure 26. DPAK (TO-252) footprint (a)

a. All dimensions are in millimeters

4.2 TO-220FP package information

Dia L6 L2 *L7* L3 Ľ5 F1 F2 Ε 7012510_Rev_K_B

Figure 27. TO-220FP package outline

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Table 10. TO-220FP package mechanical data

Dim.	mm				
	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		

4.3 **TO-220 package information**

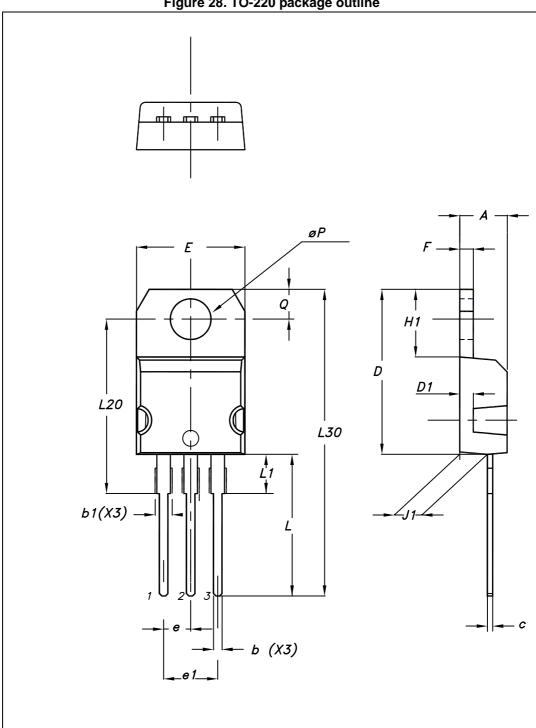


Figure 28. TO-220 package outline

47/

0015988_typeA_Rev_T

Table 11. TO-220 package mechanical data

Dim.		mm	
	Min.	Тур.	Max.
Α	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	
Е	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	
ØP	3.75		3.85
Q	2.65		2.95

4.4 IPAK (TO-251) type A package information

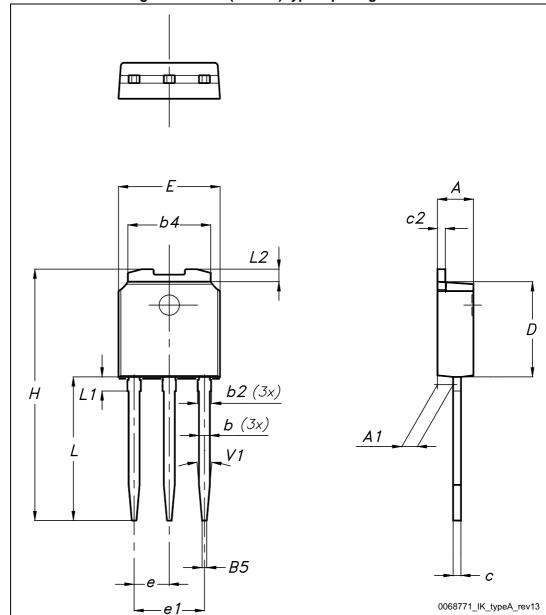


Figure 29. IPAK (TO-251) type A package outline

Table 12. IPAK (TO-251) type A package mechanical data

DIM		mm.	
Dilvi	min.	typ.	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°	

5 Packaging 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

AM08852v1

AM08852v1

Figure 30. Tape for DPAK

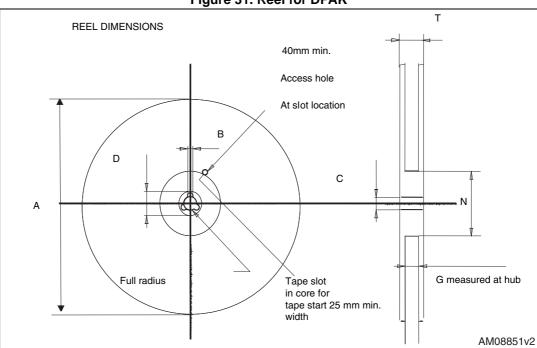


Figure 31. Reel for DPAK

Table 13. DPAK tape and reel mechanical data

Tape				Reel		
Dim.	mm		Dim.	mm		
	Min.	Max.	— Dim.	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		Base qty.	2500	
P1	7.9	8.1		Bulk qty.	2500	
P2	1.9	2.1			•	
R	40					
Т	0.25	0.35				
W	15.7	16.3				

6 Revision history

Table 14. Document revision history

Date	Revision	Changes
11-Jul-2013	1	First release.
18-Feb-2014	2	 Added: IPAK package Modified: E_{AS} value in <i>Table 2</i> Modified: R_{thj-case} in <i>Table 3</i> Modified: typical values in <i>Table 5</i>, 6 and 7 Added: Section 2.1: Electrical characteristics (curves) Updated: Figure 25, 26 and <i>Table 9</i> Added: <i>Table 12</i> and <i>Figure 29</i> Minor text changes
25-Sep-2015 3		 Updated title, features and description in cover page. Updated Figure 10, Figure 11 and Section 4: Package information. Minor text changes.

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