

1 Electrical ratings

Table 1. Absolute maximum ratings

Countral.	Davisator	Value		l l mit
Symbol	Parameter -	DPAK,TO-220	TO-220FP	Unit
V_{DS}	Drain-source voltage	60	00	V
V _{GS}	Gate-source voltage	±3	30	V
I _D	Drain current (continuous) at T _C = 25 °C	5	5 (1)	Α
I _D	Drain current (continuous) at T _C = 100 °C	3.16	3.16 ⁽¹⁾	Α
I _{DM} (2)	Drain current (pulsed) 20		20 (1)	Α
P _{TOT}	Total dissipation at T _C = 25 °C	90	25	W
ESD	Gate-source human body model (R = 1.5 k Ω , C = 100 pF)	3		kV
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat-sink (t = 1 s, T _C = 25 °C)	2.5		kV
dv/dt (3)	Peak diode recovery voltage slope	4.5		V/ns
Tj	Operating junction temperature range	FF to 4F0		°C
T _{stg}	Storage temperature range	-55 to 150		10

- 1. Limited by maximum junction temperature.
- 2. Pulse width limited by safe operating area.
- 3. $I_{SD} \le 5$ A, $di/dt \le 200$ A/ μ s, $V_{DSpeak} \le V_{(BR)DSS}$, $V_{DD} = 80\%$ $V_{(BR)DSS}$.

Table 2. Thermal data

Symbol Parameter			Unit		
Symbol	r al allietei	DPAK	TO-220	TO-220FP	Oilit
R _{thj-case}	Thermal resistance junction-case	1.39		5	°C/W
R _{thj-amb}	Thermal resistance junction-ambient		62.5		°C/W
R _{thj-pcb} (1)	Thermal resistance junction-pcb	50			°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j Max)	5	А
E _{AS}	Single pulse avalanche energy (starting $T_j = 25$ °C, $I_D = I_{AR}$, $V_{DD} = 50$ V)	220	mJ

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2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	I _D = 1 mA, V _{GS} = 0 V	600			V
lasa	Zero gate voltage drain	V _{GS} = 0 V, V _{DS} = 600 V			1	μA
I _{DSS}	current	V_{GS} = 0 V, V_{DS} = 600 V, T_{C} = 125 °C ⁽¹⁾			50	μA
I _{GSS}	Gate body leakage current	V _{DS} = 0 V, V _{GS} = ±20 V			±10	μA
V _{GS(th)}	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50 \mu A$	3	3.75	4.5	V
R _{DS(on)}	Static drain-source on resistance	V _{GS} = 10 V, I _D = 2.5 A		1.2	1.6	Ω

^{1.} Defined by design, not subject to production test.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{iss}	Input capacitance			690		
C _{oss}	Output capacitance	V _{DS} = 25 V, f = 1 MHz, V _{GS} = 0 V	_	90		pF
C _{rss}	Reverse transfer capacitance			20		
Coss eq. (1)	Equivalent output capacitance	V _{DS} = 0 to 480 V, V _{GS} = 0 V	-	40		pF
Qg	Total gate charge	V _{DD} = 400 V, I _D = 5 A, V _{GS} = 0 to 10 V		26	34	
Q _{gs}	Gate-source charge	(see Figure 16. Test circuit for gate charge	_	6		nC
Q _{gd}	Gate-drain charge	behavior)		14		

^{1.} $C_{\text{oss eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS} .

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 300 V, I _D = 2.5 A,		16		
t _r	Rise time	$R_G = 4.7 \Omega$, $V_{GS} = 10 V$		25		
t _{d(off)}	Turn-off delay time	switching times and Figure 20. Switching		36		
t _r	Fall time		25		ns	
t _{r(Voff)}	Off-voltage rise time	V _{DD} = 480 V, I _D = 5 A,	-	12	_	115
t _f	Fall time	$R_G = 4.7 \Omega, V_{GS} = 10 V$		10		
t _c	Cross-over time	(see Figure 17. Test circuit for inductive load switching and diode recovery times and Figure 20. Switching time waveform)		24		

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Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{SD}	Source-drain current				5	
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)		-		20	Α
V _{SD} (2)	Forward on voltage	I _{SD} = 5 A, V _{GS} = 0 V	-		1.6	V
t _{rr}	Reverse recovery time	I _{SD} = 5 A, di/dt = 100 A/μs		485		ns
Q _{rr}	Reverse recovery charge	V _{DD} = 30 V (see Figure 17. Test circuit for	-	2.7		μC
I _{RRM}	Reverse recovery current	inductive load switching and diode recovery times)		11		Α

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

Table 8. Gate-Source Zener Diode

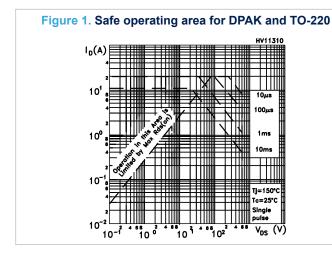
Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)GSO}	Gate-source breakdown voltage	$I_{GS} = \pm 1 \text{ mA}, I_{D} = 0 \text{ A}$	30	-	-	V

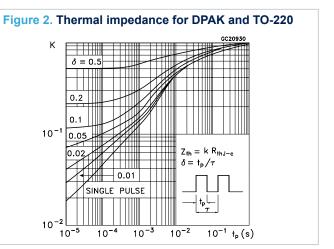
The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

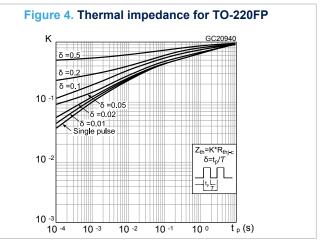
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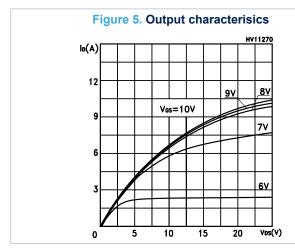


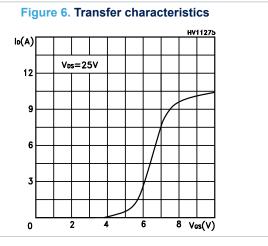
2.1 Electrical characteristics curves











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Figure 7. Static drain-source on resistance

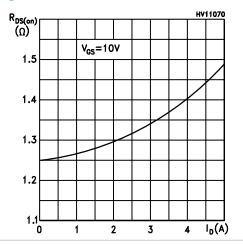


Figure 8. Gate charge vs gate-source voltage

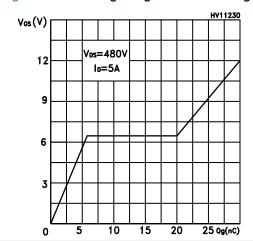


Figure 9. Capacitance variations

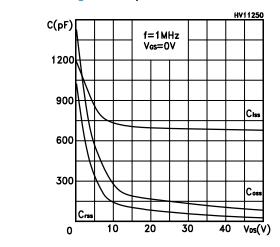


Figure 10. Normalized gate threshold voltage vs temperature

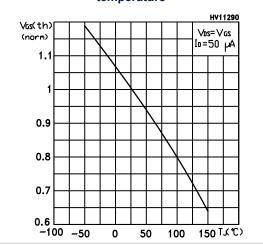


Figure 11. Normalized on resistance vs temperature

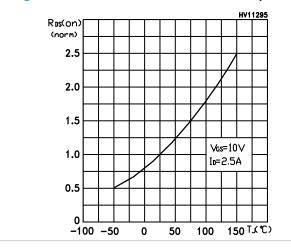
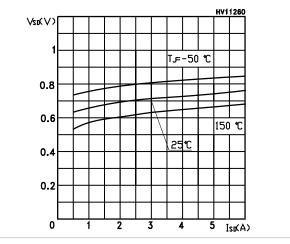


Figure 12. Source-drain diode forward characteristic



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Figure 13. Normalized $V_{(BR)DSS}$ vs temperature

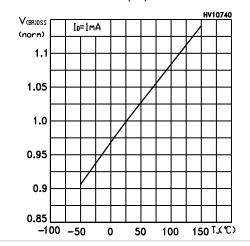
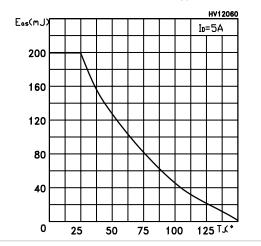


Figure 14. Maximum avalanche energy vs temperature



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3 Test circuits

Figure 15. Test circuit for resistive load switching times

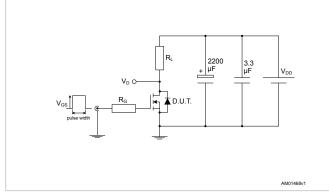


Figure 17. Test circuit for inductive load switching and diode recovery times

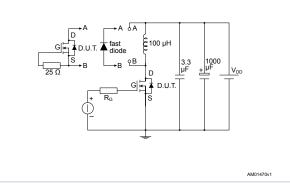


Figure 18. Unclamped inductive load test circuit

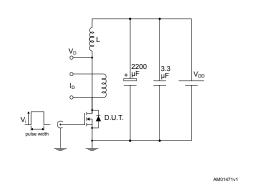


Figure 19. Unclamped inductive waveform

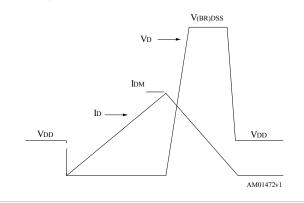
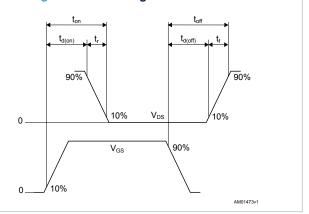


Figure 20. Switching time waveform



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4 Package information

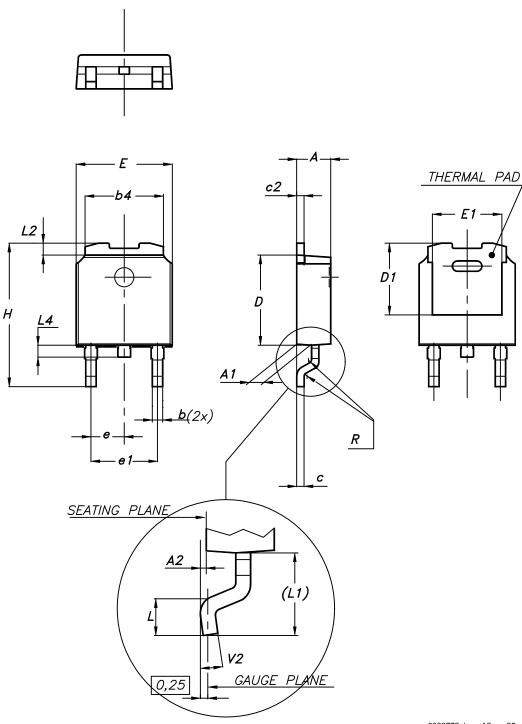
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

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DPAK (TO-252) type A2 package information 4.1

Figure 21. DPAK (TO-252) type A2 package outline



0068772_type-A2_rev25

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Table 9. DPAK (TO-252) type A2 mechanical data

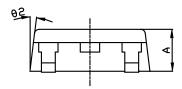
Di		mm	
Dim.	Min.	Тур.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
С	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1	4.95	5.10	5.25
E	6.40		6.60
E1	5.10	5.20	5.30
е	2.159	2.286	2.413
e1	4.445	4.572	4.699
Н	9.35		10.10
L	1.00		1.50
L1	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

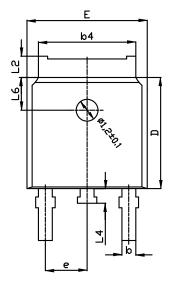
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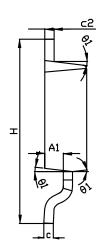


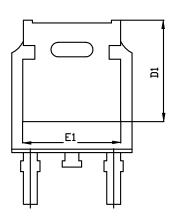
4.2 DPAK (TO-252) type C2 package information

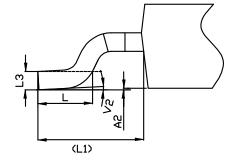
Figure 22. DPAK (TO-252) type C2 package outline











0068772_C2_25



Table 10. DPAK (TO-252) type C2 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
Е	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°

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Figure 23. DPAK (TO-252) recommended footprint (dimensions are in mm)

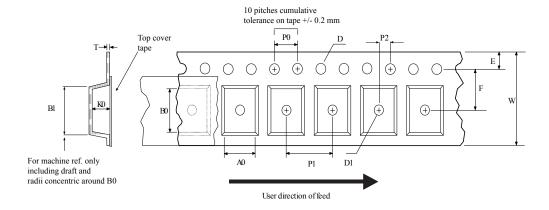
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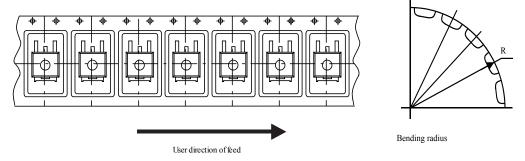
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4.3 DPAK (TO-252) packing information

Figure 24. DPAK (TO-252) tape outline



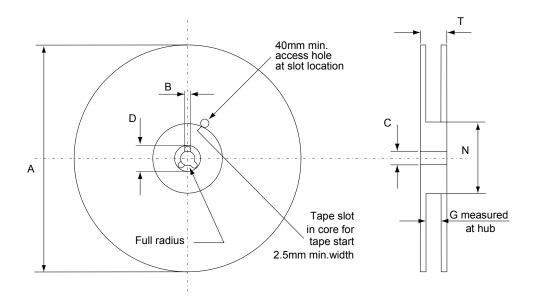


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Figure 25. DPAK (TO-252) reel outline



AM06038v1

Table 11. DPAK (TO-252) tape and reel mechanical data

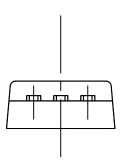
Таре				Reel		
Dim.	n	nm	Dim.	1	mm	
Dilli.	Min.	Max.	Dilli.	Min.	Max.	
A0	6.8	7	Α		330	
В0	10.4	10.6	В	1.5		
B1		12.1	С	12.8	13.2	
D	1.5	1.6	D	20.2		
D1	1.5		G	16.4	18.4	
Е	1.65	1.85	N	50		
F	7.4	7.6	Т		22.4	
K0	2.55	2.75				
P0	3.9	4.1	Base	qty.	2500	
P1	7.9	8.1	Bulk	qty.	2500	
P2	1.9	2.1				
R	40					
Т	0.25	0.35				
W	15.7	16.3				

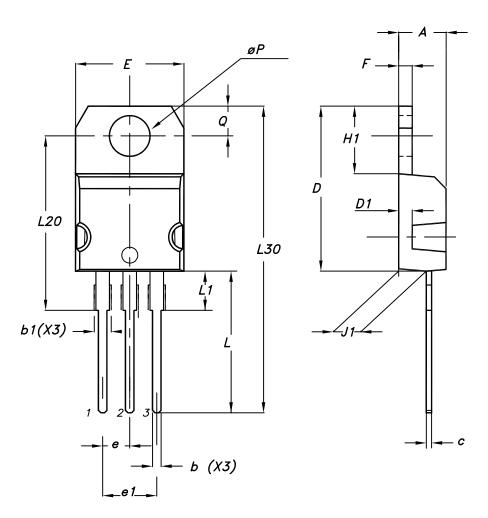
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4.4 TO-220 type A package information

Figure 26. TO-220 type A package outline





0015988_typeA_Rev_21



Table 12. TO-220 type A package mechanical data

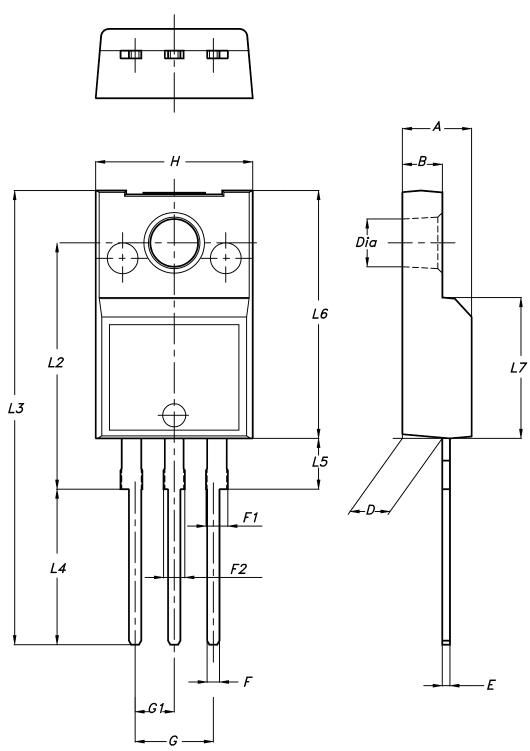
Dim.		mm	
DIM.	Min.	Тур.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
С	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
е	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øΡ	3.75		3.85
Q	2.65		2.95

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4.5 TO-220FP package information

Figure 27. TO-220FP package outline



7012510_Rev_12_B



Table 13. TO-220FP package mechanical data

Dim.	mm		
	Min.	Тур.	Max.
Α	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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5 Ordering information

Table 14. Order codes

Order code	Marking	Package	Packing
STD5NK60ZT4	D5NK60Z	DPAK	Tape and reel
STP5NK60Z	P5NK60Z	TO-220	Tube
STP5NK60ZFP	P5NK60ZFP	TO-220FP	Tube

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Revision history

Table 15. Document revision history

Date	Version	Changes
05-Apr-2005	1	First issue
29-Apr-2005	2	Modified value in Table 7.
06-Sep-2005	3	Inserted Ecopack indication
14-Oct-2005	4	Modified value on Table 1
28-Oct-2005	5	Tape & Reel info added
14-Nov-2005	6	Modified value on Table 6
15-Dec-2005	7	Various corrections
		Removed maturity status indication from cover page. The document status is production data.
22-Aug-2018	8	Updated Section 4 Package information.
		Minor text changes.

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	4.5	TO-220FP package information	18			
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