

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220	TO-220FP	
V _{GS}	Gate-source voltage	±30		V
I _D	Drain current (continuous) at T _C = 25 °C	12	12 ⁽¹⁾	A
	Drain current (continuous) at T _C = 100 °C	7.5	7.5 ⁽¹⁾	
I _{DM} ⁽²⁾	Drain current pulsed	48	48 ⁽¹⁾	A
P _{TOT}	Total power dissipation at T _C = 25 °C	160	35	W
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	15		V/ns
T _J	Operating junction temperature range	-65 to 150		°C
T _{stg}	Storage temperature range			°C

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤ 12 A, di/dt ≤ 400 A/μs, V_{DD} = 80% V_{(BR)DSS}.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		D ² PAK	TO-220	TO-220FP	
R _{thj-case}	Thermal resistance junction-case	2.78		3.57	°C/W
R _{thj-a}	Thermal resistance junction-ambient	62.5			°C/W
R _{thj-pcb} ⁽¹⁾	Thermal resistance junction-pcb	35			°C/W

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AS}	Avalanche current, repetitive or not repetitive (pulse width limited by T _J max)	6	A
E _{AS}	Single-pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AS} , V _{DD} = 50 V)	400	mJ

2 Electrical characteristics

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

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	500			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 500\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			10	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 30\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		300	350	m Ω

1. Defined by design, not subject to production test.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1000	-	pF
C_{oss}	Output capacitance		-	250	-	pF
C_{rss}	Reverse transfer capacitance		-	20	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }400\text{ V}$, $V_{GS} = 0\text{ V}$	-	90	-	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 250\text{ V}$, $I_D = 6\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	20	-	ns
t_r	Rise Time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	10	-	ns
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	28	-	nC
Q_{gs}	Gate-source charge		-	8	-	nC
Q_{gd}	Gate-drain charge		-	16	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, gate DC Bias = 0, test signal level = 20 mV, open drain	-	1.6	-	Ω

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 6. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		12	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		48	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 12\text{ A}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$	-	270		ns
Q_{rr}	Reverse recovery charge		-	2.23		μC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	16.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	340		ns
Q_{rr}	Reverse recovery charge		-	3		μC
I_{RRM}	Reverse recovery current		-	18		A

1. Pulse width is limited by safe operating area.

2. Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

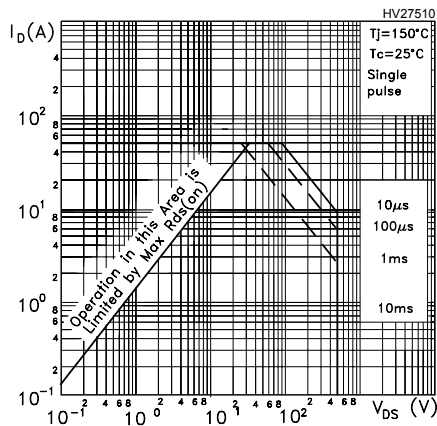
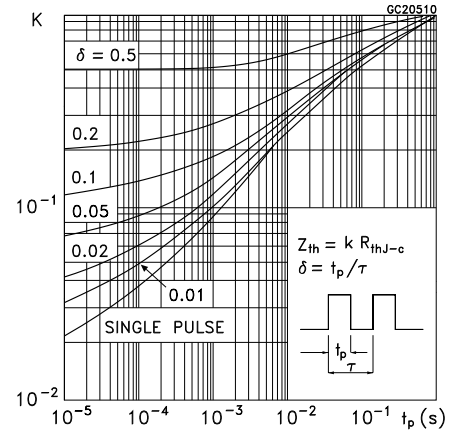
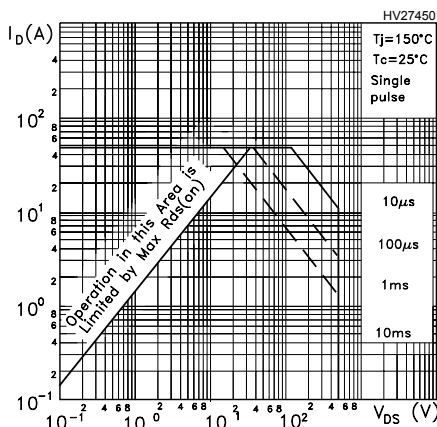
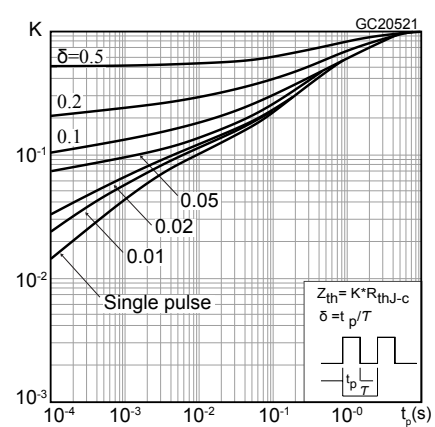
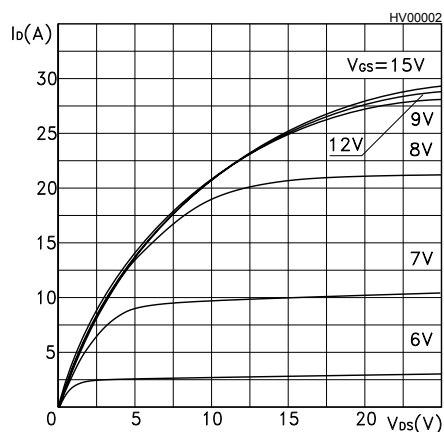
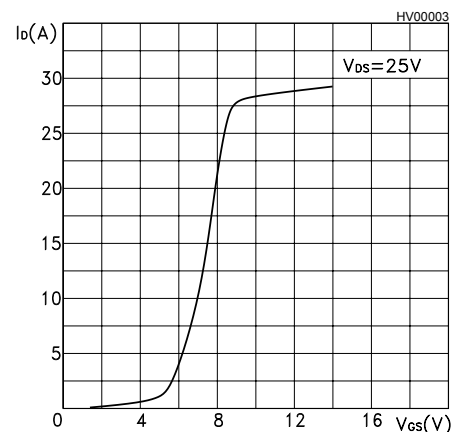
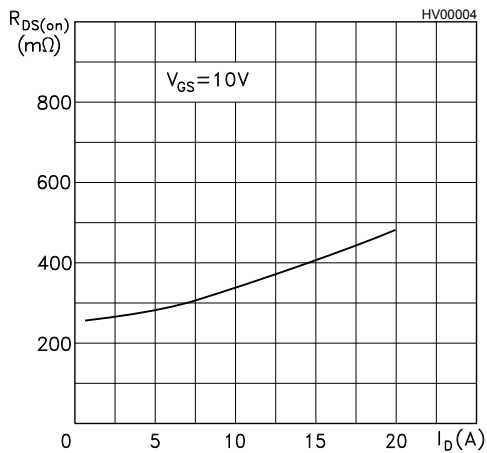
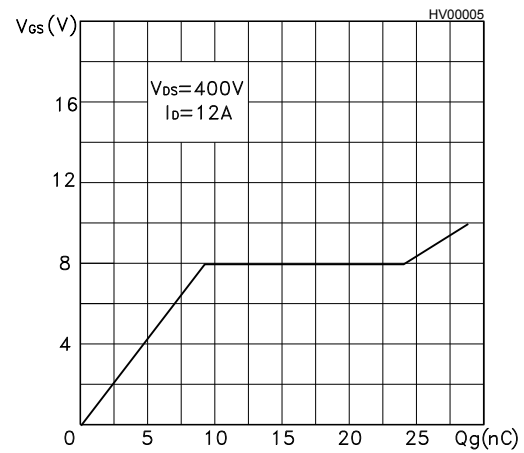
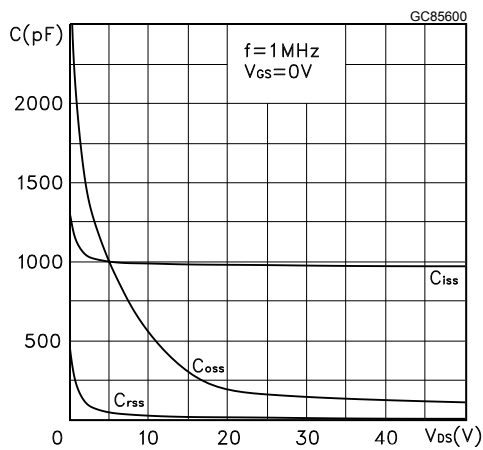
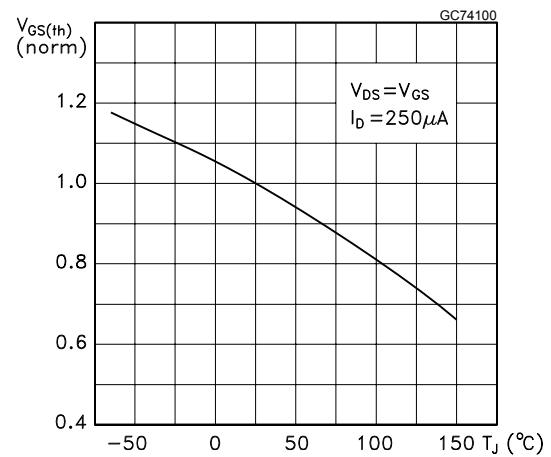
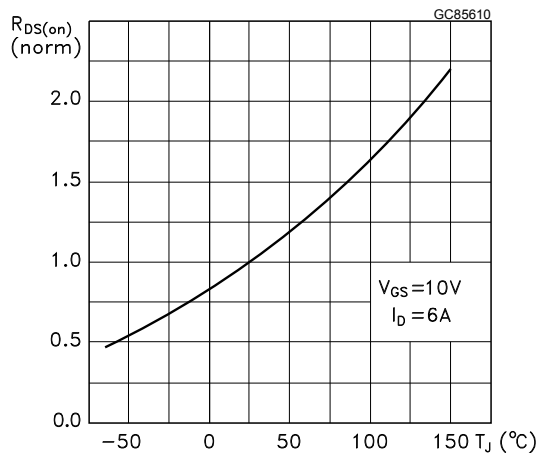
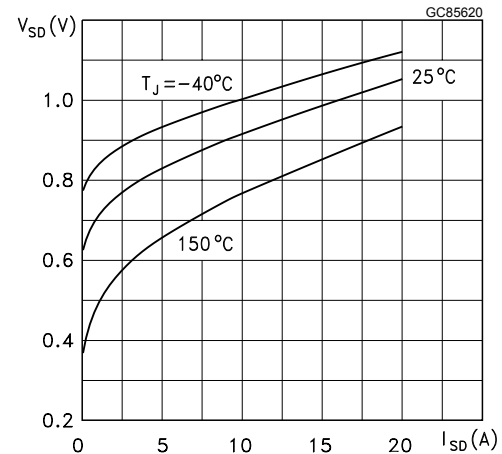
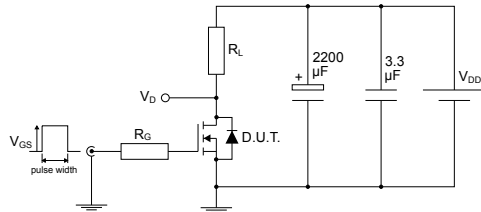
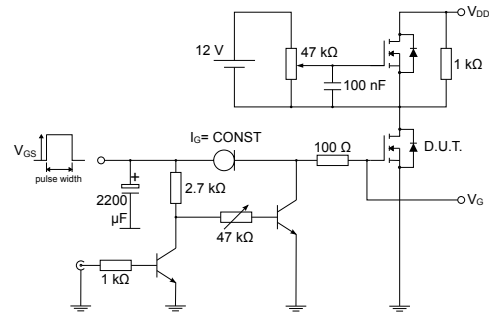
Figure 1. Safe operating area for D²PAK and TO-220

Figure 2. Thermal impedance for D²PAK and TO-220

Figure 3. Safe operating area for TO-220FP

Figure 4. Thermal impedance for TO-220FP

Figure 5. Output characteristics

Figure 6. Transfer characteristics


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 characteristics


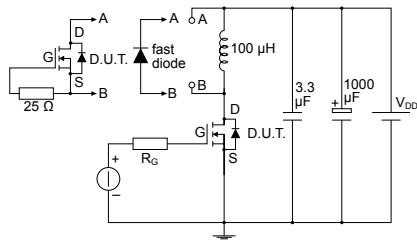
3 Test circuits

Figure 13. Test circuit for resistive load switching times


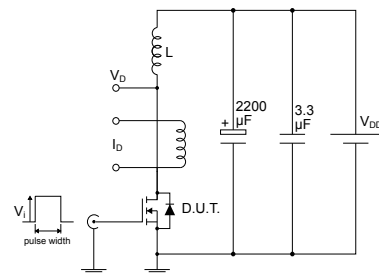
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Figure 14. Test circuit for gate charge behavior


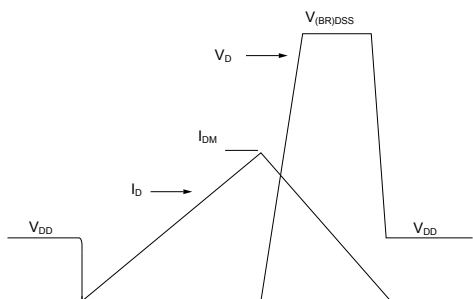
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Figure 15. Test circuit for inductive load switching and diode recovery times


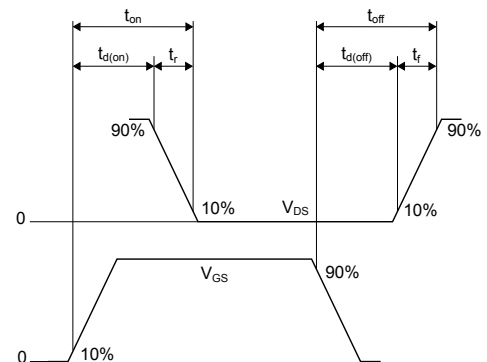
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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


AM01472v1

Figure 18. Switching time waveform


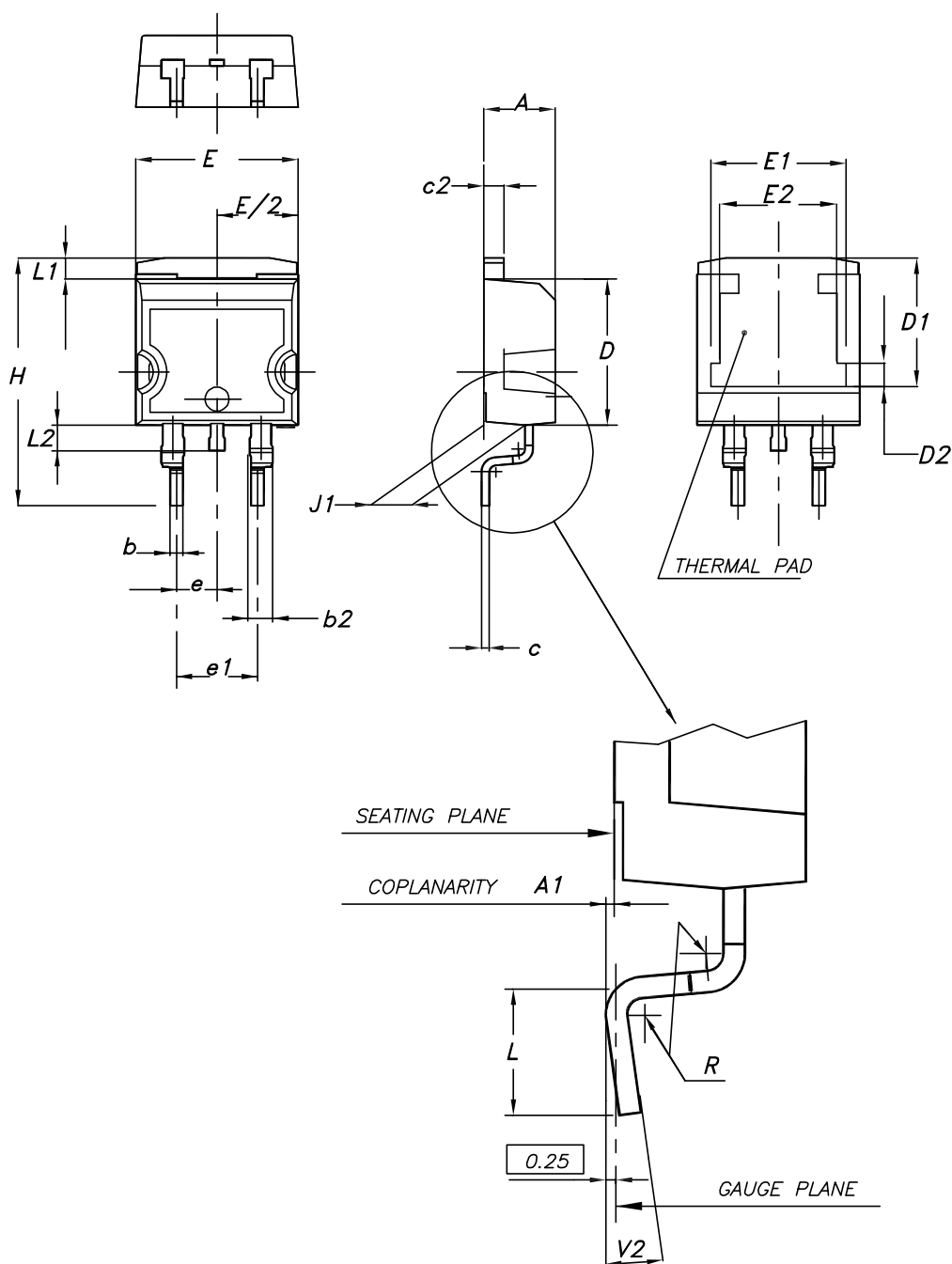
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4 Package information

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 D²PAK (TO-263) type A package information

Figure 19. D²PAK (TO-263) type A package outline

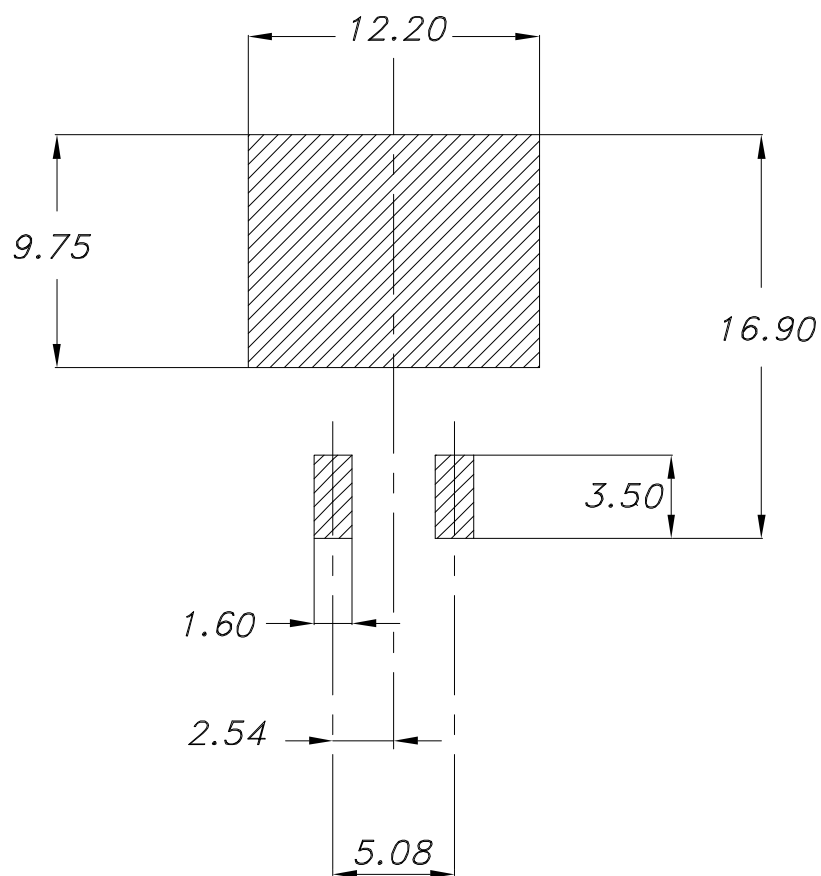


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Table 7. D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

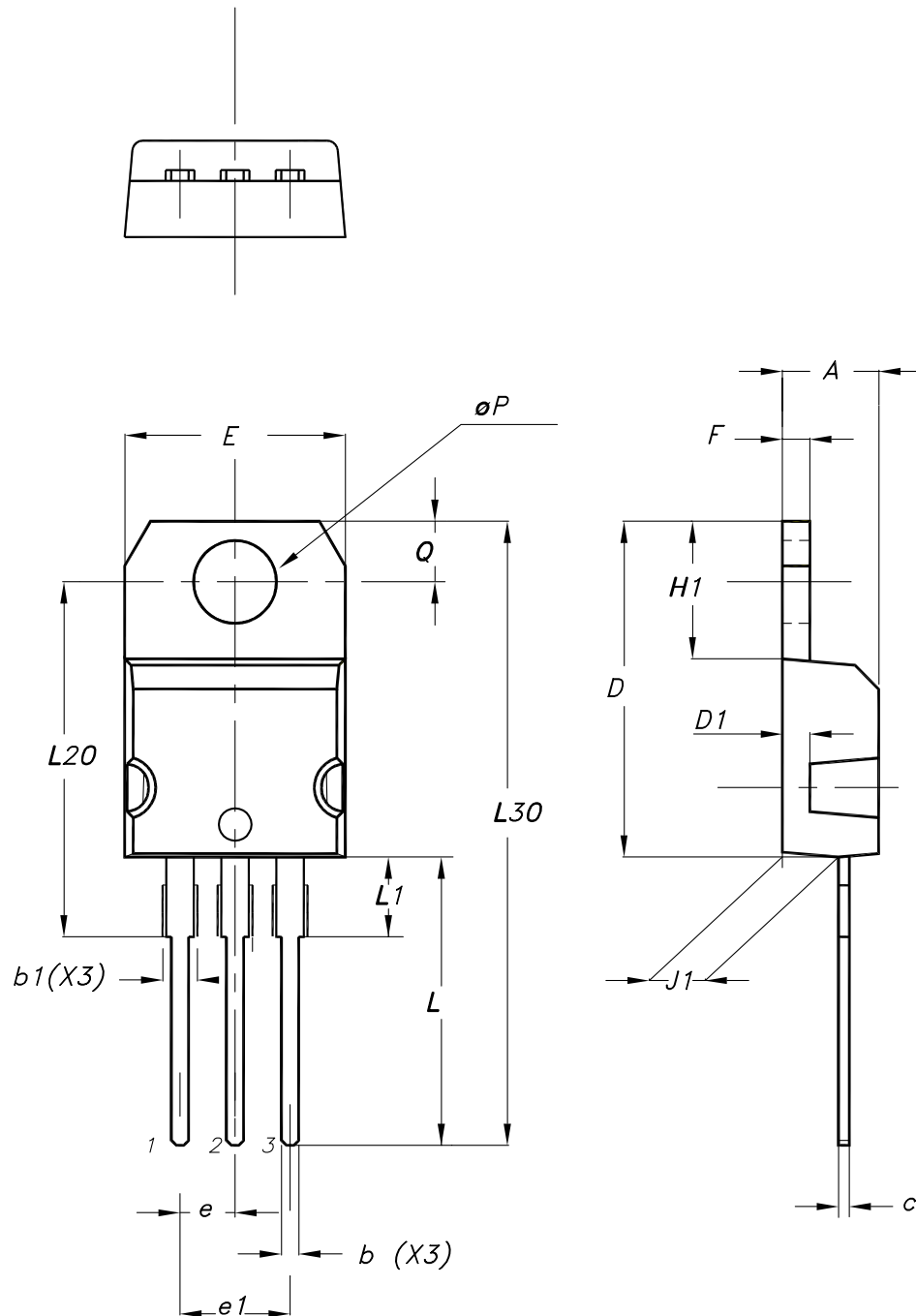
Figure 20. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint_26

4.2 TO-220 type A package information

Figure 21. TO-220 type A package outline



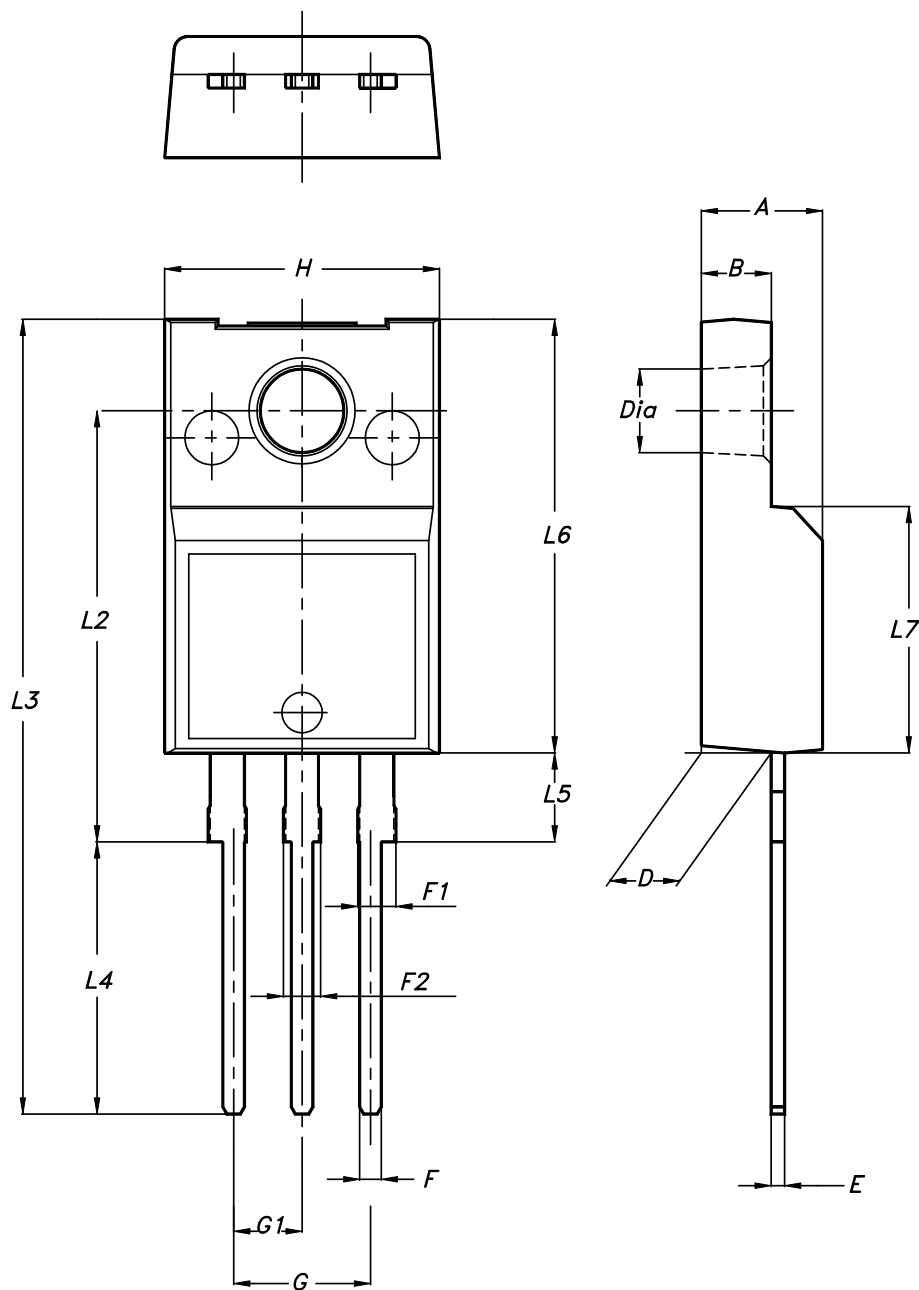
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Table 8. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

4.3 TO-220FP package information

Figure 22. TO-220FP package outline



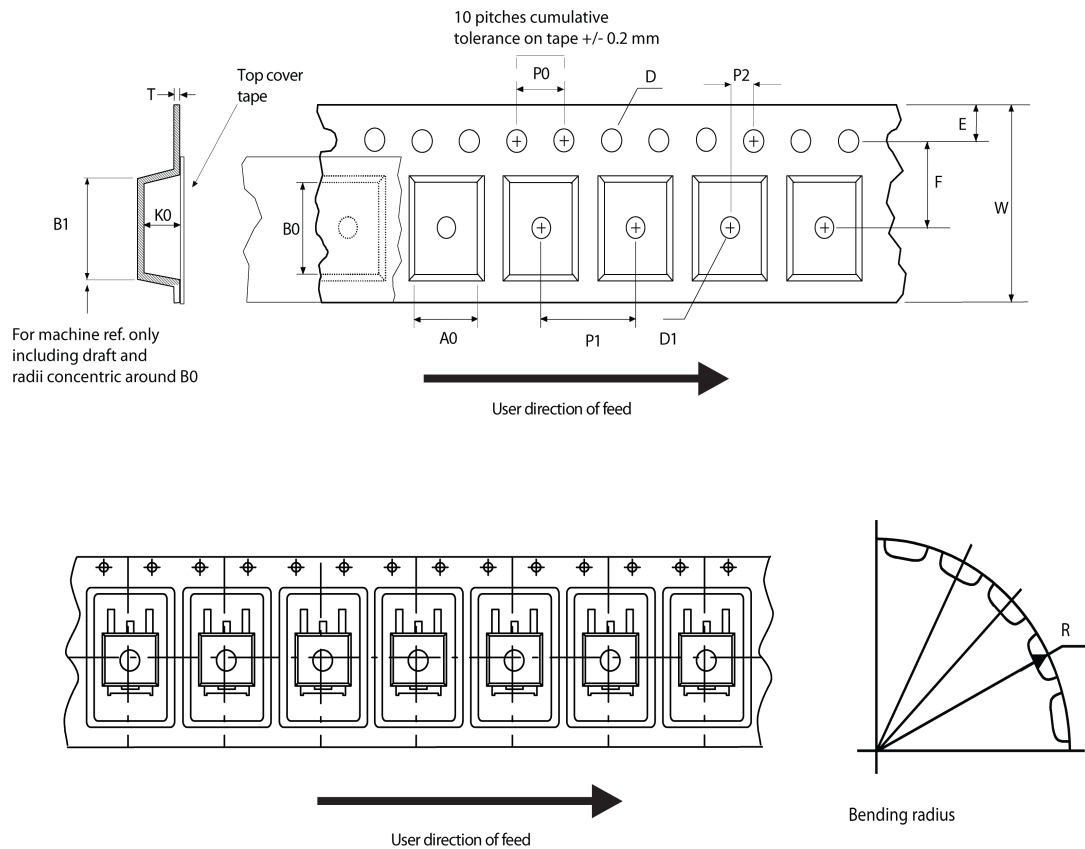
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Table 9. TO-220FP package mechanical data

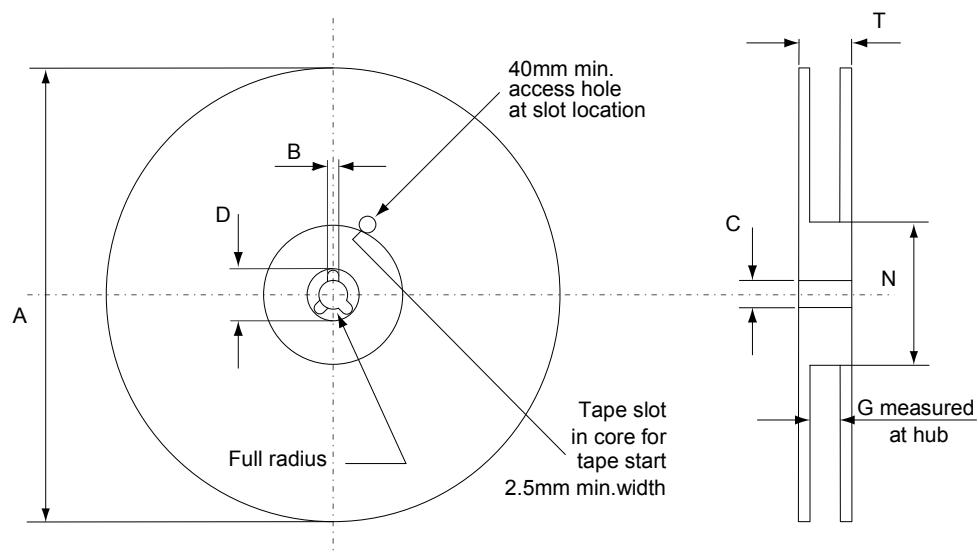
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.4 D²PAK packing information

Figure 23. D²PAK tape outline



AM08852v1

Figure 24. D²PAK reel outline


AM06038v1

Table 10. D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1	Base quantity		
P1	11.9	12.1			
P2	1.9	2.1	Bulk quantity		
R	50				
T	0.25	0.35			
W	23.7	24.3			

5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STB12NM50T4	B12NM50	D ² PAK	Tape and reel
STP12NM50	P12NM50	TO-220	Tube
STP12NM50FP	P12NM50FP	TO-220FP	Tube

Revision history

Table 12. Document revision history

Date	Revision	Changes
14-Mar-2004	8	Preliminary version
15-Feb-2006	9	New voltage value on first page at t_{jmax} .
05-Apr-2006	10	Inserted ecopack indication
27-Jul-2006	11	New template, no content change
22-Oct-2020	12	The part number STB12NM50-1 have been moved to a separate datasheet and the document has been updated accordingly. Updated cover page. Updated Section 1 Electrical ratings and Section 2 Electrical characteristics. Added Section 5 Ordering information. Minor text changes.

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