



STB5N62K3, STD5N62K3, STF5N62K3 STP5N62K3, STU5N62K3

N-channel 620 V, 1.28 Ω , 4.2 A SuperMESH3™ Power MOSFET
D²PAK, DPAK, TO-220FP, TO-220 and IPAK

Features

Order codes	V _{DSS}	R _{DS(on) max.}	I _D	P _w
STB5N62K3 STD5N62K3	620 V	< 1.6 Ω	4.2 A	70 W
STF5N62K3				25 W
STP5N62K3 STU5N62K3				70 W

- 100% avalanche tested
- Extremely large avalanche performance
- Gate charge minimized
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

Application

Switching applications

Description

These devices are made using the SuperMESH3™ Power MOSFET technology that is obtained via improvements applied to STMicroelectronics' SuperMESH™ technology combined with a new optimized vertical structure. The resulting product has an extremely low on resistance, superior dynamic performance and high avalanche capability, making it especially suitable for the most demanding applications.

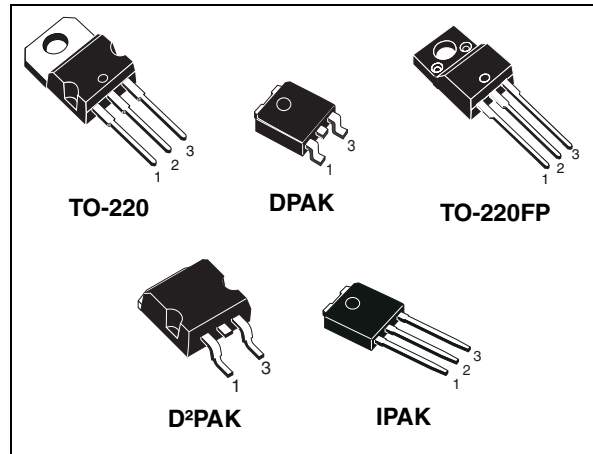


Figure 1. Internal schematic diagram

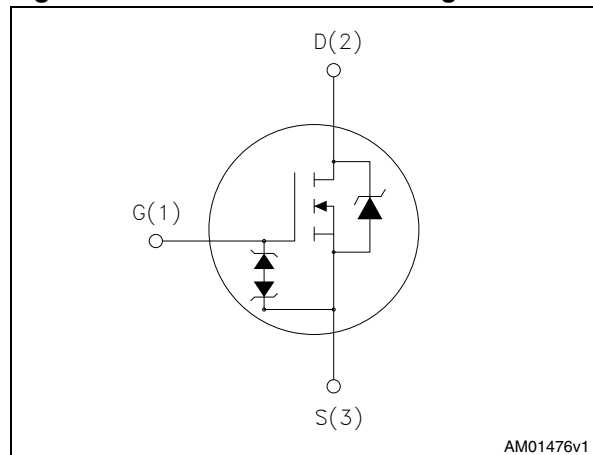


Table 1. Device summary

Order codes	Marking	Packages	Packaging
STB5N62K3 STD5N62K3 STF5N62K3 STP5N62K3 STU5N62K3	5N62K3	D ² PAK DPAK TO-220FP TO-220 IPAK	Tape and reel Tape and reel Tube Tube Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220, DPAK D ² PAK, IPAK	TO-220FP	
V _{DS}	Drain- source voltage	620		V
V _{GS}	Gate- source voltage	± 30		V
I _D	Drain current (continuous) at T _C = 25 °C	4.2	4.2 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	3	3 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	16.8	16.8 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	70	25	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	4.2		A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	120		mJ
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12		V/ns
di/dt ⁽³⁾	Diode reverse recovery current slope	400		A/μs
V _{ISO}	Insulation withstand voltage (AC)		2500	
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} ≤ I_D, peak V_{DS} ≤ V_{(BR)DSS}, V_{DD} = 80% V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameter	Value					Unit
		TO-220	D ² PAK	IPAK	TO-220FP	DPAK	
R _{thj-case}	Thermal resistance junction-case max	1.79			5	1.79	°C/W
R _{thj-amb}	Thermal resistance junction-amb max	62.50		62.50			°C/W
R _{thj-pcb}	Thermal resistance junction-pcb max		30			50	°C/W
T _J	Maximum lead temperature for soldering purpose	300		300			°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	620			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = Max rating V _{DS} = Max rating, 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	3.75	4.5	V
R _{DS(on)}	Static drain-source on resistance	V _{GS} = 10 V, I _D = 2.1 A		1.28	1.6	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{DS} = 50 V, f = 1 MHz, V _{GS} = 0	-	680	-	pF
C _{oss}	Output capacitance			50		pF
C _{rss}	Reverse transfer capacitance			8		pF
C _{OSS eq} ⁽¹⁾	Equivalent output capacitance	V _{GS} = 0, V _{DS} = 0 to 496 V		16.6		pF
R _g	Gate input resistance	f = 1 MHz open drain	-	4	-	Ω
Q _g	Total gate charge	V _{DD} = 496 V, I _D = 4.2 A,	-	26	-	nC
Q _{gs}	Gate-source charge	V _{GS} = 10 V		4		nC
Q _{gd}	Gate-drain charge	(see Figure 20)		16		nC

1. C_{OSS eq}⁽¹⁾ 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.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 310\text{ V}$, $I_D = 4.2\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 19)	-	12	-	ns
t_r	Rise time			8		ns
$t_{d(off)}$	Turn-off-delay time			40		ns
t_f	Fall time			21		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD}	Source-drain current		-		4.2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				16.8	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4.2\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 4.2\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 21)	-	290		ns
Q_{rr}	Reverse recovery charge			1900	nC	
I_{RRM}	Reverse recovery current			13	A	
t_{rr}	Reverse recovery time	$I_{SD} = 4.2\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ $T_J = 150\text{ }^\circ\text{C}$ (see Figure 21)	-	320		ns
Q_{rr}	Reverse recovery charge			2200	nC	
I_{RRM}	Reverse recovery current			14	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
BV_{GSO}	Gate-source breakdown voltage	$I_{gs} = \pm 1\text{ mA}$ (open drain)	30	-	-	V

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for D²PAK, TO-220

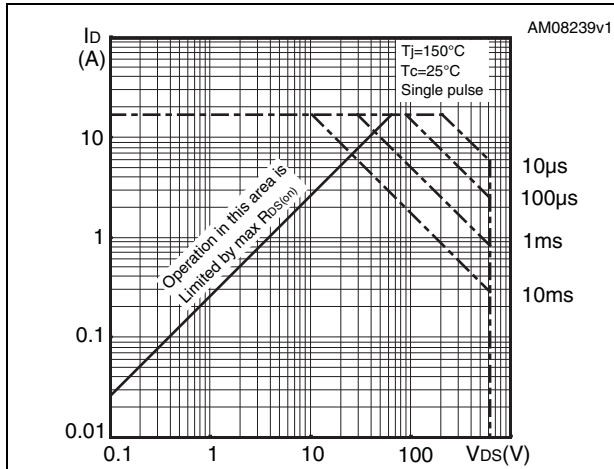


Figure 3. Thermal impedance for D²PAK, TO-220

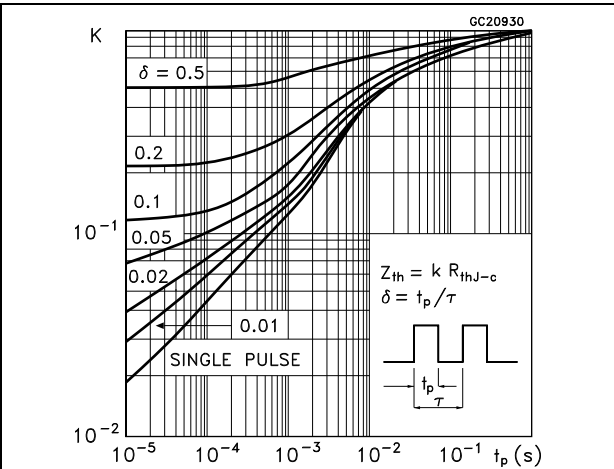


Figure 4. Safe operating area for TO-220FP

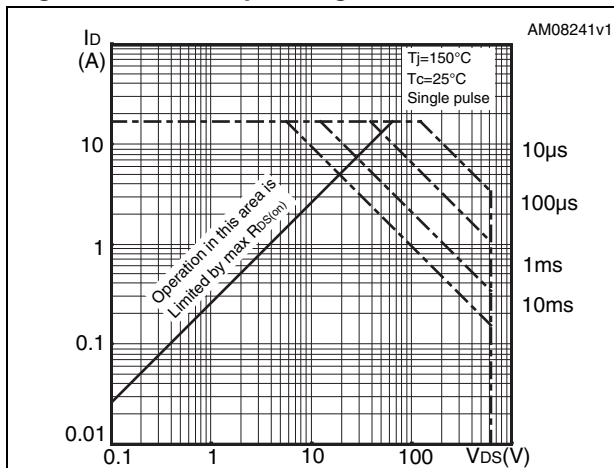


Figure 5. Thermal impedance for TO-220FP

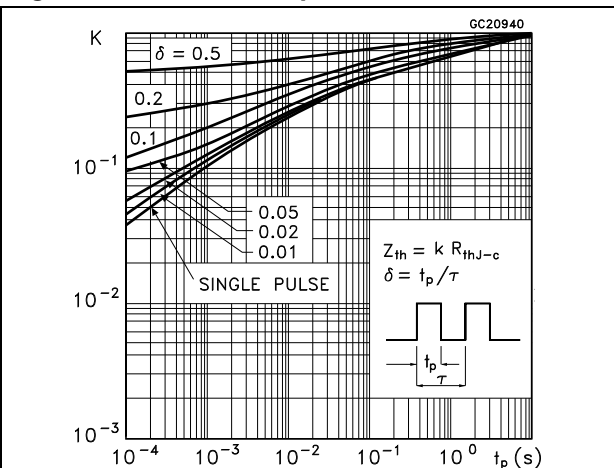


Figure 6. Safe operating area for DPAK, IPAQ

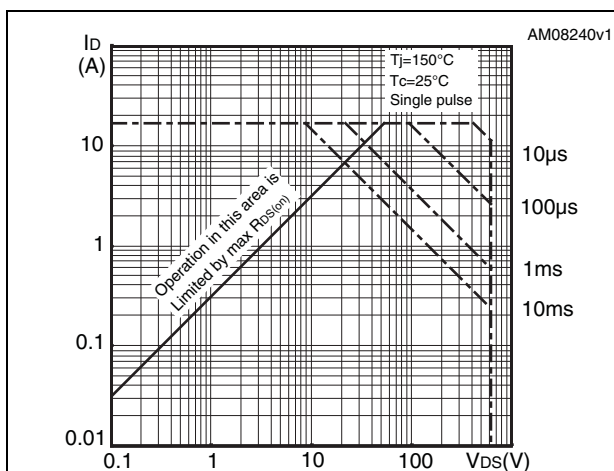


Figure 7. Thermal impedance for DPAK, IPAQ

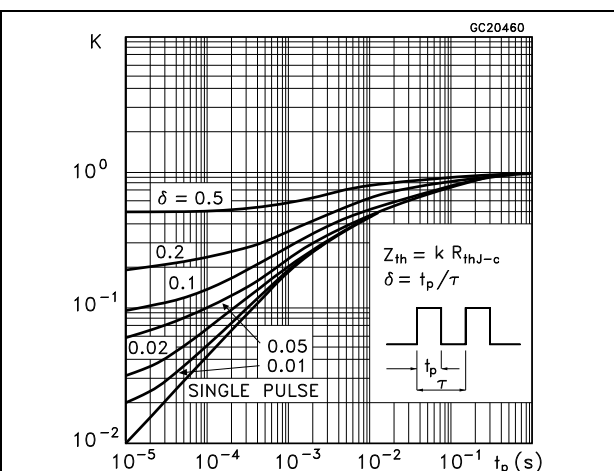


Figure 8. Output characteristics

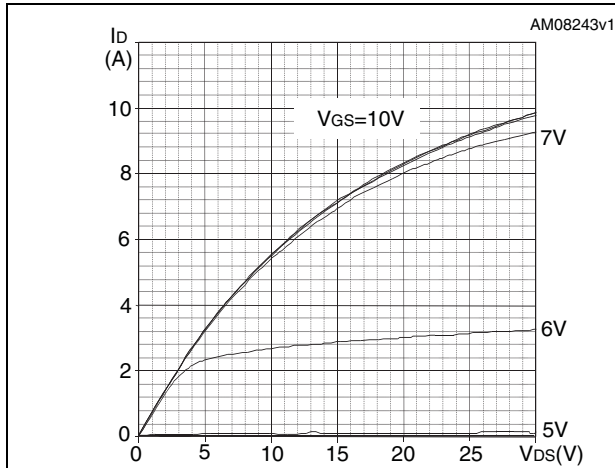


Figure 9. Transfer characteristics

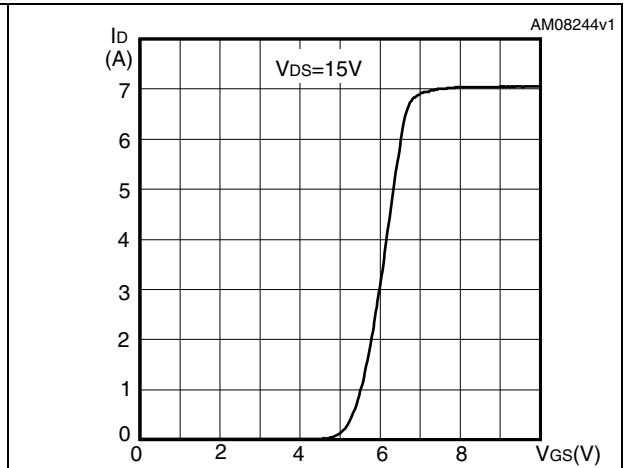


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on resistance

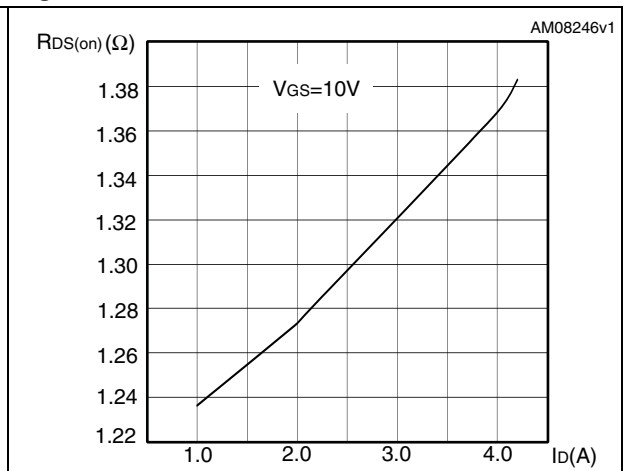
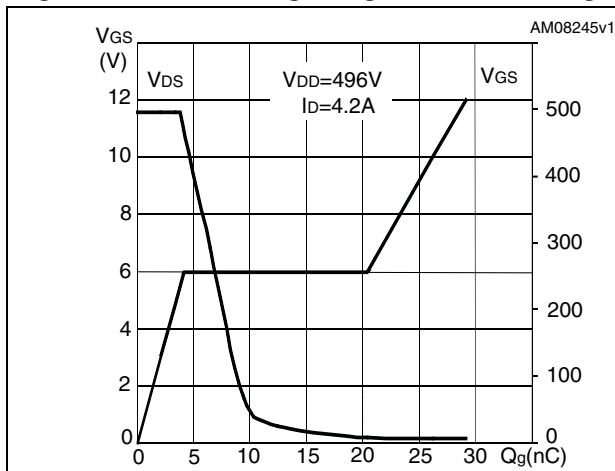


Figure 12. Capacitance variations

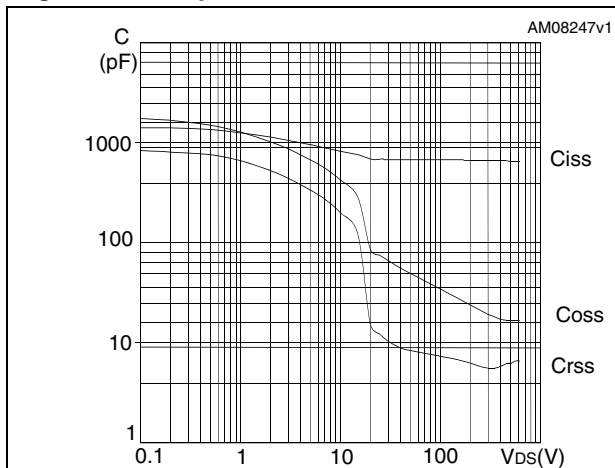


Figure 13. Output capacitance stored energy

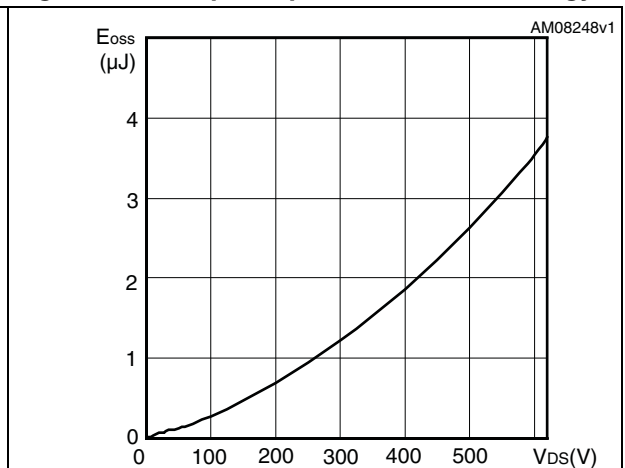


Figure 14. Normalized gate threshold voltage vs temperature

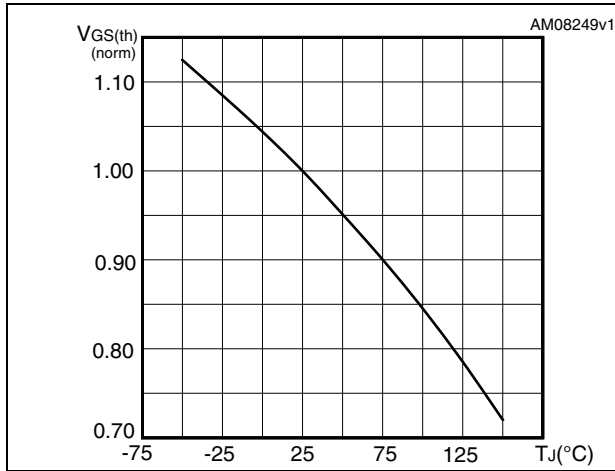


Figure 15. Normalized on resistance vs temperature

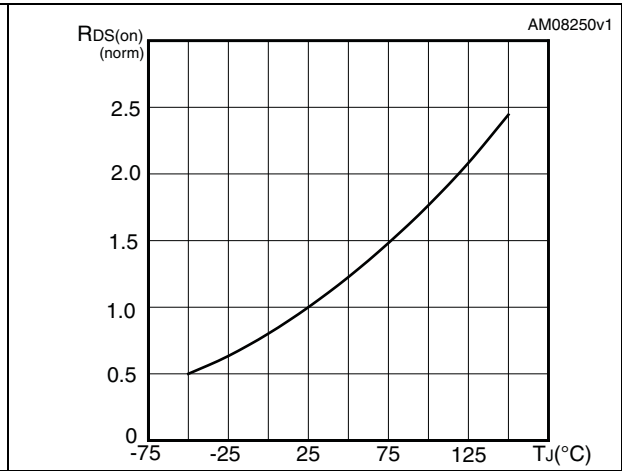


Figure 16. Source-drain diode forward characteristics

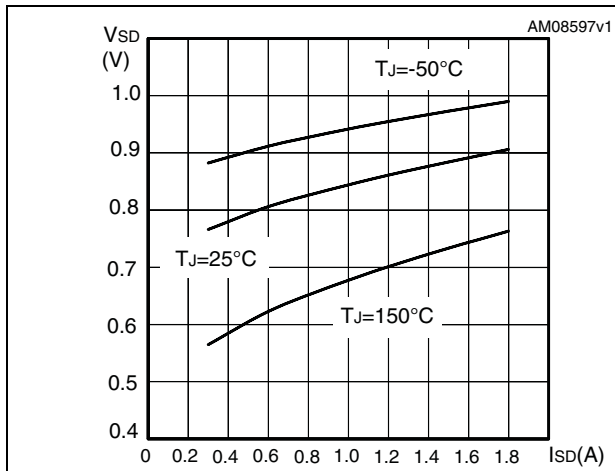


Figure 17. Normalized BV_{DSS} vs temperature

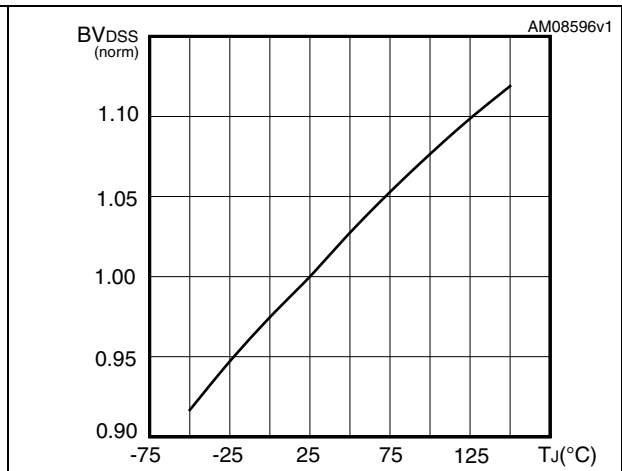
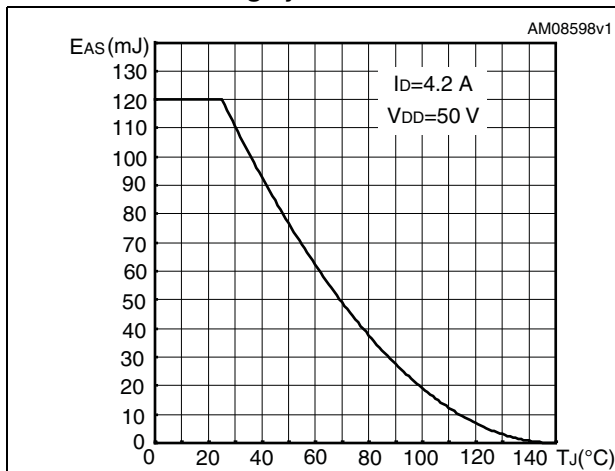


Figure 18. Maximum avalanche energy vs starting Tj



3 Test circuits

Figure 19. Switching times test circuit for resistive load

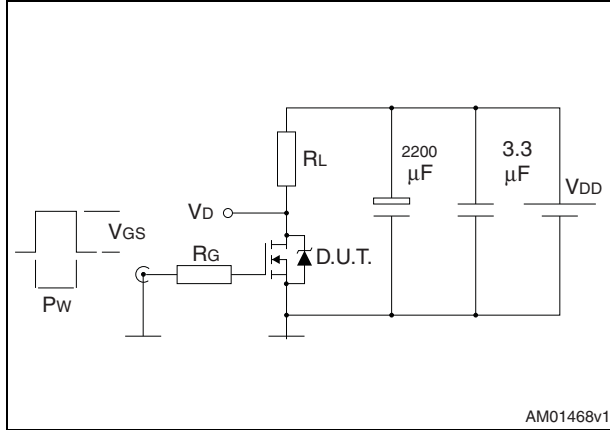


Figure 20. Gate charge test circuit

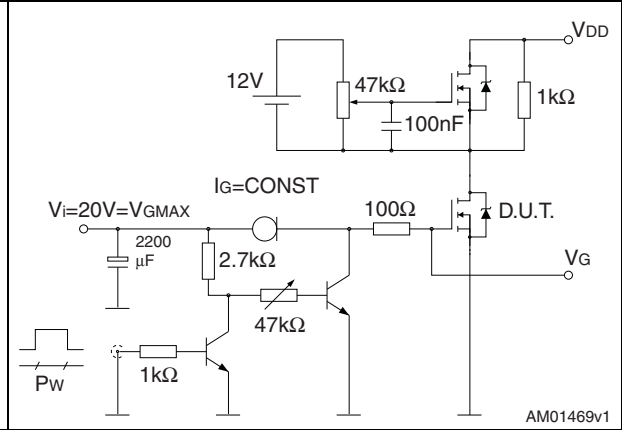


Figure 21. Test circuit for inductive load switching and diode recovery times

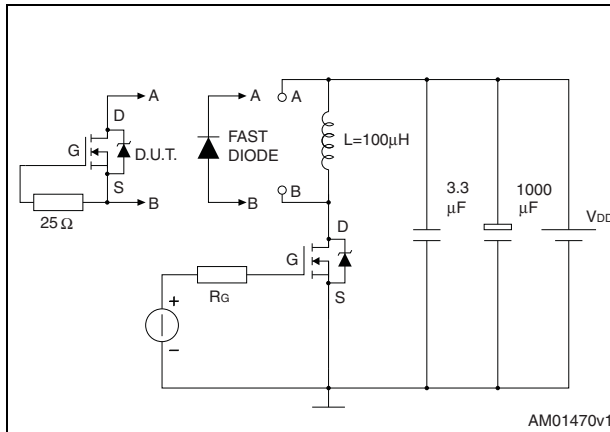


Figure 22. Unclamped inductive load test circuit

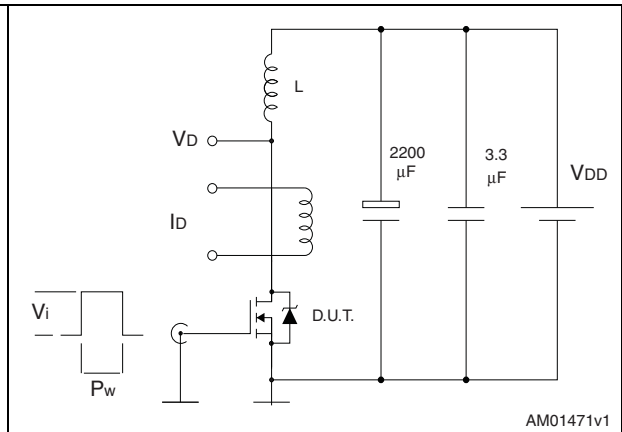


Figure 23. Unclamped inductive waveform

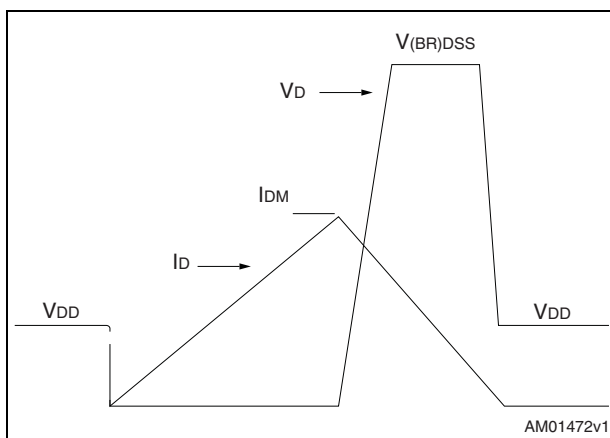
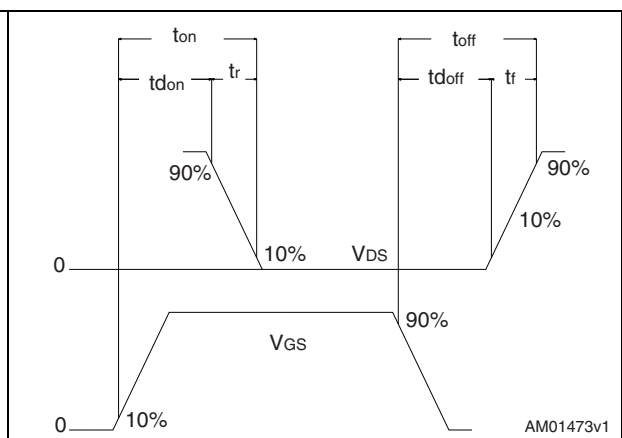


Figure 24. Switching time waveform



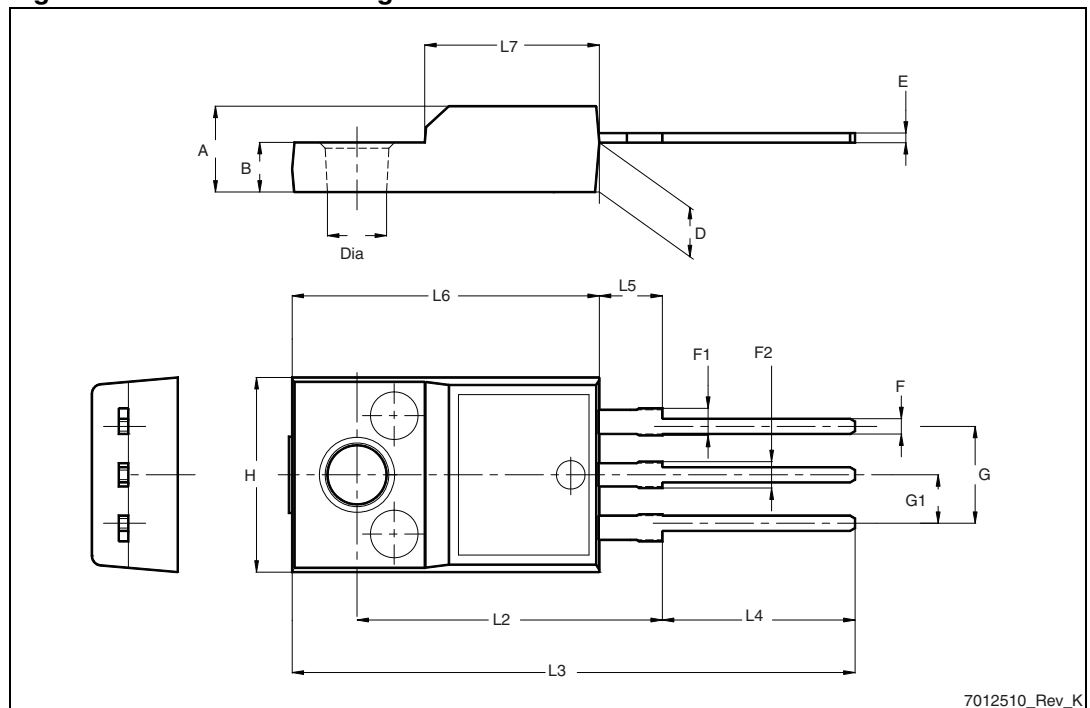
4 Package mechanical data

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.

Table 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	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
H	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

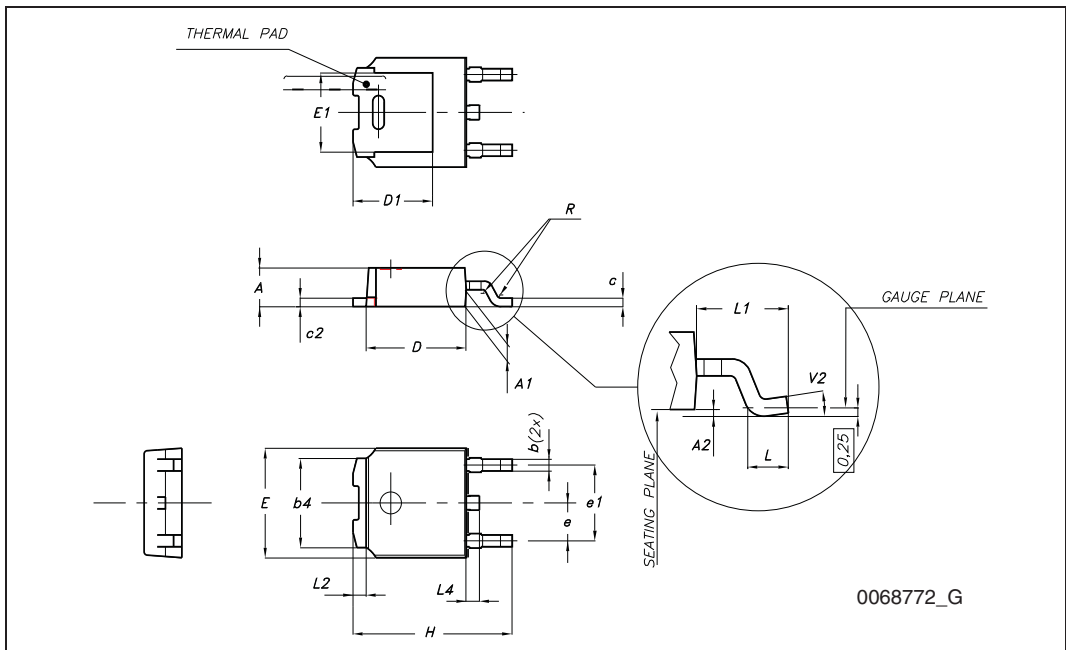
Figure 25. TO-220FP drawing



7012510_Rev_K

TO-252 (DPAK) mechanical data

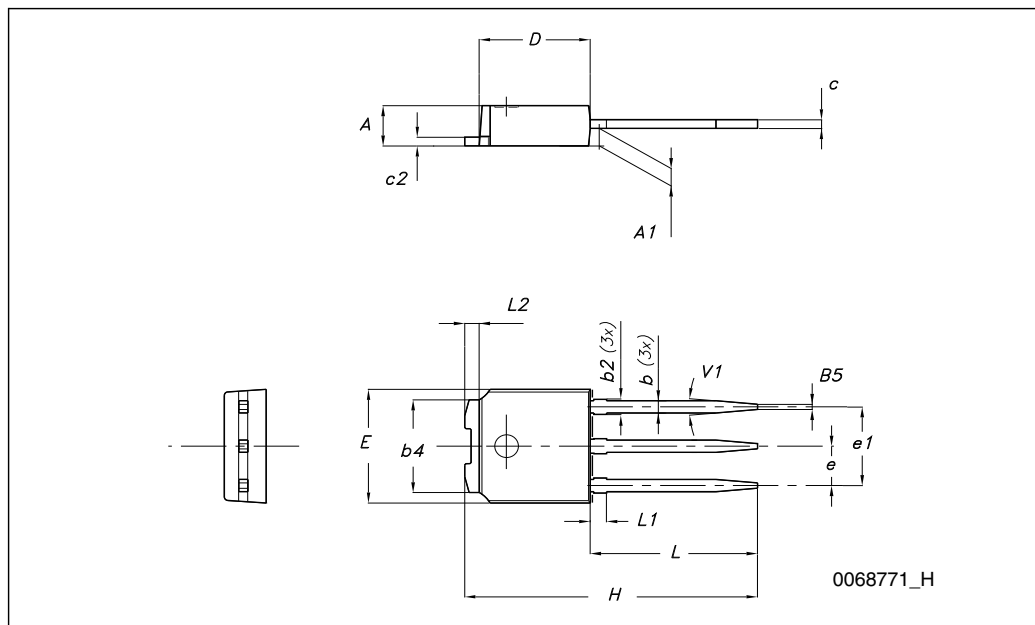
DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



0068772_G

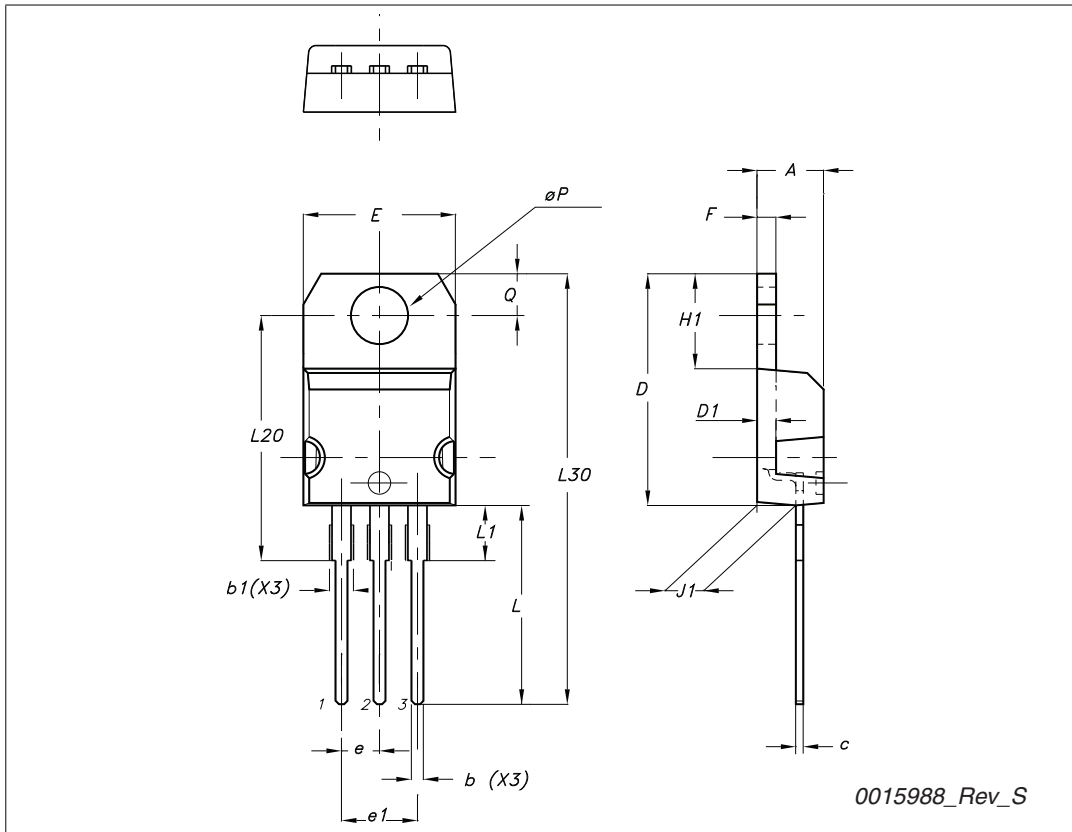
TO-251 (IPAK) mechanical data

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
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	
V1		10°	



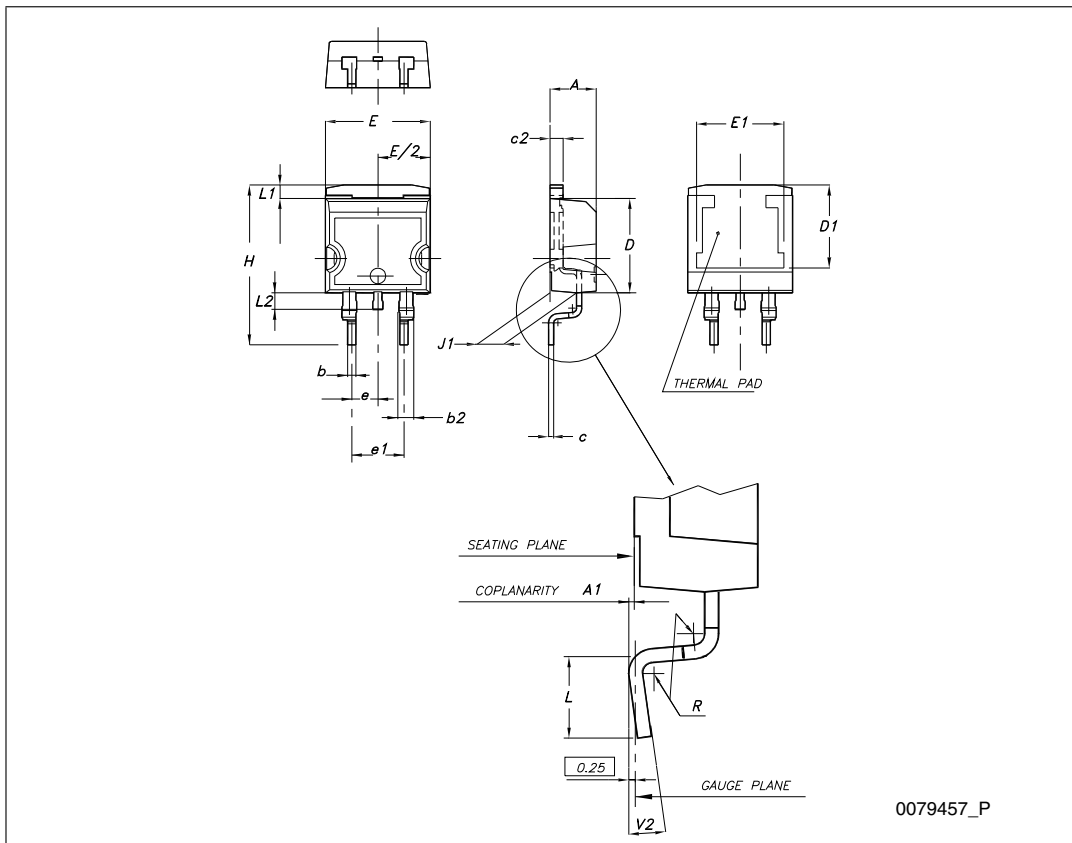
TO-220 type A mechanical data

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	
∅P	3.75		3.85
Q	2.65		2.95



D²PAK (TO-263) mechanical data

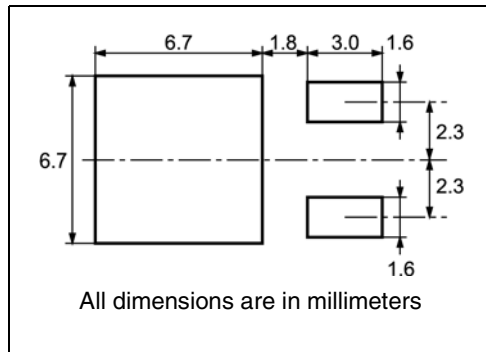
Dim.	mm.		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°



0079457_P

5 Package mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

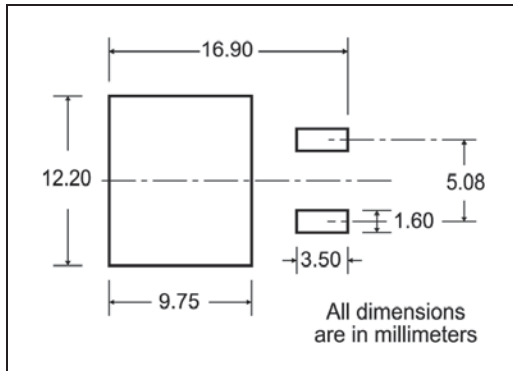
REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start

2.5mm min. width

REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

TRL

FEED DIRECTION

Bending radius R min.

6 Revision history

Table 10. Document revision history

Date	Revision	Changes
09-Apr-2010	1	First release.
20-Oct-2010	2	– Added new package, mechanical data: IPAK; – Added new package, mechanical data: D ² PAK; – Document status promoted from preliminary data to datasheet.

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