



STB7N52K3, STD7N52K3 STF7N52K3, STP7N52K3

N-channel 525 V, 0.84 Ω , 6.2 A, D²PAK, DPAK, TO-220FP, TO-220
SuperMESH3™ Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D	P _w
STB7N52K3	525 V	< 0.98 Ω	6.2 A	90 W
STD7N52K3	525 V	< 0.98 Ω	6.2 A	90 W
STF7N52K3	525 V	< 0.98 Ω	6.2 A ⁽¹⁾	25 W
STP7N52K3	525 V	< 0.98 Ω	6.2 A	90 W

1. Limited by package

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances
- Improved diode reverse recovery characteristics
- Zener-protected

Application

- Switching applications

Description

SuperMESH3™ is a new 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.

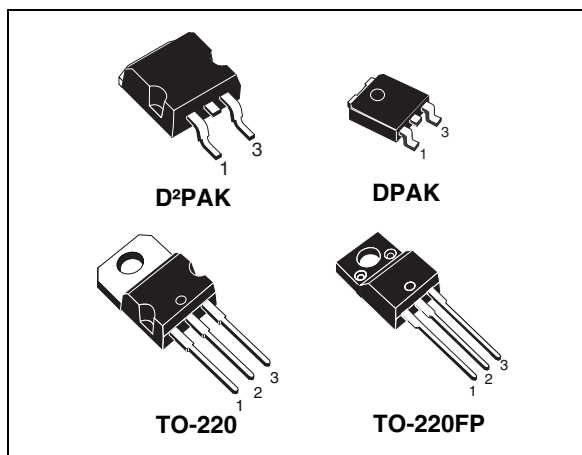


Figure 1. Internal schematic diagram

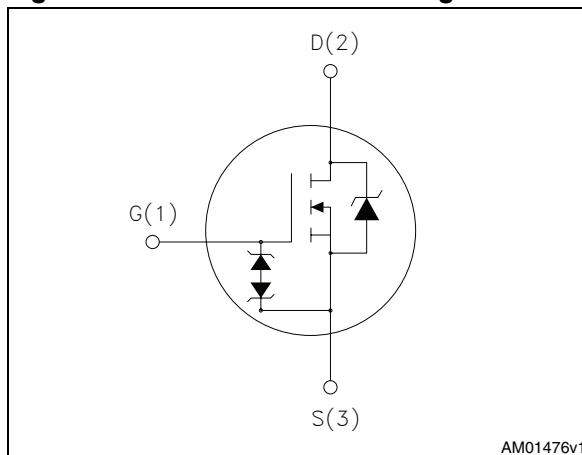


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB7N52K3	7N52K3	D ² PAK	Tape and reel
STD7N52K3	7N52K3	DPAK	Tape and reel
STF7N52K3	7N52K3	TO-220FP	Tube
STP7N52K3	7N52K3	TO-220	Tube

Contents

1 **Electrical ratings** 3

2 **Electrical characteristics** 4

 2.1 Electrical characteristics (curves) 6

3 **Test circuits** 9

4 **Package mechanical data** 10

5 **Package mechanical data** 15

6 **Revision history** 17



1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220	DPAK	D ² PAK	TO-220FP	
V _{DS}	Drain-source voltage (V _{GS} = 0)	525				V
V _{GS}	Gate- source voltage	± 30				V
I _D	Drain current (continuous) at T _C = 25 °C	6.2			6.2 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	4.5			4.5 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	24.8			24.8 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	90			25	W
I _{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _j max)	6.2				A
E _{AS}	Single pulse avalanche energy (starting T _j = 25°C, I _D = I _{AR} , V _{DD} = 50V)	100				mJ
V _{ESD(G-S)}	Gate source ESD(HBM-C = 100 pF, R = 1.5 kΩ)	2500				V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12				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 _{stg}	Storage temperature	-55 to 150				°C
T _j	Max. operating junction temperature	150				°C

1. Limited by package

2. Pulse width limited by safe operating area

3. $I_{SD} \leq 6.3\text{ A}$, $di/dt = \text{TBD}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	DPAK	D ² PAK	TO-220FP	
R _{thj-case}	Thermal resistance junction-case max	1.39			5	°C/W
R _{thj-pcb}	Thermal resistance junction-pcb max		50	30		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	62.5			62.5	°C/W
T _l	Maximum lead temperature for soldering purpose	300				°C

2 Electrical characteristics

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

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	525			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$			1 50	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 3.1\text{ A}$		0.84	0.98	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	737 110 10	-	pF pF pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0$	-	198	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	126	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	4	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 420\text{ V}$, $I_D = 6\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 20)	-	34 4.4 15	-	nC nC nC

1. $C_{oss\text{ eq.}}$ 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}
2. $C_{oss\text{ eq.}}$ 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.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 260\text{ V}$, $I_D = 3\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 19)	-	11	-	ns
t_r	Rise time			22		ns
$t_{d(off)}$	Turn-off-delay time			30		ns
t_f	Fall time			22		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		6.2	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				24.8	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 6\text{ A}$, $V_{GS} = 0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 6\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 24)	-	260		ns
Q_{rr}	Reverse recovery charge			1		nC
I_{RRM}	Reverse recovery current			11		A
t_{rr}	Reverse recovery time	$I_{SD} = 6\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 24)	-	338		ns
Q_{rr}	Reverse recovery charge			1.4		nC
I_{RRM}	Reverse recovery current			13		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
$BV_{GSO}^{(1)}$	Gate-source breakdown voltage	$I_{gs} = \pm 1\text{ mA}$ (open drain)	30	-	-	V

1. 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 TO-220, D²PAK

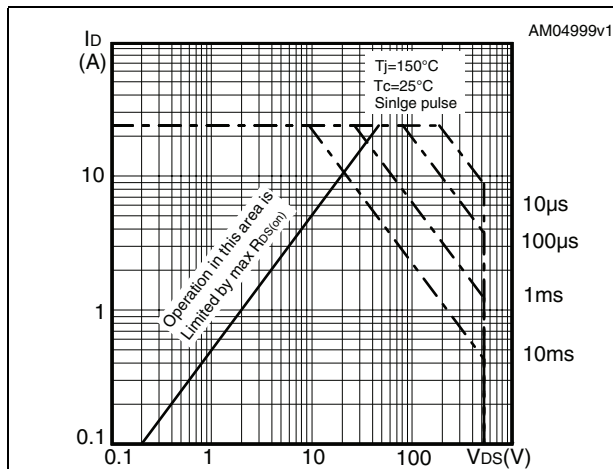


Figure 3. Thermal impedance for TO-220, D²PAK

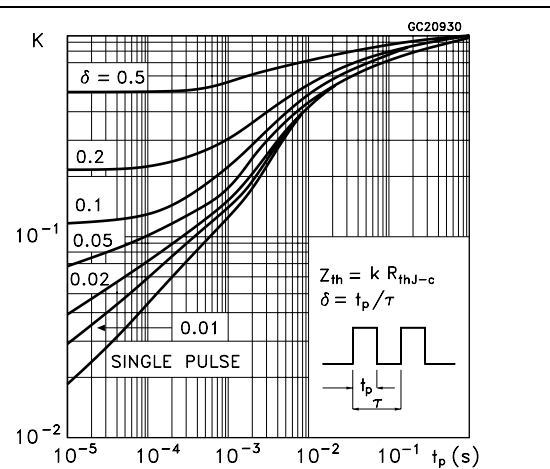


Figure 4. Safe operating area for DPAK

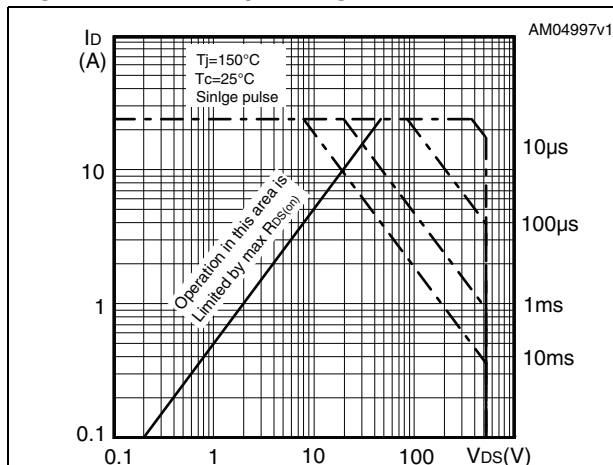


Figure 5. Thermal impedance for DPAK

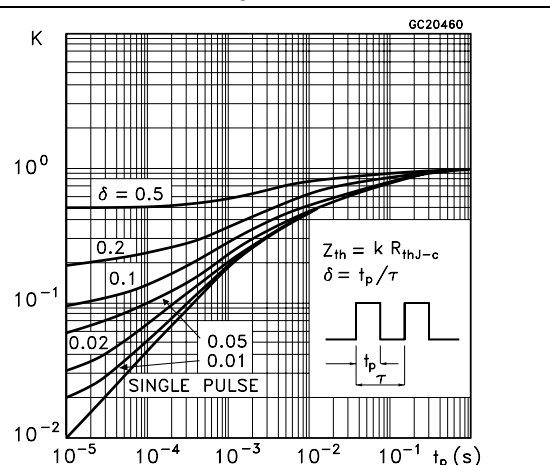


Figure 6. Safe operating area for TO-220FP

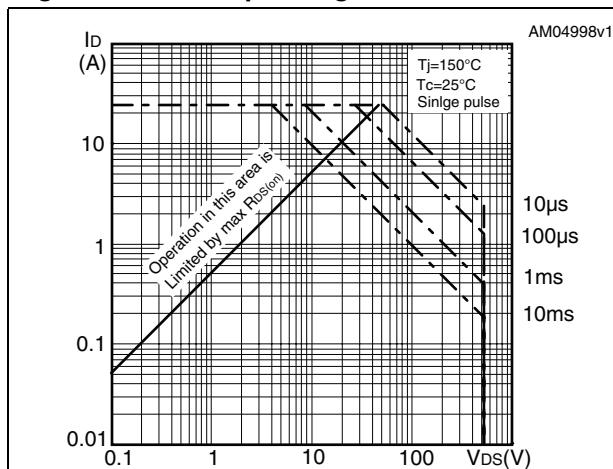


Figure 7. Thermal impedance for TO-220FP

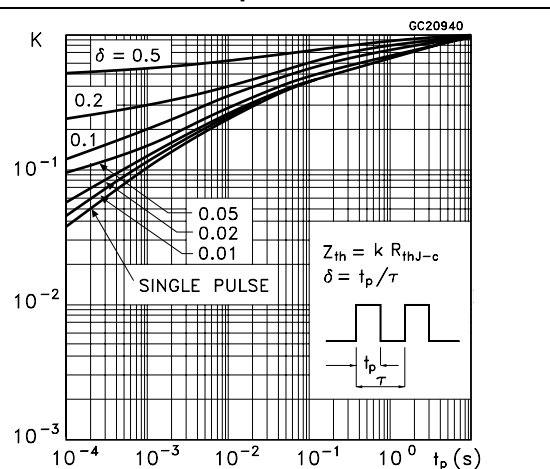


Figure 8. Output characteristics

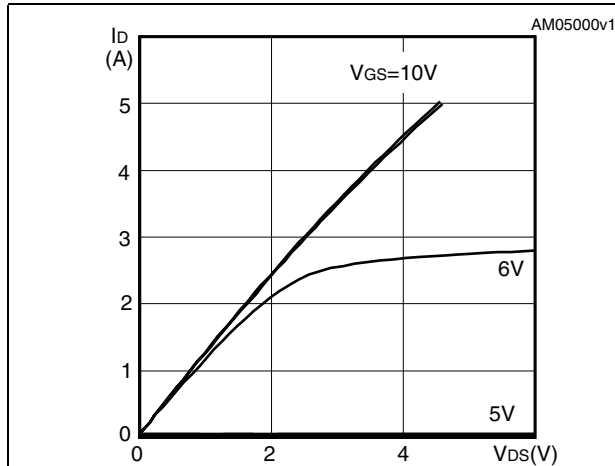


Figure 9. Transfer characteristics

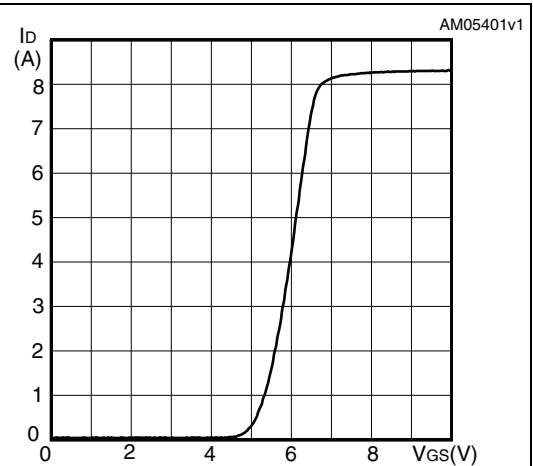
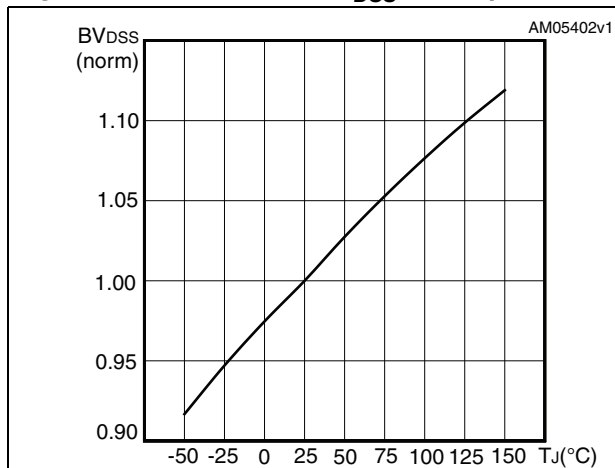
Figure 10. Normalized BV_{DSS} vs temperature

Figure 11. Static drain-source on resistance

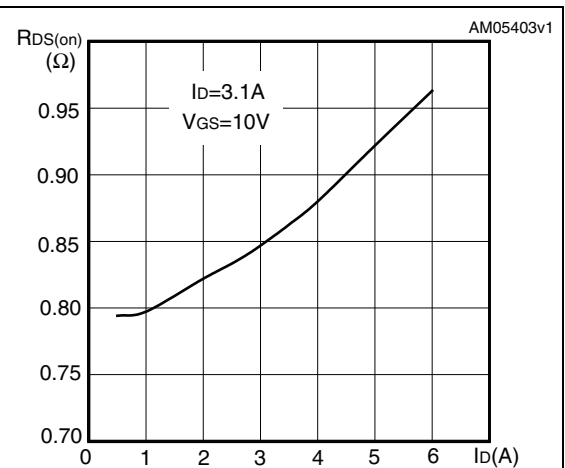


Figure 12. Output capacitance stored energy

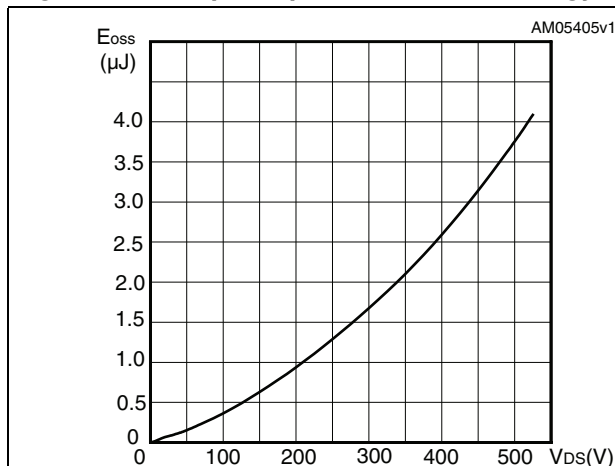


Figure 13. Capacitance variations

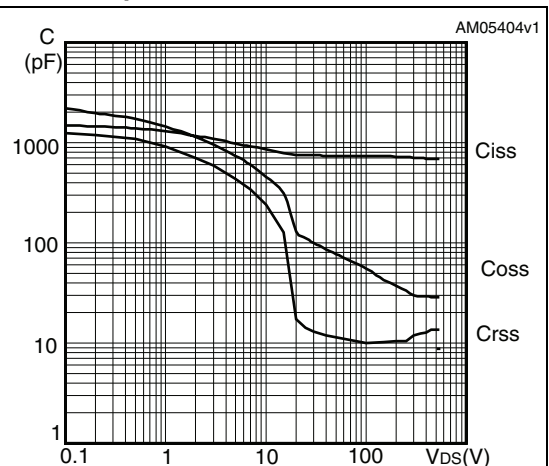


Figure 14. Gate charge vs gate-source voltage Figure 15. Normalized on resistance vs temperature

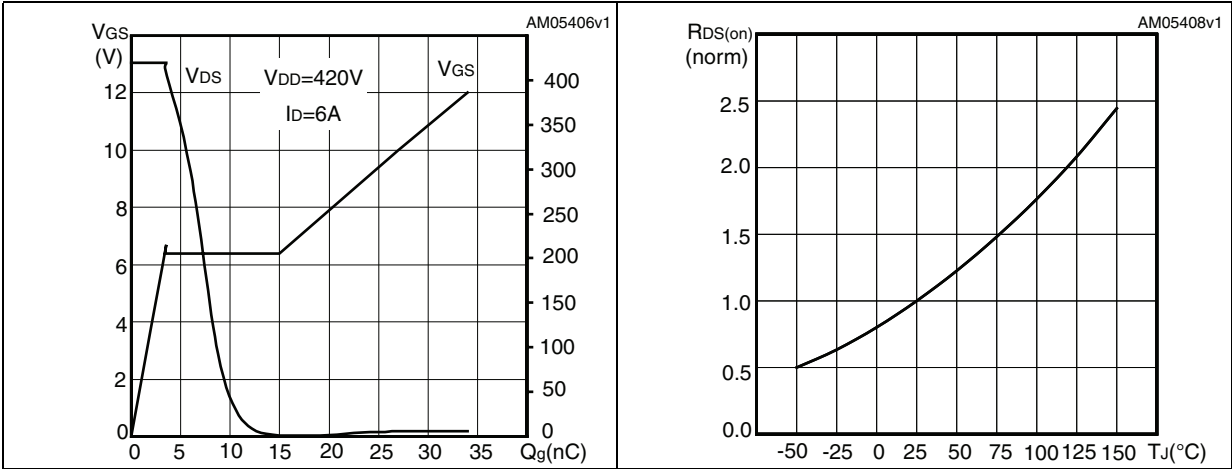


Figure 16. Normalized gate threshold voltage vs temperature Figure 17. Maximum avalanche energy vs temperature

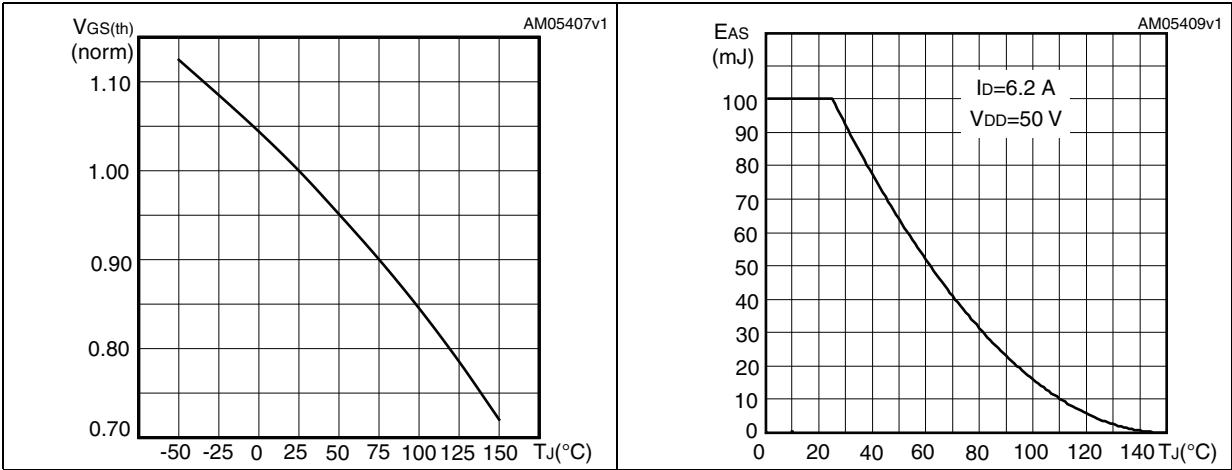
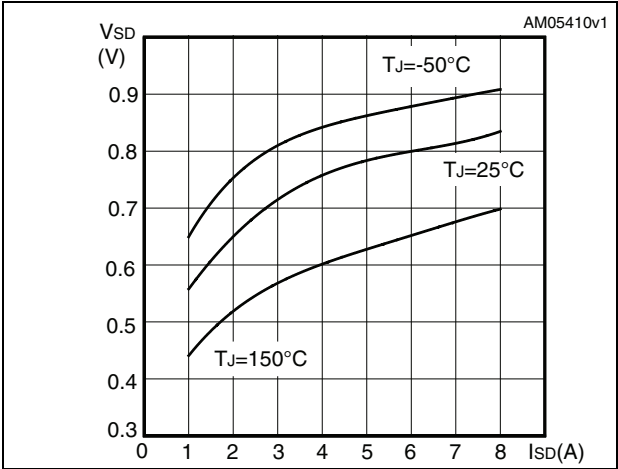


Figure 18. Source-drain diode forward characteristics



3 Test circuits

Figure 19. Switching times test circuit for resistive load

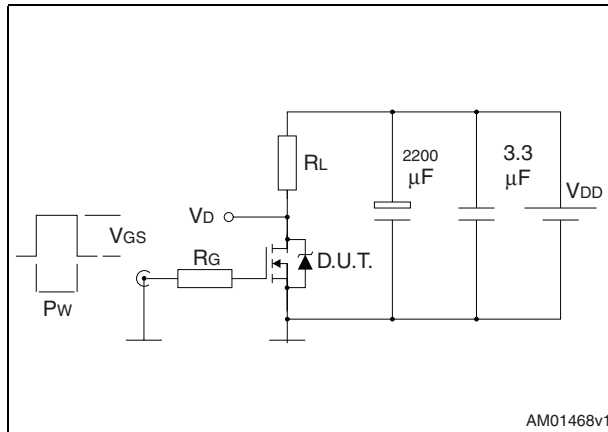


Figure 20. Gate charge test circuit

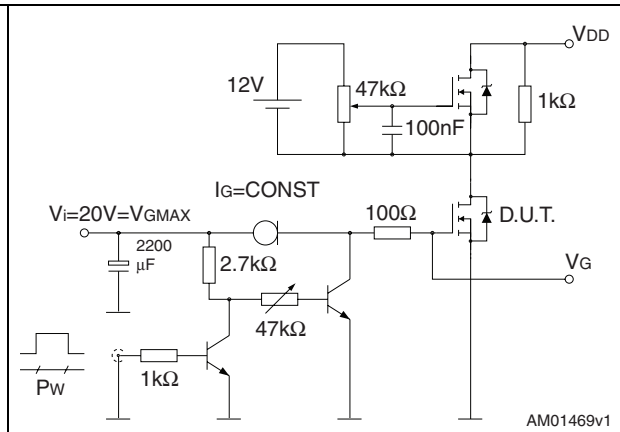


Figure 21. Test circuit for inductive load switching and diode recovery times

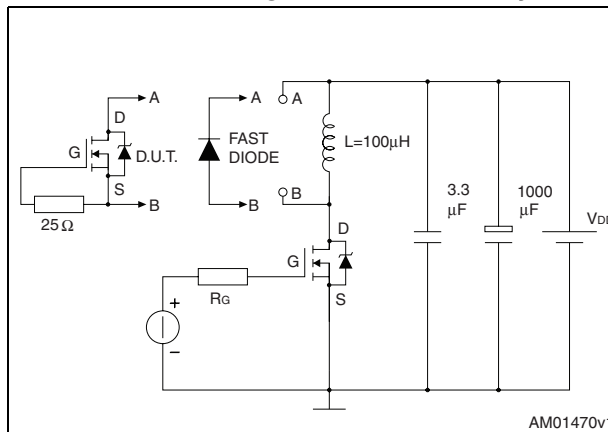


Figure 22. Unclamped Inductive load test circuit

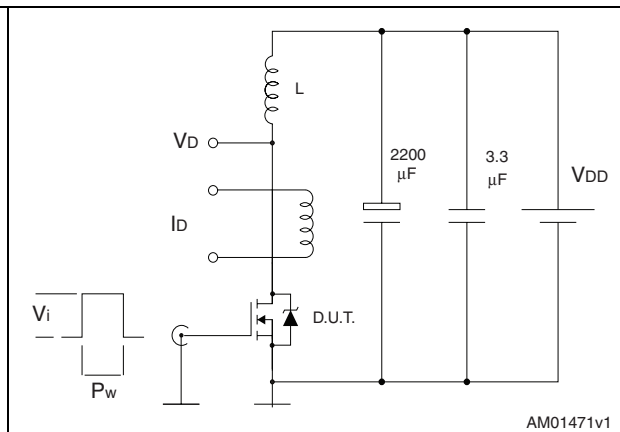


Figure 23. Unclamped inductive waveform

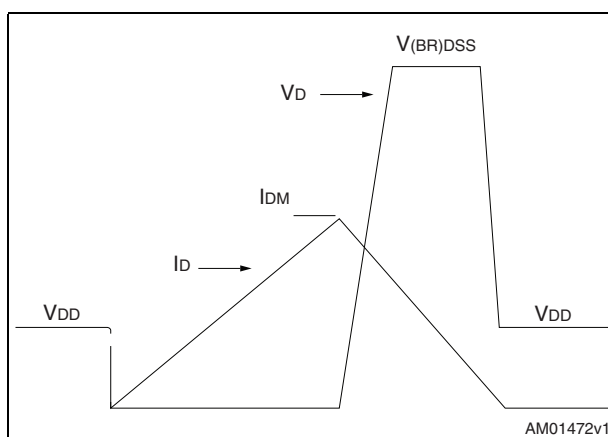
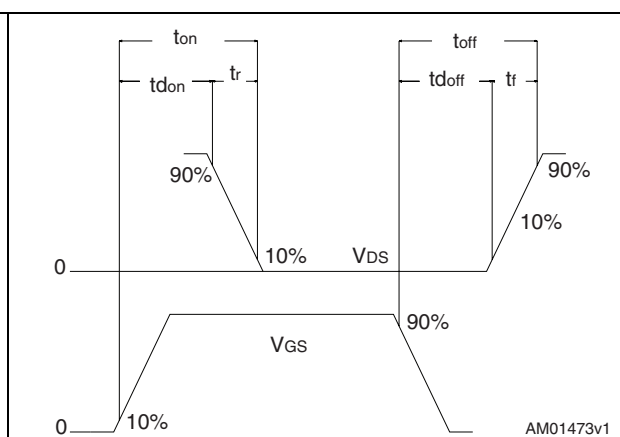


Figure 24. Switching time waveform

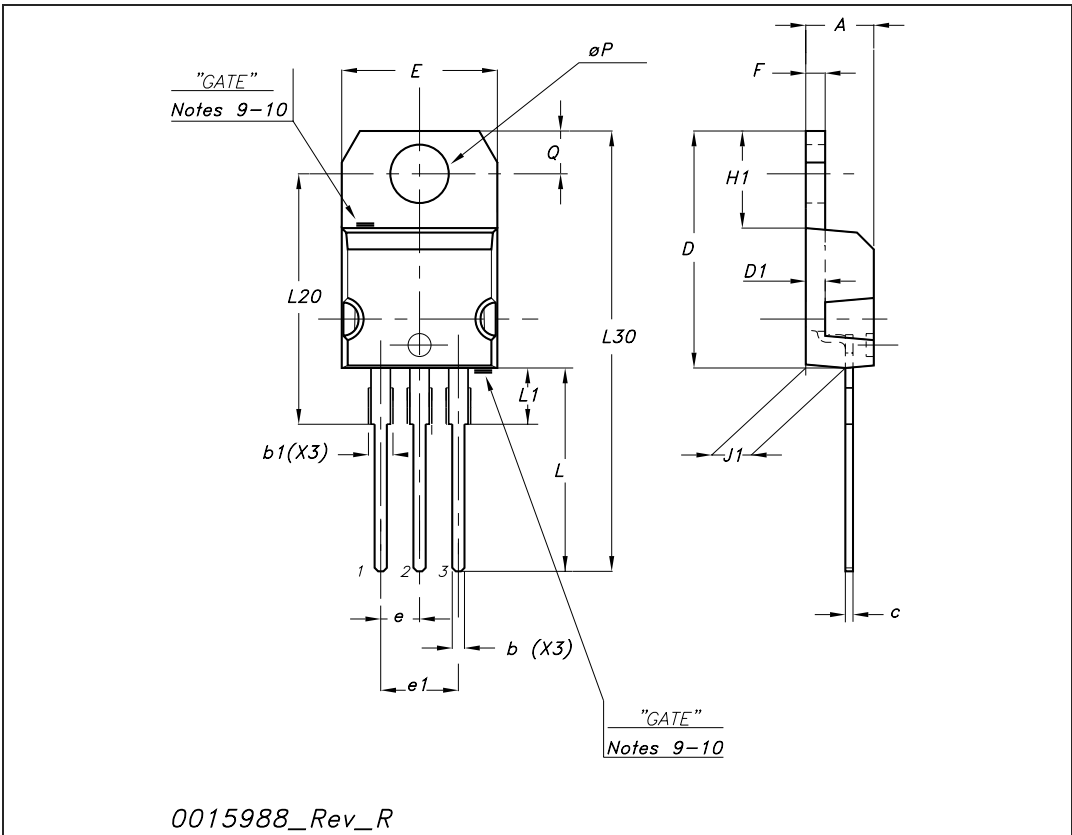


4 Package mechanical data

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.

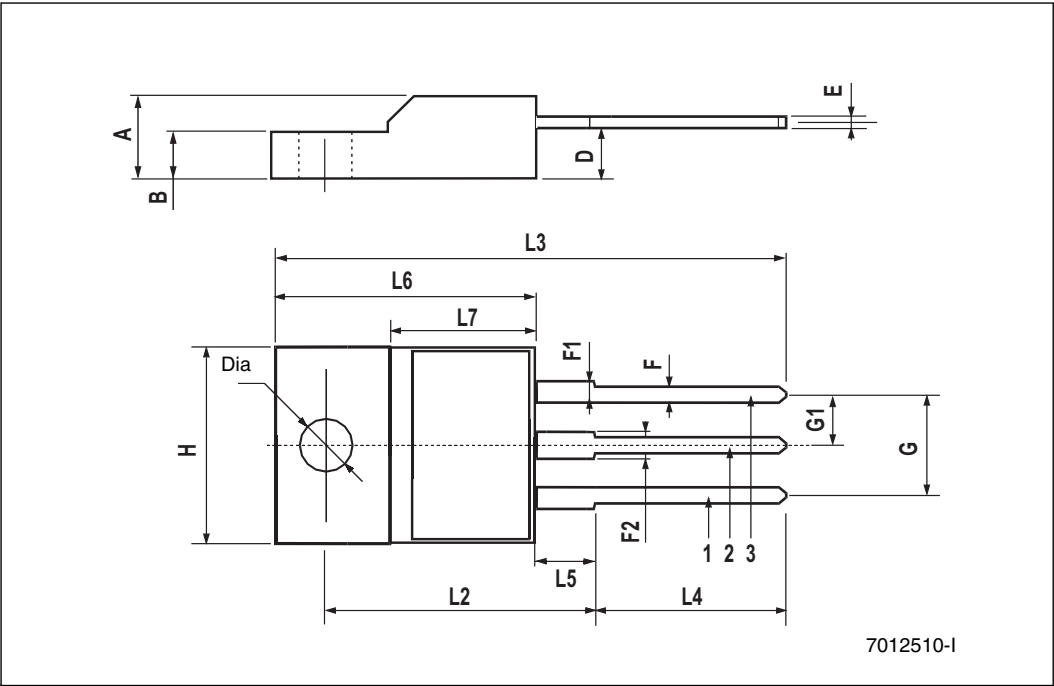
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



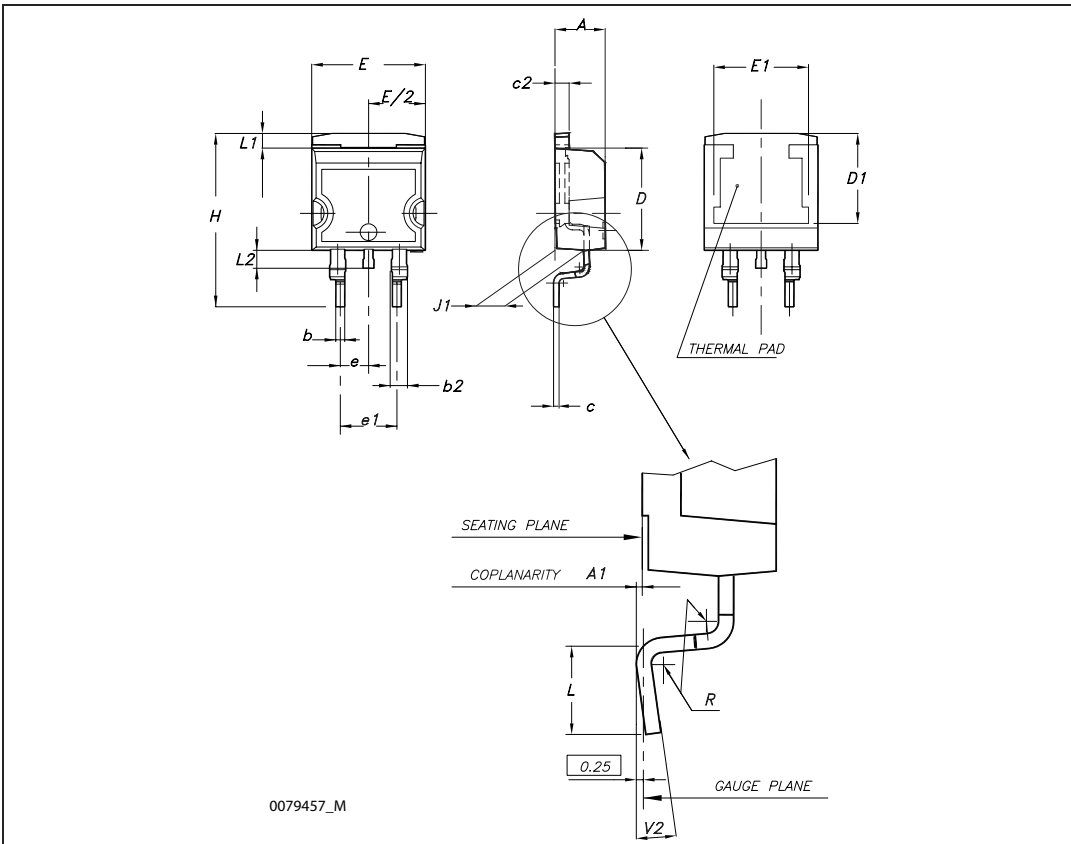
TO-220FP mechanical data

Dim.	mm.			inch		
	Min.	Typ	Max.	Min.	Typ.	Max.
A	4.40		4.60	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.70	0.017		0.027
F	0.75		1.00	0.030		0.039
F1	1.15		1.50	0.045		0.067
F2	1.15		1.50	0.045		0.067
G	4.95		5.20	0.195		0.204
G1	2.40		2.70	0.094		0.106
H	10		10.40	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.80		10.60	0.385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.90		16.40	0.626		0.645
L7	9		9.30	0.354		0.366
Dia	3		3.2	0.118		0.126



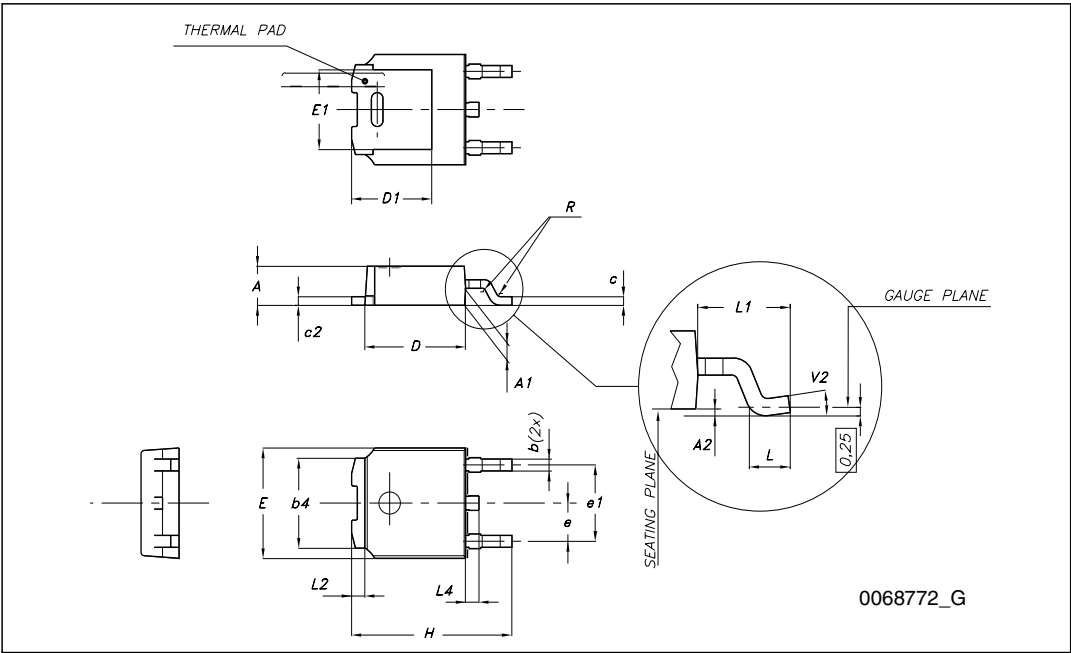
D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



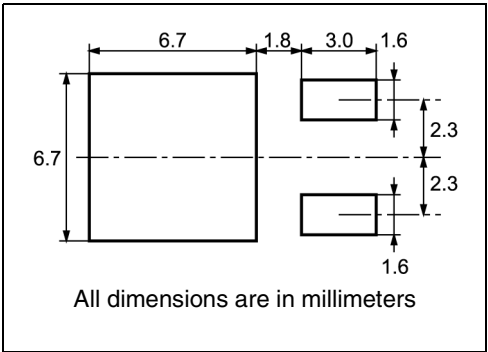
TO-252 (DPAK) mechanical data

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 °

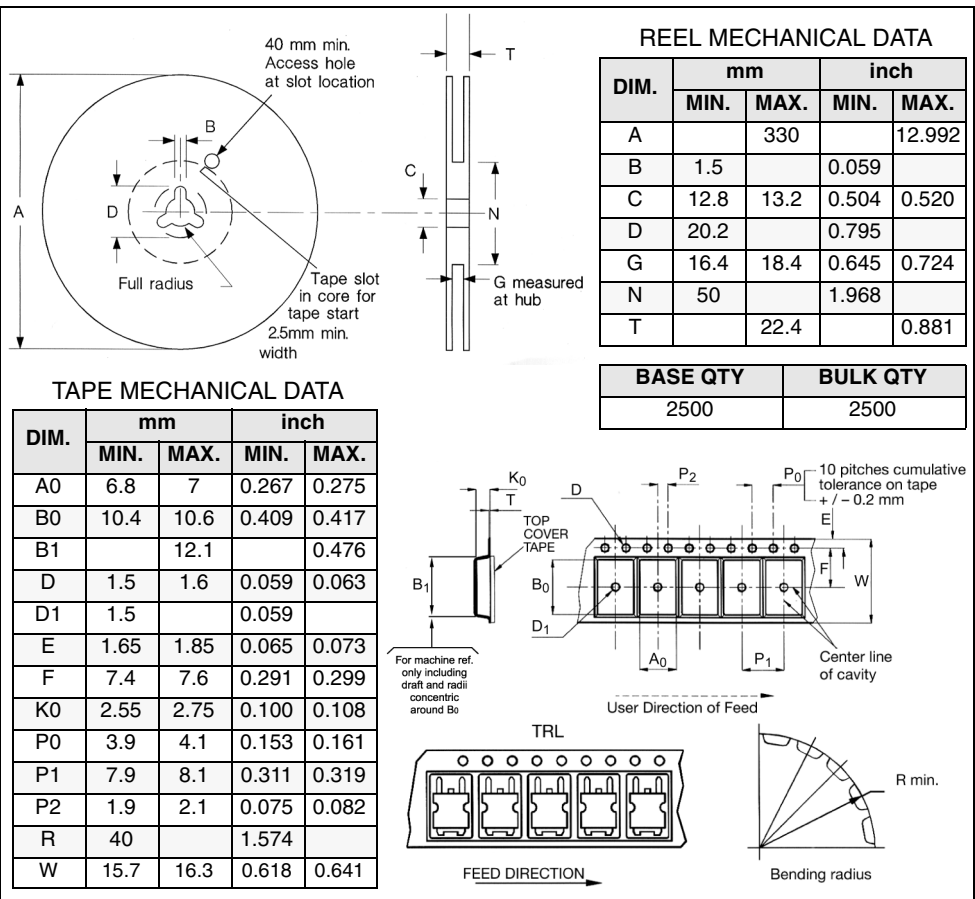


5 Package mechanical data

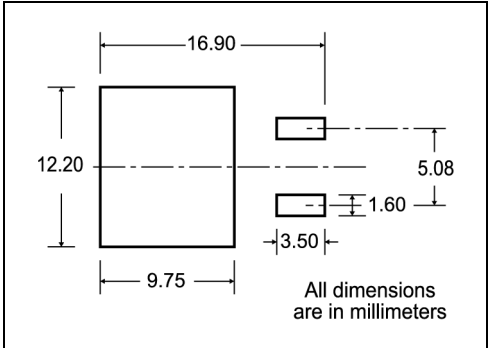
DPAK FOOTPRINT



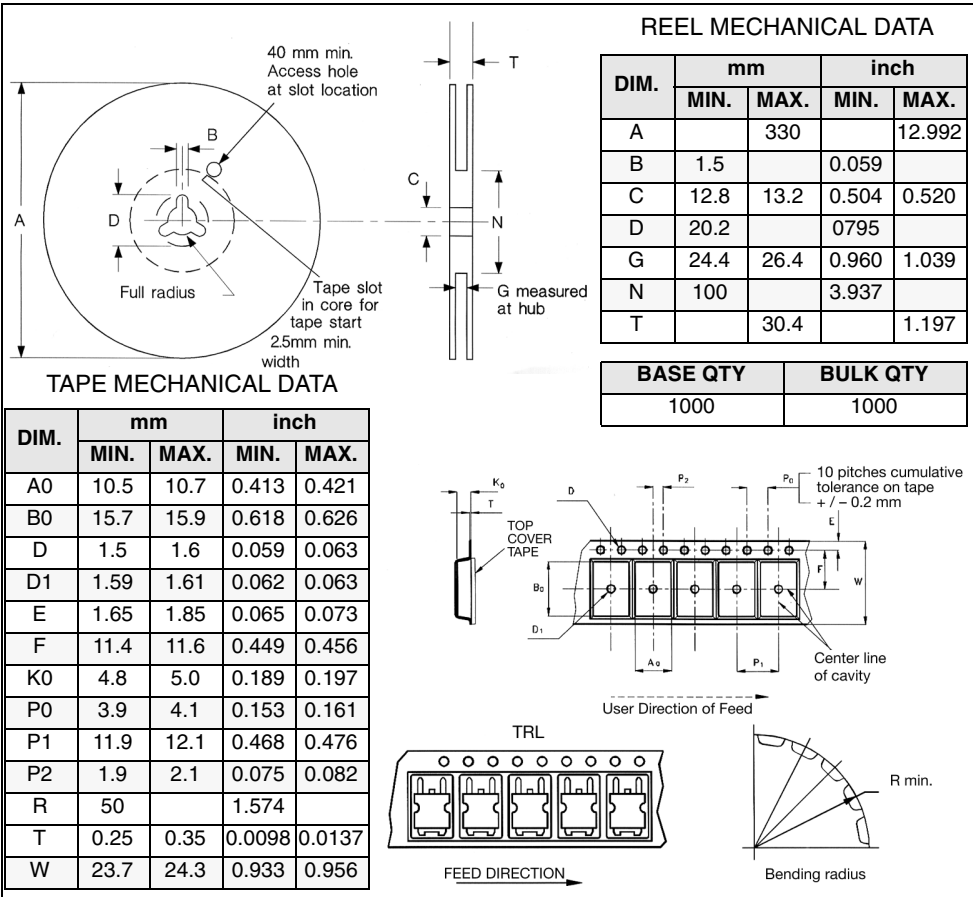
TAPE AND REEL SHIPMENT



D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
07-Jul-2008	1	First release
10-Sep-2009	2	Document status promoted from preliminary data to datasheet.

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