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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK /TO-220	TO-220FP	
V _{DS}	Drain-source voltage (V _{GS} = 0)	75		V
V _{DGR}	Drain-gate voltage (R _{GS} = 20KΩ)	75		V
V _{GS}	Gate-source voltage	± 20		V
I _D ⁽¹⁾	Drain current (continuous) at T _C = 25°C	80	80	A
I _D ⁽¹⁾	Drain current (continuous) at T _C =100°C	70	70	A
I _{DM} ⁽²⁾	Drain current (pulsed)	320	320	A
P _{TOT}	Total dissipation at T _C = 25°C	300	45	W
	Derating factor	2.0	0.3	W/°C
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12		V/ns
E _{AS} ⁽⁴⁾	Single pulse avalanche energy	700		mJ
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s;T _C =25°C)	--	2000	V
T _J T _{stg}	Operating junction temperature Storage temperature	-55 to 175		°C

1. Current limited by package
2. Pulse width limited by safe operating area
3. I_{SD} ≤ 80A, di/dt ≤ 300A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ T_{JMAX}
4. Starting T_J = 25 °C, I_D = 40A, V_{DD} = 37.5V

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK /TO-220	TO-220FP	
R _{thJC}	Thermal resistance junction-case max	0.5	3.33	°C/W
R _{thJA}	Thermal resistance junction-ambient max	62.5		°C/W
T _l	Maximum lead temperature for soldering purpose ⁽¹⁾	300		°C

1. 1.6mm from case for 10sec)

2 Electrical characteristics

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

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0$	75			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$, $V_{DS} = \text{Max rating @ } 125^{\circ}\text{C}$			1 10	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$, $I_D = 40\text{A}$		0.0095	0.011	Ω

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{V}$, $I_D = 40\text{A}$		20		S
C_{iss}	Input capacitance	$V_{DS} = 25\text{V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		3700		pF
C_{oss}	Output capacitance			730		pF
C_{rss}	Reverse transfer capacitance			240		pF
Q_g	Total gate charge	$V_{DD} = 60\text{V}$, $I_D = 80\text{A}$ $V_{GS} = 10\text{V}$		117	160	nC
Q_{gs}	Gate-source charge			27		nC
Q_{gd}	Gate-drain charge			47		nC

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 37.5V$, $I_D = 45A$, $R_G = 4.7\Omega$, $V_{GS} = 10V$ Figure 15 on page 9		25		ns
t_r	Rise time			100		ns
$t_{d(off)}$	Turn-off delay time			66		ns
t_f	Fall time			30		ns

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 80A$, $V_{GS} = 0$			1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 80A$, $di/dt = 100A/\mu s$, $V_{DD} = 25V$, $T_J = 150^\circ C$ Figure 17 on page 9		132		ns
Q_{rr}	Reverse recovery charge			660		nC
I_{RRM}	Reverse recovery current			10		A

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

2.1 Electrical characteristics (curves)

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

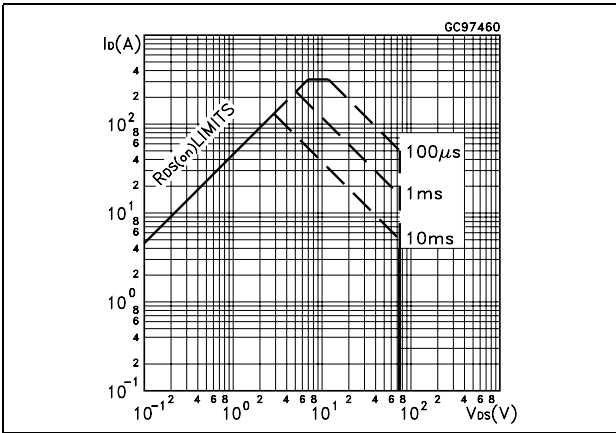


Figure 2. Thermal impedance for TO-220 - D²PAK

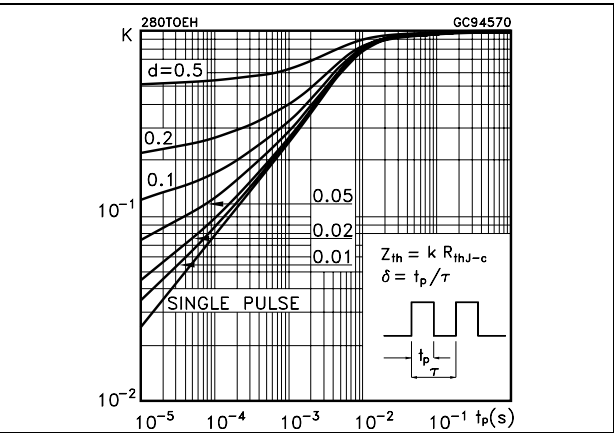


Figure 3. Safe operating area for TO-220FP

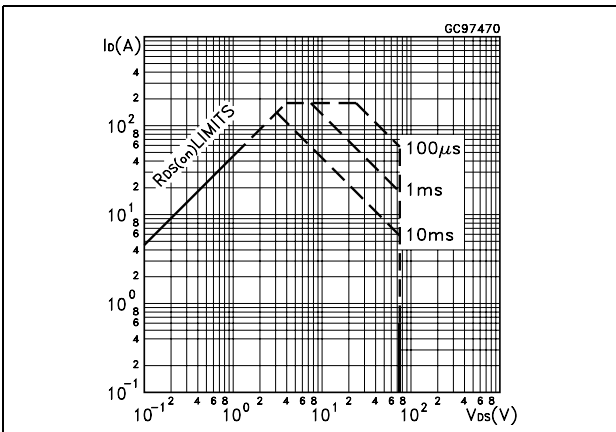


Figure 4. Thermal impedance for TO-220FP

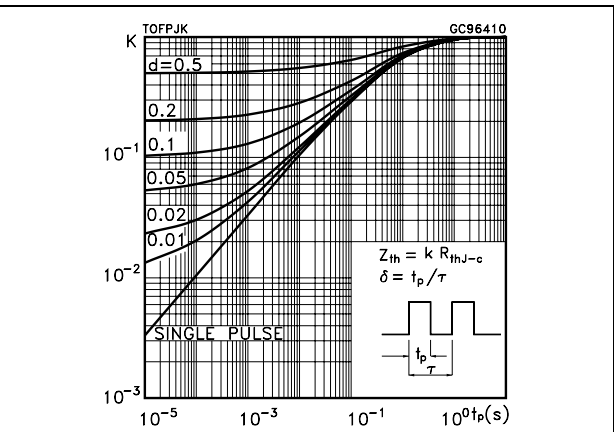


Figure 5. Output characteristics

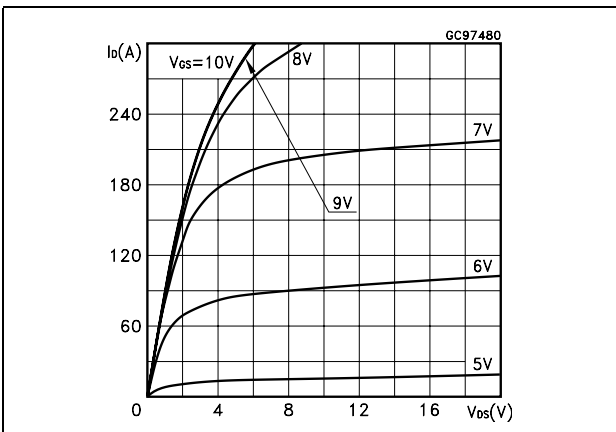


Figure 6. Transfer characteristics

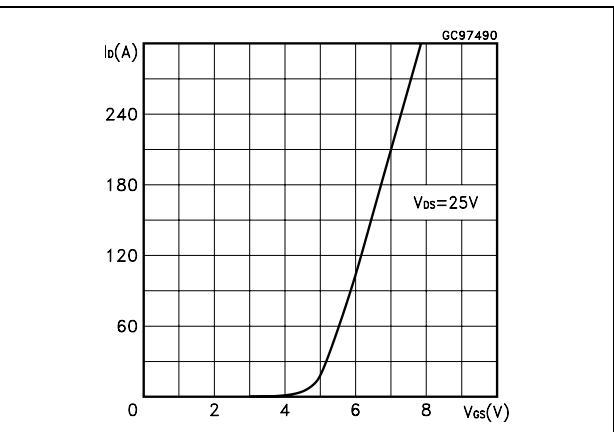


Figure 7. Transconductance

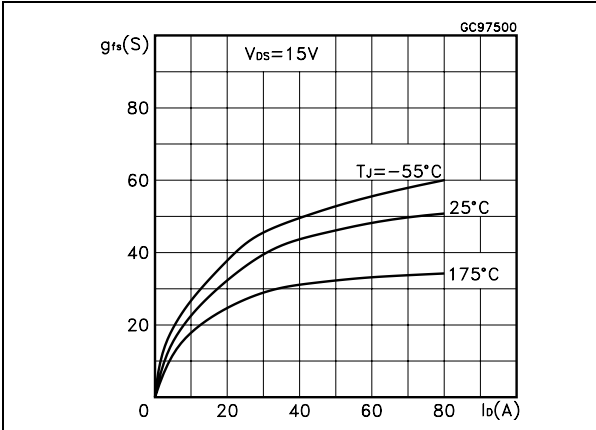


Figure 8. Static drain-source on resistance

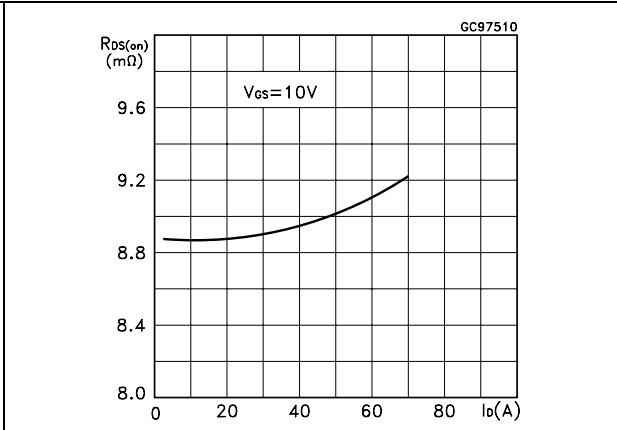


Figure 9. Gate charge vs gate-source voltage

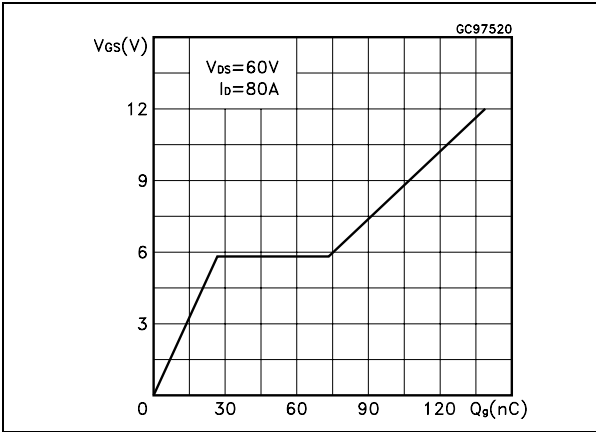


Figure 10. Capacitance variations

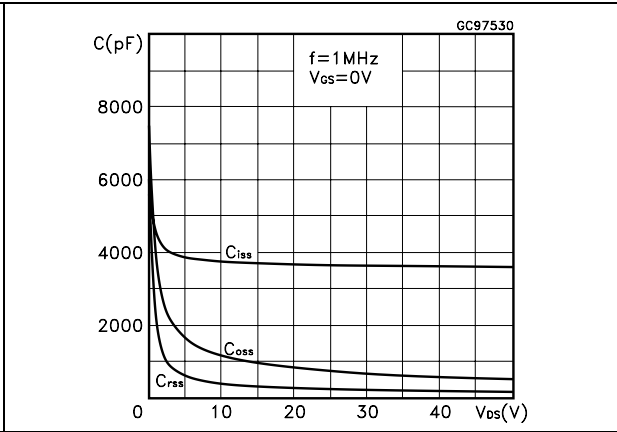


Figure 11. Normalized gate threshold voltage vs temperature

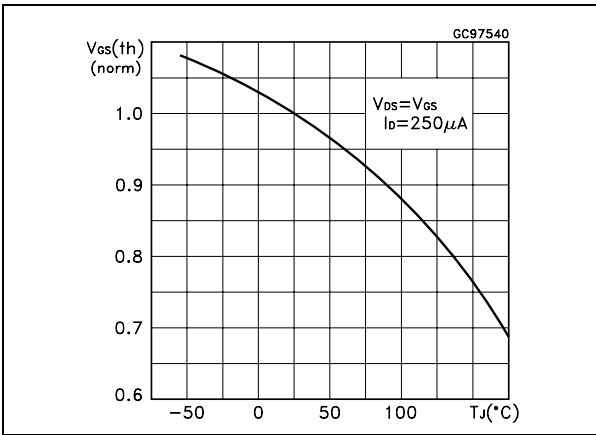


Figure 12. Normalized on resistance vs temperature

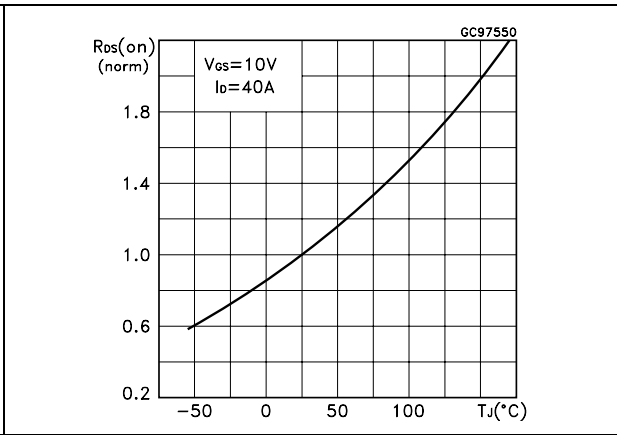


Figure 13. Source-drain diode forward characteristics

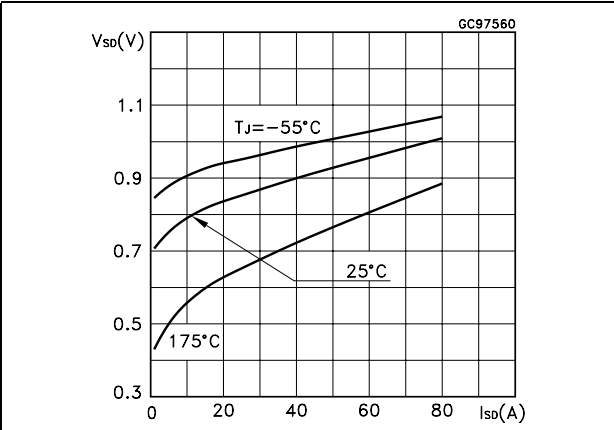
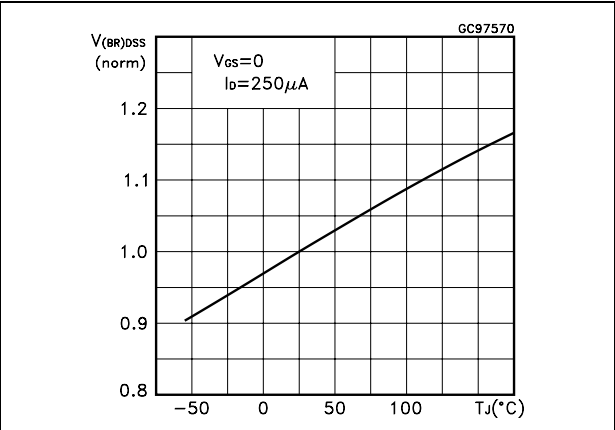


Figure 14. Normalized B_{VDSS} vs temperature



3 Test circuit

Figure 15. Switching times test circuit for resistive load

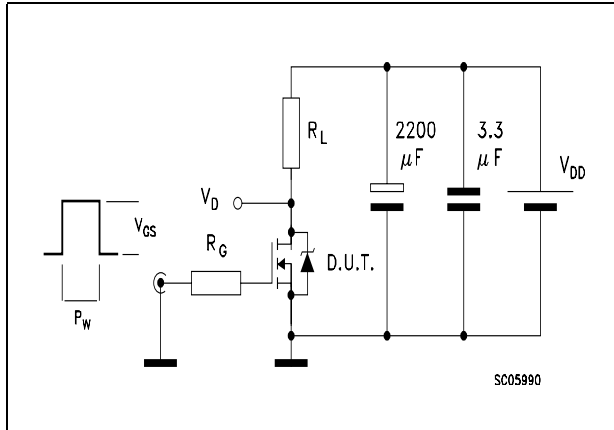


Figure 16. Gate charge test circuit

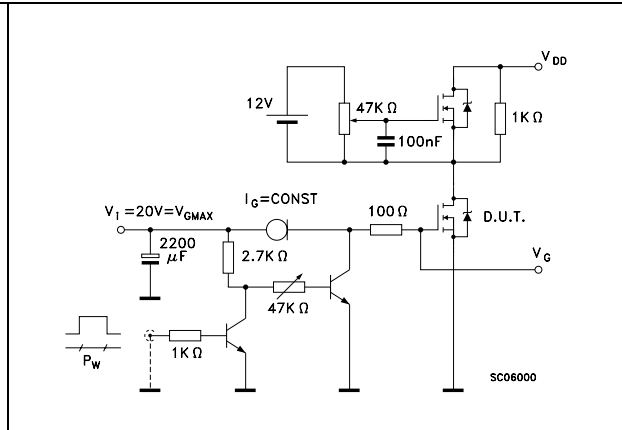


Figure 17. Test circuit for inductive load switching and diode recovery times

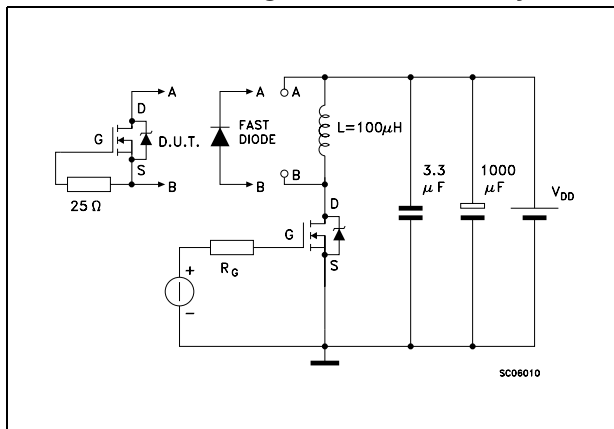


Figure 18. Unclamped inductive load test circuit

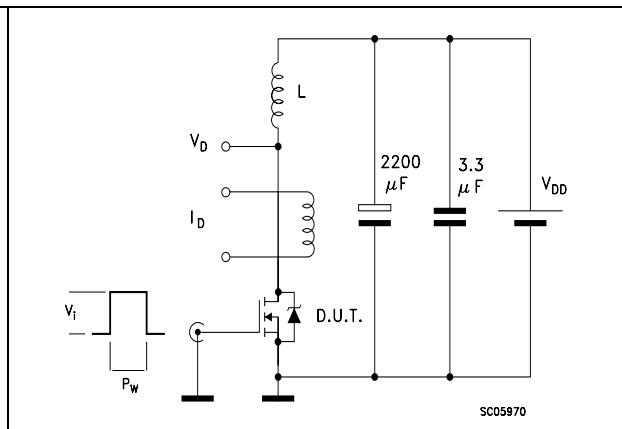
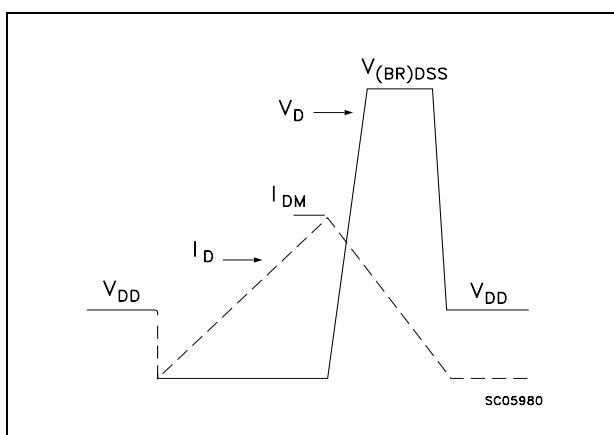


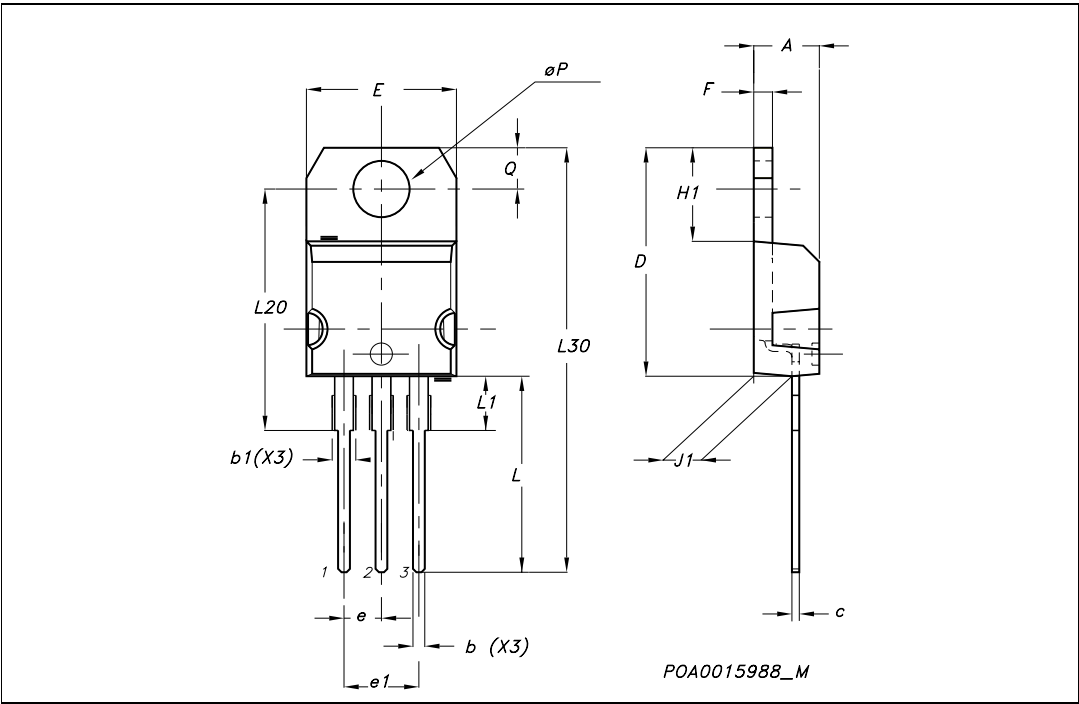
Figure 19. Unclamped inductive waveform



4 Package mechanical data

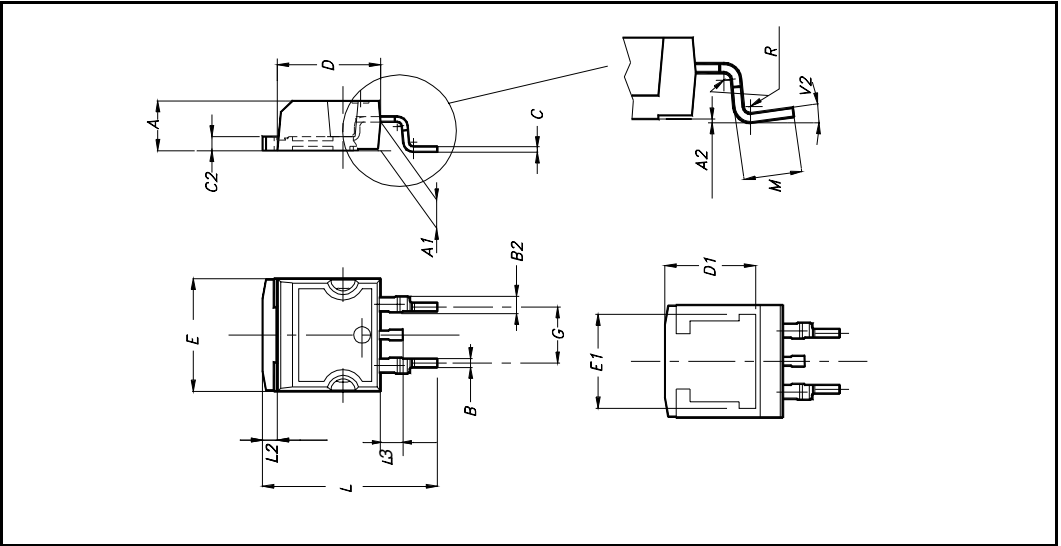
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

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	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
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		0.052
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



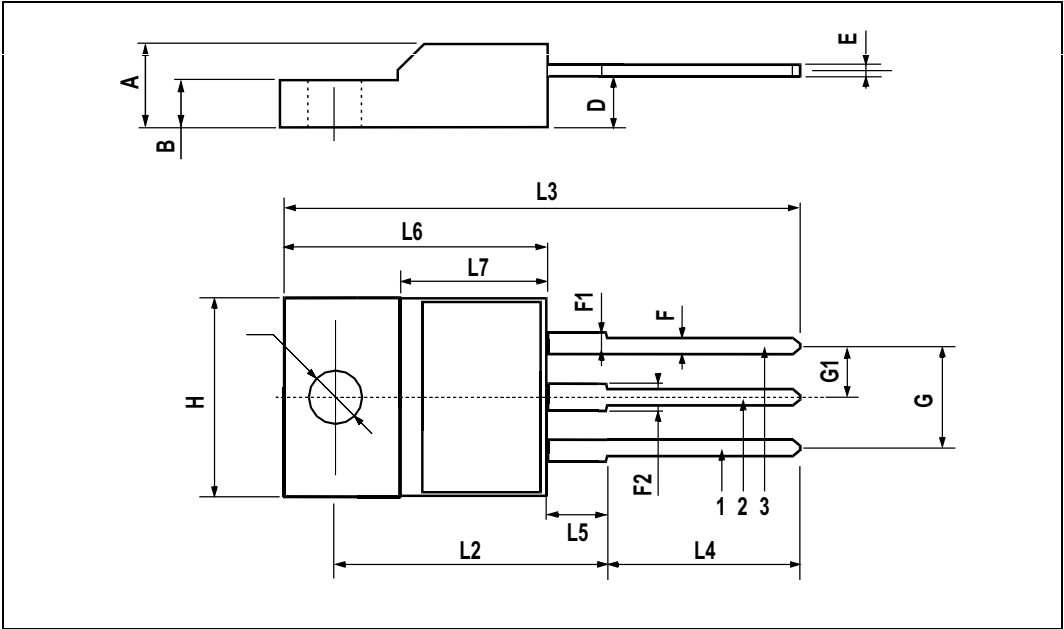
D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



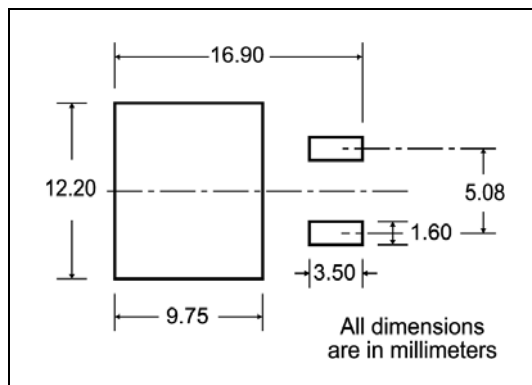
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	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		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

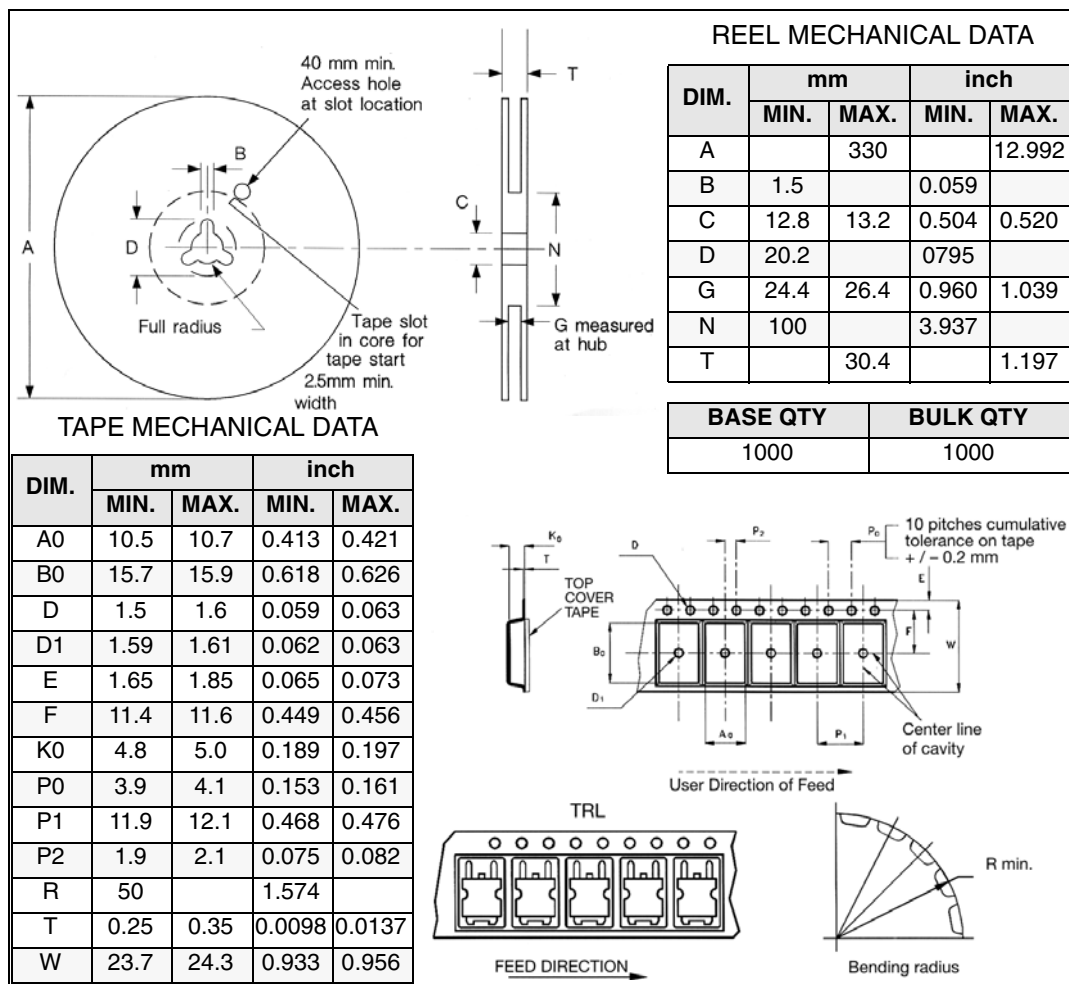


5 Packaging mechanical data

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT



* on sales type

6 Revision history

Table 7. Revision history

Date	Revision	Changes
03-Aug-2006	6	Complete version
15-Sep-2006	7	R _{DS(on)} value update
27-Feb-2007	8	The document has been reformatted

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