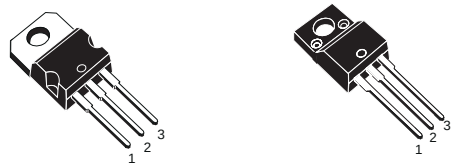
STP20NM50FD
STF20NM50D - STB20NM50FD

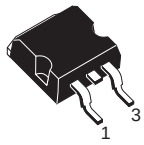
N-CHANNEL 500V - 0.22Ω - 20A TO-220/TO-220FP/D²PAK
FDmesh™ Power MOSFET (with FAST DIODE)

TYPE	V_{DSS}	$R_{DS(on)}$	$R_{ds(on)}*Q_g$	I_D
STP20NM50FD	500V	<0.25Ω	8.36 Ω*nC	20 A
STF20NM50D	500V	<0.25Ω	8.36 Ω*nC	20 A
STB20NM50FD	500V	<0.25Ω	8.36 Ω*nC	20 A

- TYPICAL R_{DS}(on) = 0.22Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS

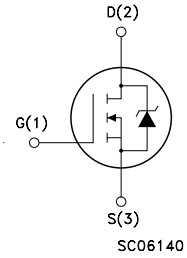


TO-220 **TO-220FP**



D²PAK

INTERNAL SCHEMATIC DIAGRAM



DESCRIPTION

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

APPLICATIONS

- ZVS PHASE-SHIFT FULL BRIDGE CONVERTERS FOR SMPS AND WELDING EQUIPMENT

ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP20NM50FD	P20NM50FD	TO-220	TUBE
STF20NM50D	F20NM50D	TO-220FP	TUBE
STB20NM50FD	B20NM50FD	D²PAK	TAPE & REEL

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP20NM50FD STB20NM50FD	STF20NM50D	
V_{DS}	Drain-source Voltage (V_{GS} = 0)	500		V
V_{DGR}	Drain-gate Voltage (R_{GS} = 20 kΩ)	500		V
V_{GS}	Gate- source Voltage	±30		V
I_D	Drain Current (continuous) at T_C = 25°C	20	20 (*)	A
I_D	Drain Current (continuous) at T_C = 100°C	14	14 (*)	A
I_{DM} (●)	Drain Current (pulsed)	80	80 (*)	A
P_{TOT}	Total Dissipation at T_C = 25°C	192	45	W
	Derating Factor	1.2	0.36	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	20		V/ns
V_{ISO}	Insulation Winthstand Voltage (DC)	--	2000	V
T_{stg}	Storage Temperature	–65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

(●) Pulse width limited by safe operating area

(1) $I_{SD} \le 20A$, $di/dt \le 200$ A/µs, $V_{DD} \le V_{(BR)DSS}$, $T_j \le T_{JMAX.}$

(*) Limited only by maximum temperature allowed

THERMAL DATA

			TO-220 / D^2PAK	TO-220FP	
Rthj-case	Thermal Resistance Junction-case	Max	0.65	2.8	°C/W
Rthj-amb	Thermal Resistance Junction-ambient	Max	62.5		°C/W
T_l	Maximum Lead Temperature For Soldering Purpose		300		°C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	10	A
E_{AS}	Single Pulse Avalanche Energy (starting T_j = 25 °C, $I_D = I_{AR}$, V_{DD} = 35 V)	700	mJ

ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED)

ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	I_D = 250 µA, V_{GS} = 0	500			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating			1	µA
		V_{DS} = Max Rating, T_C = 125 °C			10	µA
I_{GSS}	Gate-body Leakage Current (V_{DS} = 0)	V_{GS} = ±30V			±100	nA
$V_{GS(th}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{GS} = 10V, I_D = 10A		0.22	0.25	Ω

ELECTRICAL CHARACTERISTICS (CONTINUED)

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$, $I_D = 10A$		9		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V$, f = 1 MHz, $V_{GS} = 0$		1380 290 40		pF pF pF
$C_{oss\ eq.}$ (2)	Equivalent Output Capacitance	$V_{GS} = 0V$, $V_{DS} = 0V$ to 400V		130		pF
R_g	Gate Input Resistance	f=1 MHz Gate DC Bias=0 Test Signal Level=20mV Open Drain		2.8		Ω

(1) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %.

(2) $C_{oss\ eq.}$ 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}.

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 250V$, $I_D = 10$ A $R_G = 4.7\Omega$ $V_{GS} = 10V$ (see test circuit, Figure 3)		22		ns
t_r	Rise Time			20		ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 400V$, $I_D = 20A$, $V_{GS} = 10V$		38 18 10	53	nC nC nC

SWITCHING OFF

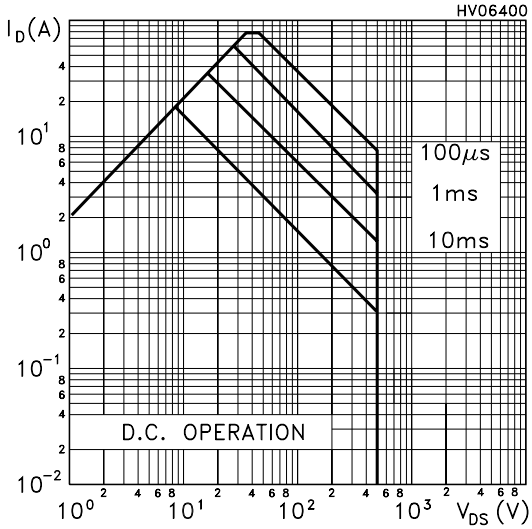
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 400V$, $I_D = 20$ A, $R_G = 4.7\Omega$, $V_{GS} = 10V$ (see test circuit, Figure 5)		6		ns
t_f	Fall Time			15		ns
t_c	Cross-over Time			30		ns

SOURCE DRAIN DIODE

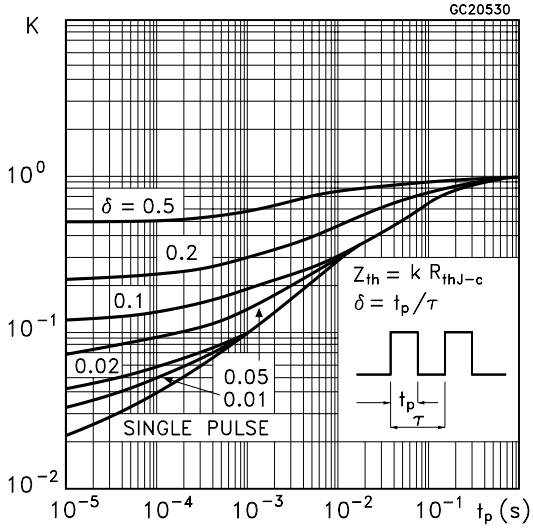
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				20	A
I_{SDM} (2)	Source-drain Current (pulsed)				80	A
V_{SD} (1)	Forward On Voltage	$I_{SD} = 20$ A, $V_{GS} = 0$			1.5	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 20$ A, di/dt = 100A/µs, $V_{DD} = 60V$, $T_j = 150°C$ (see test circuit, Figure 5)		245		ns
Q_{rr}	Reverse Recovery Charge			2		µC
I_{RRM}	Reverse Recovery Current			16		A

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

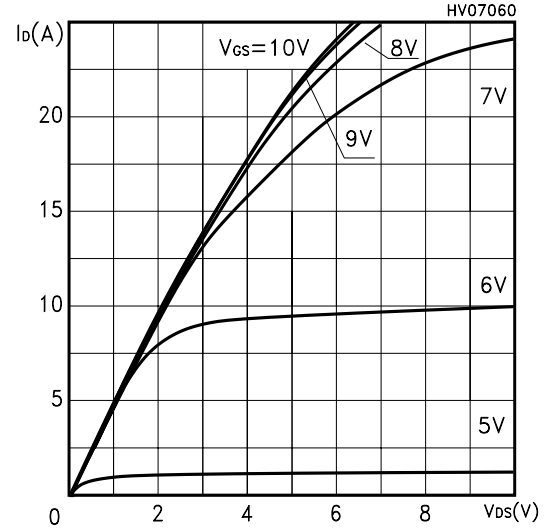
Safe Operating Area For TO-220 / I²PAK



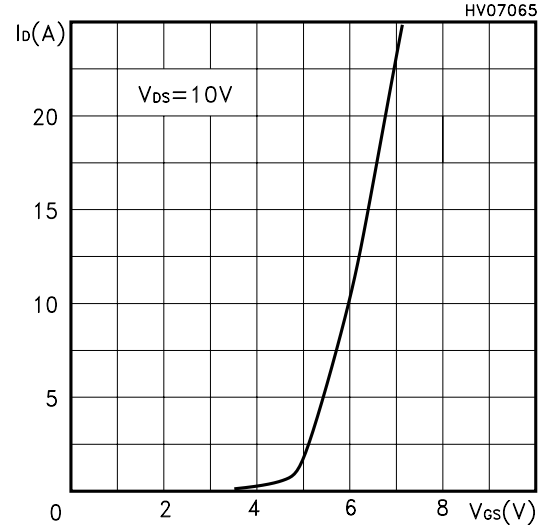
Thermal Impedance For TO-220 / I²PAK



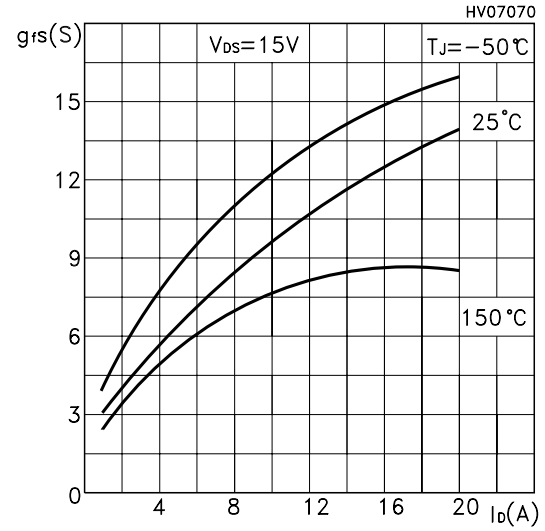
Output Characteristics



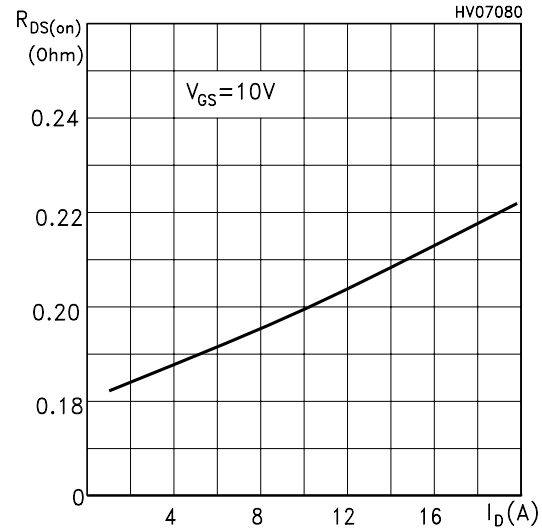
Transfer Characteristics



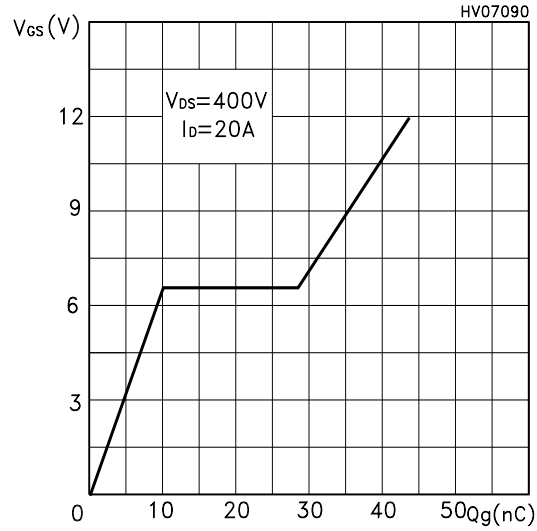
Transconductance



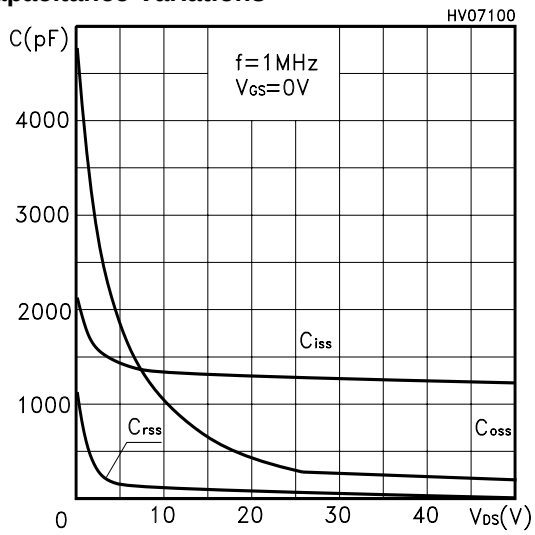
Static Drain-source On Resistance



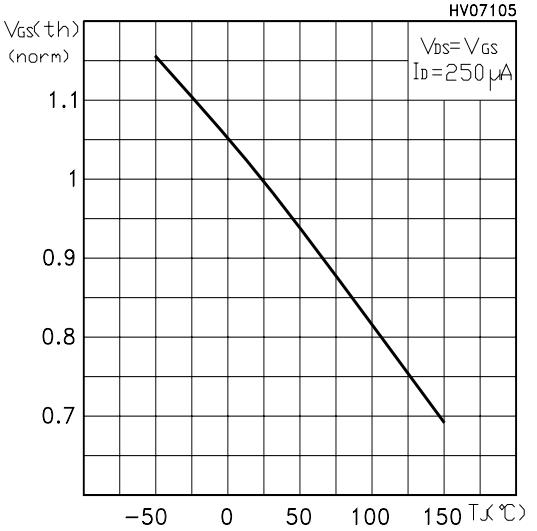
Gate Charge vs Gate-source Voltage



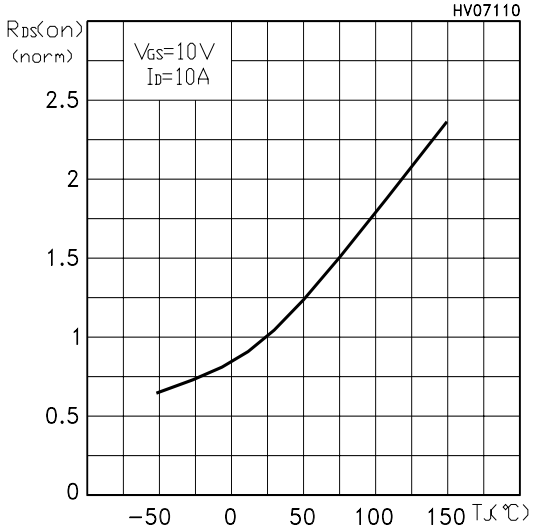
Capacitance Variations



Normalized Gate Thereshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

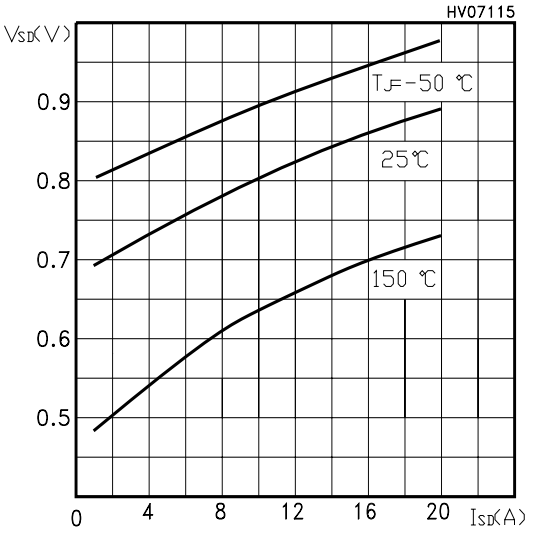


Fig. 1: Unclamped Inductive Load Test Circuit

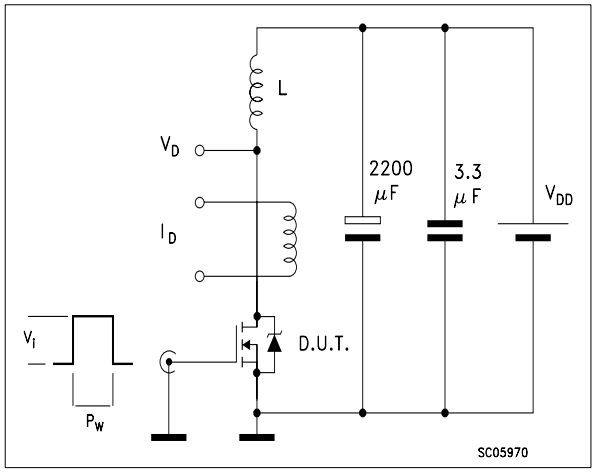


Fig. 2: Unclamped Inductive Waveform

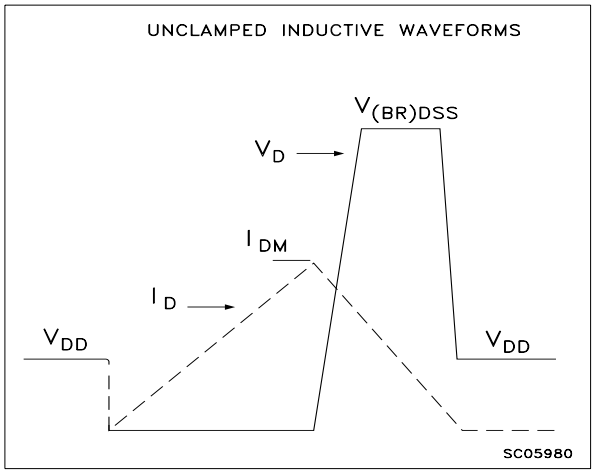


Fig. 3: Switching Times Test Circuit For Resistive Load

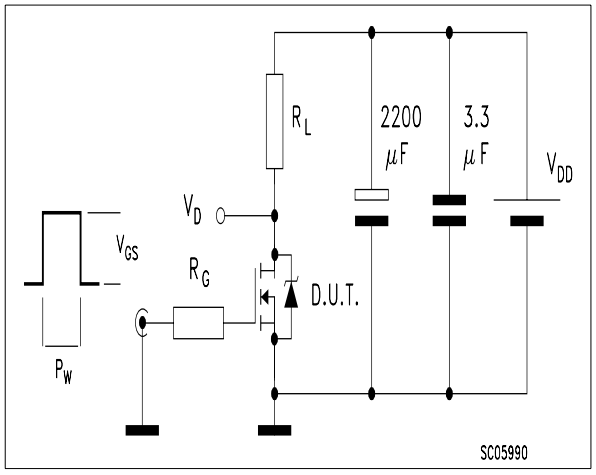


Fig. 4: Gate Charge test Circuit

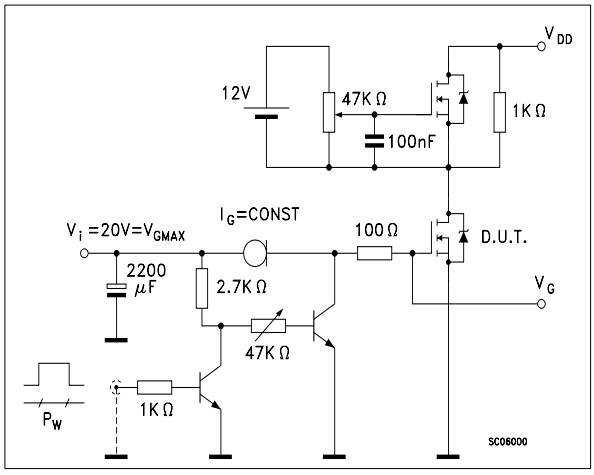
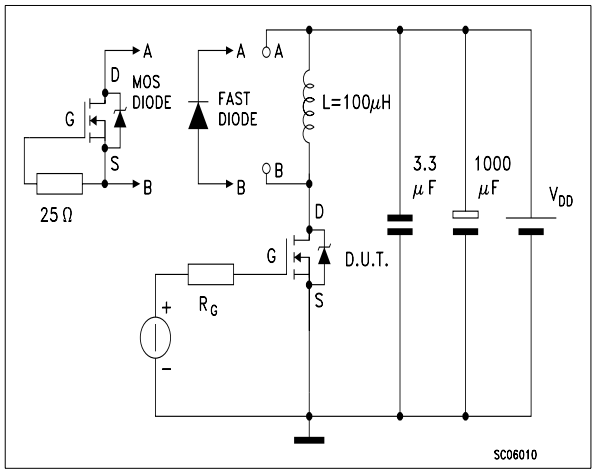
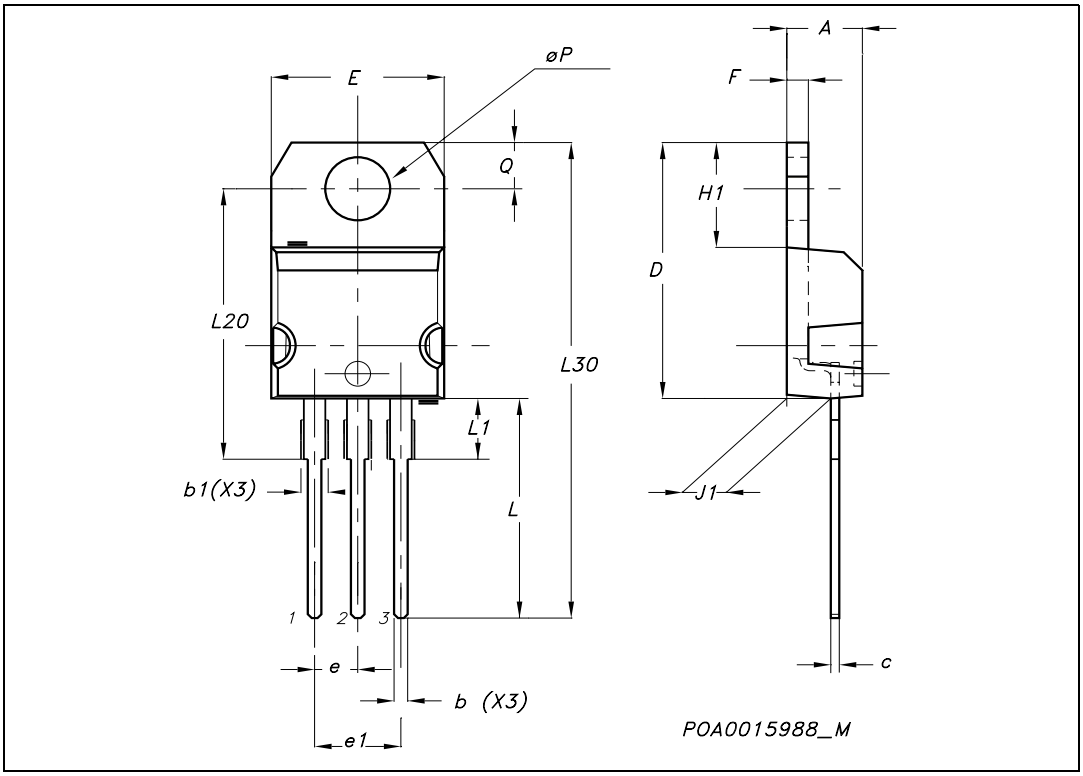


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



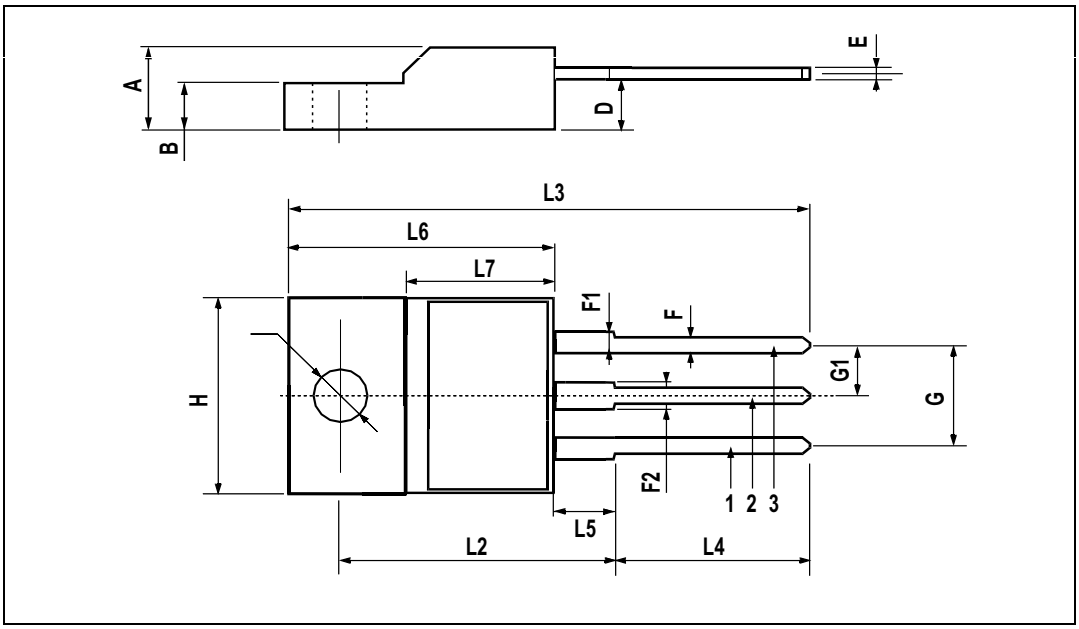
TO-220 MECHANICAL DATA

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



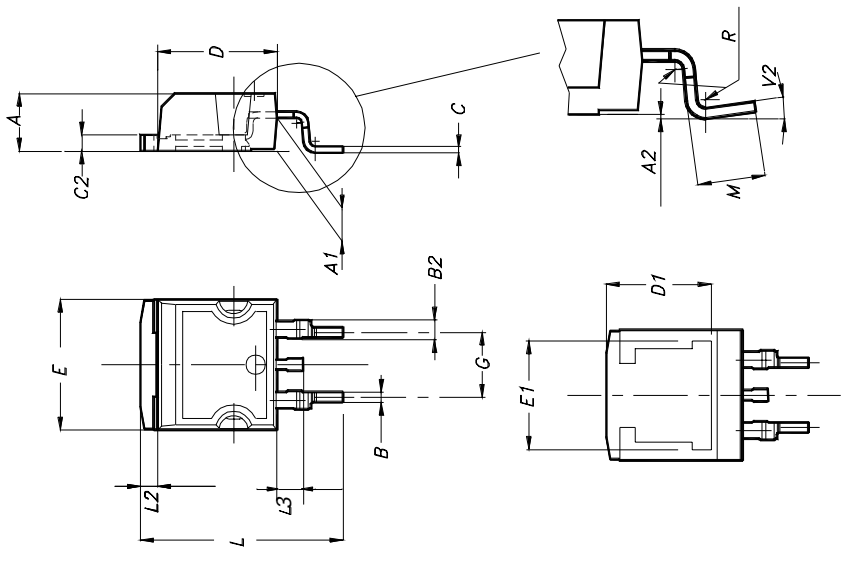
TO-220FP MECHANICAL DATA

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

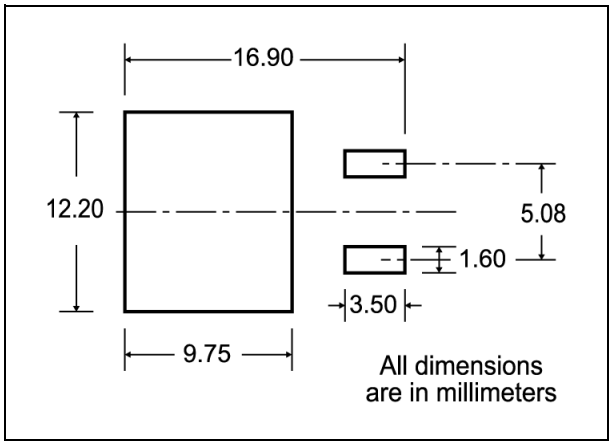


D²PAK MECHANICAL DATA

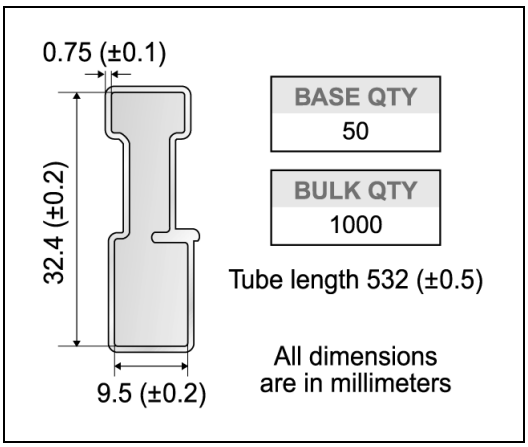
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
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	0º		4º			



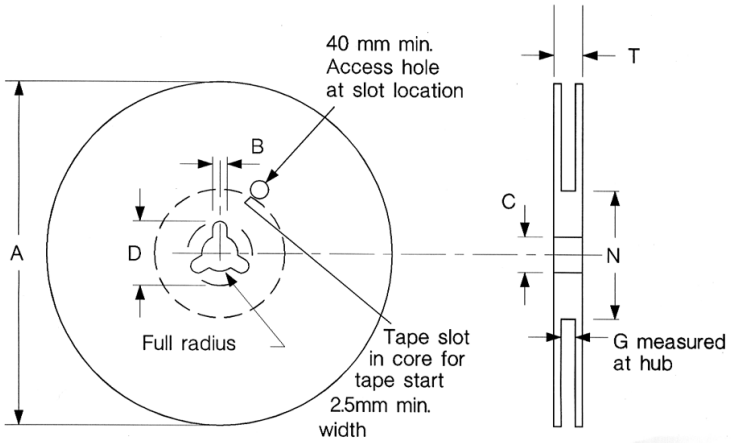
D^2PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*



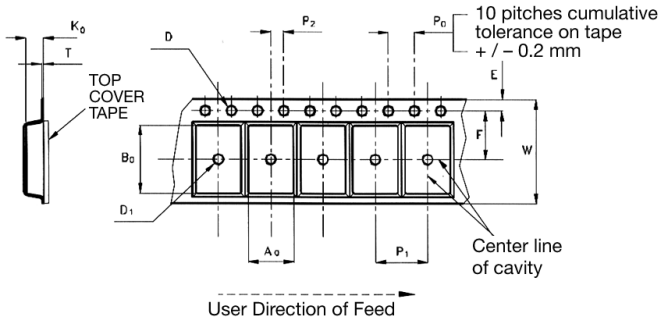
REEL MECHANICAL DATA

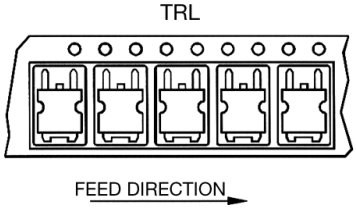
DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

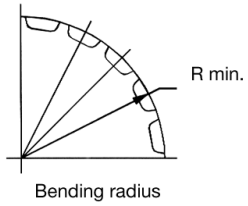
BASE QTY	BULK QTY
1000	1000

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







* on sales type