



STP20NM60 - STP20NM60FP STB20NM60 STB20NM60-1

N-CHANNEL 650V @T_{jmax} - 0.25Ω -20A TO-220/FP/D²PAK/I²PAK
MDmesh™ MOSFET

TYPE	V _{DSS} (@T _{jmax})	R _{DS(on)}	I _D
STP20NM60	650 V	< 0.29 Ω	20 A
STP20NM60FP	650 V	< 0.29 Ω	20 A
STB20NM60	650 V	< 0.29 Ω	20 A
STB20NM60-1	650 V	< 0.29 Ω	20 A

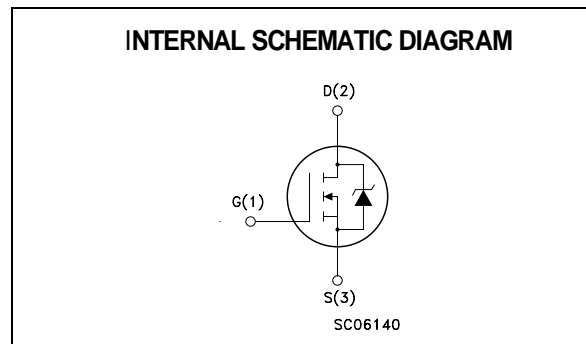
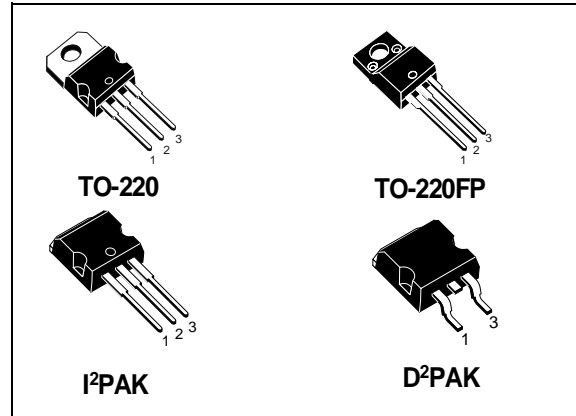
- TYPICAL R_{DS(on)} = 0.25Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE

DESCRIPTION

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

APPLICATIONS

The MDmesh™ family is very suitable for increasing power density of high voltage converters allowing system miniaturization and higher efficiencies.



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP(B)20NM60(-1)	STP20NM60FP	
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	12.6	12.6(*)	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	15		V/ns
V _{ISO}	Insulation Withstand Voltage (DC)	--	2500	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} ≤ 20A, di/dt ≤ 400A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

(*) Limited only by maximum temperature allowed

STP20NM60 / STP20NM60FP / STB20NM60 / STB20NM60-1

THERMAL DATA

			TO-220/D ² PAK/I ² PAK	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} = 50 V)	650	mJ

ELECTRICAL CHARACTERISTICS (T_{CASE} = 25 °C UNLESS OTHERWISE SPECIFIED)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source Breakdown Voltage	I _D = 250 μA, V _{GS} = 0	600			V
I _{DSS}	Zero Gate Voltage Drain Current (V _{GS} = 0)	V _{DS} = Max Rating V _{DS} = Max Rating, T _C = 125 °C			1 10	μA μA
I _{GSS}	Gate-body Leakage Current (V _{DS} = 0)	V _{GS} = ±30V			±100	nA

ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	3	4	5	V
R _{DS(on)}	Static Drain-source On Resistance	V _{GS} = 10V, I _D = 10A		0.25	0.29	Ω

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g _{fs} (1)	Forward Transconductance	V _{DS} > I _{D(on)} × R _{DS(on)max} , I _D = 10A		11		S
C _{iss}	Input Capacitance	V _{DS} = 25V, f = 1 MHz, V _{GS} = 0		1500		pF
C _{oss}	Output Capacitance			350		pF
C _{rss}	Reverse Transfer Capacitance			35		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		1.6		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}.

ELECTRICAL CHARACTERISTICS (CONTINUED)

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 200V, I_D = 10 A$ $R_G = 4.7\Omega, V_{GS} = 10V$		25		ns
t_r	Rise Time	(see test circuit, Figure 3)		20		ns
Q_g	Total Gate Charge	$V_{DD} = 400V, I_D = 20A,$ $V_{GS} = 10V$		39	54	nC
Q_{gs}	Gate-Source Charge			10		nC
Q_{gd}	Gate-Drain Charge			20		nC

SWITCHING OFF

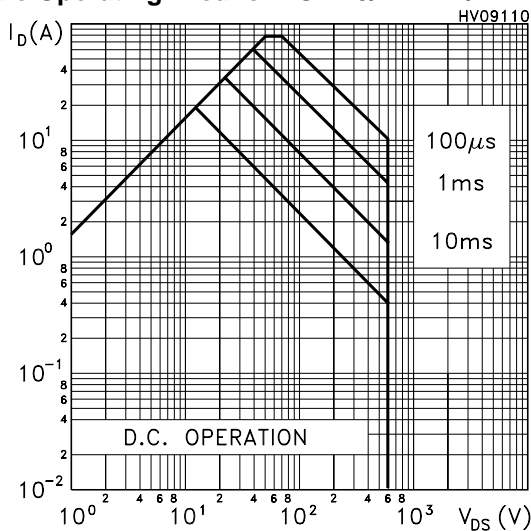
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 480V, I_D = 20 A,$ $R_G = 4.7\Omega, V_{GS} = 10V$		6		ns
t_f	Fall Time	(see test circuit, Figure 5)		11		ns
t_c	Cross-over Time			21		ns

SOURCE DRAIN DIODE

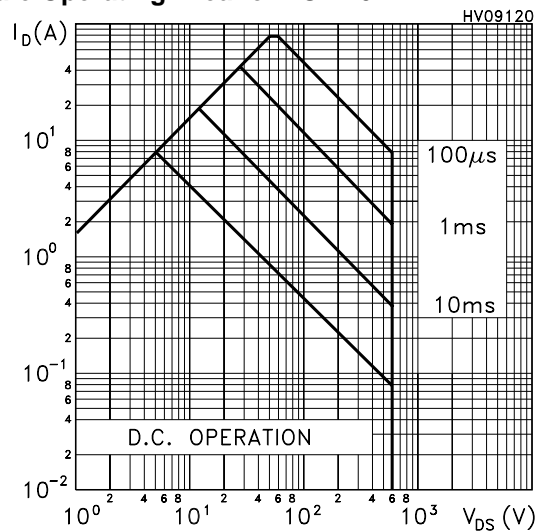
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				20	A
$I_{SDM(2)}$	Source-drain Current (pulsed)				80	A
$V_{SD(1)}$	Forward On Voltage	$I_{SD} = 20 A, V_{GS} = 0$			1.5	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 20 A, di/dt = 100A/\mu s,$ $V_{DD} = 100 V, T_j = 25^\circ C$		390		ns
Q_{rr}	Reverse Recovery Charge	(see test circuit, Figure 5)		5		μC
I_{rrm}	Reverse Recovery Current			25		A
t_{rr}	Reverse Recovery Time	$I_{SD} = 20 A, di/dt = 100A/\mu s,$ $V_{DD} = 100 V, T_j = 150^\circ C$		510		ns
Q_{rr}	Reverse Recovery Charge	(see test circuit, Figure 5)		6.5		μC
I_{rrm}	Reverse Recovery Current			26		A

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

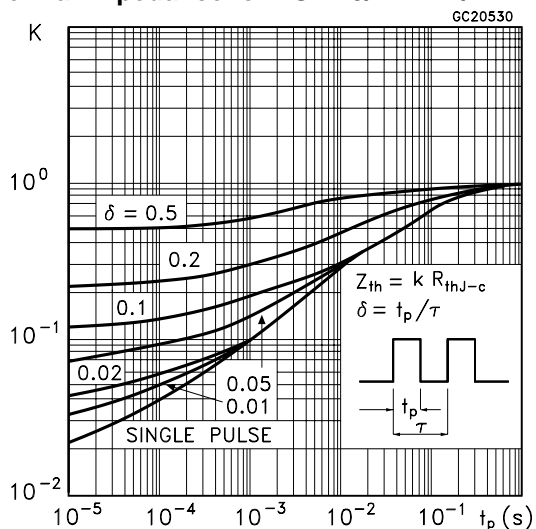
Safe Operating Area for TO-220/D2PAK/I2PAK



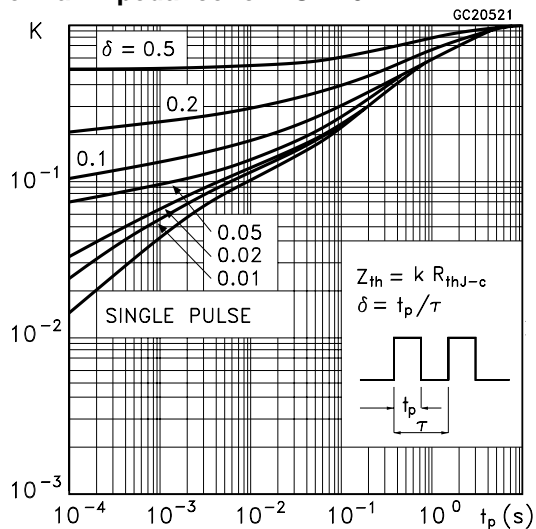
Safe Operating Area for TO-220FP



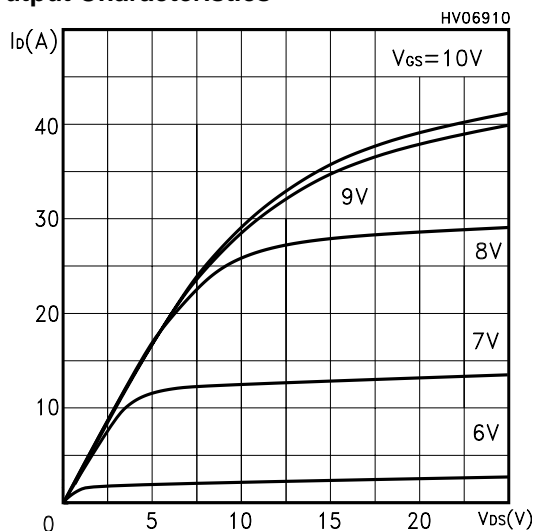
Thermal Impedance for TO-220/D2PAK/I2PAK



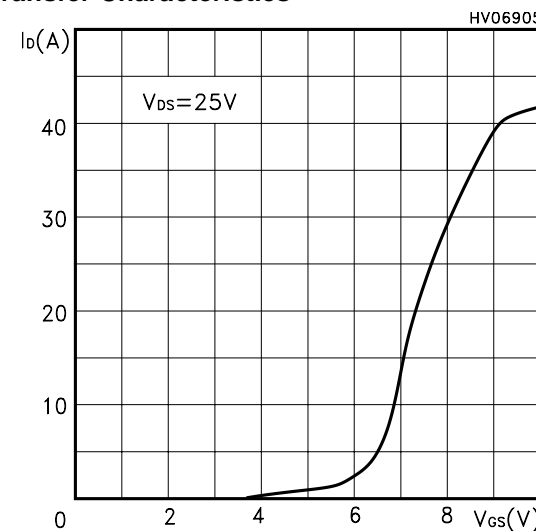
Thermal Impedance for TO-220FP



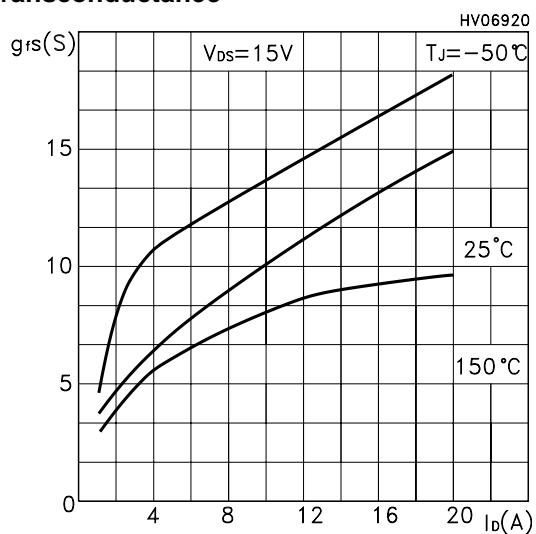
Output Characteristics



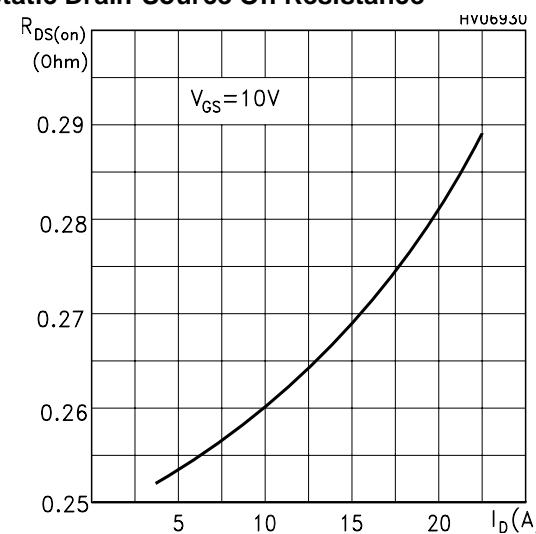
Transfer Characteristics



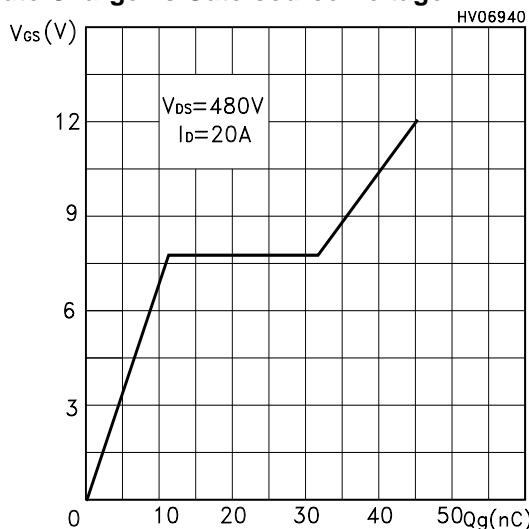
Transconductance



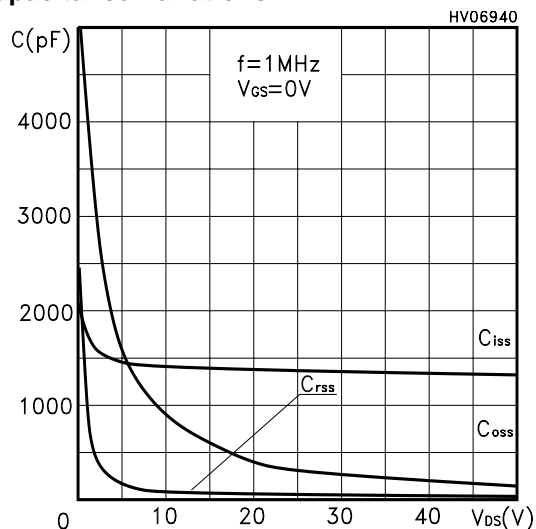
Static Drain-Source On Resistance



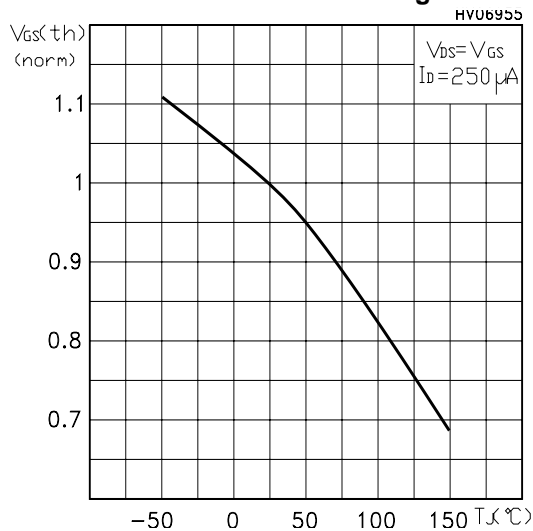
Gate Charge vs Gate-source Voltage



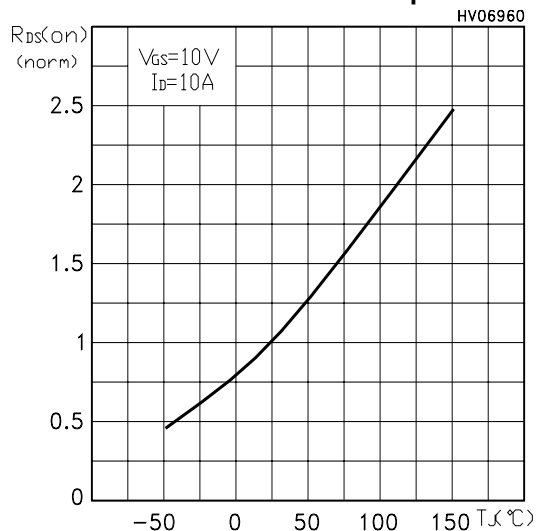
Capacitance Variations



Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

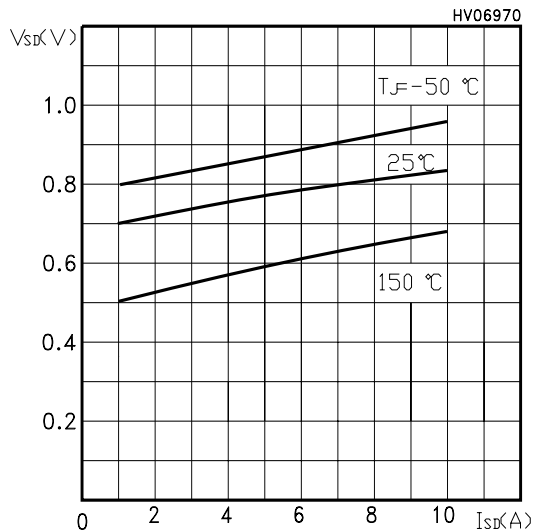


Fig. 1: Unclamped Inductive Load Test Circuit

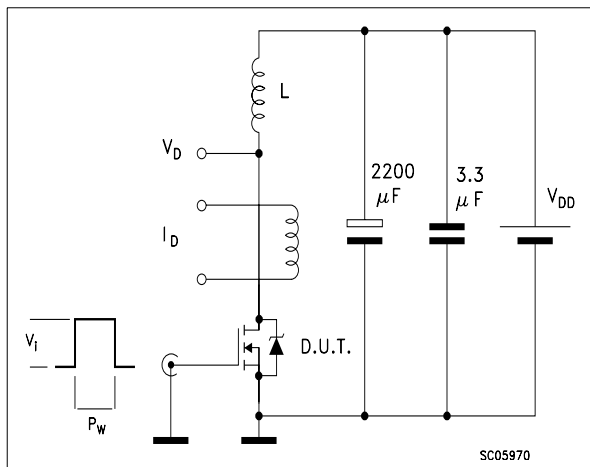


Fig. 2: Unclamped Inductive Waveform

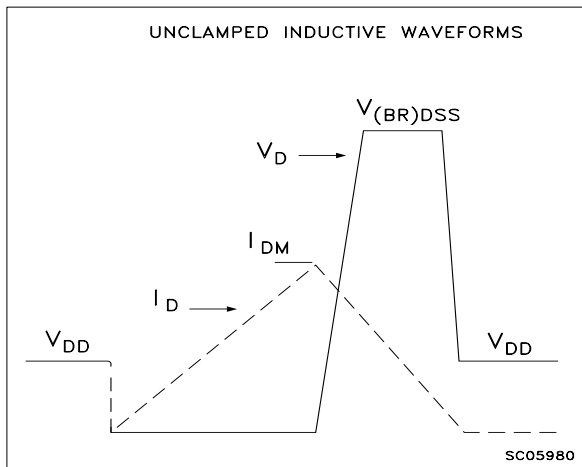


Fig. 3: Switching Times Test Circuit For Resistive Load

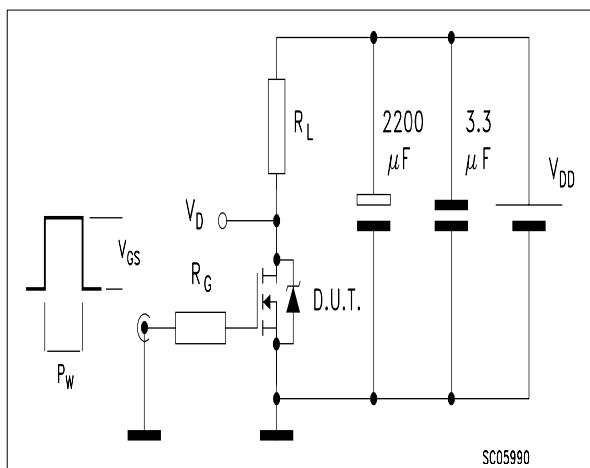


Fig. 4: Gate Charge test Circuit

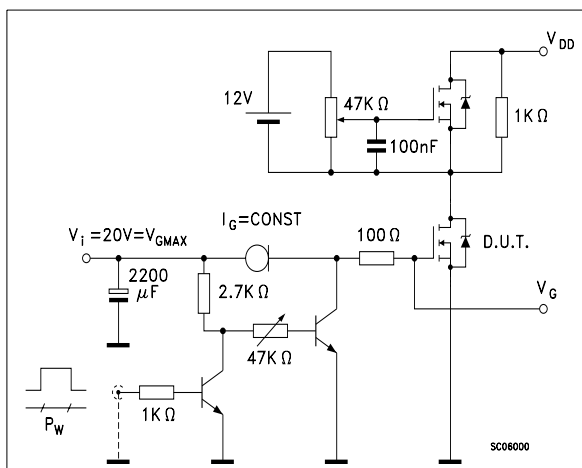
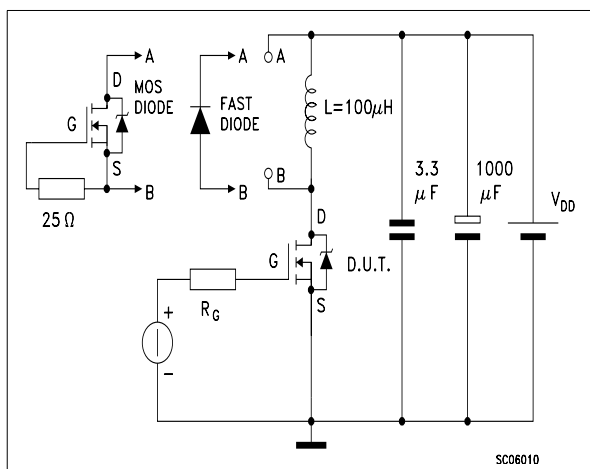
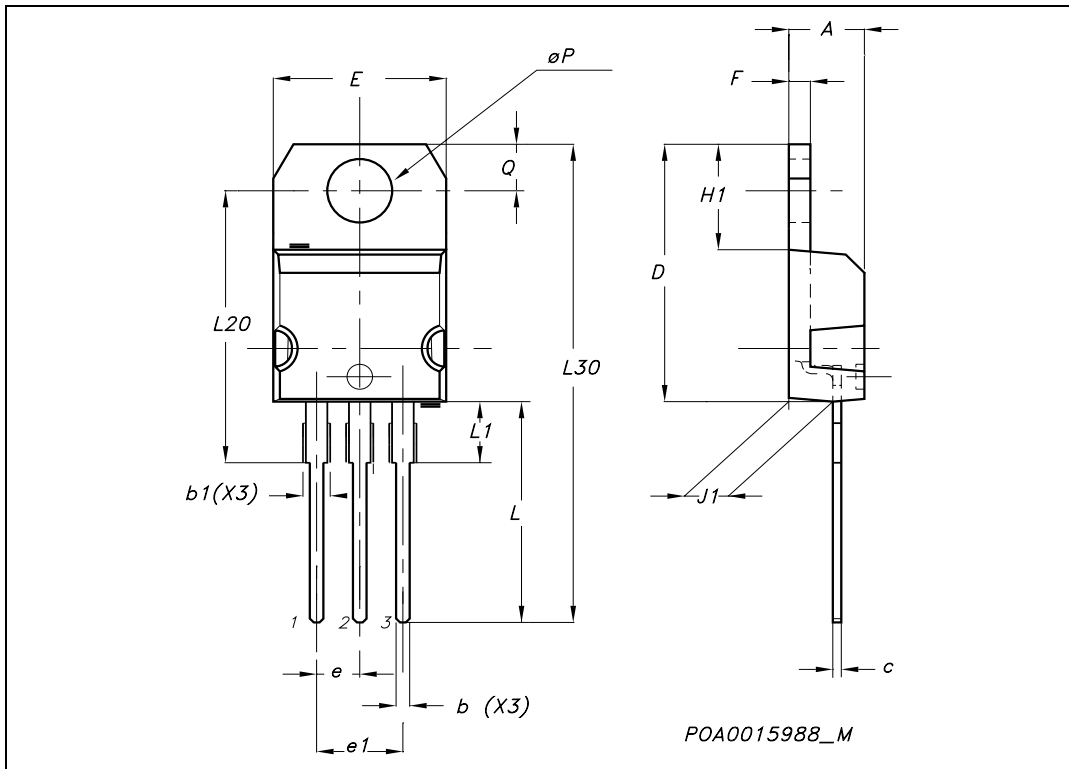


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



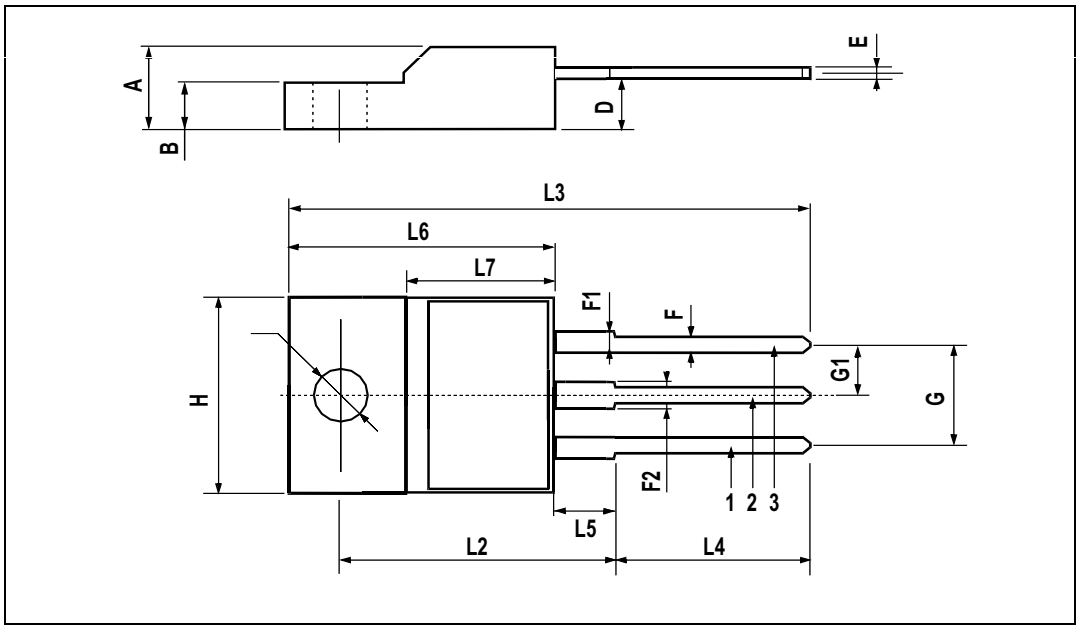
TO-220 MECHANICAL DATA

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



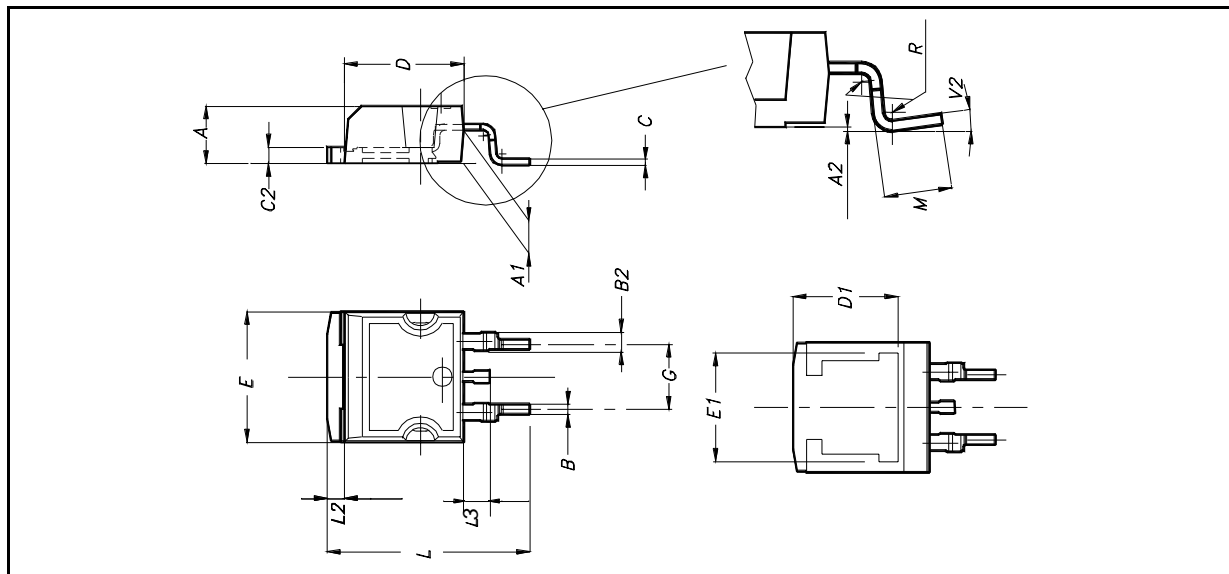
TO-220FP MECHANICAL DATA

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
∅	3		3.2	0.118		0.126



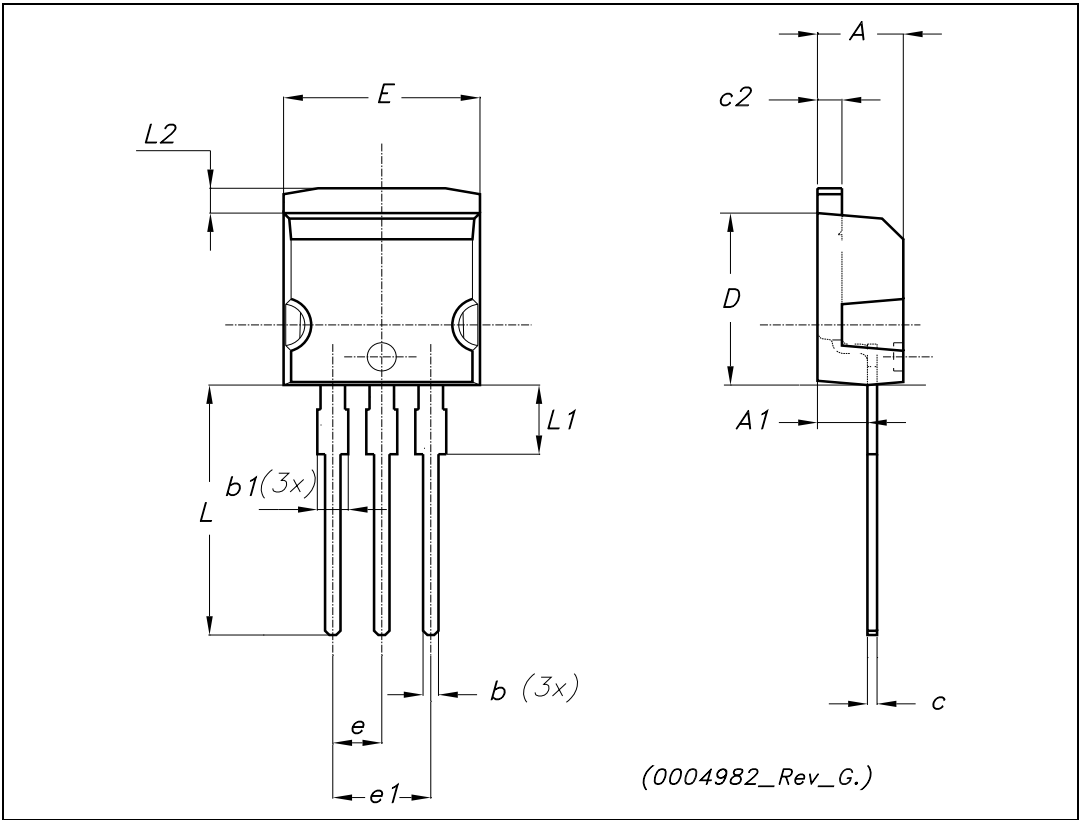
D²PAK MECHANICAL DATA

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	0°		8°			

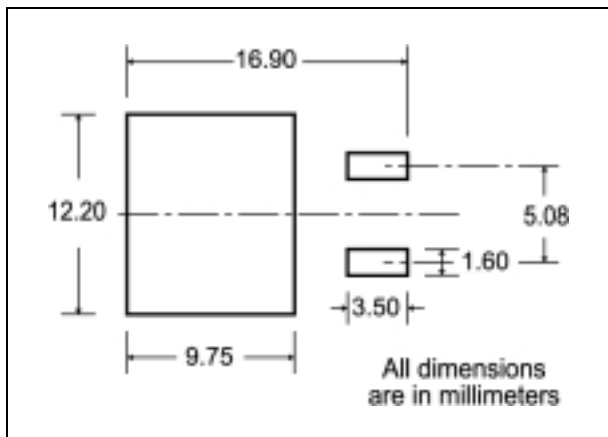


TO-262 (I²PAK) MECHANICAL DATA

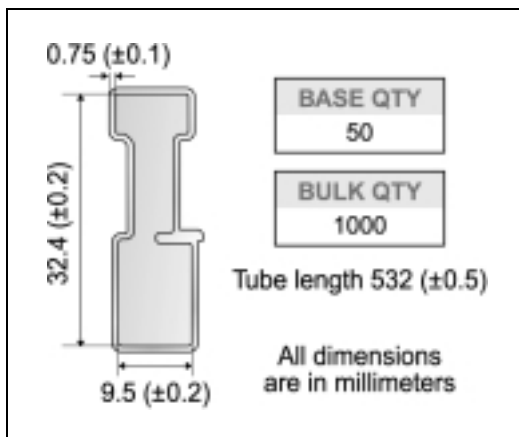
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*

Diagram showing the tape mechanical data. It includes a top view of the tape with dimensions A, B, C, D, and G. A 40 mm min. access hole is shown at the slot location. The tape slot in the core has a 2.5 mm min. width. The full radius is also indicated. A side view shows dimensions T, C, N, and G measured at the hub.

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

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

Diagram showing the reel mechanical data. It includes a top view of the reel with dimensions A₀, B₀, D₁, E, F₀, F₁, F₂, F₃, F₄, F₅, F₆, F₇, F₈, F₉, F₁₀, F₁₁, F₁₂, F₁₃, F₁₄, F₁₅, F₁₆, F₁₇, F₁₈, F₁₉, F₂₀, F₂₁, F₂₂, F₂₃, F₂₄, F₂₅, F₂₆, F₂₇, F₂₈, F₂₉, F₃₀, F₃₁, F₃₂, F₃₃, F₃₄, F₃₅, F₃₆, F₃₇, F₃₈, F₃₉, F₄₀, F₄₁, F₄₂, F₄₃, F₄₄, F₄₅, F₄₆, F₄₇, F₄₈, F₄₉, F₅₀, F₅₁, F₅₂, F₅₃, F₅₄, F₅₅, F₅₆, F₅₇, F₅₈, F₅₉, F₆₀, F₆₁, F₆₂, F₆₃, F₆₄, F₆₅, F₆₆, F₆₇, F₆₈, F₆₉, F₇₀, F₇₁, F₇₂, F₇₃, F₇₄, F₇₅, F₇₆, F₇₇, F₇₈, F₇₉, F₈₀, F₈₁, F₈₂, F₈₃, F₈₄, F₈₅, F₈₆, F₈₇, F₈₈, F₈₉, F₉₀, F₉₁, F₉₂, F₉₃, F₉₄, F₉₅, F₉₆, F₉₇, F₉₈, F₉₉, F₁₀₀. The diagram also shows the top cover tape, the center line of the cavity, the user direction of feed, the feed direction, and the bending radius (R min.).

* on sales type



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