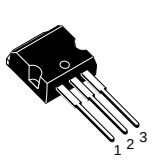
STB20NM60A-1
STP20NM60A - STF20NM60A

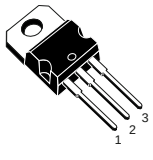
N-CHANNEL 650V@Tj_{max} - 0.25Ω - 20A I²PAK/TO-220/TO-220FP
MDmesh™ MOSFET

TYPE	V_{DSS} @Tj_{max}	$R_{DS(on)}$	I_D
STB20NM60A-1	650 V	< 0.29 Ω	20 A
STP20NM60A	650 V	< 0.29 Ω	20 A
STF20NM60A	650 V	< 0.29 Ω	20 A

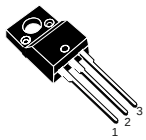
- TYPICAL $R_{DS}(on)$ = 0.25Ω
- HIGH dv/dt
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE



I²PAK



TO-220

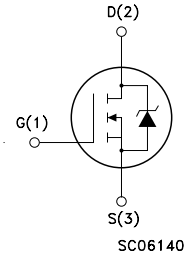


TO-220FP

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.

INTERNAL SCHEMATIC DIAGRAM



APPLICATIONS

- SPECIFICALLY DESIGNED FOR ADAPTORS IN QUASI-RESONANT CONFIGURATION

ORDER CODES

PART NUMBER	MARKING	PACKAGE	PACKAGING
STB20NM60A-1	B20NM60A	I^2PAK	TUBE
STP20NM60A	P20NM60A	TO-220	TUBE
STF20NM60A	F20NM60A	TO-220FP	TUBE

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STB20NM60A-1 STP20NM60A	STF20NM60A	
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 Winthstand Voltage (DC)	--	2500	V
T_{stg}	Storage Temperature	–55 to 150		°C
T_j	Max. Operating Junction Temperature			

(•) Pulse width limited by safe operating area
(1) $I_{SD} \leq 20A$, $di/dt \leq 400$ A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX.}$
(*) Limited only by maximum temperature allowed

THERMAL DATA

			I^2PAK/TO-220	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

ELECTRICAL CHARACTERISTICS (T_{CASE} = 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	600			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	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{GS} = 10V, I_D = 10A		0.25	0.29	Ω

ELECTRICAL CHARACTERISTICS (CONTINUED)

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$, $I_D = 10A$		11		S
C_{iss}	Input Capacitance	$V_{DS} = 25V$, f = 1 MHz, $V_{GS} = 0$		1630		pF
C_{oss}	Output Capacitance			350		pF
C_{rss}	Reverse Transfer Capacitance			33		pF
$C_{oss\ eq.}$ (2)	Equivalent Output Capacitance	$V_{GS} = 0V$, $V_{DS} = 0V$ to 400V		150		pF

(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	$V_{DD} = 300V$, $I_D = 10$ A $R_G = 4.7\Omega$ $V_{GS} = 10V$ (see test circuit, Figure 3)		20		ns
t_r	Rise Time			16		ns
Q_g	Total Gate Charge	$V_{DD} = 400V$, $I_D = 20A$, $V_{GS} = 10V$		45	60	nC
Q_{gs}	Gate-Source Charge			8.2		nC
Q_{gd}	Gate-Drain Charge			19		nC

SWITCHING OFF

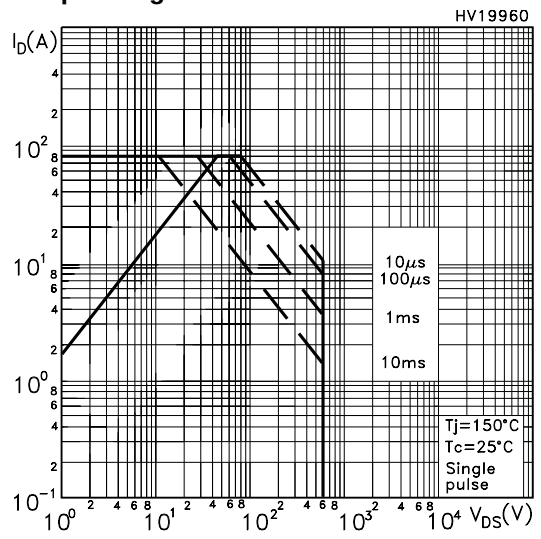
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off Delay Time	$V_{DD} = 300V$, $I_D = 20$ A, $R_G = 4.7\Omega$, $V_{GS} = 10V$ (see test circuit, Figure 5)		46		ns
t_f	Fall Time			20		ns

SOURCE DRAIN DIODE

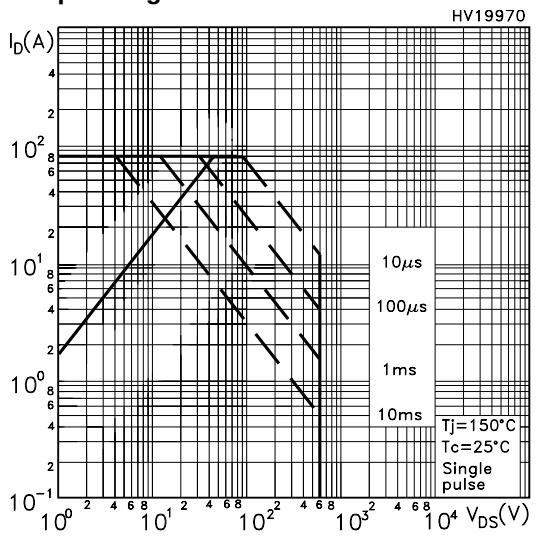
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				20	A
I_{SDM} (2)	Source-drain Current (pulsed)				80	A
V_{SD} (1)	Forward On Voltage	$I_{SD} = 20$ A, $V_{GS} = 0$			1.5	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 20$ A, di/dt = 100A/µs, $V_{DD} = 50$ V, $T_j = 25°C$ (see test circuit, Figure 5)		432		ns
Q_{rr}	Reverse Recovery Charge			5.1		µC
I_{rrm}	Reverse Recovery Current			23.6		A
t_{rr}	Reverse Recovery Time	$I_{SD} = 20$ A, di/dt = 100A/µs, $V_{DD} = 50$ V, $T_j = 150°C$ (see test circuit, Figure 5)		595		ns
Q_{rr}	Reverse Recovery Charge			7.3		µC
I_{rrm}	Reverse Recovery Current			24.8		A

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

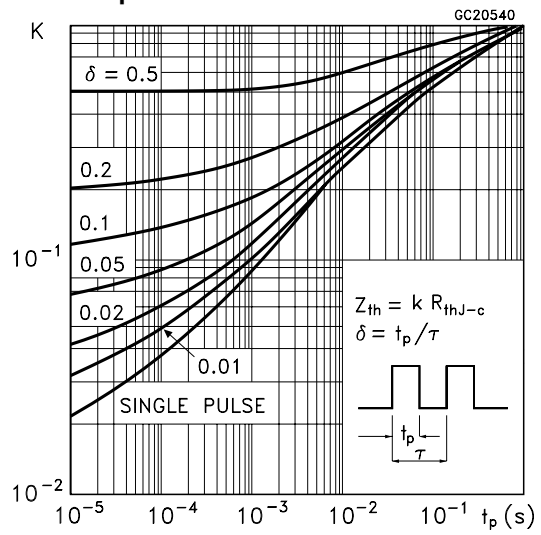
Safe Operating Area for TO-220/I2PAK



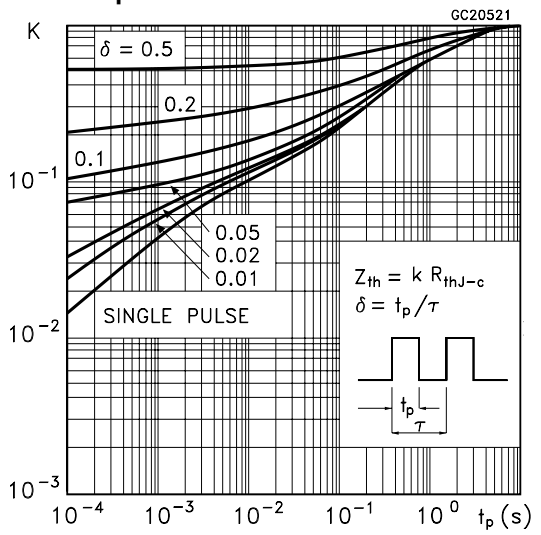
Safe Operating Area for TO-220FP



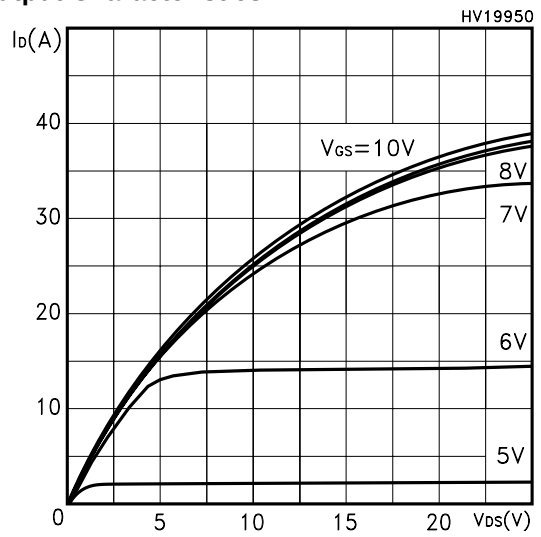
Thermal Impedance for TO-220/I2PAK



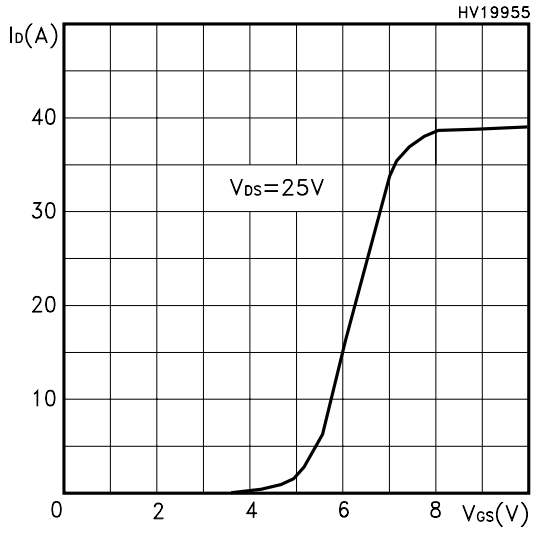
Thermal Impedance for TO-220FP



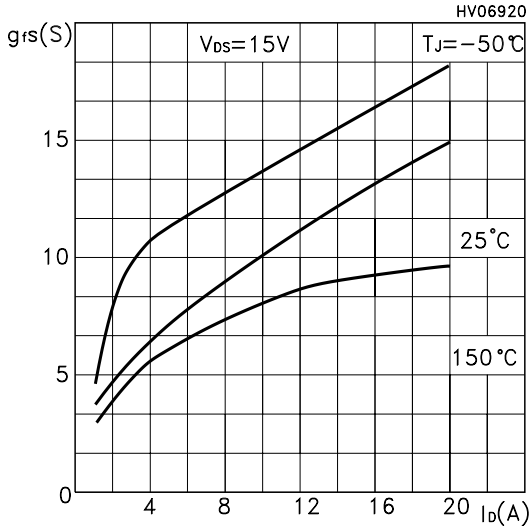
Output Characteristics



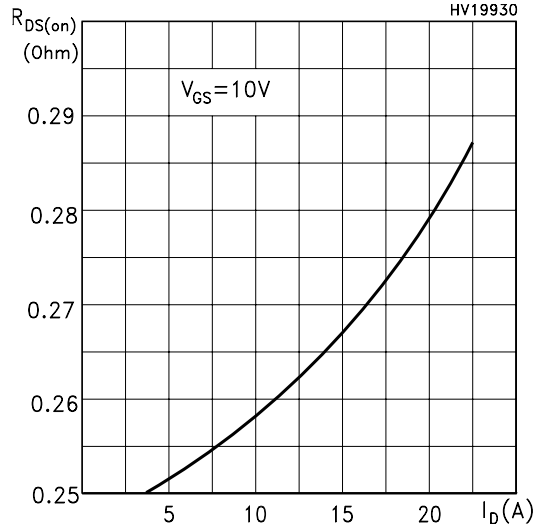
Transfer Characteristics



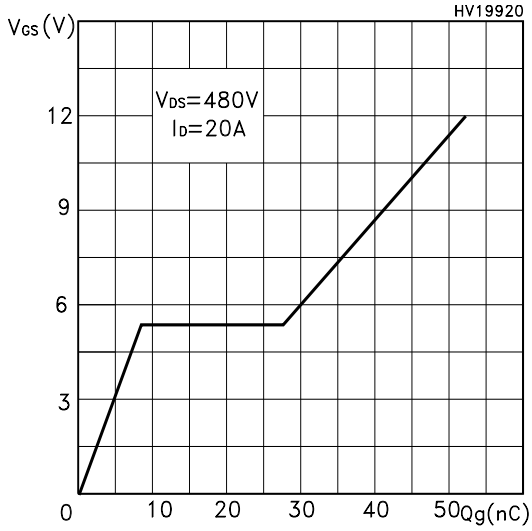
Transconductance



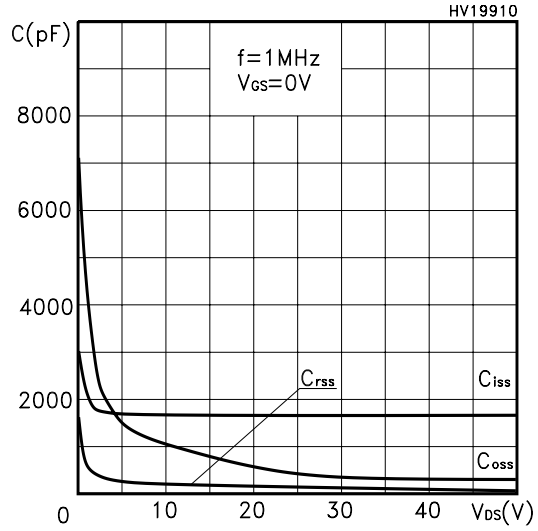
Static Drain-Source On Resistance



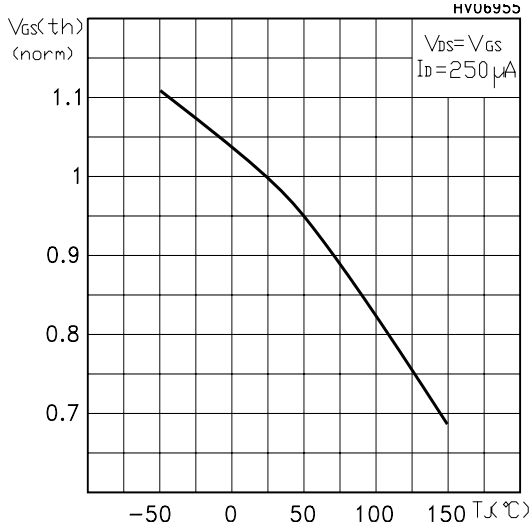
Gate Charge vs Gate-source Voltage



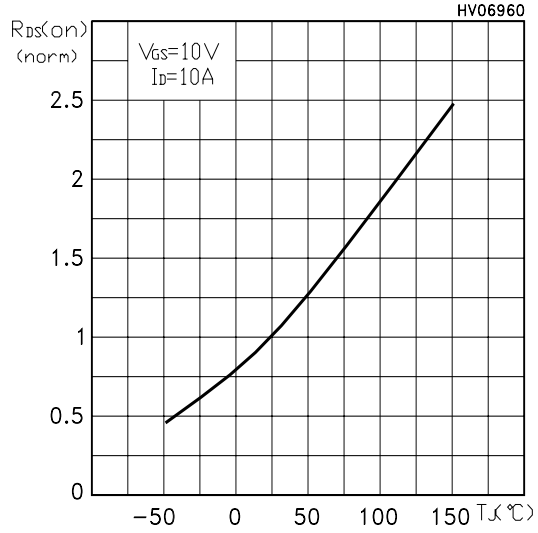
Capacitance Variations



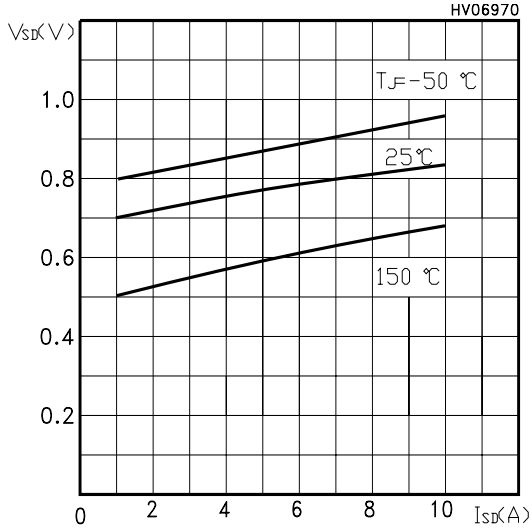
Normalized Gate Thereshold Voltage vs Temp.



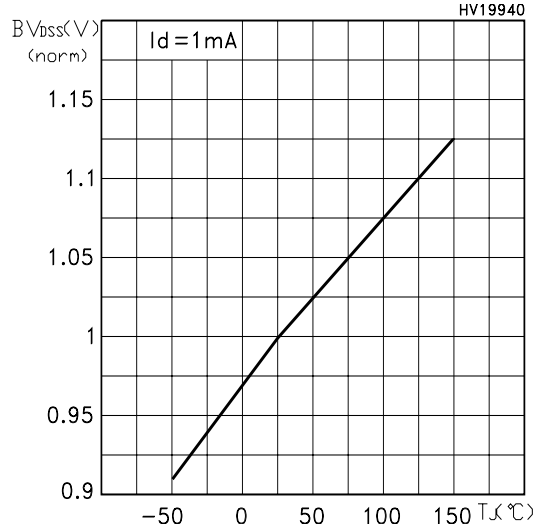
Normalized On Resistance vs Temperature



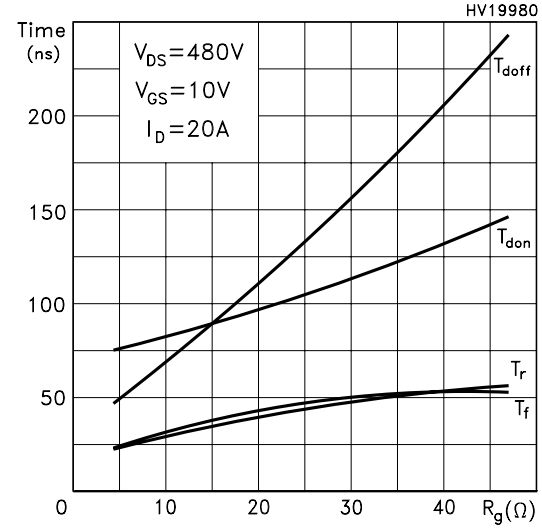
Source-drain Diode Forward Characteristics



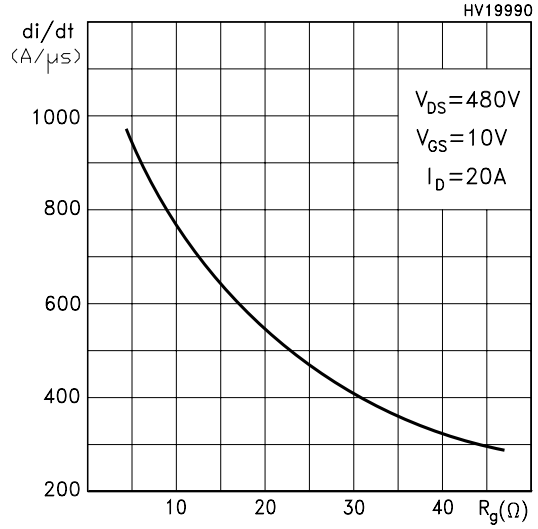
Normalized BVDSS vs Temperature



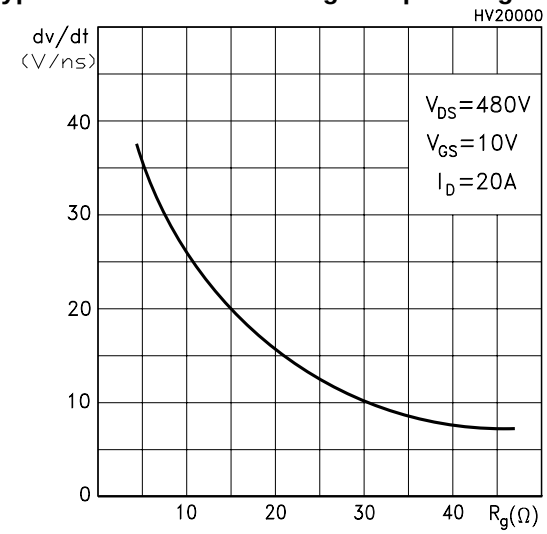
Typical Switching Time vs Rg



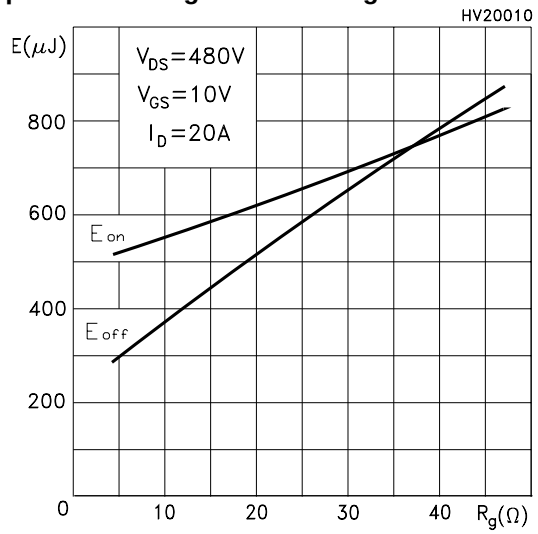
Typical Drain Current Slope vs Rg



Typical Drain Source Voltage Slope vs Rg



Typical Switching Losses vs Rg



Typical Coss Stored Energy vs Rg

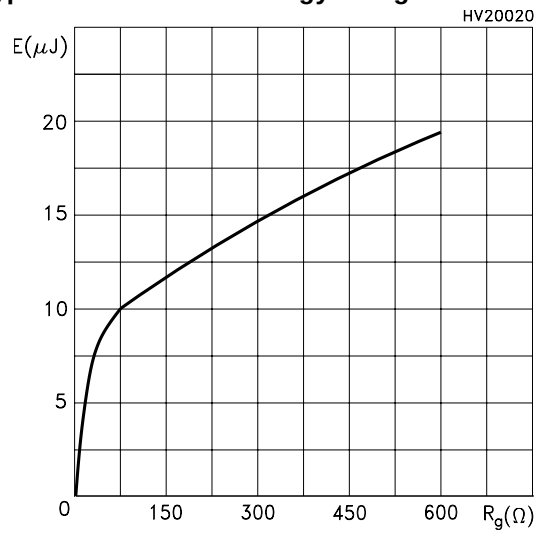


Fig. 1: Unclamped Inductive Load Test Circuit

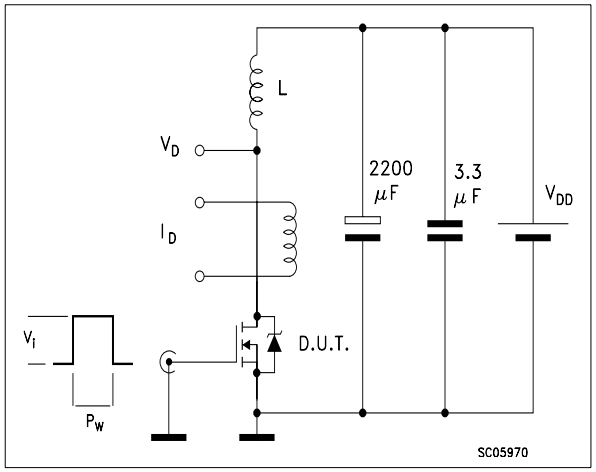


Fig. 2: Unclamped Inductive Waveform

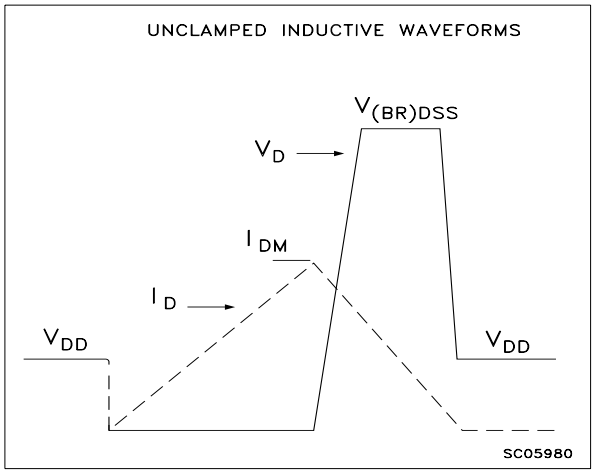


Fig. 3: Switching Times Test Circuit For Resistive Load

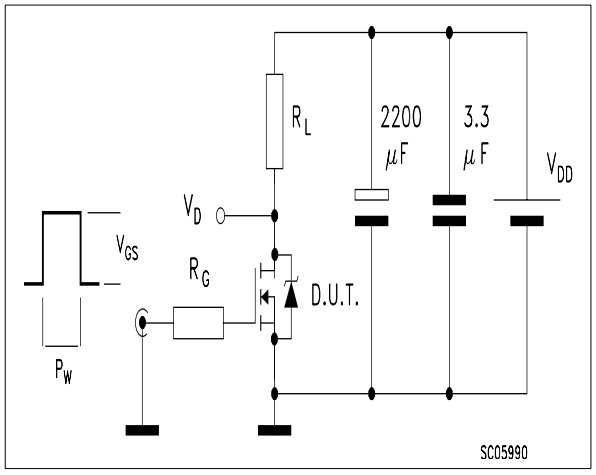


Fig. 4: Gate Charge test Circuit

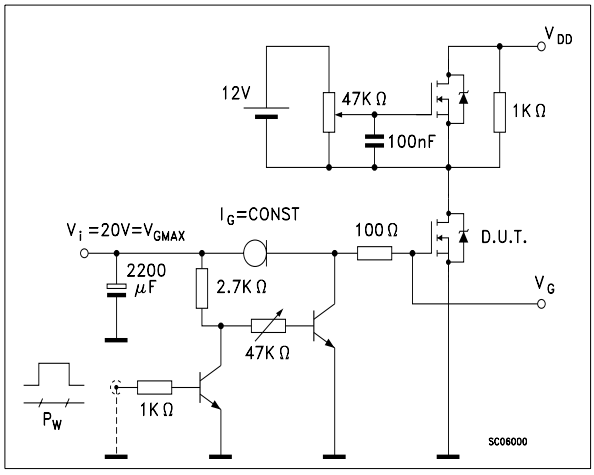
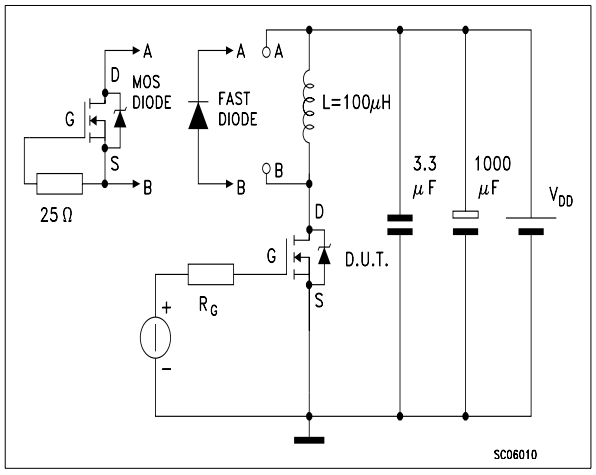
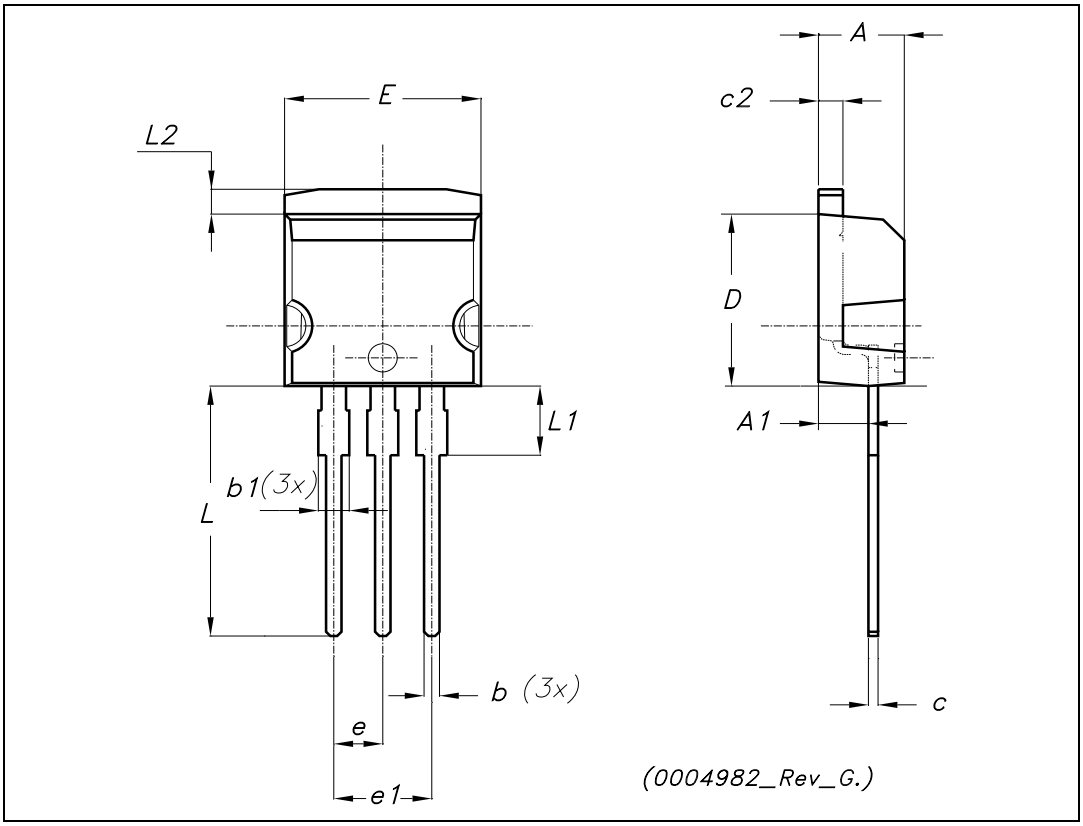


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



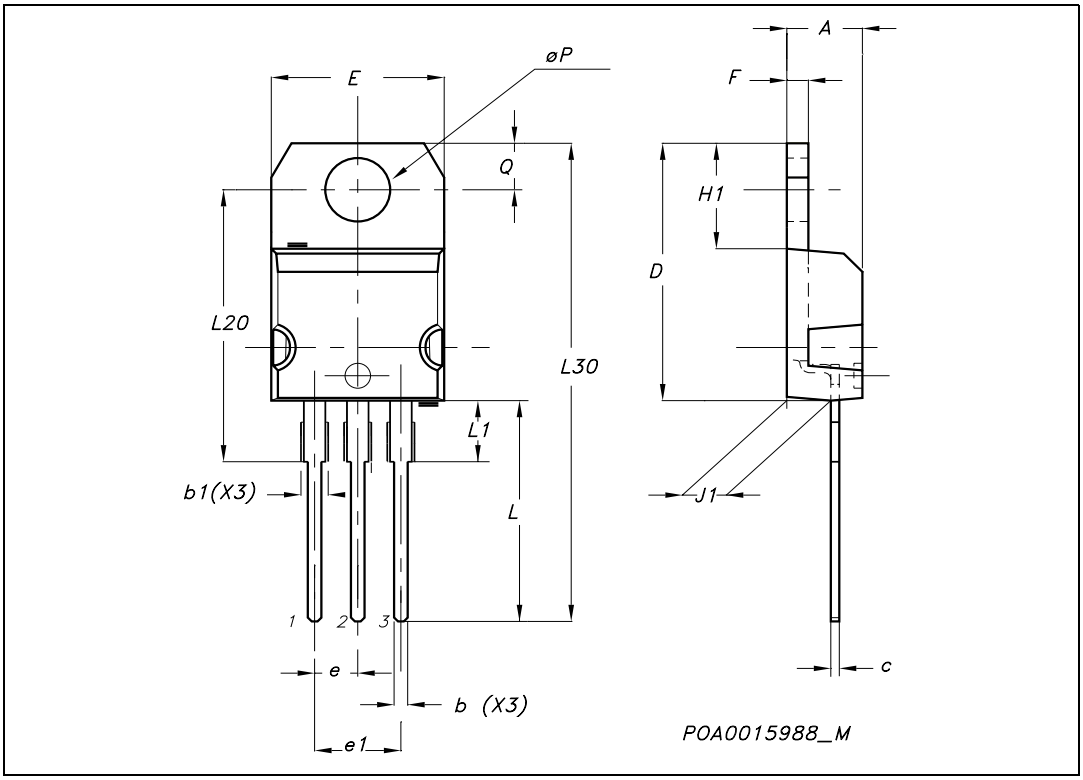
TO-262 (I^2PAK) MECHANICAL DATA

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



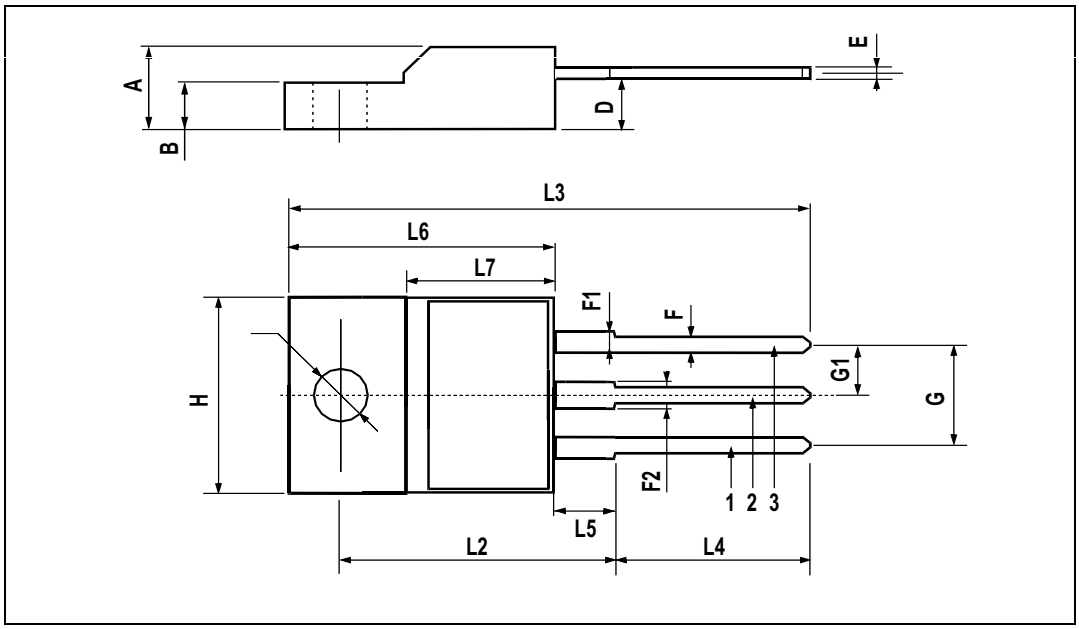
TO-220 MECHANICAL DATA

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



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