



# STB20NM60A-1 STP20NM60A - STF20NM60A

N-CHANNEL 650V @  $T_{jmax}$  - 0.25Ω - 20A I<sup>2</sup>PAK/TO-220/TO-220FP  
MDmesh™ MOSFET

TYPE	V <sub>DSS</sub> @T <sub>jmax</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
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

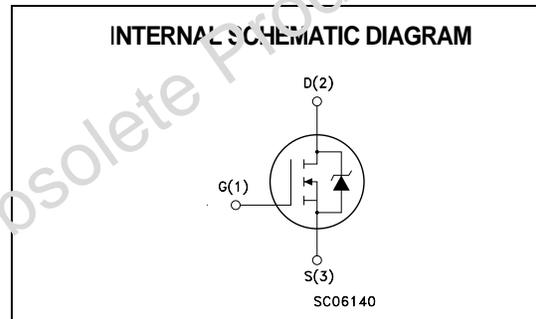
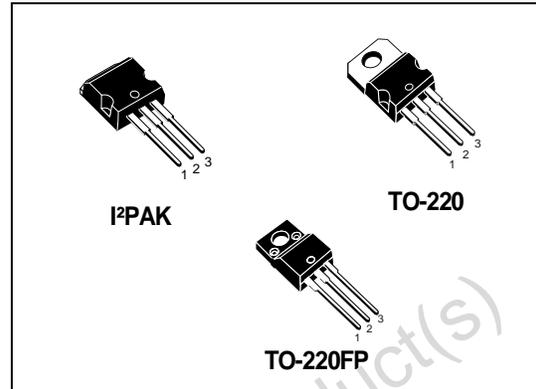
- TYPICAL R<sub>DS(on)</sub> = 0.25Ω
- HIGH dv/dt
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE

## 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

- SPECIFICALLY DESIGNED FOR ADAPTORS IN QUASI-RESONANT CONFIGURATION



## ORDER CODES

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

## STB20NM60A-1/STP20NM60A/STF20NM60A

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STB20NM60A-1 STP20NM60A	STF20NM60A	
V <sub>GS</sub>	Gate-source Voltage	±30		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	20	20(*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	12.6	12.6(*)	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	80	80(*)	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 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 <sub>ISO</sub>	Insulation Withstand Voltage (DC)	--	2500	V
T <sub>stg</sub>	Storage Temperature	-55 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature			

(•) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 20A, di/dt ≤ 400 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

(\*) Limited only by maximum temperature allowed

### THERMAL DATA

			I <sup>2</sup> PAK/TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	0.65	2.8	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient	Max	62.5		°C/W
T <sub>l</sub>	Maximum Lead Temperature For Soldering Purpose		300		°C

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED)

ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0	600			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C			1 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 30V			±100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2	3	4	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 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  $\mu$ s, 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**

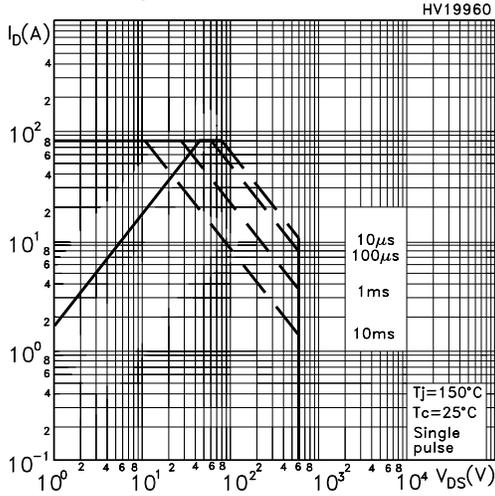
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				20	A
$I_{SDM}$ (2)	Source-drain Current (pulsed)				80	A
$V_{SD}$ (1)	Forward On Voltage	$I_{SD} = 20$ A, $V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20$ A, $di/dt = 100A/\mu$ s, $V_{DD} = 50$ V, $T_j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

Note: 1. Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %.

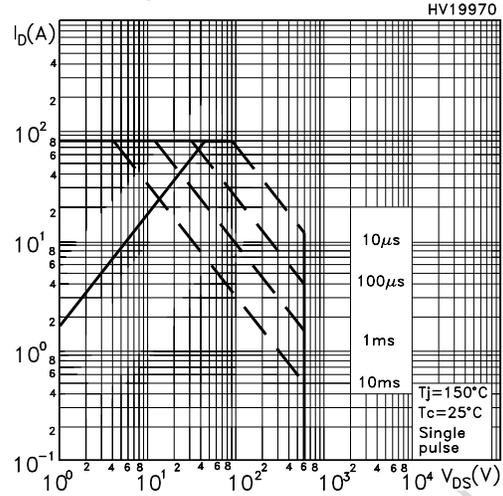
2. Pulse width limited by safe operating area.

STB20NM60A-1/STP20NM60A/STF20NM60A

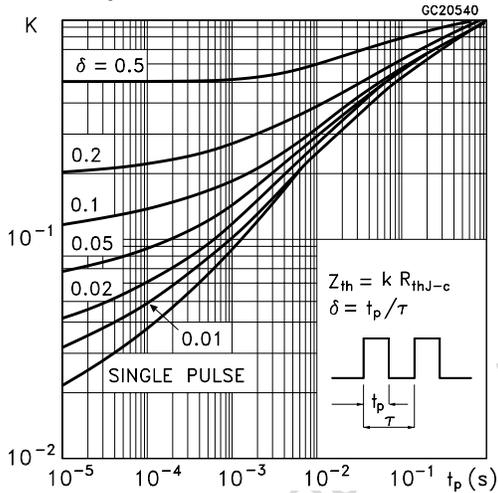
Safe Operating Area for TO-220/I2PAK



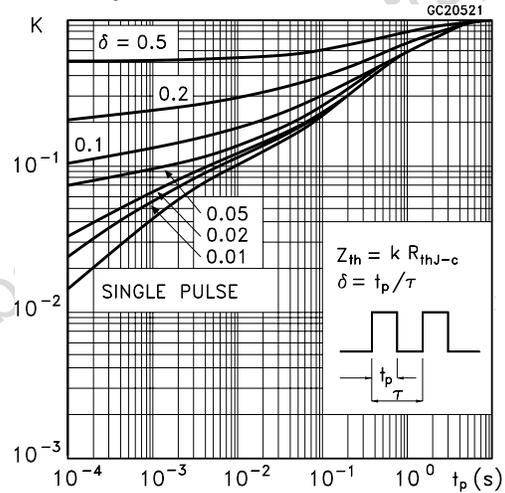
Safe Operating Area for TO-220FP



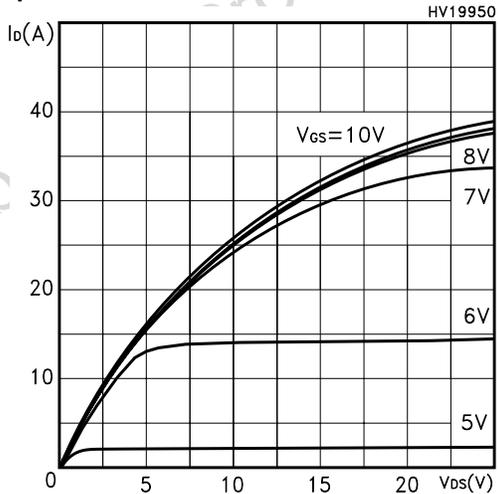
Thermal Impedance for TO-220/I2PAK



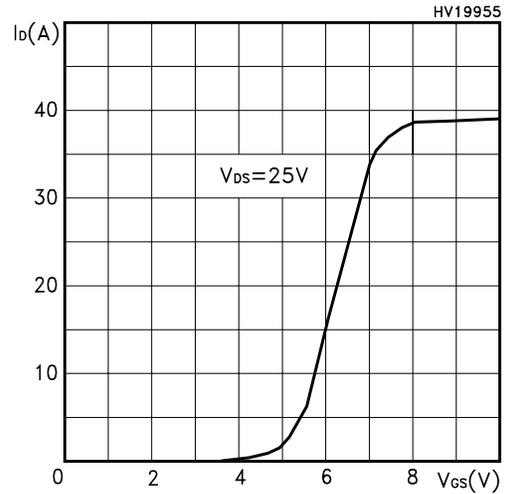
Thermal Impedance for TO-220FP



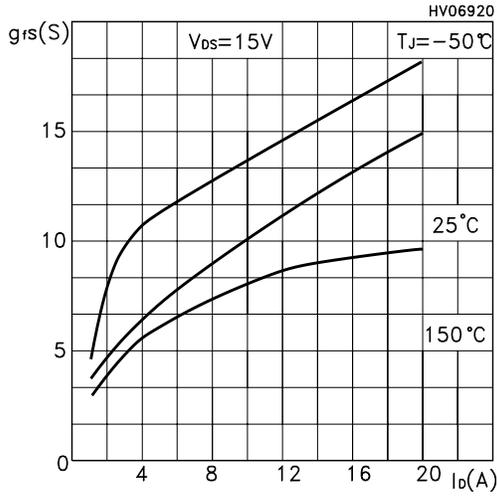
Output Characteristics



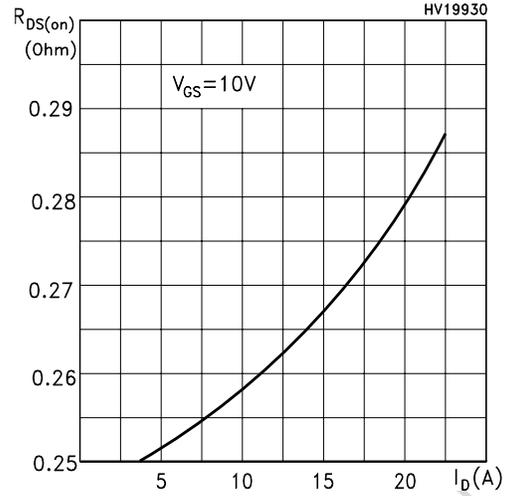
Transfer Characteristics



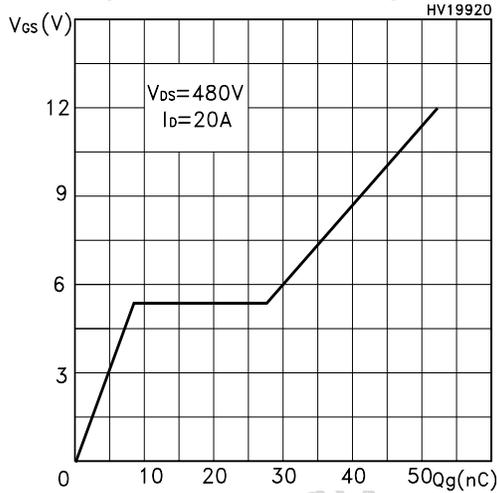
Transconductance



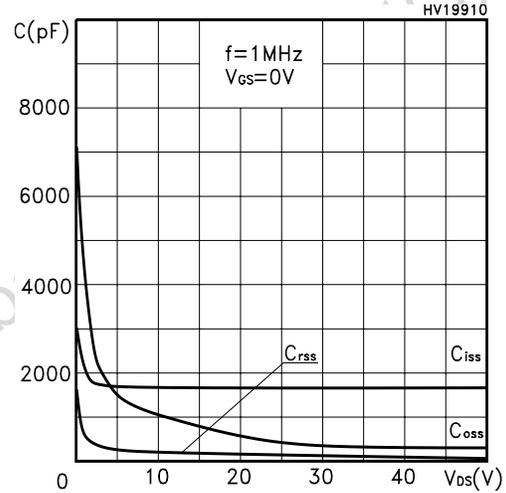
Static Drain-Source On Resistance



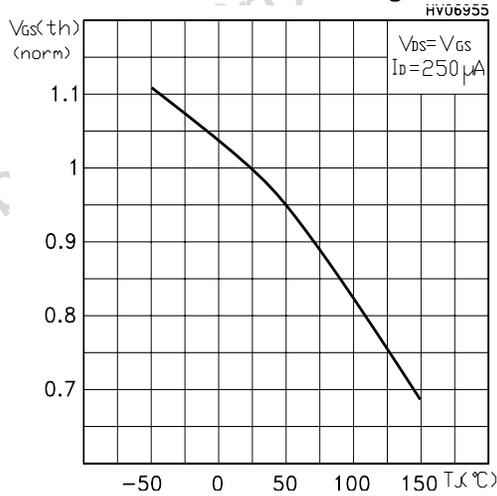
Gate Charge vs Gate-source Voltage



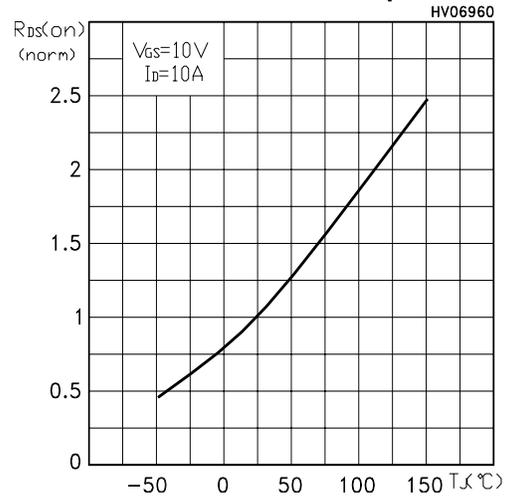
Capacitance Variations



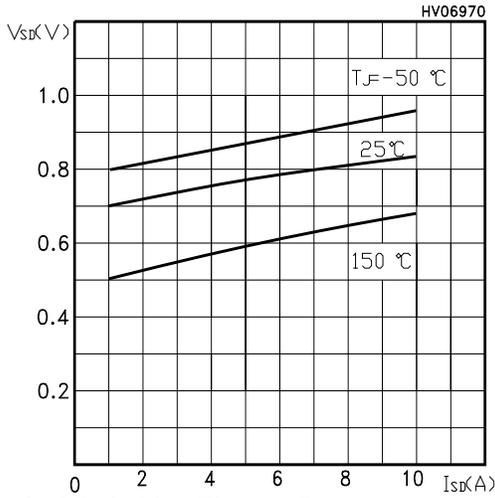
Normalized Gate Threshold Voltage vs Temp.



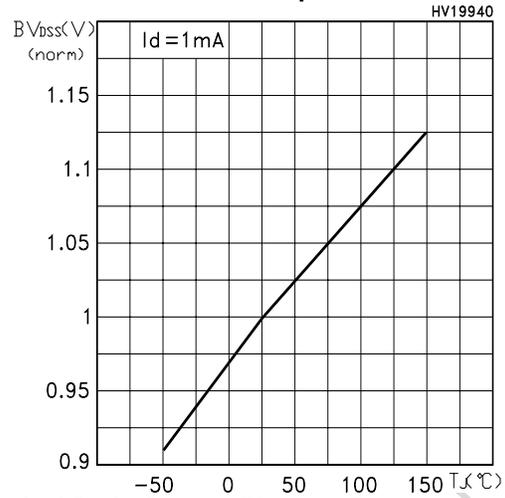
Normalized On Resistance vs Temperature



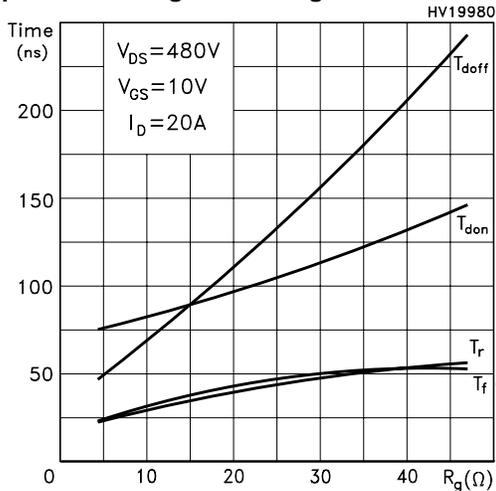
Source-drain Diode Forward Characteristics



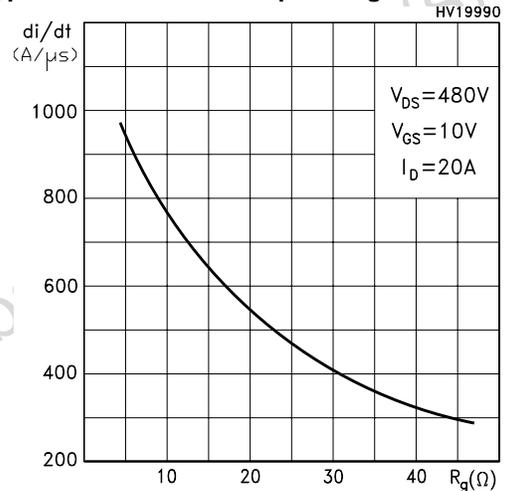
Normalized BVDSS vs Temperature



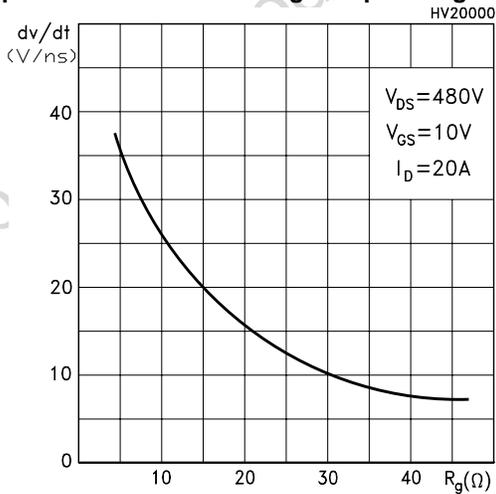
Typical Switching Time vs Rg



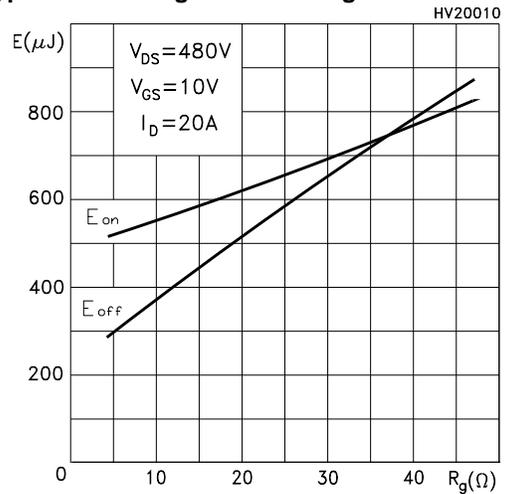
Typical Drain Current Slope vs Rg



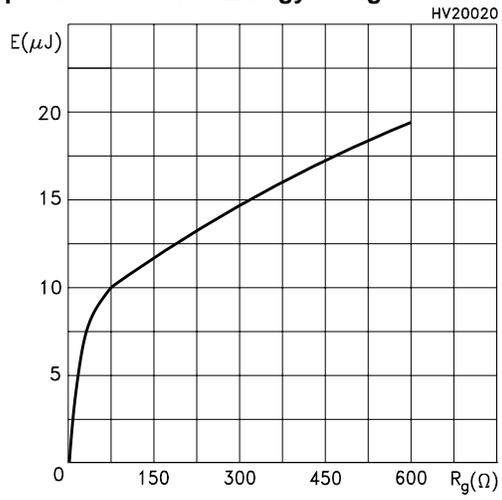
Typical Drain Source Voltage Slope vs Rg



Typical Switching Losses vs Rg



Typical Coss Stored Energy vs Rg



Obsolete Product(s) - Obsolete Product(s)

Fig. 1: Unclamped Inductive Load Test Circuit

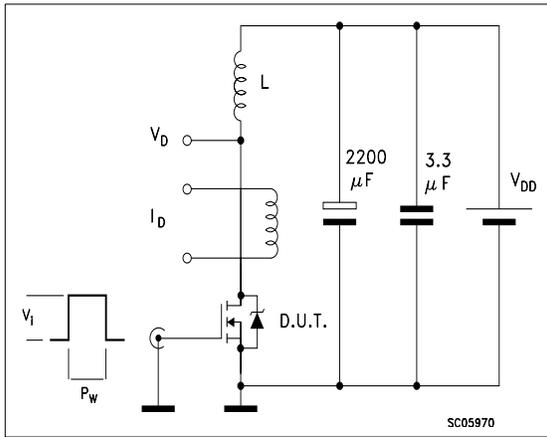


Fig. 2: Unclamped Inductive Waveform

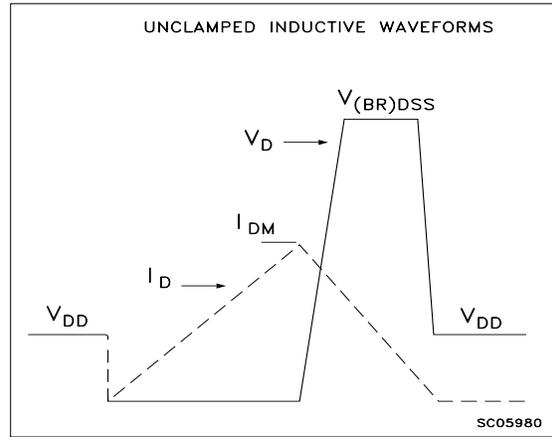


Fig. 3: Switching Times Test Circuit For Resistive Load

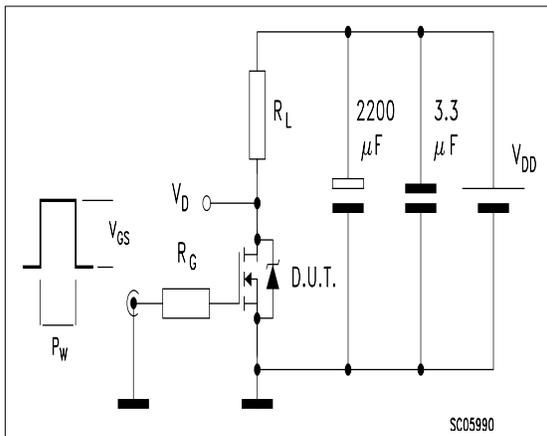


Fig. 4: Gate Charge test Circuit

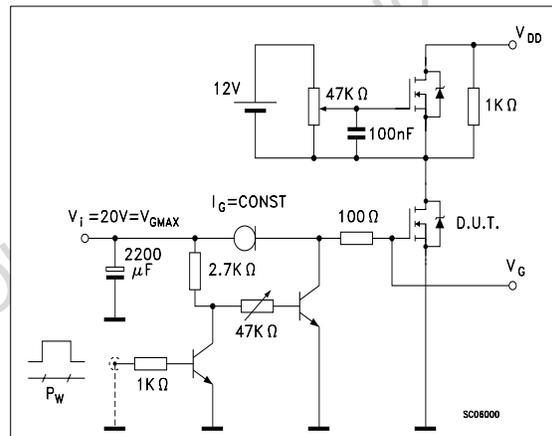
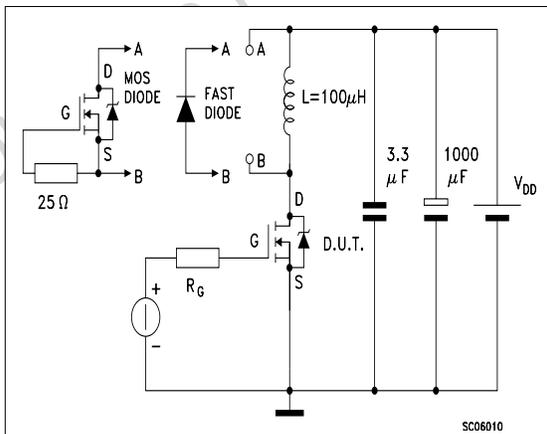
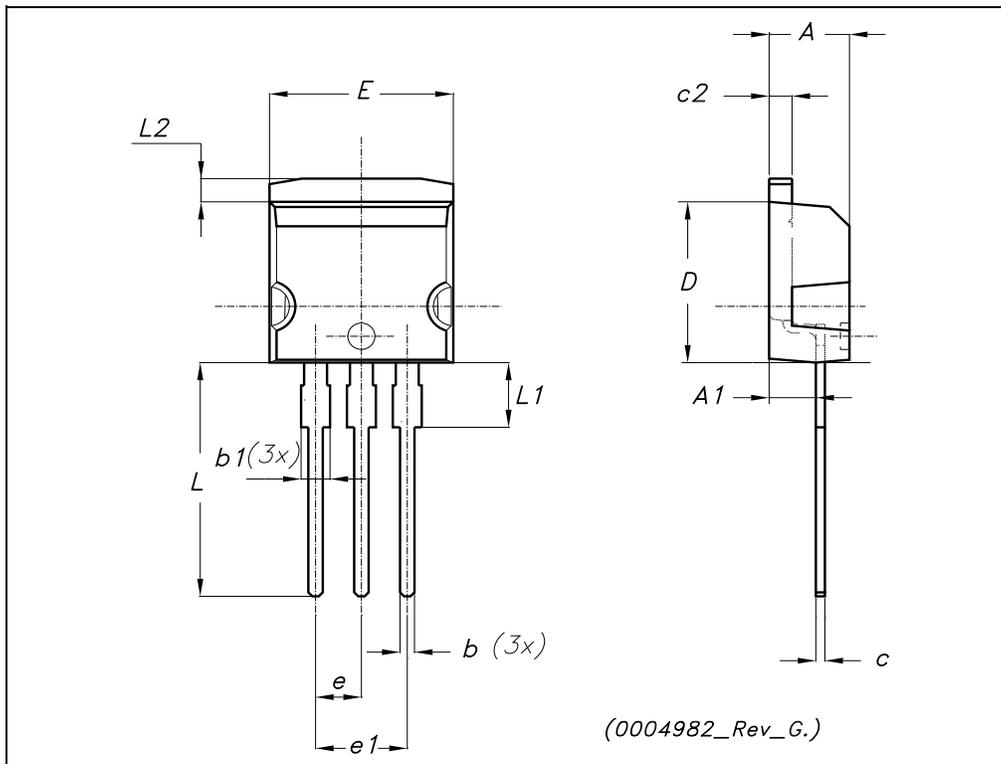


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



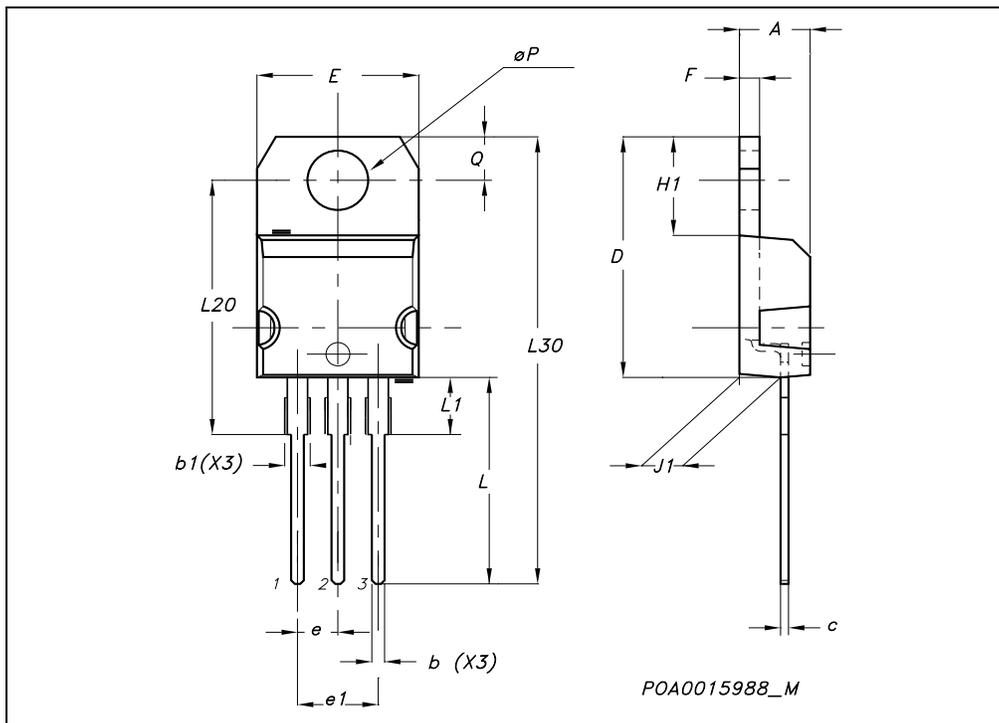
TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA

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



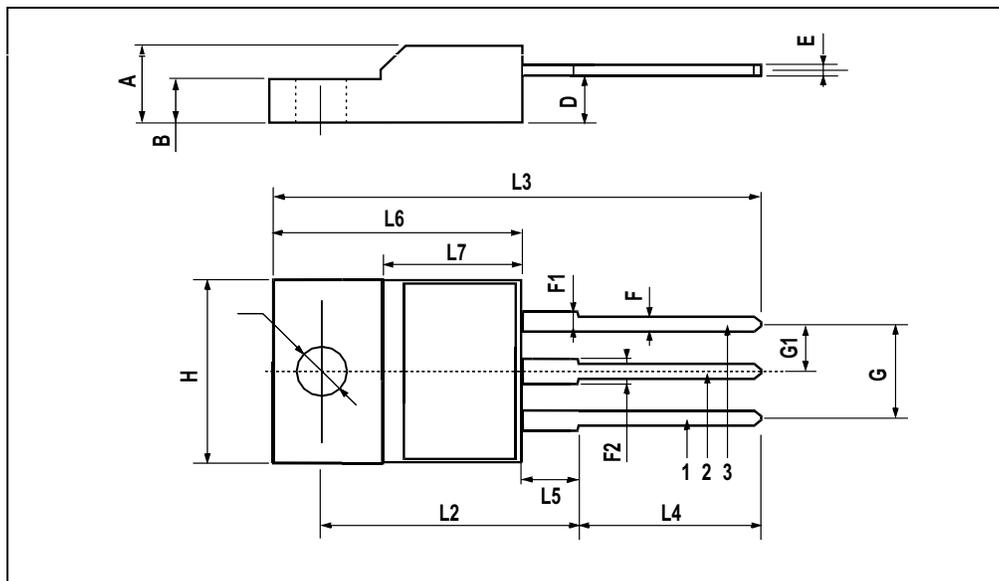
TO-220 MECHANICAL DATA

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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