



STP60NE06-16 STP60NE06-16FP

N-CHANNEL 60V - 0.013 Ω - 60A TO-220/TO-220FP
"SINGLE FEATURE SIZE™" POWER MOSFET

Table 1. General Features

Type	V _{DSS}	R _{DS(on)}	I _D
STP60NE06-16	60 V	< 0.016 Ω	60 A
STP60NE06-16FP	60 V	< 0.016 Ω	35 A

FEATURES SUMMARY

- TYPICAL R_{DS(on)} = 0.013 Ω
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- LOW GATE CHARGE 100°C
- HIGH dv/dt CAPABILITY
- APPLICATION ORIENTED CHARACTERIZATION

DESCRIPTION

This Power Mosfet is the latest development of STMicroelectronics unique "Single Feature Size" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

APPLICATIONS

- DC MOTOR CONTROL
- DC-DC & DC-AC CONVERTERS
- SYNCHRONOUS RECTIFICATION

Figure 1. Package

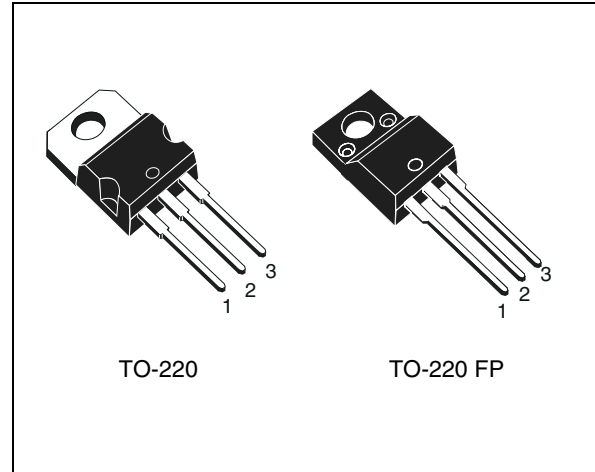


Figure 2. Internal Schematic Diagram

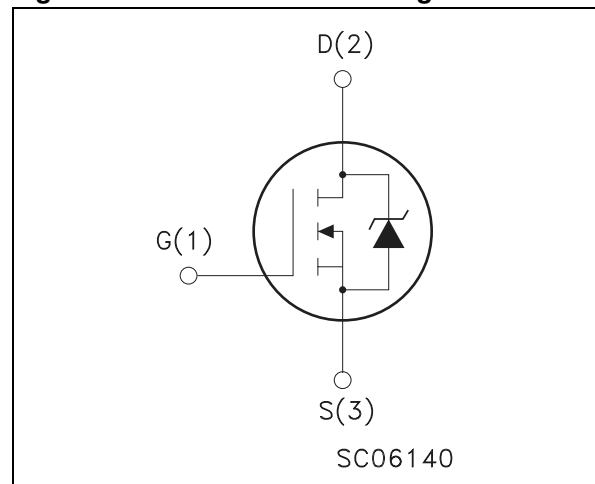


Table 2. Order Codes

Part Number	Marking	Package	Packaging
STP60NE06-16	P60NE06	TO-220	TUBE
STP60NE06-16FP	P60NE06FP	TO-220FP	TUBE

Table 3. Absolute Maximum Ratings

Symbol	Parameter	Value		Unit
		STP60NE06-16	STP60NE06-16FP	
V_{DS}	Drain-source Voltage ($V_{GS} = 0$)	60		V
V_{DGR}	Drain- gate Voltage ($R_{GS} = 20\text{ k}\Omega$)	60		V
V_{GS}	Gate-source Voltage	± 20		V
I_D	Drain Current (cont.) at $T_C = 25\text{ }^\circ\text{C}$	60	35	A
I_D	Drain Current (cont.) at $T_C = 100\text{ }^\circ\text{C}$	42	24	A
$I_{DM}^{(1)}$	Drain Current (pulsed)	240	240	A
P_{tot}	Total Dissipation at $T_C = 25\text{ }^\circ\text{C}$	150	40	W
	Derating Factor	1	0.3	W/ $^\circ\text{C}$
V_{ISO}	Insulation Withstand Voltage (DC)	–	2000	V
$dv/dt^{(2)}$	Peak Diode Recovery voltage slope	6		V/ns
T_{stg}	Storage Temperature	-65 to 175		$^\circ\text{C}$
T_j	Max. Operating Junction Temperature	175		$^\circ\text{C}$

Note: 1. Pulse width limited by safe operating area
2. $I_{SD} \leq 60\text{ A}$, $di/dt \leq 300\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

Table 4. Thermal Data

Symbol	Parameter	Value		Unit
		TO-220	TO220-FP	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	3.75	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient Max	62.5		$^\circ\text{C}/\text{W}$
T_l	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

Table 5. Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, $\delta < 1\%$)	60	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25\text{ }^\circ\text{C}$; $I_D = I_{AR}$; $V_{DD} = 25\text{ V}$)	350	mJ

ELECTRICAL CHARACTERISTICS ($T_{\text{case}} = 25^{\circ}\text{C}$ unless otherwise specified)**Table 6. Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source Breakdown Voltage	$I_D = 250\ \mu\text{A}$ $V_{\text{GS}} = 0$	60			V
I_{DSS}	Zero Gate Voltage	$V_{\text{DS}} = \text{Max Rating}$			1	μA
	Drain Current ($V_{\text{GS}} = 0$)	$V_{\text{DS}} = \text{Max Rating}$ $T_c = 125^{\circ}\text{C}$			10	μA
I_{GSS}	Gate-body Leakage Current ($V_{\text{DS}} = 0$)	$V_{\text{GS}} = \pm 20\ \text{V}$			± 100	nA

Table 7. On ⁽¹⁾

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}} = V_{\text{GS}}$; $I_D = 250\ \mu\text{A}$	2	3	4	V
$R_{\text{DS(on)}}$	Static Drain-source On Resistance	$V_{\text{GS}} = 10\text{V}$; $I_D = 30\ \text{A}$		0.013	0.016	Ω

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %**Table 8. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{\text{fs}}^{(1)}$	Forward Transconductance	$V_{\text{DS}} > I_{\text{D(on)}} \times R_{\text{DS(on)max}}$; $I_D = 30\ \text{A}$	20	35		S
C_{iss}	Input Capacitance	$V_{\text{DS}} = 25\ \text{V}$; $f = 1\ \text{MHz}$; $V_{\text{GS}} = 0$		4600	6200	pF
C_{oss}	Output Capacitance			580	800	pF
C_{rss}	Reverse Transfer Capacitance			140	200	pF

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %**Table 9. Switching On**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on Time	$V_{\text{DD}} = 30\ \text{V}$; $I_D = 30\ \text{A}$		40	60	ns
t_{r}	Rise Time	$R_G = 4.7\ \Omega$; $V_{\text{GS}} = 10\ \text{V}$		125	180	ns
Q_{g}	Total Gate Charge	$V_{\text{DD}} = 48\ \text{V}$; $I_D = 60\ \text{A}$; $V_{\text{GS}} = 10\ \text{V}$		115	160	nC
Q_{gs}	Gate-Source Charge			25		nC
Q_{gd}	Gate-Drain Charge			40		nC

Table 10. Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{\text{r(Voff)}}$	Off-voltage Rise Time	$V_{\text{DD}} = 48\ \text{V}$; $I_D = 60\ \text{A}$ $R_G = 4.7\ \Omega$; $V_{\text{GS}} = 10\ \text{V}$		15	25	ns
t_{f}	Fall Time			150	210	ns
t_{c}	Cross-over Time			180	260	ns

Table 11. Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				60	A
$I_{SDM}^{(1)}$	Source-drain Current (pulsed)				240	A
$V_{SD}^{(2)}$	Forward On Voltage	$I_{SD} = 60 \text{ A}; V_{GS} = 0$			1.5	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 60 \text{ A}; di/dt = 100 \text{ A}/\mu\text{s}$		100		ns
Q_{rr}	Reverse RecoveryCharge	$V_{DD} = 30 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$		0.4		μC
I_{RRAM}	Reverse RecoveryCharge			8		A

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

Figure 3. Safe Operating Area for TO-220

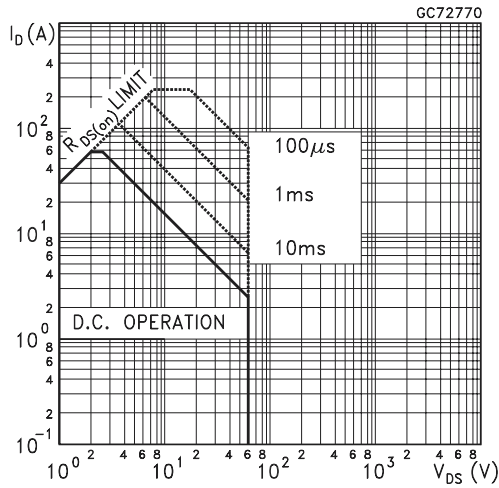


Figure 4. Safe Operating Area for TO-220FP

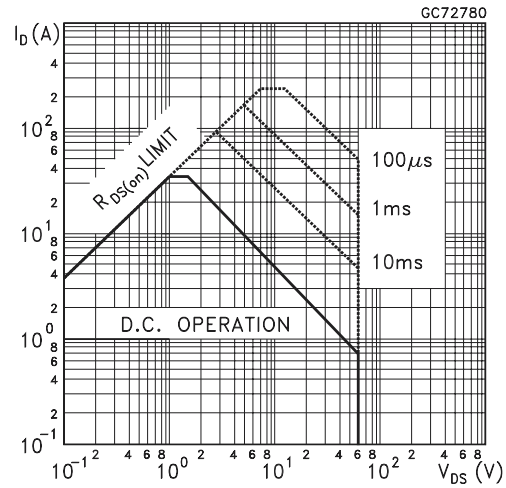


Figure 5. Thermal Impedance for TO-220

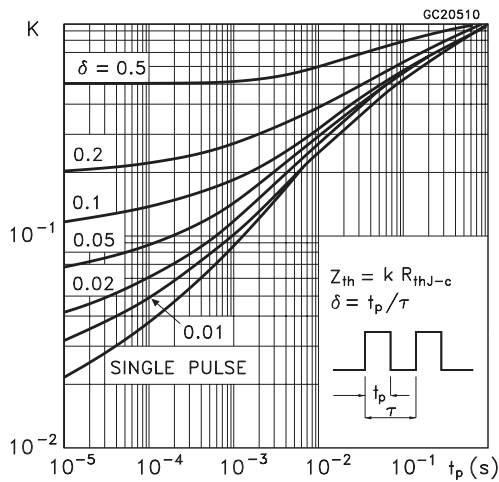


Figure 6. Thermal Impedance for TO-220FP

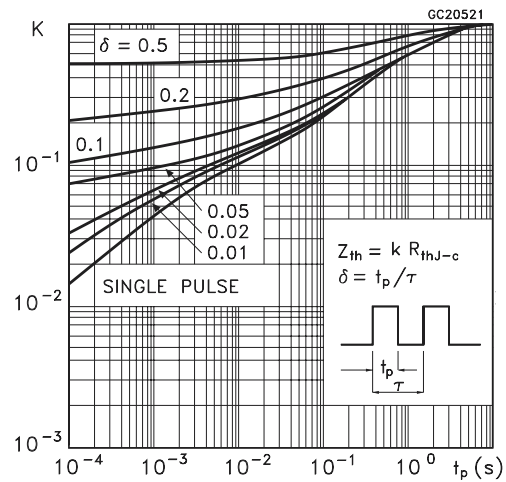


Figure 7. Output Characteristics

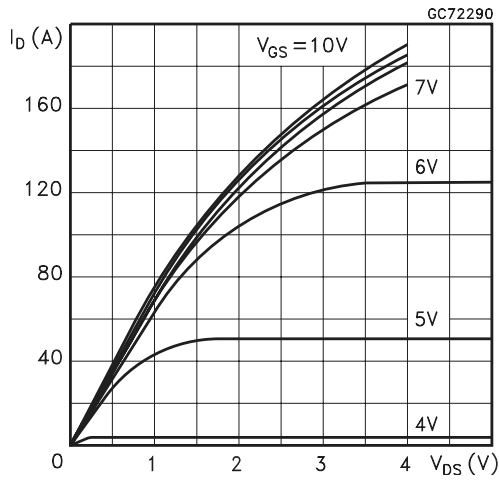


Figure 8. Transfer Characteristics

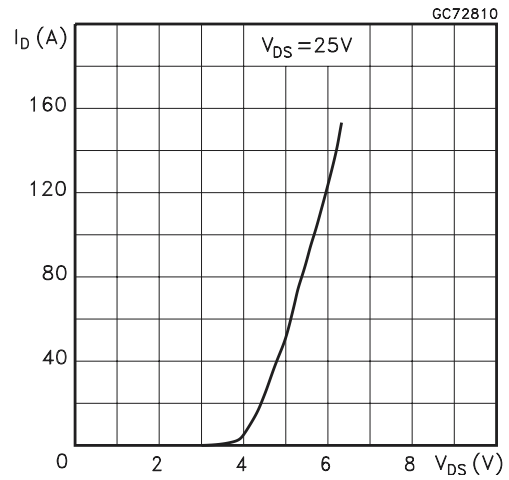


Figure 9. Transconductance

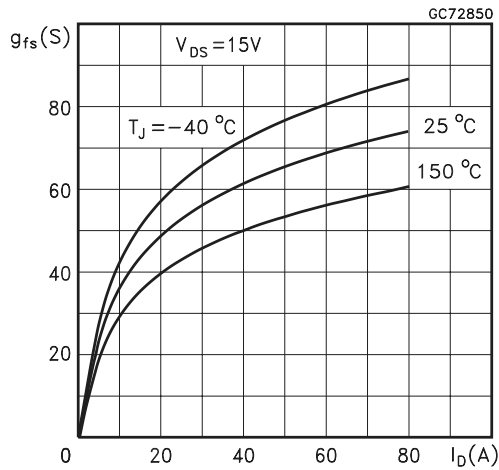


Figure 10. Static Drain-source On Resistance

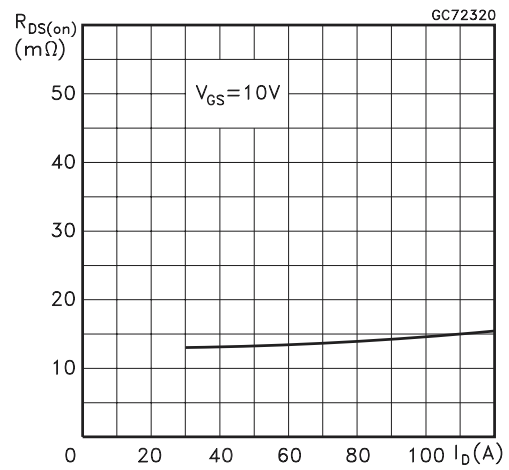


Figure 11. Gate Charge vs Gate-source Voltage

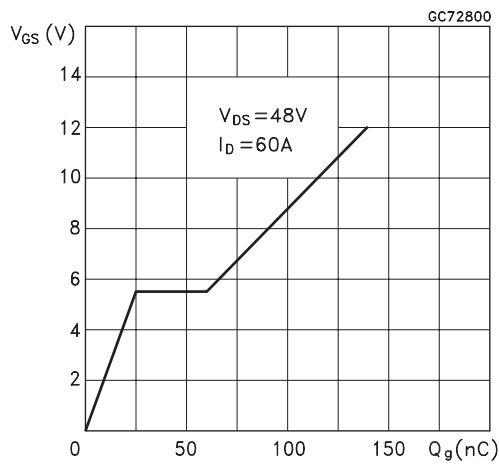


Figure 12. Capacitance Variations

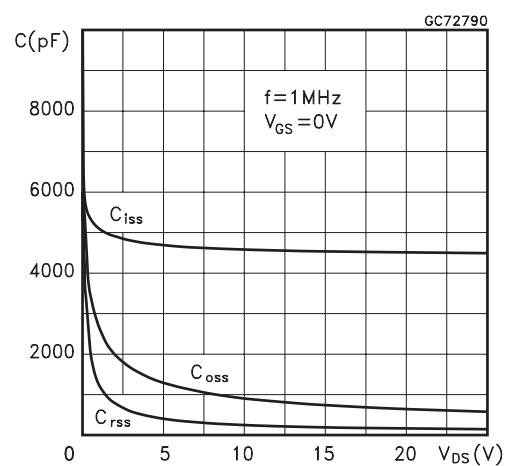


Figure 13. Normalized Gate Threshold Voltage vs Temperature

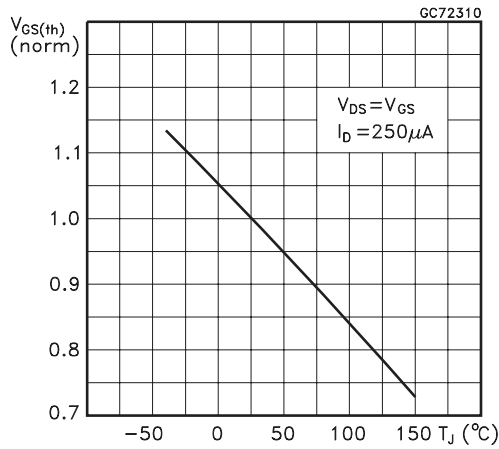


Figure 14. Normalized On Resistance vs Temperature

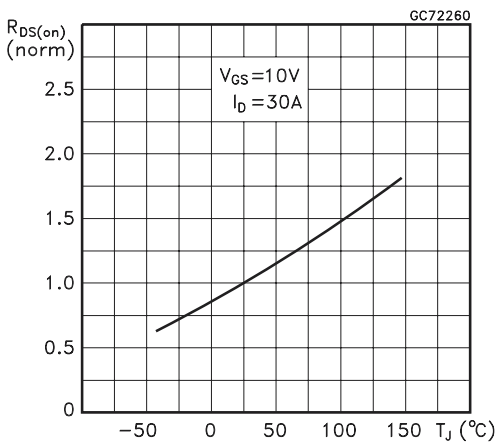


Figure 15. Source-drain Diode Forward Characteristics

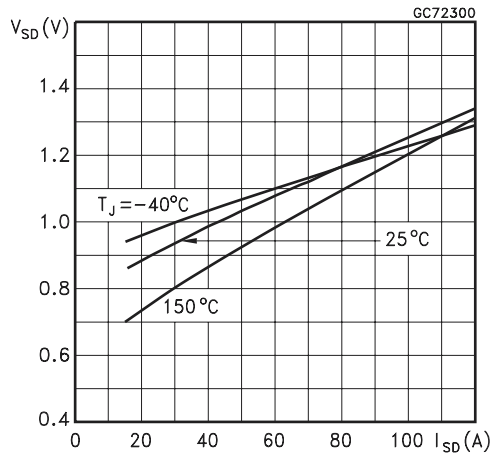
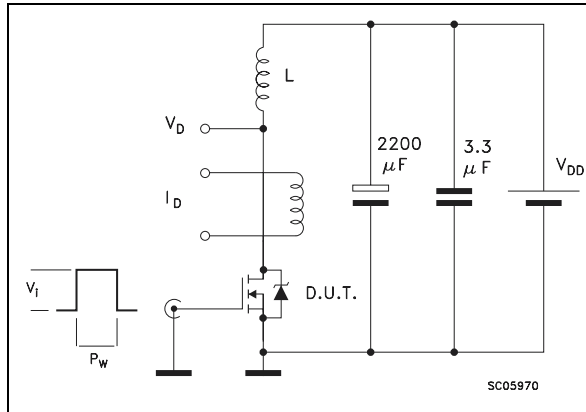
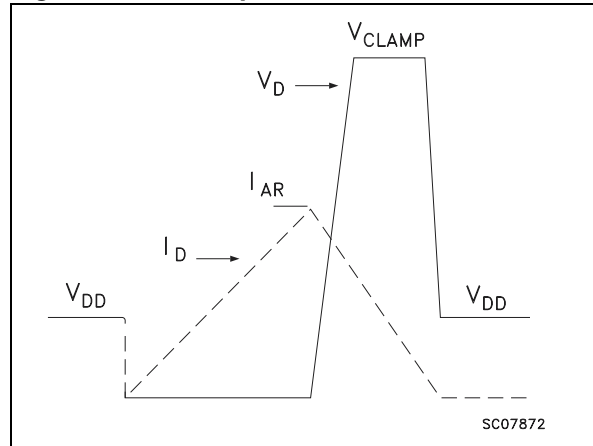
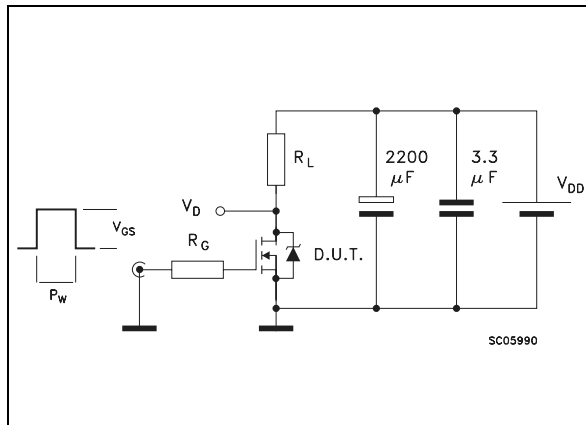
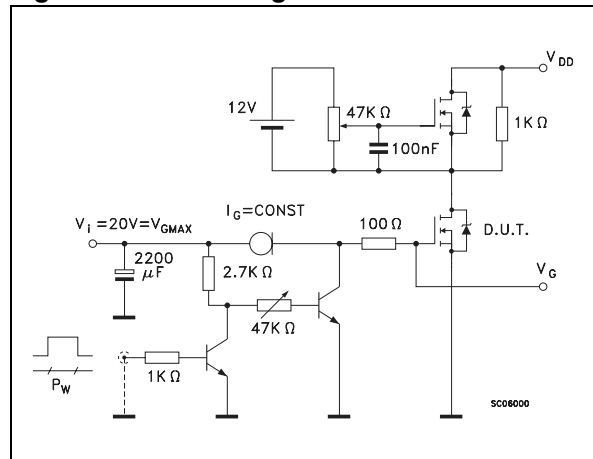
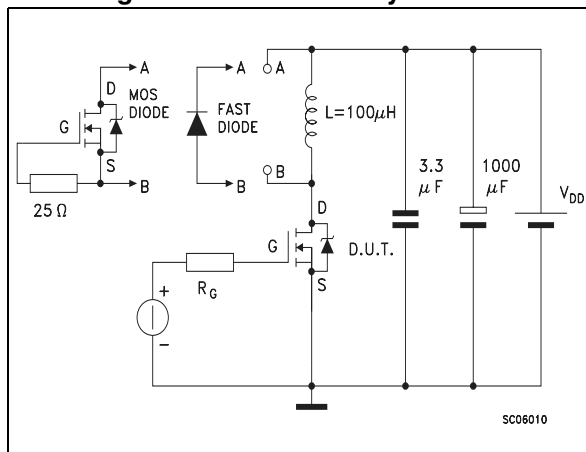


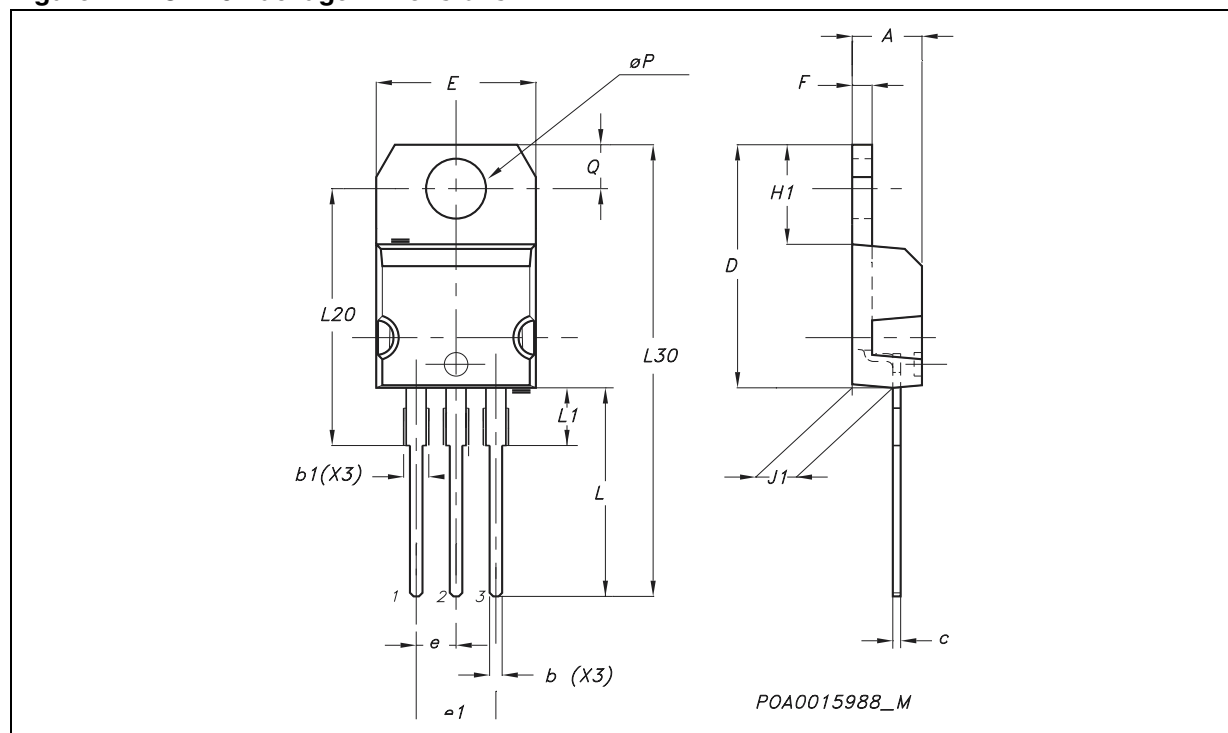
Figure 16. Unclamped Inductive Load Test Circuit**Figure 17. Unclamped Inductive Waveforms****Figure 18. Switching Times Test Circuits For Resistive Load****Figure 19. Gate Charge Test Circuit****Figure 20. Test Circuit For Inductive Load Switching And Diode Recovery Times**

PACKAGE MECHANICAL

Table 12. TO-220 Mechanical Data

Symbol	millimeters			inches		
	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

Figure 21. TO-220 Package Dimensions

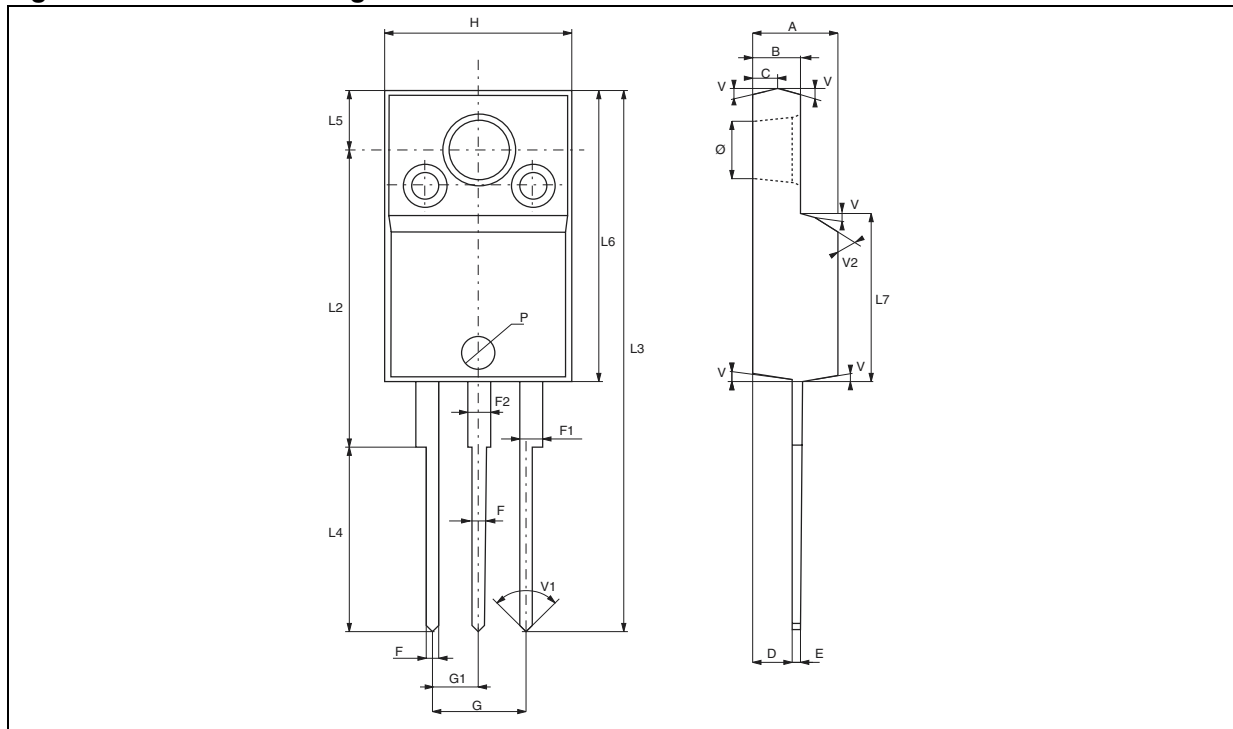


Note: Drawing is not to scale.

Table 13. TO-220FP Mechanical Data

Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
B	2.50		2.70	0.098		0.106
C	1.00		1.30	0.039		0.051
D	2.50		2.75	0.098		0.108
E	0.40		0.70	0.016		0.027
F	0.75		1.00	0.030		0.039
F1	1.15		1.70	0.045		0.066
F2	1.15		1.70	0.045		0.066
G	4.95		5.20	0.195		0.204
G1	2.40		2.70	0.094		0.106
H	10.00		10.40	0.393		0.409
L2		16.00			0.630	
L3	28.60		30.60	1.126		1.204
L4	9.80		10.60	0.385		0.417
L5	3.30		3.50	0.129		0.137
L6	15.90		16.40	0.626		0.645
L7	9.00		9.30	0.354		0.366
P			1.60			0.063
V		5°			5°	
V1	50°		100°	50°		100°
V2	44°		46°	44°		46°
Ø	3.00		3.20	0.118		0.126

Figure 22. TO-220FP Package Dimensions



Note: Drawing is not to scale.

REVISION HISTORY

Table 14. Revision History

Date	Revision	Description of Changes
December-1997	1	First Issue
14-Apr-2004	2	Stylesheet update. No content change.

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