STP3NB60
STP3NB60FP

N-CHANNEL 600V - 3.3 Ω - 3.3A TO-220/TO-220FP
PowerMESH™ MOSFET

Table 1. General Features

Type	V_{DSS}	$R_{DS(on)}$	I_D
STP3NB60	600 V	< 3.6 Ω	3.3 A
STP3NB60FP	600 V	< 3.6 Ω	2.2 A

FEATURES SUMMARY

- TYPICAL $R_{DS(on)}$ = 3.3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

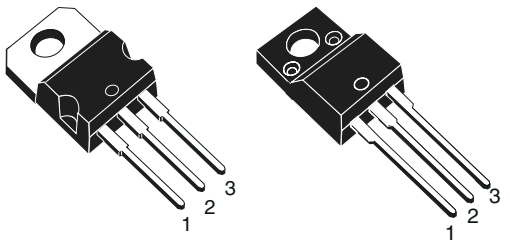
DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest RDS(on) per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE

Figure 1. Package



TO-220 TO-220FP

Figure 2. Internal Schematic Diagram

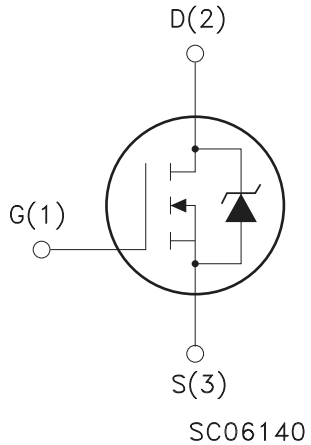


Table 2. Order Codes

Part Number	Marking	Package	Packaging
STP3NB60	P3NB60	TO-220	TUBE
STP3NB60FP	P3NB60FP	TO-220FP	TUBE

Table 3. Absolute Maximum Ratings

Symbol	Parameter	Value		Unit
		STP3NB60	STP3NB60FP	
V_{DS}	Drain-source Voltage (V_{GS} = 0)	600		V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	600		V
V_{GS}	Gate-source Voltage	± 30		V
I_D	Drain Current (cont.) at T_C = 25 °C	3.3	2.2	A
I_D	Drain Current (cont.) at T_C = 100 °C	2.1	1.4	A
I_{DM} (1)	Drain Current (pulsed)	13.2	13.2	A
P_{tot}	Total Dissipation at T_C = 25 °C	80	35	W
	Derating Factor	0.64	0.28	W°/C
dv/dt (2)	Peak Diode Recovery voltage slope	4.5	4.5	V/ns
V_{ISO}	Insulation Withstand Voltage (DC)	–	2000	V
T_{stg}	Storage Temperature	-65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

Note: 1. Pulse width limited by safe operating area
2. $I_{SD} \leq 7A$, di/dt ≤ 200 A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$

Table 4. Thermal Data

Symbol	Parameter		Value		Unit
			TO-220	TO220-FP	
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.56	3.57	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5		°C/W
T_l	Maximum Lead Temperature For Soldering Purpose		300		°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, δ < 1%)	3.3	A
E_{AS}	Single Pulse Avalanche Energy (starting T_j = 25 °C; $I_D = I_{AR}$; V_{DD} = 50 V)	100	mJ

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Table 6. 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	V_{DS} = Max Rating			1	μA
	Drain Current (V_{GS} = 0)	V_{DS} = Max Rating; Tc = 125 °C			50	μA
I_{GSS}	Gate-body Leakage Current (V_{DS} = 0)	V_{GS} = ± 30 V			± 100	nA

Table 7. On (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	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 = 1.6 A		3.3	3.6	Ω

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

Table 8. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{DS} > $I_{D(on)}$ x $R_{DS(on)max}$; I_D = 1.6 A	1.2	2		S
C_{iss}	Input Capacitance	V_{DS} = 25 V f = 1 MHz V_{GS} = 0		400	520	pF
C_{oss}	Output Capacitance			57	77	pF
C_{rss}	Reverse Transfer Capacitance			7	9	pF

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

Table 9. Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
td(on)	Turn-on Time	V_{DD} = 300 V; I_D = 1.6 A; R_G = 4.7 Ω		11	17	ns
tr	Rise Time	V_{GS} = 10 V (see test circuit, Figure 18)		7	11	ns
Q_g	Total Gate Charge	V_{DD} = 480 V; I_D = 3.3 A; V_{GS} = 10 V		15	22	nC
Q_{gs}	Gate-Source Charge			6.2		nC
Q_{gd}	Gate-Drain Charge			5.6		nC

Table 10. Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	V_{DD} = 480 V; I_D = 3.3 A; R_G = 4.7 Ω		11	16	ns
t_f	Fall Time	V_{GS} = 10 V; (see test circuit, Figure 20)		13	18	ns
t_c	Cross-over Time			18	25	ns

Table 11. Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				3.3	A
I_{SDM} (1)	Source-drain Current (pulsed)				13.2	A
V_{SD} (2)	Forward On Voltage	I_{SD} = 3.3 A V_{GS} = 0			1.6	V
t_{rr}	Reverse Recovery Time	I_{SD} = 3.3 A; di/dt = 100 A/µs V_{DD} = 100 V; T_j = 150 °C (see test circuit, Figure 20)		500		ns
Q_{rr}	Reverse RecoveryCharge			2.1		µC
I_{RRAM}	Reverse RecoveryCharge			8.5		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

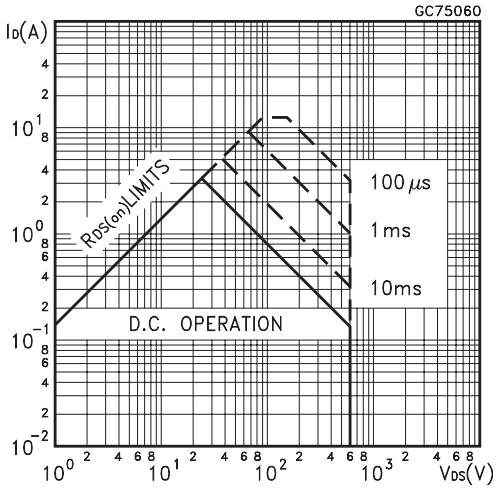


Figure 4. Safe Operating Area for TO-220FP

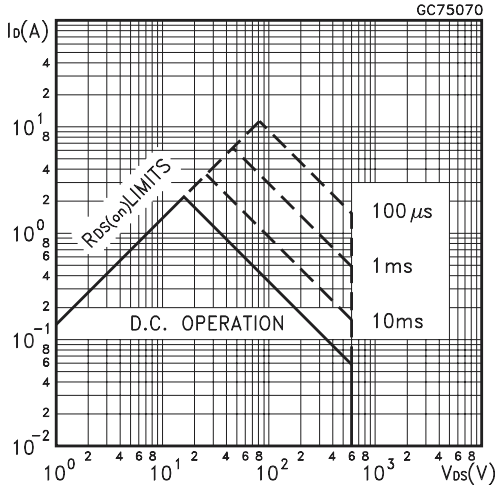


Figure 5. Thermal Impedance for TO-220

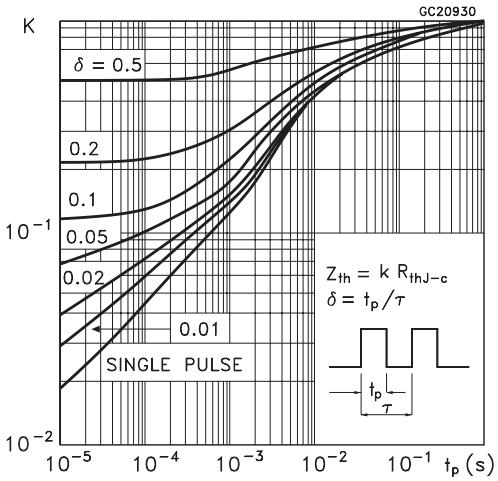


Figure 6. Thermal Impedance for TO-220FP

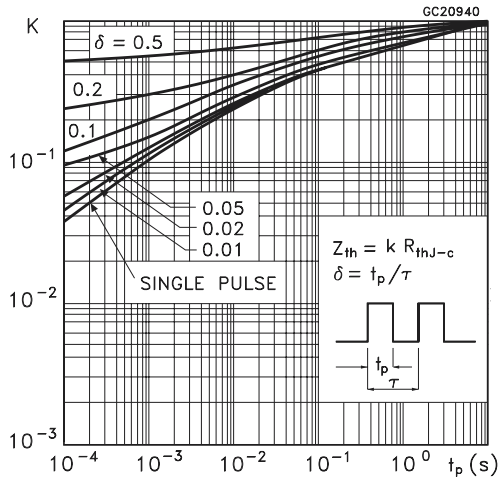


Figure 7. Output Characteristics

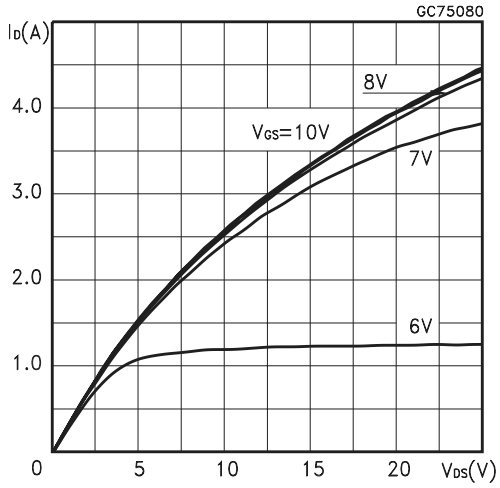


Figure 8. Transfer Characteristics

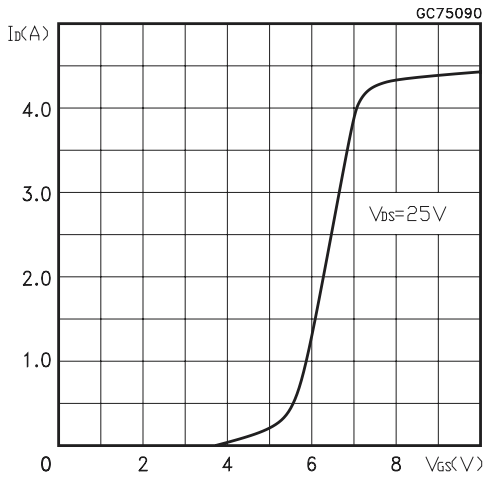


Figure 9. Transconductance

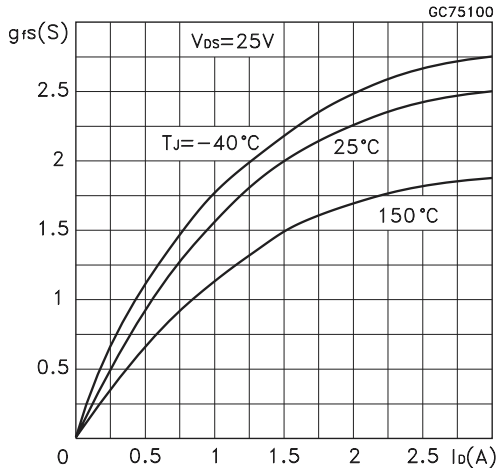


Figure 10. Static Drain-source On Resistance

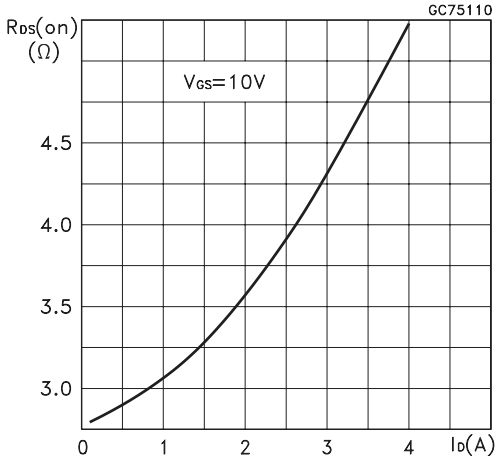


Figure 11. Gate Charge vs Gate-source Voltage

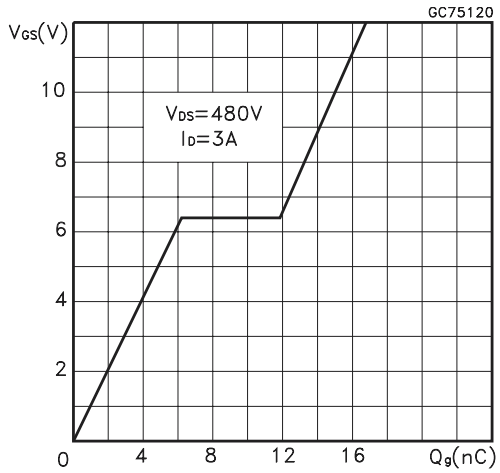


Figure 12. Capacitance Variations

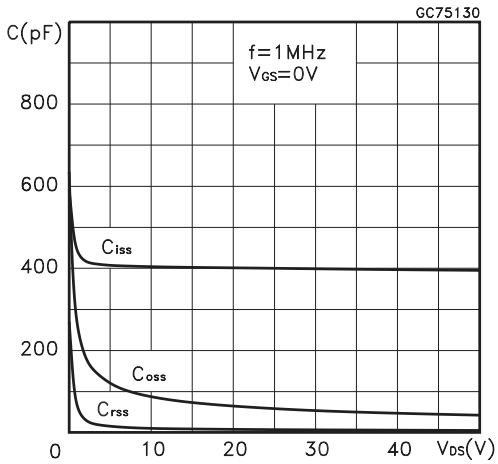


Figure 13. Normalized Gate Thresold Voltage vs Temperature

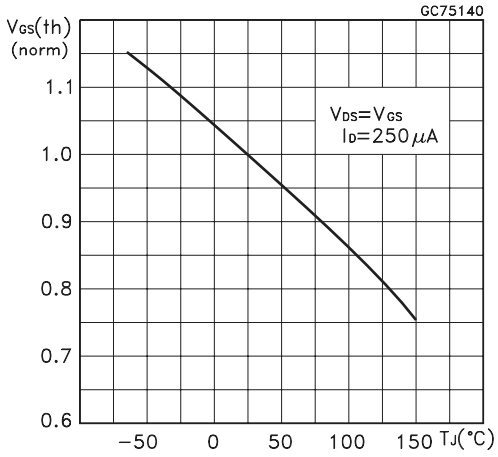


Figure 14. Normalized On Resistance vs Temperature

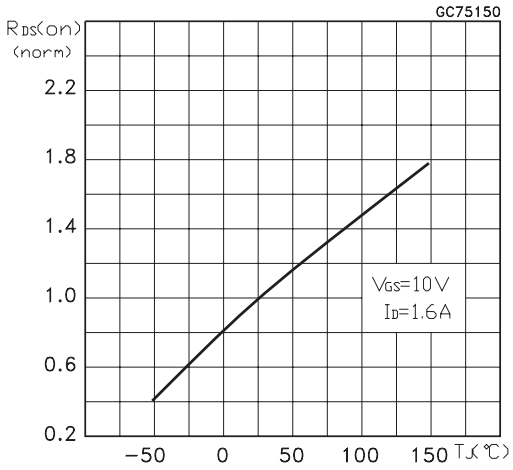


Figure 15. Source-drain Diode Forward Characteristics

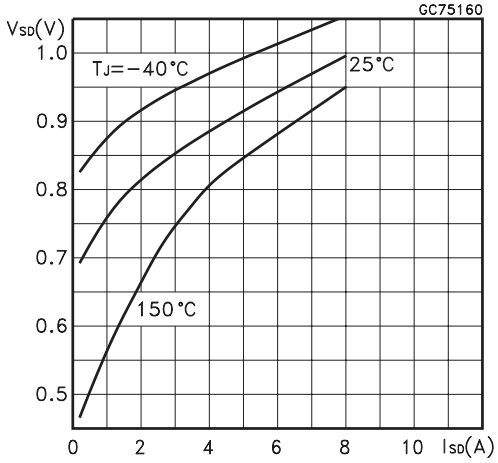


Figure 16. Unclamped Inductive Load Test Circuit

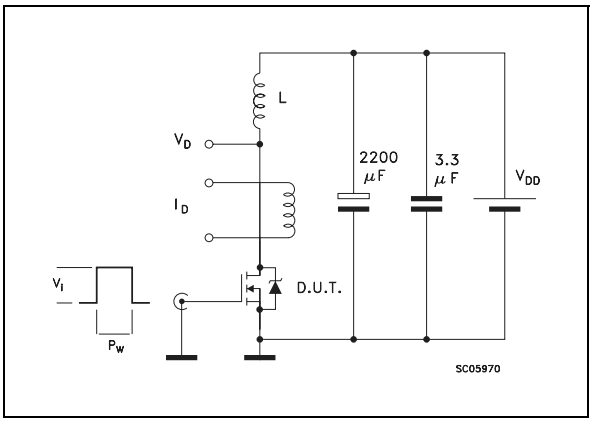


Figure 17. Unclamped Inductive Waveforms

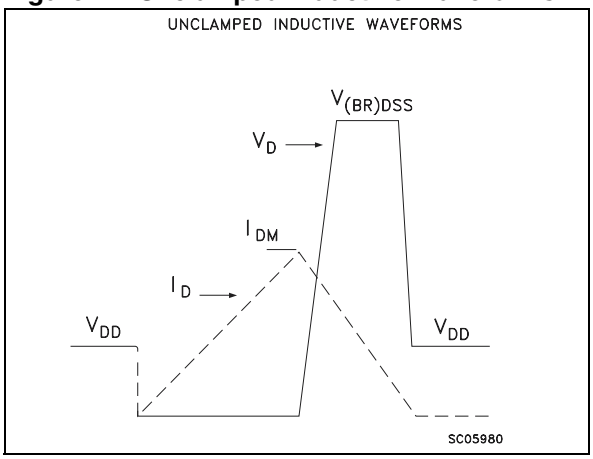


Figure 18. Switching Times Test Circuits For Resistive Load

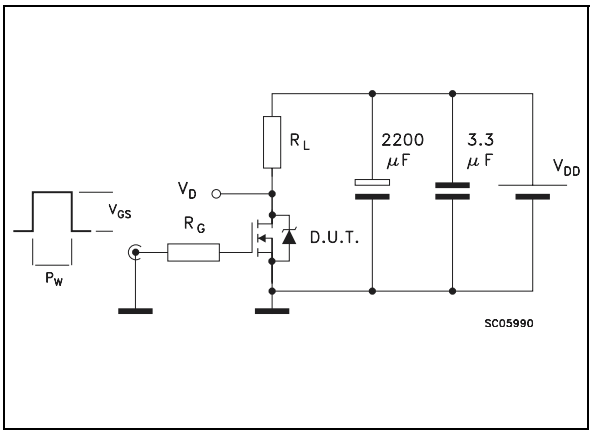


Figure 19. Gate Charge Test Circuit

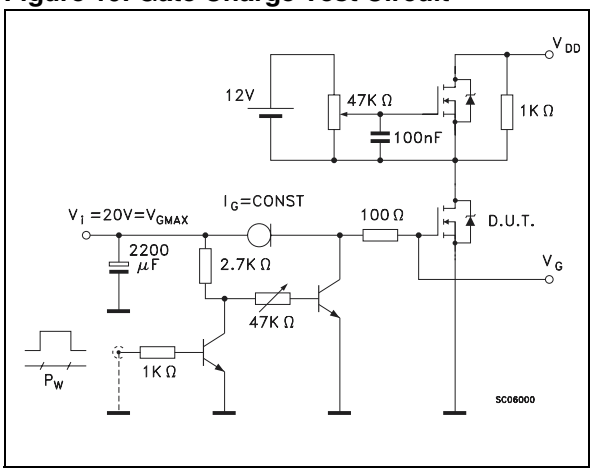
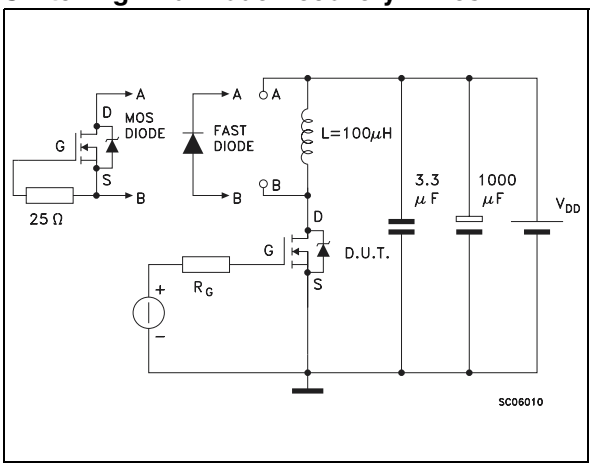


Figure 20. Test Circuit For Inductive Load Switching And Diode Recovery Times

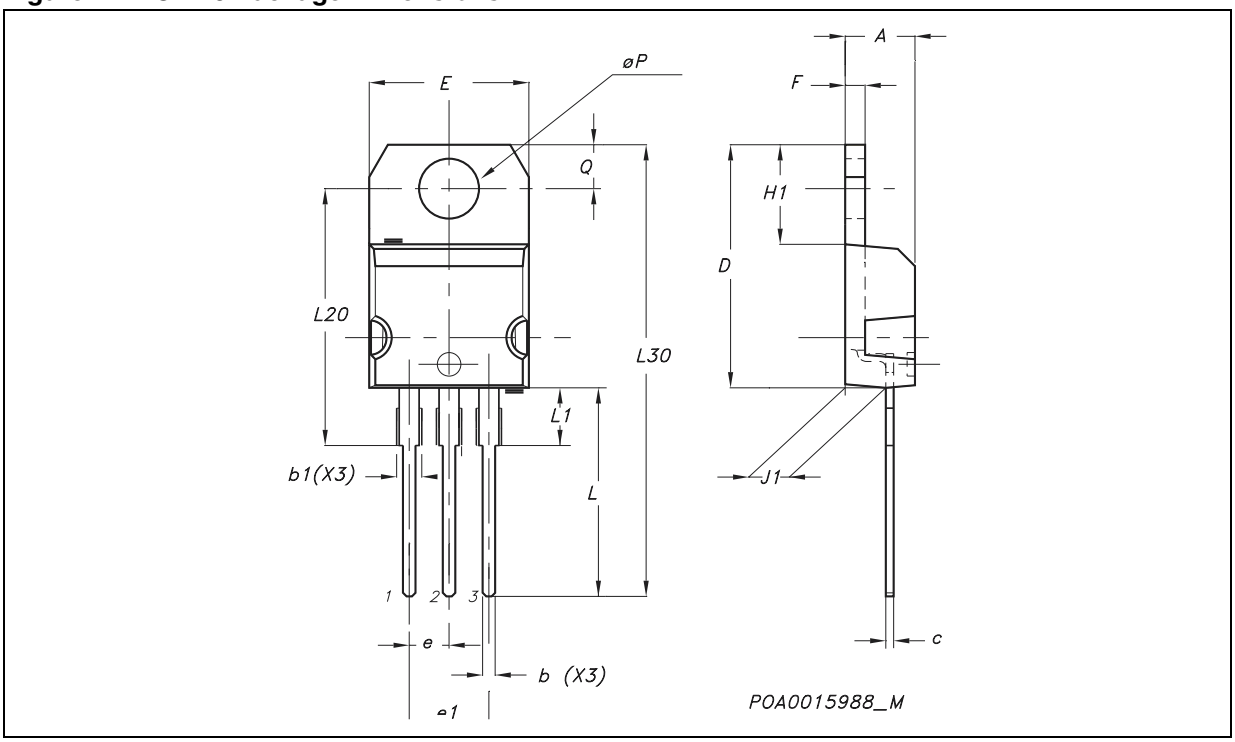


PACKAGE MECHANICAL

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

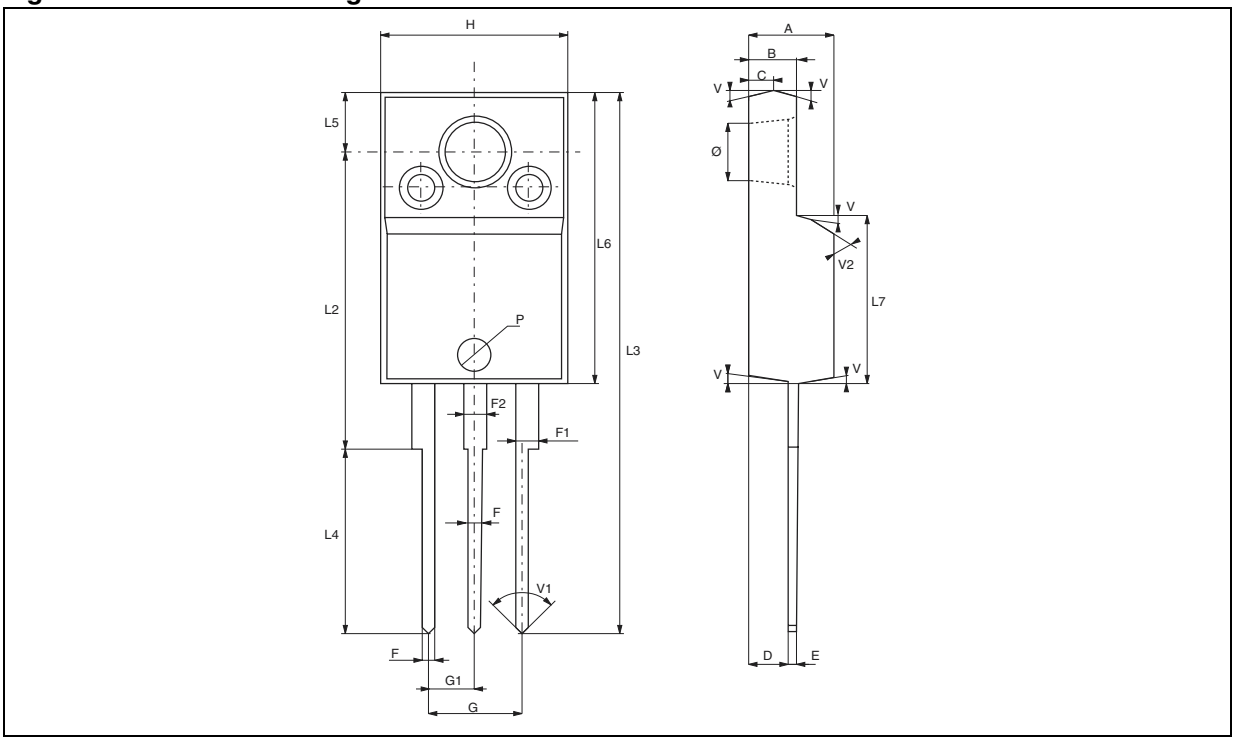


Note: Drawing is not to scale.

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
March-1998	1	First Issue
14-Apr-2004	2	Stylesheet update. No content change.