

# STP9NB60 STP9NB60FP

## N - CHANNEL 600V - 0.7Ω - 9A TO-220/TO220FP PowerMESH™ MOSFET

TYPE	V <sub>DSS</sub>	R <sub>D(on)</sub>	I <sub>D</sub>
STP9NB60	600 V	< 0.8 Ω	9.0 A
STP9NB60FP	600 V	< 0.8 Ω	9.0 A

- TYPICAL R<sub>D(on)</sub> = 0.7 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 R<sub>D(on)</sub> per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

### APPLICATIONS

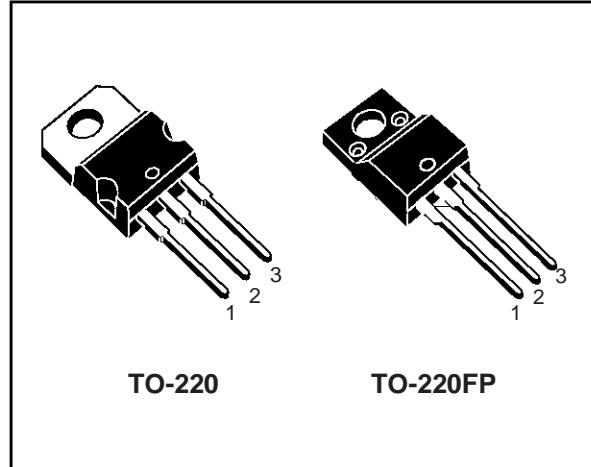
- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE

### ABSOLUTE MAXIMUM RATINGS

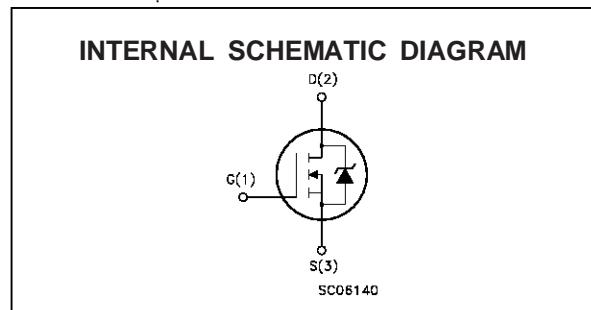
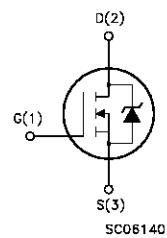
Symbol	Parameter	Value		Unit
		STP9NB60	STP9NB60FP	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	600	600	V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	600	600	V
V <sub>GS</sub>	Gate-source Voltage	± 30	± 30	V
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 25 °C	9.0	9.0(*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 100 °C	5.7	5.7(*)	A
I <sub>DM(•)</sub>	Drain Current (pulsed)	36	36	A
P <sub>tot</sub>	Total Dissipation at T <sub>c</sub> = 25 °C	125	40	W
	Derating Factor	1.0	0.32	W/°C
dv/dt(1)	Peak Diode Recovery voltage slope	4.5	4.5	V/ns
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	—	2000	V
T <sub>stg</sub>	Storage Temperature	-65 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature	150		°C

(•) Pulse width limited by safe operating area

(\*) Limited only by maximum temperature allowed



**INTERNAL SCHEMATIC DIAGRAM**



(1) I<sub>SD</sub> ≤ 9A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

## STP9NB60/FP

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### THERMAL DATA

			TO-220	TO-220FP	
R <sub>thj-case</sub>	Thermal Resistance Junction-case	Max	1.0	3.12	°C/W
R <sub>thj-amb</sub> R <sub>thc-sink</sub>	Thermal Resistance Junction-ambient Thermal Resistance Case-sink	Max Typ	62.5 0.5	300	°C/W °C/W °C
T <sub>I</sub>	Maximum Lead Temperature For Soldering Purpose				

### AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max, δ < 1%)	9	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	850	mJ

### ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

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 50	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 30 V			± 100	nA

ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA	3	4	5	V
R <sub>D(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V I <sub>D</sub> = 3 A		0.7	0.8	Ω
I <sub>D(on)</sub>	On State Drain Current	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>D(on)max</sub> V <sub>GS</sub> = 10 V	9.0			A

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (*)	Forward Transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>D(on)max</sub> I <sub>D</sub> = 4.5 A	3.0	6.5		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0		1480 210 25	1924 273 33	pF pF pF

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**ELECTRICAL CHARACTERISTICS (continued)**

## SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Time Rise Time	$V_{DD} = 300 \text{ V}$ $I_D = 4.5 \text{ A}$ $R_G = 4.7 \Omega$ $V_{GS} = 10 \text{ V}$ (see test circuit, figure 3)		25 11	35 15	ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 480 \text{ V}$ $I_D = 9.0 \text{ A}$ $V_{GS} = 10 \text{ V}$		40 10.5 17.5	56	nC nC nC

## SWITCHING OFF

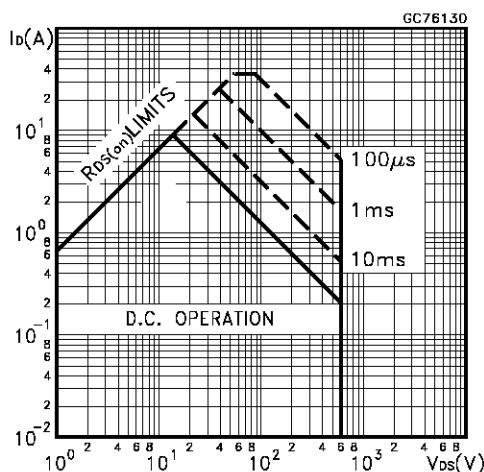
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(V_{off})}$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 480 \text{ V}$ $I_D = 9.0 \text{ A}$ $R_G = 4.7 \Omega$ $V_{GS} = 10 \text{ V}$ (see test circuit, figure 5)		12 10 21	17 14 29	ns ns ns

## SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}(\bullet)$	Source-drain Current Source-drain Current (pulsed)				9.0 36	A A
$V_{SD} (\ast)$	Forward On Voltage	$I_{SD} = 9.0 \text{ A}$ $V_{GS} = 0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 9.0 \text{ A}$ $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 100 \text{ V}$ $T_j = 150 \text{ }^\circ\text{C}$ (see test circuit, figure 5)		600 5.4 18		ns $\mu\text{C}$ A

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %( $\bullet$ ) Pulse width limited by safe operating area

## Safe Operating Area for TO-220



## Safe Operating Area for TO-220FP

