

**GENERAL DESCRIPTION**

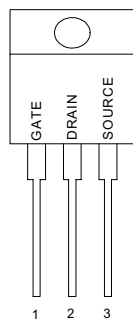
This high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

**FEATURES**

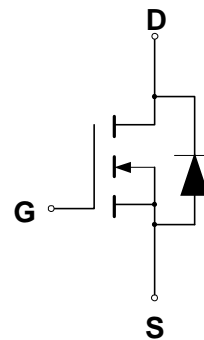
- ◆ Robust High Voltage Termination
- ◆ Avalanche Energy Specified
- ◆ Source-to-Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- ◆ Diode is Characterized for Use in Bridge Circuits
- ◆  $I_{BSS}$  Specified at Elevated Temperature

**PIN CONFIGURATION**

TO-220FP  
Front View



**SYMBOL**



N-Channel MOSFET

**ABSOLUTE MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Drain to Current – Continuous	$I_D$	5.0	A
– Pulsed	$I_{DM}$	20	
Gate-to-Source Voltage – Continue	$V_{GS}$	$\pm 20$	V
– Non-repetitive	$V_{GSM}$	$\pm 40$	V
Total Power Dissipation	$P_D$	35	W
Derate above 25°C		0.28	W/°C
Operating and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150	°C
Single Pulse Drain-to-Source Avalanche Energy – $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100\text{V}, V_{GS} = 10\text{V}, I_L = 7\text{A}, L = 10\text{mH}, R_G = 25\Omega$ )	$E_{AS}$	245	mJ
Thermal Resistance – Junction to Case	$\theta_{JC}$	1.0	°C/W
– Junction to Ambient	$\theta_{JA}$	62.5	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	°C

(1) Pulse Width and frequency is limited by  $T_J(\text{max})$  and thermal response

### ORDERING INFORMATION

Part Number	Package
IRF5N60	TO-220 Full Pak

### ELECTRICAL CHARACTERISTICS

Unless otherwise specified,  $T_J = 25^\circ\text{C}$ .

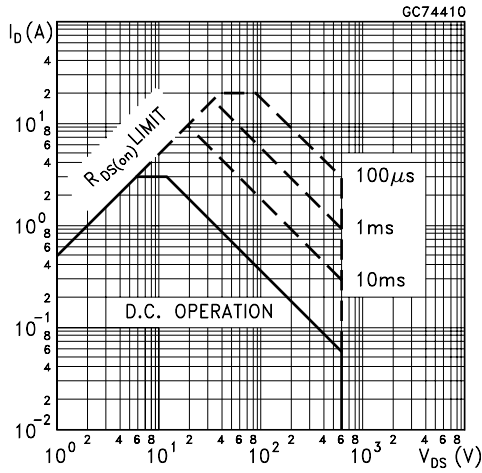
Characteristic		Symbol	IRF5N60			Units
			Min	Typ	Max	
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ V}$ , $I_D = 250\ \mu\text{A}$ )		$V_{(BR)DSS}$	600			V
Drain-Source Leakage Current ( $V_{DS} = 600\text{ V}$ , $V_{GS} = 0\text{ V}$ ) ( $V_{DS} = 480\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125^\circ\text{C}$ )		$I_{DSS}$			50 50	$\mu\text{A}$
Gate-Source Leakage Current-Forward ( $V_{gsf} = 30\text{ V}$ , $V_{DS} = 0\text{ V}$ )		$I_{GSSF}$			100	nA
Gate-Source Leakage Current-Reverse ( $V_{gsr} = -30\text{ V}$ , $V_{DS} = 0\text{ V}$ )		$I_{GSSR}$			-100	nA
Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$ )		$V_{GS(th)}$	3.0		5.0	V
Static Drain-Source On-Resistance ( $V_{GS} = 10\text{ V}$ , $I_D = 2.5\text{A}$ ) *		$R_{DS(on)}$		1.8	2.0	$\Omega$
Forward Transconductance ( $V_{DS} > I_D(ON) \cdot R_{DS(ON)max}$ , $I_D = 2.5\text{A}$ ) *		$g_{FS}$	2.5	4.5		mhos
Input Capacitance	( $V_{DS} = 25\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$		680	884	pF
Output Capacitance		$C_{oss}$		103	139	pF
Reverse Transfer Capacitance		$C_{rss}$		11	15	pF
Turn-On Delay Time	( $V_{DD} = 300\text{ V}$ , $I_D = 2.5\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 4.7\Omega$ ) *	$t_{d(on)}$		12	17	ns
Rise Time		$t_r$		10	14	ns
Turn-Off Delay Time		$t_{d(off)}$		36		ns
Fall Time		$t_f$		25		ns
Total Gate Charge	( $V_{DS} = 480\text{ V}$ , $I_D = 5.0\text{ A}$ , $V_{GS} = 10\text{ V}$ ) *	$Q_g$		21	30	nC
Gate-Source Charge		$Q_{gs}$		7.6		nC
Gate-Drain Charge		$Q_{gd}$		7.5		nC
Internal Drain Inductance (Measured from the drain lead 0.25" from package to center of die)		$L_D$		4.5		nH
Internal Drain Inductance (Measured from the source lead 0.25" from package to source bond pad)		$L_S$		7.5		nH
<b>SOURCE-DRAIN DIODE CHARACTERISTICS</b>						
Forward On-Voltage(1)	( $I_{SD} = 5.0\text{ A}$ , $V_{DD} = 100\text{ V}$ $d_s/d_i = 100\text{A}/\mu\text{s}$ )	$V_{SD}$			1.6	V
Forward Turn-On Time		$t_{on}$		**		ns
Reverse Recovery Time		$t_{rr}$		610		ns

\* Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 1.5\%$

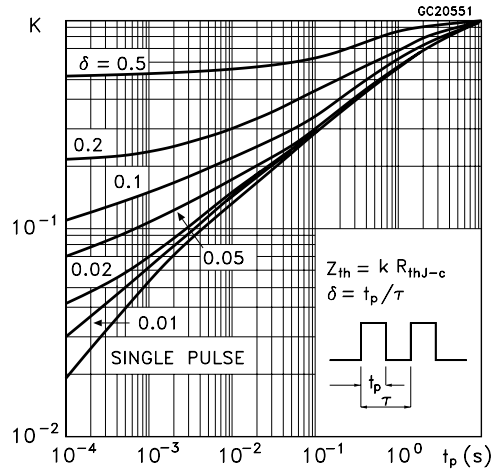
\*\* Negligible, Dominated by circuit inductance

TYPICAL ELECTRICAL CHARACTERISTICS

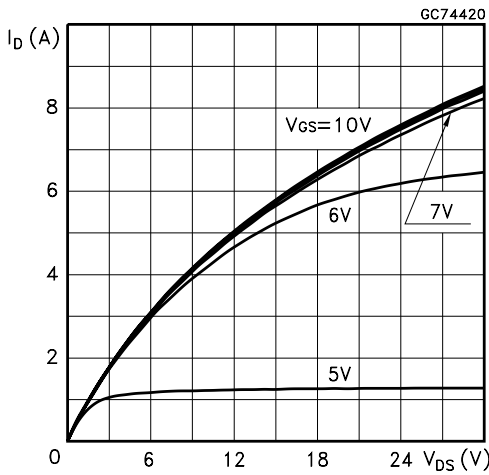
Safe Operating Area for TO-220FP



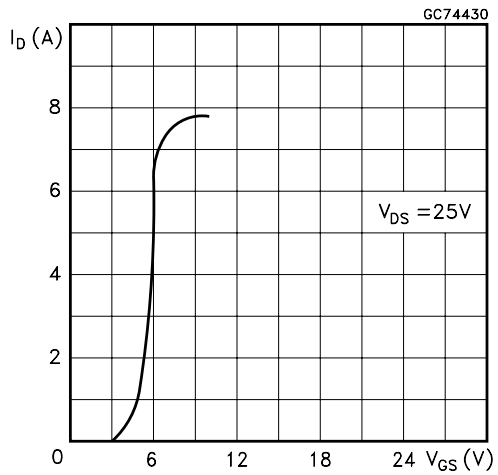
Thermal Impedance for TO-220FP



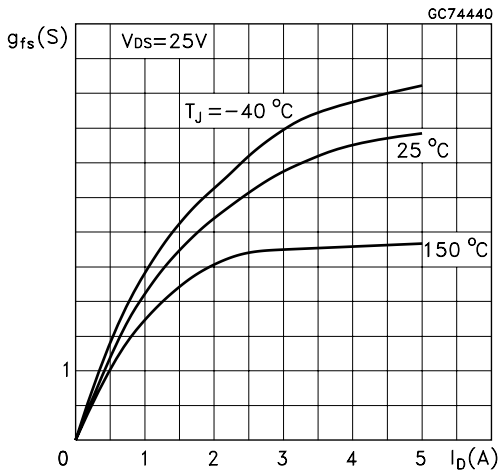
Output Characteristics



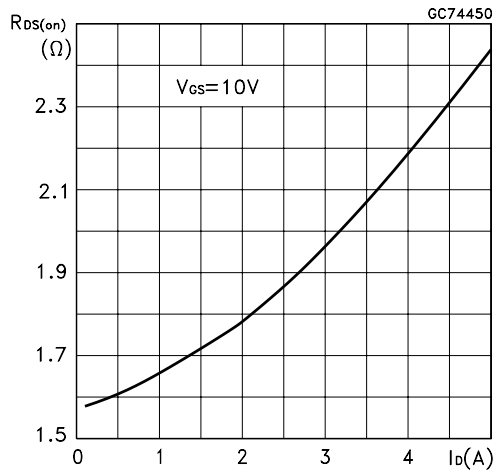
Transfer Characteristics



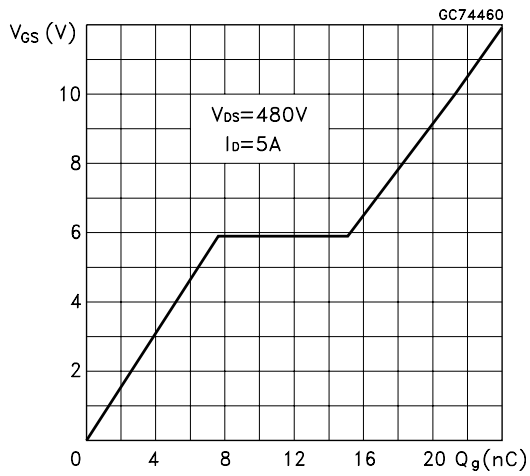
Transconductance



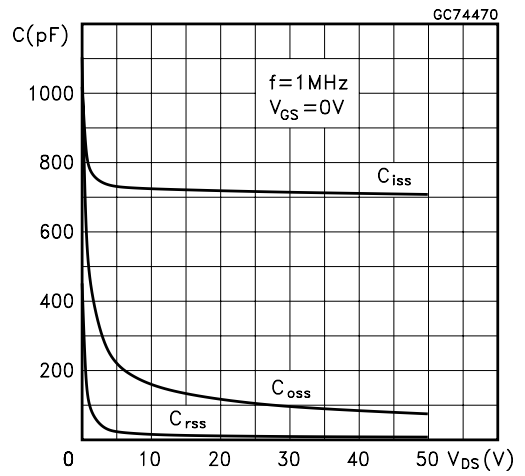
Static Drain-source On Resistance



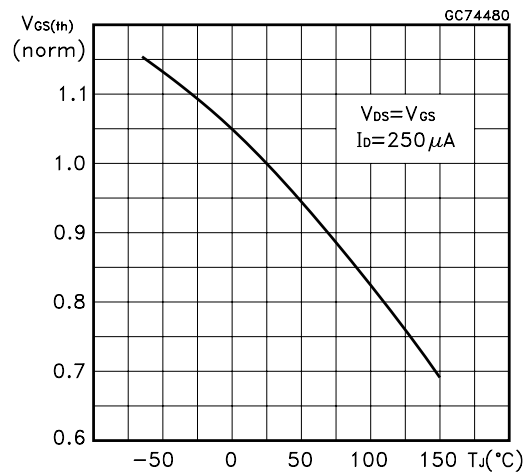
Gate Charge vs Gate-source Voltage



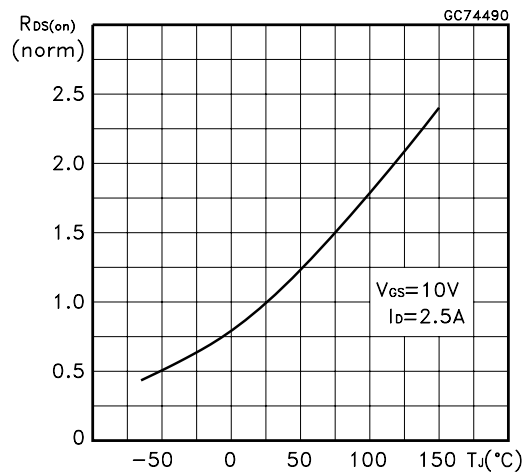
Capacitance Variations



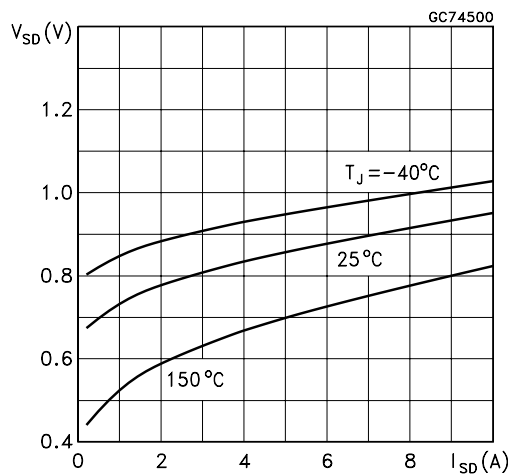
Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics



**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	0.385		0.417
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

