

## N-Channel Power MOSFET 20A, 500Volts

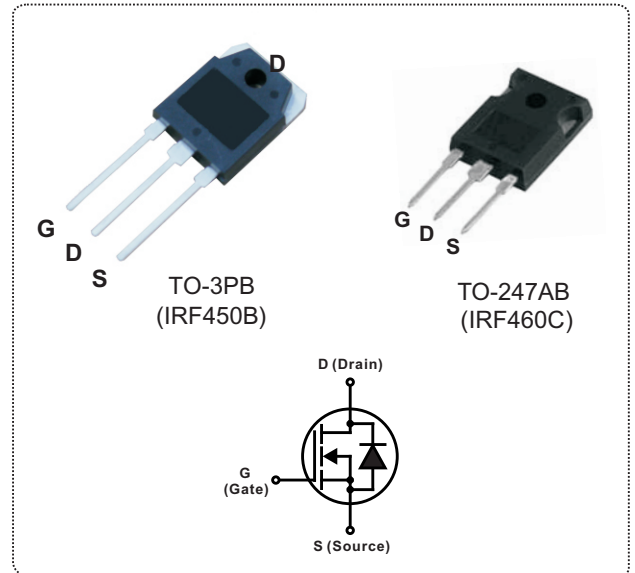
### DESCRIPTION

The Nell **IRF460** is a three-terminal silicon device with current conduction capability of 20A, fast switching speed, low on-state resistance, breakdown voltage rating of 500V, and max. threshold voltage of 4 volts.

They are designed for use in applications such as switched mode power supplies, DC to DC converters, motor control circuits UPS and general purpose switching applications.

### FEATURES

- $R_{DS(ON)} = 0.27\Omega @ V_{GS} = 10V$
- Ultra low gate charge(210nC Max.)
- Low reverse transfer capacitance ( $C_{RSS} = 350pF$  typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



### PRODUCT SUMMARY

$I_D$ (A)	20
$V_{DSS}$ (V)	500
$R_{DS(ON)}$ ( $\Omega$ )	0.27 @ $V_{GS} = 10V$
$Q_G$ (nC) max.	210

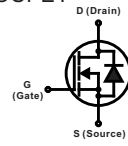
### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ C$ unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	VALUE	UNIT
$V_{DSS}$	Drain to Source voltage	$T_J = 25^\circ C$ to $150^\circ C$	500	V
$V_{DGR}$	Drain to Gate voltage	$R_{GS} = 20K\Omega$	500	
$V_{GS}$	Gate to Source voltage		$\pm 20$	
$I_D$	Continuous Drain Current ( $V_{GS} = 10V$ )	$T_C = 25^\circ C$	20	A
		$T_C = 100^\circ C$	13	
$I_{DM}$	Pulsed Drain current(Note 1)		80	
$I_{AR}$	Avalanche current(Note 1)		20	
$E_{AR}$	Repetitive avalanche energy(Note 1)	$I_{AR} = 20A, R_{GS} = 50\Omega, V_{GS} = 10V$	28	mJ
$E_{AS}$	Single pulse avalanche energy(Note 2)	$I_{AS} = 20A, L = 4.3mH$	960	
dv/dt	Peak diode recovery dv/dt(Note 3)		3.5	V/ns
$P_D$	Total power dissipation	$T_C = 25^\circ C$	280	W
	Derate above $25^\circ C$		2.2	W/ $^\circ C$
$T_J$	Operation junction temperature		-55 to 150	$^\circ C$
$T_{STG}$	Storage temperature		-55 to 150	
$T_L$	Maximum soldering temperature, for 10 seconds	1.6mm from case	300	
	Mounting torque, #6-32 or M3 screw		10 (1.1)	lbf-in (N·m)

Note: 1. Repetitive rating: pulse width limited by junction temperature.  
 2.  $I_{AS} = 20A, L = 4.3mH, V_{DD} = 50V, R_G = 25\Omega$ , starting  $T_J = 25^\circ C$ .  
 3.  $I_{SD} \leq 20A, di/dt \leq 160A/\mu s, V_{DD} \leq V_{(BR)DSS}$ , starting  $T_J = 25^\circ C$ .

THERMAL RESISTANCE						
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	
$R_{th(j-c)}$	Thermal resistance, junction to case			0.45	°C/W	
$R_{th(c-s)}$	Thermal resistance, case to heat sink		0.24			
$R_{th(j-a)}$	Thermal resistance, junction to ambient			40		

ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise specified)						
SYMBOL	PARAMETER	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
◎ STATIC						
$V_{(BR)DSS}$	Drain to source breakdown voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	500			V
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown voltage temperature coefficient	$I_D = 1\text{mA}, V_{DS} = V_{GS}$		0.63		V/°C
$I_{DSS}$	Drain to source leakage current	$V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$			25.0	$\mu\text{A}$
		$V_{DS} = 400\text{V}, V_{GS} = 0\text{V}$			250	
$I_{GSS}$	Gate to source forward leakage current	$V_{GS} = 20\text{V}, V_{DS} = 0\text{V}$			100	nA
	Gate to source reverse leakage current	$V_{GS} = -20\text{V}, V_{DS} = 0\text{V}$			-100	
$R_{DS(ON)}$	Static drain to source on-state resistance	$I_D = 12\text{A}, V_{GS} = 10\text{V}$			0.27	$\Omega$
$V_{GS(TH)}$	Gate threshold voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.0		4.0	V
$g_{fs}$	Forward transconductance	$V_{DS} = 50\text{V}, I_D = 12\text{A}$	13			S
◎ DYNAMIC						
$C_{ISS}$	Input capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		4200		$\mu\text{F}$
$C_{OSS}$	Output capacitance			870		
$C_{RSS}$	Reverse transfer capacitance			350		
$t_{d(ON)}$	Turn-on delay time	$V_{DD} = 250\text{V}, V_{GS} = 10\text{V}$ $I_D = 20\text{A}, R_G = 4.3\Omega, R_D = 13\Omega$ (Note 1,2)		18		ns
$t_r$	Rise time			59		
$t_{d(OFF)}$	Turn-off delay time			110		
$t_f$	Fall time			58		
$Q_G$	Total gate charge	$V_{DD} = 400\text{V}, V_{GS} = 10\text{V}$ $I_D = 20\text{A},$ (Note 1,2)			210	nC
$Q_{GS}$	Gate to source charge				29	
$Q_{GD}$	Gate to drain charge (Miller charge)				110	
$L_D$	Internal drain inductance	Between lead, 6mm(0.25") form package and center of die contact		5		nH
$L_S$	Internal source inductance			13		

SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise specified)						
SYMBOL	PARAMETER	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{SD}$	Diode forward voltage	$I_{SD} = 20\text{A}, V_{GS} = 0\text{V}$			1.8	V
$I_S (I_{SD})$	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			20	A
$I_{SM}$	Pulsed source current				80	
$t_{rr}$	Reverse recovery time	$I_{SD} = 20\text{A}, V_{GS} = 0\text{V},$ $dI_F/dt = 100\text{A}/\mu\text{s}$		570	860	ns
$Q_{rr}$	Reverse recovery charge			5.7	8.6	$\mu\text{C}$

Note: 1. Pulse test: Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
2. Essentially independent of operating temperature.

## ORDERING INFORMATION SCHEME

**IRF 460 B**

**MOSFET series**

N = N-Channel, IRF series

**Current and Voltage rating,  $I_D$  &  $V_{DS}$**

20A / 500V

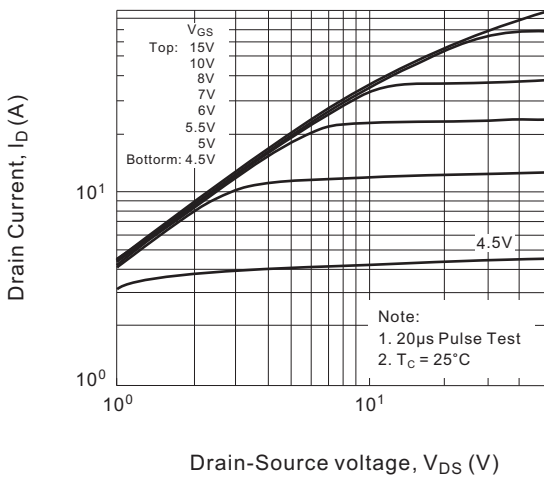
**Package type**

B = TO-3P(B)

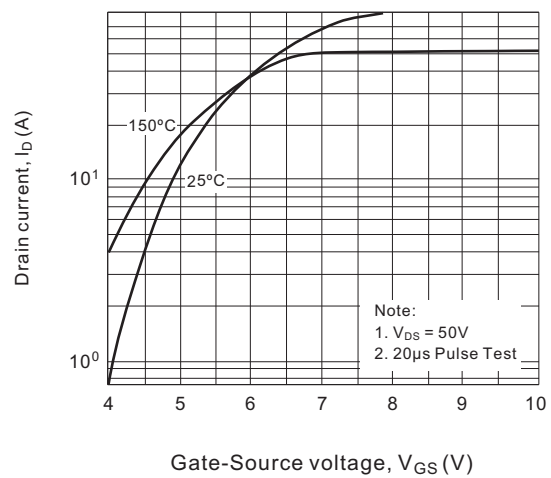
C = TO-247AB

## ■ TYPICAL CHARACTERISTICS

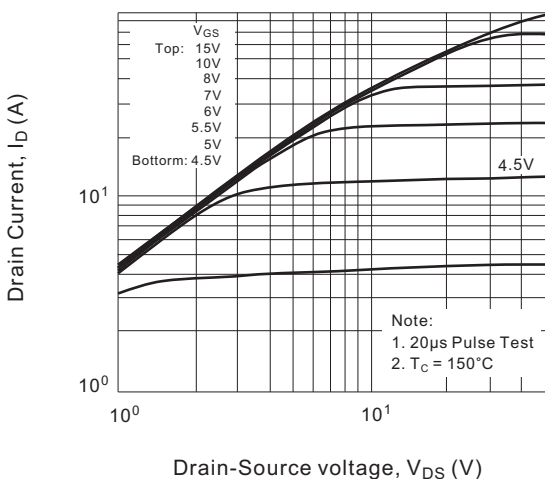
**Fig.1 Typical output characteristics,  $T_C=25^\circ\text{C}$**



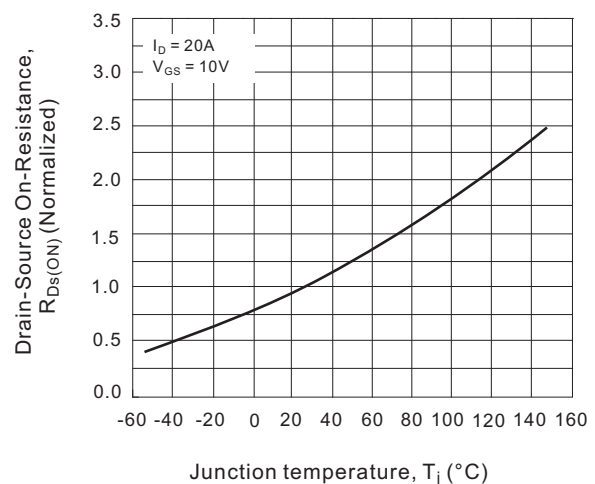
**Fig.2 Typical transfer characteristics**



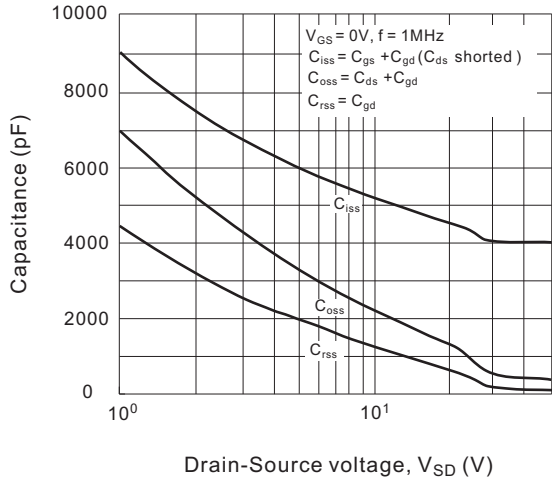
**Fig.3 Typical output characteristics,  $T_C=150^\circ\text{C}$**



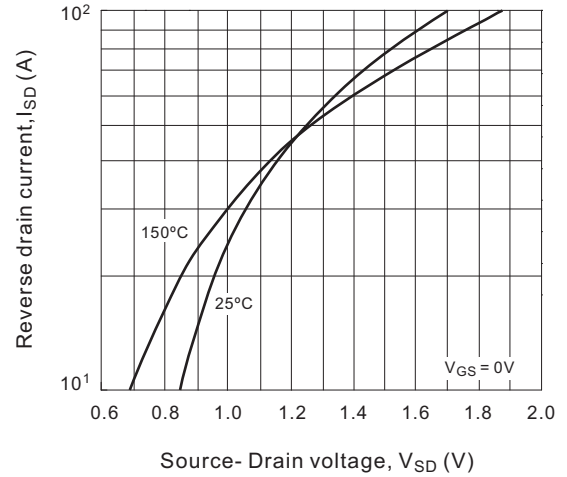
**Fig.4 Normalized On-Resistance vs. Temperature**



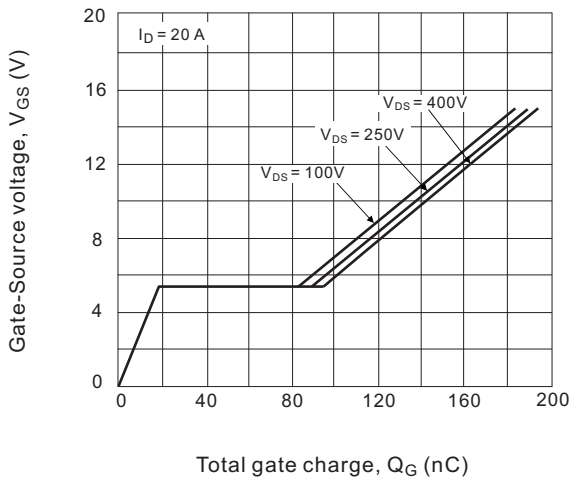
**Fig.5 Typical capacitance vs. Drain-to-Source voltage**



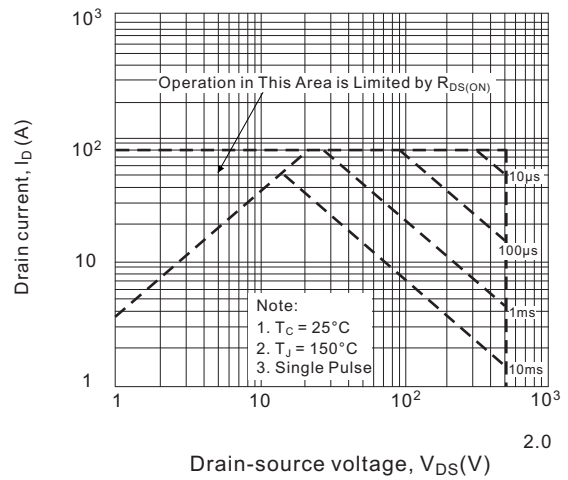
**Fig.6 Typical source-drain diode forward voltage**



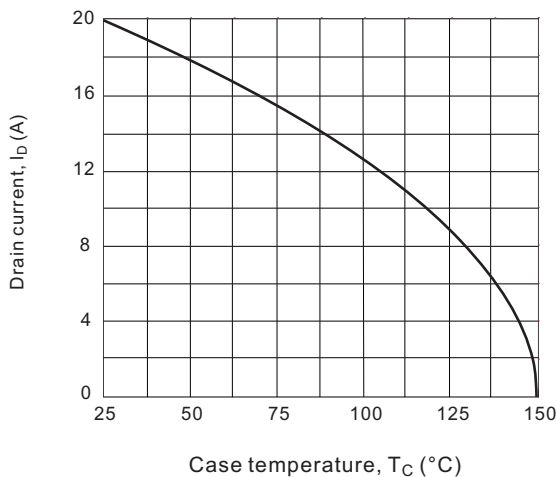
**Fig.7 Typical gate charge vs. gate-to-source voltage**



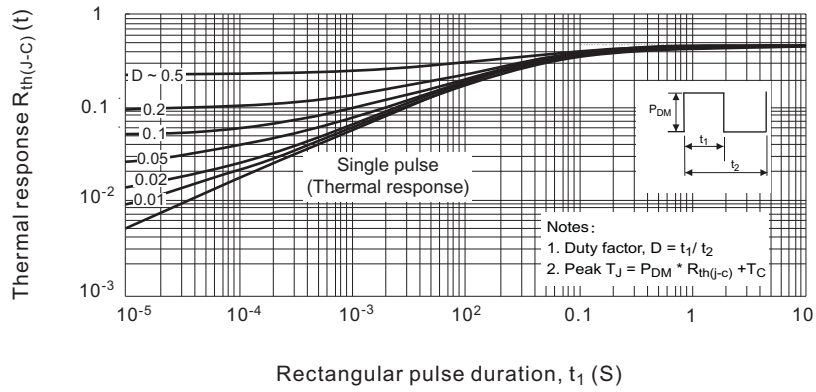
**Fig.8 Maximum safe operating area**



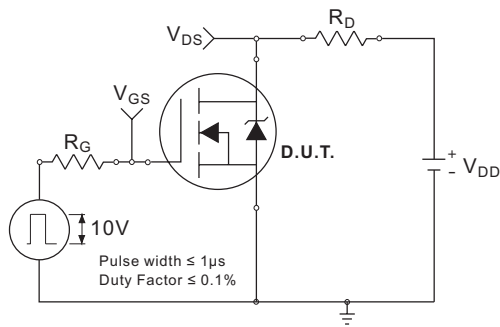
**Fig.9 Maximum drain current vs. Case temperature**



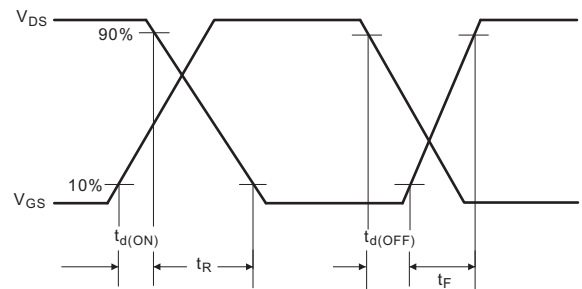
**Fig.10 Maximum effective transient thermal impedance, Junction-to-Case**



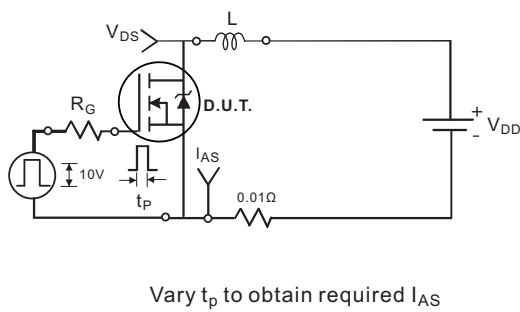
**Fig.11a. Switching time test circuit**



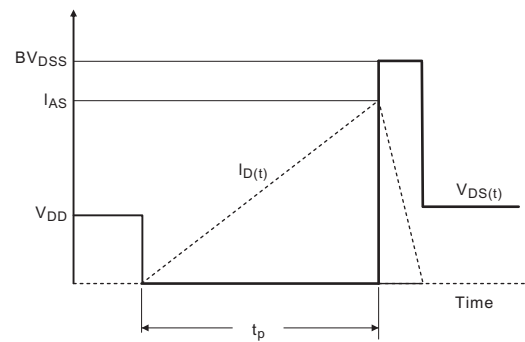
**Fig.11b. Switching time waveforms**



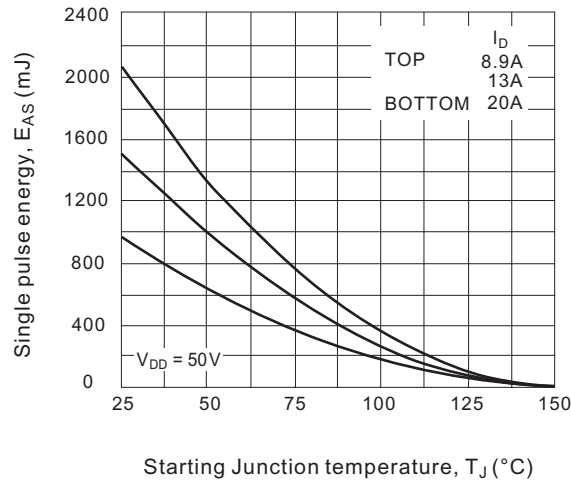
**Fig.12a. Unclamped Inductive test circuit**



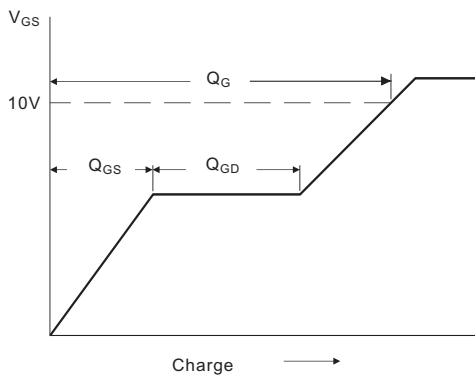
**Fig.12b. Unclamped Inductive waveforms**



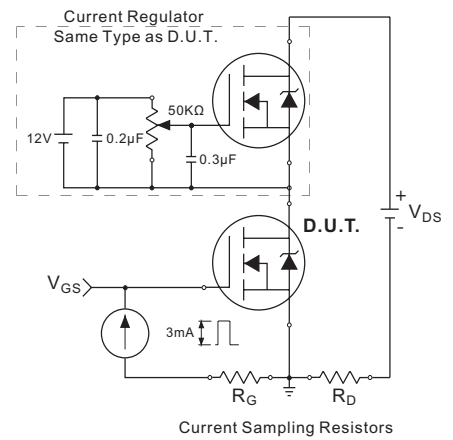
**Fig.12c. Maximum avalanche energy vs. Drain current**



**Fig.13a. Basic gate charge waveform**



**Fig.13b. Gate charge test circuit**



**Fig.14 Peak diode recovery dv/dt test circuit for N-Channel MOSFET**

