

IRL540NPbF

HEXFET® Power MOSFET

- Lead-Free
- Logic-Level Gate Drive
- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

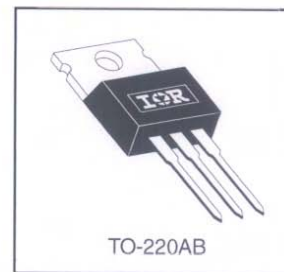
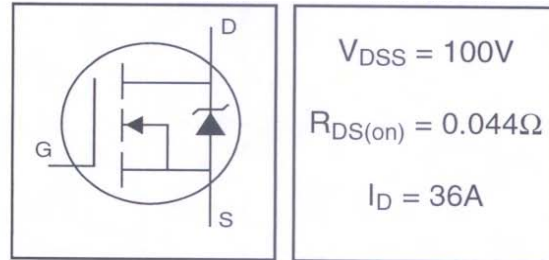
The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	36	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	26	
I_{DM}	Pulsed Drain Current ①	120	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	140	W
	Linear Derating Factor	0.91	W/°C
V_{GS}	Gate-to-Source Voltage	± 16	V
E_{AS}	Single Pulse Avalanche Energy②	310	mJ
I_{AR}	Avalanche Current①	18	A
E_{AR}	Repetitive Avalanche Energy①	14	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	

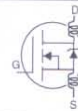
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	1.1	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	



Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.11	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.044	Ω	$V_{GS} = 10V, I_D = 18A$ ④
		—	—	0.053		$V_{GS} = 5.0V, I_D = 18A$ ④
		—	—	0.063		$V_{GS} = 4.0V, I_D = 15A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	1.0	—	2.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
g_{fs}	Forward Transconductance	14	—	—	S	$V_{DS} = 25V, I_D = 18A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 100V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 80V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 16V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -16V$
Q_g	Total Gate Charge	—	—	74	nC	$I_D = 18A$
Q_{gs}	Gate-to-Source Charge	—	—	9.4		$V_{DS} = 5.0V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	38		$V_{GS} = 5.0V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	11	—	ns	$V_{DD} = 50V$
t_r	Rise Time	—	81	—		$I_D = 18A$
$t_{d(off)}$	Turn-Off Delay Time	—	39	—		$R_G = 5.0\Omega, V_{GS} = 5.0V$
t_f	Fall Time	—	62	—		$R_D = 2.7\Omega$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	1800	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	350	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	170	—		$f = 1.0\text{MHz}$, See Fig. 5



Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	36	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①⑥	—	—	120		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 18A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	190	290	ns	$T_J = 25^\circ\text{C}, I_F = 18A$
Q_{rr}	Reverse Recovery Charge	—	1.1	1.7	μC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 1.9\text{mH}$
 $R_G = 25\Omega, I_{AS} = 18A$. (See Figure 12)

- ③ $I_{SD} \leq 18A, di/dt \leq 180A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 175^\circ\text{C}$

- ④ Pulse width $\leq 300\mu s$; duty cycle $\leq 2\%$

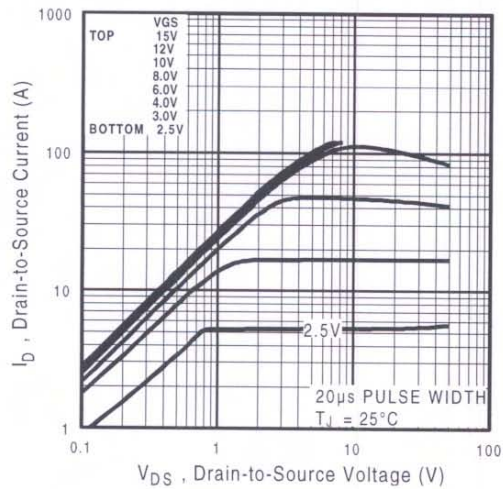


Fig 1. Typical Output Characteristics

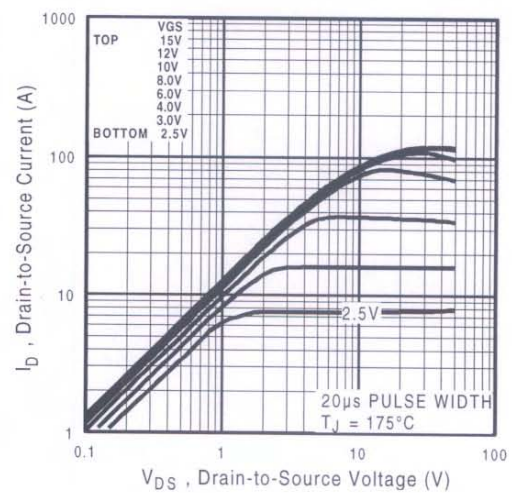


Fig 2. Typical Output Characteristics

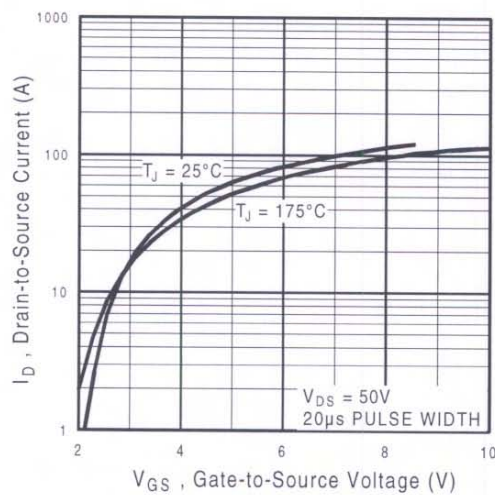


Fig 3. Typical Transfer Characteristics

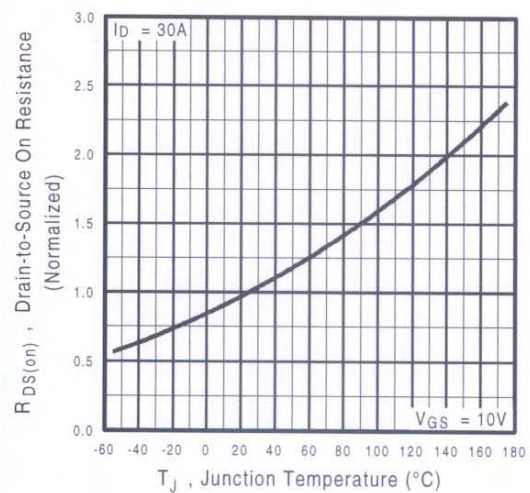


Fig 4. Normalized On-Resistance Vs. Temperature

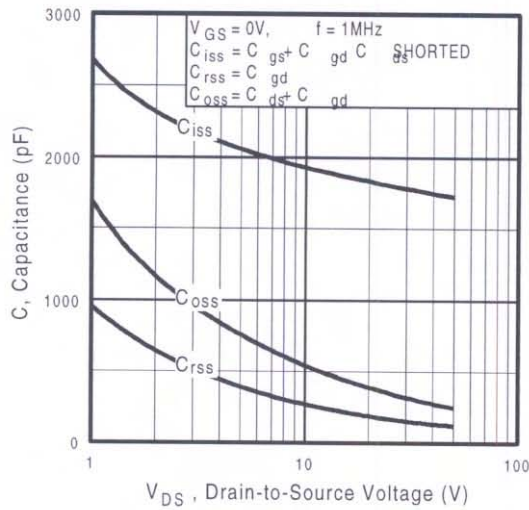


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

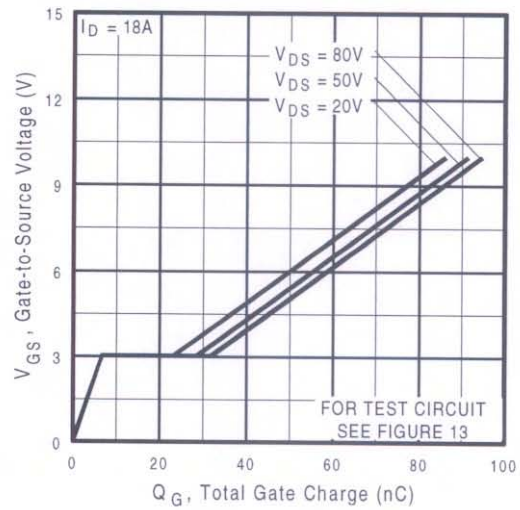


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

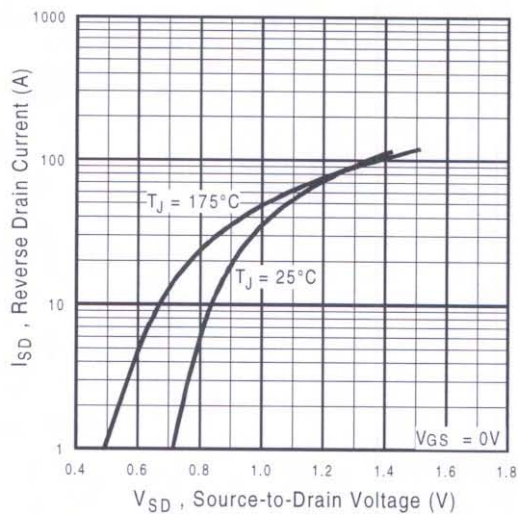


Fig 7. Typical Source-Drain Diode Forward Voltage

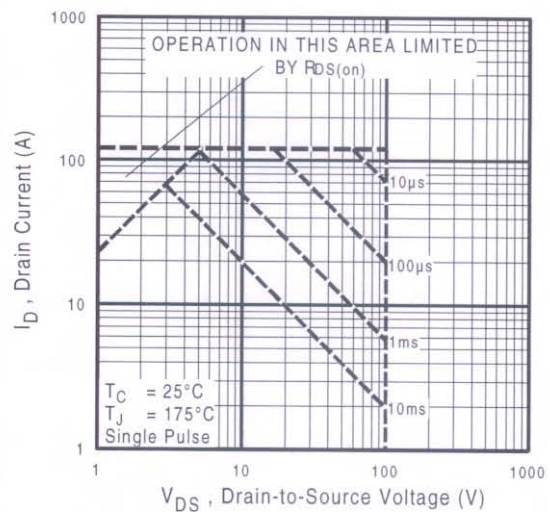


Fig 8. Maximum Safe Operating Area

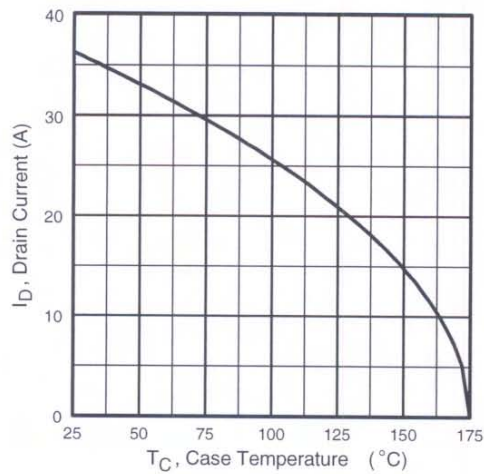


Fig 9. Maximum Drain Current Vs. Case Temperature

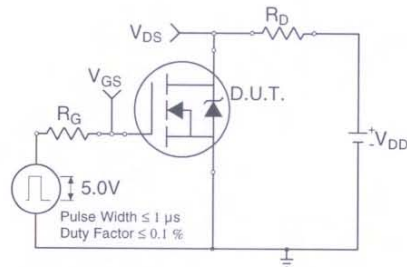


Fig 10a. Switching Time Test Circuit

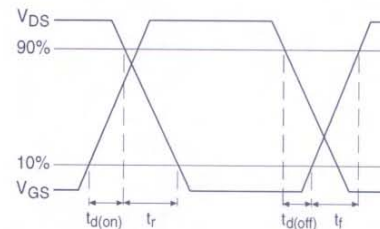


Fig 10b. Switching Time Waveforms

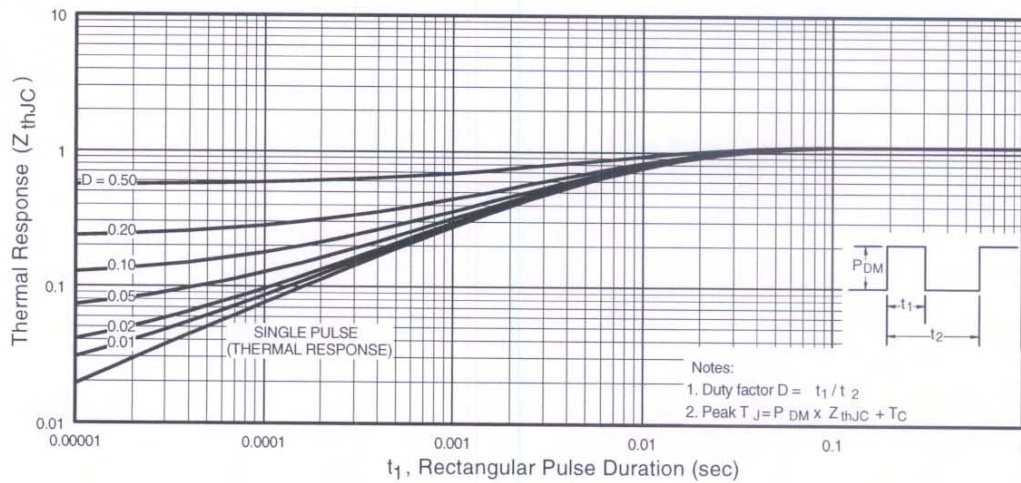


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRL540NPbF

International
IR Rectifier

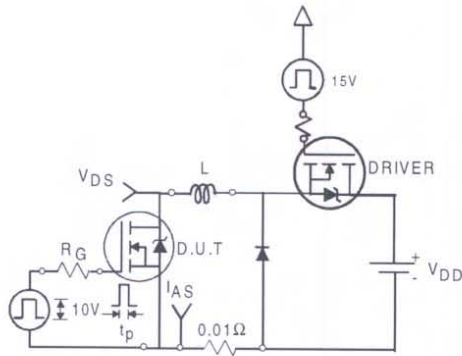


Fig 12a. Unclamped Inductive Test Circuit

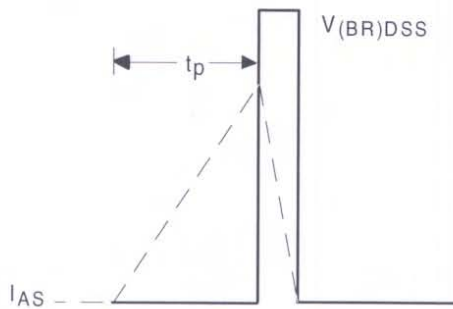


Fig 12b. Unclamped Inductive Waveforms

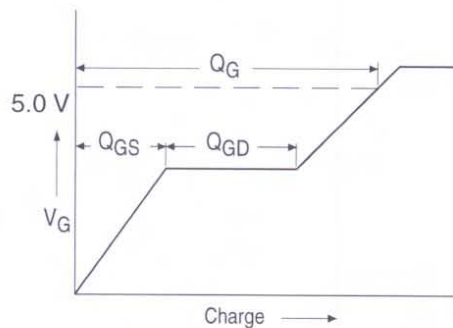


Fig 13a. Basic Gate Charge Waveform

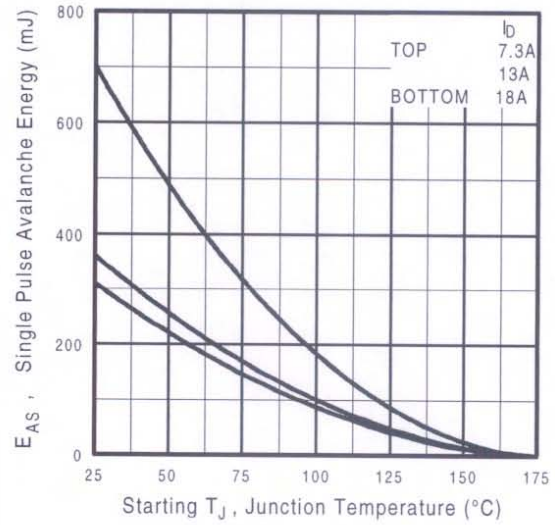


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

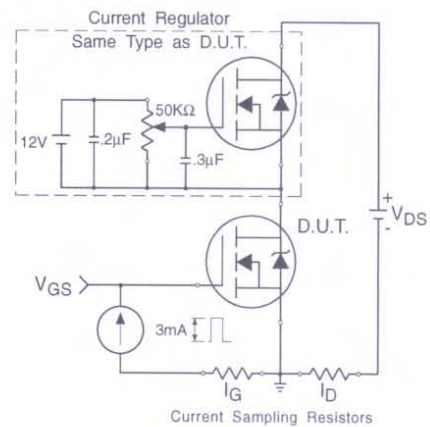


Fig 13b. Gate Charge Test Circuit

Circuit Layout Considerations

- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance

Circuit Diagram Labels:

- ①: Pulse Generator
- ②: Driver MOSFET
- ③: D.U.T. (Device Under Test) MOSFET
- ④: Load Resistor

Component Labels:

- R_G : Gate Resistor
- V_{DD} : Supply Voltage

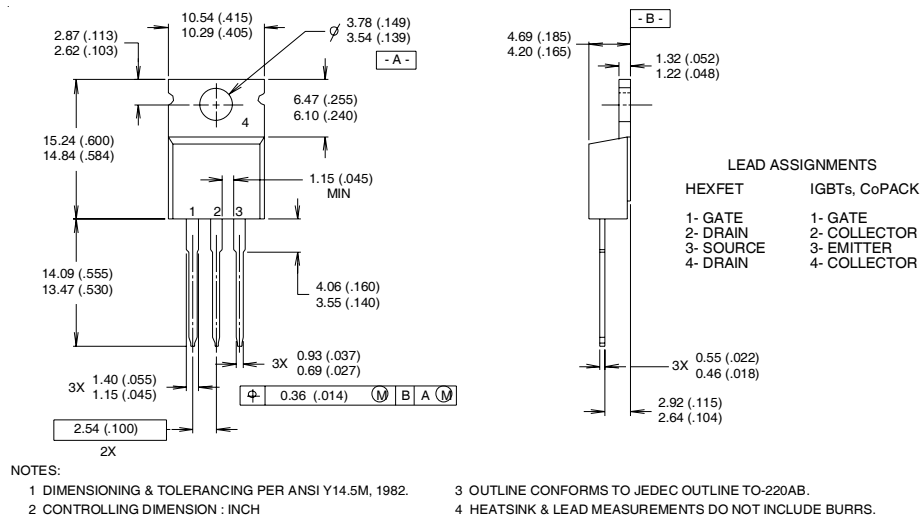
Characterization Parameters:

- dv/dt controlled by R_G
- Driver same type as D.U.T.
- I_{SP} controlled by Duty Factor "D"
- D.U.T. - Device Under Test



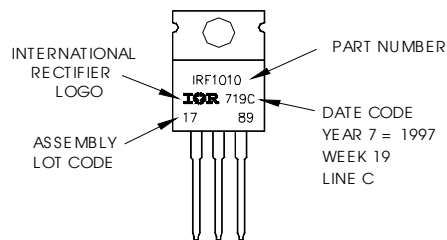
TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line
position indicates "Lead-Free"



Data and specifications subject to change without notice.

International
IOR Rectifier

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