

**REPETITIVE AVALANCHE AND dv/dt RATED  
 HEXFET® TRANSISTORS  
 THRU-HOLE -TO-204AE (TO-3)**

**IRF9230  
 JANTX2N6806  
 JANTXV2N6806  
 REF:MIL-PRF-19500/562  
 200V, P-CHANNEL**

**Product Summary**

Part Number	BVDSS	RDS(on)	ID
IRF9230	-200V	0.80 Ω	-6.5A

The HEXFET® technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry and unique processing of this latest "State of the Art" design achieves: very low on-state resistance combined with high transconductance; superior reverse energy and diode recovery dv/dt capability.

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters.

They are well suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high energy pulse circuits.



TO-3

**Features:**

- Repetitive Avalanche Ratings
- Dynamic dv/dt Rating
- Hermetically Sealed
- Simple Drive Requirements
- Ease of Paralleling
- ESD Rating: Class 1C per MIL-STD-750, Method 1020

**Absolute Maximum Ratings**

	Parameter		Units
ID @ VGS = 0V, TC = 25°C	Continuous Drain Current	-6.5	A
ID @ VGS = 0V, TC = 100°C	Continuous Drain Current	-4.0	
IDM	Pulsed Drain Current ①	-26	
PD @ TC = 25°C	Max. Power Dissipation	75	W
	Linear Derating Factor	0.60	W/°C
VGS	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	181	mJ
IAR	Avalanche Current ①	-6.5	A
EAR	Repetitive Avalanche Energy①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)	
	Weight	11.5 (typical)	g

For footnotes refer to the last page

**Electrical Characteristics @ T<sub>J</sub> = 25°C (Unless Otherwise Specified)**

	Parameter	Min	Typ	Max	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	-200	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = -1.0mA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	-0.20	—	V/°C	Reference to 25°C, I <sub>D</sub> = -1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.80	Ω	V <sub>GS</sub> = -10V, I <sub>D</sub> = -4.0A <sup>④</sup>
		—	—	0.92		V <sub>GS</sub> = -10V, I <sub>D</sub> = -6.5A <sup>④</sup>
V <sub>GS(th)</sub>	Gate Threshold Voltage	-2.0	—	-4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA
g <sub>fs</sub>	Forward Transconductance	2.0	—	—	S	V <sub>DS</sub> = -15V, I <sub>DS</sub> = -4.0A <sup>④</sup>
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	-25	μA	V <sub>DS</sub> = -160V, V <sub>GS</sub> = 0V
		—	—	-250		V <sub>DS</sub> = -160V V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	—	-100	nA	V <sub>GS</sub> = -20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	100	nA	V <sub>GS</sub> = 20V
Q <sub>g</sub>	Total Gate Charge	—	—	31	nC	V <sub>GS</sub> = -10V, I <sub>D</sub> = -6.5A V <sub>DS</sub> = -100V
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	7.0		
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	17		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	50	ns	V <sub>DD</sub> = -100V, I <sub>D</sub> = -6.5A, V <sub>GS</sub> = -10V, R <sub>G</sub> = 7.5Ω
t <sub>r</sub>	Rise Time	—	—	100		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	100		
t <sub>f</sub>	Fall Time	—	—	80		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	6.1	—	nH	Measured from the center of drain pad to center of source pad
C <sub>iss</sub>	Input Capacitance	—	700	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = -25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	200	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	40	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	-6.5	A	
I <sub>SM</sub>	Pulse Source Current (Body Diode) <sup>①</sup>	—	—	-26		
V <sub>SD</sub>	Diode Forward Voltage	—	—	-6.0	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = -6.5A, V <sub>GS</sub> = 0V <sup>④</sup>
t <sub>rr</sub>	Reverse Recovery Time	—	—	400	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = -6.5A, di/dt ≤ -100A/μs
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	4.0	μC	V <sub>DD</sub> ≤ -50V <sup>④</sup>
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub> .				

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction to Case	—	—	1.67	°C/W	Soldered to a 2" square copper-clad board
R <sub>thJA</sub>	Junction-to-Ambient	—	—	30		

Note: Corresponding Spice and Saber models are available on International Rectifier Website.

For footnotes refer to the last page

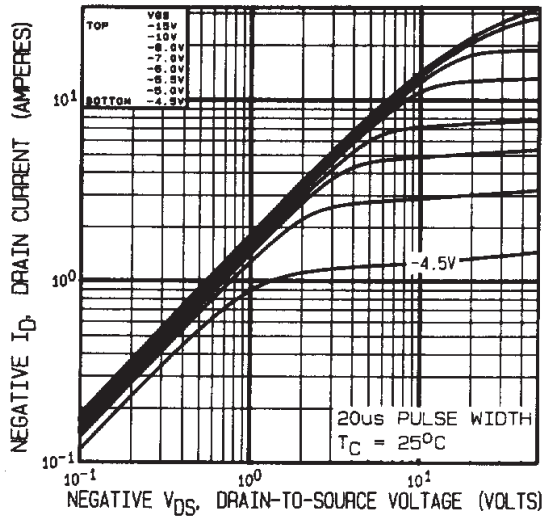


Fig 1. Typical Output Characteristics

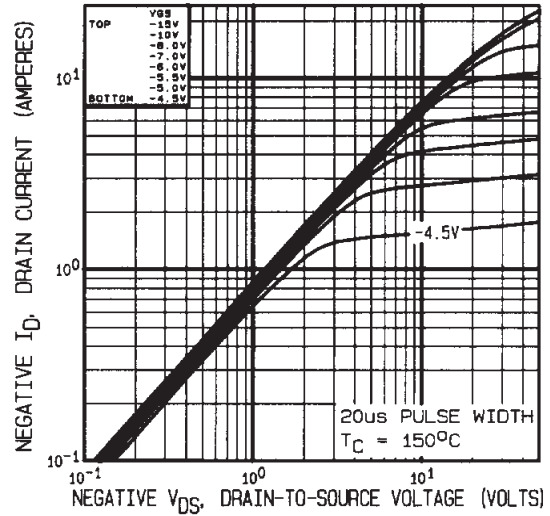


Fig 2. Typical Output Characteristics

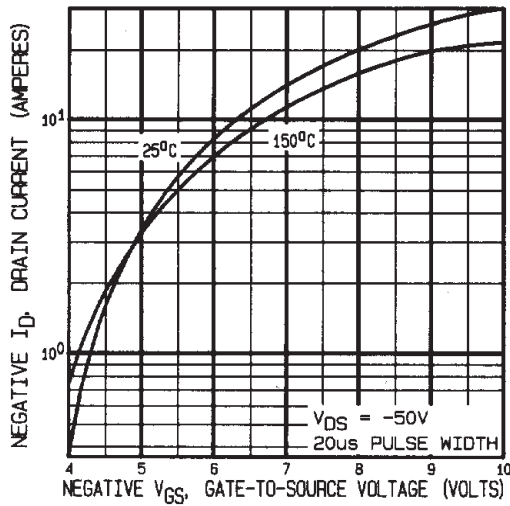


Fig 3. Typical Transfer Characteristics

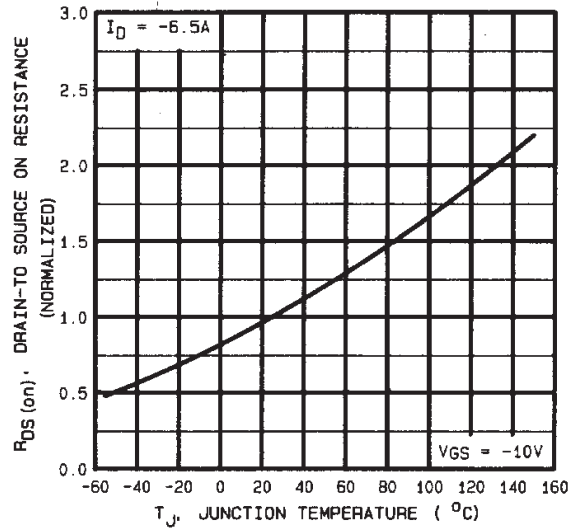
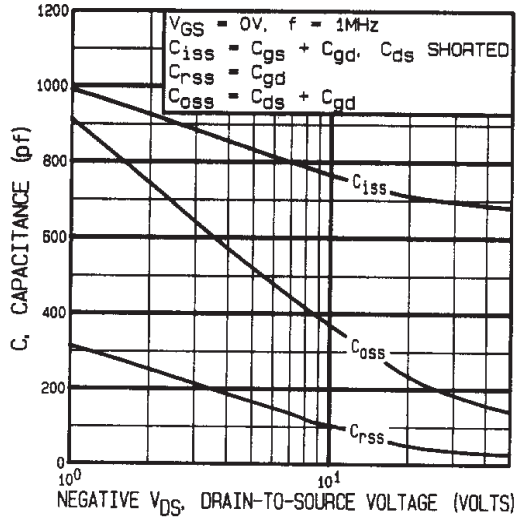
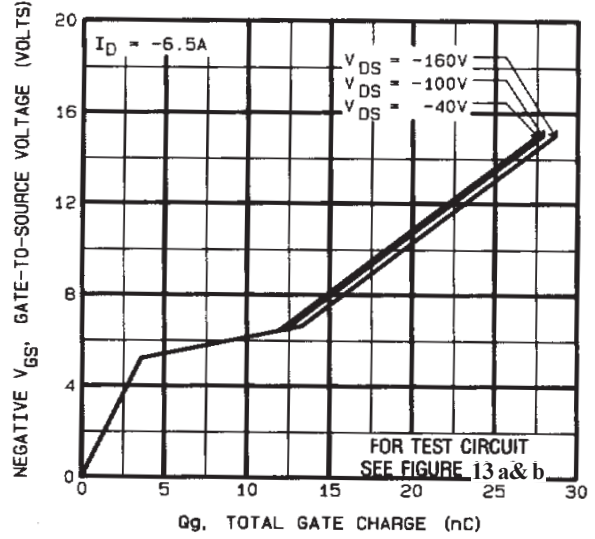


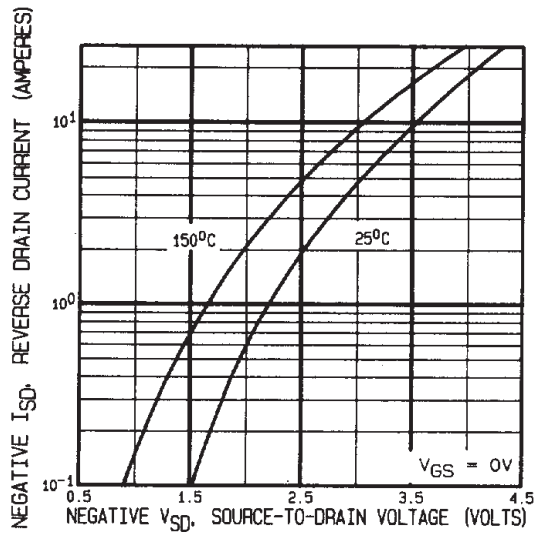
Fig 4. Normalized On-Resistance Vs. Temperature



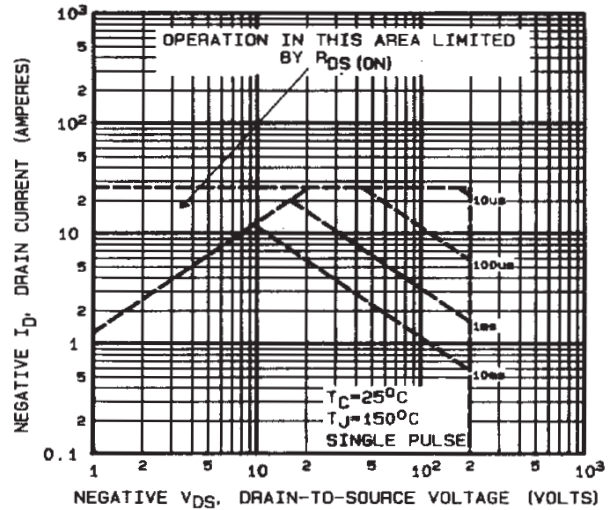
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



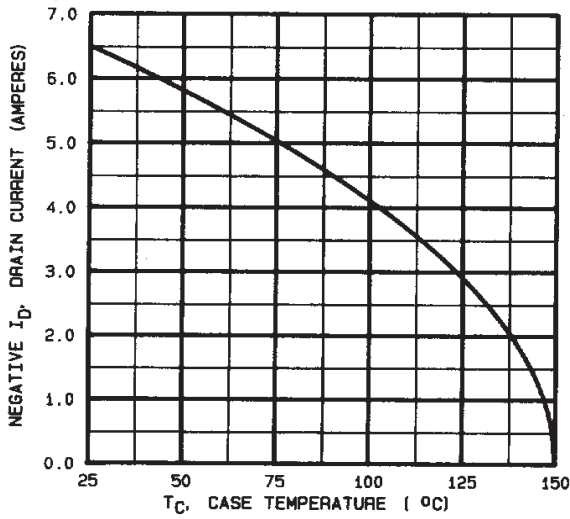
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



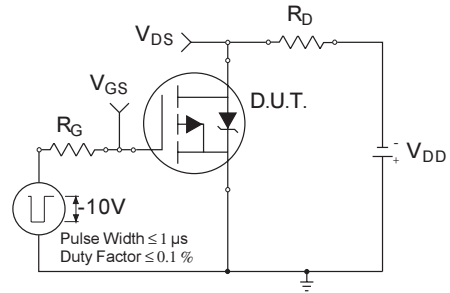
**Fig 7.** Typical Source-Drain Diode Forward Voltage



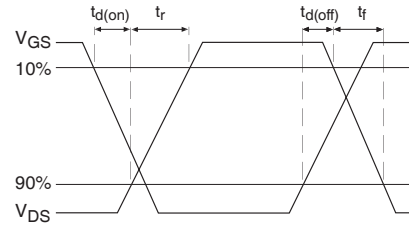
**Fig 8.** Maximum Safe Operating Area



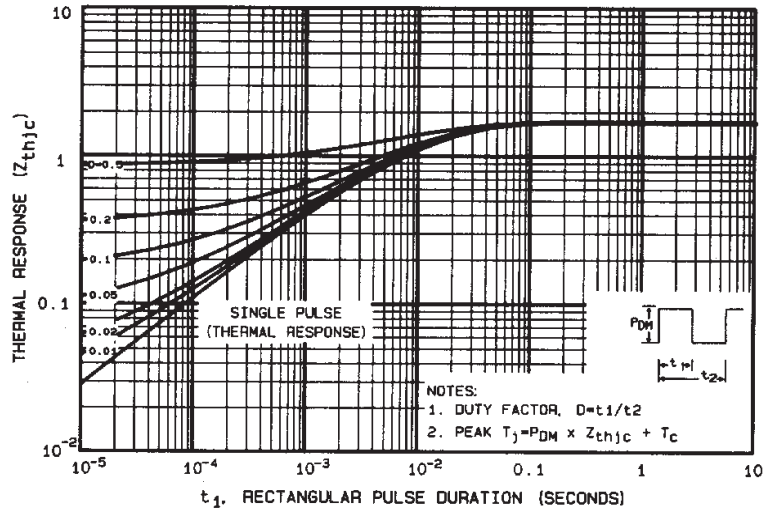
**Fig 9.** Maximum Drain Current Vs. Case Temperature



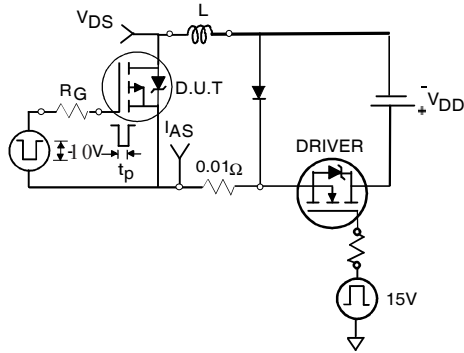
**Fig 10a.** Switching Time Test Circuit



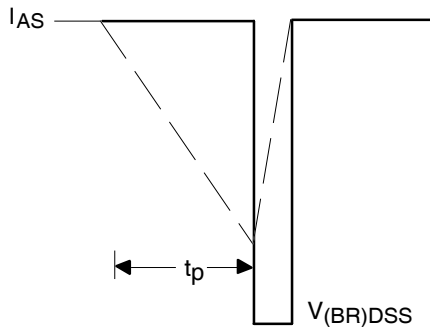
**Fig 10b.** Switching Time Waveforms



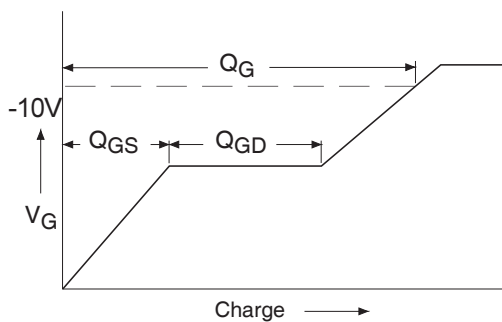
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



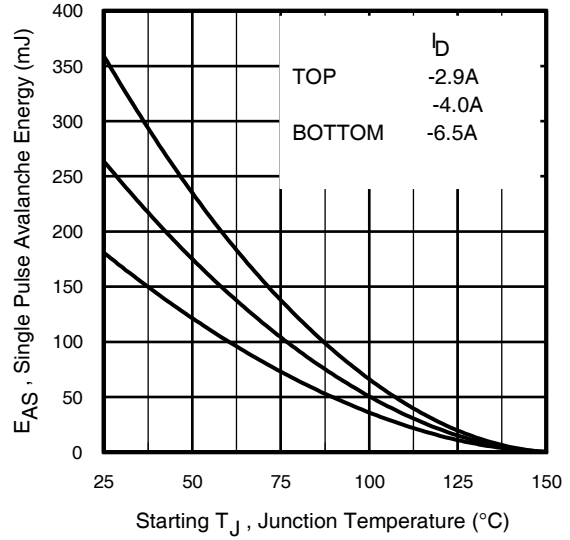
**Fig 12a.** Unclamped Inductive Test Circuit



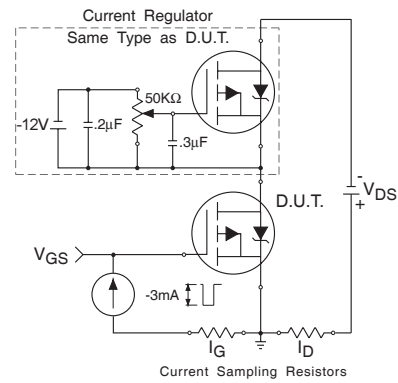
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 13a.** Basic Gate Charge Waveform



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

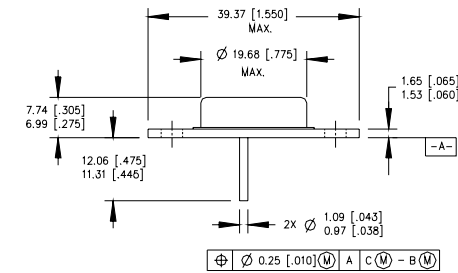


**Fig 13b.** Gate Charge Test Circuit

**Footnotes:**

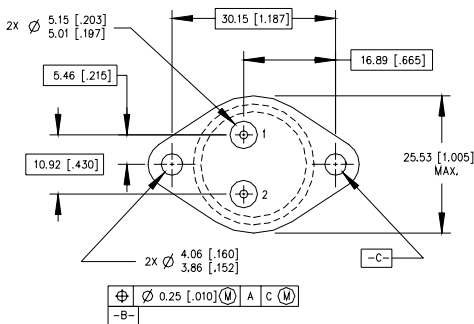
- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = -50V$ , starting  $T_J = 25^\circ C$ ,  
 Peak  $I_L = -6.5A$ ,  $V_{GS} = -10V$ ,  $L = 8.6mH$
- ③  $I_{SD} \leq -6.5A$ ,  $di/dt \leq -120A/\mu s$ ,  
 $V_{DD} \leq -200V$ ,  $T_J \leq 150^\circ C$   
 Suggested  $R_G = 7.5 \Omega$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$

**Case Outline and Dimensions —TO-204AE (TO-3)**



PIN ASSIGNMENTS

HEXFET	SCHÖTTKY	IGBT
1 - SOURCE	1 - ANODE 1	1 - GATE
2 - GATE	2 - ANODE 2	2 - EMITTER
3 - DRAIN (CASE)	3 - COMMON CATHODE (CASE)	3 - COLLECTOR (CASE)



NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION : INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-204-AA.