# International TOR Rectifier

# REPETITIVE AVALANCHE AND dv/dt RATED HEXFET®TRANSISTORS THRU-HOLE (TO-205AF)

IRFF9230 JANTX2N6851 JANTXV2N6851 JANS2N6851 REF:MIL-PRF-19500/564

200V, P-CHANNEL

#### **Product Summary**

Part Number	BVDSS	RDS(on)	ΙD
IRFF9230	-200V	$\Omega$ 08.0	-4.0A

The HEXFET<sup>®</sup> 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.

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of parelleling 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.



#### Features:

- Repetitive Avalanche Ratings
- Dynamic dv/dt Rating
- Hermetically Sealed
- Simple Drive Requirements
- Ease of Paralleling

### **Absolute Maximum Ratings**

	Parameter		Units
ID @ VGS = -10V, TC = 25°C Continuous Drain Current		-4.0	
ID @ VGS = -10V, TC = 100°C	Continuous Drain Current	-2.4	A
IDM	Pulsed Drain Current ①	-16	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	25	W
	Linear Derating Factor	0.20	W/°C
VGS	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	75	mJ
IAR	Avalanche Current ①	_	Α
EAR	Repetitive Avalanche Energy ①	_	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
TJ	Operating Junction	-55 to 150	
TSTG Storage Temperature Range			°C
	Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)	
	Weight	0.98(typical)	g

For footnotes refer to the last page

# International **TOR** Rectifier

# Electrical Characteristics @ Tj = 25°C (Unless Otherwise Specified)

	Parameter	Min	Тур	Max	Units	Test Conditions
BVDSS	Drain-to-Source Breakdown Voltage	-200	_		V	VGS = 0V, ID = -1.0mA
ΔBVDSS/ΔTJ	Temperature Coefficient of Breakdown Voltage	_	-0.22	_	V/°C	Reference to 25°C, ID = -1.0mA
RDS(on)	Static Drain-to-Source On-State	_	_	0.80		VGS = -10V, ID = -2.4A ④
	Resistance	_	_	1.68	Ω	VGS =-10V, ID =-4.0A ④
VGS(th)	Gate Threshold Voltage	-2.0	_	-4.0	V	$V_{DS} = V_{GS}$ , $I_{D} = -250\mu A$
9fs	Forward Transconductance	2.2	_		S (U)	V <sub>DS</sub> > -15V, I <sub>DS</sub> = -2.4A ④
IDSS	Zero Gate Voltage Drain Current	_	_	-25		V <sub>DS</sub> = -160V, V <sub>GS</sub> =0V
		—	_	-250	μA	V <sub>DS</sub> = -160V
						VGS = 0V, TJ = 125°C
IGSS	Gate-to-Source Leakage Forward	_	_	-100		Vgs=-20V
IGSS	Gate-to-Source Leakage Reverse	_	_	100	nA	V <sub>GS</sub> = 20V
Qg	Total Gate Charge	14.7	_	34.8		VGS =-10V, ID = -4.0A
Qgs	Gate-to-Source Charge	0.8	_	7.0	nC	V <sub>DS</sub> =-100V
Qgd	Gate-to-Drain ('Miller') Charge	5.0	_	17		
td(on)	Turn-On Delay Time	_	_	50		$V_{DD} = -100V, I_{D} = -4.0A,$
tr	Rise Time	_	_	100		$V_{GS}$ =-10 $V_{RG}$ =7.5 $\Omega$
td(off)	Turn-Off Delay Time	_	_	100	ns	
tf	Fall Time	_	_	80		
LS + LD	Total Inductance	_	7.0	1	nΗ	Measured from drain lead (6mm/0.25in. from package) to source lead (6mm/0.25in. from package)
Ciss	Input Capacitance	_	700			$V_{GS} = 0V, V_{DS} = -25V$
Coss	Output Capacitance	_	200	_	pF	f = 1.0MHz
C <sub>rss</sub>	Reverse Transfer Capacitance		40			

## Source-Drain Diode Ratings and Characteristics

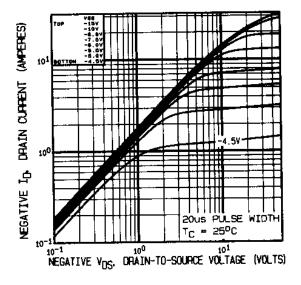
	Parameter		Min	Тур	Max	Units	Test Conditions
Is	Continuous Source Current (Body Diode)		_	_	-4.0	Α	
ISM	Pulse Source Current (Body D	iode) ①	_	_	-20		
VSD	Diode Forward Voltage		_	_	-6.0	V	$T_j = 25$ °C, $I_S = -4.0$ A, $V_{GS} = 0$ V ④
trr	Reverse Recovery Time		_	_	400	nS	$T_j = 25^{\circ}C$ , $I_F = -4.0A$ , $di/dt \le -100A/\mu s$
QRR	Reverse Recovery Charge		_	_	4.0	μC	V <sub>DD</sub> ≤ -50V ④
ton	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by LS + LD.					

### **Thermal Resistance**

	Parameter	Min	Тур	Max	Units	Test Conditions
RthJC	Junction-to-Case	_	_	5.0	00.004	
R <sub>th</sub> JA	Junction-to-Ambient	_	_	175	°C/W	Typical socket mount

Note: Corresponding Spice and Saber models are available on the G&S Website.

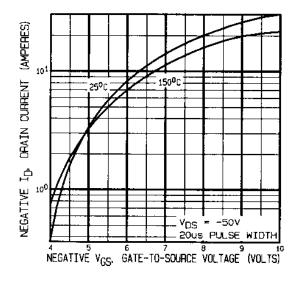
For footnotes refer to the last page



NEGATIVE VDS. DAAIN-TO-SOURCE VOLTAGE (VOLTS)

Fig 1. Typical Output Characteristics





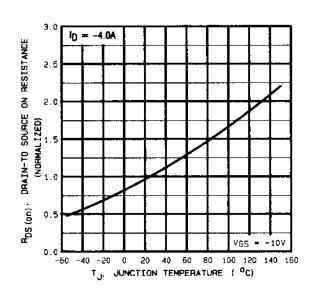
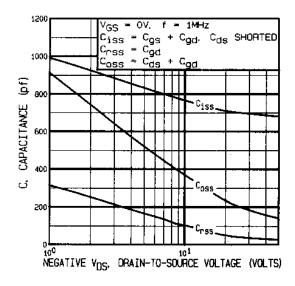


Fig 3. Typical Transfer Characteristics

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

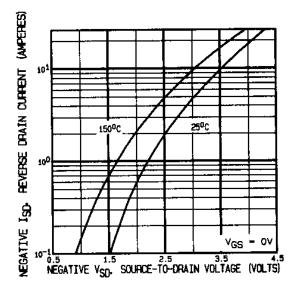


(VOLTS) GATE-TO-SOURCE VOLTAGE 16 12 NEGATIVE V<sub>GS'</sub> FOR TEST CINCUIT SEE FIGURE 13 a& b TOTAL GATE CHARGE (nC)

= -4.0A

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

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



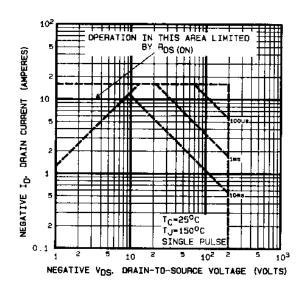
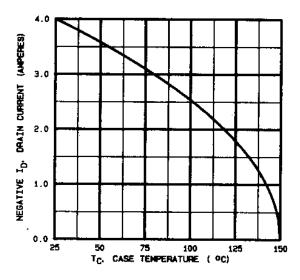


Fig7. Typical Source-Drain Diode Forward Voltage

Fig8. Maximum Safe Operating Area



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

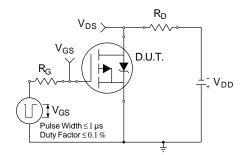


Fig 10a. Switching Time Test Circuit

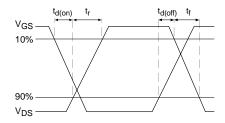


Fig 10b. Switching Time Waveforms

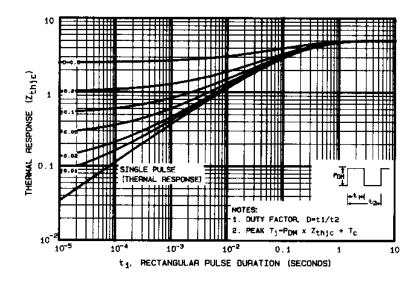


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

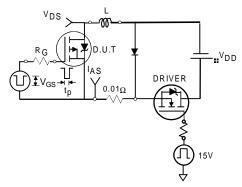


Fig 12a. Unclamped Inductive Test Circuit

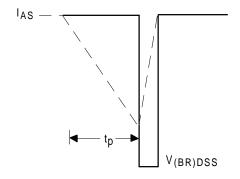


Fig 12b. Unclamped Inductive Waveforms

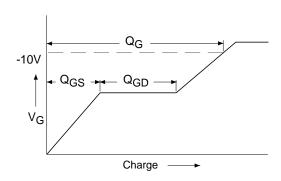
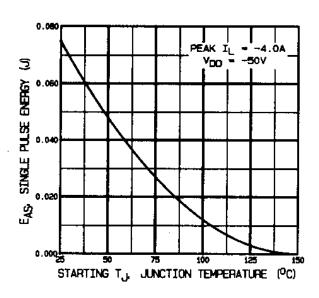


Fig 13a. Basic Gate Charge Waveform



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

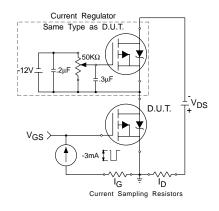


Fig 13b. Gate Charge Test Circuit

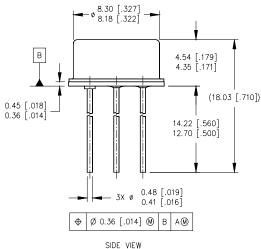


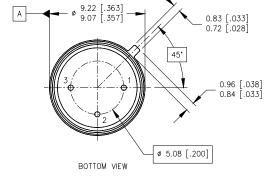
#### **Foot Notes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = -50V$ , starting  $T_{J} = 25$ °C, Peak  $I_{L} = -4.0A, V_{GS} = -10V$

- ③ I<sub>SD</sub> ≤ -4.0A, di/dt ≤ -120A/ $\mu$ s, V<sub>DD</sub>≤ -200V, T<sub>J</sub> ≤ 150°C Suggested RG = 7.5 Ω
- ④ Pulse width ≤ 300  $\mu$ s; Duty Cycle ≤ 2%

#### Case Outline and Dimensions —TO-205AF





#### NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME 14.5M-1994.
- 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3. CONTROLLING DIMENSION: INCH.
- 4. CONFORMS TO JEDEC OUTLINE TO-205AF (TO-39).

#### LEGEND

- 1- SOURCE
- 2- GATE
- 3- DRAIN



IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information. Data and specifications subject to change without notice. 04/01