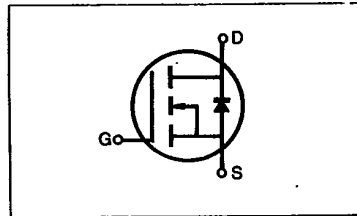
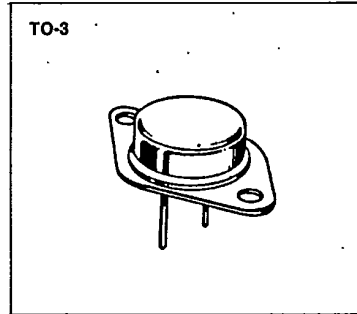


## N-CHANNEL POWER MOSFETS

### IRF230/231/232/233

#### FEATURES

- Low  $R_{DS(on)}$
- Improved inductive ruggedness
- Fast switching times
- Rugged polysilicon gate cell structure
- Low input capacitance
- Extended safe operating area
- Improved high temperature reliability
- TO-3 package (Standard)



#### PRODUCT SUMMARY

Part Number	$V_{DS}$	$R_{DS(on)}$	$I_D$
IRF230	200V	0.4 $\Omega$	9.0A
IRF231	150V	0.4 $\Omega$	9.0A
IRF232	200V	0.6 $\Omega$	8.0A
IRF233	150V	0.6 $\Omega$	8.0A

#### MAXIMUM RATINGS

Characteristic	Symbol	IRF230	IRF231	IRF232	IRF233	Unit
Drain-Source Voltage (1)	$V_{DSS}$	200	150	200	150	Vdc
Drain-Gate Voltage ( $R_{GS}=1.0M\Omega$ ) (1)	$V_{DGR}$	200	150	200	150	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 20$				Vdc
Continuous Drain Current $T_C=25^\circ C$	$I_D$	9.0	9.0	8.0	8.0	Adc
Continuous Drain Current $T_C=100^\circ C$	$I_D$	6.0	6.0	5.0	5.0	Adc
Drain Current—Pulsed (3)	$I_{DM}$	36	36	32	32	Adc
Gate Current—Pulsed	$I_{GM}$	$\pm 1.5$				Adc
Total Power Dissipation @ $T_C=25^\circ C$ Derate above $25^\circ C$	$P_D$	75 0.6				Watts W/ $^\circ C$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to 150				$^\circ C$
Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	300				$^\circ C$

Notes: (1)  $T_J=25^\circ C$  to  $150^\circ C$

(2) Pulse test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$

(3) Repetitive rating: Pulse width limited by max. junction temperature

**IRF230/231/232/233****ELECTRICAL CHARACTERISTICS** ( $T_C=25^\circ\text{C}$  unless otherwise specified)

Characteristic	Symbol	Type	Min	Typ	Max	Units	Test Conditions
Drain-Source Breakdown Voltage	$BV_{DSS}$	IRF230	200	—	—	V	$V_{GS}=0V$
		IRF232	—	—	—	—	
		IRF231 IRF233	150	—	—	—	V
Gate Threshold Voltage	$V_{GS(th)}$	ALL	2.0	—	4.0	V	$V_{DS}=V_{GS}$ , $I_D=250\mu A$
Gate-Source Leakage Forward	$I_{GSS}$	ALL	—	—	100	nA	$V_{GS}=20V$
Gate-Source Leakage Reverse	$I_{GSS}$	ALL	—	—	-100	nA	$V_{GS}=-20V$
Zero Gate Voltage Drain Current	$I_{DSS}$	ALL	—	—	250	$\mu A$	$V_{DS}=\text{Max. Rating}$ , $V_{GS}=0V$
			—	—	1000	$\mu A$	$V_{DS}=\text{Max. Rating} \times 0.8$ , $V_{GS}=0V$ , $T_C=125^\circ\text{C}$
On-State Drain-Source Current (2)	$I_{D(on)}$	IRF230	9.0	—	—	A	$V_{DS} > I_{D(on)} \times R_{DS(on) \text{ max.}}$ , $V_{GS}=10V$
		IRF231	—	—	—	—	
		IRF232 IRF233	8.0	—	—	—	
Static Drain-Source On-State Resistance (2)	$R_{DS(on)}$	IRF230	—	0.25	0.4	$\Omega$	$V_{GS}=10V$ , $I_D=5.0A$
		IRF231	—	—	—	—	
		IRF232 IRF233	—	0.4	0.6	$\Omega$	
Forward Transconductance (2)	$g_{fs}$	ALL	3.0	4.6	—	$\Omega$	$V_{DS} > I_{D(on)} \times R_{DS(on) \text{ max.}}$ , $I_D=5.0A$
Input Capacitance	$C_{iss}$	ALL	—	720	800	pF	$V_{GS}=0V$ , $V_{DS}=25V$ , $f=1.0\text{MHz}$
Output Capacitance	$C_{oss}$	ALL	—	250	450	pF	
Reverse Transfer Capacitance	$C_{rss}$	ALL	—	60	150	pF	
Turn-On Delay Time	$t_{d(on)}$	ALL	—	—	30	ns	$V_{DD}=0.5BV_{DSS}$ , $I_D=5.0A$ , $Z_\theta=15\Omega$ (MOSFET switching times are essentially independent of operating temperature.)
Rise Time	$t_r$	ALL	—	—	50	ns	
Turn-Off Delay Time	$t_{d(off)}$	ALL	—	—	50	ns	
Fall Time	$t_f$	ALL	—	—	40	ns	
Total Gate Charge (Gate-Source Plus Gate-Drain)	$Q_g$	ALL	—	19	30	nC	$V_{GS}=10V$ , $I_D=12A$ , $V_{DS}=0.8 \text{ Max. Rating}$ (Gate charge is essentially independent of operating temperature.)
Gate-Source Charge	$Q_{gs}$	ALL	—	5.0	—	nC	
Gate-Drain ("Miller") Charge	$Q_{gd}$	ALL	—	14	—	nC	

**THERMAL RESISTANCE**

Junction-to-Case	$R_{thJC}$	ALL	—	—	1.67	K/W	
Case-to-Sink	$R_{thCS}$	ALL	—	0.1	—	K/W	Mounting surface flat, smooth, and greased
Junction-to-Ambient	$R_{thJA}$	ALL	—	—	30	K/W	Free Air Operation

Notes: (1)  $T_J=25^\circ\text{C}$  to  $150^\circ\text{C}$ (2) Pulse test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ 

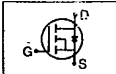
(3) Repetitive rating: Pulse width limited by max. junction temperature



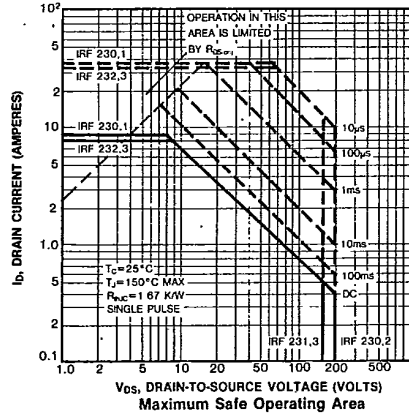
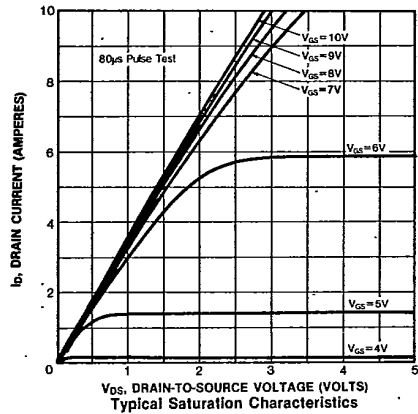
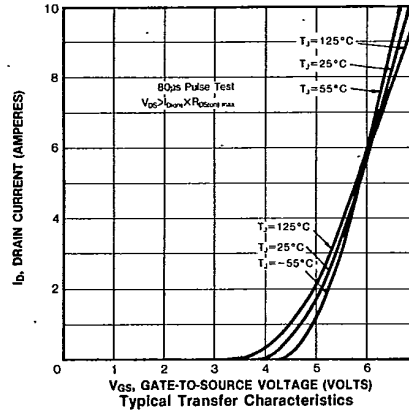
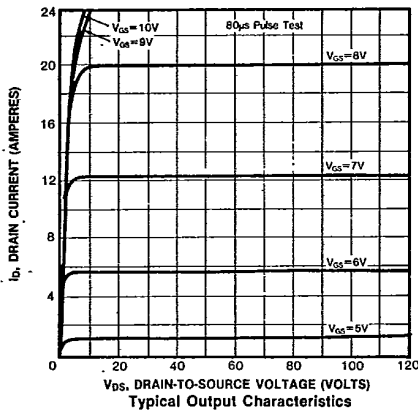
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**N-CHANNEL  
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**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

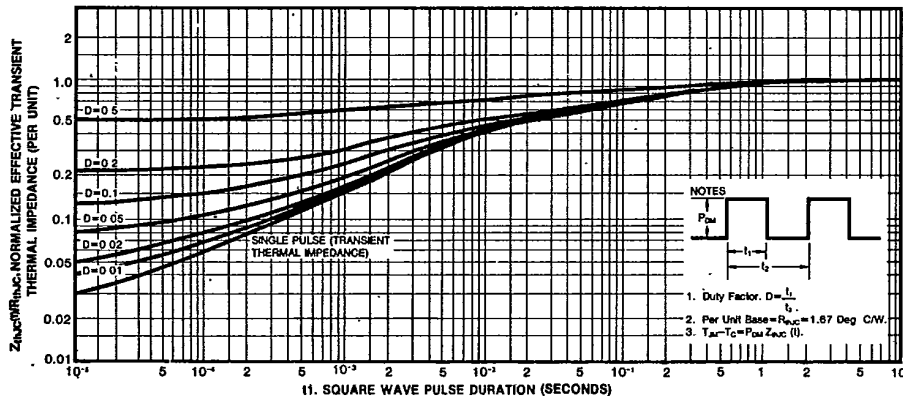
Characteristic	Symbol	Type	Min	Typ	Max	Units	Test Conditions
Continuous Source Current (Body Diode)	$I_S$	IRF230	—	—	9.0	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier 
		IRF231	—	—	8.0	A	
		IRF232 IRF233	—	—	8.0	A	
Pulse Source Current (Body Diode) (3)	$I_{SM}$	IRF230	—	—	36	A	
		IRF231	—	—	32	A	
		IRF232 IRF233	—	—	32	A	
Diode Forward Voltage (2)	$V_{SD}$	IRF230	—	—	2.0	V	$T_C=25^\circ\text{C}$ , $I_S=9.0\text{A}$ , $V_{GS}=0\text{V}$
		IRF231	—	—	2.0	V	$T_C=25^\circ\text{C}$ , $I_S=8.0\text{A}$ , $V_{GS}=0\text{V}$
		IRF232 IRF233	—	—	1.8	V	$T_C=25^\circ\text{C}$ , $I_S=8.0\text{A}$ , $V_{GS}=0\text{V}$
Reverse Recovery Time	$t_{rr}$	ALL	—	450	—	ns	$T_J=150^\circ\text{C}$ , $I_F=9.0\text{A}$ , $di/dt=100\text{A}/\mu\text{s}$

Notes: (1)  $T_J=25^\circ\text{C}$  to  $150^\circ\text{C}$  (2) Pulse test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$   
 (3) Repetitive rating: Pulse width limited by max. junction temperature

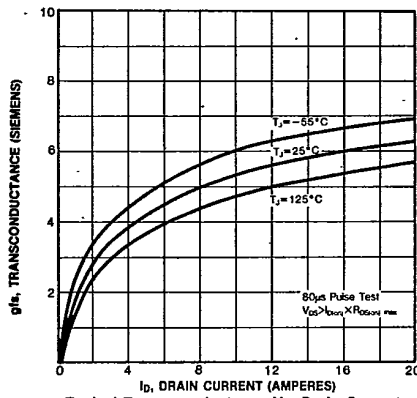


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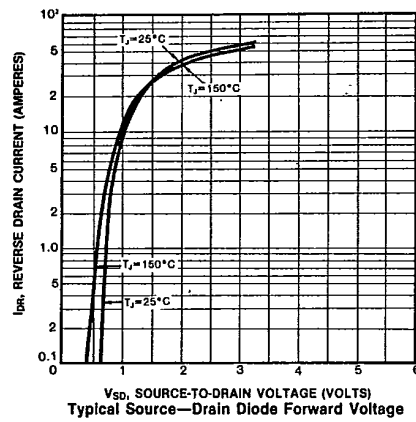
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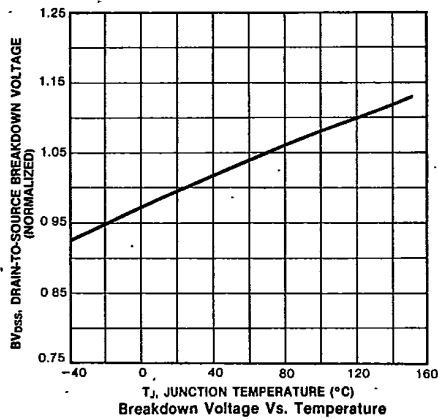
11. SQUARE WAVE PULSE DURATION (SECONDS)  
Maximum Effective Transient Thermal Impedance Junction-to-Case Vs. Pulse Duration



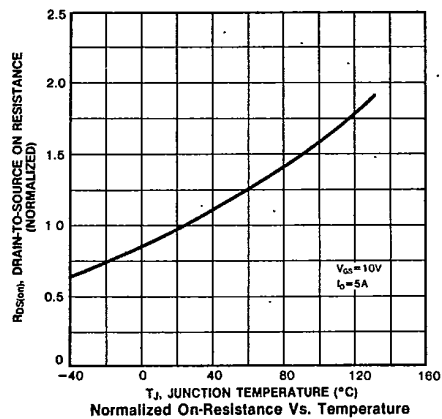
Typical Transconductance Vs. Drain Current



Typical Source-Drain Diode Forward Voltage



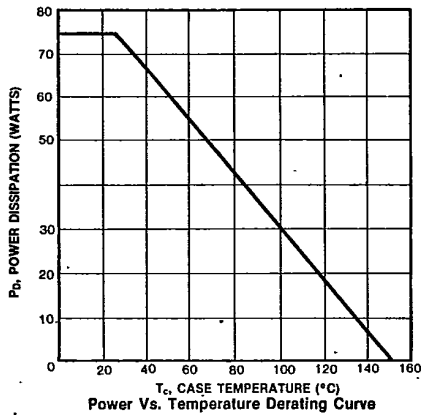
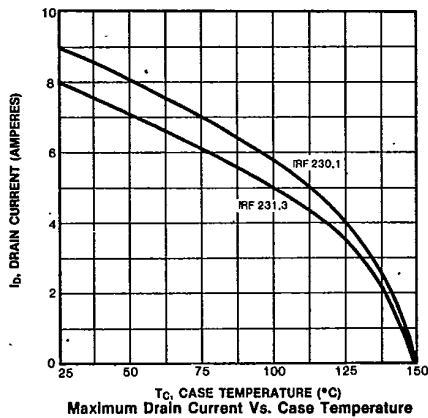
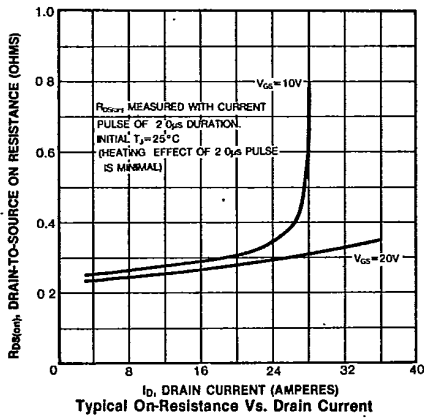
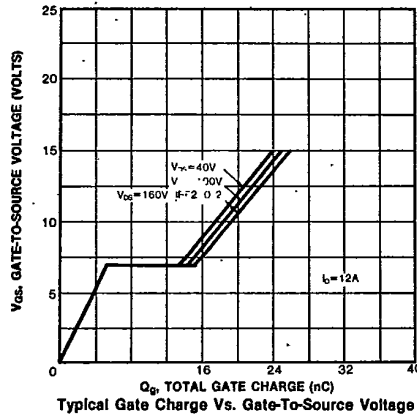
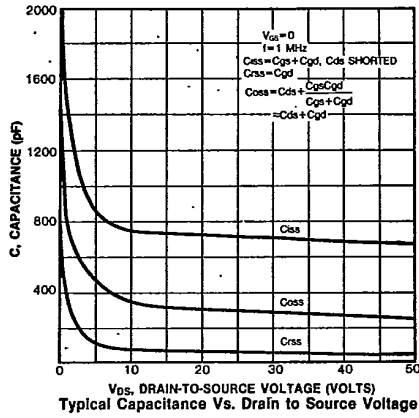
Breakdown Voltage Vs. Temperature



Normalized On-Resistance Vs. Temperature

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