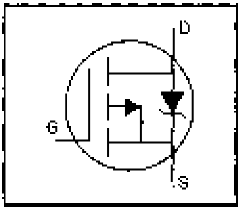
International
IOR Rectifier

IRFD9024

HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Repetitive Avalanche Rated
- For Automatic Insertion
- End Stackable
- P-Channel
- 175°C Operating Temperature
- Fast Switching



$V_{DSS} = -60V$

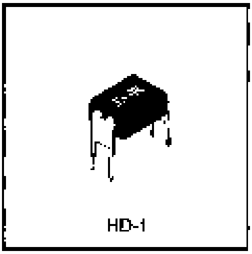
$R_{DS(on)} = 0.28\Omega$

$I_D = -1.6A$

Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The 4-pin DIP package is a low cost machine-insertable case style which can be stacked in multiple combinations on standard 0.1 inch pin centers. The dual drain serves as a thermal link to the mounting surface for power dissipation levels up to 1 watt.



HD-1

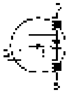
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25°C$	Continuous Drain Current, V_{GS} @ -10 V	-1.6	A
I_D @ $T_C = 100°C$	Continuous Drain Current, V_{GS} @ -10 V	-1.1	
I_{DM}	Pulsed Drain Current ①	-13	
P_D @ $T_C = 25°C$	Power Dissipation	1.3	W
	Linear Derating Factor	0.0083	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	140	mJ
I_{AR}	Avalanche Current ①	-1.6	A
E_{AR}	Repetitive Avalanche Energy ①	0.13	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-4.5	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JA}$	Junction-to-Ambient	—	—	120	°C/W

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-60	—	—	V	V_{GS}=0V, I_D=-250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.056	—	V/°C	Reference to 25°C, I_D=-1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.28	Ω	V_{GS}=-10V, I_D=-0.96A ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	V_{DS}=V_{GS}, I_D=-250µA
g_{fs}	Forward Transconductance	1.3	—	—	S	V_{DS}=-25V, I_D=-0.96A ④
I_{DSS}	Drain-to-Source Leakage Current	—	—	-100	µA	V_{DS}=-60V, V_{GS}=0V
		—	—	-500		V_{DS}=-48V, V_{GS}=0V, T_J=150°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	-100	nA	V_{GS}=-20V
	Gate-to-Source Reverse Leakage	—	—	100		V_{GS}=20V
Q_g	Total Gate Charge	—	—	19	nC	I_D=-11A
Q_{gs}	Gate-to-Source Charge	—	—	5.4		V_{DS}=-48V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	11		V_{GS}=-10V See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	13	—	ns	V_{DD}=-30V
t_r	Rise Time	—	62	—		I_D=-11A
$t_{d(off)}$	Turn-Off Delay Time	—	15	—		R_G=18Ω
t_f	Fall Time	—	29	—		R_D=2.5Ω See Figure 10 ④
L_D	Internal Drain Inductance	—	4.0	—	nH	Between lead, 6 mm (0.25in.) from package and center of die contact 
L_S	Internal Source Inductance	—	6.0	—		
C_{iss}	Input Capacitance	—	570	—	pF	V_{GS}=0V
C_{oss}	Output Capacitance	—	360	—		V_{DS}=-25V
C_{rss}	Reverse Transfer Capacitance	—	65	—		f=1.0MHz See Figure 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-1.6	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-13		
V_{SD}	Diode Forward Voltage	—	—	-6.3	V	T_J=25°C, I_S=-1.6A, V_{GS}=0V ④
t_{rr}	Reverse Recovery Time	—	100	200	ns	T_J=25°C, I_F=-11A
Q_{rr}	Reverse Recovery Charge	—	0.32	0.64	µC	di/dt=100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is neglegible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature (See Figure 11)

② V_{DD}=-25V, starting T_J=25°C, L=15mH R_G=25Ω, I_{AS}=-3.2A (See Figure 12)

③ I_{SD}≤-11A, di/dt≤140A/µs, V_{DD}≤$V_{(BR)DSS}$, T_J≤175°C

④ Pulse width ≤ 300 µs; duty cycle ≤2%.

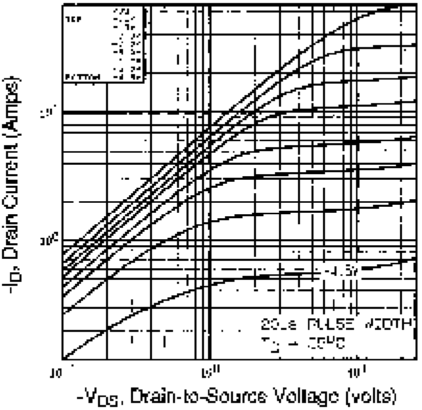


Fig 1. Typical Output Characteristics, T_C=25°C

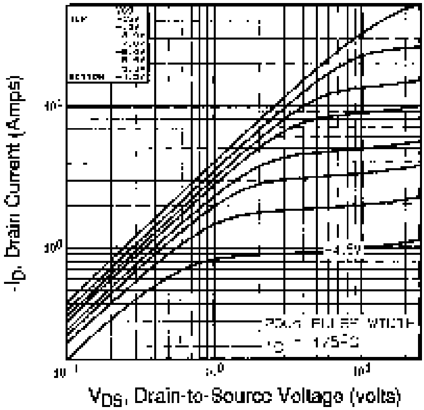


Fig 2. Typical Output Characteristics, T_C=175°C

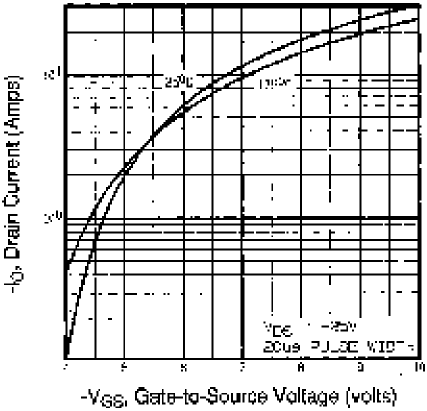


Fig 3. Typical Transfer Characteristics

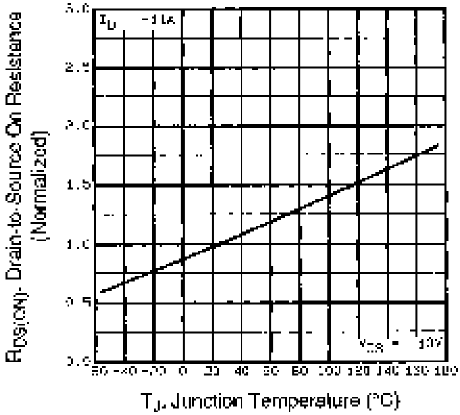


Fig 4. Normalized On-Resistance Vs. Temperature

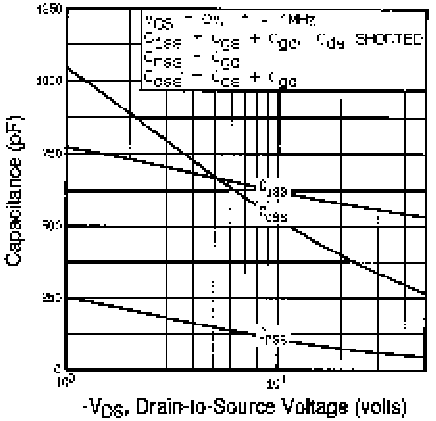


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

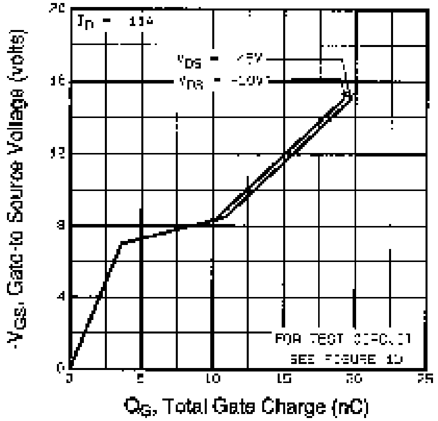


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

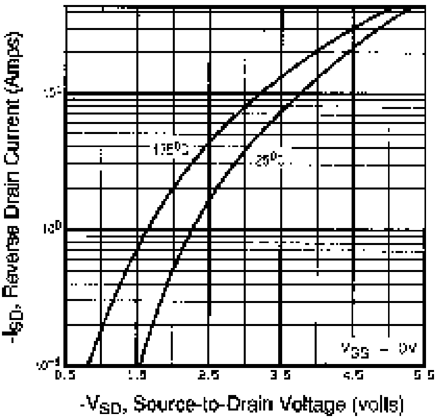


Fig 7. Typical Source-Drain Diode Forward Voltage

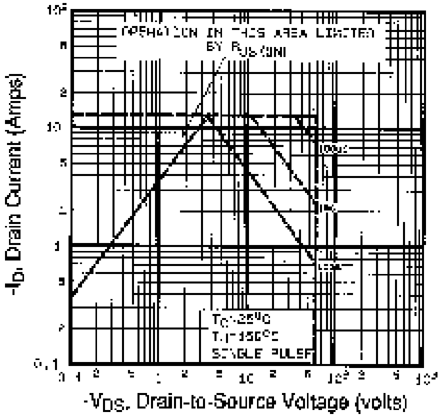


Fig 8. Maximum Safe Operating Area

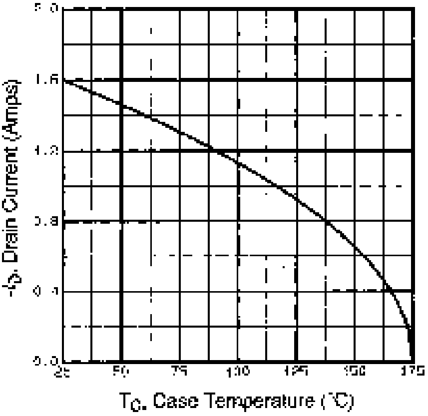


Fig 9. Maximum Drain Current Vs. Case Temperature

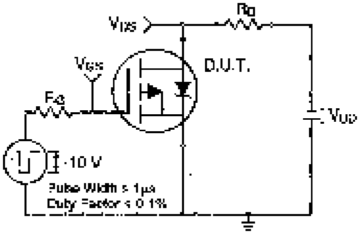


Fig 10a. Switching Time Test Circuit

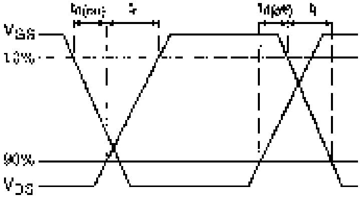


Fig 10b. Switching Time Waveforms

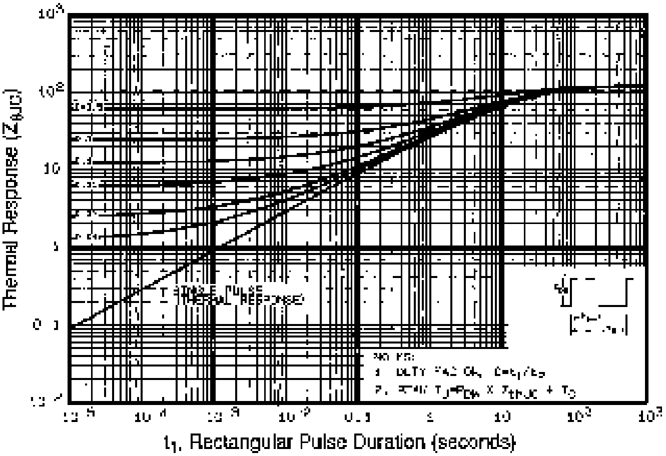


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

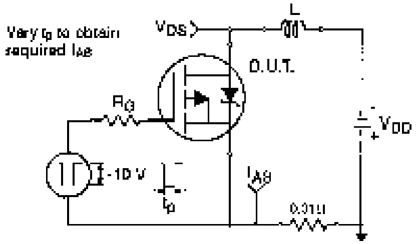


Fig 12a. Unclamped Inductive Test Circuit

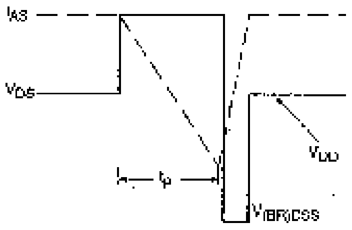


Fig 12b. Unclamped Inductive Waveforms

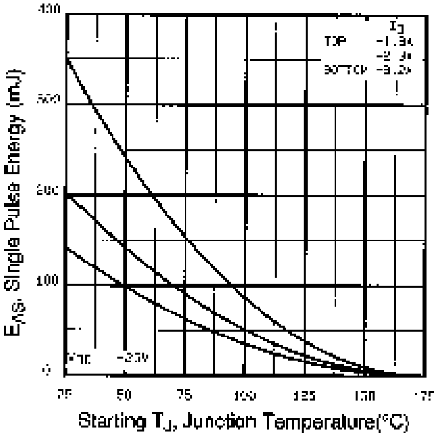


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

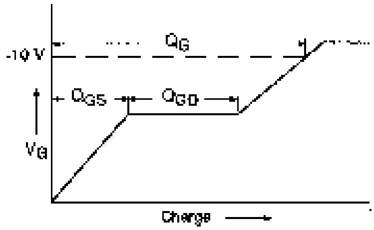


Fig 13a. Basic Gate Charge Waveform

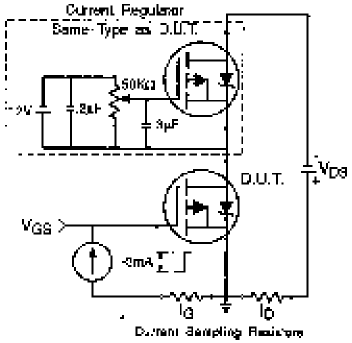


Fig 13b. Gate Charge Test Circuit

Appendix A: Figure 14, **Peak** Diode Recovery dv/dt Test Circuit – See page 1506

Appendix B: Package Outline Mechanical Drawing – See page 1507

Appendix C: Part Marking Information – See page 1515

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