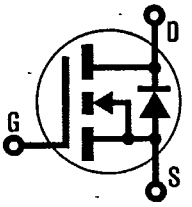
INTERNATIONAL RECTIFIER IOR

HEXFET® TRANSISTORS IRFD210

IRFD213

N-CHANNEL HEXDIP™

1-WATT RATED POWER MOSFETs
(4 PIN, DUAL-IN-LINE PLASTIC PACKAGE)



4-PIN DIP

200 Volt, 1.5 Ohm, 1-Watt HEXDIP

HEXFET technology is the key to International Rectifier's advanced line of power MOSFET transistors. Efficient geometry and unique processing of the HEXFET design achieve a very low on-state resistance combined with high transconductance and great device ruggedness. HEXFETs feature all of the established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling, and temperature stability of the electrical parameters.

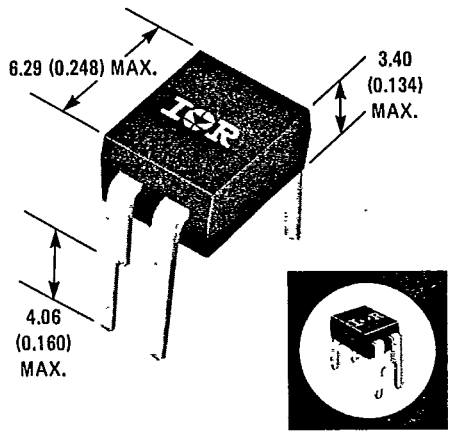
The HEXDIP 4-pin, Dual-In-Line Package brings the advantages of HEXFETs to high volume applications where automatic PC Board insertion is desirable, such as circuit boards for computers, printers, telecommunications equipment and consumer products. Their compatibility with automatic insertion equipment, low-profile and end-stackable features represent the state-of-the-art in power device packaging

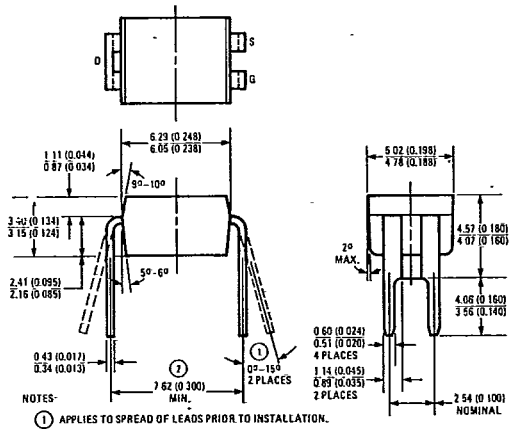
- For Automatic Insertion
- Compact Plastic Package
- End Stackable
- Fast Switching
- Low Drive Current
- Easily Paralleled
- Excellent Temperature Stability

Product Summary

Part Number	V_{DS}	$R_{DS(on)}$	I_D
IRFD210	200V	1.5Ω	0.6A
IRFD213	150V	2.4Ω	0.45A

CASE STYLE AND DIMENSIONS





Case Style HD-1 (Similar to JEDEC Outline MO-001AN)
Dimensions in Millimeters and (Inches)

IRFD210, IRFD213 Devices

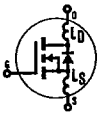
Absolute Maximum Ratings

Parameter		IRFD210	IRFD213	Units
V_{DS}	Drain — Source Voltage ①	200	150	V
V_{DGR}	Drain — Gate Voltage (R_{GS} = 20 kΩ) ①	200	150	V
I_D @ T_A = 25°C	Continuous Drain Current	0.6	0.45	A
I_{DM}	Pulsed Drain Current	2.5	1.8	A
V_{GS}	Gate — Source Voltage	±20		V
P_D @ T_A = 25°C	Max. Power Dissipation	1.0 (See Fig. 13)		W
	Linear Derating Factor	0.008 (See Fig. 13)		W/K③
I_{LM}	Inductive Current, Clamped	(See Fig. 14 and 15) L = 100μH 2.5	1.8	A
T_J T_{stg}	Operating Junction and Storage Temperature Range	−55 to 150		°C
	Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)		°C

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

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain — Source Breakdown Voltage	IRFD210	200	—	—	V	V_{GS} = 0V
		IRFD213	150	—	—	V	I_D = 250μA
$V_{GS(th)}$	Gate Threshold Voltage	ALL	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250μA
I_{GSS}	Gate — Source Leakage Forward	ALL	—	—	500	nA	V_{GS} = 20V
I_{GSS}	Gate — Source Leakage Reverse	ALL	—	—	−500	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	ALL	—	—	250	μA	V_{DS} = Max. Rating, V_{GS} = 0V
			—	—	1000	μA	V_{DS} = Max. Rating x 0.8, V_{GS} = 0V, T_C = 125°C
$I_{D(on)}$	On-State Drain Current ②	IRFD210	0.6	—	—	A	V_{DS} > $I_{D(on)}$ x $R_{DS(on)}$ max., V_{GS} = 10V
		IRFD213	0.45	—	—	A	
$R_{DS(on)}$	Static Drain — Source On-State Resistance ②	IRFD210	—	1.0	1.5	Ω	V_{GS} = 10V, I_D = 0.3A
		IRFD213	—	1.5	2.4	Ω	
g_{fs}	Forward Transconductance ②	ALL	0.5	0.8	—	S (℧)	V_{DS} > $I_{D(on)}$ x $R_{DS(on)}$ max., I_D = 0.3A
C_{iss}	Input Capacitance	ALL	—	135	150	pF	V_{GS} = 0V, V_{DS} = 25V, f = 1.0 MHz See Fig. 9
C_{oss}	Output Capacitance	ALL	—	60	80	pF	
C_{rss}	Reverse Transfer Capacitance	ALL	—	16	25	pF	
$t_{d(on)}$	Turn-On Delay Time	ALL	—	8.0	15	ns	V_{DD} = 0.5 BV_{DSS}, I_D = 0.3A, Z_o = 50Ω See Fig. 16 (MOSFET switching times are essentially independent of operating temperature.)
t_r	Rise Time	ALL	—	15	25	ns	
$t_{d(off)}$	Turn-Off Delay Time	ALL	—	10	15	ns	
t_f	Fall Time	ALL	—	8.0	15	ns	
Q_g	Total Gate Charge (Gate-Source Plus Gate-Drain)	ALL	—	5.0	7.5	nC	V_{GS} = 10V, I_D = 2.5A, V_{DS} = 0.8 Max. Rating. See Fig. 17 for test circuit. (Gate charge is essentially independent of operating temperature.)
Q_{gs}	Gate-Source Charge	ALL	—	2.0	—	nC	
Q_{gd}	Gate-Drain ("Miller") Charge	ALL	—	3.0	—	nC	
L_D	Internal Drain Inductance	ALL	—	4.0	—	nH	Measured from the drain lead, 2.0mm (0.08 in.) from package to center of die.
L_S	Internal Source Inductance	ALL	—	6.0	—	nH	Measured from the source lead, 2.0mm (0.08 in.) from package to source bonding pad.

Modified MOSFET symbol showing the internal device inductances.



Thermal Resistance

R_{thJA}	Junction-to-Ambient	ALL	—	—	120	K/W③	Typical socket mount

Source-Drain Diode Ratings and Characteristics

I_S	Continuous Source Current (Body Diode)	IRFD210	—	—	0.6	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.
		IRFD213	—	—	0.45	A	
I_{SM}	Pulse Source Current (Body Diode)	IRFD210	—	—	2.5	A	
		IRFD213	—	—	1.8	A	
V_{SD}	Diode Forward Voltage ②	IRFD210	—	—	2.0	V	T_A = 25°C, I_S = 0.6A, V_{GS} = 0V
		IRFD213	—	—	1.8	V	T_A = 25°C, I_S = 0.45A, V_{GS} = 0V
t_{rr}	Reverse Recovery Time	ALL	—	290	—	ns	T_J = 150°C, I_F = 0.6A, dI_F/dt = 100A/μs
Q_{RR}	Reverse Recovered Charge	ALL	—	2.0	—	μC	T_J = 150°C, I_F = 0.6A, dI_F/dt = 100A/μs
t_{on}	Forward Turn-on Time	ALL	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L_S + L_D.				

①T_J = 25°C to 150°C. ②Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%. ③K/W = °C/W, W/K = W/°C

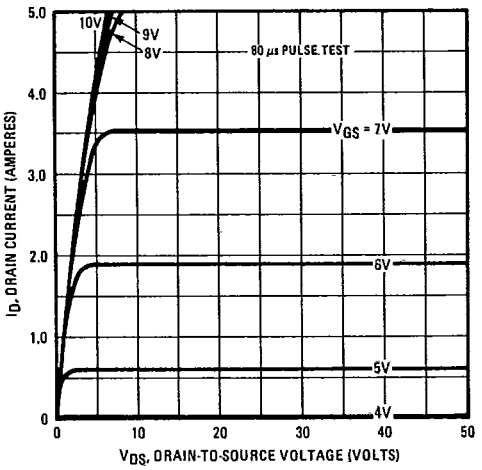


Fig. 1 – Typical Output Characteristics

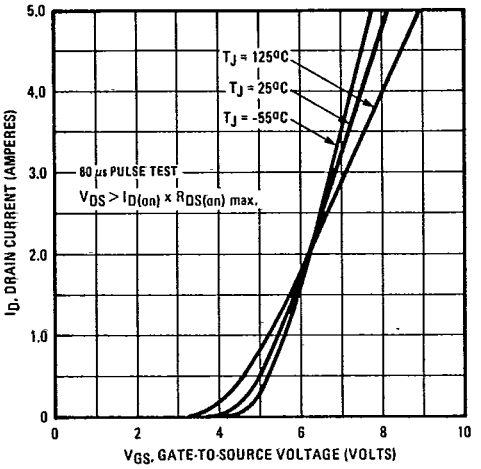


Fig. 2 – Typical Transfer Characteristics

4-PIN DIP

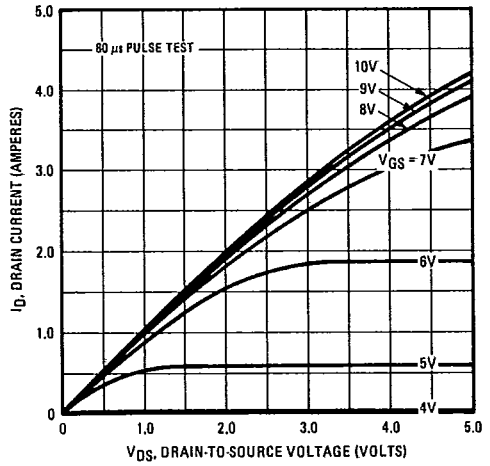


Fig. 3 – Typical Saturation Characteristics

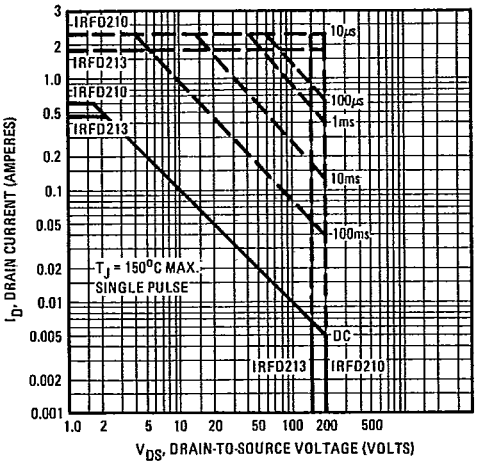


Fig. 4 – Maximum Safe Operating Area

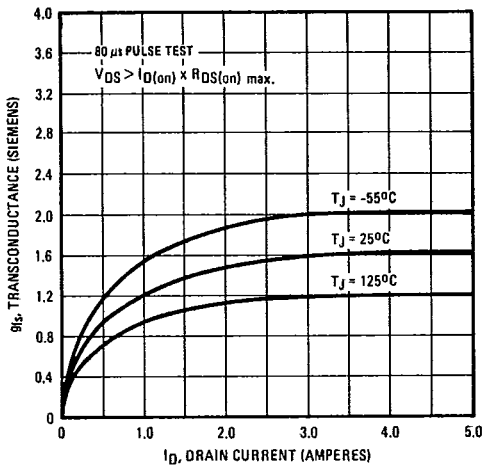


Fig. 5 – Typical Transconductance Vs. Drain Current

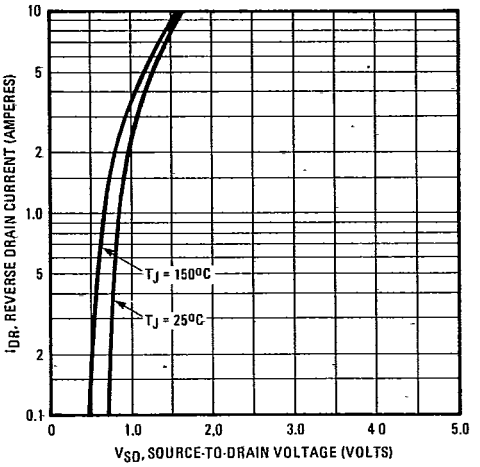


Fig. 6 – Typical Source-Drain Diode Forward Voltage

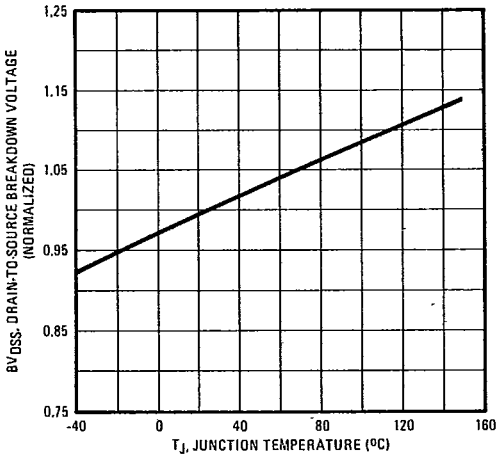


Fig. 7 – Breakdown Voltage Vs. Temperature

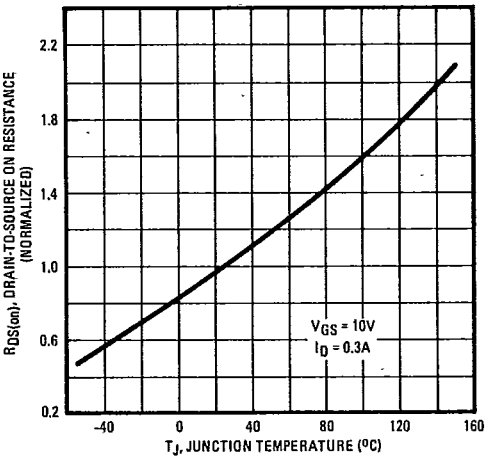


Fig. 8 – Normalized On-Resistance Vs. Temperature

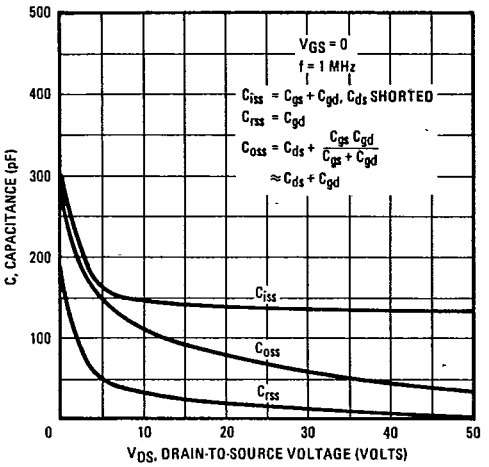


Fig. 9 — Typical Capacitance Vs. Drain-to-Source Voltage

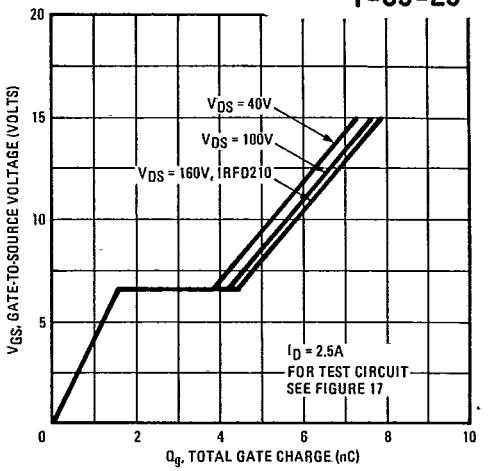


Fig. 10 — Typical Gate Charge Vs. Gate-to-Source Voltage

4-PIN DIP

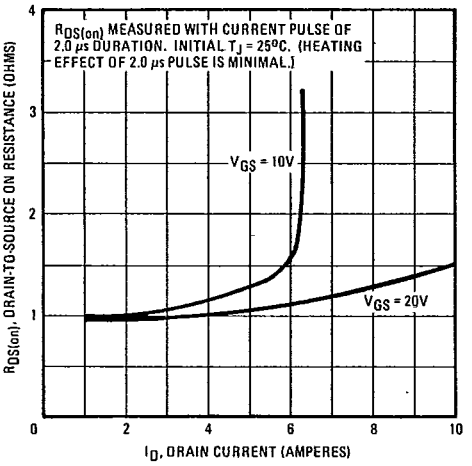


Fig. 11 — Typical On-Resistance Vs. Drain Current

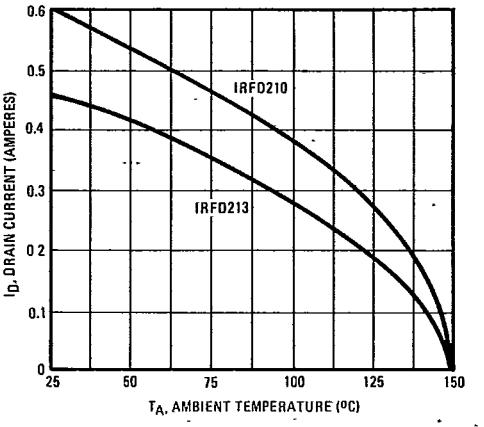


Fig. 12 — Maximum Drain Current Vs. Case Temperature

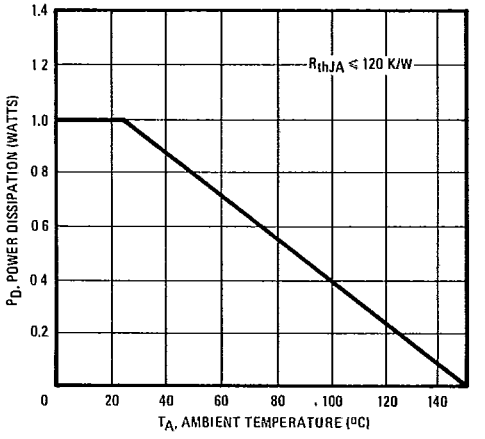


Fig. 13 — Power Vs. Temperature Derating Curve

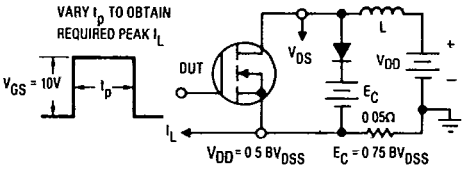


Fig. 14 — Clamped Inductive Test Circuit

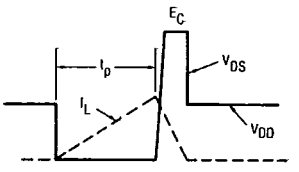


Fig. 15 — Clamped Inductive Waveforms

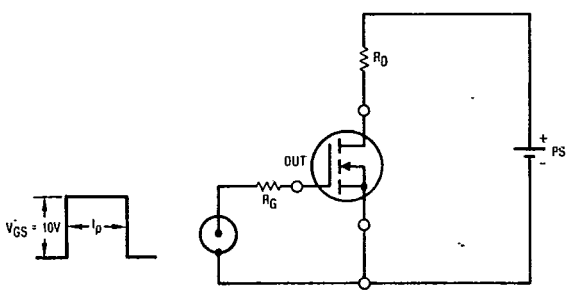


Fig. 16 – Switching Time Test Circuit

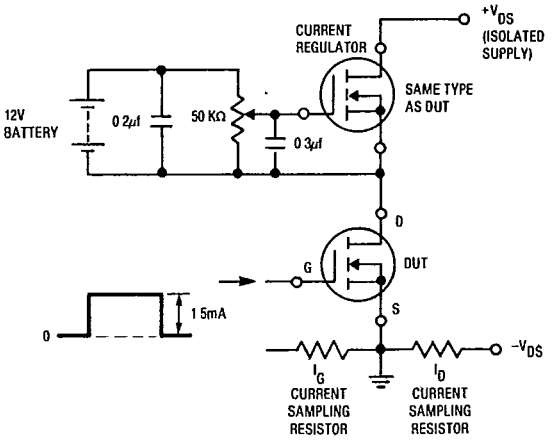


Fig. 17 — Gate Charge Test Circuit

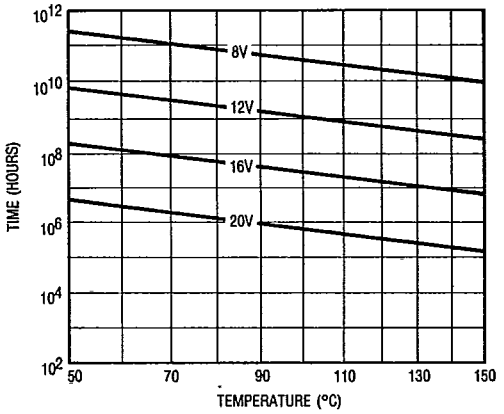


*Fig. 18 — Typical Time to Accumulated 1% Gate Failure

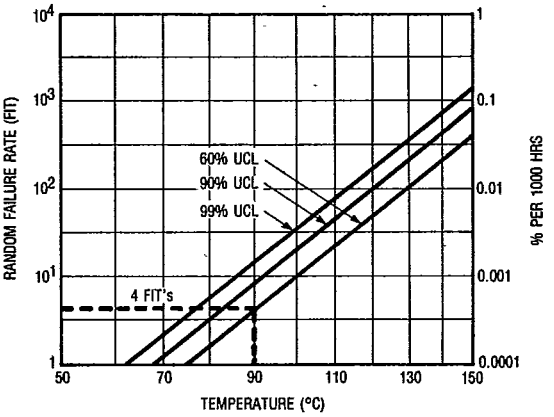


*Fig. 19 — Typical High Temperature Reverse Bias (HTRB) Failure Rate

*The data shown is correct as of April 15, 1987. This information is updated on a quarterly basis; for the latest reliability data, please contact your local IR field office.