

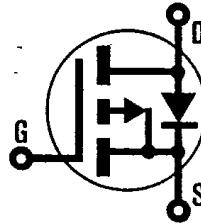
INTERNATIONAL RECTIFIER

INTERNATIONAL RECTIFIER **IR**

**HEXFET® TRANSISTORS IRFD9110**

**P-CHANNEL  
HEXDIP™**

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



**IRFD9113**



**-100 Volt, 1.2 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.

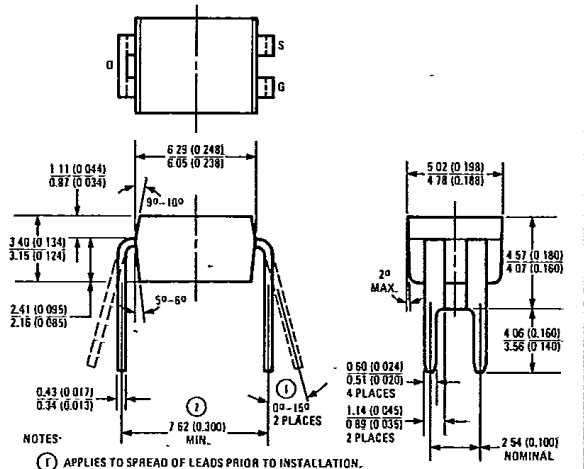
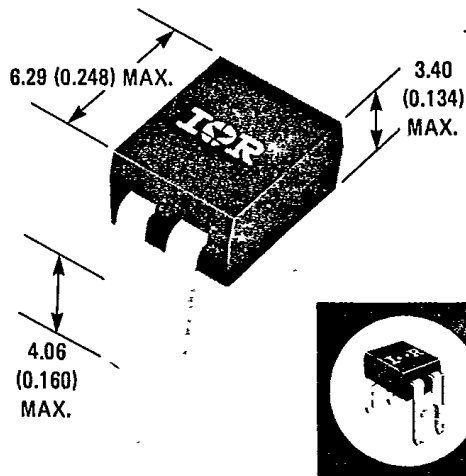
The HEXDIP 4-pin, Dual-In-Line Package brings the advantages of HEXFETs to high volume applications where automatic PC Board insertion is desirable, such as circuit boards for computers, printers, telecommunications equipment and consumer products. Their compatibility with automatic insertion equipment,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

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

**Product Summary**

Part Number	V <sub>DS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
IRFD9110	-100V	1.2Ω	-0.7A
IRFD9113	-60V	1.6Ω	-0.6A

**CASE STYLE AND DIMENSIONS**



- NOTES:
- ① APPLIES TO SPREAD OF LEADS PRIOR TO INSTALLATION.
  - ② APPLIES TO INSTALLED LEAD CENTERS.

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

# IRFD9110, IRFD9113 Devices

11E D 4855452 0008411 2

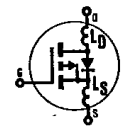
## Absolute Maximum Ratings

## INTERNATIONAL RECTIFIER

T-37-25

Parameter	IRFD9110	IRFD9113	Units
V <sub>DS</sub> Drain - Source Voltage ①	-100	-60	V
V <sub>DGR</sub> Drain - Gate Voltage (R <sub>GSS</sub> = 20 kΩ) ①	-100	-60	V
I <sub>D</sub> @ T <sub>A</sub> = 25°C Continuous Drain Current	-0.7	-0.6	A
I <sub>DM</sub> Pulsed Drain Current	-3.0	-2.5	A
V <sub>GS</sub> Gate - Source Voltage	± 20		V
P <sub>D</sub> @ T <sub>A</sub> = 25°C Max. Power Dissipation	1.0 (See Fig. 13)		W
Linear Derating Factor	0.01 (See Fig. 13)		W/K ③
I <sub>LM</sub> Inductive Current, Clamped	(See Fig. 14 and 15) L = 100μH		A
	-3.0	-2.5	
T <sub>J</sub> Operating Junction and Storage Temperature Range	-55 to 150		°C
T <sub>stg</sub> Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)		°C


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

Parameter	Type	Min.	Typ.	Max.	Units	Test Conditions	
BV <sub>DSS</sub> Drain - Source Breakdown Voltage	IRFD9110	-100	-	-	V	V <sub>GS</sub> = 0V	
	IRFD9113	-60	-	-	V	I <sub>D</sub> = -250μA	
V <sub>GS(th)</sub> Gate Threshold Voltage	ALL	-2.0	-	-4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA	
I <sub>GSS</sub> Gate - Source Leakage Forward	ALL	-	-	-500	nA	V <sub>GS</sub> = -20V	
I <sub>GSS</sub> Gate - Source Leakage Reverse	ALL	-	-	500	nA	V <sub>GS</sub> = 20V	
I <sub>DSS</sub> Zero Gate Voltage Drain Current	ALL	-	-	-250	μA	V <sub>DS</sub> = Max. Rating, V <sub>GS</sub> = 0V	
		-	-	-1000	μA	V <sub>DS</sub> = Max. Rating x 0.8, V <sub>GS</sub> = 0V, T <sub>C</sub> = 125°C	
I <sub>D(on)</sub> On-State Drain Current ②	IRFD9110	-0.7	-	-	A	V <sub>DS</sub> > I <sub>D(on)</sub> x R <sub>DS(on)</sub> max., V <sub>GS</sub> = -10V	
	IRFD9113	-0.6	-	-	A		
R <sub>DS(on)</sub> Static Drain - Source On-State Resistance ②	IRFD9110	-	1.0	1.2	Ω	V <sub>GS</sub> = -10V, I <sub>D</sub> = -0.3A	
	IRFD9113	-	1.2	1.6	Ω		
g <sub>fs</sub> Forward Transconductance ②	ALL	0.59	0.88	-	S (r <sub>fs</sub> )	V <sub>DS</sub> ≤ 50V, I <sub>D</sub> = -0.6A	
C <sub>iss</sub> Input Capacitance	ALL	-	180	250	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = -25V, f = 1.0 MHz See Fig. 9	
C <sub>oss</sub> Output Capacitance	ALL	-	85	100	pF		
C <sub>rss</sub> Reverse Transfer Capacitance	ALL	-	30	35	pF		
t <sub>d(on)</sub> Turn-On Delay Time	ALL	-	15	30	ns	V <sub>DD</sub> = 0.5 I <sub>D</sub> = -0.3A, Z <sub>o</sub> = 50Ω See Fig. 16 (MOSFET switching times are essentially independent of operating temperature.)	
t <sub>r</sub> Rise Time	ALL	-	30	60	ns		
t <sub>d(off)</sub> Turn-Off Delay Time	ALL	-	20	40	ns		
t <sub>f</sub> Fall Time	ALL	-	20	40	ns		
Q <sub>g</sub> Total Gate Charge (Gate-Source Plus Gate-Drain)	ALL	-	11	15	nC	V <sub>GS</sub> = -15V, I <sub>D</sub> = -1.5A, V <sub>DS</sub> = 0.8 Max. Rating. See Fig. 17 for test circuit. (Gate charge is essentially independent of operating temperature.)	
Q <sub>gs</sub> Gate-Source Charge	ALL	-	5.7	-	nC		
Q <sub>gd</sub> Gate-Drain ("Miller") Charge	ALL	-	5.3	-	nC		
L <sub>D</sub> Internal Drain Inductance	ALL	-	4.0	-	nH	Measured from the drain lead, 2.0mm (0.08 in.) from header to center of die.	Modified MOSFET symbol showing the internal device inductances. 
L <sub>S</sub> Internal Source Inductance	ALL	-	6.0	-	nH	Measured from the source lead, 2.0mm (0.08 in.) from header to source bonding pad.	

## Thermal Resistance

R <sub>thJA</sub> Junction-to-Ambient	ALL	-	-	120	K/W ③	Typical socket mount
---------------------------------------	-----	---	---	-----	-------	----------------------

## Source-Drain Diode Ratings and Characteristics

I <sub>S</sub> Continuous Source Current (Body Diode)	IRFD9110	-	-	-0.7	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier. 
	IRFD9113	-	-	-0.6	A	
I <sub>SM</sub> Pulse Source Current (Body Diode)	IRFD9110	-	-	-3.0	A	
	IRFD9113	-	-	-2.5	A	
V <sub>SD</sub> Diode Forward Voltage ②	IRFD9110	-	-	-5.5	V	T <sub>C</sub> = 25°C, I <sub>S</sub> = -0.7A, V <sub>GS</sub> = 0V
	IRFD9113	-	-	-5.3	V	T <sub>C</sub> = 25°C, I <sub>S</sub> = -0.6A, V <sub>GS</sub> = 0V
t <sub>rr</sub> Reverse Recovery Time	ALL	-	120	-	ns	T <sub>J</sub> = 150°C, I <sub>F</sub> = -0.7A, dI <sub>F</sub> /dt = 100A/μs
Q <sub>RR</sub> Reverse Recovered Charge	ALL	-	6.0	-	μC	T <sub>J</sub> = 150°C, I <sub>F</sub> = -0.7A, dI <sub>F</sub> /dt = 100A/μs
t <sub>on</sub> Forward Turn-on Time	ALL	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub> .				

① T<sub>J</sub> = 25°C to 150°C. ② Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%. ③ KW = °C/W, W/K = W/°C

INTERNATIONAL RECTIFIER

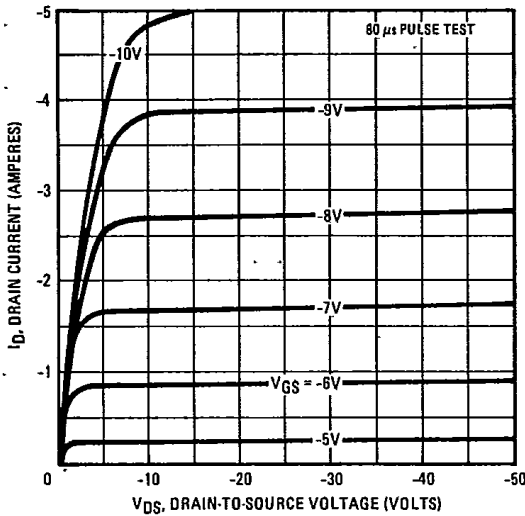


Fig. 1 - Typical Output Characteristics

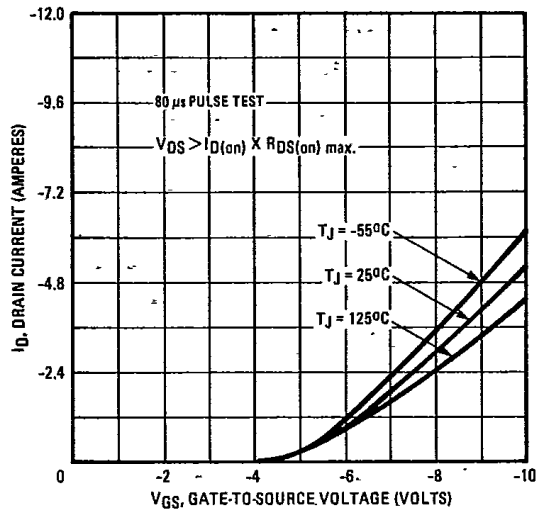


Fig. 2 - Typical Transfer Characteristics

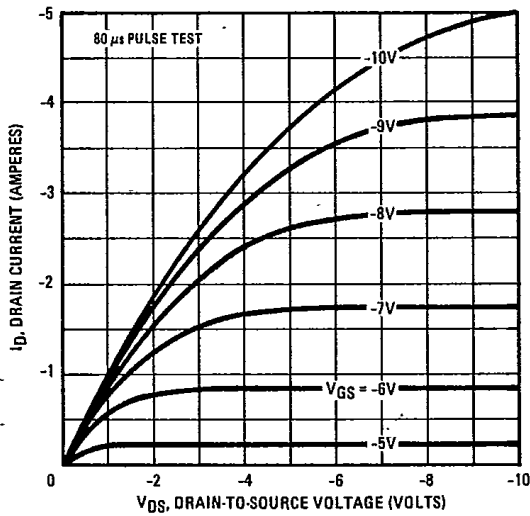


Fig. 3 - Typical Saturation Characteristics

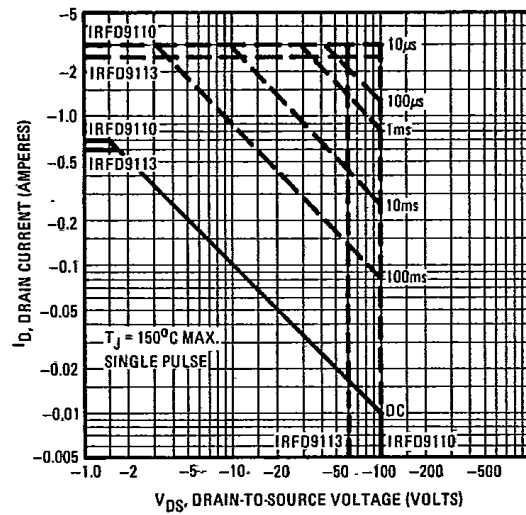


Fig. 4 - Maximum Safe Operating Area



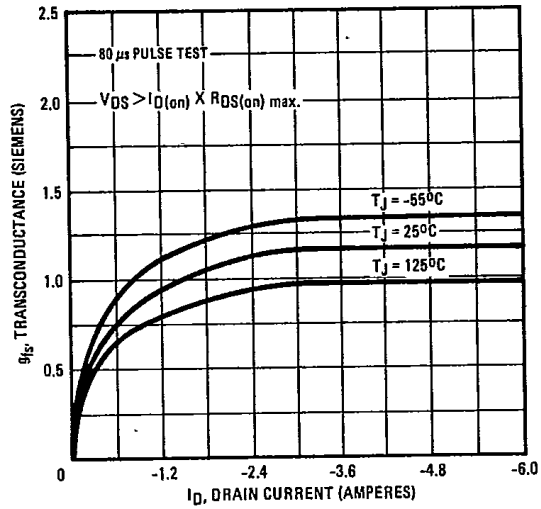


Fig. 5 – Typical Transconductance Vs. Drain Current

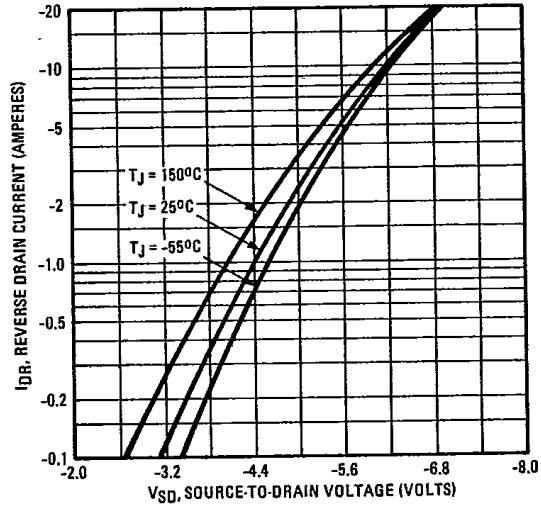


Fig. 6 – Typical Source-Drain Diode Forward Voltage

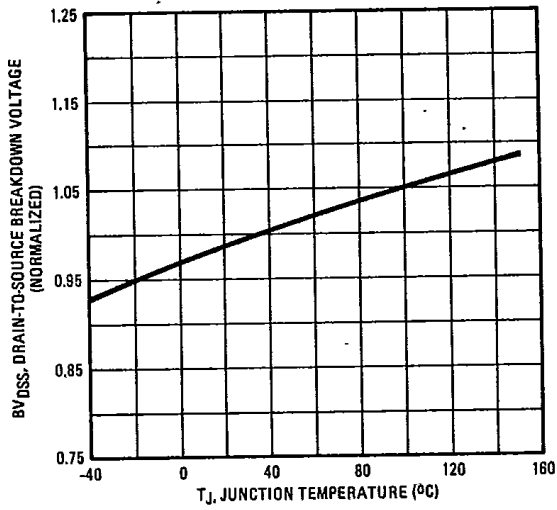


Fig. 7 – Breakdown Voltage Vs. Temperature

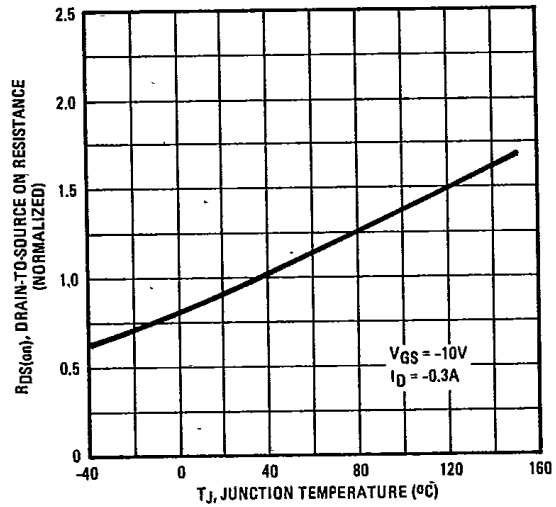


Fig. 8 – Normalized On-Resistance Vs. Temperature

INTERNATIONAL RECTIFIER

T-37-25

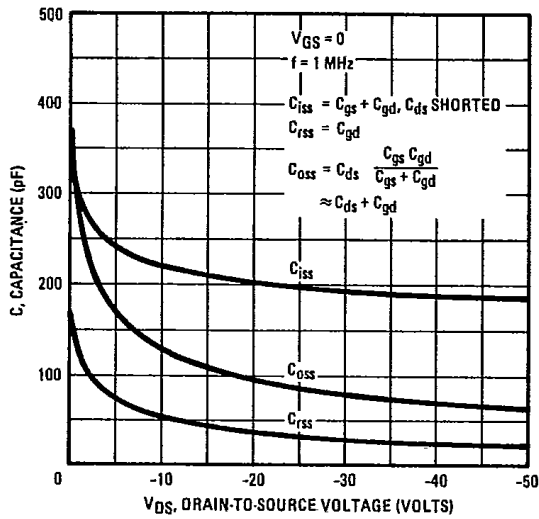


Fig. 9 - Typical Capacitance Vs. Drain-to-Source Voltage

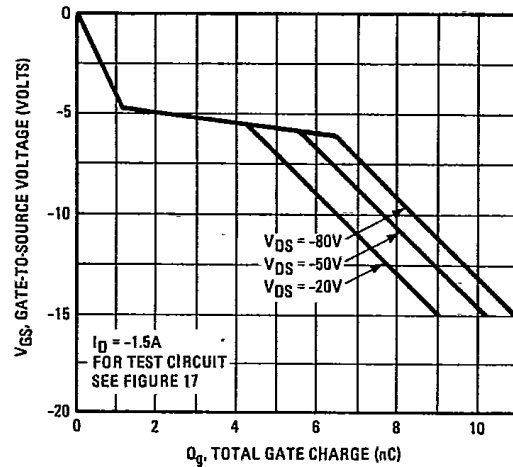


Fig. 10 - Typical Gate Charge Vs. Gate-to-Source Voltage

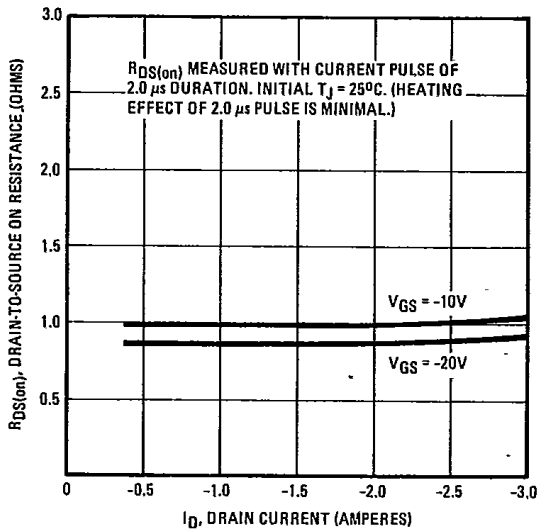


Fig. 11 - Typical On-Resistance Vs. Drain Current

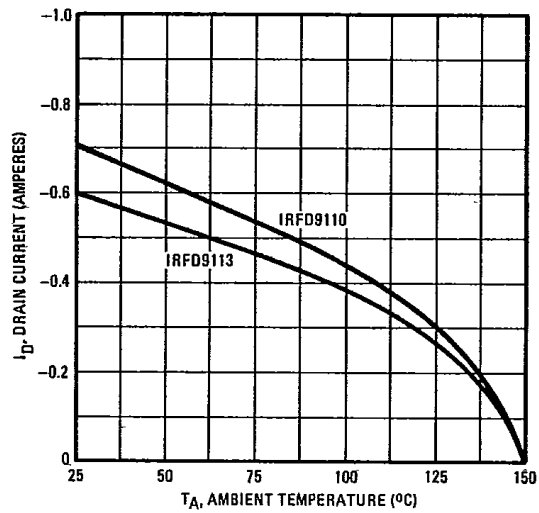


Fig. 12 - Maximum Drain Current Vs. Case Temperature

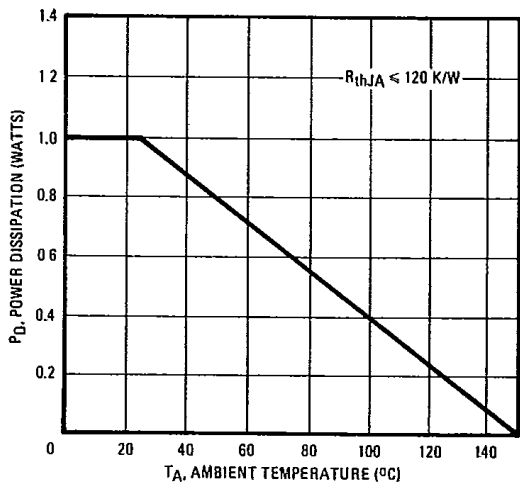


Fig. 13 - Power Vs. Temperature Derating Curve

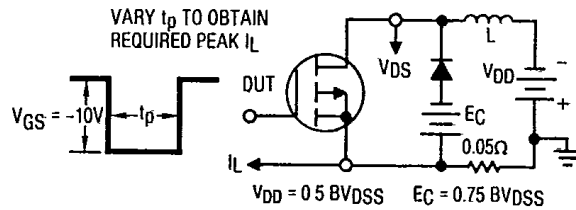


Fig. 14 - Clamped Inductive Test Circuit

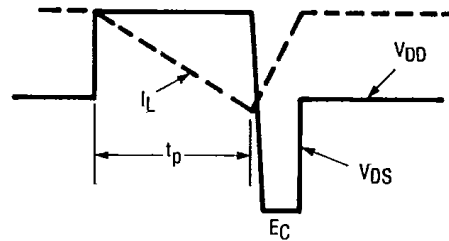
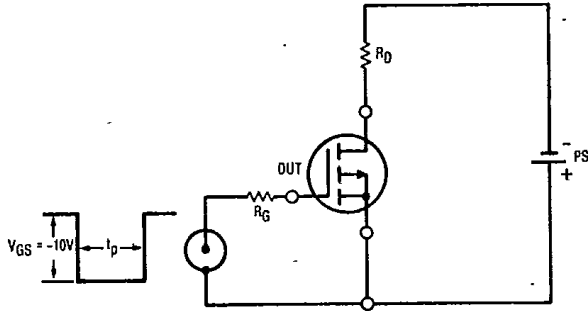


Fig. 15 - Clamped Inductive Waveforms

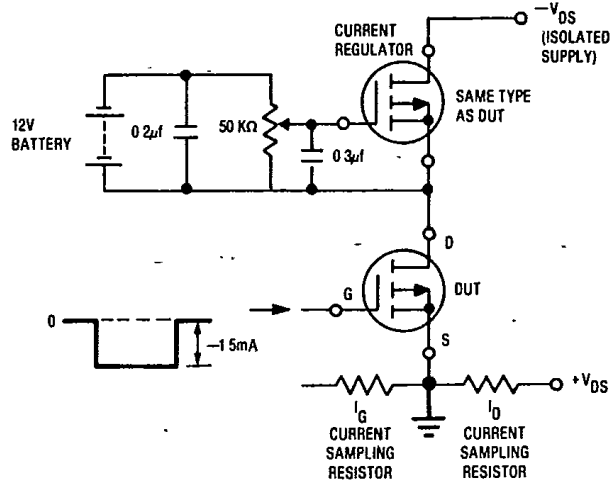
**IRFD9110, IRFD9113 Devices**  
**INTERNATIONAL RECTIFIER**

11E D 4855452 0008415 0

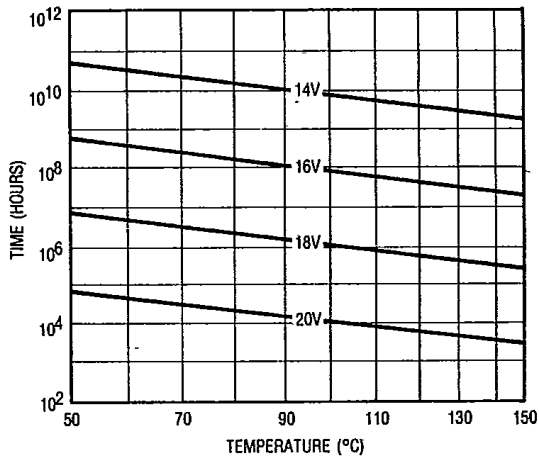
T-37-25



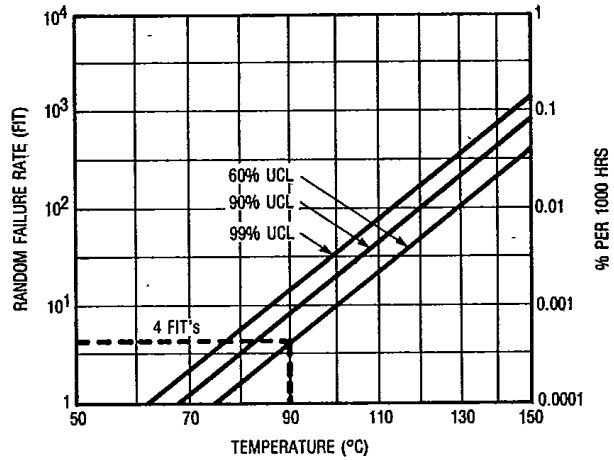
**Fig. 16 — Switching Time Test Circuit**



**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.