

# International IR Rectifier

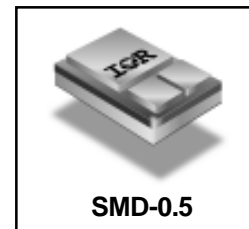
## RADIATION HARDENED POWER MOSFET SURFACE MOUNT (SMD-0.5)

PD - 93820

### IRHNJ7130 100V, N-CHANNEL RAD-Hard™ HEXFET® MOSFET TECHNOLOGY

#### Product Summary

Part Number	Radiation Level	RDS(on)	Id
IRHNJ7130	100K Rads (Si)	0.18Ω	14.4A
IRHNJ3130	300K Rads (Si)	0.18Ω	14.4A
IRHNJ4130	600K Rads (Si)	0.18Ω	14.4A
IRHNJ8130	1000K Rads (Si)	0.18Ω	14.4A



International Rectifier's RAD-Hard™ HEXFET® MOSFET technology provides high performance power MOSFETs for space applications. This technology has over a decade of proven performance and reliability in satellite applications. These devices have been characterized for both Total Dose and Single Event Effects (SEE). The combination of low RDS(on) and low gate charge reduces the power losses in switching applications such as DC to DC converters and motor control. These devices retain all of the well established advantages of MOSFETs such as voltage control, fast switching, ease of paralleling and temperature stability of electrical parameters.

#### Features:

- Single Event Effect (SEE) Hardened
- Low RDS(on)
- Low Total Gate Charge
- Proton Tolerant
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Package
- Surface Mount
- Light Weight

#### Absolute Maximum Ratings

#### Pre-Irradiation

	Parameter		Units
Id @ VGS = 12V, TC = 25°C	Continuous Drain Current	14.4	A
Id @ VGS = 12V, TC = 100°C	Continuous Drain Current	9.1	
IdM	Pulsed Drain Current ①	58	
Pd @ TC = 25°C	Max. Power Dissipation	75	W
	Linear Derating Factor	0.6	W/°C
VGS	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy	150 ②	mJ
IAR	Avalanche Current ①	14.4	A
EAR	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt	6.0 ③	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Pckg. Mounting Surface Temp.	300 (for 5s)	
	Weight	1.0 (Typical)	g

For footnotes refer to the last page

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## IRHNJ7130

## Pre-Irradiation

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

	Parameter	Min	Typ	Max	Units	Test Conditions
B <sub>V</sub> DSS	Drain-to-Source Breakdown Voltage	100	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔB <sub>V</sub> DSS/ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	0.11	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.18	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.1A ④
		—	—	0.20		V <sub>GS</sub> = 12V, I <sub>D</sub> = 14.4A
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0mA
g <sub>fs</sub>	Forward Transconductance	2.5	—	—	S (r)	V <sub>DS</sub> > 15V, I <sub>DS</sub> = 9.1A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	25	μA	V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	-100	nA	V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	50	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 14.4A V <sub>DS</sub> = 50V
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	10		
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	20		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	35	ns	V <sub>DD</sub> = 50V, I <sub>D</sub> = 14.4A, R <sub>G</sub> = 7.5Ω
t <sub>r</sub>	Rise Time	—	—	75		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	70		
t <sub>f</sub>	Fall Time	—	—	60		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	4.0	—	nH	Measured from the center of drain pad to center of source pad
C <sub>iss</sub>	Input Capacitance	—	960	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	340	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	85	—		

## Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	14.4	A	T <sub>j</sub> = 25°C, I <sub>S</sub> = 14.4A, V <sub>GS</sub> = 0V ④
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	58		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.5	V	T <sub>j</sub> = 25°C, I <sub>F</sub> = 14.4A, di/dt ≥ 100A/μs
t <sub>rr</sub>	Reverse Recovery Time	—	—	275	nS	V <sub>DD</sub> ≤ 25V ④
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	2.5	μC	
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub> .				

## Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction-to-Case	—	—	1.67	°C/W	

For footnotes refer to the last page

## Radiation Characteristics

IRHNJ7130

International Rectifier Radiation Hardened MOSFETs are tested to verify their radiation hardness capability. The hardness assurance program at International Rectifier is comprised of two radiation environments. Every manufacturing lot is tested for total ionizing dose (per notes 5 and 6) using the TO-3 package. Both pre- and post-irradiation performance are tested and specified using the same drive circuitry and test conditions in order to provide a direct comparison.

**Table 1. Electrical Characteristics @ Tj = 25°C, Post Total Dose Irradiation** ⑤⑥

	Parameter	100K Rads(Si) <sup>1</sup>		300K to 1000K Rads (Si) <sup>2</sup>		Units	Test Conditions
		Min	Max	Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	100	—	100	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage ④	2.0	4.0	1.25	4.5		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0mA
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	100	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100	—	-100		V <sub>GS</sub> = -20V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	25	—	25	μA	V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (TO-39)	—	0.19	—	0.25	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.1A
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (SMD-0.5)	—	0.18	—	0.24	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.1A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.5	—	1.5	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 14.4A

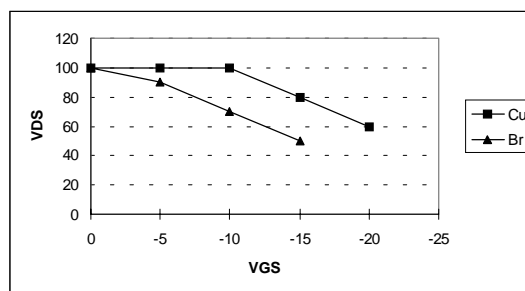
1. Part numbers IRHNJ7130, IRHNJ3130, IRHNJ4130

2. Part number IRHNJ8130

International Rectifier radiation hardened MOSFETs have been characterized in heavy ion environment for Single Event Effects (SEE). Single Event Effects characterization is illustrated in Fig. a and Table 2.

**Table 2. Single Event Effect Safe Operating Area**

Ion	LET MeV/(mg/cm <sup>2</sup> )	Energy (MeV)	Range (μm)	V <sub>DS</sub> (V)				
				@ V <sub>GS</sub> =0V	@ V <sub>GS</sub> =-5V	@ V <sub>GS</sub> =-10V	@ V <sub>GS</sub> =-15V	@ V <sub>GS</sub> =-20V
Cu	28.0	285	43.0	100	100	100	80	60
Br	36.8	305	39.0	100	90	70	50	—



**Fig a. Single Event Effect, Safe Operating Area**

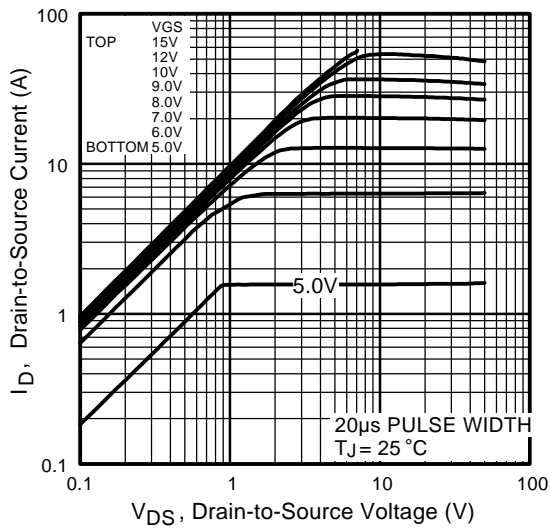
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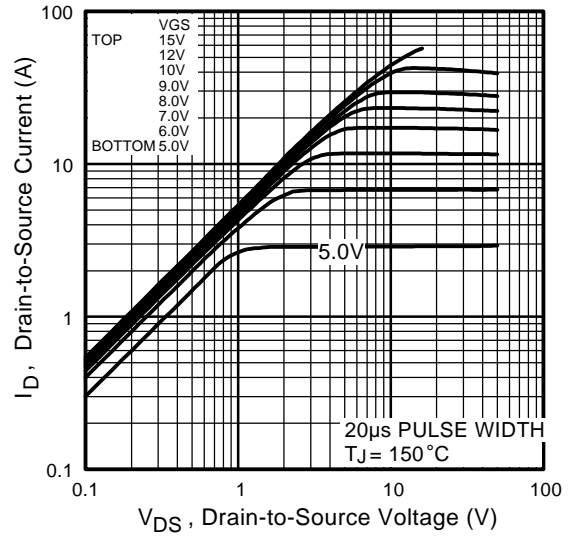
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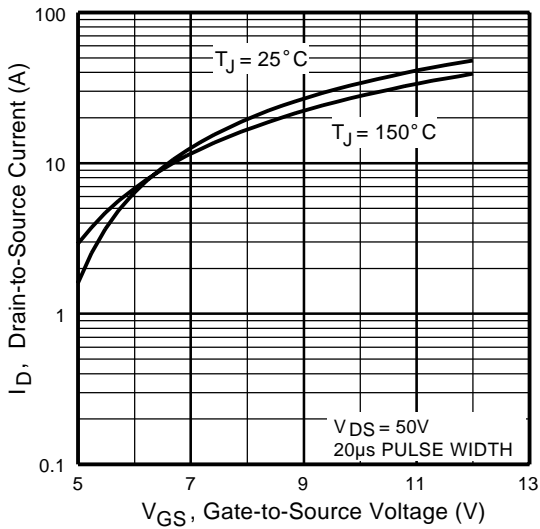
**Pre-Irradiation**



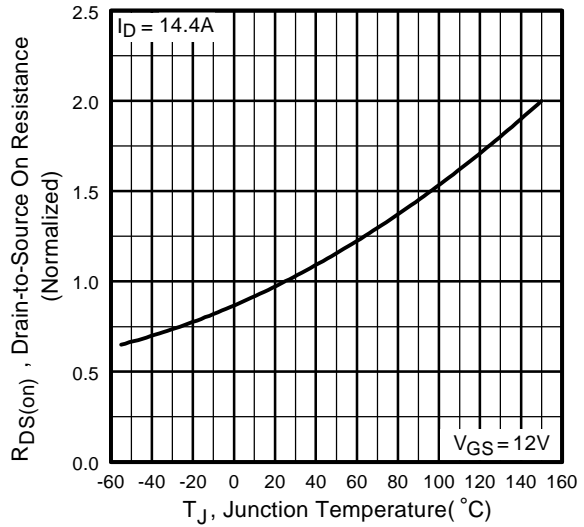
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics



**Fig 3.** Typical Transfer Characteristics



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

Pre-Irradiation

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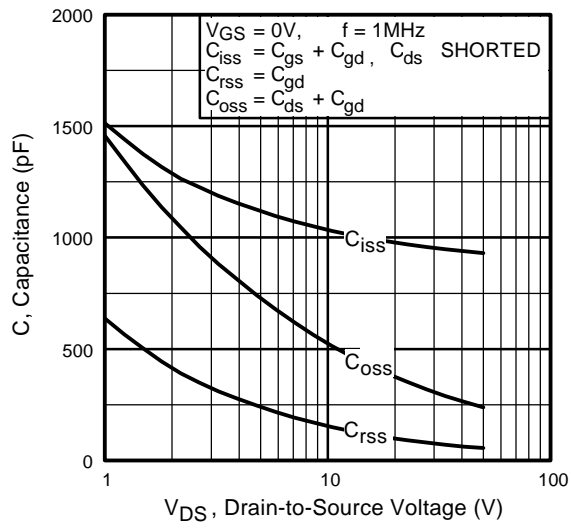


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

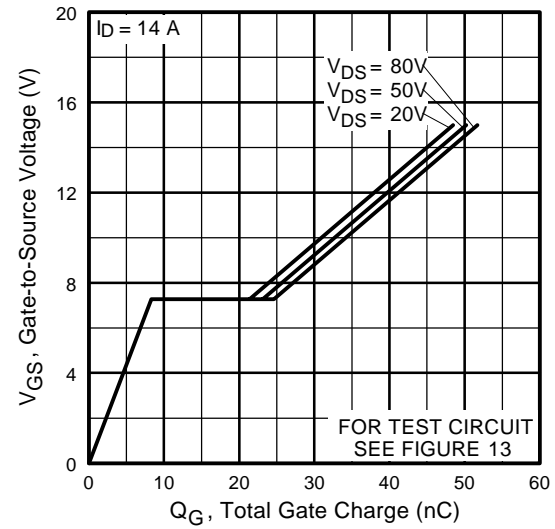


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

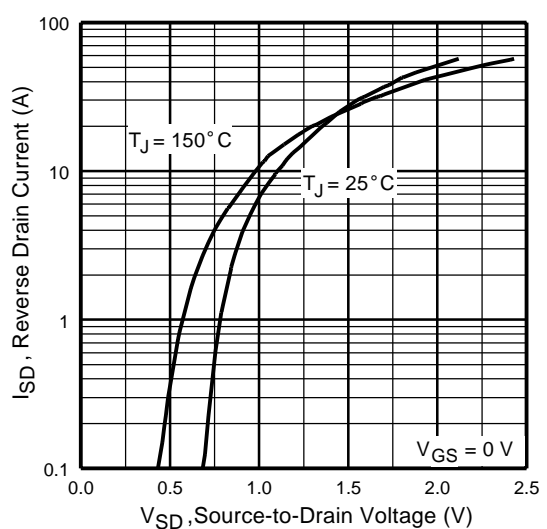


Fig 7. Typical Source-Drain Diode Forward Voltage

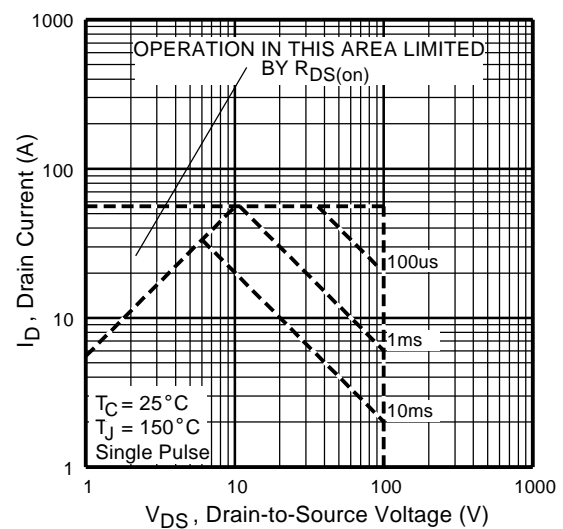


Fig 8. Maximum Safe Operating Area

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Pre-Irradiation

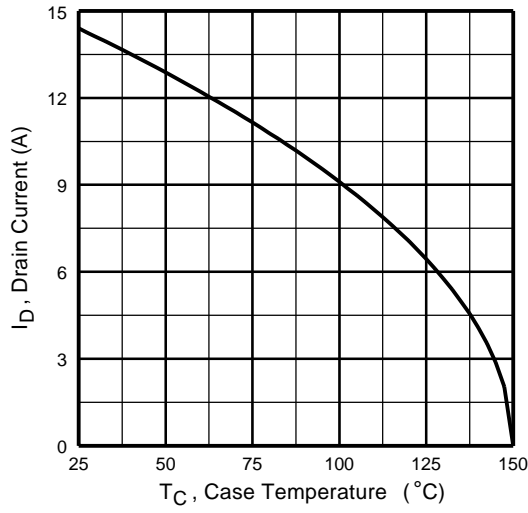


Fig 9. Maximum Drain Current Vs. Case Temperature

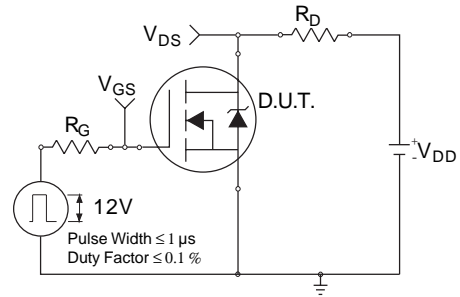


Fig 10a. Switching Time Test Circuit

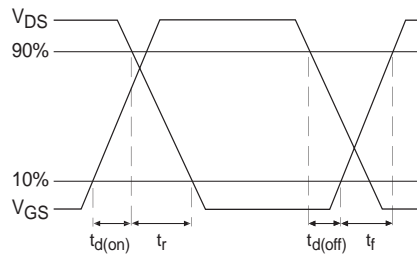


Fig 10b. Switching Time Waveforms

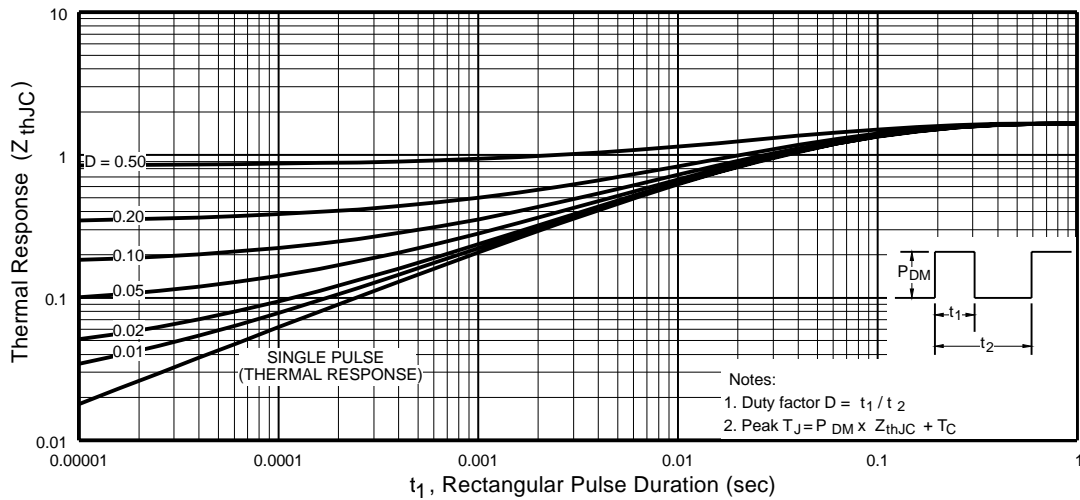


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

Pre-Irradiation

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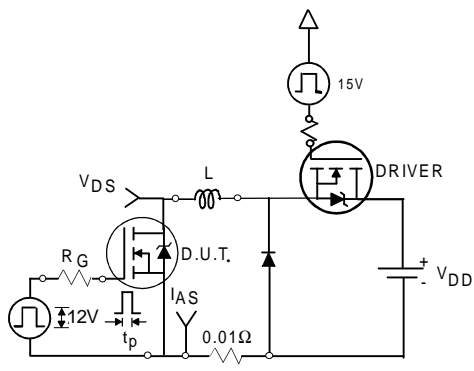


Fig 12a. Unclamped Inductive Test Circuit

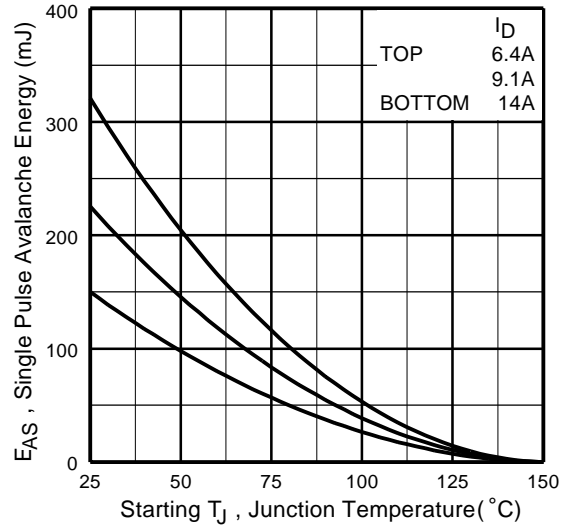


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

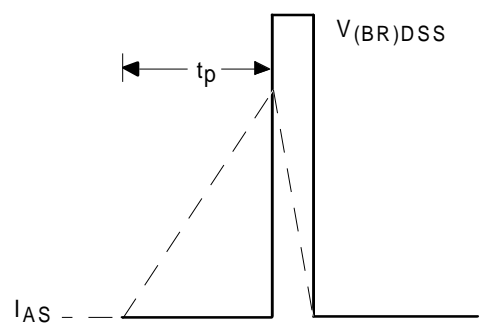


Fig 12b. Unclamped Inductive Waveforms

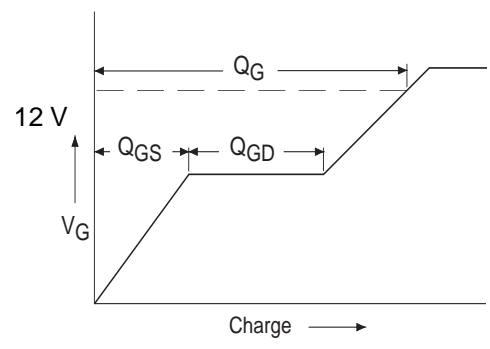


Fig 13a. Basic Gate Charge Waveform

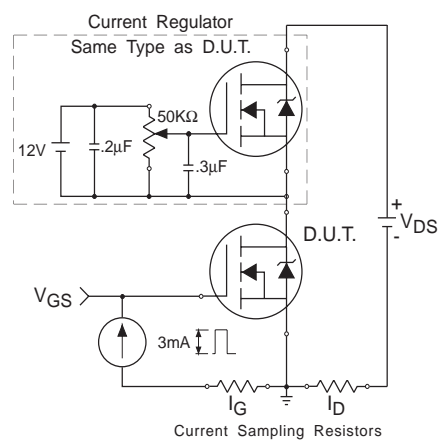
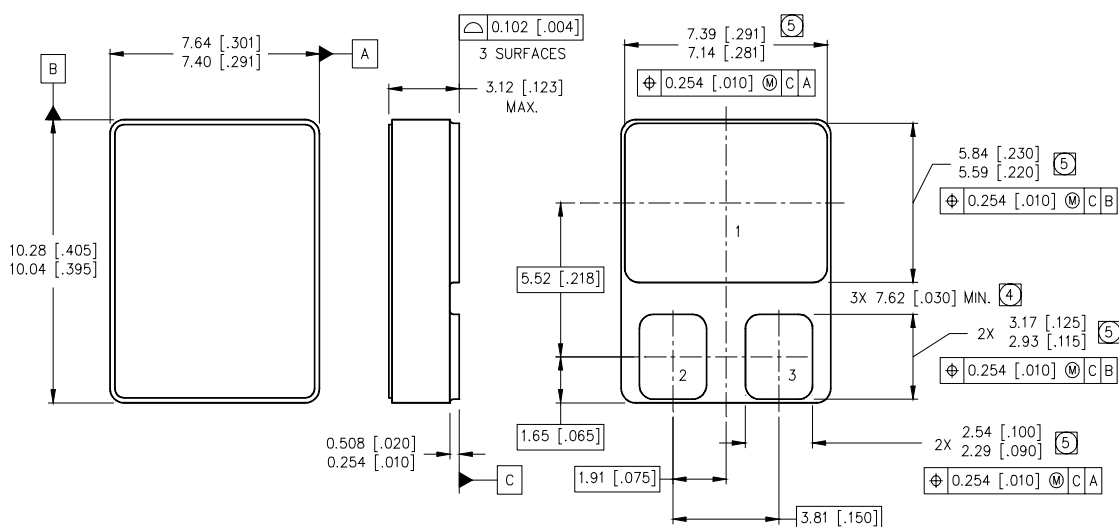


Fig 13b. Gate Charge Test Circuit

**IRHNJ7130****Pre-Irradiation****Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 25V$ , starting  $T_J = 25^\circ C$ ,  $L = 1.4mH$ , Peak  $I_L = 14.4A$ ,  $V_{GS} = 12V$
- ③  $I_{SD} \leq 14.4A$ ,  $di/dt \leq 395A/\mu s$ ,  $V_{DD} \leq 100V$ ,  $T_J \leq 150^\circ C$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$
- ⑤ **Total Dose Irradiation with VGS Bias.**  
12 volt  $V_{GS}$  applied and  $V_{DS} = 0$  during irradiation per MIL-STD-750, method 1019, condition A
- ⑥ **Total Dose Irradiation with VDS Bias.**  
80 volt  $V_{DS}$  applied and  $V_{GS} = 0$  during irradiation per MIL-STD-750, method 1019, condition A

**Case Outline and Dimensions — SMD-0.5****NOTES:**

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- ④ DIMENSION INCLUDES METALLIZATION FLASH.
- ⑤ DIMENSION DOES NOT INCLUDE METALLIZATION FLASH.

**PAD ASSIGNMENTS**

- 1 = DRAIN  
2 = GATE  
3 = SOURCE

International  
**IR** Rectifier

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**IR CANADA:** 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200  
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*Data and specifications subject to change without notice. 3/00*