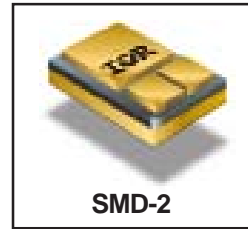


**RADIATION HARDENED  
 POWER MOSFET  
 SURFACE-MOUNT (SMD-2)**

**IRHNA67164  
 150V, N-CHANNEL  
 R<sub>6</sub> TECHNOLOGY**

**Product Summary**

Part Number	Radiation Level	RDS(on)	Id
IRHNA67164	100K Rads (Si)	0.018Ω	56A*
IRHNA63164	300K Rads (Si)	0.018Ω	56A*



**SMD-2**

International Rectifier's R6™ technology provides superior power MOSFETs for space applications. These devices have improved immunity to Single Event Effect (SEE) and have been characterized for useful performance with Linear Energy Transfer (LET) up to 90MeV/(mg/cm<sup>2</sup>). Their combination of very low R<sub>DS(on)</sub> and faster switching times reduces power loss and increases power density in today's high speed switching applications such as DC-DC converters and motor controllers. These devices retain all of the well established advantages of MOSFETs such as voltage control, ease of paralleling and temperature stability of electrical parameters.

**Features:**

- Low R<sub>DS(on)</sub>
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Surface Mount
- Ceramic Package
- Light Weight

**Absolute Maximum Ratings**

**Pre-Irradiation**

	Parameter		Units
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 25°C	Continuous Drain Current	56*	A
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 100°C	Continuous Drain Current	49	
I <sub>DM</sub>	Pulsed Drain Current ①	224	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	250	W
	Linear Derating Factor	2.0	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	283	mJ
I <sub>AR</sub>	Avalanche Current ①	56	A
EAR	Repetitive Avalanche Energy ①	25	mJ
dv/dt	Peak Diode Recovery dv/dt ③	7.5	V/ns
T <sub>J</sub>	Operating Junction	-55 to 150	°C
T <sub>STG</sub>	Storage Temperature Range		
	Pckg. Mounting Surface Temp.	300 (for 5s)	
	Weight	3.3 (Typical)	g

\* Current is limited by package  
 For footnotes refer to the last page

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

	Parameter	Min	Typ	Max	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	150	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	0.17	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.018	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 49A ④
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	50	—	—	S (⑦)	V <sub>DS</sub> = 15V, I <sub>DS</sub> = 49A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	10	μA	V <sub>DS</sub> = 120V, V <sub>GS</sub> = 0V
		—	—	25		V <sub>DS</sub> = 120V, 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		V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	230	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 56A V <sub>DS</sub> = 75V
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	70		
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	90		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	35	ns	V <sub>DD</sub> = 75V, I <sub>D</sub> = 56A, V <sub>GS</sub> = 12V, R <sub>G</sub> = 2.35Ω
t <sub>r</sub>	Rise Time	—	—	170		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	85		
t <sub>f</sub>	Fall Time	—	—	35		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	2.8	—	nH	Measured from the center of drain pad to center of source pad
C <sub>iss</sub>	Input Capacitance	—	7390	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	1144	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	28	—		
R <sub>g</sub>	Internal Gate Resistance	—	0.52	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	56*	A	T <sub>j</sub> = 25°C, I <sub>S</sub> = 56A, V <sub>GS</sub> = 0V ④
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	224		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.2	V	T <sub>j</sub> = 25°C, I <sub>F</sub> = 56A, di/dt ≤ 100A/μs
t <sub>rr</sub>	Reverse Recovery Time	—	—	370	ns	V <sub>DD</sub> ≤ 50V ④
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	4.5	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> .				

\* Current is limited by package

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction-to-Case	—	—	0.5	°C/W	

**Note:** Corresponding Spice and Saber models are available on International Rectifier Web site.

For footnotes refer to the last page

## Radiation Characteristics

IRHNA67164

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	Up to 300K Rads (Si)		Units	Test Conditions ⑧
		Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	150	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	4.0		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0mA
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
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	μA	V <sub>DS</sub> = 120V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.019	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 49A
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (SMD-2)	—	0.018	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 49A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.2	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 56A

Part numbers IRHNA67164 and IRHNA63164

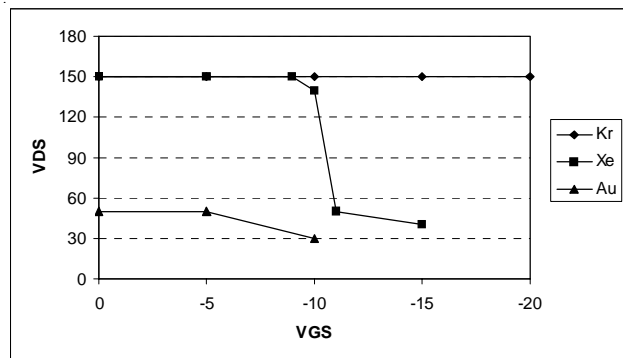
International Rectifier radiation hardened MOSFETs have been characterized in heavy ion environment for Single Event Effects (SEE). Single Event Effects characterization is illustrated in Fig. a and Tables.

### Tables for Single Event Effect Safe Operating Area

Ion Kr LET = 39 MeV/(mg/cm <sup>2</sup> ) Energy = 312 MeV Range = 39 μm	
VGS Bias (Volts)	VDS Bias (Volts)
0	150
-5	150
-10	150
-15	150
-20	150

Ion Xe LET = 59 MeV/(mg/cm <sup>2</sup> ) Energy = 825 MeV Range = 66 μm	
VGS Bias (Volts)	VDS Bias (Volts)
0	150
-5	150
-9	150
-10	140
-11	50
-15	40

Ion Au LET = 90 MeV/(mg/cm <sup>2</sup> ) Energy = 1480 MeV Range = 80 μm	
VGS Bias (Volts)	VDS Bias (Volts)
0	50
-5	50
-10	30



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

For footnotes refer to the last page

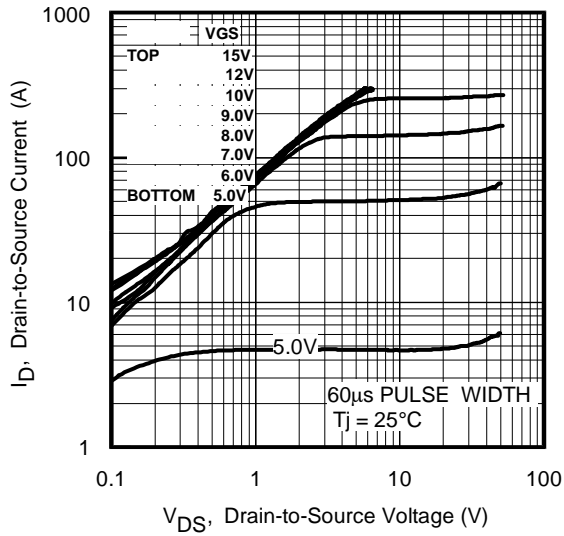


Fig 1. Typical Output Characteristics

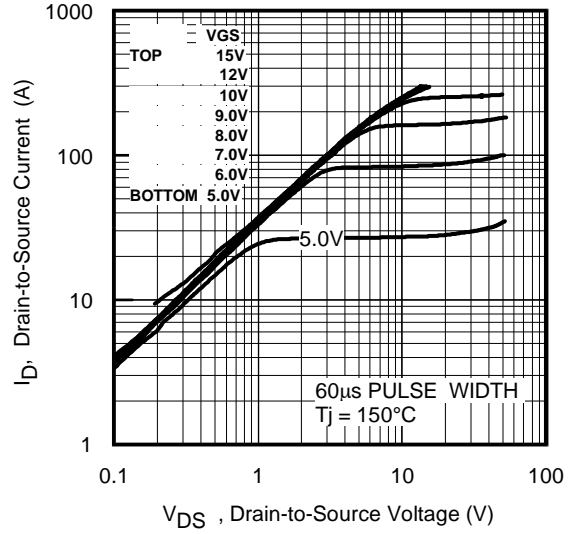


Fig 2. Typical Output Characteristics

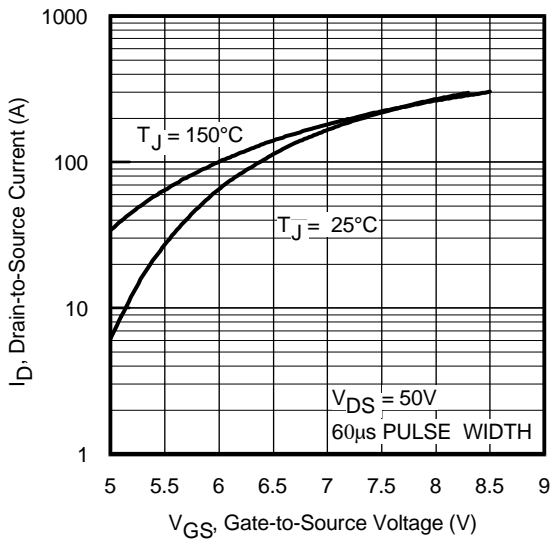


Fig 3. Typical Transfer Characteristics

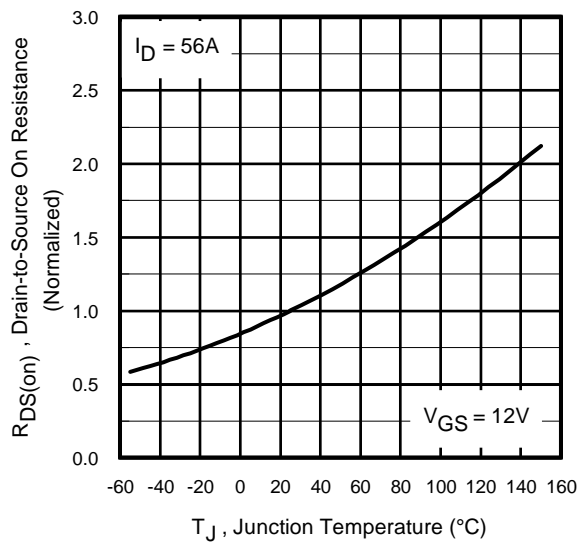


Fig 4. Normalized On-Resistance Vs. Temperature

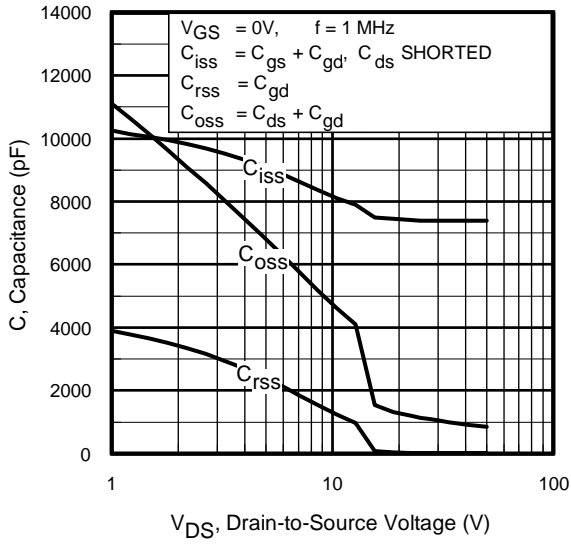


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

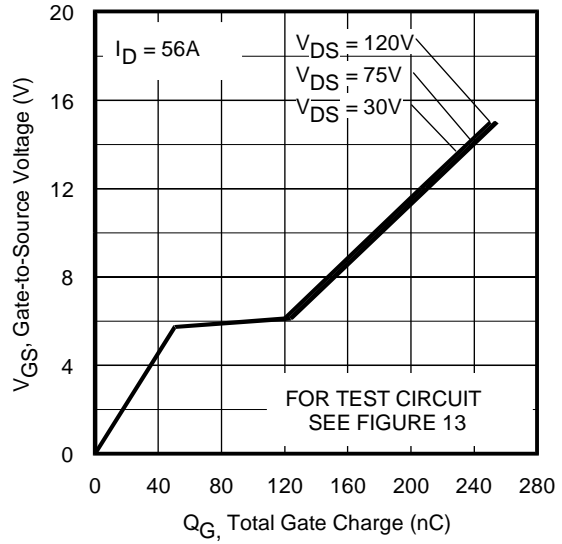


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

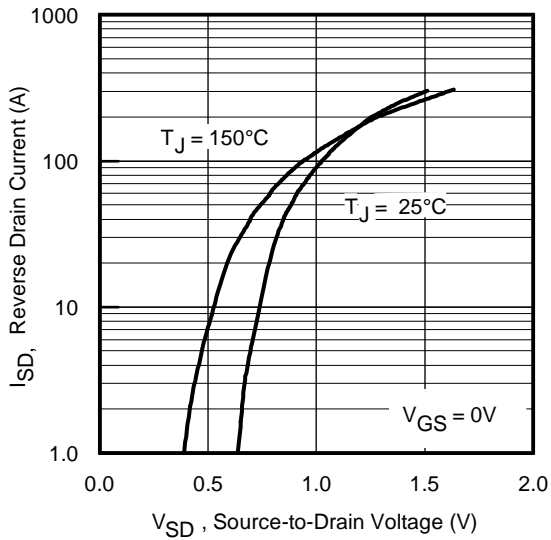


Fig 7. Typical Source-Drain Diode Forward Voltage

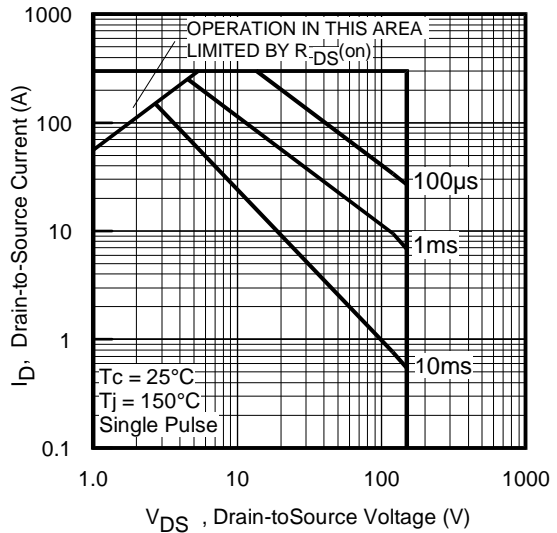


Fig 8. Maximum Safe Operating Area

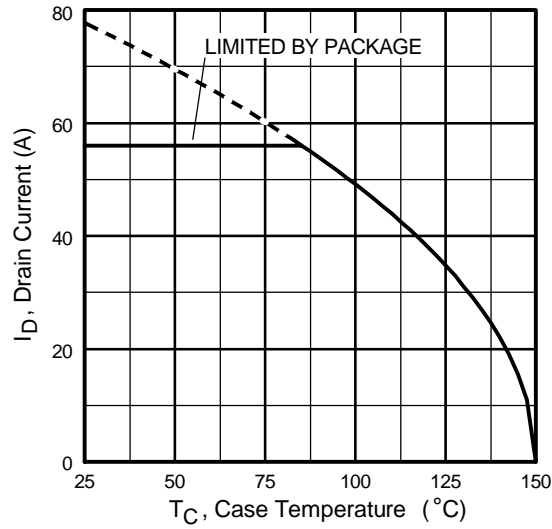


Fig 9. Maximum Drain Current Vs. Case Temperature

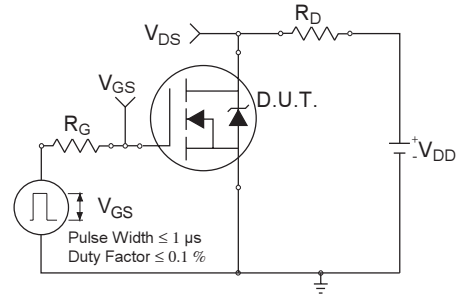


Fig 10a. Switching Time Test Circuit

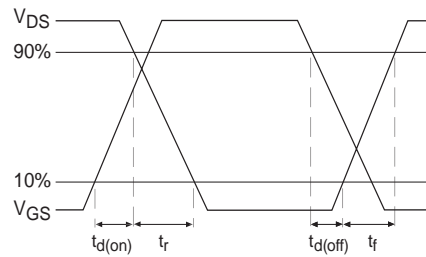


Fig 10b. Switching Time Waveforms

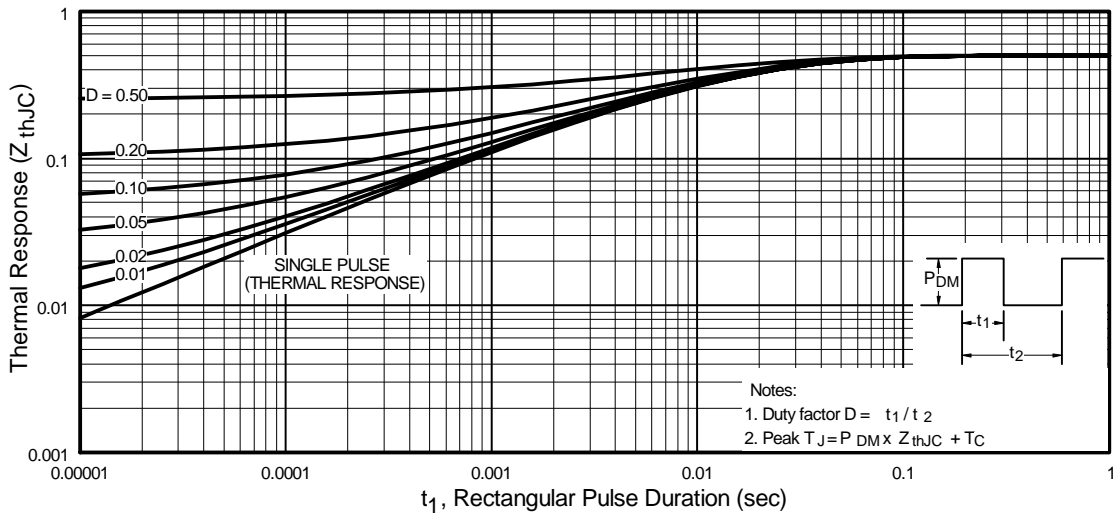


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

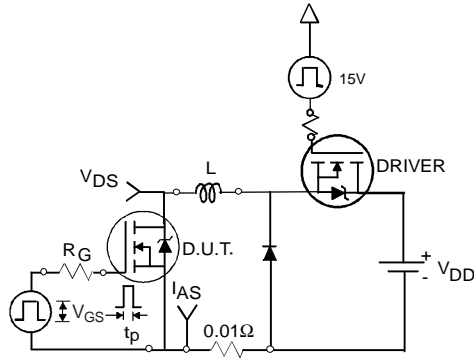


Fig 12a. Unclamped Inductive Test Circuit

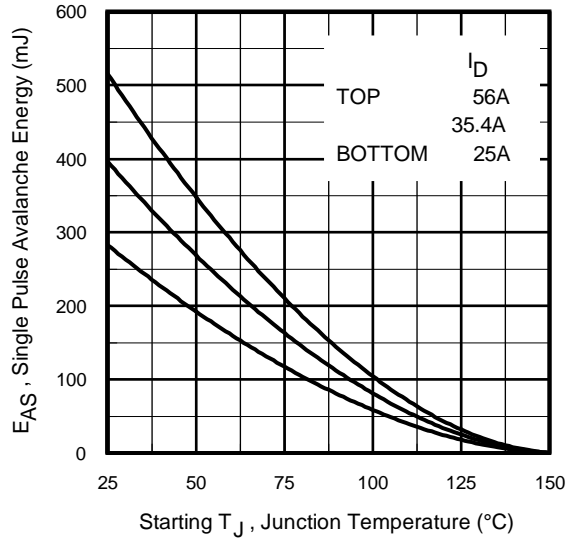


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

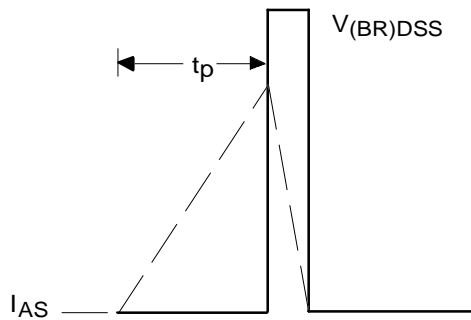


Fig 12b. Unclamped Inductive Waveforms

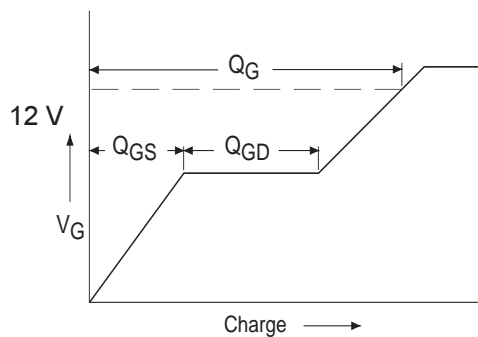


Fig 13a. Basic Gate Charge Waveform

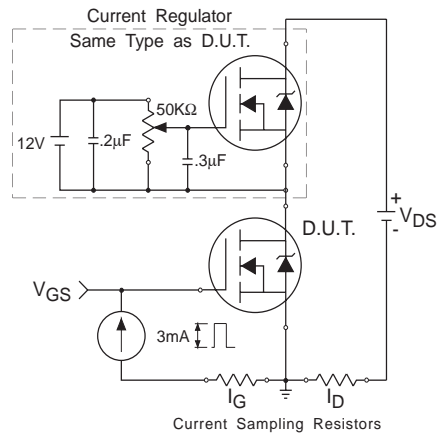
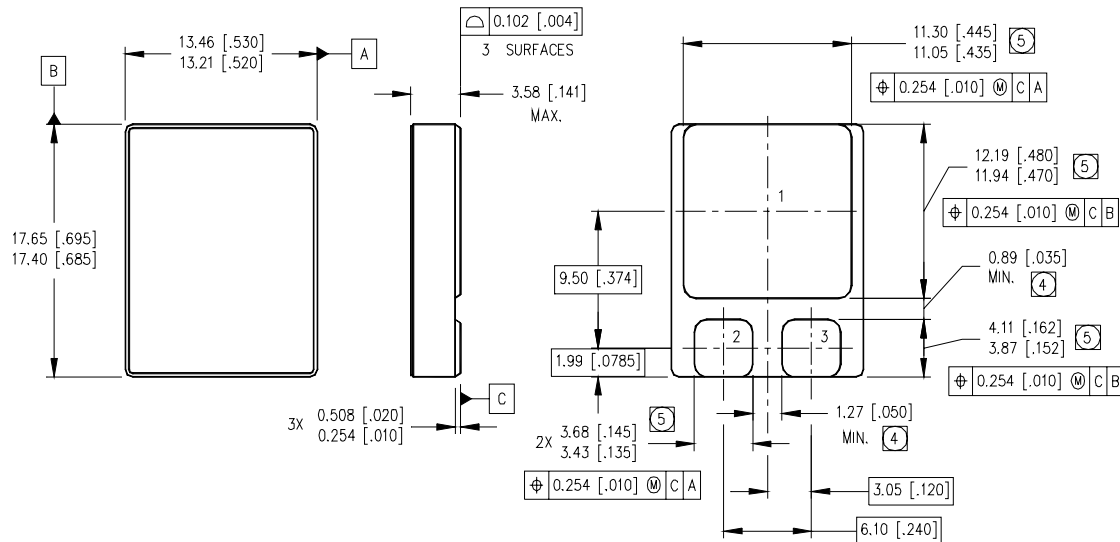


Fig 13b. Gate Charge Test Circuit

**Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 50V$ , starting  $T_J = 25^\circ C$ ,  $L = 0.18mH$   
Peak  $I_L = 56A$ ,  $V_{GS} = 12V$
- ③  $ISD \leq 56A$ ,  $di/dt \leq 860/\mu s$ ,  
 $V_{DD} \leq 150V$ ,  $T_J \leq 150^\circ C$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$
- ⑤ **Total Dose Irradiation with  $V_{GS}$  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  $V_{DS}$  Bias.**  
120 volt  $V_{DS}$  applied and  $V_{GS} = 0$  during irradiation per MIL-STD-750, method 1019, condition A.

**Case Outline and Dimensions — SMD-2**



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

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
**IR LEOMINSTER :** 205 Crawford St., Leominster, Massachusetts 01453, USA Tel: (978) 534-5776  
 TAC Fax: (310) 252-7903

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