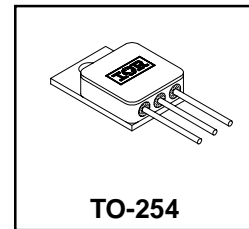


**RADIATION HARDENED  
 POWER MOSFET  
 THRU-HOLE (TO-254)**

**IRHM57264SE  
 250V, N-CHANNEL  
 R5 TECHNOLOGY**

**Product Summary**

Part Number	Radiation Level	RDS(on)	ID
IRHM57264SE	100K Rads (Si)	0.066Ω	35A*



International Rectifier's R5™ technology provides high performance power MOSFETs for space applications. These devices have been characterized for Single Event Effects (SEE) with useful performance up to an LET of 80 (MeV/(mg/cm<sup>2</sup>)). 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
- Neutron Tolerant
- Identical Pre- and Post-Electrical Test Conditions
- Repetitive Avalanche Ratings
- Dynamic dv/dt Ratings
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Electrically Isolated
- Ceramic Eyelets
- Light Weight

**Absolute Maximum Ratings**

**Pre-Irradiation**

	Parameter		Units
ID @ VGS = 12V, TC = 25°C	Continuous Drain Current	35*	A
ID @ VGS = 12V, TC = 100°C	Continuous Drain Current	26	
IDM	Pulsed Drain Current ①	140	
PD @ TC = 25°C	Max. Power Dissipation	250	W
	Linear Derating Factor	2.0	W/°C
VGS	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	500	mJ
IAR	Avalanche Current ①	35	A
EAR	Repetitive Avalanche Energy ①	25	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063 in.(1.6 mm from case for 10s))	
	Weight	9.3 ( Typical)	g

\* Current is limited by internal wire diameter  
 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
B <sub>V</sub> D <sub>SS</sub>	Drain-to-Source Breakdown Voltage	250	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔB <sub>V</sub> D <sub>SS</sub> /ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	0.32	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>D</sub> S(on)	Static Drain-to-Source On-State Resistance	—	—	0.066	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 26A ④
V <sub>GS</sub> (th)	Gate Threshold Voltage	2.5	—	4.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0mA
g <sub>fs</sub>	Forward Transconductance	30	—	—	S (Ω)	V <sub>DS</sub> > 15V, I <sub>DS</sub> = 26A ④
I <sub>D</sub> SS	Zero Gate Voltage Drain Current	—	—	10	μA	V <sub>DS</sub> = 200V, V <sub>GS</sub> = 0V
		—	—	25		V <sub>DS</sub> = 200V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>G</sub> SS	Gate-to-Source Leakage Forward	—	—	100	nA	V <sub>GS</sub> = 20V
I <sub>G</sub> SS	Gate-to-Source Leakage Reverse	—	—	-100		V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	165	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 35A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	45		V <sub>DS</sub> = 125V
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	75		
t <sub>d</sub> (on)	Turn-On Delay Time	—	—	35	ns	V <sub>DD</sub> = 125V, I <sub>D</sub> = 35A R <sub>G</sub> = 2.35Ω
t <sub>r</sub>	Rise Time	—	—	125		
t <sub>d</sub> (off)	Turn-Off Delay Time	—	—	80		
t <sub>f</sub>	Fall Time	—	—	65		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	6.8	—	nH	Measured from Drain lead (6mm /0.25in. from package) to Source lead (6mm /0.25in. from package) with Source wires internally bonded from Source Pin to Drain Pad
C <sub>iss</sub>	Input Capacitance	—	5050	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	780	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	65	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	35*	A	T <sub>j</sub> = 25°C, I <sub>S</sub> = 35A, V <sub>GS</sub> = 0V ④
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	140		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.2	V	T <sub>j</sub> = 25°C, I <sub>F</sub> = 35A, di/dt ≥ 100A/μs
t <sub>rr</sub>	Reverse Recovery Time	—	—	503	ns	V <sub>DD</sub> ≤ 25V ④
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	7.7	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 internal wire diameter

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>th</sub> JC	Junction-to-Case	—	—	0.50	°C/W	Typical socket mount
R <sub>th</sub> CS	Case-to-Sink	—	0.21	—		
R <sub>th</sub> JA	Junction-to-Ambient	—	—	48		

**Note:** Corresponding Spice and Saber models are available on the G&S Website.

For footnotes refer to the last page

## Radiation Characteristics

IRHM57264SE

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**

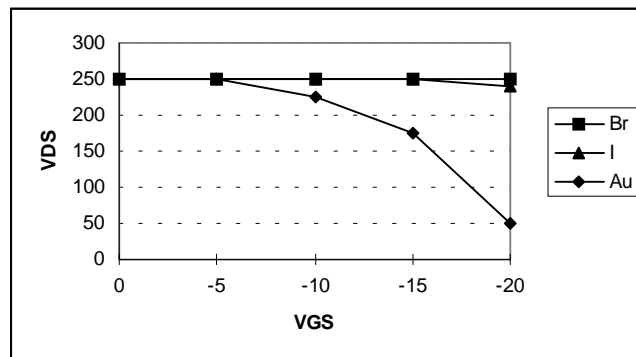
	Parameter	100K Rads (Si)		Units	Test Conditions ⑧
		Min	Max		
BVDSS	Drain-to-Source Breakdown Voltage	250	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage ④	2.0	4.5		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0mA
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100		V <sub>GS</sub> = -20V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	μA	V <sub>DS</sub> = 160V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ④				
	On-State Resistance (TO-3)	—	0.061	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 35A
R <sub>DS(on)</sub>	Static Drain-to-Source ④				
	On-State Resistance (TO-254)	—	0.066	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 35A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.2	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 35A

1. Part number IRHM57264SE

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)	VDS (V)				
				@ VGS=0V	@ VGS=-5V	@ VGS=-10V	@ VGS=-15V	@ VGS=-20V
Br	36.7	309	39.5	250	250	250	250	250
I	59.8	341	32.5	250	250	250	250	240
Au	82.3	350	28.4	250	250	225	175	50



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

For footnotes refer to the last page

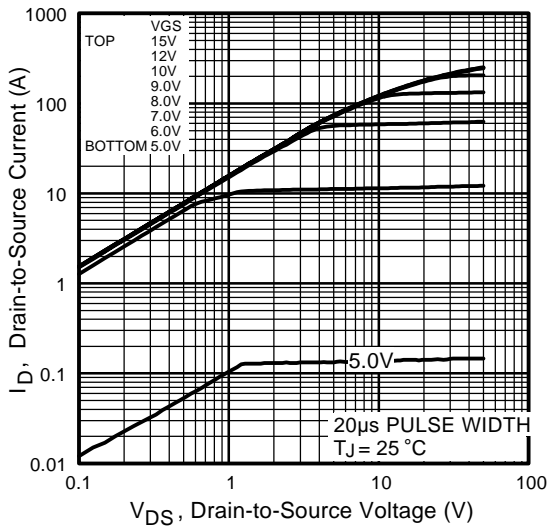


Fig 1. Typical Output Characteristics

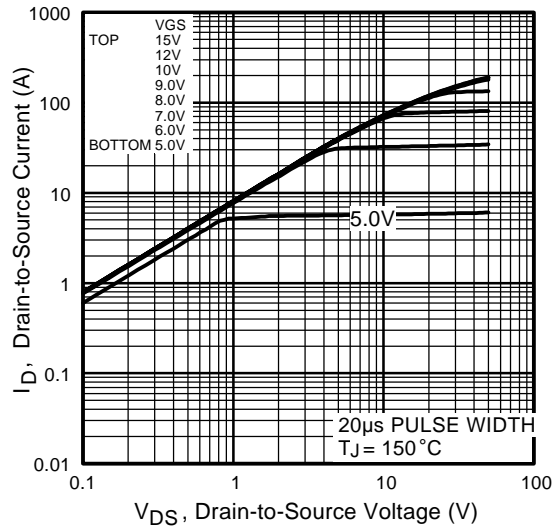


Fig 2. Typical Output Characteristics

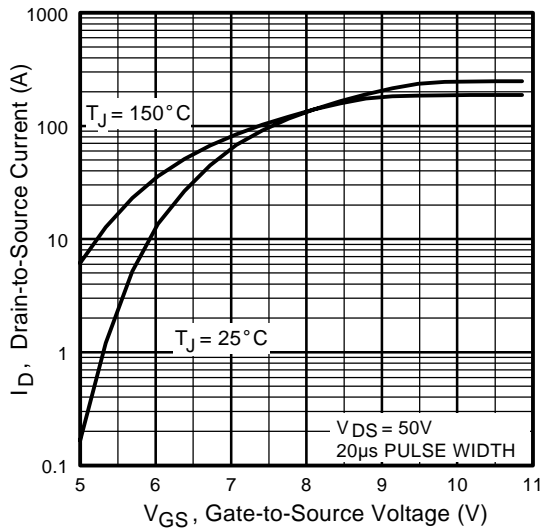


Fig 3. Typical Transfer Characteristics

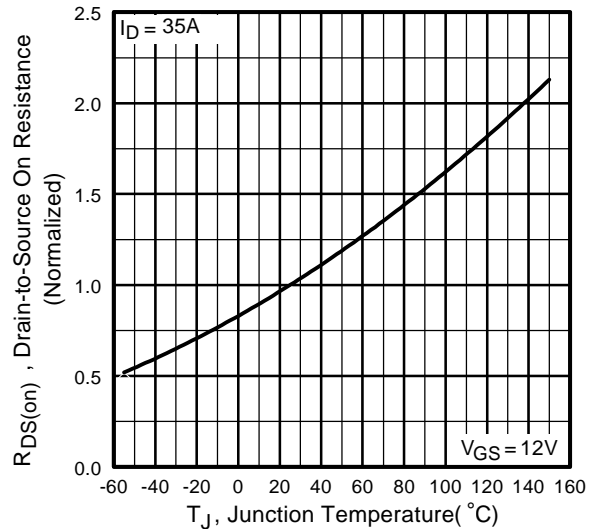
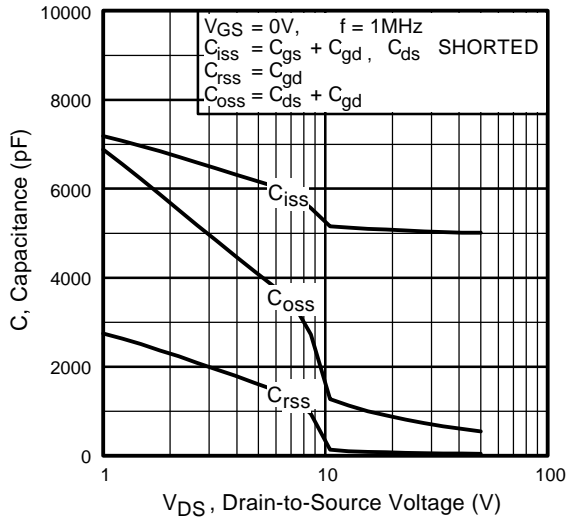
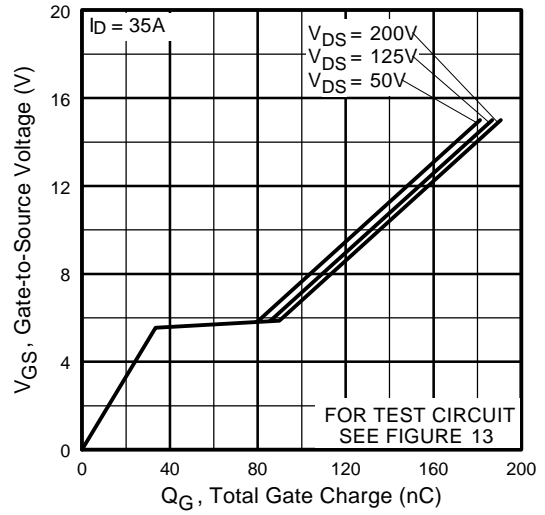


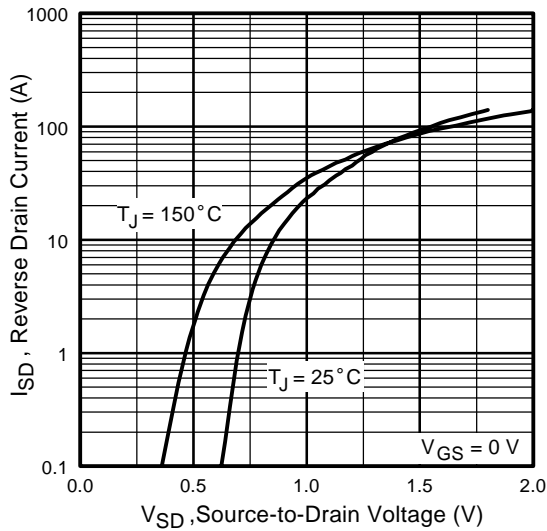
Fig 4. Normalized On-Resistance Vs. Temperature



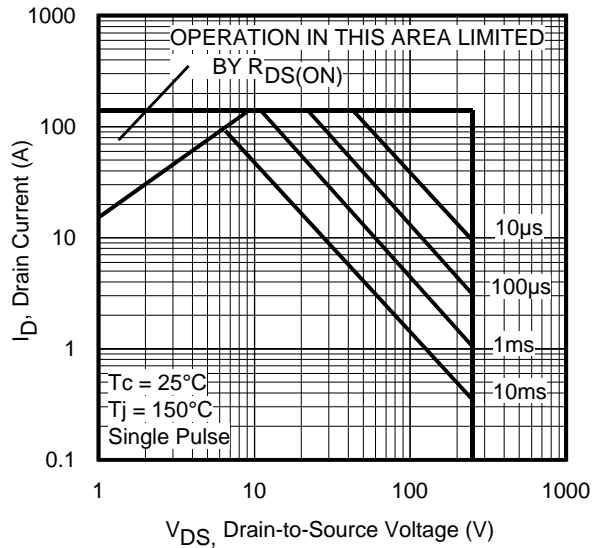
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



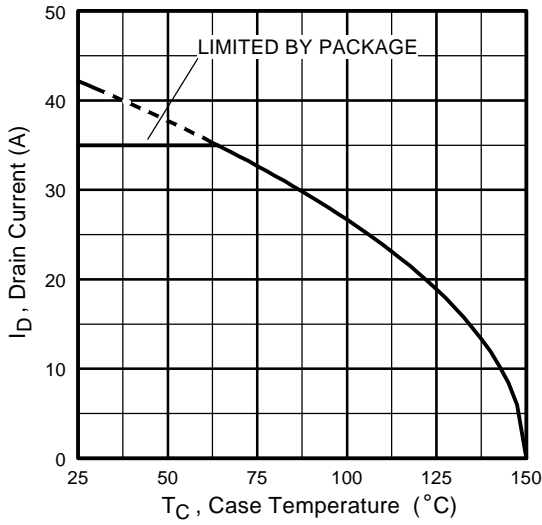
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



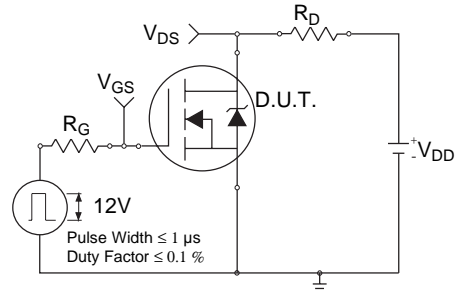
**Fig 7.** Typical Source-Drain Diode Forward Voltage



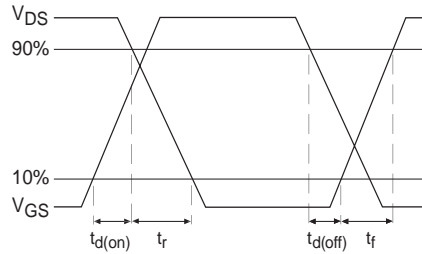
**Fig 8.** Maximum Safe Operating Area



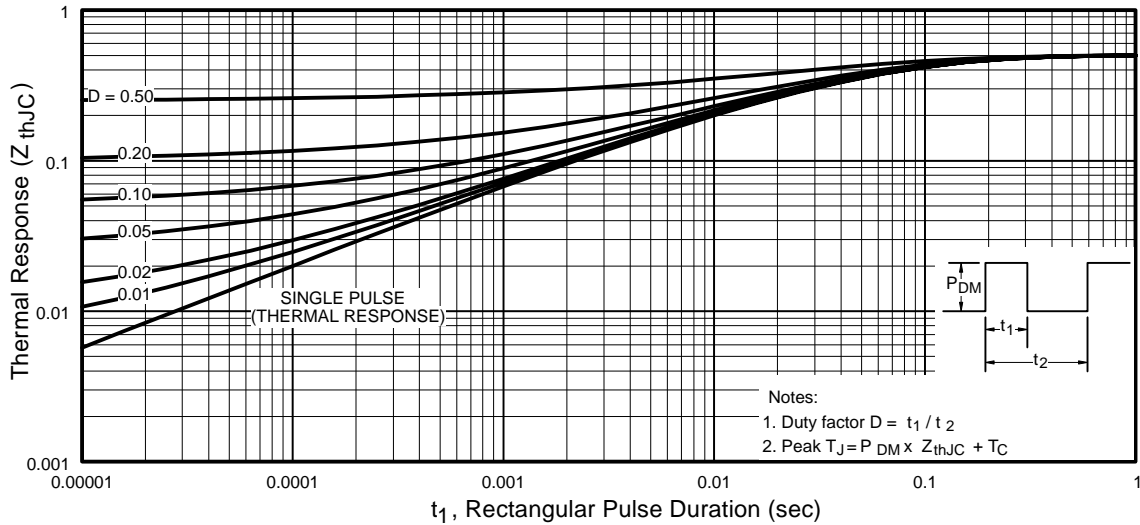
**Fig 9.** Maximum Drain Current Vs. Case Temperature



**Fig 10a.** Switching Time Test Circuit



**Fig 10b.** Switching Time Waveforms



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

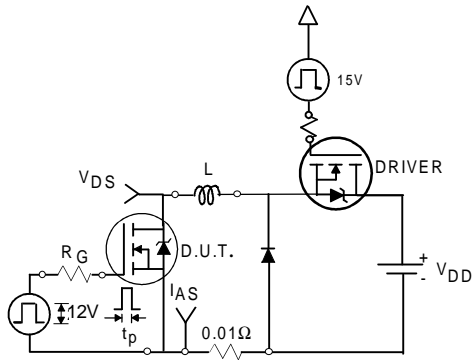


Fig 12a. Unclamped Inductive Test Circuit

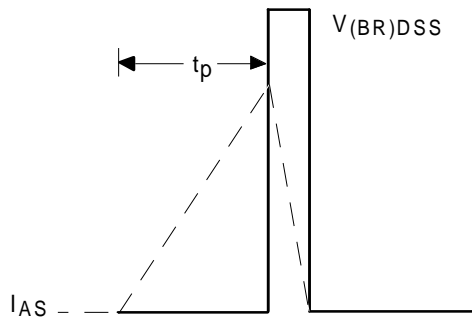


Fig 12b. Unclamped Inductive Waveforms

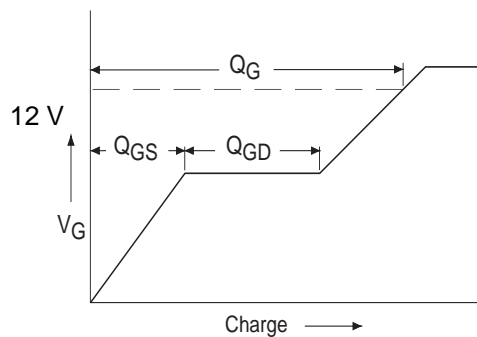


Fig 13a. Basic Gate Charge Waveform

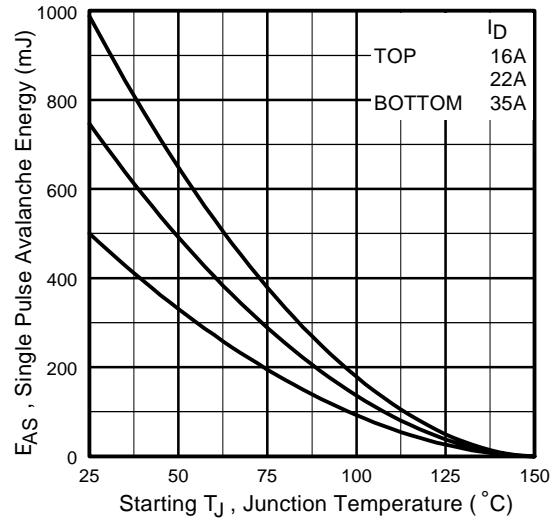


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

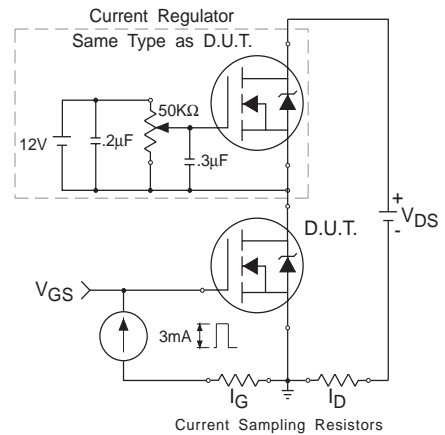
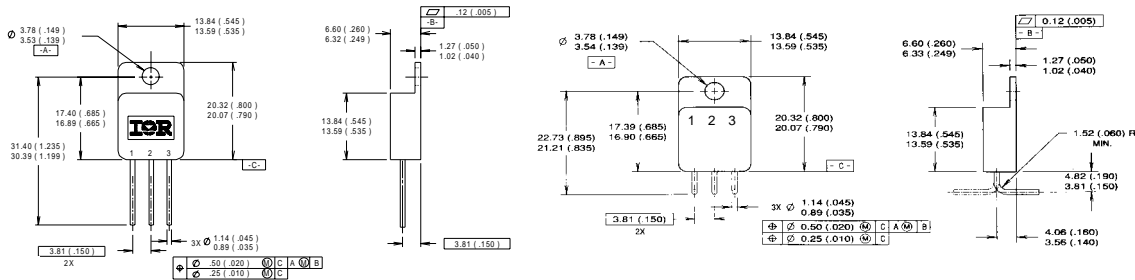


Fig 13b. Gate Charge Test Circuit

**Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 50V$ , starting  $T_J = 25^\circ C$ ,  $L=0.87mH$   
Peak  $I_L = 35A$ ,  $V_{GS} = 12V$
- ③  $ISD \leq 35A$ ,  $di/dt \leq 215A/\mu s$ ,  
 $V_{DD} \leq 250V$ ,  $T_J \leq 150^\circ C$
- 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.**  
200 volt  $V_{DS}$  applied and  $V_{GS} = 0$  during irradiation per MIL-STD-750, method 1019, condition A.

**Case Outline and Dimensions — TO-254AA**



- NOTES:**
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
  3. LEADFORM IS AVAILABLE IN EITHER ORIENTATION

- LEGEND**
- 1- DRAIN
  - 2- SOURCE
  - 3- GATE

**CAUTION**

**BERYLLIA WARNING PER MIL-PRF-19500**

Package containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.



**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
**IR EUROPEAN REGIONAL CENTER:** 439/445 Godstone Rd, Whyteleafe, Surrey CR3 OBL, UK Tel: ++ 44 (0)20 8645 8000  
**IR CANADA:** 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200  
**IR GERMANY:** Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 (0) 6172 96590  
**IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111  
**IR JAPAN:** K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo 171 Tel: 81 (0)3 3983 0086  
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*Data and specifications subject to change without notice. 3/00*