

# International IR Rectifier

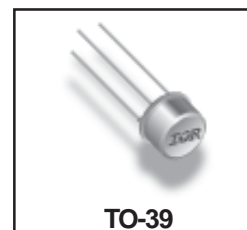
## RADIATION HARDENED POWER MOSFET THRU-HOLE (TO-39)

**IRHF57034  
JANSR2N7492T2  
60V, N-CHANNEL  
REF: MIL-PRF-19500/701**

**R5 TECHNOLOGY**

### Product Summary

Part Number	Radiation Level	R <sub>DS(on)</sub>	I <sub>D</sub>	QPL Part Number
IRHF57034	100K Rads (Si)	0.048Ω	12A*	JANSR2N7492T2
IRHF53034	300K Rads (Si)	0.048Ω	12A*	JANSF2N7492T2
IRHF54034	500K Rads (Si)	0.048Ω	12A*	JANSG2N7492T2
IRHF58034	1000K Rads (Si)	0.060Ω	12A*	JANSH2N7492T2



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 R<sub>DS(on)</sub> 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
- Ultra Low R<sub>DS(on)</sub>
- Identical Pre- and Post-Electrical Test Conditions
- Repetitive Avalanche Ratings
- Dynamic dv/dt Ratings
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed

### 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	12*	A
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 100°C	Continuous Drain Current	9.5	
I <sub>DM</sub>	Pulsed Drain Current ①	48	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	25	W
	Linear Derating Factor	0.2	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	270	mJ
I <sub>AR</sub>	Avalanche Current ①	12	A
E <sub>AR</sub>	Repetitive Avalanche Energy ①	2.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	9.6	V/ns
T <sub>J</sub>	Operating Junction	-55 to 150	°C
T <sub>STG</sub>	Storage Temperature Range		
	Lead Temperature	300 ( 0.063 in./1.6mm from case for 10s)	
	Weight	0.98 (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
B <sub>V</sub> DSS	Drain-to-Source Breakdown Voltage	60	—	—	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	—	0.062	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.048	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.5A 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	12	—	—	S (Ω)	V <sub>DS</sub> ≥ 15V, I <sub>DS</sub> = 9.5A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	10	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
		—	—	25		V <sub>DS</sub> = 48V, 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	—	—	40	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 12A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	10		V <sub>DS</sub> = 30V
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	15		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	25	ns	V <sub>DD</sub> = 30V, I <sub>D</sub> = 12A V <sub>GS</sub> = 12V, R <sub>G</sub> = 7.5Ω
t <sub>r</sub>	Rise Time	—	—	100		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	35		
t <sub>f</sub>	Fall Time	—	—	30		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	7.0	—	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	—	1160	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	530	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	18	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	12*	A	T <sub>j</sub> = 25°C, I <sub>S</sub> = 12A, V <sub>GS</sub> = 0V ④
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	48		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.5	V	T <sub>j</sub> = 25°C, I <sub>F</sub> = 12A, di/dt ≤ 100A/μs
t <sub>rr</sub>	Reverse Recovery Time	—	—	100	ns	V <sub>DD</sub> ≤ 25V ④
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	300	nC	
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	—	—	5.0	°C/W	Typical socket mount
R <sub>thJA</sub>	Junction-to-Ambient	—	—	175		

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

For footnotes refer to the last page

## Radiation Characteristics

## IRHF57034, JANSR2N7492T2

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 500K Rads(Si) <sup>1</sup>		1000K Rads (Si) <sup>2</sup>		Units	Test Conditions
		Min	Max	Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	60	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	4.0	1.5	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	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100	—	-100		V <sub>GS</sub> = -20 V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	—	25	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.034	—	0.043	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.5A
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (TO-39)	—	0.048	—	0.060	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 9.5A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.5	—	1.5	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 12A

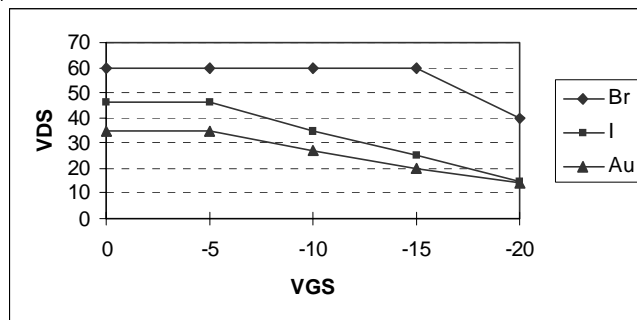
1. Part numbers IRHF57034 (JANSR2N7492T2), IRHF53034 (JANSF2N7492T2) and IRHF54034 (JANSR2N7492T2)

2. Part number IRHF58034 (JANSH2N7492T2)

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
Br	37.3	285	36.8	60	60	60	60	40
Xe	63	300	29	46	46	35	25	15
Au	86.6	2068	106	35	35	27	20	14



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

For footnotes refer to the last page

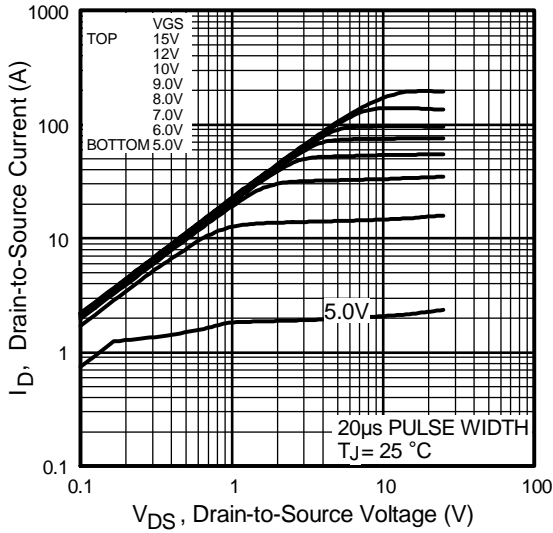


Fig 1. Typical Output Characteristics

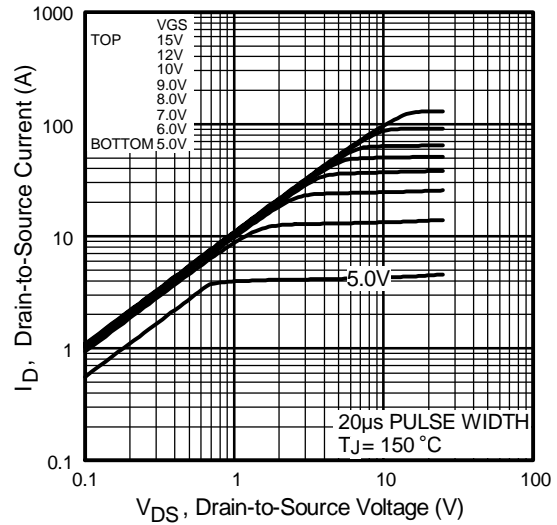


Fig 2. Typical Output Characteristics

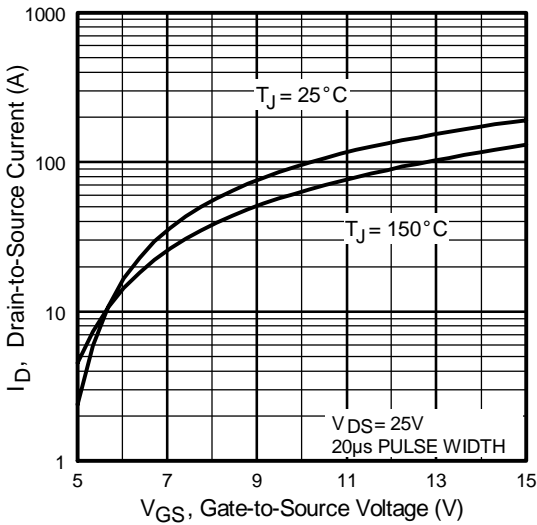


Fig 3. Typical Transfer Characteristics

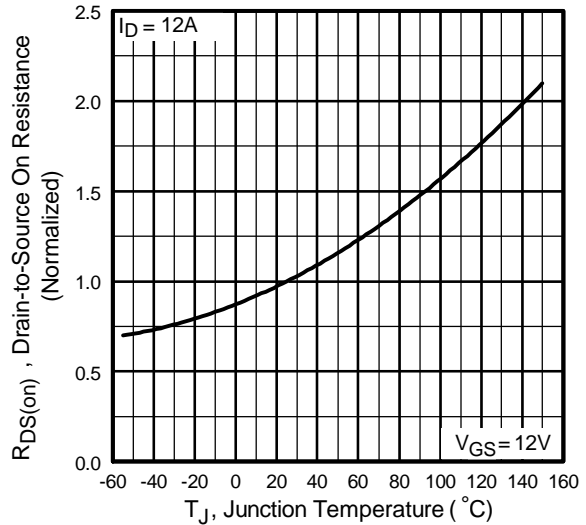


Fig 4. Normalized On-Resistance Vs. Temperature

Pre-Irradiation

IRHF57034, JANSR2N7492T2

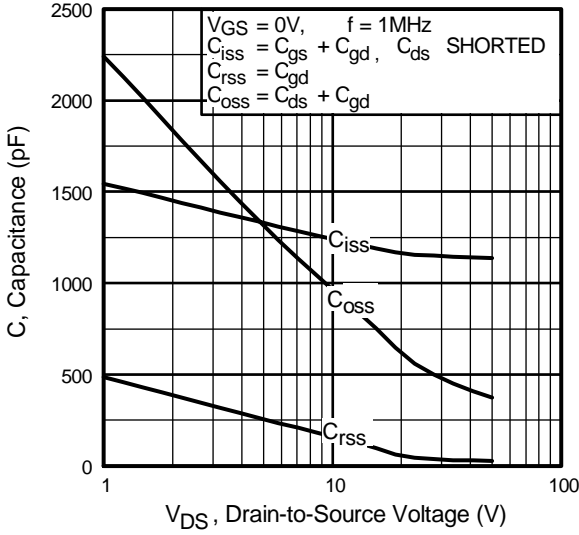


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

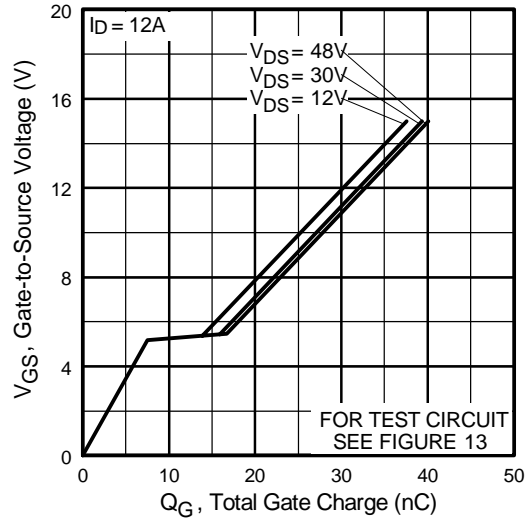


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

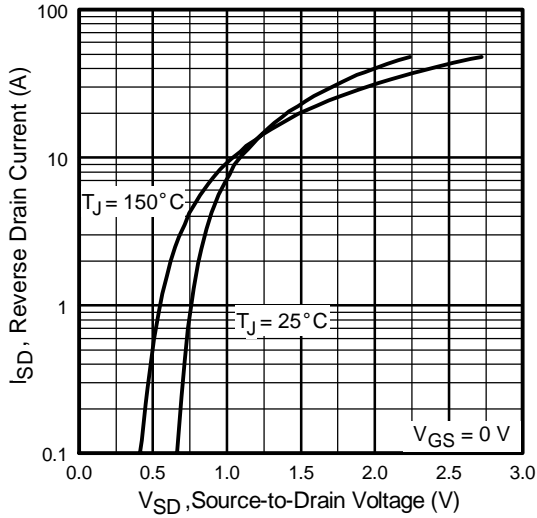


Fig 7. Typical Source-Drain Diode Forward Voltage

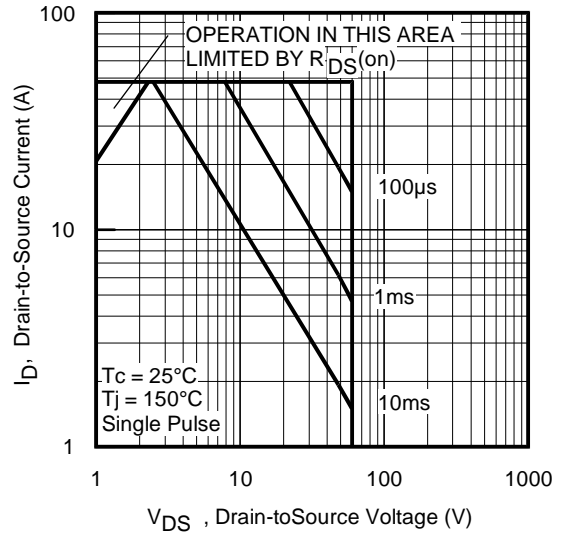


Fig 8. Maximum Safe Operating Area

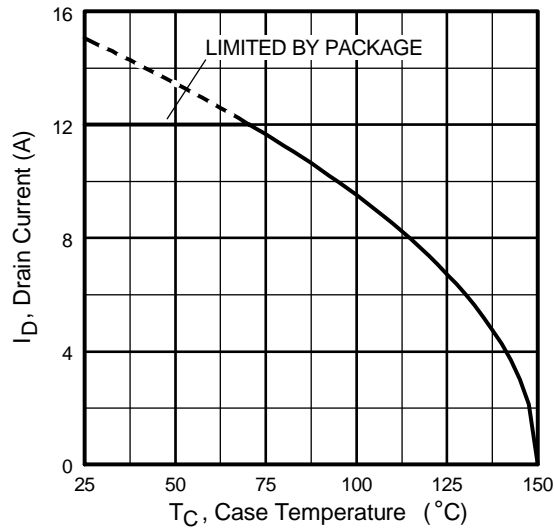


Fig 9. Maximum Drain Current Vs. Case Temperature

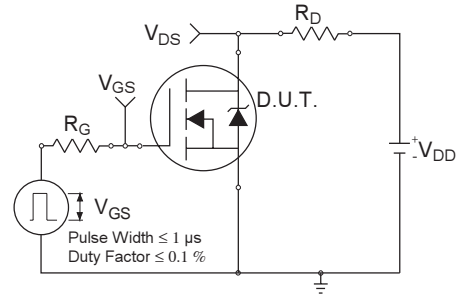


Fig 10a. Switching Time Test Circuit

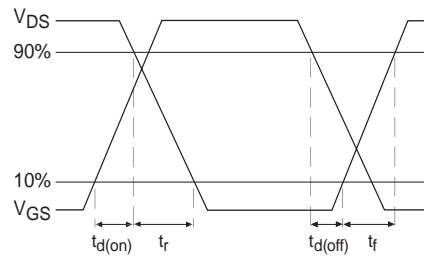


Fig 10b. Switching Time Waveforms

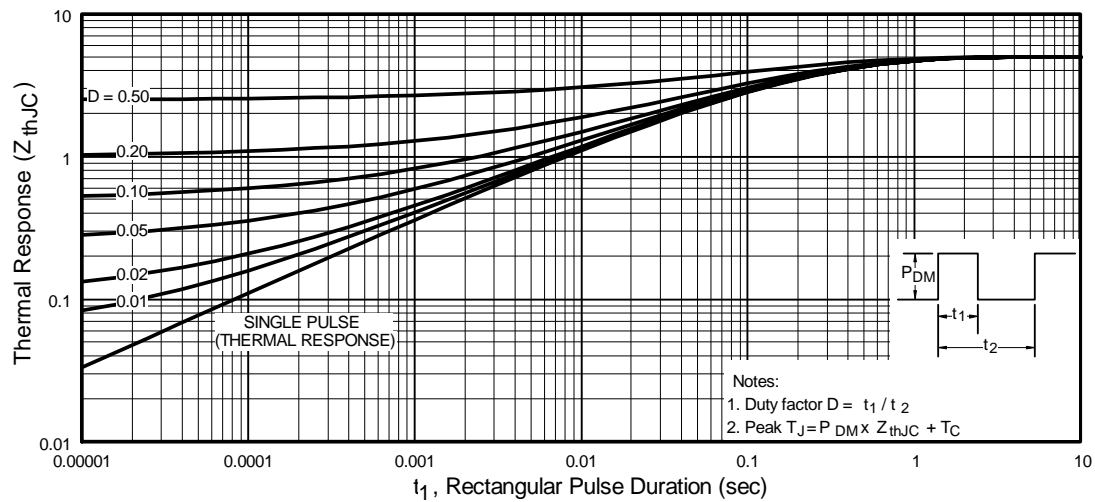


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

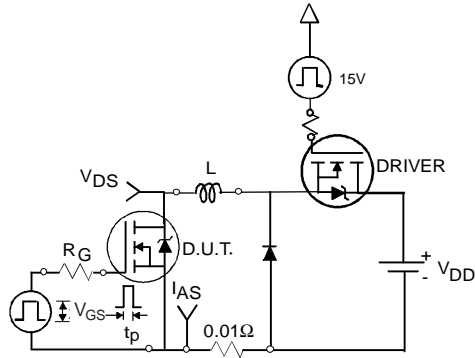


Fig 12a. Unclamped Inductive Test Circuit

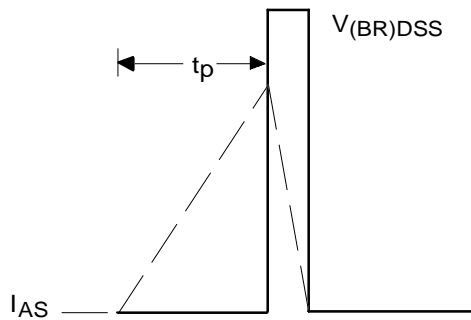


Fig 12b. Unclamped Inductive Waveforms

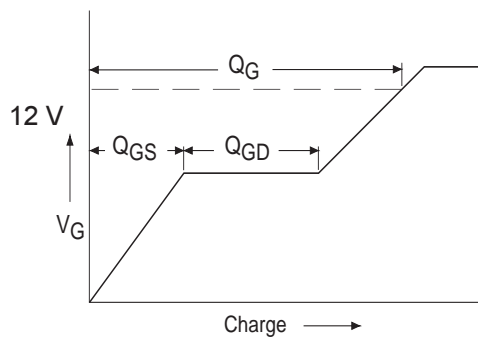


Fig 13a. Basic Gate Charge Waveform

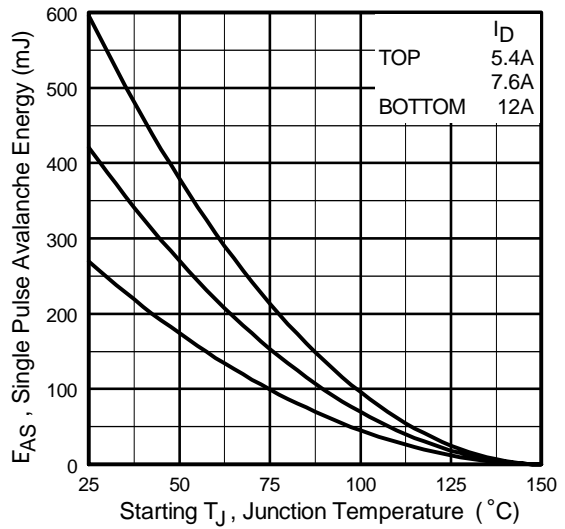


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

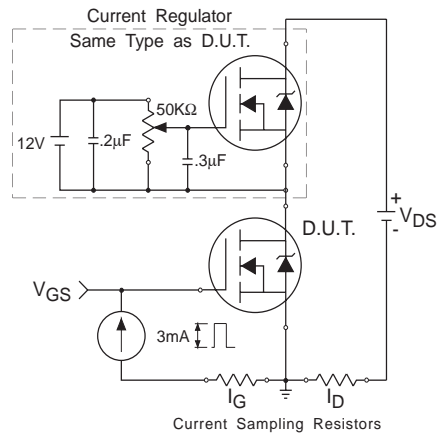
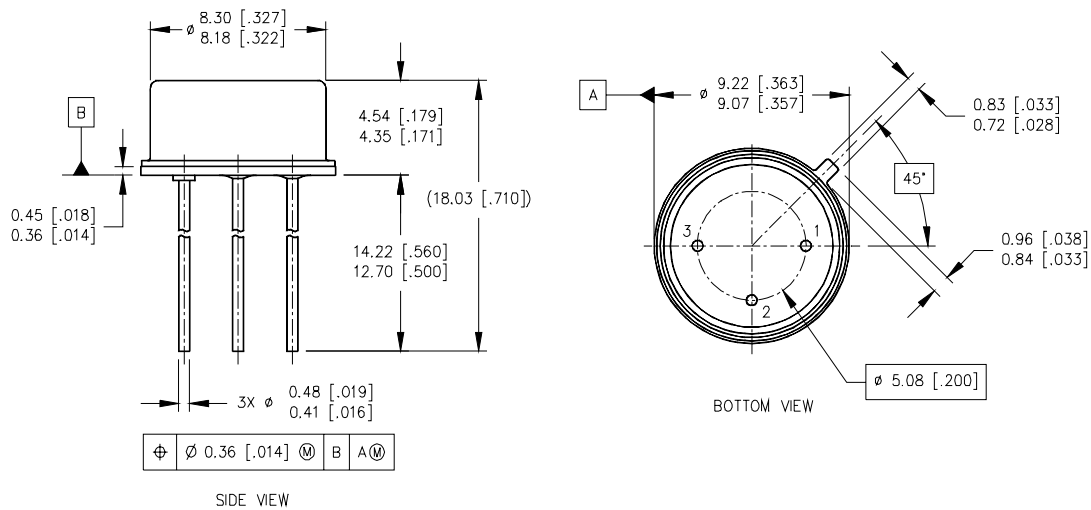


Fig 13b. Gate Charge Test Circuit

**Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 25V$ , starting  $T_J = 25^\circ C$ ,  $L = 3.74mH$   
Peak  $I_L = 12A$ ,  $V_{GS} = 12V$
- ③  $ISD \leq 12A$ ,  $di/dt \leq 244A/\mu s$ ,  
 $V_{DD} \leq 60V$ ,  $T_J \leq 150^\circ C$
- 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.**  
48 volt  $V_{DS}$  applied and  $V_{GS} = 0$  during irradiation per MIL-STD-750, method 1019, condition A.

**Case Outline and Dimensions — TO-205AF (Modified TO-39)**



**NOTES:**

- 1. DIMENSIONING AND TOLERANCING PER ASME 14.5M-1994.
- 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3. CONTROLLING DIMENSION: INCH.
- 4. CONFORMS TO JEDEC OUTLINE TO-205AF (TO-39).

**LEGEND**

- 1- SOURCE
- 2- GATE
- 3- DRAIN

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

Visit us at [www.irf.com](http://www.irf.com) for sales contact information.

Data and specifications subject to change without notice. 04/2006