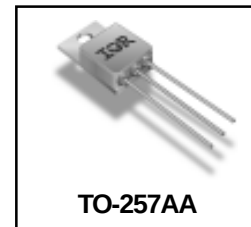


**RADIATION HARDENED
POWER MOSFET
THRU-HOLE (TO-257AA)**

**IRHY57230CM
200V, N-CHANNEL
R₅ TECHNOLOGY**

Product Summary

Part Number	Radiation Level	RDS(on)	ID
IRHY57230CM	100K Rads (Si)	0.20Ω	13A
IRHY53230CM	300K Rads (Si)	0.20Ω	13A
IRHY54230CM	600K Rads (Si)	0.20Ω	13A
IRHY58230CM	1000K Rads (Si)	0.25Ω	13A



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/cm²)). 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
- Ultra Low RDS(on)
- Low Total Gate Charge
- Proton Tolerant
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Package
- Light Weight

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
ID @ VGS = 12V, TC = 25°C	Continuous Drain Current	13	A
ID @ VGS = 12V, TC = 100°C	Continuous Drain Current	8.2	
IDM	Pulsed Drain Current ①	52	
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 ②	60	mJ
IAR	Avalanche Current ①	13	A
EAR	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.4	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063in./1.6mm from case for 10sec)	
	Weight	4.3 (Typical)	g

For footnotes refer to the last page

Electrical Characteristics @ T_j = 25°C (Unless Otherwise Specified)

	Parameter	Min	Typ	Max	Units	Test Conditions
BV _{DSS}	Drain-to-Source Breakdown Voltage	200	—	—	V	V _{GS} = 0V, I _D = 1.0mA
ΔBV _{DSS} /ΔT _j	Temperature Coefficient of Breakdown Voltage	—	0.26	—	V/°C	Reference to 25°C, I _D = 1.0mA
R _{DS(on)}	Static Drain-to-Source On-State Resistance	—	—	0.2	Ω	V _{GS} = 12V, I _D = 8.2A ④
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 1.0mA
g _{fs}	Forward Transconductance	10	—	—	S (r _S)	V _{DS} > 15V, I _{DS} = 8.2A ④
I _{DSS}	Zero Gate Voltage Drain Current	—	—	10	μA	V _{DS} = 160V, V _{GS} = 0V
		—	—	25		V _{DS} = 160V, V _{GS} = 0V, T _j = 125°C
I _{GSS}	Gate-to-Source Leakage Forward	—	—	100	nA	V _{GS} = 20V
I _{GSS}	Gate-to-Source Leakage Reverse	—	—	-100		V _{GS} = -20V
Q _g	Total Gate Charge	—	—	50	nC	V _{GS} = 12V, I _D = 13A V _{DS} = 100V
Q _{gs}	Gate-to-Source Charge	—	—	7.4		
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	20		
t _{d(on)}	Turn-On Delay Time	—	—	25	ns	V _{DD} = 100V, I _D = 13A, R _G = 7.5Ω
t _r	Rise Time	—	—	100		
t _{d(off)}	Turn-Off Delay Time	—	—	35		
t _f	Fall Time	—	—	30		
L _S + L _D	Total Inductance	—	6.8	—	nH	Measured from drain lead (6mm/0.25in. from package) to source lead (6mm/0.25in. from package)
C _{iss}	Input Capacitance	—	1043	—	pF	V _{GS} = 0V, V _{DS} = 25V f = 1.0MHz
C _{oss}	Output Capacitance	—	190	—		
C _{rss}	Reverse Transfer Capacitance	—	20	—		

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I _S	Continuous Source Current (Body Diode)	—	—	13	A	T _j = 25°C, I _S = 13A, V _{GS} = 0V ④
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	52		
V _{SD}	Diode Forward Voltage	—	—	1.2	V	T _j = 25°C, I _F = 13A, di/dt ≥ 100A/μs
t _{rr}	Reverse Recovery Time	—	—	343	ns	V _{DD} ≤ 25V ④
Q _{RR}	Reverse Recovery Charge	—	—	2.25	μC	
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L _S + L _D .				

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R _{thJC}	Junction-to-Case	—	—	1.67	°C/W	
R _{thJA}	Junction-to-Ambient	—	—	80		

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

For footnotes refer to the last page

Radiation Characteristics

IRHY57230CM

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 600K Rads(Si) ¹		1000K Rads (Si) ²		Units	Test Conditions
		Min	Max	Min	Max		
BV _{DSS}	Drain-to-Source Breakdown Voltage	200	—	200	—	V	V _{GS} = 0V, I _D = 1.0mA
V _{GS(th)}	Gate Threshold Voltage ④	2.0	4.0	1.5	4.0		V _{GS} = V _{DS} , I _D = 1.0mA
I _{GSS}	Gate-to-Source Leakage Forward	—	100	—	100	nA	V _{GS} = 20V
I _{GSS}	Gate-to-Source Leakage Reverse	—	-100	—	-100		V _{GS} = -20V
I _{DSS}	Zero Gate Voltage Drain Current	—	10	—	10	μA	V _{DS} =160V, V _{GS} =0V
R _{DS(on)}	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.204	—	0.255	Ω	V _{GS} = 12V, I _D = 8.2A
R _{DS(on)}	Static Drain-to-Source ④ On-State Resistance (TO-257AA)	—	0.2	—	0.25	Ω	V _{GS} = 12V, I _D = 8.2A
V _{SD}	Diode Forward Voltage ④	—	1.2	—	1.2	V	V _{GS} = 0V, I _S = 13A

1. Part numbers IRHY57230CM, IRHY53230CM and IRHY54230CM

2. Part number IRHY58230CM

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 ²)	Energy (MeV)	Range (μm)	V _{DS} (V)				
				@V _{GS} =0V	@V _{GS} =-5V	@V _{GS} =-10V	@V _{GS} =-15V	@V _{GS} =-20V
Br	36.7	309	39.5	200	200	150	150	50
I	59.4	341	32.5	200	200	40	35	30
Au	82.3	350	28.4	50	35	25	—	—

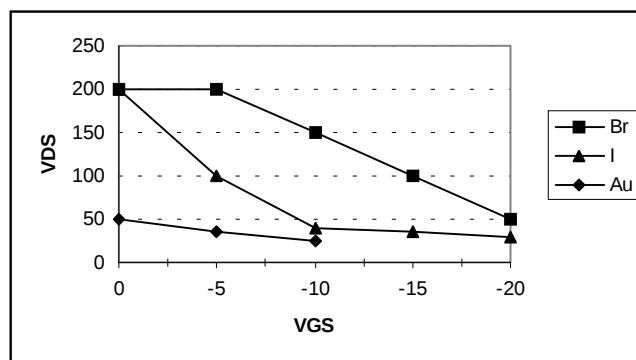


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

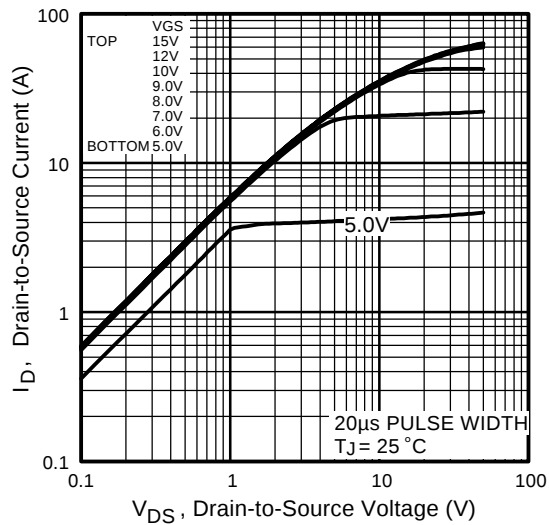


Fig 1. Typical Output Characteristics

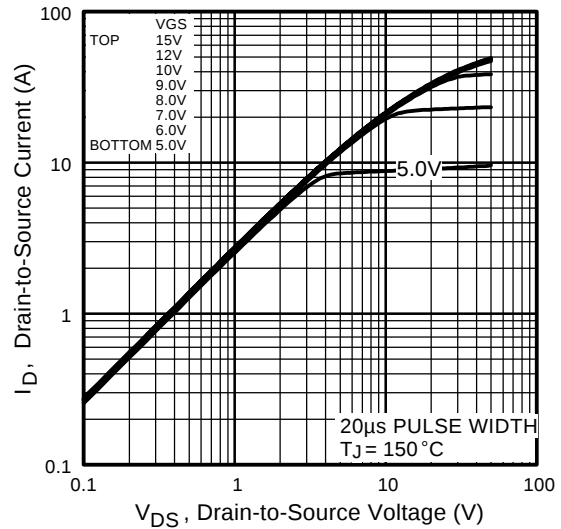


Fig 2. Typical Output Characteristics

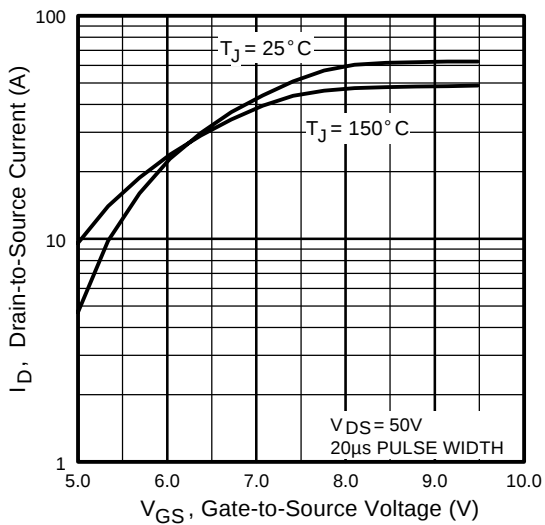


Fig 3. Typical Transfer Characteristics

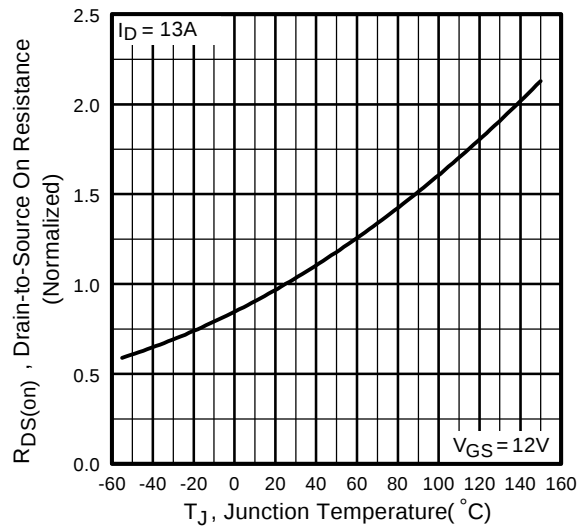


Fig 4. Normalized On-Resistance Vs. Temperature

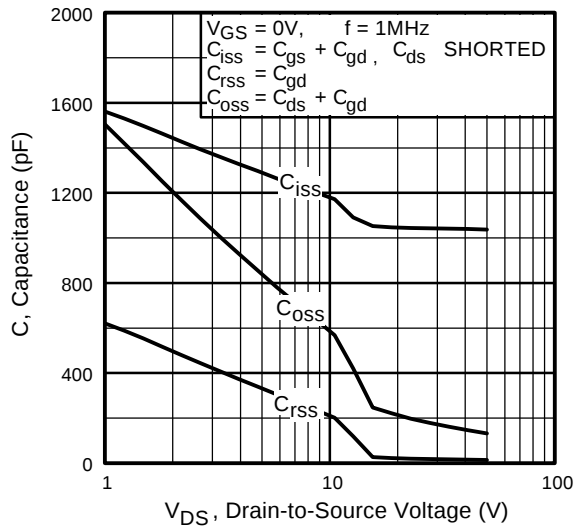


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

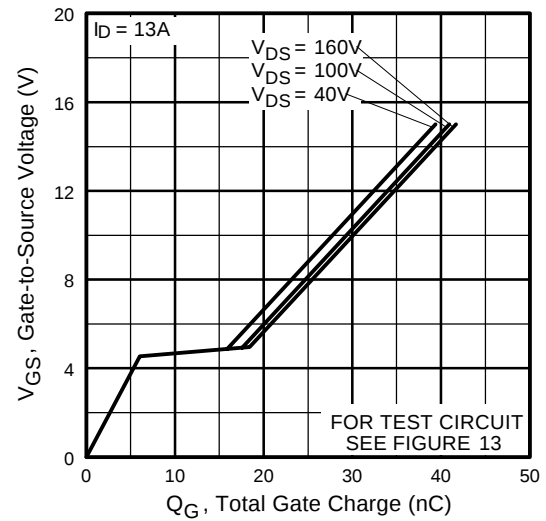


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

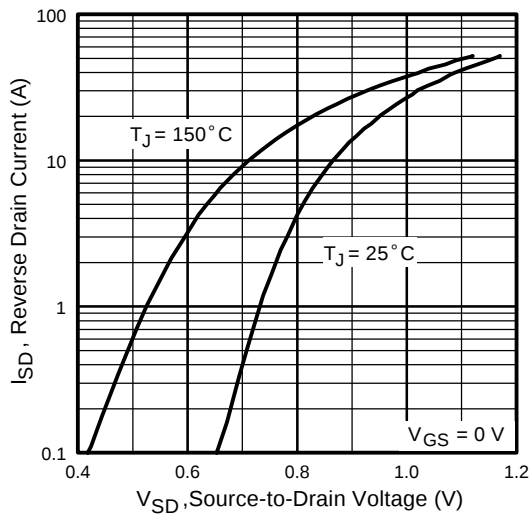


Fig 7. Typical Source-Drain Diode Forward Voltage

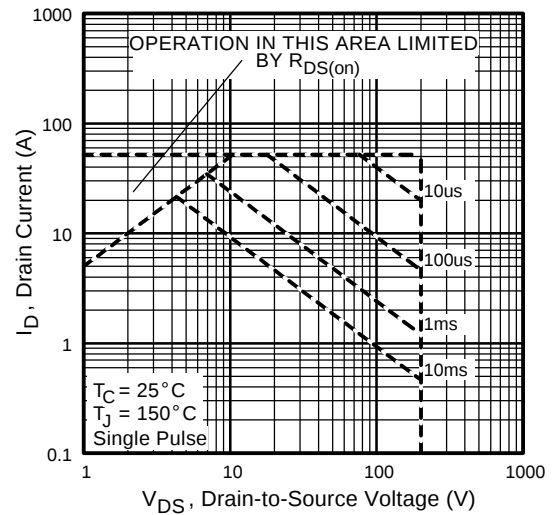


Fig 8. Maximum Safe Operating Area

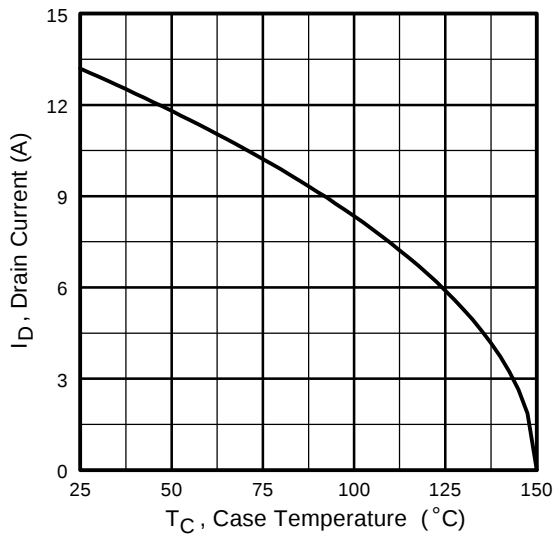


Fig 9. Maximum Drain Current Vs. Case Temperature

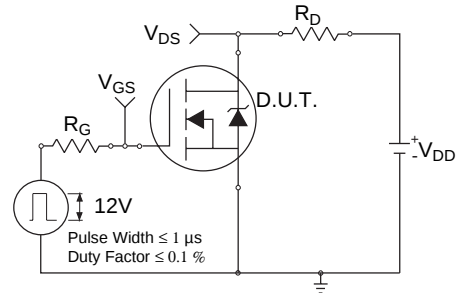


Fig 10a. Switching Time Test Circuit

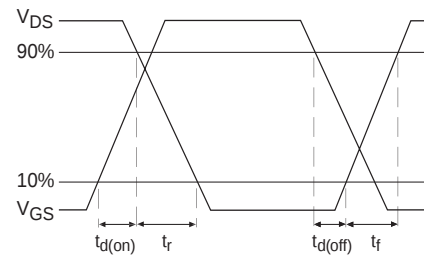


Fig 10b. Switching Time Waveforms

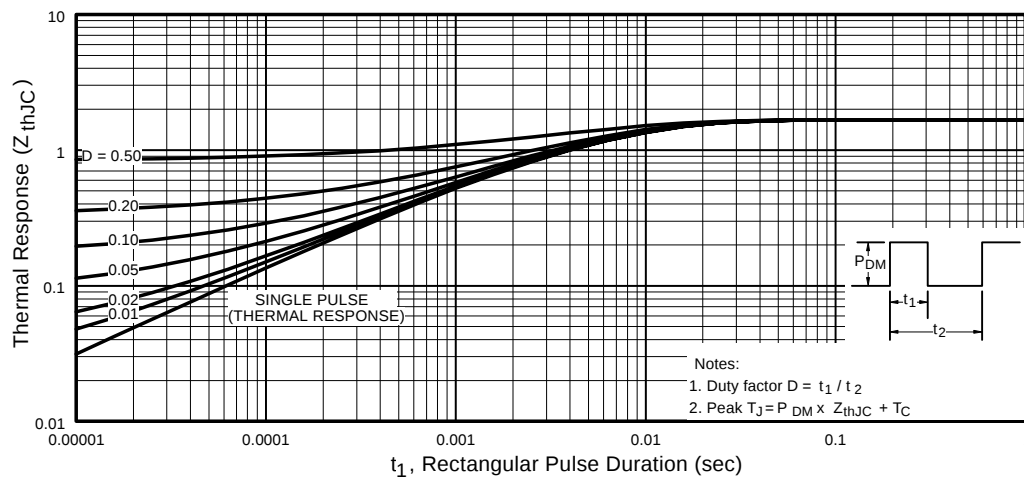


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

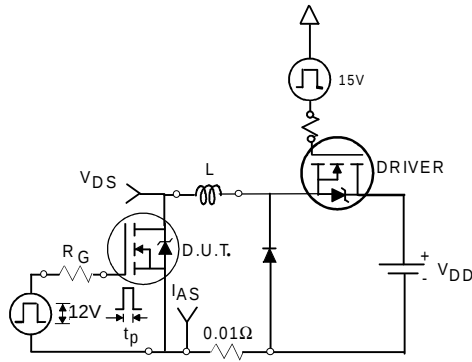


Fig 12a. Unclamped Inductive Test Circuit

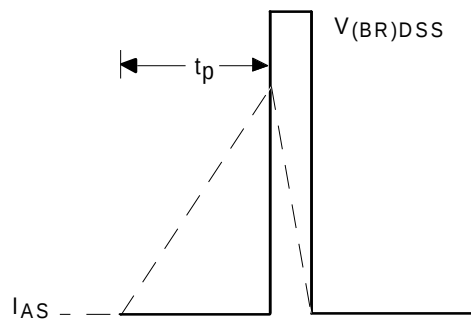


Fig 12b. Unclamped Inductive Waveforms

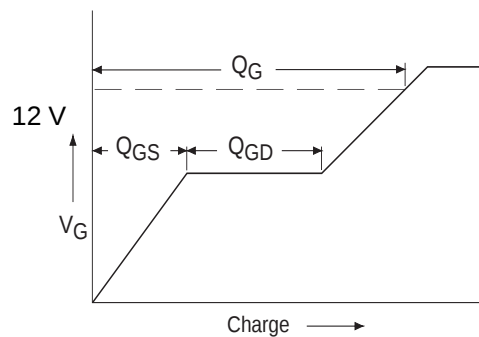


Fig 13a. Basic Gate Charge Waveform

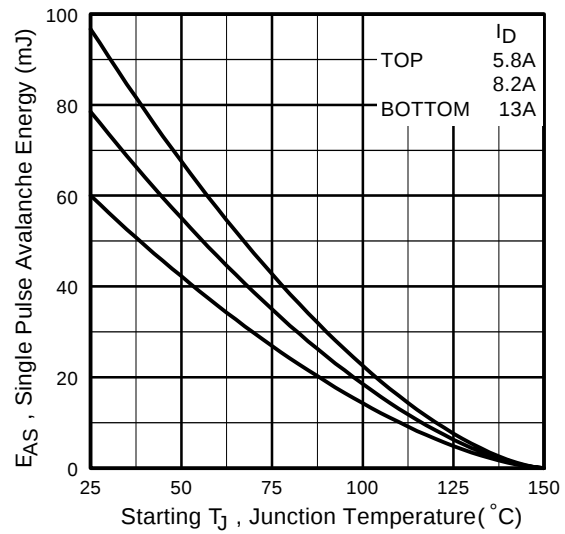


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

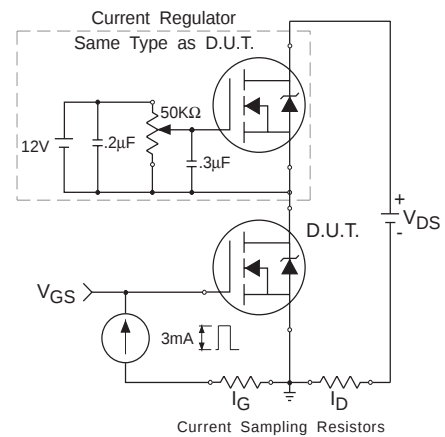


Fig 13b. Gate Charge Test Circuit

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② $V_{DD} = 50V$, starting $T_J = 25^{\circ}C$, $L = 0.67\text{ mH}$
Peak $I_L = 13A$, $V_{GS} = 12V$
- ③ $I_{SD} \leq 13A$, $di/dt \leq 274A/\mu s$,
 $V_{DD} \leq 200V$, $T_J \leq 150^{\circ}C$
- ④ Pulse width $\leq 300\text{ }\mu s$; 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.**
160 volt V_{DS} applied and $V_{GS} = 0$ during irradiation per MIL-STD-750, method 1019, condition A.

Top View Dimensions:

- Package Body Width: 10.66 [.420] / 10.42 [.410]
- Package Body Length: 16.89 [.665] / 16.39 [.645]
- Pin Pitch: 2.54 [.100] (2X)
- Pin Width: 0.88 [.035] / 0.64 [.025] (3X)
- Mounting Hole Diameter: 3.81 [.150] / 3.56 [.140]
- Mounting Hole Position: 0.36 [.014] (M) B A (M)
- Lead Length: 13.51 [.532]
- Lead Spacing: 16.51 [.650] / 15.24 [.600]
- Lead Diameter: 0.25 [.010] (M) B A (M)

Side View Dimensions:

- Package Height: 5.08 [.200] / 4.83 [.190]
- Lead Length: 10.67 [.420] / 10.42 [.410]
- Lead Spacing: 0.838 [.033] MAX
- Mounting Hole Position: 1.14 [.045] / 0.89 [.035]
- Mounting Hole Diameter: 0.13 [.005]
- Lead Diameter: 0.35 [.012]

Pin Configurations:

- IRF540N (D S G): Pin 1 (Drain), Pin 2 (Source), Pin 3 (Gate)
- IRF540P (G D S): Pin 1 (Gate), Pin 2 (Drain), Pin 3 (Source)

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-257AA.

D - DRAIN
S - SOURCE
G - GATE

International IOR Rectifier

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 252-7105
IR GREAT BRITAIN: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020
IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
IR JAPAN: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086
IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630
IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936
Data and specifications subject to change without notice. 1/2000