

**RADIATION HARDENED
 LOGIC LEVEL POWER MOSFET
 SURFACE MOUNT (UB)**

**IRHLUB7970Z4
 60V, P-CHANNEL
 R7™ TECHNOLOGY**

Product Summary

Part Number	Radiation Level	RDS(on)	ID
IRHLUB7970Z4	100K Rads (Si)	1.2Ω	-0.53A
IRHLUB7930Z4	300K Rads (Si)	1.2Ω	-0.53A



International Rectifier's R7™ Logic Level Power Mosfets provide simple solution to interfacing CMOS and TTL control circuits to power devices in space and other radiation environments. The threshold voltage remains within acceptable operating limits over the full operating temperature and post irradiation. This is achieved while maintaining single event gate rupture and single event burnout immunity.

These devices are used in applications such as current boost low signal source in PWM, voltage comparator and operational amplifiers.

Features:

- 5V CMOS and TTL Compatible
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Complimentary N-Channel Available - IRHLUB770Z4
- Available on Tape & Reel

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
ID @ VGS = -4.5V, TC = 25°C	Continuous Drain Current	-0.53	A
ID @ VGS = -4.5V, TC = 100°C	Continuous Drain Current	-0.33	
IDM	Pulsed Drain Current ①	-2.12	
Pd @ TC = 25°C	Max. Power Dissipation	0.6	W
	Linear Derating Factor	0.0045	W/°C
VGS	Gate-to-Source Voltage	±10	V
EAS	Single Pulse Avalanche Energy ②	3.5	mJ
IAR	Avalanche Current ①	-0.53	A
EAR	Repetitive Avalanche Energy ①	0.06	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-4.4	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Pckg. Mounting Surface Temp.	300 (for 5s)	
	Weight	43 (Typical)	mg

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	-60	—	—	V	V _{GS} = 0V, I _D = -250μA
ΔBV _{DSS} /ΔT _J	Temperature Coefficient of Breakdown Voltage	—	-0.055	—	V/°C	Reference to 25°C, I _D = -1.0mA
R _{DS(on)}	Static Drain-to-Source On-State Resistance	—	—	1.2	Ω	V _{GS} = -4.5V, I _D = -0.33A ④
V _{GS(th)}	Gate Threshold Voltage	-1.0	—	-2.0	V	V _{DS} = V _{GS} , I _D = -250μA
g _{fs}	Forward Transconductance	0.8	—	—	S (r _o)	V _{DS} = -10V, I _{DS} = -0.33A ④
I _{DSS}	Zero Gate Voltage Drain Current	—	—	-1.0	μA	V _{DS} = -48V, V _{GS} = 0V
		—	—	-10		V _{DS} = -48V, V _{GS} = 0V, T _J = 125°C
I _{GSS}	Gate-to-Source Leakage Forward	—	—	-100	nA	V _{GS} = -10V
I _{GSS}	Gate-to-Source Leakage Reverse	—	—	100		V _{GS} = 10V
Q _g	Total Gate Charge	—	—	3.6	nC	V _{GS} = -4.5V, I _D = -0.53A V _{DS} = -30V
Q _{gs}	Gate-to-Source Charge	—	—	1.5		
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	1.8		
t _{d(on)}	Turn-On Delay Time	—	—	22	ns	V _{DD} = -30V, I _D = -0.53A, V _{GS} = -4.5V, R _G = 24Ω
t _r	Rise Time	—	—	22		
t _{d(off)}	Turn-Off Delay Time	—	—	27		
t _f	Fall Time	—	—	27		
L _S + L _D	Total Inductance	—	8.4	—	nH	Measured from the center of drain pad to center of source pad
C _{iss}	Input Capacitance	—	167	—	pF	V _{GS} = 0V, V _{DS} = -25V f = 1.0MHz
C _{oss}	Output Capacitance	—	43	—		
C _{rss}	Reverse Transfer Capacitance	—	10	—		
R _g	Gate Resistance	—	29	—		

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I _S	Continuous Source Current (Body Diode)	—	—	-0.53	A	T _j = 25°C, I _S = -0.53A, V _{GS} = 0V ④
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	-2.12		
V _{SD}	Diode Forward Voltage	—	—	-5.0	V	T _j = 25°C, I _F = -0.53A, di/dt ≤ -100A/μs
t _{rr}	Reverse Recovery Time	—	—	50	ns	V _{DD} ≤ -25V ④
Q _{RR}	Reverse Recovery Charge	—	—	25	nC	
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 _{thJA}	Junction-to-Ambient	—	—	220	°C/W	

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

For footnotes refer to the last page

Radiation Characteristics

IRHLUB7970Z4

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	Upto 300K Rads (Si) ¹		Units	Test Conditions ③
		Min	Max		
BV _{DSS}	Drain-to-Source Breakdown Voltage	-60	—	V	V _{GS} = 0V, I _D = -250μA
V _{GS(th)}	Gate Threshold Voltage	-1.0	-2.0		V _{GS} = V _{DS} , I _D = -250μA
I _{GSS}	Gate-to-Source Leakage Forward	—	-100	nA	V _{GS} = -10V
I _{GSS}	Gate-to-Source Leakage Reverse	—	100		V _{GS} = 10V
I _{DSS}	Zero Gate Voltage Drain Current	—	-1.0	μA	V _{DS} = -48V, V _{GS} = 0V
R _{DS(on)}	Static Drain-to-Source On-State Resistance (TO-39) ④	—	1.2	Ω	V _{GS} = -4.5V, I _D = -0.33A
R _{DS(on)}	Static Drain-to-Source On-state Resistance (UB) ④	—	1.2	Ω	V _{GS} = -4.5V, I _D = -0.33A
V _{SD}	Diode Forward Voltage ④	—	-5.0	V	V _{GS} = 0V, I _D = -0.53A

1. Part numbers IRHLUB7970Z4, IRHLUB7930Z4

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)	VDS (V)							
				@VGS= 0V	@VGS= 2V	@VGS= 4V	@VGS= 5V	@VGS= 6V	@VGS= 7V	@VGS= 8V	@VGS= 10V
Br	37	285	36.8	-60	-60	-60	-60	-60	-50	-35	-25
I	60	345	32.7	-60	-60	-60	-60	-60	-20	-	-
Au	82	357	28.5	-60	-60	-60	-60	-	-	-	-

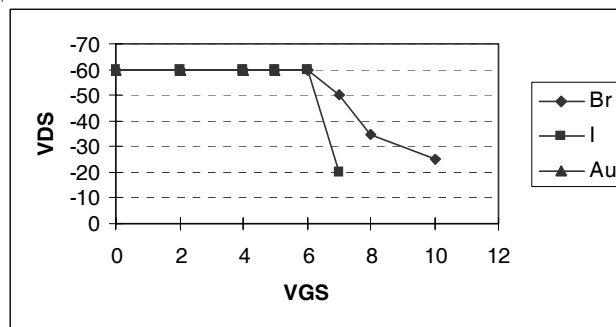


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

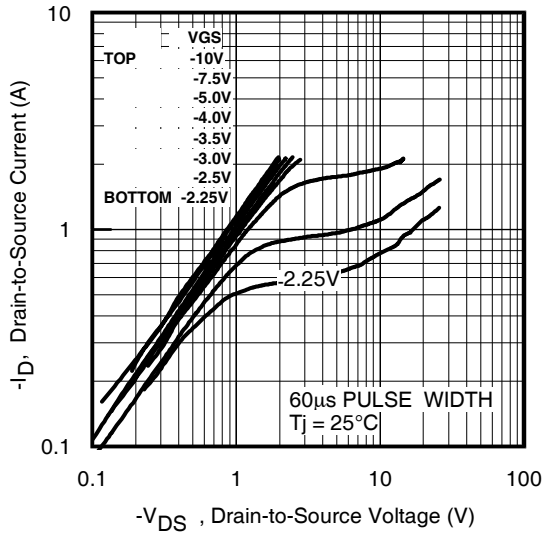


Fig 1. Typical Output Characteristics

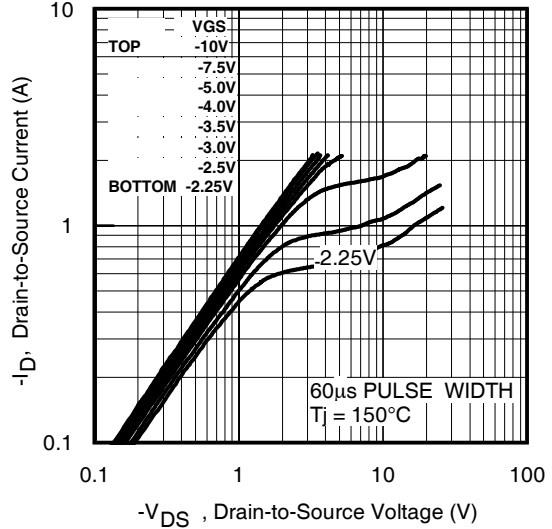


Fig 2. Typical Output Characteristics

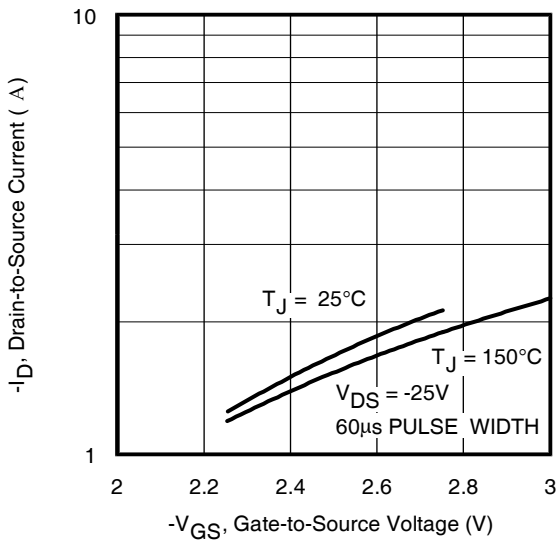


Fig 3. Typical Transfer Characteristics

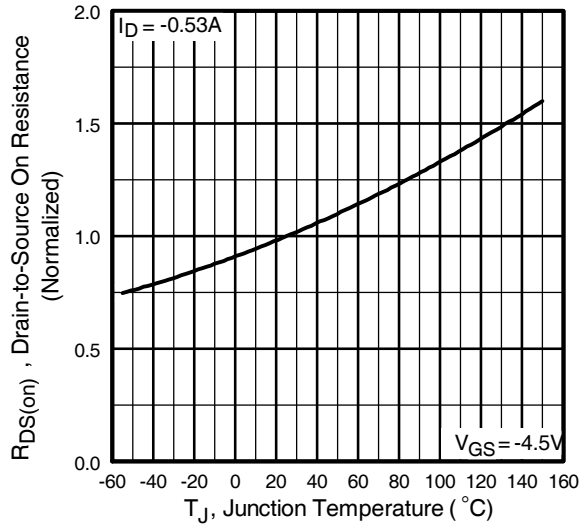


Fig 4. Normalized On-Resistance Vs. Temperature

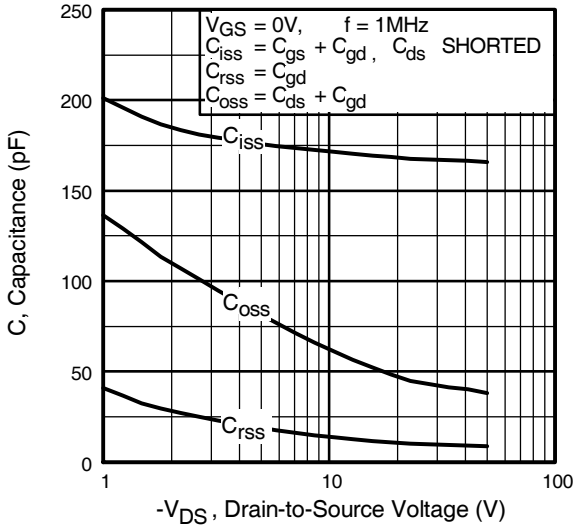


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

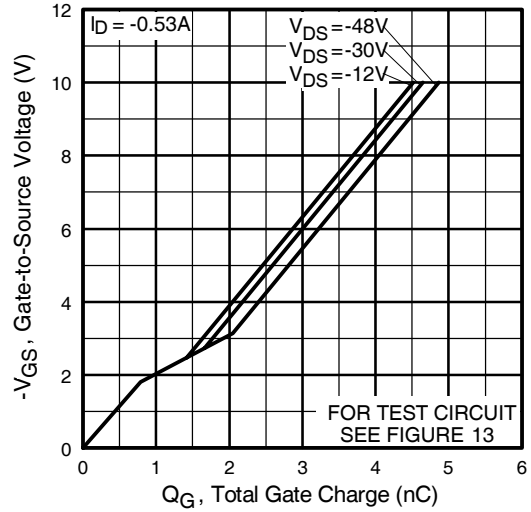


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

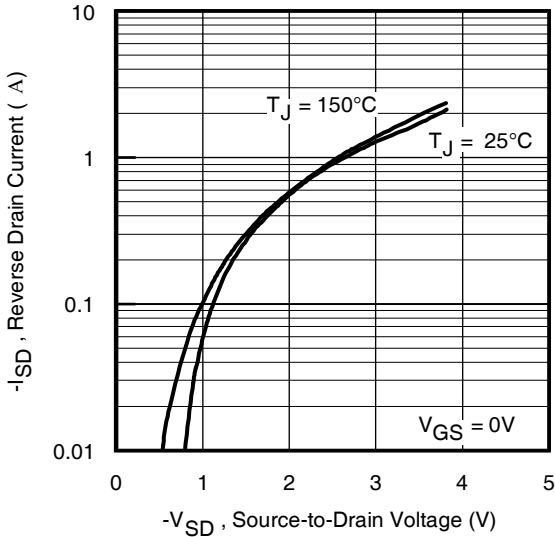


Fig 7. Typical Source-Drain Diode Forward Voltage

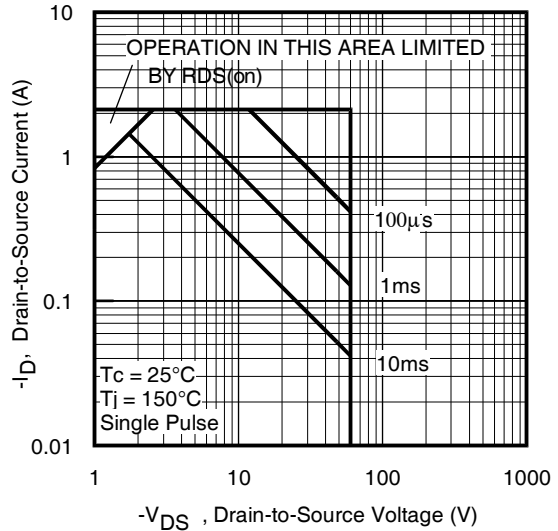


Fig 8. Maximum Safe Operating Area

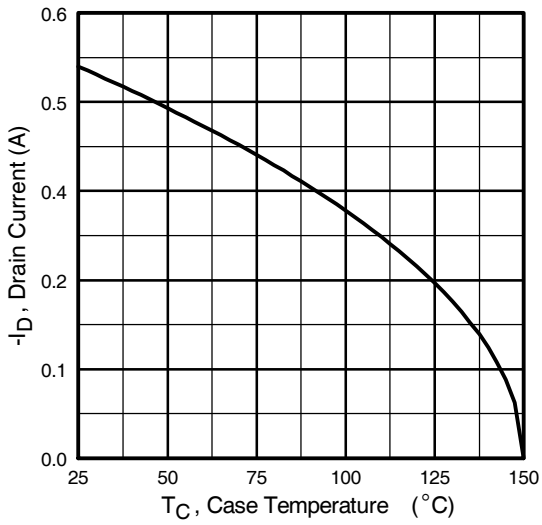


Fig 9. Maximum Drain Current Vs. Case Temperature

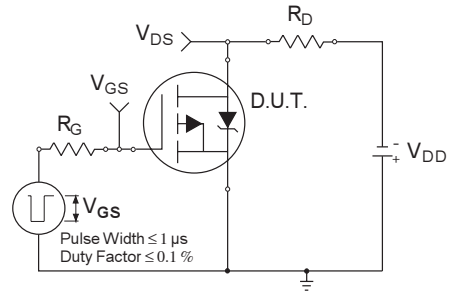


Fig 10a. Switching Time Test Circuit

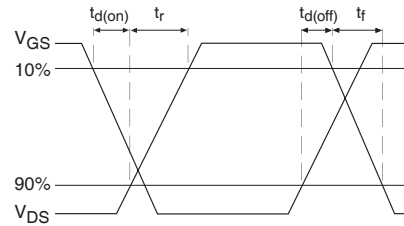


Fig 10b. Switching Time Waveforms

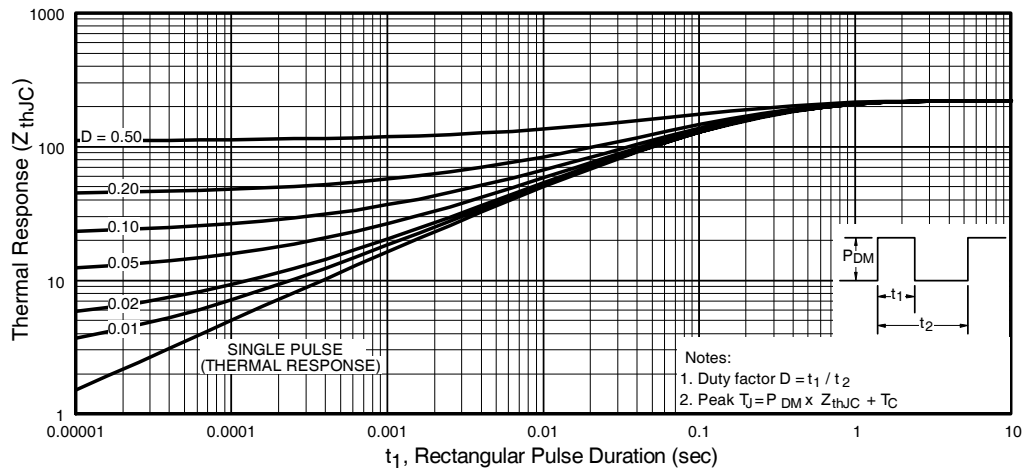


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

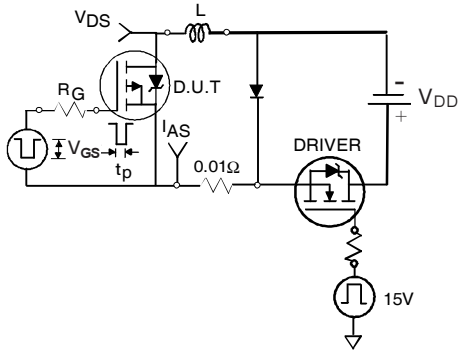


Fig 12a. Unclamped Inductive Test Circuit

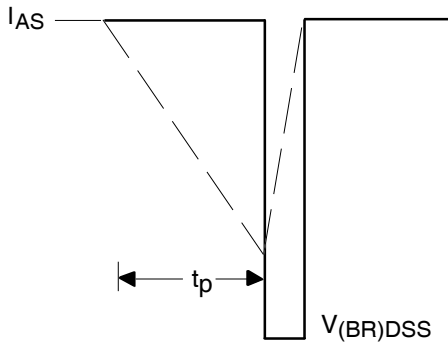


Fig 12b. Unclamped Inductive Waveforms

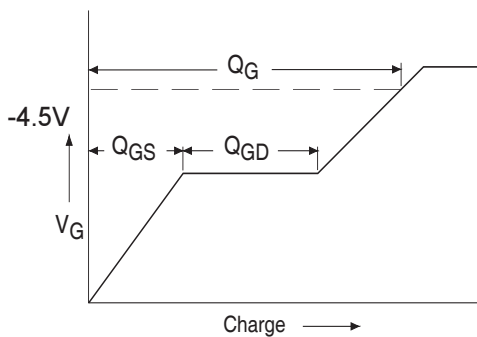


Fig 13a. Basic Gate Charge Waveform

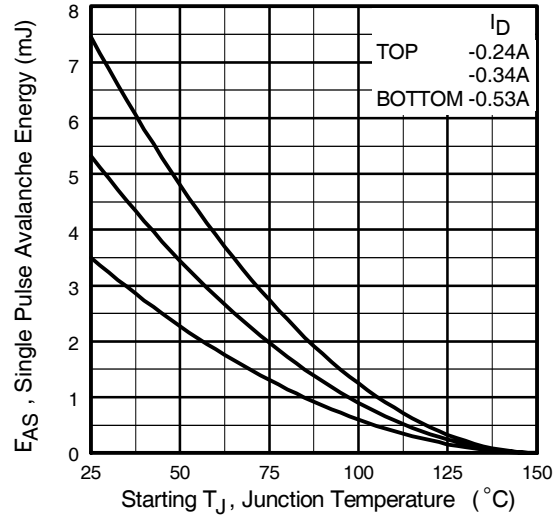


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

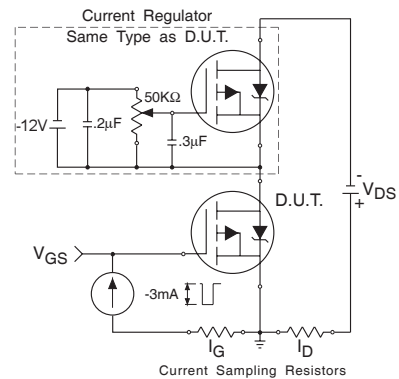
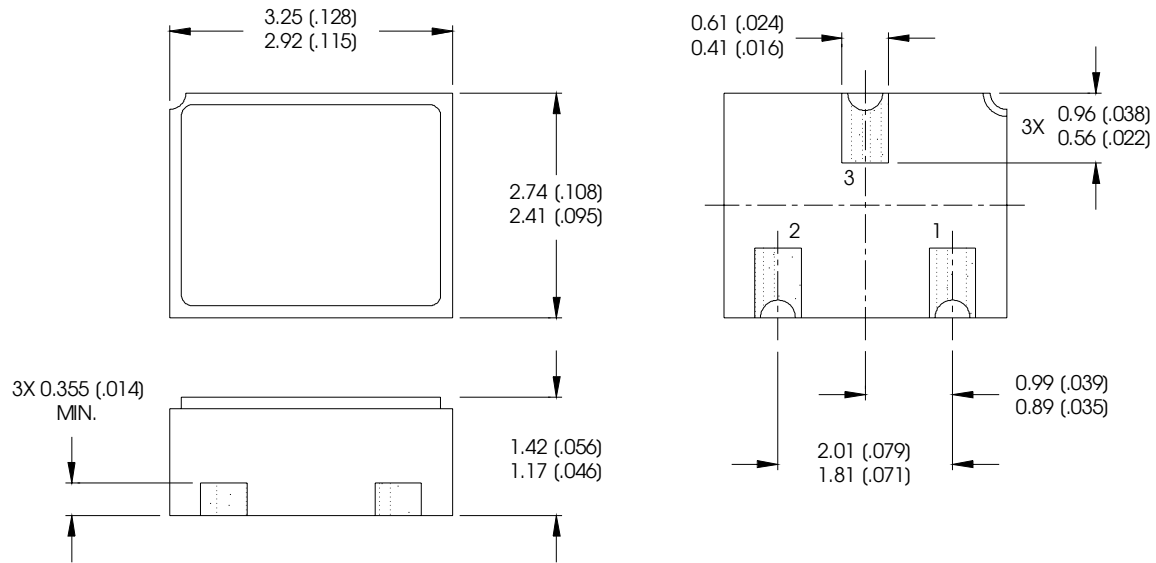


Fig 13b. Gate Charge Test Circuit

Footnotes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② $V_{DD} = -25V$, starting $T_J = 25^{\circ}C$, $L = 25mH$
Peak $I_L = -0.53A$, $V_{GS} = -10V$
- ③ $I_{SD} \leq -0.53A$, $di/dt \leq -100A/\mu s$,
 $V_{DD} \leq -60V$, $T_J \leq 150^{\circ}C$
- ④ Pulse width $\leq 300 \mu s$; Duty Cycle $\leq 2\%$
- ⑤ **Total Dose Irradiation with V_{GS} Bias.**
-10 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 — UB



NOTES:

- 1. OUTLINE CONFORMS TO MIL-PRF-19500/255L
- 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
- 3. CONTROLLING DIMENSION: INCH.

PAD ASSIGNMENTS

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



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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