

International

IR Rectifier

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

PD-96997

**IRHYB67134CM
150V, N-CHANNEL**

R6 TECHNOLOGY

Product Summary

Part Number	Radiation Level	R _{DS(on)}	I _D
IRHYB67134CM	100K Rads (Si)	0.09Ω	19A
IRHYB63134CM	300K Rads (Si)	0.09Ω	19A



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/cm²). Their combination of very low R_{DS(on)} 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_{DS(on)}
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Eyelets
- Electrically Isolated
- Light Weight

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
I _D @ V _{GS} = 12V, T _C = 25°C	Continuous Drain Current	19	A
I _D @ V _{GS} = 12V, T _C = 100°C	Continuous Drain Current	12	
I _{DM}	Pulsed Drain Current ①	76	
P _D @ T _C = 25°C	Max. Power Dissipation	75	W
	Linear Derating Factor	0.6	W/°C
V _{GS}	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	67	mJ
I _{AR}	Avalanche Current ①	19	A
E _{AR}	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	7.8	V/ns
T _J	Operating Junction	-55 to 150	°C
T _{STG}	Storage Temperature Range		
	Lead Temperature	300 (0.063 in. /1.6 mm from case for 10s)	
	Weight	3.7 (Typical)	g

For footnotes refer to the last page

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

	Parameter	Min	Typ	Max	Units	Test Conditions
B _V DSS	Drain-to-Source Breakdown Voltage	150	—	—	V	V _{GS} = 0V, I _D = 1.0mA
ΔB _V DSS/ΔT _J	Temperature Coefficient of Breakdown Voltage	—	0.19	—	V/°C	Reference to 25°C, I _D = 1.0mA
R _{DS(on)}	Static Drain-to-Source On-State Resistance	—	—	0.09	Ω	V _{GS} = 12V, I _D = 12A ④
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 1.0mA
g _{fs}	Forward Transconductance	12	—	—	S (S)	V _{DS} = 15V, I _{DS} = 12A ④
I _{DSS}	Zero Gate Voltage Drain Current	—	—	10	μA	V _{DS} = 120V, V _{GS} = 0V
		—	—	25		V _{DS} = 120V, 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 = 19A
Q _{gs}	Gate-to-Source Charge	—	—	15		V _{DS} = 75V
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	18		
t _{d(on)}	Turn-On Delay Time	—	—	20	ns	V _{DD} = 75V, I _D = 19A
t _r	Rise Time	—	—	30		V _{GS} = 12V, R _G = 7.5Ω
t _{d(off)}	Turn-Off Delay Time	—	—	35		
t _f	Fall Time	—	—	25		
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	—	1540	—	pF	V _{GS} = 0V, V _{DS} = 25V
C _{oss}	Output Capacitance	—	240	—		f = 1.0MHz
C _{rss}	Reverse Transfer Capacitance	—	5.2	—		
R _g	Internal Gate Resistance	—	1.1	—	Ω	f = 1.0MHz, open drain

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I _S	Continuous Source Current (Body Diode)	—	—	19	A	
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	76		
V _{SD}	Diode Forward Voltage	—	—	1.2	V	T _j = 25°C, I _S = 19A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	—	300	ns	T _j = 25°C, I _F = 19A, di/dt ≤ 100A/μs
Q _{RR}	Reverse Recovery Charge	—	—	2.6	μC	V _{DD} ≤ 25V ④
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		Typical Socket Mount

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

For footnotes refer to the last page

Radiation Characteristics

IRHYB67134CM

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 _{DSS}	Drain-to-Source Breakdown Voltage	150	—	V	V _{GS} = 0V, I _D = 1.0mA
V _{GS(th)}	Gate Threshold Voltage	2.0	4.0		V _{GS} = V _{DS} , I _D = 1.0mA
I _{GSS}	Gate-to-Source Leakage Forward	—	100	nA	V _{GS} = 20V
I _{GSS}	Gate-to-Source Leakage Reverse	—	-100		V _{GS} = -20V
I _{DSS}	Zero Gate Voltage Drain Current	—	10	μA	V _{DS} =120V, V _{GS} =0V
R _{DS(on)}	Static Drain-to-Source On-State Resistance (TO-3)	—	0.092	Ω	V _{GS} = 12V, I _D = 12A
R _{DS(on)}	Static Drain-to-Source On-State Resistance (Low Ohmic TO-257)	—	0.090	Ω	V _{GS} = 12V, I _D = 12A
V _{SD}	Diode Forward Voltage ④	—	1.2	V	V _{GS} = 0V, I _D = 19A

Part numbers IRHYB67134CM and IRHYB63134CM

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.

Tables for Single Event Effect Safe Operating Area

Ion Kr LET = 39 MeV/(mg/cm ²) 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 ²) 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 ²) Energy = 1480 MeV Range = 80 μm	
VGS Bias (Volts)	VDS Bias (Volts)
0	50
-5	50
-10	30

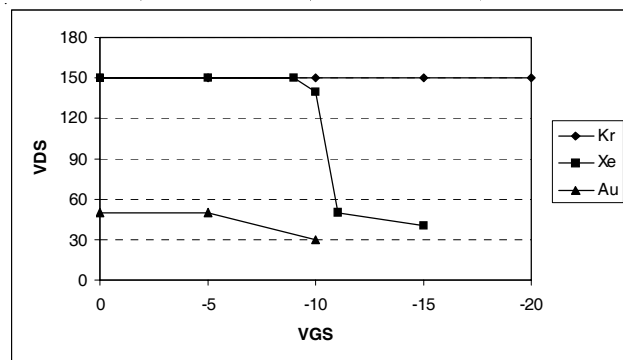


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

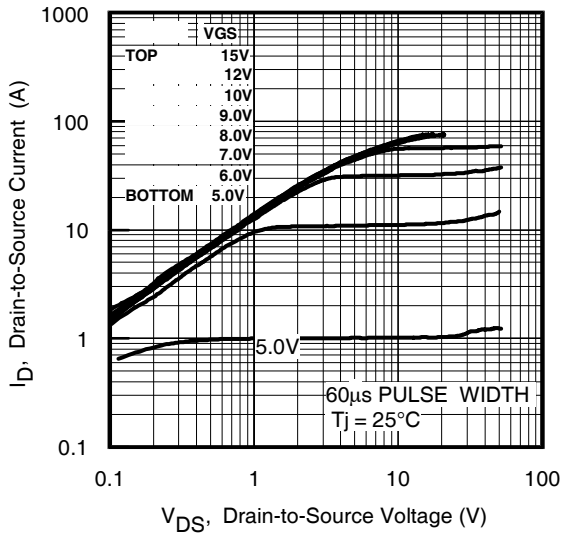


Fig 1. Typical Output Characteristics

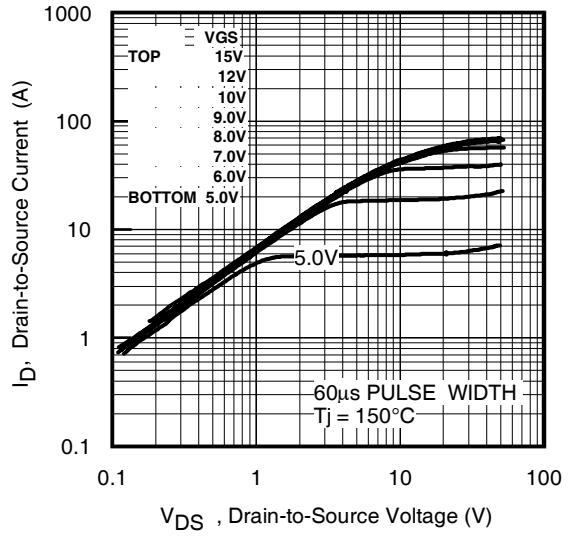


Fig 2. Typical Output Characteristics

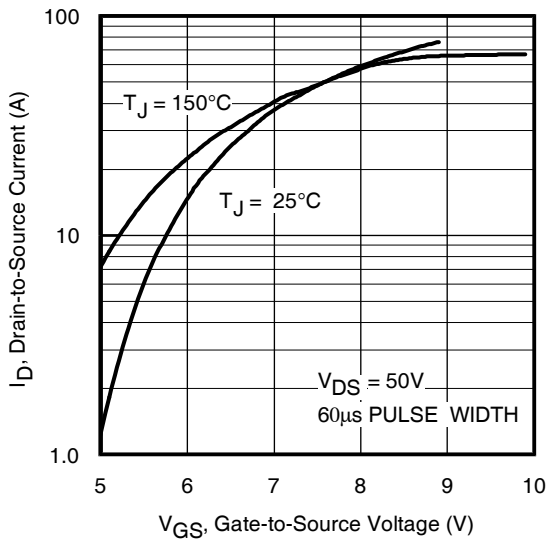


Fig 3. Typical Transfer Characteristics

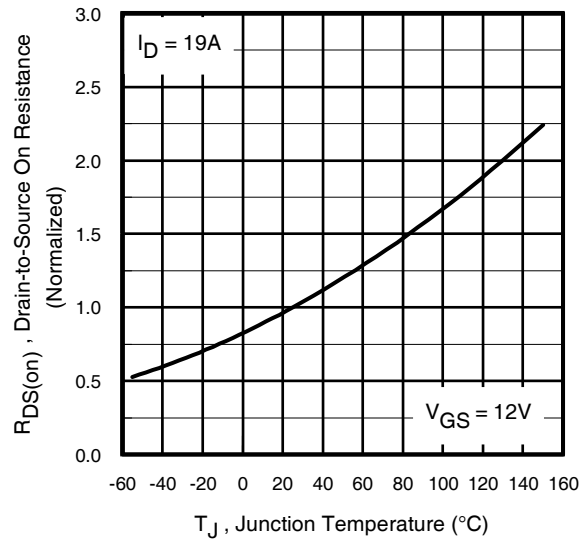


Fig 4. Normalized On-Resistance Vs. Temperature

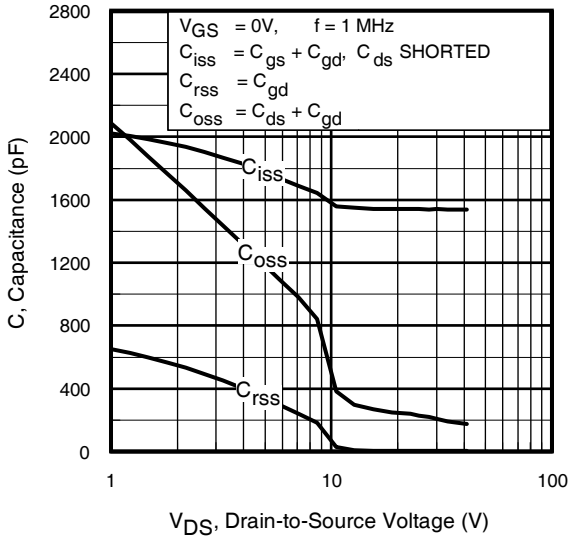


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

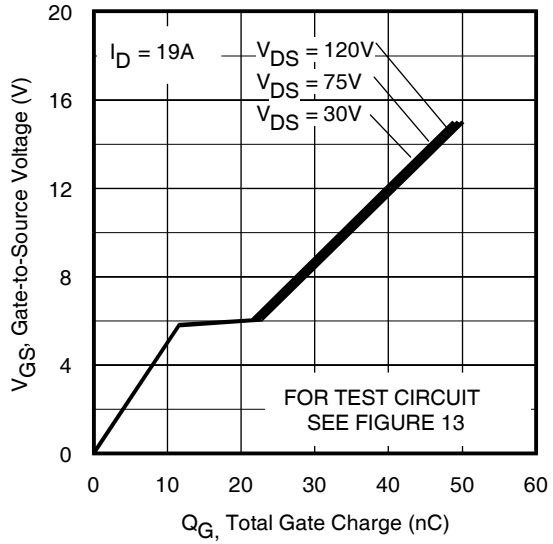


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

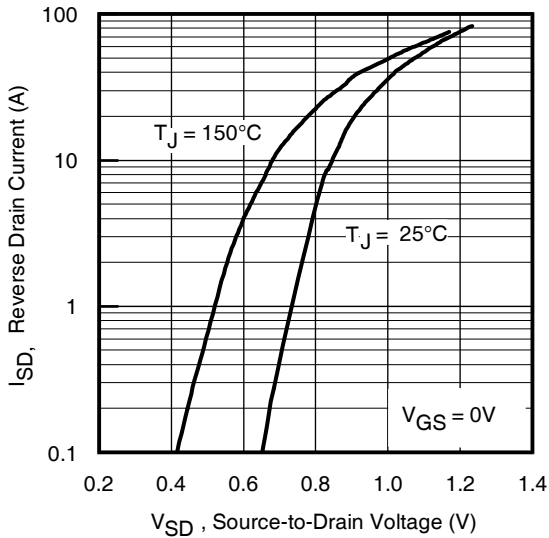


Fig 7. Typical Source-Drain Diode Forward Voltage

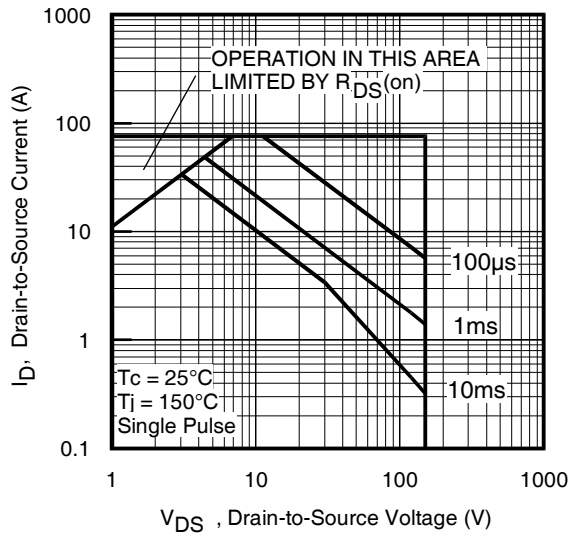


Fig 8. Maximum Safe Operating Area

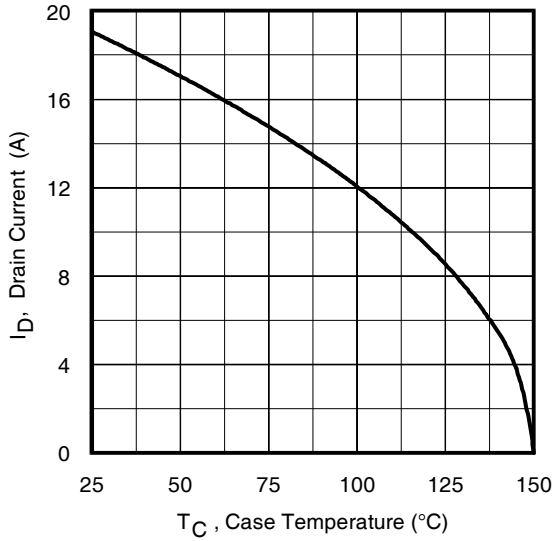


Fig 9. Maximum Drain Current Vs. Case Temperature

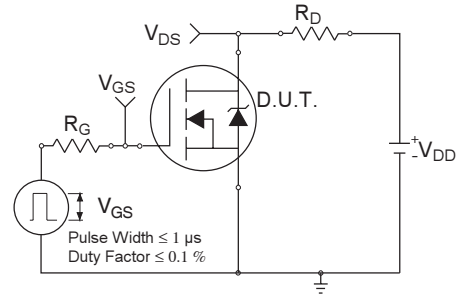


Fig 10a. Switching Time Test Circuit



Fig 10b. Switching Time Waveforms

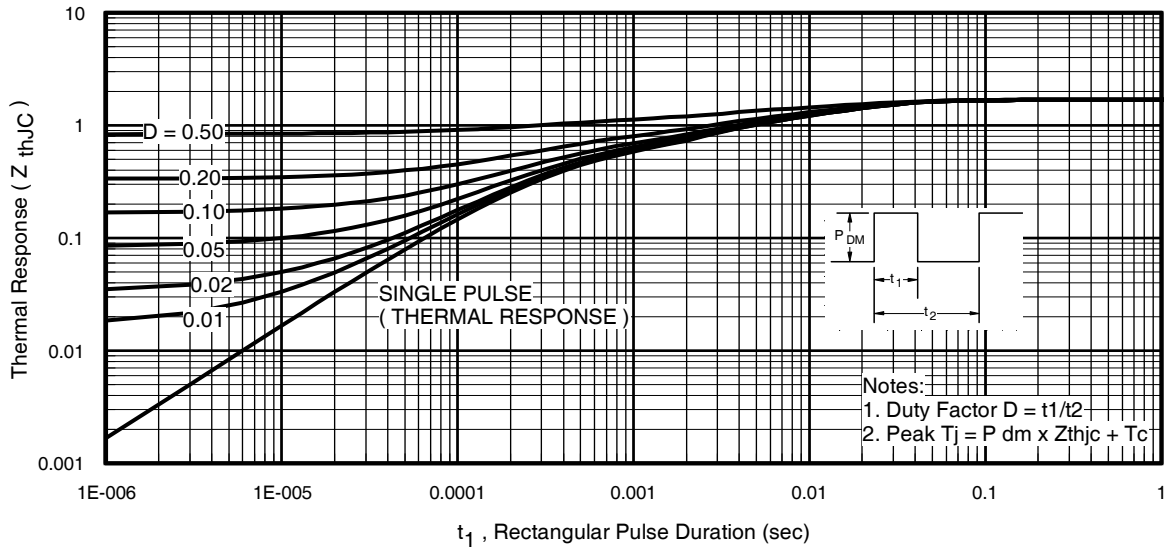


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

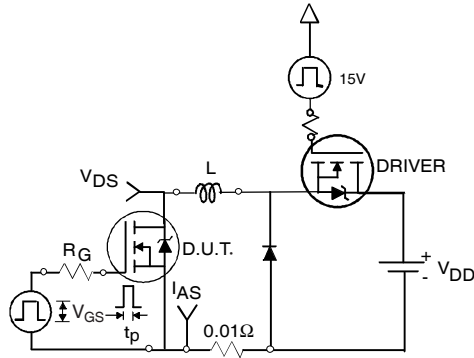


Fig 12a. Unclamped Inductive Test Circuit



Fig 12b. Unclamped Inductive Waveforms

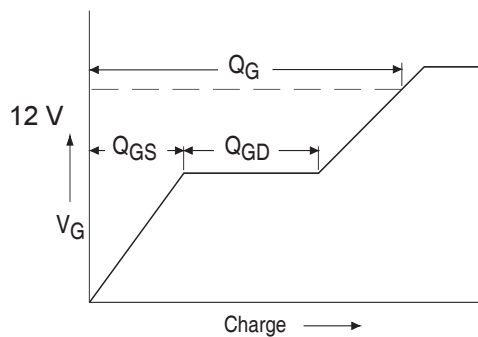


Fig 13a. Basic Gate Charge Waveform

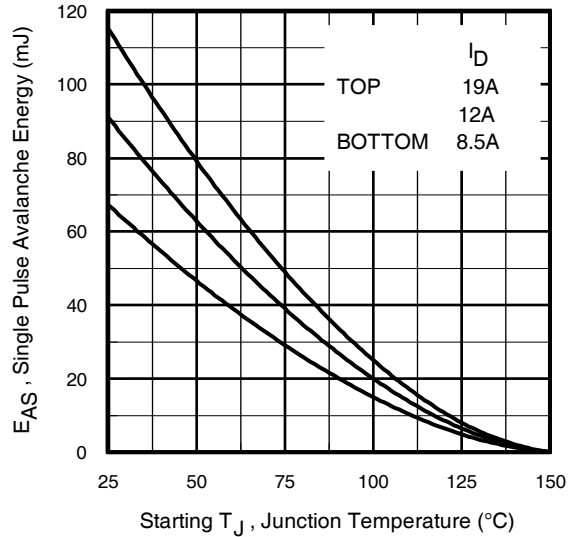


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

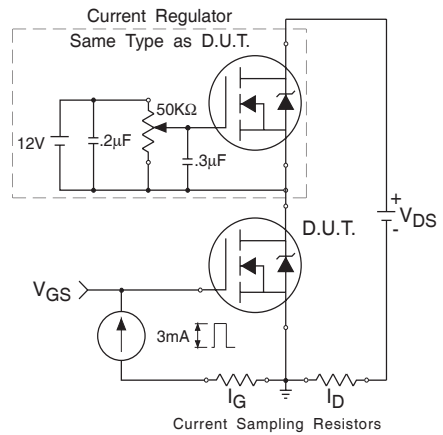
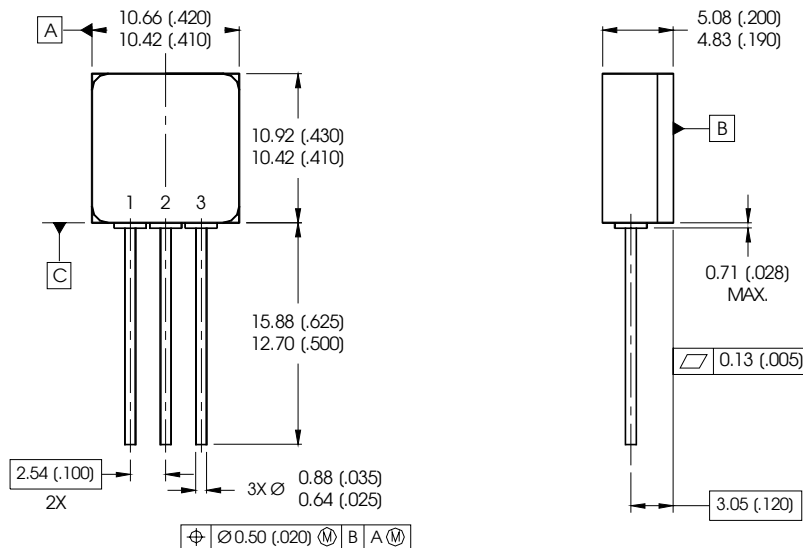


Fig 13b. Gate Charge Test Circuit

Footnotes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② $V_{DD} = 25V$, starting $T_J = 25^\circ C$, $L = 0.37mH$
Peak $I_L = 19A$, $V_{GS} = 12V$
- ③ $I_{SD} \leq 19A$, $di/dt \leq 570A/\mu s$,
 $V_{DD} \leq 150V$, $T_J \leq 150^\circ C$
- 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 — Low-Ohmic TO-257AA (Tab-less)



NOTES:

- 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.

LEAD ASSIGNMENTS

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

International
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Data and specifications subject to change without notice. 05/2005