

International
IR Rectifier

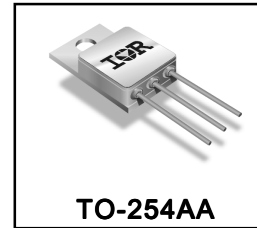
IRHM7064
JANSR2N7431
60V, N-CHANNEL

RADIATION HARDENED
POWER MOSFET
THRU-HOLE (T0-254AA)

REF:MIL-PRF-19500/663
RAD Hard™ HEXFET® TECHNOLOGY

Product Summary

Part Number	Radiation Level	RDS(on)	ID	QPL Part Number
IRHM7064	100K Rads (Si)	0.021Ω	35*A	JANSR2N7431
IRHM3064	300K Rads (Si)	0.021Ω	35*A	JANSF2N7431
IRHM4064	600K Rads (Si)	0.021Ω	35*A	JANS G2N7431
IRHM8064	1000K Rads (Si)	0.021Ω	35*A	JANSH2N7431



International Rectifier's RADHard HEXFET® technology provides high performance power MOSFETs for space applications. This technology has over a decade of proven performance and reliability in satellite applications. These devices have been characterized for both Total Dose and Single Event Effects (SEE). 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
- 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	35*	A
ID @ VGS = 12V, TC = 100°C	Continuous Drain Current	35	
IDM	Pulsed Drain Current ①	284	
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	2.5	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063 in.(1.6mm) from case for 10s)	
	Weight	9.3 (Typical)	g

For footnotes refer to the last page

*Current is limited by pin diameter

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 = 1.0mA
ΔBV _{DSS} /ΔT _J	Temperature Coefficient of Breakdown Voltage	—	0.056	—	V/°C	Reference to 25°C, I _D = 1.0mA
R _{DSON}	Static Drain-to-Source On-State Resistance	—	—	0.021	Ω	V _{GS} = 12V, I _D = 35A ④
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 1.0mA
g _{fs}	Forward Transconductance	18	—	—	S (Ω)	V _{DS} > 15V, I _{DS} = 35A ④
I _{DSS}	Zero Gate Voltage Drain Current	—	—	25	μA	V _{DS} = 48V, V _{GS} = 0V
		—	—	250		V _{DS} = 48V, 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	—	—	270	nC	V _{GS} = 12V, I _D = 35A
Q _{gs}	Gate-to-Source Charge	—	—	60		V _{DS} = 30V
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	110		
t _{d(on)}	Turn-On Delay Time	—	—	27	ns	V _{DD} = 30V, I _D = 35A V _{GS} = 12V, R _G = 2.35Ω
t _r	Rise Time	—	—	120		
t _{d(off)}	Turn-Off Delay Time	—	—	120		
t _f	Fall Time	—	—	100		
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) with Source wires internally bonded from Source Pin to Drain Pad
C _{iss}	Input Capacitance	—	4900	—	pF	V _{GS} = 0V, V _{DS} = 25V f = 1.0MHz
C _{OSS}	Output Capacitance	—	2800	—		
C _{rSS}	Reverse Transfer Capacitance	—	860	—		

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I _S	Continuous Source Current (Body Diode)	—	—	35*	A	
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	284		
V _{SD}	Diode Forward Voltage	—	—	1.5	V	T _J = 25°C, I _S = 35A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	—	360	nS	T _J = 25°C, I _F = 35A, di/dt ≤ 100A/μs V _{DD} ≤ 50V ④
Q _{RR}	Reverse Recovery Charge	—	—	3.1	μC	
t _{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L _S + L _D .				

*Current is limited by pin diameter

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R _{thJC}	Junction-to-Case	—	—	0.50	°C/W	Typical socket mount
R _{thJA}	Junction-to-Ambient	—	—	48		
R _{thCS}	Case-to-Sink	—	0.21	—		

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

For footnotes refer to the last page

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) ¹	300 - 1000K Rads (Si) ²	Units		Test Conditions		
			Min	Max			
BVDSS	Drain-to-Source Breakdown Voltage	60	—	60	—	V	V _{GS} = 0V, I _D = 1.0mA
V _{GS(th)}	Gate Threshold Voltage	2.0	4.0	1.25	4.5		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} = -20 V
I _{DSS}	Zero Gate Voltage Drain Current	—	25	—	50	μA	V _{DS} =48V, V _{GS} =0V
R _{DS(on)}	Static Drain-to-Source ④	—	0.021	—	0.031	Ω	V _{GS} = 12V, I _D = 35A
	On-State Resistance (TO-3)						
R _{DS(on)}	Static Drain-to-Source ④	—	0.021	—	0.031	Ω	V _{GS} = 12V, I _D = 35A
	On-State Resistance (TO-254AA)						
V _{SD}	Diode Forward Voltage ④	—	1.5	—	1.5	V	V _{GS} = 0V, I _S = 35A

1. Part numbers IRHM7064

2. Part number IRHM3064, IRHM4064 and IRHM8064

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
I	59.9	345	32.8	60	60	45	40	30
Br	36.8	305	39	40	35	30	25	20

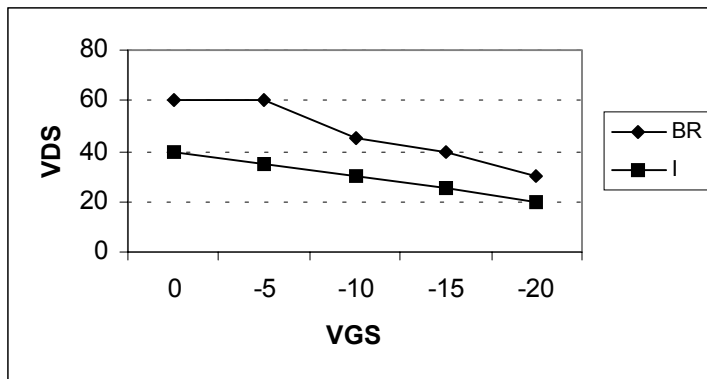


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

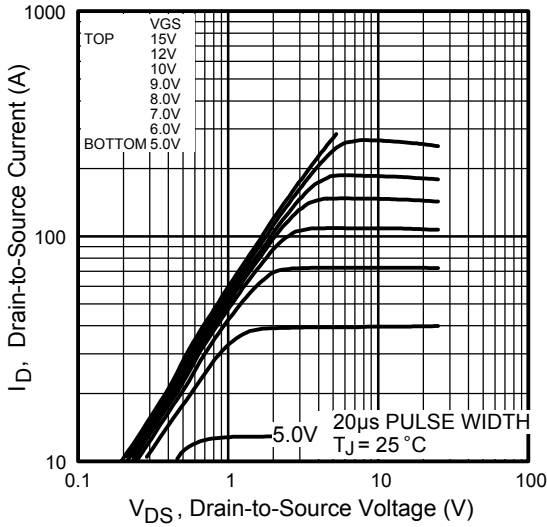


Fig 1. Typical Output Characteristics

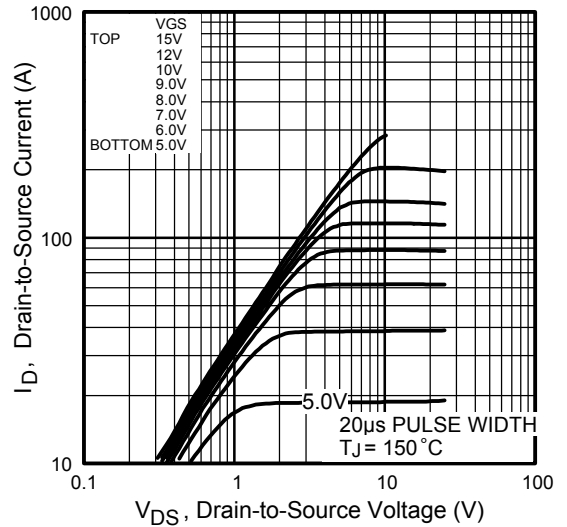


Fig 2. Typical Output Characteristics

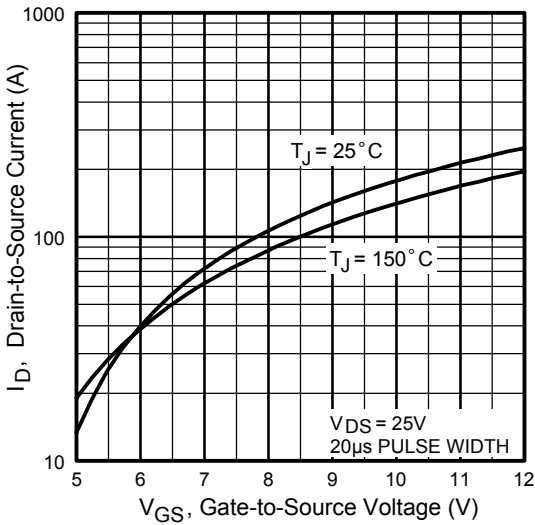


Fig 3. Typical Transfer Characteristics

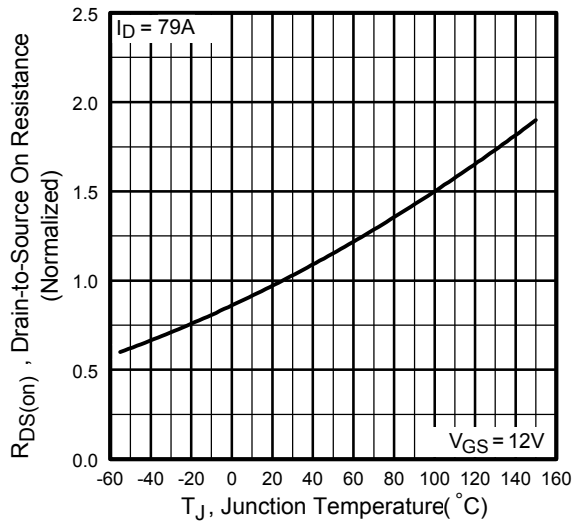


Fig 4. Normalized On-Resistance Vs. Temperature

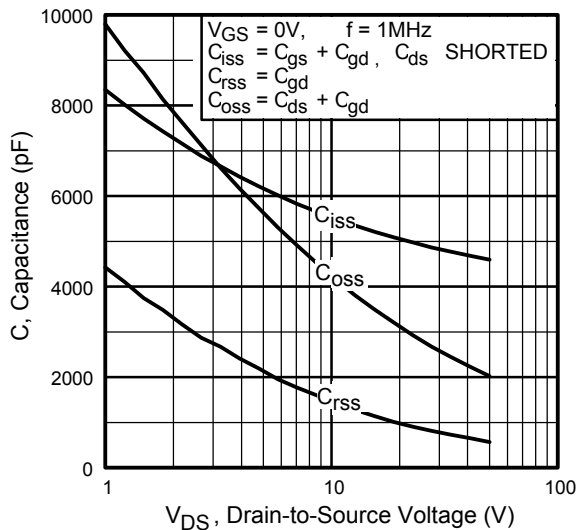


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

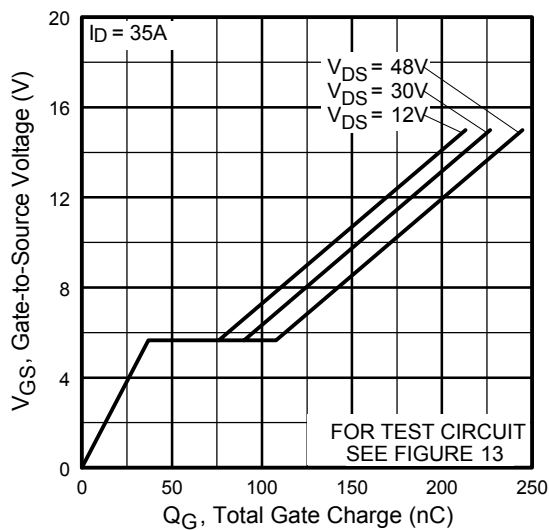


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

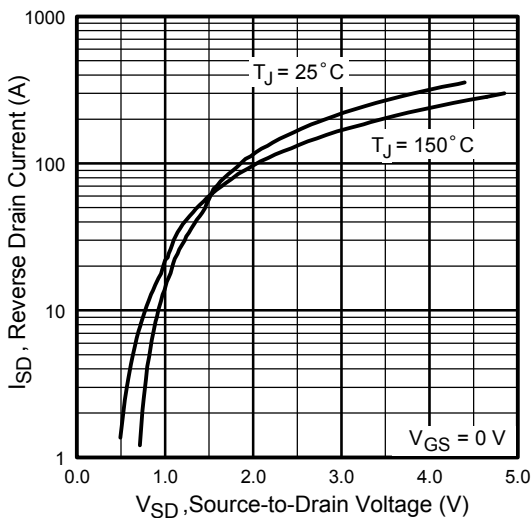


Fig 7. Typical Source-Drain Diode Forward Voltage

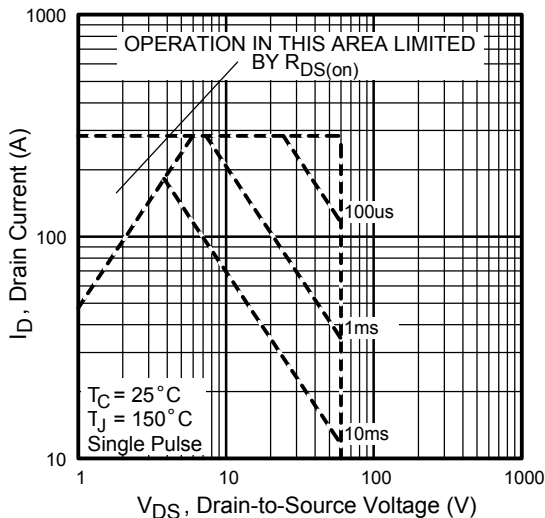


Fig 8. Maximum Safe Operating Area

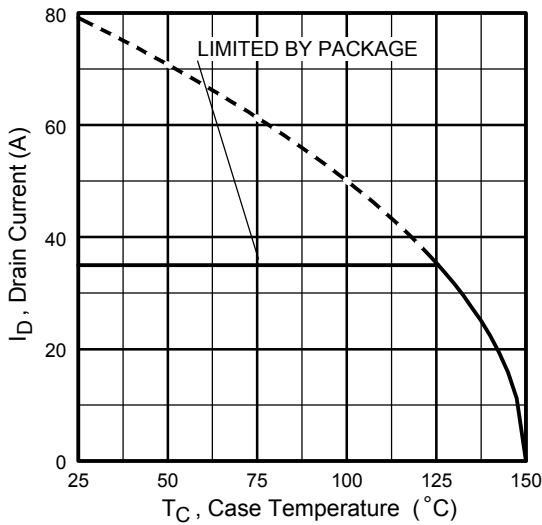


Fig 9. Maximum Drain Current Vs. Case Temperature

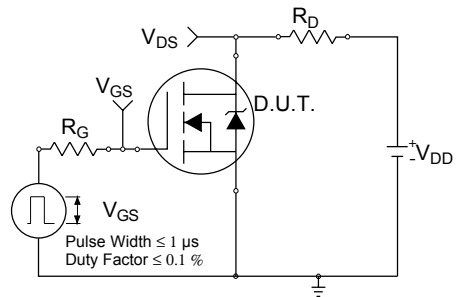


Fig 10a. Switching Time Test Circuit

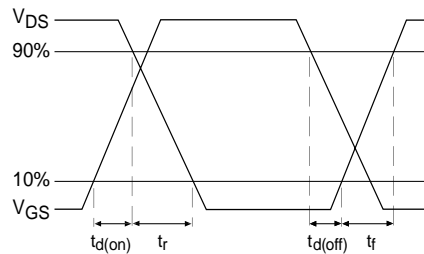


Fig 10b. Switching Time Waveforms

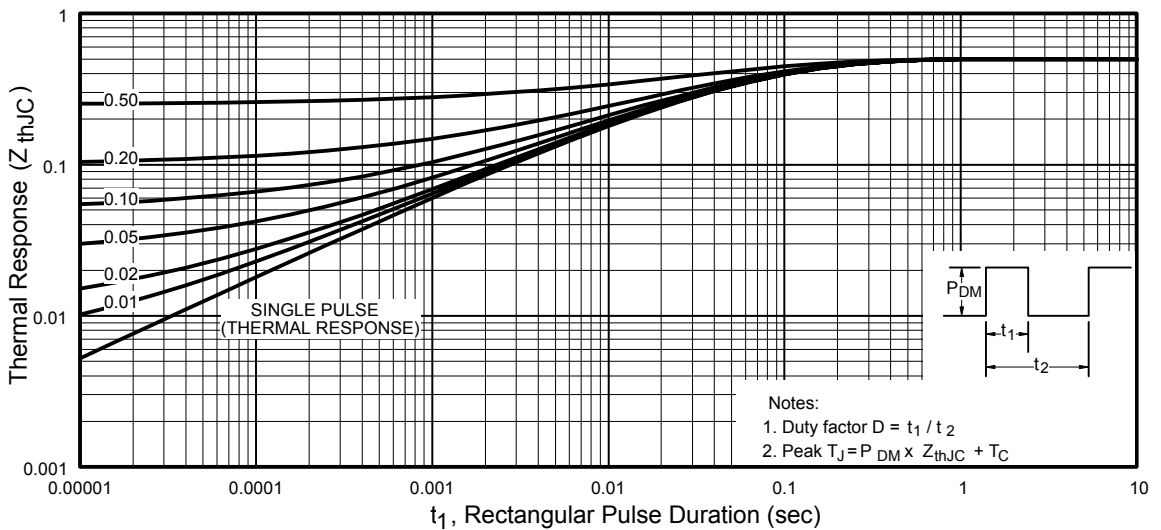


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

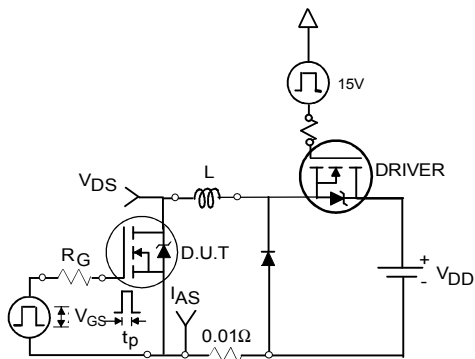


Fig 12a. Unclamped Inductive Test Circuit

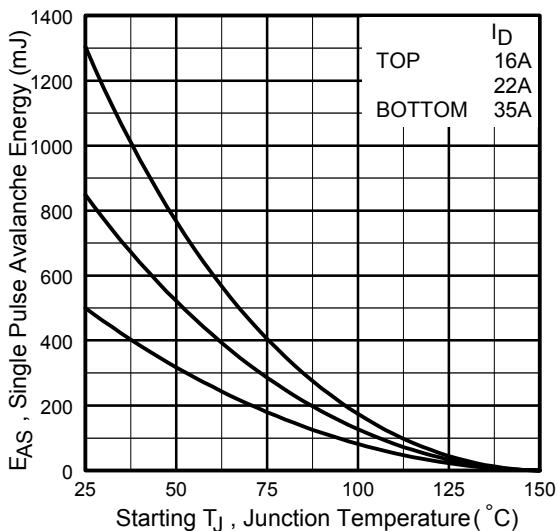


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

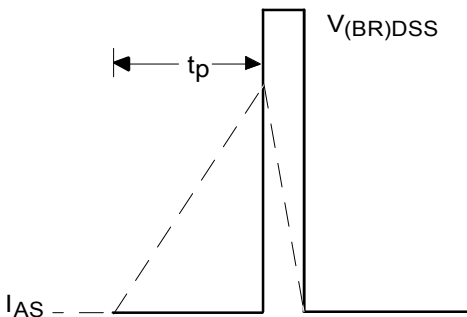


Fig 12b. Unclamped Inductive Waveforms

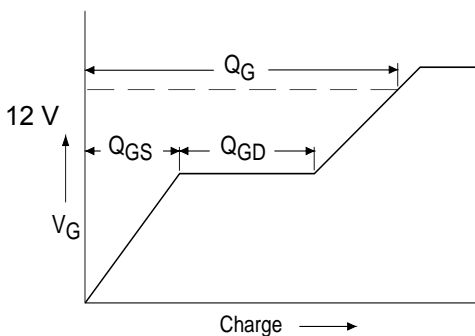


Fig 13a. Basic Gate Charge Waveform

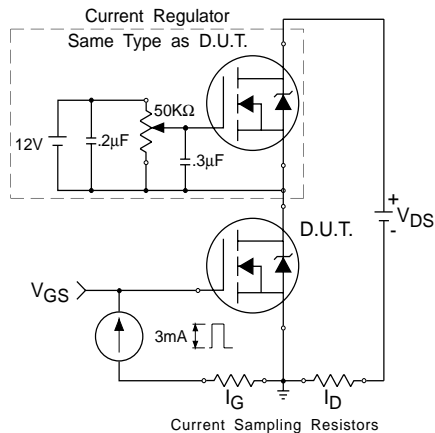
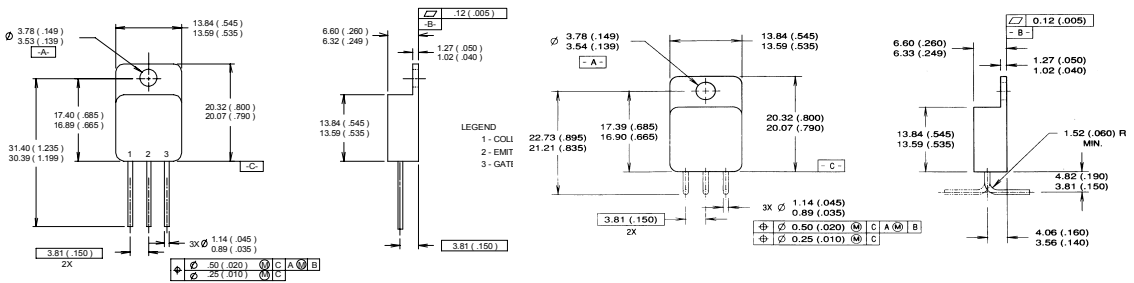


Fig 13b. Gate Charge Test Circuit

Foot Notes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② $V_{DD} = 25V$, starting $T_J = 25^{\circ}C$, $L=0.82mH$
Peak $I_L = 35A$, $V_{GS} = 12V$
- ③ $I_{SD} \leq 35A$, $di/dt \leq 220A/\mu s$,
 $V_{DD} \leq 60V$, $T_J \leq 150^{\circ}C$
- 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-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.



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