PD - 94723

International
IOR Rectifier

RADIATION HARDENED POWER MOSFET THRU-HOLE (Low-Ohmic TO-254AA)

IRHMS67160
100V, N-CHANNEL
R6 TECHNOLOGY

Product Summary

Part Number	Radiation Level	$R_{DS(on)}$	I_D
IRHMS67160	100K Rads (Si)	0.011Ω	45A*
IRHMS63160	300K Rads (Si)	0.011Ω	45A*
IRHMS64160	600K Rads (Si)	0.011Ω	45A*
IRHMS68160	1000K Rads (Si)	0.011Ω	45A*

Low-Ohmic TO-254AA

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/cm^2).

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	45*	A
I_D @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	45*	
I_{DM}	Pulsed Drain Current ①	180	
P_D @ T_C = 25°C	Max. Power Dissipation	208	W
	Linear Derating Factor	1.67	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	566	mJ
I_{AR}	Avalanche Current ①	45	A
E_{AR}	Repetitive Avalanche Energy ①	20.8	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.5	V/ns
T_J T_{STG}	Operating Junction Storage Temperature Range	-55 to 150	°C
	Lead Temperature	300 (0.063 in. /1.6 mm from case for 10s)	
	Weight	9.3 (Typical)	g

* Current is limited by package
For footnotes refer to the last page

08/14/03

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

	Parameter	Min	Typ	Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	100	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.12	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.011	Ω	V_{GS} = 12V, I_D = 45A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 1.0mA
g_{fs}	Forward Transconductance	45	—	—	S (℧)	V_{DS} = 25V, I_{DS} = 45A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	10	μA	V_{DS}= 80V ,V_{GS}=0V
		—	—	25		V_{DS} = 80V, 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	—	—	165	nC	V_{GS} =12V, I_D = 45A V_{DS} = 50V
Q_{gs}	Gate-to-Source Charge	—	—	80		
Q_{gd}	Gate-to-Drain ('Miller') Charge	—	—	60		
$t_{d(on)}$	Turn-On Delay Time	—	—	35	ns	V_{DD} = 50V, I_D = 45A V_{GS} =12V, R_G = 2.35Ω
t_r	Rise Time	—	—	125		
$t_{d(off)}$	Turn-Off Delay Time	—	—	75		
t_f	Fall Time	—	—	20		
$L_S + L_D$	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	—	8877	—	pF	V_{GS} = 0V, V_{DS} = 25V f = 100KHz
C_{oss}	Output Capacitance	—	1600	—		
C_{rss}	Reverse Transfer Capacitance	—	20.5	—		
R_g	Internal Gate Resistance	—	1.05	—	Ω	f = 0.71MHz, open drain

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	45*	A	
I_{SM}	Pulse Source Current (Body Diode) ①	—	—	180		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_j = 25°C, I_S = 45A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	500	ns	T_j = 25°C, I_F = 45A, di/dt ≤ 100A/μs V_{DD} ≤ 25V ④
Q_{RR}	Reverse Recovery Charge	—	—	6.4	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 package

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R_{thJC}	Junction-to-Case	—	—	0.60	°C/W	
R_{thCS}	Case-to-Sink	—	0.21	—		
R_{thJA}	Junction-to-Ambient	—	—	48		Typical socket mount

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

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	Up to 600K Rads(Si)[1]		1000K Rads (Si)[2]		Units	Test Conditions
		Min	Max	Min	Max		
BV_{DSS}	Drain-to-Source Breakdown Voltage	100	—	100	—	V	V_{GS} = 0V, I_D = 1.0mA
$V_{GS(th)}$	Gate Threshold Voltage	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} = -20 V
I_{DSS}	Zero Gate Voltage Drain Current	—	10	—	25	µA	V_{DS}= 80V, V_{GS} =0V
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.011	—	0.011	Ω	V_{GS} = 12V, I_D =45A
$R_{DS(on)}$	Static Drain-to-Source On-State ④ Resistance (Low-Ohmic TO-254)	—	0.011	—	0.011	Ω	V_{GS} = 12V, I_D =45A
V_{SD}	Diode Forward Voltage ④	—	1.2	—	1.2	V	V_{GS} = 0V, I_S = 45A

1. Part numbers IRHMS67160, IRHMS63160 and IRHMS64160
2. Part number IRHMS68160

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/cm2))	Energy (MeV)	Range (µm)	VDS (V) @VGS= 0V	@VGS= -5V	@VGS= -10V	@VGS= -15V	@VGS= -17V	@VGS= -19V	@VGS= -20V
Br	36.7	309	39.5	100	100	100	100	100	100	40
I	59.8	341	32.5	100	100	100	30	-	-	-
Au	82.3	350	28.4	100	100	-	-	-	-	-

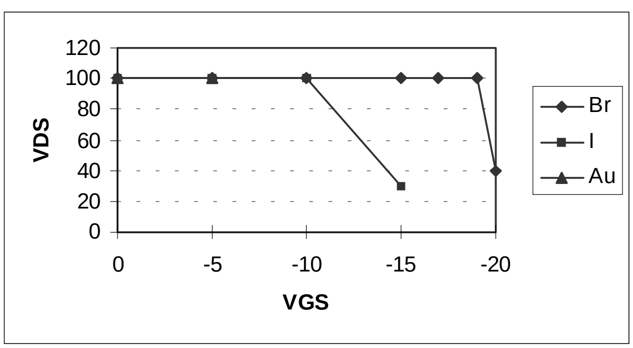


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

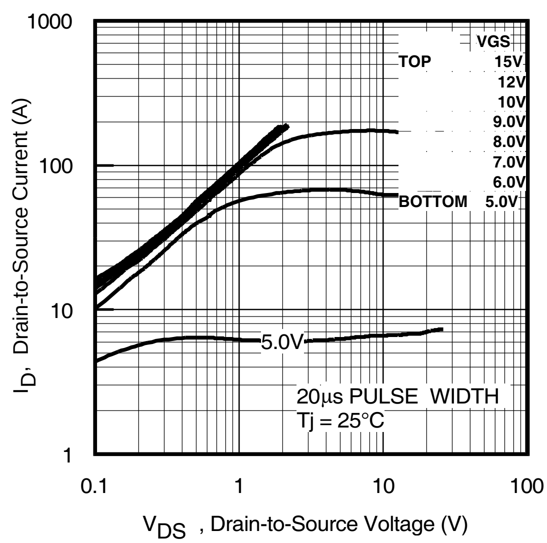


Fig 1. Typical Output Characteristics

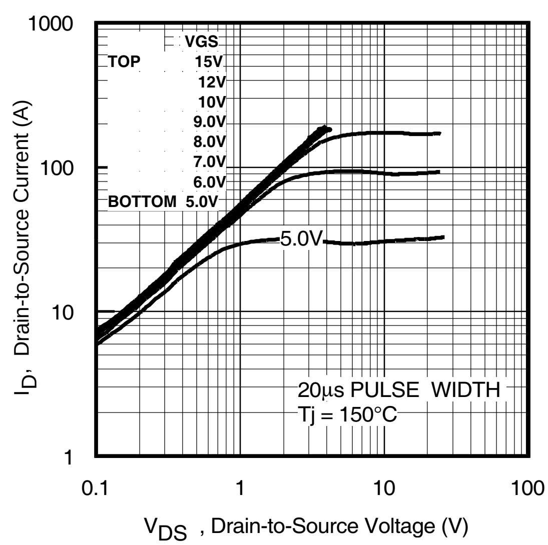


Fig 2. Typical Output Characteristics

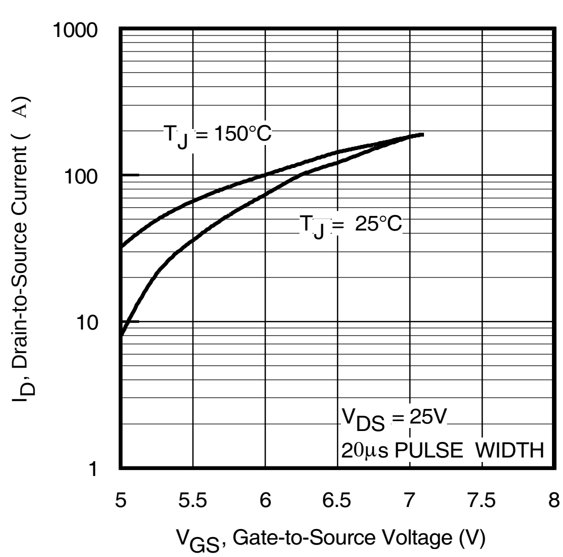


Fig 3. Typical Transfer Characteristics

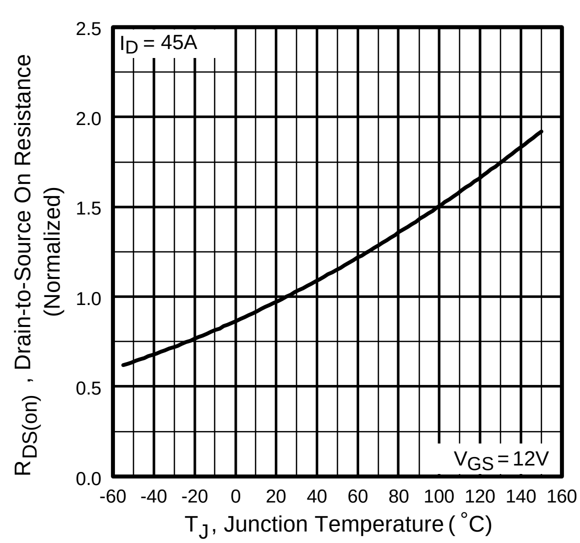


Fig 4. Normalized On-Resistance Vs. Temperature

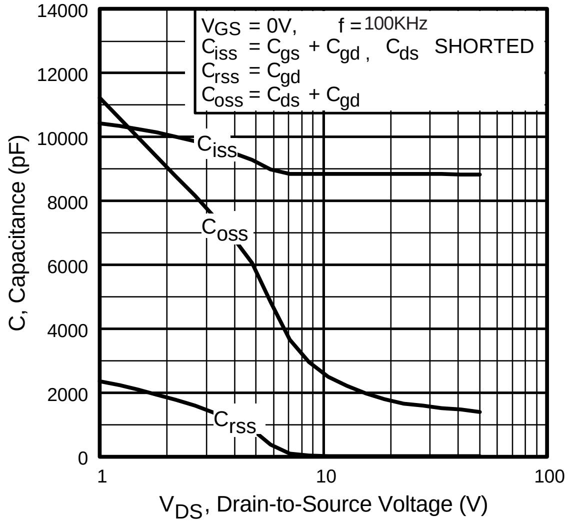


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

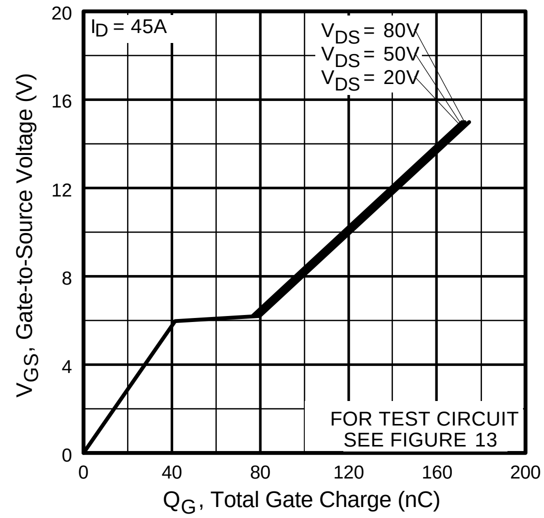


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

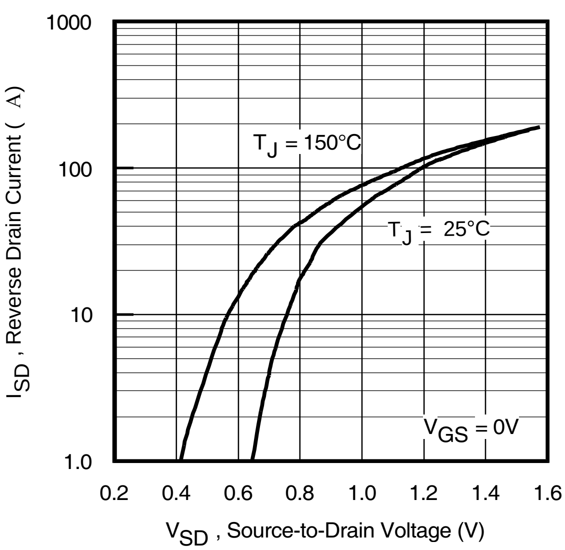


Fig 7. Typical Source-Drain Diode Forward Voltage

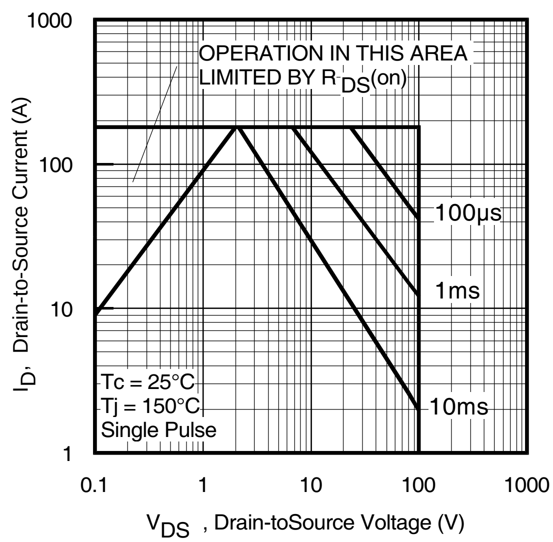


Fig 8. Maximum Safe Operating Area

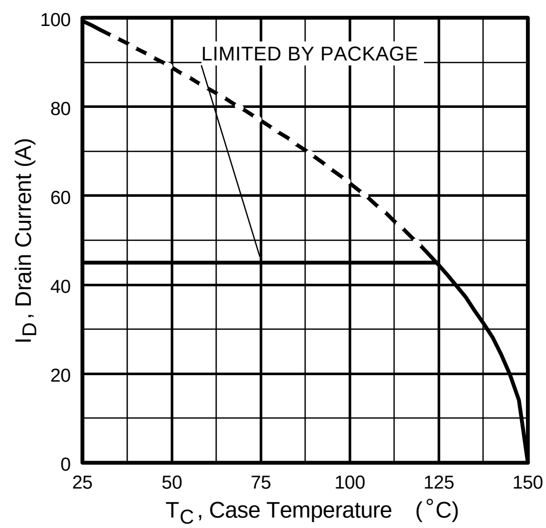


Fig 9. Maximum Drain Current Vs. Case Temperature

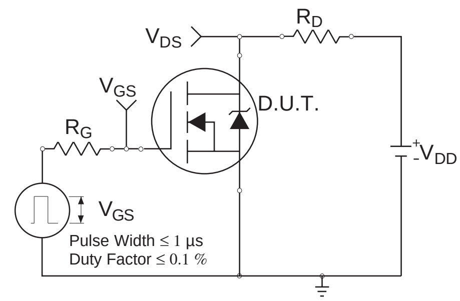


Fig 10a. Switching Time Test Circuit

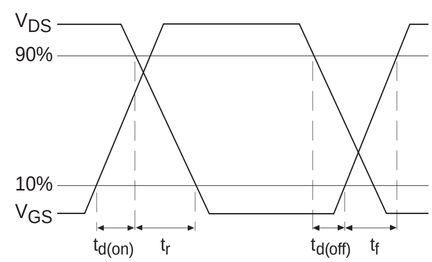


Fig 10b. Switching Time Waveforms

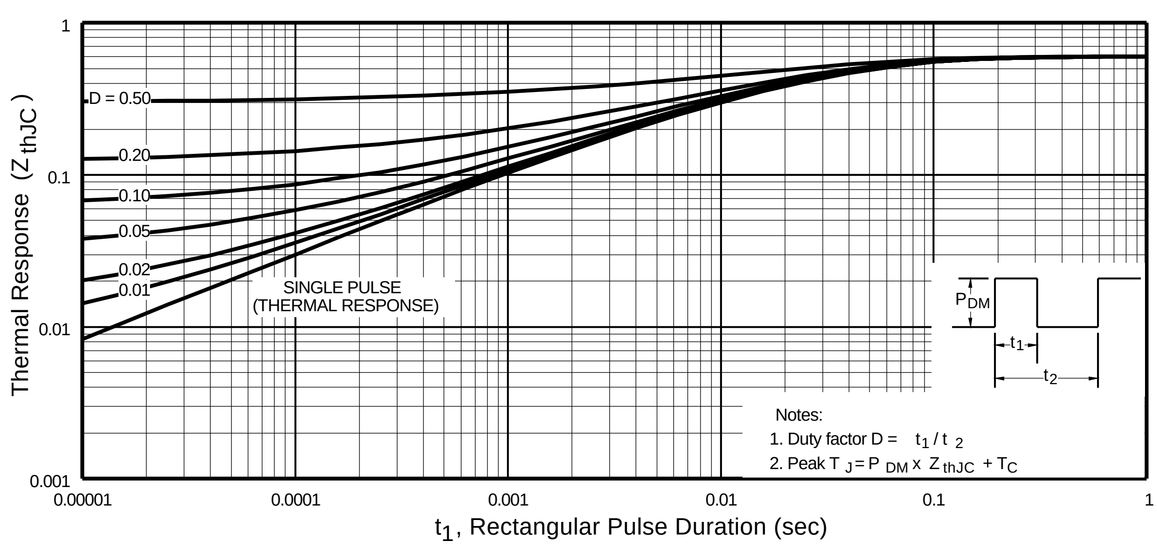


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

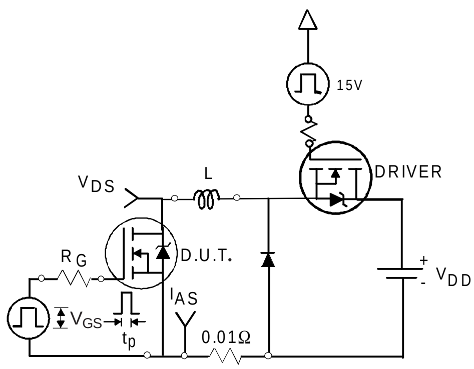


Fig 12a. Unclamped Inductive Test Circuit

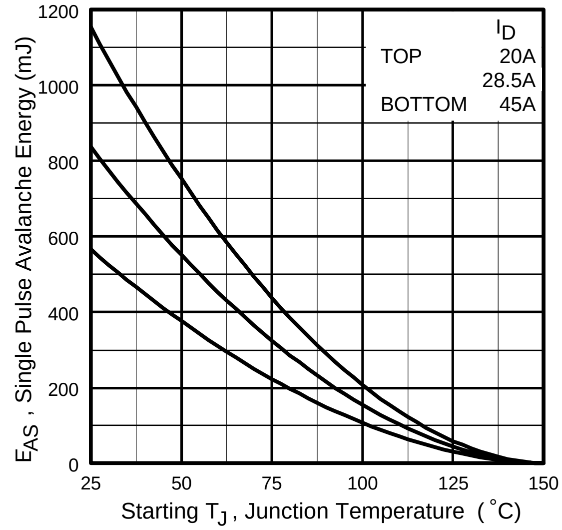


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

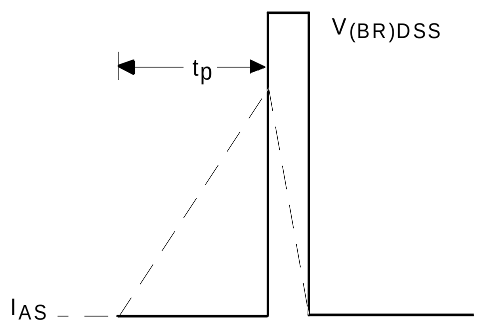


Fig 12b. Unclamped Inductive Waveforms

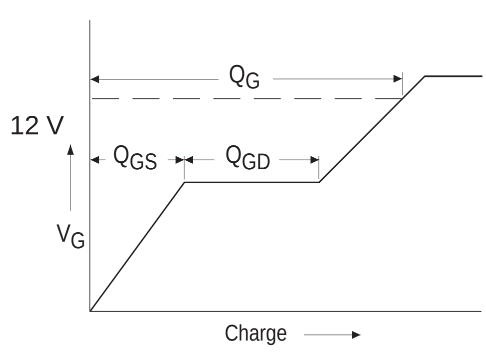


Fig 13a. Basic Gate Charge Waveform

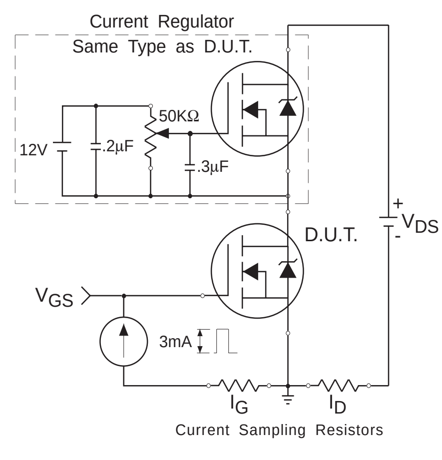


Fig 13b. Gate Charge Test Circuit

Footnotes:

① Repetitive Rating; Pulse width limited by maximum junction temperature.

② V_{DD} = 25V, starting T_J = 25°C, L= 0.56 mH Peak I_L = 45A, V_{GS} = 12V

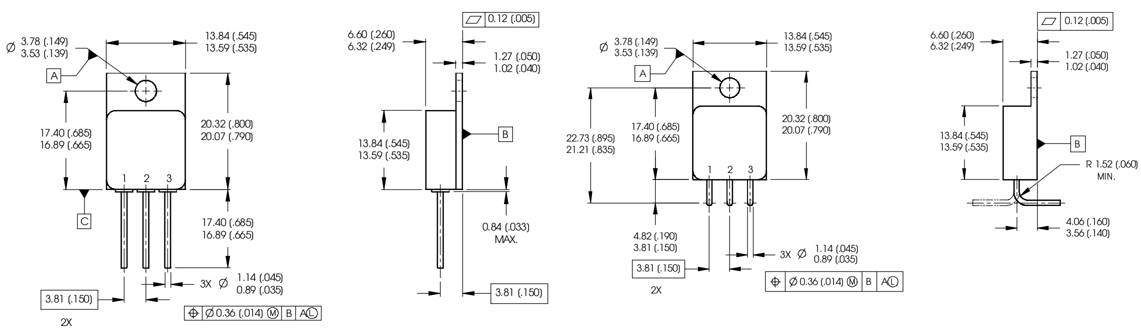
③ $I_{SD} \leq$ 45A, di/dt $\leq$ 430A/µs, $V_{DD} \leq$ 100V, $T_J \leq$ 150°C

④ Pulse width $\leq$ 300 µs; 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.** 80 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-254AA



NOTES:
1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. CONTROLLING DIMENSION: INCH.
4. CONFORMS TO JEDEC OUTLINE TO-254AA.

PIN ASSIGNMENTS
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 will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

International IOR Rectifier

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