

REPETITIVE AVALANCHE AND dv/dt RATED HEXFET® TRANSISTOR

IRHNB7260 IRHNB8260 N-CHANNEL MEGA RAD HARD

200V, 0.070 Ω , MEGA RAD HARD HEXFET

International Rectifier's RAD HARD technology HEXFETs demonstrate immunity to SEE failure. Additionally, under **identical** pre- and post-irradiation test conditions, International Rectifier's RAD HARD HEXFETs retain **identical** electrical specifications up to 1×10^5 Rads (Si) total dose. No compensation in gate drive circuitry is required. These devices are also capable of surviving transient ionization pulses as high as 1×10^{12} Rads (Si)/Sec, and return to normal operation within a few microseconds. Since the RAD HARD process utilizes International Rectifier's patented HEXFET technology, the user can expect the highest quality and reliability in the industry.

RAD HARD HEXFET transistors also feature all of the well-established advantages of MOSFETs, such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters. They are well-suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high-energy pulse circuits in space and weapons environments

Product Summary

Part Number	BV _{DSS}	R _{DS(on)}	I _D
IRHNB7260	200V	0.070 Ω	43A
IRHNB8260	200V	0.070 Ω	43A

Features:

- Radiation Hardened up to 1×10^6 Rads (Si)
- Single Event Burnout (SEB) Hardened
- Single Event Gate Rupture (SEGR) Hardened
- Gamma Dot (Flash X-Ray) Hardened
- Neutron Tolerant
- Identical Pre- and Post-Electrical Test Conditions
- Repetitive Avalanche Rating
- Dynamic dv/dt Rating
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Surface Mount
- Light Weight

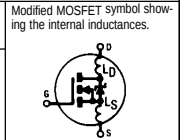
Absolute Maximum Ratings

Pre-Irradiation

	Parameter	IRHNB7260, IRHNB8260	Units
I _D @ V _{GS} = 12V, T _C = 25°C	Continuous Drain Current	43	A
I _D @ V _{GS} = 12V, T _C = 100°C	Continuous Drain Current	27	
I _{DM}	Pulsed Drain Current ①	172	
P _D @ T _C = 25°C	Max. Power Dissipation	300	W
	Linear Derating Factor	2.4	W/°C
V _{GS}	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	500	mJ
I _{AR}	Avalanche Current ①	43	A
E _{AR}	Repetitive Avalanche Energy ①	30	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.7	V/ns
T _J	Operating Junction	-55 to 150	°C
T _{STG}	Storage Temperature Range		
	Package Mounting Surface Temperature	300 (for 5 Sec.)	
	Weight	3.5 (typical)	g

Electrical Characteristics @ $T_j = 25^\circ\text{C}$ (Unless Otherwise Specified)

	Parameter	Min	Typ	Max	Units	Test Conditions
BVDSS	Drain-to-Source Breakdown Voltage	200	—	—	V	$V_{GS} = 0\text{V}$, $I_D = 1.0\text{mA}$
$\Delta BVDSS/\Delta T_j$	Temperature Coefficient of Breakdown Voltage	—	0.26	—	$^\circ\text{V}/^\circ\text{C}$	Reference to 25°C , $I_D = 1.0\text{mA}$
RDS(on)	Static Drain-to-Source On-State Resistance	—	—	0.070	Ω	$V_{GS} = 12\text{V}$, $I_D = 27\text{A}$ ④
		—	—	0.077		$V_{GS} = 12\text{V}$, $I_D = 43\text{A}$
VGS(th)	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$, $I_D = 1.0\text{mA}$
gfs	Forward Transconductance	9.0	—	—	S (τ)	$V_{DS} > 15\text{V}$, $I_{DS} = 27\text{A}$ ④
IDSS	Zero Gate Voltage Drain Current	—	—	25	μA	$V_{DS} = 0.8 \times \text{Max Rating}$, $V_{GS} = 0\text{V}$
		—	—	250		$V_{DS} = 0.8 \times \text{Max Rating}$, $V_{GS} = 0\text{V}$, $T_j = 125^\circ\text{C}$
IGSS	Gate-to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20\text{V}$
IGSS	Gate-to-Source Leakage Reverse	—	—	-100		$V_{GS} = -20\text{V}$
Qg	Total Gate Charge	—	—	290	nC	$V_{GS} = 12\text{V}$, $I_D = 43\text{A}$ $V_{DS} = \text{Max Rating} \times 0.5$
Qgs	Gate-to-Source Charge	—	—	42		
Qgd	Gate-to-Drain ('Miller') Charge	—	—	120		
td(on)	Turn-On Delay Time	—	—	50	ns	$V_{DD} = 100\text{V}$, $I_D = 43\text{A}$, $R_G = 2.35\Omega$
tr	Rise Time	—	—	200		
td(off)	Turn-Off Delay Time	—	—	200		
tf	Fall Time	—	—	130		
LD	Internal Drain Inductance	—	0.8	—	nH	Measured from drain lead, 6mm (0.25 in) from package to center of die.
LS	Internal Source Inductance	—	2.8	—		Measured from source lead, 6mm (0.25 in) from package to source bonding pad.
Ciss	Input Capacitance	—	5300	—	pF	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$ $f = 1.0\text{MHz}$
Coss	Output Capacitance	—	1200	—		
Crss	Reverse Transfer Capacitance	—	360	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
IS	Continuous Source Current (Body Diode)	—	—	43	A	Modified MOSFET symbol showing the integral reverse p-n junction rectifier.
ISM	Pulse Source Current (Body Diode) ①	—	—	172		
VSD	Diode Forward Voltage	—	—	1.8	V	$T_j = 25^\circ\text{C}$, $I_S = 43\text{A}$, $V_{GS} = 0\text{V}$ ④
trr	Reverse Recovery Time	—	—	820	ns	$T_j = 25^\circ\text{C}$, $I_F = 43\text{A}$, $di/dt \leq 100\text{A}/\mu\text{s}$
QRR	Reverse Recovery Charge	—	—	8.5	μC	$V_{DD} \leq 50\text{V}$ ④
ton	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
RthJC	Junction-to-Case	—	—	0.42	$^\circ\text{C}/\text{W}$	Soldered to a 1" sq. copper-clad board
RthJ-PCB	Junction-to PC board	—	1.6	—		

Radiation Performance of Rad Hard HEXFETs

International Rectifier Radiation Hardened HEXFETs are tested to verify their hardness capability. The hardness assurance program at International Rectifier comprises three radiation environments.

Every manufacturing lot is tested in a low dose rate (total dose) environment per MIL-STD-750, test method 1019 condition A. International Rectifier has imposed a standard gate condition of 12 volts per note 5 and a V_{DS} bias condition equal to 80% of the device rated voltage per note 6. Pre- and post- irradiation limits of the devices irradiated to 1×10^5 Rads (Si) are identical and are presented in Table 1, column 1, IRHNB7260. Post-irradiation limits of the devices irradiated to 1×10^6 Rads (Si) are presented in Table 1, column 2,

IRHNB8260. The values in Table 1 will be met for either of the two low dose rate test circuits that are used. 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.

High dose rate testing may be done on a special request basis using a dose rate up to 1×10^{12} Rads (Si)/Sec (See Table 2).

International Rectifier radiation hardened HEXFETs have been characterized in heavy ion Single Event Effects (SEE) environments. Single Event Effects characterization is shown in Table 3.

Table 1. Low Dose Rate ⑤ ⑥

	Parameter	IRHNB7260		IRHNB8260		Units	Test Conditions ⑧
		100K Rads (Si)	1000K Rads (Si)	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	1.25	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		$V_{GS} = -20V$
I _{DSS}	Zero Gate Voltage Drain Current	—	25	—	50	μA	$V_{DS}=0.8 \times \text{Max Rating}, V_{GS}=0V$
R _{DS(on)1}	Static Drain-to-Source ④ On-State Resistance One	—	.070	—	.110	Ω	$V_{GS} = 12V, I_D = 27A$
V _{SD}	Diode Forward Voltage ④	—	1.8	—	1.8	V	$T_C = 25^\circ C, I_S = 43A, V_{GS} = 0V$

Table 2. High Dose Rate ⑦

	Parameter	10 ¹¹ Rads (Si)/sec			10 ¹² Rads (Si)/sec			Units	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
V _{DSS}	Drain-to-Source Voltage	—	—	160	—	—	160	V	Applied drain-to-source voltage during gamma-dot
I _{PP}		—	21	—	—	—	21	A	Peak radiation induced photo-current
di/dt		—	—	160	—	—	8.0	A/μsec	Rate of rise of photo-current
L ₁		1.0	—	—	20	—	—	μH	Circuit inductance required to limit di/dt

Table 3. Single Event Effects

Ion	LET (Si) (MeV/mg/cm ²)	Fluence (ions/cm ²)	Range (μm)	V _{DS} Bias (V)	V _{GS} Bias (V)
Cu	28	3x 10 ⁵	~43	180	-5

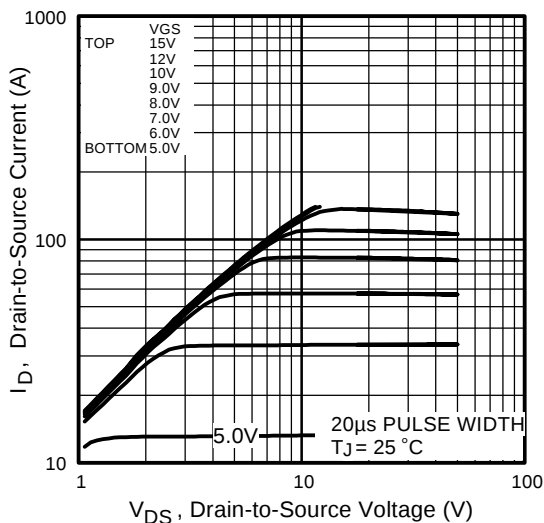


Fig 1. Typical Output Characteristics

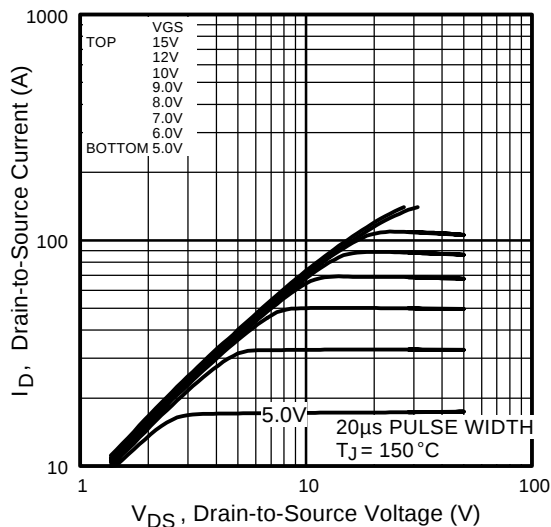


Fig 2. Typical Output Characteristics

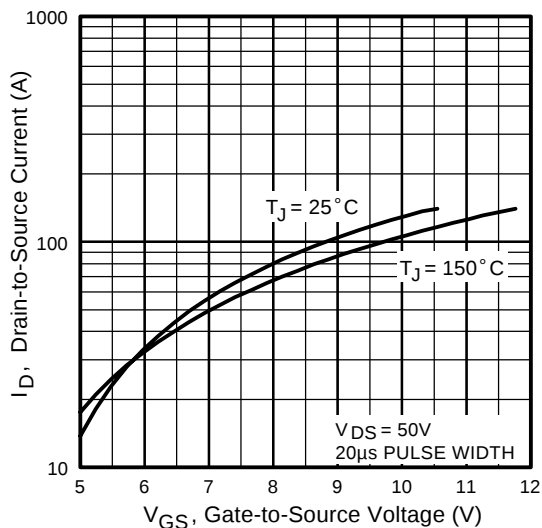


Fig 3. Typical Transfer Characteristics

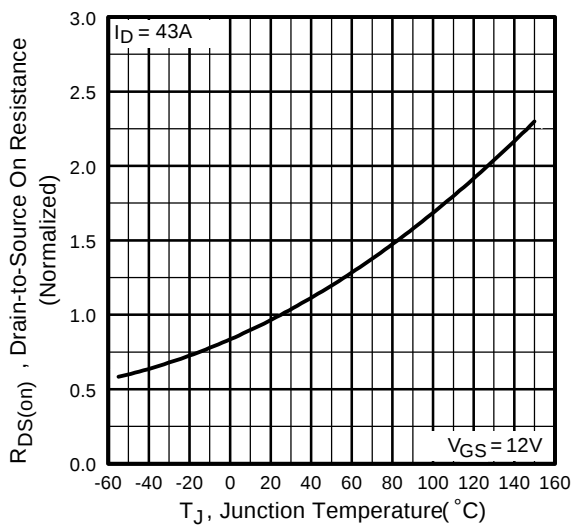


Fig 4. Normalized On-Resistance Vs. Temperature

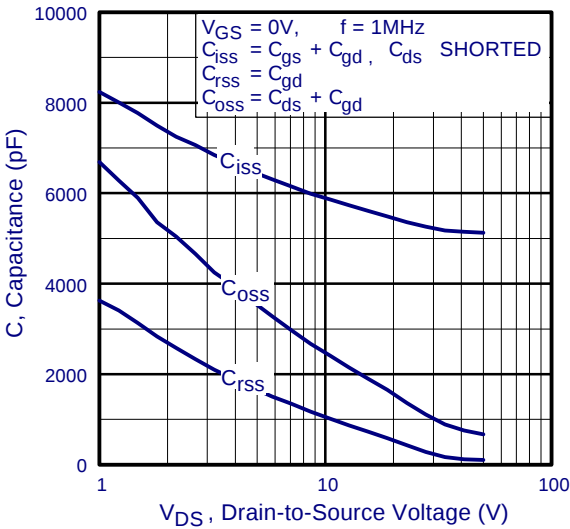


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

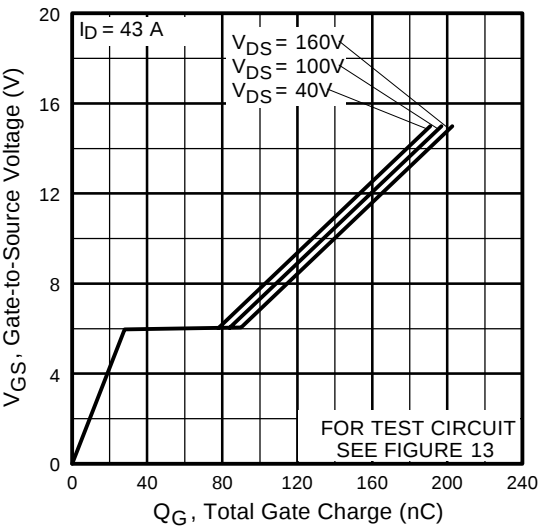


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

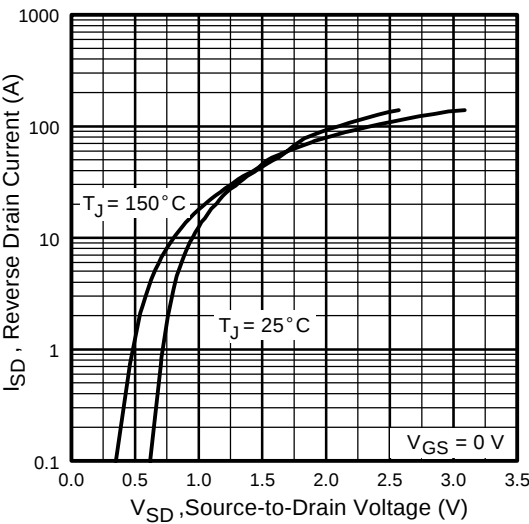


Fig 7. Typical Source-Drain Diode Forward Voltage

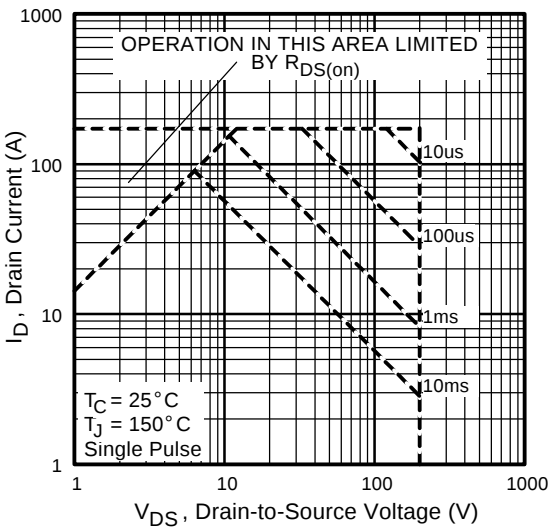


Fig 8. Maximum Safe Operating Area

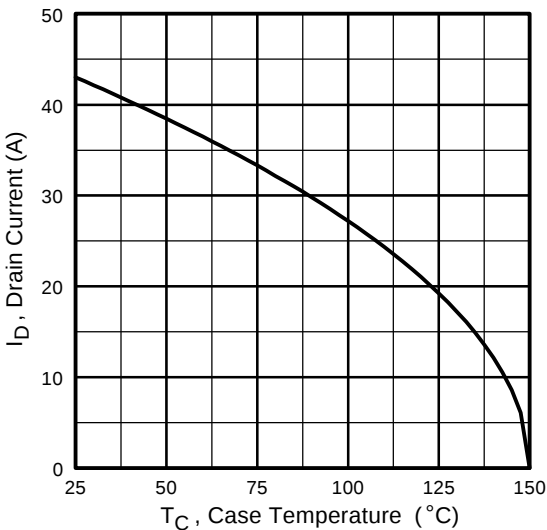


Fig 9. Maximum Drain Current Vs. Case Temperature

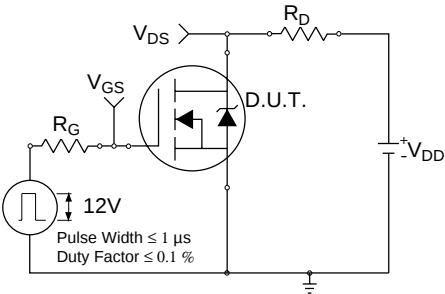


Fig 10a. Switching Time Test Circuit

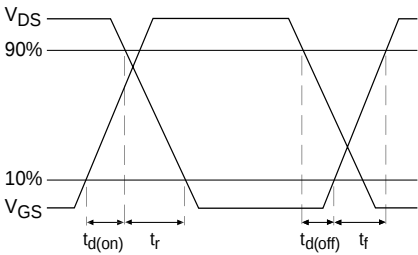


Fig 10b. Switching Time Waveforms

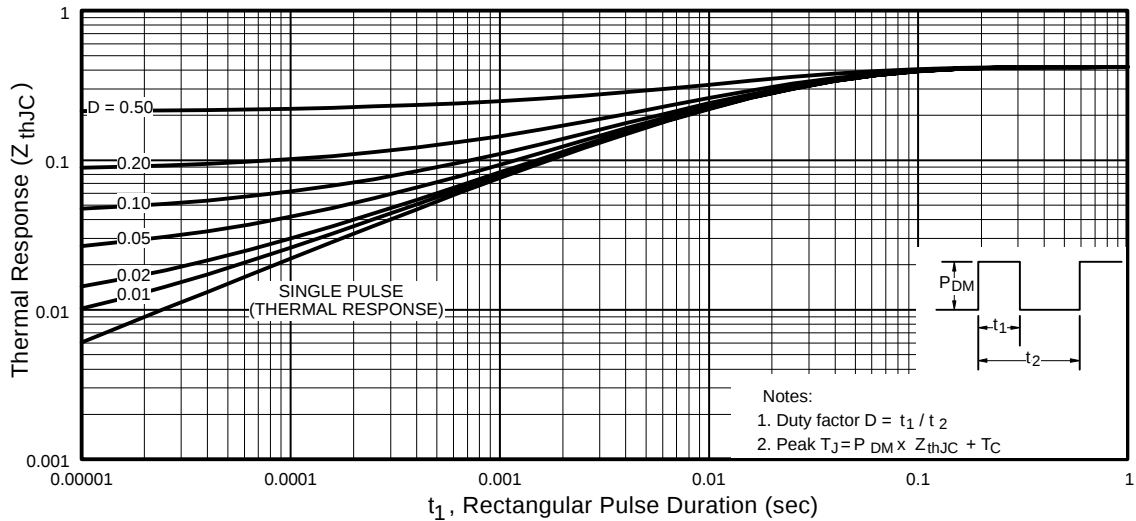


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

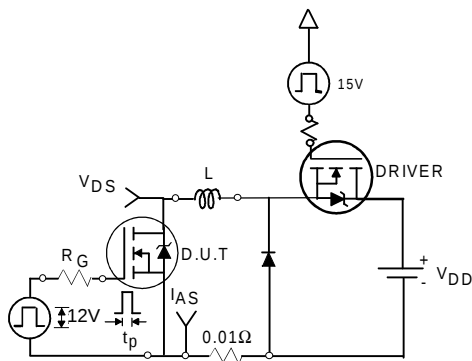


Fig 12a. Unclamped Inductive Test Circuit

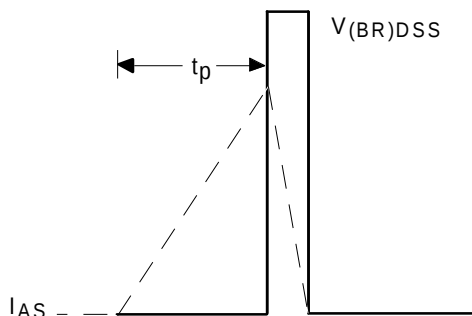


Fig 12b. Unclamped Inductive Waveforms

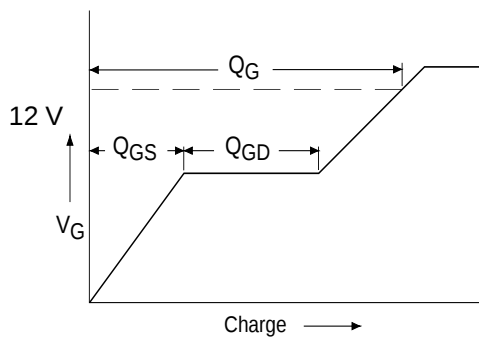


Fig 13a. Basic Gate Charge Waveform

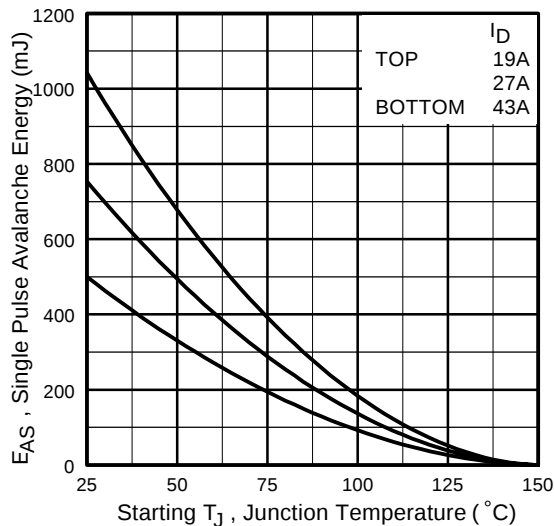


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

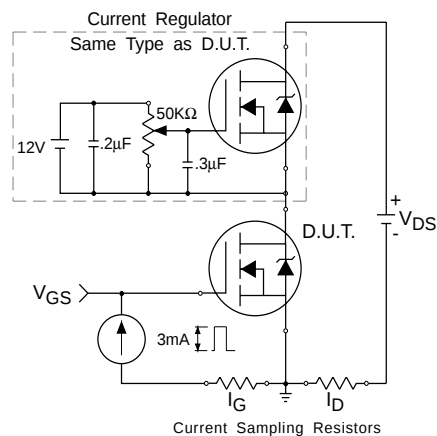
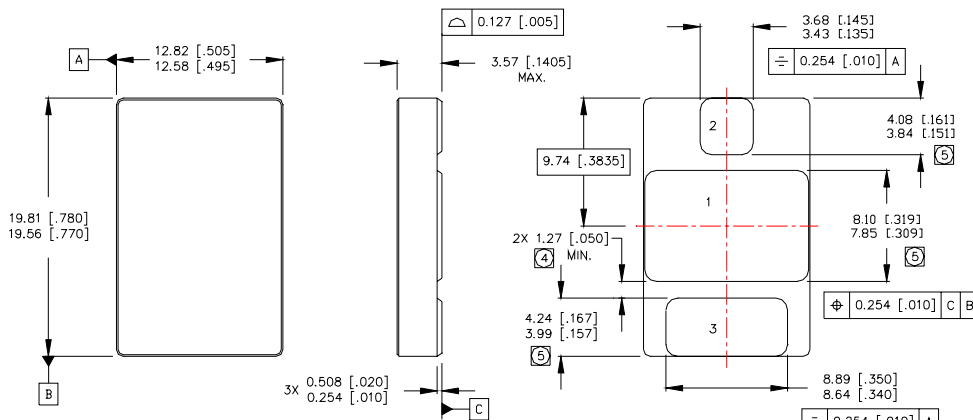


Fig 13b. Gate Charge Test Circuit

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
Refer to current HEXFET reliability report.
- ② @ $V_{DD} = 50V$, Starting $T_J = 25^{\circ}C$,
 $EAS = [0.5 * L * (I_L^2)]$
Peak $I_L = 43A$, $V_{GS} = 12V$, $25 \leq R_G \leq 200\Omega$
- ③ $I_{SD} \leq 43A$, $di/dt \leq 410A/\mu s$,
 $V_{DD} \leq BVDSS$, $T_J \leq 150^{\circ}C$
Suggested $R_G = 2.35\Omega$
- ④ Pulse width $\leq 300 \mu s$; Duty Cycle $\leq 2\%$
- ⑤ **Total Dose Irradiation with V_{GS} Bias.**
 $12 \text{ volt } V_{GS}$ applied and $V_{DS} = 0$ during irradiation per MIL-STD-750, method 1019, condition A.
- ⑥ **Total Dose Irradiation with V_{DS} Bias.**
 $V_{DS} = 0.8$ rated $BVDSS$ (pre-irradiation) applied and $V_{GS} = 0$ during irradiation per MIL-STD-750, method 1019, condition A.
- ⑦ This test is performed using a flash x-ray source operated in the e-beam mode (energy $\sim 2.5 \text{ MeV}$), 30 nsec pulse.
- ⑧ All Pre-Irradiation and Post-Irradiation test conditions are **identical** to facilitate direct comparison for circuit applications.

Case Outline and Dimensions — SMD-3



NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. DIMENSION INCLUDES METALLIZATION FLASH.
5. DIMENSION DOES NOT INCLUDE METALLIZATION FLASH.

LEAD ASSIGNMENTS

- 1 = DRAIN
2 = GATE
3 = SOURCE

SMD-3

International IOR Rectifier

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Data and specifications subject to change without notice. 8/98

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