

**RADIATION HARDENED
POWER MOSFET
SURFACE MOUNT (SMD-2)**

**2N7581U2
IRHNA67164
150V, N-CHANNEL
R6 TECHNOLOGY**

Product Summary

Part Number	Radiation Level	R _{DS(on)}	I _D
IRHNA67164	100K Rads (Si)	0.018Ω	56A*
IRHNA63164	300K Rads (Si)	0.018Ω	56A*

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
- Surface Mount
- Ceramic Package
- Light Weight

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
I _D @ V _{GS} = 12V, T _C = 25°C	Continuous Drain Current	56*	A
I _D @ V _{GS} = 12V, T _C = 100°C	Continuous Drain Current	49	
I _{DM}	Pulsed Drain Current ①	224	
P _D @ T _C = 25°C	Max. Power Dissipation	250	W
	Linear Derating Factor	2.0	W/°C
V _{GS}	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	283	mJ
I _{AR}	Avalanche Current ①	56	A
EAR	Repetitive Avalanche Energy ①	25	mJ
dv/dt	Peak Diode Recovery dv/dt ③	7.5	V/ns
T _J	Operating Junction	-55 to 150	°C
T _{STG}	Storage Temperature Range		
	Pckg. Mounting Surface Temp.	300 (for 5s)	
	Weight	3.3 (Typical)	g

* Current is limited by package

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
BV _{DSS}	Drain-to-Source Breakdown Voltage	150	—	—	V	V _{GS} = 0V, I _D = 1.0mA
ΔBV _{DSS} /ΔT _J	Temperature Coefficient of Breakdown Voltage	—	0.17	—	V/°C	Reference to 25°C, I _D = 1.0mA
R _{DS(on)}	Static Drain-to-Source On-State Resistance	—	—	0.018	Ω	V _{GS} = 12V, I _D = 49A ④
V _{GS(th)}	Gate Threshold Voltage	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 1.0mA
ΔV _{GS(th)} /ΔT _J	Gate Threshold Voltage Coefficient	—	-9.83	—	mV/°C	
g _{fs}	Forward Transconductance	50	—	—	S	V _{DS} = 15V, I _{DS} = 49A 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	—	—	230	nC	V _{GS} = 12V, I _D = 56A
Q _{gs}	Gate-to-Source Charge	—	—	70		V _{DS} = 75V
Q _{gd}	Gate-to-Drain ('Miller') Charge	—	—	90		
t _{d(on)}	Turn-On Delay Time	—	—	35	ns	V _{DD} = 75V, I _D = 56A, V _{GS} = 12V, R _G = 2.35Ω
t _r	Rise Time	—	—	170		
t _{d(off)}	Turn-Off Delay Time	—	—	85		
t _f	Fall Time	—	—	35		
L _S + L _D	Total Inductance	—	2.8	—	nH	Measured from the center of drain pad to center of source pad
C _{iss}	Input Capacitance	—	7390	—	pF	V _{GS} = 0V, V _{DS} = 25V
C _{oss}	Output Capacitance	—	1144	—		f = 100KHz
C _{rss}	Reverse Transfer Capacitance	—	28	—		
R _g	Gate Resistance	—	0.52	—	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)	—	—	56*	A	
I _{SM}	Pulse Source Current (Body Diode) ①	—	—	224		
V _{SD}	Diode Forward Voltage	—	—	1.2	V	T _J = 25°C, I _S = 56A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	—	370	ns	T _J = 25°C, I _F = 56A, di/dt ≤ 100A/μs
Q _{RR}	Reverse Recovery Charge	—	—	4.5	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 .				

* Current is limited by package

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R _{thJC}	Junction-to-Case	—	—	0.5	°C/W	

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

For footnotes refer to the last page

Radiation Characteristics

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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 @ $T_j = 25^\circ\text{C}$, Post Total Dose Irradiation ⑤⑥

	Parameter	Upto 300K Rads (Si) ¹		Units	Test Conditions
		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) ④	—	0.019	Ω	$V_{GS} = 12V, I_D = 49A$
$R_{DS(on)}$	Static Drain-to-Source On-state Resistance (SMD-2) ④	—	0.018	Ω	$V_{GS} = 12V, I_D = 49A$
V_{SD}	Diode Forward Voltage④	—	1.2	V	$V_{GS} = 0V, I_D = 56A$

1. Part numbers IRHNA67164, IRHNA63164

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. Typical Single Event Effect Safe Operating Area

LET (MeV/(mg/cm ²))	Energy (MeV)	Range (μm)	VDS (V)				
			@VGS=0V	@VGS=-5V	@VGS=-10V	@VGS=-15V	@VGS=-20V
$39 \pm 5\%$	$410 \pm 5\%$	$50 \pm 5\%$	150	150	150	150	150
$61 \pm 5\%$	$825 \pm 5\%$	$66 \pm 7.5\%$	150	150	150	40	-
$90 \pm 5\%$	$1470 \pm 5\%$	$80 \pm 5\%$	50	50	30	-	-

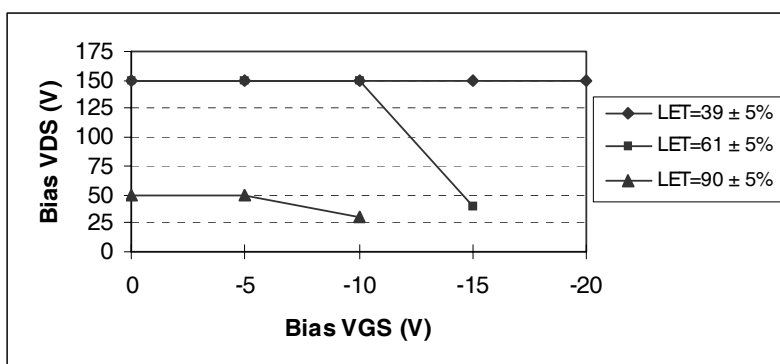


Fig a. Typical Single Event Effect, Safe Operating Area

For footnotes refer to the last page

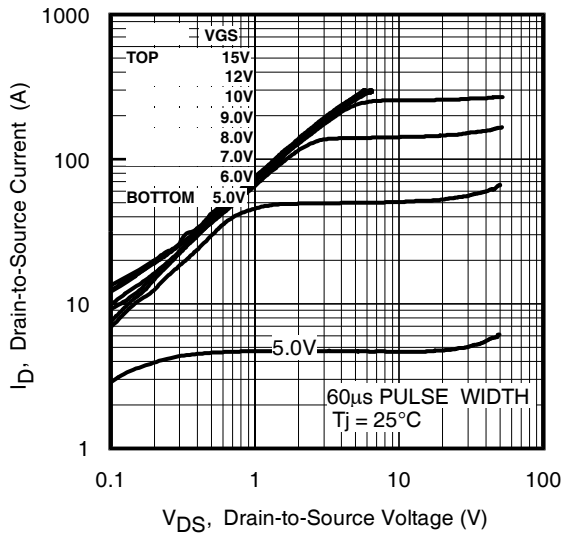


Fig 1. Typical Output Characteristics

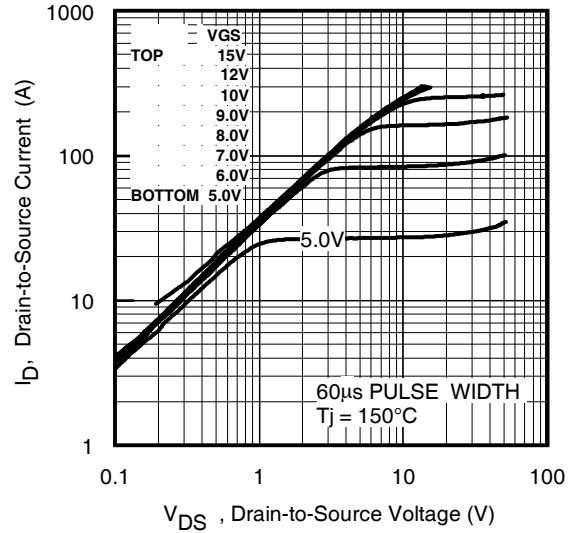


Fig 2. Typical Output Characteristics

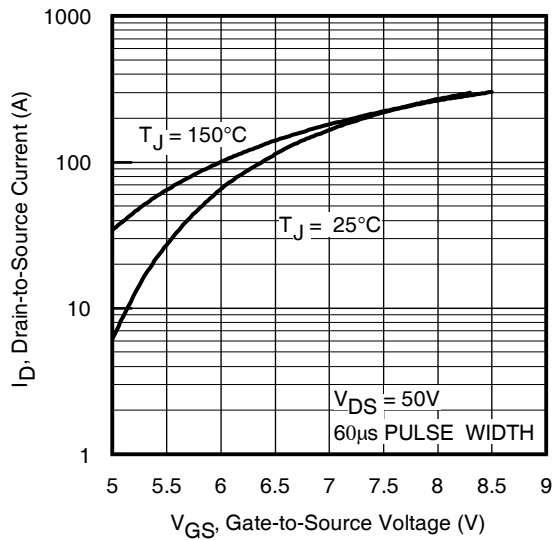


Fig 3. Typical Transfer Characteristics

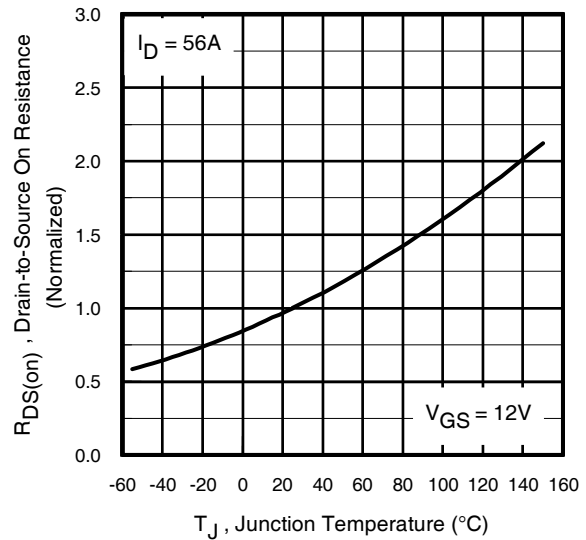
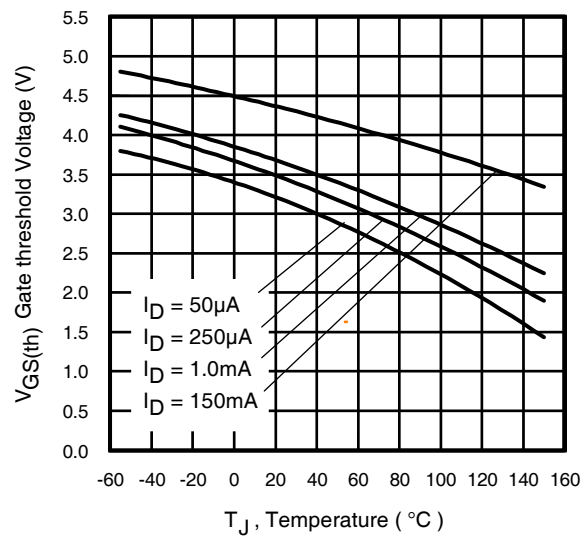
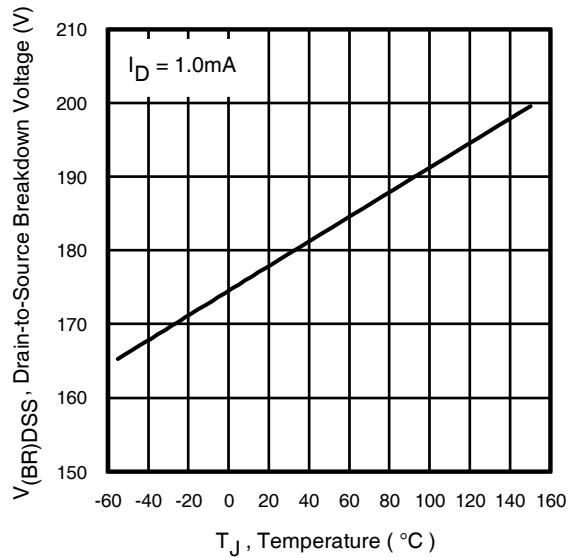
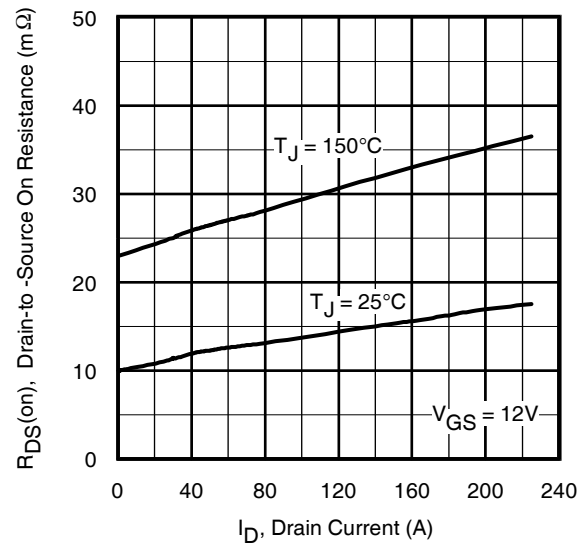
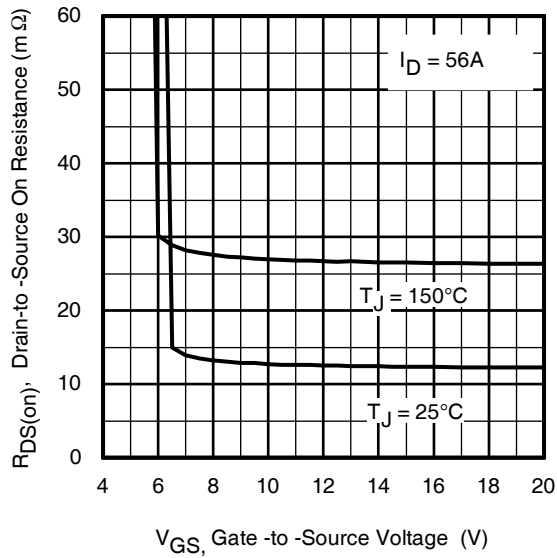


Fig 4. Normalized On-Resistance Vs. Temperature



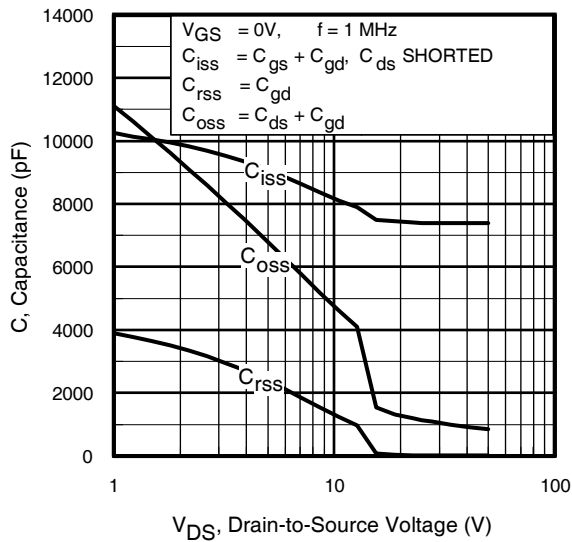


Fig 9. Typical Capacitance Vs. Drain-to-Source Voltage

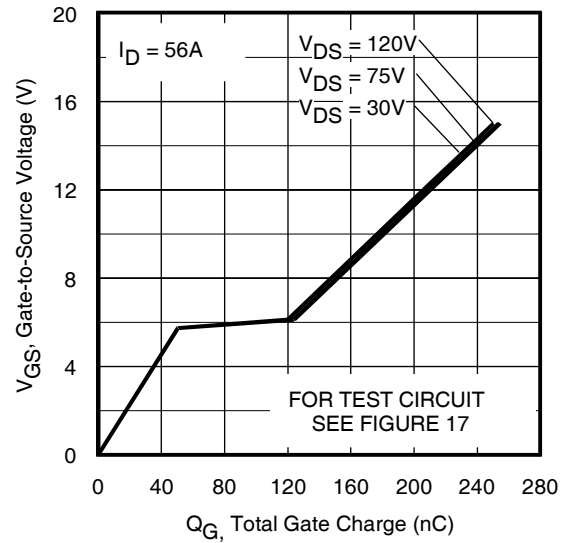


Fig 10. Typical Gate Charge Vs. Gate-to-Source Voltage

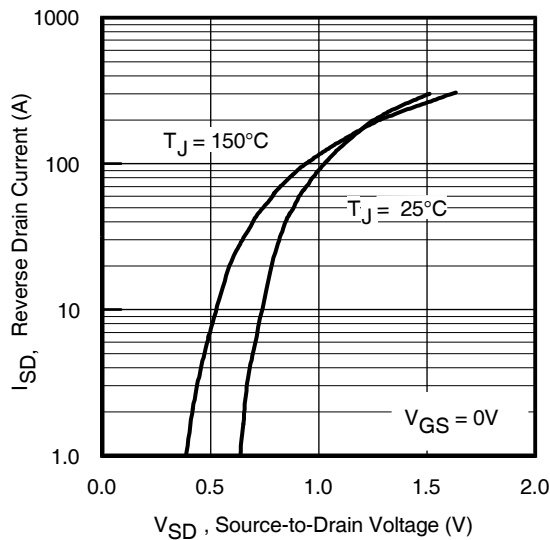


Fig 11. Typical Source-to-Drain Diode Forward Voltage

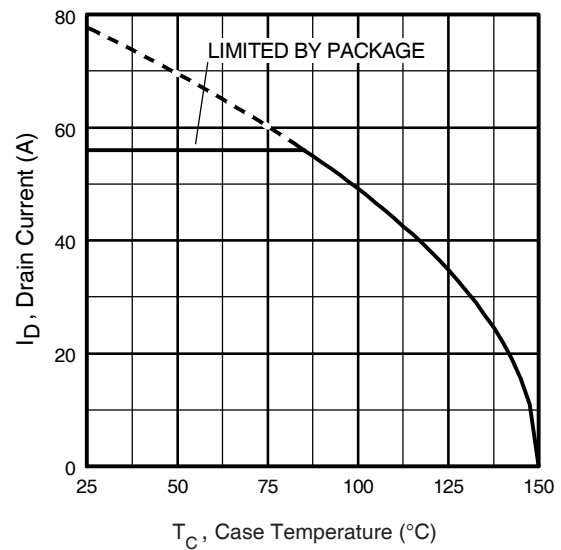


Fig 12. Maximum Drain Current Vs. Case Temperature

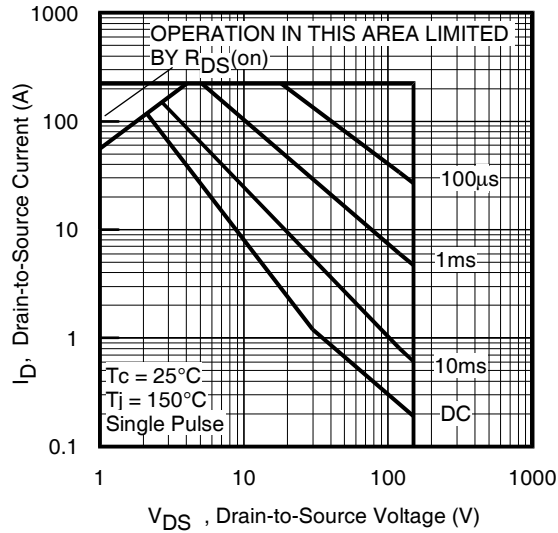


Fig 13. Maximum Safe Operating Area

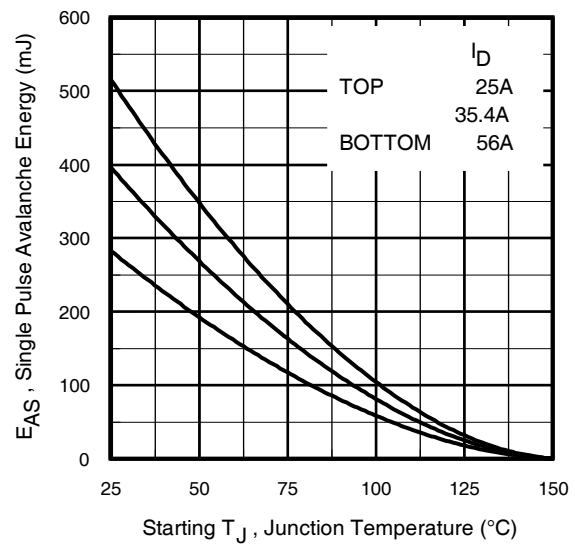


Fig 14. Maximum Avalanche Energy Vs. Drain Current

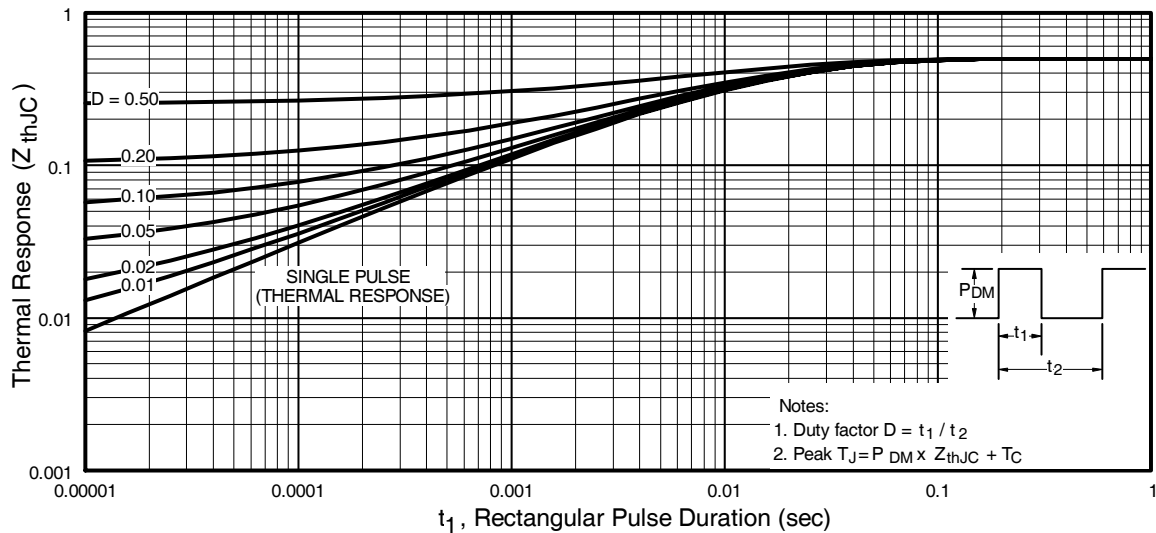


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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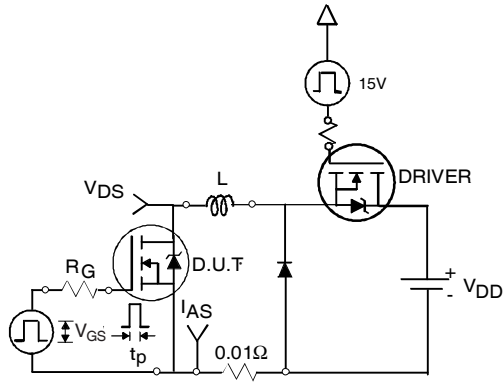


Fig 16a. Unclamped Inductive Test Circuit

Pre-Irradiation

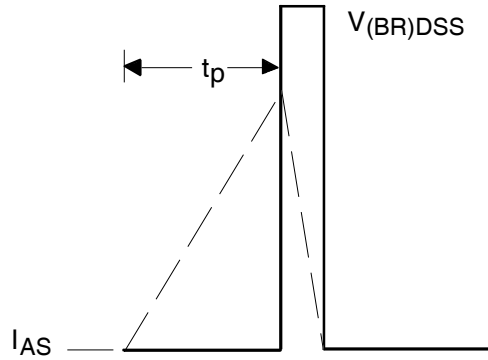


Fig 16b. Unclamped Inductive Waveforms

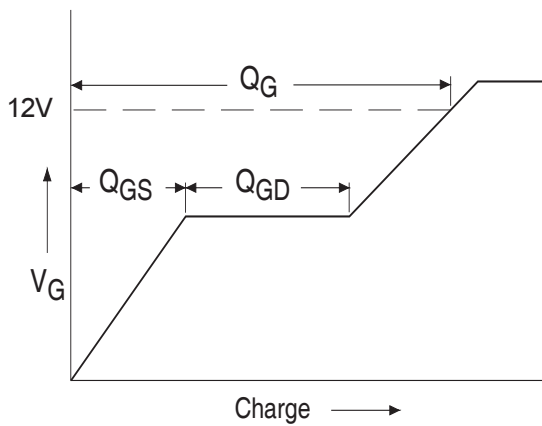


Fig 17a. Basic Gate Charge Waveform

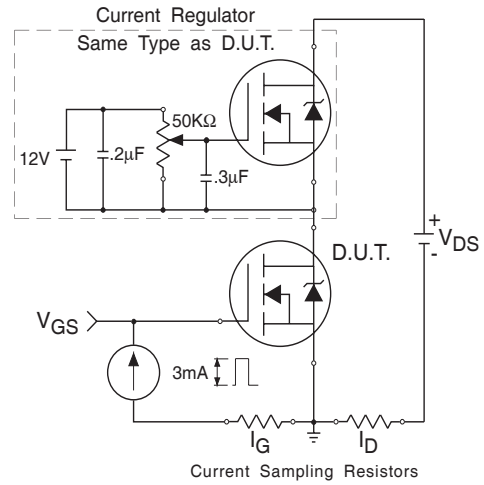


Fig 17b. Gate Charge Test Circuit

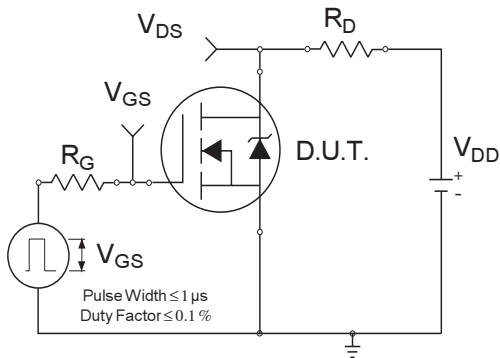


Fig 18a. Switching Time Test Circuit

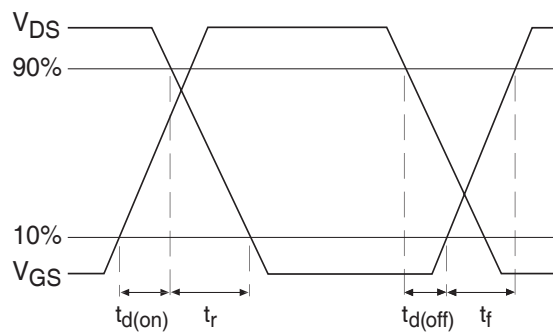


Fig 18b. Switching Time Waveforms

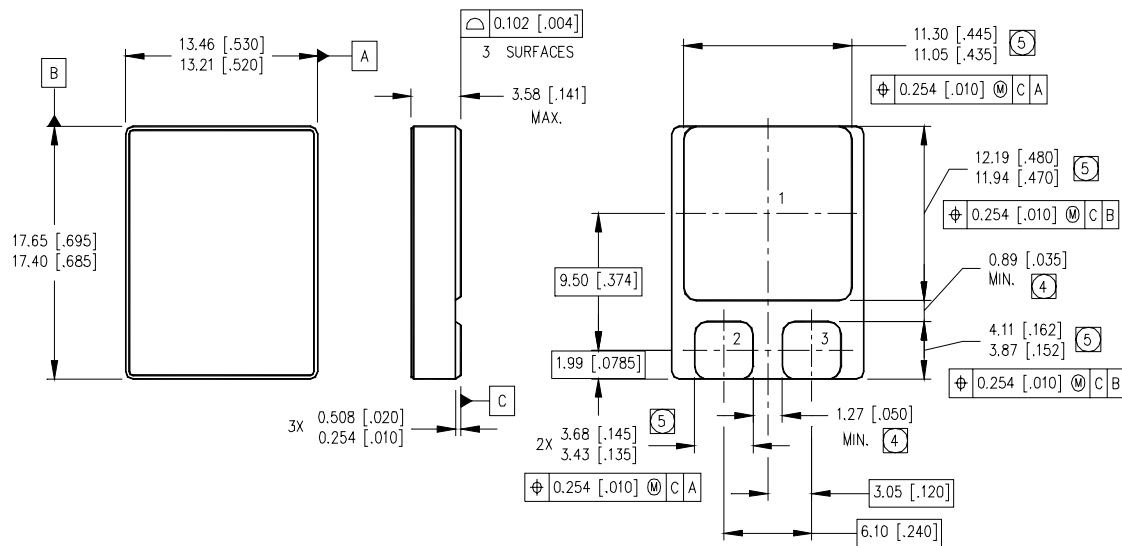
Pre-Irradiation

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Footnotes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② $V_{DD} = 50V$, starting $T_J = 25^\circ C$, $L = 0.18mH$
Peak $I_L = 56A$, $V_{GS} = 12V$
- ③ $I_{SD} \leq 56A$, $di/dt \leq 860A/\mu s$,
 $V_{DD} \leq 150V$, $T_J \leq 150^\circ C$
- 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 — SMD-2



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.

PAD ASSIGNMENTS

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

International
IR Rectifier

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Data and specifications subject to change without notice. 07/2011