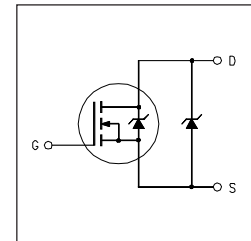
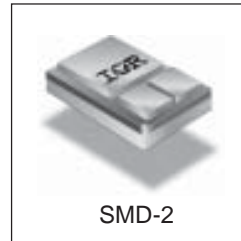


**RAD-HARD  
SYNCHRONOUS RECTIFIER  
SURFACE MOUNT (SMD-2)**

**IRHSNA57064  
60V, N-CHANNEL**

**Product Summary**

Part Number	Radiation Level	R <sub>DS(on)</sub>	Q <sub>G</sub>
IRHSNA57064	100K Rads (Si)	5.6mΩ	160nC
IRHSNA53064	300K Rads (Si)	5.6mΩ	160nC
IRHSNA54064	600K Rads (Si)	5.6mΩ	160nC
IRHSNA58064	1000K Rads (Si)	6.5mΩ	160nC



**Description:**

The SynchFet family of Co-Pack RAD-Hard MOSFETs and Schottky diodes offers the designer an innovative, board space saving solution for switching regulator and power management applications. RAD-Hard MOSFETs utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. Combining this technology with International Rectifier's low forward drop Schottky rectifiers results in an extremely efficient device suitable for use in a wide variety of Military and Space applications.

**Features:**

- Co-Pack N-channel RAD-Hard MOSFET and Schottky Diode
- Ideal for Synchronous Rectifiers in DC-DC Converters up to 75A Output
- Low Conduction Losses
- Low Switching Losses
- Low Vf Schottky Rectifier
- Refer to IRHSLNA57064 for Lower Inductance

**Absolute Maximum Ratings**

**Pre-Irradiation**

	Parameter		Units
ID @ VGS = 12V, TC = 25°C	Continuous Drain or Source Current	75*	A
ID @ VGS = 12V, TC = 100°C	Continuous Drain or Source Current	75*	
IDM	Pulsed Drain Current ①	300	
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 ④	370	mJ
IAR	Avalanche Current ①	75	A
EAR	Repetitive Avalanche Energy ①	25	mJ
IF (AV) @ TC = 25°C	Schottky and Body Diode Avg. Forward Current ③	75*	A
IF (AV) @ TC = 100°C	Schottky and Body Diode Avg. Forward Current ③	75*	
TJ, TSTG	Operating and Storage Temperature Range	-55 to 150	°C
	Pckg. Mounting Surface Temp.	300 (for 5s)	
	Weight	3.3 (Typical)	

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

**Electrical Characteristics @ T<sub>J</sub> = 25°C (Unless Otherwise Specified)**

	Parameter	Min	Typ	Max	Units	Test Conditions
B <sub>V</sub> D <sub>SS</sub>	Drain-to-Source Breakdown Voltage	60	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
R <sub>D</sub> S(on)	Static Drain-to-Source On-State Resistance	—	—	5.6	mΩ	V <sub>GS</sub> = 12V, I <sub>D</sub> = 45A <sup>②</sup>
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0mA
g <sub>fs</sub>	Forward Transconductance	45	—	—	S (S)	V <sub>DS</sub> ≥ 15V, I <sub>DS</sub> = 45A <sup>②</sup>
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	50	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> =0V
		—	—	50	mA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	-100		V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	160	nC	V <sub>GS</sub> =12V, I <sub>D</sub> =45A, V <sub>DS</sub> = 30V
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	55		
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	65		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	35	ns	V <sub>DD</sub> = 30V, I <sub>D</sub> = 45A, V <sub>GS</sub> =12V, R <sub>G</sub> = 2.35Ω
t <sub>r</sub>	Rise Time	—	—	125		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	75		
t <sub>f</sub>	Fall Time	—	—	50		
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	7.03	—	nH	Measured from center of drain pad to center of source pad

**Schottky Diode & Body Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
V <sub>S</sub> D	Diode Forward Voltage	—	—	0.93	V	T <sub>J</sub> = -55°C, I <sub>D</sub> =45A, V <sub>GS</sub> = 0V <sup>②</sup>
		—	—	0.9		T <sub>J</sub> = 25°C, I <sub>D</sub> = 45A, V <sub>GS</sub> = 0V <sup>②</sup>
		—	—	0.82		T <sub>J</sub> = 125°C, I <sub>D</sub> =45A, V <sub>GS</sub> = 0V <sup>②</sup>
t <sub>rr</sub>	Reverse Recovery Time	—	—	100	nS	T <sub>J</sub> = 25°C, I <sub>F</sub> =45A, di/dt ≤ 100A/μs
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	210	nC	V <sub>DS</sub> ≤ 30V
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	8.09	—	nH	Measured from center of drain pad to center of source pad (for Schottky only)
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub>				

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction-to-Case (MOSFET)	—	—	0.5	°C/W	
R <sub>thJC</sub>	Junction-to-Case (Schottky)	—	—	0.7		

**Note:** Corresponding Spice and Saber models are available on the Website.

For footnotes refer to the last page

## Radiation Characteristics

IRHSNA57064

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 ⑤⑥⑦**

Parameter	Parameter	Up to 600K Rads(Si) <sup>1</sup>		1000K Rads (Si) <sup>2</sup>		Units	Test Conditions
		Min	Max	Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	60	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	4.0	1.5	4.0		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0mA
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	100	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100	—	-100		V <sub>GS</sub> = -20V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	—	25	μA	V <sub>DS</sub> =48V, V <sub>GS</sub> =0V
R <sub>DS(on)</sub>	Static Drain-to-Source ② On-State Resistance (TO-3)	—	6.1	—	7.1	mΩ	V <sub>GS</sub> = 12V, I <sub>D</sub> =45A
R <sub>DS(on)</sub>	Static Drain-to-Source ② On-State Resistance (SMD-2)	—	5.6	—	6.5	mΩ	V <sub>GS</sub> = 12V, I <sub>D</sub> =45A
V <sub>SD</sub>	Diode Forward Voltage ②	—	1.3	—	1.3	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 45A

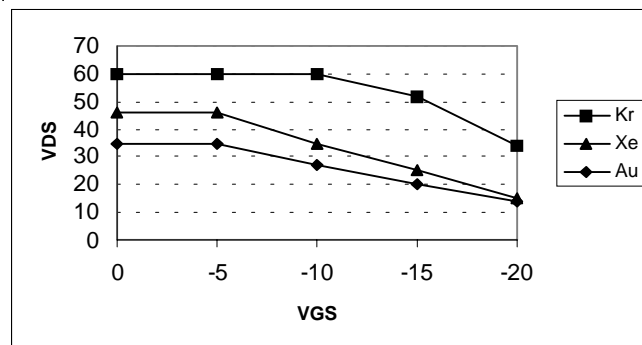
1. Part numbers IRHSNA57064, IRHSNA53064 and IRHSNA54064

2. Part number IRHSNA58064

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 ⑦**

Ion	LET MeV/(mg/cm <sup>2</sup> )	Energy (MeV)	Range (μm)	V <sub>DS</sub> (V)				
				@V <sub>GS</sub> =0V	@V <sub>GS</sub> =-5V	@V <sub>GS</sub> =-10V	@V <sub>GS</sub> =-15V	@V <sub>GS</sub> =-20V
Kr	39.2	300	37.4	60	60	60	52	34
Xe	63.3	300	29.2	46	46	35	25	15
Au	86.6	2068	106	35	35	27	20	14



**Fig a. Single Event Effect, Safe Operating Area**

For footnotes refer to the last page

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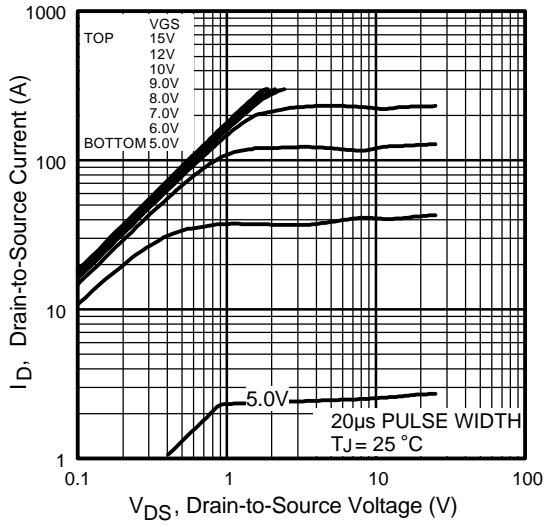


Fig 1. Typical Output Characteristics

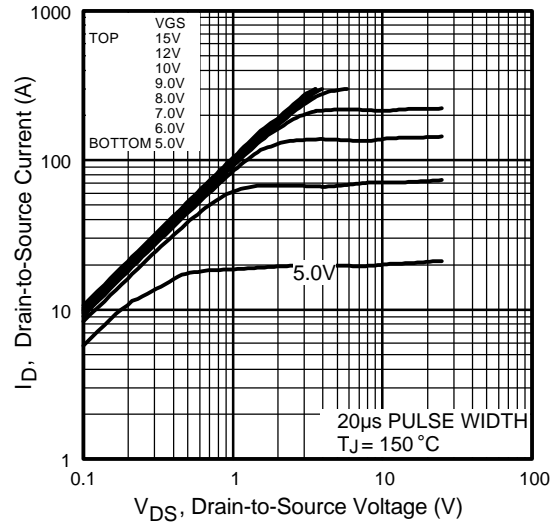


Fig 2. Typical Output Characteristics

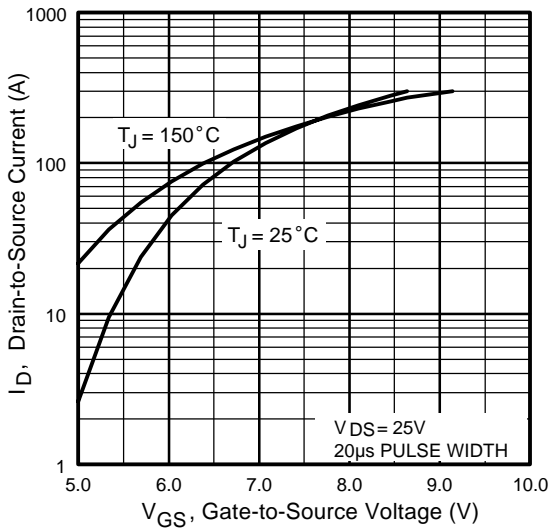


Fig 3. Typical Transfer Characteristics

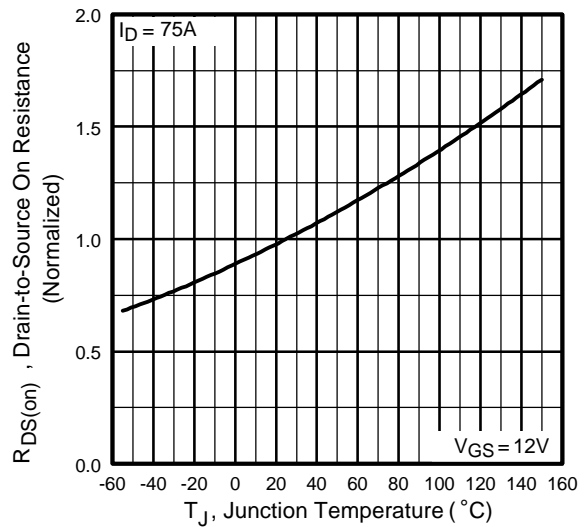
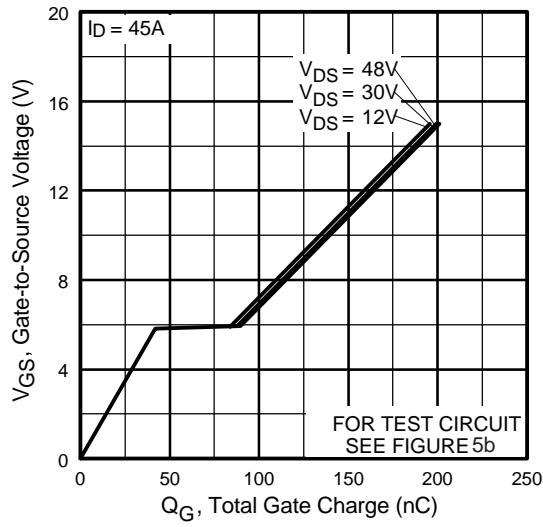
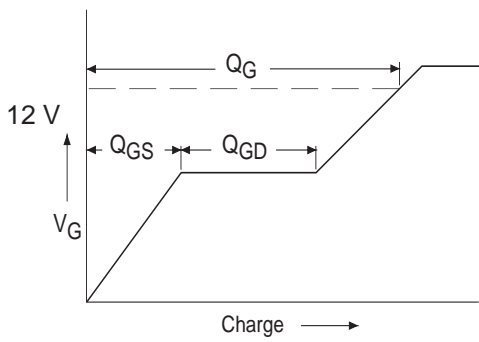


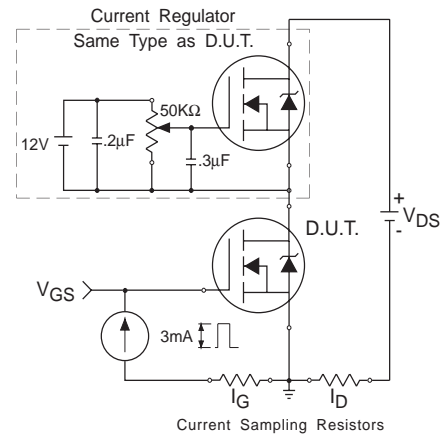
Fig 4. Normalized On-Resistance Vs. Temperature



**Fig 5.** Typical Gate Charge Vs. Gate-to-Source Voltage



**Fig 5a.** Basic Gate Charge Waveform



**Fig 5b.** Gate Charge Test Circuit

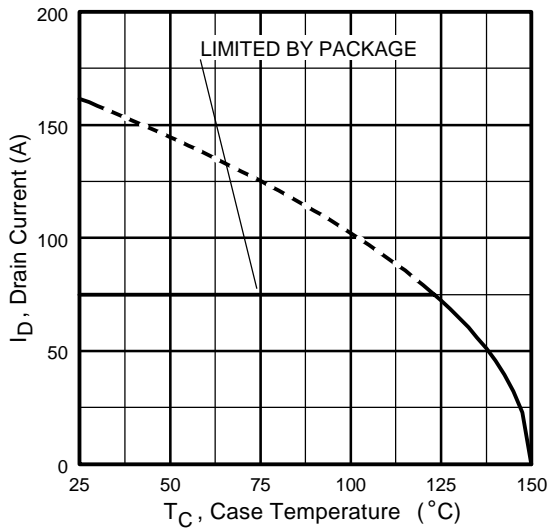


Fig 6. Maximum Drain Current Vs. Case Temperature

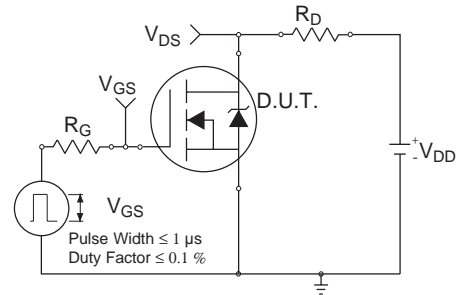


Fig 7a. Switching Time Test Circuit

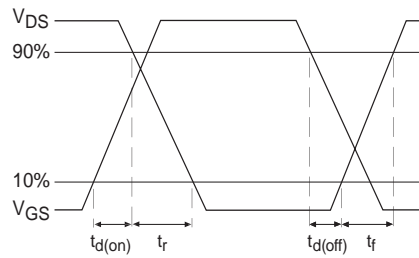


Fig 7b. Switching Time Waveforms

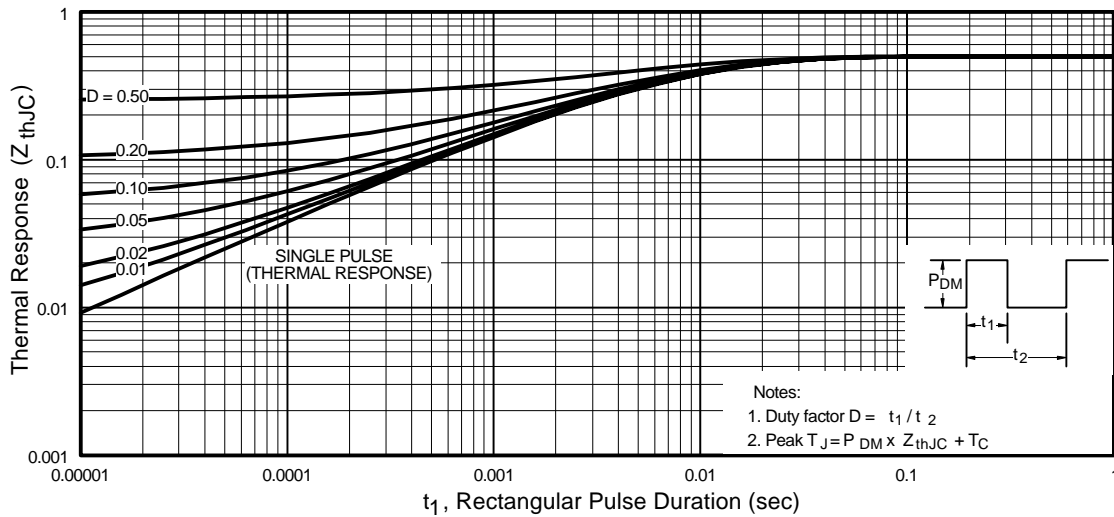
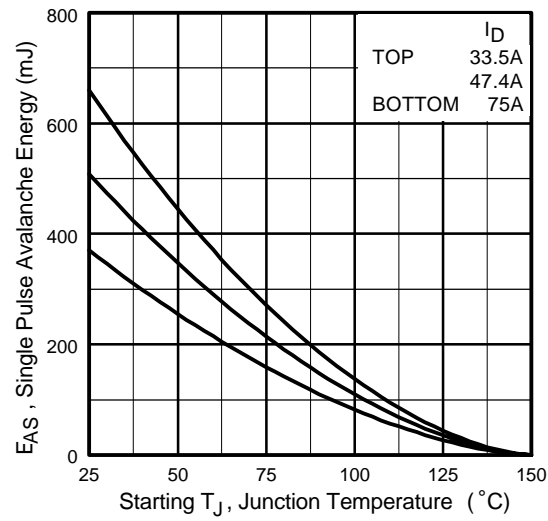
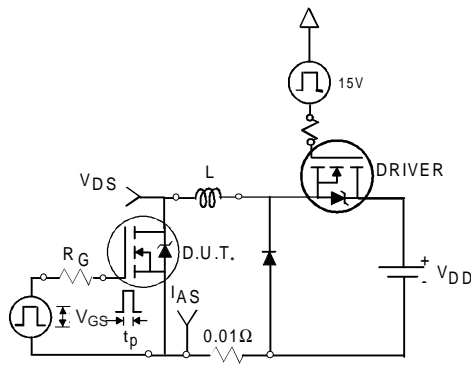


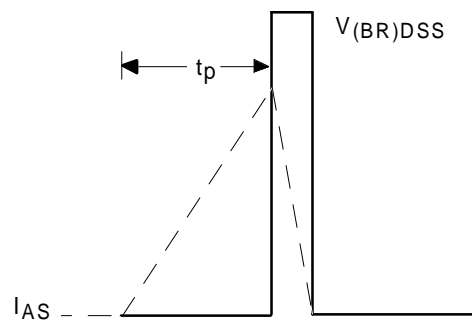
Fig 8. Maximum Effective Transient Thermal Impedance, Junction-to-Case, MOSFET



**Fig 9.** Maximum Avalanche Energy Vs. Drain Current



**Fig 9a.** Unclamped Inductive Test Circuit



**Fig 9b.** Unclamped Inductive Waveforms

MOSFET Body Diode & Schottky Diode Characteristics

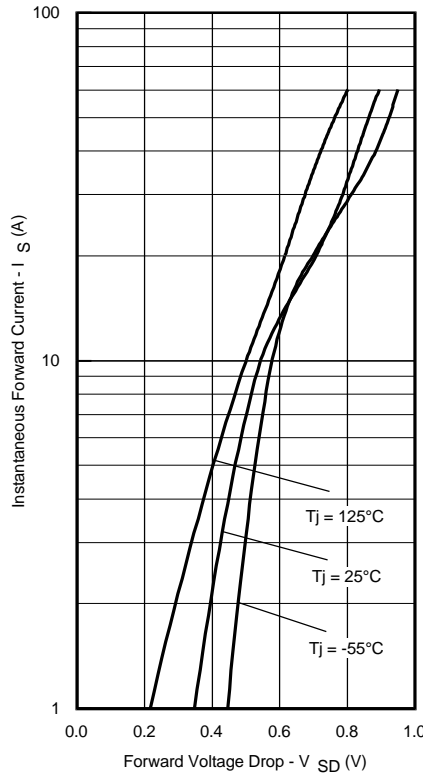


Fig. 10 - Typical Forward Voltage Drop Characteristics

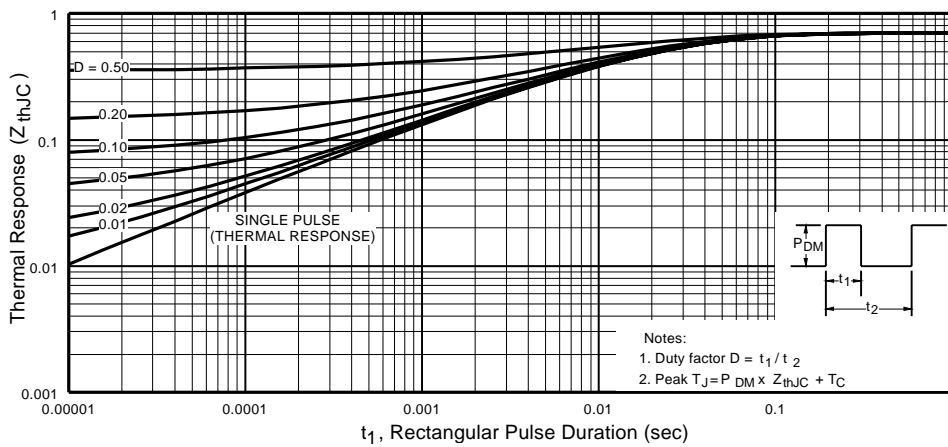


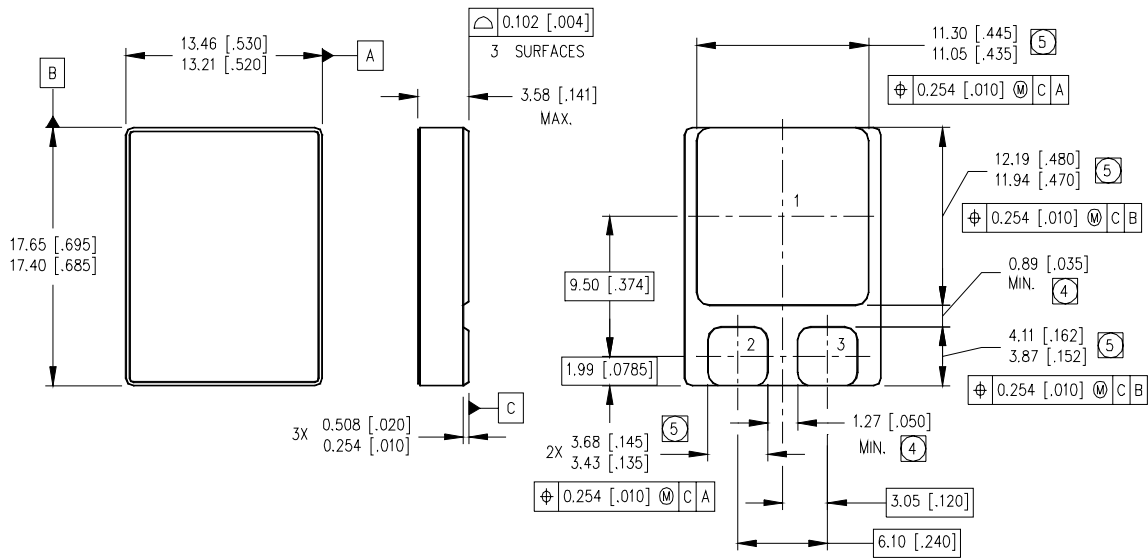
Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case, Schottky



Footnotes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature
- ② Pulse width  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2\%$
- ③ 50% Duty Cycle, Rectangular
- ④  $V_{DD} = 25\text{V}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.13 \text{ mH}$   
Peak  $I_L = 75\text{A}$ ,  $V_{GS} = 12\text{V}$
- 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.
- ⑦ Specified Radiation Characteristics are for Radiation Hardened MOSFET die only.

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



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TAC Fax: (310) 252-7903

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Data and specifications subject to change without notice. 07/02