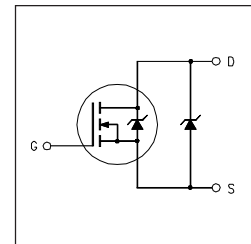
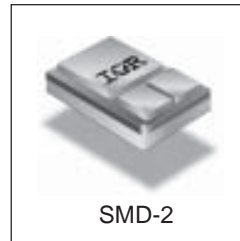


**RAD-HARD  
SYNCHRONOUS RECTIFIER  
SURFACE MOUNT (SMD-2)**

**IRHSNA57Z60  
30V, N-CHANNEL**

**Product Summary**

Part Number	Radiation Level	R <sub>DS(on)</sub>	Q <sub>G</sub>
IRHSNA57Z60	100K Rads (Si)	3.5mΩ	200nC
IRHSNA53Z60	300K Rads (Si)	3.5mΩ	200nC
IRHSNA54Z60	600K Rads (Si)	3.5mΩ	200nC
IRHSNA58Z60	1000K Rads (Si)	4.0mΩ	200nC



**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 IRHSLNA57Z60 for Lower Inductance

**Absolute Maximum Ratings**

**Pre-Irradiation**

	Parameter		Units
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 25°C	Continuous Drain or Source Current	75*	A
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 100°C	Continuous Drain or Source Current	75*	
I <sub>DM</sub>	Pulsed Drain Current ①	300	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	250	W
	Linear Derating Factor	2.0	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	±20	V
E <sub>AS</sub>	Single Pulse Avalanche Energy ④	500	mJ
I <sub>AR</sub>	Avalanche Current ①	75	A
E <sub>AR</sub>	Repetitive Avalanche Energy ①	25	mJ
I <sub>F</sub> (AV) @ T <sub>C</sub> = 25°C	Schottky and Body Diode Avg. Forward Current ③	75*	A
I <sub>F</sub> (AV) @ T <sub>C</sub> = 100°C	Schottky and Body Diode Avg. Forward Current ③	75*	
T <sub>J</sub> , T <sub>STG</sub>	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

www.irf.com

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

	Parameter	Min	Typ	Max	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	30	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	3.5	mΩ	V <sub>GS</sub> = 12V, I <sub>D</sub> = 45A②
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 (Ω)	V <sub>DS</sub> ≥ 15V, I <sub>DS</sub> = 45A②
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	50	μA	V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V
		—	—	50	mA	V <sub>DS</sub> = 24V, 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	—	—	200	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 45A, V <sub>DS</sub> = 15V
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	55		
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	—	40		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	35	ns	V <sub>DD</sub> = 15V, I <sub>D</sub> = 45A, V <sub>GS</sub> = 12V, R <sub>G</sub> = 2.35Ω
t <sub>r</sub>	Rise Time	—	—	160		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	78		
t <sub>f</sub>	Fall Time	—	—	26		
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>SD</sub>	Diode Forward Voltage	—	—	1.15	V	T <sub>J</sub> = -55°C, I <sub>D</sub> = 45A, V <sub>GS</sub> = 0V②
		—	—	1.05		T <sub>J</sub> = 25°C, I <sub>D</sub> = 45A, V <sub>GS</sub> = 0V②
		—	—	0.95		T <sub>J</sub> = 110°C, I <sub>D</sub> = 45A, V <sub>GS</sub> = 0V②
t <sub>rr</sub>	Reverse Recovery Time	—	—	175	nS	T <sub>J</sub> = 25°C, I <sub>F</sub> = 45A, di/dt ≤ 100A/μs
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	500	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

## IRHSNA57Z60

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	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	30	—	30	—	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> = -20 V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	—	25	μA	V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ② On-State Resistance (TO-3)	—	4.0	—	5.0	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)	—	3.5	—	4.0	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

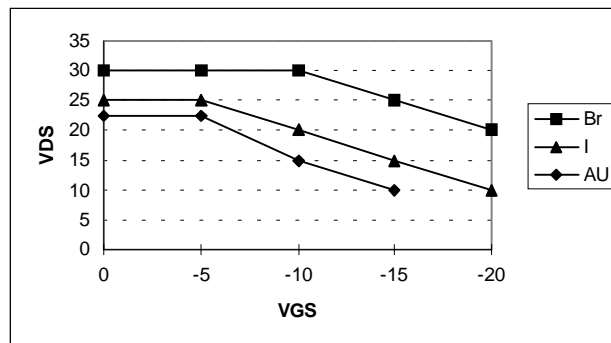
1. Part numbers IRHSNA57Z60, IRHSNA53Z60 and IRHSNA54Z60

2. Part number IRHSNA58Z60

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
Br	37.9	255	33.4	30	30	30	25	20
I	59.4	290	28.8	25	25	20	15	10
Au	80.3	313	26.5	22.5	22.5	15	10	—



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

For footnotes refer to the last page

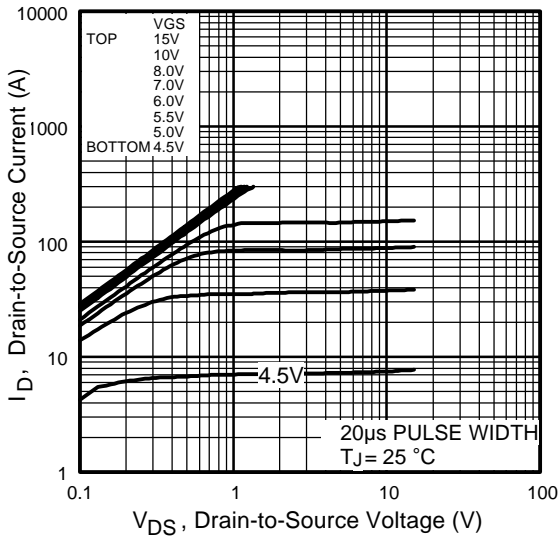


Fig 1. Typical Output Characteristics

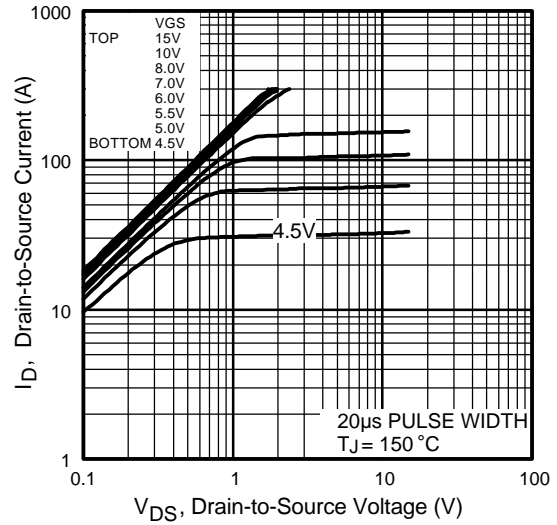


Fig 2. Typical Output Characteristics

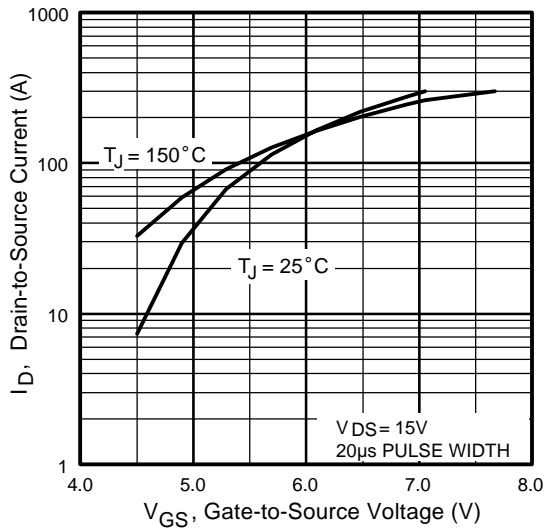


Fig 3. Typical Transfer Characteristics

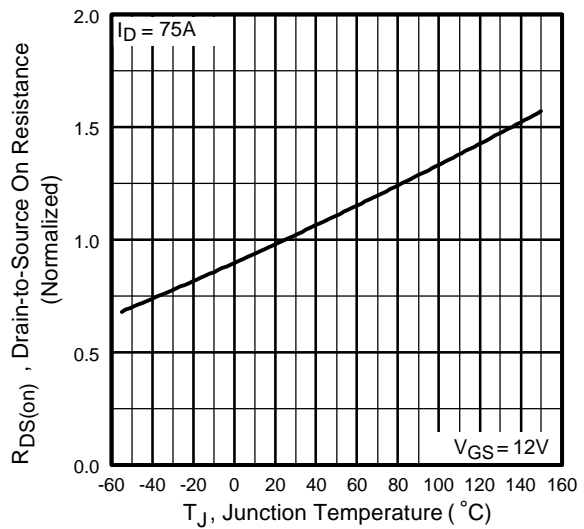


Fig 4. Normalized On-Resistance Vs. Temperature

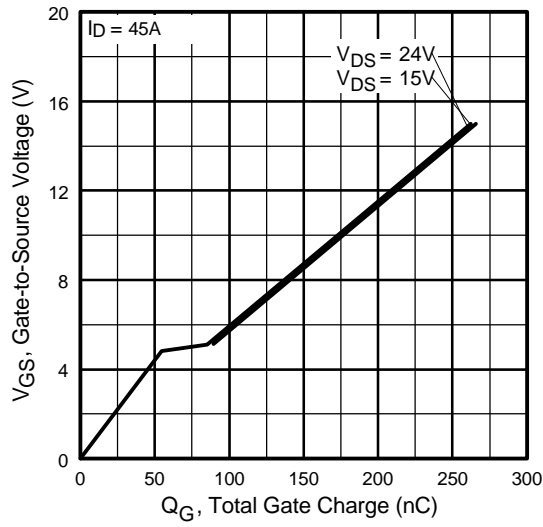


Fig 5. Typical Gate Charge Vs. Gate-to-Source Voltage

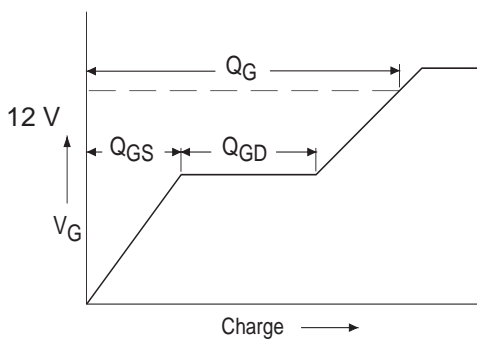


Fig 5a. Basic Gate Charge Waveform

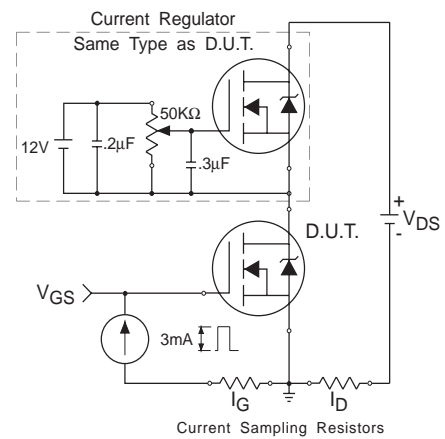


Fig 5b. Gate Charge Test Circuit

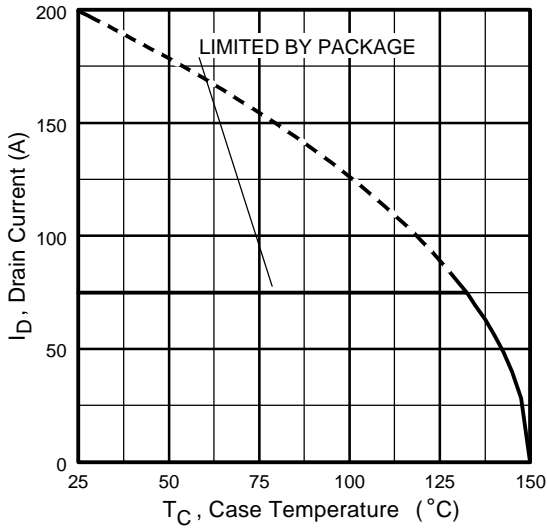


Fig 6. Maximum Drain Current Vs. Case Temperature

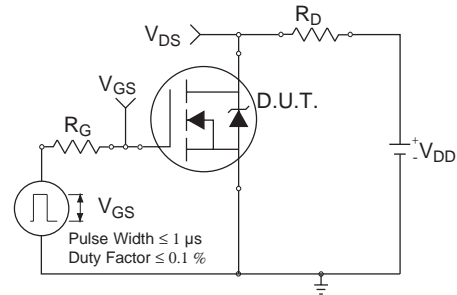


Fig 7a. Switching Time Test Circuit

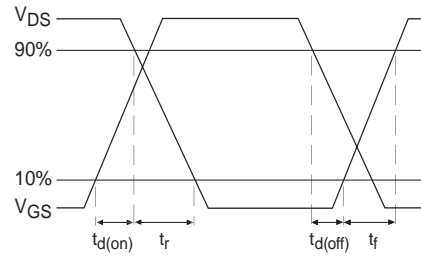


Fig 7b. Switching Time Waveforms

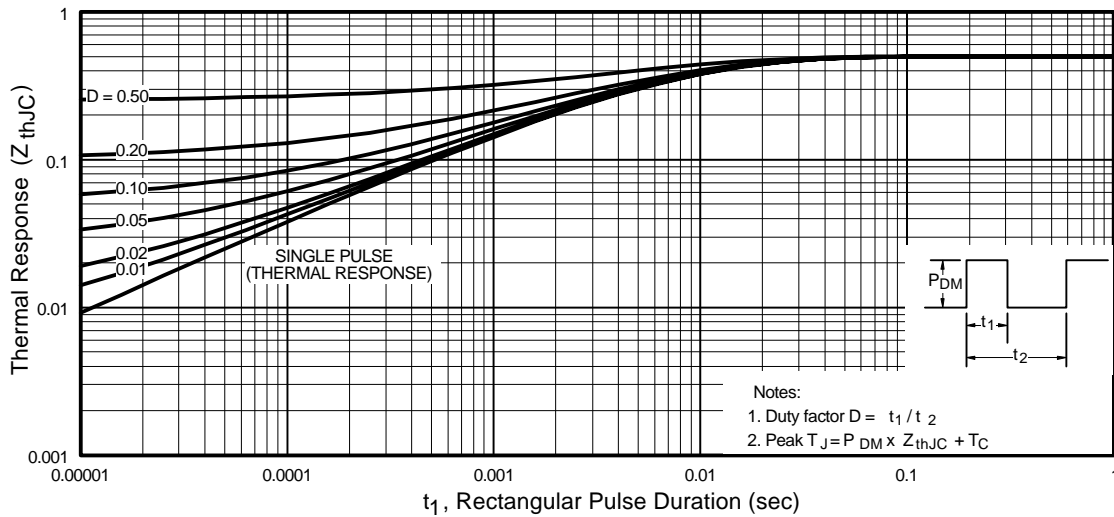
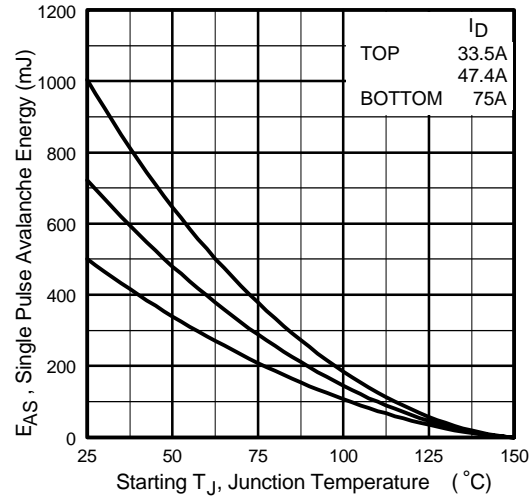
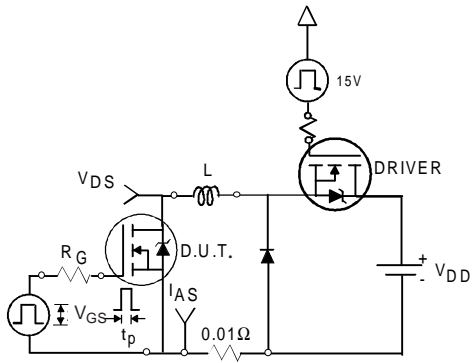


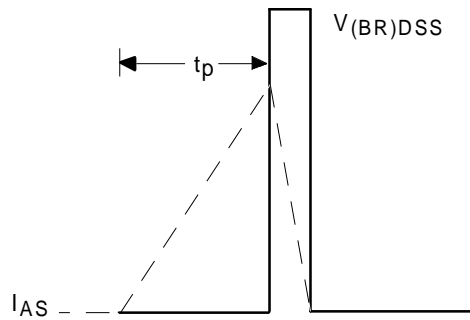
Fig 8. Maximum Effective Transient Thermal Impedance, Junction-to-Case, MOSFET



**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

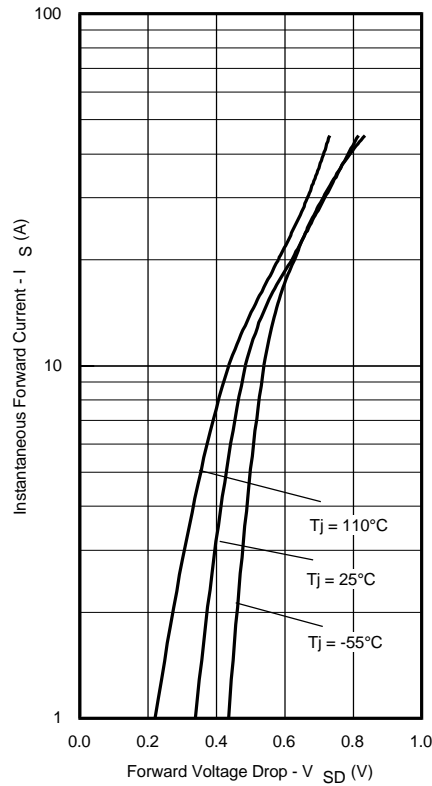


Fig. 10 - Typical Forward Voltage Drop Characteristics

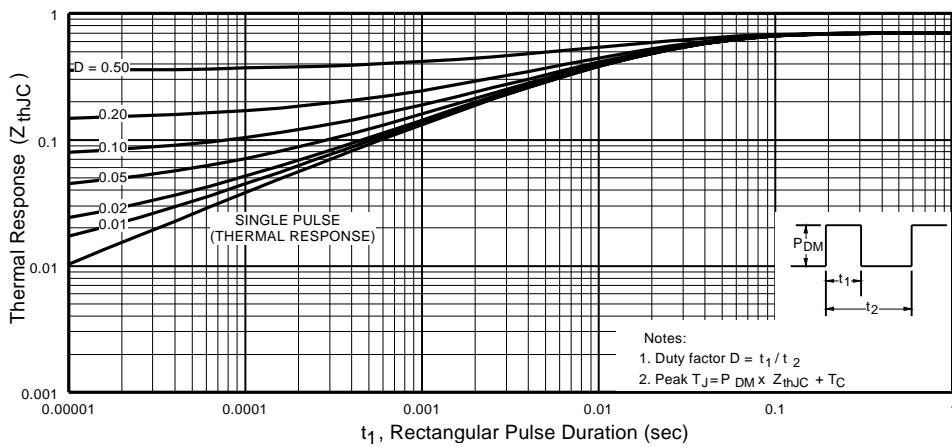


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case, Schottky





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