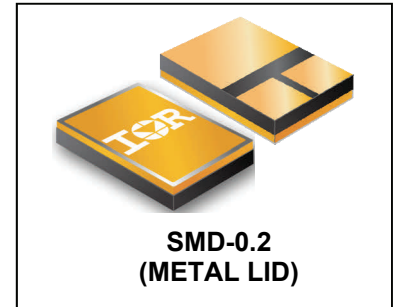


**RADIATION HARDENED  
POWER MOSFET  
SURFACE MOUNT (SMD-0.2)**

**100V, N-CHANNEL**  
**REF: MIL-PRF-19500/743**  
**R5 TECHNOLOGY**

**Product Summary**

Part Number	Radiation Level	RDS(on)	I <sub>D</sub>	QPL Part Number
IRHNM57110	100 kRads(Si)	0.22Ω	6.9A	JANSR2N7503U8
IRHNM53110	300 kRads(Si)	0.22Ω	6.9A	JANSF2N7503U8
IRHNM55110	500 kRads(Si)	0.22Ω	6.9A	JANSG2N7503U8
IRHNM58110	1000 kRads(Si)	0.22Ω	6.9A	JANSH2N7503U8



**Description**

IR HiRel R5 technology provides high performance power MOSFETs for space applications. These devices have been characterized for Single Event Effects (SEE) with useful performance up to an LET of 80 (MeV/(mg/cm<sup>2</sup>)). The combination of low R<sub>ds(on)</sub> and low gate charge reduces the power losses in switching applications such as DC to DC converters and motor control. These devices retain all of the well established advantages of MOSFETs such as voltage control, fast switching and temperature

**Features**

- Single Event Effect (SEE) Hardened
- Low RDS(on)
- Low Total Gate Charge
- Simple Drive Requirements
- Hermetically Sealed
- Surface Mount
- Ceramic Package
- Light Weight
- Complimentary P-Channel Available - IRHNM597110, IRHNMC597110

**Absolute Maximum Ratings**

Symbol	Parameter	Value	Units	Pre-Irradiation
I <sub>D1</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 25°C	Continuous Drain Current	6.9		
I <sub>D2</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 100°C	Continuous Drain Current	4.4		A
I <sub>DM</sub> @ T <sub>C</sub> = 25°C	Pulsed Drain Current ①	27.6		
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	23		W
	Linear Derating Factor	0.18		W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	± 20		V
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	24		mJ
I <sub>AR</sub>	Avalanche Current ①	6.9		A
E <sub>AR</sub>	Repetitive Avalanche Energy ①	2.3		mJ
dv/dt	Peak Diode Recovery dv/dt ③	11.5		V/ns
T <sub>J</sub> T <sub>STG</sub>	Operating Junction and Storage Temperature Range	-55 to + 150		°C
	Lead Temperature	300 (for 5s)		
	Weight	0.25 (Typical)		g

For footnotes refer to the page 2.

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	100	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.13	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	—	0.22	Ω	V <sub>GS</sub> = 12V, I <sub>D2</sub> = 4.4A ④
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
ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub>	Gate Threshold Voltage Coefficient	—	-7.5	—	mV/°C	
G <sub>fs</sub>	Forward Transconductance	3.6	—	—	S	V <sub>DS</sub> = 15V, I <sub>D2</sub> = 4.4A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	10	μA	V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V
		—	—	25		V <sub>DS</sub> = 80V, 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
	Gate-to-Source Leakage Reverse	—	—	-100		V <sub>GS</sub> = -20V
Q <sub>G</sub>	Total Gate Charge	—	—	15	nC	I <sub>D1</sub> = 6.9A
Q <sub>GS</sub>	Gate-to-Source Charge	—	—	4.0		V <sub>DS</sub> = 50V
Q <sub>GD</sub>	Gate-to-Drain ('Miller') Charge	—	—	5.0		V <sub>GS</sub> = 12V
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	6.6	ns	V <sub>DD</sub> = 50V
Tr	Rise Time	—	—	8.0		I <sub>D1</sub> = 6.9A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	34		R <sub>G</sub> = 7.5Ω
Tf	Fall Time	—	—	15		V <sub>GS</sub> = 12V
L <sub>S</sub> + L <sub>D</sub>	Total Inductance	—	6.8	—	nH	Measured from Drain lead (6mm / 0.25 in from package) to Source lead (6mm / 0.25 in from package) with Source wire internally bonded from Source pin to Drain pad
C <sub>iss</sub>	Input Capacitance	—	378	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	108	—		V <sub>DS</sub> = 25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	2.3	—		f = 100KHz
R <sub>G</sub>	Gate Resistance	—	8.0	—	Ω	f = 1.0MHz, open drain

**Source-Drain Diode Ratings and Characteristics**

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	6.9	A	
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	27.6		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.2	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 6.9A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	—	144	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 6.9A, V <sub>DD</sub> ≤ 50V di/dt = 100A/μs ④
Q <sub>rr</sub>	Reverse Recovery Charge	—	—	633	nC	
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

**Thermal Resistance**

Symbol	Parameter	Min.	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case	—	—	5.4	°C/W

**Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ② V<sub>DD</sub> = 50V, starting T<sub>J</sub> = 25°C, L = 1.0mH, Peak I<sub>L</sub> = 6.9A, V<sub>GS</sub> = 12V
- ③ I<sub>SD</sub> ≤ 6.9A, di/dt ≤ 560A/μs, V<sub>DD</sub> ≤ 100V, T<sub>J</sub> ≤ 150°C
- ④ Pulse width ≤ 300 μs; Duty Cycle ≤ 2%
- ⑤ Total Dose Irradiation with V<sub>GS</sub> Bias. 12 volt V<sub>GS</sub> applied and V<sub>DS</sub> = 0 during irradiation per MIL-STD-750, Method 1019, condition A.
- ⑥ Total Dose Irradiation with V<sub>DS</sub> Bias. 80 volt V<sub>DS</sub> applied and V<sub>GS</sub> = 0 during irradiation per MIL-STD-750, Method 1019, condition A.

## Radiation Characteristics

IR HiRel 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.

**Table1. Electrical Characteristics @ Tj = 25°C, Post Total Dose Irradiation ⑤⑥**

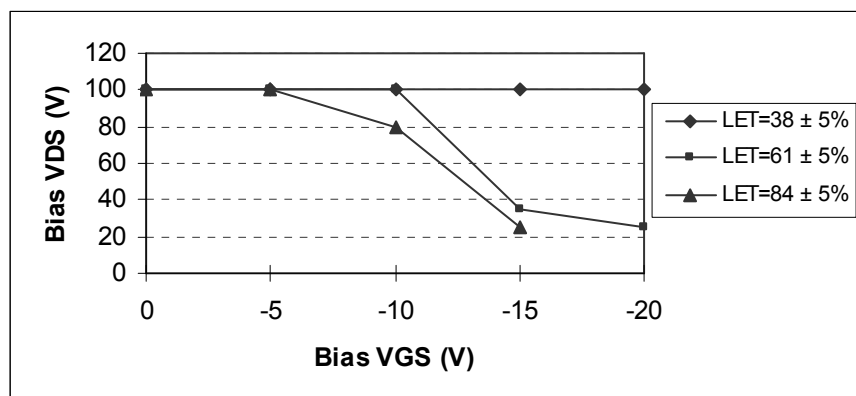
Symbol	Parameter	Up to 500 kRads (Si) <sup>1</sup>		1000 kRads (Si) <sup>2</sup>		Units	Test Conditions
		Min.	Max.	Min.	Max.		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	100	—	100	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	4.0	1.5	4.0	V	V <sub>DS</sub> = V <sub>GS</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	nA	V <sub>GS</sub> = -20V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	—	10	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (TO - 3)	—	0.226	—	0.246	Ω	V <sub>GS</sub> = 12V, I <sub>D2</sub> = 4.4A
R <sub>DS(on)</sub>	Static Drain-to-Source ④ On-State Resistance (SMD – 0.2)	—	0.226	—	0.246	Ω	V <sub>GS</sub> = 12V, I <sub>D2</sub> = 4.4A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.2	—	1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 6.9A

1. Part numbers IRHNM57110 (JANSR2N7503U8), IRHNM53110 (JANSF2N7503U8), and IRHNM55110 (JANSR2N7503U8),
2. Part numbers IRHNM58110 (JANSH2N7503U8)

IR HiRel 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.

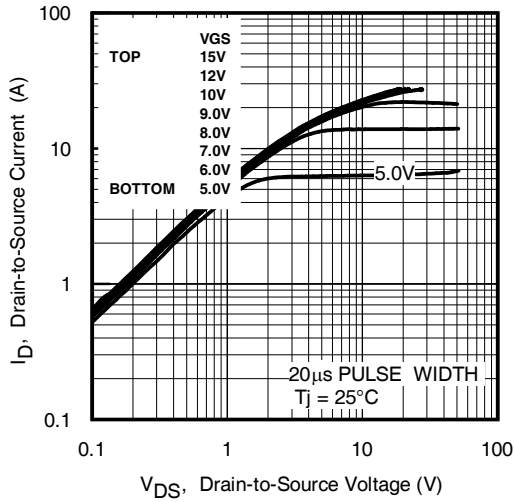
**Table 2. Typical Single Event Effect Safe Operating Area**

LET (MeV/(mg/cm <sup>2</sup> ))	Energy (MeV)	Range (μm)	VDS (V)				
			@ VGS = 0V	@ VGS = -5V	@ VGS = -10V	@ VGS = -15V	@ VGS = -20V
38 ± 5%	300 ± 7.5%	38 ± 7.5%	100	100	100	100	100
61 ± 5%	330 ± 7.5%	31 ± 10%	100	100	100	35	25
84 ± 5%	350 ± 10%	28 ± 7.5%	100	100	80	25	—

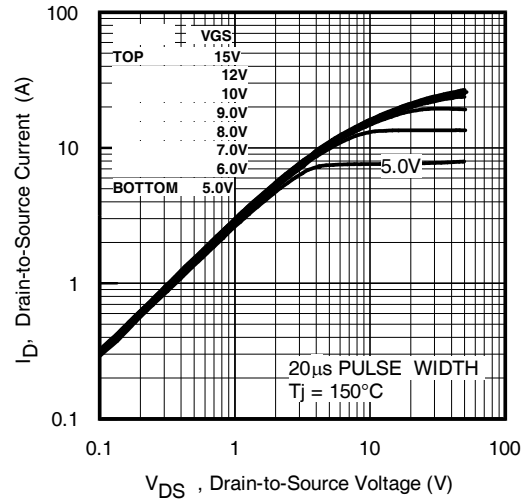


**Fig a. Typical Single Event Effect, Safe Operating Area**

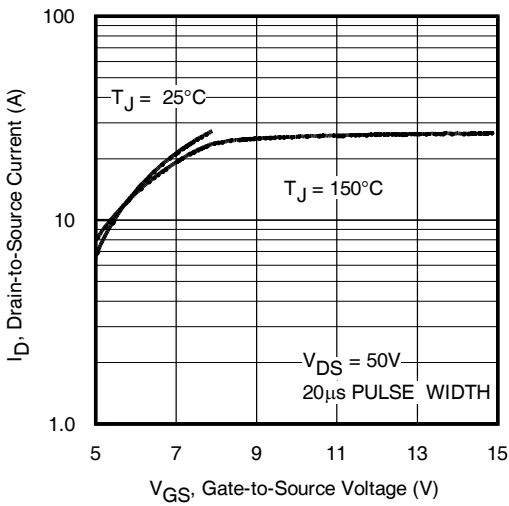
For footnotes refer to the page 2.



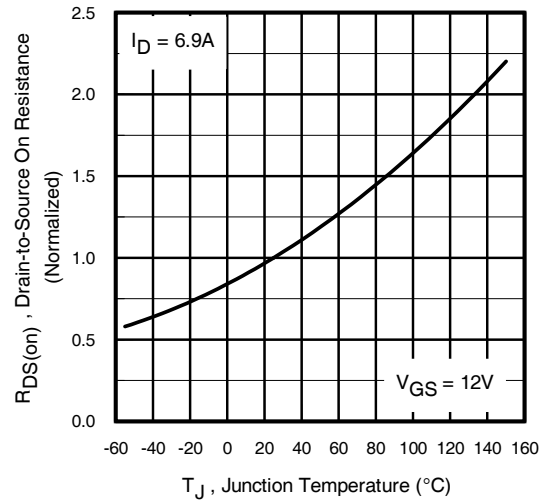
**Fig 1. Typical Output Characteristics**



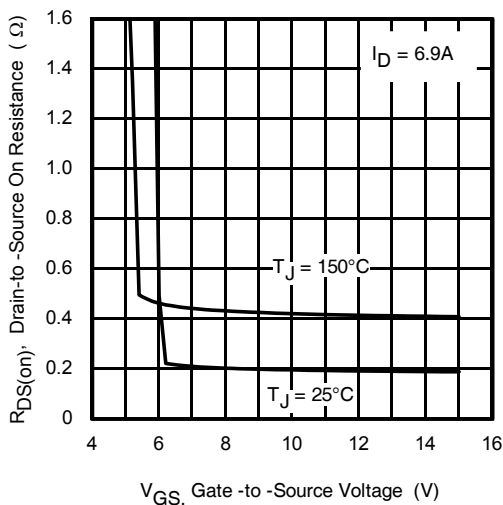
**Fig 2. Typical Output Characteristics**



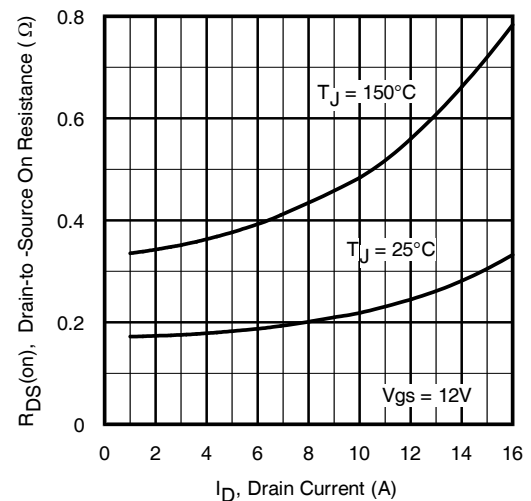
**Fig 3. Typical Transfer Characteristics**



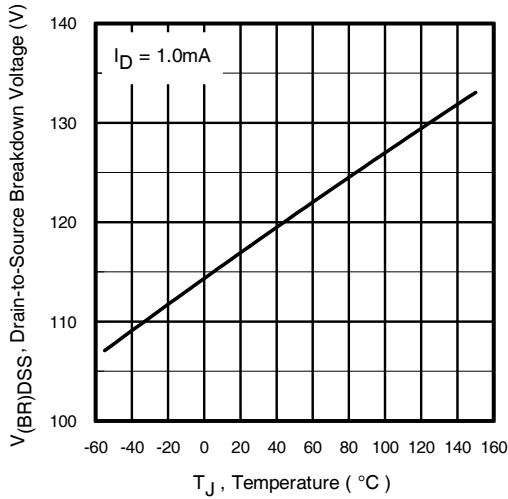
**Fig 4. Normalized On-Resistance Vs. Temperature**



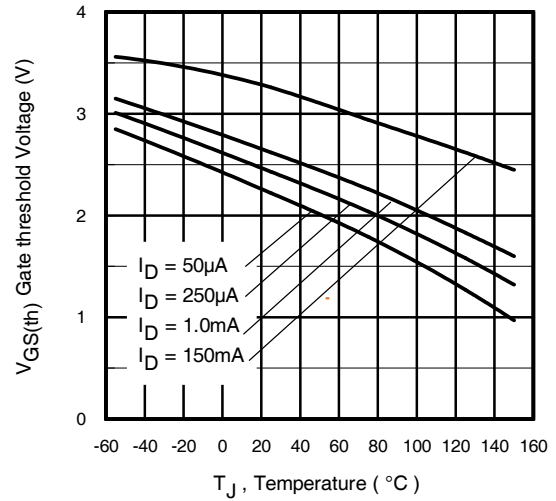
**Fig 5. Typical On-Resistance Vs Gate Voltage**



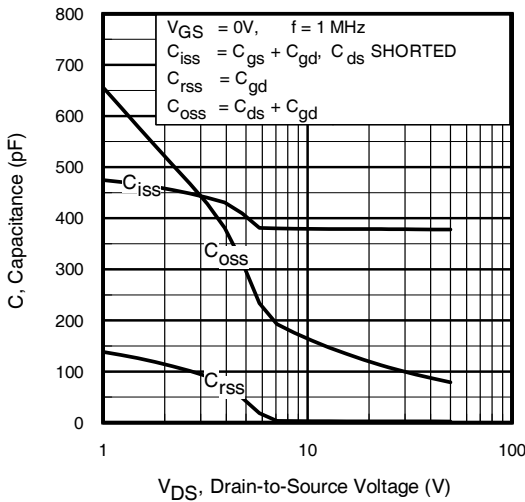
**Fig 6. Typical On-Resistance Vs Drain Current**



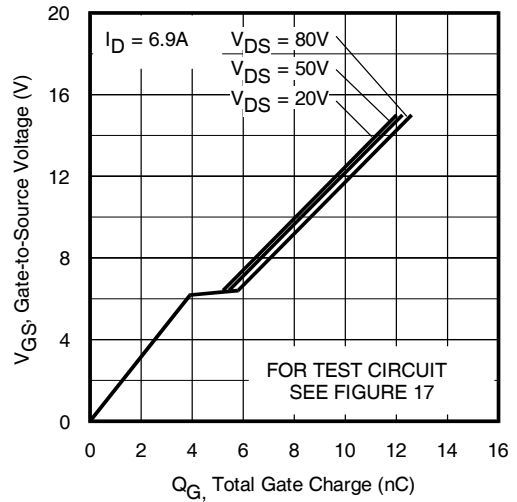
**Fig 7.** Typical Drain-to-Source Breakdown Voltage Vs Temperature



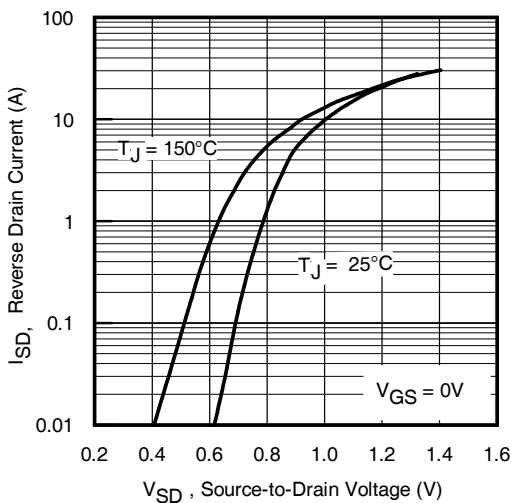
**Fig 8.** Typical Threshold Voltage Vs Temperature



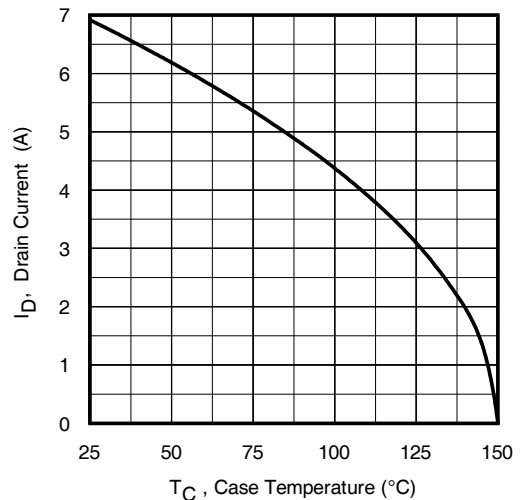
**Fig 9.** Typical Capacitance Vs. Drain-to-Source Voltage



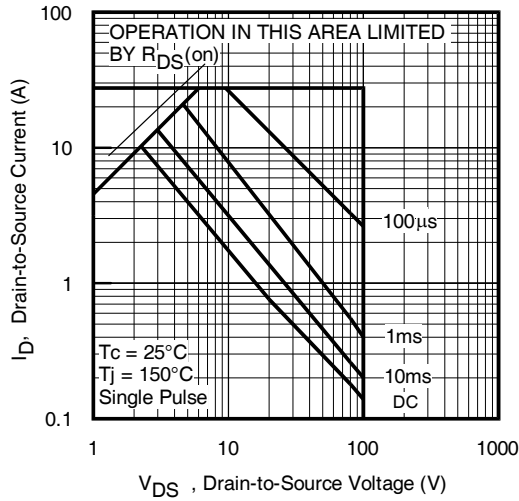
**Fig 10.** Typical Gate Charge Vs. Gate-to-Source Voltage



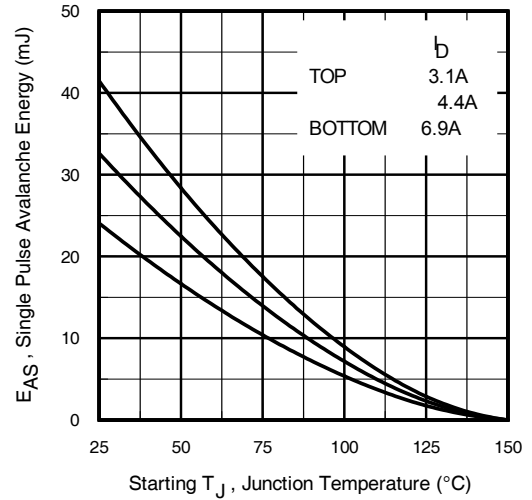
**Fig 11.** Typical Source-Drain Diode Forward Voltage



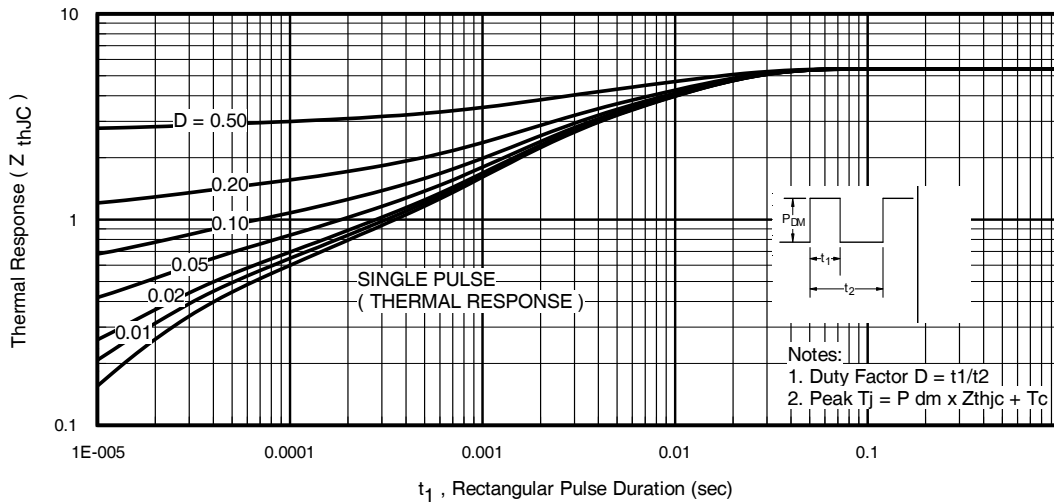
**Fig 12.** Maximum Drain Current Vs. Case Temperature



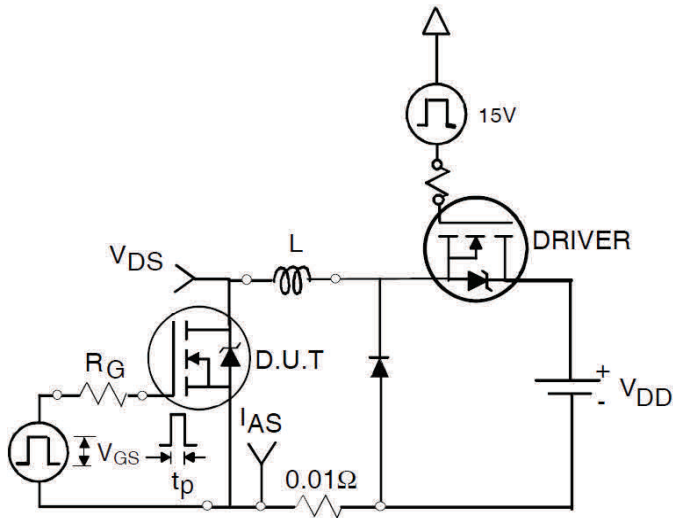
**Fig 13.** Maximum Safe Operating Area



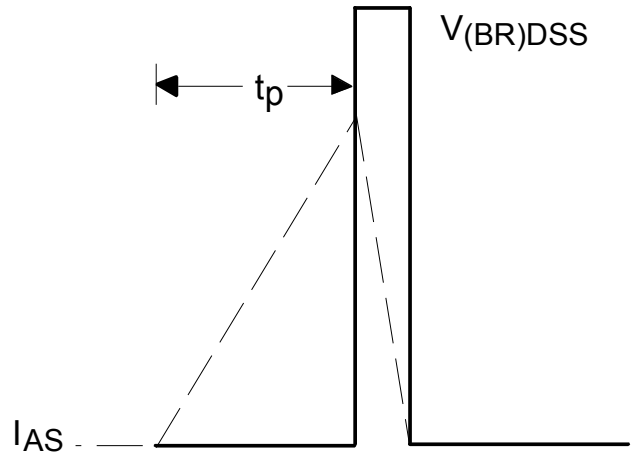
**Fig 14.** Maximum Avalanche Energy Vs. Drain Current



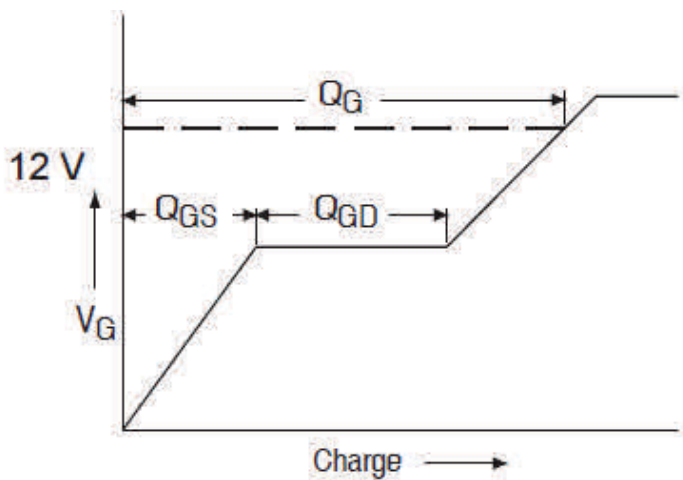
**Fig 15.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



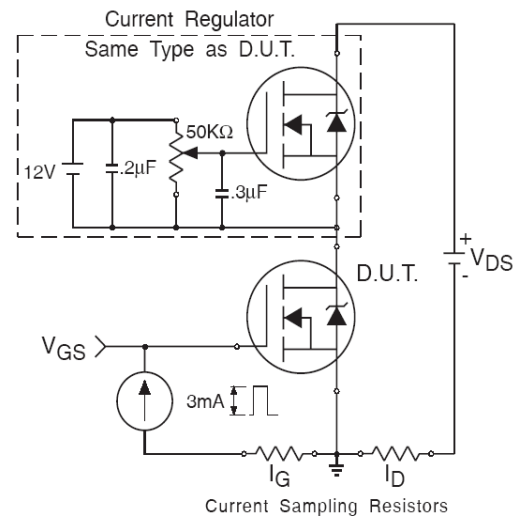
**Fig 16a.** Unclamped Inductive Test Circuit



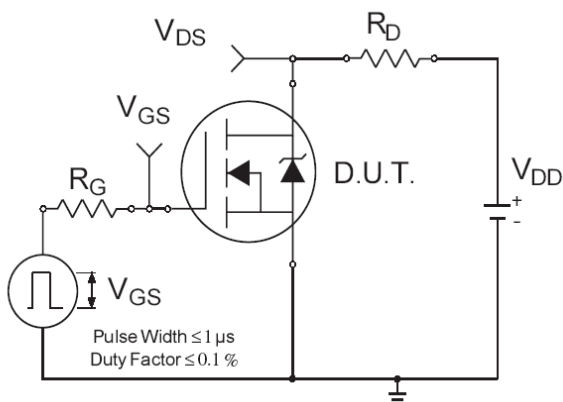
**Fig 16b.** Unclamped Inductive Waveforms



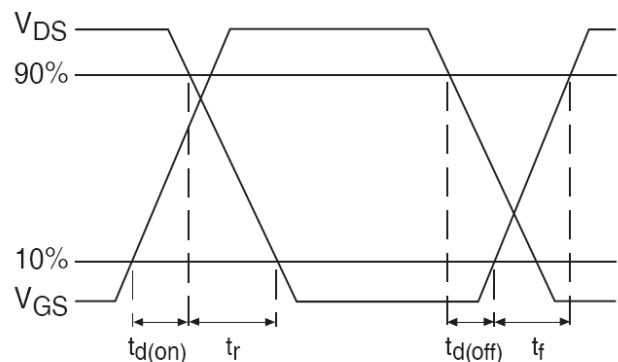
**Fig 17a.** Gate Charge Waveform



**Fig 17b.** Gate Charge Test Circuit

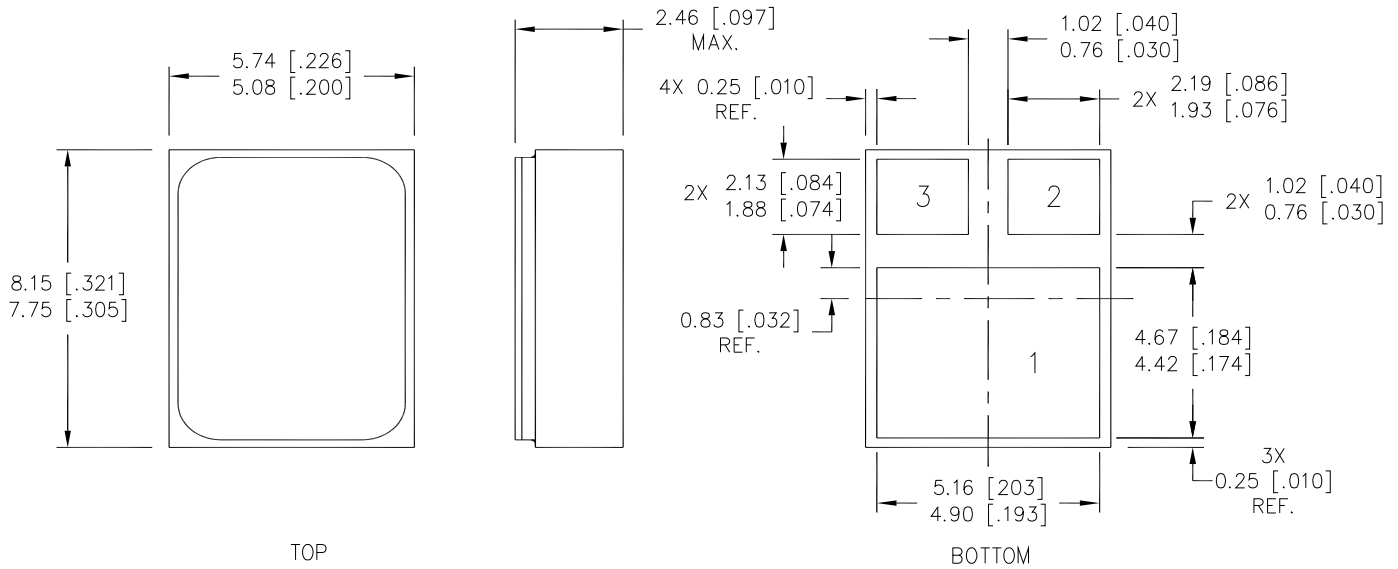


**Fig 18a.** Switching Time Test Circuit



**Fig 18b.** Switching Time Waveforms

**Case Outline and Dimensions - SMD-0.2 ( Metal Lid)**



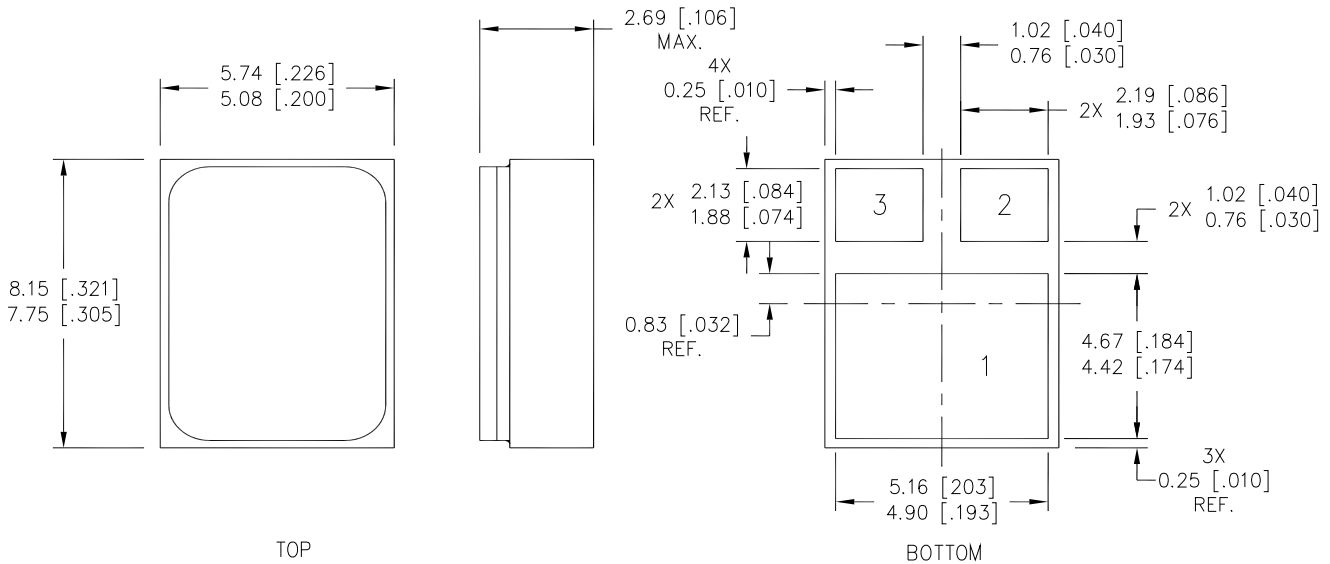
**NOTES:**

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].

PAD ASSIGNMENTS

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

**Case Outline and Dimensions - SMD-0.2 ( Ceramic Lid)**



**NOTES:**

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].


PAD ASSIGNMENTS

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



**Additional Product Summary (continued from pages 1 and 3)**

**Product Summary**

Part Number	Radiation Level	RDS(on)	I <sub>D</sub>	QPL Part Number	 <p>SMD-0.2 (CERAMIC LID)</p>
IRHNMC57110	100 kRads(Si)	0.22Ω	6.9A	JANSR2N7503U8	
IRHNMC53110	300 kRads(Si)	0.22Ω	6.9A	JANSF2N7503U8	
IRHNMC55110	500 kRads(Si)	0.22Ω	6.9A	JANSG2N7503U8	
IRHNMC58110	1000 kRads(Si)	0.22Ω	6.9A	JANSH2N7503U8	

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