PD-97179B

International
IOR Rectifier

IRHNM597110
JANSR2N7506U8
100V, P-CHANNEL
REF: MIL-PRF-19500/749

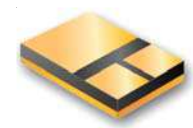
RADIATION HARDENED POWER MOSFET SURFACE MOUNT (SMD-0.2)

R5 TECHNOLOGY

Product Summary

Part Number	Radiation Level	$R_{DS(on)}$	I_D	QPL Part Number
IRHNM597110	100K Rads (Si)	1.2Ω	-3.1A	JANSR2N7506U8
IRHNM593110	300K Rads (Si)	1.2Ω	-3.1A	JANSF2N7506U8

Refer to Page 10 for 1 Additional Part Number - IRHNMC597110 (Ceramic Lid)



SMD-0.2
(METAL LID)

International Rectifier's R5[TM] 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^2)). The combination of low $R_{DS(on)}$ 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, ease of paralleling and temperature stability of electrical parameters.

Features:
- Single Event Effect (SEE) Hardened
- Low $R_{DS(on)}$
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Surface Mount
- Ceramic Package
- Light Weight
- Complimentary N-Channel Available - IRHNM57110, IRHNMC57110

Absolute Maximum Ratings — Pre-Irradiation

	Parameter		Units
I_D @ V_{GS} = -12V, T_C = 25°C	Continuous Drain Current	-3.1	A
I_D @ V_{GS} = -12V, T_C = 100°C	Continuous Drain Current	-2.0	
I_{DM}	Pulsed Drain Current ①	-12.4	
P_D @ T_C = 25°C	Max. Power Dissipation	23	W
	Linear Derating Factor	0.18	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	28	mJ
I_{AR}	Avalanche Current ①	-3.1	A
E_{AR}	Repetitive Avalanche Energy ①	2.3	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-21	V/ns
T_J T_{STG}	Operating Junction Storage Temperature Range	-55 to 150	°C
	Lead Temperature	300 (for 5s)	
	Weight	0.25 (Typical)	g

For footnotes refer to the last page

09/03/10

Electrical Characteristics @ Tj = 25°C (Unless Otherwise Specified)

	Parameter	Min	Typ	Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-100	—	—	V	V_{GS} = 0V, I_D = -1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	-0.13	—	V/°C	Reference to 25°C, I_D = -1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	1.2	Ω	V_{GS} = -12V, I_D = -2.0A ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	V_{DS} = V_{GS}, I_D = -1.0mA
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	4.88	—	mV/°C	
g_{fs}	Forward Transconductance	1.9	—	—	S	V_{DS} = -15V, I_{DS} = -2.0A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	-10	µA	V_{DS}= -80V ,V_{GS}=0V
		—	—	-25		V_{DS} = -80V, 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	—	—	11	nC	V_{GS} = -12V, I_D = -3.1A
Q_{gs}	Gate-to-Source Charge	—	—	5.0		V_{DS} = -50V
Q_{gd}	Gate-to-Drain ('Miller') Charge	—	—	4.0		
$t_{d(on)}$	Turn-On Delay Time	—	—	18	ns	V_{DD} = -50V, I_D = -3.1A,
t_r	Rise Time	—	—	26		V_{GS} = -12V, R_G = 7.5Ω
$t_{d(off)}$	Turn-Off Delay Time	—	—	24		
t_f	Fall Time	—	—	85		
$L_S + L_D$	Total Inductance	—	6.8	—	nH	Measured from the center of drain pad to center of source pad
C_{iss}	Input Capacitance	—	379	—	pF	V_{GS} = 0V, V_{DS} = -25V
C_{oss}	Output Capacitance	—	98	—		f = 100KHz
C_{rss}	Reverse Transfer Capacitance	—	9.5	—		
R_g	Gate Resistance	—	24	—	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)	—	—	-3.1	A	
I_{SM}	Pulse Source Current (Body Diode)①	—	—	-12.4		
V_{SD}	Diode Forward Voltage	—	—	-5.0	V	T_j = 25°C, I_S = -3.1A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	100	ns	T_j = 25°C, I_F = -3.1A, di/dt ≤ -100A/µs
Q_{RR}	Reverse Recovery Charge	—	—	271	nC	V_{DD} ≤ -50V ④
t_{on}	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
R_{thJC}	Junction-to-Case	—	—	5.4	°C/W	

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

For footnotes refer to the last page

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 ⑤ ⑥

	Parameter	Up to 300K Rads (Si)[1] Min	Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-100	—	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} = -80V, V_{GS} = 0V
$R_{DS(on)}$	Static Drain-to-Source④ On-State Resistance (TO-3)	—	0.916	Ω	V_{GS} = -12V, I_D = -2.0A
$R_{DS(on)}$	Static Drain-to-Source On-state ④ Resistance (SMD-0.2)	—	1.2	Ω	V_{GS} = -12V, I_D = -2.0A
V_{SD}	Diode Forward Voltage ④	—	-5.0	V	V_{GS} = 0V, I_D = -3.1A

1. Part Number IRHNM597110, IRHNM593110 and additional part numbers listed on page 10.

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
38 ± 5%	270 ± 7.5%	35 ± 7.5%	-100	-100	-100	-100	-100
61 ± 5%	330 ± 7.5%	30 ± 7.5%	-100	-100	-100	-100	-25
84 ± 5%	350 ± 7.5%	28 ± 7.5%	-100	-100	-100	-30	-

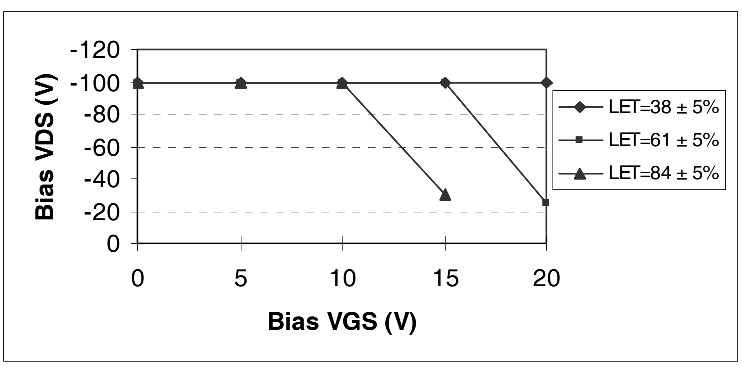


Fig a. Typical Single Event Effect, Safe Operating Area

For footnotes refer to the last page

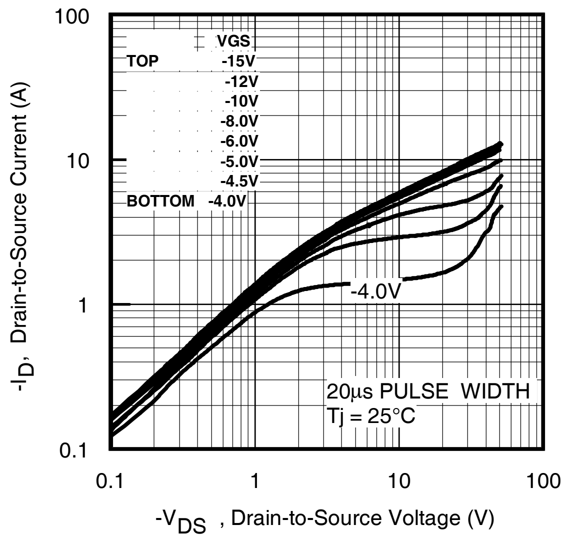


Fig 1. Typical Output Characteristics

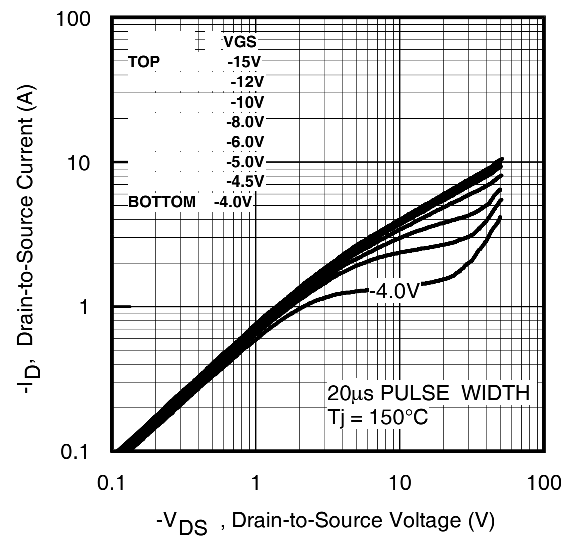


Fig 2. Typical Output Characteristics

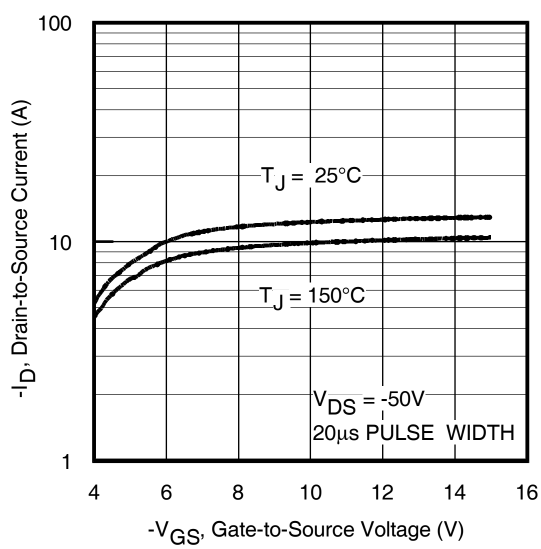


Fig 3. Typical Transfer Characteristics

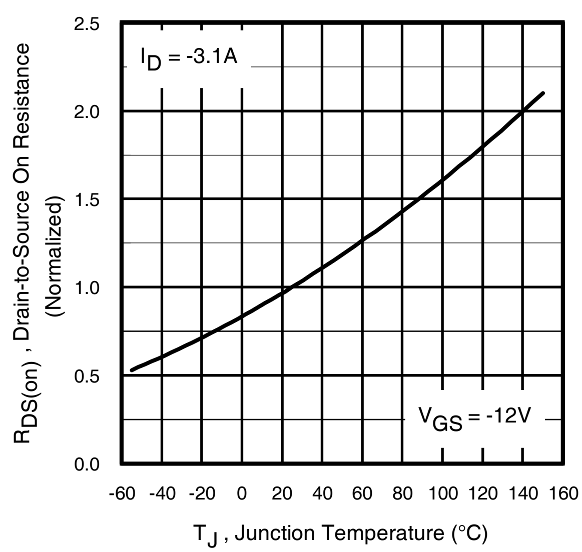


Fig 4. Normalized On-Resistance Vs. Temperature

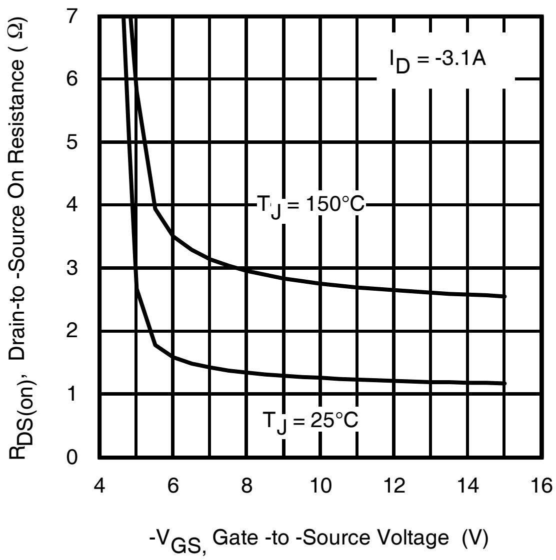


Fig 5. Typical On-Resistance Vs Gate Voltage

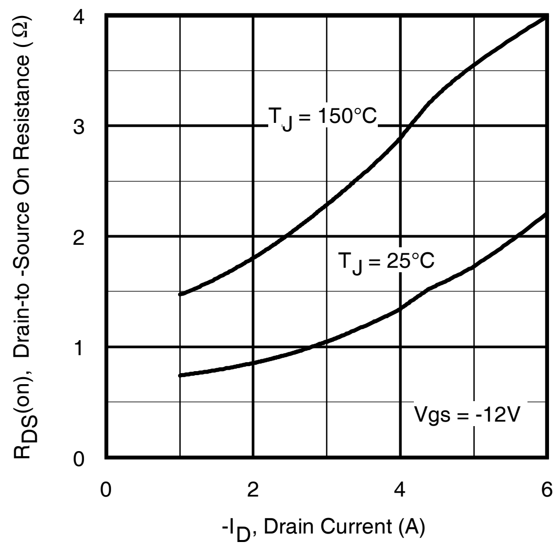


Fig 6. Typical On-Resistance Vs Drain Current

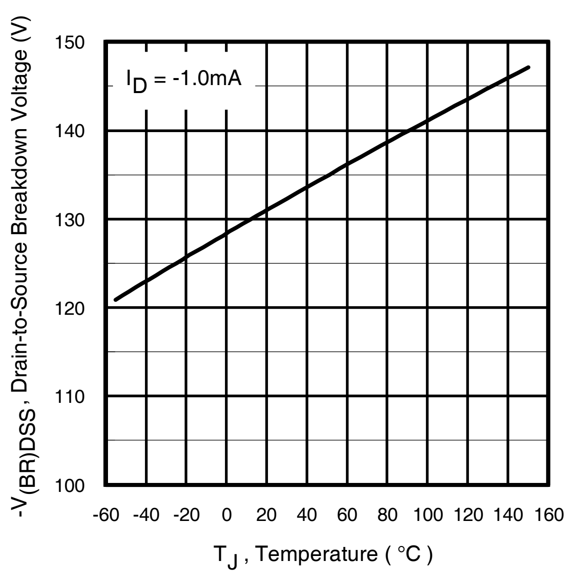


Fig 7. Typical Drain-to-Source Breakdown Voltage Vs Temperature

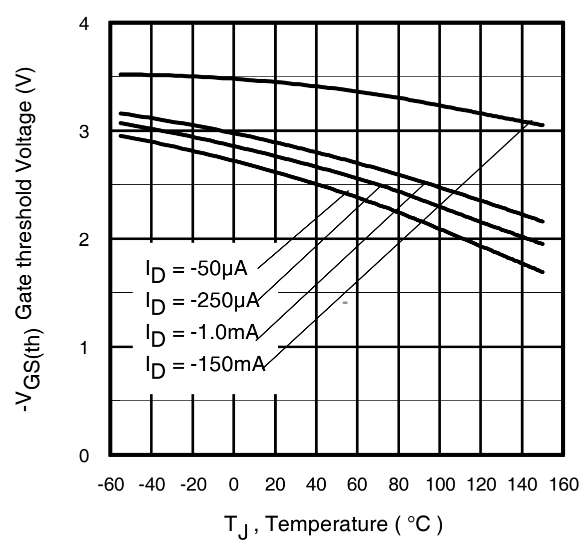


Fig 8. Typical Threshold Voltage Vs Temperature

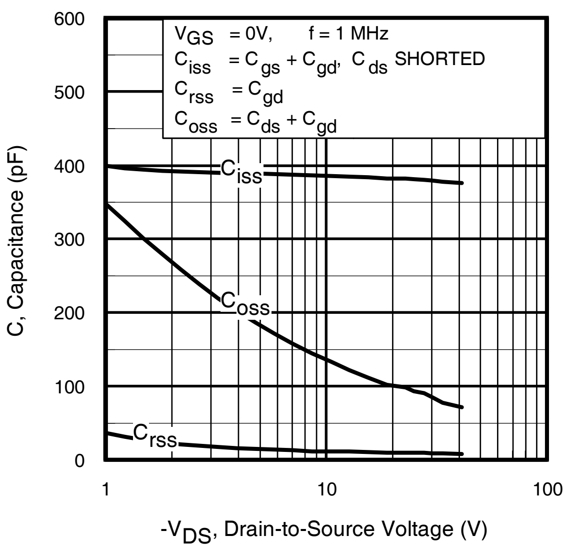


Fig 9. Typical Capacitance Vs. Drain-to-Source Voltage

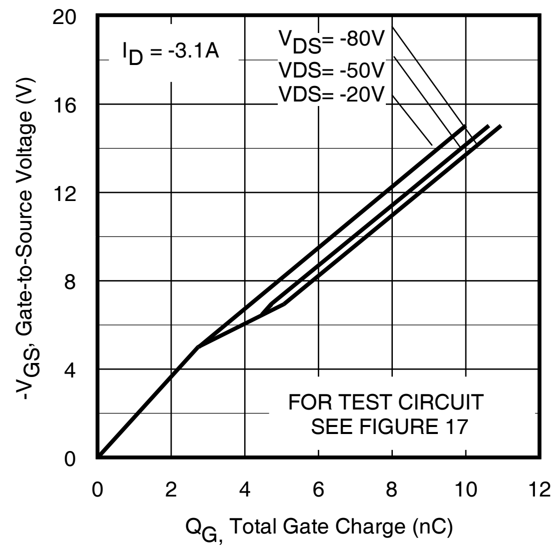


Fig 10. Typical Gate Charge Vs. Gate-to-Source Voltage

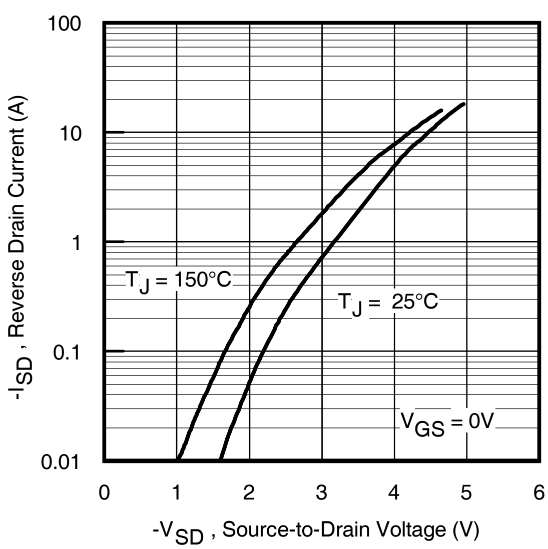


Fig 11. Typical Source-Drain Diode Forward Voltage

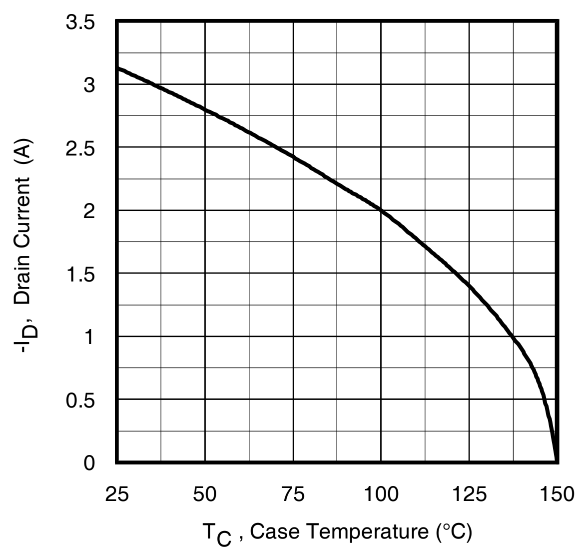


Fig 12. Maximum Drain Current Vs. Case Temperature

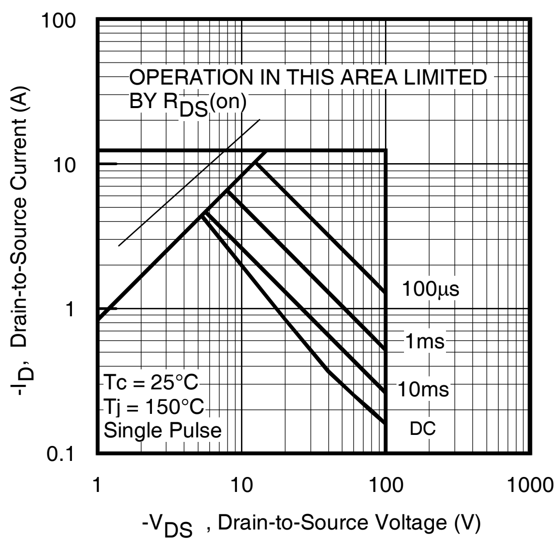


Fig 13. Maximum Safe Operating Area

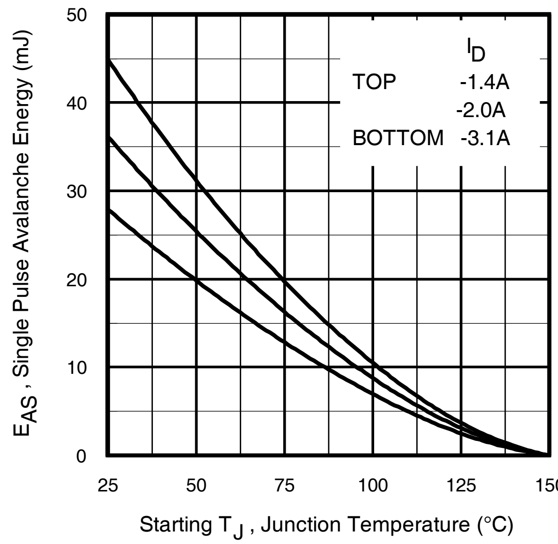


Fig 14. Maximum Avalanche Energy Vs. Drain Current

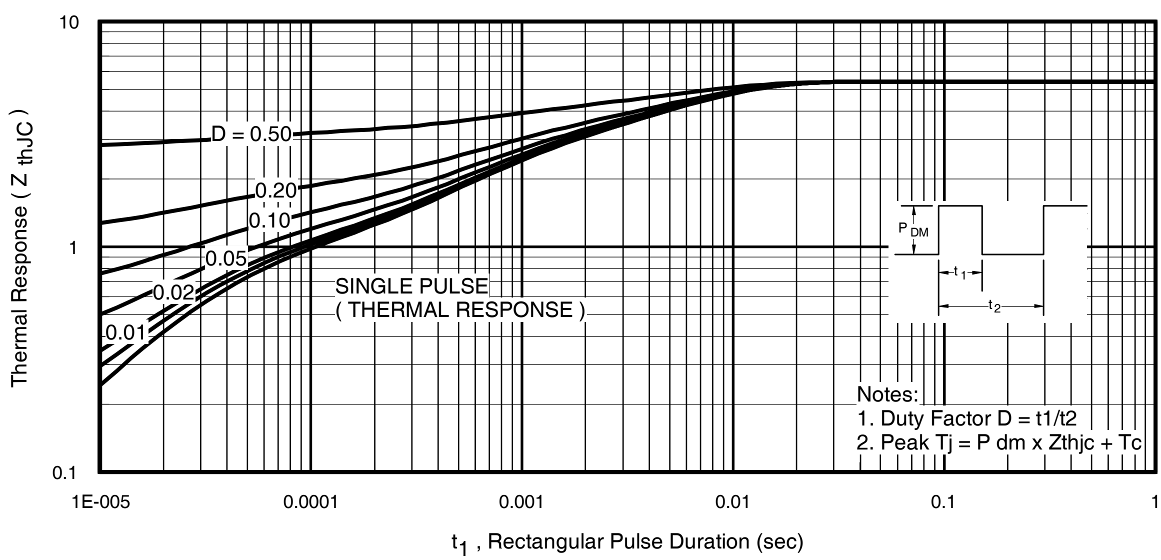


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Ambient

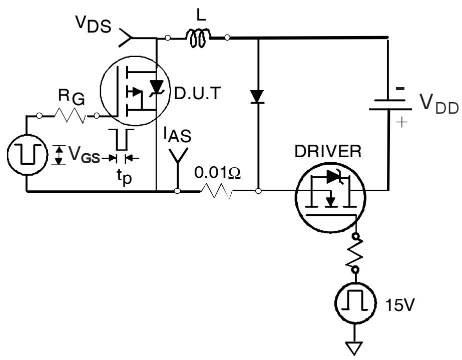


Fig 16a. Unclamped Inductive Test Circuit

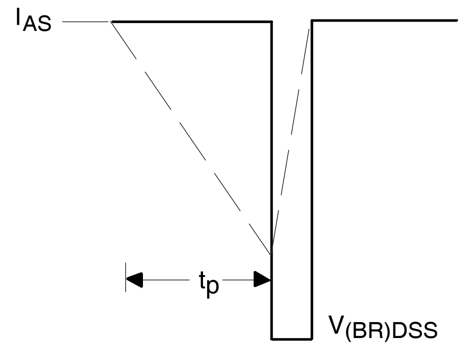


Fig 16b. Unclamped Inductive Waveforms

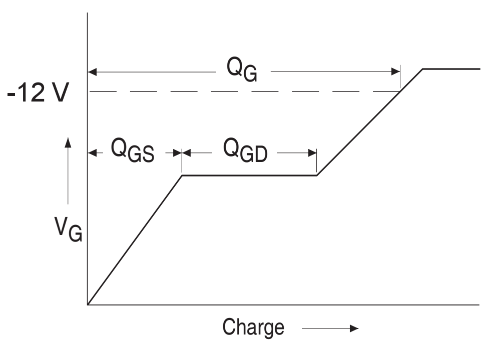


Fig 17a. Basic Gate Charge Waveform

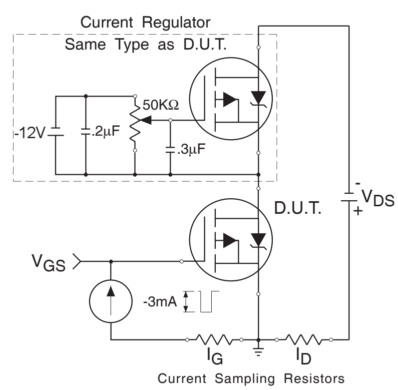


Fig 17b. Gate Charge Test Circuit

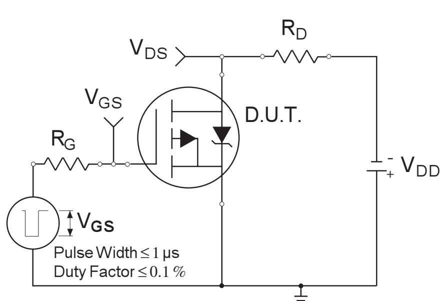


Fig 18a. Switching Time Test Circuit

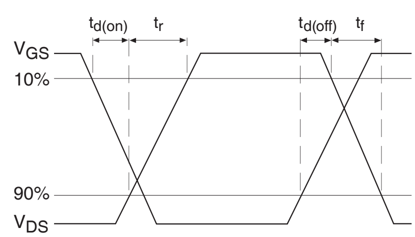
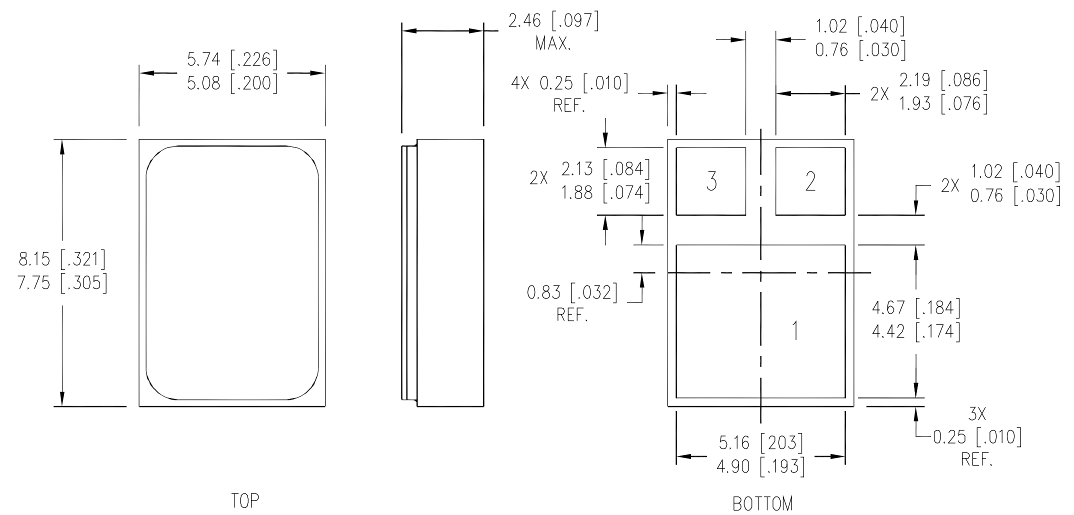


Fig 18b. Switching Time Waveforms

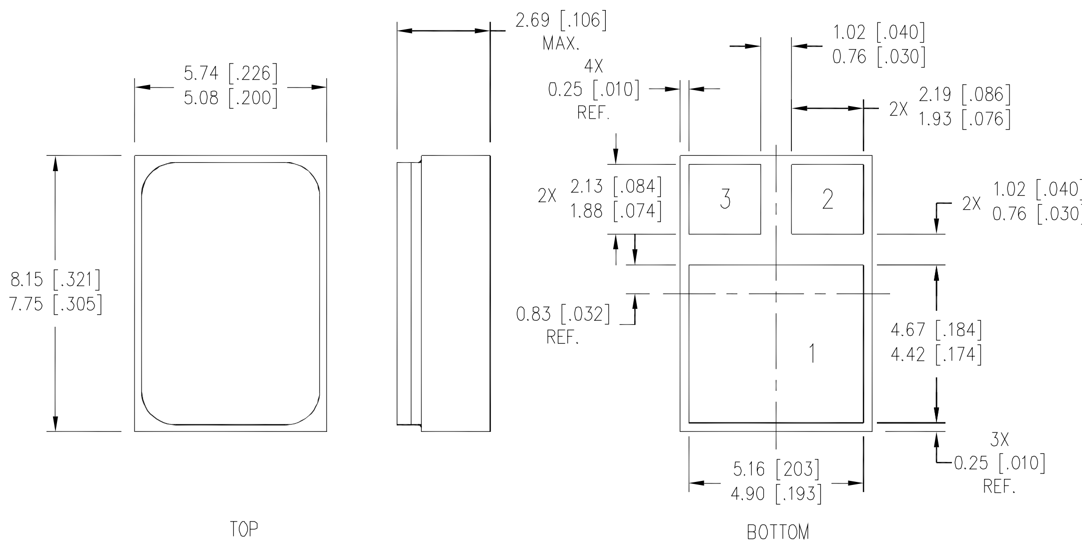
Case Outline and Dimensions — SMD-0.2 (Metal Lid)



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

PAD ASSIGNMENT
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 ASSIGNMENT
1 = DRAIN
2 = GATE
3 = SOURCE

Footnotes:

① Repetitive Rating; Pulse width limited by maximum junction temperature.

② V_{DD} = -50V, starting T_J = 25°C, L=5.8mH Peak I_L = -3.1A, V_{GS} = -12V

③ $I_{SD} \leq$ -3.1A, di/dt $\leq$ -544A/µs, $V_{DD} \leq$ -100V, $T_J \leq$ 150°C

④ Pulse width $\leq$ 300 µs; 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.** -80 volt V_{DS} applied and V_{GS} = 0 during irradiation per MIL-STD-750, method 1019, condition A.

Additional Product Summary (continued from page 1 and 3)

Product Summary

Part Number	Radiation Level	$R_{DS(on)}$	I_D	QPL Part Number
IRHNMC597110	100K Rads (Si)	1.2Ω	-3.1A	JANSR2N7506U8C
IRHNMC593110	300K Rads (Si)	1.2Ω	-3.1A	JANSF2N7506U8C

SMD-0.2
(CERAMIC LID)

International
IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
IR LEOMINSTER : 205 Crawford St., Leominster, Massachusetts 01453, USA Tel: (978) 534-5776
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.
Data and specifications subject to change without notice. 09/2010