IRHNS57264SE (JANSR2N7474U2A)

PD-97964A

Radiation Hardened Power MOSFET
Surface Mount (SupIR-SMD™)
250V, 45A, N-channel, R5 Technology

Features

- Single event effect (SEE) hardened
- Low $R_{DS(on)}$
- Low total gate charge
- Simple drive requirements
- Hermetically sealed
- Ceramic package
- Light weight
- Surface mount
- ESD rating: Class 3A per MIL-STD-750, Method 1020

Product Summary

- **Part number:** IRHNS57264SE (JANSR2N7474U2A)
  REF: MIL-PRF-19500/684
- **Radiation level:** 100 krad (Si)
- **$R_{DS(on),max}$:** 60 mΩ
- **I_D:** 45A

SupIR-SMD™

Potential Applications

- DC-DC converter
- Motor drives

Product Validation

Qualified to JANS screening flow according to MIL-PRF-19500 for space applications

Description

IR HiRel R5 technology provides high performance power MOSFETs for space applications. This technology has over a decade of proven performance and reliability in satellite applications. These devices have been characterized for both Total Dose and Single Event Effect (SEE) with useful performance up to LET of 84 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-DC converters and motor controllers. These devices retain all of the well established advantages of MOSFETs such as voltage control, fast switching and temperature stability of electrical parameters.

Ordering Information

Table 1 Ordering options

Part number	Package	Screening Level	TID Level
IRHNS57264SE	SupIR-SMD™	COTS	100 krad(Si)
JANSR2N7474U2A	SupIR-SMD™	JANS	100 krad(Si)

Table of contents

1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings (Pre-Irradiation)

Symbol	Parameter	Value	Unit
I_{D1} @ V_{GS} = 12V, T_C = 25°C	Continuous Drain Current	45	A
I_{D2} @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	28	A
I_{DM} @ T_C = 25°C	Pulsed Drain Current [1]	180	A
P_D @ T_C = 25°C	Maximum Power Dissipation	250	W
	Linear Derating Factor	2.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy [2]	222	mJ
I_{AR}	Avalanche Current [1]	45	A
E_{AR}	Repetitive Avalanche Energy [1]	25	mJ
dv/dt	Peak Diode Reverse Recovery [3]	5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Lead Temperature	300 (for 5s)	
	Weight	3.3 (Typical)	g

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

[2] V_{DD} = 50V, starting T_J = 25°C, L = 0.22mH, Peak I_L = 45A, V_{GS} = 12V

[3] $I_{SD} \leq$ 45A, di/dt ≤ 274A/µs, $V_{DD} \leq$ 250V, $T_J \leq$ 150°C

2 Device Characteristics

2.1 Electrical Characteristics (Pre-Irradiation)

Table 3 Static and Dynamic Electrical Characteristics @ T_j = 25°C (Unless Otherwise Specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	250	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.28	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.06	Ω	V_{GS} = 12V, I_{D2} = 28A [1]
$V_{GS(th)}$	Gate Threshold Voltage	2.5	—	4.5	V	V_{DS} = V_{GS}, I_D = 1mA
Gfs	Forward Transconductance	27	—	—	S	V_{DS} = 15V, I_{D2} = 28A [1]
I_{DSS}	Zero Gate Voltage Drain Current	—	—	10	µA	V_{DS} = 200V, V_{GS} = 0V
		—	—	25		V_{DS} = 200V,V_{GS} = 0V,T_J = 125°C
I_{GSS}	Gate-to-Source Leakage Forward	—	—	100	nA	V_{GS} = 20V
	Gate-to-Source Leakage Reverse	—	—	-100		V_{GS} = -20V
Q_G	Total Gate Charge	—	—	165	nC	I_{D1} = 45A V_{DS} = 125V V_{GS} = 12V
Q_{GS}	Gate-to-Source Charge	—	—	45		
Q_{GD}	Gate-to-Drain (‘Miller’) Charge	—	—	75		
$t_{d(on)}$	Turn-On Delay Time	—	—	35	ns	I_{D1} = 45A ** V_{DD} = 125V R_G = 2.35Ω V_{GS} = 12V
t_r	Rise Time	—	—	125		
$t_{d(off)}$	Turn-Off Delay Time	—	—	80		
t_f	Fall Time	—	—	65		
L_s +L_D	Total Inductance	—	4.0	—	nH	Measured from center of Drain pad to center of Source pad
C_{iss}	Input Capacitance	—	5045	—	pF	V_{GS} = 0V V_{DS} = 25V f = 1.0MHz
C_{oss}	Output Capacitance	—	781	—		
C_{rss}	Reverse Transfer Capacitance	—	70	—		

** Switching speed maximum limits are based on manufacturing test equipment and capability.

[1] Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

2.2 Source-Drain Diode Ratings and Characteristics (Pre-Irradiation)

Table 4 Source-Drain Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	45	A	
I_{SM}	Pulsed Source Current (Body Diode) [1]	—	—	180	A	
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_J = 25°C, I_S = 45A, V_{GS} = 0V [2]
t_{rr}	Reverse Recovery Time	—	—	560	ns	T_J = 25°C, I_F = 45A, V_{DD} ≤ 50V
Q_{rr}	Reverse Recovery Charge	—	—	8.6	µC	di/dt = 100A/µs [2]
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

2.3 Thermal Characteristics

Table 5 Thermal Resistance

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-Case	—	—	0.5	°C/W
$R_{\theta J\text{-}PCB}$	Junction-to-PC Board (Soldered to 2” sq copper clad board)	—	1.6	—	

2.4 Radiation Characteristics

IR HiRel Radiation Hardened MOSFETs are tested to verify their radiation hardness capability. The hardness assurance program at IR HiRel is comprised of two radiation environments. Every manufacturing lot is tested for total ionizing dose (per notes 3 and 4) 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.

2.4.1 Electrical Characteristics — Post Total Dose Irradiation

Table 6 Electrical Characteristics @ T_J = 25°C, Post Total Dose Irradiation [3, 4]

Symbol	Parameter	100krad (Si)		Unit	Test Conditions
		Min.	Max.		
BV_{DSS}	Drain-to-Source Breakdown Voltage	250	—	V	V_{GS} = 0V, I_D = 1.0mA
$V_{GS(th)}$	Gate Threshold Voltage	2.0	4.5	V	V_{DS} = V_{GS}, I_D = 1.0mA
I_{GSS}	Gate-to-Source Leakage Forward	—	100	nA	V_{GS} = 20V
	Gate-to-Source Leakage Reverse	—	-100		V_{GS} = -20V
I_{DSS}	Zero Gate Voltage Drain Current	—	10	µA	V_{DS} = 200V, V_{GS} = 0V
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance (TO-3) [2]	—	0.061	Ω	V_{GS} = 12V, I_{D2} = 28A
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance (SupIR-SMD™) [2]	—	0.060	Ω	V_{GS} = 12V, I_{D2} = 28A
V_{SD}	Diode Forward Voltage	—	1.2	V	V_{GS} = 0V, I_F = 45A

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

[2] Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

[3] Total Dose Irradiation with V_{GS} Bias. V_{GS} = 12V applied and V_{DS} = 0 during irradiation per MIL-STD-750, Method 1019, condition A.

[4] Total Dose Irradiation with V_{DS} Bias. V_{DS} = 200V applied and V_{GS} = 0 during irradiation per MIL-STD-750, Method 1019, condition A.

2.4.2 Single Event Effects — Safe Operating Area

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. 1 and Table 7.

Table 7 Typical Single Event Effects Safe Operating Area

LET (MeV/(mg/cm²))	Energy (MeV)	Range (µm)	V_{DS} (V)				
			V_{GS} = 0V	V_{GS} = -5V	V_{GS} = -10V	V_{GS} = -15V	V_{GS} = -20V
38 ± 5%	300 ± 7.5%	38 ± 7.5%	175	175	175	175	175
61 ± 5%	330 ± 7.5%	31 ± 10%	175	175	175	175	175
84 ± 5%	350 ± 7.5%	28 ± 7.5%	175	175	175	175	50

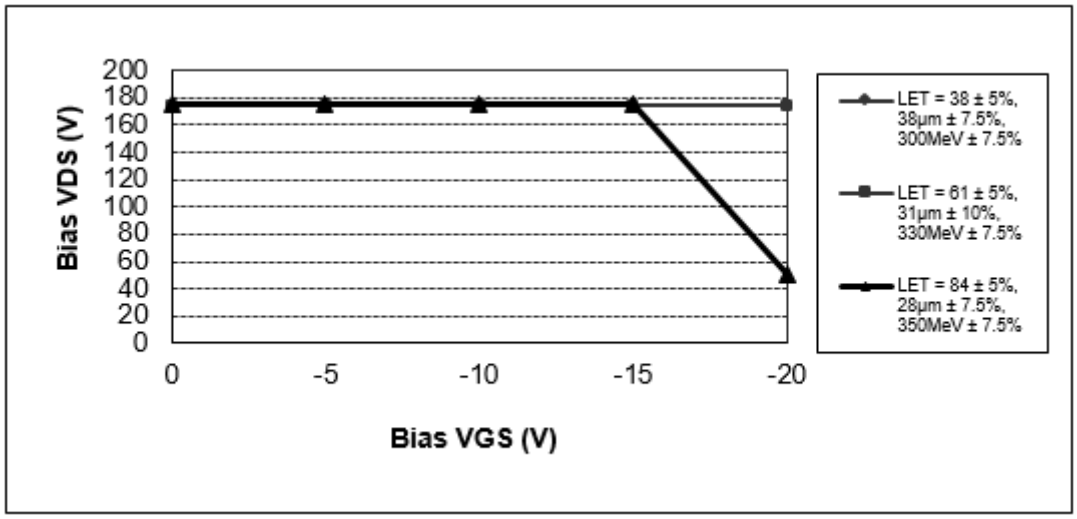


Figure 1 Typical Single Event Effect, Safe Operating Area

3 Electrical Characteristics Curves (Pre-irradiation)

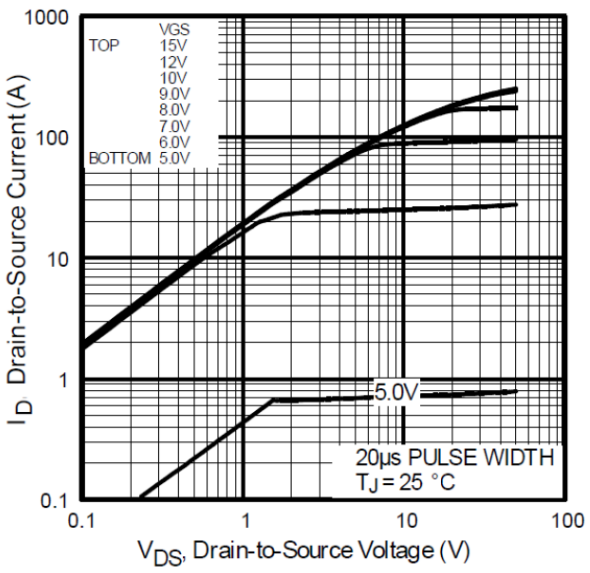


Figure 2 Typical Output Characteristics

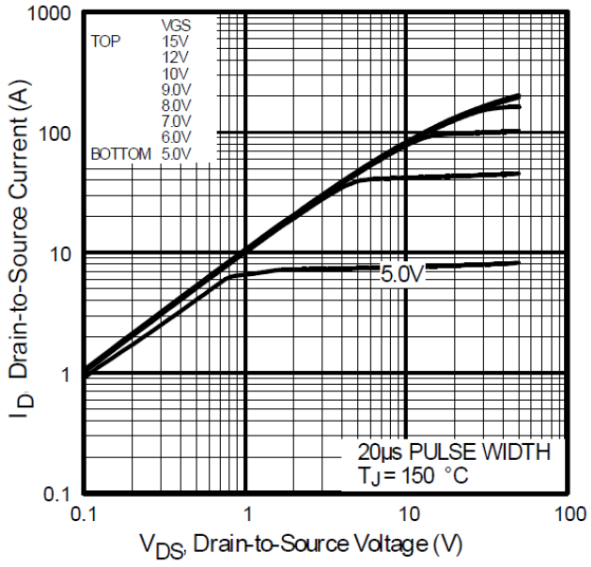


Figure 3 Typical Output Characteristics

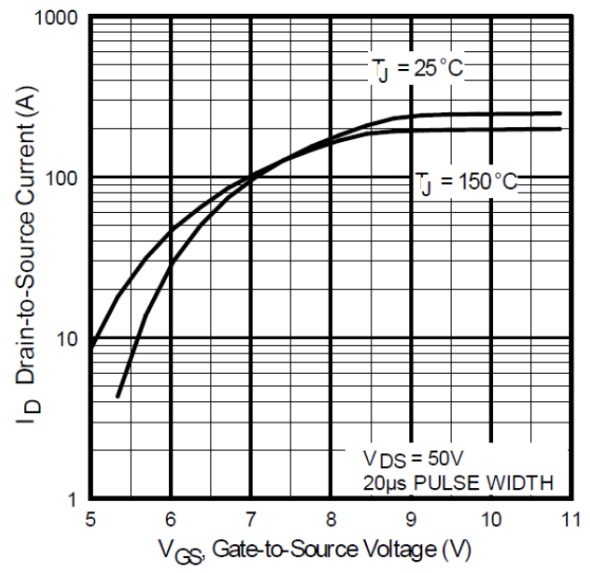


Figure 4 Typical Transfer Characteristics

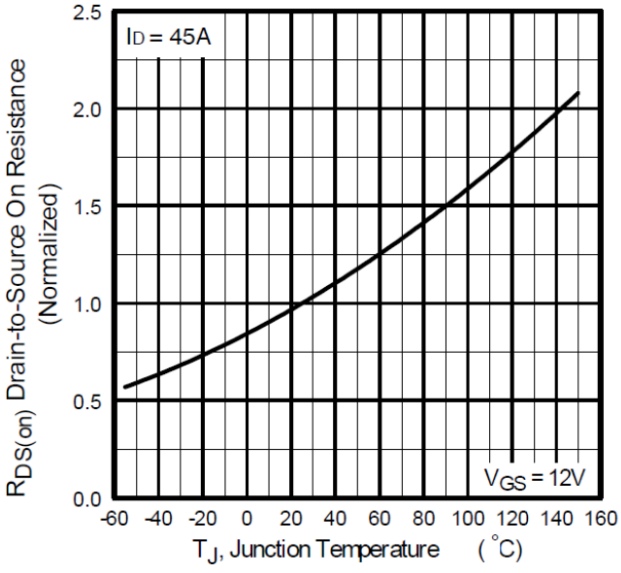


Figure 5 Normalized On-Resistance Vs. Temperature

Electrical Characteristics Curves (Pre-irradiation)

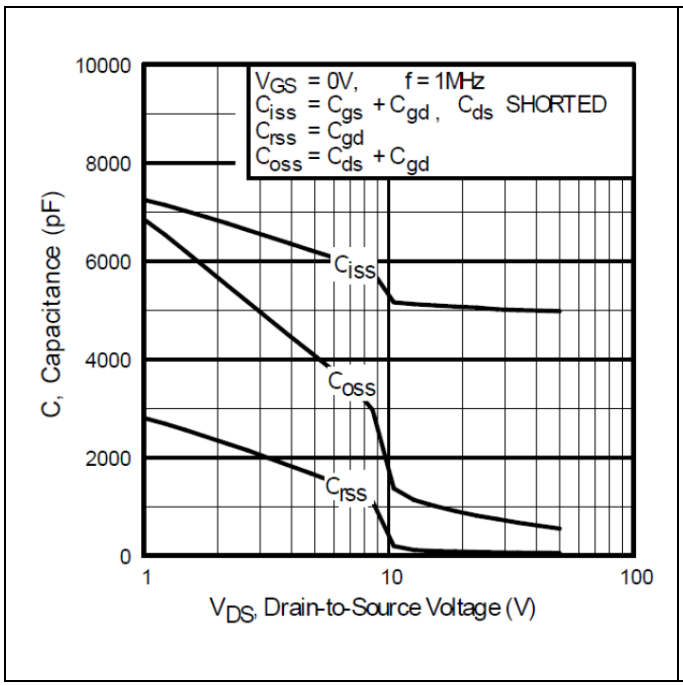


Figure 6 Typical Capacitance Vs. Drain-to-Source Voltage

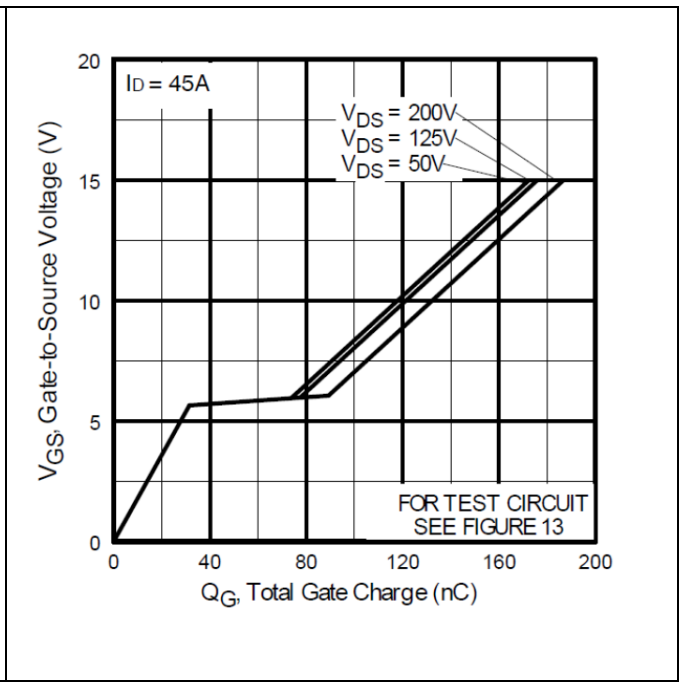


Figure 7 Gate-to-Source Voltage Vs. Typical Gate Charge

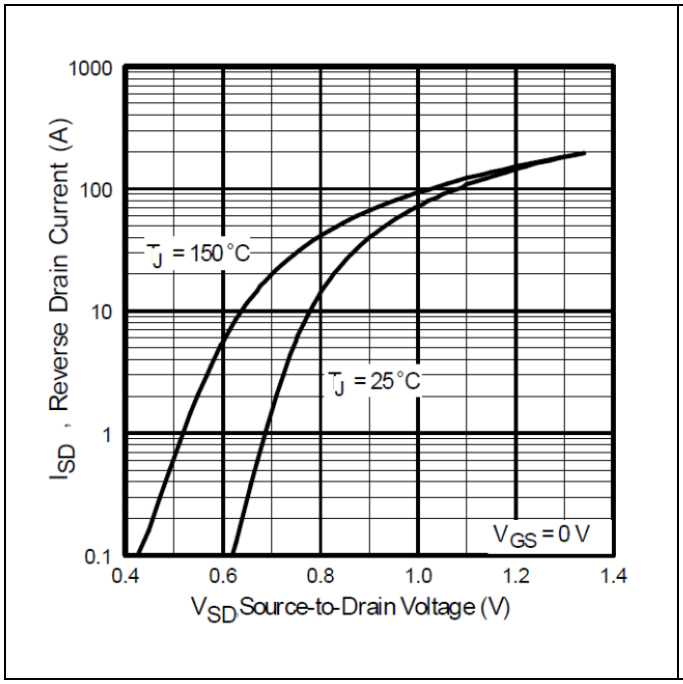


Figure 8 Typical Source-Drain Current Vs. Diode Forward Voltage

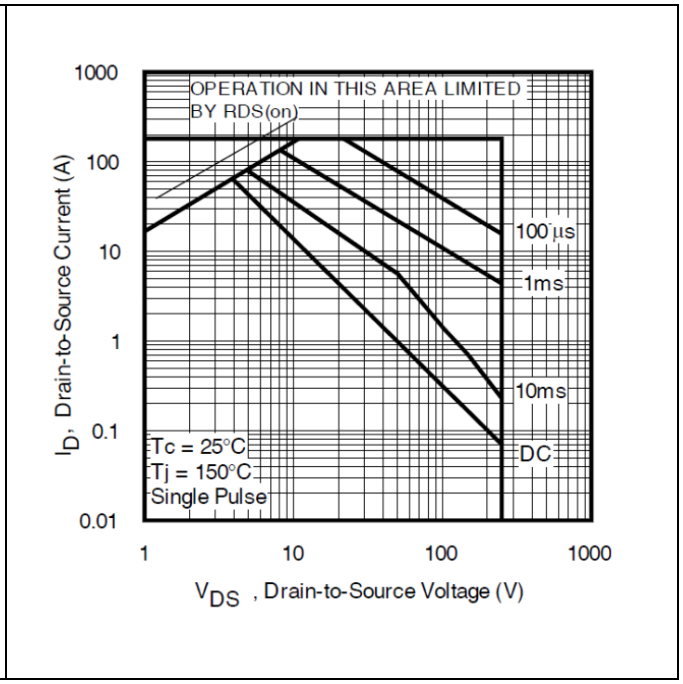


Figure 9 Maximum Safe Operating Area

Electrical Characteristics Curves (Pre-irradiation)

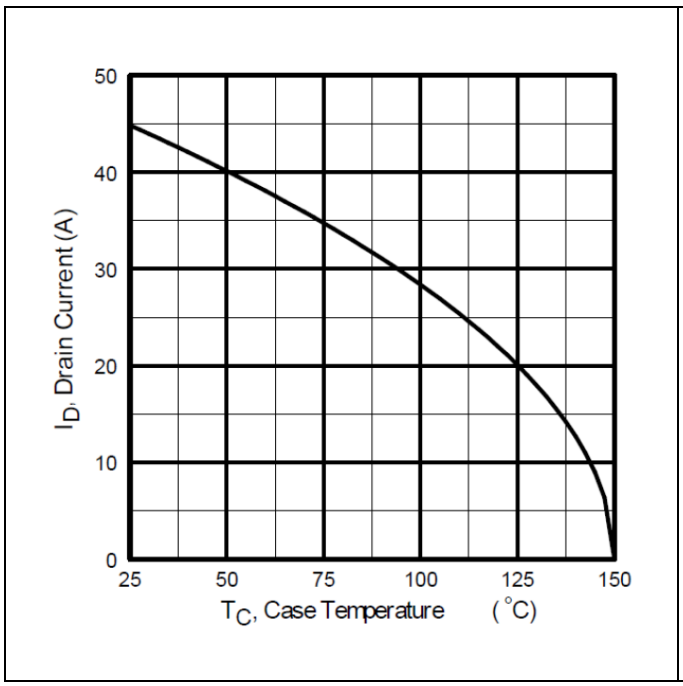


Figure 10 Maximum Drain Current Vs. Case Temperature

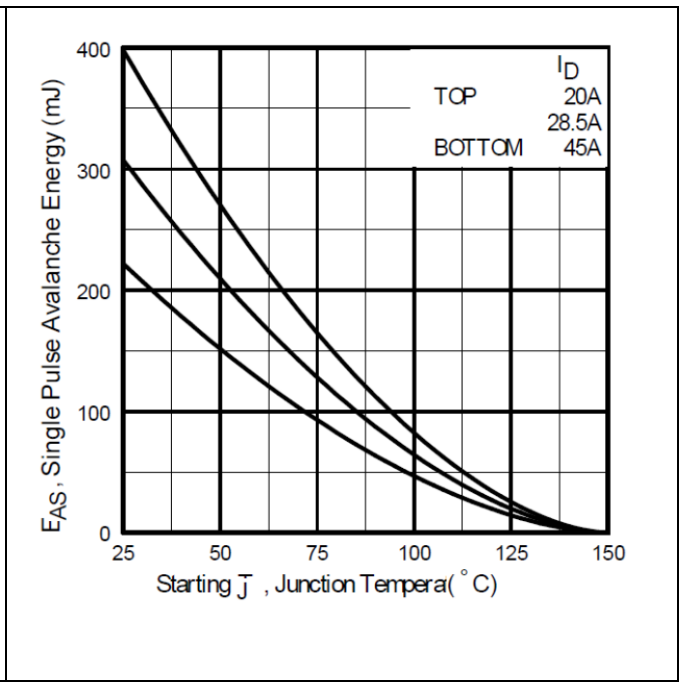


Figure 11 Maximum Avalanche Energy Vs. Junction Temperature

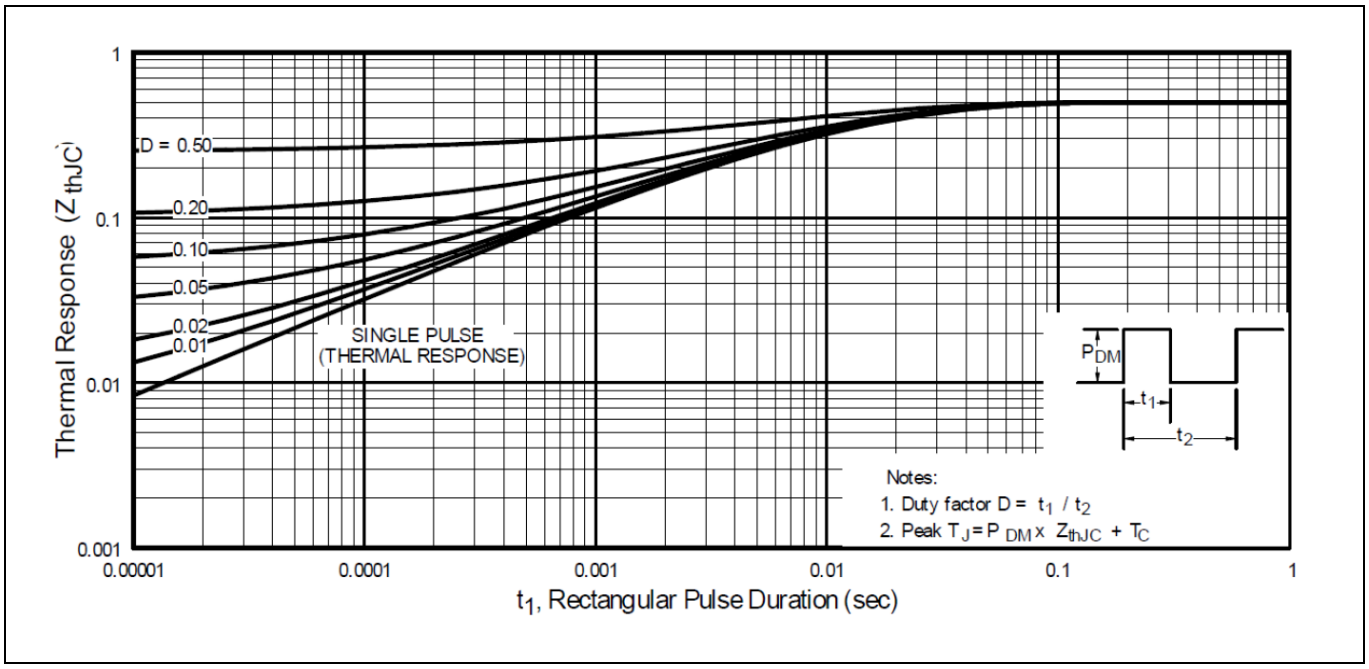


Figure 12 Maximum Effective Transient Thermal Impedance, Junction-to-Case

4 Test Circuits (Pre-irradiation)

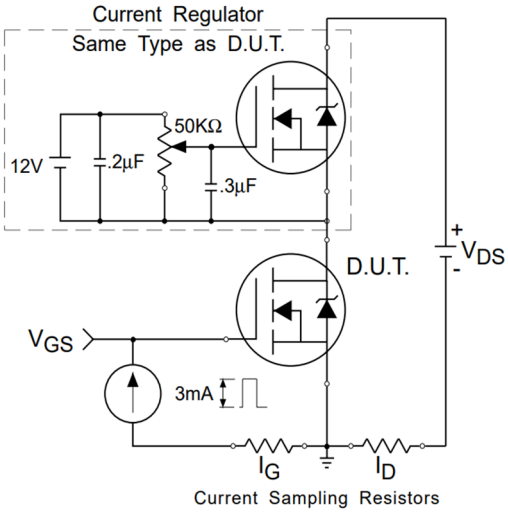


Figure 13 Gate Charge Test Circuit

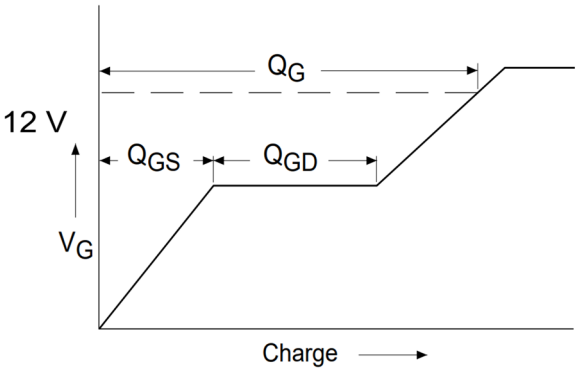


Figure 14 Gate Charge Waveform

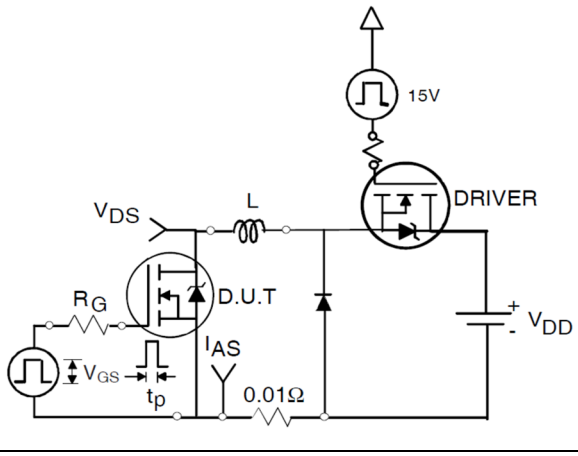


Figure 15 Unclamped Inductive Test Circuit

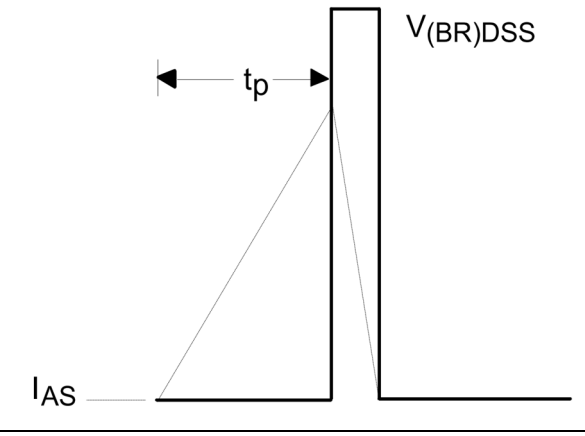


Figure 16 Unclamped Inductive Waveform

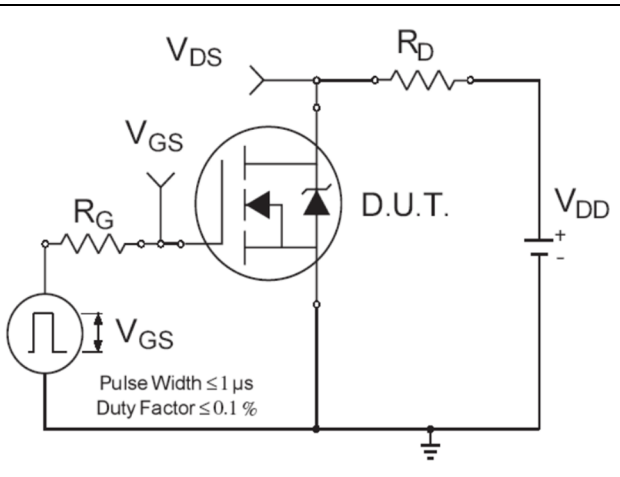


Figure 17 Switching Time Test Circuit

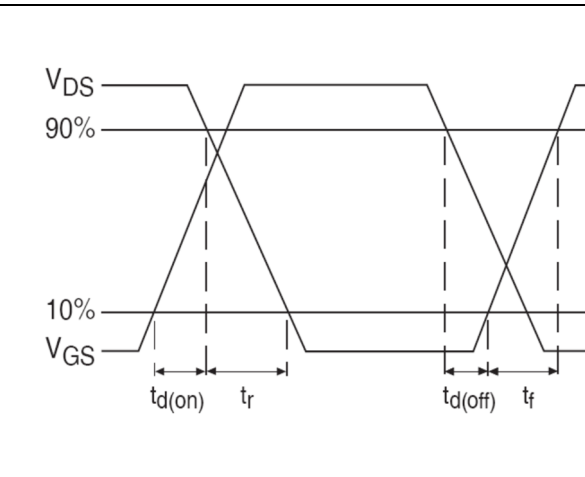
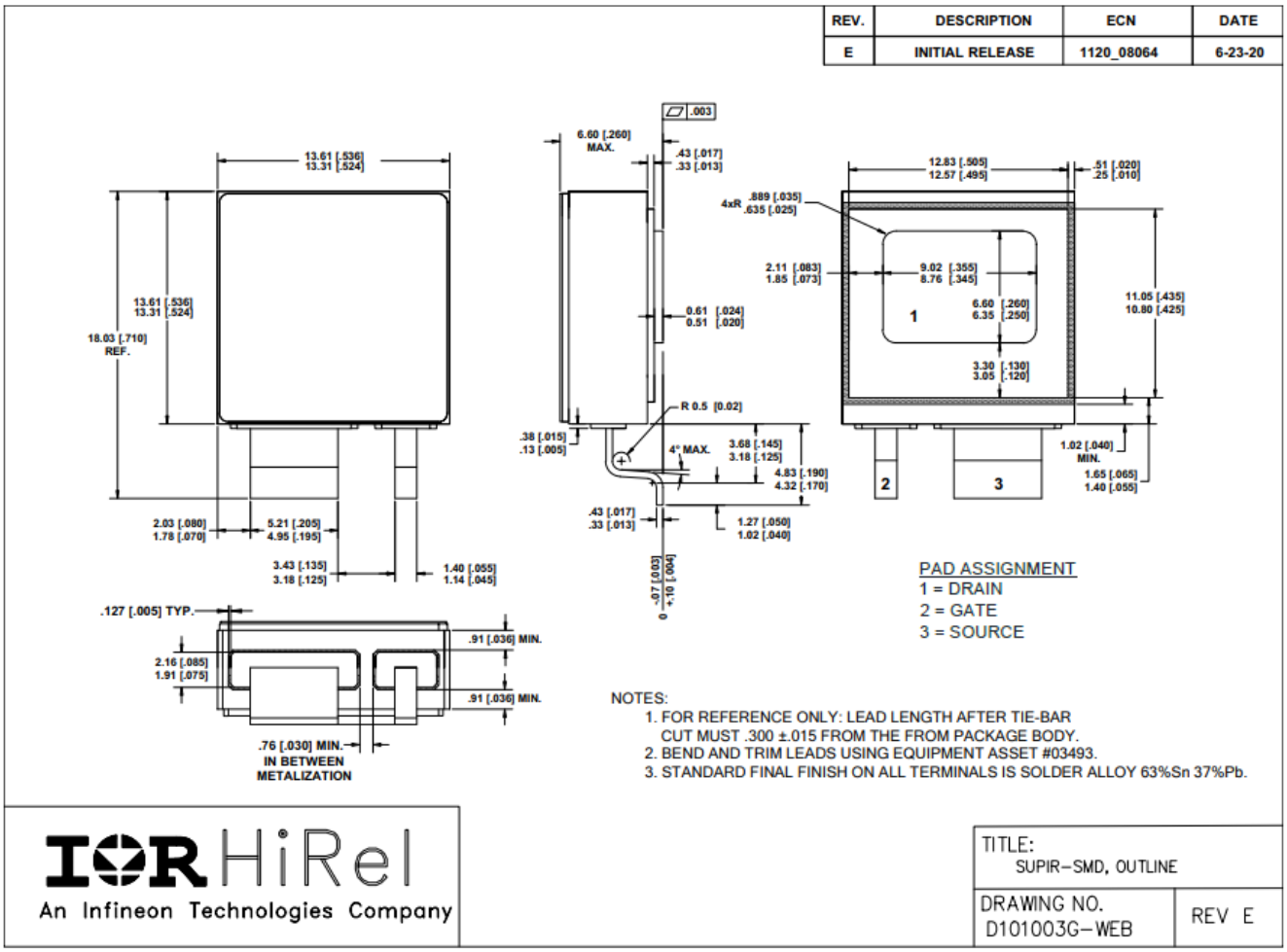


Figure 18 Switching Time Waveforms

5 Package Outline

Note: For the most updated package outline, please see the website: SupIR-SMD™



Revision history

Document version	Date of release	Description of changes
	04/10/2020	Datasheet (PD-97964)
Rev A	08/09/2021	Updated based on ECN-1120_08659

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Edition 2021-08-09

Published by

International Rectifier HiRel Products, Inc.

An Infineon Technologies company

El Segundo, California 90245 USA

Do you have a question about this document?

Email: erratum@infineon.com

Document reference

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS

Due to technical requirements components may contain dangerous substances. For information or the types in question please contact your nearest International Rectifier HiRel Products, Inc., an Infineon Technologies company, office.

International Rectifier HiRel Components may only be used in life-support devices or systems with the expressed written approval of International Rectifier HiRel Products, Inc., an Infineon Technologies company, if failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety and effectiveness of that device or system.

Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.