

# IRHLNA797064

PD-97174E

## Radiation Hardened Logic Level Power MOSFET Surface Mount (SMD-2) 60V, 56A, P-channel, R7 Technology

### Features

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

### Potential Applications

- DC-DC converter
- Motor drives

### Product Validation

Qualified according to MIL-PRF-19500 for space applications

### Description

IR HiRel R7 Logic Level Power MOSFETs provide simple solution to interfacing CMOS and TTL control circuits to power devices in space and other radiation environments. The threshold voltage remains within acceptable operating limits over the full operating temperature and post radiation. This is achieved while maintaining single event gate rupture and single event burnout immunity.

The device is ideal when used to interface directly with most logic gates, linear IC's, micro-controllers, and other device types that operate from a 3.3-5V source. It may also be used to increase the output current of a PWM, voltage comparator or an operational amplifier where the logic level drive signal is available.

### Ordering Information

**Table 1** Ordering options

Part number	Package	Screening Level	TID Level
IRHLNA797064	SMD-2	COTS	100 krad(Si)
IRHLNA797064SCV	SMD-2	JANTXV-equivalent	100 krad(Si)
IRHLNA797064SCS	SMD-2	S-Level	100 krad(Si)
IRHLNA793064	SMD-2	COTS	300 krad(Si)
IRHLNA793064SCS	SMD-2	S-Level	300 krad(Si)

### Product Summary

- **Part number:** IRHLNA797064, IRHLNA793064
- **Radiation level:** 100 krad(Si), 300 krad(Si)
- **$R_{DS(on),max}$ :** 17m $\Omega$
- **$I_D$ :** -56A

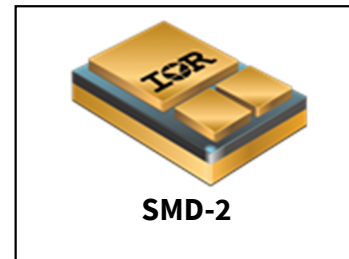


Table of contents

**Table of contents**

<b>Features .....</b>	<b>1</b>
<b>Potential Applications.....</b>	<b>1</b>
<b>Product Validation.....</b>	<b>1</b>
<b>Description .....</b>	<b>1</b>
<b>Ordering Information.....</b>	<b>1</b>
<b>Table of contents.....</b>	<b>2</b>
<b>1 Absolute Maximum Ratings .....</b>	<b>3</b>
<b>2 Device Characteristics .....</b>	<b>4</b>
2.1 Electrical Characteristics (Pre-Irradiation).....	4
2.2 Source-Drain Diode Ratings and Characteristics (Pre-Irradiation) .....	5
2.3 Thermal Characteristics .....	5
2.4 Radiation Characteristics.....	5
2.4.1 Electrical Characteristics — Post Total Dose Irradiation .....	5
2.4.2 Single Event Effects — Safe Operating Area .....	6
<b>3 Electrical Characteristics Curves (Pre-irradiation) .....</b>	<b>7</b>
<b>4 Test Circuits (Pre-irradiation) .....</b>	<b>11</b>
<b>5 Package Outline .....</b>	<b>12</b>
<b>Revision history.....</b>	<b>13</b>

## Absolute Maximum Ratings

## 1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings (Pre-Irradiation)

Symbol	Parameter	Value	Unit
$I_{D1} @ V_{GS} = -4.5V, T_C = 25^\circ C$	Continuous Drain Current	-56*	A
$I_{D2} @ V_{GS} = -4.5V, T_C = 100^\circ C$	Continuous Drain Current	-56*	A
$I_{DM} @ T_C = 25^\circ C$	Pulsed Drain Current <sup>1</sup>	-224	A
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	250	W
	Linear Derating Factor	1.67	W/°C
$V_{GS}$	Gate-to-Source Voltage	± 10	V
$E_{AS}$	Single Pulse Avalanche Energy <sup>2</sup>	1060	mJ
$I_{AR}$	Avalanche Current <sup>1</sup>	-56	A
$E_{AR}$	Repetitive Avalanche Energy <sup>1</sup>	25	mJ
$dv/dt$	Peak Diode Reverse Recovery <sup>3</sup>	-3.7	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Lead Temperature	300 (for 5 sec)	
	Weight	3.3 (Typical)	g

\* Current is limited by package

<sup>1</sup> Repetitive Rating; Pulse width limited by maximum junction temperature.<sup>2</sup>  $V_{DD} = -50V$ , starting  $T_J = 25^\circ C$ ,  $L = 0.67mH$ , Peak  $I_L = -56A$ ,  $V_{GS} = -10V$ <sup>3</sup>  $I_{SD} \leq -56A$ ,  $di/dt \leq -380A/\mu s$ ,  $V_{DD} \leq -60V$ ,  $T_J \leq 150^\circ C$

## Device Characteristics

## 2 Device Characteristics

## 2.1 Electrical Characteristics (Pre-Irradiation)

Table 3 Static and Dynamic Electrical Characteristics @  $T_j = 25^\circ\text{C}$  (Unless Otherwise Specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	-60	—	—	V	$V_{GS} = 0V, I_D = -250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.06	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D = -1.0\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	17	m $\Omega$	$V_{GS} = -4.5V, I_{D2} = -56A^1$
$V_{GS(th)}$	Gate Threshold Voltage	-1.0	—	-2.0	V	$V_{DS} = V_{GS}, I_D = -250\mu A$
$\Delta V_{GS(th)}/\Delta T_J$	Gate Threshold Voltage Temp. Coefficient	—	4.1	—	mV/ $^\circ\text{C}$	
Gfs	Forward Transconductance	65	—	—	S	$V_{DS} = -15V, I_{D2} = -56A^1$
$I_{DSS}$	Zero Gate Voltage Drain Current	—	—	-1.0	$\mu A$	$V_{DS} = -48V, V_{GS} = 0V$
		—	—	-25		$V_{DS} = -48V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Leakage Forward	—	—	-100	nA	$V_{GS} = -10V$
	Gate-to-Source Leakage Reverse	—	—	100		$V_{GS} = 10V$
$Q_G$	Total Gate Charge	—	—	130	nC	$I_{D1} = -56A$
$Q_{GS}$	Gate-to-Source Charge	—	—	35		$V_{DS} = -30V$
$Q_{GD}$	Gate-to-Drain ('Miller') Charge	—	—	55		$V_{GS} = -4.5V$
$t_{d(on)}$	Turn-On Delay Time	—	—	38	ns	$I_{D1} = -56A^{**}$ $V_{DD} = -30V$ $R_G = 2.35\Omega$ $V_{GS} = -6.0V$
$t_r$	Rise Time	—	—	265		
$t_{d(off)}$	Turn-Off Delay Time	—	—	210		
$t_f$	Fall Time	—	—	70		
$L_s + L_D$	Total Inductance	—	4.0	—	nH	Measured from center of Drain pad to center of Source pad
$C_{iss}$	Input Capacitance	—	10520	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	2780	—		$V_{DS} = -25V$
$C_{rss}$	Reverse Transfer Capacitance	—	310	—		$f = 1.0\text{MHz}$
$R_G$	Gate Resistance	—	2.3	—	$\Omega$	$f = 1.0\text{MHz}$ , open drain

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

<sup>1</sup> Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$

## Device Characteristics

## 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)	—	—	-56	A	
$I_{SM}$	Pulsed Source Current (Body Diode) <sup>1</sup>	—	—	-224	A	
$V_{SD}$	Diode Forward Voltage	—	—	-5.0	V	$T_J = 25^\circ\text{C}$ , $I_S = -56\text{A}$ , $V_{GS} = 0\text{V}$ <sup>2</sup>
$t_{rr}$	Reverse Recovery Time	—	—	150	ns	$T_J = 25^\circ\text{C}$ , $I_F = -56\text{A}$ , $V_{DD} \leq -25\text{V}$ $di/dt = -100\text{A}/\mu\text{s}$ <sup>2</sup>
$Q_{rr}$	Reverse Recovery Charge	—	—	430	nC	
$t_{on}$	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	$^\circ\text{C}/\text{W}$
$R_{\theta PCB}$	Junction-to-PC Board (soldered to 1inch square cu 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 @  $T_J = 25^\circ\text{C}$ , Post Total Dose Irradiation<sup>3, 4</sup>**

Symbol	Parameter	Up to 300 krad (Si) <sup>5</sup>		Unit	Test Conditions
		Min.	Max.		
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	-60	—	V	$V_{GS} = 0\text{V}$ , $I_D = -250\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	-1.0	-2.0	V	$V_{DS} = V_{GS}$ , $I_D = -250\mu\text{A}$
$I_{GSS}$	Gate-to-Source Leakage Forward	—	-100	nA	$V_{GS} = -10\text{V}$
	Gate-to-Source Leakage Reverse	—	100		$V_{GS} = 10\text{V}$
$I_{DSS}$	Zero Gate Voltage Drain Current	—	-10	$\mu\text{A}$	$V_{DS} = -48\text{V}$ , $V_{GS} = 0\text{V}$
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance (TO-3) <sup>2</sup>	—	19	$\text{m}\Omega$	$V_{GS} = -4.5\text{V}$ , $I_{D2} = -56\text{A}$
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance (SMD-2) <sup>2</sup>	—	17	$\text{m}\Omega$	$V_{GS} = -4.5\text{V}$ , $I_{D2} = -56\text{A}$
$V_{SD}$	Diode Forward Voltage	—	-5.0	V	$V_{GS} = 0\text{V}$ , $I_F = -56\text{A}$

<sup>1</sup> Repetitive Rating; Pulse width limited by maximum junction temperature.

<sup>2</sup> Pulse width  $\leq 300\mu\text{s}$ ; Duty Cycle  $\leq 2\%$ 
<sup>3</sup> Total Dose Irradiation with  $V_{GS}$  Bias.  $V_{GS} = -12\text{V}$  applied and  $V_{DS} = 0$  during irradiation per MIL-STD-750, Method 1019, condition A.

<sup>4</sup> Total Dose Irradiation with  $V_{DS}$  Bias.  $V_{DS} = -48\text{V}$  applied and  $V_{GS} = 0$  during irradiation per MIL-STD-750, Method 1019, condition A.

<sup>5</sup> Part numbers IRHLNA797064 and IRHLNA793064

**Radiation Hardened Power MOSFET Surface Mount (SMD-2)**

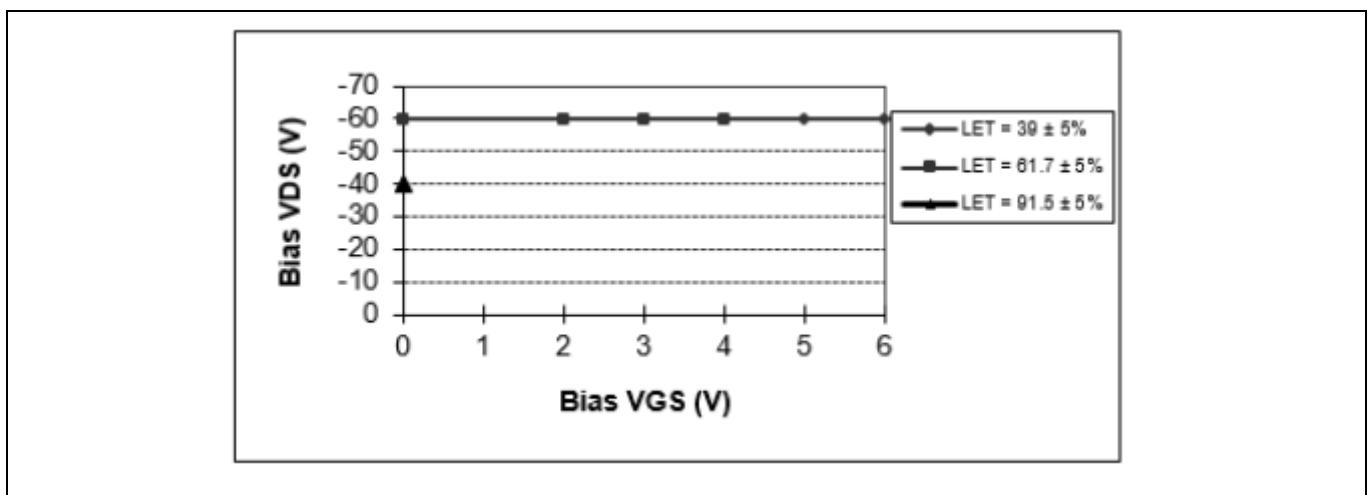
**Device Characteristics**

**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·cm <sup>2</sup> /mg)	Energy (MeV)	Range (μm)	V <sub>DS</sub> (V)					
			V <sub>GS</sub> = 0V	V <sub>GS</sub> = 2V	V <sub>GS</sub> = 3V	V <sub>GS</sub> = 4V	V <sub>GS</sub> = 5V	V <sub>GS</sub> = 6V
39.0 ± 5%	312 ± 7.5%	38.6 ± 7.5%	-60	-60	-60	-60	-60	-60
61.7 ± 5%	584 ± 7.5%	48.7 ± 7.5%	-60	-60	-60	-60	—	—
91.5 ± 5%	1262 ± 7.5%	70.1 ± 7.5%	-40	—	—	—	—	—



**Figure 1 Typical Single Event Effect, Safe Operating Area**

Radiation Hardened Power MOSFET Surface Mount (SMD-2)

Electrical Characteristics Curves (Pre-irradiation)

**3 Electrical Characteristics Curves (Pre-irradiation)**

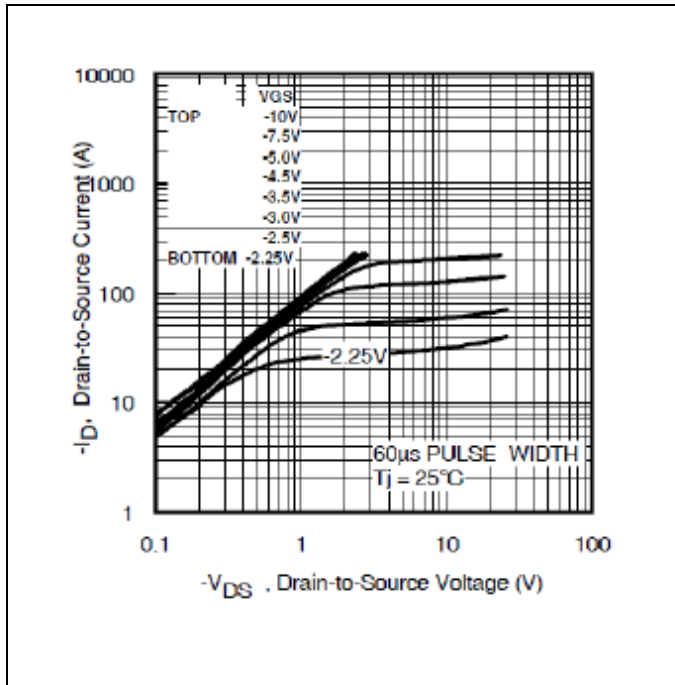


Figure 2 Typical Output Characteristics

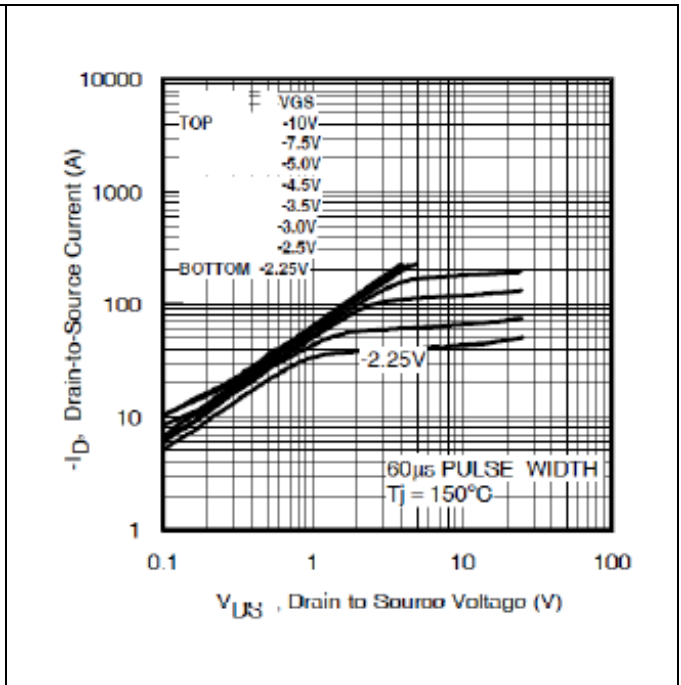


Figure 3 Typical Output Characteristics

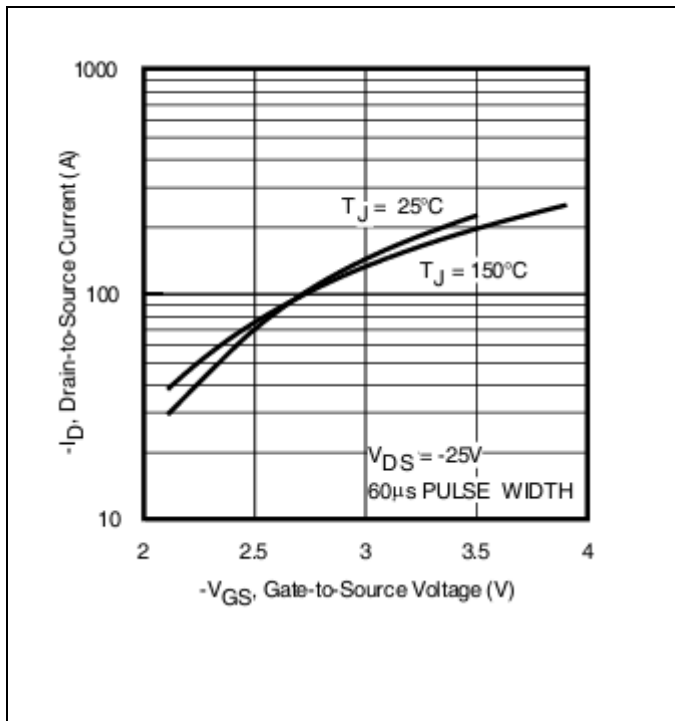


Figure 4 Typical Transfer Characteristics

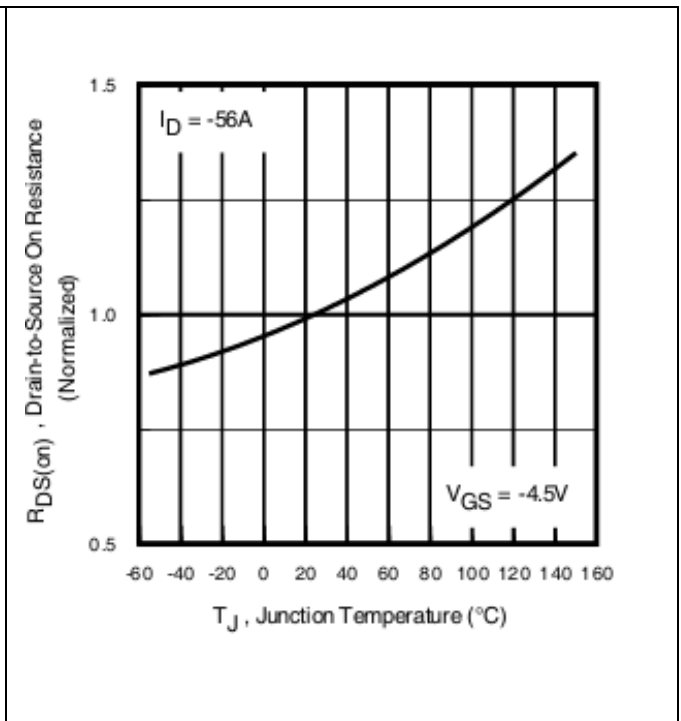


Figure 5 Normalized On-Resistance Vs. Temperature

**Radiation Hardened Power MOSFET Surface Mount (SMD-2)**

**Electrical Characteristics Curves (Pre-irradiation)**

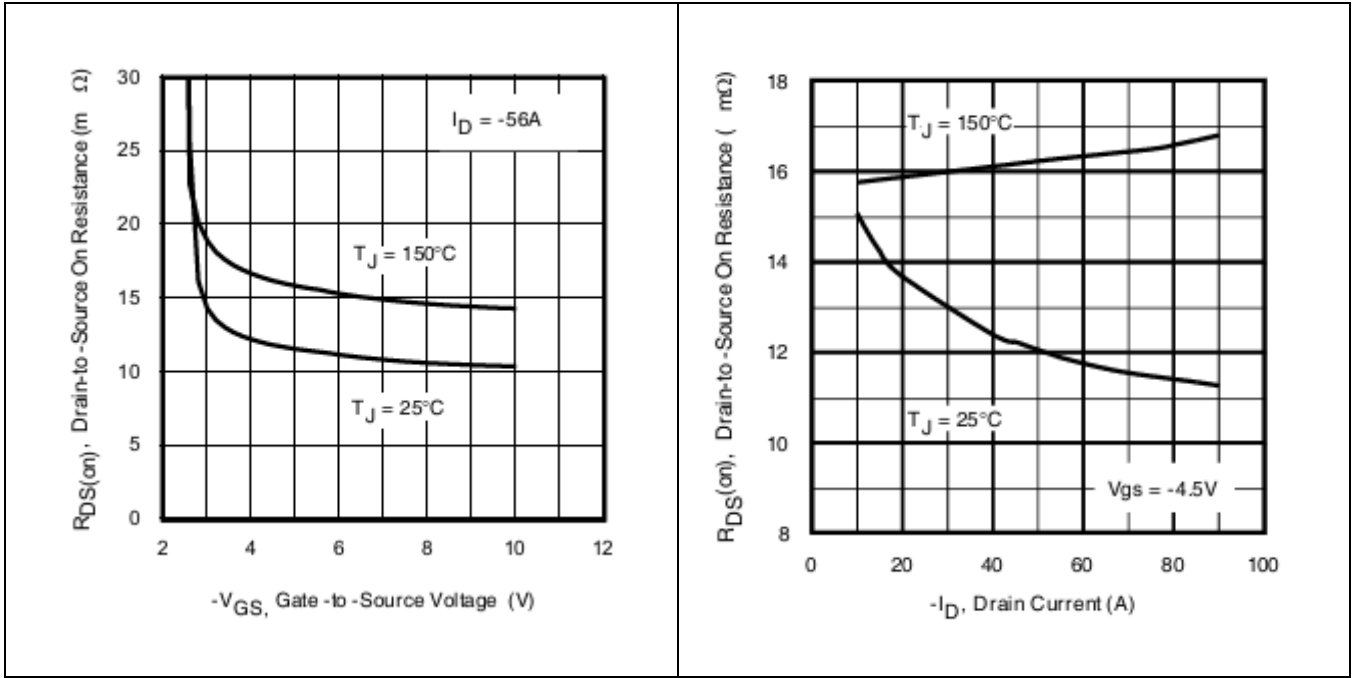


Figure 6 Typical On-Resistance Vs Gate Voltage

Figure 7 Typical On-Resistance Vs Drain Current

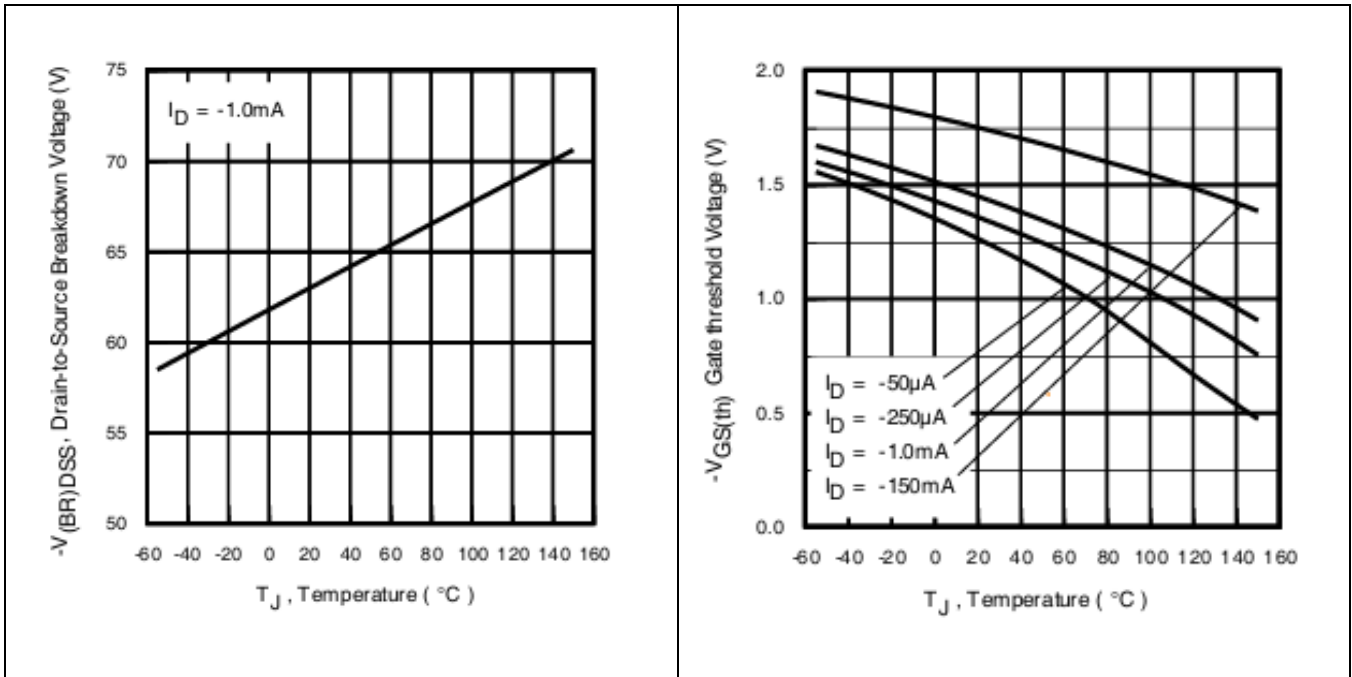


Figure 8 Typical Drain-to-Source Breakdown Voltage Vs Temperature

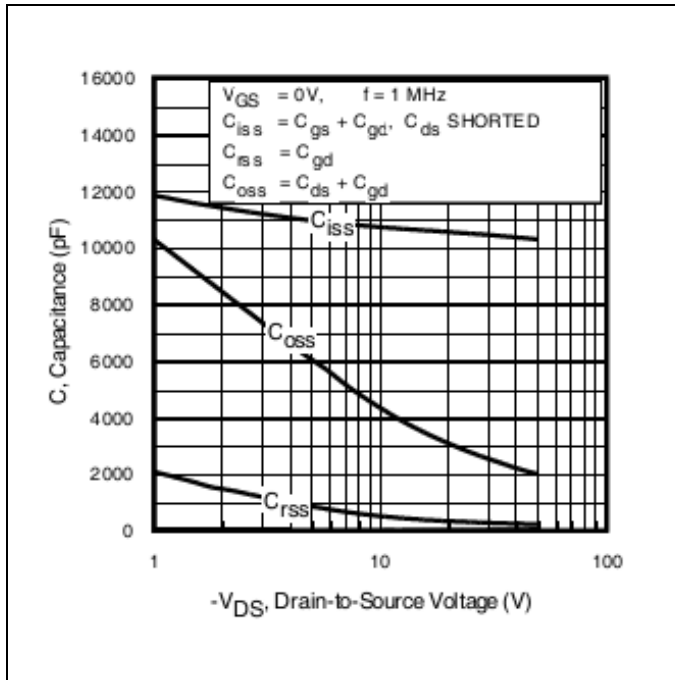
Figure 9 Typical Threshold Voltage Vs Temperature



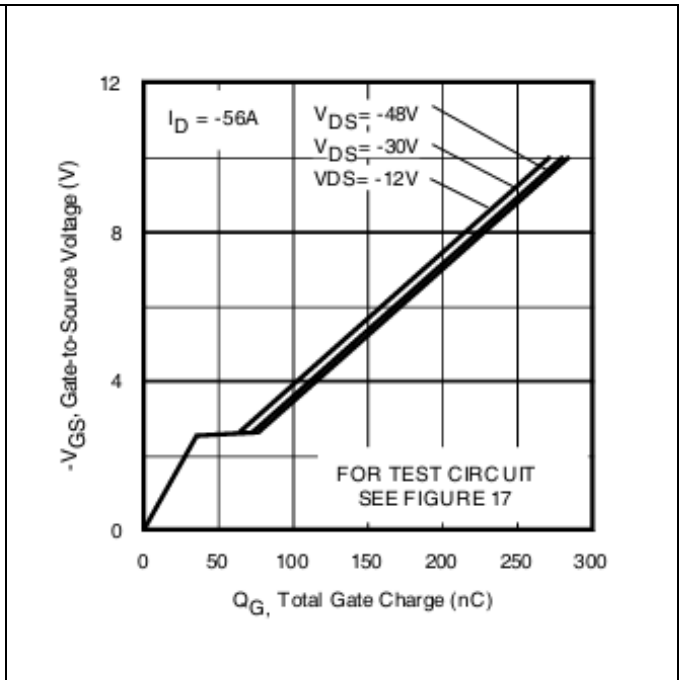
**IRHLNA797064**

**Radiation Hardened Power MOSFET Surface Mount (SMD-2)**

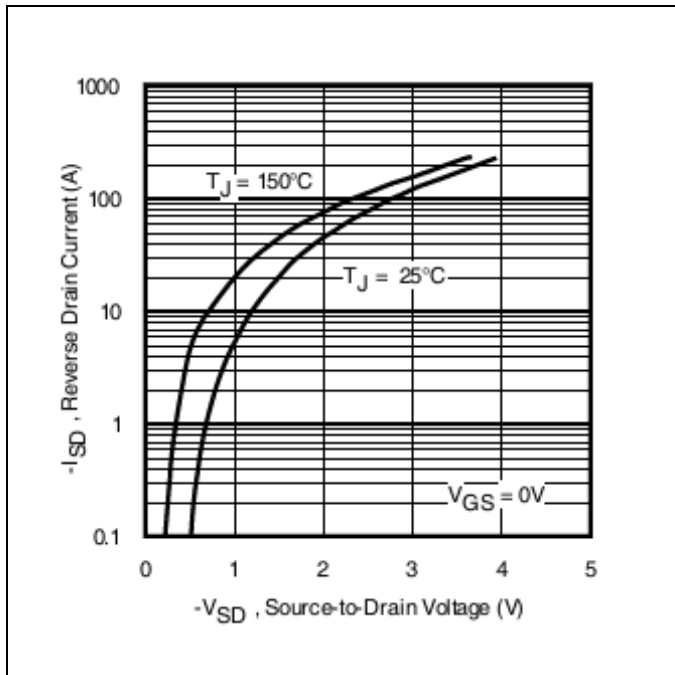
**Electrical Characteristics Curves (Pre-irradiation)**



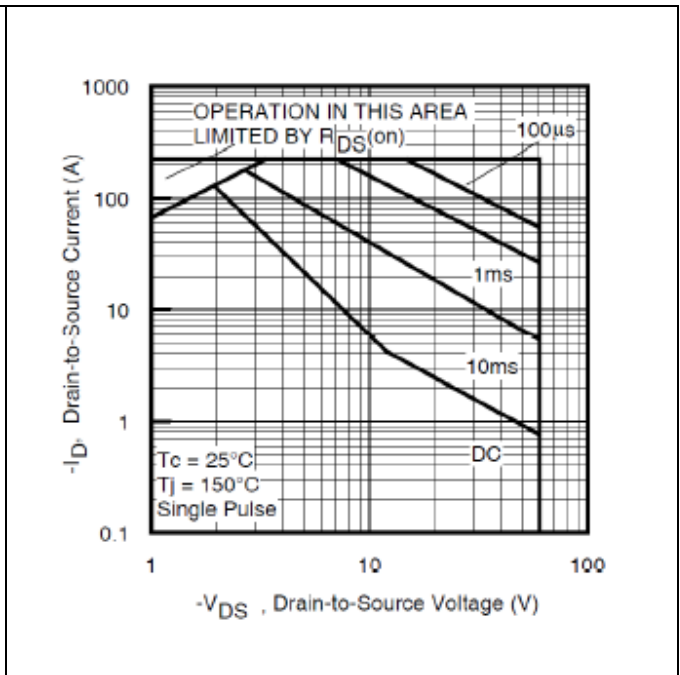
**Figure 10 Typical Capacitance Vs. Drain-to-Source Voltage**



**Figure 11 Typical Gate-to-Source Voltage Vs. Typical Gate Charge**



**Figure 12 Typical Source-Drain Current Vs. Diode Forward Voltage**



**Figure 13 Maximum Safe Operating Area**

Radiation Hardened Power MOSFET Surface Mount (SMD-2)

Electrical Characteristics Curves (Pre-irradiation)

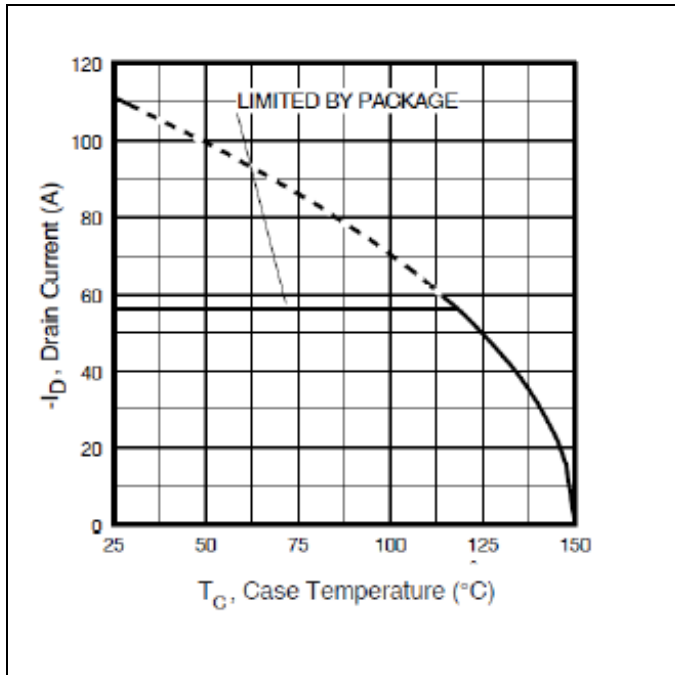


Figure 14 Maximum Drain Current Vs. Case Temperature

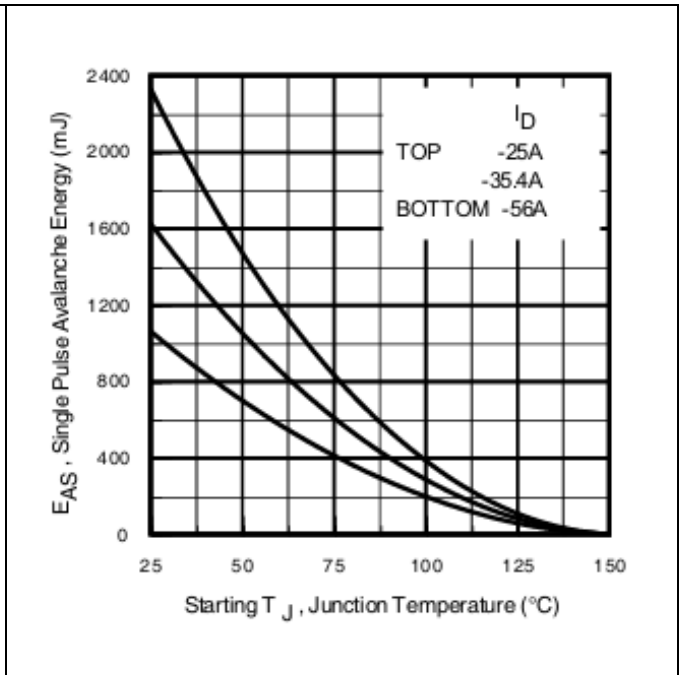


Figure 15 Maximum Avalanche Energy Vs. Junction Temperature

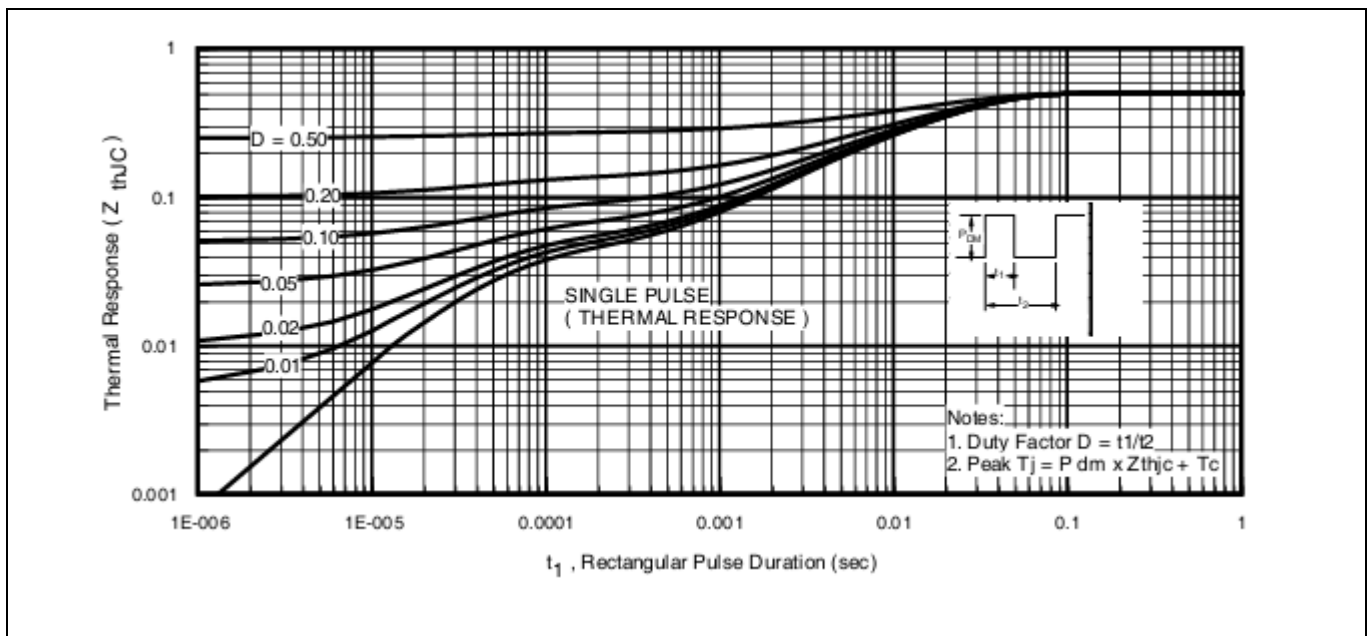


Figure 16 Maximum Effective Transient Thermal Impedance, Junction-to-Case

### 4 Test Circuits (Pre-irradiation)

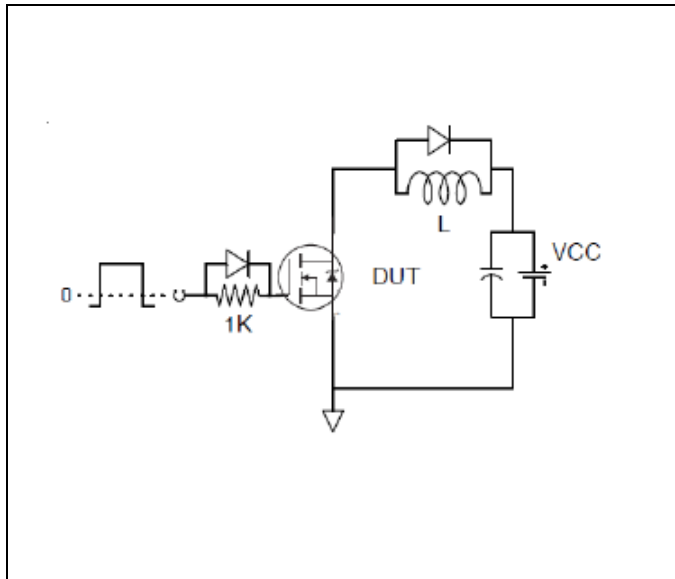


Figure 17 Gate Charge Test Circuit

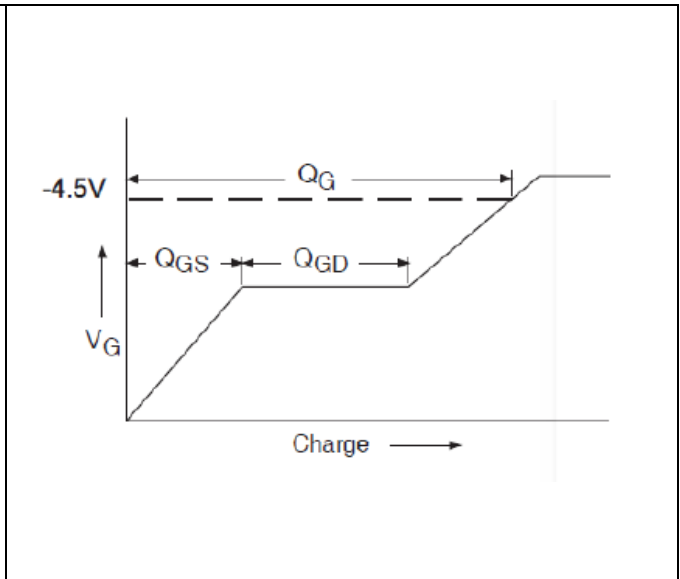


Figure 18 Gate Charge Waveform

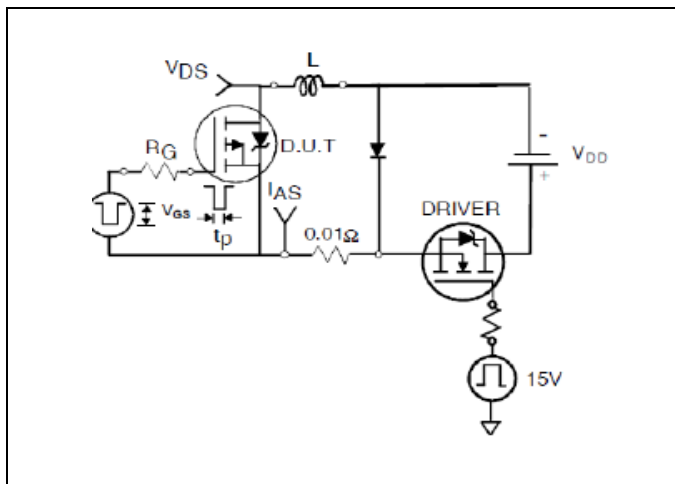


Figure 19 Unclamped Inductive Test Circuit

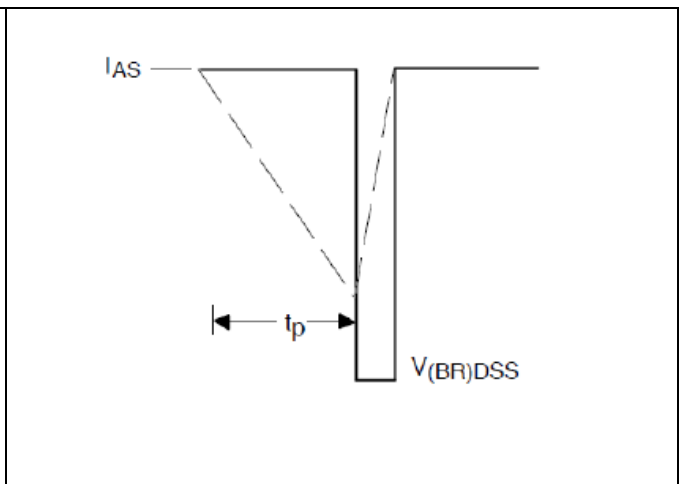


Figure 20 Unclamped Inductive Waveform

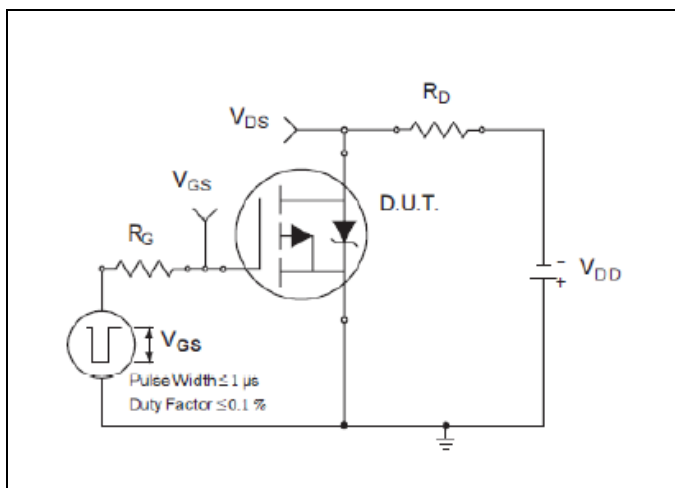


Figure 21 Switching Time Test Circuit

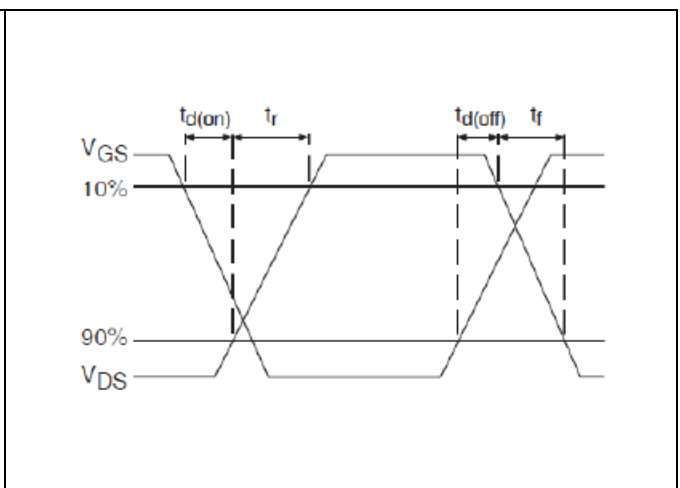
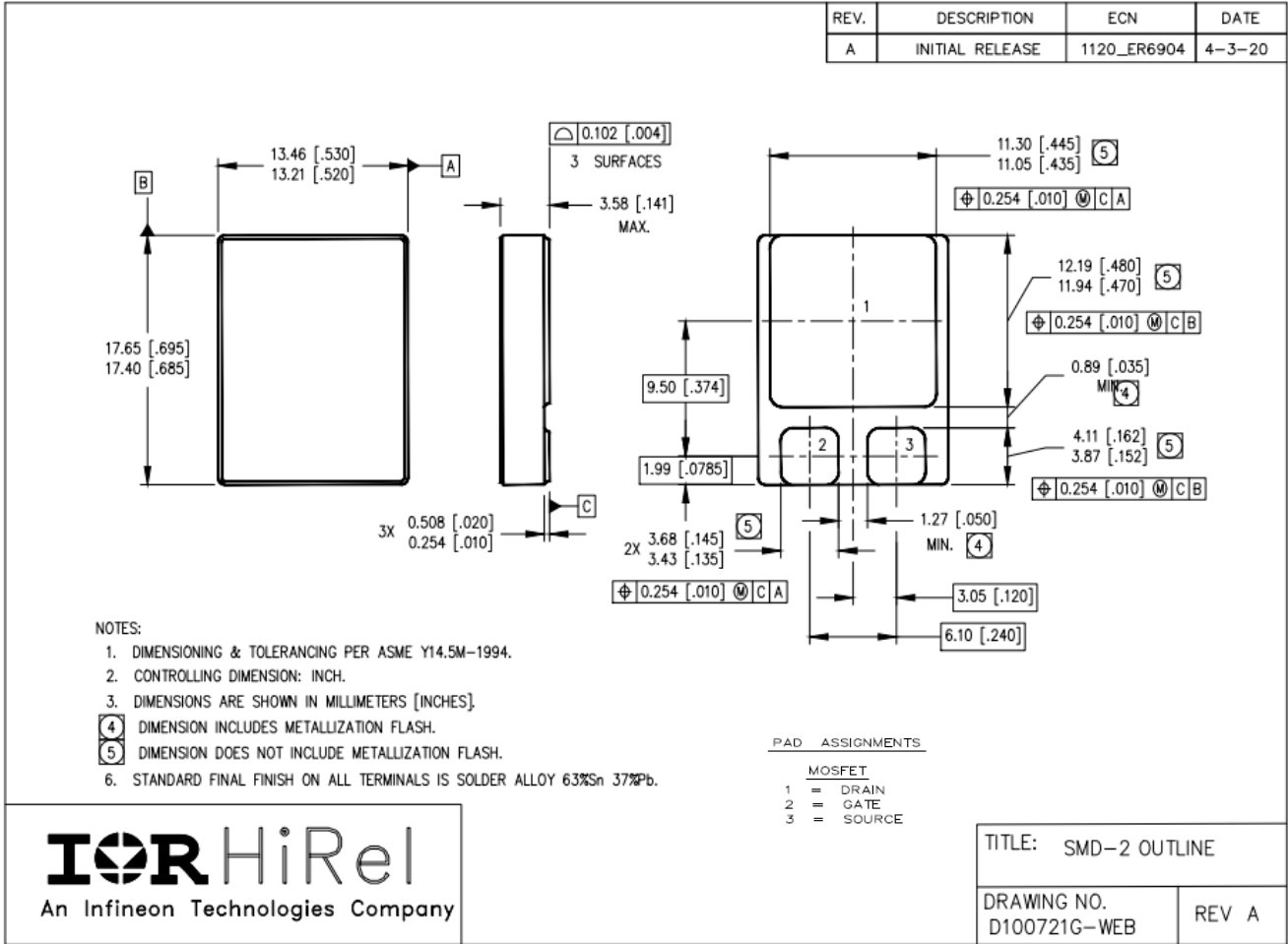


Figure 22 Switching Time Waveforms

Package Outline

# 5 Package Outline

Note: For the most updated package outline, please see the website: [SMD-2](#)



**Revision history****Revision history**

<b>Document version</b>	<b>Date of release</b>	<b>Description of changes</b>
	05/11/2007	Datasheet (PD-97174)
Rev A	06/11/2007	Added 2N7622U2
Rev B	10/10/2017	Updated based on ECN-1120_05639
Rev C	04/24/2019	Updated based on ECN-1120_07139
Rev D	03/02/2020	Updated based on ECN-1120_07827
Rev E	04/25/2022	Updated based on ECN-1120_09018

## Trademarks

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

**Edition 2022-04-25**

### Published by

**International Rectifier HiRel Products,  
Inc.**

**An Infineon Technologies company  
El Segundo, California 90245 USA**

**© 2022 Infineon Technologies AG.  
All Rights Reserved.**

**Do you have a question about this  
document?**

**Email: [erratum@infineon.com](mailto: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 ("Beschaffheitsgarantie").

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](http://www.infineon.com)).

## WARNINGS

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

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.