IR HiRel
An Infineon Technologies Company

IRHNA57064
JANSR2N7468U2

RADIATION HARDENED POWER MOSFET SURFACE MOUNT (SMD-2)

60V, N-CHANNEL
REF: MIL-PRF-19500/673
R5 TECHNOLOGY

SMD-2

Product Summary

Part Number	Radiation Level	RDS(on)	I_D	QPL Part Number
IRHNA57064	100 kRads(Si)	5.6mΩ	75A*	JANSR2N7468U2
IRHNA53064	300 kRads(Si)	5.6mΩ	75A*	JANSF2N7468U2
IRHNA55064	500 kRads(Si)	5.6mΩ	75A*	JANSG2N7468U2
IRHNA58064	1000 kRads(Si)	6.5mΩ	75A*	JANSH2N7468U2

Description

IR HiRel R5 technology provides high performance power MOSFETs for space applications. These devices have been characterized for both Total Dose and Single Event Effect (SEE) with useful performance up to LET of 80 (MeV/(mg/cm^2). The combination of low RDS(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.

Features

- Single Event Effect (SEE) Hardened
- Low RDS(on)
- Low Total Gate Charge
- Simple Drive Requirements
- Hermetically Sealed
- Electrically Isolated
- Ceramic Package
- Light Weight
- Surface Mount
- ESD Rating: Class 3B per MIL-STD-750, Method 1020

Absolute Maximum Ratings — Pre-Irradiation

Symbol	Parameter	Value	Units
I_{D1} @ V_{GS} = 12V, T_C = 25°C	Continuous Drain Current	75*	
I_{D2} @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	75*	A
I_{DM} @ T_C = 25°C	Pulsed Drain Current ①	300	
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	500	mJ
I_{AR}	Avalanche Current ①	75	A
E_{AR}	Repetitive Avalanche Energy ①	25	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.4	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

* Current is limited by package
For Footnotes, refer to the page 2.

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

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	60	——	——	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	——	0.065	——	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	——	5.6	mΩ	V_{GS} = 12V, I_D = 75A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	V_{DS} = V_{GS}, I_D = 1.0mA
Gfs	Forward Transconductance	45	——	——	S	V_{DS} = 15V, I_D = 75A ④
I_{DSS}	Zero Gate Voltage Drain Current	——	——	10	µA	V_{DS} = 48V, V_{GS} = 0V
		——	——	25		V_{DS} = 48V, 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_D = 45A
Q_{GS}	Gate-to-Source Charge	——	——	55		V_{DS} = 30V
Q_{GD}	Gate-to-Drain ('Miller') Charge	——	——	65		V_{GS} = 12V
$t_{d(on)}$	Turn-On Delay Time	——	——	35	ns	V_{DD} = 30V
tr	Rise Time	——	——	125		I_D = 45A
$t_{d(off)}$	Turn-Off Delay Time	——	——	69		R_G = 2.35Ω
t_f	Fall Time	——	——	50		V_{GS} = 12V
Ls +L_D	Total Inductance	——	4.0	——	nH	Measured from center of Drain pad to center of Source pad
C_{iss}	Input Capacitance	——	6080	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	2310	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	90	——		f = 1.0MHz

Source-Drain Diode Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	——	——	75*	A	
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	300		
V_{SD}	Diode Forward Voltage	——	——	1.3	V	T_J=25°C, I_S= 75A, V_{GS}=0V④
t_{rr}	Reverse Recovery Time	——	——	200	ns	T_J=25°C, I_F = 45A, $V_{DD} \le$ 25V
Q_{rr}	Reverse Recovery Charge	——	——	538	nC	di/dt = 100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

* Current is limited by package

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	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	——	

Footnotes:

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

② V_{DD} = 25V, starting T_J = 25°C, L = 0.18mH, Peak I_L = 75A, V_{GS} = 12V

③ $I_{SD} \le$ 45A, di/dt $\le$ 196A/µs, V_{DD} $\le$ 60V, $T_J \le$ 150°C

④ Pulse width $\le$ 300 µs; Duty Cycle $\le$ 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. 48 volt V_{DS} applied and V_{GS} = 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 IR Hirel 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

	Parameter	Up to 500 kRads (Si)[1]		1000 kRads (Si)[2]		Units	Test Conditions
		Min.	Max.	Min.	Max.		
BV_{DSS}	Drain-to-Source Breakdown Voltage	60	——	60	——	V	V_{GS} = 0V, I_D = 1.0mA
$V_{GS(th)}$	Gate Threshold Voltage	2.0	4.0	1.5	4.0	V	V_{DS} = V_{GS}, I_D = 1.0mA
I_{GSS}	Gate-to-Source Leakage Forward	——	100	——	100	nA	V_{GS} = 20V
I_{GSS}	Gate-to-Source Leakage Reverse	——	-100	——	-100	nA	V_{GS} = -20V
I_{DSS}	Zero Gate Voltage Drain Current	——	10	——	25	µA	V_{DS} = 48V, V_{GS} = 0V
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-3)	——	6.1	——	7.1	mΩ	V_{GS} = 12V, I_D = 45A
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (SMD-2)	——	5.6	——	6.5	mΩ	V_{GS} = 12V, I_D = 45A
V_{SD}	Diode Forward Voltage ④	——	1.3	——	1.3	V	V_{GS} = 0V, I_S = 75A

1. Part numbers IRHNA57064 (JANSR2N7468U2), IRHNA53064 (JANSF2N7468U2) and IRHNA55064 (JANSG2N7468U2)
2. Part number IRHNA58064 (JANSH2N7468U2)

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^2))	Energy (MeV)	Range (µm)	VDS (V)				
			@ VGS = 0V	@ VGS=-5V	@ VGS=-10V	@ VGS =-15V	@ VGS=-20V
38 ± 5%	300 ± 7.5%	38 ± 7.5%	60	60	60	60	30
61 ± 5%	330 ± 7.5%	31 ± 10%	46	46	35	25	15
84 ± 5%	350 ± 10%	28 ± 7.5%	35	30	25	20	14

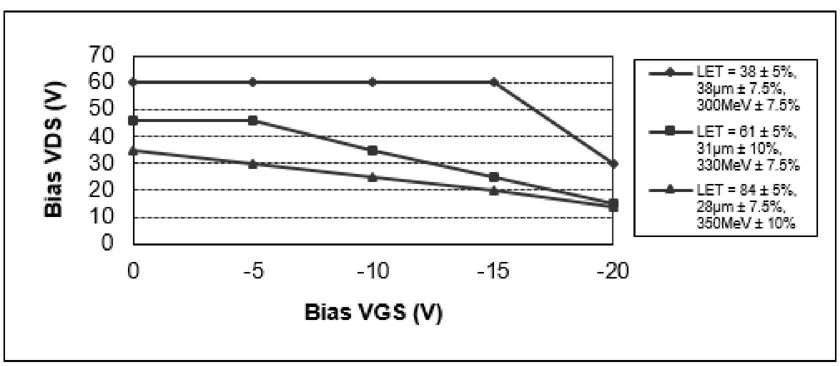


Fig a. Typical Single Event Effect, Safe Operating Area

For Footnotes, refer to the page 2.

Pre-Irradiation

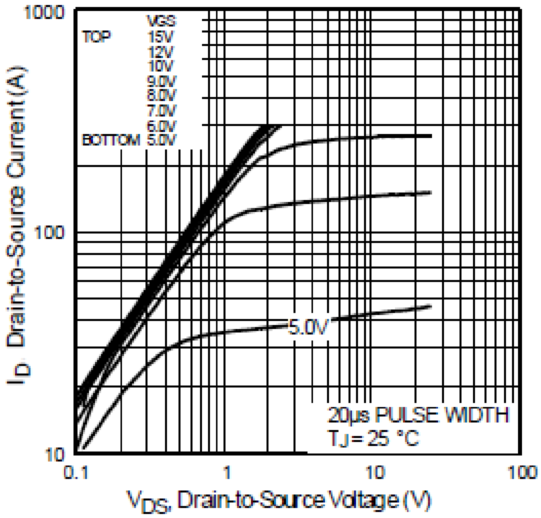


Fig 1. Typical Output Characteristics

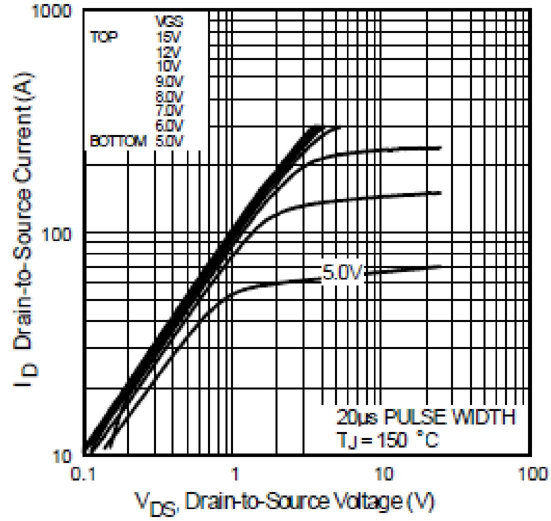


Fig 2. Typical Output Characteristics

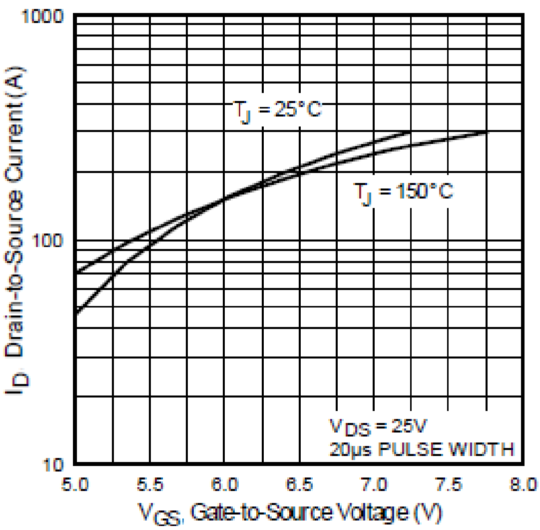


Fig 3. Typical Transfer Characteristics

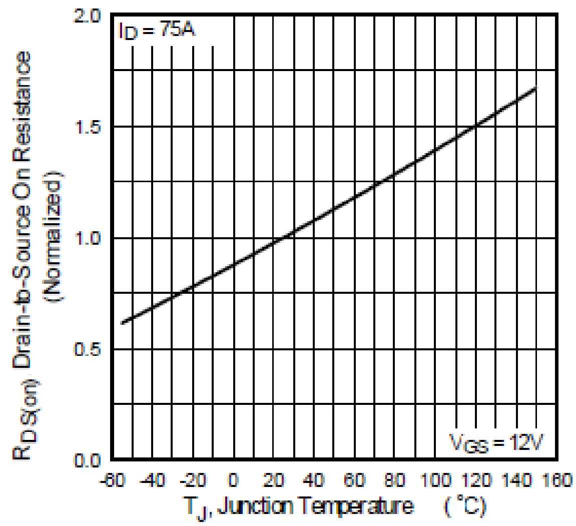


Fig 4. Normalized On-Resistance Vs. Temperature

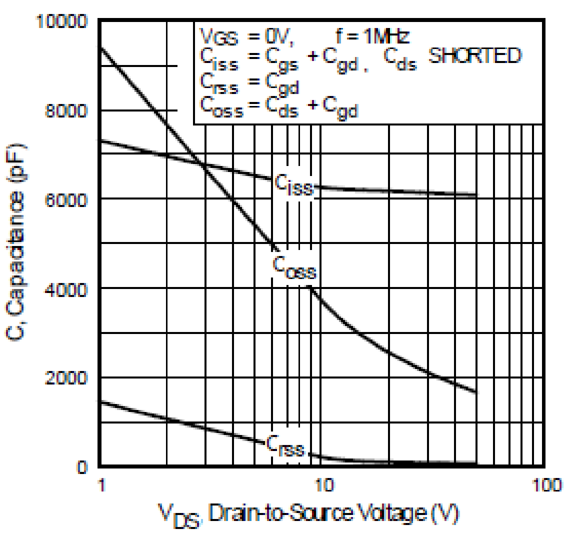


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

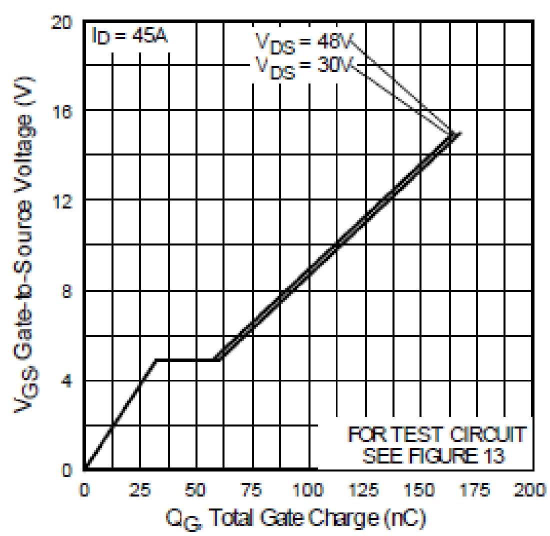


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

Pre-Irradiation

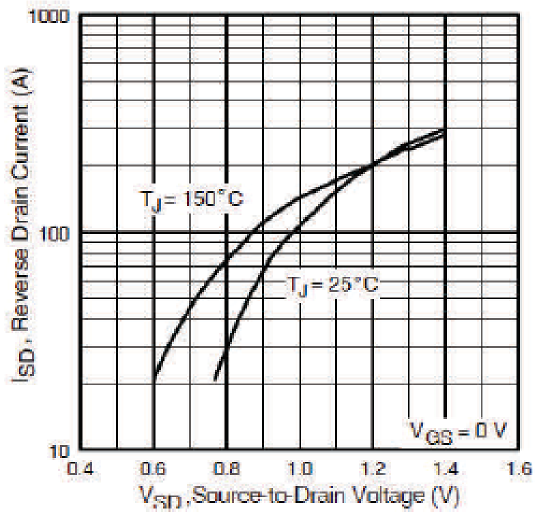


Fig 7. Typical Source-Drain Diode Forward Voltage

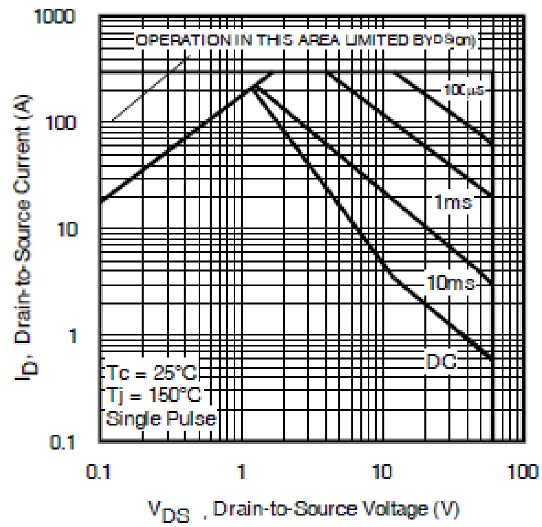


Fig 8. Maximum Safe Operating Area

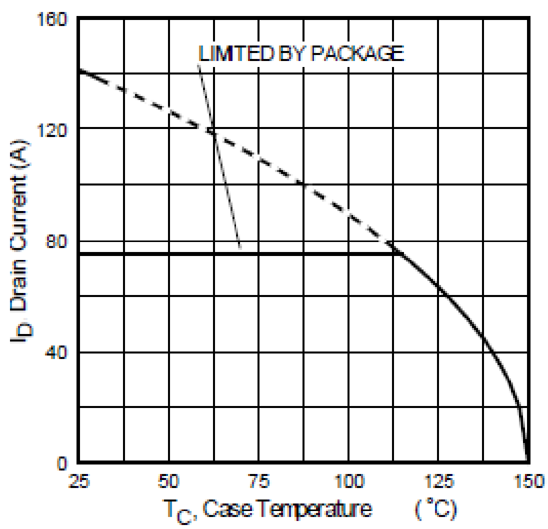


Fig 9. Maximum Drain Current Vs. Case Temperature

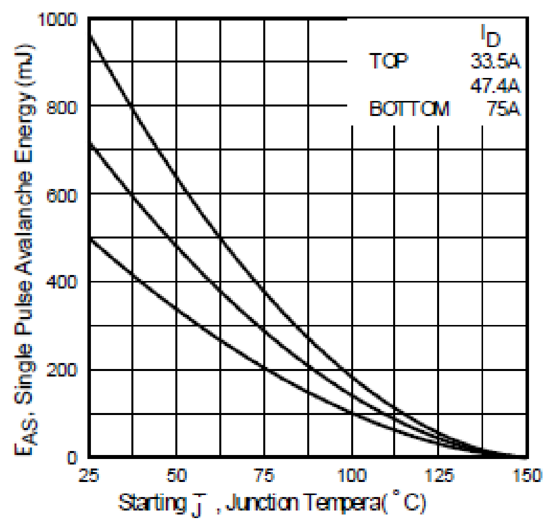


Fig 10. Maximum Avalanche Energy Vs. Drain Current

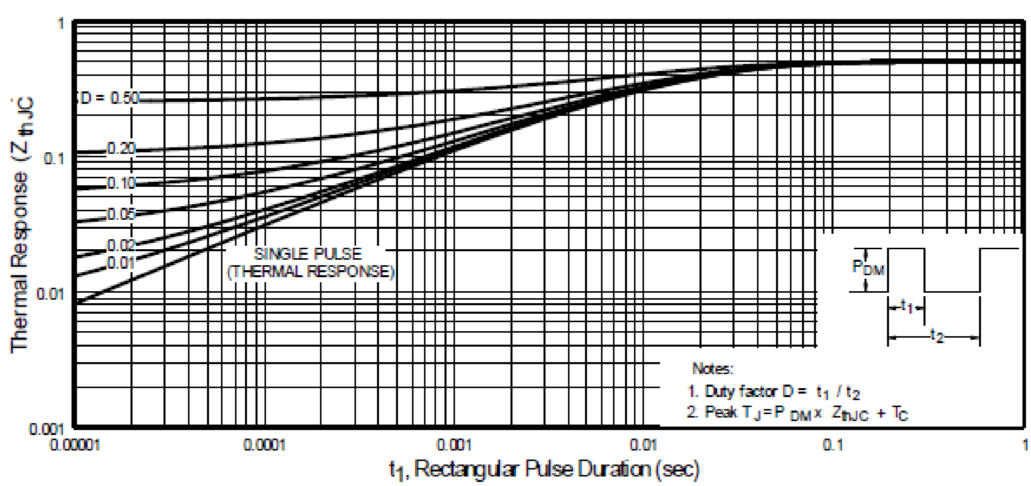


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

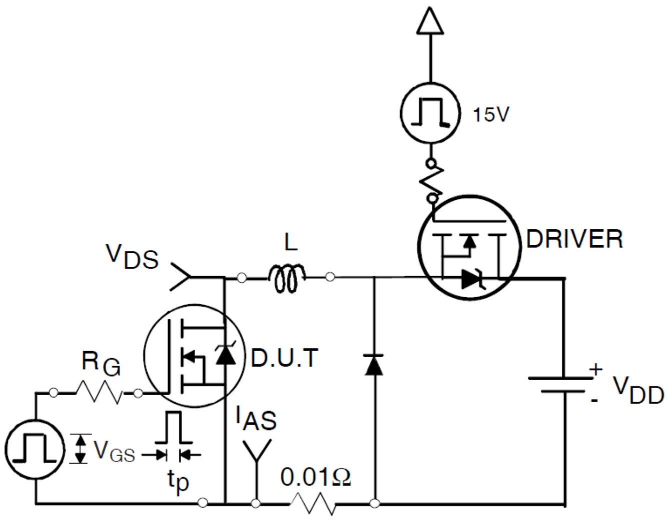


Fig 12a. Unclamped Inductive Test Circuit

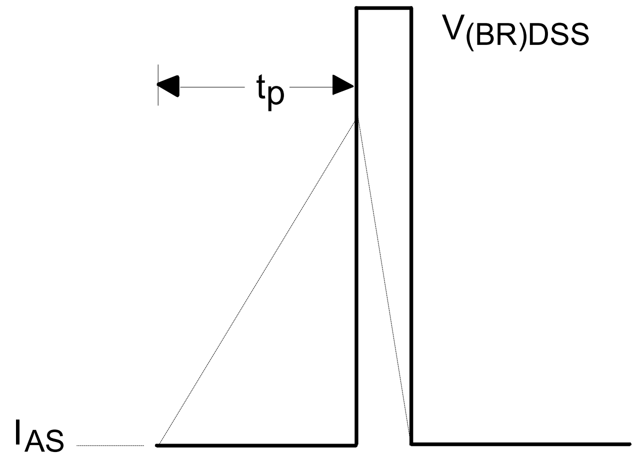


Fig 12b. Unclamped Inductive Wave-

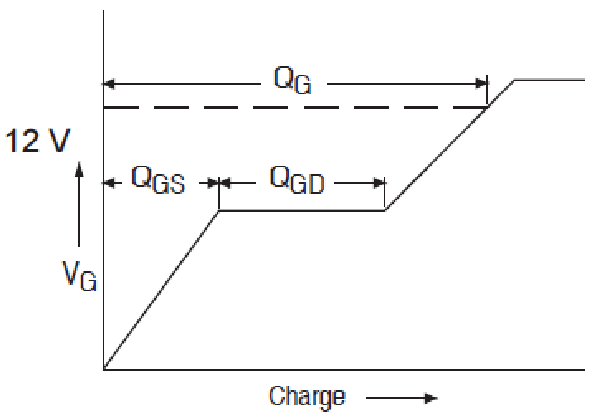


Fig 13a. Gate Charge Waveform

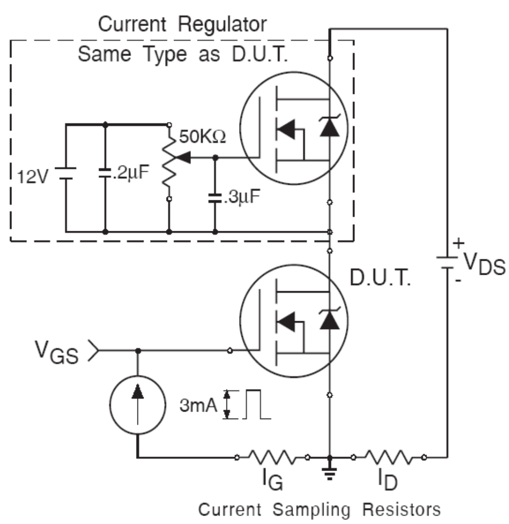


Fig 13b. Gate Charge Test Circuit

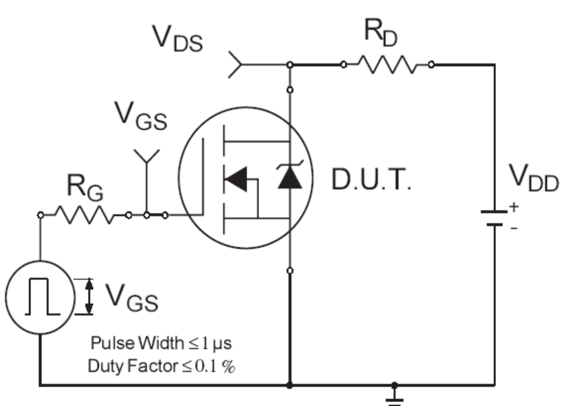


Fig 14a. Switching Time Test Circuit

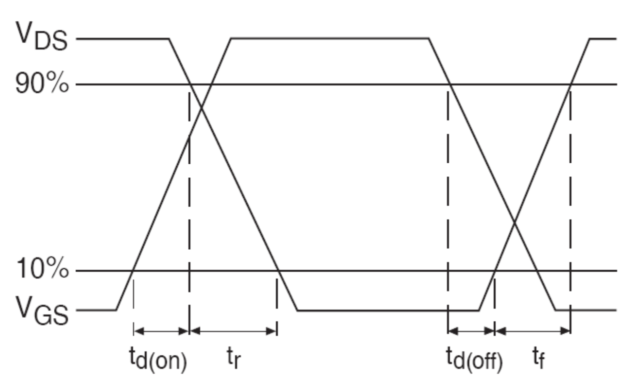
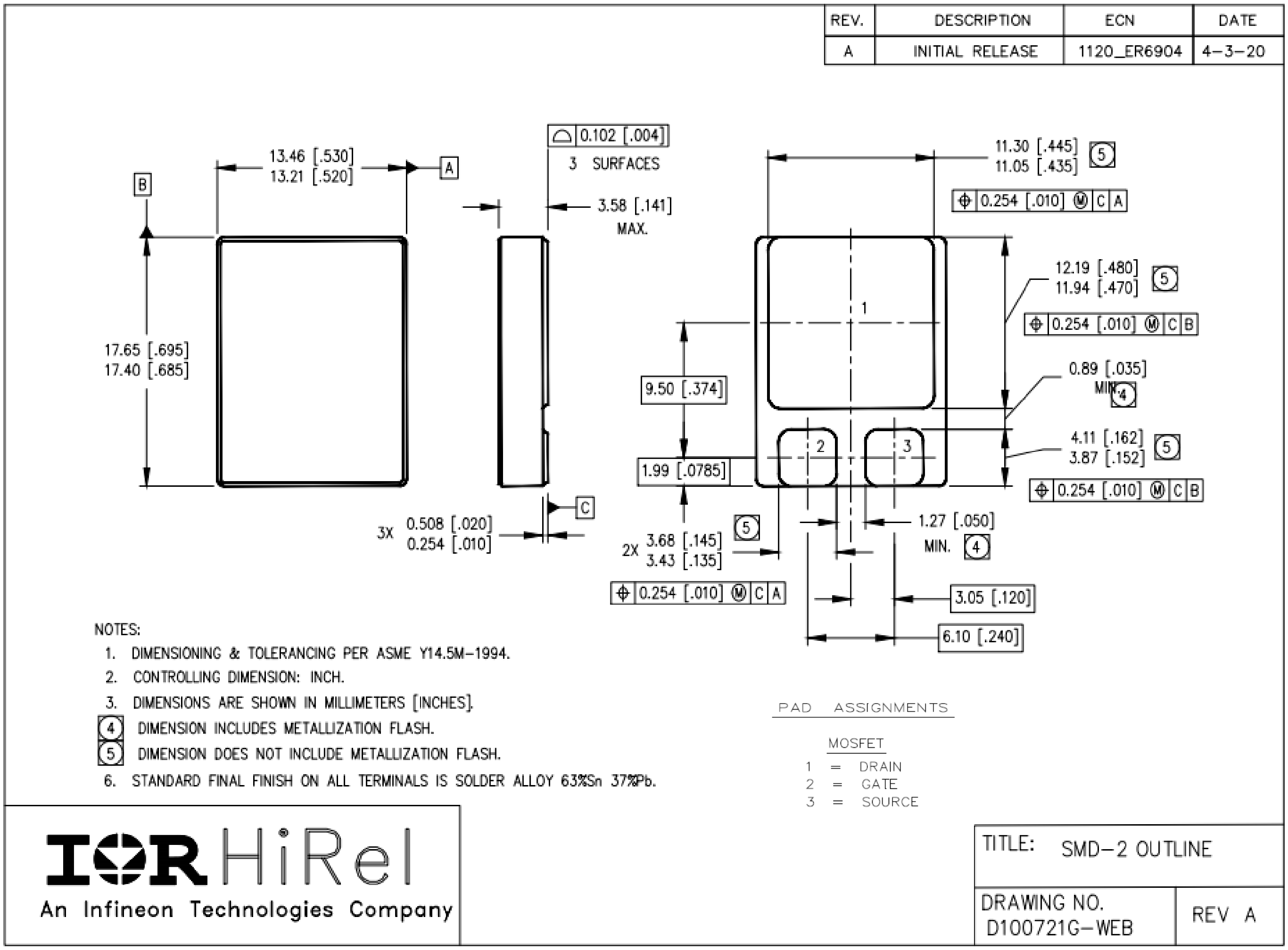


Fig 14b. Switching Time Waveforms

Note: For the most updated package outline, please see the website: SMD-2

Case Outline and Dimensions — SMD-2



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