An Infineon Technologies Company

IRHNJC9A7034
JANSR2N7647U3C

RADIATION HARDENED POWER MOSFET SURFACE MOUNT (SMD-0.5)(Ceramic Lid)

60V, N-CHANNEL
REF: MIL-PRF-19500/775
R9 TECHNOLOGY

Product Summary

Part Number	Radiation Level	RDS(on)	I_D	QPL Part Number
IRHNJC9A7034	100 kRads (Si)	18mΩ	40A*	JANSR2N7647U3C
IRHNJC9A3034	300 kRads (Si)	18mΩ	40A*	JANSF2N7647U3C

SMD-0.5 (Ceramic Lid)

Description

IR HiRel R9 technology provides superior power MOSFETs for space applications. These devices have improved immunity to Single Event Effect (SEE) and have been characterized for useful performance with Linear Energy Transfer (LET) up to 90MeV/(mg/cm^2). Their combination of low RDS(on) and faster switching times reduces the power losses and increases power density in today's high speed 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, ease of paralleling and temperature stability of electrical parameters.

Features

- Low RDS(on)
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Hermetically Sealed
- Ceramic package
- Light Weight
- Surface Mount
- ESD Rating: Class 2 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	40*	A
I_{D2} @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	29	
I_{DM} @ T_C = 25°C	Pulsed Drain Current ①	160	
P_D @ T_C = 25°C	Maximum Power Dissipation	75	W
	Linear Derating Factor	0.6	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ②	840	mJ
I_{AR}	Avalanche Current ①	40	A
E_{AR}	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	13	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Package Mounting Surface Temperature	300 (for 5s)	
	Weight	1.0 (Typical)	g

* Current is limited by package

For Footnotes, refer to the page 2.

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

Symbol	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	—	0.06	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	18	mΩ	V_{GS} = 12V, I_{D2} = 29A 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	—	-8.3	—	mV/°C	
Gfs	Forward Transconductance	20	—	—	S	V_{DS} = 15V, I_{D2} = 29A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	1.0	µA	V_{DS} = 48V, V_{GS} = 0V
		—	—	10		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	—	—	45	nC	I_{D1} = 40A*
Q_{GS}	Gate-to-Source Charge	—	—	14		V_{DS} = 30V
Q_{GD}	Gate-to-Drain ('Miller') Charge	—	—	11		V_{GS} = 12V
$t_{d(on)}$	Turn-On Delay Time	—	—	20	ns	V_{DD} = 30V
tr	Rise Time	—	—	40		I_{D1} = 40A*
$t_{d(off)}$	Turn-Off Delay Time	—	—	45		R_G = 7.5Ω
t_f	Fall Time	—	—	30		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	—	1740	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	660	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	5.0	—		f = 1.0MHz
R_G	Gate Resistance	—	1.2	—	Ω	f = 1.0MHz, open drain

Source-Drain Diode Ratings and Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	40*	A	
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	160		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_J = 25°C,I_S = 40A*, V_{GS} = 0V④
t_{rr}	Reverse Recovery Time	—	—	130	ns	T_J = 25°C, I_F = 40A*, V_{DD} ≤ 25V
Q_{rr}	Reverse Recovery Charge	—	—	590	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

Symbol	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	1.67	°C/W

Footnotes:

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

② V_{DD} = 60V, starting T_J = 25°C, L = 2.0mH, Peak I_L =29A, V_{GS} = 20V

③ I_{SD} ≤ 40A, di/dt ≤ 524A/µs, V_{DD} ≤ 60V, T_J ≤ 150°C

④ Pulse width ≤ 300 µs; Duty Cycle ≤ 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

Symbol	Parameter	Up to 300 kRads (Si) [1] Min.	Up to 300 kRads (Si) [1] Max.	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	60	——	V	V_{GS} = 0V, I_D = 1.0mA
$V_{GS(th)}$	Gate Threshold Voltage	2.0	4.0	V	V_{DS} = V_{GS}, I_D = 1.0mA
I_{GSS}	Gate-to-Source Leakage Forward	——	100	nA	V_{GS} = 20V
I_{GSS}	Gate-to-Source Leakage Reverse	——	-100	nA	V_{GS} = -20V
I_{DSS}	Zero Gate Voltage Drain Current	——	1.0	µA	V_{DS} = 48V, V_{GS} = 0V
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-3)	——	20	mΩ	V_{GS} = 12V, I_{D2} = 29A
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (SMD-0.5)	——	18	mΩ	V_{GS} = 12V, I_{D2} = 29A
V_{SD}	Diode Forward Voltage	——	1.2	V	V_{GS} = 0V, I_S = 40A

1. Part numbers IRHNJC9A7034 (JANSR2N7647U3C) and IRHNJC9A3034 (JANSF2N7647U3C)

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	VDS (V) @ VGS=-1V	VDS (V) @ VGS=-5V	VDS (V) @ VGS=-10V
38 ± 5%	355 ± 7.5%	43 ± 7.5%	60	60	60	60
60 ± 5%	753 ± 7.5%	60 ± 10%	60	60	60	60
90 ± 5%	1515 ± 10%	82 ± 7.5%	60	60	——	——

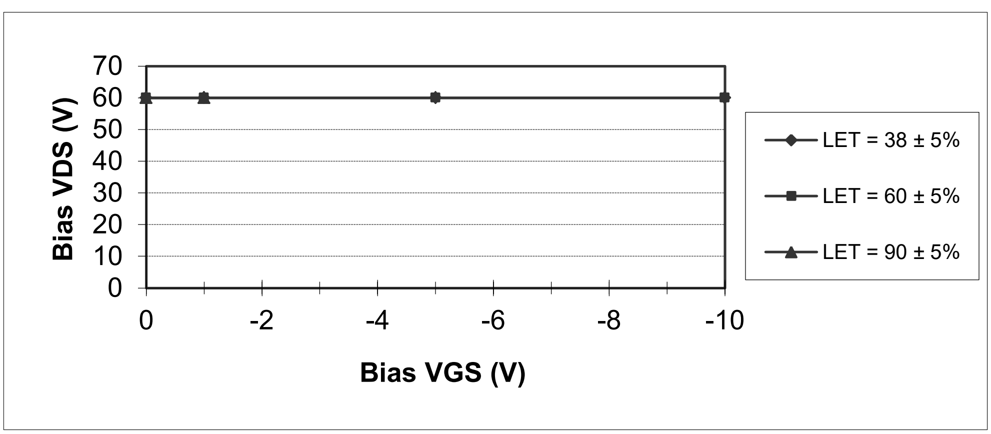


Fig a. Typical Single Event Effect, Safe Operating Area

For Footnotes, refer to the page 2.

Pre-Irradiation

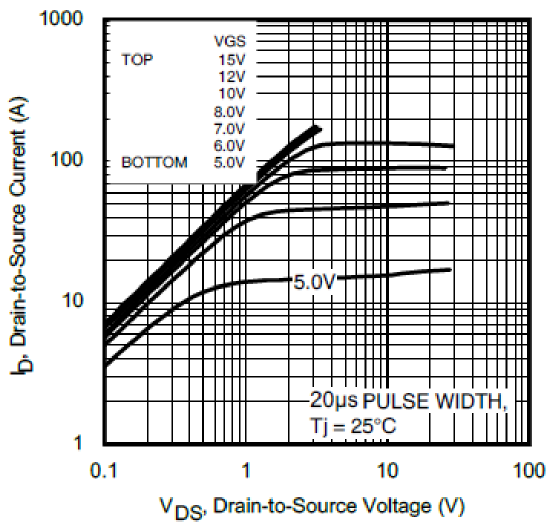


Fig 1. Typical Output Characteristics

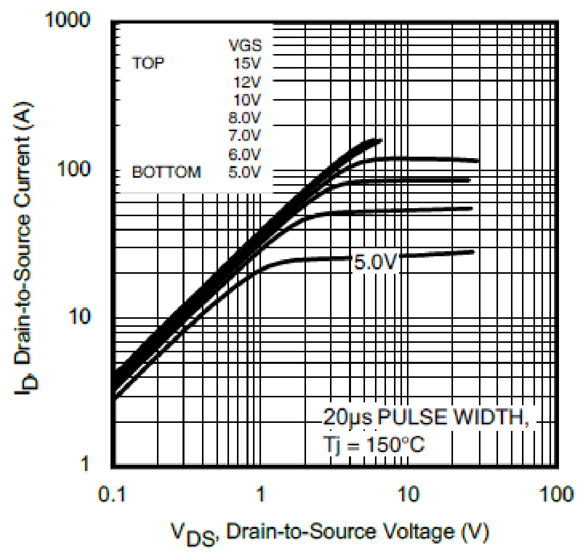


Fig 2. Typical Output Characteristics

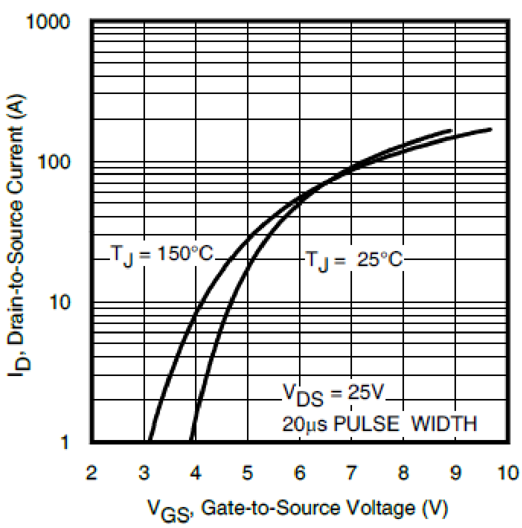


Fig 3. Typical Transfer Characteristics

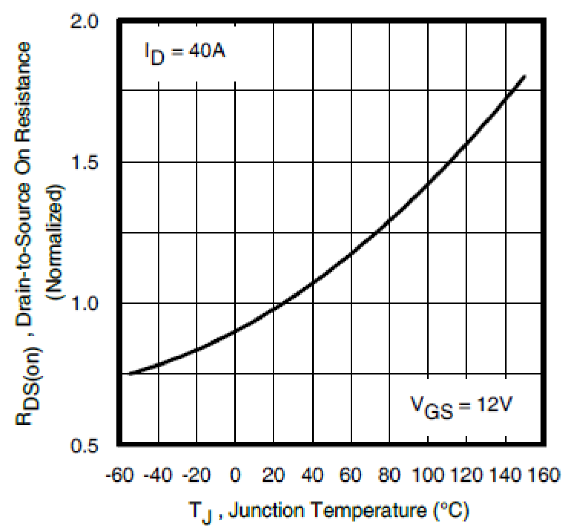


Fig 4. Normalized On-Resistance Vs. Temperature

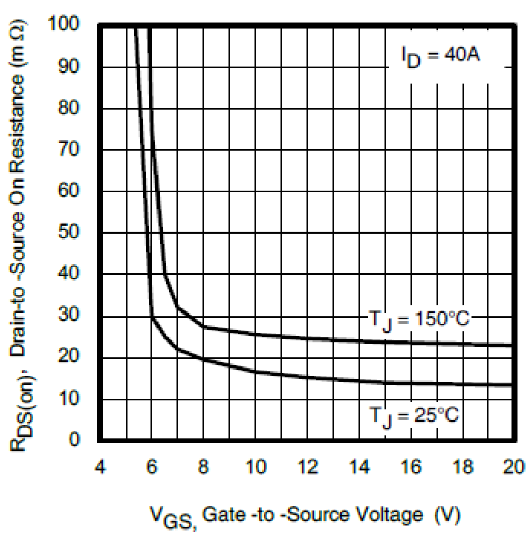


Fig 5. Typical On-Resistance Vs Gate Voltage

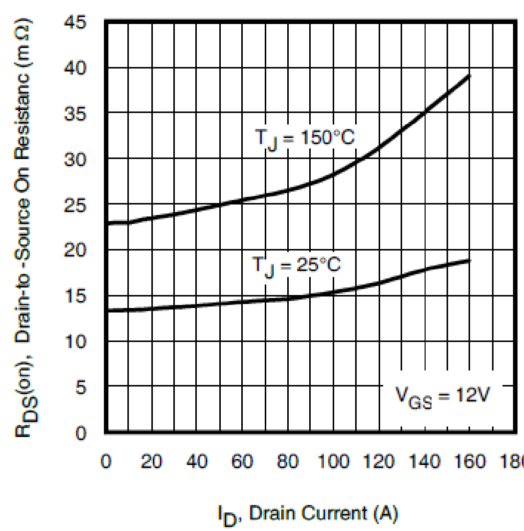


Fig 6. Typical On-Resistance Vs Drain Current

Pre-Irradiation

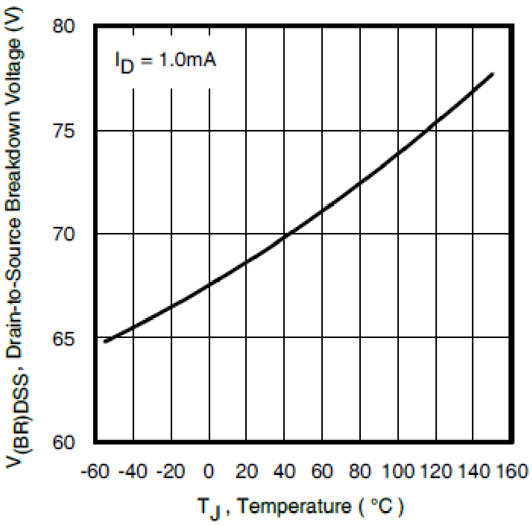


Fig 7. Typical Drain-to-Source Breakdown Voltage Vs Temperature

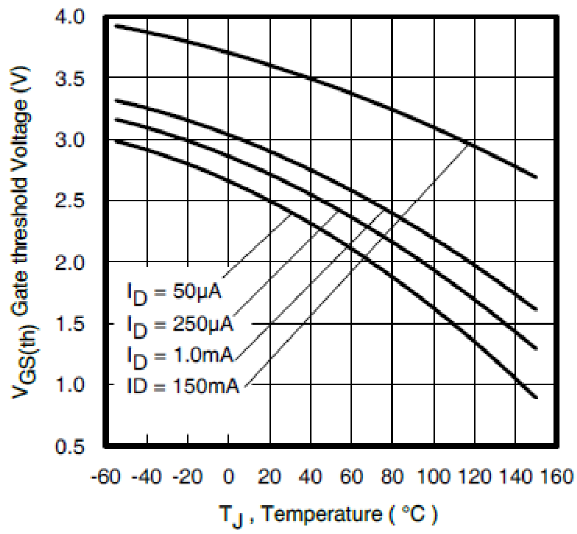


Fig 8. Typical Threshold Voltage Vs Temperature

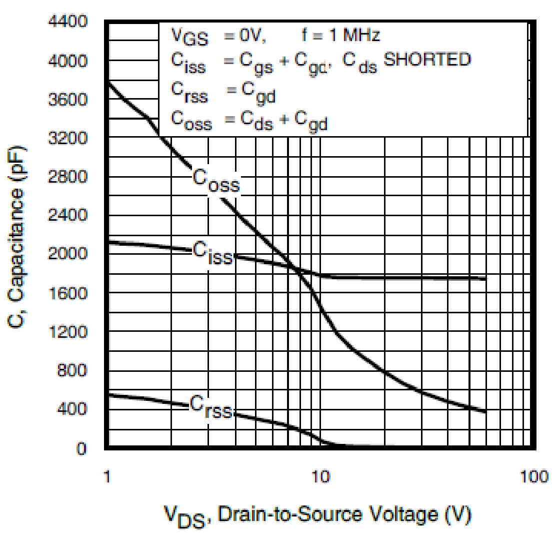


Fig 9. Typical Capacitance Vs. Drain-to-Source Voltage

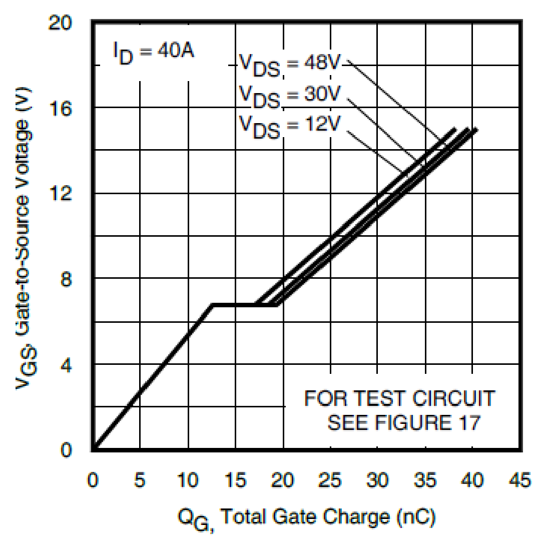


Fig 10. Typical Gate Charge Vs. Gate-to-Source Voltage

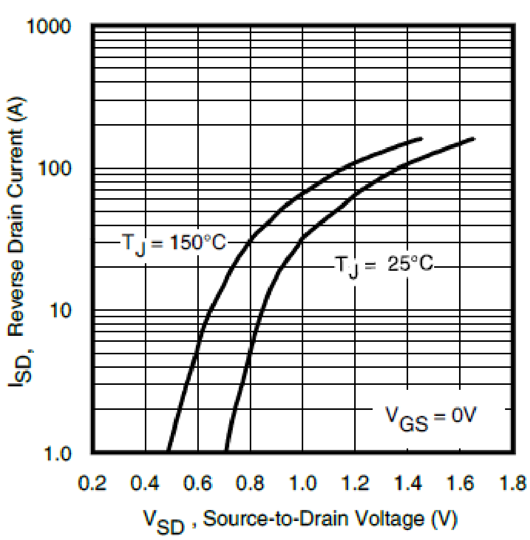


Fig 11. Typical Source-Drain Diode Forward Voltage

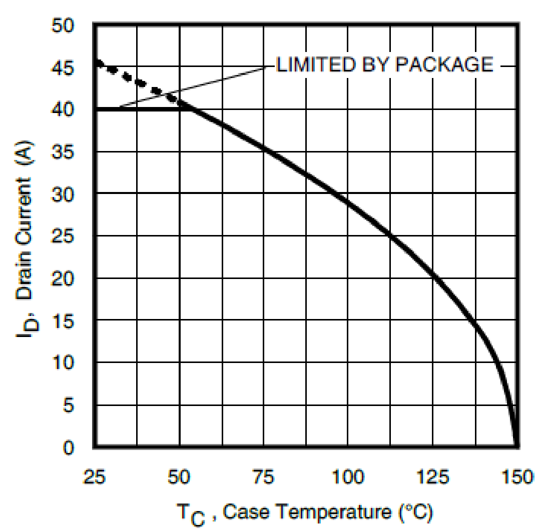


Fig 12. Maximum Drain Current Vs. Case Temperature

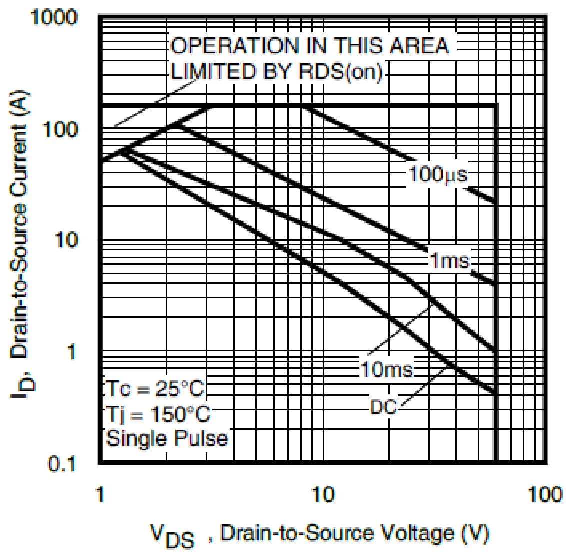


Fig 13. Maximum Safe Operating Area

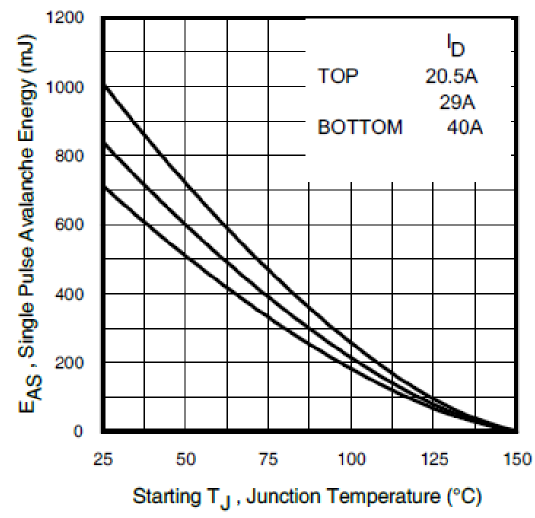


Fig 14. Maximum Avalanche Energy Vs. Drain Current

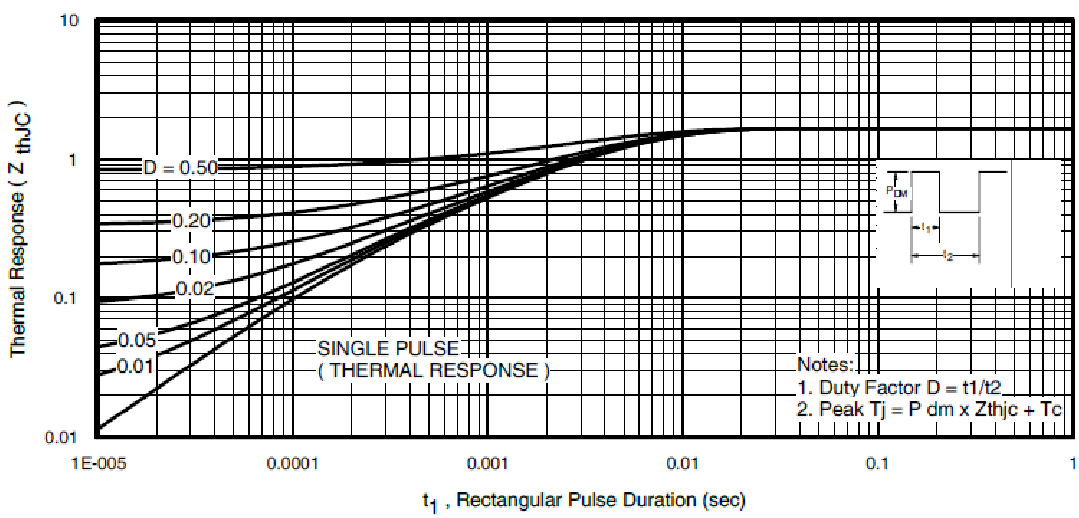


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

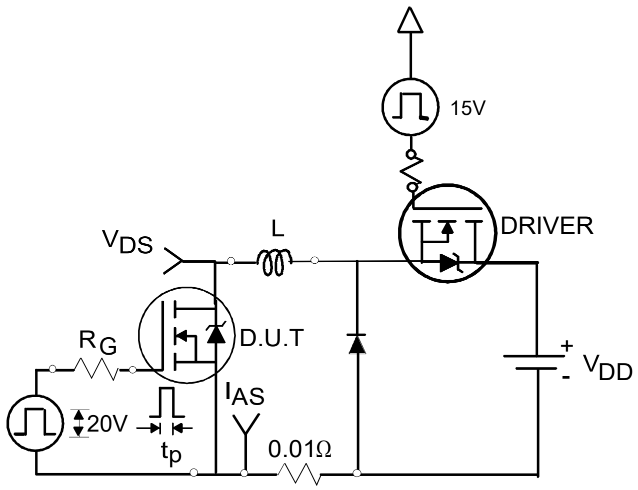


Fig 16a. Unclamped Inductive Test Circuit

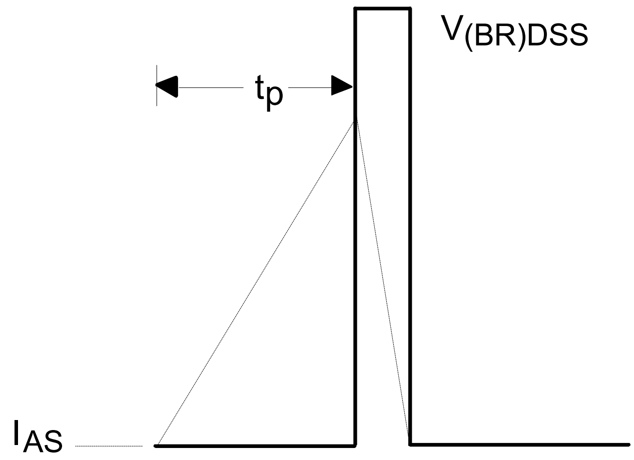


Fig 16b. Unclamped Inductive Waveforms

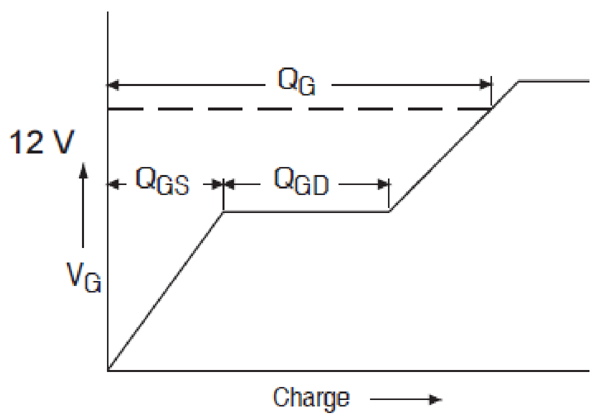


Fig 17a. Gate Charge Waveform

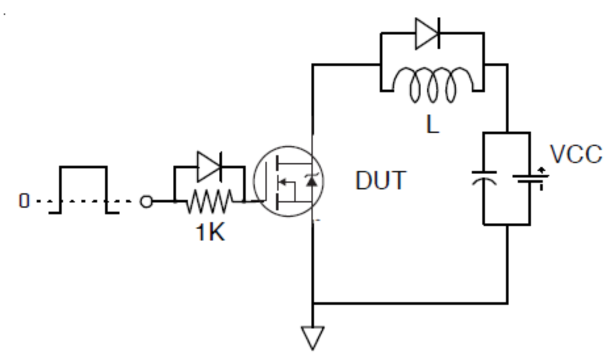


Fig 17b. Gate Charge Test Circuit

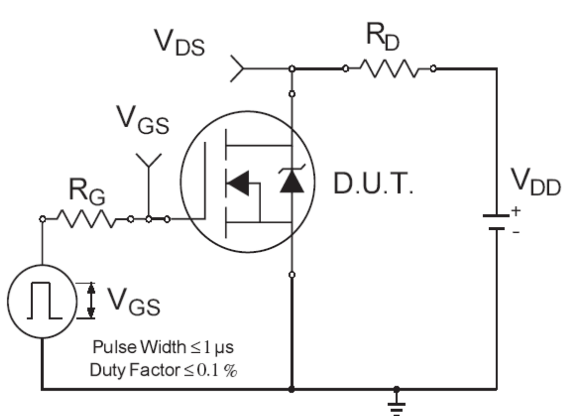


Fig 18a. Switching Time Test Circuit

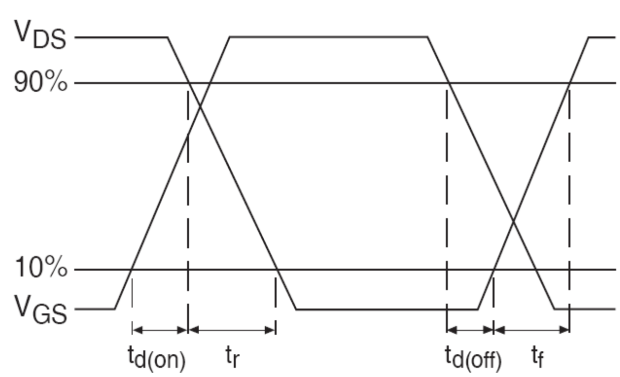
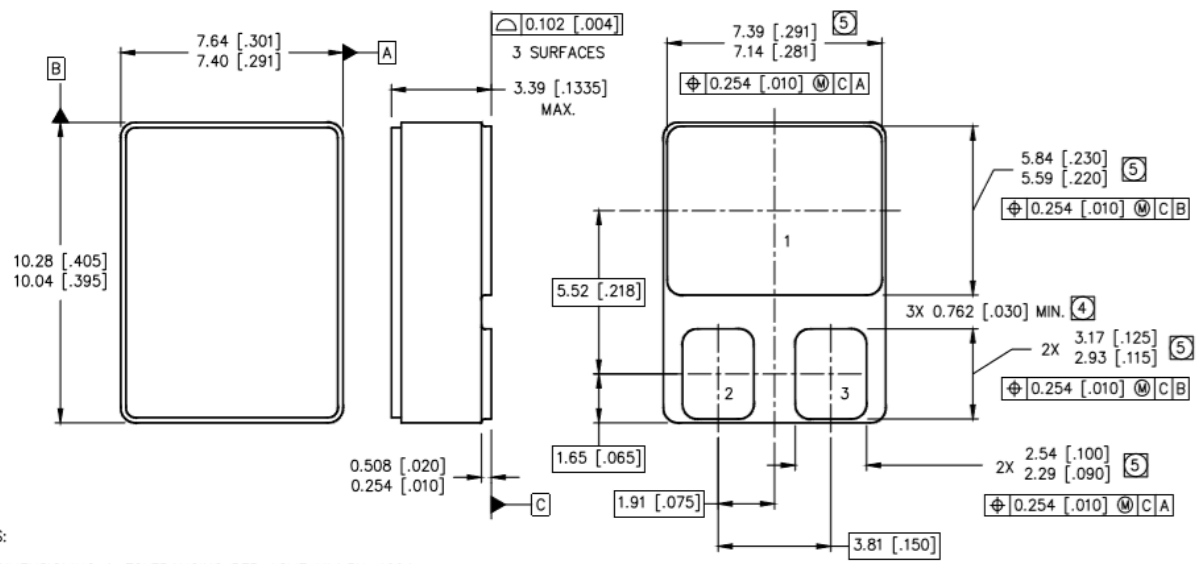


Fig 18b. Switching Time Waveforms

Note: For the most updated package outline, please see the website: [SMD-0.5 (Ceramic Lid)]

Case Outline and Dimensions - SMD-0.5 (Ceramic Lid)

REV.	DESCRIPTION	ECN	DATE
A	INITIAL RELEASE	1120_ER6904	4-3-20



NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. DIMENSION INCLUDES METALLIZATION FLASH.
5. DIMENSION DOES NOT INCLUDE METALLIZATION FLASH.
6. STANDARD FINAL FINISH ON ALL TERMINALS IS SOLDER ALLOY 63%Sn 37%Pb.

PAD ASSIGNMENTS

MOSFET

1 = DRAIN
2 = GATE
3 = SOURCE

IR HiRel
An Infineon Technologies Company

TITLE: SMD-0.5 OUTLINE WITH CERAMIC LID	
DRAWING NO. D100873G-WEB	REV A

IR HiRel
An Infineon Technologies Company

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