International
IOR Rectifier

PD-97193A

2N7594T3

IRHYS67234CM

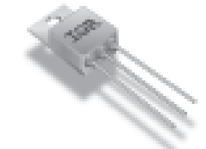
250V, N-CHANNEL

R6 TECHNOLOGY

RADIATION HARDENED POWER MOSFET THRU-HOLE (Low-Ohmic TO-257AA)

Product Summary

Part Number	Radiation Level	$R_{DS(on)}$	I_D
IRHYS67234CM	100K Rads (Si)	0.22Ω	12A
IRHYS63234CM	300K Rads (Si)	0.22Ω	12A



Low-Ohmic TO-257AA

International Rectifier's R6™ 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/cm²). Their combination of very low $R_{DS(on)}$ and faster switching times reduces power loss 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, ease of paralleling and temperature stability of electrical parameters.

Features:

- Low $R_{DS(on)}$
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Eyelets
- Electrically Isolated
- Light Weight

Absolute Maximum Ratings — Pre-Irradiation

	Parameter		Units
I_D @ V_{GS} = 12V, T_C = 25°C	Continuous Drain Current	12	A
I_D @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	7.6	
I_{DM}	Pulsed Drain Current ①	48	
P_D @ T_C = 25°C	Max. 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	80	mJ
I_{AR}	Avalanche Current ①	12	A
E_{AR}	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.2	V/ns
T_J T_{STG}	Operating Junction Storage Temperature Range	-55 to 150	°C
	Lead Temperature	300 (0.063 in. /1.6 mm from case for 10s)	
	Weight	4.3 (Typical)	g

For footnotes refer to the last page

06/15/10

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

	Parameter	Min	Typ	Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	250	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.26	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.22	Ω	V_{GS} = 12V, I_D = 7.6A 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	—	-10.2	—	mV/°C	
g_{fs}	Forward Transconductance	8.6	—	—	S	V_{DS} = 15V, I_{DS} = 7.6A ④
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
I_{GSS}	Gate-to-Source Leakage Reverse	—	—	-100		V_{GS} = -20V
Q_g	Total Gate Charge	—	—	40	nC	V_{GS} = 12V, I_D = 12A V_{DS} = 125V
Q_{gs}	Gate-to-Source Charge	—	—	12		
Q_{gd}	Gate-to-Drain ('Miller') Charge	—	—	12		
$t_{d(on)}$	Turn-On Delay Time	—	—	19	ns	V_{DD} = 125V, I_D = 12A, V_{GS} = 12V, R_G = 7.5Ω
t_r	Rise Time	—	—	27		
$t_{d(off)}$	Turn-Off Delay Time	—	—	36		
t_f	Fall Time	—	—	20		
$L_S + L_D$	Total Inductance	—	6.8	—	nH	Measured from Drain lead (6mm / 0.025 in from package) to Source lead (6mm/ 0.025 in from package)
C_{iss}	Input Capacitance	—	1420	—	pF	V_{GS} = 0V, V_{DS} = 25V f = 1.0MHz
C_{oss}	Output Capacitance	—	184	—		
C_{rss}	Reverse Transfer Capacitance	—	2.2	—		
R_g	Gate Resistance	—	0.98	—	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)	—	—	12	A	
I_{SM}	Pulse Source Current (Body Diode) ①	—	—	48		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_j = 25°C, I_S = 12A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	620	ns	T_j = 25°C, I_F = 12A, di/dt ≤ 100A/µs V_{DD} ≤ 50V ④
Q_{RR}	Reverse Recovery Charge	—	—	5.0	µC	
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	—	—	1.67	°C/W	
R_{thJA}	Junction-to-Ambient	—	—	80		Typical Socket Mount

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 ⑤⑥

	Parameter	Up to 300K Rads (Si)[1] Min	Up to 300K Rads (Si)[1] Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	250	—	V	$V_{GS} = 0V$, $I_D = 1.0mA$
$V_{GS(th)}$	Gate Threshold Voltage	2.0	4.0		$V_{GS} = V_{DS}$, $I_D = 1.0mA$
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	$V_{DS}= 200V$, $V_{GS}= 0V$
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.24	Ω	$V_{GS} = 12V$, $I_D = 7.6A$
$R_{DS(on)}$	Static Drain-to-Source On-State ④ Resistance (Low Ohmic TO-257)	—	0.22	Ω	$V_{GS} = 12V$, $I_D = 7.6A$
V_{SD}	Diode Forward Voltage ④	—	1.2	V	$V_{GS} = 0V$, $I_D = 12A$

1. Part numbers IRHYS67234CM and IRHYS63234CM

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
44 ± 5%	1350 ± 5%	125 ± 10%	250	250	250	250	40
61 ± 5%	825 ± 5%	66 ± 7.5%	250	250	250	50	-
90 ± 5%	1470 ± 5%	80 ± 5%	75	75	-	-	-

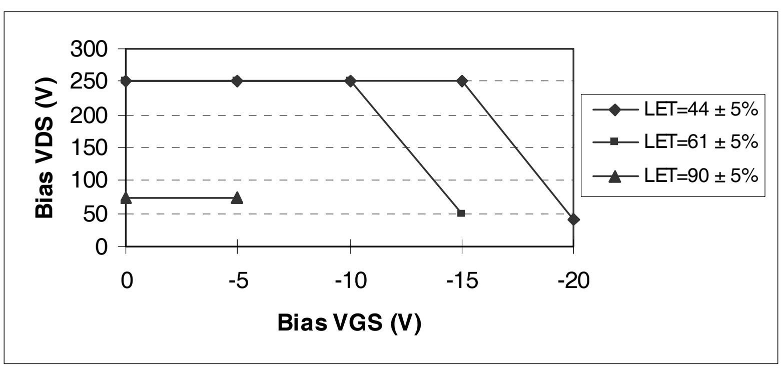


Fig a. Typical Single Event Effect, Safe Operating Area

For footnotes refer to the last page

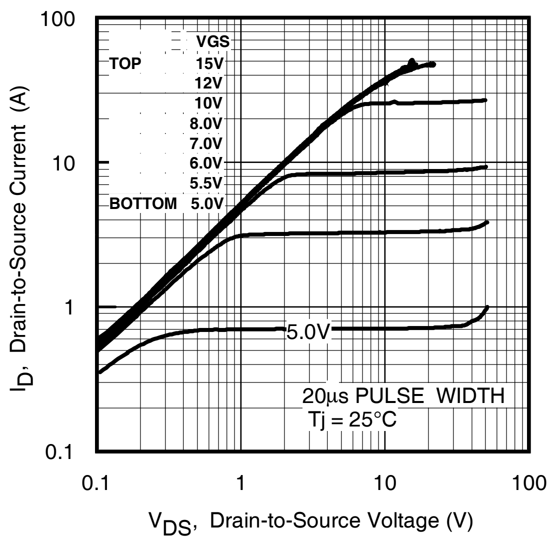


Fig 1. Typical Output Characteristics

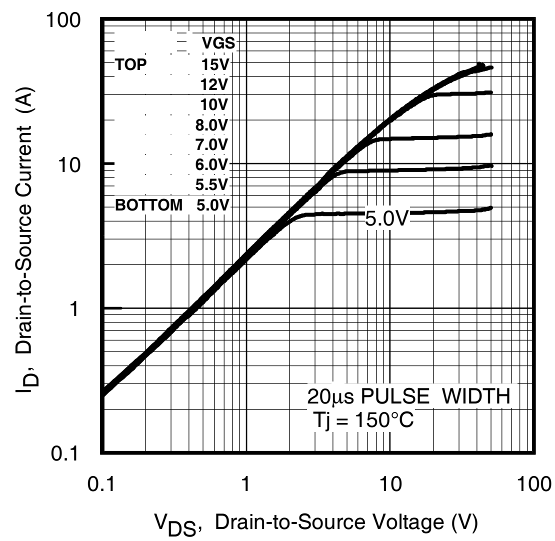


Fig 2. Typical Output Characteristics

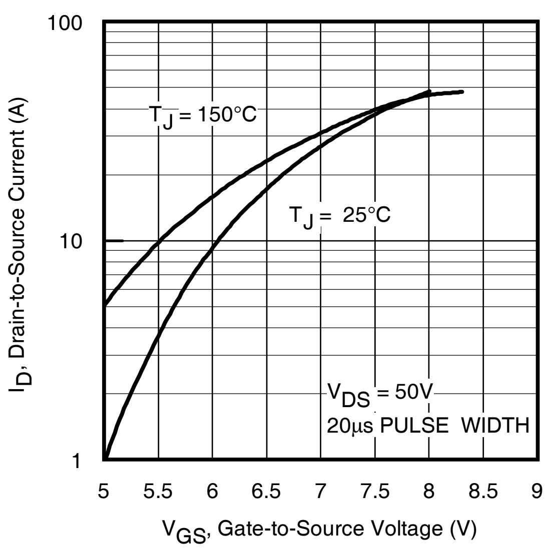


Fig 3. Typical Transfer Characteristics

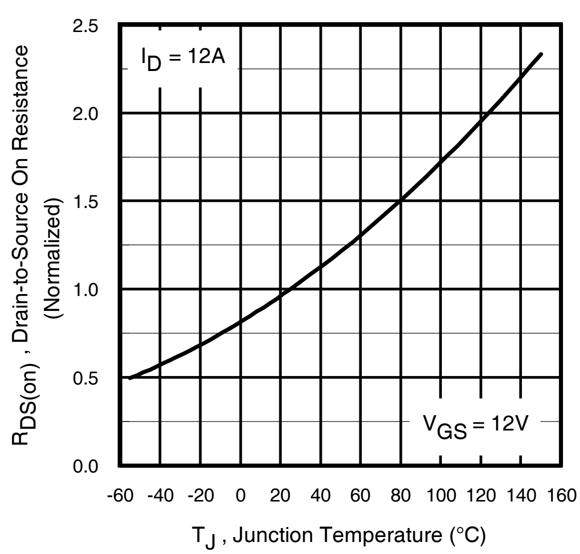


Fig 4. Normalized On-Resistance Vs. Temperature

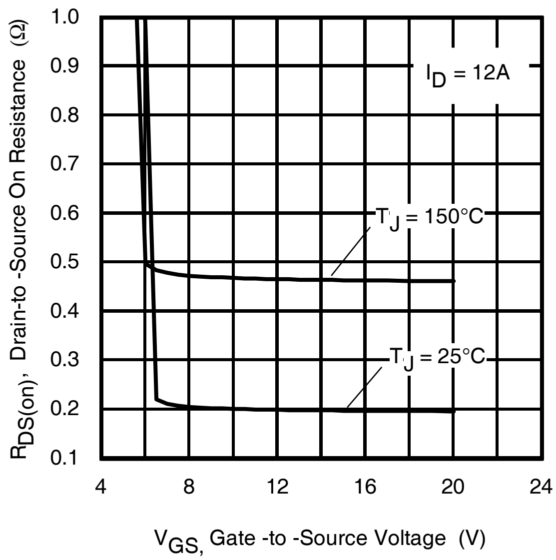


Fig 5. Typical On-Resistance Vs Gate Voltage

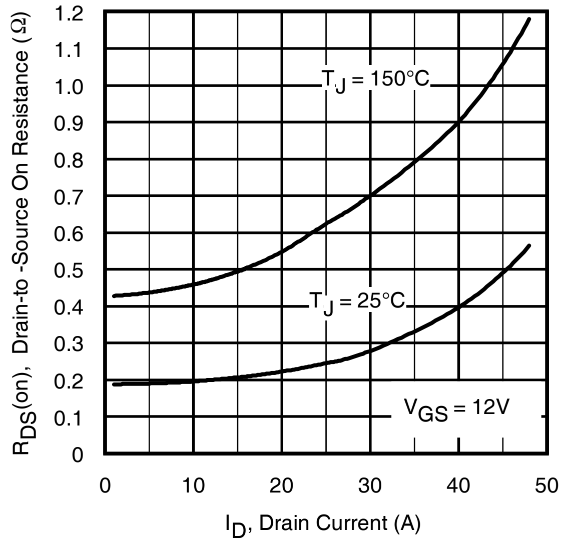


Fig 6. Typical On-Resistance Vs Drain Current

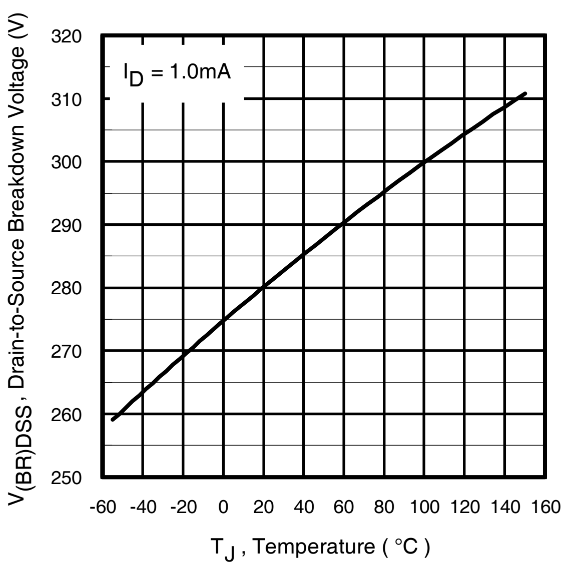


Fig 7. Typical Drain-to-Source Breakdown Voltage Vs Temperature

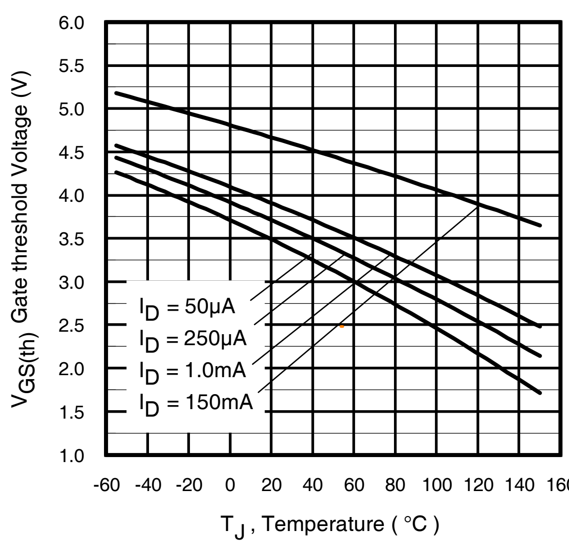


Fig 8. Typical Threshold Voltage Vs Temperature

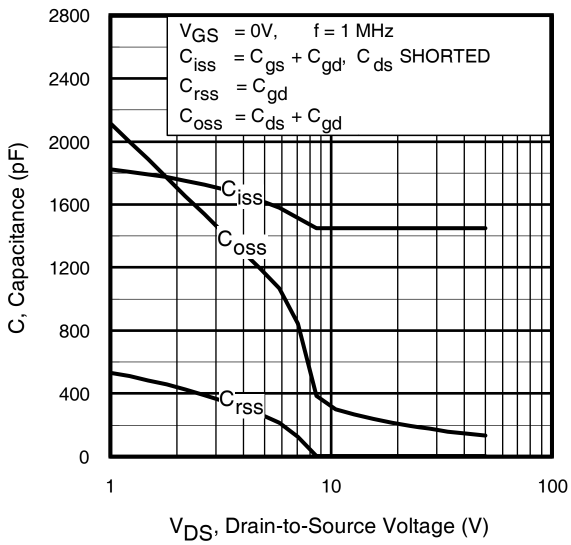


Fig 9. Typical Capacitance Vs. Drain-to-Source Voltage

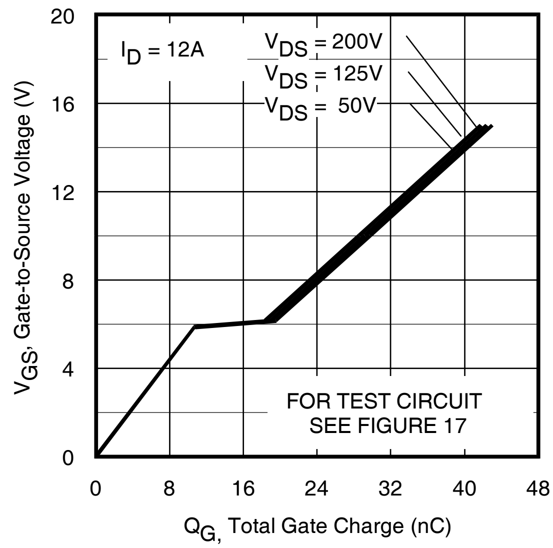


Fig 10. Typical Gate Charge Vs. Gate-to-Source Voltage

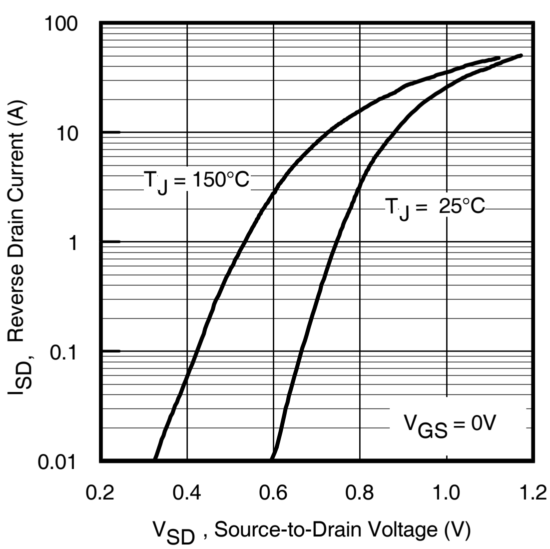


Fig 11. Typical Source-Drain Diode Forward Voltage

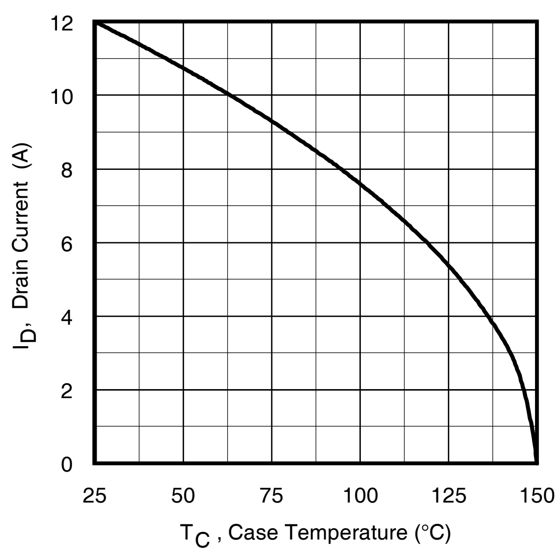


Fig 12. Maximum Drain Current Vs. Case Temperature

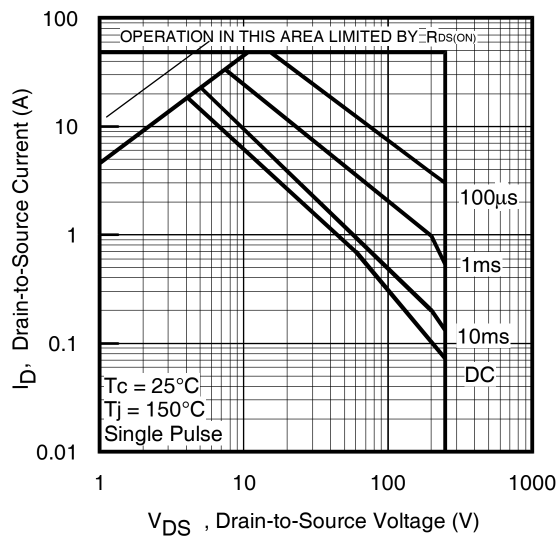


Fig 13. Maximum Safe Operating Area

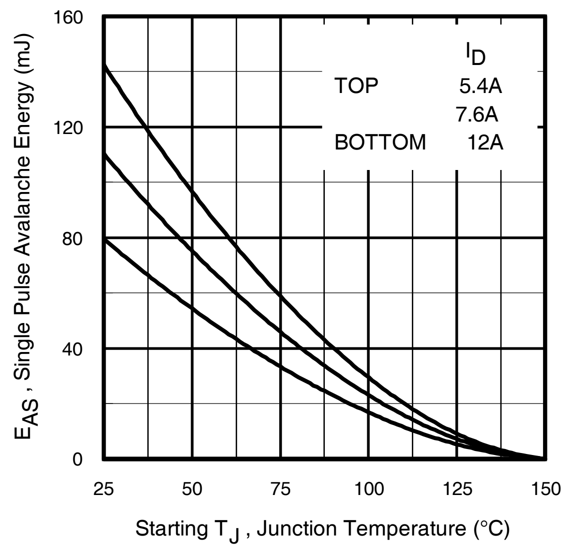


Fig 14. Maximum Avalanche Energy Vs. Drain Current

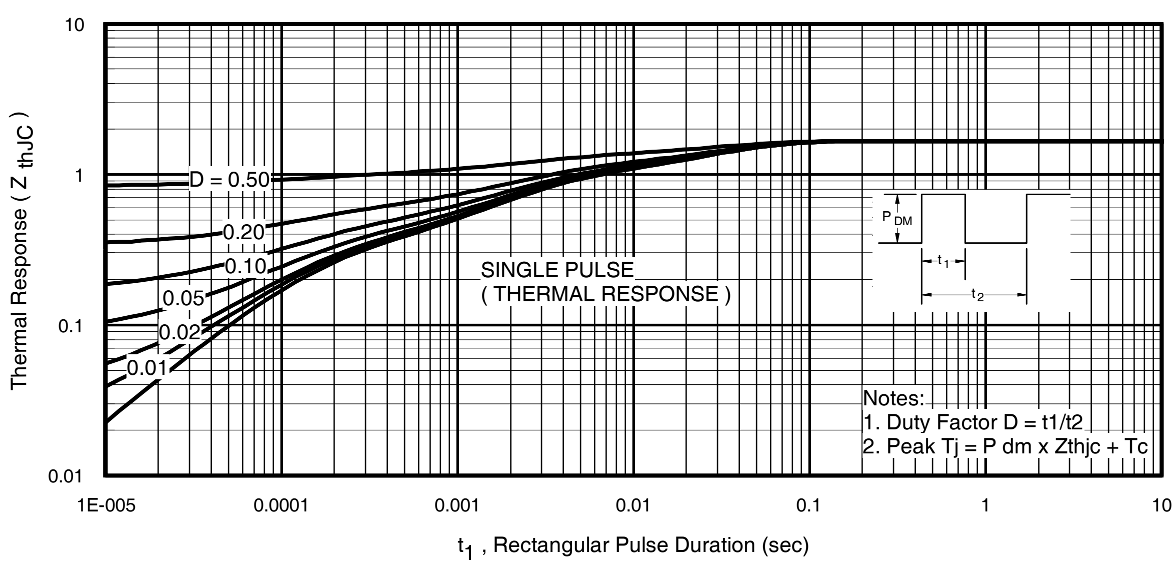


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

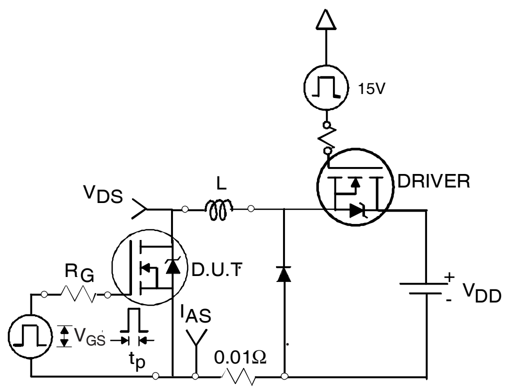


Fig 16a. Unclamped Inductive Test Circuit

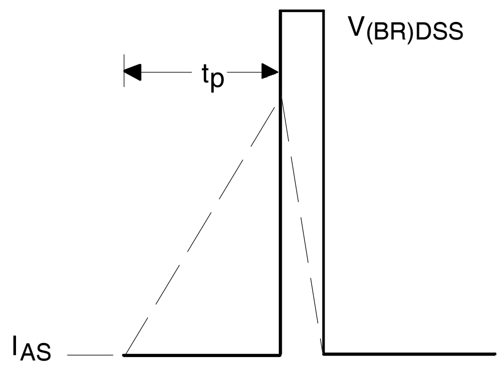


Fig 16b. Unclamped Inductive Waveforms

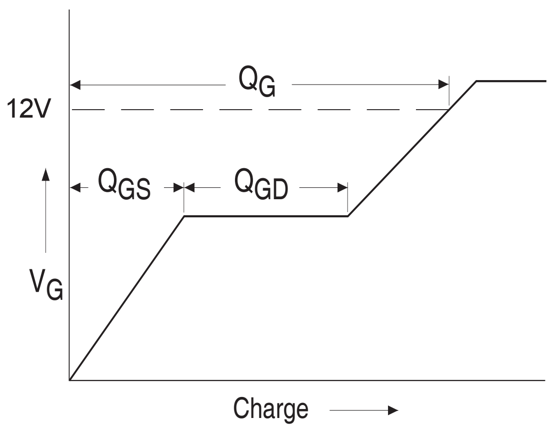


Fig 17a. Basic Gate Charge Waveform

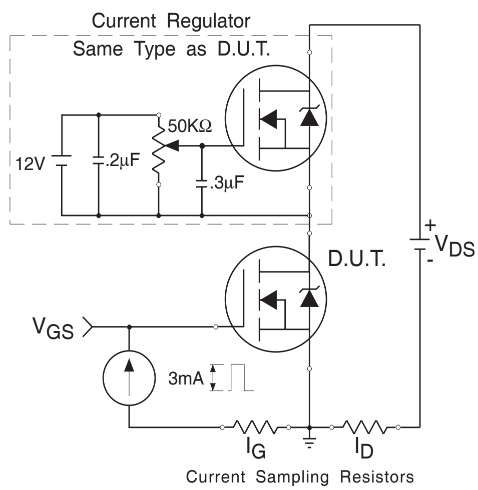


Fig 17b. Gate Charge Test Circuit

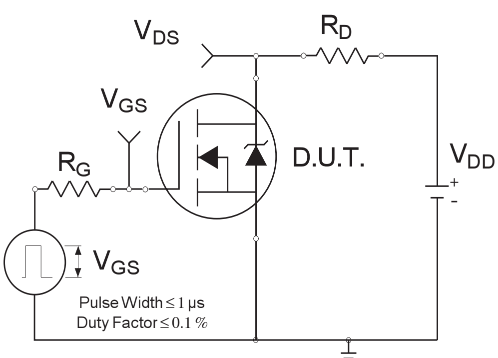


Fig 18a. Switching Time Test Circuit

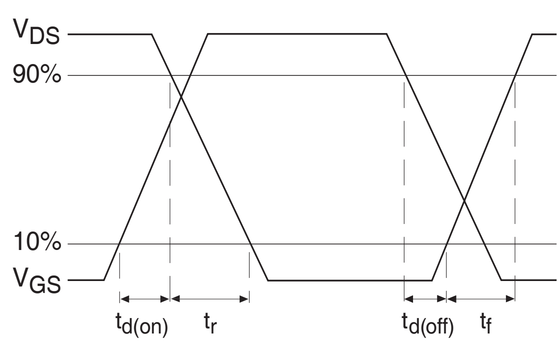


Fig 18b. Switching Time Waveforms

Footnotes:

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

② $V_{DD} \leq 50V$, starting $T_J = 25°C$, $L = 1.1mH$ Peak $I_L = 12A$, $V_{GS} = 12V$

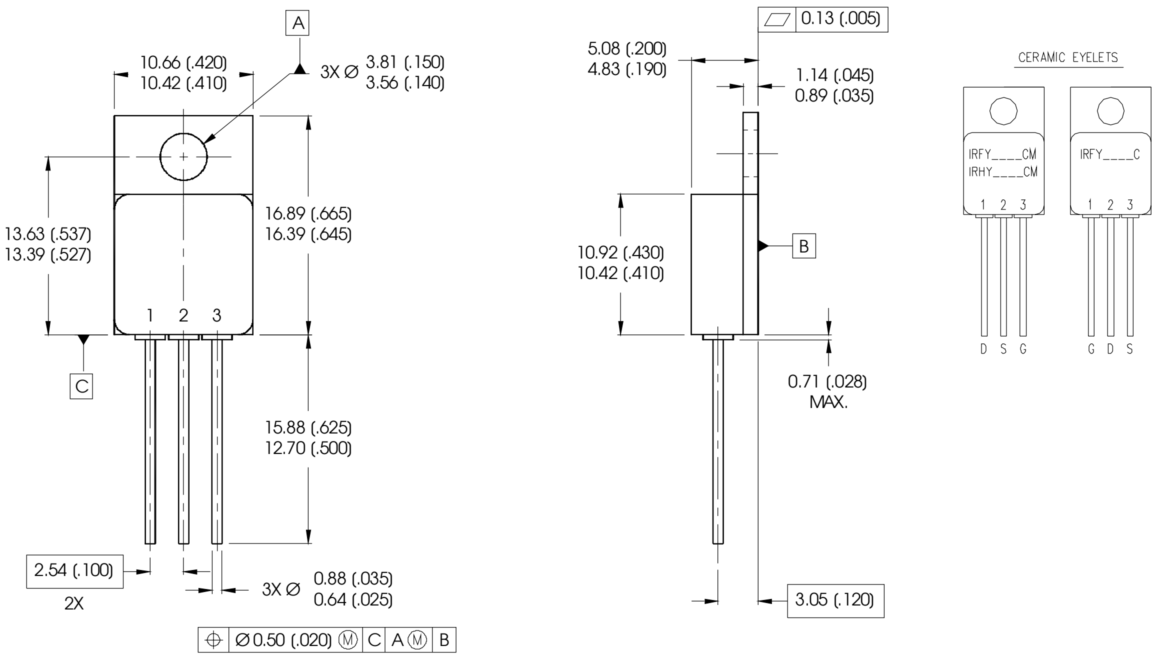
③ $I_{SD} \leq 12A$, $di/dt \leq 508A/\mu s$, $V_{DD} \leq 250V$, $T_J \leq 150°C$

④ Pulse width $\leq 300\ \mu s$; 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.** 200 volt V_{DS} applied and $V_{GS} = 0$ during irradiation per MIL-STD-750, method 1019, condition A.

Case Outline and Dimensions — Low-Ohmic TO-257AA (Low Ohmic)



NOTES:

1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE TO-257AA.

LEAD ASSIGNMENTS

1 = DRAIN
2 = SOURCE
3 = GATE

International
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