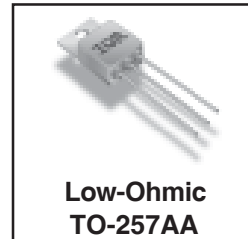


**RADIATION HARDENED  
LOGIC LEVEL POWER MOSFET  
THRU-HOLE (Low-Ohmic TO-257AA)**

**2N7607T3  
IRHLYS77034CM  
60V, N-CHANNEL  
R7™ TECHNOLOGY**

**Product Summary**

Part Number	Radiation Level	RDS(on)	ID
IRHLYS77034CM	100K Rads (Si)	0.045Ω	20A*
IRHLYS73034CM	300K Rads (Si)	0.045Ω	20A*



International Rectifier's 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.

These devices are used in applications such as current boost low signal source in PWM, voltage comparator and operational amplifiers.

**Features:**

- 5V CMOS and TTL Compatible
- Fast Switching
- Single Event Effect (SEE) Hardened
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Light Weight
- Complimentary P-Channel Available - IRHLYS797034CM

**Absolute Maximum Ratings**

**Pre-Irradiation**

	Parameter		Units
ID @ VGS = 4.5V, TC = 25°C	Continuous Drain Current	20*	A
ID @ VGS = 4.5V, TC = 100°C	Continuous Drain Current	20*	
IDM	Pulsed Drain Current ①	80	
PD @ TC = 25°C	Max. Power Dissipation	75	W
	Linear Derating Factor	0.6	W/°C
VGS	Gate-to-Source Voltage	±10	V
EAS	Single Pulse Avalanche Energy ②	98	mJ
IAR	Avalanche Current ①	20	A
EAR	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	6.9	V/ns
TJ	Operating Junction	-55 to 150	°C
TSTG	Storage Temperature Range		
	Lead Temperature	300 (0.063in/1.6mm from case for 10s)	
	Weight	4.3 (Typical)	g

\* Current is limited by package

For footnotes refer to the last page

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**Electrical Characteristics @ T<sub>j</sub> = 25°C (Unless Otherwise Specified)**

	Parameter	Min	Typ	Max	Units	Test Conditions
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	0.07	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.045	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20 ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.0	—	2.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub>	Gate Threshold Voltage Coefficient	—	-5.0	—	mV/°C	
g <sub>fs</sub>	Forward Transconductance	19	—	—	S	V <sub>DS</sub> = 10V, I <sub>DS</sub> = 20A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	1.0	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
		—	—	10		V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	—	100	nA	V <sub>GS</sub> = 10V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	-100		V <sub>GS</sub> = -10V
Q <sub>g</sub>	Total Gate Charge	—	—	34	nC	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	8.0		V <sub>DS</sub> = 30V
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	13		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	30	ns	V <sub>DD</sub> = 30V, I <sub>D</sub> = 20A, V <sub>GS</sub> = 5.0V, R <sub>G</sub> = 7.5Ω
t <sub>r</sub>	Rise Time	—	—	7.0		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	60		
t <sub>f</sub>	Fall Time	—	—	20		
LS + LD	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 <sub>iss</sub>	Input Capacitance	—	2025	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	484	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	5.1	—		
R <sub>g</sub>	Gate Resistance	—	1.16	—		

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	20*	A	T <sub>j</sub> = 25°C, I <sub>S</sub> = 20A, V <sub>GS</sub> = 0V ④
I <sub>SM</sub>	Pulse Source Current (Body Diode) ①	—	—	80		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.2	V	T <sub>j</sub> = 25°C, I <sub>F</sub> = 20A, di/dt ≤ 100A/μs
t <sub>rr</sub>	Reverse Recovery Time	—	—	200	ns	V <sub>DD</sub> ≤ 25V ④
Q <sub>R</sub>	Reverse Recovery Charge	—	—	705	nC	
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by LS + LD.				

\* Current is limited by package

**Thermal Resistance**

	Parameter	Min	Typ	Max	Units	Test Conditions
R <sub>thJC</sub>	Junction-to-Case	—	—	1.67	°C/W	Typical Socket Mount
R <sub>thJA</sub>	Junction-to-Ambient	—	—	80		

**Note: Corresponding Spice and Saber models are available on International Rectifier Web site.**

For footnotes refer to the last page

## Radiation Characteristics

## IRHLYS77034CM, 2N7607T3

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**

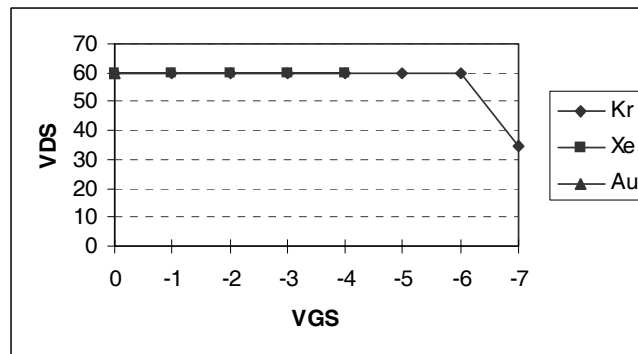
	Parameter	Up to 300K Rads (Si) <sup>1</sup>		Units	Test Conditions
		Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	60	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.0	2.0		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250μA
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	100	nA	V <sub>GS</sub> = 10V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100		V <sub>GS</sub> = -10V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	μA	V <sub>DS</sub> = 48V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance (TO-3) ④	—	0.045	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20A
R <sub>DS(on)</sub>	Static Drain-to-Source On-state Resistance (Low Ohmic TO-257) ④	—	0.045	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 20A
V <sub>SD</sub>	Diode Forward Voltage④	—	1.2	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 20A

1. Part numbers IRHLYS77034, IRHLYS73034

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**

Ion	LET (MeV/(mg/cm <sup>2</sup> ))	Energy (MeV)	Range (μm)	VDS (V)							
				@ VGS = 0V	@ VGS = -1V	@ VGS = -2V	@ VGS = -3V	@ VGS = -4V	@ VGS = -5V	@ VGS = -6V	@ VGS = -7V
Kr	37.3	400	48.6	60	60	60	60	60	60	60	35
Xe	63.3	435	38.4	60	60	60	60	60	-	-	-
Au	90	1480	80.4	60	-	-	-	-	-	-	-



**Fig a. Typical Single Event Effect, Safe Operating Area**

For footnotes refer to the last page

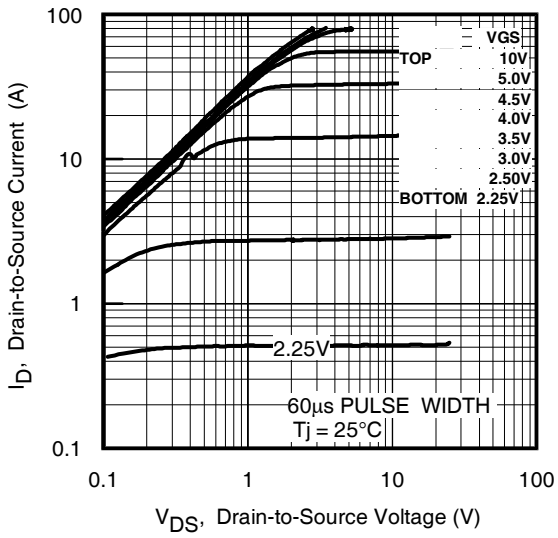


Fig 1. Typical Output Characteristics

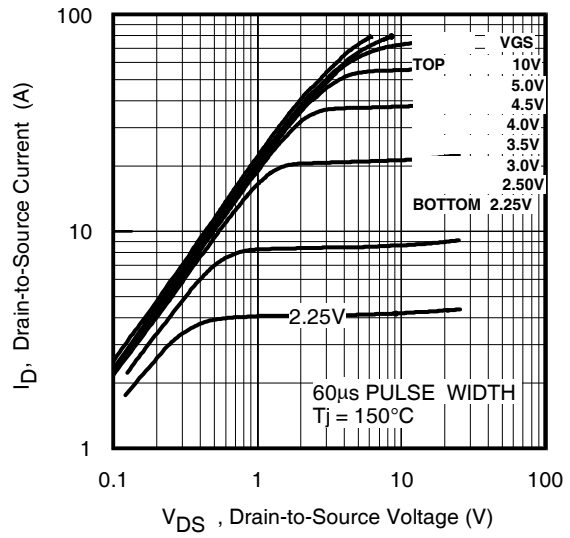


Fig 2. Typical Output Characteristics

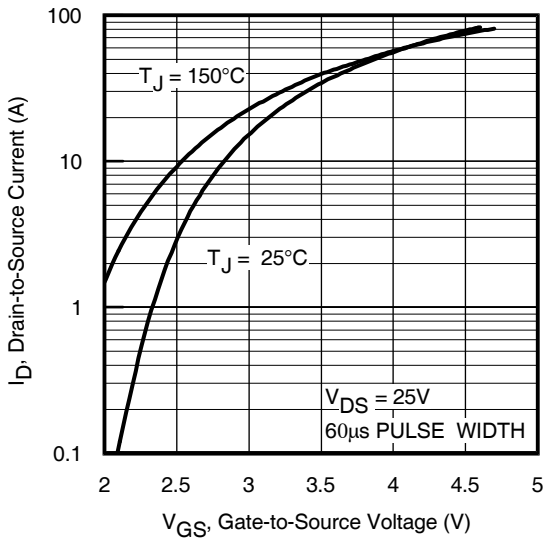


Fig 3. Typical Transfer Characteristics

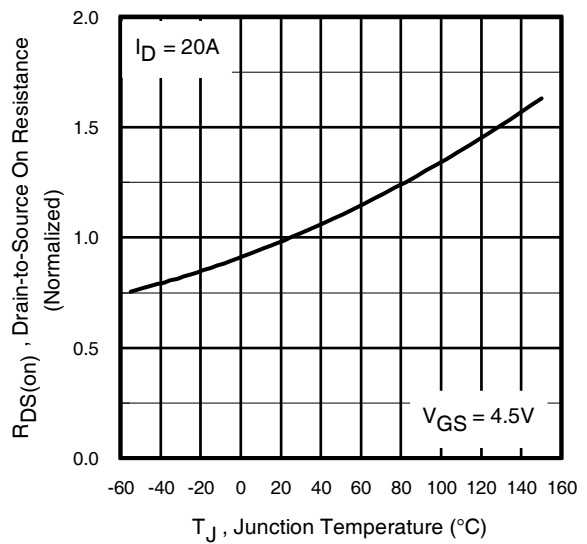
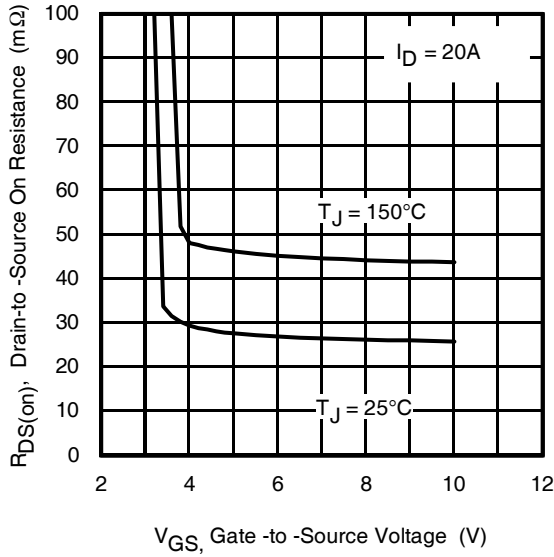


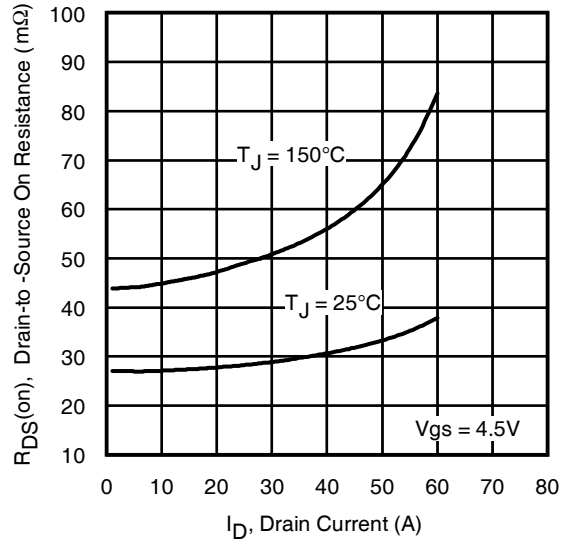
Fig 4. Normalized On-Resistance Vs. Temperature

**Pre-Irradiation**

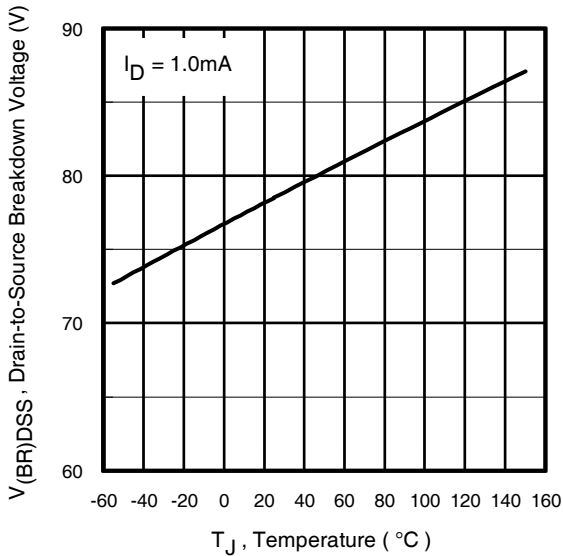
**IRHLYS77034CM, 2N7607T3**



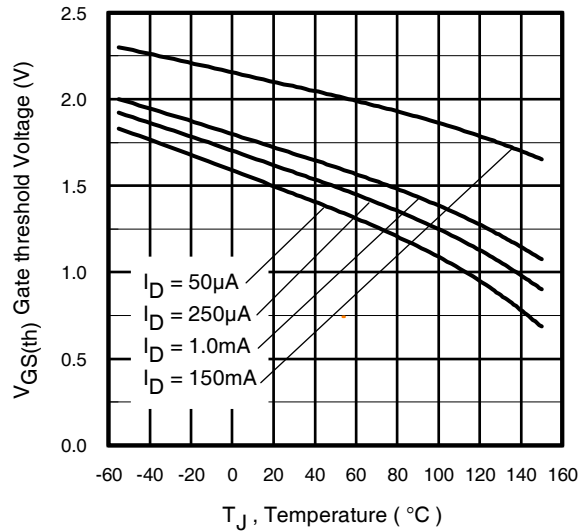
**Fig 5.** Typical On-Resistance Vs Gate Voltage



**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

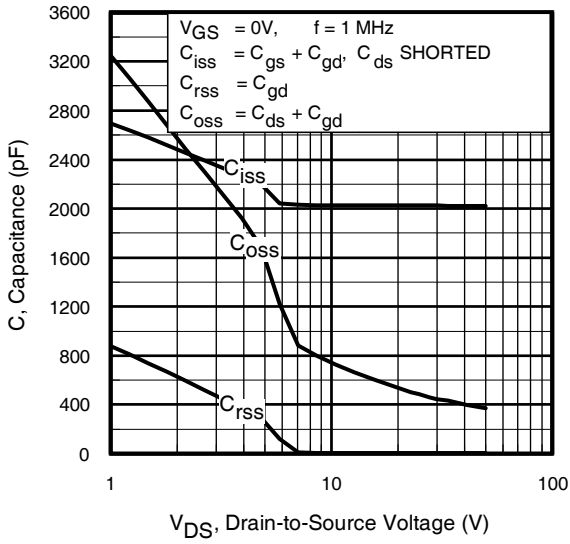


Fig 9. Typical Capacitance Vs. Drain-to-Source Voltage

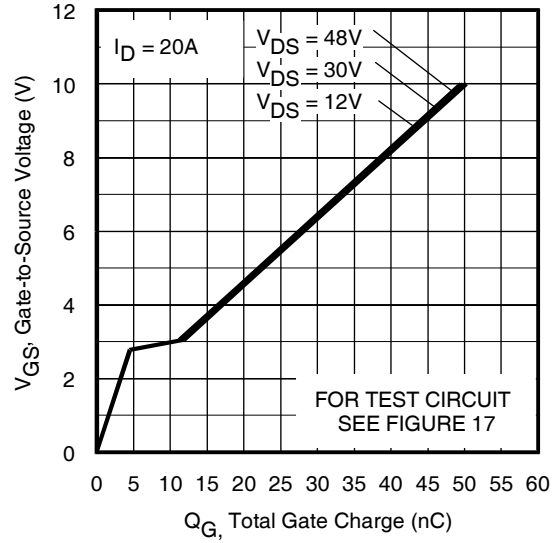


Fig 10. Typical Gate Charge Vs. Gate-to-Source Voltage

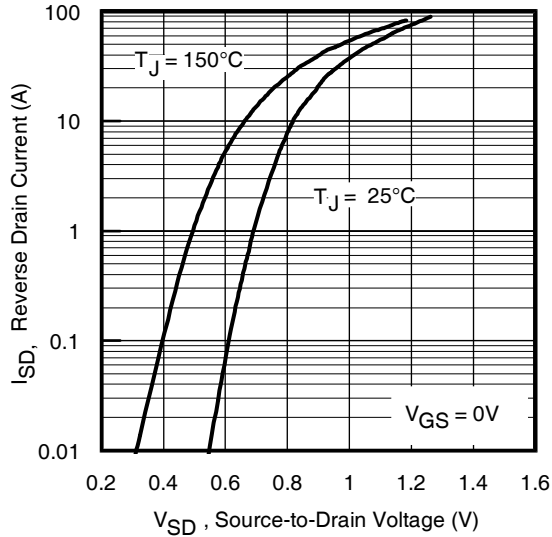


Fig 11. Typical Source-Drain Diode Forward Voltage

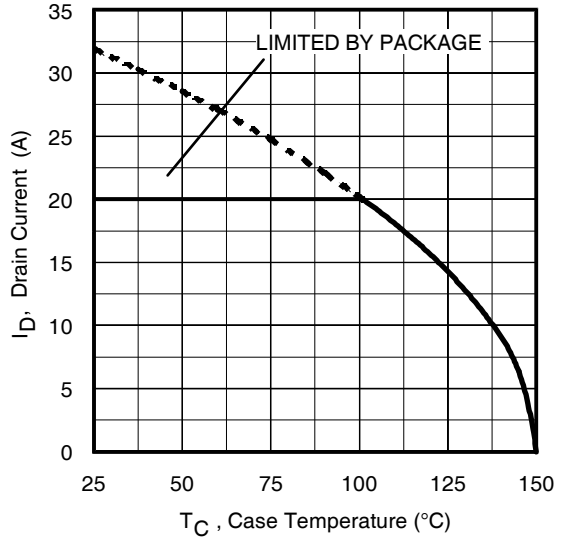


Fig 12. Maximum Drain Current Vs. Case Temperature

Pre-Irradiation

IRHLYS77034CM, 2N7607T3

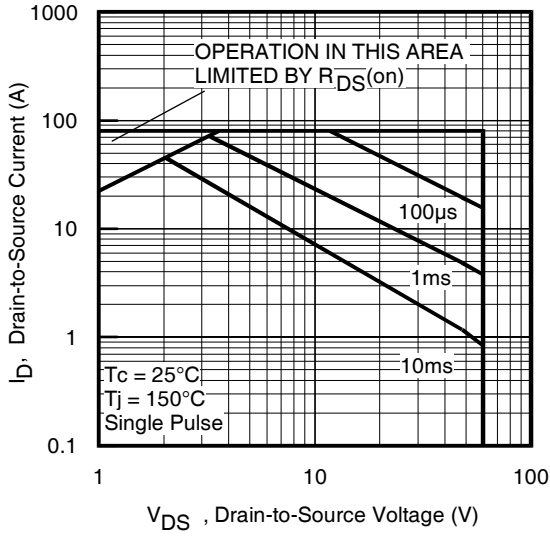


Fig 13. Maximum Safe Operating Area

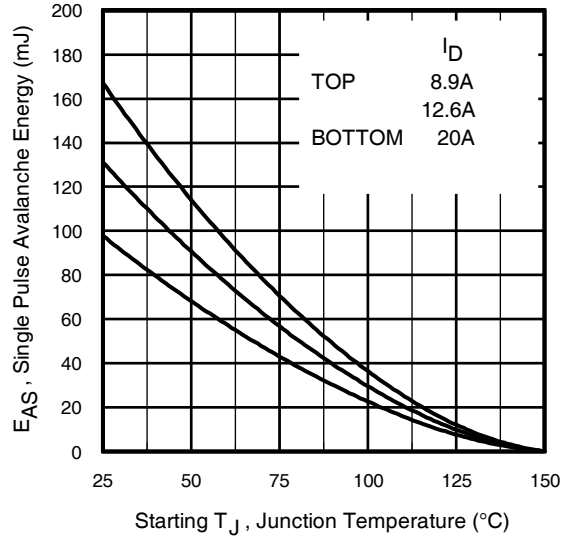


Fig 14. Maximum Avalanche Energy Vs. Drain Current

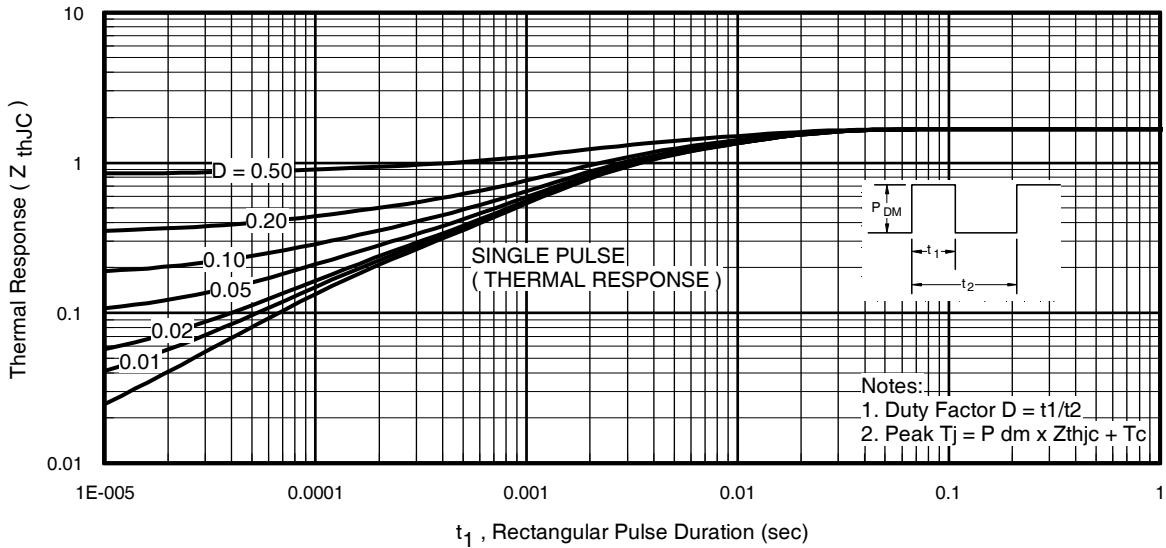


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRHLYS77034CM, 2N7607T3

Pre-Irradiation

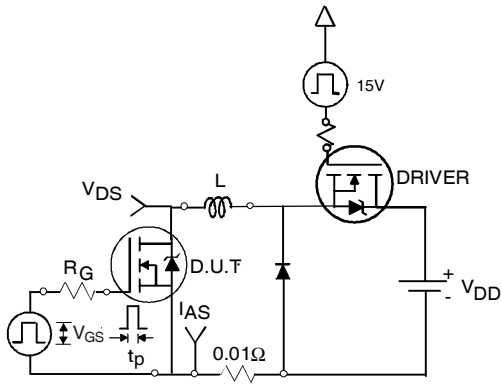


Fig 16a. Unclamped Inductive Test Circuit

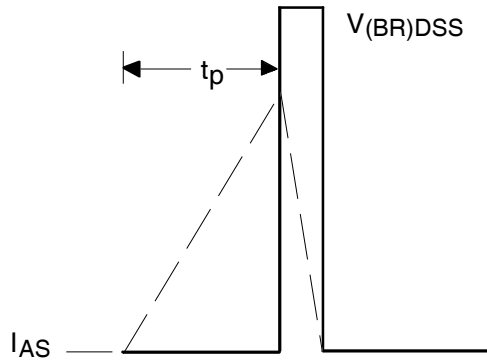


Fig 16b. Unclamped Inductive Waveforms

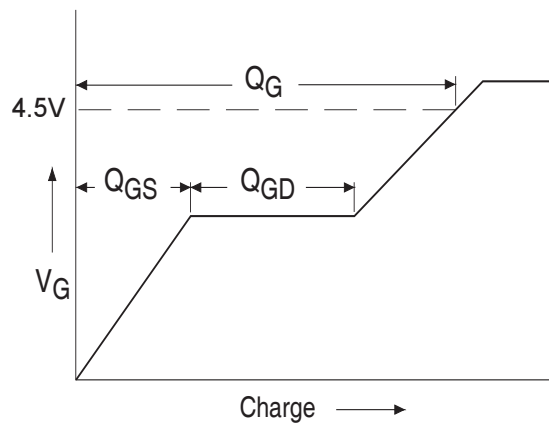


Fig 17a. Basic Gate Charge Waveform

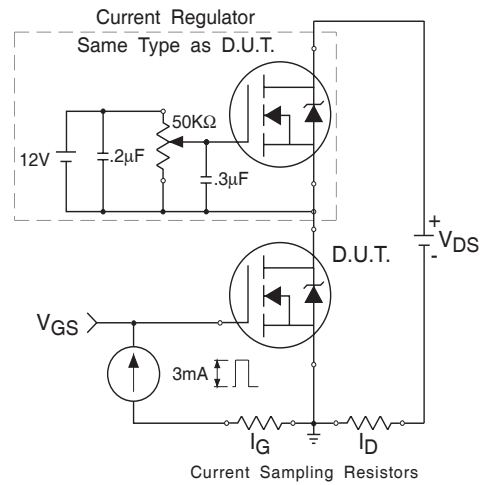


Fig 17b. Gate Charge Test Circuit

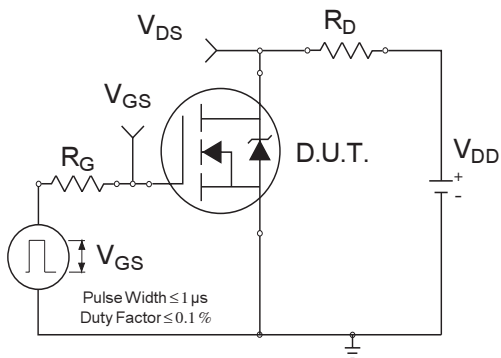


Fig 18a. Switching Time Test Circuit

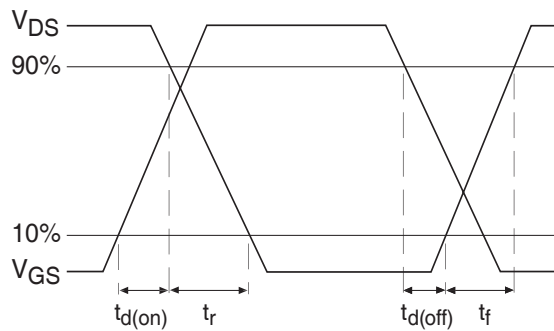


Fig 18b. Switching Time Waveforms



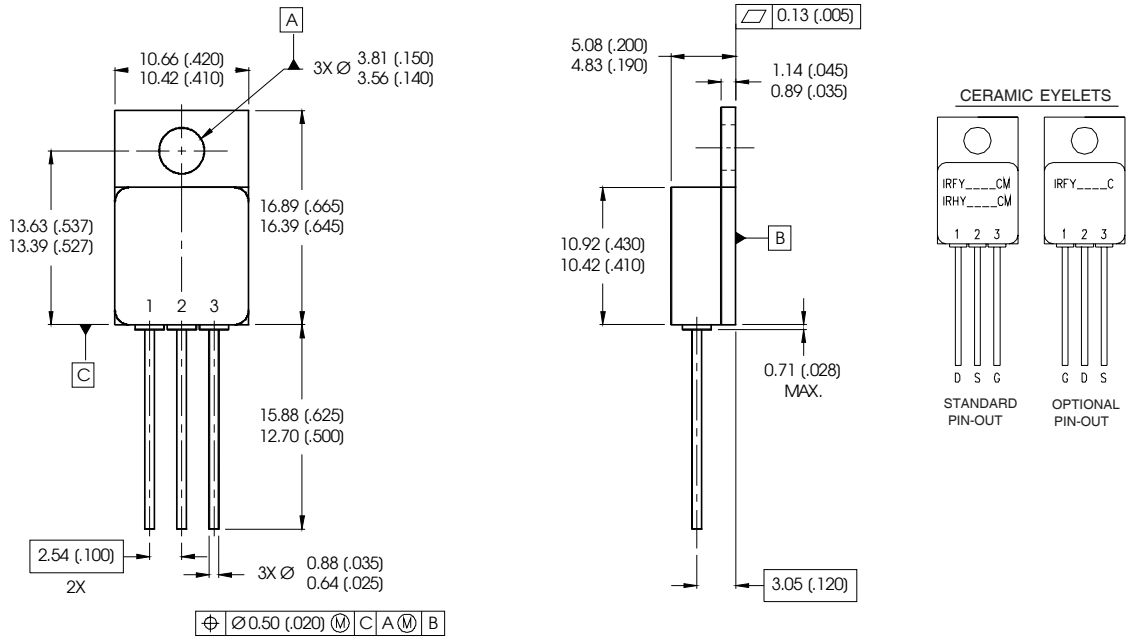
**Pre-Irradiation**

**IRHLYS77034CM, 2N7607T3**

**Footnotes:**

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 25V$ , starting  $T_J = 25^\circ C$ ,  $L = 0.49\text{ mH}$   
Peak  $I_L = 20A$ ,  $V_{GS} = 10V$
- ③  $I_{SD} \leq 20A$ ,  $di/dt \leq 347A/\mu s$ ,  
 $V_{DD} \leq 60V$ ,  $T_J \leq 150^\circ C$
- ④ Pulse width  $\leq 300\ \mu s$ ; Duty Cycle  $\leq 2\%$
- ⑤ **Total Dose Irradiation with  $V_{GS}$  Bias.**  
10 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.

**Case Outline and Dimensions — Low Ohmic TO-257AA**



**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.

**PIN ASSIGNMENTS**

- 1 = DRAIN
- 2 = SOURCE
- 3 = GATE

**CAUTION**

**BERYLLIA WARNING PER MIL-PRF-19500**

Package containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

International  
**IOR** Rectifier

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