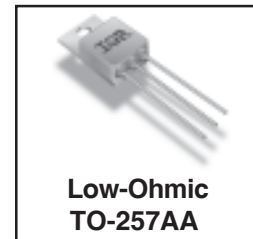


**RADIATION HARDENED  
 POWER MOSFET  
 THRU-HOLE (Low-Ohmic TO-257AA)**

**2N7588T3  
 IRHYS67130CM  
 100V, N-CHANNEL  
 TECHNOLOGY**

**Product Summary**

Part Number	Radiation Level	R <sub>DS(on)</sub>	I <sub>D</sub>
IRHYS67130CM	100K Rads (Si)	0.042Ω	20A*
IRHYS63130CM	300K Rads (Si)	0.042Ω	20A*



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/cm<sup>2</sup>). Their combination of very low R<sub>DS(on)</sub> 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<sub>DS(on)</sub>
- 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 <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 25°C	Continuous Drain Current	20*	A
I <sub>D</sub> @ V <sub>GS</sub> = 12V, T <sub>C</sub> = 100°C	Continuous Drain Current	19	
I <sub>DM</sub>	Pulsed Drain Current ①	80	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Max. Power Dissipation	75	W
	Linear Derating Factor	0.6	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	±20	V
EAS	Single Pulse Avalanche Energy ②	107	mJ
I <sub>AR</sub>	Avalanche Current ①	20	A
EAR	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.5	V/ns
T <sub>J</sub>	Operating Junction	-55 to 150	°C
T <sub>STG</sub>	Storage Temperature Range		
	Lead Temperature	300 (0.063 in. /1.6 mm from case for 10s)	
	Weight	4.3 (Typical)	g

\* Current is limited by package  
 For footnotes refer to the last page

**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	100	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Temperature Coefficient of Breakdown Voltage	—	0.12	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1.0mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance	—	—	0.042	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 19A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0mA
ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub>	Gate Threshold Voltage Coefficient	—	-8.72	—	mV/°C	
g <sub>fs</sub>	Forward Transconductance	14	—	—	S	V <sub>DS</sub> = 10V, I <sub>DS</sub> = 19A ④
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	—	10	μA	V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V
		—	—	25		V <sub>DS</sub> = 80V, 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> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	—	-100	nA	V <sub>GS</sub> = -20V
Q <sub>g</sub>	Total Gate Charge	—	—	50	nC	V <sub>GS</sub> = 12V, I <sub>D</sub> = 20A
Q <sub>gs</sub>	Gate-to-Source Charge	—	—	15		V <sub>DS</sub> = 50V
Q <sub>gd</sub>	Gate-to-Drain ('Miller') Charge	—	—	12		
t <sub>d(on)</sub>	Turn-On Delay Time	—	—	20	ns	V <sub>DD</sub> = 50V, I <sub>D</sub> = 20A, V <sub>GS</sub> = 12V, R <sub>G</sub> = 7.5Ω
t <sub>r</sub>	Rise Time	—	—	50		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	—	35		
t <sub>f</sub>	Fall Time	—	—	15		
L <sub>S</sub> + L <sub>D</sub>	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	—	1710	—	pF	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	343	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	6.5	—		
R <sub>g</sub>	Gate Resistance	—	1.1	—	Ω	f = 1.0MHz, open drain

**Source-Drain Diode Ratings and Characteristics**

	Parameter	Min	Typ	Max	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	20*	A	
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>S</sub> = 20A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	—	250	ns	T <sub>j</sub> = 25°C, I <sub>F</sub> = 20A, di/dt ≤ 100A/μs
Q <sub>RR</sub>	Reverse Recovery Charge	—	—	2.7	μC	V <sub>DD</sub> ≤ 25V ④
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L <sub>S</sub> + L <sub>D</sub> .				

\* 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	
R <sub>thJA</sub>	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

## Radiation Characteristics

## IRHYS67130CM, 2N7588T3

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

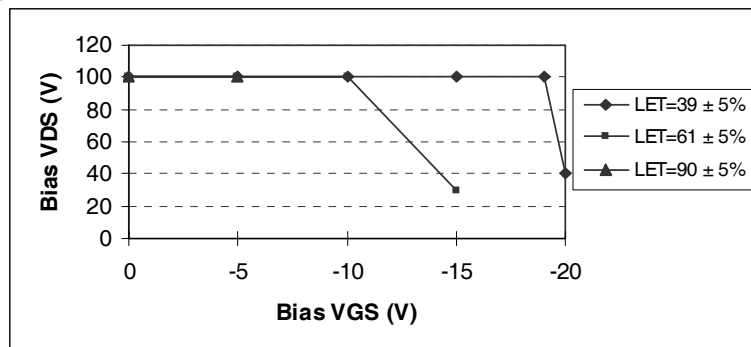
	Parameter	Up to 300K Rads (Si) <sup>1</sup>		Units	Test Conditions
		Min	Max		
BV <sub>DSS</sub>	Drain-to-Source Breakdown Voltage	100	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 1.0mA
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	4.0		V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0mA
I <sub>GSS</sub>	Gate-to-Source Leakage Forward	—	100	nA	V <sub>GS</sub> = 20V
I <sub>GSS</sub>	Gate-to-Source Leakage Reverse	—	-100		V <sub>GS</sub> = -20V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	—	10	μA	V <sub>DS</sub> = 80V, V <sub>GS</sub> = 0V
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance (TO-3) ④	—	0.044	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 19A
R <sub>DS(on)</sub>	Static Drain-to-Source On-State Resistance (Low Ohmic TO-257) ④	—	0.042	Ω	V <sub>GS</sub> = 12V, I <sub>D</sub> = 19A
V <sub>SD</sub>	Diode Forward Voltage ④	—	1.2	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 20A

1. Part numbers IRHYS67130CM and IRHYS63130CM

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 <sup>2</sup> ))	Energy (MeV)	Range (μm)	V <sub>DS</sub> (V)					
			@V <sub>GS</sub> = 0V	@V <sub>GS</sub> = -5V	@V <sub>GS</sub> = -10V	@V <sub>GS</sub> = -15V	@V <sub>GS</sub> = -19V	@V <sub>GS</sub> = -20V
39 ± 5%	315 ± 5%	40 ± 5%	100	100	100	100	100	40
61 ± 5%	345 ± 5%	32 ± 7.5%	100	100	100	30	-	-
90 ± 5%	375 ± 7.5%	29 ± 7.5%	100	100	-	-	-	-



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

For footnotes refer to the last page

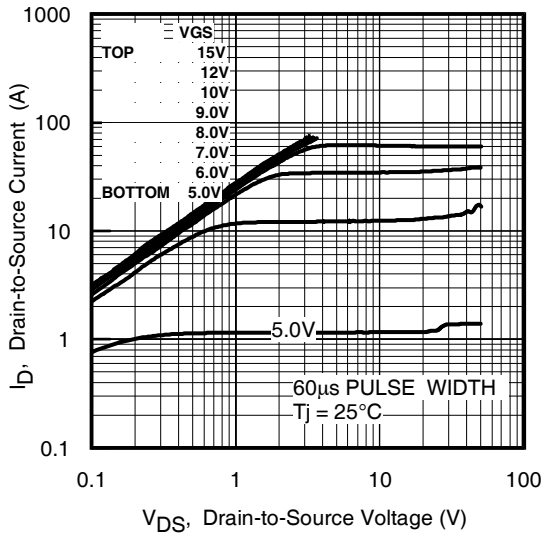


Fig 1. Typical Output Characteristics

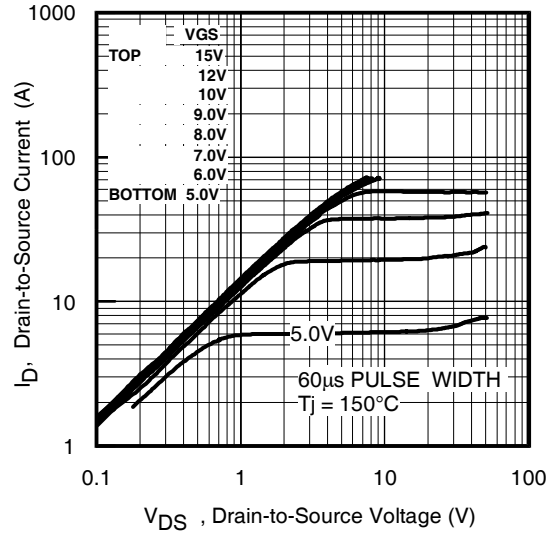


Fig 2. Typical Output Characteristics

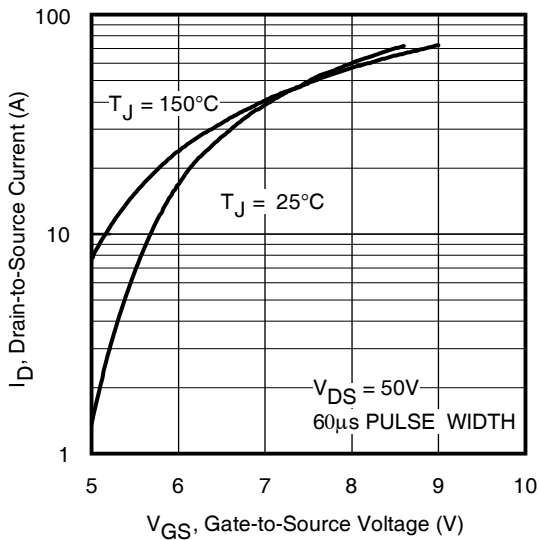


Fig 3. Typical Transfer Characteristics

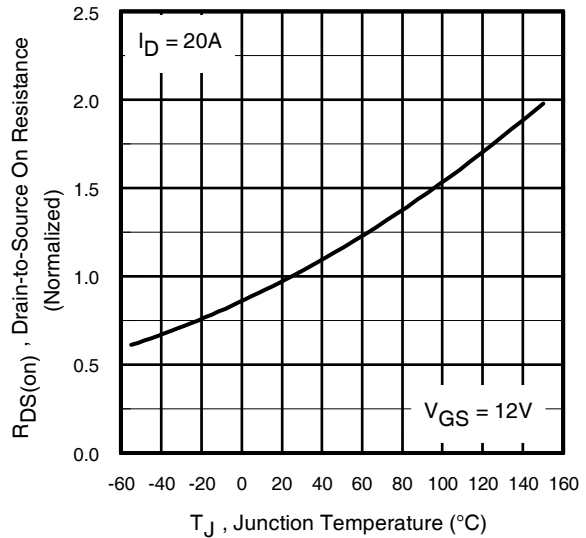


Fig 4. Normalized On-Resistance Vs. Temperature

Pre-Irradiation

IRHYS67130CM, 2N7588T3

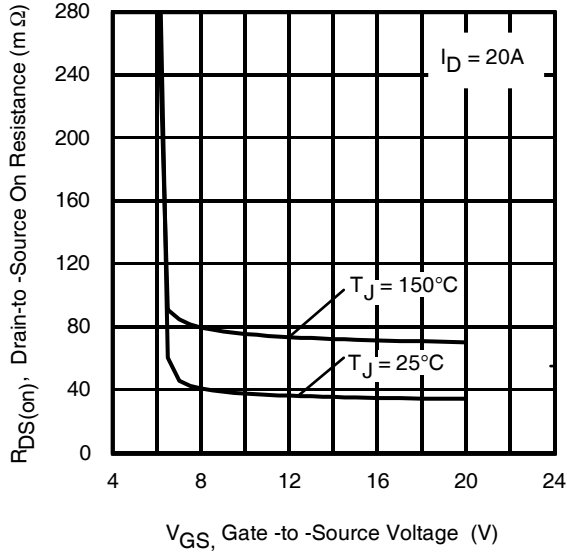


Fig 5. Typical On-Resistance Vs Gate Voltage

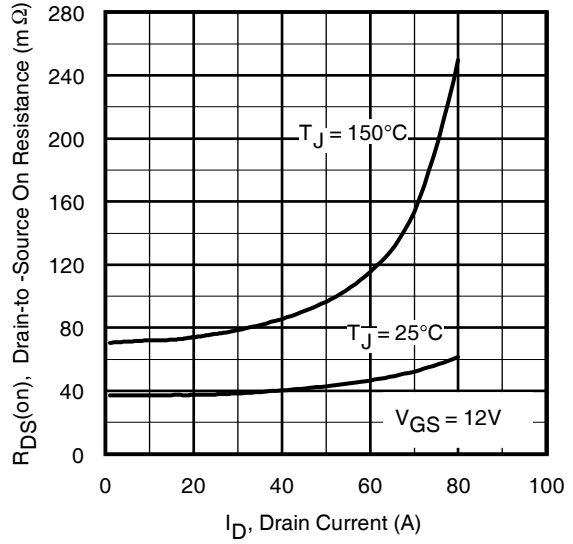


Fig 6. Typical On-Resistance Vs Drain Current

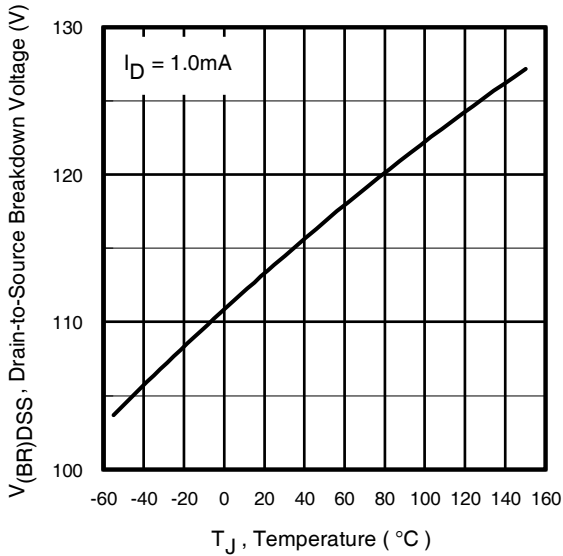


Fig 7. Typical Drain-to-Source Breakdown Voltage Vs Temperature

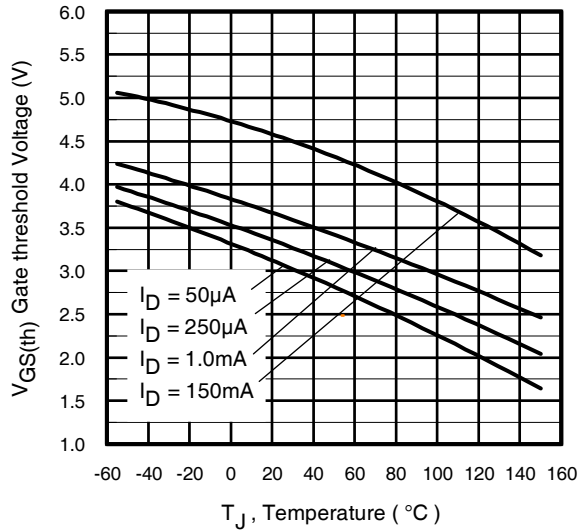
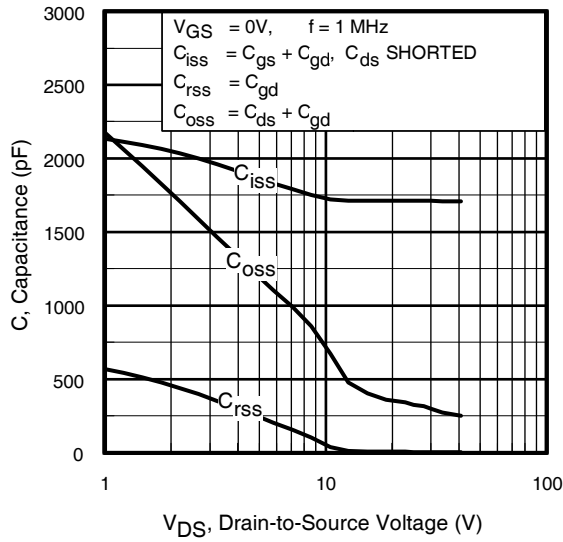
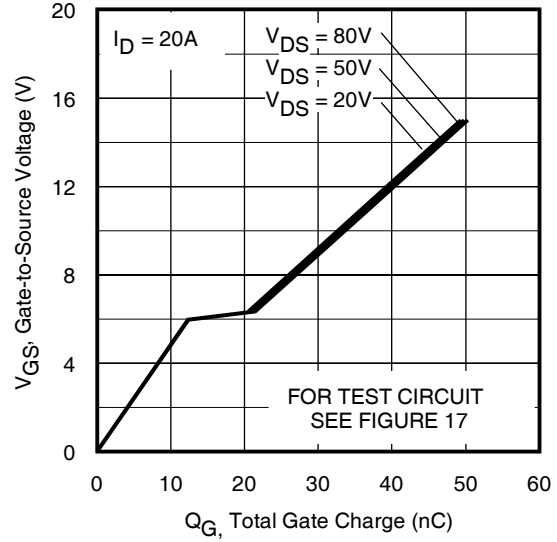


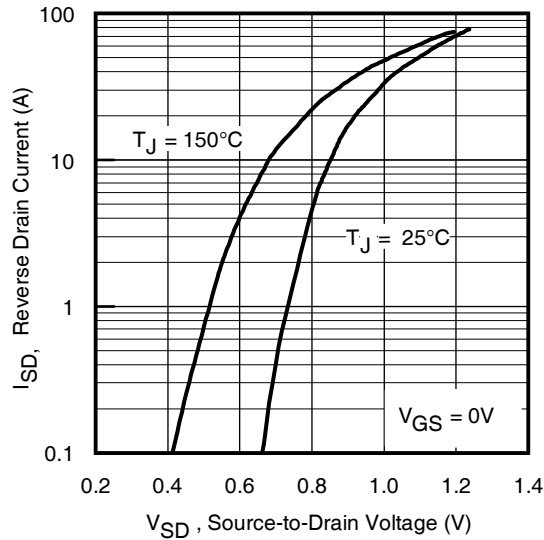
Fig 8. Typical Threshold Voltage Vs Temperature



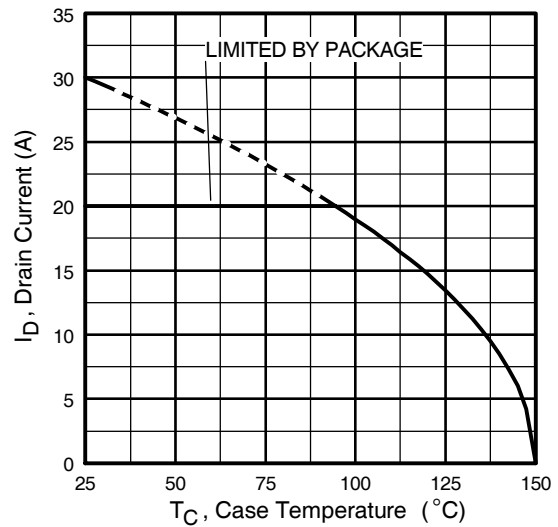
**Fig 9.** Typical Capacitance Vs. Drain-to-Source Voltage



**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

IRHYS67130CM, 2N7588T3

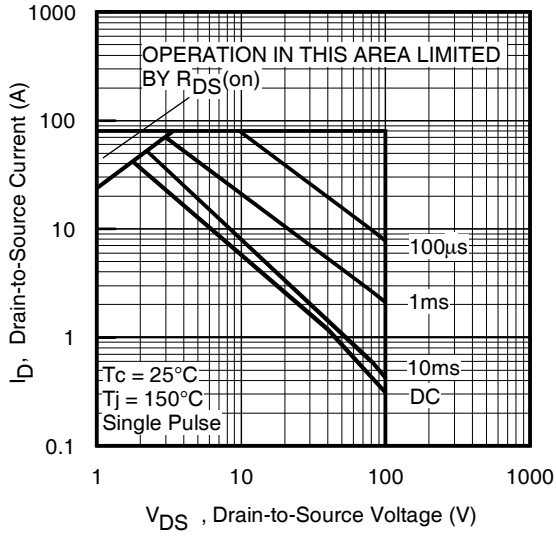


Fig 13. Maximum Safe Operating Area

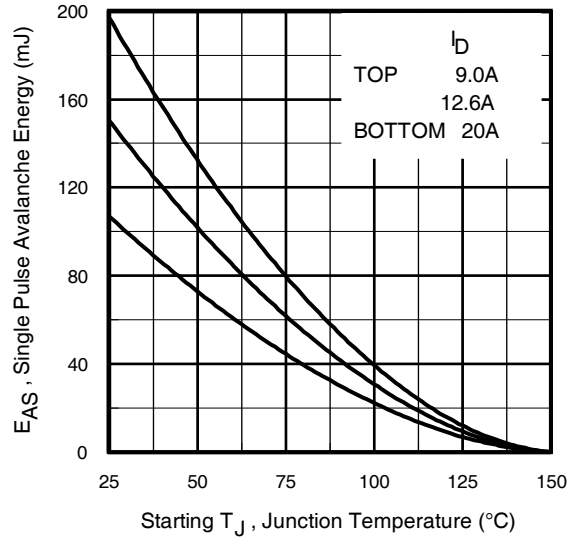


Fig 14. Maximum Avalanche Energy Vs. Drain Current

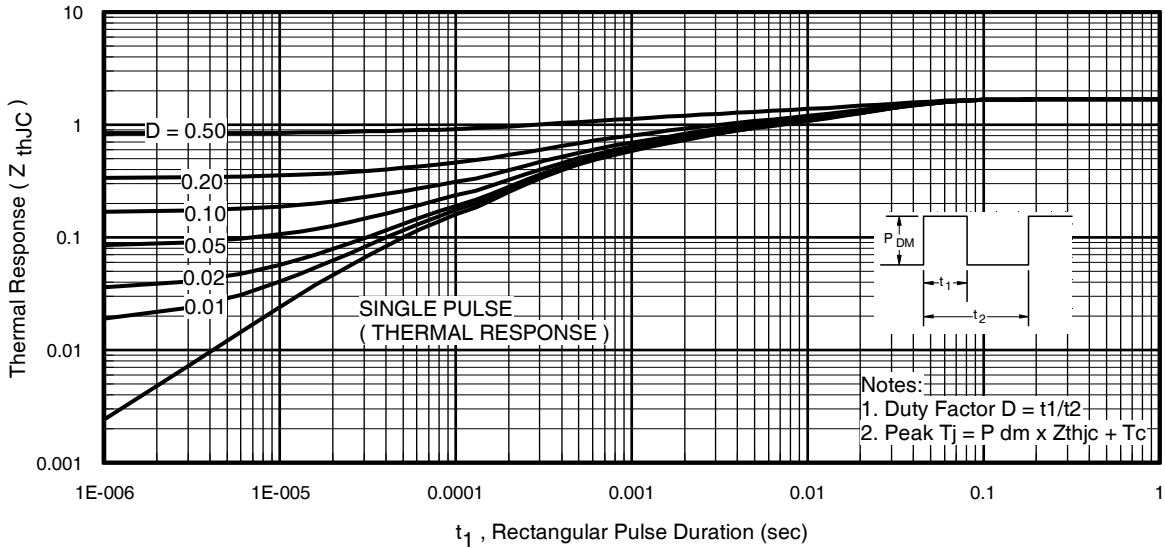


Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRHYS67130CM, 2N7588T3

Pre-Irradiation

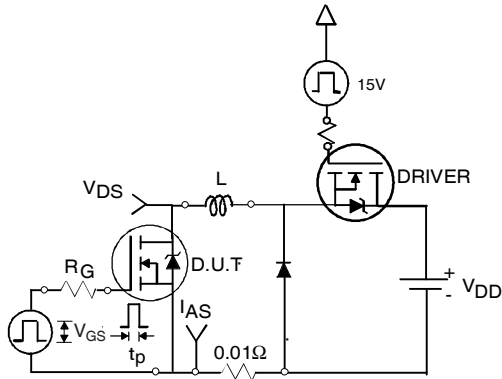


Fig 16a. Unclamped Inductive Test Circuit

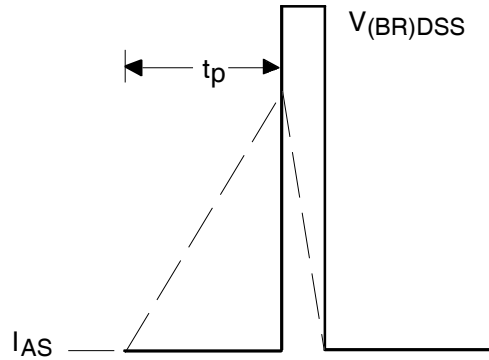


Fig 16b. Unclamped Inductive Waveforms

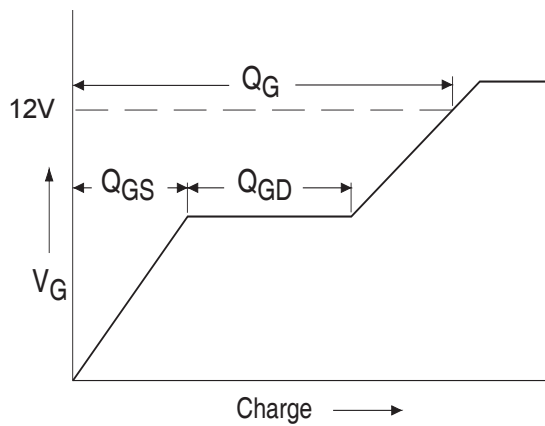


Fig 17a. Basic Gate Charge Waveform

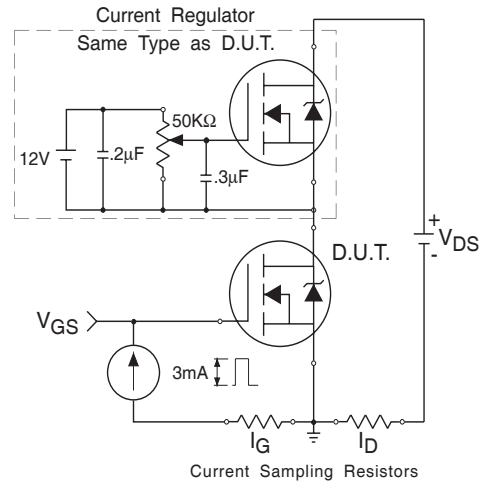


Fig 17b. Gate Charge Test Circuit

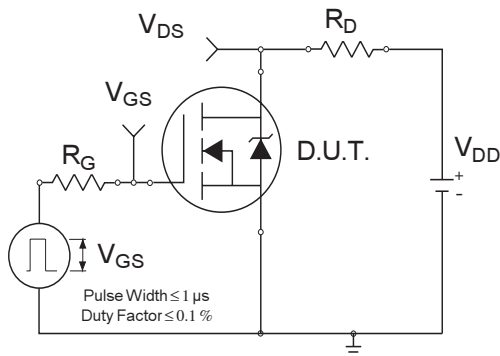


Fig 18a. Switching Time Test Circuit

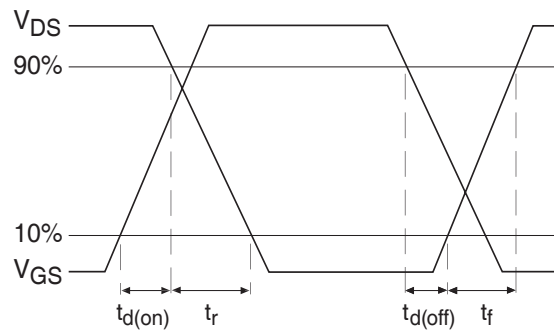


Fig 18b. Switching Time Waveforms



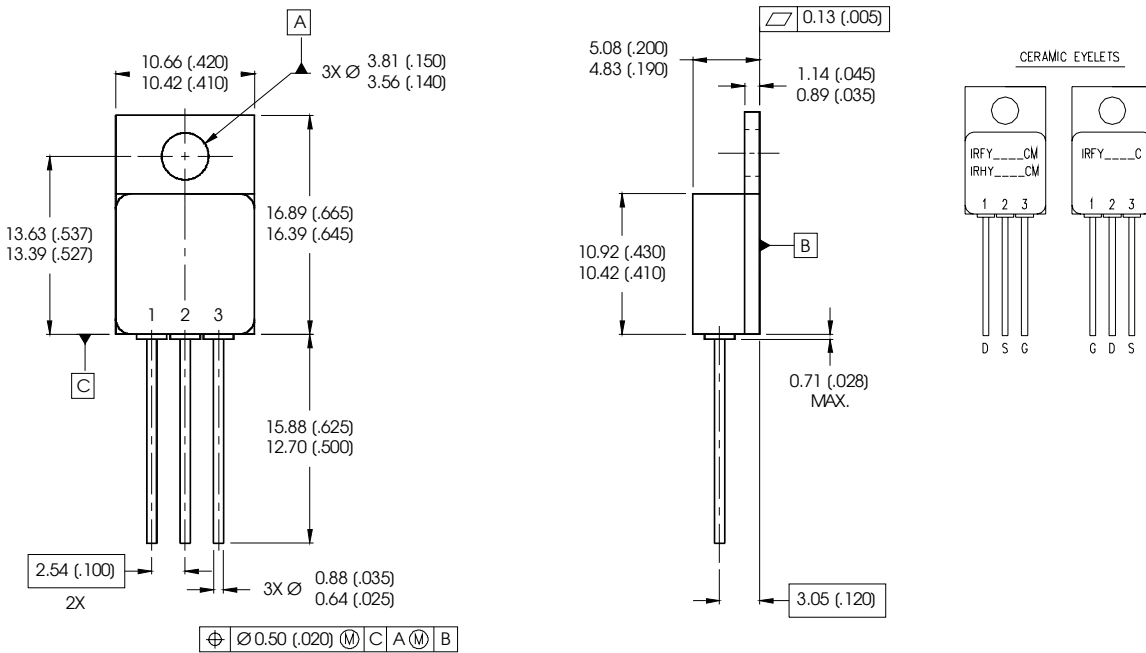
## Pre-Irradiation

## IRHYS67130CM, 2N7588T3

### Footnotes:

- ① Repetitive Rating; Pulse width limited by maximum junction temperature.
- ②  $V_{DD} = 25V$ , starting  $T_J = 25^\circ C$ ,  $L = 0.54mH$   
Peak  $I_L = 20A$ ,  $V_{GS} = 12V$
- ③  $I_{SD} \leq 20A$ ,  $di/dt \leq 575A/\mu s$ ,  
 $V_{DD} \leq 100V$ ,  $T_J \leq 150^\circ C$
- ④ Pulse width  $\leq 300 \mu s$ ; Duty Cycle  $\leq 2\%$
- ⑤ **Total Dose Irradiation with  $V_{GS}$  Bias.**  
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.**  
80 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.

### LEAD ASSIGNMENTS

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

International  
**IR** Rectifier

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TAC Fax: (310) 252-7903

Visit us at [www.irf.com](http://www.irf.com) for sales contact information.

Data and specifications subject to change without notice. 06/2010