PD - 93826

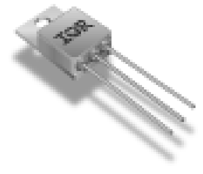
International
IOR Rectifier

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

IRHY57130CM
100V, N-CHANNEL
R5™ TECHNOLOGY

Product Summary

Part Number	Radiation Level	$R_{DS(on)}$	I_D
IRHY57130CM	100K Rads (Si)	0.060Ω	16A*
IRHY53130CM	300K Rads (Si)	0.060Ω	16A*
IRHY54130CM	600K Rads (Si)	0.060Ω	16A*
IRHY58130CM	1000K Rads (Si)	0.075Ω	16A*



TO-257AA

International Rectifier's R5™ technology provides high performance power MOSFETs for space applications. These devices have been characterized for Single Event Effects (SEE) with useful performance up to an LET of 80 (MeV/(mg/cm^2)). The combination of low $R_{DS(on)}$ and low gate charge reduces the power losses in switching applications such as DC to DC converters and motor control. 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:

- Single Event Effect (SEE) Hardened
- Ultra Low $R_{DS(on)}$
- Low Total Gate Charge
- Proton Tolerant
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Ceramic Package
- Light Weight

Absolute Maximum Ratings

Pre-Irradiation

	Parameter		Units
I_D @ V_{GS} = 12V, T_C = 25°C	Continuous Drain Current	16*	A
I_D @ V_{GS} = 12V, T_C = 100°C	Continuous Drain Current	15	
I_{DM}	Pulsed Drain Current ①	64	
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	87	mJ
I_{AR}	Avalanche Current ①	16	A
E_{AR}	Repetitive Avalanche Energy ①	7.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	1.4	V/ns
T_J T_{STG}	Operating Junction Storage Temperature Range	-55 to 150	°C
	Lead Temperature	300 (0.063in./1.6mm from case for 10sec)	
	Weight	4.3 (Typical)	g

* Current is limited by internal wire diameter
For footnotes refer to the last page

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

	Parameter	Min	Typ	Max	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	100	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.11	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.06	Ω	V_{GS} = 12V, I_D = 15A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 1.0mA
g_{fs}	Forward Transconductance	13	—	—	S (℧)	V_{DS} > 15V, I_{DS} = 15A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	10	µA	V_{DS}= 80V ,V_{GS}=0V
		—	—	25		V_{DS} = 80V, 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	—	—	50	nC	V_{GS} =12V, I_D = 16A V_{DS} = 50V
Q_{gs}	Gate-to-Source Charge	—	—	7.4		
Q_{gd}	Gate-to-Drain ('Miller') Charge	—	—	20		
$t_{d(on)}$	Turn-On Delay Time	—	—	25	ns	V_{DD} = 50V, I_D = 16A, R_G = 7.5Ω
t_r	Rise Time	—	—	100		
$t_{d(off)}$	Turn-Off Delay Time	—	—	35		
t_f	Fall Time	—	—	30		
$L_S + L_D$	Total Inductance	—	6.8	—	nH	Measured from drain lead (6mm/ 0.25in. from package) to source lead (6mm/0.25in. from package)
C_{iss}	Input Capacitance	—	1005	—	pF	V_{GS} = 0V, V_{DS} = 25V f = 1.0MHz
C_{oss}	Output Capacitance	—	365	—		
C_{rss}	Reverse Transfer Capacitance	—	50	—		

Source-Drain Diode Ratings and Characteristics

	Parameter	Min	Typ	Max	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	16*	A	
I_{SM}	Pulse Source Current (Body Diode) ①	—	—	64		
V_{SD}	Diode Forward Voltage	—	—	1.2	V	T_j = 25°C, I_S = 16A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	250	ns	T_j = 25°C, I_F = 16A, di/dt ≥ 100A/µs V_{DD} ≤ 25V ④
Q_{RR}	Reverse Recovery Charge	—	—	850	nC	
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L_S + L_D.				

* Current is limited by internal wire diameter

Thermal Resistance

	Parameter	Min	Typ	Max	Units	Test Conditions
R_{thJC}	Junction-to-Case	—	—	1.67	°C/W	
R_{thJA}	Junction-to-Ambient	—	—	80		

Note: Corresponding Spice and Saber models are available on the G&S Website.

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 600K Rads(Si)[1]		1000K Rads (Si)[2]		Units	Test Conditions
		Min	Max	Min	Max		
BV_{DSS}	Drain-to-Source Breakdown Voltage	100	—	100	—	V	V_{GS} = 0V, I_D = 1.0mA
$V_{GS(th)}$	Gate Threshold Voltage ④	2.0	4.0	1.5	4.0		$V_{GS} = V_{DS}$, 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		V_{GS} = -20 V
I_{DSS}	Zero Gate Voltage Drain Current	—	10	—	10	µA	V_{DS}= 80V, V_{GS} =0V
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-3)	—	0.064	—	0.08	Ω	V_{GS} = 12V, I_D =15A
$R_{DS(on)}$	Static Drain-to-Source ④ On-State Resistance (TO-257AA)	—	0.06	—	0.075	Ω	V_{GS} = 12V, I_D =15A
V_{SD}	Diode Forward Voltage ④	—	1.2	—	1.2	V	V_{GS} = 0V, I_S = 16A

1. Part numbers IRHY57130CM, IRHY53130CM and IRHY54130CM
2. Part number IRHY58130CM

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. Single Event Effect Safe Operating Area

Ion	LET MeV/(mg/cm^2))	Energy (MeV)	Range (µm)	V_{DS} (V)				
				@V_{GS}=0V	@V_{GS}=-5V	@V_{GS}=-10V	@V_{GS}=-15V	@V_{GS}=-20V
Br	36.7	309	39.5	100	100	100	100	100
I	59.4	341	32.5	100	100	100	35	25
Au	82.3	350	28.4	100	100	100	80	25

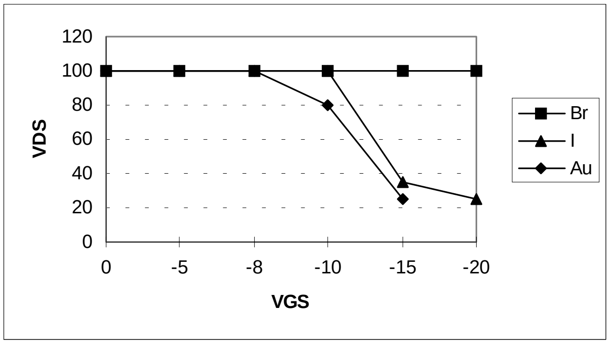


Fig a. Single Event Effect, Safe Operating Area

For footnotes refer to the last page

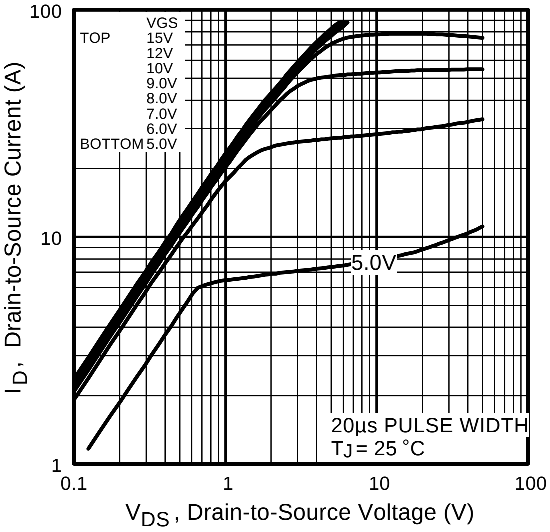


Fig 1. Typical Output Characteristics

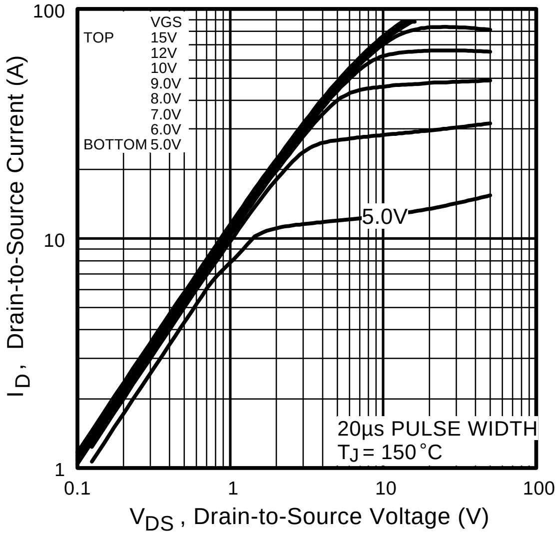


Fig 2. Typical Output Characteristics

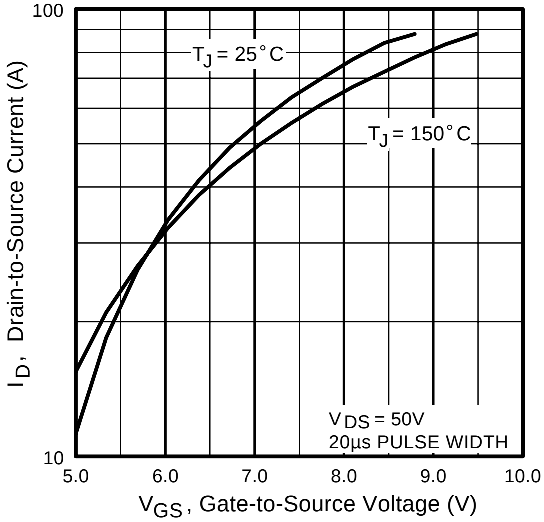


Fig 3. Typical Transfer Characteristics

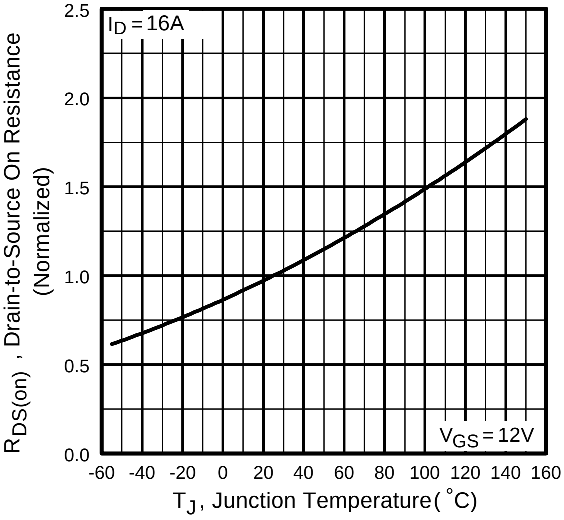


Fig 4. Normalized On-Resistance
Vs. Temperature

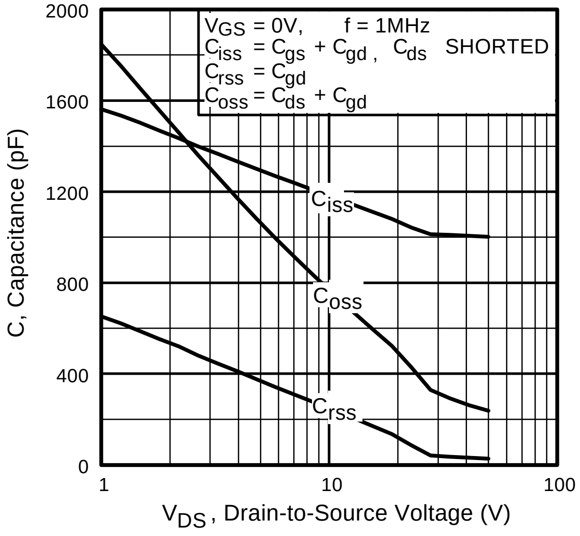


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

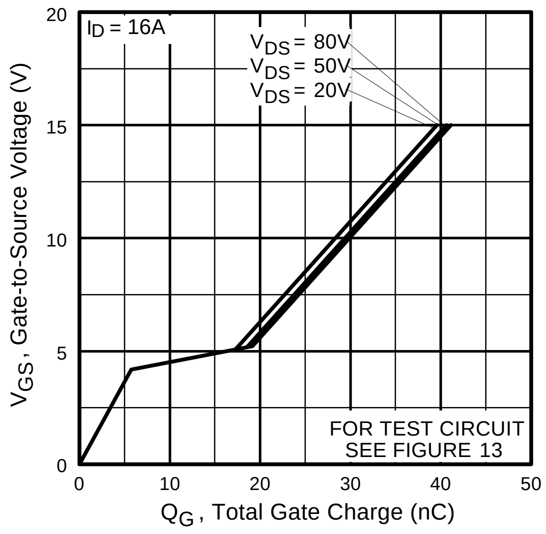


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

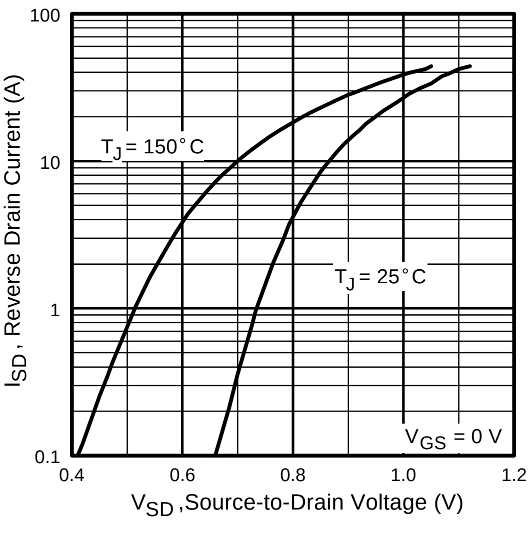


Fig 7. Typical Source-Drain Diode Forward Voltage

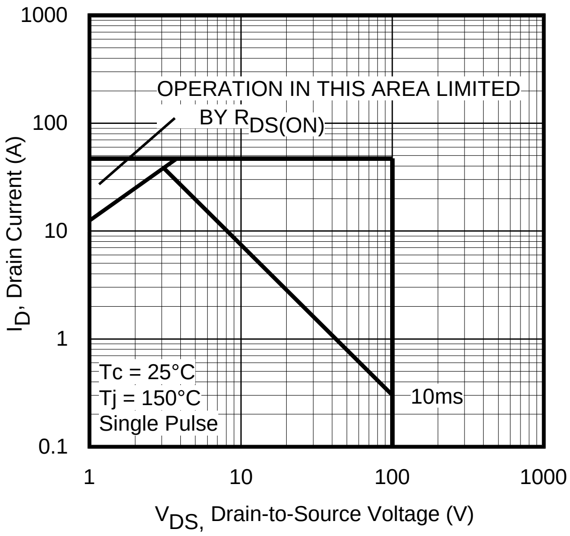


Fig 8. Maximum Safe Operating Area

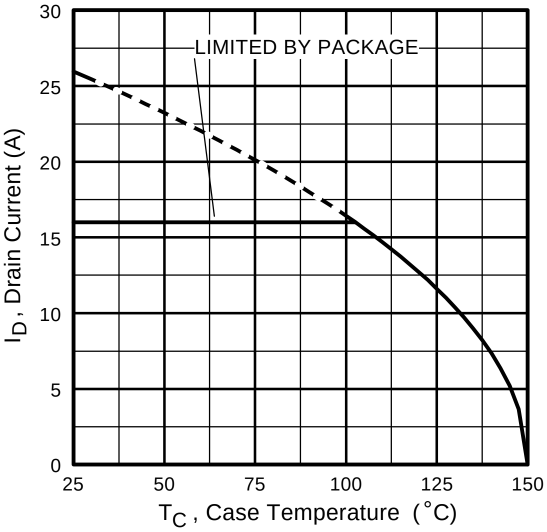


Fig 9. Maximum Drain Current Vs. Case Temperature

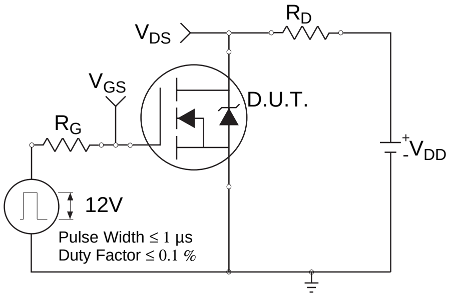


Fig 10a. Switching Time Test Circuit

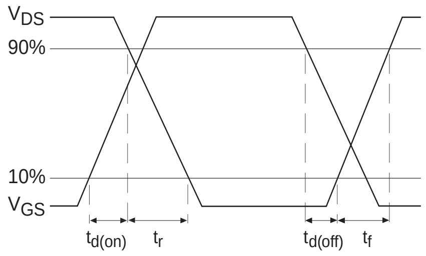


Fig 10b. Switching Time Waveforms

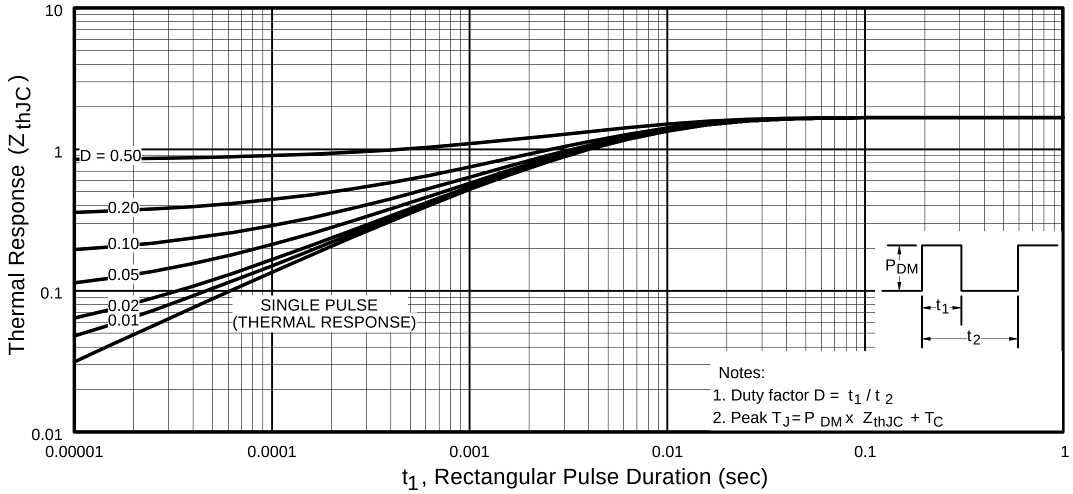


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

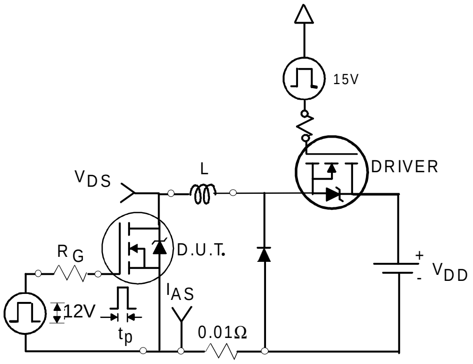


Fig 12a. Unclamped Inductive Test Circuit

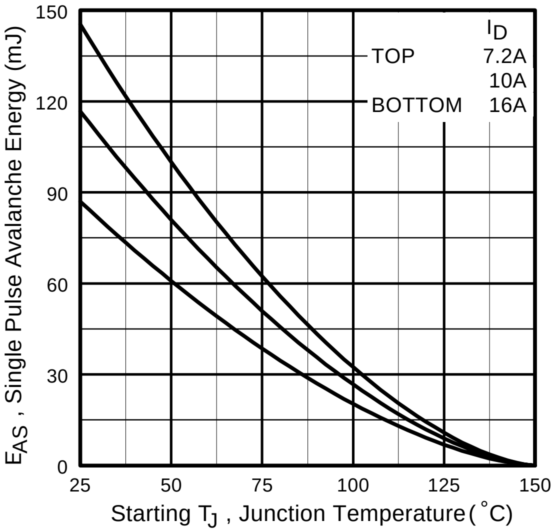


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

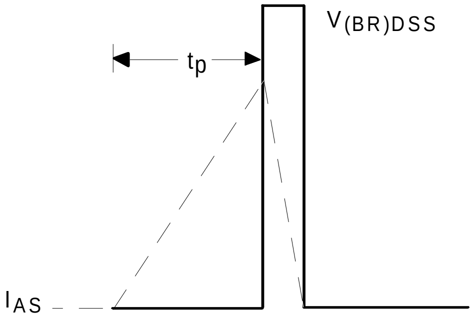


Fig 12b. Unclamped Inductive Waveforms

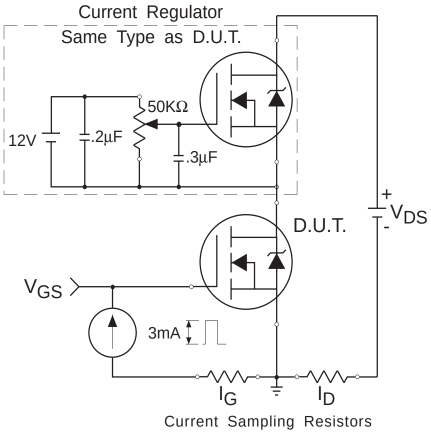


Fig 13b. Gate Charge Test Circuit

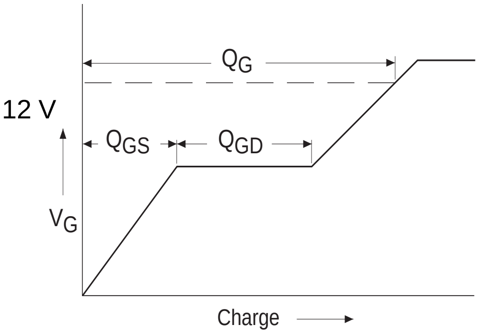


Fig 13a. Basic Gate Charge Waveform

Footnotes:

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

② V_{DD} = 50V, starting T_J = 25°C, L= 0.68mH Peak I_L = 16A, V_{GS} = 12V

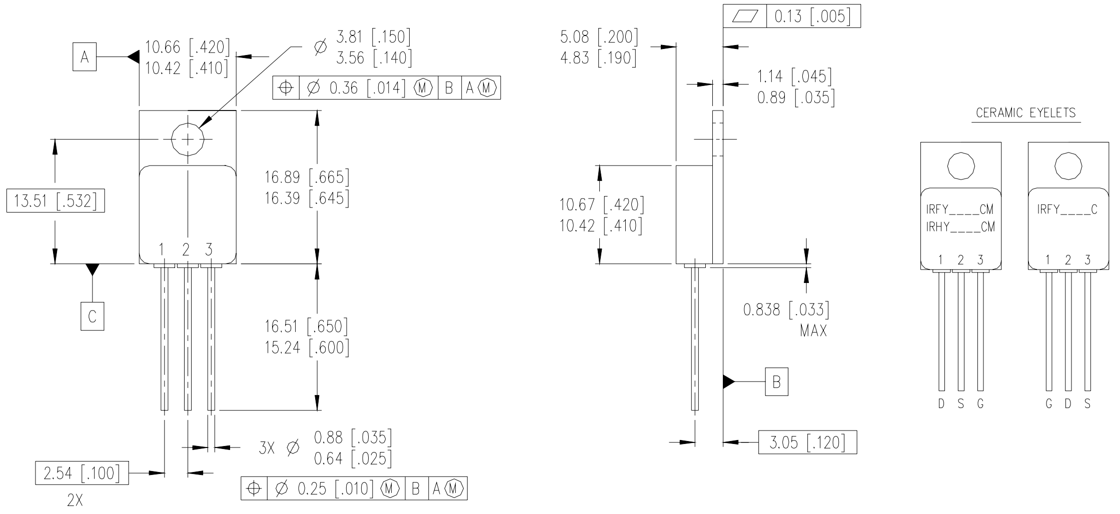
③ $I_{SD} \leq$ 16A, di/dt $\leq$ 155A/µs, $V_{DD} \leq$ 100V, $T_J \leq$ 150°C

④ Pulse width $\leq$ 300 µs; 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 — 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.

LEGEND
D - DRAIN
S - SOURCE
G - GATE

International
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