International
IOR Rectifier

PD-94400B

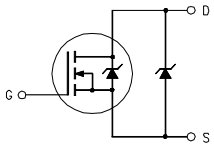
# RAD-HARD SYNCHRONOUS RECTIFIER SURFACE MOUNT (SMD-2)

# IRHSLNA57Z60
## 30V, N-CHANNEL

### Product Summary

| Part Number | Radiation Level | $R_{DS(on)}$ | $Q_G$ |
|---|---|---|---|
| IRHSLNA57Z60 | 100K Rads (Si) | 4.0mΩ | 200nC |
| IRHSLNA53Z60 | 300K Rads (Si) | 4.0mΩ | 200nC |
| IRHSLNA54Z60 | 600K Rads (Si) | 4.0mΩ | 200nC |
| IRHSLNA58Z60 | 1000K Rads (Si) | 4.5mΩ | 200nC |

SMD-2




### Description:

The SynchFet family of Co-Pack RAD-Hard MOSFETs and Schottky diodes offers the designer an innovative, board space saving solution for switching regulator and power management applications. RAD-Hard MOSFETs utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. Combining this technology with International Rectifier's low forward drop Schottky rectifiers results in an extremely efficient device suitable for use in a wide variety of Military and Space applications.

### Features:

- Co-Pack N-channel RAD-Hard MOSFET and Schottky Diode
- Ideal for Synchronous Rectifiers in DC-DC Converters up to 75A Output
- Low Conduction Losses
- Low Switching Losses
- Low Vf Schottky Rectifier
- Refer to IRHSNA57Z60 for Lower Rds(on)

### Absolute Maximum Ratings — Pre-Irradiation

| | Parameter | | Units |
|---|---|---|---|
| $I_D$ @ $V_{GS}$ = 12V, $T_C$ = 25°C | Continuous Drain or Source Current | 75* | A |
| $I_D$ @ $V_{GS}$ = 12V, $T_C$ = 100°C | Continuous Drain or Source Current | 75* | |
| $I_{DM}$ | Pulsed Drain Current ① | 300 | |
| $P_D$ @ $T_C$ = 25°C | Max. Power Dissipation | 250 | W |
| | Linear Derating Factor | 2.0 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ④ | 500 | mJ |
| $I_{AR}$ | Avalanche Current ① | 75 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 25 | mJ |
| $I_F$ (AV)@ $T_C$ = 25°C | Schottky and Body Diode Avg. Forward Current ③ | 75* | A |
| $I_F$ (AV)@ $T_C$ =100°C | Schottky and Body Diode Avg. Forward Current ③ | 75* | |
| $T_J$, $T_{STG}$ | Opeating and Storage Temperature Range | -55 to 150 | °C |
| | Pckg. Mounting Surface Temp. | 300 (for 5s) | |
| | Weight | 3.3 (Typical) | g |

* Current is limited by package

For footnotes refer to the last page

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

| | Parameter | Min | Typ | Max | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 30 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-State Resistance | — | — | 4.0 | mΩ | $V_{GS}$ = 12V, $I_D$ = 45A② |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 1.0mA |
| $g_{fs}$ | Forward Transconductance | 45 | — | — | S (℧) | $V_{DS}$ ≥ 15V, $I_{DS}$ = 45A② |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | — | — | 50 | μA | $V_{DS}$ = 24V, $V_{GS}$=0V |
| | | — | — | 50 | mA | $V_{DS}$ = 24V, $V_{GS}$ = 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 | — | — | 200 | nC | $V_{GS}$ =12V, $I_D$ = 45A, $V_{DS}$ = 15V |
| $Q_{gs}$ | Gate-to-Source Charge | — | — | 55 | | |
| $Q_{gd}$ | Gate-to-Drain ('Miller') Charge | — | — | 40 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | — | 35 | ns | $V_{DD}$ = 15V, $I_D$ = 45A, $V_{GS}$ =12V, $R_G$ = 2.35Ω |
| $t_r$ | Rise Time | — | — | 160 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | — | 78 | | |
| $t_f$ | Fall Time | — | — | 26 | | |
| $L_S + L_D$ | Total Inductance | — | 6.6 | — | nH | Measured from center of drain pad to center of source pad |

## Schottky Diode & Body Diode Ratings and Characteristics

| | Parameter | Min | Typ | Max | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.15 | V | $T_J$ = -55°C, $I_D$=45A, $V_{GS}$ = 0V② |
| | | — | — | 1.05 | | $T_J$ = 25°C, $I_D$= 45A, $V_{GS}$ = 0V② |
| | | — | — | 0.95 | | $T_J$ = 110°C, $I_D$=45A, $V_{GS}$ = 0V② |
| $t_{rr}$ | Reverse Recovery Time | — | — | 175 | nS | Tj = 25°C, $I_F$ =45A, di/dt ≤ 100A/μs |
| $Q_{RR}$ | Reverse Recovery Charge | — | — | 500 | nC | $V_{DS}$ ≤ 30V |
| $L_S + L_D$ | Total Inductance | — | 7.95 | — | nH | Measured from center of drain pad to center of source pad (for Schottky only) |
| $t_{on}$ | 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 (MOSFET) | — | — | 0.5 | °C/W | |
| $R_{thJC}$ | Junction-to-Case (Schottky) | — | — | 0.7 | | |

**Note: Corresponding Spice and Saber models are available on International Rectifier Web site.**
For footnotes refer to the last page

## Radiation Characteristics

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 ⑤⑥⑦**

| | 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 | 30 | — | 30 | — | V | $V_{GS}$ = 0V, $I_D$ = 1.0mA |
| $V_{GS(th)}$ | Gate Threshold Voltage | 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 | — | 25 | µA | $V_{DS}$= 24V, $V_{GS}$ =0V |
| $R_{DS(on)}$ | Static Drain-to-Source ② On-State Resistance (TO-3) | — | 4.0 | — | 5.0 | mΩ | $V_{GS}$ = 12V, $I_D$ =45A |
| $R_{DS(on)}$ | Static Drain-to-Source ② On-State Resistance (SMD-2) | — | 4.0 | — | 4.5 | mΩ | $V_{GS}$ = 12V, $I_D$ =45A |
| $V_{SD}$ | Diode Forward Voltage ② | — | 1.3 | — | 1.3 | V | $V_{GS}$ = 0V, $I_S$ = 45A |

1. Part numbers IRHSLNA57Z60, IRHSLNA53Z60 and IRHSLNA54Z60
2. Part number IRHSLNA58Z60

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 ⑦**

| Ion | LET MeV/(mg/cm²)) | Energy (MeV) | Range (µm) | $V_{DS}$ (V) @$V_{GS}$=0V | @$V_{GS}$=-5V | @$V_{GS}$=-10V | @$V_{GS}$=-15V | @$V_{GS}$=-20V |
|---|---|---|---|---|---|---|---|---|
| Br | 37.9 | 255 | 33.4 | 30 | 30 | 30 | 25 | 20 |
| I | 59.4 | 290 | 28.8 | 25 | 25 | 20 | 15 | 10 |
| Au | 80.3 | 313 | 26.5 | 22.5 | 22.5 | 15 | 10 | — |

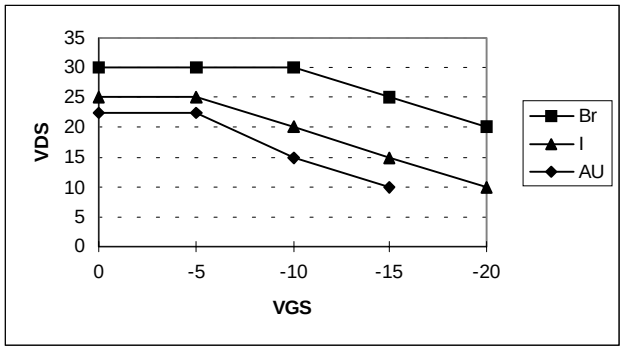



**Fig a.** Single Event Effect, Safe Operating Area

For footnotes refer to the last page

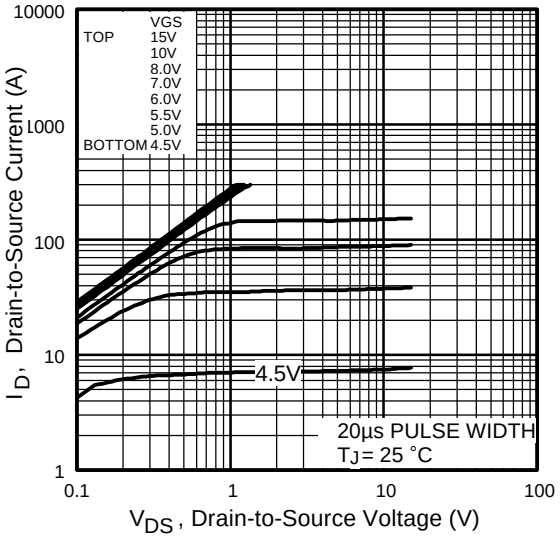



**Fig 1.** Typical Output Characteristics

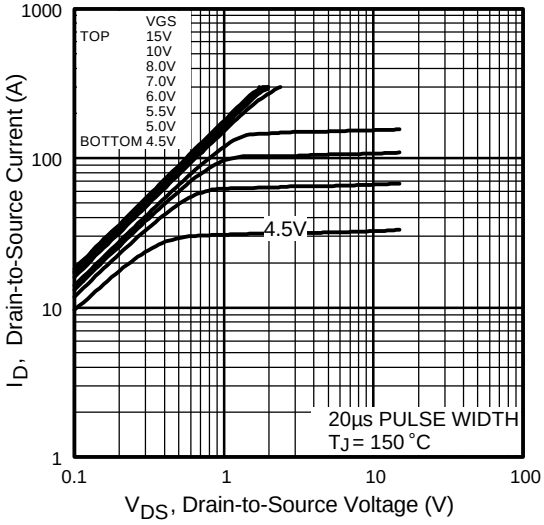



**Fig 2.** Typical Output Characteristics

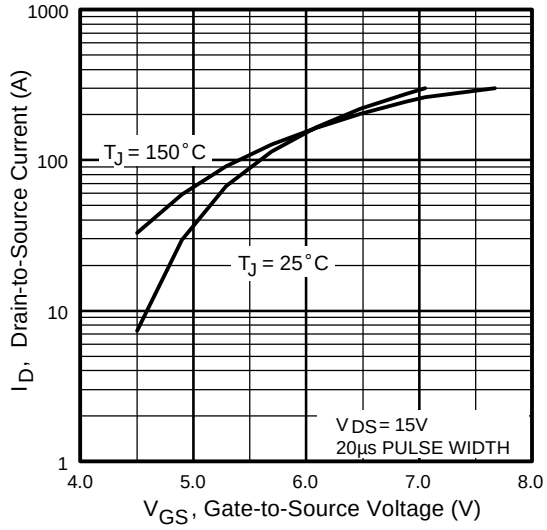



**Fig 3.** Typical Transfer Characteristics

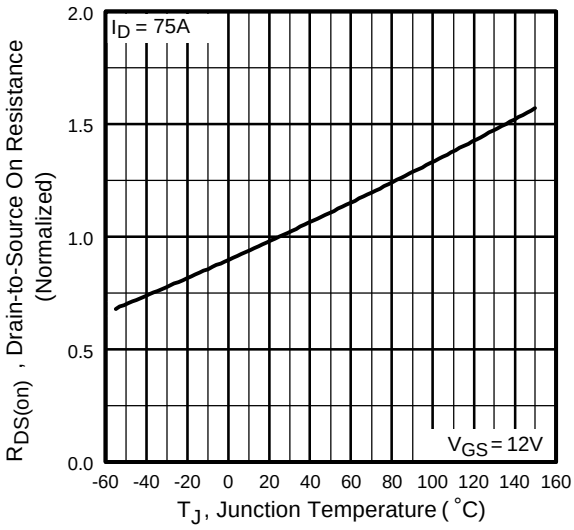



**Fig 4.** Normalized On-Resistance Vs. Temperature

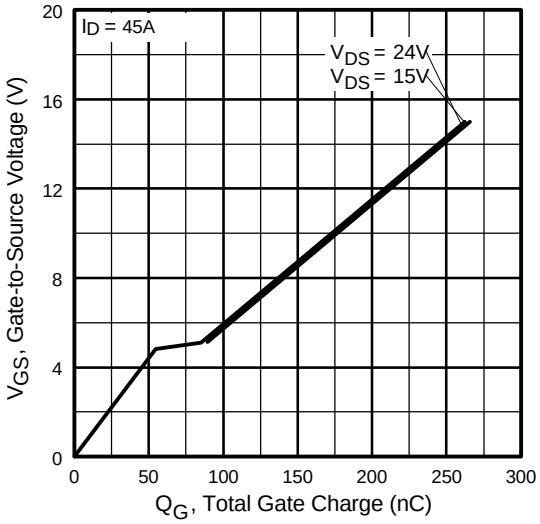



**Fig 5.** Typical Gate Charge Vs. Gate-to-Source Voltage

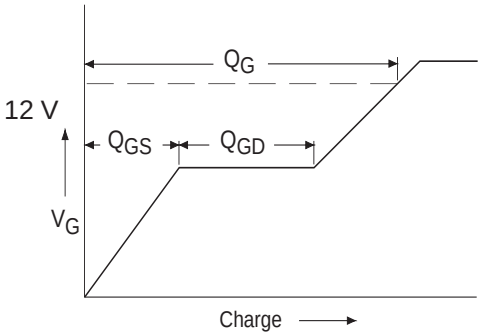



**Fig 5a.** Basic Gate Charge Waveform

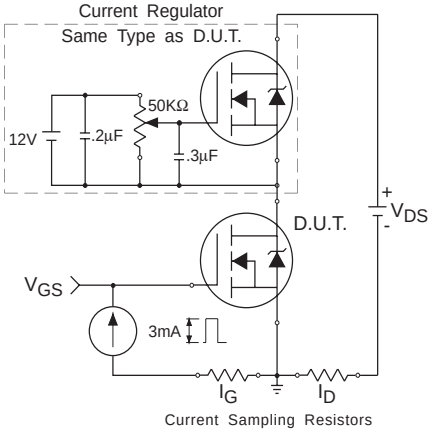



**Fig 5b.** Gate Charge Test Circuit

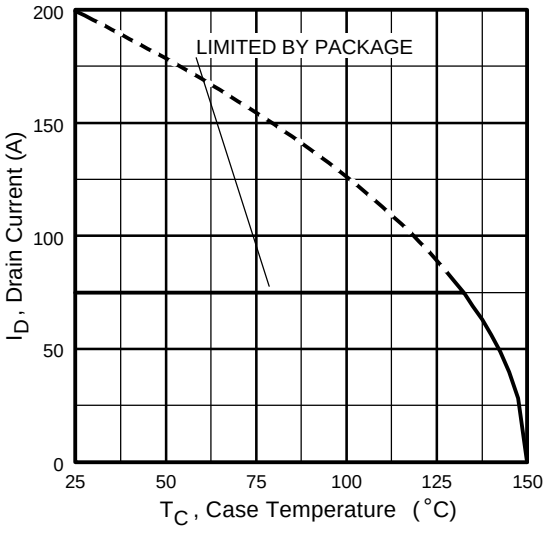



**Fig 6.** Maximum Drain Current Vs. Case Temperature

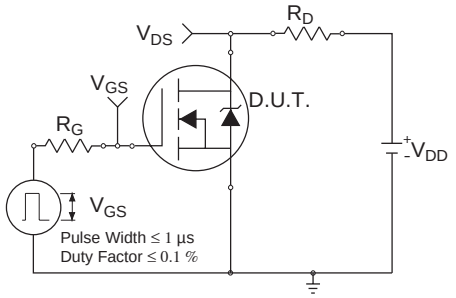



**Fig 7a.** Switching Time Test Circuit

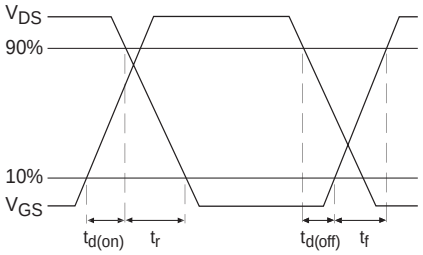



**Fig 7b.** Switching Time Waveforms

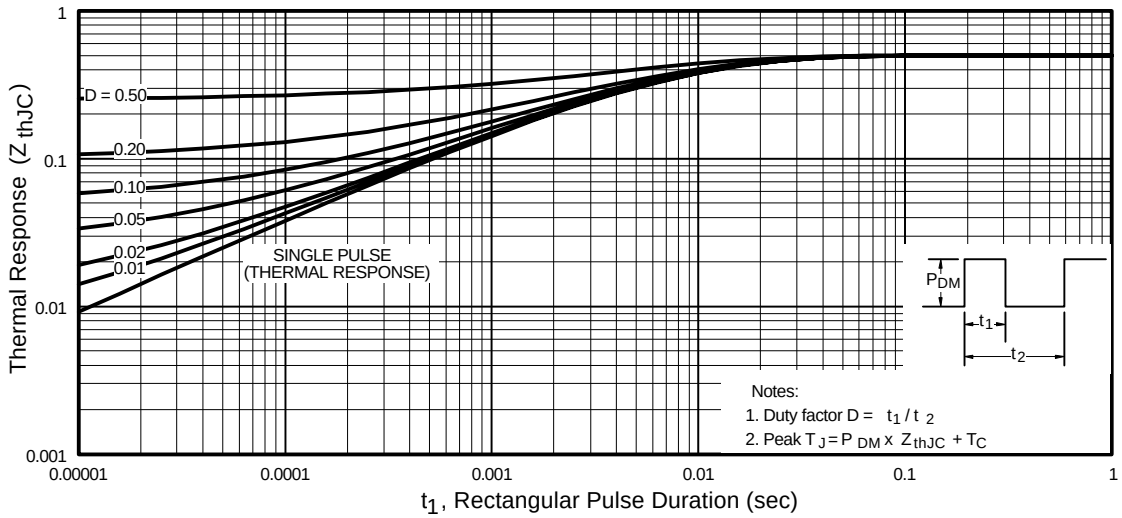



**Fig 8.** Maximum Effective Transient Thermal Impedance, Junction-to-Case, MOSFET

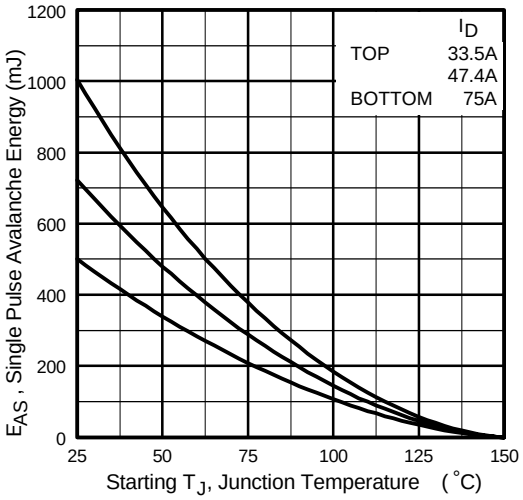



**Fig 9.** Maximum Avalanche Energy
Vs. Drain Current

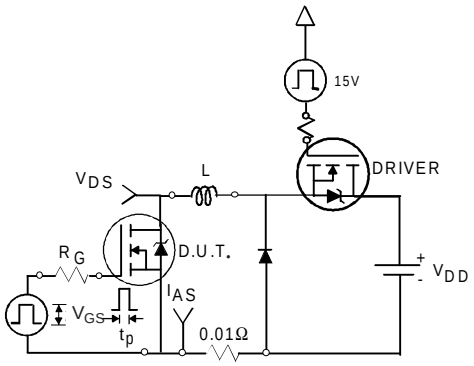



**Fig 9a.** Unclamped Inductive Test Circuit

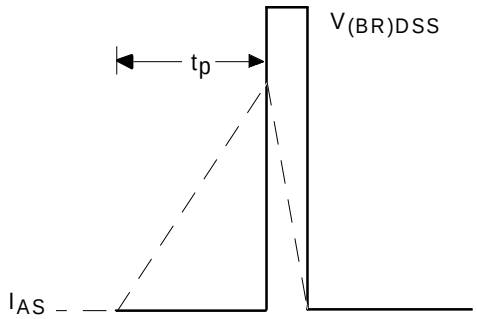



**Fig 9b.** Unclamped Inductive Waveforms

## MOSFET Body Diode & Schottky Diode Characteristics

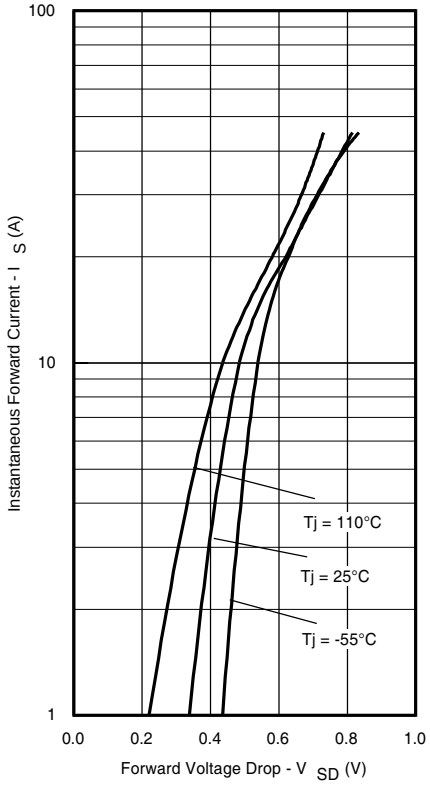



**Fig. 10** - Typical Forward Voltage Drop Characterstics

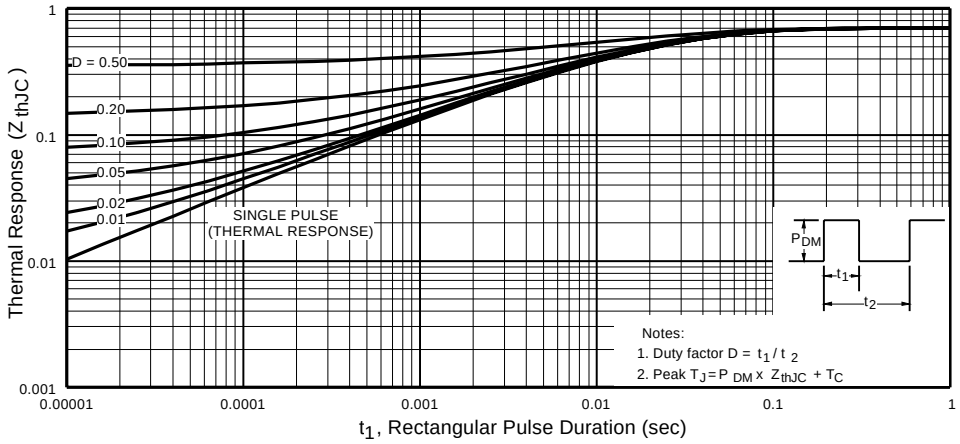



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case, Schottky

## Footnotes:

① Repetitive Rating; Pulse width limited by maximum junction temperature

② Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

③ 50% Duty Cycle, Rectangular

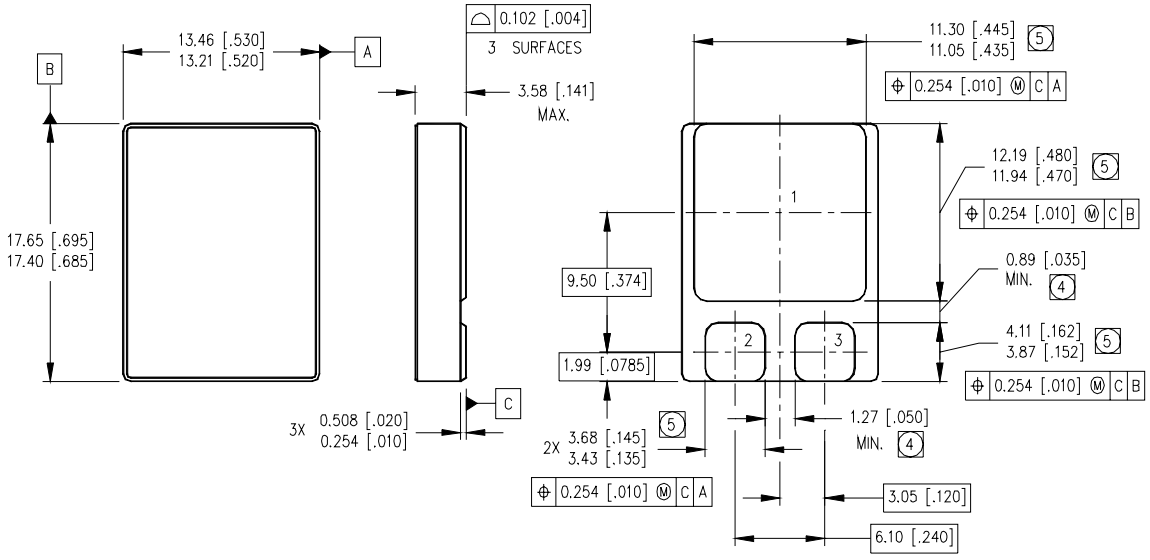
④ $V_{DD}$ = 25V, starting $T_J$ = 25°C, L= 0.3 mH Peak $I_L$ = 75A, $V_{GS}$ = 12V

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.** 24 volt $V_{DS}$ applied and $V_{GS}$ = 0 during irradiation per MIL-STD-750, method 1019, condition A.

⑦ Specified Radiation Characteristics are for Radiation Hardened MOSFET die only.

## Case Outline and Dimensions — SMD-2




NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. (4) DIMENSION INCLUDES METALLIZATION FLASH.
5. (5) DIMENSION DOES NOT INCLUDE METALLIZATION FLASH.

PAD ASSIGNMENTS

1 = DRAIN
2 = GATE
3 = SOURCE

International
IOR Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
**IR LEOMINSTER :** 205 Crawford St., Leominster, Massachusetts 01453, USA Tel: (978) 534-5776
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.
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