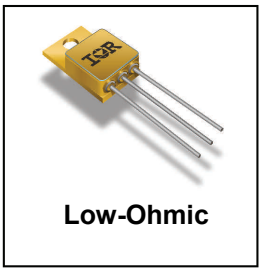
IOR HiRel
An Infineon Technologies Company

# IRHLYS77034CM
# 2N7607T3

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

**60V, N-CHANNEL**

**R7 TECHNOLOGY**



**Low-Ohmic**

### Product Summary

| Part Number | Radiation Level | RDS(on) | $I_D$ |
|---|---|---|---|
| IRHLYS77034CM | 100 kRads(Si) | 0.045Ω | 20A* |
| IRHLYS73034CM | 300 kRads(Si) | 0.045Ω | 20A* |

### Description

IR HiRel 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
- Hermetically Sealed
- Light Weight
- Complimentary P-Channel Available - IRHLYS797034CM
- ESD Rating: Class 1B per MIL-STD-750, Method 1020

### Absolute Maximum Ratings

**Pre-Irradiation**

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $I_{D1}$ @ $V_{GS}$ = 4.5V, $T_C$ = 25°C | Continuous Drain Current | 20* | A |
| $I_{D2}$ @ $V_{GS}$ = 4.5V, $T_C$ = 100°C | Continuous Drain Current | 20* | |
| $I_{DM}$ @ $T_C$ = 25°C | Pulsed Drain Current ① | 80 | |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 75 | W |
| | Linear Derating Factor | 0.6 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 10 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 98 | mJ |
| $I_{AR}$ | Avalanche Current ① | 20 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 7.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 6.9 | V/ns |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>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 |

*Current is limited by package

For footnotes refer to the page 2.

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

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.07 | — | V/°C | Reference to 25°C, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-Resistance | — | — | 0.045 | Ω | $V_{GS}$ = 4.5V, $I_{D2}$ = 20A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.0 | — | 2.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $\Delta V_{GS(th)}/\Delta T_J$ | Gate Threshold Voltage Coefficient | — | -5.0 | — | mV/°C | |
| Gfs | Forward Transconductance | 19 | — | — | S | $V_{DS}$ = 15V, $I_{D2}$ = 20A ④ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | — | — | 1.0 | µA | $V_{DS}$ = 48V, $V_{GS}$ = 0V |
| | | — | — | 10 | | $V_{DS}$ = 48V,$V_{GS}$ = 0V,$T_J$ =125°C |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | — | — | 100 | nA | $V_{GS}$ = 10V |
| | Gate-to-Source Leakage Reverse | — | — | -100 | | $V_{GS}$ = -10V |
| $Q_G$ | Total Gate Charge | — | — | 34 | nC | $I_{D1}$ = 20A |
| $Q_{GS}$ | Gate-to-Source Charge | — | — | 8.0 | | $V_{DS}$ = 30V |
| $Q_{GD}$ | Gate-to-Drain ('Miller') Charge | — | — | 16 | | $V_{GS}$ = 4.5V |
| $t_{d(on)}$ | Turn-On Delay Time | — | — | 26 | ns | $V_{DD}$ = 30V |
| Tr | Rise Time | — | — | 110 | | $I_{D1}$ = 20A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | — | 60 | | $R_G$ = 7.5Ω |
| Tf | Fall Time | — | — | 28 | | $V_{GS}$ = 5.0V |
| Ls +$L_D$ | Total Inductance | — | 6.8 | — | nH | Measured from Drain lead (6mm / 0.25 in from package) to Source lead (6mm / 0.25 in from package) with Source wire internally bonded from Source pin to Drain pad |
| $C_{iss}$ | Input Capacitance | — | 2025 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 484 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 5.1 | — | | $f$ = 1.0MHz |
| $R_G$ | Gate Resistance | — | 1.16 | — | Ω | $f$ = 1.0MHz, open drain |

## Source-Drain Diode Ratings and Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 20* | A | |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 80 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.2 | V | $T_J$ = 25°C,$I_S$ = 20A, $V_{GS}$ = 0V ④ |
| $t_{rr}$ | Reverse Recovery Time | — | — | 160 | ns | $T_J$ = 25°C ,$I_F$ = 20A, $V_{DD}$ ≤ 25V |
| $Q_{rr}$ | Reverse Recovery Charge | — | — | 705 | nC | di/dt = 100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

* Current is limited by package

## Thermal Resistance

| Symbol | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | — | 1.67 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (Typical Socket Mount) | — | — | 80 | |

**Footnotes:**

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

② $V_{DD}$ = 25V, starting $T_J$ = 25°C, L =0.49mH, Peak $I_L$ = 20A, $V_{GS}$ = 10V

③ $I_{SD}$ ≤ 20A, di/dt ≤ 347A/µs, $V_{DD}$ ≤ 60V, $T_J$ ≤ 150°C

④ Pulse width ≤ 300 µs; Duty Cycle ≤ 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. 48volt $V_{DS}$ applied and $V_{GS}$ = 0 during irradiation per MIL-STD-750, Method 1019, condition A.

## Radiation Characteristics

IR HiRel 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.

### Table1. Electrical Characteristics @ Tj = 25°C, Post Total Dose Irradiation ⑤⑥

| Symbol | Parameter | Up to 300 kRads(Si) [1] | | Units | Test Conditions |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 60 | —— | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.0 | 2.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | —— | 100 | nA | $V_{GS}$ = 10V |
| $I_{GSS}$ | Gate-to-Source Leakage Reverse | —— | -100 | nA | $V_{GS}$ = -10V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | —— | 1.0 | µA | $V_{DS}$ = 48V, $V_{GS}$ = 0V |
| $R_{DS(on)}$ | Static Drain-to-Source On-State ④ Resistance (TO-3) | —— | 0.045 | Ω | $V_{GS}$ = 4.5V, $I_{D2}$ = 20A |
| $R_{DS(on)}$ | Static Drain-to-Source On--State ④ Resistance (Low Ohmic TO-257AA) | —— | 0.045 | Ω | $V_{GS}$ = 4.5V, $I_{D2}$ = 20A |
| $V_{SD}$ | Diode Forward Voltage | —— | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 20A |

1. Part numbers IRHLYS77034 and IRHLYS73034

IR HiRel 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 = -2V | @ VGS = -4V | @ VGS = -5V | @ VGS = -6V | @ VGS = -7V |
| 38 ± 5% | 300 ± 7.5% | 38 ± 7.5% | 60 | 60 | 60 | 60 | 60 | —— |
| 62 ± 5% | 355 ± 7.5% | 33 ± 7.5% | 60 | 60 | 60 | 60 | —— | —— |
| 85 ± 5% | 380 ± 7.5% | 29 ± 7.5% | 60 | 60 | 60 | —— | —— | —— |

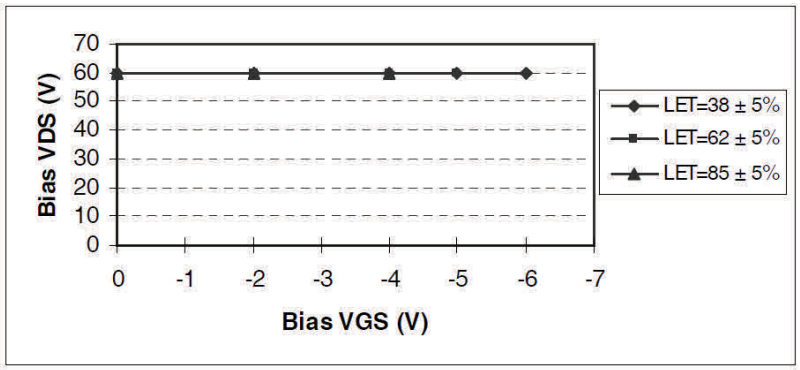



**Fig a.** Typical Single Event Effect, Safe Operating Area

For footnotes refer to the page 2.

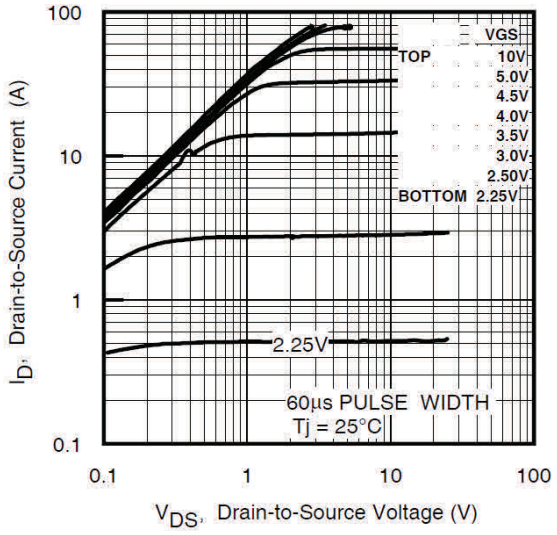



**Fig 1.** Typical Output Characteristics

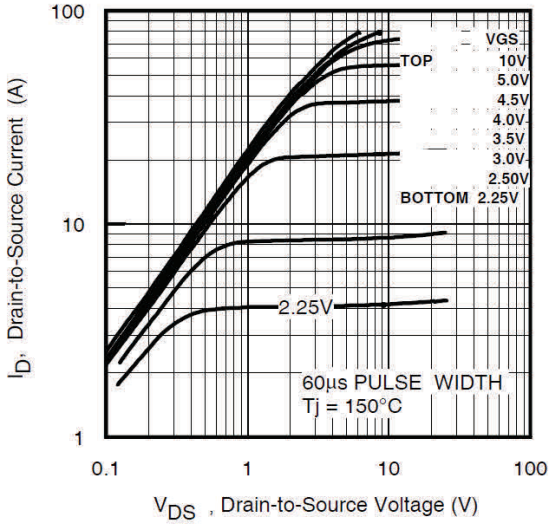



**Fig 2.** Typical Output Characteristics

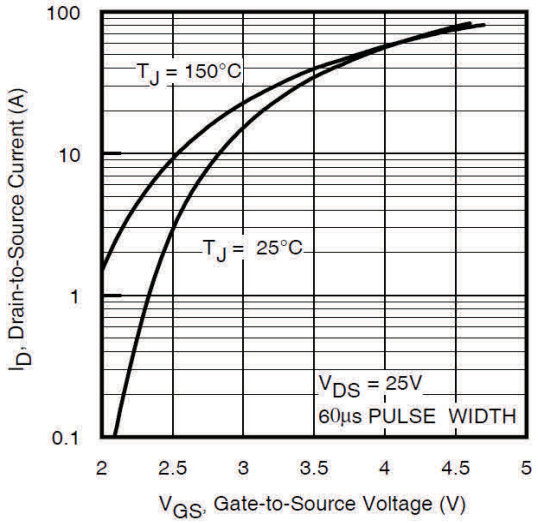



**Fig 3.** Typical Transfer Characteristics

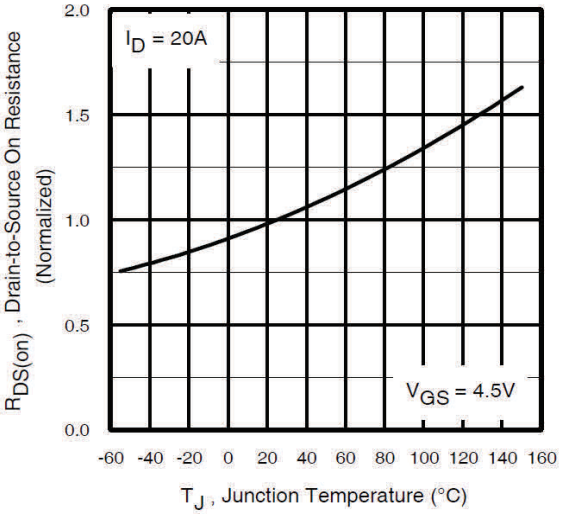



**Fig 4.** Normalized On-Resistance Vs. Temperature

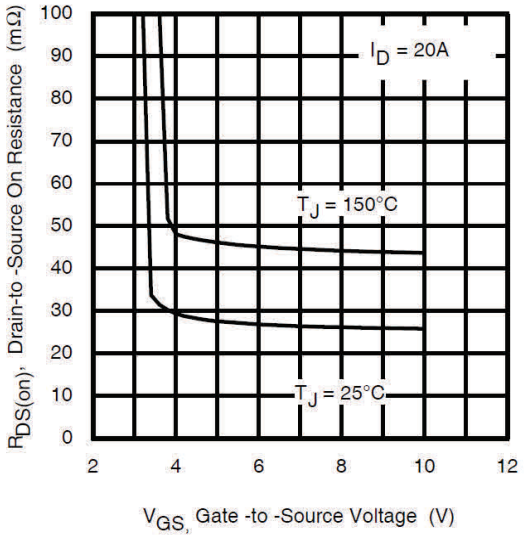



**Fig 5.** Typical On-Resistance Vs Gate Voltage

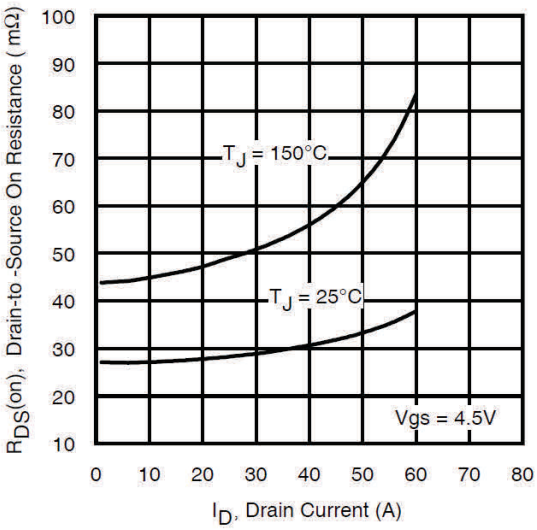



**Fig 6.** Typical On-Resistance Vs Drain Current

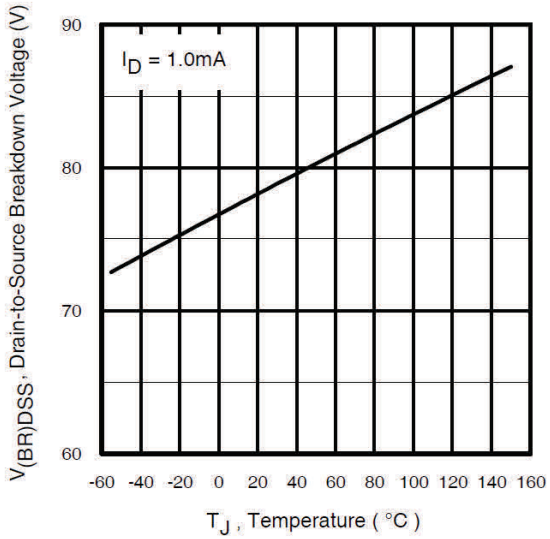



**Fig 7.** Typical Drain-to-Source Breakdown Voltage Vs Temperature

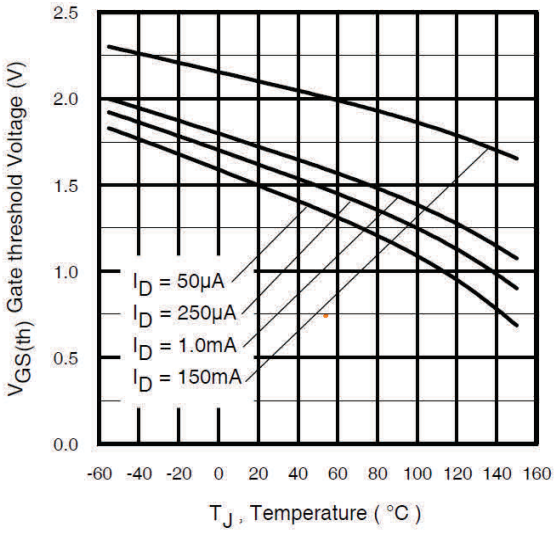



**Fig 8.** Typical Threshold Voltage Vs Temperature

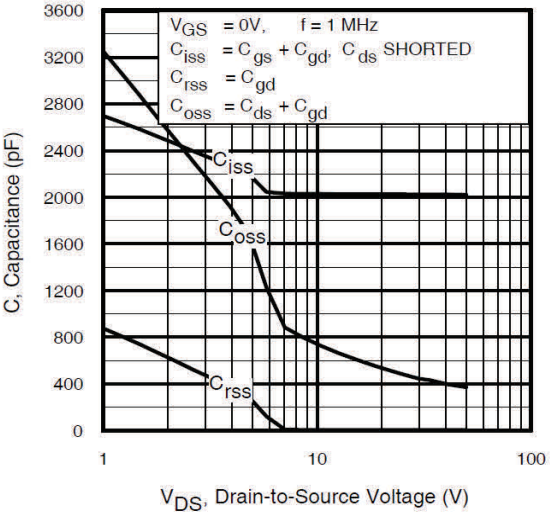



**Fig 9.** Typical Capacitance Vs. Drain-to-Source Voltage

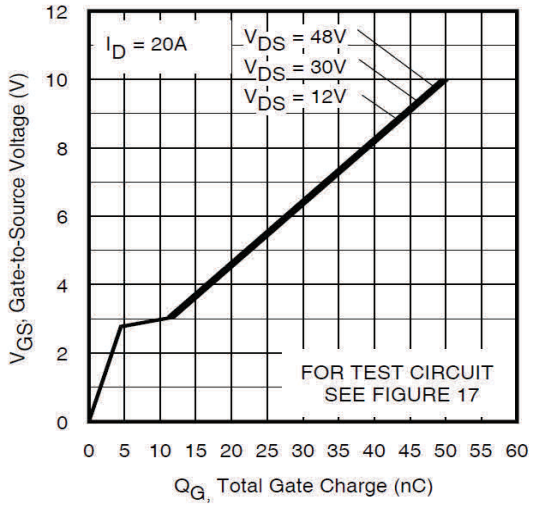



**Fig 10.** Typical Gate Charge Vs. Gate-to-Source Voltage

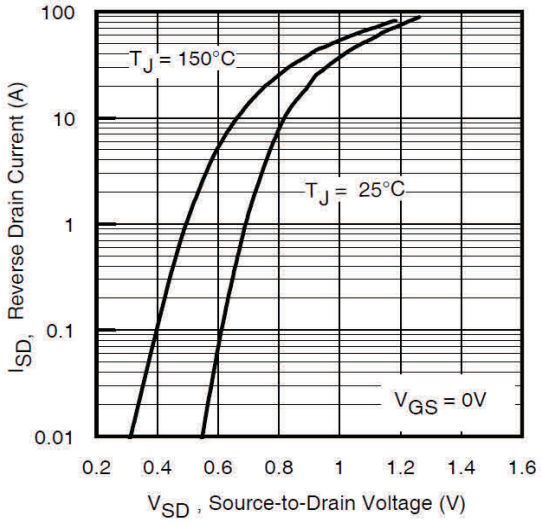



**Fig 11.** Typical Source-Drain Diode Forward Voltage

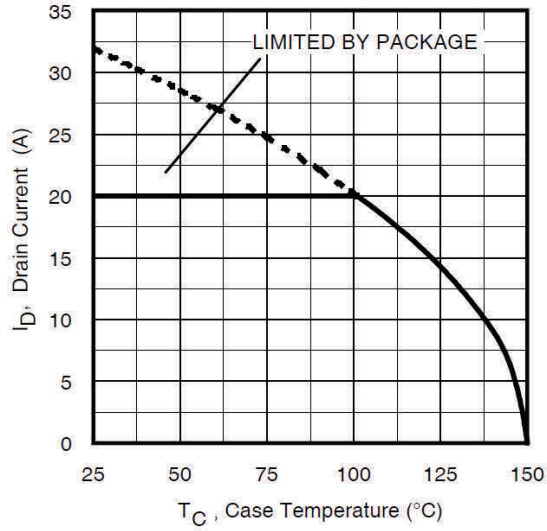



**Fig 12.** Maximum Drain Current Vs.Case Temperature

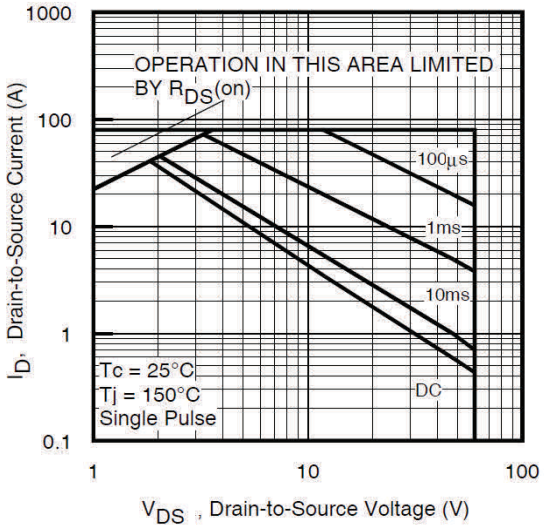



**Fig 13.** Maximum Safe Operating Area

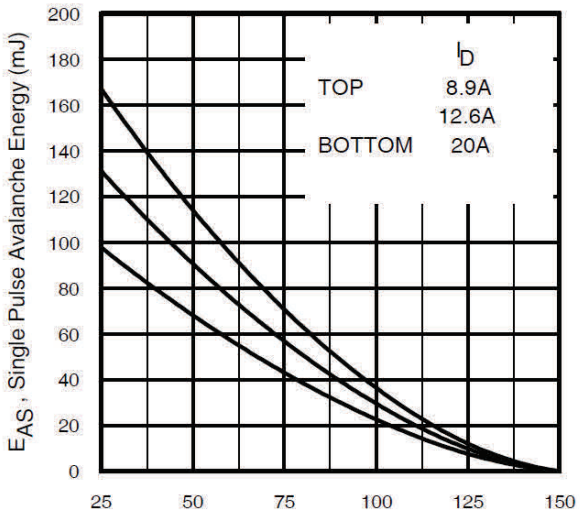



**Fig 14.** Maximum Avalanche Energy Vs. Drain Current

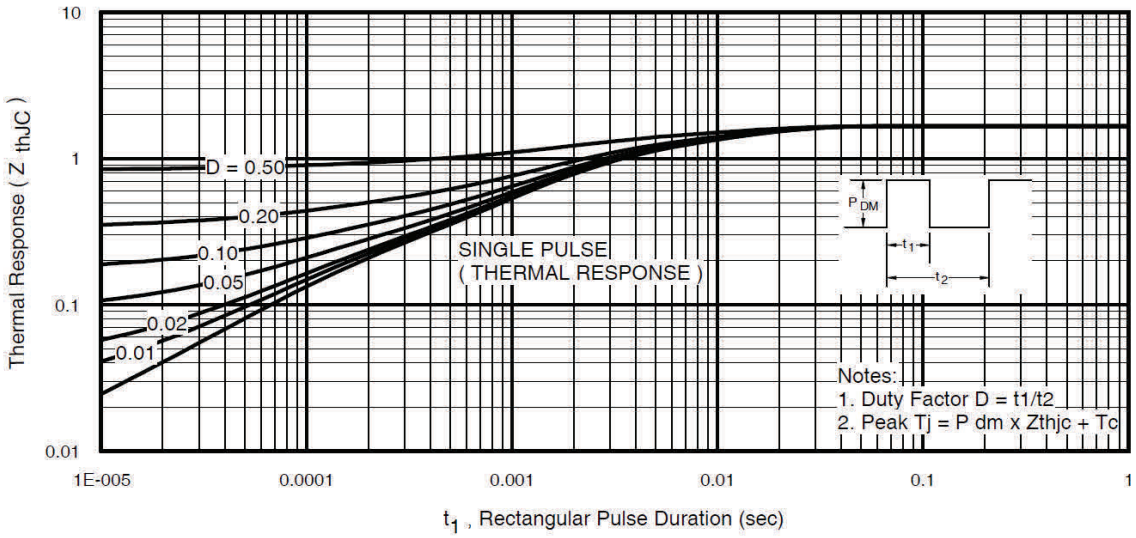



**Fig 15.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

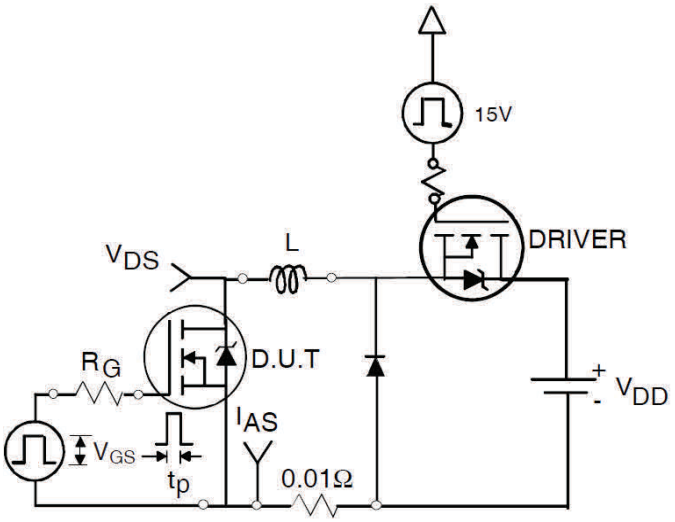



**Fig 16a.** Unclamped Inductive Test Circuit

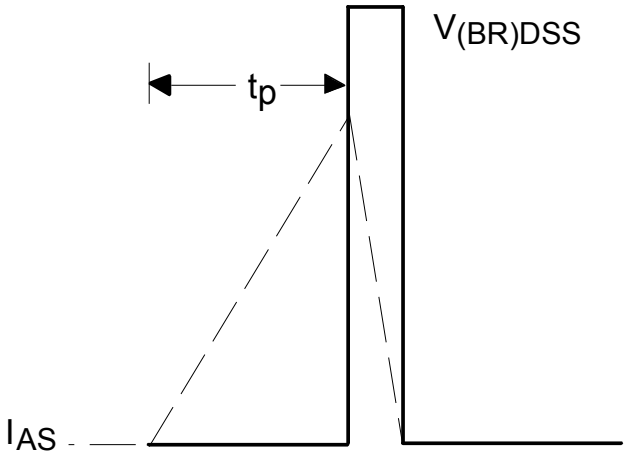



**Fig 16b.** Unclamped Inductive Waveforms

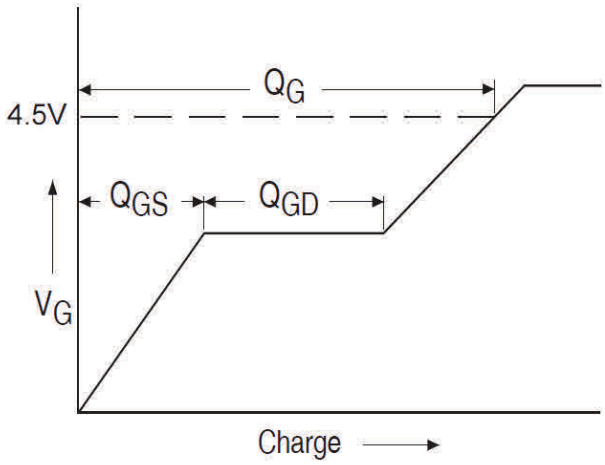



**Fig 17a.** Gate Charge Waveform

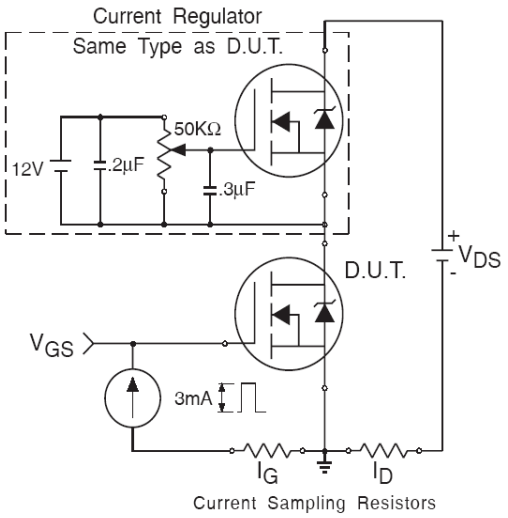



**Fig 17b.** Gate Charge Test Circuit

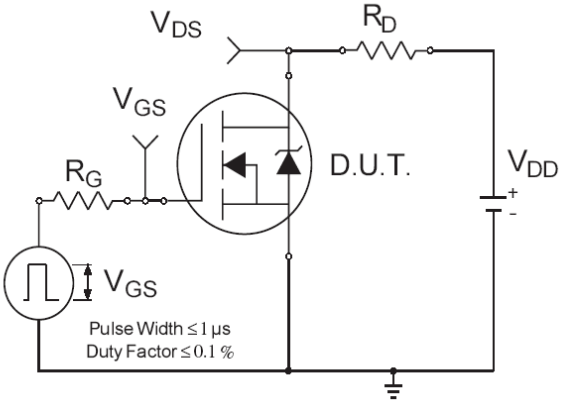



**Fig 18a.** Switching Time Test Circuit

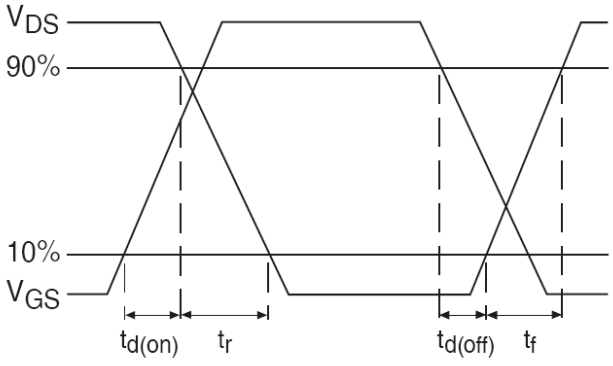
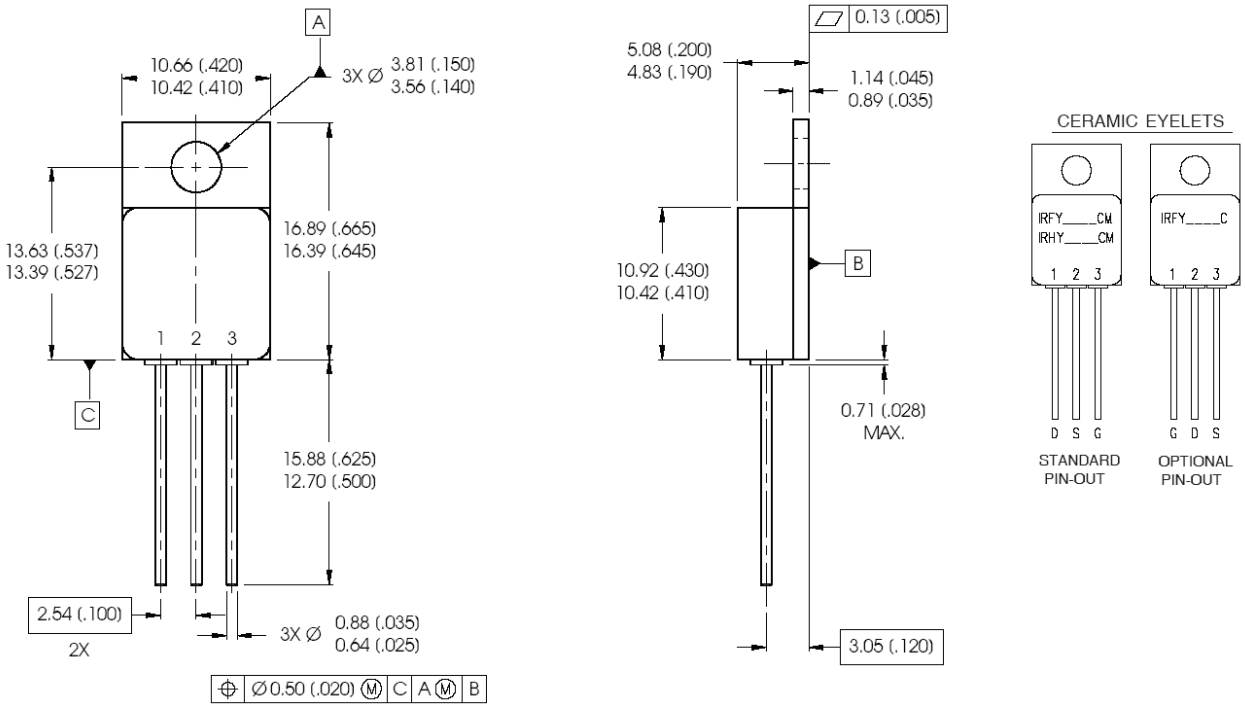



**Fig 18b.** Switching Time Waveforms

## 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

**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.

**IMPORTANT NOTICE**

The information given in this document shall be in no event regarded as guarantee of conditions or characteristic. The data contained herein is a characterization of the component based on internal standards and is intended to demonstrate and provide guidance for typical part performance. It will require further evaluation, qualification and analysis to determine suitability in the application environment to confirm compliance to your system requirements.

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