IR HiRel
An Infineon Technologies Company

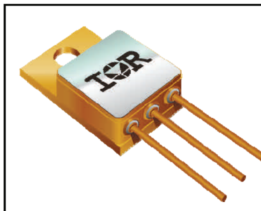
# IRHM7250
# JANSR2N7269

## RADIATION HARDENED POWER MOSFET THRU-HOLE (TO-254AA)

**200V, N-CHANNEL**
**REF: MIL-PRF-19500/603**
**RAD-Hard HEXFET TECHNOLOGY**

### Product Summary

| Part Number | Radiation Level | RDS(on) | $I_D$ | QPL Part Number |
|---|---|---|---|---|
| IRHM7250 | 100 kRads(Si) | 0.10Ω | 26A | JANSR2N7269 |
| IRHM3250 | 300 kRads(Si) | 0.155Ω | 26A | JANSF2N7269 |
| IRHM4250 | 500 kRads(Si) | 0.155Ω | 26A | JANSG2N7269 |
| IRHM8250 | 1000 kRads(Si) | 0.155Ω | 26A | JANSH2N7269 |



TO-254AA

### Description

IRHM7250 is part of the International Rectifier HiRel family of products. IR HiRel RAD-Hard HEXFET technology provides high performance power MOSFETs for space applications. This technology has over a decade of proven performance and reliability in satellite applications. These devices have been characterized for both Total Dose and Single Event Effects (SEE). The combination of low Rdson 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
- Low RDS(on)
- Low Total Gate Charge
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Electrically Isolated
- Ceramic Eyelets
- Light Weight
- ESD Rating: Class 3A per MIL-STD-750, Method 1020

### Absolute Maximum Ratings — Pre-Irradiation

| | Parameter | | Units |
|---|---|---|---|
| $I_D$ @ $V_{GS}$ = 12V, $T_C$ = 25°C | Continuous Drain Current | 26 | |
| $I_D$ @ $V_{GS}$ = 12V, $T_C$ = 100°C | Continuous Drain Current | 16 | A |
| $I_{DM}$ | Pulsed Drain Current ① | 104 | |
| $P_D$ @$T_C$ = 25°C | Maximum Power Dissipation | 150 | W |
| | Linear Derating Factor | 1.2 | W/°C |
| $V_{GS}$ | Gate-to-Source Voltage | ± 20 | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 500 | mJ |
| $I_{AR}$ | Avalanche Current ① | 26 | A |
| $E_{AR}$ | Repetitive Avalanche Energy ① | 15 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 5.0 | V/ns |
| $T_J$ $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 to + 150 | °C |
| | Lead Temperature | 300 (0.063 in. /1.6 mm from case for 10s) | |
| | Weight | 9.3 (Typical) | g |

For Footnotes, refer to the page 2.

**Pre-Irradiation**

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

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 200 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 1.0mA |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | — | 0.27 | — | V/°C | Reference to 25°C, $I_D$ = 1.0mA |
| $R_{DS(on)}$ | Static Drain-to-Source On-State Resistance | — | — | 0.10 | Ω | $V_{GS}$ = 12V, $I_D$ = 16A ④ |
| | | — | — | 0.11 | | $V_{GS}$ = 12V, $I_D$ = 26A ④ |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | — | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 1.0mA |
| Gfs | Forward Transconductance | 8.0 | — | — | S | $V_{DS}$ = 15V, $I_D$ = 16A ④ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | — | — | 25 | µA | $V_{DS}$ = 160V, $V_{GS}$ = 0V |
| | | — | — | 250 | | $V_{DS}$ = 160V,$V_{GS}$ = 0V,$T_J$ =125°C |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | — | — | 100 | nA | $V_{GS}$ = 20V |
| | Gate-to-Source Leakage Reverse | — | — | -100 | | $V_{GS}$ = -20V |
| $Q_G$ | Total Gate Charge | — | — | 170 | nC | $I_D$ = 26A |
| $Q_{GS}$ | Gate-to-Source Charge | — | — | 30 | | $V_{DS}$ = 100V |
| $Q_{GD}$ | Gate-to-Drain ('Miller') Charge | — | — | 60 | | $V_{GS}$ = 12V |
| $t_{d(on)}$ | Turn-On Delay Time | — | — | 33 | ns | $V_{DD}$ = 100V |
| tr | Rise Time | — | — | 140 | | $I_D$ = 26A |
| $t_{d(off)}$ | Turn-Off Delay Time | — | — | 140 | | $R_G$ = 2.35Ω |
| $t_f$ | Fall Time | — | — | 140 | | $V_{GS}$ = 12V |
| Ls +$L_D$ | Total Inductance | — | 6.8 | — | nH | Measured from Drain lead (6mm /0.25in from package) to Source lead (6mm/0.25in from package) with Source wire internally bonded from Source pin to Drain pad |
| $C_{iss}$ | Input Capacitance | — | 4700 | — | pF | $V_{GS}$ = 0V |
| $C_{oss}$ | Output Capacitance | — | 850 | — | | $V_{DS}$ = 25V |
| $C_{rss}$ | Reverse Transfer Capacitance | — | 210 | — | | $f$ = 1.0MHz |

## Source-Drain Diode Ratings and Characteristics

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | — | — | 26 | A | |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | — | — | 104 | | |
| $V_{SD}$ | Diode Forward Voltage | — | — | 1.4 | V | $T_J$ = 25°C,$I_S$ = 26A, $V_{GS}$ = 0V④ |
| $t_{rr}$ | Reverse Recovery Time | — | — | 820 | ns | $T_J$ = 25°C, $I_F$ = 26A, $V_{DD}$ ≤ 30V |
| $Q_{rr}$ | Reverse Recovery Charge | — | — | 12 | µC | di/dt = 100A/µs ④ |
| $t_{on}$ | Forward Turn-On Time | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$+$L_D$) | | | | |

## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | — | — | 0.83 | °C/W |
| $R_{\theta CS}$ | Case -to-Sink | — | 0.21 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient (Typical socket mount) | — | — | 48 | |

**Footnotes:**

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

② $V_{DD}$ = 50V, starting $T_J$ = 25°C, L = 1.5mH, Peak $I_L$ = 26A, $V_{GS}$ = 12V

③ $I_{SD}$ ≤ 26A, di/dt ≤ 190A/µs, $V_{DD}$ ≤ 200V, $T_J$ ≤ 150°C

④ Pulse width ≤ 300 µs; Duty Cycle ≤ 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.** 160 volt $V_{DS}$ 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 IR Hirel 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

| | Parameter | 100 kRads (Si)[1] | | 300k - 1000 kRads (Si)[2] | | Units | Test Conditions |
|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Min. | Max. | | |
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 200 | —— | 200 | —— | V | $V_{GS}$ = 0V, $I_D$ = 1.0mA |
| $V_{GS(th)}$ | Gate Threshold Voltage | 2.0 | 4.0 | 1.25 | 4.5 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 1.0mA |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | —— | 100 | —— | 100 | nA | $V_{GS}$ = 20V |
| $I_{GSS}$ | Gate-to-Source Leakage Reverse | —— | -100 | —— | -100 | nA | $V_{GS}$ = -20V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | —— | 25 | —— | 50 | µA | $V_{DS}$ = 160V, $V_{GS}$ = 0V |
| $R_{DS(on)}$ | Static Drain-to-Source ④ On-State Resistance (TO-3) | —— | 0.10 | —— | 0.155 | Ω | $V_{GS}$ = 12V, $I_D$ = 16A |
| $R_{DS(on)}$ | Static Drain-to-Source ④ On-State Resistance (TO-254AA) | —— | 0.10 | —— | 0.155 | Ω | $V_{GS}$ = 12V, $I_D$ = 16A |
| $V_{SD}$ | Diode Forward Voltage ④ | —— | 1.4 | —— | 1.4 | V | $V_{GS}$ = 0V, $I_D$ = 26A |

1. Part number IRHM7250 (JANSR2N7269)
2. Part numbers IRHM3250 (JANSF2N7269), IRHM4250 (JANSG2N7269) and IRHM8250 (JANSH2N7269)

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

| Ion | LET (MeV/(mg/cm²)) | Energy (MeV) | Range (µm) | VDS (V) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | @VGS=0V | @VGS=-5V | @VGS=-10V | @VGS=-15V | @VGS=-20V |
| Cu | 28 | 285 | 43 | 190 | 180 | 170 | 125 | —— |
| Br | 36.8 | 305 | 39 | 100 | 100 | 100 | 50 | —— |

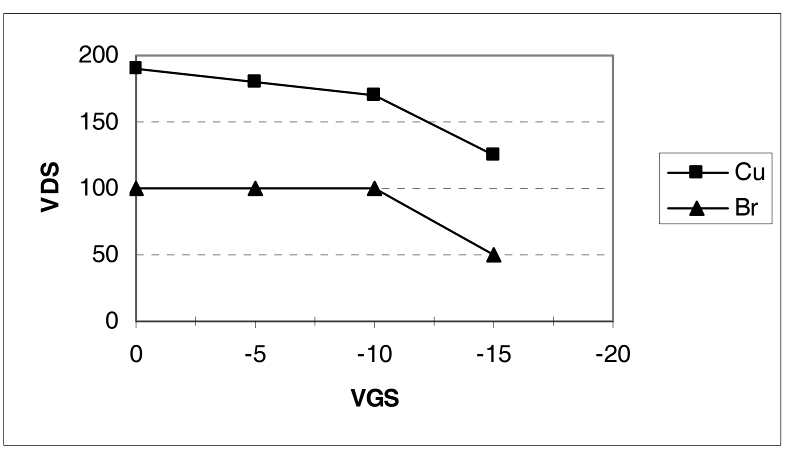



**Fig a.** Typical Single Event Effect, Safe Operating Area

For Footnotes, refer to the page 2.

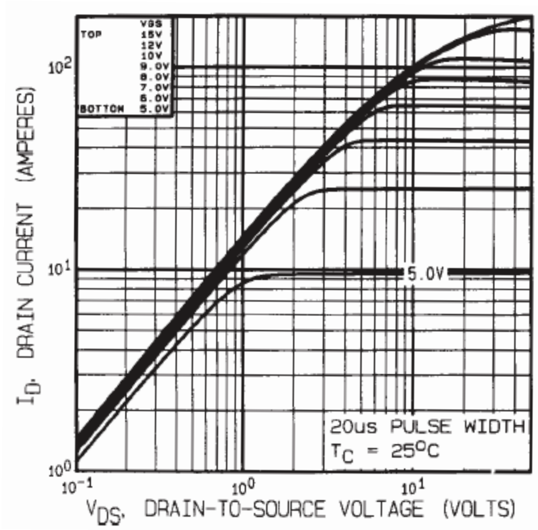



**Fig 1.** Typical Output Characteristics

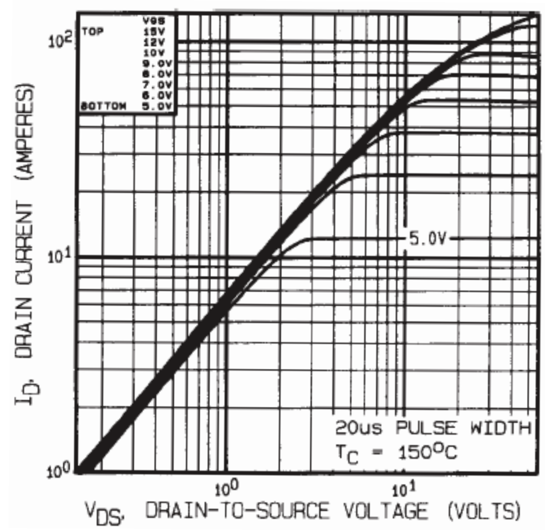



**Fig 2.** Typical Output Characteristics

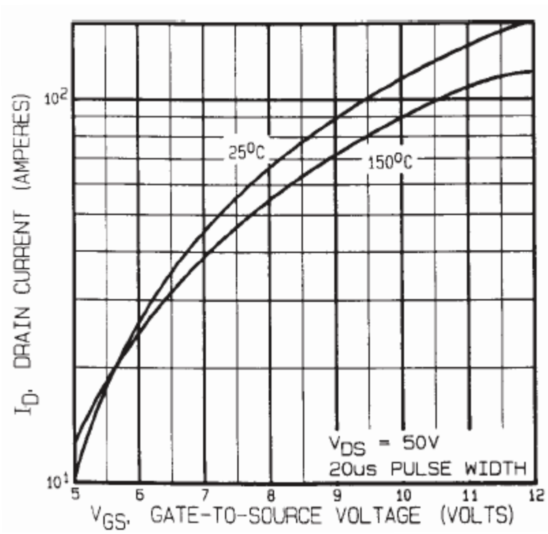



**Fig 3.** Typical Transfer Characteristics

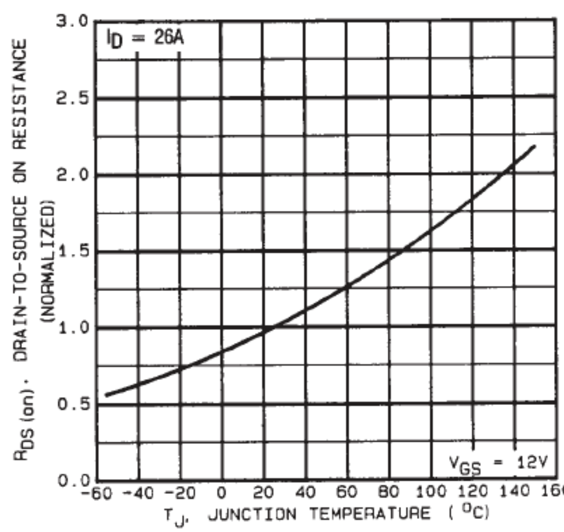



**Fig 4.** Normalized On-Resistance Vs. Temperature

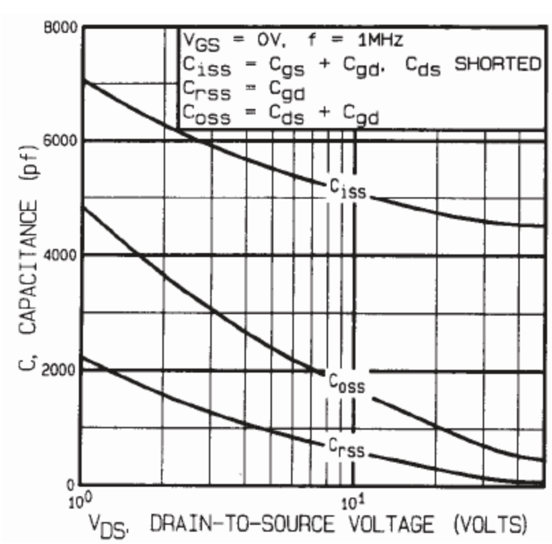



**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

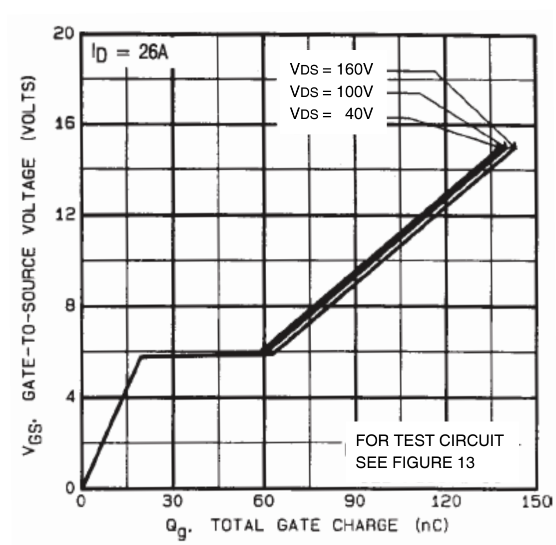



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

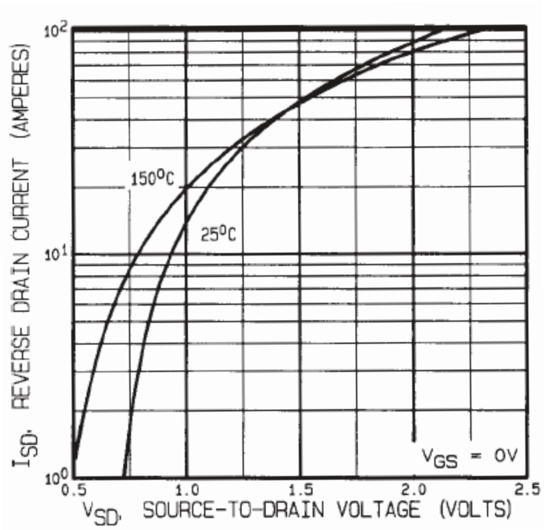



**Fig 7.** Typical Source-Drain Diode Forward Voltage

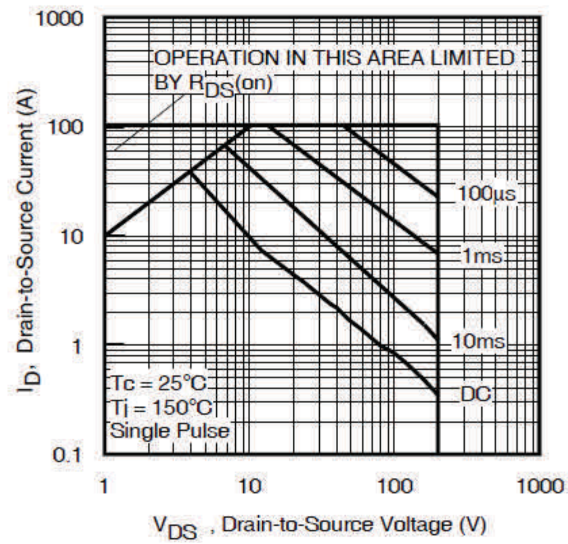



**Fig 8.** Maximum Safe Operating Area

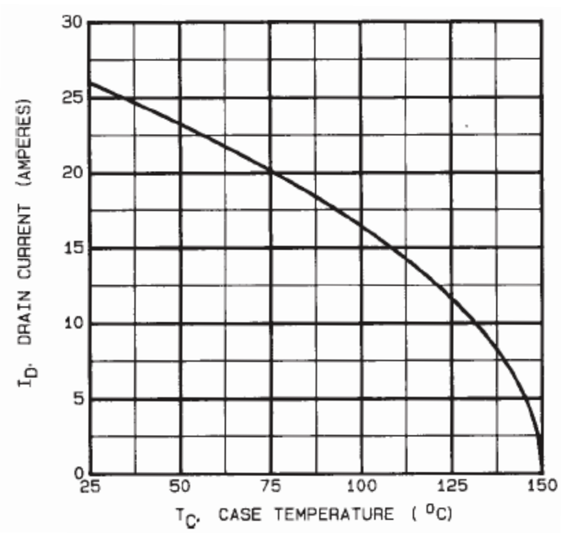



**Fig 9.** Maximum Drain Current Vs. Case Temperature

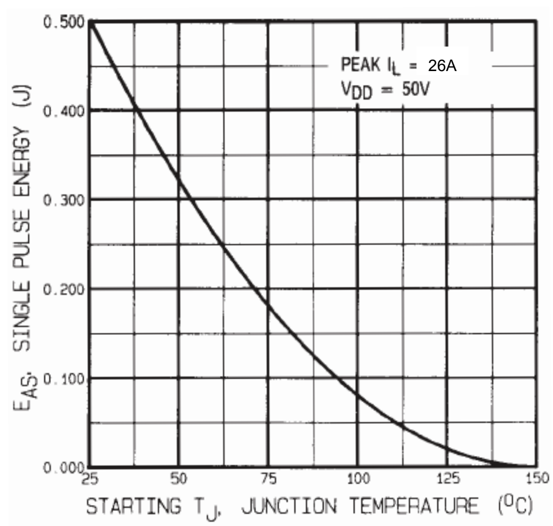



**Fig 10.** Maximum Avalanche Energy Vs. Drain Current

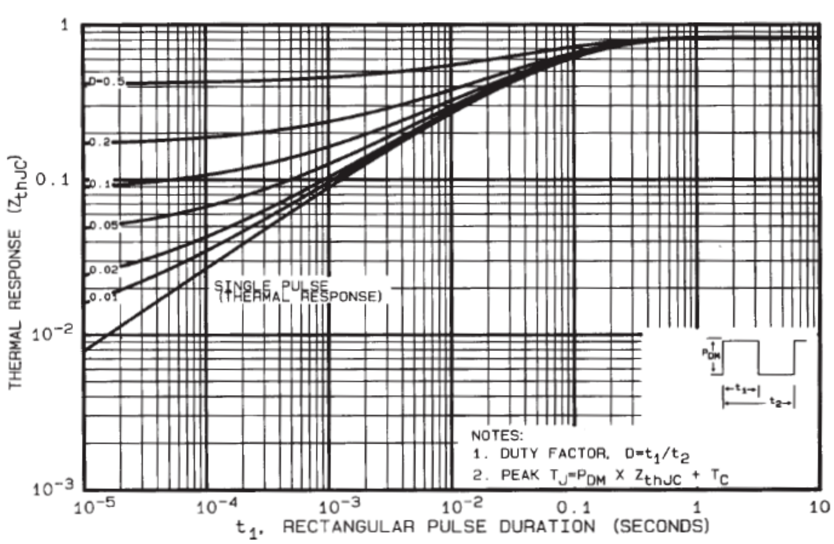



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

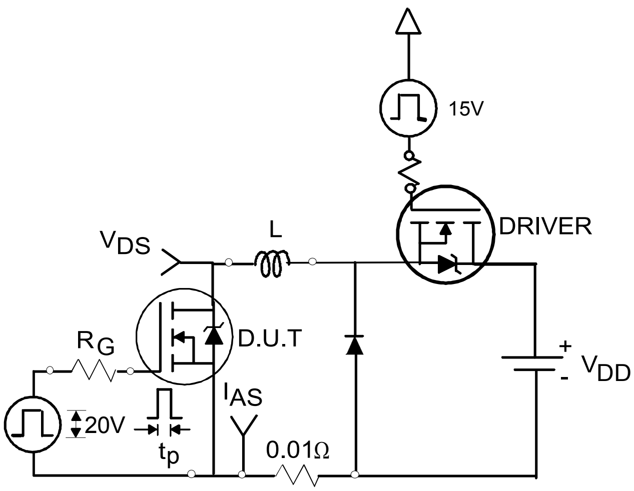



**Fig 12a.** Unclamped Inductive Test Circuit

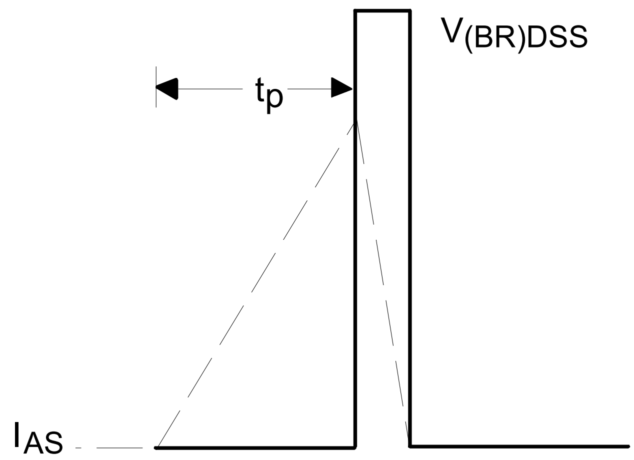



**Fig 12b.** Unclamped Inductive Waveforms

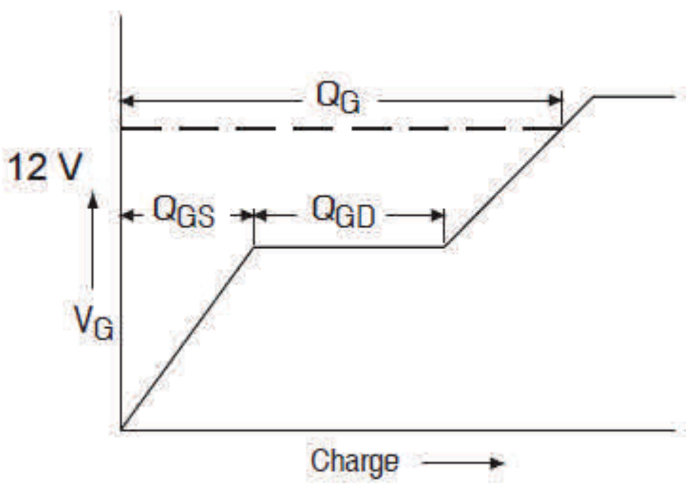



**Fig 13a.** Gate Charge Waveform

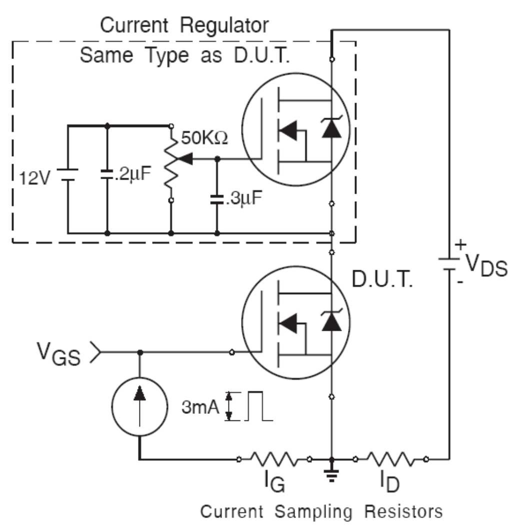



**Fig 13b.** Gate Charge Test Circuit

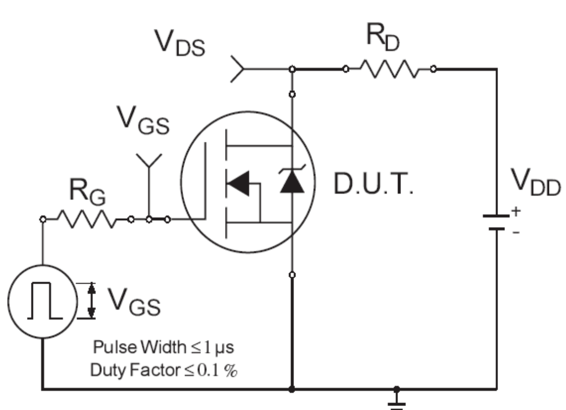



**Fig 14a.** Switching Time Test Circuit

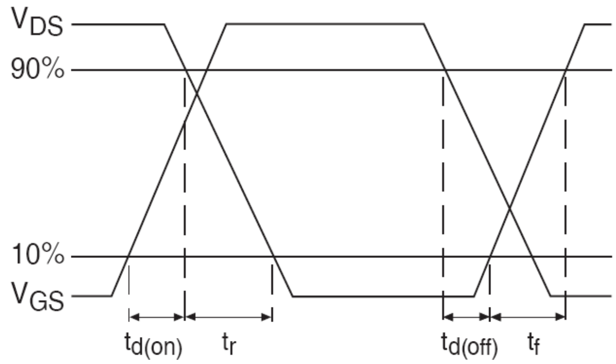
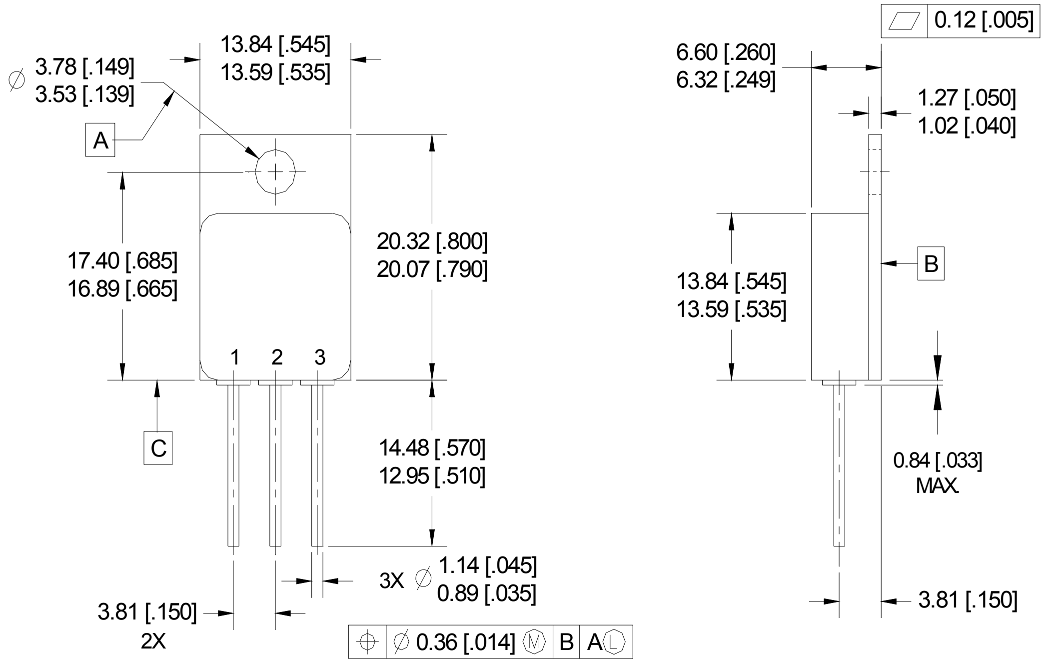



**Fig 14b.** Switching Time Waveforms

## Case Outline and Dimensions — TO-254AA




NOTES:
1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. CONTROLLING DIMENSION: INCH.
4. CONFORMS TO JEDEC OUTLINE TO-254AA.

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.

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