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INTERNATIONAL RECTIFIER

Data Sheet No. PD-9.509A

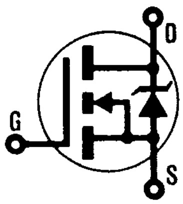
T-39-13

# INTERNATIONAL RECTIFIER IOR

## AVALANCHE AND dv/dt RATED
175°C OPERATING TEMPERATURE

# HEXFET® TRANSISTORS

# IRFZ34
# IRFZ35




## N-CHANNEL

### 60 Volt, 0.050 Ohm HEXFET TO-220AB Plastic Package

The HEXFET® technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry and unique processing of this latest "State of the Art" design achieves: very low on-state resistance combined with high transconductance; superior reverse energy and diode recovery dv/dt capability.

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters.

They are well suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high energy pulse circuits.

### Product Summary

| Part Number | $BV_{DSS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| IRFZ34 | 60V | 0.050Ω | 30A |
| IRFZ35 | 60V | 0.070Ω | 25A |

### FEATURES

- Avalanche Rated
- Dynamic dv/dt Rating
- Simple Drive Requirements
- Ease of Paralleling

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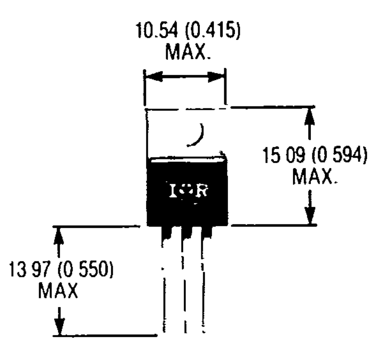
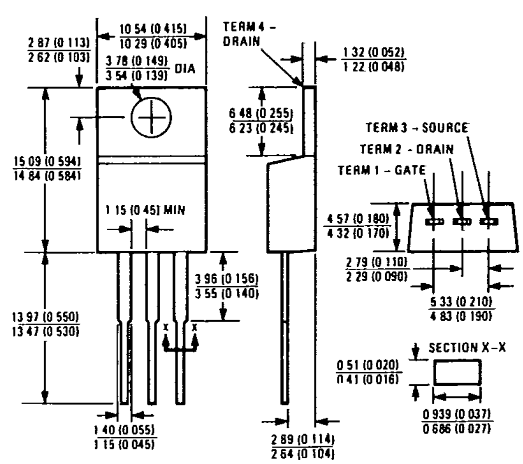
### CASE STYLE AND DIMENSIONS




Case Style TO-220AB
Dimensions in Millimeters and (Inches)

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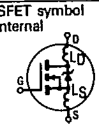
## Absolute Maximum Ratings

| Parameter | | IRFZ34 | IRFZ35 | Units |
|---|---|---|---|---|
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current | 30 | 25 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current | 21 | 18 | A |
| $I_{DM}$ | Pulsed Drain Current ① | 120 | 100 | A |
| $P_D$ @ $T_C$ = 25°C | Max. Power Dissipation | 90 | | W |
| | Linear Derating Factor | 0.60 | | W/K ⑤ |
| $V_{GS}$ | Gate-to-Source Voltage | ±20 | | V |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 19 (See Fig. 14) | | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | 4.5 (See Fig. 17) | | V/ns |
| $T_J$ $T_{STG}$ | Operating Junction Storage Temperature Range | −55 to 175 | | °C |
| | Lead Temperature | 300 (0.063 in. (1.6mm) from case for 10s) | | °C |

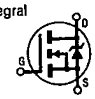
## Electrical Characteristics @ $T_J$ = 25°C (Unless Otherwise Specified)

| Parameter | | Type | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | IRFZ34 IRFZ35 | 60 | – | – | V | $V_{GS}$ = 0V, $I_D$ = 250 μA |
| $R_{DS(on)}$ | Static Drain-to-Source On-State Resistance ④ | IRFZ34 | – | 0.040 | 0.050 | Ω | $V_{GS}$ = 10V, $I_D$ = 18A |
| | | IRFZ35 | – | 0.050 | 0.070 | | |
| $I_{D(on)}$ | On-State Drain Current ④ | IRFZ34 | 30 | – | – | A | $V_{DS}$ > $I_{D(on)}$ x $R_{DS(on)}$ Max. $V_{GS}$ = 10V |
| | | IRFZ35 | 25 | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | ALL | 2.0 | – | 4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA |
| $g_{fs}$ | Forward Transconductance ④ | ALL | 9.3 | 14 | – | S (℧) | $V_{DS}$ ≥ 50V, $I_{DS}$ = 18A |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | ALL | – | – | 250 | μA | $V_{DS}$ = Max. Rating, $V_{GS}$ = 0V |
| | | | – | – | 1000 | | $V_{DS}$ = 0.8 x Max. Rating $V_{GS}$ = 0V, $T_J$ = 150°C |
| $I_{GSS}$ | Gate-to-Source Leakage Forward | ALL | – | – | 500 | nA | $V_{GS}$ = 20V |
| $I_{GSS}$ | Gate-to-Source Leakage Reverse | ALL | – | – | −500 | nA | $V_{GS}$ = −20V |
| $Q_g$ | Total Gate Charge | ALL | – | 32 | 47 | nC | $V_{GS}$ = 10V, $I_D$ = 30A |
| $Q_{gs}$ | Gate-to-Source Charge | ALL | – | 6.8 | 10 | nC | $V_{DS}$ = 0.8 x Max. Rating See Fig. 16 |
| $Q_{gd}$ | Gate-to-Drain ("Miller") Charge | | – | 15 | 22 | nC | (Independent of operating temperature) |
| $t_{d(on)}$ | Turn-On Delay Time | ALL | – | 14 | 21 | ns | $V_{DD}$ = 30V, $I_D$ ≈ 30A, $R_G$ = 12Ω |
| $t_r$ | Rise Time | ALL | – | 71 | 110 | ns | $R_D$ = 1.0Ω |
| $t_{d(off)}$ | Turn-Off Delay Time | ALL | – | 35 | 53 | ns | See Fig. 15 |
| $t_f$ | Fall Time | ALL | – | 53 | 80 | ns | (Independent of operating temperature) |
| $L_D$ | Internal Drain Inductance | ALL | – | 4.5 | – | nH | Measured from the drain lead, 6mm (0.25 in.) from package to center of die; Modified MOSFET symbol showing the internal inductances |
| $L_S$ | Internal Source Inductance | ALL | – | 7.5 | – | nH | Measured from the source lead, 6mm (0.25 in.) from package to source bonding pad |
| $C_{iss}$ | Input Capacitance | ALL | – | 1300 | – | pF | $V_{GS}$ = 0V, $V_{DS}$ = 25V |
| $C_{oss}$ | Output Capacitance | ALL | – | 650 | – | pF | f = 1.0 MHz |
| $C_{rss}$ | Reverse Transfer Capacitance | ALL | – | 100 | – | pF | See Fig. 10 |



## Source-Drain Diode Ratings and Characteristics

| | Parameter | Type | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | ALL | – | – | 30 | A | Modified MOSFET symbol showing the integral Reverse p-n junction rectifier |
| $I_{SM}$ | Pulsed Source Current (Body Diode) ① | ALL | – | – | 120 | A | |
| $V_{SD}$ | Diode Forward Voltage ④ | ALL | – | – | 1.6 | V | $T_J$ = 25°C, $I_S$ = 30A, $V_{GS}$ = 0V |
| $t_{rr}$ | Reverse Recovery Time | ALL | 50 | 100 | 220 | ns | $T_J$ = 25°C, $I_F$ = 30A, di/dt = 100 A/μs |
| $Q_{RR}$ | Reverse Recovery Charge | ALL | 1.9 | 4.2 | 9.6 | μC | |
| $t_{on}$ | Forward Turn-On Time | ALL | Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S + L_D$ | | | | |




## Thermal Resistance

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction-to-Case | ALL | – | – | 1.7 | K/W ⑤ | |
| $R_{thCS}$ | Case-to-Sink | ALL | – | 0.50 | – | K/W ⑤ | Mounting surface flat, smooth, and greased |
| $R_{thJA}$ | Junction-to-Ambient | ALL | – | – | 80 | K/W ⑤ | Typical socket mount |

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① Repetitive Rating; Pulse width limited by maximum junction temperature (see figure 5) Refer to current HEXFET reliability report

② @ $V_{DD}$ = 25V, Starting $T_J$ = 25°C, L = 50μH, $R_G$ = 25Ω, Peak $I_L$ = 21A

③ $I_{SD} \le$ 21A di/dt ≤ 200 A/μs, $V_{DD} \le BV_{DSS}$, $T_J \le$ 175°C Suggested $R_G$ = 12Ω

④ Pulse width ≤ 300 μs; Duty Cycle ≤ 2%

⑤ K/W = °C/W W/K = W/°C

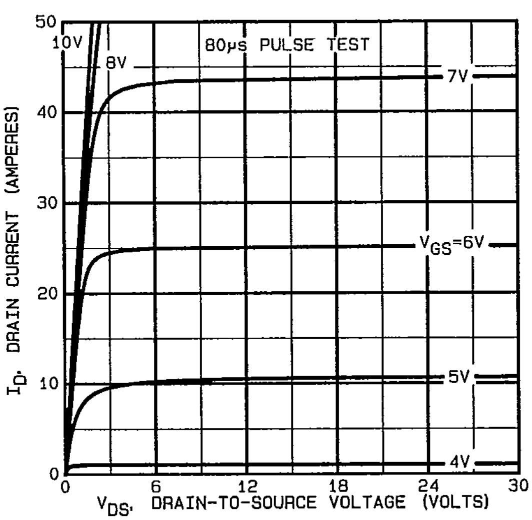


**Fig. 1 — Typical Output Characteristics**

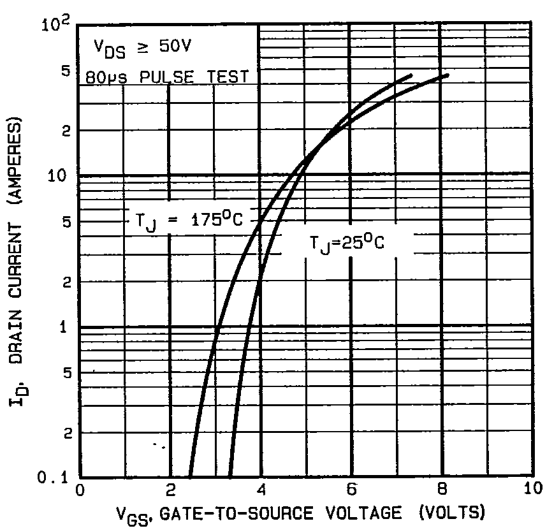


**Fig. 2 — Typical Transfer Characteristics**

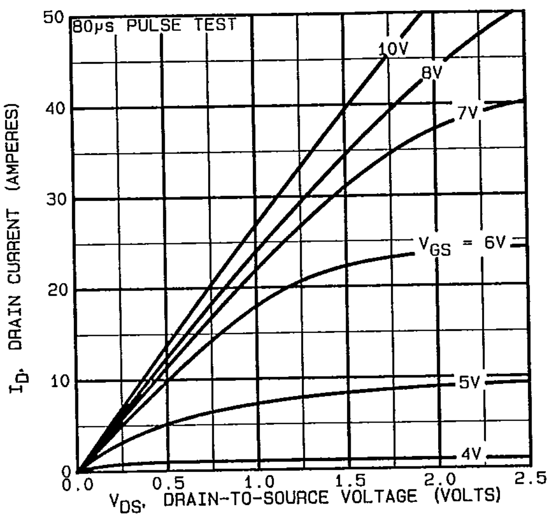


Fig. 3 — Typical Saturation Characteristics

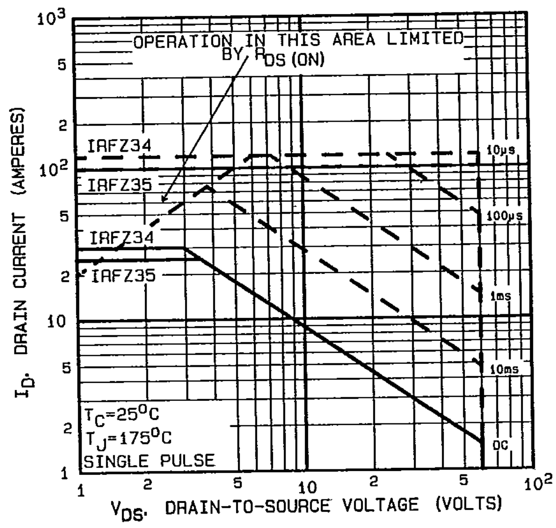


Fig. 4 — Maximum Safe Operating Area

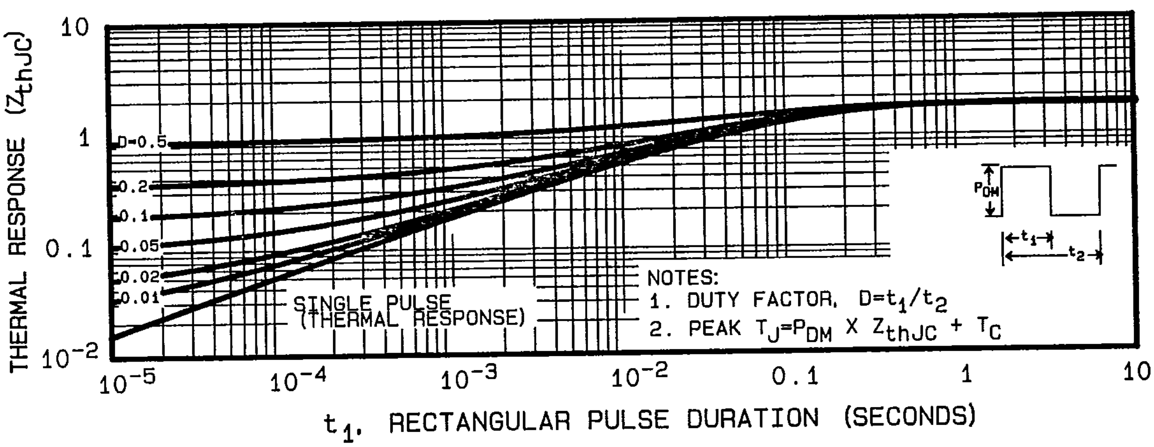


Fig. 5 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

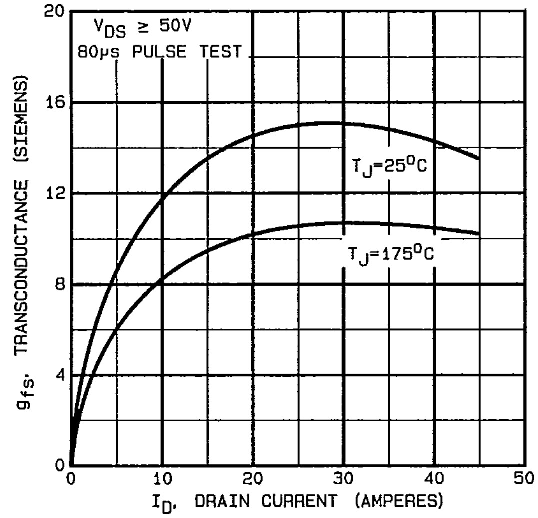


**Fig. 6 — Typical Transconductance Vs. Drain Current**

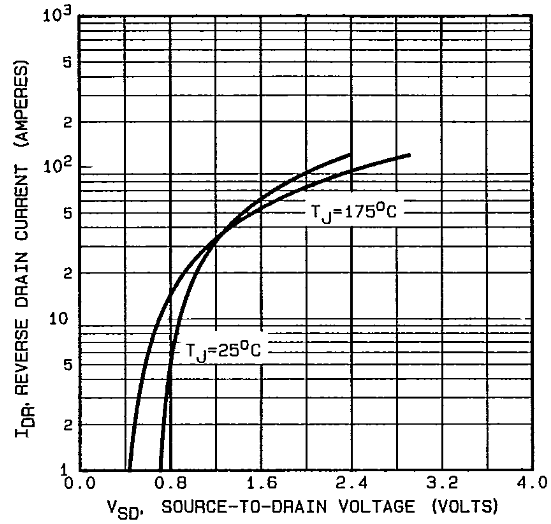


**Fig. 7 — Typical Source-Drain Diode Forward Voltage**

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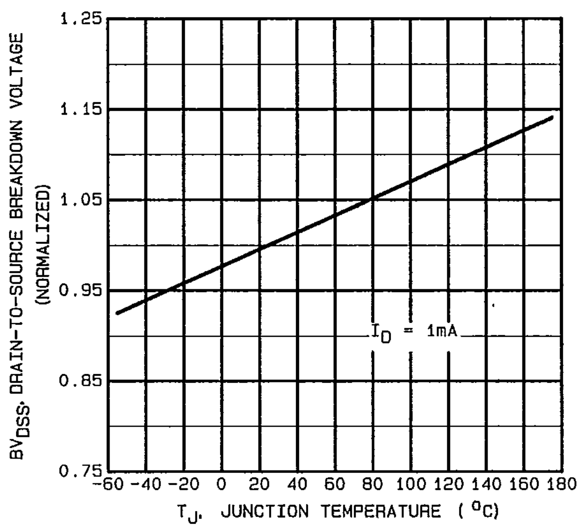


**Fig. 8 — Breakdown Voltage Vs. Temperature**

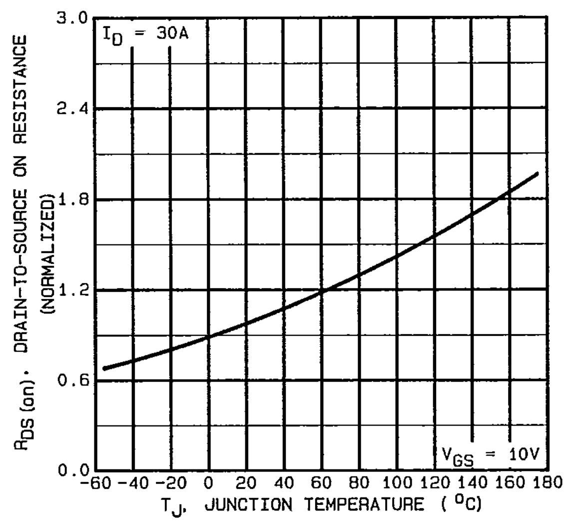


**Fig. 9 — Normalized On-Resistance Vs. Temperature**

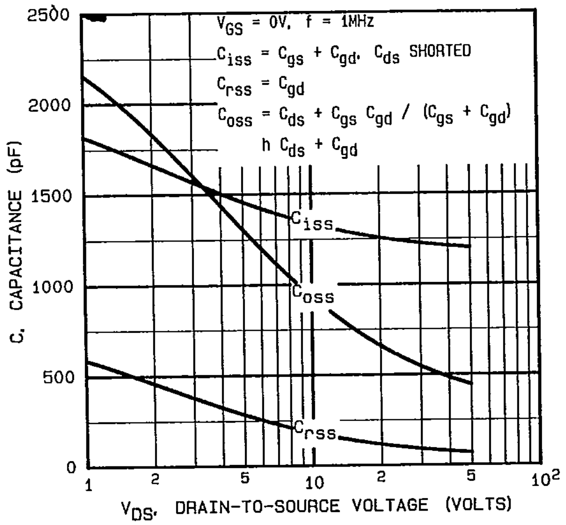


Fig. 10 — Typical Capacitance Vs. Drain-to-Source Voltage

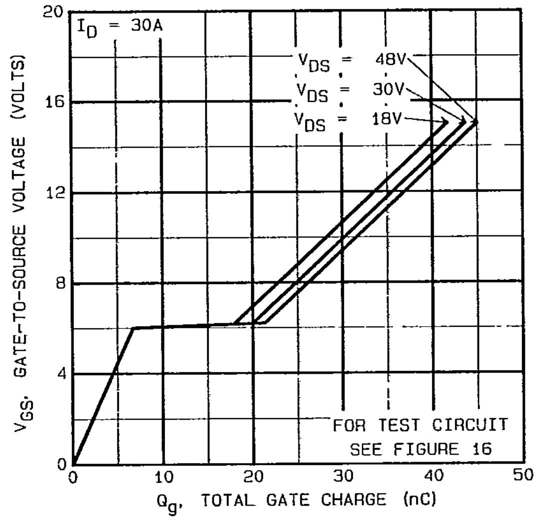


Fig. 11 — Typical Gate Charge Vs. Gate-to-Source Voltage

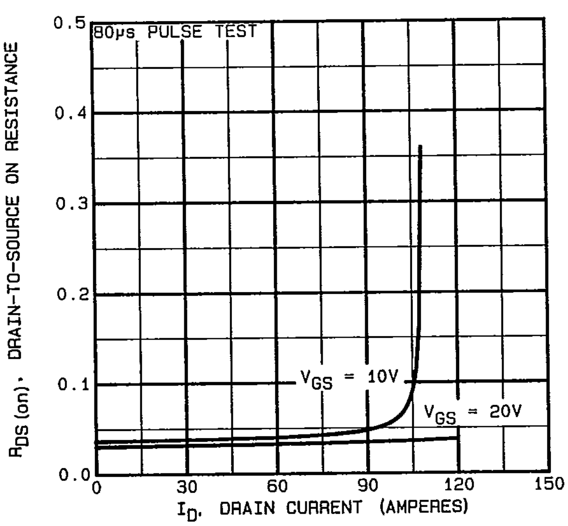


Fig. 12 — Typical On-Resistance Vs. Drain Current

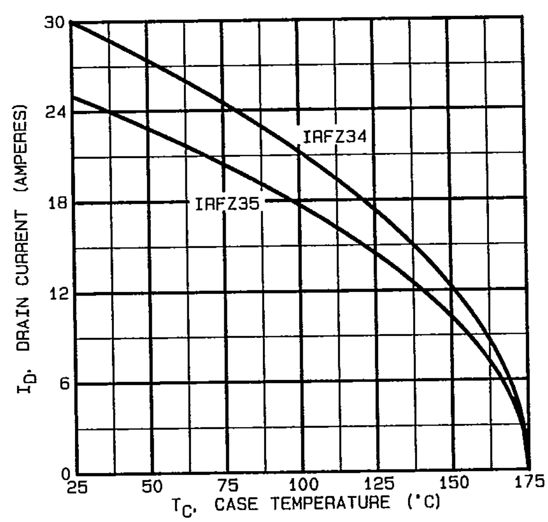


Fig. 13 — Maximum Drain Current Vs. Case Temperature

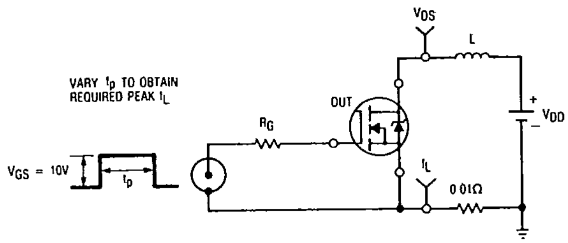


Fig. 14a — Unclamped Inductive Test Circuit

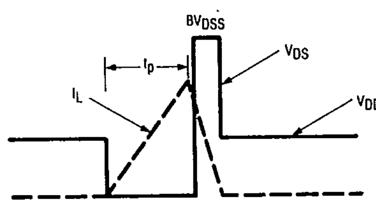


Fig. 14b — Unclamped Inductive Waveforms

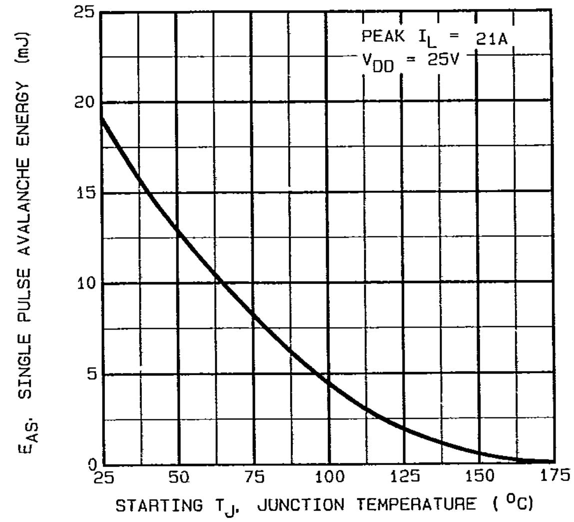


Fig. 14c — Maximum Avalanche Energy Vs. Starting Junction Temperature

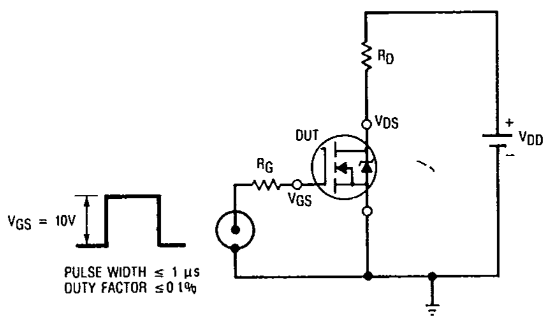


Fig. 15a — Switching Time Test Circuit

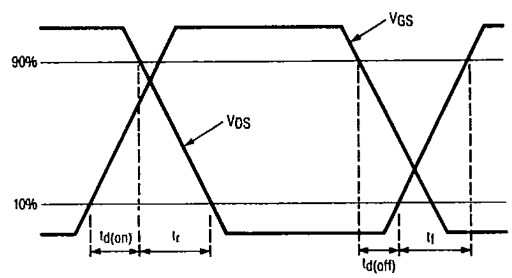


Fig. 15b — Switching Time Waveforms

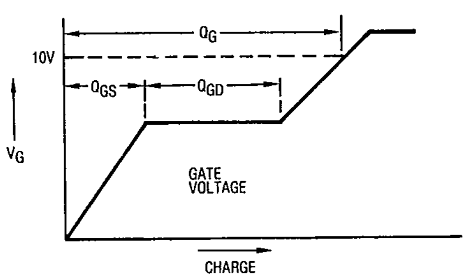


Fig. 16a — Basic Gate Charge Waveform

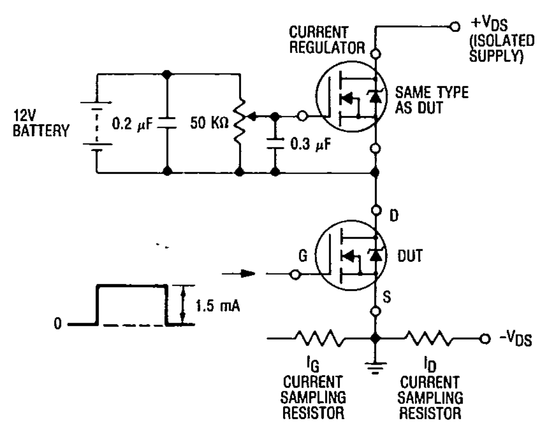


Fig. 16b — Gate Charge Test Circuit

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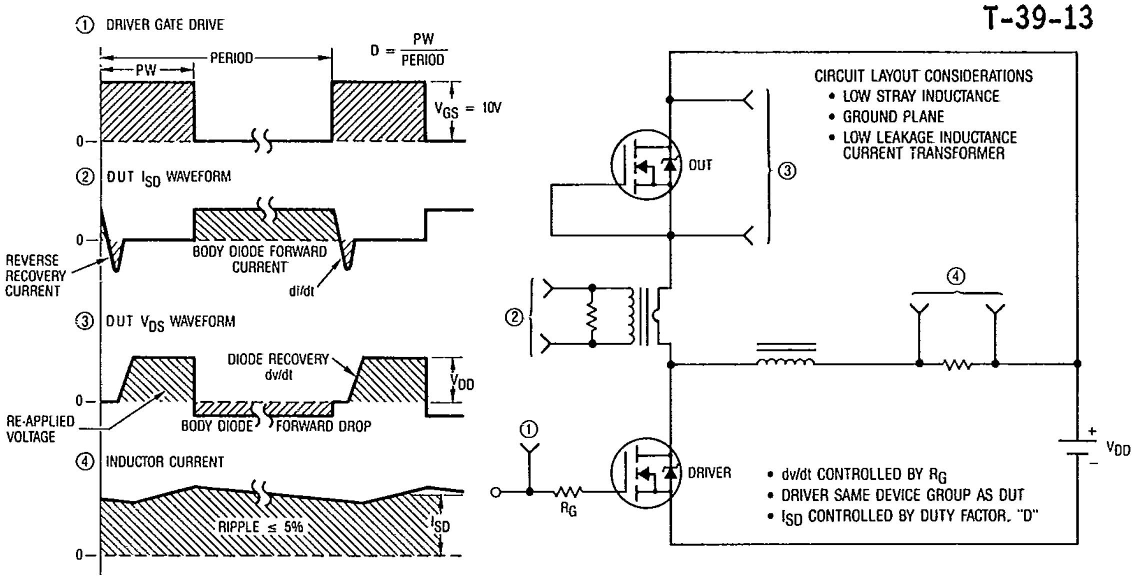


**Fig. 17 — Peak Diode Recovery dv/dt Test Circuit**

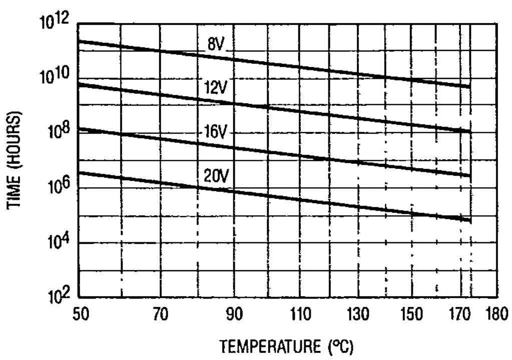


***Fig. 18 — Typical Time to Accumulated 1% Gate Failure**

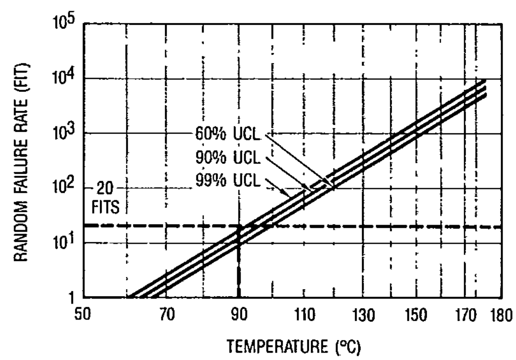


***Fig. 19 — Typical High Temperature Reverse Bias (HTRB) Failure Rate**

*The data shown is correct as of January 15, 1987. This information is updated on a quarterly basis; for the latest reliability data, please contact your local IR field office.