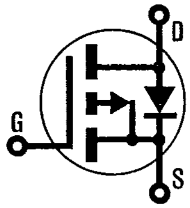
INTERNATIONAL RECTIFIER IOR

# HEXFET® TRANSISTORS IRF9630 IRF9631 IRF9632 IRF9633

## P-CHANNEL 200 VOLT POWER MOSFETs




TO-220

## -200 Volt, 0.8 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 the HEXFET design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness.

The P-Channel HEXFETs are designed for applications which require the convenience of reverse polarity operation. They retain all of the features of the more common N-Channel HEXFETs such as voltage control, very fast switching, ease of paralleling, and excellent temperature stability. The P-Channel IRF9630 device is an approximate electrical complement to the N-Channel IRF620 HEXFET.

P-Channel HEXFETs are intended for use in power stages where complementary symmetry with N-Channel devices offers circuit simplification. They are also very useful in drive stages because of the circuit versatility offered by the reverse polarity connection. Applications include motor control, audio amplifiers, switched mode converters, control circuits and pulse amplifiers.

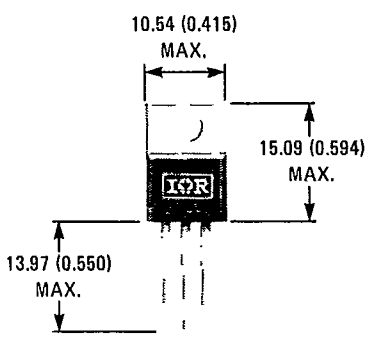
## Product Summary

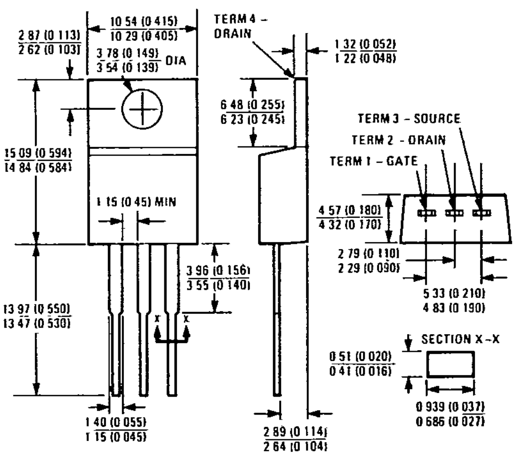
| Part Number | $V_{DS}$ | $R_{DS(on)}$ | $I_D$ |
|---|---|---|---|
| IRF9630 | -200V | 0.8Ω | -6.5A |
| IRF9631 | -150V | 0.8Ω | -6.5A |
| IRF9632 | -200V | 1.2Ω | -5.5A |
| IRF9633 | -150V | 1.2Ω | -5.5A |

## Features:

- P-Channel Versatility
- Compact Plastic Package
- Fast Switching
- Low Drive Current
- Ease of Paralleling
- Excellent Temperature Stability

## CASE STYLE AND DIMENSIONS




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

# IRF9630, IRF9631, IRF9632, IRF9633 Devices

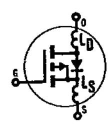
## Absolute Maximum Ratings

| | Parameter | IRF9630 | IRF9631 | IRF9632 | IRF9633 | Units |
|---|---|---|---|---|---|---|
| $V_{DS}$ | Drain - Source Voltage ① | -200 | -150 | -200 | -150 | V |
| $V_{DGR}$ | Drain - Gate Voltage ($R_{GS}$ = 20 kΩ) ① | -200 | -150 | -200 | -150 | V |
| $I_D$ @ $T_C$ = 25°C | Continuous Drain Current | -6.5 | -6.5 | -5.5 | -5.5 | A |
| $I_D$ @ $T_C$ = 100°C | Continuous Drain Current | -4.0 | -4.0 | -3.5 | -3.5 | A |
| $I_{DM}$ | Pulsed Drain Current ③ | -26 | -26 | -22 | -22 | A |
| $V_{GS}$ | Gate - Source Voltage | ± 20 | | | | V |
| $P_D$ @ $T_C$ = 25°C | Max. Power Dissipation | 75 (See Fig. 14) | | | | W |
| | Linear Derating Factor | 0.6 (See Fig. 14) | | | | W/K④ |
| $I_{LM}$ | Inductive Current, Clamped | (See Fig. 15 and 16) L = 100μH<br>-26 | -26 | -22 | -22 | A |
| $T_J$<br>$T_{stg}$ | Operating Junction and<br>Storage Temperature Range | -55 to 150 | | | | °C |
| | Lead Temperature | 300 (0.063 in. (1.6mm) from case for 10s) | | | | °C |

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

| | Parameter | Type | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain - Source Breakdown Voltage | IRF9630<br>IRF9632 | -200 | – | – | V | $V_{GS}$ = 0V |
| | | IRF9631<br>IRF9633 | -150 | – | – | V | $I_D$ = -250μA |
| $V_{GS(th)}$ | Gate Threshold Voltage | ALL | -2.0 | – | -4.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250μA |
| $I_{GSS}$ | Gate-Source Leakage Forward | ALL | – | – | -500 | nA | $V_{GS}$ = -20V |
| $I_{GSS}$ | Gate-Source Leakage Reverse | ALL | – | – | 500 | nA | $V_{GS}$ = 20V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | ALL | – | – | -250 | μA | $V_{DS}$ = Max. Rating, $V_{GS}$ = 0V |
| | | | – | – | -1000 | μA | $V_{DS}$ = Max. Rating x 0.8, $V_{GS}$ = 0V, $T_C$ = 125°C |
| $I_{D(on)}$ | On-State Drain Current ② | IRF9630<br>IRF9631 | -6.5 | – | – | A | $V_{DS}$ > $I_{D(on)}$ x $R_{DS(on)}$ max., $V_{GS}$ = -10V |
| | | IRF9632<br>IRF9633 | -5.5 | – | – | A | |
| $R_{DS(on)}$ | Static Drain-Source On-State Resistance ② | IRF9630<br>IRF9631 | – | 0.5 | 0.8 | Ω | $V_{GS}$ = -10V, $I_D$ = -3.5A |
| | | IRF9632<br>IRF9633 | – | 0.8 | 1.2 | Ω | |
| $g_{fs}$ | Forward Transconductance ② | ALL | 2.2 | 3.5 | – | S (℧) | $V_{DS}$ > $I_{D(on)}$ x $R_{DS(on)}$ max., $I_D$ = -3.5A |
| $C_{iss}$ | Input Capacitance | ALL | – | 550 | 650 | pF | $V_{GS}$ = 0V, $V_{DS}$ = -25V, f = 1.0 MHz<br>See Fig. 10 |
| $C_{oss}$ | Output Capacitance | ALL | – | 170 | 300 | pF | |
| $C_{rss}$ | Reverse Transfer Capacitance | ALL | – | 50 | 90 | pF | |
| $t_{d(on)}$ | Turn-On Delay Time | ALL | – | 30 | 50 | ns | $V_{DD}$ = 0.5 $BV_{DSS}$, $I_D$ = -3.5A, $Z_o$ = 50Ω<br>See Fig. 17<br>(MOSFET switching times are essentially independent of operating temperature.) |
| $t_r$ | Rise Time | ALL | – | 50 | 100 | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | ALL | – | 50 | 100 | ns | |
| $t_f$ | Fall Time | ALL | – | 40 | 80 | ns | |
| $Q_g$ | Total Gate Charge (Gate-Source Plus Gate-Drain) | ALL | – | 31 | 45 | nC | $V_{GS}$ = -15V, $I_D$ = -8.0A, $V_{DS}$ = 0.8 Max. Rating. See Fig. 18 for test circuit. (Gate charge is essentially independent of operating temperature.) |
| $Q_{gs}$ | Gate-Source Charge | ALL | – | 18 | – | nC | |
| $Q_{gd}$ | Gate-Drain ("Miller") Charge | ALL | – | 13 | – | nC | |
| $L_D$ | Internal Drain Inductance | ALL | – | 3.5 | – | nH | Measured from the contact screw on tab to center of die. |
| | | | – | 4.5 | – | nH | Measured from the drain lead, 6mm (0.25 in.) from package to center of die. |
| $L_S$ | Internal Source Inductance | ALL | – | 7.5 | – | nH | Measured from the source lead, 6mm (0.25 in.) from package to source bonding pad. |

Modified MOSFET symbol showing the internal device inductances.




## Thermal Resistance

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction-to-Case | ALL | – | – | 1.67 | K/W④ | |
| $R_{thCS}$ | Case-to-Sink | ALL | – | 1.0 | – | K/W④ | Mounting surface flat, smooth, and greased. |
| $R_{thJA}$ | Junction-to-Ambient | ALL | – | – | 80 | K/W④ | Typical socket mount |

## Source-Drain Diode Ratings and Characteristics

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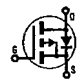
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | IRF9630 IRF9631 | — | — | -6.5 | A | Modified MOSFET symbol showing the integral reverse P-N junction rectifier.  |
| | | IRF9632 IRF9633 | — | — | -5.5 | A | |
| $I_{SM}$ | Pulse Source Current (Body Diode) ③ | IRF9630 IRF9631 | — | — | -26 | A | |
| | | IRF9632 IRF9633 | — | — | -22 | A | |
| $V_{SD}$ | Diode Forward Voltage ② | IRF9630 IRF9631 | — | — | -6.5 | V | $T_C$ = 25°C, $I_S$ = -6.5A, $V_{GS}$ = 0V |
| | | IRF9632 IRF9633 | — | — | -6.3 | V | $T_C$ = 25°C, $I_S$ = -5.5A, $V_{GS}$ = 0V |
| $t_{rr}$ | Reverse Recovery Time | ALL | — | 400 | — | ns | $T_J$ = 150°C, $I_F$ = -6.5A, $dI_F/dt$ = 100 A/μs |
| $Q_{RR}$ | Reverse Recovered Charge | ALL | — | 2.6 | — | μC | $T_J$ = 150°C, $I_F$ = -6.5A, $dI_F/dt$ = 100 A/μs |
| $t_{on}$ | Forward Turn-on Time | ALL | Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S + L_D$. | | | | |

① $T_J$ = 25°C to 150°C. ② Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%. ③ Repetitive Rating: Pulse width limited by max. junction temperature. See Transient Thermal Impedance Curve (Fig. 5).

④ K/W = °C/W
W/K = W/°C

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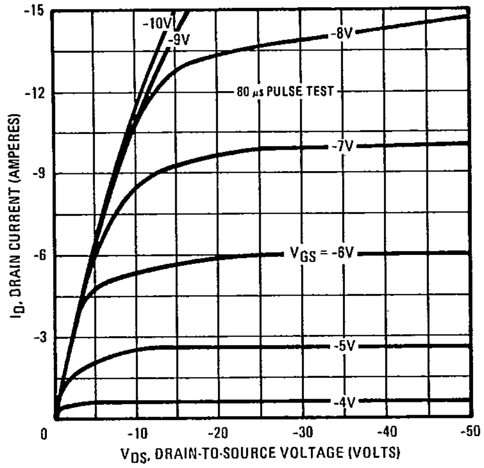


Fig. 1 — Typical Output Characteristics

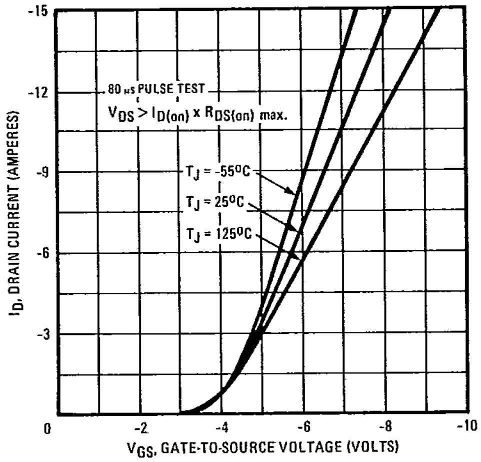


Fig. 2 — Typical Transfer Characteristics

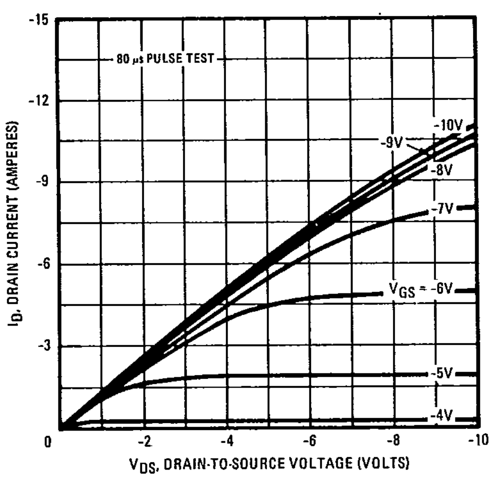


Fig. 3 — Typical Saturation Characteristics

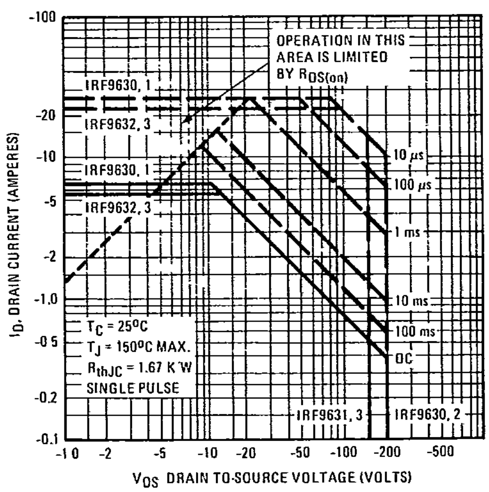


Fig. 4 — Maximum Safe Operating Area

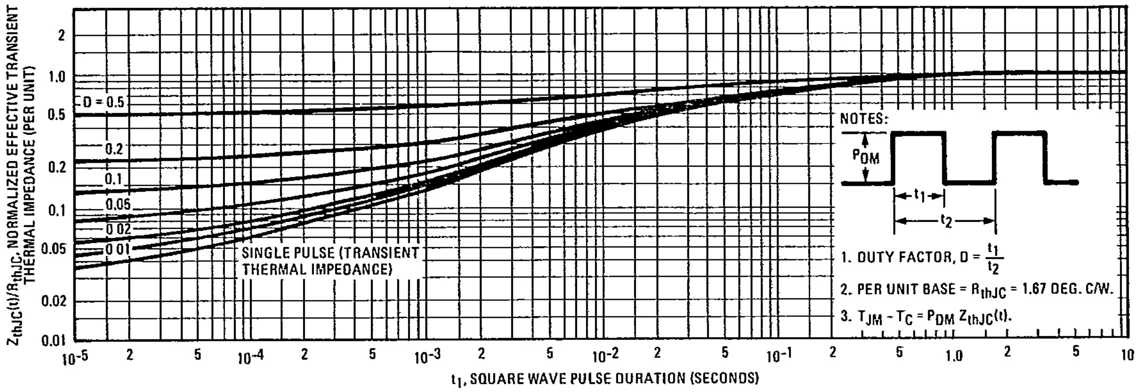


Fig. 5 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

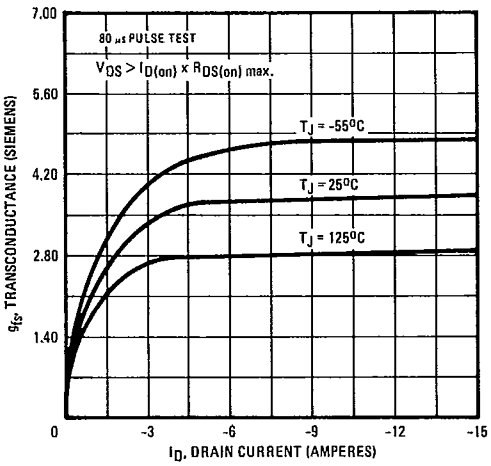


Fig. 6 — Typical Transconductance Vs. Drain Current

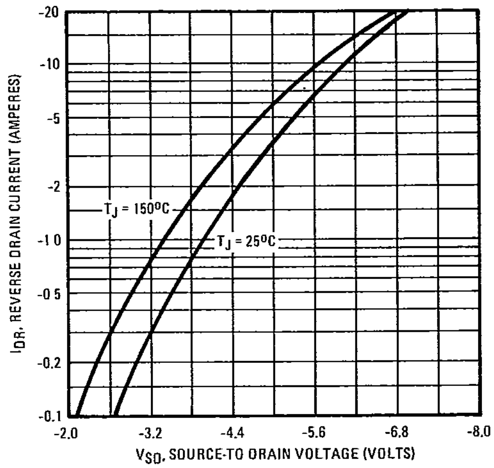


Fig. 7 — Typical Source-Drain Diode Forward Voltage

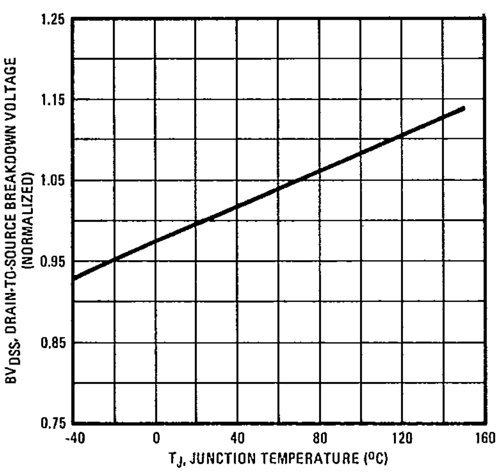


Fig. 8 — Breakdown Voltage Vs. Temperature

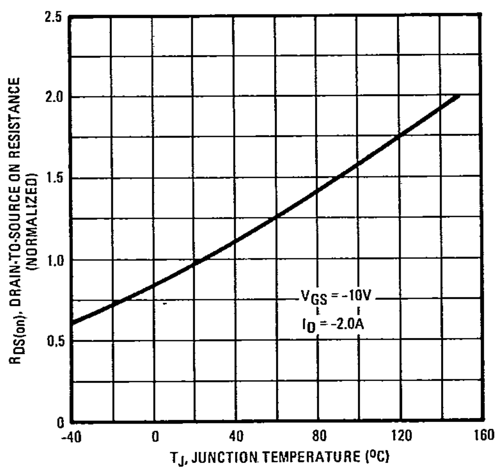


Fig. 9 — Normalized On-Resistance Vs. Temperature

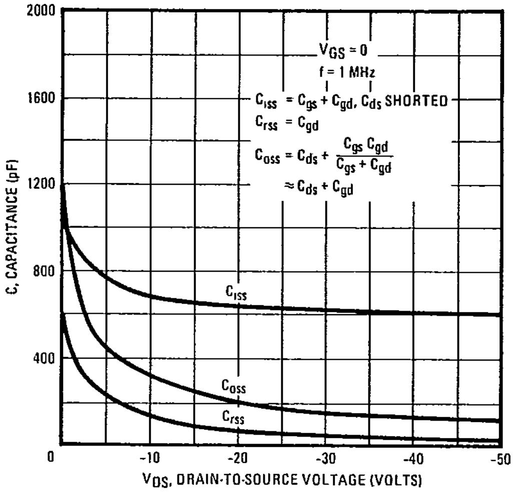


**Fig. 10 — Typical Capacitance Vs. Drain-to-Source Voltage**

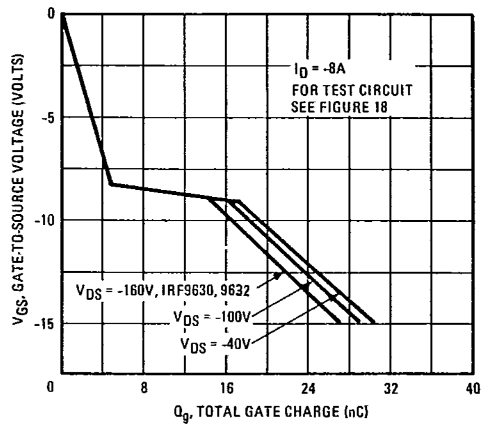


**Fig. 11 — Typical Gate Charge Vs. Gate-to-Source Voltage**

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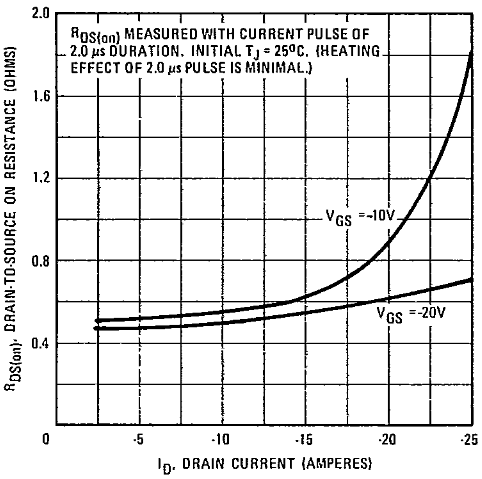


**Fig. 12 — Typical On-Resistance Vs. Drain Current**

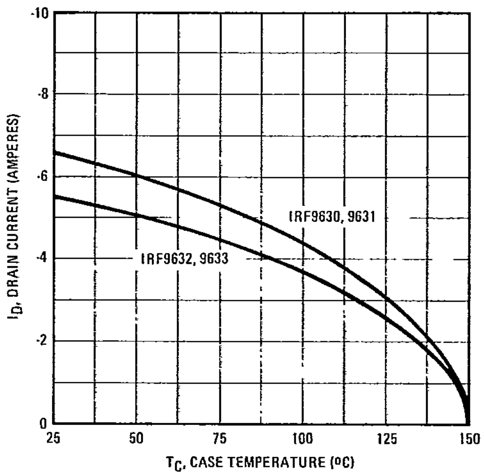


**Fig. 13 — Maximum Drain Current Vs. Case Temperature**

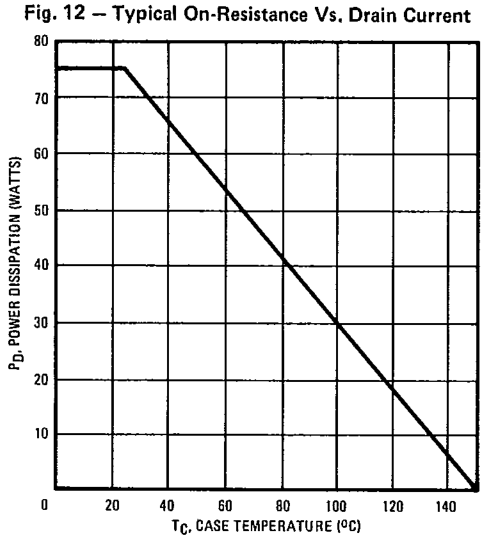


**Fig. 14 — Power Vs. Temperature Derating Curve**

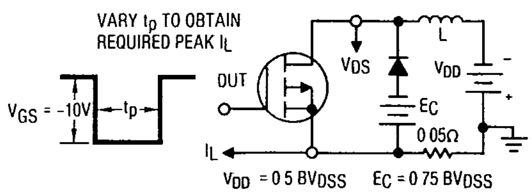


**Fig. 15 — Clamped Inductive Test Circuit**

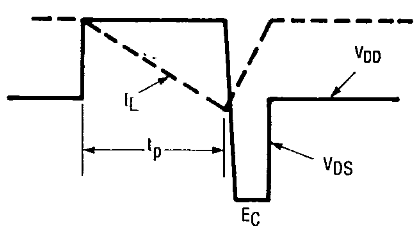


**Fig. 16 — Clamped Inductive Waveforms**

11E D 4855452 0008617 0
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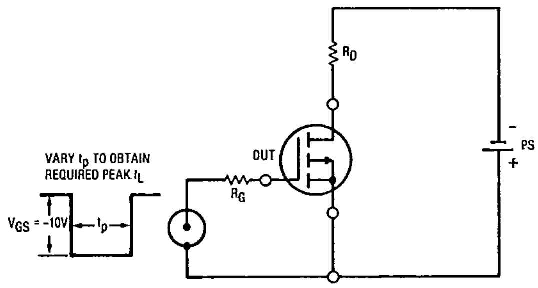


**Fig. 17 — Switching Time Test Circuit**

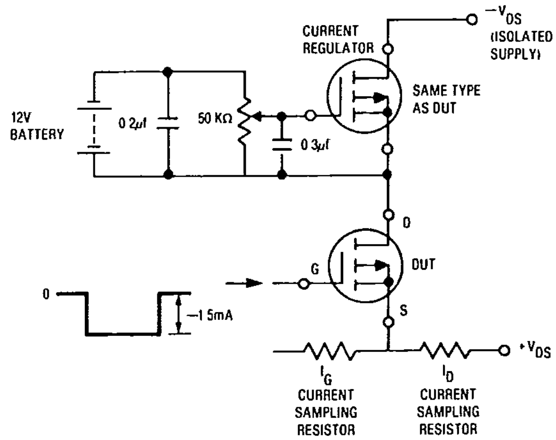


**Fig. 18 — Gate Charge Test Circuit**

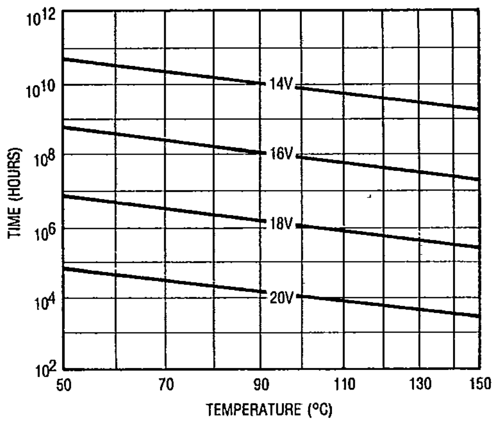


***Fig. 19 — Typical Time to Accumulated 1% Failure**

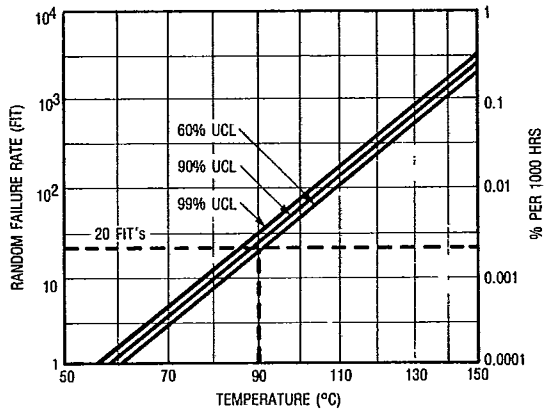


***Fig. 20 — Typical High Temperature Reverse Bias (HTRB) Failure Rate**

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