

T-39-13

INTERNATIONAL RECTIFIER

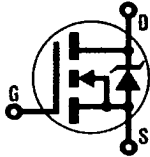
INTERNATIONAL RECTIFIER 

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

**HEXFET® TRANSISTORS**

**IRF034**

**IRF035**



**N-CHANNEL**

**60 Volt, 0.050 Ohm HEXFET**  
**TO-204AE (TO-3) Hermetic 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.

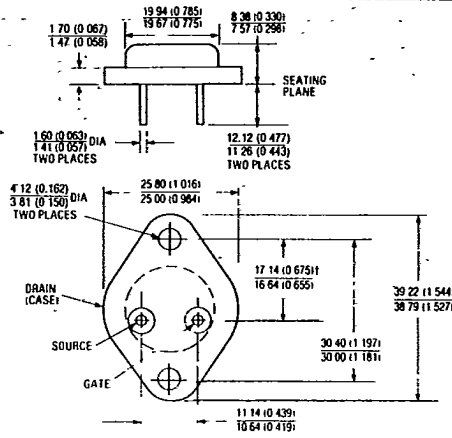
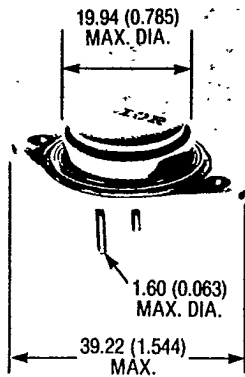
**Product Summary**

Part Number	BV <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
IRF034	60V	0.050Ω	30A
IRF035	60V	0.070Ω	25A

**FEATURES:**

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

**CASE STYLE AND DIMENSIONS**



Conforms to JEDEC Outline TO-204AE (Modified TO-3)  
Dimensions in Millimeters and (Inches)

TO-3

Absolute Maximum Ratings


Parameter	IRF034	IRF035	Units
$I_D @ T_C = 25^\circ\text{C}$ Continuous Drain Current	30	25	A
$I_D @ T_C = 100^\circ\text{C}$ Continuous Drain Current	21	18	A
$I_{DM}$ Pulsed Drain Current (1)	120	100	A
$P_D @ T_C = 25^\circ\text{C}$ Max. Power Dissipation	90		W
Linear Derating Factor	0.60		W/K (1)
$V_{GS}$ Gate-to-Source Voltage	$\pm 20$		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
$T_J$ Operating Junction	-55 to 175		$^\circ\text{C}$
$T_{STG}$ Storage Temperature Range			
Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)		$^\circ\text{C}$

Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (Unless Otherwise Specified)

Parameter	Type	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$ Drain-to-Source Breakdown Voltage	IRF034 IRF035	60	—	—	V	$V_{GS} = 0V, I_D = 250 \mu\text{A}$
$R_{DS(on)}$ Static Drain-to-Source On-State Resistance (4)	IRF034 IRF035	—	0.040 0.050	0.050 0.070	$\Omega$	$V_{GS} = 10V, I_D = 18A$
$I_{D(on)}$ On-State Drain Current (4)	IRF034 IRF035	30 25	—	—	A	$V_{DS} > I_{D(on)} \times R_{DS(on)}$ Max. $V_{GS} = 10V$
$V_{GS(th)}$ Gate Threshold Voltage	ALL	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$
$g_{fs}$ Forward Transconductance (4)	ALL	9.3	14	—	S (5)	$V_{DS} \geq 50V, I_{DS} = 18A$
$I_{DSS}$ Zero Gate Voltage Drain Current	ALL	—	—	250 1000	$\mu\text{A}$	$V_{DS} = \text{Max. Rating}, V_{GS} = 0V$ $V_{DS} = 0.8 \times \text{Max. Rating}$ $V_{GS} = 0V, T_J = 150^\circ\text{C}$
$I_{GSS}$ Gate-to-Source Leakage Forward	ALL	—	—	100	nA	$V_{GS} = 20V$
$I_{GSS}$ Gate-to-Source Leakage Reverse	ALL	—	—	-100	nA	$V_{GS} = -20V$
$Q_g$ Total Gate Charge	ALL	—	32	47	nC	$V_{GS} = 10V, I_D = 30A$ $V_{DS} = 0.8 \times \text{Max. Rating}$ See Fig. 16
$Q_{gs}$ Gate-to-Source Charge	ALL	—	6.8	10	nC	(Independent of operating temperature)
$Q_{gd}$ Gate-to-Drain ("Miller") Charge	—	—	15	22	nC	(Independent of operating temperature)
$t_{d(on)}$ Turn-On Delay Time	ALL	—	14	21	ns	$V_{DD} = 30V, I_D = 30A, R_G = 12\Omega$
$t_r$ Rise Time	ALL	—	71	110	ns	$R_D = 1.0\Omega$
$t_{d(off)}$ 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	—	5.0	—	nH	Measured from the drain lead, 6mm (0.25 in.) from package to center of die
$L_S$ Internal Source Inductance	ALL	—	13	—	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	$f = 1.0 \text{ MHz}$
$C_{rss}$ 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 ②	ALL	—	—	1.8	V	$T_J = 25^\circ\text{C}$ , $I_S = 30\text{A}$ , $V_{GS} = 0\text{V}$
$t_{rr}$ Reverse Recovery Time	ALL	45	100	220	ns	$T_J = 25^\circ\text{C}$ , $I_F = 30\text{A}$ , $di/dt = 100\text{A}/\mu\text{s}$
$Q_{RR}$ Reverse Recovery Charge	ALL	1.9	4.2	9.6	$\mu\text{C}$	
$t_{on}$ 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 ③	
$R_{thCS}$ Case-to-Sink	ALL	—	0.12	—	K/W ③	Mounting surface flat, smooth, and greased
$R_{thJA}$ Junction-to-Ambient	ALL	—	—	30	K/W ③	Typical socket mount

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

② @  $V_{DD} = 25\text{V}$ , Starting  $T_J = 25^\circ\text{C}$ ,  $L = 50\ \mu\text{H}$ ,  $R_G = 25\Omega$ , Peak  $I_L = 21\text{A}$

③  $I_{SD} \leq 21\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq 50\text{V}$ ,  $T_J \leq 175^\circ\text{C}$   
Suggested  $R_G = 12\Omega$

④  $K/W = ^\circ\text{C}/\text{W}$   
 $W/K = \text{W}/^\circ\text{C}$

⑤ Pulse width  $\leq 300\ \mu\text{s}$ ; Duty Cycle  $\leq 2\%$

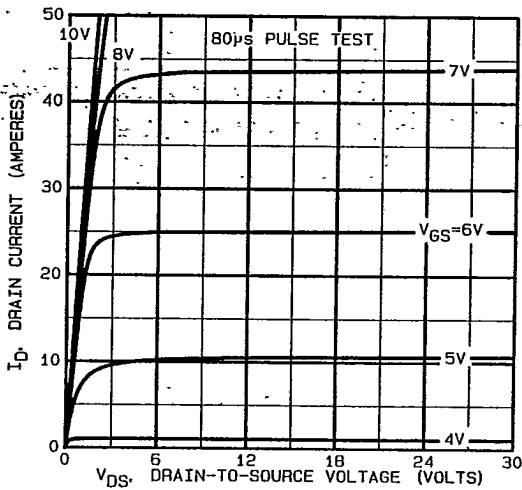


Fig. 1 — Typical Output Characteristics

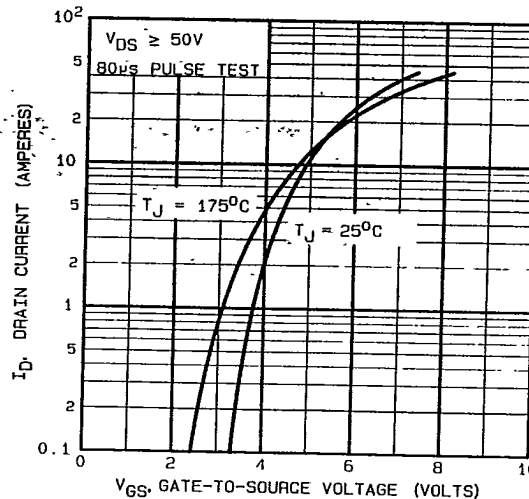


Fig. 2 — Typical Transfer Characteristics

T0-3

T-39-13

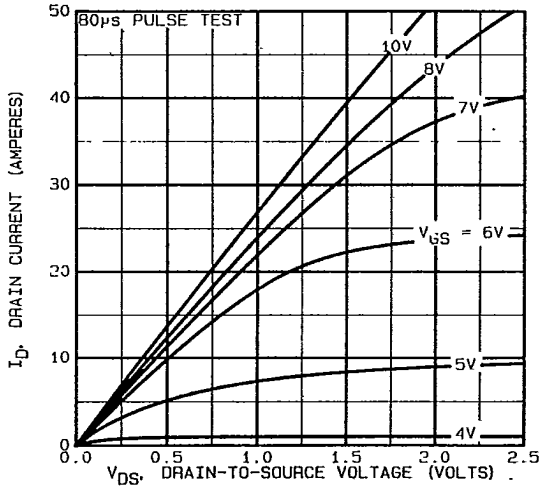


Fig. 3 — Typical Saturation Characteristics

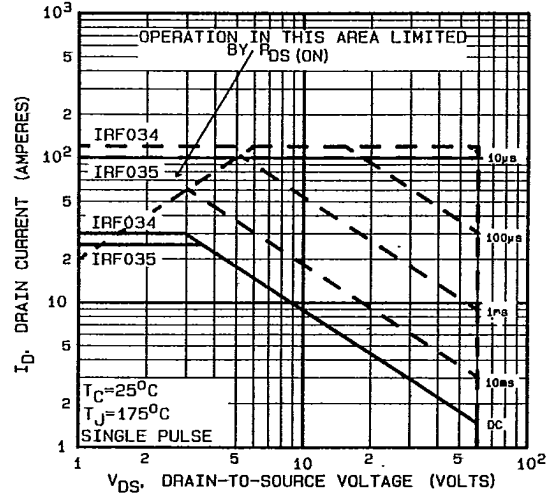


Fig. 4 — Maximum Safe Operating Area

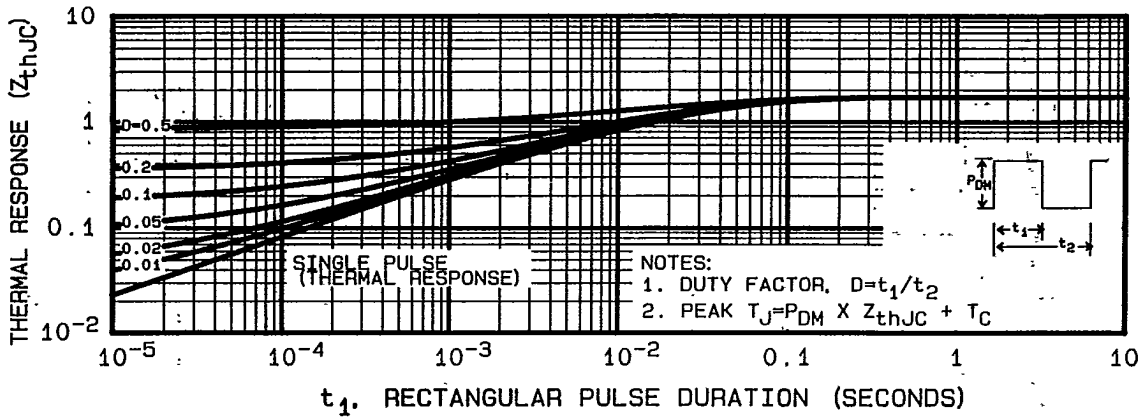


Fig. 5 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

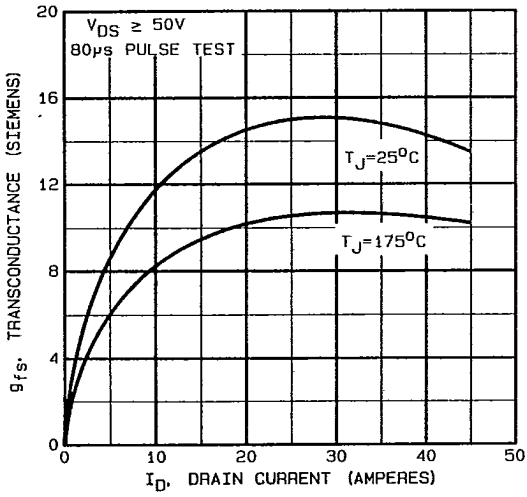


Fig. 6 — Typical Transconductance Vs. Drain Current

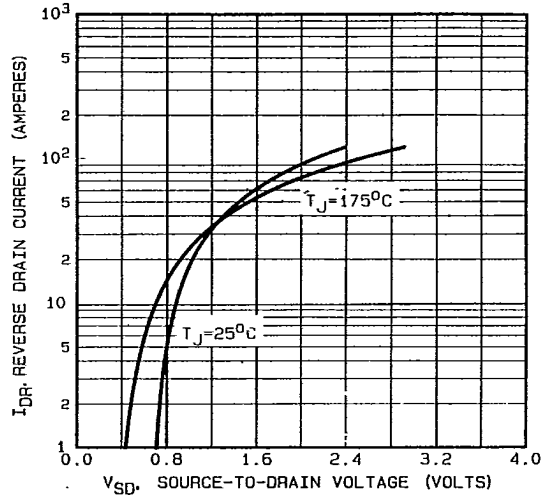


Fig. 7 — Typical Source-Drain Diode Forward Voltage

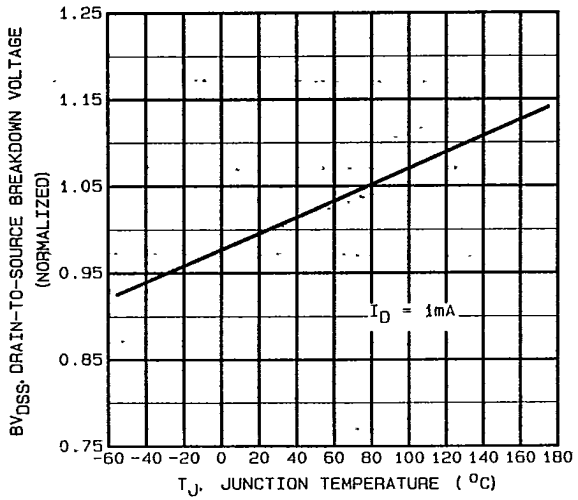


Fig. 8 — Breakdown Voltage Vs. Temperature

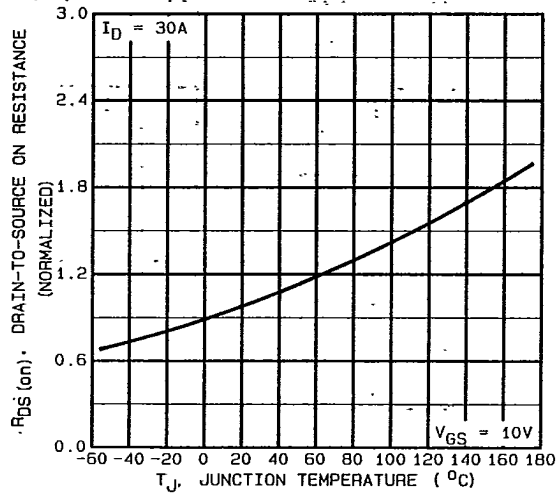


Fig. 9 — Normalized On-Resistance Vs. Temperature

T0-3

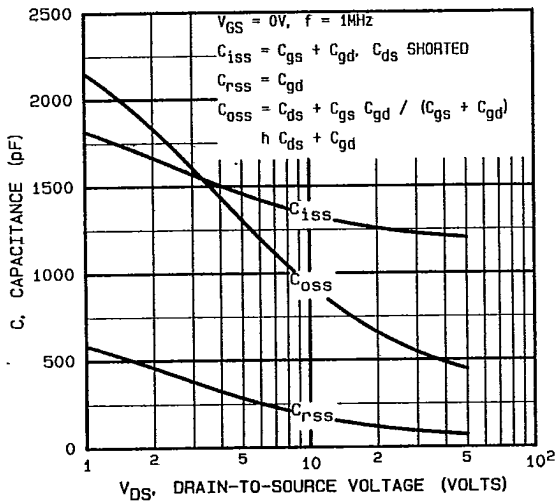


Fig. 10 — Typical Capacitance Vs. Drain-to-Source Voltage

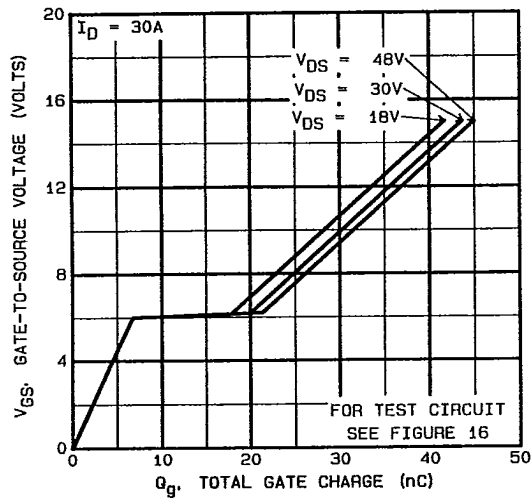


Fig. 11 — Typical Gate Charge Vs. Gate-to-Source Voltage

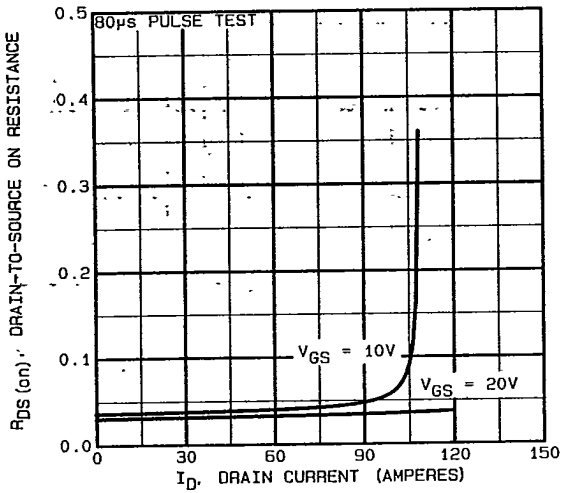


Fig. 12 — Typical On-Resistance Vs. Drain Current

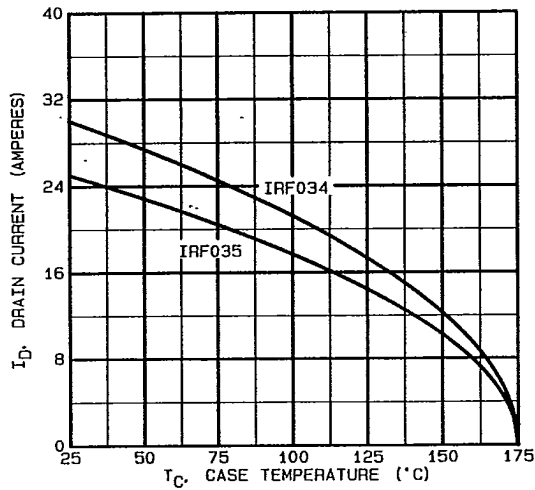


Fig. 13 — Maximum Drain Current Vs. Case Temperature

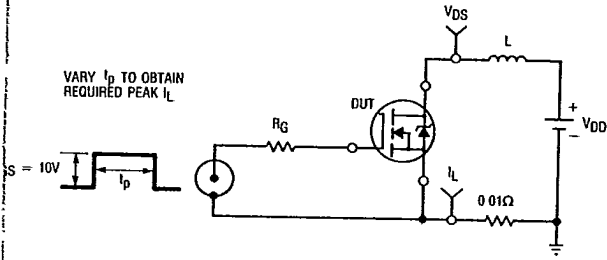


Fig. 14a — Unclamped Inductive Test Circuit

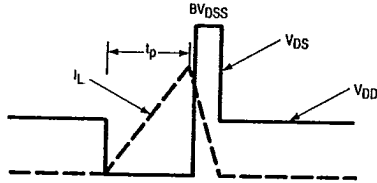


Fig. 14b — Unclamped Inductive Waveforms

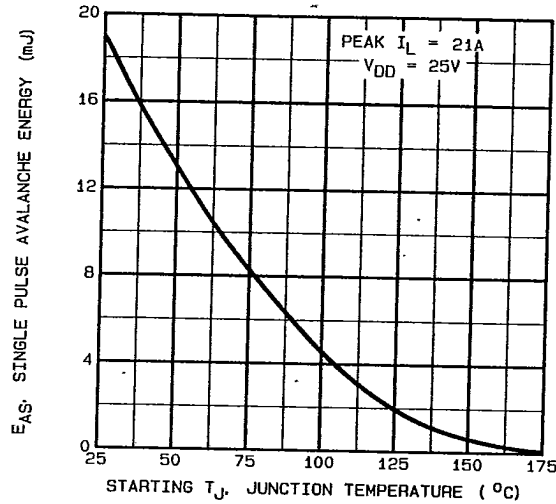


Fig. 14c — Maximum Avalanche Energy Vs. Starting Junction Temperature

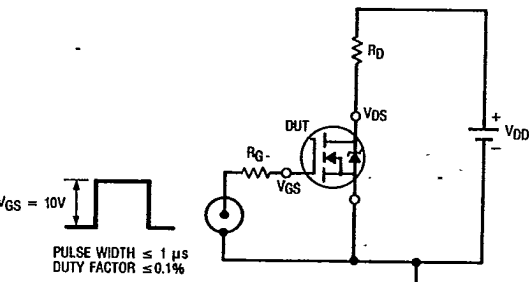


Fig. 15a — Switching Time Test Circuit

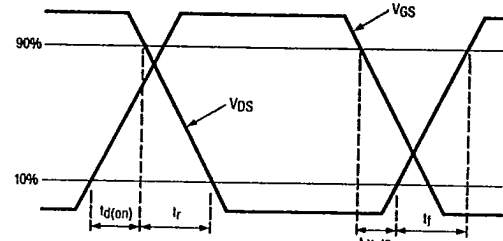


Fig. 15b — Switching Time Waveforms

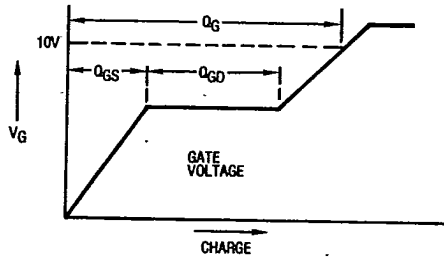


Fig. 16a — Basic Gate Charge Waveform

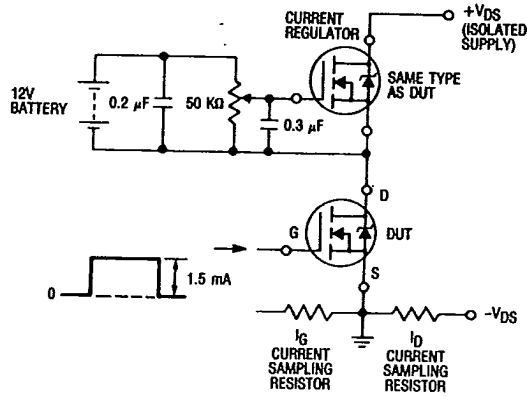


Fig. 16b — Gate Charge Test Circuit

T0-3

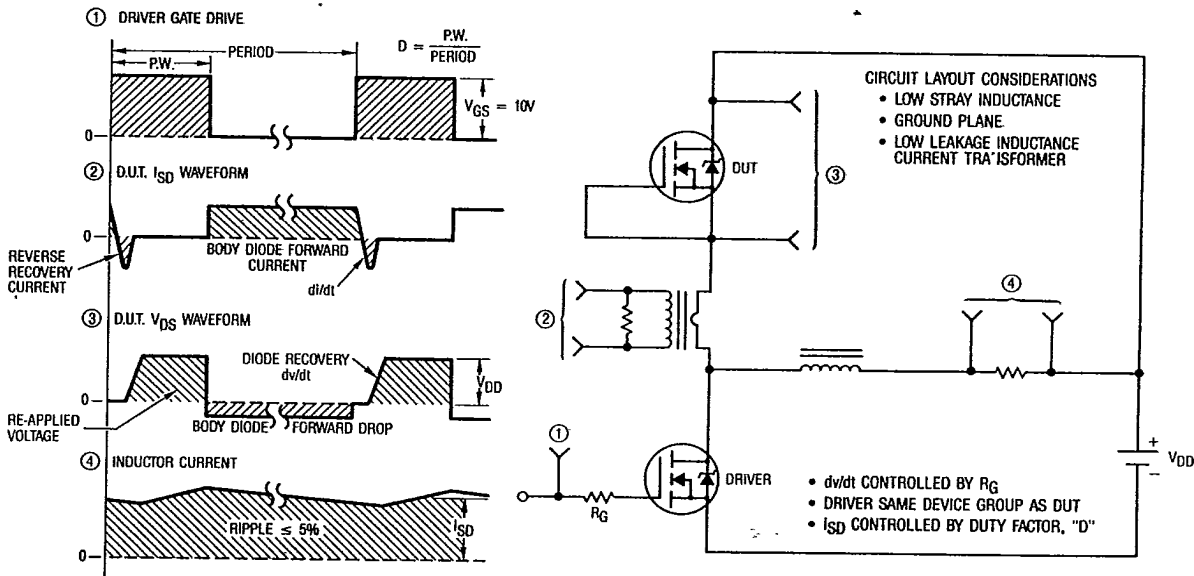
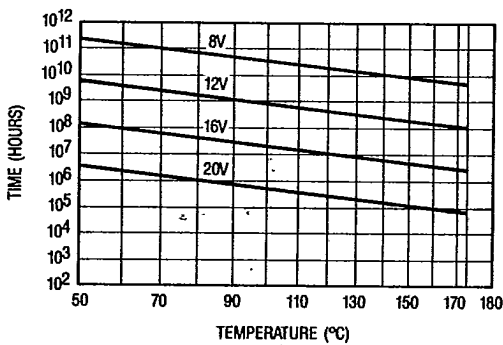
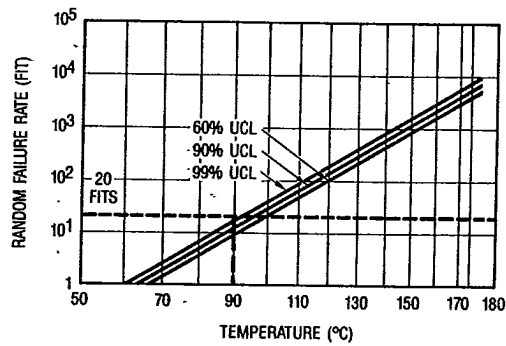


Fig. 17 — Peak Diode Recovery  $dv/dt$  Test Circuit



\*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 Jan. 15, 1987. This information is updated on a quarterly basis; for the latest reliability data, please contact your local IR field office.