



HARRIS

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IRF530/531/532/533
IRF530R/531R/532R/533R

N-Channel Power MOSFETs
Avalanche Energy Rated*

May 1992

Features

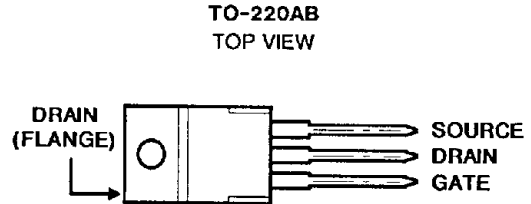
- 12A and 14A, 80V - 100V
• rDS(on) = 0.16Ω and 0.23Ω
• Single Pulse Avalanche Energy Rated*
• SOA is Power-Dissipation Limited
• Nanosecond Switching Speeds
• Linear Transfer Characteristics
• High Input Impedance

Description

The IRF530, IRF531, IRF532, and IRF533 are n-channel enhancement-mode silicon-gate power field-effect transistors. IRF530R, IRF531R, IRF532R and IRF533R types are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation.

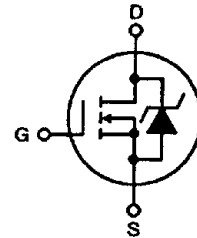
The IRF types are supplied in the JEDEC TO-220AB plastic package.

Package



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



Absolute Maximum Ratings (TC = +25°C), Unless Otherwise Specified

Table with 6 columns: Parameter, IRF530/IRF530R, IRF531/IRF531R, IRF532/IRF532R, IRF533/IRF533R, UNITS. Rows include Drain-Source Voltage, Drain-Gate Voltage, Continuous Drain Current, Pulsed Drain Current, Gate-Source Voltage, Maximum Power Dissipation, Inductive Current, Single Pulse Avalanche Energy Rating, and Temperature Range.

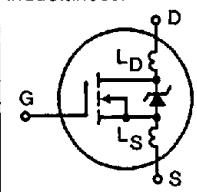
NOTES:

- 1. TJ = +25°C to +150°C.
2. Pulse Test: Pulse width ≤ 300µs, Duty Cycle ≤ 2%.
3. Repetitive rating: Pulse width limited by maximum junction temperature. See Transient Thermal Impedance Curve (Figure 5).
4. VDD = 25V, starting TJ = +25°C, L = 530µH, RGS = 25Ω, IPEAK = 14A. See Figure 15.
*R Suffix Types Only

CAUTION: These devices are sensitive to electrostatic discharge. Proper I.C. handling procedures should be followed. Copyright © Harris Corporation 1992

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Electrical Characteristics $T_C = 25^\circ\text{C}$, Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Drain-Source Breakdown Voltage IRF530/532, IRF530R/532R IRF531/533, IRF531R/533R	BV_{DSS}	$V_{GS} = 0V, I_D = 250\mu A$	100	-	-	V	
			80	-	-	V	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0	-	4.0	V	
Gate-Source Leakage Forward	I_{GSS}	$V_{GS} = 20V$	-	-	500	nA	
Gate-Source Leakage Reverse	I_{GSS}	$V_{GS} = -20V$	-	-	-500	nA	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = \text{Max Rating}, V_{GS} = 0V$ $V_{DS} = \text{Max Rating} \times 0.8, V_{GS} = 0V,$ $T_J = +125^\circ\text{C}$	-	-	250	μA	
			-	-	1000	μA	
On-State Drain Current (Note 2) IRF530/531, IRF530R/531R IRF532/533, IRF532R/533R	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON) \text{ Max}}, V_{GS} = 10V$	14	-	-	A	
			12	-	-	A	
Static Drain-Source On-State Resistance (Note 2) IRF530/531, IRF530R/531R IRF532/533, IRF532R/533R	$r_{DS(ON)}$	$V_{GS} = 10V, I_D = 8.3A$	-	0.14	0.16	Ω	
			-	0.20	0.23	Ω	
Forward Transconductance (Note 2)	g_{fs}	$V_{DS} \geq 50V, I_D = 8.3A$	5.1	7.6	-	S(\bar{f})	
Input Capacitance	C_{ISS}	$V_{GS} = 0V, V_{DS} = 25V, f = 1.0\text{MHz}$	-	800	-	pF	
Output Capacitance	C_{OSS}	See Figure 10	-	250	-	pF	
Reverse Transfer Capacitance	C_{RSS}		-	50	-	pF	
Turn-On Delay Time	$t_{d(ON)}$	$V_{DD} = 50V, I_D \approx 14A, R_G = 12\Omega$	-	12	15	ns	
Rise Time	t_r	See Figure 16. (MOSFET switching times are essentially independent of operating temperature)	-	35	51	ns	
Turn-Off Delay Time	$t_{d(OFF)}$		-	25	35	ns	
Fall Time	t_f		-	25	36	ns	
Total Gate Charge (Gate-Source + Gate-Drain)	Q_g	$V_{GS} = 10V, I_D = 14A, V_{DS} = 0.8V \text{ Max Rating}$. See Figure 17 for test circuit. (Gate charge is essentially independent of operating temperature.)	-	18	26	nC	
Gate-Source Charge	Q_{gs}		-	4	-	nC	
Gate-Drain ("Miller") Charge	Q_{gd}		-	7	-	nC	
Internal Drain Inductance	L_D	Measured from the contact screw on tab to center of die		-	3.5	-	nH
		Measured from the drain lead, 6mm (0.25in.) from package to center of die		-	4.5	-	nH
Internal Source Inductance	L_S	Measured from the source lead, 6mm (0.25") from header and source bonding pad.	-	7.5	-	nH	
Junction-to-Case	$R_{\theta JC}$		-	-	1.9	$^\circ\text{C/W}$	
Case-to-Sink	$R_{\theta CS}$	Mounting surface flat, smooth and greased	-	0.5	-	$^\circ\text{C/W}$	
Junction-to-Ambient	$R_{\theta JA}$	Free air operation	-	-	80	$^\circ\text{C/W}$	

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Source Drain Diode Ratings and Characteristics

Continuous Source Current (Body Diode)	I_S	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.	-	-	14	A
Pulse Source Current (Body Diode) (Note 3)	I_{SM}		-	-	56	A
Diode Forward Voltage (Note 2)	V_{SD}	$T_J = +25^\circ\text{C}, I_S = 14A, V_{GS} = 0V$	-	-	2.5	V
Reverse Recovery Time	t_{rr}	$T_J = +25^\circ\text{C}, I_F = 14A, di_F/dt = 100A/\mu s$	5.5	120	250	ns
Reverse Recovered Charge	Q_{RR}	$T_J = +25^\circ\text{C}, I_F = 14A, di_F/dt = 100A/\mu s$	0.26	0.6	1.3	μC
Forward Turn-on Time	t_{ON}	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S + L_D$.	-	-	-	-

NOTES: 1. $T_J = +25^\circ\text{C}$ to $+150^\circ\text{C}$

2. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$

3. Repetitive Rating: Pulse width limited by max. junction temperature. See Transient Thermal Impedance Curve (Figure 5)

4. $V_{DD} = 25V$, Start $T_J = +25^\circ\text{C}$, $L = 350\mu H$, $R_{GS} = 25\Omega$, $I_{PEAK} = 14A$ (See Figure 15)

Performance Curves

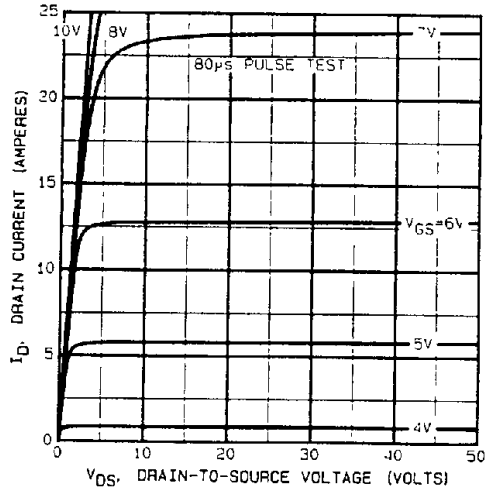


FIGURE 1. TYPICAL OUTPUT CHARACTERISTICS

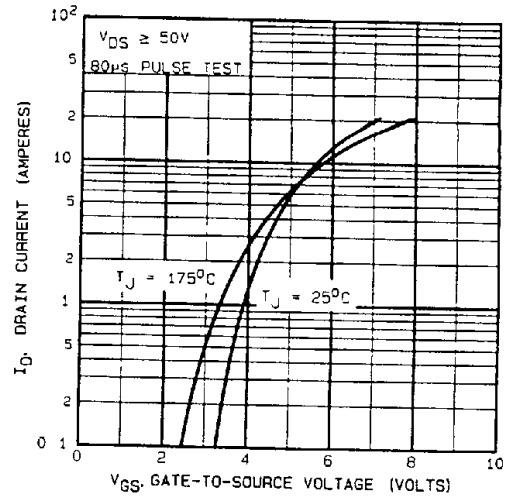


FIGURE 2. TYPICAL TRANSFER CHARACTERISTICS

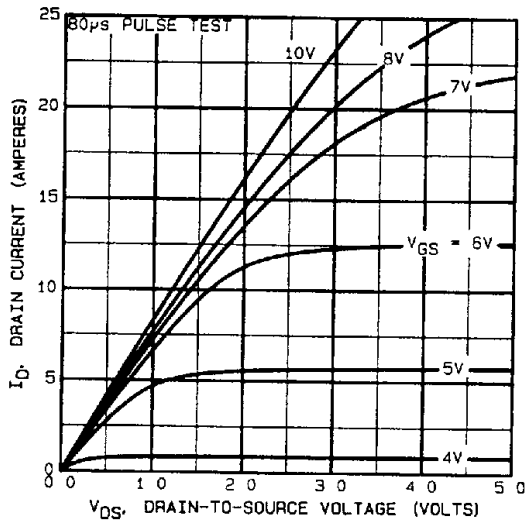


FIGURE 3. TYPICAL SATURATION CHARACTERISTICS

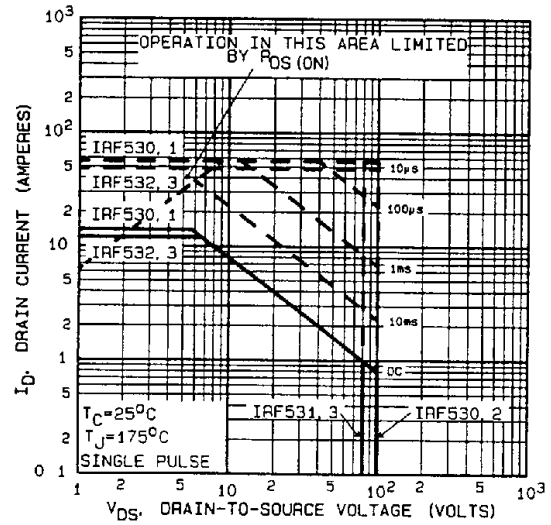


FIGURE 4. MAXIMUM SAFE OPERATING AREA

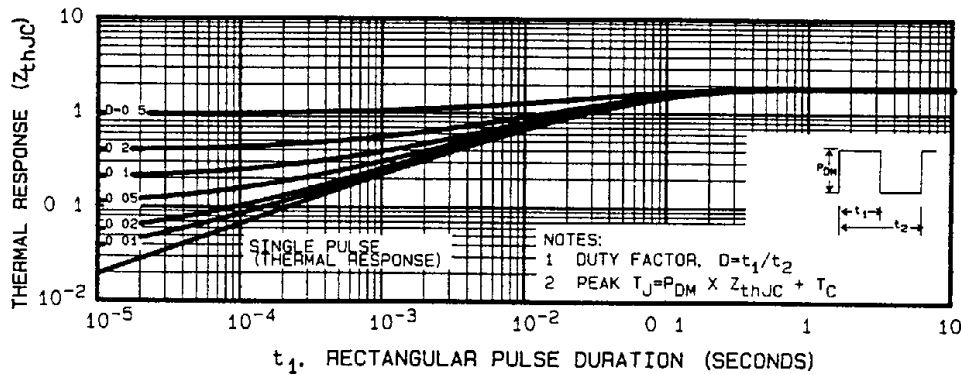


FIGURE 5. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

Performance Curves (Continued)

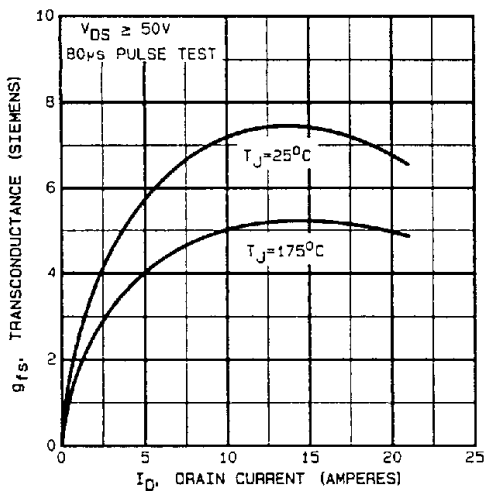


FIGURE 6. TYPICAL TRANSCONDUCTANCE vs DRAIN CURRENT

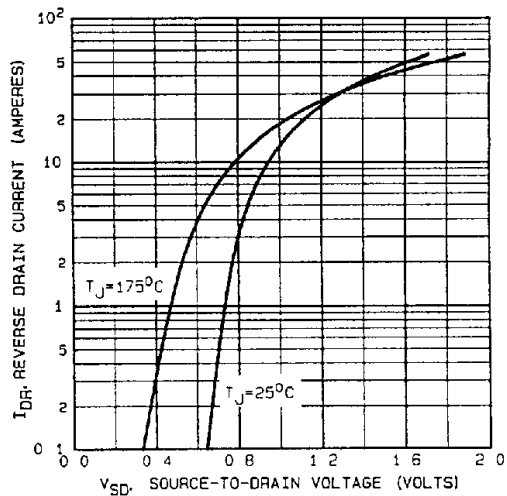


FIGURE 7. TYPICAL SOURCE-DRAIN DIODE FORWARD VOLTAGE

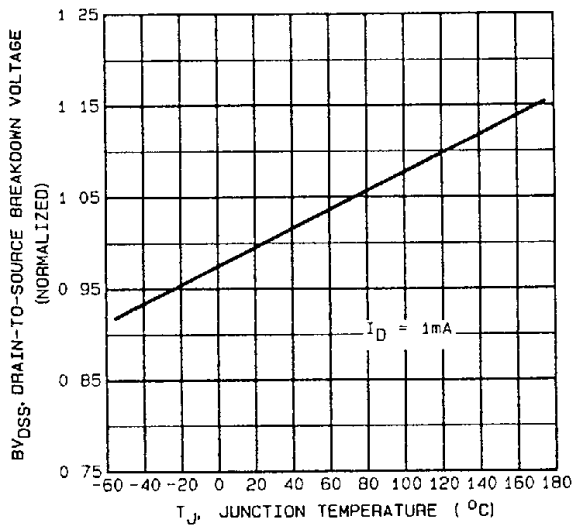


FIGURE 8. BREAKDOWN VOLTAGE vs TEMPERATURE

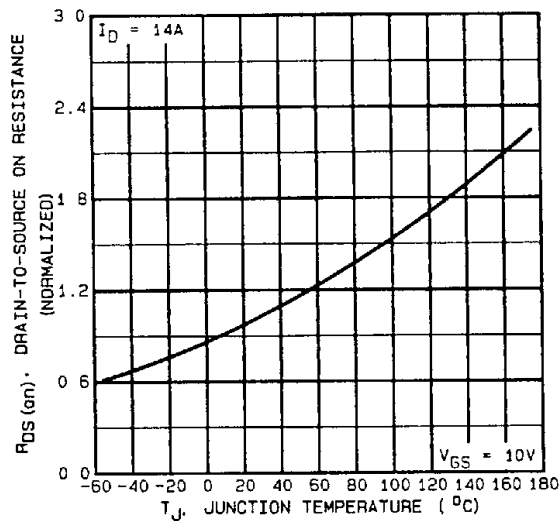


FIGURE 9. NORMALIZED ON-RESISTANCE vs TEMPERATURE

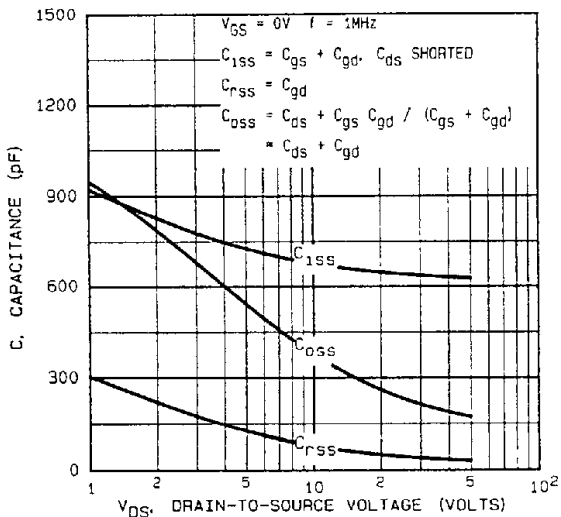


FIGURE 10. TYPICAL CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

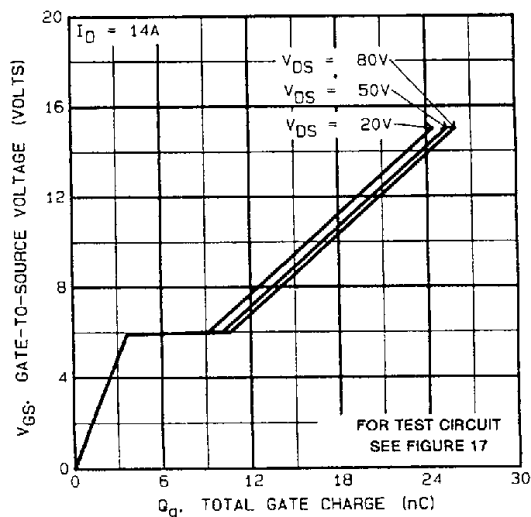


FIGURE 11. TYPICAL GATE CHARGE vs GATE-TO-SOURCE VOLTAGE

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Performance Curves (Continued)

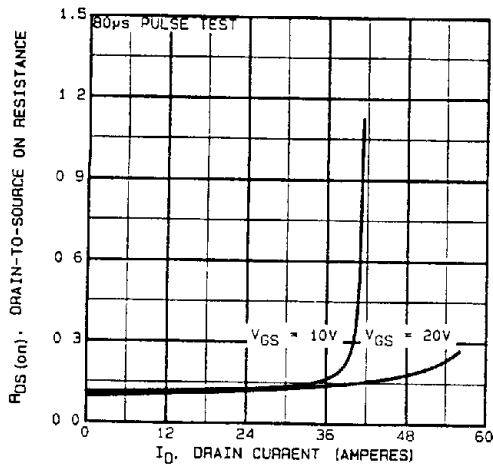


FIGURE 12. TYPICAL ON RESISTANCE vs DRAIN CURRENT

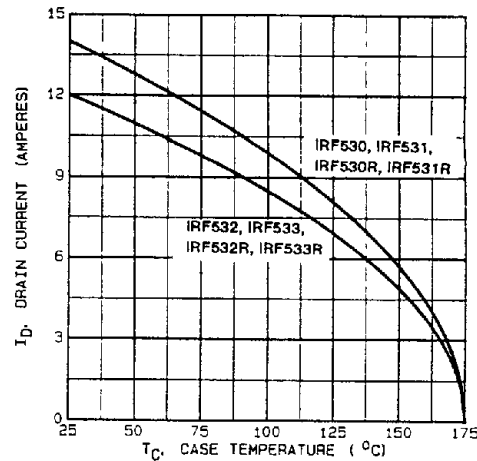


FIGURE 13. MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

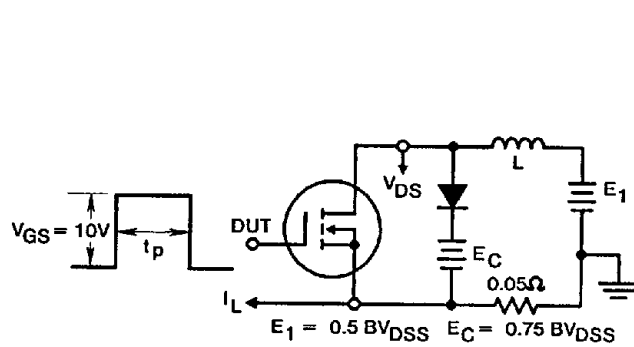


FIGURE 14a. CLAMPED INDUCTIVE TEST CIRCUIT

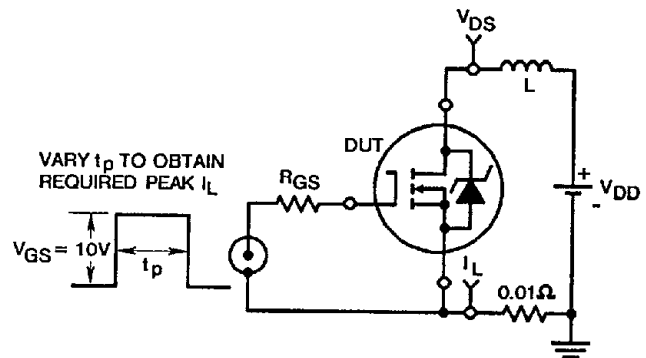


FIGURE 15a. UNCLAMPED ENERGY TEST CIRCUIT

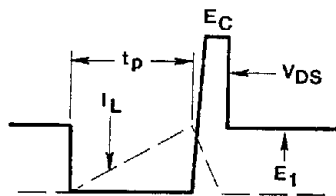


FIGURE 14b. CLAMPED INDUCTIVE WAVEFORMS

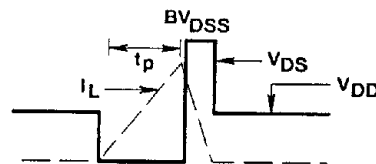


FIGURE 15b. UNCLAMPED ENERGY WAVEFORMS

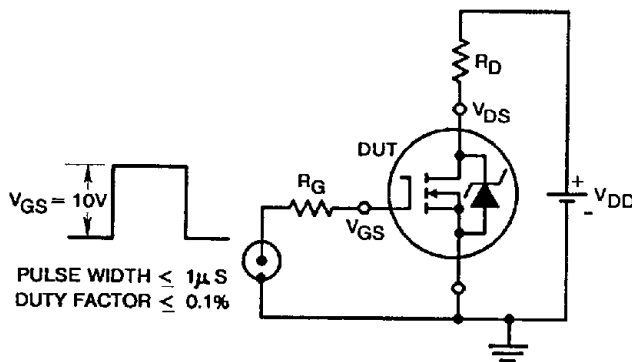


FIGURE 16. SWITCHING TIME TEST CIRCUIT

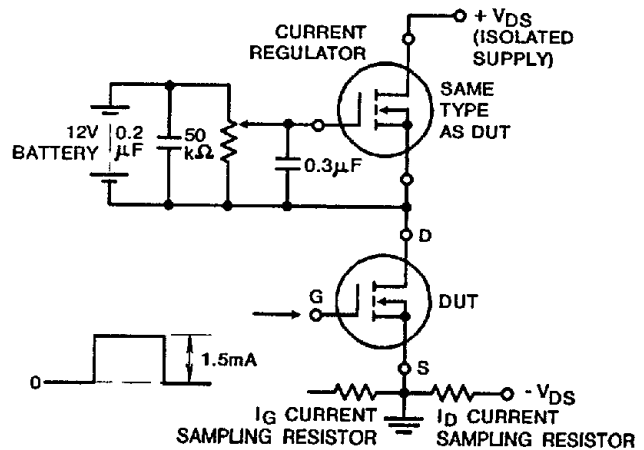


FIGURE 17. GATE CHARGE TEST CIRCUIT