

# IRFP240, IRFP241, IRFP242, IRFP243

18A and 20A, 200V and 150V, 0.18 and 0.22 Ohm,  
N-Channel Power MOSFETs

January 1998

## Features

- 18A and 20A, 200V and 150V
- $r_{DS(ON)} = 0.18\Omega$  and  $0.22\Omega$
- Single Pulse Avalanche Energy Rated
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

## Ordering Information

PART NUMBER	PACKAGE	BRAND
IRFP240	TO-247	IRFP240
IRFP241	TO-247	IRFP241
IRFP242	TO-247	IRFP242
IRFP243	TO-247	IRFP243

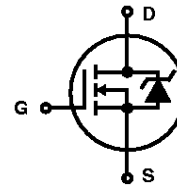
NOTE: When ordering, include the entire part number.

## Description

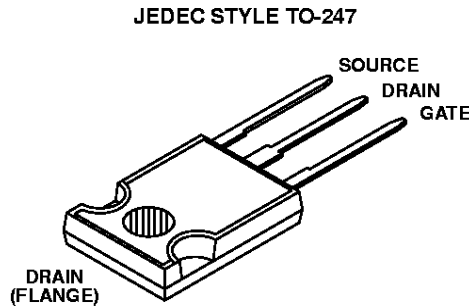
These are N-Channel enhancement mode silicon gate power field effect transistors. They are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. All of these power MOSFETs are designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. These types can be operated directly from integrated circuits.

Formerly developmental type TA17422.

## Symbol



## Packaging



# IRFP240, IRFP241, IRFP242, IRFP243

## Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

	IRFP240	IRFP241	IRFP242	IRFP243	UNITS
Drain to Source Voltage (Note 1) . . . . . $V_{DS}$	200	150	200	150	V
Drain to Gate Voltage ( $R_{GS} = 20\text{k}\Omega$ ) (Note 1) . . . . . $V_{DGR}$	200	150	200	150	V
Continuous Drain Current . . . . . $I_D$	20	20	18	18	A
$T_C = 100^\circ\text{C}$ . . . . .	12	12	11	11	A
Pulsed Drain Current (Note 3) . . . . . $I_{DM}$	80	80	72	72	A
Gate to Source Voltage . . . . . $V_{GS}$	$\pm 20$	$\pm 20$	$\pm 20$	$\pm 20$	V
Maximum Power Dissipation . . . . . $P_D$	150	150	150	150	W
Linear Derating Factor . . . . .	1.2	1.2	1.2	1.2	W/ $^\circ\text{C}$
Single Pulse Avalanche Energy Rating (Note 4) . . . . . $E_{AS}$	510	510	510	510	mJ
Operating and Storage Temperature . . . . . $T_J, T_{STG}$	-55 to 150	-55 to 150	-55 to 150	-55 to 150	$^\circ\text{C}$
Maximum Temperature for Soldering					
Leads at 0.063in (1.6mm) from Case for 10s . . . . . $T_L$	300	300	300	300	$^\circ\text{C}$
Package Body for 10s, See Techbrief 334 . . . . . $T_{pkg}$	260	260	260	260	$^\circ\text{C}$

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

**NOTE:**

1.  $T_J = 25^\circ\text{C}$  to  $125^\circ\text{C}$ .

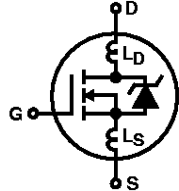
## Electrical Specifications $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage IRFP240, IRFP242	$BV_{DSS}$	$V_{GS} = 0\text{V}, I_D = 250\mu\text{A}$ , (Figure 10)	200	-	-	V
			IRFP241, IRFP243	150	-	-
Gate to Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.0	-	4.0	V
Zero-Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}, T_J = 125^\circ\text{C}$	-	-	250	$\mu\text{A}$
On-State Drain Current (Note 2) IRFP240, IRFP241	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}, V_{GS} = 11\text{V}$ , (Figure 7)	20	-	-	A
			IRFP242, IRFP243	18	-	-
Gate to Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA
Drain to Source On Resistance (Note 2) IRFP240, IRFP241	$r_{DS(ON)}$	$V_{GS} = 10\text{V}, I_D = 10\text{A}$ , (Figures 8, 9)	-	0.14	0.18	$\Omega$
			IRFP242, IRFP243	-	0.20	0.22
Forward Transconductance (Note 2)	$g_{fs}$	$V_{DS} \geq 50\text{V}, I_D = 11\text{A}$	7.3	11	-	S
Turn-On Delay Time	$t_{d(ON)}$	$V_{DD} = 100\text{V}, I_D \approx 18\text{A}, R_G = 9.1\Omega, V_{GS} = 10\text{V}, R_L = 5.4\Omega$ , (Figures 17, 18) MOSFET Switching Times are essentially Independent of Operating Temperature	-	14	21	ns
Rise Time	$t_r$		-	51	77	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	45	68	ns
Fall Time	$t_f$		-	36	54	ns
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(TOT)}$		$V_{GS} = 10\text{V}, I_D = 18\text{A}, V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, I_{G(REF)} = 1.5\text{mA}$ , (Figure 14, 19, 20) Gate Charge is Essentially Independent of Operating Temperature	-	43	60
Gate to Source Charge	$Q_{gs}$	$V_{GS} = 0\text{V}, V_{DS} = 25\text{V}, f = 1.0\text{MHz}$ , (Figure 11)	-	10	-	nC
Gate to Drain "Miller" Charge	$Q_{gd}$		-	32	-	nC
Input Capacitance	$C_{ISS}$		-	1275	-	pF
Output Capacitance	$C_{OSS}$	-	500	-	pF	
Reverse Transfer Capacitance	$C_{RSS}$	-	160	-	pF	

# IRFP240, IRFP241, IRFP242, IRFP243

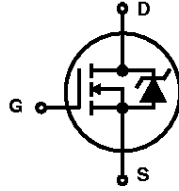
## Electrical Specifications $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Internal Drain Inductance	$L_D$	Measured Between the Contact Screw on Header that is Closer to Source and Gate Pins and Center of Die	Modified MOSFET Symbol Showing the Internal Devices Inductances	-	5.0	-	nH
Internal Source Inductance	$L_S$			Measured from the Source Lead, 6mm (0.25in) from Header to Source Bonding Pad	-	12.5	-
Junction to Case	$R_{\theta JC}$			-	-	0.83	$^\circ\text{C/W}$
Junction to Ambient	$R_{\theta JA}$	Free Air Operation		-	-	30	$^\circ\text{C/W}$



## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Continuous Source to Drain Current	$I_{SD}$	Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode		-	-	20	A
Pulse Source to Drain Current (Note 3)	$I_{SDM}$			-	-	80	A
Source to Drain Diode Voltage (Note 2)	$V_{SD}$	$T_J = 25^\circ\text{C}$ , $I_{SD} = 18\text{A}$ , $V_{GS} = 0\text{V}$ , (Figure 13)		-	-	2.0	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25^\circ\text{C}$ , $I_{SD} = 18\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$		120	250	530	ns
Reverse Recovered Charge	$Q_{RR}$	$T_J = 25^\circ\text{C}$ , $I_{SD} = 18\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$		1.3	2.6	5.6	$\mu\text{C}$



**NOTES:**

2. Pulse test: pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
3. Repetitive rating: pulse width limited by Max junction temperature. See Transient Thermal Impedance curve (Figure 3).
4.  $V_{DD} = 50\text{V}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.9\text{mH}$ ,  $R_{GS} = 50\Omega$ , peak  $I_{AS} = 20\text{A}$  (Figures 14, 15).

## Typical Performance Curves Unless Otherwise Specified

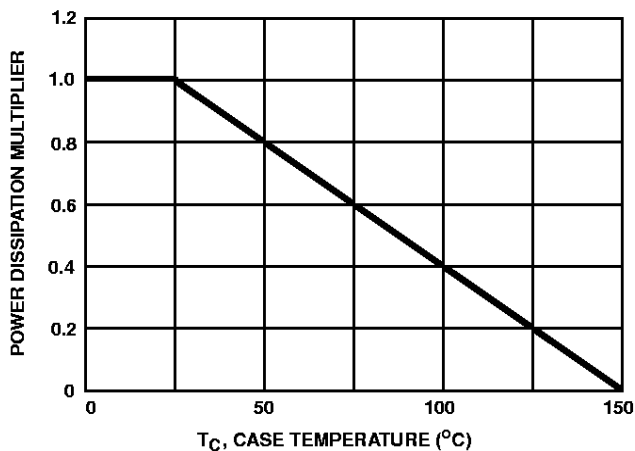


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

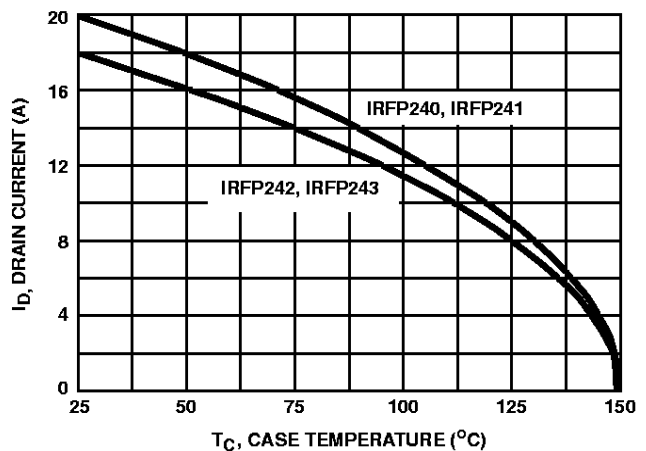


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

# IRFP240, IRFP241, IRFP242, IRFP243

## Typical Performance Curves Unless Otherwise Specified (Continued)

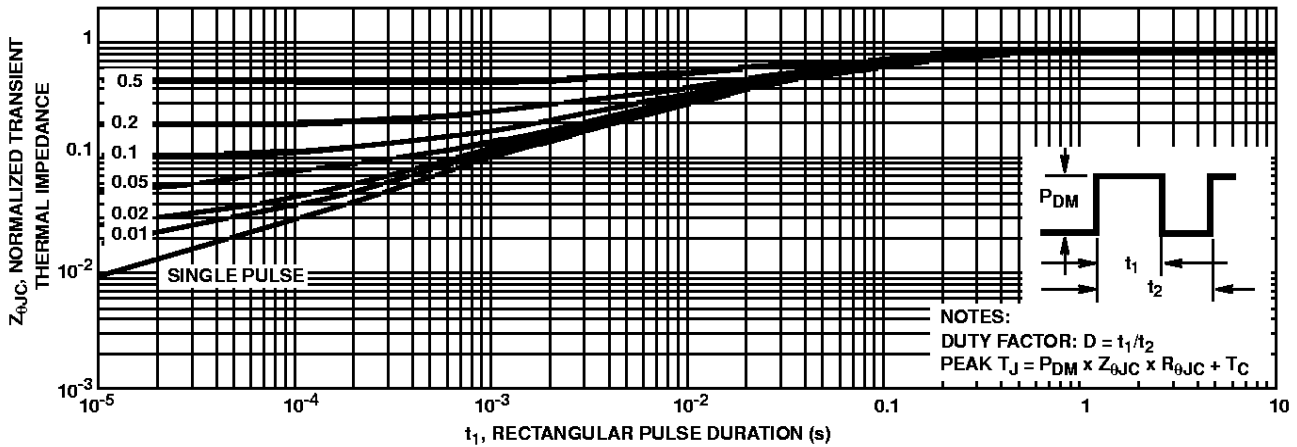


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

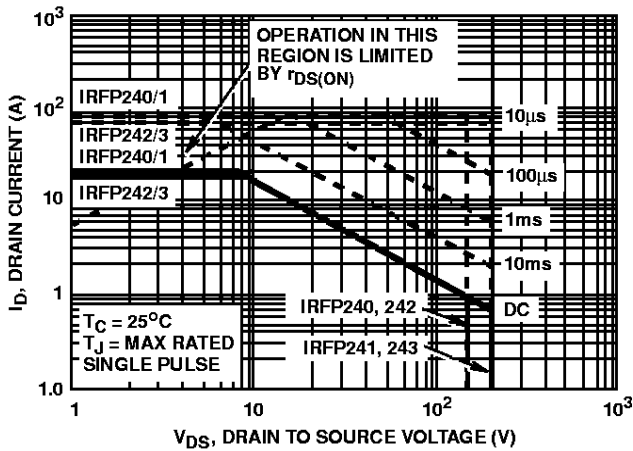


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

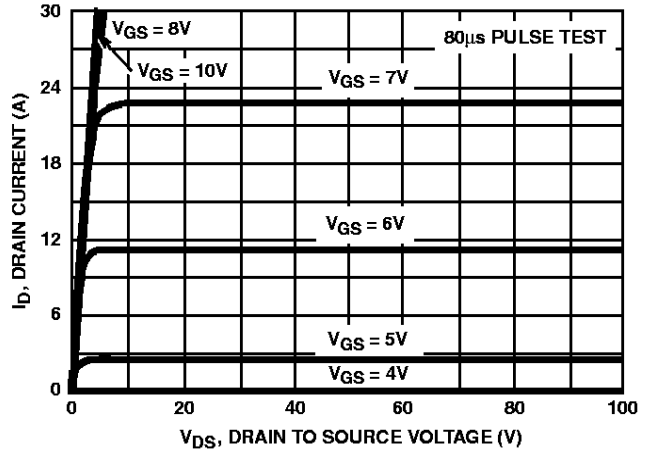


FIGURE 5. OUTPUT CHARACTERISTICS

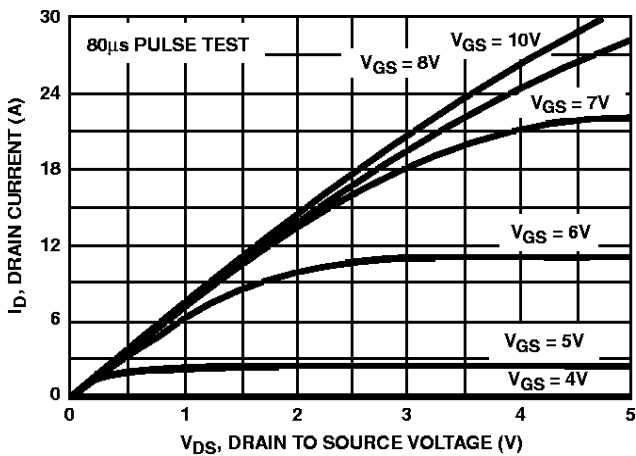


FIGURE 6. SATURATION CHARACTERISTICS

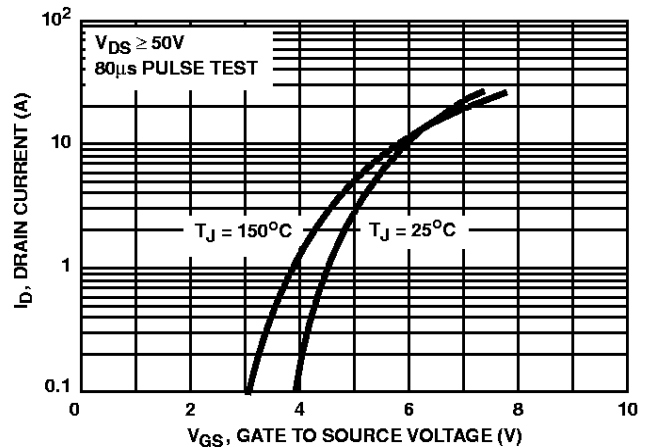
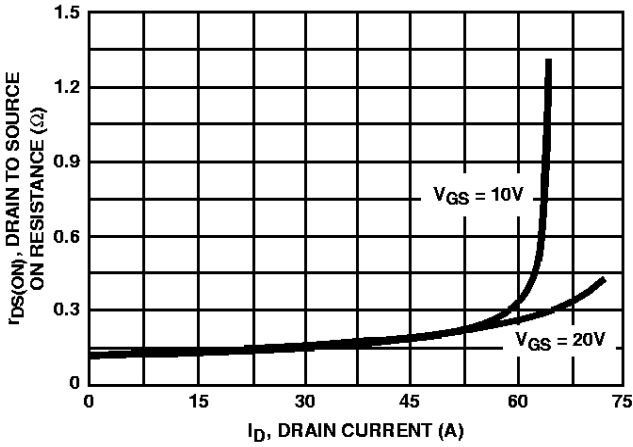


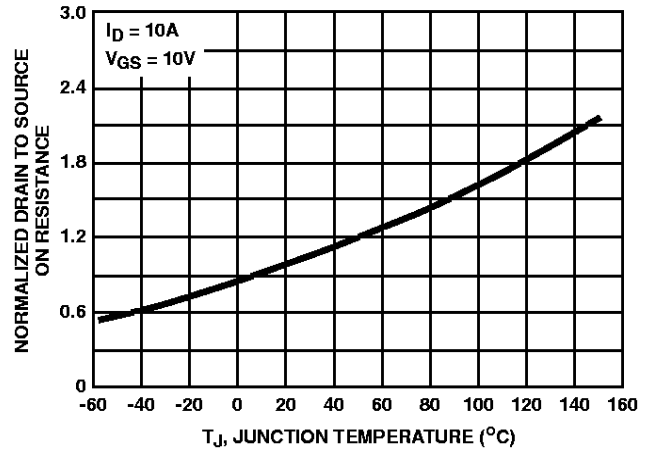
FIGURE 7. TRANSFER CHARACTERISTICS

**Typical Performance Curves** Unless Otherwise Specified (Continued)

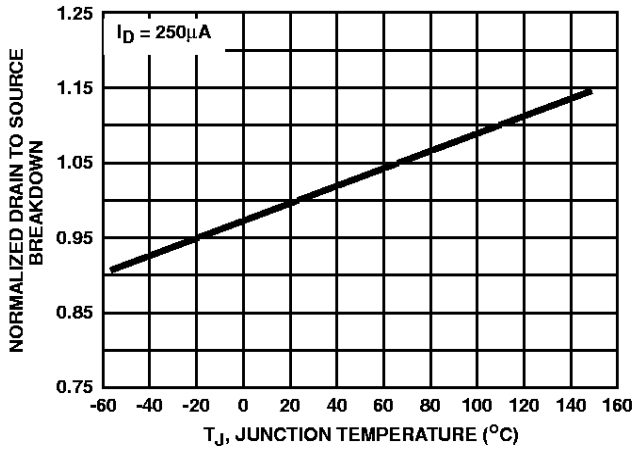


NOTE: Heating effect of 2μs pulse is minimal.

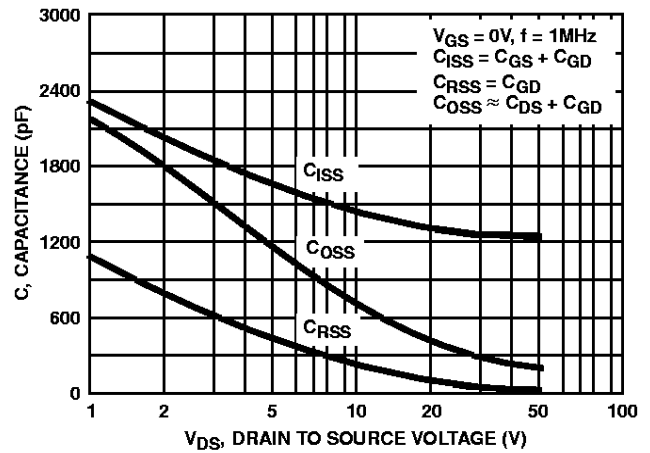
**FIGURE 8. DRAIN TO SOURCE ON RESISTANCE GATE VOLTAGE AND DRAIN CURRENT**



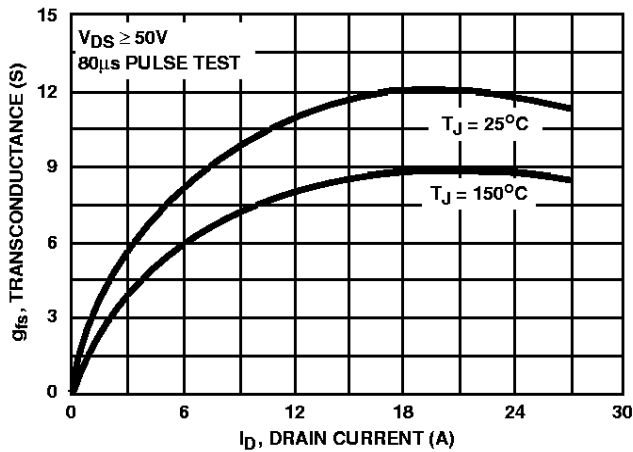
**FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE**



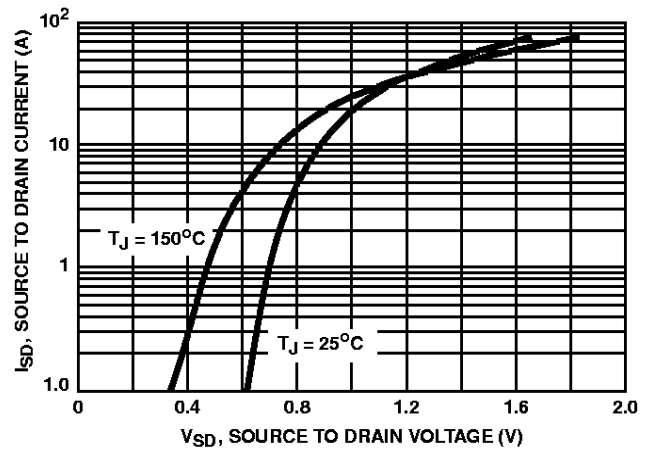
**FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE**



**FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE**



**FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT**



**FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE**

**Typical Performance Curves** Unless Otherwise Specified (Continued)

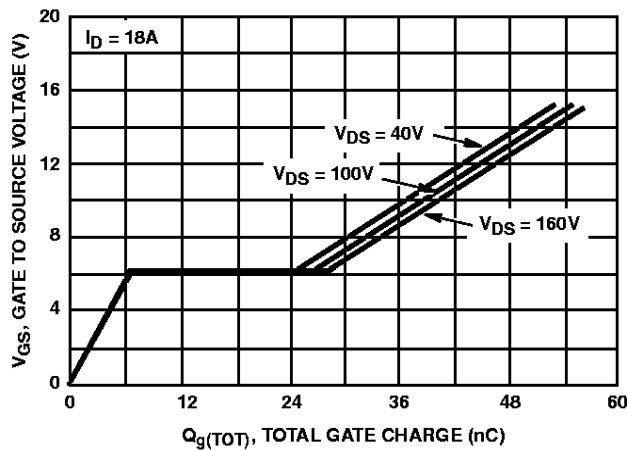


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

**Test Circuits and Waveforms**

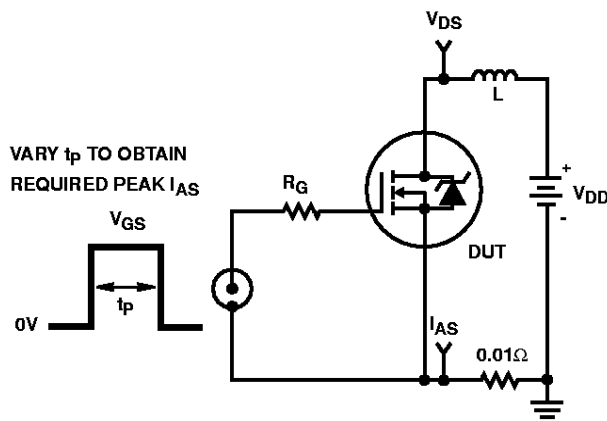


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

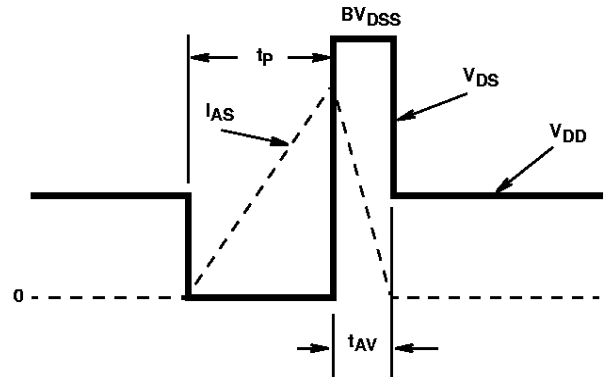


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

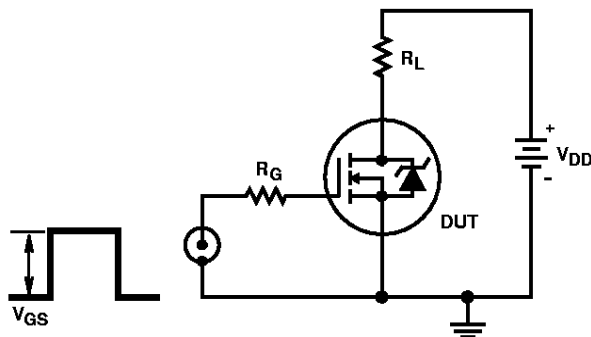


FIGURE 17. SWITCHING TIME TEST CIRCUIT

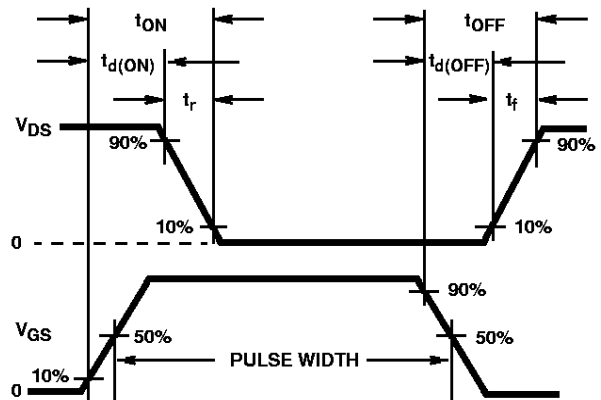


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

**Test Circuits and Waveforms** (Continued)

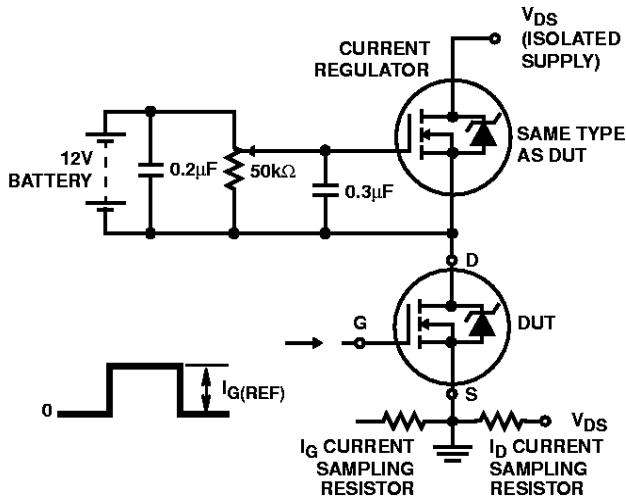


FIGURE 19. GATE CHARGE TEST CIRCUIT

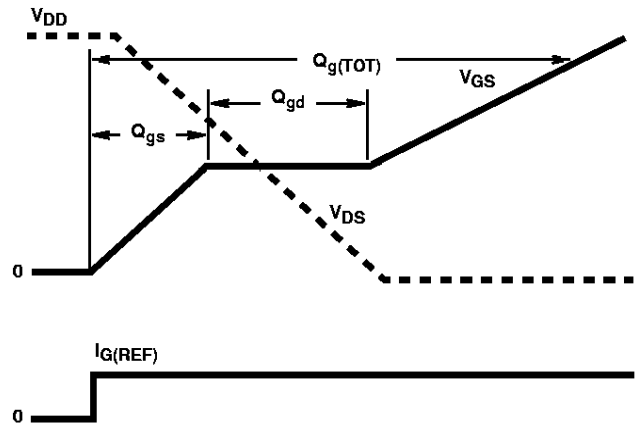


FIGURE 20. GATE CHARGE WAVEFORMS

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