

**23A, 400V, 0.200 Ohm, N-Channel Power MOSFET**

This advanced power MOSFET is designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. These are N-Channel enhancement mode silicon gate power field effect transistors 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. They can be operated directly from integrated circuits.

Formerly developmental type TA17464.

**Ordering Information**

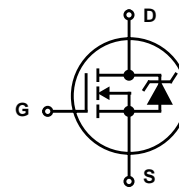
PART NUMBER	PACKAGE	BRAND
IRFP360	TO-247	IRFP360

NOTE: When ordering, use the entire part number.

**Features**

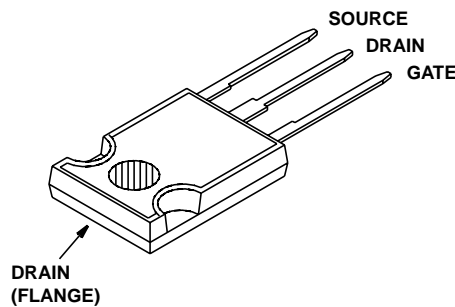
- 23A, 400V
- $r_{DS(ON)} = 0.200\Omega$
- Single Pulse Avalanche Energy Rated
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

**Symbol**



**Packaging**

**JEDEC STYLE TO-247**



# IRFP360

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

	IRFP360	UNITS
Drain to Source Voltage (Note 1) . . . . .	$V_{DS}$	400 V
Drain to Gate Voltage ( $R_{GS} = 20k\Omega$ ) (Note 1) . . . . .	$V_{DGR}$	400 V
Continuous Drain Current . . . . .	$I_D$	23 A
$T_C = 100^\circ\text{C}$ . . . . .	$I_D$	14 A
Pulsed Drain Current (Note 3) . . . . .	$I_{DM}$	92 A
Gate to Source Voltage . . . . .	$V_{GS}$	$\pm 20$ V
Maximum Power Dissipation . . . . .	$P_D$	250 W
Linear Derating Factor . . . . .		2 $W/^\circ\text{C}$
Single Pulse Avalanche Energy Rating (Note 4) . . . . .	$E_{AS}$	1200 mJ
Operating and Storage Temperature . . . . .	$T_J, T_{STG}$	-55 to 150 $^\circ\text{C}$
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from case for 10s . . . . .	$T_L$	300
Package Body for 10s, see Techbrief 334 . . . . .	$T_{pkg}$	260

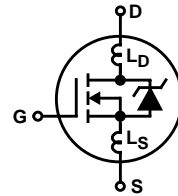
CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTE:

- $T_J = 25^\circ\text{C}$  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	$BV_{DSS}$	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$ (Figure 10)	400	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2	-	4	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)	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}, V_{GS} = 10\text{V}$	23	-	-	A
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA
On Resistance (Note 2)	$r_{DS(ON)}$	$I_D = 13\text{A}, V_{GS} = 10\text{V}$ (Figures 8, 9)	-	0.18	0.20	$\Omega$
Forward Transconductance (Note 2)	$g_{fs}$	$V_{DS} \geq 50\text{V}, I_{DS} > 13\text{A}$ (Figure 12)	14	21	-	S
Turn-On Delay Time	$t_{d(ON)}$	$V_{DD} = 200\text{V}, I_D \approx 25\text{A}, R_{GS} = 4.3\Omega, V_{GS} = 10\text{V}, R_L = 7.5\Omega$ MOSFET Switching Times are Essentially Independent of Operating Temperature	-	22	33	ns
Rise Time	$t_r$		-	94	140	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	80	120	ns
Fall Time	$t_f$		-	66	99	ns
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(TOT)}$	$V_{GS} = 10\text{V}, I_D = 25\text{A}, V_{DS} = 0.8 \times \text{Rated } BV_{DSS}$ $I_{G(REF)} = 1.5\text{mA}$ (Figure 14)	-	68	100	nC
Gate to Source Charge	$Q_{gs}$	Gate Charge is Essentially Independent of Operating Temperature	-	17	-	nC
Gate to Drain "Miller" Charge	$Q_{gd}$		-	24	-	nC
Input Capacitance	$C_{ISS}$		$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ (Figure 11)	-	4000	-
Output Capacitance	$C_{OSS}$		-	550	-	pF
Reverse Transfer Capacitance	$C_{RSS}$		-	97	-	pF
Internal Drain Inductance	$L_D$	Measured between the Contact Screw on Header closer to Source and Gate Pins and Center of Die	-	5.0	-	nH
Internal Source Inductance	$L_S$	Measured from the Source Lead, 6mm (0.25in) from Header and Source Bonding Pad	-	13	-	nH
Thermal Resistance Junction to Case	$R_{\theta JC}$		-	-	0.50	$^\circ\text{C/W}$
Thermal Resistance 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 Rectifier	-	-	23	A
Pulse Source to Drain Current (Note 2)	$I_{SDM}$		-	-	92	A
Source to Drain Diode Voltage (Note 2)	$V_{SD}$	$T_J = 25^{\circ}\text{C}$ , $I_{SD} = 23\text{A}$ , $V_{GS} = 0\text{V}$ (Figure 13)	-	-	1.8	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}$ , $I_{SD} = 25\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	200	460	1000	ns
Reverse Recovery Charge	$Q_{RR}$	$T_J = 25^{\circ}\text{C}$ , $I_{SD} = 25\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	3.1	7.1	16	$\mu\text{C}$

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  $T_J = 25^{\circ}\text{C}$ ,  $L = 4\text{mH}$ ,  $R_G = 25\Omega$ , Peak  $I_{AS} = 23\text{A}$ .

Typical Performance Curves Unless Otherwise Specified

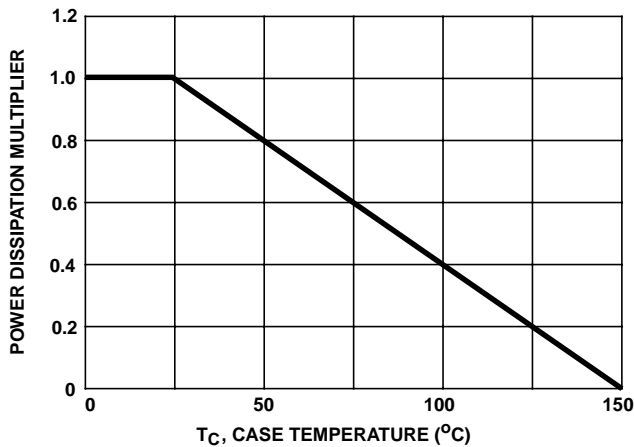


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

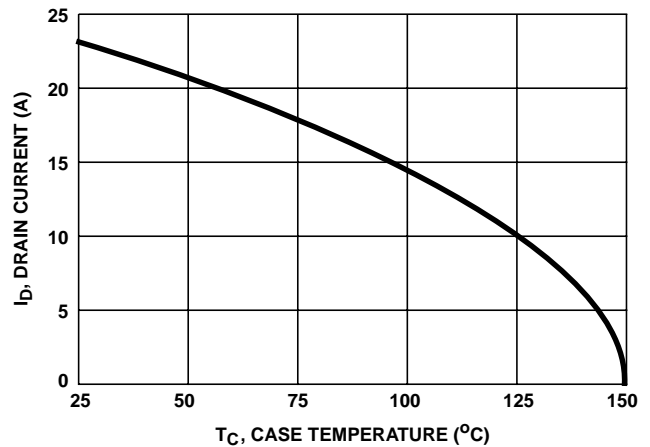


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

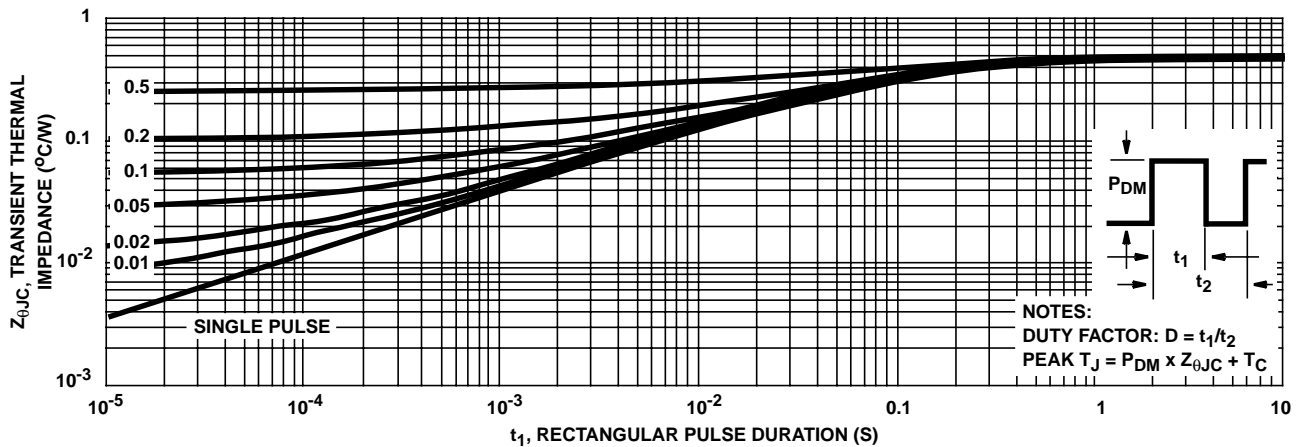


FIGURE 3. TRANSIENT THERMAL IMPEDANCE

Typical Performance Curves Unless Otherwise Specified (Continued)

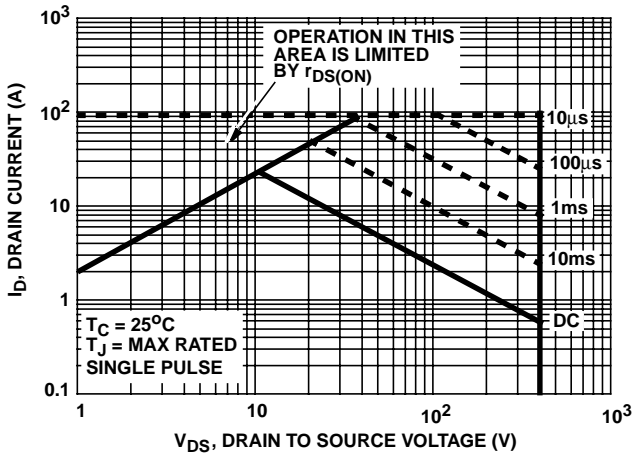


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

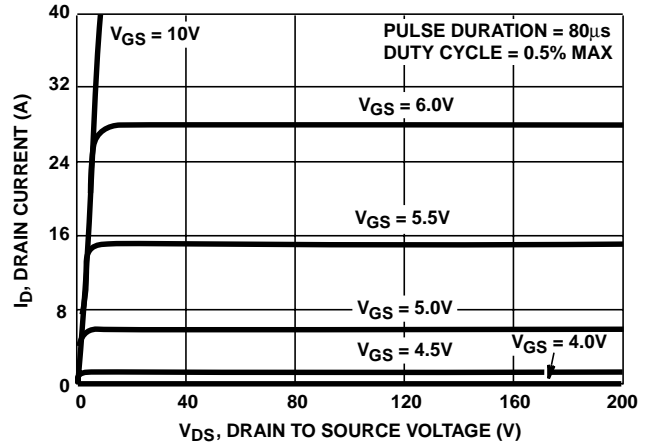


FIGURE 5. OUTPUT CHARACTERISTICS

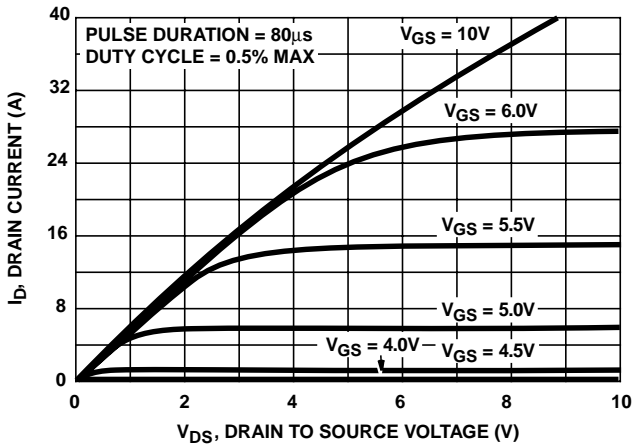


FIGURE 6. SATURATION CHARACTERISTICS

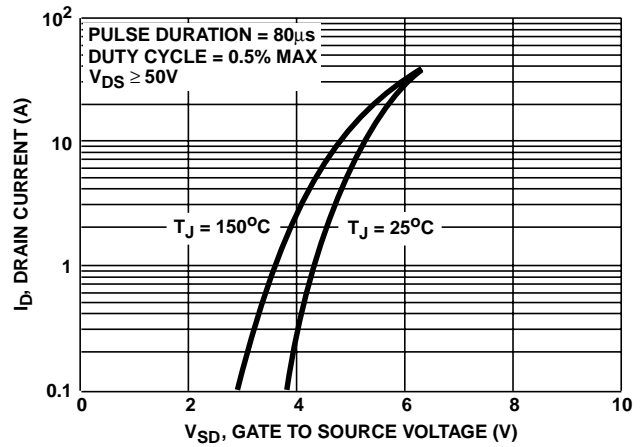


FIGURE 7. TRANSFER CHARACTERISTICS

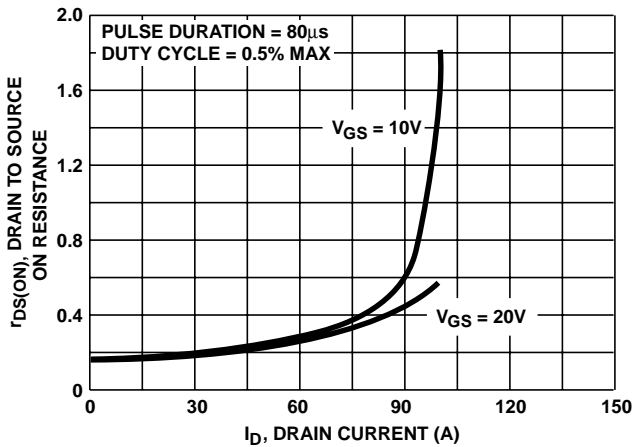


FIGURE 8. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

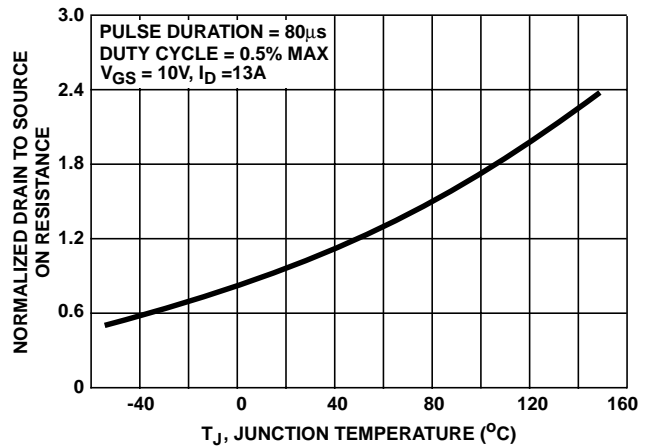


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

Typical Performance Curves Unless Otherwise Specified (Continued)

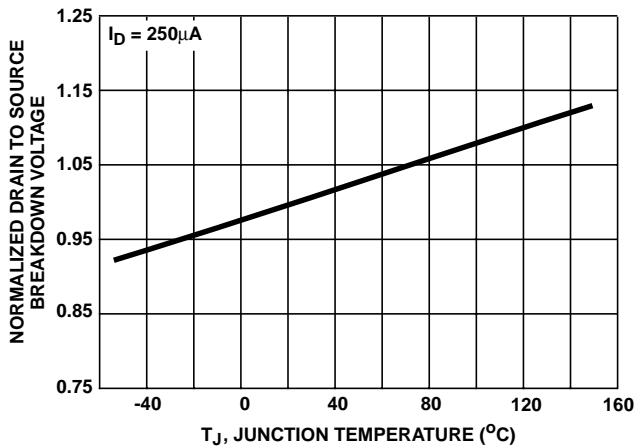


FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

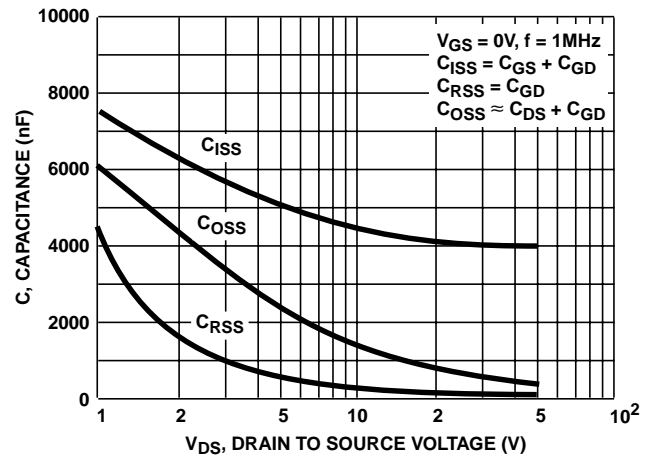


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

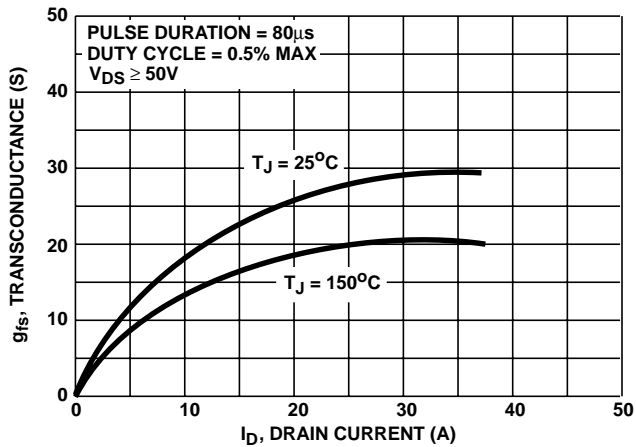


FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT

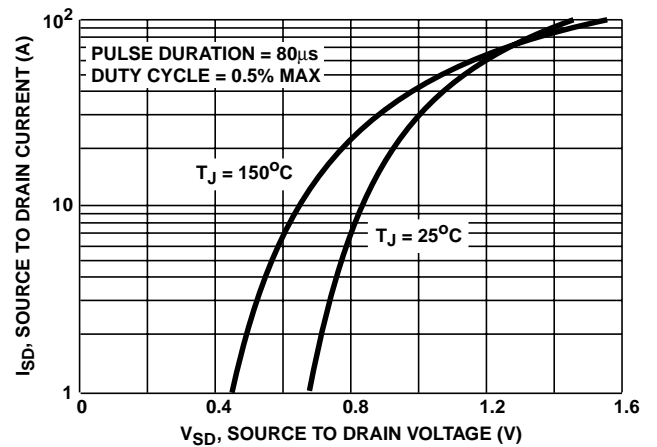


FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE

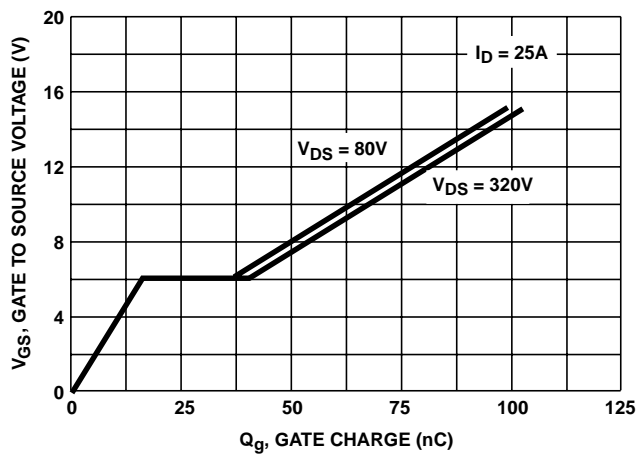


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

Test Circuits and Waveforms

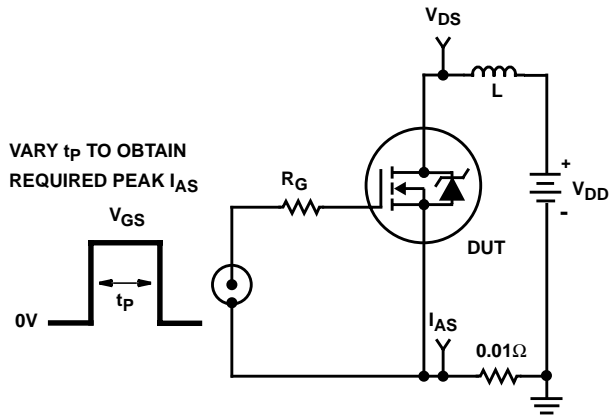


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

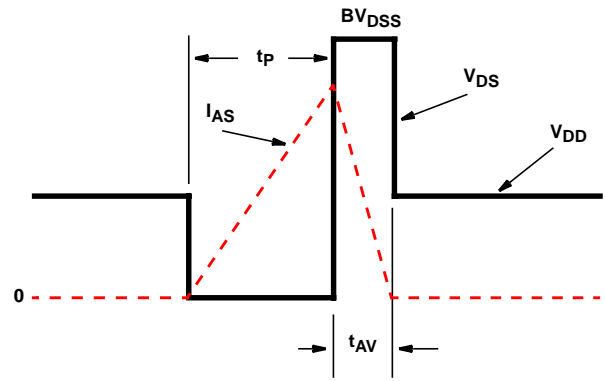


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

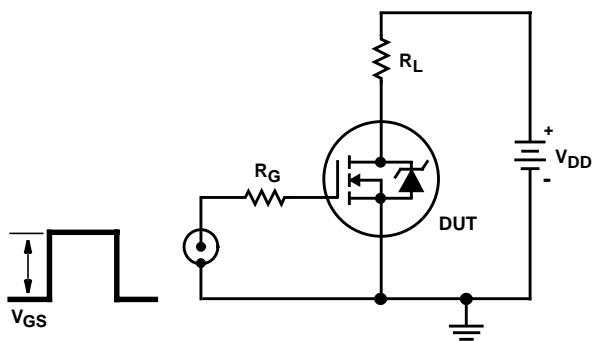


FIGURE 17. SWITCHING TIME TEST CIRCUIT

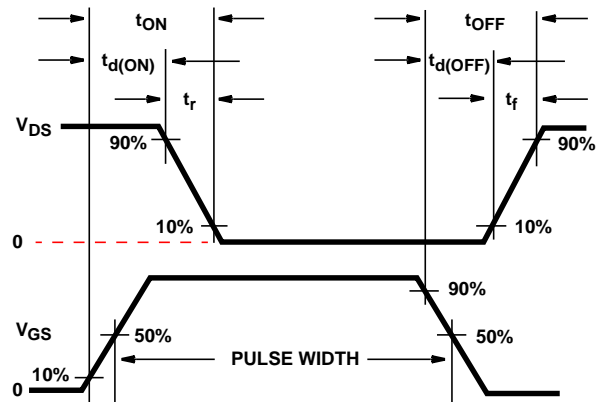


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

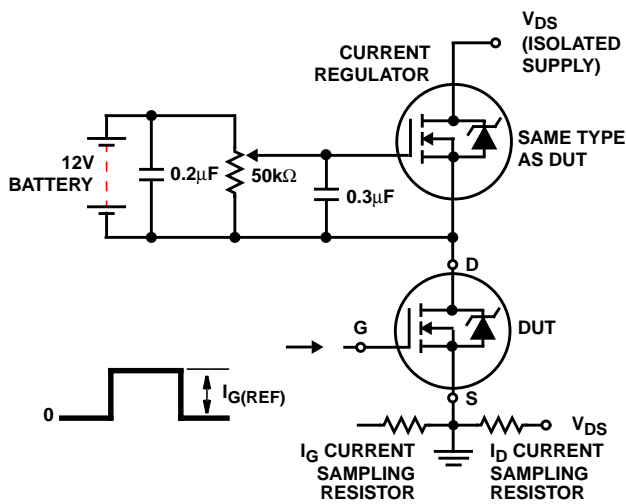


FIGURE 19. GATE CHARGE TEST CIRCUIT

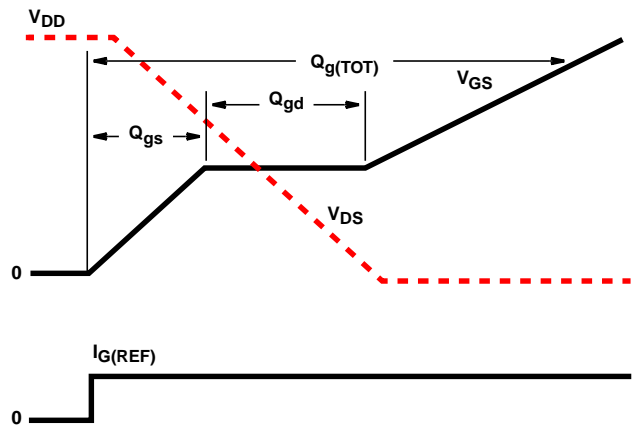


FIGURE 20. GATE CHARGE WAVEFORMS

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### **Sales Office Headquarters**

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Intersil Corporation  
P. O. Box 883, Mail Stop 53-204  
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TEL: (407) 724-7000  
FAX: (407) 724-7240

#### **EUROPE**

Intersil SA  
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100, Rue de la Fusee  
1130 Brussels, Belgium  
TEL: (32) 2.724.2111  
FAX: (32) 2.724.22.05

#### **ASIA**

Intersil (Taiwan) Ltd.  
7F-6, No. 101 Fu Hsing North Road  
Taipei, Taiwan  
Republic of China  
TEL: (886) 2 2716 9310  
FAX: (886) 2 2715 3029

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