

### 45A, 60V, 0.028 Ohm, N-Channel Power MOSFETs

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 convertors, 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 TA49028.

### Ordering Information

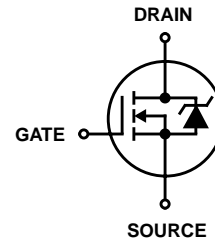
PART NUMBER	PACKAGE	BRAND
RFG45N06	TO-247	RFG45N06
RFP45N06	TO-220AB	RFP45N06
RF1S45N06SM	TO-263AB	F1S45N06

NOTE: When ordering, use the entire part number. Add the suffix, 9A, to obtain the TO-263AB variant in tape and reel, i.e. RF1S45N06SM9A.

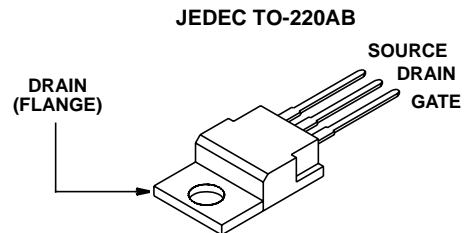
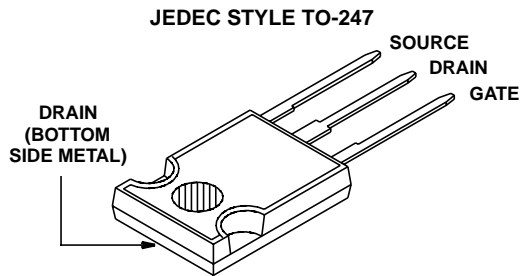
### Features

- 45A, 60V
- $r_{DS(ON)} = 0.028\Omega$
- Temperature Compensating PSPICE® Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- 175°C Operating Temperature
- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

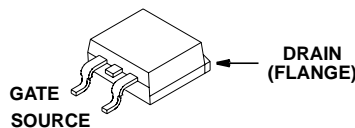
### Symbol



### Packaging



JEDEC TO-263AB



# RFG45N06, RFP45N06, RF1S45N06SM

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

	RFG45N06, RFP45N06	RF1S45N06SM	UNITS
Drain to Source Voltage (Note 1) . . . . .	$V_{DSS}$	60	V
Drain to Gate Voltage ( $R_G = 20\text{K}\Omega$ ) (Note 1) . . . . .	$V_{DGR}$	60	V
Continuous Drain Current . . . . .	$I_D$	45	A
Pulsed Drain Current (Note 3) . . . . .	$I_{DM}$	Refer to Peak Current Curve	
Gate to Source Voltage . . . . .	$V_{GS}$	$\pm 20$	V
Pulsed Avalanche Rating . . . . .	$E_{AS}$	Refer to UIS Curve	
Power Dissipation . . . . .	$P_D$	131	W
Linear Derating Factor . . . . .		0.877	$\text{W}/^\circ\text{C}$
Operating and Storage Temperature . . . . .	$T_J, T_{STG}$	-55 to 175	$^\circ\text{C}$
Maximum Temperature for Soldering			
Leads at 0.063in (1.6mm) from Case for 10s . . . . .	$T_L$	300	$^\circ\text{C}$
Package Body for 10s, See Techbrief 334 . . . . .	$T_{pk}$	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  $150^\circ\text{C}$ .

## 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 11)	60	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ (Figure 10)	2	-	4	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$ ( $125^\circ\text{C}$ )	-	-	25	$\mu\text{A}$
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA
Drain Source On Resistance (Note 2)	$r_{DS(ON)}$	$I_D = 45\text{A}, V_{GS} = 10\text{V}$ (Figure 9)	-	-	0.028	$\Omega$
Turn-On Time	$t_{ON}$	$V_{DD} = 30\text{V}, I_D = 45\text{A}$ $R_L = 0.667\Omega, V_{GS} = +10\text{V}$ $R_G = 3.6\Omega$ (Figure 13)	-	-	120	ns
Turn-On Delay Time	$t_{d(ON)}$		-	12	-	ns
Rise Time	$t_r$		-	74	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	37	-	ns
Fall Time	$t_f$		-	16	-	ns
Turn-Off Time	$t_{OFF}$		-	-	80	ns
Total Gate Charge	$Q_{g(TOT)}$	$V_{GS} = 0$ to $20\text{V}$	-	125	150	nC
Gate Charge at 10V	$Q_{g(10)}$	$V_{GS} = 0$ to $10\text{V}$				
Threshold Gate Charge	$Q_{g(TH)}$	$V_{GS} = 0$ to $2\text{V}$				
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$ (Figure 12)	-	2050	-	pF
Output Capacitance	$C_{OSS}$		-	600	-	pF
Reverse Transfer Capacitance	$C_{RSS}$		-	200	-	pF
Thermal Resistance Junction to Case	$R_{\theta JC}$		-	-	1.14	$^\circ\text{C}/\text{W}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$		-	-	80	$^\circ\text{C}/\text{W}$

## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	$V_{SD}$	$I_{SD} = 45\text{A}$	-	-	1.5	V
Diode Reverse Recovery Time	$t_{rr}$	$I_{SD} = 45\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	125	ns

**NOTES:**

2. Pulse test: pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
3. Repetitive rating: pulse width limited by maximum junction temperature. See Transient Thermal Impedance curve (Figure 3) and Peak Current Capability Curve (Figure 5).

Typical Performance Curves Unless Otherwise Specified

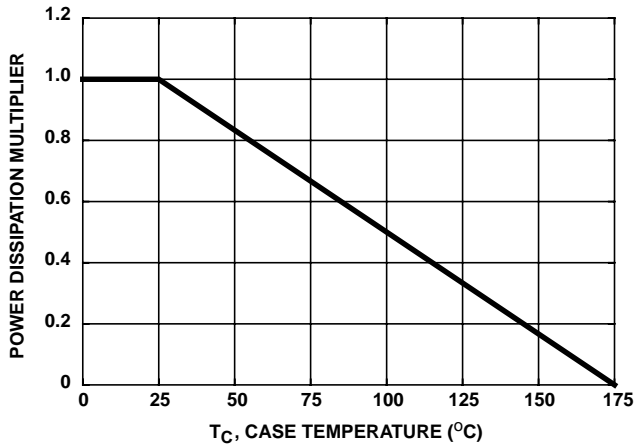


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

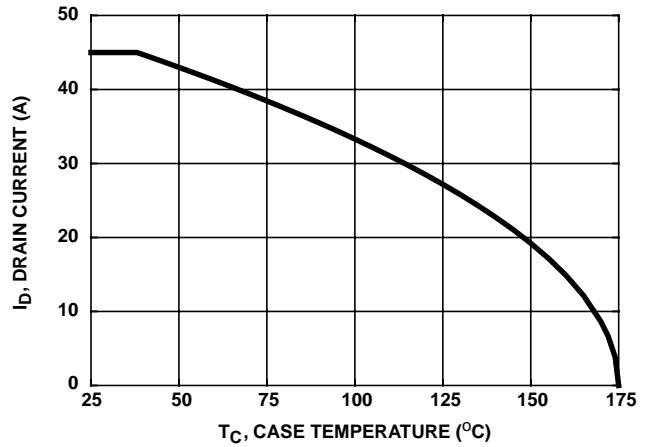


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

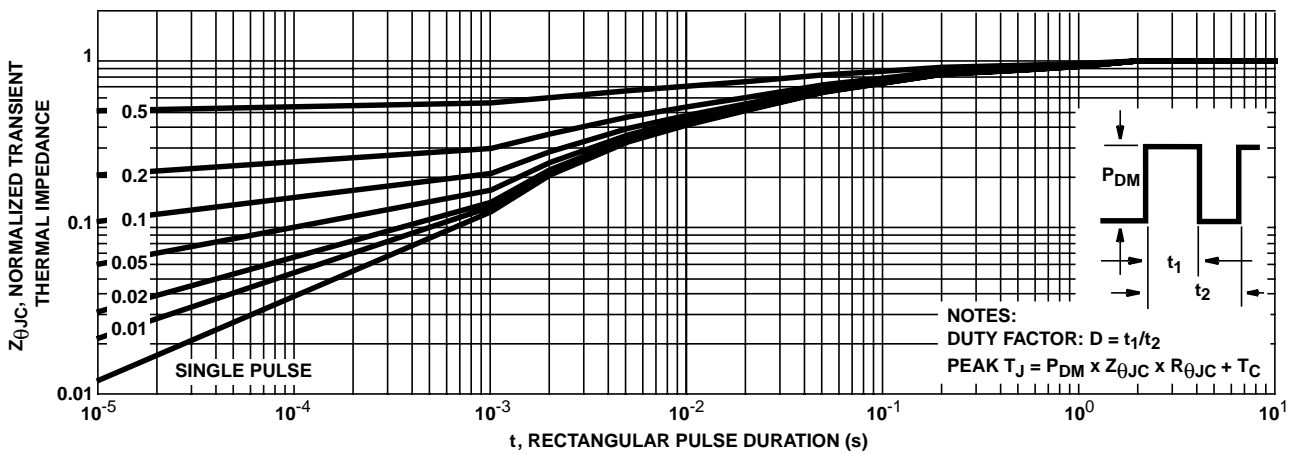


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

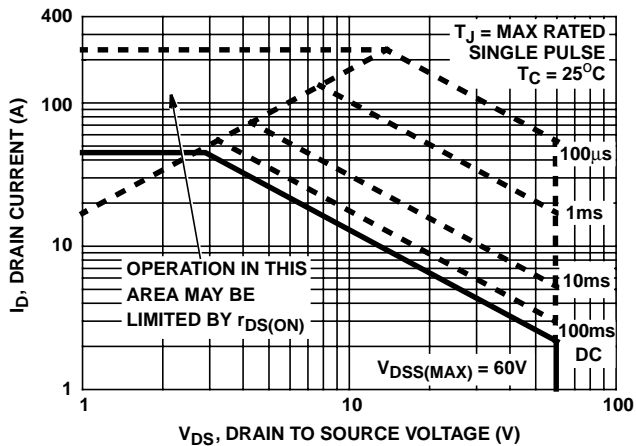


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

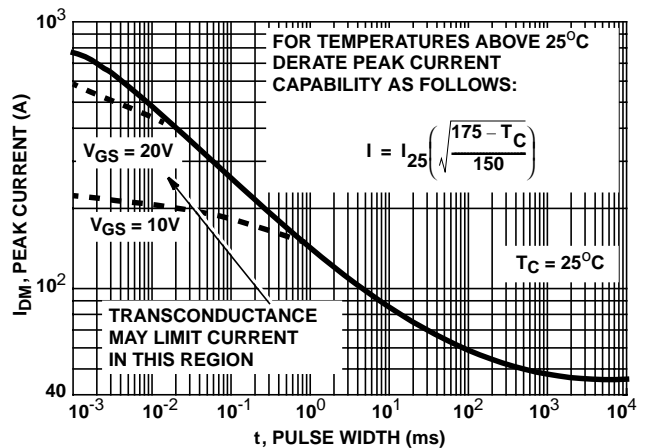
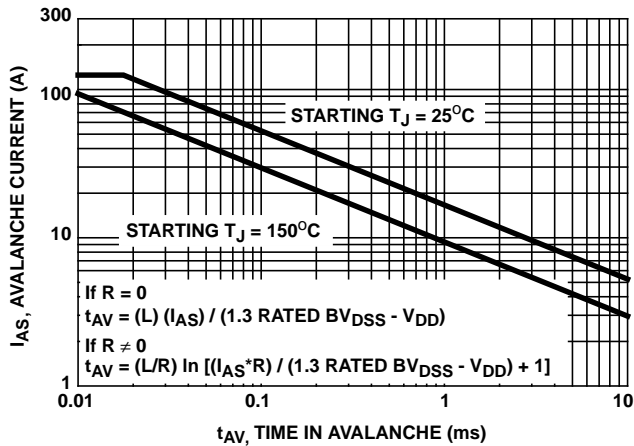


FIGURE 5. PEAK CURRENT CAPABILITY

Typical Performance Curves Unless Otherwise Specified (Continued)



NOTE: Refer to Intersil Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING

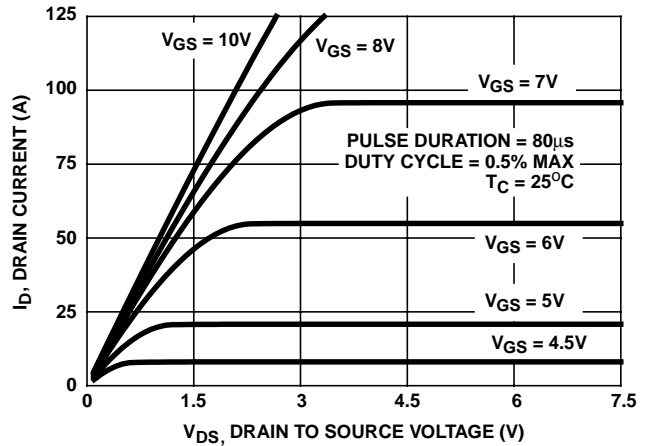


FIGURE 7. SATURATION CHARACTERISTICS

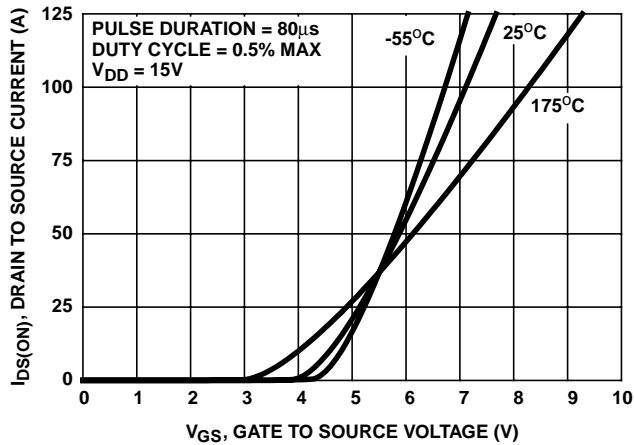


FIGURE 8. TRANSFER CHARACTERISTICS

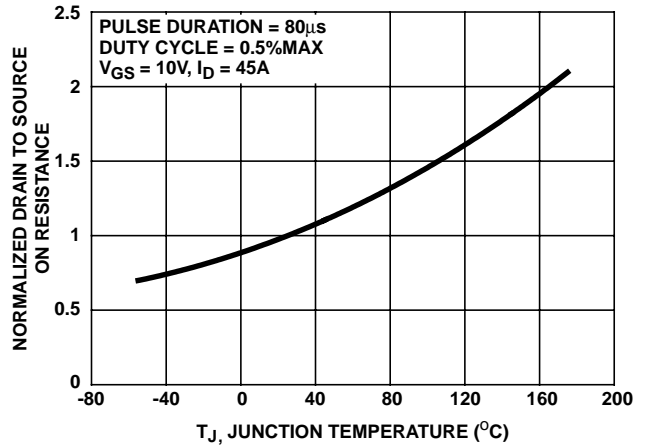


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

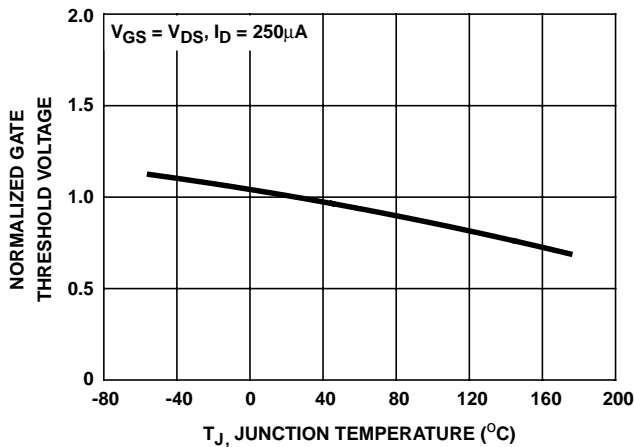


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

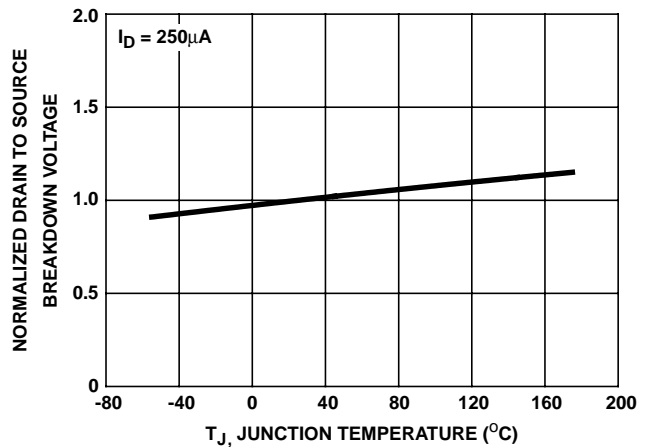


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

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

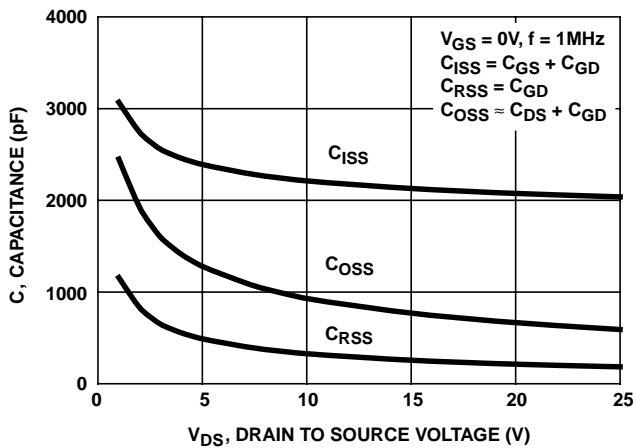
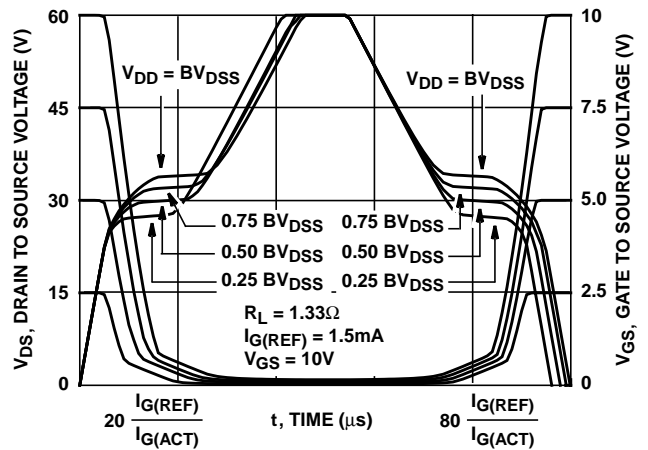


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Intersil Application Notes AN7254 and AN7260.

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

**Test Circuits and Waveforms**

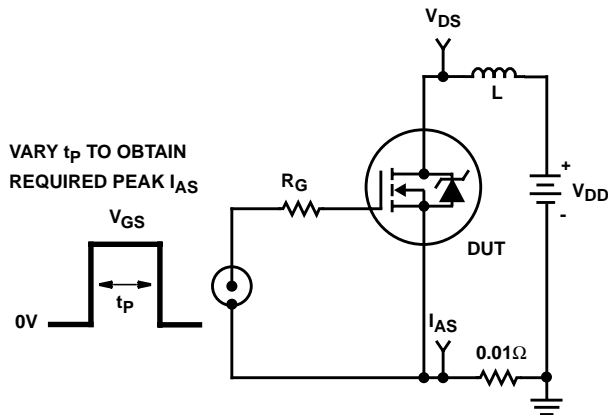


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

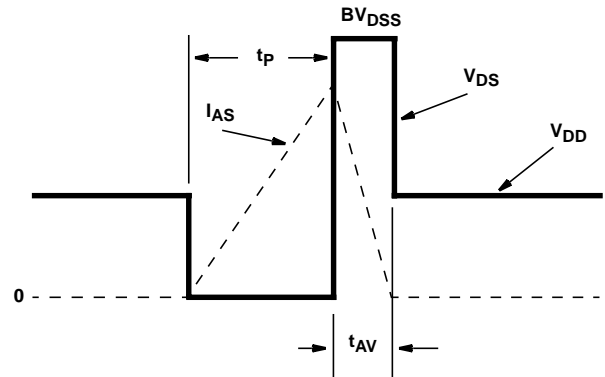


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

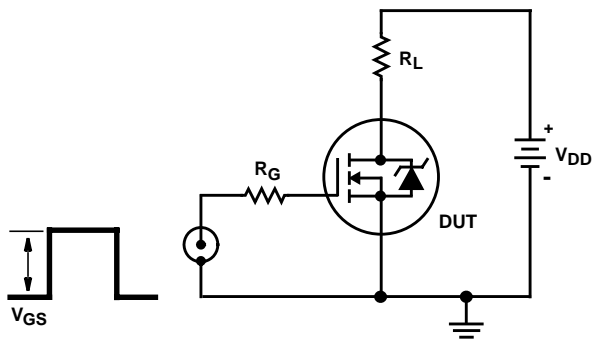


FIGURE 16. SWITCHING TIME TEST CIRCUIT

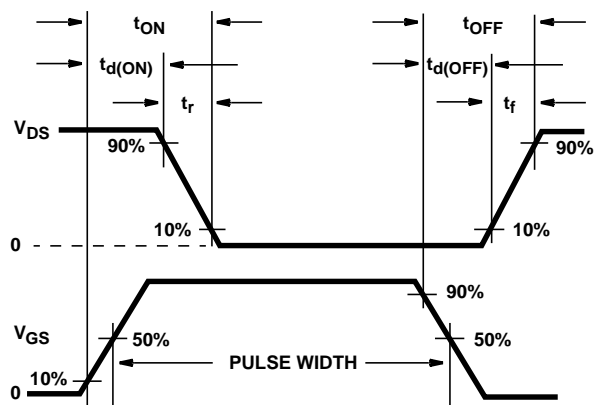


FIGURE 17. RESISTIVE SWITCHING WAVEFORMS

Test Circuits and Waveforms

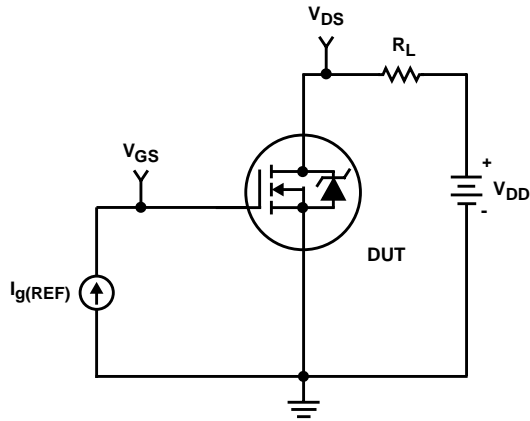


FIGURE 18. GATE CHARGE TEST CIRCUIT

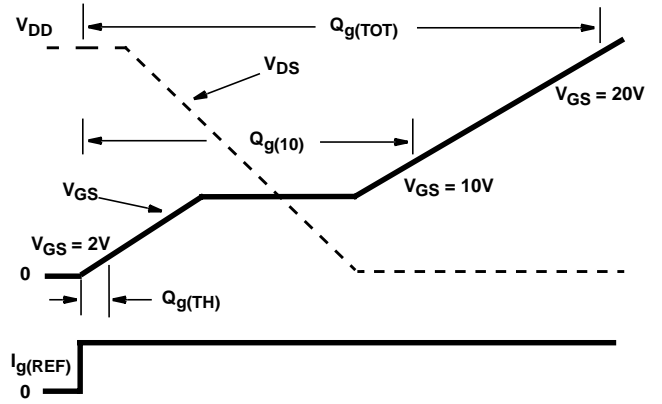


FIGURE 19. GATE CHARGE WAVEFORMS

**PSPICE Electrical Model**

.SUBCKT RFP45N06 2 1 3

REV 1/18/93

\*NOM TEMP = +25°C

CA 12 8 3.49E-9

CB 15 14 3.8E-9

CIN 6 8 2E-9

DBODY 7 5 DBDMOD  
DBREAK 5 11 DBKMOD  
DPLCAP 10 5 DPLCAPMOD

EBREAK 11 7 17 18 66.5

EDS 14 8 5 8 1

EGS 13 8 6 8 1

ESG 6 10 6 8 1

EVTO 20 6 18 8 1

IT 8 17 1

LDRAIN 2 5 1E-9

LGATE 1 9 5.65E-9

LSOURCE 3 7 4.13E-9

MOS1 16 6 8 8 MOSMOD M=0.99

MOS2 16 21 8 8 MOSMOD M=0.01

RBREAK 17 18 RBKMOD 1  
RDRAIN 5 16 RDSMOD 3.58E-3  
RGATE 9 20 0.681  
RIN 6 8 1E9  
RSOURCE 8 7 RDSMOD 13.6E-3  
RVTO 18 19 RVTOMOD 1

S1A 6 12 13 8 S1AMOD  
S1B 13 12 13 8 S1BMOD  
S2A 6 15 14 13 S2AMOD  
S2B 13 15 14 13 S2BMOD

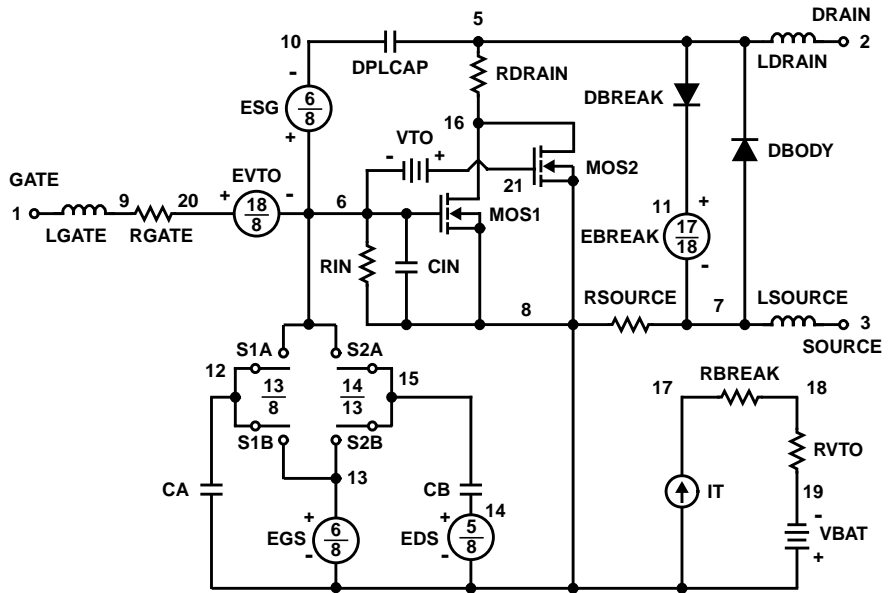
VBAT 8 19 DC 1

VTO 21 6 0.92

.MODEL DBDMOD D (IS=8.2E-13 RS=7.86E-3 TRS1=2.26E-3 TRS2=2.90E-6 CJO=2.07E-9 TT=5.72E-8)  
.MODEL DBKMOD D (RS=1.93E-1 TRS1=5.13E-4 TRS2=-2.15E-5)  
.MODEL DPLCAPMOD D (CJO=1.25E-9 IS=1E-30 N=10)  
.MODEL MOSMOD NMOS (VTO=3.862 KP=55.57 IS=1E-30 N=10 TOX=1 L=1U W=1U)  
.MODEL RBKMOD RES (TC1=1.12E-3 TC2=-5.18E-7)  
.MODEL RDSMOD RES (TC1=4.64E-3 TC2=1.58E-5)  
.MODEL RVTOMOD RES (TC1=-4.27E-3 TC2=-6.55E-6)  
.MODEL S1AMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-6.5 VOFF=-1.7)  
.MODEL S1BMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-1.7 VOFF=-6.5)  
.MODEL S2AMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-3.0 VOFF=2)  
.MODEL S2BMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=2.0 VOFF=-3.0)

.ENDS

NOTE: For further discussion of the PSPICE model consult **A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options**; authors, William J. Hepp and C. Frank Wheatley.



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