## 50A, 60V, 0.022 Ohm, N-Channel Power MOSFETs

These N-Channel power MOSFETs are manufactured using the MegaFET process. This process, which uses feature sizes approaching those of LSI integrated circuits gives optimum utilization of silicon, resulting in outstanding performance. They were designed for use in applications such as switching regulators, switching converters, motor drivers, and relay drivers. These transistors can be operated directly from integrated circuits.

Formerly developmental type TA49018.

## Ordering Information

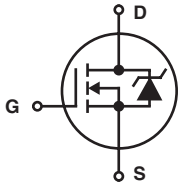
| PART NUMBER | PACKAGE | BRAND |
|---|---|---|
| RFG50N06 | TO-247 | RFG50N06 |
| RFP50N06 | TO-220AB | RFP50N06 |
| RF1S50N06SM | TO-263AB | F1S50N06 |

NOTE: When ordering, use the entire part number. Add the suffix, 9A, to obtain the TO-263AB variant in tape and reel, i.e. RF1S50N06SM9A.

## Features

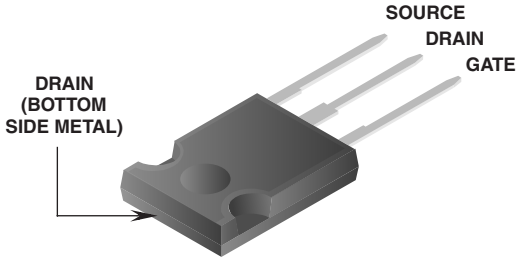
- 50A, 60V
- $r_{DS(ON)} = 0.022\Omega$
- Temperature Compensating PSPICE® Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- 175°C Operating Temperature

## Symbol

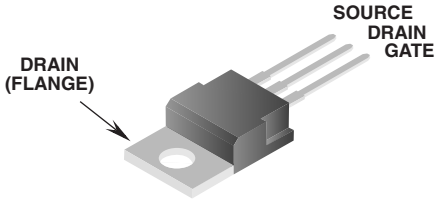



## Packaging

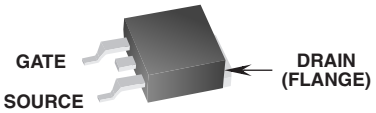
**JEDEC STYLE TO-247**




**JEDEC TO-220AB**




**JEDEC TO-263AB**




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## Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

| | | RFG50N06, RFP50N06 RF1S50N06SM | UNITS |
|---|---|---|---|
| Drain to Source Voltage (Note 1) | $V_{DSS}$ | 60 | V |
| Drain to Gate Voltage ($R_{GS}$ = 20kΩ) (Note 1) | $V_{DGR}$ | 60 | V |
| Gate to Source Voltage | $V_{GS}$ | ±20 | V |
| Continuous Drain Current (Figure 2) | $I_D$ | 50 | A |
| Pulsed Drain Current | $I_{DM}$ | (Figure 5) | |
| Pulsed Avalanche Rating | $E_{AS}$ | (Figure 6) | |
| Power Dissipation | $P_D$ | 131 | W |
| Linear Derating Factor | | 0.877 | $W/^oC$ |
| Operating and Storage Temperature | $T_J$, $T_{STG}$ | -55 to 175 | $^oC$ |
| Maximum Temperature for Soldering | | | |
| Leads at 0.063in (1.6mm) from Case for 10s | $T_L$ | 300 | $^oC$ |
| Package Body for 10s, see Techbrief 334 | $T_{pkg}$ | 260 | $^oC$ |

*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. $T_J = 25^oC$ to $150^oC$.

## Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Drain to Source Breakdown Voltage | $BV_{DSS}$ | $I_D$ = 250μA, $V_{GS}$ = 0V (Figure 11) | | 60 | - | - | V |
| Gate to Source Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA (Figure 10) | | 2 | - | 4 | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 60V, $V_{GS}$ = 0V | $T_C = 25^oC$ | - | - | 1 | μA |
| | | | $T_C = 150^oC$ | - | - | 50 | μA |
| Gate to Source Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±20V | | - | - | ±100 | nA |
| Drain to Source On Resistance | $r_{DS(ON)}$ | $I_D$ = 50A, $V_{GS}$ = 10V (Figures 9) | | - | - | 0.022 | Ω |
| Turn-On Time | $t_{ON}$ | $V_{DD}$ = 30V, $I_D$ = 50A $R_L$ = 0.6Ω, $V_{GS}$ = 10V $R_{GS}$ = 3.6Ω (Figure 13) | | - | - | 95 | ns |
| Turn-On Delay Time | $t_{d(ON)}$ | | | - | 12 | - | ns |
| Rise Time | $t_r$ | | | - | 55 | - | ns |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | - | 37 | - | ns |
| Fall Time | $t_f$ | | | - | 13 | - | ns |
| Turn-Off Time | $t_{OFF}$ | | | - | - | 75 | ns |
| Total Gate Charge | $Q_{g(TOT)}$ | $V_{GS}$ = 0 to 20V | $V_{DD}$ = 48V, $I_D$ = 50A, $R_L$ = 0.96Ω $I_{g(REF)}$ = 1.45mA (Figure 13) | - | 125 | 150 | nC |
| Gate Charge at 10V | $Q_{g(10)}$ | $V_{GS}$ = 0 to 10V | | - | 67 | 80 | nC |
| Threshold Gate Charge | $Q_{g(TH)}$ | $V_{GS}$ = 0 to 2V | | - | 3.7 | 4.5 | nC |
| Input Capacitance | $C_{ISS}$ | $V_{DS}$ = 25V, $V_{GS}$ = 0V f = 1MHz (Figure 12) | | - | 2020 | - | pF |
| Output Capacitance | $C_{OSS}$ | | | - | 600 | - | pF |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | - | 200 | - | pF |
| Thermal Resistance Junction to Case | $R_{\theta JC}$ | (Figure 3) | | - | - | 1.14 | $^oC/W$ |
| Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | TO-247 | | - | - | 30 | $^oC/W$ |
| | | TO-220, TO-263 | | - | - | 62 | $^oC/W$ |

## Source to Drain Diode Specifications

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Source to Drain Diode Voltage | $V_{SD}$ | $I_{SD}$ = 50A | - | - | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_{SD}$ = 50A, $dI_{SD}/dt$ = 100A/μs | - | - | 125 | ns |

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## *Typical Performance Curves* Unless Otherwise Specified

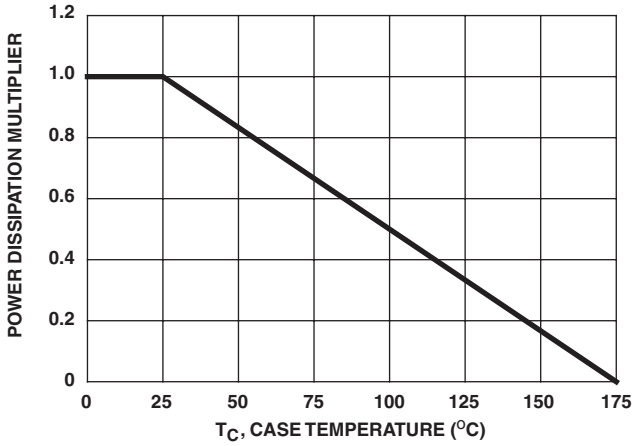



**FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE**

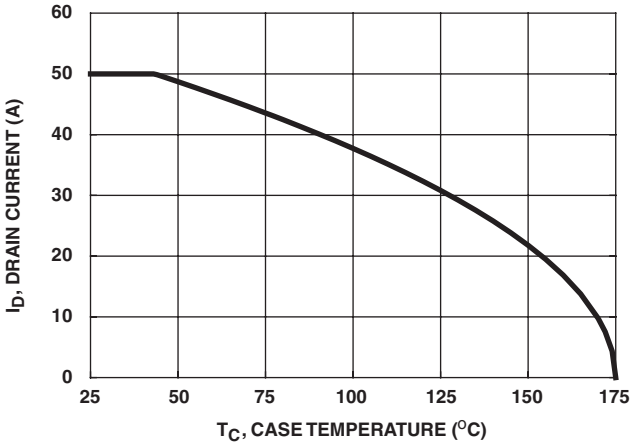



**FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE**

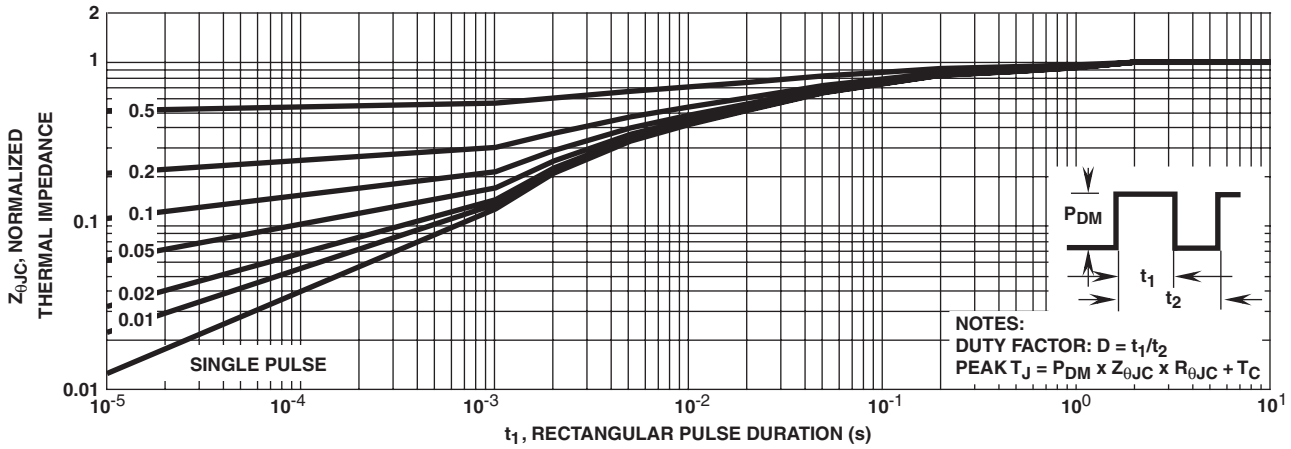



**FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE**

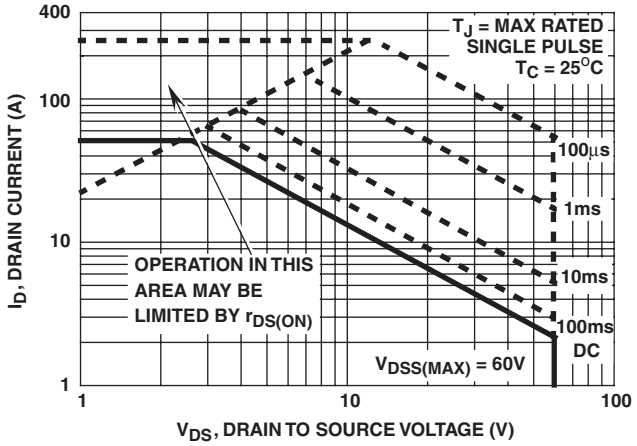



**FIGURE 4. FORWARD BIAS SAFE OPERATING AREA**

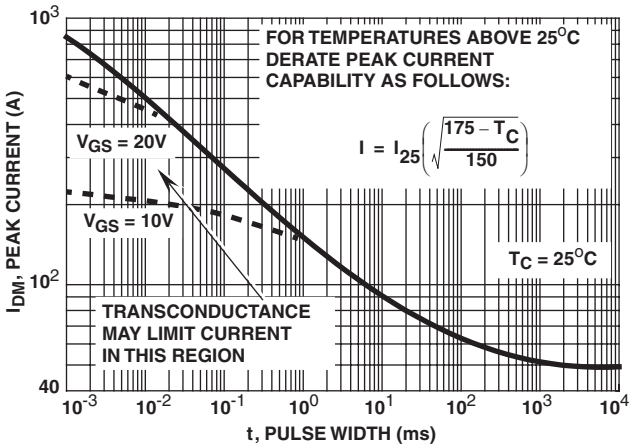
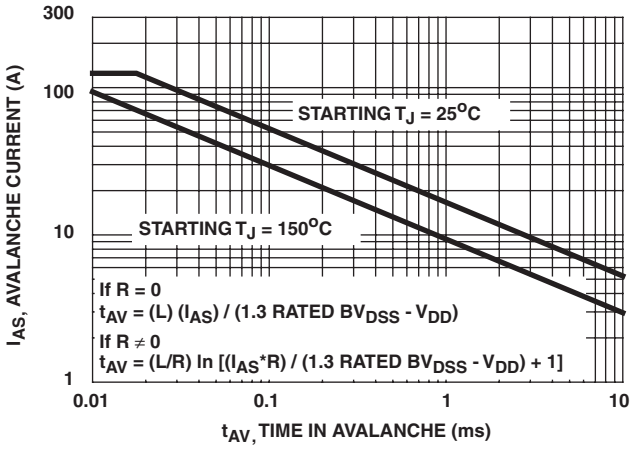



**FIGURE 5. PEAK CURRENT CAPABILITY**

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




NOTE: Refer to Fairchild Application Notes 9321 and 9322.

**FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY**

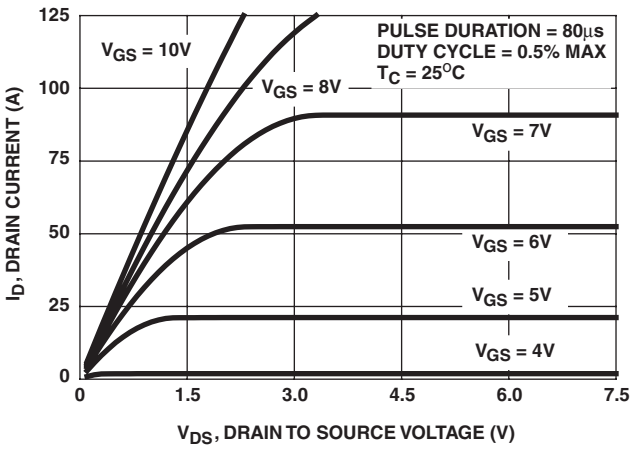



**FIGURE 7. SATURATION CHARACTERISTICS**

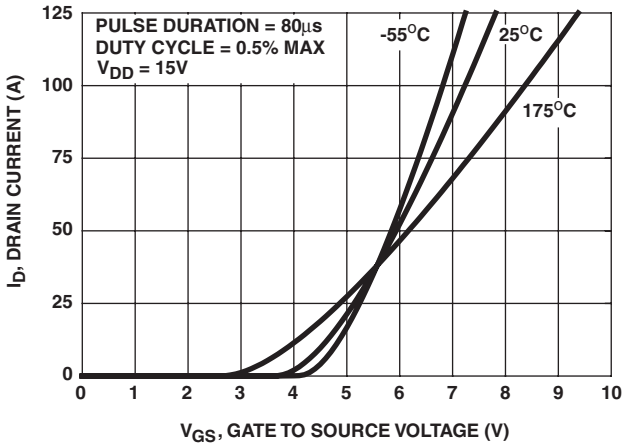



**FIGURE 8. TRANSFER CHARACTERISTICS**

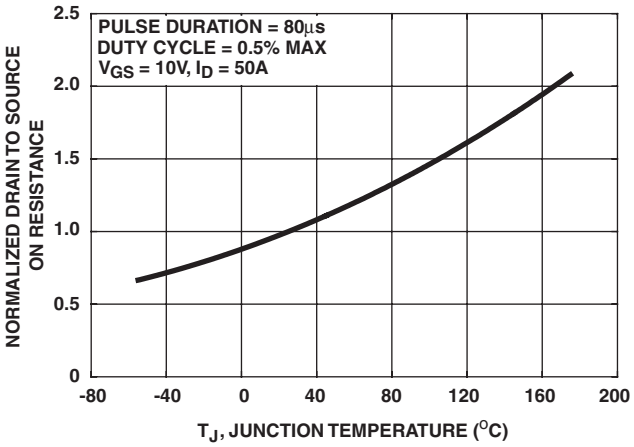



**FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE**

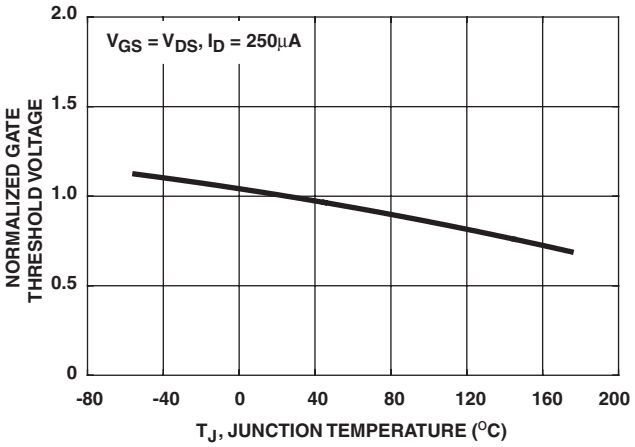



**FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE**

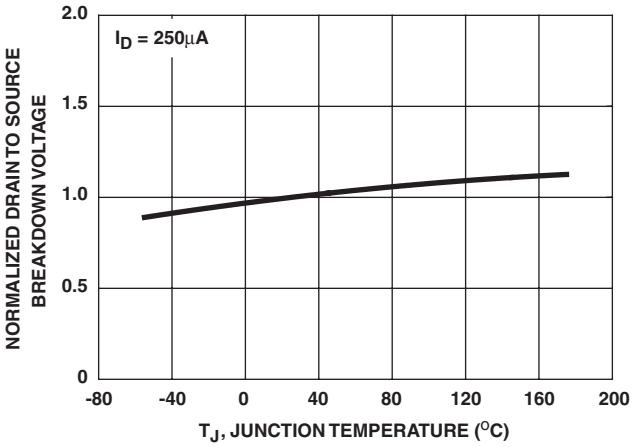



**FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE**

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## Typical Performance Curves Unless Otherwise Specified (Continued)

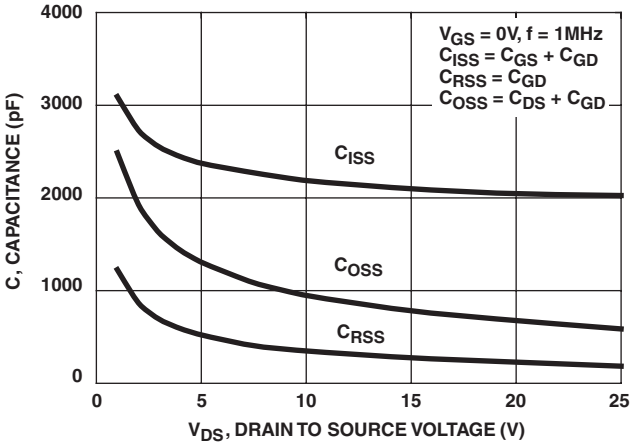
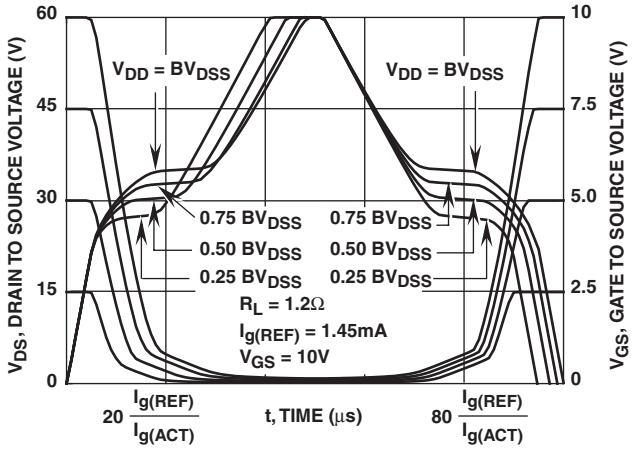



FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE




NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

## Test Circuits and Waveforms

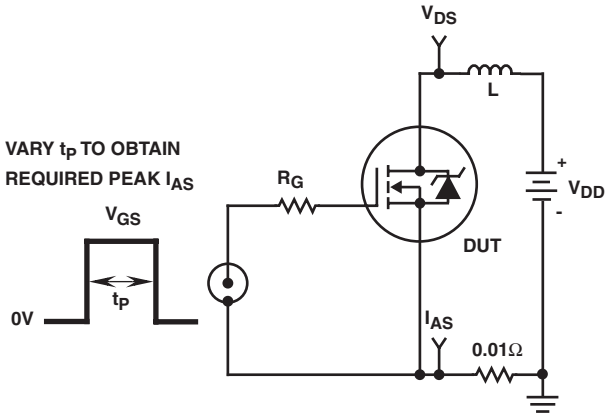



FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

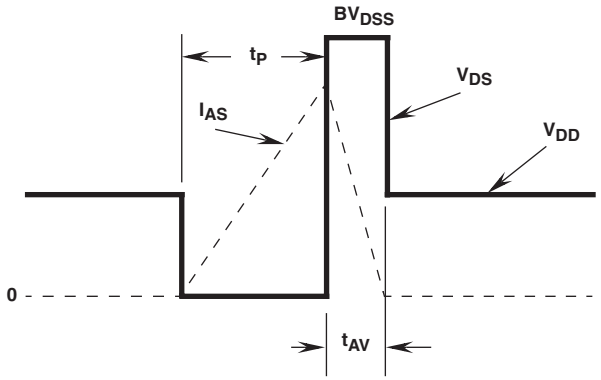



FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

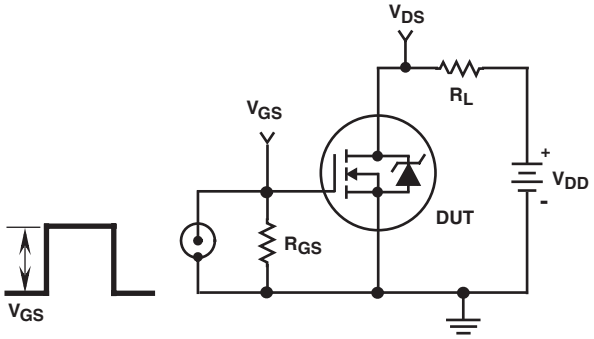



FIGURE 16. SWITCHING TIME TEST CIRCUIT

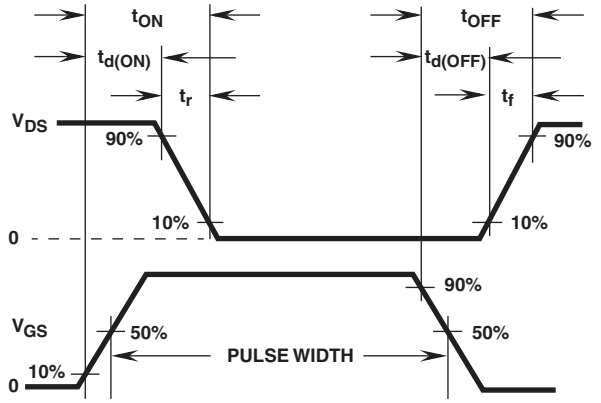



FIGURE 17. SWITCHING WAVEFORMS

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## Test Circuits and Waveforms (Continued)

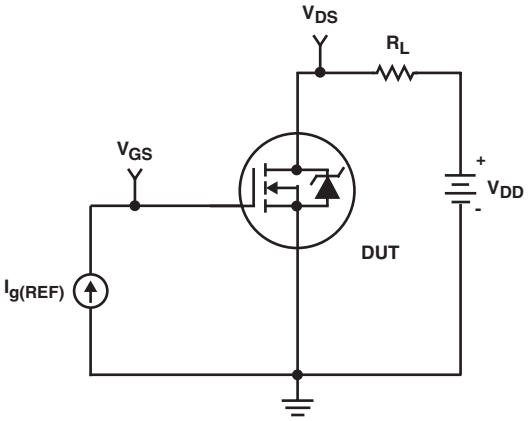



FIGURE 18. GATE CHARGE TEST CIRCUIT

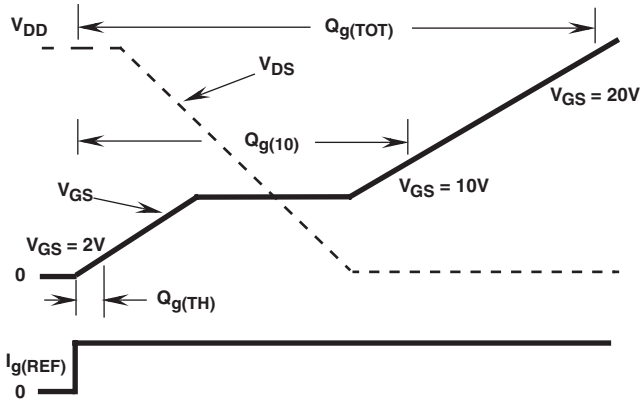



FIGURE 19. GATE CHARGE WAVEFORMS

## *PSPICE Electrical Model*

```
.SUBCKT RFP50N06  2  1  3

 REV 2/22/93

*NOM TEMP = 25°C


CA 12 8 3.68e-9
CB 15 14 3.625e-9
CIN 6 8 1.98e-9

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

EBREAK 11 7 17 18 64.59
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

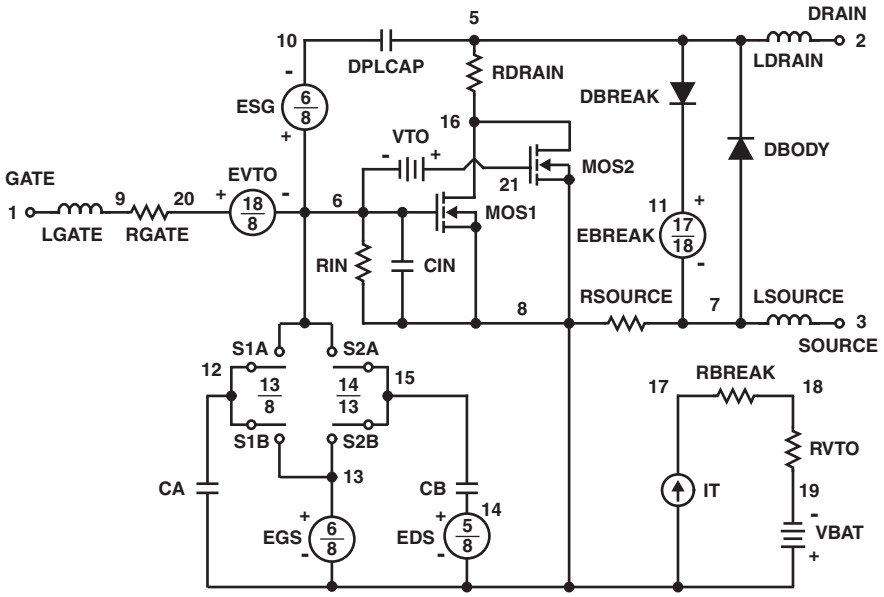
RBREAK 17 18 RBKMOD 1
RDRAIN 5 16 RDSMOD 1e-4
RGATE 9 20 0.690
RIN 6 8 1e9
RSOURCE 8 7 RDSMOD 12e-3
RVTO 18 19 RVTOMOD 1

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 0.678

.MODEL DBDMOD D (IS=9.85e-13 RS=4.91e-3 TRS1=2.07e-3 TRS2=2.51e-7 CJO=2.05e-9 TT=4.33e-8)
.MODEL DBKMOD D (RS=1.98e-1 TRS1=2.35E-4 TRS2=-3.83e-6)
.MODEL DPLCAPMOD D (CJO=1.42e-9 IS=1e-30 N=10)
.MODEL MOSMOD NMOS (VTO=3.65 KP=35 IS=1e-30 N=10 TOX=1 L=1u W=1u)
.MODEL RBKMOD RES (TC1=1.23e-3 TC2=-2.34e-7)
.MODEL RDSMOD RES (TC1=5.01e-3 TC2=1.49e-5)
.MODEL RVTOMOD RES (TC1=-5.03e-3 TC2=-5.16e-6)
.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-6.75 VOFF=-2.5)
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-2.5 VOFF=-6.75)
.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-2.7 VOFF=2.3)
.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2.3 VOFF=-2.7)

.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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| *CROSSVOLT*™ | GlobalOptoisolator™ | POP™ | SuperSOT™-3 | |
| DenseTrench™ | GTO™ | Power247™ | SuperSOT™-6 | |
| DOME™ | HiSeC™ | PowerTrench® | SuperSOT™-8 | |
| EcoSPARK™ | ISOPLANAR™ | QFET™ | SyncFET™ | |
| $E^2$CMOS™ | LittleFET™ | QS™ | TinyLogic™ | |
| EnSigna™ | MicroFET™ | QT Optoelectronics™ | TruTranslation™ | |
| FACT™ | MicroPak™ | Quiet Series™ | UHC™ | |
| FACT Quiet Series™ | MICROWIRE™ | SILENT SWITCHER® | UltraFET® | |

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