

## 25A, 60V, 0.025 Ohm, N-Channel Power MOSFET

The RFF70N06 N-Channel power MOSFET is manufactured using the MegaFET process. This process, which uses feature sizes approaching those of LSI circuits gives optimum utilization of silicon, resulting in outstanding performance. It was 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.

Reliability screening is available as either commercial or TX/TXV equivalent of MIL-S-19500. Contact Intersil Corporation High-Reliability Marketing group for any desired deviations from the data sheet.

Formerly developmental type TA49007.

### Ordering Information

PART NUMBER	PACKAGE	BRAND
RFF70N06	TO-254AA	RFF70N06

NOTE: When ordering, use the entire part number.

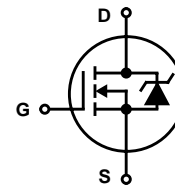
Commercial Version: RFG70N06.

### Features

- 25A†, 60V
- $r_{DS(ON)} = 0.025\Omega$
- Temperature Compensating PSPICE™ Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- 150°C Operating Temperature
- Reliability Screened

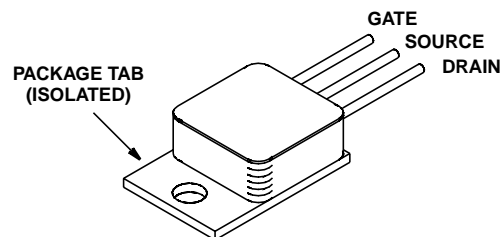
† Current is limited by the package capability.

### Symbol



### Packaging

#### JEDEC TO-254AA



CAUTION: Beryllia Warning per MIL-S-19500.  
Refer to package specifications.

## RFF70N06

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

	RFF70N06	UNITS
Drain to Source Voltage (Note 1) . . . . .	$V_{DSS}$	60 V
Drain to Gate Voltage ( $R_{GS} = 20k\Omega$ ) (Note 1) . . . . .	$V_{DGR}$	60 V
Gate to Source Voltage . . . . .	$V_{GS}$	$\pm 20$ V
Continuous Drain Current (Note 2) . . . . .	$I_D$	25 (Note 2) A
Pulsed Drain Current (Note 4) (Figure 5) . . . . .	$I_{DM}$	Refer to Peak Current Curve
Single Pulse Avalanche Rating (Figure 6) . . . . .	$E_{AS}$	Refer to UIS Curve
Power Dissipation . . . . .	$P_D$	100 W
Linear Derating Factor . . . . .		0.80 W/ $^\circ\text{C}$
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 . . . . .	$T_L$	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:

- $T_J = 25^\circ\text{C}$  to  $125^\circ\text{C}$ .
- Current is limited by the package capability.

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	60	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.0	3.0	4.5	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}, T_C = 125^\circ\text{C}$	-	-	250	$\mu\text{A}$
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}, T_C = 125^\circ\text{C}$	-	-	$\pm 100$	$\mu\text{A}$
Drain to Source On Resistance (Note 3)	$r_{DS(ON)}$	$I_D = 25\text{A}, V_{GS} = 10\text{V}$	-	-	0.025	$\Omega$
Turn-On Time	$t_{ON}$	$V_{DD} = 30\text{V}, I_D \approx 25\text{A}, R_L = 1.2\Omega,$ $V_{GS} = 10\text{V}, R_{GS} = 2.35\Omega$ (Figures 13, 16, 17)	-	-	240	ns
Turn-On Delay Time	$t_{d(ON)}$		-	25	70	ns
Rise Time	$t_r$		-	70	170	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	60	150	ns
Fall Time	$t_f$		-	25	65	ns
Turn-Off Time	$t_{OFF}$		-	-	215	ns
Total Gate Charge	$Q_{g(TOT)}$		$V_{GS} = 0$ to $20\text{V}$	-	-	260
Gate Charge at 10V	$Q_{g(10)}$	$V_{GS} = 0$ to $10\text{V}$	-	-	145	nC
Threshold Gate Charge	$Q_{g(TH)}$	$V_{GS} = 0$ to $2\text{V}$	-	-	7	nC
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ (Figure 12)	-	3100	-	pF
Output Capacitance	$C_{OSS}$		-	900	-	pF
Reverse Transfer Capacitance	$C_{RSS}$		-	300	-	pF
Thermal Resistance Junction to Case	$R_{\theta JC}$		-	-	1.25	$^\circ\text{C/W}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$		-	-	48	$^\circ\text{C/W}$

## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	$V_{SD}$	$I_{SD} = 25\text{A}$	-	1.1	1.5	V
Diode Reverse Recovery Time	$t_{rr}$	$I_{SD} = 25\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	190	300	ns

## NOTES:

- Pulse test: pulse width  $\leq 300\text{ms}$ , duty cycle  $\leq 2\%$ .
- Repetitive rating: pulse width is limited by maximum junction temperature. See Transient Thermal Impedance curve Figure 3).

Typical Performance Curves Unless Otherwise Specified

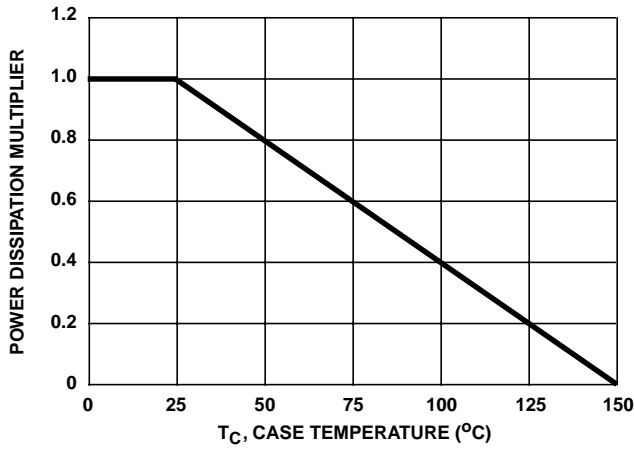


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

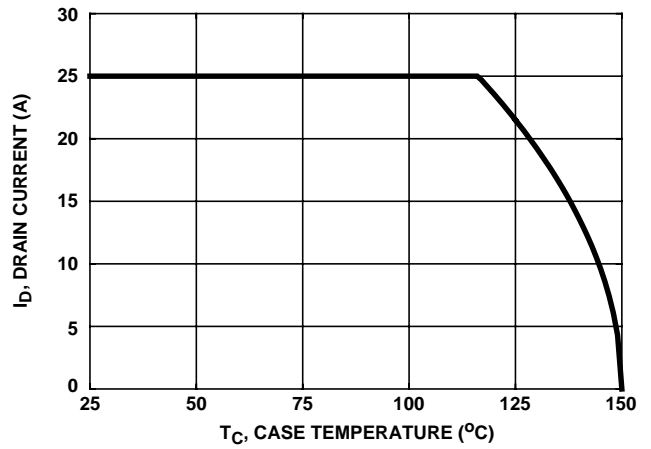


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

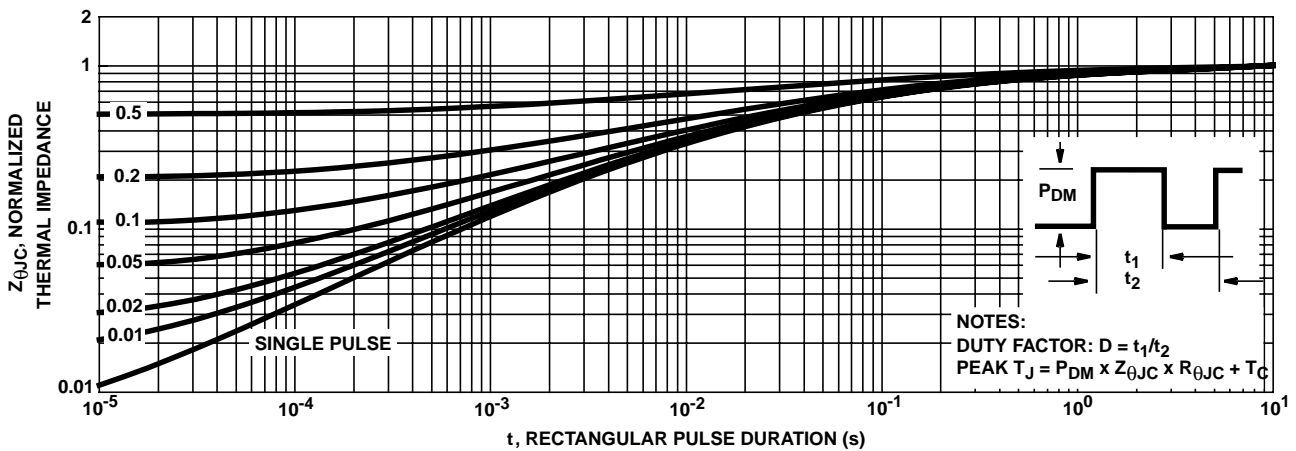


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

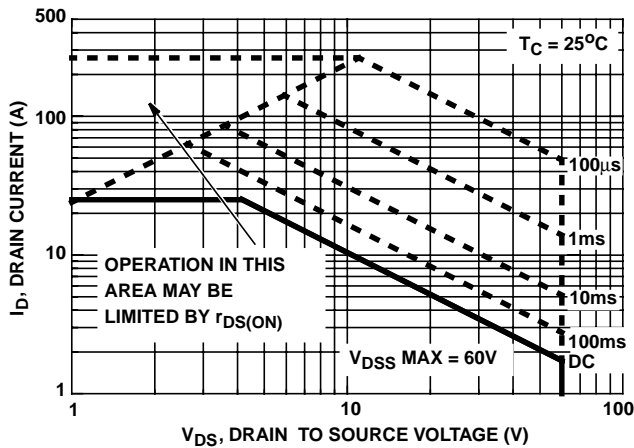


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

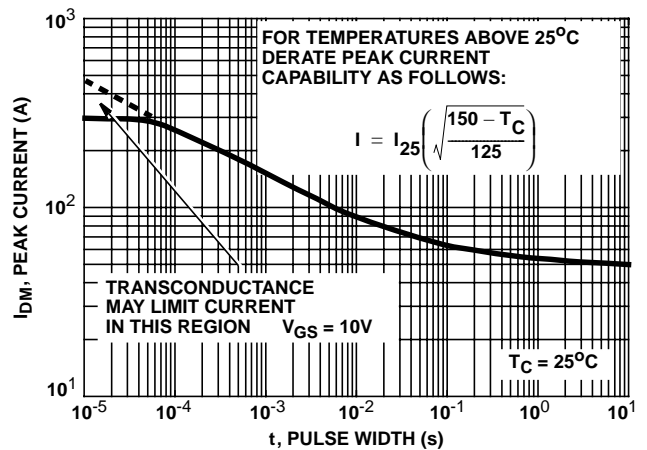
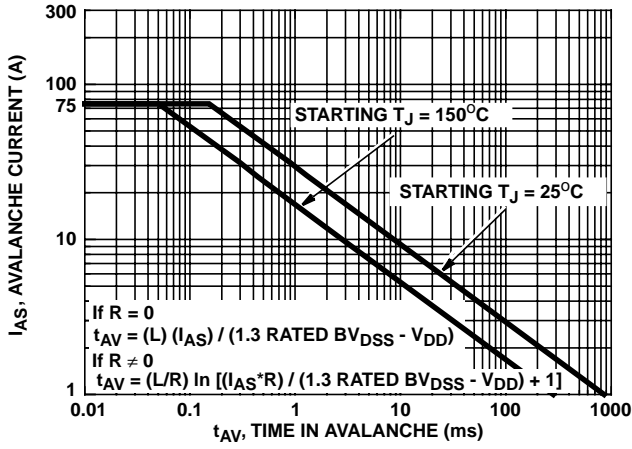


FIGURE 5. PEAK CURRENT CAPABILITY

Typical Performance Curves Unless Otherwise Specified (Continued)



NOTE: Refer to Intersil Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING

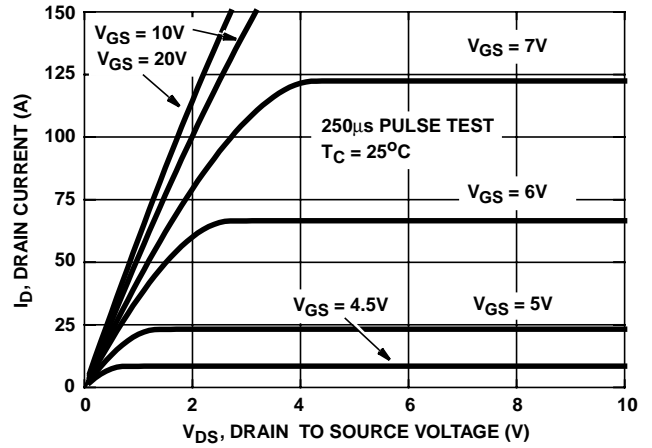


FIGURE 7. SATURATION CHARACTERISTICS

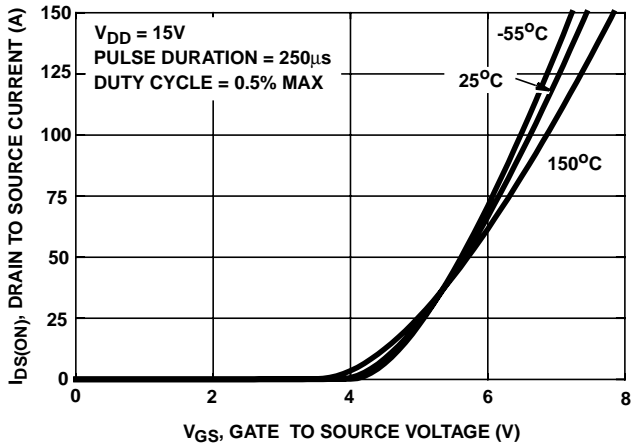


FIGURE 8. TRANSFER CHARACTERISTICS

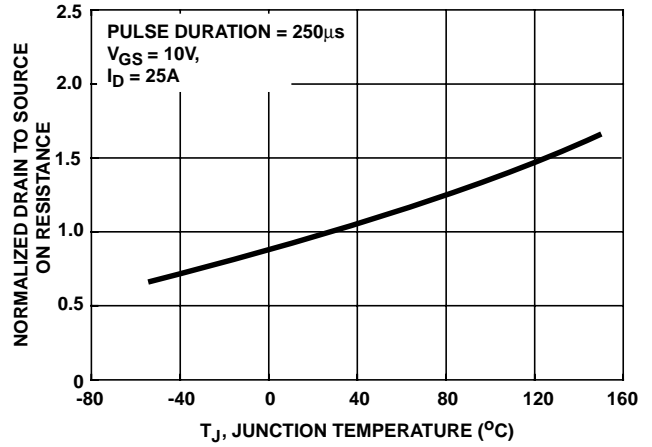


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

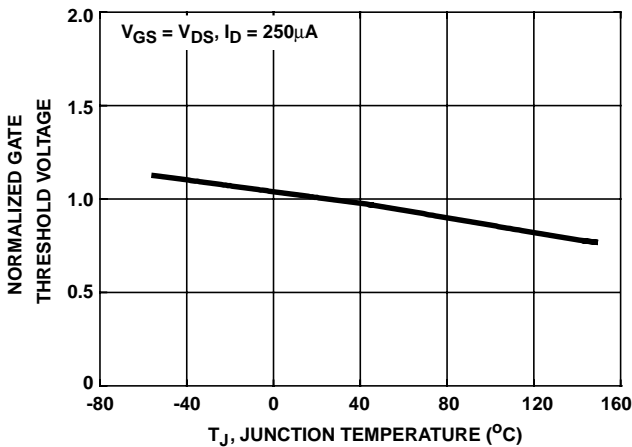


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

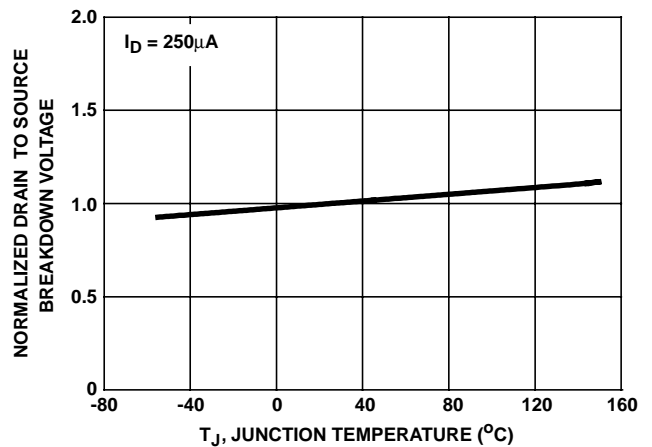


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

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

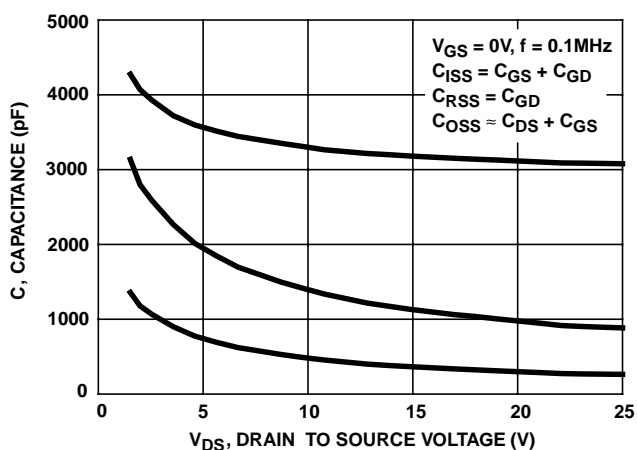
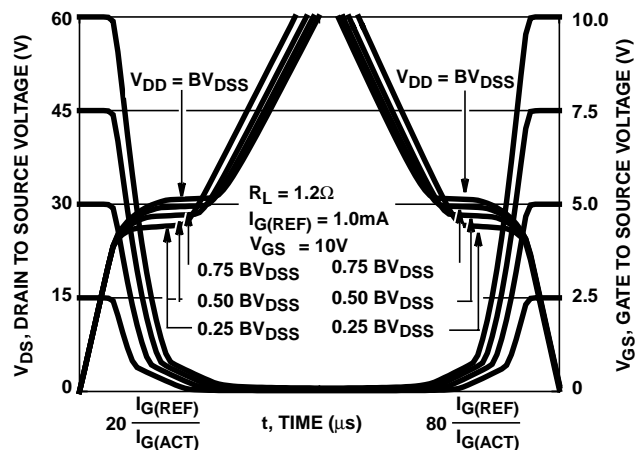


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Intersil Application Notes AN7254 and AN7260.

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

### Test Circuits and Waveforms

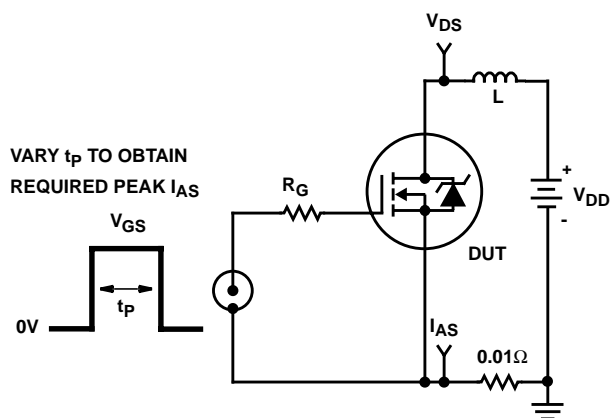


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

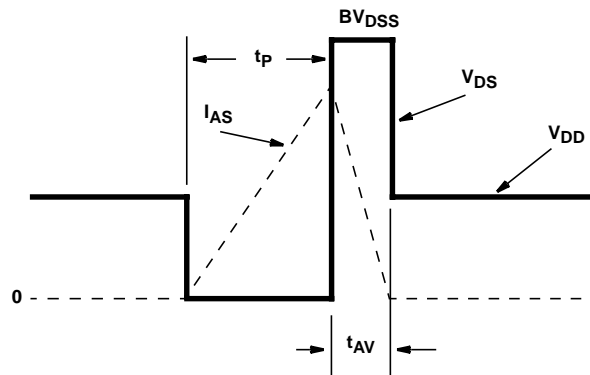


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

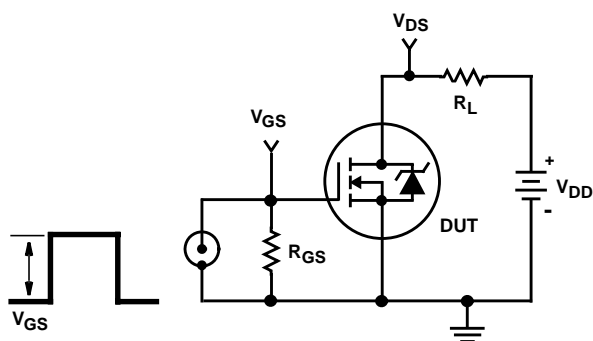


FIGURE 16. SWITCHING TIME TEST CIRCUIT

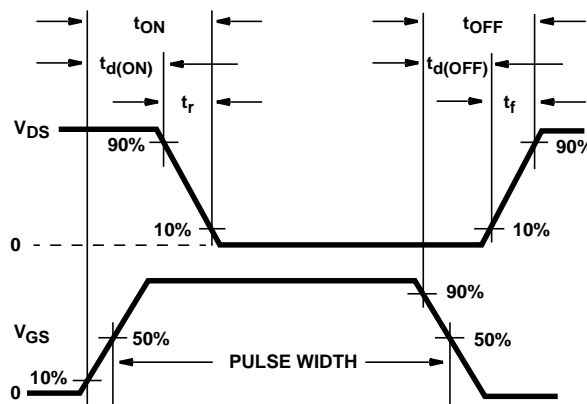


FIGURE 17. RESISTIVE SWITCHING WAVEFORMS

## Test Circuits and Waveforms (Continued)

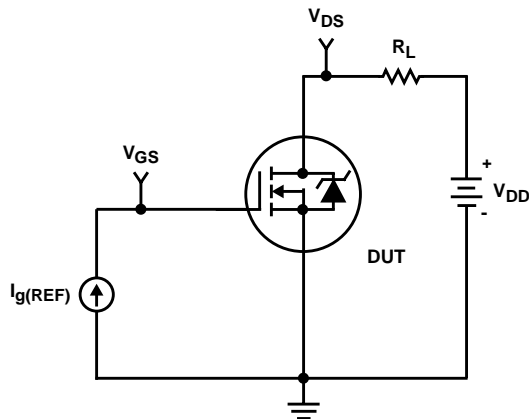


FIGURE 18. GATE CHARGE TEST CIRCUIT

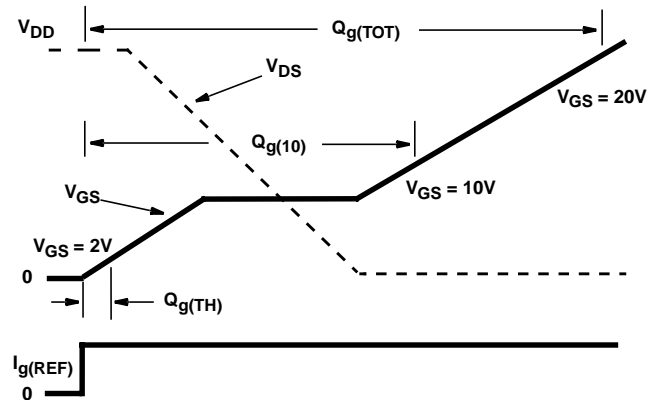


FIGURE 19. GATE CHARGE WAVEFORMS

## Data Packages - Intersil Power Transistors

### TX and TXV Equivalents

1. TX/TXV Equivalent - Standard Data Package
  - A. Certificate of Compliance
  - B. Assembly Flow Chart
  - C. Preconditioning - Attributes Data Sheet
  - D. Group A - Attributes Data Sheet
  - E. Group B - Attributes Data Sheet
  - F. Group C - Attributes Data Sheet
2. TX/TXV Equivalent - Optional Data Package
  - A. Certificate of Compliance
  - B. Assembly Flow Chart
  - C. Preconditioning - Attributes Data Sheet
    - Precondition Lot Traveler
    - Pre and Post Burn-In Read and Record Data
  - D. Group A
    - Attributes Data Sheet
    - Group A Lot Traveler
  - E. Group B
    - Attributes Data Sheet
    - Group B Lot Traveler
    - Pre and Post Read and Record Data for Intermittent Operating Life (Subgroup B3)
    - Bond Strength Data (Subgroup B3)
    - Pre and Post High Temperature Operating Life Read and Record Data (Subgroup B6)
  - F. Group C
    - Attributes Data Sheet
    - Group C Lot Traveler
    - Pre and Post Read and Record Data for Intermittent Operating Life (Subgroup C6)
    - Bond Strength Data (Subgroup C6)

## RFF70N06

## PSICE Electrical Model

SUBCKT RFF70N06 2 1 3 ; rev 5/29/95

CA 12 8 5.20e-9  
 CB 15 14 5.20e-9  
 CIN 6 8 2.80e-9

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

EBREAK 11 7 17 18 68.7  
 EDS 14 8 5 8 1  
 EGS 13 8 6 8 1  
 ESG 6 10 6 8 1  
 EVTHRESH 6 21 19 8 1  
 EZTEMPCO 20 6 18 22 1

IT 8 17 1

LDRAIN 2 5 1e-9  
 LGATE 1 9 6.04e-9  
 LSOURCE 3 7 2.24e-9

MOS1 16 6 8 8 MSTRONG M = 0.99  
 MOS2 16 21 8 8 MWEAK M = 0.01

RBREAK 17 18 RBREAKMOD 1  
 RDRAIN 50 16 RDRAINMOD 8.03e-3  
 RGATE 9 20 1  
 RIN 6 8 1e9  
 RLDRAIN 2 5 10  
 RLGATE 1 9 60.4  
 RLSOURCE 3 7 22.4  
 RSCL1 5 51 RSCLMOD 1e-6  
 RSCL2 5 50 1e3  
 RSOURCE 8 7 RSOURCEMOD 7.20e-3  
 RTHRESH 22 8 RTHRESHMOD 1  
 RZTEMPCO 18 19 RZTEMPCOMOD 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

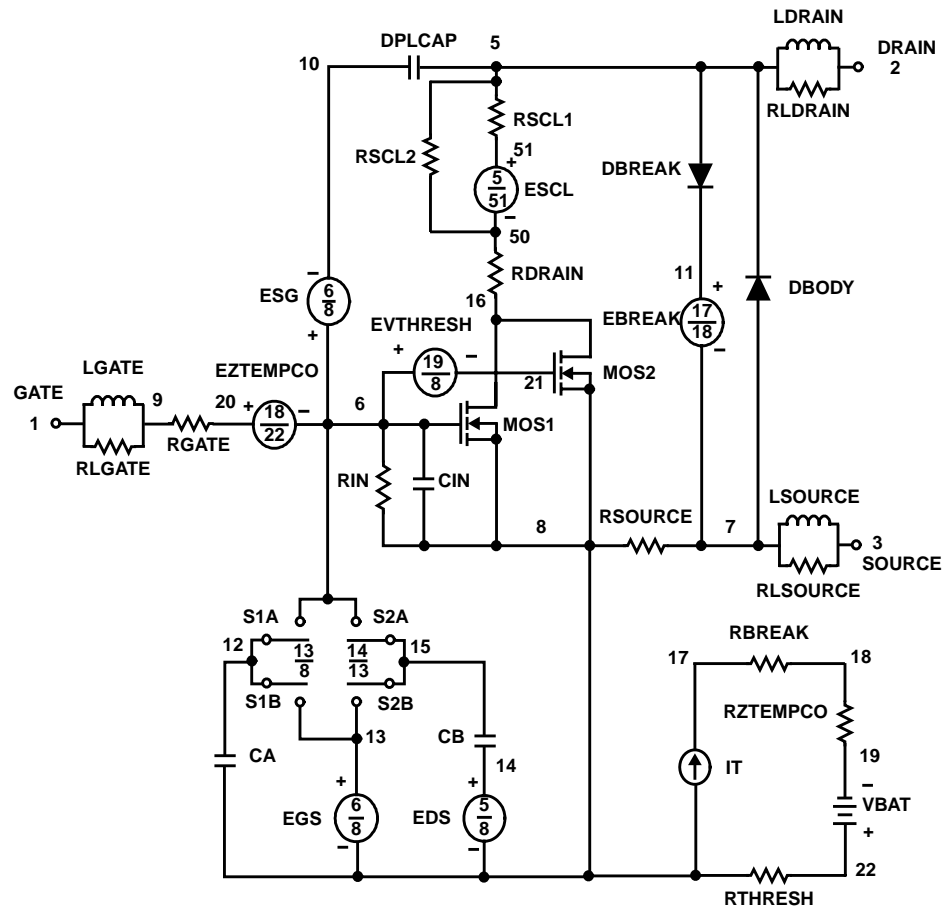
VBAT 22 19 DC 1

$$ESCL\ 51\ 50\ VALUE = \{(V(5,51)/ABS(V(5,51)))^{(PWR(V(5,51))/(1e-6*250),3))\}$$

.MODEL DBDMOD D (IS = 1e-12 RS = 11.01e-3 TRS1 = 1.75e-3 TRS2 = -0.06e-6 CJO = 2.70e-9 TT = 7.82e-8 M = 0.45)  
 .MODEL DBREAKMOD D (RS = 88e-3 TRS1 = 1.50e-3 TRS2 = 0)  
 .MODEL DPLCAPMOD D (CJO = 2.60e-9 IS = 1e-30 N = 10 M = 0.7)  
 .MODEL MSTRONG NMOS (VTO = 3.85 KP = 47.2 IS = 1e-30 N = 10 TOX = 1L = 1u W = 1u)  
 .MODEL MWEAK NMOS (VTO = 3.09 KP = 47.2 IS = 1e-30 N = 10 TOX = 1L = 1u W = 1u)  
 .MODEL RBREAKMOD RES (TC1 = 1e-3 TC2 = 0)  
 .MODEL RDRAINMOD RES (TC1 = 7e-3 TC2 = 1.90e-5)  
 .MODEL RDSOURCEMOD RES (TC1 = 1e-3 TC2 = 1e-6)  
 .MODEL RSCLMOD RES (TC1 = 0 TC2 = 0)  
 .MODEL RTHRESHMOD RES (TC1 = -3.10e-3 TC2 = -1e-5)  
 .MODEL RZTEMPCOMOD RES (TC1 = -2.25e-3 TC2 = -5.75e-7)  
 .MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -6.0 VOFF = -4.0)  
 .MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -4.0 VOFF = -6.0)  
 .MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -2.0 VOFF = 2.0)  
 .MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 2.0 VOFF = -2.0)

.ENDS

NOTE: For further discussion of the PSICE model, consult **A New PSICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options**; IEEE Power Electronics Specialist Conference Records, 1991.



## RFF70N06

## Screening Information

Screening is performed in accordance with the latest revision in effect of MIL-S-19500, (Screening Information Table)

## Delta Tests and Limits (JANTX/JANTXV Equivalent)

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V, T_C = 25^\circ C$	$\pm 20$ (Note 5)	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 80\% \text{ Rated Value}, T_C = 25^\circ C$	$\pm 25$ (Note 5)	$\mu A$
On Resistance	$r_{DS(ON)}$	$T_C = 125^\circ C \text{ at Rated } I_D$	$\pm 20\%$ (Note 6)	$\Omega$
Gate Threshold Voltage	$V_{GS(TH)}$	$I_D = 1.0mA, T_C = 25^\circ C$	$\pm 20\%$ (Note 6)	V

NOTES:

5. Or 100% of Initial Reading (whichever is greater).
6. Of Initial Reading.

## Screening Information

TEST	JANTX/JANTXV EQUIVALENT
Gate Stress	$V_{GS} = 30V, t = 250\mu s$
Pind	Optional
PDA	10%
Pre Burn-In Test (Note 7)	MIL-S-19500 Group A, Subgroup 2 (All Static Tests at $25^\circ C$ )
Steady State Gate Bias (Gate Stress)	MIL-STD-750, Method 1042, Condition B $V_{GS} = 80\% \text{ of Rated Value},$ $T_A = 150^\circ C, \text{ Time} = 48 \text{ hours}$
Interim Electrical Tests (Note 7)	All Delta Parameters Listed in the Delta Tests and Limits Table
Steady State Reverse Bias (Drain Stress)	MIL-STD-750, Method 1042, Condition A $V_{DS} = 80\% \text{ of Rated Value},$ $T_A = 150^\circ C, \text{ Time} = 168 \text{ hours}$
Final Electrical Tests (Note 7)	MIL-S-19500, Group A, Subgroup 2

NOTE:

7. Test limits are identical pre and post burn-in.

## Additional Screening Tests

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Safe Operating Area	SOA	$V_{DS} = 48V, t = 10ms$	4.8	A
Unclamped Inductive Switching	$I_{AS}$	$V_{GS(PEAK)} = 15V, L = 0.1mH$	75	A
Thermal Response	$\Delta V_{SD}$	$t_H = 100ms; V_H = 25V, I_H = 4A$	220	mV
Thermal Impedance	$\Delta V_{SD}$	$t_H = 500ms; V_H = 25V, I_H = 4A$	330	mV

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