

### **15A, 55V, 0.090 Ohm, N-Channel UltraFET Power MOSFETs**



These N-Channel power MOSFETs are manufactured using the innovative UltraFET® process. This advanced process technology

achieves the lowest possible on-resistance per silicon area, resulting in outstanding performance. This device is capable of withstanding high energy in the avalanche mode and the diode exhibits very low reverse recovery time and stored charge. It was designed for use in applications where power efficiency is important, such as switching regulators, switching converters, motor drivers, relay drivers, low-voltage bus switches, and power management in portable and battery-operated products.

Formerly developmental type TA75307.

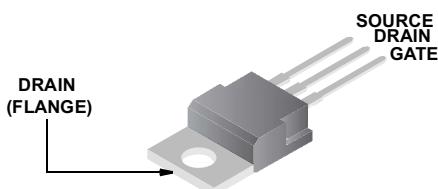
### **Ordering Information**

PART NUMBER	PACKAGE	BRAND
HUF75307P3	TO-220AB	75307P
HUF75307D3	TO-251AA	75307D
HUF75307D3S	TO-252AA	75307D

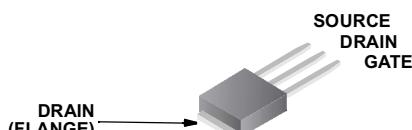
NOTE: When ordering, use the entire part number. Add the suffix T to obtain the TO-252AA variant in tape and reel, e.g., HUF75307D3ST.

### **Packaging**

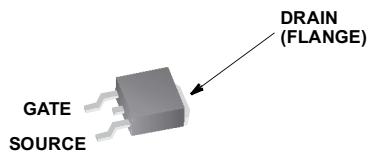
**JEDEC TO-220AB**



**JEDEC TO-251AA**



**JEDEC TO-252AA**



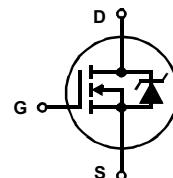
Product reliability information can be found at <http://www.fairchildsemi.com/products/discrete/reliability/index.html>  
For severe environments, see our Automotive HUFA series.

All Fairchild semiconductor products are manufactured, assembled and tested under ISO9000 and QS9000 quality systems certification.

### **Features**

- 15A, 55V
- Simulation Models
  - Temperature Compensated PSPICE® and SABER™ Models
  - SPICE and SABER Thermal Impedance Models Available on the WEB at: [www.fairchildsemi.com](http://www.fairchildsemi.com)
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
  - TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"

### **Symbol**



# HUF75307P3, HUF75307D3, HUF75307D3S

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

			UNITS
Drain to Source Voltage (Note 1) . . . . .	$V_{DSS}$	55	V
Drain to Gate Voltage ( $R_{GS} = 20\text{k}\Omega$ ) (Note 1) . . . . .	$V_{DGR}$	55	V
Gate to Source Voltage . . . . .	$V_{GS}$	$\pm 20$	V
Drain Current			
Continuous (Figure 2) . . . . .	$I_D$	15	A
Pulsed Drain Current . . . . .	$I_{DM}$	Figure 4	
Pulsed Avalanche Rating . . . . .	$E_{AS}$	Figures 6, 14, 15	
Power Dissipation . . . . .	$P_D$	45	W
Derate Above $25^\circ\text{C}$ . . . . .		0.3	$W/\text{ }^\circ\text{C}$
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 . . . . .	$T_{pkg}$	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	
<b>OFF STATE SPECIFICATIONS</b>							
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$ (Figure 11)	55	-	-	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 50\text{V}, V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$	
		$V_{DS} = 45\text{V}, V_{GS} = 0\text{V}, T_C = 150^\circ\text{C}$	-	-	250	$\mu\text{A}$	
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA	
<b>ON STATE SPECIFICATIONS</b>							
Gate to Source Threshold Voltage	$V_{GS(\text{TH})}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ (Figure 10)	2	-	4	V	
Drain to Source On Resistance	$r_{DS(\text{ON})}$	$I_D = 15\text{A}, V_{GS} = 10\text{V}$ (Figure 9)	-	0.075	0.090	$\Omega$	
<b>THERMAL SPECIFICATIONS</b>							
Thermal Resistance Junction to Case	$R_{\theta JC}$	(Figure 3)	-	-	3.3	$^\circ\text{C}/\text{W}$	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	TO-220AB	-	-	62	$^\circ\text{C}/\text{W}$	
		TO-251AA, TO-252AA	-	-	100	$^\circ\text{C}/\text{W}$	
<b>SWITCHING SPECIFICATIONS</b> ( $V_{GS} = 10\text{V}$ )							
Turn-On Time	$t_{ON}$	$V_{DD} = 30\text{V}, I_D \geq 15\text{A}, R_L = 2.0\Omega, V_{GS} = 10\text{V}, R_{GS} = 100\Omega$	-	-	60	ns	
Turn-On Delay Time	$t_d(\text{ON})$		-	7	-	ns	
Rise Time	$t_r$		-	40	-	ns	
Turn-Off Delay Time	$t_d(\text{OFF})$		-	35	-	ns	
Fall Time	$t_f$		-	45	-	ns	
Turn-Off Time	$t_{OFF}$		-	-	100	ns	
<b>GATE CHARGE SPECIFICATIONS</b>							
Total Gate Charge	$Q_g(\text{TOT})$	$V_{GS} = 0\text{V}$ to $20\text{V}$	$V_{DD} = 30\text{V}, I_D \geq 15\text{A}, R_L = 2.0\Omega, I_{g(\text{REF})} = 1.0\text{mA}$ (Figure 13)	-	16	20	nC
Gate Charge at $10\text{V}$	$Q_g(10)$	$V_{GS} = 0\text{V}$ to $10\text{V}$		-	9	11	nC
Threshold Gate Charge	$Q_g(\text{TH})$	$V_{GS} = 0\text{V}$ to $2\text{V}$		-	0.6	0.8	nC
Gate to Source Gate Charge	$Q_{gs}$			-	1.2	-	nC
Reverse Transfer Capacitance	$Q_{gd}$			-	4	-	nC

## HUF75307P3, HUF75307D3, HUF75307D3S

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
<b>CAPACITANCE SPECIFICATIONS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$	-	250	-	pF
Output Capacitance	$C_{OSS}$	(Figure 12)	-	100	-	pF
Reverse Transfer Capacitance	$C_{RSS}$		-	25	-	pF

### Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	$V_{SD}$	$I_{SD} = 15\text{A}$	-	-	1.25	V
Reverse Recovery Time	$t_{rr}$	$I_{SD} = 15\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	45	ns
Reverse Recovered Charge	$Q_{RR}$	$I_{SD} = 15\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	55	nC

### Typical Performance Curves

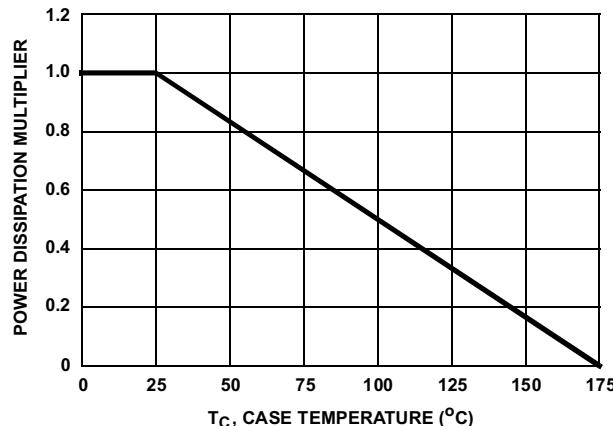


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

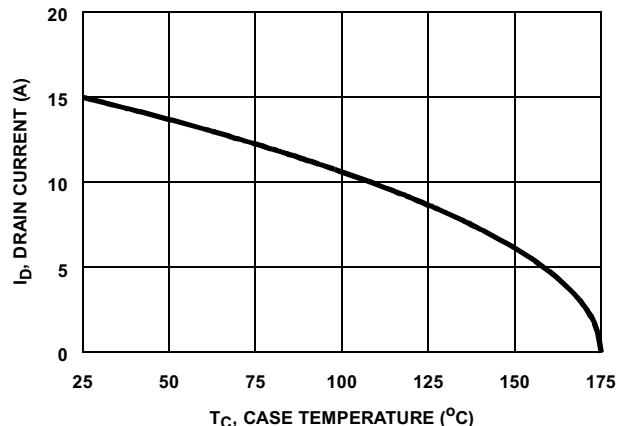


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

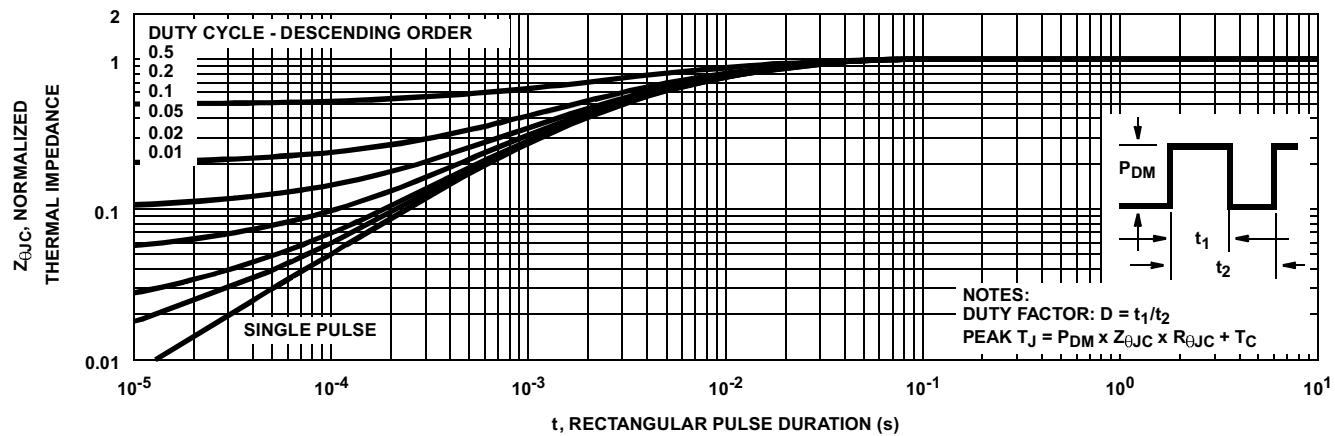


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

## HUF75307P3, HUF75307D3, HUF75307D3S

### Typical Performance Curves (Continued)

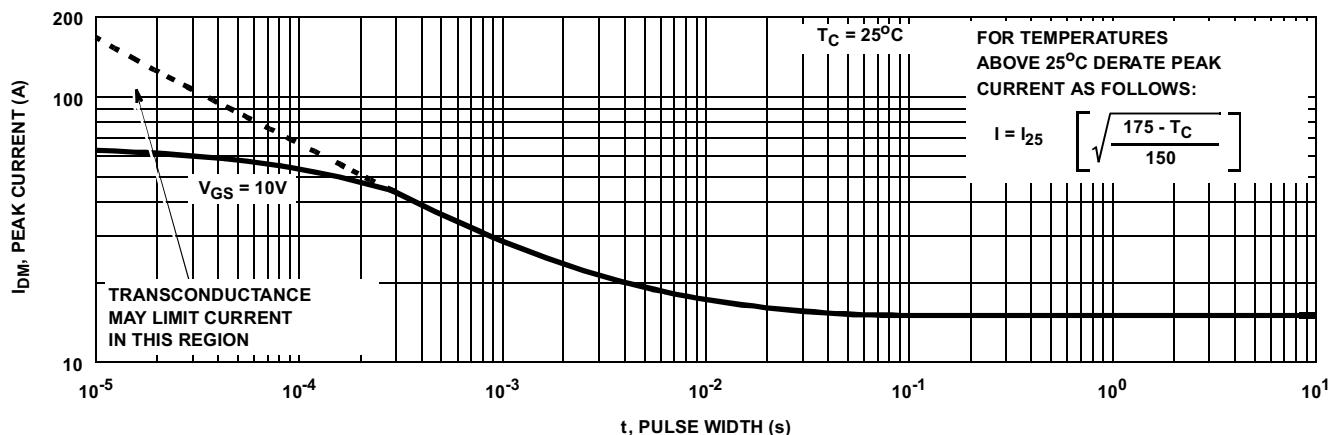


FIGURE 4. PEAK CURRENT CAPABILITY

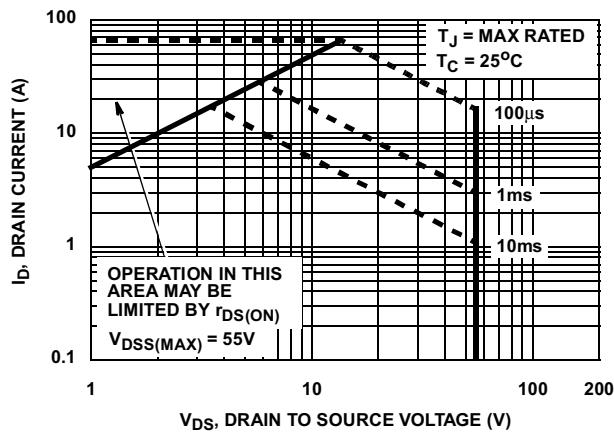
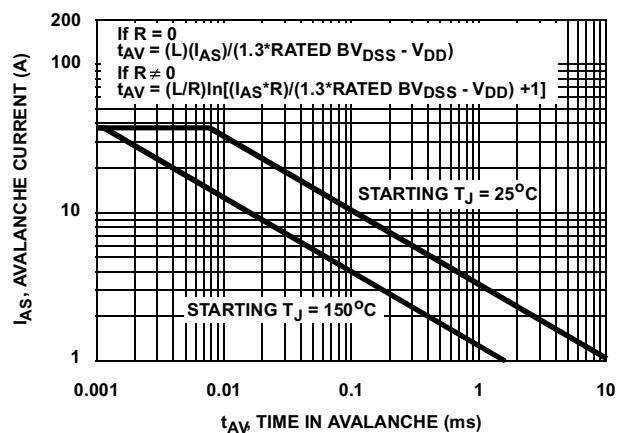


FIGURE 5. FORWARD BIAS SAFE OPERATING AREA



NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

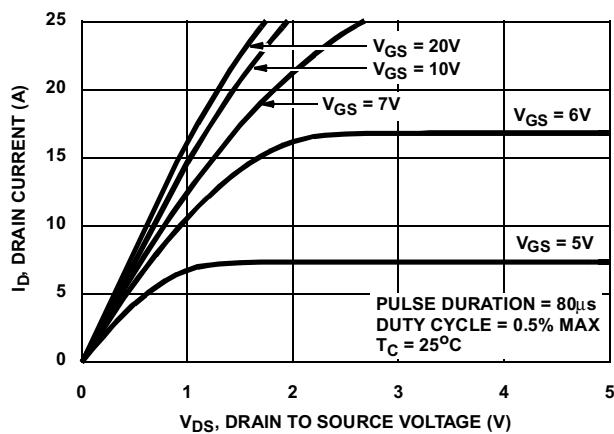


FIGURE 7. SATURATION CHARACTERISTICS

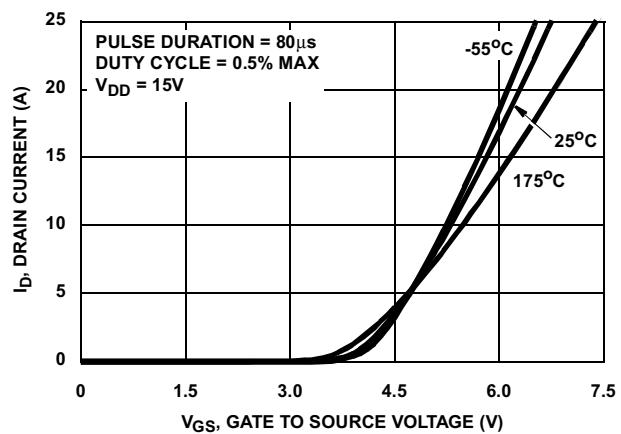


FIGURE 8. TRANSFER CHARACTERISTICS

## HUF75307P3, HUF75307D3, HUF75307D3S

### Typical Performance Curves (Continued)

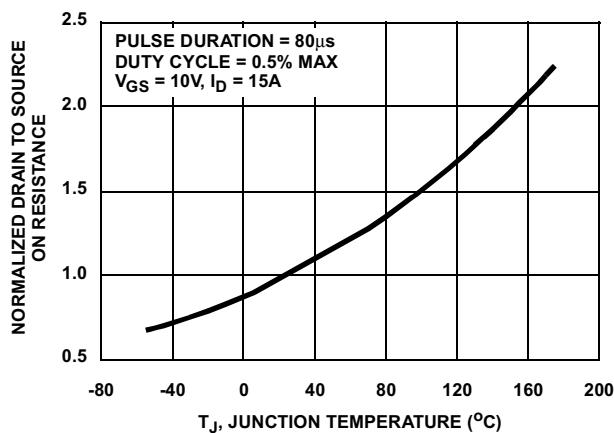


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

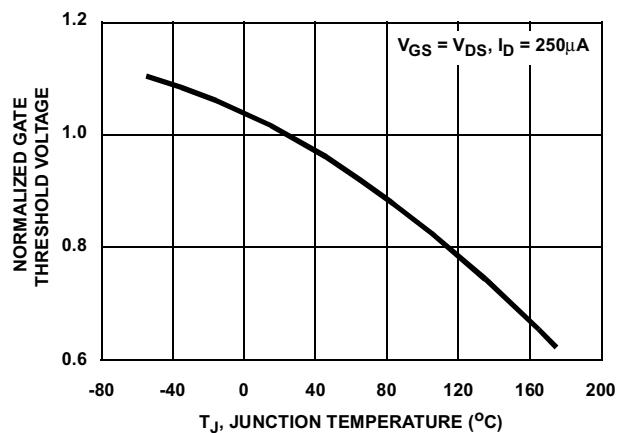


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

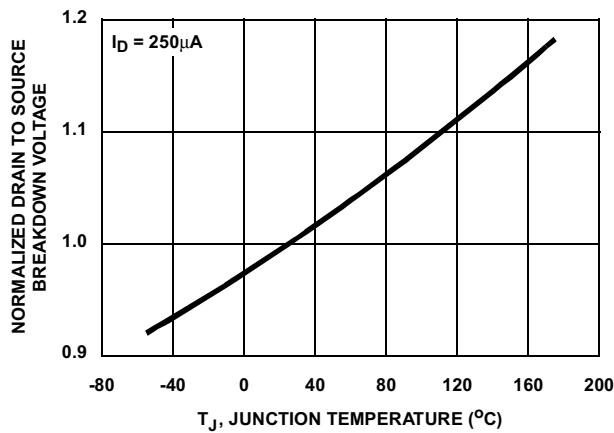


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

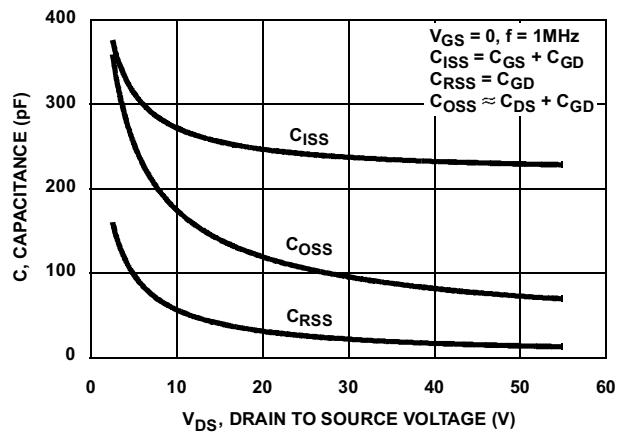
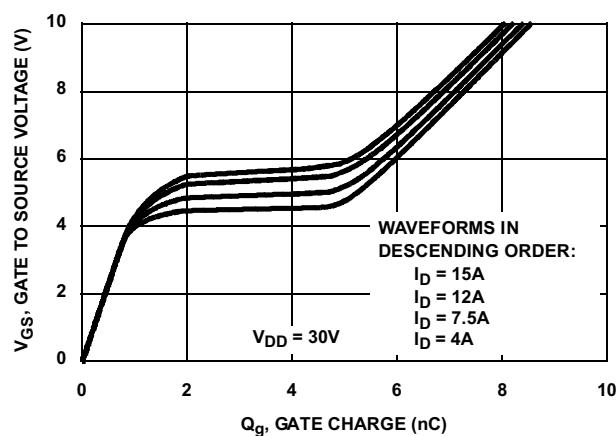


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

## HUF75307P3, HUF75307D3, HUF75307D3S

### Test Circuits and Waveforms

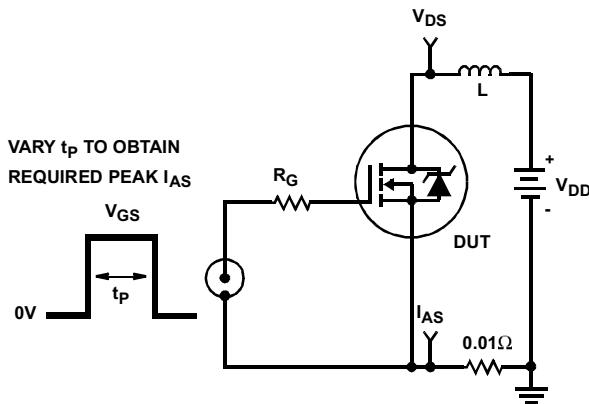


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

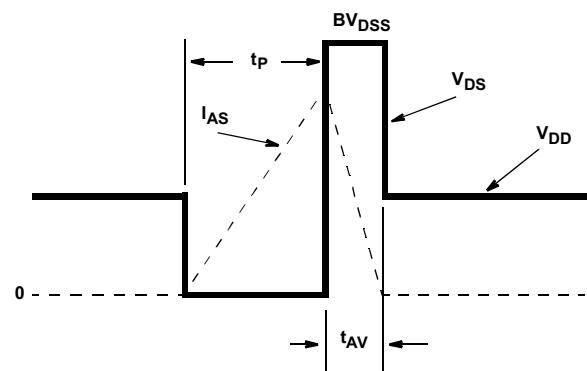


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

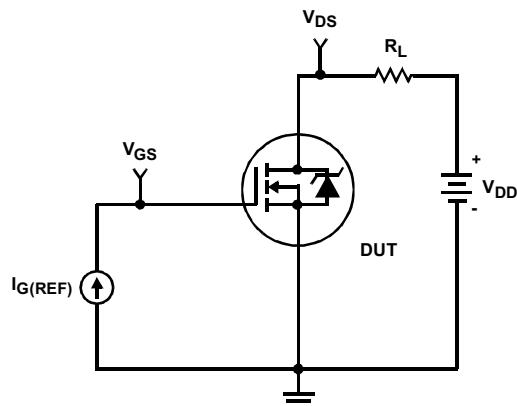


FIGURE 16. GATE CHARGE TEST CIRCUIT

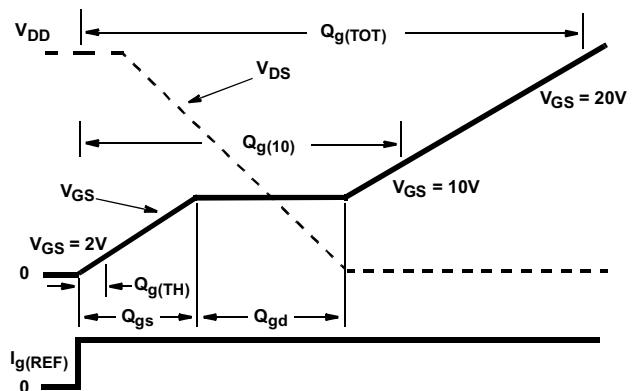


FIGURE 17. GATE CHARGE WAVEFORM

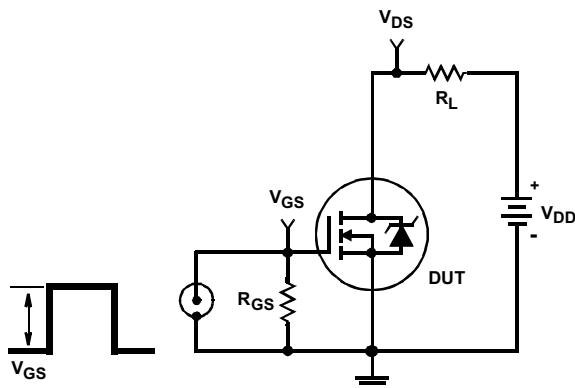


FIGURE 18. SWITCHING TIME TEST CIRCUIT

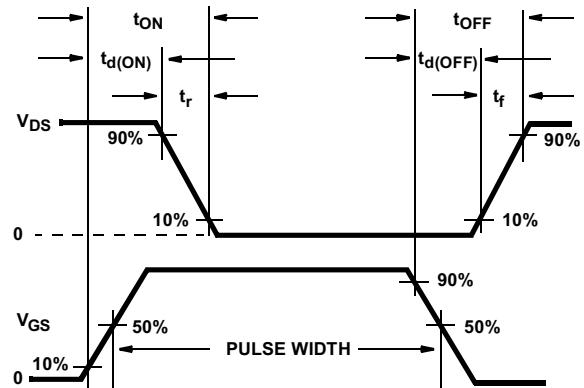


FIGURE 19. RESISTIVE SWITCHING WAVEFORMS

# HUF75307P3, HUF75307D3, HUF75307D3S

## PSPICE Electrical Model

.SUBCKT HUF75307 2 1 3 ; rev June 1997

CA 12 8 4.5e-10  
CB 15 14 4.1e-10  
CIN 6 8 2.154e-10

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

EBREAK 11 7 17 18 56  
EDS 14 8 5 8 1  
EGS 13 8 6 8 1  
ESG 6 10 6 8 1  
EVTHRES 6 21 19 8 1  
EVTEMP 20 6 18 22 1

IT 8 17 1  
LDRAIN 2 5 1e-9  
LGATE 1 9 5.97e-10  
LSOURCE 3 7 2.39e-9  
K1 LGATE LSOURCE 0.131

MMED 16 6 8 8 MMEDMOD  
MSTRO 16 6 8 8 MSTROMOD  
MWEAK 16 21 8 8 MWEAKMOD  
RBREAK 17 18 RBREAKMOD 1  
RDRAIN 50 16 RDRAINMOD 1e-3  
RGATE 9 20 1.9  
RLDRAIN 2 5 10  
RLGATE 1 9 60  
RLSOURCE 3 7 24  
RSOURCE 8 7 RSOURCEMOD 5.5e-2  
RVTHRES 22 8 RVTHRESMOD 1  
RVTEMP 18 19 RVTEMPPMOD 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

ESLC 51 50 VALUE={(V(5,51)/ABS(V(5,51)))\*(PWR(V(5,51)/(1e-6\*35),4))}

.MODEL DBODYMOD D (IS=1.6e-13 RS=1.28e-2 IKF=5.5 N=0.985 TRS1=2.9e-3 TRS2=-4e-6 CJO=3.5e-10 TT=3.1e-8 M=0.45 XTI=6)  
.MODEL DBREAKMOD D (RS=2.5e-1 IKF=0.1 TRS1=-4e-3 TRS2=3e-5)

.MODEL DPLCAPMOD D (CJO=5e-1 OIS=1e-3 ON=10 M=0.95)

.MODEL MMEDMOD NMOS (VTO=3.25 KP=2.2 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=1.9)

.MODEL MSTROMOD NMOS (VTO=3.75 KP=14.75 IS=1e-30 N=10 TOX=1 L=1u W=1u)

.MODEL MWEAKMOD NMOS (VTO=2.88 KP=0.03 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=19 RS=0.1)

.MODEL RBREAKMOD RES (TC1=1.12e-3 TC2=1e-6)

.MODEL RDRAINMOD RES (TC1=2.3e-1 TC2=6e-4)

.MODEL RSLCMOD RES (TC1=4e-3 TC2=1e-6)

.MODEL RSOURCEMOD RES (TC1=1e-3 TC2=6e-6)

.MODEL RVTHRESMOD RES (TC=-3.31e-3 TC2=-1.49e-5)

.MODEL RVTEMPPMOD RES (TC1=-1.4e-3 TC2=1e-9)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-8.1 VOFF=-4)

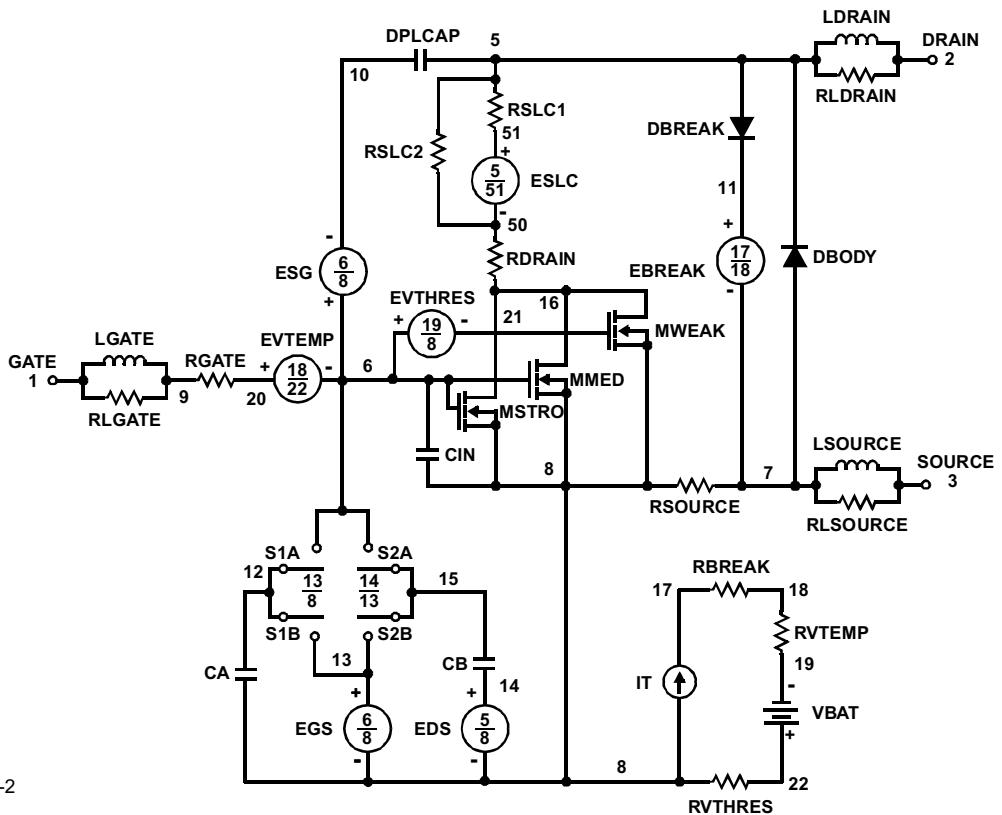
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-4 VOFF=-8.1)

.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=0 VOFF=2)

.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2 VOFF=0)

.ENDS

NOTE: For further discussion of the PSPICE model, consult **A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options**; IEEE Power Electronics Specialist Conference Records, 1991, written by William J. Hepp and C. Frank Wheatley.



# HUF75307P3, HUF75307D3, HUF75307D3S

## SABER Electrical Model

REV February 1999

template huf75307 n2, n1, n3

electrical n2, n1, n3

{

var i iscl

d..model dbodymod = (is = 1.6e-13, xti = 6, cjo = 3.5e-10, tt = 3.1e-8, n = 0.985, m = 0.45)

d..model dbreakmod = ()

d..model dplcapmod = (cjo = 5e-10, is = 1e-30, n = 10, m = 0.95)

m..model mmedmod = (type=\_n, vto = 3.25, kp = 2.2, is = 1e-30, tox = 1)

m..model mstrongmod = (type=\_n, vto = 3.75, kp = 14.75, is = 1e-30, tox = 1)

m..model mweakmod = (type=\_n, vto = 2.88, kp = 0.03, is = 1e-30, tox = 1)

sw\_vcsp..model s1amod = (ron = 1e-5, roff = 0.1, von = -8.1, voff = -4)

sw\_vcsp..model s1bmod = (ron = 1e-5, roff = 0.1, von = -4, voff = -8.1)

sw\_vcsp..model s2amod = (ron = 1e-5, roff = 0.1, von = 0, voff = 2)

sw\_vcsp..model s2bmod = (ron = 1e-5, roff = 0.1, von = 2, voff = 0)

c.ca n12 n8 = 4.5e-10

c.cb n15 n14 = 4.1e-10

c.cin n6 n8 = 2.154e-10

d.dbody n7 n71 = model=dbodymod

d.dbreak n72 n11 = model=dbreakmod

d.dplcap n10 n5 = model=dplcapmod

i.it n8 n17 = 1

I.ldrain n2 n5 = 1e-9

I.lgate n1 n9 = 5.97e-10

I.lsourc n3 n7 = 2.39e-9

m.mmed n16 n6 n8 n8 = model=mmedmod, l = 1u, w = 1u

m.mstrong n16 n6 n8 n8 = model=mstrongmod, l = 1u, w = 1u

m.mweak n16 n21 n8 n8 = model=mweakmod, l = 1u, w = 1u

res.rbreak n17 n18 = 1, tc1 = 1.12e-3, tc2 = 1e-6

res.rdbody n71 n5 = 1.28e-2, tc1 = 2.9e-3, tc2 = -4e-6

res.rdbreak n72 n5 = 0.25, tc1 = -4e-3, tc2 = 3e-5

res.rdrain n50 n16 = 1e-3, tc1 = 2.31-1, tc2 = 6e-4

res.rgate n9 n20 = 1.9

res.rladrain n2 n5 = 10

res.rlgate n1 n9 = 60

res.rlsourc n3 n7 = 24

res.rsclc1 n5 n51 = 1e-6, tc1 = 4e-3, tc2 = 1e-6

res.rsclc2 n5 n50 = 1e3

res.rsource n8 n7 = 5.5e-2, tc1 = 1e-3, tc2 = 6e-6

res.rvtemp n18 n19 = 1, tc1 = -1.4e-3, tc2 = 1e-9

res.rvthres n22 n8 = 1, tc1 = -3.31e-3, tc2 = -1.49e-5

spe.ebreak n11 n7 n17 n18 = 56

spe.edsc n14 n8 n5 n8 = 1

spe.egs n13 n8 n6 n8 = 1

spe.esg n6 n10 n6 n8 = 1

spe.evtemp n20 n6 n18 n22 = 1

spe.evthres n6 n21 n19 n8 = 1

sw\_vcsp.s1a n6 n12 n13 n8 = model=s1amod

sw\_vcsp.s1b n13 n12 n13 n8 = model=s1bmod

sw\_vcsp.s2a n6 n15 n14 n13 = model=s2amod

sw\_vcsp.s2b n13 n15 n14 n13 = model=s2bmod

v.vbat n22 n19 = dc = 1

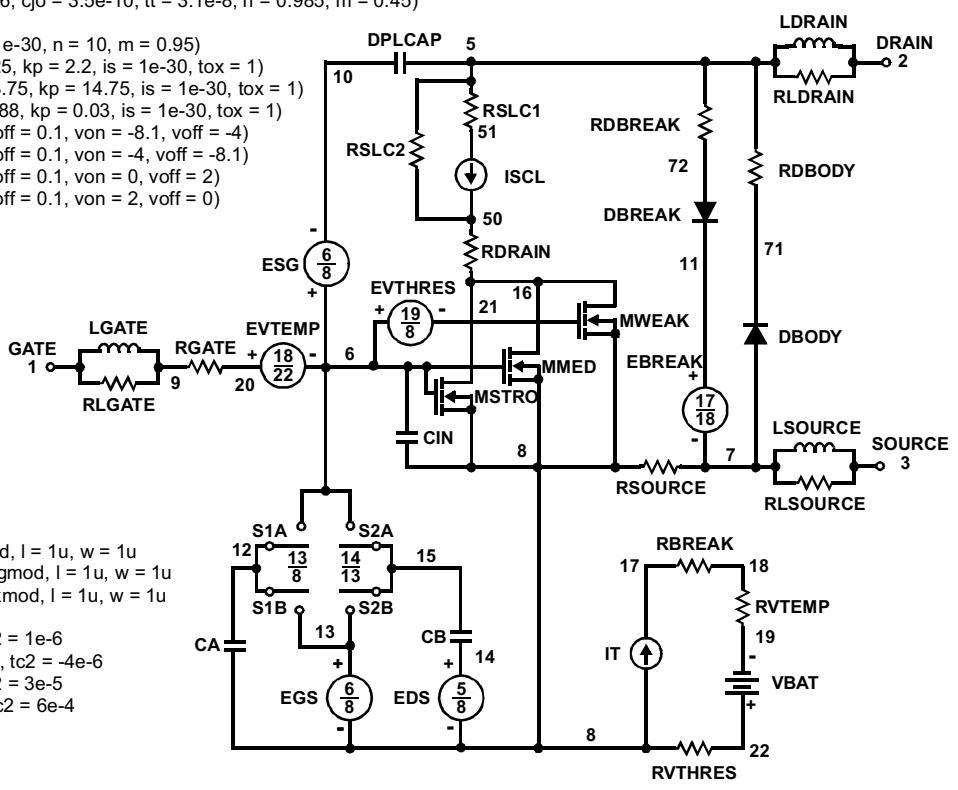
equations {

i (n51->n50) += iscl

iscl: v(n51,n50) = ((v(n5,n51)/(1e-9+abs(v(n5,n51))))\*((abs(v(n5,n51)\*1e6/35))\*\* 4))

}

}



## HUF75307P3, HUF75307D3, HUF75307D3S

### SPICE Thermal Model

REV February 1999

HUF75307

CTHERM1 th 6 8.0e-4  
CTHERM2 6 5 1.6e-3  
CTHERM3 5 4 1.9e-3  
CTHERM4 4 3 2.6e-3  
CTHERM5 3 2 5.5e-3  
CTHERM6 2 tl 1.8e-2

RTHERM1 th 6 8.0e-3  
RTHERM2 6 5 2.1e-2  
RTHERM3 5 4 2.2e-1  
RTHERM4 4 3 6.4e-1  
RTHERM5 3 2 7.7e-1  
RTHERM6 2 tl 1.0

### SABER Thermal Model

SABER thermal model HUF75307

```
template thermal_model th tl
thermal_c th, tl
{
ctherm.ctherm1 th 6 = 8.0e-4
ctherm.ctherm2 6 5 = 1.6e-3
ctherm.ctherm3 5 4 = 1.9e-3
ctherm.ctherm4 4 3 = 2.6e-3
ctherm.ctherm5 3 2 = 5.5e-3
ctherm.ctherm6 2 tl = 1.8e-2

rtherm.rtherm1 th 6 = 8.0e-3
rtherm.rtherm2 6 5 = 2.1e-2
rtherm.rtherm3 5 4 = 2.2e-1
rtherm.rtherm4 4 3 = 6.4e-1
rtherm.rtherm5 3 2 = 7.7e-1
rtherm.rtherm6 2 tl = 1.0
}
```

