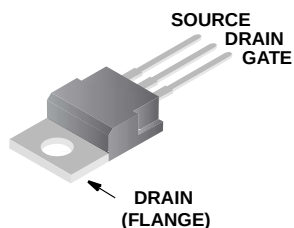


22A, 200V, 0.125 Ohm, N-Channel, UltraFET® Power MOSFET



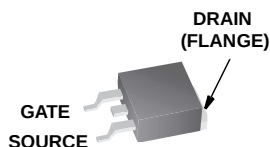
Packaging

JEDEC TO-220AB



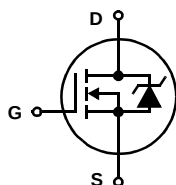
HUF75939P3

JEDEC TO-263AB



HUF75939S3ST

Symbol



Features

- Ultra Low On-Resistance
- $r_{DS(ON)} = 0.125\Omega$, $V_{GS} = 10V$
- Simulation Models
 - Temperature Compensated PSPICE® and SABER® Electrical Models
 - Spice and SABER® Thermal Impedance Models
- www.fairchildsemi.com
- Peak Current vs Pulse Width Curve
- UIS Rating Curve

Ordering Information

PART NUMBER	PACKAGE	BRAND
HUF75939P3	TO-220AB	75939P
HUF75939S3ST	TO-263AB	75939S

NOTE: When ordering, use the entire part number.

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

	HUF75939P3, HUF75939S3ST	UNITS
Drain to Source Voltage (Note 1)	V_{DSS} 200	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)	V_{DGR} 200	V
Gate to Source Voltage	V_{GS} ± 20	V
Drain Current		
Continuous ($T_C = 25^\circ\text{C}$, $V_{GS} = 10V$) (Figure 2)	I_D 22	A
Continuous ($T_C = 100^\circ\text{C}$, $V_{GS} = 10V$) (Figure 2)	I_D 16	A
Pulsed Drain Current	I_{DM} Figure 4	
Pulsed Avalanche Rating	UIS Figures 6, 14, 15	
Power Dissipation	P_D 180	W
Derate Above 25°C	1.2	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 Tech Brief TB334	T_{pkg} 260	$^\circ\text{C}$

NOTE:

1. $T_J = 25^\circ\text{C}$ to 150°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.

HUF75939P3, HUF75939S3ST

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
OFF STATE SPECIFICATIONS							
Drain to Source Breakdown Voltage	BV _{DSS}	I _D = 250μA, V _{GS} = 0V (Figure 11)	200	-	-	V	
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 190V, V _{GS} = 0V	-	-	1	μA	
		V _{DS} = 180V, V _{GS} = 0V, T _C = 150°C	-	-	250	μA	
Gate to Source Leakage Current	I _{GSS}	V _{GS} = ±20V	-	-	±100	nA	
ON STATE SPECIFICATIONS							
Gate to Source Threshold Voltage	V _{GS(TH)}	V _{GS} = V _{DS} , I _D = 250μA (Figure 10)	2	-	4	V	
Drain to Source On Resistance	r _{DS(ON)}	I _D = 22A, V _{GS} = 10V (Figure 9)	-	0.102	0.125	Ω	
THERMAL SPECIFICATIONS							
Thermal Resistance Junction to Case	R _{θJC}	TO-220 and TO-263	-	-	0.83	°C/W	
Thermal Resistance Junction to Ambient	R _{θJA}		-	-	62	°C/W	
SWITCHING SPECIFICATIONS (V _{GS} = 10V)							
Turn-On Time	t _{ON}	V _{DD} = 100V, I _D = 22A V _{GS} = 10V, R _{GS} = 4.7Ω (Figures 18, 19)	-	-	57	ns	
Turn-On Delay Time	t _{d(ON)}		-	12	-	ns	
Rise Time	t _r		-	26	-	ns	
Turn-Off Delay Time	t _{d(OFF)}		-	65	-	ns	
Fall Time	t _f		-	33	-	ns	
Turn-Off Time	t _{OFF}		-	-	147	ns	
GATE CHARGE SPECIFICATIONS							
Total Gate Charge	Q _{g(TOT)}	V _{GS} = 0V to 20V	V _{DD} = 100V, I _D = 22A, I _{g(REF)} = 1.0mA (Figures 13, 16, 17)	-	117	152	nC
Gate Charge at 10V	Q _{g(10)}	V _{GS} = 0V to 10V		-	64	83	nC
Threshold Gate Charge	Q _{g(TH)}	V _{GS} = 0V to 2V		-	5	7	nC
Gate to Source Gate Charge	Q _{gs}			-	9	-	nC
Gate to Drain “Miller” Charge	Q _{gd}			-	24	-	nC
CAPACITANCE SPECIFICATIONS							
Input Capacitance	C _{ISS}	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz (Figure 12)	-	2200	-	pF	
Output Capacitance	C _{OSS}		-	400	-	pF	
Reverse Transfer Capacitance	C _{RSS}		-	120	-	pF	

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V_{SD}	$I_{SD} = 22\text{A}$	-	-	1.25	V
		$I_{SD} = 11\text{A}$	-	-	1.00	V
Reverse Recovery Time	t_{rr}	$I_{SD} = 22\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	240	ns
Reverse Recovered Charge	Q_{RR}	$I_{SD} = 22\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	1500	nC

Typical Performance Curves

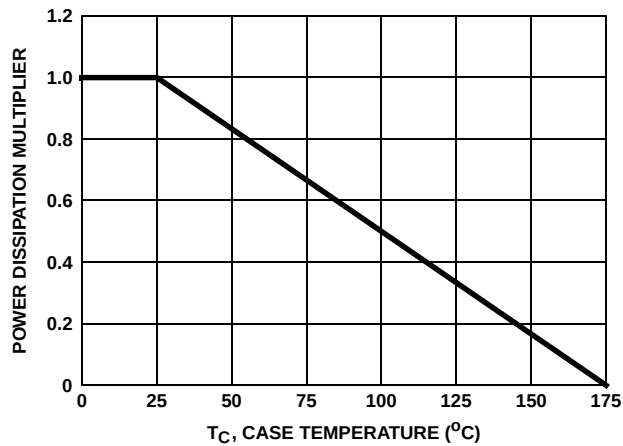


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

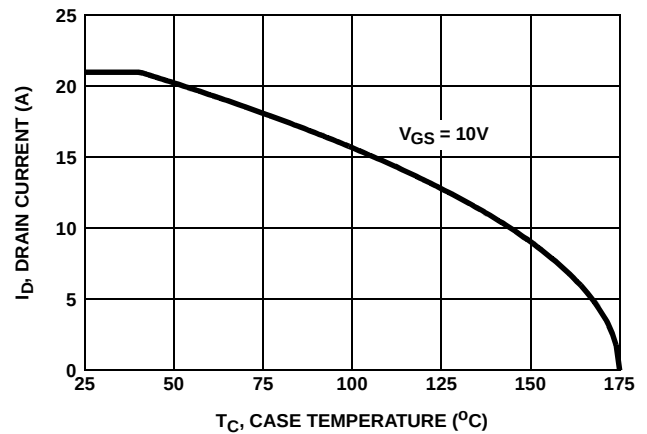


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

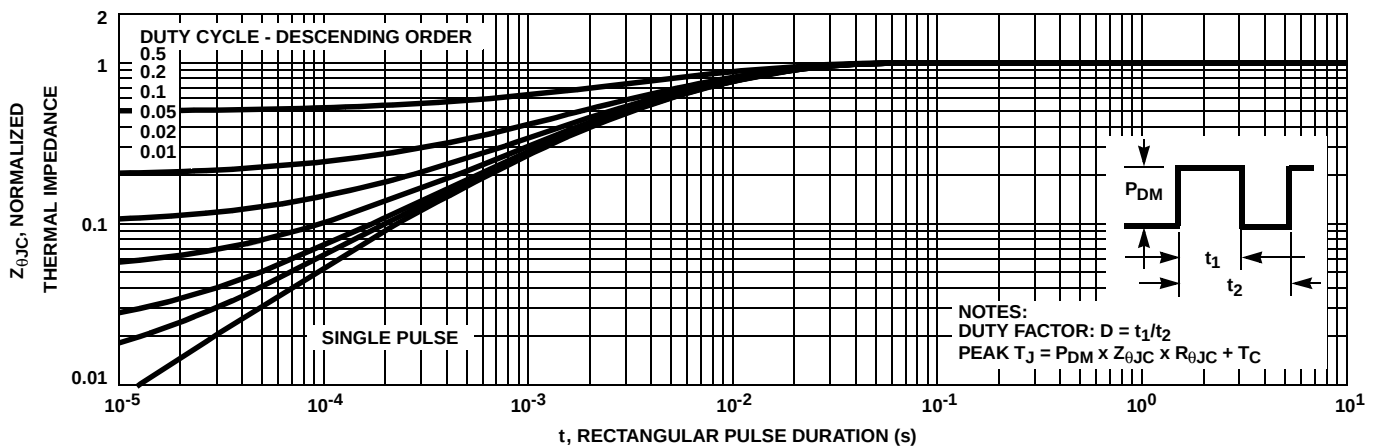


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

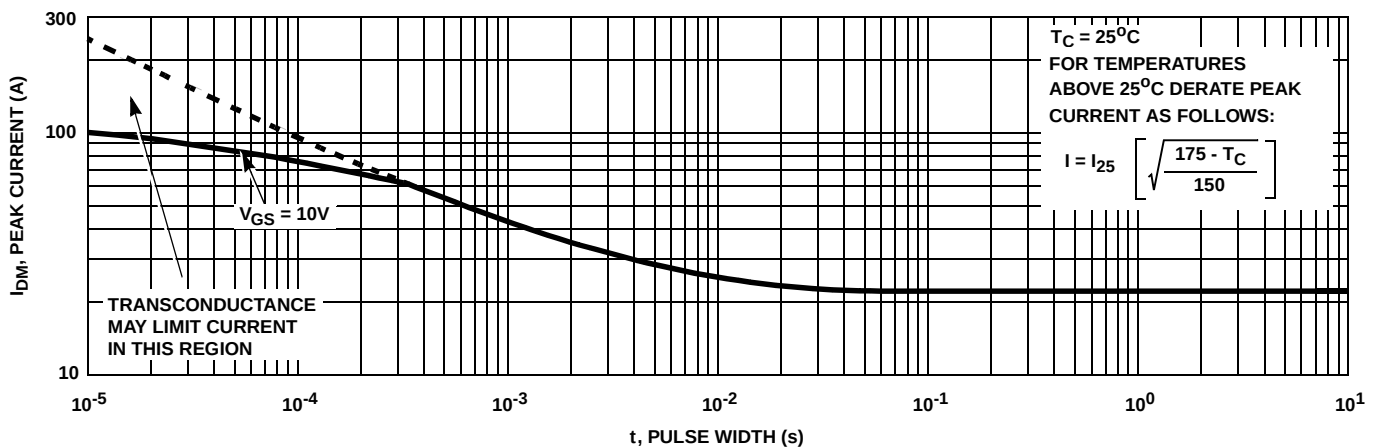


FIGURE 4. PEAK CURRENT CAPABILITY

Typical Performance Curves (Continued)

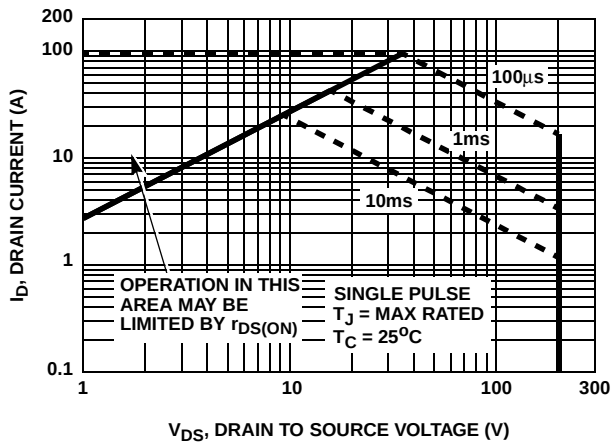
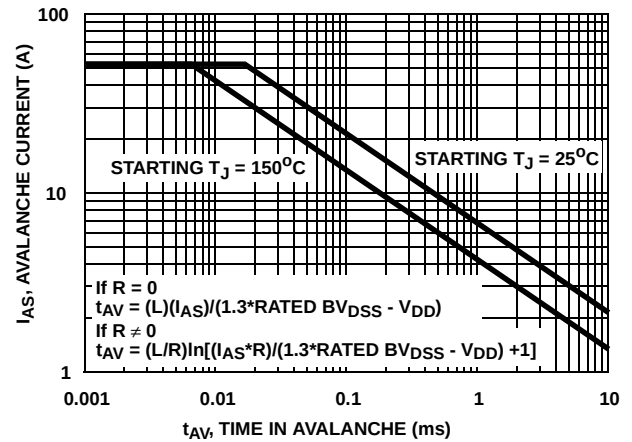


FIGURE 5. FORWARD BIAS SAFE OPERATING AREA



NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

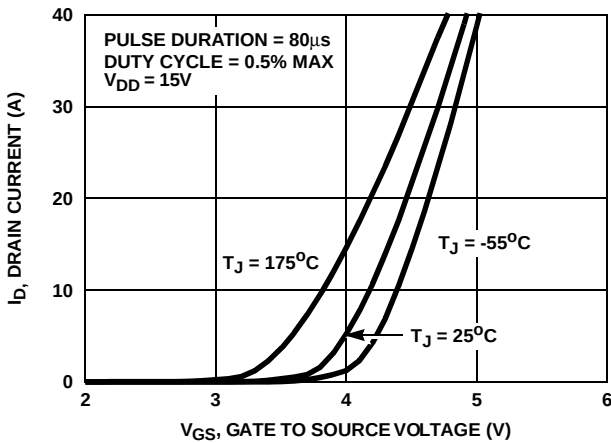


FIGURE 7. TRANSFER CHARACTERISTICS

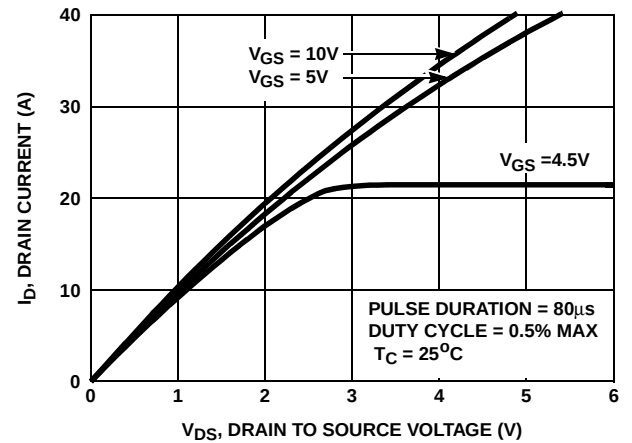


FIGURE 8. SATURATION CHARACTERISTICS

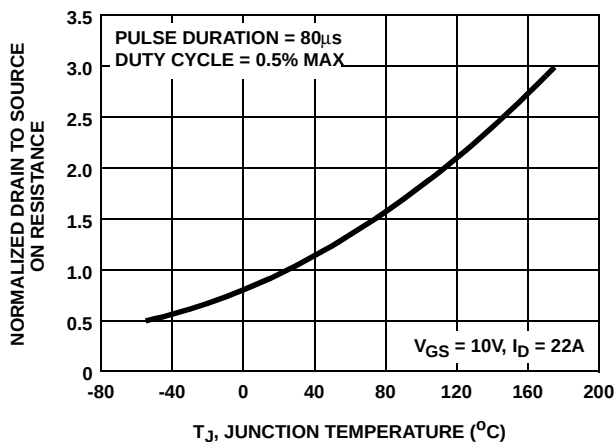


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

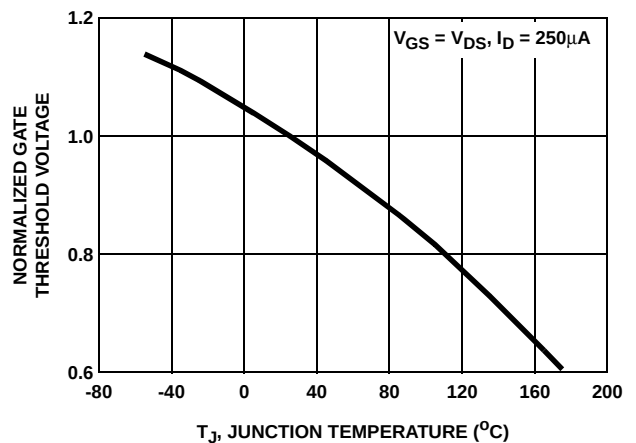


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

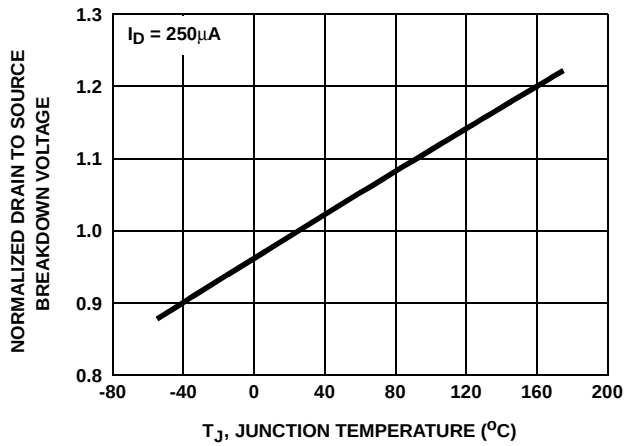


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

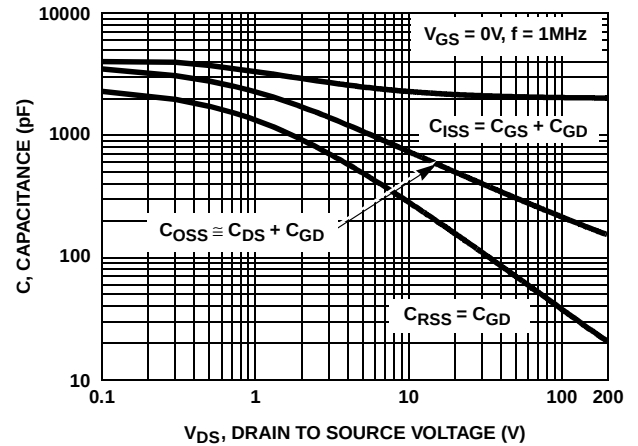
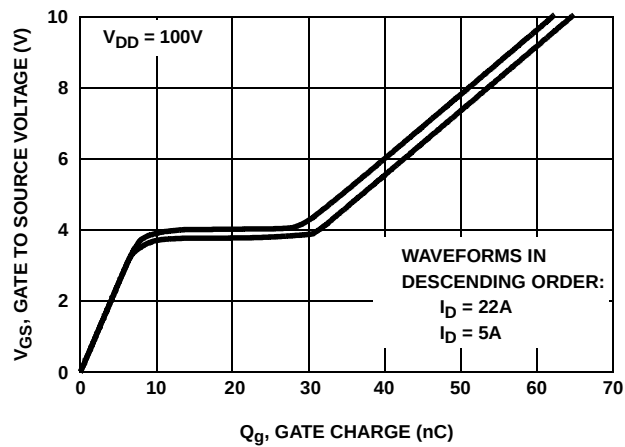


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

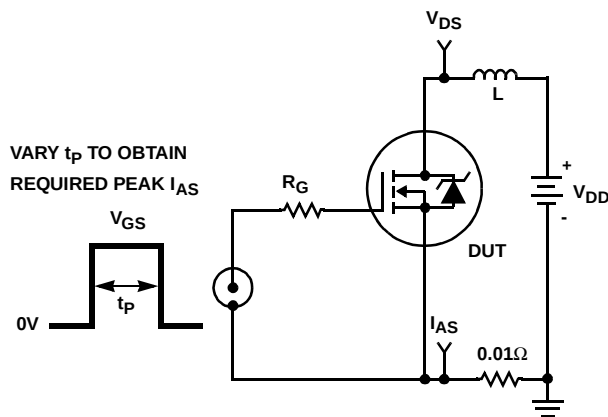


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

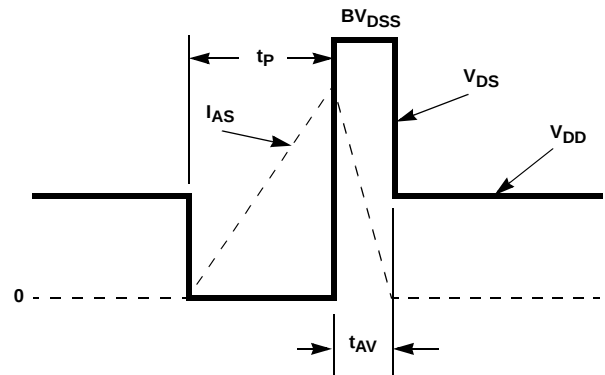


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

Test Circuits and Waveforms (Continued)

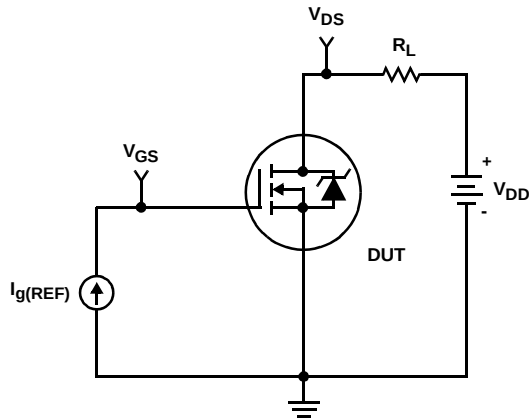


FIGURE 16. GATE CHARGE TEST CIRCUIT

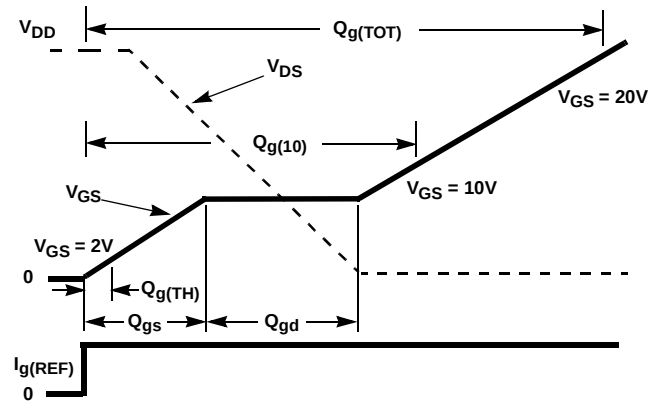


FIGURE 17. GATE CHARGE WAVEFORMS

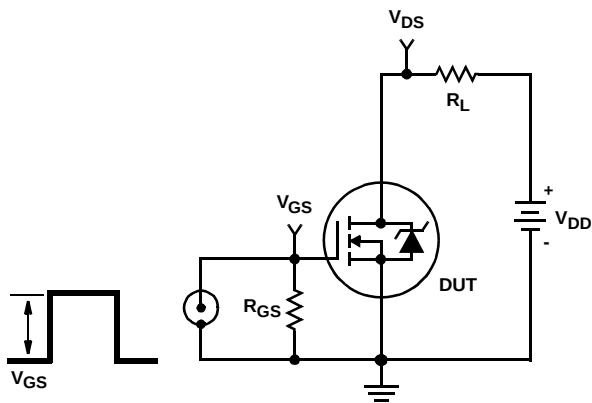


FIGURE 18. SWITCHING TIME TEST CIRCUIT

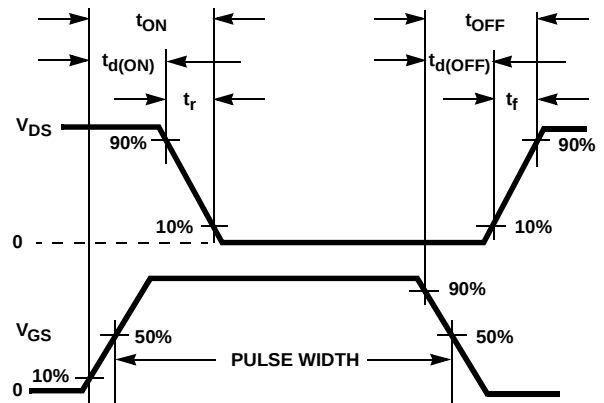


FIGURE 19. SWITCHING TIME WAVEFORM

PSPICE Electrical Model

.SUBCKT HUF75939 2 1 3 ; rev 10 October 2000

CA 12 8 3.6e-9
CB 15 14 3.5e-9
CIN 6 8 2e-9

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

EBREAK 11 7 17 18 225
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 5.78e-9
LSOURCE 3 7 3.92e-9

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 83.5e-3
RGATE 9 20 7.6e-1
RLDRAIN 2 5 10
RLGATE 1 9 57.8
RLSOURCE 3 7 39.2
RSLC1 5 51 RSLCMOD 1e-6
RSLC2 5 50 1e3
RSOURCE 8 7 RSOURCEMOD 10e-3
RVTHRES 22 8 RVTHRESMOD 1
RVTEMP 18 19 RVTEMPMOD 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

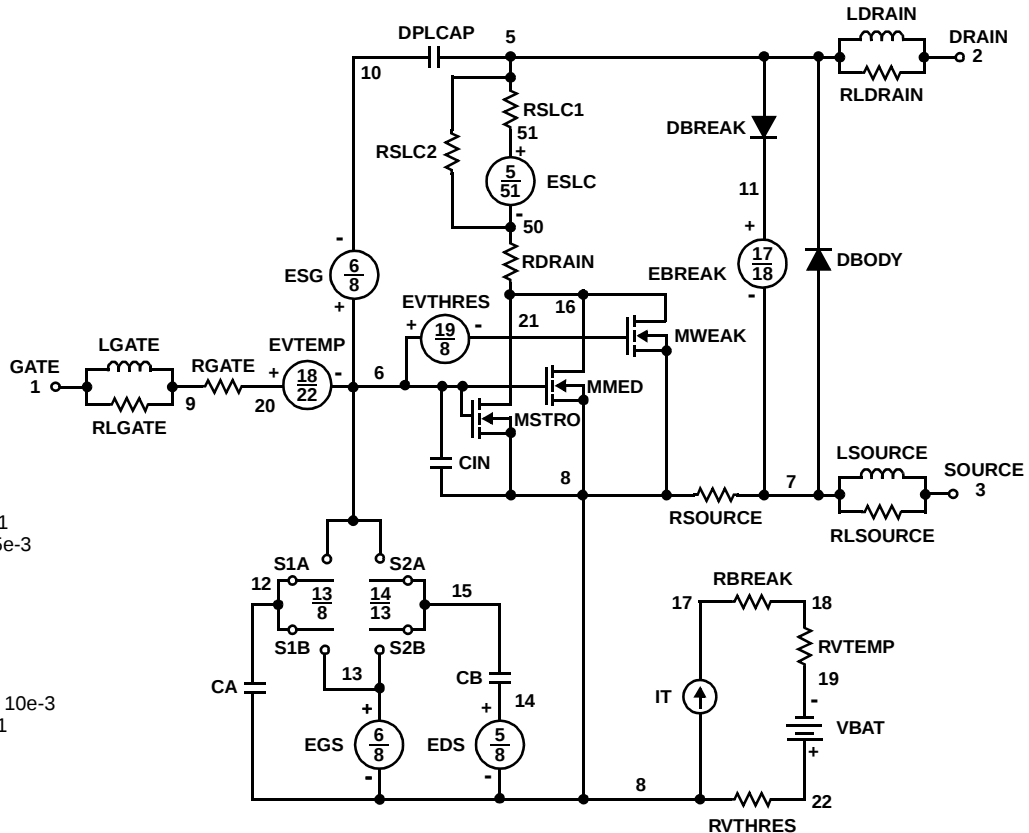
ESLC 51 50 VALUE={(V(5,51)/ABS(V(5,51)))*(PWR(V(5,51)/(1e-6*38),2.5))}

.MODEL DBODYMOD D (IS = 1.2e-12 RS = 5.5e-3 XTI = 5.5 TRS1 = 1e-5 TRS2 = 8e-6 + CJO = 12.5e-10 TT = 1e-7 M = 0.42)
.MODEL DBREAKMOD D (RS = 2. 5TRIS1 = 1e- 3TRIS2 = -8.9e-6)
.MODEL DPLCAPMOD D (CJO = 2.5e- 9IS = 1e-3 0N = 10 M = 0.9)
.MODEL MMEDMOD NMOS (VTO = 3.14 KP = 5 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 7.6e-1)
.MODEL MSTROMOD NMOS (VTO = 3.68 KP = 100 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)
.MODEL MWEAKMOD NMOS (VTO = 2.76 KP = 0.05 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 7.6 RS = 0.1)
.MODEL RBREAKMOD RES (TC1 = 1.52e- 3TC2 = -2e-7)
.MODEL RDRAINMOD RES (TC1 = 9.8e-3 TC2 = 2.6e-5)
.MODEL RSLCMOD RES (TC1 = 3e-3 TC2 = 1e-6)
.MODEL RSOURCEMOD RES (TC1 = 1e-3 TC2 = 1e-6)
.MODEL RVTHRESMOD RES (TC1 = -2.3e-3 TC2 = -1.3e-5)
.MODEL RVTEMPMOD RES (TC1 = -2.8e- 3TC2 = 1.7e-6)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -8.5 VOFF = -1)
.MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -1 VOFF = -8.5)
.MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -0.1 VOFF = 0.2)
.MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.2 VOFF = -0.1)

.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.



SPICE Thermal Model

REV 10 October 2000

T75939

CTHERM1 th 6 2.8e-3
 CHERM2 6 5 4.6e-3
 CHERM3 5 4 5.5e-3
 CHERM4 4 3 9.2e-3
 CHERM5 3 2 1.7e-2
 CHERM6 2 tl 4.3e-2

RHERM1 th 6 5e-4
 RHERM2 6 5 1.5e-3
 RHERM3 5 4 2e-2
 RHERM4 4 3 9e-2
 RHERM5 3 2 1.9e-1
 RHERM6 2 tl 2.9e-1

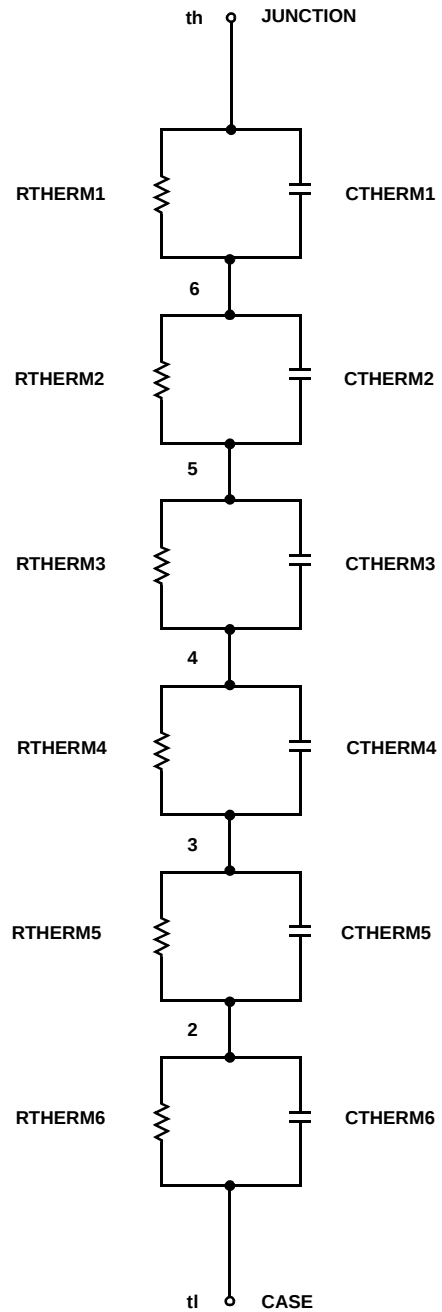
SABER Thermal Model

SABER thermal model T75939

template thermal_model th tl
 thermal_c th, tl

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    ctherm.ctherm1 th 6 = 2.8e-3
    ctherm.ctherm2 6 5 = 4.6e-3
    ctherm.ctherm3 5 4 = 5.5e-3
    ctherm.ctherm4 4 3 = 9.2e-3
    ctherm.ctherm5 3 2 = 1.7e-2
    ctherm.ctherm6 2 tl = 4.3e-2
```

```
    rtherm.rtherm1 th 6 = 5e-4
    rtherm.rtherm2 6 5 = 1.5e-3
    rtherm.rtherm3 5 4 = 2e-2
    rtherm.rtherm4 4 3 = 9e-2
    rtherm.rtherm5 3 2 = 1.9e-1
    rtherm.rtherm6 2 tl = 2.9e-1
}
```



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CoolFET TM	FRFET TM	PACMAN TM	Stealth TM	
CROSSVOLT TM	GlobalOptoisolator TM	POP TM	SuperSOT TM -3	
DenseTrench TM	GTO TM	Power247 TM	SuperSOT TM -6	
DOME TM	HiSeC TM	PowerTrench [®]	SuperSOT TM -8	
EcoSPARK TM	ISOPLANAR TM	QFET TM	SyncFET TM	
E ² CMOS TM	LittleFET TM	QS TM	TinyLogic TM	
EnSigna TM	MicroFET TM	QT Optoelectronics TM	TruTranslation TM	
FACT TM	MicroPak TM	Quiet Series TM	UHC TM	
FACT Quiet Series TM	MICROWIRE TM	SILENT SWITCHER [®]	UltraFET [®]	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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