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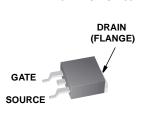


### HUF76639S3ST-F085

50A, 100V, 0.026 Ohm, N-Channel, Logic Level UltraFET® Power MOSFET

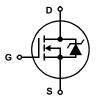
JEDEC TO-263AB

#### Packaging



#### HUF76639S3S

#### Symbol



# <u>UltraFI</u>T

#### Features

- Ultra Low On-Resistance
  - $r_{DS(ON)} = 0.026\Omega, V_{GS} = 10V$
- 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
- Switching Time vs R<sub>GS</sub> Curves

#### **Ordering Information**

PART NUMBER	PACKAGE	BRAND
HUF76639S3ST-F085	TO-263AB	76639S

NOTE: When ordering, use the entire part number. Add the suffix T to obtain the variant in tape and reel, e.g., HUF76639S3ST.

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

	HUF76639S3ST_F085	UNITS
Drain to Source Voltage (Note 1)V <sub>DSS</sub>	100	V
Drain to Gate Voltage (R <sub>GS</sub> = 20kΩ) (Note 1)	100	V
Gate to Source Voltage	±16	V
Drain Current		
Continuous (T <sub>C</sub> = $25^{\circ}$ C, V <sub>GS</sub> = 5V) I <sub>D</sub>	50	А
Continuous (T <sub>C</sub> = 25 <sup>o</sup> C, V <sub>GS</sub> = 10V) (Figure 2) I <sub>D</sub>	51	А
Continuous (T <sub>C</sub> = 100 <sup>o</sup> C, V <sub>GS</sub> = 5V) I <sub>D</sub>	35	А
Continuous (T <sub>C</sub> = 100 <sup>o</sup> C, V <sub>GS</sub> = 4.5V) (Figure 2)	34	А
Pulsed Drain Current	Figure 4	
Pulsed Avalanche Rating UIS	Figures 6, 17, 18	
Power Dissipation	180	W
Derate Above 25°C	1.2	W/ <sup>0</sup> C
Operating and Storage Temperature	-55 to 175	°C
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from Case for 10sTL	300	°C
Package Body for 10s, See Techbrief TB334 T <sub>pkg</sub>	260	°C
NOTES:		

#### 1. $T_{.1} = 25^{\circ}C$ to $150^{\circ}C$ .

**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.

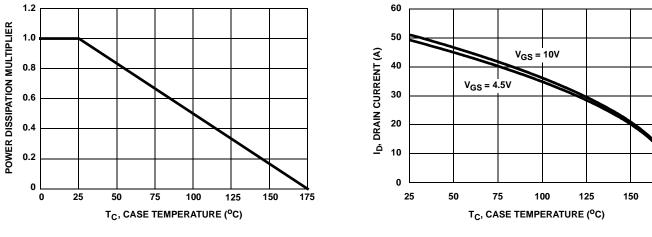
PARAMETER	SYMBOL	TES	T CONDITIONS	MIN	TYP	MAX	UNITS
OFF STATE SPECIFICATIONS	•	+			+		+
Drain to Source Breakdown Voltage	BV <sub>DSS</sub>	I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V (Figure 12)		100	-	-	V
-		$I_{D} = 250 \mu A, V_{GS} = 0$	0V , T <sub>C</sub> = -40 <sup>o</sup> C (Figure 12)	90	-	-	V
Zero Gate Voltage Drain Current	IDSS	$V_{DS} = 95V, V_{GS} = 0$	V	-	-	1	μA
		$V_{DS} = 90V, V_{GS} = 0$	V, T <sub>C</sub> = 150 <sup>o</sup> C	-	-	250	μΑ
Gate to Source Leakage Current	I <sub>GSS</sub>	$V_{GS} = \pm 16V$		-	-	±100	nA
ON STATE SPECIFICATIONS							L
Gate to Source Threshold Voltage	V <sub>GS(TH)</sub>	$V_{GS} = V_{DS}, I_D = 25$	0μA (Figure 11)	1	-	3	V
Drain to Source On Resistance	rDS(ON)	I <sub>D</sub> = 51A, V <sub>GS</sub> = 10 <sup>V</sup>	/ (Figures 9, 10)	-	0.023	0.026	Ω
THERMAL SPECIFICATIONS Thermal Resistance Junction to Case Thermal Resistance Junction to	R <sub>θJC</sub> R <sub>θJA</sub>	TO-263		-	-	0.83	°C/W
Ambient	0071						
SWITCHING SPECIFICATIONS (V <sub>GS</sub> =	= 4.5V)						
Turn-On Time	ton	$V_{DD} = 50V, I_D = 34A$ $V_{GS} = 4.5V, R_{GS} = 12\Omega$ (Figures 15, 21, 22)		-	-	336	ns
Turn-On Delay Time	<sup>t</sup> d(ON)			-	17	-	ns
Rise Time	t <sub>r</sub>			-	207	-	ns
Turn-Off Delay Time	<sup>t</sup> d(OFF)			-	83	-	ns
Fall Time	t <sub>f</sub>			-	136	-	ns
Turn-Off Time	<sup>t</sup> OFF			-	-	328	ns
SWITCHING SPECIFICATIONS (V_{GS} = $% \mathcal{O}_{GS}$	= 10V)						
Turn-On Time	<sup>t</sup> ON	$V_{DD} = 50V, I_D = 51A$ $V_{GS} = 10V, R_{GS} = 12\Omega$ (Figures 16, 21, 22)		-	-	96	ns
Turn-On Delay Time	t <sub>d(ON)</sub>			-	10	-	ns
Rise Time	t <sub>r</sub>			-	55	-	ns
Turn-Off Delay Time	<sup>t</sup> d(OFF)			-	151	-	ns
Fall Time	t <sub>f</sub>			-	110	-	ns
Turn-Off Time	tOFF			-	-	392	ns
GATE CHARGE SPECIFICATIONS				-	1	r.	
Total Gate Charge	Q <sub>g(TOT)</sub>	$V_{GS} = 0V$ to 10V	V <sub>DD</sub> = 50V,	-	71	86	nC
Gate Charge at 5V	Q <sub>g(5)</sub>	$V_{GS} = 0V \text{ to } 5V$	$I_D = 35A,$	-	39	47	nC
Threshold Gate Charge	Q <sub>g(TH)</sub>	$V_{GS} = 0V \text{ to } 1V$	I <sub>g(REF)</sub> = 1.0mA (Figures 14, 19, 20)	-	2.0	2.4	nC
Gate to Source Gate Charge	Q <sub>gs</sub>	(, , , , , , , , , , , , , , , , , , ,	-	6	-	nC	
Gate to Drain "Miller" Charge	Q <sub>gd</sub>	1		-	19	-	nC
CAPACITANCE SPECIFICATIONS		1	- I	I	1	1	
Input Capacitance	C <sub>ISS</sub>	$V_{DS} = 25V, V_{GS} = 0V,$ f = 1MHz (Figure 13)		-	2400	-	pF
Output Capacitance	C <sub>OSS</sub>			-	520	-	pF
					1		1

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

#### Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V <sub>SD</sub>	I <sub>SD</sub> = 35A	-	-	1.25	V
		I <sub>SD</sub> = 15A	-	-	1.0	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>SD</sub> = 35A, dI <sub>SD</sub> /dt = 100A/μs	-	-	137	ns
Reverse Recovered Charge	Q <sub>RR</sub>	I <sub>SD</sub> = 35A, dI <sub>SD</sub> /dt = 100A/μs	-	-	503	nC

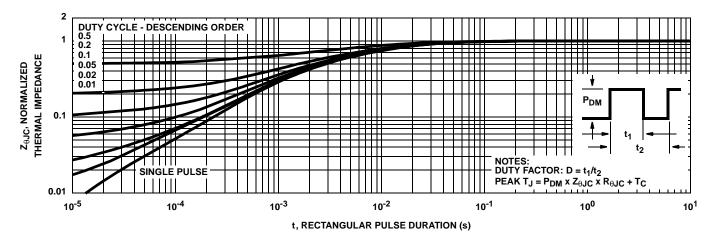
#### **Typical Performance Curves**

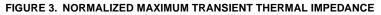


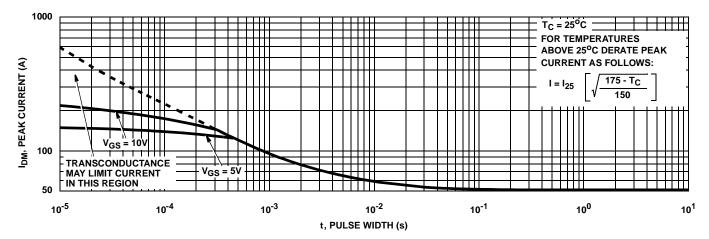




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#### Typical Performance Curves (Continued)

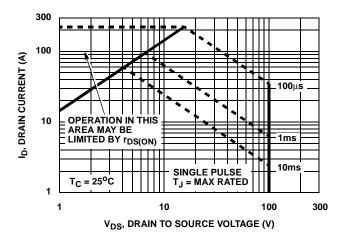


FIGURE 5. FORWARD BIAS SAFE OPERATING AREA

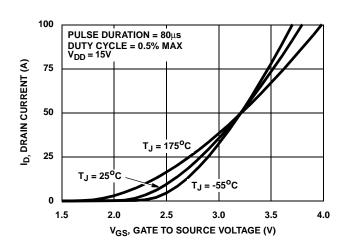


FIGURE 7. TRANSFER CHARACTERISTICS

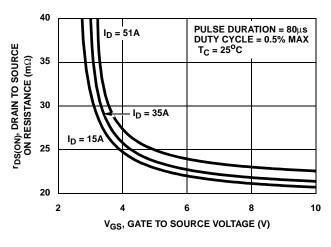


FIGURE 9. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

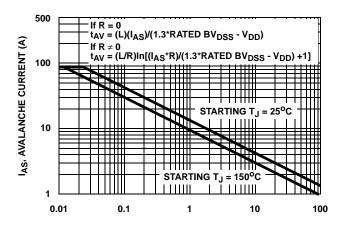


FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

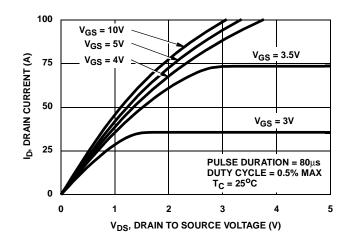
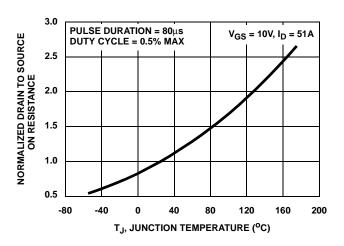
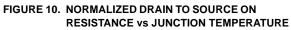
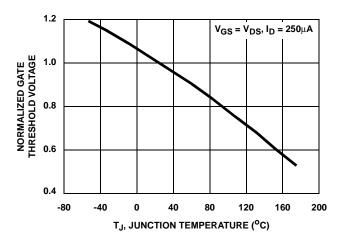


FIGURE 8. SATURATION CHARACTERISTICS





#### Typical Performance Curves (Continued)





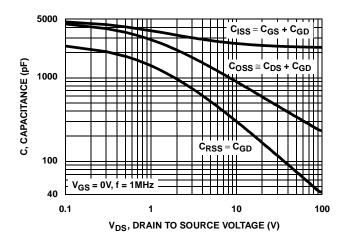


FIGURE 13. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

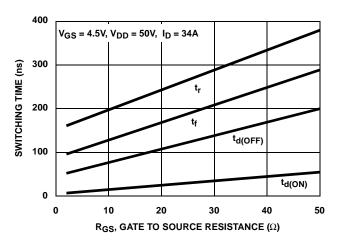


FIGURE 15. SWITCHING TIME vs GATE RESISTANCE

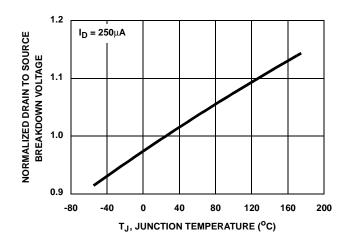


FIGURE 12. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

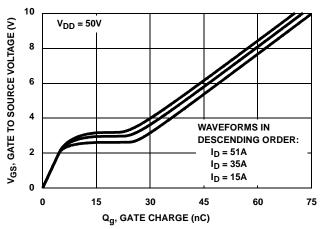


FIGURE 14. GATE CHARGE WAVEFORMS FOR CONSTANT

GATE CURRENT

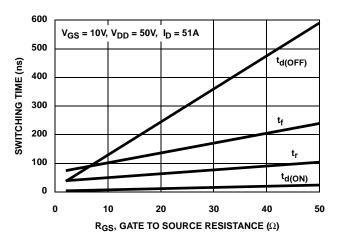


FIGURE 16. SWITCHING TIME vs GATE RESISTANCE

#### Test Circuits and Waveforms

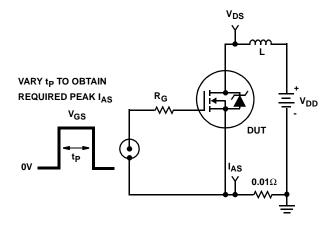


FIGURE 17. UNCLAMPED ENERGY TEST CIRCUIT

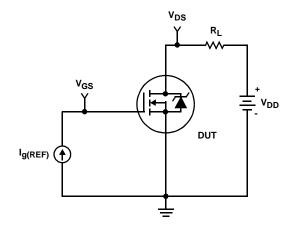


FIGURE 19. GATE CHARGE TEST CIRCUIT

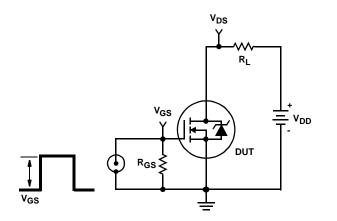


FIGURE 21. SWITCHING TIME TEST CIRCUIT

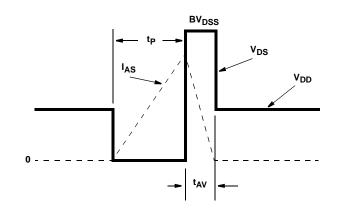


FIGURE 18. UNCLAMPED ENERGY WAVEFORMS

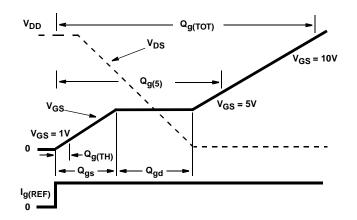


FIGURE 20. GATE CHARGE WAVEFORMS

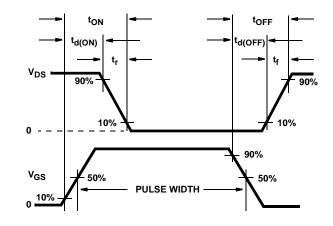


FIGURE 22. SWITCHING TIME WAVEFORM

SOURCE

<u>ი</u> 3

RVTHRES

#### **PSPICE Electrical Model**

.SUBCKT HUF76639 2 1 3 ; rev 26 July 1999

CA 12 8 4.2e-9 CB 15 14 4.2e-9 CIN 6 8 2.27e-9 DBODY 7 5 DBODYMOD DBREAK 5 11 DBREAKMOD LDRAIN **DPLCAP 10 5 DPLCAPMOD** DPLCAP 5 EBREAK 11 7 17 18 118.2 10 EDS 148581 RLDRAIN **≷**RSLC1 EGS 138681 DBREAK ESG 6 10 6 8 1 51 RSLC2 EVTHRES 6 21 19 8 1 5 EVTEMP 20 6 18 22 1 ESLC 11 IT 8 17 1 50 17 18 DBODY RDRAIN LDRAIN 2 5 1.0e-9 <u>6</u> 8 EBREAK ESG LGATE 1 9 5.1e-9 EVTHRES 16 LSOURCE 3 7 3.1e-9 21 19 8 MWEAK i∢ LGATE EVTEMP MMED 16 6 8 8 MMEDMOD RGATE GATE 1[₹ 18 MSTRO 16 6 8 8 MSTROMOD MMED 1 22 9  $\mathbf{\mathcal{M}}$ 20 MWEAK 16 21 8 8 MWEAKMOD MSTRC RLGATE RBREAK 17 18 RBREAKMOD 1 LSOURCE CIN RDRAIN 50 16 RDRAINMOD 15.8e-3 8 RGATE 9 20 1.94 RSOURCE RLDRAIN 2 5 10 RLSOURCE RLGATE 1 9 51 RLSOURCE 3 7 31 S1A 5 S2A RBREAK 121 RSI C1 5 51 RSI CMOD 1e-6 <u>13</u> 8 <u>14</u> 13 15 17 18 RSLC2 5 50 1e3 RSOURCE 8 7 RSOURCEMOD 3.6e-3 S1B ∩ S2B RVTFMP **RVTHRES 22 8 RVTHRESMOD 1** 13 СВ **RVTEMP 18 19 RVTEMPMOD 1** 19 CA IT 14 **↑** S1A 6 12 13 8 S1AMOD VBAT 5 6 S1B 13 12 13 8 S1BMOD EGS EDS 8 S2A 6 15 14 13 S2AMOD 8 S2B 13 15 14 13 S2BMOD 22

VBAT 22 19 DC 1

ESLC 51 50 VALUE = {(V(5,51)/ABS(V(5,51)))\*(PWR(V(5,51)/(1e-6\*99),3.5))}

.MODEL DBODYMOD D (IS = 2.6e-12 RS = 2.65e-3 IKF = 6 TRS1 = 1.5e-3 TRS2 = 3.5e-6 CJO = 2.1e-9 TT = 5.6e-8 M = 0.52) .MODEL DBREAKMOD D (RS = 2.5e-1 TRS1 = 1e-4 TRS2 = -1e-6) .MODEL DPLCAPMOD D (CJO = 2.6e-9 IS = 1e-30 M = 0.89 N = 10) .MODEL MMEDMOD NMOS (VTO = 1.77 KP = 7 IS = 1e-30 N = 10 TOX = 1 L = 1U W = 1U RG = 1.94) .MODEL MSTROMOD NMOS (VTO = 2.06 KP = 95 IS = 1e-30 N = 10 TOX = 1 L = 1U W = 1U) MODEL MWEAKMOD NMOS (VTO = 1.48 KP = 0.12 IS = 1e-30 N = 10 TOX = 1 L = 1U W = 1U RG = 19.4 RS = .1) .MODEL RBREAKMOD RES (TC1 = 1.05e-3 TC2 = -5e-7) .MODEL RDRAINMOD RES (TC1 = 8.5e-3 TC2 = 2.3e-5) .MODEL RSLCMOD RES (TC1 = 3.4e-3 TC2 = 2.5e-6) MODEL RSOURCEMOD RES (TC1 = 1e-3 TC2 = 1e-6) .MODEL RVTHRESMOD RES (TC1 = -1.9e-3 TC2 = -4.5e-6) .MODEL RVTEMPMOD RES (TC1 = -1.7e-3 TC2 = 1.5e-6) .MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -4.5 VOFF = -2.0) .MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -2.0 VOFF = -4.5) .MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -0.5 VOFF = 0.3) .MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.3 VOFF = -0.5)

.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.

#### SABER Electrical Model

REV 26 July 1999 template huf76639 n2,n1,n3 electrical n2,n1,n3 var i iscl d..model dbodymod = (is = 2.6e-12, cjo = 2.1e-9, tt = 5.6e-8, m = 0.52, n=10) d..model dbreakmod = () d..model dplcapmod =  $(c_{ij} = 2.6e-9, is = 1e-30, m = 0.89)$ m..model mmedmod = (type=\_n, vto = 1.77, kp = 7, is = 1e-30, tox = 1) m..model mstrongmod = (type=\_n, vto = 2.06,kp = 95, is = 1e-30, tox = 1) m..model mweakmod = (type=\_n, vto = 1.48, kp = 0.12, is = 1e-30, tox = 1) LDRAIN sw\_vcsp..model s1amod = (ron = 1e-5, roff = 0.1, von = -4.5, voff = -2.0) DPLCAP 5 DRAIN sw vcsp..model s1bmod = (ron = 1e-5, roff = 0.1, von = -2.0, voff = -4.5) o 2 10  $sw_vcsp...model s2amod = (ron = 1e-5, roff = 0.1, von = -0.5, voff = 0.3)$ RLDRAIN sw\_vcsp..model s2bmod = (ron = 1e-5, roff = 0.1, von = 0.3, voff = -0.5) RSLC1 RDBREAK 51 c.ca n12 n8 = 4.2e-9 RSLC2 ₹ 72 c.cb n15 n14 = 4.2e-9 RDBODY ISCL c.cin n6 n8 = 2.27e-9 DBREAK 50 d.dbody n7 n71 = model = dbodymod 71 d.dbreak n72 n11 = model = dbreakmod 6 8 ESG 11 d.dplcap n10 n5 = model = dplcapmod EVTHRES 16 21  $\left(\frac{19}{8}\right)$ MWEAK i.it n8 n17 = 1 i∙ LGATE EVTEMP DBODY RGATE GATE 6 18 22 EBREAK I.Idrain n2 n5 = 1.0e-9 MMED i∙ 1 0 9  $\sim$ 20 1.10ate n1 n9 = 5.1e-9MSTR RLGATE l.lsource n3 n7 = 3.1e-9 LSOURCE CIN SOURCE 8 m.mmed n16 n6 n8 n8 = model = mmedmod, I = 1u, w = 1u 3 m.mstrong n16 n6 n8 n8 = model = mstrongmod, I = 1u, w = 1u RSOURCE m.mweak n16 n21 n8 n8 = model = mweakmod, I = 1u, w = 1u RLSOURCE S1A os2A res.rbreak n17 n18 = 1, tc1 = 1.05e-3, tc2 = -5e-7 RBREAK <u>13</u> 8 <u>14</u> 13 15 res.rdbody n71 n5 = 2.65e-3, tc1 = 1.5e-3, tc2 = 3.5e-6 17 18 res.rdbreak n72 n5 = 2.5e-1, tc1 = 1e-4, tc2 = -1e-6 RVTEMP res.rdrain n50 n16 = 15.8e-3, tc1 = 8.5e-3, tc2 = 2.3e-5 o S2B S1B res.rgate n9 n20 = 1.94 13 СВ 19 CA res.rldrain n2 n5 = 10 IT (♠ 14 res.rlgate n1 n9 = 51 VBAT <u>6</u> 8 res.rlsource n3 n7 = 31 5 EGS EDS res.rslc1 n5 n51 = 1e-6, tc1 = 3.4e-3, tc2 = 2.5e-6 8 res.rslc2 n5 n50 = 1e3 22 res.rsource n8 n7 = 3.6e-3, tc1 = 1e-3, tc2 = 1e-6 RVTHRES res.rvtemp n18 n19 = 1, tc1 = -1.7e-3, tc2 = 1.5e-6 res.rvthres n22 n8 = 1, tc1 = -1.9e-3, tc2 = -4.5e-6 spe.ebreak n11 n7 n17 n18 = 118.2 spe.eds 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) + = iscliscl: v(n51,n50) = ((v(n5,n51)/(1e-9+abs(v(n5,n51))))\*((abs(v(n5,n51)\*1e6/99))\*\* 3.5))

#### SPICE Thermal Model

#### REV 26 July 1999

HUF76639T

CTHERM1 th 6 3.2e-3 CTHERM2 6 5 8.5e-3 CTHERM3 5 4 1.2e-2 CTHERM4 4 3 1.6e-2 CTHERM5 3 2 5.5e-2 CTHERM6 2 tl 1.5

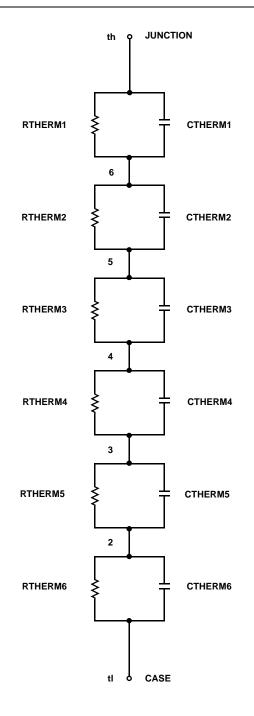
RTHERM1 th 6 8.0e-3 RTHERM2 6 5 6.8e-2 RTHERM3 5 4 9.2e-2 RTHERM4 4 3 2.0e-1 RTHERM5 3 2 2.4e-1 RTHERM6 2 tl 5.2e-2

#### SABER Thermal Model

SABER thermal model HUF76639T

template thermal\_model th tl thermal\_c th, tl { ctherm.ctherm1 th 6 = 3.2e-3 ctherm.ctherm2 6 5 = 8.5e-3 ctherm.ctherm3 5 4 = 1.2e-2 ctherm.ctherm4 4 3 = 1.6e-2 ctherm.ctherm5 3 2 = 5.5e-2 ctherm.ctherm6 2 tl = 1.5 rtherm.rtherm1 th 6 = 8.0e-3 rtherm.rtherm2 6 5 = 6.8e-2

rtherm.rtherm3 5 4 = 9.2e-2rtherm.rtherm3 5 4 = 9.2e-2rtherm.rtherm4 4 3 = 2.0e-1rtherm.rtherm5 3 2 = 2.4e-1rtherm.rtherm6 2 tl = 5.2e-2



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