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January 2012

FDB2572

N-Channel PowerTrench® MOSFET 150V, 29A, 54m Ω

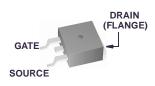
Features

- $r_{DS(ON)} = 45m\Omega$ (Typ.), $V_{GS} = 10V$, $I_D = 9A$
- $Q_q(tot) = 26nC (Typ.), V_{GS} = 10V$
- Low Miller Charge
- Low Q_{RR} Body Diode
- UIS Capability (Single Pulse and Repetitive Pulse)

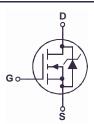
Applications

- DC/DC converters and Off-Line UPS
- Distributed Power Architectures and VRMs
- Primary Switch for 24V and 48V Systems
- High Voltage Synchronous Rectifier

Formerly developmental type 82860



TO-263AB FDB SERIES



MOSFET Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	Ratings	Units
V _{DSS}	Drain to Source Voltage	150	V
V _{GS}	Gate to Source Voltage	±20	V
	Drain Current		
	Continuous ($T_C = 25^{\circ}C$, $V_{GS} = 10V$)	29	Α
I_D	Continuous (T _C = 100°C, V _{GS} = 10V)	20	А
	Continuous ($T_{amb} = 25$ °C, $V_{GS} = 10V$, $R_{\theta JA} = 43$ °C/W)	4	А
	Pulsed	Figure 4	А
E _{AS}	Single Pulse Avalanche Energy (Note 1)	36	mJ
D	Power dissipation	135	W
P_{D}	Derate above 25°C	0.9	W/°C
T _J , T _{STG}	Operating and Storage Temperature	-55 to 175	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case, TO-263	1.11	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient , TO-263 (Note 2)	62	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient TO-263, 1in ² copper pad area	43	°C/W

Package Marking and Ordering Information

Device Marking	king Device Packag		Reel Size	Tape Width	Quantity	
FDB2572	FDB2572	TO-263AB	330mm	24mm	800 units	

Electrical Characteristics $T_C = 25^{\circ}C$ unless otherwise noted

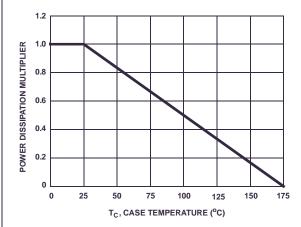
Symbol	Parameter	Test Cond	litions	Min	Тур	Max	Units
Off Chara	ncteristics		·				
B _{VDSS}	Drain to Source Breakdown Voltage	$I_D = 250 \mu A, V_{GS}$	= 0V	150	-	-	V
	Zara Cata Valtaga Drain Current	V _{DS} = 120V	V _{DS} = 120V		-	1	
I _{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V$	$T_{\rm C} = 150^{\rm o}$	-	-	250	μΑ
I _{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 20V$		-	-	±100	nA
On Chara	cteristics						
V _{GS(TH)}	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 2$	250μΑ	2	-	4	V
		I _D =9A, V _{GS} =10V		-	0.045	0.054	
r _{DS(ON)}	Drain to Source On Resistance	$I_D = 4A, V_{GS} = 6V$	V,	-	0.050	0.075	Ω
()		I _D =9A, V _{GS} =10V,		-	0.126	0.146	1
	Characteristics				T		
C _{ISS}	Input Capacitance	-V _{DS} = 25V, V _{GS} =	= 0V	-	1770	-	pF
C _{OSS}	Output Capacitance	= f = 1MHz			183	-	pF
C _{RSS}	Reverse Transfer Capacitance			-	40	-	pF
$Q_{g(TOT)}$	Total Gate Charge at 10V	$V_{GS} = 0V \text{ to } 10V$	J L	-	26	34	nC
Q _{g(TH)}	Threshold Gate Charge	$V_{GS} = 0V \text{ to } 2V$	$V_{DD} = 75V$	-	3.3	4.3	nC
Q_{gs}	Gate to Source Gate Charge		$I_D = 9A$	-	8	-	nC
Q _{gs2}	Gate Charge Threshold to Plateau		$I_g = 1.0 \text{mA}$	-	5	-	nC
Q_{gd}	Gate to Drain "Miller" Charge			-	6	-	nC
Resistive	Switching Characteristics (V _G	S = 10V)					
t _{ON}	Turn-On Time			-	-	36	ns
t _{d(ON)}	Turn-On Delay Time	$V_{DD} = 75V, I_{D} = 9A$ $V_{GS} = 10V, R_{GS} = 11.0\Omega$		-	11	-	ns
t _r	Rise Time			-	14	-	ns
t _{d(OFF)}	Turn-Off Delay Time			-	31	-	ns
t _f	Fall Time			-	14	-	ns
t _{OFF}	Turn-Off Time			-	-	66	ns

Drain-Source Diode Characteristics

V _{SD}	Source to Drain Diode Voltage	I _{SD} = 9A	-	-	1.25	V
		I _{SD} = 4A	-	-	1.0	V
t _{rr}	Reverse Recovery Time	$I_{SD} = 9A$, $dI_{SD}/dt = 100A/\mu s$	-	-	74	ns
Q _{RR}	Reverse Recovered Charge	$I_{SD} = 9A$, $dI_{SD}/dt = 100A/\mu s$	-	-	169	nC

Notes: 1: Starting T_J = 25°C, L = 0.2mH, I_{AS} = 19A. 2: Pulse Width = 100s





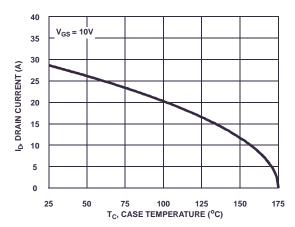


Figure 1. Normalized Power Dissipation vs Ambient Temperature

Figure 2. Maximum Continuous Drain Current vs Case Temperature

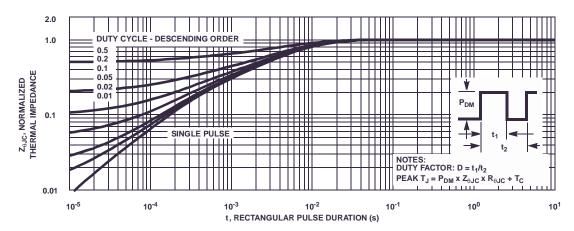


Figure 3. Normalized Maximum Transient Thermal Impedance

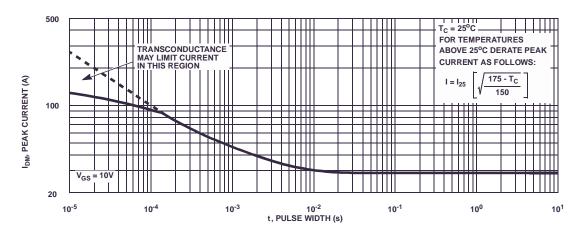
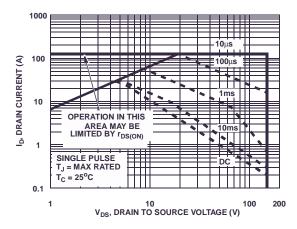


Figure 4. Peak Current Capability

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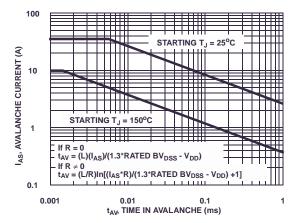
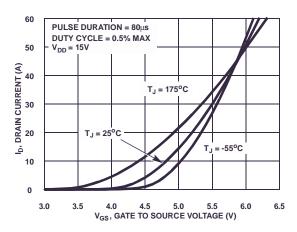


Figure 5. Forward Bias Safe Operating Area

NOTE: Refer to Fairchild Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching

Capability



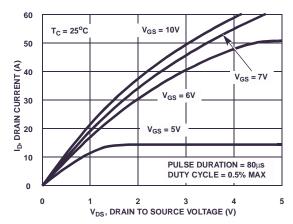
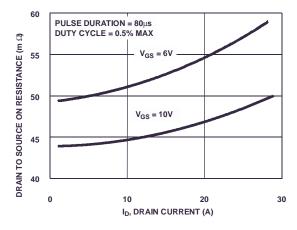


Figure 7. Transfer Characteristics

Figure 8. Saturation Characteristics



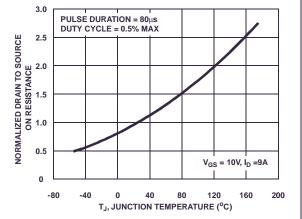


Figure 9. Drain to Source On Resistance vs Drain Current

Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

Typical Characteristics $T_C = 25^{\circ}C$ unless otherwise noted

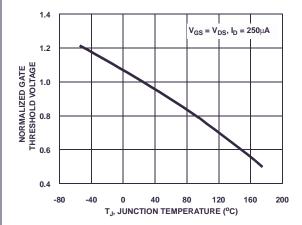
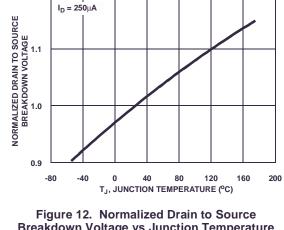


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature



1.2

Breakdown Voltage vs Junction Temperature

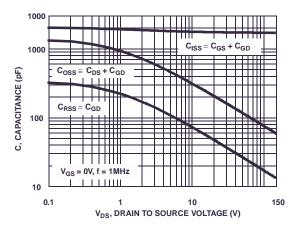


Figure 13. Capacitance vs Drain to Source Voltage

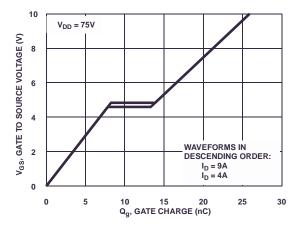
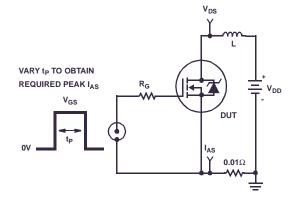


Figure 14. Gate Charge Waveforms for Constant **Gate Currents**

Test Circuits and Waveforms



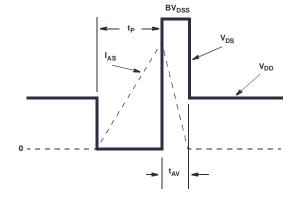


Figure 15. Unclamped Energy Test Circuit

Figure 16. Unclamped Energy Waveforms

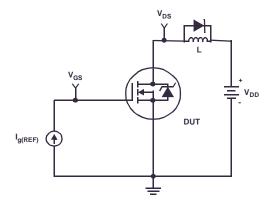


Figure 17. Gate Charge Test Circuit

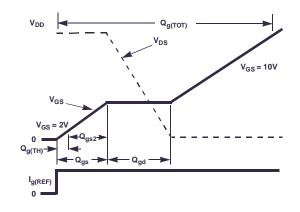


Figure 18. Gate Charge Waveforms

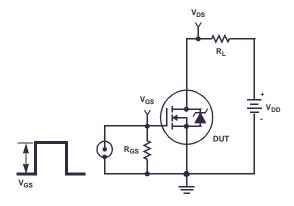


Figure 19. Switching Time Test Circuit

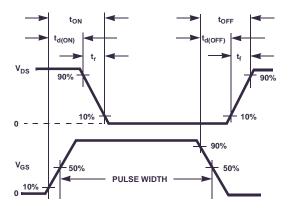


Figure 20. Switching Time Waveforms

Thermal Resistance vs. Mounting Pad Area

The maximum rated junction temperature, T_{JM} , and the thermal resistance of the heat dissipating path determines the maximum allowable device power dissipation, P_{DM} , in an application. Therefore the application's ambient temperature, T_A (°C), and thermal resistance $R_{\theta JA}$ (°C/W) must be reviewed to ensure that T_{JM} is never exceeded. Equation 1 mathematically represents the relationship and serves as the basis for establishing the rating of the part.

$$P_{DM} = \frac{(T_{JM} - T_A)}{R_{\theta JA}} \tag{EQ. 1}$$

In using surface mount devices such as the TO-263 package, the environment in which it is applied will have a significant influence on the part's current and maximum power dissipation ratings. Precise determination of P_{DM} is complex and influenced by many factors:

- Mounting pad area onto which the device is attached and whether there is copper on one side or both sides of the board.
- The number of copper layers and the thickness of the board.
- 3. The use of external heat sinks.
- 4. The use of thermal vias.
- 5. Air flow and board orientation.
- For non steady state applications, the pulse width, the duty cycle and the transient thermal response of the part, the board and the environment they are in.

Fairchild provides thermal information to assist the designer's preliminary application evaluation. Figure 21 defines the $R_{\theta JA}$ for the device as a function of the top copper (component side) area. This is for a horizontally positioned FR-4 board with 1oz copper after 1000 seconds of steady state power with no air flow. This graph provides the necessary information for calculation of the steady state junction temperature or power dissipation. Pulse applications can be evaluated using the Fairchild device Spice thermal model or manually utilizing the normalized maximum transient thermal impedance curve.

Thermal resistances corresponding to other copper areas can be obtained from Figure 21 or by calculation using Equation 2 or 3. Equation 2 is used for copper area defined in inches square and equation 3 is for area in centimeter square. The area, in square inches or square centimeters is the top copper area including the gate and source pads.

$$R_{\theta JA} = 26.51 + \frac{19.84}{(0.262 + Area)}$$
 (EQ. 2)

Area in Inches Squared

$$R_{\theta JA} = 26.51 + \frac{128}{(1.69 + Area)}$$
 (EQ. 3)

Area in Centimeters Squared

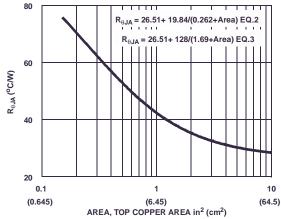


Figure 21. Thermal Resistance vs Mounting
Pad Area

```
PSPICE Electrical Model
.SUBCKT FDB2572 2 1 3;
                           rev April 2002
CA 12 8 5.5e-10
Cb 15 14 7.4e-10
                                                                                                  LDRAIN
Cin 6 8 1.7e-9
                                                             DPLCAP
                                                                                                           DRAIN
Dbody 7 5 DbodyMOD
                                                                                                  RLDRAIN
Dbreak 5 11 DbreakMOD
                                                                      €RSLC1
                                                                                   DBREAK 
Dplcap 10 5 DplcapMOD
                                                            RSLC2<sup>₹</sup>
                                                                          ESLC
Ebreak 11 7 17 18 160
                                                                                          11
Eds 14 8 5 8 1
                                                                        50
Egs 13 8 6 8 1
                                                                      ≨RDRAIN
                                                                                          17
                                                                                               DBODY
Esg 6 10 6 8 1
                                                    ESG
                                                                                  FRRFAK
Evthres 6 21 19 8 1
                                                              EVTHRES
                                                                          16
Evtemp 20 6 18 22 1
                                                                (19)
8
                                                                                    MWEAK
                                    LGATE
                                                  EVTEMP
                                            RGATE
                                                    18
22
It 8 17 1
                                                                           ←MMED
                                          I<sub>9</sub>
                                                 20
                                                                  MSTRC
                                    RLGATE
Lgate 1 9 9.56e-9
                                                                                                  LSOURCE
Ldrain 2 5 1.0e-9
                                                                   CIN
                                                                                                           SOURCE
Lsource 3 7 7.71e-9
                                                                                    RSOURCE
                                                                                                 RLSOURCE
RLgate 1 9 95.6
RLdrain 2 5 10
                                                                                       RBREAK
                                                      <u>13</u>
8
                                                           14
13
RLsource 3 7 77.1
                                                                                    17
                                                                                                RVTEMP
                                                   S1B
                                                            o S2B
Mmed 16 6 8 8 MmedMOD
                                                         13
                                                                  СВ
                                                                                                19
Mstro 16 6 8 8 MstroMOD
                                              CA
                                                                                   IT
Mweak 16 21 8 8 MweakMOD
                                                                                                  VBAT
                                                      EGS
Rbreak 17 18 RbreakMOD 1
                                                                                 8
Rdrain 50 16 Rdrain MOD 35e-3
Rgate 9 20 1.6
                                                                                       RVTHRES
RSLC1 5 51 RSLCMOD 1.0e-6
RSLC2 5 50 1.0e3
Rsource 8 7 RsourceMOD 3.0e-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*52),3))}
.MODEL DbodyMOD D (IS=6.0E-11 N=1.14 RS=3.9e-3 TRS1=3.5e-3 TRS2=3.0e-6
+ CJO=1.1e-9 M=0.63 TT=6.2e-8 XTI=4.5)
.MODEL DbreakMOD D (RS=10 TRS1=5.0e-3 TRS2=-5.0e-6)
.MODEL DplcapMOD D (CJO=3.5e-10 IS=1.0e-30 N=10 M=0.65)
.MODEL MmedMOD NMOS (VTO=3.55 KP=3 IS=1e-40 N=10 TOX=1 L=1u W=1u RG=1.6)
.MODEL MstroMOD NMOS (VTO=4.0 KP=25 IS=1e-30 N=10 TOX=1 L=1u W=1u)
.MODEL MweakMOD NMOS (VTO=2.95 KP=0.05 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=16 RS=0.1)
.MODEL RbreakMOD RES (TC1=1.15e-3 TC2=-9.5e-7)
.MODEL RdrainMOD RES (TC1=9.0e-3 TC2=2.5e-5)
.MODEL RSLCMOD RES (TC1=3.0e-3 TC2=2.5e-6)
.MODEL RsourceMOD RES (TC1=4.0e-3 TC2=1.0e-6)
.MODEL RvthresMOD RES (TC1=-4.1e-3 TC2=-1.0e-5)
.MODEL RytempMOD RES (TC1=-4.0e-3 TC2=1.0e-6)
.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-5.0 VOFF=-3.5)
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-3.5 VOFF=-5.0)
.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)
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.
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SABER Electrical Model REV April 2002

```
REV April 2002
ttemplate FDB2572 n2,n1,n3
electrical n2,n1,n3
var i iscl
dp..model dbodymod = (isl=6.0e-11,nl=1.14,rs=3.9e-3,trs1=3.5e-3,trs2=3.0e-6,cjo=1.1e-9,m=0.63,tt=6.2e-8,xti=4.5)
dp..model dbreakmod = (rs=10.trs1=5.0e-3.trs2=-5.0e-6)
dp..model dplcapmod = (cjo=3.5e-10,isl=10.0e-30,nl=10,m=0.65)
m..model mmedmod = (type=\_n, vto=3.55, kp=3, is=1e-40, tox=1)
m..model mstrongmod = (type=_n,vto=4.0,kp=25,is=1e-30, tox=1)
m..model mstrongmod = (type=_i1,vto=4.0,np=20,i0=10 00, ...., m..model mweakmod = (type=_n,vto=2.95,kp=0.05,is=1e-30, tox=1,rs=0.1)
                                                                                                             LDRAIN
sw_vcsp..model s1amod = (ron=1e-5,roff=0.1,von=-5.0,voff=-3.5)
                                                                                                                       DRAIN
sw_vcsp..model s1bmod = (ron=1e-5,roff=0.1,von=-3.5,voff=-5.0) 10
sw_vcsp..model s2amod = (ron=1e-5,roff=0.1,von=-0.5,voff=0.3)
                                                                                                             RLDRAIN
                                                                              ₹RSLC1
sw_vcsp..model s2bmod = (ron=1e-5,roff=0.1,von=0.3,voff=-0.5)
                                                                                51
c.ca n12 n8 = 5.5e-10
                                                                  RSLC2 €
c.cb n15 n14 = 7.4e-10
                                                                                  ISCL
c.cin n6 n8 = 1.7e-9
                                                                                            DBREAK 3
                                                                                50
dp.dbody n7 n5 = model=dbodymod
                                                                              ₹RDRAIN
                                                          ESG (
                                                                                                    11
dp.dbreak n5 n11 = model=dbreakmod
                                                                                                             DBODY
                                                                     EVTHRES
dp.dplcap n10 n5 = model=dplcapmod
                                                                        1<u>9</u>
8
                                                                                              MWEAK
                                                         EVTEMP
                                         LGATE
spe.ebreak n11 n7 n17 n18 = 160 GATE
                                                  RGATE
                                                           18
22
                                                                                  MMED
                                                                                              EBREAK
spe.eds n14 n8 n5 n8 = 1
                                                        20
spe.egs n13 n8 n6 n8 = 1
                                         RLGATE
spe.esg n6 n10 n6 n8 = 1
                                                                                                             LSOURCE
                                                                          CIN
                                                                                                                      SOURCE
spe.evthres n6 n21 n19 n8 = 1
spe.evtemp n20 n6 n18 n22 = 1
                                                                                           RSOURCE
                                                                                                            RLSOURCE
i.it n8 n17 = 1
                                                                                                 RBREAK
                                                                                              17
                                                                                                           18
I.lgate n1 n9 = 9.56e-9
I.ldrain n2 n5 = 1.0e-9
                                                                                                         ₹RVTEMP
I.lsource n3 n7 = 7.71e-9
                                                                          CB
                                                                                                           19
                                                    CA
                                                                                            IT
res.rlgate n1 n9 = 95.6
                                                                                                             VBAT
                                                                  8
                                                            EGS
                                                                       EDS
res.rldrain n2 n5 = 10
res.rlsource n3 n7 = 77.1
                                                                                                 RVTHRES
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=1.15e-3,tc2=-9.5e-7
res.rdrain n50 n16 = 35e-3, tc1=9.0e-3,tc2=2.5e-5
res.rgate n9 n20 = 1.6
res.rslc1 n5 n51 = 1.0e-6, tc1=3.0e-3,tc2=2.5e-6
res.rslc2 n5 n50 = 1.0e3
res.rsource n8 n7 = 3.0e-3, tc1=4.0e-3,tc2=1.0e-6
res.rvthres n22 n8 = 1, tc1=-4.1e-3,tc2=-1.0e-5
res.rvtemp n18 n19 = 1, tc1=-4.0e-3,tc2=1.0e-6
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
(v(n5,n51)/(1e-9+abs(v(n5,n51))))*((abs(v(n5,n51)*1e6/52))**3))
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SPICE Thermal Model JUNCTION REV 26 April 2002 FDB2572 CTHERM1 TH 6 3.8e-3 CTHERM2 6 5 4.0e-3 CTHERM3 5 4 4.2e-3 RTHERM1 CTHERM1 CTHERM4 4 3 4.3e-3 CTHERM5 3 2 8.5e-3 CTHERM6 2 TL 3.0e-2 6 RTHERM1 TH 6 5.5e-4 RTHERM2 6 5 5.0e-3 RTHERM3 5 4 4.5e-2 RTHERM2 CTHERM2 RTHERM4 4 3 10.5e-2 RTHERM5 3 2 3.7e-1 RTHERM6 2 TL 3.8e-1 5 SABER Thermal Model SABER thermal model FDB2572 RTHERM3 CTHERM3 template thermal_model th tl thermal_c th, tl ctherm.ctherm1 th 6 = 3.8e-3 ctherm.ctherm2 6 5 =4.0e-3 ctherm.ctherm3 5 4 =4.2e-3 ctherm.ctherm4 4 3 =4.3e-3 ctherm.ctherm5 3 2 =8.5e-3 RTHERM4 CTHERM4 ctherm.ctherm6 2 tl =3.0e-2 rtherm.rtherm1 th 6 =5.5e-4 rtherm.rtherm2 6 5 = 5.0e-33 rtherm.rtherm3 5 4 =4.5e-2 rtherm.rtherm4 4 3 =10.5e-2 rtherm.rtherm5 3 2 =3.7e-1 CTHERM5 RTHERM5 rtherm.rtherm6 2 tl =3.8e-1 2 RTHERM6 CTHERM6 tl CASE





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