

**FAIRCHILD**

SEMICONDUCTOR®

**FDP3672**

**N-Channel PowerTrench® MOSFET  
105V, 41A, 33mΩ**

September 2003

**Features**

- $r_{DS(ON)} = 25m\Omega$  (Typ.),  $V_{GS} = 10V$ ,  $I_D = 41A$
- $Q_g(tot) = 28nC$  (Typ.),  $V_{GS} = 10V$
- Low Miller Charge
- Low  $Q_{RR}$  Body Diode
- Optimized efficiency at high frequencies
- UIS Capability (Single Pulse and Repetitive Pulse)
- Qualified to AEC Q101

**Applications**

- DC/DC converters and Off-Line UPS
- Distributed Power Architectures and VRMs
- Primary Switch for 24V and 48V Systems
- High Voltage Synchronous Rectifier
- Direct Injection / Diesel Injection Systems
- 42V Automotive Load Control
- Electronic Valve Train Systems

Formerly developmental type 82760



**MOSFET Maximum Ratings**  $T_C = 25^\circ C$  unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain to Source Voltage	105	V
$V_{GS}$	Gate to Source Voltage	$\pm 20$	V
$I_D$	Drain Current		
	Continuous ( $T_C = 25^\circ C$ , $V_{GS} = 10V$ )	41	A
	Continuous ( $T_C = 100^\circ C$ , $V_{GS} = 10V$ )	31	A
	Continuous ( $T_{amb} = 25^\circ C$ , $V_{GS} = 10V$ , $R_{\theta JA} = 62^\circ C/W$ )	5.9	A
	Pulsed	Figure 4	A
$E_{AS}$	Single Pulse Avalanche Energy (Note 1)	48	mJ
$P_D$	Power dissipation	135	W
	Derate above $25^\circ C$	0.9	W/ $^\circ C$
$T_J, T_{STG}$	Operating and Storage Temperature	-55 to 175	$^\circ C$

**Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance Junction to Case TO-220	1.11	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient TO-220 (Note 2)	62	$^\circ C/W$

This product has been designed to meet the extreme test conditions and environment demanded by the automotive industry. For a copy of the requirements, see AEC Q101 at: <http://www.aecouncil.com/>

Reliability data can be found at: <http://www.fairchildsemi.com/products/discrete/reliability/index.html>.

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



## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP3672	FDP3672	TO-220AB	Tube	N/A	50 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off Characteristics

$B_{VDSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$	105	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 80\text{V}$ $V_{GS} = 0\text{V}$ $T_C = 150^\circ\text{C}$	-	-	1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(TH)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$	2	-	4	V
$r_{DS(ON)}$	Drain to Source On Resistance	$I_D = 41\text{A}$ , $V_{GS} = 10\text{V}$	-	0.025	0.033	$\Omega$
		$I_D = 21\text{A}$ , $V_{GS} = 6\text{V}$ ,	-	0.031	0.055	
		$I_D = 41\text{A}$ , $V_{GS} = 10\text{V}$ , $T_C = 175^\circ\text{C}$	-	0.063	0.070	

### Dynamic Characteristics

$C_{ISS}$	Input Capacitance	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$	-	1670	-	pF	
$C_{OSS}$	Output Capacitance		-	240	-	pF	
$C_{RSS}$	Reverse Transfer Capacitance		-	55	-	pF	
$Q_{g(TOT)}$	Total Gate Charge at 10V	$V_{GS} = 0\text{V}$ to 10V	$V_{DD} = 50\text{V}$ $I_D = 41\text{A}$ $I_g = 1.0\text{mA}$	-	28	37	nC
$Q_{g(TH)}$	Threshold Gate Charge	$V_{GS} = 0\text{V}$ to 2V		-	3.9	5	nC
$Q_{gs}$	Gate to Source Gate Charge			-	12	-	nC
$Q_{gs2}$	Gate Charge Threshold to Plateau			-	8.0	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge			-	6.5	-	nC

### Resistive Switching Characteristics ( $V_{GS} = 10\text{V}$ )

$t_{ON}$	Turn-On Time	$V_{DD} = 50\text{V}$ , $I_D = 41\text{A}$ $V_{GS} = 10\text{V}$ , $R_{GS} = 11.0\Omega$	-	-	90	ns
$t_{d(ON)}$	Turn-On Delay Time		-	12	-	ns
$t_r$	Rise Time		-	48	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time		-	24	-	ns
$t_f$	Fall Time		-	27	-	ns
$t_{OFF}$	Turn-Off Time		-	-	77	ns

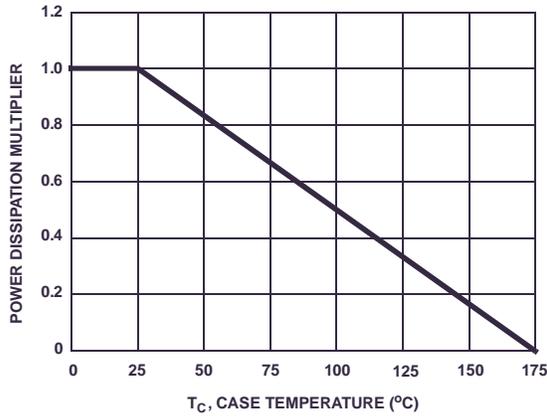
### Drain-Source Diode Characteristics

$V_{SD}$	Source to Drain Diode Voltage	$I_{SD} = 41\text{A}$	-	-	1.25	V
		$I_{SD} = 21\text{A}$	-	-	1.0	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 41\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	39	ns
$Q_{RR}$	Reverse Recovered Charge	$I_{SD} = 41\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	42	nC

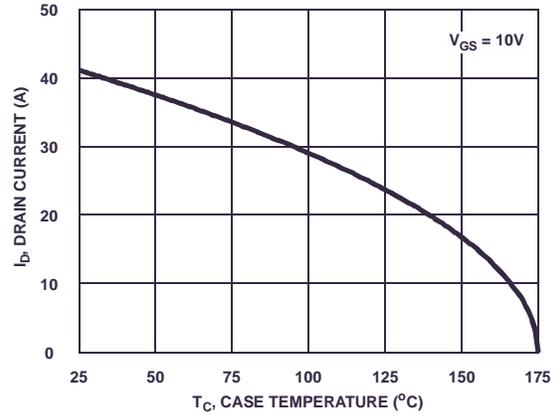
#### Notes:

- Starting  $T_j = 25^\circ\text{C}$ ,  $L = 0.11\text{mH}$ ,  $I_{AS} = 30\text{A}$ .
- Pulse Width = 100s

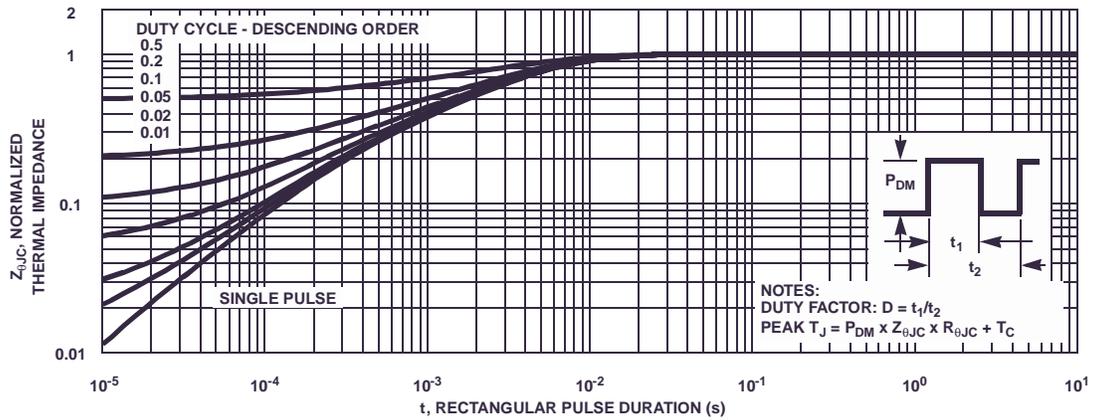
**Typical Characteristics**  $T_C = 25^\circ\text{C}$  unless otherwise noted



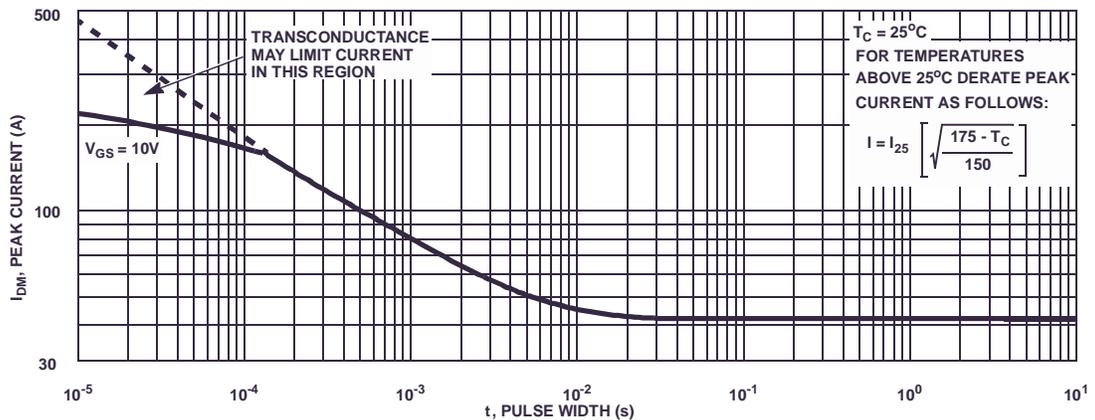
**Figure 1. Normalized Power Dissipation vs Ambient Temperature**



**Figure 2. Maximum Continuous Drain Current vs Case Temperature**

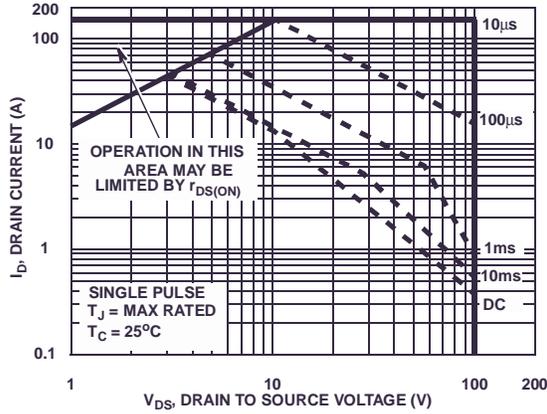


**Figure 3. Normalized Maximum Transient Thermal Impedance**

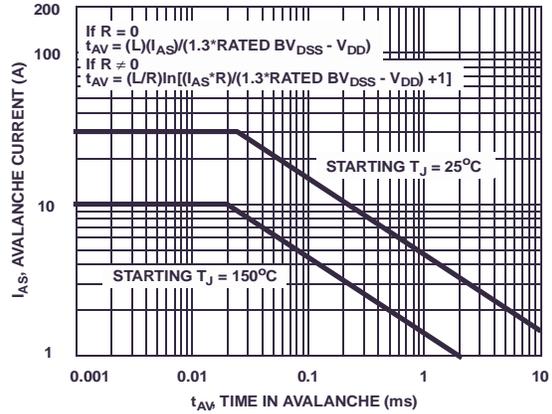


**Figure 4. Peak Current Capability**

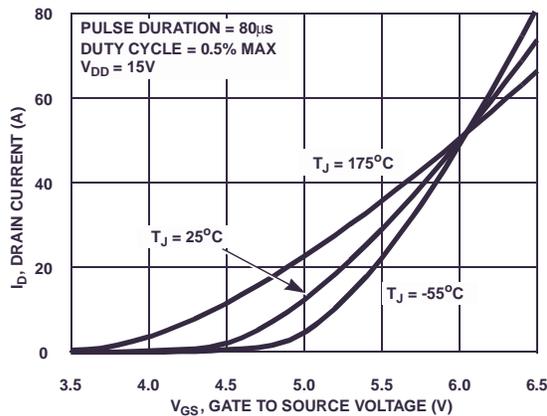
**Typical Characteristics**  $T_C = 25^\circ\text{C}$  unless otherwise noted



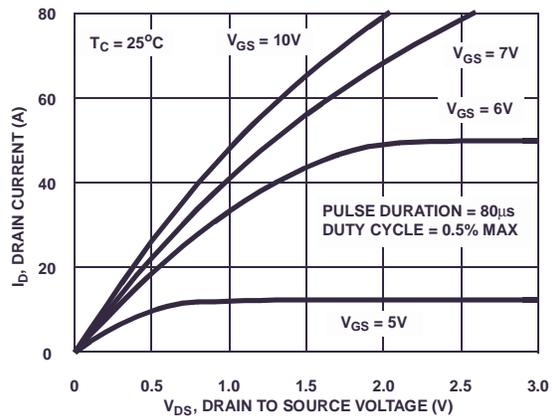
**Figure 5. Forward Bias Safe Operating Area**



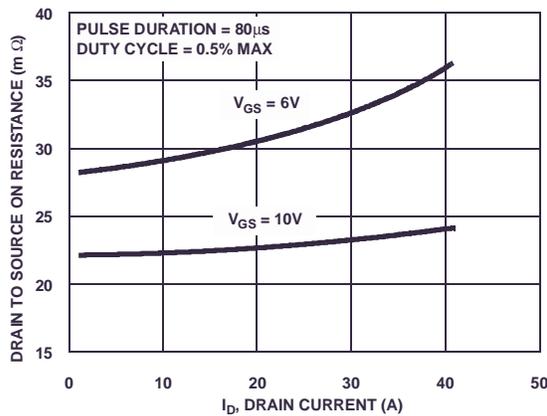
NOTE: Refer to Fairchild Application Notes AN7514 and AN7515  
**Figure 6. Unclamped Inductive Switching Capability**



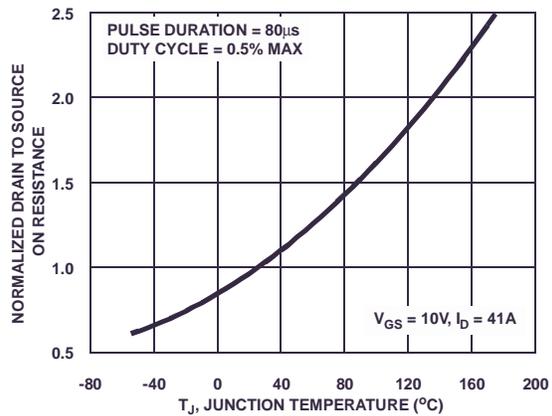
**Figure 7. Transfer Characteristics**



**Figure 8. Saturation Characteristics**

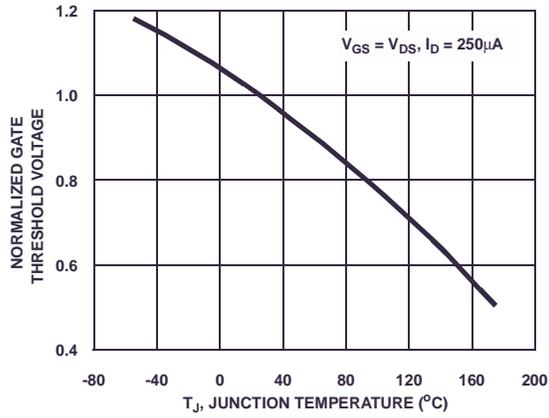


**Figure 9. Drain to Source On Resistance vs Drain Current**

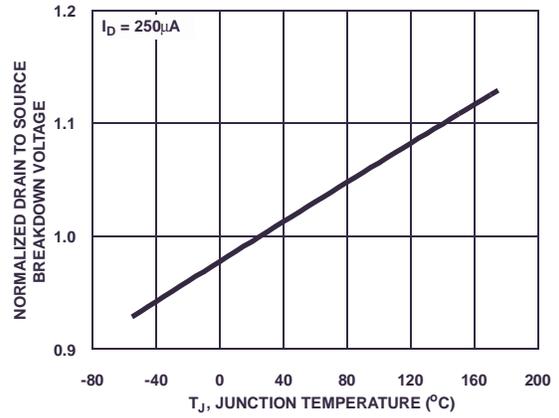


**Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature**

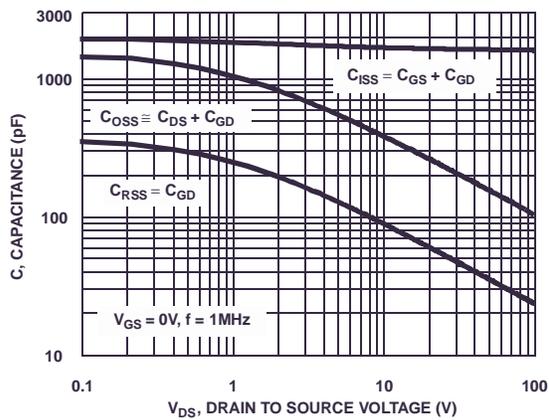
**Typical Characteristics**  $T_C = 25^\circ\text{C}$  unless otherwise noted



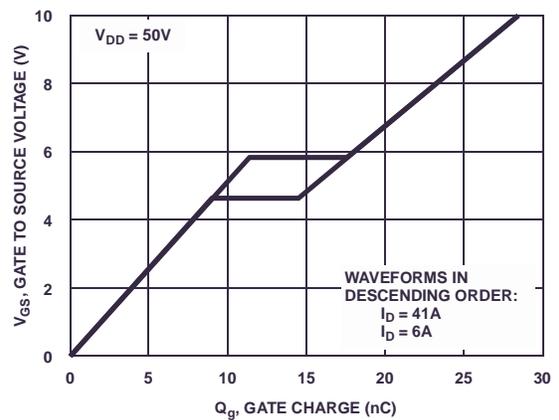
**Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature**



**Figure 12. Normalized Drain to Source 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

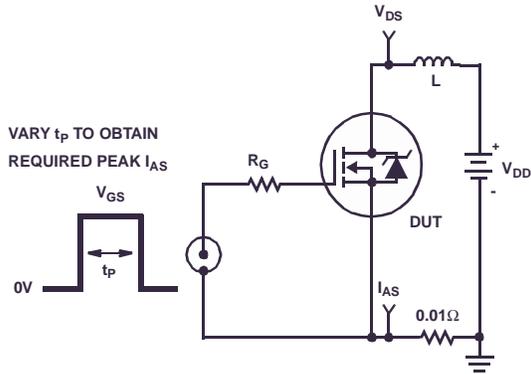


Figure 15. Unclamped Energy Test Circuit

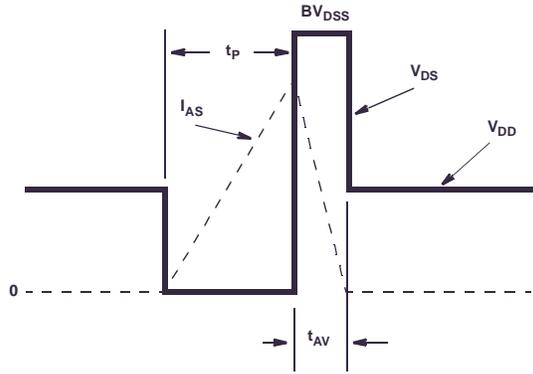


Figure 16. Unclamped Energy Waveforms

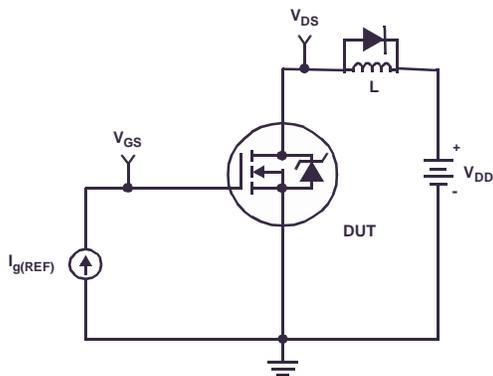


Figure 17. Gate Charge Test Circuit

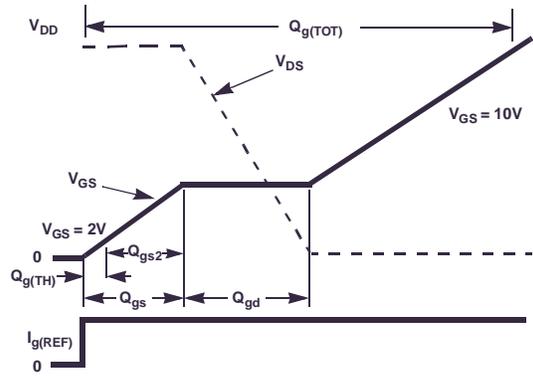


Figure 18. Gate Charge Waveforms

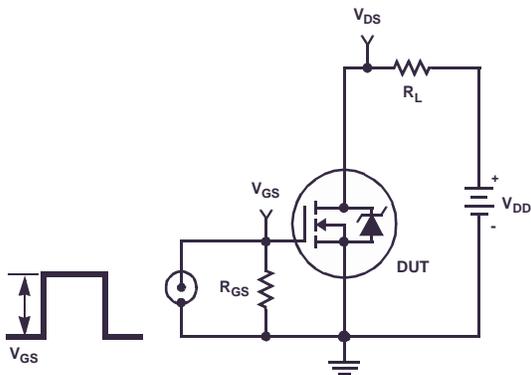


Figure 19. Switching Time Test Circuit

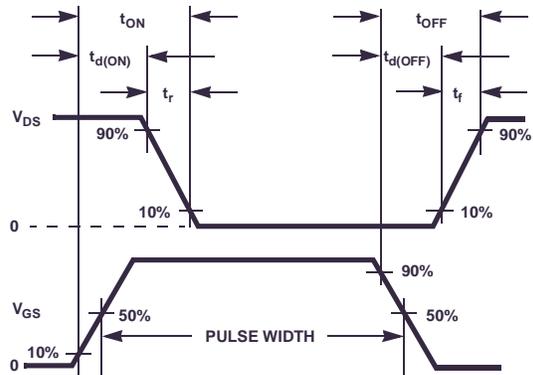


Figure 20. Switching Time Waveforms

### PSPICE Electrical Model

.SUBCKT FDP3672 2 1 3 ; rev October 2002

Ca 12 8 5.8e-10

Cb 15 14 6.8e-10

Cin 6 8 1.6e-9

Dbody 7 5 DbodyMOD

Dbreak 5 11 DbreakMOD

Dplcap 10 5 DplcapMOD

Ebreak 11 7 17 18 105

Eds 14 8 5 8 1

Egs 13 8 6 8 1

Esg 6 10 6 8 1

Evtbres 6 21 19 8 1

Evttemp 20 6 18 22 1

It 8 17 1

Lgate 1 9 9.56e-9

Ldrain 2 5 1.0e-9

Lsource 3 7 4.45e-9

RLgate 1 9 95.6

RLdrain 2 5 10

RLsource 3 7 44.5

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 6.0e-3

Rgate 9 20 1.5

Rslc1 5 51 RslcMOD 1.0e-6

Rslc2 5 50 1.0e3

Rsource 8 7 RsourceMOD 9.5e-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\*98),3))}}

.MODEL DbodyMOD D (IS=1.0E-11 N=1.05 RS=3.7e-3 TRS1=2.5e-3 TRS2=1.0e-6

+ CJO=1.2e-9 M=0.58 TT=3.75e-8 XTI=4.0)

.MODEL DbreakMOD D (RS=15 TRS1=4.0e-3 TRS2=-5.0e-6)

.MODEL DplcapMOD D (CJO=3.8e-10 IS=1.0e-30 N=10 M=0.60)

.MODEL MmedMOD NMOS (VTO=3.6 KP=3 IS=1e-40 N=10 TOX=1 L=1u W=1u RG=1.5)

.MODEL MstroMOD NMOS (VTO=4.3 KP=59 IS=1e-30 N=10 TOX=1 L=1u W=1u)

.MODEL MweakMOD NMOS (VTO=3.09 KP=0.05 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=15 RS=0.1)

.MODEL RbreakMOD RES (TC1=9.0e-4 TC2=-1.0e-7)

.MODEL RdrainMOD RES (TC1=11.0e-3 TC2= 6.1e-5)

.MODEL RslcMOD RES (TC1=3.0e-3 TC2=1.0e-6)

.MODEL RsourceMOD RES (TC1=4.0e-3 TC2=1.0e-6)

.MODEL RvthresMOD RES (TC1=-3.5e-3 TC2=-1.5e-5)

.MODEL RvtempMOD RES (TC1=-4.3e-3 TC2=1.5e-6)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-5.0 VOFF=-3.5)

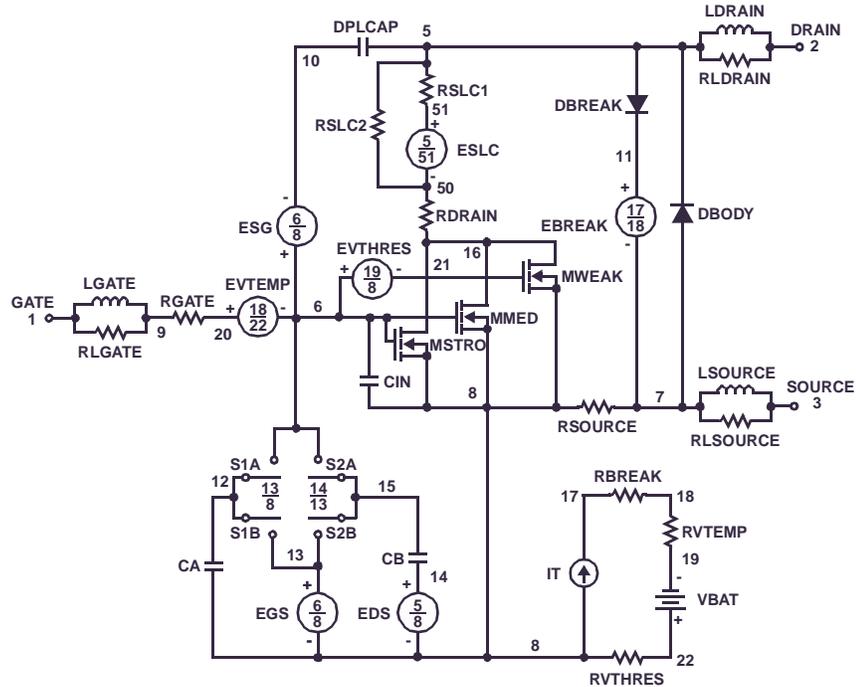
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-3.5 VOFF=-5.0)

.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)

.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 October 2002

FDP3672

```

CTHERM1 TH 6 3.2e-3
CTHERM2 6 5 3.3e-3
CTHERM3 5 4 3.4e-3
CTHERM4 4 3 3.5e-3
CTHERM5 3 2 6.4e-3
CTHERM6 2 TL 1.9e-2
    
```

```

R THERM1 TH 6 5.5e-4
R THERM2 6 5 5.0e-3
R THERM3 5 4 4.5e-2
R THERM4 4 3 10.5e-2
R THERM5 3 2 3.4e-1
R THERM6 2 TL 3.5e-1
    
```

### SABER Thermal Model

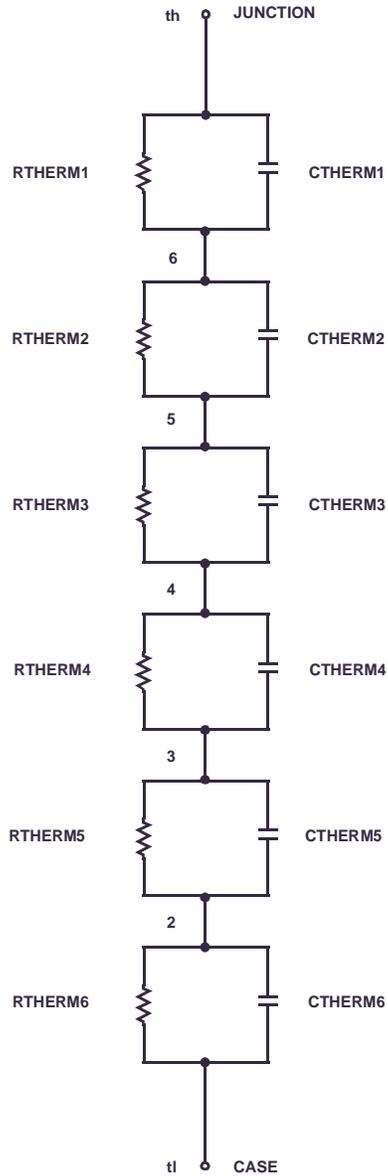
SABER thermal model FDP3672  
 template thermal\_model th tl  
 thermal\_c th, tl

```

{
cctherm.ctherm1 th 6 =3.2e-3
cctherm.ctherm2 6 5 =3.3e-3
cctherm.ctherm3 5 4 =3.4e-3
cctherm.ctherm4 4 3 =3.5e-3
cctherm.ctherm5 3 2 =6.4e-3
cctherm.ctherm6 2 tl =1.9e-2
    
```

```

rtherm.rtherm1 th 6 =5.5e-4
rtherm.rtherm2 6 5 =5.0e-3
rtherm.rtherm3 5 4 =4.5e-2
rtherm.rtherm4 4 3 =10.5e-2
rtherm.rtherm5 3 2 =3.4e-1
rtherm.rtherm6 2 tl =3.5e-1
}
    
```



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Bottomless™	FASTr™	MicroFET™	QFET®	SyncFET™
CoolFET™	FRFET™	MicroPak™	QS™	TinyLogic®
CROSSVOLT™	GlobalOptoisolator™	MICROWIRE™	QT Optoelectronics™	TINYOPTO™
DOME™	GTO™	MSX™	Quiet Series™	TruTranslation™
EcoSPARK™	HiSeC™	MSXPro™	RapidConfigure™	UHC™
E <sup>2</sup> CMOS™	IC™	OCX™	RapidConnect™	UltraFET®
EnSigna™	ImpliedDisconnect™	OCXPro™	SILENT SWITCHER®	VCX™
FACT™	ISOPLANAR™	OPTOLOGIC®	SMART START™	
Across the board. Around the world.™	OPTOPLANAR™	SPM™		
The Power Franchise™	PACMAN™	Stealth™		
Programmable Active Droop™	POP™	SuperSOT™-3		

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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.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.