

FAIRCHILD
SEMICONDUCTOR®

FDP8896_F085

N-Channel PowerTrench® MOSFET
30V, 92A, 5.9mΩ

General Description

This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low $r_{DS(ON)}$ and fast switching speed.

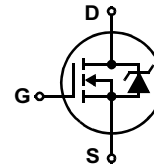
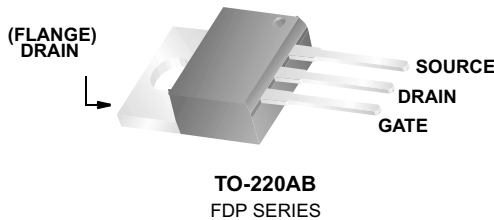
Applications

- DC/DC converters



Features

- $r_{DS(ON)} = 5.9m\Omega$ $V_{GS} = 10V$, $I_D = 35A$
- $r_{DS(ON)} = 7.0m\Omega$ $V_{GS} = 4.5V$, $I_D = 35A$
- High performance trench technology for extremely low $r_{DS(ON)}$
- Low gate charge
- High power and current handling capability
- Qualified to AEC Q101
- RoHS Compliant



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

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	30	V
V_{GS}	Gate to Source Voltage	± 20	V
I_D	Drain Current		
	Continuous ($T_C = 25^\circ C$, $V_{GS} = 10V$) (Note 1)	92	A
	Continuous ($T_C = 25^\circ C$, $V_{GS} = 4.5V$) (Note 1)	85	A
	Continuous ($T_{amb} = 25^\circ C$, $V_{GS} = 10V$, with $R_{\theta JA} = 62^\circ C/W$)	16	A
	Pulsed	Figure 4	A
E_{AS}	Single Pulse Avalanche Energy (Note 2)	74	mJ
P_D	Power dissipation	80	W
	Derate above $25^\circ C$	0.53	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	1.88	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient TO-220 (Note 3)	62	$^\circ C/W$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP8896	FDP8896_F085	TO-220AB	Tube	N/A	50 units

FDP8896_F085 N-Channel PowerTrench® MOSFET



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

$B_{V_{DS}}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$	30	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{V}$ $V_{GS} = 0\text{V}$ $T_C = 150^\circ\text{C}$	-	-	1	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	± 100	nA

On Characteristics

$V_{GS(TH)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$	1.2	-	2.5	V
$r_{DS(ON)}$	Drain to Source On Resistance	$I_D = 35\text{A}$, $V_{GS} = 10\text{V}$	-	0.0050	0.0059	Ω
		$I_D = 35\text{A}$, $V_{GS} = 4.5\text{V}$	-	0.0060	0.0070	
		$I_D = 35\text{A}$, $V_{GS} = 10\text{V}$, $T_J = 175^\circ\text{C}$	-	0.0078	0.0094	

Dynamic Characteristics

C_{ISS}	Input Capacitance	$V_{DS} = 15\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	-	2525	-	pF
C_{OSS}	Output Capacitance		-	490	-	pF
C_{RSS}	Reverse Transfer Capacitance		-	300	-	pF
R_G	Gate Resistance	$V_{GS} = 0.5\text{V}$, $f = 1\text{MHz}$	-	2.3	-	Ω
$Q_{g(TOT)}$	Total Gate Charge at 10V	$V_{GS} = 0\text{V}$ to 10V	-	48	67	nC
$Q_{g(5)}$	Total Gate Charge at 5V	$V_{GS} = 0\text{V}$ to 5V	-	25	36	nC
$Q_{g(TH)}$	Threshold Gate Charge	$V_{GS} = 0\text{V}$ to 1V	-	2.3	3.0	nC
Q_{gs}	Gate to Source Gate Charge	$V_{DD} = 15\text{V}$ $I_D = 35\text{A}$ $I_g = 1.0\text{mA}$	-	8	-	nC
Q_{gs2}	Gate Charge Threshold to Plateau		-	5.7	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	9.5	-	nC
			-			

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

t_{ON}	Turn-On Time	$V_{DD} = 15\text{V}$, $I_D = 35\text{A}$ $V_{GS} = 4.5\text{V}$, $R_{GS} = 6.2\Omega$	-	-	168	ns
$t_{d(ON)}$	Turn-On Delay Time		-	9	-	ns
t_r	Rise Time		-	103	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time		-	56	-	ns
t_f	Fall Time		-	44	-	ns
t_{OFF}	Turn-Off Time		-	-	150	ns

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Voltage	$I_{SD} = 35\text{A}$	-	-	1.25	V
		$I_{SD} = 20\text{A}$	-	-	1.0	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 35\text{A}$, $di_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	27	ns
Q_{RR}	Reverse Recovered Charge	$I_{SD} = 35\text{A}$, $di_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	12	nC

Notes:

- Package current limitation is 80A.
- Starting $T_J = 25^\circ\text{C}$, $L = 36\mu\text{H}$, $I_{AS} = 64\text{A}$, $V_{DD} = 27\text{V}$, $V_{GS} = 10\text{V}$.
- Pulse width = 100s.

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

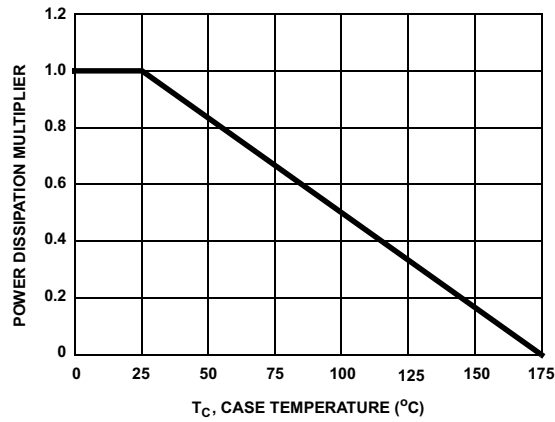


Figure 1. Normalized Power Dissipation vs Case Temperature

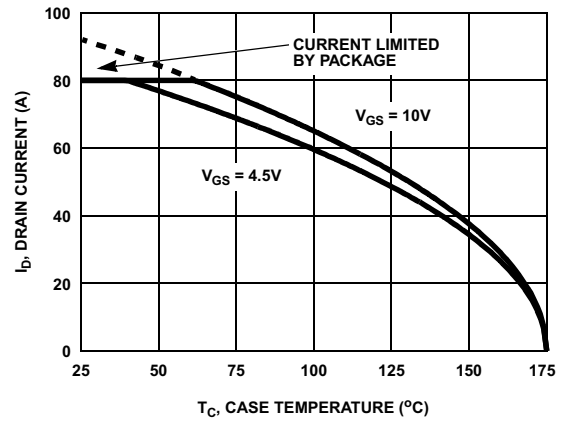


Figure 2. Maximum Continuous Drain Current vs Case Temperature

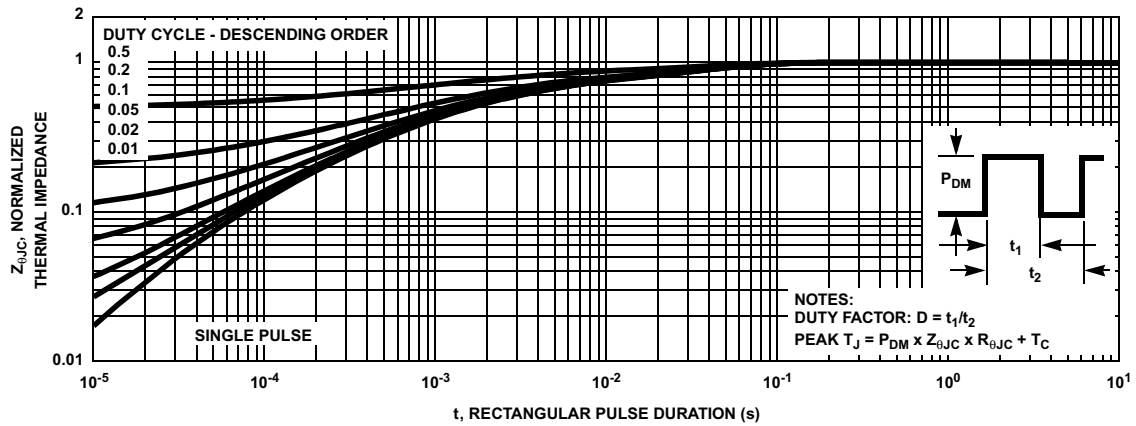


Figure 3. Normalized Maximum Transient Thermal Impedance

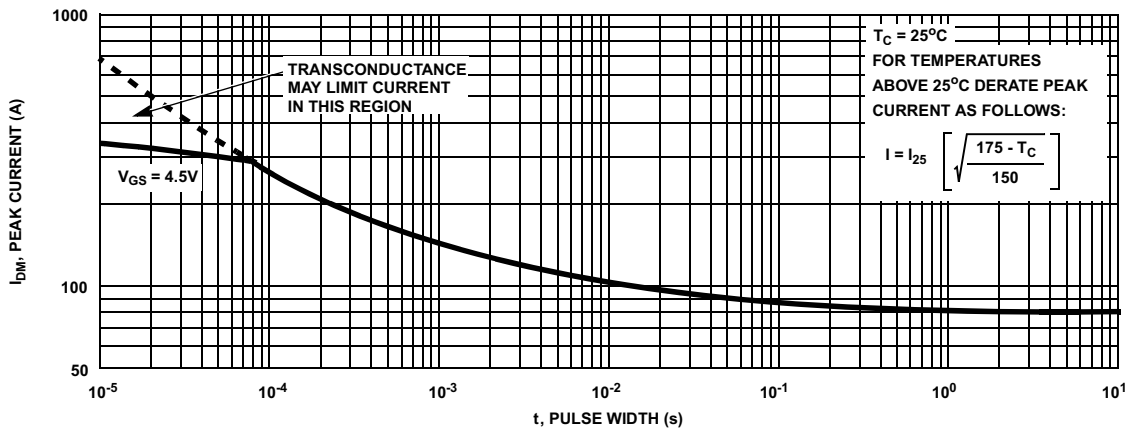


Figure 4. Peak Current Capability

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

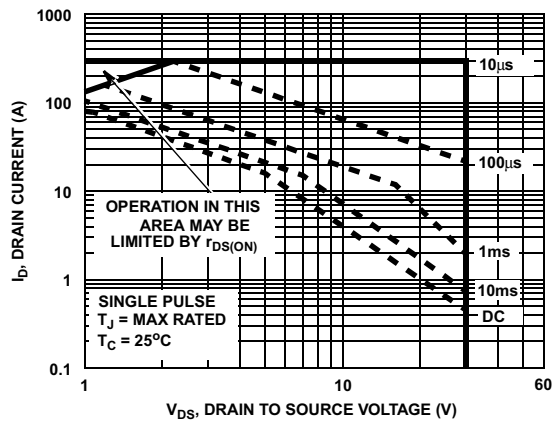
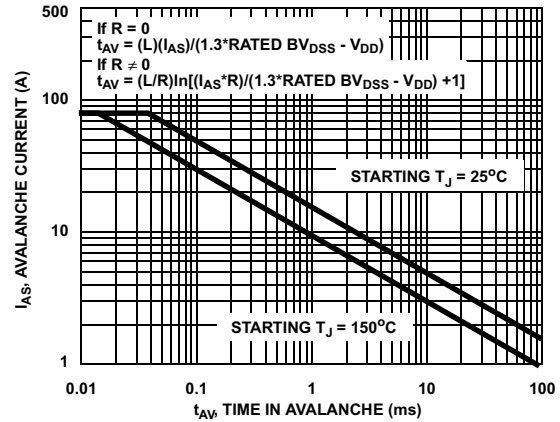


Figure 5. Forward Bias Safe Operating Area



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

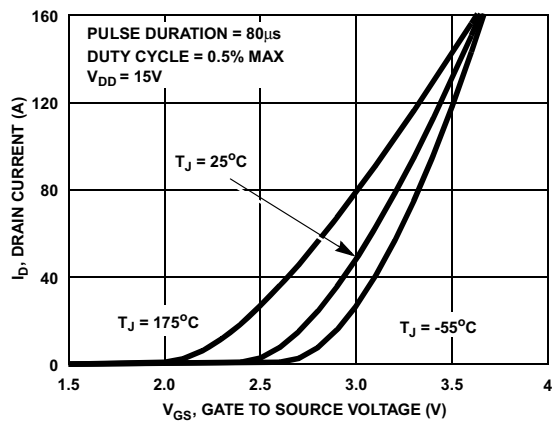


Figure 7. Transfer Characteristics

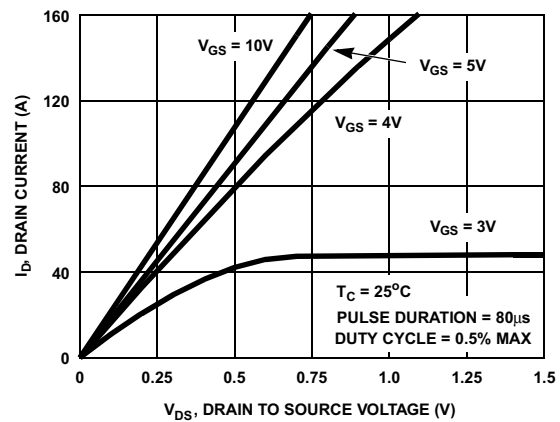


Figure 8. Saturation Characteristics

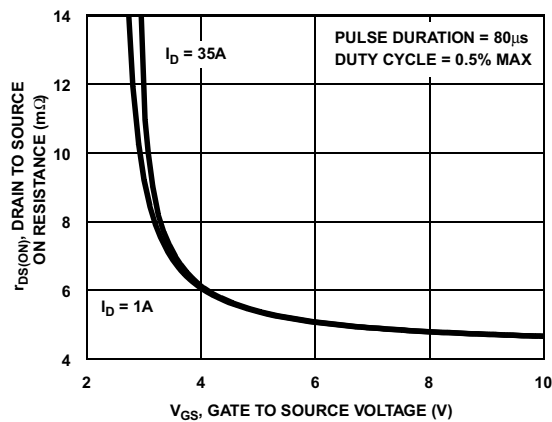


Figure 9. Drain to Source On Resistance vs Gate Voltage and Drain Current

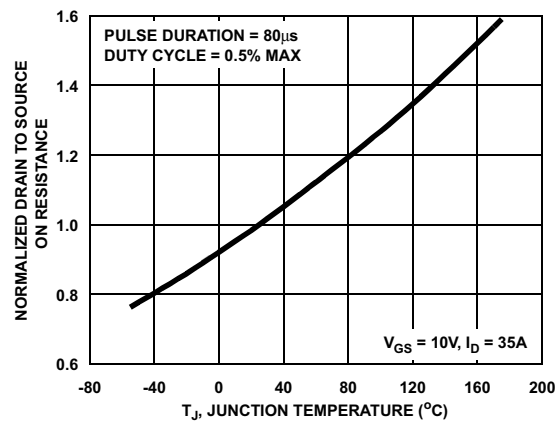


Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

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

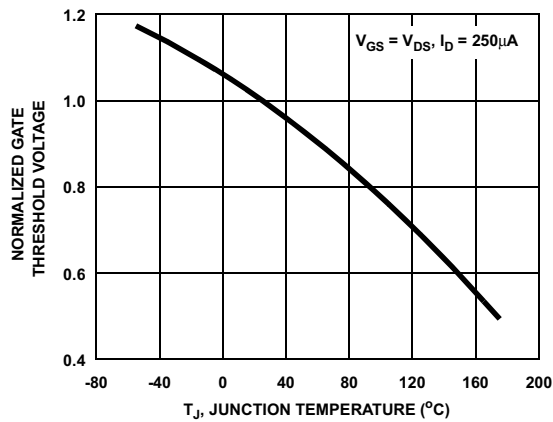


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature

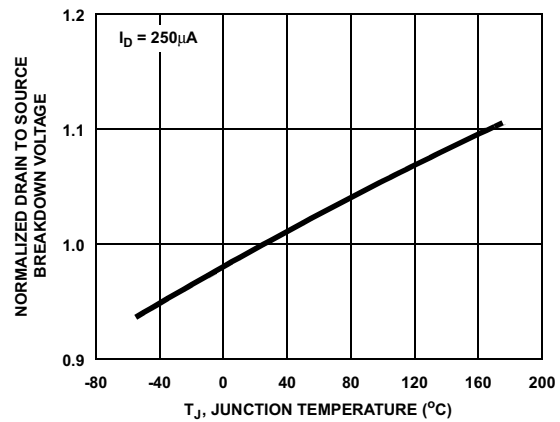


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

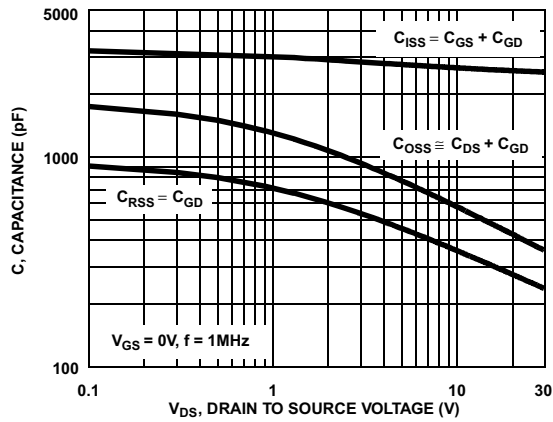


Figure 13. Capacitance vs Drain to Source Voltage

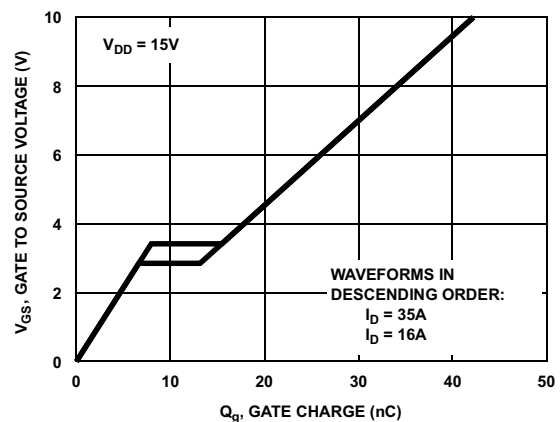


Figure 14. Gate Charge Waveforms for Constant Gate Current

Test Circuits and Waveforms

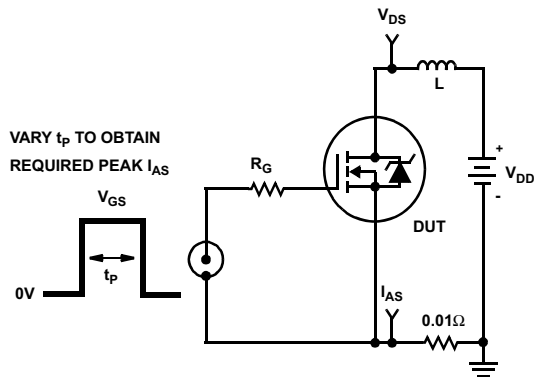


Figure 15. Unclamped Energy Test Circuit

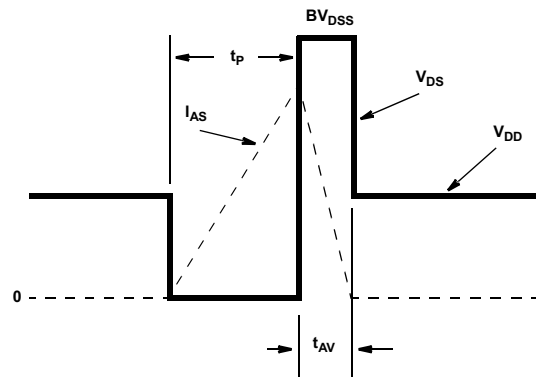


Figure 16. Unclamped Energy Waveforms

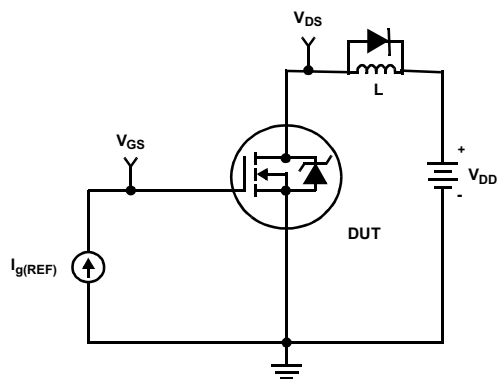


Figure 17. Gate Charge Test Circuit

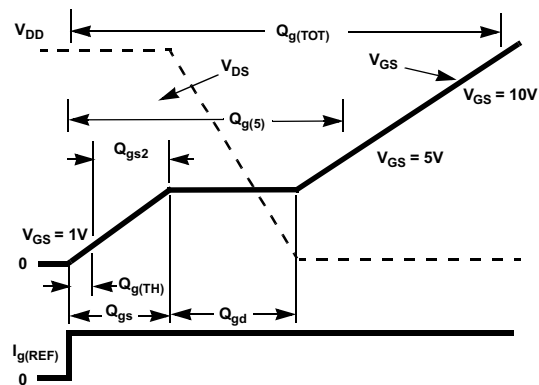


Figure 18. Gate Charge Waveforms

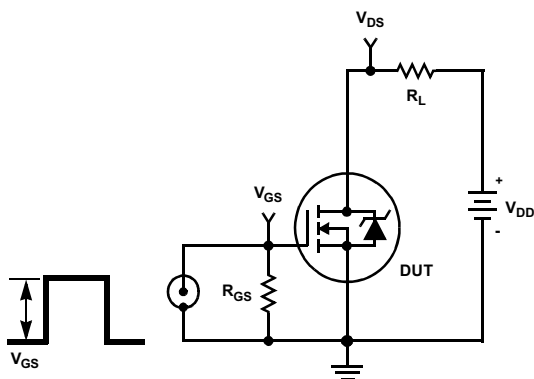


Figure 19. Switching Time Test Circuit

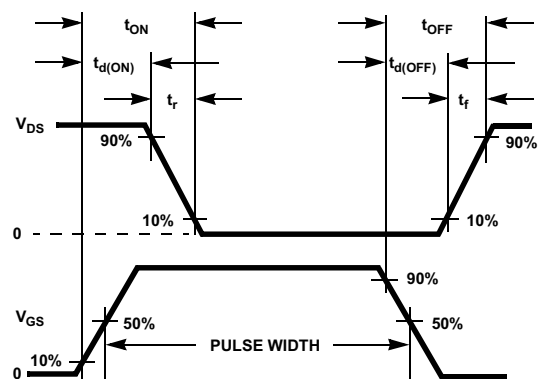


Figure 20. Switching Time Waveforms

PSPICE Electrical Model

.SUBCKT FDP8896 2 1 3 ; rev November 2003

Ca 12 8 2.3e-9
Cb 15 14 2.3e-9
Cin 6 8 2.3e-9

Dbody 7 5 DbodyMOD
Dbreak 5 11 DbreakMOD
Dplcap 10 5 DplcapMOD

Ebreak 11 7 17 18 33
Eds 14 8 5 8 1
Egs 13 8 6 8 1
Esg 6 10 6 8 1
Evthres 6 21 19 8 1
Etemp 20 6 18 22 1

It 8 17 1

Lgate 1 9 5.5e-9
Ldrain 2 5 1.0e-9
Lsource 3 7 2.7e-9

RLgate 1 9 55
RLdrain 2 5 10
RLsource 3 7 27

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 2.3e-3
Rgate 9 20 2.3
RSLC1 5 51 RSLCMOD 1e-6
RSLC2 5 50 1e3
Rsource 8 7 RsourceMOD 2e-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*500),10))}}

.MODEL DbodyMOD D (IS=4E-12 IKF=10 N=1.01 RS=2.6e-3 TRS1=8e-4 TRS2=2e-7
+ CJO=8.8e-10 M=0.57 TT=1e-16 XTI=2.2)

.MODEL DbreakMOD D (RS=8e-2 TRS1=1e-3 TRS2=-8.9e-6)

.MODEL DplcapMOD D (CJO=9.4e-10 IS=1e-30 N=10 M=0.4)

.MODEL MmedMOD NMOS (VTO=1.98 KP=10 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=2.3 T_ABS=25)

.MODEL MstroMOD NMOS (VTO=2.4 KP=350 IS=1e-30 N=10 TOX=1 L=1u W=1u T_ABS=25)

.MODEL MweakMOD NMOS (VTO=1.68 KP=0.05 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=23 RS=0.1 T_ABS=25)

.MODEL RbreakMOD RES (TC1=8.3e-4 TC2=-4e-7)

.MODEL RdrainMOD RES (TC1=1e-3 TC2=8e-6)

.MODEL RSLCMOD RES (TC1=9e-4 TC2=1e-6)

.MODEL RsourceMOD RES (TC1=7.5e-3 TC2=1e-6)

.MODEL RvthresMOD RES (TC1=-2.4e-3 TC2=-8.8e-6)

.MODEL RvtempMOD RES (TC1=-2.6e-3 TC2=2e-7)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-4 VOFF=-3)

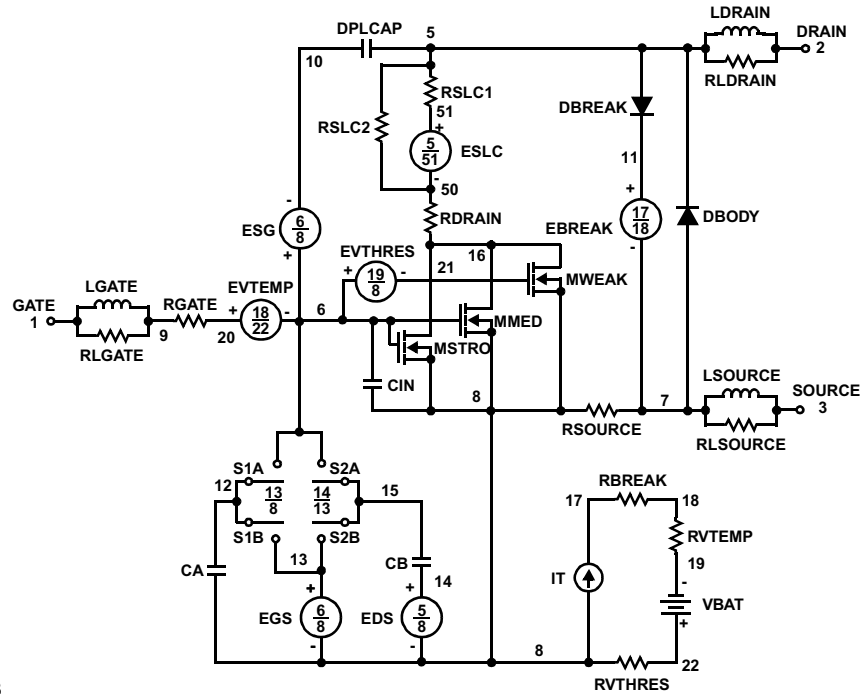
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-3 VOFF=-4)

.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-2 VOFF=-0.5)

.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-0.5 VOFF=-2)

.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.



PSPICE Thermal Model

REV 23 November 2003

FDP8896T

CTHERM1 TH 6 9e-4
CTHERM2 6 5 1e-3
CTHERM3 5 4 2e-3
CTHERM4 4 3 3e-3
CTHERM5 3 2 7e-3
CTHERM6 2 TL 8e-2

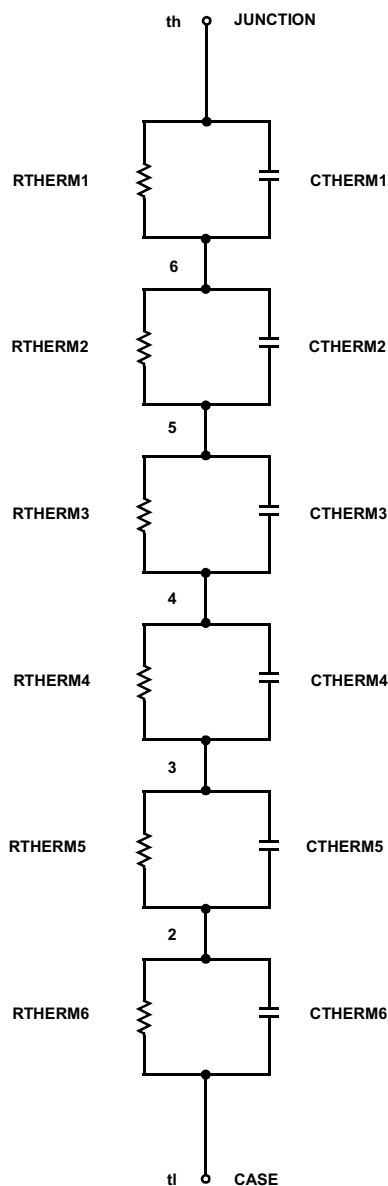
RTHERM1 TH 6 3.0e-2
RTHERM2 6 5 1.0e-1
RTHERM3 5 4 1.8e-1
RTHERM4 4 3 2.8e-1
RTHERM5 3 2 4.5e-1
RTHERM6 2 TL 4.6e-1

SABER Thermal Model

SABER thermal model FDP8896T
template thermal_model th tl
thermal_c th, tl

```
{
  ctherm.ctherm1 th 6 =9e-4
  ctherm.ctherm2 6 5 =1e-3
  ctherm.ctherm3 5 4 =2e-3
  ctherm.ctherm4 4 3 =3e-3
  ctherm.ctherm5 3 2 =7e-3
  ctherm.ctherm6 2 tl =8e-2
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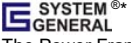
```
  rtherm.rtherm1 th 6 =3.0e-2
  rtherm.rtherm2 6 5 =1.0e-1
  rtherm.rtherm3 5 4 =1.8e-1
  rtherm.rtherm4 4 3 =2.8e-1
  rtherm.rtherm5 3 2 =4.5e-1
  rtherm.rtherm6 2 tl =4.6e-1
}
```





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CorePOWER™	Green FPS™ e-Series™	QFET®	TinyBoost™
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CTL™	GTO™	Quiet Series™	TinyCalc™
Current Transfer Logic™	IntelliMAX™	RapidConfigure™	TinyLogic®
DEUXPEED®	ISOPANAR™	 Saving our world, 1mW/W/kW at a time™	TINYOPTO™
Dual Cool™	MegaBuck™	SignalWise™	TinyPower™
EcoSPARK®	MICROCOUPLER™	SmartMax™	TinyPWM™
EfficientMax™	MicroFET™	SMART START™	TinyWire™
ESBC™	MicroPak™	SPM®	TriFault Detect™
 Fairchild®	MicroPak2™	STEALTH™	TRUECURRENT™*
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FastvCore™	OPTOLOGIC®	SupreMOS™	UniFET™
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FPS™			XS™

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

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