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May 2008

# FDP8880 / FDB8880 N-Channel PowerTrench MOSFET 30V, 54A, 11.6m $\Omega$

### **Features**

- $r_{DS(ON)} = 14.5 \text{m}\Omega$ ,  $V_{GS} = 4.5 \text{V}$ ,  $I_D = 40 \text{A}$
- $r_{DS(ON)} = 11.6m\Omega$ ,  $V_{GS} = 10V$ ,  $I_D = 40A$
- High performance trench technology for extremely low r<sub>DS(ON)</sub>
- Low gate charge
- High power and current handling capability
- RoHS Complicant

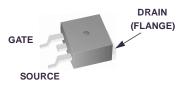


### **General Description**

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  $r_{\text{DS(ON)}}$  and fast switching speed.

### **Application**

■ DC / DC Converters



TO-263AB FDB SERIES



TO-220AB FDP SERIES



MOSFET Maximum	Ratings	$T_C = 25$ °C unless otherwise noted
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Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain to Source Voltage	30	V
V <sub>GS</sub>	Gate to Source Voltage	±20	V
	Drain Current		
	Continuous ( $T_C = 25^{\circ}C$ , $V_{GS} = 10V$ )	54	Α
I <sub>D</sub>	Continuous (T <sub>C</sub> = 25°C, V <sub>GS</sub> = 4.5V)	48	Α
	Continuous ( $T_{amb} = 25^{\circ}C$ , $V_{GS} = 10V$ , with $R_{\theta JA} = 43^{\circ}C/W$ )	11	Α
	Pulsed	Figure 4	Α
E <sub>AS</sub>	Single Pulse Avalanche Energy (Note 1)	31	mJ
	Power dissipation	55	W
$P_{D}$	Derate above 25°C	0.37	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature	-55 to 175	°C

### **Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance Junction to Case TO-220,TO-263	2.73	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient TO-220,TO-262 (Note 2)	62	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient TO-263, 1in <sup>2</sup> copper pad area	43	°C/W

# **Package Marking and Ordering Information**

<b>Device Marking</b>	Device	Package	Reel Size	Tape Width	Quantity
FDP8880	FDP8880	TO-220AB	Tube	N/A	50 units
FDB8880	FDB8880	TO-263AB	330mm	24mm	800 units

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

Symbol	Parameter	Test Co	onditions	Min	Тур	Max	Units
Off Chara	acteristics						
B <sub>VDSS</sub>	Drain to Source Breakdown Voltage	$I_D = 250 \mu A, V_G$	is = 0V	30	-	-	V
	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 24V		-	-	1	
IDSS	Zero Gate voltage Drain Current	$V_{GS} = 0V$	$T_{\rm C} = 150^{\rm o}{\rm C}$	-	-	250	μΑ
I <sub>GSS</sub>	Gate to Source Leakage Current	$V_{GS} = \pm 20V$		-	-	±100	nA

### **On Characteristics**

V <sub>GS(TH)</sub>	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\mu A$	1.2	-	2.5	V
	I <sub>D</sub> = 40A, V <sub>GS</sub> = 10V	-	0.0095	0.0116		
r-accoun	Drain to Source On Resistance	$I_D = 40A, V_{GS} = 4.5V$	-	0.012	0.0145	0
r <sub>DS(ON)</sub>	Drain to Source On Resistance	$I_D = 40A, V_{GS} = 10V,$ $T_J = 175$ °C	-	0.015	0.019	22

C <sub>ISS</sub>	Input Capacitance		-	1240	-	pF
C <sub>OSS</sub>	Output Capacitance	$V_{DS} = 15V, V_{GS} = 0V,$	-	255	-	pF
C <sub>RSS</sub>	Reverse Transfer Capacitance	f = 1MHz	-	147	-	pF
R <sub>G</sub>	Gate Resistance	$V_{GS} = 0.5V, f = 1MHz$	-	2.7	-	Ω
Q <sub>g(TOT)</sub>	Total Gate Charge at 10V	V <sub>GS</sub> = 0V to 10V	-	22	29	nC
) <sub>g(5)</sub>	Total Gate Charge at 5V	$V_{00} = 0V \text{ to } 5V$	-	12	16	nC
g(TH)	Threshold Gate Charge	$V_{GS} = 0V \text{ to } 1V$ $V_{DD} = 15V$ $I_{D} = 40A$	-	1.6	2.1	nC
gs	Gate to Source Gate Charge	$I_D = 40A$ $I_q = 1.0 \text{mA}$	-	3.2	-	nC
gs2	Gate Charge Threshold to Plateau	Ig = 1.011A	-	2.0	-	nC
	Cata ta Duain (Millan) Channa			4.0		nC
Switchir	Gate to Drain "Miller" Charge  ng Characteristics (V <sub>GS</sub> = 10V)		-	4.8	- 474	
Q <sub>gd</sub> Switchir	ng Characteristics (V <sub>GS</sub> = 10V)  Turn-On Time		-	-	171	ns
<b>witchir</b>	ng Characteristics (V <sub>GS</sub> = 10V)					
ON d(ON)	ng Characteristics (V <sub>GS</sub> = 10V)  Turn-On Time	V <sub>DD</sub> = 15V, I <sub>D</sub> = 40A	-	-	171	ns
Witchir	Turn-On Time Turn-On Delay Time	$V_{DD} = 15V, I_{D} = 40A$ $V_{GS} = 10V, R_{GS} = 13.6\Omega$	-	- 8	171	ns ns
Switchir ON d(ON) f	Turn-On Delay Time Rise Time		- - -	- 8 107	171	ns ns
ON d(ON) r d(OFF)	Turn-On Time Turn-On Delay Time Rise Time Turn-Off Delay Time			- 8 107 47	171	ns ns ns
ON d(ON) r d(OFF) f	Turn-On Time Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time		- - - -	- 8 107 47 51	171	ns ns ns ns
ON d(ON) r d(OFF) f OFF Orain-So	Turn-On Time Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-Off Time Turn-Off Time		- - - -	- 8 107 47 51	171	ns ns ns ns
d(ON) d(OFF)	Turn-On Time Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-Off Time	$V_{GS} = 10V, R_{GS} = 13.6\Omega$		- 8 107 47 51	171 - - - - 147	ns ns ns ns
ON d(ON) r d(OFF) f	Turn-On Time Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-Off Time Turn-Off Time	$V_{GS} = 10V, R_{GS} = 13.6\Omega$ $I_{SD} = 40A$		- 8 107 47 51 -	171 - - - 147	ns ns ns ns ns

Notes: 1: Starting  $T_J$  = 25°C, L = 34uH,  $I_{AS}$  = 43A,Vdd = 27V, Vgs = 10V. 2: Pulse width = 100s.

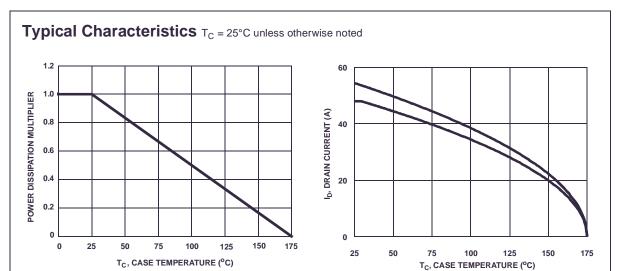


Figure 1. Normalized Power Dissipation vs Case Temperature

Figure 2. Maximum Continuous Drain Current vs Case Temperature

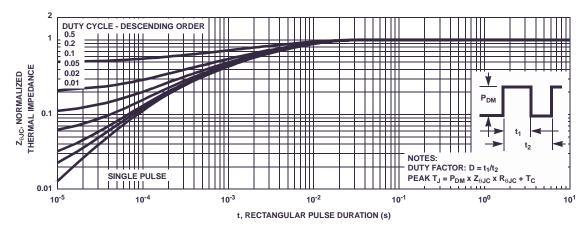


Figure 3. Normalized Maximum Transient Thermal Impedance

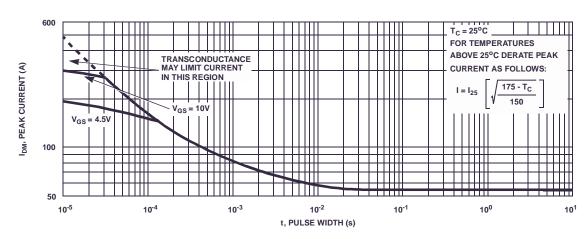
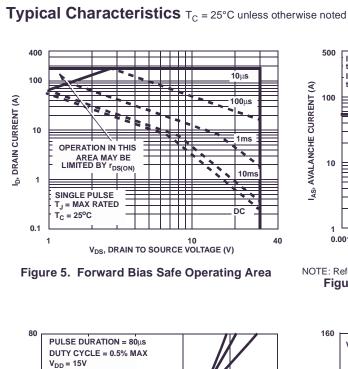
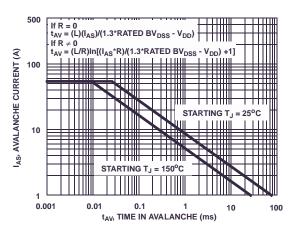


Figure 4. Peak Current Capability

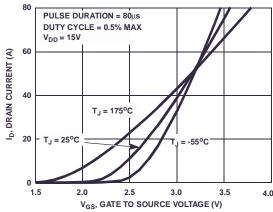




NOTE: Refer to Fairchild Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching

Capability



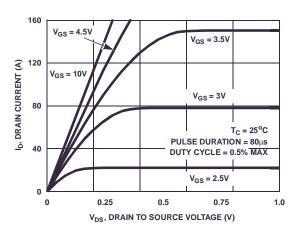
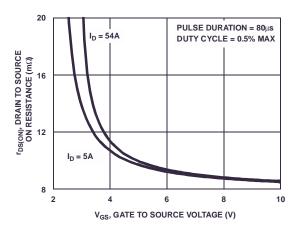


Figure 7. Transfer Characteristics

Figure 8. Saturation Characteristics



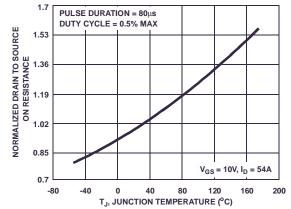


Figure 9. Drain to Source On Resistance vs Gate Voltage and Drain Current

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

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

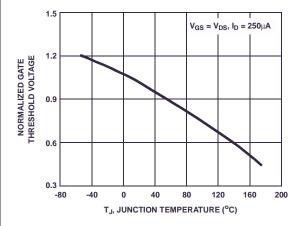


Figure 11. Normalized Gate Threshold Voltage vs
Junction Temperature

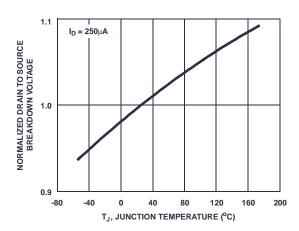


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

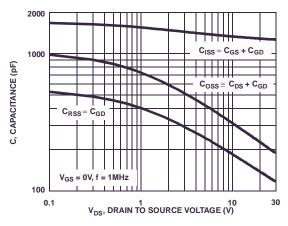


Figure 13. Capacitance vs Drain to Source Voltage

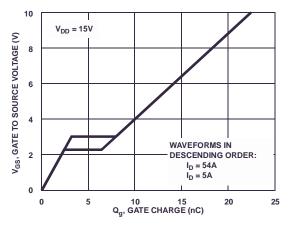


Figure 14. Gate Charge Waveforms for Constant Gate Current

### **Test Circuits and Waveforms**

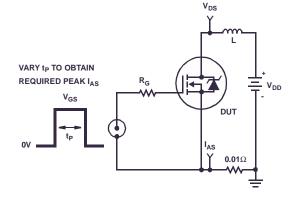


Figure 15. Unclamped Energy Test Circuit

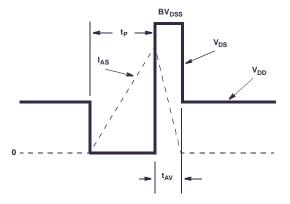


Figure 16. Unclamped Energy Waveforms

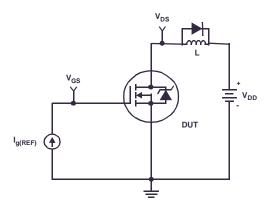


Figure 17. Gate Charge Test Circuit

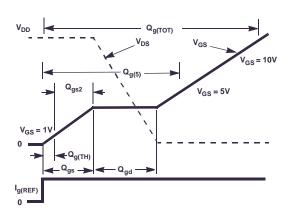


Figure 18. Gate Charge Waveforms

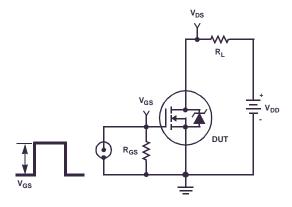


Figure 19. Switching Time Test Circuit

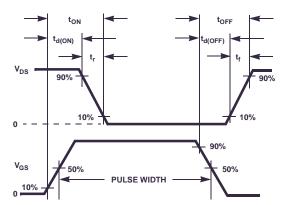
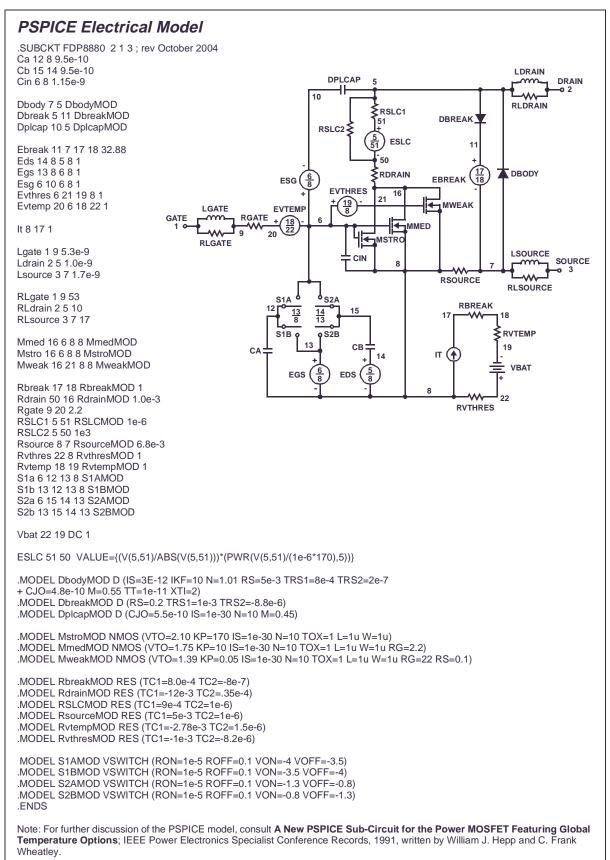
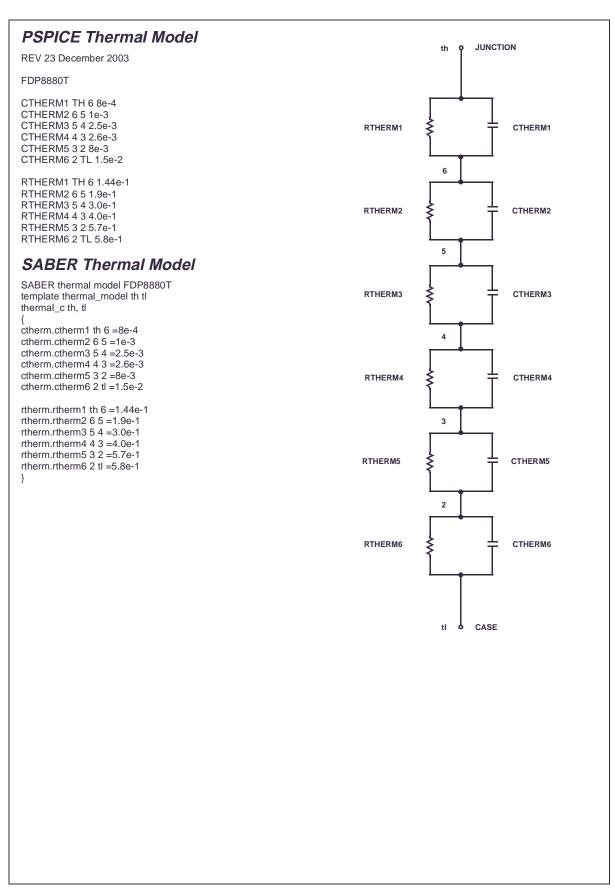


Figure 20. Switching Time Waveforms



```
SABER Electrical Model
rev October 2004
template FDP8880 n2,n1,n3
electrical n2,n1,n3
var i iscl
dp..model dbodymod = (isl=3e-12,ikf=10,nl=1.01,rs=5e-3,trs1=8e-4,trs2=2e-7,cjo=4.8e-10,m=0.55,tt=1e-11,xti=2)
dp..model dbreakmod = (rs=0.2.trs1=1e-3.trs2=-8.8e-6)
dp..model dplcapmod = (cjo=5.5e-10,isl=10e-30,nl=10,m=0.45)
m..model mstrongmod = (type=\_n, vto=2.10, kp=170, is=1e-30, tox=1)
m..model mmedmod = (type=_n, vto=1.75, kp=10, is=1e-30, tox=1)
m..model mweakmod = (type=_n, vto=1.39, kp=0.05, is=1e-30, tox=1, rs=0.1)
sw_vcsp..model s1amod = (ron=1e-5,roff=0.1,von=-4,voff=-3.5)
                                                                                                            LDRAIN
sw_vcsp..model s1bmod = (ron=1e-5,roff=0.1,von=-3.5,voff=-4)
                                                                     DPLCAP
                                                                                                                     DRAIN
sw_vcsp..model s2amod = (ron=1e-5,roff=0.1,von=-1.3,voff=-0.8)
                                                                 10
sw_vcsp..model s2bmod = (ron=1e-5,roff=0.1,von=-0.8,voff=-1.3)
                                                                                                            RLDRAIN
c.ca n12 n8 = 9.5e-10
                                                                                RSLC1
c.cb n15 n14 = 9.5e-10
                                                                               51
                                                                  RSLC2 €
c.cin n6 n8 = 1.15e-9
                                                                                 ISCI
dp.dbody n7 n5 = model=dbodymod
                                                                                           DBREAK
dp.dbreak n5 n11 = model=dbreakmod
                                                                                RDRAIN
                                                               <u>6</u>
dp.dplcap n10 n5 = model=dplcapmod
                                                          ESG
                                                                                                   11
                                                                                                            DBODY
                                                                     EVTHRES
spe.ebreak n11 n7 n17 n18 = 32.88
                                                                        (<u>19</u>)
                                                                                             MWEAK
                                          LGATE
                                                         EVTEMP
spe.eds n14 n8 n5 n8 = 1
                                                  RGATE
                                  GATE
spe.egs n13 n8 n6 n8 = 1
                                                                                              EBREAK
                                                                                 MMED
                                                9
                                                                          MSTRO
spe.esg n6 n10 n6 n8 = 1
                                         RLGATE
spe.evthres n6 n21 n19 n8 = 1
                                                                                                            LSOURCE
                                                                          CIN
spe.evtemp n20 n6 n18 n22 = 1
                                                                                                                     SOURCE
                                                                                          RSOURCE
i.it n8 n17 = 1
                                                                                                           RLSOURCE
I.lgate n1 n9 = 5.3e-9
                                                                                                 RBREAK
                                                                  14
13
I.ldrain n2 n5 = 1.0e-9
                                                                                             17
I.lsource n3 n7 = 1.7e-9
                                                                                                        ₹RVTEMP
                                                         S1B
                                                                  oS2B
                                                                          СВ
                                                                                                          19
res.rlgate n1 n9 = 53
                                                    CA
                                                                                              (
                                                                                           IT
                                                                               14
res.rldrain n2 n5 = 10
                                                                                                            VBAT
res.rlsource n3 n7 = 17
                                                            EGS
                                                                       EDS
m.mmed n16 n6 n8 n8 = model=mmedmod, l=1u, w=1u
m.mstrong n16 n6 n8 n8 = model=mstrongmod, l=1u, w=1u
                                                                                                RVTHRES
m.mweak n16 n21 n8 n8 = model=mweakmod, l=1u, w=1u
res.rbreak n17 n18 = 1, tc1=8.0e-4,tc2=-8e-7
res.rdrain n50 n16 = 1.0e-3, tc1=-12e-3,tc2=.35e-4
res.rgate n9 n20 = 2.2
res.rslc1 n5 n51 = 1e-6, tc1=9e-4,tc2=1e-6
res.rslc2 n5 n50 = 1e3
res.rsource n8 n7 = 6.8e-3, tc1=5e-3,tc2=1e-6
res.rvthres n22 n8 = 1, tc1=-1e-3,tc2=-8.2e-6
res.rvtemp n18 n19 = 1, tc1=-2.78e-3,tc2=1.5e-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
|sc| = ((v(n5,n51)/(1e-9+abs(v(n5,n51))))*((abs(v(n5,n51)*1e6/170))**5)))
```







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