FAIRCHILD

SEMICONDUCTOR®

March 2006

FDD8780/FDU8780
N-Channel PowerTrench® MOSFET
**25V, 35A, 8.5mΩ**

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.

Application

■ Vcore DC-DC for Desktop Computers and Servers

■ VRM for Intermediate Bus Architecture

Features

■ Max $r_{DS(on)}$ = 8.5mΩ at V_{GS} = 10V, I_D = 35A

■ Max $r_{DS(on)}$ = 12.0mΩ at V_{GS} = 4.5V, I_D = 35A

■ Low gate charge: $Q_{g(10)}$ = 21nC(Typ), V_{GS} = 10V

■ Low gate resistance

■ Avalanche rated and 100% tested

■ RoHS Compliant

G D S
D-PAK
(TO-252)

G D S **I-PAK**
(TO-251AA)

G
D
S
Short Lead I-PAK
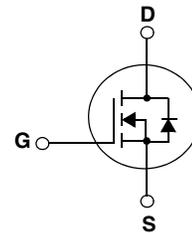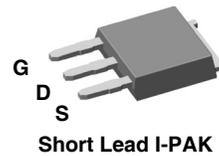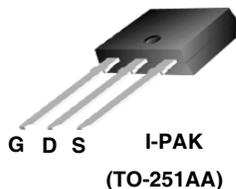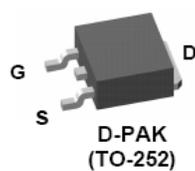
MOSFET Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DS}	Drain to Source Voltage		25	V
V_{GS}	Gate to Source Voltage		±20	V
I_D	Drain Current -Continuous (Package Limited)		35	A
	-Continuous (Die Limited)		60	
	-Pulsed	(Note 1)	224	
E_{AS}	Single Pulse Avalanche Energy	(Note 2)	73	mJ
P_D	Power Dissipation		50	W
T_J, T_{STG}	Operating and Storage Temperature		-55 to 175	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case TO-252,TO-251	3.0	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient TO-252,TO-251	100	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient TO-252,1in² copper pad area	52	°C/W

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD8780	FDD8780	TO-252AA	13''	12mm	2500 units
FDU8780	FDU8780	TO-251AA	N/A(Tube)	N/A	75 units
FDU8780	FDU8780_F071	TO-251AA	N/A(Tube)	N/A	75 units

FDD8780/FDU8780 Rev. B

www.fairchildsemi.com

Electrical Characteristics $T_J = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
Off Characteristics							
B_{VDSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu A$, $V_{GS} = 0V$		25			V
$\dfrac{\Delta B_{VDSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, referenced to 25°C			12		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 20V$, $V_{GS} = 0V$				1	μA
			$T_J = 150°C$			250	
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm20V$				±100	nA
On Characteristics							
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu A$		1.2	1.8	2.5	V
$\dfrac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\mu A$, referenced to 25°C			-6.3		mV/°C
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 10V$, $I_D = 35A$			6.5	8.5	mΩ
		$V_{GS} = 4.5V$, $I_D = 35A$			9.1	12.0	
		$V_{GS} = 10V$, $I_D = 35A$ $T_J = 175°C$			10.4	15.0	
Dynamic Characteristics							
C_{iss}	Input Capacitance	$V_{DS} = 13V$, $V_{GS} = 0V$, $f = 1MHz$			1080	1440	pF
C_{oss}	Output Capacitance				265	355	pF
C_{rss}	Reverse Transfer Capacitance				180	270	pF
R_g	Gate Resistance	$f = 1MHz$			0.9		Ω
Switching Characteristics							
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 13V$, $I_D = 35A$ $V_{GS} = 10V$, $R_{GS} = 17\Omega$			7	14	ns
t_r	Rise Time				9	18	ns
$t_{d(off)}$	Turn-Off Delay Time				43	69	ns
t_f	Fall Time				24	38	ns
Q_g	Total Gate Charge	$V_{GS} = 0V$ to $10V$	$V_{DD} = 13V$ $I_D = 35A$ $I_g = 1.0mA$		21	29	nC
Q_g	Total Gate Charge	$V_{GS} = 0V$ to $5V$			11.2	16	nC
Q_{gs}	Gate to Source Gate Charge				3.5		nC
Q_{gd}	Gate to Drain "Miller" Charge				4.7		nC
Drain-Source Diode Characteristics							
V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0V$, $I_S = 35A$			0.92	1.25	V
		$V_{GS} = 0V$, $I_S = 15A$			0.84	1.0	
t_{rr}	Reverse Recovery Time	$I_F = 35A$, $di/dt = 100A/\mu s$			28	42	ns
Q_{rr}	Reverse Recovery Charge	$I_F = 35A$, $di/dt = 100A/\mu s$			20	30	nC

Notes:
1: Pulse time < 300μs, Duty cycle = 2%.
2: Starting $T_J = 25°C$, L = 0.3mH, $I_{AS} = 22A$, $V_{DD} = 23V$, $V_{GS} = 10V$.

Typical Characteristics T_J = 25°C unless otherwise noted

PULSE DURATION = 80μs
DUTY CYCLE = 0.5%MAX

V_{GS} = 10V
V_{GS} = 4.5V
V_{GS} = 3.5V
V_{GS} = 3V

I_D, DRAIN CURRENT (A)
V_{DS}, DRAIN TO SOURCE VOLTAGE (V)
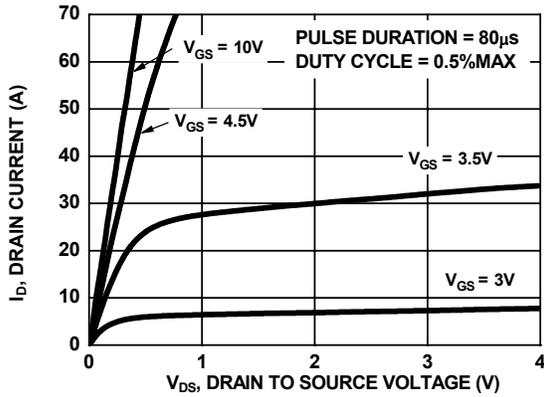
Figure 1. On Region Characteristics

PULSE DURATION = 80μs
DUTY CYCLE = 0.5%MAX

V_{GS} = 3V
V_{GS} = 3.5V
V_{GS} = 4.5V
V_{GS} = 10V

NORMALIZED DRAIN TO SOURCE ON-RESISTANCE
I_D, DRAIN CURRENT(A)
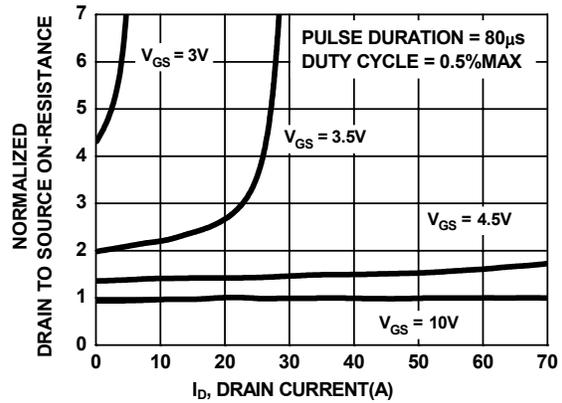
Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

I_D = 35A
V_{GS} = 10V

NORMALIZED DRAIN TO SOURCE ON-RESISTANCE
T_J, JUNCTION TEMPERATURE (°C)
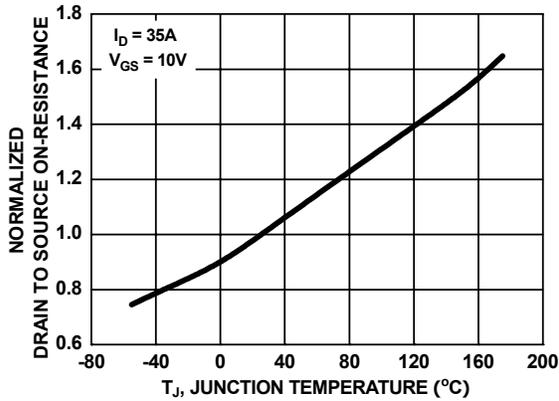
Figure 3. Normalized On Resistance vs Junction Temperature

I_D = 35A   PULSE DURATION = 80μs
DUTY CYCLE = 0.5%MAX

T_J = 175°C
T_J = 25°C

$r_{DS(on)}$, ON-RESISTANCE (mΩ)
V_{GS}, GATE TO SOURCE VOLTAGE (V)
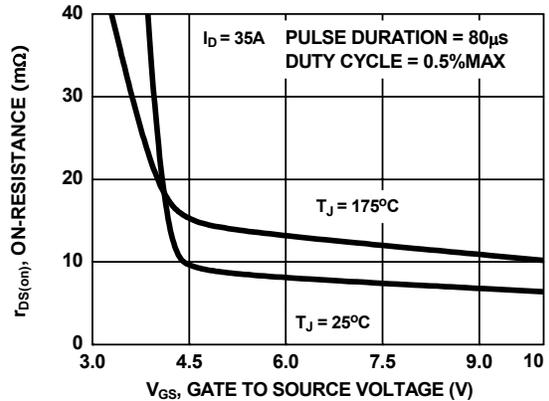
Figure 4. On-Resistance vs Gate to Source Voltage

PULSE DURATION = 80μs
DUTY CYCLE = 0.5%MAX

T_J = 175°C
T_J = 25°C
T_J = -55°C

I_D, DRAIN CURRENT (A)
V_{GS}, GATE TO SOURCE VOLTAGE (V)
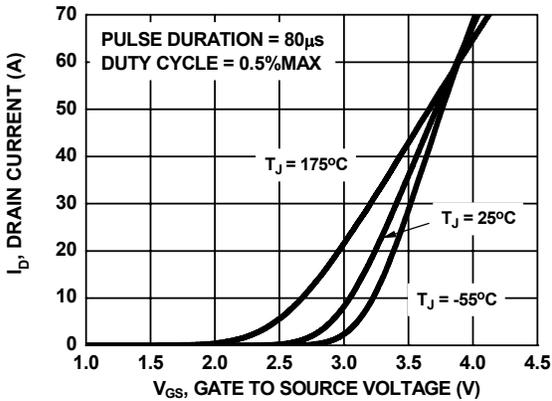
Figure 5. Transfer Characteristics

V_{GS} = 0V
T_J = 175°C
T_J = 25°C
T_J = -55°C

I_S, REVERSE DRAIN CURRENT (A)
V_{SD}, BODY DIODE FORWARD VOLTAGE (V)
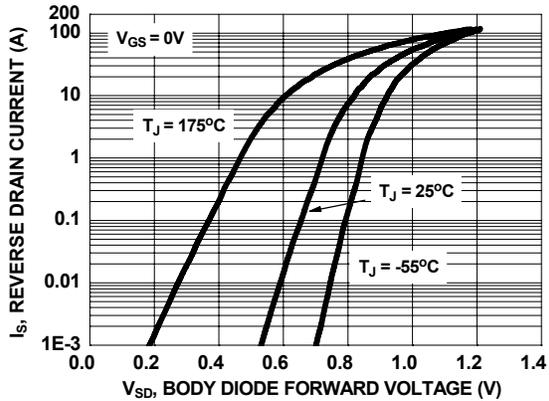
Figure 6. Source to Drain Diode Forward Voltage vs Source Current

**Typical Characteristics** T_J = 25°C unless otherwise noted
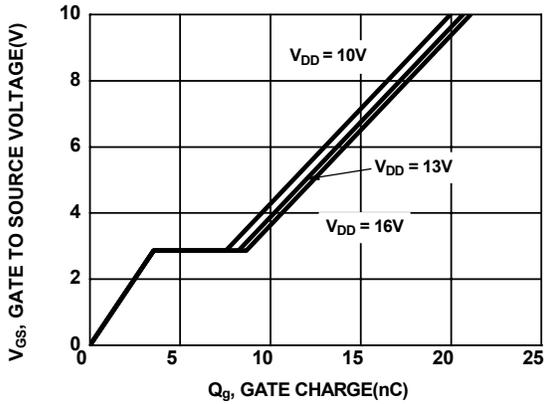
Figure 7. Gate Charge Characteristics
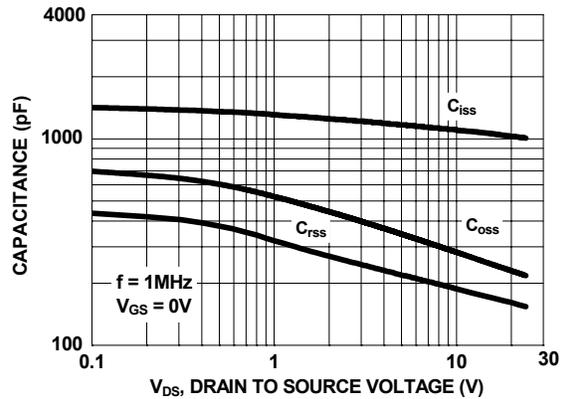
**Figure 8. Capacitance vs Drain to Source Voltage**
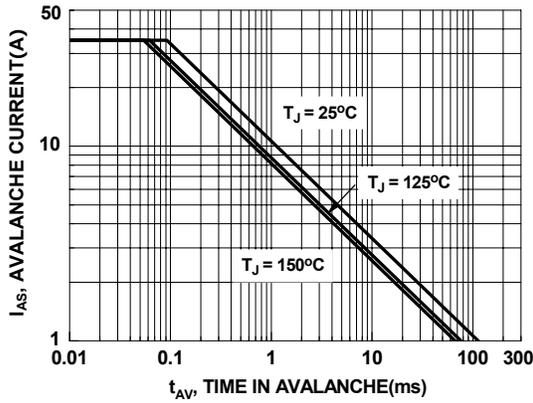
**Figure 9. Unclamped Inductive Switching Capability**
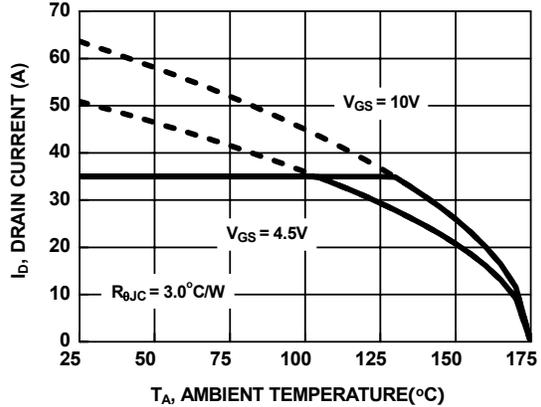
**Figure 10. Maximum Continuous Drain Current vs Case Temperature**
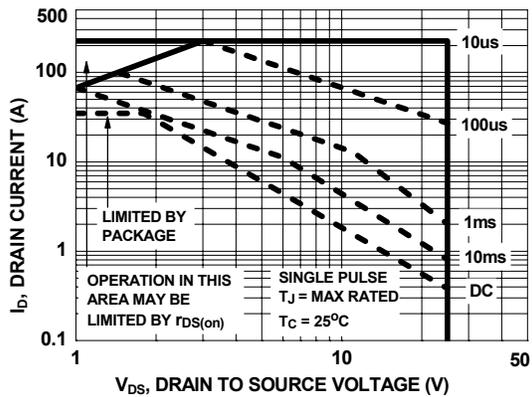
**Figure 11. Forward Bias Safe Operating Area**
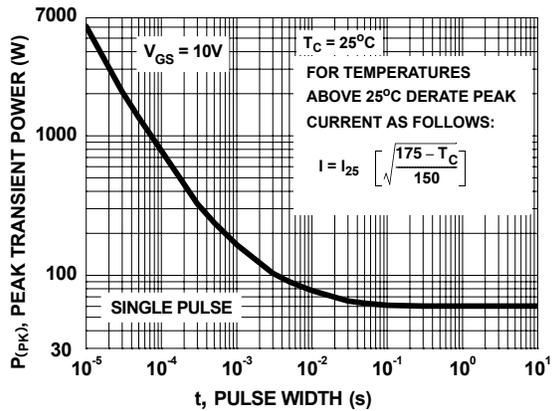
Figure 12. Single Pulse Maximum Power Dissipation

Typical Characteristics T_J = 25°C unless otherwise noted

DUTY CYCLE-DESCENDING ORDER

D = 0.5
0.2
0.1
0.05
0.02
0.01

SINGLE PULSE

NORMALIZED THERMAL IMPEDANCE, $Z_{\theta JC}$

t, RECTANGULAR PULSE DURATION(s)

NOTES:
DUTY FACTOR: D = t_1/t_2
PEAK T_J = P_{DM} x $Z_{\theta JC}$ x $R_{\theta JC}$ + T_C
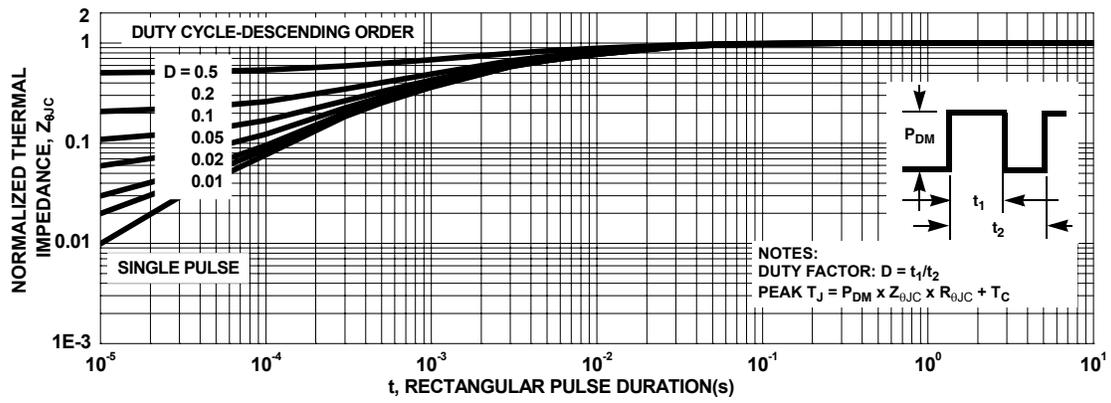
Figure 13. Transient Thermal Response Curve

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACEx™	FAST®	ISOPLANAR™	PowerSaver™	SuperSOT™-6
ActiveArray™	FASTr™	LittleFET™	PowerTrench®	SuperSOT™-8
Bottomless™	FPS™	MICROCOUPLER™	QFET®	SyncFET™
Build it Now™	FRFET™	MicroFET™	QS™	TCM™
CoolFET™	GlobalOptoisolator™	MicroPak™	QT Optoelectronics™	TinyLogic®
CROSSVOLT™	GTO™	MICROWIRE™	Quiet Series™	TINYOPTO™
DOME™	HiSeC™	MSX™	RapidConfigure™	TruTranslation™
EcoSPARK™	I²C™	MSXPro™	RapidConnect™	UHC™
E²CMOS™	i-Lo™	OCX™	µSerDes™	UltraFET®
EnSigna™	ImpliedDisconnect™	OCXPro™	ScalarPump™	UniFET™
FACT™	IntelliMAX™	OPTOLOGIC®	SILENT SWITCHER®	VCX™
FACT Quiet Series™		OPTOPLANAR™	SMART START™	Wire™
		PACMAN™	SPM™	
Across the board. Around the world.™		POP™	Stealth™	
The Power Franchise®		Power247™	SuperFET™	
Programmable Active Droop™		PowerEdge™	SuperSOT™-3	

DISCLAIMER
FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY
FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

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.

Rev. I18