www.DataSheet4U.com

FAIRCHILD SEMICONDUCTOR®

December 2008

FPF1013/4
IntelliMAX™ 1V Rated Advanced Load Management Products

Features

- 0.8V to 1.8V Input Voltage Range
- Typical $R_{DS(ON)}$ = 17mΩ @ V_{ON} - V_{IN} = 2.0V
- Output Discharge Function
- Internal Pull-down at ON Pin
- Accurate Slew Rate Controlled Turn-on time
- Low < 1μA Quiescent Current
- ESD Protected, above 8000V HBM, 2000V CDM
- RoHS Compliant
- Free from Halogenated Compounds and Antimony Oxides

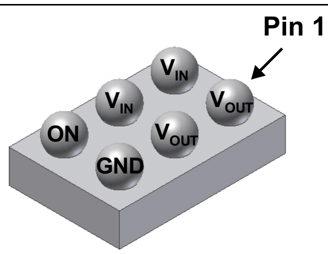
Applications

- PDAs
- Cell Phones
- GPS Devices
- MP3 Players
- Digital Cameras
- Notebook Computer

General Description

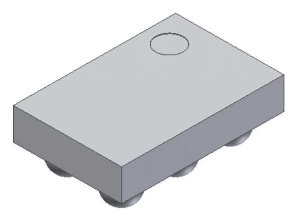
The FPF1013/4 series is an IntelliMAX advanced slew rate loadswitch offering a very low operating voltage. These devices consist of a 17mΩ N-channel MOSFET that supports an input voltage up to 2.0V. These slew rate devices control the switch turn-on and prevent excessive in-rush current from the supply rails. The input voltage range operates from 0.8V to 1.8V to fulfill today's lowest Ultraportable Device's supply requirements. Switch control is via a logic input (ON) capable of interfacing directly with low voltage control signals.

The FPF1014 has an On-Chip pull down allowing for quick and controlled output discharge when switch is turned off. The FPF1013/4 series is available in a space-saving 1X1.5 CSP-6L package.



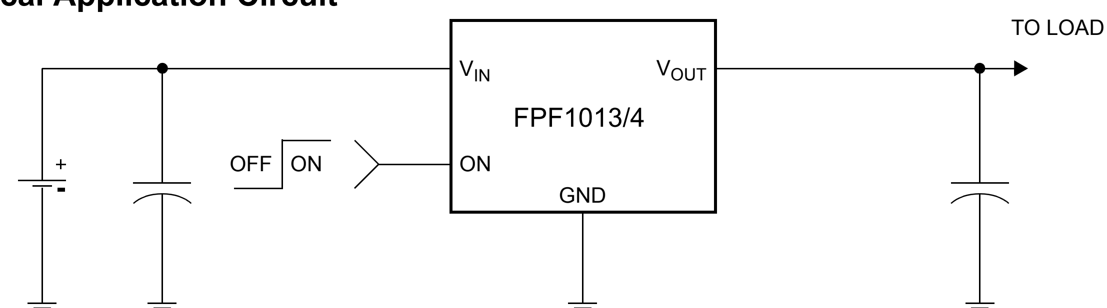
BOTTOM

www.DataSheet4U.com



TOP

Typical Application Circuit



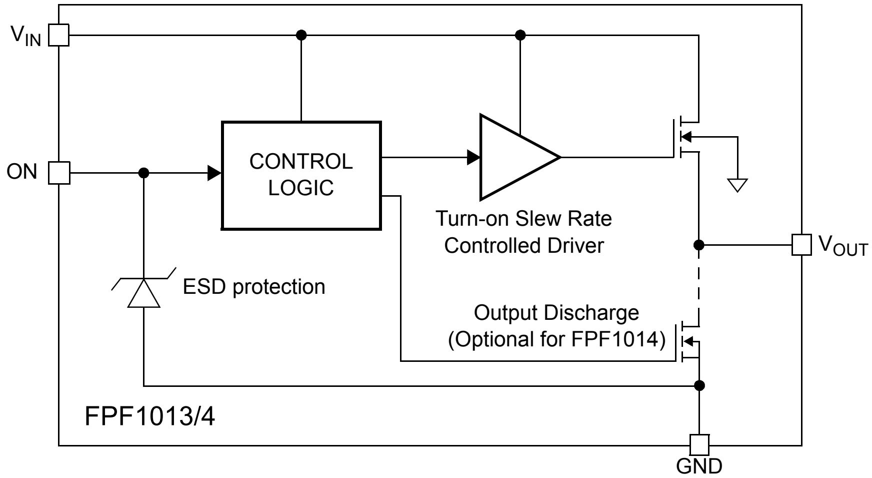
Ordering Information

Part	Switch	Turn-on Time	Output Discharge	ON Pin Activity	Package
FPF1013	17mΩ, NMOS	43μs	N/A	Active HI	CSP1X1.5
FPF1014	17mΩ, NMOS	43μs	60Ω	Active HI	CSP1X1.5

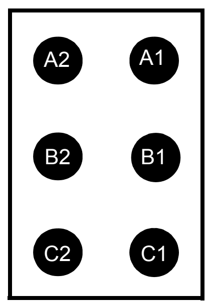
©2008 Fairchild Semiconductor Corporation

www.DataSheet4U.com

Functional Block Diagram



Pin Configuration



1.0 x 1.5 CSP Bottom View

Pin Description

Pin	Name	Function
A2, B2	V_{IN}	Supply Input: Input to the power switch and the supply voltage for the IC
C2	ON	ON Control Input
A1, B1	V_{OUT}	Switch Output: Output of the power switch
C1	GND	Ground

www.DataSheet4U.com

Absolute Maximum Ratings

Parameter		Min	Max	Unit
V_{IN}, V_{OUT} to GND		-0.3	2	V
V_{ON} to GND		-0.3	4.2	V
Maximum Continuous Switch Current			1.5	A
Power Dissipation @ T_A = 25°C (Note 1)			1.2	W
Operating Temperature Range		-40	85	°C
Storage Temperature		-65	150	°C
Thermal Resistance, Junction to Ambient			85	°C/W
Electrostatic Discharge Protection	HBM	8000		V
	CDM	2000		V

Note 1: Package power dissipation on 1 square inch pad, 2 oz. copper board

www.DataSheet4U.com

Recommended Operating Range

Parameter	Min	Max	Unit
V_{IN}	0.8	1.8	V
Ambient Operating Temperature, T_A	-40	85	°C

Electrical Characteristics

V_{IN} = 0.8 to 1.8V, T_A = -40 to +85°C unless otherwise noted. Typical values are at V_{IN} =1.8V and T_A = 25°C.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Basic Operation						
Operating Voltage	V_{IN}		0.8		1.8	V
ON Input Voltage	$V_{ON(MIN)}$	V_{IN} = 0.8V	1.8	2.8	4.0	V
	$V_{ON(MAX)}$	V_{IN} = 1.8V (Note 2)	2.8	3.8	4.0	V
Operating Current	I_{CC}	V_{IN} = 1V, V_{ON} = 3.3V, V_{OUT} = Open			1	µA
Quiescent Current	I_Q	V_{IN} = 1V, V_{ON} = GND, V_{OUT} = Open			2	µA
Off Switch Current	I_{SWOFF}	V_{IN} = 1.8V, V_{ON} = GND, V_{OUT} = GND			2	µA
On-Resistance	R_{ON}	V_{IN} = 1V, V_{ON} = 3V, I_{OUT} = 1A, T_A = 25C		17	27	mΩ
		V_{IN} = 1V, V_{ON} = 2.3V, I_{OUT} = 1A, T_A = 25°C		25	38	
Output Pull Down Resistance	R_{PD}	V_{IN} = 1V, V_{ON} = 0V, I_{OUT} = 1mA, T_A = 25°C, FPF1014		60	120	Ω
ON Input Logic Low Voltage	V_{IL}	V_{IN} = 0.8V, R_L = 1KΩ			0.3	V
		V_{IN} = 1.8V, R_L = 1KΩ			0.8	
ON Input Leakage		V_{ON} = V_{IN} or GND	-1		1	µA
Dynamic (V_{IN} = 1.0V, V_{ON} = 3.0V, T_A = 25°C)						
V_{OUT} Rise Time	T_R	R_L = 500Ω, C_L = 0.1µF		28		µs
		R_L = 3.3Ω, C_L = 10µF		38		
Turn On Time	T_{ON}	R_L = 500Ω, C_L = 0.1µF		43		µs
		R_L = 3.3Ω, C_L = 10µF		58		
V_{OUT} Fall Time	T_F	FPF1014, R_L = 500Ω, C_L = 0.1µF		14		µs
		FPF1014, R_L = 3.3Ω, C_L = 10µF		76		
Turn Off Time	T_{OFF}	FPF1014, R_L = 500Ω, C_L = 0.1µF		50		µs
		FPF1014, R_L = 3.3Ω, C_L = 10µF		96		

www.DataSheet4U.com

Note 2: $V_{ON(MAX)}$ is limited by the absolute rating.

www.DataSheet4U.com

Typical Characteristics

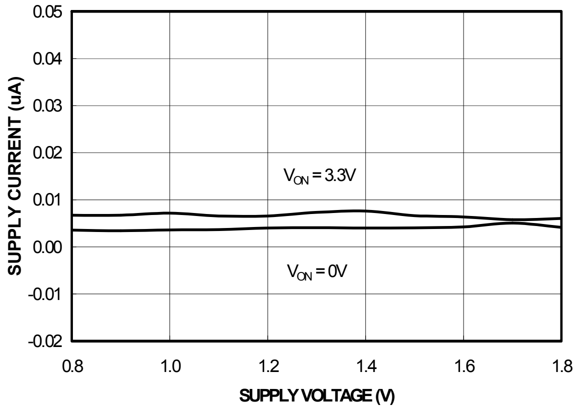


Figure 1. Supply Current vs. V_{IN}

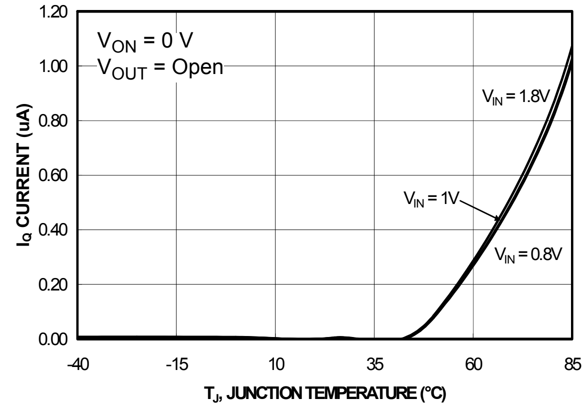
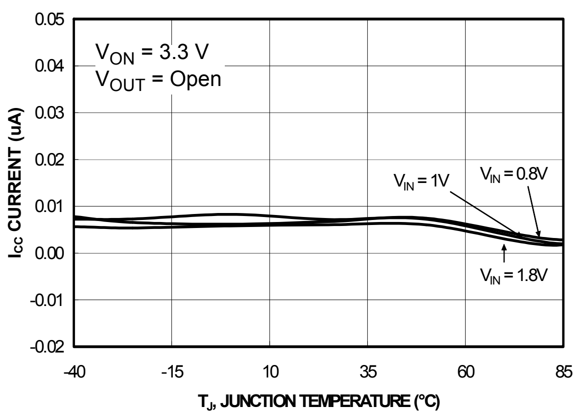


Figure 2. Off Quiescent Current vs. Temperature



www.DataSheet4U.com

Figure 3. Operating Current vs. Temperature

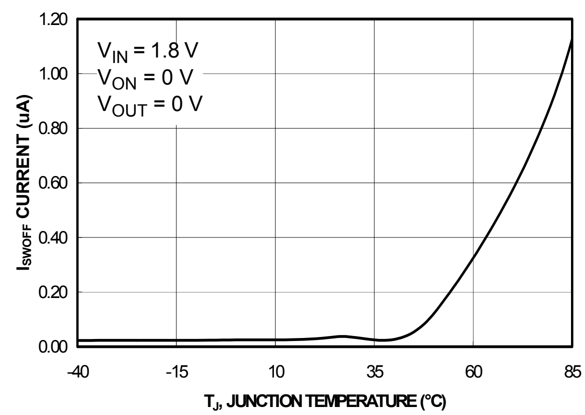


Figure 4. Off Switch Current vs. Temperature

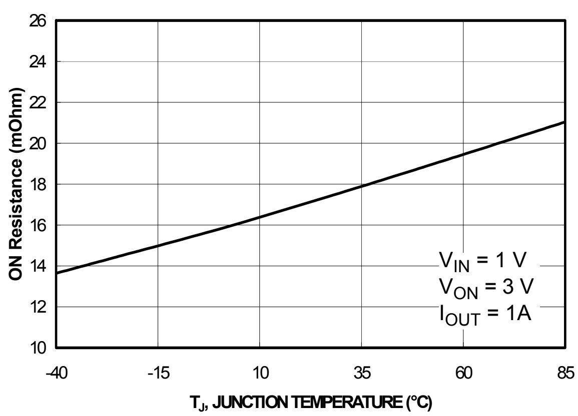


Figure 5. R_{ON} vs. Temperature

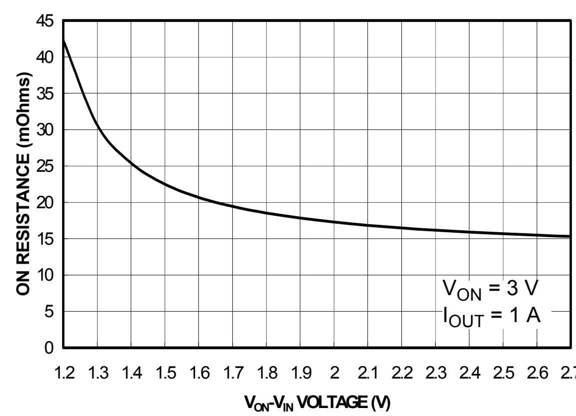


Figure 6. R_{ON} vs. V_{ON}-V_{IN}

www.DataSheet4U.com

Typical Characteristics

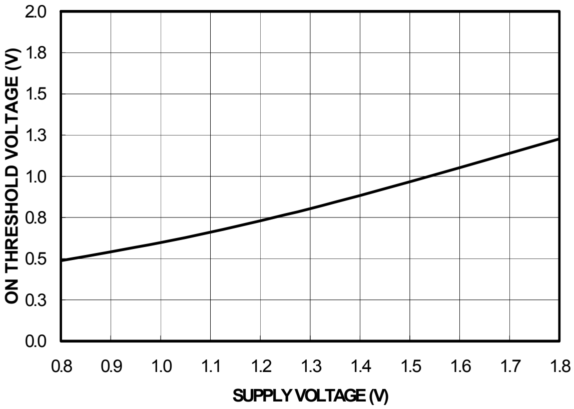


Figure 7. V_{IL} vs. V_{IN}

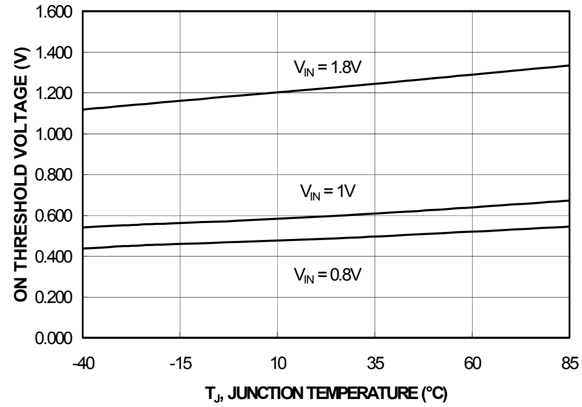
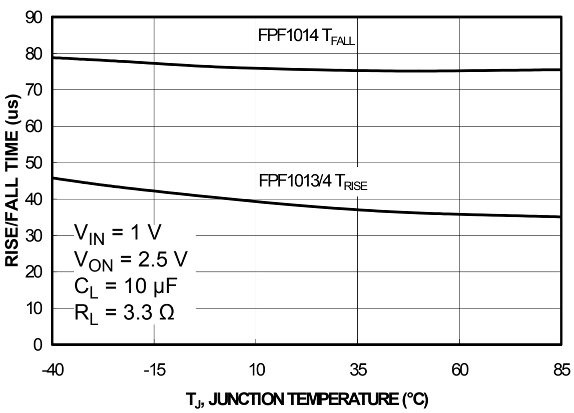


Figure 8. V_{IL} vs. Temperature



www.DataSheet4U.com

Figure 9. T_{RISE}/T_{FALL} vs. Temperature

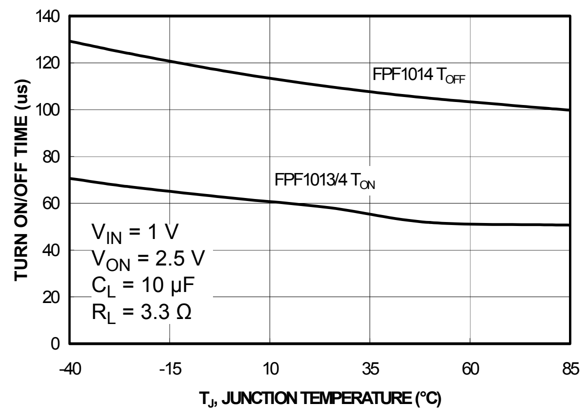


Figure 10. T_{ON}/T_{OFF} vs. Temperature

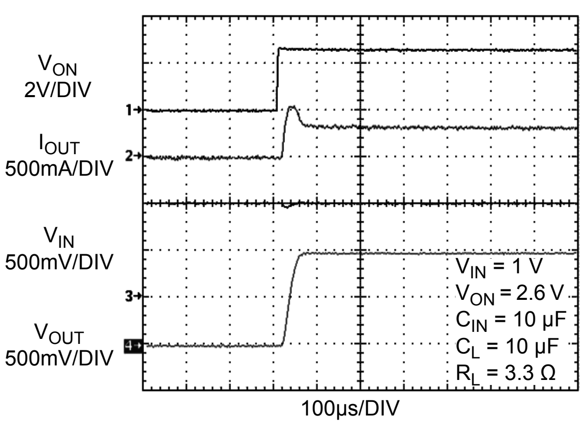


Figure 11. FPF1013/4 Turn ON Response

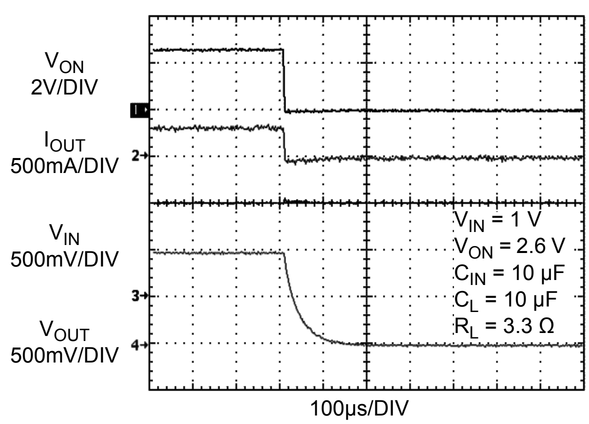


Figure 12. FPF1014 Turn OFF Response

www.DataSheet4U.com

Typical Characteristics

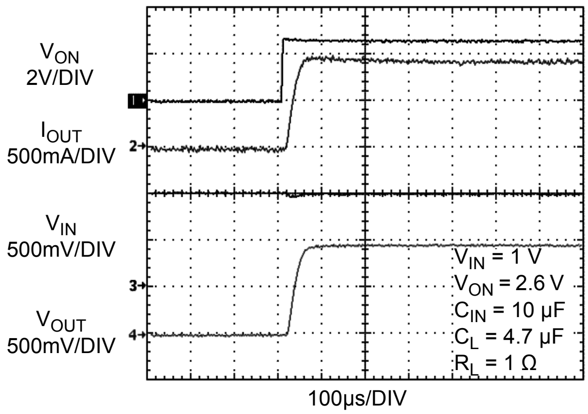


Figure 13. FPF1013/4 Turn ON Response

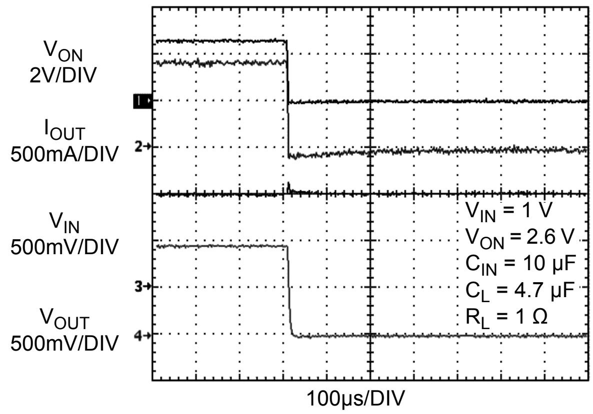
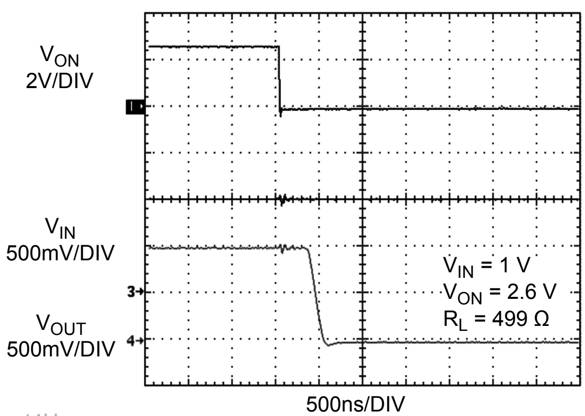


Figure 14. FPF1014 Turn OFF Response



www.DataSheet4U.com

Figure 15. FPF1014 Output Pull-down Response

www.DataSheet4U.com

Description of Operation

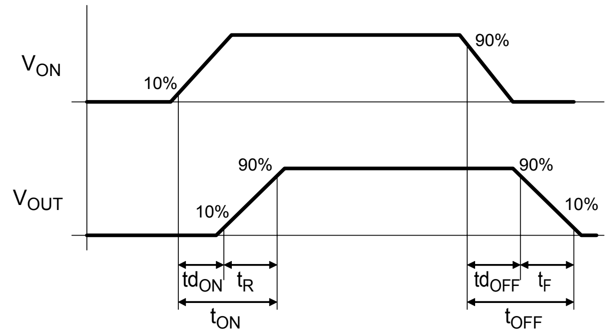
The FPF1013/4 are low $R_{DS(ON)}$ N-Channel load switches with controlled turn-on. The core of each device is a 17mΩ (V_{IN} = 1V, V_{ON} = 3V) N-Channel MOSFET and is customized for a low input operating range of 0.8 to 1.8V. The ON pin controls the state of the switch.

The FPF1014 contains a 60Ω(typ) on-chip resistor which is connected internally from V_{OUT} to GND for quick output discharge when the switch is turned off.

On/Off Control

The ON pin is active high and it controls the state of the switch. Applying a continuous high signal will hold the switch in the ON state. In order to minimize the switch on resistance, the ON pin voltage should exceed the input voltage by 2V. This device is compatible with a GPIO (General Purpose Input/Output) port, where the logic voltage level can be configured to 4V $\geq V_{ON} \geq V_{IN}$+2V and power consumed is less than 1µA in steady state.

Timing Diagram

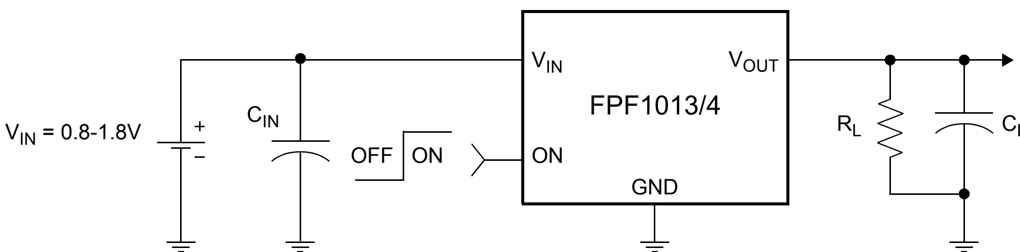


where:

td_{ON}	=	Delay On Time
t_R	=	V_{OUT} Rise Time
t_{ON}	=	Turn On Time
td_{OFF}	=	Delay Off Time
t_F	=	V_{OUT} Fall Time
t_{OFF}	=	Turn Off Time

Application Information

Typical Application



Input Capacitor

To limit the voltage drop on the input supply caused by transient in-rush currents when the switch turns-on, a capacitor must be placed between V_{IN} and GND. For minimized voltage drop, especially when the operating voltage approaches 1V a 10µF ceramic capacitor should be placed close to the V_{IN} pins. Higher values of C_{IN} can be used to further reduce the voltage drop during higher current modes of operation.

www.DataSheet4U.com

Output Capacitor

A 0.1µF capacitor, C_L, should be placed between V_{OUT} and GND. This capacitor will prevent parasitic board inductance from forcing V_{OUT} below GND when the switch turns-off. If the application has a capacitive load, the FPF1014 can be used to discharged that load through an on-chip output discharge path.

Board Layout

For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. Using wide traces or large copper planes for all pins (V_{IN}, V_{OUT}, ON and GND) will help minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance.

www.DataSheet4U.com

Improving Thermal Performance

An improper layout could result in higher junction temperature. This concern applies when continuous operation current is set to maximum allowed current and switch turns into a large capacitive load that introduce high inrush current in the transient. Since FPF1013/4 does not have thermal shutdown feature a proper layout can essentially reduce power dissipation of the switch in transient and prevents switch to exceed the maximum absolute power dissipation of 1.2W.

The V_{IN}, V_{OUT} and GND pins will dissipate most of the heat generated during a high load current condition. The layout suggested in Figure 16 provides each pin with adequate copper so that heat may be transferred as efficiently as possible out of the device. The ON pin trace may be laid-out diagonally from the device to maximize the area available to the ground pad. Placing the input and output capacitors as close to the device as possible also contributes to heat dissipation, particularly during high load currents.

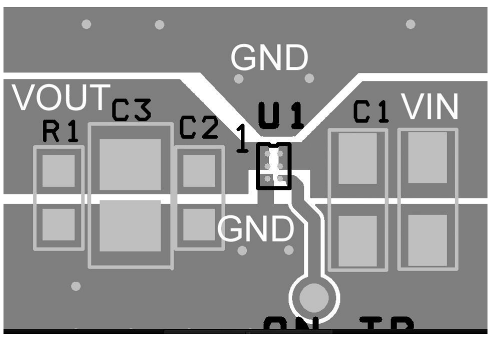


Figure 16: Proper layout of output, input and ground copper area

Demo Board Layout

FPF1013/4 Demo board has the components and circuitry to demonstrate FPF1013/4 load switches functions. Thermal performance of the board is improved using a few techniques recommended in the layout recommendations section of datasheet.

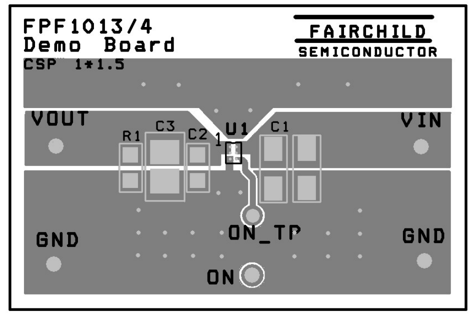
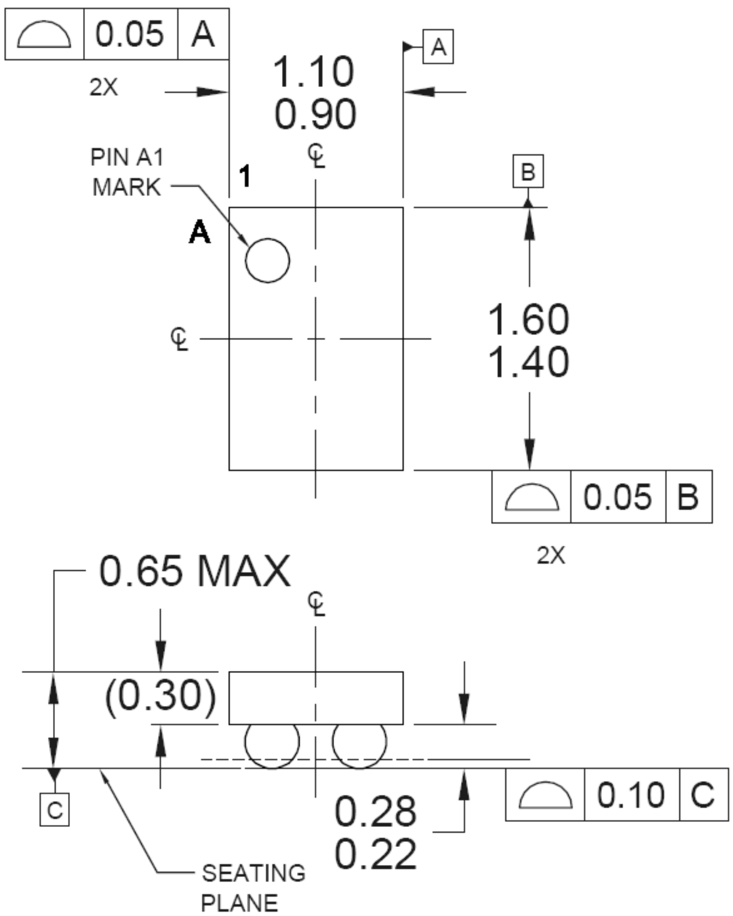


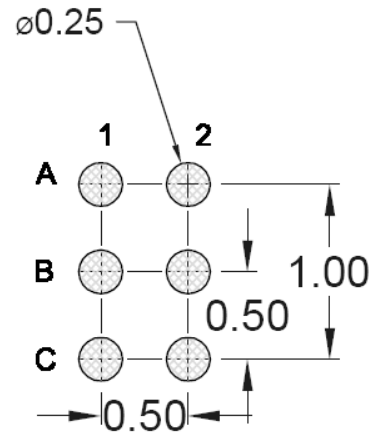
Figure 17. FPF1013/4 Demo Board Layout

www.DataSheet4U.com

www.DataSheet4U.com

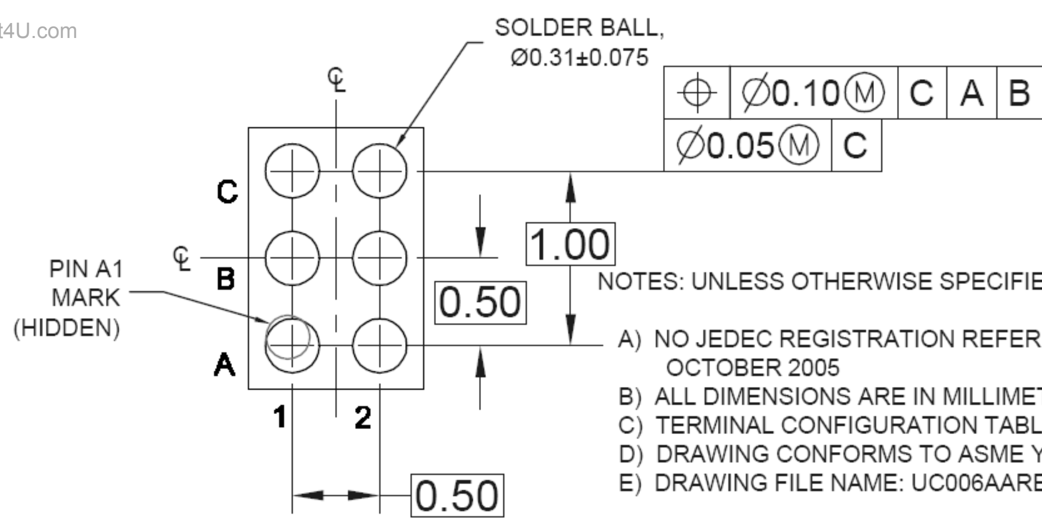
Dimensional Outline and Pad Layout





LAND PATTERN
RECOMMENDATION

www.DataSheet4U.com



NOTES: UNLESS OTHERWISE SPECIFIED

A) NO JEDEC REGISTRATION REFERENCE AS OF OCTOBER 2005
B) ALL DIMENSIONS ARE IN MILLIMETERS
C) TERMINAL CONFIGURATION TABLE.
D) DRAWING CONFORMS TO ASME Y14.5M-1994
E) DRAWING FILE NAME: UC006AAREV4.

www.DataSheet4U.com

FAIRCHILD SEMICONDUCTOR®

TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidianries, and is not intended to be an exhaustive list of all such trademarks.

Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
EcoSPARK®
EfficentMax™
EZSWITCH™ *
™
®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FlashWriter® *
FPS™
F-PFS™

FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MillerDrive™
MotionMax™
Motion-SPM™
OPTOLOGIC®
OPTOPLANAR®
®
PDP SPM™
Power-SPM™
PowerTrench®
PowerXS™

Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
™
Saving our world, 1mW/W/kW at a time™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS™
SyncFET™
SYSTEM GENERAL®
The Power Franchise®

the power franchise
TinyBoost™
TinyBuck™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
µSerDes™
SerDes™
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
XS™

* EZSWITCH™ and FlashWriter® are trademarks of System General Corporation, used under license by Fairchild Semiconductor.

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. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

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, and (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 a significant injury of the user.
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.

www.DataSheet4U.com

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

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.

Rev. I37