October 2010

FPF1207 / FPF1208

IntelliMAX™ Advanced Load Switch

Features

- 1.2V to 4.0V Input Voltage Operating Range
- Typical R_{ON}: 50mΩ at V_{IN}=3.3V
  77mΩ at V_{IN}=1.8V
  150mΩ at V_{IN}=1.2V
- Slew Rate Control with t_R: 110µs
- Output Discharge Function on FPF1208
- Low <1.5µA Quiescent Current
- Extra Low <100nA Off Supply Current
- ESD Protected: Above 7000V HBM, 2000V CDM
- GPIO/CMOS-Compatible Enable Circuitry
- 4-Bump WLCSP 0.76mm x 0.76mm, 0.4mm Pitch

Applications

- Mobile Devices and Smart Phones
- Portable Media Devices
- Ultra-Portable / Mobile Computing
- Advanced Notebook, UMPC, MID
- Portable Medical Devices
- GPS and Navigation Equipment

Description

The FPF1207/08 is an ultra-small integrated IntelliMAX™ load switch with integrated P-channel switch and analog control features. Integrated slew-rate control prevents inrush current and the resulting excessive voltage drop on power rail. The input voltage range operates from 1.2V to 4.0V to provide power-disconnect capability for post-regulated power rails in portable and consumer products. The low shut-off current of 1µA (maximum) allows power designs to meet standby and off-power drain specifications.

The FPF1207/08 is controlled by an active-HIGH logic input (ON pin) compatible with standard CMOS GPIO circuitry found on Field Programmable Gate Array (FPGA) and embedded processors. The FPF1207/08 is available in 0.76mm x 0.76mm 4-bump WLCSP.

Ordering Information

Part Number	Top Marking	Switch (Typical) at $3.3V_{IN}$	Output Discharge	ON Pin Activity	t_R	Package
FPF1207UCX	QG	50mΩ	NA	Active HIGH	110µs	4-Ball, Wafer-Level Chip-Scale Package (WLCSP), 0.76 x 0.76mm, 0.4mm Pitch
FPF1208UCX	QH	50mΩ	65Ω	Active HIGH	110µs	

Application Diagram

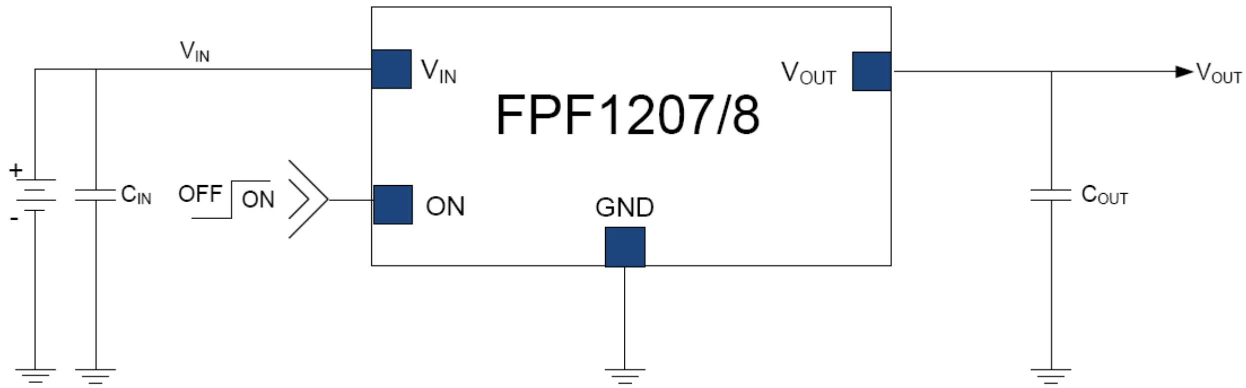


Figure 1. Typical Application

Notes:

1. C_{IN}=1μF, X5R, 0603 (for example, Murata GRM185R60J105KE26).
2. C_{OUT}=1μF, X5R, 0805 (for example, Murata GRM216R61A105KA01).

Functional Block Diagram

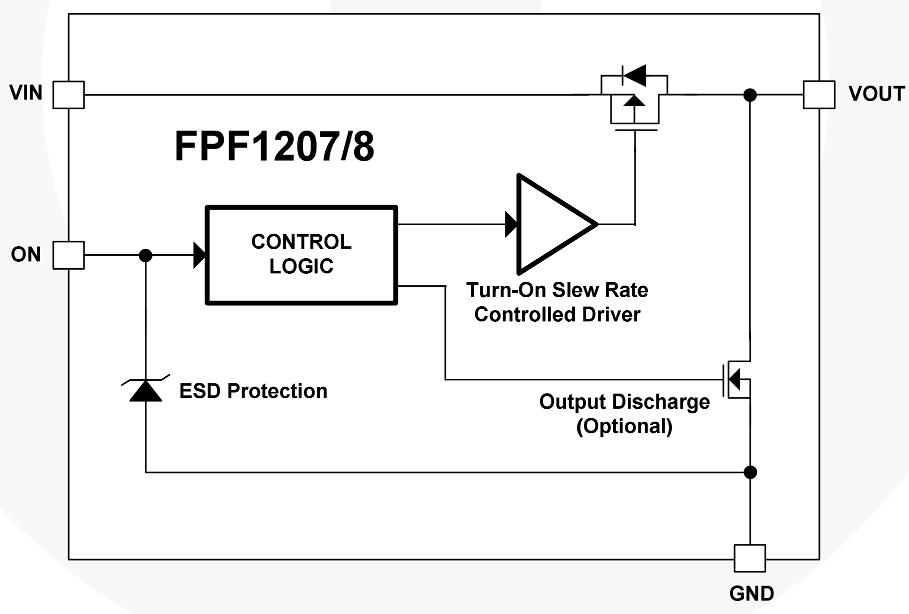


Figure 2. Functional Block Diagram (Output Discharge for FPF1208 Only)

Pin Configurations

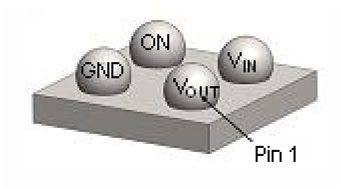


Figure 3. WLCSP Bumps Facing Up (Top View)

Figure 4. WLCSP Bumps Facing Down (Bottom View)

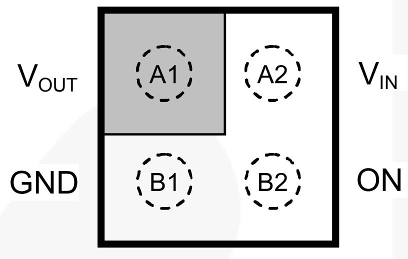


Figure 5. Pin Assignments (Top View)

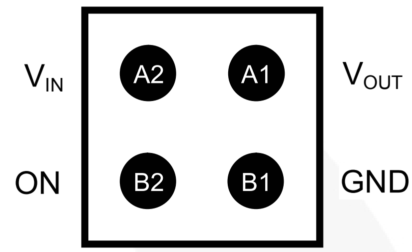


Figure 6. Pin Assignments (Bottom View)

Pin Definitions

Pin #	Name	Description
A1	V_{OUT}	Switch Output
A2	V_{IN}	Supply Input: Input to the power switch
B1	GND	Ground
B2	ON	ON/OFF control, active HIGH

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

<table>
<tr><th>Symbol</th><th colspan="2">Parameter</th><th>Min.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>V_{IN}</td><td colspan="2">V_{IN}, V_{OUT}, V_{ON} to GND</td><td>-0.3</td><td>4.2</td><td>V</td></tr>
<tr><td>I_{SW}</td><td colspan="2">Maximum Continuous Switch Current</td><td></td><td>1.2</td><td>A</td></tr>
<tr><td>P_D</td><td colspan="2">Power Dissipation at T_A=25°C</td><td></td><td>1.0</td><td>W</td></tr>
<tr><td>T_{STG}</td><td colspan="2">Storage Junction Temperature</td><td>-65</td><td>+150</td><td>°C</td></tr>
<tr><td>T_A</td><td colspan="2">Operating Temperature Range</td><td>-40</td><td>+85</td><td>°C</td></tr>
<tr><td rowspan="2">Θ_{JA}</td><td rowspan="2">Thermal Resistance, Junction-to-Ambient</td><td>1S2P with One Thermal Via</td><td></td><td>110</td><td rowspan="2">°C/W</td></tr>
<tr><td>1S2P without Thermal Via</td><td></td><td>95</td></tr>
<tr><td rowspan="2">ESD</td><td rowspan="2">Electrostatic Discharge Capability[3,4]</td><td>Human Body Model, JESD22-A114</td><td>7</td><td></td><td rowspan="2">kV</td></tr>
<tr><td>Charged Device Model, JESD22-C101</td><td>2</td><td></td></tr>
</table>

Notes:
3. Measured using 2S2P JEDEC std. PCB.
4. Measured using 2S2P JEDEC PCB COLD PLATE Method.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V_{IN}	Supply Voltage	1.2	4.0	V
T_A	Ambient Operating Temperature	-40	+85	°C

Electrical Characteristics

Unless otherwise noted, V_{IN}=1.2 to 4.0V and T_A=-40 to +85°C. Typical values are at V_{IN}=3.3V and T_A=25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Basic Operation						
V_{IN}	Supply Voltage		1.2		4.0	V
$I_{Q(OFF)}$	Off Supply Current	V_{ON}=GND, V_{OUT}=Open, V_{IN}=4V			100	nA
$I_{SD(OFF)}$	Off Switch Current	V_{ON}=GND, V_{OUT}=GND			1	µA
I_Q	Quiescent Current	I_{OUT}=0mA			1.5	µA
R_{ON}	On Resistance	V_{IN}=3.3V, I_{OUT}=200mA, T_A=25°C		50	66	mΩ
		V_{IN}=1.8V, I_{OUT}=200mA, T_A=25°C		77	91	
		V_{IN}=1.2V, I_{OUT}=200mA, T_A=25°C		150	160	
		V_{IN}=1.8V, I_{OUT}=200mA, T_A=85°C			100	
R_{PD}	Output Discharge $R_{PULL\ DOWN}$	V_{IN}=3.3V, V_{ON}=0V, I_{FORCE}=20mA, T_A=25°C, FPF1208		65	110	Ω
V_{IH}	On Input Logic HIGH Voltage	V_{IN} <1.5V	0.9			V
		V_{IN}=1.5V to 4.0V	1.1			
V_{IL}	On Input Logic LOW Voltage	V_{IN}=1.2V to 4.0V			0.75	V
I_{ON}	On Input Leakage	V_{ON}=V_{IN} or GND			1	µA
Dynamic Characteristics(5)						
t_{DON}	Turn-On Delay(6)	V_{IN}=3.3V, R_L=10Ω, C_L=0.1µF, T_A=25°C		110		µs
t_R	V_{OUT} Rise Time(6)			110		
t_{ON}	Turn-On Time(6)			220		
t_{DOFF}	Turn-Off Delay(6)	V_{IN}=3.3V, R_L=10Ω, C_L=0.1µF, T_A=25°C, FPF1207		7		µs
t_F	V_{OUT} Fall Time(6)			2		
t_{OFF}	Turn-Off Time(6)			9		
t_{DOFF}	Turn-Off Delay	V_{IN}=3.3V, R_L=10Ω, C_L=0.1µF, T_A=25°C, FPF1208		2.0		µs
t_F	V_{OUT} Fall Time			1.9		
t_{OFF}	Turn-Off Time			3.9		
t_{DOFF}	Turn-Off Delay	V_{IN}=3.3V, R_L=500Ω, C_L=0.1µF, T_A=25°C, FPF1207		10		µs
t_F	V_{OUT} Fall Time			95		
t_{OFF}	Turn-Off Time(6)			105		
t_{DOFF}	Turn-Off Delay	V_{IN}=3.3V, R_L=500Ω, C_L=0.1µF, T_A=25°C, FPF1208(7)		7.0		µs
t_F	V_{OUT} Fall Time			10.5		
t_{OFF}	Turn-Off Time(6)			17.5		

Notes:
5. These parameters are guaranteed by design and characterization; not production tested.
6. t_{DON}/t_{DOFF}/t_R/t_F are defined in Figure 25.
7. Output discharge path is enabled during device off.

Typical Performance Characteristics

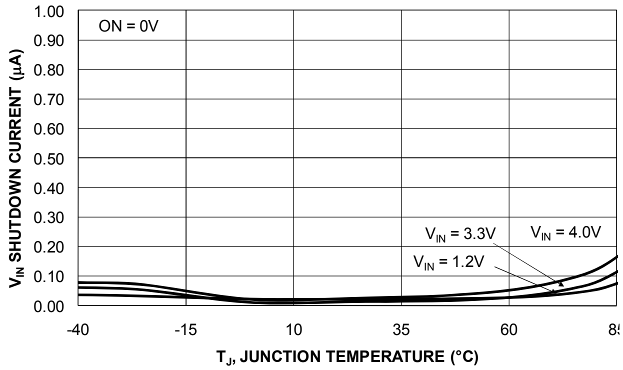


Figure 7. Shutdown Current vs. Temperature

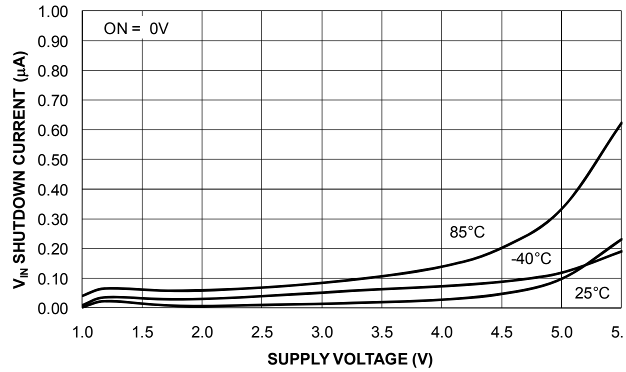


Figure 8. Shutdown Current vs. Supply Voltage

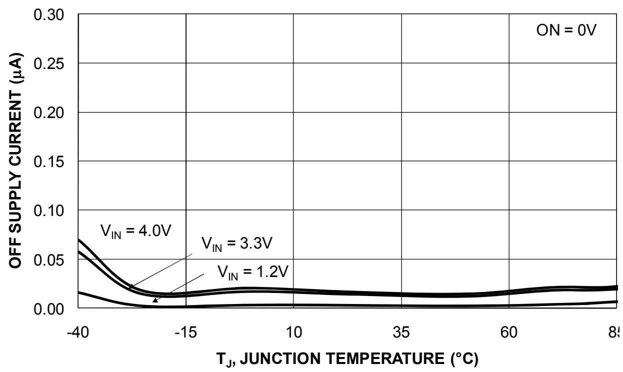


Figure 9. Off Supply Current vs. Temperature (FPF1207, V_{OUT} Floating)

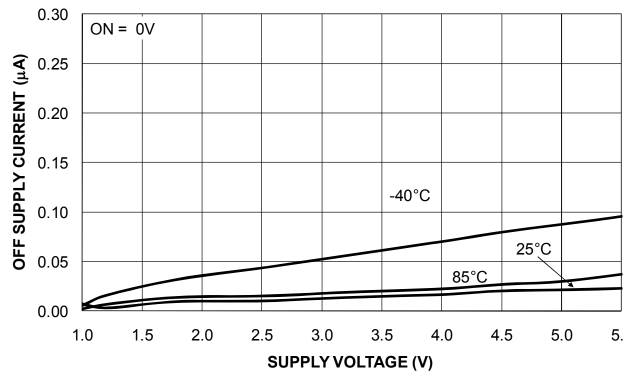


Figure 10. Off Supply Current vs. Supply Voltage (FPF1207, V_{OUT} Floating)

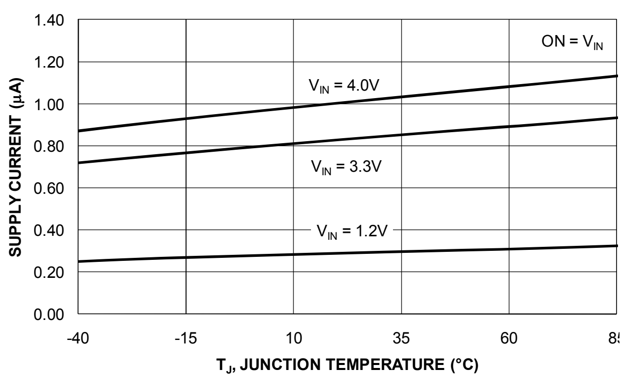


Figure 11. Quiescent Current vs. Temperature

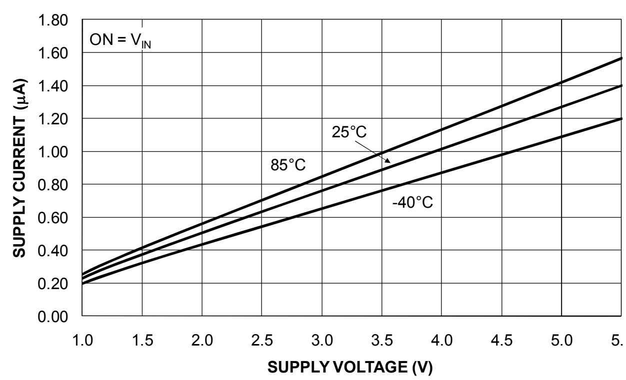


Figure 12. Quiescent Current vs. Supply Voltage

Typical Performance Characteristics

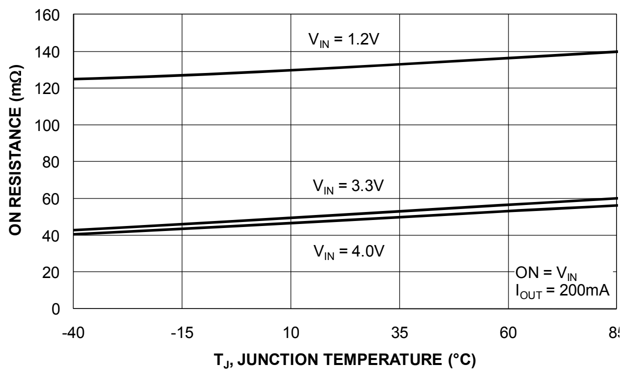


Figure 13. R_{ON} vs. Temperature

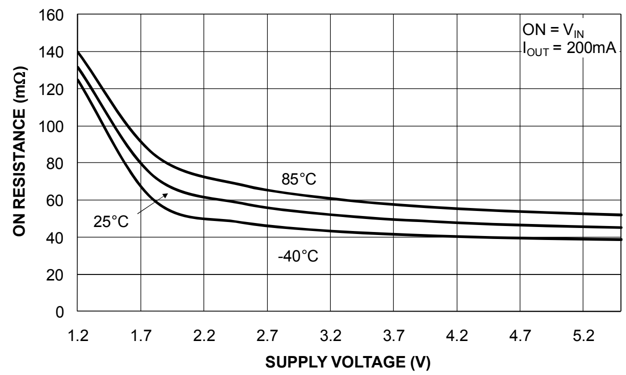


Figure 14. R_{ON} vs. Supply Voltage

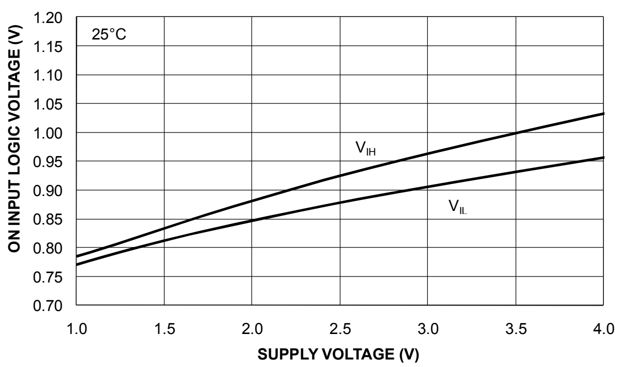


Figure 15. ON-Pin Threshold vs. V_{IN}

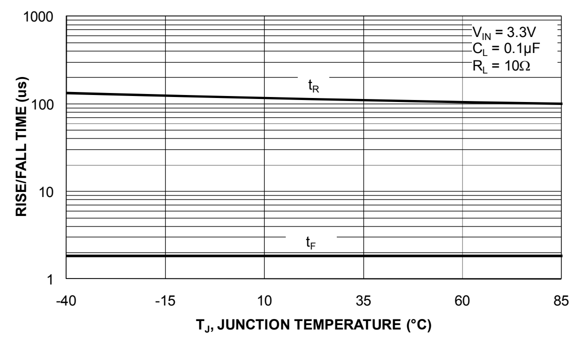


Figure 16. V_{OUT} Rise and Fall Time vs. Temperature at R_L=10Ω

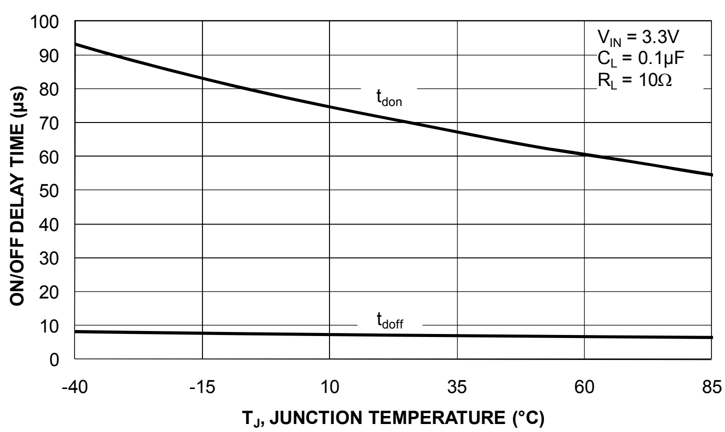


Figure 17. V_{OUT} Turn-On and Turn-Off Delay vs. Temperature at R_L=10Ω

Typical Performance Characteristics

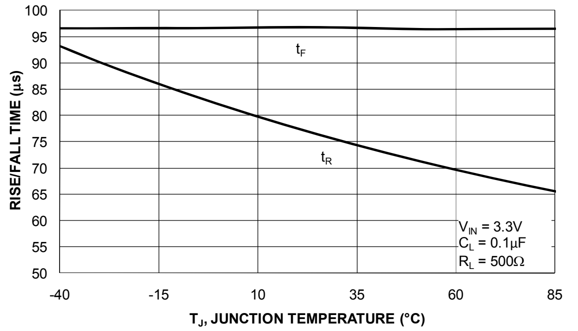


Figure 18. V_{OUT} Rise and Fall Time vs. Temperature at R_L=500Ω

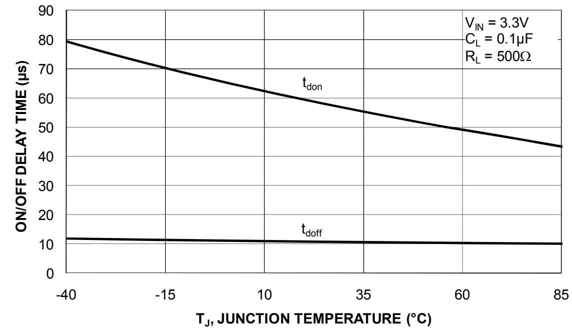


Figure 19. V_{OUT} Turn-On and Turn-Off Delay vs. Temperature at R_L=500Ω

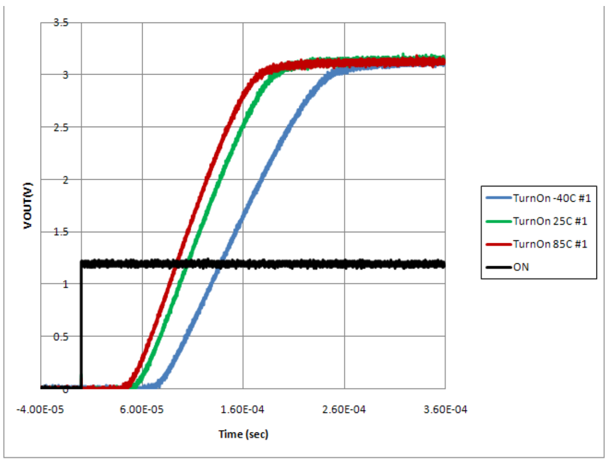


Figure 20. Turn-On Response (V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=10Ω)

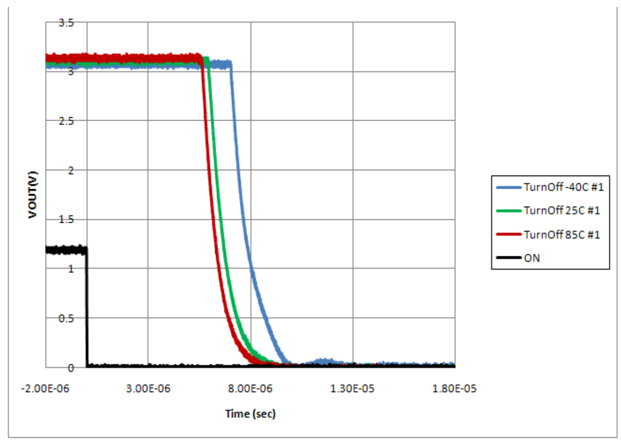


Figure 21. Turn-Off Response (V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=10Ω)

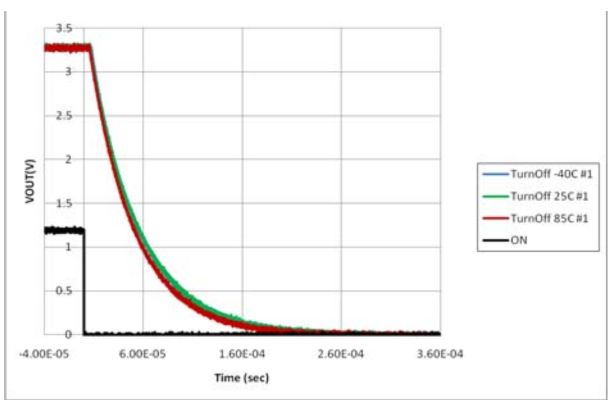


Figure 22. Turn-Off Response (FPF1207 = No Output Pull-Down Resistor) (V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=500Ω)

Typical Performance Characteristics

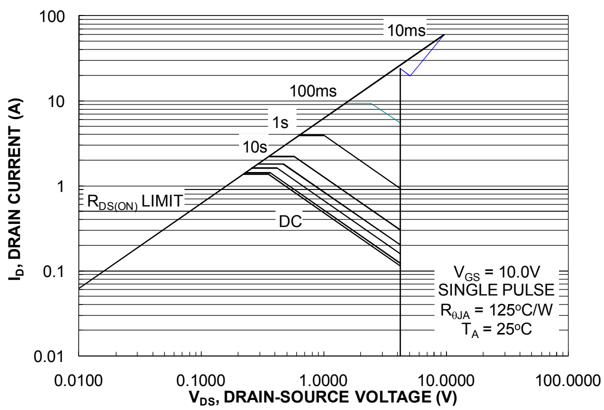


Figure 23. I_{SW} vs. V_{DS} -- SOA of FPF1207

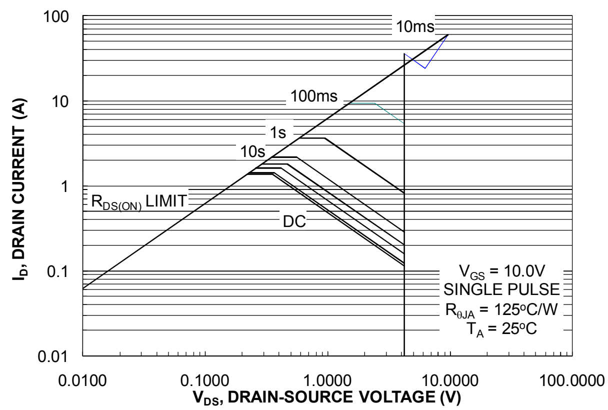


Figure 24. I_{SW} vs. V_{DS} -- SOA of FPF1208

Timing Diagram

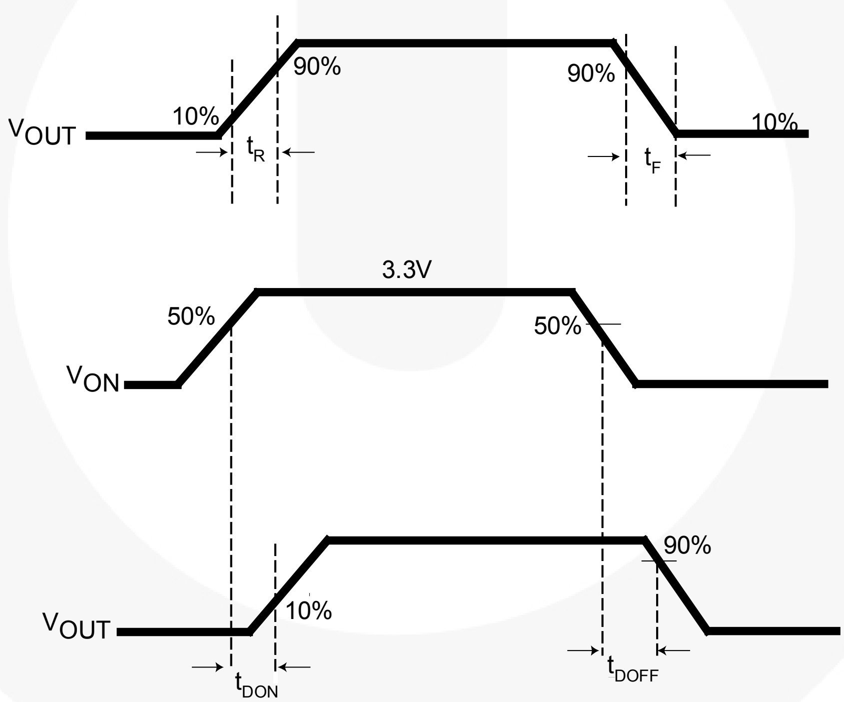


Figure 25. Timing Diagram

Notes:

8. $t_{ON}=t_R + t_{DON}$.
9. $t_{OFF}=t_F + t_{DOFF}$.

Operation and Application Description

The FPF1207 and FPF1208 are low-R_{ON} P-channel load switches with controlled turn-on. The core of each device is a 50mΩ P-channel MOSFET and controller capable of functioning over a wide input operating range of 1.2-4.0V. The ON pin, an active HIGH GIOP/CMOS-compatible input, controls the state of the switch.

The FPF1208 contains a 65Ω on-chip load resistor for quick output discharge when the switch is turned off.

Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush current when the switch turns on into a discharged load capacitor or short-circuit, a capacitor must be placed between the V_{IN} and GND pins. A 1μF ceramic capacitor, C_{IN}, placed close to the pins is usually sufficient. Higher-value C_{IN} can be used to reduce the voltage drop in higher-current applications.

Output Capacitor

A 0.1μF capacitor, C_{OUT}, should be placed between the V_{OUT} and GND pins. This capacitor prevents parasitic board inductance from forcing V_{OUT} below GND when the switch is on. C_{IN} greater than C_{OUT} is highly recommended. C_{OUT} greater than C_{IN} can cause V_{OUT} to exceed V_{IN} when the system supply is removed. This could result in current flow through the body diode from V_{OUT} to V_{IN}.

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 effect that parasitic trace inductance 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) helps minimize the parasitic electrical effects along with minimizing the case ambient thermal impedance. However, the V_{OUT} pin of FPF1208 should not connect directly the battery source due to the discharge mechanism of the load switch.

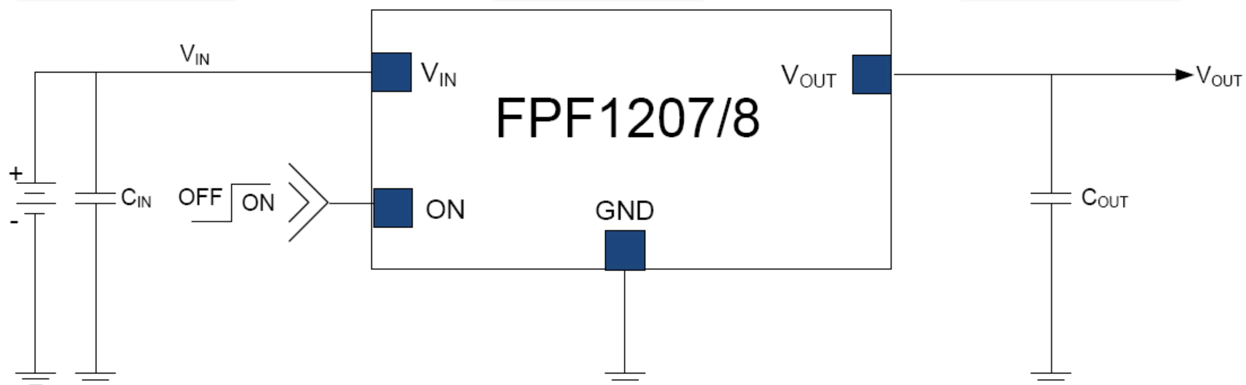
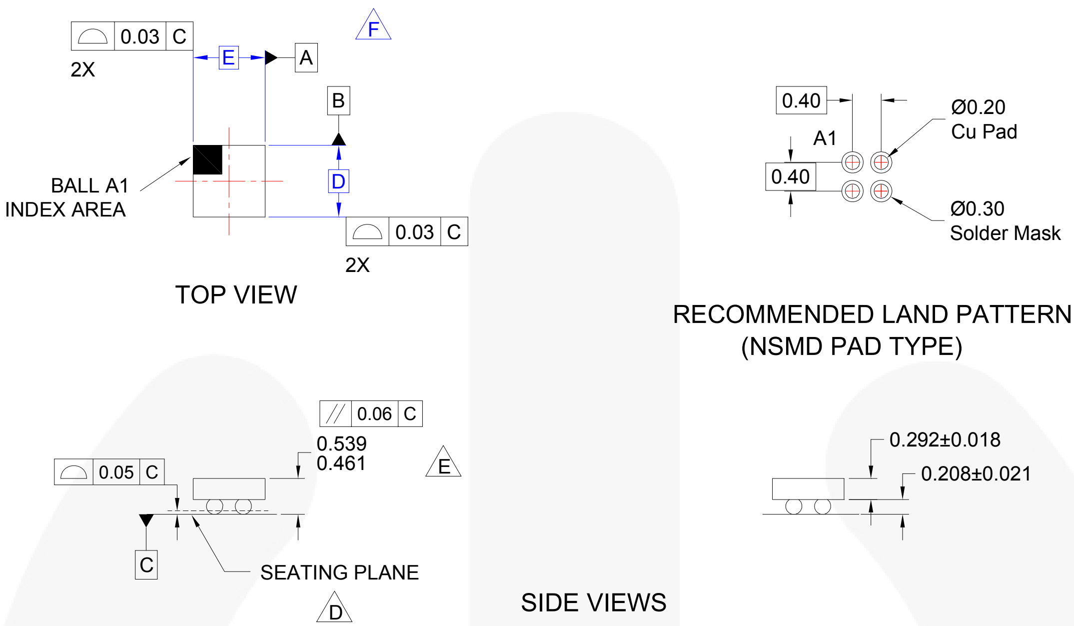
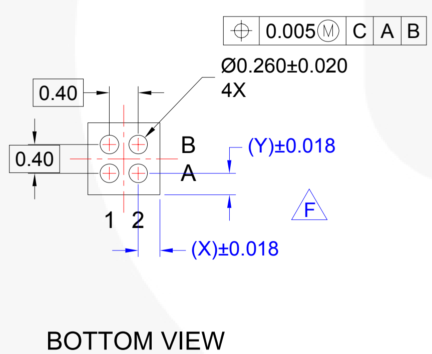


Figure 26. Typical Application

Physical Dimensions





NOTES:

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCE PER ASME Y14.5M, 1994.

D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.

E. PACKAGE NOMINAL HEIGHT IS 500 MICRONS ±39 MICRONS (461-539 MICRONS).

F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.

G. DRAWING FILNAME: MKT-UC004AFrev1.

Figure 27. 4 Ball, 0.76 x 0.76 mm Wafer Level Chip Scale WLCSP Packaging

Product-Specific Dimensions

Product	D	E	X	Y
FPF1207UCX	760µm ± 30µm	760µm ± 30µm	0.180mm± 0.018µm	0.180mm± 0.018µm
FPF1208UCX	760µm ± 30µm	760um ± 30µm	0.180mm± 0.018µm	0.180mm± 0.018µm

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SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET®
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
SYSTEM GENERAL®*
The Power Franchise®
the power franchise
TinyBoost™
TinyBuck™
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
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UniFET™
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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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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.

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