FAIRCHILD SEMICONDUCTOR®

November 2009



# FPF1107 / FPF1108
# Advance Load Management Switch

## Features

- 1.2V to 4V Input Voltage Operating Range
- Typical $R_{DS(ON)}$:
  - 35mΩ at $V_{IN}$=3.3V
  - 55mΩ at $V_{IN}$=1.8V
  - 85mΩ at $V_{IN}$=1.2V
- Slew Rate Control with $t_R$: 130µs
- Output Discharge Function on FPF1108
- Low <1µA Quiescent Current at $V_{ON}$=$V_{IN}$
- ESD Protected: Above 4000V HBM, 2000V CDM
- GPIO/CMOS-Compatible Enable Circuitry

## Applications

- Mobile Devices and Smart Phones
- Portable Media Devices
- Digital Cameras
- Advanced Notebook, UMPC, MID
- Portable Medical Devices
- GPS and Navigation Equipment



## Description

The FPF1107/08 are low $R_{DS}$ P-channel MOSFET load switches of the IntelliMAX™ family. Integrated slew-rate control prevents inrush current from glitch supply rails with capacitive loads common in power applications.

The input voltage range operates from 1.2V to 4V to fulfill today's lowest ultra-portable device supply requirements. Switch control is by a logic input (ON-pin) capable of interfacing directly with low-voltage CMOS control signals and GPIOs in embedded processors.

## Ordering Information

| Part Number | Part Marking | Switch (Typical) At 1.8$V_{IN}$ | Input Buffer | Output Discharge | ON Pin Activity | $t_R$ | Eco Status | Package |
|---|---|---|---|---|---|---|---|---|
| FPF1107 | QC | 55mΩ | CMOS | NA | Active HIGH | 130µs | Green | 4-Ball, Wafer-Level Chip-Scale Package (WLCSP), 1.0 x 1.0mm, 0.5mm Pitch |
| FPF1108 | QD | 55mΩ | CMOS | 65Ω | Active HIGH | 130µs | Green | |

*For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.*

## Application Diagram

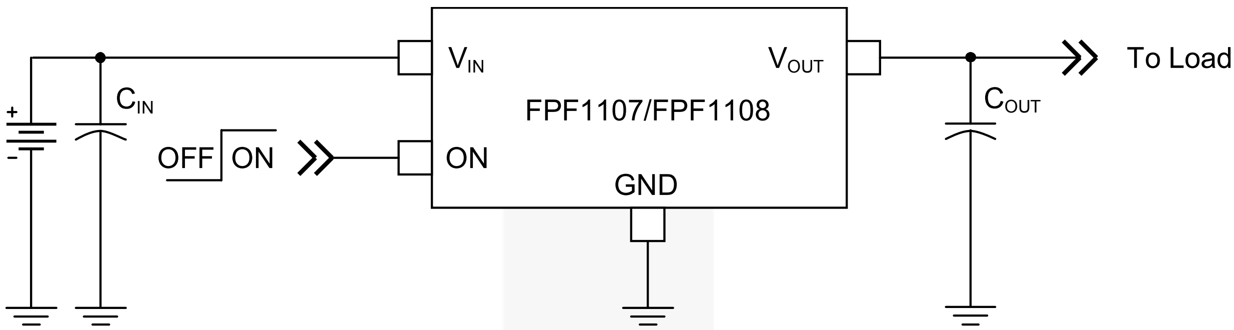



**Figure 1. Typical Application**

**Notes:**
1. $C_{IN}$=1μF, X5R, 0603, for example Murata GRM185R60J105KE26
2. $C_{OUT}$=1μF, X5R, 0805, for example Murata GRM216R61A105KA01

## Block Diagram

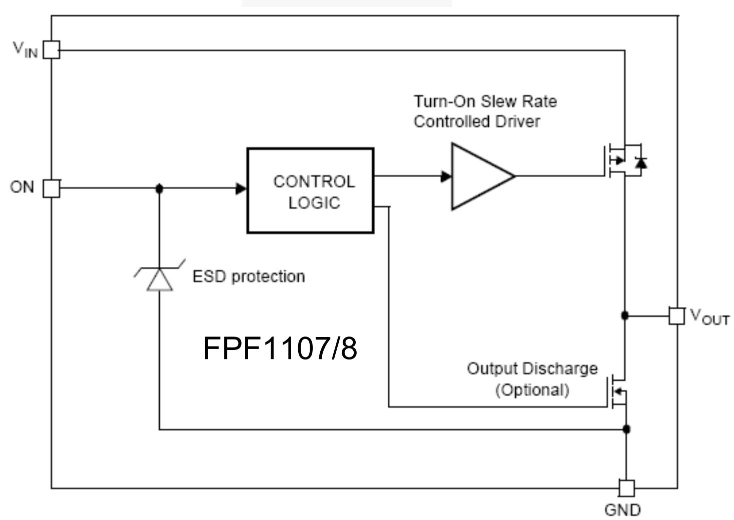





**Figure 2. Block Diagram (Output Discharge for FPF1108 Only)**

## Pin Configurations


**Figure 3. 1 x 1mm WLCSP Bumps Facing Down**

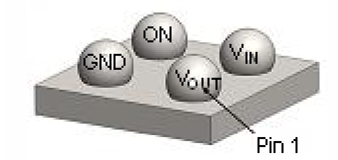



**Figure 4. 1 x 1mm WLCSP Bumps Facing Up**

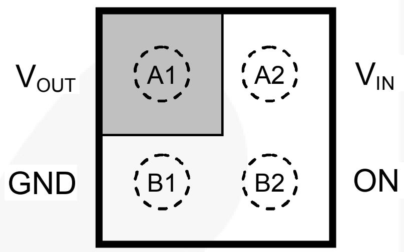



**Figure 5. Pin Assignments (Top View)**

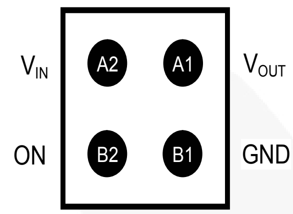



**Figure 6. Pin Assignments (Bottom View)**

## 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.

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{IN}$ | $V_{IN}$, $V_{OUT}$, $V_{ON}$ to GND | | -0.3 | 4.2 | V |
| $I_{SW}$ | Maximum Continuous Switch Current | | | 1.2 | A |
| $P_D$ | Power Dissipation at $T_A$=25°C | | | 1.0 | W |
| $T_{STG}$ | Storage Junction Temperature | | -65 | +150 | °C |
| $T_A$ | Operating Temperature Range | | -40 | +85 | °C |
| $\Theta_{JA}$ | Thermal Resistance, Junction-to-Ambient | 1S2P with 1 Thermal Via | | 95 | °C/W |
| | | 1S2P without Thermal Via | | 187 | |
| ESD | Electrostatic Discharge Capability | Human Body Model, JESD22-A114 | 4 | | kV |
| | | Charged Device Model, JESD22-C101 | 2 | | |

## 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

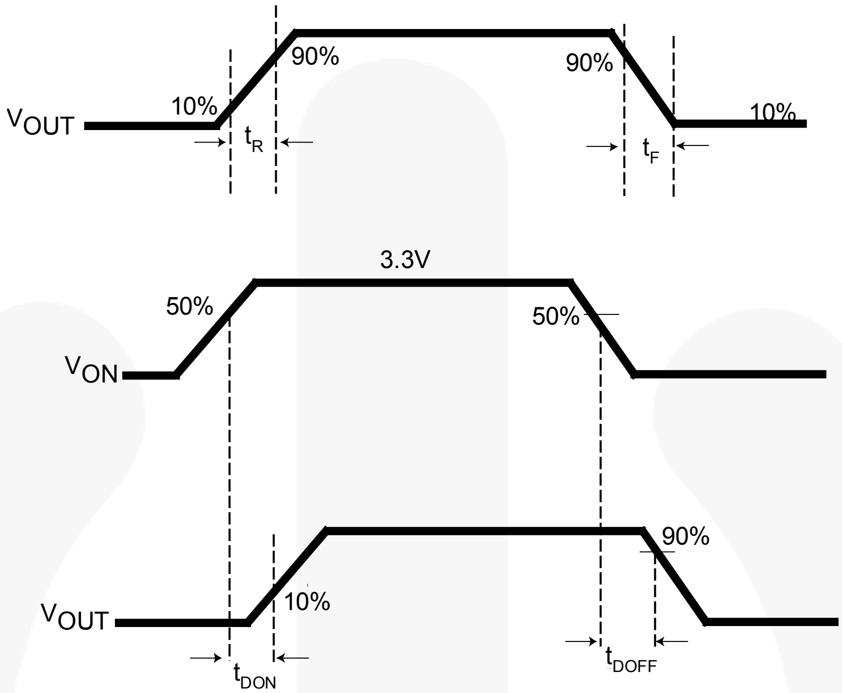
Unless otherwise noted, $V_{IN}$=1.2 to 4.0V, $T_A$=-40 to +85°C, typical values are at $V_{IN}$=3.3V and $T_A$=25°C.

| 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 | | | 1 | µA |
| $I_{SD(OFF)}$ | Off Switch Current | $V_{ON}$=GND $V_{OUT}$=GND | | | 1 | µA |
| $I_Q$ | Quiescent Current | $I_{OUT}$=0mA, $V_{ON}$=$V_{IN}$ | | | 1 | µA |
| | | $I_{OUT}$=0mA, $V_{ON}$ < $V_{IN}$ | | | 3 | |
| $R_{ON}$ | On Resistance | $V_{IN}$=3.3V, $I_{OUT}$=200mA, $T_A$=25°C | | 35 | 50 | mΩ |
| | | $V_{IN}$=1.8V, $I_{OUT}$=200mA, $T_A$=25°C | | 55 | 70 | |
| | | $V_{IN}$=1.5V, $I_{OUT}$=200mA, $T_A$=25°C | | 70 | | |
| | | $V_{IN}$=1.2V, $I_{OUT}$=200mA, $T_A$=25°C | | 85 | 150 | |
| | | $V_{IN}$=1.8V, $I_{OUT}$=200mA, $T_A$=85°C(3) | | 65 | 100 | |
| $R_{PD}$ | Output Discharge $R_{PULL\ DOWN}$ | $V_{IN}$=3.3V, $V_{ON}$=0V, $I_{FORCE}$=20mA, $T_A$=25°C, FPF1108 | | 65 | 110 | Ω |
| $V_{IH}$ | On Input Logic High Voltage | $V_{IN}$=1.2V to 4.0V | 1.1 | | | V |
| $V_{IL}$ | On Input Logic Low Voltage | $V_{IN}$=1.2V to 4.0V | | | 0.35 | V |
| $I_{ON}$ | On Input Leakage | $V_{ON}$=$V_{IN}$ or GND | -1 | | 1 | µA |
| **Dynamic Characteristics** | | | | | | |
| $t_{DON}$ | Turn-On Delay(4) | $V_{IN}$=3.3V, $R_L$=10Ω, $C_L$=0.1µF, $T_A$=25°C, FPF1107/8 | | 80 | | µs |
| $t_R$ | $V_{OUT}$ Rise Time(4) | | | 130 | | µs |
| $t_{ON}$ | Turn-On Time(4,6) | | | 210 | | µs |
| $t_{DON}$ | Turn-On Delay(4) | $V_{IN}$=3.3V, $R_L$=500Ω, $C_L$=0.1µF, $T_A$=25°C, FPF1107/8 | | 70 | 95 | µs |
| $t_R$ | $V_{OUT}$ Rise Time(4) | | | 95 | 120 | µs |
| $t_{ON}$ | Turn-On Time(4,6) | | | 165 | 215 | µs |
| **FPF1107** | | | | | | |
| $t_{DOFF}$ | Turn-Off Delay(4) | $V_{IN}$=3.3V, $R_L$=10Ω, $C_L$=0.1µF, $T_A$=25°C | | 2.0 | 2.5 | µs |
| $t_F$ | $V_{OUT}$ Fall Time(4) | | | 2.2 | | µs |
| $t_{OFF}$ | Turn-Off(4,7) | | | 4.2 | | µs |
| $t_{DOFF}$ | Turn-Off Delay(4) | $V_{IN}$=3.3V, $R_L$=500Ω, $C_L$=0.1µF, $T_A$=25°C | | 7.0 | | µs |
| $t_F$ | $V_{OUT}$ Fall Time(4) | | | 110 | | µs |
| $t_{OFF}$ | Turn-Off(4,7) | | | 117 | | µs |
| **FPF1108(5)** | | | | | | |
| $t_{DOFF}$ | Turn-Off Delay(4) | $V_{IN}$=3.3V, $R_L$=10Ω, $C_L$=0.1µF, $R_{PD}$=65Ω, $T_A$=25°C | | 2.0 | 2.5 | µs |
| $t_F$ | $V_{OUT}$ Fall Time(4) | | | 1.9 | | µs |
| $t_{OFF}$ | Turn-Off(4,7) | | | 3.9 | | µs |
| $t_{DOFF}$ | Turn-Off Delay(4) | $V_{IN}$=3.3V, $R_L$=500Ω, $C_L$=0.1µF, $R_{PD}$=65Ω, $T_A$=25°C | | 2.5 | | µs |
| $t_F$ | $V_{OUT}$ Fall Time(4) | | | 10.6 | | µs |
| $t_{OFF}$ | Turn-Off(4,7) | | | 13.1 | | µs |



**Notes:**
3. This parameter is guaranteed by design and characterization; not production tested.
4. $t_{DON}$/$t_{DOFF}$/$t_R$/$t_F$ are defined in Figure 7.
5. Output discharge path is enabled during off.

## Timing Diagram




**Notes:**

6. $t_{ON}=t_R + t_{DON}$.
7. $t_{OFF}=t_F + t_{DOFF}$.

**Figure 7. Timing Diagram**

# Typical Performance Characteristics

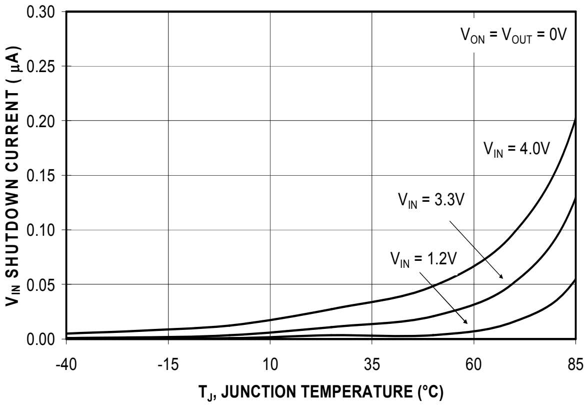



Figure 8. Shutdown Current vs. Temperature

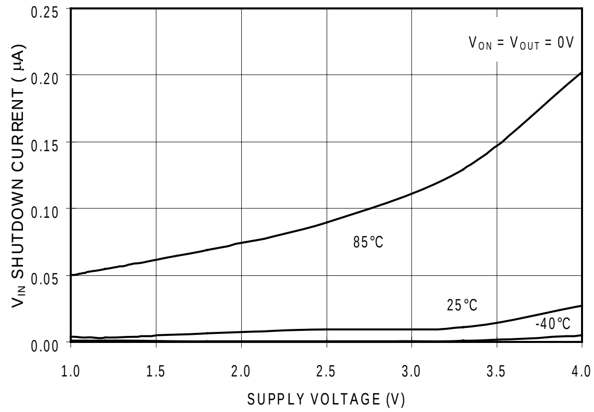



Figure 9. Shutdown Current vs. Supply Voltage

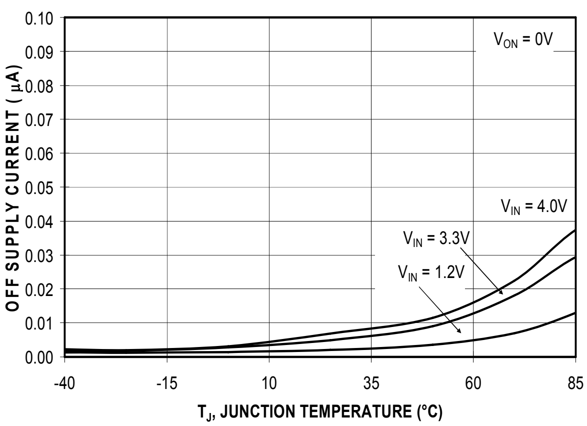





Figure 10. Off Supply Current vs. Temperature (FPF1107, VOUT is Floating)

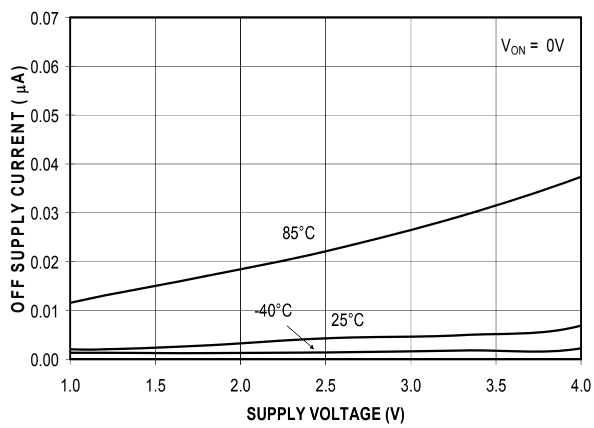



Figure 11. Off Supply Current vs. Supply Voltage (FPF1107, VOUT is Floating)

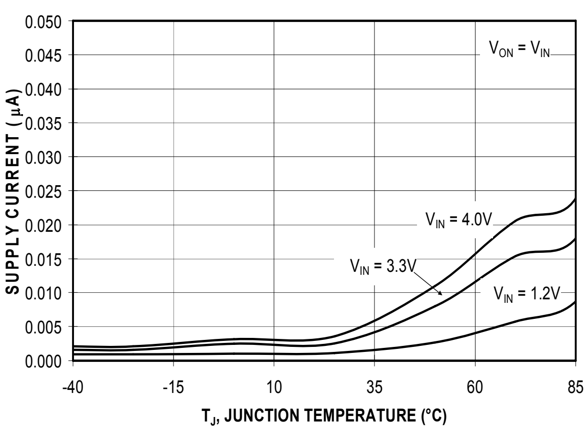



Figure 12. Quiescent Current vs. Temperature ($V_{ON}$=$V_{IN}$)

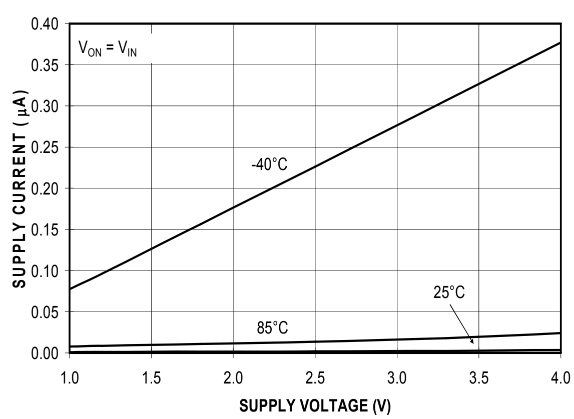



Figure 13. Quiescent Current vs. Supply Voltage

## Typical Performance Characteristics

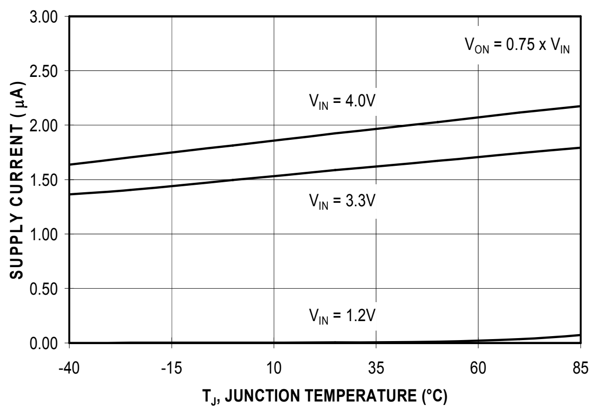



**Figure 14. Quiescent Current vs. Temperature ($V_{ON}$=0.75 x $V_{IN}$)**

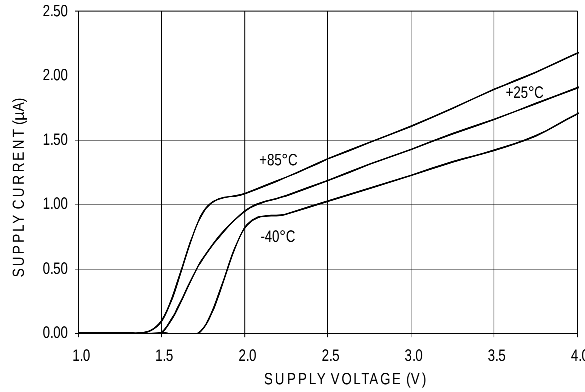



**Figure 15. Quiescent Current vs. Supply Voltage at $V_{ON}$=1.2V**

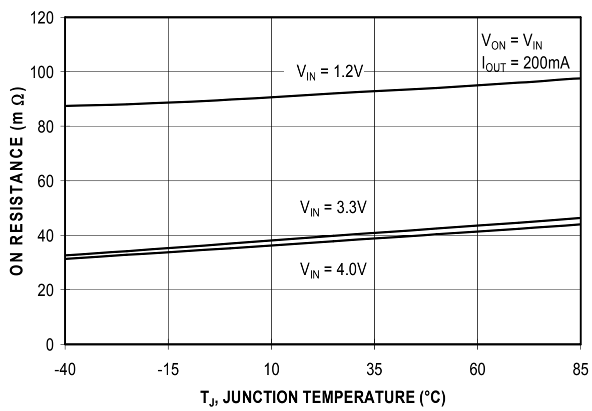



**Figure 16. $R_{ON}$ vs. Temperature**

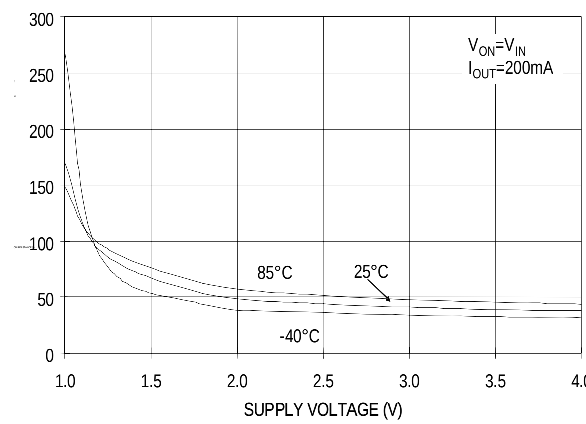



**Figure 17. $R_{ON}$ vs. Supply Voltage**



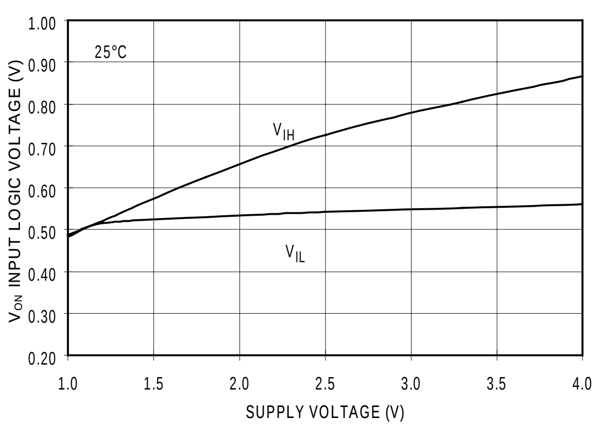



**Figure 18. ON-Pin Threshold vs. $V_{IN}$**

## Typical Performance Characteristics

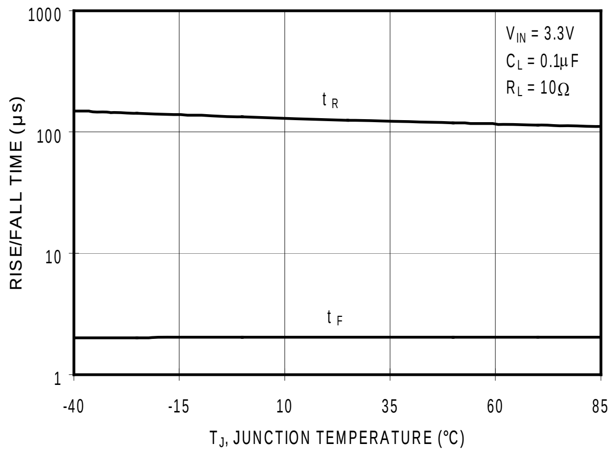



**Figure 19. $V_{OUT}$ Rise and Fall Time vs. Temperature at $R_L$=10Ω**

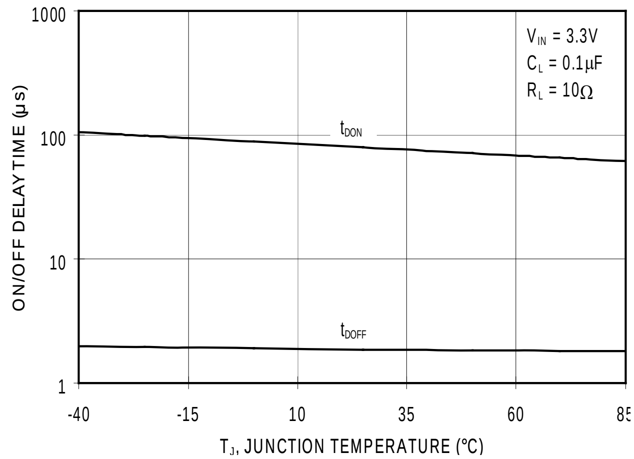



**Figure 20. $V_{OUT}$ Turn-On and Turn-Off Delay vs. Temperature at $R_L$=10Ω**

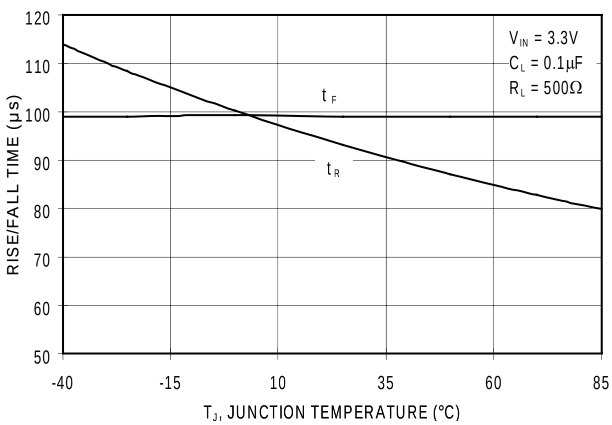



**Figure 21. $V_{OUT}$ Rise and Fall Time vs. Temperature at $R_L$=500Ω**



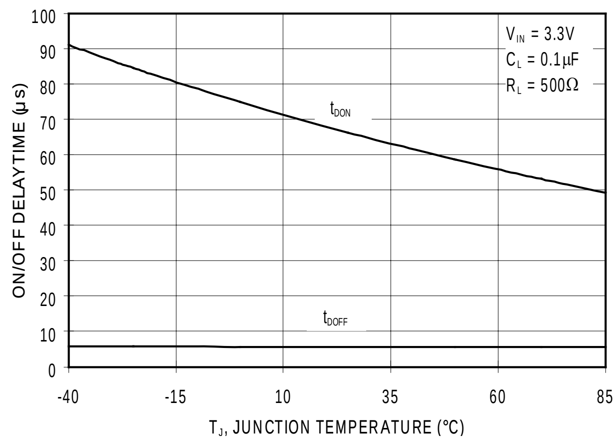



**Figure 22. $V_{OUT}$ Turn-On and Turn-Off Delay vs. Temperature at $R_L$=500Ω**

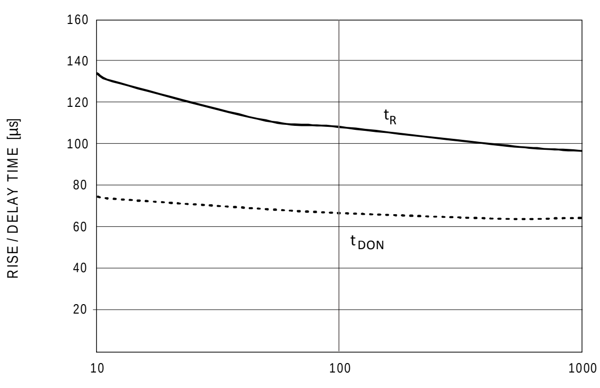



**Figure 23. $V_{OUT}$ Turn-On and Turn-Off Delay vs. Output Load at $V_{IN}$=3.3V**

## Typical Performance Characteristics

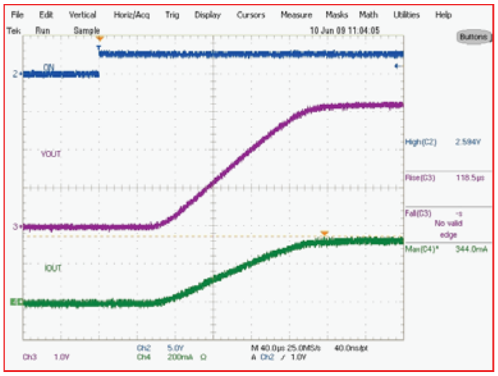



**Figure 24. Turn-On Response ($V_{IN}$=3.3V, $C_{IN}$=1µF, $C_{OUT}$=0.1µF, $R_L$=10Ω)**

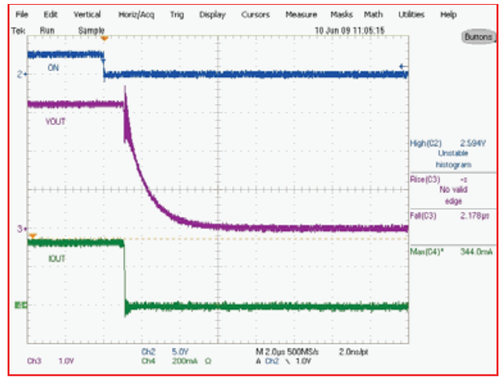



**Figure 25. Turn-Off Response ($V_{IN}$=3.3V, $C_{IN}$=1µF, $C_{OUT}$=0.1µF, $R_L$=10Ω)**

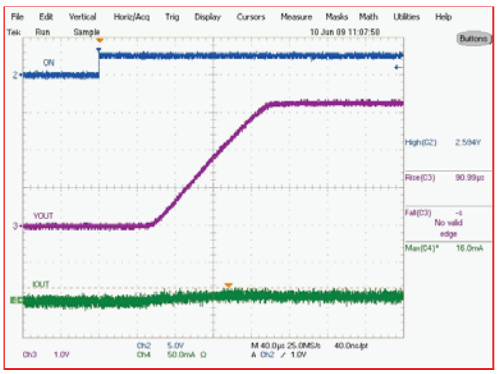



**Figure 26. Turn-On Response ($V_{IN}$=3.3V, $C_{IN}$=1µF, $C_{OUT}$=0.1µF, $R_L$=500Ω)**

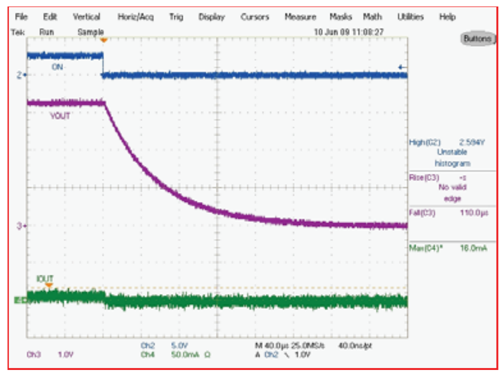



**Figure 27. Turn-Off Response (FPF1107 – No Output Pull-Down Resistor) ($V_{IN}$=3.3V, $C_{IN}$=1µF, $C_{OUT}$=0.1µF, $R_L$=500Ω)**

## Application Information

### Input Capacitor

The IntelliMAX™ switch doesn't require input capacitor. To reduce device inrush current effect, a 0.1µF ceramic capacitor, $C_{IN}$, is recommended close to the VIN pin. A higher value of $C_{IN}$ can be used to further reduce the voltage drop experienced as the switch is turned on into a large capacitive load.

### Output Capacitor

The IntelliMAX™ switch works without an output capacitor. However, if parasitic board inductance forces $V_{OUT}$ below GND when switching off, a 0.1µF capacitor, $C_{OUT}$, should be placed between $V_{OUT}$ and GND.

### Fall Time

Device output fall time can be calculated based on RC constant of external components as follows:

$$t_F = R_L \times C_L \times 2.2 \quad (1)$$

where $t_F$ is 90% to 10% fall time, $R_L$ is output load and $C_L$ is output capacitor.

The same equation works for a device with a pull-down output resistor, then $R_L$ is replaced by a parallel connected pull-down and external output resistor combination, as follows:

$$t_F = \frac{R_L \times R_{PD}}{R_L + R_{PD}} \times C_L \times 2.2 \quad (2)$$

where $t_F$ is 90% to 10% fall time, $R_L$ is output load, $R_{PD}$=65Ω is output pull-down resistor, and $C_L$ is the output capacitor.

### Resistive Output Load

If resistive output load is missing, the IntelliMAX™ switch without pull-down output resistor is not discharging output voltage. Output voltage drop depends, in that case, mainly on external device leaks.

## Recommended Land Pattern and Layout

For best thermal performance and minimal inductance and parasitic effects, it is recommended to keep input and output traces short and capacitors as close to the device as possible. Below is a recommended layout for this device to achieve optimum performance.

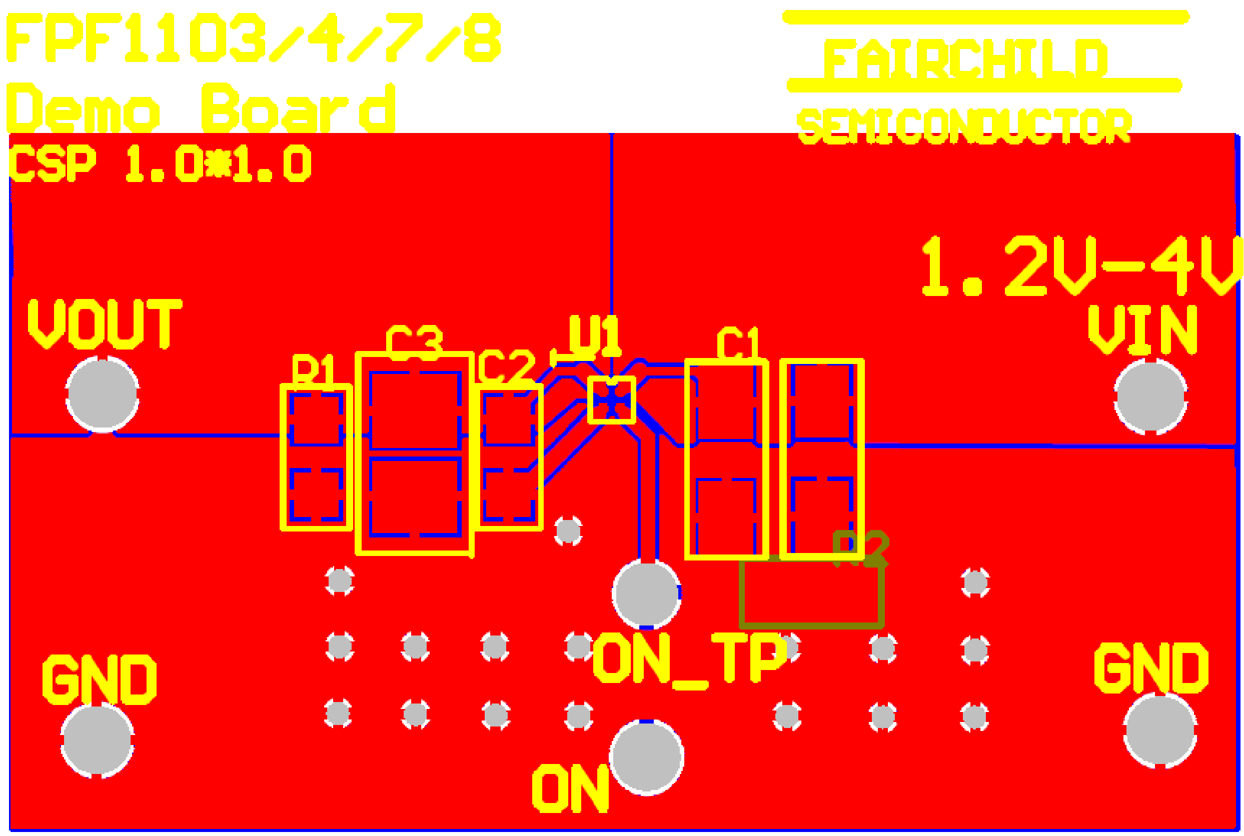
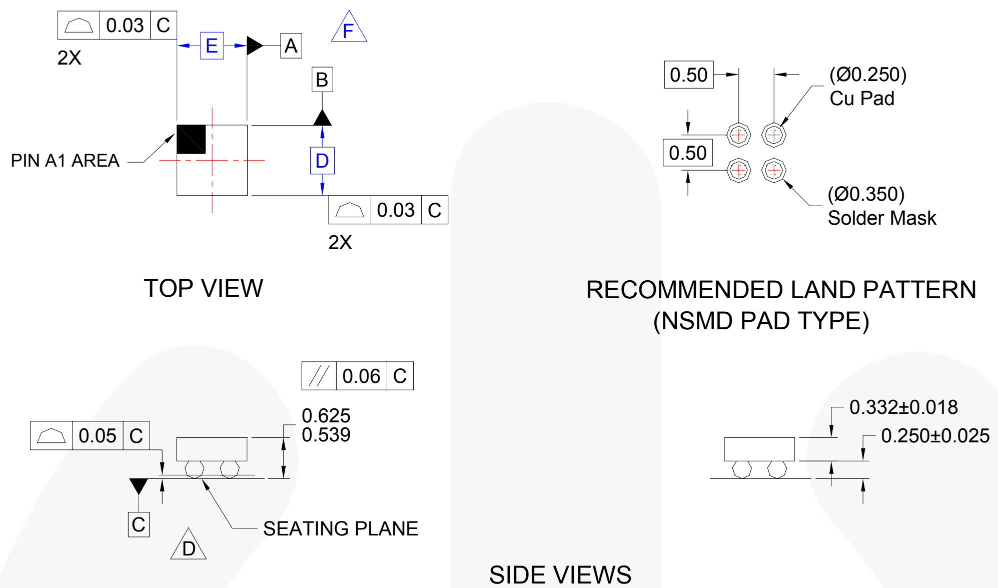
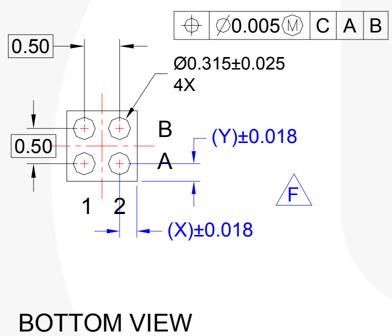



**Figure 28. Recommended Land Pattern and Layout**

## Physical Dimensions






NOTES:

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

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

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

E. PACKAGE NOMINAL HEIGHT IS 582 MICRONS ±43 MICRONS (539-625 MICRONS).

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

G. DRAWING FILENAME: MKT-UC004ABrev2.

**Figure 29. 4 Ball, 1.0 x 1.0mm Wafer Level Chip Scale WLCSP Packaging**

## Product-Specific Dimensions

| Product | D | E | X | Y |
|---|---|---|---|---|
| FPF1107 | 960µm ± 30µm | 960µm ± 30µm | 0.230mm | 0.230mm |
| FPF1108 | 960um ± 30µm | 960um ± 30µm | 0.230mm | 0.230mm |

*Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.*

*Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:* *http://www.fairchildsemi.com/packaging/*.

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EZSWITCH™*
™*
DEUXPEED™
®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FETBench™
FlashWriter®*
FPS™
F-PFS™
FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
G*max*™
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™
SignalWise™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS™
SyncFET™
Sync-Lock™
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the power franchise
TinyBoost™
TinyBuck™
TinyCalc™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TriFault Detect™
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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status | Definition |
|---|---|---|
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| 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. |
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