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November 2009

FPF1103 / FPF1104
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: 65µs
- Output Discharge Function on FPF1104
- 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 FPF1103/04 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 $1.8V_{IN}$	Input Buffer	Output Discharge	ON Pin Activity	t_R	Eco Status	Package
FPF1103	Q9	55mΩ	CMOS	NA	Active HIGH	65µs	Green	4-Ball, Wafer-Level Chip-Scale Package (WLCSP), 1.0 x 1.0mm, 0.5mm Pitch
FPF1104	QA	55mΩ	CMOS	65Ω	Active HIGH	65µs	Green	

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

Application Diagram

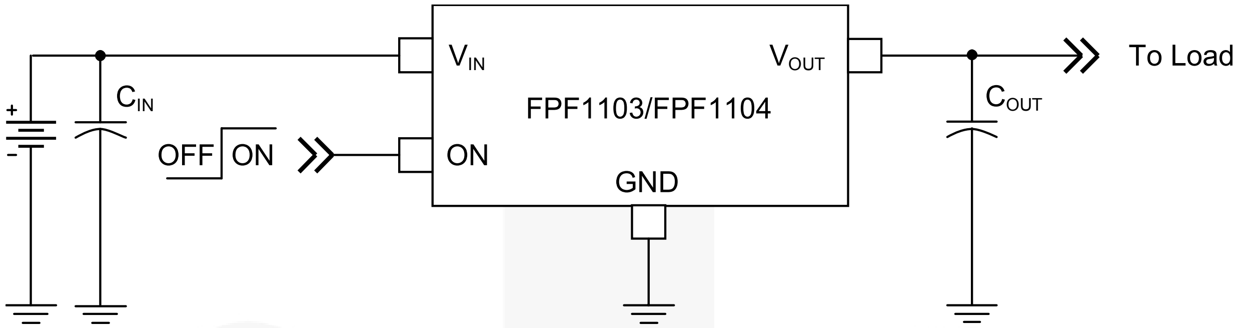


Figure 1. Typical Application

Notes:

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

Block Diagram

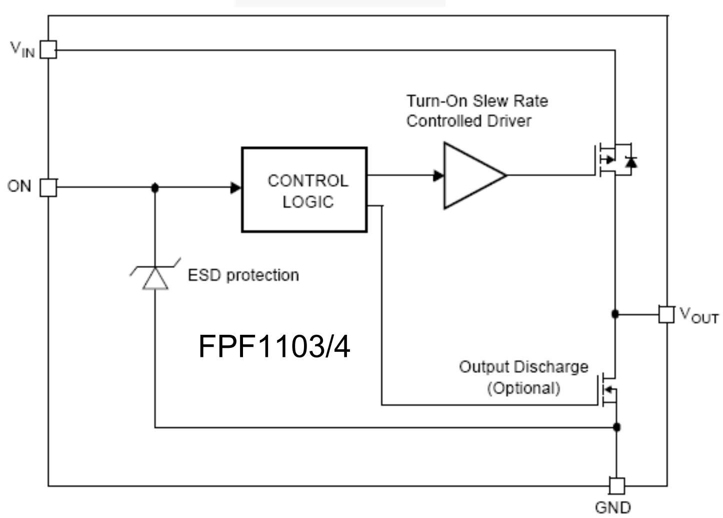


Figure 2. Block Diagram (Output Discharge for FPF1104 Only)

Pin Configurations

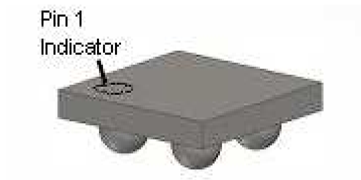


Figure 3. 1 x 1mm WLCSP Bumps Facing Down

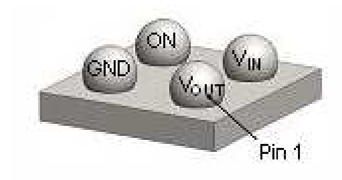


Figure 4. 1 x 1mm WLCSP Bumps Facing Up

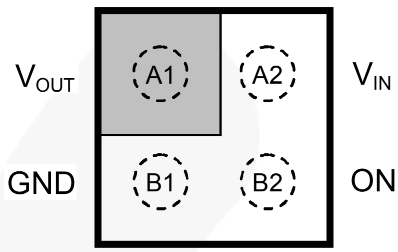


Figure 5. Pin Assignments (Top View)

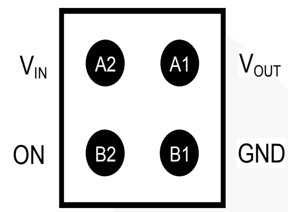


Figure 6. Pin Assignments (Bottom View)

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
Θ_{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

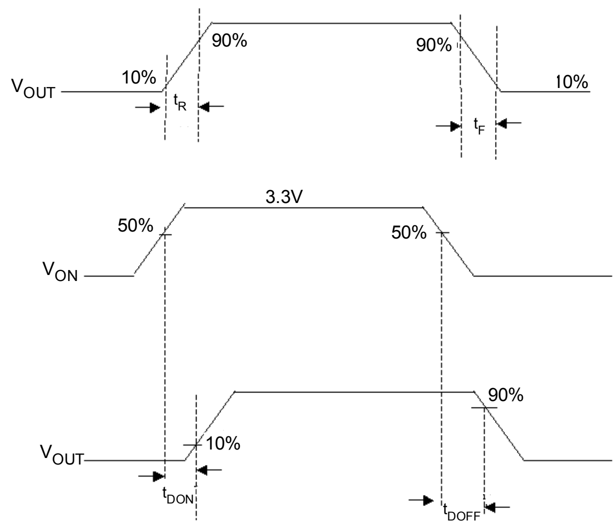
Unless otherwise noted, V_{IN}=1.2 to 4.0V, T_A=-40 to +85°C; typical values are at V_{IN}=3.3V and T_A=25°C.

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, FPF1104		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		35		µs
t_R	V_{OUT} Rise Time[4]			65		µs
t_{ON}	Turn-On Time[4,6]			100		µs
t_{DON}	Turn-On Delay[4]	V_{IN}=3.3V, R_L=500Ω, C_L=0.1µF, T_A=25°C		30	50	µs
t_R	V_{OUT} Rise Time[4]			40	55	µs
t_{ON}	Turn-On Time[4,6]			70	105	µs
FPF1103						
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
FPF1104[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

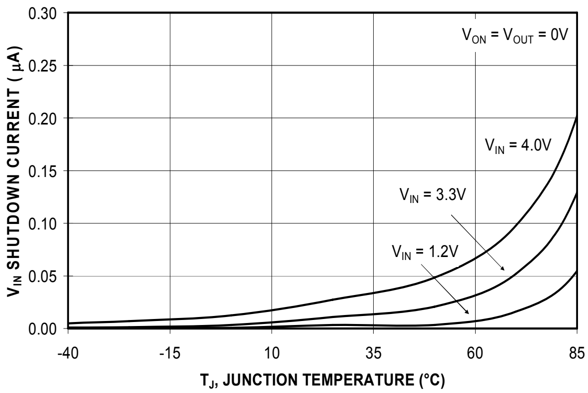


Figure 8. Shutdown Current vs. Temperature

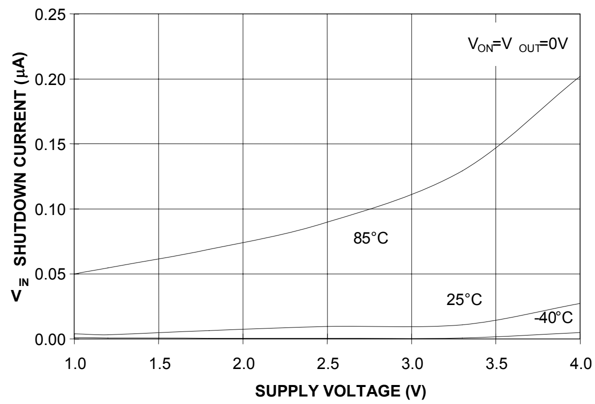


Figure 9. Shutdown Current vs. Supply Voltage

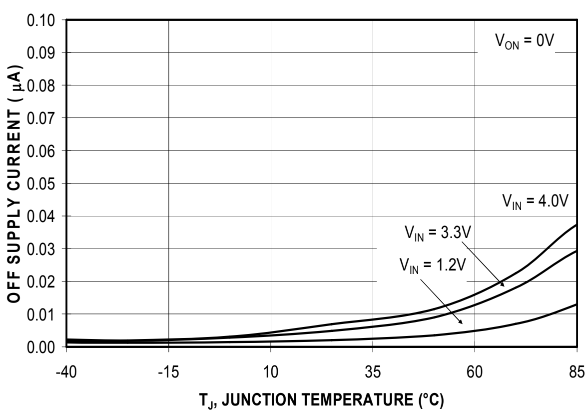


Figure 10. Off Supply Current vs. Temperature (FPF1103, V_{OUT} is floating)

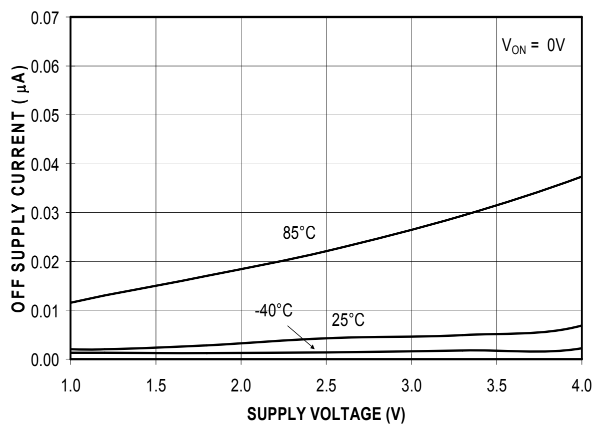


Figure 11. Off Supply Current vs. Supply Voltage (FPF1103, V_{OUT} is Floating)

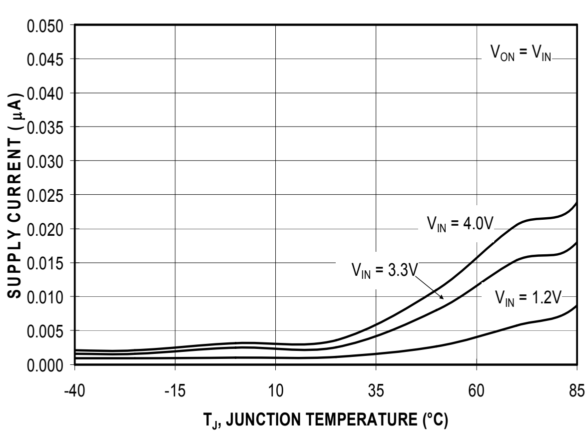


Figure 12. Quiescent Current vs. Temperature ($V_{ON}=V_{IN}$)

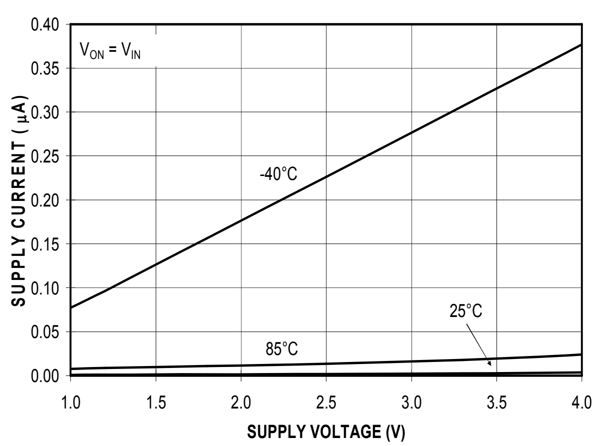


Figure 13. Quiescent Current vs. Supply Voltage

Typical Performance Characteristics

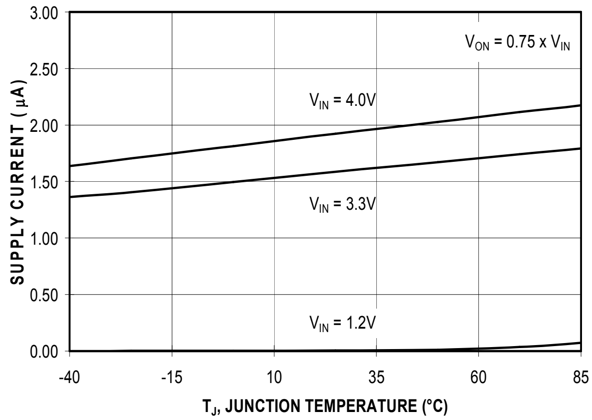


Figure 14. Quiescent Current vs. Temperature (V_{ON}=0.75 x V_{IN})

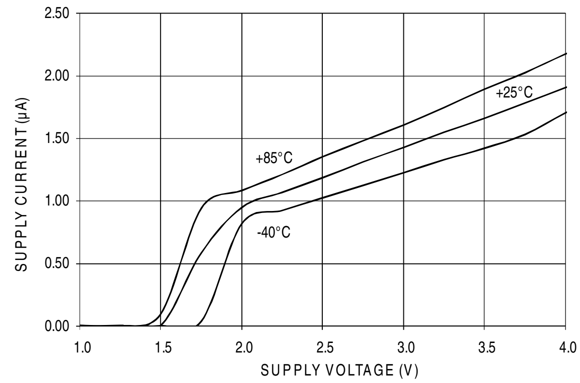


Figure 15. Quiescent Current vs. Supply Voltage at V_{ON}=1.2V

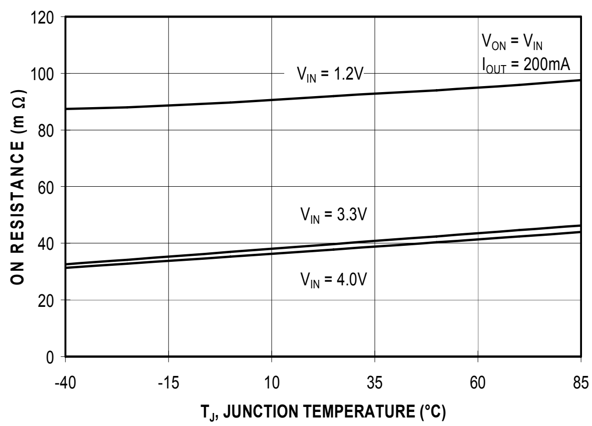


Figure 16. R_{ON} vs. Temperature

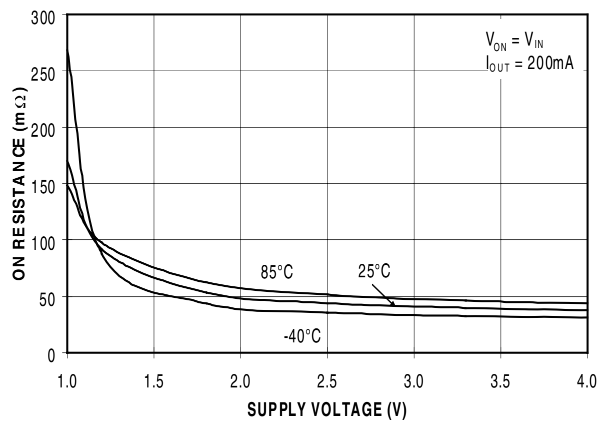


Figure 17. R_{ON} vs. Supply Voltage

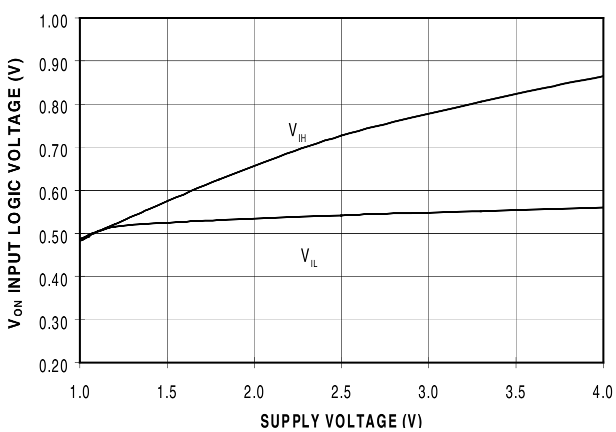


Figure 18. ON-Pin Threshold vs. V_{IN}

Typical Performance Characteristics

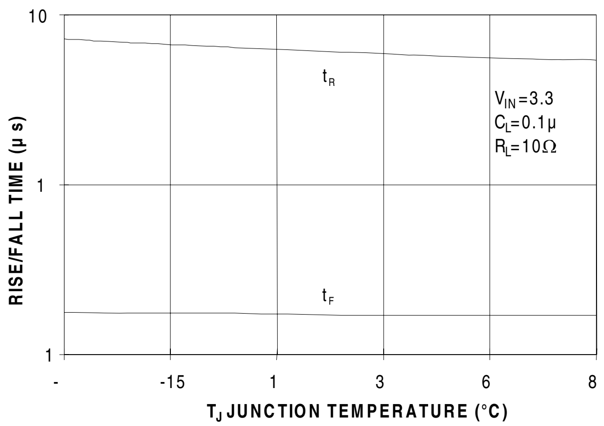


Figure 19. V_{OUT} Rise and Fall Time vs. Temperature at R_L=10Ω

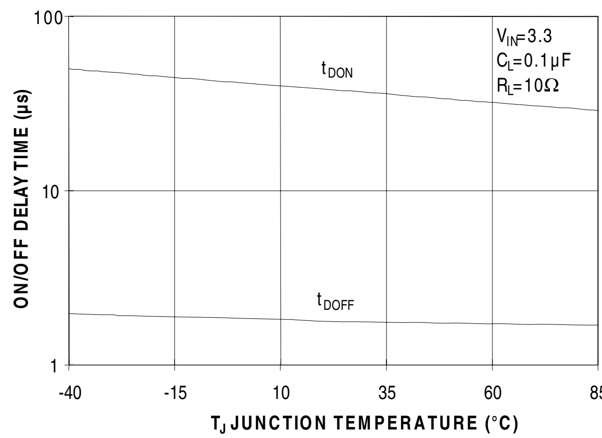


Figure 20. V_{OUT} Turn-On and Turn-Off Delay vs. Temperature at R_L=10Ω

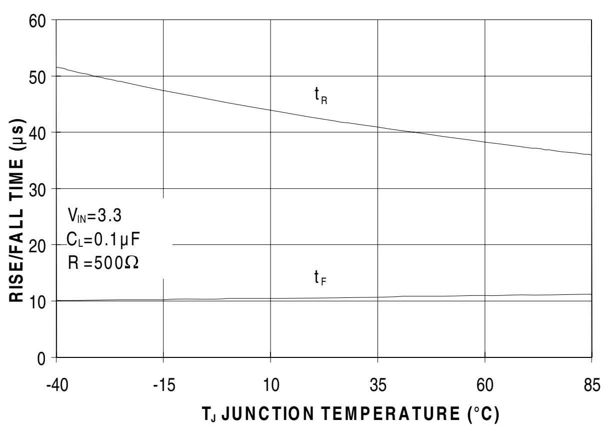


Figure 21. V_{OUT} Rise and Fall Time vs. Temperature at R_L=500Ω

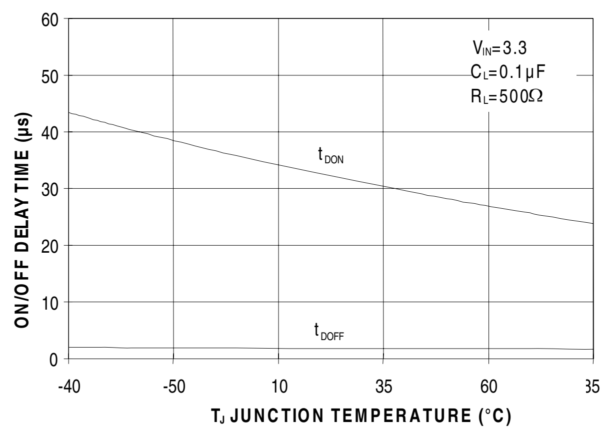


Figure 22. V_{OUT} Turn-On and Turn-Off Delay vs. Temperature at R_L=500Ω

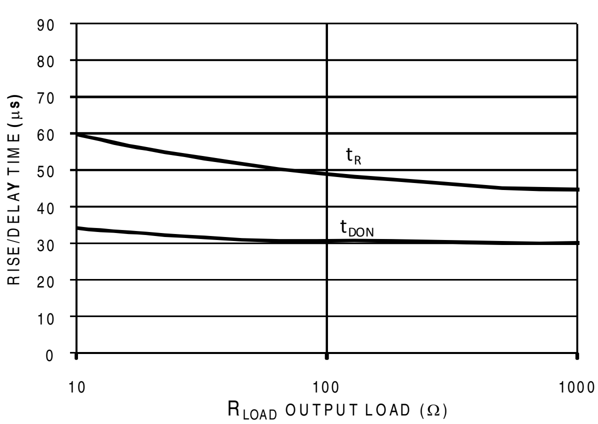


Figure 23. t_R/t_{DON} vs. Output Load at V_{IN}=3.3V

Typical Performance Characteristics

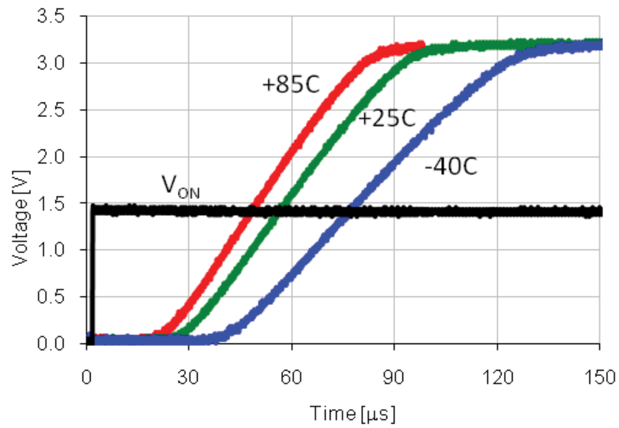


Figure 24. Turn-On Response
(V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=10Ω)

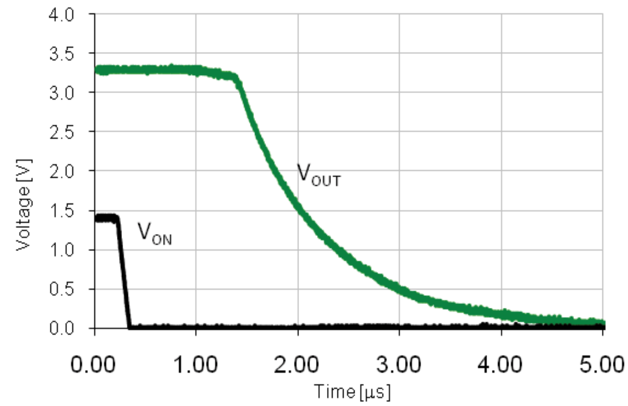


Figure 25. Turn-Off Response
(V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=10Ω)

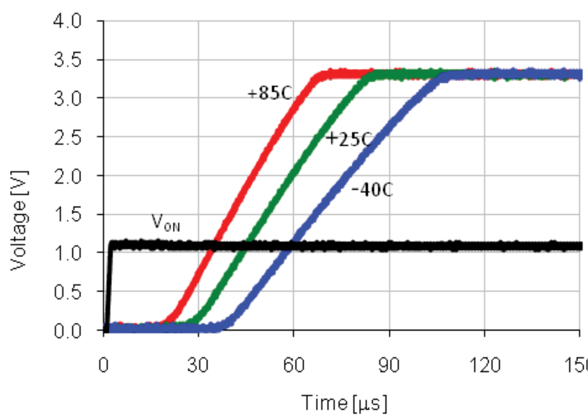


Figure 26. Turn-On Response
(V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=500Ω)

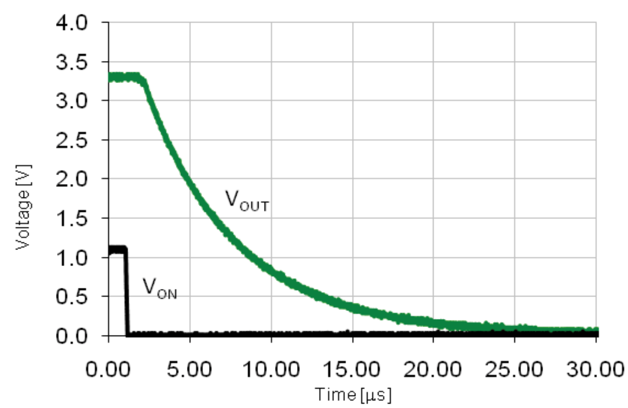


Figure 27. Turn-Off Response
(V_{IN}=3.3V, C_{IN}=1µF, C_{OUT}=0.1µF, R_L=500Ω)

Application Information

Input Capacitor

An IntelliMAX™ switch doesn't require an 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

An 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 the external components as follows:

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

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. R_L is replaced by a parallel connected pull-down and an external output resistor combination, as follows:

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

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 a pull-down output resistor is not discharging the 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.

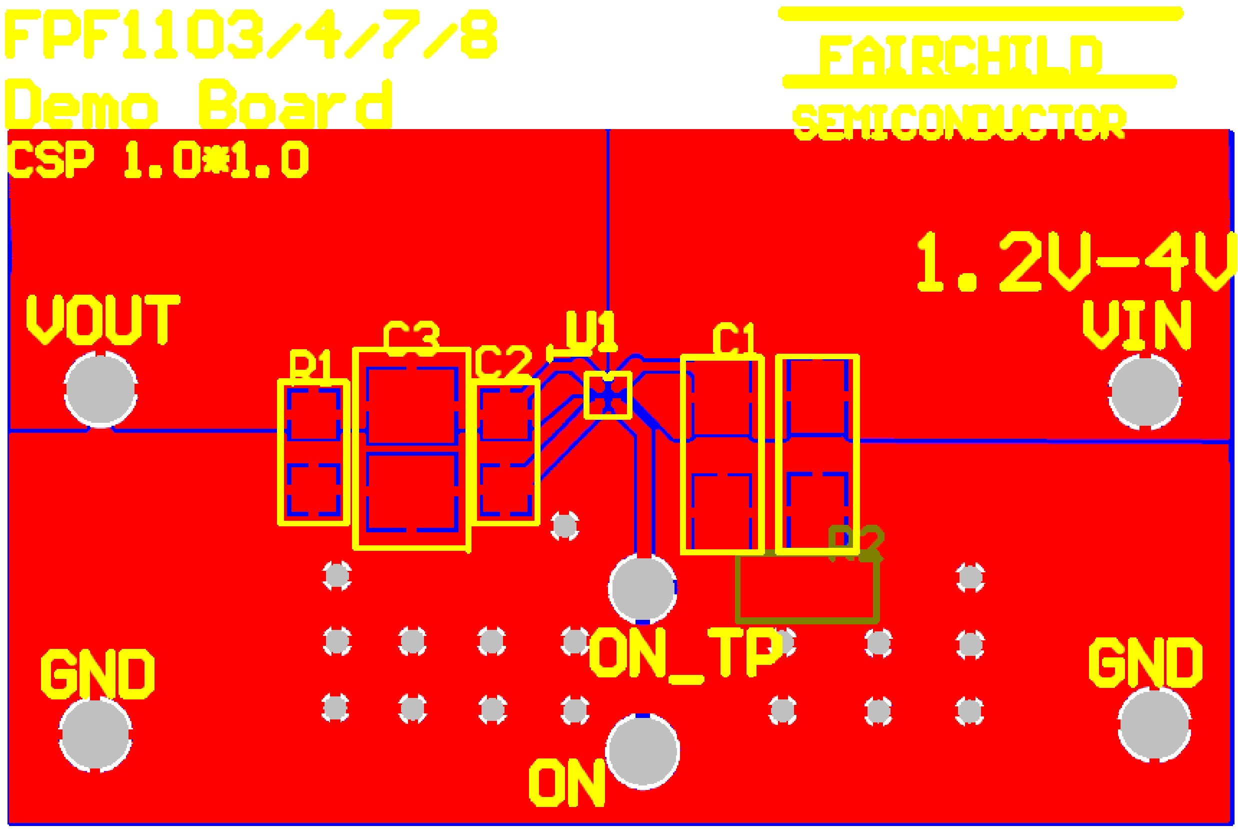


Figure 28.Recommended Land Pattern and Layout

Physical Dimensions

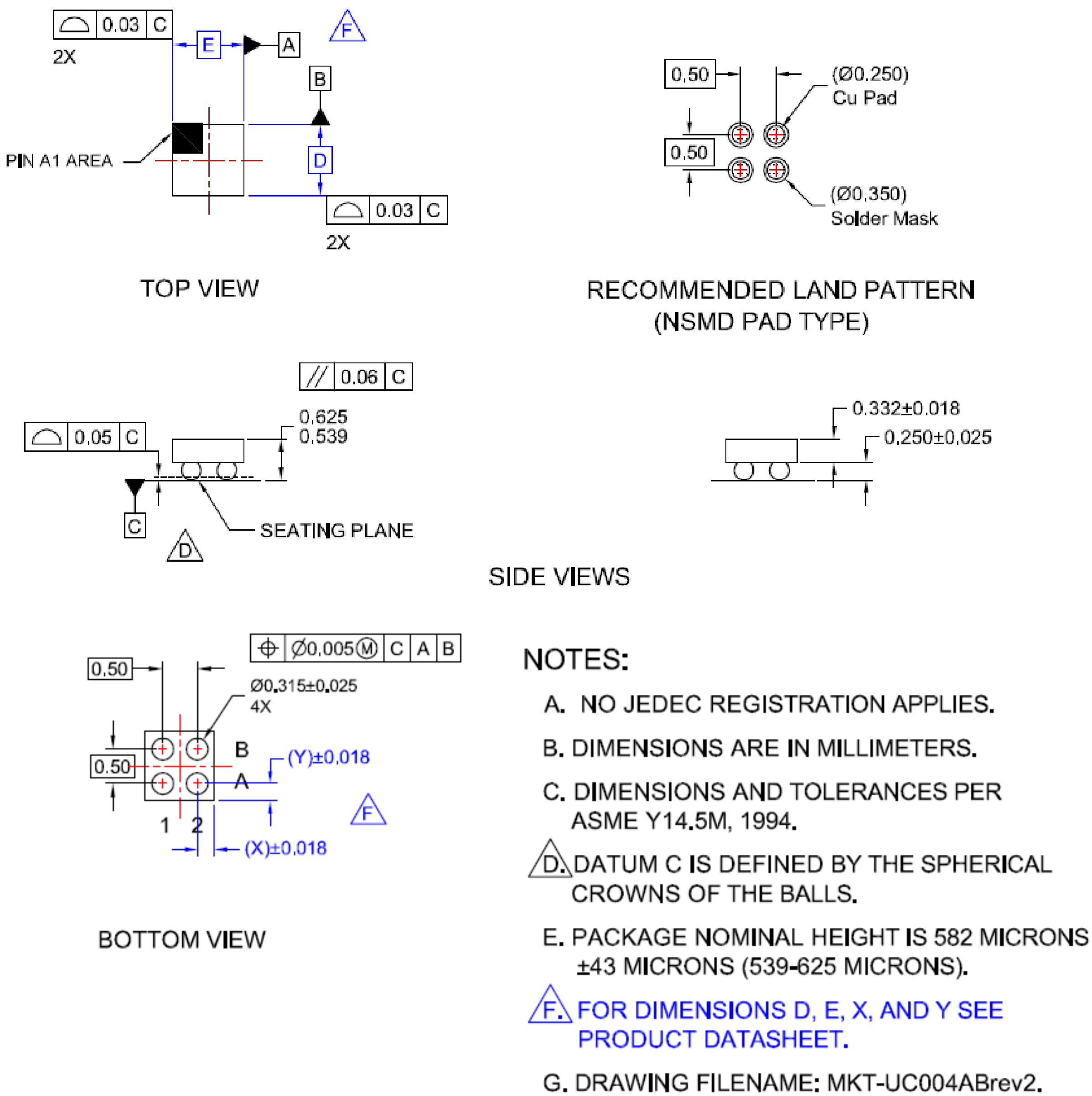


Figure 29.4 Ball, 1.0 x 1.0mm Wafer-Level Chip-Scale Packaging (WLCSP)

Product-Specific Dimensions

Product	D	E	X	Y
FPF1103	960µm ± 30µm	960µm ± 30µm	0.230mm	0.230mm
FPF1104	960um ± 30µm	960um ± 30µm	0.230mm	0.230mm

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TinyCalc™
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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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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 manufacturers 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 applications, 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 handling 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 any 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 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. I43

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