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FAIRCHILD

September 2016

FPF1504 / FPF1504L
Advanced Load Management Switch

Features

- 1.0 V to 3.6 V Input Voltage Operating Range
- Typical $R_{DS(ON)}$:
  - 15 mΩ at V_{IN}=3.3 V
  - 20 mΩ at V_{IN}=1.8 V
  - 40 mΩ at V_{IN}=1.0 V
- Slew Rate Control
- Output Discharge Function
- Low <1 µA Quiescent Current at V_{ON}=V_{IN}
- ESD Protected: 4000 V HBM, 2000 V CDM
- GPIO/CMOS-Compatible Enable Circuitry
- Active HIGH and active LOW versions

Applications

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

Description

The FPF1504/FPF1504L are low-R_{DS} P-channel MOSFET load switches of the IntelliMAX™ family. Integrated slew-rate control prevents excessive inrush current from the supply rails with capacitive loads common in power applications. In addition, the FPF1504/FPF1504L feature output discharge capability.

The input voltage range operates from 1.0 V to 3.6 V to fulfill today's mobile 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.

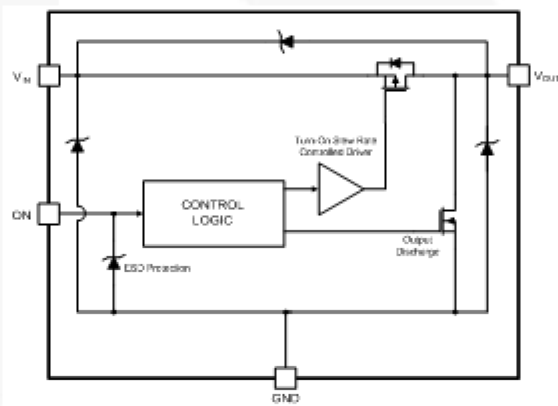


Figure 1. Block Diagram

Ordering Information

Part Number	Top Mark	Switch (Typical) At 1.8 V_{IN}	Input Buffer	Output Discharge	ON Pin Activity	Package
FPF1504UCX	G4	20 mΩ	CMOS	YES	Active HIGH	4-Ball, WLCSP, 0.5 mm Pitch
FPF1504BUCX	G4	20 mΩ	CMOS	YES	Active HIGH	4-Ball, WLCSP with Backside Laminate, 0.5 mm Pitch
FPF1504LUCX	GZ	20 mΩ	CMOS	YES	Active LOW	4-Ball, WLCSP, 0.5 mm Pitch
FPF1504LBUCX	GZ	20 mΩ	CMOS	YES	Active LOW	4-Ball, WLCSP with Backside Laminate, 0.5 mm Pitch

Application Diagram

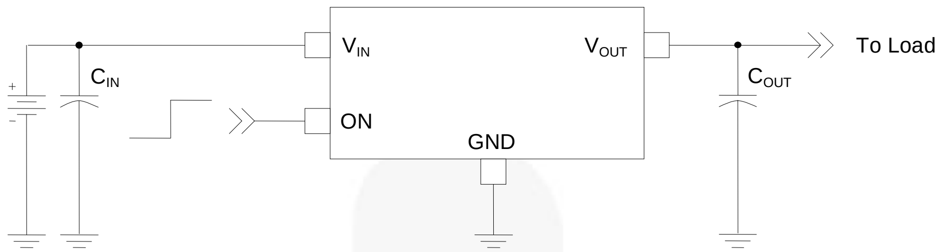


Figure 2. Typical Application

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

Pin Configurations

Figure 3. 1 x 1 mm WLCSP Bumps Facing Down

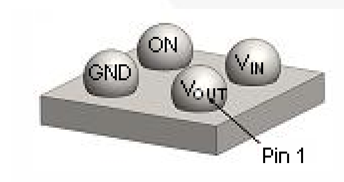


Figure 4. 1 x 1 mm WLCSP Bumps Facing Up

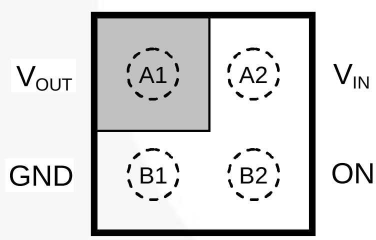


Figure 5. Pin Assignments (Top View)

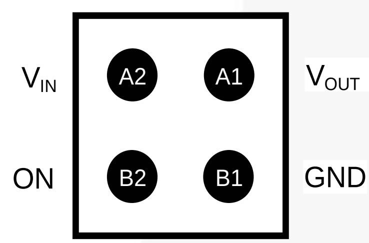


Figure 6. Pin Assignments (Bottom View)

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

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	4.0	V
I_{SW}	Maximum Continuous Switch Current			1.5	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	1.0	3.6	V
T_A	Ambient Operating Temperature	-40	+85	°C

Electrical Characteristics

Unless otherwise noted, V_{IN}=1.0 to 3.6 V, T_A=-40 to +85°C; typical values are at V_{IN}=3.3 V and T_A=25°C.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Units
Basic Operation							
V_{IN}	Supply Voltage			1.0		3.6	V
$I_{Q(OFF)}$	Off Supply Current	FPF1504	V_{ON}=GND, V_{OUT}=Open		0.25		µA
		FPF1504L	V_{ON}= V_{IN}, V_{OUT}=Open		0.3		
$I_{SD(OFF)}$	Off Switch Current	FPF1504	V_{ON}=GND, V_{OUT}=GND		0.25		
		FPF1504L	V_{ON}= V_{IN}, V_{OUT}=GND		0.3		
I_Q	Quiescent Current	FPF1504	I_{OUT}=0 mA, V_{IN}=3.6 V, V_{ON}=V_{IN}		0.08		
			I_{OUT}=0 mA, V_{ON}=$V_{IH(MIN)}$		0.75		
		FPF1504L	I_{OUT}=0 mA, V_{IN}=3.6 V, V_{ON}=GND		0.08		
			I_{OUT}=0 mA, V_{ON}=$V_{IL(MAX)}$		0.95		
R_{ON}	On Resistance		V_{IN}=3.3 V, I_{OUT}=200 mA, T_A=25°C		15	30	mΩ
			V_{IN}=1.8 V, I_{OUT}=200 mA, T_A=25°C		20	40	
			V_{IN}=1.5 V, I_{OUT}=200 mA, T_A=25°C		30		
			V_{IN}=1.0 V, I_{OUT}=200 mA, T_A=25°C		40	80	
			V_{IN}=1.8 V, I_{OUT}=200 mA, T_A=85°C(3)		35	50	
R_{PD}	Output Discharge Pull-Down Resistance		V_{ON}=0 V or V_{IN}, I_{OUT}=-20 mA		65	95	Ω
V_{IH}	On Input Logic High Voltage	FPF1504		0.8			V
V_{IL}	On Input Logic Low Voltage	FPF1504				0.3	
I_{ON}	On Input Leakage		V_{ON}=V_{IN} or GND			1	µA
Dynamic Characteristics							
t_{DON}	Turn-On Delay(4)	FPF1504	R_L=10 Ω, C_L=0.1 µF, V_{IN}=3.3 V, T_A=25°C		80		µs
t_R	V_{OUT} Rise Time(4)	FPF1504			130		
t_{ON}	Turn-On Time(4)	FPF1504			210		
t_{DON}	Turn-On Delay(4)	FPF1504	R_L=500 Ω, C_L=0.1 µF, V_{IN}=3.3 V, T_A=25°C		70	100	µs
		FPF1504L			95		
t_R	V_{OUT} Rise Time(4)	FPF1504			110	150	
		FPF1504L			115		
t_{ON}	Turn-On Time(4)	FPF1504			180	250	
		FPF1504L			210		

Continued on the following page…

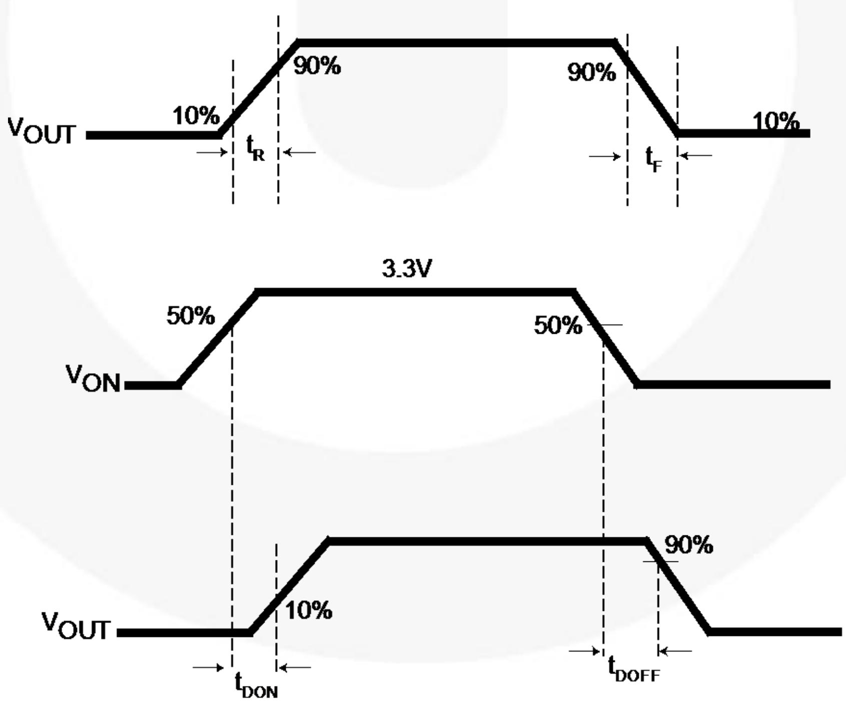
Electrical Characteristics (Continued)

Unless otherwise noted, V_{IN}=1.0 to 3.6 V, T_A=-40 to +85°C; typical values are at V_{IN}=3.3 V and T_A=25°C.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Units
Dynamic Characteristics (Continued)							
t_{DOFF}	Turn-Off Delay(4)	FPF1504	R_L=10 Ω, C_L=0.1 µF, V_{IN}=3.3 V, T_A=25°C		25	30	µs
t_F	V_{OUT} Fall Time(4)	FPF1504			2		
t_{OFF}	Turn-Off Time(4)	FPF1504			27		
t_{DOFF}	Turn-Off Delay(4)	FPF1504	R_L=500 Ω, C_L=0.1 µF, V_{IN}=3.3 V, T_A=25°C		25		µs
		FPF1504L			2		
t_F	V_{OUT} Fall Time(4)	FPF1504			12		
		FPF1504L			14		
t_{OFF}	Turn-Off Time(4)	FPF1504			37		
		FPF1504L			16		

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 – FPF1504



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

Figure 7. Timing Diagram for FPF1504

Typical Performance Characteristics for FPF1504

Applicable to active high version only.

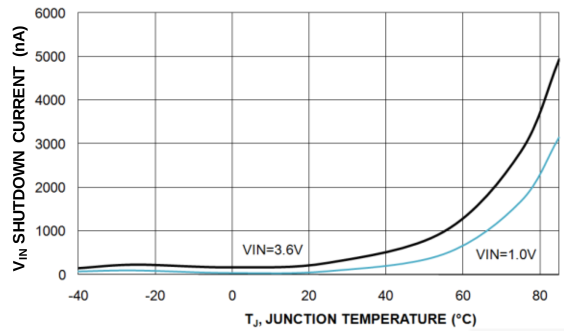


Figure 8. Shutdown Current vs. Temperature

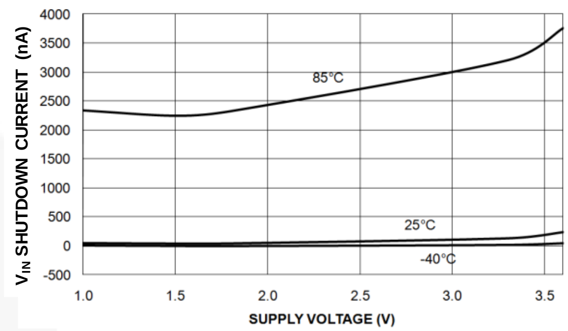


Figure 9. Shutdown Current vs. Supply Voltage

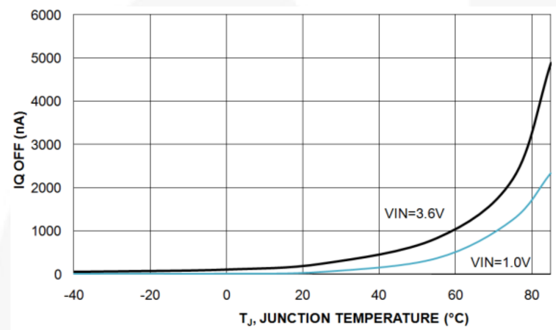


Figure 10. Off Supply Current vs. Temperature

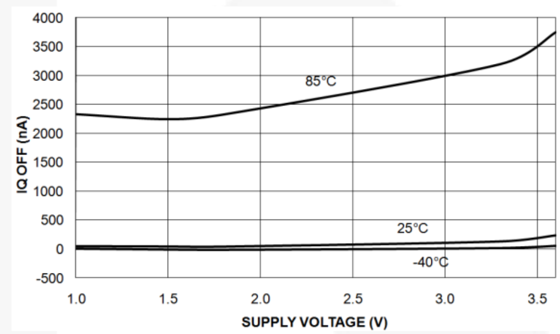


Figure 11. Off Supply Current vs. Supply Voltage

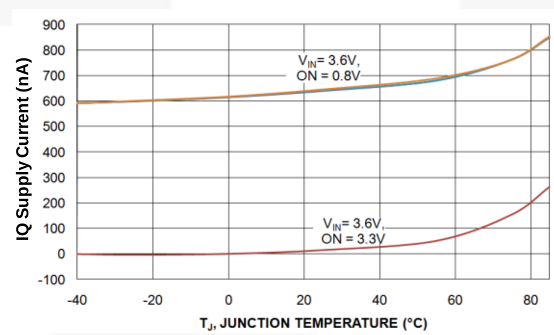


Figure 12. Quiescent Current vs. Temperature

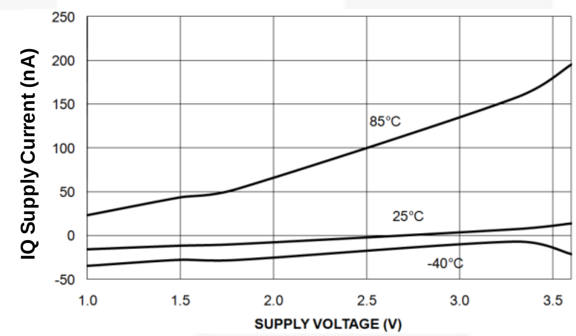


Figure 13. Quiescent Current vs. Supply Voltage (V_{ON}=V_{IN})

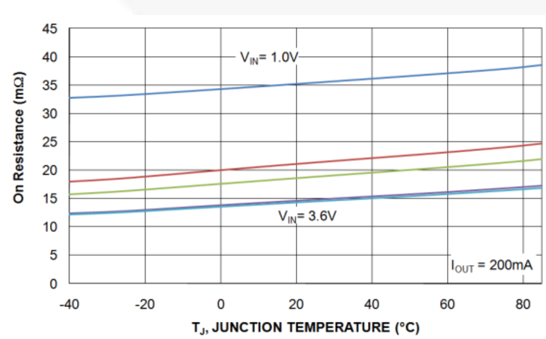


Figure 14. R_{ON} vs. Temperature

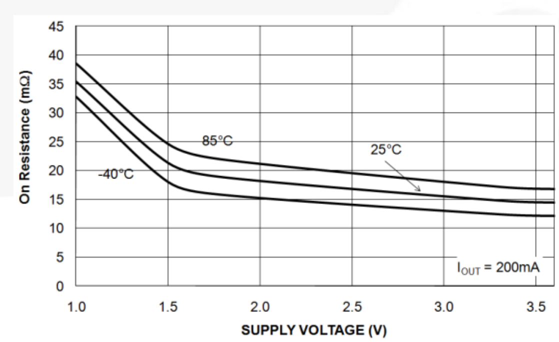


Figure 15. R_{ON} vs. Supply Voltage

Typical Performance Characteristics for FPF1504

Applicable to active high version only.

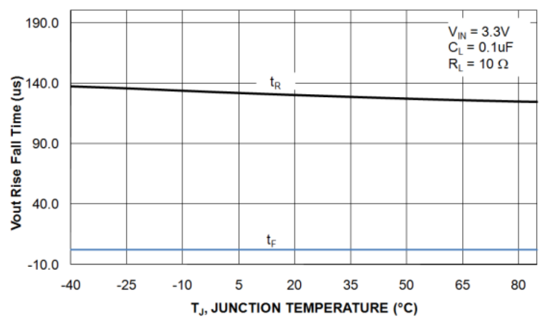


Figure 16. V_{OUT} Rise/Fall Times vs. Temperature (R_L=10 Ω)

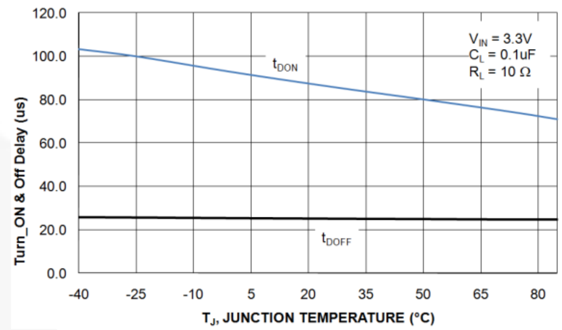


Figure 17. V_{OUT} Turn-On/Turn-Off Delays vs. Temperature (R_L=10 Ω)

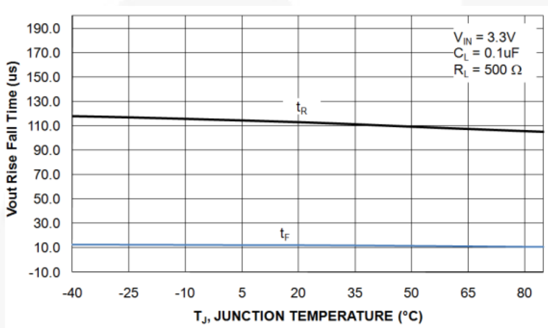


Figure 18. V_{OUT} Rise/Fall Time vs. Temperature (R_L=500 Ω)

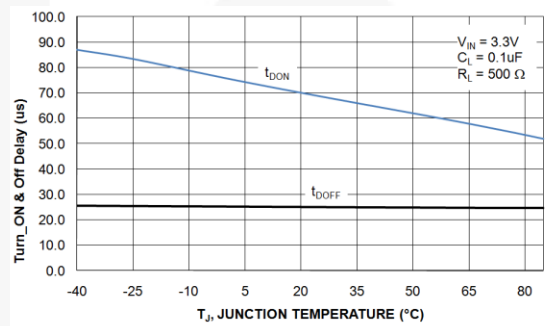


Figure 19. V_{OUT} Turn-On/Turn-Off Delays vs. Temperature (R_L=500 Ω)

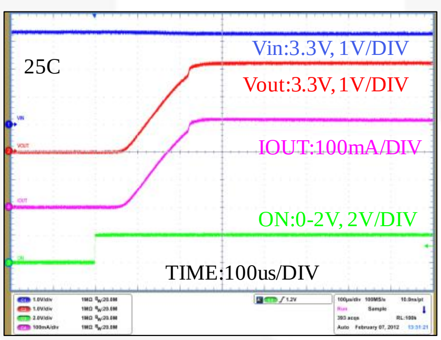


Figure 20. Turn-On Response (V_{IN}=3.3 V, C_{OUT}=0.1 µF, R_L=10 Ω)

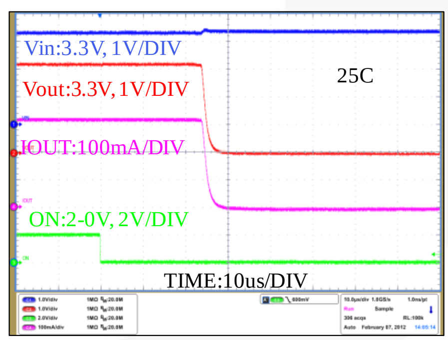


Figure 21. Turn-Off Response (V_{IN}=3.3 V, C_{OUT}=0.1 µF, R_L=10 Ω)

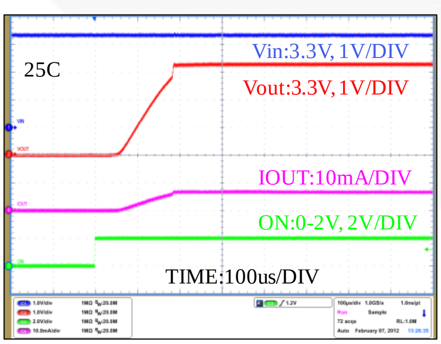


Figure 22. Turn-On Response (V_{IN}=3.3 V, C_{OUT}=0.1 µF, R_L=500 Ω)

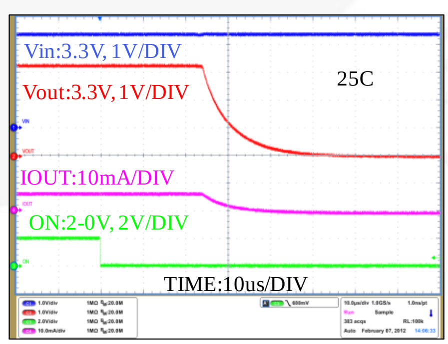


Figure 23. Turn-Off Response (V_{IN}=3.3 V, C_{OUT}=0.1 µF, R_L=500 Ω)

Application Information

Input Capacitor

IntelliMAX™ switches don't require an input capacitor. To reduce device inrush current, a 0.1 µF 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

IntelliMAX™ switches work without an output capacitor. If the applications parasitic board inductance forces V_{OUT} below GND when switching off, a 0.1 µF 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} is output pull-down resistor (65 Ω typical), and C_L is the output capacitor.

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 the capacitors as close to the device as possible. Below is a recommended layout for this device to achieve optimum performance.

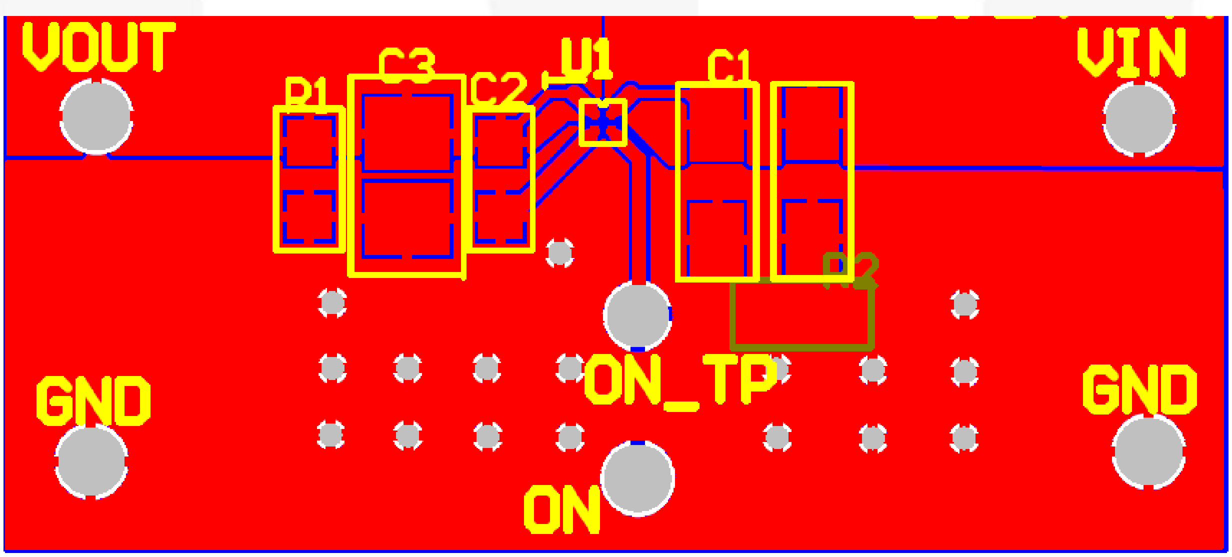
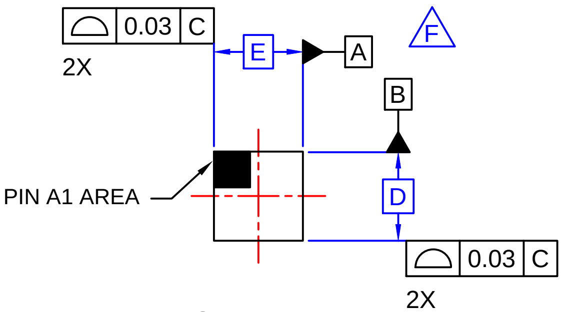


Figure 24. Recommended Land Pattern and Layout

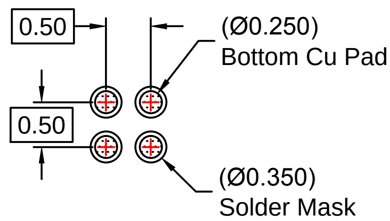
The following information applies to the WLCSP package dimensions on the next page:

Product-Specific Dimensions

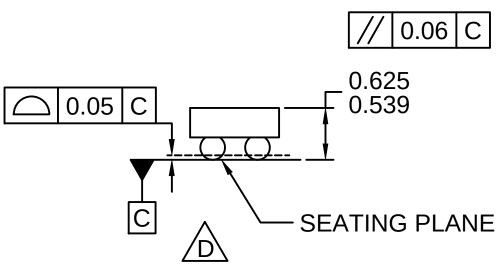
Product	D	E	X	Y
FPF1504UCX	960 µm ±30 µm	960 µm ±30 µm	0.230 mm	0.230 mm
FPF1504BUCX				
FPF1504LUCX				
FPF1504LBUCX				

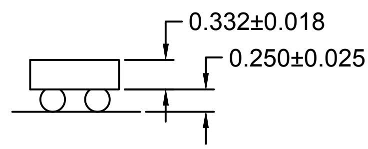


TOP VIEW

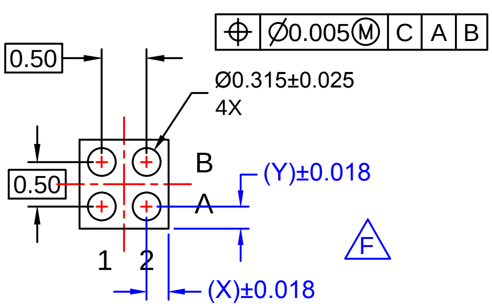


RECOMMENDED LAND PATTERN
(NSMD PAD TYPE)





SIDE VIEWS



BOTTOM VIEW

NOTES:

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.

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-UC004ABrev3.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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