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April 2016

FPF2172
IntelliMAX™ Advanced Load Management

Features

- 1.8 to 5.5 V Input Voltage Range
- Controlled Turn-On
- 200 mA Current Limit Option
- Under-Voltage Lockout (UVLO)
- Thermal Shutdown
- <1 µA Shutdown Current
- Fast Current Limit Response Time:
  - 3 µs to Moderate Over Currents
  - 20 ns to Hard Shorts
- Integrated very Low V_F Schottky Diode for Reverse Current Blocking
- RoHS Compliant

Applications

- PDAs
- Cell Phones
- GPS Devices
- MP3 Players
- Digital Cameras
- Peripheral Ports
- Hot Swap Supplies

Description

The FPF2172 is a load switch which combines the functionality of the IntelliMAX™ series load switch with a very low forward voltage drop Schottky barrier rectifier. The integrated solution provides full protection to systems and loads which may encounter large current conditions in a very compact MLP 3 x 3 package. This device contains a 0.125 Ω current-limited P-channel MOSFET which can operate over an input voltage range of 1.8-5.5 V. The Schottky diode acts as a barrier so that no reverse current can flow when the MOSFET is off and the output voltage is higher than the input voltage. Switch control is by a logic input (ON) capable of interfacing directly with low voltage control signals. Each part contains thermal shutdown protection which shuts off the switch to prevent damage to the part when a continuous over-current condition causes excessive heating.

When the switch current reaches the current limit, the part operates in a constant-current mode to prohibit excessive currents from causing damage. If the constant current condition still persists after 10 ms, these parts will shut off the switch and pull the fault signal pin (FLAGB) low. The switch will remain off until the ON pin is cycled. The minimum current limit is 200 mA.

These parts are available in a space-saving 6-lead MLP 3 x 3 package.

Ordering Information

Part Number	Current Liming [mA]	Current Limit Blanking Time [ms]	Auto-Restart Time [ms]	ON Pin Activity	Top Mark
FPF2172	200	10	n/a	Active HI	2172

Typical Application

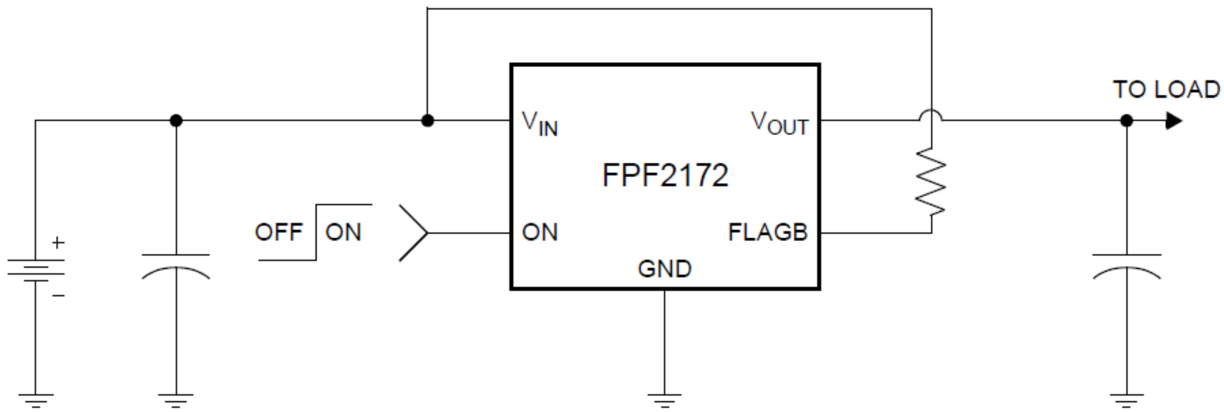


Figure 1. Typical Application

Block Diagram

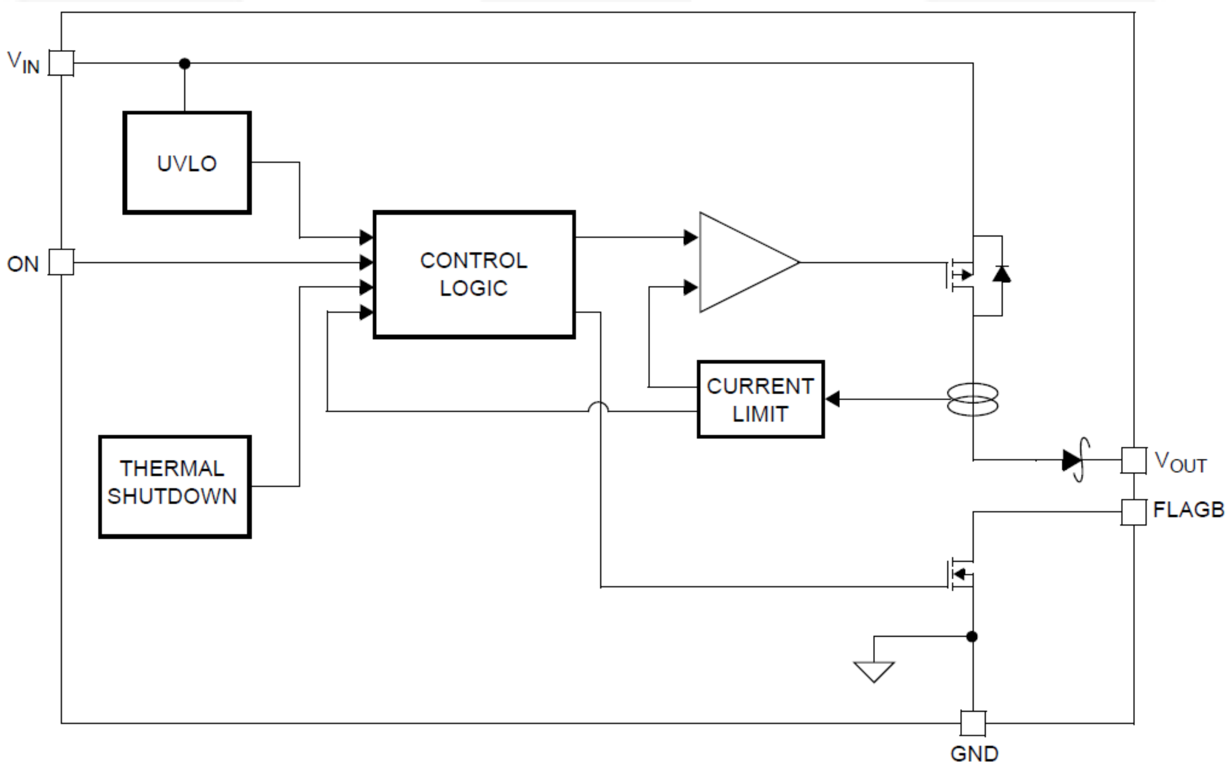


Figure 2. Block Diagram

Pin Configuration

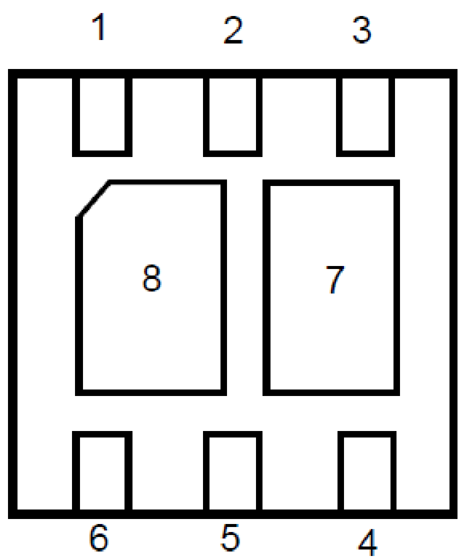


Figure 3. **3 x 3 MLP (Bottom View)**

Pin Descriptions

Pin	Name	Description
1	V_{IN}	Supply Input. Input to the power switch and the supply voltage for the IC
2, 8	NC	No Connect
3, 7	V_{OUT}	Switch Output. Output of the power switch
4	FLAGB	Fault Output. Active LO, open drain output which indicates an over current supply, Under-Voltage or Over-Temperature state.
5	GND	Ground
6	ON	ON Control Input

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}, ON, FLAGB to GND		-0.3	6.0	V
	V_{OUT} to GND		-0.3	20.0	V
P_D	Power Dissipation @ T_A = 25°C[1]			1.4	W
T_A	Operating Temperature Range		-40	85	°C
T_{STG}	Storage Temperature		-65	150	°C
Θ_{JA}	Thermal Resistance, Junction to Ambient			70	³C/W
ESD	Electrostatic Discharge Capability	Human Body Model		4000	V
		Machine Model		400	

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

Recommended Operating Conditions

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

Symbol	Parameter	Min.	Max.	Unit
V_{IN}	Input Voltage	1.8	5.5	V
T_A	Ambient Operating Temperature	-40	85	°C

Electrical Characteristics

V_{IN} = 1.8 to 5.5 V, T_A = -40 to +85°C unless otherwise noted. Typical values are at V_{IN} = 3.3 V and T_A = 25°C.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
Basic Operation							
V_{IN}	Operating Voltage			1.8		5.5	V
I_Q	Quiescent Current	I_{OUT}=0 mA, V_{ON} Active	V_{IN}=1.8 V to 3.3 V		95		µA
			V_{IN}=3.3 V to 5.5 V		110	200	
I_{SHDN}	Shutdown Current					1.0	µA
$I_{LATCHOFF}$	Latch-Off Current	V_{ON}=V_{IN}, after and Over-Current Fault			50		µA
I_R	Reverse Block Leakage Current	V_{OUT} = 20 V, V_{IN} = V_{ON} = 0 V, T_A = 25°C			10	100	µA
	Reverse Breakdown Voltage	I_{OUT} = 250 mA		20			V
V_{DROP}	Dropout Voltage	T_A = 25°C, I_{OUT} = 150 mA			0.3	0.4	V
		T_A = 85°C, I_{OUT} = 150 mA			0.23		
		T_A = -40°C, I_{OUT} = 150 mA			0.36		
V_{IH}	On Input Logic HIGH Voltage	V_{IN} = 1.8 V		0.75			V
		V_{IN} = 5.5 V		1.3			
V_{IL}	On Input Logic LOW Voltage	V_{IN} = 1.8 V				0.5	V
		V_{IN} = 5.5 V				1.0	
I_{ON}	On Input Leakage	V_{ON} = V_{IN} or GND				1.0	µA
I_{SWOFF}	Off Switch Leakage	V_{ON} = 0 V, V_{OUT} = 0 V at V_{IN} = 5.5 V, T_A = 85°C				1.0	µA
		V_{ON} = 0 V, V_{OUT} = 0 V at V_{IN} = 3.3 V, T_A = 85°C			10	100	nA
	FLAGB Output Logic Low Voltage	V_{IN} = 5.5 V, I_{SINK} = 10 mA				0.2	V
		V_{IN} = 1.8 V, I_{SINK} = 10 mA				0.3	
	FLAGB Output High Leakage Current	V_{IN} = 5 V, Switch On				1.0	µA
Protections							
I_{LIM}	Current Limit	V_{IN} = 3.3 V, V_{OUT} = 2.0 V		200	300	400	mA
	Thermal Shutdown	Shutdown Threshold			140		°C
		Return from Shutdown			130		
		Hysteresis			10		
U_{VLO}	Under-Voltage Lockout	V_{IN} Increasing		1.5	1.6	1.7	V
U_{VLOH}	Under-Voltage Lockout Hysteresis				47		mV
Dynamic Characteristics							
t_{ON}	Turn-On Time	R_L = 500 Ω, C_L = 0.1 µF			22		µs
t_{OFF}	Turn-Off Time	R_L = 500 Ω, C_L = 0.1 µF			20		µs
t_{RISE}	V_{OUT} Rise Time	R_L = 500 Ω, C_L = 0.1 µF			13		µs
t_{FALL}	V_{OUT} Fall Time	R_L = 500 Ω, C_L = 0.1 µF			117		µs
t_{BLANK}	Over-Current Blanking Time			5	10	20	ms
	Short Circuit Response Time	V_{IN} = V_{ON} = 3.3 V, Moderate Over-Current Condition			3		µs
		V_{IN} = V_{ON} = 3.3 V, Hard Short			20		ns

Typical Performance Characteristics

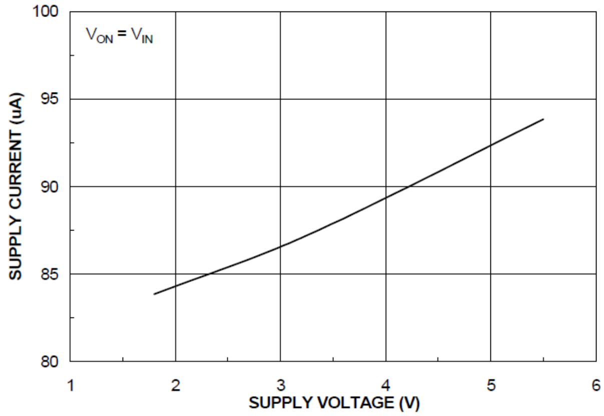


Figure 4. Quiescent Current vs. Input Voltage

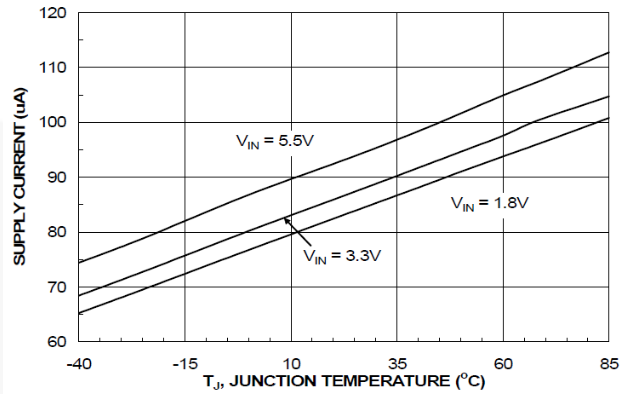


Figure 5. Quiescent Current vs. Temperature

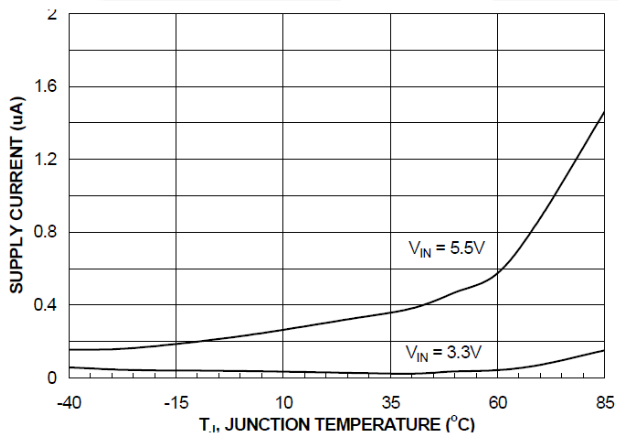


Figure 6. $I_{SHUTDOWN}$ Current vs. Temperature

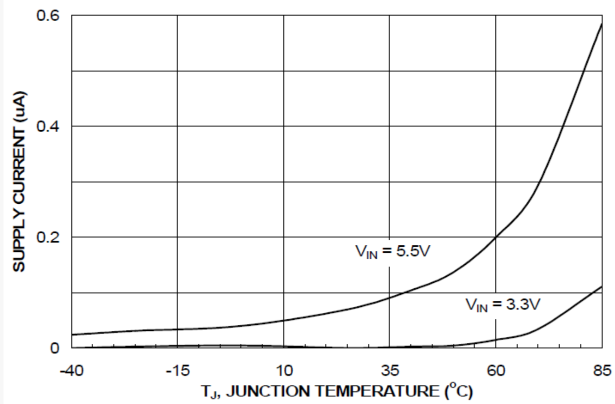


Figure 7. $I_{SWITCH\text{-}OFF}$ Current vs. Temperature

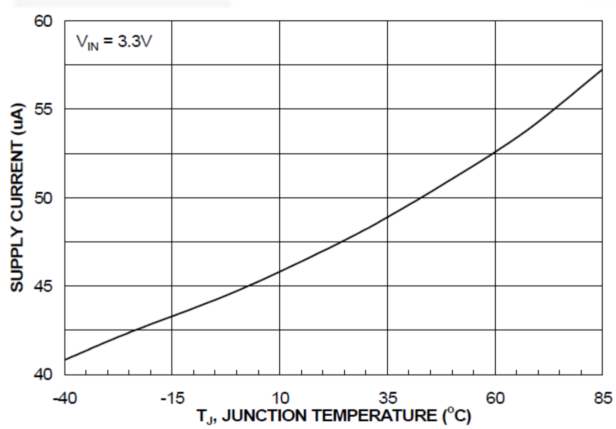


Figure 8. Latch-off Current vs. Temperature

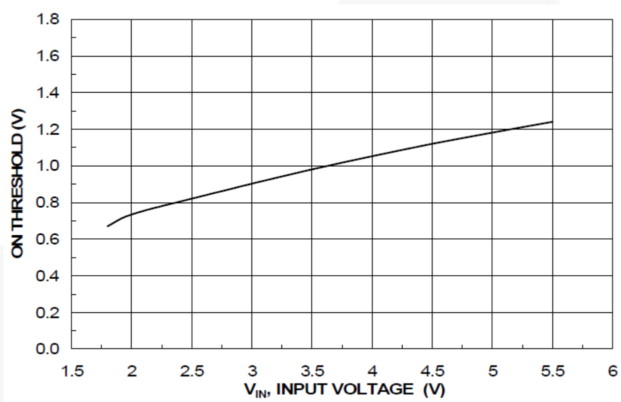


Figure 9. Input Voltage vs. On Threshold Voltage

Typical Performance Characteristics

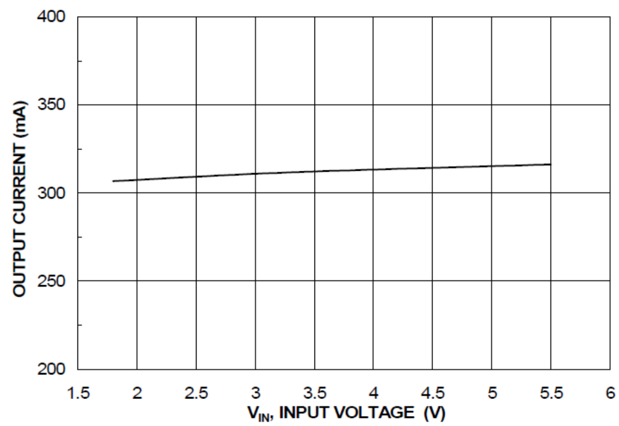


Figure 10. Current Limit vs. Output Voltage

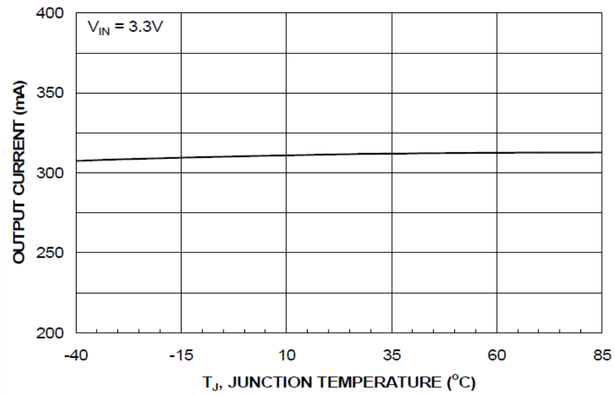


Figure 11. Current Limit vs. Temperature

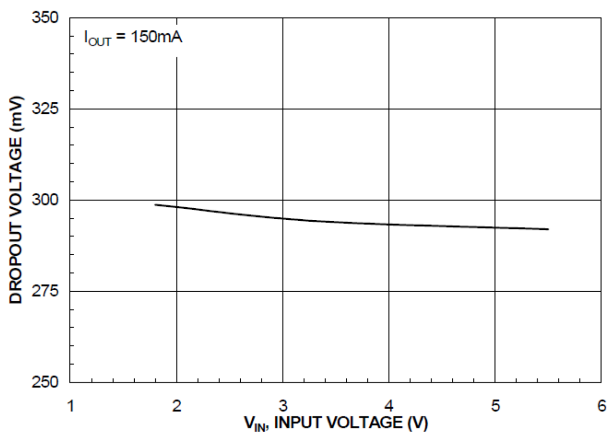


Figure 12. Drop Voltage vs. Input Voltage

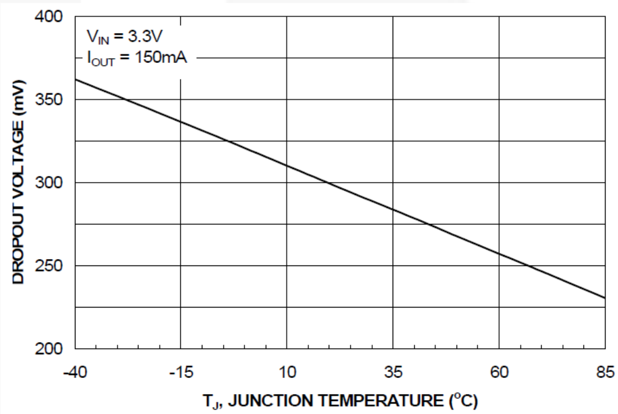


Figure 13. Drop Voltage vs. Temperature

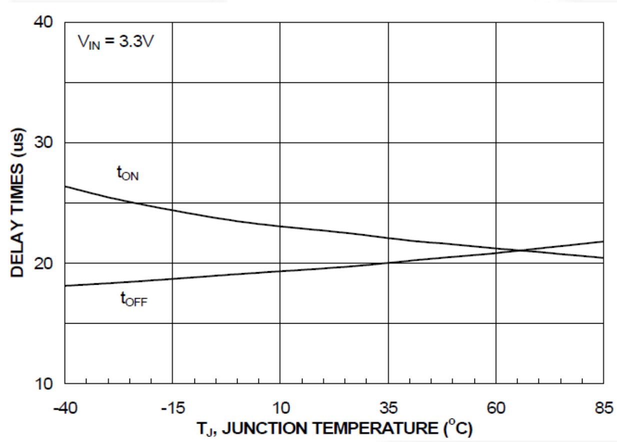


Figure 14. t_{ON}/t_{OFF} vs. Temperature

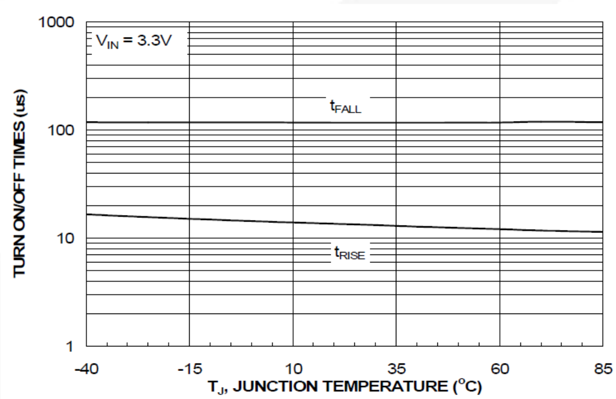


Figure 15. t_{RISE}/t_{FALL} vs. Temperature

Typical Performance Characteristics

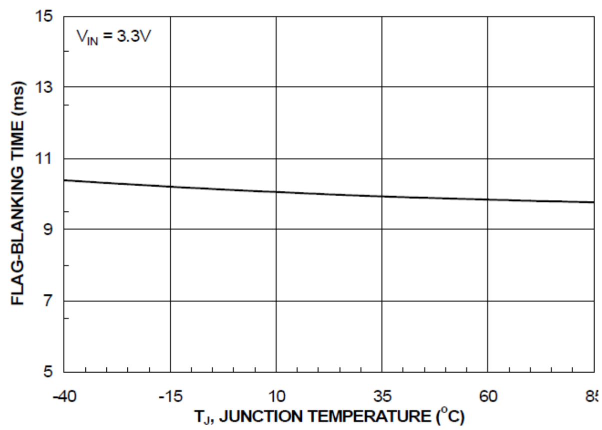


Figure 16. t_{BLANK} vs. Temperature

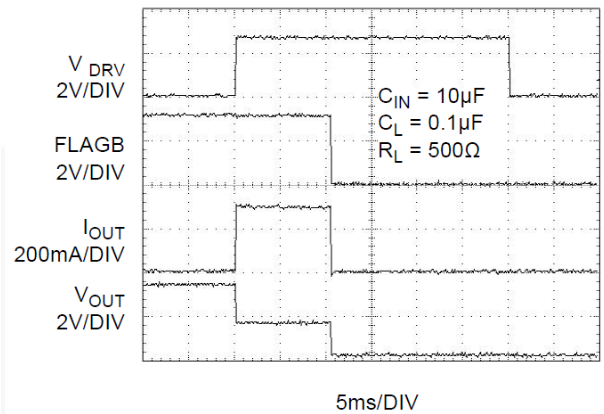


Figure 17. t_{BLANK} Response

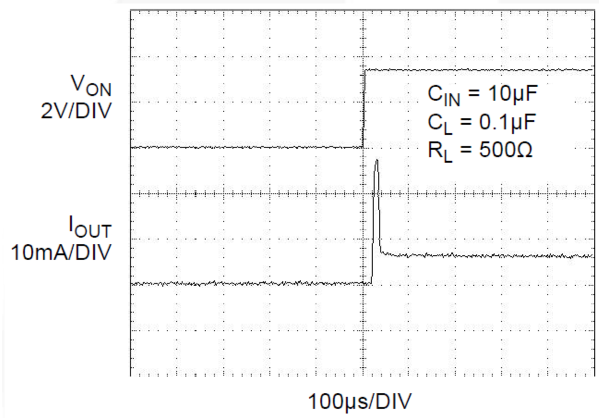


Figure 18. t_{ON} Response

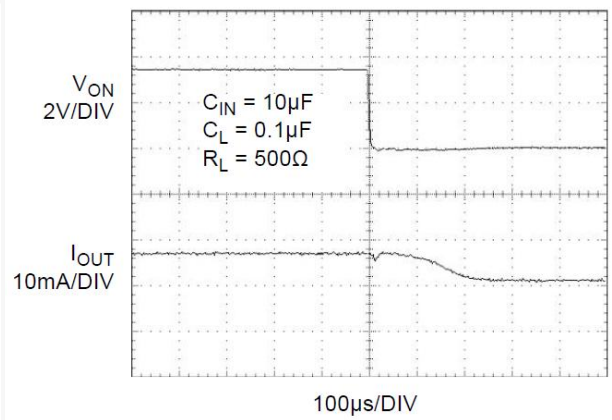


Figure 19. t_{OFF} Response

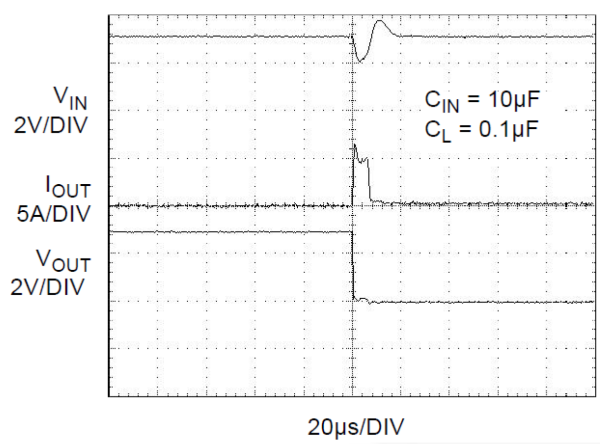


Figure 20. Short Circuit Response Time (Output Shorted to GND)

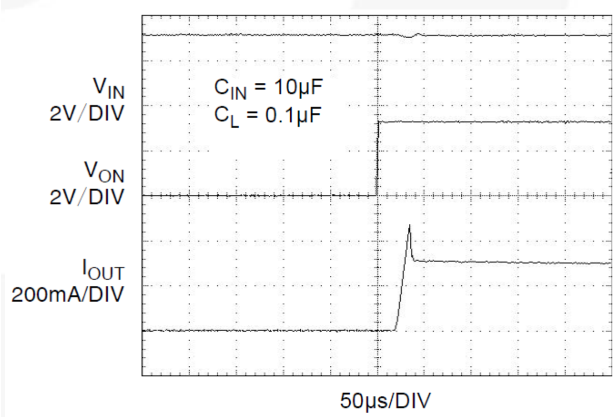


Figure 21. Current Limit Response Time (Output has a 4.7 Ω load)

Description of Operation

The FPF2172 is a current limited switch that protects systems and loads which can be damaged or disrupted by the application of high currents. The core of the device is a 0.125 Ω P-channel MOSFET and a controller capable of functioning over a wide input operating range of 1.8-5.5 V paired with a low forward voltage drop Schottky diode for reverse blocking. The controller protects against system malfunctions through current limiting, under-voltage lockout and thermal shutdown. The current limit is preset for 200 mA.

On/Off Control

The ON pin controls the state of the switch. Activating ON continuously holds the switch in the ON state so long as there is no under-voltage on V_{IN} or a junction temperature in excess of 150°C. ON is active HI and has a low threshold making it capable of interfacing with low voltage signals. When the MOSFET is off, the Schottky diode acts as a barrier so that no reverse current can flow when V_{OUT} is greater than V_{IN}.

Fault Reporting

Upon the detection of an over-current, an input under-voltage, or an over-temperature condition, the FLAGB signals the fault mode by activating LO. The FLAGB goes LO at the end of the blanking time and is latched LO and ON must be toggled to release it. FLAGB is an open-drain MOSFET which requires a pull-up resistor between V_{IN} and FLAGB. During shutdown, the pull-down on FLAGB is disabled to reduce current draw from the supply.

Current Limiting

The current limit guarantees that the current through the switch doesn't exceed a maximum value while not limiting at less than a minimum value. The minimum current is 200 mA and the maximum current is 400 mA. The device has a blanking time of 10 ms, nominally, during which the switch will act as a constant current source. At the end of the blanking time, the switch will be turned-off and the FLAGB pin will activate to indicate that current limiting has occurred.

Under-Voltage Lockout (UVLO)

The under-voltage lockout turns-off the switch if the input voltage drops below the under-voltage lockout threshold. With the ON pin active the input voltage rising above the under-voltage lockout threshold will cause a controlled turn-on of the switch which limits current over-shoots.

Thermal Shutdown

The thermal shutdown protects the die from internally or externally generated excessive temperatures. During an over-temperature condition the FLAGB is activated and the switch is turned-off. The switch automatically turns-on again if temperature of the die drops below the threshold temperature.

Applications Information

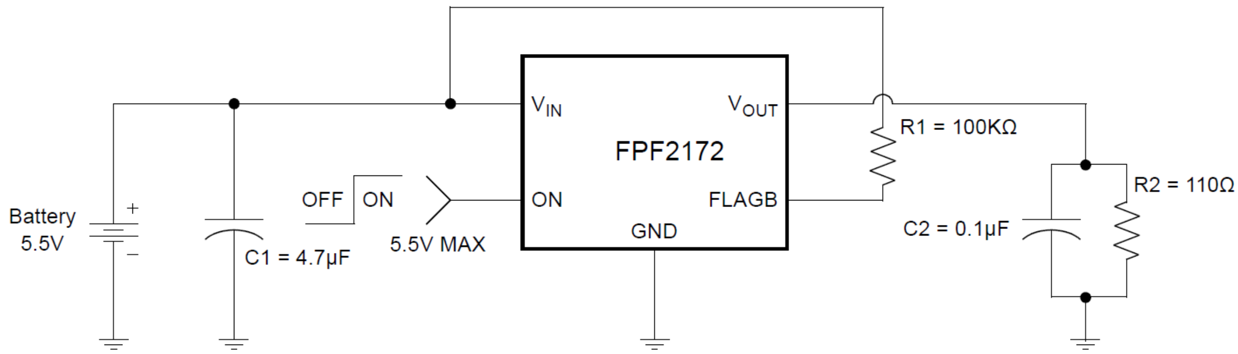


Figure 22. Typical Application

Input Capacitor

To limit the voltage drop on the input supply caused by transient in-rush currents when the switch turns-on into a discharged load capacitor or a short-circuit, a capacitor needs to be placed between V_{IN} and GND. A 4.7 µF ceramic capacitor, C_{IN}, must be placed close to the V_{IN} 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

A 0.1 µF capacitor C_{OUT}, should be placed between V_{OUT} and GND. This capacitor will prevent parasitic board inductances from forcing V_{OUT} below GND when the switch turns-off.

Power Dissipation

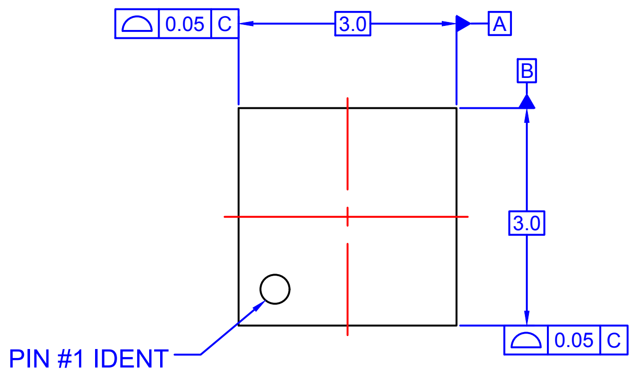
During normal operation as a switch, the power dissipation is small and has little effect on the operating temperature of the part. The parts with the higher current limits will dissipate the most power and that will only be typically:

$$P = I_{LIM} \times V_{DROP} = 0.4 \times 0.4 = 160mW \quad (1)$$

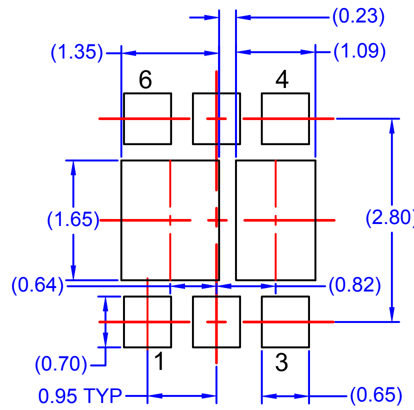
When using the part, attention must be given to the manual resetting of the part. Continuously resetting the part at a high duty cycle when a short on the output is present can cause the temperature of the part to increase. The junction temperature will only be allowed to increase to the thermal shutdown threshold. Once this temperature has been reached, toggling ON will not turn-on the switch until the junction temperature drops.

Board Layout

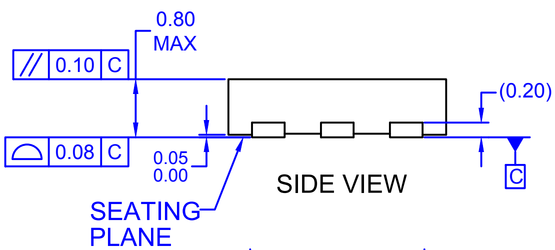
For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. Using wide traces for V_{IN}, V_{OUT} and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



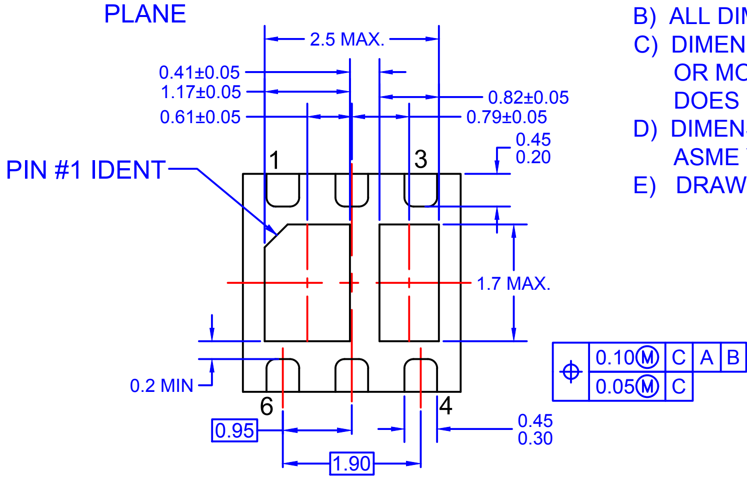
TOP VIEW



RECOMMENDED LAND PATTERN



SIDE VIEW



BOTTOM VIEW

NOTES: UNLESS OTHERWISE SPECIFIED

A) CONFORMS TO JEDEC REGISTRATION, MO-229, VARIATION WEEA

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.

D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.

E) DRAWING FILE NAME: MKT-MLP06HREV2

FAIRCHILD

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