



ON Semiconductor®

# FPF2290 Over-Voltage Protection Load Switch

## Features

- Surge Protection
  - IEC 61000-4-5: ±100 V
- Selectable Over-Voltage Protection (OVP) with OV1 and OV2 Logic inputs
  - 5.9 V ±100 mV
  - 10 V ±100 mV
  - 14 V ±280 mV
  - 23 V ±460 mV
- Over-Temperature Protection (OTP)
- Ultra-Low On-Resistance: Typ. 33 mΩ
- ESD Protection
  - Human Body Model (HBM): > 2 kV
  - Charged Device Model (CDM): > 1 kV
  - IEC 61000-4-2 Air Discharge: > 15 kV

## Description

The FPF2290 features a low- $R_{ON}$  internal FET and an operating voltage range of 2.5 V to 23 V. An internal clamping circuit is capable of shunting surge voltages of ±100 V, protecting downstream components and enhancing system robustness. The FPF2290 features over-voltage protection that powers down the internal FET if the input voltage exceeds the OVP threshold. The OVP threshold is selectable via Logic select pins (OV1 and OV2). Over-temperature protection also powers down the device at 130°C (typical).

The FPF2290 is available in a fully “green” compliant 1.3 mm × 1.8 mm Wafer-Level Chip-Scale Package (WLCSP) with backside laminate.

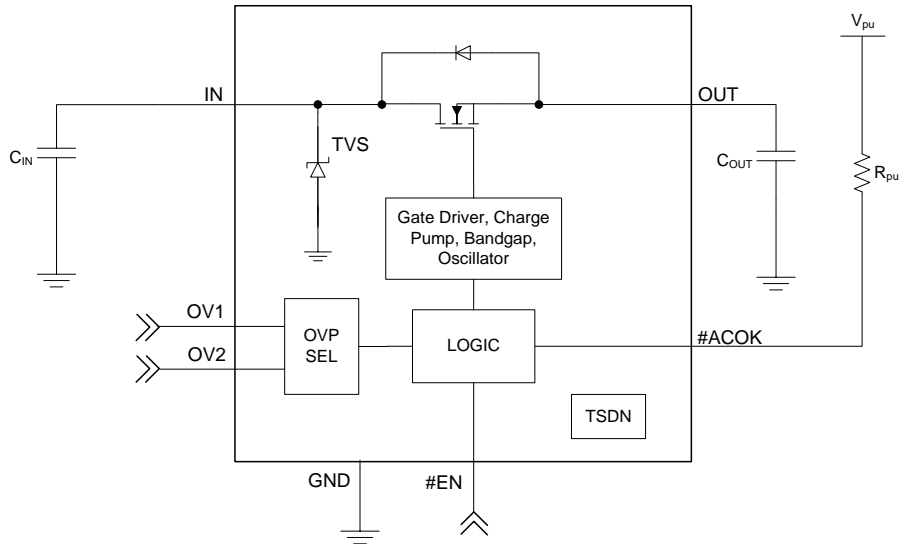
## Applications

- Mobile Handsets and Tablets
- Portable Media Players
- MP3 Players

## Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FPF2290BUCX-F130	-40°C – +85°C	HR	12-Ball, 0.4 mm Pitch WLCSP	Tape & Reel

**Block Diagram**



**Figure 1. Functional Block Diagram**

**Note:**

1. Setting OV1 and OV2 logic level are recommended before IN is applied.

## Pin Configuration

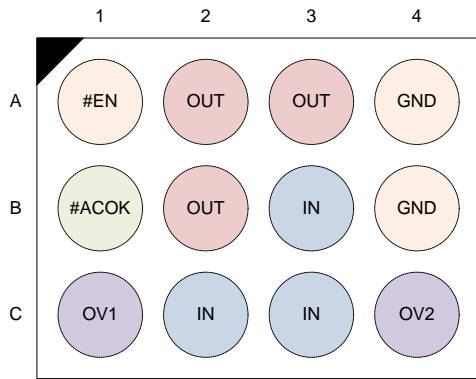
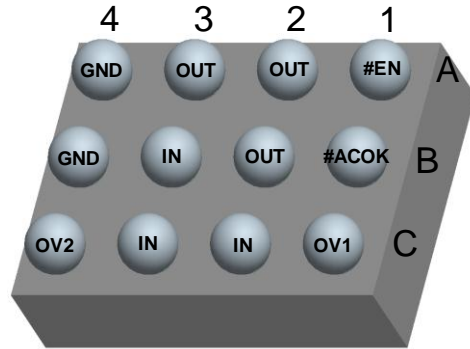
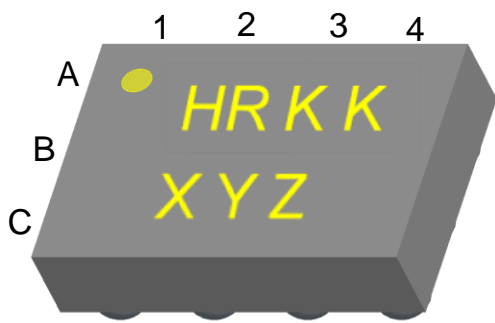


Figure 2. Pin Configuration (Top View)

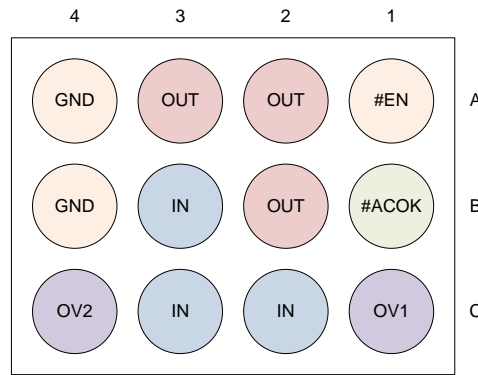


Figure 3. Pin Configuration (Bottom View)

## Pin Definitions

Name	Bump	Type	Description	
IN	B3, C2, C3	Input/Supply	Switch Input and Device Supply	
OUT	A2, A3, B2	Output	Switch Output to Load	
#ACOK	B1	Output	Power Good (Open-Drain Output)	1   Hi-Z: $V_{IN} < V_{IN\_MIN}$ OR $V_{IN} > V_{OVLO}$
				0   LOW: Voltage Stable
#EN	A1	Input	Device Enable (Active LOW)	
OV1/2	C1, C4	Input	OVLO Selection Input (see Table 1) <u>Note:</u> Apply OV1 and OV2 Logic levels before $V_{IN}$ is applied.	
GND	A4, B4	Supply	Device Ground	

Table 1. OVLO Selection

OV1	OV2	OVLO Trip Level
LOW	LOW	5.9 V $\pm$ 100 mV
HIGH	LOW	10 V $\pm$ 100 mV
LOW	HIGH	14 V $\pm$ 280 mV
HIGH	HIGH	23 V $\pm$ 460 mV

## 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 <sub>IN</sub>	V <sub>IN</sub> to GND & V <sub>IN</sub> to V <sub>OUT</sub> = GND or Float	-0.3	29.0	V
V <sub>OUT</sub>	V <sub>OUT</sub> to GND	-0.3	V <sub>IN</sub> + 0.3	V
V <sub>OVn</sub>	OV1 and OV2 to GND	-0.3	6.0	V
V <sub>EN_ACOK</sub>	Maximum DC Voltage Allowed on #EN or #ACOK Pin		6	V
I <sub>IN</sub>	Switch I/O Current (Continuous)		4.5	A
t <sub>PD</sub>	Total Power Dissipation at T <sub>A</sub> = 25°C		1.48	W
T <sub>STG</sub>	Storage Temperature Range	-65	+150	°C
T <sub>J</sub>	Maximum Junction Temperature		+150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 Seconds)		+260	°C
θ <sub>JA</sub>	Thermal Resistance, Junction-to-Ambient <sup>2)</sup> (1-in. <sup>2</sup> Pad of 2-oz. Copper)		84.1	°C/W
ESD	IEC 61000-4-2 System Level ESD	Air Discharge	15	kV
		Contact Discharge	8	
	Human Body Model, ANSI/ESDA/JEDEC JS-001-2012	All Pins	2	
	Charged Device Model, JESD22-C101	All Pins	1	
Surge	IEC 61000-4-5, Surge Protection	V <sub>IN</sub>	±100	V

### Note:

- Measured using 2S2P JEDEC std. PCB.

## 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. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V <sub>IN</sub>	Supply Voltage	2.5	23.0	V
T <sub>A</sub>	Operating Temperature	-40	+85	°C

## Electrical Characteristics

$T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $V_{IN} = 2.5$  to  $23$  V, unless otherwise indicated. Typical values are  $V_{IN} = 5.0$  V,  $I_{IN} \leq 3$  A,  $C_{IN} = 0.1$   $\mu\text{F}$  and  $T_A = 25^\circ\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
<b>Basic Operation</b>							
$V_{IN\_CLAMP}$	Input Clamping Voltage	$I_{IN} = 10$ mA		35		V	
$I_Q$	Input Quiescent Current	$V_{IN} = 5$ V, #EN = 0 V		80	115	$\mu\text{A}$	
$I_{IN\_Q}$	OVLO Supply Current	OV1 = LOW, OV2 = LOW $V_{IN} = 6.5$ V, $V_{OUT} = 0$ V		63	90	$\mu\text{A}$	
$V_{IN\_OVLO}$	Over-Voltage Trip Level	$V_{IN}$ Rising	OV1 = LOW, OV2 = LOW	5.80	5.90	6.00	V
		$V_{IN}$ Falling		5.75			
		$V_{IN}$ Rising	OV1 = HIGH, OV2 = LOW	9.90	10.00	10.10	
		$V_{IN}$ Falling		9.85			
		$V_{IN}$ Rising	OV1 = LOW, OV2 = HIGH	13.72	14.0	14.28	
		$V_{IN}$ Falling		13.52			
		$V_{IN}$ Rising	OV1 = HIGH, OV2 = HIGH	22.54	23.0	23.46	
$V_{IN}$ Falling	22.34						
$R_{ON}$	Resistance from $V_{IN}$ to $V_{OUT}$	$V_{IN} = 5$ V, $I_{OUT} = 1$ A, $T_A = 25^\circ\text{C}$		33	40	m $\Omega$	
$C_{OUT}$	OUT Load Capacitance <sup>(3)</sup>	$V_{IN} = 5$ V	0.1		1000.0	$\mu\text{F}$	
$T_{SDN}$	Thermal Shutdown n <sup>(3)</sup>			130		$^\circ\text{C}$	
$T_{SDN\_HYS}$	Thermal Shutdown n Hysteresis <sup>(3)</sup>			20		$^\circ\text{C}$	
<b>Digital Signals</b>							
$V_{OL}$	#ACOK Output Low Voltage	$I_{SINK} = 1$ mA			0.4	V	
$I_{ACOK}$	#ACOK Leakage Current	$V_{I/O} = 3.0$ V, #ACOK Deasserted			0.5	$\mu\text{A}$	
$V_{IH}$	Input HIGH Voltage (#EN, OVx)	$V_{IN} = 2.5$ V to $V_{OVLO}$	1.2			V	
$V_{IL}$	Input LOW Voltage (#EN, OVx)	$V_{IN} = 2.5$ V to $V_{OVLO}$			0.5	V	
$I_{IN}$	Input Leakage Current (#EN, OVx)	$V_{IN} = 5.0$ V, $V_{OUT} = \text{Float}$			1.0	$\mu\text{A}$	
<b>Timing Characteristics</b>							
$t_{DEB}$	Debounce Time	Time from $2.5$ V < $V_{IN} < V_{IN\_OVLO}$ to $V_{OUT} = 0.1 \times V_{IN}$	10	15	20	ms	
$t_{START}$	Soft-Start Time	Time from $V_{IN} = V_{IN\_min}$ to $0.2 \times \#ACOK$ , $V_{I/O} = 1.8$ V with 10 k $\Omega$ Pull-up Resistor	20	30	40	ms	
$t_{ON}$	Switch Turn-On Time	$R_L = 100$ $\Omega$ , $C_L = 22$ $\mu\text{F}$ , $V_{OUT}$ from $0.1 \times V_{IN}$ to $0.9 \times V_{IN}$	1	3	5	ms	
$t_{OFF}$	Switch Turn-Off Time <sup>(3)</sup>	$R_L = 100$ $\Omega$ , $C_L = 0$ $\mu\text{F}$ , $V_{IN} > V_{OVLO}$ to $V_{OUT} = 0.8 \times V_{IN}$			150	ns	

### Note:

3. Guaranteed by characterization and design.

Timing Diagrams

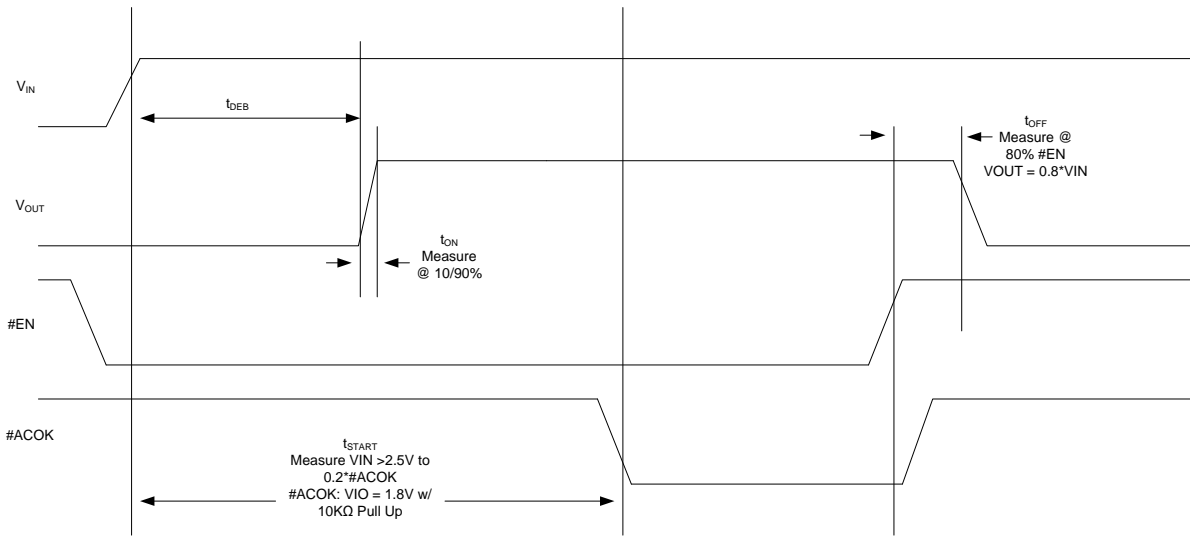


Figure 4. Timing for Power Up and Normal Operation

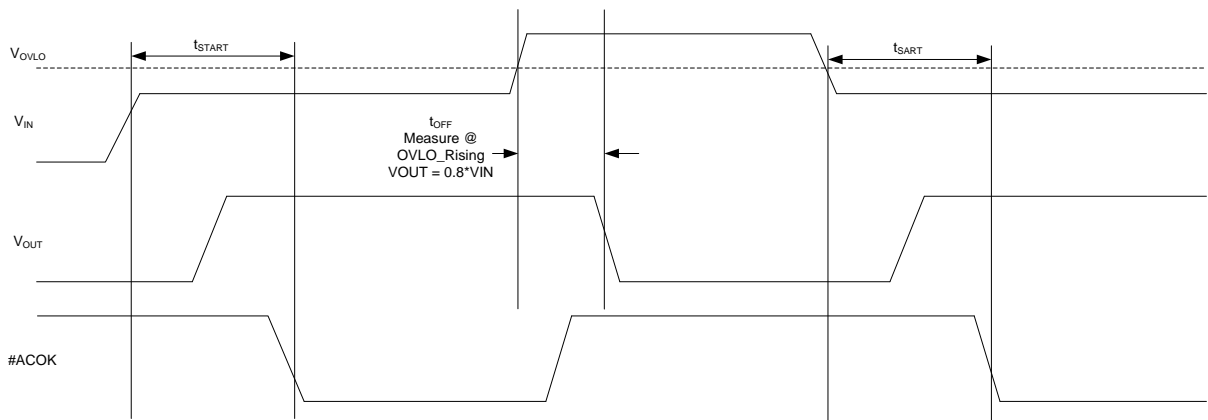
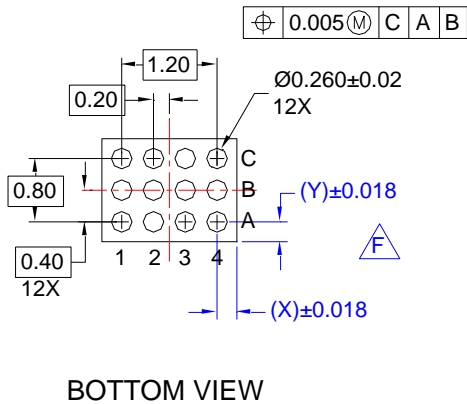
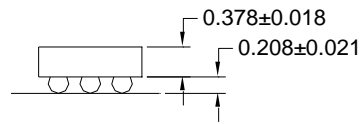
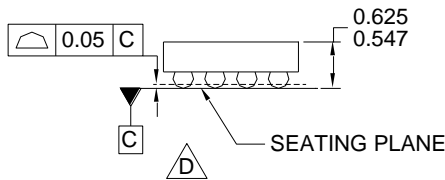
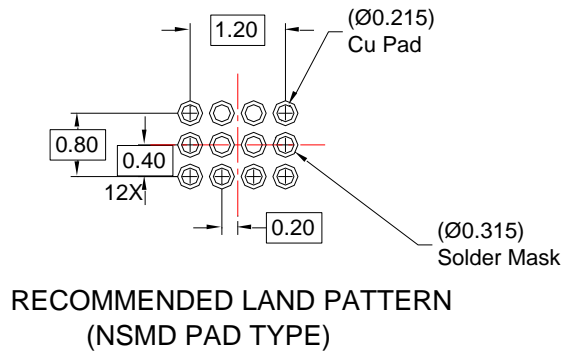
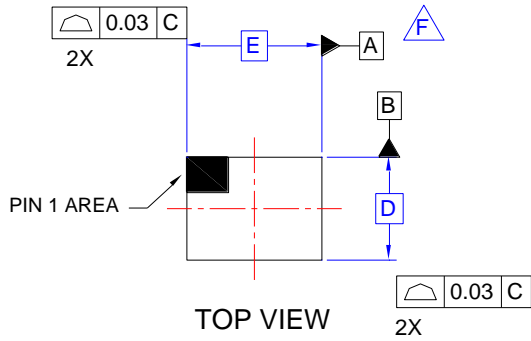


Figure 5. Timing for OVLO Trip

Product-Specific Dimensions

D	E	X	Y
1288 μm ±30 μm	1828 μm ±30 μm	314 μm ±18 μm	244 μm ±18 μm

Physical Dimensions



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 586 MICRONS ±39 MICRONS (547-625 MICRONS).
- F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.
- G. DRAWING FILENAME: MKT-UC012ZCrev2.
- H. ON SEMICONDUCTOR RECOMMENDS THAT LANDS IN THE LANDPATTERN ARE AT LEAST .215MM DIAMETER AS MEASURED AT THE BOTTOM OF THE LAND, NOT THE TOP EDGE.

Figure 6. 12-Ball, 3x4 Array, 0.4 mm Pitch, Wafer-Level Chip-Scale Package (WL CSP)

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