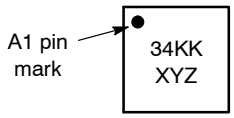
# 1.5 A Ideal Diode with Ultra-Low IQ and Small Package

# FPF1903UCX

**WLCSP4 0.70x0.70x0.454**
**CASE 567ZV**

## MARKING DIAGRAMS




34 = 2−digit Device Identifier
KK = 2−digit Lot Run Traceability Code
XY = 2−digit Date Code Format
(X: Year and Y: Week)
Z = 1−digit Assembly Plant Code

## ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

### Description

FPF1903 is a single load switch with P−type MOSFET integrated. The device can perfectly block reverse current from OUT to IN in both enabled and disabled status.

The input voltage from 1.2 V to 5.5 V. The supply current is relatively constant with load current 1.5 A, when disabled (EN = low), the power consumption is typically 250 nA, it is suitable for use in most low−voltage, portable electronic devices.

FPF1903 is in ultra−small WLCSP−4 package with 0.35 mm pin pitch.

### Features

- P−type Power Switch with Ideal Diode Feature
- IN Voltage Range: 1.2 V ~ 5.5 V
- Max Continuous Current Capability: 1.5 A
- Low Supply Quiescent Current 250 nA (Typ)
- ESD Performance: 2 kV HBM and 1.5 kV CDM
- Over−Temperature Protection (OTP)
- This is a Pb−Free Device

### Applications

- Mobile Handsets and Tablets
- Dual Power Source
- Dual Battery

## APPLICATION DIAGRAM

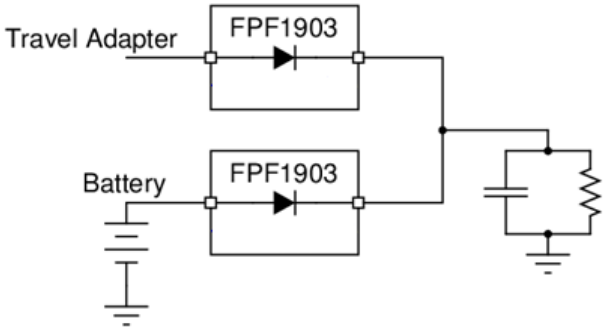



**Figure 1. Application in Dual Power Source**

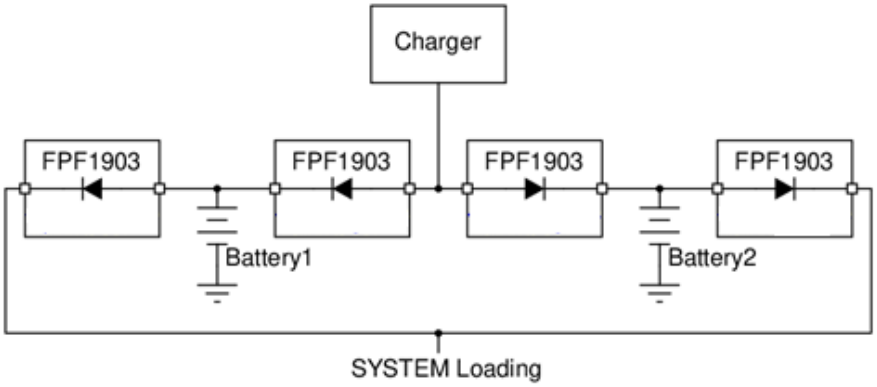



**Figure 2. Application in Dual Battery**

## BLOCK DIAGRAM

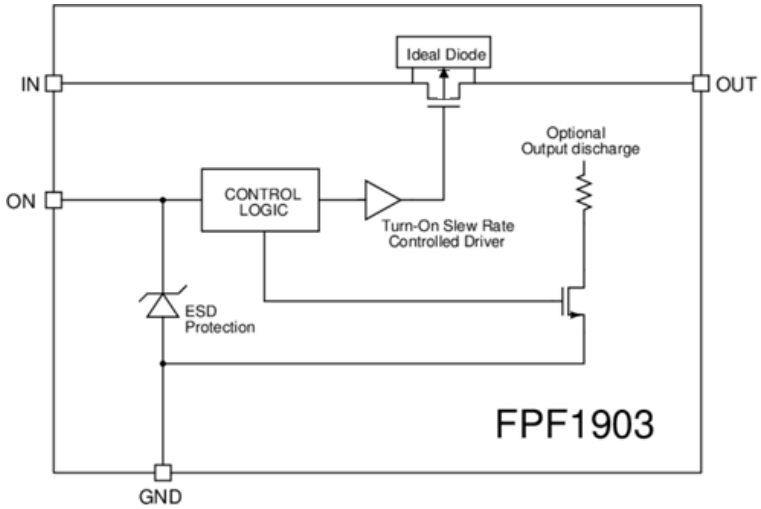



**Figure 3. Functional Block Diagram**

## PIN CONFIGURATION

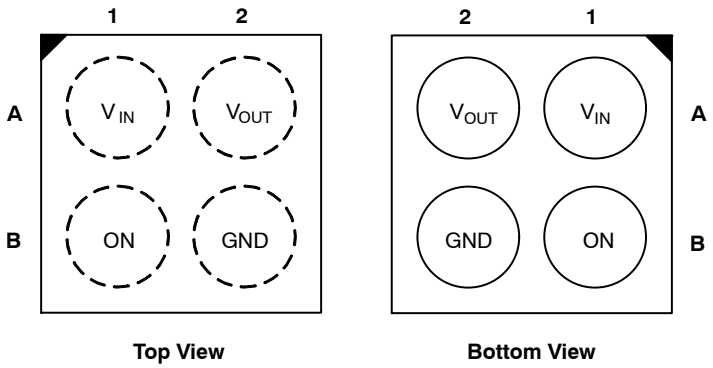



**Figure 4. Pin Configuration**

### PIN DEFINITIONS

| Name | Bump | Type | Description |
|---|---|---|---|
| $V_{IN}$ | A1 | Input/Output | Switch Input/Output and Power Paths Block Power Supply |
| $V_{OUT}$ | A2 | Input/Output | Switch Output/Input to Load |
| ON | B1 | Input | Active HIGH for Power Path |
| GND | B2 | GND | Ground |

### ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameters | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{IN}$ | IN to GND & IN to OUT = GND or Float | | −0.3 | 6 | V |
| $V_{OUT}$ | OUT to GND | | −0.3 | 6 | V |
| ON | ON to GND | | −0.3 | 6 | V |
| $I_{IN\_VOUT}$ | Continuous IN to OUT Current | | | 1.5 | A |
| | Peak IN to OUT Current (5 ms) | | | 3.0 | A |
| $T_{STG}$ | Storage Junction Temperature | | −65 | +150 | °C |
| $T_J$ | Operating Junction Temperature | | | +150 | °C |
| $T_L$ | Lead Temperature (Soldering, 10 seconds) | | | +260 | °C |
| ESD | Electrostatic Discharge Capability | Human Body Model, ANSI/ESDA/JEDEC JS−001 | 2 | | kV |
| | | Charged Device Model, JESD22−C101 | 1.5 | | |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameters | Min. | Max. | Unit |
|---|---|---|---|---|
| $V_{IN}$ | IN Operating Voltage | 1.2 | 5.5 | V |
| $C_{IN}$ | Input Capacitance for IN | 0.01 | | μF |
| $C_{OUT}$ | Output Capacitance for $V_{OUT}$ | 0.01 | 100 | μF |
| $T_A$ | Ambient Operating Temperature | −40 | 85 | °C |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

## ELECTRICAL CHARACTERISTICS

Unless otherwise noted, $V_{IN}$ = 1.2 V to 5.5 V, $T_A$ = −40°C to 85°C; typical values are at $V_{IN}$ = 5 V, $I_{IN} \le$ 1A, $C_{IN}$ = 1 μF and $T_A$ = 25°C.

| Symbol | Parameters | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **BASIC OPERATION** | | | | | | |
| $I_{Q\_IN}$ | Power Input Quiescent Current | $V_{IN}$ = 5.5 V, OUT floating, $V_{ON}$ = 5.5 V or 1.8 V, $T_A$ = 25°C | | 250 | 500 | nA |
| | | $V_{IN}$ = 5.5 V, OUT floating, $V_{ON}$ = 1.8 V or 5.5 V, $T_A$ = −40°C to 85°C | | | 600 | nA |
| $I_{SD\_IN}$ | Shutdown Current | $V_{IN}$ = 5 V, $V_{OUT}$ = 0 V, Disabled, $T_A$ = −40°C to +85°C | | 180 | 400 | nA |
| $I_{GND}$ | Ground Current (Note 1) | $V_{IN}$ = 0V, $V_{OUT}$ = 5.5 V, $V_{ON}$ = 0 V, $T_A$ = 25°C | | 180 | | nA |
| | | $V_{IN}$ = 0 V, $V_{OUT}$ = 5.5 V, $V_{ON}$ = 0 V, $T_A$ = −40°C to +85°C | | 200 | | |
| | | $V_{IN}$ = 5.5 V, $V_{OUT}$ = 5.5 V, $V_{ON}$ = 5.5 V, $T_A$ = −40°C to +85°C | | 200 | | |
| $T_{SDN}$ | Thermal Shutdown (Note 1) | | | 150 | | °C |
| $T_{SDN\_HYS}$ | Thermal Shutdown Hysteresis (Note 1) | | | 20 | | °C |
| **POWER SWITCH** | | | | | | |
| $I_{REV}$ | Reverse Current from OUT to IN | IN grounded, $V_{OUT}$ = 5.5 V, $T_A$ = −40 to 85°C | | 15 | 200 | nA |
| $V_{DROP}$ | Voltage Drop from IN to OUT | $I_{OUT}$ = 1 mA, $V_{IN}$ = 5 V, $T_A$ = 25°C | 10 | 20 | 40 | mV |
| | | $I_{OUT}$ = 1 mA, $V_{IN}$ = 5 V, $T_A$ = −40 to 85°C | | | 50 | |
| | | $I_{OUT}$ = 0.1 A, $V_{IN}$ = 5 V, $T_A$ = 25°C | 12 | 25 | 45 | |
| | | $I_{OUT}$ = 0.1 A, $V_{IN}$ = 5 V, $T_A$ = −40 to 85°C | | | 55 | |
| | | $I_{OUT}$ = 0.2 A, $V_{IN}$ = 5V, $T_A$ = 25°C | 15 | 30 | 55 | |
| | | $I_{OUT}$ = 0.2 A, $V_{IN}$ = 1.5V, $T_A$ = 25°C | | 90 | | |
| | | $I_{OUT}$ = 0.5 A, $V_{IN}$ = 5V, $T_A$ = 25°C (Note 1) | | 90 | | |
| | | $I_{OUT}$ = 1 A, $V_{IN}$ = 5V, $T_A$ = 25°C (Note 1) | | 100 | | |
| | | $I_{OUT}$ = 1.5 A, $V_{IN}$ = 5V, $T_A$ = 25°C (Note 1) | | 150 | | |
| $t_{DON}$ | Switch Turn−On Delay Time | Time from $V_{ON}$ > $V_{IH}$ to $V_{OUT}$ = 0.1 x $V_{IN}$, $V_{IN}$ = 5 V, $R_L$ = 100 Ω, $C_L$ = 0.1 μF | | 10 | | μs |
| $t_R$ | Switch Turn−On Rising Time | Time from $V_{OUT}$ = 0.1 x $V_{IN}$ to 0.9 x $V_{IN}$, $V_{IN}$ = 5 V, $R_L$ = 100 Ω, $C_L$ = 0.1 μF | | 20 | | μs |
| $t_{DOFF}$ | Switch Turn−Off Delay Time | Time from $V_{ON}$ < $V_{IL}$ to $V_{OUT}$ = 0.9 x $V_{IN}$, $V_{IN}$ = 5 V, $R_L$ = 100 Ω, $C_L$ = 0.1 μF | | 5 | | μs |
| $t_F$ | Switch Turn−Off Falling Time | Time from $V_{OUT}$ = 0.9 x $V_{IN}$ to 0.1 x $V_{IN}$, $V_{IN}$ = 5 V, $R_L$ = 100 Ω, $C_L$ = 0.1 μF | | 40 | | μs |
| **DIGITAL SIGNALS** | | | | | | |
| $V_{IH}$ | Logic Enable HIGH Voltage | ON/ONB input operating range | 0.78 | | | V |
| $V_{IL}$ | Logic Enable LOW Voltage | ON/ONB input operating range | | | 0.4 | V |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. This parameter is guaranteed by design and characterization; not production tested.

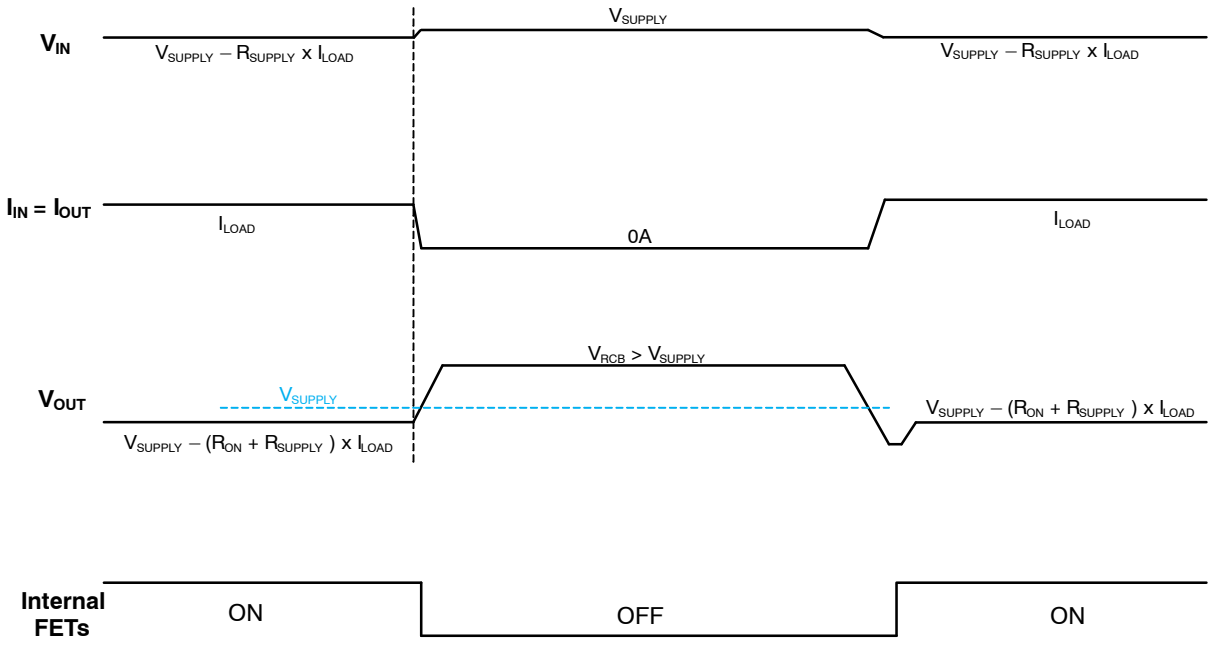



**Figure 5. Ideal Diode Behavior**

### Ideal Diode

When ON is high or floating, the device is in enable status:

- The on−resistance of the device will be regulated in light loading condition. There will be voltage drop from IN to OUT even with very low loading current. The drop depends on loading current.
- When $V_{OUT}$ is higher than $V_{IN}$, the internal MOSFET will be turned off entirely. Moreover, the body diode of the MOSFET is removed accordingly.
- When loading current is large enough, the MOSFET will be fully turned on and regulation on gate will not be implemented.

When ON is low, power FET will keep off and ideal diode function is disabled too. However, the reverse current from OUT to IN still be blocked.

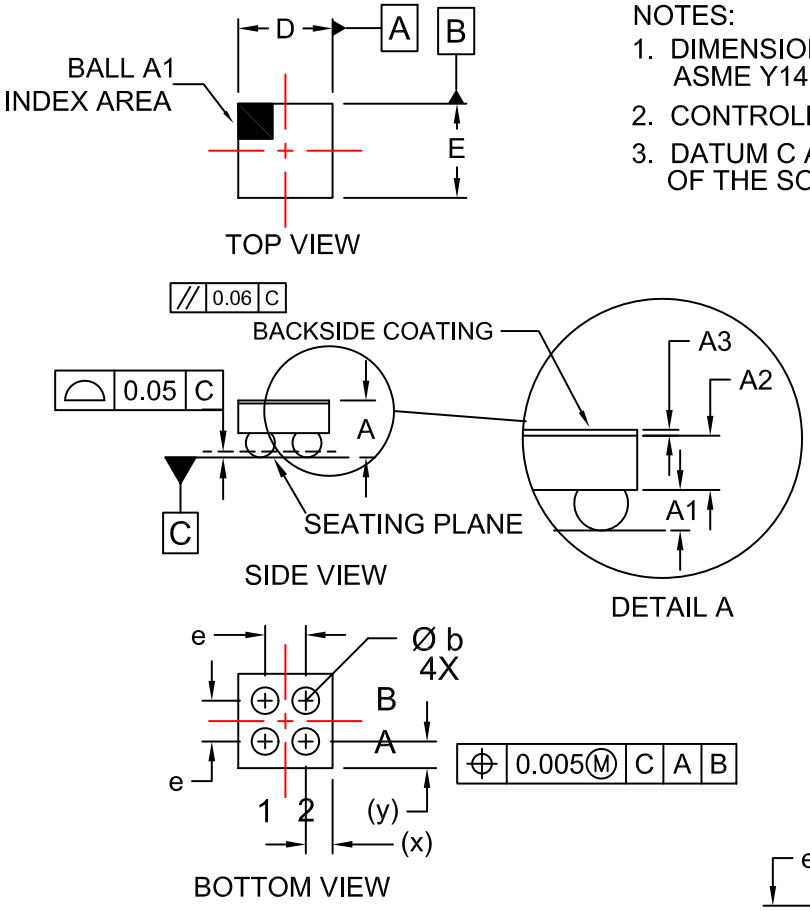
## ORDERING INFORMATION

| Part Number | Marking | Operating Temperature Range | Package | Shipping† |
|---|---|---|---|---|
| FPF1903UCX | 34 | −40°C to +85°C | 4−Ball, 0.35 mm Pitch WLCSP (WLCSP4) (Pb−Free) | Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

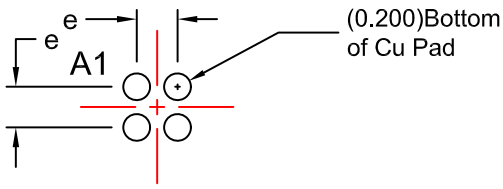
## PACKAGE DIMENSIONS

**WLCSP4 0.70x0.70x0.454**
CASE 567ZV
ISSUE O




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DATUM C APPLIES TO THE SPHERICAL CROWN OF THE SOLDER BALLS

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.413 | 0.454 | 0.495 |
| A1 | 0.154 | 0.174 | 0.194 |
| A2 | 0.237 | 0.255 | 0.273 |
| A3 | 0.022 | 0.025 | 0.028 |
| b | 0.210 | 0.230 | 0.250 |
| D | 0.67 | 0.7 | 0.73 |
| E | 0.67 | 0.7 | 0.73 |
| e | 0.35 BSC | | |
| x | 0.160 | 0.175 | 0.190 |
| y | 0.160 | 0.175 | 0.190 |




RECOMMENDED MOUNTING FOOTPRINT*
(NSMD PAD TYPE)

*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales