

300mA, Low Noise High PSRR LDO Regulator

Description

The FP6168 is a low dropout, low noise, high PSRR, low quiescent current positive linear regulator. The FP6168 can supply 300mA output current with low dropout voltage at about 160mV that optimized for battery-powered systems or portable wireless devices such as mobile phones. The shutdown function can provide remote control for the external signal to decide the on/off state of FP6168 that consumes less than 0.1 μ A during shutdown mode.

The FP6168 regulator is able to operate with output capacitors as small as 1 μ F for stability. The FP6168 fault protection includes the current limit protection and short current protection.

The FP6168 offers high precision output voltage of $\pm 1\%$. The FP6168 is available in UTDFN-4L (1.0mm \times 1.0mm) and SOT-23-5 packages which features small size.

Features

- Low V_{IN} and Wide V_{IN} Range: 1.9V to 5.5V
- Output Current 300mA^{*1}
- $\pm 1\%$ Output Voltage Accuracy
- Output Noise 65 μ V_{rms} from 10Hz to 100kHz
- V_{OUT} Fixed 1.0V to 3.3V
- Low Dropout Voltage of 160mV at 2.8V/300mA
- Ripple Rejection 80dB at 1kHz
- Low Quiescent Current at 10 μ A
- Needs Only 1 μ F Capacitor for Stability
- Inrush current protection
- Thermal Shutdown Protection
- Current Limit Protection
- Short Current Protection
- Output Discharge Function
- UTDFN-4L (1.0mm \times 1.0mm) and SOT-23-5 Packages
- RoHS Compliant

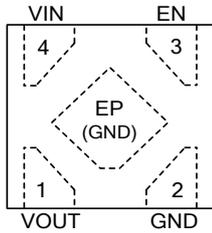
*1 Attention should be paid to the power dissipation of the package when the output current is large.

Applications

- PDAs, Mobile phones, GPS, Smartphones
- Wireless Handsets, Wireless LAN, Bluetooth®, Zigbee®
- Portable Medical Equipment
- Other Battery Powered Applications

Pin Assignment

X7 Package: UTDFN-4L (1.0mmx1.0mm) (Top view)



S5 Package: SOT-23-5

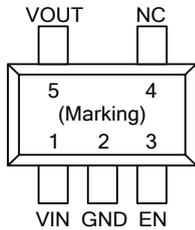
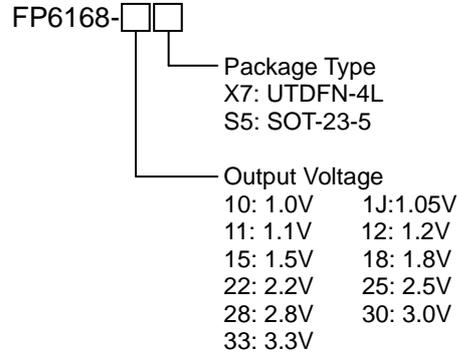


Figure 1. Pin Assignment of FP6168

Ordering Information



Marking Information

Part Number	Product Code
FP6168-10X7	bL
FP6168-1JX7	bM
FP6168-11X7	bN
FP6168-12X7	bP
FP6168-15X7	bR
FP6168-18X7	bS
FP6168-22X7	bT
FP6168-25X7	bU
FP6168-28X7	dA
FP6168-30X7	dB
FP6168-33X7	dC
FP6168-10S5	CH7
FP6168-1JS5	CH8
FP6168-11S5	CH9
FP6168-12S5	CN0
FP6168-15S5	CN1
FP6168-18S5	CN2
FP6168-22S5	CN3
FP6168-25S5	CN4
FP6168-28S5	CN5
FP6168-30S5	CN6
FP6168-33S5	CN7

Note: Please consult Fitipower sales office or authorized distributors for availability of special output voltages.

Typical Application Circuit

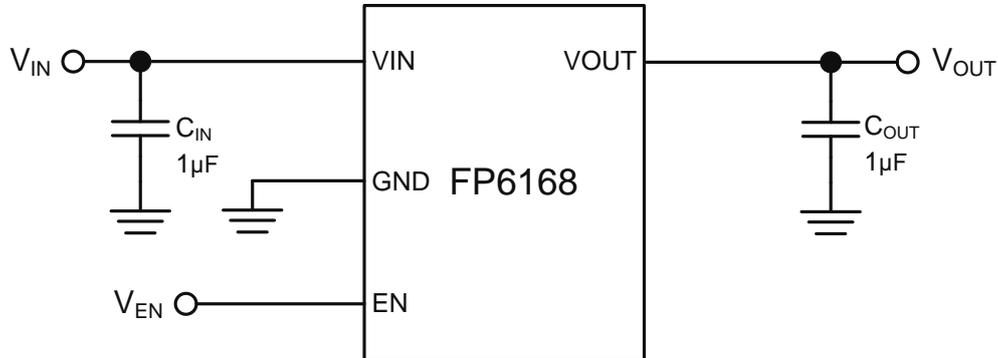


Figure 2. Typical Application Circuit of FP6168

Note 1: To prevent oscillation, it is recommended to use minimum 1µF X7R or X5R dielectric capacitors if ceramics are used as input/output capacitors.

Functional Pin Description

Pin Name	Pin No. (SOT-23-5)	Pin No. (UTDFN-4L)	Pin Function
VIN	1	4	Power is supplied to this device from this pin which is required an input filter capacitor. In general, the input capacitor in the range of 1µF to 10µF is sufficient.
GND	2	2	Common ground pin.
EN	3	3	Pull this pin high to enable IC, pull this pin low to shutdown IC. Floating this pin will be shutdown due to the built-in pull-low resistor.
NC	4	-	NC.
VOUT	5	1	The FP6168 is stable with an output capacitor 1µF or greater. The larger output capacitor will be required for application with larger load transients. The large output capacitor could reduce output noise, improve stability and PSRR.
Exposed pad	-	EP	The exposed pad must be soldered to a large PCB area and connected to GND for maximum power dissipation.

Block Diagram

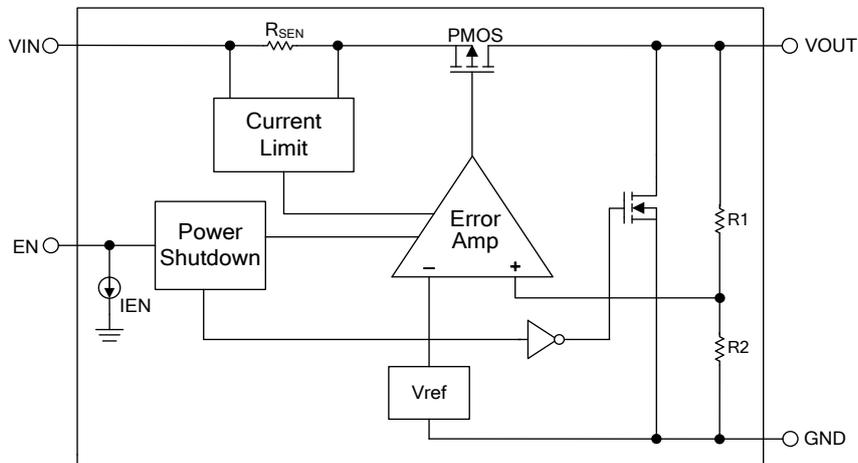


Figure 3. Block Diagram of FP6168

Absolute Maximum Ratings ^(Note 2)

- Supply Voltage V_{IN} ----- -0.3V to +6.5V
- Output Voltage V_{OUT} ----- -0.3V to +6.5V
- EN Voltage V_{EN} ----- -0.3V to $V_{IN} + 0.3V$
- Power Dissipation @ $T_A=25^\circ C$ & $T_J=125^\circ C$ (P_D)
 - UTDFN-4L (1.0mmx1.0mm) ----- 0.5W
 - SOT-23-5 ----- 0.4W
- Package Thermal Resistance (θ_{JA}) ^(Note 3)
 - UTDFN-4L (1.0mmx1.0mm) ----- 195°C/W
 - SOT-23-5 ----- 250°C/W
- Package Thermal Resistance (θ_{JC})
 - UTDFN-4L (1.0mmx1.0mm) ----- 65°C/W
 - SOT-23-5 ----- 130°C/W
- Lead Temperature (Soldering, 10sec.) ----- +260°C
- Junction Temperature (T_J) ----- -40°C to +150°C
- Storage Temperature (T_{STG}) ----- -65°C to +150°C

Note 2: Stresses beyond this listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

Note 3: θ_{JA} is measured at 25°C ambient with the component mounted on a high effective thermal conductivity 4-layer board of JEDEC-51-7. The thermal resistance greatly varies with layout, copper thickness, number of layers and PCB size.

Recommended Operating Conditions

- Supply Voltage V_{IN} ----- +1.9V to +5.5V
- Output Current I_{OUT} ----- 0mA to 300mA
- Operating Ambient Temperature Range ----- -40°C to +85°C
- Operating Junction Temperature Range ----- -40°C to +125°C

Electrical Characteristics

($V_{IN}=V_{OUT}+1V$, EN pin connected to V_{IN} , $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^{\circ}C$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Input Voltage Range	V_{IN}		1.9		5.5	V	
Quiescent Current ^(Note 4)	I_Q	$I_{OUT}=0A$	6	10	25	μA	
Standby Current	I_{STBY}	EN Pin Connected to GND		0.1	1	μA	
Output Voltage Accuracy	ΔV_{OUT}	$I_{OUT}=1mA$	-1		+1	%	
Dropout Voltage ^(Note 5)	V_{DROP}	$I_{OUT}=300mA$	$V_{OUT}=1.0V$	450	650	850	mV
			$V_{OUT}=1.05V$	410	590	770	
			$V_{OUT}=1.1V$	370	530	690	
			$V_{OUT}=1.2V$	310	440	570	
			$V_{OUT}=1.5V$	240	350	460	
			$V_{OUT}=1.8V$	160	230	300	
			$V_{OUT}=2.2V$	150	215	280	
			$V_{OUT}=2.5V$	130	180	230	
			$V_{OUT}=2.8V$	110	160	210	
			$V_{OUT}=3.0V$	100	150	200	
$V_{OUT}=3.3V$	90	135	180				
Line Regulation	ΔV_{LINE}	$I_{OUT}=1mA$, $V_{IN}=V_{OUT}+1V$ to 5V		1	8	mV	
Load Regulation ^(Note 6)	ΔV_{LOAD}	$I_{OUT}=1mA$ to 300mA		6	30	mV	
Ripple Rejection ^(Note 7)	PSRR	$V_{IN}=V_{OUT}+1V_{DC}+0.2V_{P-P(AC)}$, $f_{RIPPLE}=1KHz$, $I_{OUT}=20mA$		80		dB	
Output Noise Voltage ^(Note 7)	V_{NOISE}	$C_{OUT}=1\mu F$, $I_{OUT}=30mA$ $BW=10Hz \sim 100KHz$		65		μV_{RMS}	
Current Limit	I_{LIMIT}		320			mA	
Inrush current Limit	I_{RUSH}	$V_{OUT} > V_{OUT} * 30\%$, $C_{OUT}=22\mu F$, Time=0.2mS		150		mA	
Short Current Limit	I_{CFB}	$R_{Load}=1\Omega$	65	100	135	mA	
Output Discharge Resistance	R_{DIS}	$V_{EN}=0V$	35	60	90	Ω	
EN Pin Current	I_{EN}	$V_{EN}=2.5V$	0.09	0.3	1.11	μA	
EN Pin Threshold	$V_{EN(ON)}$	Start-up	1.0			V	
	$V_{EN(OFF)}$	Shutdown			0.4	V	
Thermal Shutdown Threshold ^(Note 7)	T_{SD}			160		$^{\circ}C$	
Thermal Shutdown Threshold Hysteresis ^(Note 7)	ΔT_{SD}			30		$^{\circ}C$	

Note 4: Except EN pull down current (I_{EN}).

Note 5: The dropout voltage is defined as $V_{IN}-V_{OUT}$, which is measured when V_{OUT} drops 2% of its normal value with the specified output current.

Note 6: Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.

Note 7: Guarantee by design.

Application Information

The FP6168 is a low dropout linear regulator that could provide 300mA output current at dropout voltage about 160mV (2.8V output voltage).

1. Output and Input Capacitor

The FP6168 regulator is designed to be stable with a wide range of output capacitors. The ESR of the output capacitor affects stability. Larger value of the output capacitor decreases the peak deviations and improves transient response for larger current changes.

The capacitor types (aluminum, ceramic, and tantalum) have different characterizations such as temperature and voltage coefficients. All ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applications. Common dielectrics used are X5R, X7R and Y5V. It is recommended to use 1 μ F to 22 μ F X5R or X7R dielectric ceramic capacitors with 30m Ω to 50m Ω ESR range between device outputs and ground for stability. The FP6168 is designed to be stable with low ESR ceramic capacitors and higher values of capacitors and ESR could improve output stability. The ESR of output capacitor is very important because it generates a zero to provide phase lead for loop stability.

There are no requirements for the ESR on the input capacitor, but its voltage and temperature coefficient have to be considered for device application environment.

2. Inrush Current Protection

The inrush current limit value at start-up increases in proportion to the capacitance of C_{OUT} . When the FP6168 is power on, the inrush current is limited to 100mA until output voltage is exceeds 30% of V_{OUT} voltage. Then the inrush current limit is increased to about 150mA, hold for about 200 μ s.

If the capacitance value of C_{OUT} is too large, the start-up time becomes longer and the time-out occurs (200 μ s), the inrush current increases, after that, all what limits the inrush current is the current limit protection value of the FP6168. Finally, output voltage reaches default value, and the output current decreases down to the value of continuous current required by the output load.

3. Protection Features

In order to prevent overloading condition from damaging the device, FP6168 has current limiting function designed to protect the device.

4. Thermal Consideration

The power handling capability of the device will be limited by allowable operation junction temperature (125 $^{\circ}$ C). The power dissipated by the device will be estimated by $P_D = I_{OUT} \times (V_{IN} - V_{OUT})$. The power dissipation should be lower than the maximum power dissipation listed in "Absolute Maximum Ratings" section.

5. Shutdown Operation

The FP6168 is shutdown by pulling the EN input low, and turned on by driving the EN high. If EN pin floating, the FP6168 will shut down because EN pin has built-in a pull low resistor (refer to Block Diagram).

6. Output Discharge Function

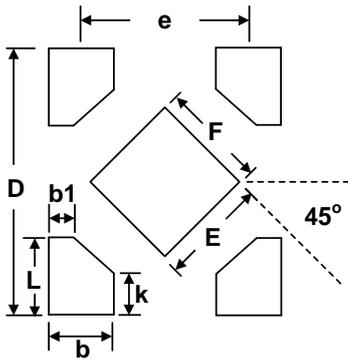
The FP6168 provides auto discharge function, an discharge MOSFET with $R_{DS(ON)}$ of 60 Ω typical is integrated between V_{OUT} and GND pins, which can discharge the charge of the output capacitors quickly when turning off FP6168 with EN pin.

7. PCB Layout Recommendation

Place the input capacitors and output capacitors as close to the device as possible. The traces which connect to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.

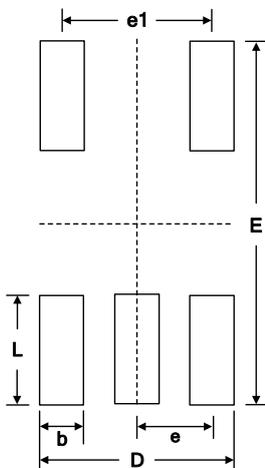
PCB Footprint

UTDFN-4L (1.0mm×1.0mm) Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER
D	1.3
E	0.48
F	0.48
L	0.4
k	0.22
b	0.25
b1	0.12
e	0.65

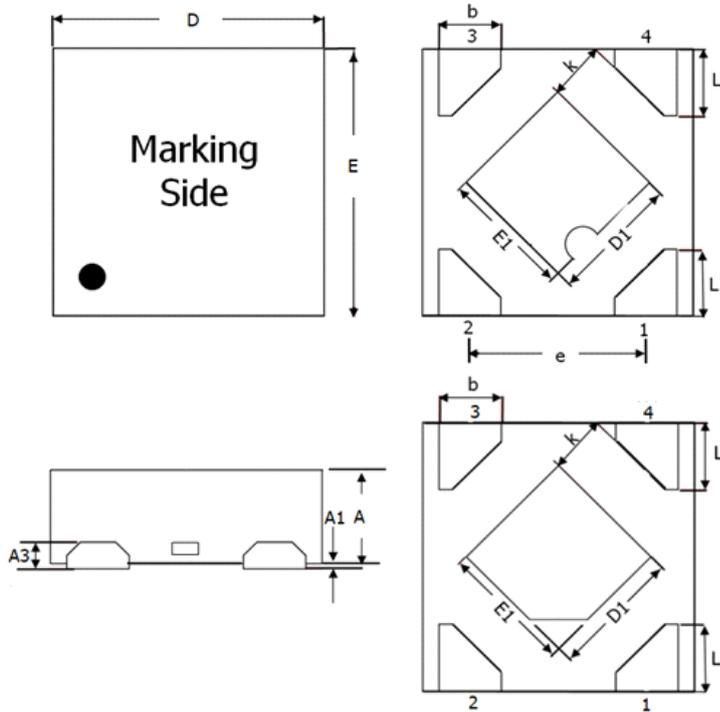
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER
b	0.55
D	2.45
E	3.80
L	1.27
e	0.95
e1	1.90

Outline Information

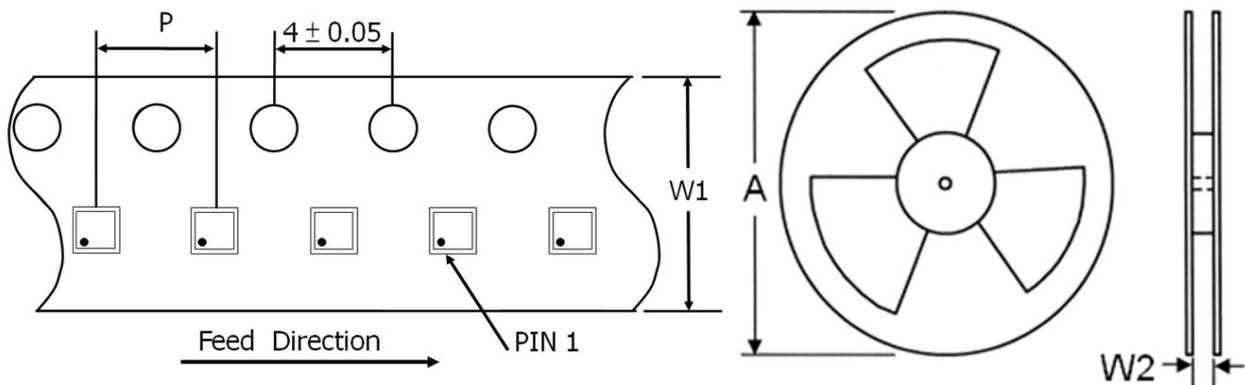
UTDFN-4L (1.0mmx1.0mm) (pitch 0.65mm) Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.32	0.60
A1	0.00	0.05
A3	0.07	0.20
D	0.95	1.05
E	0.95	1.05
D1	0.38	0.58
E1	0.38	0.58
k	0.20 REF.	
b	0.18	0.30
e	0.60	0.70
L	0.20	0.30

Note 8: Followed From JEDEC 664-1.

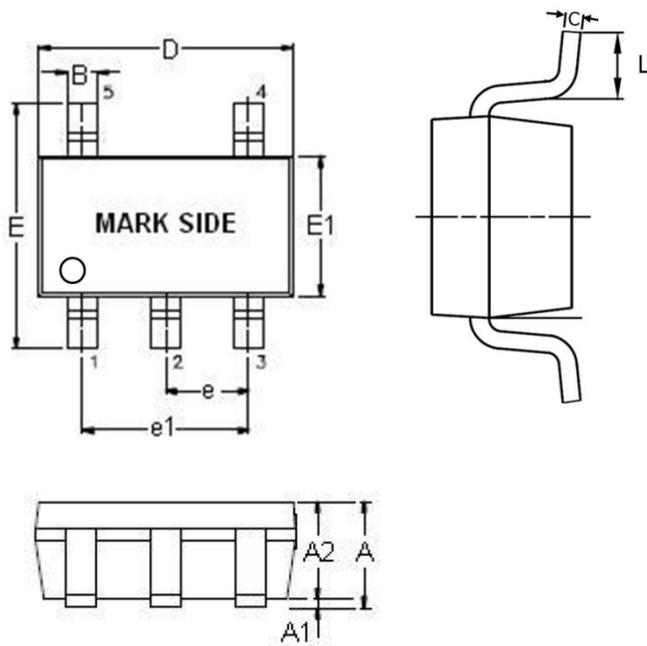
Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	9.5	400~1000	5000

Outline Information (Continued)

SOT-23-5 Package (Unit: mm)

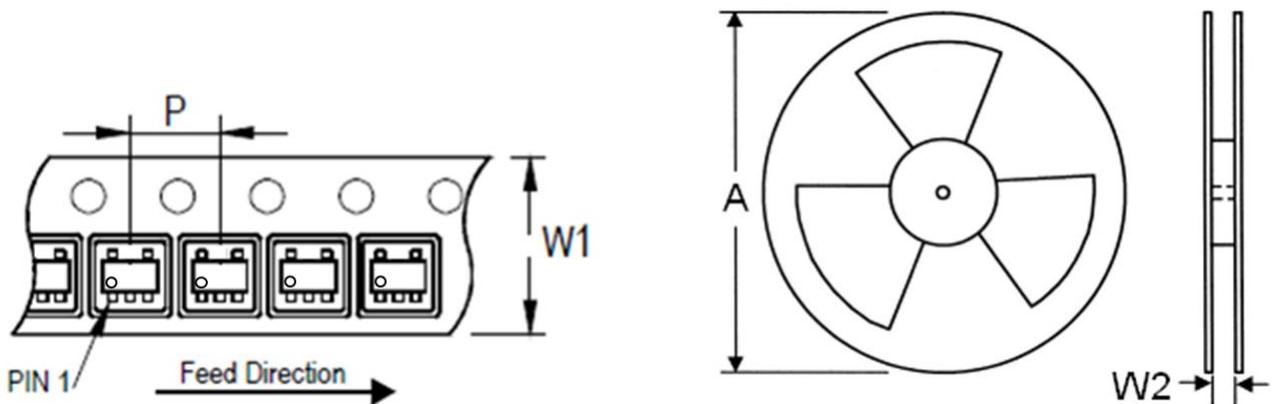


SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.30
A1	0.00	0.15
A2	0.90	1.15
B	0.28	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
C	0.08	0.20
L	0.30	0.60

Note 9: Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.3mm.

Note 10: Followed From JEDEC MO-178-C.

Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

Life Support Policy

Fitipower's products are not authorized for use as critical components in life support devices or other medical systems.