

300mA Low Noise LDO with Output Discharge Function

Description

The FP6186 is a family of CMOS low dropout (LDO) regulators with a low dropout voltage of 200mV at 300mA designed for noise-sensitive portable device, RF and wireless applications. Quiescent current of FP6186 is as low as 60 μ A and it works with low-ESR ceramic capacitors, which makes it very suitable for space sensitive handheld applications. The soft-start function will eliminate current surges during start-up and the output discharge function will dissipate the residue output voltage in the capacitor during shut-down.

Other features include current limit, thermal protection, high output accuracy, and low noise output etc..

The FP6186 is available in a SOT-23-5 package.

Features

- Low VIN and Wide VIN Range: 2.2V to 5.5V
- Guarantee Output Current 300mA
- VOUT Accuracy $\pm 1\%$
- Ripple Rejection 75dB at 1kHz
- Low Output Noise, 50 μ Vrms from 10Hz to 100kHz
- Quiescent Current as Low as 60 μ A
- Current Limit Protection
- Thermal Shutdown Protection
- 1 μ F Output Capacitor Required for Stability
- RoHS Compliant

Applications

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

Pin Assignments

S5 Package (SOT-23-5)

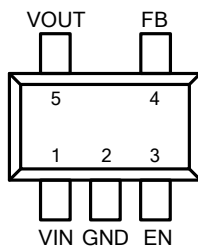


Figure 1. FP6186 Pin Assignments

Ordering Information



Marking Information

Part Number	Product Code
FP6186S5	FX1

Typical Application Circuit

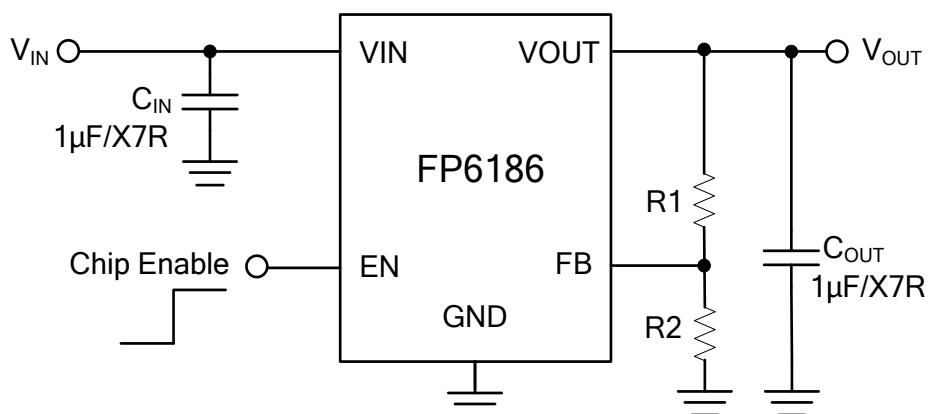


Figure 2. Typical Application Circuit for FP6186 adjustable voltage

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

Functional Pin Description

Pin Name	Pin No.	Pin Function
VIN	1	Supply voltage.
GND	2	Ground.
EN	3	Chip enable control input. Pull the pin high to enable IC, and pull low or keep it floating to disable the device.
FB	4	Feedback voltage pin.
VOUT	5	LDO output.

The diagram illustrates the control system of a voltage regulator. It features several key components and their interconnections:

- Inputs:** V_{IN} (input voltage) and EN (enable pin).
- Resistor:** A resistor labeled R_{SEN} is connected between V_{IN} and the **Current Limit** block.
- Current Limit:** A block that receives input from R_{SEN} and provides feedback to the **Error Amp**.
- Power Shutdown:** A block that receives input from EN and provides feedback to the **Error Amp**.
- Thermal Shutdown:** A block that provides feedback to the **Error Amp**.
- Error Amp:** An operational amplifier with a non-inverting input (+) connected to V_{ref} and an inverting input (-) receiving feedback from the **Current Limit**, **Power Shutdown**, and **Thermal Shutdown** blocks. Its output drives the **PMOS** transistor.
- PMOS:** A PMOS transistor whose source is connected to V_{IN} and whose gate is driven by the **Error Amp**.
- FB (Feedback):** A feedback signal taken from the output, passing through an inverter and then to the non-inverting input (+) of the **Error Amp**.
- Output:** The output of the PMOS transistor is V_{OUT} .
- Other Connections:** The EN pin is also connected to ground through a current source I_{EN} . The **FB** input is also connected to ground through a current source I_{FB} .

Absolute Maximum Ratings (Note 2)

- | | |
|---|-----------------|
| ● VIN, EN to GND ----- | -0.3V to +6V |
| ● Power Dissipation @25°C, (P _D)----- | 0.4W |
| ● Package Thermal Resistance, (θ _{JA})----- | 250°C/W |
| ● Package Thermal Resistance, (θ _{JC})----- | 130°C/W |
| ● Junction Temperature ----- | -40°C to +150°C |
| ● Storage Temperature Range (T _{STG}) ----- | -65°C to +150°C |
| ● Lead Temperature (Soldering, 10sec) ----- | +260°C |

Recommended Operating Conditions

- Supply Voltage (V_{IN}) ----- +2.2V to +5.5V
- Output Current (I_{OUT}) ----- 300mA
- Operating Temperature Range ----- -40°C to +85°C

Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input Voltage Range	V_{IN}		2.2		5.5	V
Output Voltage Accuracy	ΔV_{OUT}	$I_{OUT} = 10mA$	-1		+1	%
Quiescent Current	I_Q	$V_{EN}=5V$, $I_{OUT}=0A$		60		μA
Standby Current	I_{STBY}	$V_{EN}=0V$		0.1	1	μA
Feedback Reference	V_{FB}	$I_{OUT} = 10mA$	0.792	0.8	0.808	V
Current Limit	I_{LIM}	$R_{LOAD}=0\Omega$, $2.2V \leq V_{IN} \leq 5.5V$	0.45			A
Dropout Voltage (Note 3)	V_{DROP}	$I_{OUT}=300mA$	$V_{OUT}=1.2V$		700	mV
			$V_{OUT}=1.5V$		400	
			$V_{OUT}=1.8V$		290	
			$V_{OUT}=2.5V$		260	
			$V_{OUT}=2.7V$		240	
			$V_{OUT}=3.0V$		220	
			$V_{OUT}=3.3V$		200	
Line Regulation	ΔV_{LINE}	$I_{OUT}=1mA$, $V_{IN}=V_{OUT} + 1V$ to 5V		1	8	mV
Load Regulation (Note 4)	ΔV_{LOAD}	$I_{OUT} = 0 \sim 300mA$		6	30	mV
EN Threshold	$V_{EN(ON)}$	Start-up	1			V
	$V_{EN(OFF)}$	Shutdown			0.4	
Enable Pin Current	I_{EN}			0.3		μA
Output Noise Voltage (Note 5)	V_{ON}	$C_{OUT}=1\mu F$, $I_{OUT}=0A$		50		μV_{RMS}
Output Discharge Resistance	R_{DIS}	$V_{EN}=0V$		60		Ω
Ripple Rejection (Note 5)	PSRR	$V_{IN}=V_{OUT}+1V_{DC}+0.2V_{P-P(AC)}$, $f_{RIPPLE}=1KHz$, $V_{OUT} \geq 1.8V$, $I_{OUT}=10mA$		75		dB
Thermal Shutdown Threshold (Note 5)	T_{SD}			145		$^\circ C$
	ΔT_{SD}	Hysteresis		25		

Note 3 : 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 4 : Load regulation and dropout voltage are measured at a constant junction temperature by using a 40ms low duty cycle current pulse.

Note 5 : Guarantee by design.

Applications Information

The FP6186 is a low-noise, low-dropout, low-quiescent current linear regulator designed for space-restricted applications. These devices can supply loads up to 300mA. As shown in the block diagram, the FP6186 consists of a highly accurate band gap core, noise bypass circuit, error amplifier, P-channel pass transistor, soft start, fast discharge and an internal feedback voltage divider. The band gap reference is connected to the error amplifier's inverting input. The error amplifier compares this reference with the feedback voltage and amplifies the difference. If the feedback voltage is lower than the reference voltage, the pass transistor gate will be pulled low. This allows more current to pass to the output and increases the output voltage. If the feedback voltage is too high, the pass transistor gate will be pulled high, allowing less current to pass to the output. The output voltage is feedback through an internal resistor voltage divider connected to the VOUT pin. Additional blocks include a current limit, over temperature protection and shutdown logic. Besides, current limit and on chip thermal shutdown features provide protection against any combination of over-load or ambient temperature that could cause junction temperature exceeding maximum rating.

Output and Input Capacitor

The FP6186 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 transition response for larger current changes.

The capacitor types (aluminum, ceramic and tantalum) have different characterizations, such as temperature and voltage coefficients. All ceramic capacitors were 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 1.0μF to 4.7μF X5R or X7R dielectric ceramic capacitors with 10mΩ to 30mΩ ESR range between device outputs to ground for transient stability. The FP6186 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 is no requirement for the ESR on the input capacitor, but its voltage and temperature coefficient have to be considered for device application environment.

Current Limit

The FP6186 includes a current limit. It monitors the output current and controls the pass transistor's gate voltage to limit the output current under 450mA. The output can be shorted to ground for an indefinite amount of time without damaging the part.

Quick Discharge

The FP6186 has built-in a quick discharge circuitry to protect system function correct operation. This discharge block discharges output capacitor quickly to avoid low output voltage level to affect system's MCU abnormal work when IC is power off or enable pin pulls down.

Dropout Voltage

The minimum dropout voltage of LDO determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the FP6186 uses a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on resistance (R_{DS-ON}) multiplied by the load current

Over Temperature Protection

Over temperature protection limits total power dissipation in the FP6186. When the junction temperature exceeds 145°C, the thermal sensor will signal the shutdown logic and turn off the pass transistor. The thermal sensor will turn the pass transistor on again after the IC's junction temperature drops 25°C, resulting in a pulsed output during continuous thermal-overload conditions.

Thermal Consideration

The power handling capability of the device will be limited by maximum 125°C operation junction temperature. 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.

Applications Information (Continued)

Output Voltage Setting

The output voltage of regulator is determined by connecting external resistor dividers. The external resistor divider connects with FB pin. The output voltage is determined by the following equation:

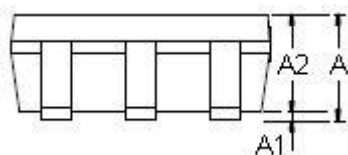
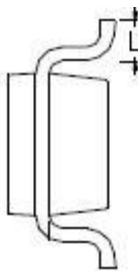
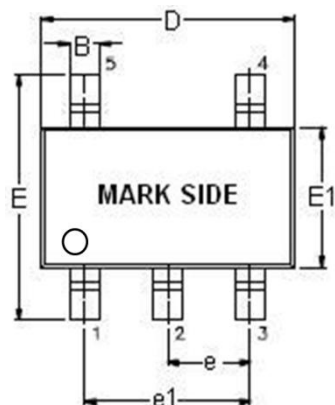
$$V_{OUT} = \frac{R1+R2}{R2} \times V_{FB} = \left(1 + \frac{R1}{R2}\right) \times 0.8$$

Active/Shutdown Input Operation

The FP6186 is turned off by pulling the EN pin low and turned on by pulling it high. The enable input is TTL/CMOS compatible threshold for simple logic interfacing. If this feature is not used, the EN pin should be connected to VIN to keep the regulator output operating normally. It will become shutdown with this pin floating because EN pin has built-in a pull down resistor (refer to Block Diagram).

Outline Information

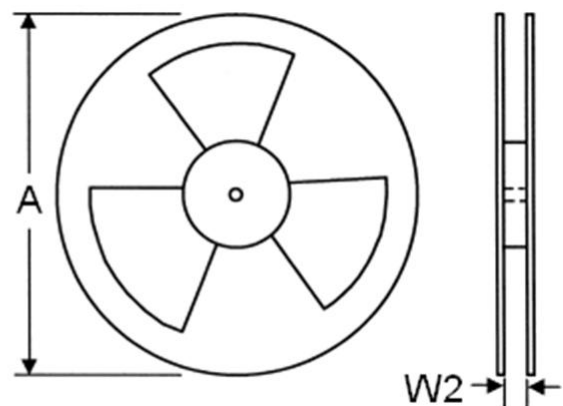
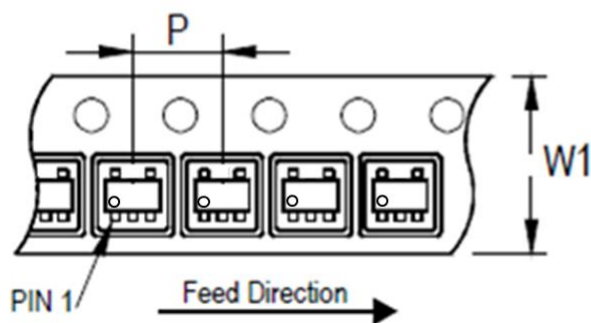
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
B	0.30	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
L	0.30	0.60

Note: 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.