FP6185

300mA, Low Noise High PSRR LDO Regulator

Description

The FP6185 is a low dropout, low noise, high PSRR, very low quiescent current positive linear regulator. The FP6185 can supply 300mA output current with low dropout voltage at about 400mV 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 FP6185 that consumes less than 0.1μA during shutdown mode.

The FP6185 regulator is able to operate with output capacitors as small as 1μF for stability. Other than the current limit protection, FP6185 also offers the on chip thermal shutdown feature providing protection against overload or any condition when the ambient temperature exceeds the maximum junction temperature.

The FP6185 offers high precision output voltage of ±2%.The FP6185 is available in SOT-23-5 package which features small size.

Features

- Low V_{IN} and Wide V_{IN} Range: 2V to 5.5V
- Output Current 300mA*1
- ±2% Output Voltage Accuracy
- Output Noise 65μVrms from 10Hz to 100kHz
- V_{OUT} Fixed 1.0V to 3.3V
- Low Dropout Voltage of 400mV at 300mA
- Ripple Rejection 75dB at 1KHz
- Very Low Quiescent Current at 35μA
- Needs Only 1μF Capacitor for Stability
- Thermal Shutdown Protection
- Current Limit Protection
- SOT-23-5 Package
- RoHS Compliant

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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

S5 Package (SOT-23-5)

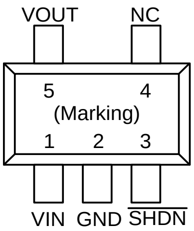


Figure 1. Pin Assignment of FP6185

Ordering Information

FP6185-□□

Package Type
S5: SOT-23-5

Output Voltage

11: 1.1V	12: 1.2V
15: 1.5V	18: 1.8V
25: 2.5V	27: 2.7V
28: 2.8V	29: 2.9V
30: 3.0V	33: 3.3V

Marking Information

Part Number	Product Code
FP6185-11S5	**FU4**
FP6185-12S5	**FD8**
FP6185-15S5	**FD9**
FP6185-18S5	**FE1**
FP6185-25S5	**FU5**
FP6185-27S5	**FU6**
FP6185-28S5	**FE3**
FP6185-29S5	**FE2**
FP6185-30S5	**FU7**
FP6185-33S5	**FE4**

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

Typical Application Circuit

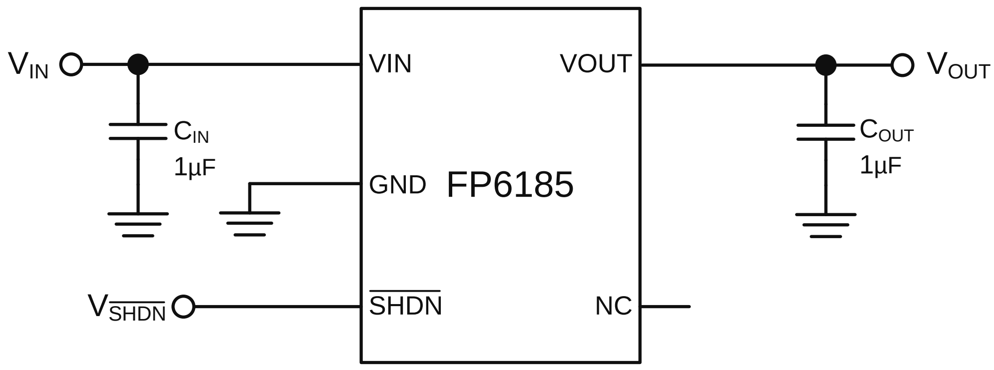


Figure 2. Typical Application Circuit of FP6185

Note: 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.	Pin Function
VIN	1	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	Common ground pin.
$\overline{\text{SHDN}}$	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	No connection.
VOUT	5	The FP6185 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.

Block Diagram

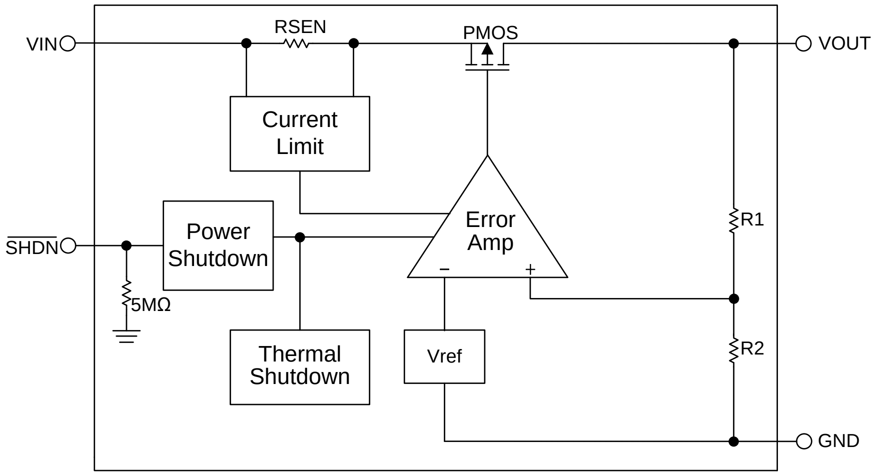


Figure 3. Block Diagram of FP6185

Absolute Maximum Ratings (Note 1)

- Supply Voltage V_{IN} -- -0.3V to +6.5V
- EN Voltage V_{EN} -- -0.3V to V_{IN}+0.3V
- Power Dissipation @ T_A=25°C & T_J=125°C (P_D)

  SOT-23-5 -- 0.4W
- Package Thermal Resistance (θ_{JA}) (Note 2)

  SOT-23-5 -- 250°C/W
- Package Thermal Resistance (θ_{JC})

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

- VIN Supply Voltage -- +2V to +5.5V
- Output Current (I_{OUT}) -- 0mA to 300mA
- Operating Temperature Range (T_{OPR}) --- -40°C to +85°C
- Operating Junction Temperature Range (T_J) -- -40°C to +125°C

Electrical Characteristics

(V_{IN}=V_{OUT}+1V, $\overline{SHDN}$ pin connected to V_{IN}, C_{IN}=1µF, C_{OUT}=1µF, T_A=25ºC, unless otherwise specified)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Input Voltage Range	V_{IN}			2		5.5	V
Current Limit	I_{LIMIT}	R_{Load}=1Ω		320			mA
Quiescent Current	I_Q	I_{OUT}=0mA			35		µA
Standby Current	I_{STBY}	$\overline{SHDN}$ Pin Connected to GND			0.1	1	µA
Output Voltage Accuracy	ΔV_{OUT}	I_{OUT}=1mA		-2		+2	%
Dropout Voltage (Note 3)	V_{DROP}	I_{OUT}=150mA	V_{OUT}=1.2V		800	1200	mV
			V_{OUT}=1.5V		600	900	
			V_{OUT}=1.8V		475	700	
			V_{OUT}=2.5V		275	400	
			V_{OUT}=2.7V		250	350	
			V_{OUT}=3.0V		225	325	
			V_{OUT}=3.3V		200	300	
Dropout Voltage (Note 3)	V_{DROP}	I_{OUT}=300mA	V_{OUT}=1.2V		1550	2300	mV
			V_{OUT}=1.5V		950	1400	
			V_{OUT}=1.8V		750	1100	
			V_{OUT}=2.5V		550	800	
			V_{OUT}=2.7V		500	700	
			V_{OUT}=3.0V		450	650	
			V_{OUT}=3.3V		400	600	
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}=0mA to 300mA			6	30	mV
Ripple Rejection (Note 5)	PSRR	V_{IN}=V_{OUT}+1V_{DC}+0.2$V_{P-P(AC)}$, f_{RIPPLE}=1KHz,V_{OUT}≧1.8V, I_{OUT}=30mA			75		dB
Output Noise Voltage (Note 5)	V_{NOISE}	C_{OUT}=1µF, I_{OUT}=0mA BW=10Hz ~ 100KHz			65		µV_{RMS}
Temperature Coefficient (Note 5)	TC	I_{OUT}=1mA, V_{IN}=5V			100		ppm/ºC
Thermal Shutdown Threshold (Note 5)	T_{SD}				145		ºC
	ΔT_{SD}	Hysteresis			25		ºC
Output Discharge Resistance	R_{DIS}	$V_{\overline{SHDN}}$=0V			60		Ω
$\overline{SHDN}$ Pin Current	$I_{\overline{SHDN}}$	$V_{\overline{SHDN}}$=2.5V			0.3		uA

Electrical Characteristics (Continued)

(V_{IN}=V_{OUT}+1V, $\overline{SHDN}$ pin connected to V_{IN}, C_{IN}=1µF, C_{OUT}=1µF, T_A=25ºC, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
$\overline{SHDN}$ Pin Threshold	$V_{\overline{SHDN}(ON)}$	Start-up	1.0			V
	$V_{\overline{SHDN}(OFF)}$	Shutdown			0.4	V

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.

Typical Performance Curves

$V_{IN}=V_{OUT}+1V$, $\overline{SHDN}$ pin connected to V_{IN}, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^oC$, unless otherwise specified

$V_{OUT}=3.3V$, $I_{OUT}=0mA$

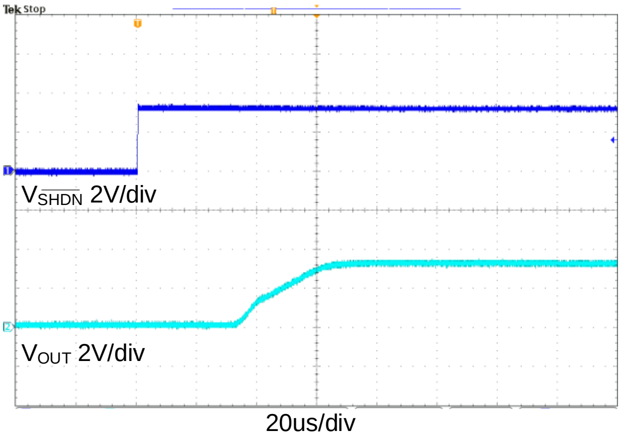


Figure 4. Turn ON Waveform

$V_{OUT}=3.3V$, $I_{OUT}=0mA$

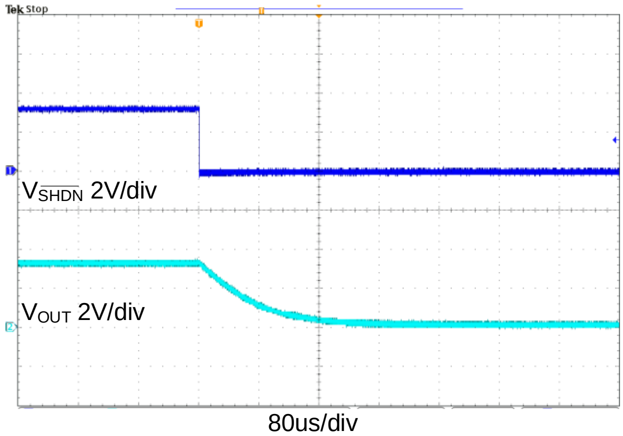


Figure 5. Turn OFF Waveform

$V_{OUT}=1.5V$, $I_{OUT}=0mA$

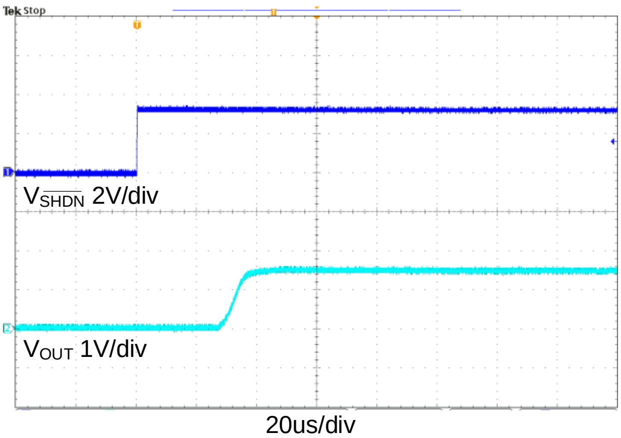


Figure 6. Turn ON Waveform

$V_{OUT}=1.5V$, $I_{OUT}=0mA$

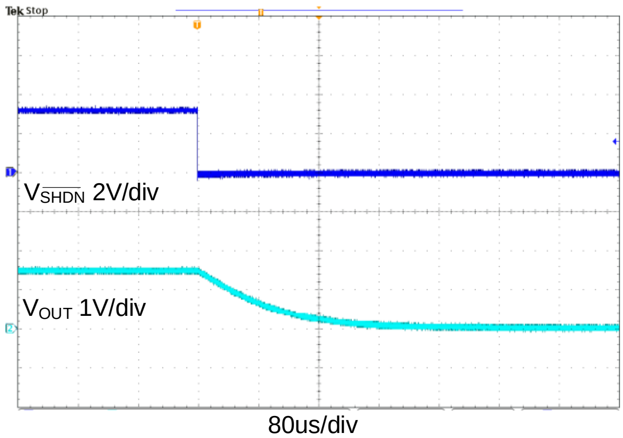


Figure 7. Turn OFF Waveform

$3.3V_{OUT}/I_{OUT}=1mA \rightarrow 300mA \rightarrow 1mA$

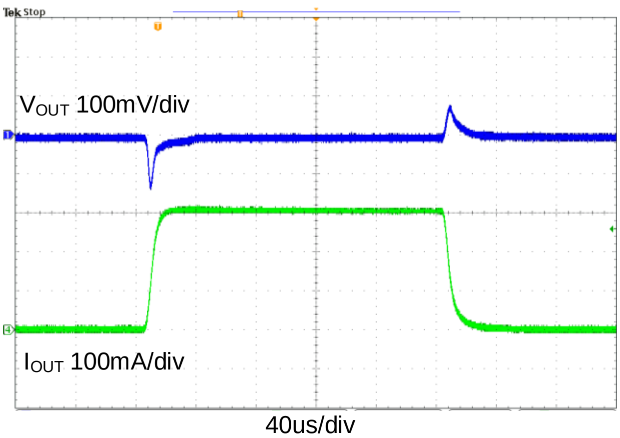


Figure 8. Load Transient Response

$1.5V_{OUT}/I_{OUT}=1mA \rightarrow 300mA \rightarrow 1mA$

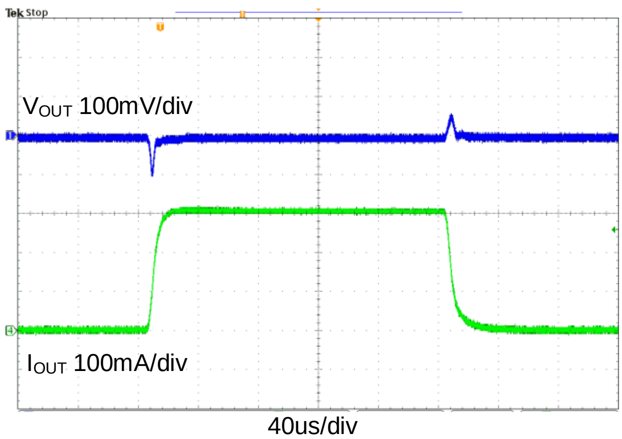


Figure 9. Load Transient Response

Typical Performance Curves (Continued)

$V_{IN}=V_{OUT}+1V$, $\overline{SHDN}$ pin connected to V_{IN}, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25^oC$, unless otherwise specified

$V_{OUT}=3.3V/10mA$, C_{IN}=none

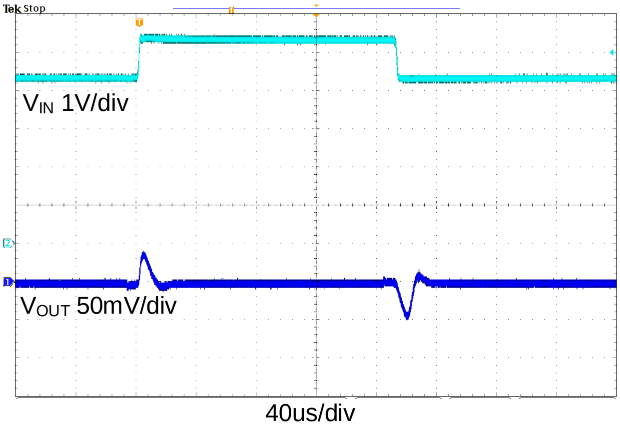


Figure 10. Line Transient Response

$V_{OUT}=1.5V/10mA$, C_{IN}=none

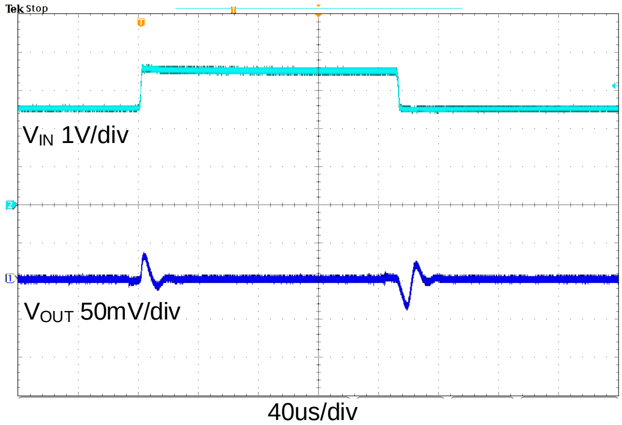


Figure 11. Line Transient Response

$I_{OUT}=1mA$

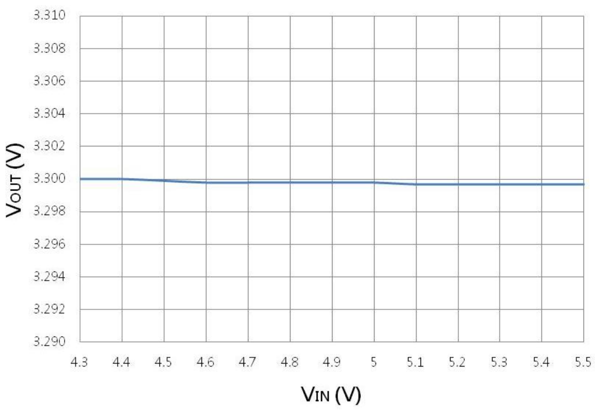


Figure 12. Output Voltage vs. Input Voltage

$I_{OUT}=1mA$

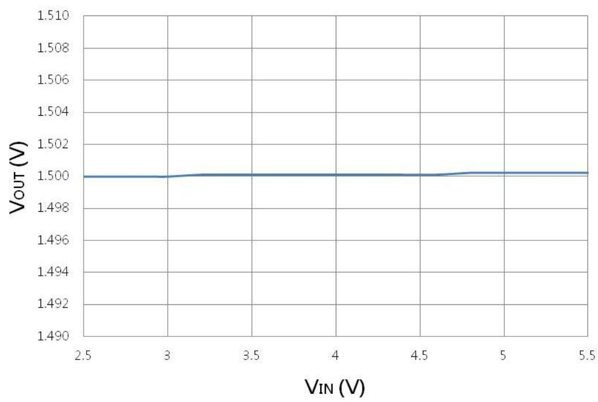


Figure 13. Output Voltage vs. Input Voltage

$V_{IN}=5V$

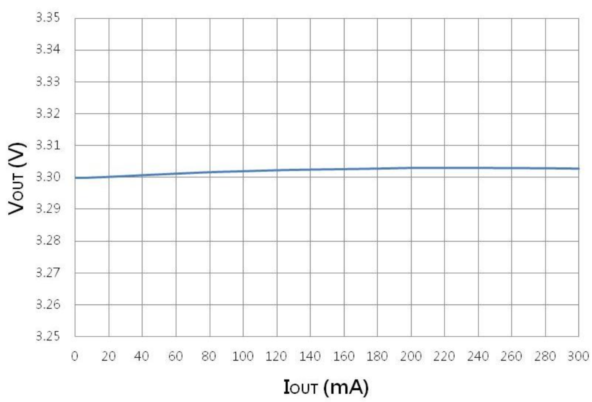


Figure 14. Output Voltage vs. Output Current

$V_{IN}=3.3V$

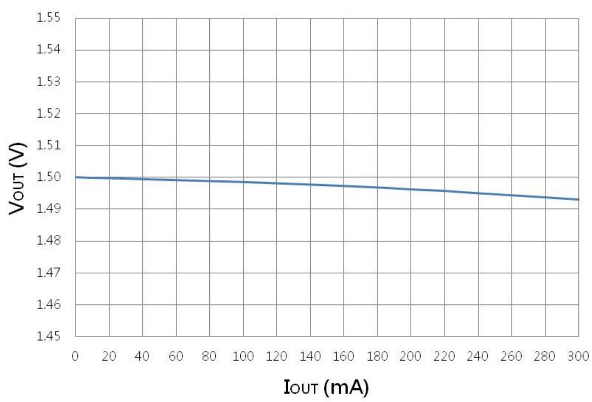


Figure 15. Output Voltage vs. Output Current

Typical Performance Curves (Continued)

V_{IN}=V_{OUT}+1V, $\overline{SHDN}$ pin connected to V_{IN}, C_{IN}=1µF, C_{OUT}=1µF, T_A=25ºC, unless otherwise specified

V_{OUT}=3.3V

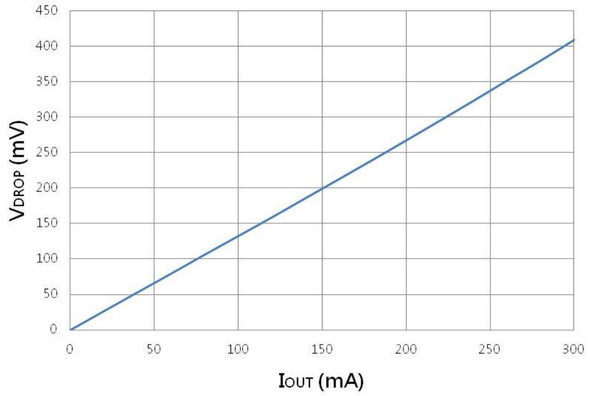


Figure 16. Dropout Voltage vs. Output Current

V_{OUT}=1.5V

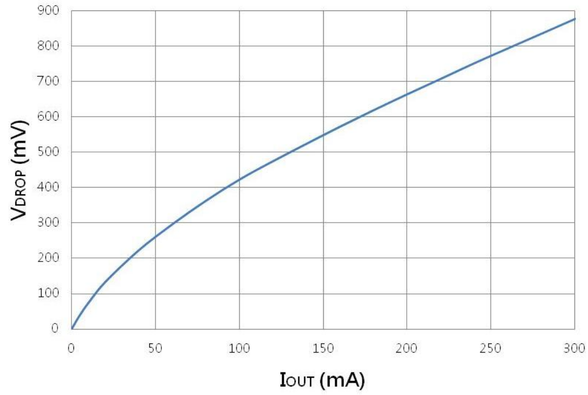


Figure 17. Dropout Voltage vs. Output Current

I_{OUT}=1mA

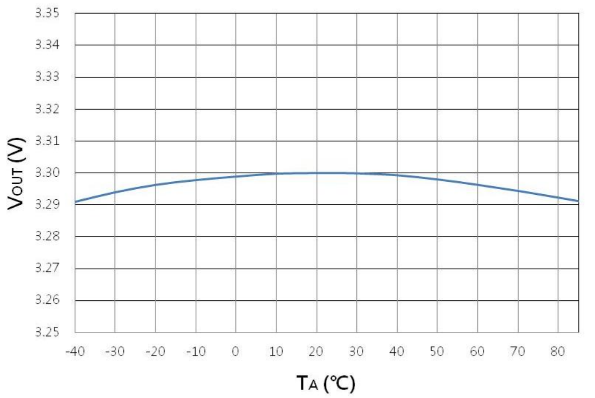


Figure 18. Output Voltage vs. Temperature

I_{OUT}=1mA

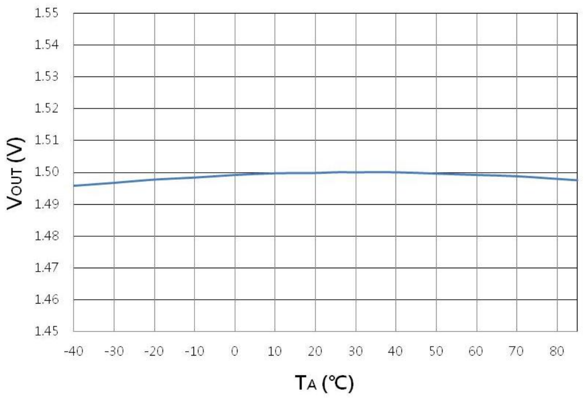


Figure 19. Output Voltage vs. Temperature

V_{IN}=4.3V, V_{OUT}=3.3V

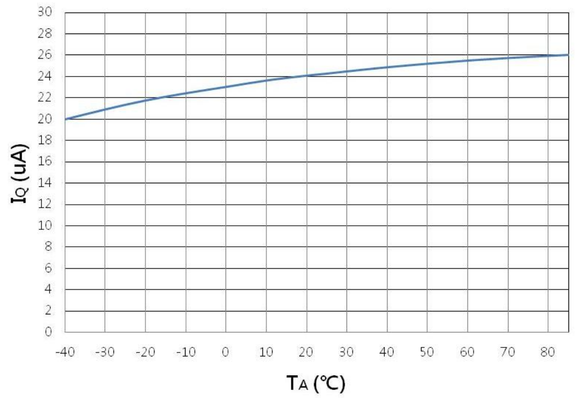


Figure 20. Quiescent Current vs. Temperature

V_{IN}=2.5V, V_{OUT}=1.5V

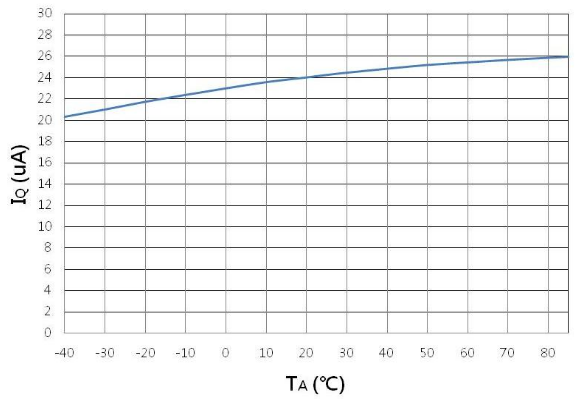


Figure 21. Quiescent Current vs. Temperature

Typical Performance Curves (Continued)

V_{IN}=V_{OUT}+1V, $\overline{SHDN}$ pin connected to V_{IN}, C_{IN}=1µF, C_{OUT}=1µF, T_A=25ºC, unless otherwise specified

V_{OUT}=3.3V, $V_{\overline{SHDN}}$=0V

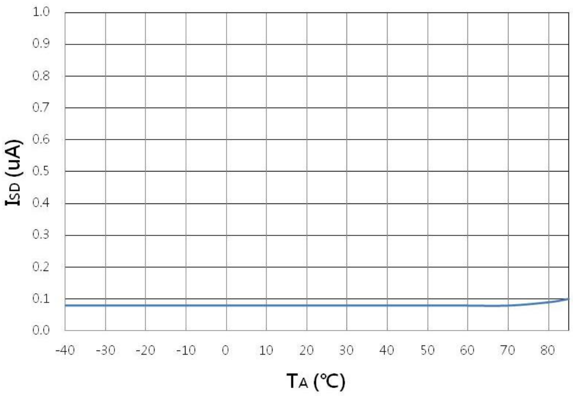


Figure 22. Shutdown Current vs. Temperature

V_{OUT}=1.5V, $V_{\overline{SHDN}}$=0V

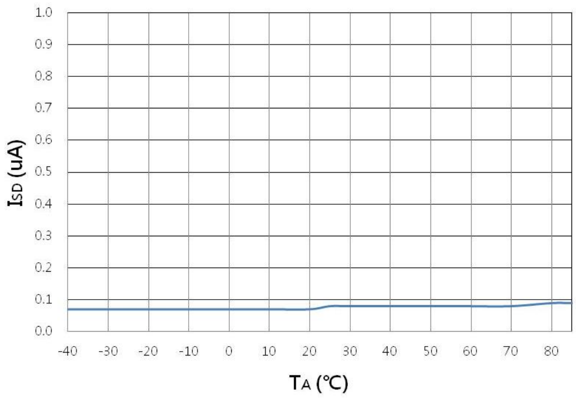


Figure 23. Shutdown Current vs. Temperature

V_{OUT}=3.3V, I_{OUT}=0mA

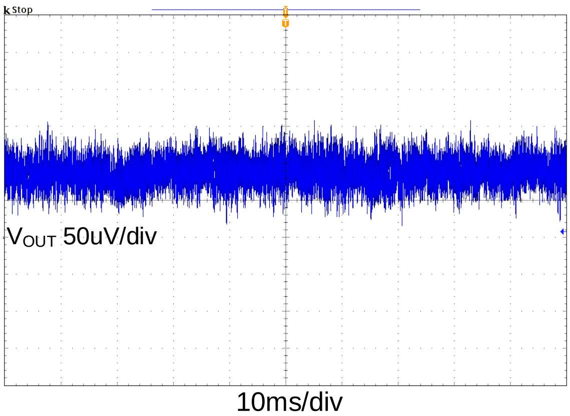


Figure 24. Output Noise Voltage

V_{OUT}=1.5V, I_{OUT}=0mA

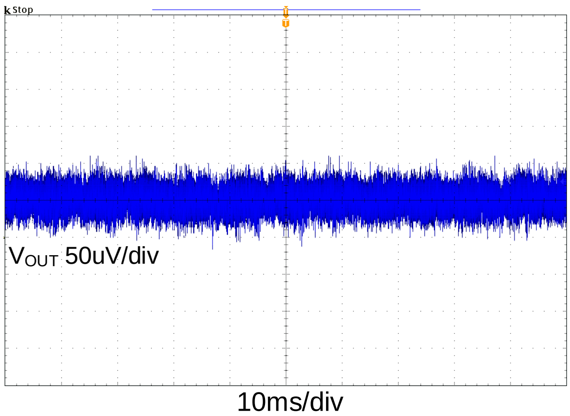


Figure 25. Output Noise Voltage

Application Information

The FP6185 is a low dropout linear regulator that could provide 300mA output current at dropout voltage about 400mV. Current limit and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed maximum junction temperature.

1. Output and Input Capacitor

The FP6185 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 1µF to 10µF X5R or X7R dielectric ceramic capacitors with 30mΩ to 50mΩ ESR range between device outputs and ground for stability. The FP6185 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. Protection Features

In order to prevent overloading or thermal condition from damaging the device, FP6185 has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during over-temperature condition.

3. Thermal Consideration

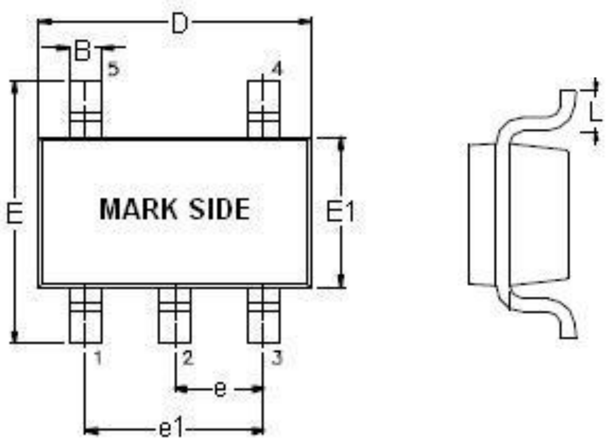
The power handling capability of the device will be limited by allowable operation junction temperature (125ºC). The power dissipated by the device will be estimated by $P_D=I_{OUT}\times(V_{IN}-V_{OUT})$. The power dissipation should be lower than the maximum power dissipation listed in "Absolute Maximum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

4. Shutdown Operation

The FP6185 is shutdown by pulling the $\overline{SHDN}$ input low, and turned on by driving the $\overline{SHDN}$ high. If $\overline{SHDN}$ pin floating, the FP6185 will shut down because $\overline{SHDN}$ pin has built-in a pull low resistor (refer to Block Diagram).

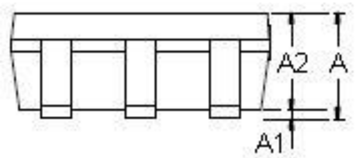
Outline Information

SOT-23-5 Package (Unit: mm)

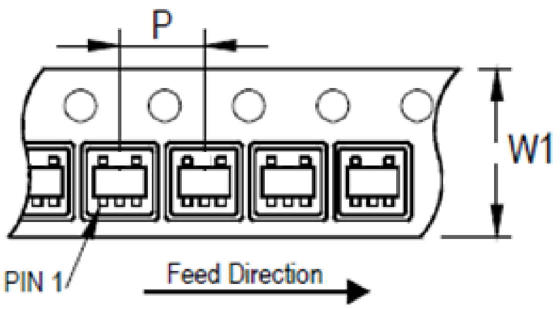


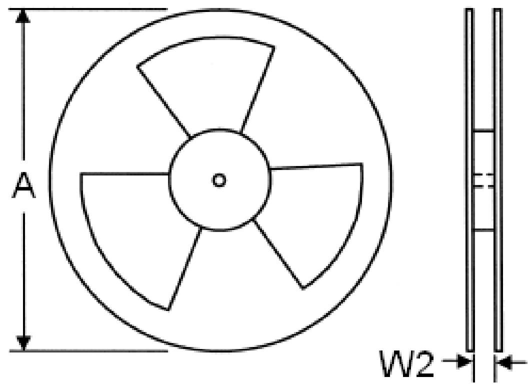
SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

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