Ultra Low Noise, Low-Dropout 150mA Linear Regulator

Description

The FP6151 is a CMOS low dropout, positive linear regulator with very low noise and quiescent current. With an external 0.01uF bypass capacitor, output noise is about 30μVrms over a 10Hz to 100KHz bandwidth. The FP6151 can supply 150mA output current with a lower dropout voltage about 150mV.

The FP6151 is suitable for portable RF and wireless application such as Cellular Handsets, The FP6151 is designed and optimized to work with low-value, low cost ceramic capacitors. The FP6151 consumes less than 0.1uA during shutdown mode. Besides its current limit protection and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed junction temperature.

The FP6151 includes a reference bypass pin in order to reduce output noise and a logic-controlled shut-down input.

The space-saving tiny SOT-23-5 and SC-82 packages are attractive for hand-held applications.

Features

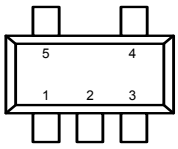
- Low 30μVrms Output Noise around 10Hz to 100KHz.
- Low Dropout Voltage of 150mV at 150mA Output Current
- Guaranteed 150mA Output Current
- Very Low Quiescent Current about 40uA
- Shutdown Function
- ± 2% Accuracy Output Voltage
- Needs Only 1μF Capacitor for Stability
- Thermal Shutdown and Current Limiting Protection Functions
- Low-ESR Ceramic Capacitor for Output Stability.
- RoHS Compliant

Applications

- Portable Instruments
- Battery Power System
- GSM and CDMA Cellular Handsets
- Wireless Devices
- PDA and Notebook Computers

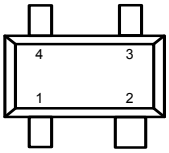
Pin Assignments

AS5 Package (SOT-23-5)



TOP VIEW
1. VIN
2. GND
3. $\overline{SHDN}$
4. BP
5. VOUT

C8 Package (SC-82)



TOP VIEW
1. $\overline{SHDN}$
2. GND
3. VOUT
4. VIN

Figure 1. Pin Assignment of FP6151

Ordering Information

FP6151-□□□□

- TR: Tape / Reel
  Blank: Tube
- P: Pb Free with Commercial Standard (RoHS Compliant)
- Package Type
  AS5: SOT-23-5
  C8: SC-82
- Output Voltage

15: 1.5V	2J: 2.85V
18: 1.8V	29: 2.9V
20: 2.0V	30: 3.0V
25: 2.5V	33: 3.3V
28: 2.8V	

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

SOT-23-5 Marking

Part Number	Product Code	Part Number	Product Code
FP6151-15AS5P	bA	FP6151-2JAS5P	bF
FP6151-18AS5P	bB	FP6151-29AS5P	bG
FP6151-20AS5P	bC	FP6151-30AS5P	bH
FP6151-25AS5P	bD	FP6151-33AS5P	bJ
FP6151-28AS5P	bE		

SC-82 Marking

Part Number	Product Code	Part Number	Product Code
FP6151-15C8P	bV	FP6151-2JC8P	b0
FP6151-18C8P	bW	FP6151-29C8P	b1
FP6151-20C8P	bX	FP6151-30C8P	b2
FP6151-25C8P	bY	FP6151-33C8P	b3
FP6151-28C8P	bZ		

Typical Application Circuit

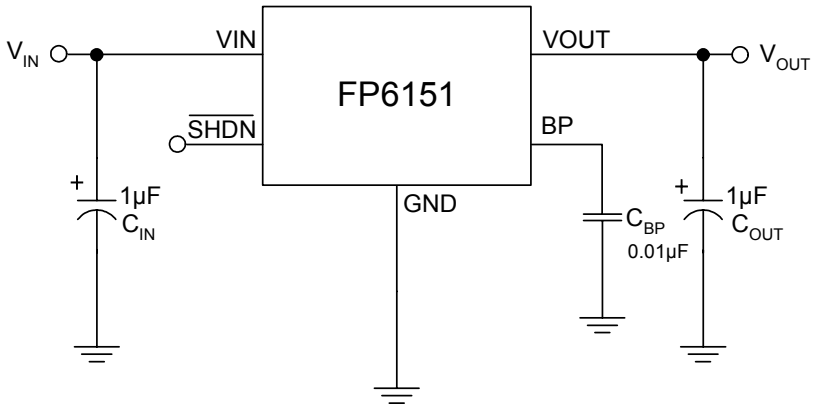


Figure 2. Typical Application Circuit of FP6151

Note：To provide 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 Function
VIN	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.
VOUT	The output supplies power to loads. The output capacitor is required to prevent output voltage unstable. The FP6151 is stable with an output capacitor 1μF or greater. The larger output capacitor will be required for application with large transit load to limit peak voltage transits, besides could reduce output noise, improve stability, PSRR.
GND	Common ground pin
BP	The noise Bypass. The BP Pin is used to augment the internal low pass filter to improve noise performance. Any value capacitor may be used; larger values will result in lower output noise but it will increase initial power start-up time. The shutdown exit delay time also will be affected. If not used, this pin must be left unconnected.
$\overline{SHDN}$	Pull this pin high to enable IC , pull this pin low to shutdown IC. Logic input control this device active or shut off. The shutdown pin can't be left floating and must be tied to the V_{IN} pin if not used.

Block Diagram

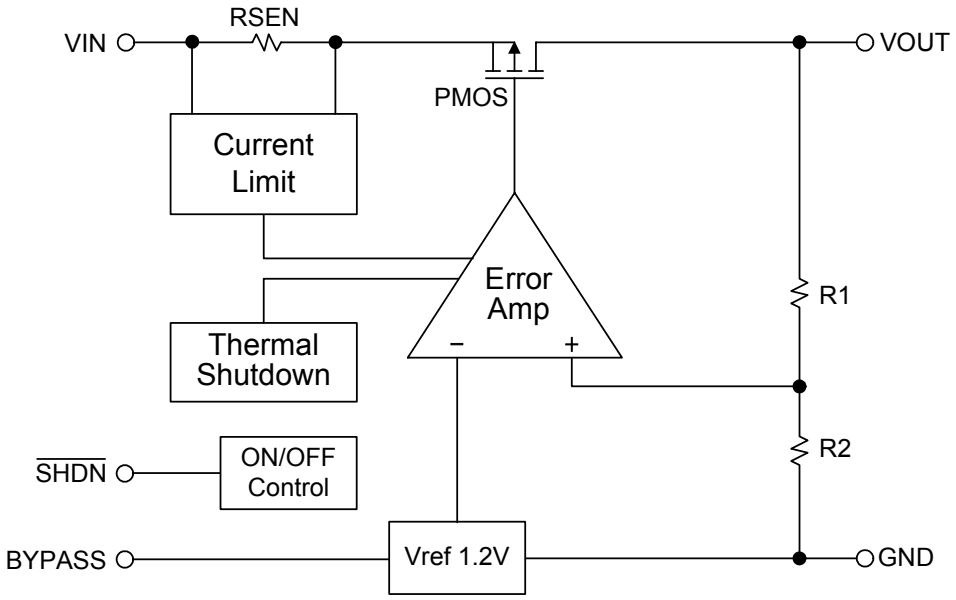


Figure 3. Block Diagram of FP6151

Absolute Maximum Ratings

- Supply Input Voltage (V_{IN})---------- - 0.3 to + 6V
- Maximum Junction Temperature (T_J)---------- + 150℃
- Power Dissipation：
  - SOT-25 (P_D) ---------- + 0.3W
  - SC-82 (P_D)--- ---------- + 0.15W
- Package Thermal Resistance：
  - SOT-25 (θ_{JA})---------- + 250℃/W
  - SC-82 (θ_{JA})---------- + 500℃/W
- Storage Temperature Range (T_S)---------- - 65 to + 150℃
- Lead Temperature (Soldering, 10 sec.) (T_{LEAD})---------- + 260℃

Note：Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

Recommended Operating Conditions

- Input Voltage (V_{IN})---------- + 2.8 to + 5.5V
- Operating Junction Temperature Range (T_J)---------- - 40 to + 125℃

Electrical Characteristics

(V_{IN}=V_{OUT}+1V or V_{IN}=2.8V whichever is greater, C_{IN}=1μF, C_{OUT}=1μF, T_A=25 ºC, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage Accuracy	ΔV_{OUT}	I_O= 1mA	-2		+2	%
Current Limit	I_{LIMIT}	R_{LOAD}=1Ω	200			mA
Quiescent Current	I_Q	I_O= 0mA		40		μA
Dropout Voltage (Note 1)	V_{DROP}	I_O=150mA 1.5V ≤ V_{OUT} ≤ 2.0V		600		mV
		I_O=150mA 2.0V < V_{OUT} ≤ 2.8V		200		
		I_O=150mA 2.8V < V_{OUT} ≤ 4.5V		150		
Line Regulation	ΔV_{LINE}	I_O=1mA, V_{IN}=V_{OUT} +1V to 5V		3	10	mV
Load Regulation (Note 2)	ΔV_{LOAD}	I_O=0mA to 150mA		20	60	mV
Ripple Rejection	PSRR	V_{IN}=V_{OUT}+1V f_{RIPPLE} = 1KHz, C_{OUT} = 1μF		65		dB
Output Noise	E_{NO}	10Hz to 100KHz, C_{BP}= 0.01μF		30		μVrms
Standby Current	I_{STBY}	$\overline{SHDN}$=GND, Shutdown			0.2	μA
$\overline{SHDN}$ Input Bias Current	I_{IBSD}	$\overline{SHDN}$=V_{IN} or GND			100	nA
$\overline{SHDN}$ Threshold (logic High)	V_{IH}	V_{IN}=5V,Enable	1.0			V
$\overline{SHDN}$ Threshold (logic Low)	V_{IL}	V_{IN}=5V,Shutdown			0.4	V
Temperature Coefficient	T_C	I_{OUT} = 1mA, V_{IN} = 5V		50		ppm/ ºC
Thermal Shutdown Temperature	T_{SD}			160		ºC
Thermal Shutdown Hysteresis	ΔTSD			25		ºC

Note 1：The dropout voltage is defined as V_{IN}-V_{OUT}, which is measured when V_{OUT} drops about 100mV.

Note 2：Regulation is measured at a constant junction temperature by using 40ms current pulse and load regulation in the load range from 0mA to 150mA.

Typical Performance Curves

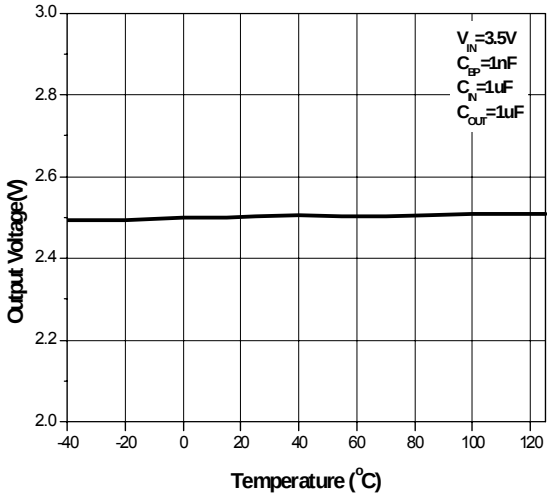


Figure 4. Output Voltage vs. Temperature (V_{OUT}=2.5V)

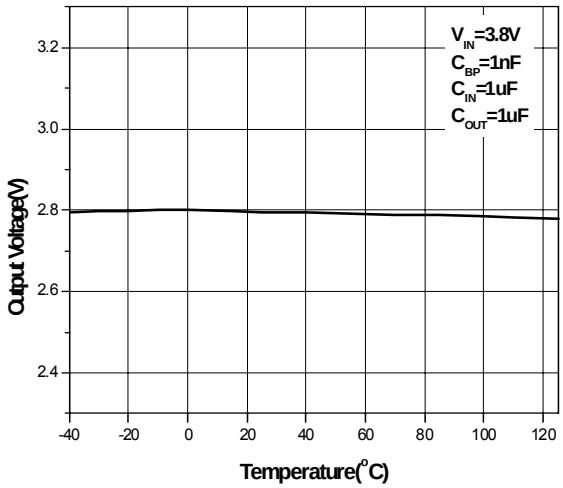


Figure 5. Output Voltage vs. Temperature (V_{OUT}=2.8V)

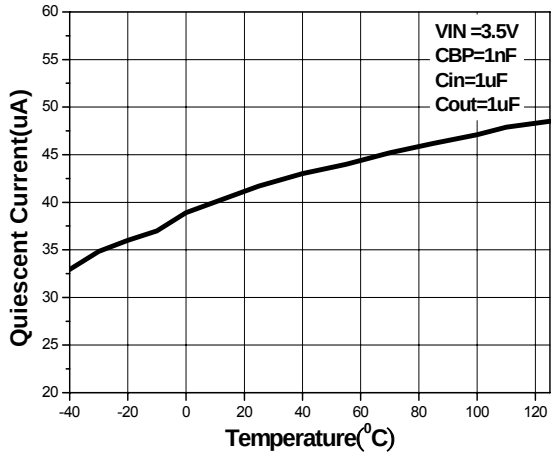


Figure 6. Quiescent Current vs. Temperature (V_{OUT}=2.5V)

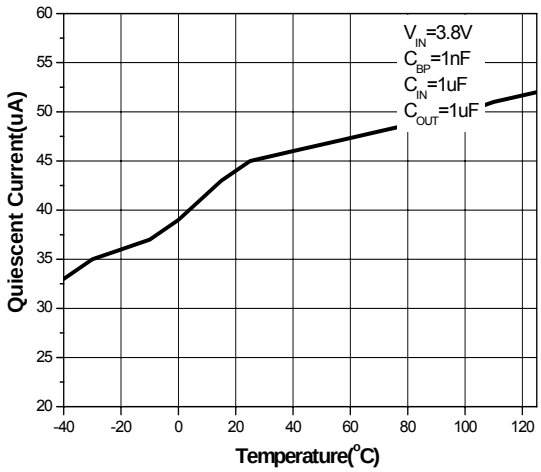


Figure 7. Quiescent Current vs. Temperature (V_{OUT}=2.8V)

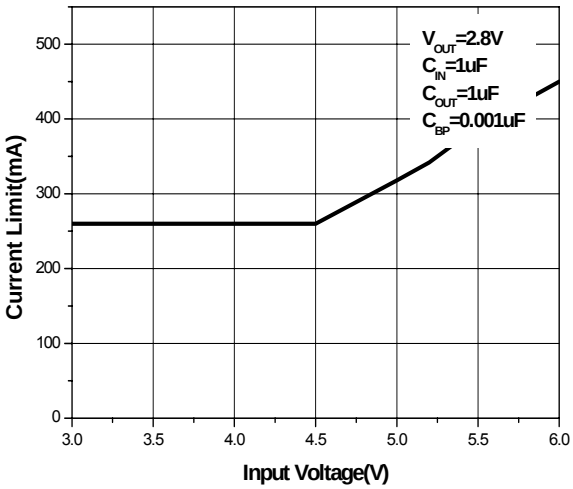


Figure 8. Current limit vs. Input Voltage

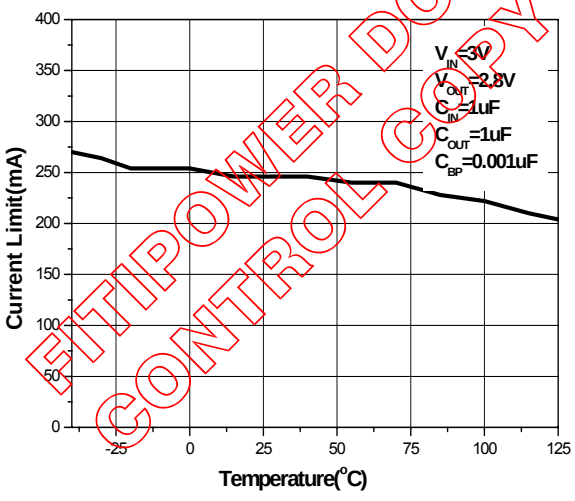


Figure 9. Current limit vs. Temperature

Typical Performance Curves (Continued)

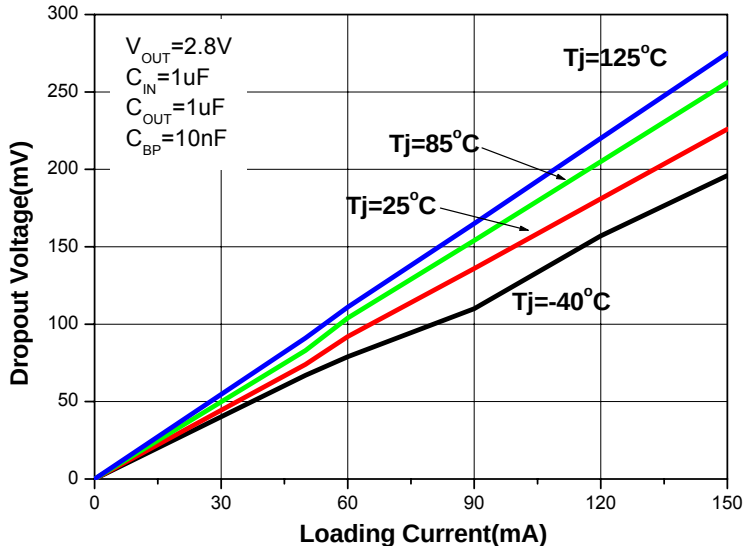


Figure 10. Dropout Voltage vs. Loading Current

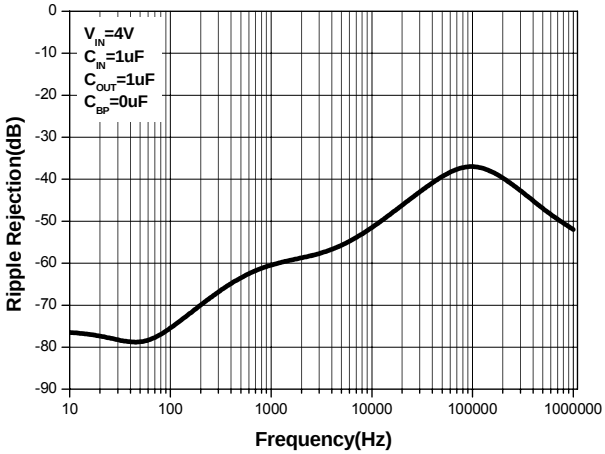


Figure 11. Ripple Rejection

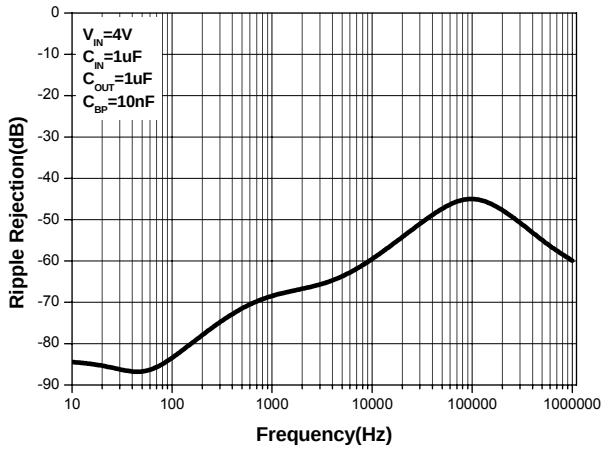


Figure 12. Ripple Rejection

V_{IN}=4~5V V_{OUT}=2.8V I_{OUT}=1mA
C_{IN}=C_{OUT}=2.2uF C_{BP}=0.01uF

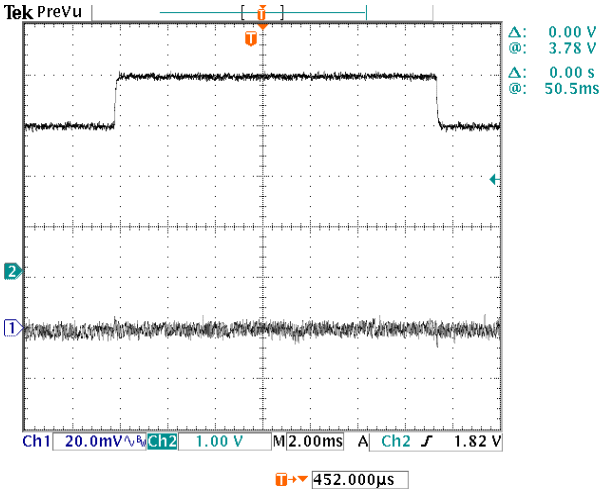


Figure 13. Line Transition Response

V_{IN}=4~5V V_{OUT}=2.8V I_{OUT}=10mA
C_{IN}=C_{OUT}=2.2uF C_{BP}=0.01uF

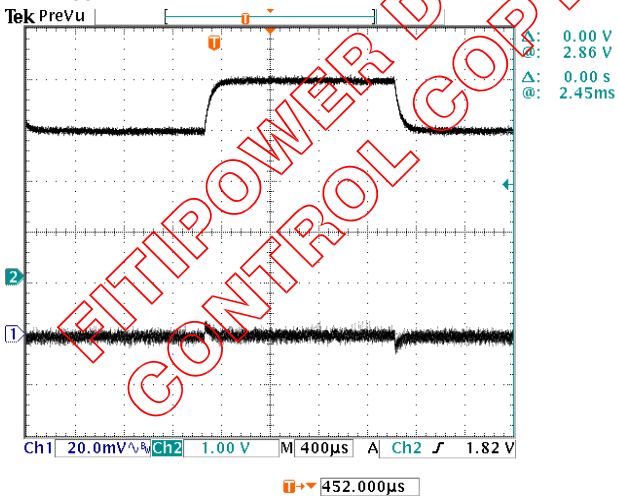


Figure 14. Line Transition Response

Typical Performance Curves (Continued)

V_{IN}=4V V_{OUT}=2.8V I_{OUT}=1~100mA
C_{IN}=C_{OUT}=1uF C_{BP}=0.01uF

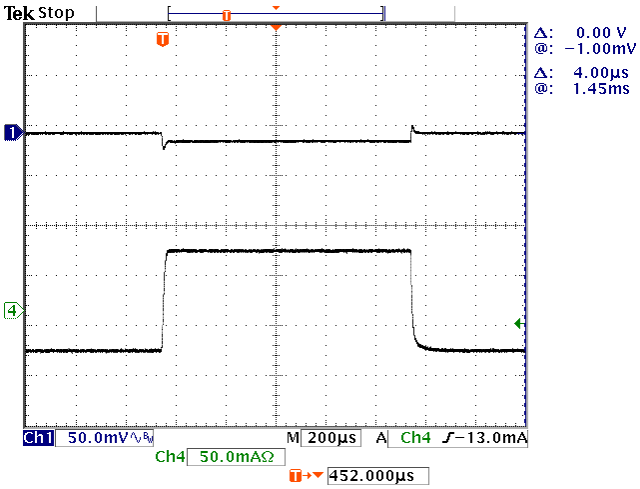


Figure 15. Load Transition Response

V_{IN}=4V V_{OUT}=2.8V I_{OUT}=1~100mA
C_{IN}=C_{OUT}=2.2uF C_{BP}=0.01uF

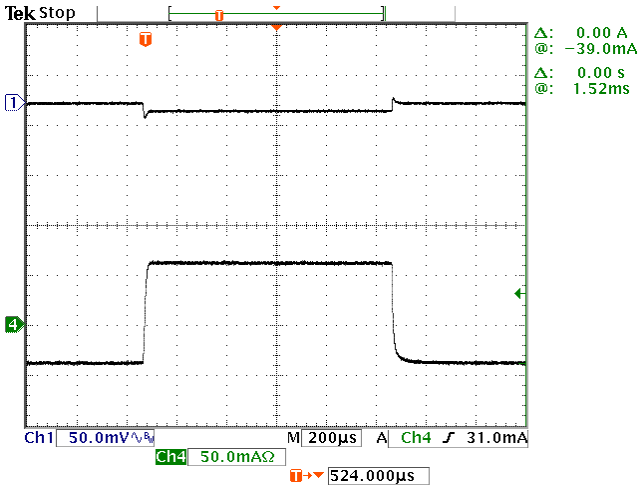


Figure 16. Load Transition Response

V_{IN}=4V V_{OUT}=2.8V C_{BP}=0uF
I_{OUT}=100mA C_{IN}=C_{OUT}=2.2uF

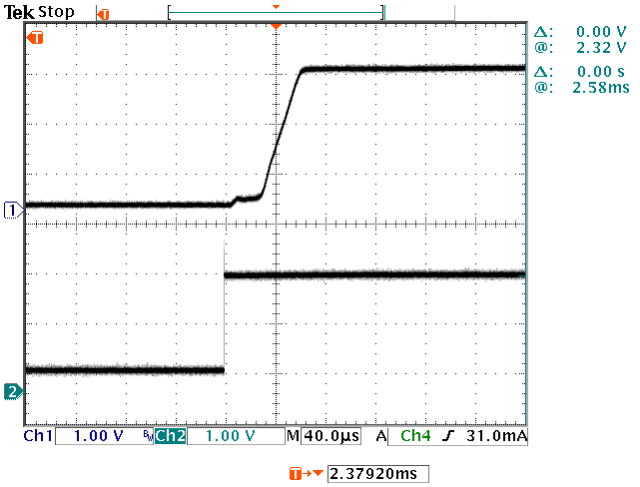


Figure 17. Shutdown Exit Time

V_{IN}=4V V_{OUT}=2.8V C_{BP}=0uF
I_{OUT}=100mA C_{IN}=C_{OUT}=2.2uF

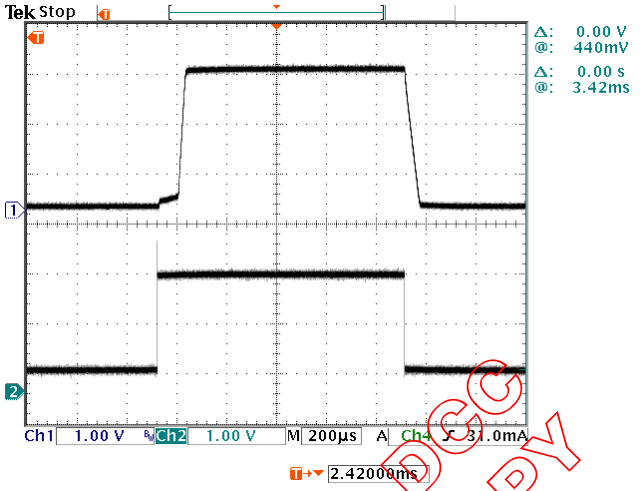


Figure 18. Shutdown Exit Time

Application Information

The FP6151 series are low dropout linear regulators that could provide 150mA output current at dropout voltage about 150mV. Besides, current limit and on chip thermal shutdown features provide protection against any combination of overload or ambient temperature that could exceed junction temperature.

1. Output and Input Capacitor

The FP6151 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 provides to improve 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 1uF to 10uF X5R or X7R dielectric ceramic capacitors with 30mΩ to 50mΩ ESR range between device outputs to ground for transient stability. The FP6151 is designed to be stable with low ESR ceramic capacitors and higher values of capacitors and ESR could improve output stability.

So 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 the capacitor voltage and temperature coefficients have to be considered for device application environment.

2. Protection Features

In order to prevent overloading or thermal condition to damage device, FP6151 regulator has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

3. Thermal Consideration

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

The power dissipated by the device will be made up of PD=I_{OUT} ×(V_{IN}-V_{OUT}). The power dissipation should be lower than the maximum power dissipation listed in “Absolute Maximum Ratings”.

4. Noise Bypass capacitor

The BP pin connecting a 0.01uF or 0.001uF capacitor that could reduce noise and improve PSRR on the regulator output. Besides it also affects start up time and shutdown exit time. The smaller the capacitor value, the shorter the power up time.

5. No-Load Stability

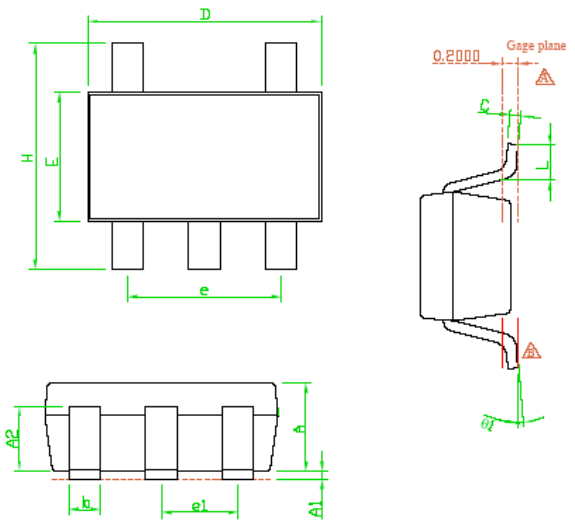
The FP6151 will remain stable and in regulation with no external load. This is specially important in CMOS RAM keep-active applications.

6. Active/Shutdown Input Operation

The FP6151 is turned off by pulling the $\overline{SHDN}$ pin low and turned on by pulling it high. If this feature is not used, the $\overline{SHDN}$ pin should be connected to VIN to keep the regulator output available at all time.

Outline Information

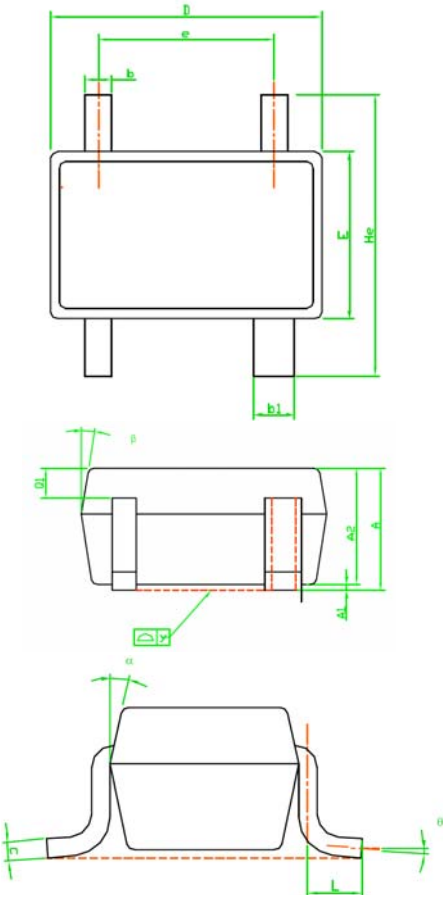
SOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER		
	MIN	NOM	MAX
A	1.00	1.10	1.30
A1	0.00	---	0.10
A2	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.10	0.15	0.25
D	2.70	2.90	3.10
E	1.50	1.60	1.80
e	---	1.90(TYP)	---
H	2.60	2.80	3.00
L	0.37	---	---
θ1	1°	5°	9°
e1	---	0.95(TYP)	---

Note 1：Package Body Sizes Exclude Mold Flash Protrusions or Gate Burrs.
Note 2：Tolerance ± 0.1000 mm(4mil) Unless Otherwise Specified.
Note 3：Coplanarity：0.1000 mm
Note 4：Dimension L Is Measured in Gage plane.

SC-82 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER		
	MIN	NOM	MAX
A	0.80	---	1.10
A1	0.00	---	0.10
A2	0.80	---	1.00
b	0.15	0.20	0.30
b1	0.25	0.30	0.40
C	0.10	---	0.20
D	1.80	2.00	2.20
E	1.15	1.25	1.35
e	---	1.30	---
He	1.80	2.10	2.40
L	0.10	---	0.45
Q1	0.10	---	0.40
y	---	---	0.10
α	---	---	17°
β	---	---	12°
θ	- 15°	0	15°

Note 1：Package Body Sizes Exclude Mold Flash and Gate Burrs.
Note 2：Tolerance ± 0.10 mm(4 mil) Unless Otherwise Specified.
Note 3：Controlling Dimension Is Millimeter. Converted Inch Dimension Are Not Necessarily Exact.
Note 4：Followed from EIAJ ED-7500-2.
Note 5：Dimension L Is measured Form 0.1 mm above Seated Plane.

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