150mA Low Noise and High PSRR Low Dropout Linear Regulator with Shutdown

Description

The FP6138 is a low dropout, low noise, high PSRR, very low quiescent current positive linear regulator. The FP6138 can supply 150mA output current with low dropout voltage at about 200mV 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 FP6138 that consumes less than 0.1μA during shutdown mode.

The FP6138 regulator is able to operate with output capacitors as small as 1μF for stability. Other than the current limit protection, FP6138 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 FP6138 offers high precision output voltage of ± 2%. It is housed in a low-profile, space-saving 5-lead SOT-23-5 package.

Features

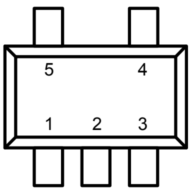
- Low Dropout Voltage of 150mV at 100mA
- 30μVrms Output Noise from 10Hz to 100KHz
- Guaranteed 150mA Output Current
- High Power Supply Rejection Ratio 65dB at 1KHz
- Very Low Quiescent Current at 35μA
- Max. ± 2% Output Voltage Accuracy
- Needs Only 1μF Capacitor for Stability
- Fast Response in Line/Load Transient
- Thermal Shutdown Protection
- Current Limit Protection
- Low-ESR Ceramic Capacitor for Output Stability
- Miniature Package: SOT-23-5
- RoHS Compliant

Applications

- Mobile Phones
- Notebook, Sub-Notebook and Tablet Computers
- DSC
- Portable Information Appliances
- Battery Power Systems

Pin Assignments

S5 Package (SOT-23-5)



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

Figure 1. Pin Assignment of FP6138

Ordering Information

FP6138-□□□□

- TR: Tape / Real
  Blank: Tube
- P: Pb Free with Commercial Standard (RoHS Compliant)
- Package Type
  S5: SOT-23-5
- Output Voltage
  15: 1.5V   28: 2.8V
  18: 1.8V   30: 3.0V
  25: 2.5V   33: 3.3V

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
FP6138-15S5P	fJ	FP6138-28S5P	fM
FP6138-18S5P	fK	FP6138-30S5P	fN
FP6138-25S5P	fL	FP6138-33S5P	fP

Typical Application Circuit

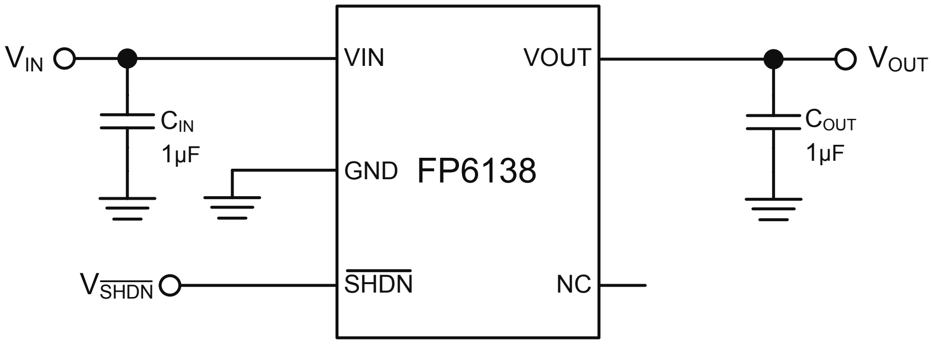


Figure 2. Typical Application Circuit of FP6138

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 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 from oscillation. The FP6138 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.
NC	No connection
GND	Common ground pin
$\overline{\text{SHDN}}$	Pull this pin high to enable IC ; Pull this pin low to shutdown IC

Block Diagram

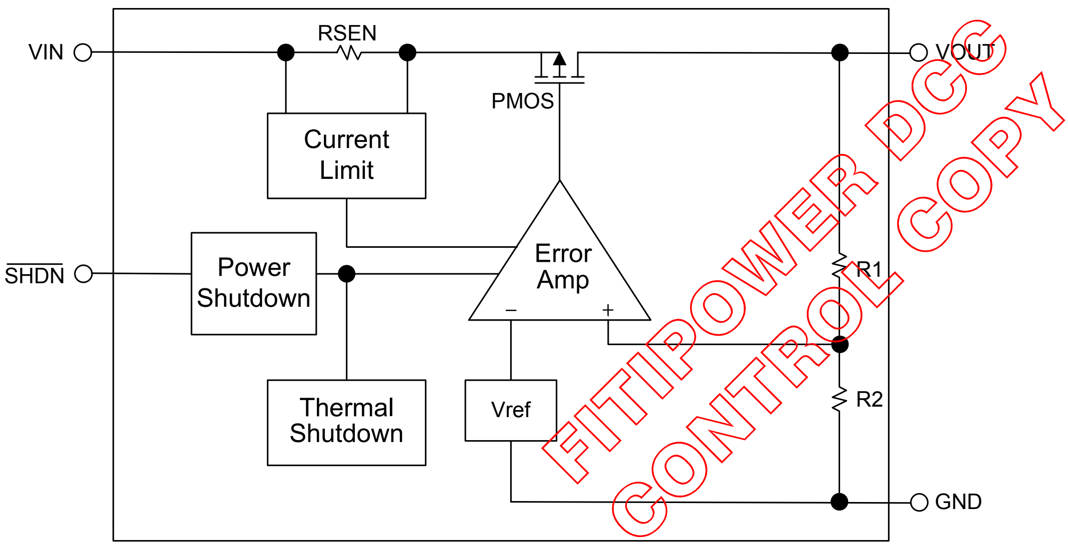


Figure 3. Block Diagram of FP6138

Absolute Maximum Ratings

- Supply Input Voltage (V_{IN})-- + 6V
- Maximum Junction Temperature (T_J)-- + 150℃
- Power Dissipation SOT-23 (P_D)-- + 0.4W
- Package Thermal Resistance SOT-23 (θ_{JA})--- + 250℃/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})-- + 2.0 to + 5.5V
- Operating Junction Temperature Range (T_J)-- - 40 to + 125℃

Electrical Characteristics

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

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Current Limit	I_{LIMIT}	R_{Load}=1Ω		200			mA
Quiescent Current	I_Q	I_O= 0mA			35	60	μA
Standby Current	I_{STBY}	$\overline{SHDN}$ pin connected to GND			0.1	1	μA
Output Voltage Accuracy	ΔV_{OUT}	I_O= 1mA		-2		+2	%
Dropout Voltage (Note 1)	V_{DROP}	I_O=100mA	$V_{OUT} \leq 1.8V$		550		mV
			$1.9V \leq V_{OUT} \leq 2.4V$		330		
			$2.5V \leq V_{OUT} \leq 3.3V$		170		
Line Regulation	ΔV_{LINE}	I_O=1mA, V_{IN}=V_{OUT} +1V to 5V			1	8	mV
Load Regulation (Note 2)	ΔV_{LOAD}	I_O=0mA to 150mA			6	30	mV
Ripple Rejection	PSRR	V_{IN}=V_{OUT}+1V, f_{RIPPLE} = 1KHz			65		dB
Temperature Coefficient	TC	I_{OUT} = 1mA, V_{IN} = 5V			100		ppm / ºC
Output Noise	E_{NO}	10Hz to 100KHz			30		μVrms
Thermal Shutdown Temperature	TSD				160		ºC
Thermal Shutdown Hysteresis	ΔTSD				25		ºC
Shutdown Pin Input Current	$I_{\overline{SHDN}}$	$\overline{SHDN}$ pin connected to GND or V_{IN}				0.1	μA
Shutdown Pin Voltage (ON)	$V_{\overline{SHDN}(ON)}$	Start-up		1.0			V
Shutdown Pin Voltage (OFF)	$V_{\overline{SHDN}(OFF)}$	Shutdown				0.4	V

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.

Application Information

The FP6138 is a low dropout linear regulator that could provide 150mA output current at dropout voltage about 200mV. 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 FP6138 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 1uF to 10uF X5R or X7R dielectric ceramic capacitors with 30mΩ to 50mΩ ESR range between device outputs and ground for stability. The FP6138 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, FP6138 has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during over-loading 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 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 FP6138 is shutdown by pulling the $\overline{SHDN}$ input low, and turned on by driving the $\overline{SHDN}$ high. If this function is not used, the $\overline{SHDN}$ input should be tied to VIN to keep the regulator on at all time (the $\overline{SHDN}$ pin must not be left floating).

Typical Performance Curves

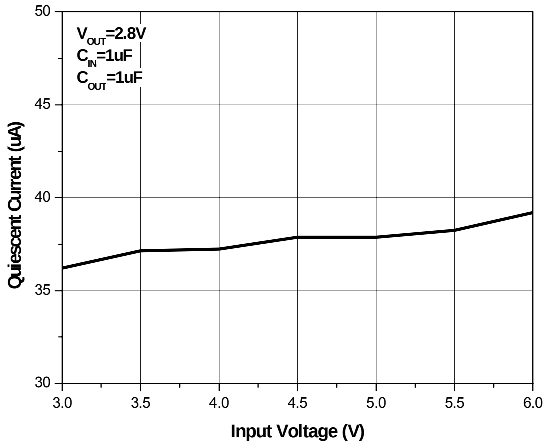


Figure 4. Quiescent Current vs. Input Voltage

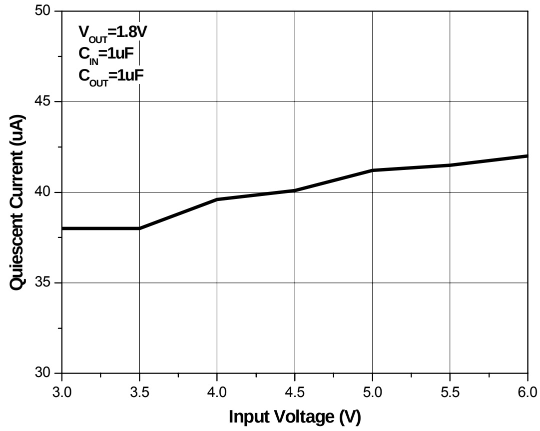


Figure 5. Quiescent Current vs. Input Voltage

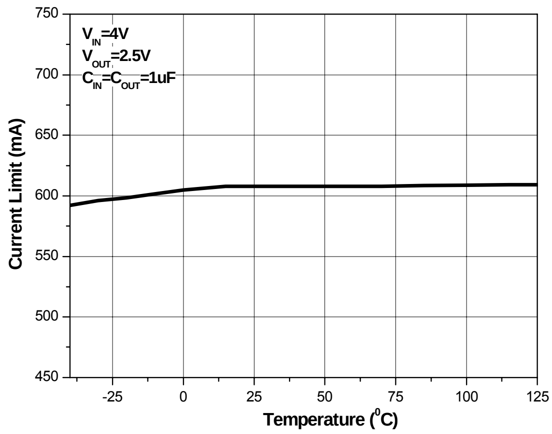


Figure 6. Current Limit vs. Temperature

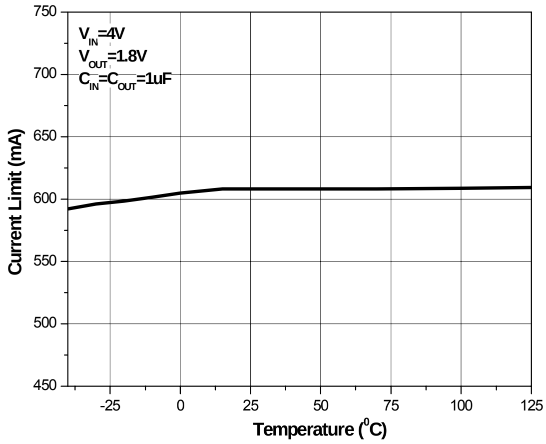


Figure 7. Current Limit vs. Temperature

V_{IN}=2.8V V_{OUT}=1.8V I_{OUT}= 1mA to 100mA

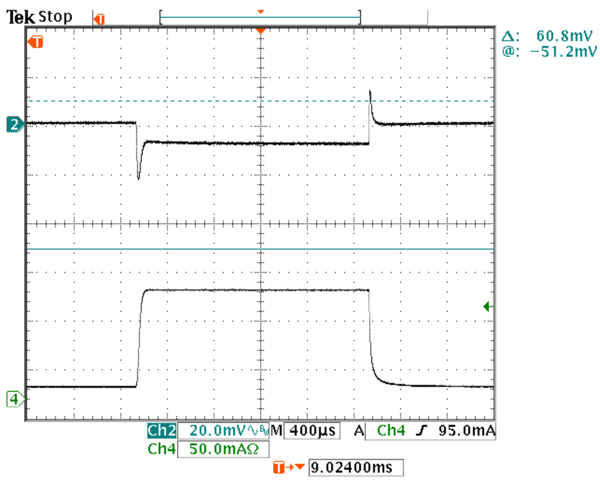


Figure 8. Load Transition Response

V_{IN}=3.8V V_{OUT}=2.8V I_{OUT}=1mA to 100mA

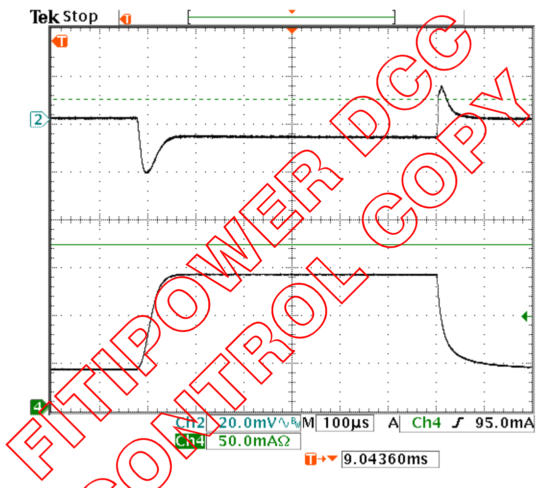


Figure 9. Load Transition Response

Typical Performance Curves (Continued)

V_{IN}=4.3V V_{OUT}=3.3V I_{OUT}=1mA to 100mA

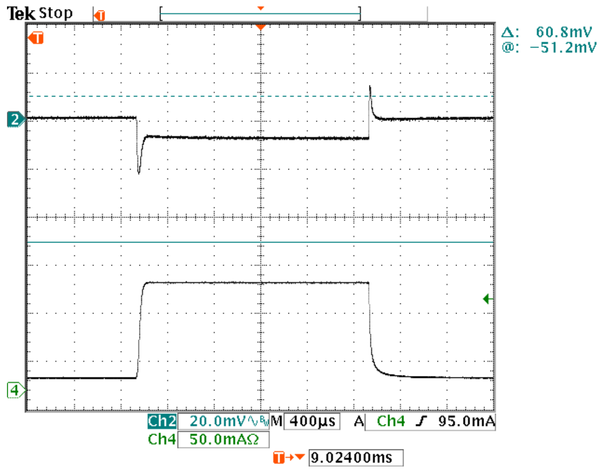


Figure 10. Load Transition Response

V_{IN}=3.5V V_{OUT}=2.5V I_{OUT}=1mA to 100mA

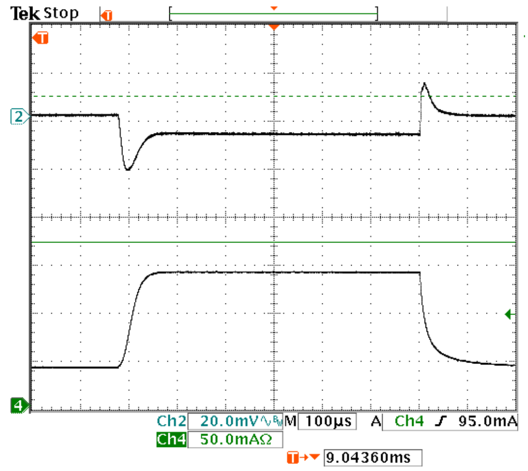


Figure 11. Load Transition Response

V_{IN}=4V V_{OUT}=2.8V I_{OUT}=100mA

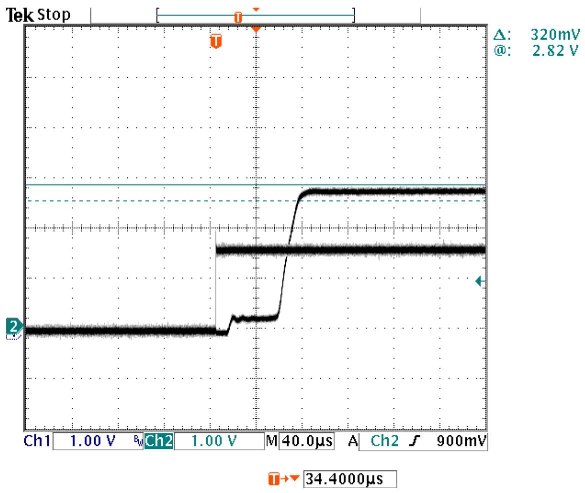


Figure 12. Shutdown /Enable Test

V_{IN}=4V V_{OUT}=2.8V I_{OUT}=100mA

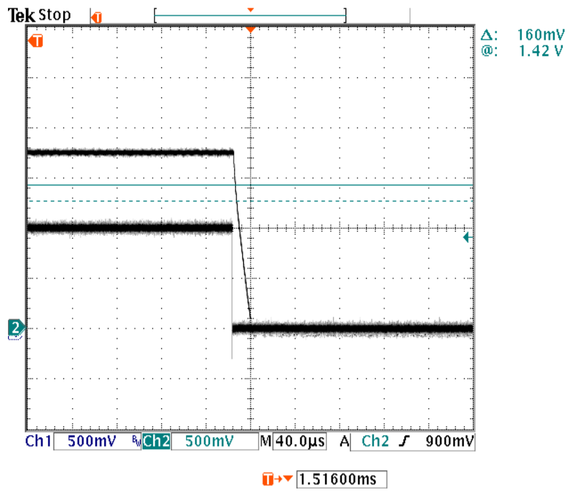


Figure 13. Shutdown /Enable Test

V_{IN}=3V→ 4V V_{OUT}=1.8V I_{OUT}=10mA

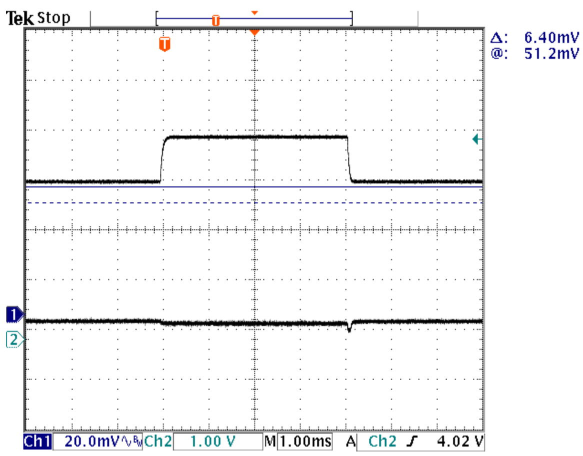


Figure 14. Line Transition Response

V_{IN}=4V→ 5V V_{OUT}=2.8V I_{OUT}=10mA

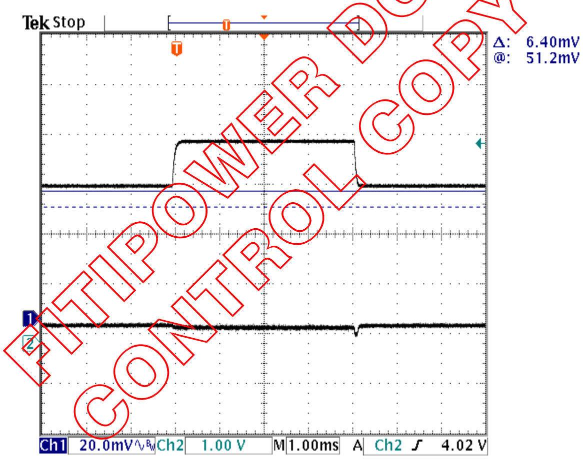


Figure 15. Line Transition Response

Typical Performance Curves (Continued)

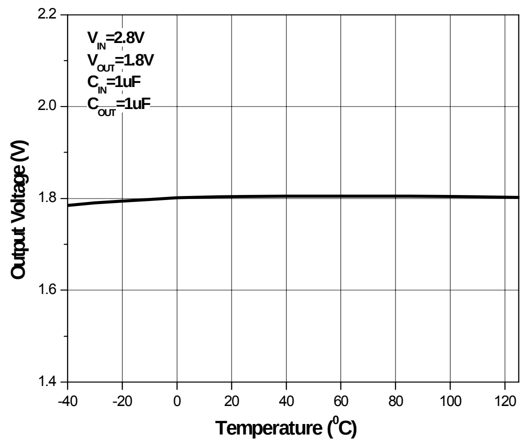


Figure 16. Output Voltage vs. Temperature

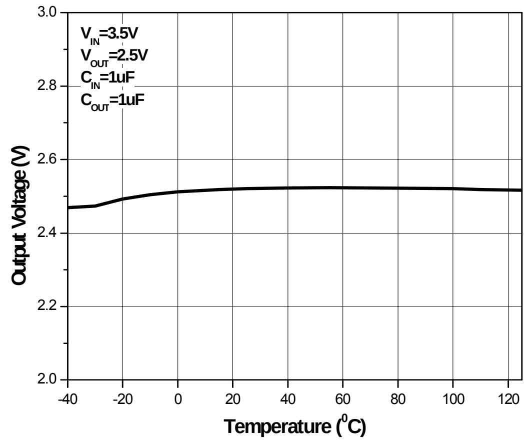


Figure 17. Output Voltage vs. Temperature

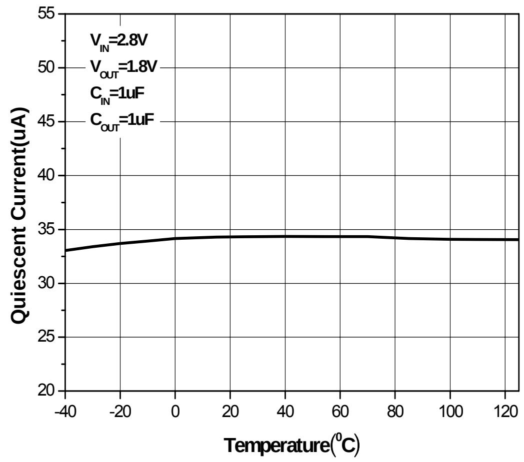


Figure 18. Quiescent Current vs. Temperature

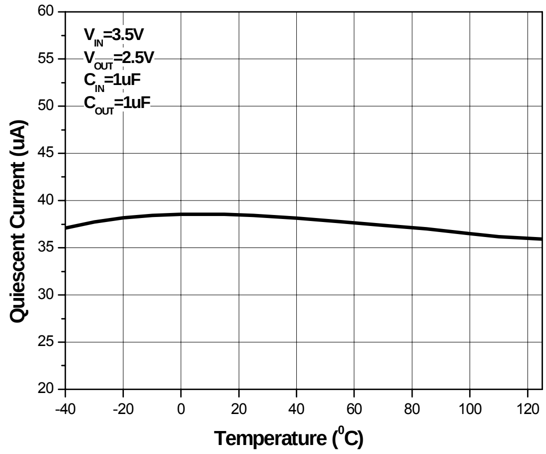


Figure 19. Quiescent Current vs. Temperature

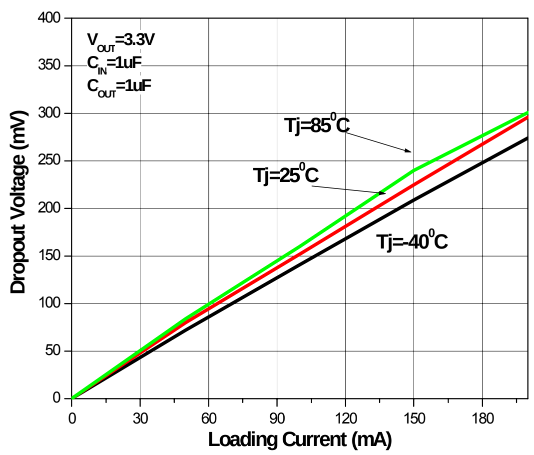


Figure 20. V_{OUT}=3.3V Dropout vs. Temperature

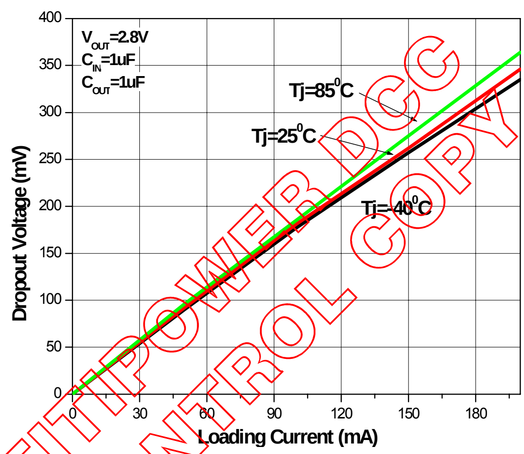


Figure 21. V_{OUT}=2.8V Dropout vs. Temperature

Typical Performance Curves (Continued)

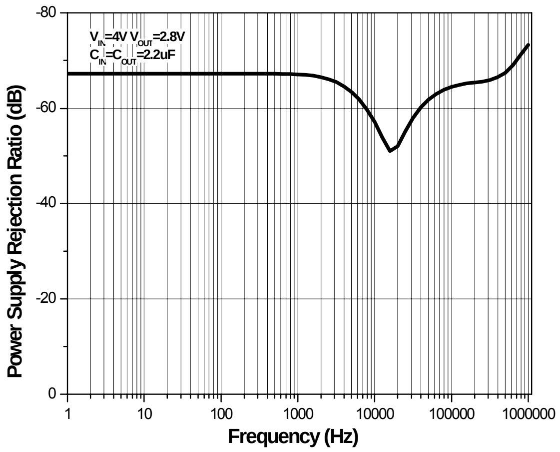


Figure 22. Power Supply Rejection Ratio vs. Frequency

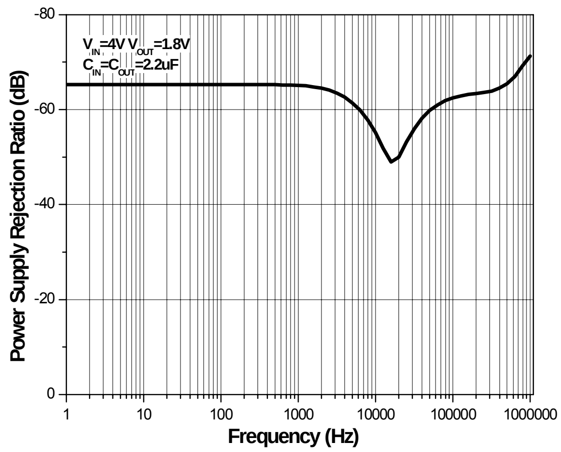
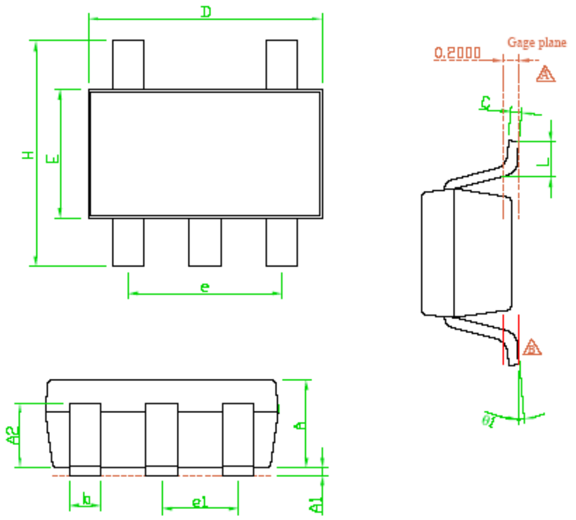


Figure 23. Power Supply Rejection Ratio vs. Frequency

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	1º	5º	9º
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.

Life Support Policy

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