FEATURES

- Low dropout voltage: 180mV at 300mA (Vo=3.3V)
- Quiescent current: Typ. 65μA
- 2% Voltage Accuracy
- High PSRR: 70dB at 1KHz
- Thermal Shutdown
- Current Limiting
- Excellent line and load regulation
- Fast response
- Short circuit protection
- Low temperature coefficient
- Shutdown current: 0.5μA
- Space saving SOT23-5L package

GENERAL DESCRIPTION

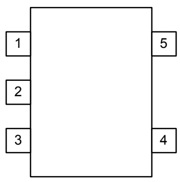
The FSP2132 series of positive voltage linear regulators feature low quiescent current (Typ. 65μA) and low dropout voltage, making them ideal for battery powered applications. Their high PSRR make them useful in applications where AC noise on the input power supply must be suppressed. Space saving SOT23-5L package is attractive for portable and handheld applications. They have both thermal shutdown and a current limit feature to prevent device failure from extreme operating conditions. They are stable with an output capacitor of 2.2μF or greater.

APPLICATIONS

- Cordless phones
- Cellular phones
- Bluetooth earphones
- Digital Cameras
- Portable electronics
- WLANs
- MP3 players

PIN CONFIGURATION

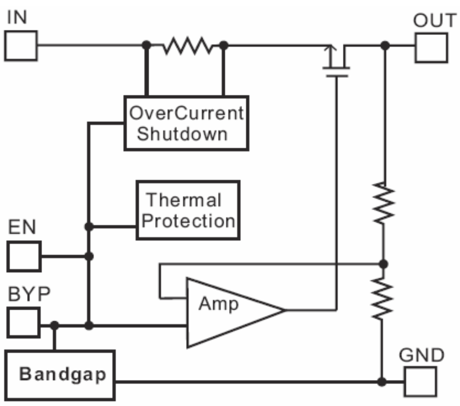
(Top View)



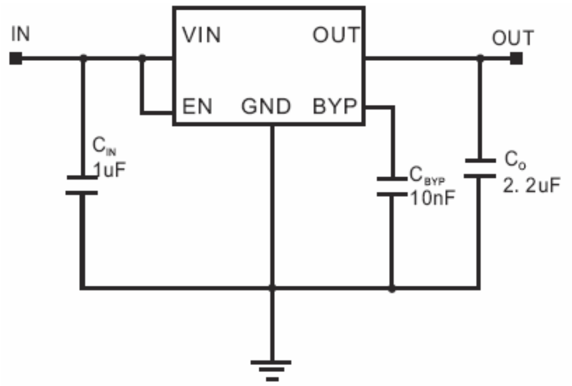
PIN DESCRIPTION

Pin Number	Pin Name	Pin Function
1	VIN	Input
2	GND	Ground
3	EN	Chip Enable (active high)
4	BYP	Bypass pin, need a 10μF capacitor connected to GND
5	VOUT	Output

BLOCK DIAGRAM



TYPICAL APPLICATIONS CIRCUITS



ABSOLUTE MAXIMUM RATINGS

Parameter	Rating	Unit
Input Supply Voltage	+6	V
Output Current	300	mA
Output Pin Voltage	GND-0.3 to VIN+0.3	V
ESD Rating	Class B	
Internal Power Dissipation	400	mW
Junction to Case Thermal Resistance (θ_{JC})	130	℃/ W
Junction to Ambient Thermal Resistance (θ_{JA})	250	℃/ W
Operating temperature	-40 to 85	°C
Operating Junction Temperature	-40 to 125	°C
Storage Temperature	-65 to 150	°C
Lead Temperature (Soldering, 5 sec)	300	°C

Note: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

■ ELECTRICAL CHARACTERISTICS

(V_{IN} = V_O + 1V, C_{IN} = 1μF, C_O = 2.2μF, T_A= 25°C unless otherwise specified.)

<table>
<tr><th>PARAMETER</th><th>SYMBOL</th><th colspan="2">TEST CONDITIONS</th><th>MIN</th><th>TYP</th><th>MAX</th><th>UNIT</th></tr>
<tr><td>Input Voltage</td><td>V_{IN}</td><td colspan="2"></td><td>Note1</td><td></td><td>5.5</td><td>V</td></tr>
<tr><td>Output Voltage Accuracy</td><td>V_O</td><td colspan="2">I_O= 1mA</td><td>-2</td><td></td><td>+2</td><td>%</td></tr>
<tr><td>Output Current</td><td>I_O</td><td colspan="2"></td><td>300</td><td></td><td>Note2</td><td>mA</td></tr>
<tr><td>Ground Current</td><td>I_{GND}</td><td colspan="2">I_O= 1mA to 300mA</td><td></td><td>70</td><td>90</td><td>μA</td></tr>
<tr><td>Quiescent Current</td><td>I_Q</td><td colspan="2">I_O= 0mA</td><td></td><td>65</td><td>90</td><td>μA</td></tr>
<tr><td rowspan="3">Line Regulation</td><td rowspan="3">LNR</td><td colspan="2">I_O= 1mA, V_O < 2V
V_{IN} =2.8V to 3.8V</td><td>-0.15</td><td>0.1</td><td>0.15</td><td rowspan="3">%/V</td></tr>
<tr><td colspan="2">I_O= 1mA, 2≤ V_O < 3.3V
V_{IN} =V_O + 0.5V to V_O + 1V</td><td>-0.1</td><td>0.03</td><td>0.1</td></tr>
<tr><td colspan="2">I_O= 1mA, V_O ≥3.3V
V_{IN} =V_O + 0.5V to V_O + 1V</td><td>-0.4</td><td>0.2</td><td>0.4</td></tr>
<tr><td>Load Regulation Error</td><td>LDR</td><td colspan="2">I_O = 1mA to 300mA</td><td>-1</td><td>0.2</td><td>1</td><td>%</td></tr>
<tr><td>Temperature Coefficient</td><td>T_C</td><td colspan="2">I_O = 1mA</td><td></td><td>40</td><td></td><td>ppm/°C</td></tr>
<tr><td>Over Temperature Shutdown</td><td>OTS</td><td colspan="2">I_O = 1mA</td><td></td><td>150</td><td></td><td>°C</td></tr>
<tr><td>Over Temperature Hysteresis</td><td>OTH</td><td colspan="2">I_O = 1mA</td><td></td><td>30</td><td></td><td>°C</td></tr>
<tr><td rowspan="3">Power Supply Ripple Rejection (with bypass Cap.)</td><td rowspan="3">PSRR</td><td rowspan="3">I_O = 100mA
C_{BYP} = 10nF
V_o =1.8V</td><td>f=100Hz</td><td></td><td>70</td><td></td><td rowspan="6">dB</td></tr>
<tr><td>f= 1KHz</td><td></td><td>70</td><td></td></tr>
<tr><td>f= 10KHz</td><td></td><td>50</td><td></td></tr>
<tr><td rowspan="3">Power Supply Ripple Rejection (without bypass Cap.)</td><td rowspan="3">PSRR</td><td rowspan="3">I_O = 100mA
V_o =1.8V</td><td>f=100Hz</td><td></td><td>70</td><td></td></tr>
<tr><td>f= 1KHz</td><td></td><td>60</td><td></td></tr>
<tr><td>f= 10KHz</td><td></td><td>40</td><td></td></tr>
<tr><td rowspan="3">Dropout Voltage</td><td rowspan="3">V_{DO}</td><td rowspan="3">I_O = 300mA</td><td>V_O= 1.8V</td><td></td><td>850</td><td>1100</td><td rowspan="3">mV</td></tr>
<tr><td>2.5 ≤ V_O < 3.3V</td><td></td><td>370</td><td>450</td></tr>
<tr><td>V_O ≥ 3.3V</td><td></td><td>180</td><td>230</td></tr>
<tr><td>EN Input High Threshold</td><td>V_{IH}</td><td colspan="2">V_{IN} = 2.5V to 5V</td><td>1.5</td><td></td><td></td><td>V</td></tr>
<tr><td>EN Input Low Threshold</td><td>V_{IL}</td><td colspan="2">V_{IN} = 2.5V to 5V</td><td></td><td></td><td>0.3</td><td>V</td></tr>
<tr><td>Output Noise</td><td>V_n</td><td colspan="2">C_{BYP} =10nF, f = 10Hz to 100kHz</td><td></td><td>50</td><td></td><td>μV_{RMS}</td></tr>
<tr><td>Shutdown Current</td><td>I_{SD}</td><td colspan="2">V_{EN} = 0V</td><td></td><td>0.01</td><td>1</td><td>μA</td></tr>
</table>

Note 1：The minimum input voltage of the FSP2132 is determined by output voltage and dropout voltage. The minimum input voltage is defined as:
$V_{IN(MIN)}$=V_O+V_{DROP}

Note 2: Output current is limited by P_D, maximum I_O=P_D/($V_{IN(MAX)}$-V_O)

APPLICATION INFORMATION

Capacitor Selection and Regulator Stability

Similar to any low dropout regulator, the external capacitors used with the FSP2132 must be carefully selected for regulator stability and performance.

Using a capacitor, C_{IN}, whose value is＞1μF at the FSP2132 input pin, the amount of the capacitance can be increased without limit. Please note that the distance between C_{IN} and the input pin of the FSP2132 should not exceed 0.5 inch. Ceramic capacitors are suitable for the FSP2132. Capacitors with larger values and lower ESR provide better PSRR and line-transient response.

The FSP2132 is designed specifically to work with low ESR ceramic output capacitors in order to save space and improve performance. Using an output ceramic capacitor whose value is ＞2.2μF with ESR＞5mΩ ensure stability.

A 10nF bypass capacitor connected to BYP pin is suggested for suppressing output noise. The capacitor, in series connection with an internal 200kΩ resistor, forms a low-pass filter for noise reduction. Increasing the capacitance will slightly decrease the output noise, but increase the start-up time.

Load Transient Considerations

The figure11 shows the FSP2132 load transient response. It shows two components the output response: a DC shift from the output impedance due to the load current change and transient response. The DC shift is quite small due to excellent load regulation of the FSP2132. The transient spike, resulting from a step change in the load current from 1mA to 300mA, is 20mV. The ESR of the output capacitor is critical to the transient spike. A larger capacitance along with smaller ESR results in a smaller spike.

Shutdown Input Operation

The FSP2132 is shutdown by pulling the EN input low, and is turned on by tying the EN input to VIN or leaving the EN input floating.

Internal P-Channel Pass Transistor

The FSP2132 features a 0.75Ω P-Channel MOSFET device as a pass transistor. The P-MOS pass transistor enables the FSP2132 to consume only 65μA of ground current during low dropout, light load, or heavy load operations. This feature increases the battery operation life time.

Dropout Voltage

A regulator's minimum dropout voltage determines the lowest usable supply voltage. The FSP2132 has a typical 300mV dropout voltage. In battery powered systems, this will determine the useful end-of-life battery voltage.

Current Limit and Short Circuit Protection

The FSP2132 features a current limit, which monitors and controls the gate voltage of the pass transistor. The output current can be limited to 400mA by regulating the gate voltage. The FSP2132 also has a built-in short circuit current limit.

Thermal Considerations

Thermal protection limits power dissipation in the FSP2132. When the junction temperature exceeds 150℃, the OTP (Over Temperature Protection) starts the thermal shutdown and turns the pass transistor off. The pass transistor resumes operation after the junction temperature drops below 120℃.

For continuous operation, the junction temperature should be maintained below 125℃. The power dissipation is defined as :

$P_D=(V_{IN}-V_{OUT})*I_O+V_{IN}*I_{GND}$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surrounding airflow and temperature difference between junction and ambient. The maximum power dissipation can be calculated by the following formula:

$P_{D(MAX)}=(T_{J(MAX)}-T_A)/\theta_{JA}$

Where $T_{J(MAX)}$ is the maximum allowable junction temperature 125℃. T_A is the ambient temperature and θ_{JA} is the thermal resistance from the junction to the ambient.

For example, θ_{JA} is 250℃/W for the SOT23-5L package, based on the standard JEDEC 51-3 for a single layer thermal test board. The maximum power dissipation at T_A=25℃ can be calculated by the following formula:

$P_{D(MAX)}$= (125℃-25℃)/250=0.4W

It is also useful to calculated the junction temperature of the FSP2132 under a set of specific conditions. In this example let the input voltage V_{IN}=3.3V, the output current I_O=300mA and the case temperature T_A=40℃ measured by a thermal couple during operation. The power dissipation for the V_O=2.8V version of the FSP2132 can be calculated as:

P_D=(3.3V-2.8V)*300mA+3.3V*70μA≌150mW

And the junction temperature, T_J, can be calculated as follows:

$T_J=T_A+P_D*\theta_{JA}$

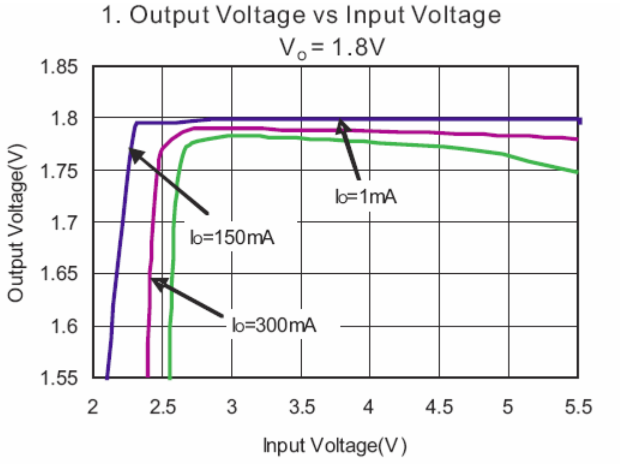
T_J=40℃+0.15W*250℃/W

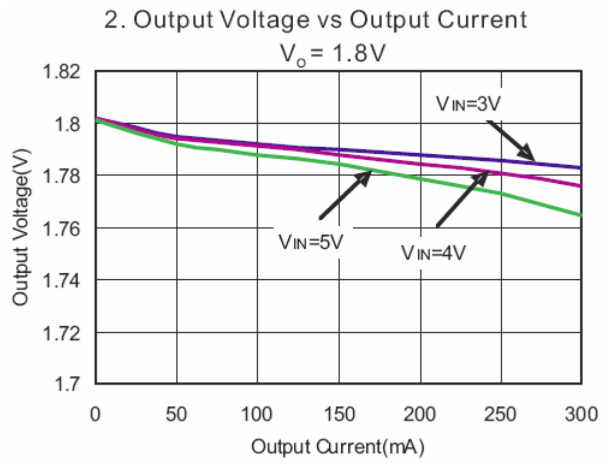
=77.5℃＜$T_{J(MAX)}$ =125℃

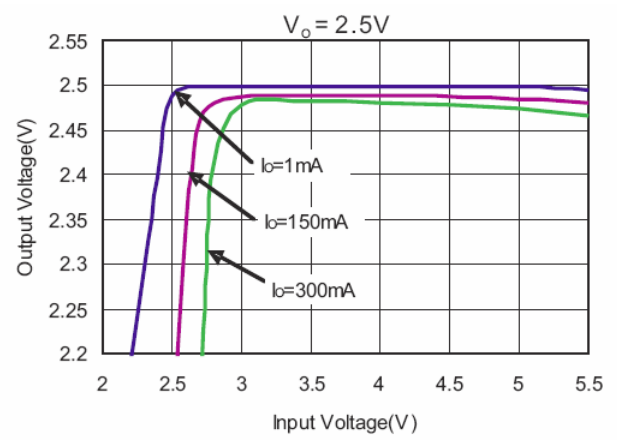
For this operating condition, TJ, is lower than the absolute maximum operating junction temperature, 125℃, so it is safe to use the FSP2132 in this configuration.

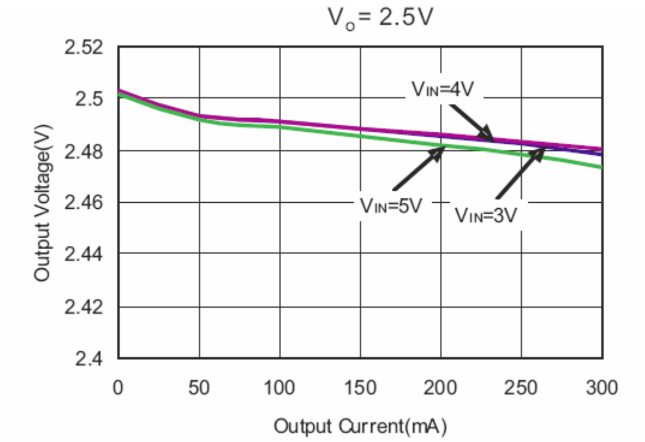
■ TYPICAL PERFORMANCE CHARACTERISTICS

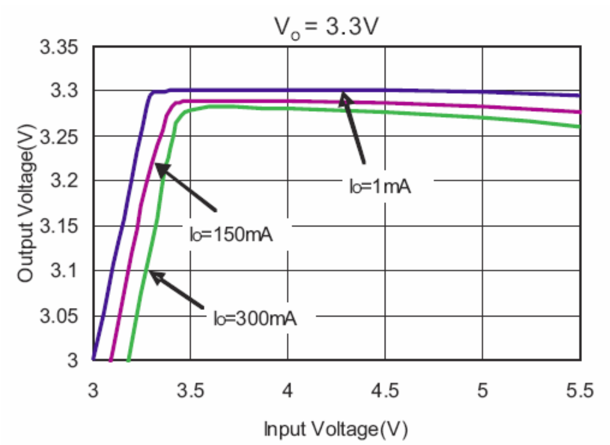
(V_{IN} = V_{EN} , C_{IN} = 1μF, C_O = 2.2μF , C_{BYP} =10nF T_A = 25°C unless otherwise specified.)

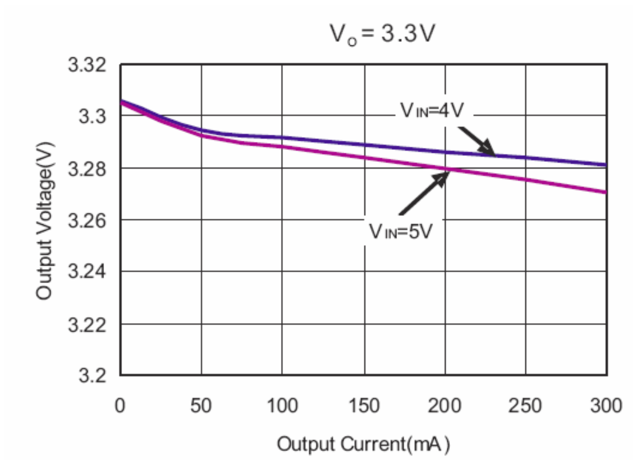






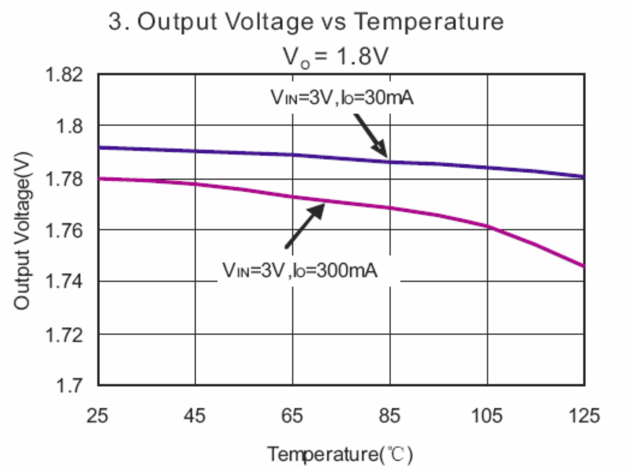


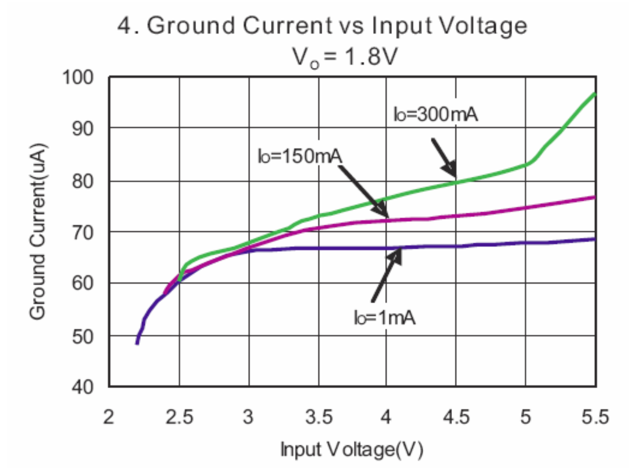


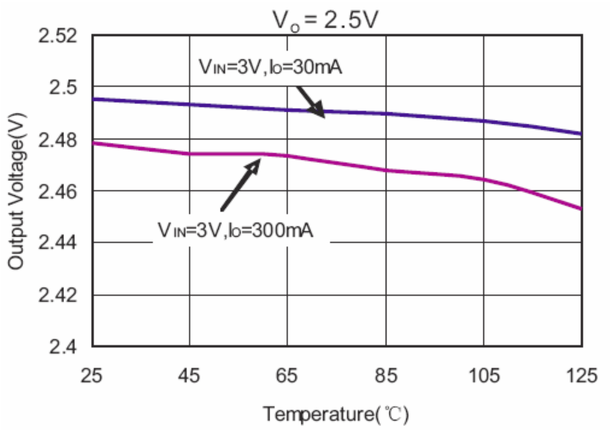


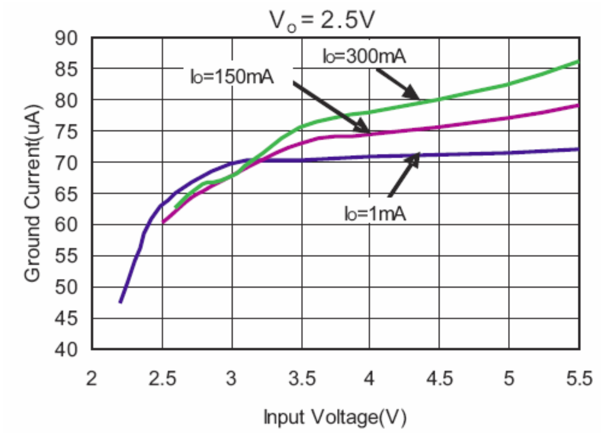
■ TYPICAL PERFORMANCE CHARACTERISTICS（CONTINUED）

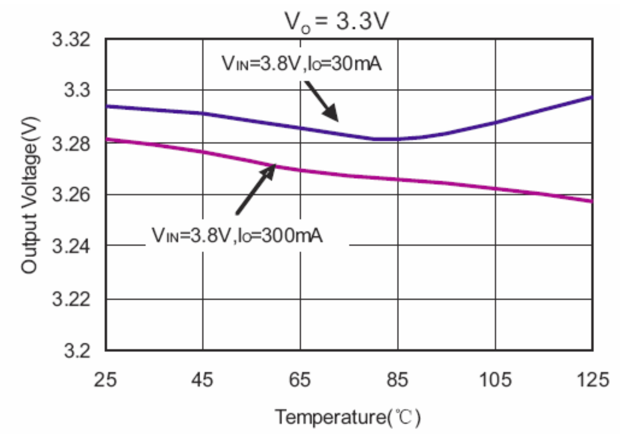
(V_{IN} = V_{EN} , C_{IN} = 1µF, C_O = 2.2µF , C_{BYP} =10nF T_A = 25°C unless otherwise specified.)

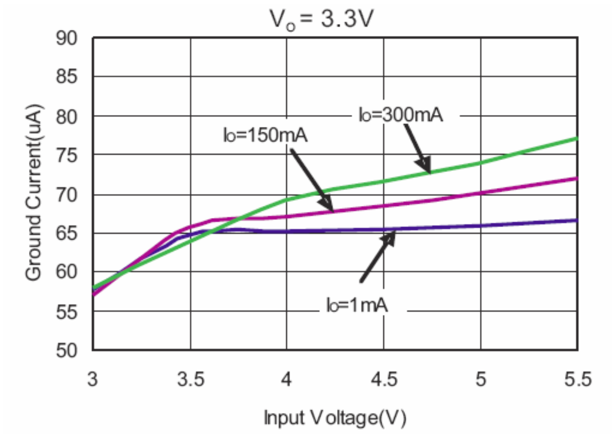






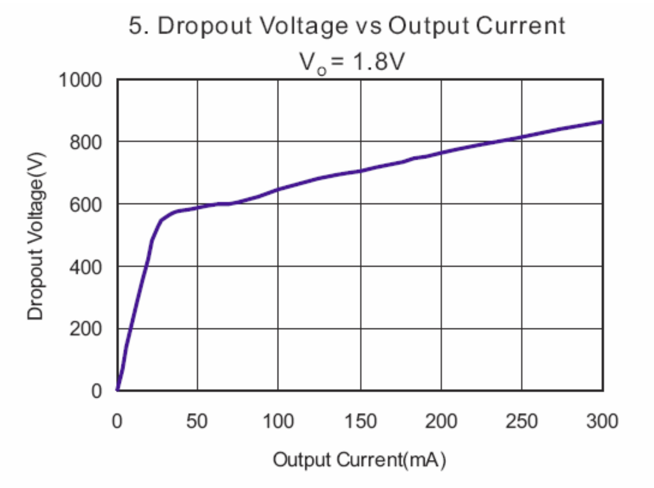


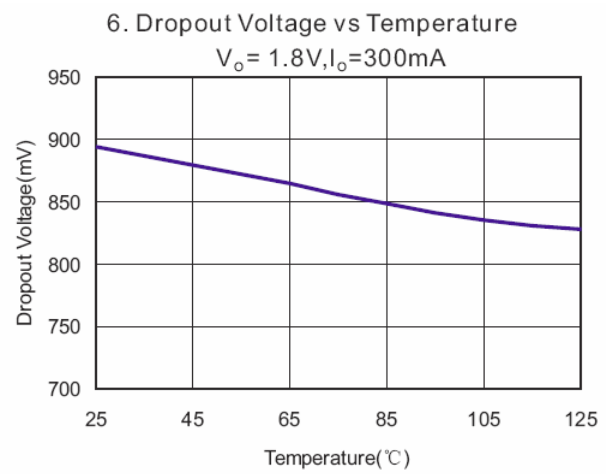


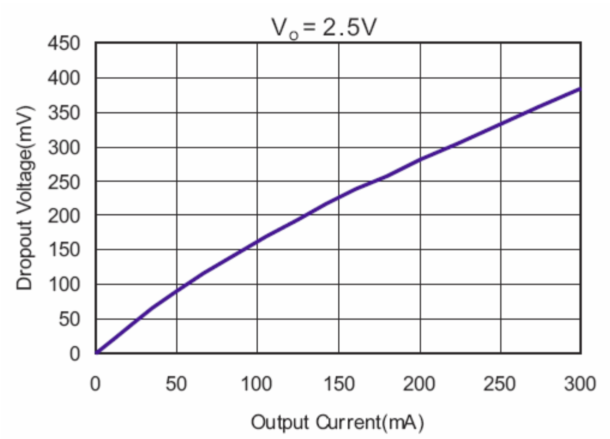


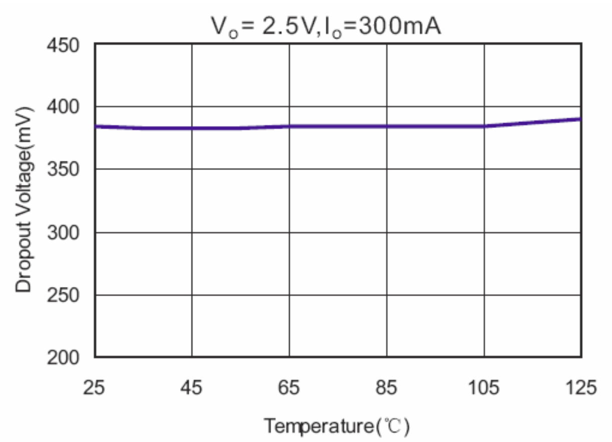
■ TYPICAL PERFORMANCE CHARACTERISTICS（CONTINUED）

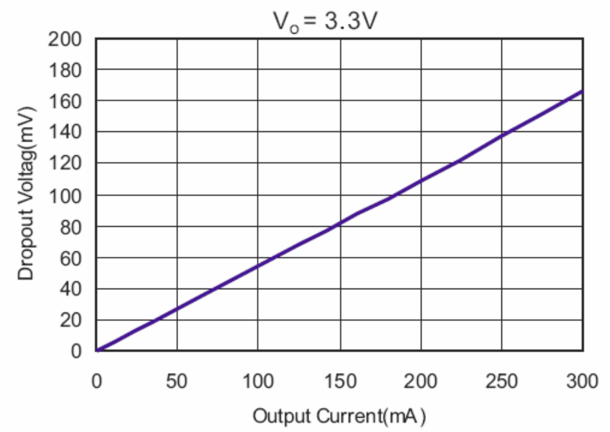
(V_{IN} = V_{EN} , C_{IN} = 1μF, C_O = 2.2μF , C_{BYP} =10nF T_A = 25°C unless otherwise specified.)

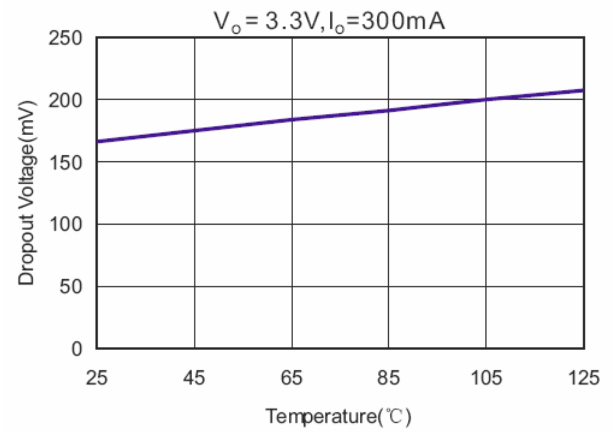






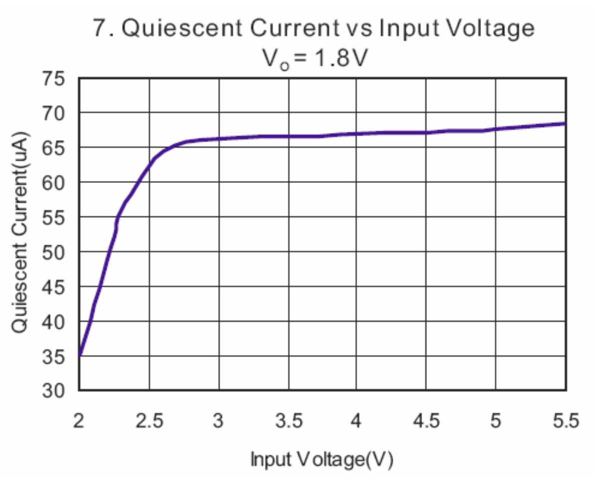


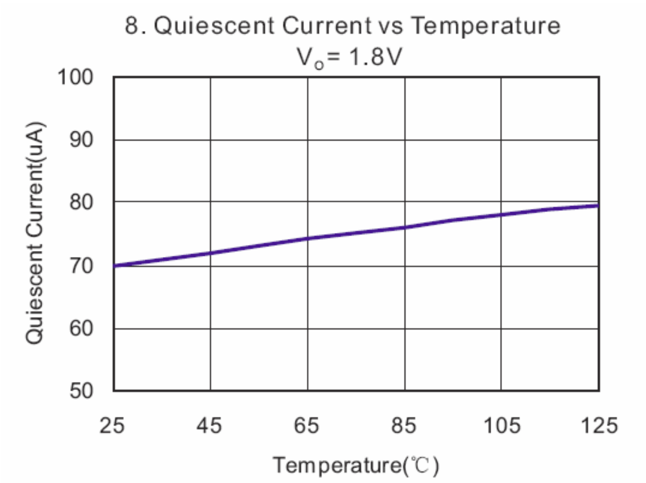


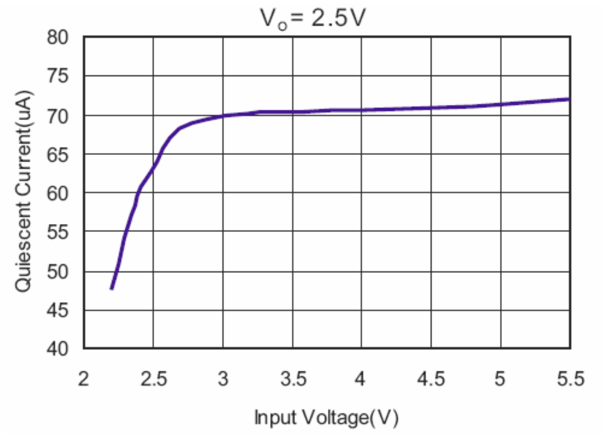


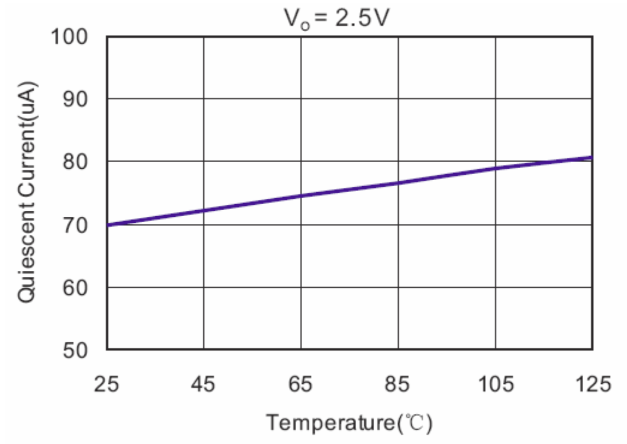
■ TYPICAL PERFORMANCE CHARACTERISTICS（CONTINUED）

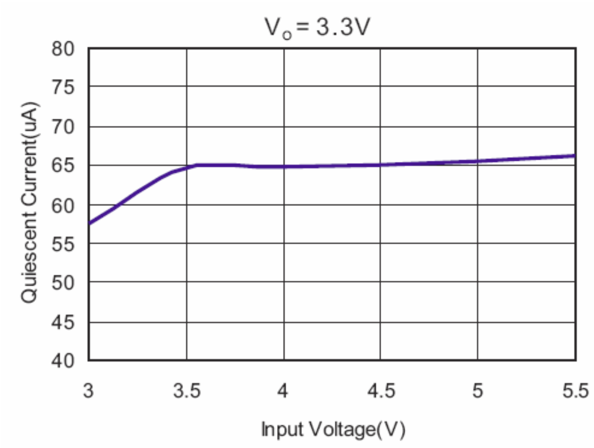
(V_{IN} = V_{EN} , C_{IN} = 1µF, C_O = 2.2µF , C_{BYP} =10nF T_A = 25°C unless otherwise specified.)

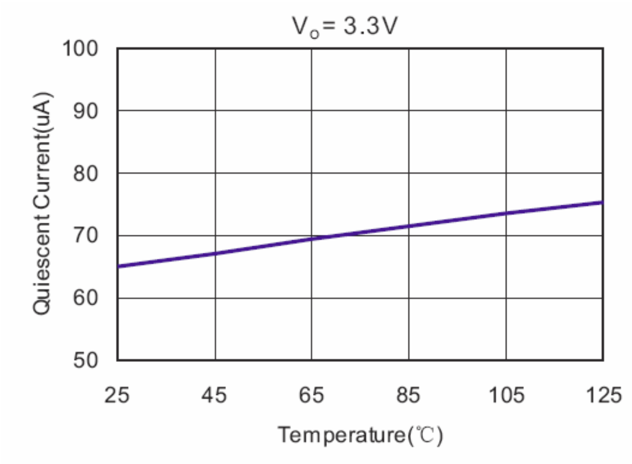








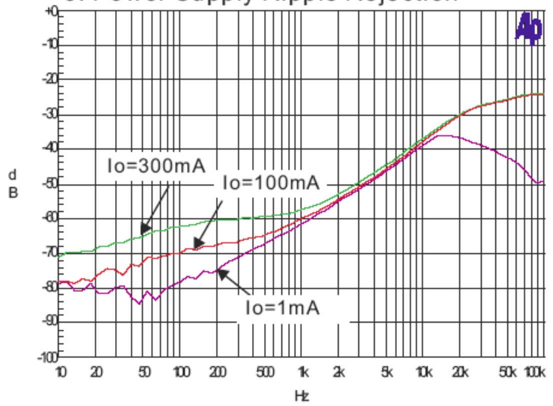




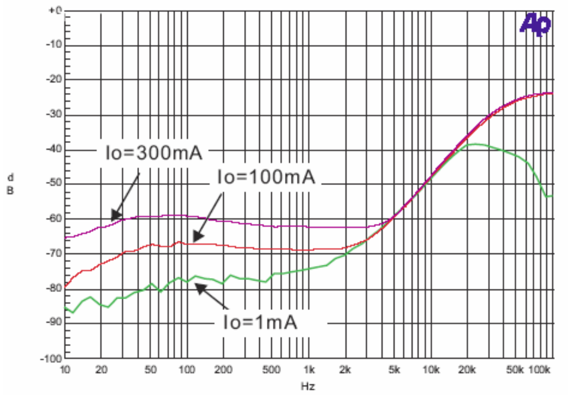
■ TYPICAL PERFORMANCE CHARACTERISTICS（CONTINUED）

(V_{IN} = V_{EN} , C_{IN} = 1µF, C_O = 2.2µF , C_{BYP} =10nF T_A = 25°C unless otherwise specified.)

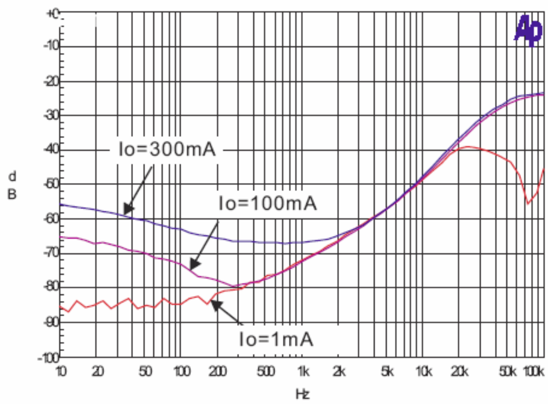
9. Power Supply Ripple Rejection



Vo=2.5V, V_{IN}=4V,Vpp=1V

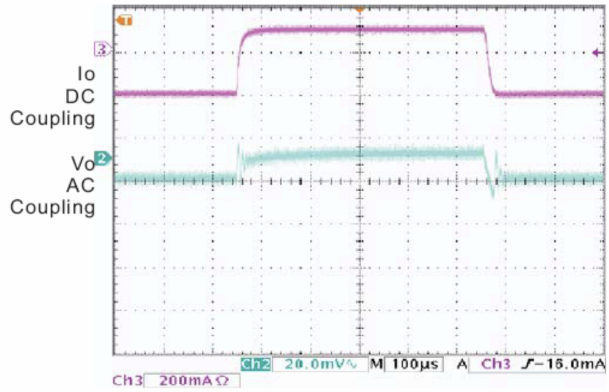


Vo=2.5V, V_{IN}=4V,Vpp=1V,C_{BYP}=10nF



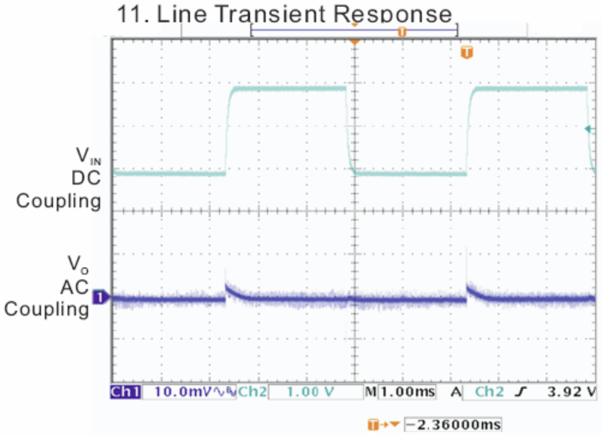
Vo=1.8V, V_{IN}=4V,Vpp=1V,C_{BYP}=10nF

10. Load Transient Response



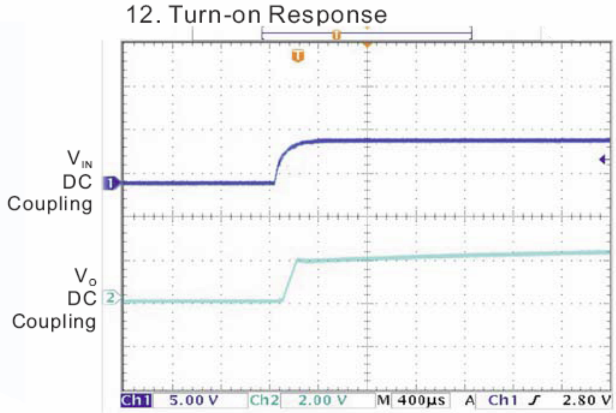
Vo=2.5V,V_{IN}=3.3V,Io=1mA to 300mA

11. Line Transient Response



Vo=2.5V,V_{IN}=3V to 5V,Io=1mA

12. Turn-on Response



V_{IN}=0 to 5V

■ ORDERING INFORMATION

FSP2132XXXX

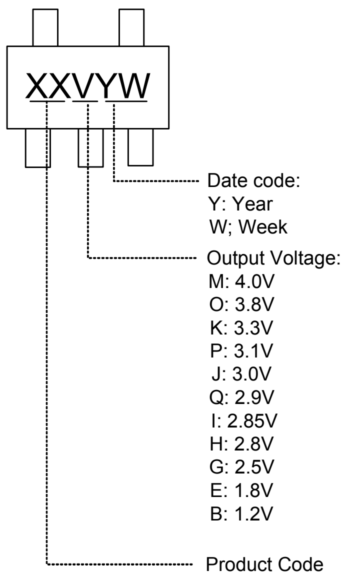
Package Type:
C: SOT23-5L

Output Voltage:
40: 4.0V
38: 3.8V
33: 3.3V
31: 3.1V
30: 3.0V
29: 2.9V
285: 2.85V
28: 2.8V
25: 2.5V
18: 1.8V
12: 1.2V

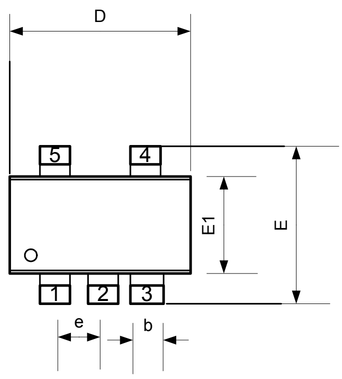
Packing:
A: Tape & Reel

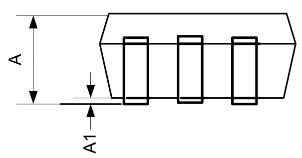
Temperature Grade:
D: -40~85℃

■ MARKING INFORMATION



■ PACKAGE INFORMATION





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	**Max.**	**Min.**	**Max.**
A	0.889	1.295	0.036	0.052
A1	0.000	0.152	0.000	0.006
b	0.353	0.599	0.014	0.024
D	2.692	3.099	0.108	0.124
E	2.591	2.977	0.104	0.119
E1	1.397	1.803	0.056	0.072
e	0.838	1.041	0.034	0.042