Bay Linear
Inspire the Linear Power

100mA, µCap, Low Dropout Voltage Regulator — B5213

Smallest SC70

Description

The B5213 is a µCap, low dropout voltage regulator with very low quiescent current, 220 µA typical, at 80mA load. It also has very low dropout voltage, typically 20mV at light load and 330mV at 80mA. The B5213 provides up to 80mA and consumes a typical of 1 µA in disable mode.

The B5213 is optimized to work with low value, low cost ceramic capacitors. The output typically require only 0.47 µF of output capacitance for stability. The enable pin can be tied to V_{IN} for easy device layout.

The B5213 is designed for portable, battery powered equipment applications with small space requirements.

The B5213 is available in a space saving 5- pin SC70 package. Performance is specified for the – 40 °C to + 125 °C temperature range and is available in 2.8V, 3.0V and 3.3V fixed voltages. For other output voltage options, please contact Bay Linear.

Features

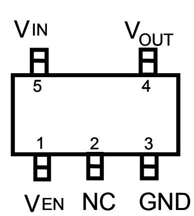
- **Output Current 100mA**
- **Space Saving SC70**
- **2.8.0V, 3.3V and 3.0V Versions**
- **Very Low Quiescent Current**
- **Low Dropout Voltage**
- **Very Low Temperature Coefficient**
- **Needs only 1µF for Stability**
- **Error Flag warns of output dropout**
- **Logic-Controlled Electronic Shutdown**
- **Pin-to-Pin MIC5213**

Applications

- **Battery Powered Systems**
- **Portable instrumentation**
- **Notebooks Computers**
- **Potable Consumer Equipment**
- **Bar Code Scanner**
- **Cellular Phones**

Pin Connection

SC-70 (L5)



Top View

Ordering Information

Package	
SC70-5	B5213-XX

"XX" Voltage Selection Guide

Vout	XX Code
2.8V	28
3.3V	33
3.0V	3

V_{EN}
Logic High = Enabled
Logic Low = Shutdown

Absolute Maximum Rating

Parameter	
Power Dissipation	Internally Limited
Lead Temperature (Soldering 5 seconds)	260 °C
Storage Temperature Range	-65 °C to +150 °C
Operating Junction Temperature	-40 °C to +125 °C
Input Supply Voltage	2.7V to 6V
V_{EN}	0V to V_{IN}
Shutdown Input Voltage	-0.3V to +30V
Package Thermal Resistance	478°C

Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_J = 25 °C, $V_{IN} = V_{OUT}$ + 1V, I_L = 1mA, C_L = 0.47 µF, $V_{EN} \geq$ 2.0V. Boldface limits apply at the temperature extremes.

Parameter	Conditions	MIN	TYP	MAX	UNIT
Output Voltage		-3 -4		3 4	%
Output Voltage Temperature Coefficient	(Note 10)		50	200	ppm / ° C
Line Regulation	$V_{IN} = V_{OUT}$ +1V to 6V		0.008	0.3	%
Load Regulation	I_L=0.1mA to 80mA (Note 6)		0.08	0.3 0.5	%
Dropout Voltage (Note 7)	I_L = 100µA I_L = 20mA I_L = 50mA I_L = 80mA		20 70 180 330	 350 600	mV
Ground pin Current	I_L = 100µA, $V_{EN}\geq$2.0V(active) I_L = 20mA, $V_{EN}\geq$2.0V(active) I_L = 500mA, $V_{EN}\geq$2.0V(active) I_L = 80mA, $V_{EN}\geq$2.0V(active)		160 180 200 220	 750 3000	µA
Ground pin Current at Dropout	$V_{IN}=V_{OUT(NOMINAL)}$-0.5V Note (8)		200	300	µA
Quiescent Current	$V_{EN}\leq$0.4V(Shutdown)		110	170	µA
Current Limit	V_{OUT} = 0		180	250	mA
Enable Input					
Thermal Regulation	(Note 9)		0.05		% / W
Enable Input Voltage Level	V_{IL}, logic Low (off) V_{IH}, Logic High (on)	 2.0		0.6	µA
Enable Input Current	$V_{EN}\leq$0.4V $V_{IH}\geq$2.0V		0.01 15	1 50	µA

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5kΩ in series with 100pF.

Note 3: The maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. All numbers apply for packages soldered directly into a PC board.

Note 4: Typical Values represent the most likely parametric norm.

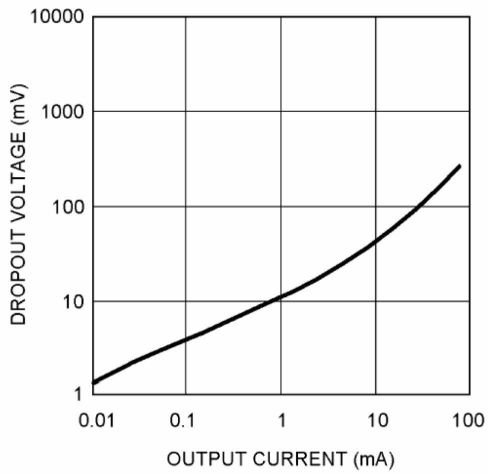
Note 5: All limits are guaranteed by testing or statistical analysis.

Note 6: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

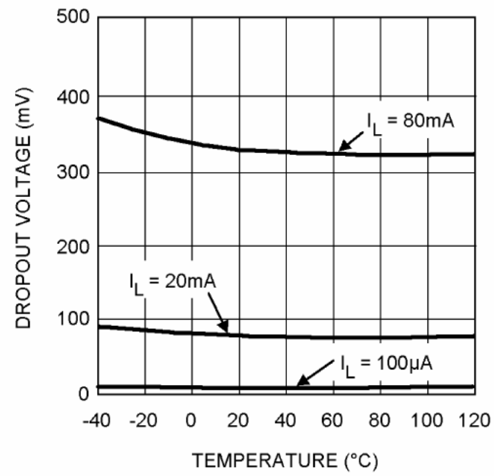
Note 7: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at 1V differential.

Note 8: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

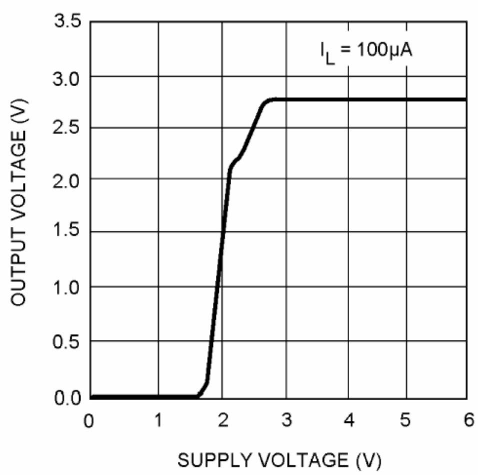
Dropout Voltage vs. Output Current



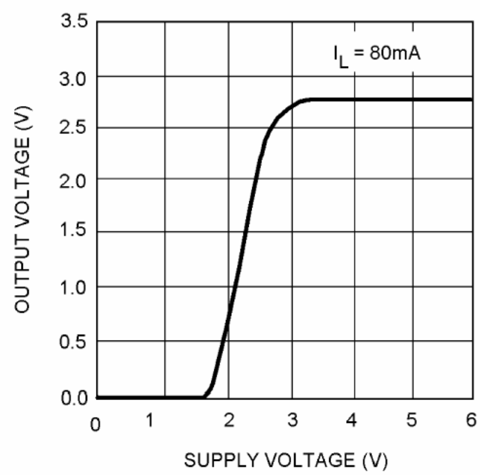
Dropout Voltage vs. Temperature



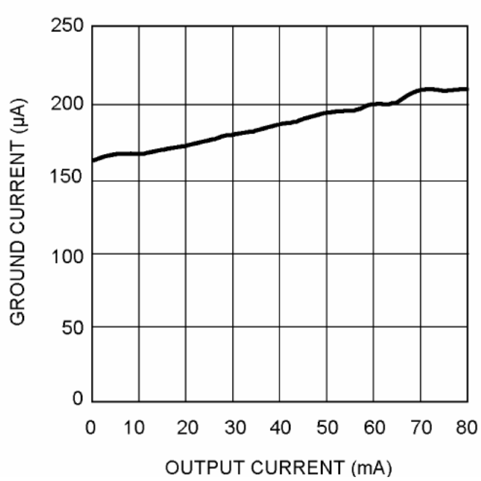
Dropout Characteristics



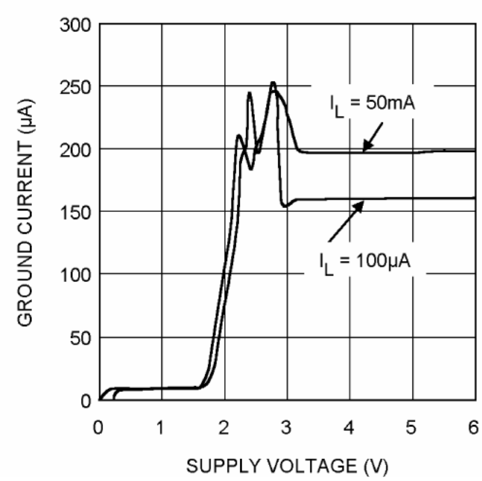
Dropout Characteristics



Ground Current vs. Output Current



Ground Current vs. Supply Voltage



APPLICATION HINTS

The B5213 is a low dropout, linear regulator designed primarily for battery- powered applications. The B5213 can be used with low cost ceramic capacitors, typical value of 0.47 µF.

As illustrated in the simplified schematics, the B5213 consists of a 1.25V reference, error amplifier, P-channel pass transistor and internal feedback voltage diode. The 1.25V reference is connected to the input of the error amp. The error amp compares this reference with the feedback voltage. If the feedback voltage is lower than the reference, the pass transistor gate is pulled lower allowing more current to pass and increasing the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled up allowing less current to pass to the output. The output voltage is feedback through the resistor divider. Additional blocks include short circuit current protection and thermal protection.

The B5213 features an 80mA P- channel MOSFET transistor. This provides several advantages over similar designs using PNP pass transistors including longer battery life.

The P- channel MOSFET requires no base drive, which reduces quiescent current considerably. PNP based regulators waste considerable amounts of current in dropout when the pass transistor saturates. They also have high base drive currents under large loads. The B5213 does not suffer from these problems and consumes only the specified quiescent current under light and heavy loads.

External Capacitors

Like any low- dropout regulators, the B5213 requires external capacitors for regulator stability. The B5213 is specially designed for portable applications requiring minimum board space and the smallest components.

A 0.1µF capacitor should be placed from V_{IN} to GND if there is more than 10 inches of wire between the input and AC filter or when a battery is used as the input. This capacitor must be Located a distance of not more than 1cm from the input pin and returned to a clean analog ground.

The B5213 is designed to work with small ceramic output capacitors. Ceramic capacitors ranging between 0.47 µF to 4.7 µF are the smallest and least expensive.

No- Load Stability

The B5213 will remain stable and in regulation with no- load (other than the internal voltage divider). This is especially important in CMOS RAM keep- alive applications.

Enable Input

The B5213 is shut off by pulling the VEN pin below 0.6V; all internal circuitry is powered off and the quiescent current is typically 1 µA. Pulling the V_{EN} high above 2V re- enables the device and allows operation. If the shut down feature is not used, the V_{EN} pin should be tied to V_{IN} to keep the regulator output on all the time.

Thermal Behavior

The B5213 regulator has internal thermal shutdown to protect the device from over heating. Under all operating conditions, the maximum junction temperature of the B5213 must be below 125 °C. Maximum power dissipation can be calculated based on the output current and the voltage drop across the part. The maximum power dissipation is

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

ϕ_{JA} is the junction- to- ambient thermal resistance, 478 °C/ W for the B5213 in the SC70 package. T_A is the maximum ambient temperature $T_{J(MAX)}$ is the maximum junction temperature of the die, 125 °C

When operating the B5213 at room temperature, the maximum power dissipation is 209mW.

The actual power dissipated by the regulator is

$$PD = (V_{IN} - V_{OUT}) I_L + V_{IN} I_{GND}$$

The figure below shows the voltage and currents, which are present in the circuit.

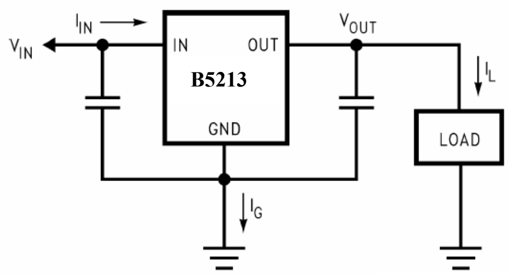


FIGURE 1. Power Dissipation Diagram

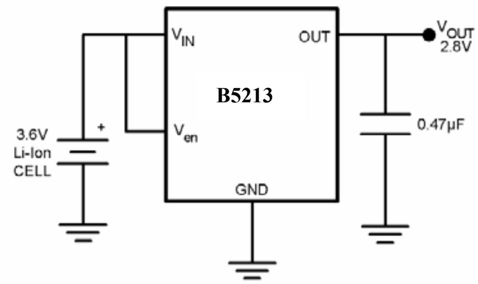
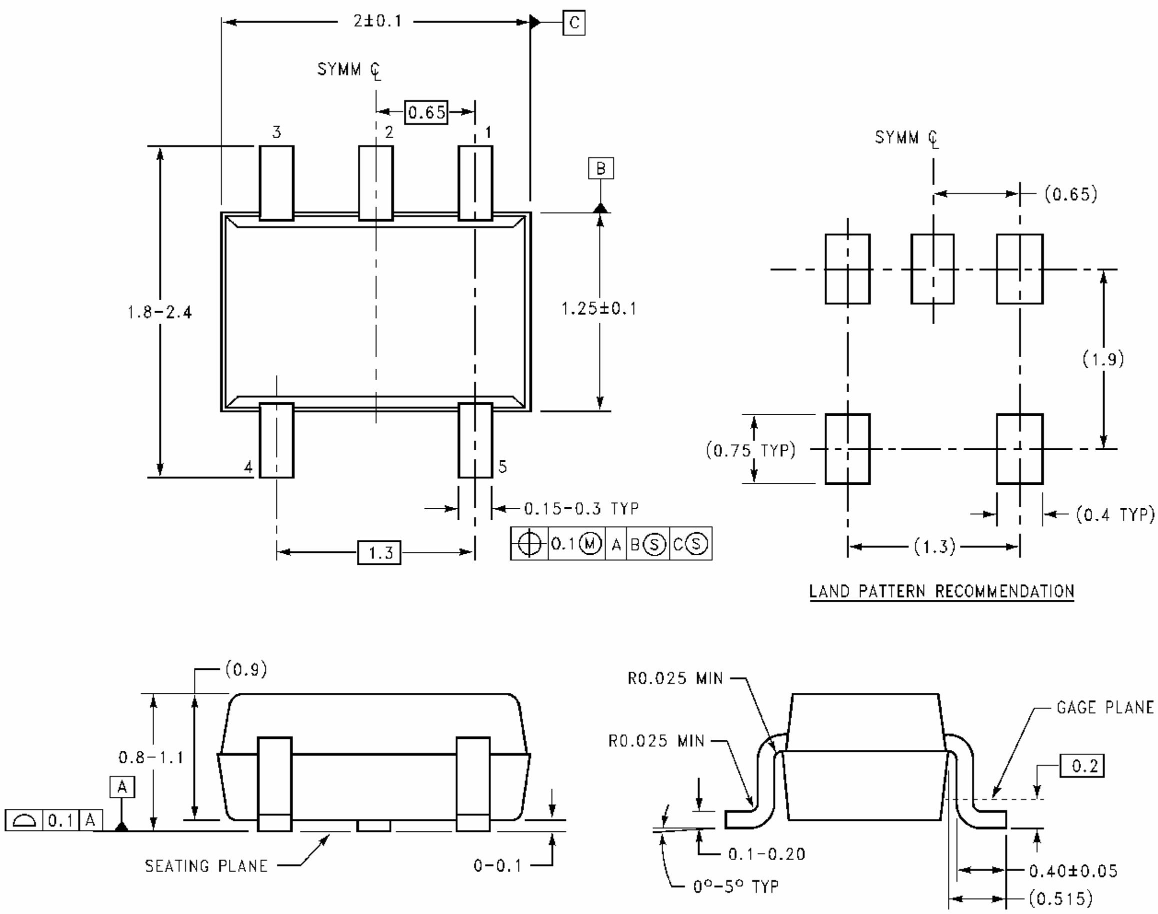


FIGURE 2. Single-Cell Regulator



DIMENSIONS ARE IN MILLIMETERS

5-Pin SC70-5