



SPX5205

150 mA, Low-Noise LDO Voltage Regulator

FEATURES

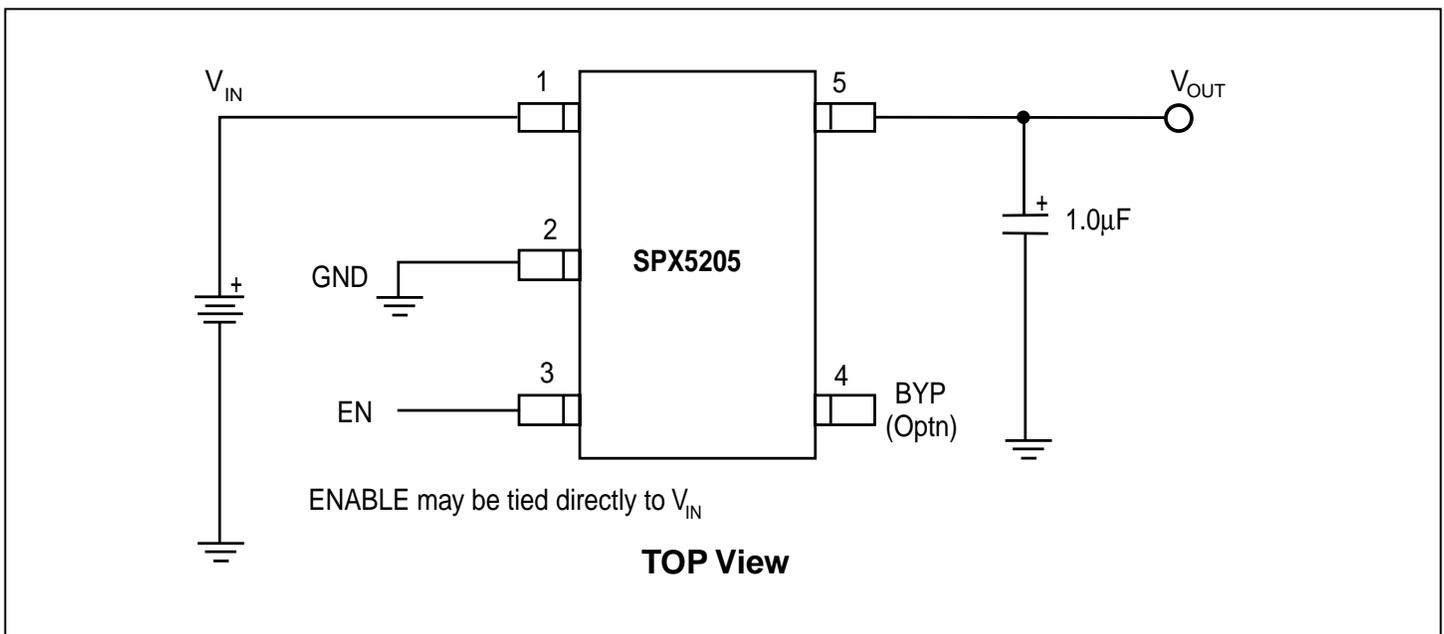
- Low Noise Output LDO, 40 μV_{RMS} possible
- 1% Initial Accuracy
- Very Low Quiescent Current, 70 μA
- Low Dropout Voltage (210mV at 150mA)
- Current & Thermal Limiting
- Reverse-Battery Protection
- Wide Range of Fix Output Voltages
1.8V, 2.0, 2.5V, 2.8V, 3.3V, and 5.0V
- Zero Off-Mode Current
- Small 5-Pin SOT-23
- Pin Compatible to MIC5205/MAX8877 (Fixed Option Only) and AS3815

APPLICATIONS

- PDA
- Battery Powered Systems
- Cellular Phone
- Cordless Telephones
- Radio Control Systems
- Portable/Palm-Top/Notebook Computers
- Portable Consumer Equipment
- Portable Instrumentation
- Bar Code Scanners
- SMPS Post-Regulator

PRODUCT DESCRIPTION

The SPX5205 is a positive voltage regulator with very low dropout voltage, output noise and quiescent current (750 μA at 100 mA). V_{OUT} has a tolerance of less than 1% and is temperature compensated. Fixed output voltages, 1.8V, 2.0, 2.5V, 2.8V, 3.3V, and 5.0V, and an adjustable version are available in a small 5-pin SOT-23 package. Other key features include zero off-mode current, reverse battery protection, thermal shutdown and current limit. The SPX5205 is an excellent choice for use in battery-powered applications, and where power conservation is desired such as: cellular/ cordless telephones, radio control systems, and portable computers.



ABSOLUTE MAXIMUM RATINGS

Thermal Shutdown	Internally Limited
Lead Temp. (Soldering, 5 Seconds)	260°C
Operating Junction Temperature Range	-40°C to +125°C
Input Supply Voltage	-20V to +20V
Enable Input Voltage	-20V to +20V

RECOMMENDED OPERATING CONDITIONS

Input Voltage	+2.5V to +16V
Operating Junction Temperature Range ...	-40°C to +125°C
Enable Input Voltage	0V to V_{IN}
SOT-23-5 (θ_{JA})	See Note 1

ELECTRICAL CHARACTERISTICS

$T_J = 25^\circ\text{C}$, $V_{IN} = V_{OUT} + 1\text{V}$, $I_L = 100\mu\text{A}$, $C_L = 1\mu\text{F}$, and $V_{ENABLE} \geq 2.4\text{V}$. Unless otherwise specified **boldface** applies over the junction temperature range

Parameter	Test Conditions	Typ	Min	Max	Units
Output Voltage Tolerance (V_{OUT})			-1 -2	+1 +2	$\%V_{NOM}$
Output Voltage Temperature Coefficient		57			ppm/°C
Line Regulation	$V_{IN} = V_{OUT} + 1\text{V}$ to 16V	0.03		0.1 0.2	$\%/V$
Load Regulation	$I_L = 0.1\text{mA}$ to 150mA	0.1		0.2 0.5	$\%$
Dropout Voltage (See Note 2) ($V_{IN} - V_O$)	$I_L = 100\mu\text{A}$	30		50 70	mV
	$I_L = 50\text{mA}$	140		190 230	
	$I_L = 100\text{mA}$	180		250 300	
	$I_L = 150\text{mA}$	210		275 350	
Quiescent Current (I_{GND})	$V_{ENABLE} \leq 0.6\text{V}$	< 1		1	μA
	$V_{ENABLE} \leq 0.25\text{V}$			5	
Ground Pin Current (I_{GND})	$I_L = 100\mu\text{A}$	70		125 150	μA
	$I_L = 50\text{mA}$	350		600 800	
	$I_L = 100\text{mA}$	750		1000 1500	
	$I_L = 150\text{mA}$	1300		1900 2500	
Ripple Rejection (PSRR)		70			dB
Current Limit (I_{LIMIT})	$V_{OUT} = 0\text{V}$	360		500	mA
Output Noise (e_{NO})	$I_L = 10\text{mA}$, $C_L = 1\mu\text{F}$ (10Hz – 100kHz.)	300			μV_{RMS}
	$I_L = 10\text{mA}$, $C_L = 10\mu\text{F}$, $C_{BYP} = 1\mu\text{F}$, $C_{IN} = 1\mu\text{F}$, (10Hz – 100kHz.)	40			
Input Voltage Level Logic Low (V_{IL})	OFF			0.6	V
Input Voltage Level Logic High (V_{IH})	ON		2.0		
ENABLE Input Current	$V_{IL} \leq 0.6\text{V}$	0.01		2	μA
	$V_{IH} \geq 2.0\text{V}$	2		20	

Note 1: The maximum allowable power dissipation is a function of maximum operating junction temperature, $T_{J(max)}$, the junction to ambient thermal resistance, and the ambient, θ_{JA} , and the ambient temperature T_A . The maximum allowable power dissipation at any ambient temperature is given:

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

exceeding the maximum allowable power limit will result in excessive die temperature; thus, the regulator will go into thermal shutdown.

The θ_{JA} of the AS3815 is 220°C/W mounted on a PC board.

Note 2: Not applicable to output voltages of less than 2V.

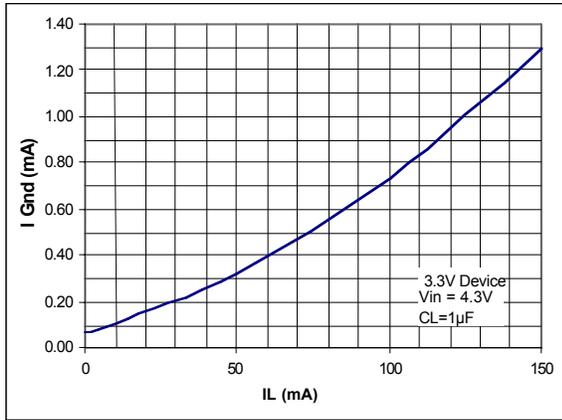


Figure 1. Ground Current vs Load Current for 3.3V device

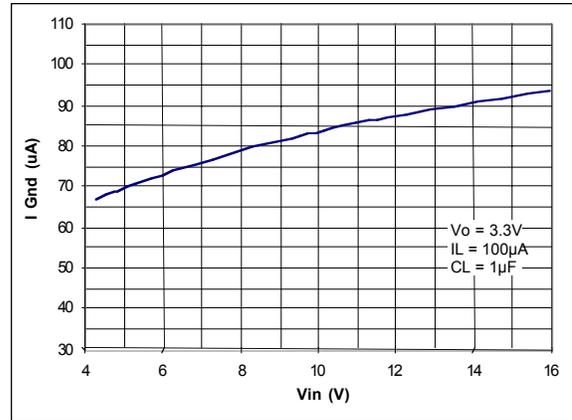


Figure 2. Ground Current vs Input Voltage for a 3.3V device

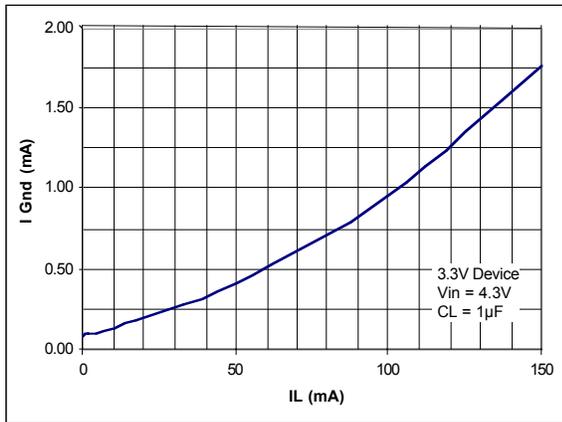


Figure 3. Ground Current vs Load Current in dropout

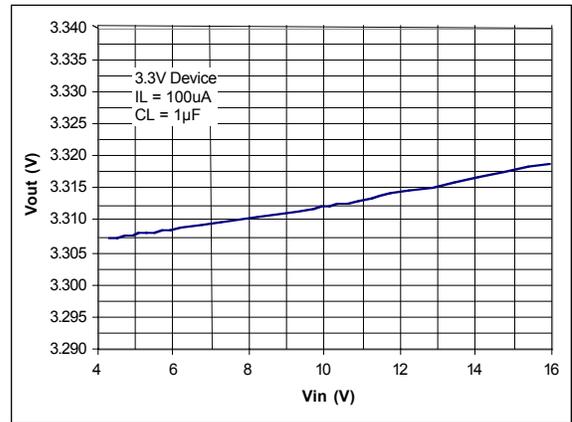


Figure 4. Output Voltage vs Input Voltage for a 3.3V device

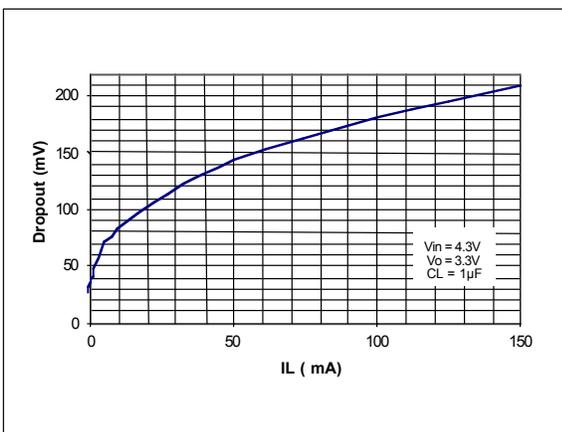


Figure 5. Dropout Voltage vs Load Current for 3.3V device

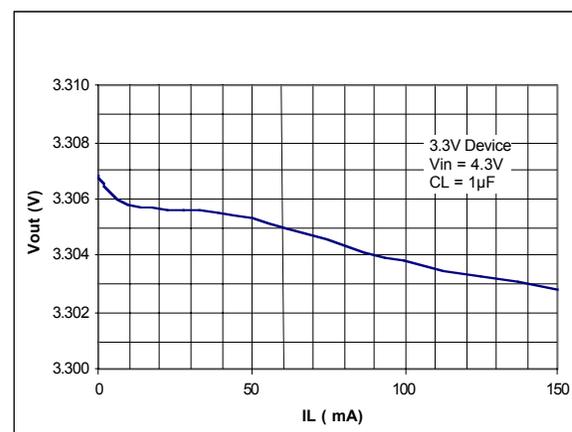


Figure 6. Output Voltage vs Load Current for a 3.3V Device

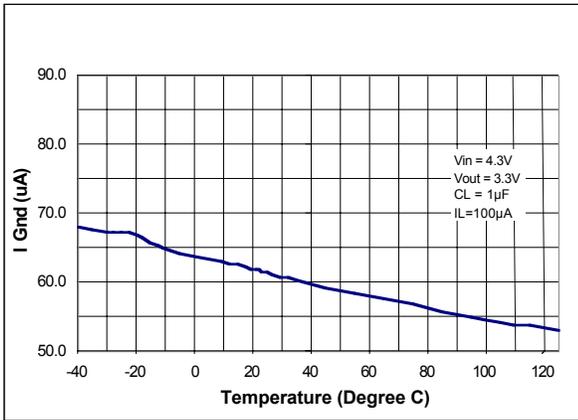


Figure 7. Ground Current vs Temperature at $I_{LOAD}=100\mu A$

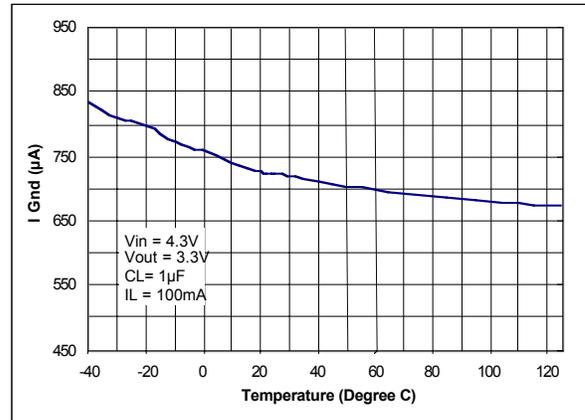


Figure 8. V Ground Current vs Temperature at $I_{LOAD}=100mA$

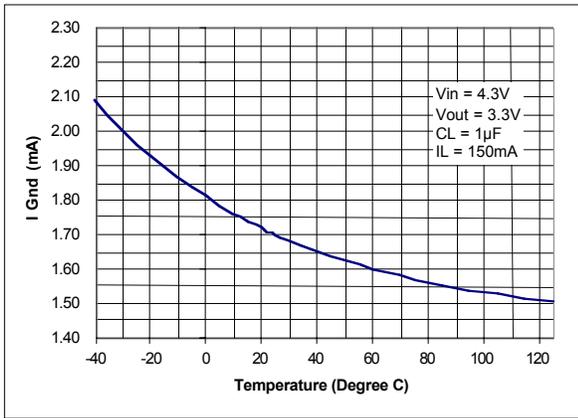


Figure 9. Ground Current in Dropout vs Temperature

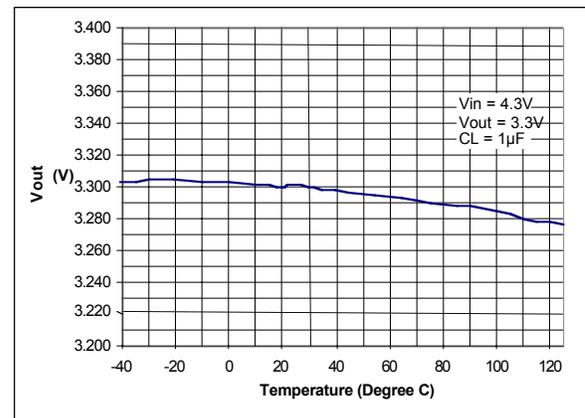


Figure 10. Output Voltage vs Temperature

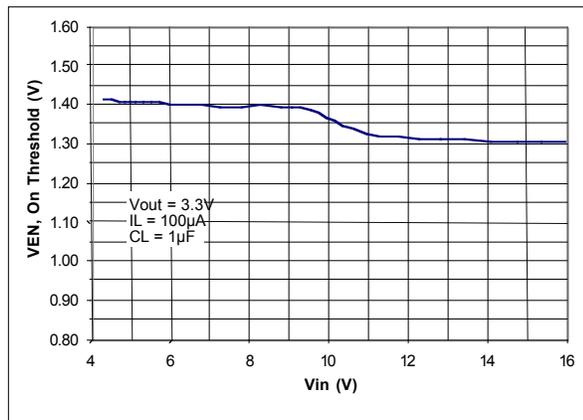


Figure 11. ENABLE Voltage ON threshold vs Input Voltage

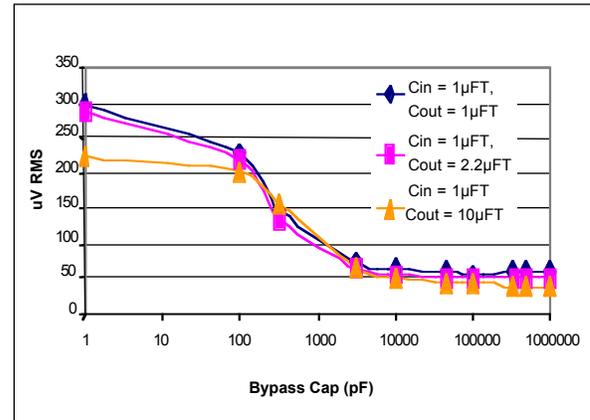


Figure 12. Output Noise vs Bypass Capacitor Value

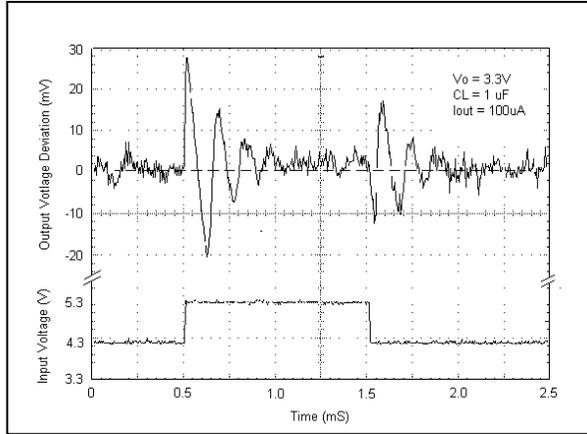


Figure 13. Line Transient Response

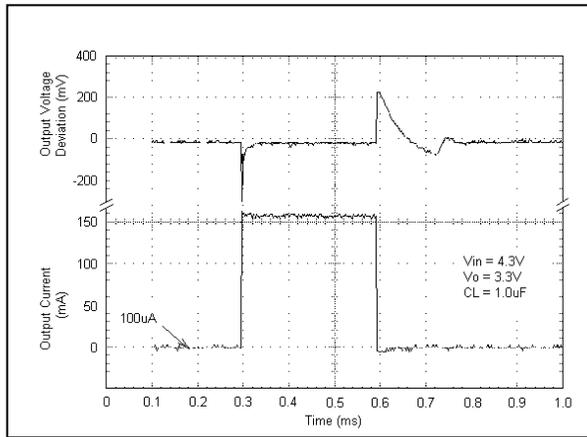


Figure 14 Load Transient Response

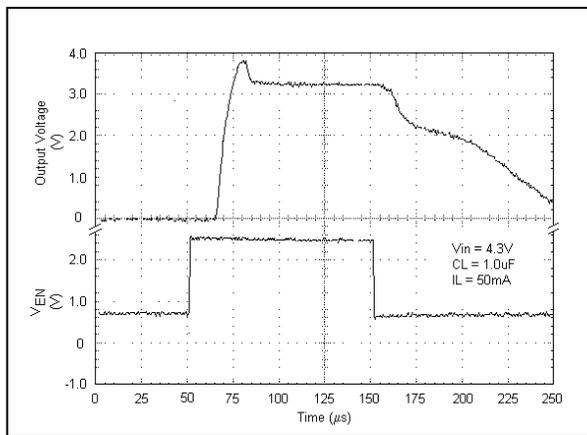


Figure 15 Switching Characteristics

Application Information

The SPX5205 requires an output capacitor for device stability.

Its value depends upon the application circuit. In general, linear regulator stability decreases with higher output currents. In applications where the SPX5205 is putting out less current, a lower output capacitance may be sufficient. For example, a regulator sourcing only 10mA, requires approximately half the capacitance as the same regulator sourcing 150mA.

Bench testing is the best method for determining the proper type and value of the capacitor since the high frequency characteristics of electrolytic capacitors vary widely, depending on type and manufacturer. A high quality 2.2μF aluminum electrolytic capacitor works in most application circuits, but the same stability often can be obtained with a 1μF tantalum electrolytic.

With the SPX5205 adjustable version, the minimum value of output capacitance is a function of the output voltage. The value decreases with higher output voltages, since closed loop gain is increased.

Typical Applications Circuits

A 10μF capacitor on BYP pin will significantly reduce output noise but it may be left unconnected if the output noise is not a major concern. The SPX5205 start-up speed is inversely proportional to the size of the BYP capacitor. Applications requiring a slow ramp-up of the output voltage should use a larger C_{BYP}. However, if a rapid turn-on is necessary, the BYP capacitor can be omitted.

The SPX5205's internal reference is available through the BYP pin.

Figure 16 represents a SPX5205 standard application circuit. The EN (enable) pin is pulled high (>2.0V) to enable the regulator. To disable the regulator, EN < 0.6V.

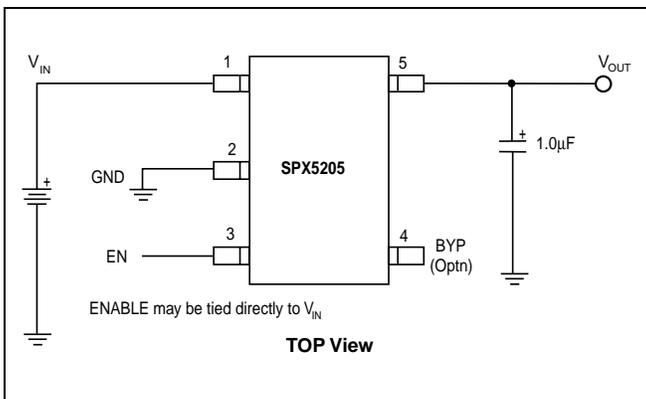


Figure 16. Standard Application Circuit

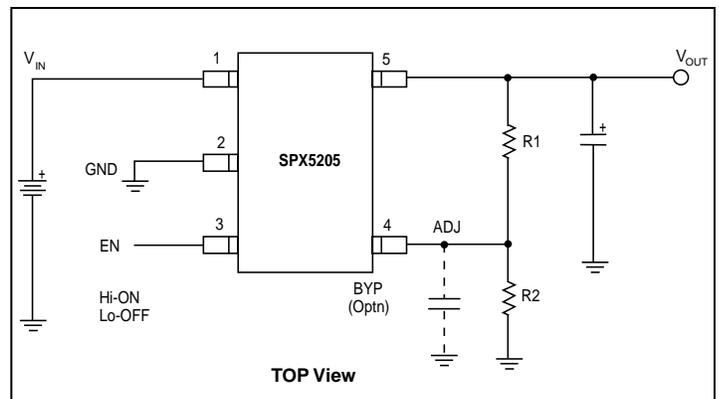


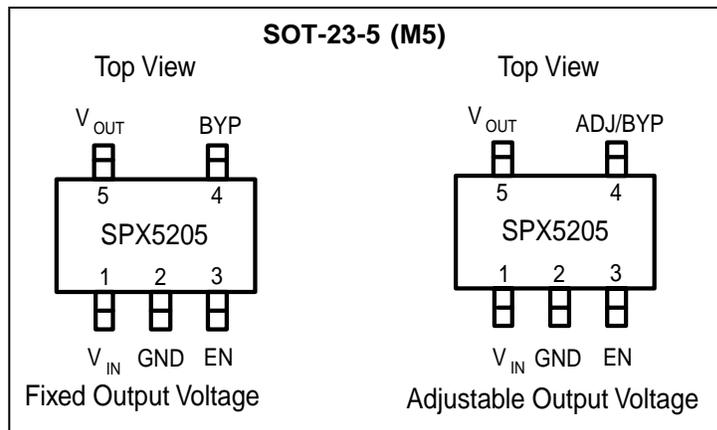
Figure 17. Typical Adjustable Output Voltage Configuration

The SPX5205 in Figure 17 illustrates a typical adjustable output voltage configuration. Two resistors (R₁ and R₂) set the output voltage. The output voltage is calculated using the formula:

$$V_{OUT} = 1.235V \times \left[1 + \frac{R1}{R2} \right]$$

R₂ must be > 10 kΩ and for best results, R₂ should be between 22 kΩ and 47kΩ. A capacitor placed between Adj and ground will provide improved noise performance.

PACKAGE PINOUT



Ordering Information

Part Number	Accuracy	Output Voltage	Package
SPX5205M5	1%	Adj	5 lead SOT-23
SPX5205M5-1.8	1%	1.8V	5 lead SOT-23
SPX5205M5-2.0	1%	2.0V	5 lead SOT-23
SPX5205M5-2.5	1%	2.5V	5 lead SOT-23
SPX5205M5-2.8	1%	2.8V	5 lead SOT-23
SPX5205M5-3.3	1%	3.3V	5 lead SOT-23
SPX5205M5-5.0	1%	5.0V	5 lead SOT-23



SIGNAL PROCESSING EXCELLENCE

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