MIC5230

10mA Microcurrent Voltage Regulator

Preliminary Information

General Description

The MIC5230 is a family of efficient linear voltage regulators with a very low dropout voltage (typically 20mV at light loads and 132mV at 10mA), and an extremely low ground current (1µA typical, across the full output current range).

Designed especially for hand-held battery powered devices, the MIC5230 offers better than 3% initial accuracy. This regulator's ability to also sink current improves regulation under very light-load conditions.

The MIC5230 is offered in the tiny SOT-23-5 package with a 5.0V fixed output voltage. Other voltages are available. Contact Micrel for details.

Features

- Extremely low quiescent current
- Tiny SOT-23-5 surface mount package
- Wide selection of output voltages
- Guaranteed 10mA output
- Low dropout voltage
- No output capacitor needed
- Insensitive to output capacitor ESR
- Tight load and line regulation
- Low temperature coefficient

Applications

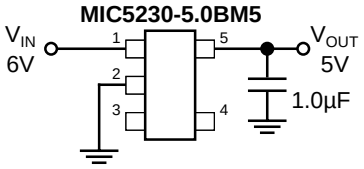
- Real time clocks
- SRAM backup
- Cellular telephones
- Laptop, notebook, and palmtop computers
- Battery-powered equipment
- Bar code scanners
- SMPS post-regulator/dc-to-dc modules
- High-efficiency linear power supplies

Ordering Information

Part Number	Marking	Voltage	Temperature Range	Package
MIC5230-5.0BM5	LC50	5.0V	–40°C to +85°C	SOT-23-5

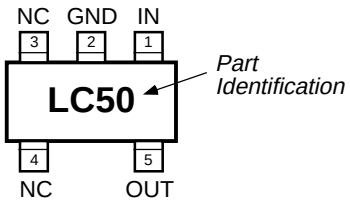
Other voltages available. Contact Micrel for details.

Typical Application



5V Linear Regulator Application

Pin Configuration



MIC5230-5.0BM5

Pin Description

Pin Number	Pin Name	Pin Function
1	IN	Supply Input
2	GND	Ground
3,4	NC	Not internally connected. Connect to ground plane for lowest package thermal resistance.
5	OUT	Regulated Output

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{IN}) ..... –0.6V to +18V
Output Current (I_{OUT}) ..... 0.5A peak
Power Dissipation (P_D) ..... 0.3W @ 25°C
Lead Temperature (soldering, 5 sec.) ..... 260°C
Storage Temperature (T_A) ..... –60°C to +150°C

Operating Ratings

Input Voltage (V_{IN}) ..... 3.5V to 16V
Output Current (I_{OUT}) 40mA
Ambient Temperature (T_A) ..... –40°C to +85°C
Junction Temperature (T_J) ..... –40°C to +125°C
Thermal Resistance ..... **Note 6**

Electrical Characteristics

$V_{IN} = V_{OUT} + 1V$; $I_L = 1mA$; $C_L = 1\mu F$; $T_J = 25°C$, **bold** values indicate $–40°C \le T_J \le +125°C$; unless noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{OUT}	Output Voltage	initial variation from nominal V_{OUT}	–3		3	%
$\Delta V_{OUT}/\Delta T$	Output Voltage Temperature Coefficient	**Note 2**		800	1200	ppm/°C
$\Delta V_{OUT}/V_{OUT}$	Line Regulation	V_{IN} = 6V to 16V		0.2	0.25	%
$\Delta V_{OUT}/V_{OUT}$	Load Regulation	I_L = 10µA to 10mA, **Note 3**		0.12		%
		I_L = 10µA sink to 10µA source, **Note 4**		2.4		%
V_{DO}	Dropout Voltage, **Note 5**	I_L = 1mA		13		mV
		I_L = 10mA		132		mV
I_Q	Ground Pin Current	V_{IN} = 6V, I_L = 10mA		1	3	µA
		V_{IN} = 16V, I_L = 10mA		1.1	4	µA
I_{SC}	Short Circuit Current, **Note 1**	V_{OUT} = 0V, V_{DD} = 6V		200	300	mA

General Note: Devices are ESD protected; however, handling precautions are recommended.

Note 1: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

Note 2: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 3: Regulation is measured at constant junction temperature using low duty cycle pulse testing.

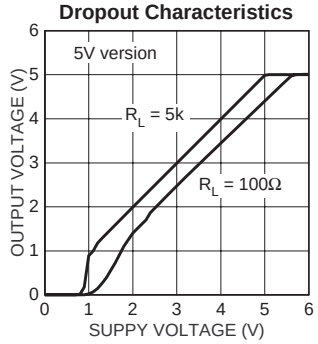
Note 4: Load regulation (sink to source) is the difference in output voltage when a 10µA current reverses from sinking to sourcing. The MIC5230 will sink as well as source output current.

Note 5: 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.

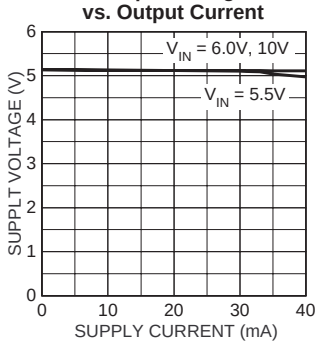
Note 6: The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(max)}$, the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D(max)} = (T_{J(max)} – T_A) / \theta_{JA}$. The θ_{JC} of the MIC5230 is 180°C/W. Mounted to a standard PC board, the θ_{JA} is approximately 220°C/W.

Typical Characteristics

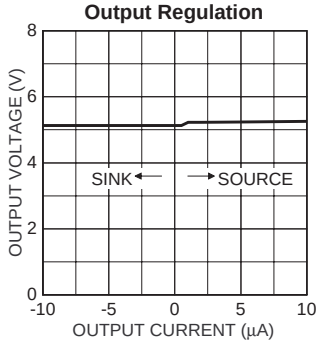
Dropout Characteristics



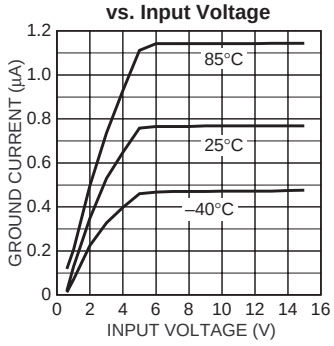
Output Voltage vs. Output Current



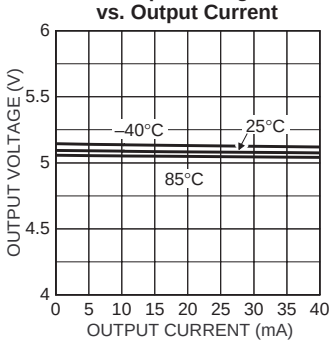
Source-Sink Output Regulation



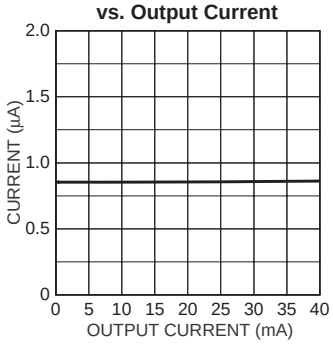
Ground Current vs. Input Voltage



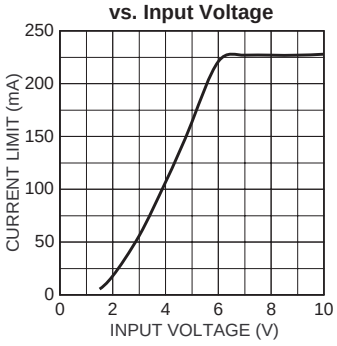
Output Voltage vs. Output Current



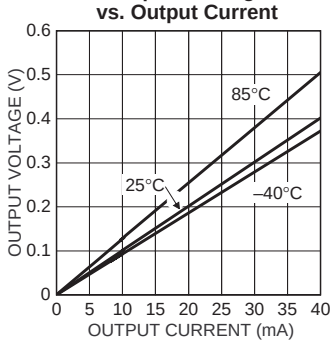
Ground Current vs. Output Current



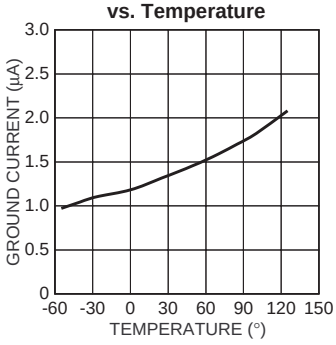
Current Limit vs. Input Voltage



Dropout Voltage vs. Output Current



Ground Current vs. Temperature



Applications Information

Input Capacitor

A 0.1µF (or larger) capacitor should be placed from the IN (supply input) to GND (ground) if there is more than 20 cm of wire between IN and the ac filter capacitor or if supplied from a battery.

Output Capacitors

The MIC5230 does not require an output capacitor for stability. A 1µF or larger capacitor is recommended between OUT (output) and GND to improve the regulator's transient response. 0.1µF can be used to reduce overshoot recovery time at the expense of overshoot amplitude. The ESR (effective series resistance) of this capacitor has no effect on regulator stability, but low-ESR capacitors improve high frequency transient response. The value of this capacitor may be increased without limit, but values larger than 10µF tend to increase the settling time after a step change in input voltage or output current.

The MIC5230 has no minimum load current; it will remain stable and in regulation with no load (other than the internal voltage divider). This is especially important in real-time clock and CMOS RAM keep-alive applications.

Safe Operating Conditions

MIC5230 output current is not internally limited. Under short-circuit conditions, output current is proportional to input voltage and the resulting power dissipation may cause excessive junction temperatures. The typical short circuit current with an input voltage of 6V is 200mA, or a power dissipation of 1.2W. Since overtemperature shutdown is not provided, power dissipation must be limited to prevent the junction temperature from exceeding +125°C.

Microcurrent Converter

The MIC5230 can be used to regulate the output of an MIC2660 charge pump to create a 3V to 5V converter. See Figure 1. This converter is suitable for where 5V at 5mA or less is needed within a circuit otherwise powered from a 3V supply.

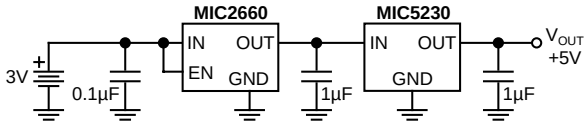


Figure 1. 3V to 5V/5mA Converter