

# MICREL

## MIC5203

### 50mA Low-Dropout Voltage Regulator

#### Preliminary Information

#### General Description

The MIC5203 is a family of efficient linear voltage regulators with very low dropout voltage (typically 50mV at light loads and 300mV at 50mA), and very low ground current (750μA at 50mA output), offering better than 3% initial accuracy with a logic compatible ON/OFF switching input. Designed especially for hand-held battery powered devices, the MIC5203 is switched by a CMOS or TTL compatible logic signal and when disabled, power consumption drops nearly to zero. If logic control is not required, the Enable pin may be tied to the Input for 3-terminal operation. The ground current of the MIC5203 increases only slightly in dropout, further prolonging battery life. Key MIC5203 features include protection against reversed battery, current limiting, and overtemperature shutdown.

The MIC5203 is available in 3.0V, 3.3V, 4.75V, and 5.0V fixed voltage configurations. Other voltages are available; contact Micrel for details.

#### Features

- Tiny four lead surface mount package
- Choice of output voltage: 3.0V, 3.3V, 4.75V, or 5.0V
- Guaranteed 50mA output
- Low quiescent current
- Low dropout voltage
- Tight load and line regulation
- Low temperature coefficient
- Current and thermal limiting
- Reversed input polarity protection
- Zero OFF mode current
- Logic-controlled electronic shutdown

#### Applications

- 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

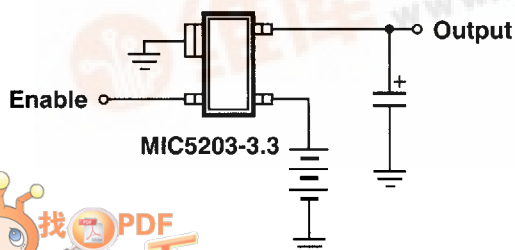
3

#### Ordering Information

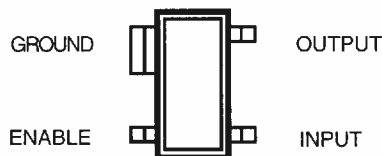
Part Number	Marking	Volts	Junction Temperature Range	Package
MIC5203-3.0CM4	LA30	3.0	0°C to +125°C	SOT-143
MIC5203-3.3CM4	LA33	3.3	0°C to +125°C	SOT-143
MIC5203-4.7CM4	LA47	4.75	0°C to +125°C	SOT-143
MIC5203-5.0CM4	LA50	5.0	0°C to +125°C	SOT-143

Other voltages are available; contact Micrel for details.

#### Typical Application



#### Pin Configuration



## Absolute Maximum Ratings

Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device beyond its specified **Recommended Operating Conditions**.

Power Dissipation ..... Internally Limited  
 Lead Temperature (Soldering, 5 seconds) ..... 260°C  
 Junction Temperature Range ..... -40°C to +125°C  
 Input Supply Voltage ..... -20V to +20V  
 ENABLE Input Voltage ..... -20V to +20V  
 ESD Rating ..... > 2000V  
 SOT-143  $\theta_{JA}$  ..... See Note 1

## Recommended Operating Conditions

Input Voltage ..... 2.5V to 16V  
 Operating Junction Temperature Range ..... 0°C to +125°C  
 ENABLE Input Voltage ..... 0V to  $V_{CC}$

## Electrical Characteristics

Limits in standard typeface are for  $T_J = 25^\circ\text{C}$  and limits in **boldface** apply over the junction temperature range of 0°C to +125°C.

Unless otherwise specified,  $V_{IN} = V_{OUT} + 1\text{V}$ ,  $I_L = 1\text{mA}$ ,  $C_L = 1\mu\text{F}$ , and  $V_{CONTROL} \geq 2.0\text{V}$ .

Symbol	Parameter	Conditions	Min	Typical	Max	Units
$V_O$	Output Voltage Accuracy		-3 -4		3 4	%
$\frac{\Delta V_O}{\Delta T}$	Output Voltage Temperature Coef.	(Note 2)		50	200	ppm/°C
$\frac{\Delta V_O}{V_O}$	Line Regulation	$V_{IN} = V_{OUT} + 1\text{V}$ to 16V			0.4 0.6	%
$\frac{\Delta V_O}{V_O}$	Load Regulation	$I_L = 0.1\text{mA}$ to 50mA (Note 3)			0.5 0.7	%
$V_{IN} - V_O$	Dropout Voltage (Note 4)	$I_L = 100\mu\text{A}$ $I_L = 20\text{mA}$ $I_L = 30\text{mA}$ $I_L = 50\text{mA}$		35 200 250 300	450	mV
$I_O$	Quiescent Current	$V_{CONTROL} \leq 0.4\text{V}$ (Shutdown)		0.01	10	$\mu\text{A}$
$I_{GND}$	Ground Pin Current (Note 5)	$V_{CONTROL} \geq 2.0\text{V}$ (Active), $I_L = 100\mu\text{A}$ $I_L = 20\text{mA}$ $I_L = 30\text{mA}$ $I_L = 50\text{mA}$		180 270 390 760	1000	$\mu\text{A}$
$I_{GNDDO}$	Ground Pin Current at Dropout	$V_{IN} = 0.5\text{V}$ less than designed $V_{OUT}$ (Note 5)		200	300	$\mu\text{A}$
$I_{LIMIT}$	Current Limit	$V_{OUT} = 0\text{V}$	50	80		mA
$\frac{\Delta V_O}{\Delta P_D}$	Thermal Regulation	(Note 6)		0.05		%/W

### Control Input

$V_{IL}$ $V_{IH}$	Input Voltage Level Logic Low Logic High	OFF ON	2.0		0.6	V
$I_{IL}$ $I_{IH}$	Control Input Current	$V_{IL} \leq 0.6\text{V}$ $V_{IH} \geq 2.0\text{V}$		0.01 15	1 50	$\mu\text{A}$

**Notes:**

**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. The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_{jmax}$ , the junction-to-ambient thermal resistance,  $\theta_{JA}$ , and the ambient temperature,  $T_A$ . The maximum allowable power dissipation at any ambient temperature is calculated using:  $P_{max} = (T_{jmax} - T_A) / \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.  $\theta_{JA}$  of the SOT-143 is 250°C/W, mounted on a PC board.

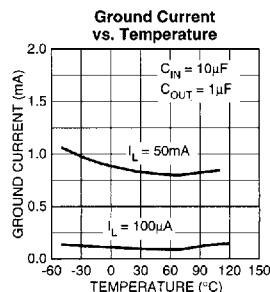
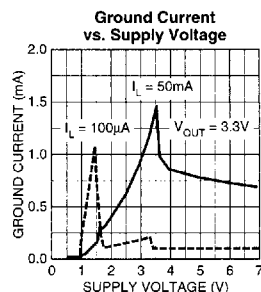
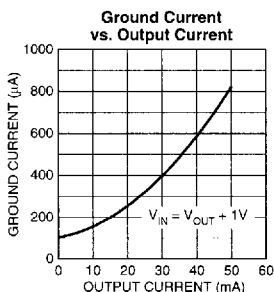
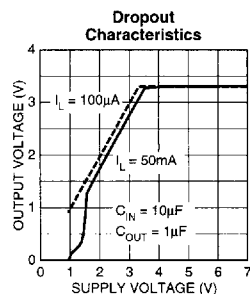
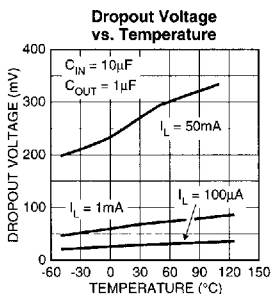
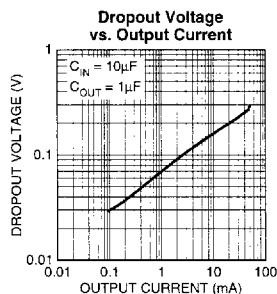
**Note 2:** Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

**Note 3:** Regulation is measured at constant junction temperature using low duty cycle pulse testing. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

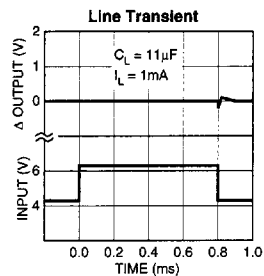
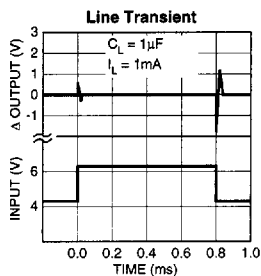
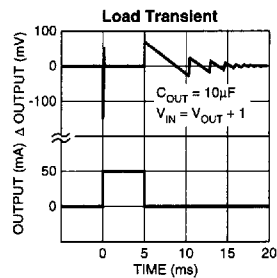
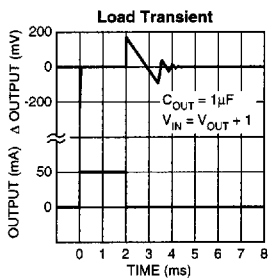
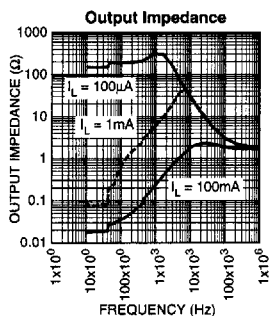
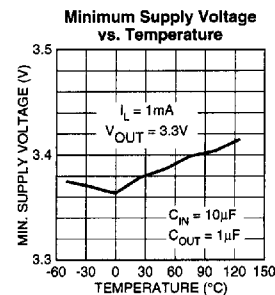
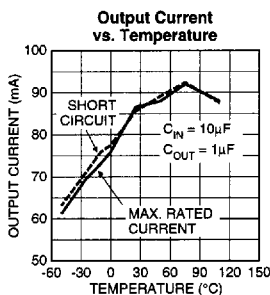
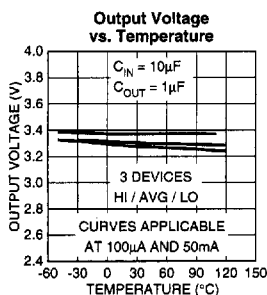
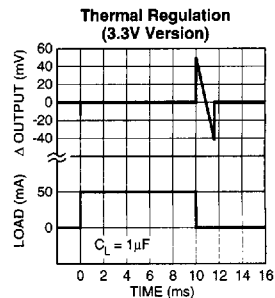
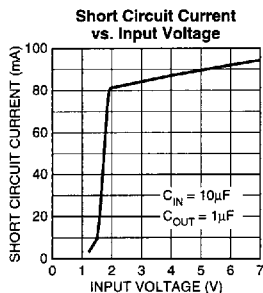
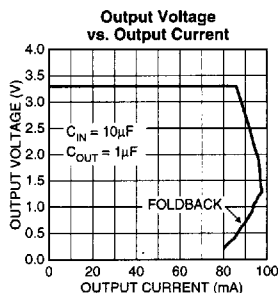
**Note 4:** Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at 1V differential.

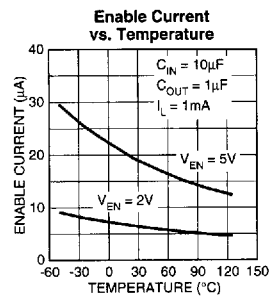
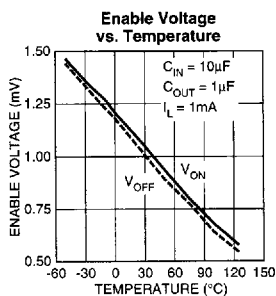
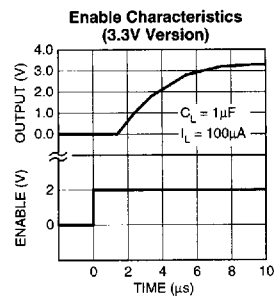
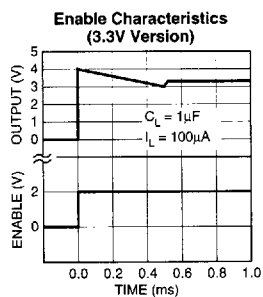
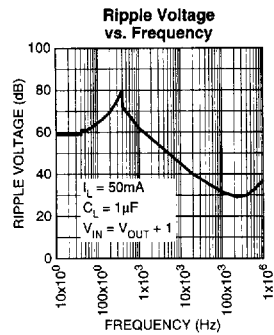
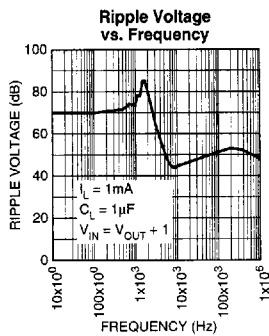
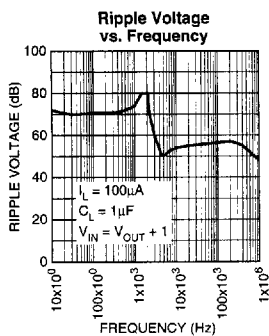
**Note 5:** Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

**Note 6:** Thermal regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 50mA load pulse at  $V_{in} = 16V$  for  $T = 10ms$ .

**Typical Characteristics**

## Typical Characteristics





## Applications Information

### External Capacitors

A  $1\mu\text{F}$  capacitor is recommended between the MIC5203 output and ground to prevent oscillations due to instability. Larger values serve to improve the regulator's transient response. Most types of tantalum or aluminum electrolytics will be adequate; film types will work, but are costly and therefore not recommended. Many aluminum electrolytics have electrolytes that freeze at about  $-30^{\circ}\text{C}$ , so solid tantalums are recommended for operation below  $-25^{\circ}\text{C}$ . The important parameters of the capacitor are an effective series resistance of about  $5\Omega$  or less and a self-resonant frequency above  $500\text{kHz}$ . The value of this capacitor may be increased without limit.

At lower values of output current, less output capacitance is required for output stability. The capacitor can be reduced to  $0.22\mu\text{F}$  for current below  $10\text{mA}$  or  $0.1\mu\text{F}$  for currents below  $1\text{mA}$ .

The MIC5203 will remain stable and in regulation with no load other than the internal voltage divider, unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

A  $0.1\mu\text{F}$  (or larger) capacitor should be placed from the MIC5203 input to ground if there is more than 10 inches of wire between the input and the AC filter capacitor or if a battery is used as the input.

### ENABLE Input

The MIC5203 features nearly zero OFF mode current. When the ENABLE input is held below  $0.7\text{V}$ , all internal circuitry is powered off. Pulling this pin high (over  $2.0\text{V}$ ) re-enables the device and allows operation. The ENABLE pin requires a small amount of current, typically  $15\mu\text{A}$ . While the logic threshold is TTL/CMOS compatible, ENABLE may be pulled as high as  $30\text{V}$ , independent of the voltage on  $V_{\text{IN}}$ .