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

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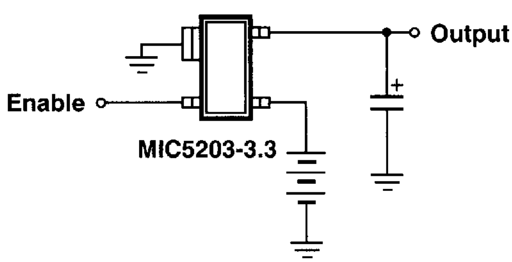
Ordering Information

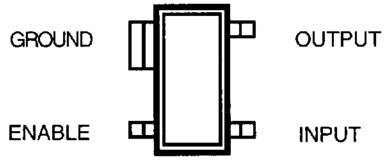
Part Number	Marking	Volts	Junction Temperature Range	Package
MIC5203-3.0CM4	LA30	3.0	0°C to +125°C	SOT-143
MIC5203-3.3CM4	LA33	3.3	0°C to +125°C	SOT-143
MIC5203-4.7CM4	LA47	4.75	0°C to +125°C	SOT-143
MIC5203-5.0CM4	LA50	5.0	0°C to +125°C	SOT-143

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 θ_{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°C and limits in **boldface** apply over the junction temperature range of 0°C to +125°C. Unless otherwise specified, $V_{IN} = V_{OUT} + 1V$, I_L = 1mA, C_L = 1µF, and $V_{CONTROL} \geq 2.0V$.

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	$V_{IN} = V_{OUT+1}$ V to 16V			0.4 **0.6**	%
$\frac{\Delta V_O}{V_O}$	Load Regulation	I_L = 0.1mA to 50mA (Note 3)			0.5 **0.7**	%
$V_{IN} - V_O$	Dropout Voltage (Note 4)	I_L = 100µA I_L = 20mA I_L = 30mA I_L = 50mA		35 200 250 300	 **450**	mV
I_Q	Quiescent Current	$V_{CONTROL} \leq 0.4V$ (Shutdown)		0.01	10	µA
I_{GND}	Ground Pin Current (Note 5)	$V_{CONTROL} \geq 2.0V$ (Active), I_L = 100µA I_L = 20mA I_L = 30mA I_L = 50mA		180 270 390 760	 **1000**	µA
I_{GNDDO}	Ground Pin Current at Dropout	V_{IN} = 0.5V less than designed V_{OUT} (Note 5)		200	**300**	µA
I_{LIMIT}	Current Limit	V_{OUT} = 0V	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	$V_{IL} \leq 0.6V$ $V_{IH} \geq 2.0V$		0.01 15	1 **50**	µA

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, θ_{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. θ_{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.

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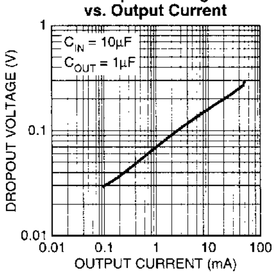
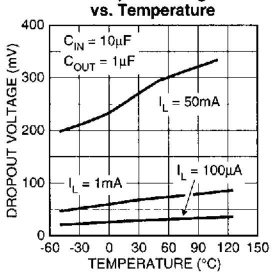
Typical Characteristics

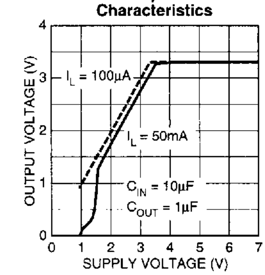
Dropout Voltage vs. Output Current



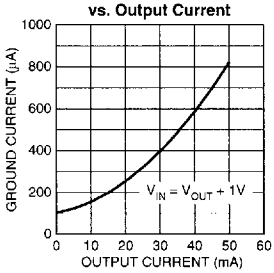
Dropout Voltage vs. Temperature



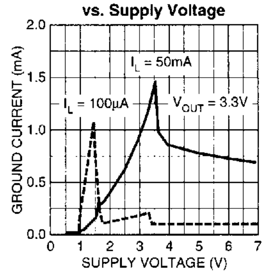
Dropout Characteristics



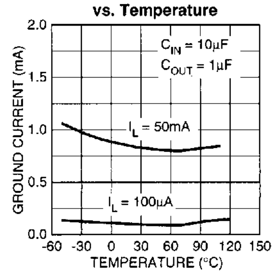
Ground Current vs. Output Current



Ground Current vs. Supply Voltage

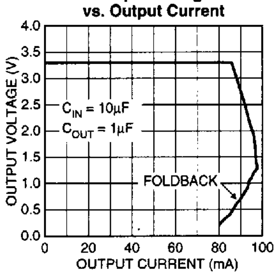


Ground Current vs. Temperature

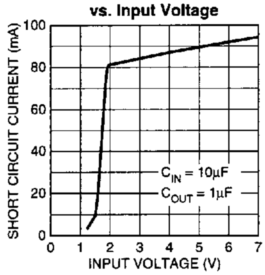


Typical Characteristics

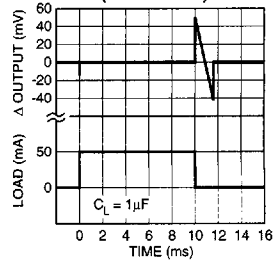
Output Voltage vs. Output Current



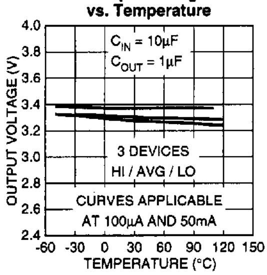
Short Circuit Current vs. Input Voltage



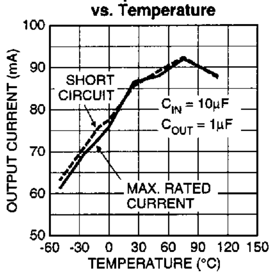
Thermal Regulation (3.3V Version)



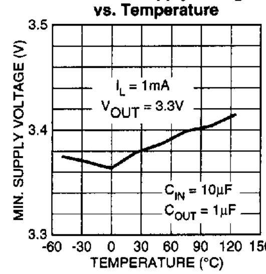
Output Voltage vs. Temperature



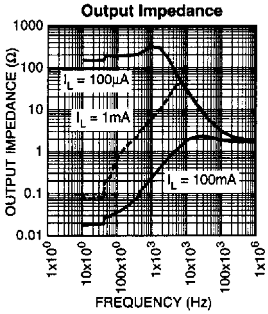
Output Current vs. Temperature



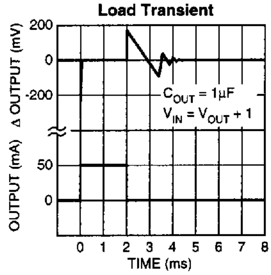
Minimum Supply Voltage vs. Temperature



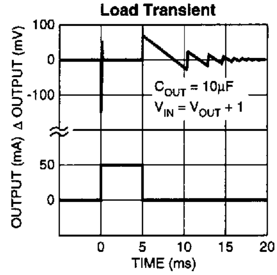
Output Impedance



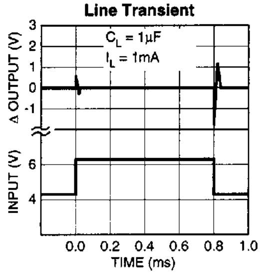
Load Transient



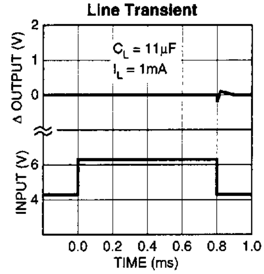
Load Transient



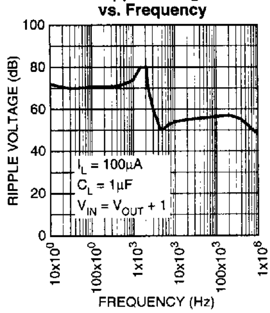
Line Transient



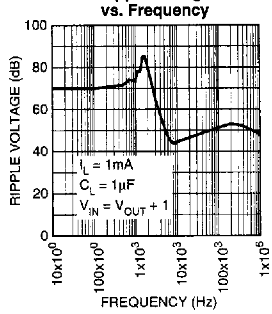
Line Transient



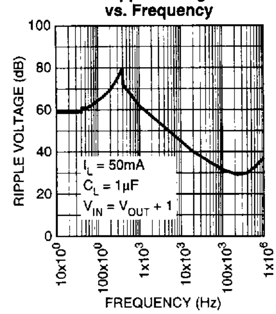
Ripple Voltage vs. Frequency



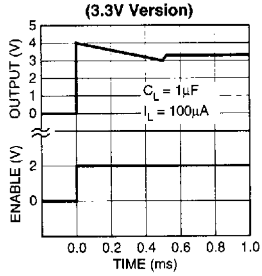
Ripple Voltage vs. Frequency



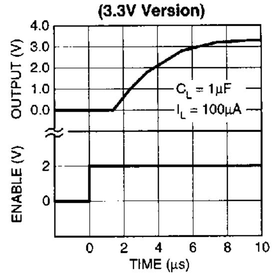
Ripple Voltage vs. Frequency



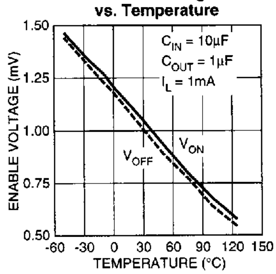
Enable Characteristics (3.3V Version)



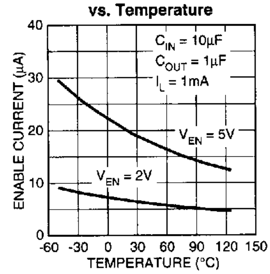
Enable Characteristics (3.3V Version)



Enable Voltage vs. Temperature



Enable Current vs. Temperature



Applications Information

External Capacitors

A 1µF 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°C, so solid tantalums are recommended for operation below –25°C. The important parameters of the capacitor are an effective series resistance of about 5Ω or less and a self-resonant frequency above 500kHz. 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 0.22µF for current below 10mA or 0.1µF for currents below 1 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 0.1µF (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 0.7V, all internal circuitry is powered off. Pulling this pin high (over 2.0V) re-enables the device and allows operation. The ENABLE pin requires a small amount of current, typically 15µA. While the logic threshold is TTL/CMOS compatible, ENABLE may be pulled as high as 30V, independent of the voltage on V_{IN}.