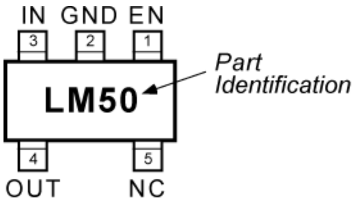
Ordering Information(1)

Part Number	Marking	Voltage	Temperature Range	Package	Lead Finish
MIC5231-2.75BM5	LM2H	2.75V	–40°C to +125°C	5-Pin SOT-23	Standard
MIC5231-2.75YM5	LM2H(2)	2.75V	–40°C to +125°C	5-Pin SOT-23(3)	Pb-Free
MIC5231-3.0BM5	LM30	3.0V	–40°C to +125°C	5-Pin SOT-23	Standard
MIC5231-3.0YM5	LM30(2)	3.0V	–40°C to +125°C	5-Pin SOT-23(3)	Pb-Free
MIC5231-3.3BM5	LM33	3.3V	–40°C to +125°C	5-Pin SOT-23	Standard
MIC5231-3.3YM5	LM33(2)	3.3V	–40°C to +125°C	5-Pin SOT-23(3)	Pb-Free
MIC5231-5.0BM5	LM50	5.0V	–40°C to +125°C	5-Pin SOT-23	Standard
MIC5231-5.0YM5	LM50(2)	5.0V	–40°C to +125°C	5-Pin SOT-23(3)	Pb-Free

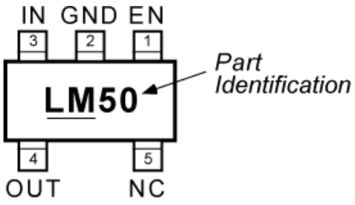
Notes:

1. Other voltages available. Contact factory for details.
2. Under bar (_) symbol used to identify Pb-Free device may not be to scale.
3. SOT-23-5 is a RoHS-compliant package. Lead finish is a NiPdAu. Mold compound is Halogen free.

Pin Configuration



MIC5231-5.0BM5 (M5)



MIC5231-5.0YM5 (M5)

Pin Description

Pin Number	Pin Name	Pin Function
1	EN	Enable (Input): Active high. Logic high = enable; logic low = shutdown. Do not float.
2	GND	Ground.
3	IN	Supply Input.
4	OUT	Regulated Output.
5	NC	Not internally connected.

Absolute Maximum Ratings[1]

Supply Voltage (V_{IN})...................................... –0.6V to +14V
Lead Temperature (soldering, 5sec.)......................... 260°C
Storage Temperature (T_s) .... –60°C to +150°C
ESD Rating[3].. 2kV

Operating Ratings[2]

Supply Voltage (V_{IN}).. 3.5VV to 12V
Ambient Temperature (T_A) .... –40°C to +85°C
Junction Temperature (T_J) .... –40°C to +125°C
Thermal Resistance[4]

Electrical Characteristics

$V_{IN} = V_{OUT} + 1V$; $I_L = 100\mu A$; $C_L = 0.47\mu F$; $T_J = 25°C$, **bold** values indicate $–40°C \le T_J \le +125°C$, unless noted.

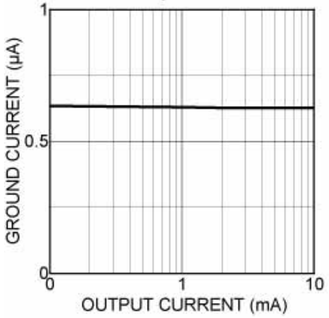
Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OUT}	Output Voltage Accuracy	variation from nominal V_{OUT}	–2 **–3**		+2 **+3**	% %
$\Delta V_{OUT}/\Delta_T$	Output Voltage Temperature Coefficient	**Note 5**		250		ppm/°C
$\Delta V_{OUT}/V_{OUT}$	Line Regulation	V_{IN} = 6V to 12V		0.2	0.25	%
	Load Regulation	I_L = 10µA to 10mA, **Note 6**		0.2	1	%
V_{DO}	Dropout Voltage, **Note 7**	I_L = 1mA		15		mV
		I_L = 10mA		150	300	mV
I_Q	Ground Pin Current	V_{IN} = 6V, I_L = 10mA		0.65	3	µA
		V_{IN} = 12V, I_L = 10mA		1.1	**4**	µA
PSRR	Ripple Rejection	f = 100Hz, I_L = 100µA		50		dB
Enable Input						
V_{ENL}	Enable Input Voltage	V_{EN} = logic low (regulator off)		0.4	**0.18**	V
		V_{EN} = logic high (regulator on)	**1.4**			V
I_{ENL}	Enable Input Current	$V_{ENL} \le 0.18V$ (regulator off)		1		nA
I_{ENH}	Enable Input Current	$V_{ENH} \ge 1.4V$ (regulator on)		1		nA

Notes:

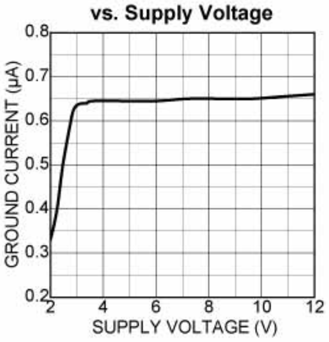
1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. Devices are ESD sensitive. Handling precautions recommended.
4. The maximum allowable power dissipation at any T_A (ambient temperature) is $P_{D(max)} = (T_{J(max)} – T_A) \div \theta_{JA}$. The θ_{JC} of the MIC5231 is 130°C/W. Mounted to a standard PC board, the θ_{JA} is approximately 235°C/W.
5. Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.
6. Regulation is measured at constant junction temperature using low duty cycle pulse testing.
7. Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value measured at 1Vdifferential. For outputs below 3.5V, dropout voltage is the input-to-output differential with the minimum input voltage 3.5V. Minimum input operating voltage is 3.5V.

Typical Characteristics

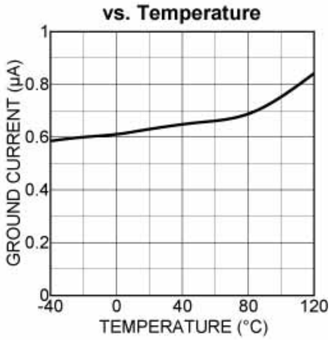
Ground Current vs. Output Current



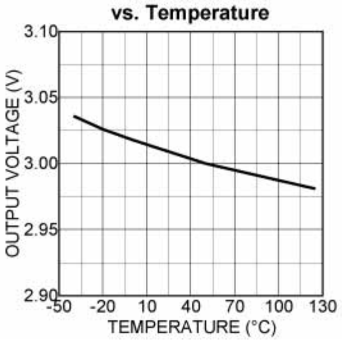
Ground Current vs. Supply Voltage



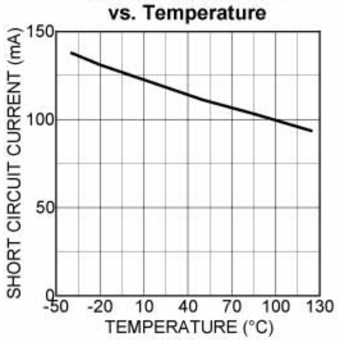
Ground Current vs. Temperature



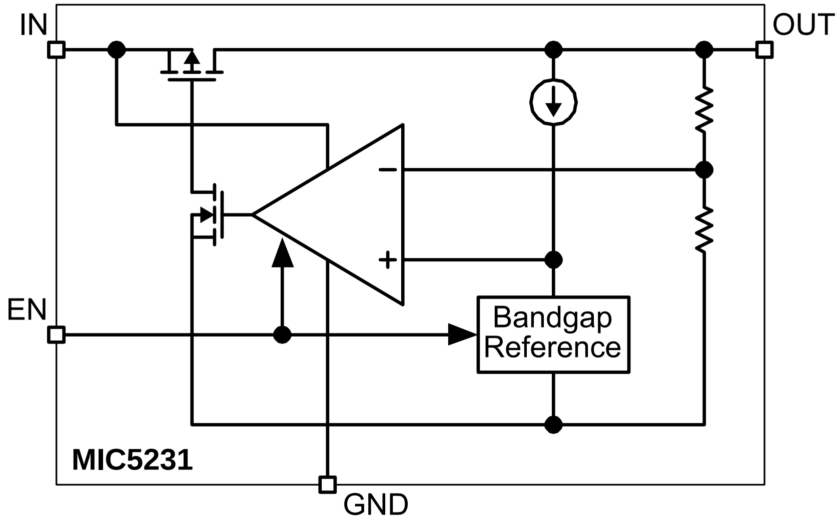
Ground Current vs. Temperature



Short Circuit Current vs. Temperature



Block Diagram



Application 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 20cm of wire between IN and the ac filter capacitor or if supplied from a battery.

Output Capacitors

The MIC5231 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. A 0.1µF capacitor 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 MIC5231 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.

Minimum Load Current

The MIC5231 does not require a minimum load for proper operation. This allows the device to operate in applications where very light output currents are required for keep-alive purposes. This is important for powering SRAM or Flash memory in low-power modes for handheld devices.

Safe Operating Conditions

The MIC5231 does not incorporate current limit or thermal shutdown in the design. The output pass element is approximately 15Ω, therefore, when a short occurs from the output to ground, the current is self-limited. The pass element has a positive temperature coefficient, such that when the device gets hot, the output impedance goes up, limiting the current even further. The maximum junction temperature for the device is +125°C, and it is important that this is not exceeded for any length of time.

Thermal Considerations

The MIC5231 is not intended for sourcing currents that would cause a large power loss in the device, but since it is not current limited, it is possible to source more than the rated 10mA. At this point, it is important to ensure that the die temperature does not exceed +125°C.

Power dissipation in the regulator is calculated as follows:

$$P_D = (V_{IN} - V_{OUT})I_{OUT} + V_{IN} \cdot I_{GND}$$

The MIC5231 consumes only 0.65µA over load and does not need to consider that contribution in the power dissipation equation, therefore the equation is simplified.

$$P_D = (V_{IN} - V_{OUT})I_{OUT}$$

The MIC5231, in the IttyBitty SOT-23-5 package, has a thermal resistance, junction-to-ambient, of 235°C/W. Using this number, the power dissipation capability of that package, without exceeding a +125°C junction temperature rating, can easily be calculated.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

$$P_{D(MAX)} = \frac{125°C - T_A}{235°C/W}$$

If the device is being operated at +85°C, the maximum power dissipation allowed can easily be determined.

$$P_{D(MAX)} = \frac{125°C - 85°C}{235°C/W}$$

$$P_{D(MAX)} = 170mW$$

Therefore, the device can only dissipate 170mW maximum. If the MIC5231 is powered off of a 12V source and the output voltage is 3.3V, the maximum output current can be calculated.

$$P_{D(MAX)} = (V_{IN} - V_{OUT})I_{OUT}$$

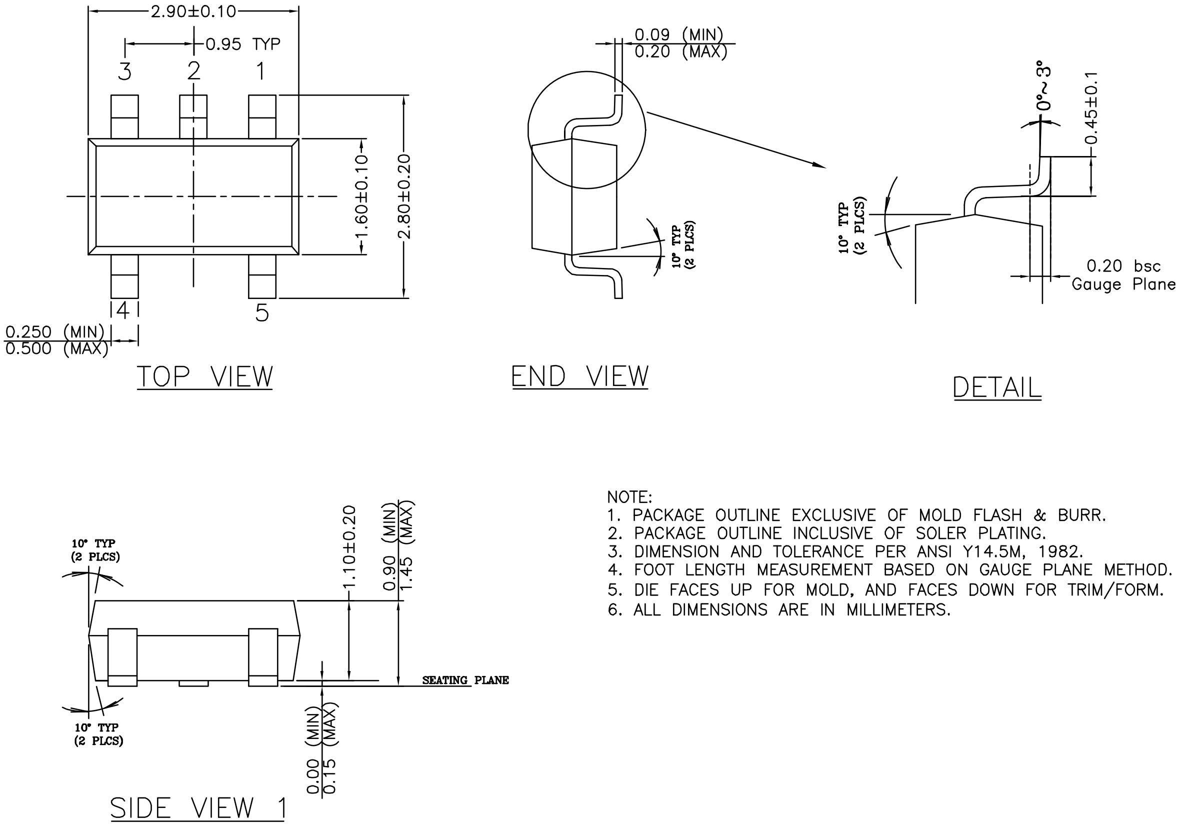
$$170mW = (12V - 3.3V)I_{OUT}$$

$$I_{OUT} = \frac{170mW}{8.7V}$$

$$I_{OUT} = 19.5mA$$

Therefore, the device can source almost 20mA at an ambient of +85°C before the die temperature exceeds +125°C.

Package Information



NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & BURR.
2. PACKAGE OUTLINE INCLUSIVE OF SOLER PLATING.
3. DIMENSION AND TOLERANCE PER ANSI Y14.5M, 1982.
4. FOOT LENGTH MEASUREMENT BASED ON GAUGE PLANE METHOD.
5. DIE FACES UP FOR MOLD, AND FACES DOWN FOR TRIM/FORM.
6. ALL DIMENSIONS ARE IN MILLIMETERS.

5-Pin SOT-23 (M5)

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