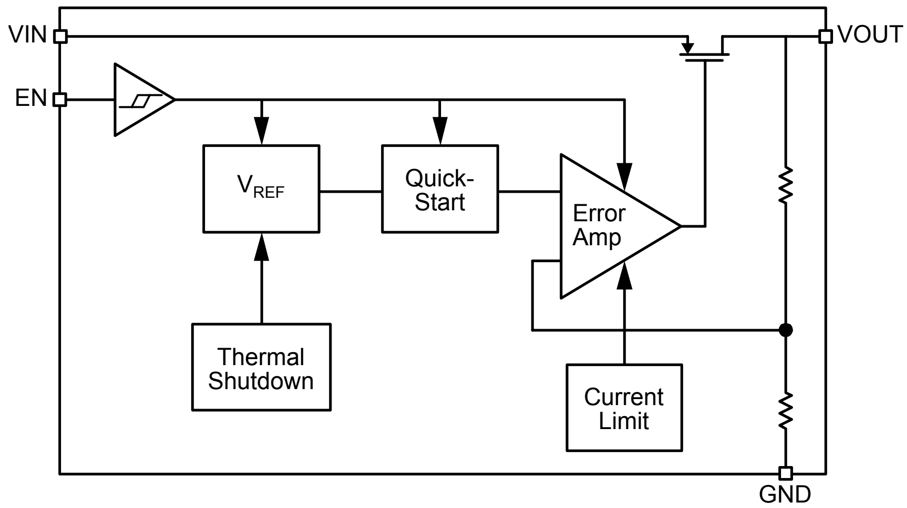
Block Diagram



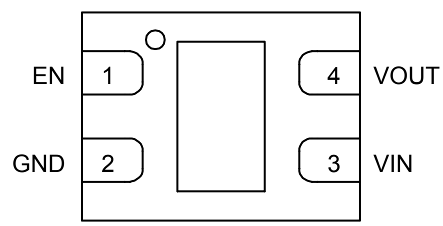
MIC5303 Block Diagram

Ordering Information[1]

Part Number	Marking Code	Voltage	Temperature Range	Package	Lead Finish
MIC5303-1.5YMT	1M5	1.5V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-1.8YMT	1M8	1.8V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.1YMT	2M1	2.1V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.5YMT	2M5	2.5V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.6YMT	2M6	2.6V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.8YMT	2M8	2.8V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.85YMT	2MN	2.85V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-2.9YMT	2M9	2.9V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-3.0YMT	3M0	3.0V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free
MIC5303-3.3YMT	3M3	3.3V	–40°C to +125°C	4-Pin 1.2mm x 1.6mm Thin MLF®	Pb-Free

Note:
1. Other voltages available. Contact Micrel Marketing for details.

Pin Configuration



4-Pin 1.2mm x 1.6mm Thin MLF® (MT)

Pin Description

Pin Number	Pin Name	Pin Function
1	EN	Enable Input. Active High. High = on, low = off. Do not leave floating.
2	GND	Ground
3	VIN	Supply Input
4	VOUT	Output Voltage
HS Pad	EPAD	Exposed heatsink pad connected to ground internally.

Absolute Maximum Ratings[1]

Supply Voltage (V_{IN}) .... 0V to +6V
Enable Input (V_{EN}) .... 0V to +6V
Power Dissipation[3] .... Internally Limited
Lead Temperature (soldering, 5 sec.) .... 260°C
Junction Temperature (T_J) .... –40°C to +125°C
Storage Temperature (T_s) .... –65°C to +150°C

Operating Ratings[2]

Supply voltage (V_{IN}) .... +2.3V to +5.5V
Enable Input (V_{EN}) .... 0V to V_{IN}
Junction Temperature (T_A) .... –40°C to +125°C
Junction Thermal Resistance
Thin MLF® -4 (θ_{JA}) .... 173°C/W

Electrical Characteristics[4]

$V_{IN} = V_{OUT} + 1V$; $C_{OUT} = 1.0\mu F$; $I_{OUT} = 100\mu A$; $T_J = 25°C$, **bold** values indicate –40°C to +125°C, unless noted.

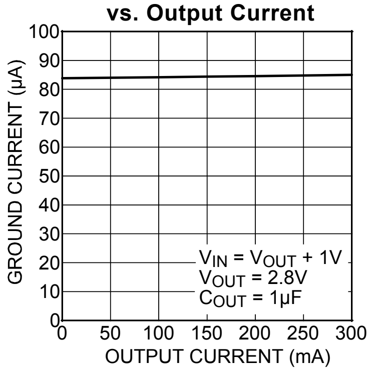
Parameter	Condition	Min	Typ	Max	Units
Output Voltage Accuracy	Variation from nominal V_{OUT}	–2		+2	%
	Variation from nominal V_{OUT}; –40°C to +125°C	**–3**		**+3**	%
Line Regulation	$V_{IN} = V_{OUT}$ +1V to 5.5V; $I_{OUT} = 100\mu A$		0.02	0.3 **0.6**	%/V
Load Regulation[5]	I_{OUT} = 100µA to 150mA		0.5	**2.0**	%
Dropout Voltage[6]	I_{OUT} = 100µA		0.1		mV
	I_{OUT} = 50mA		15	**35**	mV
	I_{OUT} = 150mA		50	**100**	mV
	I_{OUT} = 300mA		100	**200**	mV
Ground Pin Current[7]	I_{OUT} = 0 to 300mA, EN = High		85	**120**	µA
Ground Pin Current in Shutdown	V_{EN} = 0V		0.1	2	µA
Ripple Rejection	f = up to 1kHz; C_{OUT} = 1.0µF		65		dB
	f = 1kHz – 20kHz; C_{OUT} = 1.0µF		42		dB
Current Limit	V_{OUT} = 0V	**350**	460	**850**	mA
Output Voltage Noise	C_{OUT} =1µF, 10Hz to 100kHz		120		μV_{RMS}
Enable Input					
Enable Input Voltage	Logic Low			**0.2**	V
	Logic High	**1.1**			V
Enable Input Current	$V_{IL} \leq 0.2V$		0.01		µA
	$V_{IH} \geq 1.0V$		0.01		µA
Turn-on Time	C_{OUT} = 1.0µF		35	**100**	µs

Notes:

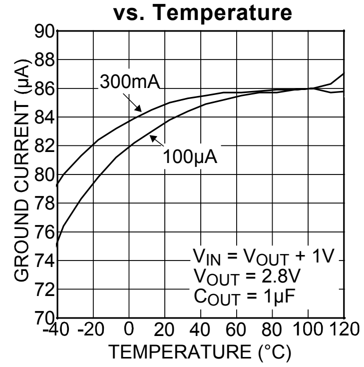
1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. The maximum allowable power dissipation of any T_A (ambient temperature) is $P_{D(max)} = (T_{J(max)} - T_A) / \theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.
4. Specification for packaged product only.
5. 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.
6. 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.
7. Ground pin current is the regulator quiescent current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

Typical Characteristics

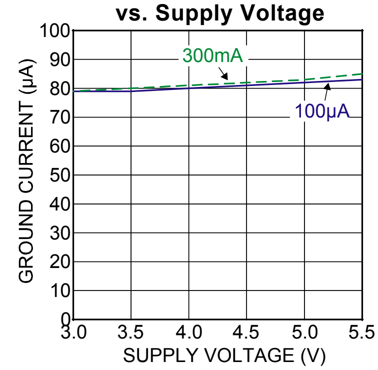
Ground Pin Current vs. Output Current



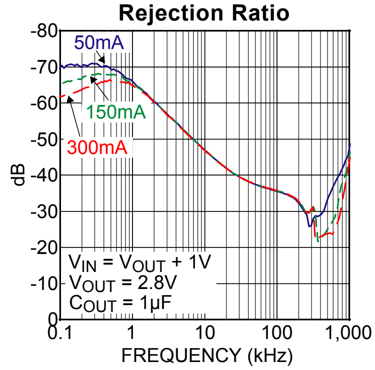
Ground Pin Current vs. Temperature



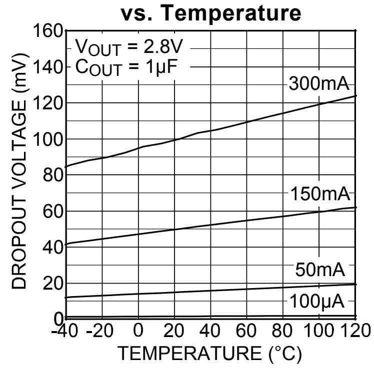
Ground Pin Current vs. Supply Voltage



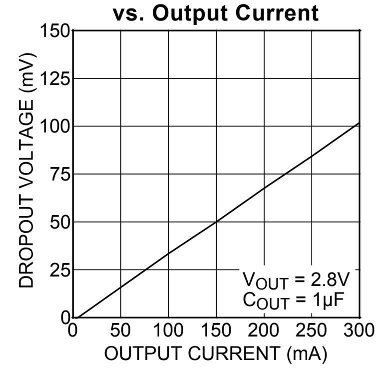
Power Supply Rejection Ratio



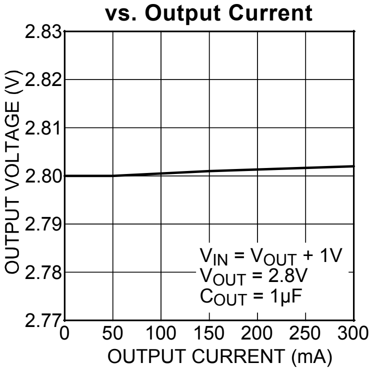
Dropout Voltage vs. Temperature



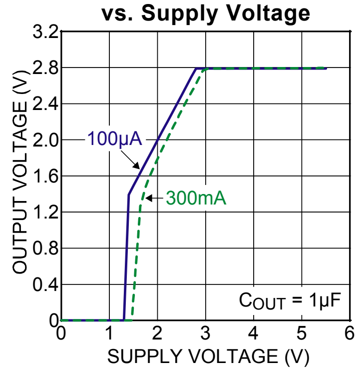
Dropout Voltage vs. Output Current



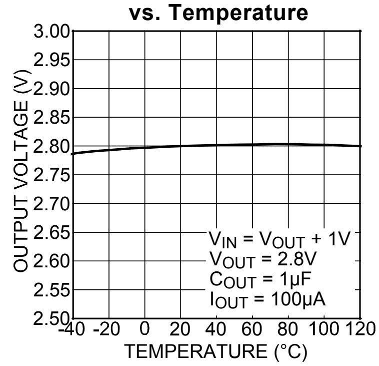
Output Voltage vs. Output Current



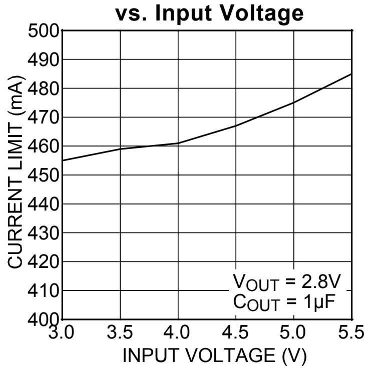
Output Voltage vs. Supply Voltage



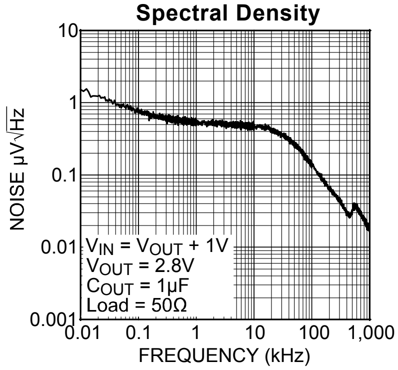
Output Voltage vs. Temperature



Current Limit vs. Input Voltage

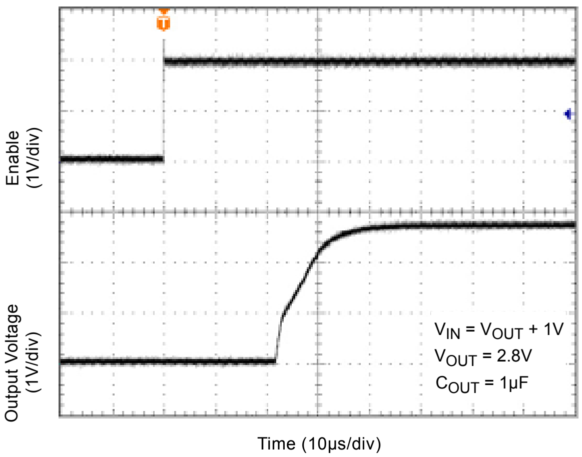


Output Noise Spectral Density

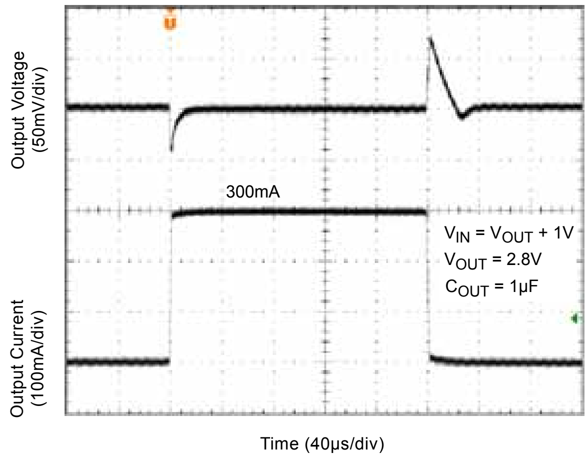


Functional Characteristics

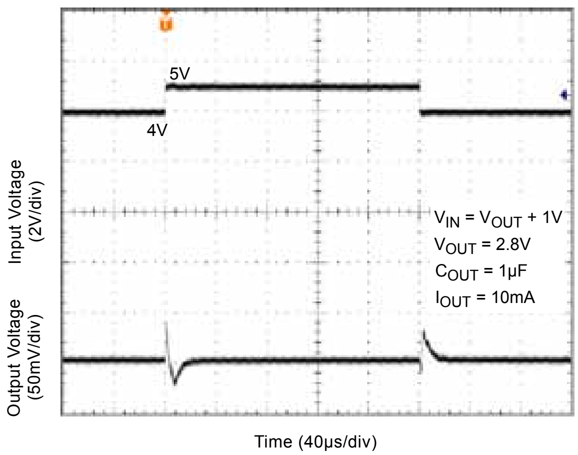
Enable Turn-On



Load Transient Response



Line Transient Response



Application Information

Enable/Shutdown

The MIC5303 comes with an active-high enable pin that allows the regulator to be disabled. Forcing the enable pin low disables the regulator and sends it into a “zero” off-mode-current state. In this state, current consumed by the regulator goes nearly to zero. Forcing the enable pin high enables the output voltage. The active-high enable pin uses CMOS technology and the enable pin cannot be left floating; a floating enable pin may cause an indeterminate state on the output.

Input Capacitor

The MIC5303 is a high-performance, high bandwidth device. Therefore, it requires a well-bypassed input supply for optimal performance. A 1µF capacitor is required from the input-to-ground to provide stability. Low-ESR ceramic capacitors provide optimal performance at a minimum of space. Additional high-frequency capacitors, such as small-valued NPO dielectric-type capacitors, help filter out high-frequency noise and are good practice in any RF-based circuit.

Output Capacitor

The MIC5303 requires an output capacitor of 1µF or greater to maintain stability. The design is optimized for use with low-ESR ceramic chip capacitors. High ESR capacitors may cause high frequency oscillation. The output capacitor can be increased, but performance has been optimized for a 1µF ceramic output capacitor and does not improve significantly with larger capacitance.

X7R/X5R dielectric-type ceramic capacitors are recommended because of their temperature performance. X7R-type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60%, respectively, over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

No-Load Stability

Unlike many other voltage regulators, the MIC5303 will remain stable and in regulation with no load. This is especially important in CMOS RAM keep-alive applications.

Thermal Considerations

The MIC5303 is designed to provide 300mA of continuous current. Maximum ambient operating temperature can be calculated based on the output current and the voltage drop across the part. Given that the input voltage is 3.6V, the output voltage is 2.8V and the output current = 300mA.

The actual power dissipation of the regulator circuit can be determined using the equation:

$$P_D = (V_{IN} – V_{OUT})\, I_{OUT} + V_{IN}\, I_{GND}$$

Because this device is CMOS and the ground current is typically <100µA over the load range, the power dissipation contributed by the ground current is < 1% and can be ignored for this calculation.

$$P_D = (3.6V – 2.8V) \times 300mA$$

$$P_D = 0.24W$$

To determine the maximum ambient operating temperature of the package, use the junction-to-ambient thermal resistance of the device and the following basic equation:

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

$T_{J(max)}$ = 125°C, the maximum junction temperature of the die θ_{JA} thermal resistance = 173°C/W.

The table below shows junction-to-ambient thermal resistance for the MIC5303 in the 4-pin 1.2mm x 1.6mm MLF® package.

Package	θ_{JA} Recommended Minimum Footprint
4-Pin 1.2x1.6 MLF®	173°C/W

Thermal Resistance

Substituting P_D for $P_{D(max)}$ and solving for the ambient operating temperature will give the maximum operating conditions for the regulator circuit. The junction-to-ambient thermal resistance for the minimum footprint is 173°C/W.

The maximum power dissipation must not be exceeded for proper operation.

For example, when operating the MIC5303-2.8YML at an input voltage of 3.6V and 300mA load with a minimum footprint layout, the maximum ambient operating temperature T_A can be determined as follows:

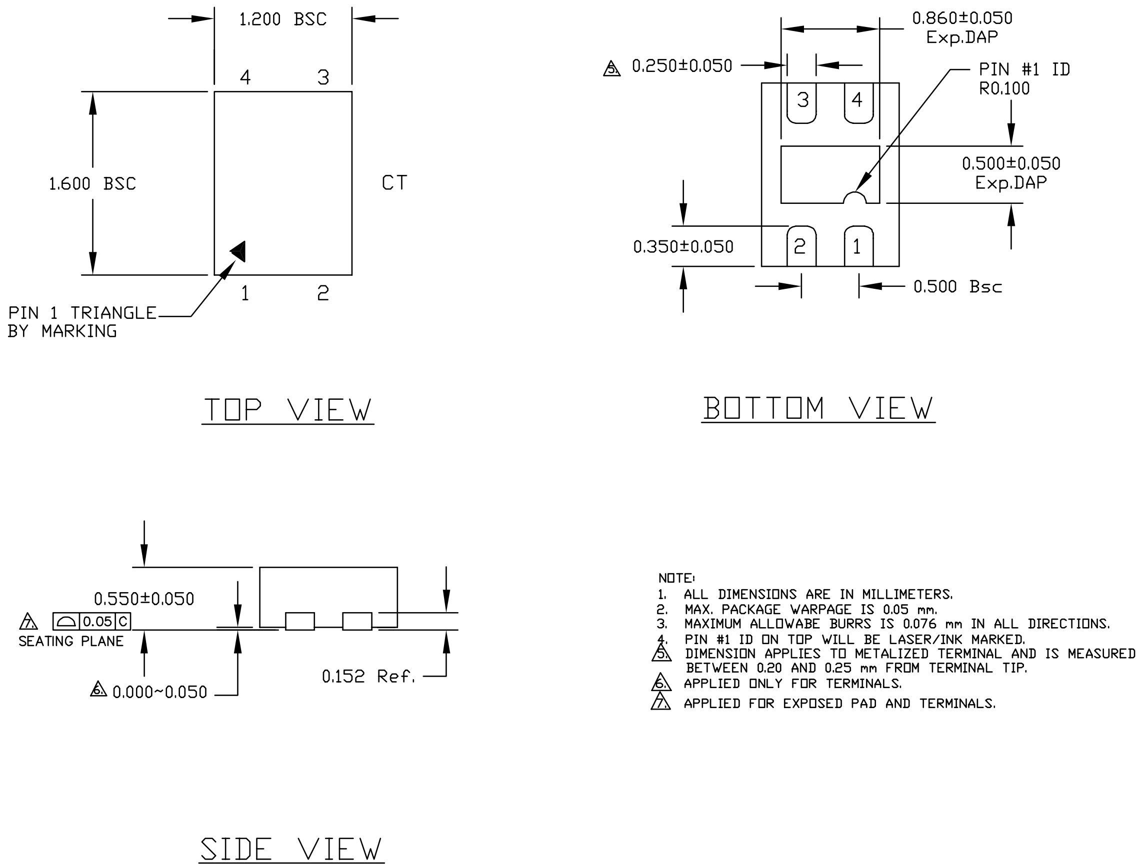
$$0.24W = (125°C – T_A)/(173°C/W)$$

$$T_A=83°C$$

Therefore, a 2.8V application with 300mA of output current can accept an ambient operating temperature of 83°C in a 1.2mm x 1.6mm MLF® package. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to the “Regulator Thermals” section of *Micrel’s Designing with Low-Dropout Voltage Regulators* handbook. This information can be found on Micrel's website at:

http://www.micrel.com/_PDF/other/LDOBk_ds.pdf

Package Information



4-Pin 1.2mm x 1.6mm Thin MLF® (MT)

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