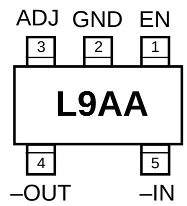
Pin Configuration



MIC5271BM5
Adjustable Output Voltage

Pin Description

Pin Number (Adj.)	Pin Name	Pin Function
1	EN	Enable Input. TTL logic compatible enable input. Logic High = ON, Logic Low or open = OFF.
2	GND	Ground.
3	ADJ	Adjustable (Input): Adjustable feedback output connects to resistor voltage divider.
4	–OUT	Negative Regulator Output.
5	–IN	Negative Supply Input.

Absolute Maximum Ratings (Note 1)

Input Voltage (V_{-IN}) .... –20V to +0.3V
Enable Voltage (V_{EN}) .... –20V to +20V
Power Dissipation (P_D) .... Internally Limited
Junction Temperature (T_J) .... –40°C to +125°C
Lead Temperature (soldering, 5 sec.) .... 260°C
Storage Temperature (T_S) .... –65°C to +150°C
ESD Rating, **Note 3**

Operating Ratings (Note 2)

Input Voltage (V_{IN}) .... –16V to –3.3V
Enable Voltage (V_{EN}) .... –16V to +16V
Junction Temperature (T_J) .... –40°C to +125°C
Thermal Resistance (θ_{JA}) **Note 4** .... 235°C/W

Electrical Characteristics (Note 5)

$V_{IN} = V_{OUT} – 1.0V$; $C_{OUT} = 4.7\mu F$, $I_{OUT} = 100\mu A$; $T_J = 25°C$, **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 6**		100		ppm/°C
$\Delta V_{OUT}/V_{OUT}$	Line Regulation	$V_{IN} = V_{OUT} – 1V$ to –16V		0.04	0.15 **0.2**	%/V
$\Delta V_{OUT}/V_{OUT}$	Load Regulation	$I_{OUT} = 100\mu A$ to 100mA, **Note 7**		0.4	1.8 **2.0**	% %
$V_{IN} – V_{OUT}$	Dropout Voltage, **Note 8**	$I_{OUT} = 100\mu A$		55		mV
		$I_{OUT} = 50mA$		360	500	mV
		$I_{OUT} = 100mA$		500	700 **900**	mV
I_{GND}	Ground Current, **Note 9**	$I_{OUT} = 100\mu A$		25	**100**	µA
		$I_{OUT} = 50mA$		0.9		mA
		$I_{OUT} = 100mA$		2.0	3.0	mA
I_{GND_SD}	Ground current in shutdown	$V_{EN} = \pm 0.6V$	**–1.0**	0.1	**+1.0**	µA
PSRR	Ripple Rejection	f = 120Hz		50		dB
I_{LIMIT}	Current Limit	$V_{OUT} = 0V$		235	**350**	mA
Enable Input						
T_{ON}	Turn-on Time	Time to V_{OUT} = 90% nom.		60		µs
V_{EN}	Input Low voltage	Regulator OFF			±0.6	V
	Input High Voltage	Regulator ON	±2.0			V
I_{EN}	Enable Input Current	$V_{EN} = \pm 0.6V$ and –2.0V $V_{EN} = +2.0V$		 5.6	**0.1** **10.0**	µA

Note 1. Exceeding the absolute maximum rating may damage the device.

Note 2. The device is not guaranteed to function outside its operating rating.

Note 3. Devices are ESD sensitive. Handling precautions recommended.

Note 4. 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: $P_{D(max)} = (T_{J(max)} – T_A) / \theta_{JA}$, where θ_{JA} is 235°C/W. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. See the *"Thermal Considerations"* section for details.

Note 5. Specification for packaged product only.

Note 6. Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

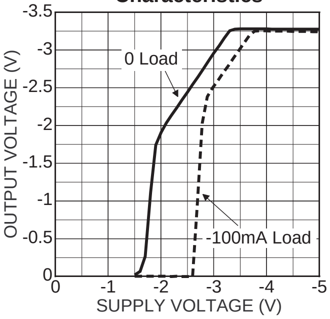
Note 7. Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 100µA to 100mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

Note 8. 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.

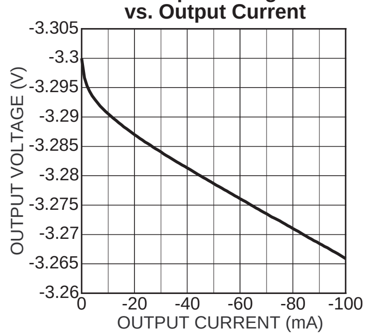
Note 9. Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

Typical Characteristics

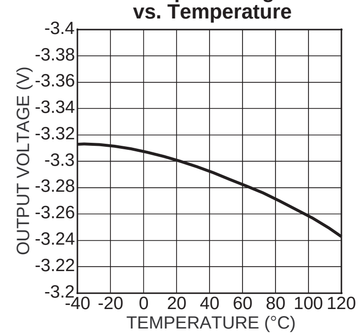
Dropout Characteristics



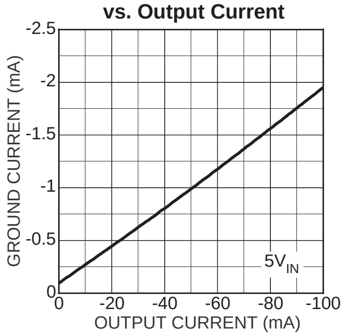
Output Voltage vs. Output Current



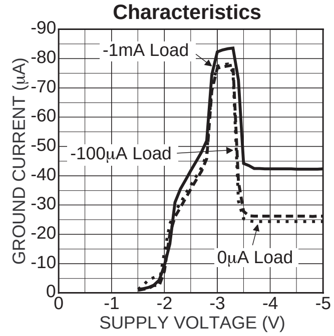
Output Voltage vs. Temperature



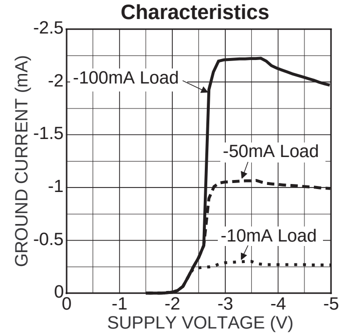
Ground Current vs. Output Current



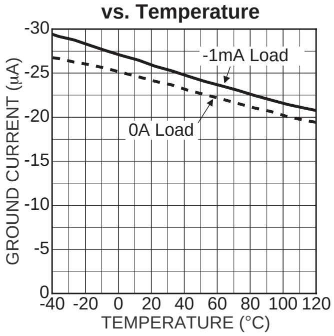
Ground Current Characteristics



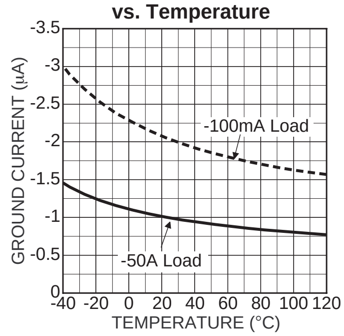
Ground Current Characteristics



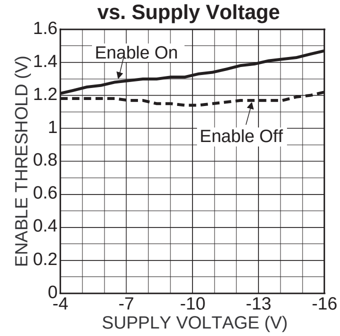
Ground Current vs. Temperature



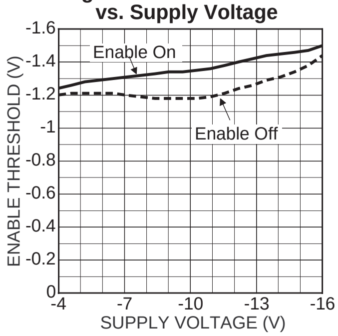
Ground Current vs. Temperature



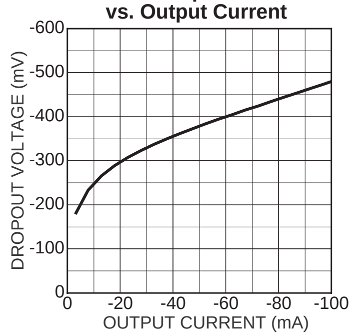
Positive Enable Threshold vs. Supply Voltage



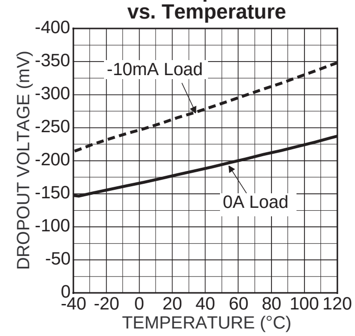
Negative Enable Threshold vs. Supply Voltage



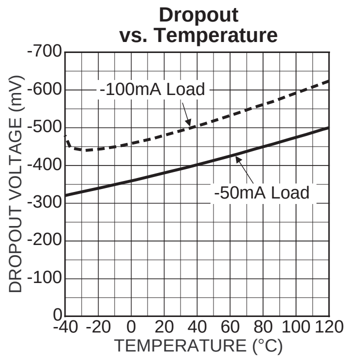
Dropout vs. Output Current



Dropout vs. Temperature

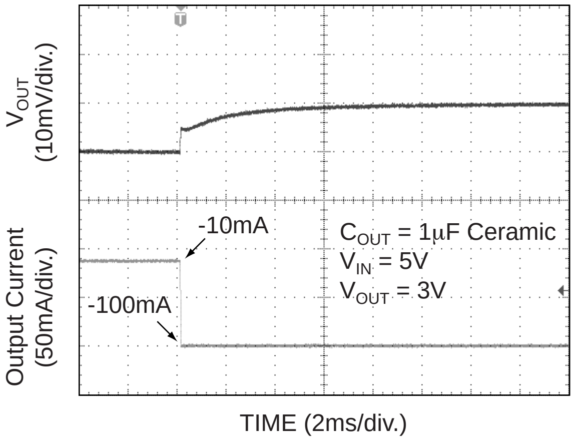


Typical Characteristics (continued)

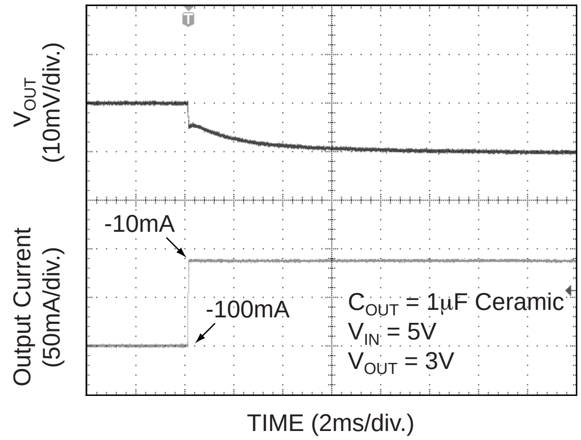


Functional Characteristics

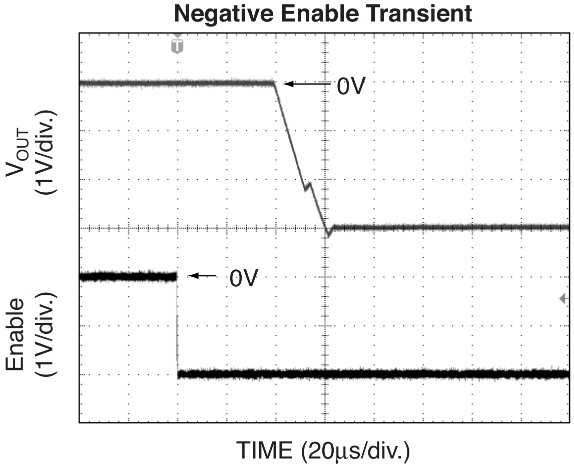
Load Transient



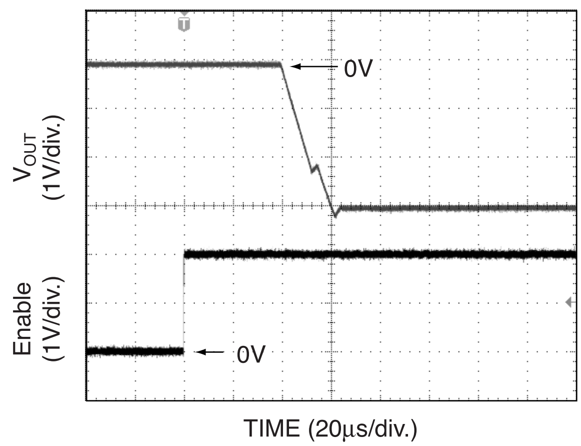
Load Transient



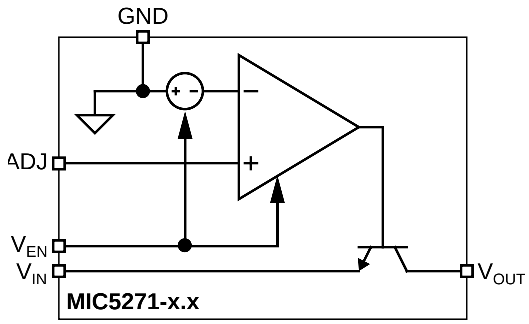
Negative Enable Transient



Positive Enable Transient



Functional Diagram



Applications Information

The MIC5271 is a general-purpose negative regulator that can be used in any system that requires a clean negative voltage from a negative output. This includes post regulating of DC-DC converters (transformer based or charge pump based voltage converters). These negative voltages typically require a negative low dropout voltage regulator to provide a clean output from typically noisy lines.

Input Capacitor

A 1µF input capacitor should be placed from IN to GND if there is more than 2 inches of wire or trace between the input and the AC filter capacitor, or if a battery is used as the input.

Output Capacitor

The MIC5271 requires an output capacitor for stable operation. A minimum of 1µF of output capacitance is required. The output capacitor can be increased without limitation to improve transient response. The output does not require ESR to maintain stability, therefore a ceramic capacitor can be used. High-ESR capacitors may cause instability. Capacitors with an ESR of 3Ω or greater at 100kHz may cause a high frequency oscillation.

Low-ESR tantalums are recommended due to the tight capacitance tolerance over temperature.

Ceramic chip capacitors have a much greater dependence on temperature, depending upon the dielectric. The X7R is recommended for ceramic capacitors because the dielectric will change capacitance value by approximately 15% over temperature. The Z5U dielectric can change capacitance value by as much 50% over temperature, and the Y5V dielectric can change capacitance value by as much as 60% over temperature. To use a ceramic chip capacitor with the Y5V dielectric, the value must be much higher than a tantalum to ensure the same minimum capacitor value over temperature.

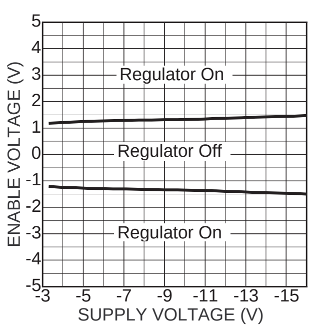
No-Load Stability

The MIC5271 does not require a load for stability.

Enable Input

The MIC5271 comes with an enable pin that allows the regulator to be disabled. Forcing the enable pin higher than the negative threshold and lower than the positive threshold 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. The MIC5271 will be in the on mode when the voltage applied to the enable pin is either greater than the positive threshold or less than the negative threshold.

Enable Input



Thermal Considerations

Absolute values will be used for thermal calculations to clarify the meaning of power dissipation and voltage drops across the part.

Proper thermal design for the MIC5271-5.0BM5 can be accomplished with some basic design criteria and some simple equations. The following information must be known to implement your regulator design:

V_{IN} = input voltage
V_{OUT} = output voltage
I_{OUT} = output current
T_A = ambient operating temperature
I_{GND} = ground current

Maximum power dissipation can be determined by knowing the ambient temperature, T_A, the maximum junction temperature, 125°C, and the thermal resistance, junction to ambient. The thermal resistance for this part, assuming a minimum footprint board layout, is 235°C/W. The maximum power dissipation at an ambient temperature of 25°C can be determined with the following equation:

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

$$P_{D(max)} = \frac{125°C - 25°C}{235°C/W}$$

$$P_{D(max)} = 425mW$$

The actual power dissipation of the regulator circuit can be determined using one simple equation.

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

Substituting $P_{D(max)}$, determined above, for P_D and solving for the operating conditions that are critical to the application will give the maximum operating conditions for the regulator circuit. The maximum power dissipation number cannot be exceeded for proper operation of the device. The maximum input voltage can be determined using the output voltage of 5.0V and an output current of 100mA. Ground current, of 1mA for 100mA of output current, can be taken from the "*Electrical Characteristics*" section of the data sheet.

$$425mW = (V_{IN} - 5.0V)100mA + V_{IN} \times 1mA$$

$$425mW = (100mA \times V_{IN} + 1mA \times V_{IN}) - 500mW$$

$$925mW = 101mA \times V_{IN}$$

$$V_{IN} = 9.16Vmax$$

Therefore, a –5.0V application at 100mA of output current can accept a maximum input voltage of –9.16V in a SOT-23-5 package. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to Regulator Thermals section of Micrel's *"Designing with Low Dropout Voltage Regulators"* handbook.

Adjustable Regulator Application

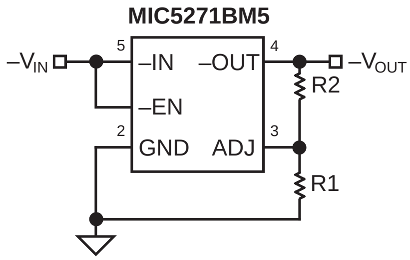


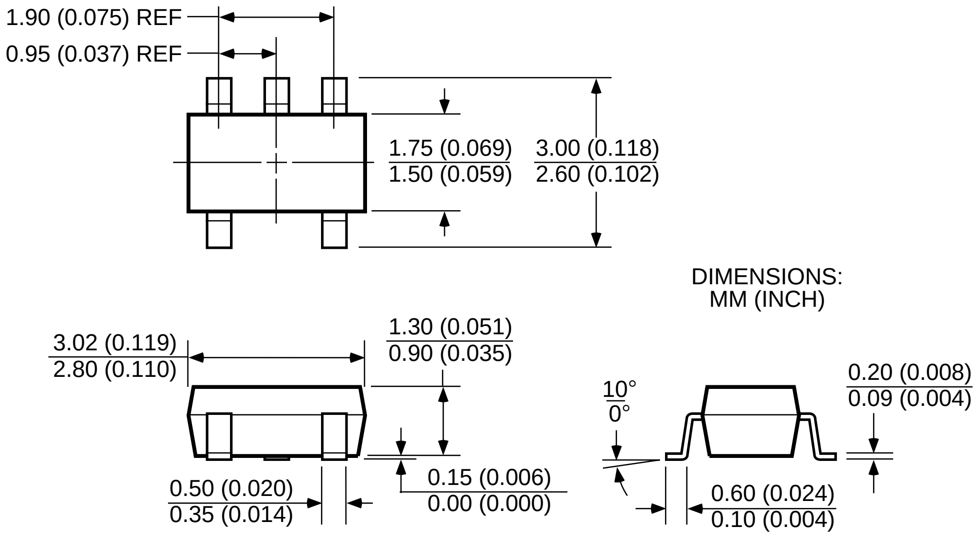
Figure 1. Adjustable Voltage Application

The MIC5271BM5 can be adjusted from 1.20V to 14V by using two external resistors (Figure 1). The resistors set the output voltage based on the following equation:

$$|V_{OUT}| = V_{REF}\left(1 + \frac{R2}{R1}\right)$$

Where V_{REF} = 1.20V

Package Information



SOT-23-5 (M5)

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