

### General Description

The MIC5202 is a family of dual linear voltage regulators with very low dropout voltage (typically 17mV at light loads and 210mV at 100mA), and very low ground current (1mA at 100mA output—each section), offering better than 1% initial accuracy with a logic compatible ON/OFF switching input. Designed especially for hand-held battery powered devices, the MIC5202 is switched by a CMOS or TTL compatible logic signal. This ENABLE control may be tied directly to  $V_{IN}$  if unneeded. When disabled, power consumption drops nearly to zero. The ground current of the MIC5202 increases only slightly in dropout, further prolonging battery life. Key MIC5202 features include protection against reversed battery, current limiting, and over-temperature shutdown.

The MIC5202 is available in several fixed voltages. Other options are available; contact Micrel for details.

### Features

- High output voltage accuracy
- Variety of output voltages
- Guaranteed 100mA output
- Low quiescent current
- Low dropout voltage
- Extremely tight load and line regulation
- Very low temperature coefficient
- Current and thermal limiting
- Reverse-battery protection
- Zero OFF mode current
- Logic-controlled electronic shutdown
- Available in SO-8 package

### Applications

- Cellular Telephones
- Laptop, Notebook, and Palmtop Computers
- Battery Powered Equipment
- PCMCIA  $V_{CC}$  and  $V_{PP}$  Regulation/Switching
- Bar Code Scanners
- SMPS Post-Regulator/ DC to DC Modules
- High Efficiency Linear Power Supplies

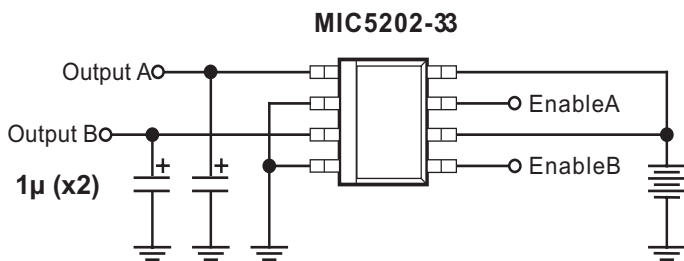
### Ordering Information

Part Number		Volts	Accuracy	Temperature Range	Package
Standard	Pb-Free				
MIC5202-3.0BM	MIC5202-3.0YM	3.0	1%	-40°C to +125°C	SO-8
MIC5202-3.3BM	MIC5202-3.3YM	3.3	1%	-40°C to +125°C	SO-8
MIC5202-4.8BM	MIC5202-4.8YM	4.85	1%	-40°C to +125°C	SO-8
MIC5202-5.0BM	MIC5202-5.0YM	5.0	1%	-40°C to +125°C	SO-8

\* Junction Temperature

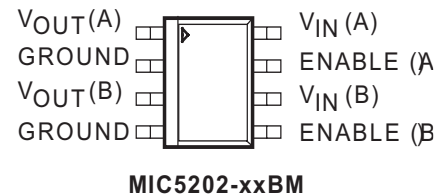
Other voltages are available; contact Micrel for details.

### Typical Application



ENABLE pins may be tied directly to  $V_{IN}$

### Pin Configuration



Both GROUND pins must be tied to the same potential.  $V_{IN}$  (A) and  $V_{IN}$  (B) may run from separate supplies.

## 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 **Operating Ratings**.

Power Dissipation..... Internally Limited  
 Lead Temperature (Soldering, 5 seconds) .....260°C  
 Operating Junction Temperature Range..... -40°C to +125°C  
 Input Supply Voltage .....-20V to +60V  
 ENABLE Input Voltage .....-20V to +60V  
 SO-8  $\theta_{JA}$  .....See Note 1

## Recommended Operating Conditions

Input Voltage .....2.5V to 26V  
 Operating Junction Temperature Range..... -40°C to +125°C  
 ENABLE Input Voltage .....0V to  $V_{IN}$

## 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  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Specifications are for each half of the (dual) MIC5202. Unless otherwise specified,  $V_{IN} = V_{OUT} + 1\text{V}$ ,  $I_L = 1\text{mA}$ ,  $C_L = 10\mu\text{F}$ , and  $V_{CONTROL} \geq 2.0\text{V}$ .

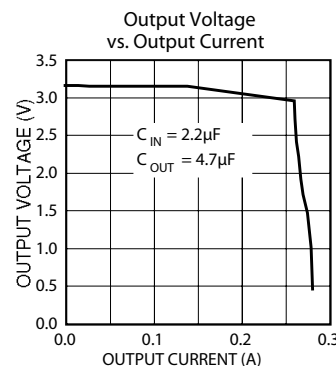
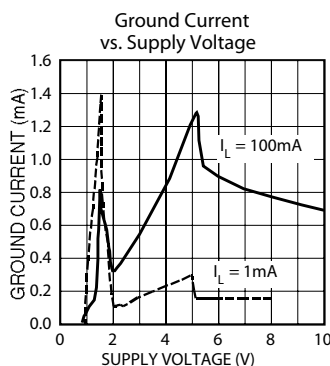
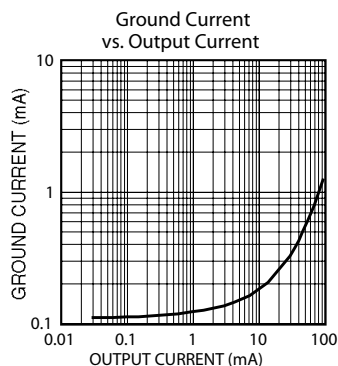
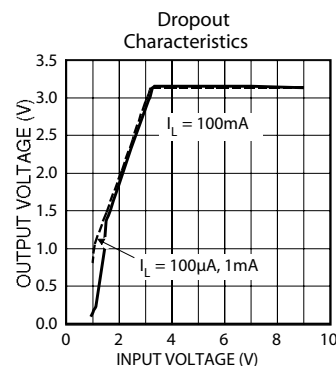
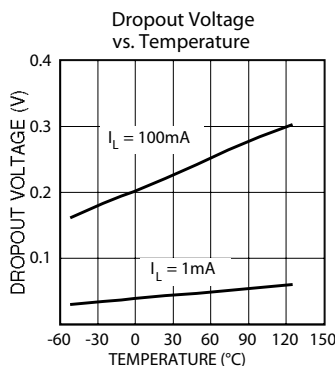
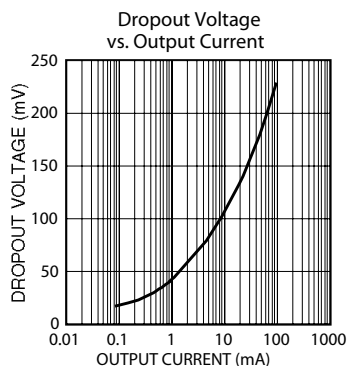
Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_o$	Output Voltage	Variation from specified $V_{OUT}$ Accuracy	-1 -2		1 2	%
$\frac{\Delta V_o}{\text{ppm}/^\circ\text{C}}$ $\Delta T$	Output Voltage Temperature Coef.	(Note 2)		40	150	
$\frac{\Delta V_o}{V_o}$	Line Regulation	$V_{IN} = V_{OUT} + 1\text{V}$ to 26V		0.004	0.10 <b>0.40</b>	%
$\frac{\Delta V_o}{V_o}$	Load Regulation	$I_L = 0.1\text{mA}$ to 100mA (Note 3)		0.04	0.16 <b>0.30</b>	%
$V_{IN} - V_o$	Dropout Voltage (Note 4)	$I_L = 100\mu\text{A}$ $I_L = 20\text{mA}$ $I_L = 30\text{mA}$ $I_L = 50\text{mA}$ $I_L = 100\text{mA}$		17 130 150 180 225	<b>350</b>	mV
$I_Q$	Quiescent Current	$V_{CONTROL} \leq 0.7\text{V}$ (Shutdown)		0.01		$\mu\text{A}$
$I_{GND}$	Ground Pin Current	$V_{CONTROL} \geq 2.0\text{V}$ , $I_L = 100\mu\text{A}$ $I_L = 20\text{mA}$ $I_L = 30\text{mA}$ $I_L = 50\text{mA}$ $I_L = 100\text{mA}$		170 270 330 500 1200	<b>1500</b>	$\mu\text{A}$
PSRR	Ripple Rejection			75		dB
$I_{GNDDO}$	Ground Pin Current at Dropout	$V_{IN} = 0.5\text{V}$ less specified $V_{OUT}$ , $I_L = 100\mu\text{A}$ (Note 5)		270	<b>330</b>	$\mu\text{A}$
$I_{LIMIT}$	Current Limit	$V_{OUT} = 0\text{V}$		<b>280</b>		mA
$\frac{\Delta V_o}{\Delta P_D}$	Thermal Regulation	(Note 6)		0.05		%/W
$e_n$	Output Noise			100		$\mu\text{V}$

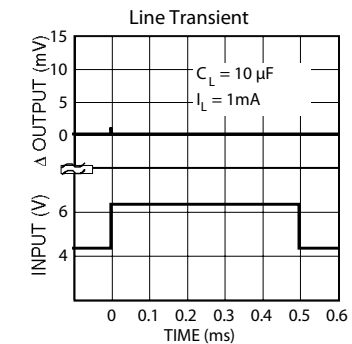
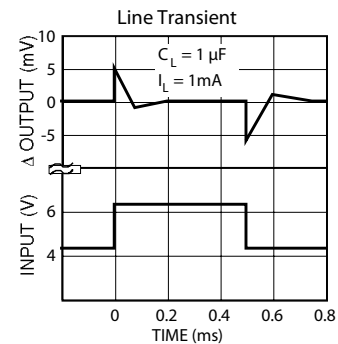
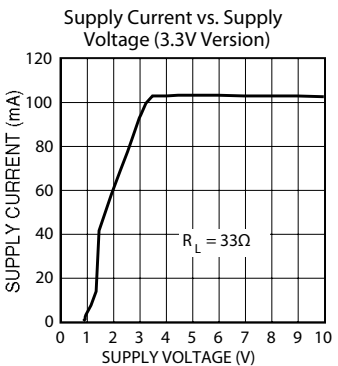
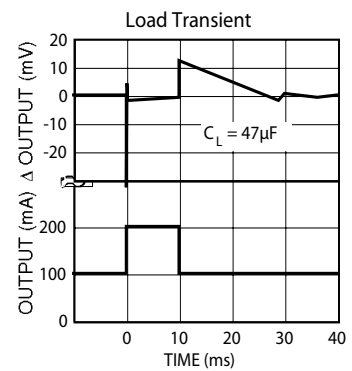
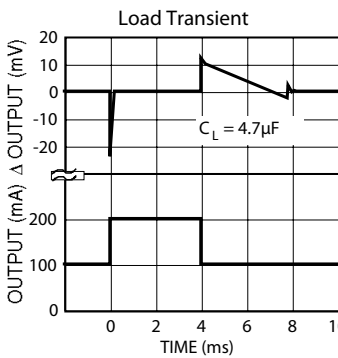
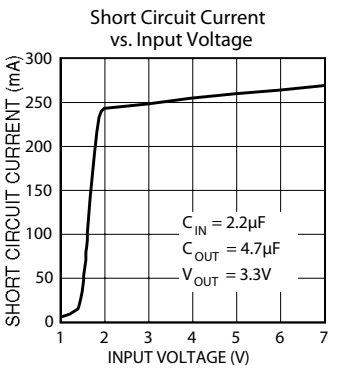
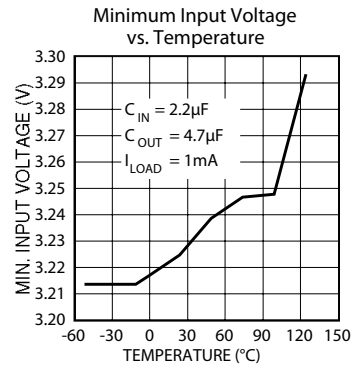
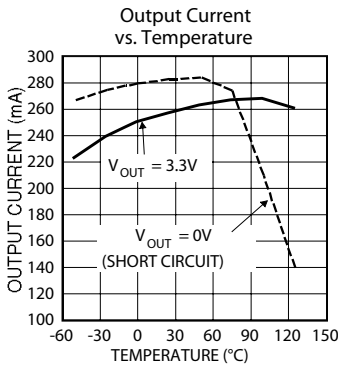
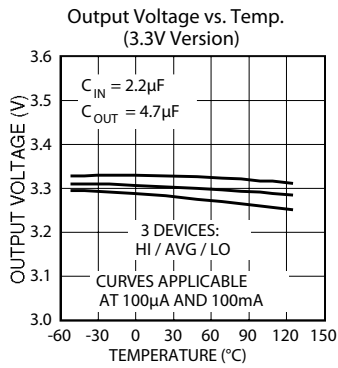
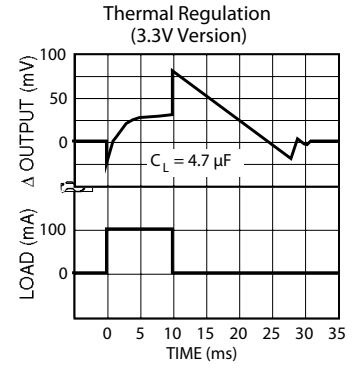
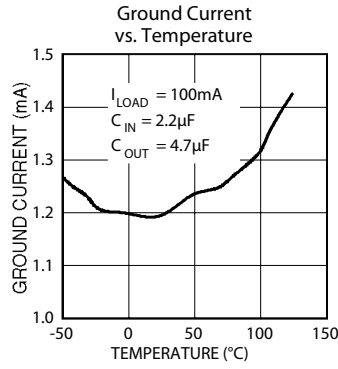
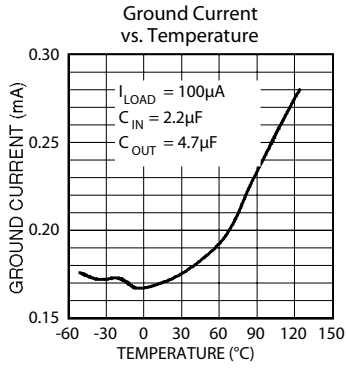
## Control Input

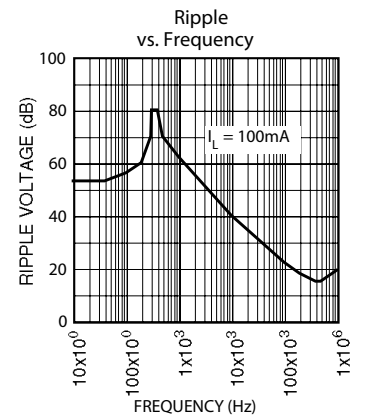
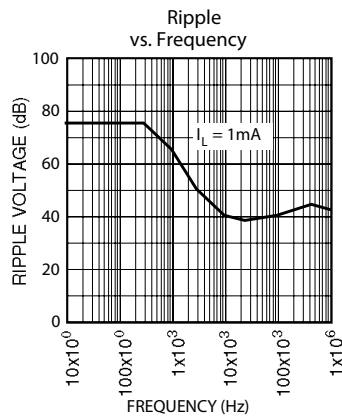
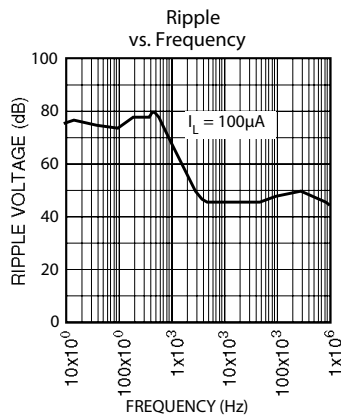
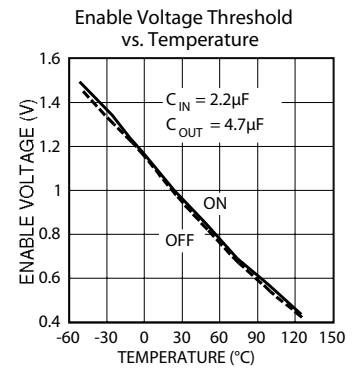
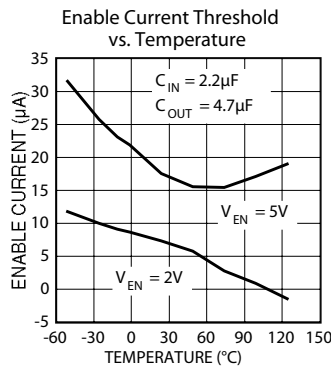
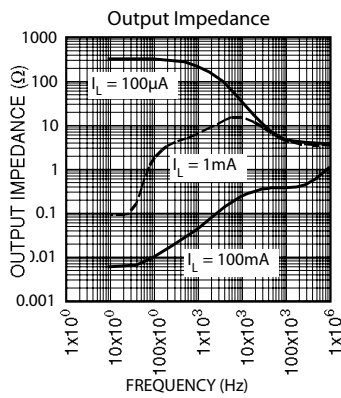
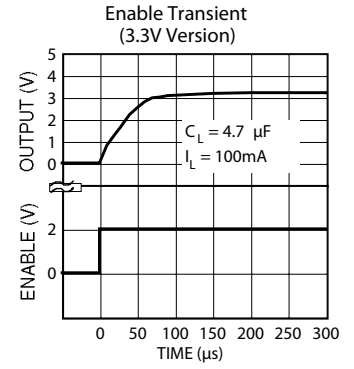
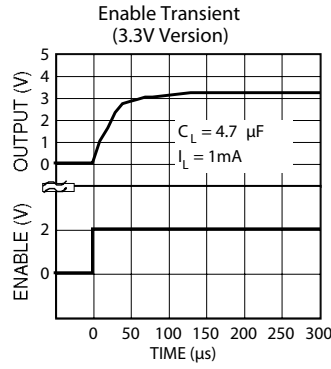
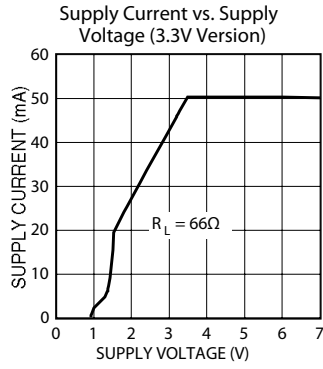
$V_{IL}$	Input Voltage Level Logic Low Logic High	OFF ON	<b>2.0</b>		0.7	V
$I_{IL}$ $I_{IH}$	Control Input Current	$V_{IL} \leq 0.7\text{V}$ $V_{IH} \geq 2.0\text{V}$		0.01 8	<b>50</b>	$\mu\text{A}$

- 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,  $T_{J(MAX)}$ , 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:  $P_{(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. The junction to ambient thermal resistance of the MIC5202BM is 160°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. Parts are tested for load regulation in the load range from 0.1mA to 100mA. 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 100mA load pulse at  $V_{IN} = 26V$  for  $t = 10ms$ , and is measured

**Typical Characteristics** (Each Regulator—2 Regulators/Package)







## Applications Information

### External Capacitors

A 1 $\mu$ F capacitor is recommended between the MIC5202 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 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 0.47 $\mu$ F for current below 10mA or 0.33 $\mu$ F for currents below 1 mA. A 1 $\mu$ F capacitor should be placed from the MIC5202 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 supply.

### ENABLE Input

The MIC5202 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 15 $\mu$ A. While the logic threshold is TTL/CMOS compatible, ENABLE may be pulled as high as 30V, independent of the voltage on  $V_{\text{IN}}$ . The two portions of the MIC5202 may be enabled separately.

### General Notes

The MIC5202 will remain stable and in regulation with no load in addition to the internal voltage divider, unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications. Thermal shutdown is independent on both halves of the dual MIC5202, however an over-temperature condition on one half might affect the other because of proximity. When used in dual supply systems where the regulator load is returned to a negative supply, the output voltage must be diode clamped to ground.

Both MIC5202 GROUND pins must be tied to the same ground potential. Isolation between the two halves allows connecting the two  $V_{\text{IN}}$  pins to different supplies.

## Thermal Considerations

### Part I. Layout

The MIC5202-xxBM (8-pin surface mount package) has the following thermal characteristics when mounted on a single layer copper-clad printed circuit board.

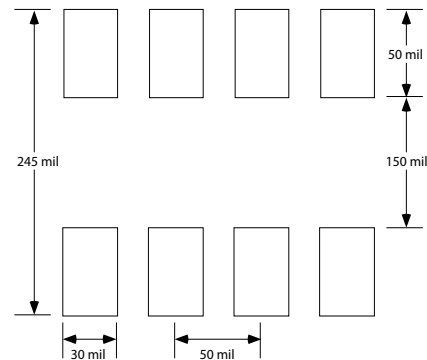
PC Board Dielectric	$\theta_{\text{JA}}$
FR4	160 $^{\circ}\text{C}/\text{W}$
Ceramic	120 $^{\circ}\text{C}/\text{W}$

Multi-layer boards having a ground plane, wide traces near the pads, and large supply bus lines provide better thermal conductivity.

The "worst case" value of 160 $^{\circ}\text{C}/\text{W}$  assumes no ground plane, minimum trace widths, and a FR4 material board.

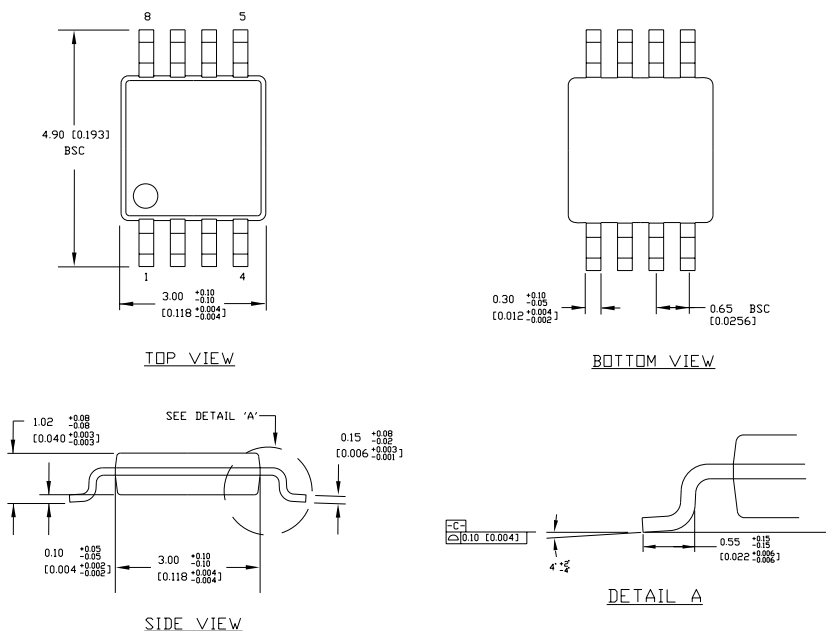
### Part II. Nominal Power Dissipation and Die Temperature

The MIC5202-xxBM at a 25 $^{\circ}\text{C}$  ambient temperature will operate reliably at up to 625mW power dissipation when mounted in the "worst case" manner described above. At an ambient temperature of 55 $^{\circ}\text{C}$ , the device may safely dissipate 440mW. These power levels are equivalent to a die temperature of 125 $^{\circ}\text{C}$ , the recommended maximum temperature for non-military grade silicon integrated circuits.



Minimum recommended board pad size, SO-8.

Package Information



- NOTES:
1. DIMENSIONS ARE IN MM [INCHES].
  2. CONTROLLING DIMENSION: MM
  3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.20 [0.008] PER SIDE.

8-Pin SOP (M)

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