MIC5202

Dual 100 mA Low-Dropout Regulator

Features

- High Output Voltage Accuracy
- Variety of Output Voltages
- Up to 100 mA of Continuous Output Current
- Low Ground Current
- Low Dropout Voltage
- Excellent Line and Load Regulations
- Extremely Low Temperature Coefficient
- Current and Thermal Limit Protections
- Reverse-Battery Protection
- Zero-Off Mode Current
- Logic-Controlled Electronic Shutdown
- 8-Pin SOIC Package

Applications

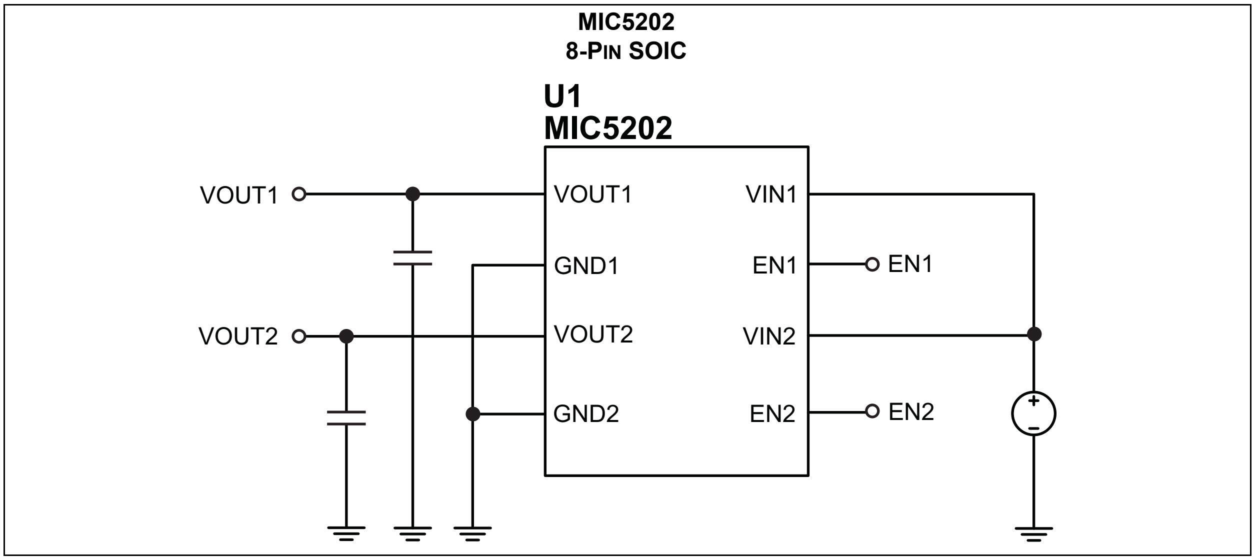
- Cell Phones
- Laptop, Notebook, and Palmtop Computers
- Battery-Powered Equipment
- PCMCIA V_{CC} and V_{PP} Regulation/Switching
- Barcode Scanners
- SMPS Post-Regulator/DC-to-DC Modules
- High-Efficiency Linear Power Supplies

General Description

The MIC5202 is a dual linear voltage regulator with low dropout voltage (typically 17 mV at light loads and 210 mV at 100 mA), and low ground current (1 mA at 100 mA per output). Ideal for battery-operated applications, the MIC5202 offers 1% output voltage accuracy and dual enable pins. The enable pins may be driven individually or tied directly to V_{IN}. When the part is disabled, power consumption drops to nearly zero. The MIC5202 ground current increases slightly in dropout, which minimizes power consumption and increases battery life. Some key features include reversed battery protection, current-limit, and overtemperature protection.

The MIC5202 is available in fixed output voltages in the small 8-pin SOIC package.

Typical Application Schematic



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Supply Voltage (V_{IN1}, V_{IN2}) .... –20V to +60V
Enable Input Voltage (EN1, EN2) .... –20V to +60V
ESD Rating (Note 1) .... ESD Sensitive

Operating Ratings ‡

Input Supply Voltage (V_{IN1}, V_{IN2}) .... +2.5V to +26V
Enable Input Voltage (EN1, EN2) .... 0V to V_{IN}

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ Notice: The device is not guaranteed to function outside its operating ratings.

Note 1: Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5 kΩ in series with 100 pF.

TABLE 1-1: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $V_{IN} = V_{OUT} + 1V$, $C_{OUT} = 10\ \mu F$; $I_{OUT} = 1\ mA$; $T_J = 25°C$, **bold** values indicate –40°C ≤ T_J ≤ +125°C; unless noted. Specifications are for one LDO. (**Note 1**).

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy	V_{OUT}	–1	—	1	%	—
		–2	—	**2**		
Output Voltage Temperature Coefficient (Note 2)	$\Delta V_{OUT}/\Delta T$	—	40	**150**	ppm/°C	—
Line Regulation	$\Delta V_{OUT}/V_{OUT}$	—	0.004	0.10	%	$V_{IN} = V_{OUT} + 1V$ to 26V
		—	—	**0.40**		
Load Regulation (Note 3)	$\Delta V_{OUT}/V_{OUT}$	—	0.04	0.16	%	$I_{OUT} = 0.1\ mA$ to 100 mA
		—	—	**0.30**		
Dropout Voltage (Note 4)	$V_{IN} - V_{OUT}$	—	17	—	mV	$I_{OUT} = 100\ \mu A$
		—	130	—		$I_{OUT} = 20\ mA$
		—	150	—		$I_{OUT} = 30\ mA$
		—	180	—		$I_{OUT} = 50\ mA$
		—	225	**350**		$I_{OUT} = 100\ mA$
Ground Pin Current Shutdown	$I_{SHUTDOWN}$	—	0.01	—	µA	$V_{EN} \leq 0.7V$ (shutdown)
Ground Pin Current (Note 5)	I_{GND}	—	170	—	µA	$V_{EN} \geq 2.0V$, $I_{OUT} = 100\ \mu A$
		—	270	—		$I_{OUT} = 20\ mA$
		—	330	—		$I_{OUT} = 30\ mA$
		—	500	—		$I_{OUT} = 50\ mA$
		—	1200	**1500**		$I_{OUT} = 100\ mA$
Ground Pin Current in Dropout	I_{GNDDO}	—	270	**330**	µA	$V_{IN} = 0.5V$ less than V_{OUT}, $I_{OUT} = 100\ \mu A$
Power Supply Rejection Ratio	PSRR	—	75	—	dB	—
Short Circuit Current Limit	I_{LIMIT}	—	280	—	mA	$V_{OUT} = 0V$
Thermal Regulation (Note 6)	$\Delta V_{OUT}/\Delta P_D$	—	0.05	—	%/W	—
Output Noise	e_n	—	100	—	µV	—

Note 1: Specification for packaged product only.

2: Output voltage temperature coefficient is defined as the worst case voltage change divided by the temperature range.

3: Load regulation is measured at a constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1 mA to 100 mA. Changes in output voltage caused by heating effects are covered by the thermal regulation specification.

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.

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.

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 100 mA load pulse at $V_{IN} = 26V$ for t = 10 ms.

TABLE 1-1: ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $V_{IN} = V_{OUT} + 1V$, $C_{OUT} = 10\ \mu F$; $I_{OUT} = 1\ mA$; $T_J = 25°C$, **bold** values indicate –40°C ≤ T_J ≤ +125°C; unless noted. Specifications are for one LDO. (**Note 1**).

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Enable Input						
Enable Input Voltage	V_{EN}	—	—	0.7	V	Logic-Low = Off
		2.0	—	—		Logic-High = On
Enable Input Current	I_{ENL}	—	0.01	—	µA	V_{EN} ≤ 0.7V
	I_{ENH}	—	8	**50**		V_{EN} ≥ 2.0V

Note 1: Specification for packaged product only.

2: Output voltage temperature coefficient is defined as the worst case voltage change divided by the temperature range.

3: Load regulation is measured at a constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1 mA to 100 mA. Changes in output voltage caused by heating effects are covered by the thermal regulation specification.

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.

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.

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 100 mA load pulse at V_{IN} = 26V for t = 10 ms.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Junction Operating Temperature Range	T_J	–40	—	+125	°C	Note 1
Storage Temperature	T_S	–65	—	+150	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 10s
Package Thermal Resistances						
Thermal Resistance, SOIC 8-Ld	θ_{JA}	—	63	—	°C/W	—

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

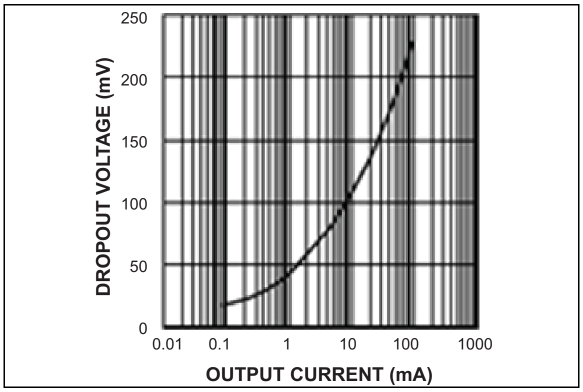


FIGURE 2-1: *Dropout Voltage vs. Output Current.*

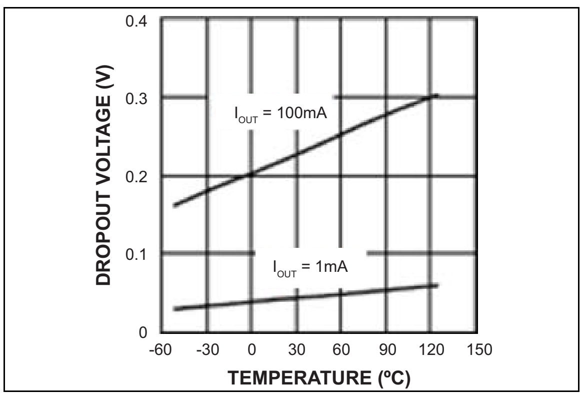


FIGURE 2-2: *Dropout Voltage vs. Temperature.*

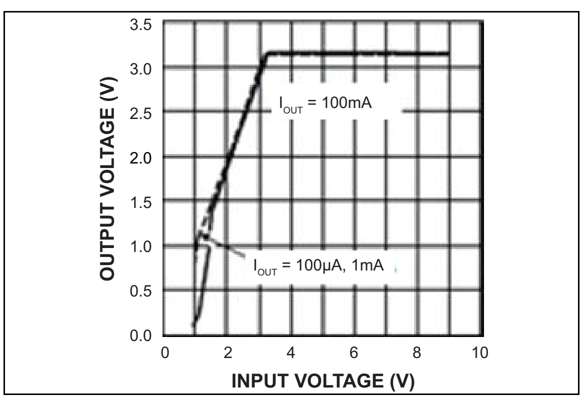


FIGURE 2-3: *Dropout Characteristics.*

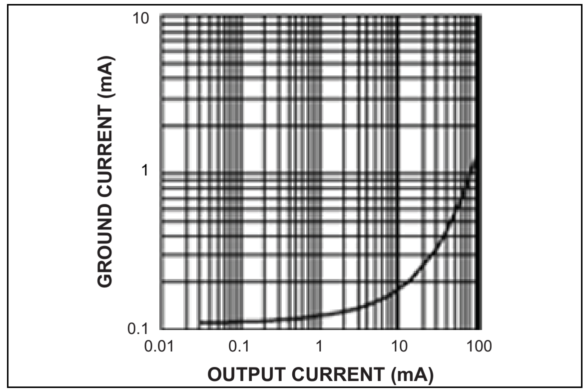


FIGURE 2-4: *Ground Current vs. Output Current.*

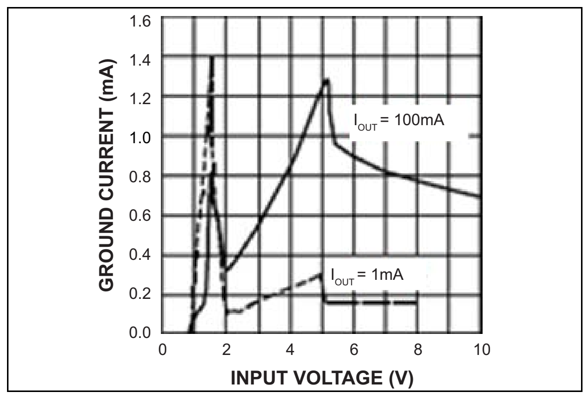


FIGURE 2-5: *Ground Current vs. Input Voltage.*

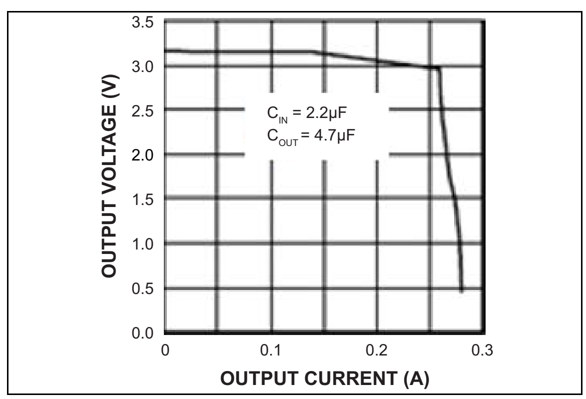


FIGURE 2-6: *Output Voltage vs. Output Current.*

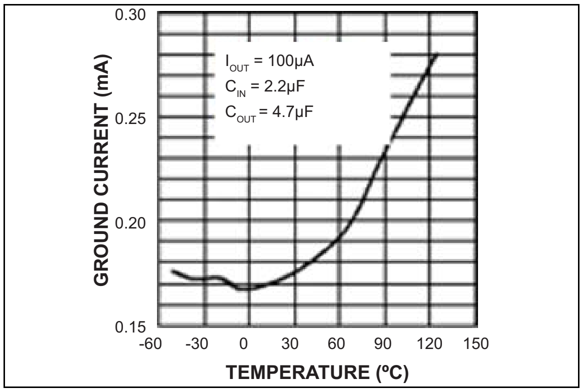


FIGURE 2-7: *Ground Current vs. Temperature.*

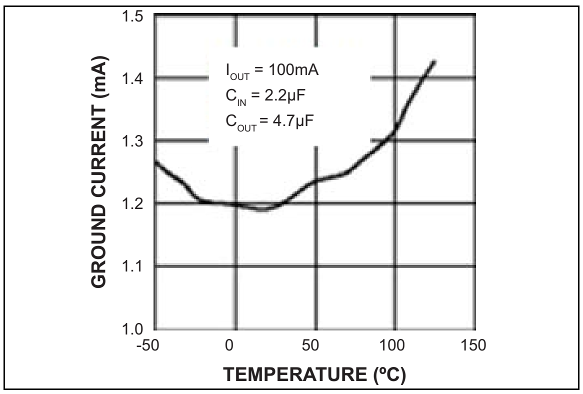


FIGURE 2-8: *Ground Current vs. Temperature.*

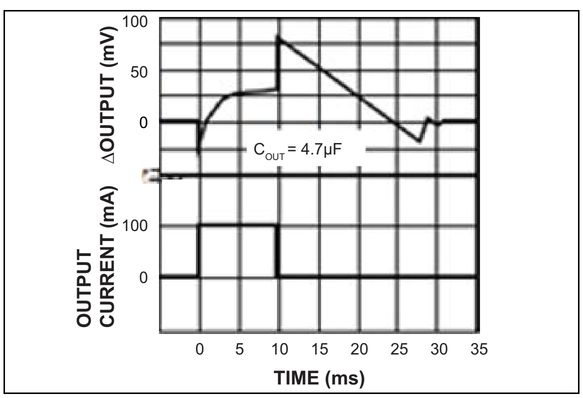


FIGURE 2-9: *Thermal Regulation (3.3V Version).*

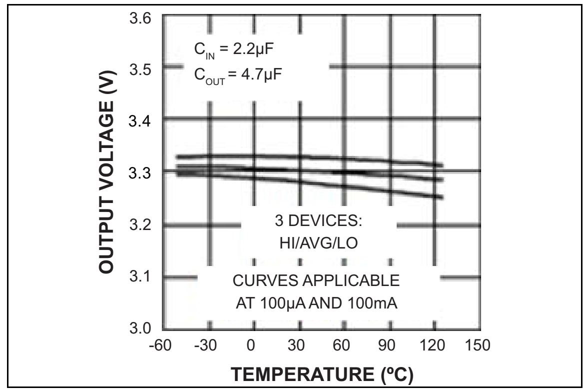


FIGURE 2-10: *Output Voltage vs. Temperature (3.3V Version).*

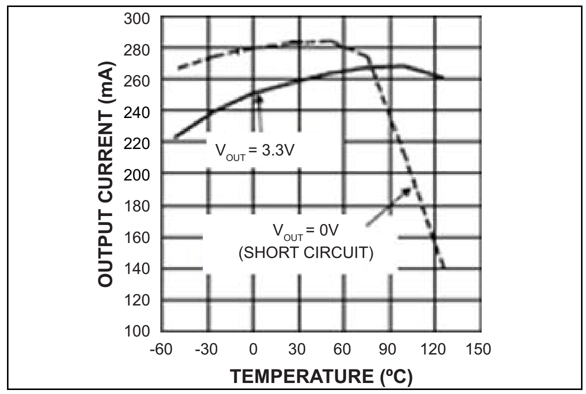


FIGURE 2-11: *Output Current vs. Temperature.*

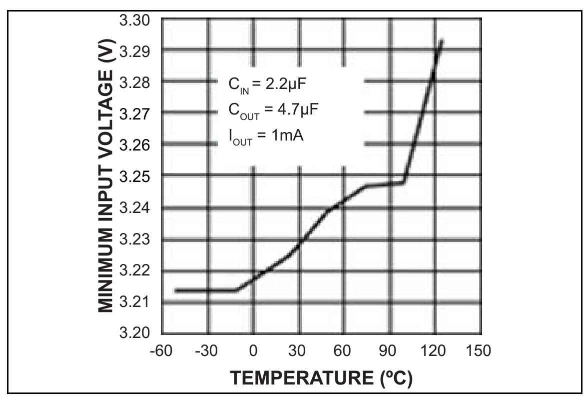


FIGURE 2-12: *Minimum Input Voltage vs. Temperature.*

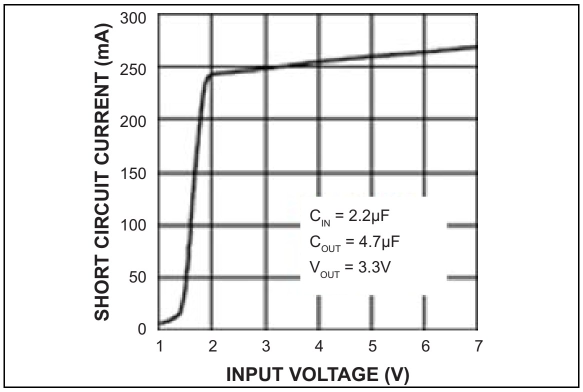


FIGURE 2-13: *Short Circuit Current vs. Input Voltage.*

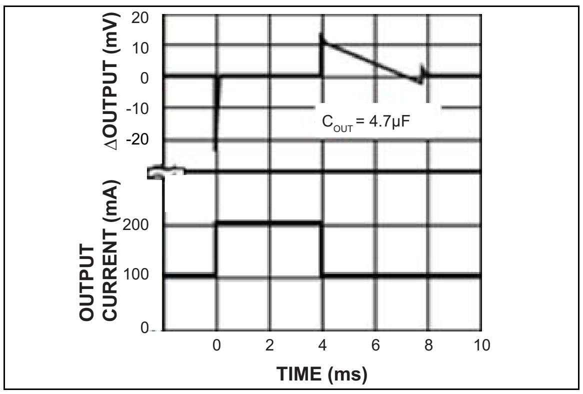


FIGURE 2-14: *Load Transient.*

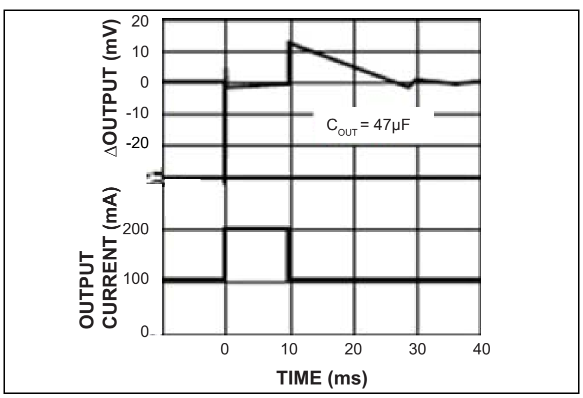


FIGURE 2-15: *Load Transient.*

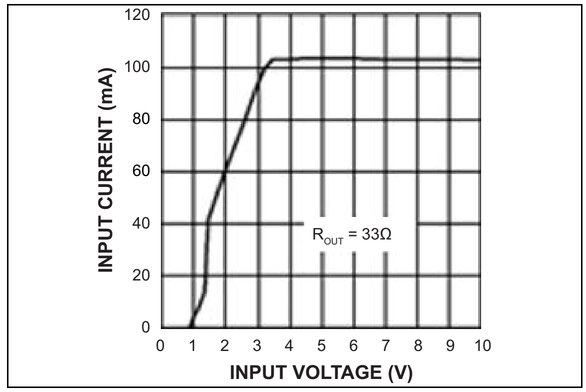


FIGURE 2-16: *Input Current vs. Input Voltage (3.3V Version).*

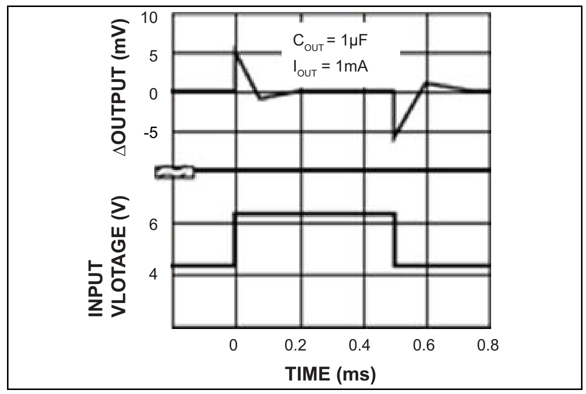


FIGURE 2-17: *Line Transient.*

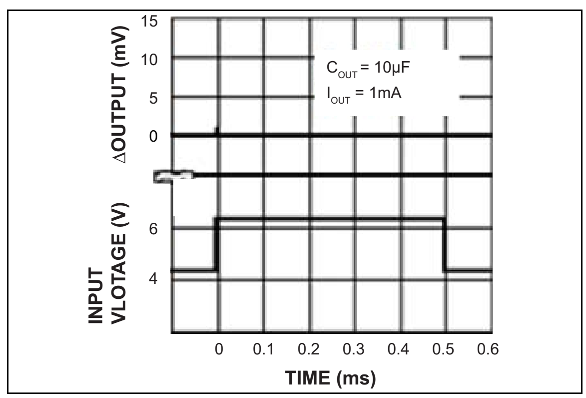


FIGURE 2-18: *Line Transient.*

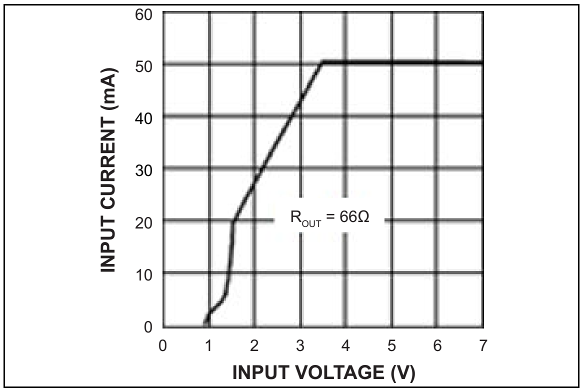


FIGURE 2-19: Input Current vs. Input Voltage (3.3V Version).

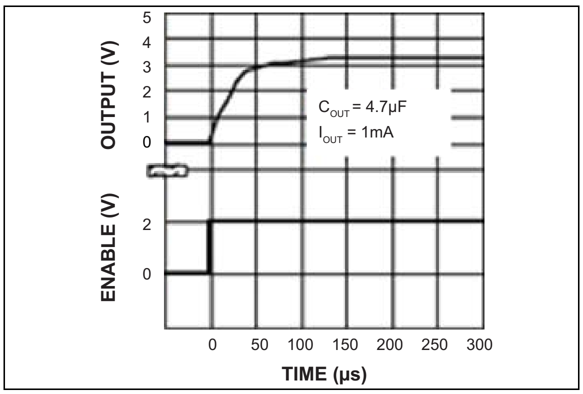


FIGURE 2-20: Enable Transient (3.3V Version).

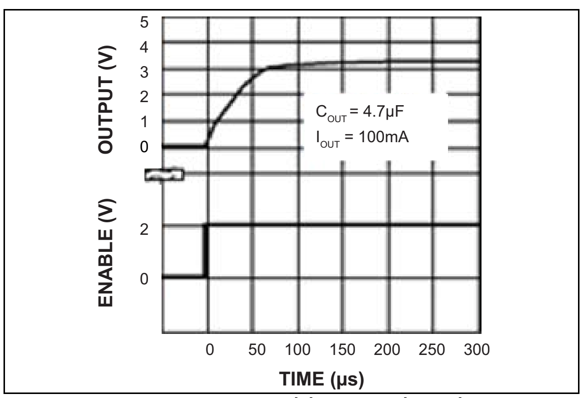


FIGURE 2-21: Enable Transient (3.3V Version).

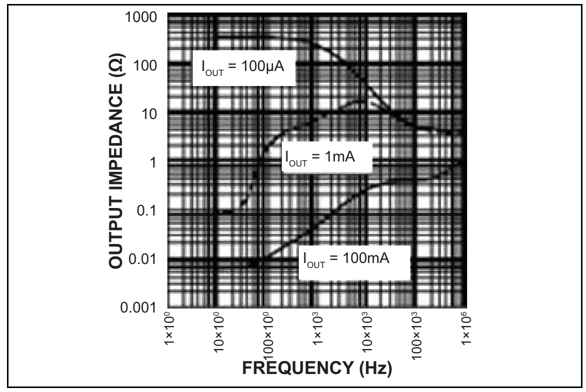


FIGURE 2-22: Output Impedance.

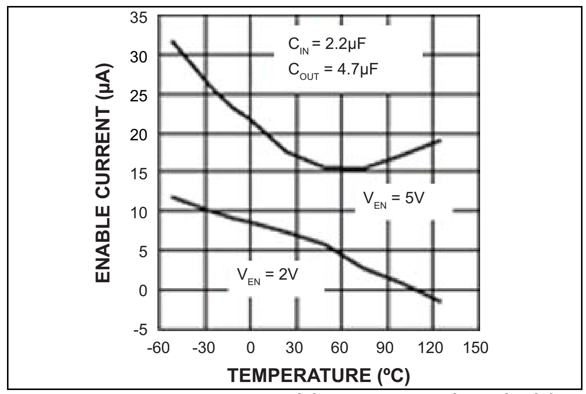


FIGURE 2-23: Enable Current Threshold vs. Temperature.

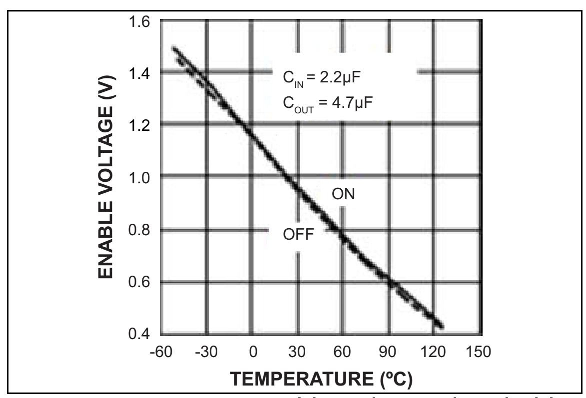


FIGURE 2-24: Enable Voltage Threshold vs. Temperature.

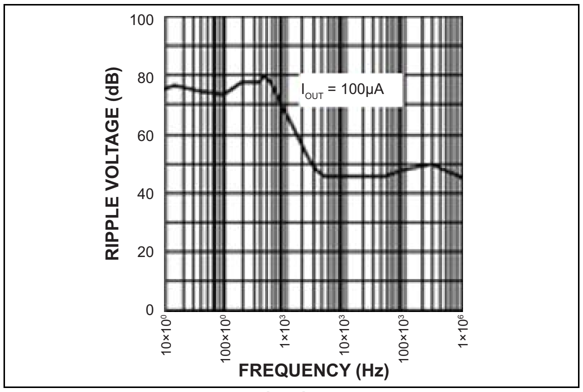


FIGURE 2-25: *Ripple vs. Frequency.*

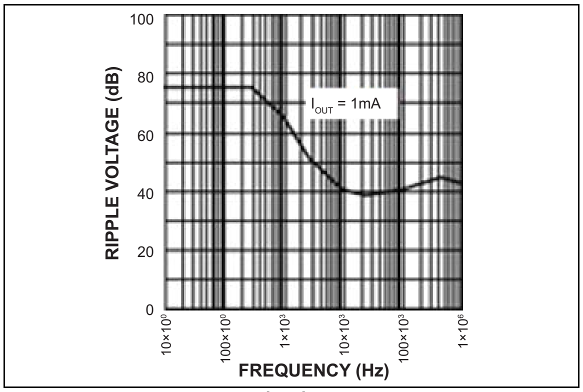


FIGURE 2-26: *Ripple vs. Frequency.*

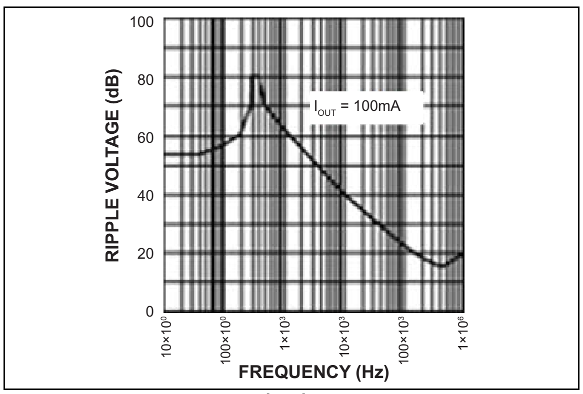


FIGURE 2-27: *Ripple vs. Frequency.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

Package Type

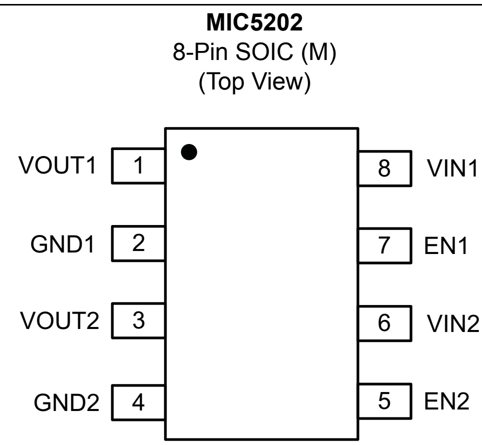


TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	V_{OUT1}	Output of regulator 1.
2	GND1	Ground pin of LDO1.
3	V_{OUT2}	Output of regulator 2.
4	GND2	Ground pin of LDO2.
5	EN2	Enable input for LDO2. Active-high Input. Logic-high = On, logic-low = Off. Do not leave floating.
6	V_{IN2}	Voltage input for LDO2.
7	EN1	Enable input for LDO1. Active-high Input. Logic-high = On, logic-low = Off. Do not leave floating.
8	V_{IN1}	Voltage input for LDO1.

4.0 APPLICATION INFORMATION

The MIC5202 is a dual linear voltage regulator with low dropout voltage and low ground current features. Ideal for battery-operated applications, the MIC5202 offers 1% output voltage accuracy, two independent enable pins, reversed battery protection, short circuit current limit and overtemperature protection. When the MIC5202 is disabled, the ground pin current drops to sub-micro amp and prolongs the battery life.

4.1 Input Supply Voltage

V_{IN1} and V_{IN2} provide power to each internal circuit and may be tied together.

4.2 Ground

Both ground pins (pin 2 and 4) must be tied to the same ground potential when using a single power supply.

4.3 Input Capacitor

A 1 µF tantalum or aluminum electrolytic capacitor should be placed close to each V_{IN} pin if there is more than 10 inches of copper between the input and the capacitor, or if a battery is used as the supply.

4.4 Output Capacitor

The MIC5202 requires an output capacitor of 1 µF or greater to maintain stability. Increasing the output capacitor leads to an improved transient response; however, the size and cost also increase. Most tantalum and aluminum electrolytic capacitors are adequate; film capacitors will work as well, but at a higher cost. Many aluminum electrolytics have electrolytes that freeze at –30°C, so tantalum capacitors are recommended for operations below –25°C. An equivalent series resistance (ESR) of 5Ω or less with a resonance frequency above 500 kHz is recommended. The output capacitor value may be increased without limit.

At lower output loads, a smaller output capacitor value is required for output stability. The capacitor can be reduced to 0.47 µF for current below 10 mA or 0.33 µF for current below 1 mA.

4.5 No-Load Stability

Unlike many other voltage regulators, the MIC5202 remains stable and in regulation with no load. This is especially important in CMOS RAM keep-alive applications.

4.6 Enable Input

The MIC5202 features dual active-high enable pins that allow each regulator to be enabled and disabled independently. Forcing the enable pin low disables the regulator and sends it to 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 typically consumes 8 µA of current and cannot be left floating; a floating enable pin may cause an indeterminate state on the output.

4.7 Thermal Shutdown

When the internal die temperature of MIC5202 reaches the limit, the internal driver is disabled until the die temperature falls.

5.0 THERMAL CONSIDERATIONS

5.1 Layout

The MIC5202 (8-pin SOIC package) has the thermal characteristics shown in Table 5-1, when mounted on a single-layer copper-clad printed circuit board.

TABLE 5-1: THERMAL CHARACTERISTIC CONSIDERATIONS

PC Board Dielectric	θ_{JA}
FR4	160°C/W
Ceramic	120°C/W

Multi-layer boards with a dedicated ground plane, wide traces, and large supply bus lines provide better thermal conductivity.

The “worst case” value of 160°C/W assumes no ground plane, minimum trace widths, and a FR4 material board.

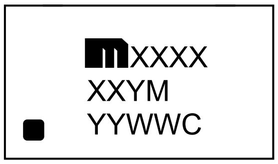
5.2 Nominal Power Dissipation and Die Temperature

At +25°C ambient temperature, the MIC5202 operates reliably at up to 625 mW when mounted in the “worst case” manner described in the previous section. At an ambient temperature of +55°C, the device can safely dissipate 440 mW. These power levels are equivalent to a die temperature of +125°C, which corresponds to the recommended maximum temperature for non-military grade silicon integrated circuits.

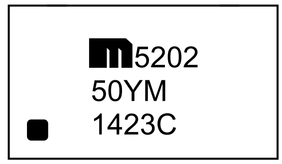
6.0 PACKAGING INFORMATION

6.1 Package Marking Information

8-Pin SOIC*



Example

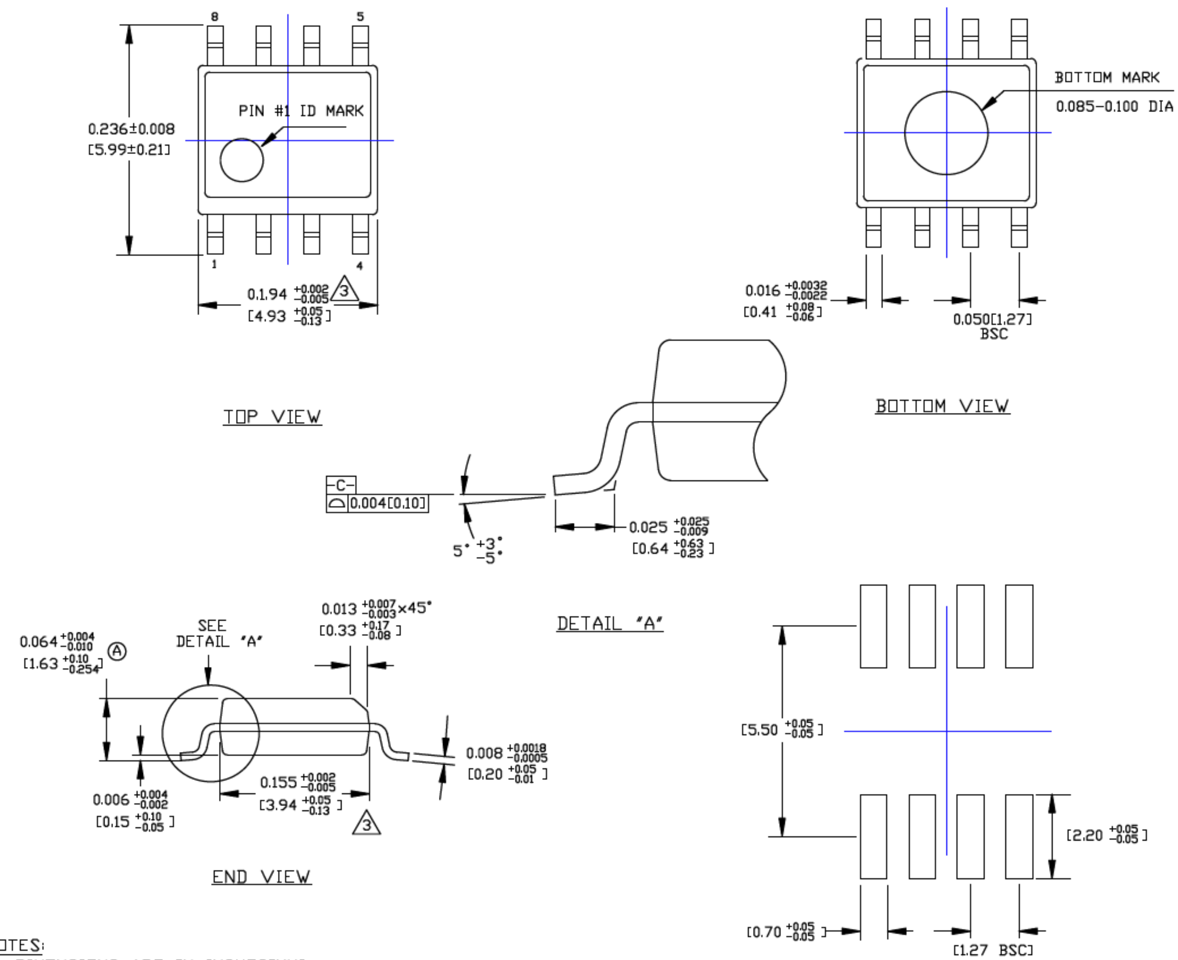


Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Note:		In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo. Underbar (_) symbol may not be to scale.

8-Pin SOIC Package Outline and Recommended Land Pattern

TITLE
8 LEAD SOICN PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOICN-8LD-PL-1	**UNIT**	INCH [MM]



NOTES:
1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.010[0.25] PER SIDE.

RECOMMENDED LAND PATTERN

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (August 2016)

- Converted Micrel document MIC5202 to Microchip data sheet DS20005614A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	-	X.X	X	XX	-	X.X
Device		Output Voltage	Temperature	Package		Media Type

Device:	MIC5202:		Dual 100 mA Low-Dropout Regulator
Output Voltage:	3.0	=	3.0V
	3.3	=	3.3V
	4.8	=	4.85V
	5.0	=	5.0V
Temperature:	Y	=	–40°C to +125°C
Package:	M	=	8-Pin SOIC
Media Type:	TR	=	2,500/Reel
	blank	=	95/Tube

Examples:

a) MIC5202-3.0YM: Dual 100 mA Low-Dropout Regulator, 3.0V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 95/Tube

b) MIC5202-3.0YM-TR: Dual 100 mA Low-Dropout Regulator, 3.0 Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 2,500/Reel

c) MIC5202-3.3YM: Dual 100 mA Low-Dropout Regulator, 3.3V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 95/Tube

d) MIC5202-3.3YM-TR: Dual 100 mA Low-Dropout Regulator, 3.3V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 2,500/Reel

e) MIC5202-4.8YM: Dual 100 mA Low-Dropout Regulator, 4.85V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 95/Tube

f) MIC5202-4.8YM-TR: Dual 100 mA Low-Dropout Regulator, 4.85V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 2,500/Reel

g) MIC5202-5.0YM: Dual 100 mA Low-Dropout Regulator, 5.0V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 95/Tube

h) MIC5202-5.0YM-TR: Dual 100 mA Low-Dropout Regulator, 5.0V Voltage, –40°C to +125°C Temp. Range, 8-Pin SOIC, 2,500/Reel

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