# MIC5203

## µCap 80 mA LDO Regulator

## Features

- Tiny 4- and 5-Lead Surface-Mount Packages
- Wide Selection of Output Voltages
- Guaranteed 80 mA Output
- Low Quiescent Current
- Low Dropout Voltage
- Low Temperature Coefficient
- Current and Thermal Limiting
- Reversed Input Polarity Protection
- Zero Off-Mode Current
- Logic-Controlled Shutdown
- Stability with Low-ESR Ceramic Capacitors

## Applications

- Cellular Telephones
- Laptop, Notebook, and Palmtop Computers
- Battery-Powered Equipment
- Barcode Scanners
- SMPS Post-Regulator and DC/DC Modules
- High-Efficiency Linear Power Supplies

## General Description

The MIC5203 is a µCap 80 mA linear voltage regulator with very low dropout voltage (typically 20 mV at light loads and 300 mV at 80 mA) and very low ground current (225 µA at 20 mA output), offering better than 3% initial accuracy with a logic-compatible enable input.

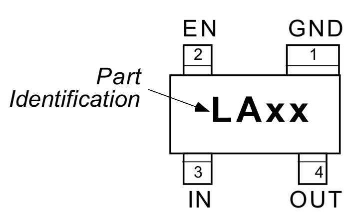
The µCap regulator design is optimized to work with low- value, low-cost ceramic capacitors. The outputs typically require only 0.47 µF of output capacitance for stability.

Designed especially for hand-held, battery-powered devices, the MIC5203 can be controlled by a CMOS or TTL compatible logic signal. When disabled, power consumption drops nearly to zero. If on-off control is not required, the enable pin may be tied to the input for 3-terminal operation. The ground current of the MIC5203 increases only slightly in dropout, further prolonging battery life. Key MIC5203 features include current limiting, overtemperature shutdown, and protection against reversed battery.

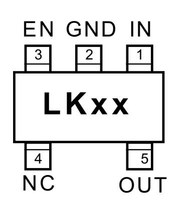
The MIC5203 is available in 2.8V, 3.0V, 3.3V, 3.6V, 3.8V, 4.0V, 4.5V, 4.75V, and 5.0V fixed voltages. Other voltages are available.

## Package Types

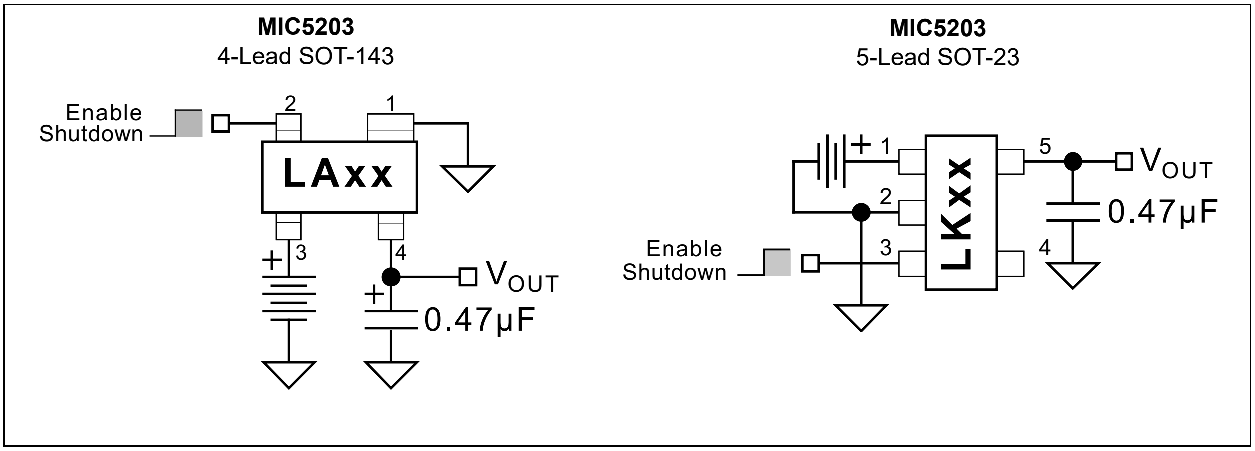
**MIC5203**
4-Lead SOT-143 (M4)




**MIC5203**
5-Lead SOT-23 (M5)



## Typical Application Circuits



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Input Voltage ($V_{IN}$) ........ –20V to +20V
Enable Input Voltage ($V_{EN}$) ........ –20V to +20V
Power Dissipation ($P_D$) (Note 1) ........ Internally Limited

### Operating Ratings ‡

Supply Input Voltage ($V_{IN}$) ........ +2.5V to +16V
Enable Input Voltage ($V_{EN}$) ........ 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:** The maximum allowable power dissipation at 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. The $\theta_{JA}$ of the MIC5205-xxYM5 (all versions) is 220°C/W mounted on a PC board.

## ELECTRICAL CHARACTERISTICS

**Electrical Characteristics:** $V_{IN} = V_{OUT}$ +1V; $I_L$ = 1 mA; $C_L$ = 0.47 µF; $V_{EN}$ ≥ 2.0V; $T_J$ = +25°C, **bold** values indicate –40°C < $T_J$ ≤ +125°C, unless noted.

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy | $V_O$ | –3 | — | 3 | % | — |
| | | **–4** | — | **4** | | |
| Output Voltage Temperature Coefficient | $\Delta V_O/\Delta T$ | — | 50 | **200** | ppm/°C | Note 1 |
| Line Regulation | $\Delta V_O/V_O$ | — | 0.008 | 0.3 | % | $V_{IN} = V_{OUT}$ + 1V to 16V |
| | | — | — | **0.5** | | |
| Load Regulation | $\Delta V_O/V_O$ | — | 0.08 | 0.3 | % | $I_L$ = 0.1 mA to 80 mA, Note 2 |
| | | — | — | 0.5 | | |
| Dropout Voltage, Note 3 | $\Delta V_O/V_O$ | — | 20 | — | mV | $I_L$ = 100 µA |
| | | — | 200 | **350** | | $I_L$ = 20 mA |
| | | — | 250 | — | | $I_L$ = 50 mA |
| | | — | 300 | **600** | | $I_L$ = 80 mA |
| Quiescent Current | $I_Q$ | — | 0.01 | 10 | µA | $V_{EN}$ ≤ 0.4V (shutdown) |
| Ground Pin Current, Note 4 | $I_{GND}$ | — | 180 | — | µA | $I_L$ = 100 µA, $V_{EN}$ ≥ 2.0V (active) |
| | | — | 225 | **750** | | $I_L$ = 20 mA, $V_{EN}$ ≥ 2.0V (active) |
| | | — | 850 | — | | $I_L$ = 50 mA, $V_{EN}$ ≥ 2.0V (active) |
| | | — | 1800 | **3000** | | $I_L$ = 80 mA, $V_{EN}$ ≥ 2.0V (active) |
| Ground Pin Current at Dropout | $I_{GNDDO}$ | — | 200 | **300** | µA | $V_{IN} = V_{OUT(nom)}$ – 0.5V, Note 4 |
| Current Limit | $I_{LIMIT}$ | — | 180 | **250** | mA | $V_{OUT}$ = 0V |
| Thermal Regulation | $\Delta V_O/\Delta_{PD}$ | — | 0.05 | — | %/W | Note 5 |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

**Electrical Characteristics:** $V_{IN} = V_{OUT}$ +1V; $I_L$ = 1 mA; $C_L$ = 0.47 µF; $V_{EN} \geq$ 2.0V; $T_J$ = +25°C, **bold** values indicate –40°C < $T_J \leq$ +125°C, unless noted.

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **ENABLE Input** | | | | | | |
| Enable Input Voltage Level | $V_{IL}$ | — | — | **0.6** | V | Logic low (off) |
| | | 2.0 | — | — | | Logic low (on) |
| Enable Input Current | $I_{IL}$ | — | 0.01 | 1 | µA | $V_{IL} \leq$ 0.6V |
| | $I_{IH}$ | — | 15 | **50** | | $V_{IH} \geq$ 2.0V |

**Note 1:** Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

**2:** Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1 mA to 150 mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

**3:** 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.

**4:** 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.

**5:** 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 150 mA load pulse at $V_{IN}$ = 16V for t = 10 ms.

## TEMPERATURE SPECIFICATIONS (Note 1)

| Parameters | Symbol | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| **Temperature Ranges** | | | | | | |
| Junction Temperature Range | $T_J$ | –40 | — | +125 | °C | — |
| Storage Temperature Range | $T_S$ | –60 | — | +150 | °C | — |
| Lead Temperature | — | — | — | +260 | °C | Soldering, 5s |
| **Package Thermal Resistances** | | | | | | |
| Thermal Resistance SOT-143 | $\theta_{JA}$ | — | 250 | — | °C/W | Note 2 |
| Thermal Resistance SOT-23-5 | | — | 220 | — | °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., $T_A$, $T_J$, $\theta_{JA}$). 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:** The maximum allowable power dissipation at 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.

## 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.

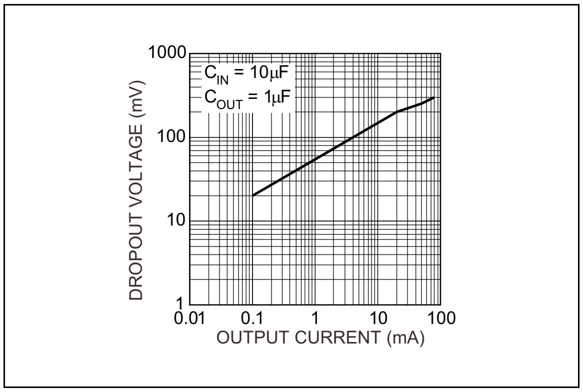



***FIGURE 2-1:*** *Dropout Voltage vs. Output Current.*

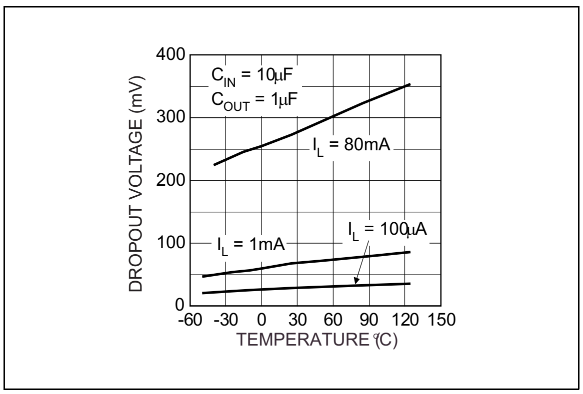



***FIGURE 2-2:*** *Dropout Voltage vs. Temperature.*

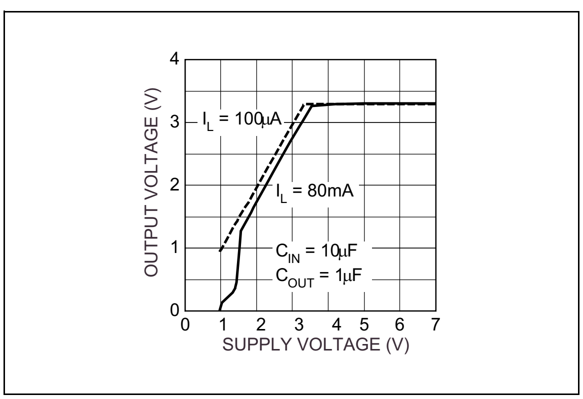



***FIGURE 2-3:*** *Dropout Characteristics.*

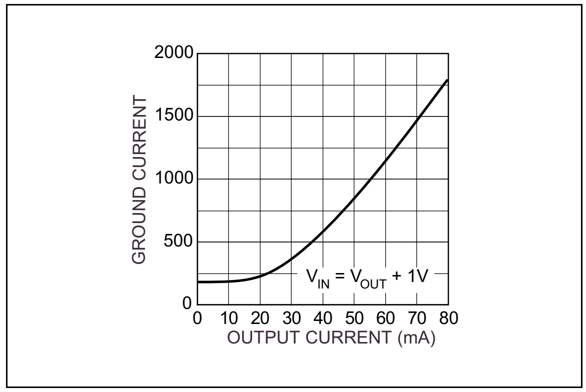



***FIGURE 2-4:*** *Ground Current vs. Output Current.*

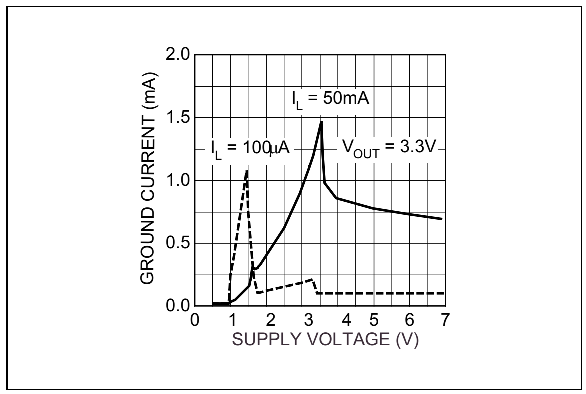



***FIGURE 2-5:*** *Ground Current vs. Supply Voltage.*

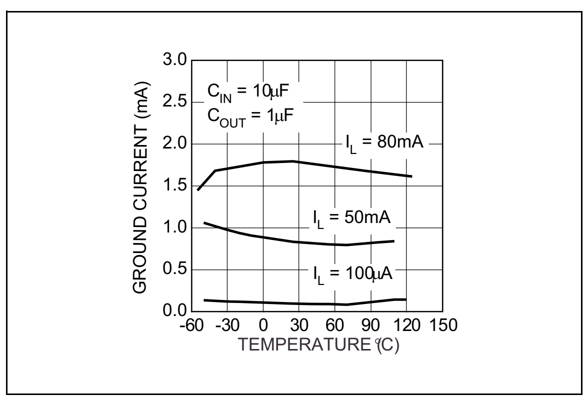



***FIGURE 2-6:*** *Ground Current vs. Temperature.*

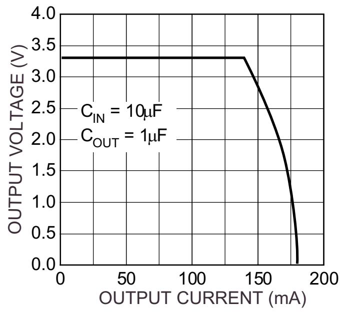



***FIGURE 2-7:*** *Output Voltage vs. Output Current.*

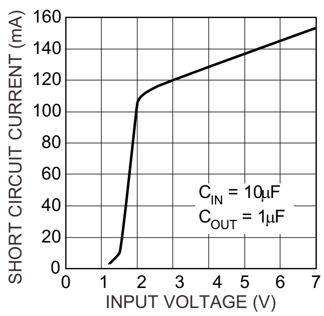



***FIGURE 2-8:*** *Short Circuit vs. Input Voltage.*

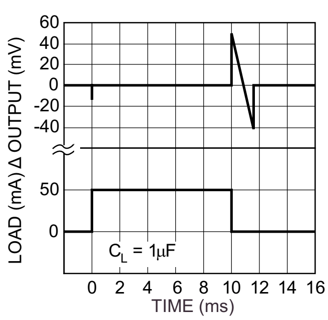



***FIGURE 2-9:*** *Thermal Regulation (3.3V Version).*

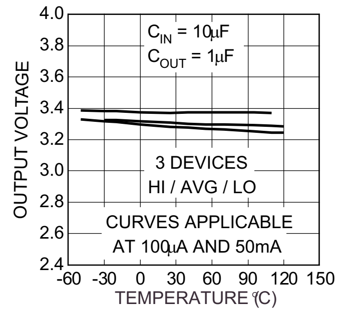



***FIGURE 2-10:*** *Output Voltage vs. Temperature.*

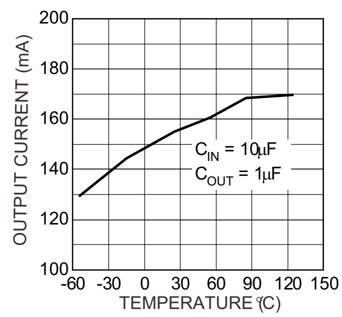



***FIGURE 2-11:*** *Short Circuit Current vs. Temperature.*

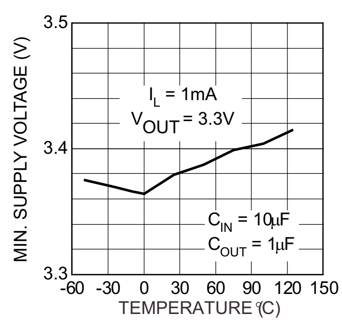



***FIGURE 2-12:*** *Minimum Supply Voltage vs. Temperature.*

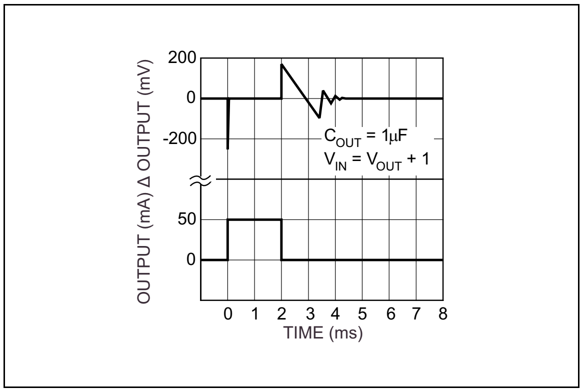



***FIGURE 2-13:*** *Load Transient.*

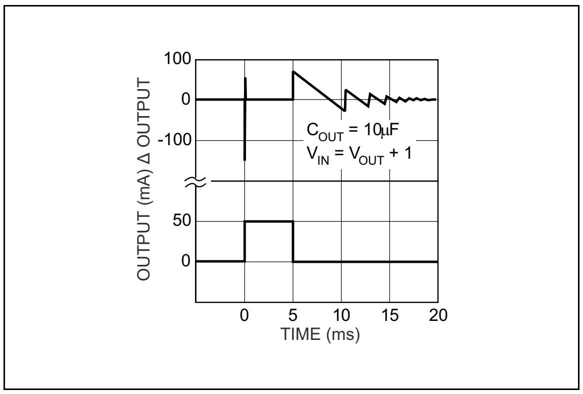



***FIGURE 2-14:*** *Load Transient.*

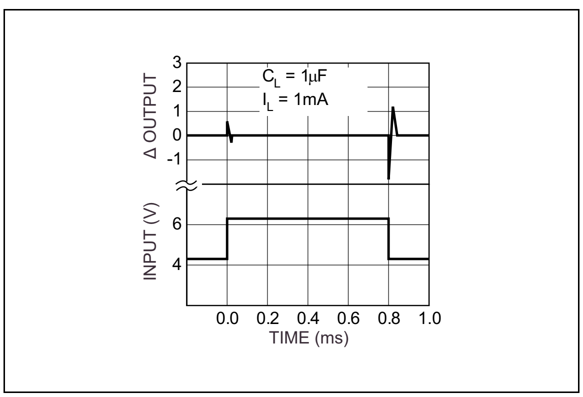



***FIGURE 2-15:*** *Line Transient.*

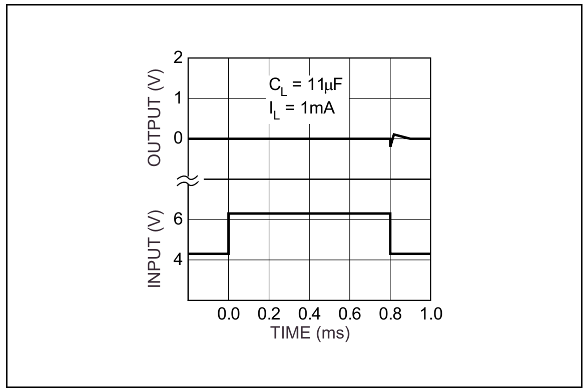



***FIGURE 2-16:*** *Line Transient.*

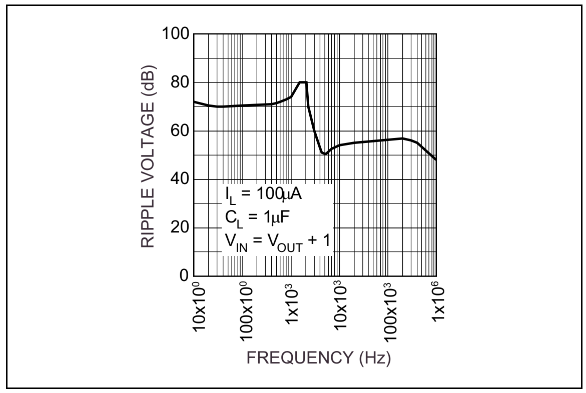



***FIGURE 2-17:*** *Ripple Voltage vs. Frequency.*

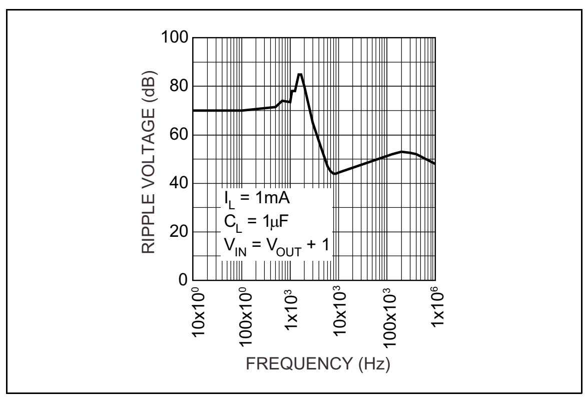



***FIGURE 2-18:*** *Ripple Voltage vs. Frequency.*

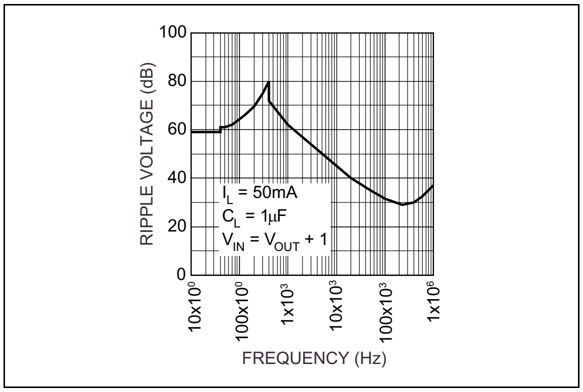



***FIGURE 2-19:*** *Ripple Voltage vs. Frequency.*

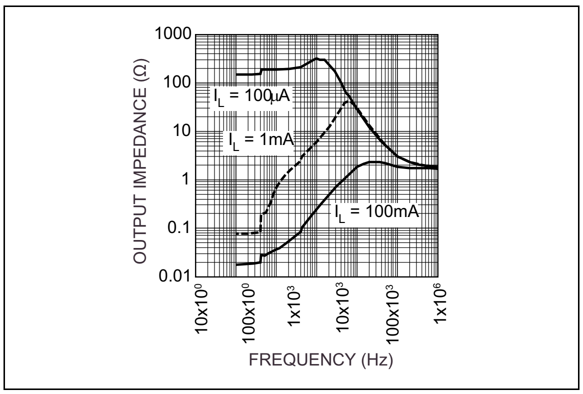



***FIGURE 2-20:*** *Output Impedance.*

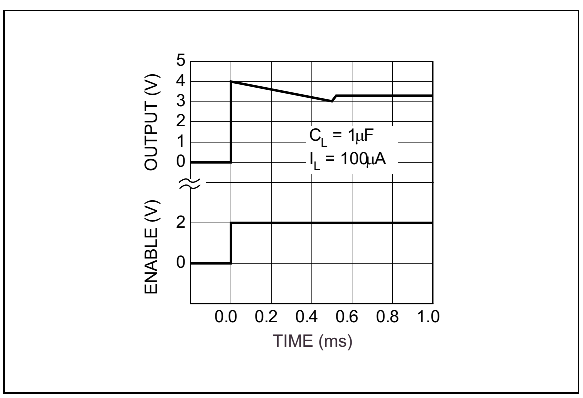



***FIGURE 2-21:*** *Enable Characteristics (3.3 Version).*

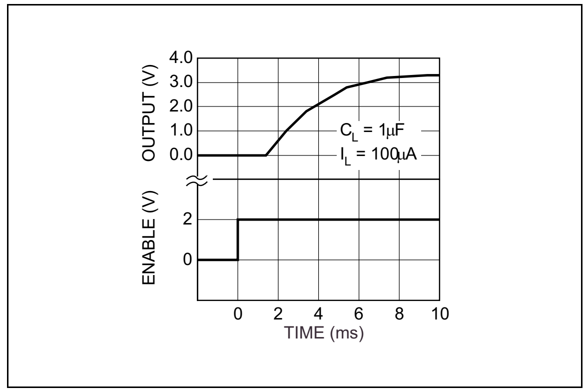



***FIGURE 2-22:*** *Enable Characteristics (3.3 Version).*

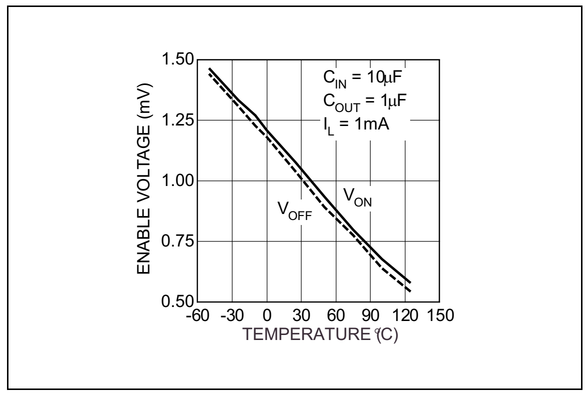



***FIGURE 2-23:*** *Enable Voltage vs. Temperature.*

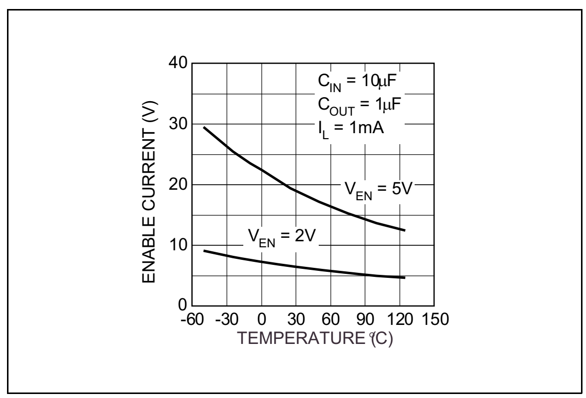



***FIGURE 2-24:*** *Enable Current vs. Temperature.*

## 3.0 PIN DESCRIPTIONS

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

**TABLE 3-1: PIN FUNCTION TABLE**

| Pin Number SOT-143 | Pin Number SOT-23-5 | Pin Name | Description |
|---|---|---|---|
| 1 | 2 | GND | Ground |
| 2 | 3 | EN | Enable (Input): TTL/CMOS compatible control input.<br>Logic high = enabled; logic low or open = shutdown |
| 3 | 1 | IN | Supply input |
| — | 4 | NC | Not internally connected |
| 4 | 5 | OUT | Regulator output |

# 4.0 APPLICATION INFORMATION

## 4.1 Input Capacitor

A 0.1 µF capacitor should be placed from IN to GND if there are more than 10 inches of wire between the input and the AC filter capacitor or if a battery is used as the input.

## 4.2 Output Capacitor

Typical PNP based regulators require an output capacitor to prevent oscillation. The MIC5203 is ultra-stable, requiring only 0.47 µF of output capacitance for stability. The regulator is stable with all types of capacitors, including the tiny, low-ESR ceramic chip capacitors. The output capacitor value can be increased without limit to improve transient response.

The capacitor should have a resonant frequency above 500 kHz. Ceramic capacitors work, but some dielectrics have poor temperature coefficients, which will affect the value of the output capacitor over temperature. Tantalum capacitors are much more stable over temperature, but typically are larger and more expensive. Aluminum electrolytic capacitors will also work, but they have electrolytes that freeze at about –30°C. Tantalum or ceramic capacitors are recommended for operation below –25°C.

## 4.3 No-Load Stability

The MIC5203 will remain stable and in regulation with no load (other than the internal voltage divider) unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

## 4.4 Enable Input

The MIC5203 features nearly zero off-mode current. When EN (enable input) is held below 0.6V, all internal circuitry is powered off. Pulling EN high (over 2.0V) re-enables the device and allows operation. EN draws a small amount of current, typically 15 µA. While the logic threshold is TTL/CMOS compatible, EN may be pulled as high as 20V, independent of $V_{IN}$.

# 5.0 PACKAGING INFORMATION

## 5.1 Package Marking Information

| 4-Lead SOT-143* | Example |
|---|---|
| XXXX<br>NNN | LA33<br>415 |

| 5-Lead SOT-23* | Example |
|---|---|
| XXXX<br>NNN | LK45<br>415 |

**TABLE 5-1: MARKING CODES**

| SOT-143 Part # | Marking | Voltage | SOT-23 Part # | Marking | Voltage |
|---|---|---|---|---|---|
| MIC5203-2.6YM4 | LA26 | 2.6V | MIC5203-2.6YM5 | LK26 | 2.6V |
| MIC5203-2.8YM4 | LA28 | 2.8V | MIC5203-2.8YM5 | LK28 | 2.8V |
| MIC5203-3.0YM4 | LA30 | 3.0V | MIC5203-3.0YM5 | LK30 | 3.0V |
| MIC5203-3.3YM4 | LA33 | 3.3V | MIC5203-3.3YM5 | LK33 | 3.3V |
| MIC5203-3.6YM4 | LA36 | 3.6V | MIC5203-3.6YM5 | LK36 | 3.6V |
| MIC5203-3.8YM4 | LA38 | 3.8V | MIC5203-3.8YM5 | LK38 | 3.8V |
| MIC5203-4.0YM4 | LA40 | 4.0V | MIC5203-4.0YM5 | LK40 | 4.0V |
| MIC5203-4.5YM4 | LA45 | 4.5V | MIC5203-4.5YM5 | LK45 | 4.5V |
| MIC5203-4.7YM4 | LA47 | 4.7V | MIC5203-4.7YM5 | LK47 | 4.7V |
| MIC5203-5.0YM4 | LA50 | 5.0V | MIC5203-5.0YM5 | LK50 | 5.0V |

**Legend:**

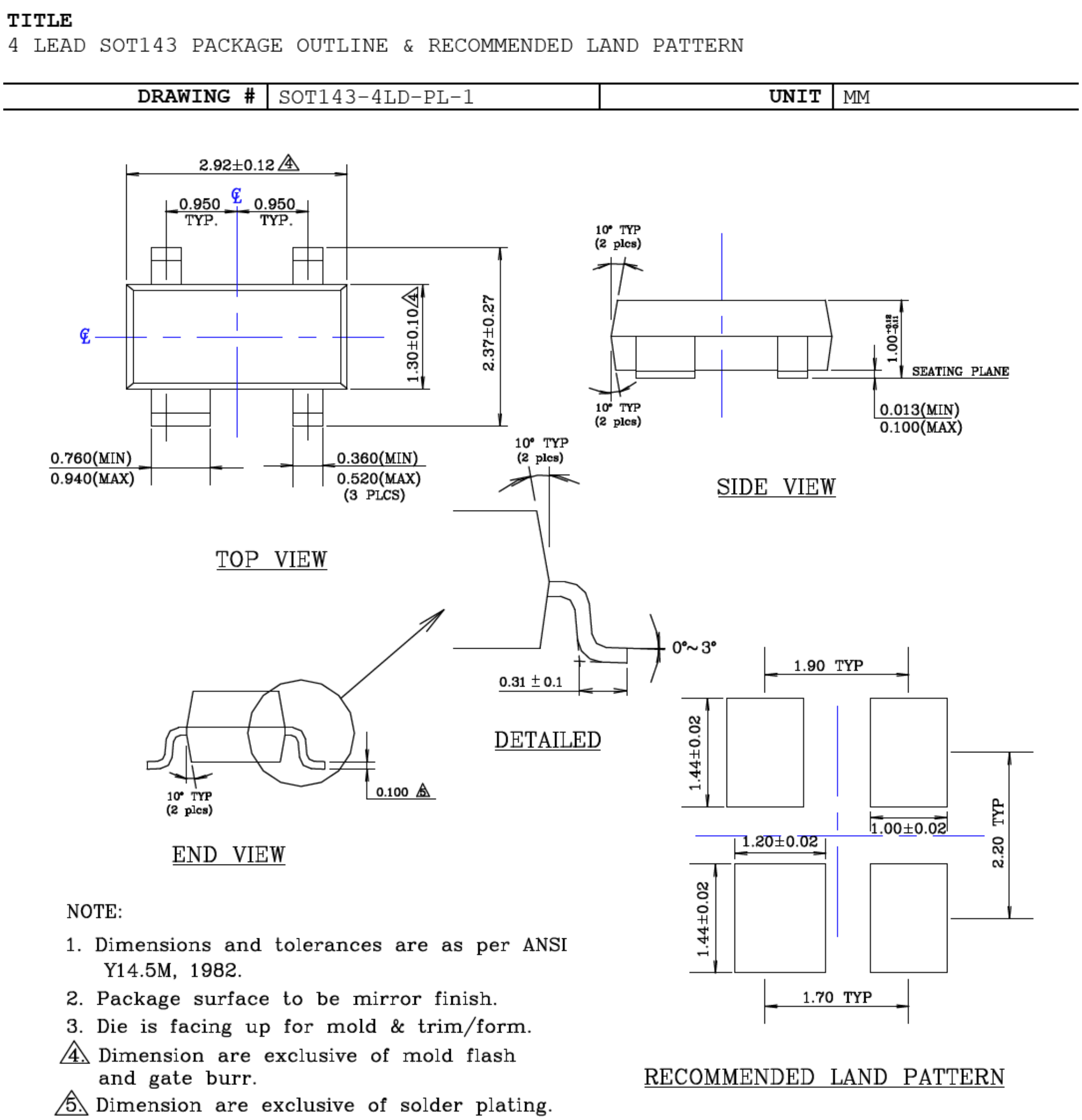
| | |
|---|---|
| XX...X | Product code or customer-specific information |
| Y | Year code (last digit of calendar year) |
| YY | Year code (last 2 digits of calendar year) |
| WW | Week code (week of January 1 is week ‘01’) |
| NNN | Alphanumeric traceability code |
| (e3) | Pb-free JEDEC® designator 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 (_) and/or Overbar (‾) symbol may not be to scale.

## 4-Lead SOT-143 Package Outline and Recommended Land Pattern

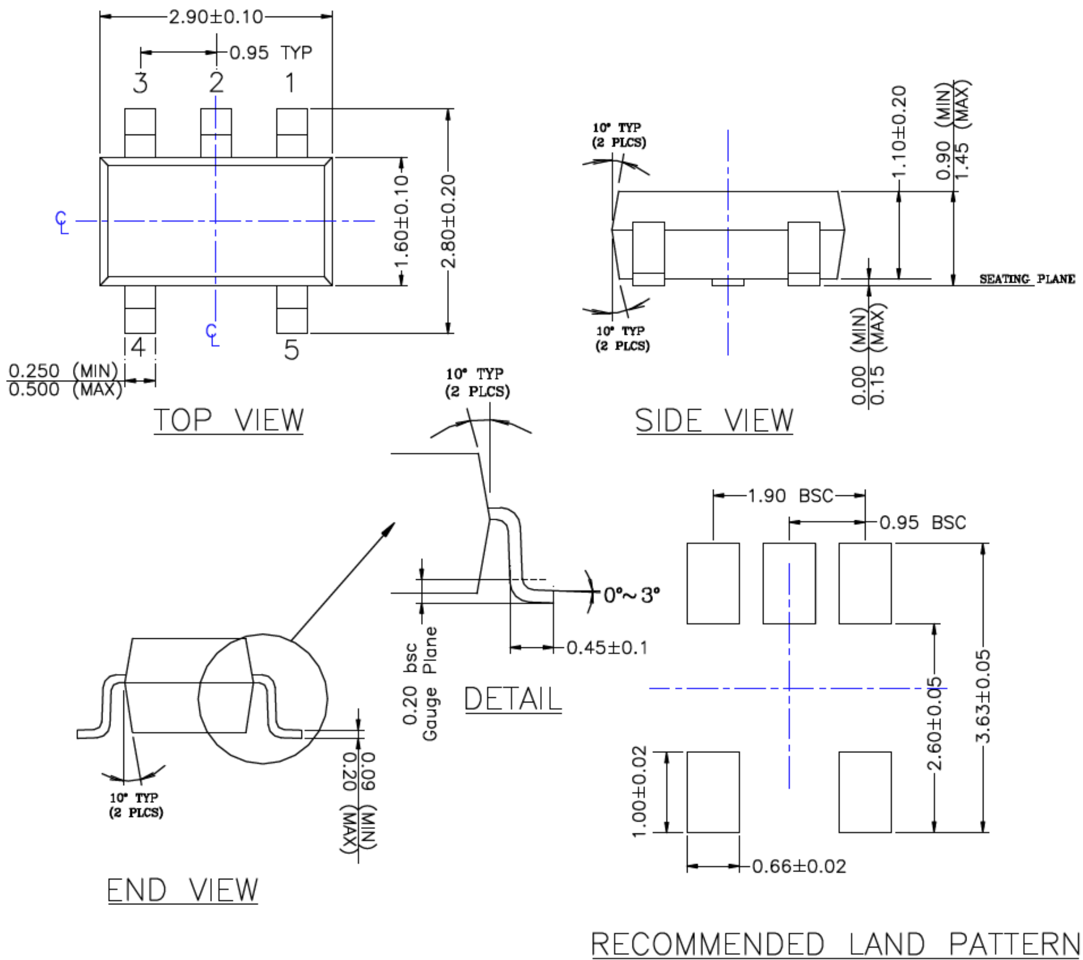



| Note: | For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging. |
|---|---|

## 5-Lead SOT-23 Package Outline and Recommended Land Pattern

**TITLE**
5 LEAD SOT23 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

| DRAWING # | SOT23-5LD-PL-1 | UNIT | MM |
|---|---|---|---|




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.

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 (November 2021)

- Converted Micrel document MIC5203 to Microchip data sheet DS20006609A.
- 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 | –XX |
|---|---|---|---|---|
| Device | Voltage | Temperature | Package | Media Type |

| | | |
|---|---|---|
| **Device:** | MIC5203: | µCap 80 mA LDO Regulator |
| **Voltage:** | 2.8 = | 2.8V |
| | 3.0 = | 3.0V |
| | 3.3 = | 3.3V |
| | 3.6 = | 3.6V |
| | 3.8 = | 3.8V |
| | 4.0 = | 4.0V |
| | 4.5 = | 4.5V |
| | 4.75 = | 4.75V |
| | 5.0 = | 5.0V |
| **Temperature:** | Y = | –40°C to +125°C |
| **Package:** | M4 = | 4-Lead SOT-143 |
| | M5 = | 5-Lead SOT-23 |
| **Media Type:** | TR = | 3,000/Reel |

**Examples:**

| | |
|---|---|
| a) MIC5203-2.8YM4-TR | MIC5203, µCap 80 mA LDO Regulator, –40°C to +125°C, Temperature Range, 4-Lead SOT-143, 3,000/Reel |
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**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

**NOTES:**

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