



# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

## General Description

The MAX821/MAX822 microprocessor ( $\mu$ P) supervisory circuits monitor power supplies in  $\mu$ P and digital systems. They provide excellent circuit reliability and low cost by eliminating external components and adjustments when used with 5V-powered or 3V-powered circuits. The MAX821/MAX822 also provide a power-on reset timeout delay that is pin selectable to 1ms (max), 20ms (min), or 100ms (min).

These devices perform a single function: they assert a reset signal whenever the  $V_{CC}$  supply voltage falls below a preset threshold, and they keep reset asserted for the pin-selected reset timeout delay after  $V_{CC}$  has risen above the reset threshold. The only difference between the two devices is that the MAX821 has an active-low  $\overline{\text{RESET}}$  output (which is guaranteed to be in the correct state for  $V_{CC}$  down to 1V), while the MAX822 has an active-high RESET output. The reset comparator is designed to ignore fast transients on  $V_{CC}$ . Reset thresholds suitable for operation with a variety of supply voltages are available.

Low supply current makes the MAX821/MAX822 ideal for use in portable equipment. These devices come in a 4-pin SOT143 package.

## Applications

Bar-Code Scanners  
Computers  
Controllers  
Intelligent Instruments  
Critical  $\mu$ P and  $\mu$ C Power Monitoring  
Portable/Battery-Powered Equipment

## Typical Operating Circuit



## Features

- ◆ Pin-Selectable, Precision Power-On Reset Delay: 1ms (max), 20ms (min), or 100ms (min)
- ◆ Precision Monitoring of +3V to +5V Power-Supply Voltages
- ◆ 2.5 $\mu$ A Supply Current
- ◆ Guaranteed Over Temperature (-40°C to +125°C)
- ◆ Guaranteed  $\overline{\text{RESET}}$  Valid to  $V_{CC} = 1\text{V}$  (MAX821)
- ◆ Power-Supply Transient Immunity
- ◆ No External Components
- ◆ SOT143 Package

## Ordering Information

| PART        | NOMINAL $V_{TH}$ (V) | TOP MARK* |
|-------------|----------------------|-----------|
| MAX821LUS-T | 4.63                 | AZ_ _     |
| MAX821MUS-T | 4.38                 | BA_ _     |
| MAX821PUS-T | 4.00                 | BM_ _     |
| MAX821TUS-T | 3.08                 | BB_ _     |
| MAX821SUS-T | 2.93                 | BC_ _     |
| MAX821UUS-T | 2.78                 | BL_ _     |
| MAX821RUS-T | 2.63                 | BD_ _     |
| MAX822LUS-T | 4.63                 | BF_ _     |
| MAX822MUS-T | 4.38                 | BG_ _     |
| MAX822TUS-T | 3.08                 | BH_ _     |
| MAX822SUS-T | 2.93                 | BJ_ _     |
| MAX822RUS-T | 2.63                 | BK_ _     |

\* The first two letters in the package top mark identify the part, while the remaining two letters are the lot-tracking code. Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

## Pin Configuration



# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)

V<sub>CC</sub> .....-0.3V to 6.0V  
 All Other Inputs.....-0.3V to (V<sub>CC</sub> + 0.3V)  
 Input Current, V<sub>CC</sub>, SRT.....20mA  
 Output Current, RESET or  $\overline{\text{RESET}}$ .....20mA

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

SOT143-4 (derate 4mW/°C above +70°C).....320mW  
 Operating Temperature Range .....-40°C to +125°C  
 Storage Temperature Range .....-65°C to +160°C  
 Lead Temperature (soldering, 10sec).....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = full range, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

| PARAMETER                               | SYMBOL            | CONDITIONS                                                             | MIN                                                   | TYP | MAX  | UNITS  |
|-----------------------------------------|-------------------|------------------------------------------------------------------------|-------------------------------------------------------|-----|------|--------|
| V <sub>CC</sub> Range                   |                   | T <sub>A</sub> = 0°C to +70°C                                          | 1.0                                                   |     | 5.5  | V      |
|                                         |                   | T <sub>A</sub> = -40°C to +85°C                                        | 1.2                                                   |     | 5.5  |        |
| Supply Current                          | I <sub>CC</sub>   | MAX82_L/M/P,<br>V <sub>CC</sub> = 5.5V, I <sub>OUT</sub> = 0           | T <sub>A</sub> = +25°C                                |     | 2.5  | μA     |
|                                         |                   |                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 12   |        |
|                                         |                   | MAX82_R/S/T/U,<br>V <sub>CC</sub> = 5.5V, I <sub>OUT</sub> = 0         | T <sub>A</sub> = +25°C                                |     | 1.8  |        |
|                                         |                   |                                                                        | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |     | 9    |        |
| Reset Threshold (Note 1)                | V <sub>TH</sub>   | MAX82_L                                                                | T <sub>A</sub> = +25°C                                |     | 4.56 | V      |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 4.50 |        |
|                                         |                   | MAX82_M                                                                | T <sub>A</sub> = +25°C                                |     | 4.31 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 4.25 |        |
|                                         |                   | MAX82_P                                                                | T <sub>A</sub> = +25°C                                |     | 3.97 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 3.91 |        |
|                                         |                   | MAX82_T                                                                | T <sub>A</sub> = +25°C                                |     | 3.04 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 3.00 |        |
|                                         |                   | MAX82_S                                                                | T <sub>A</sub> = +25°C                                |     | 2.89 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 2.85 |        |
|                                         |                   | MAX82_U                                                                | T <sub>A</sub> = +25°C                                |     | 2.74 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 2.70 |        |
|                                         |                   | MAX82_R                                                                | T <sub>A</sub> = +25°C                                |     | 2.59 |        |
|                                         |                   |                                                                        | T <sub>A</sub> = -40°C to +125°C                      |     | 2.55 |        |
| Reset Threshold Tempco                  |                   |                                                                        |                                                       | 30  |      | ppm/°C |
| V <sub>CC</sub> to Reset Delay (Note 1) |                   | V <sub>CC</sub> falling at 1mV/μs                                      |                                                       | 50  |      | μs     |
| Reset Active Timeout Period             | t <sub>RP</sub>   | SRT = GND                                                              | 0.5                                                   | 0.8 | 1    | ms     |
|                                         |                   | SRT = V <sub>CC</sub>                                                  | 20                                                    | 32  | 40   |        |
|                                         |                   | SRT = unconnected                                                      | 100                                                   | 160 | 200  |        |
| SRT Input Current (Note 2)              |                   | $\overline{\text{RESET}}$ = low for MAX821,<br>RESET = high for MAX822 | SRT = GND                                             |     | -100 | μA     |
|                                         |                   |                                                                        | SRT = V <sub>CC</sub>                                 |     | 100  |        |
|                                         |                   |                                                                        | SRT = unconnected                                     |     | -1   |        |
| SRT Input Threshold                     | V <sub>IL</sub>   | $\overline{\text{RESET}}$ = low for MAX821,<br>RESET = high for MAX822 | 0.07V <sub>CC</sub>                                   |     |      | V      |
|                                         | V <sub>IH</sub>   |                                                                        | 0.9V <sub>CC</sub>                                    |     |      |        |
|                                         | V <sub>OPEN</sub> |                                                                        | 0.5V <sub>CC</sub>                                    |     |      |        |

# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

MAX821/MAX822

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC}$  = full range,  $T_A$  = -40°C to +125°C, unless otherwise noted. Typical values are at  $T_A$  = +25°C.)

| PARAMETER                                                                              | SYMBOL   | CONDITIONS                                                                       | MIN                                                                             | TYP | MAX | UNITS |
|----------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----|-----|-------|
| SRT Input Capacitance<br>(Note 3) (see <i>Setting the Reset Timeout Delay</i> section) |          | Internal                                                                         |                                                                                 |     | 20  | pF    |
| $\overline{\text{RESET}}$ Output Voltage<br>(MAX821)                                   | $V_{OL}$ | MAX821L/M/P only, $I_{SINK} = 3.2\text{mA}$ ,<br>$V_{CC} = V_{TH(MIN)}$          |                                                                                 |     | 0.4 | V     |
|                                                                                        |          | MAX821R/S/T/U only, $I_{SINK} = 1.2\text{mA}$ ,<br>$V_{CC} = V_{TH(MIN)}$        |                                                                                 |     | 0.3 |       |
|                                                                                        |          | $I_{SINK} = 50\mu\text{A}$                                                       | $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$ ,<br>$V_{CC} \geq 1\text{V}$     |     | 0.3 |       |
|                                                                                        |          |                                                                                  | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ ,<br>$V_{CC} \geq 1.2\text{V}$ |     | 0.3 |       |
|                                                                                        | $V_{OH}$ | MAX821L/M/P only, $I_{SOURCE} = 800\mu\text{A}$ ,<br>$V_{CC} \geq V_{TH(MAX)}$   | $V_{CC} - 1.5$                                                                  |     |     |       |
|                                                                                        |          | MAX821R/S/T/U only, $I_{SOURCE} = 500\mu\text{A}$ ,<br>$V_{CC} \geq V_{TH(MAX)}$ | $0.8V_{CC}$                                                                     |     |     |       |
| RESET Output Voltage<br>(MAX822)                                                       | $V_{OL}$ | MAX822L/M only, $I_{SINK} = 3.2\text{mA}$ ,<br>$V_{CC} = V_{TH(MAX)}$            |                                                                                 |     | 0.4 | V     |
|                                                                                        |          | MAX822R/S/T only, $I_{SINK} = 1.2\text{mA}$ ,<br>$V_{CC} = V_{TH(MAX)}$          |                                                                                 |     | 0.3 |       |
|                                                                                        | $V_{OH}$ | $I_{SOURCE} = 150\mu\text{A}$ , $1.4\text{V} \leq V_{CC} \leq V_{TH(MIN)}$       | $0.8V_{CC}$                                                                     |     |     |       |

**Note 1:**  $\overline{\text{RESET}}$  output for MAX821; RESET output for MAX822.

**Note 2:** During reset active timeout period only.

**Note 3:** Guaranteed by design.

## Typical Operating Characteristics

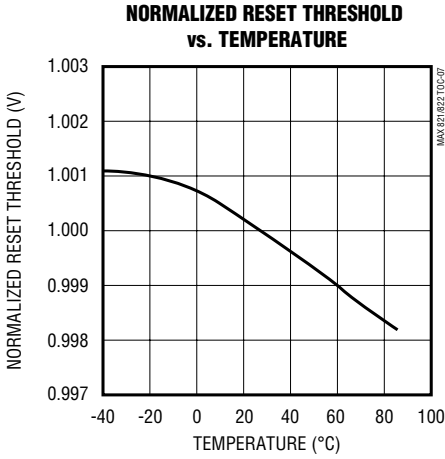
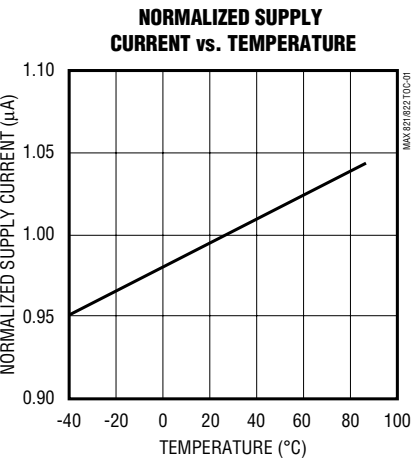
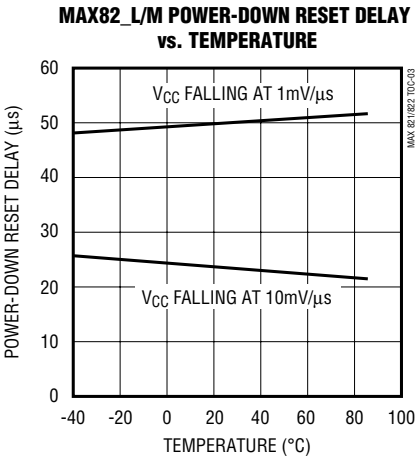
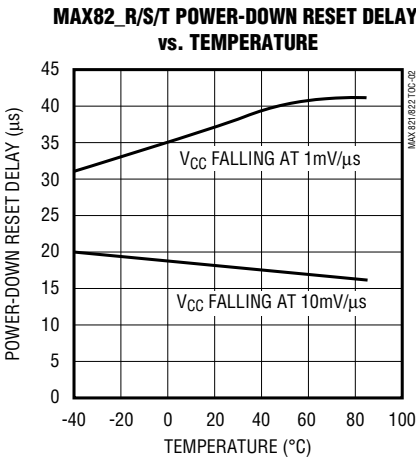
( $T_A$  = +25°C, unless otherwise noted.)



# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



## Pin Description

| PIN    |        | NAME                      | FUNCTION                                                                                                                                                                                                                                             |
|--------|--------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MAX821 | MAX822 |                           |                                                                                                                                                                                                                                                      |
| 1      | 1      | GND                       | Ground                                                                                                                                                                                                                                               |
| 2      | —      | $\overline{\text{RESET}}$ | Active-Low Reset Output. $\overline{\text{RESET}}$ is low while $V_{CC}$ is below the reset threshold. It remains low for the reset timeout period after the reset condition is terminated. The reset timeout period is determined by the SRT input. |
| —      | 2      | RESET                     | Active-High Reset Output. RESET is high while $V_{CC}$ is below the reset threshold. It remains high for the reset timeout period after the reset condition is terminated. The reset timeout period is determined by the SRT input.                  |
| 3      | 3      | SRT                       | Set Reset Timeout Input. Connect to GND for 1ms (max) delay; connect to $V_{CC}$ for 20ms (min) delay; leave unconnected for 100ms (min) delay.                                                                                                      |
| 4      | 4      | $V_{CC}$                  | Supply Voltage                                                                                                                                                                                                                                       |

# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

## Detailed Description

### Reset Output

A microprocessor's ( $\mu$ P's) reset input starts the  $\mu$ P in a known state. These  $\mu$ P supervisory circuits assert reset to prevent code-execution errors during power-up, power-down, or brownout conditions. They also provide a reset timeout delay that is pin programmable to 1ms (max), 20ms (min), or 100ms (min). This feature allows flexibility in designing bar-code scanners, hand-held devices, and other applications that require quick or nonstandard power-up times.

The MAX821's  $\overline{\text{RESET}}$  output is guaranteed to be a logic low for  $V_{CC} > 1V$ . Once  $V_{CC}$  exceeds the reset threshold, an internal timer keeps  $\overline{\text{RESET}}$  low for the reset timeout period, as determined by the Set Reset Timeout (SRT) input. See the *Setting the Reset Timeout Delay* section.

If a brownout condition occurs ( $V_{CC}$  dips below the reset threshold),  $\overline{\text{RESET}}$  goes low. Any time  $V_{CC}$  goes below the reset threshold, the internal timer resets to zero, and  $\overline{\text{RESET}}$  goes low. The internal timer begins counting after  $V_{CC}$  returns above the reset threshold, and  $\overline{\text{RESET}}$  remains low for the reset timeout period.

The MAX822 has an active-high RESET output that is the inverse of the MAX821's  $\overline{\text{RESET}}$  output.

### Setting the Reset Timeout Delay

Use the three-level Set Reset Timeout (SRT) input to set the reset timeout delay. Connect SRT to GND for a 1ms (max) delay; connect it to  $V_{CC}$  for a 20ms (min) delay; or leave it unconnected for a 100ms (min) delay.

If you choose to drive the SRT pin with an external signal, make sure the signal source can charge/discharge the capacitance on SRT quickly enough ( $< 500\mu s$ ) to avert an unintended reset timeout delay.

To ensure proper operation when selecting the 100ms timeout (SRT = unconnected), minimize capacitive loading on the SRT pin ( $< 200pF$ ). Excessive capacitive loading can select an unintended faster timeout mode.

### Reset Threshold Accuracy

The MAX821/MAX822 are designed to meet their worst-case specifications over their entire operating temperature range. Choose a reset threshold guaranteed to assert at a voltage below the power supply's regulation range and above the minimum specified operating voltage range for the system's ICs.



Figure 1. Maximum Transient Duration Without Causing a Reset Pulse vs. Comparator Overdrive

## Applications Information

### Negative-Going $V_{CC}$ Transients

While designed to issue a reset to the microprocessor ( $\mu$ P) during power-up, power-down, and brownout conditions, the MAX821/MAX822 are relatively immune to short-duration, negative-going  $V_{CC}$  transients (glitches).

Figure 1 shows the maximum transient duration vs. reset comparator overdrive for which the MAX821/MAX822 typically do not generate a reset pulse. This graph was generated using a negative-going pulse applied to  $V_{CC}$ , starting above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the typical maximum pulse width a negative-going  $V_{CC}$  transient may have without causing a reset pulse to be issued. As the magnitude of the transient increases (goes farther below the reset threshold), the maximum allowable pulse width decreases. Typically, for the MAX821/MAX822, a  $V_{CC}$  transient that goes 100mV below the reset threshold and lasts 12μs or less will not cause a reset pulse to be issued. A 0.1μF capacitor mounted as close as possible to  $V_{CC}$  can provide additional transient immunity, if desired.

MAX821/MAX822

## 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

### Ensuring a Valid $\overline{\text{RESET}}$ Output Down to $V_{CC} = 0V$

When  $V_{CC}$  falls below 1V, the MAX821  $\overline{\text{RESET}}$  output no longer sinks current—it becomes an open circuit. Therefore, high-impedance CMOS logic inputs connected to the  $\overline{\text{RESET}}$  output can drift to undetermined voltages. This presents no problem in most applications, since most  $\mu$ P and other circuitry is inoperative with  $V_{CC}$  below 1V. However, in applications where the  $\overline{\text{RESET}}$  output must be valid down to 0V, adding a pull-down resistor to the  $\overline{\text{RESET}}$  pin will cause any stray leakage currents to flow to ground, holding  $\overline{\text{RESET}}$  low (Figure 2a). R1's value is not critical; 100k $\Omega$  is large enough not to load  $\overline{\text{RESET}}$ , and small enough to pull  $\overline{\text{RESET}}$  to ground.

A 100k $\Omega$  pull-up resistor to  $V_{CC}$  is also recommended for the MAX822 if  $\overline{\text{RESET}}$  is required to remain valid for  $V_{CC} < 1V$  (Figure 2b).

### Interfacing to $\mu$ Ps with Bidirectional Reset Pins

$\mu$ Ps with bidirectional reset pins (such as the Motorola 68HC11 series) can contend with the MAX821 reset output. For example, if the MAX821  $\overline{\text{RESET}}$  output is asserted high and the  $\mu$ P wants to pull it low, indeterminate logic levels may result. To correct such cases, connect a 4.7k $\Omega$  resistor between the MAX821  $\overline{\text{RESET}}$  output and the  $\mu$ P reset I/O (Figure 3). Buffer the reset output to other system components.

### Chip Information

TRANSISTOR COUNT: 492

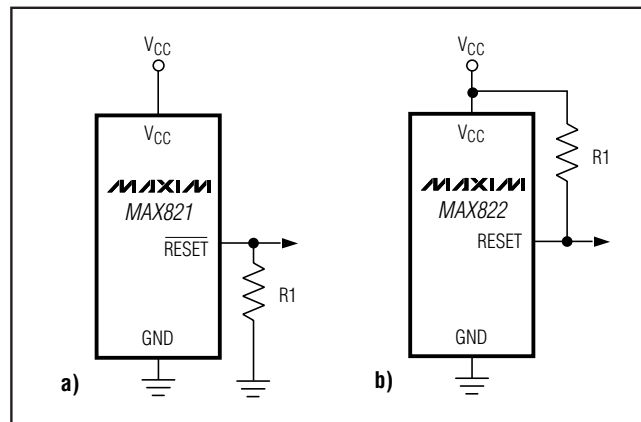


Figure 2.  $\overline{\text{RESET}}$ /RESET Valid to  $V_{CC} = \text{Ground}$  Circuit

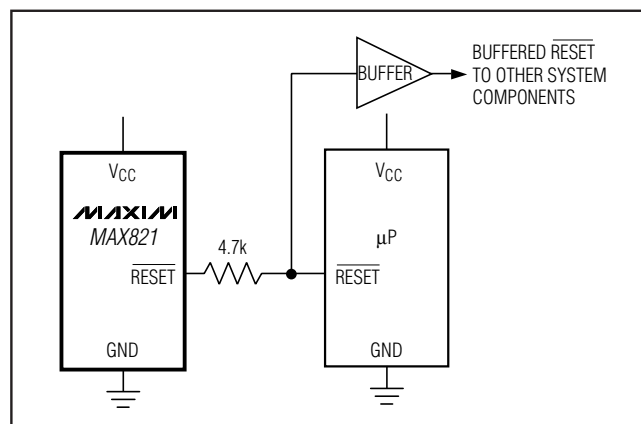
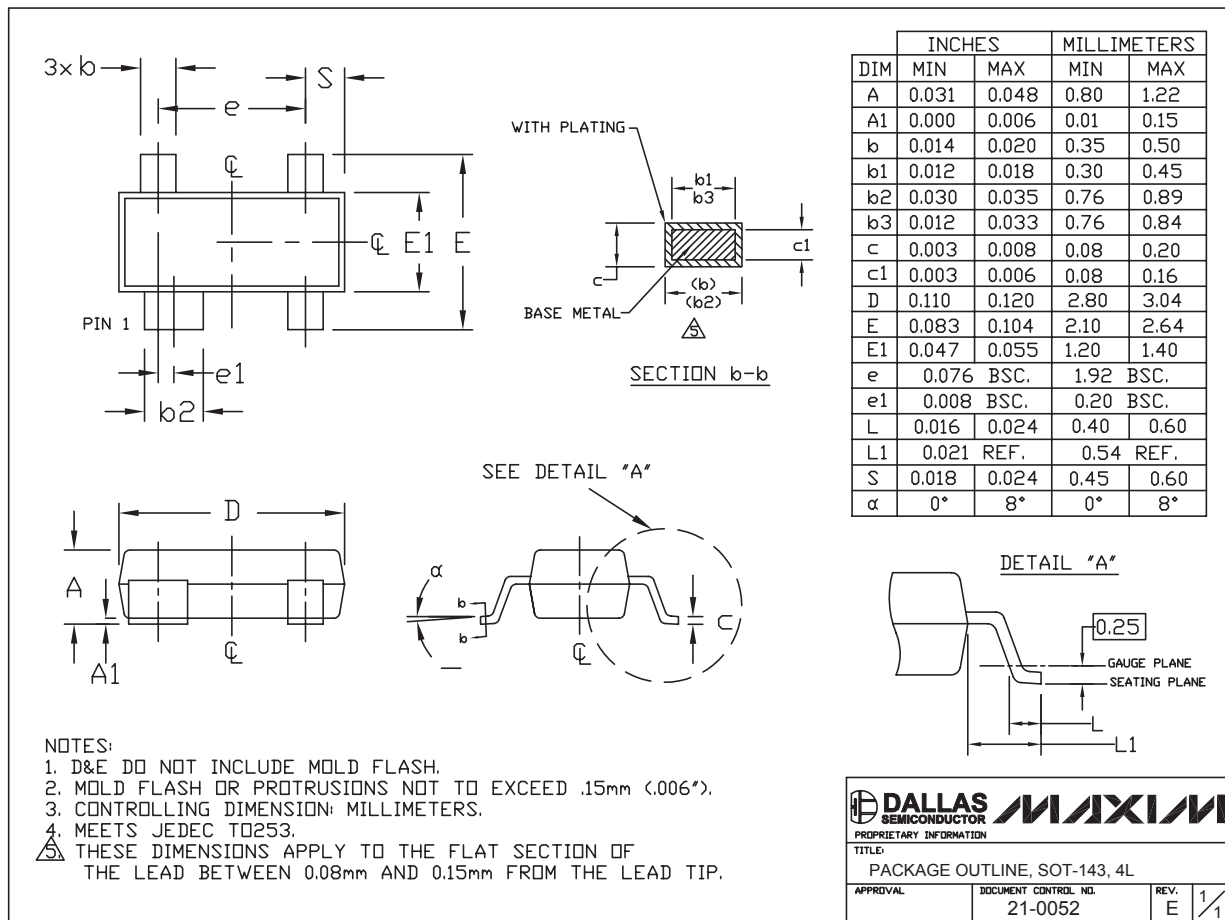


Figure 3. Interfacing to  $\mu$ Ps with Bidirectional Reset I/O

# 4-Pin $\mu$ P Voltage Monitors with Pin-Selectable Power-On Reset Timeout Delay

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



SOT-143 4L EPS

MAX821/MAX822

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