



Ultra-Small, Adjustable Sequencing/Supervisory Circuits

General Description

The MAX6895–MAX6899 is a family of small, low-power, voltage-monitoring circuits with sequencing capability. These miniature devices offer tremendous flexibility with an adjustable threshold capable of monitoring down to 0.5V and an external capacitor-adjustable time delay. These devices are ideal for use in power-supply sequencing, reset sequencing, and power-switching applications. Multiple devices can be cascaded for complex sequencing applications.

A high-impedance input with a 0.5V threshold allows an external resistive divider to set the monitored threshold. The output asserts (OUT = high or $\overline{\text{OUT}}$ = low) when the input voltage rises above the 0.5V threshold and the enable input is asserted (ENABLE = high or $\overline{\text{ENABLE}}$ = low). When the voltage at the input falls below 0.5V or when the enable input is deasserted (ENABLE = low or $\overline{\text{ENABLE}}$ = high), the output deasserts (OUT = low or $\overline{\text{OUT}}$ = high). All devices provide a capacitor-programmable delay time from when the input rises above 0.5V to when the output is asserted. The MAX689_A versions provide the same capacitor-adjustable delay from when enable is asserted to when the output asserts. The MAX689_P devices have a 1 μ s propagation delay from when enable is asserted to when the output asserts.

The MAX6895A/P offers an active-high enable input and an active-high push-pull output. The MAX6896A/P offers an active-low enable input and an active-low push-pull output. The MAX6897A/P offers an active-high enable input and an active-high open-drain output. Finally, the MAX6898A/P offers an active-low enable input and an active-low open-drain output. The MAX6899A/P offers an active-low enable with an active-high push-pull output.

All devices operate from a 1.5V to 5.5V supply voltage and are fully specified over the -40°C to +125°C operating temperature range. These devices are available in ultra-small 6-pin μ DFN (1.0mm x 1.5mm) and thin SOT23 (1.60mm x 2.90mm) packages.

Applications

| | |
|-------------------------|-----------------------------|
| Automotive | Computers/Servers |
| Medical Equipment | Critical μ P Monitoring |
| Intelligent Instruments | Set-Top Boxes |
| Portable Equipment | Telecom |

Typical Operating Circuit and Selector Guide appear at end of data sheet.

Features

- ◆ 1.8% Accurate Adjustable Threshold Over Temperature
- ◆ Operate from VCC of 1.5V to 5.5V
- ◆ Capacitor-Adjustable Delay
- ◆ Active-High/Low Enable Input Options
- ◆ Active-High/Low Output Options
- ◆ Open-Drain (28V Tolerant)/Push-Pull Output Options
- ◆ Low Supply Current (10 μ A, typ)
- ◆ Fully Specified from -40°C to +125°C
- ◆ Ultra-Small 6-Pin μ DFN Package or Thin SOT23 Package

Ordering Information

| PART | PIN-PACKAGE | TOP MARK |
|---------------|--------------|----------|
| MAX6895AALT+ | 6 μ DFN | +AW |
| MAX6895AAZT+ | 6 Thin SOT23 | +AADK |
| MAX6895PALT+T | 6 μ DFN | +AX |
| MAX6895PAZT+ | 6 Thin SOT23 | +AADL |
| MAX6896AALT+ | 6 μ DFN | +AY |
| MAX6896AAZT+ | 6 Thin SOT23 | +AADO |
| MAX6896PALT+T | 6 μ DFN | +AZ |
| MAX6896PAZT+ | 6 Thin SOT23 | +AADP |

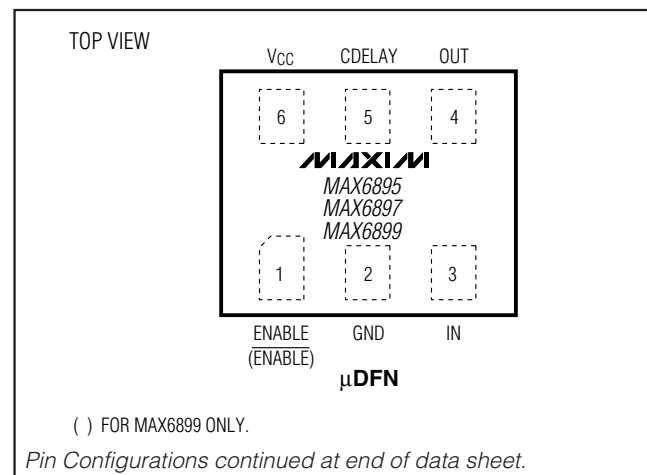
Ordering Information continued at end of data sheet.

Note: All devices are specified over the -40°C to +125°C operating temperature range.

+ Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

Pin Configurations



MAX6895–MAX6899

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ABSOLUTE MAXIMUM RATINGS

| | |
|---|------------------------------|
| V_{CC} , \overline{ENABLE} , \overline{IN} | -0.3V to +6V |
| OUT, \overline{OUT} (push-pull) | -0.3V to ($V_{CC} + 0.3V$) |
| OUT, \overline{OUT} (open-drain)..... | -0.3V to +30V |
| CDELAY..... | -0.3V to ($V_{CC} + 0.3V$) |
| Output Current (all pins)..... | $\pm 20mA$ |
| Continuous Power Dissipation ($T_A = +70^\circ C$) | |
| 6-Pin μ DFN (derate 2.1mW/ $^\circ C$ above +70 $^\circ C$)..... | 167.7mW |
| 6-Pin Thin SOT23 (derate 9.1mW/ $^\circ C$ above +70 $^\circ C$) | 727.3mW |

| | |
|---|-----------------------------------|
| Package Junction-to-Ambient Thermal Resistance (θ_{JA}) (Note 1) | |
| 6-Pin μ DFN..... | 477 $^\circ C/W$ |
| 6-Pin Thin SOT23 | 110 $^\circ C/W$ |
| Package Junction-to-Case Thermal Resistance (θ_{JC}) (Note 1) | |
| 6-Pin Thin SOT23 | 50 $^\circ C/W$ |
| Operating Temperature Range | -40 $^\circ C$ to +125 $^\circ C$ |
| Storage Temperature Range | -65 $^\circ C$ to +150 $^\circ C$ |
| Junction Temperature | +150 $^\circ C$ |
| Lead Temperature (soldering, 10s) | +300 $^\circ C$ |
| Soldering Temperature (reflow) | +260 $^\circ C$ |

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four layer board. For detailed information on package thermal considerations refer to www.maxim-ic.com/thermal-tutorial.

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

($V_{CC} = 1.5V$ to $5.5V$, $T_A = -40^\circ C$ to $+125^\circ C$, unless otherwise specified. Typical values are at $V_{CC} = 3.3V$ and $T_A = +25^\circ C$, unless otherwise noted.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--------------|---|-------|------|-------|----------|
| SUPPLY | | | | | | |
| Operating Voltage Range | V_{CC} | | 1.5 | | 5.5 | V |
| Undervoltage Lockout (Note 3) | UVLO | V_{CC} falling | 1.20 | | 1.35 | V |
| V_{CC} Supply Current | I_{CC} | $V_{CC} = 3.3V$, no load | | 10 | 20 | μA |
| IN | | | | | | |
| Threshold Voltage | V_{TH} | V_{IN} rising, $1.5V < V_{CC} < 5.5V$ | 0.491 | 0.5 | 0.509 | V |
| Hysteresis | V_{HYST} | V_{IN} falling | | 5 | | mV |
| Input Current (Note 4) | I_{IN} | $V_{IN} = 0V$ or V_{CC} | -15 | | +15 | nA |
| CDELAY | | | | | | |
| Delay Charge Current | I_{CD} | | 200 | 250 | 300 | nA |
| Delay Threshold | V_{TCD} | CDELAY rising | 0.95 | 1.00 | 1.05 | V |
| CDELAY Pulldown Resistance | R_{CDELAY} | | | 130 | 500 | Ω |
| ENABLE/\overline{ENABLE} | | | | | | |
| Input Low Voltage | V_{IL} | | | | 0.4 | V |
| Input High Voltage | V_{IH} | | 1.4 | | | V |
| Input Leakage Current | I_{LEAK} | ENABLE, $\overline{ENABLE} = V_{CC}$ or GND | -100 | | +100 | nA |

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ELECTRICAL CHARACTERISTICS (continued)

($V_{CC} = 1.5V$ to $5.5V$, $T_A = -40^{\circ}C$ to $+125^{\circ}C$, unless otherwise specified. Typical values are at $V_{CC} = 3.3V$ and $T_A = +25^{\circ}C$, unless otherwise noted.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|-------------|---|--------------------------|-----|-----|---------|
| OUT/OUT | | | | | | |
| Output Low Voltage (Open-Drain or Push-Pull) | V_{OL} | $V_{CC} \geq 1.2V$, $I_{SINK} = 90\mu A$, MAX6895/MAX6897/MAX6899 only | | | 0.3 | V |
| | | $V_{CC} \geq 2.25V$, $I_{SINK} = 0.5mA$ | | | 0.3 | |
| | | $V_{CC} \geq 4.5V$, $I_{SINK} = 1mA$ | | | 0.4 | |
| Output High Voltage (Push-Pull) | V_{OH} | $V_{CC} \geq 2.25V$, $I_{SOURCE} = 500\mu A$ | $0.8 \times V_{CC}$ | | | V |
| | | $V_{CC} \geq 4.5V$, $I_{SOURCE} = 800\mu A$ | $0.8 \times V_{CC}$ | | | |
| Output Open-Drain Leakage Current | I_{LKG} | Output high impedance, $V_{OUT} = 28V$ | | | 1 | μA |
| TIMING | | | | | | |
| IN to OUT/OUT Propagation Delay | t_{DELAY} | V_{IN} rising | $C_{DELAY} = 0\mu F$ | 40 | | μs |
| | | | $C_{DELAY} = 0.047\mu F$ | 190 | | ms |
| | t_{DL} | V_{IN} falling | | 16 | | μs |
| Startup Delay (Note 5) | | | | 2 | | ms |
| ENABLE/ENABLE Minimum Input Pulse Width | t_{PW} | | 1 | | | μs |
| ENABLE/ENABLE Glitch Rejection | | | | 100 | | ns |
| ENABLE/ENABLE to OUT/OUT Delay | t_{OFF} | From device enabled to device disabled | | 150 | | ns |
| ENABLE/ENABLE to OUT/OUT Delay | t_{PROPP} | From device disabled to device enabled (P version) | | 150 | | ns |
| | | From device disabled to device enabled (A version) | $C_{DELAY} = 0\mu F$ | 20 | | μs |
| t_{PROPA} | | | $C_{DELAY} = 0.047\mu F$ | 190 | | ms |

Note 2: All devices are production tested at $T_A = +25^{\circ}C$. Limits over temperature are guaranteed by design.

Note 3: When V_{CC} falls below the UVLO threshold, the outputs will deassert (OUT goes low, \overline{OUT} goes high). When V_{CC} falls below 1.2V, the out cannot be determined.

Note 4: Guaranteed by design.

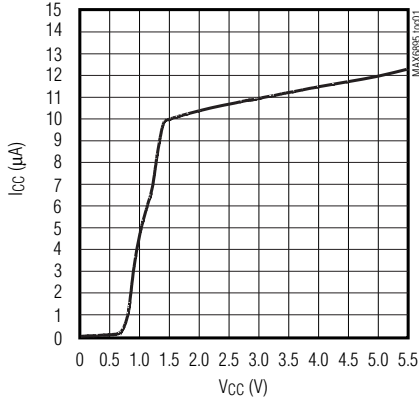
Note 5: During the initial power-up, V_{CC} must exceed 1.5V for at least 2ms before the output is guaranteed to be in the correct state.

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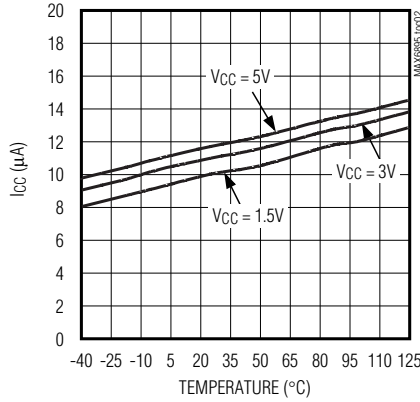
Typical Operating Characteristics

($V_{CC} = 3.3V$ and $T_A = +25^\circ C$, unless otherwise noted.)

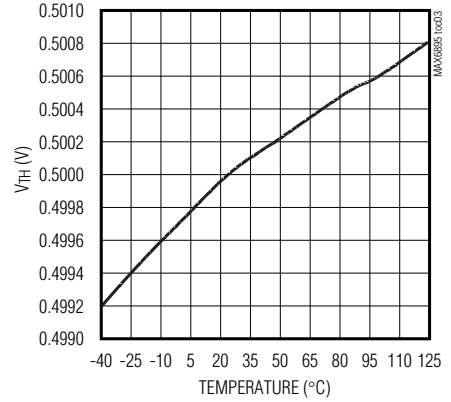
SUPPLY CURRENT vs. SUPPLY VOLTAGE



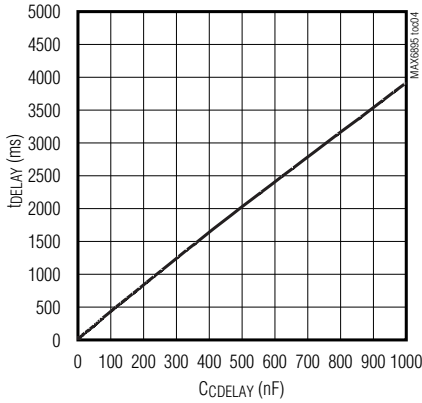
SUPPLY CURRENT vs. TEMPERATURE



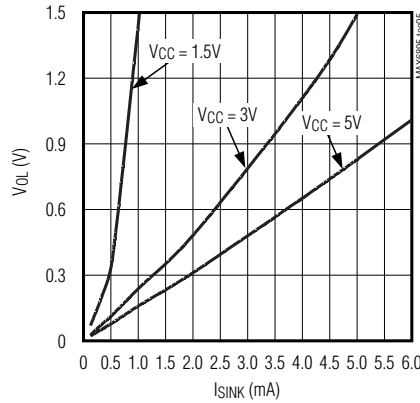
IN THRESHOLD vs. TEMPERATURE



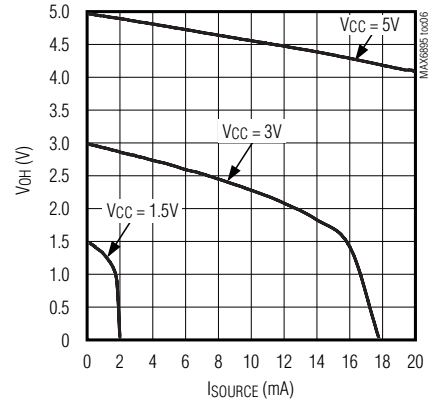
OUT DELAY vs. CCDELAY



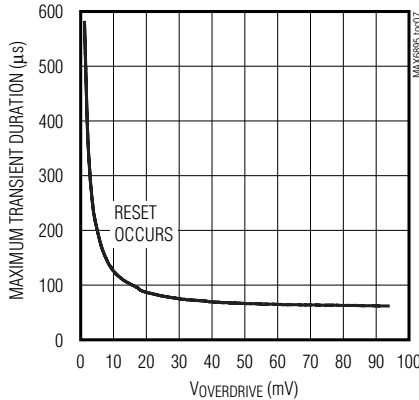
OUTPUT LOW VOLTAGE vs. SINK CURRENT



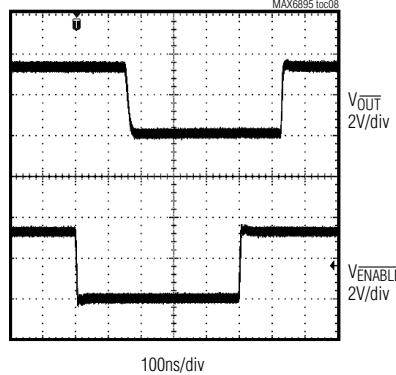
OUTPUT HIGH VOLTAGE vs. SOURCE CURRENT



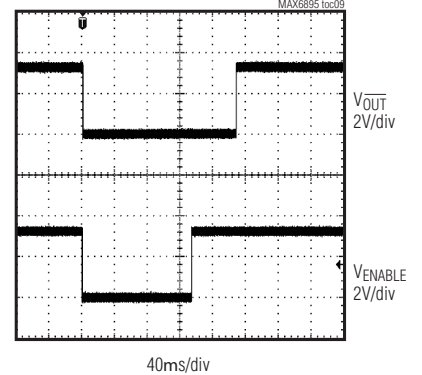
MAXIMUM TRANSIENT DURATION vs. INPUT OVERDRIVE



ENABLE TURN-ON/OFF (MAX6896P)



ENABLE TURN-ON/OFF DELAY (MAX6895A)



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Pin Description

MAX6895-MAX6899

| PIN | | | | | | NAME | FUNCTION |
|---------------------|---------------|---------------------|---------------|-----------|---------------|----------------------------|--|
| MAX6895/ MAX6897 | | MAX6896/ MAX6898 | | MAX6899 | | | |
| μ DFN | THIN SOT23 | μ DFN | THIN SOT23 | μ DFN | THIN SOT23 | | |
| 1 | 1 | — | — | — | — | ENABLE | Active-High Logic-Enable Input. Drive ENABLE low to immediately deassert the output to its false state (OUT = low or $\overline{\text{OUT}}$ = high) independent of V_{IN} . With V_{IN} above V_{TH} , drive ENABLE high to assert the output to its true state (OUT = high or $\overline{\text{OUT}}$ = low) after the adjustable delay period (MAX689_A) or a 150ns propagation delay (MAX689_P). |
| — | — | 1 | 1 | 1 | 1 | $\overline{\text{ENABLE}}$ | Active-Low Logic-Enable Input. Drive $\overline{\text{ENABLE}}$ high to immediately deassert the output to its false state (OUT = low or $\overline{\text{OUT}}$ = high) independent of V_{IN} . With V_{IN} above V_{TH} , drive $\overline{\text{ENABLE}}$ low to assert the output to its true state (OUT = high or $\overline{\text{OUT}}$ = low) after the adjustable delay period (MAX689_A) or a 150ns propagation delay (MAX689_P). |
| 2 | 2 | 2 | 2 | 2 | 2 | GND | Ground |
| 3 | 3 | 3 | 3 | 3 | 3 | IN | High-Impedance Monitor Input. Connect IN to an external resistive divider to set the desired monitored threshold. The output changes state when V_{IN} rises above 0.5V and when V_{IN} falls below 0.495V. |
| 4 | 4 | — | — | 4 | 4 | OUT | Active-High Sequencer/Monitor Output, Push-Pull (MAX6895/MAX6899) or Open-Drain (MAX6897). OUT is asserted to its true state (OUT = high) when V_{IN} is above V_{TH} and the enable input is in its true state (ENABLE = high or $\overline{\text{ENABLE}}$ = low) for the capacitor-adjusted delay period. OUT is deasserted to its false state (OUT = low) immediately after V_{IN} drops below $V_{\text{TH}} - 5\text{mV}$ or the enable input is in its false state (ENABLE = low or $\overline{\text{ENABLE}}$ = high). The open-drain version requires an external pullup resistor. |
| — | — | 4 | 4 | — | — | $\overline{\text{OUT}}$ | Active-Low Sequencer/Monitor Output, Push-Pull (MAX6896) or Open-Drain (MAX6898). OUT is asserted to its true state ($\overline{\text{OUT}}$ = low) when V_{IN} is above V_{TH} and the enable input is in its true state (ENABLE = high or $\overline{\text{ENABLE}}$ = low) after the CDELAY adjusted timeout period. OUT is deasserted to its false state ($\overline{\text{OUT}}$ = high) immediately after V_{IN} drops below $V_{\text{TH}} - 5\text{mV}$ or the enable input is in its false state (ENABLE = low or $\overline{\text{ENABLE}}$ = high). The open-drain version requires an external pullup resistor. |
| 5 | 6 | 5 | 6 | 5 | 6 | CDELAY | Capacitor-Adjustable Delay. Connect an external capacitor (C_{CDELAY}) from CDELAY to GND to set the IN to OUT (and ENABLE to OUT or $\overline{\text{ENABLE}}$ to OUT for A version devices) delay period. $t_{\text{DELAY}} = (C_{\text{CDELAY}} \times 4.0 \times 10^6) + 40\mu\text{s}$. There is a fixed short delay (40 μs , typ) for the output deasserting when V_{IN} falls below V_{TH} . |
| 6 | 5 | 6 | 5 | 6 | 5 | VCC | Supply Voltage Input. Connect a 1.5V to 5.5V supply to VCC to power the device. For noisy systems, bypass with a 0.1 μF ceramic capacitor to GND. |

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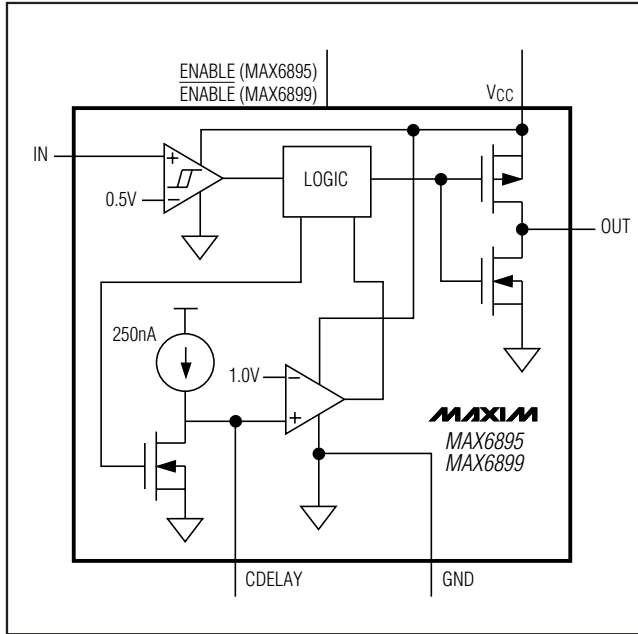


Figure 1. MAX6895/MAX6899 Functional Diagram

Detailed Description

The MAX6895–MAX6899 is a family of ultra-small, low-power, sequencing/supervisory circuits. These devices provide adjustable voltage monitoring for inputs down to 0.5V. They are ideal for use in power-supply sequencing, reset sequencing, and power-switching applications. Multiple devices can be cascaded for complex sequencing applications.

Voltage monitoring is performed through a high-impedance input (IN) with an internally fixed 0.5V threshold. When the voltage at IN falls below 0.5V or when the enable input is deasserted (ENABLE = low or $\overline{\text{ENABLE}}$ = high), the output deasserts (OUT goes low or $\overline{\text{OUT}}$ goes high). When V_{IN} rises above 0.5V and the enable input is asserted (ENABLE = high or $\overline{\text{ENABLE}}$ = low), the output asserts (OUT goes high or $\overline{\text{OUT}}$ goes low) after a capacitor-programmable time delay.

With V_{IN} above 0.5V, the enable input can be used to turn the output on or off. After the enable input is asserted, the output turns on with a capacitor-programmable delay period (A version) or with a 150ns propagation delay (P version). Tables 1, 2, and 3 detail the output state depending on the various input and enable conditions.

Table 1. MAX6895/MAX6897 Output

| IN | ENABLE | OUT |
|---------------------------------|--------|---------------------------------|
| $V_{\text{IN}} < V_{\text{TH}}$ | Low | Low |
| $V_{\text{IN}} < V_{\text{TH}}$ | High | Low |
| $V_{\text{IN}} > V_{\text{TH}}$ | Low | Low |
| $V_{\text{IN}} > V_{\text{TH}}$ | High | OUT = V_{CC} (MAX6895) |
| | | OUT = high impedance (MAX6897) |

Table 2. MAX6896/MAX6898 Output

| IN | ENABLE | $\overline{\text{OUT}}$ |
|---------------------------------|--------|---|
| $V_{\text{IN}} < V_{\text{TH}}$ | Low | $\overline{\text{OUT}} = V_{\text{CC}}$ (MAX6896) |
| | | $\overline{\text{OUT}} = \text{high impedance}$ (MAX6898) |
| $V_{\text{IN}} < V_{\text{TH}}$ | High | $\overline{\text{OUT}} = V_{\text{CC}}$ (MAX6896) |
| | | $\overline{\text{OUT}} = \text{high impedance}$ (MAX6898) |
| $V_{\text{IN}} > V_{\text{TH}}$ | Low | Low |
| $V_{\text{IN}} > V_{\text{TH}}$ | High | $\overline{\text{OUT}} = V_{\text{CC}}$ (MAX6896) |
| | | $\overline{\text{OUT}} = \text{high impedance}$ (MAX6898) |

Table 3. MAX6899 Output

| IN | ENABLE | OUT |
|---------------------------------|--------|------|
| $V_{\text{IN}} < V_{\text{TH}}$ | Low | Low |
| $V_{\text{IN}} < V_{\text{TH}}$ | High | Low |
| $V_{\text{IN}} > V_{\text{TH}}$ | Low | High |
| $V_{\text{IN}} > V_{\text{TH}}$ | High | Low |

Supply Input (V_{CC})

The device operates with a V_{CC} supply voltage from 1.5V to 5.5V. To maintain a 1.8% accurate threshold, V_{CC} must be above 1.5V. When V_{CC} falls below the UVLO threshold, the output deasserts. When V_{CC} falls below 1.2V the output state cannot be determined. For noisy systems, connect a 0.1 μF ceramic capacitor from V_{CC} to GND as close to the device as possible. For the push-pull active-high output option, a 100k Ω external pulldown resistor to ground ensures the correct logic state for V_{CC} down to 0.

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Monitor Input (IN)

Connect the center point of a resistive divider to IN to monitor external voltages (see R1 and R2 of the *Typical Operating Circuit*). IN has a rising threshold of $V_{TH} = 0.5V$ and a falling threshold of $0.495V$ (5mV hysteresis). When V_{IN} rises above V_{TH} and ENABLE is high (or \overline{ENABLE} is low) OUT goes high (\overline{OUT} goes low) after the programmed t_{DELAY} period. When V_{IN} falls below $0.495V$, OUT goes low (\overline{OUT} goes high) after a $16\mu s$ delay. IN has a maximum input current of $15nA$ so large-value resistors are permitted without adding significant error to the resistive divider.

Adjustable Delay (CDELAY)

When V_{IN} rises above V_{TH} with ENABLE high (\overline{ENABLE} low), the internal $250nA$ current source begins charging an external capacitor connected from CDELAY to GND. When the voltage at CDELAY reaches $1V$, the output

asserts (OUT goes high or \overline{OUT} goes low). When the output asserts, C_{DELAY} is immediately discharged. Adjust the delay (t_{DELAY}) from when V_{IN} rises above V_{TH} (with ENABLE high or \overline{ENABLE} low) to OUT going high (OUT going low) according to the equation:

$$t_{DELAY} = C_{DELAY} \times 4.0 \times 10^6 + 40\mu s$$

where C_{DELAY} is the external capacitor from CDELAY to GND.

For adjustable delay devices (A version), when $V_{IN} > 0.5V$ and ENABLE goes from low to high (\overline{ENABLE} goes from high to low) the output asserts after a t_{DELAY} period. For nonadjustable delay devices (P version) there is a $1\mu s$ propagation delay from when the enable input is asserted to when the output asserts. Figures 2 through 5 show the timing diagrams for the adjustable and fixed delay versions, respectively.

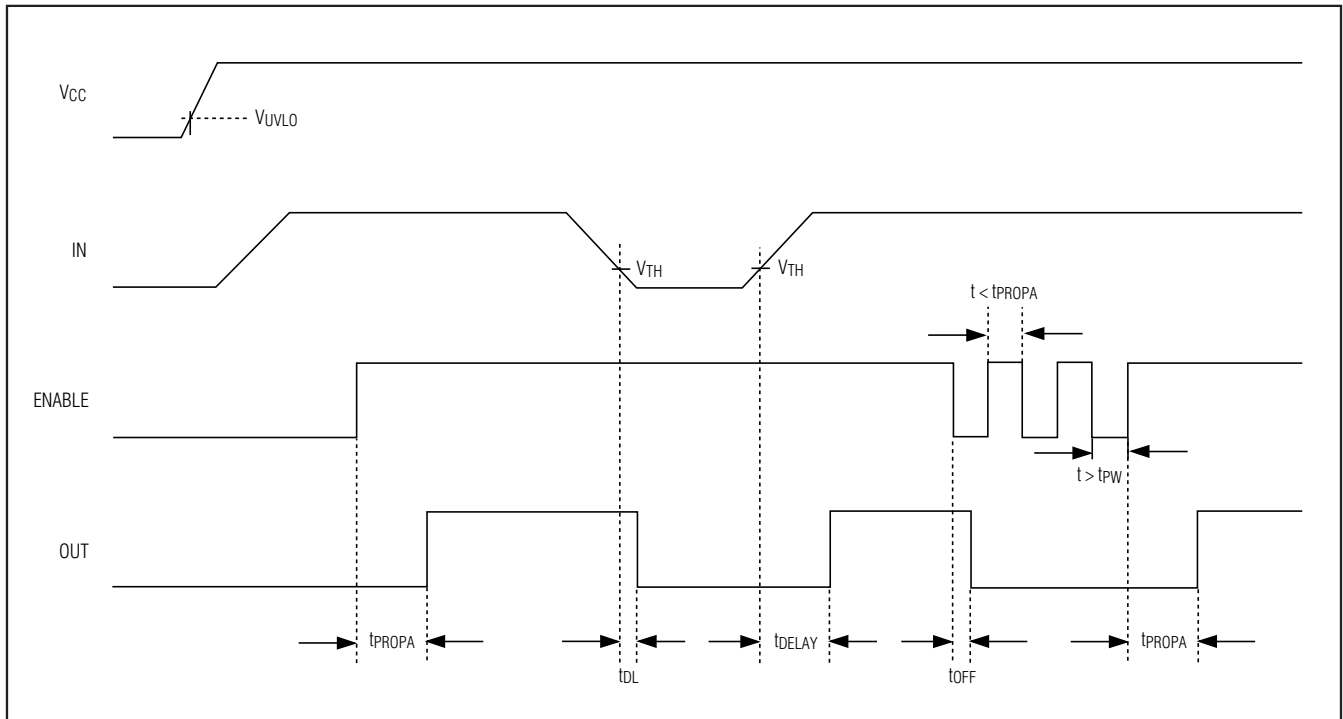


Figure 2. MAX6895A/MAX6897A Timing Diagram

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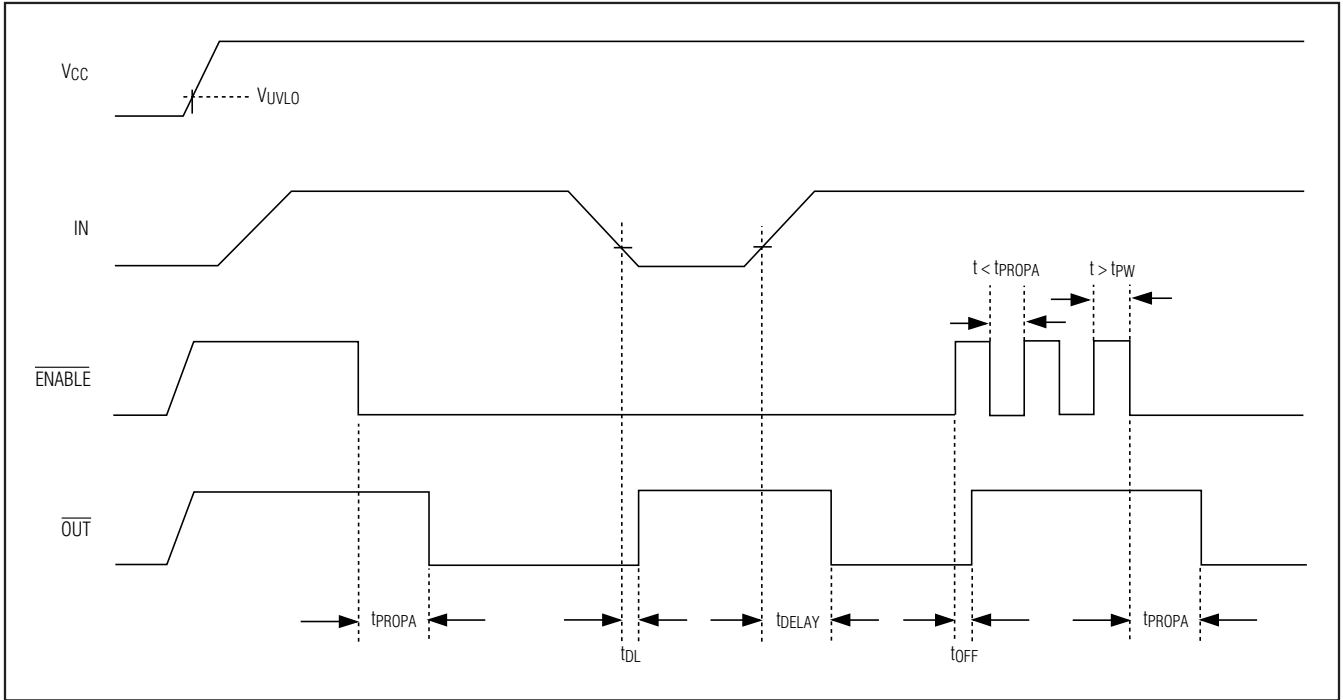


Figure 3. MAX6896A/MAX6898A Timing Diagram

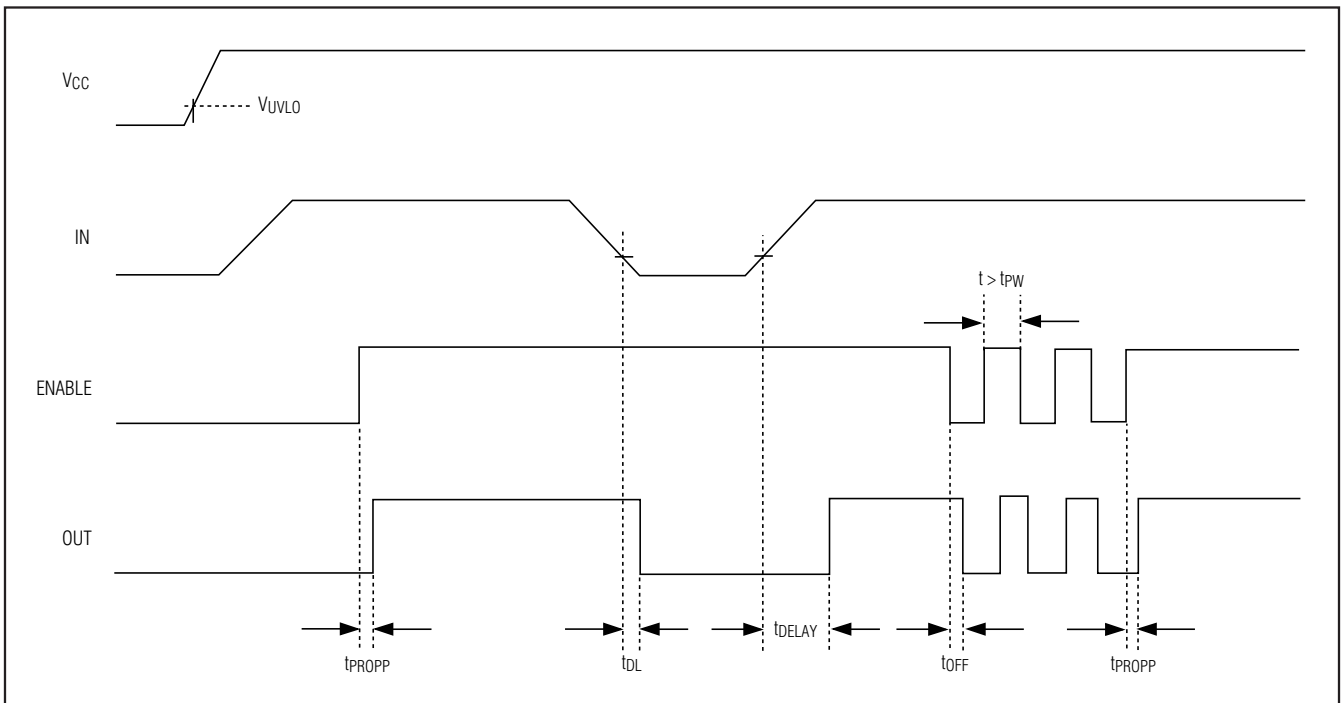


Figure 4. MAX6895P/MAX6897P Timing Diagram

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MAX6895-MAX6899

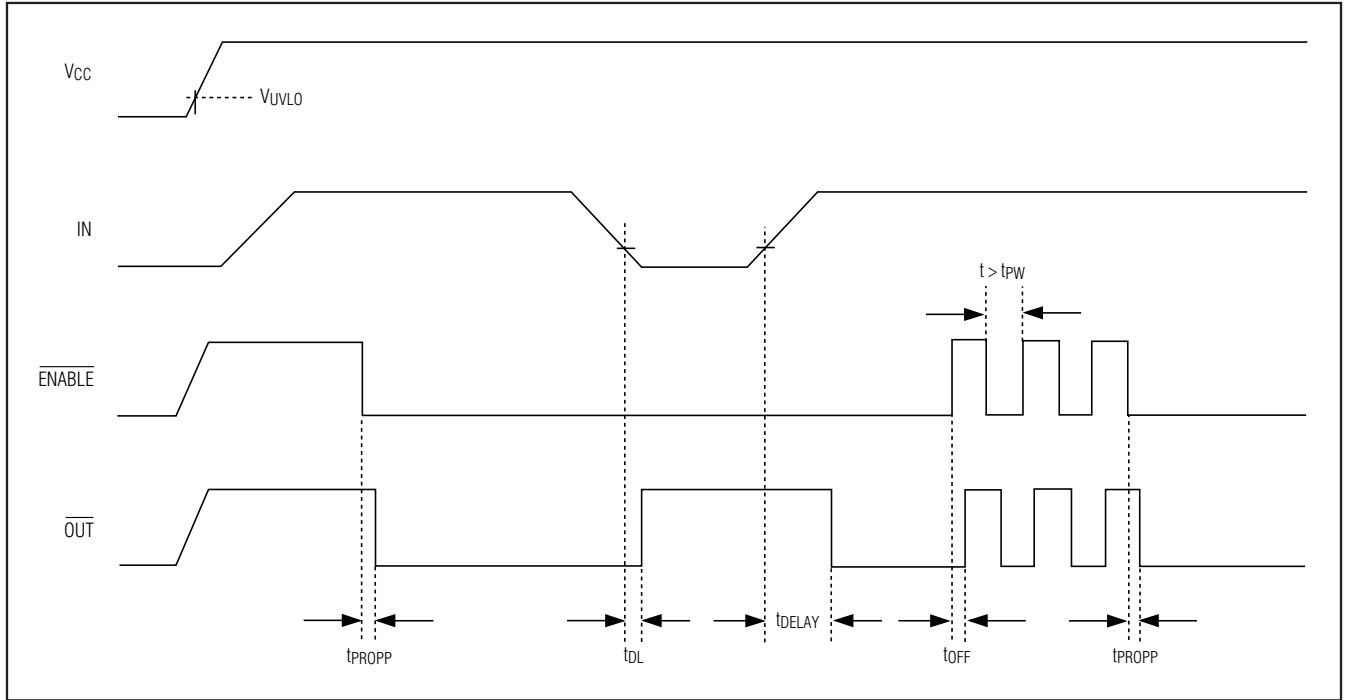


Figure 5. MAX6896P/MAX6898P Timing Diagram

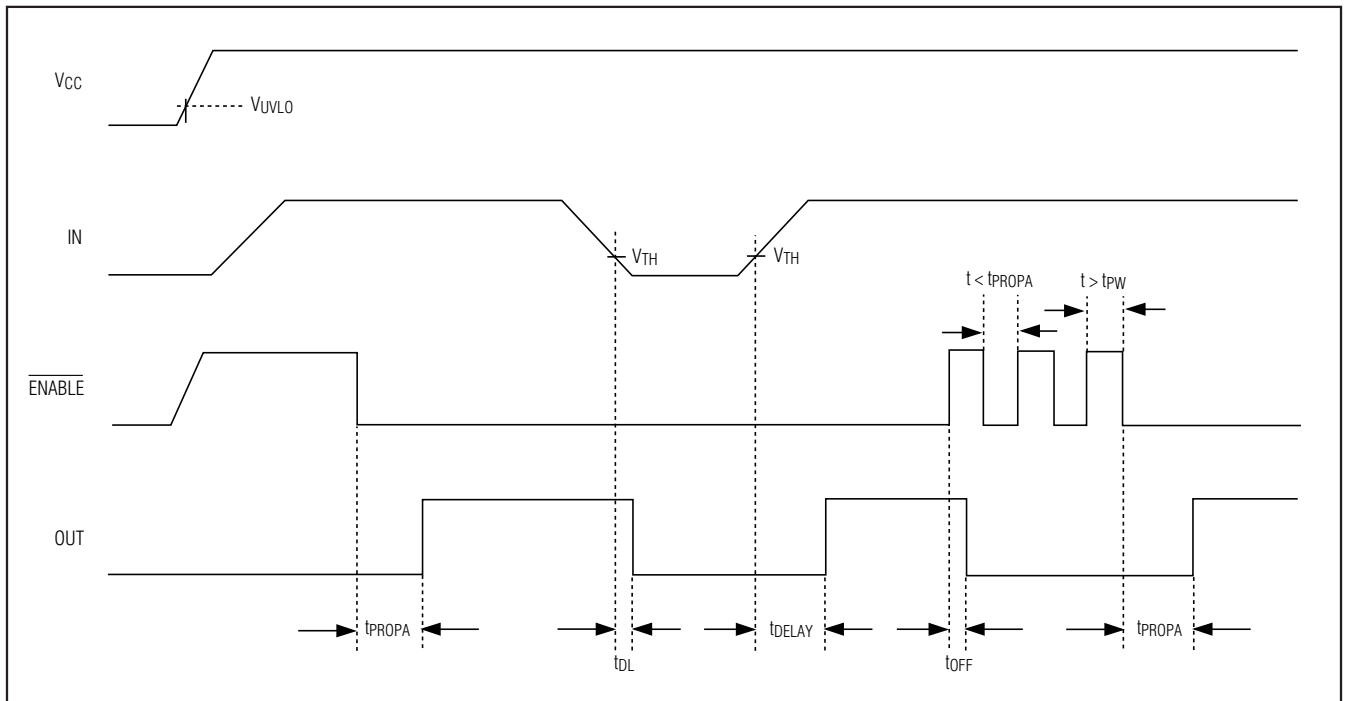


Figure 6. MAX6899A Timing Diagram

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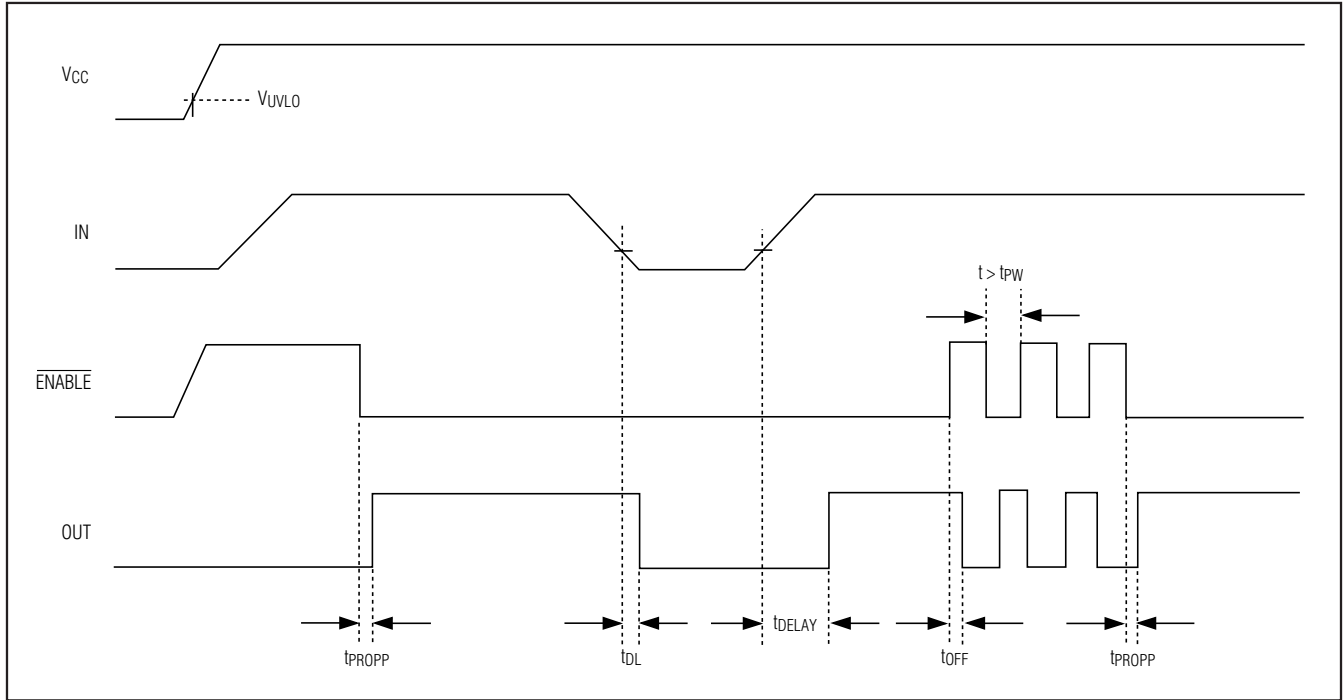


Figure 7. MAX6899P Timing Diagram

Enable Input (ENABLE or $\overline{\text{ENABLE}}$)

The MAX6895/MAX6897 offer an active-high enable input (ENABLE), while the MAX6896/MAX6898/MAX6899 offer an active-low enable input ($\overline{\text{ENABLE}}$). With V_{IN} above V_{TH} , drive ENABLE high ($\overline{\text{ENABLE}}$ low) to force OUT high ($\overline{\text{OUT}}$ low) after the adjustable delay time (A versions). For P version devices, when $V_{IN} > 0.5V$ and enable is asserted, the output asserts after typically 150ns.

The enable input has logic-high and logic-low voltage thresholds of 1.4V and 0.4V, respectively. For both versions, when $V_{IN} > 0.5V$, drive $\overline{\text{ENABLE}}$ low ($\overline{\text{ENABLE}}$ high) to force OUT low ($\overline{\text{OUT}}$ high) within 150ns typ.

Output (OUT or $\overline{\text{OUT}}$)

The MAX6895/MAX6899 offer an active-high, push-pull output (OUT), and the MAX6896 offers an active-low push-pull output ($\overline{\text{OUT}}$). The MAX6897 offers an active-high open-drain output (OUT), and the MAX6898 offers an active-low open-drain output ($\overline{\text{OUT}}$).

Push-pull output devices are referenced to V_{CC} . Open-drain outputs can be pulled up to 28V.

Applications Information

Input Threshold

The MAX6895–MAX6899 monitor the voltage on IN with an external resistive divider (see R1 and R2 in the *Typical Operating Circuit*). Connect R1 and R2 as close to IN as possible. R1 and R2 can have very high values to minimize current consumption due to low IN leakage currents ($\pm 15nA$ max). Set R2 to some conveniently high value ($1M\Omega$, for example) and calculate R1 based on the desired monitored voltage using the following formula:

$$R1 = R2 \times \left[\frac{V_{\text{MONITOR}}}{V_{IN}} - 1 \right]$$

where V_{MONITOR} is the desired monitored voltage and V_{IN} is the detector input threshold (0.5V).

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Pullup Resistor Values (MAX6897/MAX6898)

The exact value of the pullup resistors for the open-drain outputs is not critical, but some consideration should be made to ensure the proper logic levels when the device is sinking current. For example, if $V_{CC} = 2.25V$ and the pullup voltage is 28V, you would try to keep the sink current less than 0.5mA as shown in the *Electrical Characteristics* table. As a result, the pullup resistor should be greater than 56k Ω . For a 12V pullup, the resistor should be larger than 24k Ω . It should be noted that the ability to sink current is dependent on the V_{CC} supply voltage.

Typical Application Circuits

Figures 8, 9, 10 show typical applications for the MAX6895–MAX6899. Figure 8 shows the MAX6895

used with a p-channel MOSFET in an overvoltage protection circuit. Figure 9 shows the MAX6895 in a low-voltage sequencing application using an n-channel MOSFET. Figure 10 shows the MAX6895 used in a multiple-output sequencing application.

Using an n-Channel Device for Sequencing

In higher power applications, using an n-channel device reduces the loss across the MOSFETs as it offers a lower drain-to-source on-resistance. However, an n-channel MOSFET requires a sufficient V_{GS} voltage to fully enhance it for a low R_{DS_ON} . The application in Figure 9 shows the MAX6895 in a switch sequencing application using an n-channel MOSFET.

Similarly, if a higher voltage is present in the system, the open-drain version can be used in the same manner.

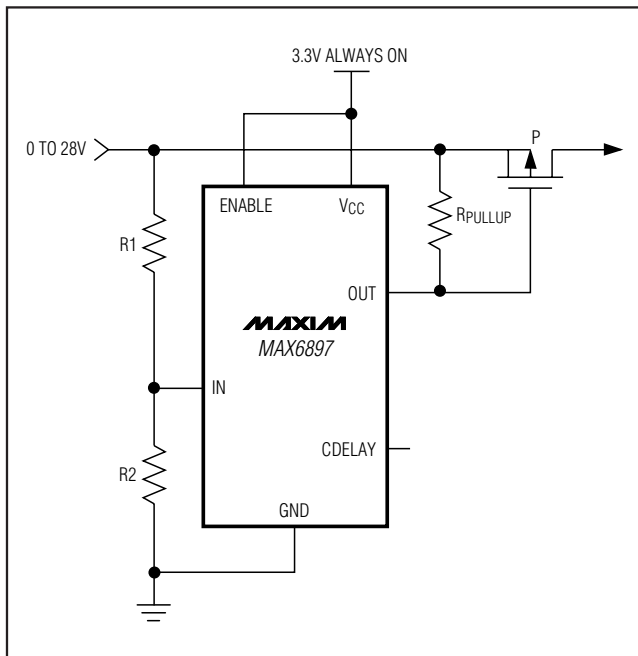


Figure 8. Overvoltage Protection

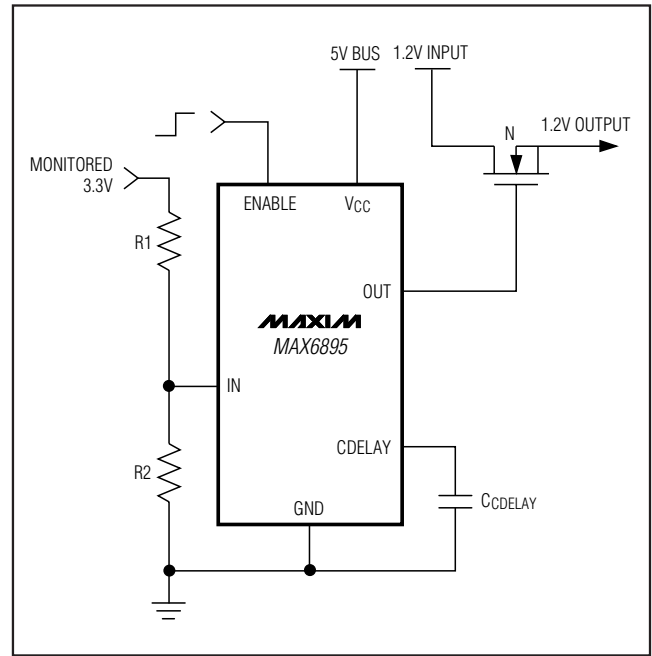


Figure 9. Low-Voltage Sequencing Using an n-Channel MOSFET

Ultra-Small, Adjustable Sequencing/Supervisory Circuits

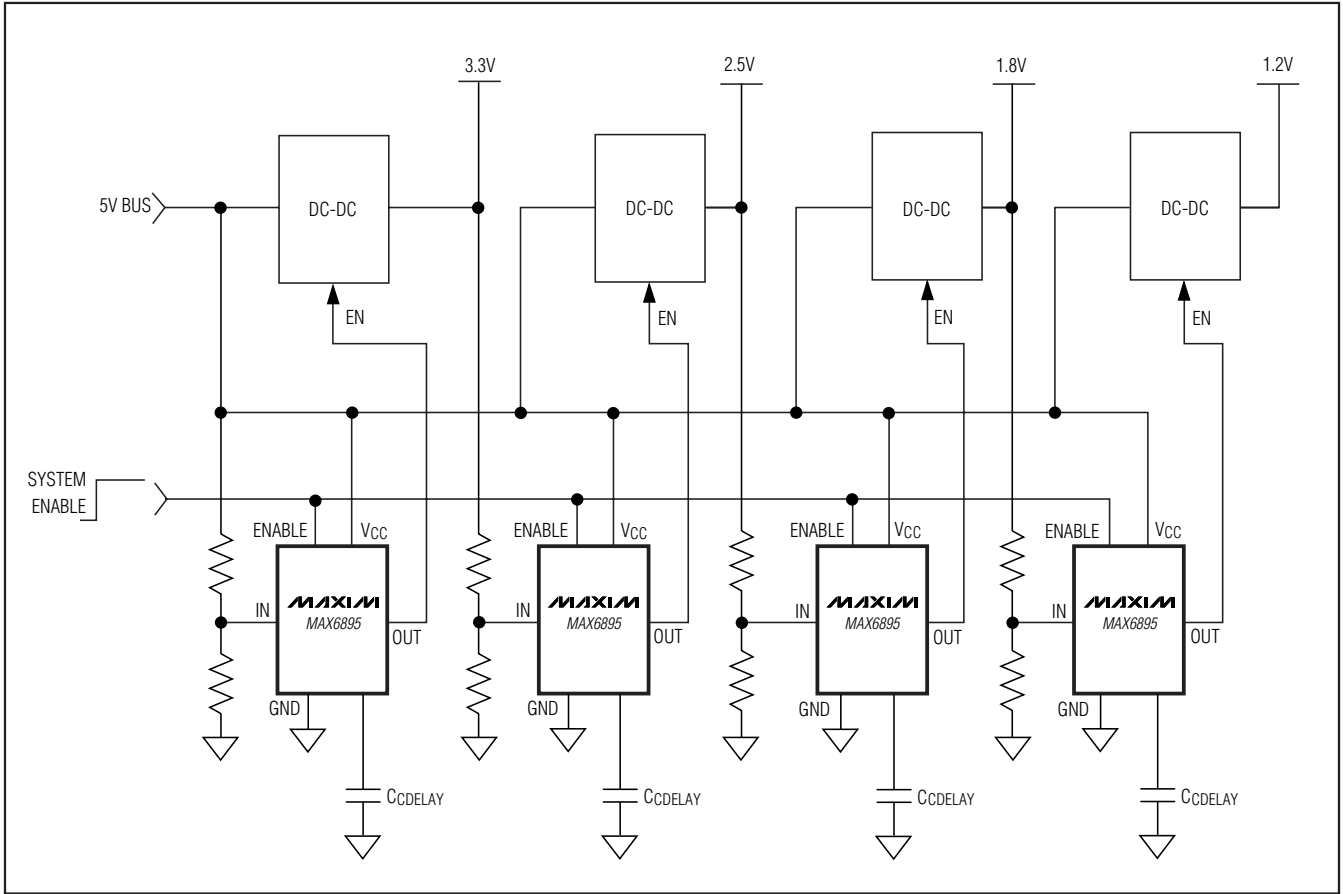


Figure 10. Multiple-Output Sequencing

Ultra-Small, Adjustable Sequencing/Supervisory Circuits

Selector Guide

MAX6895-MAX6899

| PART | ENABLE INPUT | OUTPUT | INPUT (IN) DELAY | ENABLE DELAY |
|---------------|--------------|-------------------------|----------------------|----------------------|
| MAX6895AALT+T | Active-High | Active-High, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6895AAZT+T | Active-High | Active-High, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6895PALT+T | Active-High | Active-High, Push-Pull | Capacitor Adjustable | 150ns Delay |
| MAX6895PAZT+T | Active-High | Active-High, Push-Pull | Capacitor Adjustable | 150ns Delay |
| MAX6896AALT+T | Active-Low | Active-Low, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6896AAZT+T | Active-Low | Active-Low, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6896PALT+T | Active-Low | Active-Low, Push-Pull | Capacitor Adjustable | 150ns Delay |
| MAX6896PAZT+T | Active-Low | Active-Low, Push-Pull | Capacitor Adjustable | 150ns Delay |
| MAX6897AALT+T | Active-High | Active-High, Open-Drain | Capacitor Adjustable | Capacitor Adjustable |
| MAX6897AAZT+T | Active-High | Active-High, Open-Drain | Capacitor Adjustable | Capacitor Adjustable |
| MAX6897PALT+T | Active-High | Active-High, Open-Drain | Capacitor Adjustable | 150ns Delay |
| MAX6897PAZT+T | Active-High | Active-High, Open-Drain | Capacitor Adjustable | 150ns Delay |
| MAX6898AALT+T | Active-Low | Active-Low, Open-Drain | Capacitor Adjustable | Capacitor Adjustable |
| MAX6898AAZT+T | Active-Low | Active-Low, Open-Drain | Capacitor Adjustable | Capacitor Adjustable |
| MAX6898PALT+T | Active-Low | Active-Low, Open-Drain | Capacitor Adjustable | 150ns Delay |
| MAX6898PAZT+T | Active-Low | Active-Low, Open-Drain | Capacitor Adjustable | 150ns Delay |
| MAX6899AALT+T | Active-Low | Active-High, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6899AAZT+T | Active-Low | Active-High, Push-Pull | Capacitor Adjustable | Capacitor Adjustable |
| MAX6899PALT+T | Active-Low | Active-High, Push-Pull | Capacitor Adjustable | 150ns Delay |
| MAX6899PAZT+T | Active-Low | Active-High, Push-Pull | Capacitor Adjustable | 150ns Delay |

Ordering Information (continued)

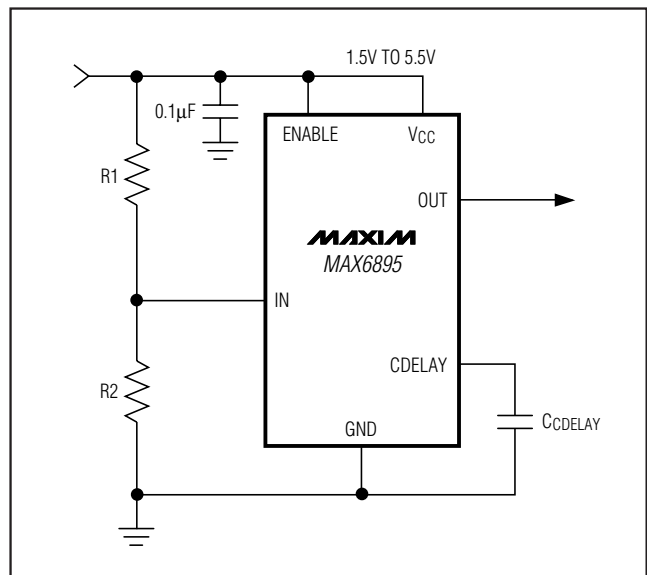
| PART | PIN-PACKAGE | TOP MARK |
|---------------|--------------|----------|
| MAX6897AALT+ | 6 μ DFN | +BA |
| MAX6897AAZT+ | 6 Thin SOT23 | +AADQ |
| MAX6897PALT+T | 6 μ DFN | +BB |
| MAX6897PAZT+ | 6 Thin SOT23 | +AADR |
| MAX6898AALT+ | 6 μ DFN | +BD |
| MAX6898AAZT+ | 6 Thin SOT23 | +AADS |
| MAX6898PALT+T | 6 μ DFN | +BC |
| MAX6898PAZT+ | 6 Thin SOT23 | +AADT |
| MAX6899AALT+ | 6 μ DFN | +LO |
| MAX6899AAZT+ | 6 Thin SOT23 | +AADM |
| MAX6899PALT+T | 6 μ DFN | +LP |
| MAX6899PAZT+ | 6 Thin SOT23 | +AADN |

Note: All devices are specified over the -40°C to $+125^{\circ}\text{C}$ operating temperature range.

+ Denotes a lead(Pb)-free/RoHS-compliant package.

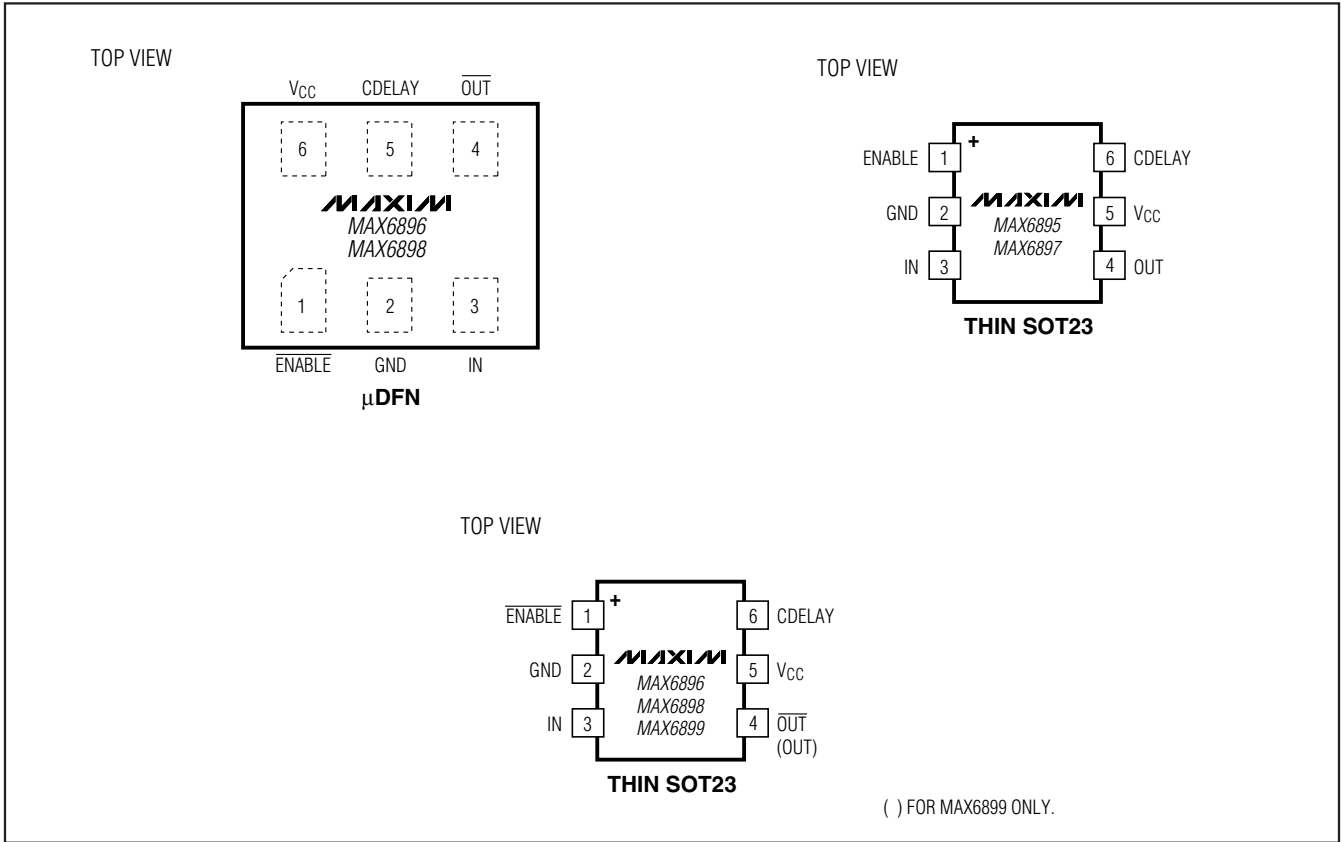
T = Tape and reel.

Typical Operating Circuit



Ultra-Small, Adjustable Sequencing/Supervisory Circuits

Pin Configurations (continued)



Chip Information

PROCESS: BICMOS

Package Information

For the latest package outline information and land patterns, go to www.maxim-ic.com/packages. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO. | LAND PATTERN NO. |
|--------------|--------------|-------------------------|-------------------------|
| 6 μ DFN | L611+1 | 21-0147 | 90-0080 |
| 6 Thin SOT23 | Z6+1 | 21-0114 | 90-0242 |

Ultra-Small, Adjustable Sequencing/Supervisory Circuits

Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|-----------------|---------------|---|---------------|
| 5 | 10/07 | — | 1, 13, 18 |
| 6 | 11/09 | Corrected <i>Absolute Maximum Ratings</i> and made style corrections to <i>Electrical Characteristics</i> and TOC8 and TOC9 | 2-5 |
| 7 | 7/10 | Revised Figures 3, 4, and 6. | 7-9 |

MAX6895-MAX6899

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