



**THE DATASHEET OF  
AP1703FWG-7**



**Features**

- Precision Monitoring of +2.5V, +3V, +3.3V, and +5V Power-Supply Voltages
- Fully Specified Over Temperature
- Available in three Output Configurations
- Push-Pull **RESET** Low Output (AP1701/3)
- Push-Pull **RESET** High Output (AP1702/4)
- 200ms Min. Power-On Reset Pulse Width
- 20µA Supply Current (Typ.)
- Guaranteed Reset Valid to  $V_{CC} = +1V$
- Power Supply Transient Immunity
- No External Components
- Green Packages: SC59-3L and SOT23
- Lead Free Finish / RoHS Compliant (Note 1)

**General Description**

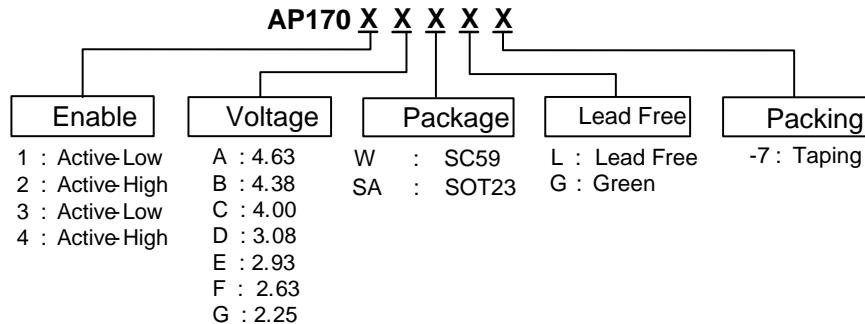
The AP1701/2/3/4 are used for microprocessor ( $\mu P$ ) supervisory circuits to monitor the power supplies in  $\mu P$  and digital systems. They provide excellent circuit reliability and low cost by eliminating external components and adjustments when used with +5V, +3.3V, +3.0V powered circuits.

These circuits perform a single function: they assert a reset signal whenever the  $V_{CC}$  supply voltage declines below a preset threshold, keeping it asserted for at least 240ms after  $V_{CC}$  has risen above the reset threshold. Reset thresholds suitable for operation with a variety of supply voltages are available. The AP1701/2/3/4 have push pull outputs. The AP1701/3 have an active low **RESET** output, while the AP1702/4 has an active high **RESET** output. The reset comparator is designed to ignore fast transients on  $V_{CC}$ , and the outputs are guaranteed to be in the correct logic state for  $V_{CC}$  down to 1V. Low supply current makes the AP1701/2/3/4 ideal for use in portable equipment. The AP1701/2/3/4 is available in a 3-pin SC59 package.

**Applications**

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

**Ordering Information**



Notes: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7*.

| Device    | Package Code | Packaging (Note 2) | 7" Tape and Reel |                    |
|-----------|--------------|--------------------|------------------|--------------------|
|           |              |                    | Quantity         | Part Number Suffix |
| AP170XXW  | W            | SC59               | 3000/Tape & Reel | -7                 |
| AP170XXSA | SA           | SOT23              | 3000/Tape & Reel | -7                 |

Notes: 2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

**Pin Assignments**



**Pin Descriptions**

| Name                              | Description  |
|-----------------------------------|--|
| GND                               | Ground   |
| $\overline{\text{RESET}}$ (RESET) | Reset Output Pin<br>L: for AP1701/3<br>H: for AP1702/4 |
| $V_{CC}$                          | Operating Voltage Input                                |

## Absolute Maximum Ratings

| Symbol      | Parameter   | Rating                     | Unit |
|-------------|---|----------------------------|------|
| $V_{CC}$    | Terminal Voltage (with respect to GND)  | -0.3 to +6.0               | V    |
| $V_{RESET}$ | RESET, $\overline{RESET}$ (push-pull)   | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| $I_{CC}$    | Input Current, $V_{CC}$   | 20                         | mA   |
| $I_O$       | Output Current, RESET, $\overline{RESET}$   | 20                         | mA   |
| $P_D$       | Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ ),<br>de-rate 4mW/°C above +70°C | 320                        | mW   |
| $T_{OP}$    | Operating Junction Temperature Range  | -40 to +105                | °C   |
| $T_{ST}$    | Storage Temperature Range   | -65 to +150                | °C   |

## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ )

| Symbol      | Parameter                                   | Conditions  | Min.           | Typ. | Max. | Unit          |
|-------------|---|---|----------------|------|------|---------------|
| $V_{CC}$    | $V_{CC}$ Range                              | $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$  | 1.0            |      | 5.5  | V             |
| $I_{CC}$    | Supply Current                              | $V_{TH} + 1.0\text{V}$  |                | 20   | 30   | $\mu\text{A}$ |
| $V_{TH}$    | Reset Threshold<br>$T_A = 25^\circ\text{C}$ | AP1701/2/3/4A   | 4.54           | 4.63 | 4.72 | V             |
|             |   | AP1701/2/3/4B   | 4.29           | 4.38 | 4.47 |               |
|             |   | AP1701/2/3/4C   | 3.92           | 4.00 | 4.08 |               |
|             |   | AP1701/2/3/4D   | 3.02           | 3.08 | 3.14 |               |
|             |   | AP1701/2/3/4E   | 2.87           | 2.93 | 2.99 |               |
|             |   | AP1701/2/3/4F   | 2.57           | 2.63 | 2.68 |               |
|             |   | AP1701/2/3/4G   | 2.20           | 2.25 | 2.30 |               |
|             | Reset Threshold<br>Tempco                   |   |                | 30   |      | ppm/<br>°C    |
| $T_S$       | Set-up Time                                 | $V_{CC} = 0$ to ( $V_{TH} - 100\text{mV}$ )   | 100            |      |      | $\mu\text{s}$ |
| $T_{DELAY}$ | Reset Active<br>Timeout Period              | $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$  | 100            | 240  | 600  | ms            |
| $V_{OL}$    | $\overline{RESET}$ Output<br>Voltage Low    | $V_{CC} = V_{TH} \text{ min}$ , $I_{SINK} = 1.2\text{mA}$ , AP1701/3                      |                |      | 0.3  | V             |
|             |   | $V_{CC} = V_{TH} \text{ min}$ , $I_{SINK} = 3.2\text{mA}$                                 |                |      | 0.4  |               |
|             |   | $V_{CC} > 1.0\text{V}$ , $I_{SINK} = 50\mu\text{A}$                                       |                |      | 0.3  |               |
| $V_{OH}$    | $\overline{RESET}$ Output<br>Voltage-High   | $V_{CC} > V_{TH} \text{ max}$ , $I_{SOURCE} = 500\mu\text{A}$ , AP1701/3                  | $0.8V_{CC}$    |      |      | V             |
|             |   | $V_{CC} > V_{TH} \text{ max}$ , $I_{SOURCE} = 800\mu\text{A}$                             | $V_{CC} - 1.5$ |      |      |               |
| $V_{OL}$    | RESET Output<br>Voltage-Low                 | $V_{CC} = V_{TH} \text{ max}$ , $I_{SINK} = 1.2\text{mA}$ , AP1702/4                      |                |      | 0.3  | V             |
|             |   | $V_{CC} = V_{TH} \text{ max}$ , $I_{SINK} = 3.2\text{mA}$                                 |                |      | 0.4  |               |
| $V_{OH}$    | RESET Output<br>Voltage-High                | $1.8\text{V} < V_{CC} < V_{TH} \text{ min}$ , $I_{SOURCE} = 150\mu\text{A}$ ,<br>AP1702/4 | $0.8 V_{CC}$   |      |      | V             |

## Typical Application Circuit



## Function Description

A microprocessor's ( $\mu$ P's) reset input starts the  $\mu$ P in a known state. The AP1701/2/3/4 assert reset to prevent code-execution errors during power-up, power-down, or brownout conditions. They assert a reset signal whenever the  $V_{CC}$  supply voltage declines below a preset threshold, keeping it asserted for at least 240ms after  $V_{CC}$  has risen above the reset threshold. The AP1701/2/3/4 have a push-pull output stage.

### Applications Information

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

In addition to issuing a reset to the  $\mu$ P during power-up, power-down, and brownout conditions, the AP1701/2/3/4 are relatively immune to short-duration negative-going  $V_{CC}$  transients (glitches).

The AP1701/2/3/4 do not generate a reset pulse. The graph was generated using a negative going pulse applied to  $V_{CC}$ , starting 0.5V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width a negative going  $V_{CC}$  transient can have without causing a reset pulse. As the magnitude of the transient increases (goes farther below the reset threshold), the maximum allowable pulse width decreases. Typically, a  $V_{CC}$  transient that goes 100mV below the reset threshold and lasts 100 $\mu$ s or less will not cause a reset pulse. A 0.1 $\mu$ F bypass capacitor mounted as close as possible to the  $V_{CC}$  pin provides additional transient immunity.

#### Ensuring a Valid Reset Output Down to $V_{CC} = 0$

$\overline{\text{RESET}}$  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; after this interval,  $\overline{\text{RESET}}$  goes high. If a brownout condition occurs ( $V_{CC}$  dips  $\overline{\text{RESET}}$

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 starts after  $V_{CC}$  returns above the reset threshold, and  $\overline{\text{RESET}}$  remains low for the reset timeout period.

When  $V_{CC}$  falls below 1V, the AP1701/3  $\overline{\text{RESET}}$  output no longer sinks current—it becomes an open circuit. Therefore, high-impedance CMOS logic inputs connected to  $\overline{\text{RESET}}$  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  $\overline{\text{RESET}}$  must be valid down to 0V, adding a pull down resistor to  $\overline{\text{RESET}}$  causes any stray leakage currents to flow to ground, holding  $\overline{\text{RESET}}$  low. R1's value is not critical; 100k are large enough not to load  $\overline{\text{RESET}}$  and small enough to pull  $\overline{\text{RESET}}$  to ground. For the AP1702/4 if  $\overline{\text{RESET}}$  is required to remain valid for  $V_{CC} < 1V$ .

#### Benefits of Highly Accurate Reset Threshold

Most  $\mu$ P supervisor ICs has reset threshold voltages between 5% and 10% below the value of nominal supply voltages. This ensures a reset will not occur within 5% of the nominal supply, but will occur when the supply is 10% below nominal. When using ICs rated at only the nominal supply  $\pm 5\%$ , this leaves a zone of uncertainty where the supply is between 5% and 10% low, and where the reset may or may not be asserted.

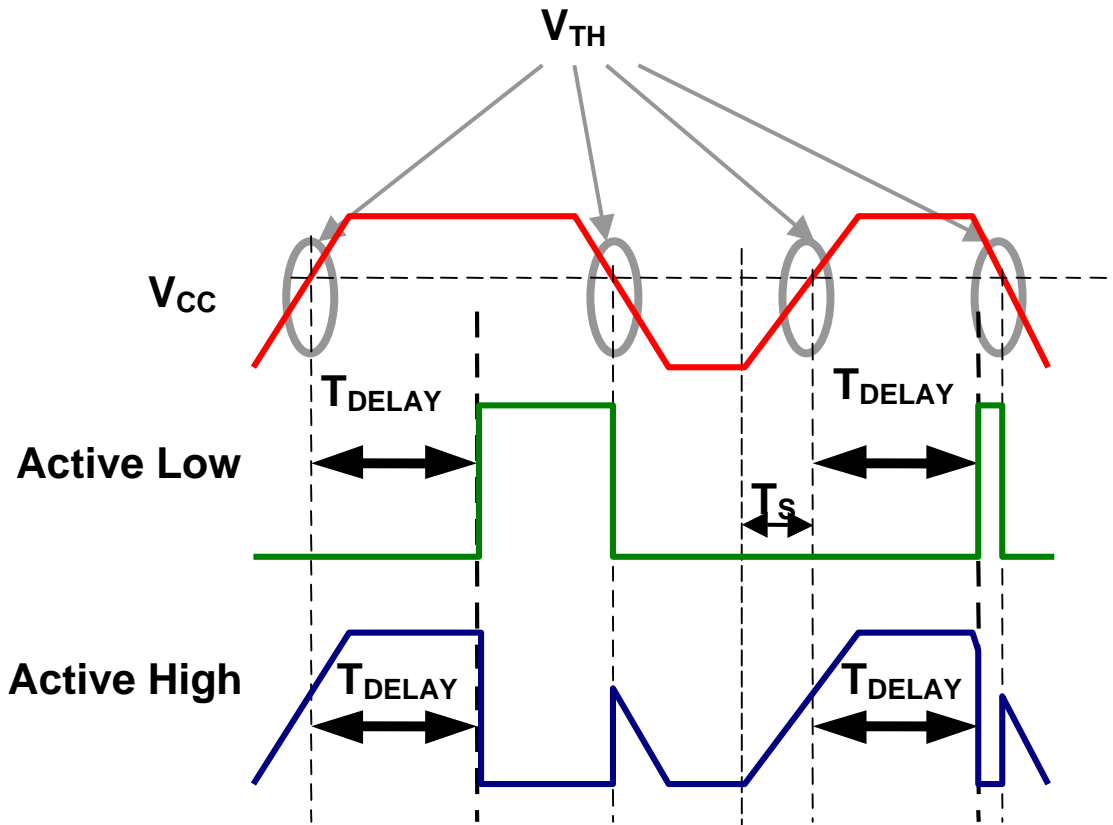
**Block Diagram**



**Performance Characteristics**

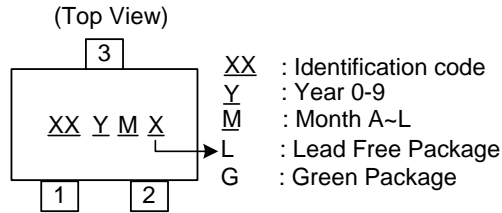


**Timing Diagram**



**Marking Information**

(1) SC59-3L



(2) SOT23





3-PIN MICROPROCESSOR RESET CIRCUITS

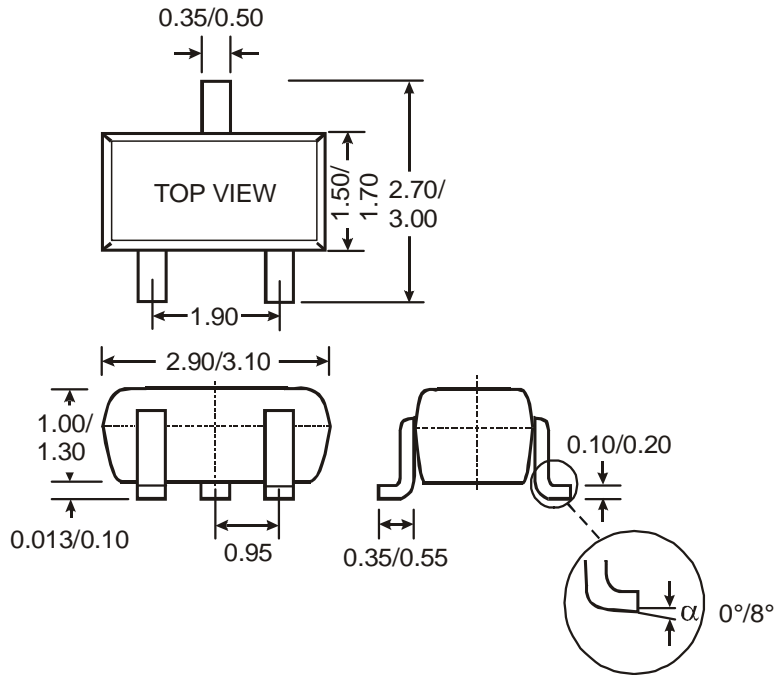
Marking Information (Continued)

| Device    | Package (Note 3) | Identification Code |
|-----------|------------------|---------------------|
| AP1701ASA | SOT23            |                     |
| AP1701BSA | SOT23            |                     |
| AP1701CSA | SOT23            |                     |
| AP1701DSA | SOT23            |                     |
| AP1701ESA | SOT23            |                     |
| AP1701FSA | SOT23            |                     |
| AP1701GSA | SOT23            |                     |
| AP1702ASA | SOT23            |                     |
| AP1702BSA | SOT23            |                     |
| AP1702CSA | SOT23            |                     |
| AP1702DSA | SOT23            |                     |
| AP1702ESA | SOT23            |                     |
| AP1702FSA | SOT23            |                     |
| AP1702GSA | SOT23            |                     |
| AP1703ASA | SOT23            |                     |
| AP1703BSA | SOT23            |                     |
| AP1703CSA | SOT23            |                     |
| AP1703DSA | SOT23            |                     |
| AP1703ESA | SOT23            |                     |
| AP1703FSA | SOT23            |                     |
| AP1703GSA | SOT23            |                     |
| AP1704ASA | SOT23            |                     |
| AP1704BSA | SOT23            |                     |
| AP1704CSA | SOT23            |                     |
| AP1704DSA | SOT23            |                     |
| AP1704ESA | SOT23            |                     |
| AP1704FSA | SOT23            |                     |
| AP1704GSA | SOT23            |                     |
| AP1701AW  | SC59             | EA                  |
| AP1701BW  | SC59             | EB                  |
| AP1701CW  | SC59             | EC                  |
| AP1701DW  | SC59             | ED                  |
| AP1701EW  | SC59             | EE                  |
| AP1701FW  | SC59             | EF                  |
| AP1701GW  | SC59             | W1                  |
| AP1702AW  | SC59             | E0                  |
| AP1702BW  | SC59             | E2                  |
| AP1702CW  | SC59             | E3                  |
| AP1702DW  | SC59             | E4                  |
| AP1702EW  | SC59             | E5                  |
| AP1702FW  | SC59             | E6                  |
| AP1702GW  | SC59             | W2                  |
| AP1703AW  | SC59             | EG                  |
| AP1703BW  | SC59             | EH                  |
| AP1703CW  | SC59             | EI                  |
| AP1703DW  | SC59             | EJ                  |
| AP1703EW  | SC59             | EK                  |
| AP1703FW  | SC59             | EL                  |
| AP1703GW  | SC59             | W3                  |
| AP1704AW  | SC59             | E7                  |
| AP1704BW  | SC59             | E8                  |
| AP1704CW  | SC59             | E9                  |
| AP1704DW  | SC59             | EM                  |
| AP1704EW  | SC59             | EN                  |
| AP1704FW  | SC59             | EP                  |
| AP1704GW  | SC59             | W4                  |

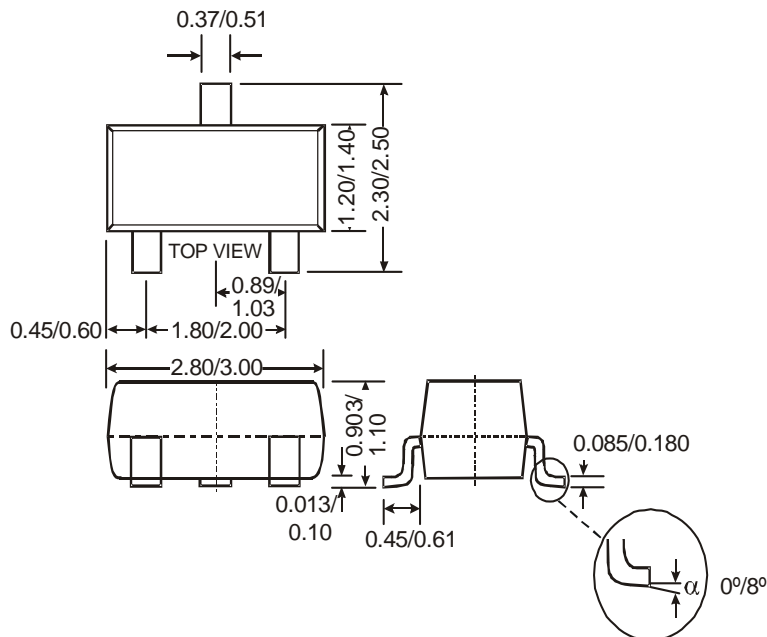
Notes: 3. For Packaging Details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

**Package Information** (All Dimensions in mm)

(1) Package Type: SC59-3L



(2) Package Type: SOT23



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