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# AS1904, AS1905, AS1906

## Ultra Low-Power $\mu$ P Supervisory Circuit

Data Sheet

**World's Lowest  
Power  
Consumption!**

## 1 General Description

The AS1904/5/6 family is an ultra low-power supervisory circuit device.

The device can be used to monitor the supply voltage of digital systems and microprocessors and initiate a reset when the voltage goes below a predefined threshold. The duration of the reset is 5/20/100/500ms (typ.) after the supply voltage has risen above the threshold.

The device exhibits excellent reliability and can reduce application costs by eliminating all external components.

The device is available with different output drivers:

- The AS1904 has a push-pull driver with an active low reset.
- The AS1905 uses the same output stage as the AS1904, but has an active high reset.
- The AS1906 has an open drain output with active low reset.

All devices operate down to a voltage of 1V.

The reset thresholds are factory-trimmable between 2.2V and 3.08V in steps of approximately 100mV.

Each device of the AS1904/5/6 family is offered with four time-out periods of 5/20/100/500ms.

The extremely low current consumption of only 150nA (typ) at 3.3V makes the device ideal for use in portable applications.

All devices are available in a 3-pin SOT23 package.

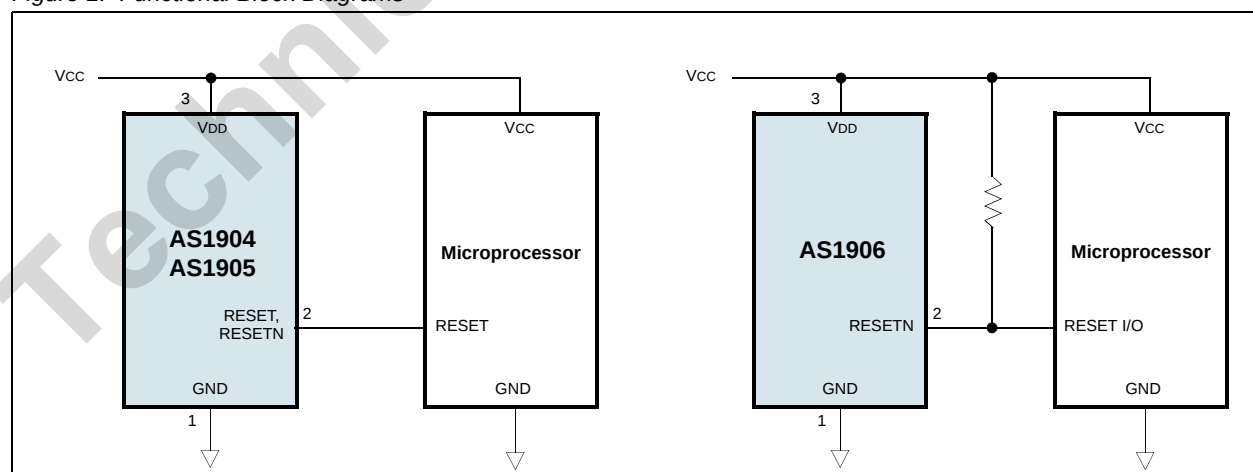
## 2 Key Features

- Low 150nA (typical) Supply Current
- Precision Monitoring of 2.5-, 3-, and 3.3V-Power Supplies
- Supply Voltage Range 1.0 to 3.6V
- Reset Threshold Available from 2.2 to 3.1V
- Available in three Versions
  - AS1904 Push-Pull RESETN
  - AS1905 Push-Pull RESET
  - AS1906 Open Drain RESETN
- 4 Time-Out Periods Ranging from 5 to 500ms
- Detection Voltage Accuracy:  $\pm 1.5\%$
- Temperature Range: -40 to +85°C
- SOT23-3 Package
- Superior Upgrade to austriamicrosystems AS1901/2/3 Device Family

## 3 Applications

The devices are ideal for computers, intelligent instruments, controllers, critical microprocessor and micro-controller, power monitoring and portable/battery-powered equipment.

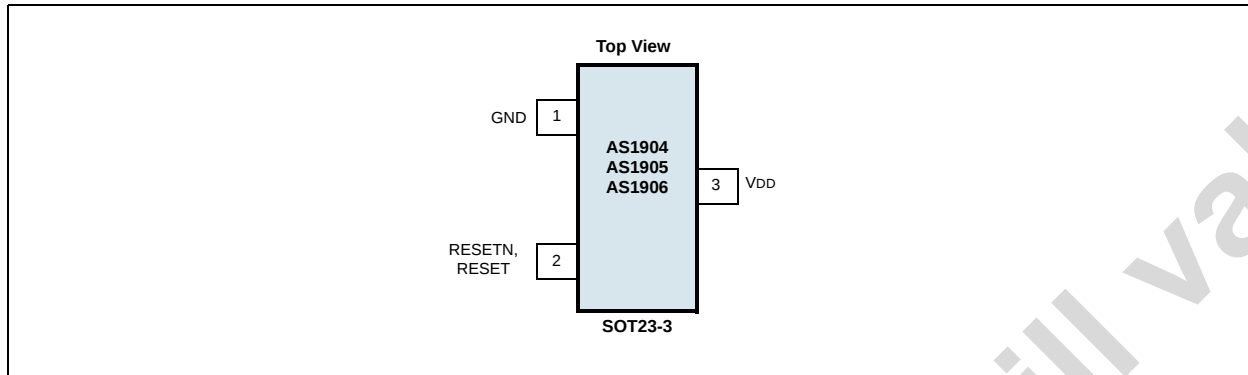
Figure 1. Functional Block Diagrams



## 4 Pinout

### Pin Assignments

Figure 2. Pin Assignments (Top View)



### Pin Descriptions

Table 1. Pin Descriptions

| Pin Number    |        | Pin Name        | Description                                                                                                                                                                                                                                   |
|---------------|--------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AS1904/AS1906 | AS1905 |                 |                                                                                                                                                                                                                                               |
| 1             | 1      | GND             | Ground                                                                                                                                                                                                                                        |
| 2             | -      | RESETN          | Active-low reset output. RESETN remains low while V <sub>DD</sub> is below the reset threshold and for t <sub>TP</sub> after V <sub>DD</sub> rises above the reset threshold. RESETN is open-drain on the AS1906 and push-pull on the AS1904. |
| -             | 2      | RESET           | Active-high reset output. RESET remains high while V <sub>DD</sub> is below the reset threshold and for t <sub>TP</sub> after V <sub>DD</sub> rises above the reset threshold.                                                                |
| 3             | 3      | V <sub>DD</sub> | Supply voltage.                                                                                                                                                                                                                               |

## 5 Absolute Maximum Ratings

Stresses beyond those listed in Table 2 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.

Table 2. Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$  Unless Otherwise Noted)

| Parameter                             | Limits                        | Units            | Notes                                                                                                                                                                                                         |
|---------------------------------------|-------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>DD</sub> to GND                | -0.3 to +5                    | V                |                                                                                                                                                                                                               |
| RESET/RESETN to GND                   | -0.3 to V <sub>DD</sub> + 0.3 | V                |                                                                                                                                                                                                               |
| Input Current (V <sub>DD</sub> )      | 20                            | mA               |                                                                                                                                                                                                               |
| Output Current (RESET, RESETN)        | 20                            | mA               |                                                                                                                                                                                                               |
| Rate of Rise (V <sub>DD</sub> )       | 100                           | V/ $\mu\text{s}$ |                                                                                                                                                                                                               |
| Operating Temperature Range ( $T_A$ ) | -40 to +85                    | $^\circ\text{C}$ |                                                                                                                                                                                                               |
| Storage Temperature Range             | -65 to +150                   | $^\circ\text{C}$ |                                                                                                                                                                                                               |
| Package-Body Peak Temperature         | +260                          | $^\circ\text{C}$ | The reflow peak soldering temperature (body temperature) specified is in accordance with IPC/JEDEC J-STD-020C "Moisture/Reflow Sensitivity Classification for non-hermetic Solid State Surface Mount Devices" |

## 6 Electrical Characteristics

$V_{DD}$  = Full Range;  $T_A$  =  $-40^\circ$  to  $+85^\circ\text{C}$ ; Unless Otherwise Specified

Table 3. Electrical Characteristics

| Parameter                                         | Symbol            | Conditions                                                            | Min                    | Typ             | Max                    | Unit |
|---------------------------------------------------|-------------------|-----------------------------------------------------------------------|------------------------|-----------------|------------------------|------|
| V <sub>DD</sub> Range                             | V <sub>DD</sub>   | $T_A = 0$ to $+70^\circ\text{C}$                                      | 1.0                    |                 | 3.6                    | V    |
|                                                   |                   | $T_A = -40$ to $+85^\circ\text{C}$                                    | 1.2                    |                 | 3.6                    | V    |
| Supply Current                                    | I <sub>DD</sub>   | V <sub>DD</sub> = 3.3V, No Load                                       |                        | 150             | 290                    | nA   |
| RESET Threshold Voltage <sup>1</sup>              | V <sub>TH</sub>   | $T_A = +25^\circ\text{C}$                                             | V <sub>TH</sub> - 1.5% | V <sub>TH</sub> | V <sub>TH</sub> + 1.5% | V    |
|                                                   |                   | $T_A = -40$ to $+85^\circ\text{C}$                                    | V <sub>TH</sub> - 2.5% | V <sub>TH</sub> | V <sub>TH</sub> + 2.5% | V    |
| V <sub>DD</sub> to Reset Delay <sup>2</sup>       | t <sub>RD</sub>   | V <sub>DD</sub> = V <sub>TH</sub> to (V <sub>TH</sub> - 100mV)        |                        | 20              | 50                     | μs   |
| RESET Active Time-Out Period <sup>3</sup>         | t <sub>TP</sub>   |                                                                       | t <sub>TP</sub> - 40%  | t <sub>TP</sub> | t <sub>TP</sub> + 60%  | ms   |
| RESETN Output Voltage (AS1904/AS1906)             | V <sub>OL</sub>   | I <sub>SINK</sub> = 1.2mA, V <sub>DD</sub> = 2.1V, reset asserted     |                        |                 | 0.4                    | V    |
|                                                   |                   | I <sub>SINK</sub> = 400μA, V <sub>DD</sub> = 1.2V, reset asserted     |                        |                 | 0.4                    | V    |
| RESETN Output Voltage (AS1904)                    | V <sub>OH</sub>   | I <sub>SOURCE</sub> = 1.2mA, V <sub>DD</sub> = 3.2V                   | 0.8 x V <sub>DD</sub>  |                 |                        | V    |
| RESET Output Voltage (AS1905)                     | V <sub>OH</sub>   | I <sub>SOURCE</sub> = 500μA, V <sub>DD</sub> = 2.1V, reset asserted   | 0.8 x V <sub>DD</sub>  |                 |                        | V    |
|                                                   |                   | I <sub>SOURCE</sub> = 100μA, V <sub>DD</sub> = 1.2V, reset asserted   | 0.8 x V <sub>DD</sub>  |                 |                        | V    |
|                                                   | V <sub>OL</sub>   | I <sub>SINK</sub> = 1.2mA, V <sub>DD</sub> = 3.2V, reset not asserted |                        |                 | 0.4                    | V    |
| RESET Threshold Hysteresis                        | V <sub>HYST</sub> |                                                                       |                        | 10              |                        | mV   |
| Open-Drain RESETN Output Leakage Current (AS1906) | I <sub>LEAK</sub> |                                                                       |                        |                 | 0.1                    | μA   |

### Notes:

<sup>1</sup> See Table 6, "Coding of Factory-Trimmed Reset Threshold Voltages," on page 6.

<sup>2</sup> Guaranteed by design.

<sup>3</sup> See Table 4, "Coding of Factory-trimmed Reset Active Time-Out Period," on page 6.

## 7 Typical Operating Characteristics

Figure 3. Supply Current vs. Temperature

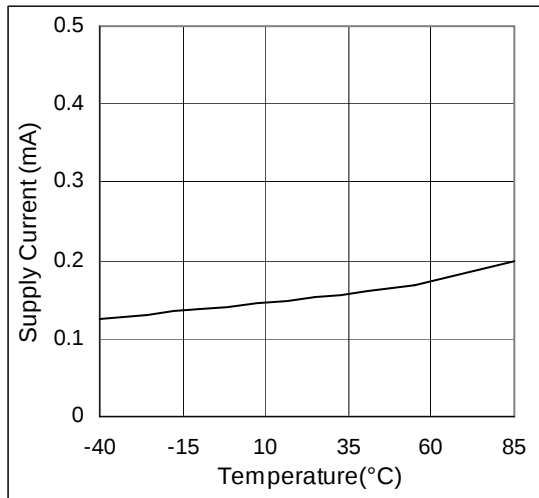


Figure 4. Power Down Reset Delay vs. Temp.

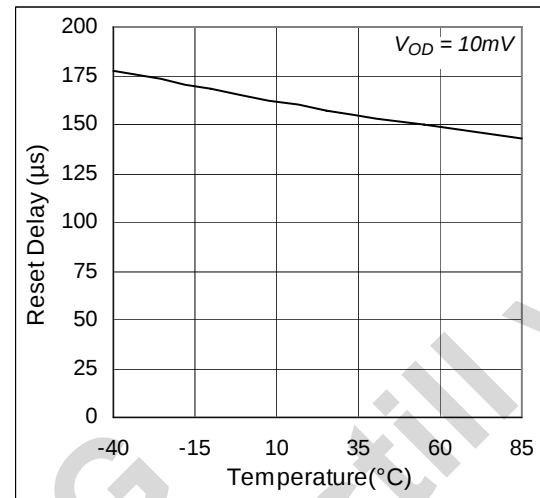


Figure 5. Power-Up Reset Timeout vs. Temperature

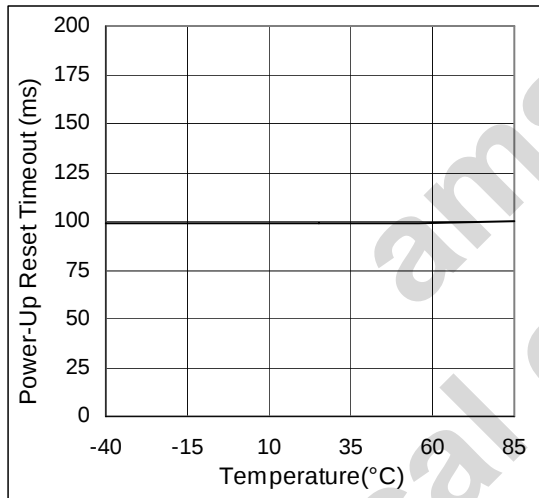
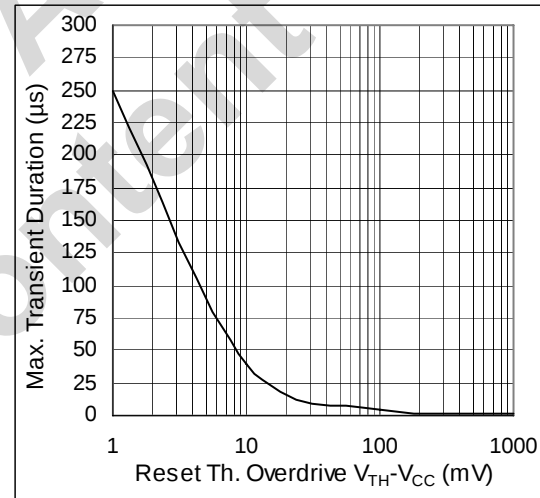


Figure 6. Max. Trans. Duration vs. Reset Th.



Overdrive

## 8 Detailed Description

### Interfacing to Microprocessors with Bi-Directional Reset Pins

The device has an open drain RESETN output, which enables easy interfacing to microprocessors ( $\mu$ P) with bi-directional reset pins, such as the Motorola 68HC11. The RESETN pin of the microcontroller ( $\mu$ C) can be connected directly to the  $\mu$ P supervisor's RESETN output with a single pull-up resistor (see Figure 1 on page 1).

### Negative-Going VDD Transients

The device is optimized to ignore short-duration, negative-going VDD transients (glitches) in order to avoid incorrect resets.

In the graph Maximum Transient Duration vs. Reset Threshold Overdrive (page 6), the conditions are shown, for which the reset pulses are not generated. In the graph the maximum pulse width that a negative VDD transient may have when a reset signal is generated. As the amplitude of the transient increases, the maximum allowable pulse width decreases.

### Options

Table 4. Coding of Factory-trimmed Reset Active Time-Out Period

| Device    | Suffix | tTP in Milliseconds |     |     |
|-----------|--------|---------------------|-----|-----|
|           |        | Min                 | Typ | Max |
| AS190x_xx | A      | 3                   | 5   | 8   |
| AS190x_xx | B      | 12                  | 20  | 32  |
| AS190x_xx | C      | 60                  | 100 | 160 |
| AS190x_xx | D      | 300                 | 500 | 800 |

Table 5. Output Variants

| Device    | Output Functionality |
|-----------|----------------------|
| AS1904xxx | Active Low (RESETN)  |
| AS1905xxx | Active High (RESET)  |
| AS1906xxx | Open Drain (RESETN)  |

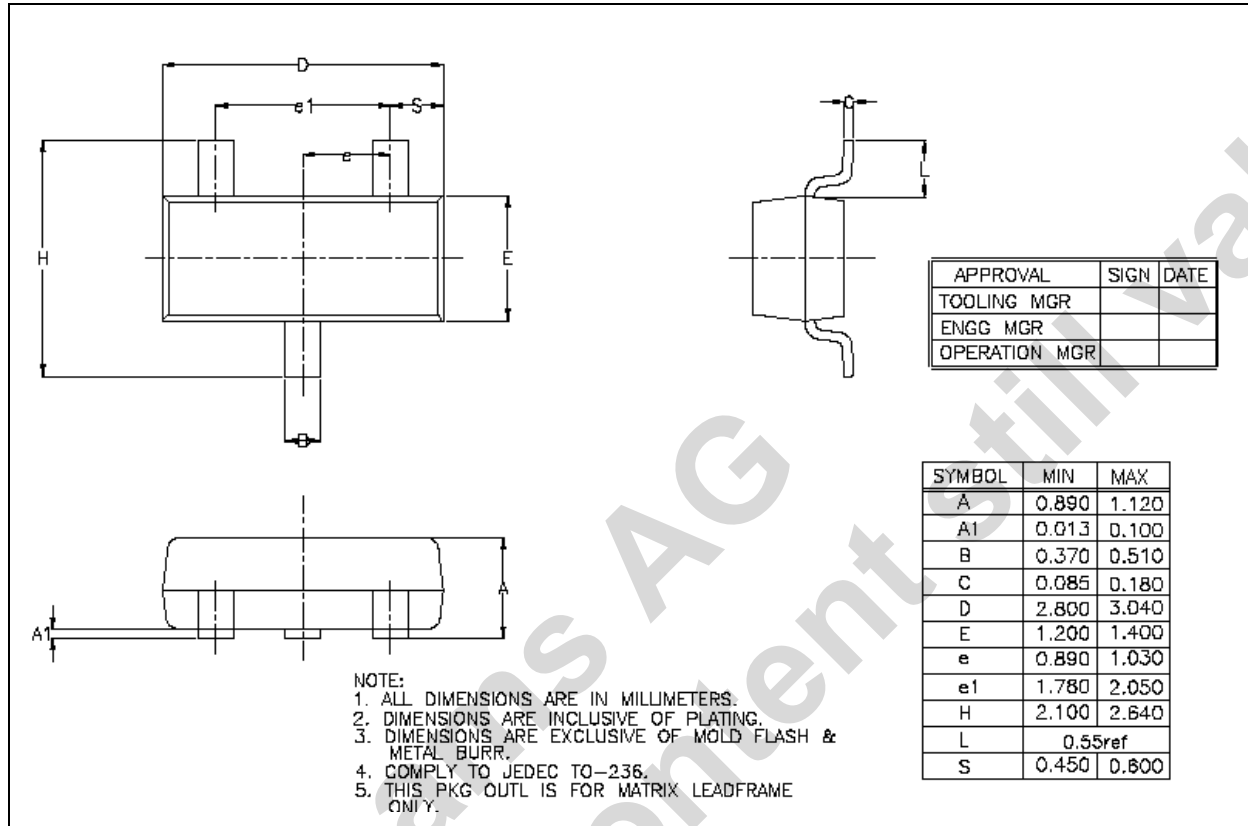
Table 6. Coding of Factory-Trimmed Reset Threshold Voltages

| Device    | Suffix | Reset Threshold Voltage, VTH in V |      |       |                   |       |
|-----------|--------|-----------------------------------|------|-------|-------------------|-------|
|           |        | TA = +25°C                        |      |       | TA = -40 to +85°C |       |
|           |        | Min                               | Typ  | Max   | Min               | Max   |
| AS190xx__ | 22     | 2.167                             | 2.2  | 2.233 | 2.145             | 2.255 |
| AS190xx__ | 23     | 2.285                             | 2.32 | 2.355 | 2.262             | 2.378 |
| AS190xx__ | 24     | 2.364                             | 2.4  | 2.436 | 2.340             | 2.460 |
| AS190xx__ | 25     | 2.463                             | 2.5  | 2.538 | 2.438             | 2.563 |
| AS190xx__ | 26     | 2.591                             | 2.63 | 2.669 | 2.564             | 2.696 |
| AS190xx__ | 27     | 2.660                             | 2.7  | 2.741 | 2.633             | 2.768 |
| AS190xx__ | 28     | 2.758                             | 2.8  | 2.842 | 2.730             | 2.870 |
| AS190xx__ | 29     | 2.886                             | 2.93 | 2.974 | 2.857             | 3.003 |
| AS190xx__ | 30     | 2.955                             | 3.0  | 3.045 | 2.925             | 3.075 |
| AS190xx__ | 31     | 3.034                             | 3.08 | 3.126 | 3.003             | 3.157 |

## 9 Package Drawings and Markings

The device is available in a 3-pin SOT-23 package.

Figure 7. 3-Pin SOT-23 Package.



## 10 Ordering Information

The device is available in the following standard versions.

| Standard Part | Threshold (V) | Duration (mS) | Marking |
|---------------|---------------|---------------|---------|
| AS1904C23     | 2.32          | 100           | ASGI    |
| AS1904C26     | 2.63          | 100           | ASDB    |
| AS1904C31     | 3.08          | 100           | ASDG    |
| AS1905C23     | 2.32          | 100           | ASDI    |
| AS1905C26     | 2.63          | 100           | ASDL    |
| AS1905C31     | 3.08          | 100           | ASDQ    |
| AS1906C23     | 2.32          | 100           | ASDS    |
| AS1906C26     | 2.63          | 100           | ASDV    |
| AS1906C28     | 2.8           | 100           | ASDX    |
| AS1906C31     | 3.08          | 100           | ASGK    |

Non-standard versions require a minimum order of 30,000 units. Contact austriamicrosystems for availability of non-standard versions.

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