

### 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  $\overline{\text{RESET}}$  Active Low (APX809)
- Push-Pull  $\text{RESET}$  Active High (APX810)
- 200ms Typ Power-On Reset Pulse Width
- 30 $\mu$ A Supply Current (Typ.)
- Guaranteed Reset Valid to  $V_{CC} = +1V$
- No External Components
- SOT23 and SOT23R: Available in "Green" Molding Compound (No Br, Sb)
- Lead Free Finish/RoHS Compliant (Note 1)

### General Description

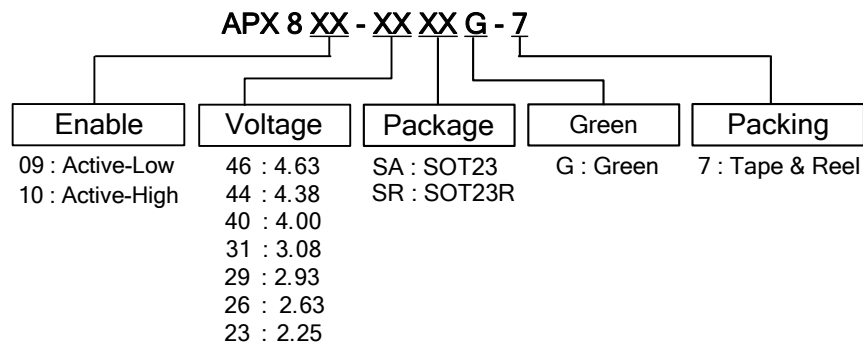
The APX809/810 are used for microprocessor ( $\mu$ P) supervisory circuits to monitor the power supplies in  $\mu$ P and digital systems. They provide excellent circuit reliability and low cost by eliminating external components and adjustments when used with +5V, +3.3V, +3.0V powered circuits.

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 APX809/810 have push pull outputs. The APX809 have an active low  $\overline{\text{RESET}}$  output, while the APX810 has an active high  $\text{RESET}$  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 APX809/810 ideal for use in portable equipment. The APX809/810 is available in a 3-pin SOT23 and SOT23R packages.

### Applications

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

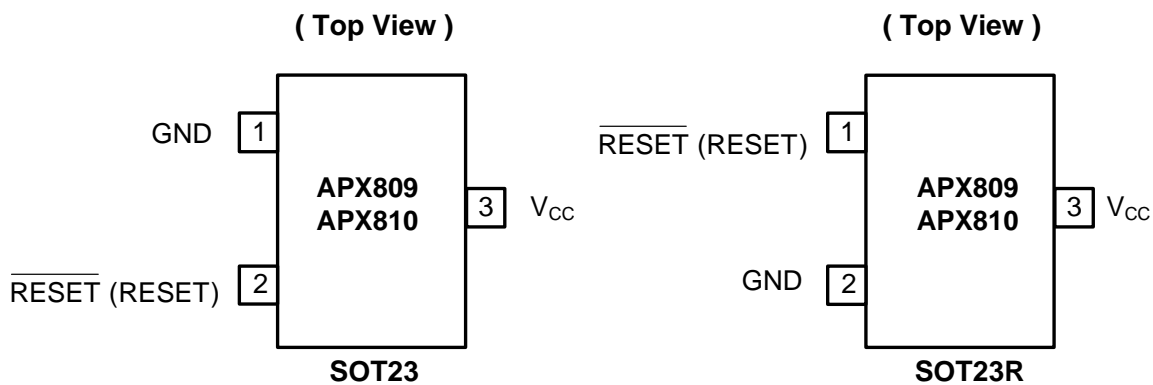
### Ordering Information



| Device         | Package Code | Packaging (Note 2) | 7" Tape and Reel |                    |
|----------------|--------------|--------------------|------------------|--------------------|
|                |              |                    | Quantity         | Part Number Suffix |
| APX809-XXSAG-7 | SA           | SOT23              | 3000/Tape & Reel | -7                 |
| APX810-XXSAG-7 | SA           | SOT23              | 3000/Tape & Reel | -7                 |
| APX809-XXSRG-7 | SR           | SOT23R             | 3000/Tape & Reel | -7                 |
| APX810-XXSRG-7 | SR           | SOT23R             | 3000/Tape & Reel | -7                 |

- Notes:
1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at [http://www.diodes.com/products/lead\\_free.html](http://www.diodes.com/products/lead_free.html).
  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**

| Pin Name                          | Description  |
|-----------------------------------|--|
| GND                               | Ground   |
| $\overline{\text{RESET}}$ (RESET) | Reset Output Pin<br>L: for APX809<br>H: for APX810 |
| $V_{CC}$                          | Operating Voltage Input                            |

**Absolute Maximum Ratings**

| Symbol             | Parameter   | Rating                     | Unit             |
|--------------------|---|----------------------------|------------------|
| ESD HBM            | Human Body Model ESD Protection   | 5                          | KV               |
| ESD MM             | Machine Model ESD Protection  | 500                        | V                |
| $V_{CC}$           | Supply Voltage  | -0.3 to +6.0               | V                |
| $V_{\text{RESET}}$ | RESET, $\overline{\text{RESET}}$ (push-pull)  | -0.3 to ( $V_{CC} + 0.3$ ) | V                |
| $I_{CC}$           | Input Current, $V_{CC}$   | 20                         | mA               |
| $I_O$              | Output Current, RESET, $\overline{\text{RESET}}$  | 20                         | mA               |
| $P_D$              | Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ ),<br>de-rate 4mW/ $^\circ\text{C}$ above +70 $^\circ\text{C}$ | 400                        | mW               |
| $T_{OP}$           | Operating Junction Temperature Range  | -40 to +105                | $^\circ\text{C}$ |
| $T_{ST}$           | Storage Temperature Range   | -65 to +150                | $^\circ\text{C}$ |

### Recommended Operating Conditions

| Symbol   | Parameter                                 | Min | Max              | Unit       |
|----------|---|-----|------------------|------------|
| $V_{CC}$ | Supply Voltage                            | 1.1 | 5.5              | V          |
| $V_{IN}$ | Input Voltage                             | 0   | ( $V_{CC}+0.3$ ) | V          |
| $T_A$    | Operating Ambient Temperature Range       | -40 | 85               | °C         |
| $T_R$    | Vcc Rising Time ( $V_{CC} = 0 \sim V_T$ ) |     | 100              | V/ $\mu$ S |

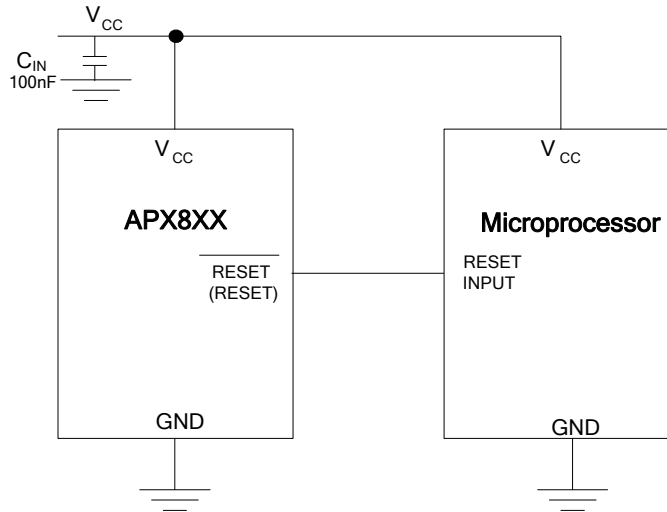
### Electrical Characteristics ( $T_A = 25^\circ\text{C}$ )

$T_A = -40$  to  $85^\circ\text{C}$  unless otherwise note. Typical values are at  $T_A = +25^\circ\text{C}$ .

| Symbol        | Parameter                              | Test 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                         | $V_{TH} + 0.2\text{V}$   |   | 30   | 40   | $\mu\text{A}$ |   |
| $V_{TH}$      | Reset Threshold                        | APX809/810-23  | $T_A = 0^\circ\text{C} \sim 85^\circ\text{C}$   | 2.21 | 2.25 | 2.30          | V |
|               |  | APX809/810-26  |   | 2.59 | 2.63 | 2.69          |   |
|               |  | APX809/810-29  |   | 2.88 | 2.93 | 3.00          |   |
|               |  | APX809/810-31  |   | 3.02 | 3.08 | 3.15          |   |
|               |  | APX809/810-40  |   | 3.93 | 4.00 | 4.08          |   |
|               |  | APX809/810-44  |   | 4.31 | 4.38 | 4.47          |   |
|               |  | APX809/810-46  |   | 4.56 | 4.63 | 4.72          |   |
|               | Reset Threshold                        | APX809/810-23  | $T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$ | 2.20 | 2.25 | 2.30          | V |
|               |  | APX809/810-26  |   | 2.57 | 2.63 | 2.69          |   |
|               |  | APX809/810-29  |   | 2.86 | 2.93 | 3.00          |   |
|               |  | APX809/810-31  |   | 3.00 | 3.08 | 3.15          |   |
|               |  | APX809/810-40  |   | 3.92 | 4.00 | 4.08          |   |
|               |  | APX809/810-44  |   | 4.29 | 4.38 | 4.47          |   |
|               |  | APX809/810-46  |   | 4.54 | 4.63 | 4.72          |   |
|               | Reset Threshold Tempco                 |  |   | 30   |      | ppm/°C        |   |
| $T_S$         | Set-up Time                            | $V_{CC} = V_{TH}$ to $(V_{TH} - 100\text{mV})$                     |   | 20   |      | $\mu\text{s}$ |   |
| $T_{DELAY}$   | Reset Active Timeout Period            | $T_A = 0^\circ\text{C}$ to $+85^\circ\text{C}$                     | 140   | 200  | 280  | ms            |   |
| $V_{OL}$      | RESET Output Voltage Low (APX809)      | $V_{CC} = V_{TH} - 0.2, I_{SINK} = 1.2\text{mA}$                   |   |      | 0.3  | V             |   |
|               |  | $V_{CC} = V_{TH} - 0.2, I_{SINK} = 3.2\text{mA}$                   |   |      | 0.4  |               |   |
|               |  | $V_{CC} > 1.0\text{V}, I_{SINK} = 50\mu\text{A}$                   |   |      | 0.3  |               |   |
| $V_{OH}$      | RESET Output Voltage-High (APX809)     | $V_{CC} > V_{TH} + 0.2, I_{SOURCE} = 500\mu\text{A}$               | $0.8V_{CC}$                                     |      |      | V             |   |
|               |  | $V_{CC} > V_{TH} + 0.2, I_{SOURCE} = 800\mu\text{A}$               | $V_{CC} - 1.5$                                  |      |      |               |   |
| $V_{OL}$      | RESET Output Voltage-Low (APX810)      | $V_{CC} = V_{TH} + 0.2, I_{SINK} = 1.2\text{mA}$                   |   |      | 0.3  | V             |   |
|               |  | $V_{CC} = V_{TH} + 0.2, I_{SINK} = 3.2\text{mA}$                   |   |      | 0.4  |               |   |
| $V_{OH}$      | RESET Output Voltage-High (APX810)     | $1.8\text{V} < V_{CC} < V_{TH} - 0.2, I_{SOURCE} = 150\mu\text{A}$ | $0.8 V_{CC}$                                    |      |      | V             |   |
| $\theta_{JA}$ | Thermal Resistance Junction-to-Ambient | SOT23/SOT23R (Note 3)  |   | 201  |      | °C/W          |   |
| $\theta_{JC}$ | Thermal Resistance Junction-to-Case    | SOT23/SOT23R (Note 3)  |   | 56   |      | °C/W          |   |

Notes: 3. Test condition for SOT23/ SOT23R: Devices mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

### Typical Application Circuit



### Functional Description

A microprocessor's ( $\mu\text{P}$ 's) reset input starts the  $\mu\text{P}$  in a known state. The APX809/810 assert reset to prevent code-execution errors during power-up, power-down, or brownout conditions. They assert a reset signal whenever the  $V_{\text{CC}}$  supply voltage declines below a preset threshold, keeping it asserted for at least 240ms after  $V_{\text{CC}}$  has risen above the reset threshold. The APX809/810 have a push-pull output stage.

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

$\overline{\text{RESET}}$  is guaranteed to be a logic low for  $V_{\text{CC}} > 1\text{V}$ . Once  $V_{\text{CC}}$  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 ( $V_{\text{CC}}$  dips below the  $\overline{\text{RESET}}$  reset threshold),  $\overline{\text{RESET}}$  goes low. Any time  $V_{\text{CC}}$  goes below the reset threshold, the internal timer resets to zero, and  $\overline{\text{RESET}}$  goes low. The internal timer starts after  $V_{\text{CC}}$  returns above the reset threshold, and  $\overline{\text{RESET}}$  remains low for the reset timeout period.

When  $V_{\text{CC}}$  falls below 1V, the APX809  $\overline{\text{RESET}}$  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  $\mu\text{P}$  and other circuitry is inoperative with  $V_{\text{CC}}$  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 APX810 if  $\overline{\text{RESET}}$  is required to remain valid for  $V_{\text{CC}} < 1\text{V}$ .

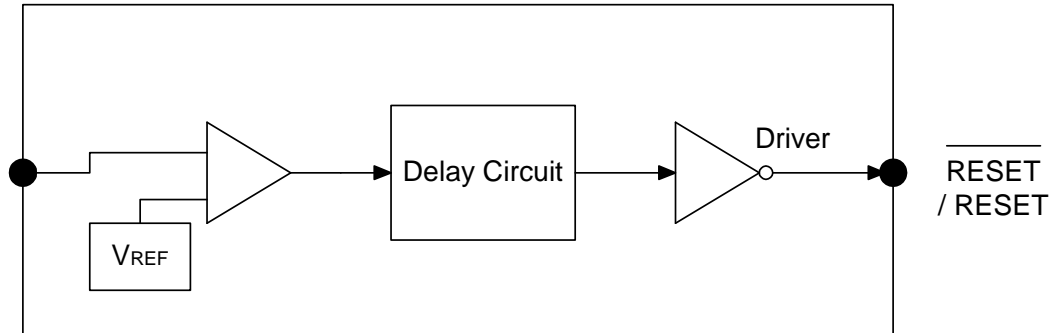
#### Benefits of Highly Accurate Reset Threshold

Most  $\mu\text{P}$  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.

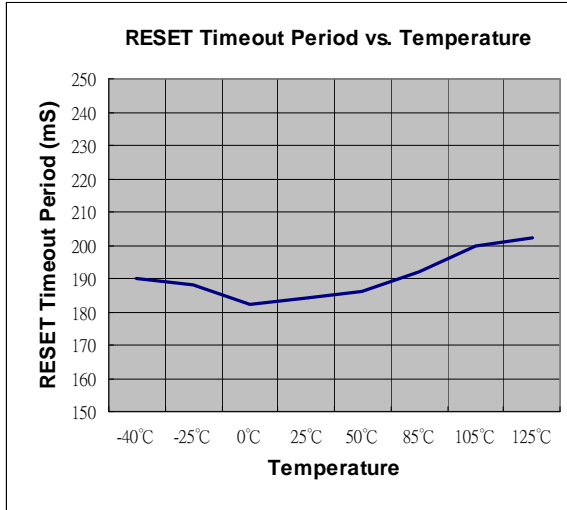
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**Block Diagram**

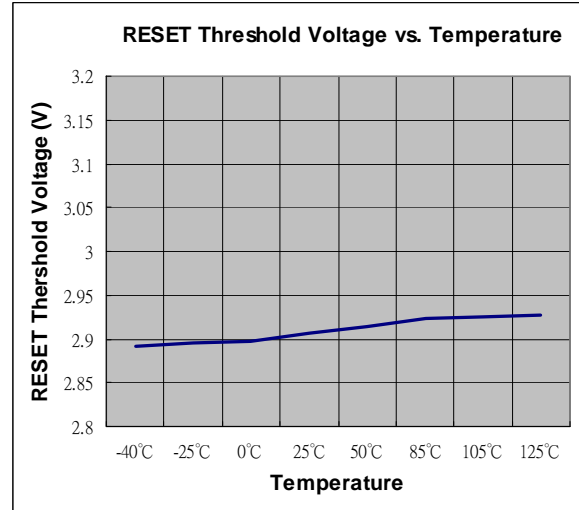
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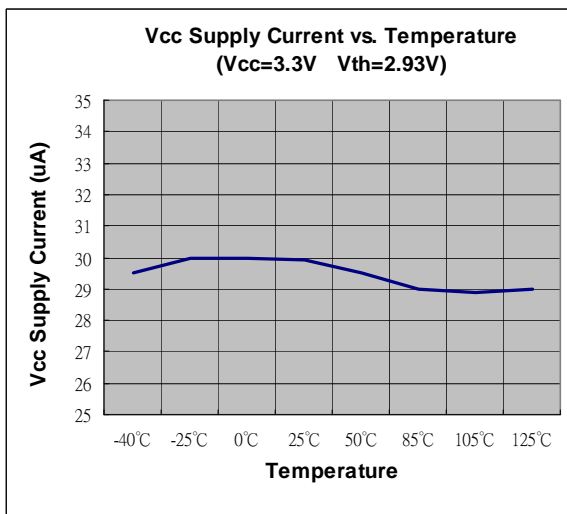
**Performance Characteristics**



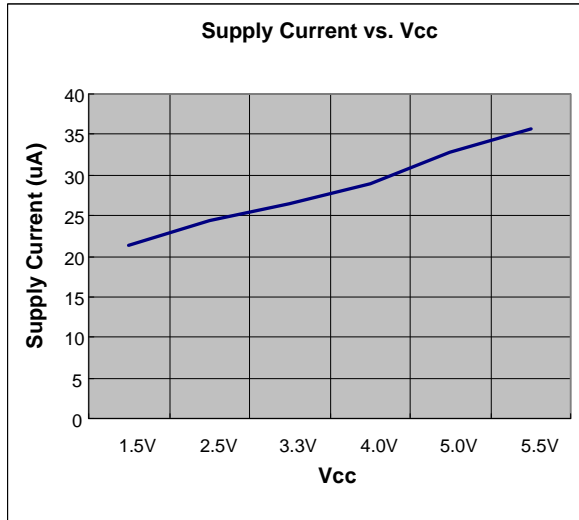
**Figure 1**



**Figure 2**



**Figure 3**

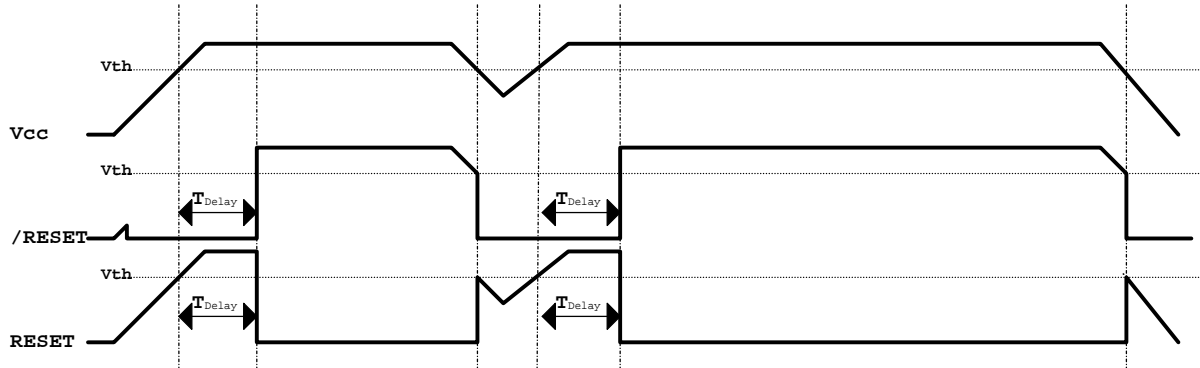


**Figure 4**

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**Timing Diagram**

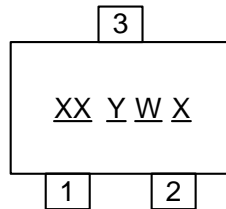
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**Marking Information**

(1) SOT23/SOT23R

( Top View )



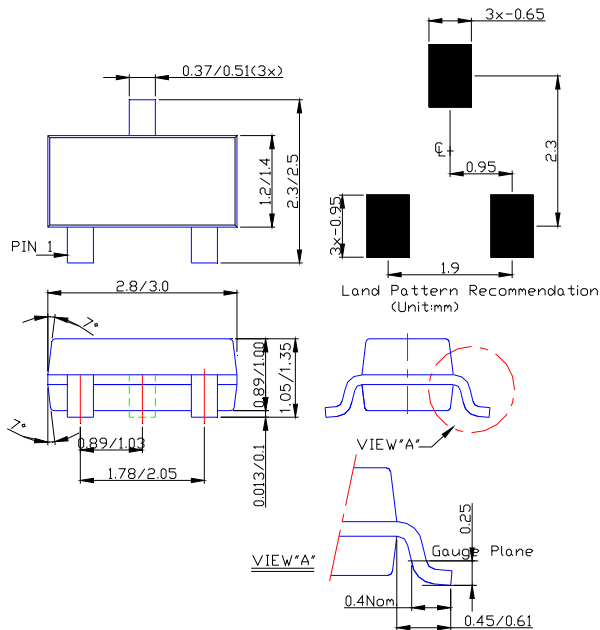
XX : Identification code  
Y : Year 0~9  
W : Week : A~Z : 1~26 week;  
a~z : 27~52 week; z represents  
52 and 53 week  
X : A~Z : Green

| Device      | Package | Identification Code |
|-------------|---------|---------------------|
| APX809-46SA | SOT23   | X2                  |
| APX809-44SA | SOT23   | X3                  |
| APX809-40SA | SOT23   | X4                  |
| APX809-31SA | SOT23   | X5                  |
| APX809-29SA | SOT23   | X6                  |
| APX809-26SA | SOT23   | X7                  |
| APX809-23SA | SOT23   | X8                  |
| APX810-46SA | SOT23   | XA                  |
| APX810-44SA | SOT23   | XB                  |
| APX810-40SA | SOT23   | XC                  |
| APX810-31SA | SOT23   | XD                  |
| APX810-29SA | SOT23   | XE                  |
| APX810-26SA | SOT23   | XF                  |
| APX810-23SA | SOT23   | XG                  |
| APX809-46SR | SOT23R  | Y2                  |
| APX809-44SR | SOT23R  | Y3                  |
| APX809-40SR | SOT23R  | Y4                  |
| APX809-31SR | SOT23R  | Y5                  |
| APX809-29SR | SOT23R  | Y6                  |
| APX809-26SR | SOT23R  | Y7                  |
| APX809-23SR | SOT23R  | Y8                  |
| APX810-46SR | SOT23R  | YA                  |
| APX810-44SR | SOT23R  | YB                  |
| APX810-40SR | SOT23R  | YC                  |
| APX810-31SR | SOT23R  | YD                  |
| APX810-29SR | SOT23R  | YE                  |
| APX810-26SR | SOT23R  | YF                  |
| APX810-23SR | SOT23R  | YG                  |



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

**(1) Package Type: SOT23/SOT23R**



Notes: 4. Package outline dimensions as shown on Diodes Inc. package outline dimensions document AP02002, which can be found on our website at <http://www.diodes.com/datasheets/ap02002.pdf>

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