# SGM823
# 5-Pin Microprocessor Supervisory Circuit with Watchdog Timer and Manual Reset

## GENERAL DESCRIPTION

The SGM823 microprocessor (μP) supervisory circuit combines reset output, watchdog, and manual reset input functions in SOT-23-5 package. It significantly improves system reliability and accuracy compared to separate ICs or discrete components. The SGM823 is specifically designed to ignore fast transients on $V_{CC}$.

Four preprogrammed reset threshold voltages are available. This device has an active-low reset output, which is guaranteed to be in the correct state for $V_{CC}$ down to 1V. The SGM823 also offers a watchdog input and manual reset input.

The SGM823 is available in a Green SOT-23-5 package. It operates over an ambient temperature range of -40℃ to +125℃.

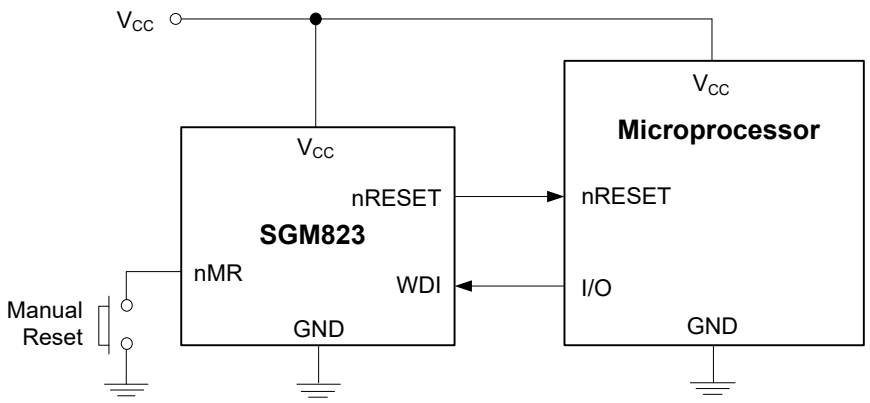
## FEATURES

- **Ultra-Low Supply Current: < 1μA (TYP)**
- **Precision Supply-Voltage Monitor**
  - **4.63V for SGM823-L**
  - **3.08V for SGM823-T**
  - **2.93V for SGM823-S**
  - **2.63V for SGM823-R**
- **Push-Pull nRESET Output**
- **Guaranteed nRESET Valid at $V_{CC}$ = 1V**
- **Fully Specified over Temperature**
- **200ms Reset Pulse Width**
- **Power-Supply Transient Immunity**
- **Watchdog Timer with 1.6s Timeout**
- **Debounced TTL/CMOS-Compatible**
- **Manual Reset Input**
- **No External Components**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

## APPLICATIONS

Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical μP Power Monitoring

## TYPICAL APPLICATION

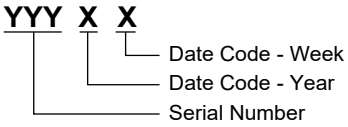


# PACKAGE/ORDERING INFORMATION

| MODEL | RESET THRESHOLD (V) | PACKAGE DESCRIPTION | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|
| SGM823 | 4.63 | SOT-23-5 | SGM823-LXN5G/TR | MNFXX | Tape and Reel, 3000 |
| | 3.08 | SOT-23-5 | SGM823-TXN5G/TR | MG6XX | Tape and Reel, 3000 |
| | 2.93 | SOT-23-5 | SGM823-SXN5G/TR | MG7XX | Tape and Reel, 3000 |
| | 2.63 | SOT-23-5 | SGM823-RXN5G/TR | MG8XX | Tape and Reel, 3000 |

## MARKING INFORMATION

NOTE: XX = Date Code.




Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (With respect to GND)
- $V_{CC}$ ..... -0.3V to 6.0V
- All Other Inputs ..... -0.3V to ($V_{CC}$ + 0.3V)

Input Current
- $V_{CC}$ ..... 20mA
- GND ..... 20mA

Output Current
- All Outputs ..... 20mA

Package Thermal Resistance
SOT-23-5, $\theta_{JA}$ ..... 234℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM ..... 4000V
MM ..... 400V
CDM ..... 1000V

## RECOMMENDED OPERATING CONDITIONS

Ambient Temperature Range ..... -40℃ to +125℃

## OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

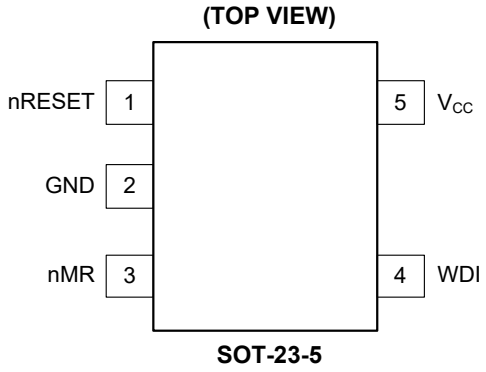
## ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

## PIN CONFIGURATION




## PIN DESCRIPTION

| NAME | FUNCTION |
|---|---|
| nRESET | Active-Low Reset Output. Pulses low for 200ms when triggered, and remains low whenever $V_{CC}$ is below the reset threshold or when nMR is logic low. It remains low for 200ms after one of the following occurs: $V_{CC}$ rises above the reset threshold, the watchdog triggers a reset, or nMR goes from low to high. |
| GND | Ground. 0V ground reference for all signals. |
| nMR | Manual Reset Input Pin. A logic low on nMR asserts reset. Reset remains asserted as long as nMR is held low and for 200ms after nMR returns high. The active-low input has an internal 59kΩ pull-up resistor. It can be driven from a CMOS logic line or shorted to ground with a switch. Leave open or connect to $V_{CC}$ if unused. |
| WDI | Watchdog Input Pin. If WDI remains either high or low for longer than the watchdog timeout period, the internal watchdog timer runs out and a reset is triggered. The internal watchdog timer clears whenever reset is asserted, or whenever WDI sees a rising or falling edge. If WDI is left unconnected or is connected to a three-stated buffer output, the watchdog feature is disabled. |
| $V_{CC}$ | Supply Voltage. |

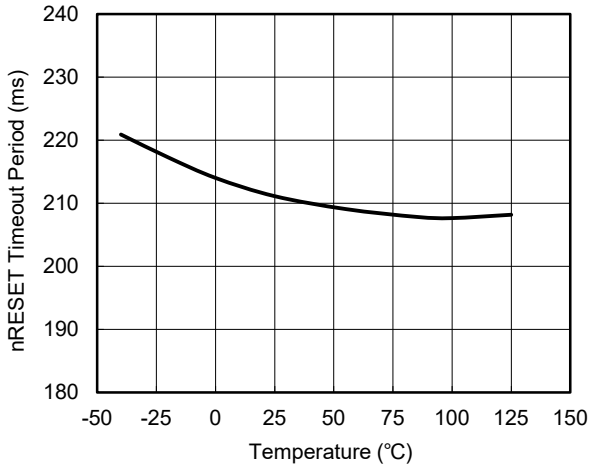
## ELECTRICAL CHARACTERISTICS

($T_A$ = +25℃, $V_{CC}$ = 4.73V to 5.5V for SGM823-L, $V_{CC}$ = 3.14V to 5.5V for SGM823-T, $V_{CC}$ = 2.99V to 5.5V for SGM823-S, $V_{CC}$ = 2.68V to 5.5V for SGM823-R, Full = -40℃ to +125℃, unless otherwise noted.)

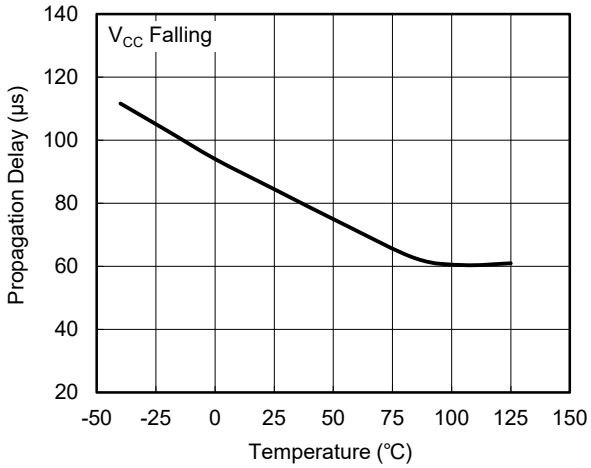
| PARAMETER | | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Operating Voltage Range ($V_{CC}$) | | | Full | 1 | | 5.5 | V |
| Supply Current ($I_{SUPPLY}$) | | $V_{CC}$ = 3.6V | Full | | 0.5 | 1.2 | μA |
| | | $V_{CC}$ = 5.5V | Full | | 0.7 | 1.4 | |
| nRESET Threshold ($V_{nRST}$) | | SGM823-L | +25℃ | 4.55 | 4.63 | 4.70 | V |
| | | | Full | 4.54 | 4.63 | 4.73 | |
| | | SGM823-T | +25℃ | 3.03 | 3.08 | 3.13 | |
| | | | Full | 3.02 | 3.08 | 3.14 | |
| | | SGM823-S | +25℃ | 2.88 | 2.93 | 2.98 | |
| | | | Full | 2.87 | 2.93 | 2.99 | |
| | | SGM823-R | +25℃ | 2.59 | 2.63 | 2.67 | |
| | | | Full | 2.58 | 2.63 | 2.68 | |
| nRESET Threshold Hysteresis ($V_{HYS}$) | | SGM823-L | +25℃ | | 20 | | mV |
| | | SGM823-T | +25℃ | | 14 | | |
| | | SGM823-S | +25℃ | | 13 | | |
| | | SGM823-R | +25℃ | | 12 | | |
| nRESET Threshold Temperature Coefficient | | | Full | | 20 | | ppm/℃ |
| nRESET Pulse Width ($t_{RP}$) | | | Full | 140 | 200 | 290 | ms |
| nRESET Output Voltage | $V_{OH}$ | SGM823-L, $V_{CC}$ = $V_{nRST(MAX)}$, $I_{SOURCE}$ = 120μA | Full | $V_{CC}$ - 1.5 | | | V |
| | | SGM823-T/S/R, $V_{CC}$ = $V_{nRST(MAX)}$, $I_{SOURCE}$ = 30μA | Full | 0.8 × $V_{CC}$ | | | |
| | $V_{OL}$ | SGM823-L, $V_{CC}$ = $V_{nRST(MIN)}$, $I_{SINK}$ = 3.2mA | Full | | | 0.4 | |
| | | SGM823-T/S/R, $V_{CC}$ = $V_{nRST(MIN)}$, $I_{SINK}$ = 1.2mA | Full | | | 0.3 | |
| | | $V_{CC}$ = 1V, $V_{CC}$ falling, $I_{SINK}$ = 50μA | Full | | | 0.3 | |
| nRESET Output Short-Circuit Current ($I_{SOURCE}$) | | SGM823-L, nRESET = 0V, $V_{CC}$ = 5.5V | Full | | | 460 | μA |
| | | SGM823-T/S/R, nRESET = 0V, $V_{CC}$ = 3.6V | Full | | | 430 | |
| $V_{CC}$ to Reset Delay ($t_{RD}$) | | $V_{nRST}$ - $V_{CC}$ = 100mV | +25℃ | | 84 | | μs |
| Watchdog Timeout Period ($t_{WD}$) | | | Full | 1.1 | 1.6 | 2.4 | sec |
| WDI Pulse Width ($t_{WP}$) | | $V_{IL}$ = 0V, $V_{IH}$ = $V_{CC}$ | Full | 90 | | | ns |
| WDI Input Threshold | Low | $V_{CC}$ = 5V | Full | | | 0.8 | V |
| | High | $V_{CC}$ = 5V | Full | 3.5 | | | |
| | Low | $V_{nRST(MAX)}$ < $V_{CC}$ < 3.6V | Full | | | 0.8 | |
| | High | $V_{nRST(MAX)}$ < $V_{CC}$ < 3.6V | Full | 0.7 × $V_{CC}$ | | | |
| WDI Input Current | | WDI = $V_{CC}$, time average | Full | | 0.02 | 0.5 | μA |
| | | WDI = 0V, time average | Full | -0.5 | -0.01 | | |
| nMR Input Voltage | $V_{IL}$ | | Full | | | 0.8 | V |
| | $V_{IH}$ | | Full | 2 | | | |
| nMR Pulse Width ($t_{MR}$) | | | Full | 300 | | | ns |
| nMR Noise Immunity (Pulse width with no reset) | | | +25℃ | | 130 | | ns |
| nMR to nRESET Out Delay ($t_{MD}$) | | | Full | | | 470 | ns |
| nMR Pull-Up Resistance (Internal) | | | Full | 44 | 59 | 78 | kΩ |

## TYPICAL PERFORMANCE CHARACTERISTICS

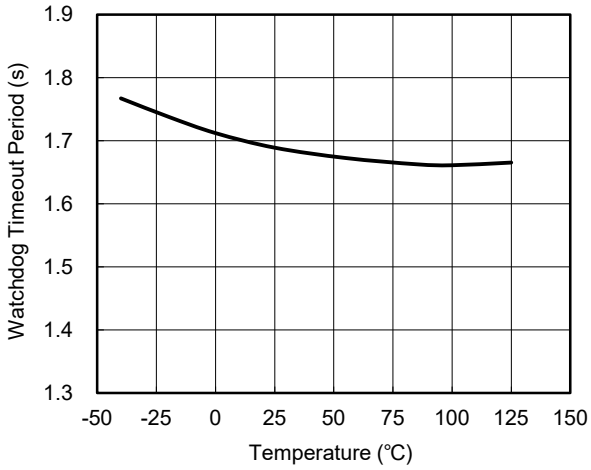
nRESET Timeout Period vs. Temperature



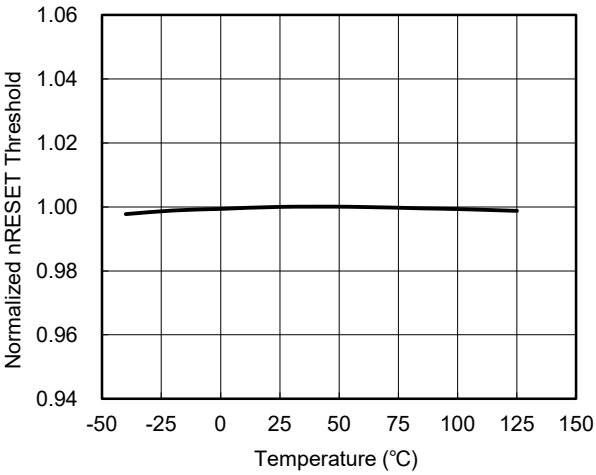

nRESET Comparator Propagation Delay vs. Temperature



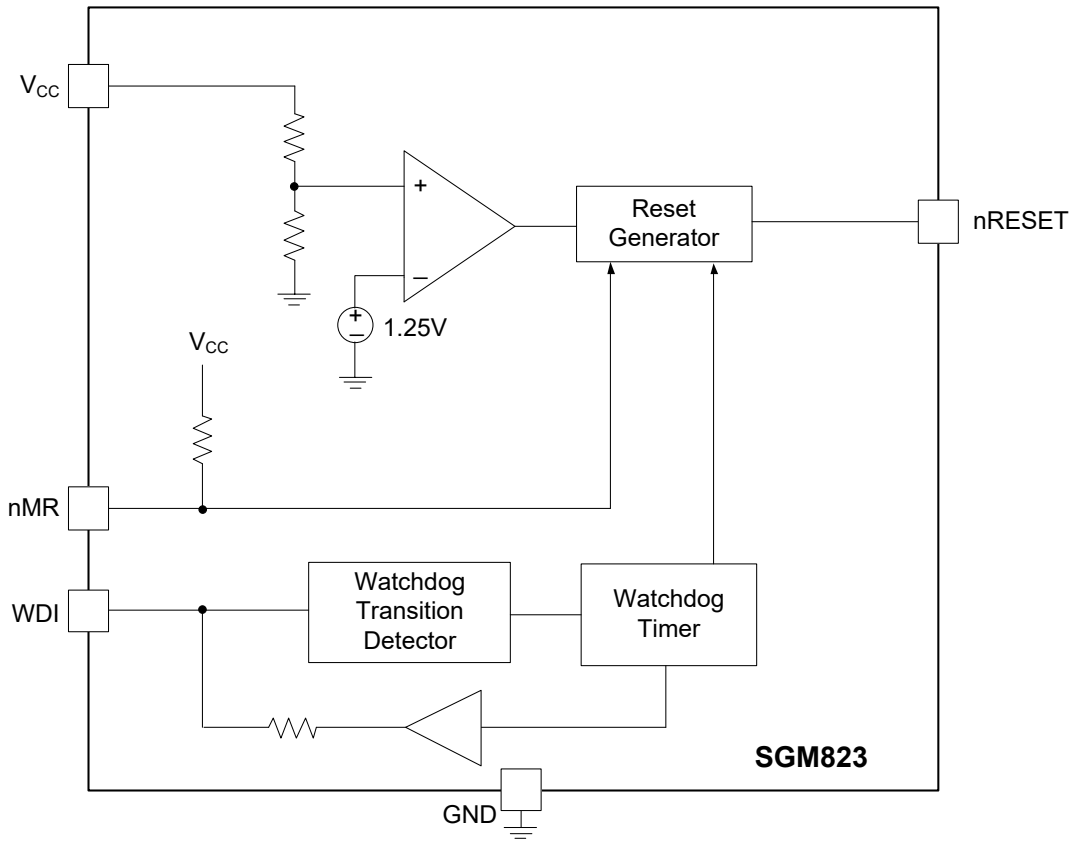

Watchdog Timeout Period vs. Temperature




Normalized nRESET Threshold Voltage vs. Temperature



## FUNCTIONAL BLOCK DIAGRAM



# DETAILED DESCRIPTION

## nRESET Output

A microprocessor's (μP's) reset input starts the μP in a known state. The SGM823 μP supervisory circuit asserts a reset to prevent code-execution errors during power-up, power-down, and brownout conditions. nRESET is guaranteed to be a logic low for $V_{CC}$ down to 1V. During power-up, when $V_{CC}$ exceeds the rising threshold voltage ($V_{nRST}$ + $V_{HYS}$), an internal timer keeps nRESET low for the specified reset timeout period ($t_{RP}$); after this interval, nRESET returns high (Figure 1).

If $V_{CC}$ drops below the falling threshold voltage ($V_{nRST}$) (a brownout condition occurs), nRESET goes low. Each time nRESET is asserted, it stays low for the reset timeout period. Any time $V_{CC}$ goes below the reset threshold, the internal timer restarts. nRESET both sources and sinks current.

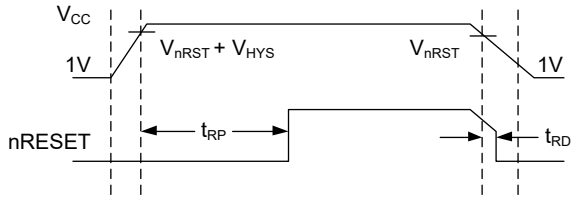



**Figure 1. nRESET Timing Diagram**

## Manual Reset Input

Many μP-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. On the SGM823, a logic low on nMR asserts reset. Reset remains asserted while nMR is low, and for $t_{RP}$ (200ms nominal) after it returns high. nMR has an internal 59kΩ pull-up resistor, so it can be left open if not used. This input can be driven with CMOS logic levels or with open-drain/collector outputs. Connect a normally open momentary switch from nMR to GND to create a manual reset function; external debounce circuitry is not required. If nMR is driven from long cables or the device is used in a noisy environment, connect a 0.1μF capacitor from nMR to GND to provide additional noise immunity.

## Watchdog Input

On the SGM823, the watchdog circuit monitors the μP's activity. If the μP does not toggle the watchdog input (WDI) within $t_{WD}$ (1.6s), reset asserts. The internal 1.6s timer is cleared by either a reset pulse or by toggling WDI, which detects pulses as short as 90ns. While reset is asserted, the timer remains cleared and does not count. As soon as reset is released, the timer starts counting (Figure 2).

Disable the watchdog function by leaving WDI unconnected or by three-stating the driver connected to WDI. The watchdog input is internally driven low during the first 7/8 of the watchdog timeout period and high for the last 1/8 of the watchdog timeout period. When WDI is left unconnected, this internal driver clears the 1.6s timer every 1.4s. When WDI is three-stated or unconnected, the maximum allowable leakage current is 10μA and the maximum allowable load capacitance is 200pF.

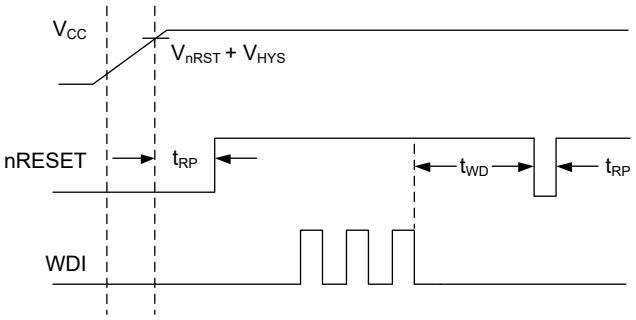



**Figure 2. Watchdog Timing Relationship**

# APPLICATION INFORMATION

## Interfacing to µPs with Bidirectional Reset Pins

The nRESET output maximum pull-up current is 460µA for L version (430µA for T/S/R versions). This allows µPs with bidirectional resets, such as the 68HC11, to force nRESET low when the SGM823 is pulling nRESET high (Figure 3).

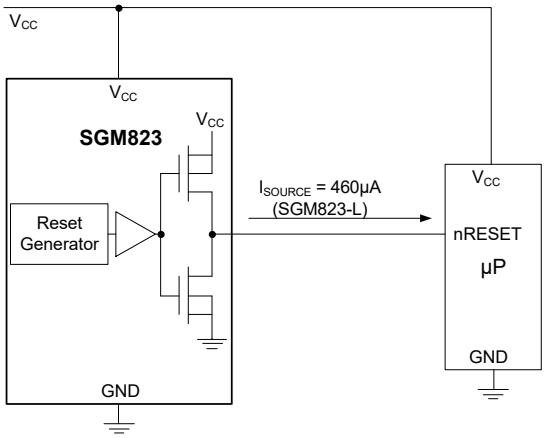



**Figure 3. Interfacing to µP with Bidirectional Resets**

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

This supervisor is relatively immune to short duration, negative-going $V_{CC}$ transients (glitches), which usually do not require the entire system to shut down. Resets are issued to the µP during power-up, power-down and brownout conditions.

An optional 0.1µF bypass capacitor mounted close to $V_{CC}$ provides additional transient immunity.

## Watchdog Input Current

The SGM823 WDI is internally driven through a buffer and series resistor from the watchdog counter. When WDI is left unconnected, the watchdog timer is serviced within the watchdog timeout period by a low-high-low pulse from the counter chain. For minimum watchdog input current (minimum overall power consumption), leave WDI low for the majority of the watchdog timeout period, pulsing it low-high-low once within the first 7/8 of the watchdog timeout period to reset the watchdog timer.

## Watchdog Software Considerations

One way to help the watchdog timer monitor software execution more closely is to set and reset the watchdog input at different points in the program, rather than pulsing the watchdog input high-low-high or low-high-low. This technique avoids a stuck loop, in which the watchdog timer would continue to be reset inside the loop, keeping the watchdog from timing out.

Figure 4 shows an example of a flow diagram where the I/O driving the watchdog input is set high at the beginning of the program, set low at the beginning of every subroutine or loop, then set high again when the program returns to the beginning. If the program should hang in any subroutine, the problem would quickly be corrected, since the I/O is continually set low and the watchdog timer is allowed to time out, causing a reset or interrupt to be issued. As described in the Watchdog Input Current section, this scheme results in higher time average WDI input current than leaving WDI low for the majority of the timeout period and periodically pulsing it low-high-low.

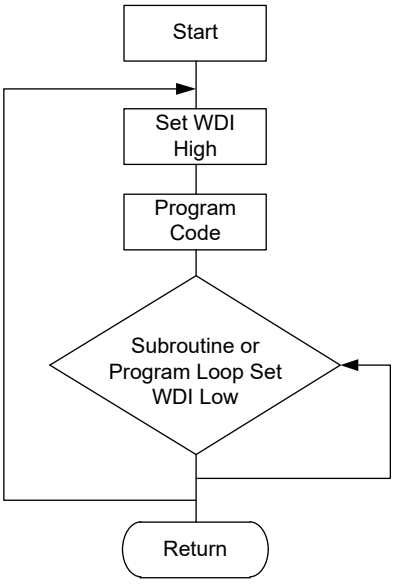



**Figure 4. Watchdog Flow Diagram**

# REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

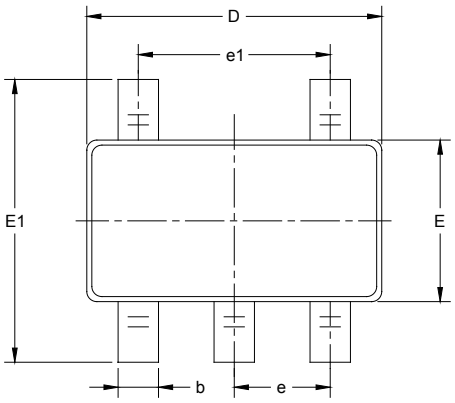
| JULY 2020 – REV.A.1 to REV.A.2 | Page |
|---|---|
| Updated Features section | 1 |
| Changed Detailed Description section | 7 |

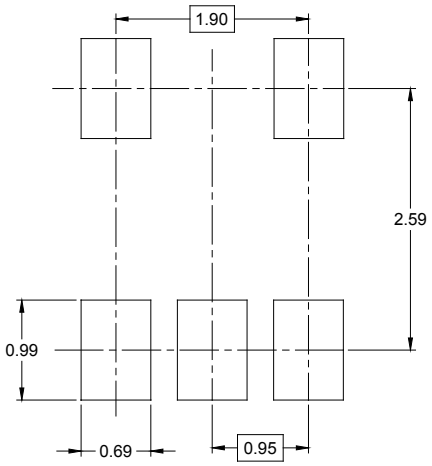
| JANUARY 2020 – REV.A to REV.A.1 | Page |
|---|---|
| Changed Electrical Characteristics section | 4 |
| Changed Typical Performance Characteristics section | 5 |
| Changed Figure 1 | 7 |

| Changes from Original (DECEMBER 2018) to REV.A | Page |
|---|---|
| Changed from product preview to production data | All |

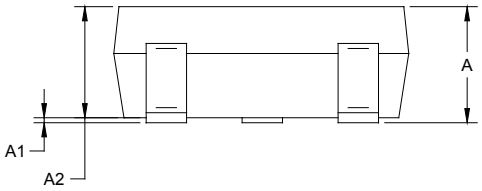
# PACKAGE OUTLINE DIMENSIONS

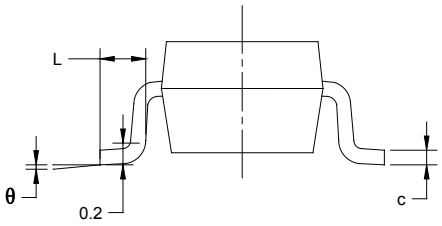
## SOT-23-5




**RECOMMENDED LAND PATTERN** (Unit: mm)

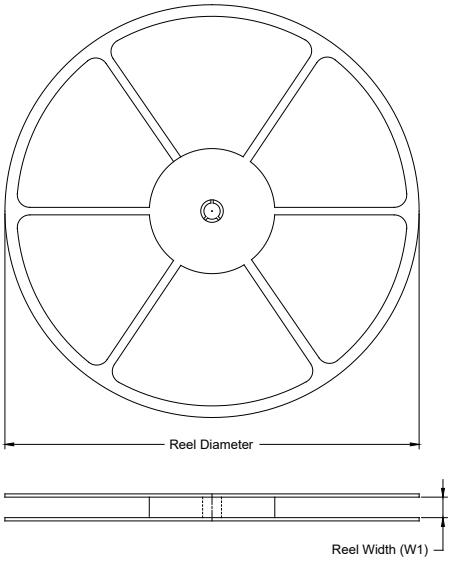


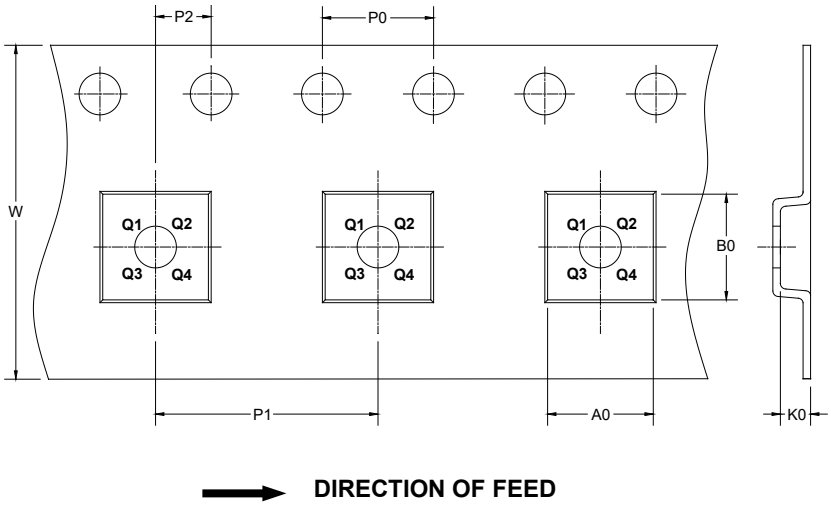

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950 BSC | | 0.037 BSC | |
| e1 | 1.900 BSC | | 0.075 BSC | |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS




DIRECTION OF FEED

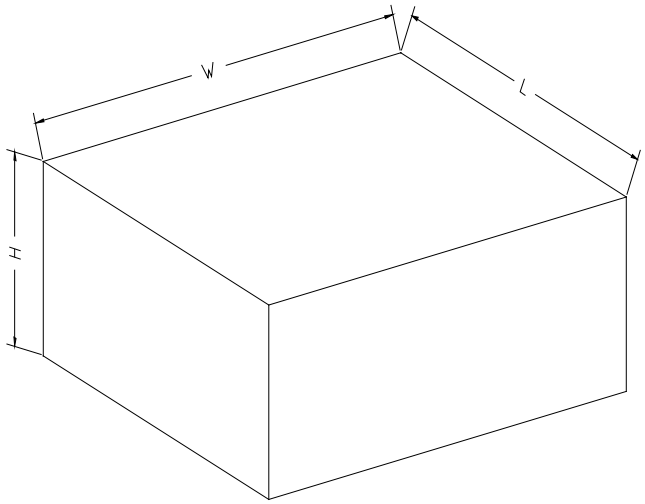
NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|
| SOT-23-5 | 7″ | 9.5 | 3.20 | 3.20 | 1.40 | 4.0 | 4.0 | 2.0 | 8.0 | Q3 |

DD0001

## CARTON BOX DIMENSIONS




NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|---|---|---|---|---|
| 7″ (Option) | 368 | 227 | 224 | 8 |
| 7″ | 442 | 410 | 224 | 18 |

DD0002