

SGM824

5-Pin Microprocessor Supervisory Circuit with Watchdog Timer

GENERAL DESCRIPTION

The SGM824 microprocessor (μ P) supervisory circuit combines reset output, watchdog input functions in SOT-23-5 package. It significantly improves system reliability and accuracy compared to separate ICs or discrete components. The SGM824 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 SGM824 offers a watchdog input and a complementary active-high reset.

The SGM824 is available in a Green SOT-23-5 package. It operates over an ambient temperature range of -40°C to $+125^{\circ}\text{C}$.

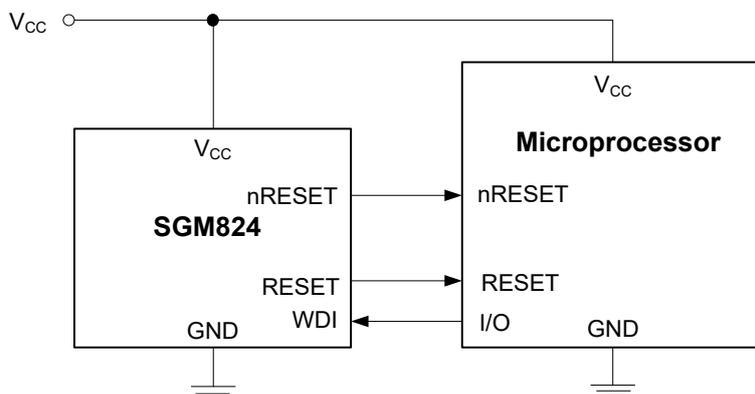
FEATURES

- **Ultra-Low Supply Current:** $< 1\mu\text{A}$ (TYP)
- **Precision Supply-Voltage Monitor**
 - ♦ 4.63V for SGM824-L
 - ♦ 3.08V for SGM824-T
 - ♦ 2.93V for SGM824-S
 - ♦ 2.63V for SGM824-R
- **Two Reset Output Options**
 - ♦ Push-Pull nRESET
 - ♦ Push-Pull RESET
- **Guaranteed Reset Valid at $V_{CC} = 1\text{V}$**
- **Fully Specified over Temperature**
- **200ms Reset Pulse Width**
- **Power-Supply Transient Immunity**
- **Watchdog Timer with 1.6s Timeout**
- **Debounced TTL/CMOS-Compatible**
- **No External Components**
- **-40°C to $+125^{\circ}\text{C}$ Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

APPLICATIONS

Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical μ P Power Monitoring

TYPICAL APPLICATION



PACKAGE/ORDERING INFORMATION

| MODEL | RESET THRESHOLD (V) | PACKAGE DESCRIPTION | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|--------|---------------------|---------------------|-----------------|-----------------|---------------------|
| SGM824 | 4.63 | SOT-23-5 | SGM824-LXN5G/TR | MZ1XX | Tape and Reel, 3000 |
| | 3.08 | SOT-23-5 | SGM824-TXN5G/TR | MG9XX | Tape and Reel, 3000 |
| | 2.93 | SOT-23-5 | SGM824-SXN5G/TR | MGAXX | Tape and Reel, 3000 |
| | 2.63 | SOT-23-5 | SGM824-RXN5G/TR | MGBXX | Tape and Reel, 3000 |

MARKING INFORMATION

NOTE: XX = Date Code.

YYY X X

Date Code - Week
 Date Code - Year
 Serial Number

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, θ_{JA} 234°C/W

Junction Temperature +150°C

Storage Temperature Range -65°C to +150°C

Lead Temperature (Soldering, 10s) +260°C

ESD Susceptibility

HBM 4000V

MM 400V

CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Ambient Temperature Range -40°C to +125°C

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.

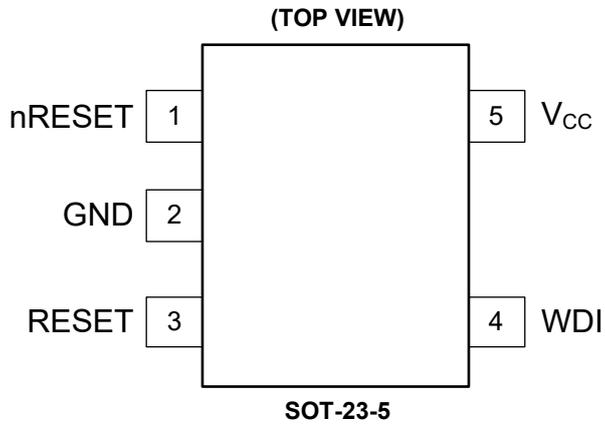
ESD SENSITIVITY CAUTION

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

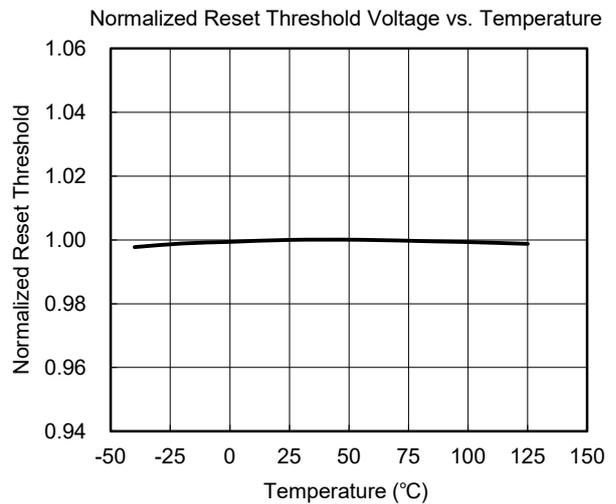
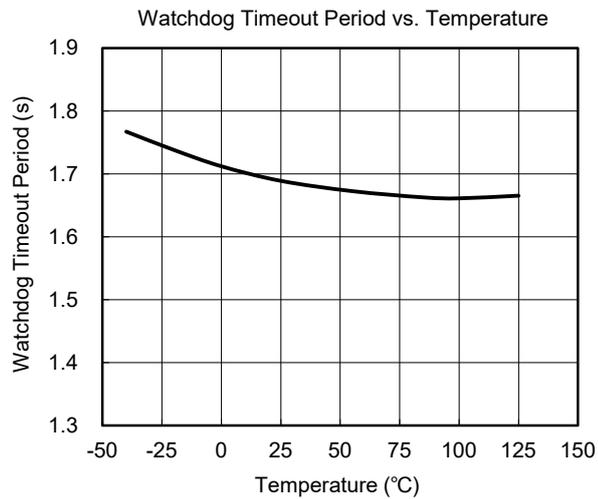
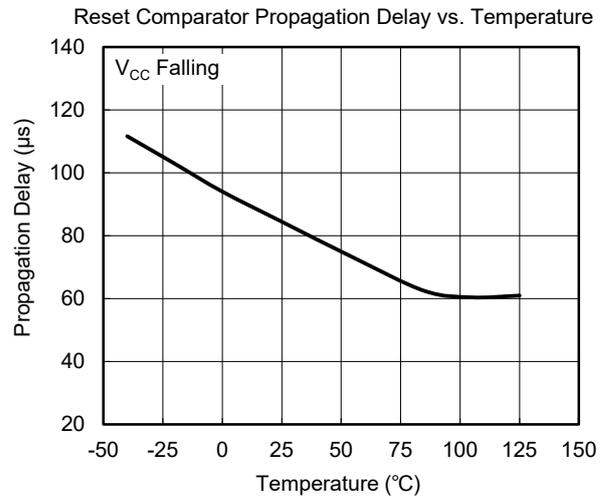
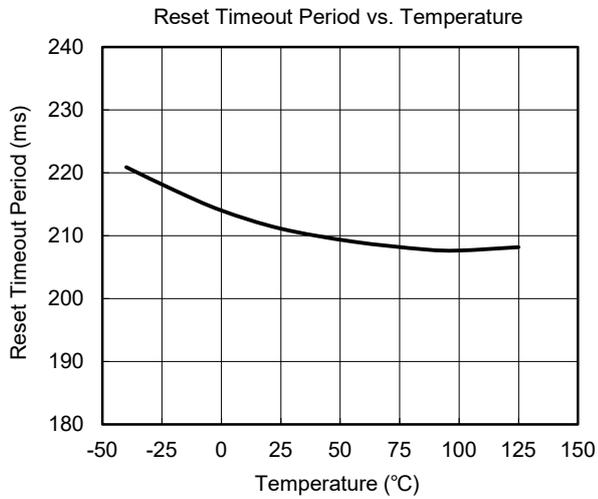
| NAME | FUNCTION |
|-----------------|---|
| nRESET | Active-Low Reset Output. Pulses low for 200ms when triggered, and remains low whenever V _{CC} is below the reset threshold. It remains low for 200ms after one of the following occurs: V _{CC} rises above the reset threshold, or the watchdog triggers a reset. |
| GND | Ground. 0V ground reference for all signals. |
| RESET | Active-High Reset Output. Inverse of nRESET. |
| 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

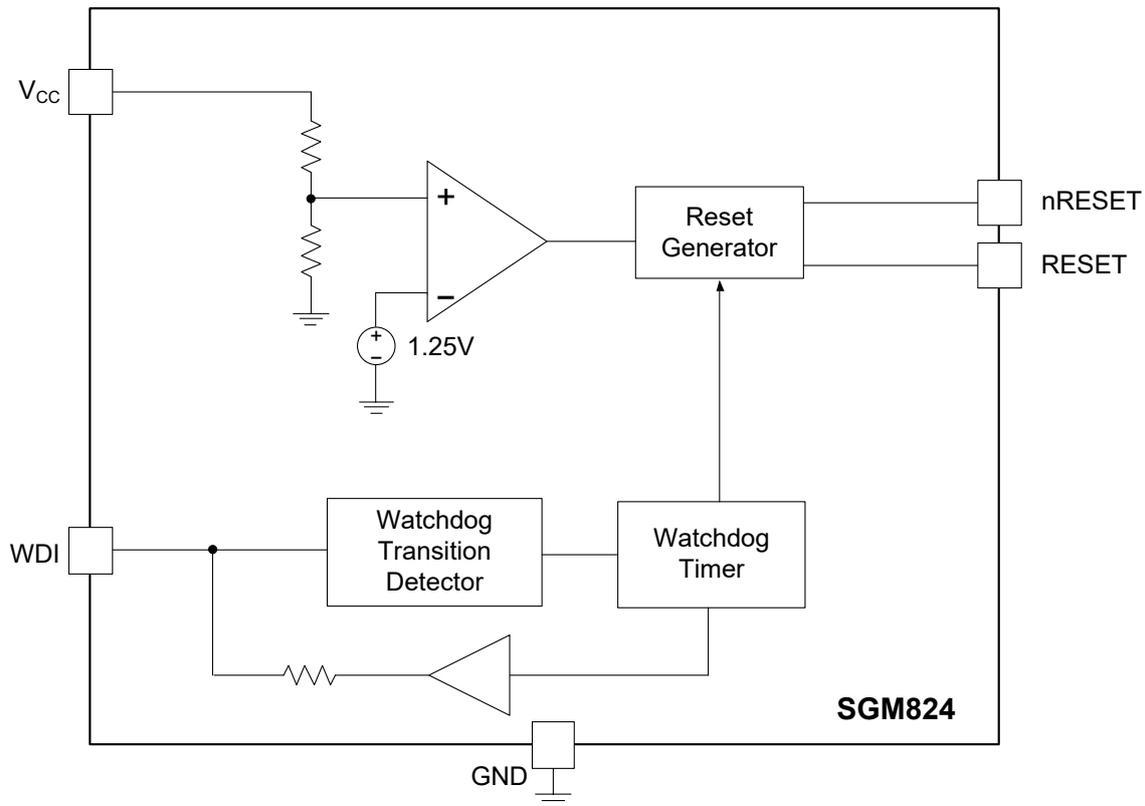
($T_A = +25^\circ\text{C}$, $V_{CC} = 4.73\text{V}$ to 5.5V for SGM824-L, $V_{CC} = 3.14\text{V}$ to 5.5V for SGM824-T, $V_{CC} = 2.99\text{V}$ to 5.5V for SGM824-S, $V_{CC} = 2.68\text{V}$ to 5.5V for SGM824-R, Full = -40°C to $+125^\circ\text{C}$, unless otherwise noted.)

| PARAMETER | | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---------------------|--|---|------|---------------------|------|-----------------------|
| Operating Voltage Range (V_{CC}) | | | Full | 1 | | 5.5 | V |
| Supply Current (I_{SUPPLY}) | | $V_{CC} = 3.6\text{V}$ | Full | | 0.5 | 1.2 | μA |
| | | $V_{CC} = 5.5\text{V}$ | Full | | 0.7 | 1.4 | |
| Reset Threshold (V_{RST}) | | SGM824-L | $+25^\circ\text{C}$ | 4.55 | 4.63 | 4.70 | V |
| | | | Full | 4.54 | 4.63 | 4.73 | |
| | | SGM824-T | $+25^\circ\text{C}$ | 3.03 | 3.08 | 3.13 | |
| | | | Full | 3.02 | 3.08 | 3.14 | |
| | | SGM824-S | $+25^\circ\text{C}$ | 2.88 | 2.93 | 2.98 | |
| | | | Full | 2.87 | 2.93 | 2.99 | |
| SGM824-R | $+25^\circ\text{C}$ | 2.59 | 2.63 | 2.67 | | | |
| | Full | 2.58 | 2.63 | 2.68 | | | |
| Reset Threshold Hysteresis (V_{HYS}) | | SGM824-L | $+25^\circ\text{C}$ | | 20 | | mV |
| | | SGM824-T | $+25^\circ\text{C}$ | | 14 | | |
| | | SGM824-S | $+25^\circ\text{C}$ | | 13 | | |
| | | SGM824-R | $+25^\circ\text{C}$ | | 12 | | |
| Reset Threshold Temperature Coefficient | | | Full | | 20 | | ppm/ $^\circ\text{C}$ |
| Reset Pulse Width (t_{RP}) | | | Full | 140 | 200 | 290 | ms |
| nRESET Output Voltage | | V_{OH} | SGM824-L, $V_{CC} = V_{RST(MAX)}$, $I_{SOURCE} = 120\mu\text{A}$ | Full | $V_{CC} - 1.5$ | | V |
| | | | SGM824-T/S/R, $V_{CC} = V_{RST(MAX)}$, $I_{SOURCE} = 30\mu\text{A}$ | Full | $0.8 \times V_{CC}$ | | |
| | | V_{OL} | SGM824-L, $V_{CC} = V_{RST(MIN)}$, $I_{SINK} = 3.2\text{mA}$ | Full | | 0.4 | |
| | | | SGM824-T/S/R, $V_{CC} = V_{RST(MIN)}$, $I_{SINK} = 1.2\text{mA}$ | Full | | 0.3 | |
| $V_{CC} = 1\text{V}$, V_{CC} falling, $I_{SINK} = 50\mu\text{A}$ | Full | | | 0.3 | | | |
| nRESET Output Short-Circuit Current (I_{SOURCE}) | | SGM824-L, nRESET = 0V, $V_{CC} = 5.5\text{V}$ | Full | | | 460 | μA |
| | | SGM824-T/S/R, nRESET = 0V, $V_{CC} = 3.6\text{V}$ | Full | | | 430 | |
| RESET Output Voltage | | V_{OH} | $V_{CC} > 1.8\text{V}$, $I_{SOURCE} = 150\mu\text{A}$ | Full | $0.8 \times V_{CC}$ | | V |
| | | V_{OL} | SGM824-L, $V_{CC} = V_{RST(MAX)}$, $I_{SINK} = 3.2\text{mA}$ | Full | | 0.4 | |
| | | | SGM824-T/S/R, $V_{CC} = V_{RST(MAX)}$, $I_{SINK} = 1.2\text{mA}$ | Full | | 0.3 | |
| V_{CC} to Reset Delay (t_{RD}) | | $V_{RST} - V_{CC} = 100\text{mV}$ | $+25^\circ\text{C}$ | | 84 | | μs |
| Watchdog Timeout Period (t_{WD}) | | | Full | 1.1 | 1.6 | 2.4 | sec |
| WDI Pulse Width (t_{WP}) | | $V_{IL} = 0\text{V}$, $V_{IH} = V_{CC}$ | Full | 90 | | | ns |
| WDI Input Threshold | | Low | $V_{CC} = 5\text{V}$ | Full | | 0.8 | V |
| | | High | $V_{CC} = 5\text{V}$ | Full | 3.5 | | |
| | | Low | $V_{RST(MAX)} < V_{CC} < 3.6\text{V}$ | Full | | 0.8 | |
| | | High | $V_{RST(MAX)} < V_{CC} < 3.6\text{V}$ | Full | $0.7 \times V_{CC}$ | | |
| WDI Input Current | | WDI = V_{CC} , time average | Full | | 0.02 | 0.5 | μA |
| | | WDI = 0V, time average | Full | -0.5 | -0.01 | | |

TYPICAL PERFORMANCE CHARACTERISTICS



FUNCTIONAL BLOCK DIAGRAM



DETAILED DESCRIPTION

Reset Output

A microprocessor’s (μP ’s) reset input starts the μP in a known state. The SGM824 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 ($V_{RST} + V_{HYS}$), 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_{RST}) (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. RESET on the SGM824 is the inverse of nRESET.

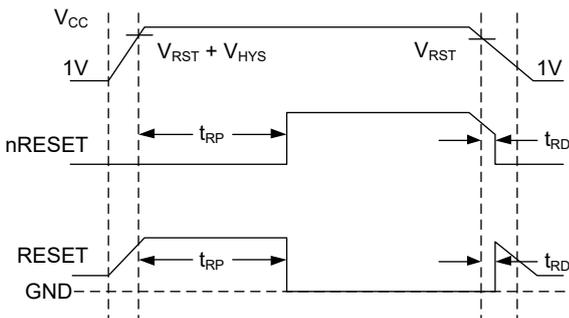


Figure 1. Reset Timing Diagram

Watchdog Input

On the SGM824, 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 10 μA and the maximum allowable load capacitance is 200pF.

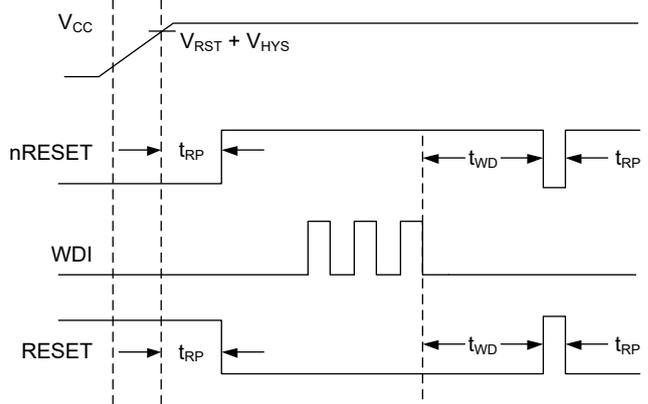


Figure 2. Watchdog Timing Relationship

APPLICATION INFORMATION

Interfacing to μ Ps with Bidirectional Reset Pins

The nRESET output maximum pull-up current is $460\mu\text{A}$ for L version ($430\mu\text{A}$ for T/S/R versions). This allows μ Ps with bidirectional resets, such as the 68HC11, to force nRESET low when the SGM824 is pulling nRESET high (Figure 3).

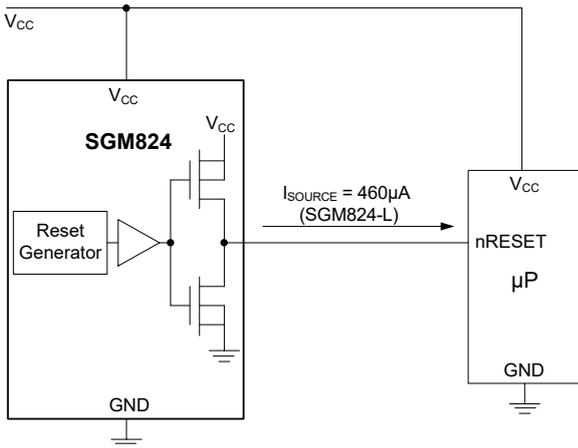


Figure 3. Interfacing to μ P with Bidirectional Resets

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 μ P during power-up, power-down and brownout conditions.

An optional $0.1\mu\text{F}$ bypass capacitor mounted close to V_{CC} provides additional transient immunity.

Watchdog Input Current

The SGM824 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.

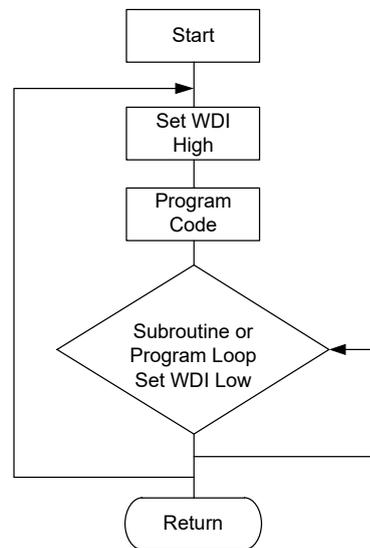


Figure 4. Watchdog Flow Diagram

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 |

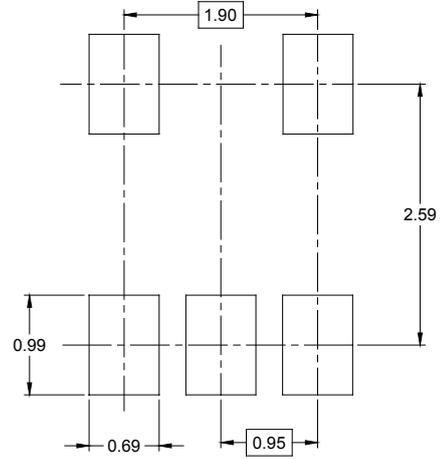
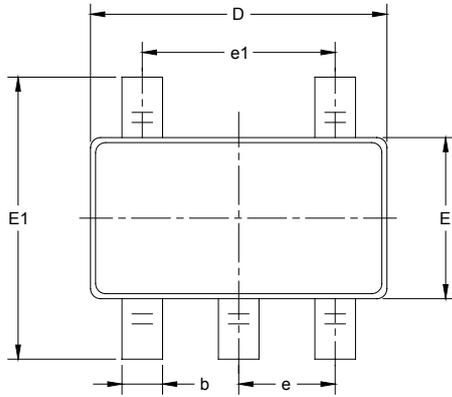
| JANUARY 2020 – REV.A to REV.A.1 | Page |
|---|-------------|
| Changed Electrical Characteristics section | 4 |
| Changed Typical Performance Characteristics section | 5 |
| Changed Figure 1..... | 7 |

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

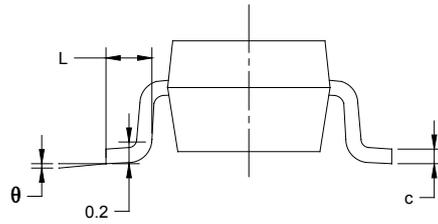
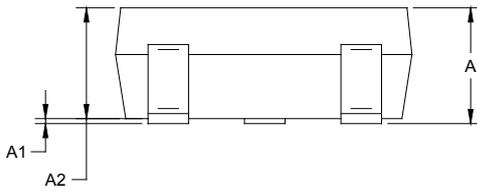
PACKAGE INFORMATION

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

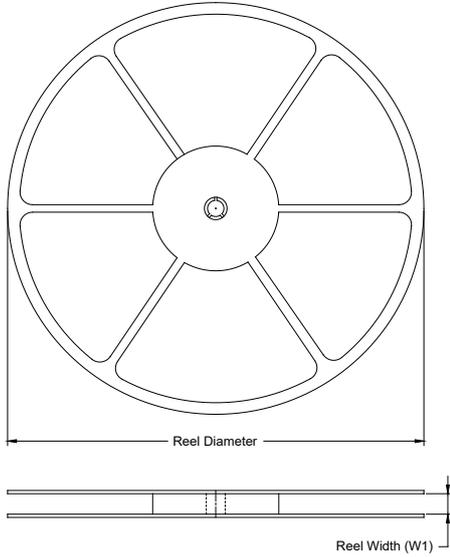


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|----------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 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° |

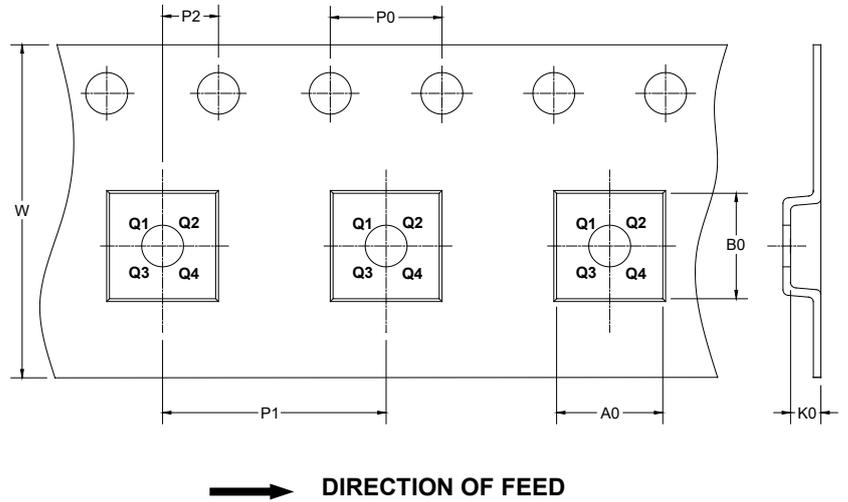
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

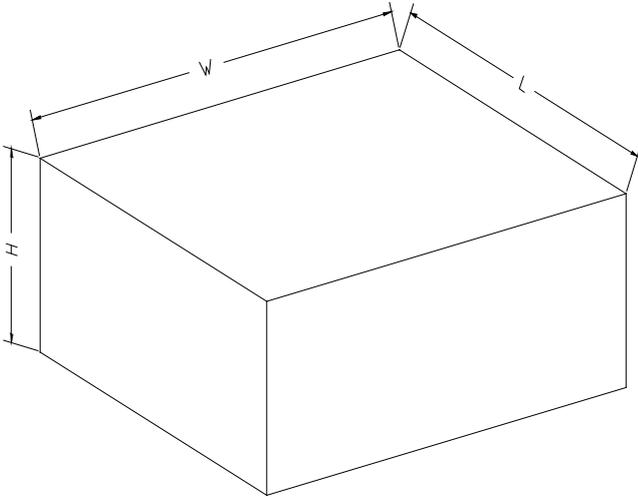
KEY PARAMETER LIST OF TAPE AND REEL

| 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

PACKAGE INFORMATION

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