SGM824A
5-Pin Microprocessor Supervisory Circuit with Watchdog Timer

GENERAL DESCRIPTION

The SGM824A is a complete microprocessor supervisory device which combines reset and watchdog functions in a SOT-23-5 package. System reliability is significantly improved by such integration compared to the designs with individual ICs or discrete components. The SGM824A also features an excellent transient immunity to ignore fast V_{CC} transients.

The device has an active-low reset output (nRESET) that is activated by a watchdog expiry event or due to a low V_{CC} voltage. The nRESET output is guaranteed to be in the correct logic state even if V_{CC} falls down to 1V. The device also has a complementary active-high reset output (RESET). The SGM824A is offered in three fixed V_{CC} reset threshold voltages.

The SGM824A is available in a Green SOT-23-5 package. It operates over an ambient temperature range of -40℃ to +125℃.

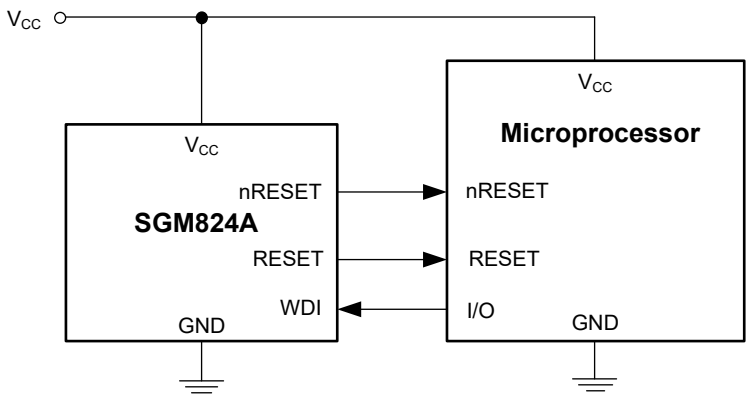
FEATURES

- **Ultra-Low Supply Current: 0.64μA (TYP)**
- **Precision Supply-Voltage Monitor**
  - **2.19V for SGM824A-Y**
  - **1.67V for SGM824A-W**
  - **1.58V for SGM824A-V**
- **Two Reset Output Options**
  - **Push-Pull nRESET**
  - **Push-Pull RESET**
- **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**
- **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

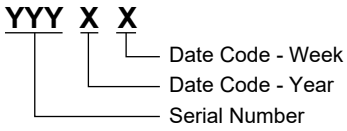


PACKAGE/ORDERING INFORMATION

MODEL	RESET THRESHOLD (V)	PACKAGE DESCRIPTION	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM824A	2.19	SOT-23-5	SGM824A-YXN5G/TR	CV8XX	Tape and Reel, 3000
	1.67	SOT-23-5	SGM824A-WXN5G/TR	CV7XX	Tape and Reel, 3000
	1.58	SOT-23-5	SGM824A-VXN5G/TR	CV6XX	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, θ_{JA} ..... 251℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 4000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Junction 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.

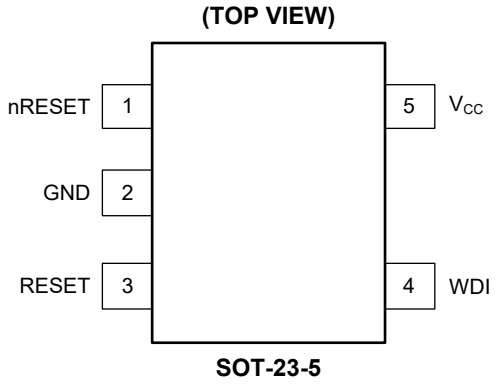
ESD SENSITIVITY CAUTION

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

PIN	NAME	I/O	FUNCTION
1	nRESET	O	Active-Low Reset Output. It delivers a 200ms (TYP) low pulse when activated. nRESET remains low if V_{CC} is below the reset threshold. It goes (or remains) low for 200ms after any of the following events: V_{CC} rises above the reset threshold or a watchdog expiry triggers a reset.
2	GND	–	Ground. 0V ground reference for all signals.
3	RESET	I	Active-High Reset Output. Inverse of nRESET.
4	WDI	I	Watchdog Input Pin. If WDI remains high or low for longer than the watchdog timeout period, the internal watchdog timer expires and a reset is triggered. The internal watchdog timer is cleared while a reset is asserted. The watchdog timer is also cleared if the WDI input is changed (on rising or falling edges). The watchdog feature is disabled if WDI is left open or if it is connected to a three-stated buffer output in Hi-Z state.
5	V_{CC}	I	Supply Voltage.

NOTE: I: input; O: output.

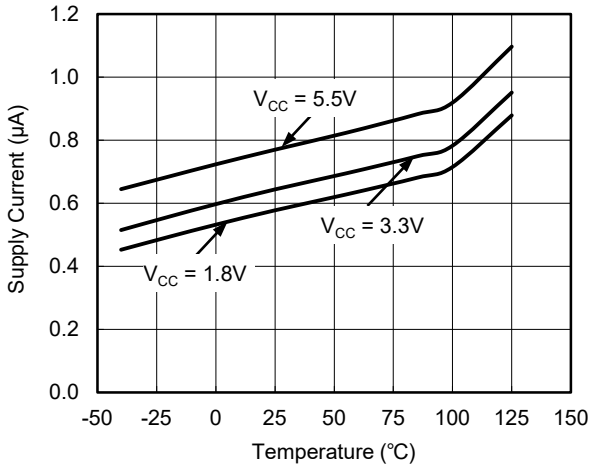
ELECTRICAL CHARACTERISTICS

(V_{CC} = 2.1V to 2.75V for SGM824A-Y, V_{CC} = 1.53V to 2.0V for SGM824A-W/V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

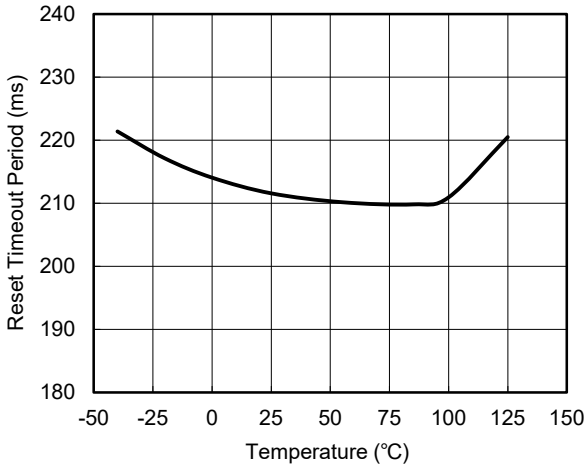
PARAMETER		CONDITIONS		MIN	TYP	MAX	UNITS
Operating Voltage Range (V_{CC})				1		5.5	V
Supply Current (I_{SUPPLY})		V_{CC} = 3.3V			0.64	1.60	μA
		V_{CC} = 5.5V			0.77	1.80	
Reset Threshold (V_{RST})		SGM824A-Y	T_J = +25℃	2.155	2.195	2.235	V
			T_J = -40℃ to +85℃	2.150	2.195	2.240	
			T_J = -40℃ to +125℃	2.105	2.195	2.285	
		SGM824A-W	T_J = +25℃	1.640	1.675	1.710	
			T_J = -40℃ to +85℃	1.635	1.675	1.715	
			T_J = -40℃ to +125℃	1.590	1.675	1.760	
		SGM824A-V	T_J = +25℃	1.550	1.585	1.620	
			T_J = -40℃ to +85℃	1.545	1.585	1.625	
			T_J = -40℃ to +125℃	1.515	1.585	1.655	
Reset Threshold Hysteresis (V_{HYS})		SGM824A-Y			11		mV
		SGM824A-W			8		
		SGM824A-V			8		
Reset Threshold Temperature Coefficient		T_J = -40℃ to +85℃			20		ppm/℃
Reset Pulse Width (t_{RP})				120	200	300	ms
nRESET Output Voltage	V_{OH}	V_{CC} ≥ 1.8V, I_{SOURCE} = 200μA, reset not asserted		0.8 × V_{CC}			V
		V_{CC} ≥ 3.15V, I_{SOURCE} = 500μA, reset not asserted		0.8 × V_{CC}			
		V_{CC} ≥ 4.75V, I_{SOURCE} = 800μA, reset not asserted		0.8 × V_{CC}			
	V_{OL}	V_{CC} ≥ 1.0V, I_{SINK} = 50μA, reset asserted				0.3	
		V_{CC} ≥ 1.2V, I_{SINK} = 100μA, reset asserted				0.3	
		V_{CC} ≥ 2.55V, I_{SINK} = 1.2mA, reset asserted				0.3	
		V_{CC} ≥ 4.25V, I_{SINK} = 3.2mA, reset asserted				0.4	
RESET Output Voltage	V_{OH}	V_{CC} ≥ 1.0V, I_{SOURCE} = 1μA, reset asserted		0.8 × V_{CC}			V
		V_{CC} ≥ 1.5V, I_{SOURCE} = 100μA, reset asserted		0.8 × V_{CC}			
		V_{CC} ≥ 2.55V, I_{SOURCE} = 500μA, reset asserted		0.8 × V_{CC}			
		V_{CC} ≥ 4.25V, I_{SINK} = 800μA, reset asserted		0.8 × V_{CC}			
	V_{OL}	V_{CC} ≥ 1.8V, I_{SINK} = 500μA, reset not asserted				0.3	
		V_{CC} ≥ 3.15V, I_{SINK} = 1.2mA, reset not asserted				0.3	
		V_{CC} ≥ 4.75V, I_{SINK} = 3.2mA, reset not asserted				0.4	
V_{CC} to Reset Delay (t_{RD})		V_{RST} - V_{CC} = 100mV			90		μs
Watchdog Timeout Period (t_{WD})				1.1	1.6	2.4	s
WDI Pulse Width (t_{WP})		V_{IL} = 0V, V_{IH} = V_{CC}		90			ns
WDI Input Threshold	Low	V_{CC} = 5.5V				0.8	V
	High	V_{CC} = 5.5V		3.5			
	Low	$V_{RST(MAX)}$ < V_{CC} < 3.3V				0.6	
	High	$V_{RST(MAX)}$ < V_{CC} < 3.3V		0.7 × V_{CC}			
WDI Input Current		WDI = V_{CC}, time average			0.01	0.5	μA
		WDI = 0V, time average		-0.5	-0.01		

TYPICAL PERFORMANCE CHARACTERISTICS

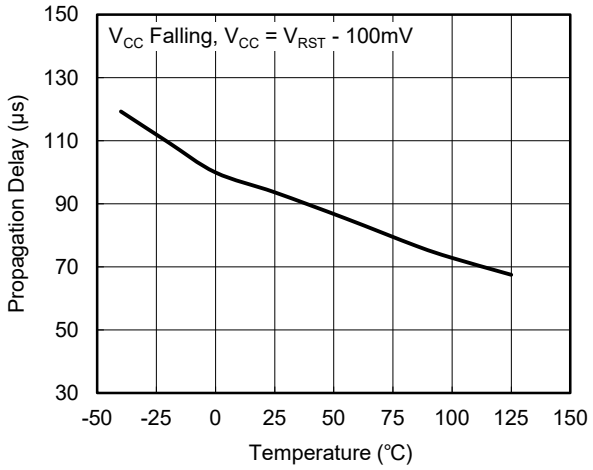
Supply Current vs. Temperature



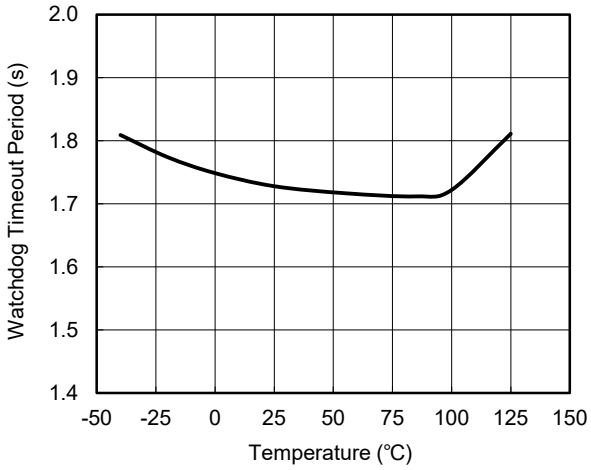
Reset Timeout Period vs. Temperature



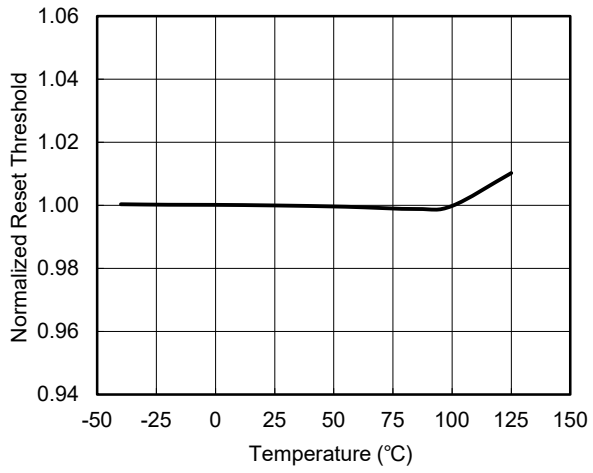
V_{CC} to Reset Propagation Delay vs. Temperature



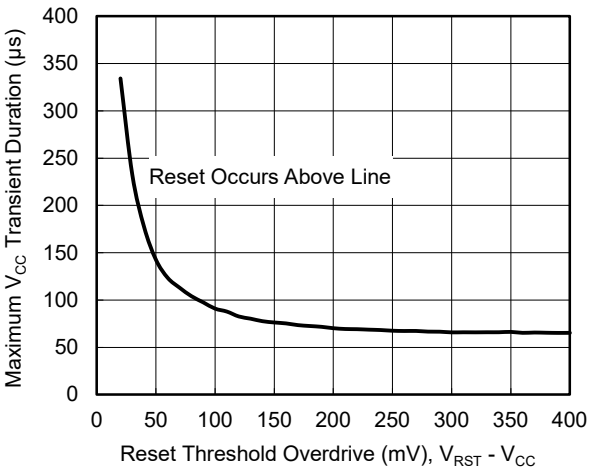
Watchdog Timeout Period vs. Temperature



Normalized Reset Threshold Voltage vs. Temperature

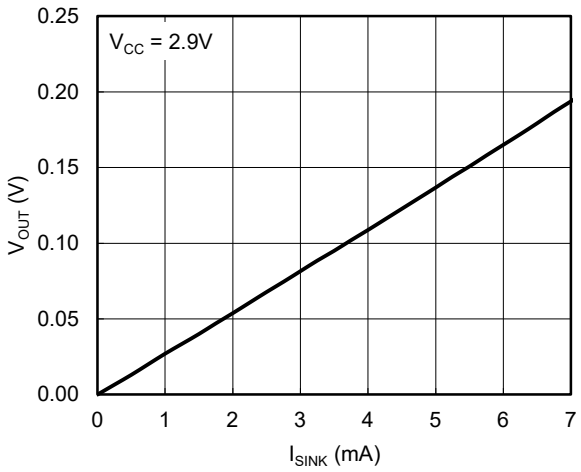


Maximum V_{CC} Transient Duration vs. Reset Threshold Overdrive

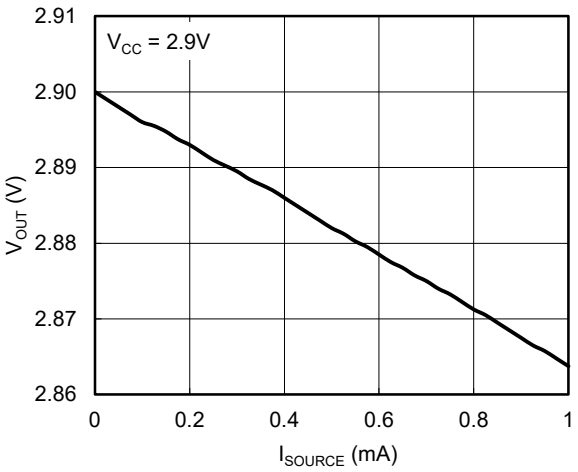


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

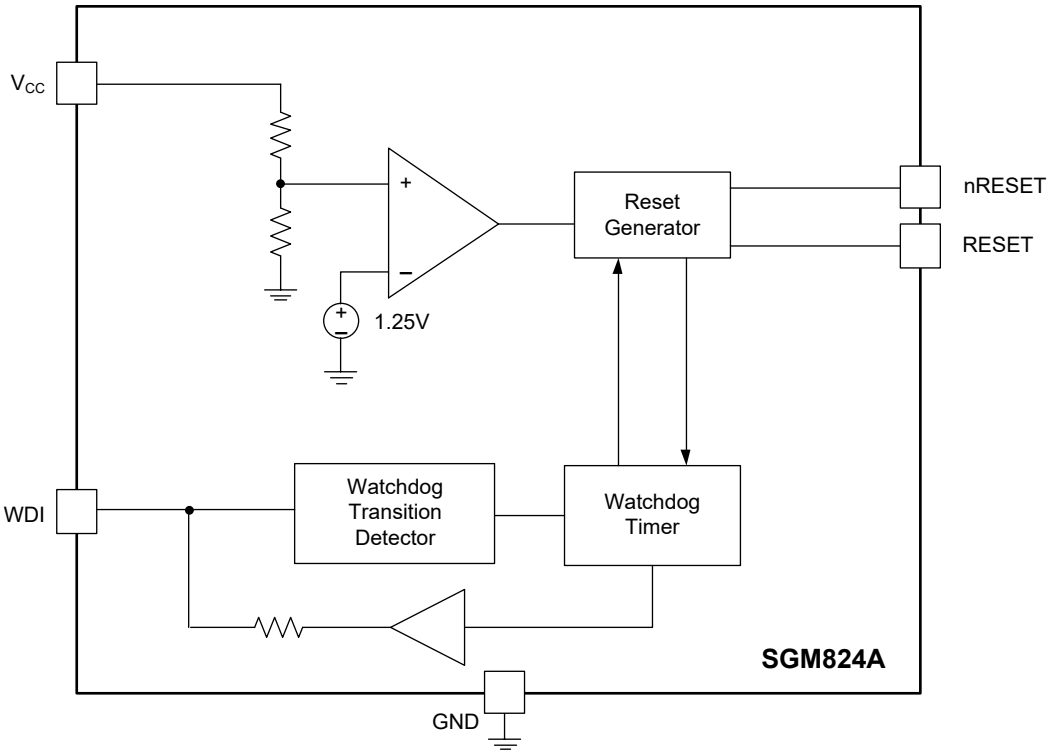
Voltage Output (V_{OUT}) Low vs. I_{SINK}



Voltage Output (V_{OUT}) High vs. I_{SOURCE}



FUNCTIONAL BLOCK DIAGRAM



DETAILED DESCRIPTION

Reset Output

The reset input of a microprocessor (μP) initiates it to a known state. The SGM824A supervisory circuit asserts a reset to the supervised μP to prevent the code-execution errors that may occur due to power-up, power-down, brownout conditions or other transients. nRESET is guaranteed to be a logic low for V_{CC} voltage down to 1V. During power-up, when V_{CC} exceeds the rising threshold voltage (V_{RST} + V_{HYS}), an internal timer keeps nRESET in low state for the reset timeout period (t_{RP}) before nRESET returns to the high state (Figure 1).

If V_{CC} drops below the falling threshold voltage (V_{RST}) (a brownout condition occurs), a reset is asserted and nRESET goes low. In general, nRESET remains low for the t_{RP} (200ms, TYP) period every time after the last event. So, if during the low period of nRESET, V_{CC} goes up and dips below V_{RST} again, the internal timer will restart for a new t_{RP} period. The nRESET output can source and sink current. RESET on the SGM824A is the inverse of nRESET.

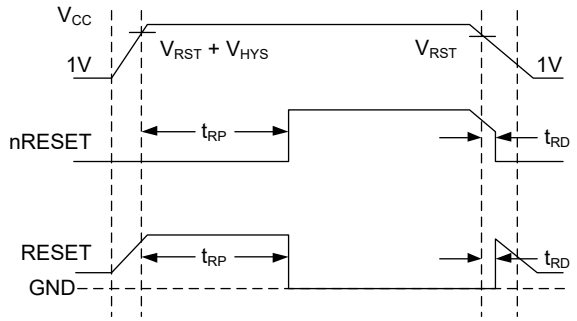


Figure 1. Reset Timing Diagram

Watchdog Input

The internal watchdog circuit monitors the μP's activity by checking the WDI input. If the μP does not toggle the WDI within the watchdog t_{WD} (1.6s, TYP) period, reset asserts. So, the code should be written such that successive toggles on WDI occur in periods not longer than the lowest t_{WD} time to reset the internal watchdog timer and prevent μP reset when the code is running normally. The watchdog timer is cleared by either toggling WDI or by a pulse with a duration as short as 90ns. While the reset is asserted, the watchdog timer is cleared and timer does not count. It starts counting when the reset is released (Figure 2).

To disable the watchdog function, leave the WDI pin open. If WDI is driven by a 3-state buffer, set it to the Hi-Z state. In this case the buffer leakage current should not exceed 10μA. The maximum capacitance seen on the WDI pin should be less than 200pF to assure that watchdog remains disabled. The watchdog input is internally oscillating when it is left open to clear the watchdog timer and prevent it from generating a reset. It is driven low during the first 7/8 of the watchdog timeout period and driven high in the last 1/8 of that. For example if the WDI input is open and the watchdog timeout is 1.6s, the watchdog timer will automatically clear every 1.4s and reset will not occur.

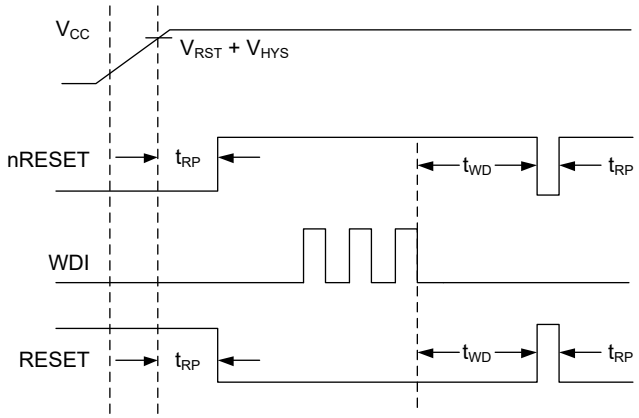


Figure 2. Watchdog Timing Relationship

APPLICATION INFORMATION

Using SGM824A with Microprocessors with Bidirectional Reset Pins

Some microprocessors can internally force their reset pins low to assert a reset (bidirectional reset pins). The low pull-up current of the SGM824A allows using of them along with the microprocessors with bidirectional resets, such as the 68HC11. The microprocessor can force nRESET low when nRESET is pulled high by the SGM824A with no issues (Figure 3).

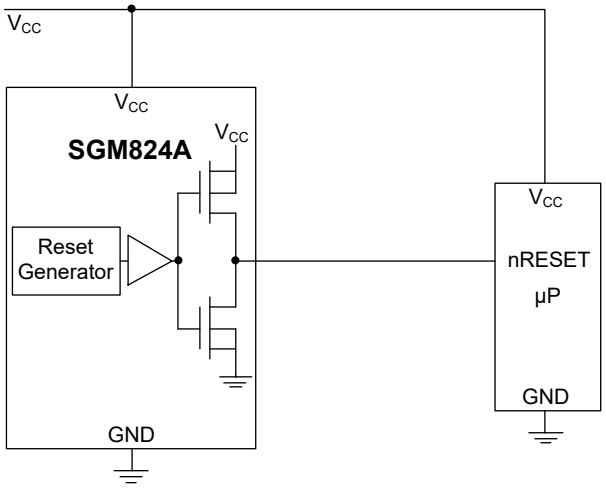


Figure 3. Interfacing to µP with Bidirectional Resets

Negative-Going V_{CC} Transients

The SGM824A is quite immune to short time, negative V_{CC} transients (glitches) that normally should not require the entire system to shut down. Resets are applied to the microprocessor during power-up, power-down and brownout conditions and not when an insignificant V_{CC} transient occurs.

An optional 0.1µF bypass capacitor can be placed close to V_{CC} pin for additional transient immunity.

Watchdog Input Current

The WDI input is internally driven by a buffer and series resistor from an internal counter chain stage of the watchdog. Therefore, when WDI is left open, the watchdog timer is automatically cleared before timeout (by an internal low-high-low pulse).

To get the minimum WDI input current (minimum power loss), leave WDI low for the majority of the timeout period and send a high pulse within the first 7/8 of the timeout period for clearing the watchdog timer.

Watchdog Software Considerations

To have a more effective watchdog in software monitoring, rather than generating pulses by a code segment, set and reset the WDI input at different points of the program code. For example, set it in the main program and reset it in a periodic timing interrupt. For example if WDI is toggled within an unwanted infinite loop, it will continuously reset watchdog as a normal condition and the processor is not reset.

Figure 4 shows an example of a good flow diagram. The WDI is set high at the beginning of the program, and is set low at the beginning of every subroutine or loop, then is set high again when the program returns to the beginning. If the processor hangs in any subroutine, the WDI toggling will not occur and the watchdog will reset the processor and correct the situation.

The reset output may also be connected to an interrupt input of the µP for a corrective action if preferred.

Note that such watchdog control schemes may not be optimal if the total power consumption is critical as discussed in the watchdog input current section.

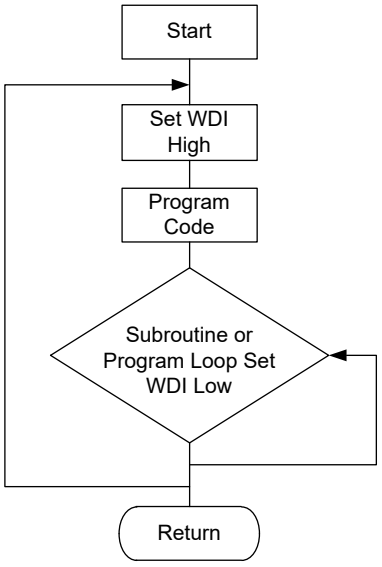


Figure 4. Watchdog Flow Diagram

REVISION HISTORY

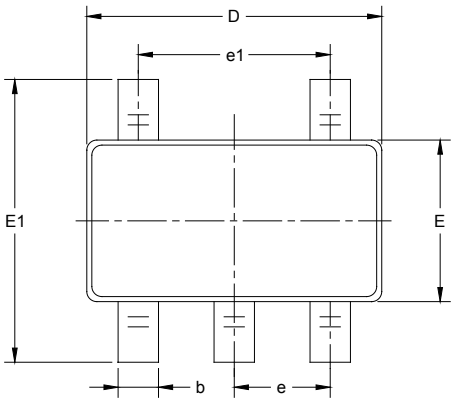
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

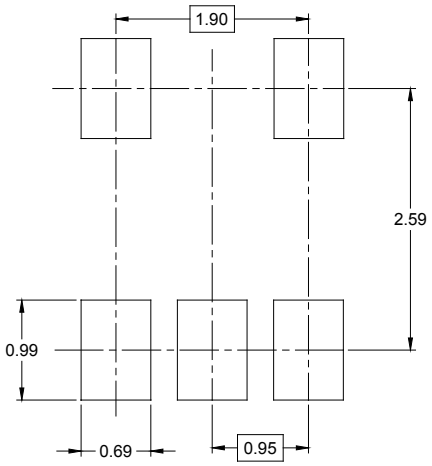
OCTOBER 2020 – REV.A to REV.A.1	Page
Added 2.19V Reset Threshold	1, 2, 4

Changes from Original (JULY 2020) to REV.A	Page
Changed from product preview to production data	All

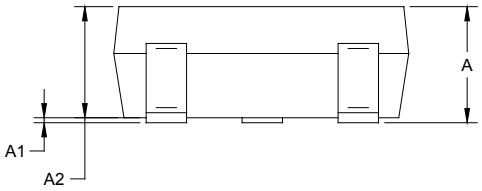
PACKAGE OUTLINE DIMENSIONS

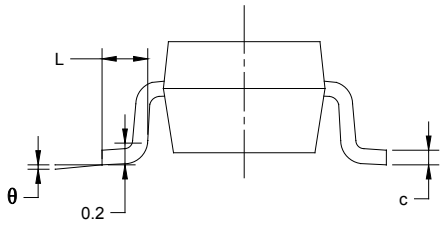
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

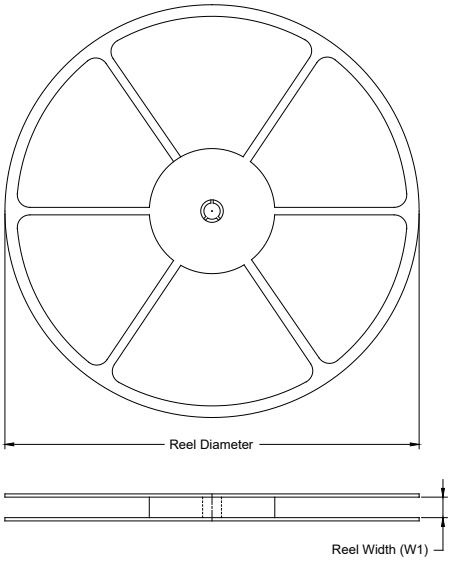




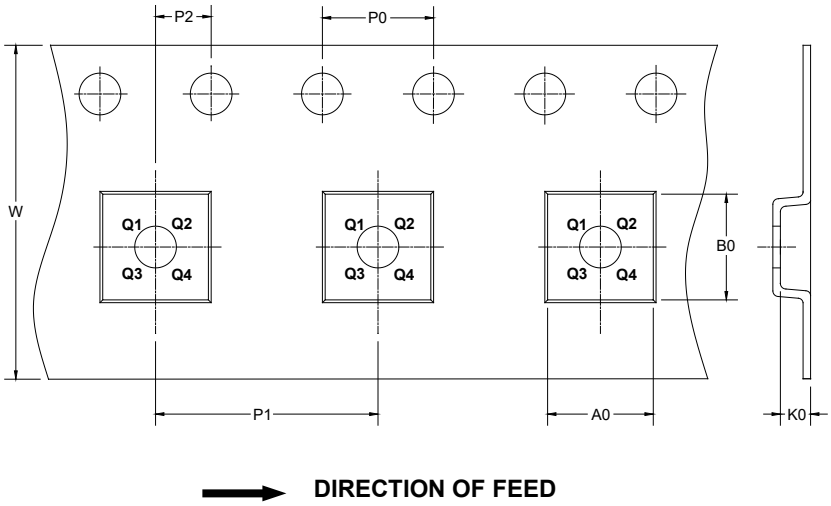
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 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



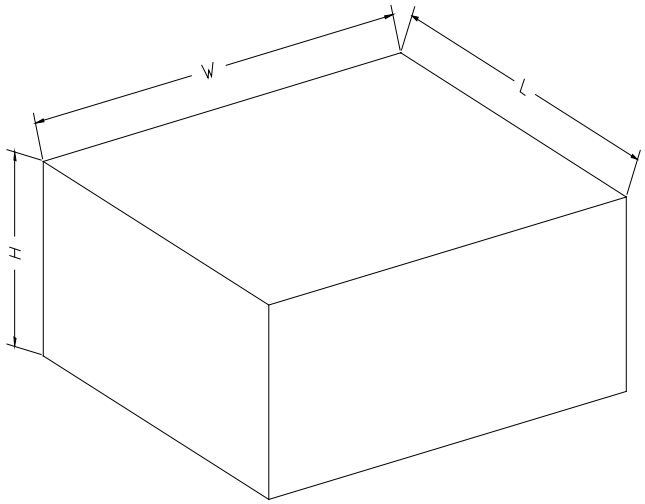
NOTE: The picture is only for reference. Please make the object as the standard.

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