SGM706S
8-Pin Microprocessor Supervisory Circuit with Watchdog Timer and Manual Reset

GENERAL DESCRIPTION

The SGM706S is an integrated microprocessor supervisory device. Compared with the design using a single IC or discrete components, this integration design has the advantage of improving system stability and accuracy. The SGM706S can be reset under power-up, power-down or even voltage reduction brownout conditions. When V_{CC} is as low as 1V, the reset output can still operate. And it also has a low-level active manual reset nMR function.

The SGM706S provides an independent watchdog monitoring circuit, which is activated when its WDI input has not toggled for more than 1.68s.

When the power supply fails, the battery power is low, or the additional power supply needs to be monitored, it can be realized by the 1.25V threshold detector of the SGM706S.

The SGM706S is available in a Green SOIC-8 package. It operates over an junction temperature range of -40℃ to +125℃.

TYPICAL APPLICATION

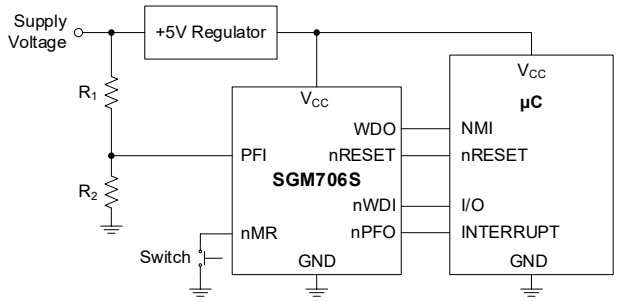


Figure 1. Typical Application Circuit

FEATURES

- **Ultra-Low Supply Current: < 1µA (TYP)**
- **Precision Supply-Voltage Monitor**
  - **4.63V for SGM706S-L**
  - **4.38V for SGM706S-M**
  - **4.0V for SGM706S-J**
  - **3.08V for SGM706S-T**
  - **2.93V for SGM706S-S**
  - **2.63V for SGM706S-R**
  - **2.32V for SGM706S-Z**
  - **1.63V for SGM706S-X**
- **Guaranteed nRESET Valid at V_{CC} = 1V**
- **210ms Reset Pulse Width**
- **Debounced TTL/CMOS-Compatible**
- **Manual Reset Input**
- **Watchdog Timer with 1.68s Timeout**
- **Voltage Monitor for Power-Fail or Low-Battery Warning**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green SOIC-8 Package**

APPLICATIONS

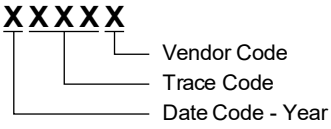
Computers
Battery-Powered Applications
Portable Equipment
Automotive Equipment
Safety Systems
Intelligent Instruments
Critical µC Power Monitoring
Microprocessor Systems

PACKAGE/ORDERING INFORMATION

MODEL	RESET THRESHOLD (V)	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM706S-L	4.63	SOIC-8	-40℃ to +125℃	SGM706S-LXS8G/TR	0OCXS8 XXXXX	Tape and Reel, 4000
SGM706S-M	4.38	SOIC-8	-40℃ to +125℃	SGM706S-MXS8G/TR	0EEXS8 XXXXX	Tape and Reel, 4000
SGM706S-J	4.0	SOIC-8	-40℃ to +125℃	SGM706S-JXS8G/TR	0OBXS8 XXXXX	Tape and Reel, 4000
SGM706S-T	3.08	SOIC-8	-40℃ to +125℃	SGM706S-TXS8G/TR	0ODXS8 XXXXX	Tape and Reel, 4000
SGM706S-S	2.93	SOIC-8	-40℃ to +125℃	SGM706S-SXS8G/TR	033XS8 XXXXX	Tape and Reel, 4000
SGM706S-R	2.63	SOIC-8	-40℃ to +125℃	SGM706S-RXS8G/TR	032XS8 XXXXX	Tape and Reel, 4000
SGM706S-Z	2.32	SOIC-8	-40℃ to +125℃	SGM706S-ZXS8G/TR	0OEXS8 XXXXX	Tape and Reel, 4000
SGM706S-X	1.63	SOIC-8	-40℃ to +125℃	SGM706S-XXS8G/TR	0EFXS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Trace Code and 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
- SOIC-8, θ_{JA} ..... 150.8℃/W
- SOIC-8, θ_{JB} ..... 104.5℃/W
- SOIC-8, θ_{JC} ..... 97.9℃/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.

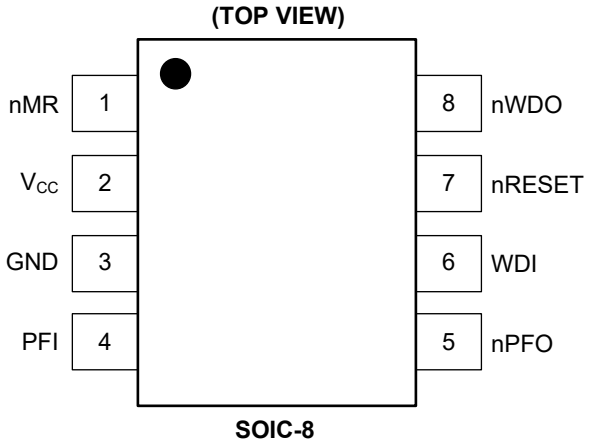
ESD SENSITIVITY CAUTION

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	FUNCTION
1	nMR	Manual Reset Input Pin. It is an active-low reset input with an internal 200μA (V_{CC} = +5V) pull-up current. nMR can be driven by a CMOS/TTL logic or by a switch shorting to GND. If not used, leave it open or connect it to V_{CC}.
2	V_{CC}	Supply Voltage Pin.
3	GND	Ground.
4	PFI	Power-Fail Voltage Monitor Input Pin. nPFO goes low when PFI is lower than 1.25V. If not used, connect PFI to GND or V_{CC}.
5	nPFO	Power-Fail Voltage Monitor Output Pin. nPFO goes low when PFI is lower than 1.25V. nPFO remains high when PFI is more than 1.25V.
6	WDI (1)	Watchdog Input Pin. If the WDI remains high or low for longer than the watchdog timeout period (1.68s, TYP), the internal watchdog timer will expire and nWDO will go low. The internal watchdog timer is kept clear while a reset is asserted or WDI is three-stated. The timer is also cleared if the WDI input is changed (on rising or falling edges). The watchdog feature is disabled if the WDI is left open or if it is connected to a three-stated buffer output.
7	nRESET	Active-Low Reset Output Pin. It delivers a 210ms (TYP) low pulse when activated. nRESET will remain low if V_{CC} is below the reset threshold or nMR is logic low. It goes (or remains) low for 210ms after any of the following events: V_{CC} rises above the reset threshold or the nMR input goes from low to high.
8	nWDO	Watchdog Output Pin. If WDI can not reach a rising edge or a falling edge in 1.68s, the watchdog timer will timeout. Meanwhile, nWDO is pulled low and remains low until the watchdog timer is cleared. nWDO goes low when V_{CC} is below the reset threshold. nWDO is different from nRESET in that it does not have a minimum pulse width. As long as V_{CC} is higher than the reset threshold, nWDO will immediately go high.

NOTE: If it requires the SGM706S to switch WDI from normal state to disable state, ensure that the WDI enters the high-Z state from high level.

ELECTRICAL CHARACTERISTICS

(V_{CC} = 4.780V to 5.5V for L Model; V_{CC} = 4.520V to 5.5V for M Model; V_{CC} = 4.130V to 5.5V for J Model; V_{CC} = 3.180V to 5.5V for T Model; V_{CC} = 3.025V to 5.5V for S Model; V_{CC} = 2.715V to 5.5V for R Model; V_{CC} = 2.395V for Z Model; V_{CC} = 1.685V for X Model, T_J = -40℃ to +125℃, typical values are at measured T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply							
Operating Voltage Range	V_{CC}			1.0		5.5	V
Supply Current	I_{SUPPLY}	V_{CC} = 3.6V			0.9	1.87	μA
		V_{CC} = 5.5V			1.07	2.17	μA
nRESET							
nRESET Threshold	V_{nRST}	SGM706S-L	T_J = +25℃	4.520	4.63	4.740	V
			T_J = -40℃ to +125℃	4.415		4.780	
		SGM706S-M	T_J = +25℃	4.275	4.38	4.485	
			T_J = -40℃ to +125℃	4.180		4.520	
		SGM706S-J	T_J = +25℃	3.905	4.0	4.095	
			T_J = -40℃ to +125℃	3.810		4.130	
		SGM706S-T	T_J = +25℃	3.005	3.08	3.155	
			T_J = -40℃ to +125℃	2.930		3.180	
		SGM706S-S	T_J = +25℃	2.860	2.93	3.000	
			T_J = -40℃ to +125℃	2.795		3.025	
		SGM706S-R	T_J = +25℃	2.565	2.63	2.695	
			T_J = -40℃ to +125℃	2.525		2.715	
		SGM706S-Z	T_J = +25℃	2.265	2.32	2.375	
			T_J = -40℃ to +125℃	2.225		2.395	
		SGM706S-X	T_J = +25℃	1.590	1.63	1.670	
			T_J = -40℃ to +125℃	1.565		1.685	
nRESET Threshold Hysteresis	V_{HYS}	SGM706S-L			20		mV
		SGM706S-M			19		
		SGM706S-J			18		
		SGM706S-T			14		
		SGM706S-S			13		
		SGM706S-R			12		
		SGM706S-Z			11		
		SGM706S-X			8		
nRESET Pulse Width	t_{RS}			70	210	340	ms
nRESET Output Voltage		I_{SOURCE} = 800μA		0.7 × V_{CC}			V
		I_{SINK} = 3.2mA				0.4	
		V_{CC} = 1V, I_{SINK} = 50μA				0.3	
VCC to nRESET Delay	t_{RD}	V_{nRST} - V_{CC} = 100mV			14		μs

ELECTRICAL CHARACTERISTICS (continued)

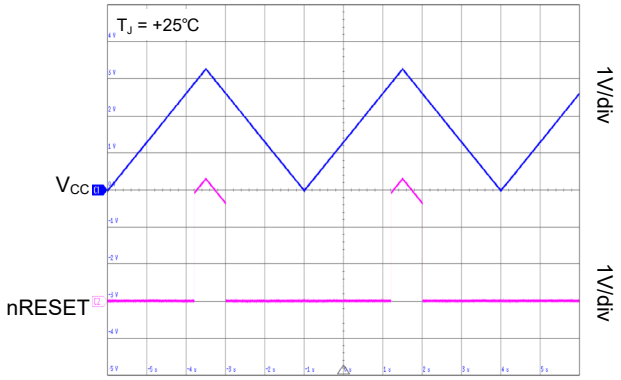
(V_{CC} = 4.780V to 5.5V for L Model; V_{CC} = 4.520V to 5.5V for M Model; V_{CC} = 4.130V to 5.5V for J Model; V_{CC} = 3.180V to 5.5V for T Model; V_{CC} = 3.025V to 5.5V for S Model; V_{CC} = 2.715V to 5.5V for R Model; V_{CC} = 2.395V for Z Model; V_{CC} = 1.685V for X Model, T_J = -40℃ to +125℃, typical values are at measured T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Watchdog						
Watchdog Timeout Period	t_{WD}		0.56	1.68	2.72	s
WDI Pulse Width	t_{WP}	V_{IL} = 0V, V_{IH} = V_{CC}	90			ns
WDI Low-Level Input Voltage	V_{IL_WDI}	V_{nRST_MAX} < V_{CC} < 5V			0.5	V
WDI High-Level Input Voltage	V_{IH_WDI}	V_{nRST_MAX} < V_{CC} < 5V	0.7 × V_{CC}			V
WDI Input Current		WDI = V_{CC}		0.01	1	μA
		WDI = 0V	-1	-0.01		
nWDO Output Voltage		I_{SOURCE} = 800μA	0.7 × V_{CC}			V
		I_{SINK} = 1.2mA			0.2	
Manual Reset						
nMR Pull-up Current		nMR = 0V, V_{CC} = 5V	150	200	250	μA
nMR Pulse Width	t_{MR}		320			ns
nMR Low-Level Input Voltage	V_{IL_nMR}				0.6	V
nMR High-Level Input Voltage	V_{IH_nMR}		2			V
nMR to nRESET Output Delay	t_{MD}				420	ns
PFI/nPFO						
PFI Input Threshold		V_{CC} = 5V	1.17	1.25	1.31	V
PFI Input Current				0.4	50	nA
nPFO Output Voltage		I_{SOURCE} = 800μA	0.7 × V_{CC}			V
		I_{SINK} = 3.2mA			0.3	

TYPICAL PERFORMANCE CHARACTERISTICS

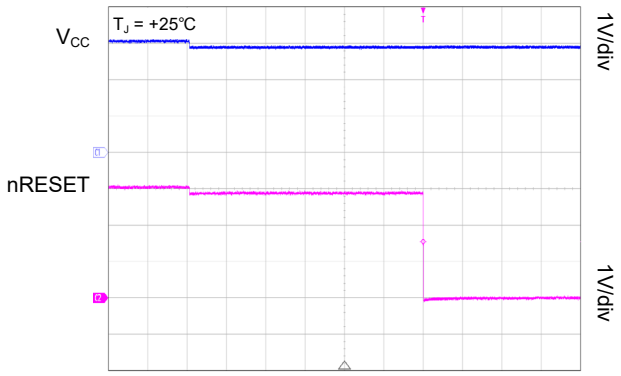
V_{CC} = 3.3V, unless otherwise noted.

nRESET Output Voltage vs. Supply Voltage



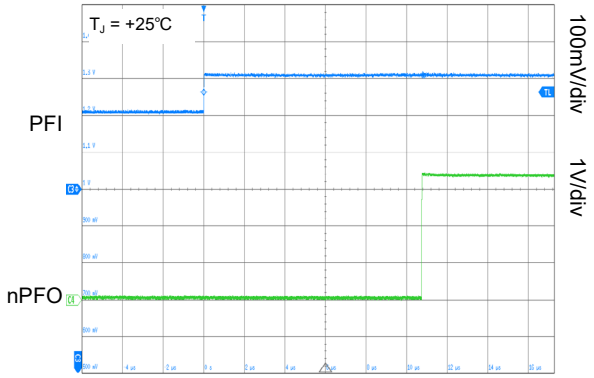
Time (1s/div)

nRESET Response Time



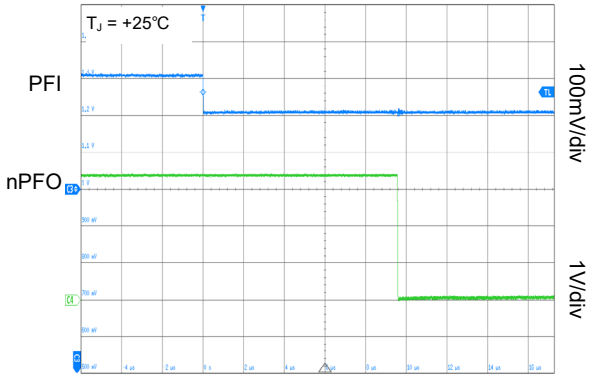
Time (2μs/div)

Power-Fail Comparator De-Assertion Response Time



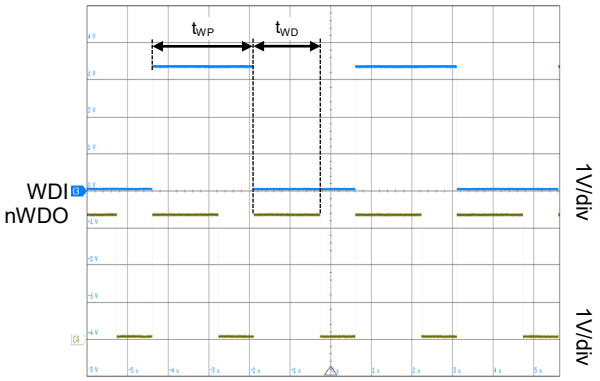
Time (2μs/div)

Power-Fail Comparator Assertion Response Time



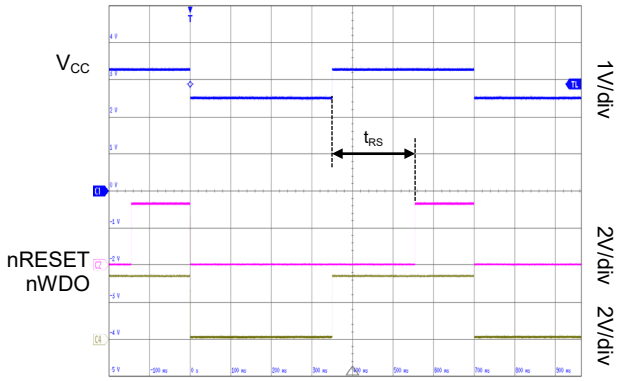
Time (2μs/div)

Watchdog Timing



Time (1s/div)

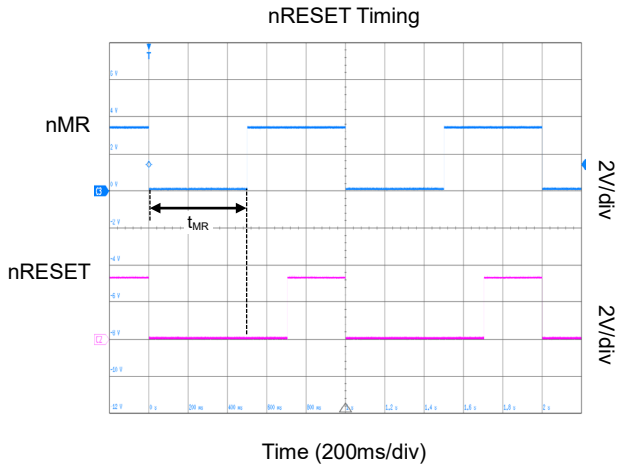
nRESET and nWDO Timing



Time (100ms/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

V_{CC} = 3.3V, unless otherwise noted.



FUNCTIONAL BLOCK DIAGRAM

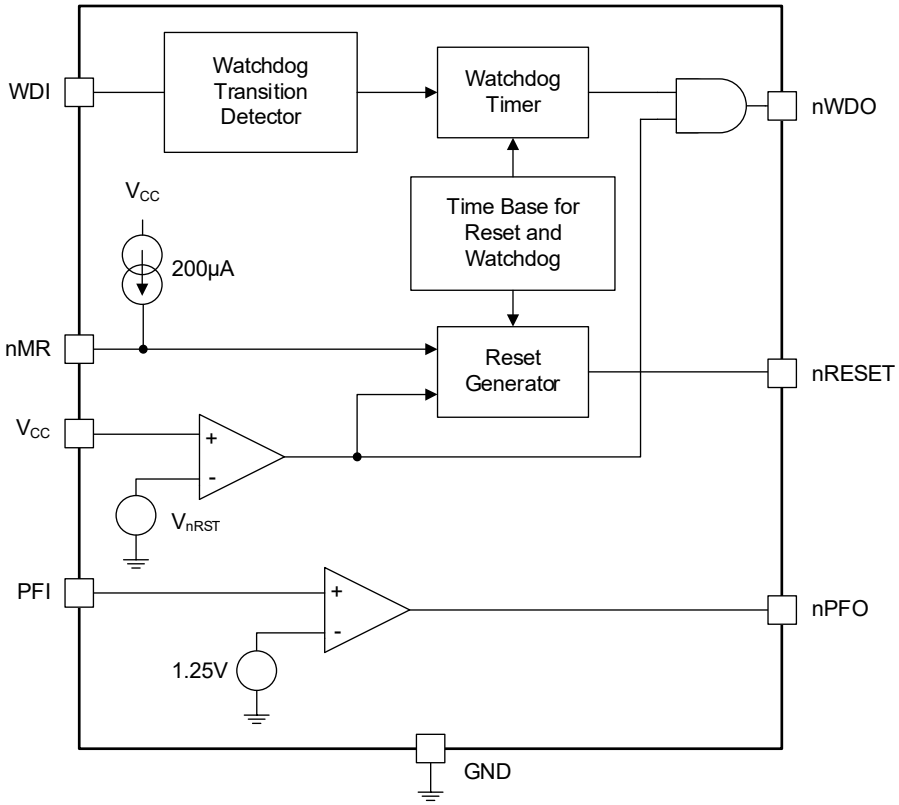


Figure 2. SGM706S Block Diagram

DETAILED DESCRIPTION

Precise Reset Threshold

When the supply voltage drops significantly for the power supply fault, the SGM706S can even operate normally, which greatly reduces the possibility of system failure. In addition, the internal reference voltage accuracy of the SGM706S is very high, which guarantees high reliability of the devices.

To ensure sufficient time for the power supply and microprocessor to stabilize after power-up, a 210ms (TYP) reset output will hold by the internal timer after V_{CC} exceeds the reset threshold voltage. Similarly, a 210ms (TYP) reset output will also exist after the power supply recover from brownout or interruption that allows the power supply and microprocessor to have enough time to reach a steady state.

The SGM706S has an active-low nRESET output. When V_{CC} is as low as 1V during power-down, the nRESET will keep output a low level. This not only keeps the microprocessor shutdown when the supply voltage falls, but also prevents the microprocessor from occurring false actions when it powers up.

Watchdog

A watchdog timer is integrated in SGM706S. It must be periodically triggered by a rising edge or a falling edge of WDI. If the WDI cannot be triggered during the timeout period (1.68s, TYP) and WDI is not three-stated, the internal watchdog timer expires and nWDO goes low.

The internal watchdog timer is cleared while a reset is asserted or WDI is three-stated or WDI is fed on time within the timeout period.

Manual Reset (nMR)

The SGM706S provides a manual reset (nMR) function that allows users to reset the system manually. It is an active-low reset input with an internal pull-up resistor of 25kΩ. When the nMR is low, and for t_{RS} (210ms, TYP), after nMR returns high, the reset remains active. The nMR can be driven by a CMOS logic or by a reset switch shorting to GND. If not used, leave it open or connect it to the V_{CC}. When the device is far away from the reset switch or used in a noisy environment, a 0.1μF capacitor is recommended to connect between nMR and GND.

PFI, nPFO

For SGM706S, PFI (Power-Fail Input) and nPFO (Power-Fail Push-Pull Output) pins can be used for power-fail warning or monitoring a power supply of the other device, and do not affect nRESET pin.

The internal voltage reference (1.25V) is used for compare with PFI pin. Once the PFI voltage is lower than the negative-going input threshold voltage, the nPFO goes low. Once PFI voltage exceeds positive-going input threshold voltage, the output goes high. Connecting a resistor divider externally can monitor any voltages above 1.25V.

To ensure that the PFI leakage current can be ignored in comparision with the current through the resistor divider and to minimize the resistor power consumption, the sum of two resistors should be about 1MΩ. To ensure the accuracy of the detection voltage, the tolerance of the external resistor should be less than 1%. It is recommended to leave nPFO floating and connect PFI to V_{CC} pin if the PFI comparator is not used.

APPLICATION INFORMATION

nRESET Valid to V_{CC} = 0V

The nRESET of SGM706S stops sinking current and becomes open circuit if V_{CC} is below 1.0V. And if a high-impedance input is connected to nRESET, the input voltage will drift and be undetermined. To solve the problem, it is recommended to use a 100kΩ resistor between nRESET and GND.

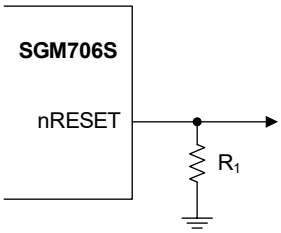


Figure 3. nRESET Valid to Ground Circuit

Monitoring Other Voltage Lines

Connect a voltage divider network to PFI and adjust the ratio appropriately. nPFO can be used to monitor another voltage line, which does not affect nRESET pin.

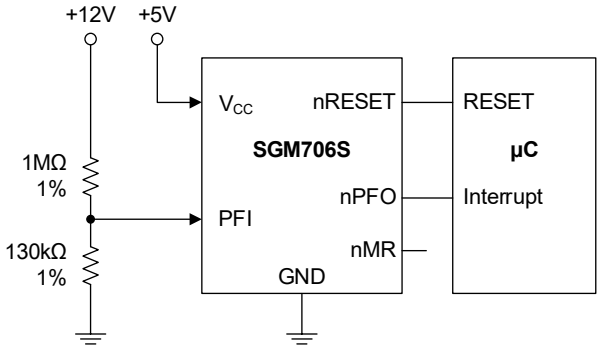


Figure 4. Power-Fail Voltage Monitoring

Connect a voltage divider network to PFI and connect nPFO to nMR can attain dual voltage lines monitoring simultaneously. It asserts nRESET in the conditions of 5V supply, V_{CC} falls below the reset threshold or the 12V supply falls approximately below 11V. Figure 5 shows the dual voltage lines monitoring of SGM706S configuration.

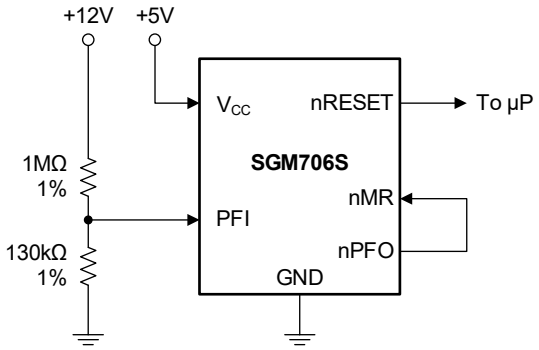


Figure 5. Dual Voltage Lines Monitoring

PFI can also be used to monitor a negative supply rail. The configuration is shown below. When the negative rail is lower than some negative voltage which makes V_{PFI} between 0V and 1.25V, a low nPFO will not drive the transistor to pull nMR low and nRESET will not be triggered. When the negative rail is degraded, which makes V_{PFI} be higher than 1.25V, a high nPFO drives the transistor to pull nMR low and trigger nRESET. And the accuracy of this circuit is not high, depending on the PFI threshold tolerance, V_{CC} line and the resistors.

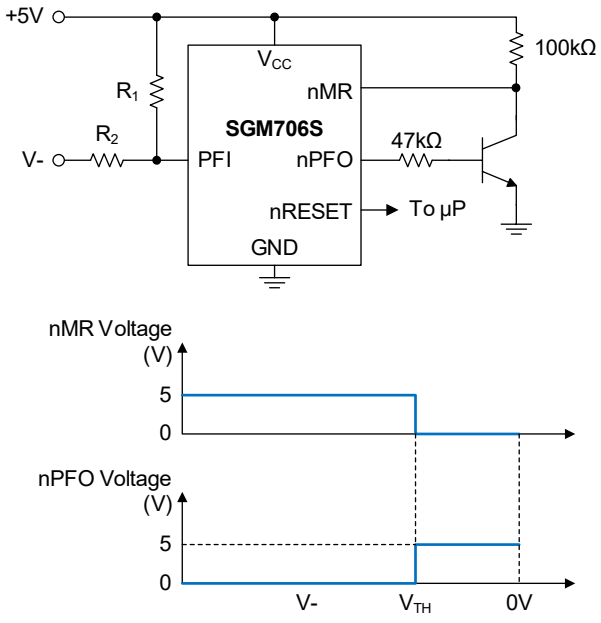


Figure 6. Negative Voltage Monitoring

APPLICATION INFORMATION (continued)

The negitive rail voltage can be caculated by Equation 1, and V_{TH} is always negitive.

$$\frac{5 - 1.25}{R_1} = \frac{1.25 - V_{TH}}{R_2} \quad (1)$$

The reset pin of some μC devices is bidirectional, such as the Motorola 68HC11 series. Connecting the SGM706S nRESET output to μC RESET output directly may cause race and hazard. For example, if nRESET is logic high and the RESET is logic low, connecting them directly may result in indeterminate logic levels, even damage the RESET pin of μC.

Therefore, a 4.7kΩ resistor is recommended to be connected between nRESET and the μC reset I/O as show in Figure 7. Besides, buffer the nRESET output to reset other system components.

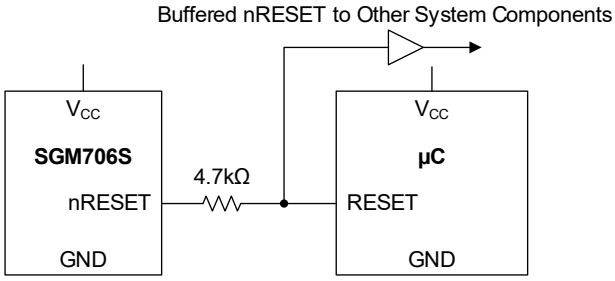


Figure 7. Interfacing to μCs with Bidirectional Reset I/O

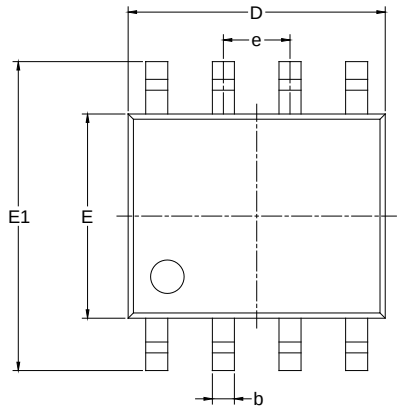
REVISION HISTORY

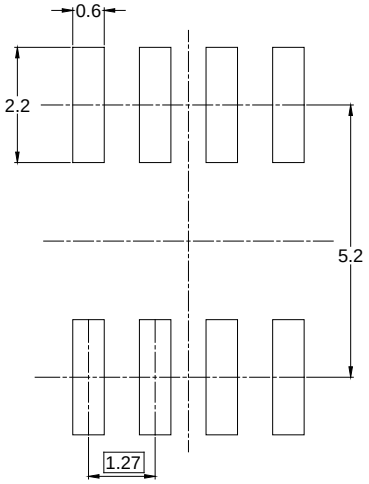
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBER 2023) to REV.A	Page
Changed from product preview to production data	All

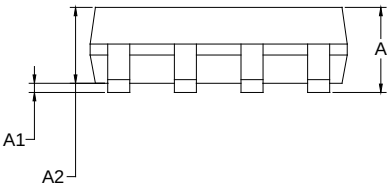
PACKAGE OUTLINE DIMENSIONS

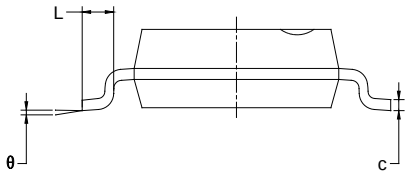
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)



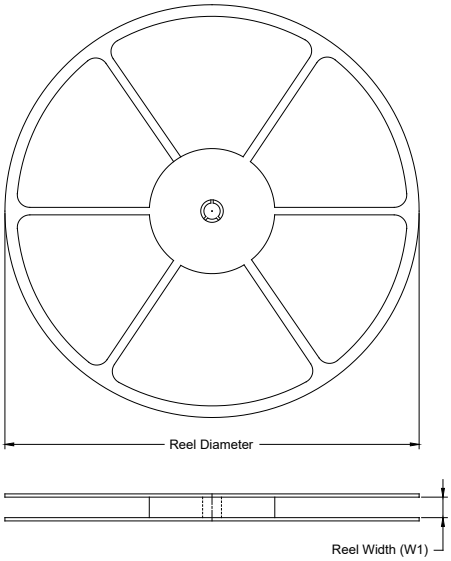


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

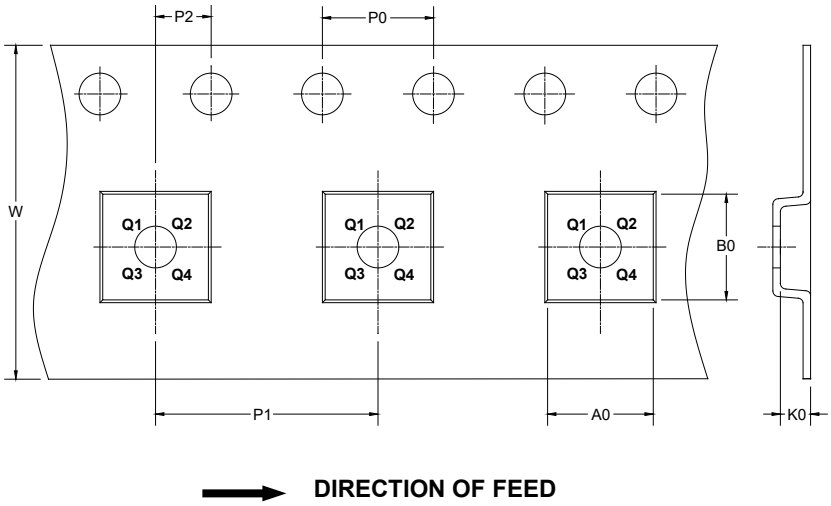
NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

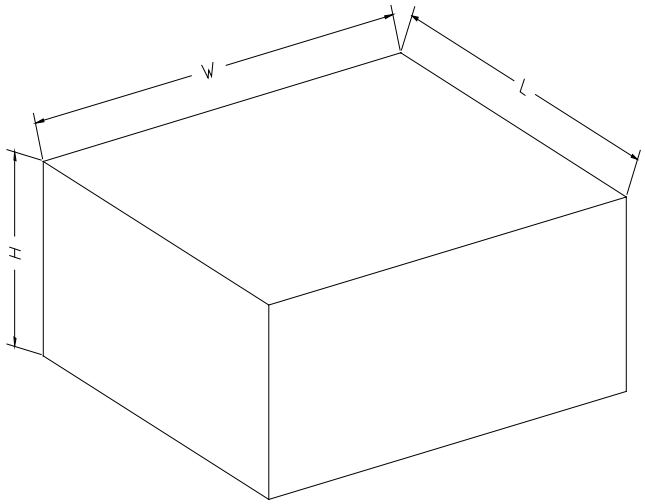
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

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
13″	386	280	370	5

DD0002