SGM856xQ
Nano I_Q Precision Voltage Supervisor with Precision Timeout Watchdog Timer for Automotive Applications

GENERAL DESCRIPTION

The SGM856xQ is a high-precision voltage supervisor with ±1.2% accuracy over the operating temperature range. It only consumes 750nA (TYP) quiescent current and provides a timeout watchdog with fixed timeout period.

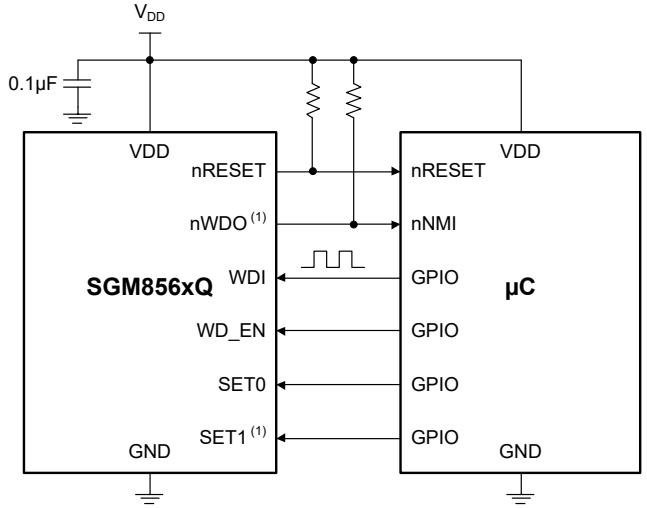
The SGM856xQ gives four available watchdog timeout period options, which are preset as a default value and can be configured by the users for setting different multiples of the default value by SET0/SET1. The watchdog function can be enabled or disabled by the WD_EN pin.

The output asserted times for nRESET or nWDO are all preset. The SGM856xxD-xQ is a unique device that latches the output until an effective watchdog input is detected.

The device is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM856xQ is available in Green TDFN-1.5×1.5-6L and TSOT-23-8 packages.

TYPICAL APPLICATION



NOTE: 1. nWDO and SET1 pins are only available in TSOT package.

Figure 1. Typical Application Circuit

FEATURES

- **AEC-Q100 Qualified for Automotive Applications**
  - **Device Temperature Grade 1**
  - **T_A = -40℃ to +125℃**
- **Factory-Programmed Watchdog Timeout**
  - **Factory-Programmed Options: 70ms, 1.12s, 4.48s, 17.92s**
- **Factory-Programmed Reset Delay with Scaling**
  - **Factory-Programmed Options: 11.2ms, 44.8ms, 179.2ms, Latched (t_D = 2.8ms)**
- **Supply Voltage Range: 1.6V to 6.5V**
- **Fixed Threshold Voltage: 2.3V, 3.0V, 4.6V**
  - **±1.2% (MAX) Voltage Threshold Accuracy**
  - **Built-in Hysteresis: 2.1% (TYP)**
- **Ultra-Low Supply Current: 750nA (TYP)**
- **Active-Low Open-Drain Outputs**
- **Various Programmability Options:**
  - **Watchdog Enable**
  - **On-the-Fly Timer Extension: 1X to 128X**
  - **Latched Output Option**
- **Available in Green TDFN-1.5×1.5-6L and TSOT-23-8 Packages**

APPLICATIONS

Driver Monitoring
On-Board and Wireless Charger (OBC)
Front Camera
Battery Management System (BMS)
Surround View System ECU

代理商 威尔芯 www.visvie.com 联系电话 138 2526 8270

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE TOP MARKING	PACKING OPTION
SGM856AAB-2.3Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAB-2.3QTHR6G/TR	35C XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856AAB-2.3QTN8G/TR	XXXYY 35Q	Tape and Reel, 3000
SGM856AAB-3.0Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAB-3.0QTHR6G/TR	35D XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856AAB-3.0QTN8G/TR	XXXYY 2YO	Tape and Reel, 3000
SGM856AAB-4.6Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAB-4.6QTHR6G/TR	35E XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856AAB-4.6QTN8G/TR	XXXYY 35R	Tape and Reel, 3000
SGM856AAD-2.3Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAD-2.3QTHR6G/TR	35G XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to+125℃	SGM856AAD-2.3QTN8G/TR	XXXYY 35S	Tape and Reel, 3000
SGM856AAD-3.0Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAD-3.0QTHR6G/TR	35H XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to+125℃	SGM856AAD-3.0QTN8G/TR	XXXYY 2YU	Tape and Reel, 3000
SGM856AAD-4.6Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856AAD-4.6QTHR6G/TR	35I XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to+125℃	SGM856AAD-4.6QTN8G/TR	XXXYY 35T	Tape and Reel, 3000
SGM856BAA-3.0Q	TSOT-23-8	-40℃ to +125℃	SGM856BAA-3.0QTN8G/TR	XXXYY 300	Tape and Reel, 3000
SGM856BAB-2.3Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAB-2.3QTHR6G/TR	35K XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAB-2.3QTN8G/TR	XXXYY 2YQ	Tape and Reel, 3000
SGM856BAB-3.0Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAB-3.0QTHR6G/TR	35L XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAB-3.0QTN8G/TR	XXXYY 2YR	Tape and Reel, 3000
SGM856BAB-4.6Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAB-4.6QTHR6G/TR	35M XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAB-4.6QTN8G/TR	XXXYY 2YS	Tape and Reel, 3000
SGM856BAD-2.3Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAD-2.3QTHR6G/TR	2MF XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAD-2.3QTN8G/TR	XXXYY 24H	Tape and Reel, 3000
SGM856BAD-3.0Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAD-3.0QTHR6G/TR	35O XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAD-3.0QTN8G/TR	XXXYY 2YW	Tape and Reel, 3000
SGM856BAD-4.6Q	TDFN-1.5×1.5-6L	-40℃ to+125℃	SGM856BAD-4.6QTHR6G/TR	35P XXX	Tape and Reel, 3000
	TSOT-23-8	-40℃ to +125℃	SGM856BAD-4.6QTN8G/TR	XXXYY 2YX	Tape and Reel, 3000
SGM856CAA-3.0Q	TSOT-23-8	-40℃ to +125℃	SGM856CAA-3.0TN8G/TR	XXXYY 301	Tape and Reel, 3000

PACKAGE/ORDERING INFORMATION (continued)

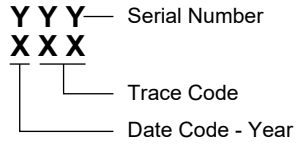
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE TOP MARKING	PACKING OPTION
SGM856CAB-3.0Q	TSOT-23-8	-40℃ to +125℃	SGM856CAB-3.0QTN8G/TR	XXXYY 2YZ	Tape and Reel, 3000
SGM856CAD-3.0Q	TSOT-23-8	-40℃ to +125℃	SGM856CAD-3.0QTN8G/TR	XXXYY 2Z1	Tape and Reel, 3000

NOTE: For more models not listed above, please contact your local SGMICRO sales representatives.

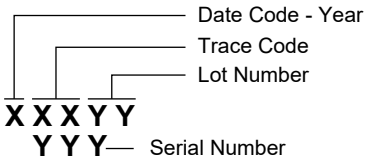
MARKING INFORMATION

NOTE: XXX = Date Code and Trace Code.

TDFN-1.5×1.5-6L



TSOT-23-8



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.

Device Naming Convention

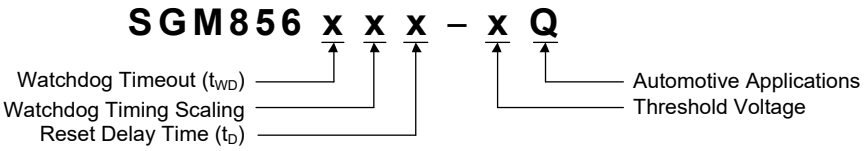


Table 1. Device Naming Convention

DESCRIPTION		NOMENCLATURE	VALUE
Watchdog Timeout (t_{WD})		A	70ms
		B	1.12s
		C	4.48s
		D	17.92s
Watchdog Timing Scaling	TDFN-1.5×1.5-6L	A	1, 2
		B	1, 8
		C	1, 32
		D	1, 64
	TSOT-23-8	A	1, 2, 4
		B	1, 8, 16
		C	1, 32, 64
		D	1, 64, 128
Reset Delay Time (t_D)		A	11.2ms
		B	44.8ms
		C	179.2ms
		D	Latched Output
Threshold Voltage		2.3	2.3V
		3.0	3.0V
		4.6	4.6V

ABSOLUTE MAXIMUM RATINGS

VDD Voltage ..... -0.3V to 7V
WD_EN, SETx, WDI ..... -0.3V to 7V
nRESET, nWDO Voltage ..... -0.3V to 7V
nRESET, nWDO Current ..... -20mA to 20mA
Package Thermal Resistance
TDFN-1.5×1.5-6L, θ_{JA} ..... 147.8℃/W
TDFN-1.5×1.5-6L, θ_{JB} ..... 54.6℃/W
TDFN-1.5×1.5-6L, θ_{JC} ..... 124.9℃/W
TSOT-23-8, θ_{JA} ..... 135.4℃/W
TSOT-23-8, θ_{JB} ..... 54.3℃/W
TSOT-23-8, θ_{JC} ..... 95.6℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility (1) (2)
HBM ..... ±4000V
CDM ..... ±1000V

NOTES:

1. For human body model (HBM), all pins comply with AEC-Q100-002 specification.

2. For charged device model (CDM), all pins comply with AEC-Q100-011 specification.

RECOMMENDED OPERATING CONDITIONS

VDD Voltage ..... 1.6V to 6.5V
WD_EN, SETx, WDI ..... 0V to V_{DD}
nRESET, nWDO Voltage ..... 0V to 6.5V
nRESET, nWDO Current ..... -5mA to 5mA
Operating 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

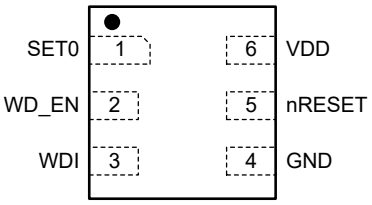
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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.

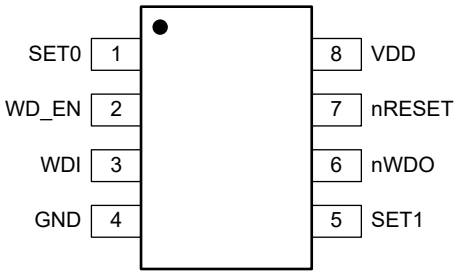
PIN CONFIGURATIONS

(TOP VIEW)



TDFN-1.5×1.5-6L

(TOP VIEW)



TSOT-23-8

PIN DESCRIPTION

PIN		NAME	TYPE	FUNCTION
TDFN	TSOT			
1	1	SET0	I	Logic Input. SET0, along with SET1, determines the watchdog timeout ratio. Do not leave it floating. If the device has two SET pins, only the WD_EN can be used to disable the watchdog, while SET[1:0] = 00 or 01 means watchdog timing scaling coefficient is 1.
2	2	WD_EN	I	Watchdog Enable Input. Logic high input enables the watchdog and logic low disables the watchdog. Do not leave it floating.
3	3	WDI	I	Watchdog Input. The watchdog timer is cleared every time a falling edge is detected at this pin. Do not leave it floating.
4	4	GND	G	Ground Pin.
5	7	nRESET	O	Open-Drain Reset Output. It is recommended to place a 100kΩ resistor to pull up this pin. This pin is asserted low once VDD is below under-voltage threshold (V_{IT-}). For pin-out configurations without an independent nWDO pin, the nRESET signal is also asserted in occurence of any watchdog errors.
6	8	VDD	I	Supply Voltage Pin. For noisy systems, it is advised to place a 0.1μF ceramic capacitor between the VDD pin and GND.
—	5	SET1	I	Logic Input. SET1, along with SET0, determines the watchdog timeout ratio. Do not leave it floating. If the device has two SET pins, only the WD_EN can be used to disable the watchdog, while SET[1:0] = 00 or 01 means watchdog timing scaling coefficient is 1.
—	6	nWDO	O	Open-Drain Watchdog Output. It is recommended to place a 100kΩ resistor to pull up this pin. The nWDO pin is asserted low for a duration of nRESET timeout delay (t_D) under watchdog timeout errors. The watchdog functionality is disabled when the nRESET pin is logic low.

NOTE: I = input, O = output, G = ground.

ELECTRICAL CHARACTERISTICS

(V_{DD} = 1.6V to 6.5V, R_{nRESET} = 100kΩ to VDD, R_{nWDO} = 100kΩ to VDD, nRESET/nWDO load C_{LOAD} = 10pF, VDD ramp rate ≤ 1V/μs, T_A = -40℃ to +125℃, typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Common Parameters						
Input Supply Voltage	V_{DD}		1.6		6.5	V
Negative-Going Input Threshold Accuracy	V_{IT-}	V_{IT-} = 2.3V, 3.0V, 4.6V	-1.2	±0.5	1.2	%
Hysteresis	V_{HYS}		1	2.1	4	%
Supply Current into VDD Pin	I_{DD}	V_{DD} = 2.5V	0.3	0.75	1.7	μA
		V_{DD} = 6.5V	0.5	1.11	4	μA
Power-On Reset Voltage (1)	V_{POR}	V_{OL_MAX} = 300mV, I_{OUT_SINK} = 15μA			900	mV
Low-Level Input Voltage WD_EN, WDI, SETx	V_{IL}				0.25 × V_{DD}	V
High Level Input Voltage WD_EN, WDI, SETx	V_{IH}		0.8 × V_{DD}			V
nRESET, nWDO						
Low-Level Output Voltage	V_{OL}	V_{DD} =1.6V, I_{OUT_SINK} = 500μA			300	mV
		V_{DD} = 3.3V, I_{OUT_SINK} = 2mA			300	mV
Open-Drain Output Leakage Current	I_{LKG}	V_{DD} = $V_{PULL-UP}$ = 6.5V			300	nA

NOTE: 1. V_{POR} is the minimum V_{DD} voltage level for a controlled output state.

TIMING REQUIREMENTS

(V_{DD} = 1.6V to 6.5V, R_{nRESET} = 100kΩ to VDD, R_{nWDO} = 100kΩ to VDD, nRESET/nWDO load C_{LOAD} = 10pF, VDD ramp rate ≤ 1V/μs, T_A = -40℃ to +125℃, typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Glitch Immunity V_{IT-}	t_{GI_VIT-}	5% V_{IT-} overdrive (1)		21		μs
WDI Pulse Duration to Start Next Frame	t_{P-WD}	V_{DD} > V_{IT-}	1			μs
WD_EN Hold Time to Enable WD Operation	$t_{HD-WDEN}$	V_{DD} > V_{IT-}	200			μs
SETx Hold Time to Change WD Timer Setting	$t_{HD-SETx}$	V_{DD} > V_{IT-}	150			μs
Watchdog Timeout Period	t_{WD}	SGM856Axx-xQ	56.4	70	82	ms
		SGM856Bxx-xQ	0.9	1.12	1.32	s
		SGM856Cxx-xQ	3.6	4.48	5.28	s
		SGM856Dxx-xQ	14.4	17.92	21.12	s
Startup Delay (2)	t_{STRT}			275		μs
nRESET Detect Delay for VDD Falling below V_{IT-}	t_{P_HL}	V_{DD} = (V_{IT+} + 10%) to (V_{IT-} - 10%) (3)		17	35	μs
Reset Time Delay	t_D	SGM856xxA-xQ	9	11	13.2	ms
		SGM856xxB-xQ	36	45	52.8	
		SGM856xxC-xQ	144	179	211.2	
Watchdog Timeout Delay	t_{nWDO}			t_D		s

NOTES:

1. Overdrive% = [(V_{DD}/V_{IT-}) - 1] × 100%

2. After rising above V_{IT+} from an initial voltage lower than the specified minimum V_{DD}, nRESET deassertion occurs after the cumulative duration of t_{STRT} and t_D.

3. t_{P_HL} is measured from threshold trip point (V_{IT-}) to nRESET assertion. V_{IT+} = V_{IT-} + V_{HYS}.

TIMING DIAGRAM

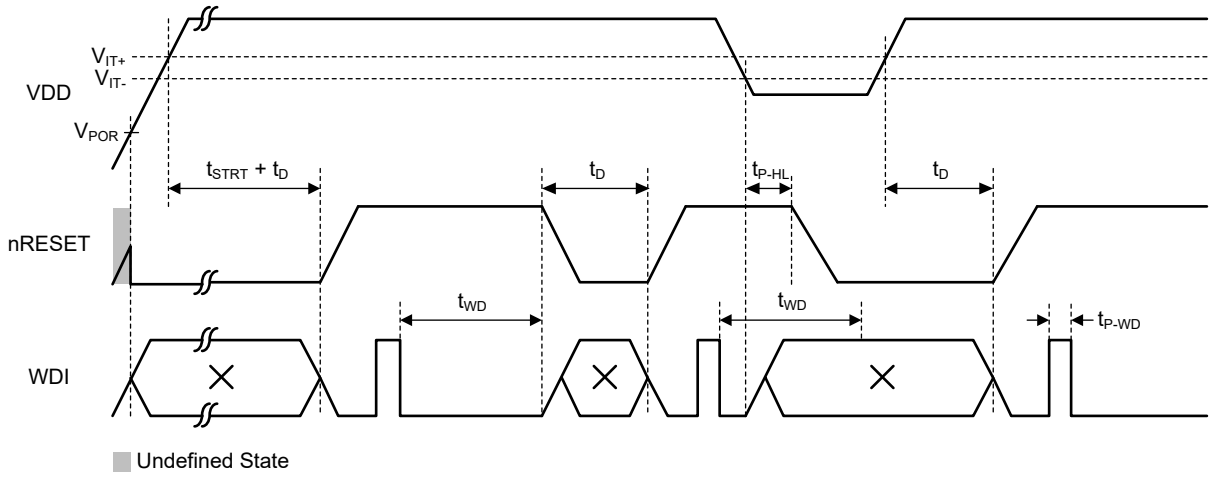


Figure 2. Timing Diagram for TDFN Package

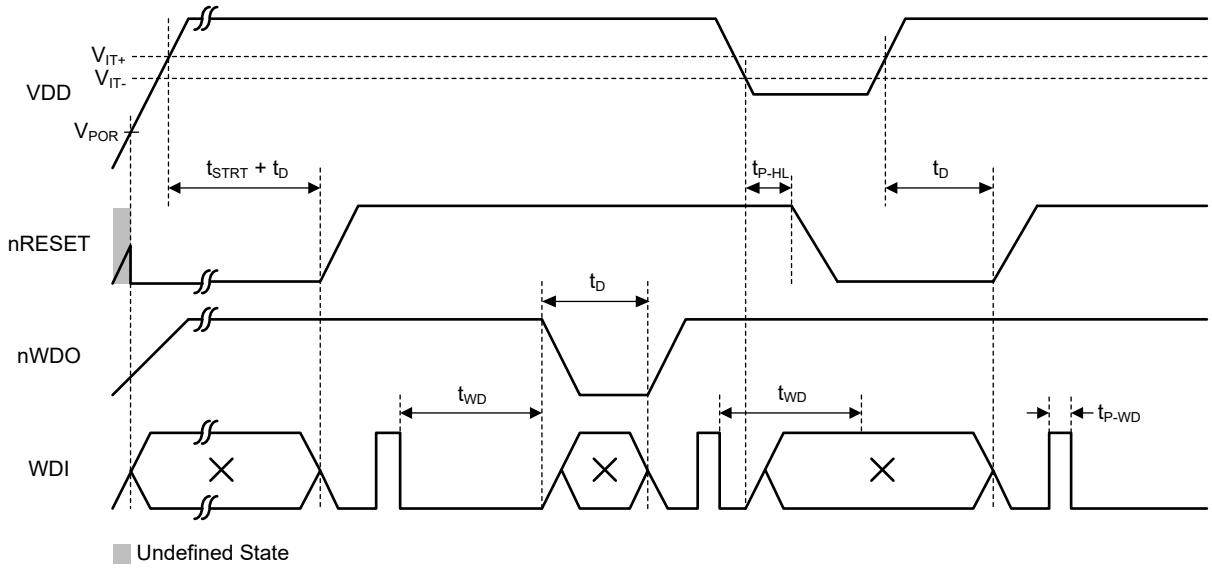
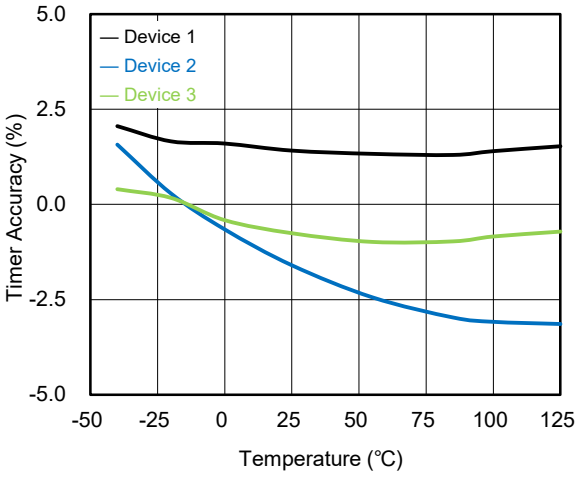


Figure 3. Timing Diagram for TSOT Package

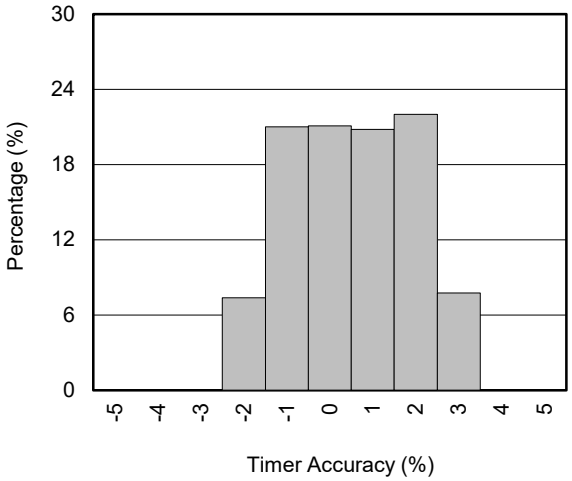
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, unless otherwise noted.

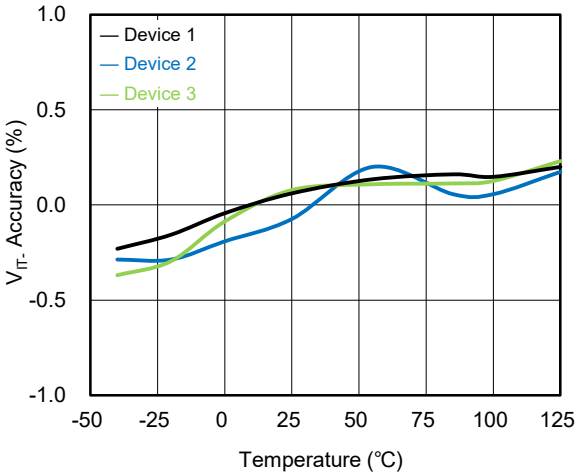
Timer Accuracy vs. Temperature



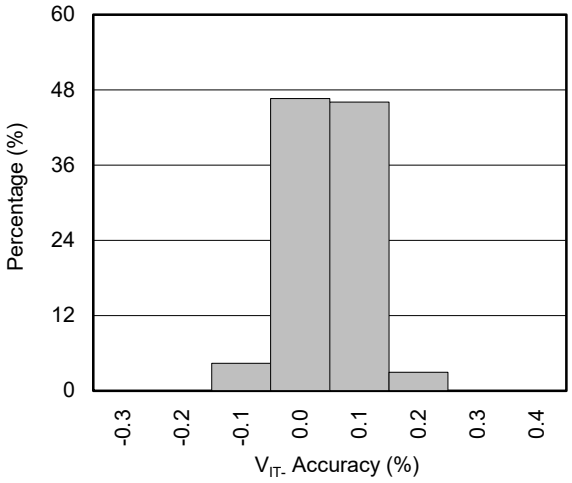
Timer Accuracy Histogram



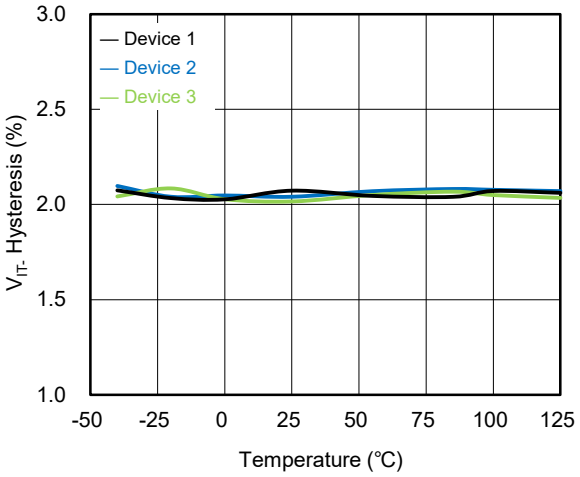
V_{IT-} Accuracy vs. Temperature



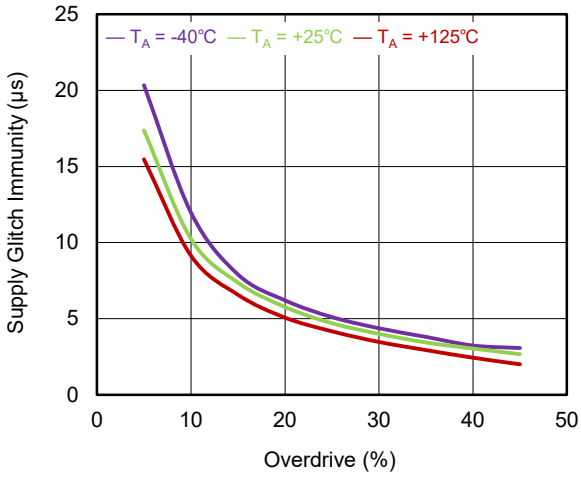
V_{IT-} Accuracy Histogram



V_{IT-} Hysteresis vs. Temperature



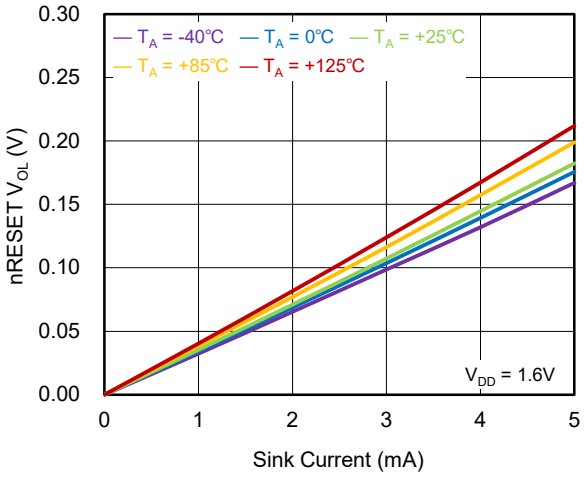
Supply Glitch Immunity vs. Overdrive



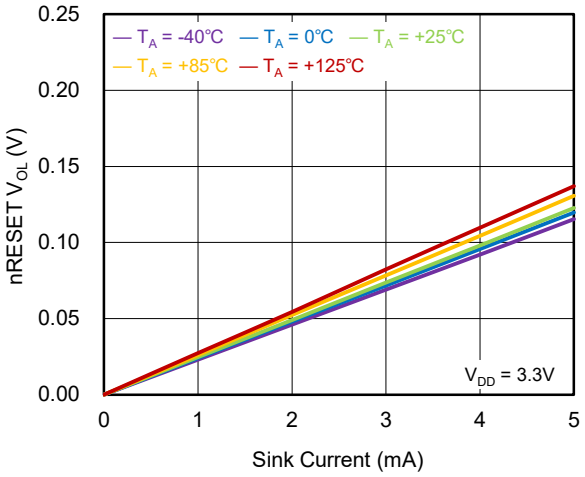
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, unless otherwise noted.

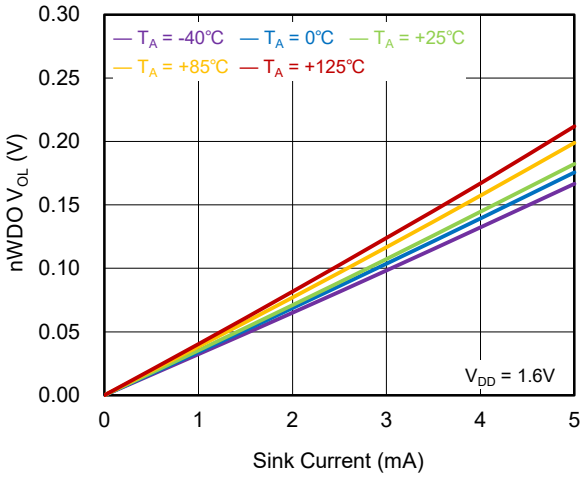
nRESET V_{OL} vs. I_{SINK}



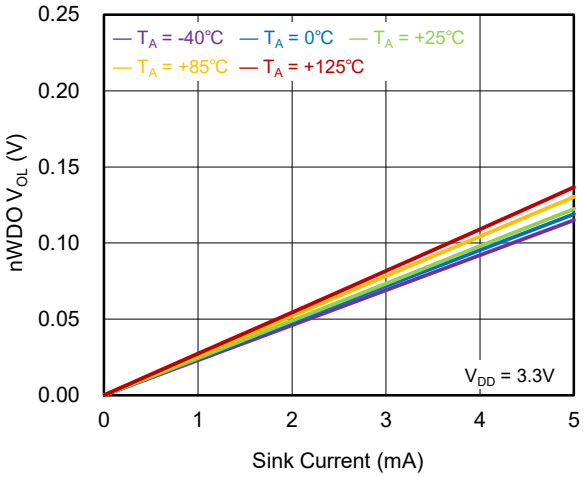
nRESET V_{OL} vs. I_{SINK}



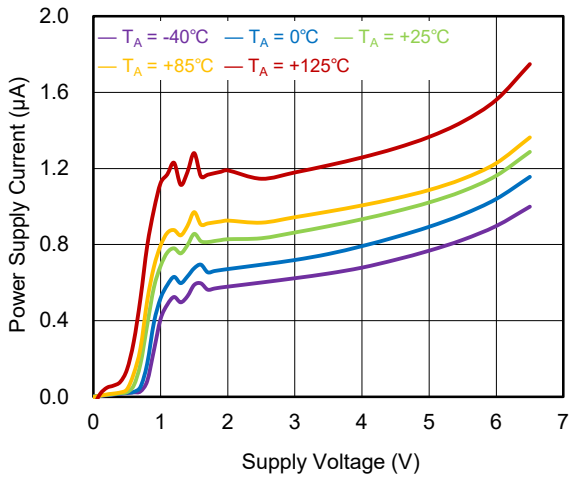
nWDO V_{OL} vs. I_{SINK} (TSOT Package Only)



nWDO V_{OL} vs. I_{SINK} (TSOT Package Only)



Supply Current vs. Power Supply Voltage



FUNCTIONAL BLOCK DIAGRAM

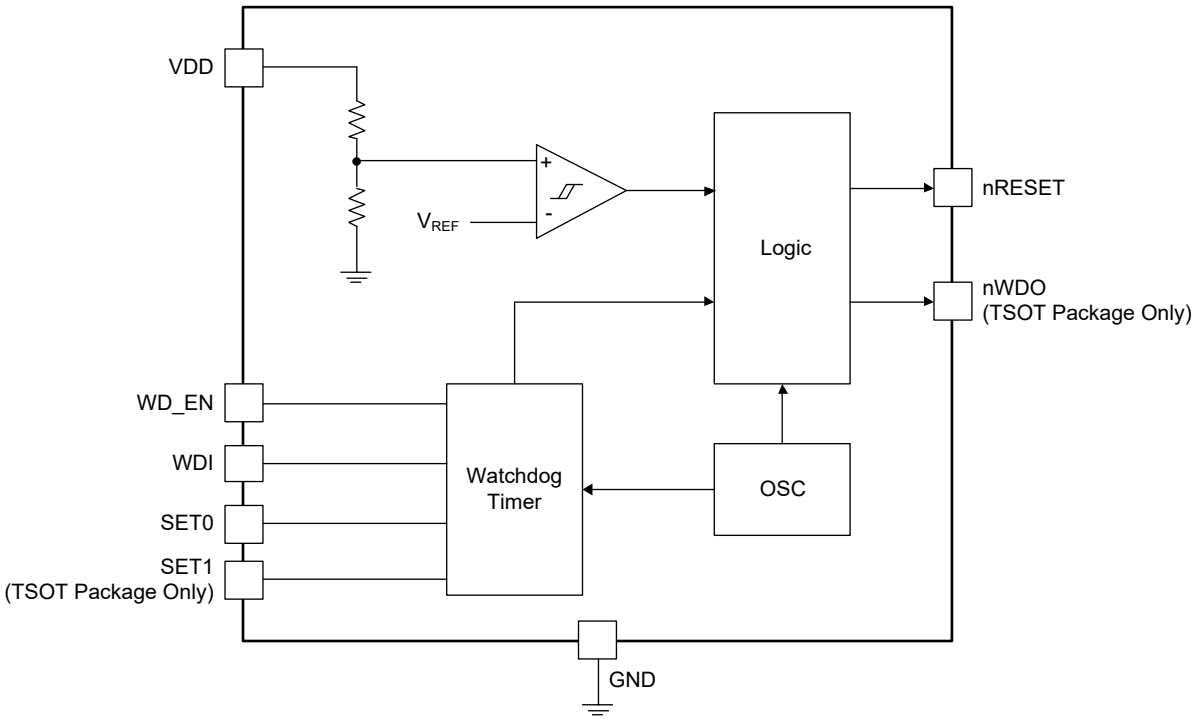


Figure 4. Block Diagram

DETAILED DESCRIPTION

Overview

The SGM856xQ is a high-precision voltage supervisor, integrated with an accurate watchdog timer in the specified temperature range of -40℃ to +125℃. Besides, it ensures an accurate hysteresis of ±2.1% on the threshold, which makes it very suitable for systems that need small tolerance. It can also disable the watchdog function with the WD_EN pin and extend the watchdog scaling with the SETx pins.

Feature Description

Voltage Supervisor

The SGM856xQ provides three fixed monitored voltage thresholds: 2.3V, 3.0V and 4.6V. It can precisely monitor voltages with quiescent current down to only 750nA.

For the TDFN package of SGM856xQ, the nRESET pin is the ANDed output of the internal voltage supervisor and watchdog timer.

Figure 5 and Figure 6 illustrate the timing diagram of the SGM856xQ. When V_{DD} is lower than V_{POR}, the nRESET pin is floating. After V_{DD} rises above V_{POR}, the nRESET output is asserted low. If the V_{DD} continues to increase above the positive-going threshold (V_{IT+}), the nRESET will keep low for the time duration of t_{STRT} + t_D and then goes high. Once the nRESET is deasserted, the watchdog timer begins to work. The nRESET will maintain the deasserted state until the V_{DD} drops below the negative-going threshold V_{IT-}. Note that the device takes t_D to pull high the nRESET when V_{DD} ramps up from a point higher than V_{DD_MIN}.

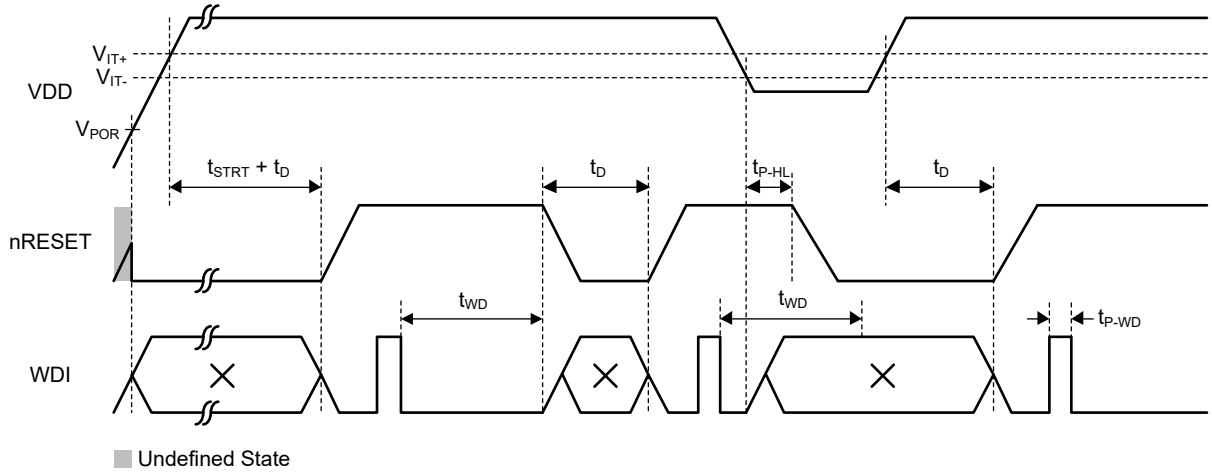


Figure 5. Voltage Supervisor Timing Diagram for TDFN Package

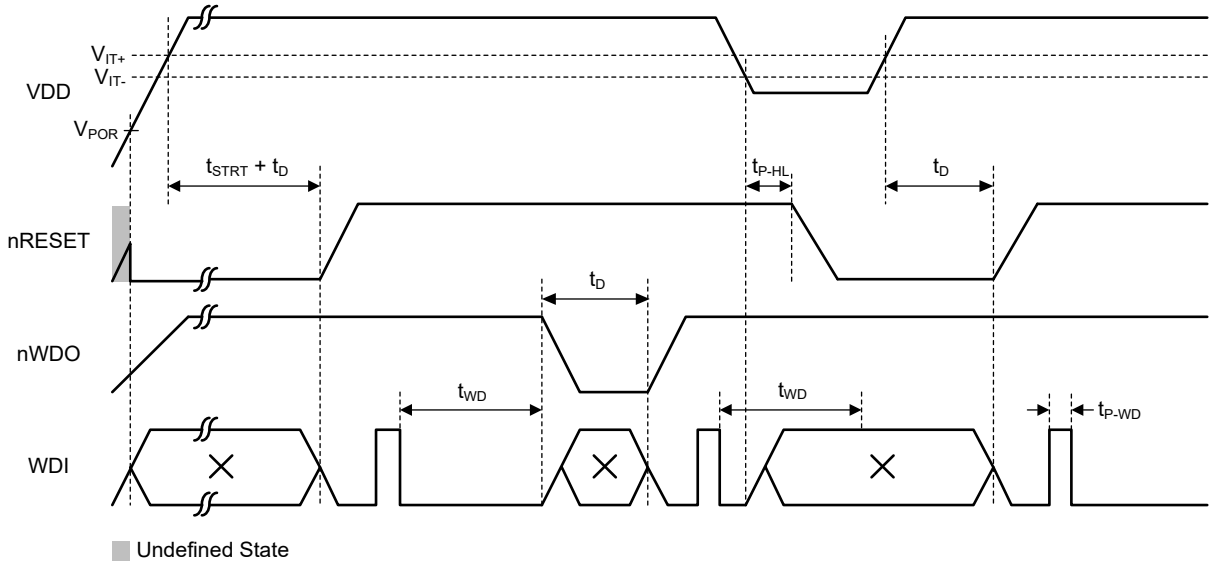


Figure 6. Voltage Supervisor Timing Diagram for TSOT Package

DETAILED DESCRIPTION (continued)

Timeout Watchdog Timer

The SGM856xQ offers high precision watchdog functionality, while the TDFN package has no nWDO pin. In fact, the nRESET pin of the TDFN package is the ANDed output of the nRESET and nWDO signals. In the following, the watchdog output is uniformly referred to as nWDO for the convenience.

When $V_{DD} > V_{IT-} + V_{HYS}$ and the nRESET is deasserted after the t_D time, the watchdog function becomes active. In other words, the nWDO is forcely to be high if nRESET is logic low.

The SGM856xQ continuously checks whether a watchdog timeout event occurs once the nRESET is logic high. The watchdog timer will be refreshed under the following conditions:

- A falling edge at the WDI pin;
- A falling/rising edge at the SETx pins;
- A rising edge at nRESET or WD_EN is detected.
- Toggling WD_EN from logic high to logic low;
- SETx state transition.

Once the watchdog does not receive a valid refresh signal during t_{WD}, the nWDO for TSOT package and the nRESET for TDFN package will be pulled low for t_D. Figure 7 shows the basic operation for timeout watchdog timer operation.

The SGM856xQ provides four kinds of timeout delay options: 70ms, 1.12s, 4.48s and 17.92s with ±20% accuracy. It also provides the opportunity to set multiples of t_{WD} through the SETx pin. Details can be seen in SETx Pin Behavior section.

Watchdog Enable/Disable Operation

In some applications, such as firmware update and step-by-step debug, disabling the watchdog function momentarily is necessary and significant. The SGM856xQ performs this task through the WD_EN pin. Pulling the WD_EN pin high can enable the watchdog function, while pulling it down can disable the watchdog function. The state transition for the WD_EN pin can be achieved at any time. The nWDO for TSOT package and the nRESET for TDFN package will respond instantaneously to logic high once the WD_EN pin is pulled low as shown in Figure 8 and Figure 9.

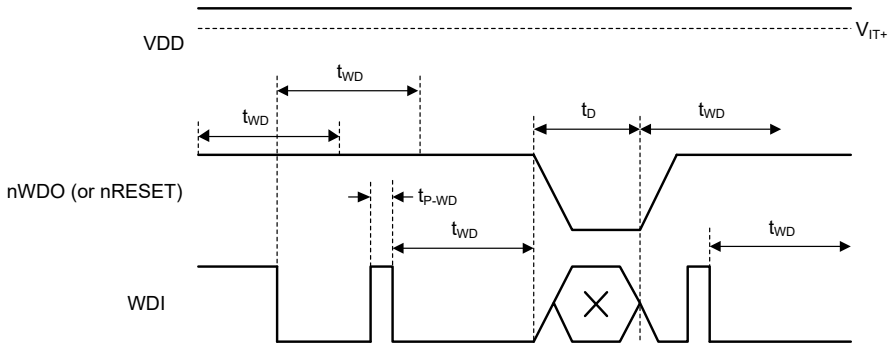


Figure 7. Timeout Watchdog Timer Operation

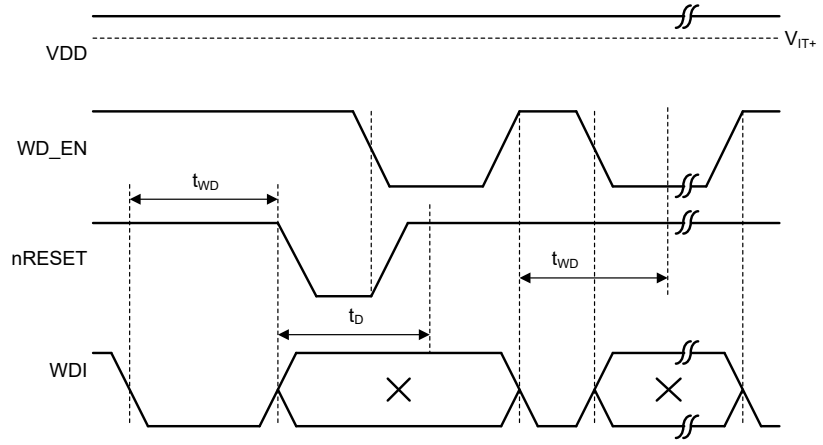


Figure 8. Watchdog Enable: WD_EN Pin Control for TDFN Package

DETAILED DESCRIPTION (continued)

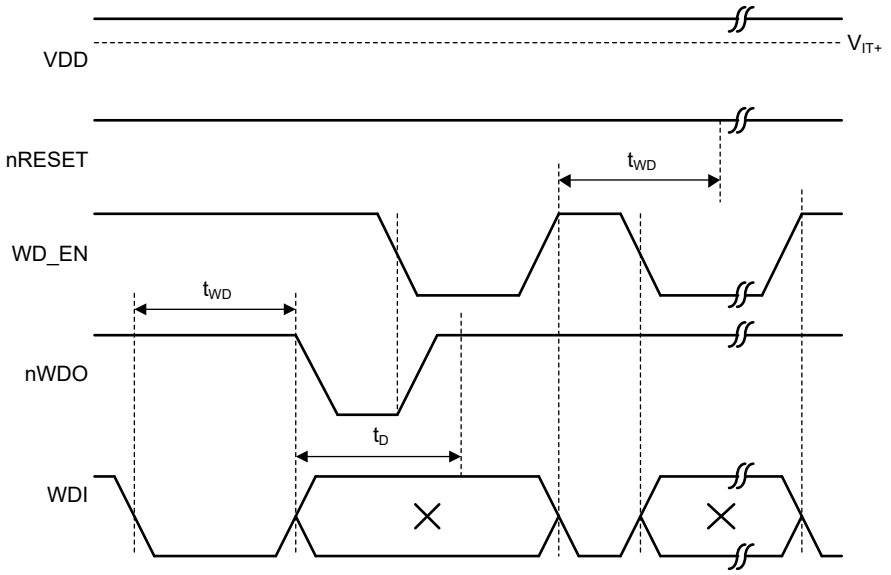


Figure 9. Watchdog Enable: WD_EN Pin Control for TSOT Package

SETx Pin Behavior

The SGM856xQ offers one SET pin for the TDFN package and two SETx pins for the TSOT package. Changing the SETx pins combination allows for achieving integer multiple fundamental t_{WD} to meet various application requirements. The fundamental t_{WD} is determined by the used model which is described clearly in Device Naming Convention. The SETx information is read and saved in the power on process and can be modified at any time in the normal operation. When the SETx combination is modified, the watchdog timer is cleared and recounted as the new coding.

Table 2 presents an example of the t_{WD} values for different SET0 logic levels for TDFN package.

Table 2. t_{WD} Scaling with SET0 Pin

Watchdog Time Scaling Selection	t_{WD} Scaling Coefficient	
	SET0 = 0	SET0 = 1
A	× 1	× 2
B	× 1	× 8
C	× 1	× 32
D	× 1	× 64

The SGM856xQ TSOT package has two SETx pins and offers three different time scaling options. The SET[1:0] = 01 combination sets the same t_{WD} option as the SET[1:0] = 00. Table 3 presents an example of the t_{WD} values for different SET0/SET1 logic levels.

Table 3. t_{WD} Scaling with SET0 & SET1 Pins

Watchdog Time Scaling Selection	t_{WD} Scaling Coefficient			
	SET[1:0] = 00	SET[1:0] = 01	SET[1:0] = 10	SET[1:0] = 11
A	× 1	× 1	× 2	× 4
B	× 1	× 1	× 8	× 16
C	× 1	× 1	× 32	× 64
D	× 1	× 1	× 64	× 128

Figure 10 and Figure 11 show the timing behavior with respect to SET0 status changes for TDFN package. While Figure 12 and Figure 13 show the timing behavior with respect to SETx status changes for TSOT package.

DETAILED DESCRIPTION (continued)

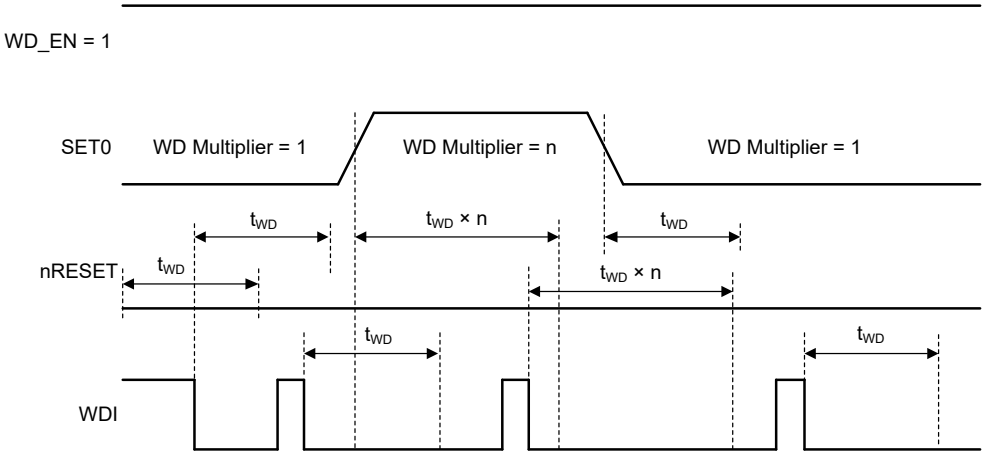
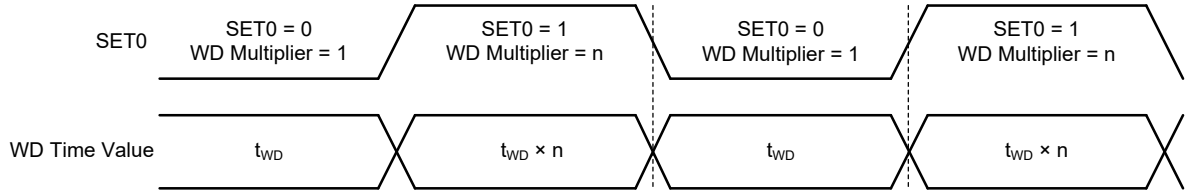


Figure 10. Watchdog Behavior with with SET0 Pin Status



t_{WD} = Fixed based on factory-set option.

n = Fixed based on time-set multiplier chosen.

Figure 11. Watchdog Operation with SET0 Pin

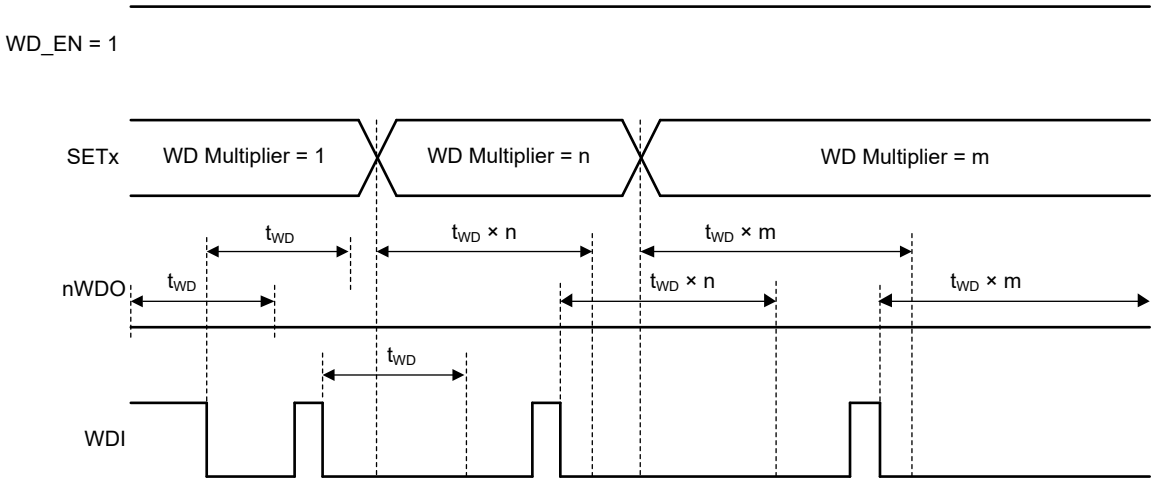
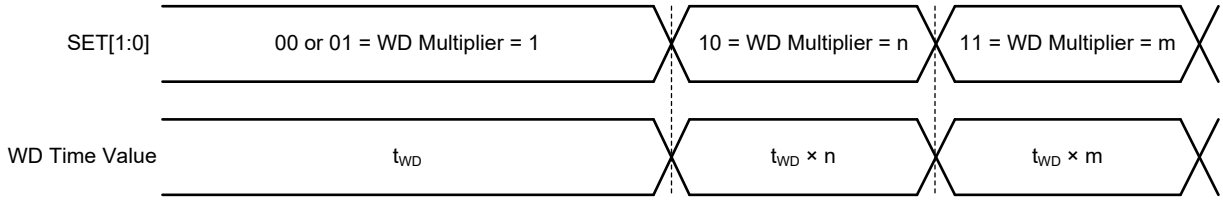


Figure 12. Watchdog Behavior with with SETx Pin Status



t_{WD} = Fixed based on factory-set option.

n, m = Fixed based on time-set multiplier chosen.

Figure 13. Watchdog Operation with 2 SETx Pins

DETAILED DESCRIPTION (continued)

Device Functional Modes

Table 4 and Table 5 summarize the functional modes of the SGM856xQ. t_{PULSE} is the time between falling edges on WDI.

Watchdog Output Latch Function

The watchdog output will be latched low due to the timeout error for SGM856xxD-xQ. For the TDFN package with only nRESET output, the nRESET pin is the ANDed output of the internal voltage supervisor and watchdog timer. To exit the latched state, the following actions can be taken:

- A new power cycle for the VDD pin;
- A valid WDI falling edge;
- Toggling WD_EN from logic high to logic low.

Table 4. Device Functional Modes for TDFN Package

VDD	Watchdog Status	WDI	nRESET
$V_{DD} < V_{POR}$	Not Applicable	—	Undefined
$V_{POR} \le V_{DD} < V_{IT-}$	Not Applicable	Ignored	Low
$V_{DD} \ge V_{IT+}$	Disabled	Ignored	High
	Enabled	$t_{PULSE} < t_{WD_MIN}$	High
	Enabled	$t_{PULSE} > t_{WD_MAX}$	Low

Table 5. Device Functional Modes for TSOT Package

VDD	Watchdog Status	WDI	nWDO	nRESET
$V_{DD} < V_{POR}$	Not Applicable	—	Undefined	Undefined
$V_{POR} \le V_{DD} < V_{IT-}$	Not Applicable	Ignored	High	Low
$V_{DD} \ge V_{IT+}$	Disabled	Ignored	High	High
	Enabled	t_{PULSE} (1) $< t_{WD_MIN}$	High	High
	Enabled	t_{PULSE} (1) $> t_{WD_MAX}$	Low	High

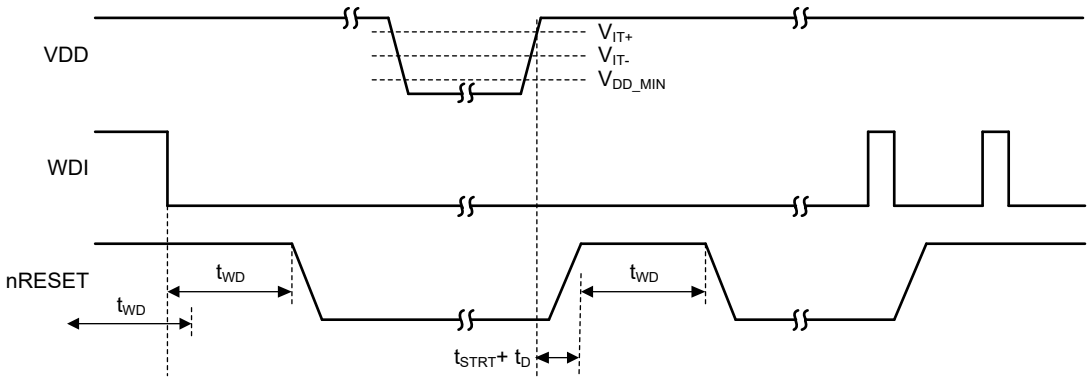


Figure 14. Output Latch Timing Behavior for TDFN Package

DETAILED DESCRIPTION (continued)

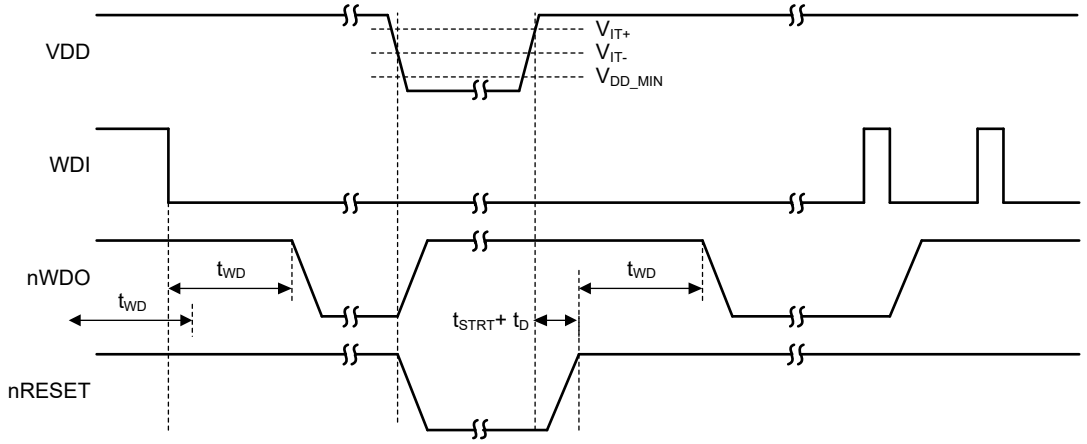


Figure 15. Output Latch Timing Behavior for TSOT Package

APPLICATION INFORMATION

Calculating the nRESET/nWDO Pull-up Resistor

The nRESET and nWDO pins are both open-drain outputs, as shown in Figure 16. When selecting an appropriate pull-up resistor, the total system current consumption (including quiescent current flowing into VDD and currents flowing through the pull-up resistors), the low-level output voltage (V_{OL}), the capacitor between the nRESET/nWDO and GND, and the leakage current of nRESET/nWDO pin should be taken into consideration.

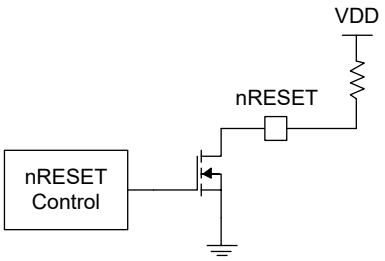


Figure 16. Open-Drain RESET Configuration

A tradeoff is made between V_{OL} and the current flowing into the nRESET and nWDO pins (I_{nRST} and I_{nWDO}). The constraint for V_{OL} is lower than 0.3V and for I_{nRST} and I_{nWDO} is lower than 0.3μA. I_{nRST} and I_{nWDO} should be kept below 2mA for V_{DD} ≥ 3V and 500μA for V_{DD} = 1.6V. Note that every time only one of nRESET and nWDO will be pulled low. Thus, only the current flowing through one pull-up resistor should be considered.

For example, when the power rail is pulled up to 2.5V, the pull-up resistor should be larger than 4.4kΩ due to V_{OL}. Take the pull-up resistor as 100kΩ, the obtained total current consumption is 25.75μA.

Power Supply Recommendations

This device is configured to function normally with an input voltage ranging from 1.6V to 6.5V. Note that incorporating a capacitor ranging from 0.1μF to 1μF between the VDD and GND pins is advisable, depending on the noise characteristics of the input voltage supply.

Layout Guidelines

Though not mandatory, placing a 0.1μF ceramic capacitor close to the VDD pin is recommended to suppress the noise or transient spikes.

Place the pull-up resistors for nRESET and nWDO pins as close to the corresponding pin as possible.

REVISION HISTORY

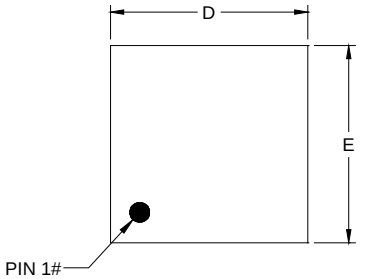
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

SEPTEMBER 2026 – REV.A to REV.A.1	Page
Added TDFN-1.5×1.5-6L package	All

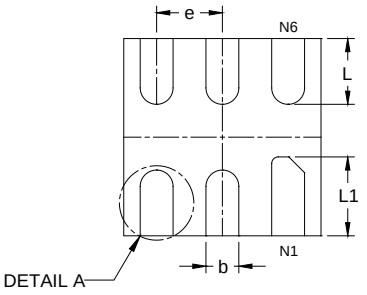
Changes from Original to REV.A (MAY 2026)	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

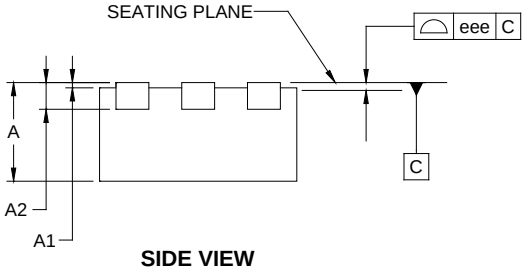
TDFN-1.5×1.5-6L



TOP VIEW



BOTTOM VIEW

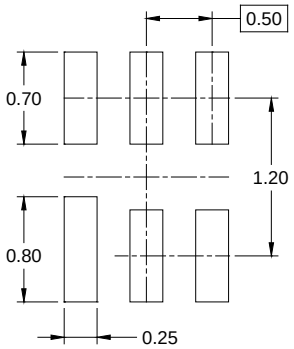


SIDE VIEW



DETAIL A

ALTERNATE TERMINAL CONSTRUCTION



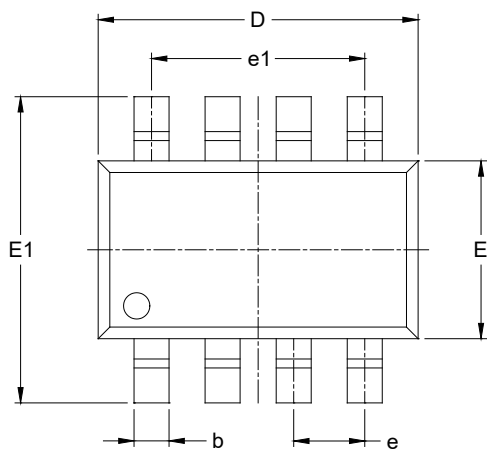
RECOMMENDED LAND PATTERN (Unit: mm)

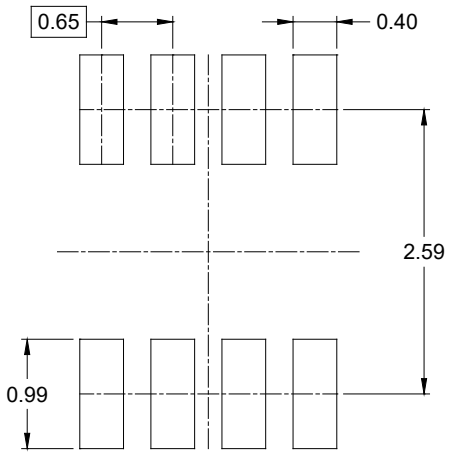
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.700	-	0.800
A1	0.000	-	0.050
A2		0.203 REF	
b	0.180	-	0.300
D	1.400	-	1.600
E	1.400	-	1.600
e		0.500 BSC	
L	0.400	-	0.600
L1	0.500	-	0.700
eee		0.080	

NOTE: This drawing is subject to change without notice.

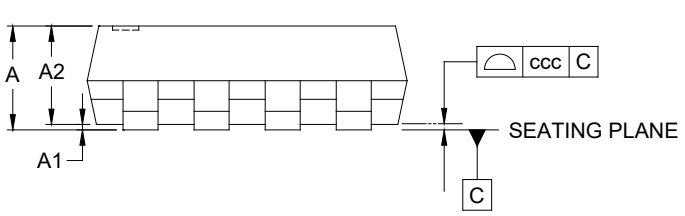
PACKAGE OUTLINE DIMENSIONS

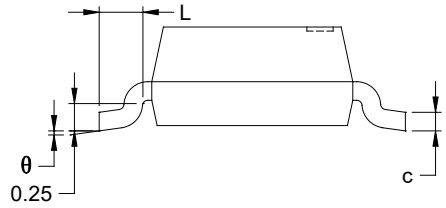
TSOT-23-8





RECOMMENDED LAND PATTERN (Unit: mm)



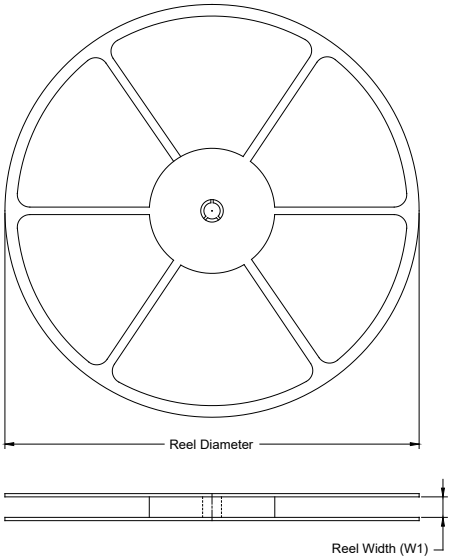


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.100
A1	0.000	-	0.100
A2	0.700		1.000
b	0.220	-	0.380
c	0.080		0.200
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.550	-	3.050
e	0.650 BSC		
e1	1.950 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

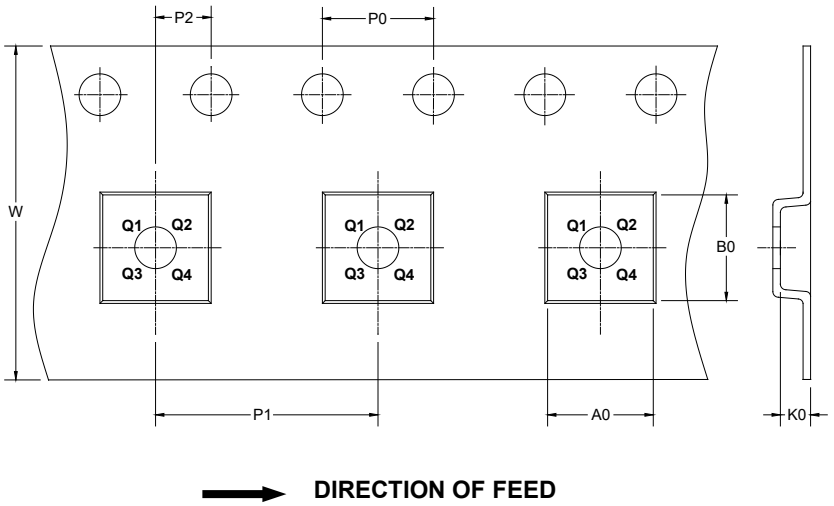
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-193.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



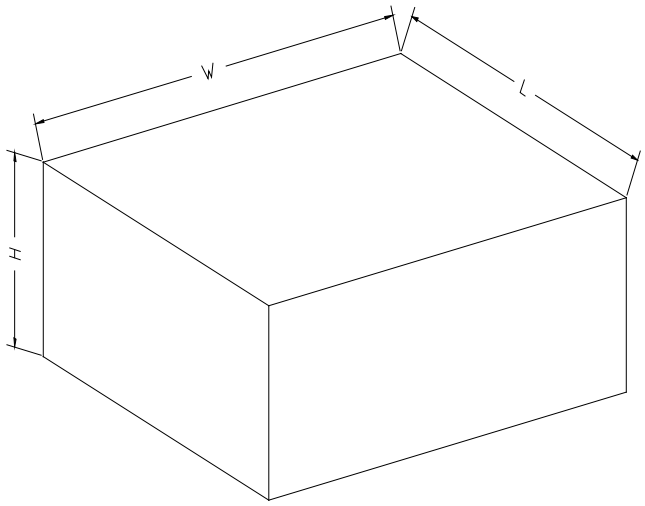
NOTE: The picture is only for reference. Please make the object as the standard.

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
TDFN-1.5×1.5-6L	7"	9.5	1.70	1.70	0.95	4.0	4.0	2.0	8.0	Q2
TSOT-23-8	7"	9.5	3.20	3.20	1.10	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