SGM8756
Micro-Power, Single-Supply, WLCSP Comparator with Precision Voltage Reference

GENERAL DESCRIPTION

The SGM8756 is a single, low power comparator with a precision voltage reference. It is optimized for low voltage operation from 2.5V to 5.5V single supply, and consumes only 40μA supply current. These two advantages make the device a good choice for portable and battery-powered equipment. Meanwhile, the SGM8756 has a great trade-off between low power and high speed, whose propagation delay is only 280ns with 100mV overdrive.

The SGM8756 supports rail-to-rail input and output operation. The input common mode voltage range is from $-V_S$ to $+V_S$. The device has an input offset voltage of ±3mV (MAX) and an input bias current of ±0.1nA (TYP). The SGM8756 has a push-pull output structure, which is capable of sinking and sourcing milliamps of current. The comparator output structure is specially designed to decrease the surges of supply current during switching. It can sufficiently reduce the overall power consumption in dynamic states, and almost eliminate many common power faults found in other comparators. The SGM8756 has an internal hysteresis for reducing comparator sensitivity to noise, even when the input signals move slowly.

The SGM8756 integrates a 1.23V voltage reference. The voltage reference features a low temperature drift of 100ppm/℃ (MAX) and a high accuracy of ±0.4% (MAX).

The SGM8756 is available in a Green WLCSP-1.4×0.9-6B package. It is specified over the operating temperature range of -40℃ to +125℃.

FEATURES

- **Supply Voltage Range: 2.5V to 5.5V**
- **Low Supply Current:**
  - **40μA (TYP) Quiescent Current**
  - **50μA with 100kHz Switching at 5V**
- **Low Propagation Delay: 280ns (TYP)**
- **Rail-to-Rail Input and Output**
- **Push-Pull Output**
- **Sink and Source Current Capability: 100mA (TYP)**
- **Internal Hysteresis: 5mV (TYP)**
- **Internal Voltage Reference:**
  - **Accuracy: ±0.4% (MAX)**
  - **Temperature Drift: 100ppm/℃ (MAX)**
  - **Stable Output Capacitor Range: 0nF to 4.7nF**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green WLCSP-1.4×0.9-6B Package**

APPLICATIONS

Industrial Equipment
Medical Equipment
Telecom Equipment

TYPICAL APPLICATION

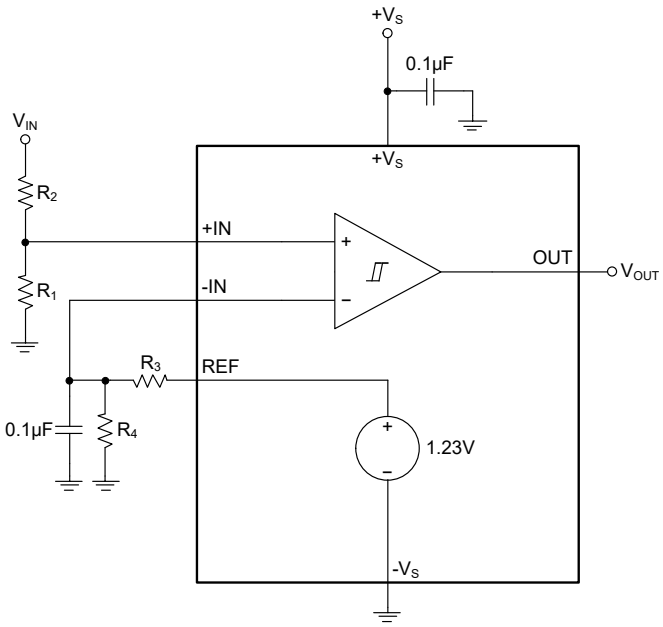


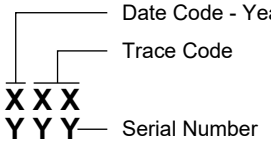
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8756	WLCSP-1.4×0.9-6B	-40℃ to +125℃	SGM8756XG/TR	XXX 1SO	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXX = Date Code and Trace 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

Supply Voltage, $+V_S$ to $-V_S$ ..... -0.3V to 6V
All Other Pins..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Current into Input Pins ..... ±20mA
Package Thermal Resistance
WLCSP-1.4×0.9-6B, θ_{JA}..... 147.1℃/W
WLCSP-1.4×0.9-6B, θ_{JB}..... 45.1℃/W
Junction Temperature.....+150℃
Storage Temperature Range .....-65℃ to +150℃
Lead Temperature (Soldering, 10s).....+260℃
ESD Susceptibility (1) (2)
HBM.....±8000V
CDM .....±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range .....2.5V to 5.5V
Power Supply Rise Time.....20μs (MIN)
Operating 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

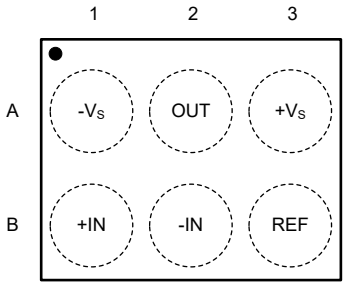
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

(TOP VIEW)



WLCSP-1.4×0.9-6B

PIN DESCRIPTION

PIN	NAME	FUNCTION
A1	$-V_S$	Negative Power Supply.
A2	OUT	Output of Comparator.
A3	$+V_S$	Positive Power Supply.
B1	+IN	Non-Inverting Input of Comparator.
B2	-IN	Inverting Input of Comparator.
B3	REF	Output of Voltage Reference.

ELECTRICAL CHARACTERISTICS

($+V_S$ = 2.5V to 5.5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, minimum and maximum values are at T_A = -40℃ to +125℃, and typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_S			2.5		5.5	V
Supply Current	I_S	V_S = 2.5V			35	70	μA
		V_S = 5.5V			40	80	
Comparator							
Input Offset Voltage (1)	V_{OS}	V_{CM} = 0V to V_S	V_S = 2.5V		±0.5	±3.5	mV
			V_S = 5.5V		±0.5	±3	
Input Hysteresis	V_{HYST}			2.4	5	8.7	mV
Input Bias Current	I_B	V_{CM} = 0V to V_S			±0.1	±20	nA
Input Offset Current	I_{OS}	V_{CM} = 0V to V_S			±0.1	±5	nA
Input Common Mode Voltage Range	V_{CM}			$-V_S$		$+V_S$	V
Common Mode Rejection Ratio	CMRR	V_{CM} = 0V to V_S	V_S = 2.5V	53	76		dB
			V_S = 5.5V	62	83		
Power Supply Rejection Ratio	PSRR			60	80		dB
Input Capacitance	C_{IN}	V_S = 5V			5.5		pF
Output Short-Circuit Current	I_{SINK}	V_{OUT} = $+V_S$	V_S = 2.5V	35	65		mA
			V_S = 5.5V	60	85		
	I_{SOURCE}	V_{OUT} = $-V_S$	V_S = 2.5V	35	60		
			V_S = 5.5V	65	100		
Output Voltage Low	V_{OL}	V_S = 2.5V, I_{SINK} = 3.5mA			0.08	0.1	V
		V_S = 5.5V, I_{SINK} = 8mA			0.15	0.18	
Output Voltage High	V_{OH}	V_S = 2.5V, I_{SOURCE} = 3.5mA		2.43	2.46		V
		V_S = 5.5V, I_{SOURCE} = 8mA		5.41	5.45		
Rise/Fall Time	t_R/t_F	C_L = 15pF			16		ns
		C_L = 50pF			20		
		C_L = 200pF			30		
Propagation Delay (2)	t_{PLH}/t_{PHL}	V_S = 2.5V, C_L= 15pF	Overdrive = 50mV		290		ns
			Overdrive = 100mV		280		
Power-Up Time	t_{PU}	Time to V_{OUT} valid logic state			12		μs

NOTES:

1. Input offset voltage is the midway voltage for the hysteresis zone of the comparator.
2. The trip point determined by offset and hysteresis is exceeded by overdrive voltage.

ELECTRICAL CHARACTERISTICS (continued)

($+V_S$ = 2.5V to 5.5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, minimum and maximum values are at T_A = -40℃ to +125℃, and typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Voltage Reference						
Output Voltage Reference	V_{REF}	T_A = +25℃	1.225	1.23	1.235	V
Output Voltage Temperature Drift (3)	$\Delta V_{REF}/\Delta T$			16	100	ppm/℃
Line Regulation	$\Delta V_{REF}/\Delta V_S$			20	100	μV/V
Load Regulation	$\Delta V_{REF}/\Delta I_{REF}$	Sinking: I_{REF} = 0μA to 500μA		0.5	1	μV/μA
		Sourcing: I_{REF} = 0μA to 500μA		0.5	1	
Output Short-Circuit Current	I_{SINK}	V_{REF} = $+V_S$	4	6		mA
	I_{SOURCE}	V_{REF} = $-V_S$	2.5	6		
Thermal Hysteresis (4)	T_{HYST}			100		ppm
Long-Term Stability		1000h at T_A = +25℃		100		ppm
Ripple Rejection	$\Delta V_{REF}/\Delta V_S$	V_S = 5V ± 100mV, f = 120Hz		88		dB
Turn-On Settling Time	t_{R_VREF}	To V_{REF} = 1% of final value		55		μs
Stable Output Capacitor Range (3)	C_{L_VREF}		0		4.7	nF

NOTES:

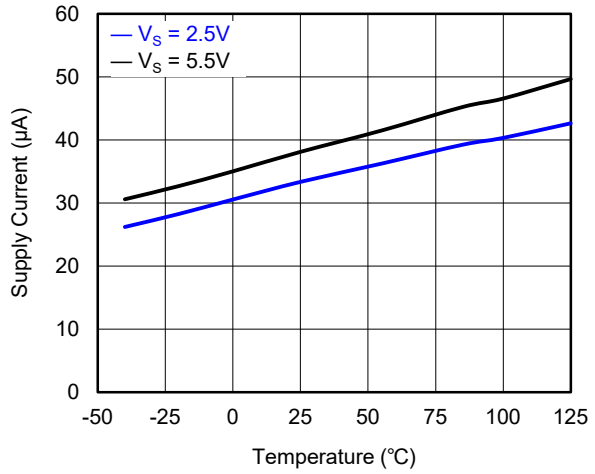
3. Specified by design and characterization, not production tested.

4. Thermal hysteresis is defined as the output voltage difference of the reference at +25℃ after three temperature excursions, each starting from +25℃, rising to +125℃, dropping to -40℃, and returning to +25℃.

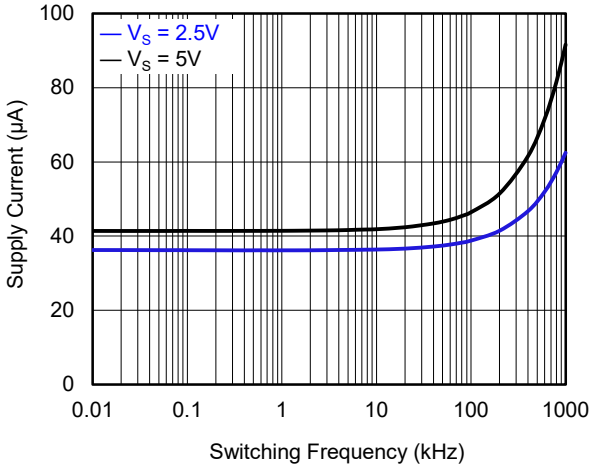
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, $+V_S$ = 5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, unless otherwise noted.

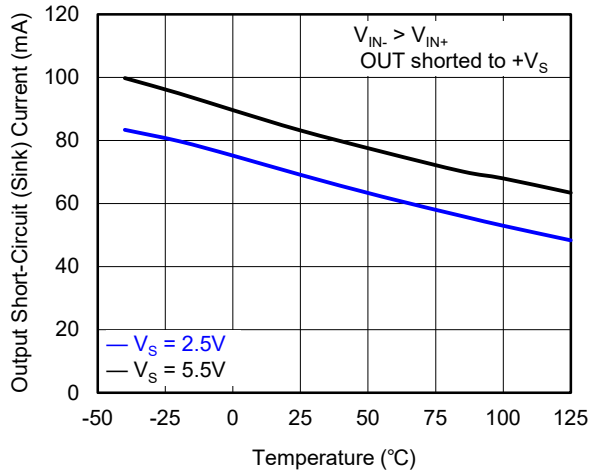
Supply Current vs. Temperature



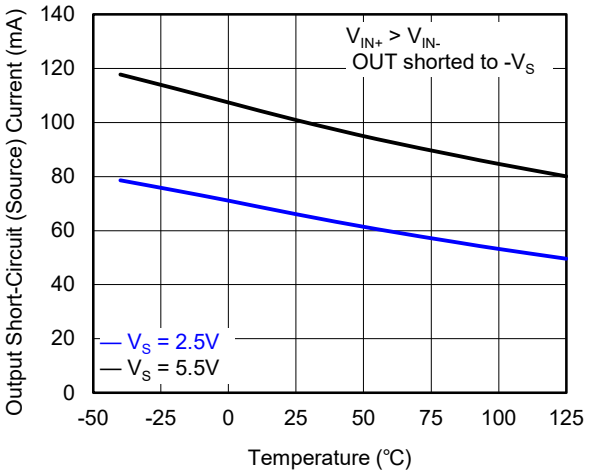
Supply Current vs. Switching Frequency



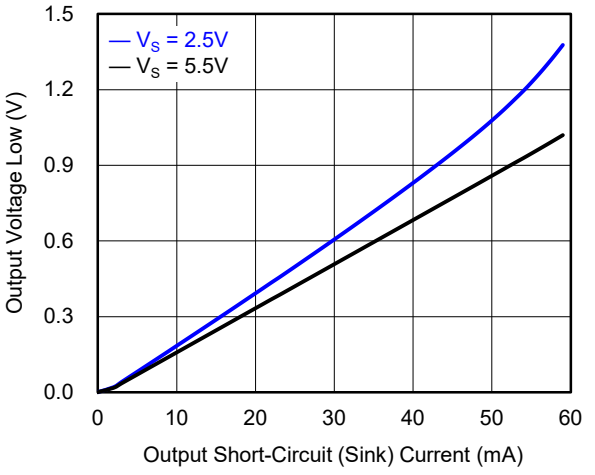
Output Short-Circuit (Sink) Current vs. Temperature



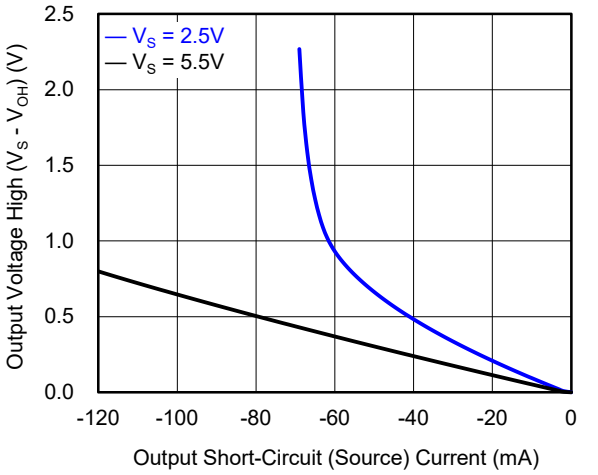
Output Short-Circuit (Source) Current vs. Temperature



Output Voltage Low vs. Output Short-Circuit (Sink) Current



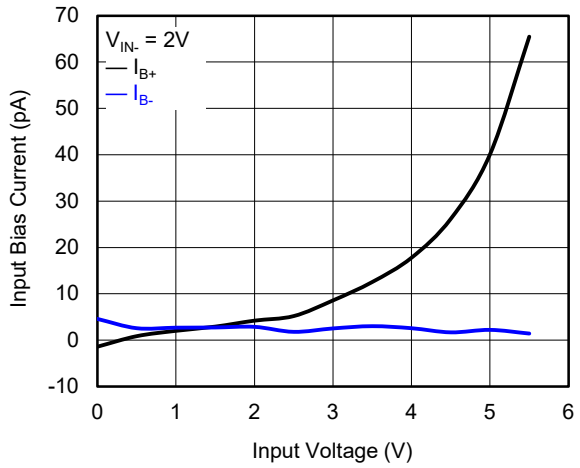
Output Voltage High (V_S - V_{OH}) vs. Output Short-Circuit (Source) Current



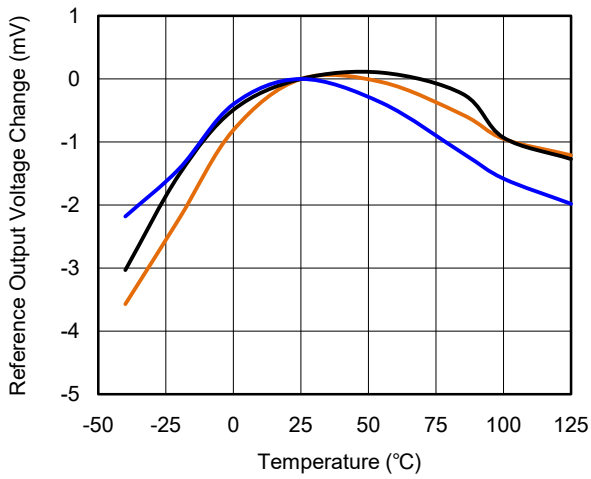
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, $+V_S$ = 5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, unless otherwise noted.

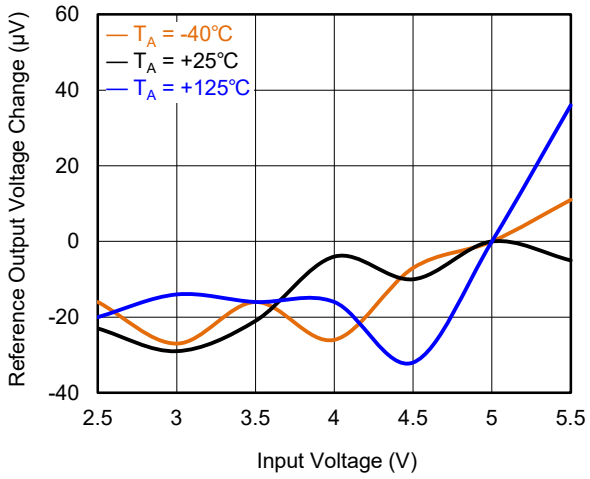
Input Bias Current vs. Input Voltage



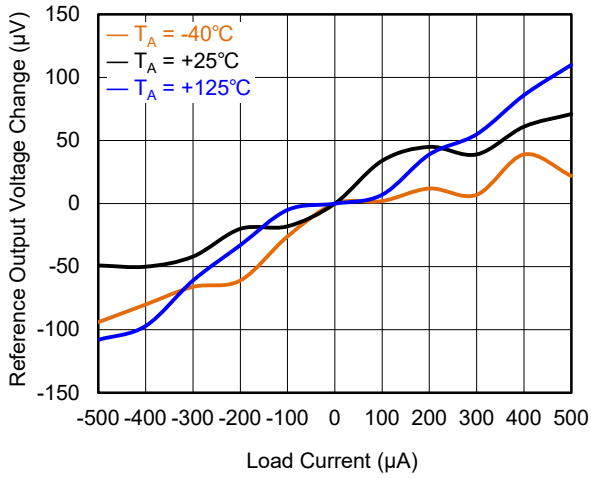
Reference Output Voltage Temperature Drift



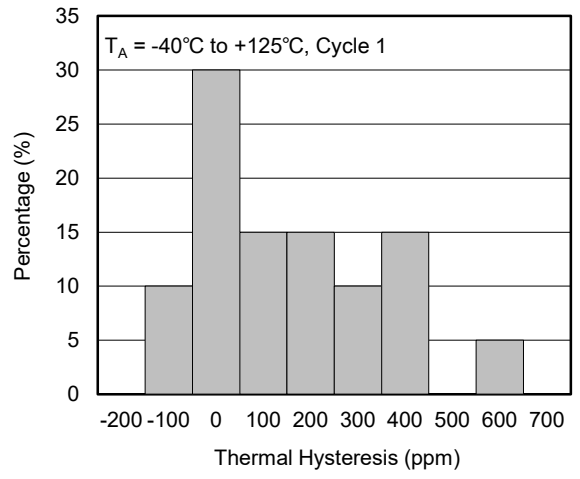
Line Regulation



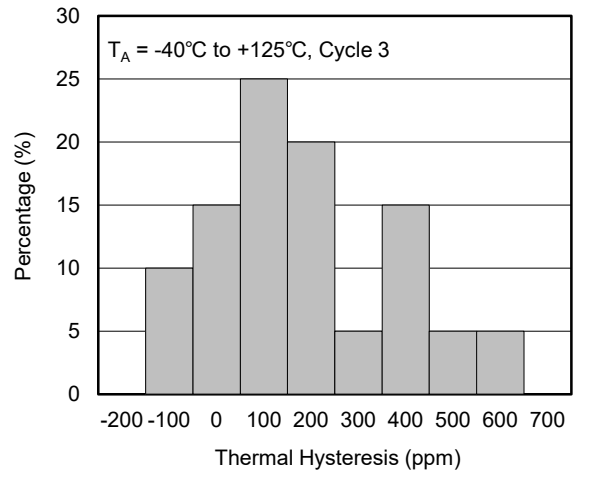
Load Regulation



Thermal Hysteresis Production Distribution



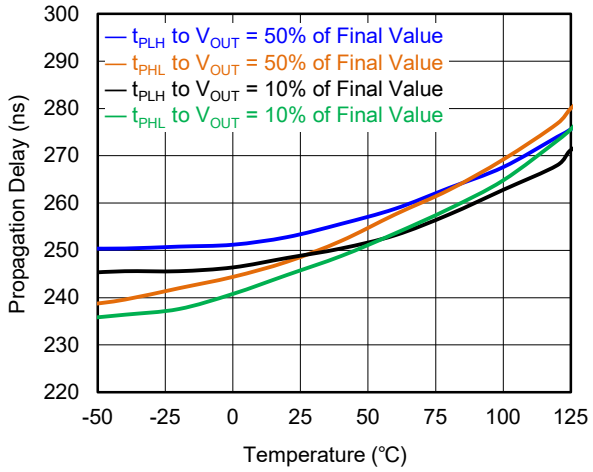
Thermal Hysteresis Production Distribution



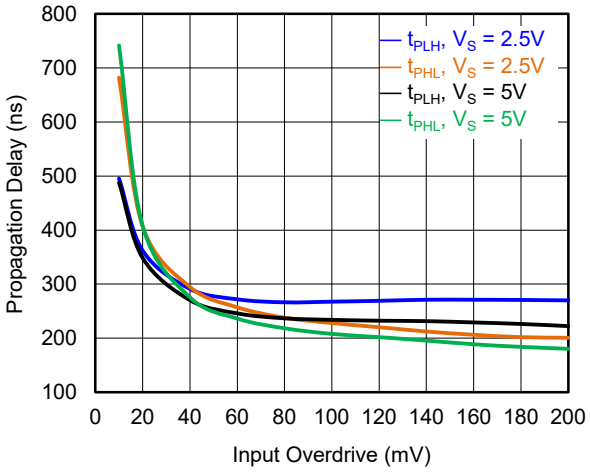
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, $+V_S$ = 5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, unless otherwise noted.

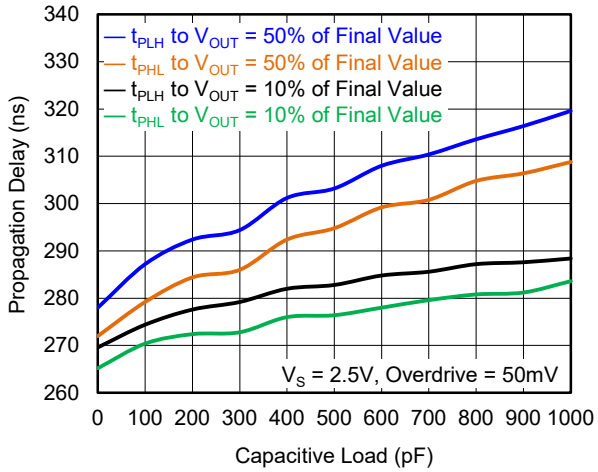
Propagation Delay vs. Temperature



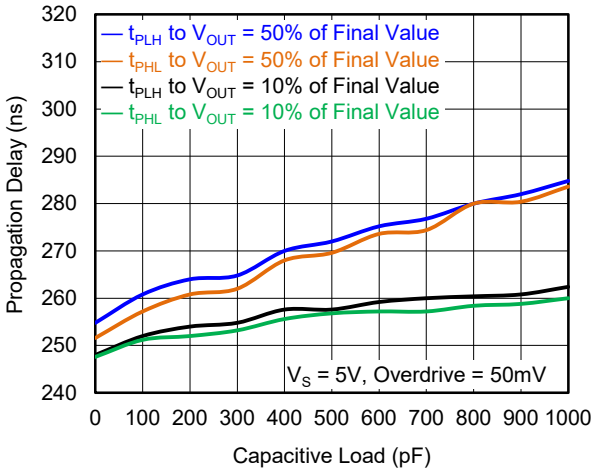
Propagation Delay vs. Input Overdrive



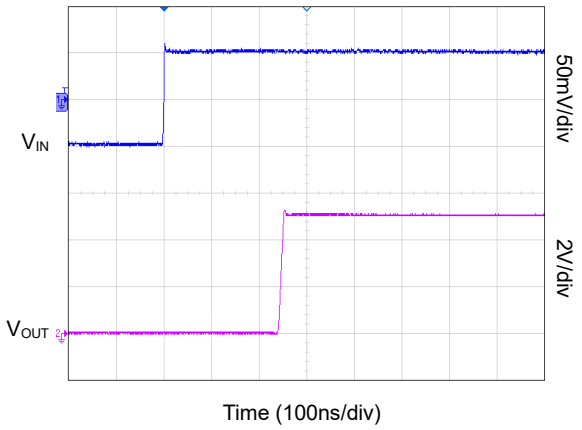
Propagation Delay vs. Capacitive Load



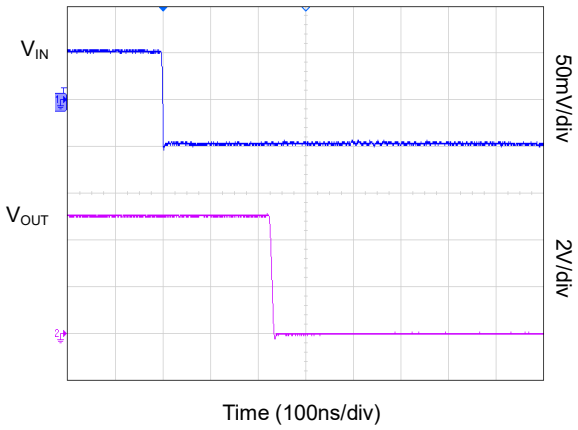
Propagation Delay vs. Capacitive Load



Propagation Delay (L-H)



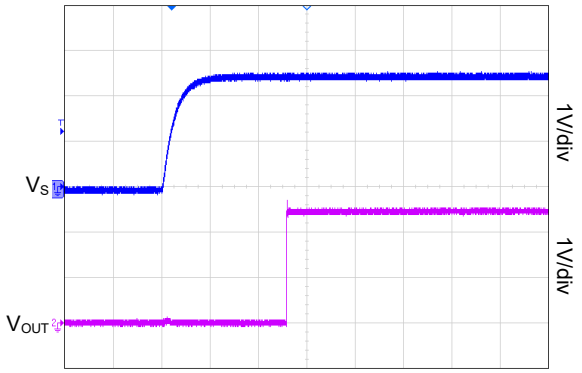
Propagation Delay (H-L)



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

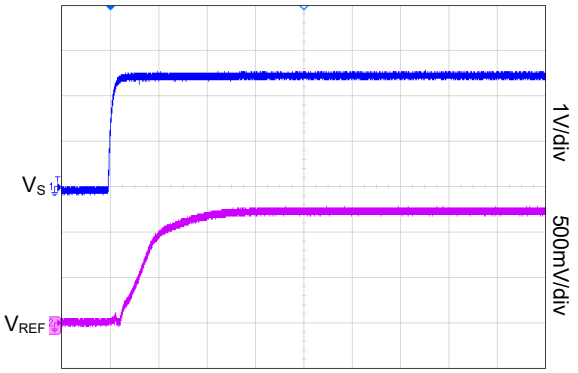
At T_A = +25℃, $+V_S$ = 5V, $-V_S$ = 0V, V_{CM} = 0V, I_{OUT} = 0A, I_{REF} = 0A, unless otherwise noted.

Power-Up Delay (OUT)



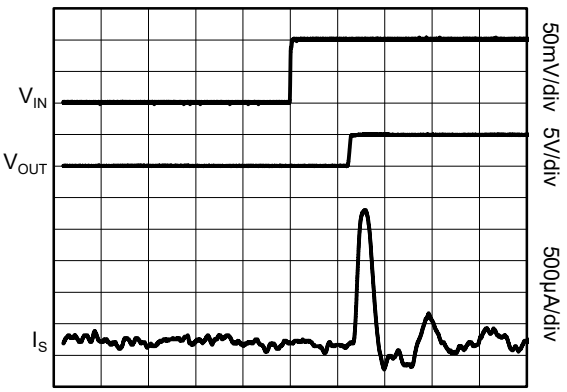
Time (5μs/div)

Power-Up Delay (REF)



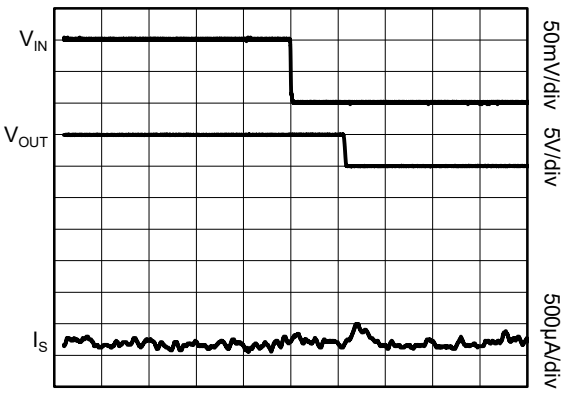
Time (20μs/div)

Switching Current (OUT Rising Edge)



Time (200ns/div)

Switching Current (OUT Falling Edge)



Time (200ns/div)

FUNCTIONAL BLOCK DIAGRAM

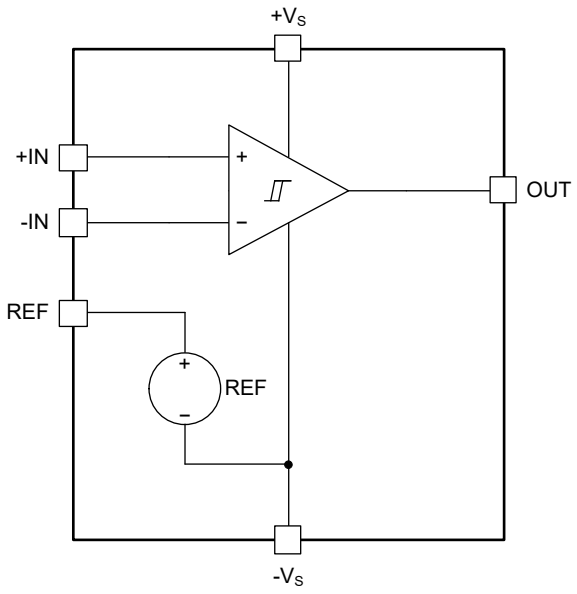


Figure 2. Block Diagram

DETAILED DESCRIPTION

The SGM8756 comprises a single comparator that operates at low power and voltage levels, along with a precise 1.23V voltage reference. SGM8756 is optimized for low voltage operation from 2.5V to 5.5V single supply, consuming only 40μA quiescent current. The common mode range extends 0.3V beyond the power supply voltage rails.

Internal Hysteresis

The 5mV internal hysteresis of the SGM8756 guarantees clear output switching, even when dealing with input signals that change slowly.

Comparator Input

The input common mode range of the comparator spans from $-V_S$ to $+V_S$. Within these boundaries, the comparator can function with any differential input voltage. When the input voltage lies between the supply rails, the typical input bias current is ±0.1nA. To protect the inputs of the comparator from going out of range, the internal diode connected to $-V_S$ is taken into account. To explain, the internal diode will be forward biased if the input voltage is below $-V_S$ and the input bias current of the comparator will increase exponentially in this situation.

Comparator Output

The SGM8756 has a push-pull output structure, which is specially designed to decrease the surges of supply current during switching. It can sufficiently reduce the overall power consumption in dynamic states, and almost eliminate many common power faults found in other comparators. The incorporation of substantial internal output drivers enables a rail-to-rail output swing capable of sinking and sourcing currents of up to 100mA.

Reference Performance

The temperature drift of reference is just 100ppm/℃ (MAX) and the accuracy of the output voltage is significantly high, being within ±0.4%.

The voltage reference remains stable when subjected to capacitive loads of up to 4.7nF. In scenarios where the load or power supply may undergo abrupt changes, attaching an output capacitor to the REF pin can mitigate overshoot or undershoot and enhance the circuit's transient response. The reference load current cannot exceed the reference short-circuit current. Otherwise, it may cause a drop in the reference voltage.

APPLICATION INFORMATION

Adding External Hysteresis

The effect of significant input noise is an issue that has to be taken into consideration for applications with slow moving or noisy input signals. The output will switch as the result of the input noise, although there is 5mV internal hysteresis. For this case, it is recommended to add external resistors at the positive terminal of the comparator. For the circuit shown in Figure 3 and the following formula, the external hysteresis can be obtained. The noise immunity is improved.

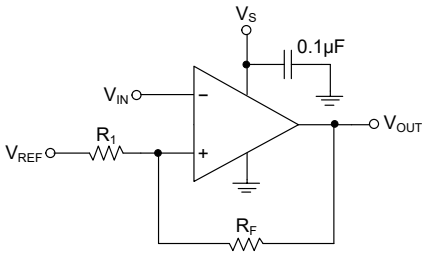


Figure 3. Additional Hysteresis

$$V_{HYS} = V_S(\frac{R_1}{R_F + R_1}) \quad (1)$$

Power Supply Recommendations

A 100nF bypass capacitor must be placed as close as possible to the $+V_S$ pin, and try to keep the wiring as short as possible. The 100nF capacitor provides a charge for high-frequency component. The SGM8756 is not recommended for applications requiring rapid cycling of V_S. It is better to power down V_S to 0V for more than 1s before powering it on again.

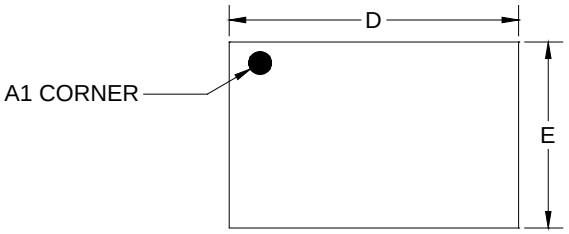
REVISION HISTORY

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

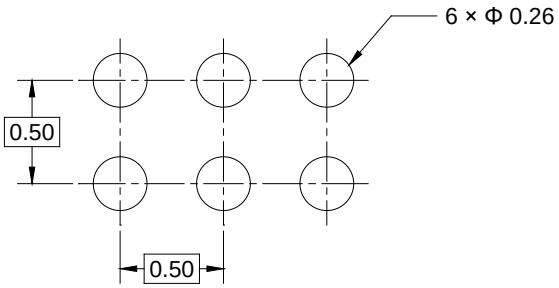
Changes from Original (SEPTEMBER 2025) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

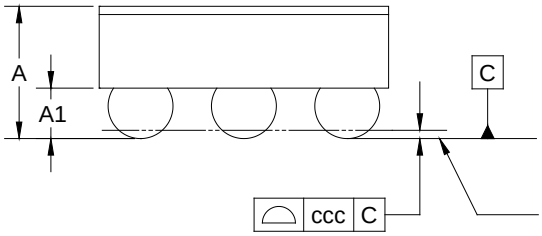
WLCSP-1.4×0.9-6B



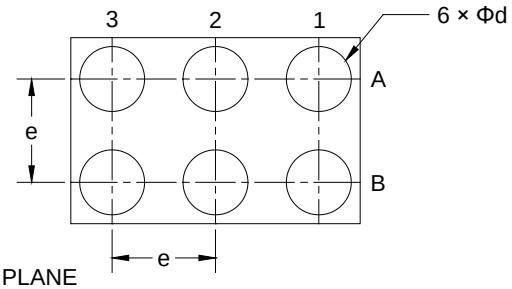
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



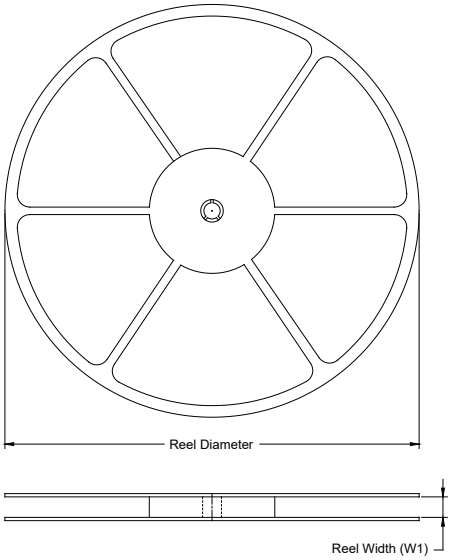
BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	0.678
A1	0.224	-	0.264
D	1.370	-	1.430
E	0.870	-	0.930
d	0.284	-	0.344
e	0.500 BSC		
ccc	0.050		

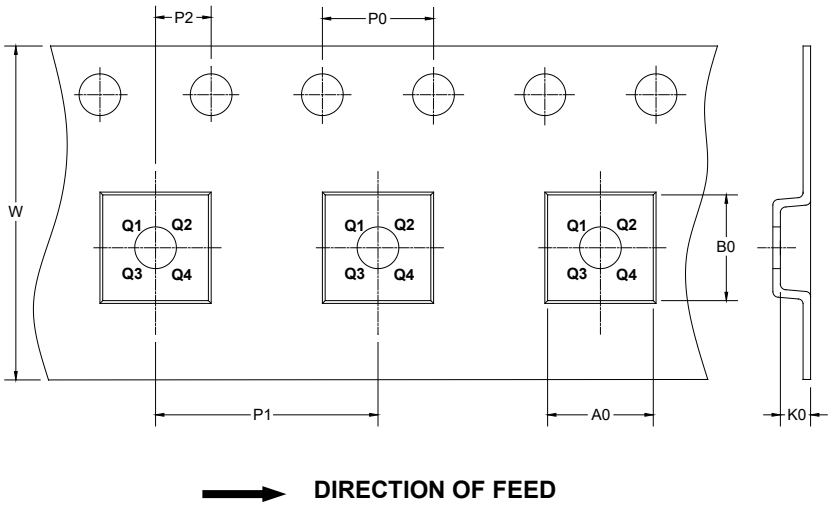
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



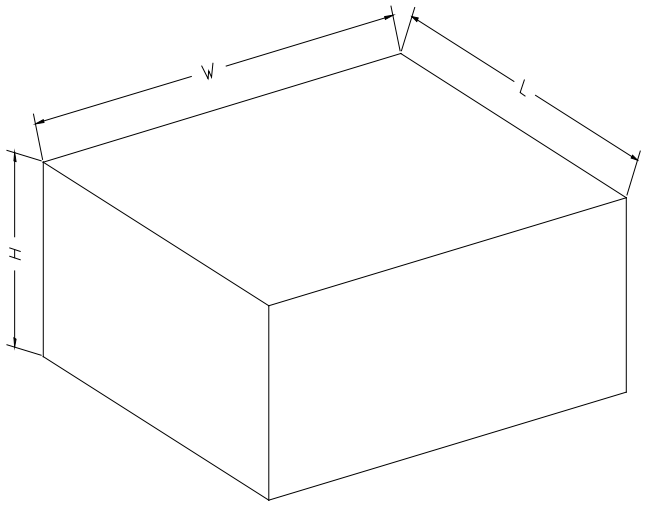
NOTE: The picture is only for reference. Please make the object as the standard.

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
WLCSP-1.4×0.9-6B	7″	9.5	1.00	1.50	0.77	4.0	4.0	2.0	8.0	Q2

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