

# SGM8746

## 155ns, Low-Power, 3V/5V, Rail-to-Rail Input Single-Supply Comparator

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### GENERAL DESCRIPTION

The SGM8746 is a single high-speed comparator optimized for systems powered from a 3V or 5V supply. The device features high-speed response, low-power consumption, and rail-to-rail input range. Propagation delay is 155ns, while supply current is only 22 $\mu$ A.

The input common mode range of the SGM8746 extends beyond both power supply rails. The output pulls to within 0.1V of either supply rail without external pull-up circuitry, making the device ideal for interface with both CMOS and TTL logics. All input and output pins can tolerate a continuous short-circuit fault condition to either rail. Internal hysteresis ensures clean output switching, even with slow-moving input signals.

The SGM8746 is available in Green SOT-23-5 and SC70-5 packages. It is rated over the -40°C to +85°C temperature range.

### FEATURES

- **Fast, 155ns Propagation Delay (10mV Overdrive)**
- **Low Power Consumption:**  
22 $\mu$ A (TYP) at  $V_S = 3V$
- **Wide Supply Voltage Range: 2.7V to 5.5V**
- **Optimized for 3V and 5V Applications**
- **Rail-to-Rail Input Voltage Range**
- **Low Offset Voltage: 0.8mV (TYP)**
- **Internal Hysteresis for Clean Switching**
- **Output Swing to within 190mV from Rails with 4mA Output Current**
- **CMOS/TTL-Compatible Output**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green SOT-23-5 and SC70-5 Packages**

### APPLICATIONS

Line Receivers  
Battery-Powered Systems  
Threshold Detectors/Discriminators  
3V/5V Systems  
Zero-Crossing Detectors  
Sampling Circuits

## PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8746	SOT-23-5	-40°C to +85°C	SGM8746YN5G/TR	SM5XX	Tape and Reel, 3000
	SC70-5	-40°C to +85°C	SGM8746YC5G/TR	SM6XX	Tape and Reel, 3000

## MARKING INFORMATION

NOTE: XX = Date Code.

## SOT-23-5/SC70-5

YYY X X

Date Code - Month

Date Code - Year

Serial Number

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $+V_S$ to $-V_S$ .....	6V
$V_{IN}$ Differential .....	$\pm 2.5V$
Voltage at Input/Output Pins .....	$(-V_S) - 0.3V$ to $(+V_S) + 0.3V$
Junction Temperature .....	+150°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (Soldering, 10s) .....	+260°C
ESD Susceptibility	
HBM .....	6000V
MM .....	400V

## RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range .....	-40°C to +85°C
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## 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

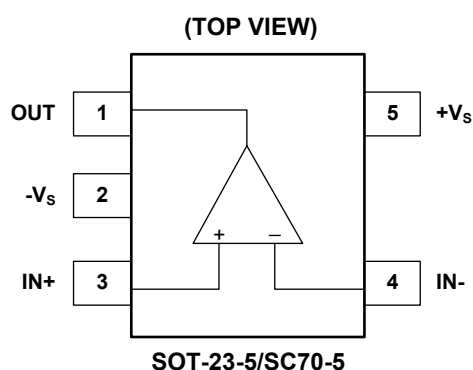
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions.

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 very small parametric changes could cause the device not to meet its published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

## PIN CONFIGURATIONS



## ELECTRICAL CHARACTERISTICS

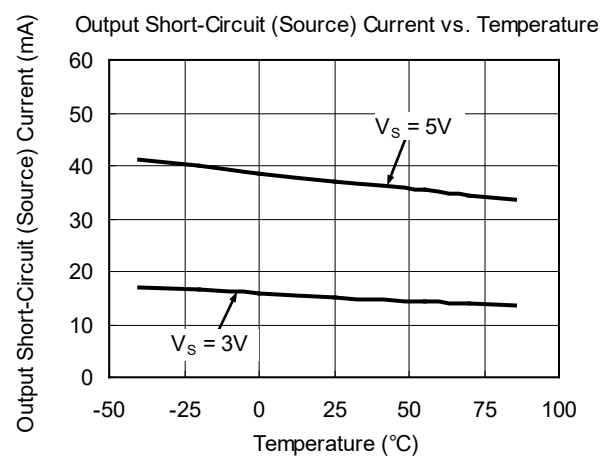
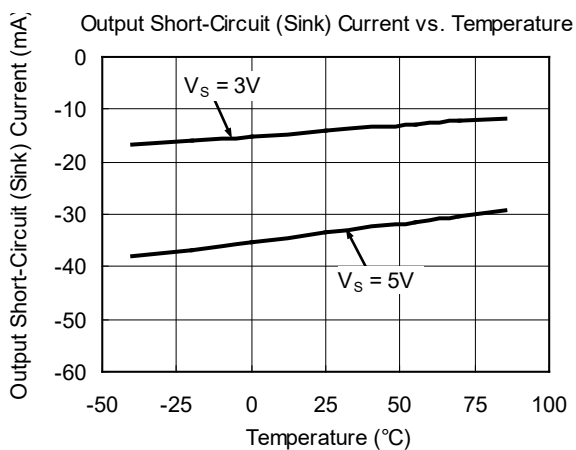
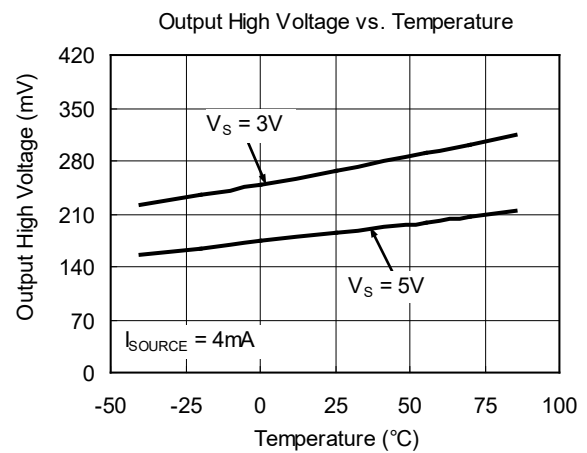
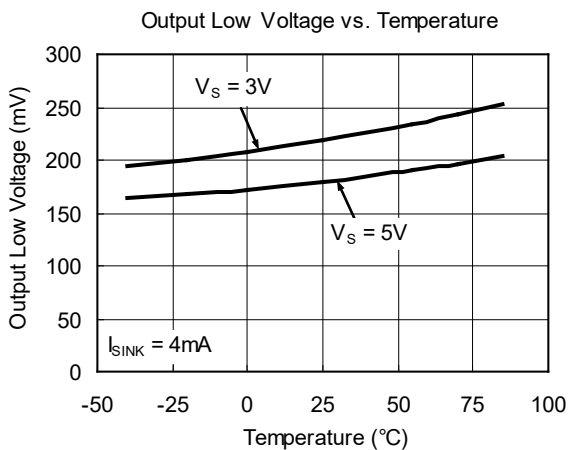
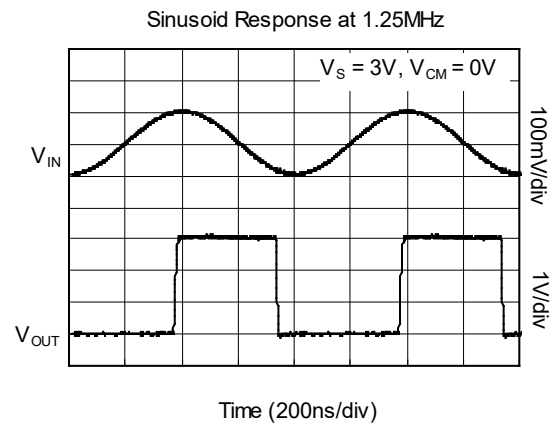
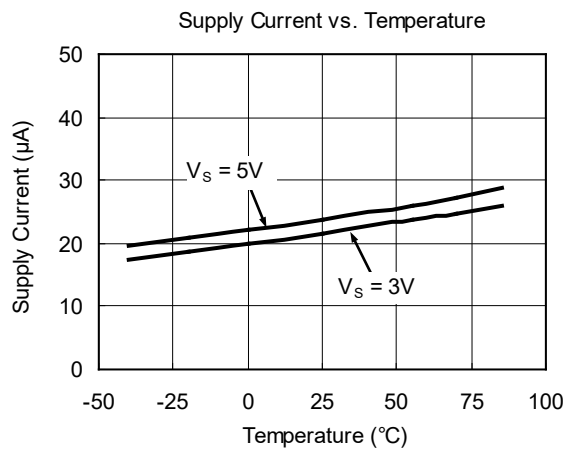
(V<sub>S</sub> = 5.0V, V<sub>CM</sub> = 0V, C<sub>L</sub> = 15pF, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage <sup>(1)</sup>	V <sub>S</sub>		2.7		5.5	V
Input Common Mode Voltage Range <sup>(2)</sup>	V <sub>CM</sub>		-0.1		V <sub>S</sub> + 0.1	V
Input Offset Voltage <sup>(3)</sup>	V <sub>OS</sub>	V <sub>S</sub> = 5V, V <sub>CM</sub> = 0V		0.8	4.9	mV
		-40°C ≤ T <sub>A</sub> ≤ +85°C			5.8	
Input Hysteresis <sup>(4)</sup>	V <sub>HYST</sub>	V <sub>S</sub> = 5V, V <sub>CM</sub> = 0V		2.5		mV
Output Short-Circuit Current	I <sub>SOURCE</sub>	V <sub>S</sub> = 5V, Out to V <sub>S</sub> /2	22.5	34		mA
		-40°C ≤ T <sub>A</sub> ≤ +85°C	19			
	I <sub>SINK</sub>	V <sub>S</sub> = 5V, Out to V <sub>S</sub> /2		-33	-25.5	
		-40°C ≤ T <sub>A</sub> ≤ +85°C			-21	
Common Mode Rejection Ratio <sup>(5)</sup>	CMRR	V <sub>S</sub> = 5V, V <sub>CM</sub> = 0V to 5V	59	78		dB
		-40°C ≤ T <sub>A</sub> ≤ +85°C	54			
Power Supply Rejection Ratio	PSRR	V <sub>CM</sub> = 0V, V <sub>S</sub> = 2.7V to 5.5V	58	71		dB
		-40°C ≤ T <sub>A</sub> ≤ +85°C	54			
Output Voltage Swing from Rail	V <sub>OH</sub>	V <sub>S</sub> = 5V, I <sub>OUT</sub> = 4mA		188	275	mV
		-40°C ≤ T <sub>A</sub> ≤ +85°C			305	
	V <sub>OL</sub>	V <sub>S</sub> = 5V, I <sub>OUT</sub> = -4mA		179	222	
		-40°C ≤ T <sub>A</sub> ≤ +85°C			248	
Supply Current	I <sub>S</sub>	V <sub>S</sub> = 3V, I <sub>OUT</sub> = 0		22	32	μA
		-40°C ≤ T <sub>A</sub> ≤ +85°C			40	
		V <sub>S</sub> = 5V, I <sub>OUT</sub> = 0		25	39	
		-40°C ≤ T <sub>A</sub> ≤ +85°C			52	
Propagation Delay (High to Low)		V <sub>S</sub> = 3V, Overdrive = 10mV		155		ns
		V <sub>S</sub> = 3V, Overdrive = 100mV		95		
Propagation Delay (Low to High)		V <sub>S</sub> = 3V, Overdrive = 10mV		145		ns
		V <sub>S</sub> = 3V, Overdrive = 100mV		120		
Rise Time	t <sub>RISE</sub>	V <sub>S</sub> = 3V, Overdrive = 10mV		10		ns
		V <sub>S</sub> = 3V, Overdrive = 100mV		8		
Fall Time	t <sub>FALL</sub>	V <sub>S</sub> = 3V, Overdrive = 10mV		8		ns
		V <sub>S</sub> = 3V, Overdrive = 100mV		6		

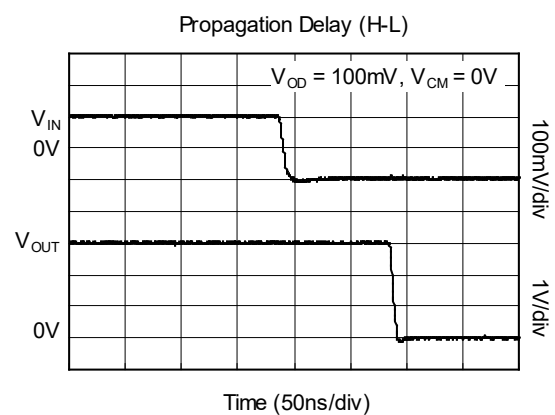
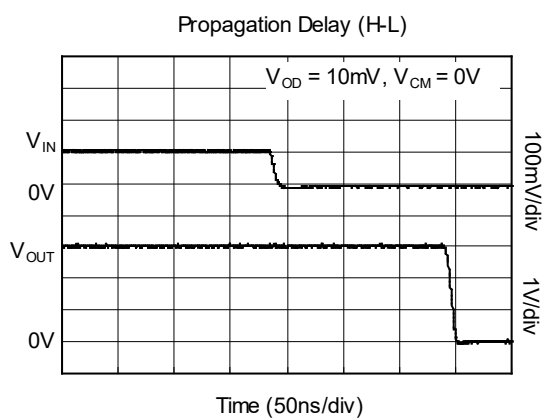
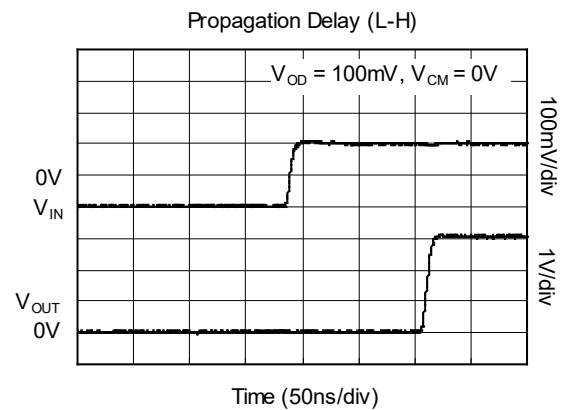
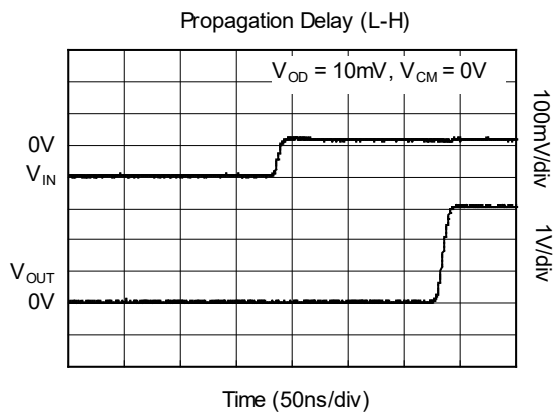
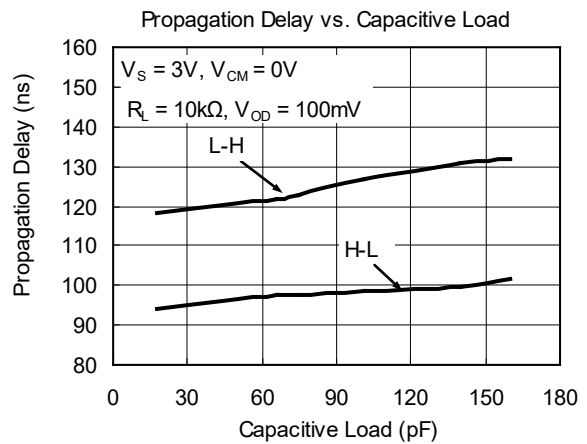
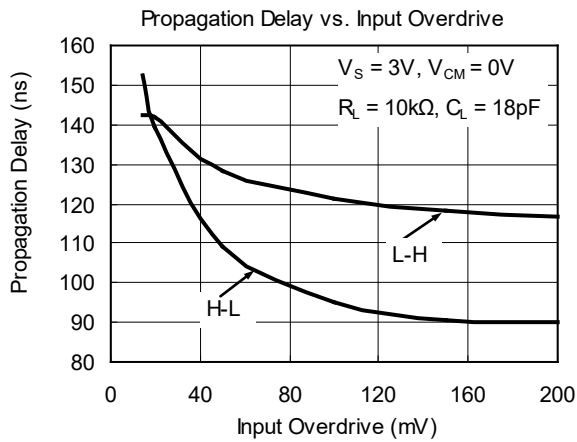
## NOTES:

1. Inferred from PSRR test.
2. Inferred from PD test. Note also that either or both inputs can be driven to the absolute maximum limit (0.1V beyond either supply rail) without damage or false output inversion.
3. V<sub>OS</sub> is defined as the center of the input-referred hysteresis zone. See Figure 1.
4. The input-referred trip points are the extremities of the differential input voltage required to make the comparator output change state. The difference between the upper and lower trip points is equal to the width of the input-referred hysteresis zone. See Figure 1.
5. Specified over the full input common mode voltage range (V<sub>CM</sub>).

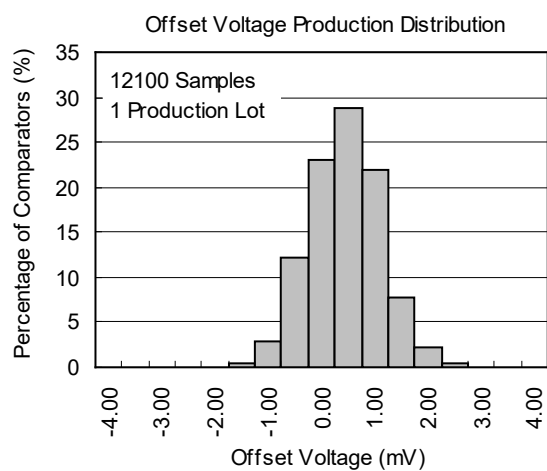
## TYPICAL PERFORMANCE CHARACTERISTICS



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



## DETAILED DESCRIPTION

The SGM8746 is a single-supply comparator that features internal hysteresis, high speed, and low power. With 4mA output current, its output is pulled to within 190mV of either supply rail without external pull-up or pull-down circuitry. Rail-to-rail input voltage range and low-voltage single-supply operation make the device ideal for portable equipment. The SGM8746 interfaces directly to CMOS and TTL logics.

Most high-speed comparators oscillate in the linear region because of noise or undesired parasitic feedback. This tends to occur when the voltage on one input is at or equal to the voltage on the other input. To counter the parasitic effects and noise, the SGM8746 has an internal hysteresis of 2.5mV.

The hysteresis in a comparator creates two trip points: one for the rising input voltage and one for the falling input voltage (Figure 1). The difference between the trip points is the hysteresis. The average of the trip points is the offset voltage. When the comparator's input voltages are equal, the hysteresis effectively causes one comparator input voltage to move quickly past the other, thus taking the input out of the region where oscillation occurs. Standard comparators require hysteresis to be added with external resistors. The SGM8746's fixed internal hysteresis eliminates these resistors. To increase hysteresis and noise margin even more, add positive feedback with two resistors as a voltage divider from the output to the non-inverting input.

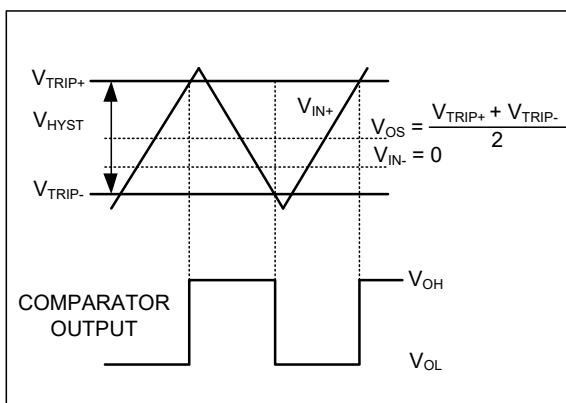


Figure 1. Input and Output Waveform,  
Non-Inverting Input Varied

Figure 1 illustrates the case where  $IN-$  is fixed and  $IN+$  is varied. If the inputs were reversed, the figure would look the same, except the output would be inverted.

### Output Stage Circuitry

The SGM8746 contains a current-driven output stage as shown in Figure 2. During an output transition,  $I_{SOURCE}$  or  $I_{SINK}$  is pushed or pulled to the output pin. The output source or sink current is high during the transition, creating a rapid slew rate. Once the output voltage reaches  $V_{OH}$  or  $V_{OL}$ , the source or sink current decreases to a small value, capable of maintaining the  $V_{OH}$  or  $V_{OL}$  static condition. This significant decrease in current conserves power after an output transition has occurred.

One consequence of a current-driven output stage is a linear dependence between the slew rate and the load capacitance. A heavy capacitive load will slow down a voltage output transition. This can be useful in noise-sensitive applications where fast edges may cause interference.

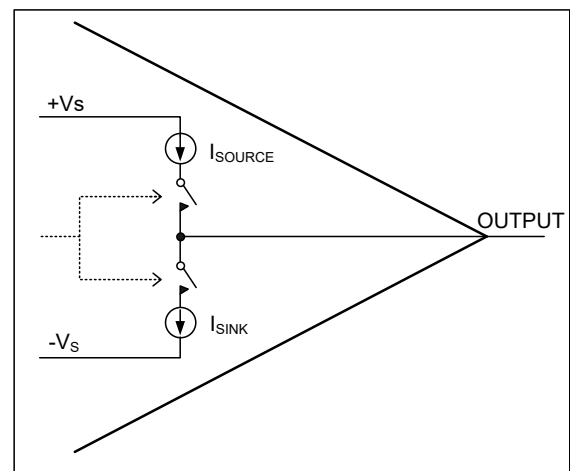


Figure 2. Output Stage Circuitry

## APPLICATION INFORMATION

## Circuit Layout and Bypassing

The high gain-bandwidth product of the SGM8746 requires design precautions to realize the full high-speed capabilities of the comparator. The recommended precautions are:

- 1) Use a PCB with a good, unbroken, low-inductance ground plane.
- 2) Place a decoupling capacitor (a 0.1 $\mu$ F ceramic capacitor is a good choice) as close to +V<sub>S</sub> as possible.
- 3) Pay close attention to the decoupling capacitor's bandwidth, keeping leads short.
- 4) On the inputs and output, keep lead lengths short to avoid unwanted parasitic feedback around the comparator.
- 5) Solder the device directly to the PCB instead of using a socket.

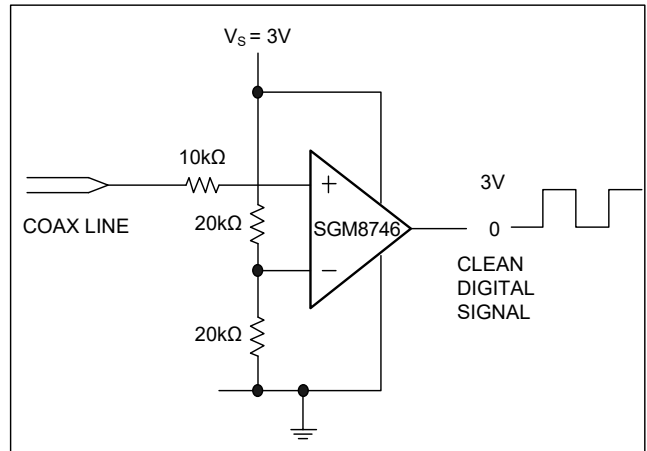


Figure 4. Line Receiver Application

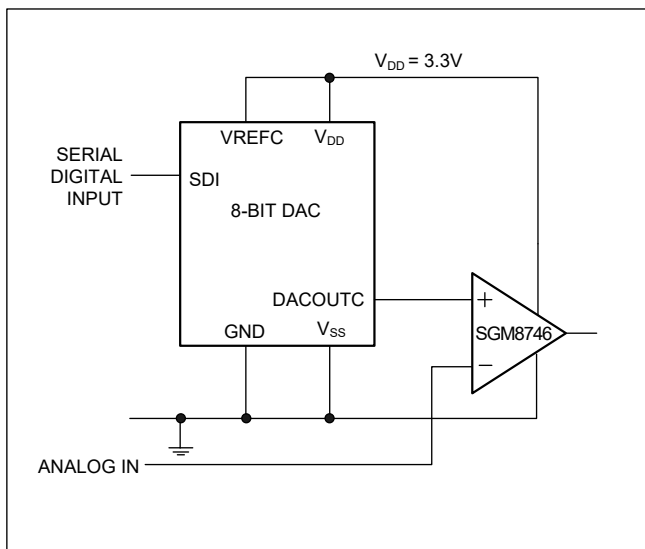


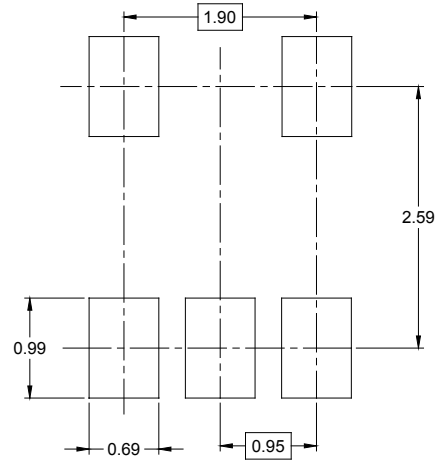
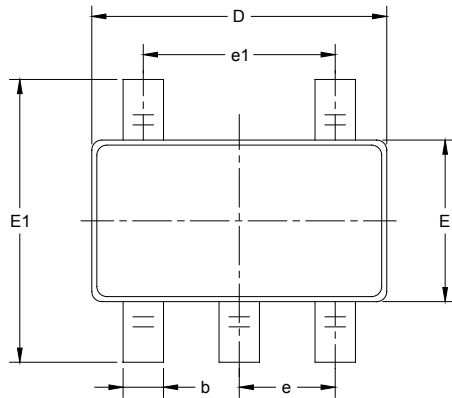
Figure 3. 3.3V Digitally Controlled Threshold Detector



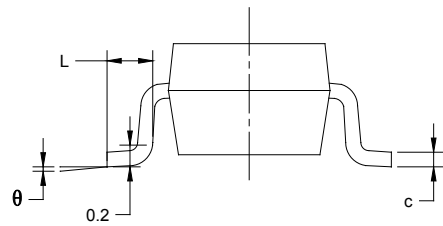
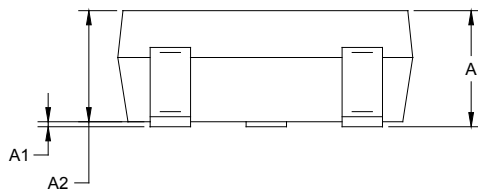
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOT-23-5



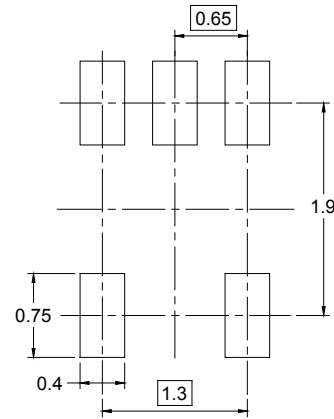
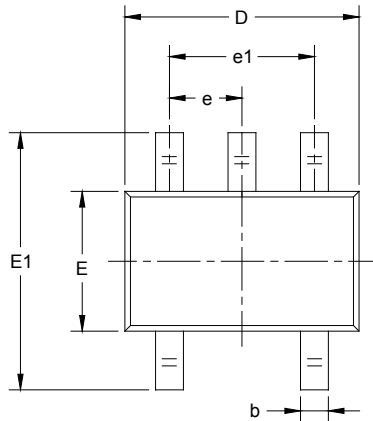
RECOMMENDED LAND PATTERN (Unit: mm)



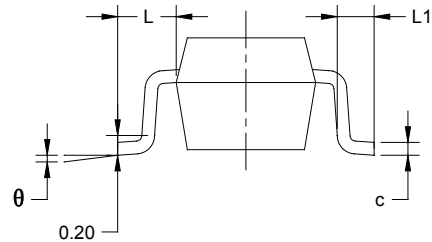
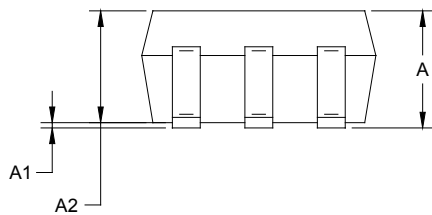
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

## PACKAGE OUTLINE DIMENSIONS

### SC70-5



RECOMMENDED LAND PATTERN (Unit: mm)

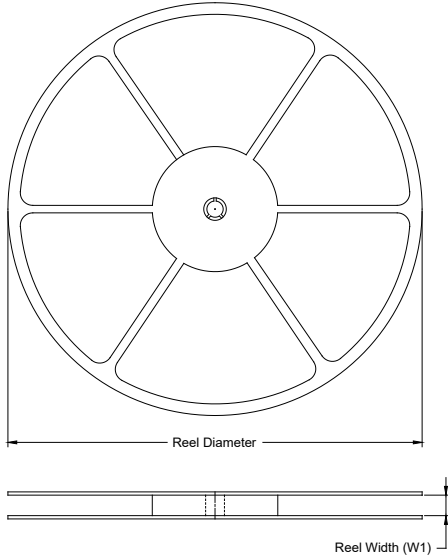


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.65 TYP		0.026 TYP	
e1	1.300 BSC		0.051 BSC	
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

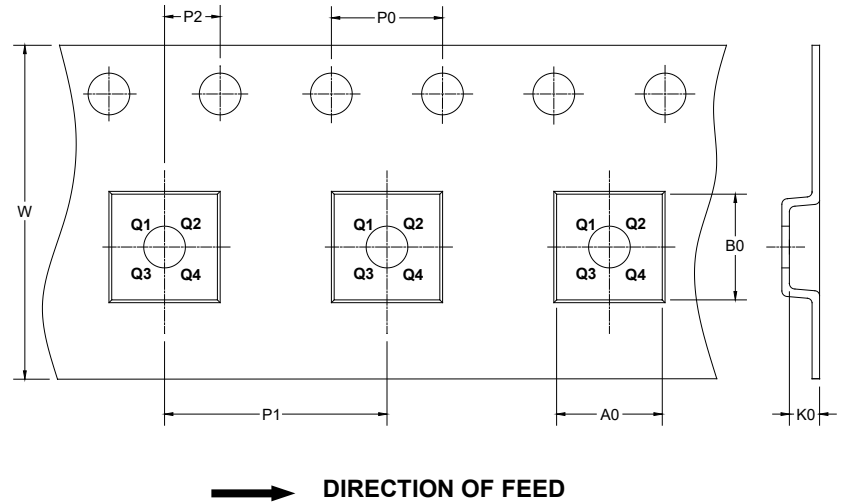
## PACKAGE INFORMATION

### TAPE AND REEL INFORMATION

#### REEL DIMENSIONS



#### TAPE DIMENSIONS



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

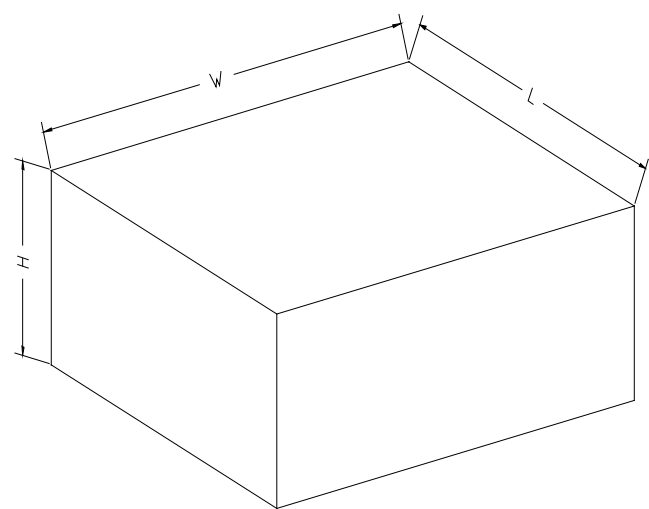
#### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
SC70-5	7"	9.5	2.25	2.55	1.20	4.0	4.0	2.0	8.0	Q3

DD0001

# PACKAGE INFORMATION

## CARTON BOX DIMENSIONS



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

## KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7" (Option)	368	227	224	8
7"	442	410	224	18

DD0002