SGM8745
6ns, Low-Power, 3V/5V, Rail-to-Rail Input Single-Supply Comparator

GENERAL DESCRIPTION

The SGM8745 is a dual 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 6ns, while supply current is only 2.6mA.

The input common mode range of the SGM8745 extends beyond both power supply rails. The outputs pull 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 SGM8745 is available in Green SOIC-8 and MSOP-8 packages. It is rated over the -40℃ to +85℃ temperature range.

FEATURES

- **Fast, 6ns Propagation Delay (100mV Overdrive)**
- **Low Power Consumption:**
  2.6mA (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 195mV from Rails with 4mA Output Current**
- **CMOS/TTL-Compatible Outputs**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green SOIC-8 and MSOP-8 Packages**

APPLICATIONS

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

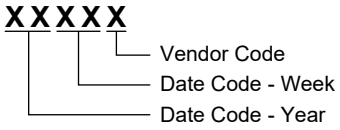
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8745	SOIC-8	-40℃ to +85℃	SGM8745YS8G/TR	SGM 8745YS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40℃ to +85℃	SGM8745YMS8G/TR	SGM8745 YMS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

SOIC-8/MSOP-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.

ABSOLUTE MAXIMUM RATINGS

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

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +85℃

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

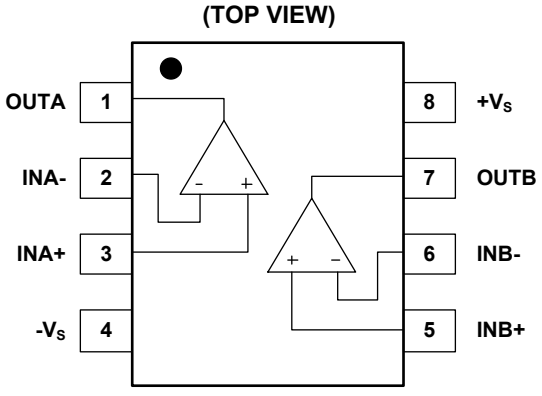
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

(TOP VIEW)



SOIC-8/MSOP-8

ELECTRICAL CHARACTERISTICS

(V_S = 5.0V, V_{CM} = 0V, C_L = 15pF, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage (1)	V_S		2.7		5.5	V
Input Common Mode Voltage Range (2)	V_{CM}		-0.1		V_S + 0.1	V
Input Offset Voltage (3)	V_{OS}	V_S = 5V, V_{CM} = 0V		0.8	4.9	mV
		-40℃ ≤ T_A ≤ +85℃			5.6	
Input Hysteresis (4)	V_{HYST}	V_S = 5V, V_{CM} = 0V		3		mV
Output Short-Circuit Current	I_{SOURCE}	V_S = 5V, Out to V_S/2	23.5	35		mA
		-40℃ ≤ T_A ≤ +85℃	19.5			
	I_{SINK}	V_S = 5V, Out to V_S/2		-31	-25	
		-40℃ ≤ T_A ≤ +85℃			-20	
Common Mode Rejection Ratio (5)	CMRR	V_S = 5V, V_{CM} = 0V to 5V	60	77		dB
		-40℃ ≤ T_A ≤ +85℃	57			
Power Supply Rejection Ratio	PSRR	V_{CM} = 0V, V_S = 2.7V to 5.5V	56	74		dB
		-40℃ ≤ T_A ≤ +85℃	51			
Output Voltage Swing from Rail	V_{OH}	V_S = 5V, I_{OUT} = 4mA		195	275	mV
		-40℃ ≤ T_A ≤ +85℃			308	
	V_{OL}	V_S = 5V, I_{OUT} = -4mA		188	245	
		-40℃ ≤ T_A ≤ +85℃			277	
Supply Current	I_S	V_S = 3V, I_{OUT} = 0		2.6	3.4	mA
		-40℃ ≤ T_A ≤ +85℃			3.8	
		V_S = 5V, I_{OUT} = 0		2.8	3.6	
		-40℃ ≤ T_A ≤ +85℃			4.1	
Propagation Delay (High to Low)		V_S = 3V, Overdrive = 10mV		11		ns
		V_S = 3V, Overdrive = 100mV		6		
Propagation Delay (Low to High)		V_S = 3V, Overdrive = 10mV		11		ns
		V_S = 3V, Overdrive = 100mV		6		
Rise Time	t_{RISE}	V_S = 3V, Overdrive = 10mV		8		ns
		V_S = 3V, Overdrive = 100mV		8		
Fall Time	t_{FALL}	V_S = 3V, Overdrive = 10mV		6		ns
		V_S = 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.

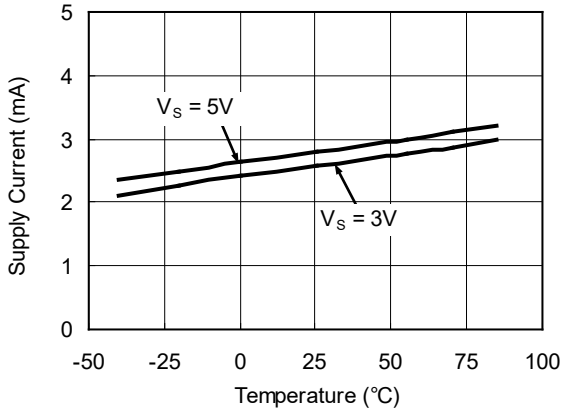
3. V_{OS} is defined as the center of the input-referred hysteresis zone. See Figure 1.

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.

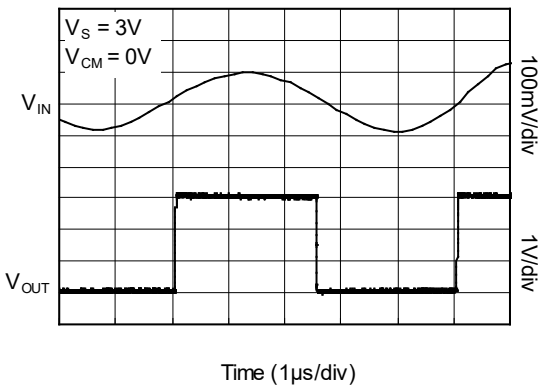
5. Specified over the full input common mode voltage range (V_{CM}).

TYPICAL PERFORMANCE CHARACTERISTICS

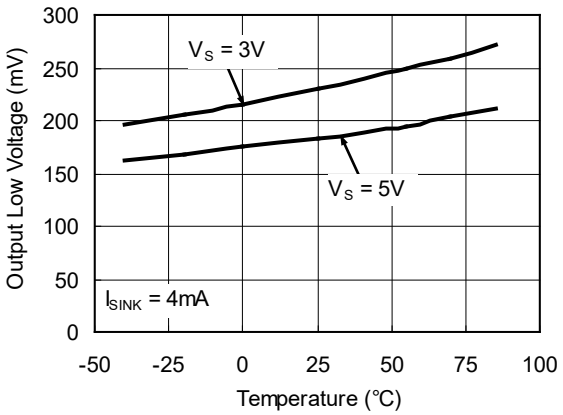
Supply Current vs. Temperature



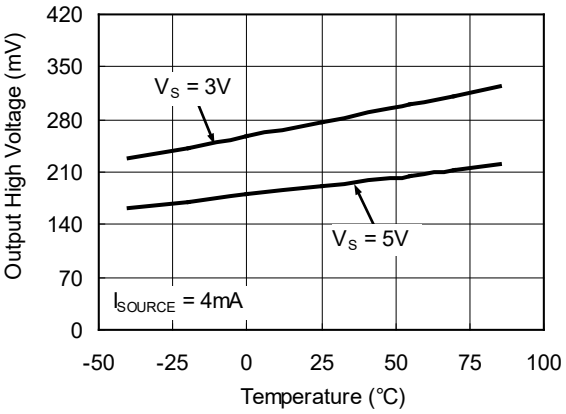
Sinusoid Response at 0.2MHz



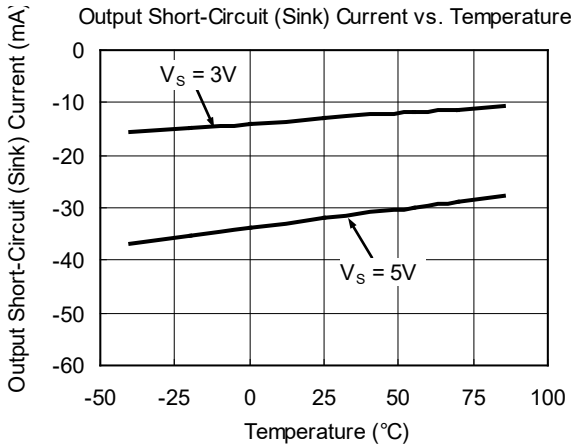
Output Low Voltage vs. Temperature



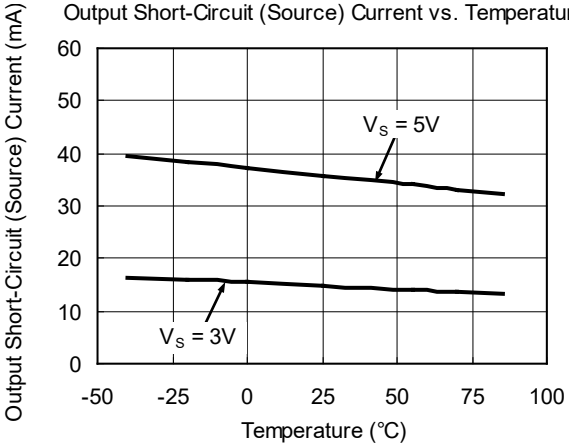
Output High Voltage vs. Temperature



Output Short-Circuit (Sink) Current vs. Temperature

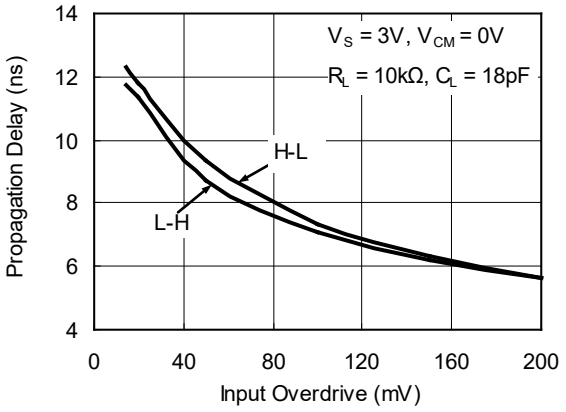


Output Short-Circuit (Source) Current vs. Temperature

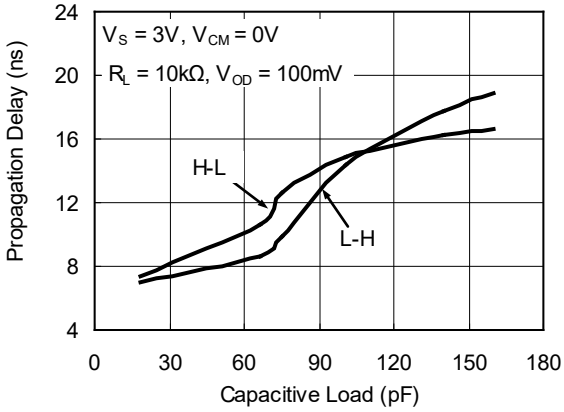


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

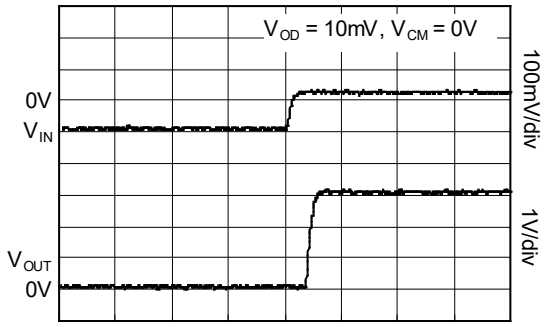
Propagation Delay vs. Input Overdrive



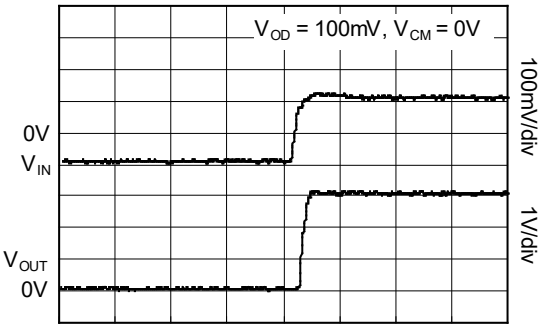
Propagation Delay vs. Capacitive Load



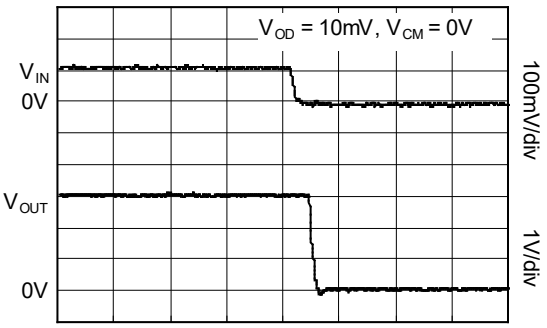
Propagation Delay (L-H)



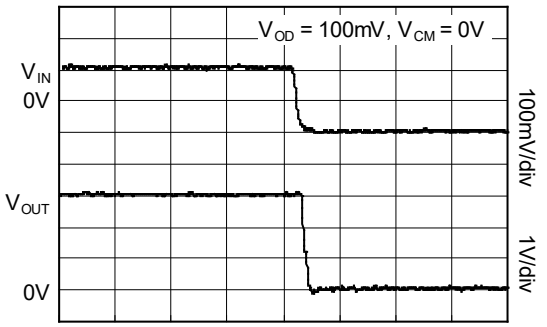
Propagation Delay (L-H)



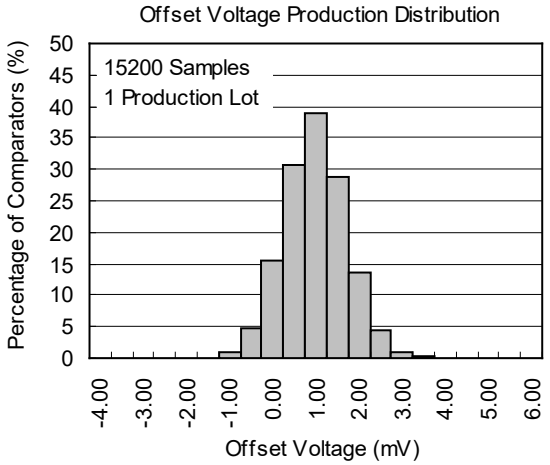
Propagation Delay (H-L)



Propagation Delay (H-L)



TYPICAL PERFORMANCE CHARACTERISTICS (continued)



DETAILED DESCRIPTION

The SGM8745 is a single-supply comparator that features internal hysteresis, high speed, and low power. With 4mA output current, its output is pulled to within 195mV 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 SGM8745 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 SGM8745 has an internal hysteresis of 3mV.

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 SGM8745'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.

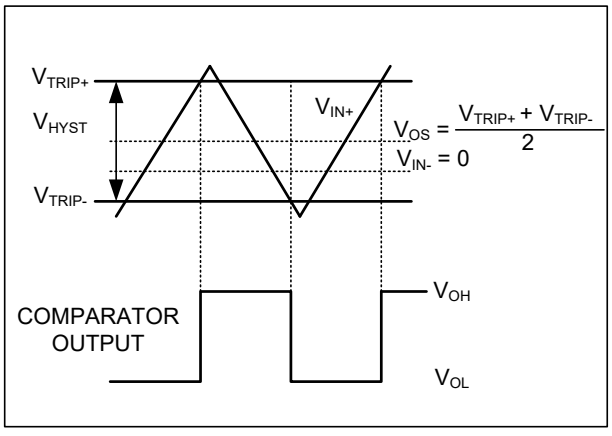


Figure 1. Input and Output Waveform, Non-Inverting Input Varied

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 SGM8745 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.

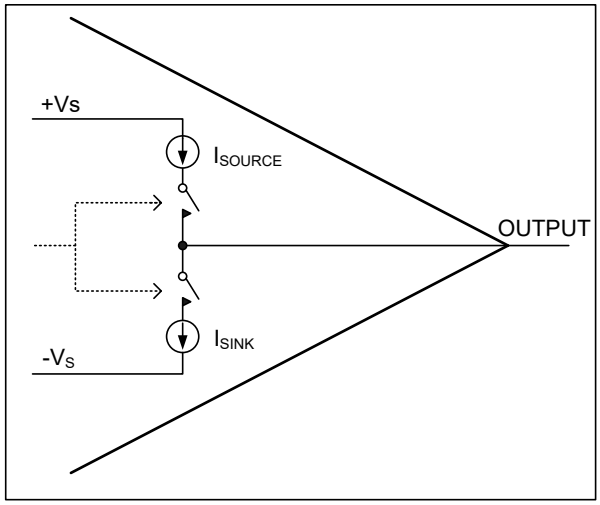


Figure 2. Output Stage Circuitry

APPLICATION INFORMATION

Circuit Layout and Bypassing

The high gain-bandwidth product of the SGM8745 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 0.1μF ceramic capacitor is a good choice) as close to $+V_S$ as possible.
3) Pay close attention to the decoupling capacitor's bandwidth, keeping leads short.
4) On the inputs and outputs, 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.

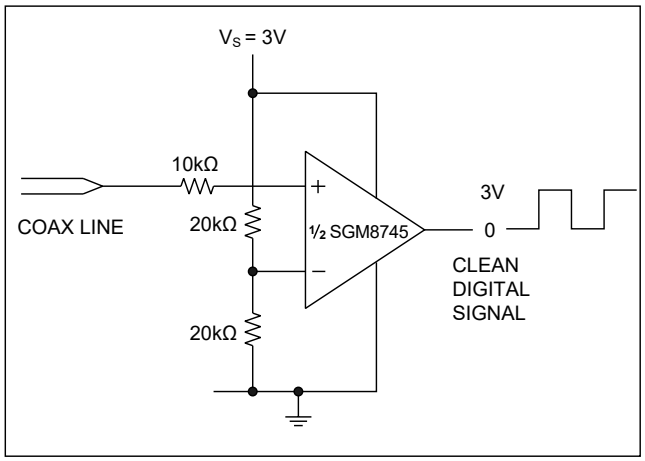


Figure 4. Line Receiver Application

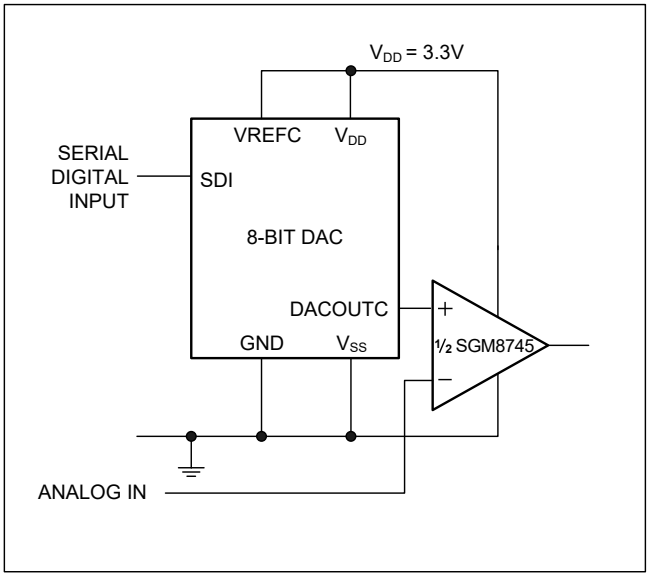


Figure 3. 3.3V Digitally Controlled Threshold Detector

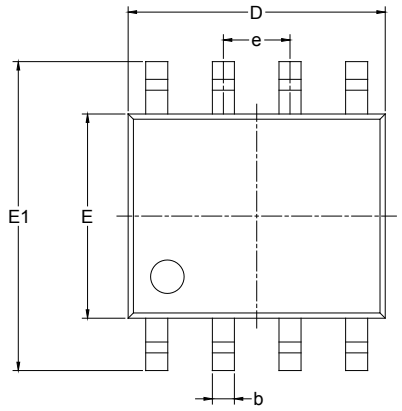
REVISION HISTORY

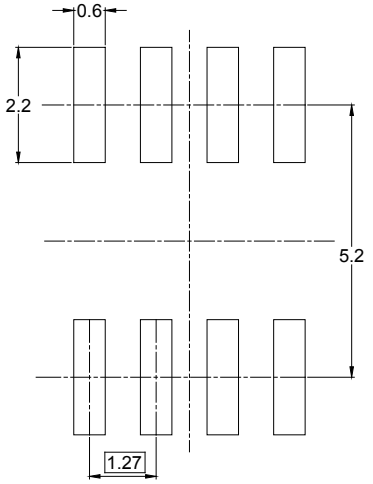
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBER 2014) to REV.A	Page
Changed from product preview to production data	All

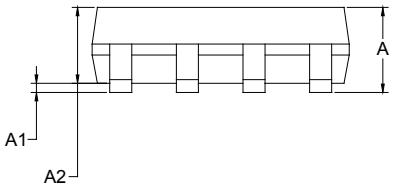
PACKAGE OUTLINE DIMENSIONS

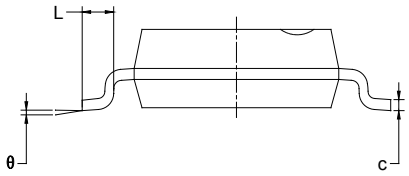
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)

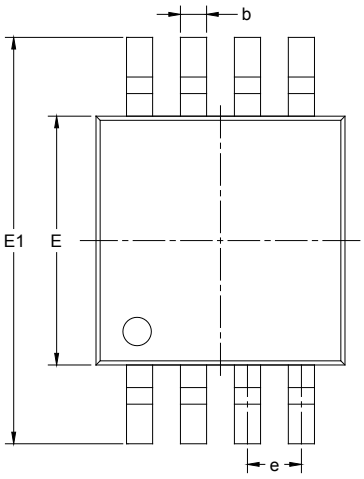


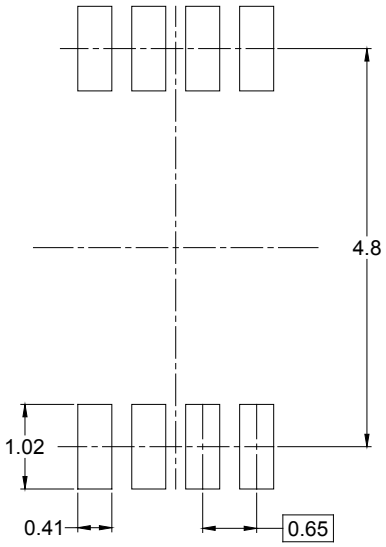


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

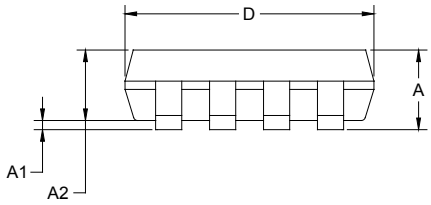
PACKAGE OUTLINE DIMENSIONS

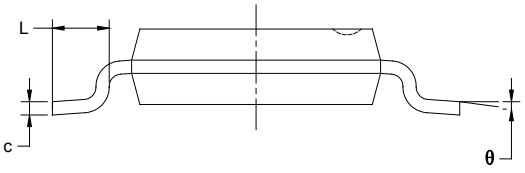
MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

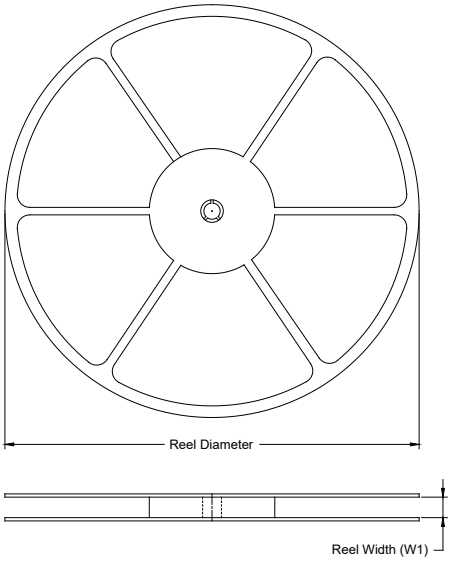




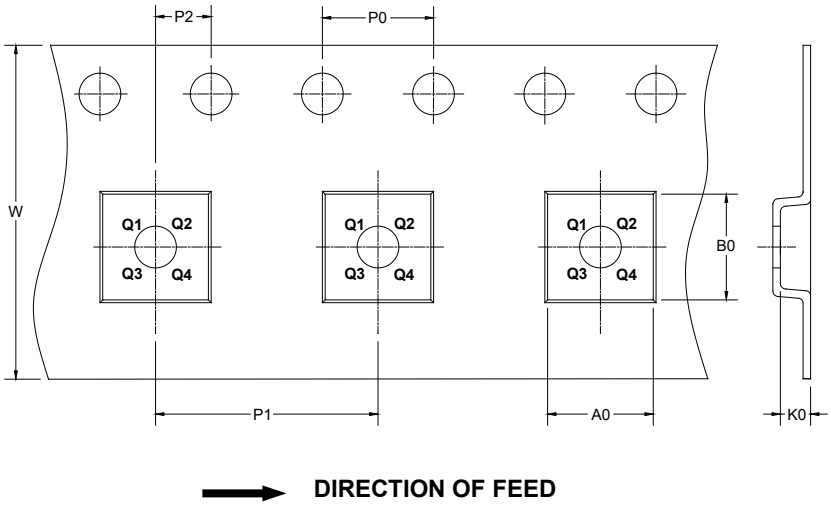
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



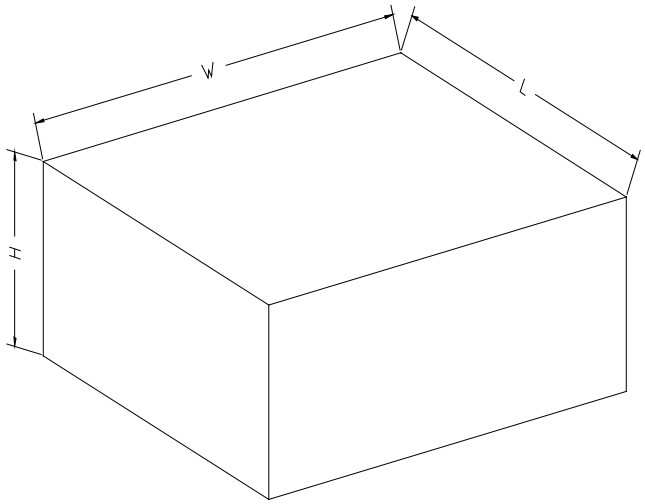
NOTE: The picture is only for reference. Please make the object as the standard.

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
SOIC-8	13″	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP-8	13″	12.4	5.20	3.30	1.50	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