Ultra-low Power, RRIO, 1.8V, Push-Pull Output Comparators

Features

- **46uA (Typ) Low Power Consumption**
- **Fast, 70ns Propagation Delay**
- **Single-Supply Operation from +1.8V ~ +5.5V**
- **Low Offset Voltage: 3mV (Max)**
- **Rail-to-Rail Input and Output**
- **CMOS/TTL-Compatible Output**
- **Internal Hysteresis for Clean Switching**
- **No Phase Reversal for Overdriven Inputs**
- **Operating Temperature: -40°C ~ +85°C**
- **Small Package:**

HGV331 Available in SOT23-5 and SC70-5 Packages
HGV332 Available in SOP-8 and MSOP-8 Packages

General Description

The HGV331 is low-power, high-speed comparator with internal hysteresis, optimized for systems powered from a 3V or 5V supply. The device features high-speed response, low-power consumption, low offset voltage, and rail-to-rail input and output range.

Propagation delay is 70ns (100mV overdrive), while supply current is 46uA per comparator. The internal input hysteresis eliminates output switching due to internal input noise voltage. The maximum input offset voltage is 3mV, and the operating range is from 1.8V to 5.5V.

All devices are specified for the temperature range of -40℃ to +85℃. The HGV331 single is available in Green SC70-5 and SOT23-5 packages. The HGV332 dual is available in Green SOP-8 and MSOP-8 packages.

Applications

- Alarm and Monitoring Circuits
- Peak and Zero-crossing Detectors
- Logic Level Shifting or Translation
- RC Timers
- Window Comparators
- IR Receivers
- Portable Systems

Pin Configuration

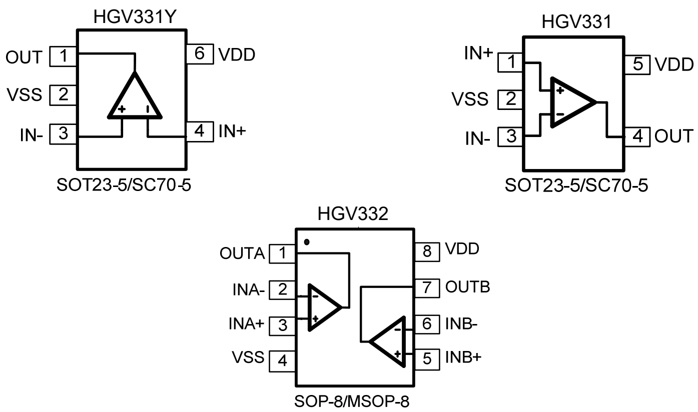


Figure 1. Pin Assignment Diagram

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
HGV331M5/TR	SOT23-5	V331	REEL	3000/reel
HGV331M7/TR	SC70-5	V331	REEL	3000/reel
HGV332M/TR	SOP8L	HGV332	REEL	2500/reel
HGV332MM/TR	MSOP8	HGV332	REEL	2500/reel

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to Vss)	-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)	Vss-0.5V	V_{DD}+0.5V
PDB Input Voltage	Vss-0.5V	+7V
Operating Temperature Range	-40°C	+85°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°C	
Package Thermal Resistance (T_A=+25℃)		
SOP-8, θ_{JA}	125°C/W	
MSOP-8, θ_{JA}	216°C/W	
SOT23-5, θ_{JA}	190°C/W	
SC70-5, θ_{JA}	333°C/W	
ESD Susceptibility		
HBM	4KV	
MM	300V	

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Electrical Characteristics

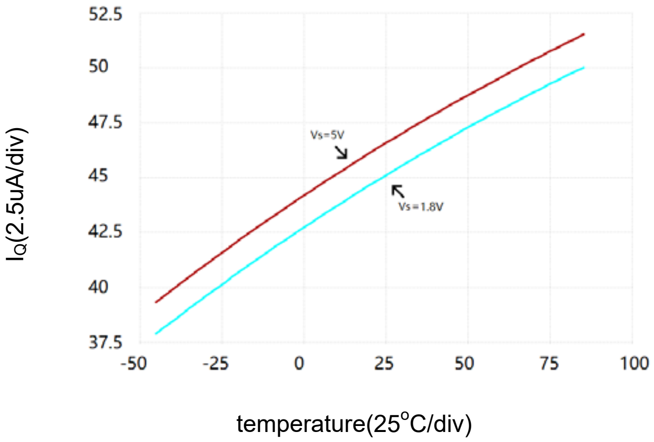
(At V_S = +5V, V_{CM} = 0V, C_L = 15pF, and T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TYP	MIN	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = 0V	0.5		3	mV
Input Bias Current	I_B		6			pA
Input Offset Current	I_{OS}		4			pA
Input Hysteresis	V_{hys}		6			mV
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1 to +5.6			V
Common-Mode Rejection Ratio	CMRR	V_S = 5V, V_{CM} = 0V to 5V	70	50		dB
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	Vs=5V, I_O = 1mA	Vs - 0.05		Vs - 0.3	V
	V_{OL}		57		300	mV
Output Short-Circuit Current	I_{SOURCE}	V_S = 5V, Out to V_S/2	35			mA
	I_{SINK}		33			
POWER SUPPLY						
Operating Voltage Range			1.8			V
			5.5			V
Power Supply Rejection Ratio	PSRR	V_S = +1.6V to +5.5V, V_{CM} = 0V	75	60		dB
Quiescent Current / Comparator	I_Q		46			uA
DYNAMIC PERFORMANCE (CL = 15pF)						
Propagation Delay (Low to High)	T_{dLH}	V_S = 3V, Overdrive = 10mV	98.6			ns
		V_S = 3V, Overdrive = 100mV	77.5			ns
Propagation Delay (High to Low)	T_{dHL}	V_S = 3V, Overdrive = 10mV	114.7			ns
		V_S = 3V, Overdrive = 100mV	59.4			ns
Rise Time	T_r	V_S = 3V, Overdrive = 10mV	5			ns
		V_S = 3V, Overdrive = 100mV	5			ns
Fall Time	T_f	V_S = 3V, Overdrive = 10mV	5			ns
		V_S = 3V, Overdrive = 100mV	5			ns

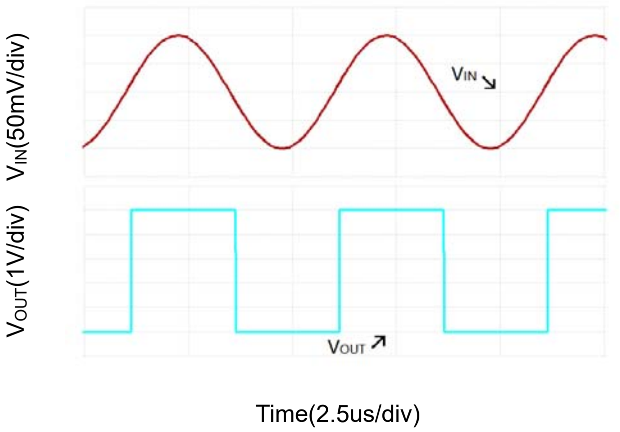
Typical Performance characteristics

At T_A=+25°C, V_S=+5V, and C_L=15pF, unless otherwise noted.

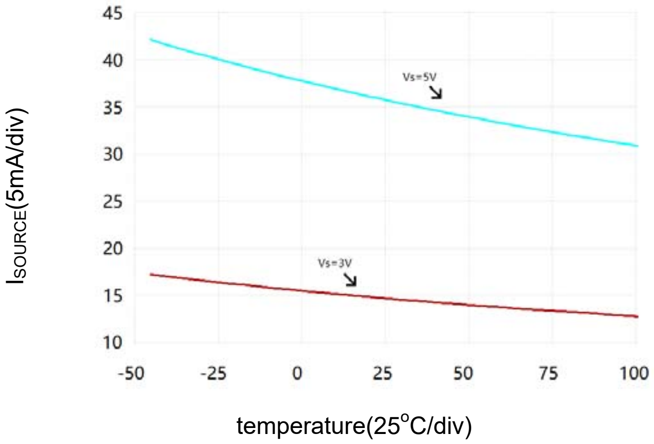
Supply Current vs. Temperature



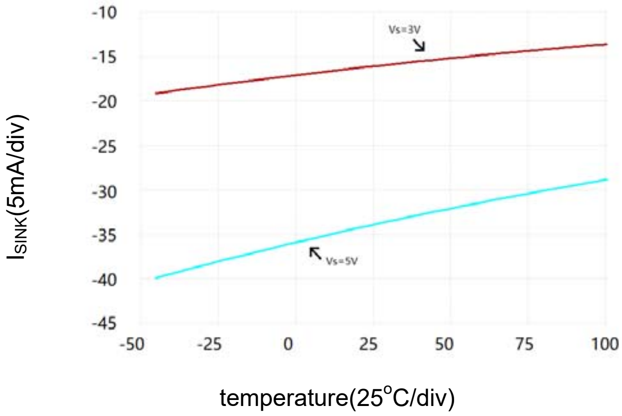
Sinusoid Response at 0.2MHz



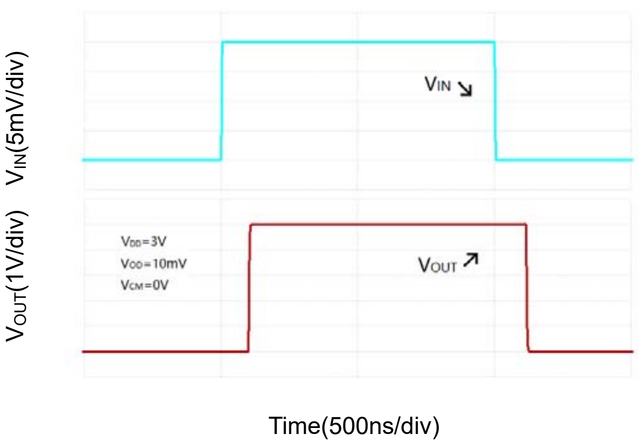
Output Short-Circuit (Source) Current vs. Temperature



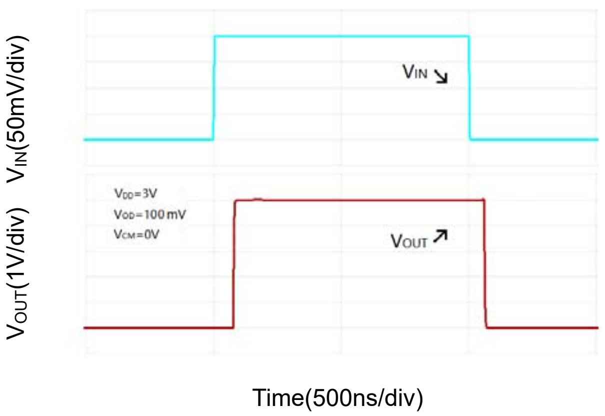
Output Short-Circuit (Sink) Current vs. Temperature



Progation Delay (L-H&H-L)



Progation Delay (L-H&H-L)



Application Note

Size

HGV331 comparator is low-power, high-speed and suitable for a wide range of general-purpose applications. The small footprints of the HGV331 package saves space on printed circuit boards and enable the design of smaller electronic products. The HGV331 interfaces directly to CMOS and TTL logics.

Power Supply Bypassing and Board Layout

HGV331 operates from a single 1.8V to 5.5V supply or dual ±0.9V to ±2.75V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 46uA per channel) of HGV331 will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

HGV331 operates under wide input supply voltage (1.8V to 5.5V). In addition, all temperature specifications apply from -40 °C to +85 °C. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime

Rail-to-Rail Input

The input common-mode range of HGV331 extends 100mV beyond the supply rails (V_{SS}-0.1V to V_{DD}+0.1V). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

Internal Hysteresis

Because of noise or undesired parasitic feedback, high-speed comparators oscillate in the linear region. Oscillation tends to occur when the voltage on one input is at or equal to the voltage on the other input. The LM806 family eliminates this undesired oscillation by integrating an internal hysteresis of 6mV.

The hysteresis in a comparator creates two trip points: one for the rising input voltage and one for the falling input voltage (Figure 2). The difference between two trip points is the hysteresis, while the average of two 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.

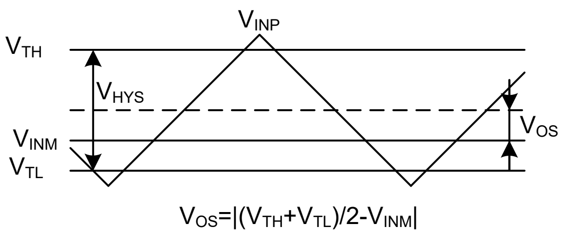


Figure 2. Comparator's hysteresis and offset

External Hysteresis

Greater flexibility in selecting hysteresis is achieved by using external resistors. Hysteresis reduces output chattering when one input is slowly moving past the other.

Non-Inverting Comparator with Hysteresis

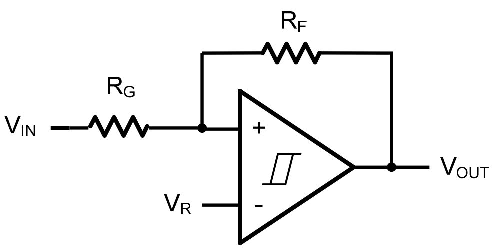


Figure 3. Non-Inverting Comparator with Hysteresis

A non-inverting comparator with hysteresis requires a two-resistor network, as shown in Figure 3 and a voltage reference (V_R) at the inverting input.

$$V_{TH} = \frac{R_G + R_F}{R_F} \times V_R$$

$$V_{TL} = \frac{R_G + R_F}{R_F} \times V_R - \frac{R_G}{R_F} \times V_{DD}$$

$$V_{HYS} = \frac{R_G}{R_F} \times V_{DD}$$

Inverting Comparator with Hysteresis

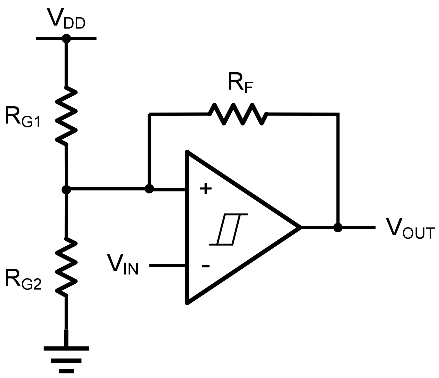


Figure 4. Inverting Comparator with Hysteresis

The inverting comparator with hysteresis requires a three-resistor network that is referenced to the comparator supply voltage (V_{DD}), as shown in Figure 4.

$$V_{TH} = \frac{R_{G2}}{R_{G1} \,||\, R_F + R_{G2}} \times V_{DD}$$

$$V_{TL} = \frac{R_{G2} \,||\, R_F}{R_{G2} \,||\, R_F + R_{G1}} \times V_{DD}$$

$$V_{HYS} = \frac{R_{G1} \,||\, R_{G2}}{R_{G1} \,||\, R_{G2} + R_F} \times V_{DD}$$

Typical Application Circuits

Line Receiver

A Line Receiver using HGV331 is shown in Figure 5. Resistors R_{G1} and R_{G2} set the bias point at the comparator's inverting input. R_{IN} should be same as $R_{G1}||R_{G2}$ to get a better match. HGV331 detects the voltage of the Coax Line, and outputs logic high or logic low quickly with no glitch.

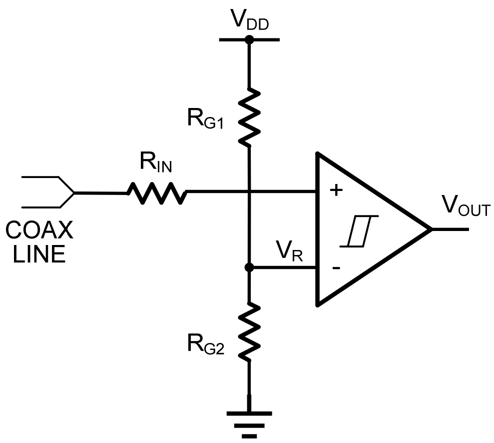


Figure 5. Line Receiver

IR Receiver

HGV331 is an ideal candidate to be used as an infrared receiver shown in Figure 6. The infrared photo diode creates a current relative to the amount of infrared light present. The current creates a voltage across R_{IN}. When this voltage level cross the voltage applied by the voltage divider to the inverting input, the output transitions. Optional R_F provides additional hysteresis for noise immunity.

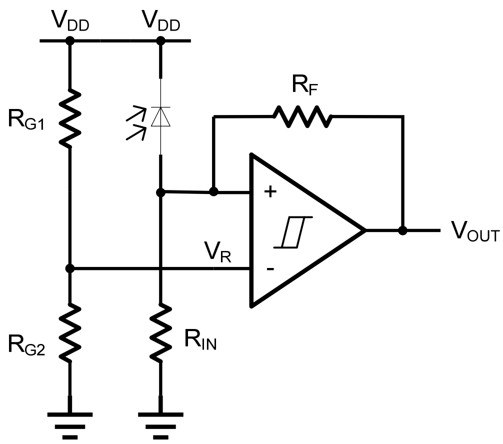


Figure 6. IR Receiver

Oscillator

A oscillator using HGV331 is shown in Figure 7. Resistors R_{G1} and R_{G2} set the bias point at the comparator's inverting input. The period of oscillator is set by the time constant of R_C and C_{IN}. The maximum frequency is limited by the large signal propagation delay of the comparator. HGV331 is low propagation delay guarantees the high frequency oscillation.

If R_{G1}=R_{G2}= R_F, then the frequency of the oscillator is:

$$f_{OSC} = \frac{1}{2 \times \ln 2 \times R_C \times C_{IN}}$$

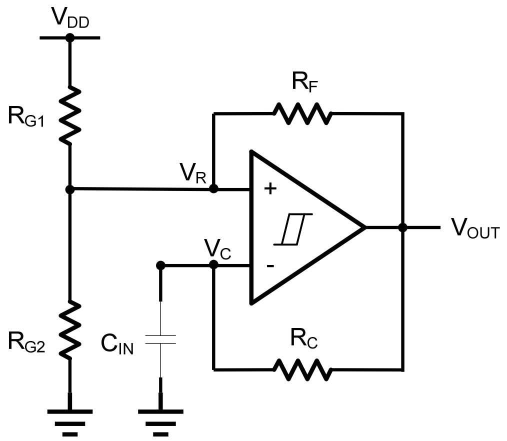
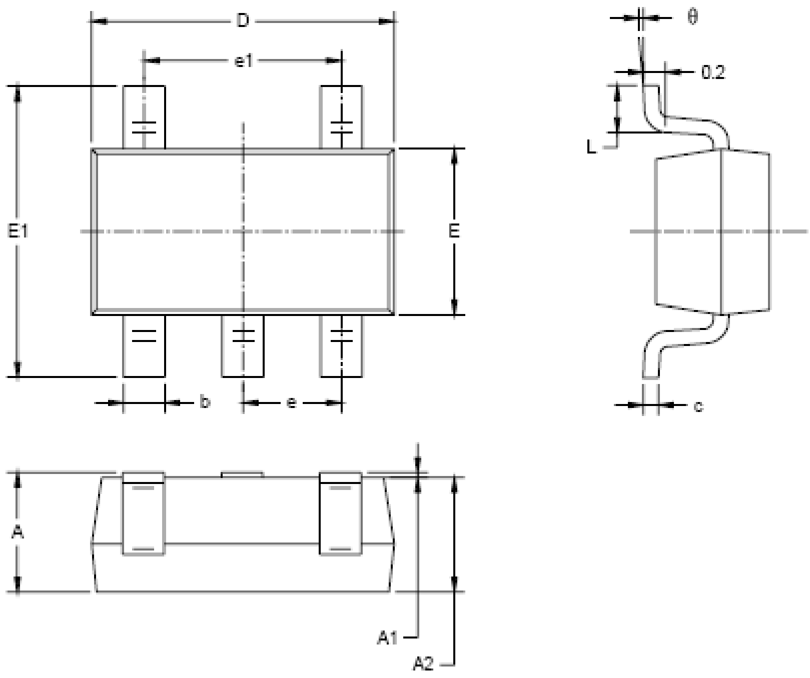


Figure 7. Oscillator

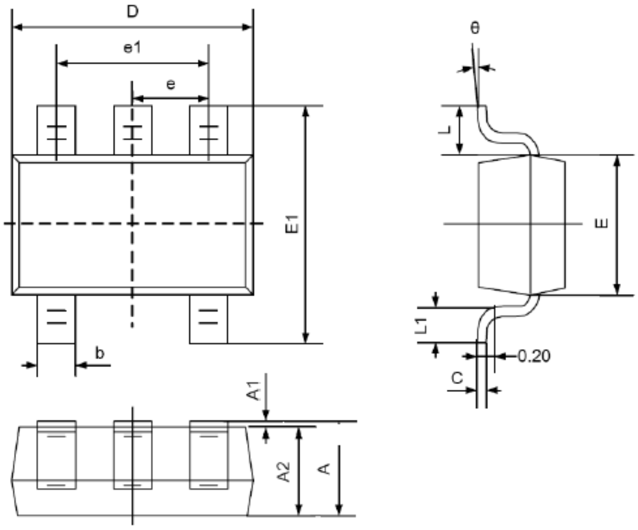
Package Information

SOT23-5



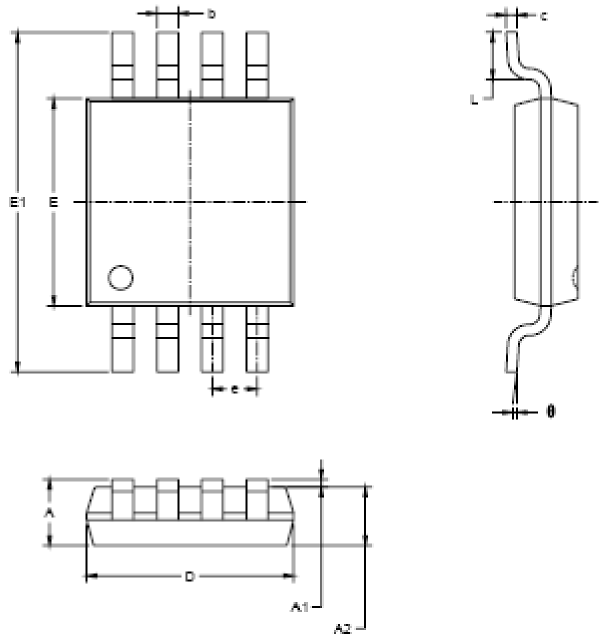
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037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

SC70-5



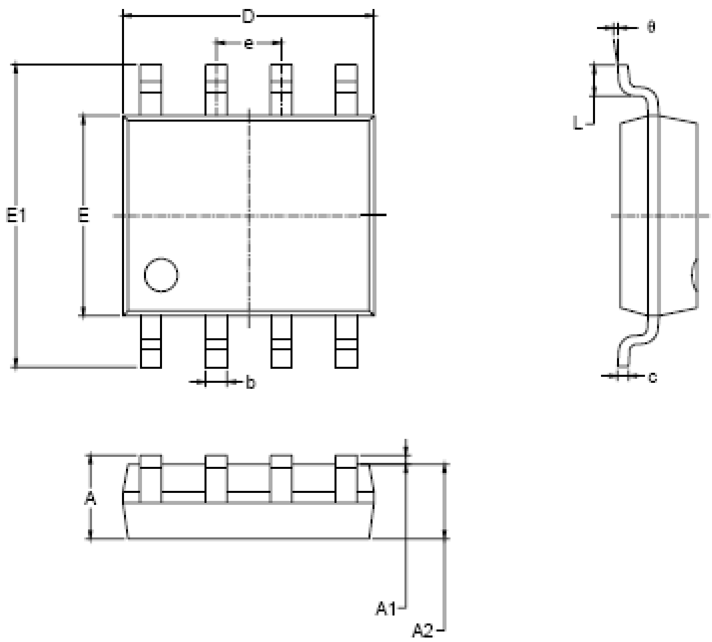
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
C	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650TYP		0.026TYP	
e1	1.200	1.400	0.047	0.055
L	0.525REF		0.021REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

MSOP-8



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°

SOP-8



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°

Important statement:

Huaguan Semiconductor Co,Ltd. reserves the right to change the products and services provided without notice. Customers should obtain the latest relevant information before ordering, and verify the timeliness and accuracy of this information.

Customers are responsible for complying with safety standards and taking safety measures when using our products for system design and machine manufacturing to avoid potential risks that may result in personal injury or property damage.

Our products are not licensed for applications in life support, military, aerospace, etc., so we do not bear the consequences of the application of these products in these fields.

Our documentation is only permitted to be copied without any tampering with the content, so we do not accept any responsibility or liability for the altered documents.