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:

  LMV331 Available in SOT-23-5 and SC70-5 Packages
  LMV393 Available in DIP-8, SOP-8, SOT23-8, MSOP-8 and DFN-8 Packages

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
LMV331M5/TR	SOT-23-5	V331,R1IF,R1IK	REEL	3000pcs/reel
LMV331M7/TR	SC70-5（SOT-353）	V331,R2F,R2R	REEL	3000pcs/reel
LMV393N	DIP-8	LMV393	TUBE	2000pcs/box
LMV393M/TR	SOP-8	LMV393	REEL	2500pcs/reel
LMV393MM/TR	MSOP-8	LMV393,V393	REEL	2500pcs/reel
LMV393M8/TR	SOT-23-8	V393	REEL	3000pcs/reel
LMV393DQ/TR	DFN-8 2*2	LMV393	REEL	4000pcs/reel

Note：SOT-353 equal to SC70-5 Package Type.

General Description

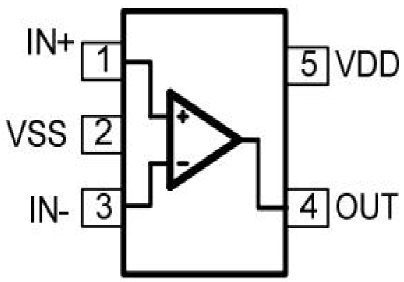
The LMV331 is low-power, high-speed comparator with internal hysteresis, optimized for systems powered from a 3V or 5V supply. The device features high-speed response, low-power consumption, low offset voltage, and rail-to-rail input and output range.
Propagation delay is 70ns (100mV overdrive), while 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 LMV331 single is available in Green SC70-5 and SOT-23-5 packages. The LMV393 dual is available in Green DIP-8, SOP-8, SOT23-8, MSOP-8 and DFN-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

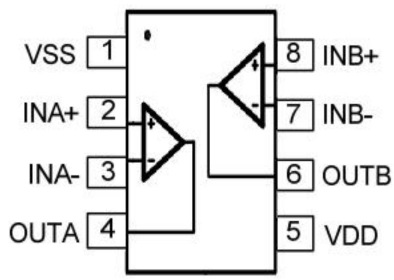
Pin Configuration

LMV331



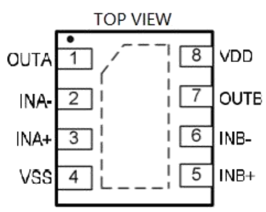
SOT-23-5/SC70-5

LMV393



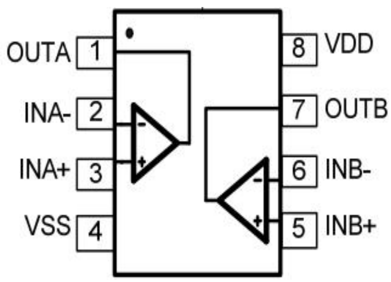
SOT-23-8

LMV393



DFN-8 2*2

LMV393



DIP-8/SOP-8/MSOP-8

Absolute Maximum Ratings

Condition		Min	Max
Power Supply Voltage (VDD to Vss)		-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)		Vss-0.5V	VDD+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)		-	+245°C
Package Thermal Resistance (TA=+25℃)	SOP-8, θJA	-	125°C/W
	MSOP-8, θJA	-	216°C/W
	SOT-23-5, θJA	-	190°C/W
	SC70-5, θJA	-	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

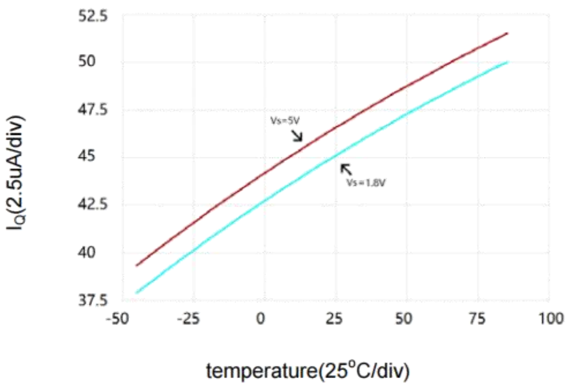
(At VS = +5V, VCM = 0V, CL = 15pF, and TA = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	LMV331/LMV393			
			TYP	MIN	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage	VOS	VCM = 0V	0.5		3	mV
Input Bias Current	IB		6			pA
Input Offset Current	IOS		4			pA
Input Hysteresis	Vhys		6			mV
Common-Mode Voltage Range	VCM	VS = 5.5V	-0.1 to +5.6			V
Common-Mode Rejection Ratio	CMRR	VS = 5V, VCM = 0V to 5V	70	50		dB
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	VOH	Vs=5V, IO = 1mA	Vs - 0.05		Vs - 0.3	V
	VOL		57		300	mV
Output Short-Circuit Current	ISOURCE	VS = 5V, Out to VS/2	35			mA
	ISINK		33			
POWER SUPPLY						
Operating Voltage Range			1.8			V
			5.5			V
Power Supply Rejection Ratio	PSRR	VS = +1.6V to +5.5V, VCM = 0V	75	60		dB
Quiescent Current / Comparator	IQ		46			uA
DYNAMIC PERFORMANCE (CL = 15pF)						
Propagation Delay (Low to High)	TdLH	VS = 3V, Overdrive = 10mV	98.6			ns
		VS = 3V, Overdrive = 100mV	77.5			ns
Propagation Delay (High to Low)	TdHL	VS = 3V, Overdrive = 10mV	114.7			ns
		VS = 3V, Overdrive = 100mV	59.4			ns
Rise Time	Tr	VS = 3V, Overdrive = 10mV	5			ns
		VS = 3V, Overdrive = 100mV	5			ns
Fall Time	Tf	VS = 3V, Overdrive = 10mV	5			ns
		VS = 3V, Overdrive = 100mV	5			ns

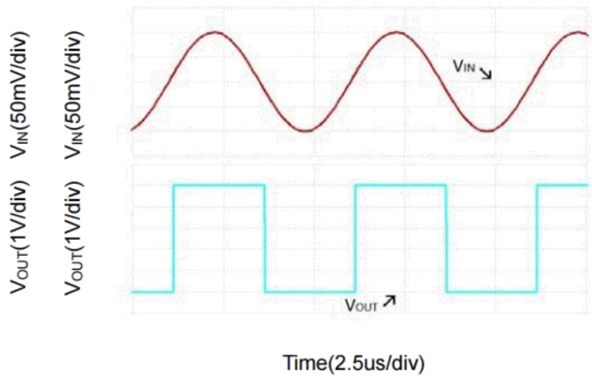
Typical Performance characteristics

At TA=+25°C, VS=+5V, and CL=15pF, unless otherwise noted.

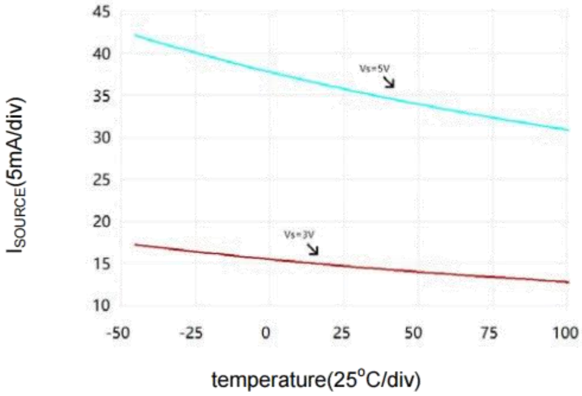
Supply Current vs. Temperature



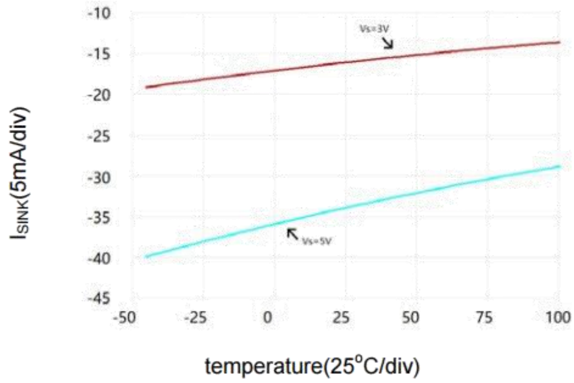
Sinusoid Response at 0.2MHz



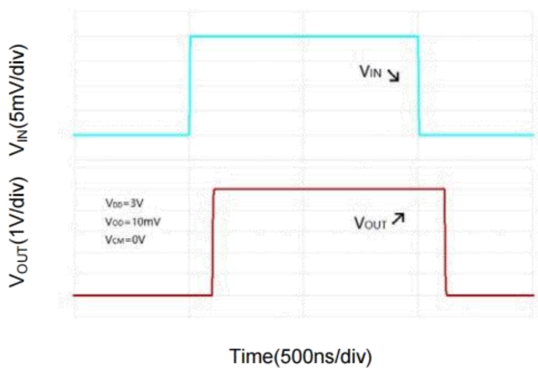
Output Short-Circuit (Source) Current vs. Temperature



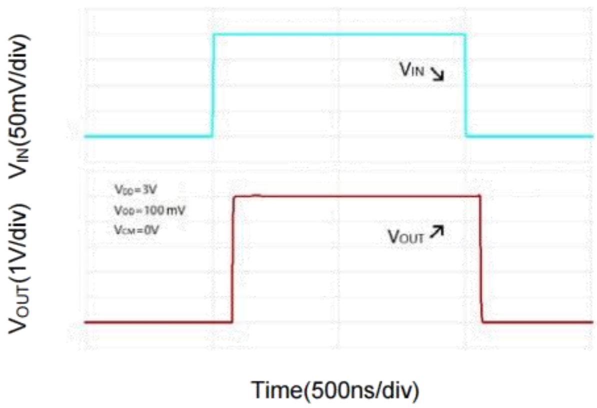
Output Short-Circuit (Sink) Current vs. Temperature



Progation Delay (L-H&H-L)



Progation Delay (L-H&H-L)



Application Note

Size

LMV331 comparator is low-power, high-speed and suitable for a wide range of general-purpose applications. The small footprints of the LMV331 package saves space on printed circuit boards and enable the design of smaller electronic products. The LMV331 interfaces directly to CMOS and TTL logics.

Power Supply Bypassing and Board Layout

LMV331 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 VDD pin in single supply operation. For dual supply operation, both VDD and VSS supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 46uA per channel) of LMV331 will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

LMV331 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 LMV331 extends 100mV beyond the supply rails (VSS-0.1V to VDD+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.

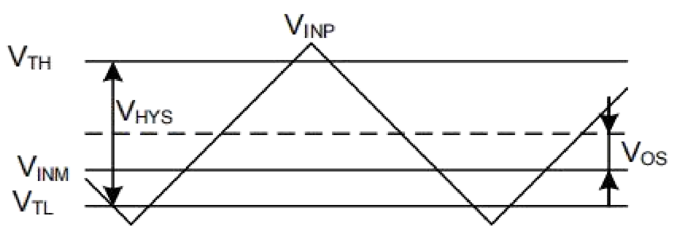


Figure 2. Comparator’s hysteresis and offset

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

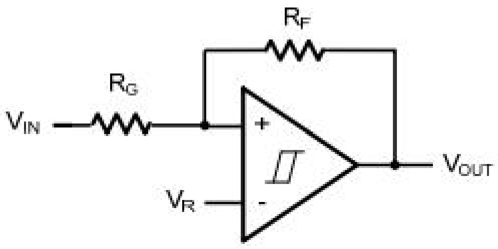


Figure 3. Non-Inverting Comparator with Hysteresis

A non-inverting comparator with hysteresis requires a two-resistor network, as shown in Figure 3 and a voltage reference (VR) 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

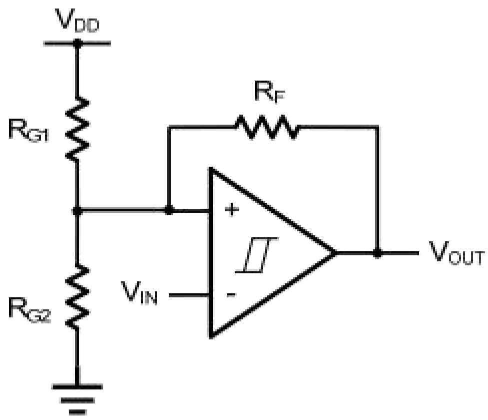


Figure 4. Inverting Comparator with Hysteresis

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.

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

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

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

Typical Application Circuits

Line Receiver

A Line Receiver using LMV331 is shown in Figure 5. Resistors RG1 and RG2 set the bias point at the comparator's inverting input. RIN should be same as RG1||RG2 to get a better match. LMV331 detects the voltage of the Coax Line, and outputs logic high or logic low quickly with no glitch.

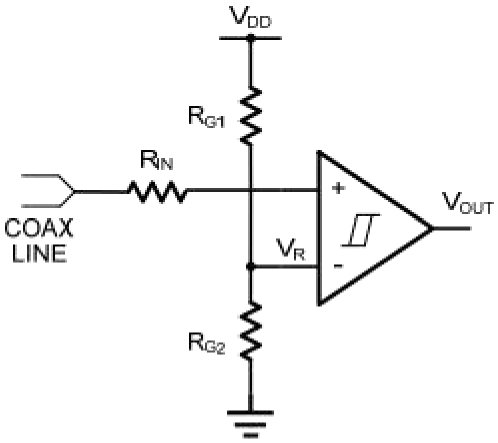


Figure 5. Line Receiver

IR Receiver

LMV331 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 RIN. When this voltage level cross the voltage applied by the voltage divider to the inverting input, the output transitions. Optional RF provides additional hysteresis for noise immunity.

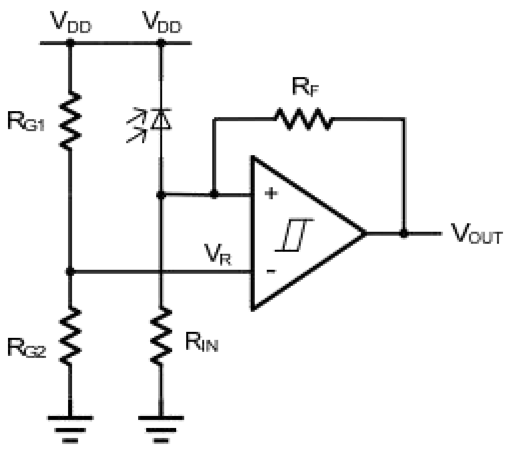


Figure 6. IR Receiver

Oscillator

A oscillator using LMV331 is shown in Figure 7. Resistors RG1 and RG2 set the bias point at the comparator's inverting input. The period of oscillator is set by the time constant of RC and CIN. The maximum frequency is limited by the large signal propagation delay of the comparator. LMV331 is low propagation delay guarantees the high frequency oscillation.

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

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

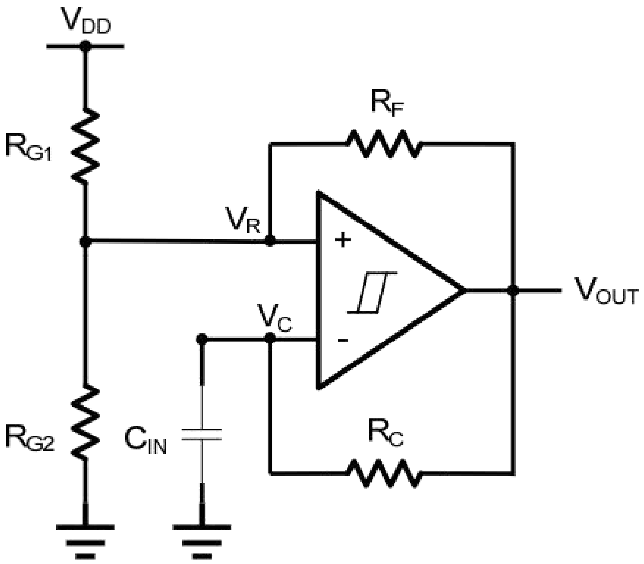
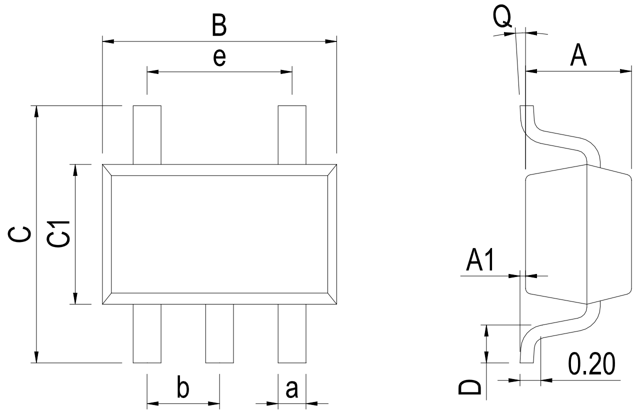


Figure 7. Oscillator

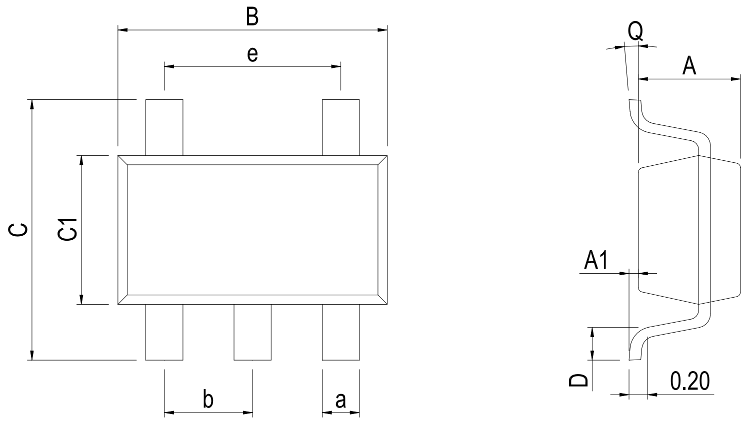
Physical Dimensions

SOT-23-5



Dimensions In Millimeters(SOT-23-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.95 BSC	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40		

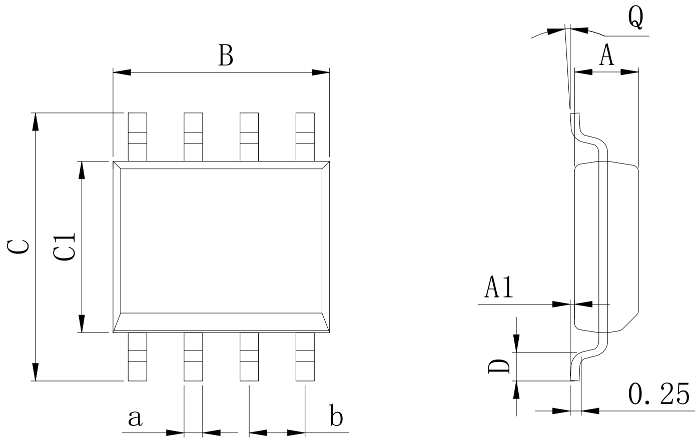
SC70-5(SOT-353)



Dimensions In Millimeters(SC70-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	0.90	0.00	2.00	2.15	1.15	0.26	0°	0.15	0.65	1.30 BSC
Max:	1.00	0.15	2.20	2.45	1.35	0.46	8°	0.35	BSC	

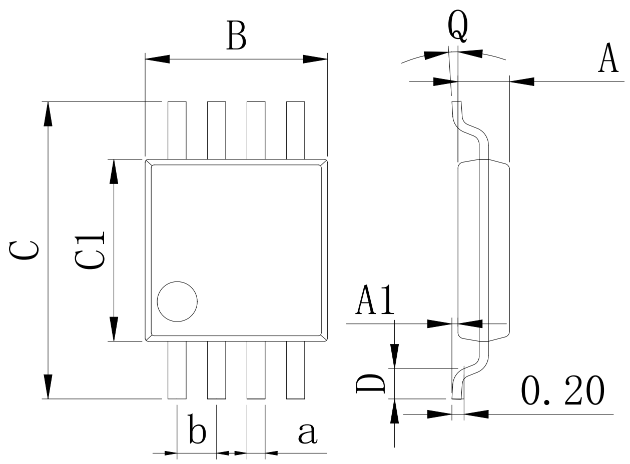
Physical Dimensions

SOP-8



Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

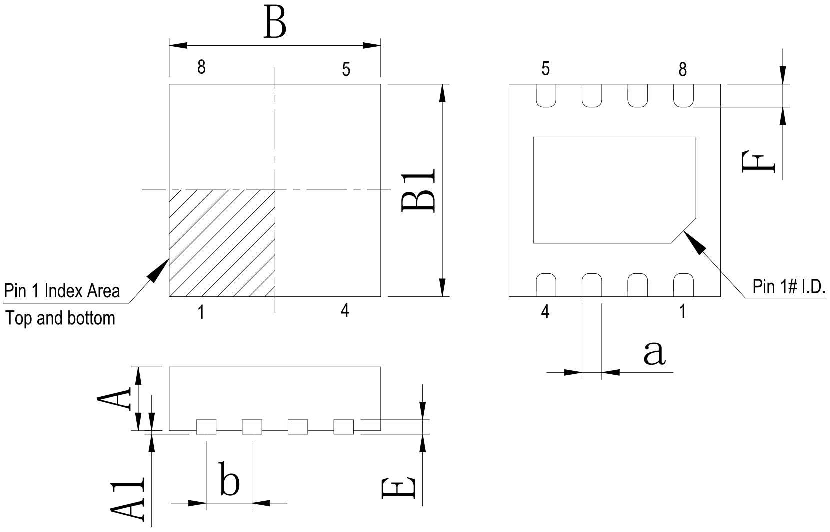
MSOP-8



Dimensions In Millimeters(MSOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.80	0.05	2.90	4.75	2.90	0.35	0°	0.25	0.65 BSC
Max:	0.90	0.20	3.10	5.05	3.10	0.75	8°	0.35	

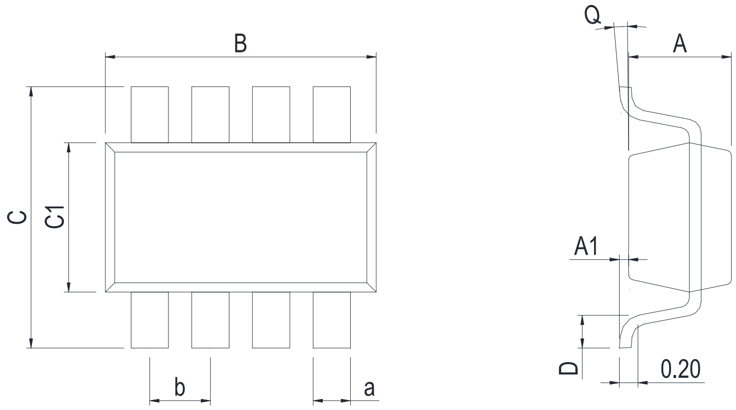
Physical Dimensions

DFN-8 2*2



Dimensions In Millimeters(DFN-8 2*2)								
Symbol:	A	A1	B	B1	E	F	a	b
Min:	0.85	0	1.90	1.90	0.15	0.25	0.18	0.50TYP
Max:	0.95	0.05	2.10	2.10	0.25	0.45	0.30	

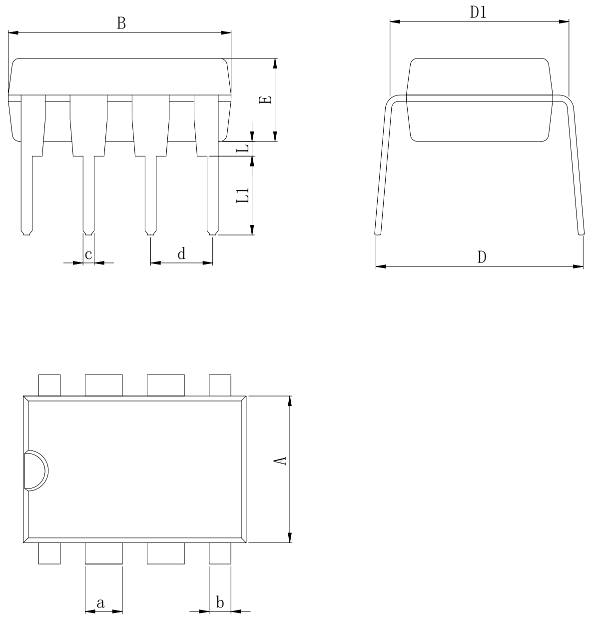
SOT23-8



Dimensions In Millimeters(SOT23-8)								
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.65 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40	

Physical Dimensions

DIP-8



Dimensions In Millimeters(DIP-8)											
Symbol:	A	B	D	D1	E	L	L1	a	b	c	d
Min:	6.10	9.00	8.10	7.42	3.10	0.50	3.00	1.50	0.85	0.40	2.54 BSC
Max:	6.68	9.50	10.9	7.82	3.55	0.70	3.60	1.55	0.90	0.50	

Revision History

DATE	REVISION	PAGE
2017-9-17	New	1-13
2023-10-30	Update encapsulation type， Update Lead Temperature、Update SC70-5 Physical Dimensions	1，3、10

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change its products and services without notice. Before ordering, the customer shall obtain the latest relevant information and verify whether the information is up to date and complete. Huaguan Semiconductor does not assume any responsibility or obligation for the altered documents.

Customers are responsible for complying with safety standards and taking safety measures when using Huaguan Semiconductor products for system design and machine manufacturing. You will bear all the following responsibilities: Select the appropriate Huaguan Semiconductor products for your application; Design, validate and test your application; Ensure that your application meets the appropriate standards and any other safety,security or other requirements. To avoid the occurrence of potential risks that may lead to personal injury or property loss.

Huaguan Semiconductor products have not been approved for applications in life support, military, aerospace and other fields, and Huaguan Semiconductor will not bear the consequences caused by the application of products in these fields. All problems, responsibilities and losses arising from the user's use beyond the applicable area of the product shall be borne by the user and have nothing to do with Huaguan Semiconductor, and the user shall not claim any compensation liability against Huaguan Semiconductor by the terms of this Agreement.

The technical and reliability data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, safety information and other resources provided for the performance of semiconductor products produced by Huaguan Semiconductor are not guaranteed to be free from defects and no warranty, express or implied, is made. The use of testing and other quality control technologies is limited to the quality assurance scope of Huaguan Semiconductor. Not all parameters of each device need to be tested.

The documentation of Huaguan Semiconductor authorizes you to use these resources only for developing the application of the product described in this document. You have no right to use any other Huaguan Semiconductor intellectual property rights or any third party intellectual property rights. It is strictly forbidden to make other copies or displays of these resources. You should fully compensate Huaguan Semiconductor and its agents for any claims, damages, costs, losses and debts caused by the use of these resources. Huaguan Semiconductor accepts no liability for any loss or damage caused by infringement.