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

1. 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°C to +85°C. The LMV331 single is available in Green SC70-5 and SOT23-5 packages. The LMV332 dual is available in Green SOP-8 and MSOP-8 packages.

2. 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 SOT23-5 and SC70-5 Packages
- LMV332 Available in SOP-8 and MSOP-8 Packages

3. Applications

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

4. Ordering Information

Type Number	Package Type	Marking	Packing
LMV331IDBV	SOT23-5	12YD, V331	Tape & Reel
LMV331IDCK	SC70-5	V331	Tape & Reel
LMV332ID	SOP-8	V332	Tape & Reel
LMV332IDGK	MSOP-8	V332	Tape & Reel

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.

5. Pinning

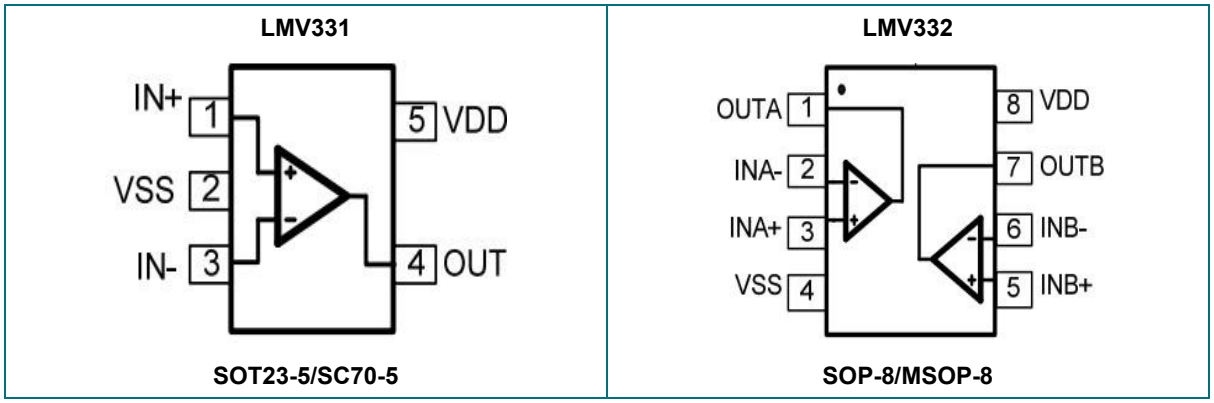


Fig 1. Pin Assignment Diagram

6. 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°C)	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

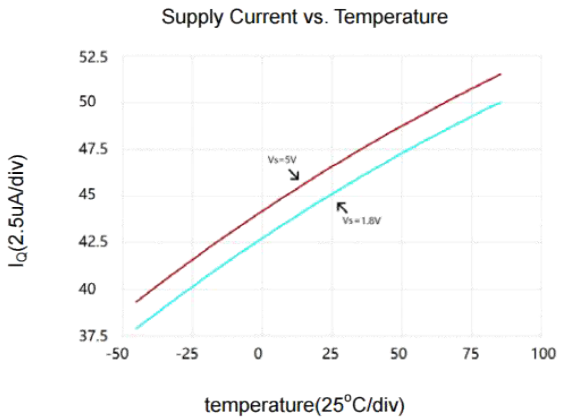
7. Electrical Characteristics

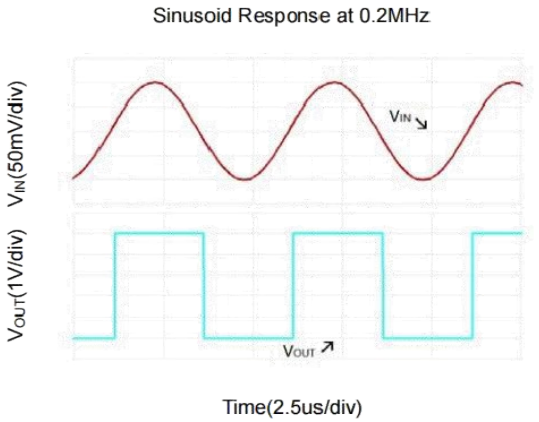
@ V_S = +5V, V_{CM} = 0V, C_L = 15pF, and T_A = +25°C, unless otherwise noted.

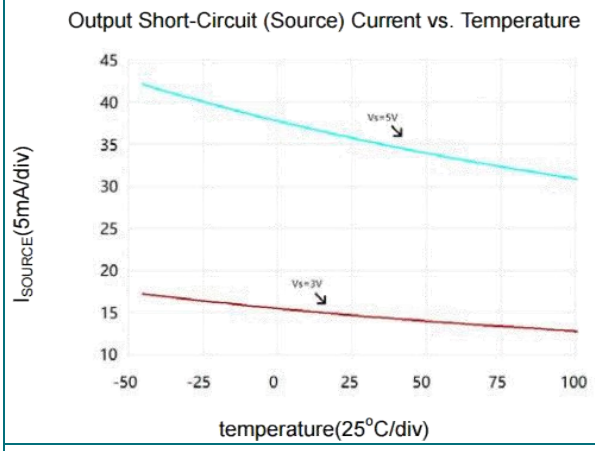
PARAMETER	SYMBOL	CONDITIONS	VALUES			
			TYP	MIN	MAX	UNITS
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = 0V	0.5		3	mV
Input Bias Current	I_B		6			pA
Input Offset Current	I_{OS}		4			pA
Input Hysteresis	V_{hys}		6			mV
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1 to +5.6			V
Common-Mode 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 (C_L = 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

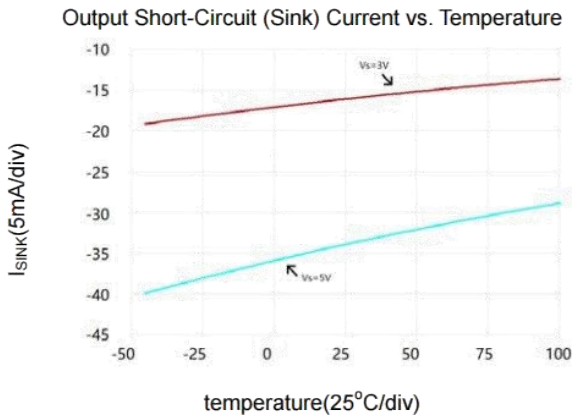
8. Typical Performance characteristics

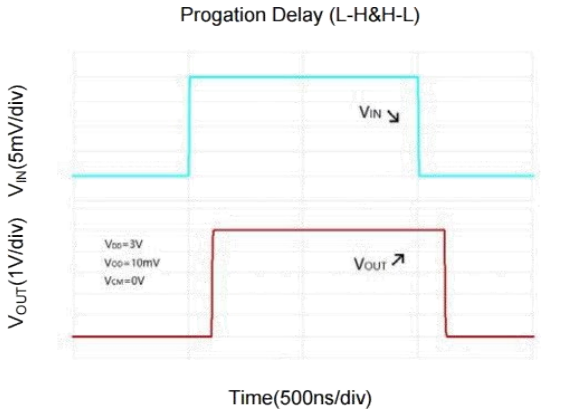
@ T_A=+25°C, V_S=+5V, and C_L=15pF, unless otherwise noted.

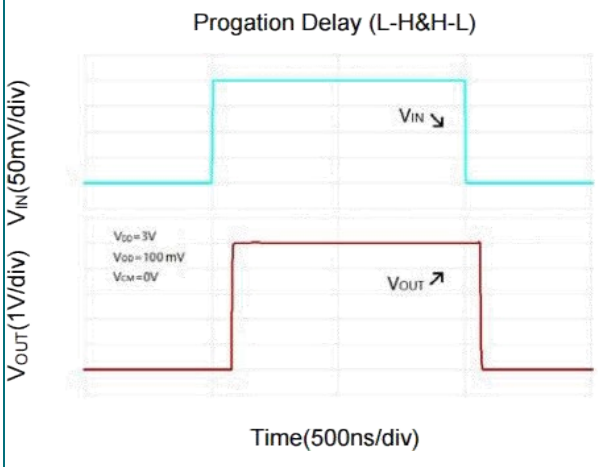












9. Application Note

9.1. 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.

9.2. 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 V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

9.3. 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.

9.4. 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

9.5. 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.

9.6. 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.

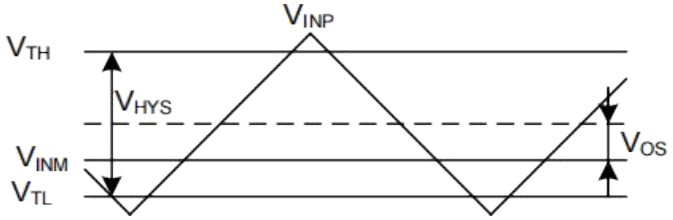


Fig 2. Comparator's hysteresis and offset

10. 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

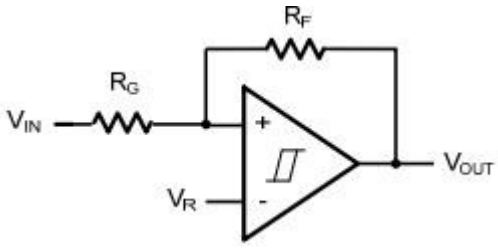


Fig 3. Non-Inverting Comparator with Hysteresis

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

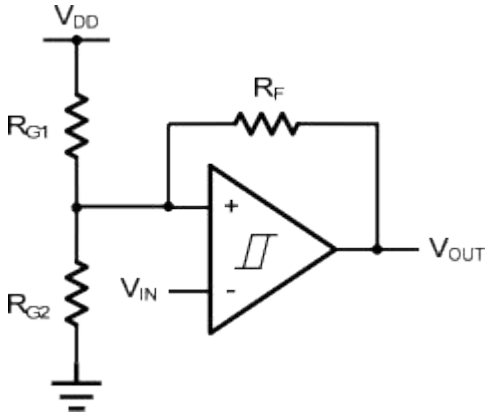


Fig 4. Inverting Comparator with Hysteresis

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.

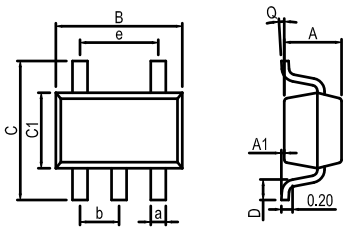
$$V_{TH} = \frac{R_{G2}}{R_{G1} \parallel R_F + R_{G2}} \times V_{DD}$$

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

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

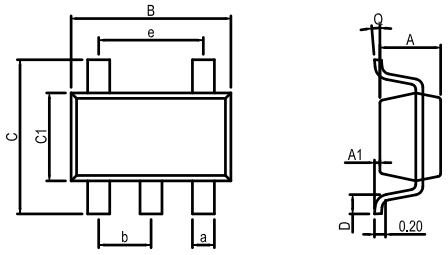
11. Package Outlines

11.1. SOT23-5



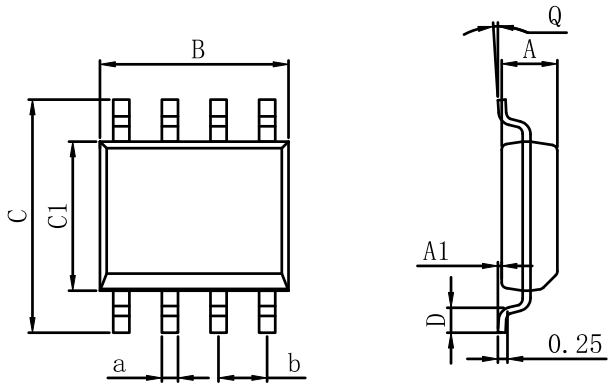
Dimensions In Millimeters(SOT23-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	0.95 BSC	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40		

11.2. SC70-5



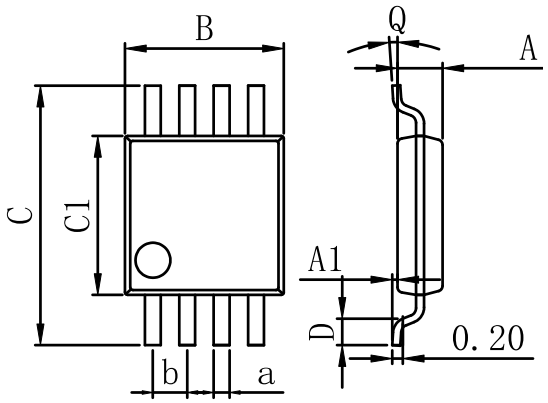
Dimensions In Millimeters(SC70-5)										
Symbol:	A	A1	B	C	C1	D	Q	a	b	e
Min:	0.90	0.00	2.00	2.15	1.15	0.26	0°	0.30	0.65 BSC	1.30 BSC
Max:	1.00	0.15	2.20	2.45	1.35	0.46	8°	0.40		

11.3. SOP-8



Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.9	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	

11.4. MSOP-8



Dimensions In Millimeters(MSOP8)									
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	

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