

LM331 Single Comparator

1. General Description

1.1 Description

The LM331 is the single comparator version, and the output can be connected to other open-collector outputs to achieve wired-AND relationships. It can operate from 2V to 36V .

The LM331 consist one voltage comparator that is designed to operate from a single power supply over a wide range of voltages. The device is the most cost-effective solutions for applications where low offset voltage, high supply voltage capability, low supply current, and space saving are the primary specifications in circuit design for portable consumer products.

1.2 Features

- Wide range of single supply voltage 2V to 36V
- Low output saturation voltage
0.1V@ $I_{OL}=4mA(Typ)$
- Low power dissipation 0.9mA@ $V_{CC}=5V(Typ)$
- Low input offset voltage $\pm 1mV(Typ)$
- Range of differential input voltage $\pm V_{CC}$
- Open drain output

1.3 Device Information

PART NUMBER	PACKAGE
LM331	SOT23

2. Connection Diagrams and Pin Description

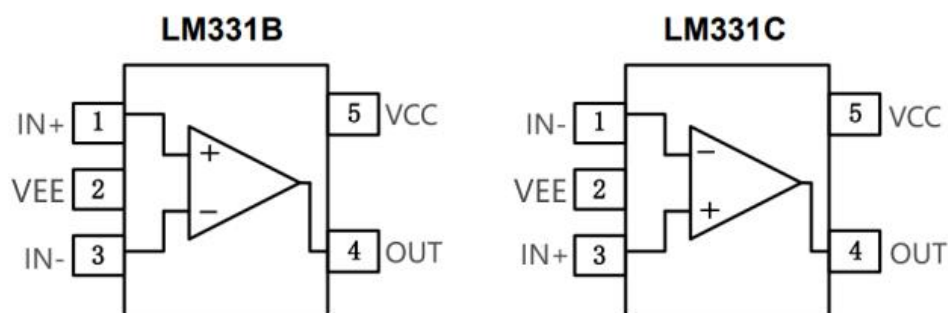


Figure 2.1 Top View

PIN No.		NAME	I/O	FUNCTION
LM331B	LM331C			
4	4	OUT	O	Output pin of comparator
3	1	IN1-	I	Negative input pin of comparator
1	3	IN1+	I	Positive input pin of comparator
2	2	VEE		Negative power supply
5	5	VCC		Positive power supply

3. Schematic Diagram

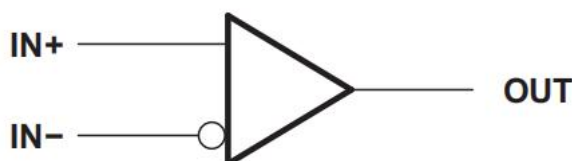


Figure 3.1: LM331 simplified schematic

4. Specifications

4.1 Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Symbol	Parameter	MIN	MAX	Unit
V _{CC}	Single Supply Voltage ⁽¹⁾		36	V
V _S	Dual Supply Voltage	-18	18	V
V _{IDR}	Differential Input Voltage ⁽²⁾	-18	18	V
V _{ICR}	Common-Mode Input Voltage	-0.3	V _{CC}	V
V _O	Output Voltage		36	V
I _O	Output Current		30	mA
	Duration of Output Short Circuit to Ground	Unlimited		
T _J	Junction Temperature		150	°C
T _{OP}	Operating Temperature	-40	85	°C

Absolute maximum ratings are those values beyond which the device could be permanently damaged. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions.

(1) All voltage values, except differential voltages, are with respect to network ground.

(2) Differential voltages are at IN+ with respect to IN-.

4.2 Recommended Operating Conditions

Symbol	Parameter	Test Condition	MIN	TYP	MAX	Unit
V _{CC}	Supply Voltage		2	--	36	V

4.3 Electrical Characteristics

($T_a=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, $V_{EE}=\text{GND}$, unless otherwise specified)

Symbol	Parameter	Test Condition	MIN	TYP	MAX	Unit
I_{CC}	Supply Current	$V_{CC}=5\text{V}$, no load	--	0.9	2	mA
		$V_{CC}=30\text{V}$, no load	--	1.1	2	mA
I_B	Input Bias Current		--	100	500	nA
V_{OS}	Input Offset Voltage	$V_{CC}=5\text{--}30\text{V}$	--	1	10	mV
I_{OS}	Input Offset Current		--	5	50	nA
V_{CMR}	Common-Mode Voltage Range ⁽¹⁾	$T_a=25^{\circ}\text{C}$	0	-	$V_{CC}-1.5$	V
A_{VD}	Large Signal Differential Voltage Amplification	$V_{CC}=15\text{V}$, $V_O=1.4\text{V}$ to 11.4V , $R_L \geq 15\text{k}\Omega$ to V_{CC}	--	200	--	V/mV
V_{OL}	Low-Level Output Voltage	$I_{OL}=4\text{mA}$, $V_{DM}=-1\text{V}$	--	100	400	mV
I_{OL}	Output Current(sinking)	$V_{OL}=1.5\text{V}$, $V_{DM}=-1\text{V}$	--	20	--	mA
I_{OH}	High-level Output Current	$V_{OH}=5\text{V}$, $V_{DM}=1\text{V}$	--		1	μA
		$V_{OH}=30\text{V}$, $V_{DM}=1\text{V}$	--		1	μA

(1) The voltage at either input should not be allowed to go negative by more than 0.3V otherwise output may be incorrect and excessive input current can flow. The upper end of the common-mode voltage range is limited by $V_{CC}-2\text{V}$. However only one input needs to be in the valid common mode range, the other input can go up the maximum V_{CC} level and the comparator provides a proper output state. Either or both inputs can go to maximum V_{CC} level without damage.

5. Detailed Description

5.1 Overview

The LM331 has proven ubiquity and versatility across a wide range of applications. This is due to its low power, wide range of supply voltage and high speed. The open-drain output allows the user to configure the output's logic high voltage (V_{OH}) and can be used to enable the comparator to be used in AND functionality.

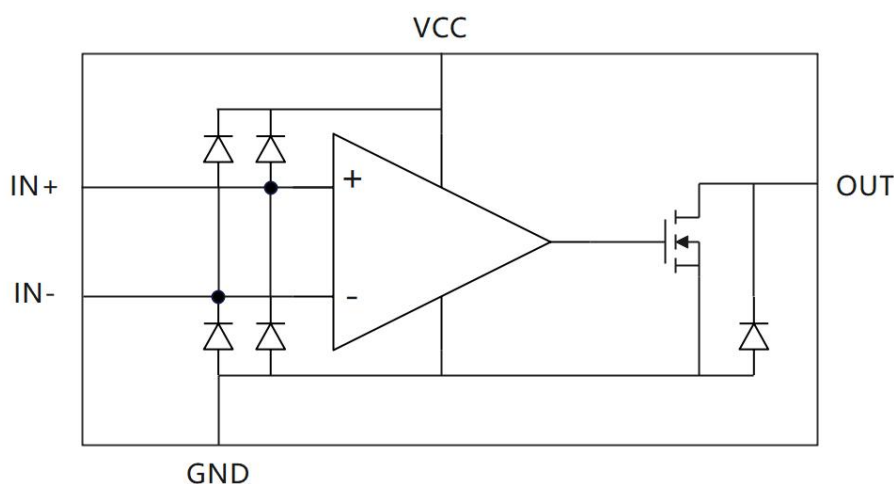


Figure 5.1 Functional Block Diagram

6. Applications information

6.1 Application Information

LM331 is typically used to compare a single signal to a reference or two signals against each other. Many users take advantage of the open drain output to drive the comparison logic output to a logic voltage level to an MCU or logic device. The wide supply range and high voltage capability makes this comparator optimal for level shifting to a higher or lower voltage.

6.2 Typical Application

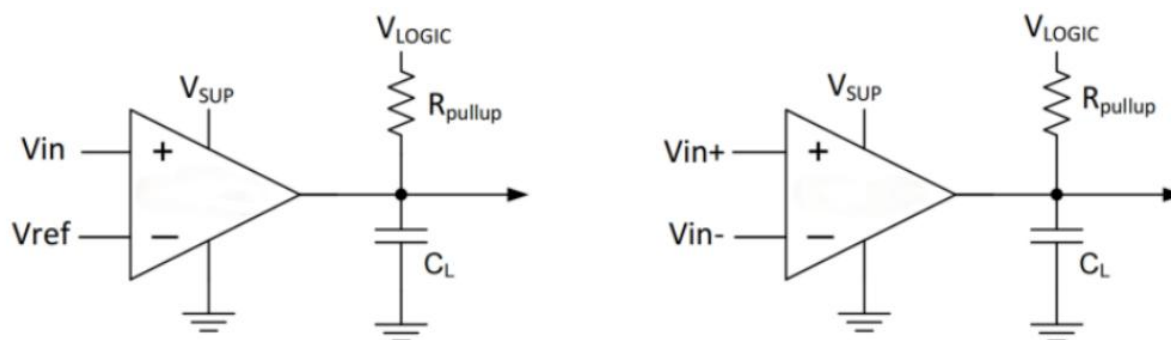


Figure 6.1 Single-Ended and Differential Comparator Configurations

6.3 Detailed Design Procedure

When using the device in a general comparator application, determine the following:

- Input Voltage Range
- Minimum Overdrive Voltage
- Output and Drive Current
- Response Time

6.4 Input Voltage Range

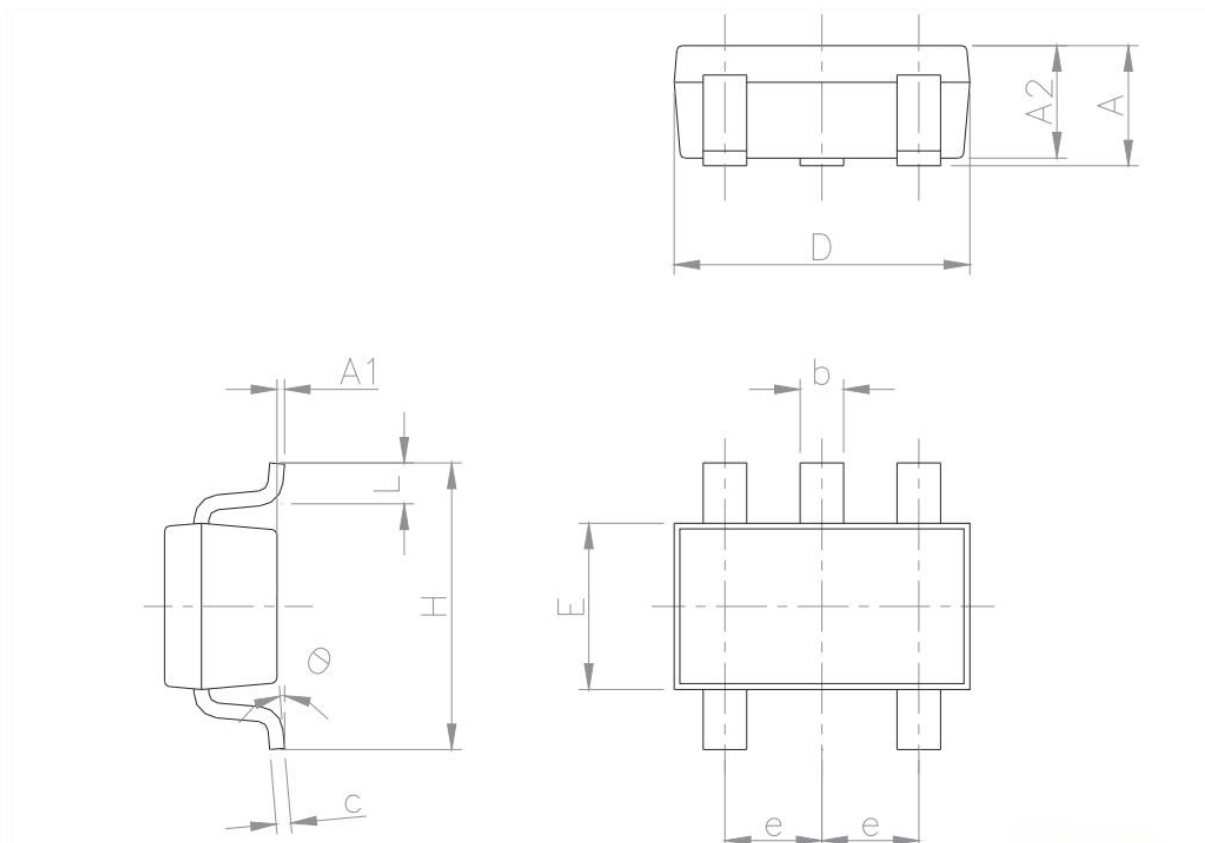
When choosing the input voltage range, the input common mode voltage range (V_{CMR}) must be taken in to account. If temperature operation is below 25°C the V_{CMR} can range from 0V to $V_{CC} - 2.0V$. This limits the input voltage range to as high as $V_{CC} - 2.0V$ and as low as 0V. Operation outside of this range can yield incorrect comparisons.

7. Ordering Information

Orderable Device	Package Type	Pins	Packing	Package Qty
LM331BLT05ARCQ	SOT23	5	Tape & Reel	3000
LM331CLT05ARCQ	SOT23	5	Tape & Reel	3000

8. Package Information

8.1 SOT23-5



Symbol	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	-	1.45	0.035	-	0.057
A1	-	-	0.15	-	-	0.006
A2	0.90	-	1.30	0.035	-	0.051
b	0.35	-	0.50	0.014	-	0.020
c	0.09	-	0.20	0.004	-	0.008
D	2.80	-	3.05	0.110	-	0.120
E	1.50	-	1.75	0.059	-	0.069
e	-	0.95	-	-	0.037	-
H	2.60	-	3.00	0.102	-	0.118
L	0.10	-	0.60	0.004	-	0.024
θ	0 degrees	-	10 degrees	-	-	-