LM2903

Dual Voltage Comparator

Description

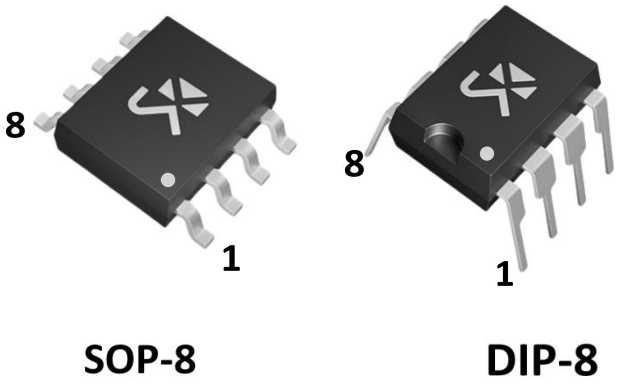
The LM2903 consists of two independent and precise voltage comparators with an input offset voltage not exceeding 2.0mV. It can operate under either a single power supply or dual power supplies, and its current consumption is independent of the amplitude of the power supply voltage. These comparators feature a unique performance: even when operating with a single power supply, their input common-mode voltage range can reach zero level. They are mainly used in consumer electronic products.

The chip is available in DIP-8 or SOP-8 package.

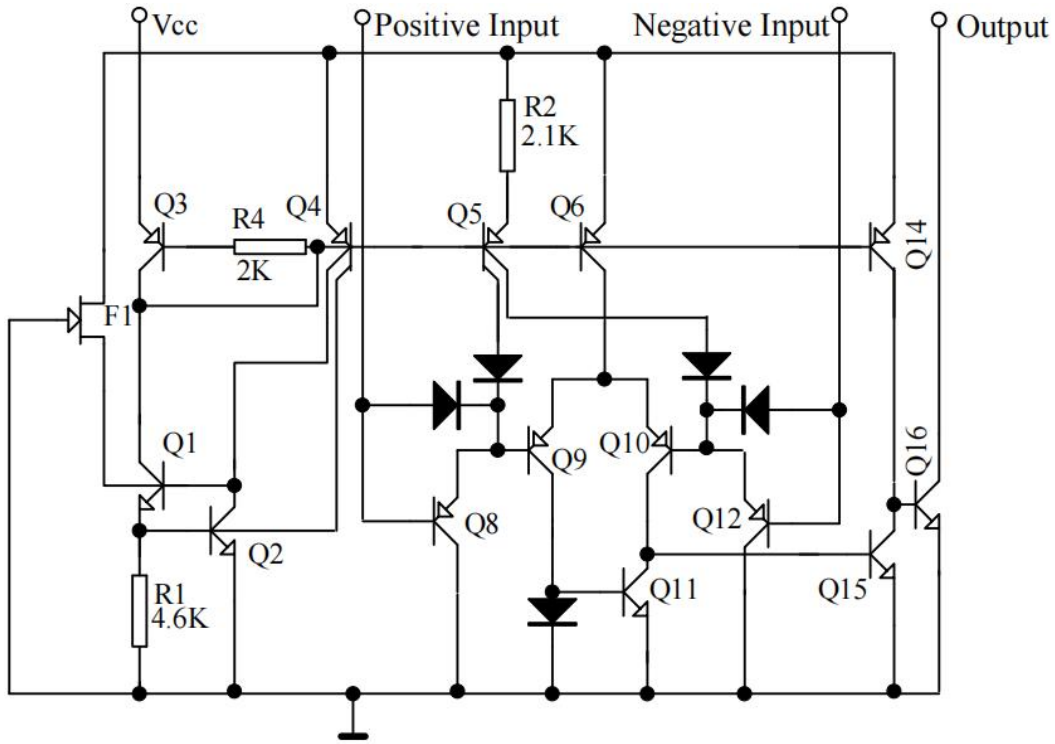
Features

- Wide Operating Power Supply Voltage Range:
  Single Power Supply: 2.0V~36V
  Dual Power Supplies: ±1.0V~±18V
- Low Supply Current: 0.8mA, Independent of Power Supply Voltage
- Low Input Bias Current: 25nA(Typ.)
- Low Input Offset Current: ±5nA(Typ.)
- Low Input Offset Voltage: ±5mV(Max.)
- Input Differential Voltage Range Consistent with Power Supply Voltage Range
- Compatible with TTL, DTL, ECL, MOS, and CMOS

Applications



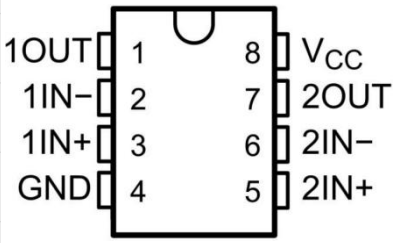
Function Block Diagram



Ordering Information

Type	Marking	Package
LM2903-H8	LM2903	DIP-8
LM2903-P8	LM2903	SOP-8

Pin Description

Pin Number	Pin Name	I/O	Description	Pin Configuration Diagram
1	1OUT	O	Output of the 1st comparator	
2	1IN-	I	Inverting input of the 1st comparator	
3	1IN+	I	Non-inverting input of the 1st comparator	
4	GND	P	Ground	
5	2IN+	I	Non-inverting input of the 2nd comparator	
6	2IN-	I	Inverting input of the 2nd comparator	
7	2OUT	O	Output of the 2nd comparator	
8	V_{CC}	P	Power supply	

Absolute Maximum Ratings (T_A=25℃ unless otherwise noted)

Parameter		Symbol	Min	Max	Unit
Supply Voltage	Dual Power Supplies	V_{CC}	-	±18	V
	Single Power Supply		-	36	
Input Differential Voltage		V_{IDR}	-	36	V
Input Common-Mode Voltage		V_{ICR}	-0.3	36	V
Output Short-Circuit Current to Ground		I_{SC}	-	20	mA
Maximum Operating Junction Temperature		T_J	-	125	℃
Power Dissipation		P_D	-	570	mW
Storage Temperature		T_S	-65	150	℃
Operating Ambient Temperature		T_A	-40	125	℃

Electrical Characteristics(T_A=25°C, V_{CC}=5V, unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{IO}	T_A=25°C	-	±1	±5	mV
		-40°C≤T_A≤125°C	-	-	±12	
Input Offset Current	I_{IO}	T_A=25°C	-	±5	±50	nA
		-40°C≤T_A≤125°C	-	-	±200	
Input Bias Current	I_{IB}	T_A=25°C	-	25	250	nA
		-40°C≤T_A≤125°C	-	-	500	
Input Common-Mode Voltage Range	V_{ICR}	T_A=25°C	0	-	V_{CC}-1.5	V
		-40°C≤T_A≤125°C	0	-	V_{CC}-2.0	
Power Supply Current	I_{CC}	R_L=∞	-	0.4	1.0	mA
		R_L=∞,V_{CC}=30V	-	-	2.5	
Voltage Gain	G_V	R_L≥15kΩ,V_{CC}=15V	50	200	-	V/mV
Large-Signal Response Time	t_{RES}	V_{IN}=TTL Logic Swing, V_{REF}=1.4V,V_{RL}=5V,R_L=5.1kΩ	-	300	-	ns
Response Time	t_{TLH}	V_{RL}=5V,R_L=5.1kΩ	-	1.3	-	μs
Input Differential Voltage	V_{ID}		-	-	V_{CC}	V
Output Sink Current	I_{SINK}	IN-≥1.0V,IN+=0V,V_O≤1.5V	6	16	-	mA
Output Saturation Voltage	V_{SAT}	IN-≥1.0V,IN+=0V,I_{SINK}≤4.0mA	-	150	400	mV
		IN-≥1.0V,IN+=0V,I_{SINK}≤4.0mA, -40°C≤T_A≤125°C	-	-	700	
Output Leakage Current	I_{OL}	IN+≥1.0V,IN-=0V,V_O=5V	-	0.1	-	nA
		IN+≥1.0V,IN-=0V,V_O=30V, -40°C≤T_A≤125°C	-	-	1000	

Typical Application

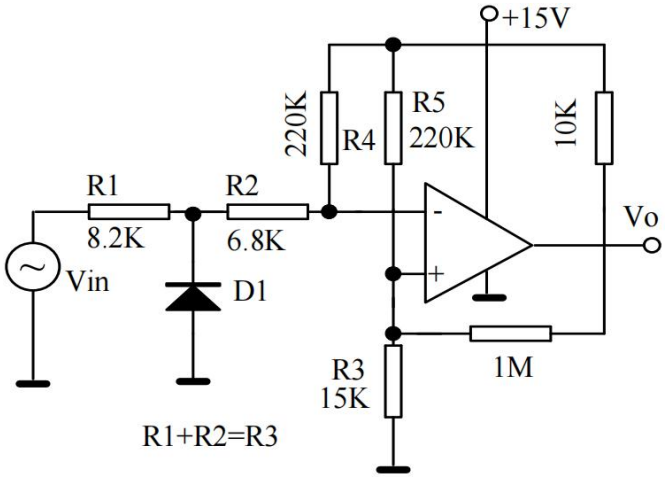


Figure 1. Zero-Crossing Detector
(Single Power Supply Application)

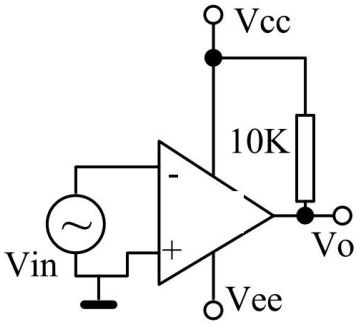


Figure 2. Zero-Crossing Detector
(Dual Power Supply Application)

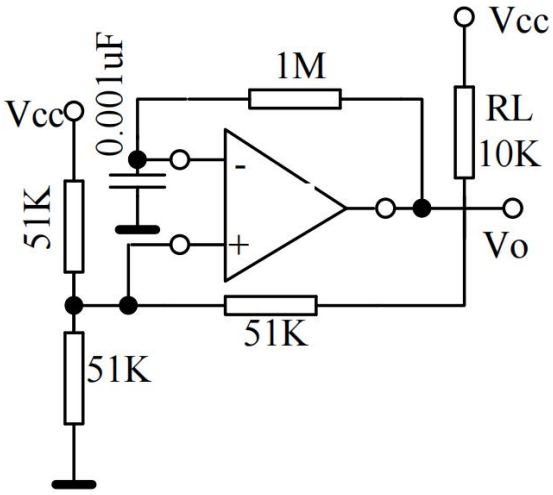


Figure 3. Square Wave Oscillator

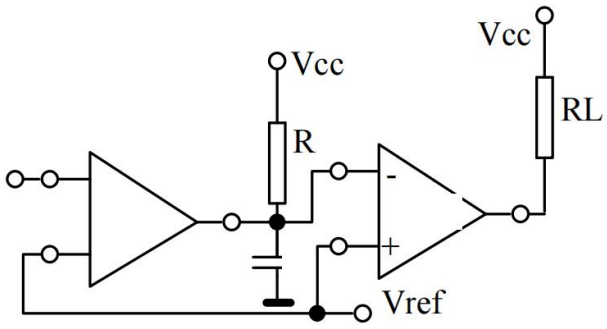


Figure 4. Delay Generator

Usage Instructions

The LM2903 is a high-gain, wide-bandwidth device. Like most comparators, it is prone to oscillation if there is coupling caused by parasitic capacitance between the output and input terminals. This phenomenon only occurs during the transition of the output voltage when the comparator changes state. Adding bypass filtering to the power supply cannot solve this problem; a standard PCB layout helps reduce input-output parasitic capacitance coupling. Reducing the input resistance to less than 10kΩ will reduce the feedback signal, and adding even a small amount of positive feedback (hysteresis of 1.0~10mV) can result in fast switching, making oscillation due to parasitic capacitance impossible. Unless hysteresis is used, directly inserting the IC and adding resistors to the pins will cause input-output oscillation within a very short switching cycle. If the input signal is a pulse waveform with relatively fast rise and fall times, hysteresis is not required.

All unused pins of the comparator must be connected to ground.

The bias network of the LM2903 ensures that its quiescent current is independent of the power supply voltage range (2.0~30V).

Typically, the power supply does not require a bypass capacitor.

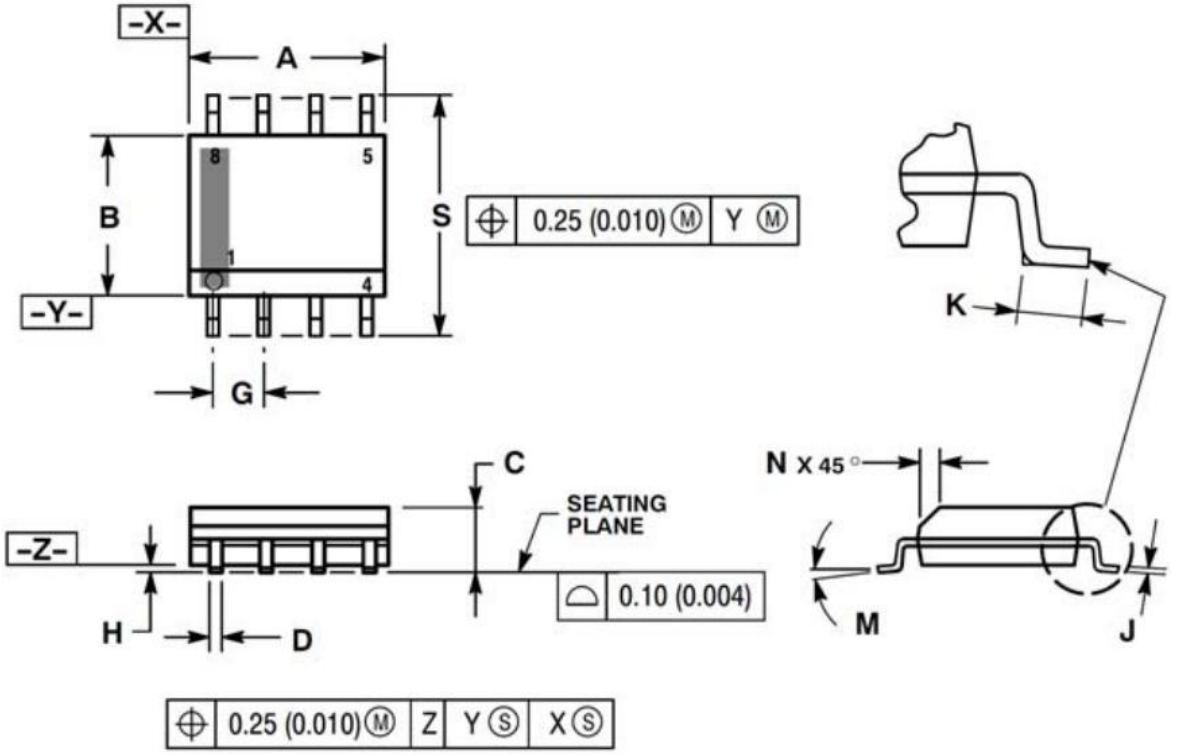
The differential input voltage can be greater than V_{CC} without damaging the device. The protection circuit must prevent the input voltage from exceeding -0.3V at the negative terminal.

The output section of the LM2903 is an open-collector, emitter-grounded NPN output transistor, and a multi-collector output can be used to provide an OR function. The output load resistor can be connected to any power supply voltage within the allowable range, independent of the voltage at the V_{CC} terminal. This output can act as a simple open-circuit to ground (when the load resistor is not used). The sink current of the output section is limited by the available drive and the β value of the device. When the limit current (16mA) is reached, the output transistor will exit saturation and the output voltage will rise rapidly. The output saturation voltage is limited by the approximately 60Ω γSAT of the output transistor. When the load current is small, the low offset voltage (about 1.0mV) of the output transistor allows the output to be clamped to zero level.

Package Information

SOP-8

Dimensions in mm



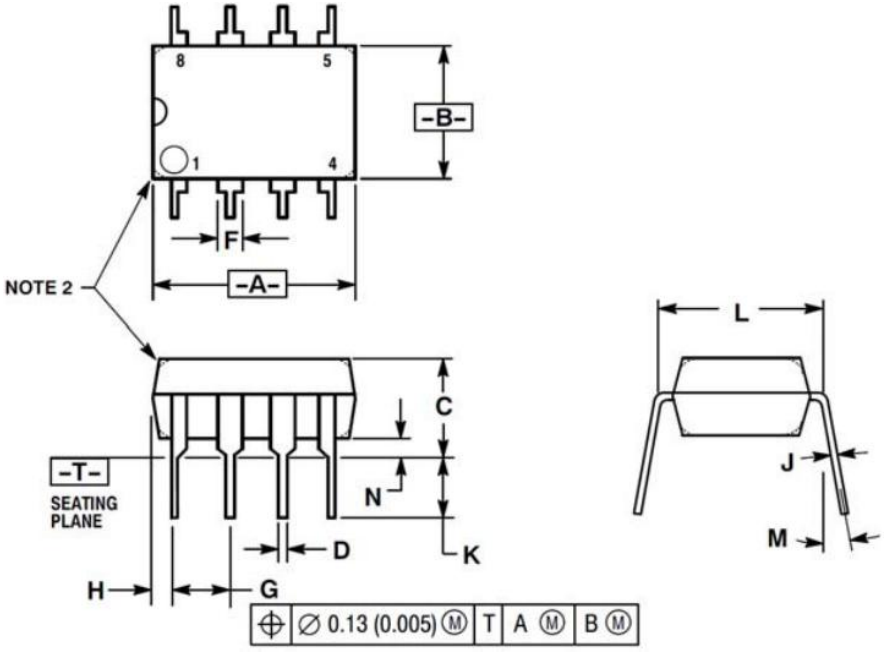
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

Package Information

DIP-8

Dimensions in mm



Note: 1.Dimension to center of lead when formed parallel
2.Package contour optional(Round or square corners)
3.Dimensioning and tolerancing per ANSI Y14.5M, 1982

Symbol	Millimeter		Inches	
	Min	Max	Min	Max
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	-	10°	-	10°
N	0.76	1.01	0.030	0.040

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