LM2903

General-Purpose High-Voltage Open-Drain Output Dual Comparator

Features

- **Wide Supply Voltage Range**

  Single Supply: 3.3V to 32V

  Dual Supplies: ±1.65V to ±16V

- **Low Supply Current Drain:55uA**

- **Low Input Bias Current: 25nA (Typical)**

- **Low Input Offset Current: ±5.0nA (Typical)**

- **Low Input Offset Voltage: 1.0mV (Typical)**

- **Input Common Mode Voltage Range**

  Includes Ground

- **Differential Input Voltage Range Equals to**

  the Power Supply Voltage

- **Low Output Saturation Voltage**

- **Open-Drain Output for Maximum Flexibility**

Applications

- **Hysteresis Comparators**

- **Factory Automation & Control**

- **Industrial Equipment**

- **Test and Measurement**

- **Cordless Power Tool &Vacuum Robot**

- **Wireless Infrastructure**
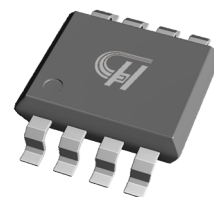
General Description

The LM2903 is the dual comparator version, and the outputs can be connected to other open-collector outputs to achieve wired-AND relationships. It can operate from 3.3V to 32V, and have low power consuming 55μA (TYP) per channel.

The LM2903 consist of two independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Quiescent current is independent of the supply voltage. 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.

The LM2903 is available in Green SOIC-8(SOP-8) and MSOP8 packages. It operates over an ambient temperature range of -40°C to +125°C
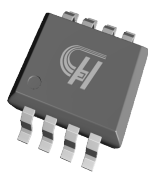
MSOP-8   SOIC-8(SOP-8)

Figure 1. Package Type of LM2903

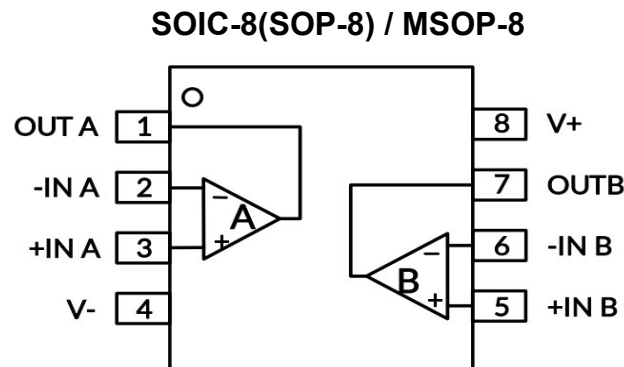# General-Purpose High-Voltage Open-Drain Output Dual Comparator

Pin Configuration

SOIC-8(SOP-8) / MSOP-8

OUT A — 1   8 — V+
-IN A — 2   7 — OUTB
+IN A — 3   6 — -IN B
V- — 4   5 — +IN B

Figure 2. Pin Configuration of LM2903 (Top View)

Pin Function Table

SOIC-8 (SOP-8)	MSOP-8	Name	I/O (1)	Function Description
1	1	OUTA	O	Output, Channel A
2	2	-INA	I	Inverting input, channel A
3	3	+INA	I	Noninverting input, channel A
4	4	V-	P	Negative (lowest) Power Supply
5	5	+INB	I	Noninverting input, channel B
6	6	-INB	I	Inverting input, channel B
7	7	OUTB	O	Output, Channel B
8	8	V+	P	Positive (highest) Power Supply

Note (1) I=Input, O=Output, P=Power.

Ordering Information

Circuit Type

Type:
LM2903

TR : Tape and Reel

Package:
DR8: SOIC-8(SOP-8)
DM8: MSOP-8
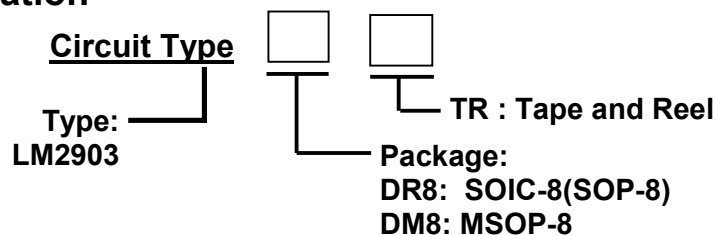
Ordering Code

Part Number	Marking ID note a	Temperature Range	Package	Package Type
LM2903DR8TR	LM2903XX	-40'C to +125'C	SOIC-8 (SOP-8)	Tape&Reel, 4000
LM2903DM8TR	LM2903XX	-40'C to +125'C	MSOP-8	Tape&Reel, 4000

note a. marking information: XX, the 1ST X is date code-Year(A=2010, B=2011,...)

the 2nd X is date code-month(A=Jan, B=Feb,...L=Dec). for example: S5BBA (2011,January)

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Absolute Maximum Ratings [Note 1]

Parameter		Symbol	Min.	Max.	Unit
Supply Voltage, Vs=(V+) - (V-)		V_{CC}	-	36	V
Input Pin Voltage(IN+, IN-)		V_{IN}	(V-) - 0.3	(V+) + 0.3	
Signal Output Pin Voltage		V_{out}	(V-) - 0.3	(V+) + 0.3	
Signal input pin Current (IN+, IN-)		I_{IK}	-10	10	mA
Signal Output pin Current		I_{out}	-55	55	mA
Output Short-Circuit to Ground Current		I_{LIM}	Continuous		-
Power Dissipation @T_A=+25'C	SOIC-8 (SOP-8)	P_D	660		mW
	MSOP-8		450		
Package thermal impedance	SOIC-8 (SOP-8)	θ_{JA}	110		'C/W
	MSOP-8		170		
Storage Temperature Range		T_{STG}	-65	+150	'C
Operating Junction Temperature		T_J	-40	+150	'C
Lead Temperature (Soldering, 10s)		T_{LEAD}	+260		'C
ESD Class(Human Body Model)		HMB	2000		V
ESD Class(Machine Model)		MM	200		

Note 1: Stresses above those listed under"Maximum Ratings" may cause permanent damage to the device.

This is a stress rating only and functional operation of the device at those or any other conditions

above those indicated in the operational listings of this specification is not implied. Exposure to

maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

Parameter		Symbol	Min	Max	Unit
Supply Voltage, Vs=(V+) - (V-)	Single-supply	V_{CC}	3.3	32	V
	Dual-supply	V_{CC}	±1.65	±16	V
Operating Temperature Range		T_A	-40	+125	'C

General-Purpose High-Voltage Open-Drain Output Dual Comparator

Electrical Characteristics:

(At TA = +25☼C, VCM=(Vs/2), VS=5V, unless otherwise noted.) (1)

Parameter	Symbol	Conditions	Min[2]	Type[3]	Max[2]	Unit
Operating Voltage Range	**Vs**	-	3.3	-	32	**V**
Input Offset Voltage	V_{OS}	Vs=5V to 32V	-3.5	±0.8	3.5	**mV**
		Vs=5V to 32V, TA= -40'C to +125'C	-	-	7	
Quiescent Current	I_Q	Vs=5V, no load	-	110	180	**uA**
		Vs=32V, no load, TA= -40'C to +125'C	-	150	-	
Input Bias Current[4][5]	I_B	TA=25'C	-	10	50	**pA**
		TA= -40'C to +125'C	-	-	100	
Input Offset Current[4]	I_{OS}	TA=25'C	-	10	50	**pA**
		TA= -40'C to +125'C	-	-	100	
Common-Mode Voltage Range	V_{CM}	Vs=3.3V to 32V	(V-)	-	(V+)-1.5	**V**
		Vs=3.3V to 32V, TA= -40'C to +125'C	(V-)	-	(V+)-2.0	
Large signal differential Voltage amplification	**AVD**	Vs=15V, VO=1.4V to 11.4V, RL>=15K to (V+)	50	200	-	**V/mV**
Low-level output voltage	V_{OL}	Isink<=4mA, VID= -1V	-	200	300	**mV**
Output Current (Sink)	I_{OL}	VO=1.5V; VID=-1V; VS=5V	6.0	23	-	**mA**
High-Level Output Leakage Current	$I_{OH\text{-}LKG}$	(V+)=VO=5V; VID=1V	-	80	400	**nA**
		(V+)=VO=32V; VID=1V	-	100	500	**nA**
Switching Characteristics						
Propagation Delay H To L [6]	Vs=5V	T_{PHL}	RPU=5.1KΩ, Overdrive =10mV	-	2.5	-	**us**
			RPU=5.1KΩ, Overdrive =100mV	-	0.5	-	
	Vs=32V		RPU=5.1KΩ, Overdrive =10mV	-	1.8	-	
			RPU=5.1KΩ, Overdrive =100mV	-	0.7	-	
Propagation Delay L To H [6]	Vs=5V	T_{PLH}	RPU=5.1KΩ, Overdrive =10mV	-	4.1	-	**us**
			RPU=5.1KΩ, Overdrive =100mV	-	1.6	-	
	Vs=32V		RPU=5.1KΩ, Overdrive =10mV	-	3.1	-	
			RPU=5.1KΩ, Overdrive =100mV	-	1.4	-	

note (1). Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device.

(2). Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3). Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(4). This parameter is ensured by design and/or characterization and is not tested in production.

(5). Positive current corresponds to current flowing into the device.

(6). High-to-low and low-to-high refers to the transition at the input.

General-Purpose High-Voltage Open-Drain Output Dual Comparator

Performance Characteristics (Unless Otherwise Specified.)
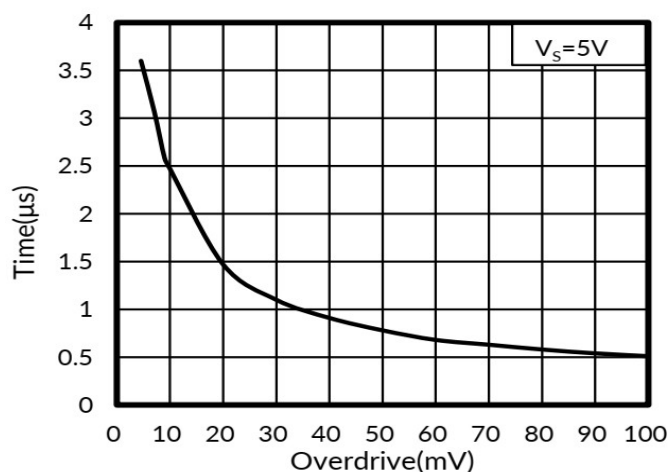
**Response Time vs Input Overdrives
Negative Transition**
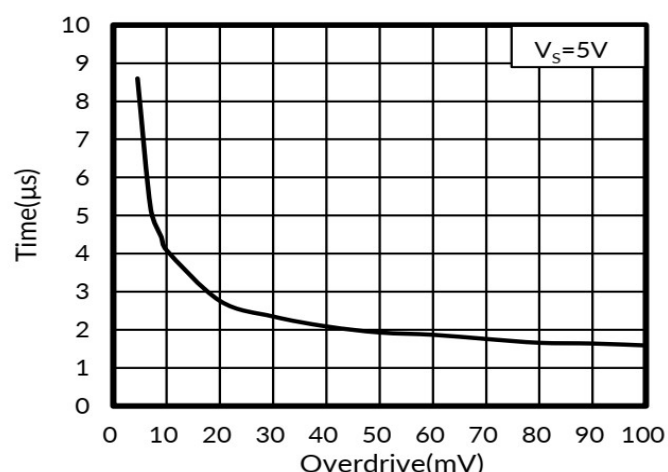
**Response Time vs Input Overdrives
Positive Transition**
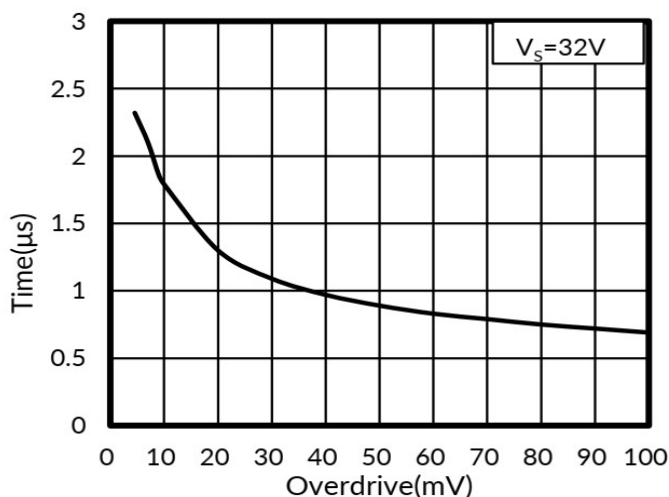
**Response Time vs Input Overdrives
Negative Transition**
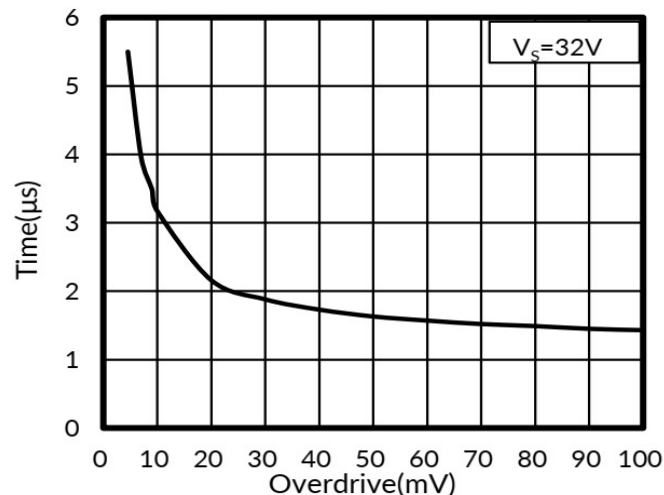
**Response Time vs Input Overdrives
Positive Transition**
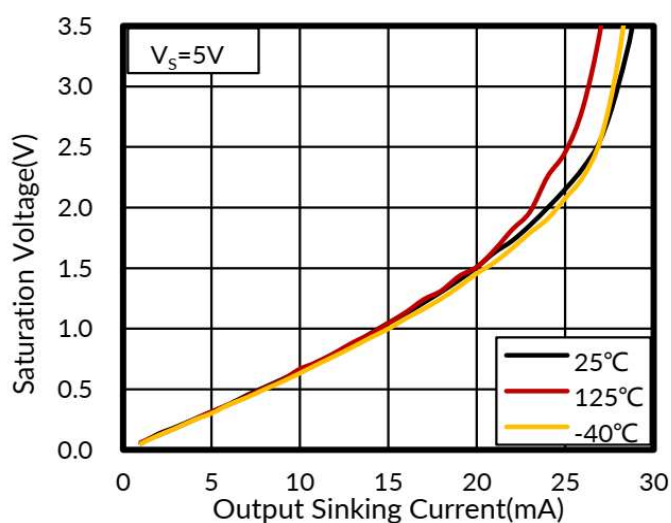
**Saturation Voltage vs Output Sink
Current**
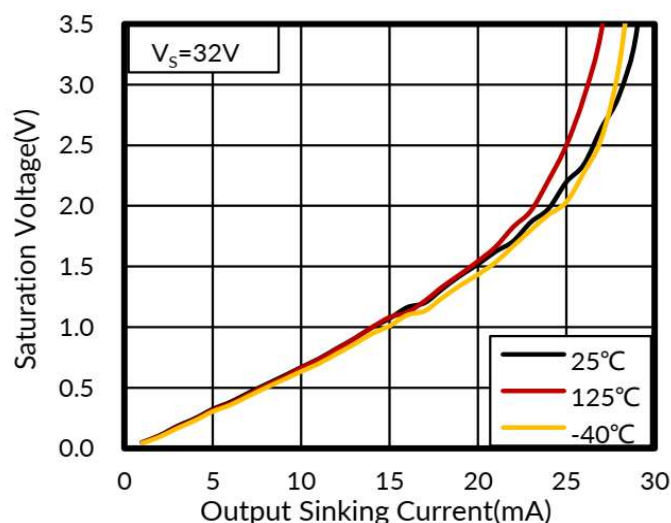
**Saturation Voltage vs Output Sink
Current**

General-Purpose High-Voltage Open-Drain Output Dual Comparator

Detailed Description

Overview

The LM2903 family of comparators can operate up to 32V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to its low power and high speed. The open-drain output allows the user to configure the output's logic low voltage (VOL) and can be utilized to enable the comparator to be used in AND functionality.
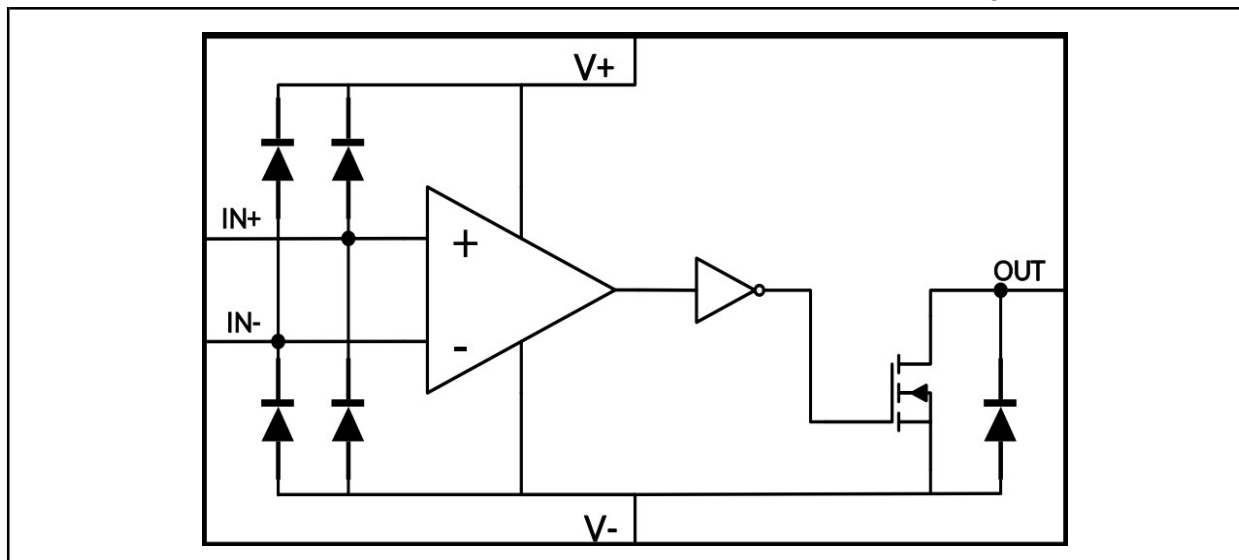

Figure 3. Functional Block Diagram

Application Information

The LM2903 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 (logic high with pull-up) 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.

Detailed Design Procedure

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

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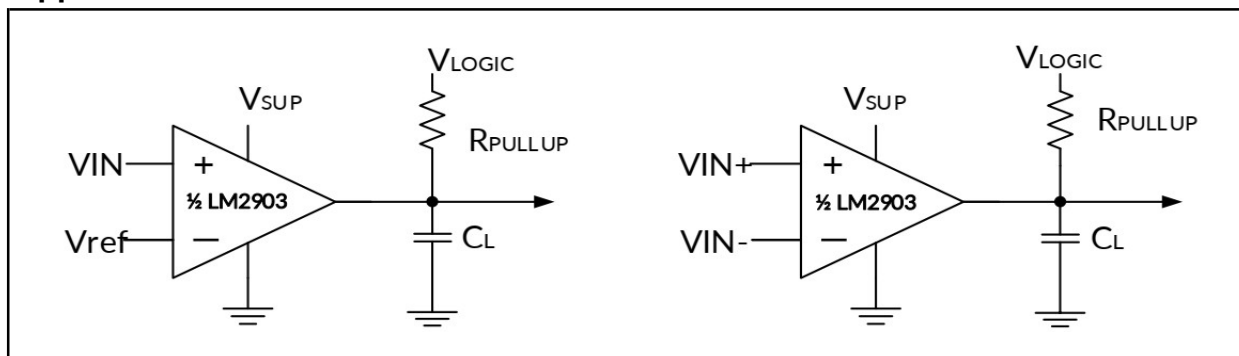- Output and Drive Current
- Response Time

Typical Application

Figure 4. Single-Ended and Differential Comparator Configurations

Application Information

Application Information

When choosing the input voltage range, the input common mode voltage range(VICR)must be taken in to account. If temperature operation is below 25°C the VICR can range from 0 V to VCC – 2.0 V.

This limits the input voltage range to as high as VCC – 2.0 V and as low as 0 V. Operation outside of this range can yield incorrect comparisons.

Layout

Layout Guidelines

For accurate comparator applications without hysteresis, it is important maintain a stable power supply with minimized noise and glitches. To achieve this, it is best to add a bypass capacitor between the supply voltage and ground. This should be implemented on the positive power supply and negative supply (if available). If a negative supply is not being used, do not put a capacitor between the IC's GND pin and system ground. Minimize coupling between outputs and inverting inputs to prevent output oscillations. Do not run output and inverting input traces in parallel unless there is a VCC or GND trace between output and inverting input traces to reduce coupling. When series resistance is added to inputs, place resistor close to the device.
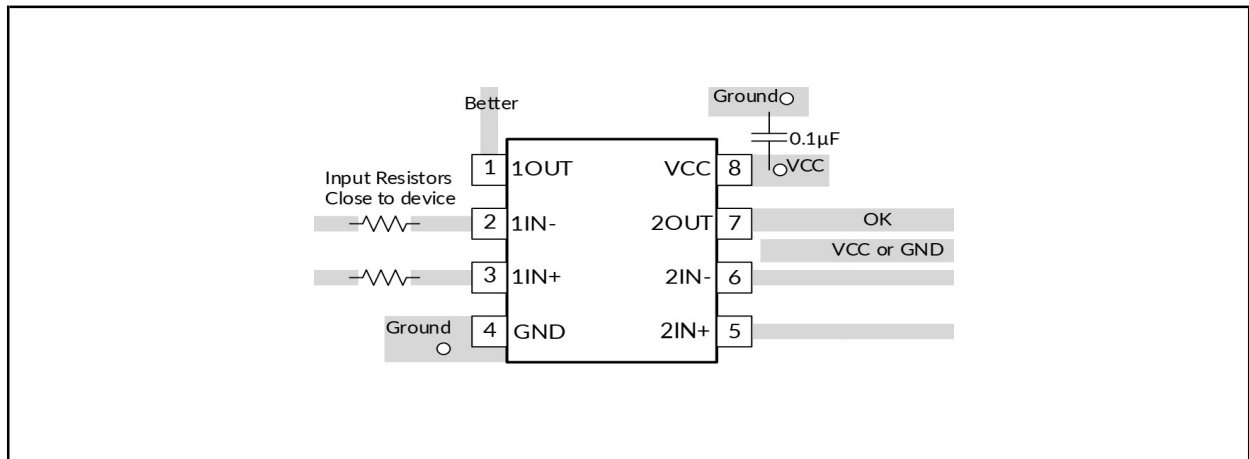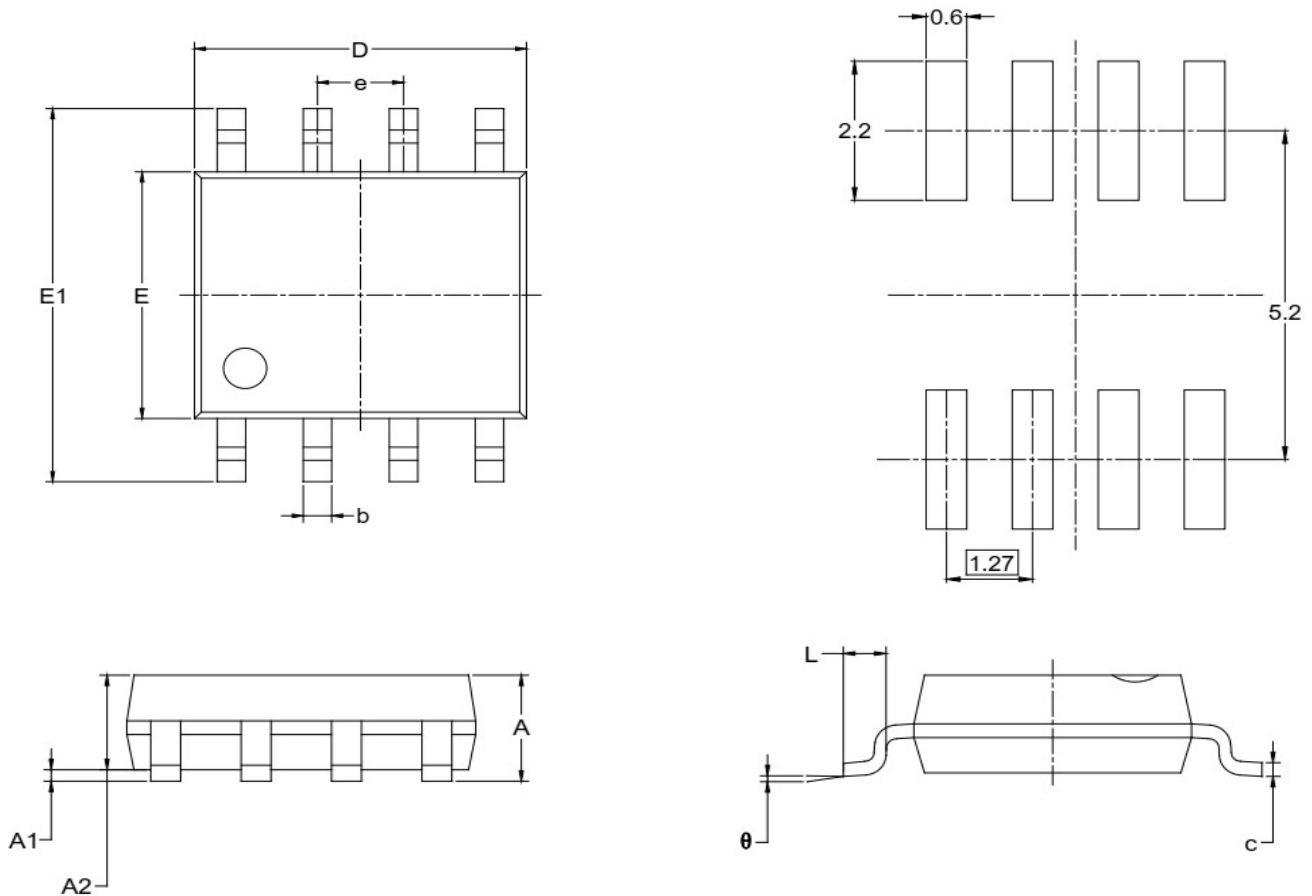
Layout Example

Figure 5. LM2903 Layout Example

**General-Purpose High-Voltage Open-Drain Output Dual Comparator**

Mechanical Dimensions

DR8 : SOIC-8/SOP-8   **Unit: mm (inch)**

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°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

General-Purpose High-Voltage Open-Drain Output Dual Comparator

Mechanical Dimensions(Con.)

DM8 : MSOP-8

Unit: mm (inch)
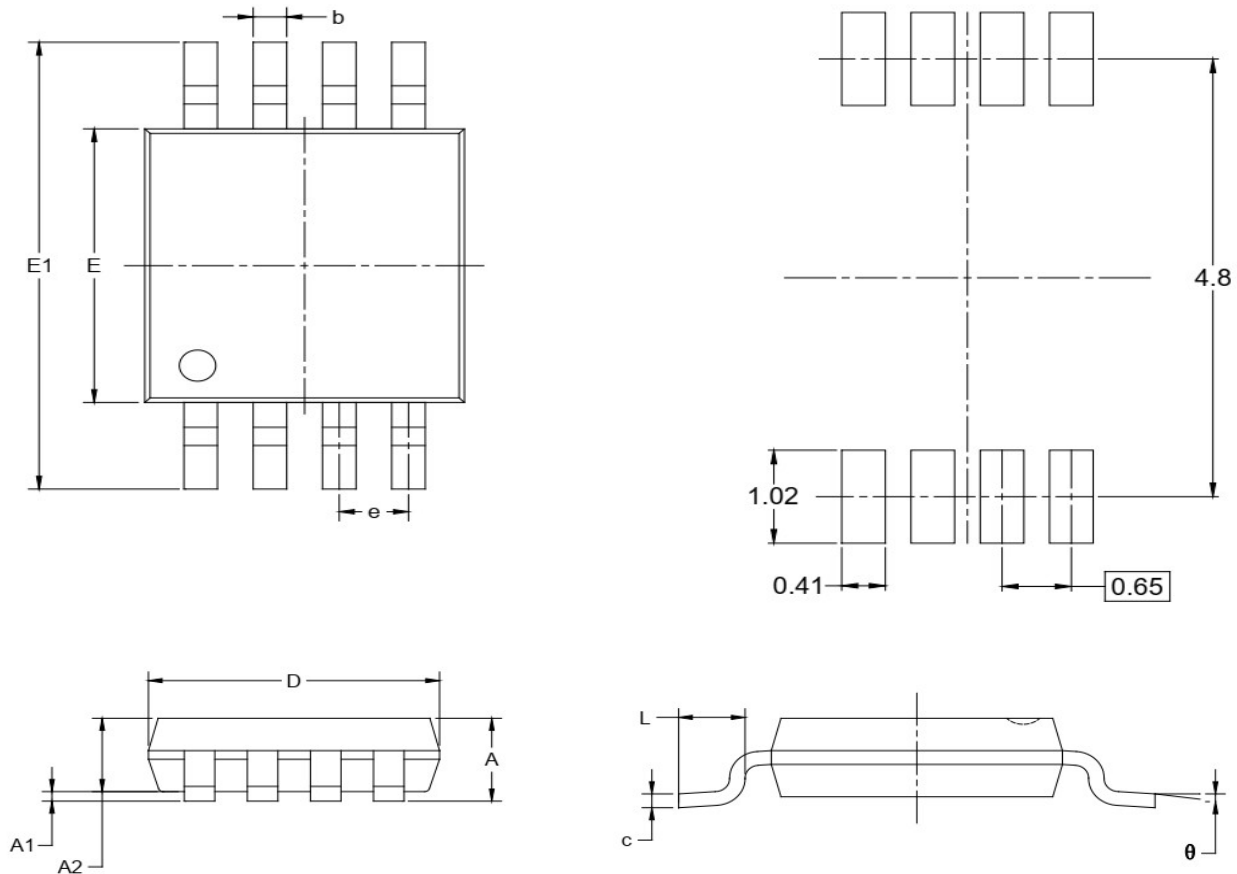
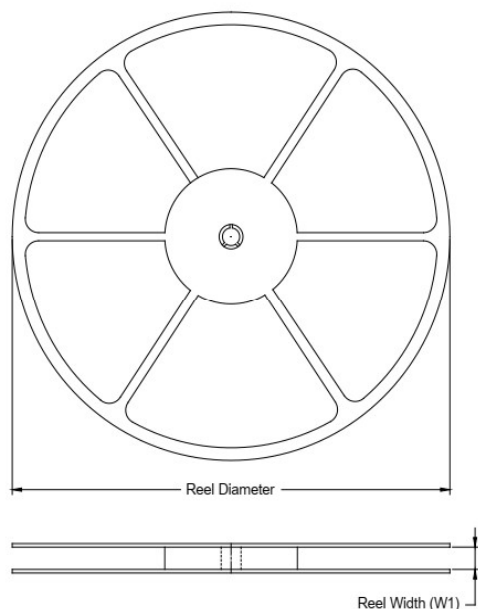| Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	**MAX**	**MIN**	**MAX**
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
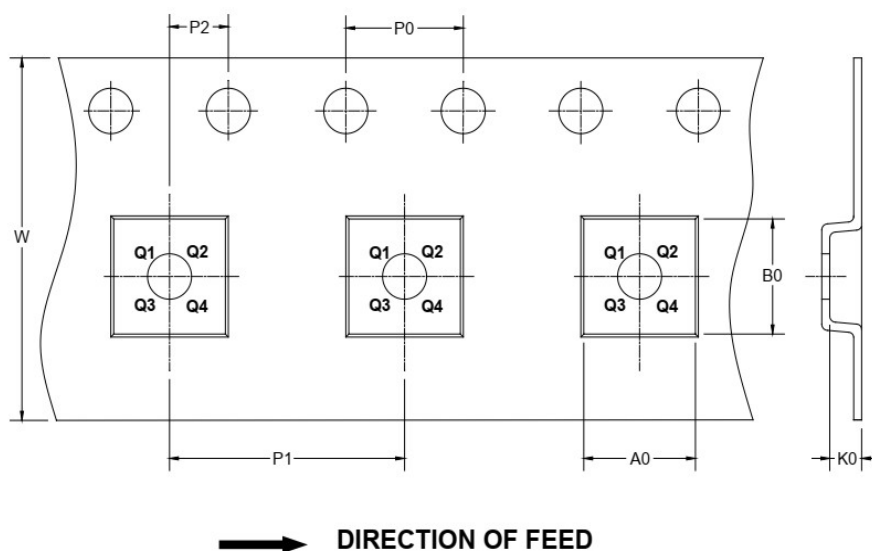2. This drawing is subject to change without notice.

General-Purpose High-Voltage Open-Drain Output Dual Comparator

TAPE AND REEL INFORMATION

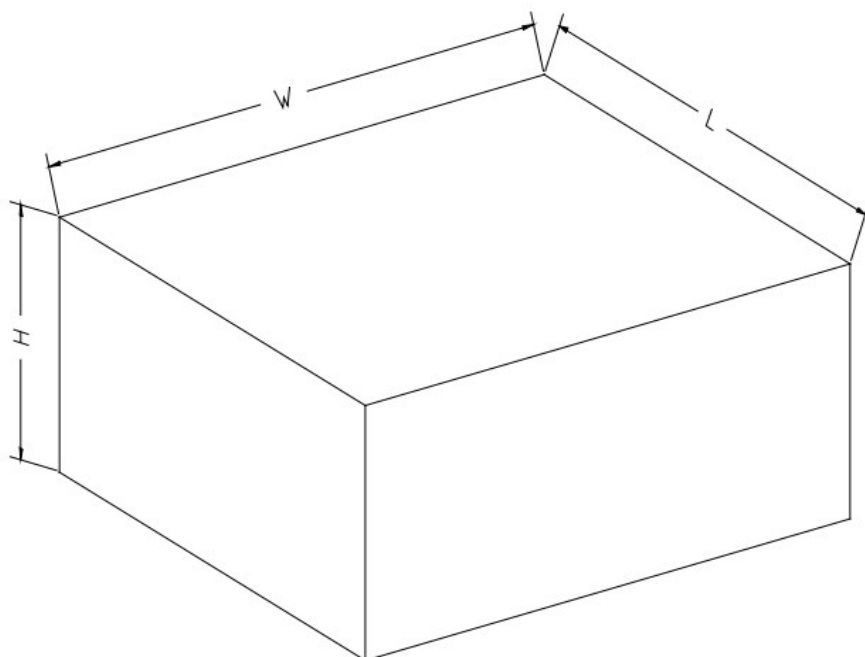### REEL DIMENSIONS

TAPE DIMENSIONS

DIRECTION OF FEED

NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
MSOP-8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

CARTON BOX DIMENSIONS

NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13″	386	280	370	5