36V, General-Purpose, Industry Comparators

LM2901 and LM2903 Comparators

1 Introduction

The LM2901 and LM2903 are dual and quad channel voltage comparators with very low input offset voltage specifcaton. They are designed to operate from a single power supply over a wide range of voltages, however operation from split power supplies is also possible. They offer low power supply current independent of the magnitude of the power supply voltage.

These comparators family are designed to directly interface with TTL and CMOS. When operating from both plus and minus power supplies, the comparators could directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.

The LM2903(dual) is offered in SOP8 package, the quad of LM2901 is offered in SOP14 package. Both devices are rated over −40°C to +125°C industrial temperature range.

2 Features

- Wide Supply: 3.0V to 36V
- Faster Response Time: 1.3μs (typical)
- Low Input Bias Current:25nA (typical)
- Large Voltage Gain: 100dB (typical)
- Low Offset Voltage: ±2mV (typical)
- Open Collector Output
- Input Common-Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equal To Power Supply
- ExtendedTemperature Range:
  −40°C to +125°C

3 Applications

- Industrial Application
- Solar Inverter
- White Goods
- Battery Management System
- Medical Equipment

4 Available Packages

PART NUMBER	PACKAGE
LM2901-PHN	SOP14
LM2903-PAN	SOP8

5 Orderable Information

MODEL	DEVICE	PACKAGE	OP TEMP	ECO PLAN	MSL	PACKING OPTION	SORT
LM2901	LM2901-PHN	SOP14	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 2500 Units / Reel	Active
LM2903	LM2903-PAN	SOP8	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 4000 Units / Reel	Active
Others	-	-	-	-	-	-	Customized

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by JSCJ.

MSL: Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers; Obsolete: The device has been discontinued.

6 Pin Configuration and Marking Information

6.1 Pin Configuration and Function

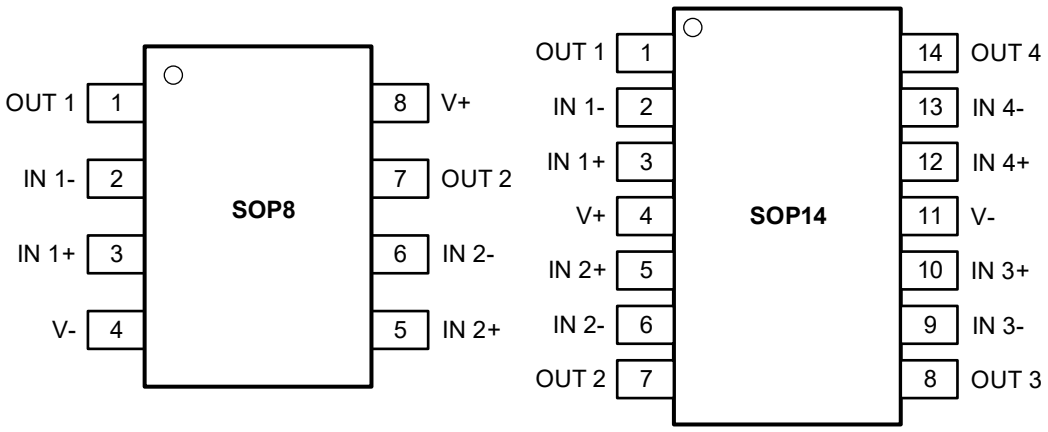
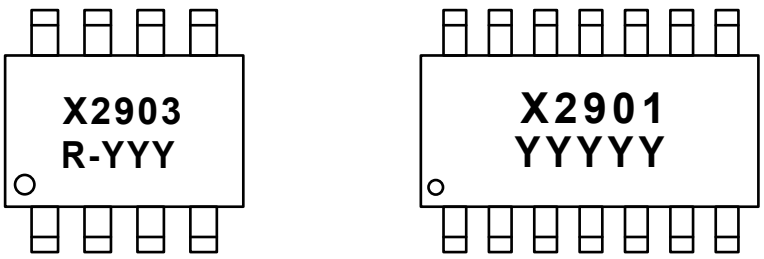


Figure 6-1. LM2901 and LM2903 Pin Map

PIN	LM2903	LM2901	I / O	DESCRIPTION
NAME	SOP8	SOP14		
OUT 1	1	1	O	Output of the operational amplifier 1.
IN 1-	2	2	I	Negative input of the operational amplifier 1.
IN 1+	3	3	I	Positive input of the operational amplifier 1.
V+	8	4	-	Positive (highest) supply.
IN 2+	5	5	I	Positive input of the operational amplifier 2.
IN 2-	6	6	I	Negative input of the operational amplifier 2.
OUT 2	7	7	O	Output of the operational amplifier 2.
OUT 3	-	8	O	Output of the operational amplifier 3.
IN 3-	-	9	I	Negative input of the operational amplifier 3.
IN 3+	-	10	I	Positive input of the operational amplifier 3.
V-	4	11	-	Negative (lowest) supply or ground for single supply.
IN 4+	-	12	I	Positive input of the operational amplifier 4.
IN 4-	-	13	I	Negative input of the operational amplifier 4.
OUT 4	-	14	O	Output of the operational amplifier 4.

6.2 Marking Information



"**2901 and 2903**": Device number.

"**YYY and YYYYY**": Code, indicates weekly record information.

7 Specifications

7.1 Absolute Maximum Ratings

(over operating ambient temperature range, unless otherwise specified)(1)

CHARACTERISTIC	SYMBOL	VALUE	UNIT
Supply voltage[(V+)-(V-)]	V_S	40	V
Signal input Voltage(2) range	-	-0.3~40V	V
Differential input voltage	-	±36	mA
Output short-circuit	T_{sc}	Continuous(3)	mA
Maximum junction temperature	$T_{J\ MAX}$	150	°C
Storage temperature	T_{stg}	-65 ~ 150	°C
Soldering temperature & time	T_{solder}	260°C, 10s	-

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. 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*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) Input pins are diode-clamped to the power-supply rails. Current limit input signals that can swing more than 0.5V beyond the supply rails to 10mA or less.

(3) Short circuits from outputs to V_S can cause excessive heating and eventual destruction. A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

7.2 Recommend Operating Conditions

(over operating ambient temperature range, unless otherwise specified)

PARAMETER		SYMBOL	MIN.	NOM.	MAX.	UNIT
Power supply range	T_A = -40 ~ 125°C	V_S	3.0	-	36	V
Operating ambient temperature		T_A	-40	-	125	°C

7 Specifications

7.3 ESD Ratings

ESD RATINGS		VALUE	UNIT
Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(4)	500	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101(5)	1000	

(4) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
(5) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

7.4 Thermal Information

THERMAL METRIC(6)	SYMBOL	SOP14	SOP8	UNIT
Junction-to-ambient thermal resistance	$R_{\Theta JA}$	115.7	125.0	ÁC/W
Reference maximum power dissipation (continuous)	$P_{D\ Ref}$	1.08	1.00	W

(6) T_A = 25°C, measured on evaluation board with 1oz. copper traces of minimum pad size, all device outputs were active.

7 Specifications

7.5 Electrical Characteristics

V_S = 5.0V to 36V, T_A = +25°C, unless otherwise noted.

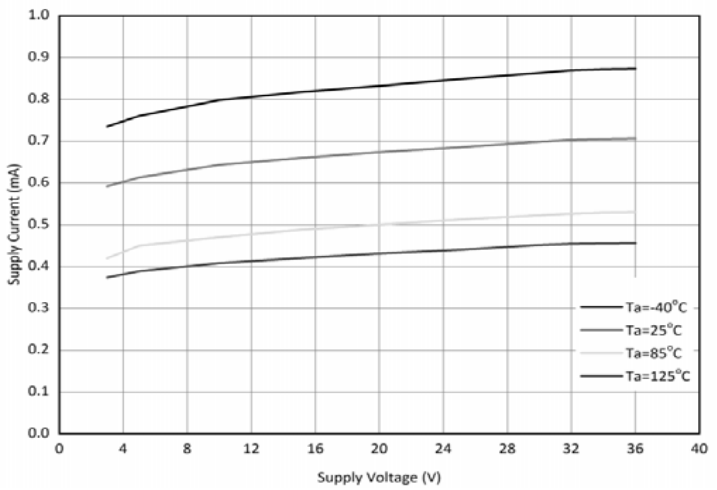
CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
OFFSET VOLTAGE						
Input offset voltage	V_{OS}	V_S = 5.0V to 30V, V_{OUT} = 1.4V	-	±2	±7	mV
		V_S = 5.0V to 30V, V_{OUT} = 1.4V T_A = −40 to +125°C	-	-	±15	
INPUT BIAS CURRENT						
Input bias current	I_B	V_{CM} = 0	-	-25	-250	nA
		V_{CM} = 0, T_A = −40 to +125°C	-	-	-400	
Input offset current	I_{OS}	V_{CM} = 0	-	5	50	nA
		V_{CM} = 0, T_A = −40 to +125°C	-	-	200	
INPUT VOLTAGE						
Common-mode voltage range	V_{CM}	V_S = 5.0V to 36V	$-V_S$	-	$+V_S$-1.5	V
		V_S = 5.0V to 36V, T_A = −40 to +125°C	$-V_S$	-	$+V_S$-2.0	
VOLTAGE GAIN						
Large-signal differential-voltage amplification	A_{VD}	V_S = 15.0V, V_{OUT} = 1V ~ 11V $R_L \geq$ 15K	50	200	-	V/mV
PROPAGATION DELAY TIME						
Propagation delay time	T_{PD}	R_L = 5.1k, V_{RL} = 5V, C_L = 15pF TTL-Level Input Step	-	0.3	-	µs
		R_L = 5.1k, V_{RL} = 5V, C_L = 15pF 100mV Input Step With 5mV Overdrive	-	1.3	-	
OUTPUT						
Low output voltage swing	V_{OL}	I_{OL} = 4mA, V_{ID} = -1V	-	200	400	mV
		I_{OL} = 4mA, V_{ID} = -1V, T_A = −40 to +125°C	-	-	700	
Low-level output current	I_{OL}	V_{OL} = 1.5V, V_{ID} = -1V	6	16	-	mA
High-level output current	I_{OH}	V_{OL} = 5V, V_{ID} = 1V	0.1	50	-	nA
		V_{OL} = 30V, V_{ID} = 1V, T_A = −40 to +125°C	-	-	1	µA
POWER SUPPLY						
Quiescent current of LM2903	I_Q	V_S = 5V	-	400	1000	µA
		V_S = 30V	-	650	1750	
Quiescent current of LM2901	I_Q	V_S = 5V	-	850	1990	µA
		V_S = 30V	-	1150	2490	

7 Specifications

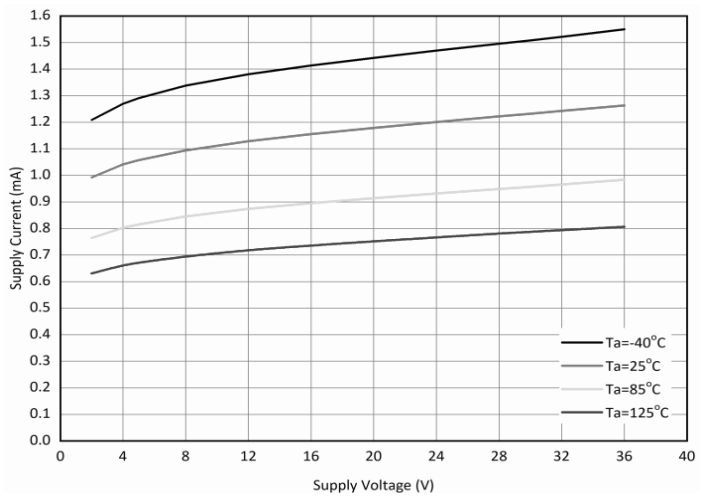
7.6 Typical Characteristics

V_S = 5V, RL = 5.1k, T_A = 25°C and V_{OUT} = 0V, unless otherwise noted.

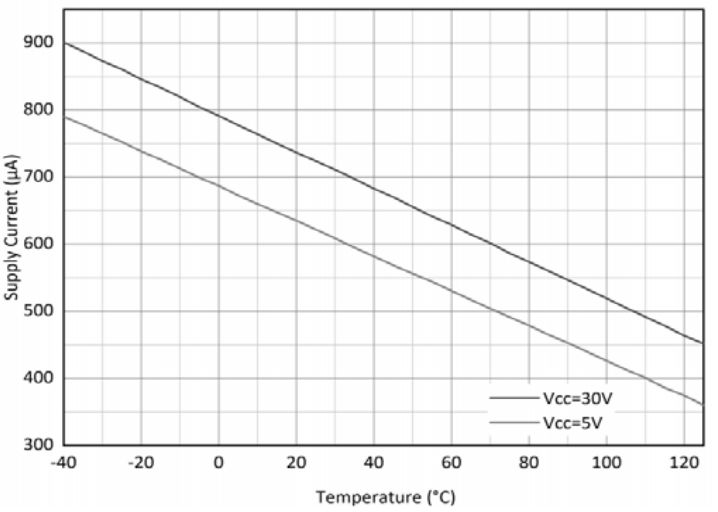
LM2903 Quiescent Current vs. Supply Voltage



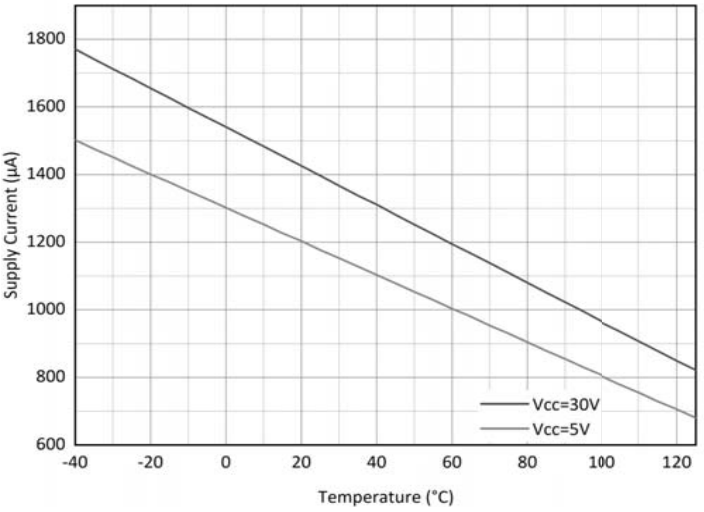
LM2901 Quiescent Current vs. Supply Voltage



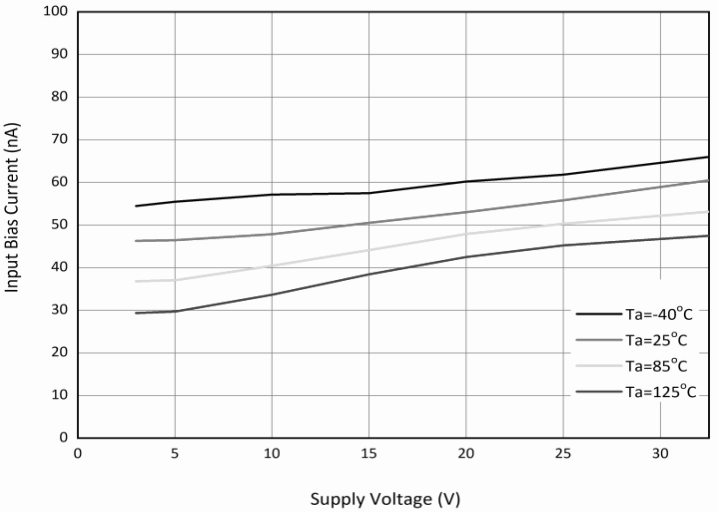
LM2903 Quiescent Current vs. Temperature



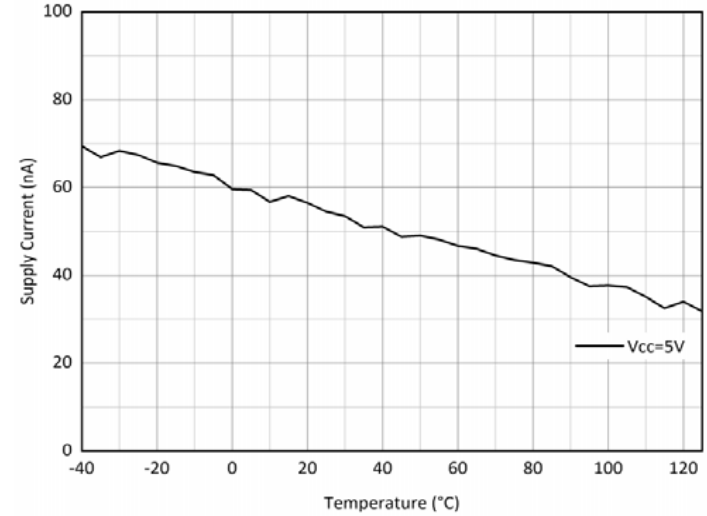
LM2901 Quiescent Current vs. Temperature



Input Bias Current vs. Supply Voltage



Input Bias Current vs. Temperature

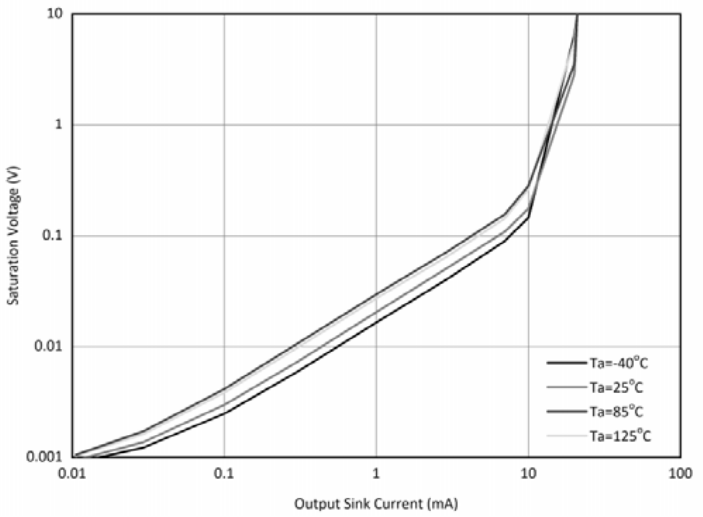


7 Specifications

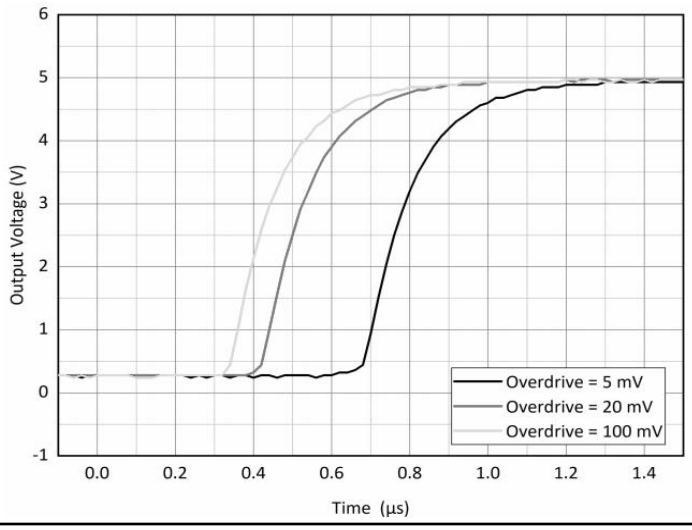
7.6 Typical Characteristics (continued)

V_S = 5V, RL = 5.1k, T_A = 25°C and V_{OUT} = 0V, unless otherwise noted.

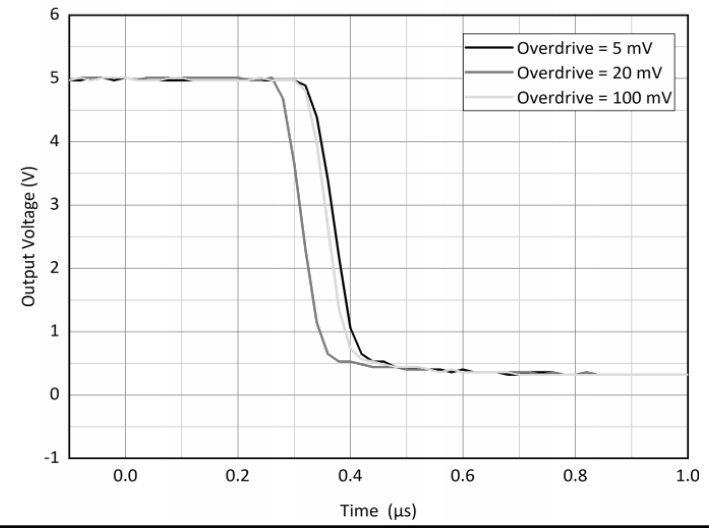
Output Sink Current vs. Saturaton Voltage



Response Time for Various Over drives Positve Transition



Response Time for Various Over drives Negative Transition



8 Detail Description

8.1 Description

The LM2901 and LM2903 are dual and quad channel voltage comparators with very low input offset voltage specifcaton. They are designed to operate from a single power supply over a wide range of voltages, however operation from split power supplies is also possible. They offer low power supply current independent of the magnitude of the power supply voltage.

8.2 Feature Description

Ground Sensing and Rail to Rail Output

The LM2901/2903 family implements a rail-to-rail topology that is capable of swinging to within 10mV of either rail. Since the inputs can go 300mV beyond either rail, the comparator can easily perform ‘true ground’ sensing.

The maximum output current is a function of total supply voltage. As the supply voltage of the comparator increases, the output current capability also increases. Attention must be paid to keep the junction temperature of the IC below 150°C when the output is in continuous short-circuit condition. The output of the amplifier has reverse-biased ESD diodes connected to each supply. The output should not be forced more than 0.5V beyond either supply, otherwise current will flow through these diodes.

9 Application and Implementation

9.1 Application Information

The LM2901 and LM2903 are 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 comaprator optimal for level shifting to a higher or lower voltage.

9.2 Typical Application Circuits

The LM2901 and LM2903 family are designed to directly interface with TTL and CMOS. When operating from both plus and minus power supplies, the comparators could directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.

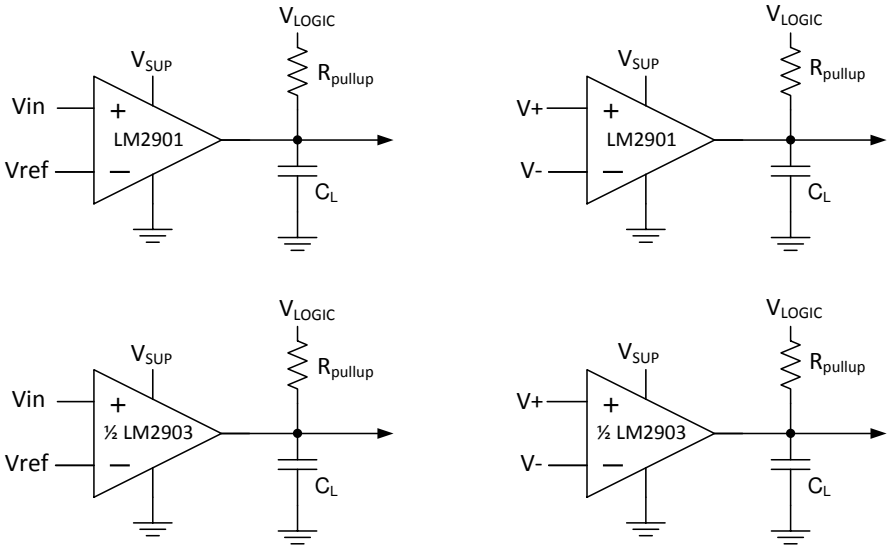


Figure 9-1. Single-Ended and Differential Comparator Configurations

IR Receiver

The LM2901/2903 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 RD. When this voltage level cross the voltage applied by the voltage divider to the inverting input, the output transitions. Optional Ro provides additional hysteresis for noise immunity.

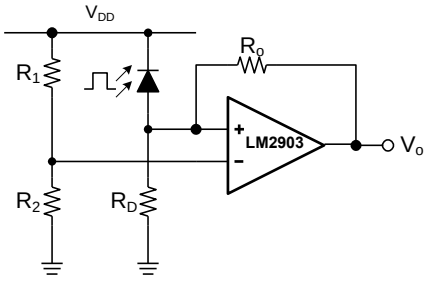


Figure 9-2. IR Receiver

9 Application and Implementation

9.3 Power Supply Recommendations

The LM2901/2903 family's power supply pin should have a local bypass capacitor (i.e., 0.01μF to 0.1μF) within 2mm for good high frequency performance. It can also use a bulk capacitor (i.e., 1μF or larger) within 100mm to provide large, slow currents. This bulk capacitor can be shared with other analog parts.

Good ground layout improves performance by decreasing the amount of stray capacitance and noise at the comparator's inputs and outputs. To decrease stray capacitance, minimize PCB lengths and resistor leads, and place external components as close to the comparator' pins as possible.

9.4 Layout Guidelines

To achieve the maximum performance of the extremely high input impedance and low offset voltage of the LM2901/2903 devices, care is needed in laying out the circuit board. The PCB surface must remain clean and free of moisture to avoid leakage currents between adjacent traces. Surface coating of the circuit board reduces surface moisture and provides a humidity barrier, reducing parasitic resistance on the board. The use of guard rings around the amplifier inputs further reduces leakage currents. Figure 9-3 shows proper guard ring configuration and the top view of a surface-mount layout. The guard ring does not need to be a specific width, but it should form a continuous loop around both inputs. By setting the guard ring voltage equal to the voltage at the non-inverting input, parasitic capacitance is minimized as well. For further reduction of leakage currents, components can be mounted to the PCB using Teflon standoff insulators.

Other potential sources of offset error are thermoelectric voltages on the circuit board. This voltage, also called Seebeck voltage, occurs at the junction of two dissimilar metals and is proportional to the temperature of the junction. The most common metallic junctions on a circuit board are solder-to-board trace and solder-to-component lead. If the temperature of the PCB at one end of the component is different from the temperature at the other end, the resulting Seebeck voltages are not equal, resulting in a thermal voltage error.

This thermocouple error can be reduced by using dummy components to match the thermoelectric error source. Placing the dummy component as close as possible to its partner ensures both Seebeck voltages are equal, thus canceling the thermocouple error. Maintaining a constant ambient temperature on the circuit board further reduces this error. The use of a ground plane helps distribute heat throughout the board and reduces EMI noise pickup.

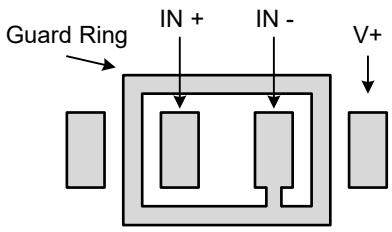
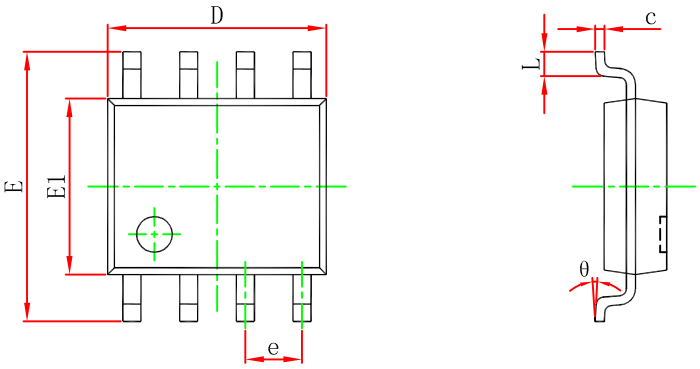


Figure 9-3. Guard Ring

10 Mechanical Information

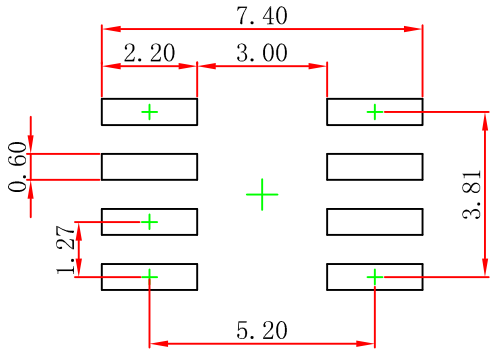
10.1 SOP8 Mechanical Information

Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A	1.370	1.670	0.054	0.066
A1	0.070	0.250	0.003	0.010
A2	1.350	1.550	0.053	0.061
b	0.300	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
e	1.270（BSC）		0.050（BSC）	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP8 Suggest Pad Layout



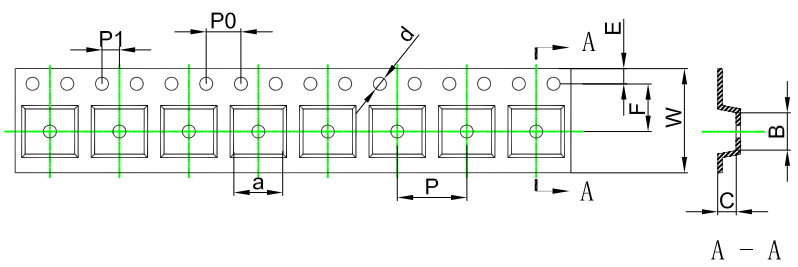
NOTE:

1. Controlling dimension: in millimeters.
2. General tolerance: ±0.05mm.
3. The pad layout is for reference purposes only.

11 Packaging Information

11.1 SOP8 Tape and Reel Information

Embossed Carrier Tape



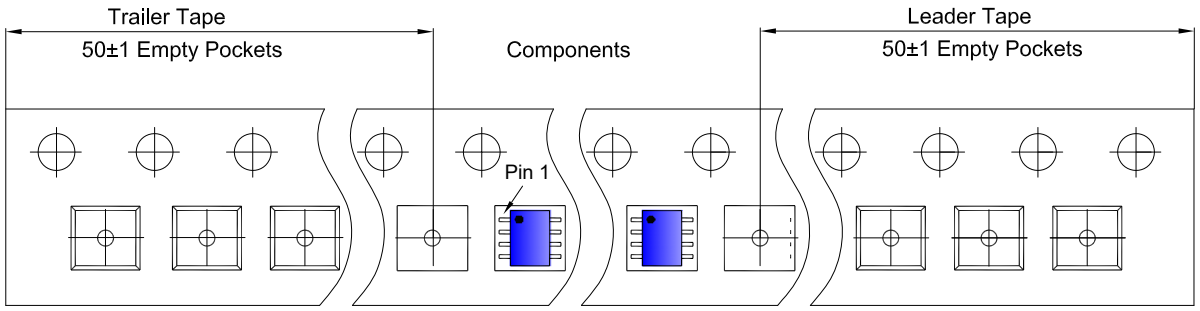
Packaging Description:

SOP8 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 2,500 units per 13" or 33cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

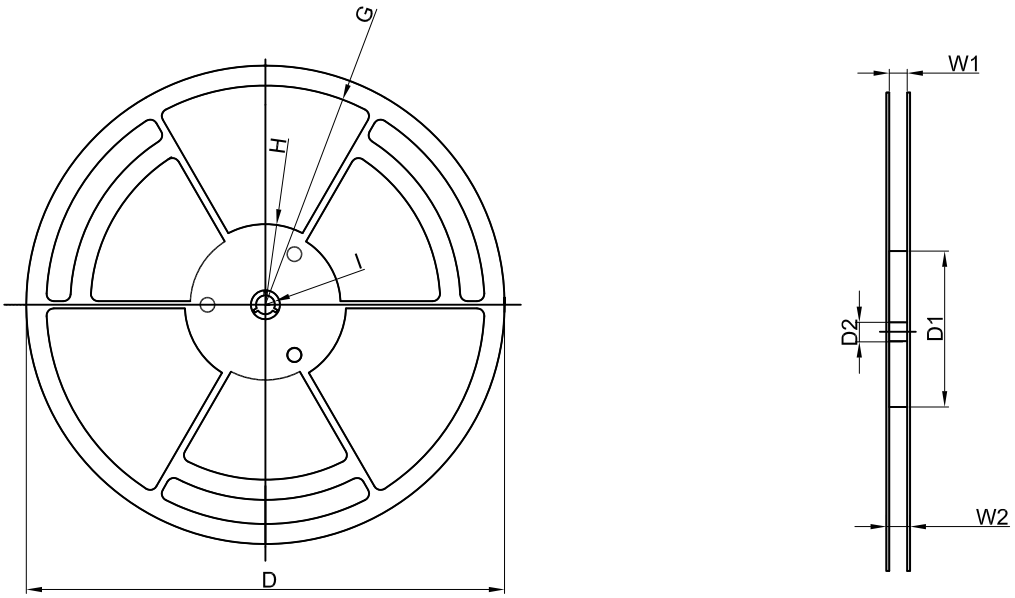
ALL DIM IN mm

Dimensions are in millimeter										
Pkg type	a	B	C	d	E	F	P0	P	P1	W
SOP8	6.40	5.40	2.10	Ø1.50	1.75	5.50	4.00	8.00	2.00	12.00

Tape Leader and Trailer



Reel



Dimensions are in millimeter								
Reel Option	D	D1	D2	G	H	I	W1	W2
13"Dia	Ø330.00	100.00	13.00	R151.00	R56.00	R6.50	12.40	17.60

REEL	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)	G.W.(kg)
4,000 pcs	13 inch	8,000 pcs	360×360×65	64,000 pcs	565×380×390	

12 Notes and Revision History

12.1 Associated Product Family and Others

To view other products of the same type or IC products of other types, click the official website of JSCJ -- https: ***www.jscj-elec.com*** for more details.

12.2 Notes

Electrostatic Discharge Caution

This IC may be damaged by ESD. Relevant personnel shall comply with correct installation and use specifications to avoid ESD damage to the IC. If appropriate measures are not taken to prevent ESD damage, the hazards caused by ESD include but are not limited to degradation of integrated circuit performance or complete damage of integrated circuit. For some precision integrated circuits, a very small parameter change may cause the whole device to be inconsistent with its published specifications.

12.3 Revision History

December 2024: released LM2901 and LM2903 rev - 1.0.

DISCLAIMER

IMPORTANT NOTICE, PLEASE READ CAREFULLY

The information in this data sheet is intended to describe the operation and characteristics of our products. JSCJ has the right to make any modification, enhancement, improvement, correction or other changes to any content in this data sheet, including but not limited to specification parameters, circuit design and application information, without prior notice.

Any person who purchases or uses JSCJ products for design shall: 1. Select products suitable for circuit application and design; 2. Design, verify and test the rationality of circuit design; 3. Procedures to ensure that the design complies with relevant laws and regulations and the requirements of such laws and regulations. JSCJ makes no warranty or representation as to the accuracy or completeness of the information contained in this data sheet and assumes no responsibility for the application or use of any of the products described in this data sheet.

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