# AUTOMOTIVE COMPLIANT DUAL AND QUAD DIFFERENTIAL COMPARATORS

## Description

The LM2901Q/2903Q series comparators consist of four and two independent precision voltage comparators with very low input offset voltage specification. 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.

The LM2901Q/2903Q series comparators are designed to directly interface with TTL and CMOS.

The LM2903Q dual devices are available in SO-8, MSOP-8 and TSSOP-8; and the LM2901Q quad devices are available in SO-14 and TSSOP-14 - all are in industry-standard pinouts.

All use “green” mold compound and are qualified to AEC-Q100 Grade 1 and are Automotive Compliant supporting PPAPs.

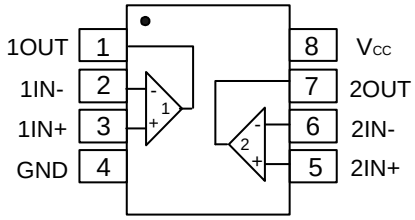
## Features

- Wide Power Supply Range:
  - Single Supply: 2V to 36V
  - Dual Supplies: ±1.0V to ±18V
- Very Low Supply Current Drain – Independent of Supply Voltage
  - LM2903Q: 0.6mA
  - LM2901Q: 0.9mA
- Low Input Bias Current: 25nA
- Low Input Offset Current: ±5nA
- Typical Offset Voltage:
  - Non-A Device: 2mV
  - A Device: 1mV
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to the Power Supply Voltage
- Low Output Saturation Voltage:
  - LM2903Q: 200mV at 4mA
  - LM2901Q: 100mV at 4mA
- Output Voltage Compatible with TTL, MOS and CMOS
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**
- **Qualified to AEC-Q100 Grade 1**
- **PPAP Capable (Note 4)**

## Pin Assignments

LM2903Q/ LM2903AQ

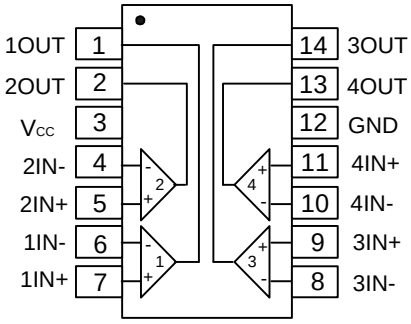
**(Top View)**




**SO-8/TSSOP-8/MSOP-8**

LM2901Q/ LM2901AQ

**(Top View)**




**SO-14/TSSOP-14**

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Automotive products are AEC-Q100 qualified and are PPAP capable. Refer http://www.diodes.com/quality/product_compliance_definitions/.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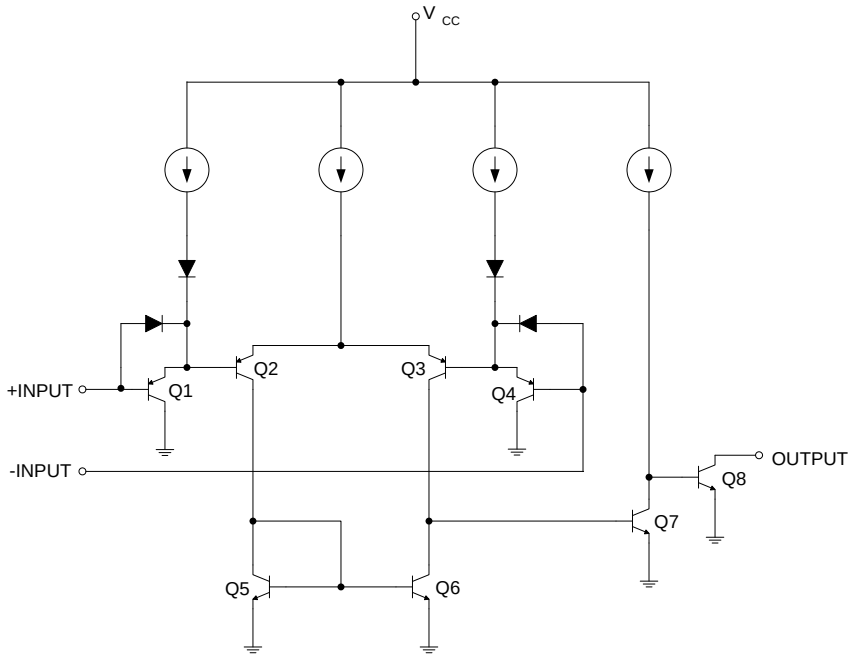
## Schematic Diagram




**Functional Block Diagram of LM2901Q/2901AQ/2903Q/2903AQ (Each Comparator)**

## Pin Descriptions

| **LM2901Q, LM2901AQ** | | |
|---|---|---|
| **Pin Name** | **Pin #** | **Function** |
| 1OUT | 1 | Channel 1 Output |
| 2OUT | 2 | Channel 2 Output |
| $V_{CC}$ | 3 | Chip Supply Voltage |
| 2IN- | 4 | Channel 2 Inverting Input |
| 2IN+ | 5 | Channel 2 Non-Inverting Input |
| 1IN- | 6 | Channel 1 Inverting Input |
| 1IN+ | 7 | Channel 1 Non-Inverting Input |
| 3IN- | 8 | Channel 3 Inverting Input |
| 3IN+ | 9 | Channel 3 Non-Inverting Input |
| 4IN- | 10 | Channel 4 Inverting Input |
| 4IN+ | 11 | Channel 4 Non-Inverting Input |
| GND | 12 | Ground |
| 4OUT | 13 | Channel 4 Output |
| 3OUT | 14 | Channel 3 Output |
| **LM2903Q, LM2903AQ** | | |
| 1OUT | 1 | Channel 1 Output |
| 1IN- | 2 | Channel 1 Inverting Input |
| 1IN+ | 3 | Channel 1 Non-inverting Input |
| GND | 4 | Ground |
| 2IN+ | 5 | Channel 2 Non-Inverting Input |
| 2IN- | 6 | Channel 2 Inverting Input |
| 2OUT | 7 | Channel 2 Output |
| $V_{CC}$ | 8 | Chip Supply Voltage |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## Absolute Maximum Ratings (Note 5) (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 36 | V |
| $V_{ID}$ | Differential Input Voltage | | 36 | V |
| $V_{IN}$ | Input Voltage | | -0.3 to +36 | V |
| $I_{IN}$ | Input Current ($V_{IN}$ < -0.3V) | | 50 | mA |
| $V_O$ | Output Voltage | | 36 | V |
| $I_O$ | Output Current | | 20 | mA |
| — | Duration of Output Short Circuit to Ground (Note 6) | | Unlimited | — |
| $\theta_{JA}$ | Package Thermal Impedance (Note 7) | LM2903_QS-13 | 150 | °C/W |
| | | LM2903_QTH-13 | 175 | |
| | | LM2903_QM8-13 | 200 | |
| | | LM2901_QS14 | 89 | |
| | | LM2901_QT14 | 100 | |
| $T_A$ | Operating Temperature Range | | -40 to +125 | °C |
| $T_J$ | Operating Junction Temperature | | +150 | °C |
| $T_{ST}$ | Storage Temperature Range | | -65 to +150 | °C |
| $T_{LEAD}$ | Lead Temperature (Soldering, 10 seconds) | | +260 | °C |

Notes: 5. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6. Short circuits from outputs to $V_{CC}$ can cause excessive heating and eventual destruction.

7. Maximum power dissipation is a function of $T_{J(MAX)}$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(MAX)} - T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of +150°C can affect reliability.

## ESD Ratings

| | | | |
|---|---|---|---|
| Human Body Mode ESD Protection (Note 8) | LM2901_QS14 | 500 | V |
| | LM2901_QT14 | 500 | |
| | LM2903_QS-13 | 500 | |
| | LM2903_QTH-13 | 500 | |
| | LM2903_QM8-13 | <500 | |
| Charge Device Mode ESD Protection | LM2901_QS14 | 1,000 | |
| | LM2901_QT14 | | |
| | LM2903_QS-13 | | |
| | LM2903_QTH-13 | | |
| | LM2903_QM8-13 | | |

Note: 8. Human body model, 1.5kΩ in series with 100pF.

## Recommended Operating Conditions (Over Operating Free-Air Temperature Range, unless otherwise noted.)

| Parameter | | Min | Max | Units |
|---|---|---|---|---|
| Supply Voltage | Single Supply | 2 | 36 | V |
| | Dual Supply | ±1 | ±18 | |
| Ambient Temperature Range | | -40 | +125 | °C |
| Junction Temperature Range | | -40 | +125 | |


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## Electrical Characteristics (Notes 9 & 10) (@$V_{CC}$ = 5.0V, GND = 0V, $T_A$ = +25°C, unless otherwise specified.)

**LM2901Q, LM2901AQ**

| Parameter | | Conditions | | $T_A$ | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input Offset Voltage | $V_{IC}$ = $V_{CMR}$ Min, $V_O$ = 1.4V, $V_{CC}$ = 5V to 30V (Note 11) | Non-A Device | $T_A$ = +25°C | — | 2 | 7 | mV |
| | | | | Full Range | — | — | 15 | |
| | | | A-Suffix Device | $T_A$ = +25°C | — | 1 | 2 | |
| | | | | Full Range | — | — | 4 | |
| $I_B$ | Input Bias Current | $I_{IN+}$ or $I_{IN-}$ with OUT in Linear Range, $V_{CM}$ = 0V (Note 12) | | $T_A$ = +25°C | — | 25 | 250 | nA |
| | | | | Full Range | — | — | 500 | |
| $I_{IO}$ | Input Offset Current | $I_{IN+}$ - $I_{IN-}$, $V_{CM}$ = 0V | | $T_A$ = +25°C | — | 5 | 50 | nA |
| | | | | Full Range | — | — | 200 | |
| $V_{CMR}$ | Input Common-Mode Voltage Range | $V_{CC}$ = 30V (Note 13) | | $T_A$ = +25°C | 0 to $V_{CC}$ -1.5 | — | — | V |
| | | | | Full Range | 0 to $V_{CC}$ -2 | — | — | |
| $I_{CC}$ | Supply Current (Four Comparators) | $R_L$ = ∞ on Quad Channels | $V_{CC}$ = 30V | $T_A$ = +25°C | — | 1.2 | 2.5 | mA |
| | | | | Full range | — | — | 3.5 | |
| | | | $V_{CC}$ = 5V | $T_A$ = +25°C | — | 0.9 | 2 | |
| | | | | Full Range | — | — | 3.0 | |
| $A_V$ | Voltage Gain | $V_{CC}$ = 15V, $V_{OUT}$ = 1V to 11V, $R_L$ ≥ 15kΩ, | | $T_A$ = +25°C | 50 | 200 | — | V/mV |
| — | Large Signal Response Time | $V_{IN}$ = TTL Logic Swing, $V_{REF}$ = 1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1kΩ | | $T_A$ = +25°C | — | 300 | — | ns |
| — | Response Time | $V_{RL}$ = 5V, $R_L$ = 5.1kΩ (Note 14) | | $T_A$ = +25°C | — | 1.3 | — | µs |
| $I_{O(SINK)}$ | Output Sink Current | $V_{IN-}$ = 1V, $V_{IN+}$ = 0, $V_O$ ≤ 1.5V | | $T_A$ = +25°C | 6 | 16 | — | mA |
| $V_{SAT}$ | Saturation Voltage | $V_{IN-}$ = 1V, $V_{IN+}$ = 0, $I_{SINK}$ ≤ 4mA | | $T_A$ = +25°C | — | 100 | 400 | mV |
| | | | | Full Range | — | — | 700 | |
| $I_{O(LEAK)}$ | Output Leakage Current | $V_{IN-}$ = 0V, $V_{IN+}$ = 1, $V_O$ = 5V | | $T_A$ = +25°C | — | 0.1 | — | nA |
| | | $V_{IN-}$ = 0V, $V_{IN+}$ = 1, $V_O$ = 30V | | Full Range | — | — | 1 | µA |
| $V_{ID}$ | Differential Input Voltage | All $V_{IN}$ ≥0V (or V- if used) (Note 15) | | Full Range | — | — | 36 | V |

Notes:
9. 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. The typical values are not tested and are not guaranteed on shipped production material.
10. All limits are guaranteed by testing or statistical analysis. Limits over the full temperature (-40 ≤ $T_A$ ≤ +125°C) are guaranteed by design, but not tested in production.
11. $V_O$ ≅ 1.4V, $R_S$ = 0Ω with $V_{CC}$ from 5V to 30V.
12. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
13. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V (@ +25°C). The upper end of the common-mode voltage range is $V_{CC}$ -1.5V (@ +25°C), but either or both inputs can go to +36V without damage, independent of the magnitude of $V_{CC}$.
14. The response time specified is for a 100mV step input with 5mV overdrive. For larger overdrive signals 300ns can be obtained, see typical performance characteristics.
15. Positive excursions of input voltage may exceed the power supply level. As long as other voltages remain within the common mode range, the comparator will provide a proper output stage. The low voltage state must not be less than -0.3V (or 0.3V below the magnitude of the negative power supply, if used).


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## Electrical Characteristics (continued) (Notes 9 & 10) (@$V_{CC}$ = 5.0V, GND = 0V, $T_A$ = +25°C, unless otherwise specified.)

**LM2903Q, LM2903AQ**

| Parameter | | Conditions | | $T_A$ | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input Offset Voltage | $V_{IC}$ = $V_{CMR}$ Min, $V_O$ = 1.4V, $V_{CC}$ = 5V to =30V (Note 11) | Non-A Device | $T_A$ = +25°C | — | 2 | 7 | mV |
| | | | | Full Range | — | — | 15 | |
| | | | A-Suffix Device | $T_A$ = +25°C | — | 1 | 2 | |
| | | | | Full Range | — | — | 4 | |
| $I_B$ | Input Bias Current | $I_{IN+}$ or $I_{IN-}$ with OUT in Linear Range, $V_{CM}$ = 0V (Note 12) | | $T_A$ = +25°C | — | 25 | 250 | nA |
| | | | | Full Range | — | — | 500 | |
| $I_{IO}$ | Input Offset Current | $I_{IN+}$ - $I_{IN-}$, $V_{CM}$ = 0V | | $T_A$ = +25°C | — | 5 | 50 | nA |
| | | | | Full Range | — | — | 200 | |
| $V_{CMR}$ | Input Common-Mode Voltage Range | $V_{CC}$= 30V (Note 13) | | $T_A$ = +25°C | 0 to $V_{CC}$ -1.5 | — | — | V |
| | | | | Full Range | 0 to $V_{CC}$-2 | — | — | |
| $I_{CC}$ | Supply Current | $R_L$ = ∞ on Both Channels | $V_{CC}$= 30V | $T_A$ = +25°C | — | 0.7 | 1.7 | mA |
| | | | | Full Range | — | — | 3.0 | |
| | | | $V_{CC}$ = 5V | $T_A$ = +25°C | — | 0.6 | 1 | |
| | | | | Full Range | — | — | 2.0 | |
| $A_V$ | Voltage Gain | $V_{CC}$ = 15V, $V_{OUT}$ = 1V to 11V, $R_L$ ≥ 15kΩ, | | $T_A$ = +25°C | 50 | 200 | — | V/mV |
| — | Large Signal Response Time | $V_{IN}$ = TTL Logic Swing, $V_{REF}$ = 1.4V, $V_{RL}$ = 5V, $R_L$ = 5.1kΩ | | $T_A$ = +25°C | — | 300 | — | ns |
| — | Response Time | $V_{RL}$ = 5V, $R_L$ = 5.1kΩ (Note 14) | | $T_A$ = +25°C | — | 1.3 | — | µs |
| $I_{O(SINK)}$ | Output Sink Current | $V_{IN-}$ = 1V, $V_{IN+}$ = 0, $V_O$ ≤ 1.5V | | $T_A$ = +25°C | 6 | 16 | — | mA |
| $V_{SAT}$ | Saturation Voltage | $V_{IN-}$ = 1V, $V_{IN+}$ = 0, $I_{SINK}$ ≤ 4mA | | $T_A$ = +25°C | — | 200 | 400 | mV |
| | | | | Full Range | — | — | 700 | |
| $I_{O(LEAK)}$ | Output Leakage Current | $V_{IN-}$ = 0V, $V_{IN+}$ = 1, $V_O$ = 5V | | $T_A$ = +25°C | — | 0.1 | — | nA |
| | | $V_{IN-}$ = 0V, $V_{IN+}$ = 1, $V_O$ = 30V | | Full Range | — | — | 1 | µA |
| $V_{ID}$ | Differential Input Voltage | All $V_{IN}$ ≥0V (or V- if used) (Note 15) | | Full Range | — | — | 36 | V |

Notes:
9. 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. The typical values are not tested and are not guaranteed on shipped production material
10. All limits are guaranteed by testing or statistical analysis. Limits over the full temperature (-40 ⩽ $T_A$ ⩽ +125°C) are guaranteed by design, but not tested in production.
11. $V_O$ ≅ 1.4V, $R_S$ = 0Ω with $V_{CC}$ from 5V to 30V.
12. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
13. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V (@ +25°C). The upper end of the common-mode voltage range is $V_{CC}$ -1.5V (@ +25°C), but either or both inputs can go to +36V without damage, independent of the magnitude of $V_{CC}$.
14. The response time specified is for a 100mV step input with 5mV overdrive. For larger overdrive signals 300ns can be obtained, see typical performance characteristics.
15. Positive excursions of input voltage may exceed the power supply level. As long as other voltages remain within the common-mode range, the comparator will provide a proper output stage. The low voltage state must not be less than -0.3V (or 0.3V below the magnitude of the negative power supply, if used).


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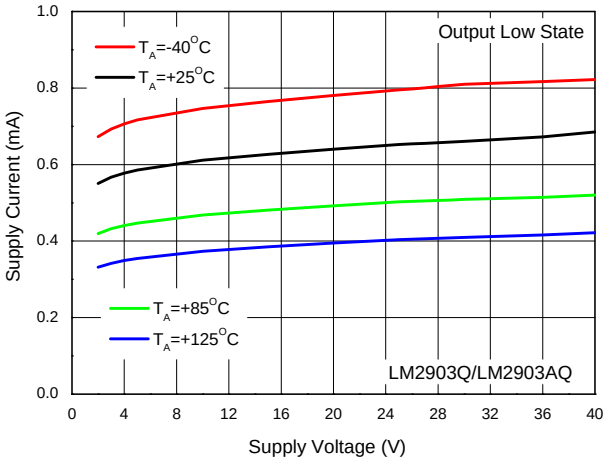
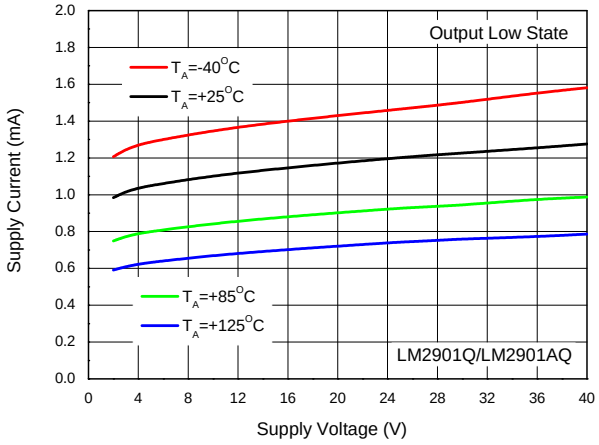
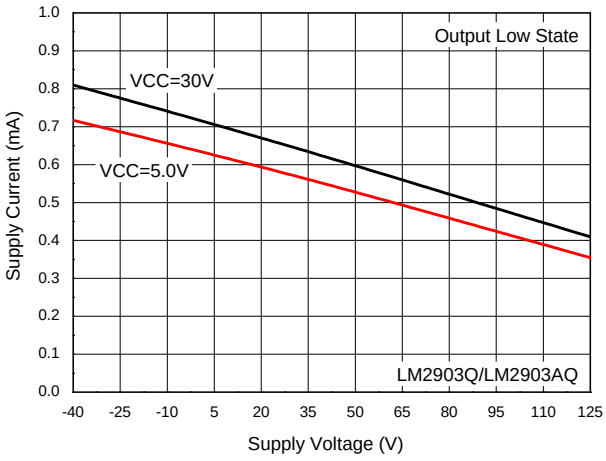
## Performance Characteristics



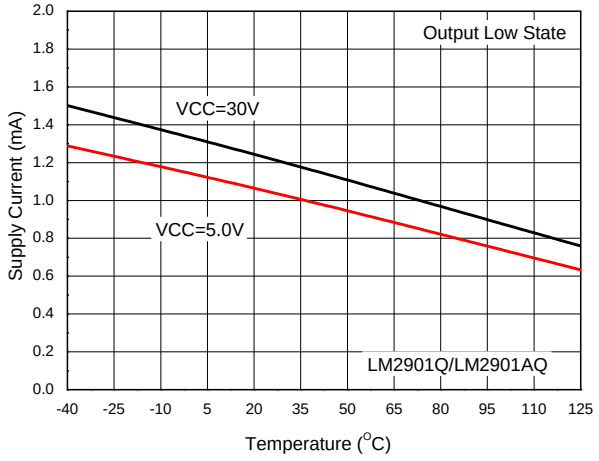

Supply Current vs. Supply Voltage



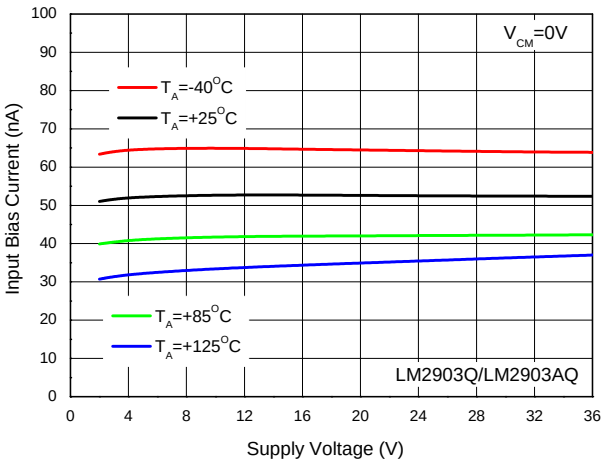

Supply Current vs. Supply Voltage



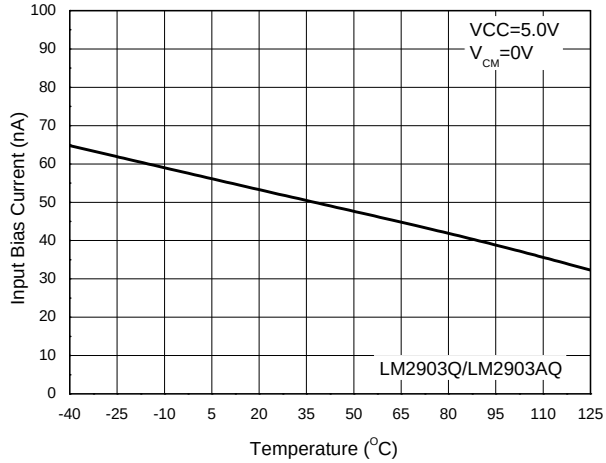

Supply Current vs. Temperature




Supply Current vs. Temperature




Input Bias Current vs. Supply Voltage




Input Bias Current vs. Temperature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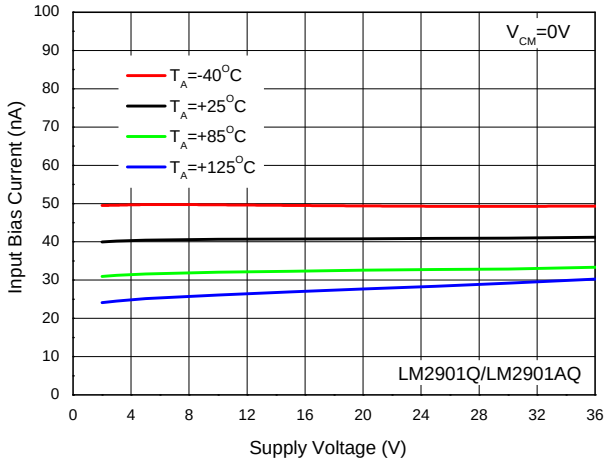
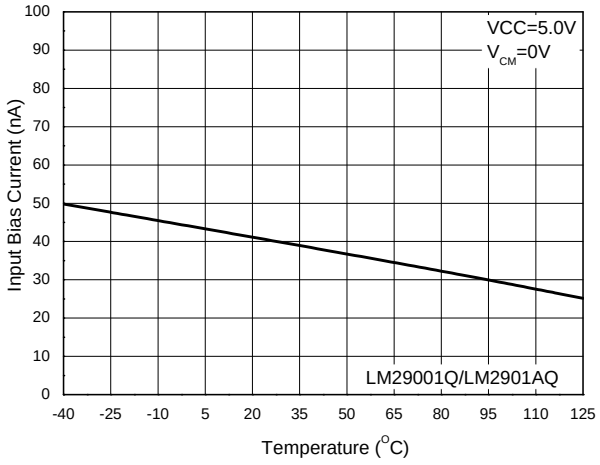
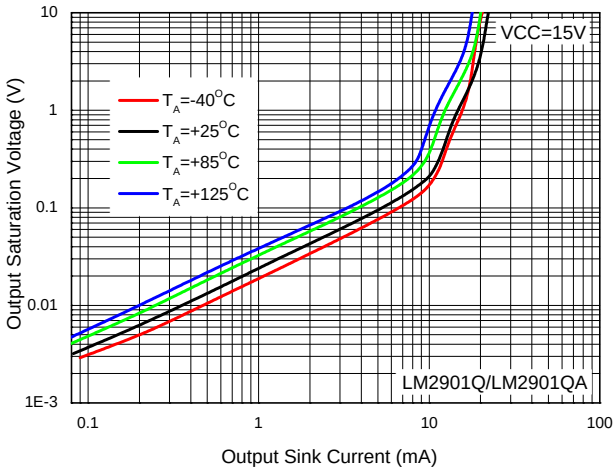
## Performance Characteristics (continued)



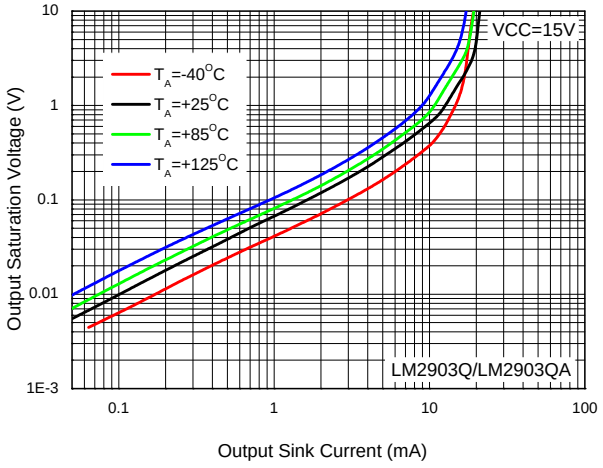

Input Bias Current vs. Supply Voltage



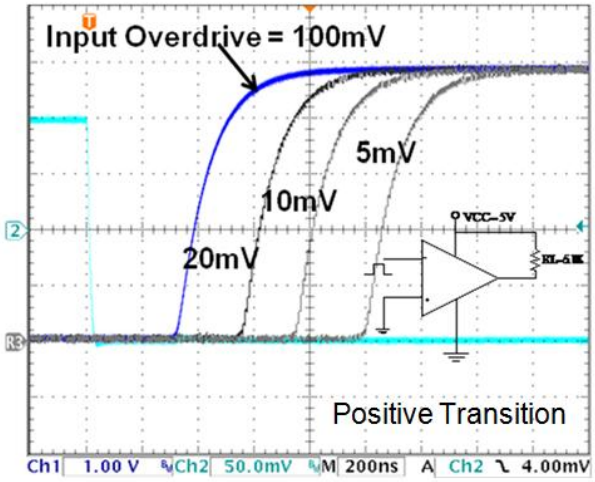

Input Bias Current vs. Temperature



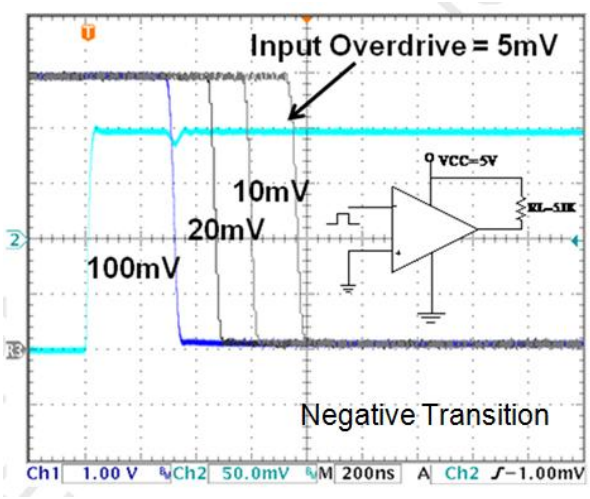

Output Saturation Voltage vs. Sink Current




Output Saturation Voltage vs. Sink Current




Response Time for Various Input Overdrive




Response Time for Various Input Overdrive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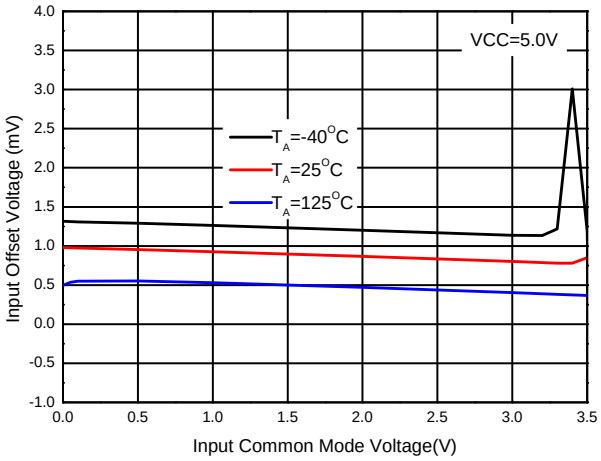
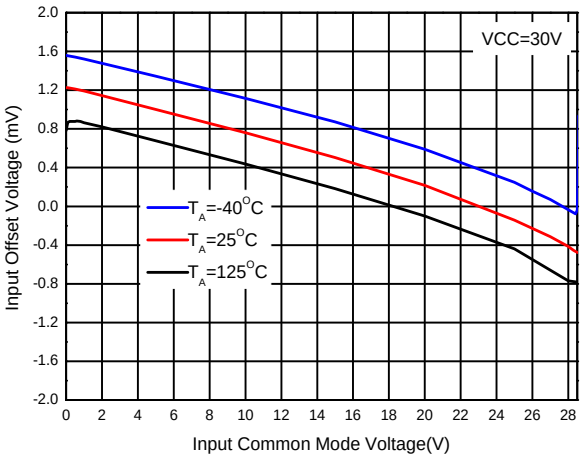
## Performance Characteristics (continued)




Input Offset Voltage vs. Input Common-Mode Voltage




Input Offset Voltage vs. Input Common-Mode Voltage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## Application Information

### General Information

The LM2901Q/2903Q series comparators are high-gain, wide-bandwidth devices, and like most comparators, can easily oscillate if the output lead is inadvertently allowed to capacitive couple to the inputs via stray capacitance. This shows up only during the output voltage transition intervals as the comparator changes states. Standard PC board layout is helpful as it reduces stray input-output coupling. Reducing the input resistors to <10kΩ reduces the feedback signal levels and finally, adding even a small amount (1.0 to 10mV) of positive feedback (hysteresis) causes such a rapid transition that oscillations due to stray feedback are not possible. Simply socketing the IC and attaching resistors to the pins will cause input-output oscillations during the small transition intervals unless hysteresis is used. If the input signal is a pulse waveform, with relatively fast rise and fall times, hysteresis is not required. All input pins of any unused comparators should be tied to the negative supply.

The bias network of the LM2901Q/2903Q series comparators establishes a quiescent current independent of the magnitude of the power supply voltage over the range of from 2.0 $V_{DC}$ to 30 $V_{DC}$.

The differential input voltage may be larger than $V_{CC}$ without damaging the device. Protection should be provided to prevent the input voltages from becoming negative more than -0.3 $V_{DC}$ (@ +25°C). An input clamp diode can be used as shown in the applications section.

The output of the LM2901Q/2903Q series comparators is the uncommitted collector of a grounded-emitter NPN output transistor. Many collectors can be tied together to provide an output OR'ing function. An output pull-up resistor can be connected to any available power supply voltage within the permitted supply voltage range and there is no restriction on this voltage due to the magnitude of the voltage applied to the $V_{CC}$ terminal of LM2901/2903 series comparator package. The output can also be used as a simple SPST switch to ground (when a pull-up resistor is not used).

The amount of current the output device can sink is limited by the drive available (which is independent of $V_{CC}$) and the β of this device. When the maximum current limit is reached (approximately 16mA), the output transistor will come out of saturation and the output voltage will rise very rapidly. The output saturation voltage is limited by the approximately 60Ω $R_{SAT}$ of the output transistor. The low offset voltage of the output transistor (1.0mV) allows the output to clamp essentially to ground level for small load currents.


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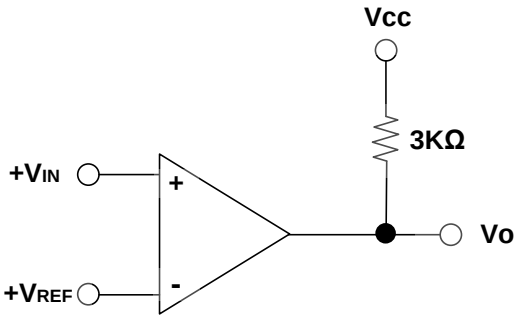
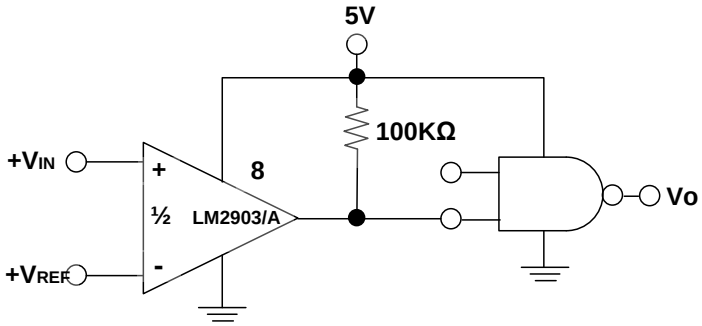
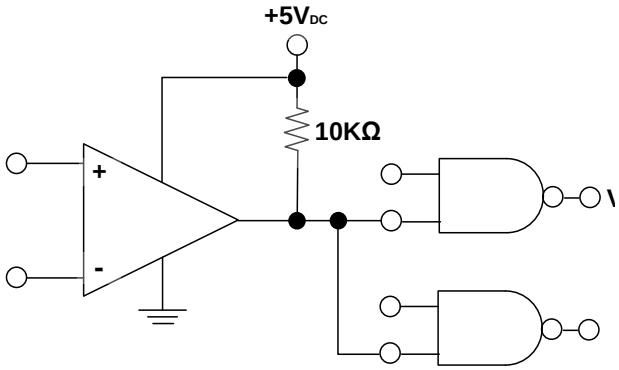
## Typical Application Circuit ($V_{CC}$ = 5.0 $V_{DC}$)



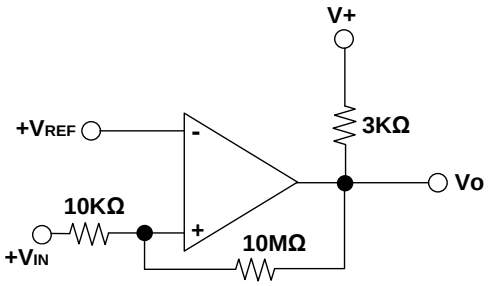

Basic Comparator



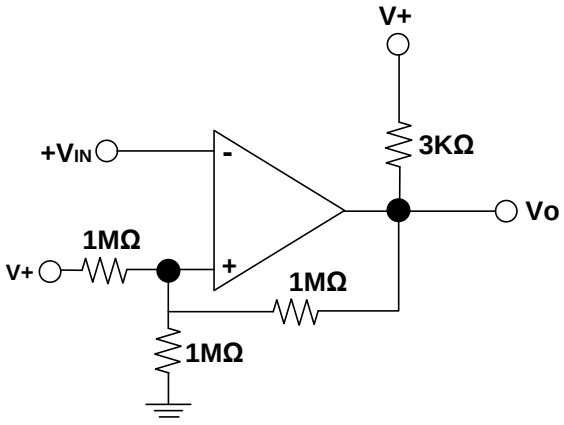

Driving CMOS



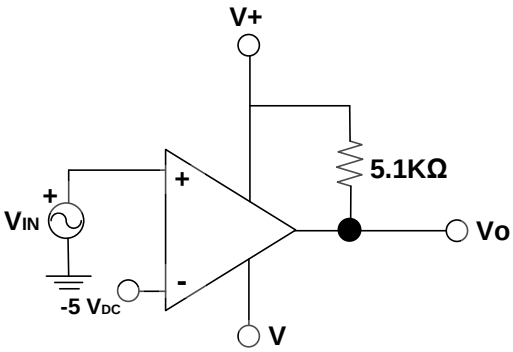

Driving TTL




Non-Inverting Comparator with Hysteresis




Inverting Comparator with Hysteresis




Comparator with a Negative Reference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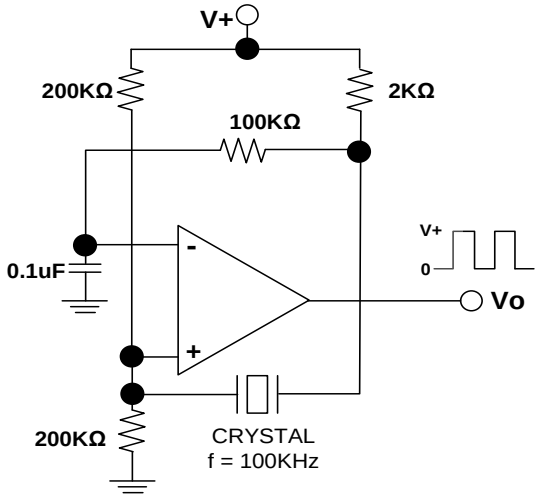
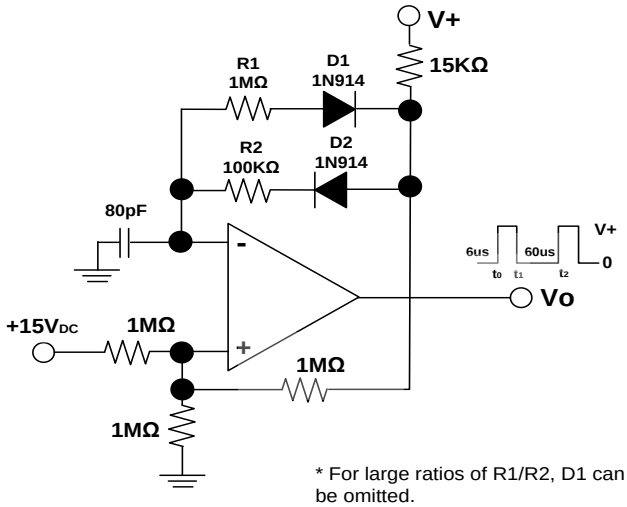
## Typical Application Circuit (continued) ($V_{CC}$ = 5.0 $V_{DC}$)

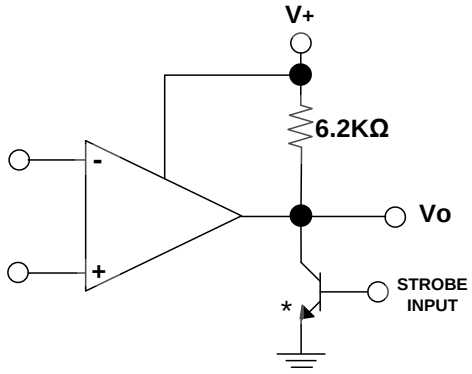



Crystal Controlled Oscillator



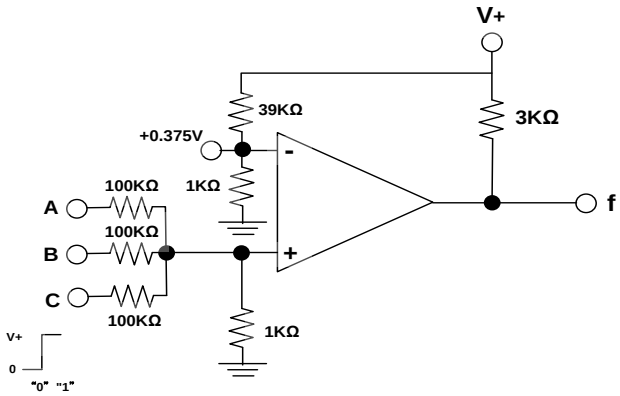

* For large ratios of R1/R2, D1 can be omitted.

Pulse Generator

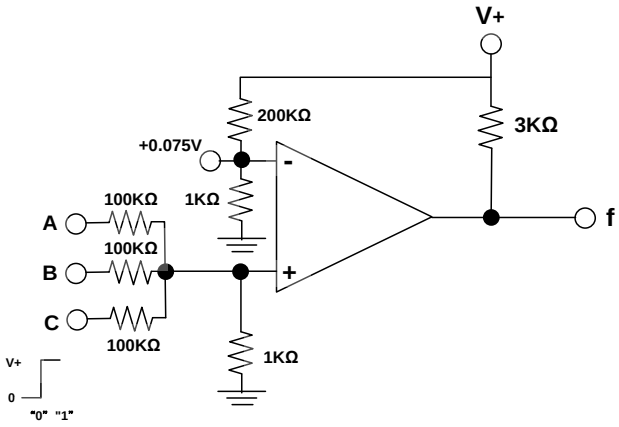



*Or logic gate without pull-up resistor

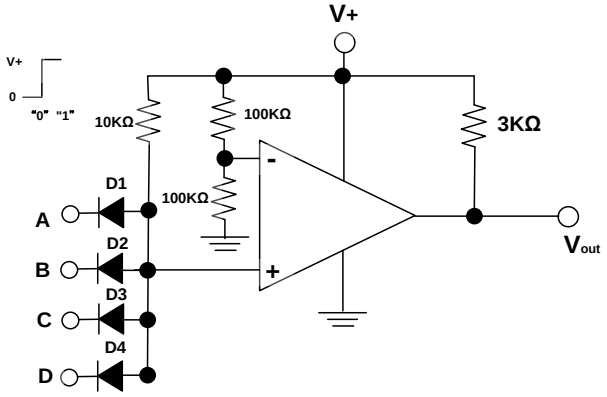
Output Strobing




AND Gate




OR Gate




Large Fan-in AND Gate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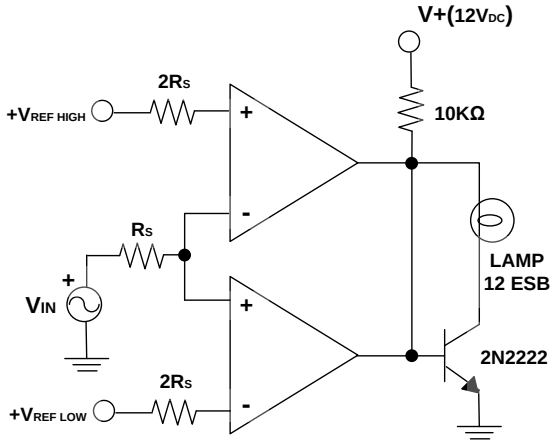
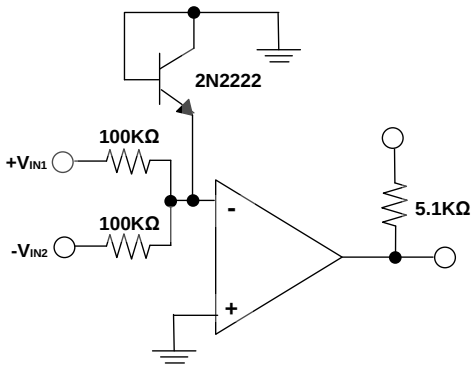
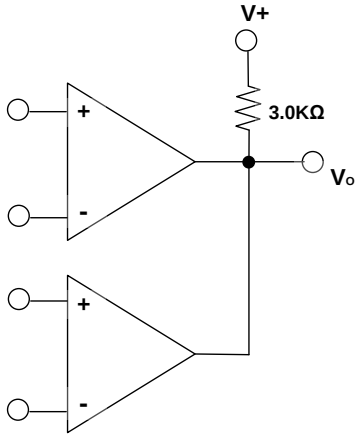
## Typical Application Circuit (cont.) ($V_{CC}$ = 5.0 $V_{DC}$)



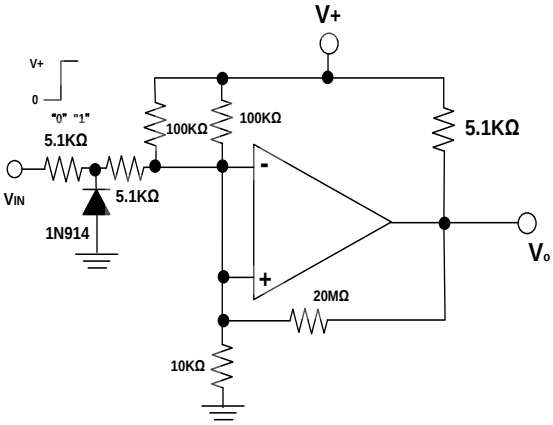

Limit Comparator



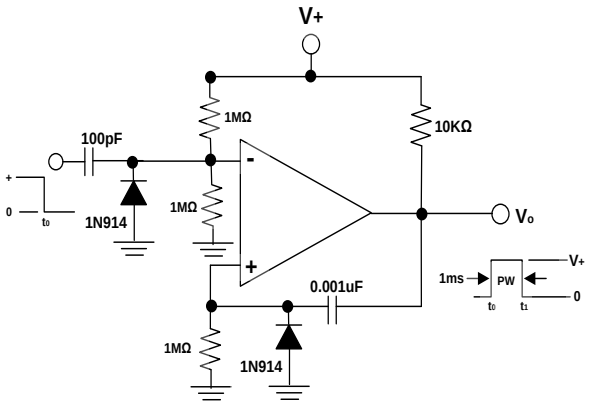

Comparing Input Voltage of
Opposite Polarity



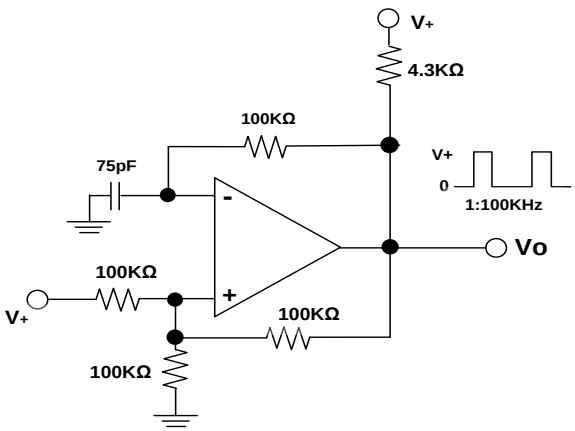

ORing the Outputs




Zero Crossing Detector
(Single Power Supply)




One-Shot Multivibrator




Squarewave Oscillator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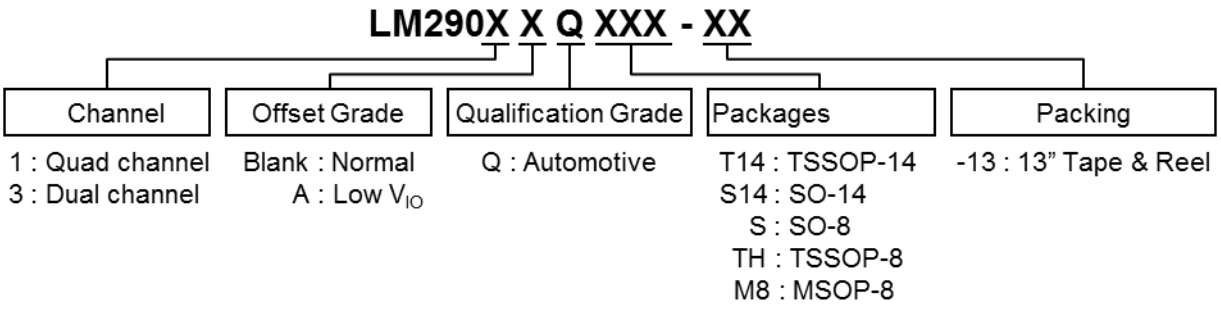
## Ordering Information




| Part Number | Package Code | Packaging (Note 16) | 13" Tape and Reel | | Qualification Grade (Note 17) |
|---|---|---|---|---|---|
| | | | Quantity | Part Number Suffix | |
| LM2901QT14-13 | T14 | TSSOP-14 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2901AQT14-13 | T14 | TSSOP-14 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2901QS14-13 | S14 | SO-14 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2901AQS14-13 | S14 | SO-14 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903QS-13 | S | SO-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903AQS-13 | S | SO-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903QTH-13 | TH | TSSOP-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903AQTH-13 | TH | TSSOP-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903QM8-13 | M8 | MSOP-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |
| LM2903AQM8-13 | M8 | MSOP-8 | 2,500/Tape & Reel | -13 | Automotive Compliant |

Notes: 16. For packaging details, go to our website at http://www.diodes.com/products/packages.html.
17. LM2901Q/2903Q have been qualified to AEC-Q100 grade 1 and are classified as "Automotive Compliant" which supports PPAP documentation. See LM2901/2903 datasheet for commercial qualified versions.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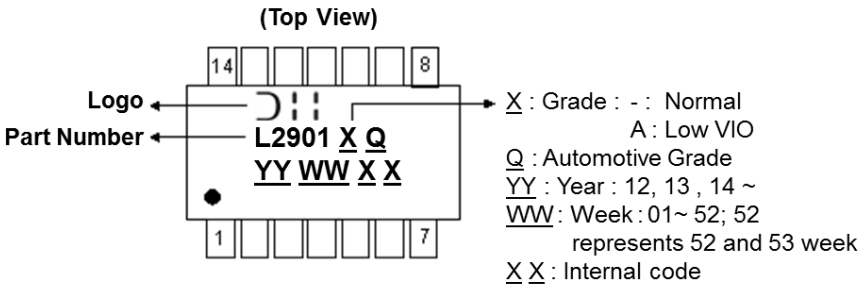
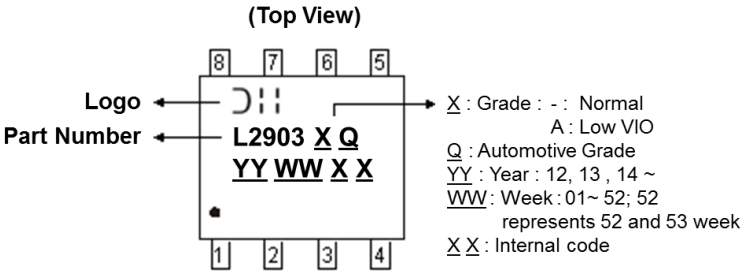
## Marking Information

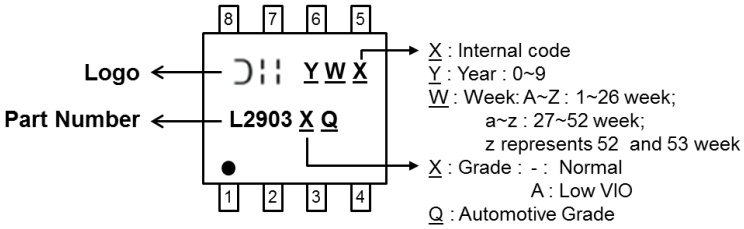
**(1) TSSOP-14 and SO-14**




**(2) SO-8**




**(3) MSOP-8 and TSSOP-8**





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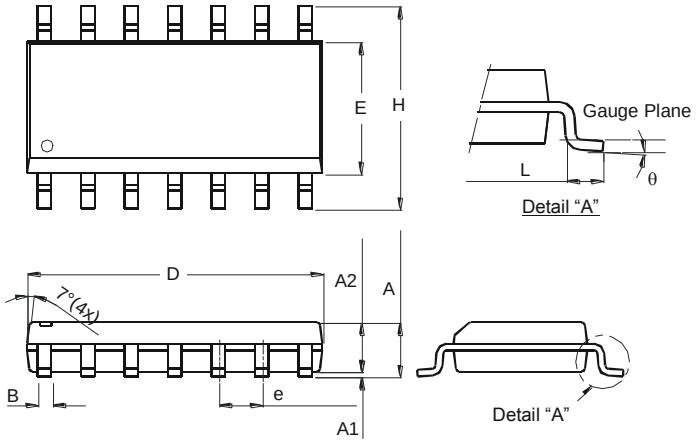
## Package Outline Dimensions

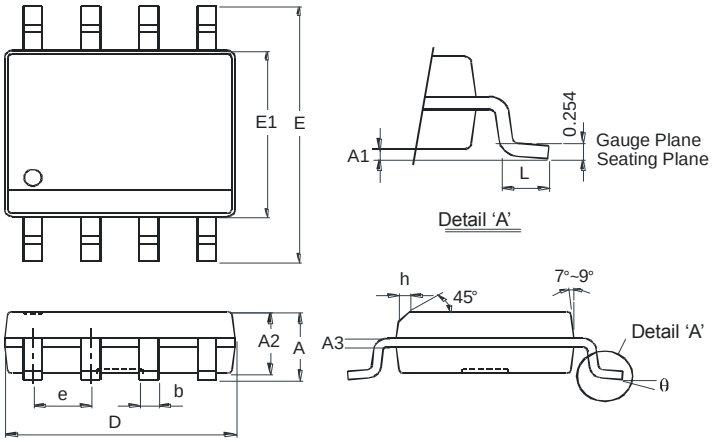
Please see http://www.diodes.com/package-outlines.html for the latest version.

**SO-14**




| SO-14 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | 1.47 | 1.73 |
| **A1** | 0.10 | 0.25 |
| **A2** | 1.45 Typ | |
| **B** | 0.33 | 0.51 |
| **D** | 8.53 | 8.74 |
| **E** | 3.80 | 3.99 |
| **e** | 1.27 Typ | |
| **H** | 5.80 | 6.20 |
| **L** | 0.38 | 1.27 |
| **θ** | 0° | 8° |
| **All Dimensions in mm** | | |

**SO-8**




| SO-8 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | — | 1.75 |
| **A1** | 0.10 | 0.20 |
| **A2** | 1.30 | 1.50 |
| **A3** | 0.15 | 0.25 |
| **b** | 0.3 | 0.5 |
| **D** | 4.85 | 4.95 |
| **E** | 5.90 | 6.10 |
| **E1** | 3.85 | 3.95 |
| **e** | 1.27 Typ | |
| **h** | — | 0.35 |
| **L** | 0.62 | 0.82 |
| **θ** | 0° | 8° |
| **All Dimensions in mm** | | |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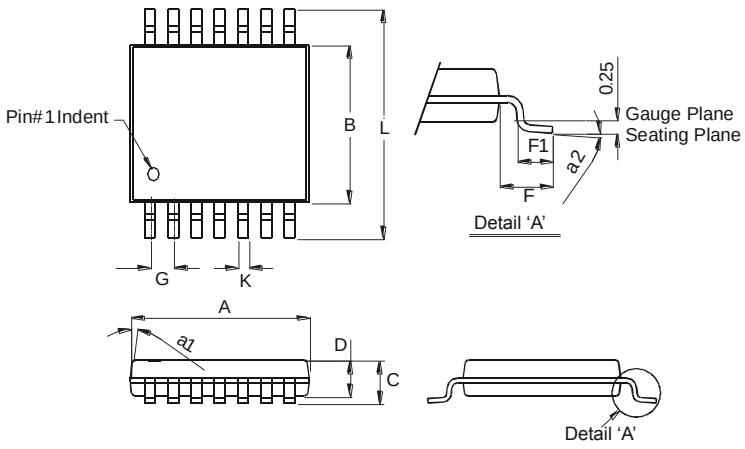
## Package Outline Dimensions (Continued)

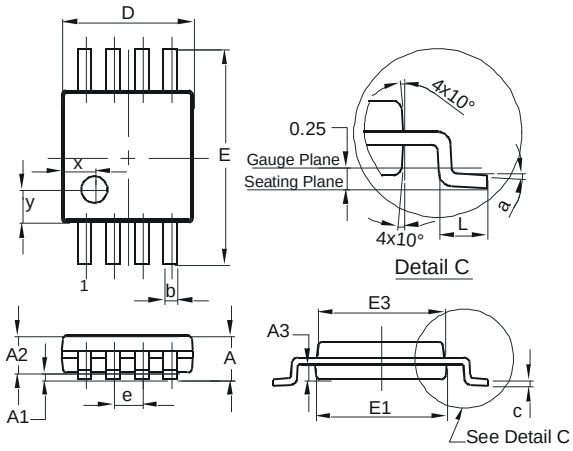
Please see http://www.diodes.com/package-outlines.html for the latest version.

**TSSOP-14**



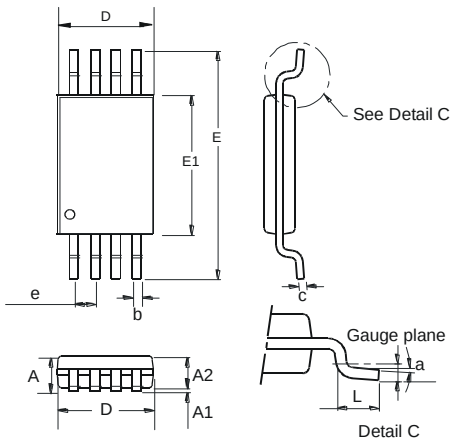

| TSSOP-14 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **a1** | 7° (4X) | |
| **a2** | 0° | 8° |
| **A** | 4.9 | 5.10 |
| **B** | 4.30 | 4.50 |
| **C** | — | 1.2 |
| **D** | 0.8 | 1.05 |
| **F** | 1.00 Typ | |
| **F1** | 0.45 | 0.75 |
| **G** | 0.65 Typ | |
| **K** | 0.19 | 0.30 |
| **L** | 6.40 Typ | |
| **All Dimensions in mm** | | |

**MSOP-8**




| MSOP-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | — | 1.10 | — |
| **A1** | 0.05 | 0.15 | 0.10 |
| **A2** | 0.75 | 0.95 | 0.86 |
| **A3** | 0.29 | 0.49 | 0.39 |
| **b** | 0.22 | 0.38 | 0.30 |
| **c** | 0.08 | 0.23 | 0.15 |
| **D** | 2.90 | 3.10 | 3.00 |
| **E** | 4.70 | 5.10 | 4.90 |
| **E1** | 2.90 | 3.10 | 3.00 |
| **E3** | 2.85 | 3.05 | 2.95 |
| **e** | — | — | 0.65 |
| **L** | 0.40 | 0.80 | 0.60 |
| **a** | 0° | 8° | 4° |
| **x** | — | — | 0.750 |
| **y** | — | — | 0.750 |
| **All Dimensions in mm** | | | |

**TSSOP-8**




| TSSOP-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **a** | 0.09 | — | — |
| **A** | — | 1.20 | — |
| **A1** | 0.05 | 0.15 | — |
| **A2** | 0.825 | 1.025 | 0.925 |
| **b** | 0.19 | 0.30 | — |
| **c** | 0.09 | 0.20 | — |
| **D** | 2.90 | 3.10 | 3.025 |
| **e** | — | — | 0.65 |
| **E** | — | — | 6.40 |
| **E1** | 4.30 | 4.50 | 4.425 |
| **L** | 0.45 | 0.75 | 0.60 |
| **All Dimensions in mm** | | | |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## Suggested Pad Layout

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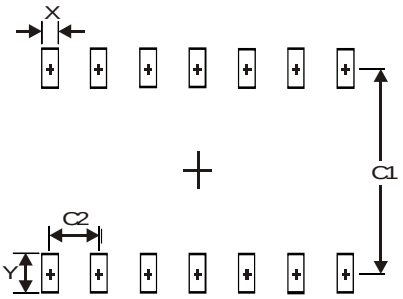
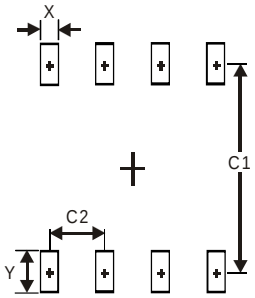
**SO-14**



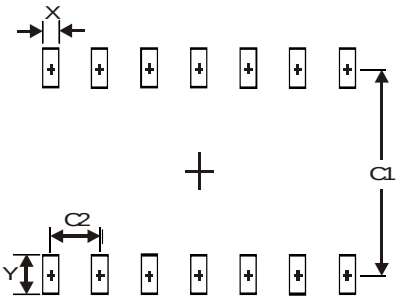

| Dimensions | Value (in mm) |
|---|---|
| X | 0.60 |
| Y | 1.50 |
| C1 | 5.4 |
| C2 | 1.27 |

**SO-8**




| Dimensions | Value (in mm) |
|---|---|
| X | 0.60 |
| Y | 1.55 |
| C1 | 5.4 |
| C2 | 1.27 |

**TSSOP-14**




| Dimensions | Value (in mm) |
|---|---|
| X | 0.45 |
| Y | 1.45 |
| C1 | 5.9 |
| C2 | 0.65 |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## Suggested Pad Layout (Continued)

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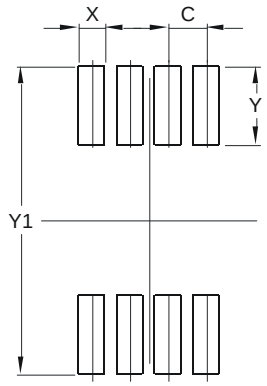
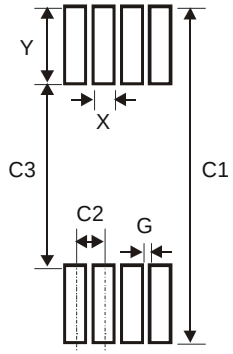
**MSOP-8**




| Dimensions | Value (in mm) |
|---|---|
| C | 0.650 |
| X | 0.450 |
| Y | 1.350 |
| Y1 | 5.300 |

**TSSOP-8**




| Dimensions | Value (in mm) |
|---|---|
| X | 0.45 |
| Y | 1.78 |
| C1 | 7.72 |
| C2 | 0.65 |
| C3 | 4.16 |
| G | 0.20 |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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

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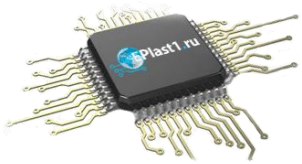
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

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