DESCRIPTION

The AO2901 is quad comparators 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 45μA (Typ.) per channel.

The AO2901 consist of four 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 AO2901 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 AO2901 operates over an ambient temperature range of -40°C to +125°C.

The AO2901 is available in SOP14 and TSSOP14 packages. All are AEC-Q100 Qualified

ORDERING INFORMATION

Package Type	Part Number	
SOP14 AEC-Q100 SPQ:4,000pcs/Reel	M14	AO2901M14VR
		AO2901M14VRQ
TSSOP14 AEC-Q100 SPQ:4,000pcs/Reel	TMX14	AO2901TMX14VR
		AO2901TMX14VRQ
Note	V: Halogen free Package R: Tape & Reel Q: AEC-Q100 Qualified	
AiT provides all RoHS products		

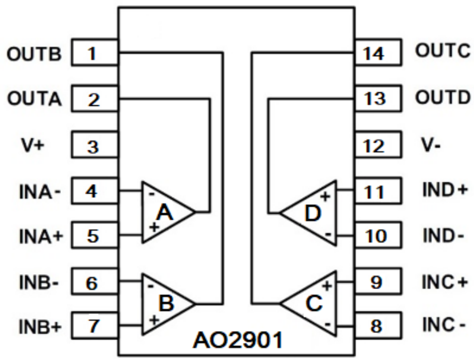
FEATURES

- AEC-Q100 Qualified for Automotive Applications
- Supply Range: +3.3V to +32V
- Low Supply Current 45μA (Typ.) per channel at V_S = 5V
- Common-Mode Input Voltage Range Includes Ground
- Low Output Saturation Voltage
- Open-Drain Output for Maximum Flexibility
- Specified up to +125°

APPLICATION

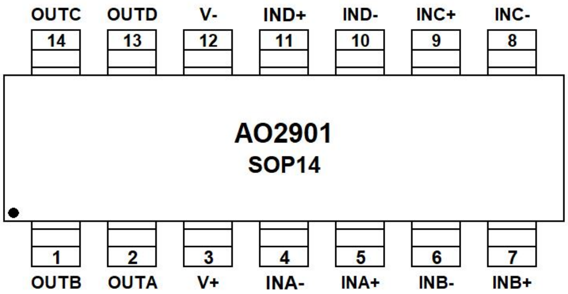
- Hysteresis Comparators
- Factory Automation & Control
- Industrial Equipment
- Test and Measurement
- Cordless Power Tool
- Vacuum Robot
- Wireless Infrastructure

TYPICAL APPLICATION

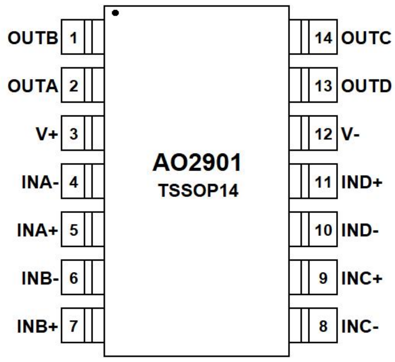


SOP14/TSSOP14

PIN DESCRIPTION



SOP14, M14
Top View



TSSOP14, TMX14
Top View

Pin #		Symbol	I/O*	Functions
SOP14	TSSOP14			
1	1	OUTB	O	Output, channel B
2	2	OUTA	O	Output, channel A
3	3	V+	P	Positive (highest) power supply
4	4	INA-	I	Inverting input, channel A
5	5	INA+	I	Noninverting input, channel A
6	6	INB-	I	Inverting input, channel B
7	7	INB+	I	Noninverting input, channel B
8	8	INC-	I	Inverting input, channel C
9	9	INC+	I	Noninverting input, channel C
10	10	IND-	I	Inverting input, channel D
11	11	IND+	I	Noninverting input, channel D
12	12	V-	P	Negative (lowest) power supply
13	13	OUTD	O	Output, channel D
14	14	OUTC	O	Output, channel C

*I=Input, O=Output, P=Power.

ABSOLUTE MAXIMUM RATINGS

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

Supply Voltage, V_S=(V+) - (V-)		+36V
Input Pin Voltage, (IN+, IN-) (1)		(V-)-0.3V~(V+) +0.3V
Signal Output Pin Voltage (2)		(V-)-0.3V~(V+) +0.3V
Signal Input Pin Current (IN+, IN-) (1)		-10mA~+10mA
Signal Output Pin Current (2)		-55mA~+55mA
Output Short-Circuits Current (3)		Continuous
$θ_{JA}$, Package Thermal Impedance(4)	SOP14	104.5℃/W
	TSSOP14	89.21℃/W
T_A, Operating Temperature Range		-40℃ ~ +125℃
T_J, Junction Temperature (5)		-40℃ ~ +150℃
T_{STG}, Storage Temperature		-65℃ ~ +150℃
$V_{(ESD)}$, Electrostatic Discharge	Human-Body Model (HBM), Per AEC Q100-002(6)	±2000V
	Charged-Device Model (CDM), Per AEC Q100-011	±500V
	Latch-Up (LU), Per AEC Q100-004	±100mA

Stresses above may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(1) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.
(2) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.3V beyond the supply rails should be current-limited to ±55mA or less.
(3) Short-circuit from output to V_{CC} can cause excessive heating and eventual destruction.
(4) The package thermal impedance is calculated in accordance with JESD-51.
(5) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{θJA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{θJA}$. All numbers apply for packages soldered directly onto a PCB.
(6) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

RECOMMENDED OPERATING CONDITIONS

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

		Min.	Non.	Max.	Units
V_S=(V+)-(V-), Supply Voltage	Single-Supply	3.3	-	32	V
	Dual-Supply	±1.65	-	±16	

ELECTRICAL CHARACTERISTICS

T_A = +25℃, V_{CM}=(V_S/2), V_S=5V, unless otherwise noted.(1)

Parameter	Symbol	Conditions	Min. (2)	Typ. (3)	Max. (2)	Units
Operating Voltage Range	V_S	-	3.3	-	32	V
Quiescent Current	I_Q	V_S=5V, no load	-	180	360	μA
		V_S=32V, no load, T_A=-40℃~ +125℃	-	-	420	
Input Offset Voltage	V_{OS}	V_S=5V~32V	-4.5	±0.8	4.5	mV
		V_S=5V~32V T_A=-40℃~ +125℃	-5.0	-	5.0	
Input Bias Current (4)(5)	I_B	T_A=+25℃	-	10	50	pA
		T_A=-40℃~ +125℃	-	-	100	nA
Input Offset Current (4)	I_{OS}	T_A=+25℃	-	10	50	pA
		T_A=-40℃~ +125℃	-	-	100	nA
Common-Mode Voltage Range (6)	V_{CM}	V_S=3.3V ~ 32V	(V-)	-	(V+)-1.5	V
		V_S=3.3V ~ 32V T_A=-40℃~ +125℃	(V-)	-	(V+)-2.0	
Large Signal Differential Voltage Amplification	A_{VD}	V_S=15V,V_O=1.4V~11.4V, R_L≥15k to (V+)	50	200	-	V/mV
Low-Level Output Voltage	V_{OL}	I_{sink}≤4mA, V_{ID}=-1V	-	200	300	mV
		I_{sink}≤4mA, V_{ID}=-1V T_A=-40℃~ +125℃	-	-	500	
Output Current (Sinking)	I_{OL}	V_O=1.5V; V_{ID}=-1V; V_S=5V	9	23	-	mA
High-Level Output Leakage Current	I_{OH-LKG}	(V+) =V_O=5V; V_{ID}=1V	-	80	400	nA
		(V+) =V_O=32V; V_{ID}=1V	-	100	500	

(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) The voltage at either the input or common mode should not be allowed to negative by more than 0.3 V. The upper end of the common mode voltage range is (V+) – 1.5 V; however, one input can exceed Vs, and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 32 V without damage.

Parameter	Symbol	Conditions	Min. (2)	Typ. (3)	Max. (2)	Units
Switching Characteristics						
Propagation Delay H to L (7) (V_S=5V)	T_{PHL}	RPU=5.1KΩ, Overdrive =10mV	-	2.0	-	μs
		RPU=5.1KΩ, Overdrive =100mV	-	0.4	-	
Propagation Delay H to L (7) (V_S=32V)		RPU=5.1KΩ, Overdrive =10mV	-	2.2	-	
		RPU=5.1KΩ, Overdrive =100mV	-	0.4	-	
Propagation Delay L to H (7) (V_S=5V)	T_{PLH}	RPU=5.1KΩ, Overdrive =10mV	-	2.5	-	
		RPU=5.1KΩ, Overdrive =100mV	-	0.8	-	
Propagation Delay L to H (7) (V_S=32V)		RPU=5.1KΩ, Overdrive =10mV	-	2.2	-	
		RPU=5.1KΩ, Overdrive =100mV	-	0.7	-	

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

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, V_S=5V, R_{PULLUP}=5.1k, V_{CM} = V_S/2, C_L=15pF, unless otherwise noted.

Fig.1 Response Time vs. Input Overdrives
Negative Transition

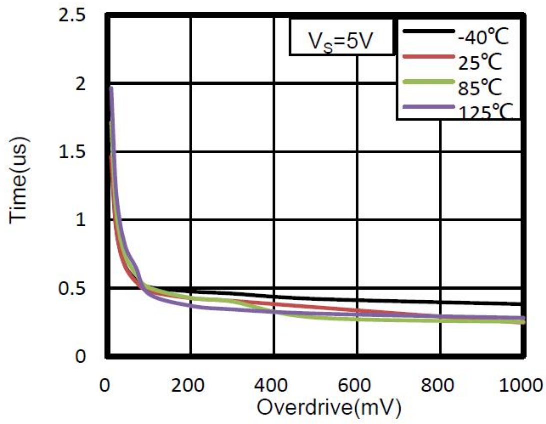


Fig.2 Response Time vs. Input Overdrives
Positive Transition

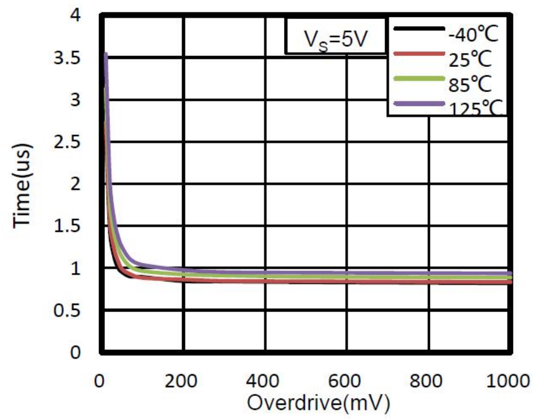


Fig.3 Response Time vs. Input Overdrives
Negative Transition

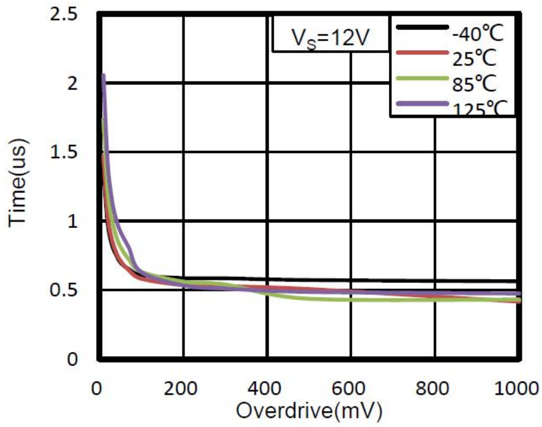


Fig.4 Response Time vs. Input Overdrives
Positive Transition

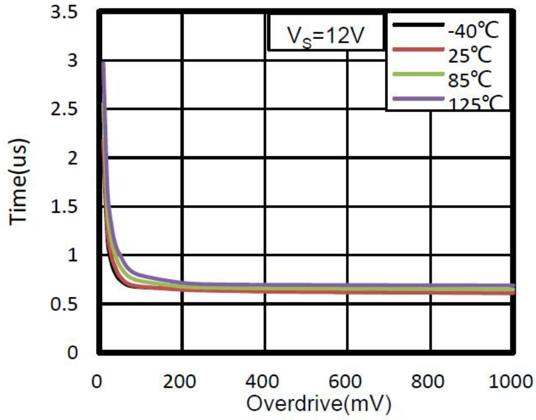


Fig.5 Response Time vs. Input Overdrives
Negative Transition

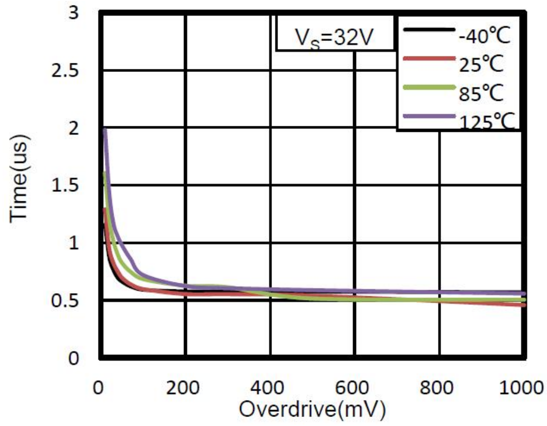


Fig.6 Response Time vs. Input Overdrives
Positive Transition

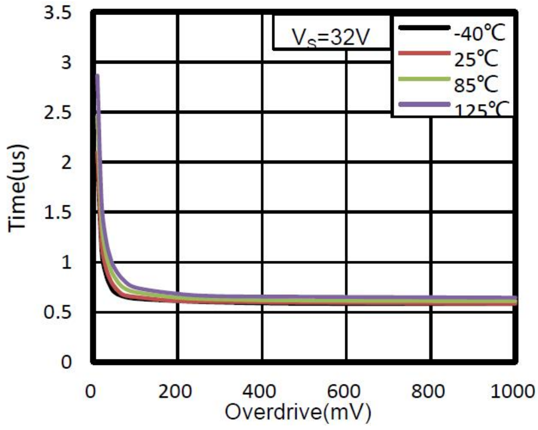


Fig.7 Total Supply Current vs. Supply Voltage

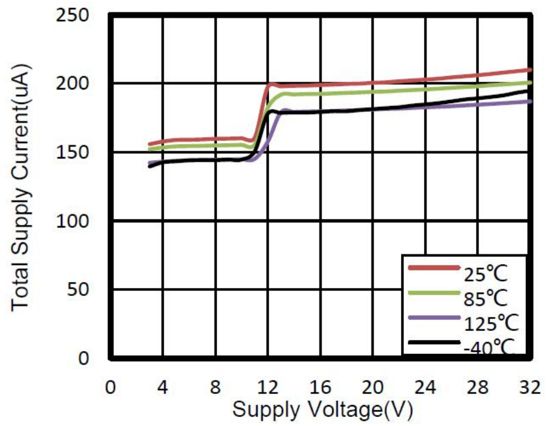


Fig.8 Total Supply Current vs. Input Voltage

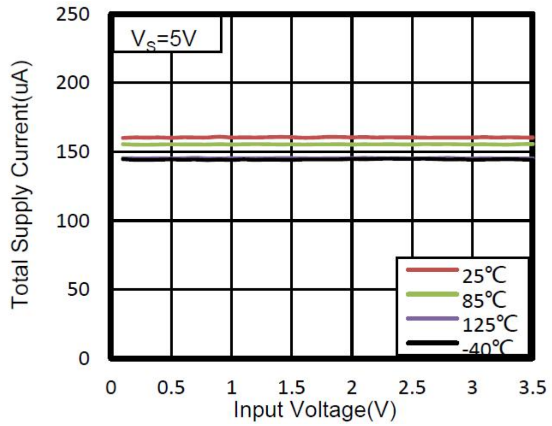


Fig.9 Total Supply Current vs. Input Voltage

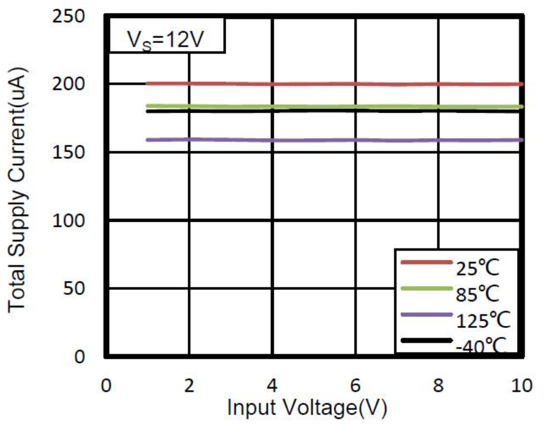


Fig.10 Total Supply Current vs. Input Voltage

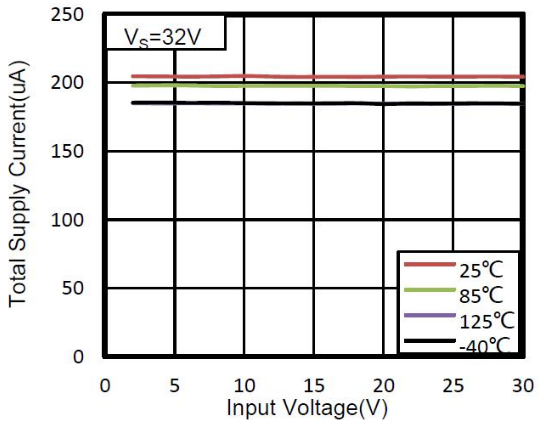


Fig.11 Input Offset Voltage vs. Temperature

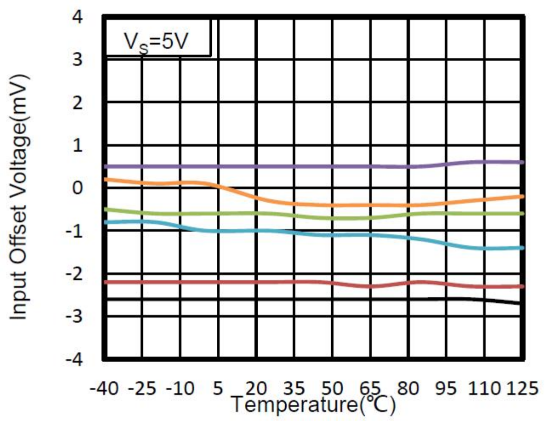


Fig.12 Input Offset Voltage vs. Temperature

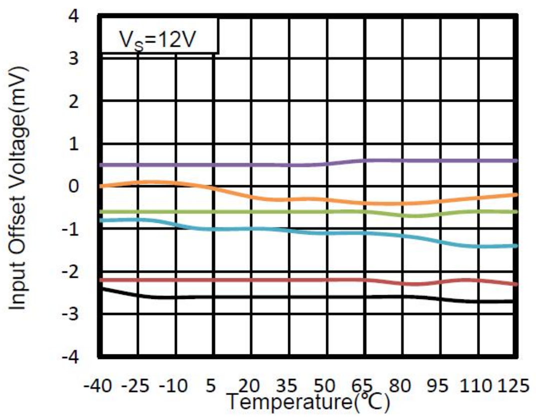


Fig.13 Input Offset Voltage vs. Temperature

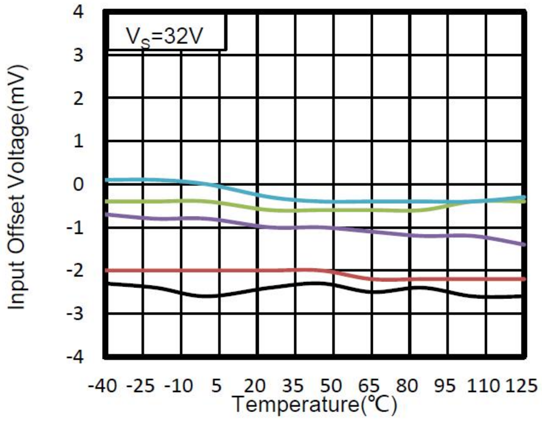


Fig.14 Input Offset Voltage vs. Supply Voltage at -40°C

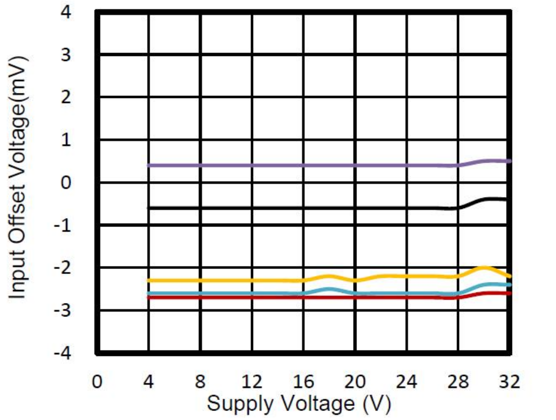


Fig.15 Input Offset Voltage vs. Supply Voltage at 25°C

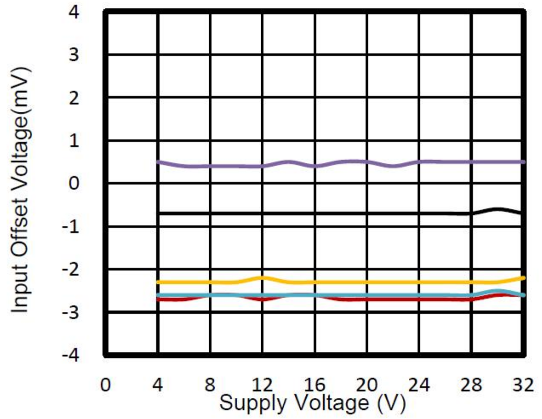


Fig.16 Input Offset Voltage vs. Supply Voltage at 85°C

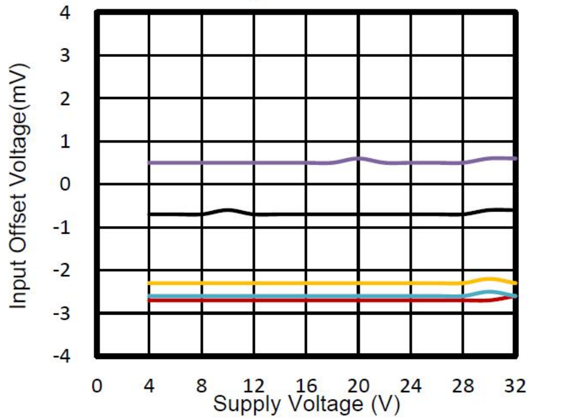


Fig.17 Input Offset Voltage vs. Supply Voltage at 125°C

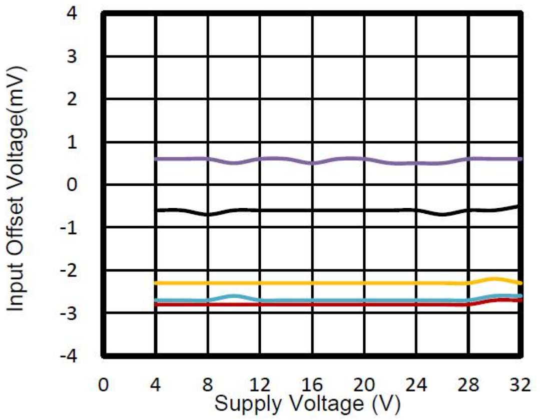


Fig.18 Output Low Voltage vs. Output Sinking Current

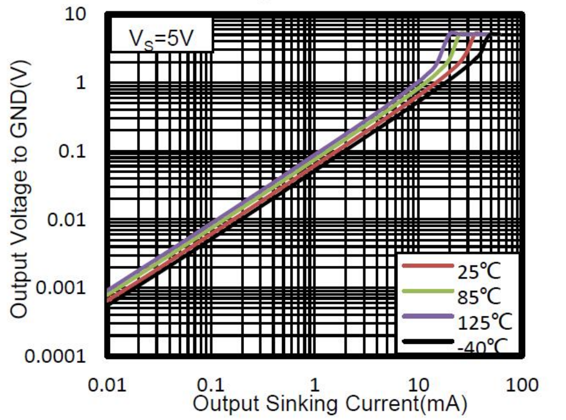


Fig.19 Output Low Voltage vs. Output Sinking Current

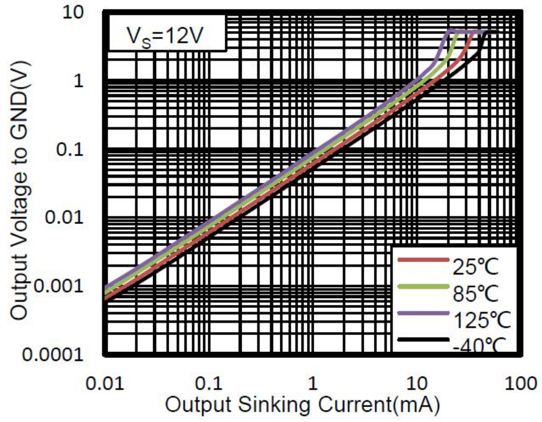


Fig.20 Output Low Voltage vs. Output Sinking Current

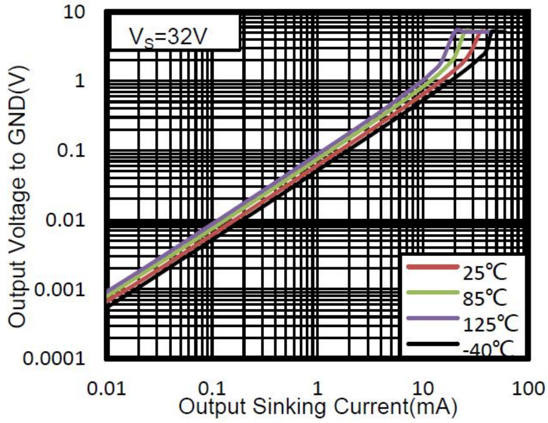


Fig.21 Output High Leakage Current vs. Temperature

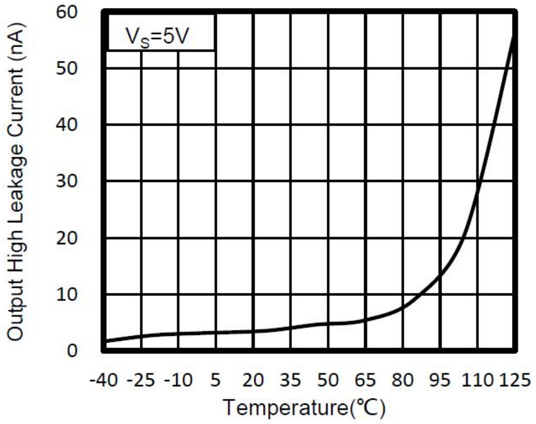
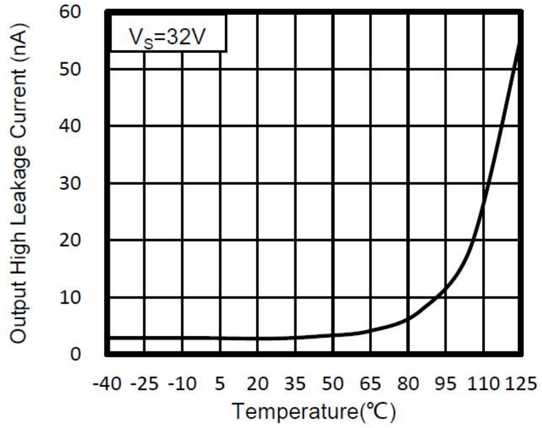
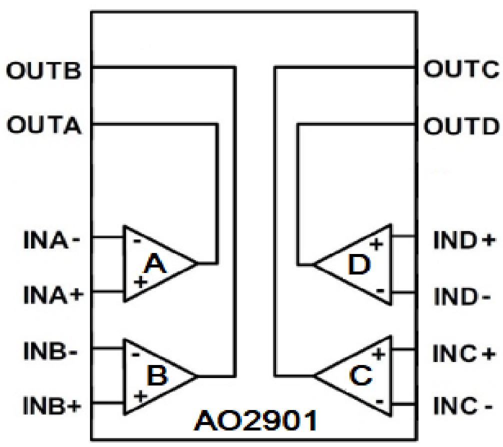


Fig.22 Output High Leakage Current vs. Temperature



BLOCK DIAGRAM



DETAILED INFORMATION

The AO2901 operation 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 (V_{OL}) and can be utilized to enable the comparator to be used in AND functionality.

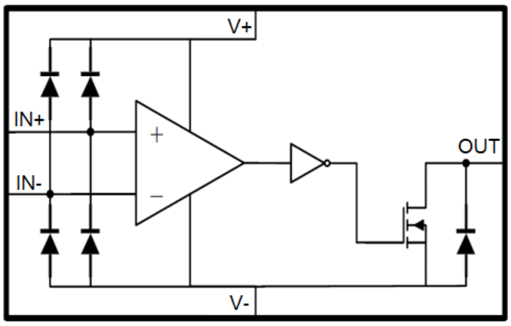


Figure1. Functional Block Diagram

Application Information

The AO2901 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.

Typical Application

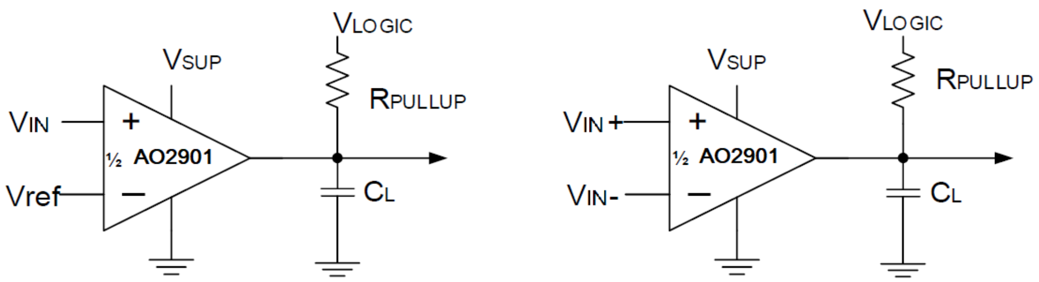


Figure2. Single-Ended and Differential Comparator Configurations

Detailed Design Procedure

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

1. Input Voltage Range
2. Minimum Overdrive Voltage
3. Output and Drive Current
4. Response Time

Input Voltage Range

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

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 V_{CC} 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

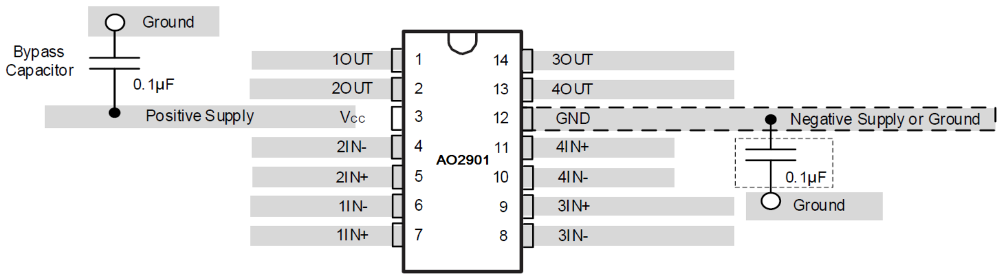
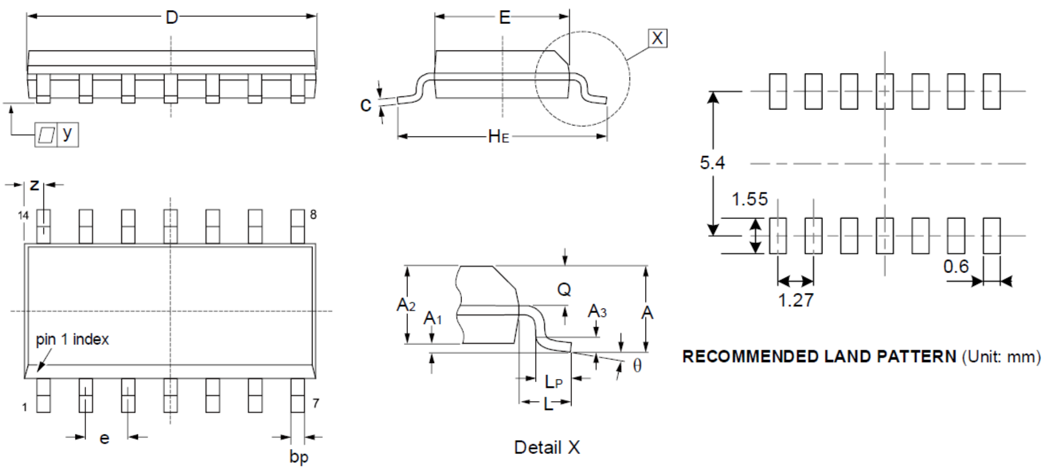


Figure3. AO2901 Layout Example

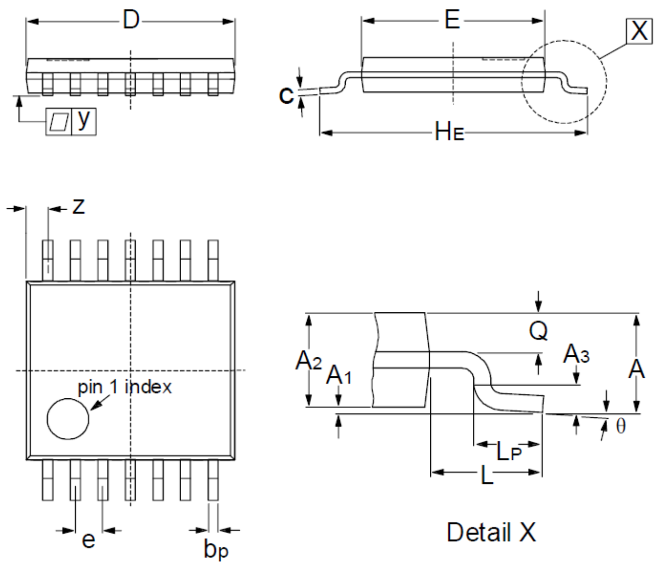
PACKAGE INFORMATION

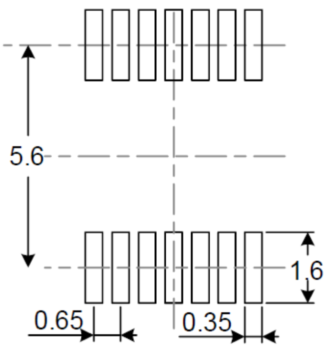
Dimension in SOP14 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	-	1.750
A_1	0.100	0.250
A_2	1.250	1.450
A_3	0.250	
b_p	0.360	0.490
c	0.190	0.250
D	8.550	8.750
E	3.800	4.000
H_E	5.800	6.200
e	1.270	
L	1.050	
L_P	0.400	1.000
Q	0.600	0.700
Z	0.300	0.700
y	0.100	
θ	0°	8°

Dimension in TSSOP14 (Unit: mm)





RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Millimeters	
	Min	Max
A	-	1.100
A_1	0.050	0.150
A_2	0.800	0.950
A_3	0.250	
b_p	0.190	0.300
c	0.100	0.200
D	4.900	5.100
E	4.300	4.500
H_E	6.200	6.600
e	0.650	
L	1.000	
L_P	0.500	0.750
Q	0.300	0.400
Z	0.380	0.720
y	0.100	
θ	0°	8°

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