General-Purpose High-Voltage Open-Drain Output Quad Comparators

1 FEATURES

- **Supply Range: 3.3V to 32V**
- **Supply Current: 760µA (TYP) 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°C**
- **Micro SIZE PACKAGES: SOP14, TSSOP14**

2 APPLICATIONS

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

3 DESCRIPTIONS

The LM2901V is the quad 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 760µA (TYP).

The LM2901V 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 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 LM2901V is available in Green SOP14, TSSOP14 packages. It operates over an ambient temperature range of -40°C to 125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM2901V	SOP14	8.65mm×3.90mm
	TSSOP14	5.00mm×4.40mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Table of Contents

4 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2024/10/11	Preliminary version completed
A.1	2025/03/24	Initial version completed

5 PACKAGE/ORDERING INFORMATION (1)

Orderable Device	Package Type	Pin	Channel	Op Temp(°C)	Device Marking (2)	MSL (3)	Package Qty
LM2901VXP	SOP14	14	4	-40°C ~125°C	LM2901V	MSL3	Tape and Reel, 4000
LM2901VXQ	TSSOP14	14	4	-40°C ~125°C	LM2901V	MSL3	Tape and Reel, 4000

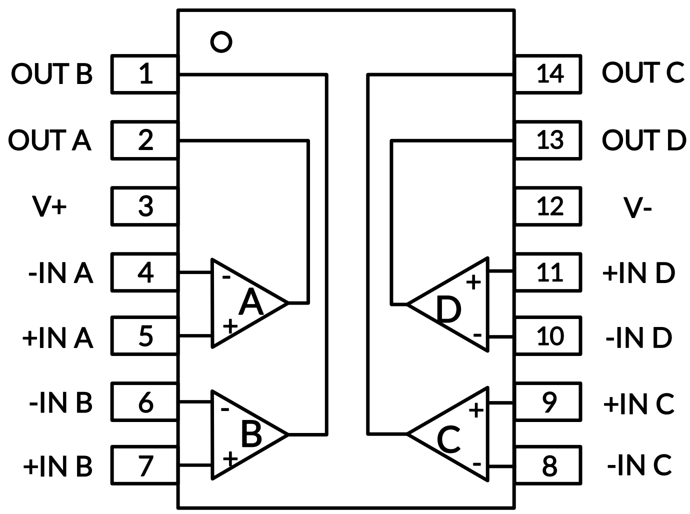
NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F, Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

6 PIN CONFIGURATION AND FUNCTIONS



Pin Description

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

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

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

			MIN	MAX	UNIT
Voltage	Supply, V_S=(V+) - (V-)			36	V
	Input pin (IN+, IN-)		(V-)-0.3	(V+) +0.3	
	Signal output pin		(V-)-0.3	(V+) +0.3	
Current	Signal input pin (IN+, IN-)			-10	mA
	Signal output pin			55	mA
	Output short-circuits (2)		Continuous		
θ_{JA}	Package thermal impedance (3)	SOP14		105	°C/W
		TSSOP14		90	
Temperature	Operating range, T_A		-40	125	°C
	Junction, T_J (4)		-40	150	
	Storage, T_{stg}		-65	150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
(2) Short-circuit from output to V_{CC} can cause excessive heating and eventual destruction.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM), per ANSI/ESDA/JEDEC JS-001-2023	±2000	V
		Charged-device model (CDM), per ANSI/ESDA/JEDEC JS-002-2022	±1000	V

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

7.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
Supply voltage, V_S= (V+) - (V-)	Single-supply	3.3		32	V
	Dual-supply	±1.65		±16	

7.4 ELECTRICAL CHARACTERISTICS

(At T_A = +25°C, V_{CM}=(V_S/2), V_S=5V, unless otherwise noted.) [1]

PARAMETER		CONDITIONS	LM2901V MIN[2]	LM2901V TYP[3]	LM2901V MAX[2]	UNIT
V_S	Operating Voltage Range		3.3		32	V
I_Q	Quiescent Current	V_S=5V, no load		760	1100	μA
		V_S=32V, no load, T_A=-40°C to 125°C			1500	μA
V_{OS}	Input offset voltage	V_S=3.3V to 32V	-3.5	±0.5	3.5	mV
		V_S=3.3V to 32V T_A=-40°C to 125°C	-4		4	mV
IB	Input Bias Current [4] [5]	T_A=25°C		10	50	pA
		T_A=-40°C to 125°C			50	nA
I_{OS}	Input Offset Current [4]	T_A=25°C		10	50	pA
		T_A=-40°C to 125°C			50	nA
V_{CM}	Common-Mode Voltage Range [6]	V_S=3.3V to 32V	(V-)		(V+)-1.5	V
		V_S=3.3V to 32V T_A=-40°C to 125°C	(V-)		(V+)-2.0	V
A_{VD}	Large signal differential voltage amplification	V_S=15V, V_O=1.4V to 11.4V, R_L≥15k to (V+)	20	100		V/mV
V_{OL}	Low-Level output voltage	I_{sink}≤4mA, V_{ID}=-1V		200	300	mV
		I_{sink}≤4mA, V_{ID}=-1V T_A=-40°C to 125°C			400	mV
I_{OL}	Output Current(sinking)	V_O=1.5V; V_{ID}=-1V	18	28		mA
I_{OH-LKG}	High-Level Output Leakage Current	(V+) =V_O=5V; V_{ID}=1V		2	50	nA
		(V+) =V_O=32V; V_{ID}=1V		30	500	nA
Switching Characteristics						
T_{PHL}	Propagation Delay H To L[7]	V_S=5V; RPU=5.1KΩ, Overdrive =10mV		0.5		μs
		V_S=5V; RPU=5.1KΩ, Overdrive =100mV		0.26		μs
		V_S=32V; RPU=5.1KΩ, Overdrive =10mV		0.45		μs
		V_S=32V; RPU=5.1KΩ, Overdrive =100mV		0.25		μs
T_{PLH}	Propagation Delay L To H[7]	V_S=5V; RPU=5.1KΩ, Overdrive =10mV		0.9		μs
		V_S=5V; RPU=5.1KΩ, Overdrive =100mV		0.65		μs
		V_S=32V; RPU=5.1KΩ, Overdrive =10mV		0.8		μs
		V_S=32V; RPU=5.1KΩ, Overdrive =100mV		0.6		μs

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) The voltage at either the input or common mode should not be allowed to negative by more that 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.

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

7.5 TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

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

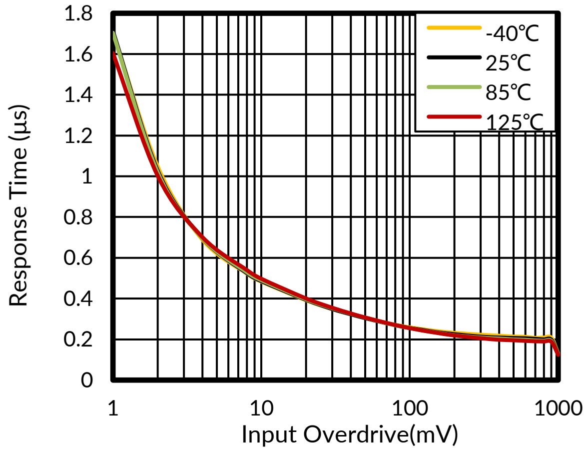


Figure 1. Response Time vs Input Overdrives Negative Transition, 5V

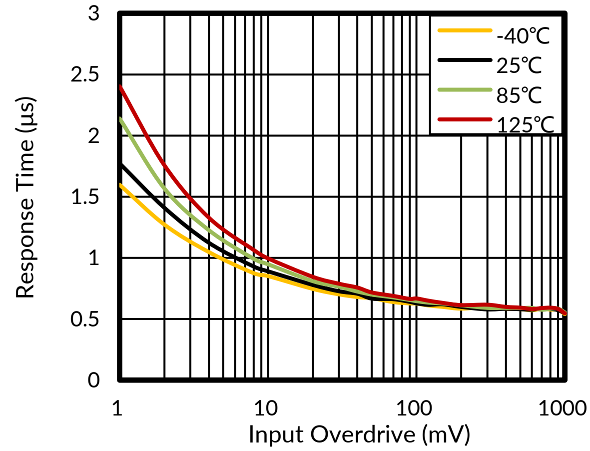


Figure 2. Response Time vs Input Overdrives Positive Transition, 5V

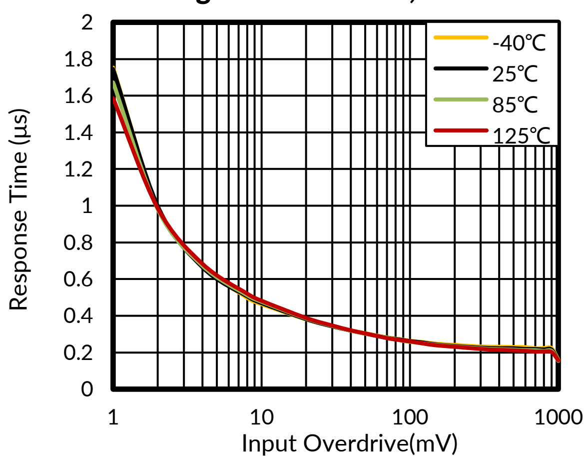


Figure 3. Response Time vs Input Overdrives Negative Transition, 12V

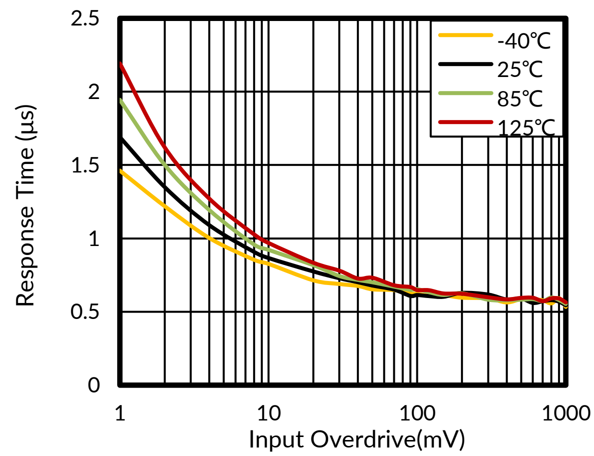


Figure 4. Response Time vs Input Overdrives Positive Transition, 12V

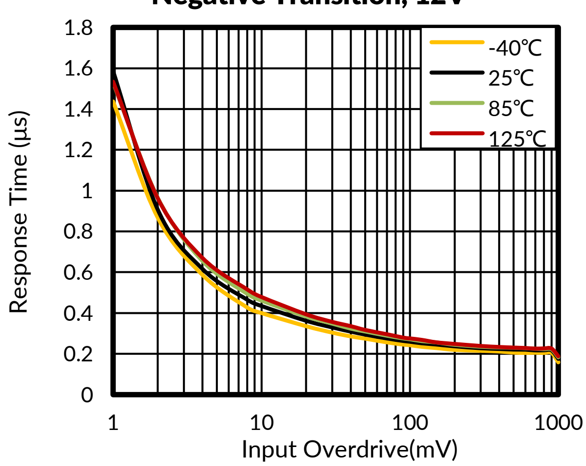


Figure 5. Response Time vs Input Overdrives Negative Transition, 32V

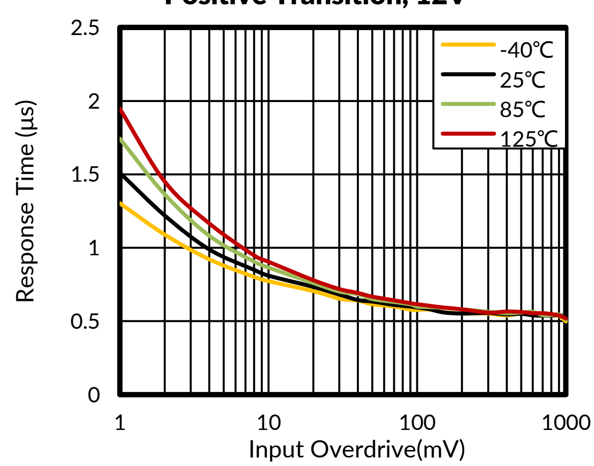


Figure 6. Response Time vs Input Overdrives Positive Transition, 32V

TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

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

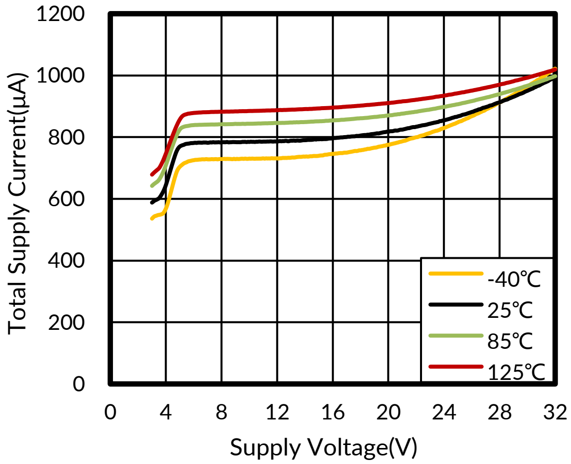


Figure 7. Total Supply Current vs Supply Voltage

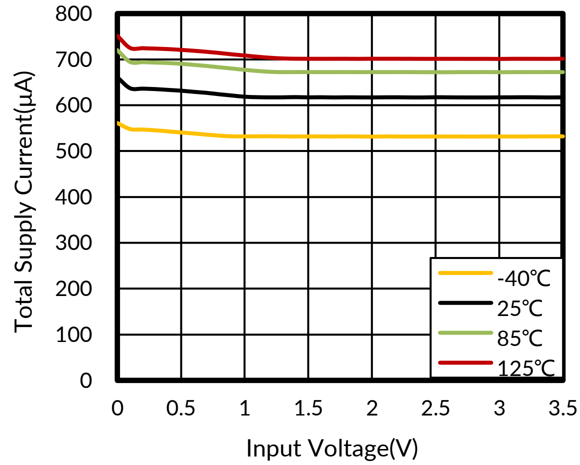


Figure 8. Total Supply Current vs Input Voltage at 5V

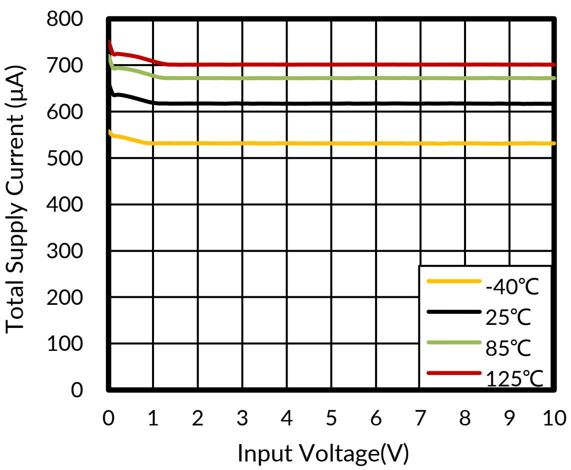


Figure 9. Total Supply Current vs Input Voltage at 12V

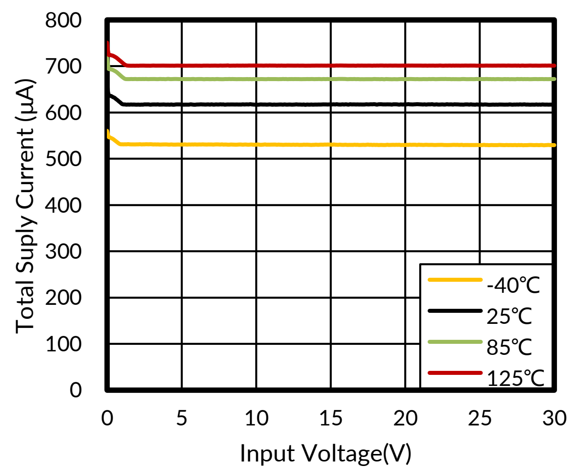


Figure 10. Total Supply Current vs Input Voltage at 32V

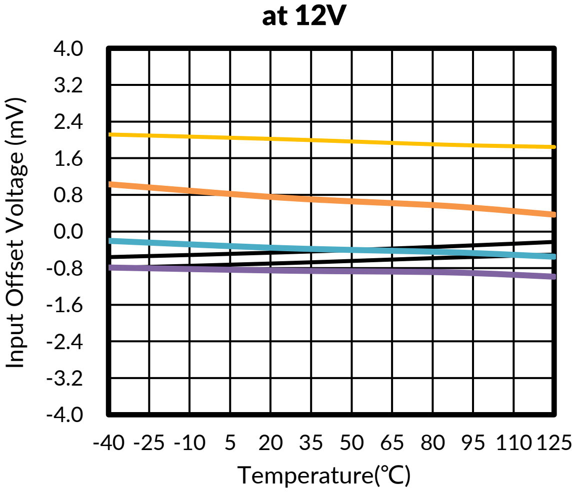


Figure 11. Input Offset Voltage vs Temperature at 5V

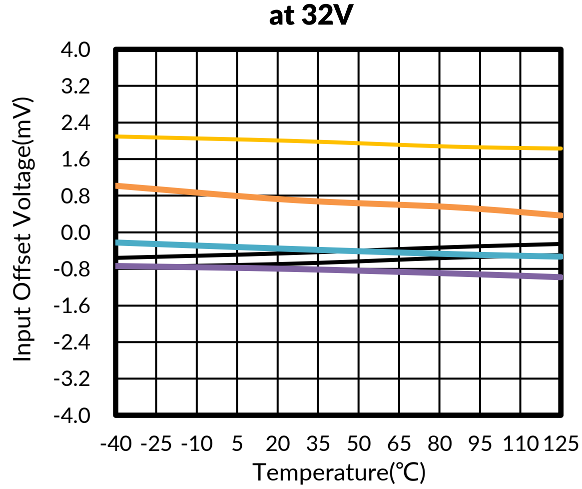


Figure 12. Input Offset Voltage vs Temperature at 12V

TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

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

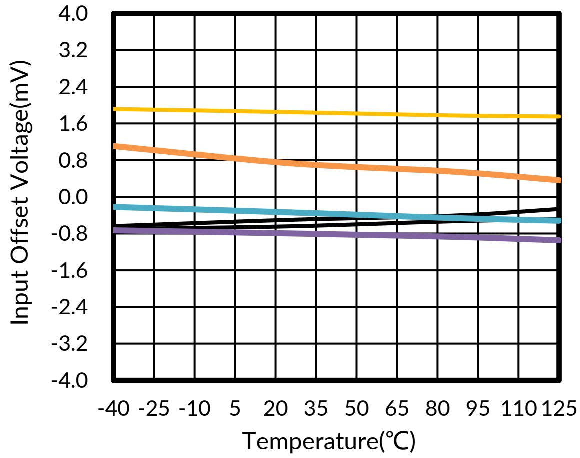


Figure 13. Input Offset Voltage vs Temperature at 32V

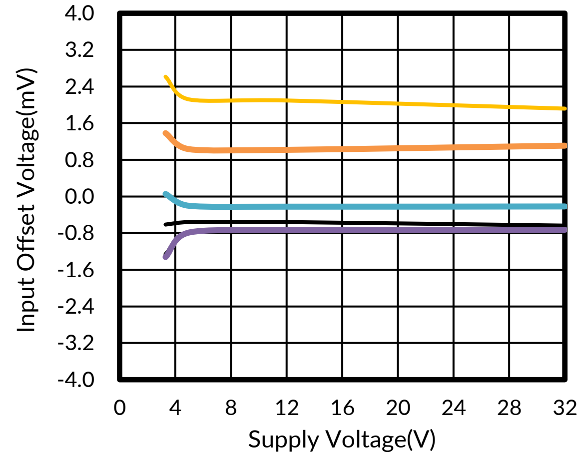


Figure 14. Input Offset Voltage vs Supply Voltage at -40°C

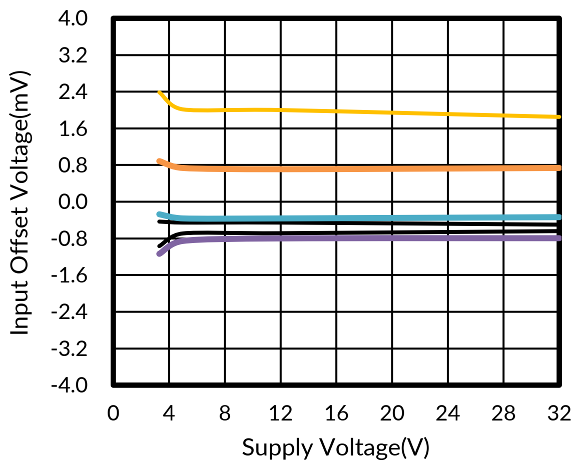


Figure 15. Input Offset Voltage vs Supply Voltage at 25°C

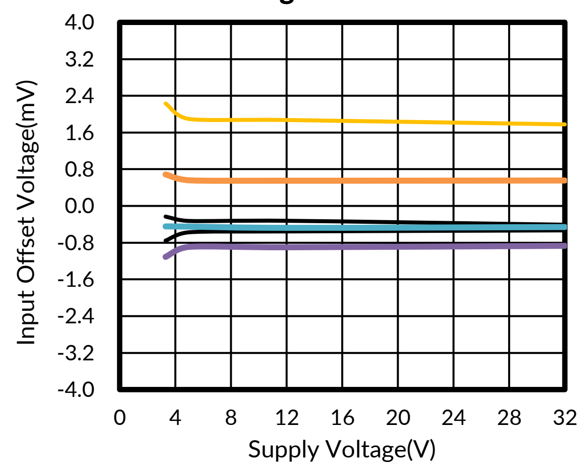


Figure 16. Input Offset Voltage vs Supply Voltage at 85°C

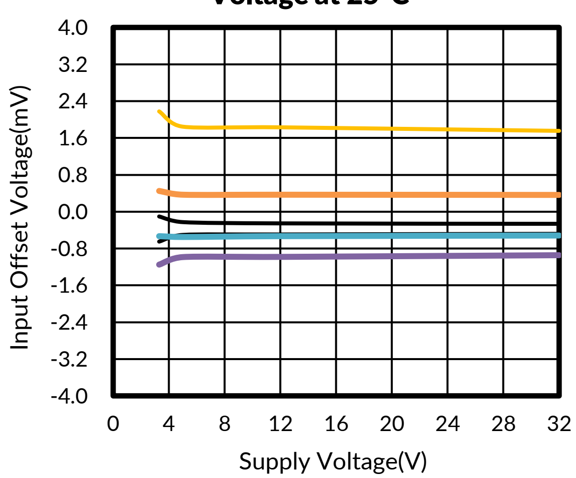


Figure 17. Input Offset Voltage vs Supply Voltage at 125°C

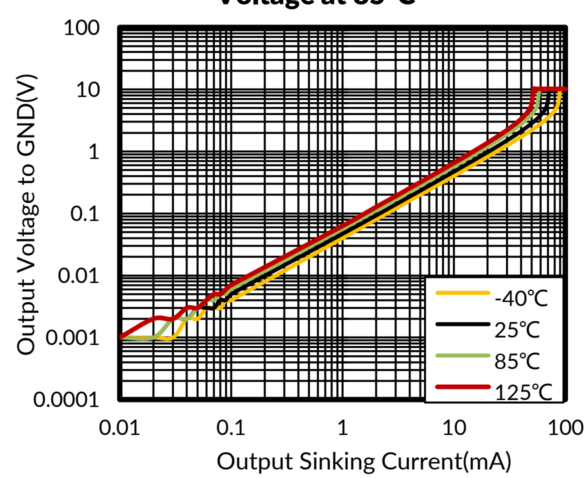


Figure 18. Output Low Voltage vs Output Sinking Current at 5V

TYPICAL CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

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

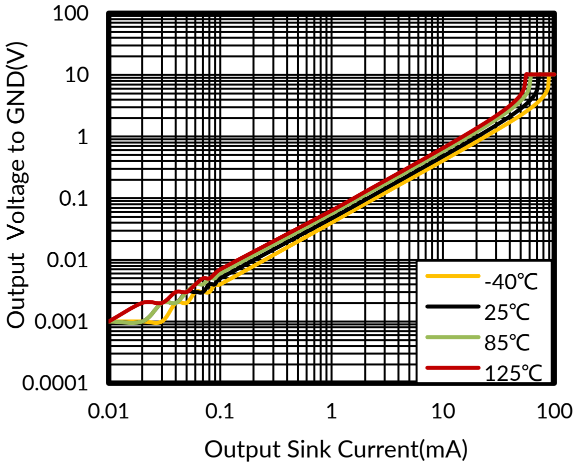


Figure 19. Output Low Voltage vs Output Sinking Current at 12V

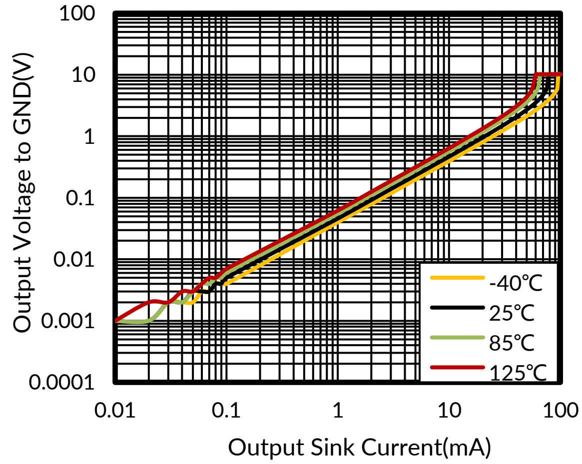


Figure 20. Output Low Voltage vs Output Sinking Current at 32V

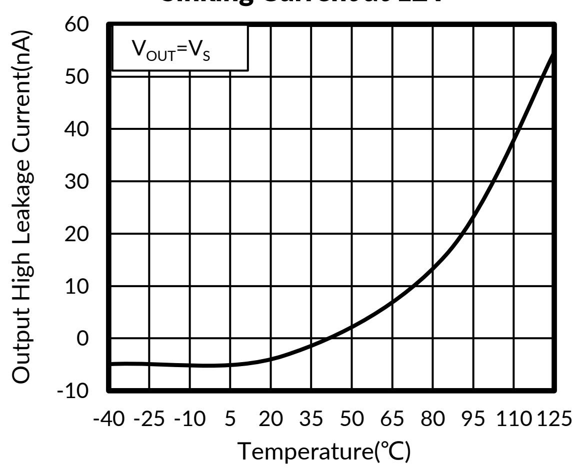


Figure 21. Output High Leakage Current vs Temperature at 5V

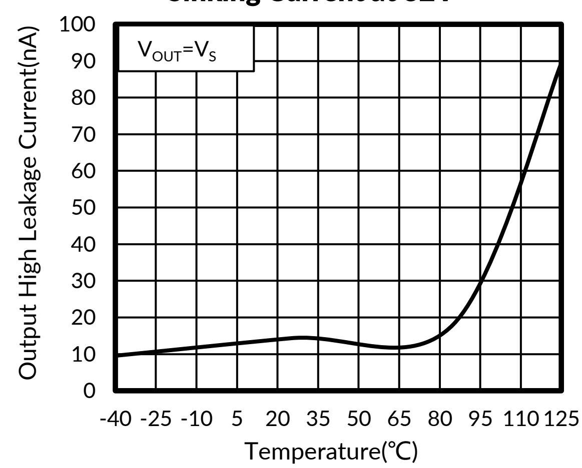


Figure 22. Output High Leakage Current vs Temperature at 32V

8 DETAILED DESCRIPTION

The LM2901V 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 (V_{OL}) and can be utilized to enable the comparator to be used in AND functionality.

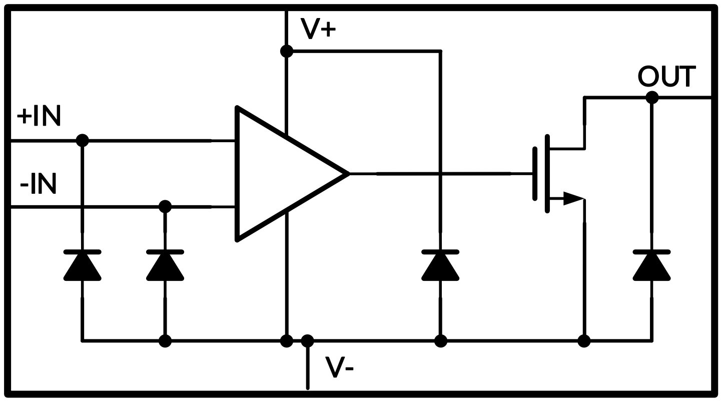


Figure 23. Functional Block Diagram

9 APPLICATION AND IMPLEMENTATION

Information in the following applications sections is not part of the RUNIC component specification, and RUNIC does not warrant its accuracy or completeness. RUNIC's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

LM2901V 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.

9.2 Typical Application

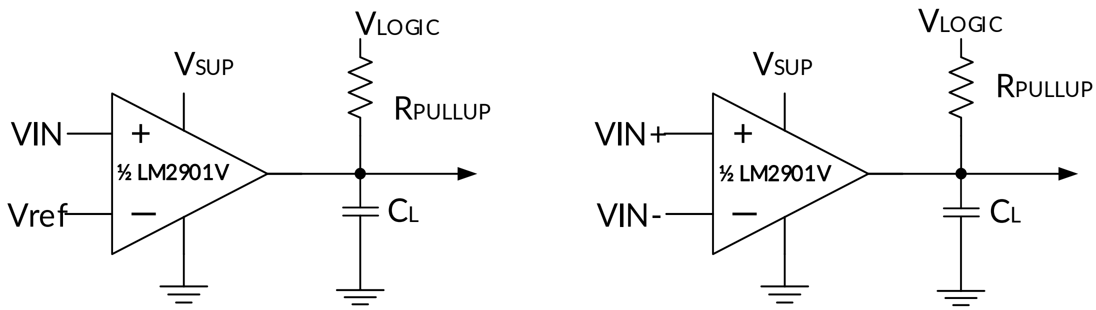


Figure 24. Single-Ended and Differential Comparator Configurations

9.3 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

9.4 Input Voltage Range

When choosing the input voltage range, the input common mode voltage range (V_{ICR}) must be taken in to account. The V_{ICR} limits the input voltage range to as high as V_{CC}– 2.0V and as low as 0V. Operation outside of this range can yield incorrect comparisons.

The following is a list of input voltage situation and the outcomes:

1. When IN- and IN+ are both within the common-mode range:
   a. If IN- is higher than IN+ and the offset voltage, the output is low and the output transistor is sinking current
   b. If IN- is lower than IN+ and the offset voltage, the output is high impedance and the output transistor is not conducting
2. When IN- is higher than common-mode and IN+ is within common-mode range, the output is low and the output transistor is sinking current
3. When IN+ is higher than common-mode and IN- is within common-mode range, the output is high impedance and the output transistor is not conducting
4. When IN- and IN+ are both higher than common-mode, the output is undefined. Not recommended for this input voltage situation.

10 LAYOUT

10.1 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.

10.2 Layout Example

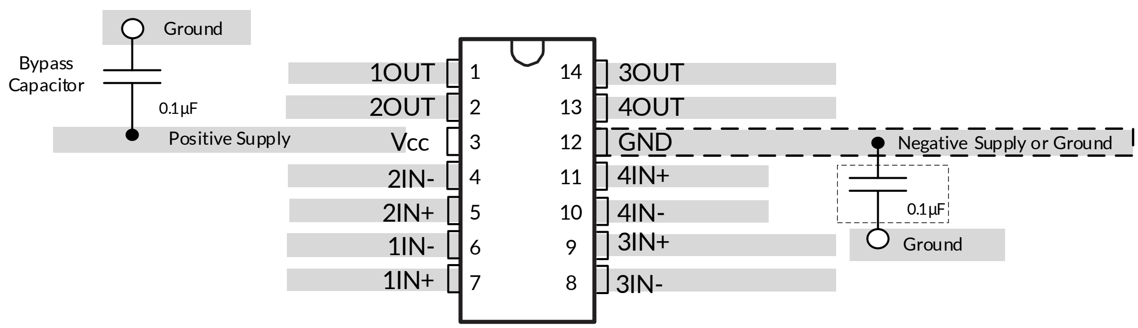
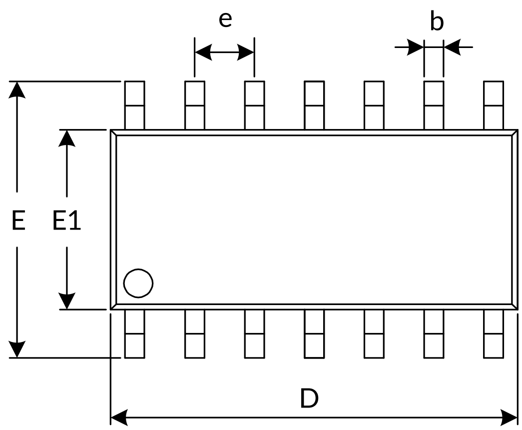
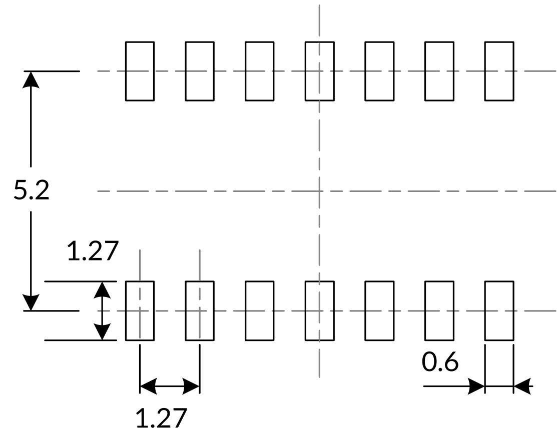


Figure 25. LM2901V Layout Example

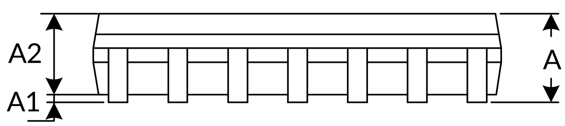
11 PACKAGE OUTLINE DIMENSIONS

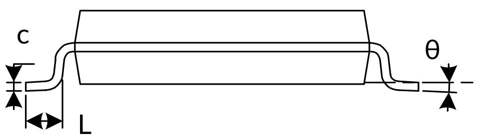
SOP14 (3)





RECOMMENDED LAND PATTERN (Unit: mm)

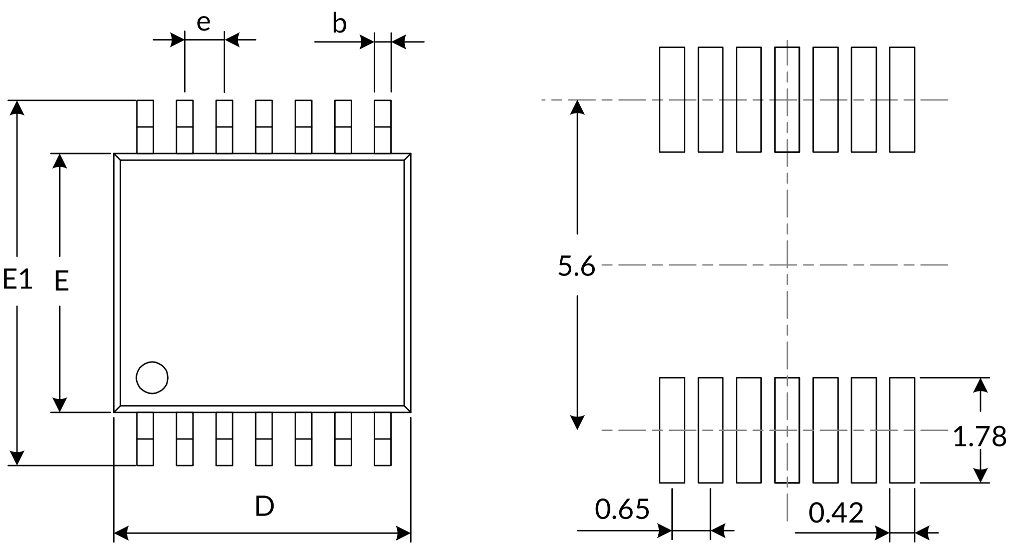




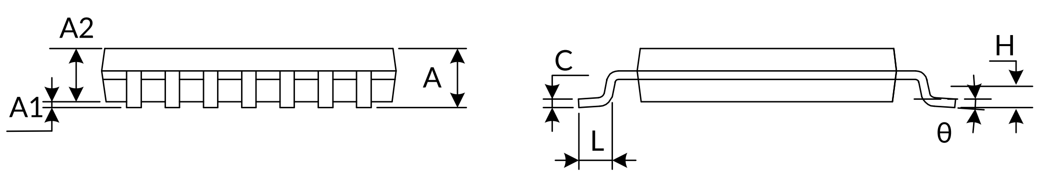
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D (1)	8.450	8.850	0.333	0.348
e	1.270(BSC) (2)		0.050(BSC) (2)	
E	5.800	6.200	0.228	0.244
E1 (1)	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

NOTE:
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

TSSOP14 (3)



RECOMMENDED LAND PATTERN (Unit: mm)



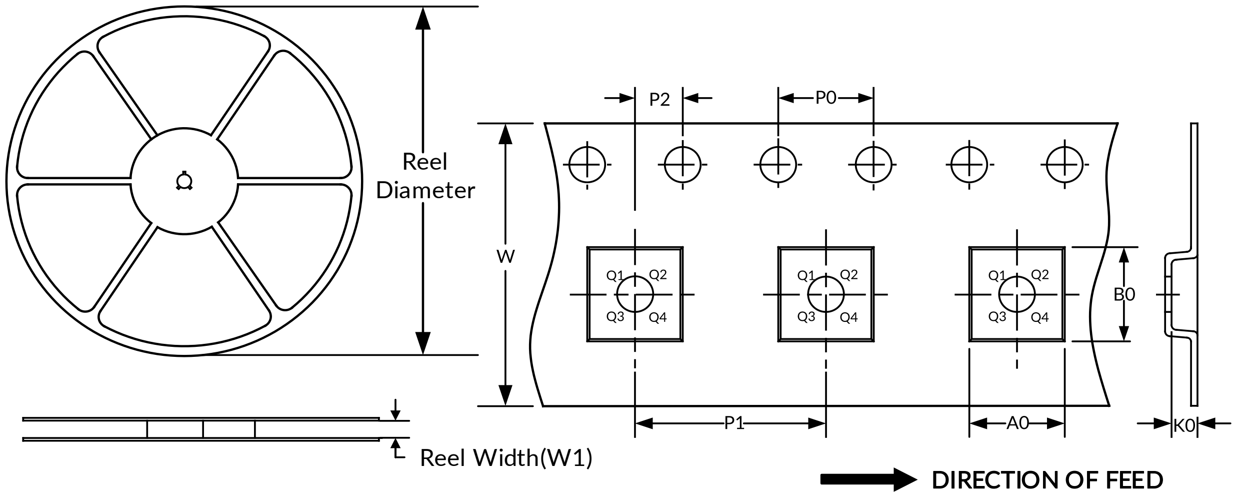
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D (1)	4.860	5.100	0.191	0.201
E (1)	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC) (2)		0.026(BSC) (2)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

NOTE:
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

12 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



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 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOP14	13''	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP14	13''	12.4	6.95	5.60	1.20	4.0	8.0	2.0	12.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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