LM339S, LM2901S

Single Supply Quad Comparators

These comparators are designed for use in level detection, low−level sensing and memory applications in consumer and industrial electronic applications.

Features

- Single or Split Supply Operation
- Low Input Bias Current: 25 nA (Typ)
- Low Input Offset Current: ±5.0 nA (Typ)
- Low Input Offset Voltage
- Input Common Mode Voltage Range to GND
- Low Output Saturation Voltage: 130 mV (Typ) @ 4.0 mA
- TTL and CMOS Compatible
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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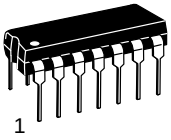
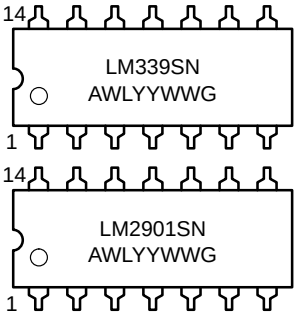
MARKING DIAGRAMS

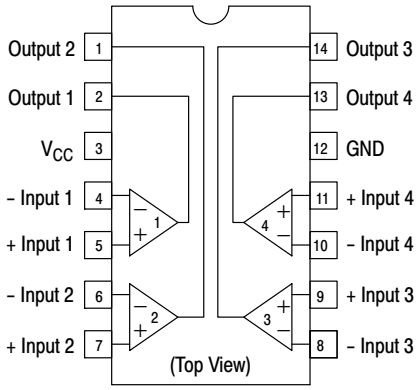


PDIP−14
N SUFFIX
CASE 646



LMxxxx = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y, YY = Year
WW = Work Week
G = Pb−Free Package

PIN CONNECTIONS



ORDERING INFORMATION

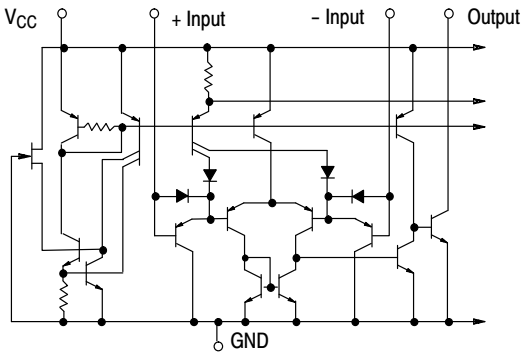
See detailed ordering and shipping information on page 5 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+36 or ±18	Vdc
Input Differential Voltage Range	V_{IDR}	36	Vdc
Input Common Mode Voltage Range	V_{ICMR}	−0.3 to V_{CC}	Vdc
Output Short Circuit to Ground (Note 1)	I_{SC}	Continuous	
Power Dissipation @ T_A = 25°C Plastic Package Derate above 25°C	P_D $1/R_{\theta JA}$	 1.0 8.0	 W mW/°C
Junction Temperature	T_J	150	°C
Operating Ambient Temperature Range LM2901S LM339S	T_A	 −40 to +105 0 to +70	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. The maximum output current may be as high as 20 mA, independent of the magnitude of V_{CC}. Output short circuits to V_{CC} can cause excessive heating and eventual destruction.



NOTE: Diagram shown is for 1 comparator.

Figure 1. Circuit Schematic

ELECTRICAL CHARACTERISTICS (V_{CC} = +5.0 Vdc, T_A = +25°C, unless otherwise noted)

Characteristic	Symbol	LM339S			LM2901S			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (Note 2)	V_{IO}	−	±2.0	±5.0	−	±2.0	±7.0	mVdc
Input Bias Current (Notes 2, 3) (Output in Analog Range)	I_{IB}	−	25	250	−	25	250	nA
Input Offset Current (Note 2)	I_{IO}	−	±5.0	±50	−	±5.0	±50	nA
Input Common Mode Voltage Range	V_{ICMR}	0	−	V_{CC} −1.5	0	−	V_{CC} −1.5	V
Supply Current	I_{CC}							mA
R_L = ∞ (For All Comparators)		−	0.8	2.0	−	0.8	2.0	
R_L = ∞, V_{CC} = 30 Vdc		−	1.0	2.5	−	1.0	2.5	
Voltage Gain R_L ≥ 15 kΩ, V_{CC} = 15 Vdc	A_{VOL}	50	200	−	25	100	−	V/mV
Large Signal Response Time V_I = TTL Logic Swing, V_{ref} = 1.4 Vdc, V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ	−	−	200	−	−	200	−	ns
Response Time (Note 4) V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ	−	−	1.0	−	−	1.0	−	μs
Output Sink Current V_I (−) ≥ +1.0 Vdc, V_I(+) = 0, V_O ≤ 1.5 Vdc	I_{Sink}	6.0	16	−	6.0	16	−	mA
Saturation Voltage V_I(−) ≥ +1.0 Vdc, V_I(+) = 0, I_{sink} ≤ 4.0 mA	V_{sat}	−	130	400	−	130	400	mV
Output Leakage Current V_I(+) ≥ +1.0 Vdc, V_I(−) = 0, V_O = +5.0 Vdc	I_{OL}	−	0.1	−	−	0.1	−	nA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. At the output switch point, $V_O \simeq$ 1.4 Vdc, $R_S \leq$ 100 Ω 5.0 Vdc ≤ V_{CC} ≤ 30 Vdc, with the inputs over the full common mode range (0 Vdc to V_{CC} −1.5 Vdc).
3. The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.
4. The response time specified is for a 100 mV input step with 5.0 mV overdrive. For larger signals, 300 ns is typical.

PERFORMANCE CHARACTERISTICS (V_{CC} = +5.0 Vdc, T_A = T_{low} to T_{high} (Note 5))

Characteristic	Symbol	LM339S			LM2901S			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (Note 6)	V_{IO}	–	–	±9.0	–	–	±15	mVdc
Input Bias Current (Notes 6, 7) (Output in Analog Range)	I_{IB}	–	–	400	–	–	500	nA
Input Offset Current (Note 6)	I_{IO}	–	–	±150	–	–	±200	nA
Input Common Mode Voltage Range	V_{ICMR}	0	–	V_{CC} −2.0	0	–	V_{CC} −2.0	V
Saturation Voltage $V_I(-) \geq +1.0$ Vdc, $V_I(+) = 0$, $I_{sink} \leq 4.0$ mA	V_{sat}	–	–	700	–	–	700	mV
Output Leakage Current $V_I(+) \geq +1.0$ Vdc, $V_I(-) = 0$, $V_O = 30$ Vdc	I_{OL}	–	–	1.0	–	–	1.0	μA
Differential Input Voltage All $V_I \geq 0$ Vdc	V_{ID}	–	–	V_{CC}	–	–	V_{CC}	Vdc

5. (LM339S) T_{low} = 0°C, T_{high} = +70°C
   (LM2901S) T_{low} = −40°C, T_{high} = +105°C
6. At the output switch point, $V_O \simeq$ 1.4 Vdc, $R_S \leq 100\ \Omega$ 5.0 Vdc ≤ V_{CC} ≤ 30 Vdc, with the inputs over the full common mode range (0 Vdc to V_{CC} −1.5 Vdc).
7. The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.

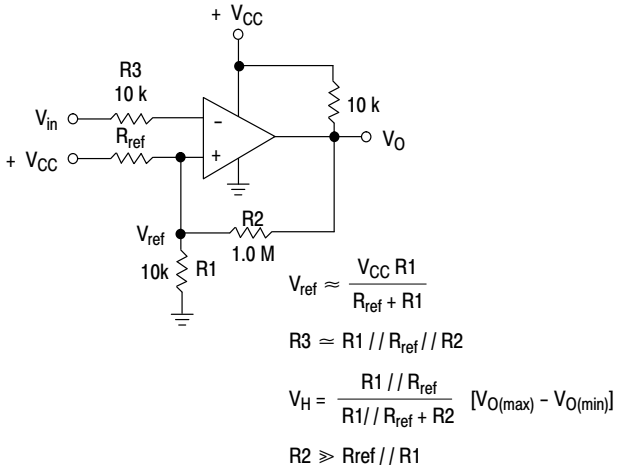


Figure 2. Inverting Comparator with Hysteresis

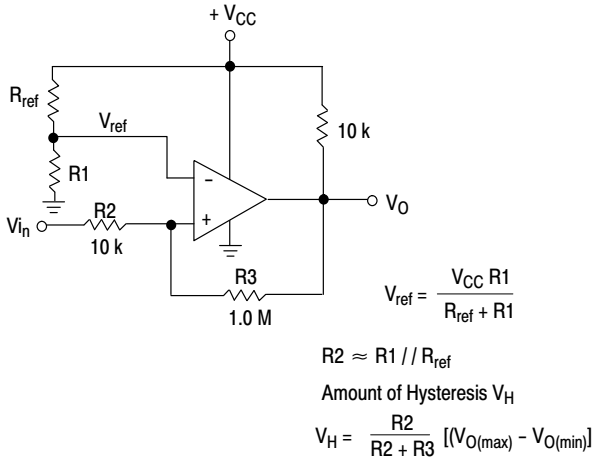
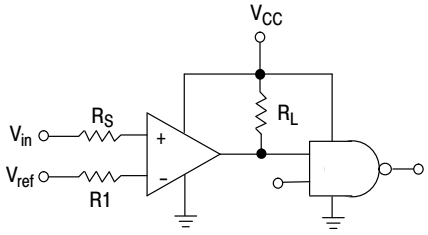


Figure 3. Noninverting Comparator with Hysteresis



R_S = Source Resistance
$R1 \simeq R_S$

Logic	Device	V_{CC} (V)	R_L kΩ
CMOS	1/4 MC14001	+15	100
TTL	1/4 MC7400	+5.0	10

Figure 4. Driving Logic

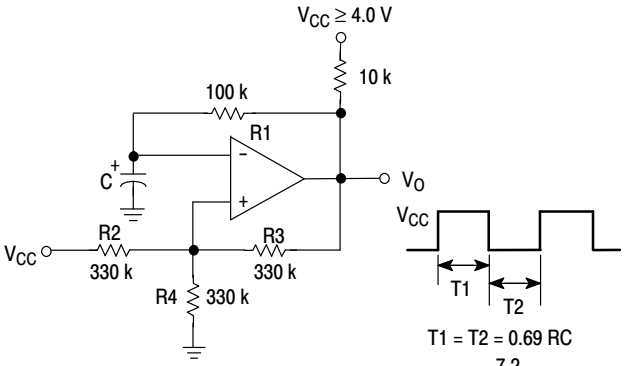
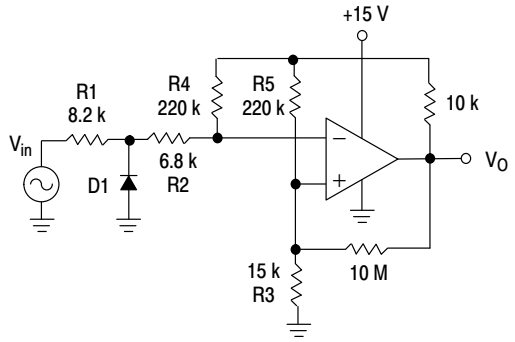


Figure 5. Squarewave Oscillator

APPLICATIONS INFORMATION

These quad comparators feature high gain, wide bandwidth characteristics. This gives the device oscillation tendencies if the outputs are capacitively coupled to the inputs via stray capacitance. This oscillation manifests itself during output transitions (V_{OL} to V_{OH}). To alleviate this situation input resistors < 10 kΩ should be used. The addition of positive feedback (< 10 mV) is also recommended. It is good design practice to ground all unused input pins.

Differential input voltages may be larger than supply voltages without damaging the comparator's inputs. Voltages more negative than −300 mV should not be used.



D1 prevents input from going negative by more than 0.6 V.

$$R1 + R2 = R3$$

$$R3 \leq \frac{R5}{10} \text{ for small error in zero crossing}$$

Figure 6. Zero Crossing Detector (Single Supply)

$V_{in(min)} \approx 0.4$ V peak for 1% phase distortion ($\Delta\theta$).

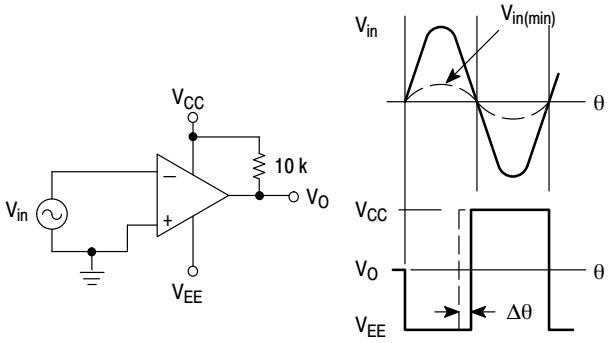


Figure 7. Zero Crossing Detector (Split Supplies)

ORDERING INFORMATION

Device	Package	Shipping†
LM339SNG	PDIP−14 (Pb−Free)	25 Units / Rail
LM2901SNG	PDIP−14 (Pb−Free)	25 Units / Rail

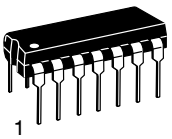
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

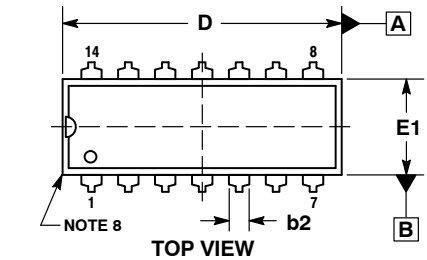
ON Semiconductor®

PDIP−14
CASE 646−06
ISSUE S

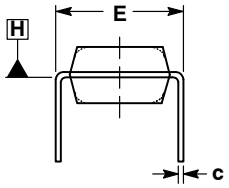
DATE 22 APR 2015



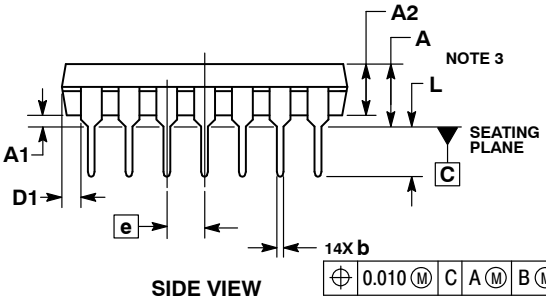
SCALE 1:1



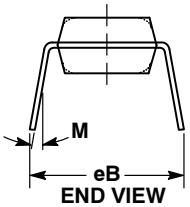
TOP VIEW



END VIEW
WITH LEADS CONSTRAINED
NOTE 5



SIDE VIEW

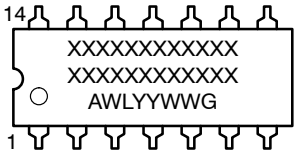


END VIEW
NOTE 6

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS−3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	----	0.210	---	5.33
A1	0.015	----	0.38	---
A2	0.115	0.195	2.92	4.95
b	0.014	0.022	0.35	0.56
b2	0.060 TYP		1.52 TYP	
C	0.008	0.014	0.20	0.36
D	0.735	0.775	18.67	19.69
D1	0.005	----	0.13	---
E	0.300	0.325	7.62	8.26
E1	0.240	0.280	6.10	7.11
e	0.100 BSC		2.54 BSC	
eB	----	0.430	---	10.92
L	0.115	0.150	2.92	3.81
M	----	10°	---	10°

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42428B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.	
DESCRIPTION:	PDIP−14		PAGE 1 OF 2

PDIP−14
CASE 646−06
ISSUE S

DATE 22 APR 2015

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER
4. NO CONNECTION
5. EMITTER
6. BASE
7. COLLECTOR
8. COLLECTOR
9. BASE
10. EMITTER
11. NO CONNECTION
12. EMITTER
13. BASE
14. COLLECTOR

STYLE 2:
CANCELLED

STYLE 3:
CANCELLED

STYLE 4:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. NO CONNECTION
5. GATE
6. SOURCE
7. DRAIN
8. DRAIN
9. SOURCE
10. GATE
11. NO CONNECTION
12. GATE
13. SOURCE
14. DRAIN

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. NO CONNECTION
5. SOURCE
6. DRAIN
7. GATE
8. GATE
9. DRAIN
10. SOURCE
11. NO CONNECTION
12. SOURCE
13. DRAIN
14. GATE

STYLE 6:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. NO CONNECTION
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. NO CONNECTION
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 7:
PIN 1. NO CONNECTION
2. ANODE
3. ANODE
4. NO CONNECTION
5. ANODE
6. NO CONNECTION
7. ANODE
8. ANODE
9. ANODE
10. NO CONNECTION
11. ANODE
12. ANODE
13. NO CONNECTION
14. COMMON CATHODE

STYLE 8:
PIN 1. NO CONNECTION
2. CATHODE
3. CATHODE
4. NO CONNECTION
5. CATHODE
6. NO CONNECTION
7. CATHODE
8. CATHODE
9. CATHODE
10. NO CONNECTION
11. CATHODE
12. CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 9:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. ANODE/CATHODE
7. COMMON ANODE
8. COMMON ANODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. NO CONNECTION
12. ANODE/CATHODE
13. ANODE/CATHODE
14. COMMON CATHODE

STYLE 10:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. NO CONNECTION
7. COMMON ANODE
8. COMMON CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 11:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. ANODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE

STYLE 12:
PIN 1. COMMON CATHODE
2. COMMON ANODE
3. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. COMMON ANODE
7. COMMON CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. ANODE/CATHODE
14. ANODE/CATHODE

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