

# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## Single Supply Quad Comparators

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

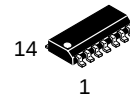
### Features

- Single or Split Supply Operation
- Low Input Bias Current: 25 nA (Typ)
- Low Input Offset Current:  $\pm 5.0$  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
- ESD Clamps on the Inputs Increase Reliability without Affecting Device Operation
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- Pb-Free Packages are Available

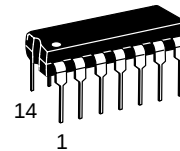


**ON Semiconductor®**

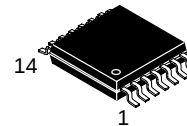
<http://onsemi.com>



**SOIC-14**  
**D SUFFIX**  
**CASE 751A**

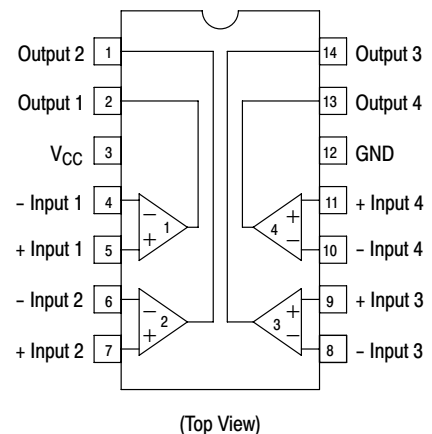


**PDIP-14**  
**N, P SUFFIX**  
**CASE 646**



**TSSOP-14**  
**DTB SUFFIX**  
**CASE 948G**

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 8 of this data sheet.

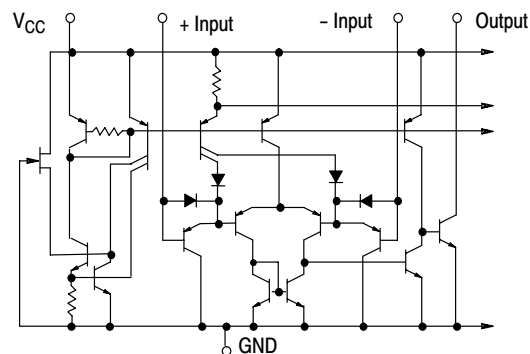
# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## MAXIMUM RATINGS

| Rating                                                                                             | Symbol                     | Value                                                                                  | Unit                      |
|----------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------|---------------------------|
| Power Supply Voltage<br>LM239/LM339/LM2901, V<br>MC3302                                            | $V_{CC}$                   | +36 or $\pm 18$<br>+30 or $\pm 15$                                                     | Vdc                       |
| Input Differential Voltage Range<br>LM239/LM339/LM2901, V<br>MC3302                                | $V_{IDR}$                  | 36<br>30                                                                               | 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 @ $T_A = 25^\circ\text{C}$<br>Plastic Package<br>Derate above $25^\circ\text{C}$ | $P_D$<br>$1/R_{\theta JA}$ | 1.0<br>8.0                                                                             | W<br>mW/ $^\circ\text{C}$ |
| Junction Temperature                                                                               | $T_J$                      | 150                                                                                    | $^\circ\text{C}$          |
| Operating Ambient Temperature Range<br>LM239<br>MC3302<br>LM2901<br>LM2901V, NCV2901<br>LM339      | $T_A$                      | $-25$ to $+85$<br>$-40$ to $+85$<br>$-40$ to $+105$<br>$-40$ to $+125$<br>$0$ to $+70$ | $^\circ\text{C}$          |
| Storage Temperature Range                                                                          | $T_{stg}$                  | $-65$ to $+150$                                                                        | $^\circ\text{C}$          |
| ESD Protection at any Pin (Note 2)<br>Human Body Model<br>Machine Model                            | $V_{ESD}$                  | 1500<br>200                                                                            | V                         |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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.
2.  $V_{ESD}$  rating for NCV/SC devices is: Human Body Model – 2000 V; Machine Model – 200 V.



NOTE: Diagram shown is for 1 comparator.

**Figure 1. Circuit Schematic**

# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = +5.0$ Vdc, $T_A = +25^\circ\text{C}$ , unless otherwise noted)

| Characteristic                                                                                                                       | Symbol     | LM239/339 |            |                | LM2901/2901V/<br>NCV2901 |            |                | MC3302 |            |                | Unit          |
|--------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|------------|----------------|--------------------------|------------|----------------|--------|------------|----------------|---------------|
|                                                                                                                                      |            | Min       | Typ        | Max            | Min                      | Typ        | Max            | Min    | Typ        | Max            |               |
| Input Offset Voltage (Note 4)                                                                                                        | $V_{IO}$   | –         | $\pm 2.0$  | $\pm 5.0$      | –                        | $\pm 2.0$  | $\pm 7.0$      | –      | $\pm 3.0$  | $\pm 20$       | mVdc          |
| Input Bias Current (Notes 4, 5)<br>(Output in Analog Range)                                                                          | $I_{IB}$   | –         | 25         | 250            | –                        | 25         | 250            | –      | 25         | 500            | nA            |
| Input Offset Current (Note 4)                                                                                                        | $I_{IO}$   | –         | $\pm 5.0$  | $\pm 50$       | –                        | $\pm 5.0$  | $\pm 50$       | –      | $\pm 3.0$  | $\pm 100$      | nA            |
| Input Common Mode Voltage Range                                                                                                      | $V_{ICMR}$ | 0         | –          | $V_{CC} - 1.5$ | 0                        | –          | $V_{CC} - 1.5$ | 0      | –          | $V_{CC} - 1.5$ | V             |
| Supply Current<br>$R_L = \infty$ (For All Comparators)<br>$R_L = \infty$ , $V_{CC} = 30$ Vdc                                         | $I_{CC}$   | –         | 0.8<br>1.0 | 2.0<br>2.5     | –                        | 0.8<br>1.0 | 2.0<br>2.5     | –      | 0.8<br>1.0 | 2.0<br>2.5     | mA            |
| Voltage Gain<br>$R_L \geq 15$ k $\Omega$ , $V_{CC} = 15$ Vdc                                                                         | $A_{VOL}$  | 50        | 200        | –              | 25                       | 100        | –              | 25     | 100        | –              | V/mV          |
| Large Signal Response Time<br>$V_I = \text{TTL Logic Swing}$ ,<br>$V_{ref} = 1.4$ Vdc, $V_{RL} = 5.0$ Vdc,<br>$R_L = 5.1$ k $\Omega$ | –          | –         | 300        | –              | –                        | 300        | –              | –      | 300        | –              | ns            |
| Response Time (Note 6)<br>$V_{RL} = 5.0$ Vdc, $R_L = 5.1$ k $\Omega$                                                                 | –          | –         | 1.3        | –              | –                        | 1.3        | –              | –      | 1.3        | –              | $\mu\text{s}$ |
| Output Sink Current<br>$V_I(-) \geq +1.0$ Vdc, $V_I(+)=0$ ,<br>$V_O \leq 1.5$ Vdc                                                    | $I_{Sink}$ | 6.0       | 16         | –              | 6.0                      | 16         | –              | 6.0    | 16         | –              | mA            |
| Saturation Voltage<br>$V_I(-) \geq +1.0$ Vdc, $V_I(+)=0$ ,<br>$I_{sink} \leq 4.0$ mA                                                 | $V_{sat}$  | –         | 130        | 400            | –                        | 130        | 400            | –      | 130        | 500            | mV            |
| Output Leakage Current<br>$V_I(+)\geq +1.0$ Vdc, $V_I(-)=0$ ,<br>$V_O = +5.0$ Vdc                                                    | $I_{OL}$   | –         | 0.1        | –              | –                        | 0.1        | –              | –      | 0.1        | –              | nA            |

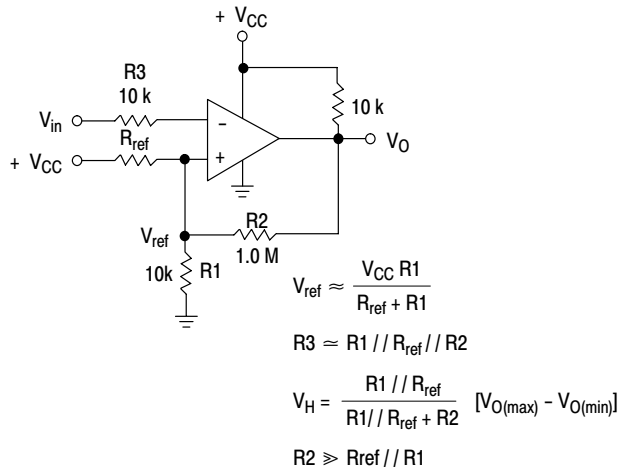
- (LM239)  $T_{low} = -25^\circ\text{C}$ ,  $T_{high} = +85^\circ$   
(LM339)  $T_{low} = 0^\circ\text{C}$ ,  $T_{high} = +70^\circ\text{C}$   
(MC3302)  $T_{low} = -40^\circ\text{C}$ ,  $T_{high} = +85^\circ\text{C}$   
(LM2901)  $T_{low} = -40^\circ\text{C}$ ,  $T_{high} = +105^\circ$   
(LM2901V & NCV2901)  $T_{low} = -40^\circ\text{C}$ ,  $T_{high} = +125^\circ\text{C}$   
*NCV2901 is qualified for automotive use.*
- At the output switch point,  $V_O \approx 1.4$  Vdc,  $R_S \leq 100$   $\Omega$   $5.0$  Vdc  $\leq V_{CC} \leq 30$  Vdc, with the inputs over the full common mode range (0 Vdc to  $V_{CC} - 1.5$  Vdc).
- The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.
- The response time specified is for a 100 mV input step with 5.0 mV overdrive. For larger signals, 300 ns is typical.

# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

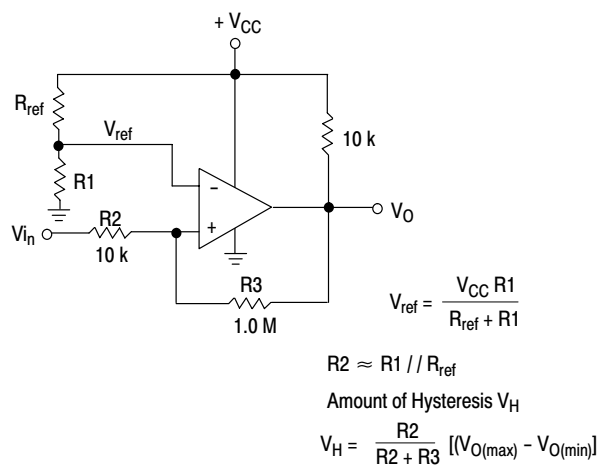
## PERFORMANCE CHARACTERISTICS ( $V_{CC} = +5.0$ Vdc, $T_A = T_{low}$ to $T_{high}$ [Note 7])

| Characteristic                                                                             | Symbol     | LM239/339 |     |                | LM2901/2901V/<br>NCV2901 |     |                | MC3302 |     |                | Unit |
|--------------------------------------------------------------------------------------------|------------|-----------|-----|----------------|--------------------------|-----|----------------|--------|-----|----------------|------|
|                                                                                            |            | Min       | Typ | Max            | Min                      | Typ | Max            | Min    | Typ | Max            |      |
| Input Offset Voltage (Note 8)                                                              | $V_{IO}$   | –         | –   | ±9.0           | –                        | –   | ±15            | –      | –   | ±40            | mVdc |
| Input Bias Current (Notes 8, 9)<br>(Output in Analog Range)                                | $I_{IB}$   | –         | –   | 400            | –                        | –   | 500            | –      | –   | 1000           | nA   |
| Input Offset Current (Note 8)                                                              | $I_{IO}$   | –         | –   | ±150           | –                        | –   | ±200           | –      | –   | ±300           | nA   |
| Input Common Mode Voltage Range                                                            | $V_{ICMR}$ | 0         | –   | $V_{CC} - 2.0$ | 0                        | –   | $V_{CC} - 2.0$ | 0      | –   | $V_{CC} - 2.0$ | V    |
| Saturation Voltage<br>$V_{I(-)} \geq +1.0$ Vdc, $V_{I(+)} = 0$ ,<br>$I_{sink} \leq 4.0$ mA | $V_{sat}$  | –         | –   | 700            | –                        | –   | 700            | –      | –   | 700            | mV   |
| Output Leakage Current<br>$V_{I(+)} \geq +1.0$ Vdc, $V_{I(-)} = 0$ ,<br>$V_O = 30$ Vdc     | $I_{OL}$   | –         | –   | 1.0            | –                        | –   | 1.0            | –      | –   | 1.0            | µA   |
| Differential Input Voltage<br>All $V_I \geq 0$ Vdc                                         | $V_{ID}$   | –         | –   | $V_{CC}$       | –                        | –   | $V_{CC}$       | –      | –   | $V_{CC}$       | Vdc  |

7. (LM239)  $T_{low} = -25^{\circ}\text{C}$ ,  $T_{high} = +85^{\circ}\text{C}$   
 (LM339)  $T_{low} = 0^{\circ}\text{C}$ ,  $T_{high} = +70^{\circ}\text{C}$   
 (MC3302)  $T_{low} = -40^{\circ}\text{C}$ ,  $T_{high} = +85^{\circ}\text{C}$   
 (LM2901)  $T_{low} = -40^{\circ}\text{C}$ ,  $T_{high} = +105^{\circ}\text{C}$   
 (LM2901V & NCV2901)  $T_{low} = -40^{\circ}\text{C}$ ,  $T_{high} = +125^{\circ}\text{C}$   
*NCV2901 is qualified for automotive use.*
8. At the output switch point,  $V_O \approx 1.4$  Vdc,  $R_S \leq 100 \Omega$ ,  $5.0 \text{ Vdc} \leq V_{CC} \leq 30 \text{ Vdc}$ , with the inputs over the full common mode range (0 Vdc to  $V_{CC} - 1.5$  Vdc).
9. The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.
10. The response time specified is for a 100 mV input step with 5.0 mV overdrive. For larger signals, 300 ns is typical.



**Figure 2. Inverting Comparator with Hysteresis**



**Figure 3. Noninverting Comparator with Hysteresis**

# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## Typical Characteristics

( $V_{CC} = 15 \text{ Vdc}$ ,  $T_A = +25^\circ\text{C}$  (each comparator) unless otherwise noted.)

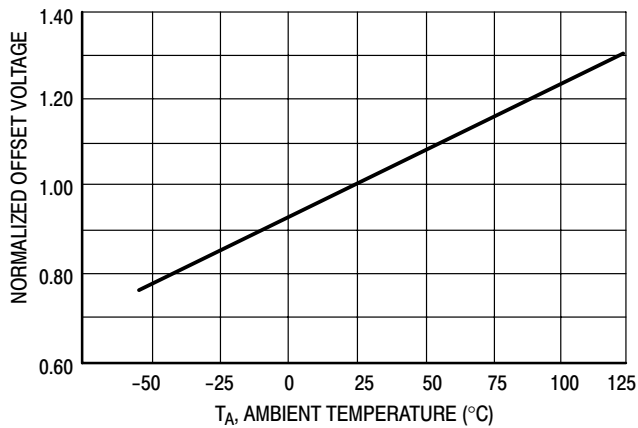


Figure 4. Normalized Input Offset Voltage

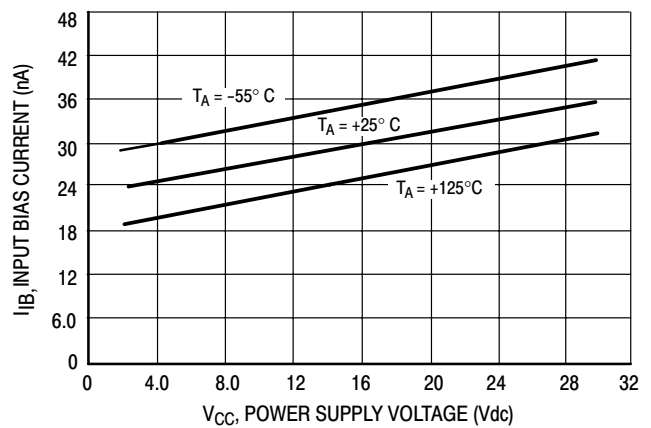


Figure 5. Input Bias Current

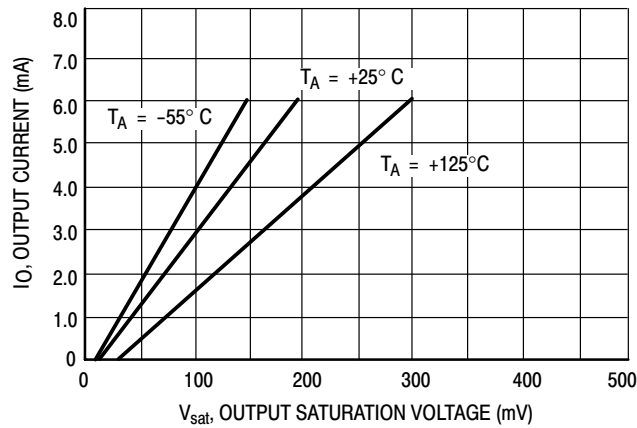
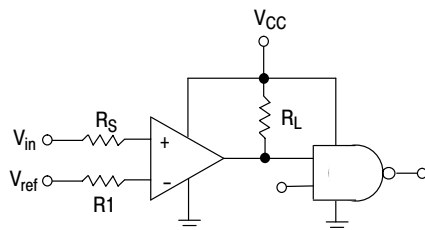


Figure 6. Output Sink Current versus Output Saturation Voltage



$R_S$  = Source Resistance  
 $R_1 \approx R_S$

| Logic | Device      | $V_{CC}$ (V) | $R_L$ k $\Omega$ |
|-------|-------------|--------------|------------------|
| CMOS  | 1/4 MC14001 | +15          | 100              |
| TTL   | 1/4 MC7400  | +5.0         | 10               |

Figure 7. Driving Logic

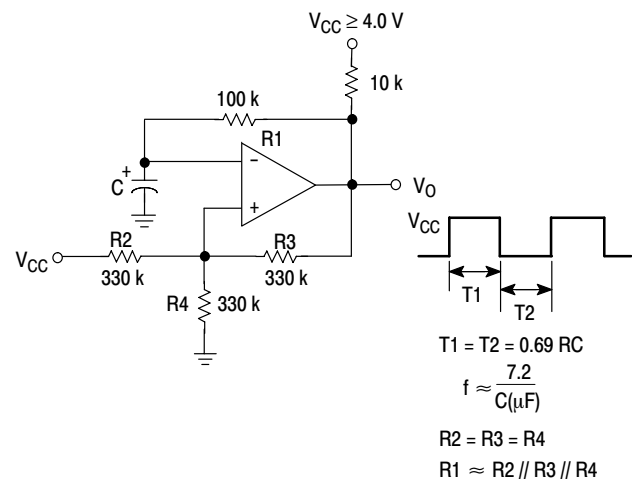
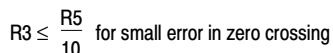


Figure 8. Squarewave Oscillator

Differential input voltages may be larger than supply voltages without damaging the comparator's inputs. Voltages more negative than  $-300\text{ mV}$  should not be used.



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

The diagram shows a circuit and its corresponding waveforms. The circuit is an inverting amplifier with a feedback resistor of 10 kΩ. The input is a sine wave  $V_{in}$  connected to the inverting input (-). The non-inverting input (+) is connected to ground. The output  $V_O$  is taken from the output terminal. The supply rails are labeled  $V_{CC}$  and  $V_{EE}$ . The waveforms show the input sine wave  $V_{in}$  and the output square wave  $V_O$ . The phase shift  $\Delta\theta$  is indicated between the zero-crossing of the input sine wave and the transition of the output square wave. The minimum input voltage  $V_{in(min)}$  is marked on the sine wave.

## ORDERING INFORMATION

| Device      | Package              | Shipping <sup>†</sup> |
|-------------|----------------------|-----------------------|
| LM239D      | SOIC-14              | 55 Units/Tube         |
| LM239DG     | SOIC-14<br>(Pb-Free) |                       |
| LM239DR2    | SOIC-14              | 2500 / Tape & Reel    |
| LM239DR2G   | SOIC-14<br>(Pb-Free) |                       |
| LM239DTBR2  | TSSOP-14*            |                       |
| LM239DTBR2G | TSSOP-14*            |                       |
| LM239N      | PDIP-14              | 25 Units/Rail         |
| LM239NG     | PDIP-14<br>(Pb-Free) |                       |
| LM339D      | SOIC-14              | 55 Units/Tube         |
| LM339DG     | SOIC-14<br>(Pb-Free) |                       |
| LM339DR2    | SOIC-14              | 2500 / Tape & Reel    |
| LM339DR2G   | SOIC-14<br>(Pb-Free) |                       |
| LM339DTBR2  | TSSOP-14*            |                       |
| LM339DTBR2G | TSSOP-14*            |                       |

\*This package is inherently Pb-Free.

# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## ORDERING INFORMATION

| Device        | Package              | Shipping <sup>†</sup> |
|---------------|----------------------|-----------------------|
| LM339N        | PDIP-14              | 25 Units/Rail         |
| LM339NG       | PDIP-14<br>(Pb-Free) |                       |
| LM2901D       | SOIC-14              | 55 Units/Rail         |
| LM2901DG      | SOIC-14<br>(Pb-Free) |                       |
| LM2901DR2     | SOIC-14              | 2500 / Tape & Reel    |
| LM2901DR2G    | SOIC-14<br>(Pb-Free) |                       |
| LM2901DTBR2   | TSSOP-14*            |                       |
| LM2901DTBR2G  | TSSOP-14*            |                       |
| LM2901N       | PDIP-14              | 25 Units/Rail         |
| LM2901NG      | PDIP-14<br>(Pb-Free) |                       |
| LM2901VD      | SOIC-14              | 55 Units/Tube         |
| LM2901VDG     | SOIC-14<br>(Pb-Free) |                       |
| LM2901VDR2    | SOIC-14              | 2500 / Tape & Reel    |
| LM2901VDR2G   | SOIC-14<br>(Pb-Free) |                       |
| LM2901VDTBR2  | TSSOP-14*            |                       |
| LM2901VDTBR2G | TSSOP-14*            |                       |
| LM2901VN      | PDIP-14              | 25 Units/Rail         |
| LM2901VNG     | PDIP-14<br>(Pb-Free) |                       |
| NCV2901DR2    | SOIC-14              | 2500 / Tape & Reel    |
| NCV2901DR2G   | SOIC-14<br>(Pb-Free) |                       |
| NCV2901DTBR2G | TSSOP-14*            |                       |
| NCV2901CTR    | Bare Die             | 6000 / Tape & Reel    |
| MC3302D       | SOIC-14              | 55 Units/Tube         |
| MC3302DG      | SOIC-14<br>(Pb-Free) |                       |
| MC3302DR2     | SOIC-14              | 2500 / Tape & Reel    |
| MC3302DR2G    | SOIC-14<br>(Pb-Free) |                       |
| MC3302DTBR2   | TSSOP-14*            |                       |
| MC3302DTBR2G  | TSSOP-14*            |                       |
| MC3302P       | PDIP-14              | 25 Units/Rail         |
| MC3302PG      | PDIP-14<br>(Pb-Free) |                       |

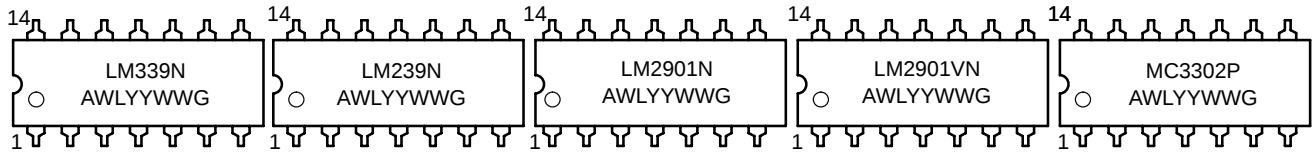
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

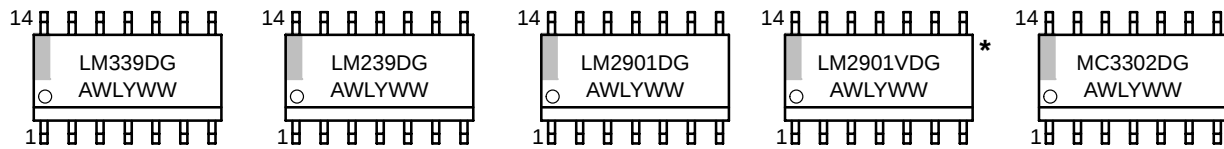
# LM339, LM239, LM2901, LM2901V, NCV2901, MC3302

## MARKING DIAGRAMS

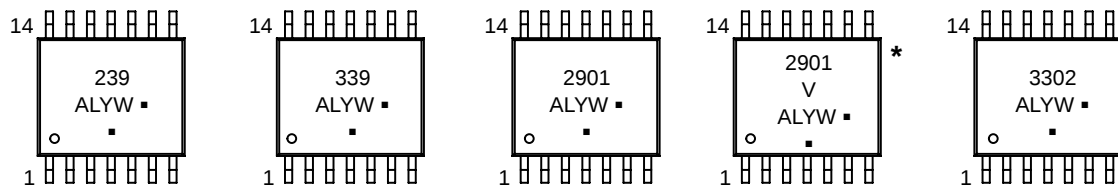
### PDIP-14 N, P SUFFIX CASE 646



### SOIC-14 D SUFFIX CASE 751A



### TSSOP-14 DTB SUFFIX CASE 948G



A = Assembly Location

WL, L = Wafer Lot

YY, Y = Year

WW, W = Work Week

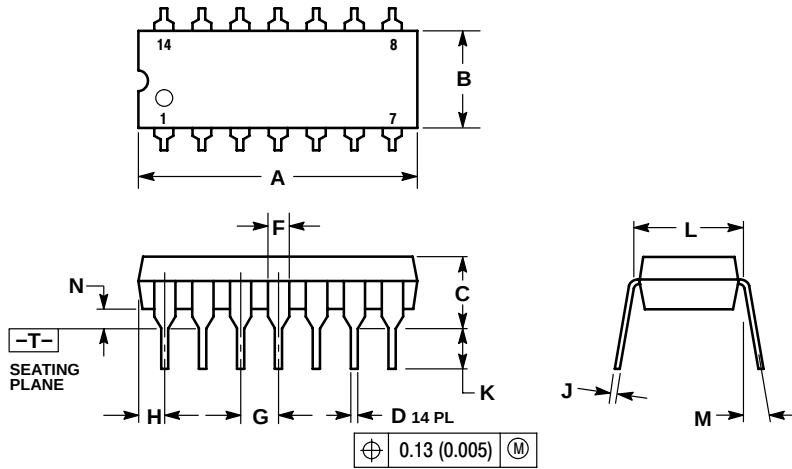
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

\*This marking diagram also applies to NCV2901.

PACKAGE DIMENSIONS

PDIP-14  
CASE 646-06  
ISSUE P



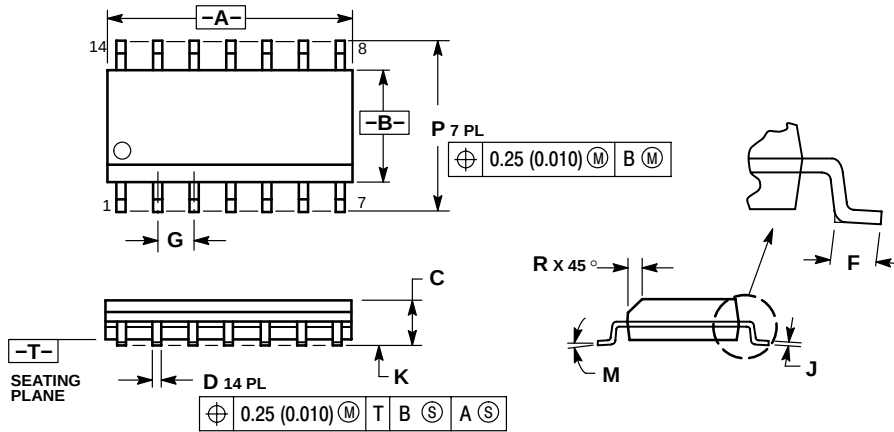
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 19.56 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.290     | 0.310 | 7.37        | 7.87  |
| M   | ---       | 10°   | ---         | 10°   |
| N   | 0.015     | 0.039 | 0.38        | 1.01  |

PACKAGE DIMENSIONS

SOIC-14  
CASE 751A-03  
ISSUE H

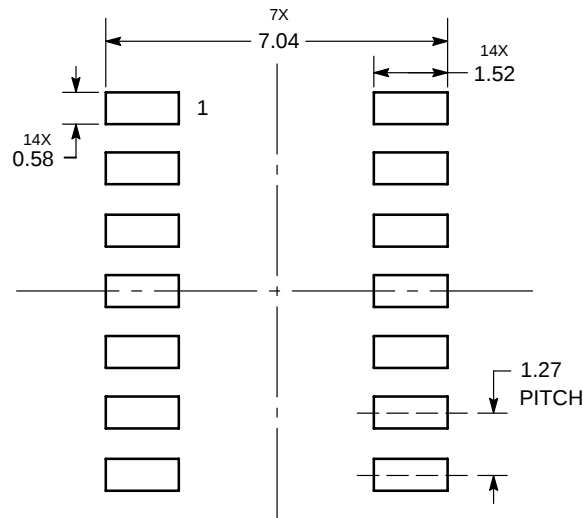


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 8.55        | 8.75 | 0.337     | 0.344 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.054     | 0.068 |
| D   | 0.35        | 0.49 | 0.014     | 0.019 |
| E   | 0.40        | 1.25 | 0.016     | 0.049 |
| F   | 1.27 BSC    |      | 0.050 BSC |       |
| J   | 0.19        | 0.25 | 0.008     | 0.009 |
| K   | 0.10        | 0.25 | 0.004     | 0.009 |
| M   | 0°          | 7°   | 0°        | 7°    |
| P   | 5.80        | 6.20 | 0.228     | 0.244 |
| R   | 0.25        | 0.50 | 0.010     | 0.019 |

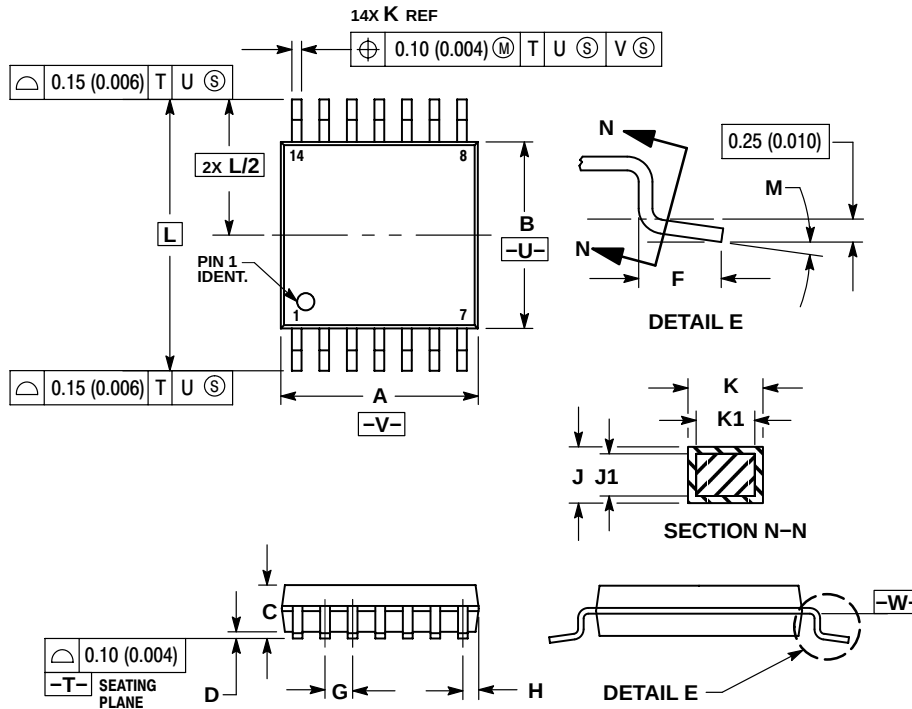
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

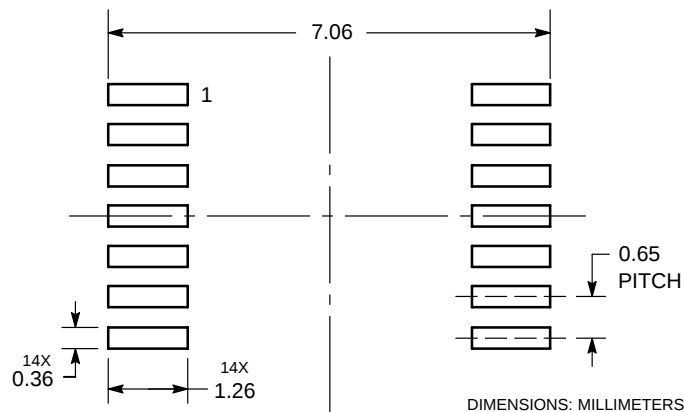
TSSOP-14  
CASE 948G-01  
ISSUE B

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.90        | 5.10 | 0.193     | 0.200 |
| B   | 4.30        | 4.50 | 0.169     | 0.177 |
| C   | ---         | 1.20 | ---       | 0.047 |
| D   | 0.05        | 0.15 | 0.002     | 0.006 |
| F   | 0.50        | 0.75 | 0.020     | 0.030 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.50        | 0.60 | 0.020     | 0.024 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0° 8°       |      | 0° 8°     |       |

## SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

#### PUBLICATION ORDERING INFORMATION

##### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada

Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910

Japan Customer Focus Center  
Phone: 81-3-5773-3850

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local  
Sales Representative