

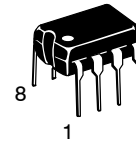
# Low Offset Voltage Dual Comparators

## LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

The LM393 series are dual independent precision voltage comparators capable of single or split supply operation. These devices are designed to permit a common mode range-to-ground level with single supply operation. Input offset voltage specifications as low as 2.0 mV make this device an excellent selection for many applications in consumer, automotive, and industrial electronics.

### Features

- Wide Single-Supply Range: 2.0 Vdc to 36 Vdc
- Split-Supply Range:  $\pm 1.0$  Vdc to  $\pm 18$  Vdc
- Very Low Current Drain Independent of Supply Voltage: 0.4 mA
- Low Input Bias Current: 25 nA
- Low Input Offset Current: 5.0 nA
- Low Input Offset Voltage: 5.0 mV (max) LM293/393
- Input Common Mode Range to Ground Level
- Differential Input Voltage Range Equal to Power Supply Voltage
- Output Voltage Compatible with DTL, ECL, TTL, MOS, and CMOS Logic Levels
- ESD Clamps on the Inputs Increase the Ruggedness of the Device without Affecting Performance
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



PDIP-8  
N SUFFIX  
CASE 626

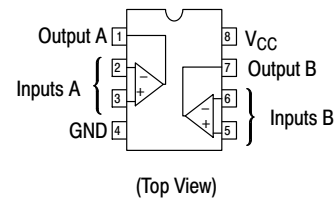


SOIC-8  
D SUFFIX  
CASE 751



Micro8™  
DM SUFFIX  
CASE 846A

### PIN CONNECTIONS



### DEVICE MARKING AND ORDERING INFORMATION

See detailed marking information and ordering and shipping information on page 6 of this data sheet.

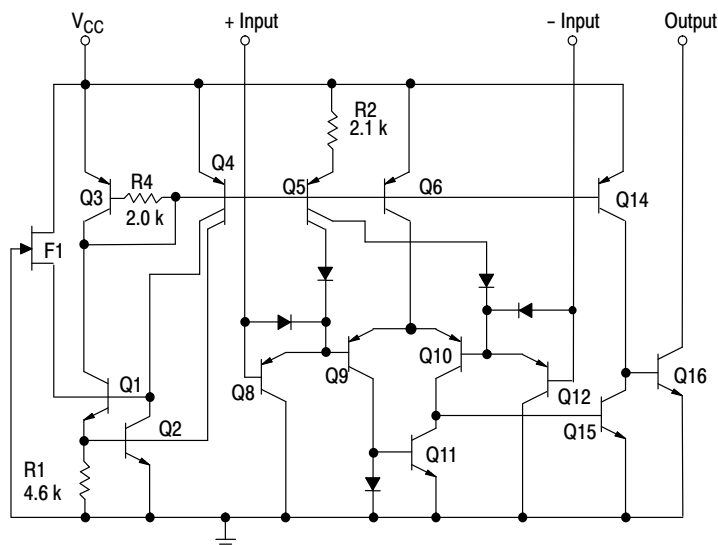


Figure 1. Representative Schematic Diagram  
(Diagram shown is for 1 comparator)

# LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

## MAXIMUM RATINGS

| Rating                                                                                                        | Symbol                     | Value                                                | Unit                       |
|---------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------|----------------------------|
| Power Supply Voltage                                                                                          | $V_{CC}$                   | +36 or $\pm 18$                                      | V                          |
| Input Differential Voltage                                                                                    | $V_{IDR}$                  | 36                                                   | V                          |
| Input Common Mode Voltage Range                                                                               | $V_{ICR}$                  | -0.3 to +36                                          | V                          |
| Output Voltage                                                                                                | $V_O$                      | 36                                                   | V                          |
| Output Short Circuit-to-Ground<br>Output Sink Current (Note 1)                                                | $I_{SC}$<br>$I_{Sink}$     | Continuous<br>20                                     | mA                         |
| Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$                               | $P_D$<br>$1/R_{\theta JA}$ | 570<br>5.7                                           | mW<br>mW/ $^\circ\text{C}$ |
| Operating Ambient Temperature Range<br>LM293<br>LM393, LM393E<br>LM2903, LM2903E<br>LM2903V, NCV2903 (Note 2) | $T_A$                      | -25 to +85<br>0 to +70<br>-40 to +105<br>-40 to +125 | $^\circ\text{C}$           |
| Maximum Operating Junction Temperature<br>LM393, LM393E, LM2903, LM2903E, LM2903V<br>LM293, NCV2903           | $T_{J(max)}$               | 150<br>150                                           | $^\circ\text{C}$           |
| Storage Temperature Range                                                                                     | $T_{stg}$                  | -65 to +150                                          | $^\circ\text{C}$           |

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.
2. NCV2903 is qualified for automotive use.

## ESD RATINGS

| Rating                                                                 | HBM  | MM  | Unit |
|------------------------------------------------------------------------|------|-----|------|
| ESD Protection at any Pin (Human Body Model – HBM, Machine Model – MM) |      |     |      |
| NCV2903 (Note 2)                                                       | 2000 | 200 | V    |
| LM393E, LM2903E                                                        | 1500 | 150 | V    |
| LM393DG/DR2G, LM2903DG/DR2G                                            | 250  | 100 | V    |
| All Other Devices                                                      | 1500 | 150 | V    |

# LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0$ Vdc, $T_{low} \leq T_A \leq T_{high}$ , unless otherwise noted.)

| Characteristic                                                                                                                                                                                               | Symbol     | LM293, LM393, LM393E |           |                | LM2903/E/V,<br>NCV2903 |           |                | Unit          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------------------|-----------|----------------|------------------------|-----------|----------------|---------------|
|                                                                                                                                                                                                              |            | Min                  | Typ       | Max            | Min                    | Typ       | Max            |               |
| Input Offset Voltage (Note 4)<br>$T_A = 25^\circ\text{C}$<br>$T_{low} \leq T_A \leq T_{high}$                                                                                                                | $V_{IO}$   | –                    | $\pm 1.0$ | $\pm 5.0$      | –                      | $\pm 2.0$ | $\pm 7.0$      | mV            |
|                                                                                                                                                                                                              |            | –                    | –         | $\pm 9.0$      | –                      | $\pm 9.0$ | $\pm 15$       |               |
| Input Offset Current<br>$T_A = 25^\circ\text{C}$<br>$T_{low} \leq T_A \leq T_{high}$                                                                                                                         | $I_{IO}$   | –                    | $\pm 5.0$ | $\pm 50$       | –                      | $\pm 5.0$ | $\pm 50$       | nA            |
|                                                                                                                                                                                                              |            | –                    | –         | $\pm 150$      | –                      | $\pm 50$  | $\pm 200$      |               |
| Input Bias Current (Note 5)<br>$T_A = 25^\circ\text{C}$<br>$T_{low} \leq T_A \leq T_{high}$                                                                                                                  | $I_{IB}$   | –                    | 20        | 250            | –                      | 20        | 250            | nA            |
|                                                                                                                                                                                                              |            | –                    | –         | 400            | –                      | 20        | 500            |               |
| Input Common Mode Voltage Range (Note 6)<br>$T_A = 25^\circ\text{C}$<br>$T_{low} \leq T_A \leq T_{high}$                                                                                                     | $V_{ICR}$  | 0                    | –         | $V_{CC} - 1.5$ | 0                      | –         | $V_{CC} - 1.5$ | V             |
|                                                                                                                                                                                                              |            | 0                    | –         | $V_{CC} - 2.0$ | 0                      | –         | $V_{CC} - 2.0$ |               |
| Voltage Gain<br>$R_L \geq 15$ k $\Omega$ , $V_{CC} = 15$ Vdc, $T_A = 25^\circ\text{C}$                                                                                                                       | $A_{VOL}$  | 50                   | 200       | –              | 25                     | 200       | –              | V/mV          |
| Large Signal Response Time<br>$V_{in} = \text{TTL Logic Swing}$ , $V_{ref} = 1.4$ Vdc<br>$V_{RL} = 5.0$ Vdc, $R_L = 5.1$ k $\Omega$ , $T_A = 25^\circ\text{C}$                                               | –          | –                    | 300       | –              | –                      | 300       | –              | ns            |
| Response Time (Note 7)<br>$V_{RL} = 5.0$ Vdc, $R_L = 5.1$ k $\Omega$ , $T_A = 25^\circ\text{C}$                                                                                                              | $t_{TLH}$  | –                    | 1.3       | –              | –                      | 1.5       | –              | $\mu\text{s}$ |
| Input Differential Voltage (Note 8)<br>All $V_{in} \geq \text{GND}$ or $V^-$ Supply (if used)                                                                                                                | $V_{ID}$   | –                    | –         | $V_{CC}$       | –                      | –         | $V_{CC}$       | V             |
| Output Sink Current<br>$V_{in} \geq 1.0$ Vdc, $V_{in+} = 0$ Vdc, $V_O \leq 1.5$ Vdc $T_A = 25^\circ\text{C}$                                                                                                 | $I_{Sink}$ | 6.0                  | 16        | –              | 6.0                    | 16        | –              | mA            |
| Output Saturation Voltage<br>$V_{in} \geq 1.0$ Vdc, $V_{in+} = 0$ , $I_{Sink} \leq 4.0$ mA, $T_A = 25^\circ\text{C}$<br>$T_{low} \leq T_A \leq T_{high}$                                                     | $V_{OL}$   | –                    | 150       | 400            | –                      | –         | 400            | mV            |
|                                                                                                                                                                                                              |            | –                    | –         | 700            | –                      | 200       | 700            |               |
| Output Leakage Current<br>$V_{in-} = 0$ V, $V_{in+} \geq 1.0$ Vdc, $V_O = 5.0$ Vdc, $T_A = 25^\circ\text{C}$<br>$V_{in-} = 0$ V, $V_{in+} \geq 1.0$ Vdc, $V_O = 30$ Vdc,<br>$T_{low} \leq T_A \leq T_{high}$ | $I_{OL}$   | –                    | 0.1       | –              | –                      | 0.1       | –              | nA            |
|                                                                                                                                                                                                              |            | –                    | –         | 1000           | –                      | –         | 1000           |               |
| Supply Current<br>$R_L = \infty$ Both Comparators, $T_A = 25^\circ\text{C}$<br>$R_L = \infty$ Both Comparators, $V_{CC} = 30$ V                                                                              | $I_{CC}$   | –                    | 0.4       | 1.0            | –                      | 0.4       | 1.0            | mA            |
|                                                                                                                                                                                                              |            | –                    | –         | 2.5            | –                      | –         | 2.5            |               |

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.

LM293  $T_{low} = -25^\circ\text{C}$ ,  $T_{high} = +85^\circ\text{C}$

LM393, LM393E  $T_{low} = 0^\circ\text{C}$ ,  $T_{high} = +70^\circ\text{C}$

LM2903, LM2903E  $T_{low} = -40^\circ\text{C}$ ,  $T_{high} = +105^\circ\text{C}$

LM2903V & NCV2903  $T_{low} = -40^\circ\text{C}$ ,  $T_{high} = +125^\circ\text{C}$

NCV2903 is qualified for automotive use.

- 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.
- At output switch point,  $V_O \approx 1.4$  Vdc,  $R_S = 0$   $\Omega$  with  $V_{CC}$  from 5.0 Vdc to 30 Vdc, and over the full input common mode range (0 V to  $V_{CC} - 1.5$  V).
- Due to the PNP transistor inputs, bias current will flow out of the inputs. This current is essentially constant, independent of the output state, therefore, no loading changes will exist on the input lines.
- Input common mode of either input should not be permitted to go more than 0.3 V negative of ground or minus supply. The upper limit of common mode range is  $V_{CC} - 1.5$  V.
- Response time is specified with a 100 mV step and 5.0 mV of overdrive. With larger magnitudes of overdrive faster response times are obtainable.
- The comparator will exhibit proper output state if one of the inputs becomes greater than  $V_{CC}$ , the other input must remain within the common mode range. The low input state must not be less than  $-0.3$  V of ground or minus supply.



LM293/393

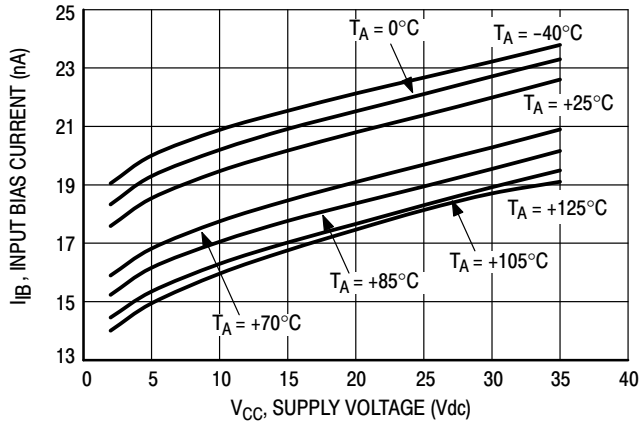


Figure 2. Input Bias Current versus Power Supply Voltage

LM2903

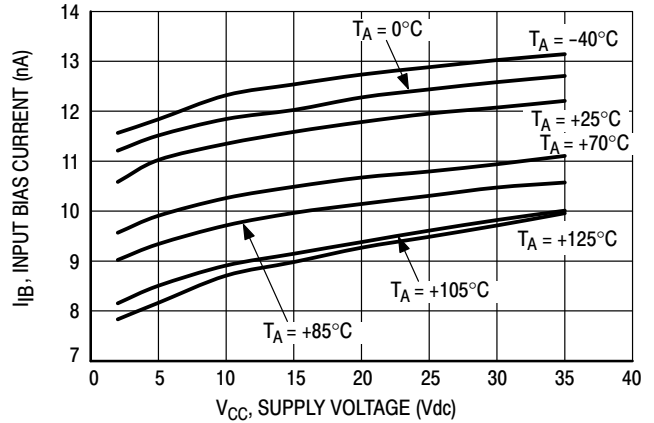


Figure 3. Input Bias Current versus Power Supply Voltage

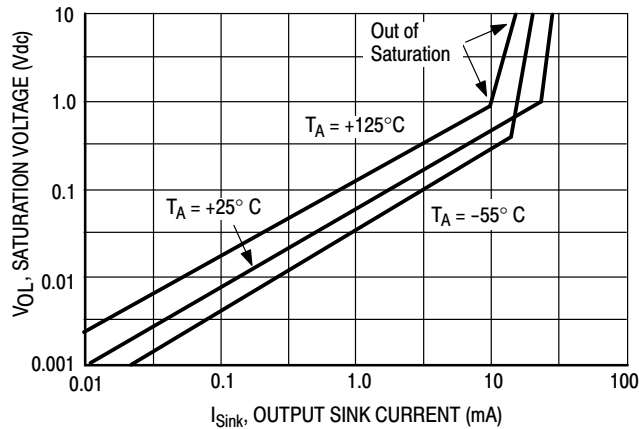


Figure 4. Output Saturation Voltage versus Output Sink Current

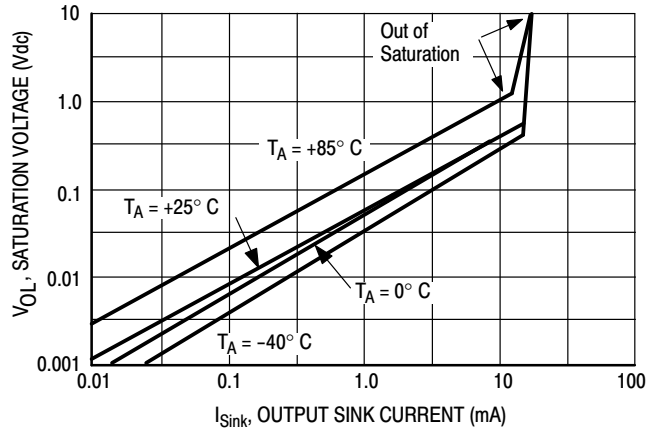


Figure 5. Output Saturation Voltage versus Output Sink Current

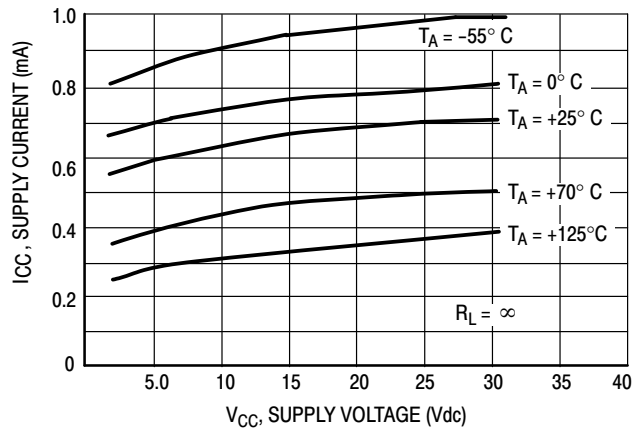


Figure 6. Power Supply Current versus Power Supply Voltage

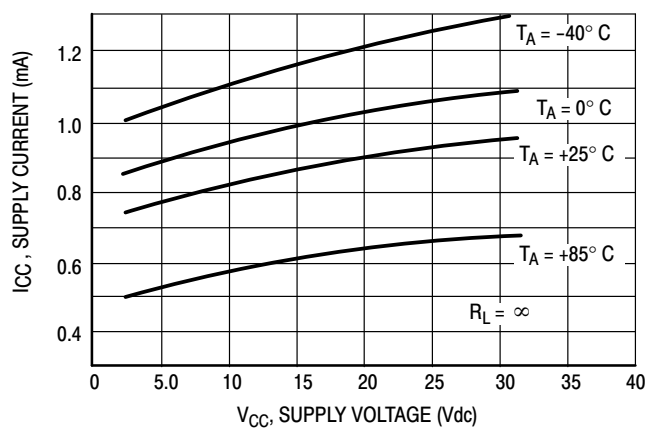


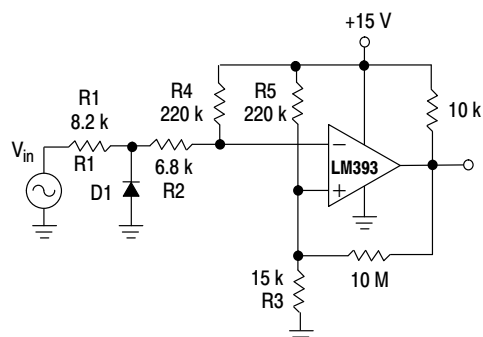
Figure 7. Power Supply Current versus Power Supply Voltage

## APPLICATIONS INFORMATION

These dual comparators feature high gain, wide bandwidth characteristics. This gives device oscillation tendencies if the outputs are capacitively coupled to the inputs via stray capacitance during output transients. To minimize risk of these oscillations, avoid routing output and negative input traces in parallel or put VCC or GND trace between them for coupling reduction. It is also good to keep input resistors as low as possible and place them close to device.

The addition of positive feedback (<10 mV) is also recommended. It is good design practice to ground all unused pins.

Differential input voltages may be larger than supply voltage without damaging the comparator's inputs. Voltages more negative than -0.3 V should not be used.

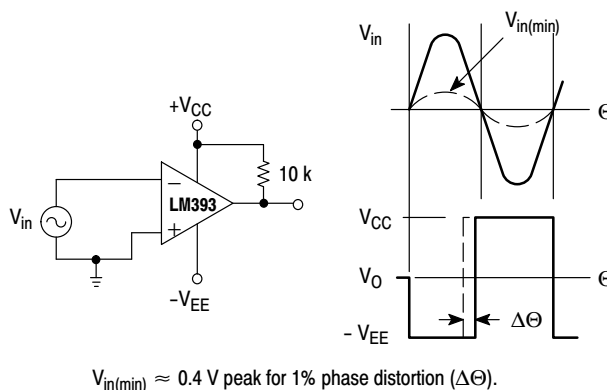


D1 prevents input from going negative by more than 0.6 V.

$$R1 + R2 = R3$$

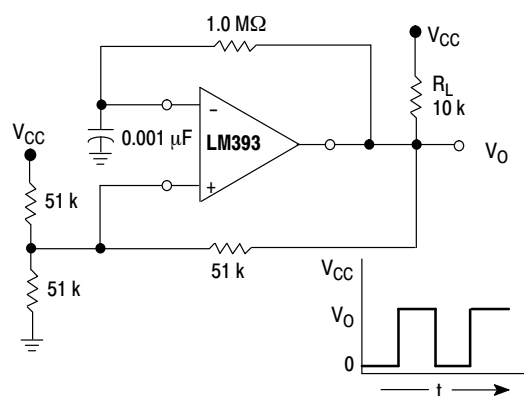
$$R3 \leq \frac{R5}{10} \text{ for small error in zero crossing.}$$

**Figure 8. Zero Crossing Detector (Single Supply)**

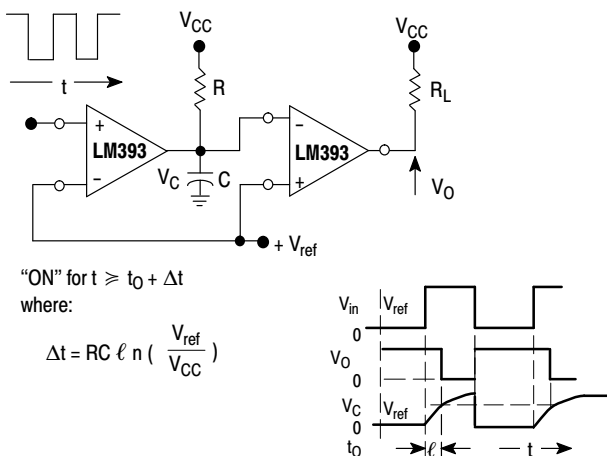


$$V_{in(min)} \approx 0.4 \text{ V peak for } 1\% \text{ phase distortion } (\Delta\Theta).$$

**Figure 9. Zero Crossing Detector (Split Supply)**



**Figure 10. Free-Running Square-Wave Oscillator**

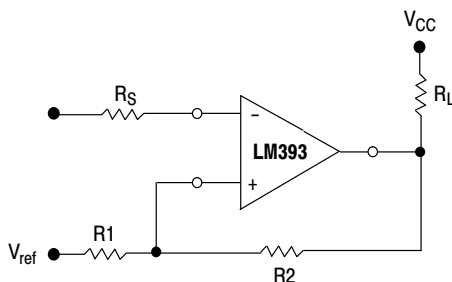


"ON" for  $t \geq t_0 + \Delta t$

where:

$$\Delta t = RC \ln \left( \frac{V_{ref}}{V_{CC}} \right)$$

**Figure 11. Time Delay Generator**



$$R_S = R1 \parallel R2$$

$$V_{th1} = V_{ref} + \frac{(V_{CC} - V_{ref}) R1}{R1 + R2 + R_L}$$

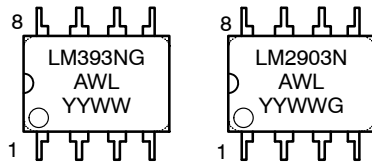
$$V_{th2} = V_{ref} - \frac{(V_{ref} - V_{O Low}) R1}{R1 + R2}$$

**Figure 12. Comparator with Hysteresis**

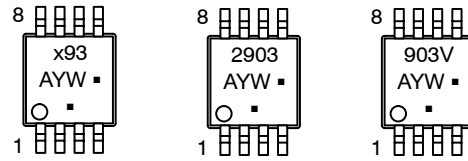
# LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

## MARKING DIAGRAMS

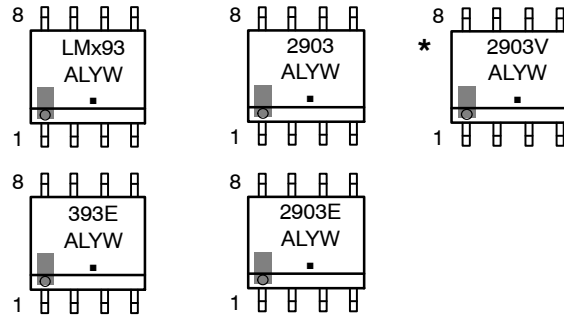
**PDIP-8  
CASE 626**



**Micro8  
CASE 846A**



**SOIC-8  
CASE 751**



x = 2 or 3  
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
▪, G = Pb-Free Package

(Note: Microdot may be in either location)

\*This marking diagram also applies to NCV2903DR2G

# LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

## ORDERING INFORMATION

| Device        | Operating Temperature Range | Package             | Shipping <sup>†</sup> |
|---------------|-----------------------------|---------------------|-----------------------|
| LM293DG       | -25 °C to +85 °C            | SOIC-8<br>(Pb-Free) | 98 Units / Rail       |
| LM293DR2G     |                             |                     | 2500 / Tape & Reel    |
| LM293DMR2G    |                             | Micro8<br>(Pb-Free) | 4000 / Tape and Reel  |
| LM393DG       | 0 °C to +70 °C              | SOIC-8<br>(Pb-Free) | 98 Units / Rail       |
| LM393DR2G     |                             |                     | 2500 / Tape & Reel    |
| LM393EDR2G    |                             | SOIC-8<br>(Pb-Free) | 2500 / Tape & Reel    |
| LM393NG       |                             | PDIP-8<br>(Pb-Free) | 50 Units / Rail       |
| LM393DMR2G    |                             | Micro8<br>(Pb-Free) | 4000 / Tape and Reel  |
| LM2903DG      | -40 °C to +105 °C           | SOIC-8<br>(Pb-Free) | 98 Units / Rail       |
| LM2903DR2G    |                             |                     | 2500 / Tape & Reel    |
| LM2903EDR2G   |                             | SOIC-8<br>(Pb-Free) | 2500 / Tape & Reel    |
| LM2903DMR2G   |                             | Micro8<br>(Pb-Free) | 4000 / Tape and Reel  |
| LM2903NG      |                             | PDIP-8<br>(Pb-Free) | 50 Units / Rail       |
| LM2903VDG     | -40 °C to +125 °C           | SOIC-8<br>(Pb-Free) | 98 Units / Rail       |
| LM2903VDR2G   |                             |                     | 2500 / Tape & Reel    |
| LM2903VNG     |                             | PDIP-8<br>(Pb-Free) | 50 Units / Rail       |
| NCV2903DR2G*  |                             | SOIC-8<br>(Pb-Free) | 2500 / Tape & Reel    |
| NCV2903DMR2G* |                             | Micro8<br>(Pb-Free) | 4000 / Tape & Reel    |

† 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](#).

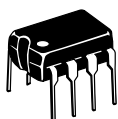
\* NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

**REVISION HISTORY**

| <b>Revision</b> | <b>Description of Changes</b>                                                                                                                       | <b>Date</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 34              | Front page layout update, update of the first paragraph of the Applications Information section (p.5) and an update of Figure 8 and Figure 10 (p.5) | 9/16/2025   |

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

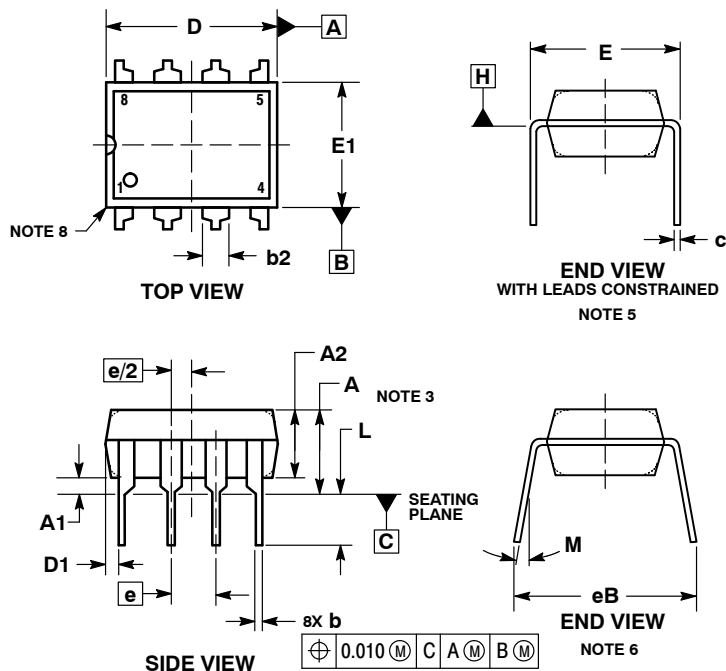




**SCALE 1:1**

**PDIP-8**  
CASE 626-05  
ISSUE P

DATE 22 APR 2015



STYLE 1:

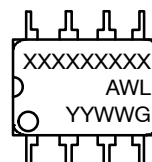
- PIN 1. AC IN  
2. DC + IN  
3. DC - IN  
4. AC IN  
5. GROUND  
6. OUTPUT  
7. AUXILIARY  
8.  $V_{CC}$

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   | 0.015     | 0.210            | 0.38        | 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   | 0.355     | 0.400            | 9.02        | 10.16            |
| 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 <sup>-3</sup> |             | 10 <sup>-3</sup> |

### GENERIC MARKING DIAGRAM\*



- XXXX = 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 "a", may or may not be present. Some products may not follow the Generic Marking.

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98ASB42420B</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>PDIP-8</b>      | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

**onsemi** and **onsemi** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** 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. **onsemi** does not convey any license under its patent rights nor the rights of others.



SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION 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.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

GENERIC  
MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = 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. Some products may not follow the Generic Marking.

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

STYLES ON PAGE 2

|                  |             |                                                                                                                                                                                     |
|------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98ASB42564B | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | SOIC-8 NB   | PAGE 1 OF 2                                                                                                                                                                         |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi 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. onsemi does not convey any license under its patent rights nor the rights of others.

**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

|                                                                                                                                                                                                   |                                                                                                                                                                                          |                                                                                                                                                                                    |                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. EMITTER<br>2. COLLECTOR<br>3. COLLECTOR<br>4. EMITTER<br>5. EMITTER<br>6. BASE<br>7. BASE<br>8. EMITTER                                                                 | <b>STYLE 2:</b><br>PIN 1. COLLECTOR, DIE, #1<br>2. COLLECTOR, #1<br>3. COLLECTOR, #2<br>4. COLLECTOR, #2<br>5. BASE, #2<br>6. EMITTER, #2<br>7. BASE, #1<br>8. EMITTER, #1               | <b>STYLE 3:</b><br>PIN 1. DRAIN, DIE #1<br>2. DRAIN, #1<br>3. DRAIN, #2<br>4. DRAIN, #2<br>5. GATE, #2<br>6. SOURCE, #2<br>7. GATE, #1<br>8. SOURCE, #1                            | <b>STYLE 4:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE<br>4. ANODE<br>5. ANODE<br>6. ANODE<br>7. ANODE<br>8. COMMON CATHODE                                                                           |
| <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. DRAIN<br>3. DRAIN<br>4. DRAIN<br>5. GATE<br>6. GATE<br>7. SOURCE<br>8. SOURCE                                                                               | <b>STYLE 6:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. DRAIN<br>4. SOURCE<br>5. SOURCE<br>6. GATE<br>7. GATE<br>8. SOURCE                                                                    | <b>STYLE 7:</b><br>PIN 1. INPUT<br>2. EXTERNAL BYPASS<br>3. THIRD STAGE SOURCE<br>4. GROUND<br>5. DRAIN<br>6. GATE 3<br>7. SECOND STAGE Vd<br>8. FIRST STAGE Vd                    | <b>STYLE 8:</b><br>PIN 1. COLLECTOR, DIE #1<br>2. BASE, #1<br>3. BASE, #2<br>4. COLLECTOR, #2<br>5. COLLECTOR, #2<br>6. EMITTER, #2<br>7. EMITTER, #1<br>8. COLLECTOR, #1                              |
| <b>STYLE 9:</b><br>PIN 1. EMITTER, COMMON<br>2. COLLECTOR, DIE #1<br>3. COLLECTOR, DIE #2<br>4. EMITTER, COMMON<br>5. EMITTER, COMMON<br>6. BASE, DIE #2<br>7. BASE, DIE #1<br>8. EMITTER, COMMON | <b>STYLE 10:</b><br>PIN 1. GROUND<br>2. BIAS 1<br>3. OUTPUT<br>4. GROUND<br>5. GROUND<br>6. BIAS 2<br>7. INPUT<br>8. GROUND                                                              | <b>STYLE 11:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. DRAIN 2<br>7. DRAIN 1<br>8. DRAIN 1                                               | <b>STYLE 12:</b><br>PIN 1. SOURCE<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                                 |
| <b>STYLE 13:</b><br>PIN 1. N.C.<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                              | <b>STYLE 14:</b><br>PIN 1. N-SOURCE<br>2. N-GATE<br>3. P-SOURCE<br>4. P-GATE<br>5. P-DRAIN<br>6. P-DRAIN<br>7. N-DRAIN<br>8. N-DRAIN                                                     | <b>STYLE 15:</b><br>PIN 1. ANODE 1<br>2. ANODE 1<br>3. ANODE 1<br>4. ANODE 1<br>5. CATHODE, COMMON<br>6. CATHODE, COMMON<br>7. CATHODE, COMMON<br>8. CATHODE, COMMON               | <b>STYLE 16:</b><br>PIN 1. EMITTER, DIE #1<br>2. BASE, DIE #1<br>3. EMITTER, DIE #2<br>4. BASE, DIE #2<br>5. COLLECTOR, DIE #2<br>6. COLLECTOR, DIE #2<br>7. COLLECTOR, DIE #1<br>8. COLLECTOR, DIE #1 |
| <b>STYLE 17:</b><br>PIN 1. VCC<br>2. V2OUT<br>3. V1OUT<br>4. TXE<br>5. RXE<br>6. VEE<br>7. GND<br>8. ACC                                                                                          | <b>STYLE 18:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. CATHODE<br>8. CATHODE                                                                 | <b>STYLE 19:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. MIRROR 2<br>7. DRAIN 1<br>8. MIRROR 1                                             | <b>STYLE 20:</b><br>PIN 1. SOURCE (N)<br>2. GATE (N)<br>3. SOURCE (P)<br>4. GATE (P)<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                   |
| <b>STYLE 21:</b><br>PIN 1. CATHODE 1<br>2. CATHODE 2<br>3. CATHODE 3<br>4. CATHODE 4<br>5. CATHODE 5<br>6. COMMON ANODE<br>7. COMMON ANODE<br>8. CATHODE 6                                        | <b>STYLE 22:</b><br>PIN 1. I/O LINE 1<br>2. COMMON CATHODE/VCC<br>3. COMMON CATHODE/VCC<br>4. I/O LINE 3<br>5. COMMON ANODE/GND<br>6. I/O LINE 4<br>7. I/O LINE 5<br>8. COMMON ANODE/GND | <b>STYLE 23:</b><br>PIN 1. LINE 1 IN<br>2. COMMON ANODE/GND<br>3. COMMON ANODE/GND<br>4. LINE 2 IN<br>5. LINE 2 OUT<br>6. COMMON ANODE/GND<br>7. COMMON ANODE/GND<br>8. LINE 1 OUT | <b>STYLE 24:</b><br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR/ANODE<br>4. COLLECTOR/ANODE<br>5. CATHODE<br>6. CATHODE<br>7. COLLECTOR/ANODE<br>8. COLLECTOR/ANODE                                      |
| <b>STYLE 25:</b><br>PIN 1. VIN<br>2. N/C<br>3. REXT<br>4. GND<br>5. IOUT<br>6. IOUT<br>7. IOUT<br>8. IOUT                                                                                         | <b>STYLE 26:</b><br>PIN 1. GND<br>2. dv/dt<br>3. ENABLE<br>4. ILIMIT<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. VCC                                                                    | <b>STYLE 27:</b><br>PIN 1. ILIMIT<br>2. OVLO<br>3. UVLO<br>4. INPUT+<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. DRAIN                                                            | <b>STYLE 28:</b><br>PIN 1. SW_TO_GND<br>2. DASIC_OFF<br>3. DASIC_SW_DET<br>4. GND<br>5. V_MON<br>6. VBULK<br>7. VBULK<br>8. VIN                                                                        |
| <b>STYLE 29:</b><br>PIN 1. BASE, DIE #1<br>2. EMITTER, #1<br>3. BASE, #2<br>4. EMITTER, #2<br>5. COLLECTOR, #2<br>6. COLLECTOR, #2<br>7. COLLECTOR, #1<br>8. COLLECTOR, #1                        | <b>STYLE 30:</b><br>PIN 1. DRAIN 1<br>2. DRAIN 1<br>3. GATE 2<br>4. SOURCE 2<br>5. SOURCE 1/DRAIN 2<br>6. SOURCE 1/DRAIN 2<br>7. SOURCE 1/DRAIN 2<br>8. GATE 1                           |                                                                                                                                                                                    |                                                                                                                                                                                                        |

|                         |                    |                                                                                                                                                                                     |
|-------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98ASB42564B</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>SOIC-8 NB</b>   | <b>PAGE 2 OF 2</b>                                                                                                                                                                  |

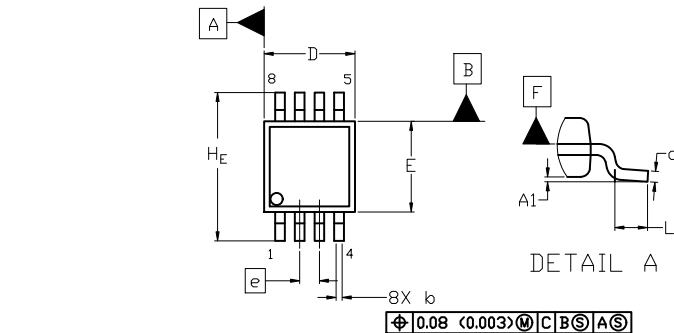
**onsemi** and **onsemi** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** 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. **onsemi** does not convey any license under its patent rights nor the rights of others.



SCALE 2:1

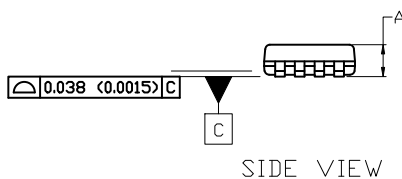
**Micro8**  
**CASE 846A-02**  
**ISSUE K**

DATE 16 JUL 2020

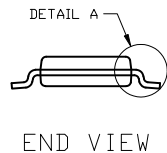


TOP VIEW

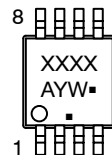
NOTE 3



SIDE VIEW



END VIEW

**GENERIC**  
**MARKING DIAGRAM\***


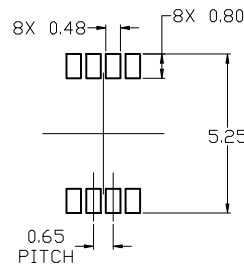
XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*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. Some products may not follow the Generic Marking.

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION E DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS D AND E ARE DETERMINED AT DATUM F.
5. DATUMS A AND B ARE TO BE DETERMINED AT DATUM F.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.


**RECOMMENDED**  
**MOUNTING FOOTPRINT**

■ For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM-10.

| DIM            | MILLIMETERS |      |      |
|----------------|-------------|------|------|
|                | MIN.        | NOM. | MAX. |
| A              | ---         | ---  | 1.10 |
| A1             | 0.05        | 0.08 | 0.15 |
| b              | 0.25        | 0.33 | 0.40 |
| c              | 0.13        | 0.18 | 0.23 |
| D              | 2.90        | 3.00 | 3.10 |
| E              | 2.90        | 3.00 | 3.10 |
| e              | 0.65 BSC    |      |      |
| H <sub>E</sub> | 4.75        | 4.90 | 5.05 |
| L              | 0.40        | 0.55 | 0.70 |

**STYLE 1:**

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- DRAIN
- DRAIN
- DRAIN
- DRAIN

**STYLE 2:**

- PIN 1. SOURCE 1
- GATE 1
- SOURCE 2
- GATE 2
- DRAIN 2
- DRAIN 2
- DRAIN 1
- DRAIN 1

**STYLE 3:**

- PIN 1. N-SOURCE
- N-GATE
- P-SOURCE
- P-GATE
- P-DRAIN
- P-DRAIN
- N-DRAIN
- N-DRAIN

|                         |                    |                                                                                                                                                                                  |
|-------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NUMBER:</b> | <b>98ASB14087C</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>MICRO8</b>      | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi 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. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)