



## LMx39x, LM2901xx Quad Differential Comparators

### 1 Features

- Wide Supply Ranges
  - Single Supply: 2 V to 36 V  
(Tested to 30 V for Non-V Devices and 32 V for V-Suffix Devices)
  - Dual Supplies:  $\pm 1$  V to  $\pm 18$  V  
(Tested to  $\pm 15$  V for Non-V Devices and  $\pm 16$  V for V-Suffix Devices)
- Low Supply-Current Drain Independent of Supply Voltage: 0.8 mA (Typical)
- Low Input Bias Current: 25 nA (Typical)
- Low Input Offset Current: 3 nA (Typical) (LM139)
- Low Input Offset Voltage: 2 mV (Typical)
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage:  $\pm 36$  V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

### 2 Applications

- Industrial
- Automotive
  - HEV/EV and Power Trains
  - Infotainment and Clusters
  - Body Control Modules
- Power Supervision
- Oscillators
- Peak Detectors
- Logic Voltage Translation

### 3 Description

The LMx39x and the LM2901xx devices consist of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible, as long as the difference between the two supplies is 2 V to 36 V, and  $V_{CC}$  is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

The LM139 and LM139A devices are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The LM239 and LM239A devices are characterized for operation from  $-25^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The LM339 and LM339A devices are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The LM2901, LM2901AV, and LM2901V devices are characterized for operation from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

**Device Information<sup>(1)</sup>**

| PART NUMBER                              | PACKAGE    | BODY SIZE (NOM)           |
|------------------------------------------|------------|---------------------------|
| LM139x                                   | CDIP (14)  | 21.30 mm $\times$ 7.60 mm |
|                                          | LCCC (20)  | 8.90 mm $\times$ 8.90 mm  |
|                                          | CFP (14)   | 9.20 mm $\times$ 6.29 mm  |
| LM139x,<br>LM239x,<br>LM339x,<br>LM2901x | SOIC (14)  | 8.70 mm $\times$ 3.90 mm  |
| LM239, LM339x,<br>LM2901                 | PDIP (14)  | 19.30 mm $\times$ 6.40 mm |
| LM239, LM2901                            | TSSOP (14) | 5.00 mm $\times$ 4.40 mm  |
| LM339x, LM2901                           | SO (14)    | 10.20 mm $\times$ 5.30 mm |
| LM339x                                   | SSOP (14)  | 6.50 mm $\times$ 5.30 mm  |

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

### Simplified Schematic



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## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

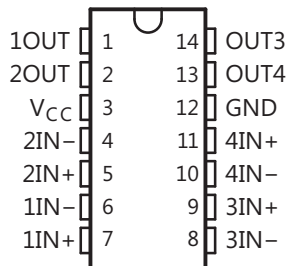
| Changes from Revision S (August 2012) to Revision T                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Page |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Deleted <i>Ordering Information</i> table. ....                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1    |
| Added Military Disclaimer to <i>Features</i> list. ....                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1    |
| Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section. No specification changes. .... | 1    |

## 5 Device Comparison Table

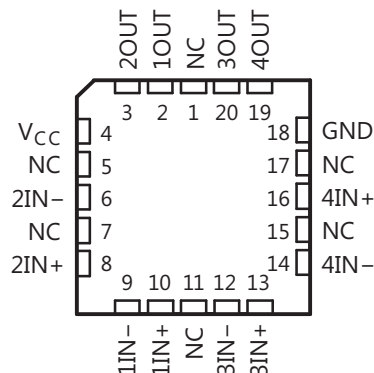
| PART NUMBER                                                   | PACKAGE    | BODY SIZE (NOM)    |
|---------------------------------------------------------------|------------|--------------------|
| LM139J, LM139AJ                                               | CDIP (14)  | 21.30 mm × 7.60 mm |
| LM139FK, LM139AFK                                             | LCCC (20)  | 8.90 mm × 8.90 mm  |
| LM139W, LM139AW                                               | CFP (14)   | 9.20 mm × 6.29 mm  |
| LM139D, LM139AD, LM239D, LM293AD, LM339D,<br>LM339AD, LM2901D | SOIC (14)  | 8.70 mm × 3.90 mm  |
| LM239N, LM339N, LM339AN, LM2901N                              | PDIP (14)  | 19.30 mm × 6.40 mm |
| LM239PW, LM2901PW                                             | TSSOP (14) | 5.00 mm × 4.40 mm  |
| LM339NS, LM339ANS, LM2901NS                                   | SOP (14)   | 10.20 mm × 5.30 mm |
| LM339DB, LM339ADB                                             | SSOP (14)  | 6.50 mm × 5.30 mm  |

## 6 Pin Configuration and Functions

D, DB, N, NS, PW, J, or W Package  
SOIC, SSOP, PDIP, SO, TSSOP, CDIP, or CFP  
Top View



FK Package  
20-Pin LCCC<sup>(1)</sup>  
Top View



(1) NC = no internal connection.

### Pin Functions

| PIN             |                           |    | I/O <sup>(1)</sup> | DESCRIPTION                            |
|-----------------|---------------------------|----|--------------------|----------------------------------------|
| NAME            | D, J, W, B, PW, DB, N, NS | FK |                    |                                        |
| 1IN+            | 7                         | 10 | I                  | Positive input pin of the comparator 1 |
| 1IN-            | 6                         | 9  | I                  | Negative input pin of the comparator 1 |
| 1OUT            | 1                         | 2  | O                  | Output pin of the comparator 1         |
| 2IN+            | 5                         | 8  | I                  | Positive input pin of the comparator 2 |
| 2IN-            | 4                         | 6  | I                  | Negative input pin of the comparator 2 |
| 2OUT            | 2                         | 3  | O                  | Output pin of the comparator 2         |
| 3IN+            | 9                         | 13 | I                  | Positive input pin of the comparator 3 |
| 3IN-            | 8                         | 12 | I                  | Negative input pin of the comparator 3 |
| 3OUT            | 14                        | 20 | O                  | Output pin of the comparator 3         |
| 4IN+            | 11                        | 16 | I                  | Positive input pin of the comparator 4 |
| 4IN-            | 10                        | 14 | I                  | Negative input pin of the comparator 4 |
| 4OUT            | 13                        | 19 | O                  | Output pin of the comparator 4         |
| GND             | 12                        | 18 | I                  | Ground                                 |
| V <sub>CC</sub> | 3                         | 4  | I                  | Supply pin                             |
| NC              | —                         | 1  | —                  | No connect (no internal connection)    |
|                 |                           | 5  |                    |                                        |
|                 |                           | 7  |                    |                                        |
|                 |                           | 11 |                    |                                        |
|                 |                           | 15 |                    |                                        |
|                 |                           | 17 |                    |                                        |

(1) I = Input, O = Output

## 7 Specifications

### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |                                                           | MIN        | MAX | UNIT |
|------------------|-----------------------------------------------------------|------------|-----|------|
| V <sub>CC</sub>  | Supply voltage <sup>(2)</sup>                             |            | 36  | V    |
| V <sub>ID</sub>  | Differential input voltage <sup>(3)</sup>                 |            | ±36 | V    |
| V <sub>I</sub>   | Input voltage range (either input)                        | –0.3       | 36  | V    |
| V <sub>O</sub>   | Output voltage                                            |            | 36  | V    |
| I <sub>O</sub>   | Output current                                            |            | 20  | mA   |
|                  | Duration of output short circuit to ground <sup>(4)</sup> | Unlimited  |     |      |
| T <sub>J</sub>   | Operating virtual-junction temperature                    |            | 150 | °C   |
|                  | Case temperature for 60 s                                 | FK package | 260 | °C   |
|                  | Lead temperature 1.6 mm (1/16 in) from case for 60 s      | J package  | 300 | °C   |
| T <sub>stg</sub> | Storage temperature                                       | –65        | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to network ground.
- (3) Differential voltages are at xIN+ with respect to xIN–.
- (4) Short circuits from outputs to V<sub>CC</sub> can cause excessive heating and eventual destruction.

### 7.2 ESD Ratings

|                    |                         | VALUE                                                                          | UNIT |
|--------------------|-------------------------|--------------------------------------------------------------------------------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±500 |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±750 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

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

|                 |                      | MIN           | MAX | UNIT |
|-----------------|----------------------|---------------|-----|------|
| V <sub>CC</sub> | Supply voltage       | Non-V devices | 2   | 30   |
|                 |                      | V devices     | 2   | 32   |
| T <sub>J</sub>  | Junction temperature | –40           | 125 | °C   |

### 7.4 Thermal Information (14-Pin Packages)

| THERMAL METRIC <sup>(1)</sup> |                                           | LMx39, LM2901 |           |          |         |            |          | UNIT    |
|-------------------------------|-------------------------------------------|---------------|-----------|----------|---------|------------|----------|---------|
|                               |                                           | D (SOIC)      | DB (SSOP) | N (PDIP) | NS (SO) | PW (TSSOP) | J (CDIP) | W (CFP) |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance    | 86            | 96        | 80       | 76      | 113        |          | °C/W    |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance |               |           |          |         |            | 15.05    | 14.65   |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

### 7.5 Thermal Information (20-Pin Packages)

| THERMAL METRIC <sup>(1)</sup> |                                           | LMx39, LM2901 | UNIT |
|-------------------------------|-------------------------------------------|---------------|------|
|                               |                                           | FK (LCCC)     |      |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance | 5.61          | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

## 7.6 Electrical Characteristics for LM139 and LM139A

at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER        |                                                 | TEST CONDITIONS <sup>(1)</sup>                                                                      |                        | T <sub>A</sub> <sup>(2)</sup> | LM139                         |      | LM139A                        |      | UNIT |
|------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------|-------------------------------|-------------------------------|------|-------------------------------|------|------|
|                  |                                                 |                                                                                                     |                        |                               | MIN                           | TYP  | MAX                           | MIN  |      |
| V <sub>IO</sub>  | Input offset voltage                            | V <sub>CC</sub> = 5 V to 30 V,<br>V <sub>IC</sub> = V <sub>ICR</sub> min,<br>V <sub>O</sub> = 1.4 V |                        | 25°C                          | 2                             | 5    | 1                             | 2    | mV   |
|                  |                                                 |                                                                                                     |                        | Full range                    | 9                             |      | 4                             |      |      |
| I <sub>IO</sub>  | Input offset current                            | V <sub>O</sub> = 1.4 V                                                                              |                        | 25°C                          | 3                             | 25   | 3                             | 25   | nA   |
|                  |                                                 |                                                                                                     |                        | Full range                    | 100                           |      | 100                           |      |      |
| I <sub>IB</sub>  | Input bias current                              | V <sub>O</sub> = 1.4 V                                                                              |                        | 25°C                          | –25                           | –100 | –25                           | –100 | nA   |
|                  |                                                 |                                                                                                     |                        | Full range                    | –300                          |      | –300                          |      |      |
| V <sub>ICR</sub> | Common-mode input-voltage range <sup>(3)</sup>  |                                                                                                     |                        | 25°C                          | 0 to<br>V <sub>CC</sub> – 1.5 |      | 0 to<br>V <sub>CC</sub> – 1.5 |      | V    |
|                  |                                                 |                                                                                                     |                        | Full range                    | 0 to<br>V <sub>CC</sub> – 2   |      | 0 to<br>V <sub>CC</sub> – 2   |      |      |
| A <sub>VD</sub>  | Large-signal differential-voltage amplification | V <sub>CC+</sub> = ±7.5 V,<br>V <sub>O</sub> = –5 V to 5 V                                          |                        | 25°C                          | 200                           |      | 50                            | 200  | V/mV |
| I <sub>OH</sub>  | High-level output current                       | V <sub>ID</sub> = 1 V                                                                               | V <sub>OH</sub> = 5 V  | 25°C                          | 0.1                           |      | 0.1                           |      | nA   |
|                  |                                                 |                                                                                                     | V <sub>OH</sub> = 30 V | Full range                    | 1                             |      | 1                             |      | μA   |
| V <sub>OL</sub>  | Low-level output voltage                        | V <sub>ID</sub> = –1 V,    I <sub>OL</sub> = 4 mA                                                   | 25°C                   | 150                           | 400                           | 150  | 400                           | mV   |      |
|                  |                                                 |                                                                                                     | Full range             | 700                           |                               | 700  |                               |      |      |
| I <sub>OL</sub>  | Low-level output current                        | V <sub>ID</sub> = –1 V,    V <sub>OL</sub> = 1.5 V                                                  | 25°C                   | 6                             | 16                            | 6    | 16                            | mA   |      |
| I <sub>CC</sub>  | Supply current (four comparators)               | V <sub>O</sub> = 2.5 V,    No load                                                                  | 25°C                   | 0.8                           | 2                             | 0.8  | 2                             | mA   |      |

- (1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
- (2) Full range (MIN to MAX) for LM139 and LM139A is –55°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
- (3) The voltage at either input or common-mode must not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ ; however, one input can exceed  $V_{CC}$ , and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 30 V without damage.

## 7.7 Electrical Characteristics for LMx39 and LMx39A

at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER        |                                                 | TEST CONDITIONS <sup>(1)</sup>                                                                            | T <sub>A</sub> <sup>(2)</sup> | LM239<br>LM339                |      | LM239A<br>LM339A              |      | UNIT |
|------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------|------|-------------------------------|------|------|
|                  |                                                 |                                                                                                           |                               | MIN                           | TYP  | MAX                           | MIN  |      |
| V <sub>IO</sub>  | Input offset voltage                            | V <sub>CC</sub> = 5 V to 30 V,<br>V <sub>IC</sub> = V <sub>ICR</sub> min,<br>V <sub>O</sub> = 1.4 V       | 25°C                          | 2                             | 5    | 1                             | 3    | mV   |
|                  |                                                 |                                                                                                           | Full range                    | 9                             |      | 4                             |      |      |
| I <sub>IO</sub>  | Input offset current                            | V <sub>O</sub> = 1.4 V                                                                                    | 25°C                          | 5                             | 50   | 5                             | 50   | nA   |
|                  |                                                 |                                                                                                           | Full range                    | 150                           |      | 150                           |      |      |
| I <sub>IB</sub>  | Input bias current                              | V <sub>O</sub> = 1.4 V                                                                                    | 25°C                          | –25                           | –250 | –25                           | –250 | nA   |
|                  |                                                 |                                                                                                           | Full range                    | –400                          |      | –400                          |      |      |
| V <sub>ICR</sub> | Common-mode input-voltage range <sup>(3)</sup>  |                                                                                                           | 25°C                          | 0 to<br>V <sub>CC</sub> – 1.5 |      | 0 to<br>V <sub>CC</sub> – 1.5 |      | V    |
|                  |                                                 |                                                                                                           | Full range                    | 0 to<br>V <sub>CC</sub> – 2   |      | 0 to<br>V <sub>CC</sub> – 2   |      |      |
| A <sub>VD</sub>  | Large-signal differential-voltage amplification | V <sub>CC</sub> = 15 V,<br>V <sub>O</sub> = 1.4 V to 11.4 V,<br>R <sub>L</sub> ≥ 15 kΩ to V <sub>CC</sub> | 25°C                          | 50                            | 200  | 50                            | 200  | V/mV |

- (1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
- (2) Full range (MIN to MAX) for LM239/LM239A is –25°C to 85°C, and for LM339/LM339A is 0°C to 70°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
- (3) The voltage at either input or common-mode must not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ ; however, one input can exceed  $V_{CC}$ , and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 30 V without damage.

## Electrical Characteristics for LMx39 and LMx39A (continued)

at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER                                     | TEST CONDITIONS <sup>(1)</sup>                     |                        | $T_A$ <sup>(2)</sup> | LM239<br>LM339 |     |     | LM239A<br>LM339A |     |     | UNIT |
|-----------------------------------------------|----------------------------------------------------|------------------------|----------------------|----------------|-----|-----|------------------|-----|-----|------|
|                                               |                                                    |                        |                      | MIN            | TYP | MAX | MIN              | TYP | MAX |      |
| $I_{OH}$ High-level output current            | $V_{ID} = 1\text{ V}$                              | $V_{OH} = 5\text{ V}$  | 25°C                 |                | 0.1 | 50  |                  | 0.1 | 50  | nA   |
|                                               |                                                    | $V_{OH} = 30\text{ V}$ | Full range           |                |     | 1   |                  |     | 1   | μA   |
| $V_{OL}$ Low-level output voltage             | $V_{ID} = -1\text{ V},$<br>$I_{OL} = 4\text{ mA}$  |                        | 25°C                 |                | 150 | 400 |                  | 150 | 400 | mV   |
|                                               |                                                    |                        | Full range           |                |     | 700 |                  |     | 700 |      |
| $I_{OL}$ Low-level output current             | $V_{ID} = -1\text{ V},$<br>$V_{OL} = 1.5\text{ V}$ |                        | 25°C                 | 6              | 16  |     | 6                | 16  |     | mA   |
| $I_{CC}$ Supply current<br>(four comparators) | $V_O = 2.5\text{ V},$<br>No load                   |                        | 25°C                 |                | 0.8 | 2   |                  | 0.8 | 2   | mA   |

## 7.8 Electrical Characteristics for LM2901

at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)

| PARAMETER                                                | TEST CONDITIONS <sup>(1)</sup>                                                                                  |                                    | $T_A$ <sup>(2)</sup> | LM2901 |                        |      | UNIT |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------|--------|------------------------|------|------|
|                                                          |                                                                                                                 |                                    |                      | MIN    | TYP                    | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_{IC} = V_{ICR}\text{ min},$<br>$V_O = 1.4\text{ V},$<br>$V_{CC} = 5\text{ V to MAX}^{(3)}$                   | Non-A devices                      | 25°C                 |        | 2                      | 7    | mV   |
|                                                          |                                                                                                                 |                                    | Full range           |        |                        | 15   |      |
|                                                          |                                                                                                                 | A-suffix devices                   | 25°C                 |        | 1                      | 2    |      |
|                                                          |                                                                                                                 |                                    | Full range           |        |                        | 4    |      |
| $I_{IO}$ Input offset current                            | $V_O = 1.4\text{ V}$                                                                                            |                                    | 25°C                 |        | 5                      | 50   | nA   |
|                                                          |                                                                                                                 |                                    | Full range           |        |                        | 200  |      |
| $I_{IB}$ Input bias current                              | $V_O = 1.4\text{ V}$                                                                                            |                                    | 25°C                 |        | –25                    | –250 | nA   |
|                                                          |                                                                                                                 |                                    | Full range           |        |                        | –500 |      |
| $V_{ICR}$ Common-mode input-voltage range <sup>(4)</sup> |                                                                                                                 |                                    | 25°C                 |        | 0 to<br>$V_{CC} - 1.5$ |      | V    |
|                                                          |                                                                                                                 |                                    | Full range           |        | 0 to<br>$V_{CC} - 2$   |      |      |
| $A_{VD}$ Large-signal differential-voltage amplification | $V_{CC} = 15\text{ V}, V_O = 1.4\text{ V to } 11.4\text{ V},$<br>$R_L \geq 15\text{ k}\Omega\text{ to } V_{CC}$ |                                    | 25°C                 |        | 25                     | 100  | V/mV |
| $I_{OH}$ High-level output current                       | $V_{ID} = 1\text{ V}$                                                                                           | $V_{OH} = 5\text{ V}$              | 25°C                 |        | 0.1                    | 50   | nA   |
|                                                          |                                                                                                                 | $V_{OH} = V_{CC}\text{ MAX}^{(3)}$ | Full range           |        |                        | 1    | μA   |
| $V_{OL}$ Low-level output voltage                        | $V_{ID} = -1\text{ V},$<br>$I_{OL} = 4\text{ mA}$                                                               | Non-V devices                      | 25°C                 |        | 150                    | 500  | mV   |
|                                                          |                                                                                                                 | V-suffix devices                   |                      |        | 150                    | 400  |      |
|                                                          |                                                                                                                 | All devices                        | Full range           |        |                        | 700  |      |
| $I_{OL}$ Low-level output current                        | $V_{ID} = -1\text{ V},$<br>$V_{OL} = 1.5\text{ V}$                                                              |                                    | 25°C                 |        | 6                      | 16   | mA   |
| $I_{CC}$ Supply current<br>(four comparators)            | $V_O = 2.5\text{ V},$<br>No load                                                                                | $V_{CC} = 5\text{ V}$              | 25°C                 |        | 0.8                    | 2    | mA   |
|                                                          |                                                                                                                 | $V_{CC} = \text{MAX}^{(3)}$        |                      |        | 1                      | 2.5  |      |

(1) All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

(2) Full range (MIN to MAX) for LM2901 is –40°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

(3)  $V_{CC}\text{ MAX} = 30\text{ V}$  for non-V devices, and 32 V for V-suffix devices

(4) The voltage at either input or common-mode must not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ ; however, one input can exceed  $V_{CC}$ , and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to  $V_{CC}\text{ MAX}$  without damage.

## 7.9 Switching Characteristics for LM2901

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER     | TEST CONDITIONS                                                                  |                                       | LM2901 | UNIT          |
|---------------|----------------------------------------------------------------------------------|---------------------------------------|--------|---------------|
|               |                                                                                  |                                       | TYP    |               |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}^{(1)(2)}$ | 100-mV input step with 5-mV overdrive | 1.3    | $\mu\text{s}$ |
|               |                                                                                  | TTL-level input step                  | 0.3    |               |

(1)  $C_L$  includes probe and jig capacitance.

(2) The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## 7.10 Switching Characteristics for LM139 and LM139A

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER     | TEST CONDITIONS                                                                  |                                       | LM139<br>LM139A | UNIT          |
|---------------|----------------------------------------------------------------------------------|---------------------------------------|-----------------|---------------|
|               |                                                                                  |                                       | TYP             |               |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}^{(1)(2)}$ | 100-mV input step with 5-mV overdrive | 1.3             | $\mu\text{s}$ |
|               |                                                                                  | TTL-level input step                  | 0.3             |               |

(1)  $C_L$  includes probe and jig capacitance.

(2) The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## 7.11 Switching Characteristics for LMx39 and LMx39A

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER     | TEST CONDITIONS                                                                  |                                       | LM239<br>LM239A<br>LM339<br>LM339A | UNIT          |
|---------------|----------------------------------------------------------------------------------|---------------------------------------|------------------------------------|---------------|
|               |                                                                                  |                                       | TYP                                |               |
| Response time | $R_L$ connected to 5 V through 5.1 k $\Omega$ ,<br>$C_L = 15\text{ pF}^{(1)(2)}$ | 100-mV input step with 5-mV overdrive | 1.3                                | $\mu\text{s}$ |
|               |                                                                                  | TTL-level input step                  | 0.3                                |               |

(1)  $C_L$  includes probe and jig capacitance.

(2) The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## 7.12 Typical Characteristics

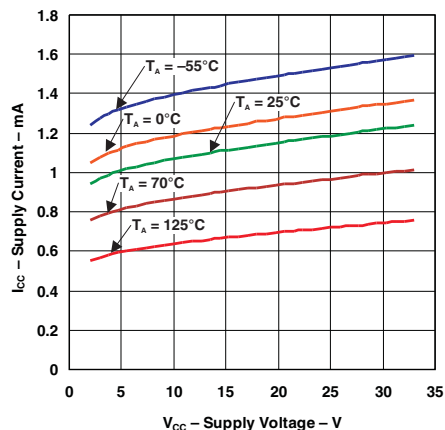


Figure 1. Supply Current vs Supply Voltage

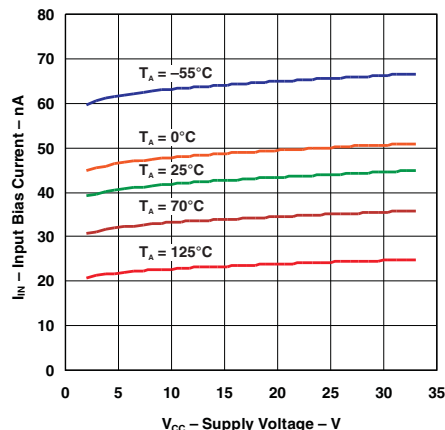


Figure 2. Input Bias Current vs Supply Voltage

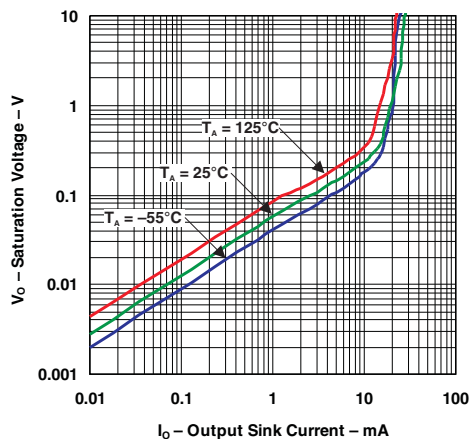


Figure 3. Output Saturation Voltage

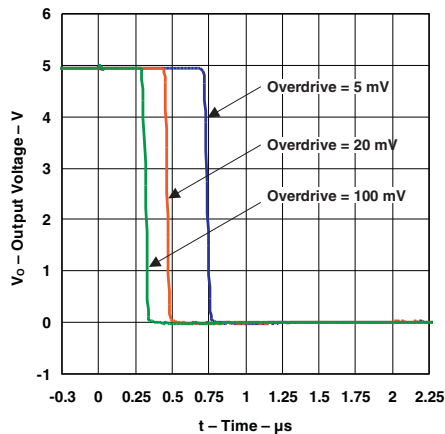


Figure 4. Response Time for Various Overdrives  
Negative Transition

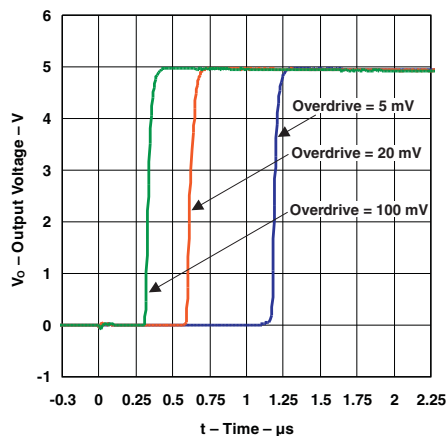


Figure 5. Response Time for Various Overdrives  
Positive Transition

## 8 Detailed Description

### 8.1 Overview

The LMx39 is a dual comparator with the ability to operate up to 36 V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to very wide supply voltages range (2 V to 36 V), low  $I_q$ , and fast response of the device.

This device is Q100 qualified and can operate over a wide temperature range ( $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ).

The open-drain output allows the user to configure the output logic low voltage ( $V_{OL}$ ) and allows the comparator to be used in AND functionality.

### 8.2 Functional Block Diagram

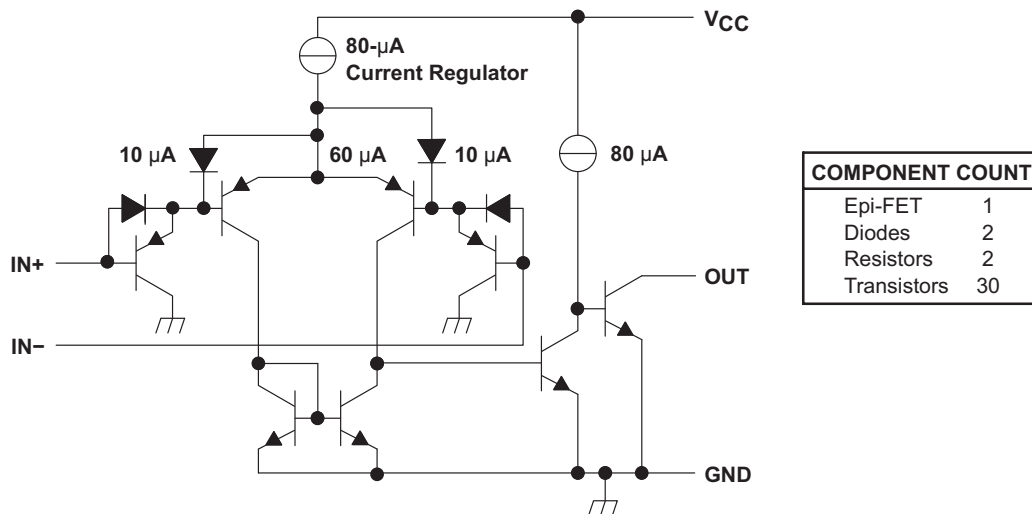


Figure 6. Schematic (Each Comparator)

### 8.3 Feature Description

LMx39 consists of a PNP Darlington pair input, allowing the device to operate with very high gain and fast response with minimal input bias current. The input Darlington pair creates a limit on the input common-mode voltage capability, allowing LMx39 to accurately function from ground to ( $V_{CC} - 1.5\text{ V}$ ) differential input. This enables much head room for modern day supplies of 3.3 V and 5 V.

The output consists of an open-drain NPN (pulldown or low-side) transistor. The output NPN sinks current when the positive input voltage is higher than the negative input voltage and the offset voltage. The  $V_{OL}$  is resistive and scales with the output current. See the [Specifications](#) section for  $V_{OL}$  values with respect to the output current.

### 8.4 Device Functional Modes

#### 8.4.1 Voltage Comparison

The LMx39 operates solely as a voltage comparator, comparing the differential voltage between the positive and negative pins and outputting a logic low or high impedance (logic high with pullup) based on the input differential polarity.

## 9 Application and Implementation

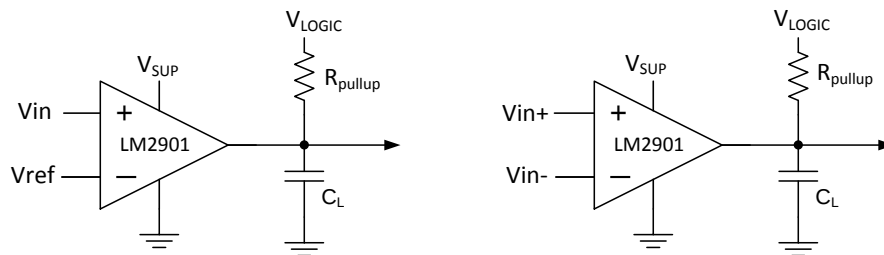
### NOTE

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

### 9.1 Application Information

Typically, the LMx39 compares either a single signal to a reference or two signals. Many users take advantage of the open-drain output to drive the comparison logic output to a logic voltage level to an MCU or logic device. The wide supply range and high voltage capability makes LMx39 optimal for level shifting to a higher or lower voltage.

### 9.2 Typical Application



**Figure 7. Single-ended and Differential Comparator Configurations**

#### 9.2.1 Design Requirements

For this design example, use the parameters listed in [Table 1](#) as the input parameters.

**Table 1. Design Parameters**

| DESIGN PARAMETER                      | EXAMPLE VALUE      |
|---------------------------------------|--------------------|
| Input Voltage Range                   | 0 V to Vsup-1.5 V  |
| Supply Voltage                        | 2 V to 36 V        |
| Logic Supply Voltage                  | 2 V to 36 V        |
| Output Current (R <sub>PULLUP</sub> ) | 1 $\mu$ A to 20 mA |
| Input Overdrive Voltage               | 100 mV             |
| Reference Voltage                     | 2.5 V              |
| Load Capacitance (C <sub>L</sub> )    | 15 pF              |

#### 9.2.2 Detailed Design Procedure

When using LMx39 in a general comparator application, determine the following:

- Input voltage range
- Minimum overdrive voltage
- Output and drive current
- Response time

##### 9.2.2.1 Input Voltage Range

When choosing the input voltage range, the input common-mode voltage range ( $V_{ICR}$ ) must be taken in to account. If temperature operation is above or below 25°C the  $V_{ICR}$  can range from 0 V to  $V_{CC} - 2$  V. This limits the input voltage range to as high as  $V_{CC} - 2$  V and as low as 0 V. Operation outside of this range can yield incorrect comparisons.

The following list describes the outcomes of some input voltage situations.

- When both IN<sup>–</sup> and IN<sup>+</sup> are both within the common-mode range:
  - If IN<sup>–</sup> is higher than IN<sup>+</sup> and the offset voltage, the output is low and the output transistor is sinking current
  - If IN<sup>–</sup> is lower than IN<sup>+</sup> and the offset voltage, the output is high impedance and the output transistor is not conducting
- When IN<sup>–</sup> is higher than common mode and IN<sup>+</sup> is within common mode, the output is low and the output transistor is sinking current
- When IN<sup>+</sup> is higher than common mode and IN<sup>–</sup> is within common mode, the output is high impedance and the output transistor is not conducting
- When IN<sup>–</sup> and IN<sup>+</sup> are both higher than common mode, the output is low and the output transistor is sinking current

### 9.2.2.2 Minimum Overdrive Voltage

Overdrive voltage is the differential voltage produced between the positive and negative inputs of the comparator over the offset voltage ( $V_{IO}$ ). In order to make an accurate comparison, the overdrive voltage ( $V_{OD}$ ) must be higher than the input offset voltage ( $V_{IO}$ ). Overdrive voltage can also determine the response time of the comparator, with the response time decreasing with increasing overdrive. [Figure 8](#) and [Figure 9](#) show positive and negative response times with respect to overdrive voltage.

### 9.2.2.3 Output and Drive Current

Output current is determined by the load and pullup resistance and logic and pullup voltage. The output current produces a low-level output voltage ( $V_{OL}$ ) from the comparator, where  $V_{OL}$  is proportional to the output current.

The output current can also effect the transient response.

### 9.2.2.4 Response Time

The load capacitance ( $C_L$ ), pullup resistance ( $R_{PULLUP}$ ), and equivalent collector-emitter resistance ( $R_{CE}$ ) levels determine the transient response. [Equation 1](#) approximates the positive response time. [Equation 2](#) approximates the negative response time. [Equation 3](#) calculates the collector-emitter resistance.

$$\tau_P \cong R_{PULLUP} \times C_L \quad (1)$$

$$\tau_N \cong R_{CE} \times C_L \quad (2)$$

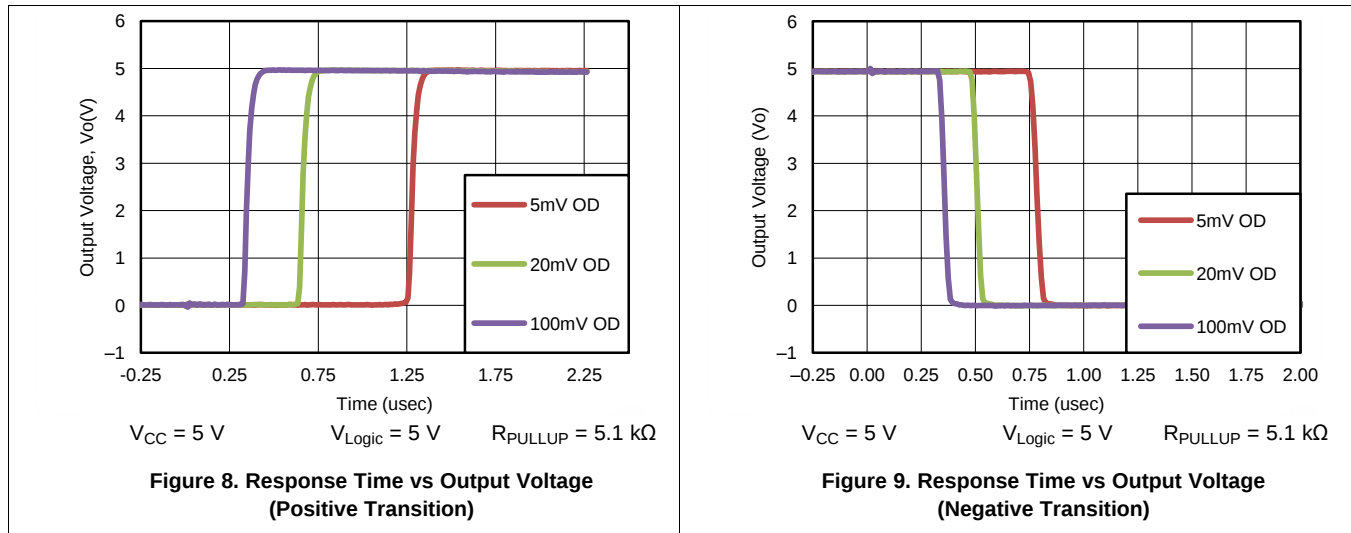
$$R_{CE} = \frac{V_{OL}}{I_{OUT}}$$

where

- $V_{OL}$  is the low-level output voltage
  - $I_{OUT}$  is the output current
- (3)

## 9.2.3 Application Curves

Figure 8 and Figure 9 were generated with scope probe parasitic capacitance of 50 pF.



## 10 Power Supply Recommendations

For fast response and comparison applications with noisy or AC inputs, use a bypass capacitor on the supply pin to reject any variation on the supply voltage. This variation can affect the common-mode range of the comparator input and create an inaccurate comparison.

## 11 Layout

### 11.1 Layout Guidelines

To create an accurate comparator application without hysteresis, maintain a stable power supply with minimized noise and glitches, which can affect the high level input common-mode voltage range. To achieve this accuracy, add a bypass capacitor between the supply voltage and ground. Place a bypass capacitor on the positive power supply and negative supply (if available).

#### NOTE

If a negative supply is not being used, do not place a capacitor between the GND pin of the device and system ground.

### 11.2 Layout Example

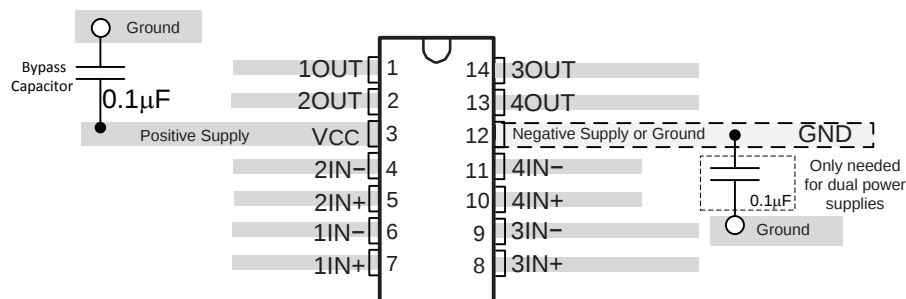


Figure 10. LMx39 Layout Example

## 12 Device and Documentation Support

### 12.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 2. Related Links**

| PARTS    | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| LM139    | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM239    | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM339    | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM139A   | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM239A   | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM339A   | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM2901   | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM2901AV | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM2901V  | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 12.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](#), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.3 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 12.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser based versions of this data sheet, refer to the left hand navigation.

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)            | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|------------------------------------|-------------------------|
| 5962-7700801VCA  | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-7700801VC<br>A<br>LM139JQMLV  | <a href="#">Samples</a> |
| 5962-87739012A   | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 5962-<br>87739012A<br>LM139AFKB    | <a href="#">Samples</a> |
| 5962-8773901CA   | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-8773901CA<br>LM139AJB         | <a href="#">Samples</a> |
| 5962-8773901DA   | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-8773901DA<br>LM139AWB         | <a href="#">Samples</a> |
| 5962-9673802V9B  | ACTIVE        | XCEPT        | KGD                | 0    | 100            | TBD                        | Call TI                 | N / A for Pkg Type   | -55 to 125   |                                    | <a href="#">Samples</a> |
| 5962-9673802VCA  | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-9673802VC<br>A<br>LM139AJQMLV | <a href="#">Samples</a> |
| 77008012A        | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 77008012A<br>LM139FKB              | <a href="#">Samples</a> |
| 7700801CA        | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 7700801CA<br>LM139JB               | <a href="#">Samples</a> |
| 7700801DA        | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 7700801DA<br>LM139WB               | <a href="#">Samples</a> |
| JM38510/11201BCA | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510<br>/11201BCA               | <a href="#">Samples</a> |
| LM139AD          | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                             | <a href="#">Samples</a> |
| LM139ADG4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                             | <a href="#">Samples</a> |
| LM139ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                             | <a href="#">Samples</a> |
| LM139ADRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                             | <a href="#">Samples</a> |
| LM139AFKB        | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 5962-<br>87739012A<br>LM139AFKB    | <a href="#">Samples</a> |
| LM139AJ          | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | LM139AJ                            | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)    | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|----------------------------|-------------------------|
| LM139AJB         | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-8773901CA<br>LM139AJB | <a href="#">Samples</a> |
| LM139AN          | OBSOLETE      | PDIP         | N                  | 14   |                | TBD                        | Call TI                 | Call TI              | -55 to 125   |                            |                         |
| LM139AW          | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | LM139AW                    | <a href="#">Samples</a> |
| LM139AWB         | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 5962-8773901DA<br>LM139AWB | <a href="#">Samples</a> |
| LM139D           | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139                      | <a href="#">Samples</a> |
| LM139DG4         | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139                      | <a href="#">Samples</a> |
| LM139DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139                      | <a href="#">Samples</a> |
| LM139DRG4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -55 to 125   | LM139                      | <a href="#">Samples</a> |
| LM139FK          | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | LM139FK                    | <a href="#">Samples</a> |
| LM139FKB         | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE              | N / A for Pkg Type   | -55 to 125   | 77008012A<br>LM139FKB      | <a href="#">Samples</a> |
| LM139J           | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | LM139J                     | <a href="#">Samples</a> |
| LM139JB          | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 7700801CA<br>LM139JB       | <a href="#">Samples</a> |
| LM139N           | OBSOLETE      | PDIP         | N                  | 14   |                | TBD                        | Call TI                 | Call TI              | -55 to 125   |                            |                         |
| LM139W           | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | LM139W                     | <a href="#">Samples</a> |
| LM139WB          | ACTIVE        | CFP          | W                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | 7700801DA<br>LM139WB       | <a href="#">Samples</a> |
| LM239AD          | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                     | <a href="#">Samples</a> |
| LM239ADE4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                     | <a href="#">Samples</a> |
| LM239ADG4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                     | <a href="#">Samples</a> |
| LM239ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                     | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM239ADRE4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                  | <a href="#">Samples</a> |
| LM239ADRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                  | <a href="#">Samples</a> |
| LM239AN          | OBSOLETE      | PDIP         | N                  | 14   |                | TBD                        | Call TI                 | Call TI              | -25 to 85    |                         |                         |
| LM239D           | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239DE4         | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239DG4         | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239DRG3        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239DRG4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239N           | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU   CU SN       | N / A for Pkg Type   | -25 to 85    | LM239N                  | <a href="#">Samples</a> |
| LM239NE4         | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | -25 to 85    | LM239N                  | <a href="#">Samples</a> |
| LM239PW          | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM239PWG4        | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM239PWR         | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM239PWRE4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM239PWRG4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM2901AVQDR      | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901AVQDRG4    | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM2901AVQPWR     | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901AVQPWRG4   | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901D          | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DE4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DG4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRE4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRG3       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901N          | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | -40 to 125   | LM2901N                 | <a href="#">Samples</a> |
| LM2901NE4        | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | -40 to 125   | LM2901N                 | <a href="#">Samples</a> |
| LM2901NSR        | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901NSRG4      | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901PW         | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901PWG4       | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901PWLE       | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD                        | Call TI                 | Call TI              | -40 to 125   |                         |                         |
| LM2901PWR        | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901PWRG3      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM2901PWRG4      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901QD         | OBSOLETE      | SOIC         | D                  | 14   |                | TBD                        | Call TI                 | Call TI              | -40 to 125   |                         |                         |
| LM2901QN         | OBSOLETE      | PDIP         | N                  | 14   |                | TBD                        | Call TI                 | Call TI              | -40 to 125   |                         |                         |
| LM2901VQDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM2901VQDRG4     | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM2901VQPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM2901VQPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM339AD          | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADBR        | ACTIVE        | SSOP         | DB                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339ADBRG4      | ACTIVE        | SSOP         | DB                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339ADE4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADG4        | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADRE4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339AN          | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU   CU SN       | N / A for Pkg Type   | 0 to 70      | LM339AN                 | <a href="#">Samples</a> |
| LM339ANE4        | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | 0 to 70      | LM339AN                 | <a href="#">Samples</a> |
| LM339ANSR        | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ANSRG4      | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM339APW         | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339APWG4       | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339APWR        | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339APWRE4      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339APWRG4      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339D           | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DBLE        | OBSOLETE      | SSOP         | DB                 | 14   |                | TBD                        | Call TI                 | Call TI              | 0 to 70      |                         |                         |
| LM339DBR         | ACTIVE        | SSOP         | DB                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DBRE4       | ACTIVE        | SSOP         | DB                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DE4         | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DG4         | ACTIVE        | SOIC         | D                  | 14   | 50             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DRE4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DRG3        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DRG4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339N           | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU   CU SN       | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NE3         | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU SN                   | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NE4         | ACTIVE        | PDIP         | N                  | 14   | 25             | Pb-Free<br>(RoHS)          | CU NIPDAU               | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NSLE        | OBSOLETE      | SO           | NS                 | 14   |                | TBD                        | Call TI                 | Call TI              | 0 to 70      |                         |                         |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM339NSR         | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339NSRG4       | ACTIVE        | SO           | NS                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339PW          | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWG4        | ACTIVE        | TSSOP        | PW                 | 14   | 90             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWLE        | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD                        | Call TI                 | Call TI              | 0 to 70      |                         |                         |
| LM339PWR         | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWRE4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWRG3       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWRG4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339Y           | OBSOLETE      |              |                    | 0    |                | TBD                        | Call TI                 | Call TI              | 0 to 70      |                         |                         |
| M38510/11201BCA  | ACTIVE        | CDIP         | J                  | 14   | 1              | TBD                        | A42                     | N / A for Pkg Type   | -55 to 125   | JM38510<br>/11201BCA    | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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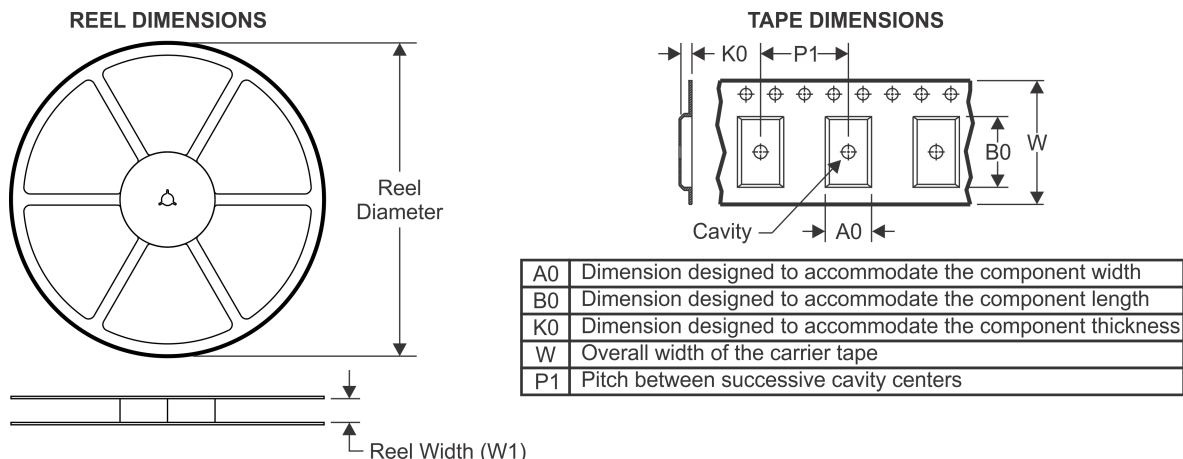
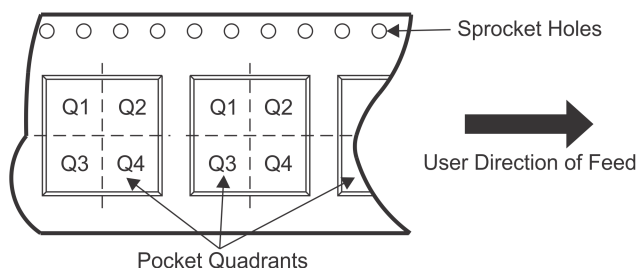
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**OTHER QUALIFIED VERSIONS OF LM139, LM139-SP, LM239A, LM2901, LM2901AV, LM2901V :**

- Catalog: [LM139](#)
- Automotive: [LM239A-Q1](#), [LM2901-Q1](#), [LM2901AV-Q1](#), [LM2901V-Q1](#)
- Enhanced Product: [LM239A-EP](#)
- Space: [LM139-SP](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM139ADR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM139DR        | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239DR        | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM239DR        | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239DR        | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239DRG3      | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM239DRG4      | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM239PWR       | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901AVQPWR   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901AVQPWRG4 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM2901DRG3     | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM2901DRG4     | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM2901NSR      | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM2901PWR     | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901PWR     | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901PWRG3   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901PWRG4   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901VQPWR   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901VQPWRG4 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339ADBR     | SSOP         | DB              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 6.6     | 2.5     | 12.0    | 16.0   | Q1            |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM339ADRG4    | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339ANSR     | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| LM339APWR     | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM339DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339DRG3     | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.3     | 8.0     | 16.0   | Q1            |
| LM339DRG4     | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339PWR      | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339PWR      | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339PWRG3    | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339PWRG4    | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM139ADR       | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM139DR        | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM239DR        | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM239DR        | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM239DR        | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM239DRG3      | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM239DRG4      | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM239PWR       | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM2901AVQPWR   | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM2901AVQPWRG4 | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM2901DRG3     | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM2901DRG4     | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM2901NSR      | SO           | NS              | 14   | 2000 | 367.0       | 367.0      | 38.0        |
| LM2901PWR      | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM2901PWR      | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM2901PWRG3   | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM2901PWRG4   | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM2901VQPWR   | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM2901VQPWRG4 | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM339ADBR     | SSOP         | DB              | 14   | 2000 | 367.0       | 367.0      | 38.0        |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM339ADRG4    | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM339ANSR     | SO           | NS              | 14   | 2000 | 367.0       | 367.0      | 38.0        |
| LM339APWR     | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM339DR       | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM339DR       | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM339DR       | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM339DRG3     | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM339DRG4     | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| LM339PWR      | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |
| LM339PWR      | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM339PWRG3    | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM339PWRG4    | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |

J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| PINS **<br>DIM | 14                     | 16                     | 18                     | 20                     |
|----------------|------------------------|------------------------|------------------------|------------------------|
| A              | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX          | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN          | —                      | —                      | —                      | —                      |
| C MAX          | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN          | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF<br>TERMINALS<br>** | A                |                  | B                |                  |
|---------------------------|------------------|------------------|------------------|------------------|
|                           | MIN              | MAX              | MIN              | MAX              |
| 20                        | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                        | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                        | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                        | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                        | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                        | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |



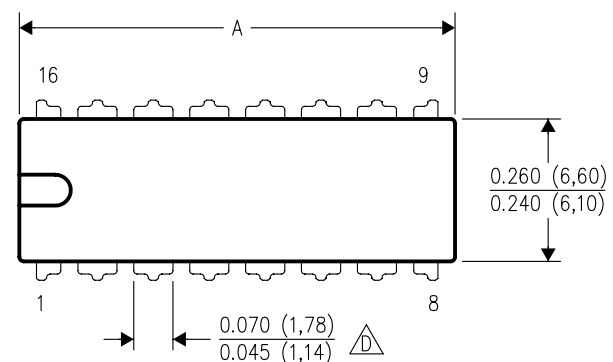
4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

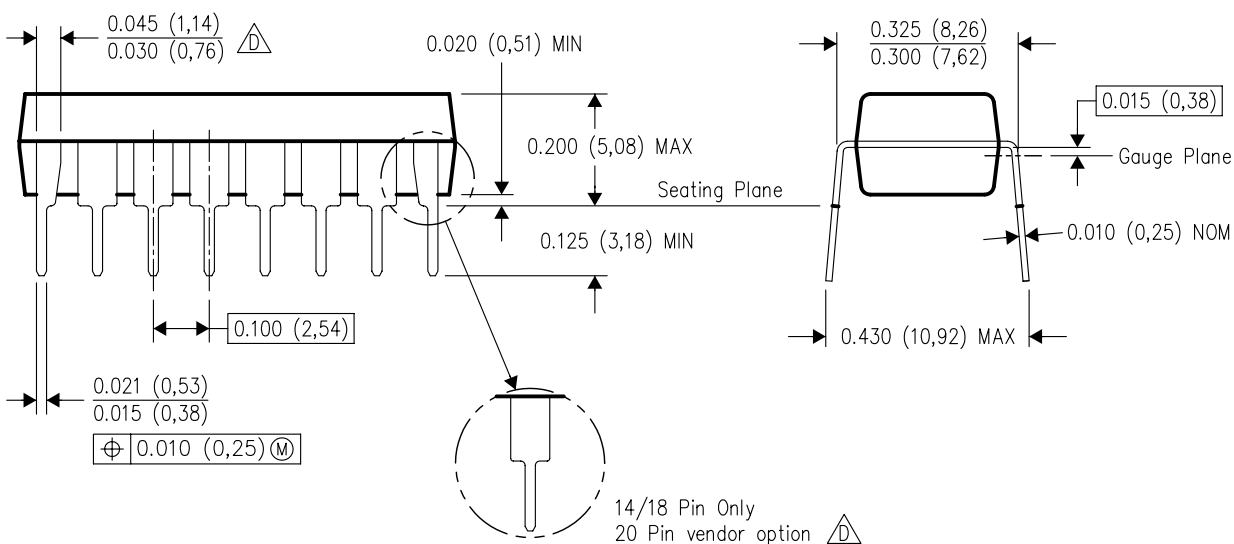
N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



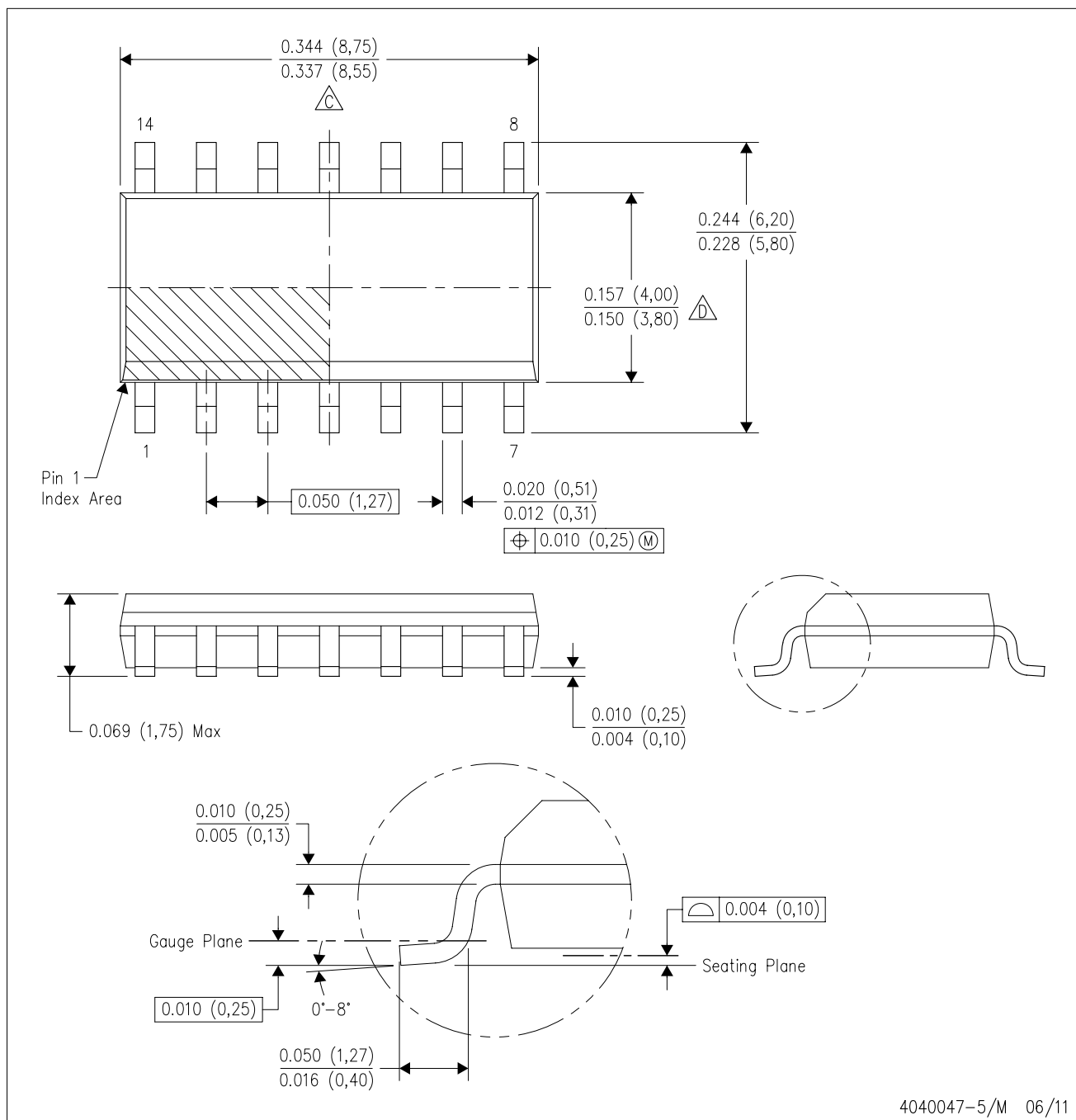
4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040047-5/M 06/11

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

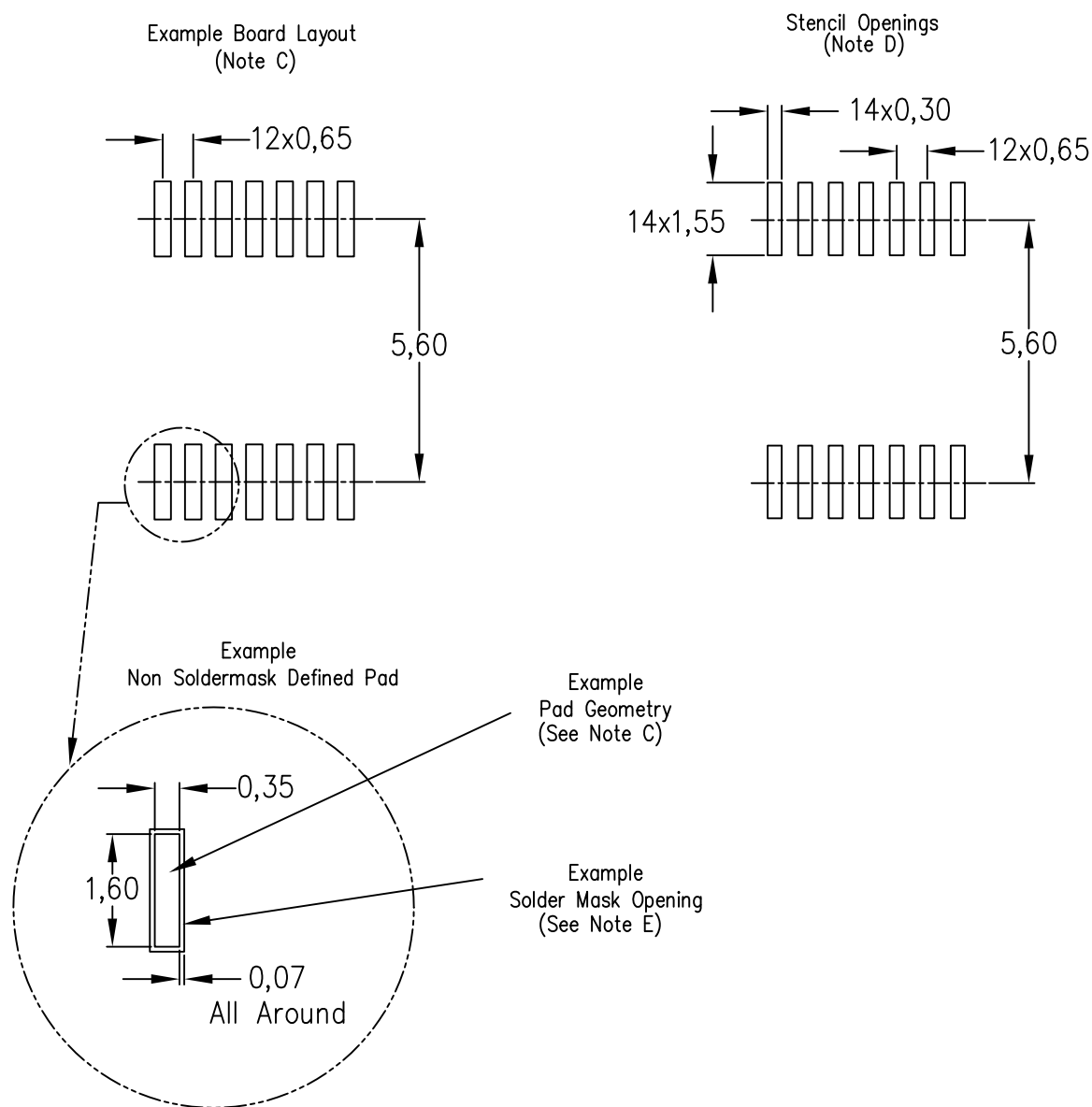
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/F 12/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



| DIM \ PINS ** | 14    | 16    | 20    | 24    |
|---------------|-------|-------|-------|-------|
| A MAX         | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN         | 9,90  | 9,90  | 12,30 | 14,70 |

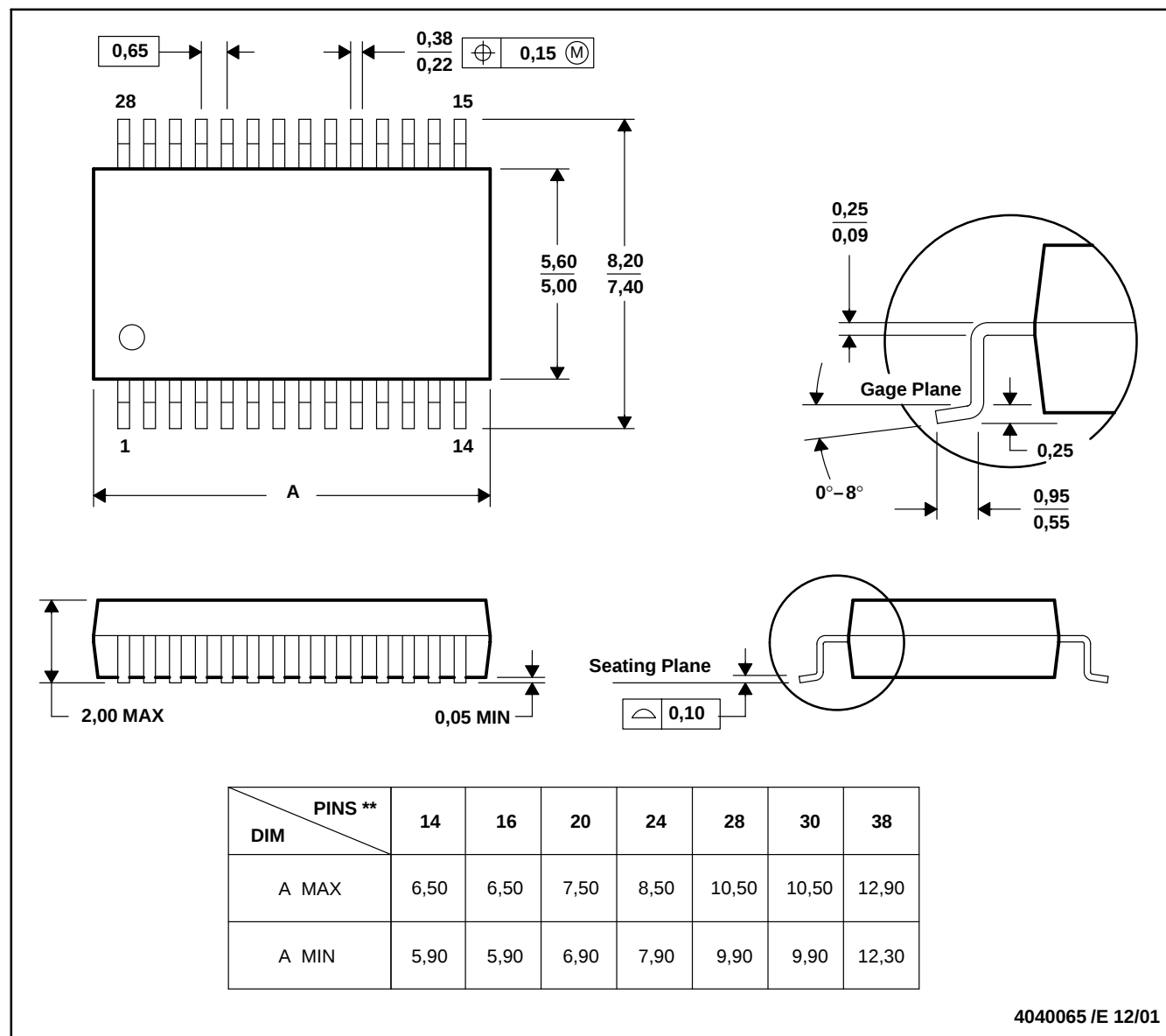
4040062/C 03/03

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150

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