

# LM339B, LM2901B, LM339, LM239, LM139, LM2901 Quad Differential Comparators

## 1 Features

- NEW [LM339B](#) and [LM2901B](#)
- Improved specifications of B-version
  - Maximum rating: up to 38 V
  - ESD rating (HBM): 2k V
  - Low input offset: 0.37 mV
  - Low input bias current: 3.5 nA
  - Low supply-current: 200  $\mu$ A per comparator
  - Faster response time of 1  $\mu$ sec
  - Extended temperature range for LM339B
- B-version is drop-in replacement for LM239, LM339 and LM2901, A and V versions
- Common-mode input voltage range includes ground
- Differential input voltage range equal to maximum-rated supply voltage:  $\pm 38$  V
- Low output saturation voltage
- Output compatible with TTL, MOS, and CMOS
- For single version, see the [TL331B](#)
- For dual version, see the [LM393B](#) or [LM2903B](#)

## 2 Applications

- [Vacuum robot](#)
- [Single phase UPS](#)
- [Server PSU](#)
- [Cordless power tool](#)
- [Wireless infrastructure](#)
- [Appliances](#)
- [Building automation](#)
- [Factory automation & control](#)
- [Motor drives](#)
- [Infotainment & cluster](#)

## 3 Description

The [LM339B](#) and [LM2901B](#) devices are the next generation versions of the industry-standard LM339 and LM2901 comparator family. These next generation B-version comparators feature lower offset voltage, higher supply voltage capability, lower supply current, lower input bias current, lower propagation delay, and improved 2 kV ESD performance and input ruggedness through dedicated ESD clamps. The LM339B and LM2901B can drop-in replace the LM239, LM339 and LM2901, for both "A" and "V" grades.

All devices consist of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages.

### Device Information

| PART NUMBER                                      | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM)           |
|--|------------------------|---------------------------|
| LM139x   | CDIP (14)              | 21.30 mm $\times$ 7.60 mm |
| LM139x, LM239x, LM339x, LM2901x, LM339B, LM2901B | SOIC (14)              | 8.70 mm $\times$ 3.90 mm  |
| LM239, LM339x, LM2901                            | PDIP (14)              | 19.30 mm $\times$ 6.40 mm |
| LM239, LM2901, LM339B, LM2901B                   | TSSOP (14)             | 5.00 mm $\times$ 4.40 mm  |
| LM339x, LM2901, LM339B, LM2901B                  | SO (14)                | 10.20 mm $\times$ 5.30 mm |
| LM339x, LM339B                                   | SSOP (14)              | 6.50 mm $\times$ 5.30 mm  |
| LM2901B  | SOT-23 (14)            | 4.20 mm $\times$ 2.00 mm  |
| LM339B, LM2901B                                  | WQFN (16)              | 3.00 mm $\times$ 3.00 mm  |

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

### Family Comparison Table

| Specification                        | <a href="#">LM339B</a> | <a href="#">LM2901B</a> | <a href="#">LM339<br/>LM339A</a> | <a href="#">LM2901<br/>LM2901A</a> | <a href="#">LM2901V<br/>LM2901AV</a> | <a href="#">LM139<br/>LM139A</a> | <a href="#">LM239<br/>LM239A</a> | Units        |
|--------------------------------------|------------------------|-------------------------|----------------------------------|------------------------------------|--------------------------------------|----------------------------------|----------------------------------|--------------|
| Supply Voltage                       | 2 to 36                | 2 to 36                 | 2 to 30                          | 2 to 30                            | 2 to 32                              | 2 to 30                          | 2 to 30                          | V            |
| Total Supply Current (5V to 36V max) | 0.8 to 1               | 0.8 to 1                | 1 to 2.5                         | 1 to 2.5                           | 1 to 2.5                             | 1 to 2.5                         | 1 to 2.5                         | mA           |
| Temperature Range                    | -40 to 85              | -40 to 125              | 0 to 70                          | -40 to 125                         | -40 to 125                           | -55 to 125                       | -25 to 85                        | $^{\circ}$ C |
| ESD (HBM)                            | 2000                   | 2000                    | 1000                             | 1000                               | 1000                                 | 1000                             | 1000                             | V            |
| Offset Voltage (Max over temp)       | $\pm 5.5$              | $\pm 5.5$               | $\pm 9$<br>$\pm 4$               | $\pm 15$<br>$\pm 4$                | $\pm 15$<br>$\pm 4$                  | $\pm 9$<br>$\pm 4$               | $\pm 9$<br>$\pm 4$               | mV           |
| Input Bias Current (typ / max)       | 3.5 / 25               | 3.5 / 25                | 25 / 250                         | 25 / 250                           | 25 / 250                             | 25 / 100                         | 25 / 250                         | nA           |
| Response Time (typ)                  | 1                      | 1                       | 1.3                              | 1.3                                | 1.3                                  | 1.3                              | 1.3                              | $\mu$ sec    |



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## 4 Revision History

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

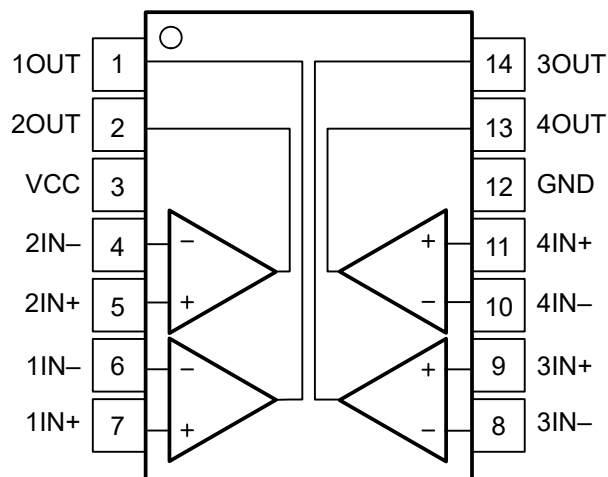
|  |             |
|--|-------------|
| <b>Changes from Revision W (October 2023) to Revision X (October 2023)</b>   | <b>Page</b> |
| • Added LM339B and LM2901B to Device Information Table for SOT-23/QFN.....   | 1           |
| <b>Changes from Revision V (December 2022) to Revision W (October 2023)</b>  | <b>Page</b> |
| • Updated thermal tables for new package releases.....   | 6           |
| • Changed Apps Input Voltage Range text to reference appnote.....  | 24          |
| <b>Changes from Revision U (November 2018) to Revision V (December 2022)</b>   | <b>Page</b> |
| • Updated the numbering format for tables, figures, and cross-references throughout the document. ....   | 1           |
| • Added "B" version throughout. Added Device Family Table. ....  | 1           |
| <b>Changes from Revision T (June 2015) to Revision U (November 2018)</b>   | <b>Page</b> |
| • Changed LM239x temperature range from 125°C to 85°C in <i>Description</i> section.....   | 1           |
| • Changed data sheet title .....   | 1           |
| • Changed LM293AD to LM239AD in <i>Device Comparison Table</i> .....   | 4           |
| • Added Input Current and related footnote in <i>Absolute Maximum Ratings</i> .....  | 6           |
| • Changed layout of <i>Recommended Operating Conditions</i> temperatures to separate rows.....   | 7           |
| • Changed values in the Thermal Information table to align with JEDEC standards.....   | 8           |
| • Added LM2901V and LMV2901AV to LM2901 Elect Char Table title to make more clear which devices are covered.....   | 13          |
| • Changed "Dual" to "Quad" and removed "Absolute Maximum" wording and mention of Q100 in <i>Overview</i> section text.....   | 23          |
| • Changed and corrected text in <i>Feature Description</i> section.....  | 23          |
| • Changed Example Values in <i>Typical Application Design Parameters</i> table .....   | 24          |
| • Added <i>Receiving Notification of Documentation Updates</i> section.....  | 27          |
| <b>Changes from Revision S (August 2012) to Revision T (June 2015)</b>   | <b>Page</b> |
| • 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 Other Versions

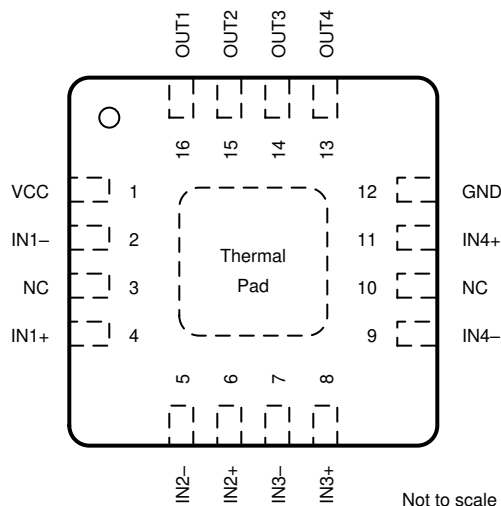
### OTHER QUALIFIED VERSIONS OF LM139-SP, LM239A, LM2901, LM2901AV, LM2901V:

- Automotive Q100: [LM239A-Q1](#), [LM2901B-Q1](#), [LM2901-Q1](#), [LM2901AV-Q1](#), [LM2901V-Q1](#)
- Enhanced Product: [LM239A-EP](#)
- Space: [LM139-SP](#)

## 6 Pin Configuration and Functions



**Figure 6-1. D, DB, N, NS, PW, DYY, J Packages**  
**14-Pin SOIC, SSOP, PDIP, SO, TSSOP, SOT-23,**  
**CDIP**  
**Top View**



NOTE: Connect exposed thermal pad directly to GND pin.

**Figure 6-2. RTE Package**  
**16-Pad WQFN With Exposed Thermal Pad**  
**Top View**

**Table 6-1. Pin Functions**

| PIN                 |                          |      | I/O    | DESCRIPTION                                    |
|---------------------|--------------------------|------|--------|--|
| NAME <sup>(1)</sup> | D, DB, N, NS, PW, DYY, J | WQFN |        |  |
| OUT1 <sup>(1)</sup> | 1                        | 16   | Output | Output pin of the comparator 2                 |
| OUT2 <sup>(1)</sup> | 2                        | 15   | Output | Output pin of the comparator 1                 |
| V <sub>CC</sub>     | 3                        | 1    | —      | Positive supply                                |
| IN2- <sup>(1)</sup> | 4                        | 5    | Input  | Negative input pin of the comparator 1         |
| IN2+ <sup>(1)</sup> | 5                        | 6    | Input  | Positive input pin of the comparator 1         |
| IN1- <sup>(1)</sup> | 6                        | 2    | Input  | Negative input pin of the comparator 2         |
| IN1+ <sup>(1)</sup> | 7                        | 4    | Input  | Positive input pin of the comparator 2         |
| IN3-                | 8                        | 7    | Input  | Negative input pin of the comparator 3         |
| IN3+                | 9                        | 8    | Input  | Positive input pin of the comparator 3         |
| IN4-                | 10                       | 9    | Input  | Negative input pin of the comparator 4         |
| IN4+                | 11                       | 11   | Input  | Positive input pin of the comparator 4         |
| GND                 | 12                       | 12   | —      | Negative supply                                |
| OUT4                | 13                       | 13   | Output | Output pin of the comparator 4                 |
| OUT3                | 14                       | 14   | Output | Output pin of the comparator 3                 |
| NC                  | —                        | 3    | —      | No Internal Connection - Leave floating or GND |
| NC                  | —                        | 10   | —      | No Internal Connection - Leave floating or GND |
| Thermal Pad         | —                        | PAD  | —      | Connect directly to GND pin                    |

(1) Some manufacturers transpose the names of channels 1 & 2. Electrically the pinouts are identical, just a difference in the channel naming convention.

## 7 Specifications

### 7.1 Absolute Maximum Ratings for LM339B and LM2901B

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

|  | MIN  | MAX       | UNIT |
|--|------|-----------|------|
| Supply voltage: $V_S = (V+) - (V-)$                  | -0.3 | 38        | V    |
| Differential input voltage : $V_{ID}$ <sup>(2)</sup> |      | ±38       | V    |
| Input pins (IN+, IN-)                                | -0.3 | 38        | V    |
| Current into input pins (IN+, IN-)                   |      | -50       | mA   |
| Output pin (OUT)                                     | -0.3 | 38        | V    |
| Output sink current                                  |      | 25        | mA   |
| Output short-circuit duration <sup>(3)</sup>         |      | Unlimited | s    |
| Junction temperature, $T_J$                          | TBD  | 150       | °C   |
| Storage temperature, $T_{stg}$                       | -65  | 150       | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) Differential voltages are at IN+ with respect to IN-.
- (3) Short circuits from outputs to V+ can cause excessive heating and eventual destruction.

### 7.2 Absolute Maximum Ratings for Non-B Versions

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

|   | MIN        | MAX       | UNIT |
|---|------------|-----------|------|
| $V_{CC}$ Supply voltage <sup>(2)</sup>                    |            | 36        | V    |
| $V_{ID}$ Differential input voltage <sup>(3)</sup>        |            | ±36       | V    |
| $V_I$ Input voltage range (either input)                  | -0.3       | 36        | V    |
| $I_K$ Input current <sup>(5)</sup>                        |            | -50       | mA   |
| $V_O$ Output voltage                                      |            | 36        | V    |
| $I_O$ Output current                                      |            | 20        | mA   |
| Duration of output short circuit to ground <sup>(4)</sup> |            | Unlimited |      |
| $T_J$ 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   |
| $T_{stg}$ 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  $V_{CC}$  can cause excessive heating and eventual destruction.
- (5) Input current flows through parasitic diode to ground and will turn on parasitic transistors that will increase  $I_{CC}$  and may cause output to be incorrect. Normal operation resumes when input is removed.

### 7.3 ESD Ratings for LM339B and LM2901B

|             |                         |   | VALUE | UNIT |
|-------------|-------------------------|---|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±2000 | V    |
|             |                         | Human-body model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±1000 |      |

- (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

### 7.4 ESD Ratings, Non-B Versions

|             |                         |  | VALUE | UNIT |
|-------------|-------------------------|--|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±500  | V    |
|             |                         | 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.

### 7.5 Recommended Operating Conditions for LM339B and LM2901B

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

|                                      | MIN        | MAX        | UNIT |
|--------------------------------------|------------|------------|------|
| Supply voltage: $V_S = (V+) - (V-)$  | 2          | 36         | V    |
| Ambient temperature, $T_A$ , LM339B  | –40        | 85         | °C   |
| Ambient temperature, $T_A$ , LM2901B | –40        | 125        | °C   |
| Input Voltage Range, $V_{IVR}$       | (V–) – 0.1 | (V+) – 2.0 | V    |

### 7.6 Recommended Operating Conditions, Non-B Versions

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

|          |                      |               | MIN | MAX | UNIT |
|----------|----------------------|---------------|-----|-----|------|
| $V_{CC}$ | Supply voltage       | Non-V devices | 2   | 30  | V    |
|          |                      | V devices     | 2   | 32  | V    |
| $T_J$    | Junction temperature | LM139x        | –55 | 125 | °C   |
|          |                      | LM239x        | –25 | 85  |      |
|          |                      | LM339x        | –0  | 70  |      |
|          |                      | LM2901x       | –40 | 125 |      |

## 7.7 Thermal Information for LM339B and LM2901B

| THERMAL METRIC <sup>(1)</sup> |  | LM339B, LM2901B |               |                 |              |              | UNIT |
|-------------------------------|--|-----------------|---------------|-----------------|--------------|--------------|------|
|                               |  | D<br>(SOIC)     | PW<br>(TSSOP) | DDY<br>(SOT-23) | RUC<br>(QFN) | RTE<br>(QFN) |      |
|                               |  | 14 PINS         | 14 PINS       | 14 PINS         | 14 PINS      | 16 PINS      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 111.2           | 136.6         |                 |              | 67.6         | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 66.9            | 66.6          |                 |              | 72.3         | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 67.8            | 79.8          |                 |              | 43.1         | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 28.0            | 17.8          |                 |              | 6.3          | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 67.4            | 79.3          |                 |              | 42.8         | °C/W |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | -               | -             | -               |              | 26.4         | °C/W |

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

## 7.8 Thermal Information for Non-B Versions

| THERMAL METRIC <sup>(1)</sup> |  | LMx39, LM2901x |              |             |            |               |             |            | UNIT |
|-------------------------------|--|----------------|--------------|-------------|------------|---------------|-------------|------------|------|
|                               |  | D<br>(SOIC)    | DB<br>(SSOP) | N<br>(PDIP) | NS<br>(SO) | PW<br>(TSSOP) | J<br>(CDIP) | W<br>(CFP) |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 98.8           | 111.8        | 79          | 96.2       | 120           | 89.5        | 156.2      | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 64.3           | 63.6         | 73.4        | 56.1       | 59            | 46.1        | 86.7       | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 59.7           | 60.5         | 58.7        | 56.9       | 68.8          | 78.7        | 154.6      | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 25.7           | 26.2         | 48.3        | 24.8       | 9.9           | 3           | 56.5       | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 59.3           | 59.8         | 58.5        | 56.4       | 68.2          | 71.8        | 133.5      | °C/W |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | —              | —            | —           | —          | —             | 24.2        | 14.3       | °C/W |

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



## 7.9 Electrical Characteristics for LM339B

$V_S = 5\text{ V}$ ,  $V_{CM} = (V_-)$ ;  $T_A = 25^\circ\text{C}$  (unless otherwise noted).

| PARAMETER    |  | TEST CONDITIONS  | MIN  | TYP        | MAX        | UNIT |
|--------------|--|--|------|------------|------------|------|
| $V_{IO}$     | Input offset voltage   | $V_S = 5\text{ to }36\text{ V}$  | -3.5 | $\pm 0.37$ | 3.5        | mV   |
|              |  | $V_S = 5\text{ to }36\text{ V}$ , $T_A = -40^\circ\text{C to }+85^\circ\text{C}$                             | -5.5 |            | 5.5        |      |
| $I_B$        | Input bias current   |  |      | -3.5       | -25        | nA   |
|              |  | $T_A = -40^\circ\text{C to }+85^\circ\text{C}$   |      |            | -50        | nA   |
| $I_{OS}$     | Input offset current   |  | -25  | $\pm 0.5$  | 25         | nA   |
|              |  | $T_A = -40^\circ\text{C to }+85^\circ\text{C}$   | -50  |            | 50         | nA   |
| $V_{CM}$     | Common mode range <sup>(1)</sup>                               | $V_S = 3\text{ to }36\text{ V}$  | (V-) |            | (V+) - 1.5 | V    |
|              |  | $V_S = 3\text{ to }36\text{ V}$ , $T_A = -40^\circ\text{C to }+85^\circ\text{C}$                             | (V-) |            | (V+) - 2.0 | V    |
| $A_{VD}$     | Large signal differential voltage amplification <sup>(2)</sup> | $V_S = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ ;<br>$R_L \geq 15\text{ k}\Omega\text{ to (V+)}$ | 50   | 200        |            | V/mV |
| $V_{OL}$     | Low level output Voltage<br>{swing from (V-)}                  | $I_{SINK} \leq 4\text{ mA}$ , $V_{ID} = -1\text{ V}$   |      | 110        | 400        | mV   |
|              |  | $I_{SINK} \leq 4\text{ mA}$ , $V_{ID} = -1\text{ V}$<br>$T_A = -40^\circ\text{C to }+85^\circ\text{C}$       |      |            | 550        | mV   |
| $I_{OH-LKG}$ | High-level output leakage current                              | (V+) = $V_O = 5\text{ V}$ ; $V_{ID} = 1\text{ V}$  |      | 0.1        | 50         | nA   |
|              |  | (V+) = $V_O = 36\text{ V}$ ; $V_{ID} = 1\text{ V}$   |      |            | 100        | nA   |
| $I_{OL}$     | Low level output current                                       | $V_{OL} = 1.5\text{ V}$ ; $V_{ID} = -1\text{ V}$ ; $V_S = 5\text{ V}$  | 6    | 21         |            | mA   |
| $I_Q$        | Quiescent current (all comparators)                            | $V_S = 5\text{ V}$ , no load   |      | 0.8        | 1.2        | mA   |
|              |  | $V_S = 36\text{ V}$ , no load, $T_A = -40^\circ\text{C to }+85^\circ\text{C}$                                |      | 1          | 1.6        | mA   |

- (1) The voltage at either input should not be allowed to go negative by more than 0.3 V otherwise output may be incorrect and excessive input current can flow. The upper end of the common-mode voltage range is limited by  $V_{CC} - 2\text{ V}$ . However only one input needs to be in the valid common mode range, the other input can go up the maximum  $V_{CC}$  level and the comparator provides a proper output state. Either or both inputs can go to maximum  $V_{CC}$  level without damage.
- (2) This parameter is ensured by design and/or characterization and is not tested in production.

## 7.10 Electrical Characteristics for LM2901B

$V_S = 5\text{ V}$ ,  $V_{CM} = (V_-)$ ;  $T_A = 25^\circ\text{C}$  (unless otherwise noted).

| PARAMETER    |  | TEST CONDITIONS   | MIN  | TYP        | MAX        | UNIT |
|--------------|--|---|------|------------|------------|------|
| $V_{IO}$     | Input offset voltage   | $V_S = 5\text{ to }36\text{ V}$   | -3.5 | $\pm 0.37$ | 3.5        | mV   |
|              |  | $V_S = 5\text{ to }36\text{ V}$ , $T_A = -40^\circ\text{C to }+125^\circ\text{C}$                       | -5.5 |            | 5.5        |      |
| $I_B$        | Input bias current   |   |      | -3.5       | -25        | nA   |
|              |  | $T_A = -40^\circ\text{C to }+125^\circ\text{C}$   |      |            | -50        | nA   |
| $I_{OS}$     | Input offset current   |   | -25  | $\pm 0.5$  | 25         | nA   |
|              |  | $T_A = -40^\circ\text{C to }+125^\circ\text{C}$   | -50  |            | 50         | nA   |
| $V_{CM}$     | Common mode range <sup>(1)</sup>                               | $V_S = 3\text{ to }36\text{ V}$   | (V-) |            | (V+) - 1.5 | V    |
|              |  | $V_S = 3\text{ to }36\text{ V}$ , $T_A = -40^\circ\text{C to }+125^\circ\text{C}$                       | (V-) |            | (V+) - 2.0 | V    |
| $A_{VD}$     | Large signal differential voltage amplification <sup>(2)</sup> | $V_S = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ ;<br>$R_L \geq 15\text{ k to } (V_+)$       | 50   | 200        |            | V/mV |
| $V_{OL}$     | Low level output Voltage<br>{swing from (V-)}                  | $I_{SINK} \leq 4\text{ mA}$ , $V_{ID} = -1\text{ V}$  |      | 110        | 400        | mV   |
|              |  | $I_{SINK} \leq 4\text{ mA}$ , $V_{ID} = -1\text{ V}$<br>$T_A = -40^\circ\text{C to }+125^\circ\text{C}$ |      |            | 550        | mV   |
| $I_{OH-LKG}$ | High-level output leakage current                              | (V+) = $V_O = 5\text{ V}$ ; $V_{ID} = 1\text{ V}$   |      | 0.1        | 50         | nA   |
|              |  | (V+) = $V_O = 36\text{ V}$ ; $V_{ID} = 1\text{ V}$  |      |            | 100        | nA   |
| $I_{OL}$     | Low level output current                                       | $V_{OL} = 1.5\text{ V}$ ; $V_{ID} = -1\text{ V}$ ; $V_S = 5\text{ V}$                                   | 6    | 21         |            | mA   |
| $I_Q$        | Quiescent current (all comparators)                            | $V_S = 5\text{ V}$ , no load  |      | 0.8        | 1.2        | mA   |
|              |  | $V_S = 36\text{ V}$ , no load, $T_A = -40^\circ\text{C to }+125^\circ\text{C}$                          |      | 1          | 1.6        | mA   |

- (1) The voltage at either input should not be allowed to go negative by more than 0.3 V otherwise output may be incorrect and excessive input current can flow. The upper end of the common-mode voltage range is limited by  $V_{CC} - 2\text{ V}$ . However only one input needs to be in the valid common mode range, the other input can go up the maximum  $V_{CC}$  level and the comparator provides a proper output state. Either or both inputs can go to maximum  $V_{CC}$  level without damage.
- (2) This parameter is ensured by design and/or characterization and is not tested in production.

## 7.11 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                           | TYP | MAX  |      |
| 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    |
| 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<br>(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.

## 7.12 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                           | TYP | MAX  |      |
| 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 |
| I <sub>OH</sub>  | High-level output current                       | V <sub>ID</sub> = 1 V   | V <sub>OH</sub> = 5 V  | 25°C                          |                               | 0.1 | 50   |                               | 0.1 | 50   | 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,<br>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,<br>V <sub>OL</sub> = 1.5 V  | 25°C                   |                               | 6                             | 16  |      | 6                             | 16  | mA   |      |
| I <sub>CC</sub>  | Supply current<br>(four comparators)            | V <sub>O</sub> = 2.5 V,<br>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 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.

## 7.13 Electrical Characteristics for LM2901, LM2901V and LM2901AV

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>$R_L \geq 15\text{ k}\Omega$ 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    | $\mu\text{A}$ |
| $V_{OL}$ 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.

## 7.14 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>$C_L = 15\text{ pF}$ <sup>(1) (2)</sup> | 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.

## 7.15 Switching Characteristics for LM339B and LM2901B

$V_S = 5\text{ V}$ ,  $V_{O\_PULLUP} = 5\text{ V}$ ,  $V_{CM} = V_S/2$ ,  $C_L = 15\text{ pF}$ ,  $R_L = 5.1\text{ k}\Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted).

| PARAMETER             | TEST CONDITIONS   | MIN  | TYP | MAX  | UNIT |
|-----------------------|---|--|-----|------|------|
| $t_{\text{response}}$ | Propagation delay time, high-to-low;<br>Small scale input signal <sup>(1)</sup> | Input overdrive = 5mV, Input step = 100mV      |     | 1000 | ns   |
| $t_{\text{response}}$ | Propagation delay time, high-to-low;<br>TTL input signal <sup>(1)</sup>         | TTL input with $V_{\text{ref}} = 1.4\text{ V}$ |     | 300  | ns   |

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

## 7.16 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>$C_L = 15\text{ pF}$ <sup>(1) (2)</sup> | 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.

## 7.17 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>$C_L = 15\text{ pF}$ <sup>(1) (2)</sup> | 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.

## 7.18 Typical Characteristics for LM339B and LM2901B Only

$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.

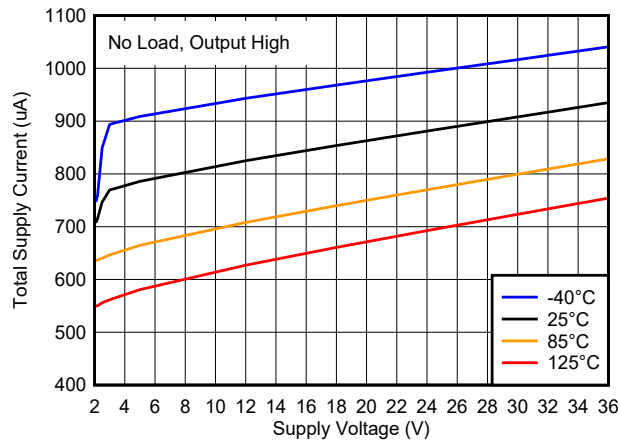


Figure 7-1. Total Supply Current vs. Supply Voltage

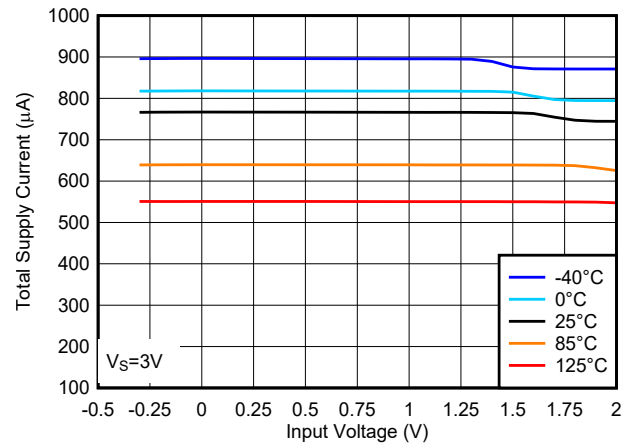


Figure 7-2. Total Supply Current vs. Input Voltage at 3V

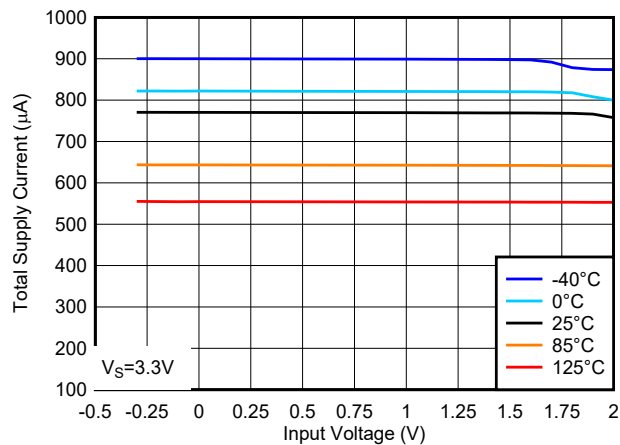


Figure 7-3. Total Supply Current vs. Input Voltage at 3.3V

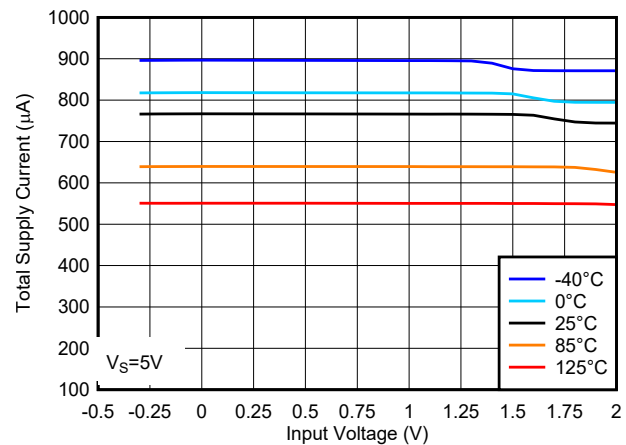


Figure 7-4. Total Supply Current vs. Input Voltage at 5V

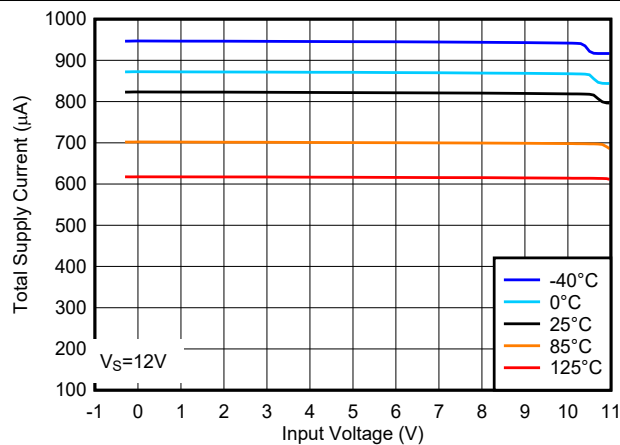


Figure 7-5. Total Supply Current vs. Input Voltage at 12V

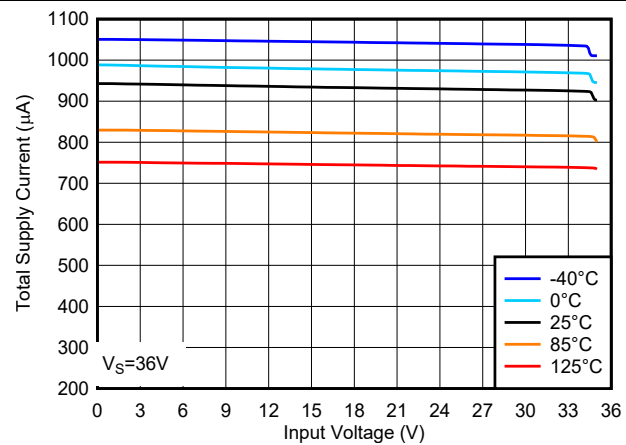


Figure 7-6. Total Supply Current vs. Input Voltage at 36V

## 7.18 Typical Characteristics for LM339B and LM2901B Only (continued)

$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.

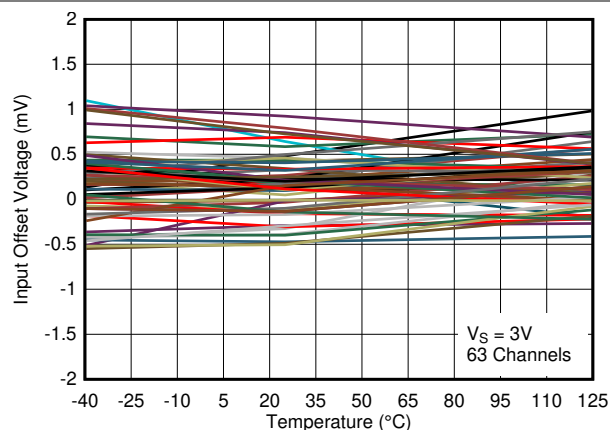


Figure 7-7. Input Offset Voltage vs. Temperature at 3V

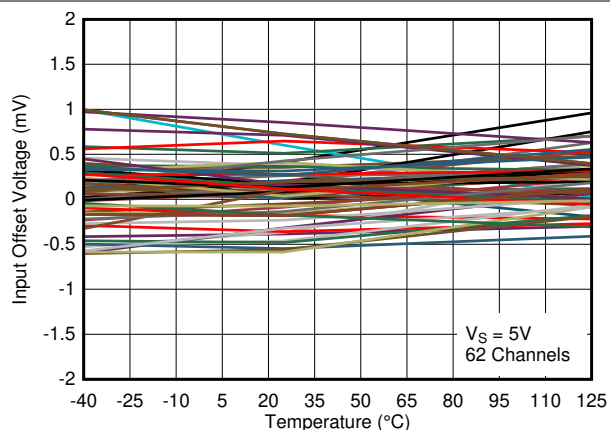


Figure 7-8. Input Offset Voltage vs. Temperature at 5V

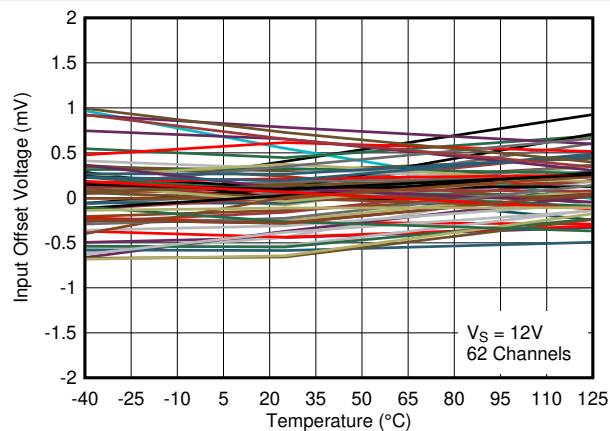


Figure 7-9. Input Offset Voltage vs. Temperature at 12V

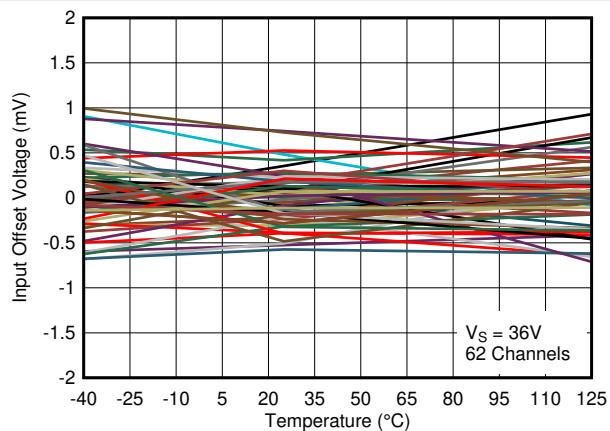


Figure 7-10. Input Offset Voltage vs. Temperature at 36V

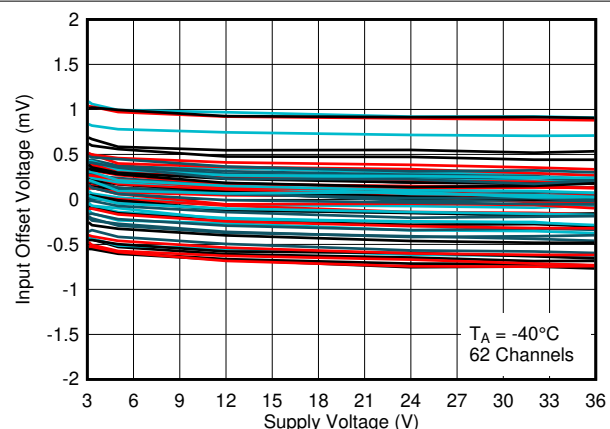


Figure 7-11. Input Offset Voltage vs. Supply Voltage at  $-40^\circ\text{C}$

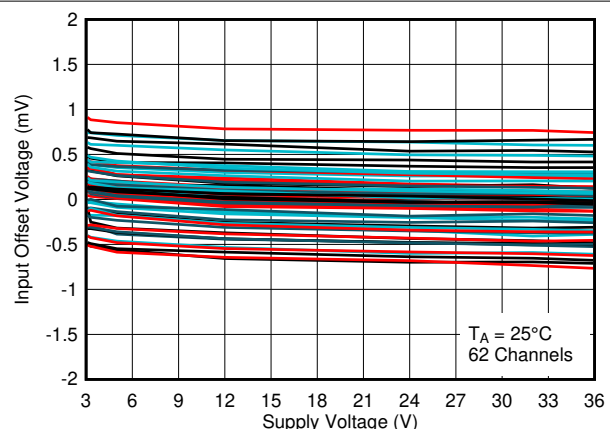


Figure 7-12. Input Offset Voltage vs. Supply Voltage at  $25^\circ\text{C}$



## 7.18 Typical Characteristics for LM339B and LM2901B Only (continued)

$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.

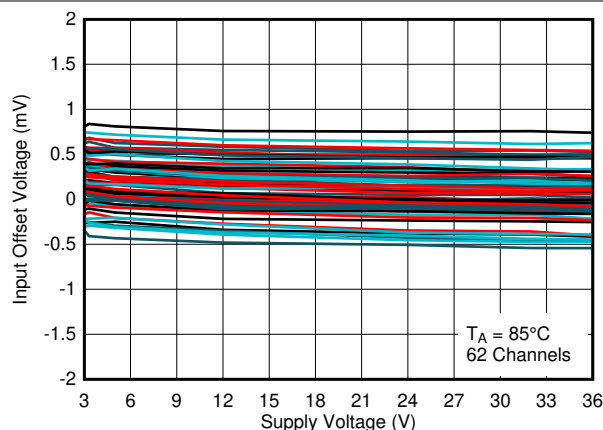


Figure 7-13. Input Offset Voltage vs. Supply Voltage at 85°C

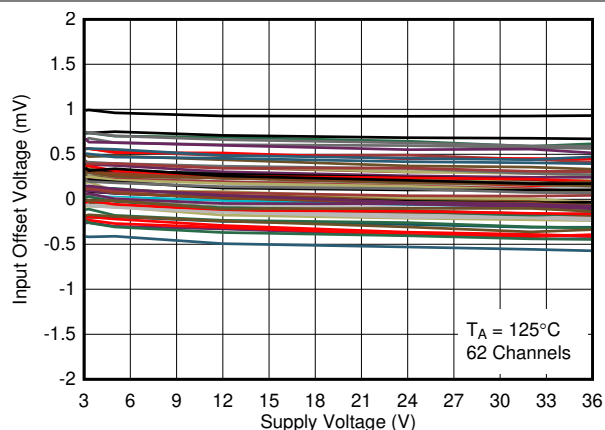


Figure 7-14. Input Offset Voltage vs. Supply Voltage at 125°C

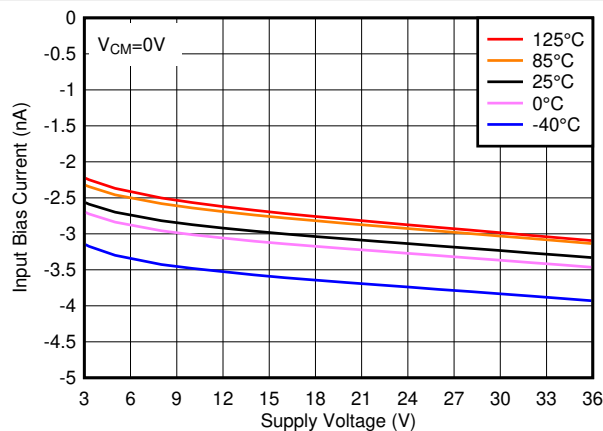


Figure 7-15. Input Bias Current vs. Supply Voltage

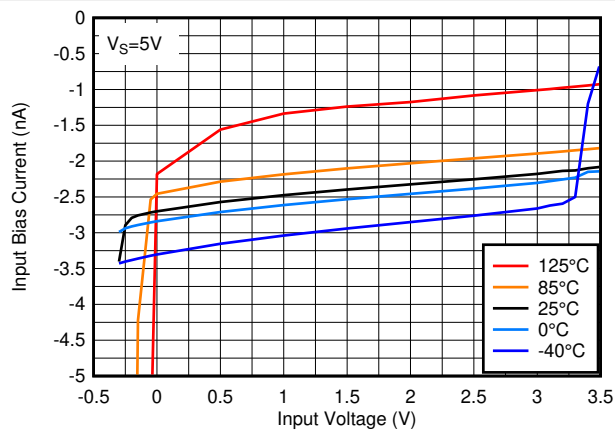


Figure 7-16. Input Bias Current vs. Input Voltage at 5V

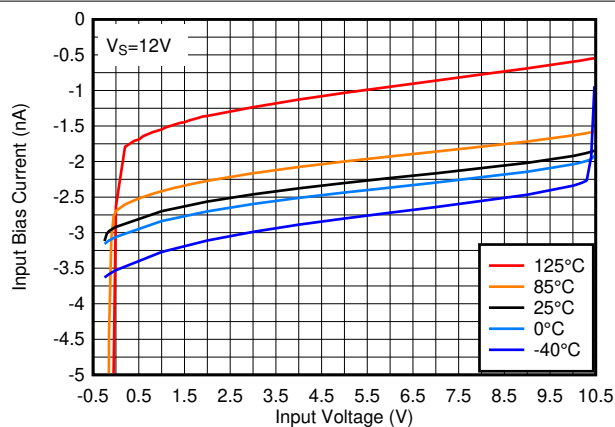


Figure 7-17. Input Bias Current vs. Input Voltage at 12V

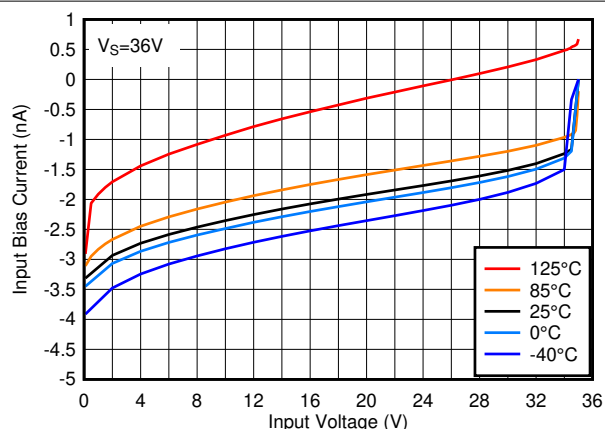
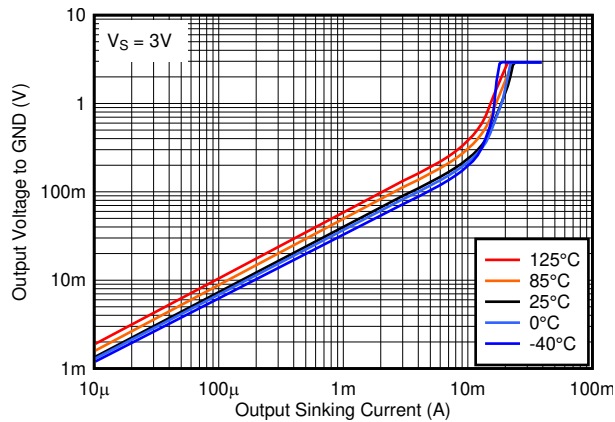


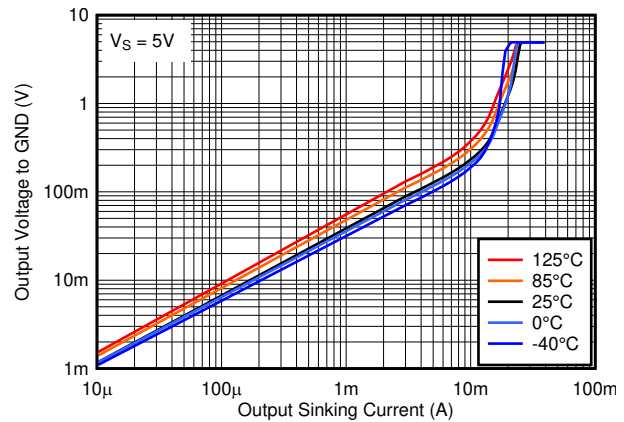
Figure 7-18. Input Bias Current vs. Input Voltage at 36V

## 7.18 Typical Characteristics for LM339B and LM2901B Only (continued)

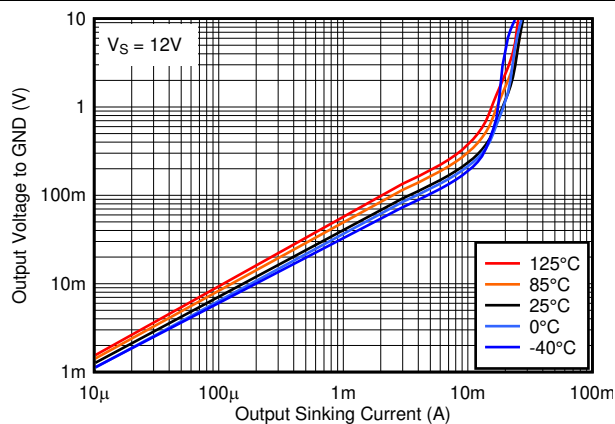
$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.



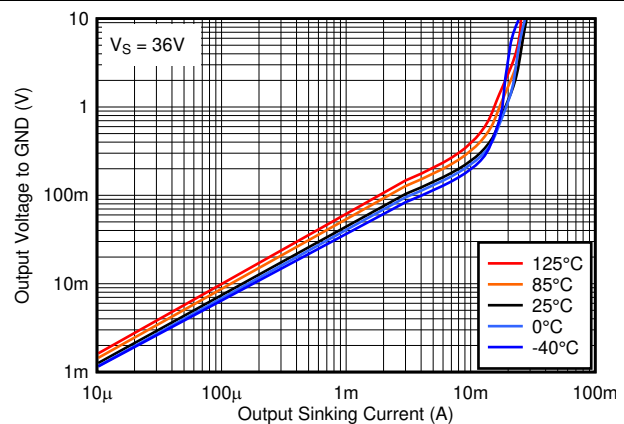
**Figure 7-19. Output Low Voltage vs. Output Sinking Current at 3V**



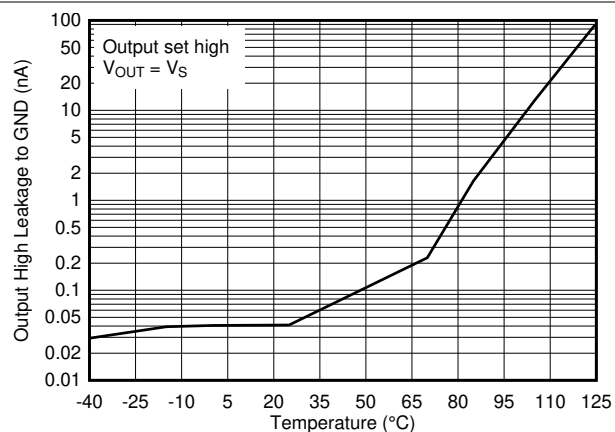
**Figure 7-20. Output Low Voltage vs. Output Sinking Current at 5V**



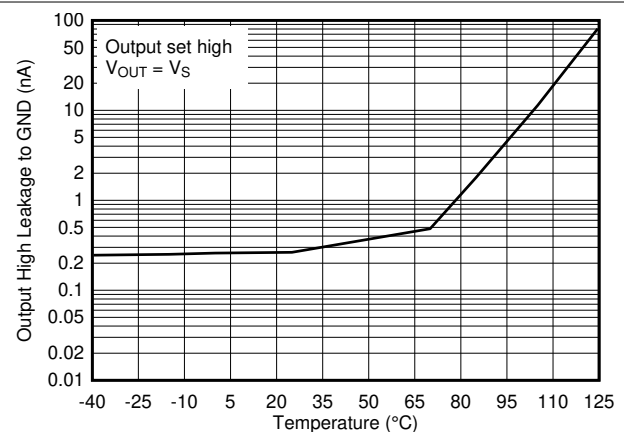
**Figure 7-21. Output Low Voltage vs. Output Sinking Current at 12V**



**Figure 7-22. Output Low Voltage vs. Output Sinking Current at 36V**



**Figure 7-23. Output High Leakage Current vs. Temperature at 5V**



**Figure 7-24. Output High Leakage Current vs. Temperature at 36V**

## 7.18 Typical Characteristics for LM339B and LM2901B Only (continued)

$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.

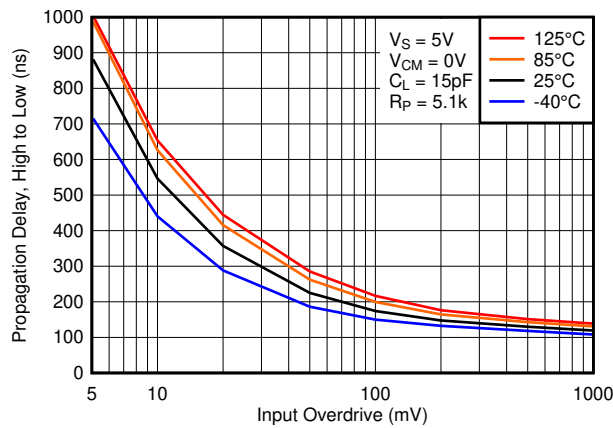


Figure 7-25. High to Low Propagation Delay vs. Input Overdrive Voltage, 5V

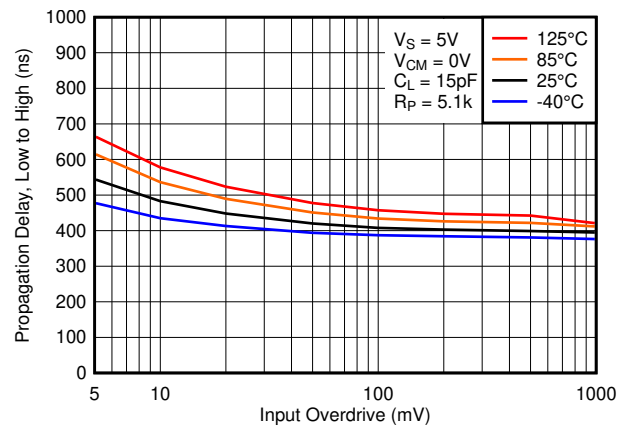


Figure 7-26. Low to High Propagation Delay vs. Input Overdrive Voltage, 5V

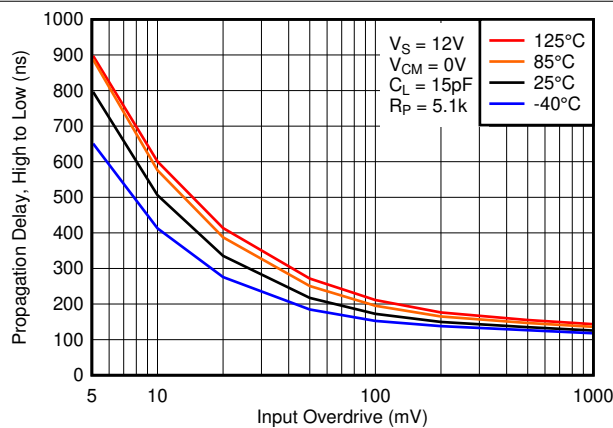


Figure 7-27. High to Low Propagation Delay vs. Input Overdrive Voltage, 12V

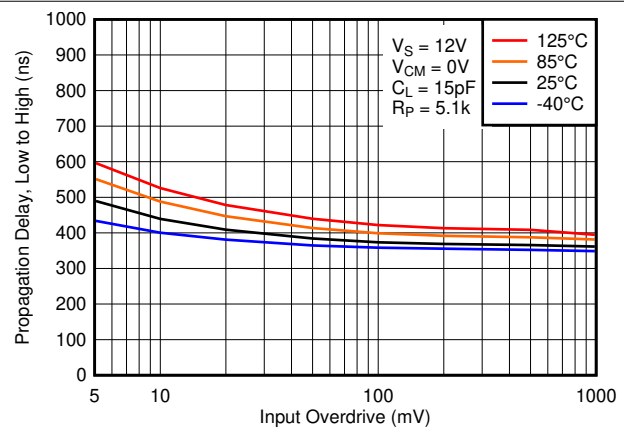


Figure 7-28. Low to High Propagation Delay vs. Input Overdrive Voltage, 12V

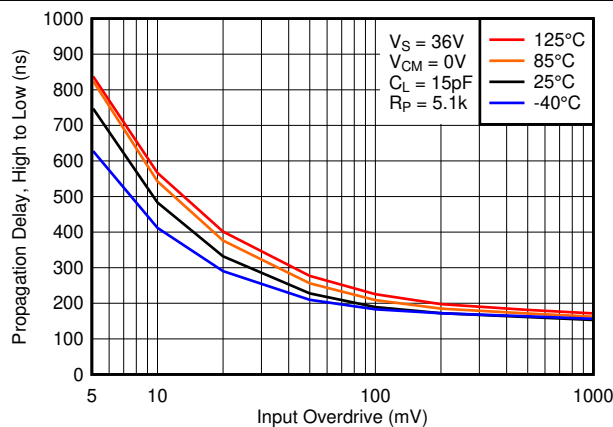


Figure 7-29. High to Low Propagation Delay vs. Input Overdrive Voltage, 36V

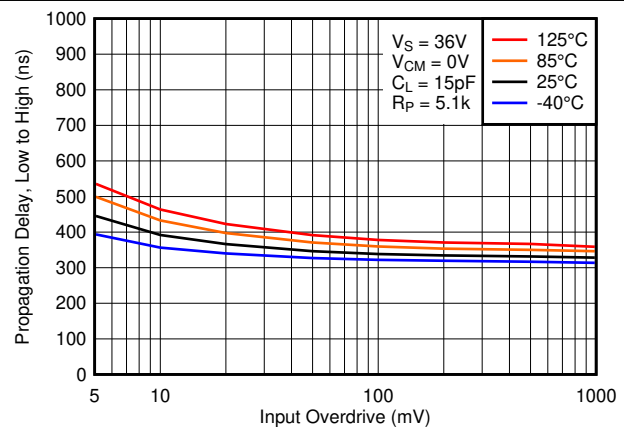
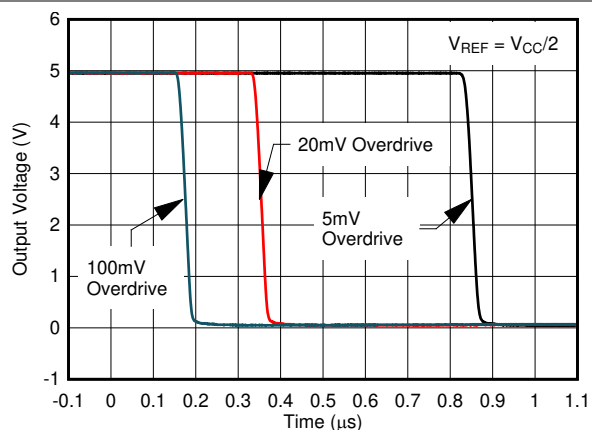


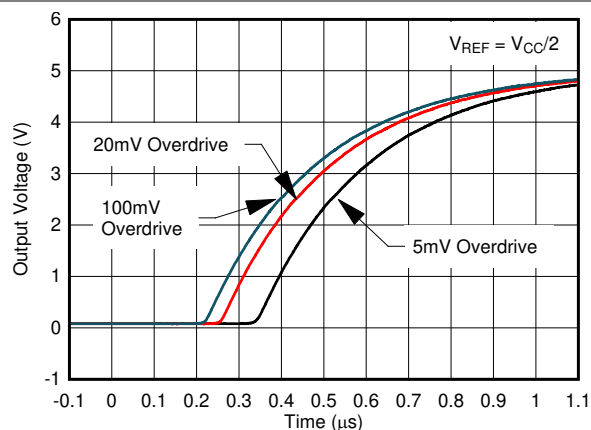
Figure 7-30. Low to High Propagation Delay vs. Input Overdrive Voltage, 36V

## 7.18 Typical Characteristics for LM339B and LM2901B Only (continued)

$T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ ,  $R_{\text{PULLUP}} = 5.1\text{ k}$ ,  $C_L = 15\text{ pF}$ ,  $V_{\text{CM}} = 0\text{ V}$ ,  $V_{\text{UNDERDRIVE}} = 100\text{ mV}$ ,  $V_{\text{OVERDRIVE}} = 100\text{ mV}$  unless otherwise noted.

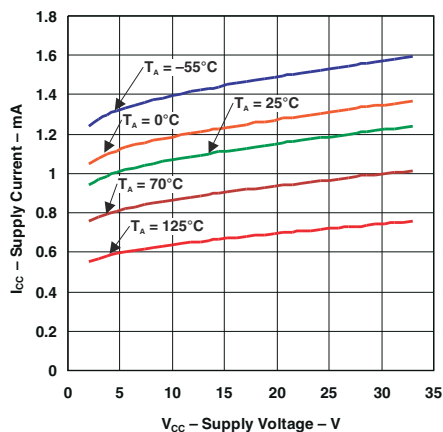


**Figure 7-31. Response Time for Various Overdrives, High-to-Low Transition**

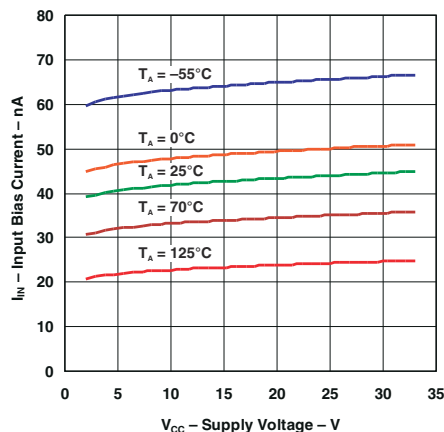


**Figure 7-32. Response Time for Various Overdrives, Low-to-High Transition**

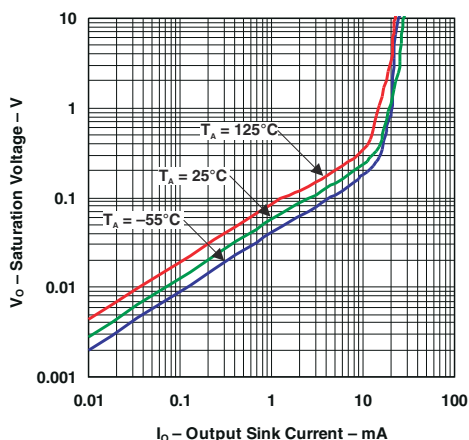
## 7.19 Typical Characteristics, Non-B Versions



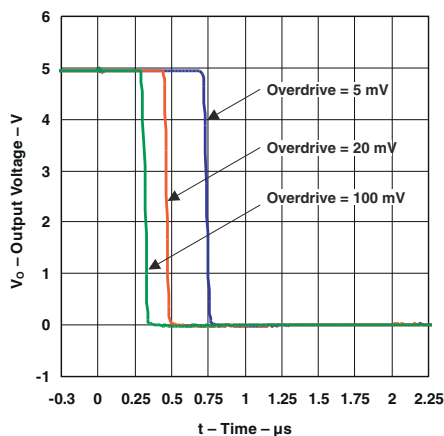
**Figure 7-33. Supply Current vs Supply Voltage**



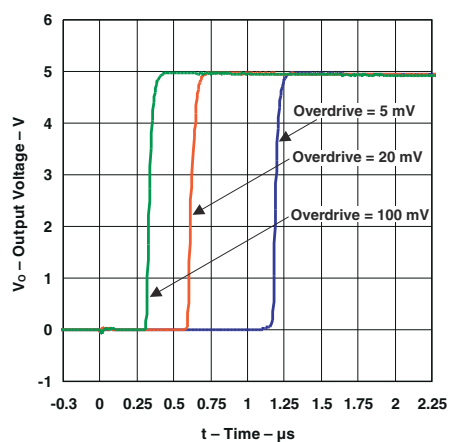
**Figure 7-34. Input Bias Current vs Supply Voltage**



**Figure 7-35. Output Saturation Voltage**



**Figure 7-36. Response Time for Various Overdrives Negative Transition**



**Figure 7-37. Response Time for Various Overdrives Positive Transition**

## 8 Detailed Description

### 8.1 Overview

The LMx39 and LM2901x are quad comparators with the ability to operate up to an absolute maximum of 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 up to 32 V), low  $I_q$ , and fast response of the device.

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

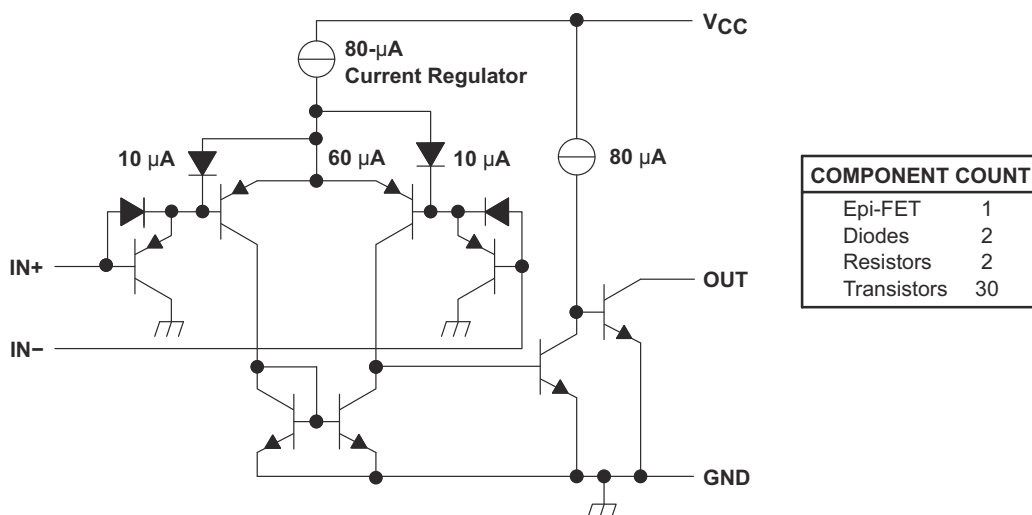


Figure 8-1. Schematic (Each Comparator)

### 8.3 Feature Description

The comparator 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 the comparator to accurately function from ground to ( $V_{CC} - 1.5$  V) differential input. Allow for ( $V_{CC} - 2$  V) at cold temperature.

The output consists of an open-collector NPN (pulldown or low-side) transistor. The output NPN sinks current when the negative input voltage is higher than the positive input voltage and the offset voltage. The  $V_{OL}$  is resistive and scales with the output current. See the [Section 7](#) section for  $V_{OL}$  values with respect to the output current.

### 8.4 Device Functional Modes

#### 8.4.1 Voltage Comparison

The comparator 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, as well as validating and testing their design implementation to confirm system functionality.

### 9.1 Application Information

Typically, a comparator compares either a single signal to a reference, or to two different 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 or LM2901x optimal for level shifting to a higher or lower voltage.

### 9.2 Typical Application

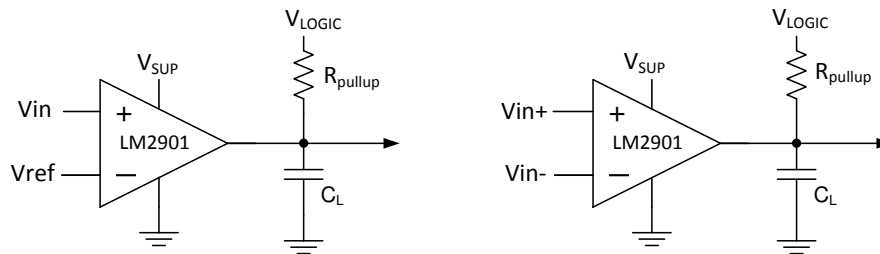


Figure 9-1. Single-ended and Differential Comparator Configurations

#### 9.2.1 Design Requirements

For this design example, use the parameters listed in [Table 9-1](#) as the input parameters.

Table 9-1. Design Parameters

| DESIGN PARAMETER                | EXAMPLE VALUE             |
|---------------------------------|---------------------------|
| Input Voltage Range             | 0 V to $V_{sup}-1.5$ V    |
| Supply Voltage                  | 4.5 V to $V_{CC}$ maximum |
| Logic Supply Voltage            | 0 V to $V_{CC}$ maximum   |
| Output Current ( $R_{PULLUP}$ ) | 1 $\mu$ A to 4 mA         |
| Input Overdrive Voltage         | 100 mV                    |
| Reference Voltage               | 2.5 V                     |
| Load Capacitance ( $C_L$ )      | 15 pF                     |

#### 9.2.2 Detailed Design Procedure

When using the 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– and IN+ are both within the common-mode range:
  - If IN– is higher than IN+ and the offset voltage, the output is low and the output transistor is sinking current
  - If IN– is lower than IN+ and the offset voltage, the output is high impedance and the output transistor is not conducting
- When IN– is higher than common mode and IN+ is within common mode, the output is low and the output transistor is sinking current
- When IN+ is higher than common mode and IN– is within common mode, the output is high impedance and the output transistor is not conducting
- When IN– and IN+ are both higher than common mode, see Section 2 of [Application Design Guidelines for LM339, LM393, TL331 Family Comparators Including the New B-versions](#)

#### 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 ( $V_{IO}$ ). 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 9-2](#) and [Figure 9-3](#) 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.

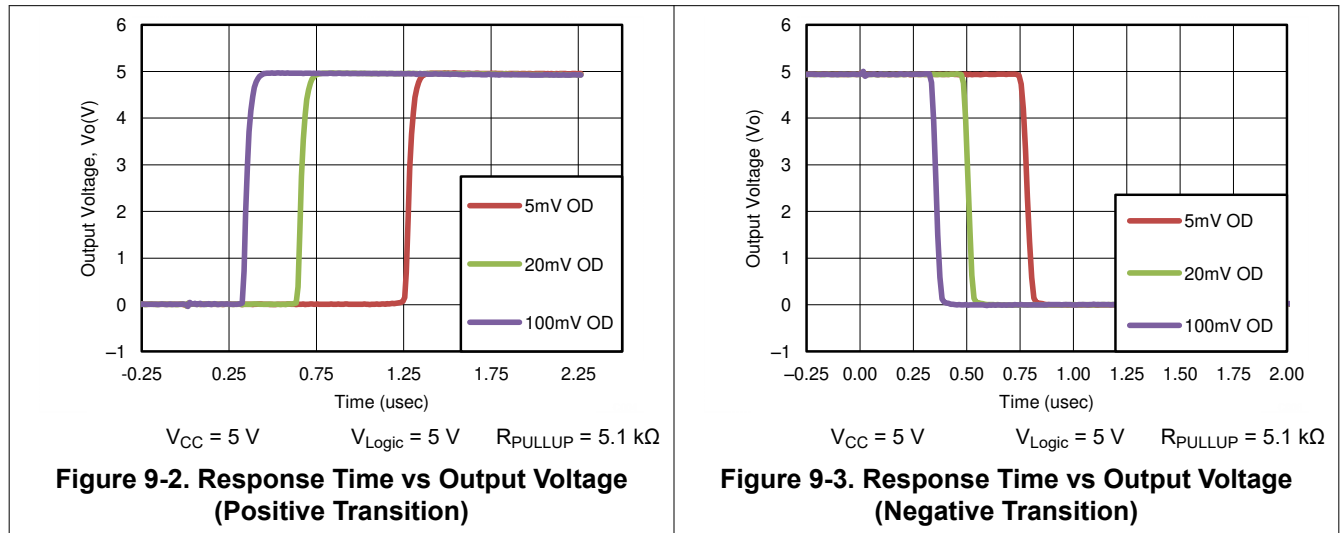
#### 9.2.2.4 Response Time

Response time is a function of input over-drive. See the [Section 7.19](#) graphs for typical response times. The rise and fall times can be determined by the load capacitance ( $C_L$ ), load/pull-up resistance ( $R_{PULLUP}$ ) and equivalent collector-emitter resistance ( $R_{CE}$ ).

- The rise time ( $\tau_R$ ) is approximately  $\tau_R \sim R_{PULLUP} \times C_L$
- The fall time ( $\tau_F$ ) is approximately  $\tau_F \sim R_{CE} \times C_L$ 
  - $R_{CE}$  can be determined by taking the slope of [Figure 7-35](#) in its linear region at the desired temperature, or by dividing the  $V_{OL}$  by  $I_{OUT}$

### 9.2.3 Application Curves

Figure 9-2 and Figure 9-3 were generated with scope probe parasitic capacitance of 50 pF.



### 9.3 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.

### 9.4 Layout

#### 9.4.1 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.

#### 9.4.2 Layout Example

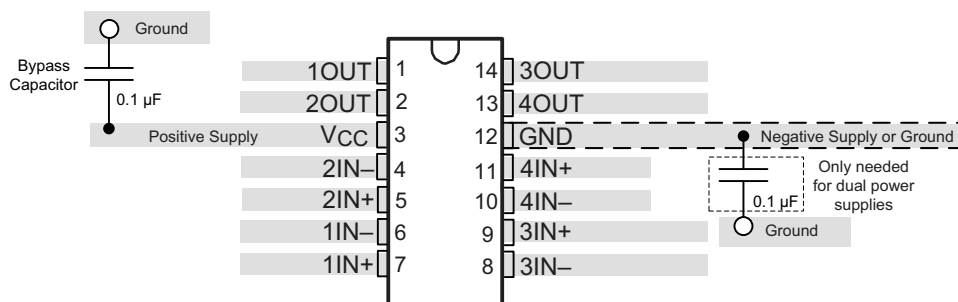


Figure 9-4. LMx39 Layout Example

## 10 Device and Documentation Support

### 10.1 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 10-1. 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> |

### 10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 10.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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](#).

### 10.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 10.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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

### 10.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 11 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 finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM139AD          | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -55 to 125   | LM139A                  |                         |
| LM139ADG4        | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -55 to 125   | LM139A                  |                         |
| LM139ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                  | <a href="#">Samples</a> |
| LM139ADRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LM139A                  | <a href="#">Samples</a> |
| LM139D           | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -55 to 125   | LM139                   |                         |
| LM139DG4         | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -55 to 125   | LM139                   |                         |
| LM139DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LM139                   | <a href="#">Samples</a> |
| LM139DRG4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | LM139                   | <a href="#">Samples</a> |
| LM239AD          | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -25 to 85    | LM239A                  |                         |
| LM239ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -25 to 85    | LM239A                  | <a href="#">Samples</a> |
| LM239ADRE4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | TBD             | Call TI                              | Call TI              | -25 to 85    |                         | <a href="#">Samples</a> |
| LM239ADRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | TBD             | Call TI                              | Call TI              | -25 to 85    |                         | <a href="#">Samples</a> |
| LM239D           | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -25 to 85    | LM239                   |                         |
| LM239DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -25 to 85    | LM239                   | <a href="#">Samples</a> |
| LM239N           | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Green    | NIPDAU   SN                          | N / A for Pkg Type   | -25 to 85    | LM239N                  | <a href="#">Samples</a> |
| LM239NE4         | ACTIVE        | PDIP         | N                  | 14   | 25             | TBD             | Call TI                              | Call TI              | -25 to 85    |                         | <a href="#">Samples</a> |
| LM239PW          | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD             | Call TI                              | Call TI              | -25 to 85    | L239                    |                         |
| LM239PWR         | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -25 to 85    | L239                    | <a href="#">Samples</a> |
| LM239PWRG4       | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD             | Call TI                              | Call TI              | -25 to 85    | L239                    |                         |
| LM2901AVQDR      | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901AVQDRG4    | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901AVQPWR     | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | 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 finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM2901AVQPWRG4   | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901AV                 | <a href="#">Samples</a> |
| LM2901BIDR       | ACTIVE        | SOIC         | D                  | 14   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LM2901B                 | <a href="#">Samples</a> |
| LM2901BIPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 3000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LM2901B                 | <a href="#">Samples</a> |
| LM2901BIRTER     | ACTIVE        | WQFN         | RTE                | 16   | 5000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | M2901B                  | <a href="#">Samples</a> |
| LM2901D          | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | -40 to 125   | LM2901                  |                         |
| LM2901DR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRE4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRG3       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901DRG4       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901N          | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -40 to 125   | LM2901N                 | <a href="#">Samples</a> |
| LM2901NSR        | ACTIVE        | SO           | NS                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LM2901                  | <a href="#">Samples</a> |
| LM2901PW         | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD             | Call TI                              | Call TI              | -40 to 125   | L2901                   |                         |
| LM2901PWR        | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901PWRG3      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901PWRG4      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901                   | <a href="#">Samples</a> |
| LM2901VQDR       | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM2901VQPWR      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM2901VQPWRG4    | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | L2901V                  | <a href="#">Samples</a> |
| LM339AD          | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | 0 to 70      | LM339A                  |                         |
| LM339ADBR        | ACTIVE        | SSOP         | DB                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339ADR         | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339ADRG4       | OBSOLETE      | SOIC         | D                  | 14   |                | TBD             | Call TI                              | Call TI              | 0 to 70      | LM339A                  |                         |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)  | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|------------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM339AN          | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Green     | NIPDAU   SN                          | N / A for Pkg Type   | 0 to 70      | LM339AN                 | <a href="#">Samples</a> |
| LM339ANE4        | ACTIVE        | PDIP         | N                  | 14   | 25             | TBD              | Call TI                              | Call TI              | 0 to 70      |                         | <a href="#">Samples</a> |
| LM339ANSR        | ACTIVE        | SO           | NS                 | 14   | 2000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | LM339A                  | <a href="#">Samples</a> |
| LM339APW         | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD              | Call TI                              | Call TI              | 0 to 70      | L339A                   |                         |
| LM339APWR        | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green     | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339APWRG4      | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | L339A                   | <a href="#">Samples</a> |
| LM339BIDR        | ACTIVE        | SOIC         | D                  | 14   | 3000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | LM339B                  | <a href="#">Samples</a> |
| LM339BIPWR       | ACTIVE        | TSSOP        | PW                 | 14   | 3000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | LM339B                  | <a href="#">Samples</a> |
| LM339BIRTER      | ACTIVE        | WQFN         | RTE                | 16   | 5000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | LM339B                  | <a href="#">Samples</a> |
| LM339D           | OBSOLETE      | SOIC         | D                  | 14   |                | TBD              | Call TI                              | Call TI              | 0 to 70      | LM339                   |                         |
| LM339DBR         | ACTIVE        | SSOP         | DB                 | 14   | 2000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DR          | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green     | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DRE4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339DRG4        | ACTIVE        | SOIC         | D                  | 14   | 2500           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339N           | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Green     | NIPDAU   SN                          | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NE3         | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Non-Green | SN                                   | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NE4         | ACTIVE        | PDIP         | N                  | 14   | 25             | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | LM339N                  | <a href="#">Samples</a> |
| LM339NSR         | ACTIVE        | SO           | NS                 | 14   | 2000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | LM339                   | <a href="#">Samples</a> |
| LM339PW          | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD              | Call TI                              | Call TI              | 0 to 70      | L339                    |                         |
| LM339PWR         | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green     | NIPDAU   SN                          | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWRE4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |
| LM339PWRG3       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green     | SN                                   | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM339PWRG4       | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | L339                    | <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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

(5) 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.

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

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**OTHER QUALIFIED VERSIONS OF LM139, LM239A, LM2901, LM2901AV, LM2901B, LM2901V :**

● Automotive : [LM239A-Q1](#), [LM2901-Q1](#), [LM2901AV-Q1](#), [LM2901B-Q1](#), [LM2901V-Q1](#)



- Enhanced Product : [LM239A-EP](#)
- Space : [LM139-SP](#)

NOTE: Qualified Version Definitions:

- 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



\*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            |
| LM139ADRG4     | 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            |
| LM139DRG4      | 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              | 16.4               | 6.5     | 9.0     | 2.1     | 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            |
| 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            |
| LM2901BIDR     | SOIC         | D               | 14   | 3000 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM2901BIPWR    | TSSOP        | PW              | 14   | 3000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2901BIRTER   | WQFN         | RTE             | 16   | 5000 | 330.0              | 12.4               | 3.3     | 3.3     | 1.1     | 8.0     | 12.0   | Q2            |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM2901DRG3    | SOIC         | D               | 14   | 2500 | 330.0              | 16.8               | 6.5     | 9.5     | 2.1     | 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            |
| 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            |
| 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               | 8.35    | 6.6     | 2.4     | 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            |
| 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            |
| LM339APWRG4   | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339BIDR     | SOIC         | D               | 14   | 3000 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339BIPWR    | TSSOP        | PW              | 14   | 3000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM339BIRTER   | WQFN         | RTE             | 16   | 5000 | 330.0              | 12.4               | 3.3     | 3.3     | 1.1     | 8.0     | 12.0   | Q2            |
| LM339DBR      | SSOP         | DB              | 14   | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| LM339DR       | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 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            |
| LM339DRG4     | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM339NSR      | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | 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 | 350.0       | 350.0      | 43.0        |
| LM139ADRG4     | SOIC         | D               | 14   | 2500 | 350.0       | 350.0      | 43.0        |
| LM139DR        | SOIC         | D               | 14   | 2500 | 350.0       | 350.0      | 43.0        |
| LM139DRG4      | SOIC         | D               | 14   | 2500 | 350.0       | 350.0      | 43.0        |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| LM239ADR       | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM239DR        | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM239DRG4      | SOIC         | D               | 14   | 2500 | 340.5       | 336.1      | 32.0        |
| LM239DRG4      | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| LM239PWR       | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901AVQPWR   | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901AVQPWRG4 | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901BIDR     | SOIC         | D               | 14   | 3000 | 356.0       | 356.0      | 35.0        |
| LM2901BIPWR    | TSSOP        | PW              | 14   | 3000 | 356.0       | 356.0      | 35.0        |
| LM2901BIRTER   | WQFN         | RTE             | 16   | 5000 | 367.0       | 367.0      | 35.0        |
| LM2901DR       | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM2901DRG3     | SOIC         | D               | 14   | 2500 | 364.0       | 364.0      | 27.0        |
| LM2901DRG4     | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM2901DRG4    | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| LM2901NSR     | SO           | NS              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901PWR     | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901PWRG3   | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM2901PWRG4   | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901VQPWR   | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM2901VQPWRG4 | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339ADBR     | SSOP         | DB              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339ADR      | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM339ANSR     | SO           | NS              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339APWR     | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339APWRG4   | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339BIDR     | SOIC         | D               | 14   | 3000 | 356.0       | 356.0      | 35.0        |
| LM339BIPWR    | TSSOP        | PW              | 14   | 3000 | 356.0       | 356.0      | 35.0        |
| LM339BIRTER   | WQFN         | RTE             | 16   | 5000 | 367.0       | 367.0      | 35.0        |
| LM339DBR      | SSOP         | DB              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339DR       | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM339DRG4     | SOIC         | D               | 14   | 2500 | 353.0       | 353.0      | 32.0        |
| LM339DRG4     | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| LM339NSR      | SO           | NS              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339PWR      | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| LM339PWRG3    | TSSOP        | PW              | 14   | 2000 | 364.0       | 364.0      | 27.0        |
| LM339PWRG4    | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |

## TUBE



\*All dimensions are nominal

| Device   | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|----------|--------------|--------------|------|-----|--------|--------|--------|--------|
| LM239N   | N            | PDIP         | 14   | 25  | 506.1  | 9      | 600    | 5.4    |
| LM239N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM2901N  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339AN  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339AN  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339AN  | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339AN  | N            | PDIP         | 14   | 25  | 506.1  | 9      | 600    | 5.4    |
| LM339N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339N   | N            | PDIP         | 14   | 25  | 506.1  | 9      | 600    | 5.4    |
| LM339N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339NE3 | N            | PDIP         | 14   | 25  | 506.1  | 9      | 600    | 5.4    |
| LM339NE4 | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339NE4 | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| LM339NE4 | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |

## GENERIC PACKAGE VIEW

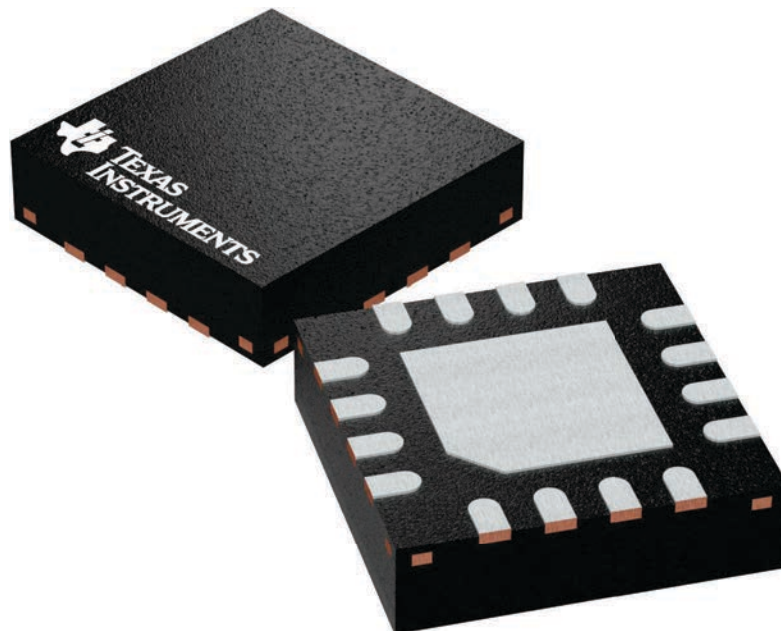
**RTE 16**

**WQFN - 0.8 mm max height**

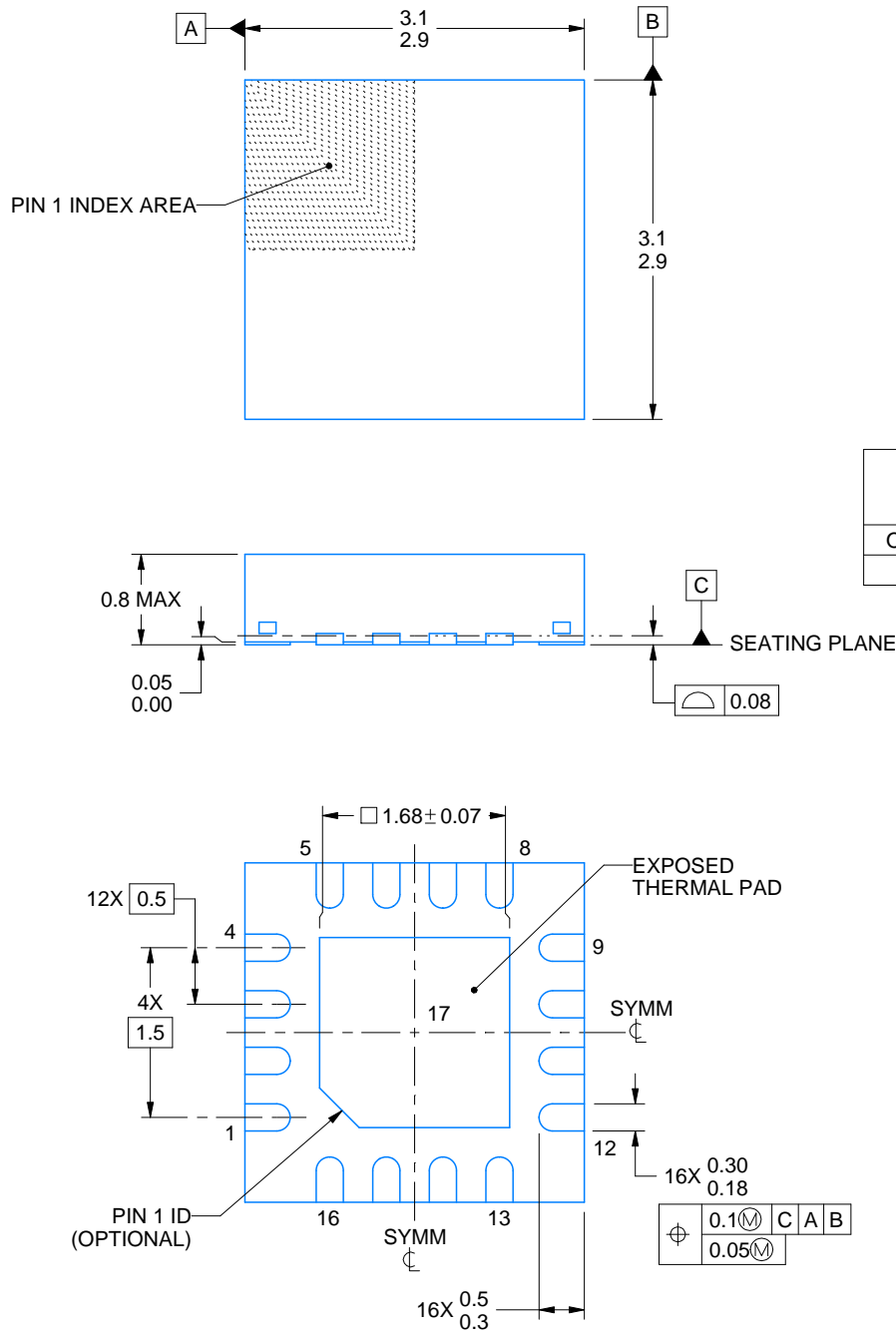
3 x 3, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4225944/A



4219117/B 04/2022

## NOTES:

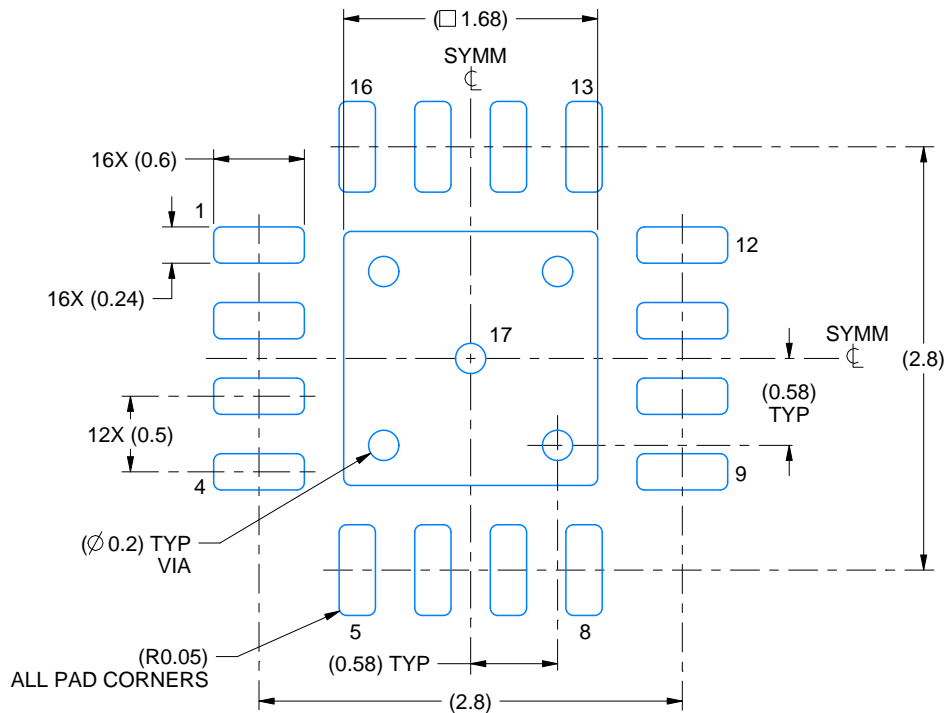
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



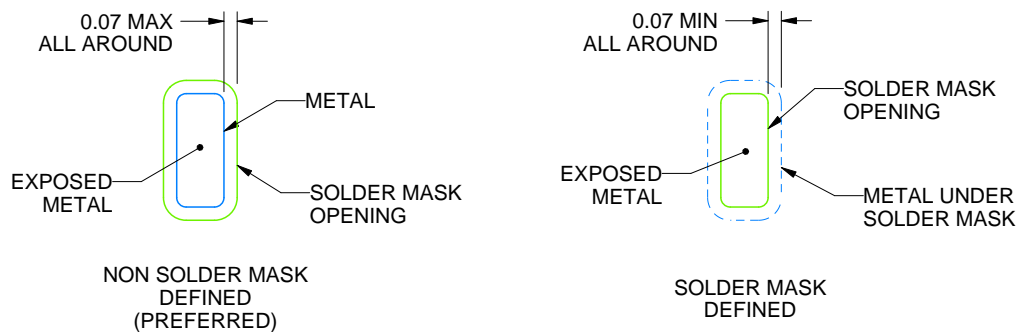
**RTE0016C**

**WQFN - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:20X



## SOLDER MASK DETAILS

4219117/B 04/2022

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

**RTE0016C**

### WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



## SOLDER PASTE EXAMPLE BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 17:  
85% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE  
SCALE:25X

4219117/B 04/2022

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

**NOTES:**

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

# 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.



4220762/A 05/2024

## NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-150.

# EXAMPLE BOARD LAYOUT

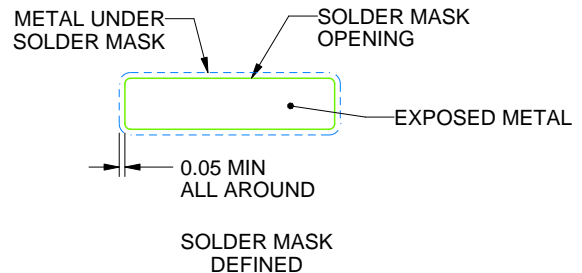
DB0014A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220762/A 05/2024

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



# EXAMPLE STENCIL DESIGN

DB0014A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220762/A 05/2024

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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.



## PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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