

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

### 1 Features

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

### 2 Applications

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

### 3 Description

The LMx39x and the LM2901x devices consist of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible, as long as the difference between the two supplies is 2 V to 36 V, and  $V_{CC}$  is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

The LM139 and LM139A devices are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . The LM239 and LM239A devices are characterized for operation from  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . The LM339 and LM339A devices are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ . The LM2901, LM2901AV, and LM2901V devices are characterized for operation from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

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

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

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

#### Simplified Schematic



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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## 4 Revision History

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

Changes from Revision T (June 2015) to Revision U	Page
• 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> .....	3
• Changed 'I' to dash in GND and VCC in I/O column of the <i>Pin Functions</i> table .....	4
• Added Input Current and related footnote in <i>Absolute Maximum Ratings</i> .....	5
• Changed layout of <i>Recommended Operating Conditions</i> temperatures to separate rows .....	5
• Changed values in the Thermal Information table to align with JEDEC standards .....	6
• Added LM2901V and LMV2901AV to LM2901 Elect Char Table title to make more clear which devices are covered. ....	8
• Changed "Dual" to "Quad" and removed "Absolute Maximum" wording and mention of Q100 in <i>Overview</i> section text. ...	11
• Changed and corrected text in <i>Feature Description</i> section .....	11
• Changed Example Values in <i>Typical Application Design Parameters</i> table .....	12
• Added <i>Receiving Notification of Documentation Updates</i> section .....	15

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

## 5 Device Comparison Table

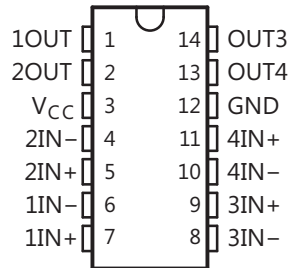
PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM139J, LM139AJ	CDIP (14)	21.30 mm × 7.60 mm
LM139FK, LM139AFK	LCCC (20)	8.90 mm × 8.90 mm
LM139W, LM139AW	CFP (14)	9.20 mm × 6.29 mm
LM139D, LM139AD, LM239D, LM239AD, LM339D, LM339AD, LM2901D	SOIC (14)	8.70 mm × 3.90 mm
LM239N, LM339N, LM339AN, LM2901N	PDIP (14)	19.30 mm × 6.40 mm
LM239PW, LM2901PW	TSSOP (14)	5.00 mm × 4.40 mm
LM339NS, LM339ANS, LM2901NS	SOP (14)	10.20 mm × 5.30 mm
LM339DB, LM339ADB	SSOP (14)	6.50 mm × 5.30 mm

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

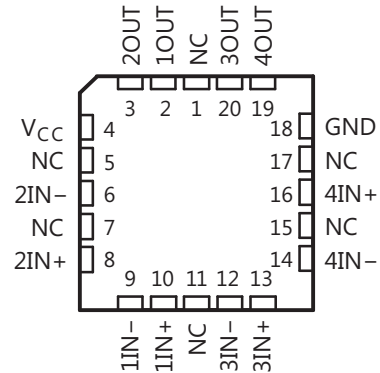
- Automotive Q100: [LM239A-Q1](#), [LM2901-Q1](#), [LM2901AV-Q1](#), [LM2901V-Q1](#)
- Enhanced Product: [LM239A-EP](#)
- Space: [LM139-SP](#)

## 6 Pin Configuration and Functions

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



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



(1) NC = no internal connection.

### Pin Functions

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

(1) I = Input, O = Output

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage <sup>(2)</sup>		36	V
V <sub>ID</sub>	Differential input voltage <sup>(3)</sup>		±36	V
V <sub>I</sub>	Input voltage range (either input)	−0.3	36	V
I <sub>K</sub>	Input current <sup>(4)</sup>		−50	mA
V <sub>O</sub>	Output voltage		36	V
I <sub>O</sub>	Output current		20	mA
	Duration of output short circuit to ground <sup>(5)</sup>	Unlimited		
T <sub>J</sub>	Operating virtual-junction temperature		150	°C
	Case temperature for 60 s	FK package	260	°C
	Lead temperature 1.6 mm (1/16 in) from case for 60 s	J package	300	°C
T <sub>stg</sub>	Storage temperature	−65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to network ground.
- (3) Differential voltages are at xIN+ with respect to xIN−.
- (4) Input current flows through parasitic diode to ground and will turn on parasitic transistors that will increase I<sub>CC</sub> and may cause output to be incorrect. Normal operation resumes when input is removed.
- (5) Short circuits from outputs to V<sub>CC</sub> can cause excessive heating and eventual destruction.

### 7.2 ESD Ratings

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

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

### 7.3 Recommended Operating Conditions

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

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	Non-V devices	2	30	V
		V devices	2	32	V
T <sub>J</sub>	Junction temperature	LM139x	−55	125	°C
		LM239x	−25	85	
		LM339x	−0	70	
		LM2901x	−40	125	

## 7.4 Thermal Information (14-Pin Packages)

THERMAL METRIC <sup>(1)</sup>	LMx39, LM2901x							UNIT
	D (SOIC)	DB (SSOP)	N (PDIP)	NS (SO)	PW (TSSOP)	J (CDIP)	W (CFP)	
$R_{\theta JA}$ Junction-to-ambient thermal resistance	98.8	111.8	79	96.2	120	89.5	156.2	°C/W
$R_{\theta JC(top)}$ Junction-to-case (top) thermal resistance	64.3	63.6	73.4	56.1	59	46.1	86.7	°C/W
$R_{\theta JB}$ Junction-to-board thermal resistance	59.7	60.5	58.7	56.9	68.8	78.7	154.6	°C/W
$\Psi_{JT}$ Junction-to-top characterization parameter	25.7	26.2	48.3	24.8	9.9	3	56.5	°C/W
$\Psi_{JB}$ Junction-to-board characterization parameter	59.3	59.8	58.5	56.4	68.2	71.8	133.5	°C/W
$R_{\theta JC(bot)}$ 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.

## 7.5 Thermal Information (20-Pin Packages)

THERMAL METRIC <sup>(1)</sup>	LM139x	UNIT
	FK (LCCC)	
$R_{\theta JA}$ Junction-to-ambient thermal resistance	82.5	°C/W
$R_{\theta JC(top)}$ Junction-to-case (top) thermal resistance	60.7	°C/W
$R_{\theta JB}$ Junction-to-board thermal resistance	59.4	°C/W
$\Psi_{JT}$ Junction-to-top characterization parameter	53	°C/W
$\Psi_{JB}$ Junction-to-board characterization parameter	58.4	°C/W
$R_{\theta JC(bot)}$ Junction-to-case (bottom) thermal resistance	9.7	°C/W

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

## 7.6 Electrical Characteristics for LM139 and LM139A

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

PARAMETER	TEST CONDITIONS <sup>(1)</sup>	$T_A$ <sup>(2)</sup>	LM139			LM139A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$ , $V_{IC} = V_{ICR\text{ min}}$ , $V_O = 1.4\text{ V}$	25°C		2	5		1	2	mV
		Full range			9			4	
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	25°C		3	25		3	25	nA
		Full range			100			100	
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$	25°C		-25	-100		-25	-100	nA
		Full range			-300			-300	
$V_{ICR}$ Common-mode input-voltage range <sup>(3)</sup>		25°C		0 to $V_{CC} - 1.5$		0 to $V_{CC} - 1.5$			V
		Full range		0 to $V_{CC} - 2$		0 to $V_{CC} - 2$			
$A_{VD}$ Large-signal differential-voltage amplification	$V_{CC+} = \pm 7.5\text{ V}$ , $V_O = -5\text{ V to }5\text{ V}$	25°C		200		50	200	V/mV	
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$	$V_{OH} = 5\text{ V}$	25°C		0.1		0.1	nA	
		$V_{OH} = 30\text{ V}$	Full range					1	$\mu\text{A}$
$V_{OL}$ Low-level output voltage	$V_{ID} = -1\text{ V}$ , $I_{OL} = 4\text{ mA}$	25°C		150	400		150	400	mV
		Full range			700			700	
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$	25°C		6	16		6	16	mA
$I_{CC}$ Supply current (four comparators)	$V_O = 2.5\text{ V}$ , 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  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
- (3) The voltage at either input or common-mode must not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ ; however, one input can exceed  $V_{CC}$ , and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to 30 V without damage.

## 7.7 Electrical Characteristics for LMx39 and LMx39A

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

PARAMETER	TEST CONDITIONS <sup>(1)</sup>	$T_A$ <sup>(2)</sup>	LM239 LM339			LM239A LM339A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$ , $V_{IC} = V_{ICR\text{ min}}$ , $V_O = 1.4\text{ V}$	25°C		2	5		1	3	mV
		Full range			9			4	
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	25°C		5	50		5	50	nA
		Full range			150			150	
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$	25°C		-25	-250		-25	-250	nA
		Full range			-400			-400	
$V_{ICR}$ Common-mode input-voltage range <sup>(3)</sup>		25°C		0 to $V_{CC} - 1.5$		0 to $V_{CC} - 1.5$			V
		Full range		0 to $V_{CC} - 2$		0 to $V_{CC} - 2$			
$A_{VD}$ Large-signal differential-voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ , $R_L \geq 15\text{ k}\Omega\text{ to }V_{CC}$	25°C		50	200		50	200	V/mV

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

## Electrical Characteristics for LMx39 and LMx39A (continued)

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

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

## 7.8 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	$V_{IC} = V_{ICR}\text{ min},$ $V_O = 1.4\text{ V},$ $V_{CC} = 5\text{ V to MAX}^{(3)}$	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 $V_{CC} - 1.5$		V			
		Full range	0 to $V_{CC} - 2$					
$A_{VD}$ Large-signal differential-voltage amplification	$V_{CC} = 15\text{ V}, V_O = 1.4\text{ V to } 11.4\text{ V},$ $R_L \geq 15\text{ k}\Omega\text{ to } V_{CC}$	25°C	25 100		V/mV			
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$	$V_{OH} = 5\text{ V}$	25°C			0.1 50	nA	
		$V_{OH} = V_{CC}\text{ MAX}^{(3)}$	Full range			1		$\mu\text{A}$
$V_{OL}$ Low-level output voltage	$V_{ID} = -1\text{ V},$ $I_{OL} = 4\text{ mA}$	Non-V devices	25°C			150 500		mV
		V-suffix devices	Full range			150 400		
		All devices	Full range			700		
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V},$ $V_{OL} = 1.5\text{ V}$	25°C	6 16			mA		
$I_{CC}$ Supply current (four comparators)	$V_O = 2.5\text{ V},$ No load	$V_{CC} = 5\text{ V}$	25°C			0.8 2		mA
		$V_{CC} = \text{MAX}^{(3)}$	Full range			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  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . 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  $32\text{ V}$  for V-suffix devices
- (4) The voltage at either input or common-mode must not be allowed to go negative by more than  $0.3\text{ V}$ . The upper end of the common-mode voltage range is  $V_{CC+} - 1.5\text{ V}$ ; however, one input can exceed  $V_{CC}$ , and the comparator will provide a proper output state as long as the other input remains in the common-mode range. Either or both inputs can go to  $V_{CC}\text{ MAX}$  without damage.



## 7.9 Switching Characteristics for LM2901

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

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

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

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

## 7.10 Switching Characteristics for LM139 and LM139A

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

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

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

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

## 7.11 Switching Characteristics for LMx39 and LMx39A

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

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

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

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

## 7.12 Typical Characteristics

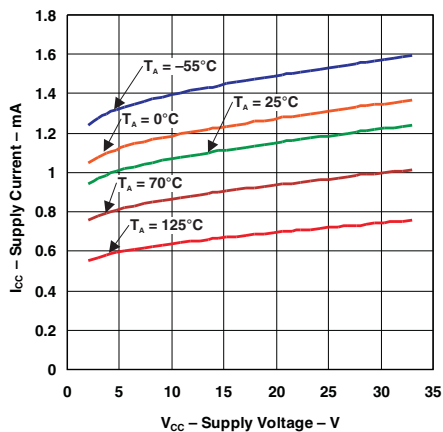


Figure 1. Supply Current vs Supply Voltage

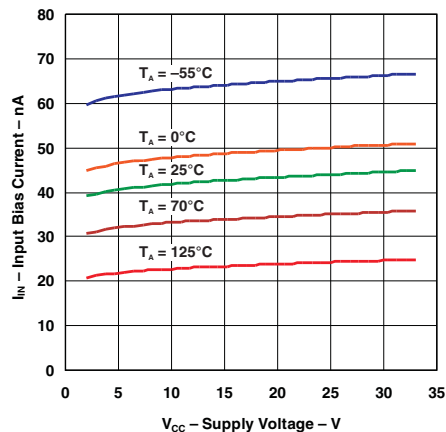


Figure 2. Input Bias Current vs Supply Voltage

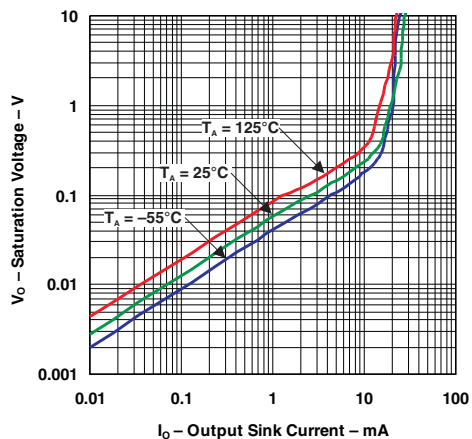


Figure 3. Output Saturation Voltage

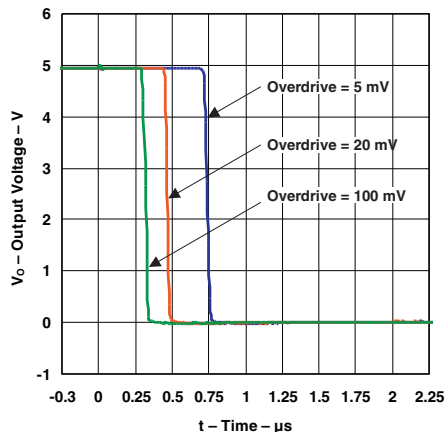


Figure 4. Response Time for Various Overdrives  
 Negative Transition

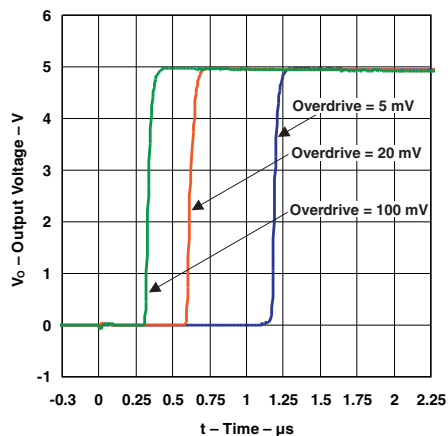


Figure 5. Response Time for Various Overdrives  
 Positive Transition

## 8 Detailed Description

### 8.1 Overview

The LMx39 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

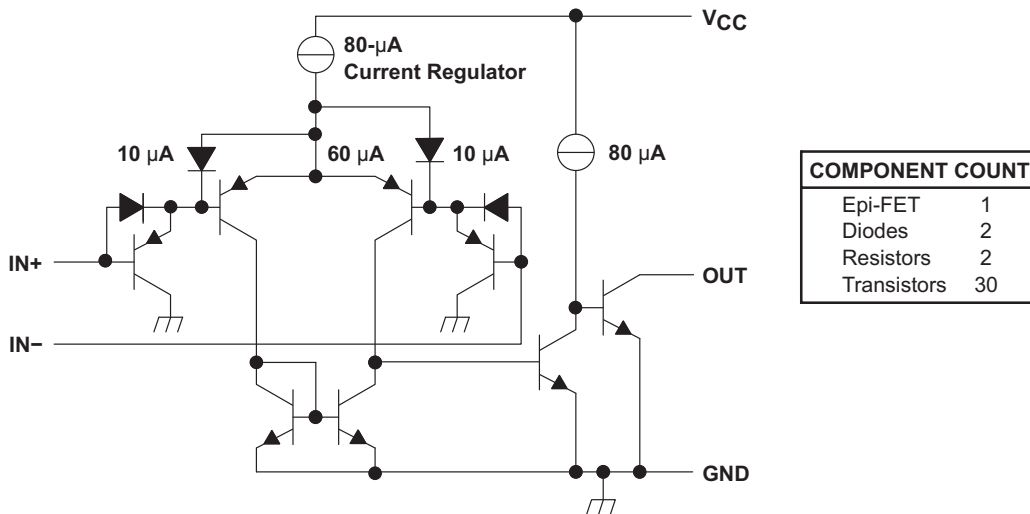


Figure 6. Schematic (Each Comparator)

### 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 [Specifications](#) 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. Validate and test the 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

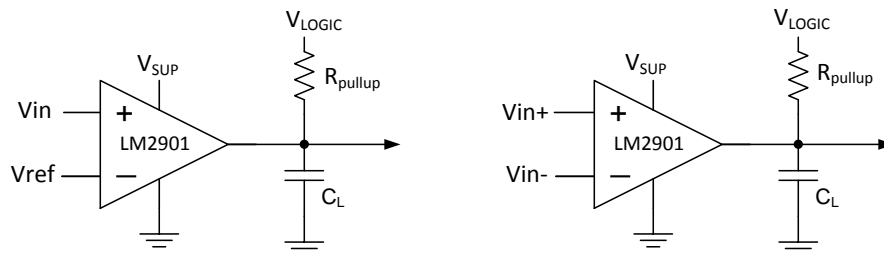


Figure 7. Single-ended and Differential Comparator Configurations

#### 9.2.1 Design Requirements

For this design example, use the parameters listed in Table 1 as the input parameters.

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input Voltage Range	0 V to $V_{sup}-1.5$ 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<sup>-</sup> and IN<sup>+</sup> are both within the common-mode range:
  - If IN<sup>-</sup> is higher than IN<sup>+</sup> and the offset voltage, the output is low and the output transistor is sinking current
  - If IN<sup>-</sup> is lower than IN<sup>+</sup> and the offset voltage, the output is high impedance and the output transistor is not conducting
- When IN<sup>-</sup> is higher than common mode and IN<sup>+</sup> is within common mode, the output is low and the output transistor is sinking current
- When IN<sup>+</sup> is higher than common mode and IN<sup>-</sup> is within common mode, the output is high impedance and the output transistor is not conducting
- When IN<sup>-</sup> and IN<sup>+</sup> are both higher than common mode, the output is low and the output transistor is sinking current

### 9.2.2.2 Minimum Overdrive Voltage

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

### 9.2.2.3 Output and Drive Current

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

The output current can also effect the transient response.

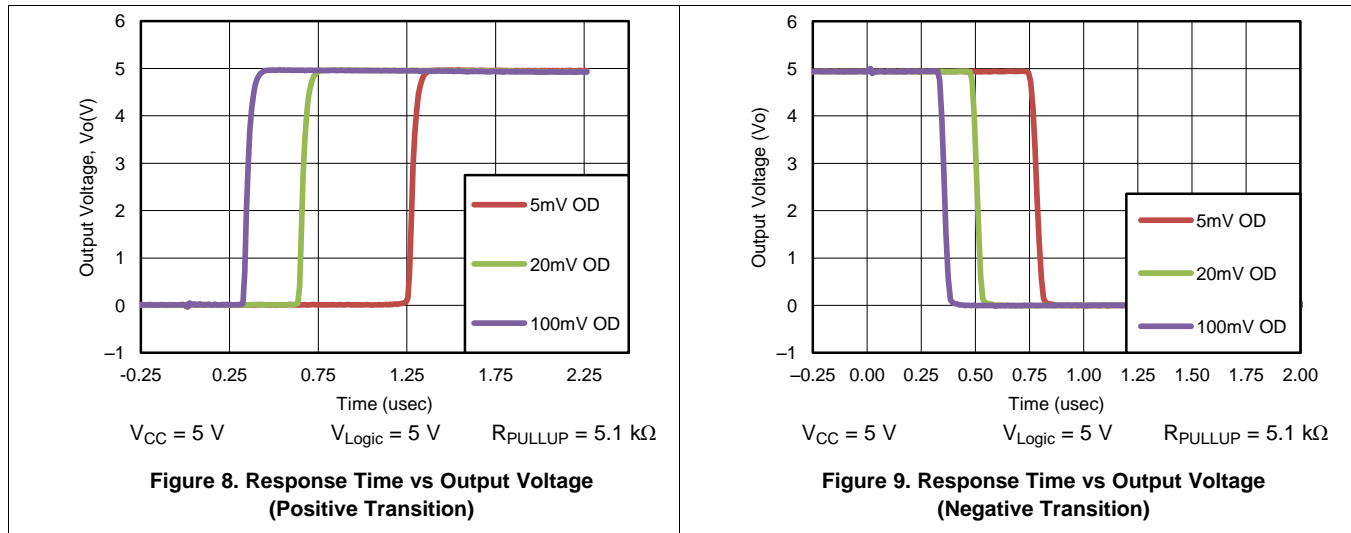
### 9.2.2.4 Response Time

Response time is a function of input over-drive. See the [Typical Characteristics](#) 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 3](#) in its linear region at the desired temperature, or by dividing the  $V_{OL}$  by  $I_{OUT}$

### 9.2.3 Application Curves

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



## 10 Power Supply Recommendations

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

## 11 Layout

### 11.1 Layout Guidelines

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

#### NOTE

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

### 11.2 Layout Example

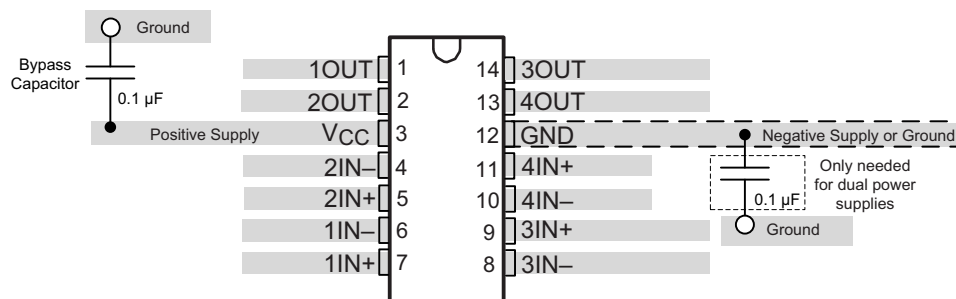


Figure 10. LMx39 Layout Example

## 12 Device and Documentation Support

### 12.1 Related Links

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

**Table 2. Related Links**

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

### 12.2 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.

### 12.3 Community Resources

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

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

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

### 12.4 Trademarks

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

### 12.5 Electrostatic Discharge Caution



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

### 12.6 Glossary

**SLYZ022** — *TI Glossary*.

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

## 13 Mechanical, Packaging, and Orderable Information

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

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM139AD	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	LM139A	<a href="#">Samples</a>
LM139ADG4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	LM139A	<a href="#">Samples</a>
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	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	LM139	<a href="#">Samples</a>
LM139DG4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	LM139	<a href="#">Samples</a>
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	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239A	<a href="#">Samples</a>
LM239ADE4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239A	<a href="#">Samples</a>
LM239ADR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-25 to 85	LM239A	<a href="#">Samples</a>
LM239ADRE4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239A	<a href="#">Samples</a>
LM239ADRG4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239A	<a href="#">Samples</a>
LM239D	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239	<a href="#">Samples</a>
LM239DE4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239	<a href="#">Samples</a>
LM239DG4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	LM239	<a href="#">Samples</a>
LM239DR	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-25 to 85	LM239	<a href="#">Samples</a>
LM239DRG3	ACTIVE	SOIC	D	14	2500	RoHS & Green	SN	Level-1-260C-UNLIM	-25 to 85	LM239	<a href="#">Samples</a>
LM239DRG4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	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>



Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM239NE4	ACTIVE	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-25 to 85	LM239N	<a href="#">Samples</a>
LM239PW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	L239	<a href="#">Samples</a>
LM239PWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	-25 to 85	L239	<a href="#">Samples</a>
LM239PWRE4	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	L239	<a href="#">Samples</a>
LM239PWRG4	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-25 to 85	L239	<a href="#">Samples</a>
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 & Non-Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	L2901AV	<a href="#">Samples</a>
LM2901AVQPWRG4	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	L2901AV	<a href="#">Samples</a>
LM2901D	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM2901	<a href="#">Samples</a>
LM2901DE4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM2901	<a href="#">Samples</a>
LM2901DG4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM2901	<a href="#">Samples</a>
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>
LM2901NE4	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	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	L2901	<a href="#">Samples</a>
LM2901PWG4	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	L2901	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
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>
LM2901VQDRG4	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 & Non-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	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<a href="#">Samples</a>
LM339ADBR	ACTIVE	SSOP	DB	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339A	<a href="#">Samples</a>
LM339ADE4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<a href="#">Samples</a>
LM339ADG4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<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>
LM339ADRE4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<a href="#">Samples</a>
LM339ADRG4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<a href="#">Samples</a>
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	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	LM339AN	<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>
LM339ANSRG4	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339A	<a href="#">Samples</a>
LM339APW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339A	<a href="#">Samples</a>
LM339APWG4	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339A	<a href="#">Samples</a>
LM339APWR	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU   SN	Level-1-260C-UNLIM	0 to 70	L339A	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM339APWRG4	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339A	<a href="#">Samples</a>
LM339D	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339	<a href="#">Samples</a>
LM339DBR	ACTIVE	SSOP	DB	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339	<a href="#">Samples</a>
LM339DBRE4	ACTIVE	SSOP	DB	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339	<a href="#">Samples</a>
LM339DE4	ACTIVE	SOIC	D	14	50	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339	<a href="#">Samples</a>
LM339DG4	ACTIVE	SOIC	D	14	50	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>
LM339DRG3	ACTIVE	SOIC	D	14	2500	RoHS & Green	SN	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>
LM339NSRG4	ACTIVE	SO	NS	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LM339	<a href="#">Samples</a>
LM339PW	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339	<a href="#">Samples</a>
LM339PWG4	ACTIVE	TSSOP	PW	14	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	L339	<a href="#">Samples</a>
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>
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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm 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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

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

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

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


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM139ADR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM139DRG4	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
LM239DR	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM239DR	SOIC	D	14	2500	330.0	17.5	6.4	9.05	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
LM239DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM239DRG3	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM239DRG3	SOIC	D	14	2500	330.0	17.5	6.4	9.05	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
LM239PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
LM239PWRG4	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

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
LM2901AVQPWRG4	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
LM2901DR	SOIC	D	14	2500	330.0	17.5	6.4	9.05	2.1	8.0	16.0	Q1
LM2901DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM2901DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM2901DR	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM2901DRG3	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM2901DRG3	SOIC	D	14	2500	330.0	17.5	6.4	9.05	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
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
LM339ADR	SOIC	D	14	2500	330.0	17.5	6.4	9.05	2.1	8.0	16.0	Q1
LM339ADR	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM339ADR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM339ADRG4	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM339ADRG4	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM339ANSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
LM339APWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
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
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	16.8	6.5	9.5	2.1	8.0	16.0	Q1
LM339DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM339DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM339DRG3	SOIC	D	14	2500	330.0	17.5	6.4	9.05	2.1	8.0	16.0	Q1
LM339DRG3	SOIC	D	14	2500	330.0	16.8	6.5	9.5	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
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

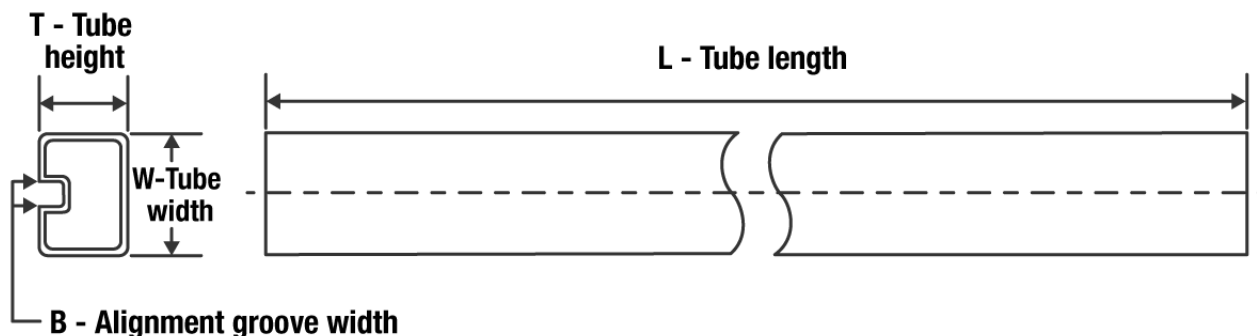
**TAPE AND REEL BOX DIMENSIONS**


\*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	340.5	336.1	32.0
LM239ADR	SOIC	D	14	2500	853.0	449.0	35.0
LM239DR	SOIC	D	14	2500	364.0	364.0	27.0
LM239DR	SOIC	D	14	2500	333.2	345.9	28.6
LM239DR	SOIC	D	14	2500	853.0	449.0	35.0
LM239DR	SOIC	D	14	2500	340.5	336.1	32.0
LM239DRG3	SOIC	D	14	2500	364.0	364.0	27.0
LM239DRG3	SOIC	D	14	2500	333.2	345.9	28.6
LM239DRG4	SOIC	D	14	2500	853.0	449.0	35.0
LM239DRG4	SOIC	D	14	2500	340.5	336.1	32.0
LM239PWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM239PWR	TSSOP	PW	14	2000	364.0	364.0	27.0
LM239PWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901AVQPWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901AVQPWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901DR	SOIC	D	14	2500	333.2	345.9	28.6



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2901DR	SOIC	D	14	2500	340.5	336.1	32.0
LM2901DR	SOIC	D	14	2500	853.0	449.0	35.0
LM2901DR	SOIC	D	14	2500	364.0	364.0	27.0
LM2901DRG3	SOIC	D	14	2500	364.0	364.0	27.0
LM2901DRG3	SOIC	D	14	2500	333.2	345.9	28.6
LM2901DRG4	SOIC	D	14	2500	340.5	336.1	32.0
LM2901DRG4	SOIC	D	14	2500	853.0	449.0	35.0
LM2901NSR	SO	NS	14	2000	853.0	449.0	35.0
LM2901PWR	TSSOP	PW	14	2000	364.0	364.0	27.0
LM2901PWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901PWRG3	TSSOP	PW	14	2000	364.0	364.0	27.0
LM2901PWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901VQPWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM2901VQPWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0
LM339ADBR	SSOP	DB	14	2000	853.0	449.0	35.0
LM339ADR	SOIC	D	14	2500	853.0	449.0	35.0
LM339ADR	SOIC	D	14	2500	333.2	345.9	28.6
LM339ADR	SOIC	D	14	2500	364.0	364.0	27.0
LM339ADR	SOIC	D	14	2500	340.5	336.1	32.0
LM339ADRG4	SOIC	D	14	2500	340.5	336.1	32.0
LM339ADRG4	SOIC	D	14	2500	853.0	449.0	35.0
LM339ANSR	SO	NS	14	2000	853.0	449.0	35.0
LM339APWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM339APWR	TSSOP	PW	14	2000	364.0	364.0	27.0
LM339APWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0
LM339DBR	SSOP	DB	14	2000	853.0	449.0	35.0
LM339DR	SOIC	D	14	2500	364.0	364.0	27.0
LM339DR	SOIC	D	14	2500	853.0	449.0	35.0
LM339DR	SOIC	D	14	2500	340.5	336.1	32.0
LM339DRG3	SOIC	D	14	2500	333.2	345.9	28.6
LM339DRG3	SOIC	D	14	2500	364.0	364.0	27.0
LM339DRG4	SOIC	D	14	2500	853.0	449.0	35.0
LM339DRG4	SOIC	D	14	2500	340.5	336.1	32.0
LM339NSR	SO	NS	14	2000	853.0	449.0	35.0
LM339PWR	TSSOP	PW	14	2000	364.0	364.0	27.0
LM339PWR	TSSOP	PW	14	2000	853.0	449.0	35.0
LM339PWRG3	TSSOP	PW	14	2000	364.0	364.0	27.0
LM339PWRG4	TSSOP	PW	14	2000	853.0	449.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
LM139AD	D	SOIC	14	50	505.46	6.76	3810	4
LM139ADG4	D	SOIC	14	50	505.46	6.76	3810	4
LM139D	D	SOIC	14	50	505.46	6.76	3810	4
LM139DG4	D	SOIC	14	50	505.46	6.76	3810	4
LM239AD	D	SOIC	14	50	506.6	8	3940	4.32
LM239AD	D	SOIC	14	50	507	8	3940	4.32
LM239ADE4	D	SOIC	14	50	506.6	8	3940	4.32
LM239ADE4	D	SOIC	14	50	507	8	3940	4.32
LM239D	D	SOIC	14	50	507	8	3940	4.32
LM239D	D	SOIC	14	50	506.6	8	3940	4.32
LM239DE4	D	SOIC	14	50	506.6	8	3940	4.32
LM239DE4	D	SOIC	14	50	507	8	3940	4.32
LM239DG4	D	SOIC	14	50	507	8	3940	4.32
LM239DG4	D	SOIC	14	50	506.6	8	3940	4.32
LM239N	N	PDIP	14	25	506	13.97	11230	4.32
LM239N	N	PDIP	14	25	506.1	9	600	5.4
LM239NE4	N	PDIP	14	25	506	13.97	11230	4.32
LM239NE4	N	PDIP	14	25	506.1	9	600	5.4
LM239PW	PW	TSSOP	14	90	530	10.2	3600	3.5
LM2901D	D	SOIC	14	50	506.6	8	3940	4.32
LM2901DE4	D	SOIC	14	50	506.6	8	3940	4.32
LM2901DG4	D	SOIC	14	50	506.6	8	3940	4.32
LM2901N	N	PDIP	14	25	506	13.97	11230	4.32
LM2901NE4	N	PDIP	14	25	506	13.97	11230	4.32
LM2901PW	PW	TSSOP	14	90	530	10.2	3600	3.5
LM2901PWG4	PW	TSSOP	14	90	530	10.2	3600	3.5
LM339AD	D	SOIC	14	50	507	8	3940	4.32
LM339AD	D	SOIC	14	50	506.6	8	3940	4.32

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM339ADE4	D	SOIC	14	50	506.6	8	3940	4.32
LM339ADE4	D	SOIC	14	50	507	8	3940	4.32
LM339ADG4	D	SOIC	14	50	506.6	8	3940	4.32
LM339ADG4	D	SOIC	14	50	507	8	3940	4.32
LM339AN	N	PDIP	14	25	506.1	9	600	5.4
LM339AN	N	PDIP	14	25	506	13.97	11230	4.32
LM339AN	N	PDIP	14	25	506	13.97	11230	4.32
LM339ANE4	N	PDIP	14	25	506	13.97	11230	4.32
LM339ANE4	N	PDIP	14	25	506.1	9	600	5.4
LM339ANE4	N	PDIP	14	25	506	13.97	11230	4.32
LM339APW	PW	TSSOP	14	90	530	10.2	3600	3.5
LM339APWG4	PW	TSSOP	14	90	530	10.2	3600	3.5
LM339D	D	SOIC	14	50	507	8	3940	4.32
LM339D	D	SOIC	14	50	506.6	8	3940	4.32
LM339DE4	D	SOIC	14	50	507	8	3940	4.32
LM339DE4	D	SOIC	14	50	506.6	8	3940	4.32
LM339DG4	D	SOIC	14	50	506.6	8	3940	4.32
LM339DG4	D	SOIC	14	50	507	8	3940	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
LM339PW	PW	TSSOP	14	90	530	10.2	3600	3.5
LM339PWG4	PW	TSSOP	14	90	530	10.2	3600	3.5

## MECHANICAL DATA

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

**PLASTIC SMALL-OUTLINE PACKAGE**

**14-PINS SHOWN**



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

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

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

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



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

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

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



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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

4040049/E 12/2002

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

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



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

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