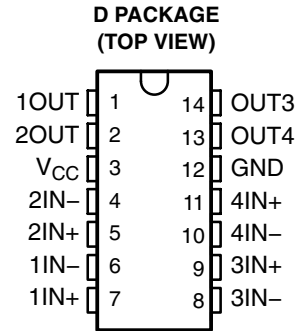


# LM239A-Q1 QUAD DIFFERENTIAL COMPARATOR

SCLS513B – JULY 2003 – REVISED FEBRUARY 2008

- Qualified for Automotive Applications
- ESD Protection Exceeds 1000 V Per MIL-STD-883, Method 3015; Exceeds 100 V Using Machine Model (C = 200 pF, R = 0); Exceeds 2000 V Charged Device Model
- Single Supply or Dual Supplies
- Wide Range of Supply Voltage . . . 2 V to 36 V
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 5 nA Typ
- Low Input Offset Voltage . . . 2 mV Typ
- 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



## description/ordering information

This device consists 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.

## ORDERING INFORMATION†

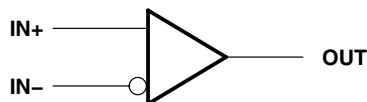
T <sub>A</sub>	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOP - D	Tape and reel	LM239AQDRQ1§	LM239AQ1

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

§ This package is only available taped and reeled, with standard quantities of 2500 pieces per reel.

## symbol (each comparator)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

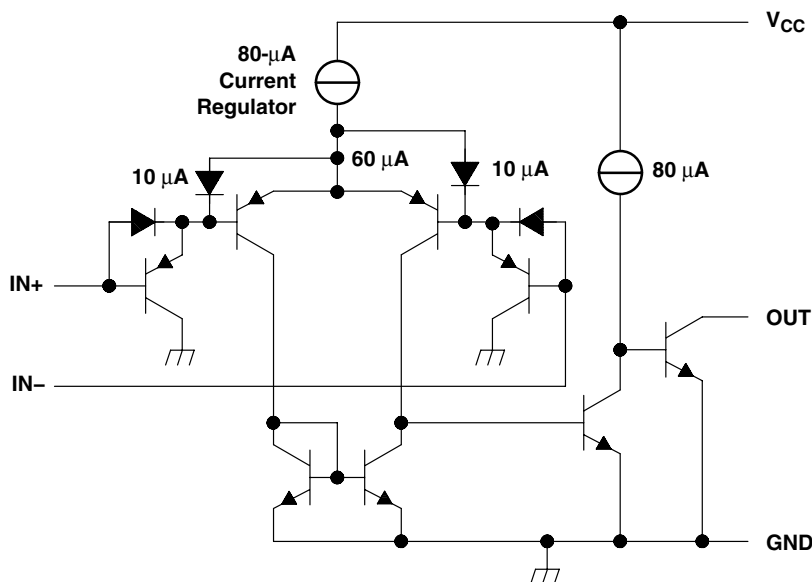
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# LM239A-Q1 QUAD DIFFERENTIAL COMPARATOR

SCLS513B – JULY 2003 – REVISED FEBRUARY 2008

## schematic (each comparator)



All current values shown are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, $V_{CC}$ (see Note 1)	36 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 36$ V
Input voltage range, $V_I$ (either input)	-0.3 V to 36 V
Output voltage, $V_O$	36 V
Output current, $I_O$	20 mA
Duration of output short circuit to ground (see Note 3)	Unlimited
Package thermal impedance, $\theta_{JA}$ (see Note 4)	86°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Maximum operating junction temperature, $T_J$	136°C
Storage temperature range, $T_{stg}$	-65°C to 150°C

† 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.

- NOTES:
1. All voltage values, except differential voltages, are with respect to network ground.
  2. Differential voltages are at IN+ with respect to IN-.
  3. Short circuits from outputs to  $V_{CC}$  can cause excessive heating and eventual destruction.
  4. The package thermal impedance is calculated in accordance with JESD 51-7.

# LM239A-Q1 QUAD DIFFERENTIAL COMPARATOR

SCLS513B – JULY 2003 – REVISED FEBRUARY 2008

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

PARAMETER		TEST CONDITIONS†	$T_A$ ‡	MIN	TYP	MAX	UNIT	
$V_{IO}$	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		1	2.5	mV	
			Full range			5.5		
$I_{IO}$	Input offset current	$V_O = 1.4\text{ V}$	25°C		5	50	nA	
			Full range			150		
$I_{IB}$	Input bias current	$V_O = 1.4\text{ V}$	25°C		-25	-250	nA	
			Full range			-400		
$V_{ICR}$	Common-mode input-voltage range		25°C		0 to	$V_{CC}-1.5$	V	
			Full range		0 to	$V_{CC}-2$		
$A_{VD}$	Large-signal differential-voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1.4\text{ V to }11.4\text{ V}$ , $R_L \geq 15\text{ k}\Omega$ to $V_{CC}$	25°C		50	200	V/mV	
$I_{OH}$	High-level output current	$V_{ID} = 1\text{ V}$	$V_{OH} = 5\text{ V}$	25°C		0.1	50	nA
			$V_{OH} = 30\text{ V}$	Full range				1
$V_{OL}$	Low-level output voltage	$V_{ID} = -1\text{ V}$ , $I_{OL} = 4\text{ mA}$	25°C		150	400	mV	
			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	25°C		0.8	2	mA	

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

‡ Full range (MIN to MAX) for LM239AQ is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ . All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Response time	$R_L$ connected to 5 V through 5.1 k $\Omega$ , $C_L = 15\text{ pF}$ §, See Note 5	100-mV input step with 5-mV overdrive		1.3	$\mu\text{s}$
		TTL-level input step		0.3	

§  $C_L$  includes probe and jig capacitance.

NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">LM239AQDRG4Q1</a>	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM239AQ1
LM239AQDRG4Q1.A	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM239AQ1
<a href="#">LM239AQDRQ1</a>	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM239AQ1
LM239AQDRQ1.A	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	LM239AQ1

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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**OTHER QUALIFIED VERSIONS OF LM239A-Q1 :**

- Catalog : [LM239A](#)
- Enhanced Product : [LM239A-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**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
LM239AQDRG4Q1	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
LM239AQDRQ1	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM239AQDRG4Q1	SOIC	D	14	2500	353.0	353.0	32.0
LM239AQDRQ1	SOIC	D	14	2500	353.0	353.0	32.0

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.

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