- **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 . . . ±36 V**
- **Low Output Saturation Voltage**
- **Output Compatible With TTL, MOS, and CMOS**

D PACKAGE
(TOP VIEW)

1OUT	1	14	OUT3
2OUT	2	13	OUT4
V_{CC}	3	12	GND
2IN−	4	11	4IN+
2IN+	5	10	4IN−
1IN−	6	9	3IN+
1IN+	7	8	3IN−
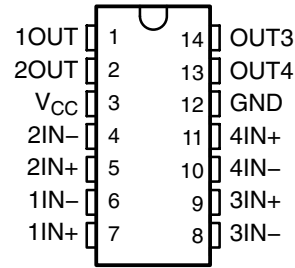
description/ordering information

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_A	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)
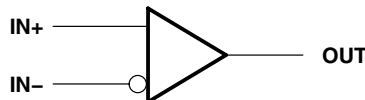
```
IN+ ─────────┐╲
             │  ╲
             │   ╲──── OUT
IN− ─────────┘○  ╱
             │  ╱
             └─╱
```

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TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

LM239A-Q1
QUAD DIFFERENTIAL COMPARATOR

schematic (each comparator)
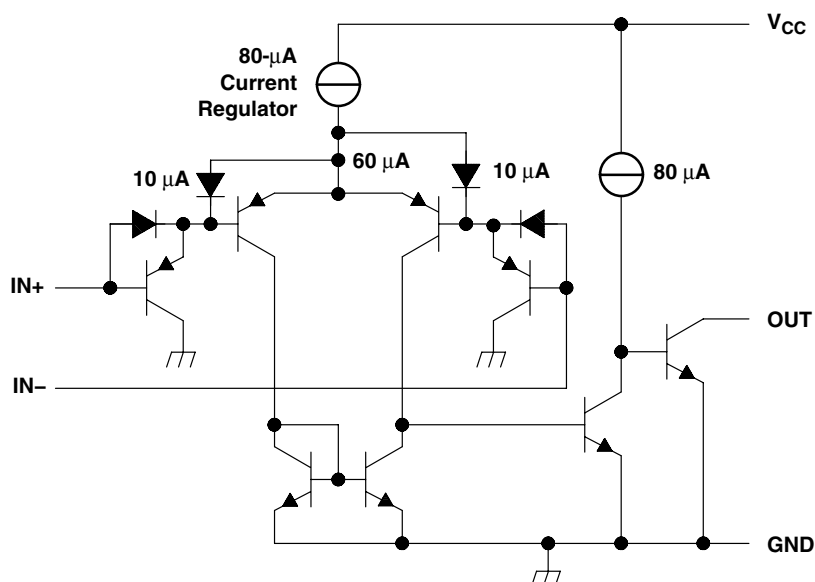
All current values shown are nominal.

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) . . . . ±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, θ_{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.

TEXAS
INSTRUMENTS
POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

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

PARAMETER		TEST CONDITIONS†		T_A‡	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{CC} = 5 V to 30 V, $V_{IC} = V_{ICR}$(min), V_O = 1.4 V		25°C		1	2.5	mV
				Full range			5.5	
I_{IO}	Input offset current	V_O = 1.4 V		25°C		5	50	nA
				Full range			150	
I_{IB}	Input bias current	V_O = 1.4 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 V, V_O = 1.4 V to 11.4 V, $R_L \geq$ 15 kΩ to V_{CC}		25°C	50	200		V/mV
I_{OH}	High-level output current	V_{ID}= 1 V	V_{OH} = 5 V	25°C		0.1	50	nA
			V_{OH} = 30 V	Full range			1	μA
V_{OL}	Low-level output voltage	V_{ID} = −1 V,	I_{OL} = 4 mA	25°C		150	400	mV
				Full range			700	
I_{OL}	Low-level output current	V_{ID} = −1 V,	V_{OL} = 1.5 V	25°C	6	16		mA
I_{CC}	Supply current (four comparators)	V_O = 2.5 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°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Response time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF§, See Note 5	100-mV input step with 5-mV overdrive		1.3		μs
		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.

TEXAS
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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)
LM239AQDRG4Q1	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
LM239AQDRQ1	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 :

PACKAGE OPTION ADDENDUM

● 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

REEL DIMENSIONS

Reel Diameter

Reel Width (W1)

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

Sprocket Holes

Q1 | Q2
Q3 | Q4

User Direction of Feed

Pocket Quadrants

*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

6.2 / 5.8 TYP

A

PIN 1 ID AREA

1

14

12X 1.27

C

SEATING PLANE

0.1 C

8.75 / 8.55 NOTE 3

2X 7.62

7

8

14X 0.51 / 0.31

B

4.0 / 3.8 NOTE 4

⊕ 0.25 Ⓜ C A B

1.75 MAX

SEE DETAIL A

0.25 / 0.13 TYP

0.25 GAGE PLANE

0° - 8°

1.27 / 0.40

0.25 / 0.10

DETAIL A
TYPICAL

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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.

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14X (1.55)

1

14X (0.6)

12X (1.27)

SYMM

14

SYMM

7

8

(R0.05)
TYP

(5.4)

LAND PATTERN EXAMPLE
SCALE:8X

SOLDER MASK
OPENING

METAL

0.07 MAX
ALL AROUND

NON SOLDER MASK
DEFINED

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

0.07 MIN
ALL AROUND

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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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.

14X (1.55)

SYMM

1

14X (0.6)

14

12X (1.27)

SYMM

7

8

(5.4)

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

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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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