

# LM139, LM239, LM339, LM139A LM239A, LM339A, LM2901 QUADRUPLE DIFFERENTIAL COMPARATORS

D1979, OCTOBER 1979—REVISED APRIL 1988

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage . . . 2 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 . . . 3 nA Typ (LM139)
- 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

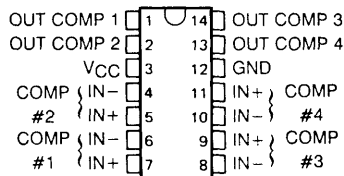
These devices consist of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies is also possible as long as the difference between the two supplies is 2 V to 36 V and pin 3 is at least 1.5 V more positive 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.

### AVAILABLE OPTIONS

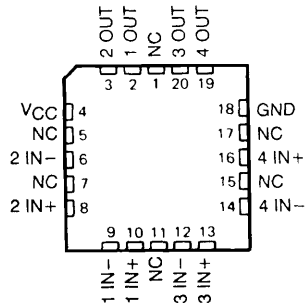
T <sub>A</sub>	V <sub>IO</sub> MAX at 25°C	PACKAGE			
		SMALL OUTLINE (D)	CERAMIC (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)
0°C to 70°C	5 mV 2 mV	LM339D LM339AD	—	LM339J LM339AJ	LM339N LM339AN
-25°C to 85°C	5 mV 2 mV	LM239D LM239AD	—	LM239J LM239AJ	LM239N LM239AN
-40°C to 125°C	7 mV	LM2901D	—	LM2901J	LM2091N
-55°C to 125°C	5 mV 2 mV	—	LM139FK LM139AFK	LM139J LM139AJ	—

The D package is available taped and reeled. Add the suffix R to the device type when ordering. (e.g., LM339DR)

LM139, LM139A . . . J PACKAGE  
ALL OTHERS . . . D, J, OR N PACKAGE  
(TOP VIEW)

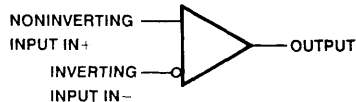


LM139, LM139A  
FK CHIP CARRIER PACKAGE  
(TOP VIEW)



NC—No internal connection

### symbol (each comparator)



3  
Voltage Comparators

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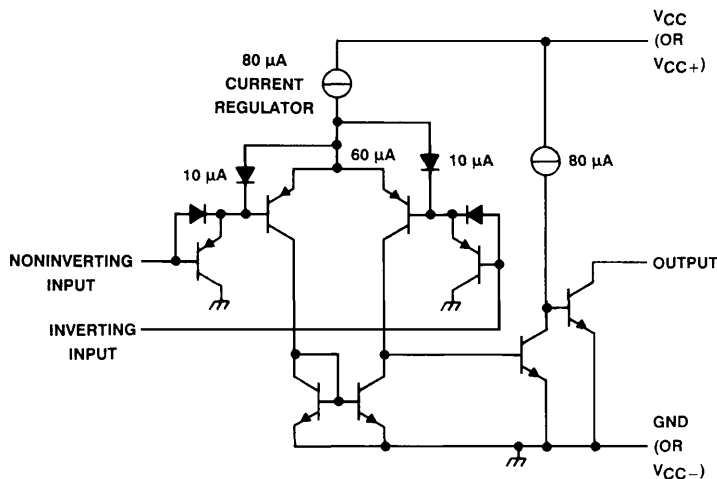
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# LM139, LM239, LM339, LM139A LM239A, LM339A, LM2901 QUADRUPLE DIFFERENTIAL COMPARATORS

schematic (each comparator)



Voltage Comparators

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

Supply voltage, $V_{CC}$ (see Note 2)	36 V
Differential input voltage (see Note 3)	$\pm 36$ V
Input voltage range (either input)	-0.3 V to 36 V
Output voltage	36 V
Output current	20 mA
Duration of output short-circuit to ground (see Note 4)	unlimited
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range: LM139	-55°C to 125°C
LM239, LM239A	-25°C to 85°C
LM339, LM339A	0°C to 70°C
LM2901	-40°C to 150°C
Storage temperature range	-65°C to 150°C
Case temperature for 60 seconds: FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package	300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or N package	260°C

- NOTES: 2. All voltage values, except differential voltages, are with respect to the network ground terminal.  
3. Differential voltages are at the noninverting input terminal with respect to the inverting input.  
4. Short circuits from outputs to  $V_{CC}$  can cause excessive heating and eventual destruction.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE $T_A$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	900 mW	7.6 mW/°C	31°C	608 mW	494 mW	—
FK	900 mW	11.0 mW/°C	68°C	880 mW	715 mW	275 mW
J (LM139, LM139A)	900 mW	11.0 mW/°C	68°C	880 mW	715 mW	275 mW
J (All others)	900 mW	8.2 mW/°C	40°C	656 mW	533 mW	—
N	900 mW	9.2 mW/°C	52°C	736 mW	598 mW	—

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

PARAMETER	TEST CONDITIONS†	LM139			LM139A			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to }30\text{ V}$ , $V_{IC} = V_{ICR\text{ min}}$ , $V_O = 1.4\text{ V}$		2	5		1	2	mV
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$		3	25		3	25	nA
				100			100	
				-25	-100		-25	-100
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$			-300			-300	nA
$V_{ICR}$ Common-mode input voltage range			0 to		0 to			
			$V_{CC}-1.5$		$V_{CC}-1.5$			
$A_{VD}$ Large-signal differential voltage amplification	$V_{CC} \pm = \pm 7.5\text{ V}$ , $V_O = -5\text{ V to }5\text{ V}$		200		50	200		V/mV
				0.1		0.1		nA
$I_{OH}$ High-level output current	$V_{ID} = 1\text{ V}$ , $V_{OH} = 30\text{ V}$		150	400		150	400	mV
				700			700	
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 4\text{ mA}$		6	16		6	16	mA
				0.8		0.8	2	
$I_{CC}$ Supply current (four comparators)	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$ , $V_O = 2.5\text{ V}$ , No load							mA

† 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
	100-mV input step with 5-mV overdrive TTL-level input step		0.3		

†  $C_L$  includes probe and jig capacitance.

NOTE 4: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.



## Voltage Comparators

# LM239, LM339, LM239A, LM339A, LM2901 QUADRUPLE DIFFERENTIAL COMPARATORS

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

PARAMETER	TEST CONDITIONS†	LM239, LM339			LM239A, LM339A			LM2901			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V}$ to $30\text{ V}$ , $V_{IC} = V_{ICR\text{ min}}$ , $V_O = 1.4\text{ V}$	2	5	2	1	2	2	2	7	mV	
	Full range	9	9	4	4	15	15	15	15	mV	
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	5	50	5	50	5	50	5	50	nA	
	Full range	150	150	150	150	200	200	200	200	nA	
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$	-25	-250	-25	-250	-25	-250	-25	-250	nA	
	Full range	-400	-400	-400	-400	-500	-500	-500	-500	nA	
Common-mode input voltage range	25°C	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	0 to $V_{CC-1.5}$	V	
	Full range	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	V	
	Full range	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	0 to $V_{CC-2}$	V	
$A_{VD}$ 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 $V_{CC}$	50	200	50	200	25	100	25	100	V/mV	
	25°C	50	200	50	200	25	100	25	100	V/mV	
$I_{OH}$ High-level output current	$V_{OH} = 5\text{ V}$	0.1	50	0.1	50	0.1	50	0.1	50	nA	
	$V_{OH} = 30\text{ V}$	1	1	1	1	1	1	1	1	$\mu\text{A}$	
$V_{OL}$ Low-level output voltage	$V_{ID} = 1\text{ V}$	150	400	150	400	150	400	150	400	mV	
	$V_{ID} = -1\text{ V}$ , $I_{OL} = 4\text{ mA}$	700	700	700	700	700	700	700	700	mV	
$I_{OL}$ Low-level output current	$V_{ID} = -1\text{ V}$ , $V_{OL} = 1.5\text{ V}$	6	16	6	16	6	16	6	16	mA	
	$V_O = 2.5\text{ V}$ , No load	0.8	2	0.8	2	0.8	2	0.8	2	mA	
$I_{CC}$ Supply current (four comparators)	$V_{CC} = 30\text{ V}$ , $V_O = 15\text{ V}$ , No load	0.8	2	0.8	2	0.8	2	0.8	2	mA	
	25°C	0.8	2	0.8	2	0.8	2	0.8	2	mA	

† Full range (MIN to MAX) for LM239 and LM239A is -25°C to 85°C, for LM339 and LM339A is 0°C to 70°C, and for LM2901 is -40°C to 125°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 $\Omega$ , $C_L = 15\text{ pF}$ ‡		1.3		$\mu\text{s}$
	See Note 5		0.3		$\mu\text{s}$

‡  $C_L$  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.