![Harris Semiconductor logo] **HARRIS** SEMICONDUCTOR

CA139, CA239
CA339, LM339*

Quad Voltage Comparators for Industrial, Commercial and Military Applications

March 1993

Features

- Operation from Single or Dual Supplies
- Common Mode Input voltage Range to GND
- Output Voltage Compatible with TTL, DTL, ECL, MOS and CMOS
- Differential Input Voltage Range Equal to the Supply Voltage
- Maximum Input Offset Voltage (V_{IO})
  - CA139A, CA239A, CA339A 2mV
  - CA139, CA239, CA339 .... 5mV
- Replacement for Industry Types 139, 239, 339, 139A, 239A, 339A

Applications

- Square Wave Generator
- Time Delay Generators
- Pulse Generators
- Multivibrators
- High Voltage Digital Logic Gates
- A/D Converters
- MOS Clock Timers

Description

The CA139, CA239, CA339, CA139A, CA239A, and CA339A types consist of four independent single or dual supply voltage comparators on a single monolithic substrate. The common mode input voltage range includes ground even when operated from a single supply, and the low power supply current drain makes these comparators suitable for battery operation. These types were designed to directly interface with TTL and CMOS.
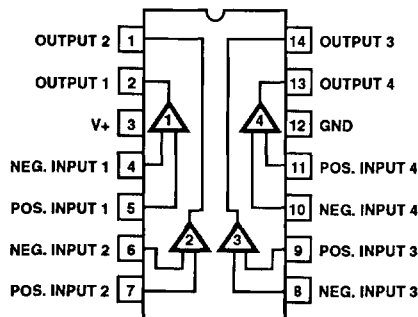
Types CA139A, CA239A, and CA339A have all the features and characteristics of their prototype counterparts CA139, CA239, and CA339 plus an even lower input offset voltage characteristic. These devices are supplied in a 14 lead Small Outline package (M suffix), in a 14 lead dual-in-line plastic package (E suffix) and in a 14 lead dual-in-line hermetic (frit seal) ceramic package (F suffix). The CA339 is also available in chip form (H suffix).
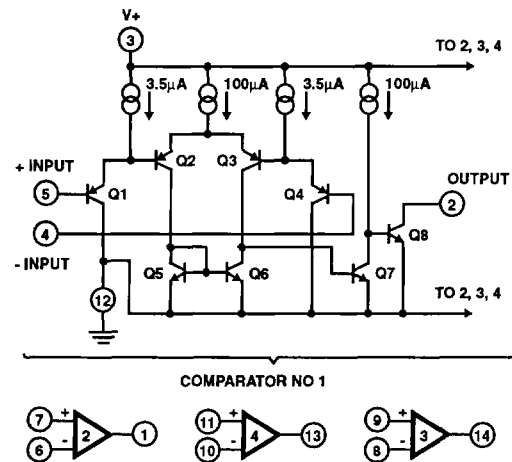
*Technical data on LM339 is identical to CA339.

Pinout

CA139, CA139A, CA239, CA239A, CA339 (PDIP, CDIP, SOIC)
CA339A (PDIP SOIC)
LM339, LM339A (PDIP)
TOP VIEW

OUTPUT 2	1	14 OUTPUT 3
OUTPUT 1	2	13 OUTPUT 4
V+	3	12 GND
NEG. INPUT 1	4	11 POS. INPUT 4
POS. INPUT 1	5	10 NEG. INPUT 4
NEG. INPUT 2	6	9 POS. INPUT 3
POS. INPUT 2	7	8 NEG. INPUT 3

Schematic Diagram

COMPARATOR NO 1

File Number **795.1**

Absolute Maximum Ratings

Supply Voltage . . . . 36V or ±18V
Differential Input Voltage. 36V
Input Voltage. . . . . -0.3V to +36V
Input Current (V_I < -0.3V) Note 4 . . . . .50mA
Output Short Circuit Duration (Single Supply) Note 5 . . Continuous
Junction Temperature. . . . . +175°C
Junction Temperature (Plastic Package) . . . . +150°C
Lead Temperature (Soldering 10 Sec.). . . . . +300°C

Operating Conditions

Operating Temperature Range . . . .-55°C to +125°C
Storage Temperature Range. . . . .-65°C to +150°C
Thermal Package Characteristics (°C/W) . . θ_{JA} θ_{JC}

	θ_{JA}	θ_{JC}
Ceramic DIP Package	71	14
Plastic DIP Package	107	38
SOIC Package.	119	36

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Specifications V+ = 5V, Unless Otherwise Specified

PARAMETER	SYMBOL	CONDITION		CA139 MIN	CA139 TYP	CA139 MAX	CA139A MIN	CA139A TYP	CA139A MAX	UNITS
Input Offset Voltage	V_{IO}	V_{REF} = 1.4V, R_S = 0, Output Switch Point V ≅ 1.4V	T_A = +25°C	-	2	5	-	1	2	mV
			Note 1	-	-	9	-	-	4	mV
Differential Input Voltage	V_{ID}	Keep All Inputs ≥ 0V for V- (if used), Notes 1, 2		-	-	36	-	-	36	V
Saturation Voltage	V_{SAT}	V_{I^-} = 1V, V_{I^+} = 0V, I_{SINK} ≤ 4mA	T_A = +25°C	-	250	400	-	250	400	mV
			Note 1	-	-	700	-	-	700	mV
Common Mode Input Voltage Range	V_{ICR}	Note 3	T_A = +25°C	0	-	V+ - 1.5	0	-	V+ - 1.5	V
			Note 1	0	-	V+ - 2	0	-	V+ - 2	V
Input Offset Current	I_{IO}	I_I+ - I_I-	T_A = +25°C	-	3	25	-	3	25	nA
			Note 1	-	-	100	-	-	100	nA
Input Bias Current	I_{IB}	I_I+ or I_I- with Output in Linear Range	T_A = +25°C	-	25	100	-	25	100	nA
			Note 1	-	-	300	-	-	300	nA
Total Supply Current	I+	R_L = ∞ on All Comparators, T_A = +25°C		-	0.8	2	-	0.8	2	mA
Output Leakage Current		V_{I^+} ≥ 1V, V_{I^-} = 0V, V_O = 5V	T_A = +25°C	-	0.1	-	-	0.1	-	nA
		V_{I^+} ≥ 1V, V_{I^-} = 0V, V_O = 30V	Note 1	-	-	1	-	-	1	μA
Output Sink Current		V_{I^-} ≥ 1V, V_{I^+} = 0V, V_O ≤ 1.5V, T_A = +25°C		6	16	-	6	16	-	mA
Voltage Gain	A_{OL}	R_L ≥ 15kΩ, V+ = 15V, T_A = +25°C		-	200	-	50	200	-	V/mV
Large Signal Response Time		V_I = TTL Logic Swing, V_{REF} = 1.4V, V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C		-	300	-	-	300	-	ns
Response Time (Figures 3 and 4)		V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C		-	1.3	-	-	1.3	-	μs

Electrical Specifications V+ = 5V, Unless Otherwise Specified

PARAMETER	SYMBOL	CONDITION		CA239, CA339 MIN	CA239, CA339 TYP	CA239, CA339 MAX	CA239A, CA339A MIN	CA239A, CA339A TYP	CA239A, CA339A MAX	UNITS
Input Offset Voltage	V_{IO}	V_{REF} = 1.4V, R_S = 0, Output Switch Point V ≅ 1.4V	T_A = +25°C	-	2	5	-	1	2	mV
			Note 1	-	-	9	-	-	4	mV

Electrical Specifications V+ = 5V, Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	CONDITION		CA239, CA339 MIN	TYP	MAX	CA239A, CA339A MIN	TYP	MAX	UNITS
Differential Input Voltage	V_{ID}	Keep All Inputs ≥ 0V for V- (if used), Notes 1, 2		-	-	36	-	-	36	V
Saturation Voltage	V_{SAT}	V_{I-} = 1V, V_{I+} = 0V, I_{SINK} ≤ 4mA	T_A = +25°C	-	250	400	-	250	400	mV
			Note 1	-	-	700	-	-	700	mV
Common Mode Input Voltage Range	V_{ICR}	Note 3	T_A = +25°C	0	-	V+ - 1.5	0	-	V+ - 1.5	V
			Note 1	0	-	V+ - 2	0	-	V+ - 2	V
Input Offset Current	I_{IO}	$I_{I+} - I_{I-}$	T_A = +25°C	-	5	50	-	5	50	nA
			Note 1	-	-	150	-	-	150	nA
Input Bias Current	I_{IB}	I_{I+} or I_{I-} with Output in Linear Range	T_A = +25°C	-	25	250	-	25	250	nA
			Note 1	-	-	400	-	-	400	nA
Total Supply Current	I+	R_L = ∞ on All Comparators, T_A = +25°C		-	0.8	2	-	0.8	2	mA
Output Leakage Current		V_{I+} ≥ 1V, V_{I-} = 0V, V_O = 5V	T_A = +25°C	-	0.1	-	-	0.1	-	nA
		V_{I+} ≥ 1V, V_{I-} = 0V, V_O = 30V	Note 1	-	-	1	-	-	1	μA
Output Sink Current		V_{I-} ≥ 1V, V_{I+} = 0V, V_O ≤ 1.5V, T_A = +25°C		6	16	-	6	16	-	mA
Voltage Gain	A_{OL}	R_L ≥ 15kΩ, V+ = 15V, T_A = +25°C		-	200	-	50	200	-	V/mV
Large Signal Response Time		V_I = TTL Logic Swing, V_{REF} = 1.4V, V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C		-	300	-	-	300	-	ns
Response Time (Figures 3 and 4)		V_{RL} = 5V, R_L = 5.1kΩ, T_A = +25°C		-	1.3	-	-	1.3	-	μs

NOTES:

1. Ambient Temperature (T_A) applicable over operating temperature range as shown below.
   CA139, CA139A = -55°C to +125°C; CA239, CA239A = -25°C to +85°C; CA339, CA339A = 0°C to +70°C
2. The comparator will provide a proper output state even if the positive swing of the inputs exceeds the power supply voltage level, if the other input remains within the common mode voltage range. The low input voltage state must not be less than -0.3V (or 0.3V below the magnitude of the negative power supply, if used).
3. The upper end of the common mode voltage range is (V+) - 1.5V, but either or both inputs can go to +30V without damage.
4. Inputs must not go more negative than -0.3V.
5. Short circuits from the output to V+ can cause excessive heating and eventual destruction. The maximum output current independent of V+ is approximately 20mA.

Metallization Mask Layout

NOTE: Dimensions in parentheses are in mm and are derived from the basic in. dimensions as indicated. Grid graduations are in mils (10⁻³ inch).
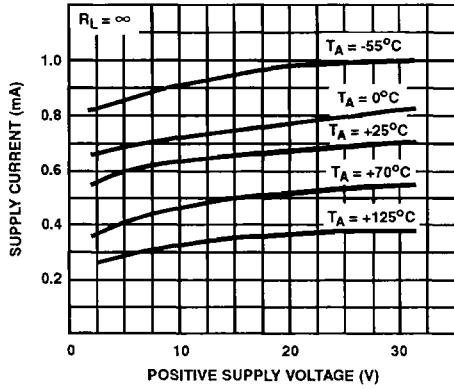
Typical Performance Curves

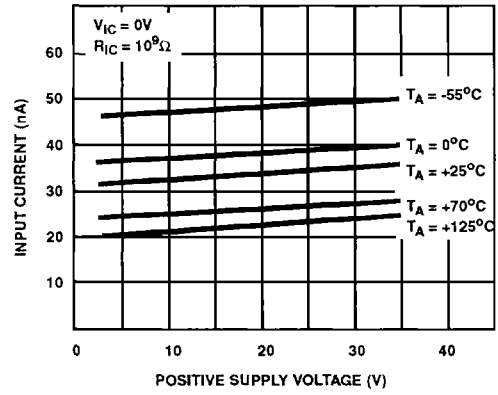FIGURE 1. SUPPLY CURRENT vs SUPPLY VOLTAGE

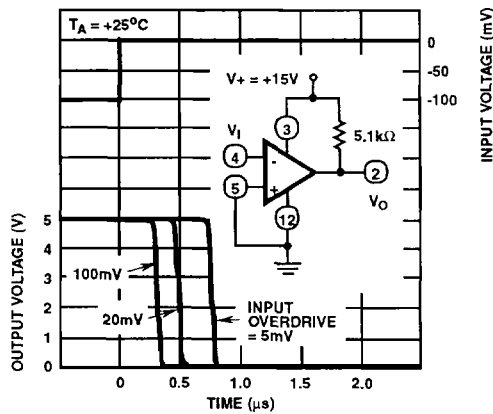FIGURE 2. INPUT CURRENT vs SUPPLY VOLTAGE

FIGURE 3. RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION
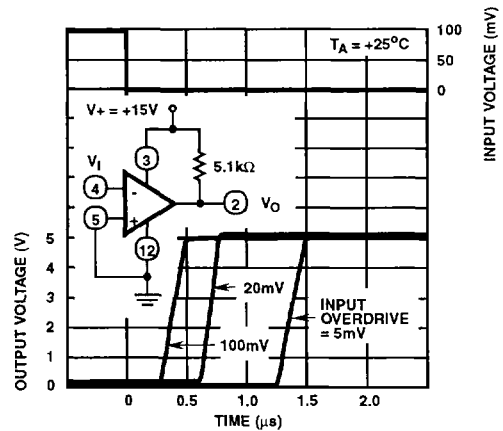

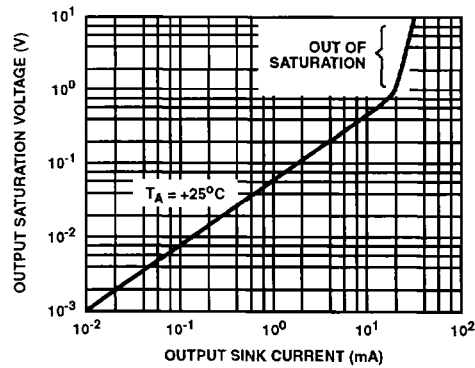
FIGURE 4. RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

FIGURE 7. OUTPUT SATURATION VOLTAGE vs OUTPUT SINK CURRENT