



## LM139,A LM239,A - LM339,A

### LOW POWER QUAD VOLTAGE COMPARATORS

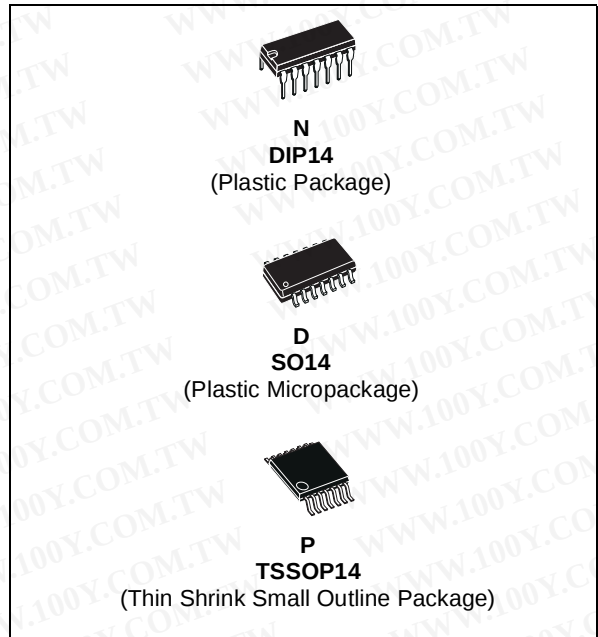
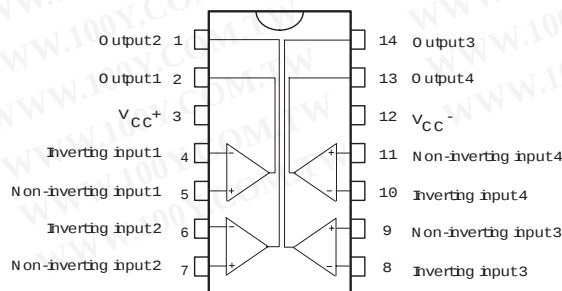
- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES FOR ALL DEVICES : +2V TO +36V OR  $\pm 1V$  TO  $\pm 18V$
- VERY LOW SUPPLY CURRENT (1.1mA) INDEPENDENT OF SUPPLY VOLTAGE (1.4mW/comparator at +5V)
- LOW INPUT BIAS CURRENT : 25nA TYP
- LOW INPUT OFFSET CURRENT :  $\pm 5nA$  TYP
- LOW INPUT OFFSET VOLTAGE :  $\pm 1mV$  TYP
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE : 250mV TYP; ( $I_o = 4mA$ )
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE
- TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS

#### DESCRIPTION

These devices consist of four independent precision voltage comparators with an offset voltage specifications as low as 2mV max for LM339A, LM239A and LM139A. All these comparators were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage.

#### PIN CONNECTIONS (top view)



#### ORDER CODE

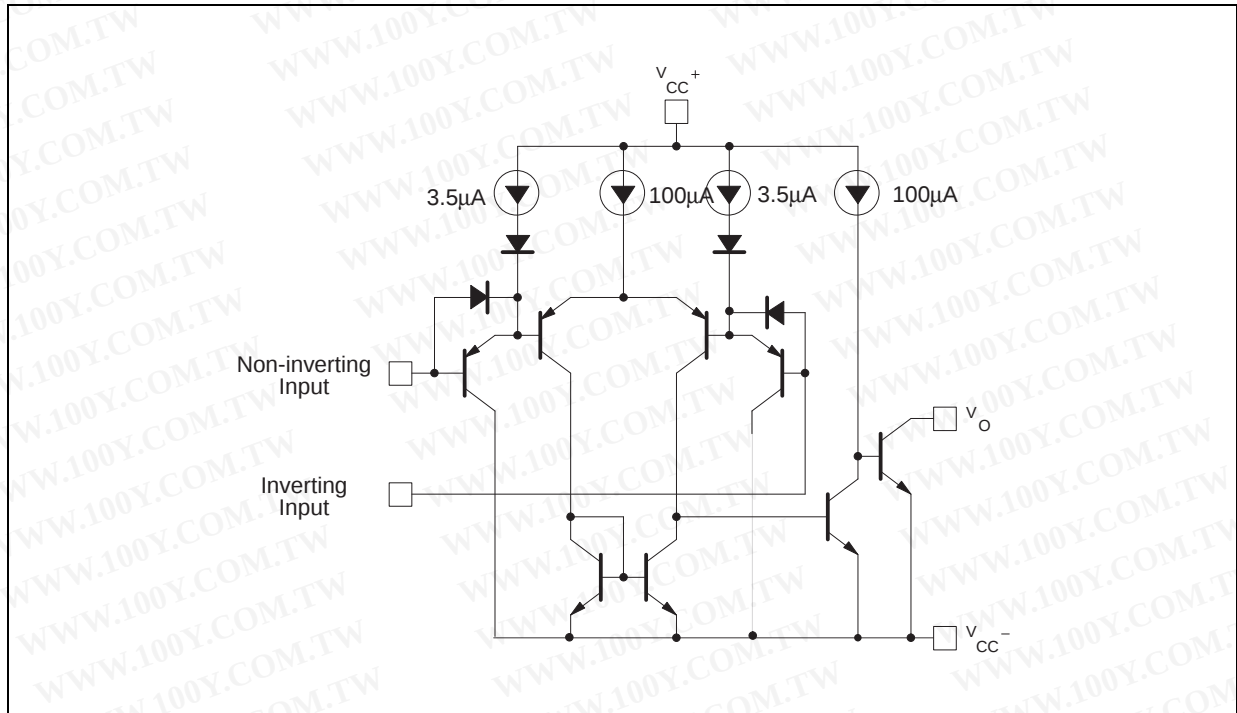
| Part Number | Temperature Range | Package |   |   |
|-------------|-------------------|---------|---|---|
|             |                   | N       | D | P |
| LM139,A     | -55°C, +125°C     | •       | • | • |
| LM239,A     | -40°C, +105°C     | •       | • | • |
| LM339,A     | 0°C, +70°C        | •       | • | • |

Example : LM139AN

N = Dual in Line Package (DIP)  
D = Small Outline Package (SO) - also available in Tape & Reel (DT)  
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

## LM139,A-LM239,A-LM339,A

### SCHEMATIC DIAGRAM (1/4 LM139)



### ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                                        | Value              | Unit |
|-----------|--------------------------------------------------|--------------------|------|
| $V_{CC}$  | Supply voltage                                   | $\pm 18$ or 36     | V    |
| $V_{id}$  | Differential Input Voltage                       | $\pm 36$           | V    |
| $V_i$     | Input Voltage                                    | -0.3 to +36        | V    |
|           | Output Short-circuit to Ground - note 1)         | Infinite           |      |
| $P_d$     | Power Dissipation 2)<br>DIP14<br>SO14<br>TSSOP14 | 1500<br>830<br>710 | mW   |
| $T_{stg}$ | Storage Temperature Range                        | -65 to +150        | °C   |
| $T_j$     | Junction Temperature                             | +150               | °C   |

1. Short-circuits from the output to  $V_{CC}^+$  can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA independent of the magnitude of  $V_{CC}^+$ .

2.  $P_d$  is calculated with  $T_{amb} = +25^\circ\text{C}$ ,  $T_j = +150^\circ\text{C}$  and  $R_{thja}$  = 80°C/W for DIP14 package  
 = 150°C/W for SO14 package  
 = 175°C/W for TSSOP14 package

### OPERATING CONDITIONS ( $T_{amb} = 25^\circ\text{C}$ )

| Symbol     | Parameter                                                                               | Value                            | Unit |
|------------|-----------------------------------------------------------------------------------------|----------------------------------|------|
| $V_{CC}$   | Supply Voltage                                                                          | 2 to 32<br>$\pm 1$ to $\pm 16$   | V    |
| $V_{icm}$  | Common Mode Input Voltage Range                                                         | 0 to ( $V_{CC}^+ - 1.5$ )        | V    |
| $T_{oper}$ | Operating Free-air Temperature Range<br>LM139, LM139A<br>LM239, LM239A<br>LM339, LM339A | -55, +125<br>-40, +105<br>0, +70 | °C   |

# ELECTRICAL CHARACTERISTICS

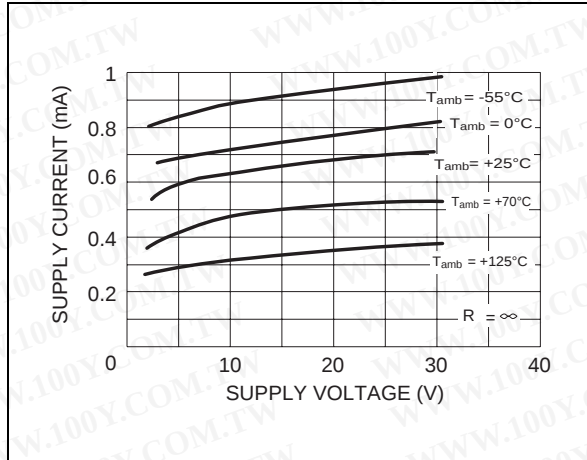
$V_{CC}^+ = +5V$ ,  $V_{CC}^- = GND$ ,  $T_{amb} = +25^{\circ}C$  (unless otherwise specified)

| Symbol     | Parameter                                                                                                                                 | LM139A - LM239A<br>LM339A |            |                                    | LM139- LM239<br>LM339 |            |                                    | Unit          |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------|------------------------------------|-----------------------|------------|------------------------------------|---------------|
|            |                                                                                                                                           | Min.                      | Typ.       | Max.                               | Min                   | Typ.       | Max.                               |               |
| $V_{io}$   | Input Offset Voltage - note <sup>1)</sup><br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                              |                           | 1          | 2<br>4                             |                       | 1          | 5<br>9                             | mV            |
| $I_{io}$   | Input Offset Current<br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                   |                           | 3          | 25<br>100                          |                       | 5          | 50<br>150                          | nA            |
| $I_{ib}$   | Input Bias Current ( $I^+$ or $I^-$ ) - note <sup>2)</sup><br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$             |                           | 25         | 100<br>300                         |                       | 25         | 250<br>400                         | nA            |
| $A_{vd}$   | Large Signal Voltage Gain<br>$V_{CC} = 15V$ , $R_L = 15k\Omega$ , $V_O = 1V$ to $11V$                                                     | 50                        | 200        |                                    | 50                    | 200        |                                    | V/mV          |
| $I_{CC}$   | Supply Current (all comparators)<br>$V_{CC} = +5V$ , no load<br>$V_{CC} = +30V$ , no load                                                 |                           | 1.1<br>1.3 | 2<br>2.5                           |                       | 1.1<br>1.3 | 2<br>2.5                           | mA            |
| $V_{icm}$  | Input Common Mode Voltage Range - note <sup>3)</sup><br>$V_{CC} = 30V$<br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$ | 0<br>0                    |            | $V_{CC}^+ - 1.5$<br>$V_{CC}^+ - 2$ | 0<br>0                |            | $V_{CC}^+ - 1.5$<br>$V_{CC}^+ - 2$ | V             |
| $V_{id}$   | Differential Input Voltage -note <sup>4)</sup>                                                                                            |                           |            | $V_{CC}^+$                         |                       |            | $V_{CC}^+$                         | V             |
| $V_{OL}$   | Low Level Output Voltage<br>$V_{id} = -1V$ , $I_{sink} = 4mA$<br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$          |                           | 250        | 400<br>700                         |                       | 250        | 400<br>700                         | mV            |
| $I_{OH}$   | High Level Output Current ( $V_{id} = 1V$ )<br>$V_{CC} = V_O = 30V$<br>$T_{amb} = +25^{\circ}C$<br>$T_{min} \leq T_{amb} \leq T_{max}$    |                           | 0.1        | 1                                  |                       | 0.1        | 1                                  | nA<br>$\mu A$ |
| $I_{sink}$ | Output Sink Current<br>$V_{id} = 1V$ , $V_O = 1.5V$                                                                                       | 6                         | 16         |                                    | 6                     | 16         |                                    | mA            |
| $t_{re}$   | Response Time - note <sup>5)</sup><br>$R_L = 5.1k\Omega$ connected to $V_{CC}^+$                                                          |                           | 1.3        |                                    |                       | 1.3        |                                    | $\mu s$       |
| $t_{rel}$  | Large Signal Response Time<br>$R_L = 5.1k\Omega$ connected to $V_{CC}^+$ , $e_i = TTL$ ,<br>$V_{(ref)} = +1.4v$                           |                           | 300        |                                    |                       | 300        |                                    | ns            |

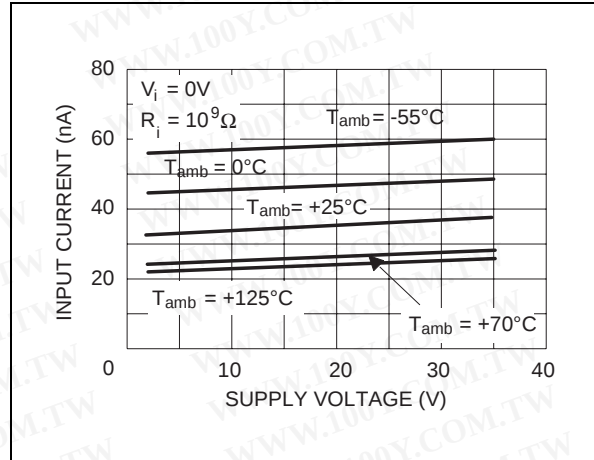
- At output switch point,  $V_O = 1.4V$ ,  $R_s = 0$  with  $V_{CC}^+$  from  $5V$  to  $30V$ , and over the full common-mode range ( $0V$  to  $V_{CC}^+ - 1.5V$ ).
- The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines.
- The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than  $0.3V$ . The upper end of the common-mode voltage range is  $V_{CC}^+ - 1.5V$ , but either or both inputs can go to  $+30V$  without damage
- The response time specified is for a  $100mV$  input step with  $5mV$  overdrive. For larger overdrive signals  $300ns$  can be obtained
- Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than  $-0.3V$  (or  $0.3V$  below the negative power supply, if used).

## LM139,A-LM239,A-LM339,A

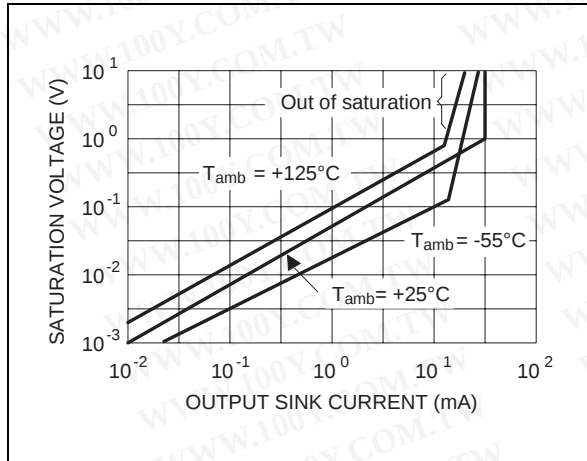
### SUPPLY CURRENT versus SUPPLY VOLTAGE



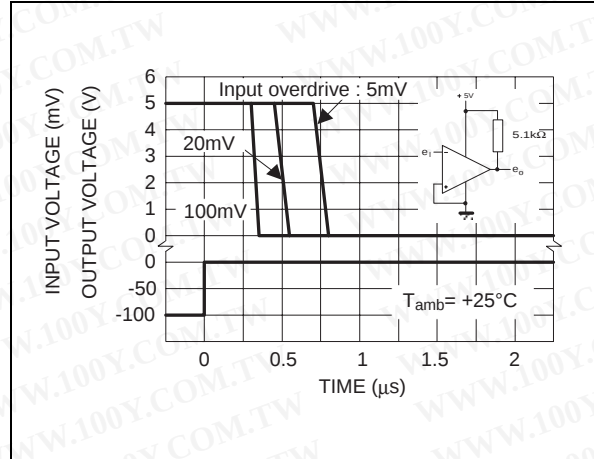
### INPUT CURRENT versus SUPPLY VOLTAGE



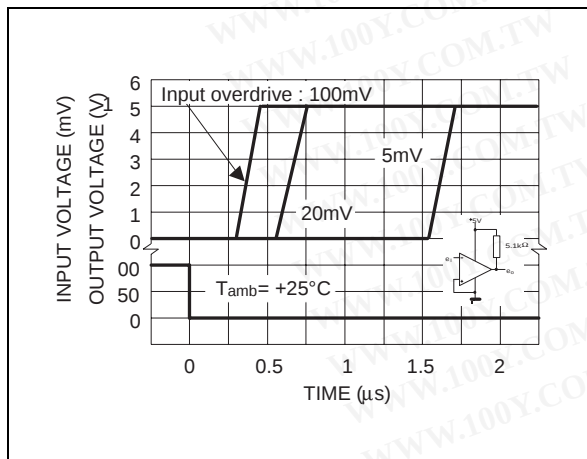
### OUTPUT SATURATION VOLTAGE versus OUTPUT CURRENT



### RESPONSE TIME FOR VARIOIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION

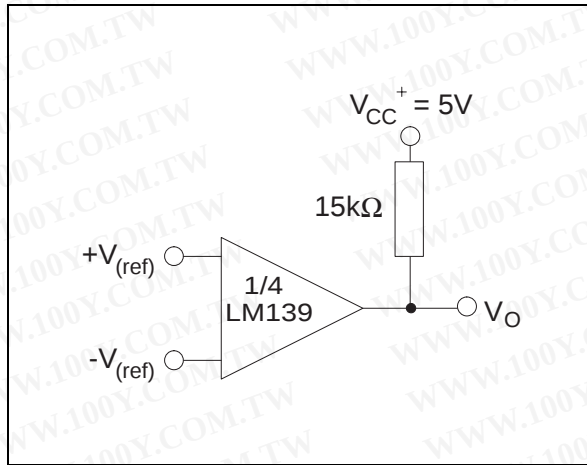


### RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

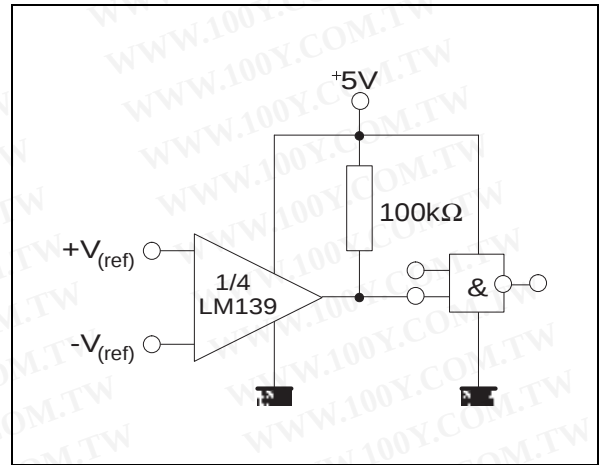


## TYPICAL APPLICATIONS

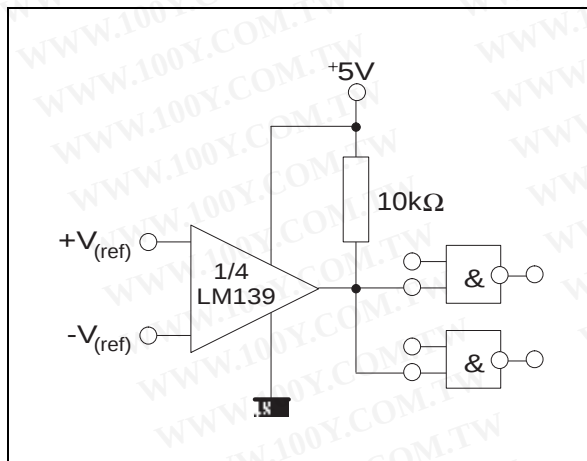
### BASIC COMPARATOR



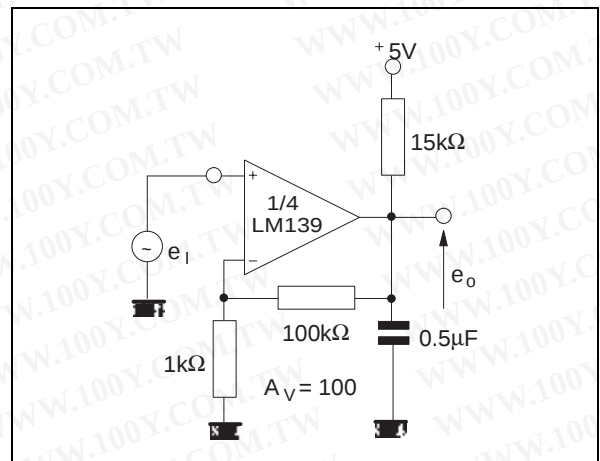
### DRIVING CMOS



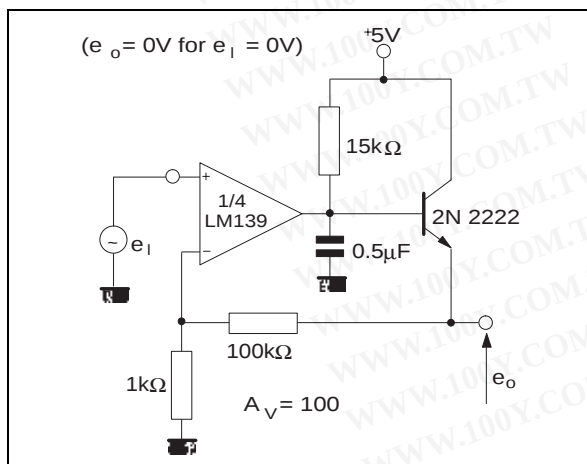
### DRIVING TTL



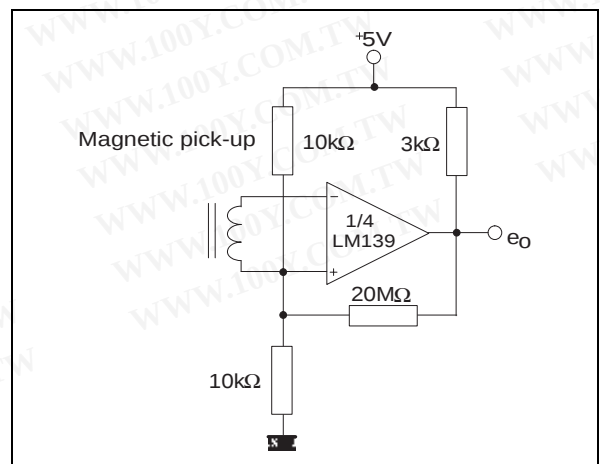
### LOW FREQUENCY OP AMP



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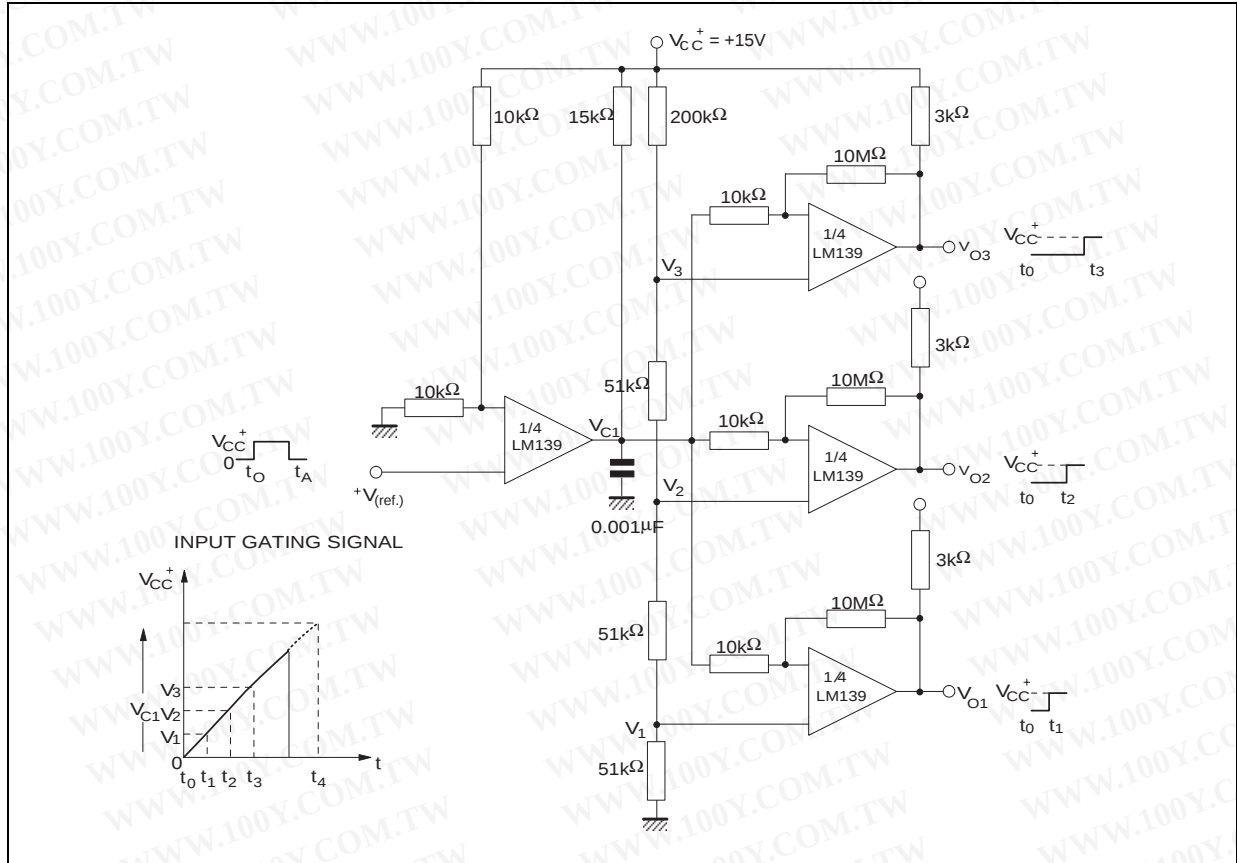
### TRANSDUCER AMPLIFIER



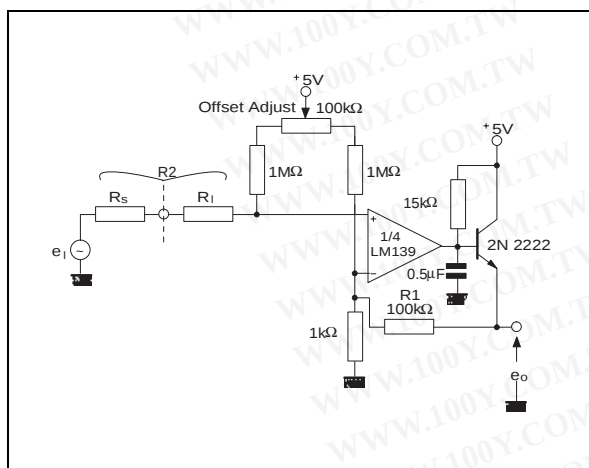
## LM139,A-LM239,A-LM339,A

### TYPICAL SINGLE (continued)

#### TIME DEALY GENERATOR



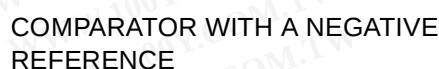
#### LOW FREQUENCY OP AMP WITH OFFSET ADJUST



## TWO-DECADE HIGH-FREQUENCY VCO

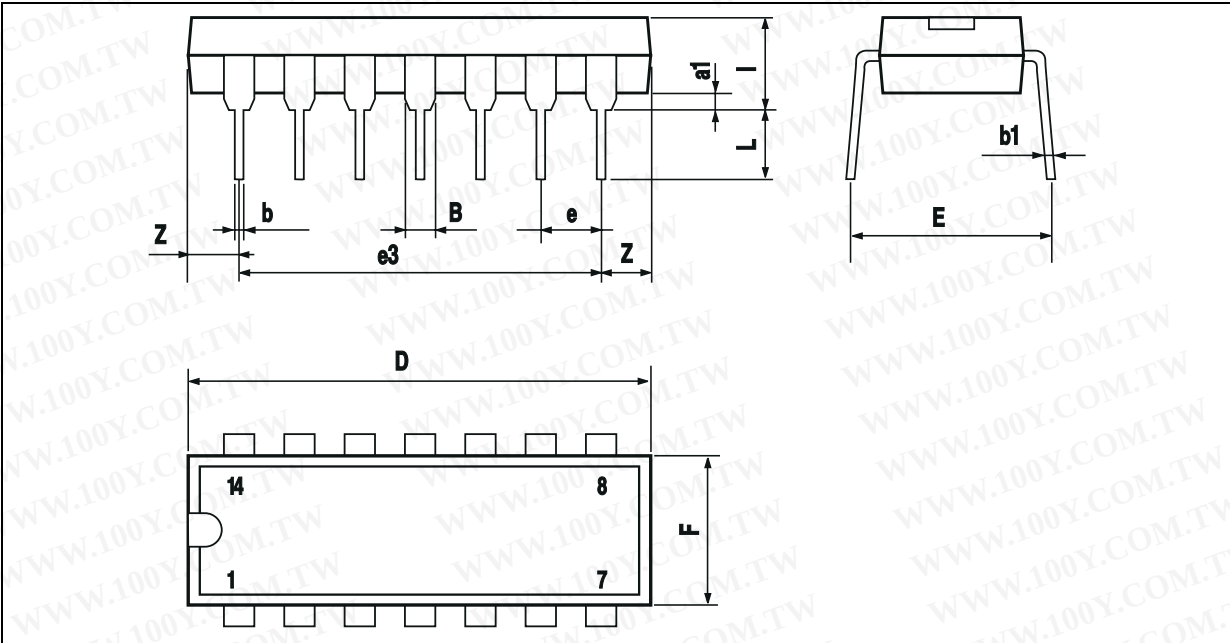


## ZERO CROSSING DETECTOR



LM139,A-LM239,A-LM339,A

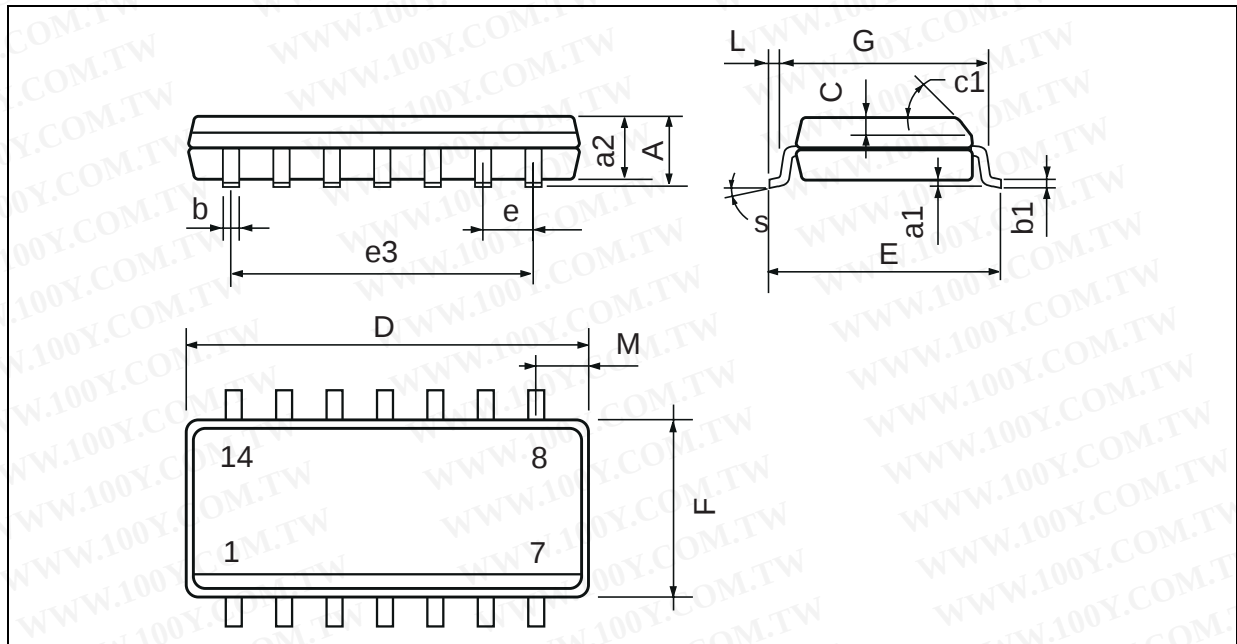
PACKAGE MECHANICAL DATA  
14 PINS - PLASTIC DIP



| Dimensions | Millimeters |       |      | Inches |       |       |
|------------|-------------|-------|------|--------|-------|-------|
|            | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| a1         | 0.51        |       |      | 0.020  |       |       |
| B          | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| b          |             | 0.5   |      |        | 0.020 |       |
| b1         |             | 0.25  |      |        | 0.010 |       |
| D          |             |       | 20   |        |       | 0.787 |
| E          |             | 8.5   |      |        | 0.335 |       |
| e          |             | 2.54  |      |        | 0.100 |       |
| e3         |             | 15.24 |      |        | 0.600 |       |
| F          |             |       | 7.1  |        |       | 0.280 |
| i          |             |       | 5.1  |        |       | 0.201 |
| L          |             | 3.3   |      |        | 0.130 |       |
| Z          | 1.27        |       | 2.54 | 0.050  |       | 0.100 |

**PACKAGE MECHANICAL DATA**

14 PINS - PLASTIC MICROPACKAGE (SO)



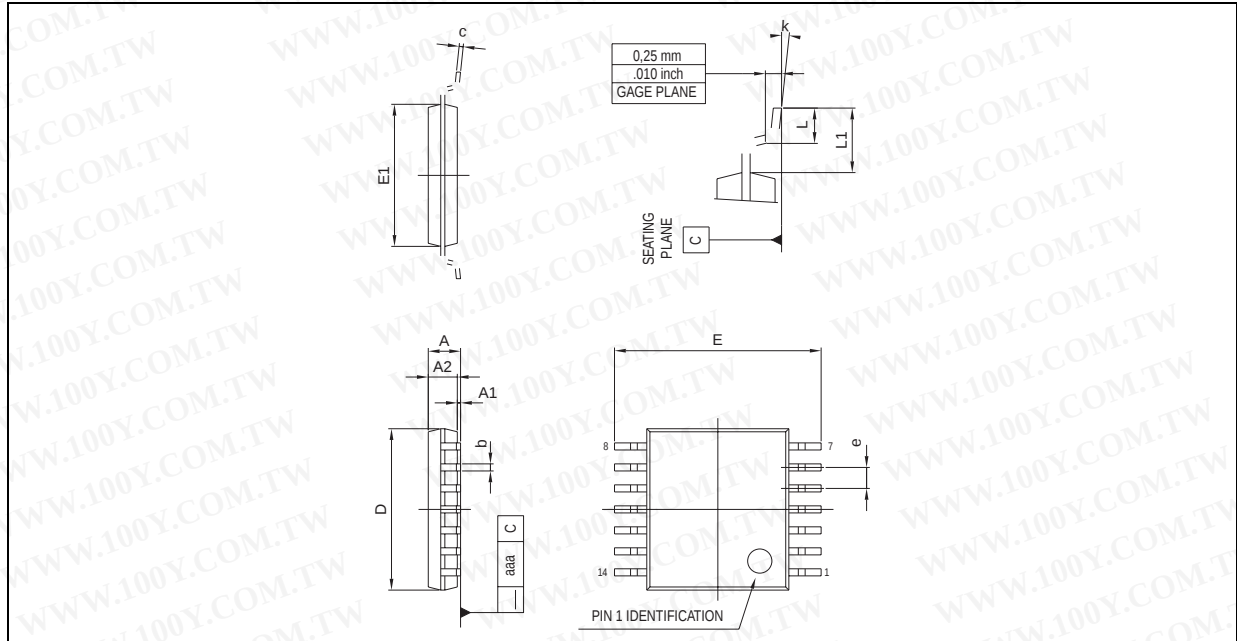
| Dimensions | Millimeters |      |      | Inches |       |       |
|------------|-------------|------|------|--------|-------|-------|
|            | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A          |             |      | 1.75 |        |       | 0.069 |
| a1         | 0.1         |      | 0.2  | 0.004  |       | 0.008 |
| a2         |             |      | 1.6  |        |       | 0.063 |
| b          | 0.35        |      | 0.46 | 0.014  |       | 0.018 |
| b1         | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C          |             | 0.5  |      |        | 0.020 |       |
| c1         | 45° (typ.)  |      |      |        |       |       |
| D (1)      | 8.55        |      | 8.75 | 0.336  |       | 0.344 |
| E          | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e          |             | 1.27 |      |        | 0.050 |       |
| e3         |             | 7.62 |      |        | 0.300 |       |
| F (1)      | 3.8         |      | 4.0  | 0.150  |       | 0.157 |
| G          | 4.6         |      | 5.3  | 0.181  |       | 0.208 |
| L          | 0.5         |      | 1.27 | 0.020  |       | 0.050 |
| M          |             |      | 0.68 |        |       | 0.027 |
| S          | 8° (max.)   |      |      |        |       |       |

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

## LM139,A-LM239,A-LM339,A

### PACKAGE MECHANICAL DATA

#### 14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



| Dimensions | Millimeters |       |       | Inches |       |       |
|------------|-------------|-------|-------|--------|-------|-------|
|            | Min.        | Typ.  | Max.  | Min.   | Typ.  | Max.  |
| A          |             |       | 1.20  |        |       | 0.05  |
| A1         | 0.05        |       | 0.15  | 0.01   |       | 0.006 |
| A2         | 0.80        | 1.00  | 1.05  | 0.031  | 0.039 | 0.041 |
| b          | 0.19        |       | 0.30  | 0.007  |       | 0.15  |
| c          | 0.09        |       | 0.20  | 0.003  |       | 0.012 |
| D          | 4.90        | 5.00  | 5.10  | 0.192  | 0.196 | 0.20  |
| E          |             | 6.40  |       |        | 0.252 |       |
| E1         | 4.30        | 4.40  | 4.50  | 0.169  | 0.173 | 0.177 |
| e          |             | 0.65  |       |        | 0.025 |       |
| k          | 0°          |       | 8°    | 0°     |       | 8°    |
| L          | 0.450       | 0.600 | 0.750 | 0.018  | 0.024 | 0.030 |
| L1         |             | 1.00  |       |        | 0.039 |       |
| aaa        |             |       | 0.100 |        |       | 0.004 |

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