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SEMICONDUCTOR



ESD



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PLED

## LM239DT-MS

Product specification

GENERAL DESCRIPTION

The LM239DT-MS is a voltage comparator used in integrated circuit. It provides lower offset voltage, higher power supply voltage capability, lower power supply current, lower propagation delay, wider temperature range and higher ESD performance.

The chip supports single power and dual power supply. For dual power supply, the supply voltage ranges from  $\pm 1.5V$  to  $\pm 18V$ , and the  $V_S$  is at least  $1.5V$  higher than the input common-mode voltage. The output is compatible with TTL and CMOS, and the drain current is not affected by the power supply voltage. The output can be connected to other drain open circuit output to achieve the wired-and" relationship.

The LM239DT-MS are available in Green SOP-14. It operates over an ambient temperature range of  $-40^{\circ}C$  to  $+125^{\circ}C$ .

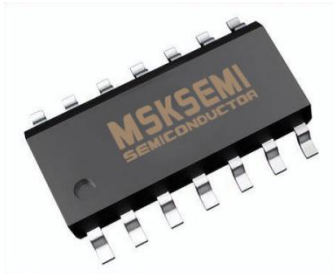
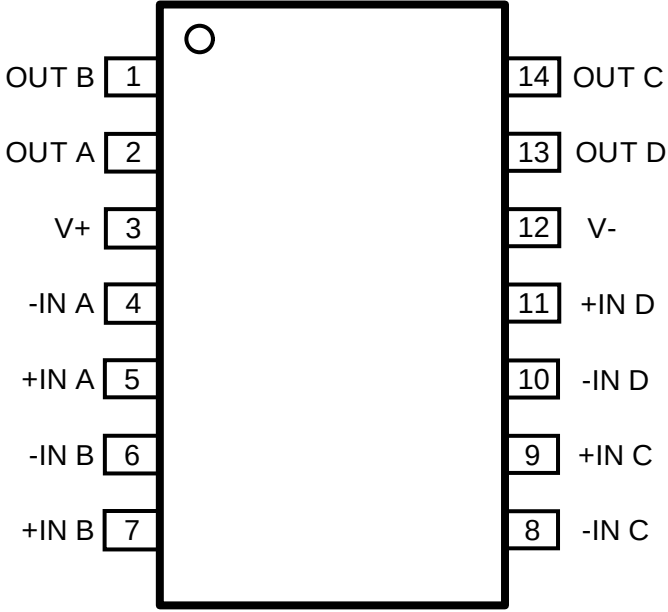
Features

- Wide Supply Range: 3V to 36V
- Low Input Offset: 2mV (Typ)
- Low Quiescent Current:  
75 $\mu$ A at  $V_S=5V$
- Low Input Bias Current: 1nA
- Input Common-Mode Voltage Range
- Includes Ground
- Open-Drain Output
- Short Response Time
- SIZE PACKAGES: SOP-14

Applications

- Hysteresis Comparators
- Floor mopping robot
- One-way UPS
- Server PSU
- Cordless power tool
- Industrial Automation and Control
- Motor driver
- Instruments and apparatus

PIN DESCRIPTION AND MARKING

| SOP-14                                                                             | Pin Description                                                                                                                                                                                                                                                                                       | Marking                                                                                                                     |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
|  |  <p>OUT B 1</p> <p>OUT A 2</p> <p>V+ 3</p> <p>-IN A 4</p> <p>+IN A 5</p> <p>-IN B 6</p> <p>+IN B 7</p> <p>14 OUT C</p> <p>13 OUT D</p> <p>12 V-</p> <p>11 +IN D</p> <p>10 -IN D</p> <p>9 +IN C</p> <p>8 -IN C</p> |  <p>MSKSEMI<br/>LM239DT<br/>MS ***</p> |

## Pin Description

| Pin Name | Pin Number | I/O | Description                     |
|----------|------------|-----|---------------------------------|
|          | SOP-14     |     |                                 |
| OUTB     | 1          | O   | Output, channel B               |
| OUTA     | 2          | O   | Output, channel A               |
| V+       | 3          | -   | Positive (highest) power supply |
| -INA     | 4          | I   | Inverting input, channel A      |
| +INA     | 5          | I   | Noninverting input, channel A   |
| -INB     | 6          | I   | Inverting input, channel B      |
| +INB     | 7          | I   | Noninverting input, channel B   |
| -INC     | 8          | I   | Inverting input, channel C      |
| +INC     | 9          | I   | Noninverting input, channel C   |
| -IND     | 10         | I   | Inverting input, channel D      |
| +IND     | 11         | I   | Noninverting input, channel D   |
| V-       | 12         | -   | Negative(lowest) power supply   |
| OUTD     | 13         | O   | Output, channel D               |
| OUTC     | 14         | O   | Output, channel C               |

## Package/Order Information

| ORDERING NUMBER | Op Temp(°C) | Package | Packing Option |
|-----------------|-------------|---------|----------------|
| LM239DT-MS      | -40°C~125°C | SOP-14  | 2500PCS        |

## Absolute Maximum Ratings<sup>(1)</sup>

|             |                                            | MIN        | MAX        | UNIT |
|-------------|--------------------------------------------|------------|------------|------|
| Voltage     | Supply, $V_s=(V+) - (V-)$                  |            | 40         | V    |
|             | Input pin (IN+, IN-) <sup>(2)</sup>        | (V-) - 0.3 | (V+) + 0.3 | V    |
|             | Signal output pin <sup>(3)</sup>           | (V-) - 0.3 | (V+) + 0.3 | V    |
| Current     | Signal Input pin (IN+, IN-) <sup>(2)</sup> | -10        | 10         | mA   |
|             | Signal output pin <sup>(3)</sup>           | -55        | 55         | mA   |
| Temperature | Operating Range                            | -40        | 125        | °C   |
|             | Storage                                    | -65        | 150        | °C   |
|             | Junction                                   |            | 150        | °C   |

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to  $\pm 55\text{mA}$  or less.

(3) Short-circuit from output to  $V_{cc}$  can cause excessive heating and eventual destruction.

ESD Ratings

|                    |                         |                                                                                          | VALUE | UNIT |
|--------------------|-------------------------|------------------------------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | ±2000 | V    |
|                    |                         | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | ±1000 | V    |

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

|                                                                         |               | MIN  | MAX | UNIT |
|-------------------------------------------------------------------------|---------------|------|-----|------|
| Supply voltage , V <sub>s</sub> = (V <sub>+</sub> ) - (V <sub>-</sub> ) | Single-supply | 3    | 36  | V    |
|                                                                         | Dual-supply   | ±1.5 | ±18 | V    |

SIMPLIFIED SCHEMATIC

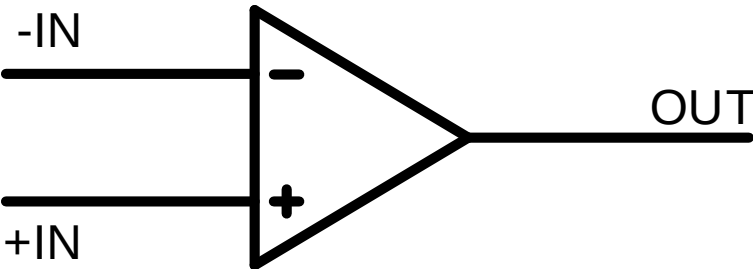


Figure 1. Simplified Schematic

## ELECTRICAL CHARACTERISTICS

At  $T_A = 25^\circ\text{C}$ ,  $V_S = +5\text{V}$ ,  $V_{IN+} = V_S$ ,  $V_{IN-} = 1.4\text{V}$ ,  $R_{PU} = 10\text{k}\Omega$ , unless otherwise noted.

| Symbol                  | PARAMETER                                           | CONDITIONS                                              | MIN | TYP | MAX     | UNIT |
|-------------------------|-----------------------------------------------------|---------------------------------------------------------|-----|-----|---------|------|
| POWER SUPPLY            |                                                     |                                                         |     |     |         |      |
| Vs                      | Operating Voltage Range                             |                                                         | 3   |     | 36      | V    |
| Iq                      | Quiescent Current<br>/per channel                   | Vs=5V                                                   |     | 75  |         | μA   |
|                         |                                                     | Vs=36V                                                  |     | 110 |         | μA   |
| INPUT CHARACTERISTICS   |                                                     |                                                         |     |     |         |      |
| Vos                     | Input offset voltage                                |                                                         | -5  | 2   | 5       | mV   |
| IB                      | Input Bias Current                                  | VCM=Vs/2                                                |     | 1   |         | nA   |
| Ios                     | Input Offset Current                                |                                                         |     | 1   |         | nA   |
| VCM                     | Common-Mode<br>Voltage Range                        |                                                         | Vs- |     | Vs+-1.5 | V    |
| AVD                     | Large-signal Differential-<br>voltage Amplification | Vs = 15 V,<br>Vo = 1.4 V to 11.4 V,<br>RL ≥ 15 kΩ to Vs | 50  | 200 |         | V/mV |
| OUTPUT CHARACTERISTICS  |                                                     |                                                         |     |     |         |      |
| IOH                     | High-level Output Current                           | VOH=36V, VID=1V                                         |     | 2   | 30      | nA   |
| IOL                     | Low-level Output Current                            | VOL=1.5V, VID=-1V                                       |     | 30  |         | mA   |
| VOL                     | Low-level Output Voltage                            | IOL=4mA, VID=-1V                                        |     | 270 |         | mV   |
| DYNAMIC CHARACTERISTICS |                                                     |                                                         |     |     |         |      |
| tRT                     | Propagation Delay H To L                            | Vs=5V , RPU=5.1kΩ,<br>Overdrive =10mV                   |     | 485 |         | ns   |
|                         |                                                     | Vs=5V , RPU=5.1kΩ,<br>Overdrive =100mV                  |     | 400 |         |      |
|                         | Propagation Delay L To H                            | Vs=5V , RPU=5.1kΩ,<br>Overdrive =10mV                   |     | 360 |         |      |
|                         |                                                     | Vs=5V , RPU=5.1kΩ,<br>Overdrive =100mV                  |     | 90  |         |      |

## DETAILED DESCRIPTION

### Overview

The LM239DT-MS family of comparators can operate up to 36V on the supply pin. This standard device has proven ubiquity and versatility across a wide range of applications. This is due to its low power and high speed. The open-drain output allows the user to configure the output's logic low voltage ( $V_{OL}$ ) and can be utilized to enable the comparator to be used in AND functionality.

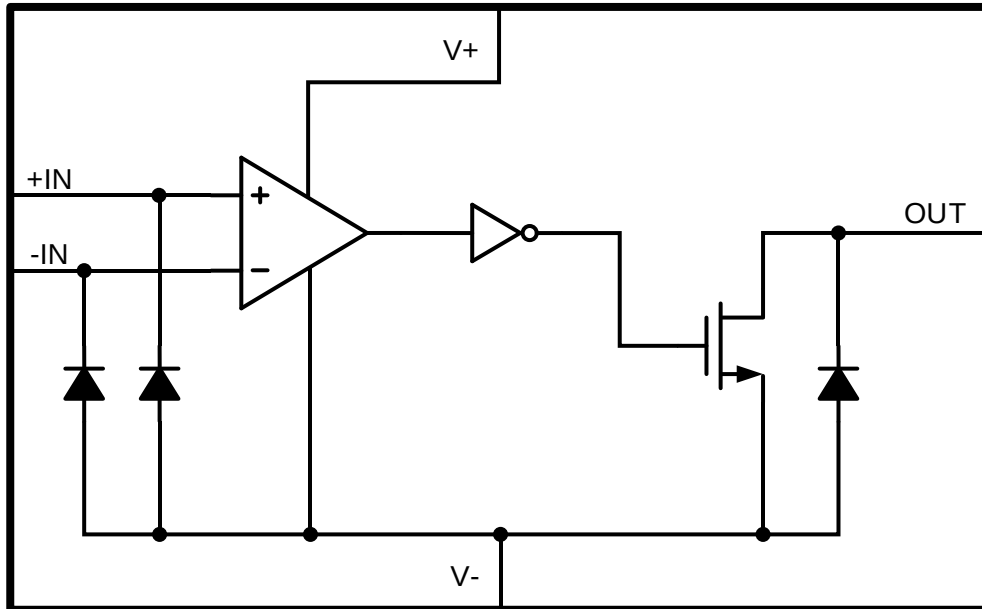


Figure 2. Functional Block Diagram

## APPLICATION and IMPLEMENTATION

### Application Information

The LM239DT-MS will typically be used to compare a single signal to a reference or two signals against each other. Many users take advantage of the open drain output (logic high with pull-up) to drive the comparison logic output to a logic voltage level to an MCU or logic device.

### Typical Application

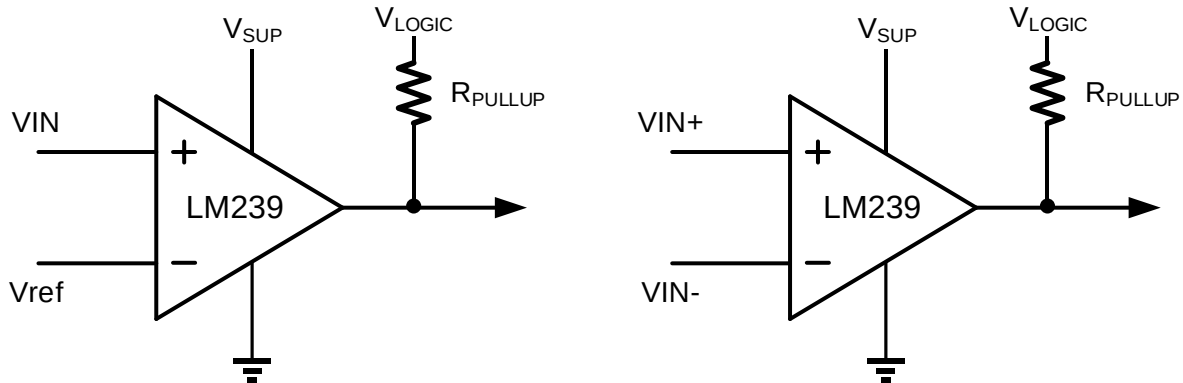


Figure 3. Typical Application Schematic

### Power Supply Recommendations

For fast response and comparison applications with noisy or AC inputs, it is recommended to use a bypass capacitor on the supply pin to reject any variation on the supply voltage. This variation causes temporary fluctuations in the comparator's input common mode range and create an inaccurate comparison.

## Layout

### Layout Guidelines

For accurate comparator applications without hysteresis it is important maintain a stable power supply with minimized noise and glitches, which can affect the high-level input common mode voltage range. In order to achieve this, it is best to add a bypass capacitor between the supply voltage and ground. This should be implemented on the positive power supply and negative supply (if available). If a negative supply is not being used, do not put a capacitor between the IC's GND pin and system ground.

### Layout Example

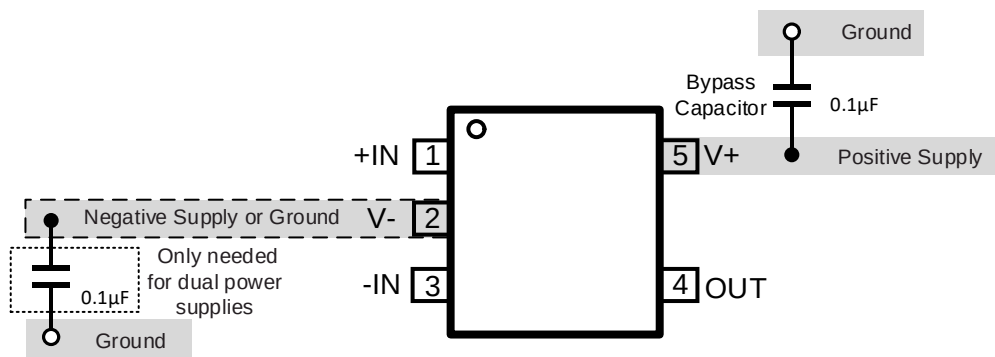
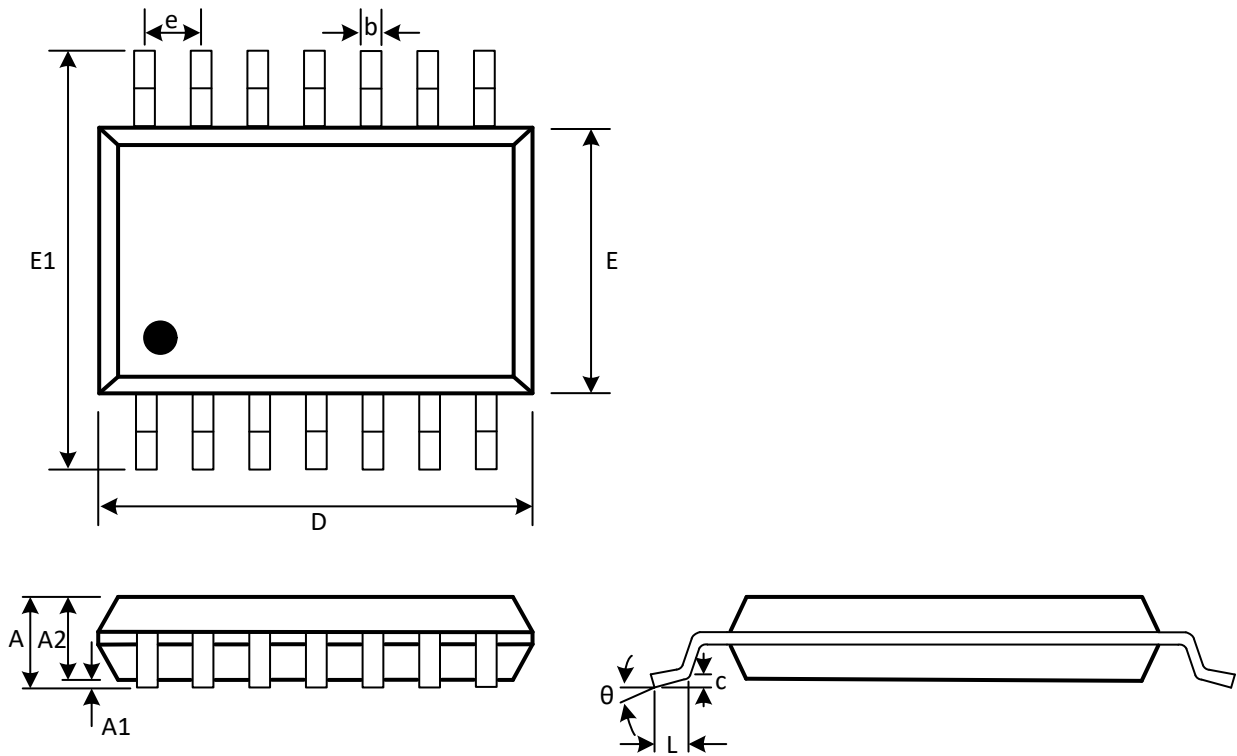


Figure 4. LM239DT-MS Layout Example

**PACKAGE DESCRIPTION**

**SOP-14**



(Unit: mm)

| Symbol | Min        | Max   |
|--------|------------|-------|
| A      | 1.350      | 1.750 |
| A1     | 0.100      | 0.250 |
| A2     | 1.350      | 1.550 |
| b      | 0.310      | 0.510 |
| c      | 0.100      | 0.250 |
| D      | 8.450      | 8.850 |
| e      | 1.270(BSC) |       |
| E1     | 5.800      | 6.200 |
| E      | 3.800      | 4.000 |
| L      | 0.400      | 1.270 |
| θ      | 0°         | 8°    |



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