LM119/LM219/LM319
High Speed Dual Comparator

General Description
The LM119 series are precision high speed dual comparators fabricated on a single monolithic chip. They are designed to operate over a wide range of supply voltages down to a single 5V logic supply and ground. Further, they have higher gain and lower input currents than devices like the LM710. The uncommitted collector of the output stage makes the LM119 compatible with RTL, DTL and TTL as well as capable of driving lamps and relays at currents up to 25 mA.

The LM319A offers improved precision over the standard LM319, with tighter tolerances on offset voltage, offset current, and voltage gain.

Although designed primarily for applications requiring operation from digital logic supplies, the LM119 series are fully specified for power supplies up to ±15V. It features faster response than the LM111 at the expense of higher power dissipation. However, the high speed, wide operating voltage range and low package count make the LM119 much more versatile than older devices like the LM711.

The LM119 is specified from −55˚C to +125˚C, the LM219 is specified from −25˚C to +85˚C, and the LM319A and LM319 are specified from 0˚C to +70˚C.

Features
- Two independent comparators
- Operates from a single 5V supply
- Typically 80 ns response time at ±15V
- Minimum fan-out of 2 each side
- Maximum input current of 1 µA over temperature
- Inputs and outputs can be isolated from system ground
- High common mode slew rate

Connection Diagram

Typical Applications (Note 2)

Relay Driver

Window Detector

Note 2: Pin numbers are for metal can package.

V_{OUT} = 5V for V_{LT} ≤ V_{IN} ≤ V_{UT}
V_{OUT} = 0 for V_{IN} ≤ V_{LT} or V_{IN} ≥ V_{UT}

See NS Package Number J14A, M14A or N14A

Note 1: Also available per SMD# 8601401 or JM38510/10306
### Absolute Maximum Ratings (Note 9)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

- **Total Supply Voltage**: 36V
- **Output to Negative Supply Voltage**: 36V
- **Ground to Negative Supply Voltage**: 25V
- **Ground to Positive Supply Voltage**: 18V
- **Differential Input Voltage**: ±5V
- **Input Voltage (Note 3)**: ±15V
- **ESD rating (1.5 kΩ in series with 100 pF)**: 800V
- **Power Dissipation (Note 4)**: 500 mW
- **Output Short Circuit Duration**: 10 sec
- **Storage Temperature Range**: −65˚C to 150˚C
- **Lead Temperature (Soldering, 10 sec.)**: 260˚C
- **Soldering Information**
  - Dual-In-Line Package: Soldering (10 seconds) 260˚C
  - Small Outline Package: Vapor Phase (60 seconds) 215˚C
  - Infrared (15 seconds) 220˚C

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

### Operating Temperature Range

<table>
<thead>
<tr>
<th>Device</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM119</td>
<td>−55˚C to 125˚C</td>
</tr>
<tr>
<td>LM219</td>
<td>−25˚C to 85˚C</td>
</tr>
</tbody>
</table>

### Electrical Characteristics (Note 5)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM119/LM219</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Offset Voltage</strong> (Note 6)</td>
<td>$T_A = 25^\circ C, R_S \leq 5k$</td>
<td>0.7</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Input Offset Current</strong> (Note 6)</td>
<td>$T_A = 25^\circ C$</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td><strong>Input Bias Current</strong></td>
<td>$T_A = 25^\circ C$</td>
<td>150</td>
<td>500</td>
</tr>
<tr>
<td><strong>Voltage Gain</strong> (Note 8)</td>
<td>$T_A = 25^\circ C$</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td><strong>Response Time</strong> (Note 7)</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 15V$</td>
<td>0.75</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Saturation Voltage</strong></td>
<td>$V_{IN} \leq -5 mV, I_{OUT} = 25 mA$</td>
<td>0.2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Saturation Voltage</strong></td>
<td>$T_A = 25^\circ C$</td>
<td>7</td>
<td>mV</td>
</tr>
<tr>
<td><strong>Input Offset Voltage</strong> (Note 6)</td>
<td>$R_S \leq 5k$</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td><strong>Input Bias Current</strong></td>
<td></td>
<td>1000</td>
<td>nA</td>
</tr>
<tr>
<td><strong>Input Voltage Range</strong></td>
<td>$V_S = \pm 15V$</td>
<td>-12</td>
<td>+12</td>
</tr>
<tr>
<td><strong>Saturation Voltage</strong></td>
<td>$V^+ = 4.5V, V^- = 0$</td>
<td>1</td>
<td>+12</td>
</tr>
<tr>
<td><strong>Saturation Voltage</strong></td>
<td>$V_{IN} \leq -6 mV, I_{SINK} \leq 3.2 mA$</td>
<td>0.23</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Output Leakage Current</strong></td>
<td>$V_{IN} \geq 5 mV, V_{OUT} = 35V$</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td><strong>Output Leakage Current</strong></td>
<td>$T_A = 25^\circ C$</td>
<td>4.3</td>
<td>mA</td>
</tr>
<tr>
<td><strong>Positive Supply Current</strong></td>
<td>$T_A = 25^\circ C, V^+ = 5V, V^- = 0$</td>
<td>8</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Negative Supply Current</strong></td>
<td>$T_A = 25^\circ C, V_S = \pm 15V$</td>
<td>3</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**Note 3:** For supply voltages less than ±15V the absolute maximum input voltage is equal to the supply voltage.

**Note 4:** The maximum junction temperature of the LM119 is 150˚C, while that of the LM219 is 110˚C. For operating at elevated temperatures, devices in the H10 package must be derated based on a thermal resistance of 160˚C/W, junction to ambient, or 19˚C/W, junction to case. The thermal resistance of the J14 and N14 packages is 100˚C/W, junction to ambient.

**Note 5:** These specifications apply for $V_S = \pm 15V$, and the Ground pin at ground, and −55˚C $\leq T_A \leq +125˚C$, unless otherwise stated. With the LM219, however, all temperature specifications are limited to −25˚C $\leq T_A \leq +85˚C$. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V supply up to ±15V supplies. Do not operate the device with more than 16V from ground to $V_S$.

**Note 6:** The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

**Note 7:** The response time specified (see definitions) is for a 100 mV input step with 5 mV overdrive.

**Note 8:** Output is pulled up to 15V through a 1.4 kΩ resistor.

**Note 9:** Refer to RETS119X for LM119H/883 and LM119J/883 specifications.
Absolute Maximum Ratings
LM319A/319 (Note 9)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM319A</th>
<th>LM319</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>Total Supply Voltage</td>
<td>36V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output to Negative Supply Voltage</td>
<td>36V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground to Negative Supply Voltage</td>
<td>25V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground to Positive Supply Voltage</td>
<td>18V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential Input Voltage</td>
<td>±5V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage (Note 10)</td>
<td>±15V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Dissipation (Note 11)</td>
<td>500 mW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Short Circuit Duration</td>
<td>10 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESD rating (1.5 kΩ in series with 100 pF)</td>
<td>800V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Storage Temperature Range
~65°C to 150°C

Lead Temperature
(Soldering, 10 sec.)
260°C

Soldering Information
Dual-In-Line Package
Soldering (10 sec.)
260°C

Small Outline Package
Vapor Phase (60 sec.)
215°C

Infrared (15 sec.)
220°C

See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.

Operating Temperature Range
LM319A, LM319
0°C to 70°C

Electrical Characteristics (Note 12)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>LM319A</th>
<th>LM319</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>Input Offset Voltage (Note 13)</td>
<td>T_A = 25°C, R_S ≤ 5k</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Input Offset Current (Note 13)</td>
<td>T_A = 25°C</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td>T_A = 25°C</td>
<td>150</td>
<td>500</td>
</tr>
<tr>
<td>Voltage Gain</td>
<td>T_A = 25°C (Note 15)</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Response Time (Note 14)</td>
<td>T_A = 25°C</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Saturation Voltage</td>
<td>V_IN ≤ −10 mV, I_OUT = 25 mA</td>
<td>T_A = 25°C</td>
<td>0.75</td>
</tr>
<tr>
<td>Output Leakage Current</td>
<td>V_IN ≥ 10 mV, V_OUT = 35V, V^* = 0, GND = 0V, T_A = 25°C</td>
<td>0.2</td>
<td>10</td>
</tr>
<tr>
<td>Input Offset Voltage (Note 13)</td>
<td>R_S ≤ 5k</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Input Offset Current (Note 13)</td>
<td></td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Input Bias Current</td>
<td></td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>V_S = ±15V</td>
<td>±13</td>
<td>3</td>
</tr>
<tr>
<td>V^* = 5V, V^* = 0</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Saturation Voltage</td>
<td>V^* ≥ 4.5V, V^* = 0</td>
<td>V_IN ≤ −10 mV, I_SINK ≤ 3.2 mA</td>
<td>0.3</td>
</tr>
<tr>
<td>Differential Input Voltage</td>
<td></td>
<td>±5</td>
<td>±5</td>
</tr>
<tr>
<td>Positive Supply Current</td>
<td>T_A = 25°C, V^* = 5V, V^* = 0</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Positive Supply Current</td>
<td>T_A = 25°C, V_S = ±15V</td>
<td>8</td>
<td>12.5</td>
</tr>
<tr>
<td>Negative Supply Current</td>
<td>T_A = 25°C, V_S = ±15V</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Note 10: For supply voltages less than ±15 the absolute maximum input voltage is equal to the supply voltage.

Note 11: The maximum junction temperature of the LM319A and LM319 is 85°C. For operating at elevated temperatures, devices in the H10 package must be derated based on a thermal resistance of 160°C/W, junction to ambient, or 19°C/W, junction to case. The thermal resistance of the N14 and J14 package is 100°C/W, junction to ambient. The thermal resistance of the M14 package is 115°C/W, junction to ambient.

Note 12: These specifications apply for V_S = ±15V, and 0°C ≤ T_A ≤ 70°C, unless otherwise stated. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V supply up to ±15V supplies. Do not operate the device with more than 16V from ground to V_S.

Note 13: The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1 mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

Note 14: The response time specified is for a 100 mV input step with 5 mA overdrive.

Note 15: Output is pulled up to 15V through a 1.4 kΩ resistor.
Typical Performance Characteristics

LM119A/LM119/LM219 (Continued)

Supply Current

- Supply Current
  - $T_a = 25^\circ C$
  - Supply Voltage
  - Positive Supply
  - Negative Supply

Output Limiting Characteristics

- Output Limiting Characteristics
  - $T_a = 25^\circ C$
  - Short Circuit Current
  - Power Dissipation

Typical Performance Characteristics

LM319A, LM319

Input Currents

- Input Currents
  - $V_i = \pm 15V$
  - Bias
  - Offset

Supply Currents

- Supply Currents
  - $V_i = \pm 15V$
  - Positive Supply
  - Negative Supply

Transfer Function

- Transfer Function
  - $V_i = \pm 15V$
  - $R_i = 1.4k$
  - $T_a = 25^\circ C$
  - Differential Input Voltage
  - Output Voltage High

Response Time for Various Input Overdrives

- Response Time for Various Input Overdrives
  - $V_i = \pm 15V$
  - $R_i = 500\Omega$
  - $V_{ff} = 5.0V$
  - $T_a = 25^\circ C$

Input Characteristics

- Input Characteristics
  - $V_i = \pm 15V$
  - $R_i = 500\Omega$
  - $V_{ff} = 5.0V$
  - $T_a = 25^\circ C$
  - Differential Input Voltage
  - Input Bias Current
Typical Performance Characteristics  LM319A, LM319  (Continued)

Response Time for Various Input Overdrives

Output Saturation Voltage

Supply Current

Common Mode Limits

Output Limiting Characteristics
*Do not operate the LM119 with more than 16V between GND and V**
Connection Diagrams

Metal Can Package

Case is connected to pin 5 (V−)

Top View
Order Number LM119H, LM119H/883 (Note 1), or LM319H
See NS Package Number H10C

Order Number LM119W/883
See NS Package Number W10A

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Physical Dimensions  inches (millimeters) unless otherwise noted

Metal Can Package (H)
Order Number LM119H, LM119H/883, LM319AH or LM319H
NS Package Number H10C

Cavity Dual-In-Line Package (J)
NS Package Number J14A
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

Dual-In-Line Package (M)
Order Number LM319AM or LM319M
NS Package Number M14A

Molded Dual-In-Line Package (N)
Order Number LM319AN or LM319N
NS Package Number N14A
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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Order Number LM119W/883, LM119WG/883
NS Package Number W10A, WG10A