# LP311

***LP311 Voltage Comparator***


Literature Number: SNOSBJ7A

National Semiconductor

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# LP311 Voltage Comparator

## General Description

The LP311 is a low power version of the industry-standard LM311. It takes advantage of stable high-value ion-implanted resistors to perform the same function as an LM311, with a 30:1 reduction in power drain, but only a 6:1 slowdown of response time. Thus the LP311 is well suited for battery-powered applications, and all other applications where fast response is not needed. It operates over a wide range of supply voltages from 36V down to a single 3V supply, with less than 200 μA drain, but it is still capable of driving a 25 mA load. The LP311 is quite easy to apply without any oscillation, if ordinary precautions are taken to minimize stray coupling from the output to either input or to the balance pins (as described in the LM311 datasheet Application Hints).

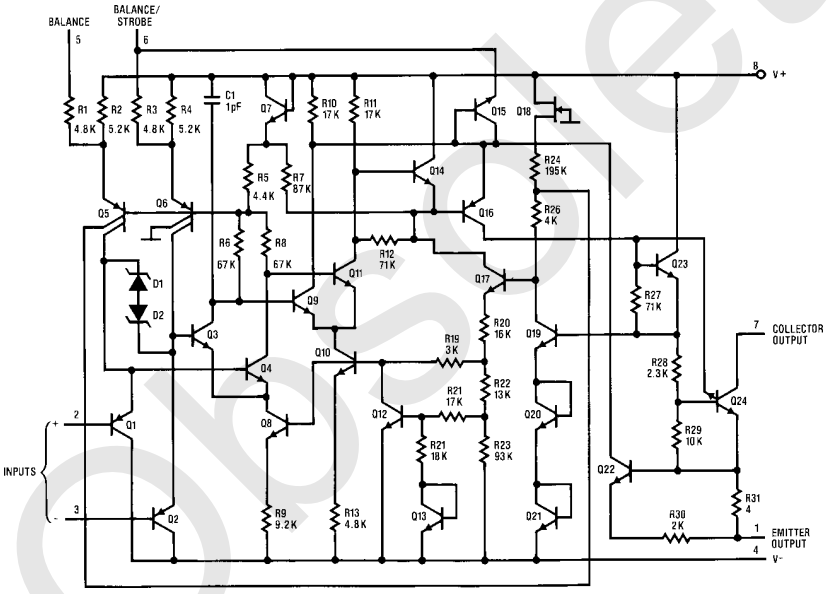
## Features

- Low power drain, 900 μW on 5V supply
- Operates from ±15V or a single supply as low as 3V
- Output can drive 25 mA
- Emitter output can swing below negative supply
- Response time: 1.2 μs
- Same pin-out as LM311
- Low input currents: 2 nA of offset, 15 nA of bias
- Large common-mode input range: −14.6V to 13.6V with ±15V supply

## Applications

- Level-detector for battery-powered instruments
- Low-power lamp or relay driver
- Low-power zero-crossing detector

## Schematic Diagram

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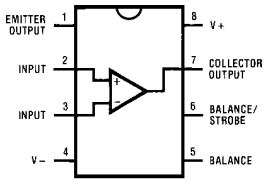
## Connection Diagram

**Dual-In-Line Package**

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**Top View**

**Order Number LP311M or LP311N**
**See NS Package Numbers M08A or N08E**

## Absolute Maximum Ratings

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

| | |
|---|---|
| Total Supply Voltage ($V_{8-4}$) | 36V |
| Collector Output to Negative Supply Voltage ($V_{7-4}$) | 40V |
| Collector Output to Emitter Output | 40V |
| Emitter Output to Negative Supply Voltage ($V_{1-4}$) | ±30V |
| Differential Input Voltage | ±30V |
| Input Voltage (Note 1) | ±15V |
| Power Dissipation (Note 2) | 500 mW |
| Output Short Circuit Duration | 10 sec |
| Operating Temperature Range | 0°C to 70°C |
| Storage Temperature Range | −65°C to 150°C |
| Lead Temperature (Soldering, 10 seconds) | 260°C |

## Electrical Characteristics

These specifications apply for $V_S = \pm 15V$ and $0°C \leq T_A \leq 70°C$, unless otherwise specified.

| Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Input Offset Voltage (Notes 3, 4) | $T_A = 25°C$, $R_S \leq 100k$ | | 2.0 | 7.5 | mV |
| Input Offset Current (Notes 3, 4) | $T_A = 25°C$ | | 2.0 | 25 | nA |
| Input Bias Current (Note 3) | $T_A = 25°C$ | | 15 | 100 | nA |
| Voltage Gain | $T_A = 25°C$, $R_L = 5k$ | 40 | 200 | | V/mV |
| Response Time (Note 5) | $T_A = 25°C$ | | 1.2 | | μs |
| Saturation Voltage (Note 6) | $V_{IN} \leq -10$ mV, $I_{OUT} = 25$ mA<br>$T_{A=25°C}$ | | 0.4 | 1.5 | V |
| Strobe Current (Note 7) | $T_A = 25°C$ | 100 | 200 | 300 | μA |
| Output Leakage Current | $V_{IN} \geq 10$ mV, $V_{OUT} = 35V$<br>$T_A = 25°C$ | | 0.2 | 100 | nA |
| Input Offset Voltage (Notes 3, 4) | $R_S \leq 100k$ | | | 10 | mV |
| Input Offset Current (Notes 3, 4) | | | | 35 | nA |
| Input Bias Current (Note 3) | | | | 150 | nA |
| Input Voltage Range | | $V^- + 0.5$ | +13.7, −14.7 | $V^+ - 1.5$ | V |
| Saturation Voltage (Note 6) | $V^+ \geq 4.5V$, $V^- = 0V$<br>$V_{IN} \leq -10$ mV, $I_{SINK} \leq 1.6$ mA | | 0.1 | 0.4 | V |
| Positive Supply Current | $T_A = 25°C$, Output on | | 150 | 300 | μA |
| Negative Supply Current | $T_A = 25°C$ | | 80 | 180 | μA |
| Minimum Operating Voltage | $T_A = 25°C$ | | 3.0 | 3.5 | V |

**Note 1:** This rating applies for ±15V supplies. The positive input voltage limit is 30V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30V below the positive supply, whichever is less.

**Note 2:** The maximum junction temperature of the LP311 is 85°C. For operating at elevated temperatures, devices in the dual-in-line package must be derated based on a thermal resistance of 160°C/W, junction to ambient.

**Note 3:** The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 4V supply up to ±15V supplies.

**Note 4:** The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with 1 mA load. Thus, these parameters define an error band and take into account the worst-case effects of voltage gain and input impedance.

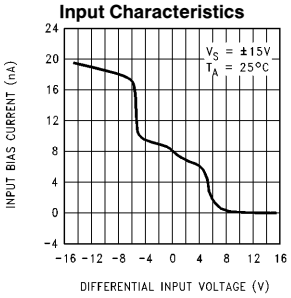
**Note 5:** The response time specified is for a 100 mV input step with 5 mV overdrive.

**Note 6:** Saturation voltage specification applies to collector-emitter voltage (V7-1) for $V_{COLLECTOR} \leq (V^+ - 3V)$.

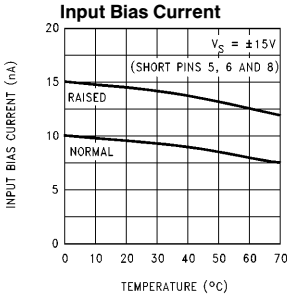
**Note 7:** This specification gives the range of current which must be drawn from the strobe pin to ensure the output is properly disabled. Do not short the strobe pin to ground. It should be current driven, 100 μA to 300 μA.

## Typical Performance Characteristics

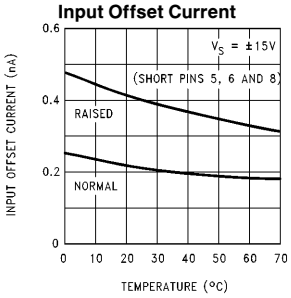
**Input Characteristics**



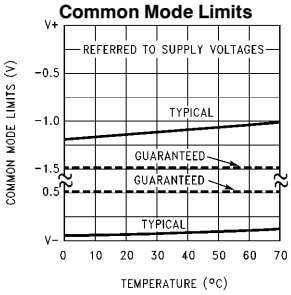

**Input Bias Current**



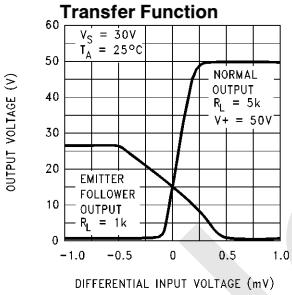

**Input Offset Current**



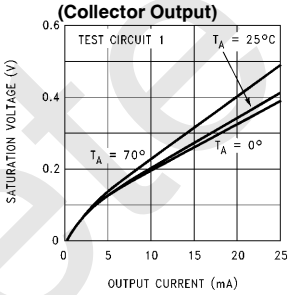

**Common Mode Limits**



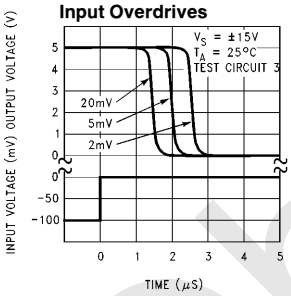

**Transfer Function**



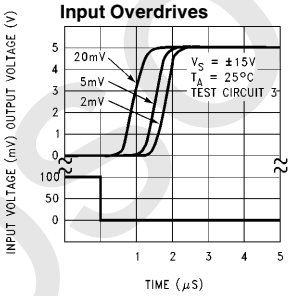

**Output Saturation Voltage (Collector Output)**



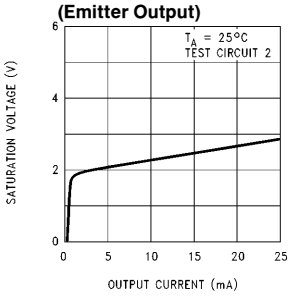

**Response Time for Various Input Overdrives**



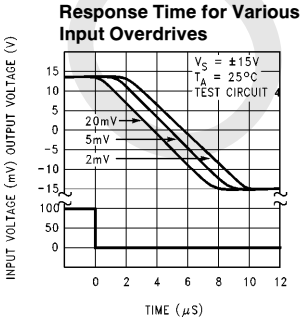

**Response Time for Various Input Overdrives**



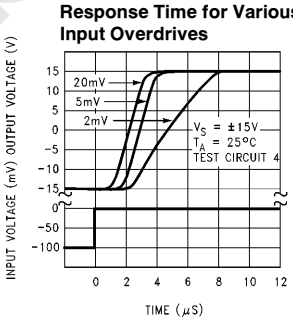

**Output Saturation Voltage (Emitter Output)**



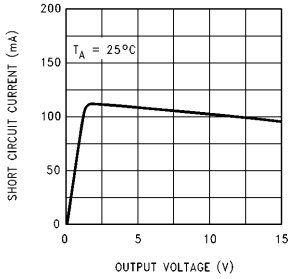

**Response Time for Various Input Overdrives**




**Response Time for Various Input Overdrives**




**Output Limiting Characteristics**

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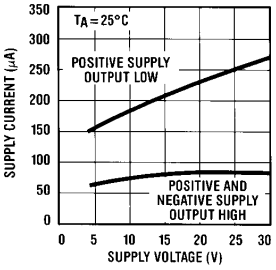
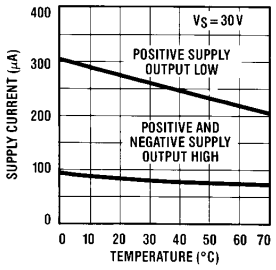
## Typical Performance Characteristics (Continued)

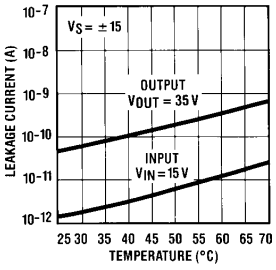
**Supply Current**




**Supply Current**




**Leakage Currents**

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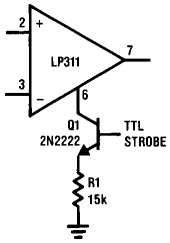
## Applications Information

For applications information and typical applications, refer to the LM311 datasheet.

## Auxiliary Circuits

**Strobing**

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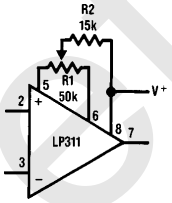
**Offset Balancing**

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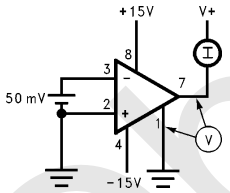
**Note:** Do not ground strobe pin.

## Test Circuits

**Test Circuit 1 (Collector Output)**

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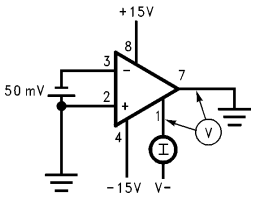
**Test Circuit 2 (Emitter Output)**

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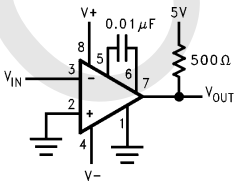
**Test Circuit 3 (Collector Output)**

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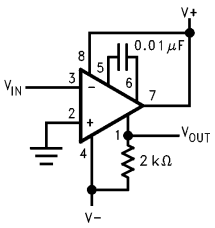
**Test Circuit 4 (Emitter Output)**

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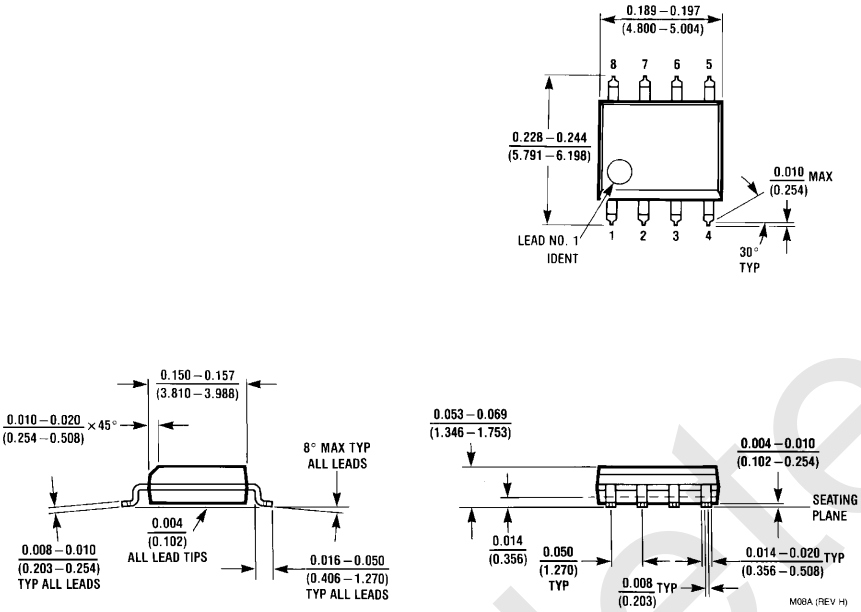
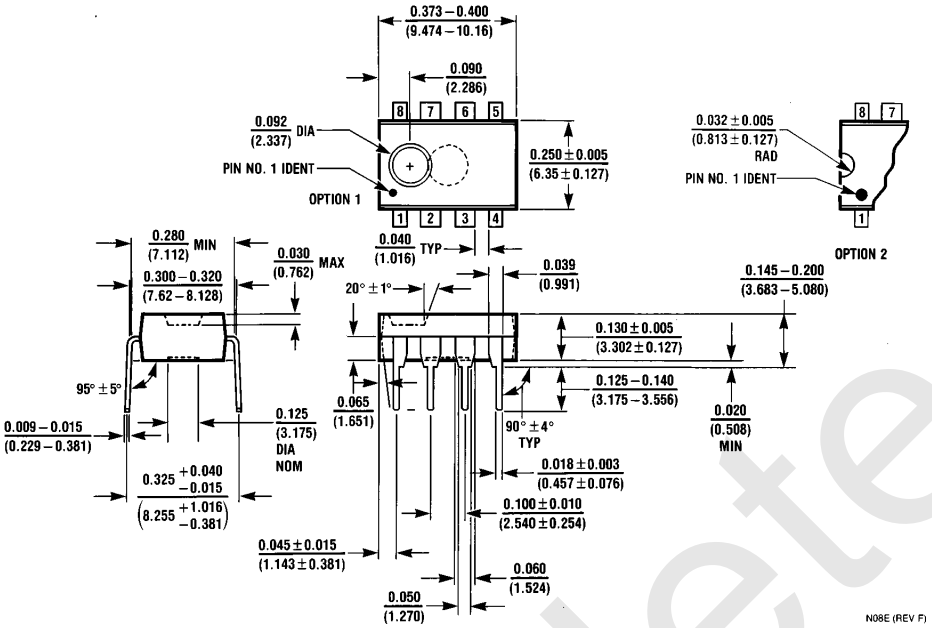
## Physical Dimensions inches (millimeters)




**Order Number LP311M**
**NS Package Number M08A**

## Physical Dimensions inches (millimeters) (Continued)




**Molded Dual-In-Line Package (N)**
**Order Number LP311N**
**NS Package Number N08E**



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