

# LM111/211/311

## Precision Voltage Comparator

### Distinctive Characteristics

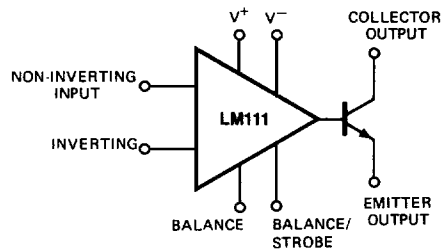
- The AMD LM111/211/311 are functionally, electrically, and pin-for-pin equivalent to the National LM 111/211/311

- Output Drive – 50V and 50mA
- Input Bias Current – 150nA max.
- Input Offset Voltage – 4mV max.
- Differential Input Voltage Range –  $\pm 30V$

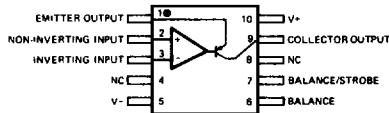
### FUNCTIONAL DESCRIPTION

The LM111/211/311 are voltage comparators featuring low input currents, high differential and common mode voltage ranges, wide supply voltage range, and outputs compatible with all bipolar and MOS circuitry. The inputs and outputs can be isolated from system ground, and the output can drive loads referred to ground or either supply. Strobing and offset balancing are available and the outputs can be wire ORed.

### FUNCTIONAL DIAGRAM



### CONNECTION DIAGRAM – Top View Ceramic Flat Package F-10-1



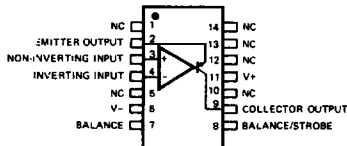
Pin 5 is connected to bottom of package.

LIC-083

LIC-081

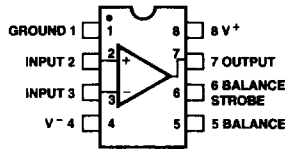
### CONNECTION DIAGRAMS – Top Views

#### Hermetic DIP D-14-1

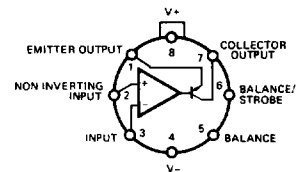


Pin 6 is connected to bottom of package.

#### Mini-DIP P-8-1



#### Metal Can H-8-1



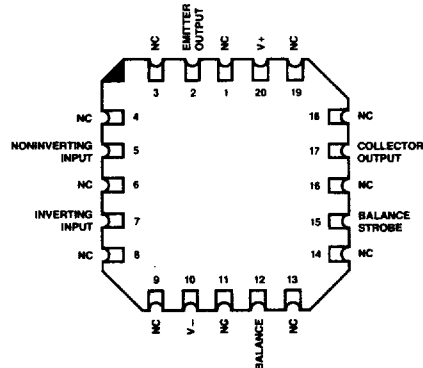
Pin 4 is connected to case. LIC-084

### ORDERING INFORMATION\*

| Part Number | Package Type         | Temperature Range | Order Number |
|-------------|----------------------|-------------------|--------------|
| LM311       | TO-99                | 0 to +70°C        | LM311H       |
|             | Hermetic DIP         | 0 to +70°C        | LM311D       |
|             | Mini-DIP             | 0 to +70°C        | LM311N       |
|             | Dice                 | 0 to +70°C        | LD311        |
|             | Leadless             | 0 to +70°C        | LM311L       |
| LM211       | TO-99                | -25 to +85°C      | LM211H       |
|             | Hermetic DIP         | -25 to +85°C      | LM211D       |
|             | Leadless             | -25 to +85°C      | LM211L       |
|             | Ceramic Flat Package | -25 to +85°C      | LM211F       |
| LM111       | TO-99                | -55 to +125°C     | LM111H       |
|             | Hermetic DIP         | -55 to +125°C     | LM111D       |
|             | Flat Pak             | -55 to +125°C     | LM111F       |
|             | Dice                 | -55 to +125°C     | LD111        |
|             | Leadless             | -55 to +125°C     | LM111L       |
|             | Ceramic Flat Package | -55 to +125°C     | LM111F       |

\*Also available with burn-in processing. To order add suffix B to part number.

### CONNECTION DIAGRAM – Top View Leadless Chip-Pak L-20-1



**LM111/211/311  
MAXIMUM RATINGS**

|  |                 |
|--|-----------------|
| Voltage from $V^+$ to $V^-$            | 36V             |
| Voltage from Collector Output to $V^-$ |                 |
| LM111/211                              | 50V             |
| LM311                                  | 40V             |
| Voltage from Emitter Output to $V^-$   | 30V             |
| Voltage between Inputs                 | $\pm 30V$       |
| Voltage from Inputs to $V^-$           | +30V, -0V       |
| Voltage from Inputs to $V^+$           | -30V            |
| Power Dissipation (Note 1)             | 500mW           |
| Output Short Circuit Duration          | 10 sec          |
| Operating Temperature Range            |                 |
| LM111                                  | -55°C to +125°C |
| LM211                                  | -25°C to +85°C  |
| LM311                                  | 0°C to +70°C    |
| Storage Temperature Range              | -65°C to +150°C |
| Lead Temperature (soldering, 10 sec)   | 300°C           |

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified) (Note 2)

| Parameters (see definitions)  | Test Conditions  | LM311    |          |      | LM111<br>LM211 |          |      | Units         |
|---|--|----------|----------|------|----------------|----------|------|---------------|
|   |  | Min.     | Typ.     | Max. | Min.           | Typ.     | Max. |               |
| Input Offset Voltage (Note 3)   |  |          | 2.0      | 7.5  |                | 0.7      | 3.0  | mV            |
| Input Offset Current (Note 3)   |  |          | 6.0      | 50.0 |                | 4.0      | 10.0 | nA            |
| Input Bias Current (Note 3)   |  |          | 100      | 250  |                | 60       | 100  | nA            |
| Response Time (Note 4)  | $R_L = 500\ \Omega$ to +5 V, $V_E = 0$                       |          | 200      |      |                | 200      |      | ns            |
| Supply Current  |  |          |          |      |                |          |      |               |
| Positive  |  |          | 3.9      | 7.5  |                | 3.9      | 6.0  | mA            |
| Negative  |  |          | 2.6      | 5.0  |                | 2.6      | 5.0  | mA            |
| Voltage Gain  |  |          | 200      |      |                | 200      |      | V/mV          |
| Saturation Voltage  | $V_{IN} < -5\ \text{mV}$ , $I_C = 50\ \text{mA}$             |          |          |      |                | 0.75     | 1.5  | Volts         |
|   | $V_{IN} < -10\ \text{mV}$ , $I_C = 50\ \text{mA}$            |          | 0.75     | 1.5  |                |          |      | Volts         |
| Output Leakage Current  | $V_{IN} \geq +5\ \text{mV}$ , $V_C$ to $V_E = 50\ \text{V}$  |          |          |      |                | 0.2      | 10.0 | nA            |
|   | $V_{IN} \geq +10\ \text{mV}$ , $V_C$ to $V_E = 40\ \text{V}$ |          | 0.2      | 50.0 |                |          |      | nA            |
| <b>The Following Specifications Apply Over The Operating Temperature Ranges</b> |  |          |          |      |                |          |      |               |
| Input Offset Voltage (Note 3)   |  |          |          | 10.0 |                |          | 4.0  | mV            |
| Input Offset Current (Note 3)   |  |          |          | 70.0 |                |          | 20.0 | nA            |
| Input Bias Current (Note 3)   |  |          |          | 300  |                |          | 150  | nA            |
| Saturation Voltage  | $V_{IN} < -6\ \text{mV}$ , $I_C = 8\ \text{mA}$              |          |          |      |                | 0.23     | 0.40 | Volts         |
|   | $V_{IN} < -10\ \text{mV}$ , $I_C = 8\ \text{mA}$             |          | 0.23     | 0.40 |                |          |      | Volts         |
| Output Leakage Current  | $V_{IN} \geq +6\ \text{mV}$ , $V_C$ to $V_E = 50\ \text{V}$  |          |          |      |                | 0.1      | 0.5  | $\mu\text{A}$ |
| Input Voltage Range   |  | $\pm 13$ | $\pm 14$ |      | $\pm 13$       | $\pm 14$ |      | Volts         |
| Supply Current  |  |          |          |      |                |          |      |               |
| Positive (Note 5)   | $T_A = 125^\circ\text{C}$                                    |          |          |      |                | 5.1      | 6.0  | mA            |
| Negative (Note 5)   |  |          |          |      |                | 4.1      | 5.0  | mA            |

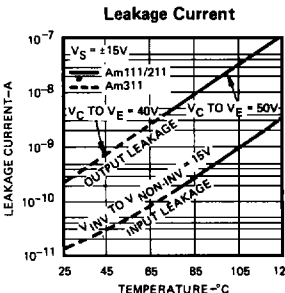
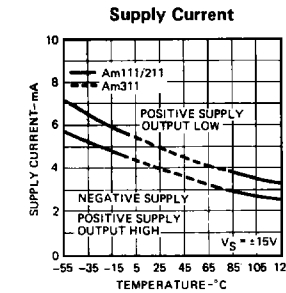
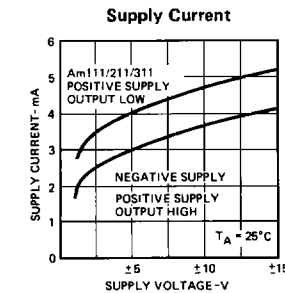
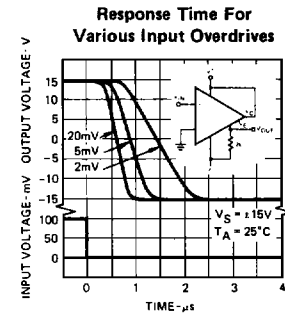
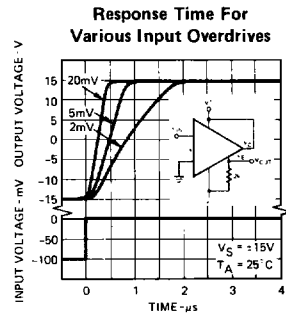
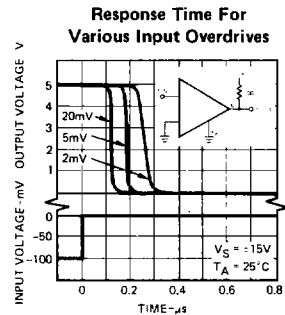
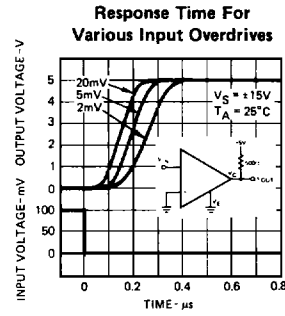
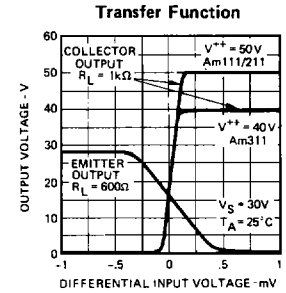
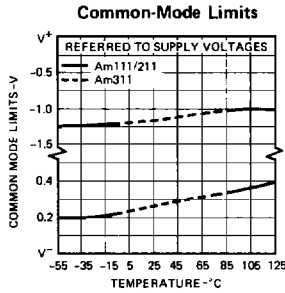
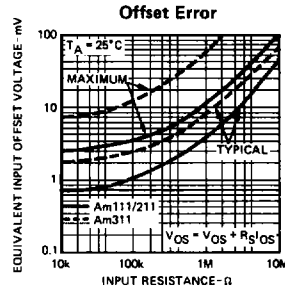
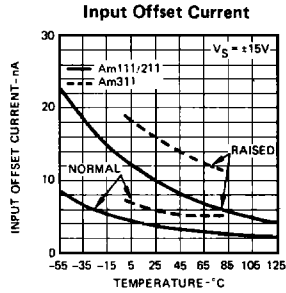
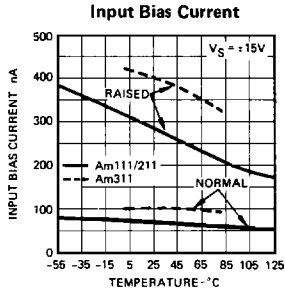
Notes: 1. For the LM111/211/311, derate Metal Can package at 6.8mW/°C for operation at ambient temperatures above 75°C, the Dual In-Line at 9mW/°C for operation at ambient temperatures above 95°C, the Flat Packages at 5.4mW/°C for operation at ambient temperatures above 57°C, and the Mini-DIP at 6.6mW/°C above 36°.

2. Unless otherwise specified, these specifications apply for  $V^+ = +15V$ ,  $V^- = -15V$ ,  $V_E = -15V$ , and  $R_L$  at collector output = 7.5k $\Omega$  to +15V.

3. The offset voltage, offset current and bias current given are the maximum values required to drive the collector output to within 1V of the supplies with a 7.5k $\Omega$  load. These parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

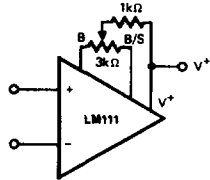
4. The response time specified (see definitions) is for a 100mV input step with 5mV overdrive.

PERFORMANCE CURVES



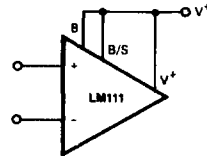
APPLICATIONS

Offset Balancing



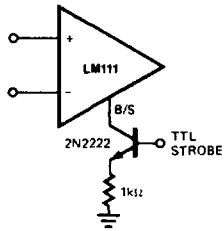
LIC-086

Increasing Input Stage Current\*



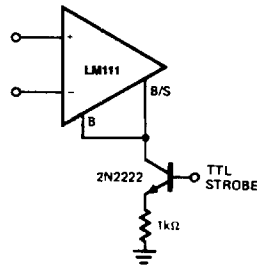
LIC-087

Strobing



LIC-088

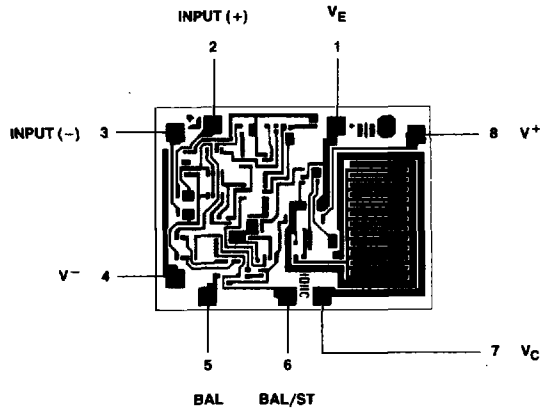
Strobing OFF both Input and Output Stages\*\*



LIC-089

\*Increases input bias current and common mode slew rate by a factor of 3.  
 \*\*Typical input current = 50pA with inputs strobed OFF.

METALLIZATION AND PAD LAYOUT



DIE SIZE: 0.048" X 0.065"