

# VOLTAGE COMPARATOR

LM111/211/311

## DESCRIPTION

The LM111 series are voltage comparators that have input currents approximately a hundred times lower than devices like the  $\mu$ A710. They are designed to operate over a wider range of supply voltages; from standard  $\pm 15V$  op amp supplies down to the single 5V supply used for IC logic. Their output is compatible with RTL, DTL, and TTL as well as MOS circuits. Further, they can drive lamps or relays, switching voltages up to 50V at currents as high as 50mA.

Both the inputs and the outputs of the LM111 series can be isolated from system ground, and the output can drive loads referred to ground, the positive supply or the negative supply. Offset balancing and strobe capability are provided and outputs can be wire OR'ed. Although slower than the  $\mu$ A710 (200ns response time vs 40ns) the devices are also much less prone to spurious oscillations. The LM111 series has the same pin configuration as the  $\mu$ A710 series.

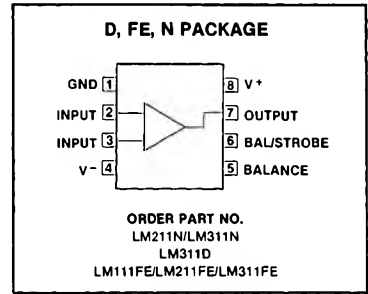
## FEATURES

- Operates from single 5V supply
- Maximum input bias current: 150nA (LM311 - 250nA)
- Maximum offset current: 20nA (LM311 - 50nA)
- Differential input voltage range:  $\pm 30V$
- Power consumption: 135mW at  $\pm 15V$
- High sensitivity—200V/mV

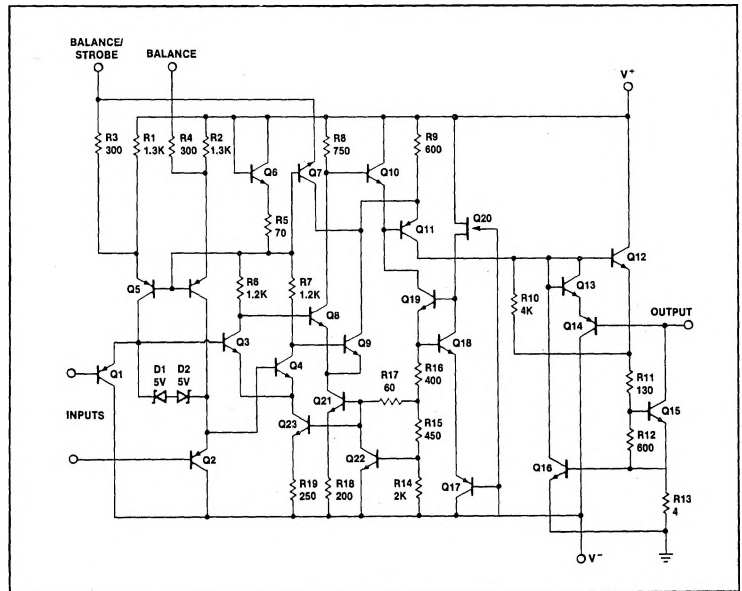
## APPLICATIONS

- Zero crossing detector
- Precision squarer
- Positive/negative peak detector
- Low voltage adjustable reference supply
- Switching power amplifier

## PIN CONFIGURATION



## EQUIVALENT SCHEMATIC



## ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNIT
Total supply voltage	36	V
Output to negative supply voltage:		
LM111/LM211	50	V
LM311	40	V
Ground to negative supply voltage	30	V
Differential input voltage	$\pm 30$	V
Input voltage <sup>1</sup>	$\pm 15$	V
Power dissipation <sup>2</sup>	500	mW
Output short circuit duration	10	sec
Operating temperature range		
LM111	-55 to +125	$^{\circ}C$
LM211	-25 to +85	$^{\circ}C$
LM311	0 to +70	$^{\circ}C$
Storage temperature range	-65 to +150	$^{\circ}C$
Lead temperature (soldering, 10sec)	300	$^{\circ}C$

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## DC ELECTRICAL CHARACTERISTICS 1,2,3

PARAMETER	TEST CONDITIONS	LM111/LM211			LM311			UNIT
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage <sup>4</sup>	$T_A = 25^\circ\text{C}, R_S \leq 50\text{k}\Omega$		0.7	3.0		2.0	7.5	mV
Input offset current <sup>4</sup>	$T_A = 25^\circ\text{C}$		4.0	10		6.0	50	nA
Input bias current	$T_A = 25^\circ\text{C}$		60	100		100	250	nA
Voltage gain	$T_A = 25^\circ\text{C}$		200			200		V/mV
Response time <sup>5</sup>	$T_A = 25^\circ\text{C}$		200			200		ns
Saturation voltage	$V_{IN} \leq -5\text{mV}, I_{OUT} = 50\text{mA}$ $T_A = 25^\circ\text{C}$		0.75	1.5		0.75	1.5	V
Strobe on current	$T_A = 25^\circ\text{C}$		3.0			3.0		mA
Output leakage current	$V_{IN} \geq 5\text{mV}, V_{OUT} = 35\text{V}$ $T_A = 25^\circ\text{C}, I_{STROBE} = 3\text{mA}$		0.2	10		0.2	50	nA
Input offset voltage <sup>4</sup>	$R_S \leq 50\text{k}\Omega$			4.0			10	mV
Input offset current <sup>4</sup>				20			70	nA
Input bias current				150			300	nA
Input voltage range	$V = \pm 15\text{V}$ (Pin 7 may go to 5V)	-14.5	13.8, -14.7	13.0	-14.5	13.8, -14.7	13.0	V
Saturation voltage	$V_+ \geq 4.5\text{V}, V_- = 0$							
	$V_{IN} \leq -6\text{mV}, I_{SINK} \leq 8\text{mA}$		0.23	0.4		0.23	0.4	V
Output leakage current	$V_{IN} \geq 5\text{mV}, V_{OUT} = 35\text{V}$		0.1	0.5				$\mu\text{A}$
Positive supply current	$T_A = 25^\circ\text{C}$		5.1	6.0		5.1	7.5	mA
Negative supply current	$T_A = 25^\circ\text{C}$		4.1	5.0		4.1	5.0	mA

**NOTES**

- This rating applies for  $\pm 15\text{V}$  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.
- The maximum junction temperature of the LM311 is  $110^\circ\text{C}$ . For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of  $150^\circ\text{C/W}$ , junction to ambient, in the N package, a thermal resistance of  $162^\circ\text{C/W}$ , and  $^\circ\text{C/W}$  for the Ceramic package. The maximum junction temperature of the LM111 is  $150^\circ\text{C}$ , while that of the LM211 is  $110^\circ\text{C}$ . For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of  $150^\circ\text{C/W}$ , junction to ambient. The thermal resistance of the Cerdip package is  $110^\circ\text{C/W}$ , junction to ambient.
- These specifications apply for  $V_S = \pm 15\text{V}$  and  $0^\circ\text{C} < T_A < 70^\circ\text{C}$  unless otherwise specified. With the LM211, however, all temperature specifications are limited to  $-25^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$  and for the LM111 is limited to  $-55^\circ\text{C} < T_A < 125^\circ\text{C}$ . The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5V supply up to  $\pm 15\text{V}$  supplies.
- The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with 1mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
- The response time specified is for a 100mV input step with 5mV overdrive.
- Do not short the strobe pin to ground; it should be current driven at 3mA to 5mA.

## TYPICAL APPLICATIONS

**ZERO CROSSING DETECTOR DRIVING MOS LOGIC**

**DETECTOR FOR MAGNETIC TRANSDUCER**

**TTL INTERFACE WITH HIGH LEVEL LOGIC**

\*Values shown are for a 0 to 30V logic swing and a 15V threshold.  
†May be added to control speed and reduce susceptibility to noise spikes.