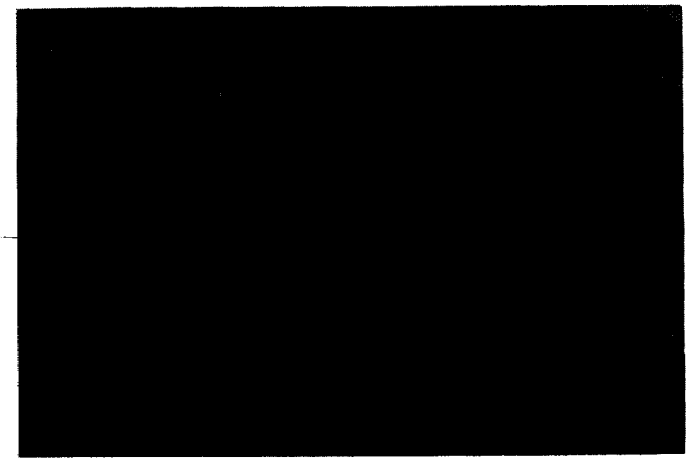
ANALOG DEVICES

Precision Comparators

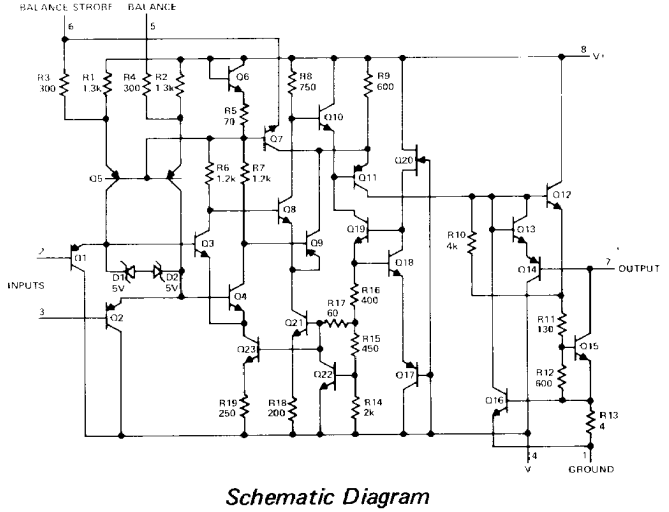
AD111/211/311

FEATURES
Differential Input Voltage Range: ±30V
Common Mode Input Voltage Range: ±14V
Supply Voltage: From +5V to ±18V
Input Offset Voltage: 3mV max
Input Bias Current: 100nA max
Output: 35V, 50mA TTL Compatible
Strobed Output
Input Offset Adjustable



PRODUCT DESCRIPTION

The AD111, AD211, and AD311 are precision voltage comparators designed for low level signal detection and high level output drive capability. Offering significant improvement over the earlier 710-type comparator in terms of bias currents and gain, the AD111 series operates on supply voltages from +5V (single ended) up to ±18V. TTL strobe capability is available with the addition of two external components. The AD311 is specified from 0 to +70°C, the AD211 from -25°C to +85°C and the AD111 over the full military temperature range -55°C to +125°C. All versions are available in the TO-99 can; the AD311 is also available in the 8 pin mini dip.



Schematic Diagram

PRODUCT HIGHLIGHTS

1. Differential voltages up to the supply voltage (30V where $V_S = \pm 15V$) are permitted so long as either positive or negative input voltages remain below the supply voltages.
2. The AD211 series operates on supply voltages from ±18V down to a single supply of only +5V.
3. The AD111 series can deliver a 50mA output current or 35V of output voltage. They can drive TTL, RTL, DTL, and MOS loads as well as lamps and relays. The outputs can be wire OR ed for window or threshold detectors.
4. Where excessive noise is present or an additional logic input is desired, the AD111 series provide TTL strobing with the addition of two external components.
5. The AD111 series offer bias currents below 100nA and gains of 200,000, thus providing the user with greater accuracy and versatility over the earlier 710-type comparators.

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SPECIFICATIONS (typical @ V_S = ±15V, V_D = 5V, R_L = 500Ω and T_A = +25°C unless otherwise specified)

Model	AD311	AD211	AD111
OPERATING TEMPERATURE RANGE	0 to +70°C	−25°C to +85°C	−55°C to +125°C
VOLTAGE GAIN	200V/mV	*	*
INPUT CHARACTERISTICS			
Maximum Input Voltage (Note 1)	±15V	*	*
Over Operating Temperature Range	±14V	*	*
Offset Voltage (Note 2)	2.0mV typ (7.5mV max)	0.7mV typ (3.0mV max)	**
Over Operating Temperature Range	10.0mV max	4.0mV max	**
Bias Current (Note 3)	100nA typ (250nA max)	60nA typ (100nA max)	**
Over Operating Temperature Range	300nA max	150nA max	**
Offset Current (Note 2)	6nA typ (50nA max)	4nA typ (10nA max)	**
Over Operating Temperature Range	70nA max	20nA max	**
OUTPUT CHARACTERISTICS			
Maximum Output to Negative Supply Voltage ($V_{7,4}$)	50V	*	*
Maximum Ground to Negative Supply Voltage ($V_{1,4}$)	30V	*	*
Leakage Current (Note 4)	0.2nA typ (50nA max)	0.2nA typ (10nA max)	**
Over Operating Temperature Range	0.1μA typ	0.1μA typ (0.5μA max)	**
Saturation Voltage (Note 5)	0.75V typ (1.5V max)	*	*
Over Operating Temperature Range (Note 6)	0.23V typ (0.4V max)	*	*
Short Circuit Duration	10 sec	*	*
POWER SUPPLIES			
Total Supply Voltage ($V_{8,4}$)	5V min (36V max)	*	*
Positive Supply Current	5.1mA typ (7.5mA max)	5.1mA typ (6mA max)	**
Negative Supply Current	4.1mA typ (5mA max)	*	*
RESPONSE TIME (Note 7)	200ns	*	*
STROBE ON CURRENT (Note 8)	3mA	*	*
THERMAL CHARACTERISTICS			
Power Dissipation	500mW max	*	*
Maximum Junction Temperature	+85°C	+110°C	+150°C
Thermal Resistance			
Junction-to-Ambient			
TO-99 Package	150°C/W	*	*
Mini-DIP Package	210°C/W	—	—
Junction-to-Case			
TO-99 Package	45°C/W	*	*
Mini-DIP Package	80°C/W	—	—
Storage Temperature Range	−65°C to +150°C	*	*
Lead Temperature (Soldering, 10 sec)	+300°C	*	*

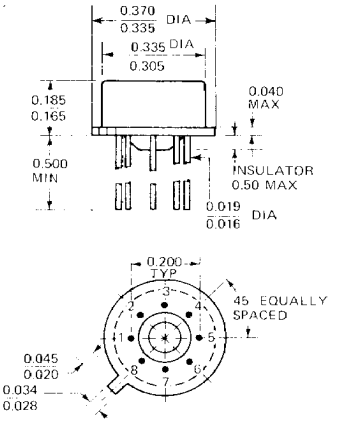
*Specifications same as AD311.
**Specifications same as AD211.
Prices and specifications subject to change without notice.

Note 1. This rating applies for ±15V supplies. The positive 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 offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance. Offset voltage is specified with an input source resistance of 50k or less.
Note 3. Input bias current for this product is defined as the average of the two input currents.
Note 4. The conditions for this specification are V_S = ±15V, Pin 1 at ground, 5mV input voltage to the 111/211 or 10mV input voltage to the 311 and the output Pin 7 pulled up to +35V.
Note 5. The conditions for this specification are V_S = ±15V, Pin 1 at ground, 5mV input voltage to the 111/211 or 10mV input voltage to the 311 and the output Pin 7 sinking 50mA.
Note 6. The conditions for this specification are V_S = ±15V, Pin 1 at ground, 6mV input to the 111/211 or 10mV input voltage to the 311 and the output Pin 7 sinking 8mA.
Note 7. The response time specified is for a 100mV input step with 5mV of overdrive "Response Time" is the interval between the application of an input step function and the time when the output crossed the TTL logic threshold.
Note 8. Strobe on current is the current that must be drawn out of the strobe terminal to disable the comparator, not the current that will flow out of the strobe terminal if it is grounded. We recommend using at least a 1kΩ resistor in series with strobe terminal.

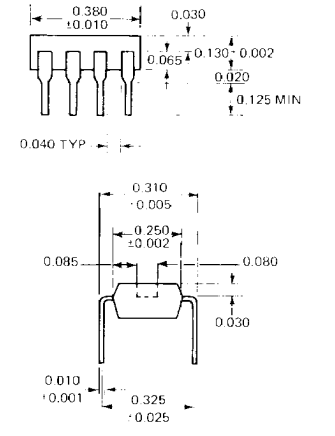
OUTLINE DIMENSIONS

Dimensions shown in inches

TO-99

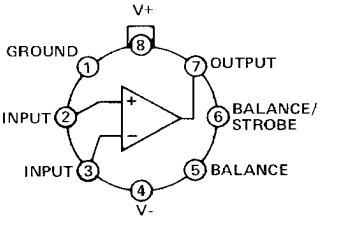


MINI-DIP

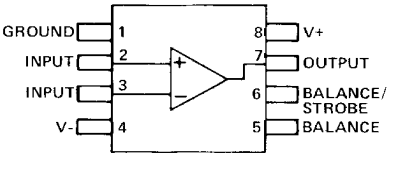


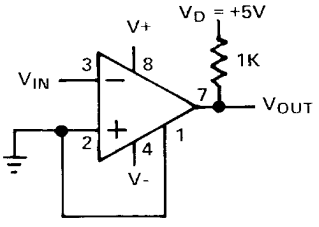
CONNECTION DIAGRAMS

TO-99
Top View

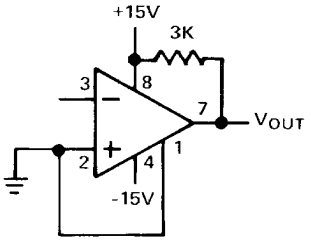


MINI-DIP
Top View

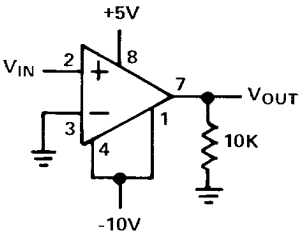




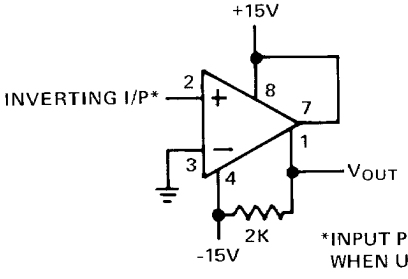
TTL Compatible Output Swing



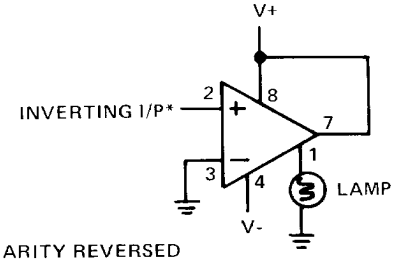
High Level TTL Compatible Output Swing



MOS Logic Compatible Output Swing

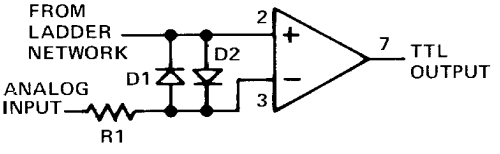


Obtaining ±15 Volt Output Swing

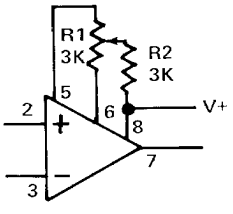


*INPUT POLARITY REVERSED WHEN USING PIN 1 AS OUTPUT

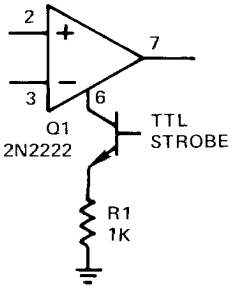
Driving Ground-Referred Load



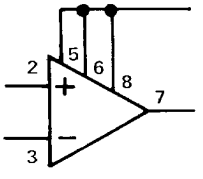
Using Clamp Diodes To Improve Response



Offset Balancing

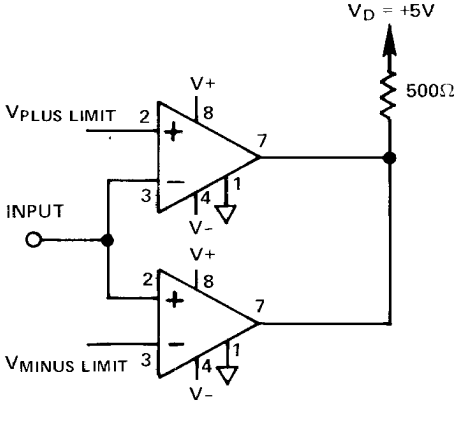


Strobing

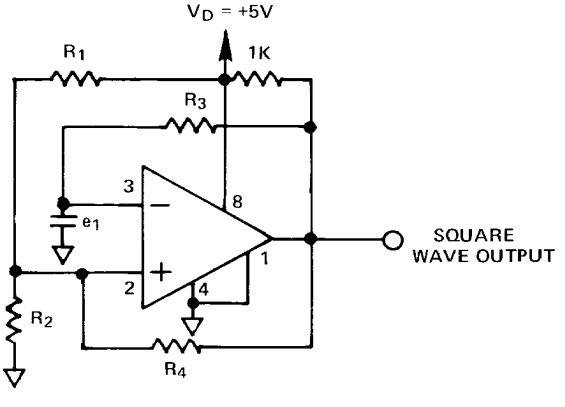


*INCREASES TYPICAL COMMON MODE SLEW FROM 7.0V/μs TO 18V/μs

*Increasing Input Stage Slew Rate**

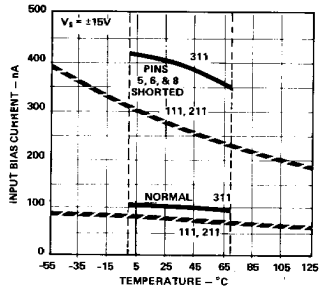


Window Detector

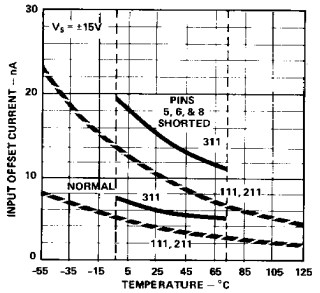


Free-Running Multivibrator

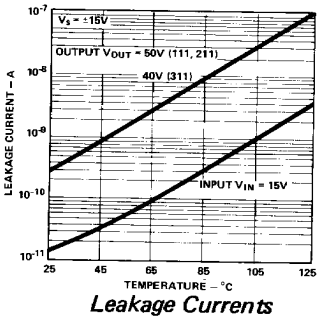
TYPICAL PERFORMANCE



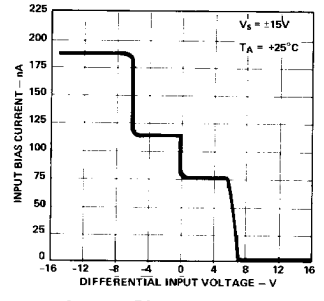
Input Bias Current



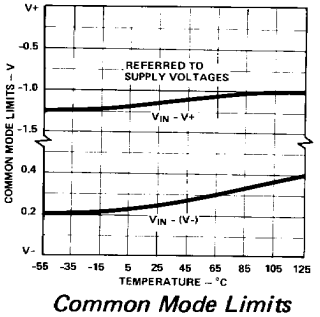
Input Offset Current



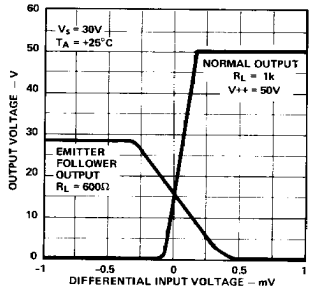
Leakage Currents



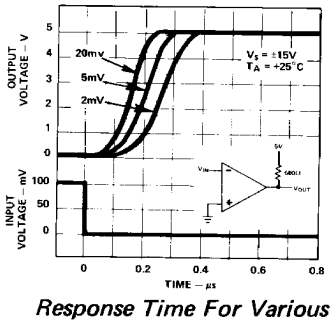
Input Characteristics



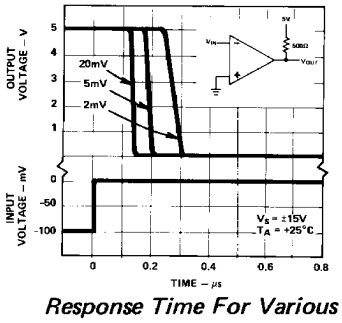
Common Mode Limits



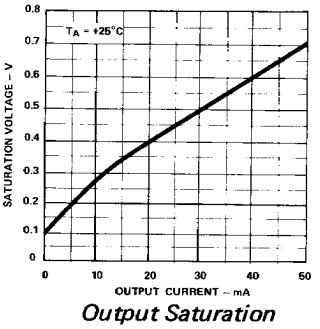
Transfer Function



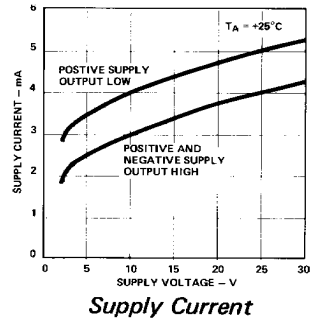
Response Time For Various Input Overdrives



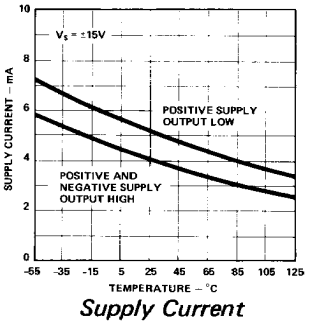
Response Time For Various Input Overdrives



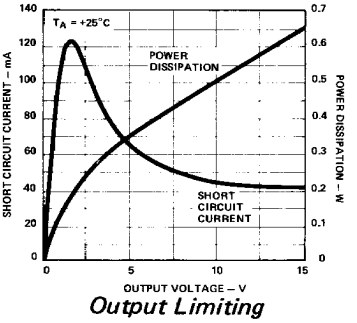
Output Saturation Voltage



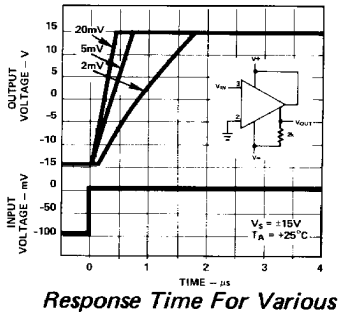
Supply Current



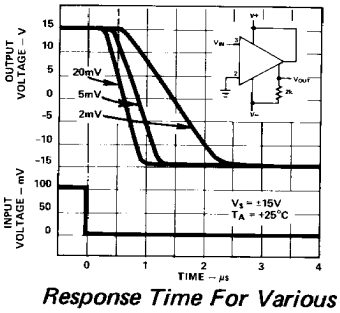
Supply Current



Output Limiting Characteristics



Response Time For Various Input Overdrives



Response Time For Various Input Overdrives