



**ANALOG  
SYSTEMS**

MA-322

**LOW-NOISE  
WIDEBAND  
OPERATIONAL AMPLIFIER**

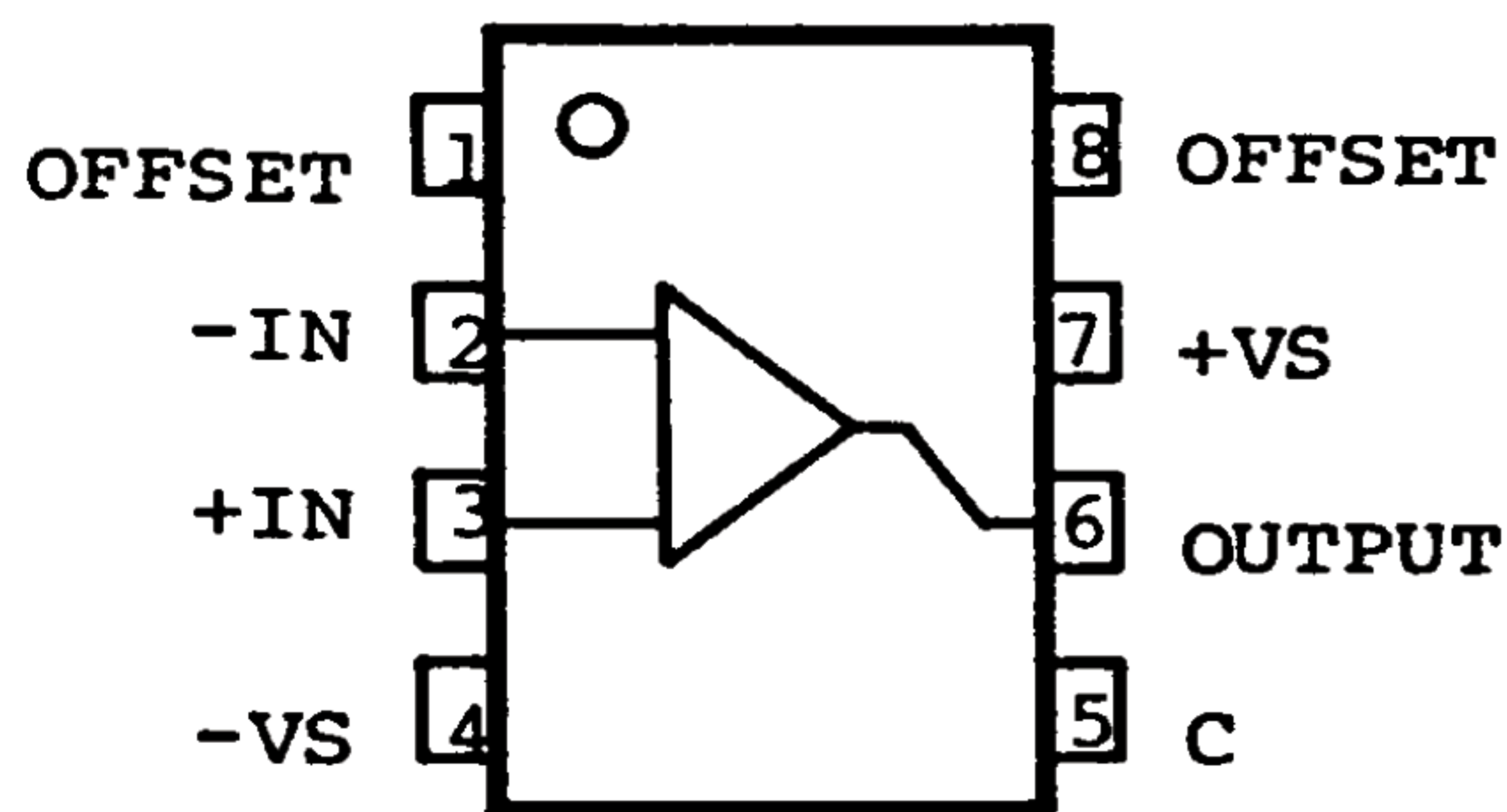
**FEATURES**

3.5nV//Hz INPUT NOISE VOLTAGE  
±20 V/μS SLEW RATE  
50 MHz GAIN-BANDWIDTH PRODUCT  
600μV UNTRIMMED OFFSET VOLTAGE  
±40mA OUTPUT LOAD CURRENT

**APPLICATIONS**

AUDIO AMPLIFIERS  
DATA ACQUISITION AMPLIFIERS  
ACTIVE FILTERS  
PRECISION LINE DRIVER

**FUNCTIONAL DIAGRAM**



Order Part Number MA-322-CP  
Epoxy Molded 8-pin mini-DIP

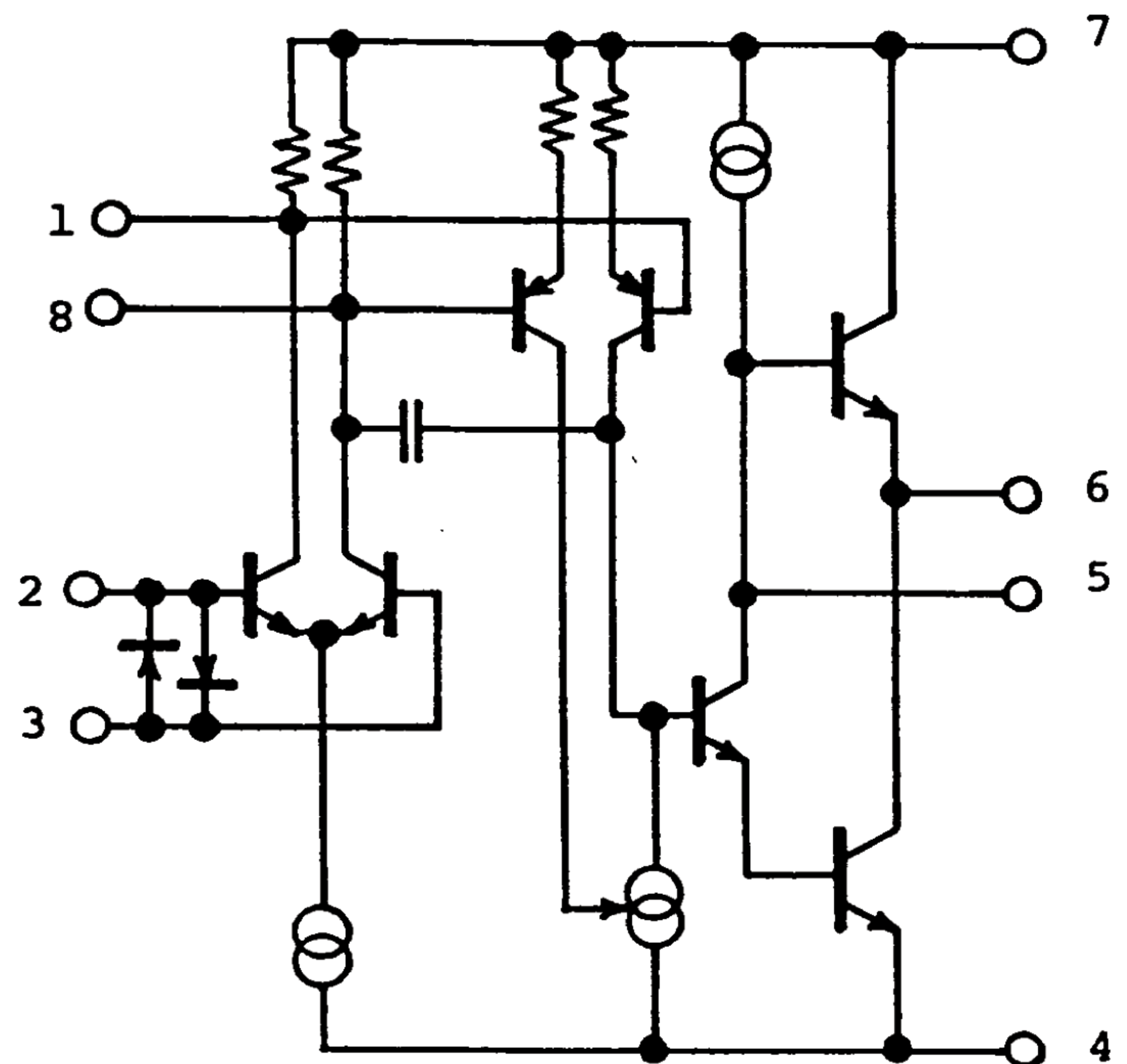
**GENERAL DESCRIPTION**

MA-322 is a differential bipolar input operational amplifier with a low noise input stage. Other unique areas include wide bandwidth with unity gain stability and moderately high output drive capability.

Input anti-parallel diodes are used to protect the input stage devices and prevent reverse breakdown of the base junction - an occurrence which would cause the low noise input characteristics to deteriorate.

Pin 5 is brought out to allow over-compensation for lowest noise possible under capacitive load, capacitive source or integrator applications. A 33pF capacitor is connected from pin 5 to pin 8 for these applications.

**SIMPLIFIED SCHEMATIC**



# ELECTRICAL CHARACTERISTICS

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage (Between +VS and -VS terminals)	40 Volts
Differential Input Voltage	0.5 Volt
Common Mode Input Voltage	$\pm$ v Supply
Power Dissipation	500 Milliwatts
Operating Temperature Range	-55°C to +75°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	+300°C

SPECIFICATIONS,  $\pm$ VS = 15V, +25°C

## INPUT

Noise Voltage <sup>1</sup>	Typical	3.5nV/ $\sqrt{\text{Hz}}$
	Maximum	5.0nV/ $\sqrt{\text{Hz}}$
Noise Current <sup>1</sup>	Typical	0.5pA/ $\sqrt{\text{Hz}}$
	Maximum	1.0pA/ $\sqrt{\text{Hz}}$
Offset Voltage	Maximum	2.0 millivolts
Offset Voltage Drift	Maximum	15uV/°C
Bias Current	Maximum	750nA
Offset Current	Maximum	150nA
Common Mode Voltage	Minimum	$\pm$ 12 Volts
Common Mode Rejection	Minimum	90dB

OPEN LOOP GAIN at DC

Minimum 94dB

## DYNAMIC RESPONSE

Slew Rate

Minimum  $\pm$ 15V/ $\mu$ S

Gain-Bandwidth Product<sup>2</sup>

Minimum 40MHz

## OUTPUT

Voltage Swing - no load

Minimum  $\pm$ 12 Volts

Load Current -  $\pm$ 10 Volt

Minimum  $\pm$ 30mA

Full Power Bandwidth

Minimum 240kHz

## POWER SUPPLY

Current

Maximum  $\pm$ 7mA

Minimum Voltage

$\pm$ 2.5V

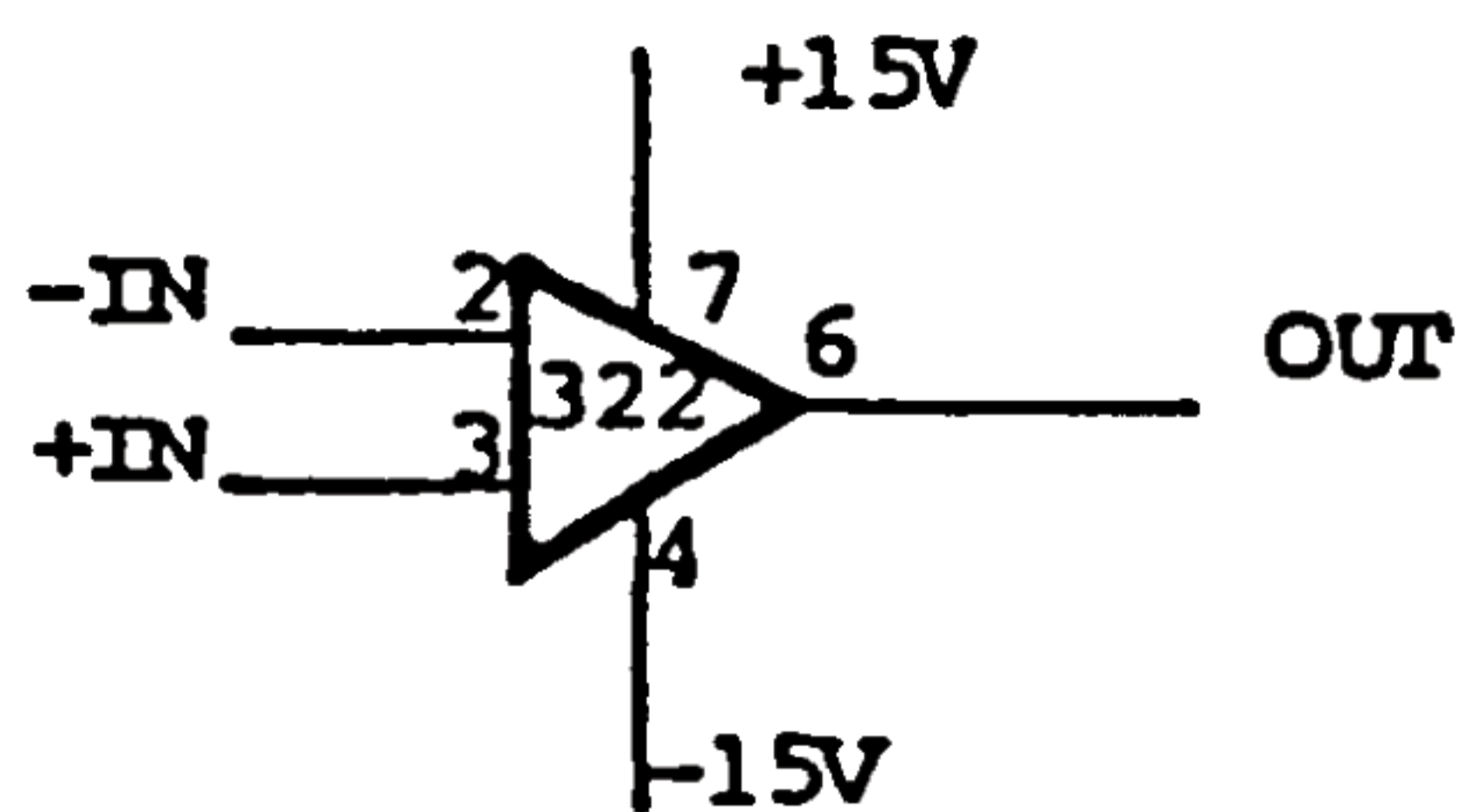
NOTES: 1. Noise Voltage and Current are measured with a bandwidth of 300Hz to 10kHz.

2. Gain-Bandwidth Product is measured at closed loop gain of 100X (40dB).

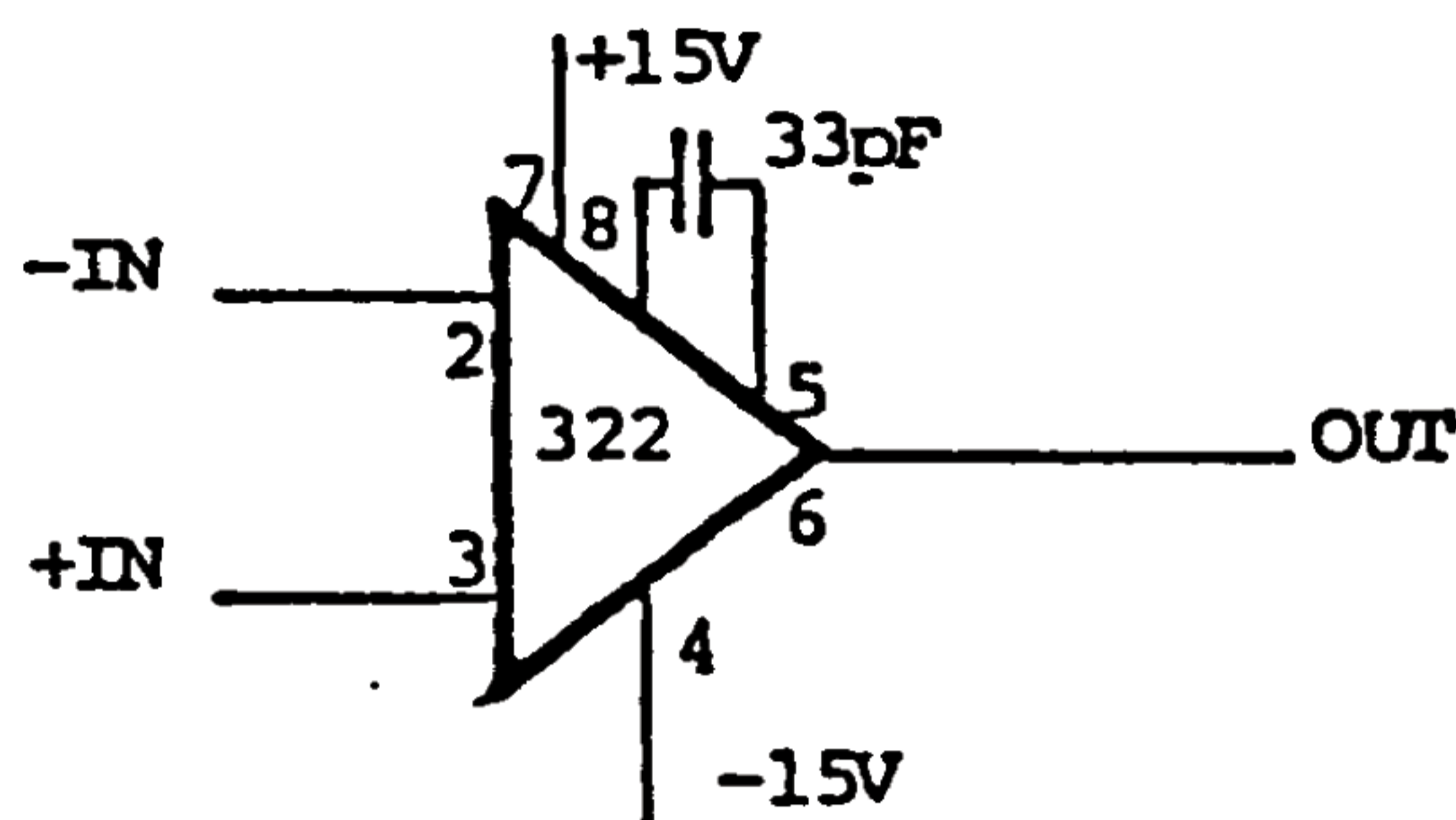
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## TYPICAL CIRCUITS AND APPLICATIONS

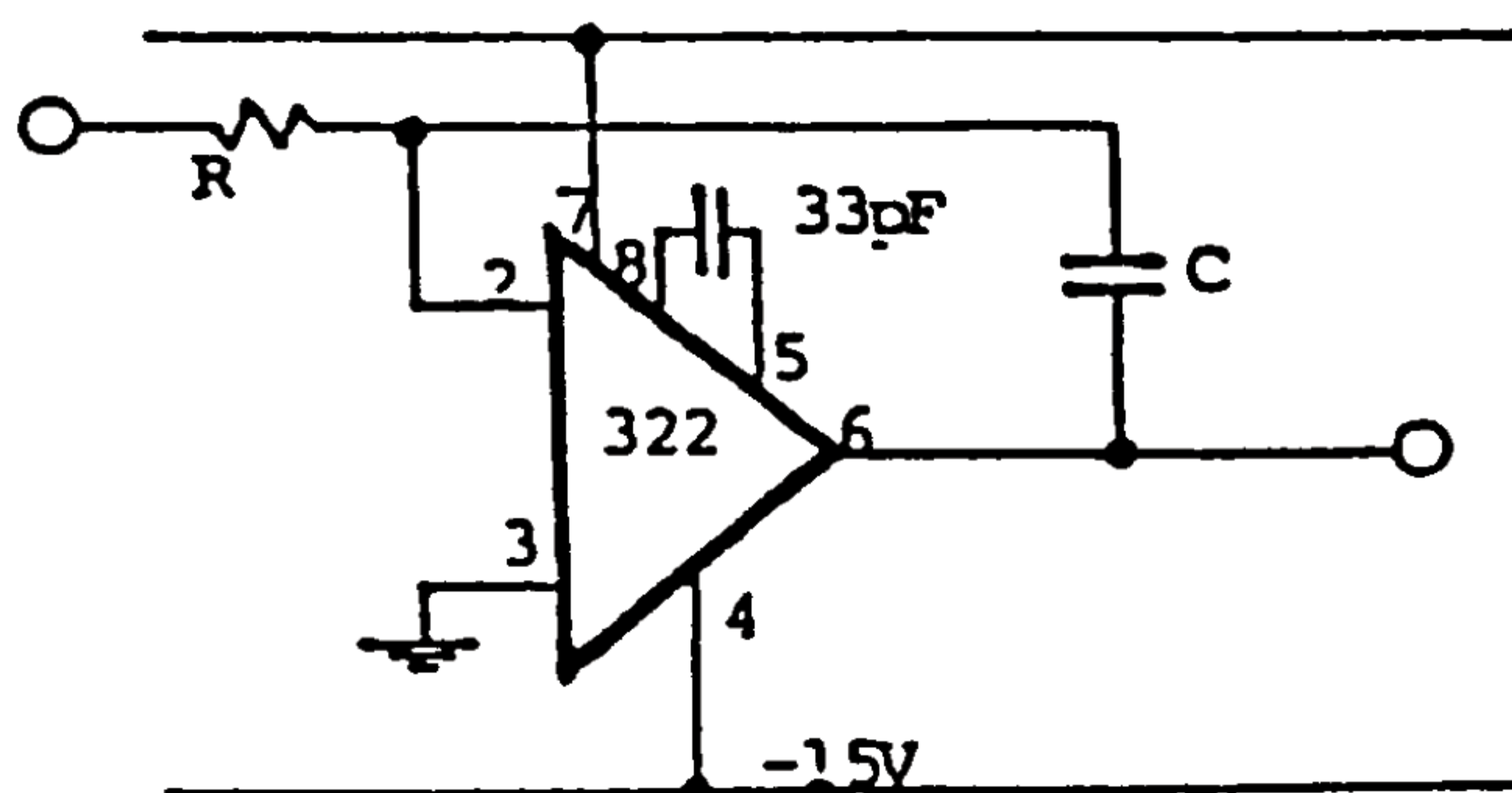
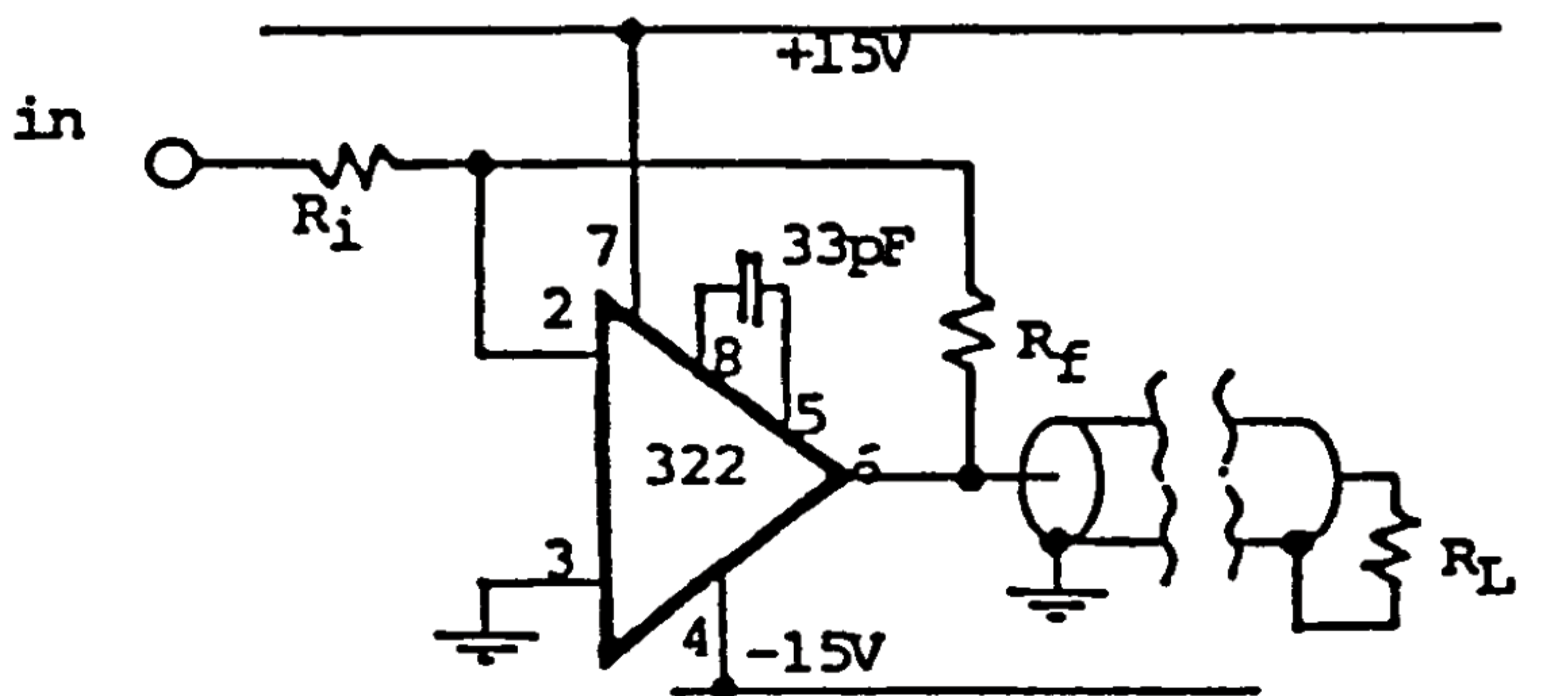
Although the MA-322 is internally compensated, there is an optional external capacitor used for over-compensation under certain conditions. The basic connections:



The optional capacitor is connected between pins 5 and 8. A typical value is 33pF.

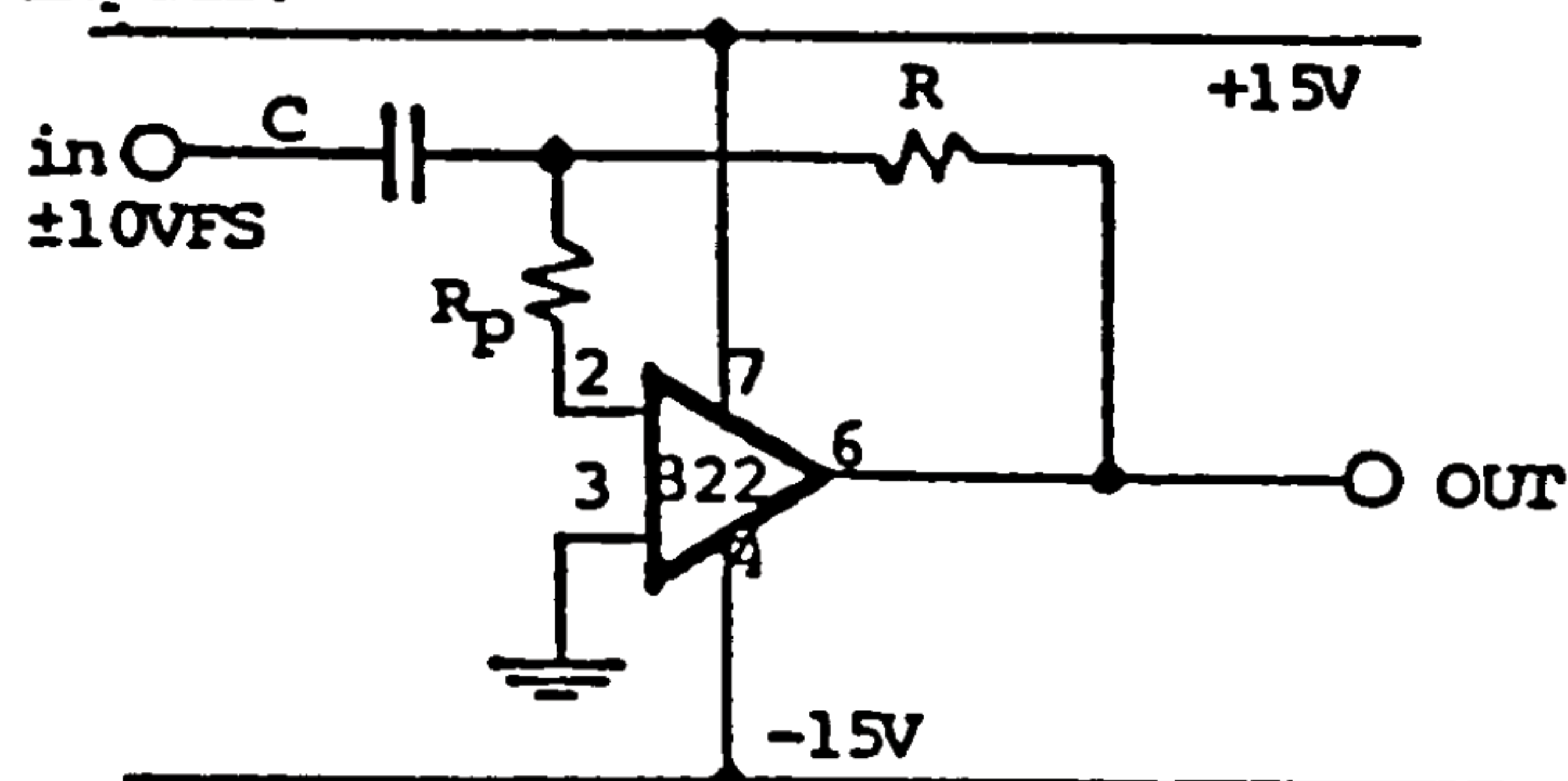


Over-compensation is suggested when MA-322 drives a capacitive load, such as a long cable, or when it is used as an integrator. Two such examples are shown below:



When used with active filters, over-compensation is recommended.

Input current should be limited when overdrive is a possibility. Because protection diodes are used between the differential inputs, excess currents can flow in differentiator and comparator applications. Protection can simply be a resistor in series with one or both inputs.



In the above circuit,  $R_p$  is 2k, which limits input current to 5mA, but has no significant effect on circuit operation.

DC offset voltage is nulled with an external potentiometer, as shown. Leads to pins 1 and 8 should be short, because they serve as actual connections to the collectors of the first stage. The use of a resistive trimmer, located within one inch of the MA-322, and away from digital or other switching signal lines is suggested.

