

# FET ces improve absolute-value amplifier

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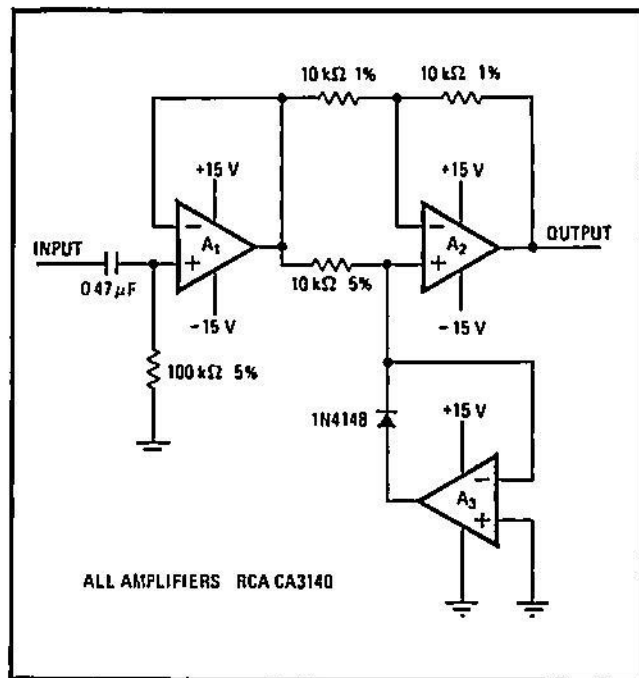
An absolute-value amplifier, also known as a precision full-wave rectifier, which features wide bandwidth and dynamic range, can be built with high-impedance operational amplifiers to produce a circuit that is more reliable than those implementing the usual phase-cancellation technique. The low input current and wide frequency range of the CA3140 bipolar/field-effect-transistor op amps eliminate the gain and phase-shift errors encountered in other designs.

As shown in the figure, op amp  $A_1$  serves as a unity-gain buffer, op amp  $A_2$  has a gain of +1 during the positive half-cycle of the input wave and a gain of -1 during the negative portions, and  $A_3$  in association with the diode forms a precision clamp.

During the positive portion of the input signal equal voltage is present at both inputs of  $A_2$ . The op amp behaves as a unity-gain follower, as determined by the feedback elements.

During the negative portions, however, the clamping action of  $A_3$  with the diode prevents the voltage at the noninverting input of  $A_2$  from going negative, effectively tying the pin to ground. Op amp  $A_2$  therefore either operates in the inverting mode or else multiplies the signal by a factor of -1.

Precision resistors for the gain-controlling elements of op amp  $A_2$  assure no greater than 2% deviation from the desired gain. The clamping circuit of  $A_3$  can accurately



ALL AMPLIFIERS RCA CA3140

**Precision full-wave rectifier.** Op amp  $A_3$ , which ensures  $A_2$  follows positive voltages and inverts negative ones, has single-ended power supply to minimize slew time and maximize stability. Power-supply pins are decoupled with  $0.47\text{-}\mu\text{F}$  capacitors.

process signals down to  $-0.3$  volt below the negative supply rail of the amplifier, which in this case is ground.

The result is an absolute-value amplifier which has a dynamic range exceeding 90 decibels and a bandwidth exceeding 1 megahertz. When this circuit is used in conjunction with a peak detector or integrator network, it becomes an invaluable building block in ac-to-dc conversion applications.  $\square$