Absolute Value Circuit/ Precision Full-Wave Rectifier

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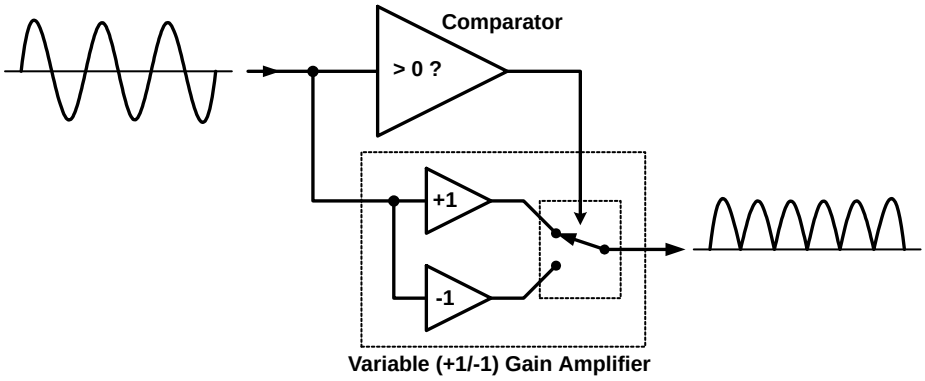
Rectifiers, or 'absolute-value' circuits are often used as detectors to measure the amplitudes of AC signals. For this type of application, the AC signal is first high-pass filtered and then rectified. Because passive rectifier circuits constructed with diodes don't respond well to signals with a magnitude less than a diode-drop (0.7V for silicon diodes), this limits their use in precision applications. For applications in which a high degree of precision is needed, op-amps can be used in conjunction with diodes to build precision rectifiers. Although these 'active rectifier' circuits can provide a high degree of precision, their response tends to be slow, resulting in significant signal distortion near zero crossings at higher frequencies.

One simple way to build a fast, accurate precision full-wave rectifier is to use a zero-threshold comparator and an amplifier with a gain that can be either +1 or -1. The comparator is used to detect the polarity of the signal (positive or negative), and the output of the comparator controls the amplifier's gain. When the signal value is positive, the gain is set positive, resulting in an output level identical to the input level. When the input is negative, however, the gain is also set negative, reversing the signal polarity, resulting in a positive output signal.

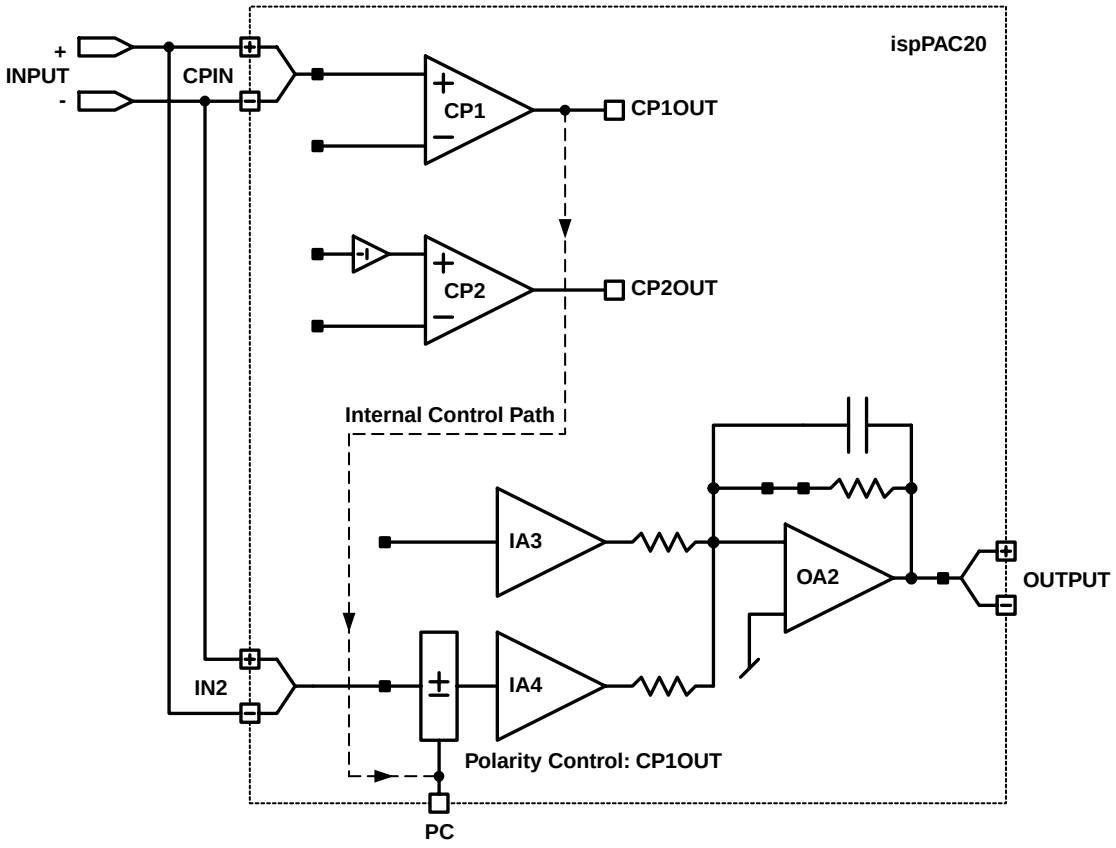
Figure 1. Precision Rectifier



This function can be readily implemented with an ispPAC®20. One method for doing so is shown in Figure 2. In this circuit, comparator CP1 is used to monitor the sign of the input signal. To both minimize the use of PACblocks and simplify internal signal routing, the input signal is fed both into the CPIN and IN2 inputs. The polarity control block in front of IA4 is used to implement the variable-gain amplifier. If the polarity control for IA4 is set to 'CP1OUT,' the polarity control block is controlled directly by the output of CP1, through an on-chip signal path.

Because the overall gain of IA4 is negative when the output of the comparator is high, either one of two things needs to be done to derive a positive rectified signal. First, the polarity of the signal being fed to IA4 can be inverted by swapping the input leads, as is shown in Figure 2. As an alternative, the CPIN input could be fed to the negative input of CP1, so that its output is high when the input signal is negative. Either case will result in a 'positive' absolute value output.

Figure 2. Precision Rectifier Implemented with ispPAC20



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