Coordinate converter aligns piezoelectric positioner

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Piezoelectric tilt elements of the kind used to position laser beams and optical scanners can be aligned with the help of this circuit, which converts the transducer's high input driving voltages, normally resolved in X-Y coordinates, into corresponding coordinates (a, b, c) in a nonorthogonal three-axis system. Only one quad operational amplifier and two resistor-array packages are used for the transformation.

The geometry of many popular piezoelectric positioning elements (a), as for example the Burleigh Instruments' PZ-80, is such that:

$$x = c - a \qquad y = b - \tfrac{1}{2}(a + c) \qquad 0 = a + b + c$$

Solving these equations simultaneously for a, b, and c yields:

$$a = \tfrac{1}{2}x - \tfrac{1}{2}y \qquad b = \tfrac{2}{3}y \qquad c = -\tfrac{1}{2}x - \tfrac{1}{3}y$$

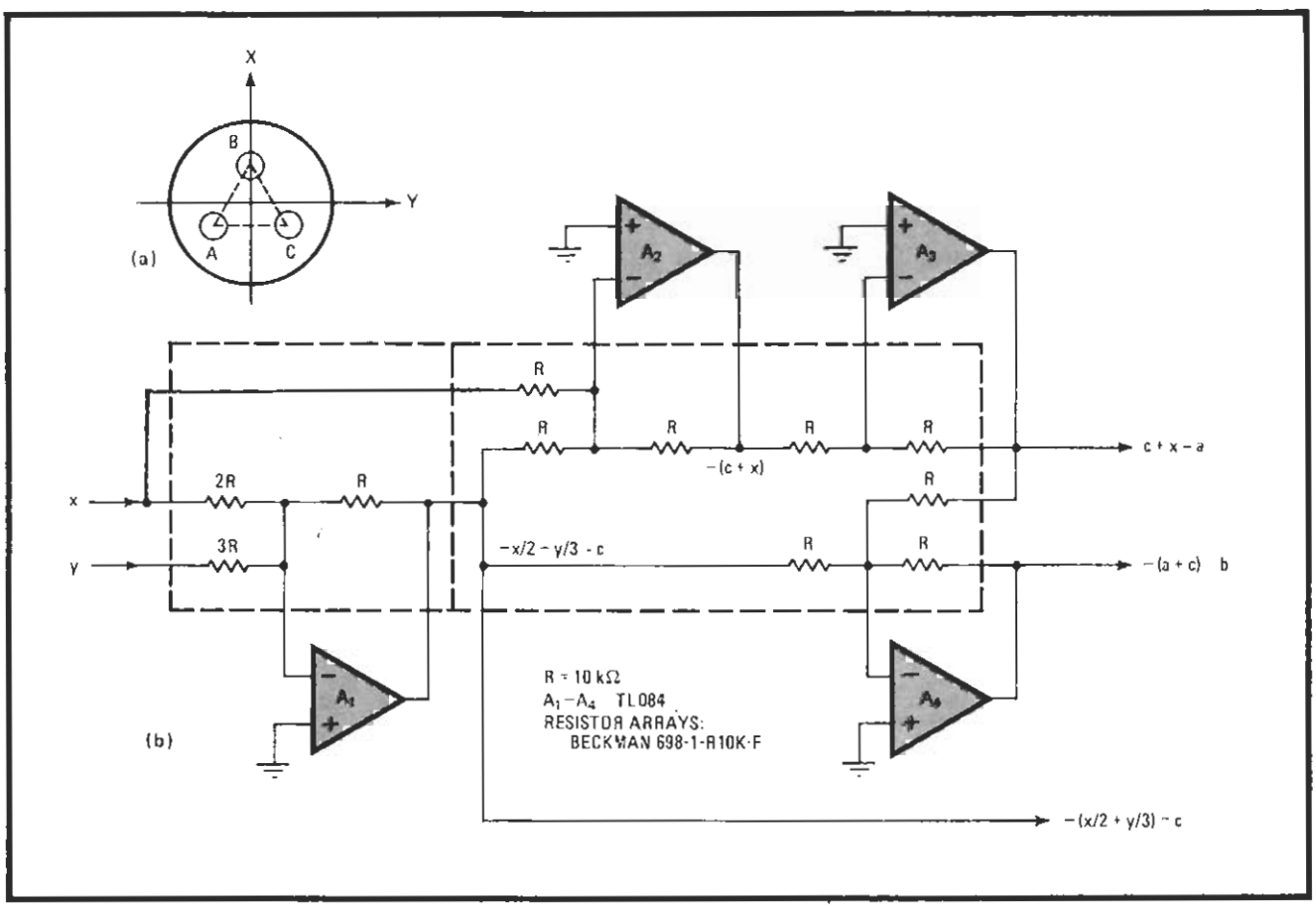
Simplifying further:

$$a = c + x \qquad b = -(a + c) \qquad c = -(x/2 + y/3)$$

The last set of equations is easily implemented by using precision resistors to set the gain of several op amps (b).

Resistor arrays in dual in-line packages will perform the transformation accurately, for their elements have a tolerance of ±0.5%. The overall circuit uncertainty becomes ±1% when two arrays are configured as shown. To ensure that the circuit occupies no more space than that taken by three dual in-line packages, the resistors are grouped in their respective arrays as shown by the dotted lines.

The TL084 op amp is more than adequate for the circuit accuracy desired, since in most applications the piezoelectric devices operate in the lower audio-frequency range. □



Beaming true. Input information for positioning laser beam, normally presented in X-Y coordinates, must be converted into three-axis coordinates for many piezoelectric transducers (a). One op amp and two precision resistor arrays perform the transformation (b).